Standard Bidding Document

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu (Works)

National

Single Stage-Two Envelope

CORRIGENDUM # 1	CORR-P71309-001
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REQUEST FOR BIDS

PROCUREMENT OF CIVIL WORKS

1. The **Pakistan Airports Authority (Planning & Development Directorate)** has reserved Funds for the procurement planned for FY **2026-27**. The **Pakistan Airports Authority (Planning & Development Directorate)** intends to apply part of the proceeds of this Fund to cover eligible payments under the contract for the "**Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu**" with the reference of "**P71309**".

2. The **Pakistan Airports Authority (Planning & Development Directorate)** invites electronic Bids from eligible Bidders for procurement of Works **(Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu)** described in the bidding documents on **EPADS v2.0**.

3. **Single Stage-Two Envelope** will be used by adopting **Least Cost Based Selection (LCBS)** Technique for the subject procurement, in line with the Public Procurement Rules, 2004 and any Regulations, Regulatory Guides, Procurement Guidelines or Instructions issued by the Authority from time to time.

4. All Bids must be accompanied by a Bid Security amounting described in Bid Security Section in Bidding Document in the form of **Bank Guarantee**. Or all bids must be accompanied by bid securing declaration in the format specified in the Bidding documents

5. E-Bidding documents, containing detailed terms & conditions, specifications and requirements etc. are available on **e-Pak Acquisition and Disposal System (EPADS)** at **https://epads.gov.pk/opportunities/federal/procurements/71309** for all the interested bidders registered on **EPADS v2.0**. Bidders are required to get themselves registered on **EPADS v2.0** to participate in Bidding process.

6. The e-bids, prepared in accordance with the instructions in the e-Bidding documents, must be submitted through **EPADS v2.0** on or before **Thursday,**

September 17, 2026 11:00 AM. E-bids will be opened by using **EPADS v2.0** on the same day at **Thursday, September 17, 2026 12:30 PM**. Manual submission of Bids shall not be entertained. Those vendor who have not yet registered on the new version of **EPADS v2.0**, may register themselves on **https://pa.epads.gov.pk/**. A tutorial to explain the registeration process is available at **https://www.youtube.com/watch?v=MNW6T38v7tc.**

In terms of Rules 48 of Public Procurement Rules, 2004 Grievance Redressal Committee (GRC) is notified for the subject procurement and notification copy is available on the procuring agency's website and on Authority's website at (**www.ppra.org.pk**).

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Instructions to Bidders

A. INTRODUCTION

1. **Scope of Bid**

1.1. The Procuring agency/Employer (PA), as indicated in the **Bid Data Sheet** (BDS) invites Bids for the execution of Works as specified in the BDS and **Section V- Works Requirements**. The name, identification, and number of lots (contracts) of this National/ International Competitive Bidding process are specified in the BDS.

2. **Source of Funds**

2.1. Source of funds as referred in Clause 2 of Bid Data Sheet.

3. **Eligible Bidders**

3.1. A bidder may be natural person, company or firm or public or semi-public agency of Pakistan or any foreign country, or any combination of them with a formal existing agreement (on Judicial Papers) in the form of a joint venture or consortium. In the case of a joint venture or consortium, all members shall be jointly and severally liable for the execution of the Contract in accordance with the terms and conditions of the Contract. The joint venture or consortium shall nominate a Lead Member as nominated in the BDS, who shall have the authority to conduct all business for and on behalf of any and all the members of the joint venture or consortium during the Bidding process, and in case of award of contract, during the execution of contract. Verifiable copy of the agreement that forms a joint venture, consortium or association shall be required to be submitted as part of the Bid.

Any bid submitted by the joint venture, consortium or association shall indicate the part of proposed contract to be performed by each party and each party shall be evaluated (or post qualified if required) with respect to its contribution only, and the responsibilities of each party shall not be substantially altered without prior written approval of the Procuring Agency and in line with any instructions issued by the Authority.

(The limit on the number of members of JV or Consortium may be prescribed

in BDS, in accordance with the guidelines issued by the PPRA).

3.2. The invitation for bids is open to all prospective bidders subject to any provisions of incorporation or licensing by the respective national/ international incorporating agency or statutory body established for that particular trade or business. Procuring agencies shall specify the registration/licensing requirements for the foreign bidder keeping in view the requirement of that business.

3.3. A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidders may be considered to have a conflict of interest with one or more parties in this Bidding process, if they:

3.3.1. are associated or have been associated in the past, directly or indirectly with a firm or any of its affiliates which have been engaged by the Procuring agency/Employer to provide consulting services for the preparation of design or technical specifications of the works that are the subject of the bid; or

3.3.2. have controlling shareholders in common; or

3.3.3. receive or have received any direct or indirect subsidy from any of them; or

3.3.4. have the same legal representative for purposes of this Bid; or

3.3.5. have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another bidder, or influence the decisions of the Procuring agency/Employer regarding this Bidding process; or

3.3.6. Submit more than one bid in this bidding process.

3.4. A Bidder may be ineligible if –

3.4.1. he is declared bankrupt or, in the case of company or firm, insolvent;

3.4.2. payments in favor of the bidder is suspended in accordance with the judgment of a court of law other than a judgment declaring bankruptcy and resulting (in accordance with the national laws) in the total or partial loss of the right to administer and dispose of its property;

3.4.3. the bidder is convicted, by a final judgment of a Court of Law or relevant Professional Statuary Body, of any offence involving professional conduct;

3.4.4. The bidder is debarred/ blacklisted by a national level Procuring agency/Employer and hence debarred due to involvement in corrupt and fraudulent practices, or performance failure or due to breach of bid securing declaration.

3.5. As and when required, bidders shall provide to the Procuring agency/Employer evidence of their eligibility, proof of compliance with the necessary legal requirements to carry out the contract effectively.

3.6. Bidders shall submit proposal relating to the nature, conditions and modalities of sub-contracting wherever the sub-contracting of any elements of the contract is envisaged.

4. **Eligible Material and Equipment**

4.1. All the material and equipment to be mobilized under the contract shall have their origin in eligible source countries, and all expenditures made under the contract will be limited to such materials and equipment. For this purpose, ineligible countries are stated in the section-IV titled as “Eligible Countries”.

B. BIDDING DOCUMENTS

5. **Contents of Bidding Documents**

5.1. The scope of Works, bidding procedures, and terms and conditions of the contract are prescribed in the bidding documents. In addition to the Invitation for Bids, the bidding documents which should be read in

conjunction with any addenda issued in accordance with ITB 7.1 include:

i. Section I -Invitation for Bids

ii. Section II Instructions to Bidders (ITBs)

iii. Section III Bid Data Sheet (BDS)

iv. Section IV Eligible Countries

v. Section V Evaluation and Qualification Criteria

vi. Section VI Works Requirements Technical Specifications & Schedule of Requirements

vii. Section VII Standard Bidding Forms

viii. Section VIII General Conditions of Contract (GCC)

ix. Section IX Particular Conditions of Contract (PCC)

x. Section X Contract Forms

5.2. The bidder is expected to examine all instructions, forms, specifications, terms and conditions prescribed in the bidding documents. Failure to furnish all the information required in the bidding documents will be at the bidder's risk and may result in the rejection of his bid.

6. **Clarification of Bidding Document, Pre-bid Meeting**

6.1. A prospective bidder requiring any clarification of the bidding document may notify the Procuring agency/Employer through **EPADS v2.0**.

6.2. The Procuring agency/Employer shall respond to the request for clarification in accordance with the Public Procurement Rules 2004, Rule No.31 i.e. **Clarification of bids**.

6.3. Should the Procuring Agency deem it necessary to amend the BIDDING document as a result of a clarification, it shall do so following the procedure under **ITB 7**.

6.4. If indicated in the **BDS**, the bidder's designated representative is invited at the bidder's cost to attend a pre-bid meeting at the place, date and time mentioned in the BDS. During this pre-bid meeting, prospective bidders may request clarification of the schedule of requirement, the evaluation criteria or any other aspects of the bidding documents.

6.5. Minutes of the pre-bid meeting, if applicable, including the text of the questions asked by bidders, including those during the meeting (without identifying the source) and the responses given, together with any responses prepared after the meeting will be uploaded on **EPADS v2.0**. Any modification to the bidding documents that may become necessary as a result of the pre-bid meeting shall be made by the Procuring agency/Employer exclusively through the use of an Addendum pursuant to **ITB 7**. Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

6.6. The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the bidder's own expense.

6.7. The bidder and any of its authorized personnel will be granted permission by the Procuring agency/Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder and its personnel will release and indemnify the Procuring agency/Employer from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

7. **Amendment of Bidding Documents**

7.1. The procuring agency may issue notification of any change, addition, modification or deletion in accordance with the PP Rules 2004, rule no. 23 i.e. **Bidding Documents**.

7.2. To give prospective bidders reasonable time in which to take an addendum/corrigendum into account in preparing their bids, the Procuring

agency/Employer may, at its discretion, extend the deadline for the submission of bids:

Provided that the Procuring agency/Employer shall extend the deadline for submission of bid in pursuance of PP Rules 2004, rule no. 27 i.e. ***Extension of time for submission of bids****, if such an addendum is issued within last three (03) days of the bid submission deadline.*

C. PREPARATION OF BIDS

8. Language of Bid

8.1. The bid prepared by the bidder, as well as all correspondence and documents relating to the bid exchanged by the bidder and the Procuring agency/Employer shall be written in the English language unless specified in the **BDS**. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant pages in the English language unless specified in the **BDS**, in which case, for purposes of interpretation of the bidder, the translation shall govern.

9. **Documents Constituting the Bids**

9.1. The Bids prepared by the Bidder shall constitute of all the documents required in the **BDS**.

10. **Documents Establishing Eligibility of Material, Equipment and Works, their Conformity to Bidding Documents**

10.1. The bid prepared by the bidder shall constitute the following components: -

10.1.1. Documentary evidence established in accordance with **ITB 10** that the material and equipment to be utilized by the Bidder for the executions of works are eligible material and equipment and conform to the Bidding Documents;

10.1.2. Documentary evidence established in accordance with **ITB 11** that the bidder has been authorized to carry out the Construction works;

10.1.3. Documentary evidence established in accordance with **ITB 11** that the bidder is eligible and/or qualified for the subject bidding process;

10.1.4. Form of Bid and Bid Prices completed in accordance with **ITB 12** and **13**;

10.1.5. Completed schedules as required, including priced Bill of Quantities in accordance with **ITB 13**.

10.1.6. Technical Proposal completed in all aspects in accordance with **ITB-15**.

10.1.7. Bid security or Bid Securing Declaration furnished in accordance with **ITB 17**;

10.1.8. Any other document required in the **BDS**.

10.2. In addition to the requirements, bids submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all members. Alternatively, a letter of intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all members and submitted with the bid, together with a copy of the proposed Agreement.

10.3. The bidder shall furnish, as part of its bid, all those documents establishing the eligibility in conformity to the terms and conditions specified in the bidding documents for all material, equipment and works which the bidder proposes to execute.

10.4. The documentary evidence of conformity of the material, equipment and works to the Bidding Documents may be in the form of literature, drawings, and data, and shall consist of:

10.4.1. a detailed description of the work methodology, approach, schedule and resources to be mobilized at site;

10.4.2. an item-by-item commentary on the Procuring agency/Employer's Technical Specifications demonstrating substantial responsiveness of the material, equipment and works to those specifications, or a statement of deviations and exceptions to the provisions of the Technical Specifications;

10.4.3. any other procurement specific documentation requirement as stated in the **BDS**.

10.5. The required documents and other accompanying documents must be in English. In case any other language than English is used the pertinent translation into English shall be attached to the original version.

11. **Documents Establishing Eligibility and Qualification of the Bidder**

11.1. The bidder shall furnish, as part of its bid, all those documents establishing the bidder's eligibility to participate in the bidding process and/or its qualification to perform the contract if its bid is accepted.

11.2. The documentary evidence of the bidder's eligibility to bid shall establish to the satisfaction of the Procuring agency/Employer that the bidder, at the time of submission of its bid, is from an eligible country as defined in Section-IV titled as "Eligible Countries".

11.3. The documentary evidence of the bidder's qualification to perform the contract if its bid is accepted shall establish to the satisfaction of Procuring agency/Employer that:

11.3.1. The bidder has the financial and technical capability necessary to perform the Contract, meets the qualification criteria specified in Section-V, Evaluation and Qualification Criteria and **BDS**.

11.3.2. In the case of a bidder not doing business within Pakistan, the bidder is or will be (if awarded the contract) represented by a local bidder (Joint Venture) in accordance with the PEC works bylaws, and in case of award of works such foreign firm is required to participate in the execution of works to carry out its obligations as prescribed in the Conditions of Contract and /or Technical Specifications.

11.3.3. That the bidder meets the qualification criteria listed in Section-V, Evaluation and Qualification Criteria and **BDS**.

12. **Forms of Bid**

12.1. The Bidder shall fill the Form of Bids furnished in the bidding documents. The Bids Form must be completed without any alterations to its format and no substitute shall be accepted.

13. **Bid Prices**

13.1. The bid prices quoted by the bidder in the Standard bid Forms, Bill of Quantities and in the Price Schedules shall conform to the requirements specified below or exclusively mentioned hereafter in the bidding documents.

13.2. The bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. If a Price Schedule shows items listed but not priced, their prices shall be construed to be included in the prices of other items in the Bill of Quantities and will not be paid for separately by the Procuring agency/Employer.

13.3. Items not listed in the Price Schedule shall be assumed not to be included in the bid, and provided that the bid is still substantially responsive in their absence or due to their nominal nature, the corresponding average price of the respective item(s) of the remaining substantially responsive bidder(s) shall be construed to be the price of those missing item(s):
Provided that:

13.3.1. where there is only one (substantially) responsive bidder, or

13.3.2. where there is provision for alternate proposals and the respective items are not listed in the other bids,

The Procuring agency/Employer may fix the price of missing items in accordance with market survey, and the same shall be considered as final price.

13.4. The Bid price to be quoted in the Form of Bid in accordance with ITB 12 shall be the total price of the bid.

13.5. Unless otherwise specified in the **BDS** and the Contract, the rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract.

13.6. If so specified in ITB 1.1, bids may be invited for individual lots (contracts) or for any combination of lots (packages).

13.7. Prices quoted by the Bidder shall be fixed during the bidder's performance of the contract and not subject to variation on any account. A bid submitted with an adjustable price will be treated as non-responsive and shall be rejected, pursuant to **ITB 27**, unless otherwise price adjustment is permissible under Conditions of the Contract.

13.8. All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date twenty-eight (28) days prior to the deadline for submission of bids, shall be included in the rates and prices and the total bid price submitted by the bidder.

14. **Currencies of Bid and Payment**

14.1. Prices shall be quoted in Pakistani Rupees unless otherwise specified in the **BDS**. Comparison of bids and tie of bid shall be treated in accordance with the PP rules 2004, rule no. 30.

15. **Documents Comprising the Technical Proposal**

15.1. The bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section VII – Standard Bid Forms, in sufficient detail to demonstrate the adequacy of the bidder's proposal to meet the work requirements and the completion time.

16. **Bid Validity Period**

16.1. Bids shall remain valid for the period specified in the BDS after the bid submission deadline prescribed by the Procuring agency/Employer. A bid valid for a shorter period shall be rejected by the Procuring agency/Employer as non-responsive. The period of bid validity will be determined from the complementary bid securing instrument i.e. the expiry period of bid security or bid securing declaration as the case may be.

16.2. Under exceptional circumstances, prior to the expiration of the initial Bids/Bid validity period, the Procuring Agency may request the Bidders' consent to an extension of the period of validity of their Bids/Bid. Such request for extension of the period of bid validity shall be carried out in accordance with the PP rules 2004, rule no. 26 i.e. Bid Validity.

17. **Bid Security or Bid Securing Declaration**

17.1. Pursuant to ITB 11.1 unless otherwise specified in the BDS, the bidder shall furnish as part of its bid, a Bid Security in accordance with the PP Rules 2004, rule no. 25 in the amount and currency specified in the BDS or Bid Securing Declaration as specified in the BDS in the format provided in Section VII (Standard Bidding Forms).
In case Procuring agency/Employer is inviting bids in lots / packages, the bidder shall be required to submit his bid security against the respective lot/ package for which he is submitting his bid.
Until the development of functionality of auto verification of financial instrument in **EPADS v2.0**, the scanned copy of bid security or bid securing declaration, as the case may be, shall be uploaded on **EPADS v2.0** whereas the original instrument to be submitted to the procuring agency before closing of bid submission deadline,

17.2. The Bid Security shall be denominated in the local currency or in another freely convertible currency, and it shall be in the form specified in the BDS which shall be in any of the following:

17.2.1. A bank guarantee, an irrevocable letter of credit issued by a Scheduled bank in the form provided in the Bidding Documents or another form acceptable to the Procuring agency/Employer and valid for twenty-

eight (28) days beyond the end of the validity of the Bid. This shall also apply if the period for Bid Validity is extended. In either case, the form must include the complete name of the bidder;

17.2.2. A cashier’s or certified cheque; or

17.2.3. Another security as indicated in the **BDS**.

17.3. The Bid Security or Bid Securing Declaration shall be in accordance with the Form of the Bid Security or Bid Securing Declaration included in Section VII (Standard Bidding Forms) or another form approved by the Procuring agency/Employer prior to the bid submission.

17.4. The Bid Security shall be payable promptly upon written demand by the Procuring agency/Employer in case any of the conditions listed in **ITB 17.9** are invoked.

17.5. Any bid not accompanied by a Bid Security or Bid Securing Declaration in accordance with **ITB 17.1 or 17.3** shall be rejected by the Procuring agency/Employer and shall be declared as non-responsive bid, pursuant to **ITB 27**.

17.6. Unsuccessful bidders’ Bid Security will be discharged or returned as promptly as possible, however in no case later than thirty (30) days after the expiration of the period of Bid Validity prescribed by the Procuring agency/Employer pursuant to **ITB 16**. The Procuring agency/Employer shall make no claim to the amount of the Bid Security, and shall promptly return the Bid Security document, after whichever of the following that occurs earliest:

17.6.1. The expiry of the Bid Security;

17.6.2. The entry into force of a procurement contract and the provision of a performance security (or guarantee), for the performance of the contract if such a security (or guarantee), is required by the Biding documents;

17.6.3. The rejection by the Procuring agency/Employer of all Bids;

17.6.4. The withdrawal of the bid prior to the deadline for the submission of bids, unless the biding documents stipulate that no such withdrawal is permitted.

17.7. The successful bidder's Bid Security will be discharged upon the bidder signing the contract pursuant to **ITB 40**, or furnishing the performance security (or guarantee), pursuant to **ITB 41**.

17.8. The Bid Security may be forfeited or the Bid Securing Declaration executed:
if a Bidder:

17.8.1. Withdraws its Bid during the period of Bid Validity as specified by the Procuring agency/Employer, and referred by the bidder on the Form of Bid except as provided for in ITB 16.2; or

17.8.2. In the case of a successful bidder, if the bidder fails:

17.8.2.1. to sign the contract in accordance with ITB 40; or

17.8.2.2. to furnish performance security (or guarantee) in accordance with ITB 41.

17.9. In case of Bid Security issued by the foreign bank is allowed by the Procuring agency/Employer, the same should be counter guaranteed by a corresponding bank in Pakistan. Furthermore, in case of joint venture, it should be in the name of Joint venture to ensure joint responsibility. In case the JV is not legally constituted at the time of bid submission, the bid security or bid securing declaration shall be in the names of all future members as named in the letter of bid.

18. **Withdrawal of Bids**

18.1. Before bid submission deadline, any bidder may withdraw, substitute, or modify its bid after it has been submitted by sending a written notice, duly signed by an authorized representative, and the corresponding must accompany the respective written notice.

19. **Format and Signing of Bid**

19.1. The Bidder shall prepare and submit Bids through EPADS with due diligence after carefully reading all the terms and condition before bid submission deadline.

D. SUBMISSION OF BIDS

20. **Submission of Bids**

20.1. All bids shall be submitted through **EPADS v2.0**.

21. **Deadline for Submission of Bids**

21.1. All bids shall be received through **EPADS v2.0** not later than bid submission deadline as specified in the **BDS**.

21.2. The Procuring agency/Employer may, under exceptional circumstances and at its discretion, extend the deadline for the submission of bids, pursuant to PP Rules 2025, rule no.39 Extension of Time for submission of bid, by amending the Bidding Documents in accordance with ITB 7, in which case all rights and obligations of the Procuring agency/Employer and bidders previously subject to the deadline will thereafter be subject to the new deadline.

22. **Substitution and Modification of bids**

22.1. A bidder may substitute or modify his bid after it has been submitted, provided that written notice of the substitution or modification of the bid, is received by the Procuring agency/Employer prior to the deadline for submission of bids.

22.2. Revised bid may be submitted after the substitution or modification made in the original bid in accordance with the provisions referred in ITB 18.

E. OPENING AND EVALUATION OF BIDS

23. **Opening of Bids**

23.1. The Procuring Agency will open bids in accordance with the PP rules 2004, rule no 28 and as specified in the **BDS**.

24. **Confidentiality**

24.1. Information relating to the examination, clarification, evaluation and comparison of bids and recommendation of contract award shall not be disclosed to bidders or any other persons not officially concerned with such process until the time of the announcement of the respective evaluation report.

25. **Clarification of Bids**

25.1. Clarification of Bidding Documents shall be carried out in accordance with the PP Rules 2025, rule no 38 i.e. Clarifications.

25.2. The alteration or modification in the bid which in any case affect the following parameters will be considered as a change in the substance of a bid:

25.2.1. evaluation & qualification criteria;

25.2.2. required scope of work;

25.2.3. contract price;

25.2.4. all securities requirements;

25.2.5. tax requirements;

25.2.6. terms and conditions of bidding documents.

25.2.7. change in the ranking of the bidder

26. **Preliminary Examination of Bids**

26.1. Prior to the detailed evaluation of bids, the Procuring agency/Employer will determine whether each bid:

26.1.1. meets the eligibility criteria defined in ITB 3 and ITB 4;

26.1.2. has been prepared as per the format and contents defined by the Procuring agency/Employer in the bidding documents;

26.1.3. has been properly signed;

26.1.4. is accompanied by the required securities; and

26.1.5. is substantially responsive to the requirements of the bidding documents.

The Procuring agency/Employer's determination of a bid's substantial responsiveness will be based on the contents of the bid itself.

26.2. A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding Documents, without material deviation or reservation. A material deviation or reservation is one that: -

26.2.1. affects in any substantial way the scope, quality, or performance of the Works;

26.2.2. limits in any substantial way, inconsistent with the bidding documents, the Procuring agency/Employer's rights or the bidders' obligations under the Contract; or

26.2.3. if rectified, would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

26.3. The Procuring agency/Employer will confirm that the documents and information specified under ITB 9, 10 and 11 have been provided in the bid. If any of these documents or information is missing, or is not provided in accordance with the Instructions to Bidders, the bid shall be rejected.

26.4. The Procuring agency/Employer may waive-off any minor informality, nonconformity, or irregularity in a bid which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder.

Explanation: A minor informality, non-conformity or irregularity is one that is merely a matter of form and not of substance. It also pertains to some

immaterial defect in a Bid or variation of a bid from the exact requirements of the invitation that can be corrected or waived without being prejudicial to other bidders. The defect or variation is immaterial when the effect on quantity, quality, or delivery is negligible when contrasted with the total cost or scope of the works. The Procuring agency/Employer either shall give the bidder an opportunity to cure any deficiency resulting from a minor informality or irregularity in a bid or waive the deficiency, whichever is advantageous to the Procuring agency/Employer. Examples of minor informalities or irregularities include failure of a bidder to –

26.4.1. Submit the number of copies of signed bids required by the invitation;

26.4.2. Furnish required information concerning the number of its employees;

26.4.3. the firm submitting a bid has formally adopted or authorized, before the date set for opening of bids, the execution of documents by typewritten, printed, or stamped signature and submits evidence of such authorization and the bid carries such a signature.

26.5. Provided that a Technical Bid is substantially responsive, the Procuring agency/Employer may request the bidder to submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities or omissions in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any such aspect of the technical Proposal linked with the ranking of the bidders. Failure of the bidder to comply with the request may result in the rejection of its bid.

26.6. Provided that a Technical Bid is substantially responsive, the Procuring agency/Employer shall rectify quantifiable nonmaterial nonconformities or omissions related to the Financial Proposal. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of the missing or nonconforming item or component.

26.7. If a bid is not substantially responsive, it will be rejected by the Procuring agency/Employer and may not subsequently be evaluated for

complete technical responsiveness.

27. **Examination of Terms and Conditions; Technical Evaluation**

27.1. The Procuring agency/Employer shall examine the bid to confirm that all terms and conditions specified in the GCC and the PCC have been accepted by the bidder without any material deviation or reservation.
For this purpose:
"**Deviation**" means departure from the requirements specified in the Bidding Document.
"**Reservation**" means setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document.

27.2. The Procuring agency/Employer shall evaluate the technical aspects of the bid submitted in accordance with ITB 30, to confirm that all requirements specified in Section VI – Works Requirement, Technical Specifications of the Bidding Documents have been met without material deviation or reservation.

27.3. If after the examination of the terms and conditions and the technical evaluation, the Procuring agency/Employer determines that the bid is not substantially responsive in accordance with ITB 27, it shall reject the bid.

28. **Correction of Arithmetic Errors**

28.1. Bids determined to be substantially responsive will be checked for any arithmetic errors. Errors will be corrected as follows: -

28.1.1. if there is a discrepancy between unit prices and the sub-total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the sub-total price shall be corrected, unless in the opinion of the Procuring agency/Employer there is an obvious misplacement of the decimal point in the unit price, in which the total price as quoted shall govern and the unit price shall be corrected;

28.1.2. if there is an error in a total corresponding to the addition or subtraction of sub-totals, the sub-totals shall prevail, and the total shall be corrected; and

28.1.3. where there is a discrepancy between the amounts in figures and in words, the amount in words will govern.

28.1.4. Where there is discrepancy between grand total of price schedule and amount mentioned on the Form of Bid, the amount referred in Price Schedule shall be treated as correct subject to elimination of other errors.

28.2. The amount stated in the Bid will, be rectified by the Procuring agency/Employer in accordance with the above procedure for the correction of errors and, with, the concurrence of the bidder, shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount, its bid shall be rejected after forfeiture of Bid Security or execution of the Bid Securing Declaration, as the case may be, in accordance with ITB 41.3.

29. **Conversion to Single Currency**

29.1. The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works from outside the Procuring agency/Employer's country (referred to as the "Foreign Currency Requirements") shall indicate the same in the letter of bid-financial proposal. The proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the Bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in his bid. Comparison of bids quoted in different currencies and conversion of bids into a single currency shall be carried out in accordance with the PP Rule 2004, rule no. 30 (2).

30. **Evaluation of Bids**

30.1. The Procuring agency/Employer shall evaluate and compare only the bids determined to be substantially responsive, pursuant to ITB 27.

30.2. In evaluating the Technical Proposal of each Bid, the Procuring agency/Employer shall use the criteria and methodologies listed in the BDS and in terms of works requirement. No other evaluation criteria or methodologies shall be permitted.

30.3. The Procuring agency/Employer's evaluation of a bid will take into account:

30.3.1. the bid price, excluding provisional sums and the provision, if any, for contingencies in the summary bill of quantities, but including day work items, where priced competitively;

30.3.2. converting the amount resulting from applying above, if relevant, to a single currency in accordance with ITB 29;

30.4. The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

30.5. If these bidding documents allow bidders to quote separate prices for different lots, and the award to a single bidder of multiple lots, the methodology of evaluation to determine the lowest evaluated lot combinations in the Form of Bid, is specified in the BDS.

30.6. If the bid, which results in the Evaluated Bid Price (Successful Bid), is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

Explanation:

“Unbalanced” or “front-loaded” bids consist of deliberately submitting bids with artificially high prices or unit rates for the early stages of a construction project, offset by artificially low prices or unit rates for the later stages of the project, to improve the contractor’s cash flow.

31. **Domestic Preference**

31.1. If the BDS so specifies, the Procuring agency/Employer will grant a margin of preference to the domestic contractor in line with the rules, regulations, regulatory guides or instructions issued by the Authority from time to time.

32. **Determination of Successful Bid**

32.1. The Procuring agency/Employer shall compare the evaluated bids in accordance with the predefined bidding procedure, of all substantially responsive bids to determine the Successful bidder.

33. **Qualification of Bidder**

33.1. The Procuring agency/Employer shall determine to its satisfaction whether the bidder is substantially responsive and whose bid is declared as Successful bid either continues to meet (if prequalification applies) or meets (if post-qualification applies) the qualifying criteria specified in Evaluation and Qualification Criteria.
Note: In case of international bidding, the parameters for incorporation or licensing within Pakistan may be fulfilled as part of post qualification.

33.2. The determination shall be based upon an examination of the documentary evidence of the bidder’s qualifications submitted by the bidder, pursuant to ITB 11.

33.3. Prior to contract award, the Procuring agency/Employer will verify that the successful bidder (including each member of a JV) is not blacklisted/debarred. The Procuring agency/Employer will conduct the same verification for each sub-contractor proposed by the successful bidder.

34. **Sub-Contractors**

34.1. The bidder shall provide details regarding any specialized sub-contractor to the Procuring agency/Employer. In case change of sub-contractors, the bidder shall promptly notify the Procuring agency/Employer and obtain approval for replacement of sub-contractors.

34.2. Bidders may propose sub-contracting up to the percentage of total value of contracts or the volume of works as specified in the BDS.

35. **Abnormally Low Financial Bid**

35.1. A procuring Agency may reject abnormally low bids in accordance with the PP Rules 2025 rule no. 43. The decision of the Procuring agency/Employer to reject a bid and reasons for the decision shall be recorded in the procurement proceedings and promptly communicated to the bidder concerned. Moreover, the Procuring agency/Employer shall not incur any liability solely by rejecting abnormally bid

Guidance for Procuring agency/Employer:

An abnormally low bid means, in the light of the Procuring agency/Employer's estimate and of all the bids submitted, the bid appears to be abnormally low by not providing a margin for normal levels of profit. In order to identify the Abnormally Low Bid (ALB) following approaches can be considered to minimize the scope of subjectivity:

35.1.1. Comparing the bid price with the cost estimate;

35.1.2. Comparing the bid price with the bids offered by other bidders submitting substantially responsive bids; and

35.1.3. Comparing the bid price with prices paid in similar contracts in the recent past either government- or development partner-funded.

35.2. The Procuring agency/Employer will determine to its satisfaction whether the bidder that is selected as having submitted the successful bid is qualified to perform the contract satisfactorily, in accordance with the criteria listed in ITB 11

35.3. The determination will take into account the bidder's financial and technical capabilities. It will be based upon an examination of the

documentary evidence of the bidder's qualifications submitted by the bidder, pursuant to ITB 11, as well as such other information as the Procuring agency/Employer deems necessary and appropriate. Factors not included in these bidding documents shall not be used in the evaluation of the bidders' qualifications.

35.4. Procuring agency/Employer may seek "Certificate for Independent Price Determination" from the bidder and the results of reference checks may be used in determining award of contract.

Explanation: *The Certificate shall be furnished by the bidder. The bidder shall certify that the price is determined keeping in view of all the essential aspects such as raw material, its processing, value addition, optimization of resources due to economy of scale, transportation, insurance and margin of profit etc.*

35.5. An affirmative determination will be a prerequisite for award of the contract to the bidder. A negative determination will result in rejection of the bidder's bid, in which event the Procuring agency/Employer will proceed to the next ranked bidder to make a similar determination of that bidder's capabilities to perform satisfactorily.

F. AWARD OF CONTRACT

36. **Criteria of Award**

36.1. Subject to ITB 36 and 37, the Procuring agency/Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has been declared as Successful Bidder, provided that such bidder has been determined to be:

36.1.1. eligible in accordance with the provisions of ITB 3;

36.1.2. is determined to be qualified to perform the Contract satisfactorily; and

36.1.3. Successful negotiations have been concluded, if any.

37. **Negotiations**

37.1. The Committee of the Procuring agency/Employer may negotiate with the Most Advantageous Bidder relating to the following areas:

37.1.1. a minor alteration to the technical (drawings, design technical specifications) details of the statement of works;

37.1.2. Methodology, work plan, staffing in view to streamline the work;

37.1.3. a minor amendment to the Particular conditions of Contract;

37.1.4. finalizing payment arrangements;

37.1.5. clarifying details that were not apparent or could not be finalized at the time of Bidding;

37.2. Where negotiation fails to result into an agreement, the Procuring agency/Employer may invite the next ranked bidder for negotiations. Where negotiations are commenced with the next ranked bidder, the Procuring agency/Employer shall not reopen earlier negotiations.

38. **Procuring agency/Employer's Right to reject All Bids**

38.1. The procuring agency has the right to reject all bids in accordance with the PP Rules 2025 rule no. 45. However, the Authority (i.e. PPRA) may call from the Procuring agency/Employer the justification of those grounds.

39. **Notification of Award**

39.1. The procuring agency shall announce and publish the evaluation result in accordance with the PP Rules 2004, rule no. 40.

39.2. Where no complaints have been lodged, the bidder whose bid has been accepted will be notified of the award by the Procuring agency/Employer prior to expiration of the bid validity period through EPADS. However, the Procuring agency/Employer shall not award any procurement contract at least for five (05) days after the announcement of final evaluation report. The notification letter (herein after and in the condition of the contract and contract form called "Letter of Acceptance"

will specify the sum that the Procuring agency/Employer will pay the successful bidder in consideration for the execution and completion of the works as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price).

39.3. The notification of award will constitute the formation of the Contract, subject to the bidder furnishing the Performance Security (or guarantee) in accordance with ITB 41 and signing of the contract in accordance with ITB 40.

39.4. Upon the successful bidder’s furnishing of the performance security (or guarantee) pursuant to ITB 41, the Procuring agency/Employer will promptly notify each unsuccessful bidder, the name of the successful bidder and the Contract amount and will discharge the Bid Security or Bid Securing Declaration of the bidder(s) pursuant to ITB 17.

40. **Signing of Contract**

40.1. Promptly after notification of award, Procuring agency/Employer shall send the successful bidder the draft agreement, incorporating all terms and conditions as agreed by the parties to the contract.

40.2. Immediately after the Redressal of grievance by the GRC, and after fulfillment of all conditions precedent of the Contract Form, the successful bidder and the Procuring agency/Employer shall sign the contract.

40.3. Where no formal signing of a contract is required, work order issued to the bidder shall be construed to be the contract.

41. **Performance Security (or Guarantee)**

41.1. After the receipt of the Letter of Acceptance, the successful bidder, within the specified time, shall deliver to the Procuring agency/Employer a Performance Guarantee in the amount and in the form stipulated in the BDS and PCC, denominated in the type and proportions of currencies in the Letter of Acceptance and in accordance with the Conditions of Contract.

41.2. If the Performance Guarantee is provided by the successful bidder and it shall be in the form specified in the BDS which shall be in any of the

following:

41.2.1. certified cheque, cashier’s or manager’s cheque, or bank draft;

41.2.2. irrevocable letter of credit issued by a scheduled bank of Pakistan or in the case of an irrevocable letter of credit issued by a foreign bank, the letter shall be confirmed or authenticated by a scheduled bank of Pakistan;

41.2.3. bank guarantee confirmed by a reputable local bank or, in the case of a successful foreign bidder, bonded by a foreign bank; or

41.2.4. surety bond callable upon demand issued by any reputable surety or insurance company.
Any Performance Guarantee submitted shall be enforceable in Pakistan.

41.3. Failure of the Most Advantageous Bidder to comply with the requirement of ITB 40 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security or declare blacklisted (in case bid securing declaration is submitted) in which event the Procuring agency/Employer may make the award to the next most advantageous bidder or reinitiate the procurement process afresh (as a case may be).

42. **Advance Payment**

42.1. Advance payment will be provided to the bidder in percentage and in the manner as agreed by the both parties in terms of Conditions of the Contract.

42.2. The Procuring agency/Employer will provide an advance payment as stipulated in the Conditions of Contract, subject to a maximum amount, as stated and/or Conditions of the Contract. The advance payment request shall be accompanied by an advance payment security (guarantee) in the form provided in Section X. For the purpose of receiving the advance payment, the bidder shall make and estimate of, and include in its bid, the expenses that will relate to the purchase of equipment, machinery, materials, and on the engagement of labor during the first month beginning with the date of the Procuring agency/Employer’s “Notice to Commence” as specified in the PCC.

43. **General Performance of the Bidders**

43.1. The Procuring agency/Employer reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts / works. The Procuring agency/Employer may seek information / report from the previous employer for consideration. However, the Procuring agency/Employer shall incorporate such parameters in the evaluation criteria and accordingly decide the fate of the bid submitted.

44. **Corrupt & Fraudulent Practices**

44.1. Procuring agencies (including beneficiaries of Government funded projects and procurement) as well as Bidders/Suppliers/Contractors under Government financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts, and will avoid to engage in any corrupt and fraudulent practices.

G. GRIEVANCE REDRESSAL & COMPLAINT REVIEW MECHANISM

45. Grievance Redressal

45.1. Grievance Redressal shall be carried out in accordance with the PP Rules 2025, rule no. 65 i.e. Redressal of grievances by the procuring agency and “Redressal of Grievances Regulations 2021”.

H. MECHANISM OF BLACKLISTING

46. Mechanism of Blacklisting

46.1. The Procuring agency/Employer shall proceed Blacklisting of Bidders/Contractors in accordance with PP Rules 2025, rule no.25 i.e. Blacklisting and “Blacklisting and Debarment of Bidders or Contractors Regulations 2024.

Bid Data Sheet

Bid Data Sheet (BDS)

The following specific data for the procurement of works shall complement, supplement, or amend the provisions in the Instructions to Bidders (ITBs). Whenever there is a conflict, the provisions herein shall prevail over those in ITBs.

A. Introduction

ITB Number
Amendments of, and Supplements to, Clauses in the Instruction to Bidders

ITB Number1.1

Name of Procuring agency/Employer: **Pakistan Airports Authority (Planning & Development Directorate)**

The subject of procurement is: **Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu**

Period for completion of the works **2 Years**

Commencement date execution of the works: **14 Days**

Type of Procurement**:Local**

ITB Number2.1

Financial year for the operations of the Procuring agency/Employer: **2026-27**
Name of Project [insert: name and summary description of the Project if any]

Name of financing institution: [insert: name if any]

Name and identification number of the Contract: **P71309**

ITB Number3.1

JV/Consortium or Association Allowed: **Yes**

Maximum number of members in the joint venture shall be: **3**.

B. Bidding Documents

ITB Number6.4

The Bidders may seek clarifications through **EPADS v2.0**: **Last Clarification Date: Thursday, August 13, 2026**
Pre-Bid Meeting: Thursday, August 13, 2026 11:00 AM

C. Preparation of Bids

ITB Number8.1

The Language of all correspondences and documents related to the Bid is: **English**

ITB Number 5.1 & 9.1

The following documentsmust be includedto constitute the Bid

1. Please refer to the attached Annexures to the Bidding Document for the bidder's submission requirements. Please attach a one-page declaration confirming that the bidder has reviewed all Annexures attached to the Bidding Documents and has duly provided all submissions in accordance with the requirements stipulated therein.

ITB Number9.4 (b)

Other procurement specific documentation requirements are:

Documents Comprising the Technical Proposal

The Technical Proposal shall comprise the following documents, duly completed, signed and stamped, together with all supporting documentary evidence required under the Bidding Documents:

A. Mandatory Bid Submission Documents

1. Duly signed and stamped complete **Volume-I of the Bidding Documents** .

2. **Letter of Bid – Technical Proposal**, in the prescribed form duly filled and signed.

3. Original **Bid Security**, in the prescribed format and amount, issued by a Scheduled Bank or other financial institution acceptable under the Bidding

Documents.

4. Mandatory documentary evidence demonstrating the Bidder's eligibility and qualification, including, but not limited to:

5. Valid Pakistan Engineering Council (PEC) Registration Certificate with the required category and specialization codes;

6. National Tax Number (NTN) Certificate;

7. Sales Tax Registration Certificate (where applicable);

8. Active Taxpayer Status;

9. Any other registration, licence or certificate required under the Bidding Documents.

10. Affidavit in the prescribed format (Attachment-I).

11. Power of Attorney in the prescribed format (Attachment-II or Attachment-III, as applicable).

12. Joint Venture Agreement or Letter of Intent to Form a Joint Venture (where applicable).

B. Standard Qualification Forms

The following forms shall be duly completed, signed and stamped, together with all supporting documents required therein:

- Form ELI-1.1 – Bidder Information Form
- Form ELI-1.2 – Joint Venture Information Form (where applicable)
- Form CON-2 – Pending Litigation
- Form FIN-3.1 – Financial Situation and Performance
- Form FIN-3.2 – Financial Resources
- Form FIN-3.3 – Current Contract Commitments / Works in Progress
- Form EXP-4.1 – List of Similar/Comparable Projects Completed During the Last Ten (10) Years

- Form EXP-4.2 – Details of Similar/Comparable Projects Completed During the Last Ten (10) Years
- Form EQU – Equipment
- Form PER-1 – Personnel Capability
- Form PER-2 – Candidate Summary

C. Technical Schedules

The following schedules shall be duly completed, signed and stamped, together with all supporting documents required therein:

- Schedule A – Schedule of Adjustment Data
- Schedule C – Construction Schedule
- Schedule D – Method Statement / Method of Performing the Works
- Schedule E – List of Major Construction Equipment
- Schedule F – Organization Chart for Supervisory Staff and Labour
- Schedule G – List of Proposed Subcontractors
- Schedule I – Construction Camp and Housing Facilities
- Schedule J – Integrity Pact
- Schedule K – Mobilization Schedule

Notes

1. All forms, schedules, declarations and supporting documents shall be submitted in the order listed above and shall be properly indexed and page-numbered.

2. Documents designated as mandatory shall form part of the Technical Proposal. Failure to submit any mandatory document may result in the Bid being declared non-responsive, subject to the provisions of the Instructions to Bidders.

3. The Technical Proposal shall contain **no financial information**, including prices, rates, amounts or any other information relating to the Financial

Proposal.

The Procuring Agency/Employer may seek clarification of non-material omissions or irregularities in accordance with the Instructions to Bidders; however, such clarification shall not be construed as permitting any change to the substance of the Bid.

ITB Number12.4

The Bid price will be/will not be subject to the price adjustment **Yes**
Price Adjustment Annexure is attached in the Annexure Section with the name of Adjustment Data.

ITB Number12.6

The Bid price shall be adjusted in accordance with Schedule-A to Bid – “Schedule of Adjustment Data” if available.

ITB Number13.1

Bidders to quote entirely in**Pak rupees (PKR)**

Schedule of Adjustment Data for Local Currency (LC)

Index Code	Index Description	Source of Index	Weighting
1	Non-adjustable	---	0.694
2	Local Labour	PBS Monthly CPI - Urban Inter-City Consumer Prices of Construction and Energy Items for Abbottabad - Labour (unskilled)	0.051
3	Steel (Reinforcing & Structural)	PBS Monthly CPI - Urban Inter-City Consumer Prices of Construction and Energy Items for Abbottabad - Iron bars (1/2" 40 grade) (M.S. bars) (per tonne)	0.089
4	High Speed Diesel (HSD)	PBS – WPI Base 2015-16 Annex – C [072-Diesel Oil]	0.092

Index Code	Index Description	Source of Index	Weighting
5	Aggregates (crushed)	PBS Monthly CPI - Urban Inter-City Consumer Prices of Construction and Energy Items for Abbottabad – Bajri (rata) (per truck) (100 CFT)	0.043
6	Electrical Wiring and Equipment	PBS – WPI Base 2015-16 Annex – C [105 Electric Wires]	0.031
	Total	PKR	1.00

ITB Number15.1

The Bid Validity period shall be **180 Days** days.

ITB Number16.1

The amount of Bid Security shall be (insert amount)

The currency of the Bid Security shall be: **PKR**.

ITB Number16.2

The Bid Security shall be in the form of:**Bank Guarantee**

D. Submission of Bids

ITB Number19.1

The deadline for Bid submission is:**Thursday, September 17, 2026 11:00 AM**
Address for submission of Original Bid Security:**P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi**

ITB Number21.1
The Bid opening shall take place at:**EPADS v2.0**
Day : ***Thursday***
Date: ***September 17, 2026***
Time : ***12:30 PM***

ITB Number27.1
The currency that shall be used for Bid evaluation and comparison purposes to convert all Bid prices expressed in various currencies is: **PKR Only**
The source of exchange rate shall be: **Nil**
The date of exchange rate shall be: **Nil**

ITB Number28.2 &28.5

Least Cost Based Selection (LCBS)

see Evaluation Criteria

ITB Number29.1

Domestic preference to apply.

Domestic preference:**No**

Preference to domestic or national suppliers or contractors shall be provided in accordance with policies of the Federal Government and/or in accordance with the regulations issued by the Authority.

If Yes, The percentage for the domestic preference alongwith calculation formula is provided in the evaluation and qualification criteria.

ITB Number32.2

Sub-contracting is allowed? : **Yes**

30% of the total value of the contract.

39.1 The Performance Security (or guarantee) shall be **10.00%**

39.2 The Performance Security (or guarantee) shall be in the form of:**Bank Guarantee**

Eligibility Criteria

Bidder's Type	Required Registration
Any	FBR (NTN) PEC

Eligibility Criteria	Document
A duly executed Authorization Letter or Power of Attorney, authorizing the designated representative to sign and submit the Bid on behalf of the Bidder or, in the case of a Joint Venture (JV), on behalf of each JV partner.	Yes
In the case of a Joint Venture, a separate Authorization Letter or Power of Attorney shall also be provided, designating an authorized representative of the JV to sign and submit the Bid on behalf of the JV as a whole. Such authorization shall be duly executed by the authorized representatives of all JV partners. [To be submitted as per the formats provided Bidding Forms.] In case this does not pertain to you attach a single pager stating this as not applicable.	Yes
Local constructor(s) applying individually shall have valid registration with Pakistan Engineering Council in Category C-A. The firm must also hold the following minimum Specialization Codes: CE-01, CE-02(ii) (Piling), CE-10 , BC-01(ii), ME-01, ME-02, ME-03, EE-03, EE-04 & EE-07. Refer to Evaluation Criteria 1.1 (b) (i). In case this does not pertain to you attach a single pager stating this as not applicable.	Yes
Local Constructor (Lead Partner) having valid PEC registration in Category C-A may form a joint venture with local constructor(s) having PEC registration in Category C-2 or above. The JV shall collectively possess all Specialization Codes listed in 1.1(b)(i) above. In case this does not pertain to you attach a single pager stating this as not applicable.	Yes

Foreign Constructor (Lead Partner) having valid PEC registration in Category FC-A may form a joint venture with local constructor(s) having PEC registration in Category C-2 or above. The JV shall collectively possess all Specialization Codes listed in 1.1(b)(i) above. In case this does not pertain to you attach a single pager stating this as not applicable.	Yes
Provision of valid NTN/STRN Certificate from Federal Board of Revenue along with proof of being an active taxpayer (where applicable).	Yes
An affidavit as per as per the standard format provided in the Technical Forms (Attachment-I) on non-judicial Stamp paper of PKR 500. Also refer to Evaluation Criteria 1.1 (d) .	Yes
JV Agreement providing joint and several liability with respect to the contract. A Joint Venture Bid must comply with the requirements of Evaluation Criteria Section 1.3	Yes

Evaluation Criteria

Least Cost Based Selection (LCBS)

Weightage

Technical Evaluation Weightage
100

Technical Marks	1000
Passing Marks	**700**
Financial Soundness – Please refer to sub-section 1.4.1 of Section V Evaluation Criteria	
Available Bank Credit Facility (Project-specific in current dates): Fifty (50) marks will be given if the available Bank Credit Line Limit is equal to PKR 1,000 million. Ten (10) additional marks will be given for every PKR 200 million increase in the Credit Line. Full marks (100) will be given if the Credit Line Limit is ≥ PKR 2,000 million. No marks will be given if the Credit Line Limit is less than PKR 1,000 million. Kindly attach Current dated Letter issued by Banks for showing project-specific sanctioned credit line. (Qualitative)(Doc Required)	100
Average Working Capital (from Audited Financial Statements of last three (03) years): Fifty (50) marks will be given if the Average Working Capital for last three years is equal to PKR 1,000 million. Ten (10) additional mark will be given for every PKR 100 million increase in Working Capital. Full marks (100) will be given if the Average Working Capital is ≥ PKR 1,500 million. No marks will be given if the Average Working Capital is less than PKR 1,000 million. Kindly attach The Audited Balance Sheets of the last three (03) financial years (Forms FIN-3.1 and FIN-3.2) from a Chartered Accountant firm. (Qualitative)(Doc Required)	100

Average Annual Turnover (from Audited Financial Statements of last three (03) years): Fifty (50) marks will be given if the Average Annual Turnover for the last three years is equal to PKR 5,000 million. Ten (10) additional mark will be given for every PKR 500 million increase in Average Annual Turnover. Full marks (100) will be given if the Average Annual Turnover is ≥ PKR 7,500 million. No marks will be given if the Average Annual Turnover is less than PKR 5,000 million. Kindly attach The Audited Balance Sheets of the last three (03) financial years (Forms FIN-3.1 and FIN-3.2) from a Chartered Accountant firm. (Qualitative)(Doc Required)	100
Experience Capability – Please refer to sub-section 1.4.2 of Section V Evaluation Criteria	
Projects of airport Building (e.g., ATC towers, terminal buildings) having a minimum project cost of PKR 2,000 million, successfully completed during the last ten (10) years. [50 marks for each successfully completed project] Kindly attach Forms EXP-4.1 and EXP-4.2 along with documentary evidence such as Letter of Award and Taking-Over Certificate/Defects Liability Certificate/Substantial Completion Certificate issued by the Client (Qualitative)(Doc Required)	100
Projects of similar nature including piling works for high-rise buildings, successfully completed with a minimum project cost of PKR 1,000 million during the last ten (10) years. [50 marks for each successfully completed project] Kindly attach Forms EXP-4.1 and EXP-4.2 along with documentary evidence such as Letter of Award and Taking-Over Certificate/Defects Liability Certificate/Substantial Completion Certificate issued by the Client. (Qualitative)(Doc Required)	100
Projects including roads, bridges, runways, taxiways, and apron works, successfully completed with a minimum project cost of PKR 3,000 million during the last ten (10) years. [50 marks for each successfully completed project] Kindly attach Forms EXP-4.1 and EXP-4.2 along with documentary evidence such as Letter of Award and Taking-Over Certificate/Defects Liability Certificate/Substantial Completion Certificate issued by the Client. (Qualitative)(Doc Required)	100

Projects of similar nature executed on Steel Structure / pre-engineered building with at least 20,000 Sft foot print, successfully completed with a minimum project cost of PKR 300 million during the last ten (10) years. [50 marks for each successfully completed project] Kindly attach Forms EXP-4.1 and EXP-4.2 along with documentary evidence such as Letter of Award and Taking-Over Certificate/Defects Liability Certificate/Substantial Completion Certificate issued by the Client. (Qualitative)(Doc Required)	100
Personnel Capability – Please refer to sub-section 1.4.3 of Section V Evaluation Criteria	
Project/Construction Manager: Must be a Bachelor's Degree holder in Civil/Electrical/Mechanical Engineering, registered with PEC. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative)(Doc Required) More than 15 years total experience (with at least 5 years in a managerial role on high-rise or complex infrastructure projects) **(20)** >12–15 years total experience **(15)** >10–12 years total experience **(10)**	20

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Civil Engineer: Must be a Bachelor's Degree holder in Civil Engineering, registered with PEC. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative)(Doc Required) More than 10 years' specific experience in execution of building projects **(20)** >7–10 years **(15)** >4–7 years **(10)**	20
Planning Engineer: Must be a Bachelor's Degree holder in Engineering registered with PEC, proficient in Primavera/MS Project. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative)(Doc Required) More than 15 years' total experience (specific experience in project planning for large-scale construction) **(20)** >12–15 years total experience **(15)** >10–12 years total experience **(10)**	20

Electrical Engineer: Must be a Bachelor's Degree holder in Electrical Engineering, registered with PEC. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative) (Doc Required) More than 8 years specific experience in electrical systems for buildings/infrastructure. **(20)** >5–8 years **(15)** >3–5 years **(10)**	20
Mechanical Engineer: Must be a Bachelor's Degree holder in Mechanical Engineering, registered with PEC. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative) (Doc Required) More than 8 years specific experience in HVAC and firefighting systems **(20)** >5–8 years **(15)** >3–5 years **(10)**	20

HSE Officer: Must hold NEBOSH IGC, IOSH, or equivalent certification. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative)(Doc Required) More than 8 years specific experience in construction safety **(20)** >5–8 years **(15)** >3–5 years **(10)**	20
Quantity Surveyor: Must hold a Diploma of Associate Engineer in Civil or a Bachelor's Degree in a relevant field. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative)(Doc Required) More than 8 years specific experience in quantity surveying/billing **(20)** >5–8 years **(15)** >3–5 years **(10)**	20

Surveyor: Must hold a Diploma of Associate Engineer in Civil or a Certificate in Surveying. Kindly attach Forms PER-1 and PER-2 supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate) of the proposed expert (Qualitative)(Doc Required) More than 8 years specific experience in land/building surveying **(10)** >5–8 years **(7)** >3–5 years **(5)**	10
Equipment Capability – Please refer to sub-section 1.4.4 of Section V Evaluation Criteria	
Concrete Batching Plant (min. 30 cu.m/hr): 01 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative)(Doc Required)	10
Concrete Pump (min. 30 cu.m/hr): 01 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative) (Doc Required)	10
Motor Grader (min. 12 ft blade) : 02 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative) (Doc Required)	20
Excavator (min. 20-ton operating weight) : 02 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative)(Doc Required)	20

Piling Rig (for bored cast-in-situ piles, dia. >1100 mm & depth 25 meters) : 01 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative)(Doc Required)	10
Loaders/Backhoes (min. 2.5 cu.m bucket) : 02 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative)(Doc Required)	20
Transit Mixers (>6 cu.m capacity) : 02 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative) (Doc Required)	20
Mobile Crane (>30-ton, all-terrain, with load chart for 30 m height) : 01 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative)(Doc Required)	10
Dump Trucks (>6 cu.m capacity) : 04 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative) (Doc Required)	20
Asphalt Paver (min. 4 m paving width) : 01 No. Kindly attach documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU) (Qualitative) (Doc Required)	10

Jobs/Lots

Jobs Without Lots :

Job	Delivery Schedule	Quantity	Bid Security

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu	**Address:** Skardu International Airport, Skardu**Schedule:** 730 Days**Quantity:** 1/job	1/job	100000000 PKR

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Work Specifications and Market Rates

Jobs Without Lots :

Job: Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Specifications / Requirements:

Sr. No	Item No	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
1					USD		(Rs)
2	G	Bill No. 01: Preliminaries and General Items - Administrative Arrangement including Transportation, Site Offices & Mess + Accommodation REF: Technical Specifications Section - 0010, Section - 0030					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
3	G-1	Providing new vehicles for the exclusive use of the Employer and the Engineer in accordance with the Technical Specification Section 0010, including supply, delivery, inspection, registration facilitation, tools, accessories, owner's manuals, warranties and all associated requirements, complete in all respects. REF: Technical Specifications Section - 0010					
4	G-1-1	Toyota Hilux Revo Rocco 2.8L 4×4 A/T. REF: Technical Specifications Section - 0010	No.	1	Not Applicable		
5	G-1-2	BYD Shark 6 DMO AWD Premium (PHEV Pickup Truck) REF: Technical Specifications Section - 0010	No.	1	Not Applicable		
6	G-1-3	Changan Oshan X7 Future Sense 7-Seat. REF: Technical Specifications Section - 0010	No.	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
7	G-1-4	Honda BRV i-VTEC S (CVT) REF: Technical Specifications Section - 0010	No.	2	Not Applicable		
8	G-2	Registration, licensing, comprehensive insurance coverage, token taxes, withholding taxes, route permits and all statutory fees, duties and charges required for operation of the vehicles, including renewals where applicable, until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010	LS	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
9	G-3	Operation, management and comprehensive maintenance of all vehicles, including provision of drivers, fuel, lubricants, tyres, batteries, consumables, routine servicing, preventive maintenance, repairs, breakdown assistance, replacement of worn or damaged parts, insurance claim handling and all other costs necessary to keep the vehicles fully operational, roadworthy and continuously available for the exclusive use of the Employer and the Engineer throughout the Contract Period until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010	LS/Month	36	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
10	G-4	Providing, establishing, furnishing, equipping, testing and commissioning a fully functional Combined Employer's and Engineer's Site Office Complex in accordance with the Drawings and Technical Specification Section-0010, including all prefabricated office buildings, conference and meeting facilities, records and sample storage rooms, toilets and ablution facilities, foundations, utility connections, internal roads, parking areas, external works, electrical and mechanical installations, lighting, air-conditioning, backup generators, water supply, sewerage and drainage systems, LAN/Wi-Fi infrastructure, furniture, IT and communication equipment, office equipment, fire safety provisions, fixtures, fittings, accessories and all ancillary works required to provide a complete and operational facility ready for use by the Employer and the	LS	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
11	G-5	Operation, management and maintenance of the Combined Employer's and Engineer's Site Office Complex from commencement of use until issuance of the DLC, including operation and maintenance of all buildings, utilities, generators, furniture, equipment and services; provision of electricity, fuel, water, internet, telephone services, stationery, office consumables, drinking water, security staff, office attendants, janitorial staff, cleaning services, repairs, replacements, utility charges and all other recurring costs necessary to maintain the facility in a safe, fully functional and satisfactory condition until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010	LS/Month	36	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
12	G-6	Provision through rental or hiring arrangements of separate furnished Staff Accommodation and Mess Facilities for the exclusive use of the Employer and the Engineer, in accordance with Technical Specification Section-0010, including suitable accommodation units, bedrooms, dining facilities, kitchens, toilets, furniture, appliances, fixtures, fittings, utensils and all other facilities necessary to provide complete, operational and habitable accommodation and mess facilities ready for occupation and use until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010, Section - 0030	LS/Month	36	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
13	G-7	Operation, management and maintenance of the Employer's and Engineer's Staff Accommodation and Mess Facilities from the date of occupation until issuance of the DLC, including provision of cooks, mess attendants, housekeeping staff, cleaners, security personnel and other support staff; payment of electricity, water, gas, internet and communication charges; procurement of cleaning materials and consumables; routine upkeep, repairs, maintenance and replacement of furniture, fixtures, fittings, appliances and utensils; waste disposal, pest control and all other services, resources and recurring costs necessary to maintain the accommodation and mess facilities in a safe, hygienic, comfortable and fully functional condition, complete in all respects. REF: Technical Specifications, Section - 0010,	LS/Month	36	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
14	G-8	Provision, preparation, maintenance, and payment of rental charges for temporary access road(s) from JSR (Main Road) to the Combined Employer's and Engineer's Site Office Complex for the entire Contract period, including grading, compaction, drainage, reinstatement, and all incidental works, complete in all respects. REF: Technical Specifications Section - 0010	LS/Month	36	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
15	G-9	Providing, installing, maintaining, (as required), and removing temporary fencing around the project site and work areas, complete in accordance with drawings, specifications, and the Engineer's instructions, including all materials, labor, equipment, fixings, supports, transportation, maintenance during the contract period, dismantling upon completion, and all incidental works, complete in all respects. REF: Technical Specifications Section - 0010	Job	1	Not Applicable		
16	CP	Bill No. 02: Civil Works – Substructure & Superstructure, SH:Pile Works					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
17	CP-1	Providing and casting in situ bored reinforced concrete piles using Ordinary portland cement / Sulphate resisting cement or as may be required, including screening, washing of aggregates, mixing of constituents using batching plant, Transportation by Transit Mixer, Pouring in the required proportion to achieve a nominal cylindrical strength in the field as per ACI-214, with the specified consistency. i/c the cost of labour, boring, equipment / machinery, platform (except the cost of steel reinforcement, its labour for bending and laying in position and boat platform etc. which will be paid separately) including the cost of concrete pump and admixture, as approved and directed by the Engineer Incharge. 3000 PSI (Dia as mentioned in drawing) REF: Technical Specifications Section -0190, Section -0150, Section -0145, Section -0140	Rft	7410	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
18	CP-2	Fabrication of mild steel reinforcement deformed bar cage of specified yield strength for R.C.C bored piles including cutting bending, lowering of cage with crane in position,welding and fastening, including the cost of binding wire, Crane Machine (also includes removal of rust from the bars) as approved and directed by the Engineer Incharge. REF: Technical Specifications Section - 0190, Section - 0150, Section - 0145, Section - 0140 Grade - 60.	Kg	122283.8	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
19	CP-3	Initial (ultimate) vertical compression load test on sacrificial Ø1000 mm bored cast-in-situ pile to 378 tons (3.0 x working load of 126 tons), by anchor-pile reaction frame, in two loading cycles, instrumented for shaft friction and end bearing, in accordance with ASTM D1143 and Section 0190 Clause 3.12. Rate to include provision of the sacrificial test pile, reaction piles, reaction frame, instrumentation, loading, monitoring, standing time and submission of test report in triplicate.	No.	1			
20	CP-4	Ditto Item 1, but test load 228 tons (3.0 x working load of 76 tons), covering pile types ATCT-F2, ATCT-F3, ATCT-F4, FS-F1 and FS-F2.	No.	1			

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
21	CP-5	Routine (proof) vertical compression load test on working Ø1000 mm bored cast-in-situ pile of Foundation Type ATCT-F1 to 189 tons (1.5 x working load), in accordance with ASTM D1143. Rate to include reaction arrangement, instrumentation, loading, monitoring, standing time and test report.	No.	1			
22	CP-6	Ditto Item 3, but test load 114 tons (1.5 x working load), on Foundation Types ATCT-F2, ATCT-F3, ATCT-F4, FS-F1 and FS-F2 - one test per foundation type.	No.	5			

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
23	CP-7	Lateral load test on working Ø1000 mm bored pile of ATCT at 10% of working load, applied cyclically, in accordance with ASTM D3966. Rate to include reaction pile, instrumentation and test report.	No.	1			
24	CP-8	Tension (uplift) load test on working Ø1000 mm bored pile of ATCT to 1.5 x design uplift load, in accordance with ASTM D3689. Rate to include reaction arrangement, instrumentation and test report. To be executed only where net uplift is confirmed in writing by the Engineer.	No.	1			

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
25	CP-9	Low-strain pile integrity test (PIT) on Ø1000 mm bored piles in accordance with ASTM D5882 and Section 0190 Clause 3.19, including pile head preparation, testing, interpretation and report. (100% of working piles.)	No.	142			
26	CP-10	Crosshole sonic logging (CSL) of Ø1000 mm bored piles in accordance with ASTM D6760, including supply and installation of four nos. 50 mm dia. steel access tubes per pile to full pile length, capping, water filling, testing, interpretation and report. (10% of working piles plus both initial test piles.)	No.	17			

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
27	CP-11	High-strain dynamic pile test (PDA) with CAPWAP analysis on Ø1000 mm bored pile in accordance with ASTM D4945 and Section 0190 Clause 3.20, complete in all respects including wave equation analysis and test report.	No.	4			
28	CP-12	Extra over the pile installation items for provision of 2 nos. sacrificial initial test piles, Ø1000 mm bored cast-in-situ, of the same length, reinforcement and installation method as the working piles, installed at positions selected by the Engineer and forming no part of the permanent works.	No.	2			
29	CB	Bill No. 02: Civil Works – Substructure & Superstructure, SH: Building Structure Work					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
30	CB-1	Excavation in all kind of soils at any level/height including clearing & grubbing, trimming/dressing out,disposal of surplus/unsuitable material at area designated by the Engineer within or outside work site, and i/c all lead & lift, marking alignment for layout by providing permanent benchmarks and alignment pillars including levels and grid lines etc. and necessary protection/ shoring/ stability to excavated areas/sides, dewatering and keeping the area to dry,all operations & arrangements in connection with earth works to complete conforming to the requirements of drawings, specifications and instructions by the Engineer In Charge. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060	Cft	46989	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
31	CB-2	Spraying termite proofing using liquid FMC/ Biflex/Terminix Exin/ Ms Hextar or eq @ spd suspension concenterate (SC), Mixing ability-HEXTAR with Ratio (1:250) = 540 Sq Ft or equivalent liquid applying with shower and certificate will be provided by the contractor for 10-years compere in complete in all respect as approved by the Engineer Incharge. REF: Technical Specifications Section - 0130	Sft	41337	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
32	CB-3	Providing, laying Engineering Fill shall be well graded and a mixture of non-toxic soil, filling shall be placed in layers not exceeding 6" in compacted thickness, filling shall be compacted to a drey density not less than 95% of maximum dry density (ASTM D-1557), i/c lead and transportation to site, as shown in drawings complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0100	Cft	133346	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
33	CB-4	Providing & Laying in position, True to line, level, grade, at any height. aggregate (as approved) including screening and washing of aggregate & Sand (as approved), finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. Ratio 1:4:8 Under footing. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	3666.31	Not Applicable		
34	CB-5	Providing & Laying in position light-weight concrete, as approved, finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0140	Cft	8509.69	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
35	CB-6	Providing, laying, compacting and curing sand, under floor and compaction, complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0120, Section - 0100	Cft	12062.5	Not Applicable		
36	CB-7	Providing, laying, dry rammed brick or stone ballast 1 1/2" to 2" gauge, complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0120, Section - 0100	Cft	6031.25	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
37	CB-8	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 3000 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
38	CB-8-1	RCC in Footing. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	24783.56	Not Applicable		
39	CB-8-2	RCC in Slab. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	20193.95	Not Applicable		
40	CB-8-3	RCC in Stairs. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	735	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
41	CB-9	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 4500 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
42	CB-9-1	RCC in Beams. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	17262.68			
43	CB-9-2	RCC In Lift & Shear Wall. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	4170	Not Applicable		
44	CB-9-3	Columns. REF: Technical Specifications Section - 0150, Section - 0145	Cft	8848.7	Not Applicable		
45	CB-10	Providing, fabrication, straightening, cutting, bending, placing, binding with annealed wire, including removal of rust from bars with sand blasting, PCC Spacer block, wastage, etc. complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0145	Kg	342864.7	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
46	CB-11	Providing and applying torch-on plain waterproofing bituminous membrane of specified thickness duly lapped/connected by heating with Torch over ps-6 primer i/c preparation/smoothen the surface complete in all respect as approved and directed by the Engineer Incharge. REF: Technical Specifications Section - 0150	Sft	18541	Not Applicable		
47	CB-12	Providing and embedding 10" (250mm) wide PVC water stopper in expansion joints of RCC structures (Retaining walls, water tanks, Slabs) complete in all respect. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Rft	461	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
48	CB-13	Providing and laying concrete block masonry having 1800 psi compressive cube strength at 28 days for Internal/External walls as in specified thickness & laid in specified cement sand mortar , placed at any height/level masonry to be laid in courses true to line, level and plumb, protected and properly cured including scaffolding, wastage, deep joints to receive rendering, chiseling including all dowels/ steel bars /anchoring/GI wall ties/strip etc., to be installed horizontally/ vertically as specified in general notes/details drawing typical, curing, placing of all embedded items in position i.e. conduits/ sleeves/ anchors/ all other fittings/ accessories etc., as necessary related to MEP provisions. Complete in all respects and conforming to the requirements of drawings, specifications and instructions by the Engineer In charge. REF: Technical					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
49	CB-13-1	4" thick 1800 PSI. REF: Technical Specifications Section - 0200	Cft	2390	Not Applicable		
50	CB-13-2	8" thick. REF: Technical Specifications Section - 0200	Cft		Not Applicable		
51	CB-13-3	Upto Plinth Level. REF: Technical Specifications Section - 0260	Cft	1800	Not Applicable		
52	CB-13-4	Above Plinth. REF: Technical Specifications Section - 0260	Cft	34320	Not Applicable		
53	CB-14	Providing and applying Cement Sand Plaster 1/2" Thick 1:4 Cement Sand Plaster on inner surface using sand (as approved) at any height / depth including making edges, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	Sft	36528	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
54	CB-15	Providing and applying Cement Sand Plaster 3/4" Thick 1:4 Cement Sand Plaster on external surface sand (as approved) at any height / depth including making edges, groove drip course, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	Sft	15572	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
55	CB-16	Providing all civil, structural, waterproofing, and mechanical works for underground fire fighting water storage tank including excavation in all types of soils; dewatering, shoring, disposal of surplus excavated material, and site preparation; plain cement concrete (PCC); reinforced cement concrete (RCC) of specified grades for raft foundation, walls, roof slab, beams, and other structural components including formwork, curing, and reinforcement steel (Grade 60) complete with cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including membranes and PVC water stops at construction and expansion joints; supply and installation of manholes with heavy-duty covers, cast iron step irons, access openings, vents, overflow, washout arrangements; complete mild steel piping system including	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
56	CB-17	Providing all civil, structural, waterproofing, and mechanical works for Underground Water Storage Tank including excavation in all types of soils, dewatering, shoring, disposal of surplus excavated material, and site preparation; plain cement concrete (PCC); reinforced cement concrete (RCC) of specified grades for raft foundation, walls, roof slab, beams, and all associated structural components including formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete mild steel piping system including	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
57	CB-18	Providing all civil, structural, waterproofing, and mechanical works for the construction of an overhead water storage tank, including reinforced cement concrete (RCC) of specified grades for base slab, walls, roof slab, beams, and all associated structural components complete with formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete mild steel piping system including inlet, outlet/suction headers, overflow, washout, vent, and spare connections with all fittings, valves, supports, fabrication, installation,	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
58	CB-19	Providing all civil, structural, waterproofing, and mechanical works for the construction of an underground rainwater harvesting storage tank, including excavation in all types of soils, dewatering, shoring, disposal of surplus excavated material, and site preparation; plain cement concrete (PCC); reinforced cement concrete (RCC) of specified grades for raft foundation, walls, roof slab, and all associated structural components complete with formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete mild steel piping system including	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
59	CB-20	Providing all civil, structural, waterproofing, and plumbing works for the construction of a Septic tank, including reinforced cement concrete (RCC) of specified grades for raft foundation, walls, partition walls, roof slab, and all associated structural components complete with formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete uPVC piping system including inlet, outlet, vent, and interconnecting pipework with all fittings, jointing, supports, testing, and commissioning; including all ancillary works necessary for a	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
60	CB-21	Construction of Circular Soakage Well, including all excavation, masonry, structural slabs, and internal filter media, executed in strict accordance with the approved architectural/structural drawings, technical specifications, and instructions of the Engineer-in-Charge. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060, Section - 0150, Section - 0145, Section - 0140	Job	1	Not Applicable		

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Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
61	CB-22	Providing and constructing manhole of the specified size and depth, including excavation in all types of soil to the required depth, disposal of surplus excavated material, plain cement concrete (PCC) bedding, cement concrete block masonry in cement mortar, internal and external cement sand plaster, benching and channeling as required, supplying and fixing heavy-duty cast iron (CI) manhole frame and cover, backfilling with approved material, compaction, curing, and all necessary materials, labor, tools, equipment, transportation, testing, and incidental works, complete in all respects, in accordance with the drawings, specifications, and Engineer's instructions. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060, Section - 0150, Section - 0140, Section - 0200, Section - 0260, Section - 0145	No	45	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
62	CB-23	All civil, structural, waterproofing, and mechanical works, comprising reinforced cement concrete of specified grades for raft, walls, and stair including formwork and curing; reinforcement steel (Grade-60) including cutting, bending, placing and binding; internal and external plaster; waterproofing membrane system; PVC water stops in construction/expansion joints; provision and fixing of floor drain; and epoxy floor, wall tiles complete in all respects as per drawings, specifications, and instructions of the Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0260	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
63	CB-24	Providing and constructing catch pit complete with excavation in all types of soil, disposal of surplus excavated material, plain cement concrete (PCC) bedding, cement concrete block masonry, internal and external cement plaster, anchoring of cast iron (CI) grating frame, fixing heavy-duty CI grating, backfilling, compaction, curing, and all necessary materials, labor, tools, equipment, testing, and incidental works, complete in all respects, as per drawings, specifications, and Engineer's instructions. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060, Section - 0150, Section - 0140, Section - 0200, Section - 0260, Section - 0145	No	36	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
64	CB-25	Supply, Installation, Testing, and Commissioning of an Underground Mild Steel (M.S.) Diesel Fuel Storage System, complete in all respects, executed turnkey in strict accordance with approved engineering drawings, technical specifications, and standards of the industry, under the direction of the Engineer-in-Charge. REF: Technical Specifications Section - 0680, 0150 - 0145 - 0140	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
65	CB-26	Providing, drilling, constructing, developing, testing and commissioning of deep bore well complete in all respects for combined domestic and ARFF water supply system, minimum 250 ft / 75 m depth or up to approved aquifer, whichever is greater, complete with 12 inch bore, 8 inch casing, screen, gravel pack, sanitary seal, submersible pump, controls, valves, pipework, testing, chlorination and connection to domestic and ARFF/fire water tanks. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0350	Job	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
66	CS	Bill No. 02: Civil Works – Substructure & Superstructure, SH: Steel Work in Space Frame Structure & Metal Deck Structure					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
67	CS-1	Design, supply, fabrication, and installation of structural steel columns using HSS sections (RHS / CHS) conforming to ASTM A36 / equivalent, including base plates, top plates, stiffeners, stubs, stool pipes, anchor bolts, angle irons, cleats, and all connection accessories. The scope includes sizing, cutting, drilling, welding, grinding, surface preparation, shop fabrication, transportation, loading/unloading, erection and alignment, complete in all respects in accordance with approved drawings, design requirements, specifications, and Engineer’s instructions. REF: Technical Specifications Section - 0160	Kg	27800	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
68	CS-2	Design, supply, fabrication, and installation of doublelayer steel space frame roof structure for the ATC Tower building at the required level, consisting of mild steel CHS tubular members of various diameters and thicknesses used as top chord, bottom chord, and diagonal members forming a 3D space frame system. The structure shall include forged steel cones, sleeves, high-strength bolts, and solid forged MEROtype node joint system, complete with fabrication, welding, tacking, CNC machining, precise node drilling, surface treatment, and powder coating of approved color. The scope further includes secondary GI purlins fixed to top nodes, handling, transportation, erection, bolting, alignment, and completion of works as per approved drawings, specifications, and Engineer’s instructions. (Note: The quantity for payment shall be measured	Sft	25550	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
69	CS-3	Supply and installation of standing seam lock roofing system using 0.70 mm thick PPGL Aluzinc sheets (AZ 150 coating), roll-formed to required lengths, including seam lock clips with thermal movement provision, ridge and eave galvanized flashing strips, ridge trays, seam fasteners, foam closures, sealants, and all necessary accessories. The work also includes 0.50 mm thick PPGL liner sheets fixed beneath roof purlins, with 100 mm thick rockwool insulation blanket of 80 kg/m³ density placed between roofing and liner sheets for thermal and acoustic insulation. The item further includes all required flashings, sealants, and water test complete in all respects as per drawings, specifications, and Engineer’s instructions. REF: Technical Specifications Section - 0160	Sft	25550	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
70	CS-4	Providing complete structural engineering services for ATC Watch Tower Steel Structure, including structural analysis, design, modelling, preparation of calculations and production of detailed construction/shop drawings based on applicable American Codes and Standards including AISC, ASTM, ASCE and relevant seismic/wind load code. The scope shall include determination and application of all design loads including dead loads, live loads, wind loads, seismic loads and equipment loads applicable to project location, complete 3D structural modelling and analysis, design reports and calculation sheets using SAP2000 and/or STAAD Pro, connection design and details in Tekla for approval. The scope also includes obtaining review/vetting and approval of the structural design and drawings from the Project Consultant/Engineer, including	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
71	CS-5	Providing, fabricating, supplying and installing MS hot-dip galvanised anchor bolts conforming to ASTM A307 Grade C / equivalent Grade 4.6 complete with heavy hex nuts, washers, anchor plates, templates and all necessary accessories for fixing of structural steel columns of ATC Watch Tower, including cutting, threading, bending, welding, galvanizing, positioning, alignment, leveling and embedding in reinforced concrete foundations as per approved shop drawings, specifications and Engineer’s instructions. The rate shall include all labour, transportation, handling, consumables and complete installation in all respects. REF: Technical Specifications Section - 0160, Section - 0010	Kg	943	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
72	CS-6	MAIN STRUCTURE: Providing, fabricating, supplying, erecting and fixing of structural steel works for construction of ATC Watch Tower comprising steel columns, beams, rafters, stringers, bracings, trusses, platforms and all related structural members fabricated from MS hollow sections, built-up sections, hot rolled H sections, I-sections, channels (C-sections), angle irons and other required structural profiles, including cutting, straightening, drilling, welding, grinding, edge preparation, stiffeners, base plates, cleat plates, connection plates, galvanized connection bolts 10.8 grade, nuts, washers, temporary supports, lifting, alignment and complete erection as per approved shop Hot rolled structural steel sections shall conform to ASTM A36, while built-up welded structural members shall conform to ASTM A572 Grade 50. The item shall include	Kg	52647	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
73	CS-7	Composite Deck Slab on Steel Structure Providing, supplying and installing composite deck slab system over steel structure comprising 0.90 mm thick galvanized profiled steel deck sheet, fixed to structural steel framework with approved fasteners and accessories, including welding/fixing of shear studs to steel beams, edge trims, closures and all necessary accessories complete as per approved drawings and specifications. The item includes casting of 100 mm thick concrete slab having minimum compressive strength of 4000 PSI (28 MPa) over metal deck, including batching, placing, vibrating, finishing and curing complete in all respects. NOTE: Steel reinforcement bars/mesh shall be measured and paid separately under relevant BOQ item Supporting structural steel framework/beams shall also be measured and paid separately. (for steel structure refer item #	Sft	4116	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
74	CS-8	Mild Steel Spiral Staircase: Providing, fabricating, supplying and erecting complete Mild Steel Spiral Stair Structure for ATC Tower, comprising central support pipe/column, stringers, treads, landing frames, base plates, stiffeners, connections, MS handrails and MS railing system, fabricated from MS plates, pipes, hollow sections, channels, angles and other required structural sections, including cutting, bending, rolling, welding, grinding, drilling, anchoring, alignment and complete installation as per approved architectural and structural drawings. Steel material for hot rolled sections shall conform to ASTM A36. REF: Technical Specifications Section - 0180	Kg	7500	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
75	CU	Bill No. 02: Civil Works – Substructure & Superstructure, SH: Utility Block Structure Work					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
76	CU-1	Excavation in all kind of soils at any level/height including clearing & grubbing, trimming/dressing out,disposal of surplus/unsuitable material at area designated by the Engineer within or outside work site, and i/c all lead & lift, marking alignment for layout by providing permanent benchmarks and alignment pillars including levels and grid lines etc. and necessary protection/ shoring/ stability to excavated areas/sides, dewatering and keeping the area to dry,all operations & arrangements in connection with earth works to complete confirming to the requirements of drawings, specifications and instructions by the Engineer In Charge. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060.0075,-0730	Cft	2551.979682	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
77	CU-2	Spraying termite proofing using liquid FMC/ Biflex/Terminix Exin/ Ms Hextar or eq @ spd suspension concentrate (SC), Mixing ability-HEXTAR with Ratio (1:250) = 540 Sq Ft or equivalent liquid applying with shower and certificate will be provided by the contractor for 10-years compere in complete in all respect as approved by the Engineer Incharge. REF: Technical Specifications Section - 0130	Sft	2250.423	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
78	CU-3	Providing, laying Engineering Fill shall be well graded and a mixture of non-toxic soil, filling shall be placed in layers not exceeding 6" in compacted thickness, filling shall be compacted to a drey density not less than 95% of maximum dry density (ASTM D-1557), i/c lead and transportation to site, as shown in drawings complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0100	Cft	9833.4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
79	CU-4	Providing & Laying in position, True to line, level, grade, at any height. aggregate (as approved) including screening and washing of aggregate & Sand (as approved), finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140					
80	CU-4.1	Ratio 1:4:8 Under footing.	Cft	967.977918	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
81	CU-5	Providing & Laying in position light-weight concrete, as approved, finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0140	Cft	557.226	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
82	CU-6	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 3000 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
83	CU-6-1	RCC in Footing. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	437.5	Not Applicable		
84	CU-6-2	RCC Pads. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	2214	Not Applicable		
85	CU-6-3	RCC in Slab. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	2245.3125	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
86	CU-7	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 4500 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
87	CU-7-1	RCC in Beams. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	586.585	Not Applicable		
88	CU-7-2	RCC Plinth Beams. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Cft	616.5	Not Applicable		
89	CU-7-3	Columns. REF: Technical Specifications Section - 0150, Section - 0145	Cft	720	Not Applicable		
90	CU-8	Providing, fabrication, straightening, cutting, bending, placing, binding with annealed wire, including removal of rust from bars with sand blasting, PCC Spacer block, wastage, etc. complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0140 -0145			Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
91	CU-8-1	Grade - 60. REF: Technical Specifications Section - 0145	Kg	22363.59	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
92	CU-9	Providing and laying concrete block masonry having 1800 psi compressive cube strength at 28 days for Internal/External walls as in specified thickness & laid in specified cement sand mortar , placed at any height/level masonry to be laid in courses true to line, level and plumb, protected and properly cured including scaffolding, wastage, deep joints to receive rendering, chiseling including all dowels/ steel bars /anchoring/GI wall ties/strip etc., to be installed horizontally/ vertically as specified in general notes/details drawing typical, curing, placing of all embedded items in position i.e. conduits/ sleeves/ anchors/ all other fittings/ accessories etc., as necessary related to MEP provisions. Complete in all respects and conforming to the requirements of drawings, specifications and instructions by the Engineer In charge. REF: Technical					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
93	CU-9-1	8" thick. REF: Technical Specifications Section - 0200			Not Applicable		
94	CU-9-2	Upto Plinth Level. REF: Technical Specifications Section - 0260	Cft	779.88	Not Applicable		
95	CU-9-3	Above Plinth. REF: Technical Specifications Section - 0260	Cft	3304.44	Not Applicable		
96	CU-10	Providing and applying Cement Sand Plaster 1/2" Thick 1:4 Cement Sand Plaster on inner surface using sand (as approved) at any height / depth including making edges, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	Sft	7083	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
97	CU-11	Providing and applying Cement Sand Plaster 3/4" Thick 1:4 Cement Sand Plaster on external surface sand (as approved) at any height / depth including making edges, groove drip course, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	Sft	6984	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
98	CU-12	Providing and laying 1/2" thick terrazzo flooring over 2" thick RCC screed (1:2:4) reinforced with #3 bars @ 12" c/c, laid over 2" thick isolation sheet (Diamond/Jumbolon), one layer of 500-gauge polythene sheet, and waterproofing treatment (Aqua Seal/Sika or approved equivalent), including all materials, labor, tools, curing, finishing, cutting, joints, and all ancillary works, complete in accordance with the drawings, specifications, and Engineer's instructions, complete in all respects. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	Sft	4490.625	Not Applicable		
99	AF	Bill No. 3 - Architectural & Finishing Works, SH: Finishing Works (ATC Building incl. Utility Services)					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
100	AF-1	Providing and laying floor of 1" Inch thick Terrazzo Tiles 24" x 24" size fine dressed on the surface without winding in ground floor over 1 inch (25 mm) cement mortar 1:2 (one cement, two sand) setting the marble tiles with grey cement slurry including curing and rubbing etc. complete, including the cost of mortar. REF: Technical Specifications Section - 0300, Section - 0270	Sft	11814.32	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
101	AF-2	Providing and Applying EPOXY RESIN FLOORING over concrete surface, as per the manufacturer's specifications i/c the cost Cleaning and Preparation of surfaces to remove dust & loose particles , repair of all visible cracks with epoxy mortar or suitable filler , The flooring shall consist of a FLOORING PRIMER to enhance adhesion between substrate and coating ,and two components protective epoxy coating to provide a smooth, durable, and seamless finish. The floor shall be resistant to abrasion, chemicals, stains, and moisture, as per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300, Section - 0330	Sft	11814.32	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
102	AF-3	Providing and laying 3/4" inches thick Granite on walls and floors, laid with dry bond over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0280	Sft	12905.19	Not Applicable		
103	AF-4	Providing and laying Porcelain Tiles of approved Texture and Size on walls and floors, laid with dry bond over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per drawings and design approved by the Architect and Engineer-in-Charge. (For Room and Offices etc) REF: Technical Specifications Section - 0300	Sft	21446.03	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
104	AF-5	Providing and laying Porcelain Tiles of approved Texture and Size on walls and floors, laid with dry bond over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per drawings and design approved by the Architect and Engineer-in-Charge. (For Toilets Blocks) REF: Technical Specifications Section - 0300, Section - 0220	Sft	12325.51	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
105	AF-6	Providing and fixing Solid Wooden Flooring in best quality sheesham wood planks 1 inch (25 mm) thick rebated including fixing with brass-screws on deodar wood battens 1-1/2 inches X 2 inches (38 mm X 51 mm) placed at 12 inches (305 mm) centre to centre and filling the gap between plank and concrete base with bitumen and sand mixed in the ratio 9 lbs. (4.1 Kg) of bitumen to one cft. (0.028 cum) of sand etc. complete in any floor. REF: Technical Specifications Section - 0300, Section - 0220	Sft	1541.94	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
106	AF-7	Raised Flooring Panels of module 600x600x32mm with Laminate surface. Heavy duty steel and Cement infill core, with metal sheet at both sides with non-conductive antistatic top Laminate surface. with Carpet tiles on top with standard adhesive Pedestals made of galvanized steel with Leveling provision. Pedestals are connected through stringer made of Galvanized pipes and concealed screws. (Fire Rating: 1 Hr) Each Tile: 4 Sq Ft with standard Accessories Pedestal 300mm, Stinger & Wall Angle,as per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	Sft	2981.76	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
107	AF-8	Raised Flooring Panels of module 600x600x32mm with Laminate surface. Heavy duty steel and Cement infill core, with metal sheet at both sides with non-conductive antistatic top Laminate surface.Pedestals made of galvanized steel with Leveling provision. Pedestals are connected through stringer made of Galvanized pipes and concealed screws.(Fire Rating: 1 Hr)Each Tile: 4 Sq Ft with standard Accessories Pedestal 300mm,Stinger & Wall Angle,Tile Weight: 13Kg as per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	Sft	1294.64	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
108	AF-9	Providing and laying in floor C.C. 1:2:4: tuff paver 80 mm thick of approved design and colour pattern laid on sand cushion filling of joint with sand and warring etc. complete as per direction of Engineer Incharge. (the cost of sand cushion is included) A) Minimum strength 7000 psi. REF: Technical Specifications Section - 0300	Sft	2020.33	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
109	AF-10	Providing and Applying Polyurethane Modified Bituminous Coating i/c the cost Cleaning and Preparation of surfaces to remove dust & loose particles ensuring optimal adhesion for the coating high quality advance polymer based cementitious waterproofing coating as a base layer to walls and Floors etc complete in all respect s per Direction by the Architect and Engineer-in-Charge.(For Toilets Block and Rooftop) REF: Technical Specifications Section - 0300-0330, Section - 0220	Sft	35694.53	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
110	AF-11	Supply, fabrication, transportation, and installation of façade system comprising approved façade panels (as specified in the drawings), complete with base aluminum framing/support structure, brackets, anchors, fasteners, adhesive, silicone sealant, gaskets, fixing accessories, and all necessary hardware. The work shall include cutting, fabrication, lifting, fixing, alignment, joint treatment, waterproofing, finishing, testing, cleaning, and all labor, materials, equipment, scaffolding, and incidentals required to complete the work in accordance with the approved shop drawings, specifications, and to the satisfaction of the Architect and Engineer-in-Charge. REF: Technical Specifications Section -0300-0240, Section - 0230			Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
111	AF-11-1	a) Ground Floor. REF: Technical Specifications Section - 0300	Sft	11968.94	Not Applicable		
112	AF-11-2	b) First Floor. REF: Technical Specifications Section - 0300	Sft	3625.75	Not Applicable		
113	AF-12	Providing and fixing Gypsum board 15mm tiles ceiling approved size tiles/strip ceiling including all accessories and hanging suspension system i.e., pump, rod etc. complete as required in any floor. REF: Technical Specifications Section - 0310, Section - 0290,Section - 0300	Sft	32531.75	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
114	AF-13	Supply, Fabrication and Installation of aluminum curtain wall fixed façade with reinforming, wind load bearing system 140km/h, with MS bracket galvanized including anchor bolting (Indux), center bolting stainless steel EPDM/gasket, weather sealant (Dolphins/Sika), including necessary hardware and ironmongery without glass,ALUMINUM THERMAL BREAK STICK SYSTEM) with mullion and Transom anodized coating with glass,Double glazed glass 32mm thick IUG (outer pan 10mm SN-40 (GUARDIAN/SAINT CABIN / AGC) tempered+ AG 12mm+ Inner pan 8mm laminated (4mm +.76 pvb+4mm both are clear with chemical insertion,Flashing /trimming (galvanized sheet 1.5mm with waterproofing membrane 1mm thick including necessary hardware,fire brier with galvanized sheet 2mm with	Sft	5081.64	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
115	AF-14	Supply, Fabrication and Installation of aluminum curtain wall fixed façade with reinforming, wind load bearing system 140km/h, with MS bracket galvanized including anchor bolting (Indux), center bolting stainless steel EPDM/gasket, weather sealant (Dolphins/Sika), including necessary hardware and ironmongery with glass, ALUMINUM THERMAL BREAK STICK SYSTEM) with mullion and Transom anodized coated with,Triple glazed glass 46mm thick IGU (outer pan 10mm SN-40 (GUARDIAN/SAINT CABIN/ AGC) tempered+ AG 10mm+ middle pan 8mm clear tempered + middle AG10MM + Inner pan 8mm laminated (4mm +.76 pvb+4mm both are clear with chemical insertion,Flashing /trimming (galvanized sheet 1.5mm with waterproofing membrane 1mm thick including necessary hardware,fire brier	Sft	6626.4	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
116	AF-15	Providing and fixing INTERNAL WALL EXPANSION JOINT complete with compressible filler board, 2-hour fire-resistant elastomeric sealant, aluminum / stainless steel cover plates, anchors, cutting, surface preparation, fixing, and making good, installed full height of structure, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0240, Section - 0230, Section - 0170	Rft	920	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
117	AF-16	Providing and fixing EXTERNAL WALL EXPANSION JOINT complete with compressible filler board, 2-hour fire-resistant elastomeric sealant, aluminum / stainless steel cover plates, anchors, cutting, surface preparation, fixing, and making good, installed full height of structure, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0240, Section - 0230, Section - 0170	Rft	184	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
118	AF-17	Providing and installing HEAVY DUTY FLUSH MOUNTED FLOOR EXPANSION JOINT with load capacity of 30 Tons (Heavy Vehicle Load) and 6.5 Ton (Forklift) system with aluminum cover plate and neoprene / elastomeric insert, suitable for high pedestrian traffic, including joint preparation, sealant, fixing accessories and finishing flush with finished floor level, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0240, Section - 0230	Rft	320	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
119	AF-18	Providing and installing TOP ROOF EXPANSION JOINT system including waterproof membrane, UV-resistant sealant, metal cover plate, drainage detail, and all accessories, suitable for commercial roofs, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	Rft	160	Not Applicable		
120	AF-19	Supply and installation of PIR Insulated Panels insulated as per drawing/design/section, complete in all respects as per manufacturer's specifications and as per Direction by the Architect and Engineer -in-Charge. REF: Technical Specifications Section - 0335	Sft	26841.94	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
121	AF-20	Providing and laying first class hollow Cement Concrete Block Masonry (1800 Psi) set in cement mortar 1:4 in straight or curved wall 8 inches thick including scaffolding, raking, out joint and curing tc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. (For External Partition Walls) REF: Technical Specifications Section - 0200, Section - 0220	Sft	14912	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
122	AF-21	Supply and Application of POLYURETHANE FOAM SPRAY with a thickness of 1 inch (2.5cm), 32 to 35 kg / m3 Density with U-Value of 0.36 W / m2k and thermal conductivity 0.03 W / (m K) Thermal Resistance R-Value of 6.5 ensuring excellent thermal insulation. approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	Sft	14912	Not Applicable		
123	AF-22	Providing & Fixing Gypsum board 15 mm thick, fixed with GI approved suspension system & joint taping tc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0310, Section - 0290	Sft	14912	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
124	AF-23	Supply and installation of single Leaf UL Listed Doors 3'-6" x 7'-0" with complete UL Accessories (UL Hinges , UL Pnic Bar with trim Handles , Smoke Seal and UL Door Closer only) Fire Rating: Fire Rating upto 90 Mins etc complete as per manufacturer’s specification and s per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0220-0300	Nos	5	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
125	AF-24	Supply and installation of Eco-Friendly WPC Doors of 38 mm thickness and minimum 5 mm shutter thickness ,i/c the cost of door frame , hardware , Hinges ,Tower Bolts, 2.75" border and Executive Polishing complete as per manufacturer specifications ,drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0220, Section - 0180-0300	Sft	1149	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
126	AF-25	Providing and fixing 1-1/2 inches (38 mm) thick best quality Ash wood solid wood door shutters ,i/c the cost of door frame , hardware , Hinges ,Tower Bolts, 2.75" border and Executive Polishing complete as per manufacturer specifications ,drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0220, Section - 0180	Sft	2394	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
127	AF-26	P/F 12mm thick tempered glass , swing door,upak made as per approved manufacturers (fixing through their approved fabricators), D- Lock, Silicon moving machines all accessories, cutting holes etc and making good damages etc. complete as required in any floor as per direction of Engineer In Charge. REF: Technical Specifications Section - 0250, Section - 0220	Sft	140	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
128	AF-27	P/F 12mm tempered glass i/c 3mm safety film 175 micron aluminum fixed partition as per approved manufactured (fixing through their approved fabricators), aluminium section D-48(100 mmx38mm and 2mm) thick, i/c the aluminium fittings and S.S. pipe 1.5"x3" (18 gauge) fixe on top will all accessories, cutting holes etc. and making good damages to walls etc. complete as required in any floor as per direction of engineer-in-charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250	Sft	175	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
129	AF-28	Providing and fixing double glazed anodized aluminium of approved colour Sliding windows as per British standard manufactured (fixing through their approved fabricators), Executive model section double glazed 101mm x 37mm and 2mm thick including the cost of aluminium netting ,fitting, with all accessories cutting hole etc. and making good damages to walls and including the cost Tinted glass panes 6mm thick to M.S. Box pipe / Aluminium etc. complete as required in any floor as per direction of engineer-in-charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250	Sft	40.5	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
130	AF-29	Providing and fixing with C.P. brass screws main door handle type yale lock of approved design,cutting wood etc., to required size, with two operating keys, as per direction of the engineer-in-Charge. REF: Technical Specifications Section - 0220	Nos	106	Not Applicable		
131	AF-30	Providing and fixing with brass or specially supplied screws hydraulic branno door closer of approved design No. 2, Yugoslavia make, cutting wood, etc., to required size and shape of necessary as per direction of the Engineer-in-Charge. REF: Technical Specifications Section - 0300	Nos	106	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
132	AF-31	Distempering with vinyl distemper of approved make and shade in two coats over and including the cost of one priming coat of lime wash including sand papering, dusting, and filling the holes, cracks and inequalities, if any, at any height in any floor. (For Ceiling only) REF: Technical Specifications Section - 0330,0300	Sft	16167.71	Not Applicable		
133	AF-32	Painting with plastic emulsion paint VIP of approved shade two coats over and including the cost of one priming coat complete over plastered surface at any height in any floor . (For Walls) REF: Technical Specifications Section - 0330, Section - 0260	Sft	71707.52	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
134	AF-33	Supply, fabrication, and installation of motorized vehicle garage rolling shutter of approved size and design, complete with galvanized steel/aluminum slats, guide rails, barrel assembly, electric motor, gearbox, manual override, remote control, locking system, all necessary hardware, testing, commissioning, and finishing, in accordance with approved shop drawings and the instructions of the Architect/Engineer-in-Charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0220, Section - 0180	Sft	2880	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
135	AF-34	Providing and laying floor of 1" Inch thick Terrazzo Tiles 24" x 24" size fine dressed on the surface without winding in ground floor over 1 inch (25 mm) cement mortar 1:2 (one cement, two sand) setting the marble tiles with grey cement slurry including curing and rubbing etc. complete, including the cost of mortar. REF: Technical Specifications Section - 0300, Section - 0270	Sft	3250	Not Applicable		
136	AF-35	Distempering with vinyl distemper of approved make and shade in two coats over and including the cost of one priming coat of lime wash including sand papering, dusting, and filling the holes, cracks and inequalities, if any, at any height in any floor. (For Ceiling only) REF: Technical Specifications Section - 0300	Sft	2995	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
137	AF-36	Painting with plastic emulsion paint VIP of approved shade two coats over and including the cost of one priming coat complete over plastered surface at any height in any floor . (For Walls) REF: Technical Specifications Section - 0330, Section - 0260	Sft	5500	Not Applicable		
138	AF-37	Providing, fabricating and fixing MS (Mild Steel) door with MS frame, including all hardware (hinges, tower bolts, lock, handles, etc.), anti-rust primer and enamel paint/powder coating, complete in all respects as per approved drawings, manufacturer's specifications, and the directions of the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0330, Section - 0220	Sft	520	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
139	AF-38	Providing and fixing double glazed anodized aluminium of approved colour Sliding windows as per British standard manufactured (fixing through their approved fabricators), Executive model section double glazed 101mm x 37mm and 2mm thick including the cost of aluminium netting ,fitting, with all accessories cutting hole etc. and making good damages to walls and including the cost Tinted glass panes 6mm thick to M.S. Box pipe / Aluminium etc. complete as required in any floor as per direction of engineer-in-charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250	Sft	500	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
140	AF-39	Providing, fabricating, supplying, and installing Aluminium Composite Panel (ACP) cladding comprising PVDF-coated aluminium skins with a non-combustible (A2) or fire-retardant (FR) mineral core, fixed on an aluminium sub-framing system complete with brackets, rails, cleats, stainless steel fasteners, anchor bolts, flashings, trims, sealants, EPDM gaskets, and all necessary accessories, including cutting, fabrication, erection, alignment, waterproof joint sealing, scaffolding, and all incidental works, complete in accordance with the drawings, specifications, and the Engineer's instructions. REF: Technical Specifications Section -0240, 0230					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
141	AF-39-1	a) Ground Floor. REF: Technical Specifications Section - 0240	Sft	11968.94	Not Applicable		
142	AF-39-2	b) First Floor. REF: Technical Specifications Section - 0240	Sft	3625.75	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
143	AF-40	Providing, fabricating, supplying, and installing manually operated roller blinds using premium-quality imported sunscreen, blackout, or translucent fabric (as specified in the drawings or approved by the Engineer), complete with a 180° manual roll-up mechanism, heavy-duty aluminium roller tube, operating chain, brackets, bottom rail, side guides (where required), mounting accessories, fixings, and all necessary hardware. The work shall include measurement, fabrication, installation, testing, and commissioning, complete in all respects, in accordance with the drawings, specifications, approved shop drawings, and the Engineer's instructions.	Sft	750	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
144	AG	Bill No. 3 - Architectural & Finishing Works, SH: Furniture, Ancillary & Gym Equipment					
145	AG-1	Supply, delivery, installation and placement of furniture complete in all respects as per approved drawings and furniture layouts, including all accessories, fittings, hardware, upholstery, finishing, transportation and commissioning as per TS. REF: Technical Specifications Section - 0210					
146	AG-1-1	Executive Table With Side Rack, Model MO-ED-ES-19, Size L 4' x D 2' x H 30", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	2	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
147	AG-1-2	Executive Chair, Model HBC (A2916), Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	2	Not Applicable		
148	AG-1-3	Conference Table, Size L 22' x D 5' x H 30", Model MO-MT-MS-06, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	1	Not Applicable		
149	AG-1-4	Conference Table, Size L 25' x D 5' x H 30", Model MO-MT-MS-06, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	1	Not Applicable		
150	AG-1-5	Genesis Chairs ORTHO HBC, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	14	Not Applicable		
151	AG-1-6	Genesis Chairs, Model Eco LBC, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	13	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
152	AG-1-7	Mesh Chair with flexible back and moveable, Model MBC B-3018, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	40	Not Applicable		
153	AG-1-8	Mesh Chair, Model MBC B-3018, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	23	Not Applicable		
154	AG-1-9	Visitor Chair, Model 01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	32	Not Applicable		
155	AG-1-10	Anatom Reception Chair, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	26	Not Applicable		
156	AG-1-11	Training Chair, Model MO-JUDY, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	65	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
157	AG-1-12	Cafeteria Chair, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	25	Not Applicable		
158	AG-1-13	Single Seater Sofa, Model Aspen, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	1	Not Applicable		
159	AG-1-14	Single Seater Sofa, Model Augusta, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	9	Not Applicable		
160	AG-1-15	Single Seater Sofa, Model Sof-22, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	8	Not Applicable		
161	AG-1-16	Single Seater Sofa Model Sof-01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	12	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
162	AG-1-17	Two Seater Sofa, Model Aspen, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	1	Not Applicable		
163	AG-1-18	Two Seater, Model Chesterfield Sofa, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	8	Not Applicable		
164	AG-1-19	Two Seater Sofa, Model Augusta, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	4	Not Applicable		
165	AG-1-20	Three Seater Sofa, Model Sof-22, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	7	Not Applicable		
166	AG-1-21	Three Seater Sofa, Model Sof-01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
167	AG-1-22	Sofa Side Table Size L 20" x W 20" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	18	Not Applicable		
168	AG-1-23	Sofa Center Table, Size L 48" x W 20" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	6	Not Applicable		
169	AG-1-24	Sofa Side Table, Size L 18" x W 18" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	6	Not Applicable		
170	AG-1-25	Side Table, Model Linea, Size L:559mm x W356mm x H:610mm, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	2	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
171	AG-1-26	Center Side Table, Size L 40" x W 40" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	5	Not Applicable		
172	AG-1-27	Café Table, Size 36'' Dia x H30'', Model MO-MULLER-MT-01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	10	Not Applicable		
173	AG-1-28	Single Bed with 6'' Mattress with Single Side Table, Table Size L 78'' x D 42'', Mattress Size 78"x 42"x 6'', Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	6	Not Applicable		
174	AG-1-29	Manager Desk, Table Size L 5' x D 2.5‘, Model MO-MD-BS-12-KENDAL, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	14	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
175	AG-1-30	Office Desk, Size L 4.5' x D 2‘, Model MO-MD-BS-06, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	10	Not Applicable		
176	AG-1-31	Study Desk, Size L 4' x D 2‘, Model MO-MD-BS-08, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	14	Not Applicable		
177	AG-1-32	Aluminium Cluster Workstation, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	13	Not Applicable		
178	AG-1-33	Low Height Storage, Size 72x15 H 34, Model MO-SLH-04, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	8	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
179	AG-1-34	OCC / Emergency Operations Centre Workstation, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	Each	1	Not Applicable		
180	AG-2	Supply, delivery, installation, testing and commissioning of commercial-grade Gym Equipment complete in all respects as per approved layouts and Technical Specification , including all accessories, safety attachments, floor protection mats and instructional signage. The equipment shall include but not be limited to the following: REF: Technical Specifications Section - 0920			Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
181	AG-2-1	Vibe Chest Press, Model VY-61A 04, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
182	AG-2-2	Arm Curl Bench, Model VY-61A 37, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
183	AG-2-3	Vibe Shoulder Press, Model VY-61A 01, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
184	AG-2-4	Vibe Lat Pulldown, Model VY-61A 15, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
185	AG-2-5	Vibe Leg Extension, Model VY-61A 24, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
186	AG-2-6	Sports Art Prime Line Heavy Duty Treadmill with LCD Console (4HP AC Motor), Model T673L, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	3	Not Applicable		
187	AG-2-7	Vibe Cable Crossover, Model VY-61A 32, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
188	AG-2-8	Vibe Multi-Adjustable Bench, Model VY-61A 46B, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	3	Not Applicable		
189	AG-2-9	Spin Bike, Model US-PG1399, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
190	AG-2-10	Vibe Air Rowing Machine, Model VY-YR 400, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
191	AG-2-11	Vibe Three Station Multi-Gym, Model USBH-143, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
192	AG-2-12	Vibe Flat Bench, Model VY-61A 47, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	2	Not Applicable		
193	AG-2-13	12 Edge Premium CPU Dumbbells, Model VN-US1007, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Kg	840	Not Applicable		
194	AG-2-14	Straight Round Barbells, Model VN-US1301, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	200	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
195	AG-2-15	Vibe Barbell Rack, Model US2031, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
196	AG-2-16	Vibe Series 3 Tier Dumbbell Rack, Model US 2017, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	Each	1	Not Applicable		
197	R	Bill No. 4 - Roads and Pavement Works					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
198	R-1	Compaction of natural ground including scarifying, breaking of clods, watering or drying, mixing, grading, levelling and compacting the existing/natural ground to the required density and formation levels, including dressing, proof rolling and field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100, Section - 0075	Sqm	13976.29	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
199	R-2	Preparation of subgrade in earth cut including scarifying to the required depth, watering or drying, mixing, grading and shaping to the required camber/crossfall, lines and levels, compacting to the specified degree of compaction, including correction of soft or yielding spots, trimming, dressing, proof rolling and field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	Sqm	26680	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
200	R-3	Formation of embankment from roadway excavation in common material, including excavation, loading, hauling, unloading, spreading in layers not exceeding 200 mm loose thickness, watering, mixing and compacting each layer to 95% Modified AASHTO MDD, proof rolling, dressing of side slopes (1V:1.5H) and formation to the required lines, grades and levels, including field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	Cum	9769.7295	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
201	R-4	Formation of embankment from roadway excavation in medium material, including excavation/loosening by suitable mechanical means, loading, hauling, unloading, breaking of clods, spreading in layers not exceeding 200 mm loose thickness, watering, mixing and compacting each layer to 95% Modified AASHTO MDD, proof rolling, dressing of side slopes (1V:1.5H) and formation to the required lines, grades and levels, including field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	Cum	9769.7295	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
202	R-5	Formation of embankment from roadway excavation in hard rock material, including excavation of rock by approved methods, breaking to sizes suitable for placement, loading, hauling, unloading, spreading in layers of specified thickness, watering, compacting each layer to the specified degree of compaction, benching of cut slopes where required, dressing of slopes and formation to the required lines, grades and levels, including testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	Cum	2171.051	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
203	R-6	Providing, laying, spreading, watering, mixing, compacting, finishing, testing, and maintaining 150 mm thick (compacted) Granular Sub-Base (GSB) course of approved material for carriageway and shoulders, laid in layers not exceeding 200 mm loose thickness and compacted to 100% Modified AASHTO Maximum Dry Density (MDD); finished true to the required lines, grades, levels, camber/crossfall, and thickness shown on the drawings; including trimming, surface tolerance checks using a 3 m straightedge, sampling, laboratory and field testing, quality control, and all incidental works necessary to complete the work in accordance with the drawings, Technical Specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications, Section 0340.	Cum	4994	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
204	R-7	"Providing, laying, spreading, watering, compacting, finishing, testing and maintaining granular base course of approved material, laid with mechanical paver in layers not exceeding 150 mm loose thickness and compacted to 100% Modified AASHTO MDD, true to the lines, grades, camber/crossfall (-2%) and thickness shown on the drawings, including surface tolerance checks with 3 m straightedge and all sampling and testing, complete in all respects as per drawings, specifications and as directed by the Engineer. Granular Base: 300mm on Carriageway & 380mm on Shoulders REF: Technical Specifications Section - 0340"	Cum	11549.59	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
205	R-8	Providing, laying, spreading, watering, compacting, finishing, testing and maintaining crushed aggregate base course of approved material, laid with mechanical paver in layers not exceeding 150 mm loose thickness and compacted to 100% Modified AASHTO MDD, true to the lines, grades, camber/crossfall (-2%) and thickness shown on the drawings, including surface tolerance checks with 3 m straightedge and all sampling and testing, complete in all respects as per drawings, specifications and as directed by the Engineer. ABC: 80mm on Carriageway REF: Technical Specifications Section - 0340	Cum	1104			

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
206	R-9	Providing, laying, and compacting 50 mm thick (compacted) plant-mixed Asphaltic Concrete Wearing Course (Class B) in accordance with the approved Job Mix Formula (JMF), including heating and mixing of aggregates and bituminous binder at an approved asphalt mixing plant; transportation to site; laying with a self-propelled electronic sensor paver true to the required lines, levels, grades, and 2% crossfall (camber); breakdown, intermediate, and finish rolling within the specified temperature limits to achieve the required density and surface finish; construction, trimming, sealing, and painting of longitudinal and transverse joints; preparation and approval of trial section; sampling, laboratory and field testing, quality control, and all incidental works necessary for the construction of the wearing course on carriageway and	Cum	3864	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
207	R-10	Providing and applying bituminous prime coat using cut-back asphalt of approved grade over the prepared and accepted granular base course surface at the specified rate of application, including cleaning and brooming of surface, heating and uniform spraying by pressure distributor, protection of treated surface and curing for 24–48 hours before overlaying, and making good any defective areas, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340	Sqm	33296	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
208	R-11	Providing and applying bituminous tack coat using cut-back asphalt of approved grade over existing bituminous/concrete surfaces and on vertical faces of joints, at the specified rate of application, including cleaning of surface, heating and uniform spraying by pressure distributor and protection until overlaying, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340	Sqm	33296	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
209	R-12	Providing and fixing precast concrete kerb in concrete Class A-1, of size H 350 x W 300mm x T 150 mm true to line, level and curvature, including preparation of foundation, cement concrete bedding and haunching/backing, jointing and pointing in cement mortar, curing and making good and paint work, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0150	RM	4240	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
210	R-13	Providing and applying pavement marking in reflective thermoplastic paint for lines of 20 cm width, including cleaning and preparation of pavement surface, setting out, application of thermoplastic material with reflectorizing glass beads by approved road marking machine to the specified thickness and rates, and protection of markings until fully set, complete in all respects as per drawings, specifications, NHA General Specifications for pavement markings and as directed by the Engineer. REF: Technical Specifications Section - 0340	RM	7360	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY
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Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
211	R-14	Providing and laying lean concrete (blinding) of the specified mix and thickness under pavements/structures, including formwork to edges, mixing by approved mechanical means, placing, compacting, levelling and finishing to the required lines and levels, curing and testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0150	Cum	539.4732038509	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
212	R-15	Providing and laying in position, true to line and level, reinforced cement concrete of cylinder strength as mentioned on the drawings, using 3/4″ down gauge graded crushed stone aggregate (as approved), sand (as approved) and SR cement (where required), to the dimensions and design shown on the drawings, including mixing with approved mechanical means, placing, compacting/vibrating, finishing smooth, curing, lifting, all arrangements for scaffolding, and formwork using dent-free steel plates or laminated wooden ply with building paper, complete in all respects as per drawings, specifications and as directed by the Engineer; reinforcement measured and paid separately under the relevant item. (Non Schedule) REF: Technical Specifications Section - 0340	Cum	2706.9857575755	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
213	R-16	Providing, cutting, bending, fabricating, placing and fixing in position deformed steel bar reinforcement, Grade 60 conforming to AASHTO M-31, of all required diameters, including binding wire, approved bar chairs/spacers, laps as shown or required, cleaning and maintaining the reinforcement in correct position during concreting, complete in all respects as per bar bending schedules, drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0145	Ton	191.22147391513	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
214	R-17	Providing, fabricating and fixing M.S. grating for drainage channels comprising 63.5 × 63.5 × 6.3 mm M.S. angle iron frame, 25.4 × 25.4 × 3.1 mm M.S. cramp welded to angle iron frame, 50.8 × 50.8 × 6.3 mm M.S. angle grating members, and RCC Channel No. 3 bars at 8–9 inches c/c, including cutting, welding, grinding, drilling, complete shop fabrication, anti-rust primer, two coats of synthetic enamel paint, lifting arrangements, anchoring, installation, and all necessary hardware, consumables, labour, tools, and accessories, complete in all respects, as per approved drawings and Engineer's instructions.. (Non Schedule) REF: Technical Specifications Section - 0340, Section - 0180	Sqm	2208	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
215	R-18	Removal of obstructing sand dunes, including excavation by suitable mechanical means, loading, hauling to Engineer-approved disposal/spoil areas, unloading, spreading, levelling and dressing of the disposal areas, complete in all respects as per specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	Cum	546917	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
216	R-19	Transportation and disposal of unsuitable/surplus excavated material from site to Engineer-approved dumping areas for a lead up to 5 km, including loading, hauling, unloading, spreading, levelling and dressing of the dumped material and maintenance of the disposal areas, complete in all respects as per specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	Cum	164479.33	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
217	R-20	Supplying, laying and fixing 150 mm diameter PVC conduit/duct pipe of approved make and quality in cable trench within the road cross-section, including cutting, jointing with solvent cement, providing necessary bends, couplers and accessories, provision of draw-wire in each conduit, proper alignment and levelling, and coordination with the utility/MEP works, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0610	RM	5520	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
218	R-21	Supplying, laying and fixing 100 mm diameter PVC conduit/duct pipe of approved make and quality in cable trench within the road cross-section, including cutting, jointing with solvent cement, providing necessary bends, couplers and accessories, provision of draw-wire in each conduit, proper alignment and levelling, and coordination with the utility/MEP works, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0610	RM	5520	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
219	R-22	Providing and laying Tuff Pavers, having 7000 PSI, crushing strength of approved manufacturer, over 2" to 3" sand cushion i/c grouting with sand in joints i/c finishing to require slope as per Complete in all respect. (50% Grey / 50% Coloured) complete in all respects as per drawings, specifications and as directed by the Engineer. (80mm thick)	Sqm	5152	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
220	R-23	Providing, fabricating, supplying and installing complete Road Sign Boards, including all signage designs, types, sizes and quantities as indicated on the approved drawings, including posts, frames, reflective sheeting, sign plates, foundations and all fixing accessories, complete in all respects, in accordance with the approved drawings, specifications and the Engineer's instructions.	Job	1	Not Applicable		
221	E	Bill No. 5 - Electrical Works					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
222	E-0.1	Supply at site, installation, testing and commissioning of new step down Oil immerse, naturally cooled, step down 11000/400/230 Volts 50 Cycles, Comprising with high/low voltage compartments and controls Type A excluding cost of Pad Pad Mounted Oil Type Transformer :- 630 kVA Capacity 11KV / 415 Volt (Prime Rating) REF: Technical Specifications Section - 0510, Section - 0490	No.	1	Not Applicable		
223	E-0.2	Supply, Installation & Testing at site of water cooled NEW diesel generating. REF: Technical Specifications Section - 0490, Section - 0500			Not Applicable		
224	E-0.2-1	150 KVA Prime rating(as per SLD) REF: Technical Specifications Section - 0490	No.	1	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
225	E-0.2-2	300 KVA Prime rating(as per SLD) REF: Technical Specifications Section - 0490	No.	1	[Up to 80% Allowed]		
226	E-0.3	Supply at site installation, testing & commissioning of UPS. REF: Technical Specifications Section - 0490, Section - 0570					
227	E-0.3-1	UPS "5 KVA-Modular", (1-Phase-In; 1-Phase Out 220V) with 15-30 minutes back-up time with battery module cabinet & IPS Complete with all respect as per SLD. REF: Technical Specifications Section - 0490, Section - 0570	No.	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
228	E-0.3-2	UPS "3 KVA-Modular", (1-Phase-In; 1-Phase Out 220V) with 15-30 minutes back-up time with battery module cabinet & IPS Complete with all respect as per SLD. REF: Technical Specifications Section - 0490, Section - 0570	No.	1	Not Applicable		
229	E-1	Fabrication, supply at site, installation at designated location, testing and commissioning of Main Panel Board (MPB) REF: Technical Specifications Section - 0490, Section - 0530, Section - 0540					
230	E-1-1	Complete as per Single Line Diagram. REF: Technical Specifications Section - 0490	No.	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
231	E-1-2	Supply, installation & connection of Active Harmonic Filters of medium voltage (11KV) with following function: Harmonic Reduction Voltage Stabilization Enhanced Equipment Life Efficiency Improvement Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0530	No.	1	Not Applicable		
232	E-1-2-1	Circuit Point Wiring. REF: Technical Specifications Section - 0490, Section - 0600					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
233	E-2.01	Supply and wiring of light circuit from DB to switchboard with 2x2.5 mm sq single core insulated 300/500 volt grade cables(P+N) and 2.5mm sq cable as circuit protective conductor (CPC) in & including PVC conduit installed/ recessed in walls / R.C.C. Slab, on ceiling or as required as per site conditions. REF: Technical Specifications Section - 0490, Section - 0530, Section - 0540, Section - 0620, Section - 0610, Section - 0600	Rft	10000	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
234	E-2.02	Supply and wiring of circuit point wiring from switch board to switch board with 2x2.5 mm sq single core insulated 300/500 volt grade cables(P+N) and 2.5mm sq cable as circuit protective conductor (CPC) in & including PVC conduit installed/ recessed in walls / R.C.C. Slab, on ceiling or as required as per site conditions. (Loop Circuit) REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600	Rft	6000	Not Applicable		
235	E-2.03	Supply and installation of Switch Board with back box. REF: Technical Specifications Section - 0490, Section - 0600					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
236	E-2.03-1	i) 3x3 back box with earthing point and switch board. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	Each	20	Not Applicable		
237	E-2.03-2	ii)6x3 back box with earthing point and switch board. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	Each	79	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
238	E-2.04	Supply and wiring of first light / Exhaust fan point consisting of one point controlled by one switch with 2x1.5mm sq (P+N) PVC insulated 300/500 volt grade wire in and including PVC conduits recessed in walls/R.C.C. slab, on ceilings or as required including all conduit accessories junction boxes, pull boxes, pull wire, 1mm2 cable as CPC complete with 10 Amp. single way switch make as approved by consultant (annexure-A) installed on & including 16 SWG sheet steel boards duly powder coated paint with earth bolt recessed in wall/column complete in all respects as per drawing & specifications. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0560, Section - 0640, Section - 0600	Each	210	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
239	E-2.05	Providing, supplying, wiring, laying, pulling, testing and commissioning of loop circuit point wiring from switch board to switch board, comprising 2 Nos. x 2.5 mm² single-core PVC insulated copper conductor cables, 300/500 V grade, for phase and neutral, along with 1 No. x 2.5 mm² single-core PVC insulated copper conductor as Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including all required PVC conduits, bends, junction boxes, inspection/pull boxes, bushes, saddles, clamps, draw wires, accessories, ferruling, tagging, terminations at both ends, connection with switch boards/accessories, cutting, chasing, making good, testing of continuity, insulation	Each	380	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
240	E-2.06	Supply and wiring of light circuit directly controlled from MCB in DB wired with 2x2.5 mm sq single core insulated 300/500 volt grade cables(P+N) and 2.5mm sq cable as circuit protective conductor (CPC) in & including PVC conduit installed/ recessed in walls / R.C.C. Slab, on ceiling or as required as per site conditions. Complete with all conduit accessories junction boxes, pull boxes as required complete in all respects as per specifications and drawings. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600, Section - 0640	Each	50	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
241	E-2.07	Providing, supplying, wiring, laying, pulling, testing and commissioning of point-to-point loop circuit wiring, comprising 2 Nos. x 2.5 mm² single-core PVC insulated copper conductor cables, 300/500 V grade, for phase and neutral, along with 1 No. x 2.5 mm² single-core PVC insulated copper conductor cable as Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including PVC conduits, bends, sleeves, junction boxes, pull boxes, inspection boxes, adaptable boxes, draw wires, bushes, saddles, clamps, supports, conduit accessories, ferruling, tagging, identification, terminations at both ends, connection with switch boards/accessories, cutting,	Each	65	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
242	E-2.08	Supply and wiring of first 3 pin 5 Amps socket outlet point make as approved by consultant from MCB in DB, with single core 2x2.5 mm sq PVC insulated 300/500 volt grade cable in & including PVC conduit recessed in walls/R.C.C. slab, or on surface of ceiling including all conduits accessories, junction boxes, pull boxes etc. 2.5mm sq cable as CPC ; & including 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600, Section - 0640	Rft	3500	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
243	E-2.09	Supply and wiring but outlet to outlet wiring of 5/10 Amps socket outlet. REF: Technical Specifications Section - 0490, Section - 0600	Rft	3500	Not Applicable		
244	E-2.1	Supply & fixing of 5 Amp 3 Pin Socket 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0600	Each	122	Not Applicable		
245	E-2.11	Supply & wiring of first 15A power sockets outlet from MCB in DB, with 2 x 4 mm sq single core cables (P+N) and 2.5 mmsq as CPC from DB to point, Complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	Rft	4500	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
246	E-2.12	Providing, supplying, wiring, laying, pulling, testing and commissioning of outlet-to-outlet wiring for 5/10 Amp socket outlet points, comprising approved PVC insulated copper conductor cables of required size as per drawings and load requirement, including phase, neutral and Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including PVC conduits, bends, sleeves, junction boxes, pull boxes, inspection boxes, adaptable boxes, draw wires, bushes, saddles, clamps, supports, conduit accessories, ferruling, tagging, identification, terminations at socket outlets/accessories, cutting, chasing, making good of walls/slabs/ceilings, testing of	Rft	1600	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
247	E-2.13	Supply & fixing of 15 Amp 3 Pin Power Socket 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0600	Each	110	Not Applicable		
248	E-2.14	Supply & wiring of first 13A power sockets outlet from MCB in DB, with 2 x 4 mm sq single core cables (P+N) and 2.5 mmsq as CPC from DB to point, Complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	Rft	4000	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
249	E-2.15	Providing, supplying, wiring, laying, pulling, testing and commissioning of outlet-to-outlet wiring for 13 Amp power socket outlet circuit, comprising 2 Nos. x 2.5 mm² single-core PVC insulated copper conductor cables for phase and neutral, along with 1 No. x 2.5 mm² single-core PVC insulated copper conductor cable as Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including PVC conduits, bends, sleeves, junction boxes, pull boxes, inspection boxes, adaptable boxes, draw wires, bushes, saddles, clamps, supports, conduit accessories, ferruling, tagging, identification, terminations at outlet boxes/socket points, cutting,	Rft	3500	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
250	E-2.16	Supply & fixing of 13 Amp 3 Pin Power Socket 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0600	Each	173	Not Applicable		
251	E-2.17	Supply & wiring IPS Single Phase of one No. 2x 6mm2 single core cables (P+N) from DB to the point and 4mm2 as CPC including cost of one no. 16 Amps Industrial Power Socket, recessed in walls /columns. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
252	E-2.18	Supply & wiring IPS Three Phase of one No. 4x 6mm2 single core cables (P+N) from DB to the point and 2x4mm2 as CPC including cost of one no. 16 Amps Industrial Power Socket, recessed in walls /columns. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	Each	2	Not Applicable		
253	E-2.19	Supply & installation of flexible connection between light point above false ceiling to light fitting in false ceiling with 3 core 23/.076 flexible cable in & including PVC flexible pipe, 15A PVC connector & pipe accessories etc as required. REF: Technical Specifications Section - 0490	Each	600	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
254	E-3.01	Supply at site, installation, testing and commissioning of PVC insulated, PVC sheathed, non-armoured copper conductor low tension power cable, 600/1000 V grade, of specified size/core configuration as mentioned in BOQ/drawings, laid in pre-installed cable tray, trench, conduit or approved route, including cable identification, end termination, cable lugs and connection at both ends, complete in all respects as per drawings, approved manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490					
255	E-3.01-1	i) 2 core 6mm.sq. REF: Technical Specifications Section - 0490	Rft	150	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
256	E-3.01-2	ii) 2 core 10mm.sq. REF: Technical Specifications Section - 0490	Rft	100	Not Applicable		
257	E-3.01A	Four Core Cable					
258	E-3.01A-1	i) 4 core 6mm.sq. REF: Technical Specifications Section - 0490	Rft	80	Not Applicable		
259	E-3.01A-2	ii) 4 core 10mm.sq. REF: Technical Specifications Section - 0490	Rft	200	Not Applicable		
260	E-3.01A-3	iii) 4 core 16mm.sq. REF: Technical Specifications Section - 0490	Rft	100	Not Applicable		
261	E-3.01A-4	iv) 4 core 25mm.sq. REF: Technical Specifications Section - 0490	Rft	150	Not Applicable		
262	E-3.01A-5	v) 4 core 95mm.sq. REF: Technical Specifications Section - 0490	Rft		Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
263	E-3.01A-6	vi) 4 core 120mm.sq. REF: Technical Specifications Section - 0490	Rft	250	Not Applicable		
264	E-3.01A-7	vii) 4 core 150mm.sq. REF: Technical Specifications Section - 0490	Rft		Not Applicable		
265	E-3.01A-8	viii) 4 core 240mm.sq. REF: Technical Specifications Section - 0490	Rft	150	Not Applicable		
266	E-3.01A-9	ix) 4 core 300mm.sq. REF: Technical Specifications Section - 0490	Rft	200	Not Applicable		
267	E-3.02	Circuit Protective Conductor (CPC) REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600					
268	E-3.02-1	i) 1 core 4mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	Rft	310	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY PPRA EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
269	E-3.02-2	iii) 1 core 6mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	Rft	500	Not Applicable		
270	E-3.02-3	iii) 1 core 10mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	Rft	200	Not Applicable		
271	E-3.02-4	iv) 1 core 16mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	Rft	300	Not Applicable		
272	E-3.02-5	v) 1 core 50mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	Rft		Not Applicable		
273	E-3.02-6	vi) 1 core 70mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	Rft	1200	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
274	E-3.03	Supply at site, installation, testing and commissioning of 20 mm dia rigid PVC conduit for electrical surface and concealed wiring installation, suitable for LV wiring containment, complete with matching PVC bends, tees, couplers, junction boxes, pull boxes, inspection boxes, saddles, clamps, supports, bushes and all required conduit accessories, fixed on surface or concealed/recessed in walls, RCC slabs, ceilings or floors as shown on drawings and as required at site, including alignment, continuity of conduit route and provision for cable pulling, complete in all respects as per drawings, approved material submittal and Technical Specifications.. REF: Technical Specifications Section - 0490, Section - 0610					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
275	E-3.03-1	i) 1-1/2" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft	300	Not Applicable		
276	E-3.03-2	ii) 2" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft	400	Not Applicable		
277	E-3.03-3	iii) 3" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft	150	Not Applicable		
278	E-3.03-4	iv) 4" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft	100	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
279	E-3.04	Supply at site of 6" dia PVC heavy duty pipe make Shavyl, Plasco / Beta Pipes to be installed underground, including cost of excavation of trench 30" deep, including cost of all PVC pipe accessories like bends, sockets, laying of PVC pipe with 4" thick layer of sand beneath pipe, 4" thick layer of brick protection and sand tape above pipe, refilling of excavations with sweet earth, ramming, watering cost of labour, material, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0600, Section - 0100	Rft	50	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
280	E-3.05	Powder Coated Ceiling Suspended / Horizontal Cable Tray in Corridor. Fabrication, supply at site, installation, testing and commissioning of perforated M.S. cable tray with cover, suitable for LV power/control cable routing, complete with approved support arrangement and standard accessories, installed on wall, vertical shaft, ceiling/false ceiling or other approved route as shown on drawings, as directed by the Engineer and in accordance with Technical Specifications, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
281	E-3.05-1	6" X 4" Cable Tray 14 SWG & Cover 18 SWG. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590	Rft	650	Not Applicable		
282	E-3.05-2	12” X 4" Cable Tray 14 SWG & Cover 18 SWG. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590	Rft	700	Not Applicable		
283	E-3.05B	Providing, fixing and installation of Cable ladder of size 28" in width and made with 2"x2" L type angle iron duly galvanized or powder coated in desired colour as approved by the consultant. The space among ladder steps shall not be more than 12", Same as shown in drawings. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590	Rft	100	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
284	E-3.06	Excavation in ordinary soil up to 2400mm depth x 1800mm wide Trench . The work also includes the site preparation. Complete in all respects. REF: Technical Specifications Section - 0490, Section - 0100	Cubic meter	70	Not Applicable		
285	E-3.07	Making of RCC Manhole 2' x 2' (LW) 2.6’ Depth make with 6 inch RCC Wall. heavy duty 2'-6" Square RCC cover, including Ground Excavation of Manholes as per Drawing & details. Complete in all respects. REF: Technical Specifications Section - 0490	Each	10	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
286	E-3.08	Supply at site, installation, testing and commissioning of XLPE insulated, aluminium tape screened, PVC/SWA/PVC armoured aluminium conductor HT power cable, 8.7/15 kV grade, 50 Hz, suitable for three-phase grounded system, laid in prepared trench, duct, conduit, cable tray or approved route as shown on drawings, including cable pulling, identification, end connections and testing, complete in all respects as per drawings, approved manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490					
287	E-3.08-1	i) 3 core 95mm sq. REF: Technical Specifications Section - 0490	Rft	3280	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
288	E-3.08-2	ii) 3 core 95mm sq (HT Termination Kits by Raychem/Equivalent) REF: Technical Specifications Section - 0490	Job	2	Not Applicable		
289	E-4.01	Providing ,installation ,testing and commissioning of the following lighting fixture including all accessories like electronic ballast, drivery circuitry , lamps, mountings etc. Complete in all respects , make as approved by consultant. REF: Technical Specifications Section - 0490, Section - 0600					
290	E-4.01-1	Down lighter covered with glass with 12 Watt Down lamp. REF: Technical Specifications Section - 0490, Section - 0560	Each	89	Not Applicable		
291	E-4.01-2	Rope light with 5 Watt per Rft. REF: Technical Specifications Section - 0490, Section - 0560	Rft	200	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
292	E-4.01-3	Flexible Linear Light 8 Watt per Rft as per instruction of Engineer Incharge. REF: Technical Specifications Section - 0490, Section - 0560	Rft	100	Not Applicable		
293	E-4.01-4	Supply & Installation of 14 Watt Bulkhead Light. REF: Technical Specifications Section - 0490, Section - 0560	Each	10	Not Applicable		
294	E-4.01-5	Supply & Installation of 40 Watt 4 feet Tube Light. REF: Technical Specifications Section - 0490, Section - 0560	Each	323	Not Applicable		
295	E-4.01-6	Supply & Installation of 120 Watt 12 feet (4' with 3) Linear Light. REF: Technical Specifications Section - 0490, Section - 0560	Each	48	Not Applicable		
296	E-4.01-7	LED panel light 2'x2'' with 40 Watt. REF: Technical Specifications Section - 0490, Section - 0560	Each	64	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
297	E-4.01-8	Supply & Installation of self contained Emergency light as approved by the electrical consultant. 2x7 Watt Fluorescent lamp NICAD batteries for 3 hours back up. REF: Technical Specifications Section - 0490, Section - 0560	Each	35	Not Applicable		
298	E-4.01-9	Supply & Installation of self contained exit light as approved by the electrical consultant. 9 Watt Fluorescent lamp NICAD batteries for 3 hours back up. REF: Technical Specifications Section - 0490, Section - 0560	Each	23	Not Applicable		
299	E-4.02	Supply and Installation of Hand dryer Mounted at surface of wall. (Make Siemens or approved brand) REF: Technical Specifications Section - 0490, Section - 0640	Each	6	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
300	E-4.03	Supply at site, installation, testing and commissioning of multimedia projector, Optoma X400LVe or approved equivalent, DLP type, minimum 4,000 ANSI lumens brightness, native XGA resolution 1024x768, contrast ratio not less than 25,000:1, with HDMI/VGA input connectivity, built-in speaker, power supply 100–240 V AC, suitable for meeting/training room presentation use, complete with EPIC gang controller or approved equivalent control switch, HDMI cable, VGA cable, power cable, ceiling/wall mounting bracket where required, connection, configuration, demonstration and handing over, complete in all respects as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0640	Each	2	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
301	E-4.04	Supply and installation of LED Aviation Obstruction Light 30W.Complete with all respect. REF: Technical Specifications Section - 0490, Section - 0560, Section - 0770	Each	10	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
302	E-4.05	Supply at site, installation, testing and commissioning of LED linear profile light, 8 W per Rft, 220–240 V AC, 50 Hz, complete with aluminium profile/housing, opal/polycarbonate diffuser, LED strip/module, LED driver, end caps, connectors and mounting accessories, suitable for surface, recessed or suspended installation as shown on drawings, including electrical connection, alignment, operational testing and handing over, complete in all respects as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0560	Rft	1700	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
303	E-4.06	Supply at site, installation, testing and commissioning of LED up-down wall light, 12 W, IP65 rated, 220–240 V AC, 50 Hz, suitable for indoor/outdoor architectural lighting application, complete with die-cast aluminium or approved weather-resistant housing, LED module, diffuser/lens, integral or external LED driver, mounting plate/bracket, glands, connectors, wiring connection, fixing accessories, operational testing and handing over, complete in all respects as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0560	Each	73	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
304	E-5.01	Supply & Laying of 1” dia PVC pipe to be laid under floor including floor cutting as required as per drawings & specifications for Computer, Tel, MATV,Networking, UPS, & Power Supply System. REF: Technical Specifications Section - 0490, Section - 0570, Section - 0610, Section - 0800	Rft	5362.5	Not Applicable		
305	E-5.02	Supply & Installation of adjustable 12 SWG die cast aluminum 10"x10"x4" Floor boxes having base box of 16 SWG G.I. sheet with 3 sets of 15A PVC connectors, including floor cutting as required as per drawings for following outlets. REF: Technical Specifications Section - 0490					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
306	E-5.02-1	2-13 Amp 3 pin socket outlets. REF: Technical Specifications Section - 0490, Section - 0600	Each	6	Not Applicable		
307	E-5.03	Supply & Installation of adjustable 12 SWG die cast aluminum 15"x15"x4" Tech boxes having base box of 16 SWG G.I. sheet with 3 sets of 15A PVC connectors, including floor cutting as required as per drawings for following outlets. REF: Technical Specifications Section - 0490					
308	E-5.03-1	2-13 Amp 3 pin socket outlets. REF: Technical Specifications Section - 0490, Section - 0600	Each	62	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
309	E-5.04	Supply and installation of RJ45 data outlet on single/double port faceplate to be installed on wall ,with necessary arrangements complete in all respect complete in all respect.(for Data) REF: Technical Specifications Section - 0490, Section - 0650	Each	75	Not Applicable		
310	E-5.05	Supply and installation of RJ11 Telephone outlet on single/double port faceplate to be installed on wall ,with necessary arrangements complete in all respect complete in all respect.(for Telephone) REF: Technical Specifications Section - 0490, Section - 0650	Each	68	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
311	E-5.06	Supply, Installation & connecting of 4 pair UTP CAT-6 cable from each Data point to Data junction box/patch panel for data system to be drawn in given prepaid PVC pipe complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0640	Rft	6000	Not Applicable		
312	E-5.06A	Supply, Installation & connecting of 4 pair UTP CAT-6 cable from each telephone to telephone junction box for telephone system to be drawn in given prepaid PVC pipe complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0640	Rft	5440	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
313	E-5.07	Supply and installation of single mode SFP module Baynet or equivalent including cost of all accessories and materials required. Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0650	Each	10	Not Applicable		
314	E-5.08	Supply and wiring of 12C-9/125µm single mode fiber optical cable OS2 type, in and including cost of 1" dia PVC conduit including cost of all PVC conduit accessories, pull wires, PVC junction boxes, complete in all respect. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0640	Rft.	1200	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
315	E-5.09	Supply and installation of 24 port rack mounted ODF including cost of all accessories and materials required. Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0650	Each	1	Not Applicable		
316	E-5.10	Supply, Installation & Connecting up of Telephone cables 0.6mm solid conductor, polyethylene insulated, 2 insulated conductors twisted together and PVC sheathed of following pairs: REF: Technical Specifications Section - 0490					
317	E-5.10-1	i) 100 Pairs cable. REF: Technical Specifications Section - 0490	Rft	1200	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
318	E-5.11	Supply at site, installation, testing and commissioning of telephone distribution board/cabinet, 100-pair capacity, suitable for termination of telephone points, complete with 5 Nos. 20-pair Krone/IDC termination strips, incoming/outgoing cable termination facility, labeling/numbering arrangement and required 1 m or 3m patch cords with one end RJ45 connector and other end IDC connector for connection between patch panel and Telephone DB, installed in IDF/MDF or approved location as shown on drawings, including termination, testing, identification and handing over, complete in all respects as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0530, Section - 0540, Section - 0650					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
319	E-5.11-1	i) Telephone DB (100 pair) REF: Technical Specifications Section - 0490	Each	1	Not Applicable		
320	E-5.12	Supply at site, installation, testing and commissioning of following Data Networking switch Layer-2 type for under mentioned nodes, consisting of following Data points to be terminated on modular patch panel, including cost of power bus bar, IDC connectors, all necessary accessories / materials, whether mentioned or not but are required for proper functioning shall be deemed to be included in the cost of this item, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0650					

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
321	E-5.12-1	24 Port Data Networking switch Layer-2 POE type. REF: Technical Specifications Section - 0490, Section - 0600	Nos.	4	Not Applicable		
322	E-5.13	Supply, installation of Patch cords of following sizes: REF: Technical Specifications Section - 0490, Section - 0650					
323	E-5.13-1	1 Meter long. REF: Technical Specifications Section - 0490	Nos.	50	Not Applicable		
324	E-5.13-2	3 Meter Long. REF: Technical Specifications Section - 0490	Nos.	25	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
325	E-5.14	Supply & Installation & connecting of ceiling recessed wifi access point with Dual Band (2.4GHz or 5 GHz) upto Wifi 6 Supported capability and speeds up to 300 Mbps Wi-Fi Protected Access (WPA, WPA2) security and data encryption IPv6 with centralized controller , complete in all respects. REF: Technical Specifications Section - 0490	Each	7	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
326	E-5.15	Supply at site, installation, testing and commissioning of data cabinet make Imported/Equivalent made of M.S sheet, powder coated, having lockable glass door at front, 4 exhaust fans on top, suitable for above mentioned data switches, consisting of the ports to be terminated on modular data cabinet, including cost of all necessary accessories / materials for passive equipment. The data cabinet and all passive equipment shall be complete in all respects including cost of all necessary materials / accessories. Patch panel shall be installed after obtaining necessary permission from the computer specialist of the Client. REF: Technical Specifications Section - 0490, Section - 0560, Section - 0640, Section - 0600, Section - 0650					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
327	E-5.15-1	Supply at site, installation, testing and commissioning of 12U data cabinet, imported or approved equivalent, 19-inch rack type, fabricated from M.S. sheet steel, powder-coated finish, complete with lockable front glass door, side panels, rack mounting rails, cable entry/exit provision, ventilation arrangement, earthing point, fixing hardware and all standard cabinet accessories, suitable for installation of data/ICT equipment, patch panels and network accessories, installed at location shown on drawings, including alignment, fixing, labeling, earthing continuity check and handing over, complete in all respects as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490	Each	4	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
328	E-5.15-2	Supply at site, installation, testing and commissioning of 6U data cabinet, imported or approved equivalent, 19-inch rack type, fabricated from M.S. sheet steel, powder-coated finish, complete with lockable front glass door, side panels, rack mounting rails, cable entry/exit provision, ventilation arrangement, earthing point, fixing hardware and all standard cabinet accessories, suitable for installation of data/ICT equipment, patch panels and network accessories, installed at location shown on drawings, including alignment, fixing, labeling, earthing continuity check and handing over, complete in all respects as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490	Each	2	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
329	E-5.15-3	Supply at site, installation, testing and commissioning of 42U floor-standing data cabinet, imported or approved equivalent, 19-inch rack type, fabricated from M.S. sheet steel with powder-coated finish, complete with lockable front glass door, rear/side panels, rack mounting rails, ventilation arrangement, cable entry/exit provision, earthing point, fixing/leveling hardware and standard cabinet accessories, suitable for installation of data/ICT equipment, switches, patch panels, fiber panels, cable managers and network accessories, installed at location shown on drawings, including alignment, fixing, labeling, earthing continuity check and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical	Each	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
330	E-5.16	Supply, installation, testing and commissioning of rack mounted Power Distribution Unit (PDU) of following sizes, to be installed on specified location as per advised by architect / engineer's incharge:-. REF: Technical Specifications Section - 0490					
331	E-5.16-1	Single Cord (1x10A/16A) PDU (1.5 kW) with minimum 10 extensions (meeting or exceeding relevant IEC/ANSI standard) REF: Technical Specifications Section - 0490	Nos	8	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
332	E-5.17	Supply & Installation of "IPTV points wiring 4 pair UTP CAT-6 with all accessories RJ45 single/double port faceplate make Orange / Clipsal/3M to be installed on wall ,with necessary arrangements.(for IPTV) in 1" dia PVC conduit for IPTV outlet board complete in all respect. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0800	Each	18	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
333	E-5.18	Supply at site, installation, testing and commissioning of Cat-6 patch panels (meeting or exceeding relevant ANSI/TIA standards),input / output RJ45 connectors suitable for Cat 6 cables patch guides along with cable managers for under mentioned nodes, including cost of power bus bar, IDC connectors, all necessary accessories / materials, whether mentioned or not but are required for proper functioning shall be deemed to be included in the cost of this item, complete in all respects make Baynet/or approved equivalent. Patch panel shall be installed after obtaining necessary permission from the computer specialist of the Client. REF: Technical Specifications Section - 0490, Section - 0650					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
334	E-5.18-1	i) 24 Ports. REF: Technical Specifications Section - 0490	Each	4	Not Applicable		
335		TELEPHONE EXCHANGE. REF: Technical Specifications Section - 0490, Section - 0650					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
336	E-5.19	Supply at site, installation, testing and commissioning of electronic telephone exchange / EPABX / IP-PBX system, suitable for project voice communication network, comprising minimum 4 trunk lines and 100 extensions, expandable capacity, operator console, required interface cards/modules, power supply, system software/licenses, programming/configuration, patching and integration with telephone distribution board/structured cabling system, complete with testing, commissioning, demonstration and handing over, as per drawings, approved material submittal, manufacturer’s recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0650	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
337		Addressable FIRE ALARM SYSTEM. REF: Technical Specifications Section - 0490, Section - 0660					
338	E-6.01	Supply, installation and connecting of addressable manual call stations press glass type with test dey, suitable for surface or flush mounting make from any one of the manufacturers as specified in Annexure "A" complete in all respects and conforming to general specifications. REF: Technical Specifications Section - 0490, Section - 0660	Each	17	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
339	E-6.02	Supply, installation and connecting of electronic alarm sounders ,complete in all respects and conforming to general specifications. REF: Technical Specifications Section - 0490, Section - 0660	Each	17	Not Applicable		
340	E-6.03	Supply, installation and connecting of addressable optical smoke detectors, complete in all respects and conforming to general specifications. REF: Technical Specifications Section - 0490, Section - 0650, Section - 0660	Each	111	Not Applicable		
341	E-6.04	Same as above 6.03 but heat detector rate of temperature rise type ,complete in all respects. REF: Technical Specifications Section - 0490, Section - 0660	Each	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
342	E-6.05	Supply & installation of Media converter complete in all respect. REF: Technical Specifications Section - 0490, Section - 0660	Each	2	Not Applicable		
343	E-6.06	Supply, installation and connecting of addressable fire alarm of following mentioned loops. Short/open circuit indications LED display / power fault, loop isolated test, complete in all respects and conforming to general specifications FACP to be installed at appropriate place as mentioned in drawings. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0660					
344	E-6.06-1	i) FACP 4 Loops. REF: Technical Specifications Section - 0490	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
345	E-6.07	Supply and wiring of Smoke / Heat detector/electrostatic sounder and manual call point 30 min Fire Rated Fire Alarm (FA) 1x2 core (1.23mm2) cable in and excluding cost of 1" dia PVC conduit with all installing accessories, complete in all respect as per drawings and specification. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0660	Rft	7152	Not Applicable		
346	E-6.08	Supply, installation of fire alarm junction boxes 16 SWG to be concealed in wall with 2 coats of anti rust paint, earthing terminal, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0660, Section - 0640					

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
347	E-6.08-1	i)Fire alarm junction boxes of appropriate size 4"x7"x4" deep. REF: Technical Specifications Section - 0490, Section - 0660, Section - 0640	Each	2	Not Applicable		
348	E-6.09	Supply at site of PVC conduit heavy duty, to be installed on RCC slabs, walls, floor or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610					
349	E-6.09-1	i) 1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft.	7152	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
350	E-6.1	Programming, configuration, testing, commissioning and handing over of complete Intelligent Addressable Fire Alarm System with read-only status integration to Building Management System (BMS), including Fire Alarm Control Panel (FACP), addressable loops, detectors, manual call points, sounders/strobes, monitor/control modules, annunciation, alarm/trouble/supervisory signals and BMS interface points as per approved cause-and-effect matrix, drawings and system architecture, complete with functional testing, integrated system testing, alarm simulation, verification in the presence of Site Engineer/Engineer's Representative, operator training for Employer's staff and submission of commissioning records, complete in all respects as per Technical Specifications. REF: Technical Specifications	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
351	E-7.01	Wiring for each IP Based POE CCTV Cameras to be installed on walls / slabs or on false ceiling with cable CAT-6 UTP Cable cable in 1" dia PVC conduit (excluding cost of pipe), complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0670	Rft	11400	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
352	E-7.02	Supply at site, installation, testing & commissioning of Full HD Indoor dome Type IP Based POE CCTV, Day and Night Type with minimum 4MP resolution pieces IR LED , Vandal proof Body, with at least 20-30 meters IR visibility, Indoor type , including mounting bracket, all fixing and mounting accessories, complete in all respects, including cost of all required accessories / materials. fixed lens. REF: Technical Specifications Section - 0490, Section - 0670	Each	40	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
353	E-7.03	Supply at site, installation, testing & commissioning of Full Outdoor (IP-65) IP Based POE CCTV, Day and Night Type with minimum 4MP resolution pieces IR LED , Vandal proof Body, with at least 20-30 meters IR visibility , including mounting bracket, all fixing and mounting accessories, complete in all respects, including cost of all required accessories / materials. REF: Technical Specifications Section - 0490, Section - 0670	Each	32	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
354	E-7.04	Supply at site, installation, testing & commissioning of Pan ,Tilt & Zoom 360 degree Full HD (16:9 1080p) Camera with minimum 4 MP resolution,32x Optical Zoom, 16x Digital Zoom, Day and Night Type, intelligent video analytics, including fixing and mounting accessories, complete in all respects, including cost of all required accessories / materials. REF: Technical Specifications Section - 0490, Section - 0650	Each	4	Not Applicable		
355	E-7.05	Supply at site, installation, testing & commissioning of Joystick, complete in all respects, including cost of all required accessories / materials. REF: Technical Specifications Section - 0490	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
356	E-7.06	Supply at site, installation, testing & commissioning of 32 channel NVR with 512 MBPs network support,4K Video Out on HDMI,12 MP max camera support, Event Trigger (alarm input, video loss), Online 2x Gigabit Ethernet Network Facility,IP Filtering,GUI Interface, Built In Software including cost of 16 terabyte Hard Disk for 90 days recording, all necessary hardware and software accessories and materials, required for NVR, complete in all respects. REF: Technical Specifications Section - 0490	Each	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
357	E-7.07	Supply at site, installation, testing and commissioning of latest-generation ultra-slim desktop computer / CPU, HP, Dell, Lenovo or approved equivalent, comprising Intel Core i7 / Intel Core Ultra 7 processor, 14th Generation or latest equivalent, minimum 16GB DDR5 RAM, minimum 1TB NVMe SSD storage, integrated graphics, Gigabit Ethernet, Wi-Fi, Bluetooth, USB/HDMI/DisplayPort connectivity, genuine licensed Windows 11 Pro 64-bit operating system, keyboard, mouse, power cable and required accessories, including installation of operating system/drivers, initial configuration, performance testing, demonstration and handing over, complete in all respects as per approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical	Each	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
358	E-7.08	Supply at site, installation,tagging, connections, testing and commissioning of following Ports Data Networking POE switch Layer-2 type, consisting of following Data points to be terminated on modular patch panel, including cost of power bus bar, IDC connectors, all necessary accessories / materials, whether mentioned or not but are required for proper functioning shall be deemed to be included in the cost of this item, complete in all respects make Dlink/Huawei or approved equivalent. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0650, Section - 0670					

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
359	E-7.08-1	16 Port Data Networking POE switch Layer-2 type. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0670	Nos.		Not Applicable		
360	E-7.08-2	24 Port Data Networking POE switch Layer-2 type. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0670	Nos.	4	Not Applicable		
361	E-7.09	Supply at site, installation, tagging and connections of following port Data Patch panels, installed in Data Rack or as per site. Including cost of all accessories and materials required. Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0650					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
362	E-7.09-1	16 Port Data Patch panels. REF: Technical Specifications Section - 0490, Section - 0650	Nos.		Not Applicable		
363	E-7.09-2	24 Port Data Patch panels. REF: Technical Specifications Section - 0490, Section - 0650	Nos.	4	Not Applicable		
364	E-7.1	Supply, installation of Patch cords of following sizes: REF: Technical Specifications Section - 0490, Section - 0650					
365	E-7.1-1	1 Meter long. REF: Technical Specifications Section - 0490	Nos.	50	Not Applicable		
366	E-7.1-2	3 Meter Long. REF: Technical Specifications Section - 0490	Nos.	25	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
367	E-7.11	Supply at site, installation, testing & commissioning of coloured CCTV monitor 4K LED 43" , including cost of all necessary accessories and materials (like bracket and mounting arrangements), Including cost of 2 HDMI Cable 4K, complete in all respect. REF: Technical Specifications Section - 0490, Section - 0670	Each	3	Not Applicable		
368	E-7.12	if required, for the integration with existing system. Supply at site, installation, testing & commissioning of 256 channel decoder for integration with existing CCTV System , including cost of all necessary accessories and materials (like bracket and mounting arrangements), complete in all respect. REF: Technical Specifications Section - 0490, Section - 0670	Each	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
369	E-7.13	Supply and fabrication of close circuit junction boxes 16 SWG to be concealed in wall with 2 coats of anti rust paint, earthing terminal, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600, Section - 0670, Section - 0640					
370	E-7.13-1	i)Junction boxes of appropriate size 4"x7". REF: Technical Specifications Section - 0490, Section - 0640	Each	2	Not Applicable		
371	E-7.14	Supply at site of PVC conduit heavy duty to be installed on RCC slabs, walls, floor or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610					

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
372	E-7.14-1	i) 1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft.	11400	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
373	E-7.15	Programming, configuration, testing, commissioning, integration and handing over of complete IP CCTV / Video Surveillance System with Video Management System (VMS), Network Video Recording / Network Attached Storage system and BMS monitoring interface, including configuration of IP cameras, recording schedules, camera naming/location tagging, user access levels, live view, playback, video analytics, alarm/event settings, storage verification, time synchronization, network connectivity and BMS status/alarm interface points, as applicable, complete with integrated system testing in the presence of Site Engineer/Engineer’s Representative, operator training for Employer’s staff and submission of commissioning/test records,	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
374	E-8.01	Supply at site, installation and commissioning of speakers wiring, to be wired with PVC insulated, PVC sheathed twin core 2x1.23mm sq 300/500 Volt. Grade, in and Excluding the cost of 1" dia heavy duty PVC conduit, installed on walls with all necessary fixing accessories as required as per site condition, all PVC conduit accessories, pull boxes, steel pull wires, complete in all respects. Wiring to be done considering each floor a separate zone. REF: Technical Specifications Section - 0490, Section - 0610	Nos	13	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
375	E-8.02	Supply at site, installation and commissioning of 15 watts wall speaker ,including cost of all necessary accessories and materials, complete in all respects. recessed/surface mounted Speakers of specified capacity housed in metallic enclosure with built in 70v/100v transformer , aluminium grill, SPL (Sound Pressure Level) (1W / 1M)= 92dB max 99dB, frequency response 130-13 Khz, EN-54 compliant, Including cost of all accessories and materials, complete in all respect. REF: Technical Specifications Section - 0780, Section - 0490	Nos	13	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
376	E-8.03	Supply at site,installation and commissioning of adjustable bidirectional ,low distortion microphone with suitable frequency response, complete in all respects. REF: Technical Specifications Section - 0490	Nos	2	Not Applicable		
377	E-8.04	Supply at site, installation, testing and commissioning of 240 Watt integrated power Amplifier, including cost of all necessary accessories / materials whether mentioned not shall be deemed to be included in the cost of item, complete in all respects. REF: Technical Specifications Section - 0490	Nos	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
378	E-8.05	Supply at site, installation, testing and commissioning of 60 Watt integrated power Amplifier, including cost of all necessary accessories / materials whether mentioned not shall be deemed to be included in the cost of item, complete in all respects. REF: Technical Specifications Section - 0490	Nos	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
379	E-8.06	Supply at site, installation, testing and commissioning of professional power mixer / PA audio integration mixer for integration of the proposed Voice Alarm and Public Address System with existing PA system / other building PA systems, rack-mounted or approved type, 230V AC, 50 Hz, suitable for 100 V line / PA audio interface as required, with minimum microphone/line inputs, auxiliary input/output, master volume control, tone control, balanced/unbalanced audio output, signal interface and required integration ports/modules as per approved system architecture, complete with HDMI/audio/control cables where applicable, connectors, patch cords, power cable, mounting accessories, configuration, functional testing, integration testing and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's	Nos	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
380	E-8.07	Supply at site of PVC conduit heavy duty, to be installed on RCC slabs, walls, floor or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610					
381	E-8.07-1	i) 1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft.	1300	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
382	E-9.01	Supply and installation of 99.97% electrolytic copper strip but dia 2x(5.7 x 8mm) or as approved by consultant) copper strip to be installed on columns as “DOWN CONDUCTORS” with saddles from lightning arrestors to earth electrodes including providing test point in each down conductor. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0630	Rft	1000	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
383	E-9.02	Providing and installation of Earthing Veractor Cone / Spike Size 2" thick, 12" long as shown in drawings or ¾” dia & 10 ft long copper rod as earth electrode 100 ft or upto the water level, below ground level including cost of boring and lowering the rod (100ft / upto the water level) down, complete with clamp and 2x70mm2 stranded copper conductor from rod to ground surface in 2” dia G.I.pipe (EL Class) with watering cap, Manhole with cover as per detail shown in drawings. all earth work should be done according to the advise of electrical consultant. REF: Technical Specifications Section - 0490, Section - 0620	Each	3	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
384	E-9.03	Providing & Fixing of one complete set of "LAS Emission Steamer" Earth pit as shown in drawings and as per the instruction of engineers incharge. REF: Technical Specifications Section - 0490, Section - 0630	Nos	3	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
385	E-9.04	Supply, design, installation, testing and commissioning of Special Lightning Air Terminal System, Controlled Early Streamer Emission (CESE) type, Prevectron 3rd Generation or approved equivalent, suitable for integration with the conventional lightning protection system for protection of rooftop equipment and building structures, complete with air terminal, mounting arrangement, down conductor interface, testing arrangement and all required system accessories, as shown on drawings and as per approved lightning protection design, manufacturer’s recommendations and Technical Specifications.. REF: Technical Specifications Section - 0490, Section - 0630			Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
386	E-9.04-1	Supply, design, installation, testing and commissioning of Prevectron type 3rd Generation Controlled Early Streamer Emission (CESE) lightning air terminal, 2nd Edition, autonomous type, without external power supply/battery, having tinned copper central pick-up rod, protection radius 45 m, Level of Protection I, suitable for NFC 17-102 / UNE 21186 based lightning protection design, complete with factory test certificate, site testing and handing over. REF: Technical Specifications Section - 0490, Section - 0630	Set	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
387	E-9.04-2	Supply and installation of GI elevation pole/support assembly for CESE lightning air terminal, 35 mm to 50 mm dia, with threaded top suitable for fixing the air terminal unit, complete with base plate, mounting bracket, clamps, anchors, fasteners and all required fixing accessories. REF: Technical Specifications Section - 0490	Set	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
388	E-9.04-3	Supply and installation of down conductor test clamp / inspection joint assembly for lightning protection system, suitable for connecting and disconnecting the down conductor from earth termination for periodic testing and earth resistance measurement, complete with brass alloy clamp, fixing arrangement and required accessories. REF: Technical Specifications Section - 0490, Section - 0630	Set	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
389	E-9.04-4	Supply, installation, testing and commissioning of lightning flash counter / performance recording equipment, electronically controlled type, suitable for recording lightning strikes in the range of 1 kA to 100 kA with 8/20 microsecond impulse current waveform, complete with mounting arrangement, connection with down conductor, testing and handing over. REF: Technical Specifications Section - 0490, Section - 0630	Set	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
390	E-9.04-5	Supply, installation, testing and commissioning of conventional Franklin rod type lightning air terminal, mounted at the highest approved point of the building structure, complete with PCC base/support, download connection, fixing accessories, testing and handing over, as shown on drawings and as directed by the Engineer. REF: Technical Specifications Section - 0490	Set	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
391	E-10.01	Providing and installation of Earthing Veractor Cone / Spike Size 2" thick, 12" long as shown in drawings or ¾” dia & 10 ft long copper rod as earth electrode 100 ft or upto the water level, below ground level including cost of boring and lowering the rod (100ft / upto the water level) down, complete with clamp and 2x70mm2 stranded copper conductor from rod to ground surface in 2” dia G.I.pipe (EL Class) with watering cap, Manhole with cover as per detail shown in drawings. all earth work should be done according to the advise of electrical consultant. REF: Technical Specifications Section - 0490, Section - 0620	Each	12	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
392	E-10.02	Providing, supplying, boring, lowering, installing, testing and commissioning of complete earthing electrode set for Low Voltage, LAN/Data and associated electronic equipment, comprising earthing cone/spike of size 2 inches thick × 12 inches long or 19 mm dia. / 3/4 inch dia. copper-clad steel/copper rod earth electrode, minimum 3.0 m / 10 ft long, driven or lowered up to 100 ft depth or up to permanent water level as shown on drawings and as directed by the Engineer, including boring, lowering, backfilling/treatment of bore, brass/tinned copper clamp, copper lugs, thimbles, nuts, bolts, washers, earth connecting point, inspection/testing arrangement, and connection with 2 × 25 sq.mm PVC insulated copper earth cables laid in 1-1/2 inch dia. G.I. pipe (Electrical Class), complete with excavation, pipe sleeves,	Each	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
393	E-10.03	Supply and installation of Earth Strips of Size 25x3 mm sq with brass nuts & bolts fitted on cable trays as specified by Engineer Incharge. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0640, Section - 0590	Rft	1800	Not Applicable		
394	E-10.04	Supply and installation of Earth connecting points comprising of 2”x9”x½” (Width x Length x Thickness) copper plate with brass nuts & bolts fitted on M.S. bracket installed on walls / columns. REF: Technical Specifications Section - 0490	Each	13	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
395	E-10.05	Supply & Installation of following sizes of PVC insulated green color single core copper conductor cables to be drawn in given PVC / M.S. conduits or laid in cable trays or installed on vertical surfaces complete with cable lugs, ties, P.G. clamps markers and accessories as required complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0640, Section - 0590					
396	E-10.05-1	i) 25mm2. REF: Technical Specifications Section - 0490	Rft	150	Not Applicable		
397	E-10.05-2	ii) 70mm2. REF: Technical Specifications Section - 0490	Rft	1560	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
398	E-11.01	Wiring for each proximity card reader to be installed on walls with 4 pair Cat. 6, UTP cable with pure copper conductor PVC insulated PVC sheathed in and including cost of 1" dia PVC conduit recessed in walls, columns, slabs, floors or above false ceiling with all necessary fixing accessories as required as per site condition, including cost of all PVC conduit accessories, pull boxes, steel pull wires, powder coated, M.S junction boxes 16 SWG of size 4"x4" with 2 coats of powder coating of orange colour, including cost of all necessary accessories and materials, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0790, Section - 0640	Rft	540	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
399	E-11.02	Providing, supplying, installation, laying, dressing, termination, testing and commissioning of wiring/cabling for each emergency push button of Access Control System, using 4-pair Cat. 6 UTP cable with 100% pure copper conductor, drawn through concealed/surface conduit, trunking, cable tray or approved raceway from the emergency push button location up to the access control panel / door controller / nearest approved termination point, including RJ45 / IDC termination, ferrules, tags, labels, sleeves, connectors, cable ties, saddles, pull boxes, junction boxes, glands, supports, fixing accessories, continuity testing, identification, dressing and all necessary accessories and incidental works required for a complete functional wiring installation. REF: Technical Specifications Section - 0490, Section - 0650, Section - 0790	Nos.	3	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
400	E-11.03	Providing, supplying, installation, laying, dressing, termination, testing and commissioning of wiring/cabling for each magnetic drop bolt door lock of Access Control System, using 4-pair Cat. 6 UTP cable with 100% pure copper conductor, drawn through concealed/surface conduit, trunking, cable tray or approved raceway from the magnetic drop bolt lock location up to the access control panel / door controller / power supply unit / nearest approved termination point, including termination at both ends, ferrules, tags, labels, sleeves, connectors, cable ties, saddles, pull boxes, junction boxes, glands, supports, fixing accessories, continuity testing, identification, dressing and all necessary accessories and incidental works required for a complete functional wiring installation. REF: Technical Specifications Section - 0490,	Nos.	3	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
401	E-11.04	Supply at site, installation, testing and commissioning of RFID Card Reader 125KHz, (for outside door) reading range 6", operating at low voltage DC supply, with mounting base suitable for interior and exterior environment with Door Interface Unit (DIU), dual color LED and speaker for comprehensive audible feedback to user. REF: Technical Specifications Section - 0490, Section - 0790	Nos.	3	Not Applicable		
402	E-11.05	Supply at site, installation, testing and commissioning of Push Button (Exit Switch) suitable for installation on BS standard size back box connected to door controller for access. REF: Technical Specifications Section - 0490, Section - 0600	Nos.	3	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
403	E-11.06	Supply at site, installation, testing and commissioning of Proximity Cards ISO bar code card standard size and thickness, thin, flexible polyvinyl chloride laminated, passive type, easy printable on both sides. REF: Technical Specifications Section - 0490	Nos.	30	Not Applicable		
404	E-11.07	Supply at site, installation, testing and commissioning of following Magnetic Drop Bolt Lock with holder and fixing accessories, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0790					
405	E-11.07-1	Single Door. REF: Technical Specifications Section - 0490	Nos.	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
406	E-11.07-2	Double Door. REF: Technical Specifications Section - 0490	Nos.	1	Not Applicable		
407	E-11.08	Supply at site, installation, testing and commissioning of 4 door controller with Dp fixing accessories,and integrated with Fire Alarm system complete in all respects. REF: Technical Specifications Section - 0490, Section - 0660	Nos.	5	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
408	E-11.09	Programming, configuration, integration, testing, commissioning, demonstration and staff training for the complete Electronic Access Control System integrated with the Building Management System (BMS), including configuration of all access-controlled doors, door controllers, card readers, emergency release / emergency push buttons, magnetic locks / drop bolts, door position contacts, request-to-exit devices, alarm inputs, access levels, time zones, user/cardholder database, alarm priorities, event logs, audit trail, operator rights, password-protected access and system reporting. The scope shall include complete software and controller programming, point-to-point testing of all field devices, verification of communication between access control panels, head-end	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
409	E-11.1	Supply, installation, configuration, testing and commissioning of operator workstation / desktop computer for Access Control and Security Control System, comprising ultra-slim desktop PC with Intel Core i7 processor or approved equivalent, minimum 8 GB RAM, 2 TB HDD / approved storage, DVD writer where required, genuine Windows Professional 64-bit operating system, keyboard, mouse, display interface, network interface, power cords, required software drivers, antivirus/security utility where applicable, and all necessary accessories required for complete operation of the Access Control and Time Management Software. The item shall include installation of the operating system, device drivers, access control/time management software client or server application as applicable, network configuration, IP addressing, user account setup	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
410	E-11.11	Supply at site, installation of PVC conduit heavy duty buried under ground or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, all necessary accessories and materials complete in all respect. REF: Technical Specifications Section - 0490, Section - 0610					
411	E-11.11-1	1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	Rft.	540	Not Applicable		
412	E-11.12	Supply, installation of Access Control Junction boxes 16 SWG to be concealed in wall with 2 coats of anti rust paint, earthing terminal, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0790, Section - 0640					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
413	E-11.12-1	Access Control Junction Box 4" x 7" x 4" deep. REF: Technical Specifications Section - 0490, Section - 0790, Section - 0640	Nos.	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
414	E-11.13	Programming, configuration, integration, testing, commissioning, demonstration and staff training for the complete Electronic Access Control System integrated with the Building Management System (BMS), including configuration of all access-controlled doors, door controllers, card readers, emergency release / emergency push buttons, magnetic locks / drop bolts, door position contacts, request-to-exit devices, alarm inputs, access levels, time zones, user/cardholder database, alarm priorities, event logs, audit trail, operator rights, password-protected access and system reporting. The scope shall include complete software and controller programming, point-to-point testing of all field devices, verification of communication between access control panels, head-end	Job	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
415	E-12.01	Supply, Installation & Programming of centralized, IP-based Integrated Building Management System with HVAC, lighting, fire alarms, access control, and CCTV. Including CPU , Mod Bus Communication Port/Bacnet with all accessories, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0660, Section - 0790, Section - 0880	Job	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY PUBLIC (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
416	E-13.01	Supply & Installation of Monocrystalline PV modules 250 kW with mounts, sensors, accessories, Cables 25mm sq, Hybrid Inverter linking of Solar PV system with Electrical Synchronizing and Load Sharing Panel with 2 Hrs Backup Time or vary as per site condition with lithium batteries as per solar vendor specification provided,complete in all respect. REF: Technical Specifications Section - 0490, Section - 0570, Section - 0870	Job	1	Not Applicable		
417	E-14	ELEVATORS Lift Type: Traction Type Passenger Lifts Brand Name : OTIS , DOPPLER , KONE , THYSSENKRUPP, SCHINDLER Country of Origin: WESTERN , EUROPE.					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
418	E-14.01	Supply of imported brand new Duplex Elevator, Machine Room Less (MRL Type), heavy duty fully complied and certified by EN 81-20, EN 81-50 and EN 81-70 Standards of minimum features including but not limited to VVVF high efficiency motor, complete inside stainless steel finish,indoor type for ambient condition of 45 °C, capacity of 1000 kg, Cabin Size 1600×1400×2300 (W×D×H) speed, 1 m/s, 11 stops/11 openings, approx. total travel height 42 meter . entrance 900 mm. Lift shall minimum includes car, hoisting machinery, counter-weight, supports, brackets, automatic controls,embedded parts, access ladder, separator screen & trap door, electric overload, shaft lightening, intercom system, gong, emergency operation for cabin/door, emergency rescue device (ups/battery) safety devices & Manual emergency	Each	2	[Up to 80% Allowed]		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
419	E-14.02	Spare Parts for use of 1 year's lifts operation	Each	2	Not Applicable		
420	E-14.03	Installation, testing, and commissioning of imported brand new Duplex Elevator, Machine Room Less (MRL Type),capacity of 1000 kg, Cabin Size 1600×1400×2300 (W×D×H) speed 1 m/s, 11 stops/ 11 openings, approx. total travel height 42 meter . entrance 900 mm. heavy duty fully complied and certified by EN 81-20, EN 81-50 and EN 81-70.	Each	2	Not Applicable		
421	E-14.04	Civil and Allied Works relevant to necessary adjustments which will be required during installation of new equipment. (door chisling, door filling, holes for display & call buttons)	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
422	E-14.05	Electrical & Ancillary Works for elevator, fan & AC including outside DB to elevator, breakers cabling and other accessories etc. (Complete in all respect).	Each	2	Not Applicable		
423	E-14.06	Supply and installation of 2 TR cooling capcity air conditioner (AC) for elevator shaft. (Make;Trane/Mitsubishi/Samsung only) AC shall be operatble at ambient temperature of 50°C.	Each	2	Not Applicable		
424	E-14.07	Supply and installation of exhaust fan propeller type of size 800 CFM	Each	2	Not Applicable		
425	E-14.08	Pre-Shipment inspection at factory in country of origin, including boarding, loadging, hotel stay and food (03 inspectors, 05 Nights stay, business class tickets)	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
426	E-14.09	Third party validation for Testing & commissioning of elevator in Pakistan	Each	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
427	E-14.10	Provision of comprehensive Operation and Maintenance (O&M) services for the installed lifts/elevators for a period of one (01) year, including preventive maintenance, corrective maintenance, routine inspection, lubrication, adjustment, cleaning, breakdown attendance, emergency service, testing, troubleshooting, supply and replacement of all required spare parts and consumables, and deployment of at least one qualified lift technician at site as required for smooth and safe operation. The scope shall include maintenance of lift machine, controller, VVVF drive, doors, door operator, guide rails, ropes/belts, safety devices, indicators, push buttons, interlocks, emergency alarm/communication system and all associated lift components, complete with service records, maintenance logbook, test reports and coordination with	Month	12	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
428	M	Bill No. 6 - Mechanical / HVAC Works					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
429	M.1	Providing, supplying at site, installation, testing, commissioning and performance verification of Floor-Standing, Forced-Draft, Fire-Tube type dual-fuel (LDO/LPG) Hot Water Generator of minimum 450 kW net output each, complete with burner, operating/safety controls and devices, flue/breaching and fuel connections, insulation, vibration isolation, foundation/support interface, power and control wiring terminations, and all incidental and ancillary works necessary for a complete, functional and operational installation, in accordance with the approved shop drawings and Technical Specification Section. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0150	Each	3	[Up to 80% Allowed]		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
430	M.2	Providing, supplying, installing, testing, commissioning and performance verification of factory-assembled, high-efficiency, VFD-controlled, water-cooled electric screw chillers (CH-1 & CH-2), minimum 527 kW cooling capacity each, complete with screw compressors, evaporator, condenser, refrigerant circuit, microprocessor controls, starters, vibration isolators, rigging, piping and electrical terminations, control integration, and all accessories and incidental works, complete in all respects in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550	Each	2	[Up to 80% Allowed]		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
431	M.3	Providing, supplying, installation, testing and commissioning of Closed-Circuit Cooling Tower (CT) , induced draft cross-flow type, 3-cell assembly (2 Duty + 1 Standby) , with minimum 650 kW heat rejection per cell capacity, complete with heat exchange coils, fans, motors, basins, drift eliminators, VFD controls, spray pumps, all internal piping, supports, isolators, terminations, and all ancillary works for a fully operational system, per Technical Specifications and complete in all respects. Technical Specifications Section - 0720, Section - 0010. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	Each	1	[Up to 80% Allowed]		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
432	M.4	Providing, supplying, installing, testing and commissioning of end-suction centrifugal Chilled Water Pump (CHWP), Minimum 567 L/min capacity at 400 kPa head, complete with VFD-compatible motor, common base frame, flexible coupling, coupling guard, vibration isolators, VFD, controls, piping and electrical connections, and all accessories and incidental works, complete in all respects in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
433	M.5	Providing, supplying, installation, testing and commissioning of end-suction centrifugal, common-base mounted Condenser Water Pump-Motor sets (CWP), VFD-compatible, minimum 1,740 L/min discharge at 320 kPa head, complete with couplings, coupling guards, base frames, vibration isolators, VFDs/controls and accessories; including alignment, piping and electrical terminations, and all incidental and ancillary works for a complete, operational installation, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	Each	2	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
434	M.6	Providing, supplying, installing, testing and commissioning of end-suction centrifugal Hot Water Pump (HWP), Minimum 567 L/min capacity at 400 kPa head, complete with VFD-compatible motor, common base frame, flexible coupling, coupling guard, vibration isolators, VFD, controls, piping and electrical connections, and all accessories and incidental works, complete in all respects in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
435	M.7	Providing, supplying at site, installation, testing and commissioning of complete Closed-Loop Water Treatment and Chemical Feeding System comprising chemical dosing pumps, corrosion/scale inhibitor feeders, pot feeder, water quality monitoring/sampling equipment and accessories; including initial system charging/passivation, chemical dosing schedule, alignment, piping and electrical terminations, and all incidental and ancillary works for a complete, operational installation, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720	Lot	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
436	M.8	Providing, supplying, installing, testing and commissioning of Cooling Water Treatment and Feeding System for cooling towers, complete with chemical dosing package, dosing pumps, chemical tank, water quality monitoring and bleed control equipment, initial chemical charging, piping, controls, electrical connections, and all accessories required for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	Lot	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
437	M.9	Providing, supplying at site, installation, testing and commissioning of complete packaged Glycol Make-up and Feed System for initial system filling, pressurization and automatic make-up of closed-loop hot water systems operating in low ambient conditions, complete with glycol concentrate, pumps, storage tank, controls, initial fill and all accessories, including all incidental and ancillary works necessary for a complete and operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0850	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
438	M.10	Providing, supplying at site, installation, testing and commissioning of the following auxiliary equipment for the Central Plant Room (CPR), in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720			Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
439	M.10-1	Factory-packaged automatic Pressurization System for closed-loop chilled/hot water hydronic network, comprising duplex pressurization pumps (lead/lag auto alternation), ASME-rated bladder-type Expansion Tank, Air & Dirt Separator, make-up water assembly (PRV, backflow preventer, solenoid valve), safety relief valve, pressure transmitters, and control panel with BAS interface and leak/abnormal make-up alarm; including piping and electrical terminations, testing, commissioning and all incidental and ancillary works, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	Lot	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
440	M.10-2	Complete Light Diesel Oil (LDO) underground storage and distribution system comprising double-wall underground storage tank (min. 100-hour continuous full-load capacity) with interstitial leak monitoring and cathodic protection, duplex transfer pumps, indoor insulated day tank (min. 8-hour capacity) with high/low/high-high alarms, heat-traced fuel piping network (-18°C rated) with insulation, fuel filtration, valves, controls, BMS integration, excavation, backfilling, foundations, testing and commissioning, complying with NFPA 30/31, API 650, UL 58, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0150	Lot	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
441	M.10-3	Self-regulating parallel-resistance electric heat tracing cable (min. 15–25 W/m) for hot water pipe network freeze protection, maintaining minimum +5°C pipe temperature at -18°C ambient, complete with fluoropolymer jacket, fixing by aluminum adhesive tape, power connection kits, end seals/splice kits, thermostatic controller (energize +4°C/de-energize +10°C), local disconnect, ground fault protection, BMS alarm contacts, weatherproof insulation cladding and all accessories, testing, commissioning and all incidental and ancillary works, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720	Lot	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
442	M-11	Providing, supplying at site, installation, testing, commissioning and performance verification of chilled/hot water Fan Coil Units, complete with dual-suction multi-blade fan, modulating water control valve, local/centralized controller, drain pan and piping connections, insulation, hangers/supports and all accessories, including all incidental and ancillary works for a complete and operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
443	M.11-1	Fan Coil Unit, Code-AA, minimum 4.0 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	Each	3	[Up to 80% Allowed]		
444	M.11-2	Fan Coil Unit, Code-A, minimum 5.7 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	Each	25	[Up to 80% Allowed]		
445	M.11-3	Fan Coil Unit, Code-B, minimum 7.0 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	Each	21	[Up to 80% Allowed]		
446	M.11-4	Fan Coil Unit, Code-C, minimum 10.5 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	Each	26	[Up to 80% Allowed]		
447	M.11-5	Fan Coil Unit, Code-D, minimum 14.5 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	Each	26	[Up to 80% Allowed]		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
448	M.12	Providing, supplying, installing, testing, commissioning and performance verification of DX ducted split air-conditioning units, complete with inverter-driven compressor, indoor and outdoor units, factory controls, refrigerant piping, condensate drain piping, insulation, supports, electrical and control connections, refrigerant charging, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
449	M.12-1	Room Inverter Split Unit (RSU + CU), ducted ceiling-concealed type, nominal cooling capacity 3 TR. REF: Technical Specifications Section - 0710, Section - 0720	Each	6	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
450	M.13	Providing, supplying, installing, testing, commissioning and performance verification of Dedicated Outdoor Air System (DOAS) air handling units, 100% outdoor air, heat recovery type, complete with EC supply and exhaust fans, plate heat exchanger, chilled/hot water coils, filters, dampers, controls, drain pan, casing, piping, electrical connections, vibration isolators, supports, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
451	M.13-1	DOAS AHU-1 (TFAU-1) - 400 L/s airflow, minimum cooling capacity 12.0 kW. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	[Up to 80% Allowed]		
452	M.13-2	DOAS AHU-2 (TFAU-2) - 550 L/s airflow, minimum cooling capacity 15.0 kW. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	[Up to 80% Allowed]		
453	M.13-3	DOAS AHU-3 (TFAU-3) - 2,200 L/s airflow, minimum cooling capacity 55.0 kW. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
454	M.14	Providing, supplying, installing, testing, commissioning and performance verification of Fans and Ventilation Systems, complete with motors, controls, vibration isolators, supports, electrical connections, backdraft dampers, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
455	M.14-1	Exhaust Fan EF-GF-1, 1000 CFM @ 1" w.g. ESP. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
456	M.14-2	Exhaust Fan EF-F-1, 1500 CFM @ 1" w.g. ESP. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		
457	M.14-3	Exhaust Fan EF F-2 (1400 CFM @ 1" ESP) REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		
458	M.14-4	Exhaust Fan EF F-3, kitchen exhaust fan suitable for grease-laden and hot air service (2000 CFM @ 1.5" w.g. ESP) REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
459	M.14-5	Vehicle Exhaust Ventilation System (LEV), complete with ductwork, retractable nozzles, hose-reel with pipe/snorkel and extraction fan, including controls, testing, commissioning and all incidental and ancillary works necessary for a complete and operational installation, in accordance with Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0830	Lot	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
460	M.14-6	Staircase Pressurization System, comprising 2 fans (1 duty + 1 standby), complete standalone system with controls and pressure sensors, integrated with BMS, including testing, commissioning and all incidental and ancillary works necessary for a complete and operational installation, in accordance with Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720	Lot	1	Not Applicable		
461	M.14-7	Supply Air Fan for CPR, wall mounted type (SF) REF: Technical Specifications Section - 0710, Section - 0720	Each	4	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
462	M.14-8	Energy Recovery Ventilator, 80% efficiency, 1500 CFM, with supply and exhaust fans and plate type heat exchanger. REF: Technical Specifications Section - 0710, Section - 0720	Each	3	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
463	M.15	CHILLED/HOT WATER PIPING WITH FITTINGS Providing, laying, jointing, testing and commissioning of Polypropylene (PP-R / PP-RP (RCT)) pipes and fittings, manufactured from virgin Fusiolen resin with no recycled content, complying with ASTM F2389, CSA B137.11 and ASTM D2774, in SDR 7.4 / 9 / 11 / 17.6 as per manufacturer's instructions, with hydronic hot water/heating lines incorporating a fiber (faser) layer to limit thermal expansion, complete with fittings, fusion jointing, hangers, supports, sleeves and all accessories, backed by manufacturer's 10-year material warranty with Engineer's approvals, including pressure testing, flushing and all incidental and ancillary works,in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
464	M.15-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	250	Not Applicable		
465	M.15-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	800	Not Applicable		
466	M.15-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	950	Not Applicable		
467	M.15-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	800	Not Applicable		
468	M.15-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	980	Not Applicable		
469	M.15-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	50	Not Applicable		
470	M.15-7	3" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	1200	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
471	M.15-8	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	750	Not Applicable		
472	M.15-9	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	750	Not Applicable		
473	M.15-10	6" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	250	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
474	M.16	CONDENSATE DRAIN PIPING - uPVC CLASS E (SCHEDULE 40) Providing, laying, jointing, testing and commissioning of uPVC (unplasticized polyvinyl chloride) Class E/Schedule 40 piping of nominal diameters below, including cost of solvent cement and specials, hangers, supports and all accessories, complete as approved and directed by the Engineer, in accordance with Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720					
475	M.16-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	290	Not Applicable		
476	M.16-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	394	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
477	M.16-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	1250	Not Applicable		
478	M.16-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	280	Not Applicable		
479	M.17	GALVANIZED STEEL PIPE (BS 1387), Providing, supplying, laying, jointing, testing and commissioning of galvanized steel piping, complete with fittings, unions, supports, sleeves, testing and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
480	M.17-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	10	Not Applicable		
481	M.17-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	20	Not Applicable		
482	M.17-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	30	Not Applicable		
483	M.17-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	25	Not Applicable		
484	M.17-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	20	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
485	M.18	Providing, laying, jointing, testing and commissioning of ¼" dia. hard-drawn copper pipe, ASTM B88 Type L, internally chemically cleaned, with brazed fittings (inert gas purged), hangers, supports and all accessories. REF: Technical Specifications Section - 0710, Section - 0720	RFT	20	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
486	M.19	VALVES AND SPECIALTIES Providing, supplying, installing, testing and commissioning of valves and piping specialties of the types and sizes specified below, complete with companion flanges, unions, gaskets, bolts, supports, identification tags, testing and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
487	M.19-1	Gate Valves. REF: Technical Specifications Section - 0710, Section - 0720					
488	M.19-1-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	120	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
489	M.19-1-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	80	Not Applicable		
490	M.19-1-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	5	Not Applicable		
491	M.19-1-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
492	M.19-1-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
493	M.19-1-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
494	M.19-1-7	3" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	4	Not Applicable		
495	M.19-1-8	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	9	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
496	M.19-1-9	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	18	Not Applicable		
497	M.19-2	Balancing Valves. REF: Technical Specifications Section - 0710, Section - 0720					
498	M.19-2-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	60	Not Applicable		
499	M.19-2-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	35	Not Applicable		
500	M.19-2-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
501	M.19-2-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
502	M.19-2-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
503	M.19-2-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		
504	M.19-2-7	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
505	M.19-2-8	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	4	Not Applicable		
506	M.19-3	Y-Strainers. REF: Technical Specifications Section - 0710, Section - 0720					
507	M.19-3-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	60	Not Applicable		
508	M.19-3-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	30	Not Applicable		
509	M.19-3-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
510	M.19-3-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
511	M.19-3-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	3	Not Applicable		
512	M.19-3-6	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		
513	M.19-3-7	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	4	Not Applicable		
514	M.19-4	Flexible Joints. REF: Technical Specifications Section - 0710, Section - 0720					
515	M.19-4-1	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	4	Not Applicable		
516	M.19-4-2	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	16	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
517	M.19-5	Check Valves. REF: Technical Specifications Section - 0710, Section - 0720					
518	M.19-5-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	45	Not Applicable		
519	M.19-5-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	65	Not Applicable		
520	M.19-5-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	5	Not Applicable		
521	M.19-5-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		
522	M.19-5-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	1	Not Applicable		
523	M.19-5-6	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
524	M.19-5-7	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	4	Not Applicable		
525	M.19-6	Ball Valves / Drain Cocks. REF: Technical Specifications Section - 0710, Section - 0720					
526	M.19-6-1	1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	20	Not Applicable		
527	M.19-6-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	15	Not Applicable		
528	M.19-6-3	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	10	Not Applicable		
529	M.19-7	Automatic Air Vents. REF: Technical Specifications Section - 0710, Section - 0720					
530	M.19-7-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	Each	8	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
531	M.20	Providing, supplying, fabricating, installing, testing and commissioning of galvanized steel ductwork, complete with fittings, flanges, flexible connections, volume control dampers, access doors, hangers, supports, sealants, stiffeners, acoustic lining (where specified), leakage testing, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	Sqft	18000	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
532	M.21	Providing, supplying at site, fabrication and installation of welded steel Breaching/Flue Stack for Hot Water Generator, minimum 6mm thick plate conforming to ASTM A36 or A283, complete with structural angle flanges at breaching and HWG connections, flue collar interface, supports, joints, stack termination,ealing, access provisions, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	SFT	800	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
533	M.22	FLEXIBLE ROUND DUCT Providing, supplying and installing insulated flexible round duct, complete with factory-applied vapour barrier, clamps, take-offs, connectors, hangers, supports, sealants and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
534	M.22-1	6" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	100	Not Applicable		
535	M.22-2	8" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	150	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
536	M.22-3	10" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	80	Not Applicable		
537	M.22-4	12" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	20	Not Applicable		
538	M.23	Providing, supplying and installing closed-cell elastomeric thermal insulation for piping, ductwork and equipment, complete with adhesive, vapour barrier sealing, insulation inserts, jackets/protection (where specified), finishing, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	Sqft	12000	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
539	M.24	INSULATION Providing, supplying and installing thermal and acoustic insulation for ductwork, piping and equipment, complete with adhesives, vapour barriers, protective jacketing/cladding, finishing, supports and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
540	M.24-1	1" Glass Fibre Blanket (0.75 lbs/ft³) + 4-Oz Aluminum Canvas Insulation for indoor supply/return air ducts concealed from vision and outdoor air ducts passing through conditioned space. REF: Technical Specifications Section - 0710, Section - 0720	SFT	13500	Not Applicable		
541	M.24-2	1" Glass Fibre Blanket (0.75 lbs/ft³) + 8-Oz Aluminum Canvas Insulation for indoor supply/return air ducts exposed to vision and in plant rooms, including protection. REF: Technical Specifications Section - 0710, Section - 0720	SFT	500	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
542	M.24-3	1.5 lbs/ft³ Fibre-Glass with Neoprene Scrim Acoustic liner on supply air ducts and sheet metal air plenums. REF: Technical Specifications Section - 0710, Section - 0720	SFT	800	Not Applicable		
543	M.24-4	2" Mineral wool (rock wool) blanket, minimum density 6 lb/ft³ with 24-gauge aluminum jacket Insulation for flue stack. REF: Technical Specifications Section - 0710, Section - 0720	SFT	800	Not Applicable		
544	M.24-5	1" Closed-Cell Elastomeric Foam Insulation for indoor chilled/hot water piping, fittings, accessories and valves. REF: Technical Specifications Section - 0710, Section - 0720					
545	M.24-5-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	250	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
546	M.24-5-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	800	Not Applicable		
547	M.24-5-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	950	Not Applicable		
548	M.24-5-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	800	Not Applicable		
549	M.24-5-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	980	Not Applicable		
550	M.24-5-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	50	Not Applicable		
551	M.24-5-7	3" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	1200	Not Applicable		
552	M.24-5-8	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	750	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
553	M.24-5-9	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	750	Not Applicable		
554	M.24-5-10	6" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	250	Not Applicable		
555	M.24-6	1/8" Self-Adhesive Vinyl Aluminum Foam Tape Insulation for cooling coil condensate drain piping, including fittings and accessories. REF: Technical Specifications Section - 0710, Section - 0720					
556	M.24-6-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	380	Not Applicable		
557	M.24-6-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	231	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
558	M.24-6-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	650	Not Applicable		
559	M.24-6-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	RFT	20	Not Applicable		
560	M.24-7	1" Closed-Cell Elastomeric Foam Insulation for Expansion Tank. REF: Technical Specifications Section - 0710, Section - 0720	LOT	1	Not Applicable		
561	M.24-8	1" Closed-Cell Elastomeric Foam Insulation for Air Separator. REF: Technical Specifications Section - 0710, Section - 0720	LOT	1	Not Applicable		
562	M.24-9	1" Removable Closed-Cell Elastomeric Jackets Insulation for Pumps. REF: Technical Specifications Section - 0710, Section - 0720	Each	6	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
563	M.24-10	1" Polyethylene (PE) Foam (0.040 W/m·K) Insulation for Chiller-Heaters. REF: Technical Specifications Section - 0710, Section - 0720	Each	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
564	M.25	Providing, supplying and installing Manual Volume Control Dampers (VCD), complete with galvanized steel frame, opposed-blade damper assembly, locking quadrant with engraved graduated position indicator (0–100% open), operating linkage, bearings, sleeves, fixing hardware, testing, commissioning, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	SFT	150	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
565	M.26	Providing, supplying and installing Fire Dampers (FD), complete with galvanized steel sleeve, retaining angles, fusible link, access door, breakaway duct connection, fixing hardware, testing, commissioning, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	SFT	50	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
566	M.27	Providing, supplying and installing flexible duct connections for vibration isolation, complete with fire-retardant flexible fabric, galvanized steel fixing frames, clamps, fasteners, sealants, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	RFT	76	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
567	M.28	AIR TERMINAL DEVICES (measurement on SFT of neck area) Providing, supplying, installing, testing, adjusting and balancing of aluminium air terminal devices, complete with powder-coated finish, fixing frames, gaskets, opposed-blade dampers (where applicable), fixing hardware and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
568	M.28-1	Supply Air Grille (CODE-I), double deflection type, extruded aluminum construction, complete with opposed blade damper. REF: Technical Specifications Section - 0710, Section - 0720	SFT	680	Not Applicable		
569	M.28-2	Filter Back Return Grille (CODE-J), extruded aluminum construction, complete with hinged filter access door, 1" washable filter, opposed blade damper. REF: Technical Specifications Section - 0710, Section - 0720	SFT	700	Not Applicable		
570	M.28-3	Fresh Air Louvers, extruded aluminium weatherproof drainable type with bird/insect screen and washable filter. REF: Technical Specifications Section - 0710, Section - 0720	SFT	50	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
571	M.29	ELECTRICAL EQUIPMENT AND CONTROLS Providing, supplying, installing, testing, commissioning and performance verification of electrical equipment and controls for the HVAC system, complete in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
572	M.29-1	Motor Control Centres (MCCs) and Auxiliary Control Panels (ACPs), floor/wall-mounted, complete with Form-2 or higher compartmentalized enclosures, ACBs/MCCBs/MCBs, VFDs/soft starters (where specified), contactors, relays, meters, surge protection, control transformer, internal wiring, terminals, earthing, labels, BMS interface and all accessories. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550	Lot	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
573	M.29-2	Complete HVAC electrical installation, excluding MCCs and ACPs, comprising power and control cabling, conduits, cable trays, trunking, junction boxes, isolators, earthing, equipment terminations, control wiring, BMS field wiring, testing, commissioning and all accessories for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720	Lot	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY PUBLIC (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
574	M.30	AUTOMATION AND CONTROLS Providing, supplying, installing, programming, testing, commissioning and performance verification of the HVAC Building Automation System (BAS), complete in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
575	M.30-1	HVAC Building Automation System (BAS) with BACnet/IP protocol-compatible DDC controls, complete with controllers, operator workstation, software, graphics, licences, sensors, actuators, control valves, control dampers, BMS interfaces, networking, point-to-point testing, system integration and all accessories necessary for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	Lot	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
576	M.30-2	Field installation works for the HVAC BAS, including control cabling, conduits, cable trays, junction boxes, field control panels, power supplies, mounting supports, equipment terminations, testing, commissioning and all accessories necessary for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	Lot	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY PUBLIC (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
577	M.30-3	Temperature and pressure instrumentation, comprising thermometers, pressure gauges, thermometer wells, gauge cocks, siphons, isolation valves, fittings, supports, calibration, testing and all accessories necessary for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720	Lot	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
578	M.31	Providing and constructing reinforced concrete foundations, housekeeping pads, equipment supports, inertia bases, vibration isolators, anchor bolts, non-shrink grout, embedded steelwork, making good and all accessories necessary for complete installation of HVAC equipment, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880, Section - 0150	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
579	M.32	Preparation, submission and revision of coordinated shop drawings, coordinated services drawings, and as-built drawings for the complete HVAC installation, Engineer's approvals and record documentation, in accordance with the Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	Job	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
580	M.33	Providing surface preparation, painting, colour coding, tagging and identification of all HVAC equipment, piping and ductwork, complete with direction-of-flow arrows, valve tags, equipment labels, pipe markers and all accessories, in accordance with the approved shop drawings and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
581	M.34	Providing Testing, Adjusting and Balancing (TAB), commissioning and performance verification of the complete HVAC system, including complete system cleaning and flushing, pre-commissioning inspections, functional performance testing, air and water balancing using calibrated instruments, adjustment of control settings, submission of TAB and commissioning reports, demonstration of system performance, attendance during Engineer's inspections, and all incidental works necessary for successful acceptance of the installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	Job	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
582	M.35	Providing comprehensive Operation and Maintenance (O&M) services for the complete HVAC installation for a period of 365 days from the date of Taking-Over by the Employer, measured on a monthly basis, including provision of qualified operating personnel for continuous daytime operation, preventive and corrective maintenance in accordance with OEM recommendations, lubrication, filter replacement, water treatment and chemical dosing, consumables, minor repairs, fault diagnosis and troubleshooting, tools and test instruments, training of the Employer's personnel, maintenance records, daily/weekly/monthly inspection reports, and all incidental works necessary to maintain the system in a safe, efficient and reliable operating condition, in accordance with the approved shop drawings, project design and Technical Specifications.	Months	12	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
583	P	Bill No. 7 - Plumbing & Fire Fighting Works					
584	P.1-1	Providing and fixing best quality white glazed earthenware One Piece Toilet Commode MS-New Avante Wall Hung WC (For Seat & Cover Tc281sj#W) (White) i/c the cost of MS-Dual Push Plate (Square Button) (Silver) , MS-Concealed Tank Half Frame and MS-AP Series - Seat & Cover (Soft Closing Model) complete with and internal fittings etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0360	Nos	22	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
585	P.1-2	Cutting of R.C.C slab via core cutter of suitable diameter by using proper technique and equipment for the crossing of utility pipes and its waterproof refilling with useful materials complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Nos	75	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
586	P.1-3	Providing & fixing best quality earthenware Vanity Basin MS-Square Under Counter (520 X 345 Mm) W/Bracket Tsp0225w (White) and including the cost of ME - Wall Mounted Single Lever Basin Mixer (Chrome) , 1 1/4" rubber plug and chrome plated brass chain pvc waste pipe 1-1/4" dia of approved pattern etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0360	Nos	16	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
587	P.1-4	Providing and fixing kitchen sink with mixer, waste coupling and tee stop cock including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Nos	1	Not Applicable		
588	P.1-5	Providing and fixing chromium plated toilet paper holder including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Nos	22	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
589	P.1-6	Providing and fixing looking glass 5mm thick first quality complete with fixing clamps including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Sft	102	Not Applicable		
590	P.1-7	Providing and fixing of Wall Mounted Shower Set Complete MS-Round Wall Mounted Overhead Shower (220 Mm Dia) (Chrome) i/c the cost of MS-ME - Bath Spout (Chrome) and MS-ME - Concealed Single Lever Bath Mixer (Chrome) etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0360	Nos	18	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
591	P.1-8	Providing and fixing soap dish including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Nos	14	Not Applicable		
592	P.1-9	Providing and fixing towel rod including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Nos	14	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
593	P.1-10	Providing and fixing tap 3/4 inch dia including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	Nos	8	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
594	P.2-1	Providing, fixing, jointing and testing Polypropylene Random (PPR) PN20 pressure pipe for cold, hot and hot water return water as per DIN 8077-8078 for pipes and DIN 16962,PN25 for fittings (polyfusion welded joints) inside building including fittings and specials (sockets, tees, elbows, bends, crosses, reducers, adaptor, plugs and union etc.) supported on walls or suspended from roof slab or run in chases including pipe hangers, supports, walls cutting for pipelines, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360, Section - 0480					
595	P.2-1-1	25 mm dia. REF: Technical Specifications Section - 0360	Rft.	1020	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
596	P.2-1-2	32 mm dia. REF: Technical Specifications Section - 0360	Rft.	750	Not Applicable		
597	P.2-1-3	40 mm dia. REF: Technical Specifications Section - 0360	Rft.	285	Not Applicable		
598	P.2-1-4	50 mm dia. REF: Technical Specifications Section - 0360	Rft.	320	Not Applicable		
599	P.2-1-5	75 mm dia. REF: Technical Specifications Section - 0360	Rft.	365	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
600	P.2-2	Providing, fixing, jointing and testing medium gauge G.I pipes including fittings and specials (sockets, tees, elbows, bends, crosses, reducers, adaptor, plugs and union etc.) supported on walls or suspended from roof slab or run in chases including pipe clamps, pipe hangers, supports, walls cutting and core cutter for cutting of concrete slab with sealing and waterproofing with epoxy grouting for pipelines, thermal insulation with glasswool insulation 65kg/ m^3 density thickness 19 mm, GI 26 gauge cladding, complete in all respects. REF: Technical Specifications Section - 0360, Section - 0480					
601	P.2-2-1	2 inch dia. REF: Technical Specifications Section - 0360	Rft.	80	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
602	P.2-2-2	2-1/2 inch dia. REF: Technical Specifications Section - 0360	Rft.	50	Not Applicable		
603	P.2-3	Providing and installing gate/ball valves of following nominal dia, of approved make ,including jointing ,fitting, painting, testing, complete in all respects to match with following G.I pipe diameters. REF: Technical Specifications Section - 0440, Section - 0480					
604	P.2-3-1	2 inch dia. REF: Technical Specifications Section - 0360	Nos.	4	Not Applicable		
605	P.2-3-2	2-1/2 inch dia. REF: Technical Specifications Section - 0360	Nos.	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
606	P.3-1	Providing, fixing, jointing and testing uPVC Class-B pipe including all fittings such as tees, bends and reducers. Also it includes the cost of joint solutions & clamping to walls, ceiling hangers, supports, cutting through walls for pipelines and pipe fittings of the following diameters, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0430, Section - 0480-0360					
607	P.3-1-1	2" dia. REF: Technical Specifications Section - 0360	Rft.	152	Not Applicable		
608	P.3-1-2	4" dia. REF: Technical Specifications Section - 0360	Rft.	1450	Not Applicable		
609	P.3-1-3	6" dia. REF: Technical Specifications Section - 0360	Rft.	520	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
610	P.3-1-4	8" dia. REF: Technical Specifications Section - 0360	Rft.	823	Not Applicable		
611	P.3-2	Providing and fixing 4" dia Floor Drain with P-trap including Stainless Steel grating and cover of approved make including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360					
612	P.3-2-1	P-Trap. REF: Technical Specifications Section - 0360	Nos.	53	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
613	P.4-1	Providing, placing sleeves and puddle flange in R.C.C. underground water tank walls, pipe connection (G.I) with inlet / outlet pipe work, manhole covers, floating ball valve etc, including all necessary accessories required for sleeves placing, complete in all respects. REF: Technical Specifications Section - 0450, Section - 0150, Section - 0145, Section - 0460, Section - 0440	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
614	P.4-2	Providing, placing sleeves and puddle flange in R.C.C. overhead water tank walls, pipe connection (G.I) with inlet / outlet pipe work, manhole covers, floating ball valve etc, including all necessary accessories required for sleeves placing, complete in all respects. REF: Technical Specifications Section - 0450, Section - 0150, Section - 0145, Section - 0460, Section - 0440- 0360	Job	2	Not Applicable		
615	P.4-3	Providing, installing, testing and commission electric geyser of approved make, complete with inlet, outlet, safety valves complete in all respects. REF: Technical Specifications Section - 0440, Section - 0480					
616	P.4-3-1	30 Litres. REF: Technical Specifications Section - 0360	Nos.	8	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
617	P.5-1	Providing, installing, testing and commission, centrifugal pumps of make KSB, Grundfos or approved equivalent of capacity 100 gpm each with stainless steel impeller capable of pumping against a total pumping head of 120 ft approx. 5 HP. coupled with water cooled electric motor of 440 volts, 3 - phase, 50 Hz. The pump shall be provided with control panel having auto / manual switches, dry running protection, low / high level water controls with alternative standby duty operation system, complete in all respects. REF: Technical Specifications Section - 0470, Section - 0480	Nos	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
618	P.5-2	Supply and install Tube Well Bore Pump complete with the pump and motor cut-out switches for control panel enclosure, valves, water hammer arrestors and all accessories ready for operation.WTP 01 A/01B : Each 0.5 Cusec ,Head 300 feet approx. 17 HP. as per the Drawings, Specifications and Standards. REF: Technical Specifications Section - 0440, Section - 0470	Nos	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
619	P.5-3	Providing, Installing, test and commission non-clogging, centrifugal submersible drainage sump pump 50 gpm against a total pumping head of 25 ft (one running one standby). coupled with water cooled IP Class 68 electric motor of 400 volts, 3 - phase, 50 Hz. of approved make with auto / manual switches, dry running protection, low / high level water controls with alternative standby duty operation system), complete in all respects. REF: Technical Specifications Section - 0470	Set	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
620	P.6-1	Providing and fixing Mild Steel Schedule 40 Seamless Pipes including all fittings such as tees, bends and reducers with cost of Painting, clamping to walls and ceiling hangers, supports, cutting through walls and concrete in slabs with core cutter for pipelines and pipe fittings of the following diameters complete in all respect. REF: Technical Specifications Section - 0360					
621	P.6-1-1	1" dia (25mm) REF: Technical Specifications Section - 0360	Rft.	4100	Not Applicable		
622	P.6-1-1	1-1/2" dia (40mm) REF: Technical Specifications Section - 0360	Rft.	1810	Not Applicable		
623	P.6-1-1	2" dia (50mm) REF: Technical Specifications Section - 0360	Rft.	620	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY PPRA EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
624	P.6-1-1	2-1/2" dia (63mm) REF: Technical Specifications Section - 0360	Rft.	1415	Not Applicable		
625	P.6-1-1	3" dia (75mm) REF: Technical Specifications Section - 0360	Rft.	535	Not Applicable		
626	P.6-1-1	4" dia (100mm) REF: Technical Specifications Section - 0360	Rft.	920	Not Applicable		
627	P.6-1-1	6" dia (150mm) REF: Technical Specifications Section - 0360	Rft.	275	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
628	P.6-2	Excavation in all kind of soils at any depth i/c all lead & lift, necessary protection/shoring/ stability to excavated areas/sides, dewatering and keeping the area to dry,all operations & arrangements in connection with earth works to complete confirming to the requirements of drawings, specifications and instructions by the Engineer In Charge. REF: Technical Specifications Section - 0360- 0400	Cft	22500	Not Applicable		
629	P.6-3	Sand Filling: Providing, laying, compacting and curing sand, compaction, complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0360	Cft	7500	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
630	P.6-4	Providing, transportation, laying, cutting, butt fusion jointing, testing, commissioning & disinfecting the Polyethylene Pipe (PE-100), PN 16, of SDR 11 of any of the manufacturer DADEX and BETA or approved equivalent including fixing all type of fittings and special such as tee, bend,cross collar, reducer, tail piece, flanged spigot,end cap, flanged socket, taper, angle branch, plug etc complete in all respects (Including Injection moulded fittings) as recommended by the manufacturer. REF: Technical Specifications Section - 0400, Section - 0480					
631	P.6-4-1	6" dia (150mm) REF: Technical Specifications Section - 0360	Rft.	3000	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
632	P.6-5	Providing and installing gate/ball valves of following nominal dia, of approved make, including jointing, fitting, painting, testing, complete in all respects to match with following pipe dia meters. REF: Technical Specifications Section - 0440, Section - 0480					
633	P.6-5-1	2-1/2" dia (63mm) REF: Technical Specifications Section - 0360	Nos.	8	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
634	P.6-6	Providing, Installing and testing (sprinklers) (K 5.6) including jointing, fitting, testing, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480					
635	P.6-6-1	Ceiling type (Concealed) REF: Technical Specifications Section - 0360	Nos.	325	Not Applicable		
636	P.6-6-2	Upright. REF: Technical Specifications Section - 0360	Nos.	80	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
637	P.6-7	Providing, Installing, testing and commissioning fire hose cabinet Single door, complete mild steel front door. UPPER COMPARTMENT Fire hose reel, 1'' X 30 Mtr. cabinet mounted, swinging manual type with nozzle & valve. LOWER COMPARTMENT 2-1/2'' x 30 Mtr. fire hose synthetic single jacket with quick coupling, 2-1/2'' oblique landing valve, with jet & spray Nozzle including Co2 fire extinguisher, portable pressure type 6kg dry powder type fire extinguisher where indicated on drawings including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480	Nos.	8	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
638	P.6-8	HOSE REEL CABINET(External): Providing, Installing, testing and commissioning fire hose cabinet Single door, complete mild steel front door. Fire hose reel, 1'' X 30 Mtr. cabinet mounted, swinging manual type with nozzle & valve. where indicated on drawings including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480	Nos.	28	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
639	P.6-9	Providing, Installing, testing and commissioning Pillar type fire hydrants with external fire hose cabinet with inlet flange 4" size with double deliveries 2 1/2" female instantaneous coupling with blank cap and chain, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360, Section - 0380, Section - 0420, Section - 0480	Nos.	28	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
640	P.6-10	Providing, Installing, testing and commissioning Pillar type fire hydrants with external fire hose cabinet with inlet flange 4" size with double deliveries 2 1/2" female instantaneous coupling with blank cap and chain, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480	Nos.	2	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
641	P.6-11	Providing, Installing, testing and commissioning fire fighting zone check assembly & drain test point consisting of Alarm valve, Gate valve, Flow switch, etc complete, at suitable locations as required by NFPA codes for Fire fighting sprinkler - wet pipe system including fire alarm panel, jointing, fitting, testing, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480-0360					
642	P.6-11-1	4" dia (100 mm) REF: Technical Specifications Section - 0360	Nos.	5	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
643	P.6-12	FM-200 System: Design, Supply, installation, testing & commissioning of FM-200 system of specified spaces mentioned on drawings. REF: Technical Specifications Section - 0700, Section - 0480	Job	1	[Up to 80% Allowed]		
644	P.6-13-1	Dry Chemical Powder Fire Extinguisher: Portable, Stored Pressure Type Highly Effective on A, B, C & E Class of Fire, Capacity : 06 Kg Fire Rating : 34A 183B Working Pressure : 14 Bar Tested at Pressure : 30 Bar. REF: Technical Specifications Section - 0380	Nos.	24	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
645	P.6-13-2	CO2 Fire Extinguisher Capacity 5Kg Extinguishing Agent CO2 Operating Temperature -20 to +60 °C Max Allowable Pressure 174 bar Test Pressure 250 bar. REF: Technical Specifications Section - 0380	Nos.	24	Not Applicable		
646	P.6-13-3	ABC Powder Ceiling Mounted Capacity 6Kg Operating Temperature -30 °C to +60 °C Operating Pressure 15 Bar Cylinder Testing Pressure 35 bar for 30 sec. REF: Technical Specifications Section - 0480	Nos.	3	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
647	P.7-1	Providing, Fixing ,testing & installing pump set for fire fighting of following capacities. (Pump must be UL Listed & FM approved) a) Horizontal centrifugal pump set (50Hz x 380V, 3 phase Motor) 750 GPM @ 10 bar complete with automatic control panel , Pressure switch & Pressure gauge. It should be capable of operating 1 remotest 21/2" hydrants 250 GPM @ min. 6.9 bar pressure. b) Horizontal centrifugal engine driven pumpset 500 GPM @ 10 bar complete with automatic control panel , Pressure switch, Pressure gauge & diesel tank. It should be capable of operating 1 remotest 21/2" hydrants 250 GPM @ min. 6.9 bar pressure. c) Jockey electric motor driven pumpset (50Hz x 380 V ,3Ph Motor) 40 GPM @ 10.5 bar complete with automatic control panel, pressure switch and pressure gauge. d) Pump control cabinet	Set	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
648	T	Bill No. 8 - ATC Equipment					
649	T-1	Provision, installation, Testing & Commissioning of VHF/AM Air Band Multimode Transceiver, frequency range 118–137 MHz, capable of AM voice, ACARS (AM-MSK), and VDL Mode 2 (D8PSK) with lifetime license Features: dual Ethernet ports for VoIP (ED-137 compliant), SNMP remote control, front-panel display, programmable output power up to 50 W, main/standby ready. Including all necessary accessories (power supply, antenna change over relay , RF lightning protector standard 19 inch rack mounting hardware , etc.). Complete in all respect. REF: Technical Specifications Section - 0740	Job	14	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
650	T-2	Provision, installation, Testing & Commissioning of UHF/AM Air Band Digital Transceiver, frequency range 225–400 MHz, output power 50W, with Ethernet connectivity for VoIP (ED-137), SNMP remote control, front-panel display, main/standby ready. Includes all accessories for standard 19 inch rack. Complete in all respect as per Technical Specification CNS-01. REF: Technical Specifications Section - 0740	Job	3	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
651	T-3	Provision, installation, Testing & Commissioning of VHF (AM) Band Pass Dual Cavity Combiner, 2-channel, for combining four VHF transceivers to a single antenna, frequency range 118–137 MHz, 4HU rack-mountable, with front panel. Complete in all respect. REF: Technical Specifications Section - 0740	Job	6	[Up to 80% Allowed]		
652	T-4	Provision, installation, Testing & Commissioning of UHF Dual Cavity Bandpass Filter/Combiner, frequency range 225–400 MHz, 4HU rack-mountable, Complete in all respect. REF: Technical Specifications Section - 0740	Job	2	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
653	T-5	Provision, installation, Testing & Commissioning of VHF Omnidirectional Antenna, dipole, frequency range 118–137 MHz, with appropriate RF connector, suitable for aviation ground station use. Complete in all respect. REF: Technical Specifications Section - 0740	Job	8	[Up to 80% Allowed]		
654	T-6	Provision, installation, Testing & Commissioning of UHF Omnidirectional Antenna, dipole type, frequency range 225–400 MHz, with appropriate RF connector, suitable for aviation ground station use complete in all respect. REF: Technical Specifications Section - 0740	Job	3	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
655	T-7	Provision, installation, Testing & Commissioning of VHF AM 10 watts Vehicle Mounted TX/RX frequency range 118–137 MHz, capable of AM voice 12V DC and (adaptable for vehicles), VoIP complete in all respect. REF: Technical Specifications Section - 0740	Job	5	[Up to 80% Allowed]		
656	T-8	Provision, installation, Testing & Commissioning of VHF AM HANDHELD Walkie Talkie Frequency Range 118 – 137 MHz (aeronautical band) Battery Built in long life rechargeable battery pack (Li ion) REF: Technical Specifications Section - 0740	Job	6	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
657	T-9	Provision, installation, Testing & Commissioning of VHF FM HANDHELD DIGITAL WALKIE TALKIE Frequency Range 146 – 174 MHz (VHF FM) Output Power ≥5 W (adjustable high/low) Battery Built in long life rechargeable battery pack (Li ion) REF: Technical Specifications Section - 0740	Job	10	[Up to 80% Allowed]		
658	T-10	Provision, installation, Testing & Commissioning of HF Transceiver, output power 1 kW, with broadband antenna system covering HF aviation bands, suitable for long-range communication. Complete in all respect. REF: Technical Specifications Section - 0740	Job	2	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
659	T-11	Provision, installation, Testing & Commissioning of HF Transceiver 125 watts , covering HF aviation bands, with broad antenna, for monitoring and replacement in case of main transceiver failure . Complete in all respect. REF: Technical Specifications Section - 0740	Job	3	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
660	T-12	Provision, installation, Testing & Commissioning of Radio Remote Controller System, standalone configuration, comprising: touch-screen display unit, microphone interface with desktop speaker, headset with aviation connector, foot pedal for PTT, monitor arm or desktop mount. The controller shall support ED-137 VoIP, dual LAN redundancy, and be capable of controlling multiple radios , telephone lines and hotlines (Analogue/Digital) Complete in all respect. REF: Technical Specifications Section - 0740	Job	8	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
661	T-13	Provision, installation, Testing & Commissioning of Automatic Low Voltage Control 100 to 230 VAC for (a.) ATC Tower (b.) ECR (c.) OCC Room with at least specification Input Voltage Range: 100-260 VAC Output Voltage 210- 230 VAC or Customized . 50Hz Pure sine wave, Power Factor 90% , Accuracy. +/- 1% Voltage control (this will be read with other applicable technical specifications. REF: Technical Specifications Section - 0740	Job	3	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
662	T-14	Provision, installation, Testing & Commissioning of Earthing / Grounding System including earthing pits for CNS Equipment and other sensitive ICT equipment. Complete in all respect as per Technical Specifications CNS-01. REF: Technical Specifications Section - 0740	Job	1	Not Applicable		
663	T-15	Provision, installation, Testing & Commissioning of AMHS Terminal / Desktop PC along with Compatible Dot Matrix Printer (LQ-310) for AHMS Terminal with redundant lines through PTCL Fiber, Satellite. Complete in all respect. REF: Technical Specifications Section - 0740	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
664	T-16	Provision, installation, Testing & Commissioning of Managed Layer 2/3 Ethernet Switch, 48x Gigabit ports, 4x SFP uplink ports, with redundancy features (e.g., dual power supply optional), suitable for rack mounting. Complete in all respect. REF: Technical Specifications Section - 0740	Job	3	Not Applicable		
665	T-17	Provision, installation, Testing & Commissioning of Handheld Capsule Type microphone with bracket. Complete in all respect suitable for aviation RRCU use as per Technical Specifications. REF: Technical Specifications Section - 0740	Job	10	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
666	T-18	Provision, installation, Testing & Commissioning of Gooseneck microphone with suitable connector for RRCU. Complete in all respect as per Technical Specification. REF: Technical Specifications Section - 0740	Job	8	Not Applicable		
667	T-19	Provision, installation, Testing & Commissioning of Aviation headset with noise-canceling microphone and appropriate connector for RRCU & Complete in all respect suitable for aviation use as per Technical Specifications. REF: Technical Specifications Section - 0740	Job	8	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
668	T-20	Provision, installation, Testing & Commissioning of Remote Control and Monitoring System (RCMS) software suite for VHF, UHF, HF radios and DVLS network management, including server software, operator client licenses Qty.04, lifetime device licenses for up to 50 radios , SNMP-based monitoring, alarm management, and reporting. Includes dedicated workstation and laptop (minimum: Intel Core i7 13th Gen. or equivalent, 16GB RAM, 1TB SSD, Windows 11 Pro) for administration. Complete in all respect. REF: Technical Specifications Section - 0740	Job	1	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
669	T-21	Provision, installation, Testing & Commissioning of Low-loss foam dielectric coaxial cable, 50 Ω impedance, ½ inch diameter, suitable for RF feeder runs. Complete in all respect for all systems to be connected and as per Technical Specification. REF: Technical Specifications Section - 0740	meter	1200	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
670	T-22	Provision, installation, Testing & Commissioning of Digital Voice Logging System (DVLS) with capacity for recording at least 48 channels (analog and VoIP). Dual redundant recording servers operating in parallel (no single point of failure), RAID storage for minimum 31 days recording, synchronized replay capability, NTP synchronization, web-based replay client, and all necessary software and accessories. Shall support ED-137, RTP, SIP, and analog audio inputs. Complete in all respect as per Technical Specification CNS-01. REF: Technical Specifications Section - 0740	Job	1	[Up to 80% Allowed]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
671	T-23	Provision, installation, Testing & Commissioning of DC power supply system with integrated monitoring and charging, using lithium battery bank providing minimum 2 hours backup at full load. Includes rectifiers, distribution, and battery management. Complete in all respect. REF: Technical Specifications Section - 0740	Job	1	Not Applicable		
672	T-24	Provision, installation, Testing & Commissioning of Double conversion online uninterruptible power supply (UPS), capacity suitable for the intended load, with maintenance bypass and battery backup for minimum 60 minutes (or as per site requirement). Complete in all respect. REF: Technical Specifications Section - 0740	Job	3	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
673	T-25	Provision, installation, Testing & Commissioning of Air Traffic Control console furniture for six (6) working positions, ergonomic design, including monitor mounts, keyboard trays, space for remote controllers, and cable management. Materials durable and anti-static. Complete in all respect. REF: Technical Specifications Section - 0740	Job	6	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
674	T-26	Provision, installation, Testing & Commissioning of Automated Weather Observing System (AWOS) for a single runway, meeting ICAO CAT I precision approach requirements. Includes central data unit; sensors for wind speed/direction (ultrasonic or mechanical), barometric pressure (redundant), temperature/humidity, cloud height (ceilometer), visibility/runway visual range (RVR), present weather detector, lightning detector; and appropriate communication interfaces. System shall generate METAR and other aviation reports, and integrate with ATC systems. Includes all accessories, cabling, and mounting hardware. Complete in all respect. REF: Technical Specifications Section - 0740	Job	1	[Up to 80% Allowed]		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
675	T-27	Provision, installation, Testing & Commissioning of Desktop Computers (All-In-One) minimum: Intel Core i7 13th Gen. or equivalent, 16GB RAM, 1TB SSD, Windows 11 Pro), and 24 Inch Screen. Complete in all respect. REF: Technical Specifications Section - 0740	Job	3	Not Applicable		
676	T-28	Provision, installation, Testing & Commissioning of FM repeater system for coordination of all area of airport .Complete in all respect. REF: Technical Specifications Section - 0740	Job	1	Not Applicable		
677	T-29	Provision, installation, Testing & Commissioning of ATC Support equipment Complete in all respect as per Technical Specification Section 0740 (SUB-DIVISION 15.2) REF: Technical Specifications Section - 0740	Lot	1	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
678	T-30	Supply, Laying, testing and commissioning of Fiber Cable complete in all respect as per Engineers Instruction. REF: Technical Specifications Section - 0650	meter	1200	Not Applicable		
679	T-31	Trenching work, including excavation, sand bedding, supply and placement of protection tiles, placement of warning tape, backfilling and compaction complete in all respect as per instruction of Engineer. REF: Technical Specifications Section - 0740	Cum	800	Not Applicable		
680	T-32	Dismantling & re-installation, testing and commissioning of ALCMS in ATCT complete in all respect as per instruction of Engineer. REF: Technical Specifications Section - 0070	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
681	T-33	Airfield lighting Control & Monitoring System Relocation Shifting touchscreen, controller, and communication links (fiber/copper).ALCMS Project relocation Programme and ensuring System Transition Support to minimize downtime., complete in all respects. Note:- Above mentioned system should be complete in all respect for proper functioning including cost of items mentioned or not. REF: Technical Specifications Section - 0740, Section - 0770	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
682	T-34	Providing, installing, testing and commissioning of Airport Crash Warning System (Crash Horn/Crash Bell Hooter), comprising electronic hooters, central control panel, interface with Air Traffic Control (ATC) console, remote/manual activation stations, control and power cabling, conduits, accessories, terminations, integration, testing, commissioning and all associated works, complete in all respects in accordance with the Drawings and Technical Specifications Section 0910. REF: Technical Specifications Section - 0910	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
683	T-35	Providing, installing, testing and commissioning of Aeronautical Beacon, including beacon assembly, mounting structure/supports, obstruction lighting interface (where applicable), power and control cabling, conduits, accessories, earthing, terminations, testing, commissioning and all associated works, complete in all respects in accordance with the Drawings and Technical Specifications Section 0900. REF: Technical Specifications Section - 0900	Job	1	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
684	T-36	FACTORY ACCEPTANCE TEST (FAT):FAT for (03) three PAA officials for (05) five working days at OEM factory (Including Return ticket, Visa fees, insurance, local transport, accommodation & DSA) REF: Technical Specifications Section - 0740, Section - 0010	Lot	3	Not Applicable		
685	T-37	FACTORY TRAINING:Factory Training for (05) five PAA technical Personnel / Engineers for (10) ten working days at OEM factory (including return ticket, visa fees, local transport, accommodation & DSA) REF: Technical Specifications Section - 0740, Section - 0010	Lot	4	Not Applicable		
686	D1	Day Works Schedule - SH: Labour					
687	D101	Project Manager	Day	10	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
688	D102	Site Engineer	Day	10	Not Applicable		
689	D103	Surveyor	Day	30	Not Applicable		
690	D104	Foreman / General Foreman	Day	30	Not Applicable		
691	D105	Charge Hand / Supervisor	Day	30	Not Applicable		
692	D106	Skilled Mason	Day	50	Not Applicable		
693	D107	Carpenter	Day	20	Not Applicable		
694	D108	Steel Fixer	Day	50	Not Applicable		
695	D109	Electrician	Day	30	Not Applicable		
696	D110	Plumber	Day	20	Not Applicable		
697	D111	HVAC Technician	Day	20	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
698	D112	Welder	Day	40	Not Applicable		
699	D113	Painter	Day	10	Not Applicable		
700	D114	Tile Setter	Day	20	Not Applicable		
701	D115	Machine Operator	Day	10	Not Applicable		
702	D116	Driver	Day	40	Not Applicable		
703	D117	Skilled Labour	Day	50	Not Applicable		
704	D118	Semi-Skilled Labour	Day	50	Not Applicable		
705	D119	Unskilled Labour	Day	100	Not Applicable		
706	D120	Watchman / Security Guard	Day	100	Not Applicable		
707	D121	Cleaner / Helper	Day	100	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
708	D2	Day Works Schedule - SH: Material					
709	D201	Ordinary Portland Cement (OPC), Type-I, 50 kg bag, ASTM C150 or equivalent	bag	100	Not Applicable		
710	D202	Coarse Sand (River/Pit), Zone-II grading, free from silt & organic matter	m3	50	Not Applicable		
711	D203	Coarse Aggregate, crushed stone, 3/4" (20mm) nominal size	m3	50	Not Applicable		
712	D204	Deformed Reinforcement Steel Bars, Grade 60 (Fy = 60,000 psi), assorted dia. 10mm-25mm	kg	1000	Not Applicable		
713	D205	Structural Steel Sections (I-Beam / Channel / Angle), Grade A36 or equivalent, assorted sizes	kg	1000	Not Applicable		
714	D206	Solid Concrete Blocks, 150mm x 200mm x 400mm (6"x8"x16"), min. compressive strength 1,500 psi	no.	500	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
715	D207	Burnt Clay Bricks (1st Class), standard size 230mm x 115mm x 75mm (9"x4.5"x3"), min. crushing strength 1,500 psi	no.	500	Not Applicable		
716	D208	Shuttering Plywood, 18mm thick, 1220mm x 2440mm (4'x8') sheet, film-faced	sheet	50	Not Applicable		
717	D209	Timber (Deodar/Kail), sawn, assorted sections, for formwork/scaffolding	cft	100	Not Applicable		
718	D210	Binding Wire, GI, 16 SWG	kg	50	Not Applicable		
719	D211	PVC Conduit Pipe, 3/4" (20mm) dia, heavy gauge, for electrical wiring	rft	500	Not Applicable		
720	D212	Copper Conductor Cable, PVC insulated, single core, assorted sizes 2.5mm2	rft	1000	Not Applicable		
721	D213	uPVC Water Supply Pipe, Class-C / Schedule-40, dia 1", threaded/solvent-weld	rft	300	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
722	D214	uPVC Sewerage Pipe, dia 4", solvent-weld joint	rft	300	Not Applicable		
723	D215	Waterproofing Membrane, APP/SBS modified bitumen, 3mm thick, torch-applied	m2	200	Not Applicable		
724	D216	Ceramic / Vitrified Floor Tiles, 600mm x 600mm, Grade-A, matt/glossy finish	m2	200	Not Applicable		
725	D217	Weather-shield Emulsion Paint, exterior grade	ltr	200	Not Applicable		
726	D218	Welding Electrodes, E6013/E7018, 3.15mm dia	kg	50	Not Applicable		
727	D219	Nails, Screws & Assorted Fasteners, GI/MS, various sizes 1"-4"	kg	20	Not Applicable		
728	D220	Non-Shrink Cementitious Grout, high strength (min. 50 MPa @ 28 days), pre-mixed	kg	100	Not Applicable		
729	D221	Silicone Sealant, weatherproof grade, 300ml cartridge	no.	50	Not Applicable		

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
730	D3	Day Works Schedule - SH: Equipment					
731	D301	Concrete Mixer, drum type, 10/7 cft capacity, diesel/electric driven	Hour	100	Not Applicable		
732	D302	Concrete Vibrator, needle type, 40mm-60mm poker dia, petrol/electric driven	Hour	100	Not Applicable		
733	D303	Diesel Generator Set, 125 kVA, silent/canopied type, with ATS panel	Hour	200	Not Applicable		
734	D304	Diesel Generator Set, 30 kVA, silent/canopied type	Hour	100	Not Applicable		
735	D305	Excavator / Backhoe Loader, bucket capacity 0.9-1.2 m3, engine power 90-100 HP	Hour	100	Not Applicable		
736	D306	Wheel Loader, bucket capacity 1.5-2.0 m3, engine power 120-150 HP	Hour	50	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY PPRA EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
737	D307	Dump Truck, 10-wheeler, payload capacity 12-16 tons (8-10 m3)	Hour	100	Not Applicable		
738	D308	Water Bowser / Tanker, capacity 5,000-6,000 litres, truck-mounted	Hour	80	Not Applicable		
739	D309	Mobile Crane, hydraulic, telescopic boom, 25-ton lifting capacity	Hour	60	Not Applicable		
740	D310	Tower Crane, max. lifting capacity 6-8 tons, jib length 40-50m	Hour	100	Not Applicable		
741	D311	Man / Material Hoist, single cage, capacity 1,000-1,200 kg	Hour	100	Not Applicable		
742	D312	Plate Compactor, plate size approx. 500mm x 400mm, centrifugal force 15-20 kN	Hour	50	Not Applicable		
743	D313	Road Roller (vibratory), single drum, 8-10 ton static weight	Hour	40	Not Applicable		

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Sr. No	ItemNo	Description	Unit	Quantity	Rate	Rate (Rs)	Amount
744	D314	Welding Machine, arc/MIG type, 300-400 amp, diesel/electric driven	Hour	80	Not Applicable		
745	D315	Air Compressor, diesel/electric driven, capacity 150-185 CFM	Hour	60	Not Applicable		
746	D316	Concrete Pump, boom/trailer mounted, output capacity 30-40 m3/hr	Hour	40	Not Applicable		
747	D317	Concrete Batching Plant, capacity 30-40 m3/hr, with weigh-batcher	Hour	40	Not Applicable		
748	D318	Total Station (electronic), with operator, accuracy +/-(2mm + 2ppm)	Hour	40	Not Applicable		
749	D319	Mobile Lighting Tower, 4 x 1000W metal halide, telescopic mast, diesel-genset mounted	Hour	60	Not Applicable		
750				Total Amount (Rs)			4968705767
						GRAND TOTAL:	Rs4,968,705,767.00

Scope of Work

Scope of Works:

The Works shall consist of the components as listed but not limited to following:

- *Construction of a new Air Traffic Control Tower (ATCT) (approx. 80 ft high) with integrated MEP, HVAC, and ICT systems.*
- *Construction of an ICAO Category-7 compliant Airport Rescue and Firefighting (ARFF) Station, including vehicle bays, control rooms, dormitories, and service areas.*
- *Construction of access roads, utility corridors, and a dedicated 7.5m wide carriageway to ensure ARFF response within 3 minutes (approx. 2 km).*
- *Installation of Communication, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) systems and an Automated Weather Observing System (AWOS).*
- *Development of support infrastructure including underground water storage tanks (60,000 IG), power supply with backup generators, sewerage systems, stormwater drainage and Solar PV system.*
- *Removal of visual obstructions (sand dunes) to ensure unobstructed line of sight from the ATC Tower.*

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Price Schedule

For Individual Jobs

#	Job Title	Quantity	Unit Price (PKR)	Total Price (PKR)	Delivery Location	Delivery Period / Year	Country of Origin
1							
2							

For Lots

#	Lot Title	Total Lot Price (PKR)	Country of Origin
1	[Lot 1 Title]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

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(PPRA)
EPADS

General Conditions of Contract

Red Book:
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The Conditions of Contract are the “General Conditions” which form part of the “Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer (“Red book”) Second edition 2017” published by the Federation Internationale Des Ingenieurs – Conseils (FIDIC) and the following “Particular Conditions” which shall complement the General Conditions of the Contract.

The successful Bidder, upon contract award, shall be required to furnish two (02) copies of aforementioned “General Conditions” for incorporation in the Works Contract.

International Federation of Consulting Engineers (FIDIC) FIDIC
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Telephone: **+41 22 568 0500**
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Website: www.fidic.org
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PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Special Conditions of Contract

PARTICULAR CONDITIONS OF CONTRACT (PCC)

Particular Conditions
(Mandatory Provisions not to be amended/substituted)

The Particular Conditions (PCC) complement the General Conditions (GCC) to specify dates, contractual requirements, and special circumstances related to the Works. The PCC consists of two parts, Part A - Contract Data and Part B - Special Provisions. The provisions to be found in the Special Provisions (Particular Conditions - Part B) take precedence over the equivalent provisions found under the same Sub-Clause number(s) in the General Conditions, and the provisions of the Contract Data (Particular Conditions - Part A) take precedence over the Special Provisions (Particular Conditions - Part B).

PART A - Contract Data

Sub-Clause 1.1.27
Defects Notification Period (DNP): **365** Days

Sub-Clause 1.1.31
Employer's name & address: **Pakistan Airports Authority (Planning & Development Directorate), Director Planning & Development P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi**

Sub-Clause 1.1.35
Engineer's name & address: To be Nominated later

To be Nominated later

Sub-Clause 1.1.84
Time for Completion: **730** days for whole of the works

Sub-Clause 1.3 (a)(ii)
Agreed method of electronic transmission: Agreed
The Electronic Transmission Methods are director.pdev@paa.gov.pk contmgntbranch@gmail.com

Sub-Clause 1.3 (d)
Address of Empoyer for Communications: **P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi**
Address of Engineer for Communications:

To be Nominated later

Address of Contractor for Communications: ----------

Sub-Clause 1.4
Contract shall be governed by the law of: **Islamic Republic of Pakistan**
Ruling language: **English**
Language for communications: **English**

Sub-Clause 2.1
After receiving the Letter of Acceptance, the Contractor shall be given right of access to all or part of the Site within: **3** days after Commencement Date

Sub-Clause 2.4
Employer's financial arrangements:

Employer's Own Funds

Sub-Clause 3.2 (e)(ii)
Engineer's Duties and Authority: **Variation resulting in an increase of the Accepted Contract Amount in excess ofone percent (1%)subject to accumulative Variations not exceeding five percent (5%)of the Accepted Contract Amount**

Sub-Clause 4.2
Performance Security (as percentage of the Accepted Contract Amount in Currencies): 10.00%
Form of Performance Guarantee: **Bank Guarantee**

Sub-Clause 4.2.1
List of Insurance Companies:

-

Sub-Clause 4.7.2
period for notification of errors in the items of reference: **Twenty Eight (28) days**

Sub-Clause 4.19
Period of payment for temporary utilities: **Each Month**

Sub-Clause 5.1 (a)
Maximum allowable accumulated value of work subcontracted (as a percentage of the Accepted Contract Amount): **30** %

Sub-Clause 5.1 (b)
Parts of the Works for which subcontracting is not permitted: 100

Subcontracting of Civil Works is not permitted, except for incidental civil works associated with the installation of equipment, for which subcontracting shall be allowed.

Sub-Clause 6.5
Normal working hours on the Site: **9**

Sub-Clause 8.3
Number of additional paper copies of programmes: **3**

Sub-Clause 8.8 & 14.15(b)
Delay Damages payable for each day of delay **0.05**% of the Accepted Contract Amountfor delay in completion of whole of the Works

Sub-Clause 8.8
Maximum amount of Delay Damages **10.00 %** of the Accepted Contract Amount

Sub-Clause 8.14
Applicability of Incentives for Early Completion **No**

Sub-Clause 12.3
Percentage profit (Not more than 10%): **Nil**

Sub-Clause 13.4.(b)(ii)
Percentage rate to be applied to Provisional Sums for overhead charges and profit: **Twenty Five percent (25%)**

Sub-Clause 14.2
Total Advance Payment: **Fifteen percent (15%) of the Accepted Contract Amount excluding Provisional Sums payable in the currencies and proportions in which the Accepted Contract Amount is payable**

Sub-Clause 14.2.1
Advance Payment Insurance **Allowed**

Mobilization Advance An interest-free Mobilization Advance of up to fifteen percent (15%) of the Accepted Contract Amount, excluding Provisional Sums, shall be paid to the Contractor in two (2) equal instalments, against an Advance Payment Guarantee in the form annexed to the Contract, issued by a Scheduled Bank acceptable to the Employer.

(a) First Instalment: The first instalment, equivalent to seven and a half percent (7.5%) of the Accepted Contract Amount excluding Provisional Sums, shall be paid within twenty-one (21) days of the Employer's receipt of the Contractor's Advance Payment Certificate from the Engineer, and of the corresponding Advance Payment Guarantee for the full amount of that instalment.

(b) Second Instalment: The second instalment, equivalent to a further seven and a half percent of the Accepted Contract Amount excluding Provisional Sums, shall be paid within forty-two (42) days from the date of payment of the first instalment, subject to the Engineer's satisfaction, evidenced in writing as to the state of mobilization of the Contractor's Personnel, Equipment, and Temporary Works on Site and against submission of the corresponding Advance Payment Guarantee for that instalment

Sub-Clause 14.2.3
Percentage deductions for the repayment of the Advance Payment: Deduction shall be made at the amortization rate of 17.5 % of the value of the Works executed of each IPC as provided in paragraph (i) of Sub-Clause GCC 14.3, starting from 2nd IPC provided that the advance payment shall be completely repaid prior to the time when 90% of the Accepted Contract Amount less Provisional Sums has been certified for payment. It may be more than 17.5% in the last instalment to ensure full repayment.

Sub-Clause 14.3
Period of payment **One Month**

Sub-Clause 14.3(b)
Number of additional paper copies of Statements: **3**

Sub-Clause 14.3 (iii)
Percentage of retention: **Seven percent (7%)**

Sub-Clause 14.3 (iii)
Limit of Retention Money (as a percentage of the Accepted Contract Amount): **Five percent (5%)**

Sub-Clause 14.5(b)(i)
Plant and Materials for payment when shipped: **Plant and Materials under Bill of "Imported Plant and Materials"**

Imported Plants and Materials

(a) Chillers (b) Cooling Towers (c) Hot Water Generators (d) Air Handling Units (e) Fan Coil Units (f) DG Sets (g) Solar PV Panels, Inverters and Lithium-Ion Batteries (h) Elevators (i) Fire Fighting Pumping Set (j) FM 200 / Clean Agent Fire System (k) VHF System (l) UHF System (m) HF System (n) DVLS system (o) AWOS (p) RRC System (q) UPS and associated Lithium-Ion Batteries

Please refer to the Annexure: Conditions of Contract – SCC Clause 14.5(b)(i) for further details

Sub-Clause 14.5(c)(i)
Plant and Materials for payment when delivered to the Site: Plant and Non Perishable Materials

Plants and Materials Onsite

(a) Steel Reinforcement / Steel Structural Members (b) Local Glass (c) Doors & Windows (d) False Ceiling (e) Tile, Marble and Granite (f) Plumbing Fittings and Fixtures (g) Pipes and Conduits (h) Pumps except Fire-Fighting Pumping Set (i) Electric Cables (j) Electric Panels (k) Transformers (l) CCTV Cameras (m) Electric Lights

Please refer to the Annexure titled Conditions of Contract – SCC Clause 14.5(c)(i) for further details

Sub-Clause 14.6.2
Minimum amount of Interim Payment Certificate (IPC): **Yes**
The Minimum Amount IPC is 1% of the Accepted Contract Amount.
[Employer to give value not exceeding one fifth of the average expected value of Interim Payment Certificate]

Sub-Clause 14.7(a)
Period of payment of Advance Payment to the Contractor**: 14 days**

Sub-Clause 14.7b(i)
Period for the Employer to make interim payments to the Contractor under Sub-Clause 14.6: **28** days

Sub-Clause 14.7b(ii)
Period for the Employer to make interim payments to the Contractor under Sub-Clause 14.13 (Final Payment)**: 56** days

Sub-Clause 14.7(c)
Period for the Employer to make final payment to the Contractor**: 56** days

Sub-Clause 14.8
Financing charges for delayed payment Local Currency (PKR):
6-Month KIBOR (Offer) +3% per annum.
Foreign Currency:
USD
6-Month SOFR (Secured Overnight Financing Rate for USD) +1% per annum.

EURO
6-Month EURIBOR (EURO Interbank Offered Rate for EURO) +1% per annum.

Others
Appropriate rates +1% (for other foreign currencies, Ref. Schedule-A, A-4 to Bid).

Sub-Clause 14.11.1(b)
Number of additional paper copies of draft Final Statements**: 3**

[insert number of copies say six (06)]

Sub-Clause 14.15
Currencies of payment of Contract Price: **as stated in the Table Schedule of Adjustment Data of Schedule A (if Given)**

Sub-Clause 14.15(a)(i)
Proportions or amounts of Local and Foreign currencies: **as stated in the Table Schedule of Adjustment Data of Schedule A (if Given)**

Sub-Clause 14.15(c)
Currencies and proportions for payment of Delay Damages: **as stated in the Table Schedule of Adjustment Data of Schedule A (if Given)**

Sub-Clause 14.15(f)
rates of exchange: **as stated in the Table IV of Schedule A (If Given)**

Sub-Clause 17.2(d)
Forces of nature, the risks of which are allocated to the Contractor: **Nil**

Sub-Clause 19.1
Permitted deductible limits:
i) insurance required for the Works: **Ten percent (10%) of loss amount on each & every loss**
ii) insurance required for Goods: **Nil**
iii) insurance required for liability for breach of professional duty: **Nil**
iv) insurance required against liability for fitness for purpose (if any is required): **Nil**
v) insurance required for injury to persons and damage to property: **Nil**
vi) insurance required for injury to employees: **Nil**
vii) other insurances required by Laws and by local practice : **Nil**

Periods for submission of insurance:
a) evidence of insurance: Not later than the Commencement Date
b) relevant policies: Within twenty eight (28) day from the Commencement Date

Sub-Clause 19.2.1(b)
Additional amount to be insured (as a percentage of the replacement value): 15% of the replacement value (Accepted Contract Amount)
Sub-Clause 19.2.2
Extent of insurance required for Goods: From Ex-Works (i.e., works, factory, warehouse, etc) to delivery at the Site
Amount of insurance required for Goods: Full replacement value

Sub-Clause 19.2.3(a)
Amount of insurance required for liability for breach of professional duty: Full replacement value of the Works to be designed by the Contractor

Sub-Clause 19.2.3(b)
Insurance required against liability for fitness for purpose: **Yes**

Sub-Clause 19.2.3
Period of insurance required for liability for breach of professional duty: Until the date of issuance of Performance Certificate

Sub-Clause 19.2.4
Amount of insurance required for injury to persons and damage to property: Injury to person and Fatal case: in accordance with Workmen Compensation Act
Damage to Property: The Amount of Insurance Required for Person Injury is In accordance with the Workmen's Compensation Act, or a minimum sum insured of PKR 3 million per person, whichever is greater
The Amount of Insurance Required for Damage to Property is PKR 50 million for each occurrence, with no limit on the number of occurrences as per his assessment of the adjoining property(ies) other than the Works] without limit to the number of incidents

Sub-Clause 19.2.6
Other insurances required by Laws and by local practice: All insurances as applicable, to the extent of execution of the project, under Federal and Provincial laws of Islamic Republic of Pakistan

Sub-Clause 21.1
Time for appointment of the DAAB: Within 28 days from the Commencement Date.
In case the Accepted Contract Amount is lesser than PKR one (01) billion, appointment of the DAAB shall be made when Dispute arises between the Parties.

Sub-Clause 21.1
The DAAB shall comprise 3
[insert either “a sole Member” or “Three Members”]
[For a Contract estimated to cost above PKR 2.5billion, the DAAB shall comprise of three members. For a Contract estimated to cost between PKR1billion and PKR2.5billion, the DAAB may comprise of three members or a sole member. For a Contract estimated to cost less than PKR1billion, a sole member is recommended.]

Sub-Clause 21.1
List of proposed members of DAAB
- proposed by Employer

Time for appointment of DAAB: Within 28 days form the Commencement Date

The DAAB shall comprise three (03) members.

Appointing entity (official) for DAAB members: Chairman Pakistan Engineering Council (PEC) from the list of PEC approved arbitrators published at its website

- proposed by Contractor
[to be inserted at the time of signing of the Contract]
1._____
2._____
3._____

Sub-Clause 21.2
Appointing entity (official) for DAAB members Managing Director Public Procurement Regulatory Authority (PPRA) or Chairman Pakistan Engineering Council (PEC) from the list of PEC approved arbitrators published at its website

Sub-Clause 21.6
Rules of Arbitration: PEC Rules of Conciliation and Arbitration or Pakistan Arbitration Act of 1940, if the former is inactive.
The place of Arbitration shall be in the Employer’s country: **Islamabad, Pakistan**

[Insert name of city]

Particular Conditions

PartB - Special Provisions

1.1 Definitions

1.1.76 “Specification”
Following is added at the end:
“and consists of two parts i.e.,
i) “Part A - Specific Provisions”; and
ii) “Part B - Technical Provisions”.”

1.2 Interpretation

“and” is deleted from the end of sub-paragraph (i) and added at the end of sub-paragraph (j).
Sub-paragraph (k) is added:
“(k) The word “tender” is synonymous with “bid” the word tenderer with “bidder”, the words “tender documents” with “bidding documents” and “Schedule of Prices” with “Bill of Quantities”, as applicable.”
1.5 Priority of Documents The documents listed at (a) through (k) of this Sub-Clause are deleted and substituted with the following:
(a) the Contract Agreement;
(b) the Letter of Acceptance;
(c) the Letter of Bid;
(d) the Particular Conditions Part A - Contract Data;
(e) the Particular Conditions Part B - SpecialProvisions;
(f) the General Conditions;
(g) the Specification Part A - SpecificProvisions;
(h) the Specification Part B- Technical Provisions;
(i) the Drawings;
(j) the completed Schedules to Bid includingBillof Quantities;
(k) the JV Undertaking (if the Contractor is a JV); and
(l) any other documents forming part of the Contract.
The addenda/corrigenda, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.

1.6 Contract Agreement

In the last line of the 1st paragraph the text “shall be borne by the Employer” is substituted by “shall be reimbursed by the Employer to the Contractor”.

3.1 The Engineer

In sub-paragraph (a) the text “as defined in the Pakistan Engineering Council Act, 1975 (Act No.V of 1976)” are added after the words “professional engineer”.

3.2 Engineer’s Duties and Authority

The Engineer shall obtain the consent in writing of the Employer before taking action under the following Sub-Clauses of these Conditions:

(a) Consenting to the subcontracting of any part of the Works under Sub-Clause 5.1 [Subcontractors]
(b) Any action under Sub-Clauses 8.9 [Employer's Suspension] and 8.12 [Prolonged Suspension]
(c) Issuance of "Taking Over Certificate" under Sub-Clause 10.1 [Taking Over the Works and Sections].
(d) Issuing the "Performance Certificate" under Sub-Clause 11.9 [Performance Certificate].
(e) Sub-Clause 13.1 [Right to Vary]: instructing a Variation, except;
(i) in an emergency situation as determined by the Engineer, or
(ii) if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Contract Data.
(f) Sub-Clause 13.3 [Variation Procedure]: approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.3.2 [Variation by Request for Proposal] or 13.2 [Value Engineering].
(g) Certifying release of second half of the Retention Money under Sub-Clause 14.9 [Release of Retention Money].
(h) Issuing Final Payment Certificate under Sub-Clause 14.13 [Issue of FPC].
(i)

Issue of FPC Sub Clauses

Engineer's Duties and Authority: Variations resulting in an increase of the Accepted Contract Amount in excess of 1% shall require approval of the Procuring agency / Employer.

*[insert Sub-Clause number (not Sub-Clause 3.7 [Agreement or Determination]
Any such requirement shall not be applied to any action by the Engineer under Sub-Clause 3.7 [Agreement or Determination], as stated in Sub-Clause 3.2 [Engineer's Duties and Authority] of the General Conditions. Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Employer.
Following is added after the words "the Employer's consent is required" in 4th paragraph:
"stating that the Employer's consent has been obtained for that specified authority"

4.2 Performance Security

4.2.1 Contractor's Obligations
The entity issuing the Performance Security and its form shall be as under:
The Performance Security shall be, at the option of the Contractor,issuedin the prescribed form included in the Bidding Documents,by(a) a Scheduled Bank in Pakistan or (b) a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan or (c)an Insurance Companylisted in the Contract Data and rated by PACRA/VIS ofratingas provided in Table below:
Accepted Contract Amount (In Eq. PKR million) Minimum Rating of Insurance Companies
Up to 1000 A (+)
1001 to no limit AA
In case of Joint Venture, the Performance Security shall be in the name of the Joint Venture or in the name of Lead/either firm of the JV or in ratio of shares of the individual JV partners.
Following paragraph is added at the end of this Sub-Clause:
"The amount of Performance Security shall be reducedto 50%following issue of the Taking-Over Certificate for the whole of the Works under Clause 10 of Conditions of Contract."

4.3 Contractor's Representative

In second paragraphthe text "professional engineer as defined in the Pakistan Engineering Council Act, 1975 (Act No. V of 1976) (having temporary licence in case of foreign engineer under Section 12 of the Pakistan Engineering Council Act, 1975 (Act No. V of 1976)" are added after the words "qualified, experienced".
In the 3rd paragraph the words "28 days" are substituted by "14 days". In 2nd line of 4thparagraph the text "or appoint a replacement" is substituted by "except appointment of a suitable temporary replacement is deployed at the Site"

4.4 Contractor's Documents

4.4.2 As-Built Records
First paragraph is deleted and the text in the last paragraph is substituted with the following:
"The Contractor shall furnish to the Engineer 6 copies, one reproducible and one electronic copy(provided the Engineer has made available to the Contractor editable form of the Drawings)of all Drawings amended to conform to the Works as built.In case the Engineer does not make available to the Contractor editable form of the Drawings, the Contractor shall furnish to the Engineer as-built data for incorporation in the Drawings. Upon receipt of PDF versions of the as-built drawings prepared by the Engineer, the Contractor shall furnish to the Engineer 6copies and one reproducible of these Drawings.
The price of such Drawings shall be deemed to be included in the Contract Price."
Following Sub-Clause is added:
4.4.4 ShopDrawings
The Contractor shall submit to the Engineer for review 3 copies of all shop and erection drawings applicable to this Contract as per provision of relevant Sub-Clause of the Contract.
Review and approval by the Engineer shall not exceed 21 days and be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory and the Engineer's review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

4.8 Health and Safety Obligations

The following text is added at the end ofthis Sub-Clause:
In the event of work being carried out outside the normal working hours and in the event of work being carried out at night, the Contractor shall at his own cost, provide and maintain such good and sufficient light as will enable the work to proceed satisfactorily and without danger. The approaches to the Site and the Works where the night work is being carried out shall be sufficiently lighted. All arrangement adopted for such lighting shall be to the satisfaction of the Engineer.

4.20 Progress Reports

At the end of sub-paragraph (g) the word "and" is deleted and at the end of sub-paragraph (h) the full stop (.) is replaced with ";", and the following new sub-paragraphs are added as:
(i) planned programme for the execution of the Works for next 56 days to enable the Engineer to determine its programme of inspection and testing;
(j) monthly summery of daily job record indicating weather conditions, deployment of Contractor's Equipment, labour employment, local material procurement and material import, if any; and
(k) salient contractual and project information.

5.1 Subcontractors

Add the following text at the end of paragraph (ii):
"underSchedule to Bid"
The following is added at the end of the last paragraph of Sub-Clause 5.1:
"All subcontracts relating to the Works shall include provisions which entitle the Employer to require the subcontract to be assigned to the Employer under sub-paragraph (a) of Sub-Clause 15.2.3 [After

Termination].
The Contractor shall give reasonable opportunity to contractors from Islamic Republic of Pakistan for subcontracts for the Works, and endeavour to employ such contractors as Subcontractors."

5.2 Nominated Subcontractors

5.2.2 Objection to Nomination
In sub-paragraph (c), "and" is deleted from the end of (i);
"." at the end of (ii) is replaced with: ", and".
The following is then added as (iii):
"(iii) be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under Sub-Clause 5.2.3 [Payment to nominated Subcontractors]."

6.1 Engagement of Staff and Labour

The following paragraph is added at the end of the Sub-Clause:
"The Contractor shall, to the extent practicable and reasonable, employ staff (not less than 50%) and labour (not less than 85%) with appropriate qualifications and experience from sources within the Islamic Republic of Pakistan."

6.7 Health and Safety of Personnel

The existing text is substituted with the following:
"In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purposes of or in connection with the Contract shall be carried out in compliance with the Safety Requirements of the Government of Pakistan with such modifications thereto as the Engineer may authorize or direct and the Contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose. The Contractor shall also provide all other medical services and appoint a health and safety officer at Site if stated in the Specifications. In case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means."

6.8 Contractor's Superintendence

Insert at the end of sub-paragraph (a) of this Sub-Clause:
"or, if not, the Contractor shall make competent interpreters available during all working hours, in a number sufficient for those persons to properly perform their superintendence duties"
The following text is added at the end of this Sub-Clause:
"The Contractor's authorized representative and his other engineers working at site shall possess valid registration with the Pakistan Engineering Council.
The Contractor's authorized representative at Site shall be authorized to exercise adequate administrative and financial powers on behalf of the Contractor so as to achieve completion of the Works as per the Contract."

6.12 Key Personnel

The following is inserted at the end of the last paragraph:
"If any of the Key Personnel are not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer."
The following Sub-Clauses 6.13 to 6.26 are added at the end of Sub-Clause 6.12:

6.13 Foreign Personnel

The Contractor may bring in to the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are

provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use all reasonable endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.
The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.

6.14 Supply of Foodstuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.15 Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

6.16 Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

6.17 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereto by Contractor's Personnel.

6.18 Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

6.19 Festivals and Religious Customs

The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.

6.20 Funeral Arrangements

The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of its local employees who may die while engaged upon the Works.

6.21 Forced Labour

The Contractor, including its Subcontractors, shall not employ or engage forced labour which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.

6.22 Child Labour

The Contractor, including its Subcontractors, shall not employ or engage child labour in accordance with relevant law(s) in force in Islamic Republic of Pakistan.

6.23 Employment Records of Workers

The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Contractor's Records].

6.24 Workers' Organizations

The Contractor shall comply with the relevant labour laws of Pakistan which recognize workers' rights to form and to join workers' organizations/Trade Union of their choosing and to bargain collectively without interference.

6.25 Non-Discrimination and Equal Opportunity

The Contractor shall not make decisions relating to the employment or treatment of Contractor's Personnel on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment of Contractor's Personnel on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices.
Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination. The Contractor shall provide protection and assistance as necessary to ensure nondiscrimination and equal opportunity, including for specific groups such as women, persons with disabilities, migrant workers and children (of working age in accordance with Sub-Clause 6.22).

6.26 Epidemics

In the event of any out-break of illness of epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities for the purpose of overcoming the same.

7.7 Ownership of Plant and Materials

The following is added before the first paragraph:
"Except as otherwise provided in the Contract,"
The following is added at the end of the Sub-Clause:
"No Plant and/or Materials that is the property of the Employer shallbe removed from the Site. If it becomes necessary to:
(i) remove any item of such Plant from the Site for the purposesof repair, the Contractor shall give a Notice, with reasons, tothe Engineer requesting consent to remove the defective ordamaged item off the Site. This Notice shall clearly identifythe item of defective or damaged Plant, and shall give detailsof: the defect or damage to be repaired; the place to whichdefective or damaged item of Plant is to be taken for repair;the transportation to be used (and insurance cover for suchtransportation); the proposed inspections and testing off theSite; and the planned duration required before the repaireditem of Plant shall be returned to the Site. The Contractorshall also provide any further details that the Employer mayreasonably require; or
(ii) replace any item(s) of such Plant and/or Materials, theContractor shall give a Notice, with reasons, to the Engineerclearly identifying the item(s) of Plant and/or Materials to bereplaced, and giving details of the due date of delivery tothe Site of the replacement item(s).
Where any item of Plant and/or Materials has become the propertyof the Employer under this Sub-Clause

before it has been deliveredto the Site, the Contractor shall ensure that such an item is notmoved except for its delivery to the Site.
The Contractor shall indemnify and hold the Employer harmlessagainst and from the consequences of any defect in title orencumbrance or charge (except any reasonable restrictionarising from the intellectual property rights of the manufacturer orproducer) on any item of Plant and/or Materials that has becomethe property of the Employer under this Sub-Clause."
The following Sub-Clause7.9 is added after Sub Clause 7.8:

7.9 Use of Pakistani Materials and Services

The Contractor shall, so far as may be consistent with the Contract, make the maximum use of materials, supplies, plant and equipment indigenous to or produced or fabricated in Pakistan and services available in Pakistan provided such materials, supplies, plant, equipment and services shall be of required standard.

8.1 Commencement of Works

The following is added before the first paragraph:
“After signing of the Contract Agreement by both Parties,” and thereafter the word “The” is replaced with the word “the”.

8.5 Extension of Time for Completion

The following is added after paragraph (c):
“for last five years”.
The following Sub-Clause 8.14 is added after Sub-Clause 8.13:

8.14 Incentives For Early Completion

If Contract Data does not state applicability of incentives for early completion, this Sub-Clause shall not apply.
The Contractor shall be entitled subject to Sub-Clause 20.2 [Claims for Payment and/or EOT] to bonus payment if the Works and/or each Section is completed earlier than the Time for Completion for the Works or Section (as the case may be). The amount of bonus for early completion of the Works and/or each Section shall be upto a limit and at a rate to 50% of the relevant limit and rate of delay damages prescribed in Contract Data and shall be paid for every day which shall elapse between the relevant Date of Completion of the Works or Section and the relevant Time for Completion.
For the purposes of calculating any bonus payment, the applicableTime for Completion stated in the Contract Data is fixed and noadjustments of this time by reason of granting an EOT will beallowed.
The following Sub-Clause 11.12 is added after Sub-Clause 11.11:

11.12 Supervisory Assistance During DNP

If provided under the Schedule of Prices, the Contractor shall provide supervisory assistance to the Employer during the DNP for the Works. Such supervisory assistance shall be as described in the Specification for the purpose of supporting the Employer's operation and maintenance of the Plant for the period specified in the Schedule of Prices after the Date of Completion.

12.2 Method of Measurement

The following paragraph is added at the end of the Sub-Clause:
“Summary of measured quantity for payment shall be delineated item-wise under four headsnamely; “Schedule of Prices Quantity”, “Quantity Executed To-date”, “Quantity Certified Previously” and “Net Quantity Executed under this Certificate”.

12.3 Valuation of the Works

The following text is added at the end of fifth paragraph of the Sub-Clause:
“Sum of overhead charges and profit for sub-paragraph (a) shall be Twenty Five percent (25%)”.

13.4 Provisional Sums

The following paragraph is inserted as the penultimate paragraph:
“The Provisional Sum shall be used to cover the Employer’s share of the DAAB members’ fees and expenses, in accordance with Clause 21. No prior instruction of the Engineer shall be required with respect to the work of the DAAB. The Contractor shall submit the DAAB members’ invoices and the satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those Statements submitted under Sub-Clause 14.3.

13.6 Adjustments for Changes in Laws

The following paragraphsare added at the end of the Sub-Clause:
“Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the Table of Adjustment Data in accordance with the provisions of Sub-Clause 13.7 [Adjustments for Changes in Cost].”

14.1 The Contract Price

The following is added at the end of the Sub-Clause:
“Notwithstanding the provisions of subparagraph (b), Contractor's Equipment, including essential spare parts, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved re-export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts, and callable in the event the Contractor's Equipment is not re-exported from the Country on completion of the Contract. A copy of the bond or bank guarantee endorsed by the customs authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon re-export of individual items of Contractor's Equipment or spare parts, or upon the completion of the Contract, the Contractor shall prepare, for approval by the customs authorities, an assessment of the residual value of the Contractor's Equipment and spare part to be re-exported, based on the depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the Contractor's Equipment and spare parts to re-exported; and (b) on the initial imported value of the Contractor's Equipment and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining.”
[The Employer may change or delete this Sub-Clause as per Project requirements]

14.2 Advance Payment

14.2.1 Advance Payment Guarantee
The entity issuing the Advance PaymentGuaranteeand its form shall be as under:
The Advance PaymentGuarantee shall be in the form of Guarantee issued by (a) a Scheduled Bank in Pakistan or (b) a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistanor (c)an Insurance Companylisted in the Contract Data and rated by PACRA/VIS ofrating as provided in Table below:

Accepted Contract Amount (In Eq. million PKR) Minimum Rating of Insurance Companies
Up to 1000 A (+)
1001 to no limit AA
In case of Joint Venture, the Advance PaymentGuarantee(s)shall be in the name of the Joint Venture or in the name of Lead/either firm of the JV or in ratio of shares of the individual JV partners.

14.6 Issue of IPC

14.6.1 The IPC
In the first line of the 1st paragraph the words “28 days” are substituted by “14 days”.

14.7 Payment

The words “or through crossed cheque in favour of the Contractor or JV partners. The Payment to JV partners shall be made at the request of the Joint Ventures in the ratio of their shares specified by them” are added at the end of the Sub-Clause.

14.8 Delayed Payment

In the first paragraph, third line, the words “compounded monthly” are deleted.
The text of 2nd paragraph is deleted and substituted with the following:
“The Employer shall pay to the Contractor compensation at the rate stated in the Contract Data.”

14.9 Release of Retention Money

The following is added at the end of Sub-Clause 14.9:
“Unless otherwise stated in the Contract, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment by the Engineer, the Contractor shall be entitled to substitute a guarantee, in the form annexed to the Particular Conditions or in another form approved by the Employer and issued by a schedule bank selected by the Contractor, for the second half of the Retention Money. The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security. On receipt by the Employer of the required guarantee, the Engineer shall certify, and the Employer shall pay the second half of the Retention Money. The release of the second half of the Retention Money against a guarantee shall then be in lieu of the release after the latest of the expiry dates of the Defects Notification Periods. The Employer shall return the guarantee to the Contractor within 21 days after receiving a copy of the Performance Certificate.

If the Performance Security required under Sub-Clause 4.2 is in the form of a demand guarantee, and the amount guaranteed under them when the Taking-Over Certificate is issued is more than half of the Retention Money, then the Retention Money guarantee will not be required. If the amount guaranteed under the Performance Security when the Taking-Over Certificate is issued is less than half of the Retention Money, the Retention Money guarantee will only be required for the difference between half of the Retention Money and the amount guaranteed under the Performance Security.

15.2 Termination for Contractor’s Default

15.2.1 Notice
Following text is added at the end of sub-paragraph (h) of this Sub-Clause:
“For the purposes of this Contract, corrupt and fraudulent practices have been defined in Public Procurement Rules 2004.”
15.2.3 After Termination
The word “and” at the end of sub-paragraph (ii) of paragraph (b) is deleted the following paragraph is added

after sub-paragraph (iii):
“(iv) all Employer-Supplied Materials and/or Employer's Equipment madeavailable to the Contractor in accordance with Sub-Clause 2.6 [Employer-Supplied Materials and Employer's Equipment], and”

15.4 Payment after Termination

The following text is added at the end of this Sub-Clause:
“The Employer shall be entitled to sell any of the Contractor’s Equipment, Temporary Works and unused materials and apply the proceeds of sale towards payment of any debt due from the Contractor to the Employer under this Clause including any outstanding payments to the Subcontractors.

16.2 Termination by Contractor

16.2.1 Notice
The sub-paragraph (j) is deleted in its entirety.
At the end of sub-paragraph (i) “; or” is replaced with “.” and at the end of sub-paragraph (h) “;” is replaced with “; or”.
In sub-paragraph (f) “84 days” are replaced with “180 days” and text “for reasons not attributable to the Contractor” is added at the end.

16.3 Contractor’s Obligations After Termination

Sub-paragraph (c) is deleted and replaced with:
"(c) deliver to the Engineer all Employer-Supplied Materials and/orEmployer's Equipment made available to the Contractor in accordance with Sub-Clause 2.6 [Employer-Supplied Materials and Employer’s Equipment]; and
(d) remove all other Goods from the Site, except as necessary for safety,and leave the Site."

17.1 Responsibility for Care of the Works

After the two instances of “Goods” in the last paragraph, the words “Employer-Supplied Materials and/orEmployer's Equipment” are added.
The following Sub-Clause 17.7 is added after Sub-Clause 17.6:

17.7 Use of Employer’s Accommodation/Facilities

The Contractor shall take full responsibility for the care of the items of the Employer’s facilities and/or accommodation, if any, as detailed in the Specification, from the date of use and/or occupation by the Contractor until the date on which such use and/or occupation is re-vested in the Employer.
If any loss or damage happens to any of the above items during a time while the Contractor is responsible for its care, arising from any cause other than a cause for which the Employer is responsible or liable, the Contractor shall promptly rectify the loss or damage at the Contractor’s risk and cost.

18.1 Exceptional Events

The words “or disorder” are replaced with “disorder or sabotage” in sub-paragraph (c) of the Clause.

18.4 Consequences of an Exceptional Event

The following is added at the end of sub-paragraph (b) after deleting the “.”:
“, including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Exceptional Events, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 19.2 [Insurance to be provided by the Contractor].”

18.5 Optional Termination

In sub-paragraph (c), the words “and necessarily” areadded after the words “was reasonably”.

19.1 General Requirements

Following text is added at the end of first paragraph:
“The Contractor shall immediately after the date of the Letter of Acceptance submit the draft of insurance policies for the Employer’s consent.”
Following text is added at the end of third paragraph:
“The Contractor shall, within the respective periods stated in the Contract Data submit to the Engineer and the Employer a) evidence that the insurances described in this Clause have been effected, and b) copies of policies of the insurances described in Sub-Clauses 19.2.1, 19.2.4 and 19.2.5.”

19.2 Insurance to be provided by the Contractor

19.2.5 Injury to employees
The words “sickness, disease” are deleted in the third line of first paragraph.

The following Sub-Clause is added after Sub-Clause 19.2.6:
19.2.7 Insurance Company
“The Contractor shall be obliged to place all insurances described in this Clause with insurers listed in the Contract Data and rated byPACRA/VISofrating as provided in Table below:

Accepted Contract Amount (In Eq. million PKR) Minimum Rating of Insurance Companies
Up to 1000 A (+)
1001 to no limit AA

21.6 Arbitration

The word “international” is deleted in the sixth line of first paragraph. The text of sub-paragraph (a) is substituted with the following:
“the Dispute shall be finally settled under the Rules of Arbitration, specified in the Contract Data;”
The following Clauses are added after Clause 21

22 Custom Duty

[Employer may incorporate provisions where applicable. However, in order to make the bid more balanced, the payment of Customs Duties should be the responsibility of the Employer.]

23 Taxes

The Contractor, Subcontractors and their employees shall be liable to pay income tax, withholding tax, super tax and other taxes on income arising out of the Contract. The rates and prices as stated in the contract shall be deemed to cover all such taxes.

24 Integrity Part

If it is found and established at any stage that the Contractor or any of his Subcontractors, agents or servants have violated or involved in violation of the Integrity Pact signed by the Contractor then the Employer shall be entitled to :
(a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder’s fee or kickback given by the Contractor or any of his Subcontractors, agent or servants;
(b) terminate the Contract; and
(c) recover from the Contractor any loss or damage to the Employer as a result of such termination or of

any other corrupt business practices of the Contractor or any of his Subcontractors, agent or servants.
The termination under sub-paragraph(b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clause 15.1 to 15.4 and the payment under Sub-Clause 15.4 shall be made after having deducted the amounts due to the Employer under sub-paragraph(a) and (c) of this Sub-Clause.
Appendix General Conditions of Dispute Avoidance/Adjudication Agreement

12 Disputes Under DAAB Agreement

In the first paragraph, third, fourth and fifth line, the text “under the Rules of Arbitration of the International Chamber of Commerce 2017……shall apply” is substituted with “under the Arbitration Act 1940 by sole arbitrator appointed by the Managing Director Public Procurement Regulatory Authority or Chairman Pakistan Engineering Council.”

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Bid Securing Declaration

FORM OF BID SECURING DECLARATION

Date:
No.:
Alternative No.: ***P71309***

To: **Pakistan Airports Authority (Planning & Development Directorate), Director Planning & Development P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi**

We, the undersigned, declare that:

We understand that, according to your conditions, Bids must be supported by a Bid-Securing Declaration.

We accept that we will be blacklisted and henceforth cross debarred for participating in respective category of public procurement proceedings for a period of (not more than) six months, if fail to abide with a bid securing declaration, however without indulging in corrupt and fraudulent practices, if we are in breach of our obligation(s) under the Bid conditions, because we:

(a) have withdrawn our Bid during the period of Bid validity specified in the Letter of Bid; or
(b) having been notified of the acceptance of our Bid by the Procuring agency/Employer during the period of Bid validity, (i) fail or refuse to sign the Contract; or (ii) fail or refuse to furnish the Performance Security (or guarantee), if required, in accordance with the ITB.

We understand this Bid Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight days after the expiration of our Bid.

Name of the Bidder*
Name of the person duly authorized to sign the Bid on behalf of the Bidder** _____
Title of the person signing the Bid _____
Signature of the person named above _____
Date signed _____ day of _____, _____
*: In the case of the Bid submitted by joint venture specify the name of the Joint Venture as Bidder
**: Person signing the Bid shall have the power of attorney given by the Bidder attached to the Bid

[Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all members to the Joint Venture that submits the Bid.]

Contract Form

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the _____ day of _____ (month) 20_____ between **Pakistan Airports Authority (Planning & Development Directorate), Director Planning & Development P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi** (hereinafter called the "Employer") of the one part and _____ (hereinafter called the "Contractor") of the other part.

WHEREAS the Employer is desirous that certain Works, viz., **Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu (*P71309*)** should be executed by the Contractor and has accepted a Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

NOW this Agreement witnessed as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents, in the order of priority, after incorporating addenda, if any, except those parts relating to Instructions to Bidders shall be deemed to form and be read and construed as part of this Agreement:

a) This Contract Agreement;
b) The Letter of Acceptance;
c) The Letter of Bid;
d) The Particular Conditions Part A - Contract Data;
e) The Particular Conditions Part B - SpecialProvisions;
f) The General Conditions;
g) The Specifications Part A - SpecificProvisions;
h) The Specifications Part B- Technical Provisions;
i) The Drawings;
j) The Completed Schedules to Bid including Schedule of Prices;
k) the JV Undertaking (if the Contractor is a JV); and
l) [Employer to insert any other documents forming part of the Contract]

The addenda/corrigenda,if any, (Excluding part relating to Instructions to Bidders alongwith Bidding Data) shall be deemed to have been incorporated at the appropriate places in the "Documents forming the Contract".

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy defects therein in conformity and in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works as per provisions of the Contract, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed on the day, month and year first before written in accordance with their respective laws.

Signature of the Contactor Signature of Employer

(Seal) (Seal)

Signed, Sealed and Delivered in the presence of:

Witness Witness

(Name, Title and Address) (Name, Title and Address)

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DAAB Agreement

[All italicised text and any text within square brackets (except sub-clause headings) in this form of agreement is for use in preparing the form and should be deleted from the final product].

Name and details of the Contract Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

_____

This Agreement made the _____day of _____ [month], _____ [year], between

Name and contact details of the Employer **Pakistan Airports Authority (Planning & Development Directorate), Director Planning & Development**
P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi
+92-992-42773
director.pdev@paa.gov.pk

Name and contact details of the Contractor _____ (name)
_____ (address)
_____ (telephone)
_____(email / other contact details);

Name and contact details of the DAAB Member _____ (name)
_____ (address)
_____ (telephone)
_____(email / other contact details);

("DAAB Agreement")

Whereas:
A. the Employer and the Contractor have entered (or intend to enter) into the Contract;
B. under the Contract, the "DAAB" or "Dispute Avoidance/Adjudication Board" means the sole member or three members (as stated in the Contract Data of the Contract) so named in the Contract, or appointed under Sub-Clause 21.1 [Constitution of the DAAB] or Sub-Clause 21.2 [Failure to Appoint DAAB Members] of the Conditions of Contract;
C. the Employer and the Contractor desire jointly to appoint the above-named DAAB Member to act on the DAAB as:
a. the sole member of the DAAB, and where this is the case, all references to the "Other Members" do not apply; or
b. one of three members / chairman [delete the one which is not applicable] of the DAAB and, where this is the case, the other two persons are:

_____ (name) _____ (name)
_____ (address) _____ (address)
_____(telephone) _____(telephone)
_____(email/ other contact details) _____ (email/other contact details)

the "**Other Members**"; and
D. the DAAB Member accepts this appointment.

The Employer, Contractor and DAAB Member jointly agree as follows:

1. The conditions of this DAAB Agreement comprise:
(a) Clause 21 [Disputes and Arbitration] of the Conditions of Contract, and any other provisions of the Contract that are applicable to the DAAB's Activities; and
(b) the "General Conditions of Dispute Avoidance/Adjudication Agreement", which is appended to the General Conditions of the "Conditions of Contract for Construction" Second Edition 2017 published by FIDIC ("GCs"), as amended and/or added to by the following provisions.
2. [Details of amendments to the GCs, if any. For example:
In the procedural rules annexed to the GCs, Rule _ is deleted and replaced by: " … "]
3. The DAAB Member shall be paid in accordance with Clause 9 of the GCs. The currency of payment shall be _____.
In respect of Sub-Clauses 9.1 and 9.2 of the GCs, the amounts of the DAAB Member's monthly fee and daily fee shall be:
monthly fee_____ per month, and
daily fee of_____ per day
(or as otherwise set under Sub-Clause 9.3 of the GCs).
4. In consideration of the above fees, and other payments to be made to the DAAB Member in accordance with the GCs, the DAAB Member undertakes to act as DAAB Member in accordance with the terms of this DAAB Agreement.
5. The Employer and the Contractor shall be jointly and severally liable for the DAAB Member's fees and other payments to be made to the DAAB Member in accordance with the GCs.
6. This DAAB Agreement shall be governed by the law of _____ (if not stated, the law that governs the Contract under Sub-Clause 1.4 of the Conditions of Contract).

SIGNED by:_____	SIGNED by:_____	SIGNED by:_____
Print name:_____	Print name:_____	DAAB Member
Title: _____	Title:_____	Title:_____
for and on behalf of the Employer	for and on behalf of the Contractor	
in the presence of	in the presence of	in the presence of
Witness:_____	Witness:_____	Witness:_____
Name:_____	Name:_____	Name:_____
Address:_____	Address:_____	Address:_____
_____	_____	_____
Date:_____	Date:_____	Date:_____

FORM OF MOBILIZATION ADVANCE GUARANTEE/ BOND

Guarantee No._____ Date _____

WHEREAS _____ (hereinafter called the 'Employer')
has entered into a Contract for _____
(Particulars of Contract)
with _____ (hereinafter called the "Contractor').
AND WHEREAS, the Employer has agreed to advance to the Contractor, at the Contractor's request, an amount of Pak Rupees _____ (PKR _____) which amount shall be advanced to the Contractor as per provisions of the Contract.
AND WHEREAS, the Employer has asked the Contractor to furnish Guarantee to secure the mobilization advance for the performance of his obligations under the said Contract.
AND WHEREAS, _____

(hereinafter called the “Guarantor”) at the request of the Contractor and in consideration of theEmployer agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.
NOW, THEREFORE, the Guarantor hereby guarantees that the Contractor shall use the advance for the purpose of above mentioned Contract and if he fails and commits default in fulfilment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Employer for payment not exceeding the aforementioned amount.
Notice in writing of any default,on the part of the Contractor, of which the Employer at his discretion of making decision, shall be given by the Employer to the Guarantor, and on such first written demand, payment shall be made by the Guarantor of all sums then due under this Guarantee without any reference to the Contractor and without any objection.
This Guarantee shall remain in force until the advance is fully adjusted against payments from the Interim Payment Certificates of the Contractor or until _____whichever is earlier.
(Date)
The Guarantor's liability under this Guarantee shall not in any case exceed the sum of
PKR _____ (PakRupees _____).
This Guarantee shall remain valid up to the aforesaid date and shall be null and void after the aforesaid date or earlier if the advance made to the Contractor is fully adjusted against paymentsfrom Interim Payment Certificates of the Contractor provided that the Guarantor

agrees that the aforesaid period of validity shall be deemed to be extended if on the above mentioned date the advance payment is not fully adjusted.

Guarantor
(Scheduled Bank/ Insurance Company)

Signature _____
Name _____
Title _____

WITNESS:

1. _____

_____

Corporate Secretary (Seal) Corporate Guarantor (Seal)

2. _____

_____

Name, Title & Address

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Retention Money Security
Demand Guarantee

_____ [Guarantor letterhead or SWIFT identifier code]
Beneficiary: _____ [Insert name and Address of Employer]
Date: _____[Insert date of issue]
RETENTION MONEY GUARANTEE No.: [Insert guarantee reference number]
Guarantor: [Insert name and address of place of issue, unless indicated in the letterhead]

We have been informed that _____ [insert name of Contractor, which in the case of a joint venture shall be the name of the joint venture] (hereinafter called "the Contractor") has entered into Contract No. _____ [insert reference number of the contract] dated _____ with the Employer, for the execution of _____ [insert name of contract and brief description of Works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, the Employer retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when the Taking-Over Certificate has been issued under the Contract and the first half of the Retention Money has been certified for payment, payment of [insert the second half of the Retention Money orifthe amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money, the difference between half of the Retention Money and the amount guaranteed under the Performance Security and, if required, the ES Performance Security] is to be made against a Retention Money guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ [insert amount in figures] () [amount in words] upon receipt by us of the Employer's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without your needing to prove or show grounds for your demand or the sum specified therein.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Employer's bank stating that the second half of the Retention Money as referred to above has been credited to the contractor on its account number _____ at _____ [insert name and address of Contractor's bank].

This guarantee shall expire no later than the …. day of ……, 2…, and any demand for payment under it must be received by us at the office indicated above on or before that date.

_____
[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

Integrity Pact

Integrity Pact

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BYTHE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS.10.00 MILLION OR MORE

Contract Number: Contract Value: Contract Title:

Dated:

[Name of Supplier] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoP) through any corrupt business practice.

Without limiting the generality of the foregoing [Name of Supplier] represents and warrants that it has fully declared the brokerage, commission, fee etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultations fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[Name of Supplier] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representative or warranty.

[Name of Supplier] accepts full responsibility and strict liability for making and false declaration, not making full disclosure, misrepresenting fact or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [Name of Supplier] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [Name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.

Name of Employer: …… Name of Bidder/Contractor: ……
Signature: …… Signature: …….
[Seal] [Seal]

Performance Guarantee Form

FORM OF PERFORMANCE SECURITY

Guarantee No._____
Executed on _____
Expiry date _____

Name of Guarantor with address: _____

Name of Principal (Contractor) with address:_____

Penal Sum of Security (express in words and figures) _____

Letter of Acceptance No. _____Dated _____

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bidding Documents and above said Letter of Acceptance (hereinafter called the Documents) and at the request of the said Principal we, the Guarantor above named, are held and firmly bound unto the **Pakistan Airports Authority (Planning & Development Directorate), Director Planning & Development P&D Directorate, HQPAA, Terminal-1 Jinnah International Airport, Karachi** (hereinafter called the Employer) in the penal sum of the amount stated above for the payment of which sum well and truly to be made to the said Employer, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has accepted the Employer's above said Letter of Acceptance for _____ _____

(Name of Contract) for the **Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu** (**P71309**) _____ (Name of Project).

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the said Documents during the original terms of the said Documents and any extensions thereof that may be granted by the Employer, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfill all the undertakings, covenants terms and conditions of the Contract and of any and all modifications of said Documents that may hereafter be made, notice of which modifications to the Guarantor being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue till all requirements of Clause11, Defects After Taking Over, of Conditions of Contract are fulfilled.

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall be received by us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

We, _____ (the Guarantor), waiving all objections and defense under the Contract, do hereby irrevocably and independently guarantee to pay to the Employer without delay upon the Employer's first written demand without cavil or arguments and without requiring the Employer to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated

above, against the Employer's written declaration that the Principal has refused or failed to perform the obligations under the Contract which payment will be effected by the Guarantor to Employer's designated Bank & Account Number.

PROVIDED ALSO THAT the Employer shall decide, whether the Principal (Contractor) has duly performed his obligations under the Contract or has defaulted in fulfilling said obligations and the Guarantor shall pay without objection any sum or sums up to the amount stated above upon first written demand from the Employer forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above-bounden Guarantor has executed this Instrument under its seal on the date indicated above, the name and corporate seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Guarantor
(Schedule Bank/ Insurance Company)
Signature: _____
Name: _____
Title: _____

Corporate Guarantor (Seal)

WITNESS:

1.
_____
_____

2.

_____
_____
Name, Title & Address

Annexure

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Adjustment Data

Schedule of Adjustment Data

SBD Document (Read-Only)

See Form Under Additional Forms and Documents: **Adjustment Data** (page number: 490)

ITB and BDS

The Annexures attached hereto, including, but not limited to, the Instructions to Bidders (ITB), Bid Data Sheet (BDS), Particular Conditions of Contract (Part A – Contract Data and Part B – Special Provisions), and any other documents expressly identified as forming part of the Bidding Documents, shall constitute an integral, essential, and binding part of the Bidding Documents.

Notwithstanding anything to the contrary contained in, or generated through, the EPADS V2.0 system, the ITB and BDS, and Conditions of Contract generated by EPADS V2.0 shall, to the extent of any technical inconsistency, discrepancy, or conflict, be deemed non-binding and shall have no legal or contractual effect. In the event of any ambiguity, discrepancy, inconsistency, or conflict between the system-generated documents and the aforesaid attached Annexures, the attached Annexures, including, but not limited to, the ITB, BDS, Particular Conditions of Contract (Part A – Contract Data and Part B – Special Provisions), and other documents forming part of the Bidding Documents, shall prevail and shall be final and binding upon both the Procuring Agency and the Bidder.

The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **ITB and BDS** (page number: 494)

Evaluation Criteria

The Evaluation Criteria annexure attached hereto shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Evaluation Criteria** (page number: 551)

Bidder Information Form

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bidder Information Form** (page number: 562)

Form CON 2

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Form CON 2** (page number: 565)

Form FIN 3.1

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Form FIN 3.1** (page number: 566)

Forms FIN

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Forms FIN** (page number: 568)

EXP Forms

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **EXP Forms** (page number: 570)

EQU Forms

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **EQU Forms** (page number: 573)

PER Forms

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **PER Forms** (page number: 574)

Attachments

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Attachments** (page number: 576)

Letter of Technical Bid

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Letter of Technical Bid** (page number: 580)

Technical Schedules

The technical forms attached as annexure shall be duly completed/filled, signed and stamped, together with all supporting documents required therein and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-

responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Schedules** (page number: 582)

Letter of Financial Bid

The financial forms attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Letter of Financial Bid** (page number: 593)

Summary of Costs

The financial forms and Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Summary of Costs** (page number: 597)

Bill No. 1

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 1** (page number: 602)

Bill No. 2

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 2** (page number: 604)

Bill No. 3

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 3** (page number: 618)

Bill No. 4

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 4** (page number: 628)

Bill No. 5

The financial forms and Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 5** (page number: 633)

Bill No. 6

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 6** (page number: 650)

Bill No. 7

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 7** (page number: 663)

Bill No. 8

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Bill No. 8** (page number: 669)

Daywork Bill

The Bill of Quantities attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Daywork Bill** (page number: 674)

Schedule H

The financial form attached as annexure shall be duly completed/filled, signed and stamped, and the bidder shall upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Schedule H** (page number: 678)

Conditions of Contract

The Annexures attached hereto, including, but not limited to, the Instructions to Bidders (ITB), Bid Data Sheet (BDS), Particular Conditions of Contract (Part A – Contract Data and Part B – Special Provisions), and any other documents expressly identified as forming part of the Bidding Documents, shall constitute an integral, essential, and binding part of the Bidding Documents.

Notwithstanding anything to the contrary contained in, or generated through, the EPADS V2.0 system, the ITB and BDS, and Conditions of Contract generated by EPADS V2.0 shall, to the extent of any technical inconsistency, discrepancy, or conflict, be deemed non-binding and shall have no legal or contractual effect. In the event of any ambiguity, discrepancy, inconsistency, or conflict between the system-generated documents and the aforesaid attached Annexures, the attached Annexures, including, but not limited to, the ITB, BDS, Particular Conditions of Contract (Part A – Contract Data and Part B – Special Provisions), and other documents forming part of the Bidding Documents, shall prevail and shall be final and binding upon

both the Procuring Agency and the Bidder.

The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Conditions of Contract** (page number: 679)

Technical Specs P1

The Technical Specifications annexure attached hereto shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specs P1** (page number: 723)

Technical Specs P2

The Technical Specifications annexure attached hereto shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specs P2** (page number: 1207)

Drawings P1

The Drawings attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply

with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P1** (page number: 1421)

Drawings P2

The Drawings attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P2** (page number: 1425)

Drawings P3

The Drawings attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P3** (page number: 1428)

Drawings P4

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P4** (page number: 1438)

Drawings P5

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P5** (page number: 1453)

Drawings P6

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P6** (page number: 1462)

Drawings P7

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P7** (page number: 1473)

Drawings P8

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P8** (page number: 1483)

Drawings P9

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P9** (page number: 1491)

Drawings P10

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P10** (page number: 1501)

Drawings P11

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P11** (page number: 1512)

Drawings P12

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P12** (page number: 1527)

Drawings P13

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P13** (page number: 1529)

Drawings P14

The Drawings attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P14** (page number: 1539)

Drawings P15

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P15** (page number: 1558)

Drawings P16

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P16** (page number: 1578)

Drawings P17

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with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P17** (page number: 1609)

Drawings P18

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P18** (page number: 1617)

Drawings P19

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P19** (page number: 1624)

Drawings P20

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P20** (page number: 1635)

Drawings P21

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P21** (page number: 1652)

Drawings P22

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P22** (page number: 1662)

Drawings P23

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P23** (page number: 1679)

Drawings P24

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P24** (page number: 1700)

Drawings P25

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Drawings P25** (page number: 1721)

Preamble to Corrigendum no. 1

The Preamble to Corrigendum No. 1attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Preamble to Corrigendum no. 1** (page number: 1729)

Addendum Drawings P1

The Drawings attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Addendum Drawings P1** (page number: 1754)

Addendum Drawings P2

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Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Addendum Drawings P2** (page number: 1766)

Addendum Drawings P3

The Drawings attached hereto as an Annexure shall constitute an integral, essential, and binding part of the Bidding Documents. The Bidder shall download the aforesaid Annexures, duly sign and stamp each page thereof, and upload the complete scanned copy as an integral part of its bid submission. Failure to comply with this requirement may render the bid non-responsive, in accordance with the applicable procurement rules and the provisions of the Bidding Documents

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Addendum Drawings P3** (page number: 1779)

Geotechnical Investigation Report

Geotechnical Investigation Report

Information (Read-Only)

See Form Under Additional Forms and Documents: **Geotechnical Investigation Report** (page number: 1791)

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Procurement Forms

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

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(PPRA)
EPADS

Additional Forms and Documents

SCHEDULE OF ADJUSTMENT DATA

Schedule of Cost Indexation

The formulae for price adjustment shall be the following:

Pn= a + b Ln / Lo + c En/ Eo + d Mn/Mo + ...

where:

"Pn" is the adjustment multiplier to be applied to the estimated Contract value in the relevant currency of the work carried out in period "n", this period being a month;

"a" is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments;

"b", "c", "d", ... are coefficients representing the estimated proportion of each cost element related to the execution of the Works as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labour, equipment and materials;

"Ln", "En", "Mn", are the current cost indices or reference prices for period "n", expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of the period (to which the particular Payment Certificate relates); and

"Lo", "Eo", "Mo", are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

The weightings (coefficients) for each of the factors of cost stated in the following table(s) of adjustment data shall only be adjusted if they have been rendered unreasonable, unbalanced or inapplicable, as a result of Variation(s).

If the currency in which the Contract price is expressed is different from the currency of the country of origin of the indices, a correction factor will be applied to avoid incorrect adjustments of the Contract price. The correction factor shall be: Z_0 / Z_1, where,

Z_0 = the number of units of currency of the origin of the indices which equal to one unit of the currency of the Contract Price on the Base date, and

Z_1 = the number of units of currency of the origin of the indices which equal to one unit of the currency of the Contract Price on the Date of Adjustment.

For the purpose of making all calculations, Pakistan Engineering Council's Standard Formula and Procedure for Price Adjustment (Second Edition, May 2022) shall be applicable in true letter and spirit. For imported plant/ equipment and materials quoted in local currency (Pak. Rs.), foreign currency, exchange rates shall be base exchange rate notified by the State Bank of Pakistan (SBP) "Mark-to-Market Revaluation Exchange Rate – Ready" on the day, 28 days prior to bid submission deadline. The change in foreign currency exchange rate will be applicable to the foreign currency component stated in the Letter of Credit established by the Contractor or his Vendor. The amount stated in the Letter of Credit shall be adjusted from gross work done while making calculations of Price Adjustment for the local items as per above formula.

SCHEDULE OF ADJUSTMENT DATA

Table I. Local Currency (LC) For All Bills

Index code	Index description	Source of index	Bidder's related currency amount		Weighting
(i)	Non-adjustable / Fixed Portion	—	PKR		**A: 0.694**
(ii)	Local Labour	PBS Monthly CPI - Urban Inter-City Consumer Prices of Construction and Energy Items for Abbottabad - Labour (unskilled)	PKR		**b: 0.051**
(iii)	Steel (Reinforcing & Structural)	PBS Monthly CPI - Urban Inter-City Consumer Prices of Construction and Energy Items for Abbottabad - Iron bars (1/2" 40 grade) (M.S. bars) (per tonne)	PKR		**c: 0.089**
(iv)	High Speed Diesel (HSD)	PBS – WPI Base 2015-16 Annex – C [072-Diesel Oil]	PKR		**d: 0.092**
(v)	Aggregates (crushed)	PBS Monthly CPI - Urban Inter-City Consumer Prices of Construction and Energy Items for Abbottabad – Bajri (rata) (per truck) (100 CFT)	PKR		**e: 0.043**
(vi)	Electrical Wiring and Equipment	PBS – WPI Base 2015-16 Annex – C [105 Electric Wires]	PKR		**f: 0.031**
Total					**1.00**

The official sources for above is https://www.pbs.gov.pk/price-statistics/

SCHEDULE OF ADJUSTMENT DATA

Price Adjustment for Imported Equipment (Exchange Rate Variation / Dollar Parity)

1. Currency of Bid and Payment
   Notwithstanding that the Bidder may incur foreign currency expenditure for the procurement of imported plant, equipment, materials or components, the Bid shall be submitted entirely in Pakistan Rupees (PKR). The Contract Price shall be expressed solely in PKR, and all payments under the Contract shall be made exclusively in PKR.

2. Foreign Currency Component
   For the items specifically identified in the Bill of Quantities and Schedule of Prices as eligible for foreign currency adjustment, the Bidder may designate up to eighty percent (80%) of the quoted rate of such item as representing the imported (foreign currency) component. The remaining portion shall be deemed to be the local currency component. The Bidder shall clearly indicate, in the prescribed schedule, the percentage of the imported component for each eligible item. Under no circumstances shall the imported component exceed 80% of the quoted rate of that item.

3. Base Exchange Rate for Bid Evaluation
   For the purpose of bid submission, bid evaluation and determination of the Contract Price, the declared foreign currency component shall be converted into PKR at the base exchange rate notified by the State Bank of Pakistan (SBP) "Mark-to-Market Revaluation Exchange Rate – Ready" on the day, 28 days prior to bid submission deadline. The evaluated Bid Price, Letter of Acceptance and Contract Price shall therefore be expressed only in PKR.

4. Exchange Rate Adjustment (Dollar Parity)
   Exchange rate adjustment shall be applicable only to the approved imported component of eligible items actually imported and incorporated into the Works. The adjustment shall be calculated as the difference between:

   (a) the Base Exchange Rate notified by the State Bank of Pakistan (SBP) "Mark-to-Market Revaluation Exchange Rate – Ready" on the day, 28 days prior to bid submission deadline; and
   (b) the Actual Customs Clearance Exchange Rate applicable to the imported goods at the time of customs clearance into Pakistan.

   The adjustment shall be limited strictly to the approved imported component of the corresponding item and shall not apply to local costs, overheads, profit, taxes, duties, inland transportation, installation, testing, commissioning or any other local expenditure.

   The adjustment amount shall be calculated using the following formula:

$$ERA = IC \times \left(\frac{ER_a - ER_b}{ER_b}\right)$$

   Where:
   ERA = Exchange Rate Adjustment
   IC = Approved Imported Currency Component i.e. Total PKR value of the imported component (as per declared percentage in the BOQ) of eligible items certified as incorporated in period "n", calculated at the Base Exchange Rate ER_b .
   ER_b = Base Exchange Rate as defined in Clause 3 above

ER_a = Actual Exchange Rate applicable at the time of customs clearance (as defined in Clause 5 below).

Where an eligible item is imported through more than one consignment, the exchange rate adjustment shall be calculated separately for each consignment using the applicable Pakistan Customs exchange rate for that consignment.

5. Applicable Exchange Rate
The applicable exchange rate for determining the exchange rate adjustment shall be:
(a) the United States Dollar exchange rate adopted by Pakistan Customs for assessment of customs duties and taxes on the date of customs clearance of the imported equipment; or
(b) where no Pakistan Customs exchange rate is available or applicable for the relevant consignment, the State Bank of Pakistan (SBP) "Mark-to-Market Revaluation Exchange Rate – Ready" prevailing on the date of customs clearance shall be used.

For the avoidance of doubt, the "date of customs clearance" shall mean the date on which the exchange rate is determined by Pakistan Customs for the assessment of customs duties and taxes, as reflected in the relevant Goods Declaration (GD) processed through the WeBOC system. The exchange rate applicable on such date, as adopted by Pakistan Customs for the assessment of duties and taxes, shall be the basis for calculating the exchange rate adjustment under the Contract.

6. Documentary Evidence
No exchange rate adjustment shall be admissible unless the Contractor submits documentary evidence satisfactory to the Employer, including, as applicable:

(a) Bill of Entry duly processed by Pakistan Customs;
(b) Goods Declaration (GD);
(c) Customs assessment and clearance documents;
(d) bill of lading or airway bill;
(e) packing list; and
(f) any other documents reasonably required by the Engineer to establish the value, quantity, customs clearance date and exchange rate applicable to the imported equipment.

7. Limitations
(i) Exchange rate adjustment shall be admissible only for equipment, materials and components specifically identified in the Contract as eligible for foreign currency adjustment.
(ii) No adjustment shall be allowed for imported goods purchased from local distributors, stockists or suppliers after customs clearance by a third party unless the Contractor produces the original or certified true copies of customs clearance documents establishing the applicable exchange rate.
(iii) Exchange rate adjustment shall not apply to any increase in customs duties, taxes, port charges, freight, insurance, demurrage, storage charges, bank charges or any other incidental costs.
(iv) The Employer reserves the right to verify all supporting documents before certifying any exchange rate adjustment.

8. Finality
The Engineer shall determine the amount of exchange rate adjustment in accordance with this Clause based on the documentary evidence submitted by the Contractor, and such determination shall form the basis for certification of payment under the Contract.

SECTION I: INVITATION FOR BIDS

PAKISTAN AIRPORTS AUTHORITY

Invitation For Bids

Bid No._____

For

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Date: July 2026

1. Pakistan Airports Authority [PAA] has reserved the funds for the above project and it is intended that part of the proceeds of the funds will be used to cover eligible payment under the contract for the above Works.
2. PAA now invites bids [electronic and hard copy in sealed envelopes] on a single stage-two envelope bidding procedure under Rule 36 (b) of Public Procurement Rules 2004 from the above eligible bidders for the above stated Works.
3. A Pre-Bid meeting will be held in the Project Director's Office, Skardu International Airport on 13th August, 2026 at 1100 HRS.
4. Bidders may download the Bidding Documents from EPADS. Bidding Drawings (electronic) are not available on EPADS due to size restrictions imposed by PPRA.
5. Original Bid Security not less than Pak Rupees One Hundred Million [PKR 100,000,000/-] must be accompanied with a Technical Bid in the form of a Bank Guarantee from any PAA's approved scheduled Bank in Pakistan [List of Approved Banks available in the Bidding Documents]. Bid Security shall be in favor of PAA valid for a period of 208 days i.e. 28 days beyond the bid validity date.
6. The bids (Technical & Financial) prepared in accordance with the instructions prescribed in the Bidding Documents must be submitted electronically through EPADS below on or before 17th September 2026 at 1100 HRS whereas Bid Security shall be submitted physically on or before this time at the address below along with the original TECHNICAL bid. FINANCIAL bid SHALL NOT be submitted as hard copy and shall only be uploaded to EPADS. "Technical Bid" will be opened on the same day at 1230 HRS. "Financial Bid" of technically qualified bidders will be opened later, the date of which will be communicated after the evaluation of Technical Bids. The Financial Bids of the technically unqualified bidders shall not be opened.
7. PAA reserves the right to accept or reject any or all Bids as per Rule-33 of Pakistan Public Procurement Rules 2004. Bids received after the due date and time shall be rejected.

Director (P & D),
Planning and Development Directorate, Pakistan Airports Authority,

Terminal-1, JIAP Karachi, Ph # (92-21) 99242773, Ext. 2081,
Fax # (92-21) 99242683
Email: director.pdev@Paa.gov.pk, contmgntbranch@gmail.com

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION II: INSTRUCTION TO BIDDERS (ITBs)

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

A. INTRODUCTION

1. Scope of Bid	1.1	The Procuring agency/Employer (PA), as indicated in the **Bid Data Sheet** (BDS) invites Bids for the execution of Works as specified in the BDS and **Section V- Works Requirements**. The name, identification, and number of lots (contracts) of this National/ International Competitive Bidding process are specified in the BDS.
2. Source of Funds	2.1	Source of funds as referred in **Bid Data Sheet.**
3. Eligible Bidders	**3.1**	A bidder may be natural person, company or firm or public or semi-public agency of Pakistan or any foreign country**,** or any combination of them with a formal existing agreement (on Judicial Papers) in the form of a joint venture or consortium. In the case of a joint venture or consortium, all members shall be jointly and severally liable for the execution of the Contract in accordance with the terms and conditions of the Contract. The joint venture or consortium shall nominate a Lead Member as nominated in the BDS, who shall have the authority to conduct all business for and on behalf of any and all the members of the joint venture or consortium during the Bidding process, and in case of award of contract, during the execution of contract. *(The limit on the number of members of JV or Consortium may be prescribed in **BDS**, in accordance with the guidelines issued by the PPRA).*
	3.2	The appointment of Lead Member in the joint venture or consortium shall be confirmed by submission of a valid Power of Attorney to the Procuring agency/Employer
	3.3	Verifiable copy of the agreement that forms a joint venture or consortium shall be required to be submitted as part of the Bid.
	3.4	Any bid submitted by the joint venture or consortium shall indicate the part of proposed contract to be performed by each party and each party shall be evaluated (or post qualified if required) with respect to its contribution only, and the responsibilities of each party shall not be substantially altered without prior written approval of the Procuring agency/Employer and in line with any instructions issued by the Authority.

	3.5	The invitation for bids is open to all prospective bidders subject to any provisions of incorporation or licensing by the respective national/ international incorporating agency or statutory body established for that particular trade or business.
	3.6 .	Foreign Bidders must be locally registered with the appropriate national incorporating body or the statutory body, before participating in the national/international competitive bidding with the exception of such procurements made by the foreign missions of Pakistan. For such purpose the bidder must have to initiate the registration process before the bid submission and the necessary evidence shall be submitted to the Procuring agency/Employer along with their bid, however, the final award will be subject to the complete registration process.
	3.7	A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidders may be considered to have a conflict of interest with one or more parties in this Bidding process, if they: a) are associated or have been associated in the past, directly or indirectly with a firm or any of its affiliates which have been engaged by the Procuring agency/Employer to provide consulting services for the preparation of design or technical specifications of the works that are the subject of the bid; or b) any of its affiliates has been hired (or is proposed to be hired) by the Procuring agency/Employer as Engineer for the Contract implementation; or c) The works to be executed are resulting from or directly related to consulting services for the preparation or implementation of the project that the bidder provided or were provided by any affiliate that directly or indirectly controls, is controlled by, or is under common control with that firm; d) have controlling shareholders in common; or e) receive or have received any direct or indirect subsidy from any of them; or f) have the same legal representative for purposes of this Bid; or g) have a relationship with each other, directly or

		through common third parties, that puts them in a position to have access to information about or influence on the bid of another bidder, or influence the decisions of the Procuring agency/Employer regarding this Bidding process; or h) Submit more than one bid in this bidding process.
	3.8	A Bidder may be ineligible if – (a) he is declared bankrupt or, in the case of company or firm, insolvent; (b) payments in favor of the bidder is suspended in accordance with the judgment of a court of law other than a judgment declaring bankruptcy and resulting (in accordance with the national laws) in the total or partial loss of the right to administer and dispose of its property; (c) legal proceedings are instituted against such bidder involving an order suspending payments and which may result, in accordance with the national laws, in a declaration of bankruptcy or in any other situation entailing the total or partial loss of the right to administer and dispose of the property; (d) the bidder is convicted, by a final judgment of a Court of Law or relevant Professional Statuary Body, of any offence involving professional conduct; (e) The bidder is debarred/ blacklisted by a national level Procuring agency/Employer and hence debarred due to involvement in corrupt and fraudulent practices, or performance failure or due to breach of bid securing declaration. (f) The bidder is blacklisted or debarred by a foreign country, international organization, or other foreign institutions for the period defined by them.
	3.9	Bidders shall provide to the Procuring agency/Employer evidence of their eligibility, proof of compliance with the necessary legal requirements to carry out the contract effectively.
	3.10	Bidders shall provide such evidence of their continued eligibility to the satisfaction of the Procuring agency/Employer, as the Procuring agency/Employer shall reasonably request.
	3.11	Bidders shall submit proposal relating to the nature,

		conditions and modalities of sub-contracting wherever the sub-contracting of any elements of the contract is envisaged.
4. Eligible Material and Equipment	4.1	All the material and equipment to be mobilized under the contract shall have their origin in eligible source countries, and all expenditures made under the contract will be limited to such materials and equipment. For this purpose, ineligible countries are stated in the section-IV titled as "Eligible Countries".
	4.2	For purposes of this Clause, "origin" means the place where the material, equipment is produced, manufactured, or processed, or through manufacture, procession, or assembly, another commercially recognized article results that differs substantially in its basic characteristics from its imported components or the place from where the services are/to be supplied.
	4.3	The nationality of the bidder shall not determine the origin of the material and equipment.
	4.4	To establish the eligibility of the material and equipment, Bidders shall fill the country-of-origin declarations included in the Form of Bid.
5. One Bid per Bidder	5.1	A bidder shall submit only one bid, in the same bidding process, either individually as a bidder or as a member in a joint venture or any similar arrangement.
	5.2	No bidder can be a sub-contractor while submitting a bid individually or as a member of a joint venture in the same bidding process.
6. Cost of Bidding	6.1	The Bidder shall bear all costs associated with the preparation and submission of its bid, and the Procuring agency/Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

B. BIDDING DOCUMENTS

7. Contents of Bidding Documents	7.1	The scope of Works, bidding procedures, and terms and conditions of the contract are prescribed in the bidding documents. In addition to the Invitation for Bids, the bidding documents which should be read in conjunction with any addenda issued in accordance with **ITB 9.2** include: **Section I -**Invitation for Bids **Section II** Instructions to Bidders (ITBs) **Section III** Bid Data Sheet (BDS) **Section IV** Eligible Countries **Section V** Works Requirements Technical Specifications & Schedule of Requirements **Section VI** Standard Bidding Forms **Section VII** General Conditions of Contract (GCC) **Section VIII** Special Conditions of Contract (SCC) **Section IX** Contract Forms
	7.2	The number of copies to be completed and submitted with the Bid is specified in the **BDS.**
	7.3	The Procuring agency/Employer is not responsible for the completeness of the bidding documents and their addenda, if they were not obtained directly from the Procuring agency/Employer or the signed pdf version downloaded from the website of the Procuring agency/Employer or the Authority's website or e-Procurement System as the case may be. However, Procuring agency/Employer shall place both the pdf and editable version of the same on its website and Authority's website or e-Procurement System to facilitate the bidder for filling the standard bidding forms.
	7.4	The bidder is expected to examine all instructions, forms, specifications, terms and conditions prescribed in the bidding documents. Failure to furnish all the information required in the bidding documents will be at the bidder's risk and may result in the rejection of his bid.
8. Clarification of Bidding Document, Pre-bid Meeting	8.1	A prospective bidder requiring any clarification of the bidding document may notify the Procuring agency/Employer in writing or in electronic form that provides record of the contents of communication at the Procuring agency/Employer's address indicated in the **BDS.**
	8.2	The Procuring agency/Employer will within three (3) working days after receiving the request for

		clarification, respond in writing or in electronic form to any request for clarification provided that such request is received not later than three (03) days prior to the deadline for the submission of Bids as prescribed in **ITB 24.1.** However, this clause shall not apply in case of alternate methods of procurement.
	8.3	Copies of the Procuring agency/Employer's response will be forwarded to all identified prospective bidders through an identified source of communication, including a description of the inquiry, but without specifying its source. In case of downloading of the bidding documents from the website of Procuring agency/Employer or e-Procurement System, the response of all such queries will also be available on the same platform available at the website.
	8.4	Should the Procuring agency/Employer deem it necessary to amend the bidding documents as a result of a clarification, it shall do so following the procedure as prescribed under **ITB 09.**
	8.5	If indicated **in the BDS**, the bidder's designated representative is invited at the bidder's cost to attend a pre-bid meeting at the place, date and time mentioned in the **BDS**. During this pre-bid meeting, prospective bidders may request clarification of the schedule of requirement, the evaluation criteria or any other aspects of the bidding documents.
	8.6	Minutes of the pre-bid meeting, if applicable, including the text of the questions asked by bidders, including those during the meeting (without identifying the source) and the responses given, together with any responses prepared after the meeting will be transmitted promptly to all prospective bidders who have obtained the bidding documents. Any modification to the bidding documents that may become necessary as a result of the pre-bid meeting shall be made by the Procuring agency/Employer exclusively through the use of an Addendum pursuant to **ITB 9.** Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.
	8.7	The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for

		construction of the Works. The costs of visiting the Site shall be at the bidder's own expense.
	8.8	The bidder and any of its authorized personnel will be granted permission by the Procuring agency/Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder and its personnel will release and indemnify the Procuring agency/Employer from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.
9. Amendment of Bidding Documents	9.1	Before the deadline for submission of bids, the Procuring agency/Employer for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder or pre-bid meeting may modify the bidding documents by issuing addenda.
	9.2	Any addendum issued including the notice of any extension of the deadline shall be part of the bidding documents pursuant to **ITB 7.1** and shall be communicated in a timely manner and on equal opportunity basis. Where notification of such change, addition, modification or deletion becomes essential, such notification shall be made in a manner similar to the original advertisement. *Provided that the bidder who had either already submitted their bid or handed over the bid to the courier prior to the issuance of any such addendum shall have the right to withdraw his already filed bid and submit the revised bid prior to the original or extended bid submission deadline.*
	9.3	To give prospective bidders reasonable time in which to take an addendum/corrigendum into account in preparing their bids, the Procuring agency/Employer may, at its discretion, extend the deadline for the submission of bids: *Provided that the Procuring agency/Employer shall extend the deadline for submission of bid, if such an addendum is issued within last three (03) days of the bid submission deadline.*

C. PREPARATION OF BIDS

10. Language of Bid	10.1	The bid prepared by the bidder, as well as all correspondence and documents relating to the bid exchanged by the bidder and the Procuring agency/Employer shall be written in the English language unless specified in the B**DS.** Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant pages in the English language unless specified in the **BDS**, in which case, for purposes of interpretation of the bidder, the translation shall govern.
11. Documents Establishing Eligibility of Material, Equipment and Works, their Conformity to Bidding Documents	11.1	The bid prepared by the bidder shall constitute the following components: - a) Documentary evidence established in accordance with **ITB 11** that the material, equipment and services to be provided by the Bidder are eligible material, equipment and services, and conform to the Bidding Documents; b) Documentary evidence established in accordance with **ITB 12** that the bidder has been authorized to carry out the Construction works; c) Documentary evidence established in accordance with **ITB 12** that the bidder is eligible and/or qualified for the subject bidding process; d) Form of Bid and Bid Prices completed in accordance with **ITB 14 and 15;** **e)** Completed schedules as required, including priced Bill of Quantities in accordance with **ITB 13 & 15.** **f)** Technical Proposal completed in all aspects in accordance with **ITB-17**. g) Bid security or Bid Securing Declaration furnished in accordance with **ITB 19;** h) Alternative bids, if permissible, in accordance with **ITB 20;** i) Duly Notarized Power of Attorney authorizing the signatory of the Bidder to submit the bid**;** and j) Any other document required in the **BDS**.

	11.2	In addition to the requirements, bids submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all members. Alternatively, a letter of intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all members and submitted with the bid, together with a copy of the proposed Agreement.
	11.3	The bidder shall furnish, as part of its bid, all those documents establishing the eligibility in conformity to the terms and conditions specified in the bidding documents for all material, equipment and works which the bidder proposes to execute.
	11.4	The documentary evidence of conformity of the material, equipment and works to the Bidding Documents may be in the form of literature, drawings, and data, and shall consist of: a) a detailed description of the work methodology, approach, schedule and resources to be mobilized at site; b) an item-by-item commentary on the Procuring agency/Employer's Technical Specifications demonstrating substantial responsiveness of the material, equipment and works to those specifications, or a statement of deviations and exceptions to the provisions of the Technical Specifications; c) any other procurement specific documentation requirement as stated in the **BDS**.
	11.5	The required documents and other accompanying documents must be in English. In case any other language than English is used the pertinent translation into English shall be attached to the original version.
12. Documents Establishing Eligibility and Qualification of the Bidder	12.1	The bidder shall furnish, as part of its bid, all those documents establishing the bidder's eligibility to participate in the bidding process and/or its qualification to perform the contract if its bid is accepted.
	12.2	The documentary evidence of the bidder's eligibility to bid shall establish to the satisfaction of the Procuring agency/Employer that the bidder, at the time of submission of its bid, is from an eligible country as defined in Section-IV titled as "Eligible Countries".

	12.3	The documentary evidence of the bidder's qualification to perform the contract if its bid is accepted shall establish to the satisfaction of Procuring agency/Employer that: a) The bidder has the financial and technical capability necessary to perform the Contract, meets the qualification criteria specified in Section-V, Evaluation and Qualification Criteria and **BDS**. b) In the case of a bidder not doing business within Pakistan, the bidder is or will be (if awarded the contract) represented by a local bidder (Joint Venture) in accordance with the PEC works bylaws, and in case of award of works such foreign firm is required to participate in the execution of works to carry out its obligations as prescribed in the Conditions of Contract and /or Technical Specifications. c) That the bidder meets the qualification criteria listed in Section-V, Evaluation and Qualification Criteria and **BDS.**
13. Letter of Bid and Schedules	13.1	The Letter of Bid (Technical or Financial as the case may be) and Schedules, including the Bill of Quantities, shall be prepared using the relevant forms furnished in Standard Bid Forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted except as provided under **ITB 22.** All blank spaces shall be filled in with the information requested.
14. Letter of Bid	14.1	The bidder shall fill the Letter of Bid (Technical or Financial as the case may be) furnished in the bidding documents. The Standard Bid Forms must be completed without any alterations to its format and no substitute shall be accepted.
15. Bid Prices	15.1	The bid prices quoted by the bidder in the Standard bid Forms, Bill of Quantities and in the Price Schedules shall conform to the requirements specified below or exclusively mentioned hereafter in the bidding documents.
	15.2	The bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. If a Price Schedule shows items listed but not priced, their prices shall be construed to be included in the prices of other items in the Bill of Quantities and will not be paid for separately by the Procuring agency/Employer.

	15.3	Items not listed in the Price Schedule shall be assumed not to be included in the bid, and provided that the bid is still substantially responsive in their absence or due to their nominal nature, the corresponding average price of the respective item(s) of the remaining substantially responsive bidder(s) shall be construed to be the price of those missing item(s): Provided that: a) where there is only one (substantially) responsive bidder, or b) where there is provision for alternate proposals and the respective items are not listed in the other bids, The Procuring agency/Employer may fix the price of missing items in accordance with market survey, and the same shall be considered as final price.
	15.4	The Bid price to be quoted in the Form of Bid in accordance with **ITB 15.1** shall be the total price of the bid.
	15.5	Unless otherwise specified in the **BDS** and the Contract, the rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract.
	15.6	If so specified in **ITB 1.1**, bids may be invited for individual lots (contracts) or for any combination of lots (packages).
	15.7	Prices quoted by the Bidder shall be fixed during the bidder's performance of the contract and not subject to variation on any account. A bid submitted with an adjustable price will be treated as non-responsive and shall be rejected, pursuant to **ITB 30,** unless otherwise price adjustment is permissible under Conditions of the Contract.
	15.8	All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date twenty-eight (28) days prior to the deadline for submission of bids, shall be included in the rates and prices and the total bid price submitted by the bidder.
16. Currencies of Bid and Payment	16.1	The currency(ies) of the bid and the currency(ies) of payments shall be as specified in the **BDS.**
	16.2	For the purposes of comparison of bids quoted in

		different currencies, the price shall be converted into a single currency specified in the bidding documents. The rate of exchange shall be the selling rate, prevailing on the date of opening of (financial part of) bids specified in the bidding documents, as notified by the State Bank of Pakistan on that day.
	16.3	Bidders shall indicate details of their expected foreign currency requirements in the Bid, if prescribed in the **BDS.**
	16.4	Bidders may be required by the Procuring agency/Employer to clarify their foreign currency requirements, if prescribed in the **BDS** and to substantiate that the amounts included in Lump Sum and in the **SCC** are reasonable and responsive to **ITB 16.1**.
17. Documents Comprising the Technical Proposal	17.1	The bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in **Section IV – Standard Bid Forms**, in sufficient detail to demonstrate the adequacy of the bidder's proposal to meet the work requirements and the completion time.
18. Bid Validity Period	18.1	Bids shall remain valid for the period specified in the **BDS** after the bid submission deadline prescribed by the Procuring agency/Employer. A bid valid for a shorter period shall be rejected by the Procuring agency/Employer as non-responsive**.** The period of bid validity will be determined from the complementary bid securing instrument i.e. the expiry period of bid security or bid securing declaration as the case may be.
	18.2	Under exceptional circumstances, prior to the expiration of the initial bid validity period, the Procuring agency/Employer may request the bidders' consent to an extension of the period of validity of their bids only once, for the period not more than the period of initial bid validity. The request and the bidders' responses shall be made in writing or in electronic forms that provide record of the content of communication. The Bid Security provided under **ITB 19** shall also be extended 28 days beyond the deadline of extended bid validity period. A bidder may refuse the request for the extension of his bid without forfeiting his bid security or causing to be executed his Bid Securing Declaration. A bidder agreeing to the

		request will not be required nor permitted to modify its bid, but will be required to extend the validity of its Bid Security or Bid Securing Declaration for the period of the extension, and in compliance with **ITB 19** in all respects.
19. Bid Security or Bid Securing Declaration	19.1	Pursuant to **ITB 11.1** unless otherwise specified in the **BDS**, the bidder shall furnish as part of its bid, a Bid Security in form of fixed amount not exceeding five percent of the estimated value of procurement determined by the Procuring agency/Employer and in the amount and currency specified in the **BDS** or Bid Securing Declaration as specified in the **BDS** in the format provided in **Section VI (Standard Bidding Forms)**. In case Procuring agency/Employer is inviting bids in lots / packages, the bidder shall be required to submit his bid security against the respective lot/ package for which he is submitting his bid, which shall not exceed five percent of the estimated value of that particular lot/ package.
	19.2	The Bid Security or Bid Securing Declaration is required to protect the Procuring agency/Employer against the risk of Bidder's conduct before award of the contract to the most advantageous bidder which would warrant the security's forfeiture, pursuant to **ITB 19.9.**
	19.3	The Bid Security shall be denominated in the local currency or in another freely convertible currency, and it shall be in the form specified in the **BDS** which shall be in any of the following: a) A bank guarantee, an irrevocable letter of credit issued by a Scheduled bank in the form provided in the Bidding Documents or another form acceptable to the Procuring agency/Employer and valid for twenty-eight (28) days beyond the end of the validity of the Bid. This shall also apply if the period for Bid Validity is extended. In either case, the form must include the complete name of the bidder; b) A cashier's or certified cheque; or c) Another security as indicated in the **BDS.**
	19.4	The Bid Security or Bid Securing Declaration shall be in accordance with the Form of the Bid Security or Bid

		Securing Declaration included in **Section VI (Standard Bidding Forms)** or another form approved by the Procuring agency/Employer prior to the bid submission.
	19.5	The Bid Security shall be payable promptly upon written demand by the Procuring agency/Employer in case any of the conditions listed in **ITB 19.9** are invoked.
	19.6	Any bid not accompanied by a Bid Security or Bid Securing Declaration in accordance with **ITB 19.1 or 19.3** shall be rejected by the Procuring agency/Employer and shall be declared as non-responsive bid, pursuant to **ITB 30**.
	19.7	Unsuccessful bidders' Bid Security will be discharged or returned as promptly as possible, however in no case later than thirty (30) days after the expiration of the period of Bid Validity prescribed by the Procuring agency/Employer pursuant to **ITB 18**. The Procuring agency/Employer shall make no claim to the amount of the Bid Security, and shall promptly return the Bid Security document, after whichever of the following that occurs earliest: (a) The expiry of the Bid Security; (b) The entry into force of a procurement contract and the provision of a performance security (or guarantee), for the performance of the contract if such a security (or guarantee), is required by the Biding documents; (c) The rejection by the Procuring agency/Employer of all Bids; (d) The withdrawal of the bid prior to the deadline for the submission of bids, unless the biding documents stipulate that no such withdrawal is permitted.
	19.8	The successful bidder's Bid Security will be discharged upon the bidder signing the contract pursuant to **ITB 47,** or furnishing the performance security (or guarantee), pursuant to **ITB 48**.
	19.9	The Bid Security may be forfeited or the Bid Securing Declaration executed: a) if a Bidder: i) Withdraws its Bid during the period of Bid Validity as specified by the Procuring agency/Employer, and referred by the bidder on

		the Form of Bid except as provided for in **ITB 18.2**; or ii) Does not accept the correction of errors pursuant to **ITB 32;** or b) In the case of a successful bidder, if the bidder fails: i) to sign the contract in accordance with **ITB 47**; or ii) to furnish performance security (or guarantee) in accordance with **ITB 48.**
	19.10	In case of Bid Security issued by the foreign bank is allowed by the Procuring agency/Employer, the same should be counter guaranteed by a corresponding bank in Pakistan. Furthermore, in case of joint venture, it should be in the name of Joint venture to ensure joint responsibility.
20. Alternative Bids by Bidders	20.1	Bidders shall submit offers that comply with the requirements of the bidding documents, including the basic bidder's technical design as indicated in the specifications and Bill of Quantities. Alternatives will not be considered, unless specifically allowed for in the **BDS**. If so allowed, **ITB 20** shall prevail.
	20.2	When alternative schedule for execution of works is explicitly invited, a statement of that effect will be included in the **BDS** as will the method for evaluating different schedule for execution of works.
	20.3	If so allowed in the **BDS**, bidders wishing to offer technical alternatives to the requirements of the bidding documents must also submit a bid that complies with the requirements of the bidding documents, including the basic technical design as indicated in the specifications. In addition to submitting the basic bid, the bidder shall provide all information necessary for a complete evaluation of the alternative by the Procuring agency/Employer, including technical specifications, breakdown of prices, and other relevant details. Only the technical alternatives, if any, of the Most Advantageous Bidder conforming to the basic technical requirements (without altering the bid price) shall be considered by the Procuring agency/Employer.
21. Withdrawal of Bids	21.1	Before bid submission deadline, any bidder may withdraw, substitute, or modify its bid after it has been submitted by sending a written notice, duly signed by

		an authorized representative, and the corresponding must accompany the respective written notice.
	21.2	Bids requested to be withdrawn in accordance with **ITB 21.1** shall be returned unopened to the bidders.
22. Format and Signing of Bid	22.1	The Bidder shall prepare an original and the number of copies of the bid as indicated in the **BDS**, clearly marking each **"ORIGINAL"** and **"COPY"** as appropriate. In the event of any discrepancy between them, the original shall prevail: *Provided that except in Single Stage One Envelope Procedure, the bid shall include only the copies of technical proposal.*
	22.2	The original and the copy (ies) of the bid shall be typed or written in indelible ink and shall be signed by the bidder or a person or persons duly authorized to sign on behalf of the bidder. This authorization shall consist of a written confirmation as specified in the **BDS** and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid, except for un-amended printed literature, shall be initialed by the person or persons signing the bid.
	22.3	Any interlineations, erasures, or overwriting shall be valid only if they are signed by the person(s) authorized for signing the Bid.

D. SUBMISSION OF BIDS

23. Sealing and Marking of Bids	23.1	In case of Single Stage One Envelope Procedure, the bidder shall seal the original and each copy of the bid in separate envelopes, duly marking the envelopes as **"ORIGINAL"** and **"COPY".** The envelopes shall then be sealed in an outer envelope securely sealed in such a manner that opening and resealing cannot be achieved undetected. **Note:** *The envelopes shall be sealed and marked in accordance with the bidding procedure adopted as referred in Rule-36 of Public Procurement Rules,2004.*
	23.2	The inner and outer envelopes shall: a) be addressed to the Procuring agency/Employer at the address given in the **BDS**; and b) bear the title of the subject procurement or project name, as the case may be as indicated in the **BDS**, the Invitation for Bids (ITB) title and number indicated in the **BDS**, and a statement: **"DO NOT**

		OPEN BEFORE", to be completed with the time and the date specified in the **BDS**, pursuant to **ITB 24.1.**
	23.3	In case of Single Stage Two Envelope Procedure, The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Proposal and the other Financial Proposal. Both envelopes to be enclosed together in an outer single envelope called the Bid. Each Bidder shall submit his bid as under: a) Bidder shall submit his **TECHNICAL PROPOSAL** and **FINANCIAL PROPOSAL** in separate inner envelopes and enclosed in a single outer envelope. b) **ORIGINAL** and each copy of the Bid shall be separately sealed and put in separate envelopes and marked as such. c) The envelopes containing the **ORIGINAL** and copies will be put in one sealed envelope and addressed / identified as given in **ITB 23.2.**
	23.4	The inner and outer envelopes shall: a) be addressed to the Procuring agency/Employer at the address provided in the **BDS**; b) bear the name and identification number of the contract as defined in the **BDS**; and provide a warning not to open before the time and date for bid opening, as specified in the **BDS** pursuant to **ITB 24.1.** c) In addition to the identification required in **ITB 23** hereof, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to **ITB 25.**
	23.5	If all envelopes are not sealed and marked as required by **ITB 23.2**, **ITB 23.3** and **ITB 23.4** or incorrectly marked, the Procuring agency/Employer will assume no responsibility for the misplacement or premature opening of bid.
24. Deadline for Submission of Bids	24.1	Bids shall be received to the Procuring agency/Employer no later than the date and time specified in the **BDS.**
	24.2	The Procuring agency/Employer may, under exceptional circumstances and at its discretion, extend the deadline for the submission of bids by amending the Bidding Documents in accordance with **ITB 9**, in which case all

		rights and obligations of the Procuring agency/Employer and bidders previously subject to the deadline will thereafter be subject to the new deadline.
25. Late Bids	25.1	The Procuring agency/Employer shall not consider for evaluation of any bid that arrives after the deadline for submission of bids, in accordance with **ITB 24**.
	25.2	Any bid received by the Procuring agency/Employer after the deadline for submission of bids shall be declared late, recorded, rejected and returned unopened to the bidder.
26. Substitution and Modification of bids	26.1	A bidder may substitute or modify his bid after it has been submitted, provided that written notice of the substitution or modification of the bid, is received by the Procuring agency/Employer prior to the deadline for submission of bids.
	26.2	Revised bid may be submitted after the substitution or modification made in the original bid in accordance with the provisions referred in **ITB 22.**

E. OPENING AND EVALUATION OF BIDS

27. Opening of Bids	27.1	The Procuring agency/Employer will open all bids, in public, in the presence of bidders' or their representatives who choose to attend, and other parties with a legitimate interest in the bid proceedings at the place, on the date and at the time, specified in the **BDS**. The bidders' representatives present shall sign a attendance sheet as a proof of their attendance.
	27.2	First, envelopes marked **"WITHDRAWAL"** shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.
	27.3	Second, outer envelopes marked **"SUBSTITUTION"** shall be opened. The inner envelopes containing the Substitution Bid shall be exchanged for the corresponding Original Bid being substituted, which is to be returned to the bidder unopened. No envelope shall be substituted unless the corresponding Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.

	27.4	Next, outer envelopes marked **"MODIFICATION"** shall be opened. No Technical Proposal and/or Financial Proposal shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of the bids. Any modification shall be read out along with the Original Bid except in case of Single Stage Two Envelope Procedure where only the Technical Proposal, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Financial Proposal, both Original and Modification, will remain unopened till the prescribed financial bid opening date.
	27.5	Other envelopes holding the bids shall be opened one at a time, in case of Single Stage One Envelope Procedure, the bidders' names, the bid prices, the total amount of each bid and of any alternative bid (if alternatives have been requested or permitted), the presence or absence of Bid Security, Bid Securing Declaration and such other details as the Procuring agency/Employer may consider appropriate, will be announced by the Procurement Evaluation Committee.
	27.6	In case of Single Stage Two Envelope Procedure, the Procuring agency/Employer will open the Technical Proposals in public at the address, date and time specified in the **BDS** in the presence of bidders' designated representatives who choose to attend and other parties with a legitimate interest in the bid proceedings. The Financial Proposals will remain unopened and will be held in custody of the Procuring agency/Employer until the specified time of their opening.
	27.7	The envelopes holding the Technical Proposals shall be opened one at a time, and the following read out and recorded: (a) the name of the bidder; (b) whether there is a modification or substitution; (c) the presence of a Bid Security or Bid Securing Declaration, if required; and (d) Any other details as the Procuring agency/Employer may consider appropriate.

	27.8	Bids not opened and not read out at the bid opening shall not be considered further for evaluation, irrespective of the circumstances.
	27.9	Bidders are advised to send in a representative with the knowledge of the content of the bid who shall verify the information read out from the submitted documents. Failure to send a representative or to point out any un-read information by the sent bidder's representative shall indemnify the Procuring agency/Employer against any claim or failure to read out the correct information contained in the bidder's bid.
	27.10	No bid will be rejected at the time of bid opening except for late bids which will be returned unopened to the bidder, pursuant to **ITB 25.**
	27.11	The Procuring agency/Employer shall prepare minutes of the bid opening. The record of the bid opening shall include, as a minimum: the name of the bidder and whether or not there is a withdrawal, substitution or modification, the bid price if applicable and the presence or absence of a Bid Security or Bid Securing Declaration.
	27.12	The bidders' representatives who are present shall be requested to sign on the attendance sheet. The omission of a bidder's signature on the record shall not invalidate the contents and affect the record. A copy of the record shall be distributed to all the bidders.
	27.13	A copy of the minutes of the bid opening shall be furnished to individual bidders upon request.
	27.14	In case of Single Stage -Two Envelop Bidding Procedure, after the announcement of technical evaluation report, the Procuring agency/Employer, shall at a time within the bid validity period, publicly open the financial proposals of the technically responsive bidder only. The financial proposal of bidders found technically non-responsive shall be returned un-opened to the respective bidders after seven days of the announcement of technical evaluation report, except those aggrieved bidder(s) whose complaints are pending before the Grievance Redressal Committee.

28. Confidentiality	28.1	Information relating to the examination, clarification, evaluation and comparison of bids and recommendation of contract award shall not be disclosed to bidders or any other persons not officially concerned with such process until the time of the announcement of the respective evaluation report.
	28.2	Any effort by a bidder to influence the Procuring agency/Employer processing of bids or award decisions may result in the rejection of its bid.
	28.3	Notwithstanding **ITB 28.2** from the time of bid opening to the time of contract award, if any bidder wishes to contact the Procuring agency/Employer on any matter related to the bidding process, it should do so in writing or in electronic forms that provides record of the content of communication.
29. Clarification of Bids	29.1	To assist in the examination, evaluation and comparison of bids, the Procuring agency/Employer may, ask any bidder for a clarification of its bid including breakdown of prices invariably in writing. Any clarification submitted by a bidder that is not in response to a request by the Procuring agency/Employer shall not be considered.
	29.2	The request for clarification and the response shall be in writing or in electronic forms that provide record of the content of communication. No change in the prices or substance of the bid shall be sought, offered, or permitted, except clarification for the correction of arithmetic errors discovered by the Procuring agency/Employer during the evaluation of bids which shall be sought in accordance with **ITB 32**.
	29.3	The alteration or modification in the bid which in any case affect the following parameters will be considered as a change in the substance of a bid: a) evaluation & qualification criteria; b) required scope of work; c) contract price; d) all securities requirements; e) tax requirements; f) terms and conditions of bidding documents.

		g) change in the ranking of the bidder
	29.4	From the time of bid opening to the time of Contract award if any bidder wishes to contact the Procuring agency/Employer on any matter related to the bid it should do so in writing or in electronic forms that provide record of the content of communication.
30. Preliminary Examination of Bids	30.1	Prior to the detailed evaluation of bids, the Procuring agency/Employer will determine whether each bid: a) meets the eligibility criteria defined in **ITB 3** and **ITB 4**; b) has been prepared as per the format and contents defined by the Procuring agency/Employer in the bidding documents; c) has been properly signed; d) is accompanied by the required securities; and e) is substantially responsive to the requirements of the bidding documents. The Procuring agency/Employer's determination of a bid's substantial responsiveness will be based on the contents of the bid itself.
	30.2	A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding Documents, without material deviation or reservation. A material deviation or reservation is one that: - a) affects in any substantial way the scope, quality, or performance of the Works; b) limits in any substantial way, inconsistent with the bidding documents, the Procuring agency/Employer's rights or the bidders' obligations under the Contract; or c) if rectified, would affect unfairly the competitive position of other bidders presenting substantially responsive bids.
	30.3	The Procuring agency/Employer will confirm that

		the documents and information specified under **ITB 11, 12** and **13** have been provided in the bid. If any of these documents or information is missing, or is not provided in accordance with the Instructions to Bidders, the bid shall be rejected.
	30.4	The Procuring agency/Employer may waive-off any minor informality, nonconformity, or irregularity in a bid which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder. ***Explanation:*** *A minor informality, non-conformity or irregularity is one that is merely a matter of form and not of substance. It also pertains to some immaterial defect in a Bid or variation of a bid from the exact requirements of the invitation that can be corrected or waived without being prejudicial to other bidders. The defect or variation is immaterial when the effect on quantity, quality, or delivery is negligible when contrasted with the total cost or scope of the works. The Procuring agency/Employer either shall give the bidder an opportunity to cure any deficiency resulting from a minor informality or irregularity in a bid or waive the deficiency, whichever is advantageous to the Procuring agency/Employer. Examples of minor informalities or irregularities include failure of a bidder to –* (a) *Submit the number of copies of signed bids required by the invitation;* (b) *Furnish required information concerning the number of its employees;* (c) *the firm submitting a bid has formally adopted or authorized, before the date set for opening of bids, the execution of documents by typewritten, printed, or stamped signature and submits evidence of such authorization and the bid carries such a signature.*
	30.5	Provided that a Technical Bid is substantially responsive, the Procuring agency/Employer may request the bidder to submit the necessary

		information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities or omissions in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any such aspect of the technical Proposal linked with the ranking of the bidders. Failure of the bidder to comply with the request may result in the rejection of its bid.
	30.6	Provided that a Technical Bid is substantially responsive, the Procuring agency/Employer shall rectify quantifiable nonmaterial nonconformities or omissions related to the Financial Proposal. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of the missing or nonconforming item or component.
	30.7	If a bid is not substantially responsive, it will be rejected by the Procuring agency/Employer and may not subsequently be evaluated for complete technical responsiveness.
31. Examination of Terms and Conditions; Technical Evaluation	31.1	The Procuring agency/Employer shall examine the bid to confirm that all terms and conditions specified in the **GCC** and the **SCC** have been accepted by the bidder without any material deviation or reservation. For this purpose: "Deviation" means departure from the requirements specified in the Bidding Document. "Reservation" means setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document.
	31.2	The Procuring agency/Employer shall evaluate the technical aspects of the bid submitted in accordance with **ITB 31,** to confirm that all requirements specified in **Section V – Works Requirement**, **Technical Specifications of** the Bidding Documents have been met without material deviation or reservation.
	31.3	If after the examination of the terms and conditions and the technical evaluation, the Procuring agency/Employer determines that the bid is not substantially responsive in accordance with **ITB 30,** it shall reject the bid.

32. Correction of Arithmetic Errors	32.1	Bids determined to be substantially responsive will be checked for any arithmetic errors. Errors will be corrected as follows: - a) if there is a discrepancy between unit prices and the sub-total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the sub-total price shall be corrected, unless in the opinion of the Procuring agency/Employer there is an obvious misplacement of the decimal point in the unit price, in which the total price as quoted shall govern and the unit price shall be corrected; b) if there is an error in a total corresponding to the addition or subtraction of sub-totals, the sub-totals shall prevail, and the total shall be corrected; and c) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern. d) Where there is discrepancy between grand total of price schedule and amount mentioned on the Form of Bid, the amount referred in Price Schedule shall be treated as correct subject to elimination of other errors.
	32.2	The amount stated in the Bid will, be rectified by the Procuring agency/Employer in accordance with the above procedure for the correction of errors and, with, the concurrence of the bidder, shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount, its bid shall be rejected after forfeiture of Bid Security or execution of the Bid Securing Declaration, as the case may be, in accordance with **ITB 19.9.**

33. Conversion to Single Currency	33.1	The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works from outside the Procuring agency/Employer's country (referred to as the "Foreign Currency Requirements") shall indicate the same in the letter of bid-financial proposal. The proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the Bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in his bid.
	33.2	To facilitate evaluation and comparison, the Procuring agency/Employer will convert all bid prices expressed in the amounts in various currencies in which the bid prices are payable. For the purposes of comparison of bids quoted in different currencies, the price shall be converted into a single currency specified in the bidding documents. The rate of exchange shall be the selling rate, prevailing on the date of opening of (financial part of) bids specified in the bidding documents, as notified by the State Bank of Pakistan on that day.
	33.3	The currency selected for converting bid prices to a common base for the purpose of evaluation, along with the source and date of the exchange rate, are specified in the **BDS**.
34. Evaluation of Bids	34.1	The Procuring agency/Employer shall evaluate and compare only the bids determined to be substantially responsive, pursuant to **ITB 30**.
	34.2	In evaluating the Technical Proposal of each Bid, the Procuring agency/Employer shall use the criteria and methodologies listed in the **BDS** and in terms of works requirement. No other evaluation criteria or methodologies shall be permitted.

	34.3	The Procuring agency/Employer's evaluation of a bid will take into account: a) the bid price, excluding provisional sums and the provision, if any, for contingencies in the summary bill of quantities, but including day work items, where priced competitively; b) price adjustment for correction of arithmetic errors in accordance with **ITB 32.1;** c) converting the amount resulting from applying (a) and (b) above, if relevant, to a single currency in accordance with **ITB 33**;
	34.4	The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.
	34.5	If these bidding documents allow bidders to quote separate prices for different lots, and the award to a single bidder of multiple lots, the methodology of evaluation to determine the lowest evaluated lot combinations in the Form of Bid, is specified in the **BDS.**
	34.6	If the bid, which results in the Evaluated Bid Price (Most Advantageous Bid), is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. **Explanation:**

		"Unbalanced" or "front-loaded" bids consist of deliberately submitting bids with artificially high prices or unit rates for the early stages of a construction project, offset by artificially low prices or unit rates for the later stages of the project, to improve the contractor's cash flow.
35. Domestic Preference	35.1	If the **BDS** so specifies, the Procuring agency/Employer will grant a margin of preference to the domestic contractor in line with the rules, regulations, regulatory guides or instructions issued by the Authority from time to time.
36. Determination of Most Advantageous Bid	36.1	The Procuring agency/Employer shall compare the evaluated bids in accordance with the predefined bidding procedure, of all substantially responsive bids to determine the Most Advantageous bidder.
37. Qualification of Bidder	37.1	The Procuring agency/Employer shall determine to its satisfaction whether the bidder is substantially responsive and whose bid is declared as most advantageous bid either continues to meet (if prequalification applies) or meets (if post-qualification applies) the qualifying criteria specified in Evaluation and Qualification Criteria. *Note: In case of International bidding, the parameters for incorporation or licensing within Pakistan may be fulfilled as part of post qualification.*
	37.2	The determination shall be based upon an examination of the documentary evidence of the bidder's qualifications submitted by the bidder, pursuant to **ITB 12**.
	37.3	Prior to contract award, the Procuring agency/Employer will verify that the successful bidder (including each member of a JV) is not blacklisted/debarred. The Procuring agency/Employer will conduct the same verification for each sub-contractor proposed by the successful bidder.

38. Sub-Contractors	38.1	The bidder shall provide details regarding any specialized sub-contractor to the Procuring agency/Employer. In case change of sub-contractors, the bidder shall promptly notify the Procuring agency/Employer and obtain approval for replacement of sub-contractors.
	38.2	Bidders may propose sub-contracting up to the percentage of total value of contracts or the volume of works as specified in the **BDS.**

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39. Abnormally Low Financial Bid	39.1	Where the bid price is considered to be abnormally low, the Procuring agency/Employer shall perform price analysis either during determination of Most Advantageous Bid or as a part of the post-qualification process. The following process shall apply: a) The Procuring agency/Employer may reject a bid if the Procuring agency/Employer has determined that the price in combination with other constituent elements of the bid is abnormally low in relation to the subject matter of the procurement (i.e. scope of the procurement or ancillary services) and raises concerns as to the capability and capacity of the respective Bidder to perform that contract; b) Before rejecting an abnormally low bid the Procuring agency/Employer shall request the bidder an explanation of the bid or of those sections which it considers contribute to the bid being abnormally low; take account of the evidence provided in response to a request in writing; and subsequently verify the bid or parts of the bid being abnormally low; c) The decision of the Procuring agency/Employer to reject a bid and reasons for the decision shall be recorded in the procurement proceedings and promptly communicated to the bidder concerned; d) The Procuring agency/Employer shall not incur any liability solely by rejecting abnormally bid; and e) An abnormally low bid means, in the light of the Procuring agency/Employer's estimate and of all the bids submitted, the bid appears to be abnormally low by not providing a margin for normal levels of profit. **Guidance for Procuring agency/Employer:** In order to identify the Abnormally Low Bid (ALB) following approaches can be considered to

		minimize the scope of subjectivity: (i) Comparing the bid price with the cost estimate; (ii) Comparing the bid price with the bids offered by other bidders submitting substantially responsive bids; and (iii) Comparing the bid price with prices paid in similar contracts in the recent past either government- or development partner-funded.
	39.2	The Procuring agency/Employer will determine to its satisfaction whether the bidder that is selected as having submitted the most advantageous bid is qualified to perform the contract satisfactorily, in accordance with the criteria listed in **ITB 12**
	39.3	The determination will take into account the bidder's financial and technical capabilities. It will be based upon an examination of the documentary evidence of the bidder's qualifications submitted by the bidder, pursuant to **ITB 12,** as well as such other information as the Procuring agency/Employer deems necessary and appropriate. Factors not included in these bidding documents shall not be used in the evaluation of the bidders' qualifications.
	39.4	Procuring agency/Employer may seek "Certificate for Independent Price Determination" from the bidder and the results of reference checks may be used in determining award of contract. ***Explanation:*** *The Certificate shall be furnished by the bidder. The bidder shall certify that the price is determined keeping in view of all the essential aspects such as raw material, its processing, value addition, optimization of resources due to economy of scale, transportation, insurance and margin of profit etc.*
	39.5	An affirmative determination will be a prerequisite for award of the contract to the bidder. A negative determination will result in rejection of the bidder's bid, in which event the Procuring agency/Employer will proceed to the next ranked bidder to make a similar

		determination of that bidder's capabilities to perform satisfactorily.

F. AWARD OF CONTRACT

40. Criteria of Award	40.1	Subject to **ITB 36** and **37**, the Procuring agency/Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has been declared as Most Advantageous Bidder, provided that such bidder has been determined to be: a) eligible in accordance with the provisions of **ITB 3;** b) is determined to be qualified to perform the Contract satisfactorily; and c) Successful negotiations have been concluded, if any.
41. Negotiations	41.1	The Committee of the Procuring agency/Employer may negotiate with the Most Advantageous Bidder relating to the following areas: (a) a minor alteration to the technical (drawings, design technical specifications) details of the statement of works; (b) Methodology, work plan, staffing in view to streamline the work; (c) a minor amendment to the special conditions of Contract; (d) finalizing payment arrangements; (e) clarifying details that were not apparent or could not be finalized at the time of Bidding;
	41.2	Where negotiation fails to result into an agreement, the Procuring agency/Employer may invite the next ranked bidder for negotiations. Where negotiations are commenced with the next ranked bidder, the Procuring agency/Employer shall not reopen earlier negotiations.

42. Procuring agency/Employer's Right to reject All Bids	42.1	Notwithstanding **ITB 37**, the Procuring agency/Employer reserves the right to reject all the bids, and to annul the bidding process at any time prior to acceptance of bid, without thereby incurring any liability to the affected bidder(s). However, the Authority (i.e. PPRA) may call from the Procuring agency/Employer the justification of those grounds.
	42.2	Notice of the rejection of all bids shall be given promptly to all bidders that have submitted bids.
	42.3	The Procuring agency/Employer shall upon request communicate to any bidder the grounds for its rejection of its bids, but is not required to justify those grounds.

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43. Variations	43.1	The Engineer shall make any variation in the quantity of the Works or any part thereof that may, in his opinion, be necessary and for that purpose, or if for any other reason it shall, in his opinion, be appropriate, he shall have the authority to instruct the Contractor to do and the Contractor shall do any of the following: a) increase or decrease the quantity of any work included in the Contract, b) omit any such work (but not if the omitted work is to be carried out by the Employer or by another contractor), c) change the character or quality or kind of any such work, d) change the levels, lines, position and dimensions of any part of the Works, e) execute additional work of any kind necessary for the completion of the Works, or f) change any specified sequence or timing of construction of any part of the Works. No such variation shall in any way vitiate or invalidate the Contract, but the effect, if any, of all such variations shall be valued in accordance with **ITB 15**. Provided that where the issue of an instruction to vary the Works is necessitated by some default of or breach of contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor.
44. Instructions for variations	44.1	The Contractor shall not make any such variation without an instruction of the Engineer. Provided that no instruction shall be required for increase or decrease in the quantity of any work where such increase or decrease is not the result of an instruction given under this Clause, but is the result of the quantities exceeding or being less than those stated in the Bill of Quantities.
45. Valuation of Variations	45.1	All variations and any additions to the Contract Price which are required to be determined in accordance with **ITB 15** (for the purposes of this Clause referred to as "varied work"), shall be valued at the rates and prices set out in the Contract if, in the opinion of the Engineer, the same shall be applicable. If the Contract does not contain any rates

		or prices applicable to the varied work, the rates and prices in the Contract shall be used as the basis for valuation so far as may be reasonable, failing which, after due consultation by the Engineer with the Procuring agency/Employer and the Contractor, suitable rates or prices shall be agreed upon between the Engineer and the Contractor. In the event of disagreement, the Engineer shall fix such rates or prices as are, in his opinion, appropriate and shall notify the Contractor accordingly, with a copy to the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to be included in certificates issued in accordance with **ITB 15.**
46. Notification of Award	46.1	Prior to the award of contract, the Procuring agency/Employer shall issue a Final Evaluation Report giving justification for acceptance or rejection of the bids.
	46.2	Where no complaints have been lodged, the bidder whose bid has been accepted will be notified of the award by the Procuring agency/Employer prior to expiration of the bid validity period in writing or through electronic means that provide record of the content of communication. However, the Procuring agency/Employer shall not award any procurement contract atleast for fifteen (15) days after the acceptance of bid. The notification letter (herein after and in the condition of the contract and contract form called “Letter of Acceptance” will specify the sum that the Procuring agency/Employer will pay the successful bidder in consideration for the execution and completion of the works as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price).
	46.3	The notification of award will constitute the formation of the Contract, subject to the bidder furnishing the Performance Security (or guarantee) in accordance with **ITB 48** and signing of the contract in accordance with **ITB 47.**
	46.4	Upon the successful bidder’s furnishing of the performance security (or guarantee) pursuant to **ITB 48**, the Procuring agency/Employer will promptly notify each unsuccessful bidder, the name of the

		successful bidder and the Contract amount and will discharge the Bid Security or Bid Securing Declaration of the bidder(s) pursuant to **ITB 19**.
47. Signing of Contract	47.1	Promptly after notification of award, Procuring agency/Employer shall send the successful bidder the draft agreement, incorporating all terms and conditions as agreed by the parties to the contract.
	47.2	Immediately after the Redressal of grievance by the GRC, and after fulfillment of all conditions precedent of the Contract Form, the successful bidder and the Procuring agency/Employer shall sign the contract.
	47.3	Where no formal signing of a contract is required, work order issued to the bidder shall be construed to be the contract.
48. Performance Security (or Guarantee)	48.1	After the receipt of the Letter of Acceptance, the successful bidder, within the specified time, shall deliver to the Procuring agency/Employer a Performance Guarantee in the amount and in the form stipulated in the **BDS and SCC**, denominated in the type and proportions of currencies in the Letter of Acceptance and in accordance with the Conditions of Contract.
	48.2	If the Performance Guarantee is provided by the successful bidder and it shall be in the form specified in the **BDS** which shall be in any of the following: (a) certified cheque, cashier's or manager's cheque, or bank draft; (b) irrevocable letter of credit issued by a scheduled bank of Pakistan or in the case of an irrevocable letter of credit issued by a foreign bank, the letter shall be confirmed or authenticated by a scheduled bank of Pakistan; (c) bank guarantee confirmed by a reputable local bank or, in the case of a successful foreign bidder, bonded by a foreign bank; or (d) surety bond callable upon demand issued by any reputable surety or insurance company. Any Performance Guarantee submitted shall be enforceable in Pakistan.
	48.3	Failure of the Most Advantageous Bidder to comply with the requirement of **ITB 47** shall constitute sufficient grounds for the annulment of the award and

		forfeiture of the Bid Security or declare blacklisted (in case bid securing declaration is submitted) in which event the Procuring agency/Employer may make the award to the next most advantageous bidder or reinitiate the procurement process afresh (as a case may be).
49. Advance Payment	49.1	Advance payment will be provided to the bidder in percentage and in the manner as agreed by the both parties in terms of Conditions of the Contract.
	49.2	The Procuring agency/Employer will provide an advance payment as stipulated in the Conditions of Contract, subject to a maximum amount, as stated and/or Conditions of the Contract. The advance payment request shall be accompanied by an advance payment security (guarantee) in the form provided in Section X. For the purpose of receiving the advance payment, the bidder shall make and estimate of, and include in its bid, the expenses that will relate to the purchase of equipment, machinery, materials, and on the engagement of labor during the first month beginning with the date of the Procuring agency/Employer's "Notice to Commence" as specified in the **SCC.**
50. General Performance of the Bidders	50.1	The Procuring agency/Employer reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts / works. The Procuring agency/Employer may seek information / report from the previous employer for consideration. However, the Procuring agency/Employer shall incorporate such parameters in the evaluation criteria and accordingly decide the fate of the bid submitted.
51. Corrupt & Fraudulent Practices	51.1	Procuring agencies (including beneficiaries of Government funded projects and procurement) as well as Bidders/Suppliers/Contractors under Government financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts, and will avoid to engage in any corrupt and fraudulent practices.

G. GRIEVANCE REDRESSAL & COMPLAINT REVIEW MECHANISM

52. Constitution of Grievance Redressal	52.1	Procuring agency/Employer shall constitute a Grievance Redressal Committee (GRC) comprising of odd number of persons with proper power and authorization to address the complaint. The GRC shall not have any of the members of Procurement Evaluation Committee. The committee must have one subject specialist depending the nature of the procurement.
53. GRC Procedure	53.1	Any party can file its written complaint against the eligibility parameters or any other terms and conditions prescribed in the prequalification or bidding documents found contrary to provision of Procurement Regulatory Framework, and the same shall be addressed by the GRC well before the bid submission deadline.
	53.2	Any bidder feeling aggrieved by any act of the Procuring agency/Employer after the submission of his bid may lodge a written complaint concerning his grievances not later than seven days of the announcement of technical evaluation report and five days after issuance of final evaluation report.
	53.3	In case, the complaint is filed against the technical evaluation report, the GRC shall suspend the procurement proceedings.
	53.4	In case, the complaint is filed after the issuance of the final evaluation report, the complainant cannot raise any objection on technical evaluation of the report: Provided that the complainant may raise the objection on any part of the final evaluation report in case where single stage one envelope bidding procedure is adopted.
	53.5	The GRC, in both the cases shall investigate and decide upon the complaint within ten days of its receipt.
	53.6	Any bidder or the Procuring agency/Employer not satisfied with the decision of the GRC may file Appeal before the Appellate Committee of the Authority on prescribed format after depositing the Prescribed fee.
	53.7	The Committee, upon receipt of the Appeal against the decision of the GRC complete in all respect shall serve notices in writing upon all the parties to Appeal.

	53.8	The committee shall call the record from the concerned Procuring agency/Employer or the GRC as the case may be, and the same shall be provided within prescribed time.
	53.9	The committee may after examination of the relevant record and hearing all the concerned parties, shall decide the complaint within fifteen (15) days of receipt of the Appeal.
	53.10	The decision of the Committee shall be in writing and shall be signed by the Head and each Member of the Committee. The decision of the committee shall be final.

H. MECHANISM OF BLACKLISTING

54. Mechanism of Blacklisting	54.1	The Procuring agency/Employer shall bar for not more than the time prescribed in Rule-19 of the Public Procurement Rules, 2004, from participating in their respective procurement proceedings, bidder or contractor who either: Involved in corrupt and fraudulent practices as defined in Rule-2 of Public Procurement Rules; i) Fails to perform his contractual obligations; and ii) Fails to abide by the id securing declaration;
	54.2	The show cause notice shall contain: (a) precise allegation, against the bidder or contractor; (b) the maximum period for which the Procuring agency/Employer proposes to debar the bidder or contractor from participating in any public procurement of the Procuring agency/Employer; and (c) the statement, if needed, about the intention of the Procuring agency/Employer to make a request to the Authority for debarring the bidder or contractor from participating in public procurements of all the procuring agencies.
	54.3	The Procuring agency/Employer shall give minimum of seven days to the bidder or contractor for submission of written reply of the show cause notice.
	54.4	In case, the bidder or contractor fails to submit written reply within the requisite time, the Procuring agency/Employer may issue notice for personal hearing to the bidder or contractor/ authorize representative of the bidder or contractor and the Procuring agency/Employer shall decide the matter

		on the basis of available record and personal hearing, if availed.
	54.5	In case the bidder or contractor submits written reply of the show cause notice, the Procuring agency/Employer may decide to file the matter or direct issuance of a notice to the bidder or contractor for personal hearing.
	54.6	The Procuring agency/Employer shall give minimum of seven days to the bidder or contractor for appearance before the designated officer of the Procuring agency/Employer for personal hearing. The designated officer shall decide the matter on the basis of the available record and personal hearing of the bidder or contractor, if availed.
	54.7	The Procuring agency/Employer shall decide the matter within fifteen (15) days from the date of personal hearing unless the personal hearing is adjourned to a next date and in such an eventuality, the period of personal hearing shall be reckoned from the last date of personal hearing.
	54.8	The Procuring agency/Employer shall communicate to the bidder or contractor the order of debarring the bidder or contractor from participating in any public procurement with a statement that the bidder or contractor may, within thirty (30) days, prefer a representation against the order before the Authority.
	54.9	Such blacklisting or barring action shall be communicated by the Procuring agency/Employer to the Authority and respective bidder or bidders in the form of decision containing the grounds for such action. The same shall be publicized by the Authority after examining the record whether the procedure defined in blacklisting and debarment mechanism has been adhered to by the Procuring agency/Employer.
	54.10	The bidder may file the review petition before the Review Petition Committee Authority within thirty (30) days of communication of such blacklisting or barring action after depositing the prescribed fee and in accordance with “Procedure of filing and disposal of review petition under Rule-19(3) Regulations, 2021”. The Committee shall evaluate the case and decide within ninety (90) days of filing of review petition.

	54.11	The committee shall serve a notice in writing upon all respondent of the review petition. The notices shall be accompanied by the copies of review petition and all attached documents of the review petition including the decision of the Procuring agency/Employer. The parties may file written statements along with essential documents in support of their contentions. The Committee may pass such order on the representation may deem fit.
	54.12	The Authority on the basis of decision made by the committee either may debar a bidder or contractor from participating in any public procurement process of all or some of the procuring agencies for such period as the deemed appropriate or acquit the bidder from the allegations. The decision of the Authority shall be final.

SECTION III: BID DATA SHEET

Bid Data Sheet (BDS)

The following specific data for the for the procurement of works shall complement, supplement, or amend the provisions in the Instructions to Bidders (ITBs). Whenever there is a conflict, the provisions herein shall prevail over those in ITBs.

BDS Clause Number	ITB Number	Amendments of, and Supplements to, Clauses in the Instruction to Bidders
A. Introduction		
1.	**1.1**	Name of Procuring agency/Employer: Director Planning & Development, Headquarters Pakistan Airports Authority, Terminal -1, JIAP, Karachi, Pakistan. Ph # (92-21) 99242773 Ext. 2081 Fax # (92-21) 99242683: Email: Director.PDEV@paa.gov.pk. Name of the Project: Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu. *Scope of Works:* *The Works shall consist of the components as listed but not limited to following:* • *Construction of a new Air Traffic Control Tower (ATCT) (approx. 80 ft high) with integrated MEP, HVAC, and ICT systems.* • *Construction of an ICAO Category-7 compliant Airport Rescue and Firefighting (ARFF) Station, including vehicle bays, control rooms, dormitories, and service areas.* • *Construction of access roads, utility corridors, and a dedicated 7.5m wide carriageway to ensure ARFF response within 3 minutes (approx. 2 km).* • *Installation of Communication, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) systems and an Automated Weather Observing System (AWOS).* • *Development of support infrastructure including underground water storage tanks (60,000 IG), power supply with backup generators, sewerage systems, stormwater drainage and Solar PV system.* • *Removal of visual obstructions (sand dunes) to ensure unobstructed line of sight from the ATC Tower.*

		Period for completion of the works – 730 days from the commencement date Commencement date execution of the works: **14 days after signing of Contract** Type of Procurement – National Competitive Bidding.
2.	**2.1**	Financial year for the operations of the Procuring agency/Employer – 2026 – 27 Name of Project – Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu. Name of financing institution – PAA through own funds Name and identification number of the Contract – not applicable
3.	**3.1**	Maximum number of members in the joint venture, consortium shall be three (03) Foreign Constructor must form JV with Local Constructor. Foreign Constructors shall not be eligible to participate in bidding individually. Foreign Constructor shall enter in to joint venture with Pakistani Constructor registered with PEC in line with PEC Bye Laws.
4.	**7.1**	Replace the text of Sub-Clause ITB. 7.1 with the following: *The Bidding Documents in addition to Invitation for Bids, are those as stated below and shall be read in conjunction with any Addenda issued in accordance with Clause IB.9:* ***BIDDING DOCUMENTS*** ***VOLUME-I*** • *Instructions to Bidders.* • *Bidding Data.* • *Evaluation and Qualification Criteria.* • *Standard Bidding Forms and Schedules to Bid* ▪ *Form ELI -1.1: Bidder Information Form* ▪ *Form ELI -1.2: Bidder's JV Information Form* ▪ *Form CON – 2: Pending Litigation* ▪ *Form FIN – 3.1: Financial Situation and Performance* ▪ *Form FIN – 3.2: Financial Resources*

		▪ *Form FIN – 3.3: Current Contract Commitments / Works in Progress* ▪ *Form Exp - 4.1: List of Similar / Comparable Projects Completed During Last Ten (10) Years* ▪ *Form Exp – 4.2: Experience of Similar / Comparable Projects Completed During Last Ten (10) Years* ▪ *Form EQU: Equipment* ▪ *Form PER-1: Personnel Capability* ▪ *Form PER-2: Candidate Summary* ▪ *Attachment-I: Affidavit* ▪ *Attachment-II: Letter of Authorization / Power of Attorney* ▪ *Attachment-III: Power of Attorney / Letter of Authorization on Behalf of Joint Venture* ▪ *Letter of Bid – Technical Proposal* ▪ *Letter of Bid - Financial Proposal* ▪ *Form of Bid Security* ▪ *Form of Bid-Securing Declaration* ▪ *Schedule – A: Schedule of Adjustment Data* ▪ *Schedule – B: Bill of Quantities (Please refer Volume-III)* ▪ *Schedule – C: Construction Schedule* ▪ *Schedule – D: Method of Performing the Work* ▪ *Schedule – E: List of Major Equipment* ▪ *Schedule – F: Organization Chart for the Supervisory Staff and Labour* ▪ *Schedule – G: List of Subcontractors* ▪ *Schedule – H: Estimated Progress Payments* ▪ *Schedule – I: Construction Camp and Housing Facilities* ▪ *Schedule -J: Integrity Pact* ▪ *Schedule K: Mobilization Schedule* • *Conditions of Contract* ▪ *Part-I: General Conditions (GC)* ▪ *Part-II: Special Conditions of the Contract* *Part A - Contract Data; and* *Part B - Special Provisions* • *Standard Forms of Contract* ▪ *Form of Notification of Award* ▪ *Form of Contract* ▪ *Form of Performance Guarantee* ▪ *Form of Avance Payment Security* ▪ *Form of Bank Guarantee for Payment of Imported Equipment/Materials*

		▪ *Form of Retention Money Security* ▪ *DAAB Agreement* ▪ *Integrity Pact* ▪ *Appendix A – List of Approved Banks by Employer* ***VOLUME-II*** • *Specifications (All Works and Special Provisions)* ***VOLUME-III*** • *Letter of Financial Bid* • *Schedules to Bid* ▪ *Schedule B to Bid: Bill of Quantities* ▪ *Appendices to Bill of Quantities* ▪ *Schedule H to Bid: Estimated Progress Payments* ***VOLUME-IV*** *Bidding Drawings*

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B. Bidding Documents

5.	**7.2**	The number of copies to be completed and returned is *One original, one hard copy*
6.	**8.1**	The address for clarification of Bidding Documents is: As per Invitation for bids and through EPADS 2.0.
	8.5	Pre-bid meeting will be/will not be held: Yes the venue, time, and date of the pre-Bid meeting: *As per Invitation for bids.*

C. Preparation of Bids

7.	**10.1**	The Language of all correspondences and documents related to the Bid is: English
8.	**11.1 (j)**	In addition to the documents stated in **ITB 11,** the following documents must be included with the Bid: *All the affidavits provided herein to the submitted by authorized representative of the bidder.*
9.	**11.4 (c)**	Other procurement specific documentation requirements are: None
10.	**15.2**	The Bidder shall quote the same unit rate and corresponding amount for all identical items in the Bill of Quantities, where identical items are those having the same item description, irrespective of the section or location in which they appear. If the Bidder quotes different unit rates or amounts for identical items, the lowest unit rate quoted by the Bidder for such identical items shall prevail and shall be deemed applicable to all such items. The Bid Price shall be corrected accordingly, and no claim or objection by the Bidder arising from such correction shall be entertained. For the avoidance of doubt, any item not expressly identified in the list of identical items but having the same item description as another item in the Bill of Quantities shall also be deemed an identical item for the purposes of this Sub-Clause.
11.	**15.5**	The bid price shall be adjusted in accordance with Schedule – A Formula for Price Adjustment.
12.	**15.6**	Name of the works: *Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu*

		The identification No. _____ The No. and identification of lots (contracts) comprising this open competitive bid _____
13.	**15.8**	*The rates and prices for all items of the Works stated in the Bill of Quantities shall be exclusive of Provincial Revenue Authority Sales Tax on Services.*
14.	**16.1**	The currency of the Bid shall be PKR
15.	**17.1**	**Documents Comprising the Technical Proposal** The Technical Proposal shall comprise the following documents, duly completed, signed and stamped, together with all supporting documentary evidence required under the Bidding Documents: **A. Mandatory Bid Submission Documents** 1. Duly signed and stamped complete **Volume-I of the Bidding Documents**. 2. **Letter of Bid – Technical Proposal**, in the prescribed form duly filled and signed. 3. Original **Bid Security**, in the prescribed format and amount, issued by a Scheduled Bank or other financial institution acceptable under the Bidding Documents. 4. Mandatory documentary evidence demonstrating the Bidder's eligibility and qualification, including, but not limited to: o Valid Pakistan Engineering Council (PEC) Registration Certificate with the required category and specialization codes; o National Tax Number (NTN) Certificate; o Sales Tax Registration Certificate (where applicable); o Active Taxpayer Status; o Any other registration, licence or certificate required under the Bidding Documents. 5. Affidavit in the prescribed format (Attachment-I). 6. Power of Attorney in the prescribed format (Attachment-II or Attachment-III, as applicable). 7. Joint Venture Agreement or Letter of Intent to Form a Joint Venture (where applicable). **B. Standard Qualification Forms** The following forms shall be duly completed, signed and stamped, together with all supporting documents required therein: • Form ELI-1.1 – Bidder Information Form • Form ELI-1.2 – Joint Venture Information Form

		(where applicable) • Form CON-2 – Pending Litigation • Form FIN-3.1 – Financial Situation and Performance • Form FIN-3.2 – Financial Resources • Form FIN-3.3 – Current Contract Commitments / Works in Progress • Form EXP-4.1 – List of Similar/Comparable Projects Completed During the Last Ten (10) Years • Form EXP-4.2 – Details of Similar/Comparable Projects Completed During the Last Ten (10) Years • Form EQU – Equipment • Form PER-1 – Personnel Capability • Form PER-2 – Candidate Summary **C. Technical Schedules** The following schedules shall be duly completed, signed and stamped, together with all supporting documents required therein: • Schedule A – Schedule of Adjustment Data • Schedule C – Construction Schedule • Schedule D – Method Statement / Method of Performing the Works • Schedule E – List of Major Construction Equipment • Schedule F – Organization Chart for Supervisory Staff and Labour • Schedule G – List of Proposed Subcontractors • Schedule I – Construction Camp and Housing Facilities • Schedule J – Integrity Pact • Schedule K – Mobilization Schedule **Notes** 1. All forms, schedules, declarations and supporting documents shall be submitted in the order listed above and shall be properly indexed and page-numbered. 2. Documents designated as mandatory shall form part of the Technical Proposal. Failure to submit any mandatory document may result in the Bid being declared non-responsive, subject to the provisions of the Instructions to Bidders. 3. The Technical Proposal shall contain **no financial information**, including prices, rates, amounts or any other information relating to the Financial Proposal. 4. The Procuring Agency/Employer may seek clarification of non-material omissions or

		irregularities in accordance with the Instructions to Bidders; however, such clarification shall not be construed as permitting any change to the substance of the Bid.
16.	**18.1**	The Bid Validity period shall be *180* days.
17.	**19.1**	The amount of Bid Security shall be PKR 100,000,000/-. The currency of the Bid Security shall be: PKR
18.	**19.3**	The Bid Security shall be in the form of: Form of Bid Security The Bid Security shall be furnished in the form of an unconditional and irrevocable Bank Guarantee issued by a Scheduled Bank in Pakistan approved by the Employer. The list of approved banks is attached as Appendix – A to these Bidding Documents. The Bid Security shall be issued in favour of the Employer and shall remain valid for a period of two hundred eight (208) days, being twenty-eight (28) days beyond the expiry of the Bid Validity Period. In the case of a Bid submitted by a Joint Venture (JV), the Bid Security shall be issued in the name of: (a) the Joint Venture, where the Joint Venture has been legally constituted; (b) the Lead Partner on behalf of the Joint Venture; or (c) one or more JV Partners in proportion to their respective participation shares in the Joint Venture, provided that the aggregate value of the Bid Security equals the amount specified in the Bidding Documents and the Bid Security expressly secures the Bid submitted by the Joint Venture.
19.	**19.3 (c)**	Other forms of security are: None
20.	**20.1**	Alternative Bids to the requirements of the Bidding Documents *will not* be permitted.
21.	**20.2**	If alternative scheduled for execution of work is explicitly invited: Not Applicable
22.	**22.1**	The number of copies of the Bid to be completed and returned shall be: *One original, one hard copy and one soft copy*. Searchable pdf versions as well as Word, Excel etc. versions of the Bids are required: *Yes*
23.	**22.2**	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: As per given format in **Attachment-II & Attachment-III as applicable**

D. Submission of Bids

24.	**23.2 (a)**	Bid shall be submitted through EPADS 2.0 and hard copies shall be submitted at the address given in the Invitation for Bid. *In case of any discrepancy between the hardcopy and the documents uploaded on EPADS V2.0, the latter shall prevail.*
25.	**23.2 (b)**	Title of the subject Procurement or Project name: *CONSTRUCTION OF NEW AIR TRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES AT SKARDU INTERNATIONAL AIRPORT, SKARDU* ITB title and No: *[insert IFB title and number]* Time and date for submission: *As per Invitation for Bids*
26.	**24.1**	The deadline for Bid submission is *As per Invitation for Bids*

E. Opening and Evaluation of Bids

27.	**27.1**	The Bid opening shall take place at: *As per Invitation for Bids*
28.	**29.2**	If a Bidder does not provide clarifications of its Bid by the date and time set reasonably (not less than seven (7) days) in the Employer's request for clarification, the Employer may proceed with the evaluation based on the information submitted in the Bid.
29.	**33.2**	The currency that shall be used for Bid evaluation and comparison purposes to convert all Bid prices expressed in various currencies is: *Not Applicable* The source of exchange rate shall be: *Not Applicable* The date of exchange rate shall be: *Not Applicable*
30.	**33.3**	The bids shall be quoted in PKR
31.	**34.2**	**Evaluation Techniques** *Bids are invited from prospective bidders as per Single Stage Two - Envelopes bidding procedure as stated in Public Procurement Rules-36 (b).* *Technical Evaluation shall be carried out in accordance with Technical Evaluation Criteria specified in Se*ction-V hereof.
32.	34.5	In case of award to a single Bidder of multiple lots; the methodology of evaluation to determine the lowest evaluated Lot combinations, in the Form of Bid is: Not Applicable

33.	**35.1**	Domestic preference is not applicable.
34.	**36.1**	*Financial Bids of only those Bidders whose Technical Bids have been determined to be substantially responsive shall be opened, examined, evaluated, and compared by the Employer in accordance with the provisions of the Bidding Documents.* *The Employer shall determine the Most Advantageous Bid, being the substantially responsive Bid that achieves the lowest evaluated Bid Price after application of all evaluation criteria and adjustments specified in the Bidding Documents. Subject to the Employer's rights under the Bidding Documents, the Bidder submitting the Most Advantageous Bid shall be recommended for award of the Contract.*
35.	**38.2**	Sub-contracting Thirty percent (30%) of the total value of the contract.
36.	**39.1**	The following procedure shall be adopted for the abnormally low bids: (a) Where the Evaluated Bid Price is more than ten percent (10%) below the Engineer's Estimate, the Bidder shall, upon written request of the Employer, submit a detailed price analysis and justification demonstrating the reasonableness, adequacy, and workability of the quoted rates. The Bidder shall also furnish a notarized affidavit affirming that: (i) the Bid Price has been quoted after due consideration of all contractual obligations, site conditions, risks, and applicable taxes and duties; (ii) the Works shall be executed and completed in accordance with the Contract within the stipulated Time for Completion at the quoted Bid Price; and (iii) the Bidder shall not abandon, suspend, or otherwise fail to perform the Contract on account of the quoted rates. The Employer shall evaluate the submitted justification and may accept or reject the Bid if the explanation is found to be unsatisfactory or fails to establish the Bidder's capability to perform the Contract. (b) Notwithstanding the above, where the Evaluated Bid Price is more than twenty percent (20%) below the Engineer's Estimate, the Bid shall be considered abnormally low and shall be rejected as non-responsive. In such event, the Employer shall proceed with the evaluation of the next lowest evaluated responsive Bid in accordance with the applicable provisions of the Public Procurement Rules, 2004 and the Bidding Documents. The Bidder shall have no claim whatsoever against the Employer arising out of the rejection of an abnormally low Bid in accordance with this Clause.
F. Award of Contract		

37.	**48.1**	The Performance Security (or guarantee) shall be *10 percent of the Contract Price.*
38.	**48.2**	The ITB 48.2 shall be deleted and replaced with the following: Form of Performance Security The Performance Security shall be furnished in the form of an unconditional and irrevocable Bank Guarantee acceptable to the Employer. The list of approved banks is attached as Appendix – A to these Bidding Documents. Where the successful Bidder is a local entity, the Bank Guarantee shall be issued or confirmed by a reputable Scheduled Bank in Pakistan acceptable to the Employer. Where the successful Bidder is a foreign entity, the Performance Security may be issued by a reputable foreign bank, provided that it is confirmed or counter-guaranteed by a reputable Scheduled Bank in Pakistan acceptable to the Employer.

G. Review of Procurement Decisions

39.	**53.1**	Bidders shall submit any grievance to the Grievance Redressal Committee (GRC) not later than five (5) days prior to the Bid Submission Deadline.
40.	**53.6**	The Address of PPRA to submit a **copy** of appeal: Grievance Redressal Appellate Committee, Public Procurement Regulatory Authority 1st Floor, G-5/2, Islamabad, Pakistan Tel: +92-51-9202254

Section IV. Eligible Countries

All the bidders are allowed to participate in the subject procurement without regard to nationality, except bidders of some nationality, prohibited in accordance with policy of the Federal Government.

Following countries are ineligible to participate in the procurement process:

1. India
2. Israel

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Section V. Evaluation and Qualification Criteria

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EVALUATION CRITERIA

The Procuring agency/Employer shall evaluate the bids in accordance with the predefined evaluation and qualification criteria mentioned in this document. No other factors, methods, or criteria shall be used. The Bidder shall provide all the information requested in the Bidding Forms.

Wherever a Bidder is required to state a monetary amount, Bidders should indicate the currency prescribed in the BDS. In case of foreign currency, the weighted average customer exchange rates shall be taken from State Bank of Pakistan on that bid opening day. Any error in determining the exchange rates in the Bid may be corrected in accordance with ITB 29.

1. QUALIFICATION

The following qualification criteria apply to this procurement. The Procuring agency/Employer shall determine, to its satisfaction, whether the Bidder meets the qualifying criteria specified in this Section. Sub-contractor's experience and resources shall not be taken into account in determining the Bidder's compliance with the qualifying criteria. However, for a Joint Venture, the collective experience, resources, and financial soundness of all partners shall be considered for the criteria specified in Sub-Clauses 1.3 and 1.4 below.

Notwithstanding the above, the Procuring Agency reserves the right to verify or seek clarification of the information furnished by the Bidders. The Procuring Agency may reject any Bid for any misrepresentation made by any Bidder in, or pursuant to, their Bid or for any statement furnished in connection therewith, which is intended to be relied upon by the Procuring Agency and which is incorrect in any respect.

Eligibility and Qualification information described hereunder must be met by the legal entity(ies) comprising the Bidder, and not the Bidder's/JV partner's sister or parent companies, subsidiaries, or affiliates.

The Procuring Agency reserves the right to waive minor deviations if these do not materially affect the capability of a Bidder to perform the contract.

1.1 MANDATORY REQUIREMENTS

All Bidders shall provide the following mandatory information/documents. Bidders who do not meet any of the mandatory requirements listed below shall not be considered for detailed evaluation and shall be disqualified.

(a) Authorization

A duly executed Authorization Letter or Power of Attorney, authorizing the designated representative to sign and submit the Bid on behalf of the Bidder or, in the case of a Joint Venture (JV), on behalf of each JV partner. In the case of a Joint Venture, a separate Authorization Letter or Power of Attorney shall also be provided, designating an authorized representative of the JV to sign and submit the Bid on behalf of the JV as a whole. Such authorization shall be duly executed by the authorized representatives of all JV partners. [To be submitted as per the formats provided Bidding Forms.]

(b) Valid Registration with Pakistan Engineering Council (PEC)

(i) Local constructor(s) applying individually shall have valid registration with Pakistan Engineering Council in Category C-A. The firm must also hold the following minimum Specialization Codes relevant to the scope of work:

- CE-01 (Roads, Pavements & Drainage) – For access roads, aprons, and stormwater drainage.
- CE-02(ii) (Piling) – For ATC Tower Building Foundation Works.
- CE-10 (General Civil Engineering Works) – For general building construction.
- BC-01(ii) (Steel-framed Buildings) – For the structural steel frame of the ATC Tower and ARFF building.
- ME-01 (HVAC) – For Heating, Ventilation, and Air Conditioning systems.
- ME-02 (Fire Prevention Systems) – For the ARFF station fire suppression and alarm systems.
- ME-03 (Lifts, Escalators & Generators) – For lifts and backup generators.
- EE-03 (Building Automation & Energy Generation) – For integration of Building Management Systems (BMS).
- EE-04 (Low Voltage Installation) – For electrical distribution, lighting, and power.
- EE-07 (Telecommunication Installation) – For installation of CNS and telecommunication equipment.

(ii) Constructors may form a Joint Venture (maximum three (3) JV partners) as follows:

- Local Constructor (Lead Partner) having valid PEC registration in Category C-A may form a joint venture with local constructor(s) having PEC registration in Category C-2 or above. The JV shall collectively possess all Specialization Codes listed in 1.1(b)(i) above.
- Foreign Constructor (Lead Partner) having valid PEC registration in Category FC-A may form a joint venture with local constructor(s) having PEC registration in Category C-2 or above. The JV shall collectively possess all Specialization Codes listed in 1.1(b)(i) above.

(c) Tax Registration

Provision of valid NTN/STRN Certificate from Federal Board of Revenue along with proof of being an active taxpayer (where applicable).

(d) Affidavits

Provision of the following affidavits (on non-judicial stamp paper of PKR 500) as per the standard format provided in the Bidding Forms:

- An affidavit to the effect that the Bidder is not currently blacklisted by any Procuring Agency, Government Department, Semi-Government Organization, or Autonomous Body.
- An affidavit to the effect that all documents, particulars, and information submitted with this Bid are true, correct, and complete, and nothing has been concealed or misstated.
- An affidavit confirming that all proposed equipment and necessary allied equipment shall be available in good working condition at the time of mobilization for the execution of Works.

- An affidavit to the effect that the Bidder has not been involved in, nor has indulged in, any corrupt, fraudulent, collusive, or coercive practices in the procurement of contracts.
- An affidavit to the effect that the Bidder is not presently involved in, nor has it been in the past, in any litigation or arbitration proceedings with any Procuring Agency. Should this be otherwise, the Bidder must provide full details in Form CON-2 "Litigation/Arbitration History".

1.2 CONFLICT OF INTEREST

The Bidder (including all members of a Joint Venture) must not be associated, nor have been associated in the past, with any consultant or other entity that has prepared the design, specifications, or bidding documents for this project, or was proposed as Engineer for the contract, over the last five (05) years. Any such association shall result in disqualification of the Bidder.

A Bidder may be considered to have a conflict of interest if they: are associated or have been associated, directly or indirectly, with a firm or any of its affiliates engaged by the Procuring Agency/Employer to provide consulting services for the preparation of design or technical specifications of these Works; have controlling shareholders in common; receive or have received any direct or indirect subsidy from any of them; have the same legal representative; have a relationship that puts them in a position to have access to information about or influence on the Bid of another Bidder; or have submitted more than one Bid in this process.

1.3 JOINT VENTURE (JV) REQUIREMENTS

A Joint Venture Bid must comply with the following requirements:

- The maximum number of members in a Joint Venture shall not exceed three (3) firms. Any Bid submitted by a JV with more than three members shall be disqualified.
- Each Bidder shall submit only one Bid, either individually or as a partner in a Joint Venture. A Bidder who submits more than one Bid, whether individually or as a JV partner, shall be disqualified and all Bids submitted by such Bidder shall not be considered for evaluation.
- The Joint Venture must collectively satisfy the financial and experience qualification criteria in Sub-Clause 1.4 below, for which purpose the relevant figures of each JV partner shall be aggregated to arrive at the JV's total capacity.
- One of the Joint Venture partners shall be nominated as the Lead Partner. This authorization shall be evidenced by submitting a power of attorney signed by the legally authorized signatories of all JV partners. The Joint Venture Agreement shall form an integral part of the Contract, if the Bid is accepted by the Procuring Agency. The JV Agreement must clearly indicate the division of works and responsibilities between the JV partners and their respective participation interests.
- The Bid shall be signed by all members of the JV so as to legally bind all partners, jointly and severally. The Bid shall be submitted together with a copy of the JV Agreement providing joint and several liability with respect to the contract.
- Any change in the composition of the JV after Bid submission shall not be permitted by the Procuring Agency and the Bid shall be liable for rejection.

1.4 DETAILED EVALUATION CRITERIA

After initial screening and confirmation of mandatory requirements, a detailed evaluation shall be undertaken using the following scoring criteria:

Category	Maximum Marks	Minimum Acceptable Marks (50%)
Financial Capability	300	150
Experience Capability	400	200
Personnel Capability	150	75
Equipment Capability	150	75
TOTAL	**1000**	**700 (aggregate)**

To qualify, Bidders must receive not less than fifty percent (50%) minimum acceptable marks in each category and achieve an aggregate of not less than seven hundred (700) marks. The Bidders are required to provide substantial documentary evidence in each case for marking under the Qualification Criteria. Where substantial evidence is not provided, marks shall not be awarded.

1.4.1 Financial Capability (Maximum: 300 Marks)

The Bidder shall demonstrate that it has access to, or has available, liquid assets, lines of credit, and other financial means sufficient to meet the cash flow requirements for the execution of the Works (Letter issued by Banks for showing sanctioned credit line).The Audited Balance Sheets of the last three (03) financial years (Forms FIN-3.1 and FIN-3.2) from a Chartered Accountant firm must be submitted and shall demonstrate the soundness of the Bidder's financial position, showing long-term profitability. Where necessary, the Procuring Agency may make inquiries with the Bidder's bankers, financial institutions, and auditors.

Marks shall be awarded under this category based on the following criteria:

Sr. No.	Description	Max. Marks	Criteria for Marks
(a)	Available Bank Credit Facility (latest)	100	Fifty (50) marks will be given if the available Bank Credit Line Limit is equal to PKR 1,000 million. Ten (10) additional marks will be given for every PKR 200 million increase in the Credit Line. Full marks (100) will be given if the Credit Line Limit is ≥ PKR 2,000 million. No marks will be given if the Credit Line Limit is less than PKR 1,000 million.
(b)	Average Working Capital (from Audited Financial	100	Fifty (50) marks will be given if the Average Working Capital for last three years is equal to PKR 1,000 million. ten (10) additional mark will

Sr. No.	Description	Max. Marks	Criteria for Marks
	Statements of last three (03) years)		be given for every PKR 100 million increase in Working Capital. Full marks (100) will be given if the Average Working Capital is ≥ PKR 1,500 million. No marks will be given if the Average Working Capital is less than PKR 1,000 million.
(c)	Average Annual Turnover (from Audited Financial Statements of last three (03) years)	100	Fifty (50) marks will be given if the Average Annual Turnover for the last three years is equal to PKR 5,000 million. Ten (10) additional mark will be given for every PKR 500 million increase in Average Annual Turnover. Full marks (100) will be given if the Average Annual Turnover is ≥ PKR 7,500 million. No marks will be given if the Average Annual Turnover is less than PKR 5,000 million.
Total Marks Allocated		**300**	*No marks shall be awarded for financial capability below the specified minimum limits.*

1.4.2 Experience Capability (Maximum: 400 Marks)

Experience for similar/comparable projects completed (Forms EXP-4.1 and EXP-4.2) will be evaluated on the basis of the following marks. Bidders shall refrain from referring to the same project under multiple categories below, to ensure a comprehensive evaluation of the firm's capabilities across different domains.

Information regarding similar/comparable nature projects shall be supported by documentary evidence such as Letter of Award and Taking-Over Certificate/Defects Liability Certificate/Substantial Completion Certificate issued by the Client. No marks shall be awarded if such documentary evidence is not attached.

Sr. No.	Experience Capability	Max. Marks
1.	Projects of airport Building (e.g., ATC towers, terminal buildings) having a minimum project cost of PKR 2,000 million, successfully completed during the last ten (10) years. [50 marks for each successfully completed project]	100
2.	Projects of similar nature including piling works for high-rise buildings, successfully completed with a minimum project cost of PKR 1,000 million during the last ten (10) years. [50 marks for each successfully completed project]	100
3.	Projects including roads, bridges, runways, taxiways, and apron	100

Sr. No.	Experience Capability	Max. Marks
	works, successfully completed with a minimum project cost of PKR 3,000 million during the last ten (10) years. [50 marks for each successfully completed project]	
4.	Projects of similar nature executed on Steel Structure / pre-engineered building with at least 20,000 Sft foot print, successfully completed with a minimum project cost of PKR 300 million during the last ten (10) years. [50 marks for each successfully completed project]	100
Maximum Total Marks Allocated	*(Marks from individual categories are capped at the maximum for that category)*	**400**

1.4.3 Personnel Capability (Maximum: 150 Marks)

Personnel capability of key personnel to be deployed at site during execution (Forms PER-1 and PER-2) will be evaluated on the basis of the following marks. For foreign professionals, equivalent qualifications and relevant experience shall be acceptable, and PEC registration for foreign professionals shall not be required.

Marks for personnel shall be awarded on the basis of the following criteria. Information regarding educational qualification, total work experience, and specific work experience shall be supported by documentary evidence including: copy of educational qualification certificate/degree; PEC registration certificate (for engineers); detailed CVs signed by the personnel; and employment status with the Bidder (appointment letter/experience certificate). No marks will be given if supporting documents are not submitted. The proposed personnel must be available for deployment at the site during execution as per the project schedule and an affidavit to this effect shall also be submitted by the bidder.

Sr. No.	Personnel	Max. Marks
i.	Project/Construction Manager	20
ii.	Civil Engineer	20
iii.	Planning Engineer	20
iv.	Electrical Engineer	20
v.	Mechanical Engineer	20
vi.	HSE Officer (NEBOSH/OSHA Certified)	20

Sr. No.	Personnel	Max. Marks
vii.	Quantity Surveyor	20
viii.	Surveyor	10
Total Marks Allocated		**150**

Marks for each personnel position shall be awarded on the basis of experience as follows:

(i) Project/Construction Manager (Civil)

Must be a Bachelor's Degree holder in Civil/Electrical/Mechanical Engineering, registered with PEC.

Work Experience	Marks
More than 15 years total experience (with at least 5 years in a managerial role on high-rise or complex infrastructure projects)	20
>12–15 years total experience	15
>10–12 years total experience	10
Less than 10 years total experience	0
Total Marks (Maximum)	**20**

(ii) Civil Engineer

Must be a Bachelor's Degree holder in Civil Engineering, registered with PEC.

Work Experience	Marks
More than 10 years' specific experience in execution of building projects	20
>7–10 years	15
>4–7 years	10
Less than 4 years	0
Total Marks (Maximum)	**20**

(iii) Planning Engineer

Must be a Bachelor's Degree holder in Engineering registered with PEC, proficient in Primavera/MS Project.

Work Experience	Marks

Work Experience	Marks
More than 15 years' total experience (specific experience in project planning for large-scale construction)	20
>12–15 years total experience	15
>10–12 years total experience	10
Less than 10 years total experience	0
Total Marks (Maximum)	**20**

(iv) Electrical Engineer

Must be a Bachelor's Degree holder in Electrical Engineering, registered with PEC.

Work Experience	Marks
More than 8 years specific experience in electrical systems for buildings/infrastructure	20
>5–8 years	15
>3–5 years	10
Less than 3 years	0
Total Marks (Maximum)	**20**

(v) Mechanical Engineer

Must be a Bachelor's Degree holder in Mechanical Engineering, registered with PEC.

Work Experience	Marks
More than 8 years specific experience in HVAC and firefighting systems	20
>5–8 years	15
>3–5 years	10
Less than 3 years	0
Total Marks (Maximum)	**20**

(vi) HSE Officer

Must hold NEBOSH IGC, IOSH, or equivalent certification.

Work Experience	Marks

Work Experience	Marks
More than 8 years specific experience in construction safety	20
>5–8 years	15
>3–5 years	10
Less than 3 years	0
Total Marks (Maximum)	**20**

(vii) Quantity Surveyor

Must hold a Diploma of Associate Engineer in Civil or a Bachelor's Degree in a relevant field.

Work Experience	Marks
More than 8 years specific experience in quantity surveying/billing	20
>5–8 years	15
>3–5 years	10
Less than 3 years	0
Total Marks (Maximum)	**10**

(ix) Surveyor

Must hold a Diploma of Associate Engineer in Civil or a Certificate in Surveying.

Work Experience	Marks
More than 8 years specific experience in land/building surveying	10
>5–8 years	7
>3–5 years	5
Less than 3 years	0
Total Marks (Maximum)	**10**

1.4.4 Equipment Capability (Maximum: 150 Marks)

The Bidder shall own, or have assured access to (through rental, lease, purchase agreement, or other means), the following key equipment in full working order, and must demonstrate that, based on known commitments, these items will be available for deployment on the proposed contract at the time of mobilization. Points are awarded based on ownership or long-term lease

agreements. Documentary evidence such as ownership documents, rental/lease agreements, or letters of intent from equipment suppliers must be provided (Form EQU).

No marks shall be awarded for equipment below the specified minimum specifications. Equipment must be in good working condition and available for mobilization as per the project schedule.

Equipment Type & Characteristics	Unit	Min. Requirement	Own/Rental	Marks
Concrete Batching Plant (min. 30 cu.m/hr)	No.	1	Own/Rental	10
Concrete Pump (min. 30 cu.m/hr)	No.	1	Own/Rental	10
Motor Grader (min. 12 ft blade)	No.	2	Own/Rental	20
Excavator (min. 20-ton operating weight)	No.	2	Own/Rental	20
Piling Rig (for bored cast-in-situ piles, dia. >1100 mm & depth 25 meters)	No.	1	Own/Rental	10
Loaders/Backhoes (min. 2.5 cu.m bucket)	No.	2	Own/Rental	20
Transit Mixers (>6 cu.m capacity)	No.	2	Own/Rental	20
Mobile Crane (>30-ton, all-terrain, with load chart for 30 m height)	No.	1	Own/Rental	10
Dump Trucks (>6 cu.m capacity)	No.	4	Own/Rental	20
Asphalt Paver (min. 4 m paving width)	No.	1	Own/Rental	10
Total Marks Allocated				**150**

Section VI Standard Bidding Forms and Schedules

- Form ELI -1.1: Bidder Information Form
- Form ELI -1.2: Bidder's JV Information Form
- Form CON – 2: Pending Litigation
- Form FIN – 3.1: Financial Situation and Performance
- Form FIN – 3.2: Financial Resources
- Form FIN – 3.3: Current Contract Commitments / Works in Progress
- Form Exp - 4.1: List of Similar / Comparable Projects Completed During Last Ten (10) Years
- Form Exp – 4.2: Experience of Similar / Comparable Projects Completed During Last Ten (10) Years
- Form EQU: Equipment
- Form PER-1: Personnel Capability
- Form PER-2: Candidate Summary
- Attachment-I: Affidavit
- Attachment-II: Letter of Authorization / Power of Attorney
- Attachment-III: Power of Attorney / Letter of Authorization on Behalf of Joint Venture
- Letter of Bid – Technical Proposal
- Letter of Bid - Financial Proposal
- Form of Bid Security
- Form of Bid-Securing Declaration
- Schedule – A: Schedule of Adjustment Data
- Schedule – B: Bill of Quantities (Please refer Volume-III)
- Schedule – C: Construction Schedule
- Schedule – D: Method of Performing the Work
- Schedule – E: List of Major Equipment
- Schedule – F: Organization Chart for the Supervisory Staff and Labour
- Schedule – G: List of Subcontractors
- Schedule – H: Estimated Progress Payments
- Schedule – I: Construction Camp and Housing Facilities
- Schedule -J: Integrity Pact
- Schedule K: Mobilization Schedule

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form ELI -1.1

Bidder Information Form

Date: _____
Bid Reference No. (if any) and title: _____
Page _____ of _____ pages

Bidder's name
In case of Joint Venture (JV), name of each member:
Bidder's country of registration: *[indicate country of Constitution]*
Bidder's year of incorporation:
Bidder's legal address [in country of registration]:
Bidder's authorized representative information Name:_____ Address:_____ Telephone/Fax numbers: _____ E-mail address: _____
1. Attached are copies of original documents, in case of JV, JV agreement, in accordance withSub-Clause IB 3.1.

Form ELI -1.2

Bidder's JV Information Form

(to be completed for each member of Bidder's JV)

Date: _____
Bid Reference No. (if any) and title: _____
Page _____ of _____ pages

Bidder's JV name:
JV member's name:
JV member's country of registration:
JV member's year of constitution:
JV member's legal address in country of constitution:
JV member's authorized representative information Name:_____ Address:_____ Telephone/Fax numbers: _____ E-mail address: _____

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form CON – 2

Pending Litigation

Bidder's Name: _____
Date: _____
JV Member's Name_____
Bid Reference No. (if any) and title: _____
Page ____ of _____ pages

Pending Litigation, in accordance with Eligibility and Qualification Criteria			
□ No pending litigation in accordance with Eligibility and Qualification Criteria, Sub-Factor 2.3. □ Pending litigation in accordance with Eligibility and Qualification Criteria, Sub-Factor 2.3 asindicated below.			
Year of dispute	**Amount in dispute (currency)**	**Contract Identification**	**Total Contract Amount (currency), Eq. PKR (exchange rate)**
		Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: Status of dispute: _____	
		Contract Identification: Name of Employer: Address of Employer: Matter in dispute: Party who initiated the dispute: Status of dispute:	

Form FIN – 3.1:

Financial Situation and Performance

Bidder's Name: _____

Date: _____

JV Member's Name_____

Bid Reference No. (if any) and title: _____

Page ____ of _____ pages

1. Financial data

Type of Financial information in (currency)	Historic information for last year, (amount in currency, currency, exchange rate*, Eq. PKR)
Statement of Financial Position (Information from Balance Sheet)	
Total Assets (TA)	
Total Liabilities (TL)	
Total Equity/Net Worth (NW)	
Current Assets (CA)	
Current Liabilities (CL)	
Working Capital (WC)	
Information from Income Statement	
Total Revenue (TR)	
Profits Before Taxes (PBT)	
Cash Flow Information	
Cash Flow from Operating Activities	

* For the exchange rate, refer Clause 1, "General" of Evaluation Criteria and Qualification Updating Forms.

2. Financial documents

The Bidder and its parties shall provide copies of financial statements for last year pursuant to Eligibility and Qualification Criteria, Sub-factor 1.5.1. The financial statements shall:

(a) reflect the financial situation of the Bidder or in case of JV member, and not an affiliatedentity (such as parent company or group member).

(b) be independently audited or certified in accordance with local legislation.

(c) be complete, including all notes to the financial statements.

(d) correspond to accounting periods already completed and audited.

☐ Attached are copies of financial statements[1] for the last year required above; and complying withthe requirements

[1] If the most recent set of financial statements is for a period earlier than 12 months from the date of bid, thereason for this should be justified.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form FIN – 3.2:

Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as specified in Eligibility and Qualification Criteria.

Financial Resources		
No.	**Source of financing**	**Amount (Eq. PKR)**
1		
2		
3		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form FIN – 3.3:

Current Contract Commitments / Works in Progress

Bidders and each member to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments					
No.	**Name of Contract**	**Employer's Contact Address,Tel, Fax**	**Value of Outstanding Work [Current Eq. PKR]**	**Estimated Completion Date**	**Average Monthly Invoicing Over Last Six Months [Eq. PKR /month)]**
1					
2					
3					
4					
5					

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form Exp - 4.1:

List of Similar / Comparable Projects Completed During Last Ten (10) Years

Name of Applicant or partner of a joint venture

*Complete the form below, listing each project under its respective category. Each project will be evaluated against only one sub-criterion. For each project listed, a separate **Form Exp 4.2** must be submitted, accompanied by supporting documentation that is properly cross-referenced. Projects listed in this Form shall be used for evaluation and any other information provided shall not be considered for evaluation. In case of JV, the combined experience of the members shall be considered and evaluated.*

The State Bank's "Exchange Rates for Market-to-Market Revaluation by Authorized Dealers in Foreign Exchange - Ready" 14 days prior to the submission deadline shall be used for conversion of other currencies to PKR.

[1] EXPERIENCE IN PROJECTS OF AIRPORT INFRASTRUCTURE (E.G. ATC TOWERS, TERMINAL BUILDINGS):

Sr.	Name of the Project	Employer	Date of Completion	Completion Cost of Project (PKR)
1.				
2.				

[2] EXPERIENCE IN PILING WORKS FOR HIGHRISE BUILDINGS

Sr.	Name of the Project	Employer	Date of Completion	Completion Cost of Project (PKR)
1.				
2.				

[3] EXPERIENCE IN ROAD, BRIDGES, RUNWAY, TAXIWAYS AND APRON

Sr.	Name of the Project	Employer	Date of Completion	Completion Cost of Project (PKR)
1.				
2.				

[4] EXPERIENCE IN STEEL STRUCTURE / PEB

Sr.	Name of the Project	Employer	Date of Completion	Completion Cost of Project (PKR)
1.				
2.				

Form Exp – 4.2:

Experience of Similar / Comparable Projects Completed During Last Ten (10) Years

Name of Applicant or partner of a Joint Venture

Applicants and each partner to an application should provide information regarding similar/ comparable projects completed. In case of JV, each partner must provide information of similar / comparable experience of having completed the projects of above qualification. The information shall be supported by documents such as Letter of Award/ Letter of Acceptance and Taking Over/ Completion Certificate, Maintenance/ Defects Liability Certificate and any other relevant document.

Attach the supporting documents right after each Form 4a.

The State Bank's "Exchange Rates for Market-to-Market Revaluation by Authorized Dealers in Foreign Exchange - Ready" 14 days prior to the submission deadline shall be used for conversion of other currencies to PKR.

Use a separate sheet for each contract.

1.	Name of Contract	
	Country	
2.	Name of Procuring Agency	
3.	Procuring Agency Address	
4.	Nature of works and special features relevant to the contract for which the Applicant wishes to pre-qualify	
5.	Contract Role (Tick One) (a) Main Contractor (b) Sub- Contractor (c) Partner in a Joint Venture	
6.	Value of the total contract (in specified currencies) at completion, or at date of award for current contract Contract Price ……. Currency……	
7.	Equivalent in Pak Rupees.	
8.	Date of Award	
9.	Date of Completion	
10.	Contract Duration (Years and Months) _____Years _____Months	
	Sub-Criteria for Assessment of Experience [A particular project will be considered against only one sub-criteria]	Please tick the relevant sub-criteria: ☐ **[1]** Experience in Projects of Commercial High-Rise Buildings (Minimum 8 Storeys) Or Airport Infrastructure Projects (E.G. ATC Towers, Terminal Buildings).

		☐ **[2]** Experience in Piling Works for Highrise Buildings ☐ **[3]** Experience in Road, Bridges, Runway, Taxiways and Apron ☐ **[4]** Experience in Steel Structure / PEB

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form EQU: Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

Omit the following information for equipment owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

PUBLIC PROCUREMENT REGULATORY AUTHORITY PPRA EPADS

Form PER-1

Personnel Capability

Name of Applicant or partner of a Joint Venture

For specific positions essential to contract implementation, Applicants should provide the names of candidate qualified to meet the specified requirements stated for each position. The data on their experience should be supplied on separate sheets using one Form for each candidate (Application Form PER-2) along with ***CVs of proposed candidates****.*

S. No.	Title of Position	Name of Personnel
i.	Project / Construction Manager	
ii.	Civil Engineer	
iii.	Planning Engineer	
iv.	BIM Designer / Manager	
v.	Electrical Engineer	
vi.	Mechanical Engineer	
vii	HSE Officer (NEBOSH/OSHA Certified)	
viii.	Draftsman (BIM Specialist)	
ix.	Quantity Surveyor	
x.	Surveyor	

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form PER-2

Candidate Summary

Name of Applicant or partner of a Joint Venture

Position		
Candidate information	1. Name of Candidate	2. Date of Birth
	3. Professional Qualification PEC / PCATP Number:	
Present employment	4. Name of Employer	
	Address of Employer	
	Telephone	Contact (manager/personnel officer)
	Fax	Telex/ Email
	Job title of candidate	Years with present employer

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the Project.

Month/ Dates/Years		**Company / Project / Position / Relevant technical and management experience (Reverse Chronological Order)**
From	**To**	

Note: The Supporting Document shall be attached right after each Form.

ATTACHMENT-I

AFFIDAVIT

[To be submitted by the Bidder/Firm on Stamp Paper of value PKR 500]

I, **[Full Name]**, son/daughter of **[Father's Name]**, adult, resident of **[Full Address]**, holding CNIC No. **[XXXXXXXXXXXXX]**, being the **[Proprietor/Partner/Authorized Representative/ Director]** of **M/s [Name of Firm]** (hereinafter referred to as the "Applicant"), do hereby solemnly affirm and declare as under:

1. **That** I am duly authorized to swear this affidavit on behalf of M/s **[Name of Firm]** and am fully conversant with the facts stated herein.

2. **That** M/s **[Name of Firm]** is not currently blacklisted or debarred by any Procuring Agency, Government Department, Semi-Government Organization, or Autonomous Body.

3. **That** M/s **[Name of Firm]** undertakes and confirms that all proposed equipment and necessary allied equipment, shall be available in good working condition at the time of mobilization for the execution of works, if awarded.

4. **That** all documents, statements, information, and particulars submitted by M/s **[Name of Firm]** in connection with this bid are true, correct, complete, and nothing has been concealed or misstated.

5. **That** M/s **[Name of Firm]** has neither been involved in nor has indulged in any corrupt, fraudulent, collusive, or coercive practices in the procurement of contracts with any Procuring Agency.

6. **That** M/s **[Name of Firm]** is not presently involved in, nor has it been involved in the past, in any litigation or arbitration proceedings with any Procuring Agency.

*[OR (if applicable)***:**

That M/s **[Name of Firm]** has been involved in litigation/arbitration with Procuring Agencies; the details whereof have been fully and accurately disclosed in the Litigation/Arbitration History submitted with the bid.]

7. **That** the contents of this affidavit are true and correct to the best of my knowledge and belief, and nothing material has been concealed therefrom.

DEPONENT
(Signature)
Name: _____
Designation: Proprietor / Partner / Authorized
Representative For and on behalf of: **M/s [Name of Firm]**

ATTESTATION
Sworn before me on this **[Day]** of **[Month, Year]** at

[City]. **Oath Commissioner / Notary Public**

ATTACHMENT-II

LETTER OF AUTHORIZATION / POWER OF ATTORNEY
[To be submitted by individual firm / each partner of JV]

Date: [Insert Date]
Ref: [Insert Reference No.] To,
[Name of Procuring Agency] [Address]

SUBJECT: AUTHORIZATION FOR SUBMISSION OF BID DOCUMENTS

Dear Sir/Madam,

We, **[Full Legal Name of the Firm/Company]**, a company duly incorporated/registered under the laws of **[Country]**, having its registered office at **[Full Address]** (hereinafter referred to as the "Firm"), do hereby appoint, nominate, and authorize **Mr./Ms. [Full Name of Authorized Representative]**, holding **[CNIC/Passport No.]**, presently working as **[Designation]** with the Firm, as our true and lawful representative (hereinafter referred to as the "Authorized Representative").

The Authorized Representative is hereby empowered and authorized on behalf of the Firm to:

1. Prepare, sign, and submit the Bid Application and all associated documents, forms, affidavits, undertakings, and declarations;
2. Respond to queries, clarifications, or requests for additional information issued by the Procuring Agency;
3. Attend meetings, discussions, or presentations related to the bidding process;
4. Perform all such acts, deeds, and things as may be necessary or incidental for the purpose of submission and processing of the Bid.

We hereby confirm that all acts, deeds, and documents executed or submitted by the Authorized Representative in connection with the above shall be deemed to have been duly authorized by the Firm and shall be binding upon us.

Thanking you.
Yours faithfully,

For and on behalf of
[Full Legal Name of the Firm/Company]

[Signature]
[Name & Designation of Authorized Signatory of Firm]
Company Seal/Stamp

[*Specimen Signature of Authorized Representative***]**
Name of Authorized Representative

Witnesses:

1. _____
   Name:
   CNIC/Passport No.:
2. _____
   Name:
   CNIC/Passport No.:

ATTACHMENT-III

POWER OF ATTORNEY / LETTER OF AUTHORIZATION ON BEHALF OF JOINT VENTURE

[To be submitted by JV only]

Date: [Insert Date]
Ref: [Insert Reference No.]

To,
[Name of Procuring Agency / Employer]
[Address]

SUBJECT: AUTHORIZATION FOR SUBMISSION OF BID ON BEHALF OF JOINT VENTURE

Dear Sir/Madam,

We, the undersigned, being duly authorized representatives of the following firms/companies (hereinafter collectively referred to as the "Joint Venture" or "JV"):

1. **[Full Legal Name of Lead Partner]**, having its registered office at **[Address]**; 2. **[Full Legal Name of Partner 2]**, having its registered office at **[Address]**; 3. **[Full Legal Name of Partner 3, if any]**, having its registered office at **[Address]**;

(each hereinafter referred to individually as a "JV Partner" and collectively as the "JV Partners"),

do hereby jointly appoint, nominate, and authorize **Mr./Ms. [Full Name of Authorized Representative]**, holding **[CNIC/Passport No.]**, as the **Authorized Representative of the Joint Venture** (hereinafter referred to as the "Authorized Representative"), to act for and on behalf of the Joint Venture in connection with the Bid for **[Name of Project]**.

The Authorized Representative is hereby jointly authorized by all JV Partners to:

1. Prepare, sign, and submit the Bid and all related forms, schedules, affidavits, undertakings, and supporting documents on behalf of the Joint Venture;
2. Make representations, provide clarifications, and respond to any queries or requests for additional information issued by the Procuring Agency;
3. Attend meetings, negotiations, and discussions related to the bidding process;
4. Receive communications, notices, and correspondence from the Procuring Agency on behalf of the Joint Venture;
5. Perform all such acts, deeds, matters, and things as may be necessary or incidental for the submission and processing of the Bid.

We hereby confirm and undertake that all acts, deeds, and documents executed or submitted by the Authorized Representative pursuant to this Authorization shall be deemed to have been duly authorized by all JV Partners and shall be legally binding upon each of us, jointly and severally.

This Power of Attorney is executed by the duly authorized signatories of each JV Partner on the date first mentioned above.

Thanking you.
Yours
faithfully,

For and on behalf of the Joint Venture Partners:

[Signature & Stamp]
Authorized Representative of Partner 1 [Lead Partner]:
[Full Legal Name]

[Signature & Stamp]
Authorized Representative of Partner 2:
[Full Legal Name]

[Signature & Stamp]
Authorized Representative of Partner 3 [if applicable]:
[Full Legal

Name]

Witnesses:

1. _____

Name:
CNIC/Passport No.:

2. _____

Name:
CNIC/Passport No.:

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Letter of Bid – Technical Proposal

INSTRUCTIONS TO BIDDERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

Place this Letter of Bid in the first envelope "TECHNICAL PROPOSAL".

The Bidder must prepare the Letter of Bid on stationery with its letterhead clearly showing the Bidder's complete name and business address.

Note: All italicized text in black font is to help Bidders in preparing this form and Bidders shall delete it from the final document.

Date of this Bid submission: [*insert date (as day, month and year) of Bid submission*]
RFB No.: [*insert number of Bidding process*]
Alternative No.: [*insert identification No if this is a Bid for an alternative*]

To: **[*insert complete name of Procuring agency/Employer*]**

We, the undersigned Bidder, hereby submit the first part of our Bid, the Technical Proposal

In submitting our Bid we make the following declarations:

(a) **No reservations:** We have examined and have no reservations to the bidding document, including addenda issued in accordance with Instructions to Bidders **(ITB 9);**
(b) **Eligibility**: We meet the eligibility requirements and have no conflict of interest in accordance with ITB 3;
(c) **Bid/Proposal-Securing Declaration**: We have not been suspended nor declared ineligible by the Procuring agency/Employer based on execution of a Bid Securing Declaration or Bid Securing Declaration in the Procuring agency/Employer's country in accordance with **ITB 3;**
(d) **Conformity:** We offer to execute works in conformity with the bidding document and in accordance with the works requirements: [*insert a brief description of the WORKS*];
(e) **Bid Validity Period**: Our Bid shall be valid for the period specified in **BDS 18.1** (as amended, if applicable) from the date fixed for the Bid submission deadline specified in **BDS 24.1** (as amended, if applicable), and it shall remain binding upon us, and may be accepted at any time before the expiration of that period;
(f) **Performance Security**: If our Bid is accepted, we commit to obtain a performance security in accordance with the bidding document;
(g) One Bid per Bidder: We are not submitting any other Bid(s) as an individual Bidder, and we are not participating in any other bid(s) as a Joint Venture member or as a subcontractor, and meet the requirements, other than Alternative Bids submitted in accordance with **ITB 20;**
(h) **Suspension and Debarment**: We, along with any of our subcontractors, suppliers, consultants, manufacturers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by the Procuring agency/Employer. Further, we are not ineligible under Pakistan laws;
(i) **State-owned enterprise or institution**: [*select the appropriate option and delete the other*] [*We are not a state-owned enterprise or institution*] / [*We are a state-owned enterprise or institution*];
(j) **Binding Contract**: We understand that this Bid, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed;
(k) **Not Bound to Accept**: We understand that you are not bound to accept the Most Advantageous Bid or any other Bid that you may receive; and

(l) **Fraud and Corruption**: We hereby certify that we have taken steps to ensure that no person acting for us, or on our behalf, engages in any type of Fraud and Corruption.

Name of the Bidder: *[*insert complete name of Bidder*]

Country of Origin of the Bidder: *[insert country of origin, in case of JV country of origin of lead member]*

Name of the person duly authorized to sign the Bid on behalf of the Bidder: ** [*insert complete name of person duly authorized to sign the Bid*]

Title of the person signing the Bid: [*insert complete title of the person signing the Bid*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*]

Date signed [*insert date of signing*] **day of** [*insert month*], [*insert year*]

*: In the case of the Bid submitted by a Joint Venture specify the name of the Joint Venture as Bidder.
**: Person signing the Bid shall have the power of attorney given by the Bidder. The power of attorney shall be attached with the Bid Schedules.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

CONSTRUCTION SCHEDULE

Pursuant to Sub-Clause 8.3 of the General Conditions, the whole of the Works, and each Section (if any), shall be completed within the Time for Completion for the Works or Section (as the case may be) stated as hereunder and mentioned in Contract Data:

Description	Time for Completion (days)
a) Whole Works	***730 days***

[The Bidder shall provide, the Construction Schedule in the bar chart (CPM, PERT or any other to be specified herein) showing the sequence of work items and the period of time during which he proposes to complete each work item in such a manner that his proposed programme for completion of the whole of the Works and Sections of the Works may meet Employer's completiontargets in days noted above and counted from the Commencement Date (Attach sheets as required for the specified form of Construction Schedule)]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

METHOD OF PERFORMING THE WORK

[The Bidder is required to submit a narrative outlining the method of performing the Work. The narrative should indicate in detail and include but not be limited to:

1. Organization Chart:

   Shall indicate head office and field office personnel involved in management and supervision, engineering, equipment maintenance and purchasing.

2. Method of executing the Works:

   The procedures for installation of equipment and machinery and transportation of equipment and materials to the site.]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

LIST OF MAJOR EQUIPMENT

[The Bidder will provide on Sheet E-2 of this Schedule *a list of all major equipment and related items, under separate heading for items owned, to be purchased or to be arranged on lease by him to carry out the Works. The information shall include make, type, capacity, and anticipated period of utilization for all equipment.*

The Bidder shall provide adequate information to demonstrate clearly that it has the capability tomeet the requirements for the key equipment listed in Sheet E-3.]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

LIST OF MAJOR EQUIPMENT

Owned, Purchased or Leased

Owned Purchased orLeased	Description of Unit(Make, Model, Year)	Capacity HP Rating	Condition	Present Location orSource	Date of Delivery atSite	Period of Work on Project
1	2	3	4	5	6	7
a. Owned						
b. To be Purchased						
c. To be arranged on Lease						

LIST OF MAJOR EQUIPMENT

Equipment details

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment □ Owned □ Rented □ Leased □ Specially manufactured	
The following information shall not be applicable for equipment owned by the Bidder		
Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

[This Table shall be used for each item of Equipment separately]

ORGANIZATION CHART FOR THE SUPERVISORY STAFF AND LABOUR

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

LIST OF SUBCONTRACTORS

I/ We intend to subcontract the following parts of the Work to subcontractors. In my/ our opinion,the subcontractors named hereunder are reliable and competent to perform that part of the work for which each is listed.

Enclosed are documentation outlining experience of subcontractors, the curriculum vitae and experience of their key personnel who will be assigned to the Contract, equipment to be supplied by them, size, location and type of contracts carried out in the past.

Part of Works (Give Details)	Subcontractor (With Complete Address)
1	2

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

CONSTRUCTION CAMP AND HOUSING FACILITIES

[The Bidder in accordance with Clause 6 of the Conditions of Contract shall provide description of his construction camp's facilities and staff housing requirements.

The Bidder shall list or explain his plans for providing these facilities for the service of the Contract as follows:

1. *Site Preparation (clearing, land preparation, etc.).*

2. *Provision of Services.*

- *a) Electrical power (expected power load, etc.).*
- *b) Water (required amount and system proposed).*
- *c) Sanitation (sewage disposal system, etc.)*

3. *Construction of Facilities*

- *a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type ofconstruction of buildings, etc.).*
- *b) Warehouses and Storage Areas (area required, type of construction and layout).*
- *c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction,etc.).*

4. *Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).*

5. *Other Items Proposed (Security services, etc.)]*

Note:

The Contractor shall be responsible for pumps, electrical power, water and electrical distribution systems, and sewerage system including all fittings, pipes and other items necessary for servicing the Contractor's construction camp.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Integrity Pact

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS.10.00 MILLION OR MORE

Contract Number: _____ Dated: _____
Contract Value: _____
Contract Title: _____

[Name of Contractor] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoP) through any corrupt business practice.

Without limiting the generality of the foregoing [Name of Contractor] represents and warrants that it has fully declared the brokerage, commission, fee etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultations fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[Name of Contractor] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representative or warranty.

[Name of Contractor] accepts full responsibility and strict liability for making and false declaration, not making full disclosure, misrepresenting fact or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [Name of Contractor] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [Name of Contractor] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.

_____ _____
[Procuring agency/Employer] [Contractor]

K-1
Schedule-K to Bid

Mobilization Schedule

Instructions to Bidders: *The Bidder shall submit a proposed Mobilization Schedule indicating the period required to mobilize the personnel, plant, equipment, temporary facilities, materials and other resources necessary for commencement of the Works. The Schedule shall demonstrate the Bidder's understanding of the mobilization requirements and shall be consistent with the proposed construction methodology and the Time for Completion.. Resp. codes: PM = Project Manager | CM = Construction Mgr | SE = Site Engineer | QC = QC Inspector | HSE = HSE Officer | HR = HR/Admin.*

Contract Title / Package	Contract No. / Reference	Bidder / Contractor Name	Date of Submission

No.	Mobilization Activity	Resp.	W1	W2	W3	W4	W5	W6
A	ADMINISTRATION & CONTRACTUAL OBLIGATIONS							
1	Performance Security Submitted to Employer	*PM*						
2	All Required Insurances Submitted to Engineer	*PM*						
3	Contractor's Representative Present on Site	*PM*						
B	SITE ESTABLISHMENT & TEMPORARY WORKS							
4	Site Hoarding, Security Fencing & Access Control	*CM*						
5	Contractor's & Engineer's Site Offices Established	*CM*						
6	Employer's & Engineer's Site Offices Established	*CM*						
7	Employer's/ Engineer's Accommodations & Support facilities	*CM*						
8	Employer's & Engineers Transport & Support facility	*CM*						
9	Workers' Accommodation & Site Welfare Facilities	*CM*						
10	Temporary Power, Water Supply & Waste Disposal	*CM*						
11	Site Survey & Establishment of Reference Benchmarks	*SE*						
C	**PLANT & EQUIPMENT MOBILIZATION**							
12	Survey Equipment & Light Vehicles on Site	*SE*						
13	Major Plant & Construction Machinery (per Schedule)	*CM*						
14	Site Laboratory & Testing Equipment Established	*QC*						
D	**PERSONNEL MOBILIZATION**							
15	Key Engineers, QS, Document Controller on Site	*HR*						
16	HSE Officer & QC Inspector Deployed	*HSE*						
17	Foremen, Skilled Labour & Trade Personnel on Site	*HR*						
E	**PROGRAMME & DOCUMENT SUBMITTALS**							
18	Contractor's Programme — Sub-Clause 8.3	*PM*						
19	QMP, HSEP & Cash Flow Forecast — Sub-Cl. 14.4	*QC*						
★ MOBILIZATION COMPLETE — Permanent Works Ready to Commence								

Signature of Authorized Representative	Name, Title & Professional Registration No.	Date

Note: *This Mobilization Schedule is a separate submission from the Contractor's Programme required under Sub-Clause 8.3. Additional rows may be added if the Contractor's plan includes activities not*

listed above. Submission of this Schedule does not relieve the Contractor of any obligation or liability under the Contract.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Letter of Bid - Financial Proposal

INSTRUCTIONS TO BIDDERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

Place this Letter of Bid - Financial Proposal in the second envelope marked "FINANCIAL PROPOSAL".

The Bidder must prepare the Letter of Bid - Financial Proposal on stationery with its letterhead clearly showing the Bidder's complete name and business address.

Note: All italicized text is to help Bidders in preparing this form.

Date of this Bid submission: [*insert date (as day, month and year) of Bid submission*]
Request for Bid No.: [*insert number of bidding process*]
Name of Project.: [*insert identification*]
Alternative No.: [*insert identification No if this is a Bid for an alternative*]

To: [*insert complete name of Procuring agency/Employer*]

We, the undersigned Bidder, hereby submit the second part of our Bid, the Financial Proposal

In submitting our Financial Proposal we make the following additional declarations:

(a) **Bid Validity Period**: Our Bid shall be valid for the period specified in **BDS 18.1** (as amended, if applicable) from the date fixed for the bid submission deadline specified in **BDS 24.1** (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(b) **Total Price:** The total price of our Bid is:

[*insert the total price of the bid in words and figures, indicating the various amounts and the respective currencies*];

(c) **Commissions, gratuities and fees:** We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract: [*insert complete name of each Recipient, its full address, the reason for which each commission or gratuity was paid and the amount and currency of each such commission or gratuity*].

Name of Recipient	Address	Reason	Amount

(If none has been paid or is to be paid, indicate "none.")

(d) **Binding Contract:** We understand that this Bid, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed.

Name of the Bidder:*[*insert complete name of the Bidder*]

Name of the person duly authorized to sign the Bid on behalf of the Bidder: ** [*insert complete name of person duly authorized to sign the Bid*]

Title of the person signing the Bid: [*insert complete title of the person signing the Bid*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*]

Date signed [*insert date of signing*] **day of** [*insert month*], [*insert year*]

*: In the case of the Bid submitted by a Joint Venture specify the name of the Joint Venture as Bidder.

**: Person signing the Bid shall have the power of attorney given by the Bidder. The power of attorney shall be attached with the Bid Schedules.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Form of Bid Security

(Bank Guarantee)

[The bank shall fill in this Bank Guarantee Form in accordance with the instructions indicated.]
[Guarantor letterhead or SWIFT identifier code]

Beneficiary: *[Purchaser to insert its name and address]*

No.: *[Purchaser to insert reference number for the Request for Bids]*

Alternative No*.: [Insert identification No if this is a Bid for an alternative]*

Date: *[Insert date of issue]*

BID GUARANTEE No.: *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ *[insert name of the Bidder, which in the case of a joint venture shall be the name of the joint venture (whether legally constituted or prospective) or the names of all members thereof]* (hereinafter called "the Applicant") has submitted or will submit to the Beneficiary its Bid (hereinafter called "the Bid") for the execution of _____ under Request for Bids No. _____ _ ("the RFB").

Furthermore, we understand that, according to the Beneficiary's conditions, Bids must be supported by a Bid guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ (_____) upon receipt by us of the Beneficiary's complying demand, supported by the Beneficiary's statement, whether in the demand itself or a separate signed document accompanying or identifying the demand, stating that either the Applicant:

(a) has withdrawn its Bid during the period of Bid validity set forth in the Applicant's Letter of Bid ("the Bid Validity Period"), or any extension thereto provided by the Applicant; or

(b) having been notified of the acceptance of its Bid by the Beneficiary during the Bid Validity Period or any extension thereto provided by the Applicant, (i) has failed to sign the contract agreement, or (ii) has failed to furnish the performance security, in accordance with the Instructions to Bidders ("ITB") of the Beneficiary's bidding document.

This guarantee will expire: (a) if the Applicant is the successful Bidder, upon our receipt of copies of the Contract agreement signed by the Applicant and the performance security issued to the Beneficiary in relation to such Contract agreement; or (b) if the Applicant is not the successful Bidder, upon the earlier of (i) our receipt of a copy of the Beneficiary's notification to the Applicant of the results of the Bidding process; or (ii) twenty-eight days after the end of the Bid Validity Period.

Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

_____

[Signature(s)]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

Form of Bid-Securing Declaration

[The Bidder shall fill in this Form in accordance with the instructions indicated.]

Date: *[date (as day, month and year)]*
No.: *[number of bidding process]*
Alternative No.: *[insert identification No if this is a Bid for an alternative]*

To: *[complete name of Procuring agency/Employer]*

We, the undersigned, declare that:

We understand that, according to your conditions, Bids must be supported by a Bid-Securing Declaration.

We accept that we will be blacklisted and henceforth cross debarred for participating in respective category of public procurement proceedings for a period of (not more than) six months, if fail to abide with a bid securing declaration, however without indulging in corrupt and fraudulent practices, if we are in breach of our obligation(s) under the Bid conditions, because we:

(a) have withdrawn our Bid during the period of Bid validity specified in the Letter of Bid; or

(b) having been notified of the acceptance of our Bid by the Procuring agency/Employer during the period of Bid validity, (i) fail or refuse to sign the Contract; or (ii) fail or refuse to furnish the Performance Security (or guarantee), if required, in accordance with the ITB.

We understand this Bid Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of [illegible] f the successful Bidder; or (ii) twenty-eight days after the expiration of [illegible]

NOT APPLICABLE

Name of the Bidder*_____

Name of the person duly au[illegible]ed to sign the Bid on behalf of the Bidder**_____

Title of the person signing the Bid_____

Signature of the person named above_____

Date signed _____ day of _____, _____

*: In the case of the Bid submitted by joint venture specify the name of the Joint Venture as Bidder
**: Person signing the Bid shall have the power of attorney given by the Bidder attached to the Bid

[Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all members to the Joint Venture that submits the Bid.]

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Preamble

Employer: Pakistan Airports Authority (PAA)

Schedule – B to the Bid

A. Preamble

1.The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Particular Conditions of Contract, Technical Specifications, and Drawings.
2.The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices bid in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.
3.The rates and prices bid in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the Contract, include all Constructional Plant, labour, supervision, materials, erection, maintenance, insurance, profit, taxes, and duties, together with all general risks, liabilities, and obligations set out or implied in the Contract.
4.A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of Items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
5.The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
6.General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities.
7.Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with Sub-Clauses 13.4 and 13.5 of the General Conditions.
8.Unless otherwise expressly provided in the Contract, the method of measurement for determining the quantities of completed work for payment shall be based on the actual quantities of work executed, measured at the Site by the Engineer in accordance with the Contract, the approved Drawings, and the Technical Specifications. Where the Technical Specifications prescribe a specific method of measurement, such method shall prevail. In the absence of a specified method, measurement shall be carried out in accordance with Good Industry Practice and the Engineer's reasonable instructions.
B. Work Items
1.The Bill of Quantities usually contains the following part Bills, which have been grouped according to the nature or timing of the work:
Volume-III – Bill of Quantities;
Bill No. 1Preliminaries and General Items
Bill No. 2Civil Works – Substructure & Superstructure
Bill No. 3Architectural & Finishing Works

Bill No. 4Roads and Pavement Works
Bill No. 5Electrical Works
Bill No. 6Mechanical / HVAC Works
Bill No. 7Plumbing & Fire Fighting Works
Bill No. 8ATC Equipment
Daywork Schedule; and
Summary Bill of Quantities.

2.If ITB 16.1 applies, Bidders shall price the Bill of Quantities in the applicable currency or currencies (Local or foreign as the case may be).

Schedule – B to the Bid
Daywork Schedule
General

1.Reference should be made to Sub-Clause 13.5 of the General Conditions. Work shall not be executed on a daywork basis except by written order of the Engineer. Bidders shall enter basic rates for daywork items in the Schedules, which rates shall apply to any quantity of daywork ordered by the Engineer. Nominal quantities have been indicated against each item of daywork, and the extended total for Daywork shall be carried forward as a Provisional Sum to the Summary Total Bid Amount. Unless otherwise adjusted, payments for daywork shall be subject to price adjustment in accordance with the provisions in the Conditions of Contract.

Daywork Labour

2.In calculating payments due to the Contractor for the execution of daywork, the hours for labour will be reckoned from the time of arrival of the labour at the job site to execute the particular item of daywork to the time of return to the original place of departure, but excluding meal breaks and rest periods. Only the time of classes of labour directly doing work ordered by the Engineer and for which they are competent to perform will be measured. The time of gangers (charge hands) actually doing work with the gangs will also be measured but not the time of foremen or other supervisory personnel.

3.The Contractor shall be entitled to payment in respect of the total time that labour is employed on daywork, calculated at the basic rates entered by the Contractor in the Schedule of Daywork Rates: 1. Labour, together with an additional percentage payment on basic rates representing the Contractor's profit, overheads, etc., as described below:

(a)The basic rates for labour shall cover all direct costs to the Contractor, including (but not limited to) the amount of wages paid to such labour, transportation time, overtime, subsistence allowances, and any sums paid to or on behalf of such labour for social benefits in accordance with law of the land. The basic rates will be payable in PKR only.

(b)The additional percentage payment to be quoted by the bidder and applied to costs incurred under (a) above shall be deemed to cover the Contractor's profit, overheads, superintendence, liabilities, and insurances and allowances to labour, timekeeping, and clerical and office work, the use of consumable stores, water, lighting, and power; the use and repair of stagings, scaffolding, workshops, and stores, portable power tools, manual plant, and tools; supervision by the Contractor's staff, foremen, and other supervisory personnel; and charges incidental to the foregoing. Payments under this item shall be made in the Pakistani Rupee:

Daywork Materials

4.The Contractor shall be entitled to payment in respect of materials used for daywork (except for materials for which the cost is included in the percentage addition to labour costs as detailed heretofore), at the basic rates entered by the Contractor in the Schedule of Daywork Rates: 2. Materials, together with an additional percentage payment on the basic rates to cover overhead charges and profit, as follows:

(a)the basic rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc., and shall provide for delivery to store for stockpiling at the Site. The basic rates shall be quoted in the currency specified in the BDS.
(b)the additional percentage payment shall also be made in the currency specified in BDS:

(c)the cost of hauling materials for use on work ordered to be carried out as daywork from the store or stockpile on the Site to the place where it is to be used will be paid in accordance with the terms for Labour and Construction in this schedule.

Daywork Contractor's Equipment

5.The Contractor shall be entitled to payments in respect of Contractor's Equipment already on Site and employed on daywork at the basic rental rates entered by the Contractor in the Schedule of Daywork Rates, Contractor's Equipment. Said rates shall be deemed to include due and complete allowance for depreciation, interest, indemnity, and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumables, and all overhead, profit, and administrative costs related to the use of such equipment.

6.In calculating the payment due to the Contractor for Contractor's Equipment employed on daywork, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Engineer, the travelling time from the part of the Site where the Contractor's Equipment was located when ordered by the Engineer to be employed on daywork and the time for return journey thereto shall be included for payment.

(a)The basic rental rates for Contractor's Equipment employed on daywork shall be stated in the currency specified in the BDS and the payment to the Contractor will be made in the currency specified in BDS.

PUBLIC PROCUREMENT REGULATORY AUTHORITY
PPRA
EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Grand Summary (Summary of Cost)

Employer: Pakistan Airports Authority (PAA)

Bill No.	Description	Ref	Amount (PKR)
Bill No. 1	Preliminaries and General Items		0.00
Bill No. 2	Civil Works - Substructure & Superstructure		0.00
Bill No. 3	Architectural & Finishing Works		0.00
Bill No. 4	Roads and Pavement Works		0.00
Bill No. 5	Electrical Works		0.00
Bill No. 6	Mechanical / HVAC Works		0.00
Bill No. 7	Plumbing & Fire Fighting Works		0.00
Bill No. 8	ATC Equipment		0.00
	Subtotal of Bills	**(A)**	**0.00**
	Total for Daywork (Provisional Sum)	**(B)**	**0.00**
	Total (A + B)	**(C)**	**0.00**
	Provisional Sum: Utility charges for Electric Load Sanction from WAPDA (Employer-fixed)	(D)	50,000,000.00
	Total Estimated Base Cost (C + D)	**(E)**	**0.00**

Bid Price (C) in Words:

_____

Pakistani Rupees (PKR)

Notes:

1. All amounts stated in this Grand Summary shall be in Pakistani Rupees (PKR) and shall be inclusive of all applicable taxes, duties, levies, and other charges payable by the Contractor, unless otherwise stated in the Contract Data.
2. Bill Nos. 1–8 correspond to the individual Bills forming the Priced Bill of Quantities, Volume-III of the Bidding Documents. The Bidder shall insert against each Bill the page number on which that Bill appears in its priced submission, and the total amount carried from that Bill.
3. Item (B) – Total for Daywork – is the sum of the Totals carried forward from the Schedule of Daywork Rates: 1. Labour, 2. Materials, and 3. Contractor's Equipment. It constitutes a Provisional Sum under Sub-Clause 13.4 [Provisional Sums] of the Conditions of Contract, to be expended only as, and to the extent, instructed by the Engineer, and does not represent work to be carried out by the Contractor as of right.
4. Item (D) – Provisional Sum for Contingency Allowance – is fixed by the Employer in the Bidding Documents and pre-inserted in the Priced Bill of Quantities issued to Bidders; Bidders shall not alter this figure. It is a Provisional Sum under Sub-Clause 13.4, to be expended, wholly or in part, only upon the Engineer's instruction. This Provisional Sum does not form part of the Bid Price at (C) and shall not be taken into account for bid evaluation or bid comparison purposes; it is reflected only in the indicative Total Estimated Contract Value at (E). This provisional sum shall be used for load sanctioning and Deposit Work to carried out by WAPDA on demand note as per procedure followed by DISCOs in accordance with NEPRA regulations and other emergent nature of work approved by the Employer .
5. Item (E) – Indicative Total Estimated Contract Value – is provided for the Employer's internal budgetary reference only, obtained by adding the fixed Provisional Sum at (D) to the Bid Price at (C). It does not form part of, and shall not be substituted for, the Bidder's evaluated Bid Price, and need not be completed by the Bidder.

6. Both the figures and the words for the Bid Price (C) must be completed by the Bidder. In the event of a discrepancy between the amount in figures and the amount in words, the amount in words shall govern, subject to the arithmetical-error correction procedure set out in the Instructions to Bidders (ITB).
7. In the event of any discrepancy between this Grand Summary, the sum of the amounts stated in the individual Bills, the Priced Bill of Quantities, or the Bid Price stated in the Letter of Bid, the correction procedure and order of precedence set out in the ITB shall apply, and the unit rates quoted in the Priced Bill of Quantities shall prevail over extended or summarized amounts.
8. This Grand Summary shall be signed and submitted together with the Letter of Bid, the Priced Bill of Quantities, and all completed Schedules to Bid, as part of the Bidder's Bid.
We confirm that the Bid Price stated above has been correctly derived from, and is fully consistent with, the rates and prices quoted in the Priced Bill of Quantities forming part of this Bid.

Signature: _____Date: _____
Name: _____Designation: _____
For and on behalf of (Bidder's Name): _____
CNIC / Passport No.: _____(Company Seal / Stamp):_____

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 1 - Preliminaries and General Items: Administrative Arrangement including Transportation, Site Offices & Mess + Accommodation

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
G	Administrative Arrangement including Transportation, Site Offices & Mess + Accommodation Ref Specs Section 0010. REF: Technical Specifications Section - 0010, Section - 0030					
G-1	Providing new vehicles for the exclusive use of the Employer and the Engineer in accordance with the Technical Specification Section 0010, including supply, delivery, inspection, registration facilitation, tools, accessories, owner's manuals, warranties and all associated requirements, complete in all respects. REF: Technical Specifications Section - 0010					
G-1-1	Toyota Hilux Revo Rocco 2.8L 4×4 A/T. REF: Technical Specifications Section - 0010	1.00	No.	Not Applicable		
G-1-2	BYD Shark 6 DMO AWD Premium (PHEV Pickup Truck) REF: Technical Specifications Section - 0010	1.00	No.	Not Applicable		
G-1-3	Changan Oshan X7 Future Sense 7-Seat. REF: Technical Specifications Section - 0010	1.00	No.	Not Applicable		
G-1-4	Honda BRV i-VTEC S (CVT) REF: Technical Specifications Section - 0010	2.00	No.	Not Applicable		
G-2	Registration, licensing, comprehensive insurance coverage, token taxes, withholding taxes, route permits and all statutory fees, duties and charges required for operation of the vehicles, including renewals where applicable, until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010	1.00	LS	Not Applicable		
G-3	Operation, management and comprehensive maintenance of all vehicles, including provision of drivers, fuel, lubricants, tyres, batteries, consumables, routine servicing, preventive maintenance, repairs, breakdown assistance, replacement of worn or damaged parts, insurance claim handling and all other costs necessary to keep the vehicles fully operational, roadworthy and continuously available for the exclusive use of the Employer and the Engineer throughout the Contract Period until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010	36.00	LS/Month	Not Applicable		
G-4	Providing, establishing, furnishing, equipping, testing and commissioning a fully functional Combined Employer's and Engineer's Site Office Complex in accordance with the Drawings and Technical Specification Section-0010, including all prefabricated office buildings, conference and meeting facilities, records and sample storage rooms, toilets and ablution facilities, foundations, utility connections, internal roads, parking areas, external works, electrical and mechanical installations, lighting, air-conditioning, backup generators, water supply, sewerage and drainage systems, LAN/Wi-Fi infrastructure, furniture, IT and communication equipment, office equipment, fire safety provisions, fixtures, fittings, accessories and all ancillary works required to provide a complete and operational facility ready for use by the Employer and the Engineer, complete in all respects. REF: Technical Specifications Section - 0010	1.00	LS	Not Applicable		
G-5	Operation, management and maintenance of the Combined Employer's and Engineer's Site Office Complex from commencement of use until issuance of the DLC, including operation and maintenance of all buildings, utilities, generators, furniture, equipment and services; provision of electricity, fuel, water, internet, telephone services, stationery, office consumables, drinking water, security staff, office attendants, janitorial staff, cleaning services, repairs, replacements, utility charges and all other recurring costs necessary to maintain the facility in a safe, fully functional and satisfactory condition until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010	36.00	LS/Month	Not Applicable		

G-6	Provision through rental or hiring arrangements of separate furnished Staff Accommodation and Mess Facilities for the exclusive use of the Employer and the Engineer, in accordance with Technical Specification Section-0010, including suitable accommodation units, bedrooms, dining facilities, kitchens, toilets, furniture, appliances, fixtures, fittings, utensils and all other facilities necessary to provide complete, operational and habitable accommodation and mess facilities ready for occupation and use until issuance of the DLC, complete in all respects. REF: Technical Specifications Section - 0010, Section - 0030	36.00	LS/Month	Not Applicable		
G-7	Operation, management and maintenance of the Employer's and Engineer's Staff Accommodation and Mess Facilities from the date of occupation until issuance of the DLC, including provision of cooks, mess attendants, housekeeping staff, cleaners, security personnel and other support staff; payment of electricity, water, gas, internet and communication charges; procurement of cleaning materials and consumables; routine upkeep, repairs, maintenance and replacement of furniture, fixtures, fittings, appliances and utensils; waste disposal, pest control and all other services, resources and recurring costs necessary to maintain the accommodation and mess facilities in a safe, hygienic, comfortable and fully functional condition, complete in all respects. REF: Technical Specifications Section - 0010, Section - 0030	36.00	LS/Month	Not Applicable		
G-8	Provision, preparation, maintenance, and payment of rental charges for temporary access road(s) from JSR (Main Road) to the Combined Employer's and Engineer's Site Office Complex for the entire Contract period, including grading, compaction, drainage, reinstatement, and all incidental works, complete in all respects. REF: Technical Specifications Section - 0010	36.00	LS/Month	Not Applicable		
G-9	Providing, installing, maintaining, (as required), and removing temporary fencing around the project site and work areas, complete in accordance with drawings, specifications, and the Engineer's instructions, including all materials, labor, equipment, fixings, supports, transportation, maintenance during the contract period, dismantling upon completion, and all incidental works, complete in all respects. REF: Technical Specifications Section - 0010	1.00	Job	Not Applicable		
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 2 - Civil Works (Substructure & Superstructure): Summary

S.No.	Description	Amount (PKR)
a	Part A - Pile Work	
b	Part B - Building Structure Work	
c	Part C - Steel Work in Space Frame Structure & Metal Deck Structure	
d	Part D - Utility Block Structure Work	
	Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 2 - Civil Works (Substructure & Superstructure): Part A - Pile Work

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
CP-1	Providing and casting in situ bored reinforced concrete piles using Ordinary portland cement / Sulphate resisting cement or as may be required, including screening, washing of aggregates, mixing of constituents using batching plant, Transportation by Transit Mixer, Pouring in the required proportion to achieve a nominal cylindrical strength in the field as per ACI-214, with the specified consistency. i/c the cost of labour, boring, equipment / machinery, platform (except the cost of steel reinforcement, its labour for bending and laying in position and boat platform etc. which will be paid separately) including the cost of concrete pump and admixture, as approved and directed by the Engineer Incharge. 3000 PSI (Dia as mentioned in drawing) REF: Technical Specifications Section - 0190, Section - 0150, Section - 0145, Section - 0140	7,410.00	Rft	Not Applicable		
CP-2	Fabrication of mild steel reinforcement deformed bar cage of specified yield strength for R.C.C bored piles including cutting bending, lowering of cage with crane in position,welding and fastening, including the cost of binding wire, Crane Machine (also includes removal of rust from the bars) as approved and directed by the Engineer Incharge. REF: Technical Specifications Section - 0190, Section - 0150, Section - 0145, Section - 0140 Grade - 60.	122,283.80	Kg	Not Applicable		
CP-3	Initial (ultimate) vertical compression load test on sacrificial Ø1000 mm bored cast-in-situ pile to 378 tons (3.0 x working load of 126 tons), by anchor-pile reaction frame, in two loading cycles, instrumented for shaft friction and end bearing, in accordance with ASTM D1143 and Section 0190 Clause 3.12. Rate to include provision of the sacrificial test pile, reaction piles, reaction frame, instrumentation, loading, monitoring, standing time and submission of test report in triplicate.	1.00	No.			
CP-4	Ditto Item 1, but test load 228 tons (3.0 x working load of 76 tons), covering pile types ATCT-F2, ATCT-F3, ATCT-F4, FS-F1 and FS-F2.	1.00	No.			
CP-5	Routine (proof) vertical compression load test on working Ø1000 mm bored cast-in-situ pile of Foundation Type ATCT-F1 to 189 tons (1.5 x working load), in accordance with ASTM D1143. Rate to include reaction arrangement, instrumentation, loading, monitoring, standing time and test report.	1.00	No.			
CP-6	Ditto Item 3, but test load 114 tons (1.5 x working load), on Foundation Types ATCT-F2, ATCT-F3, ATCT-F4, FS-F1 and FS-F2 - one test per foundation type.	5.00	No.			
CP-7	Lateral load test on working Ø1000 mm bored pile of ATCT at 10% of working load, applied cyclically, in accordance with ASTM D3966. Rate to include reaction pile, instrumentation and test report.	1.00	No.			
CP-8	Tension (uplift) load test on working Ø1000 mm bored pile of ATCT to 1.5 x design uplift load, in accordance with ASTM D3689. Rate to include reaction arrangement, instrumentation and test report. To be executed only where net uplift is confirmed in writing by the Engineer.	1.00	No.			
CP-9	Low-strain pile integrity test (PIT) on Ø1000 mm bored piles in accordance with ASTM D5882 and Section 0190 Clause 3.19, including pile head preparation, testing, interpretation and report. (100% of working piles.)	142.00	No.			
CP-10	Crosshole sonic logging (CSL) of Ø1000 mm bored piles in accordance with ASTM D6760, including supply and installation of four nos. 50 mm dia. steel access tubes per pile to full pile length, capping, water filling, testing, interpretation and report. (10% of working piles plus both initial test piles.)	17.00	No.			

CP-11	High-strain dynamic pile test (PDA) with CAPWAP analysis on Ø1000 mm bored pile in accordance with ASTM D4945 and Section 0190 Clause 3.20, complete in all respects including wave equation analysis and test report.	4.00	No.			
CP-12	Extra over the pile installation items for provision of 2 nos. sacrificial initial test piles, Ø1000 mm bored cast-in-situ, of the same length, reinforcement and installation method as the working piles, installed at positions selected by the Engineer and forming no part of the permanent works.	2.00	No.			
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 2 - Civil Works (Substructure & Superstructure): Part B - Building Structure Work

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
CB-1	Excavation in all kind of soils at any level/height including clearing & grubbing, trimming/dressing out,disposal of surplus/unsuitable material at area designated by the Engineer within or outside work site, and i/c all lead & lift, marking alignment for layout by providing permanent benchmarks and alignment pillars including levels and grid lines etc. and necessary protection/ shoring/ stability to excavated areas/sides, dewatering and keeping the area to dry,all operations & arrangements in connection with earth works to complete conforming to the requirements of drawings, specifications and instructions by the Engineer In Charge. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060	46,989.00	Cft	Not Applicable		
CB-2	Spraying termite proofing using liquid FMC/ Biflex/Terminix Exin/ Ms Hextar or eq @ spd suspension concenterate (SC), Mixing ability-HEXTAR with Ratio (1:250) = 540 Sq Ft or equivalent liquid applying with shower and certificate will be provided by the contractor for 10-years compere in complete in all respect as approved by the Engineer Incharge. REF: Technical Specifications Section - 0130	41,337.00	Sft	Not Applicable		
CB-3	Providing, laying Engineering Fill shall be well graded and a mixture of non-toxic soil, filling shall be placed in layers not exceeding 6" in compacted thickness, filling shall be compacted to a drey density not less than 95% of maximum dry density (ASTM D-1557), i/c lead and transportation to site, as shown in drawings complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0100	133,346.00	Cft	Not Applicable		
CB-4	Providing & Laying in position, True to line, level, grade, at any height. aggregate (as approved) including screening and washing of aggregate & Sand (as approved), finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. Ratio 1:4:8 Under footing. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	3,666.31	Cft	Not Applicable		
CB-5	Providing & Laying in position light-weight concrete, as approved, finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0140	8,509.69	Cft	Not Applicable		
CB-6	Providing, laying, compacting and curing sand, under floor and compaction, complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0120, Section - 0100	12,062.50	Cft	Not Applicable		
CB-7	Providing, laying, dry rammed brick or stone ballast 1 1/2" to 2" gauge, complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0120, Section - 0100	6,031.25	Cft	Not Applicable		
CB-8	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 3000 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					
CB-8-1	RCC in Footing. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	24,783.56	Cft	Not Applicable		

CB-8-2	RCC in Slab. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	20,193.95	Cft	Not Applicable		
CB-8-3	RCC in Stairs. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	735.00	Cft	Not Applicable		
CB-9	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 4500 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					
CB-9-1	RCC in Beams. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	17,262.68	Cft			
CB-9-2	RCC In Lift & Shear Wall. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	4,170.00	Cft	Not Applicable		
CB-9-3	Columns. REF: Technical Specifications Section - 0150, Section - 0145	8,848.70	Cft	Not Applicable		
CB-10	Providing, fabrication, straightening, cutting, bending, placing, binding with annealed wire, including removal of rust from bars with sand blasting, PCC Spacer block, wastage, etc. complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0145	342,864.70	Kg	Not Applicable		
CB-11	Providing and applying torch-on plain waterproofing bituminous membrane of specified thickness duly lapped/connected by heating with Torch over ps-6 primer i/c preparation/smoothen the surface complete in all respect as approved and directed by the Engineer Incharge. REF: Technical Specifications Section - 0150	18,541.00	Sft	Not Applicable		
CB-12	Providing and embedding 10" (250mm) wide PVC water stopper in expansion joints of RCC structures (Retaining walls, water tanks, Slabs) complete in all respect. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	461.00	Rft	Not Applicable		
CB-13	Providing and laying concrete block masonry having 1800 psi compressive cube strength at 28 days for Internal/External walls as in specified thickness & laid in specified cement sand mortar , placed at any height/level masonry to be laid in courses true to line, level and plumb, protected and properly cured including scaffolding, wastage, deep joints to receive rendering, chiseling including all dowels/ steel bars /anchoring/GI wall ties/strip etc., to be installed horizontally/ vertically as specified in general notes/details drawing typical, curing, placing of all embedded items in position i.e. conduits/ sleeves/ anchors/ all other fittings/ accessories etc., as necessary related to MEP provisions. Complete in all respects and conforming to the requirements of drawings, specifications and instructions by the Engineer In charge. REF: Technical Specifications Section - 0200, Section - 0260					
CB-13-1	4" thick 1800 PSI. REF: Technical Specifications Section - 0200	2,390.00	Cft	Not Applicable		
CB-13-2	8" thick. REF: Technical Specifications Section - 0200		Cft	Not Applicable		
CB-13-3	Upto Plinth Level. REF: Technical Specifications Section - 0260	1,800.00	Cft	Not Applicable		
CB-13-4	Above Plinth. REF: Technical Specifications Section - 0260	34,320.00	Cft	Not Applicable		
CB-14	Providing and applying Cement Sand Plaster 1/2" Thick 1:4 Cement Sand Plaster on inner surface using sand (as approved) at any height / depth including making edges, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	36,528.00	Sft	Not Applicable		

CB-15	Providing and applying Cement Sand Plaster 3/4" Thick 1:4 Cement Sand Plaster on external surface sand (as approved) at any height / depth including making edges, groove drip course, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	15,572.00	Sft	Not Applicable		
CB-16	Providing all civil, structural, waterproofing, and mechanical works for underground fire fighting water storage tank including excavation in all types of soils; dewatering, shoring, disposal of surplus excavated material, and site preparation; plain cement concrete (PCC); reinforced cement concrete (RCC) of specified grades for raft foundation, walls, roof slab, beams, and other structural components including formwork, curing, and reinforcement steel (Grade 60) complete with cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including membranes and PVC water stops at construction and expansion joints; supply and installation of manholes with heavy-duty covers, cast iron step irons, access openings, vents, overflow, washout arrangements; complete mild steel piping system including inlet, outlet/suction headers, fire-fighting connections, overflow, drain/washout, spare connections, valves, fittings, supports, fabrication, protective coating, testing, flushing, commissioning, and all incidental works required for a complete and functional fire-fighting water storage tank, in accordance with the drawings, technical specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Sections 0100, 0050, 0060, 0140, 0145, 0150, and 0260.	1.00	Job	Not Applicable		
CB-17	Providing all civil, structural, waterproofing, and mechanical works for Underground Water Storage Tank including excavation in all types of soils, dewatering, shoring, disposal of surplus excavated material, and site preparation; plain cement concrete (PCC); reinforced cement concrete (RCC) of specified grades for raft foundation, walls, roof slab, beams, and all associated structural components including formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete mild steel piping system including inlet, outlet/suction headers, overflow, washout, vent, and spare connections with all fittings, valves, supports, fabrication, installation, protective coating, testing, and commissioning; including all incidental works necessary for a complete and fully functional underground water storage tank, in accordance with the drawings, technical specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Sections 0100, 0050, 0060, 0140, 0145, 0150, and 0260.	1.00	Job	Not Applicable		
CB-18	Providing all civil, structural, waterproofing, and mechanical works for the construction of an overhead water storage tank, including reinforced cement concrete (RCC) of specified grades for base slab, walls, roof slab, beams, and all associated structural components complete with formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete mild steel piping system including inlet, outlet/suction headers, overflow, washout, vent, and spare connections with all fittings, valves, supports, fabrication, installation, protective coating, testing, and commissioning; including all ancillary works required for a complete and operational overhead water storage tank, in accordance with the drawings, technical specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Sections 0140, 0145, 0150, and 0260.	1.00	Job	Not Applicable		

CB-19	Providing all civil, structural, waterproofing, and mechanical works for the construction of an underground rainwater harvesting storage tank, including excavation in all types of soils, dewatering, shoring, disposal of surplus excavated material, and site preparation; plain cement concrete (PCC); reinforced cement concrete (RCC) of specified grades for raft foundation, walls, roof slab, and all associated structural components complete with formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete mild steel piping system including inlet, outlet/suction headers, overflow, washout, vent, and spare connections with all fittings, valves, supports, fabrication, installation, protective coating, testing, and commissioning; including all ancillary works necessary for a complete and operational rainwater harvesting storage tank, in accordance with the drawings, technical specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Sections 0050, 0060, 0100, 0140, 0145, 0150, and 0260.	1.00	Job	Not Applicable		
CB-20	Providing all civil, structural, waterproofing, and plumbing works for the construction of a Septic tank, including reinforced cement concrete (RCC) of specified grades for raft foundation, walls, partition walls, roof slab, and all associated structural components complete with formwork and curing; reinforcement steel (Grade 60) including cutting, bending, placing, and binding; internal and external cement plaster; complete waterproofing system including waterproofing membranes and PVC water stops at construction and expansion joints; provision and installation of access manholes with heavy-duty covers and cast iron step irons; complete uPVC piping system including inlet, outlet, vent, and interconnecting pipework with all fittings, jointing, supports, testing, and commissioning; including all ancillary works necessary for a complete and operational septic tank, in accordance with the drawings, technical specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Sections 0140, 0145, 0150, and 0260.	1.00	Job	Not Applicable		
CB-21	Construction of Circular Soakage Well, including all excavation, masonry, structural slabs, and internal filter media, executed in strict accordance with the approved architectural/structural drawings, technical specifications, and instructions of the Engineer-in-Charge. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060, Section - 0150, Section - 0145, Section - 0140	1.00	Job	Not Applicable		
CB-22	Providing and constructing manhole of the specified size and depth, including excavation in all types of soil to the required depth, disposal of surplus excavated material, plain cement concrete (PCC) bedding, cement concrete block masonry in cement mortar, internal and external cement sand plaster, benching and channeling as required, supplying and fixing heavy-duty cast iron (CI) manhole frame and cover, backfilling with approved material, compaction, curing, and all necessary materials, labor, tools, equipment, transportation, testing, and incidental works, complete in all respects, in accordance with the drawings, specifications, and Engineer's instructions. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060, Section - 0150, Section - 0140, Section - 0200, Section - 0260, Section - 0145	45.00	No	Not Applicable		
CB-23	All civil, structural, waterproofing, and mechanical works, comprising reinforced cement concrete of specified grades for raft, walls, and stair including formwork and curing; reinforcement steel (Grade-60) including cutting, bending, placing and binding; internal and external plaster; waterproofing membrane system; PVC water stops in construction/expansion joints; provision and fixing of floor drain; and epoxy floor, wall tiles complete in all respects as per drawings, specifications, and instructions of the Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0260	1.00	Job	Not Applicable		

CB-24	Providing and constructing catch pit complete with excavation in all types of soil, disposal of surplus excavated material, plain cement concrete (PCC) bedding, cement concrete block masonry, internal and external cement plaster, anchoring of cast iron (CI) grating frame, fixing heavy-duty CI grating, backfilling, compaction, curing, and all necessary materials, labor, tools, equipment, testing, and incidental works, complete in all respects, as per drawings, specifications, and Engineer's instructions. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060, Section - 0150, Section - 0140, Section - 0200, Section - 0260, Section - 0145	36.00	No	Not Applicable		
CB-25	Supply, Installation, Testing, and Commissioning of an Underground Mild Steel (M.S.) Diesel Fuel Storage System, complete in all respects, executed turnkey in strict accordance with approved engineering drawings, technical specifications, and standards of the industry, under the direction of the Engineer-in-Charge. REF: Technical Specifications Section - 0680, 0150 - 0145 - 0140	1.00	Job	Not Applicable		
CB-26	Providing, drilling, constructing, developing, testing and commissioning of deep bore well complete in all respects for combined domestic and ARFF water supply system, minimum 250 ft / 75 m depth or up to approved aquifer, whichever is greater, complete with 12 inch bore, 8 inch casing, screen, gravel pack, sanitary seal, submersible pump, controls, valves, pipework, testing, chlorination and connection to domestic and ARFF/fire water tanks. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0350	2.00	Job	Not Applicable		
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY
PPRA
EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 2 - Civil Works (Substructure & Superstructure): Part C - Steel Work in Space Frame Structure & Metal Deck Structure

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
CS-1	Design, supply, fabrication, and installation of structural steel columns using HSS sections (RHS / CHS) conforming to ASTM A36 / equivalent, including base plates, top plates, stiffeners, stubs, stool pipes, anchor bolts, angle irons, cleats, and all connection accessories. The scope includes sizing, cutting, drilling, welding, grinding, surface preparation, shop fabrication, transportation, loading/unloading, erection and alignment, complete in all respects in accordance with approved drawings, design requirements, specifications, and Engineer's instructions. REF: Technical Specifications Section - 0160	27,800.00	Kg	Not Applicable		
CS-2	Design, supply, fabrication, and installation of double layer steel space frame roof structure for the ATC Tower building at the required level, consisting of mild steel CHS tubular members of various diameters and thicknesses used as top chord, bottom chord, and diagonal members forming a 3D space frame system. The structure shall include forged steel cones, sleeves, high-strength bolts, and solid forged MERO type node joint system, complete with fabrication, welding, tacking, CNC machining, precise node drilling, surface treatment, and powder coating of approved color. The scope further includes secondary GI purlins fixed to top nodes, handling, transportation, erection, bolting, alignment, and completion of works as per approved drawings, specifications, and Engineer's instructions. (Note: The quantity for payment shall be measured based on the actual developed surface area of the completed roof structure measured along the roof profile along the edges as shown on the approved construction drawings.) REF: Technical Specifications Section - 0160, Section - 0180	25,550.00	Sft	Not Applicable		
CS-3	Supply and installation of standing seam lock roofing system using 0.70 mm thick PPGL Aluzinc sheets (AZ 150 coating), roll-formed to required lengths, including seam lock clips with thermal movement provision, ridge and eave galvanized flashing strips, ridge trays, seam fasteners, foam closures, sealants, and all necessary accessories. The work also includes 0.50 mm thick PPGL liner sheets fixed beneath roof purlins, with 100 mm thick rockwool insulation blanket of 80 kg/m³ density placed between roofing and liner sheets for thermal and acoustic insulation. The item further includes all required flashings, sealants, and water test complete in all respects as per drawings, specifications, and Engineer's instructions. REF: Technical Specifications Section - 0160	25,550.00	Sft	Not Applicable		

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CS-4	Providing complete structural engineering services for ATC Watch Tower Steel Structure, including structural analysis, design, modelling, preparation of calculations and production of detailed construction/shop drawings based on applicable American Codes and Standards including AISC, ASTM, ASCE and relevant seismic/wind load code. The scope shall include determination and application of all design loads including dead loads, live loads, wind loads, seismic loads and equipment loads applicable to project location, complete 3D structural modelling and analysis, design reports and calculation sheets using SAP2000 and/or STAAD Pro, connection design and details in Tekla for approval. The scope also includes obtaining review/vetting and approval of the structural design and drawings from the Project Consultant/Engineer, including incorporation of all review comments, necessary revisions, resubmissions, preparation of final approved construction documents, and providing all design clarifications, technical support, and coordination required during fabrication and erection of the ATC Watch Tower Steel Structure until successful completion of the works, complete in all respects as per approved drawings, specifications, applicable codes, and Engineer's instructions. REF: Technical Specifications Section - 0160, Section - 0010	1.00	Job	Not Applicable		
CS-5	Providing, fabricating, supplying and installing MS hot-dip galvanised anchor bolts conforming to ASTM A307 Grade C / equivalent Grade 4.6 complete with heavy hex nuts, washers, anchor plates, templates and all necessary accessories for fixing of structural steel columns of ATC Watch Tower, including cutting, threading, bending, welding, galvanizing, positioning, alignment, leveling and embedding in reinforced concrete foundations as per approved shop drawings, specifications and Engineer's instructions. The rate shall include all labour, transportation, handling, consumables and complete installation in all respects. REF: Technical Specifications Section - 0160, Section - 0010	943.00	Kg	Not Applicable		
CS-6	MAIN STRUCTURE: Providing, fabricating, supplying, erecting and fixing of structural steel works for construction of ATC Watch Tower comprising steel columns, beams, rafters, stringers, bracings, trusses, platforms and all related structural members fabricated from MS hollow sections, built-up sections, hot rolled H sections, I-sections, channels (C-sections), angle irons and other required structural profiles, including cutting, straightening, drilling, welding, grinding, edge preparation, stiffeners, base plates, cleat plates, connection plates, galvanized connection bolts 10.8 grade, nuts, washers, temporary supports, lifting, alignment and complete erection as per approved shop Hot rolled structural steel sections shall conform to ASTM A36, while built-up welded structural members shall conform to ASTM A572 Grade 50. The item shall include surface preparation by sand blasting /shot blasting SA2.5 profile ,and application one coat of anti rust red oxide paint, all consumables, machinery, labour, transportation and complete installation in all respects. drawings and Engineer's instructions. REF: Technical Specifications Section - 0160	52,647.00	Kg	Not Applicable		

CS-7	Composite Deck Slab on Steel Structure Providing, supplying and installing composite deck slab system over steel structure comprising 0.90 mm thick galvanized profiled steel deck sheet, fixed to structural steel framework with approved fasteners and accessories, including welding/fixing of shear studs to steel beams, edge trims, closures and all necessary accessories complete as per approved drawings and specifications. The item includes casting of 100 mm thick concrete slab having minimum compressive strength of 4000 PSI (28 MPa) over metal deck, including batching, placing, vibrating, finishing and curing complete in all respects. NOTE: Steel reinforcement bars/mesh shall be measured and paid separately under relevant BOQ item Supporting structural steel framework/beams shall also be measured and paid separately. (for steel structure refer item # 6 of this head, & for reinforcement refer item # 17 of building structure) REF: Technical Specifications Section - 0160, Section - 0150, Section - 0145	4,116.00	Sft	Not Applicable		
CS-8	Mild Steel Spiral Staircase: Providing, fabricating, supplying and erecting complete Mild Steel Spiral Stair Structure for ATC Tower, comprising central support pipe/column, stringers, treads, landing frames, base plates, stiffeners, connections, MS handrails and MS railing system, fabricated from MS plates, pipes, hollow sections, channels, angles and other required structural sections, including cutting, bending, rolling, welding, grinding, drilling, anchoring, alignment and complete installation as per approved architectural and structural drawings. Steel material for hot rolled sections shall conform to ASTM A36. REF: Technical Specifications Section - 0180	7,500.00	Kg	Not Applicable		
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 2 - Civil Works (Substructure & Superstructure): Part D - Utility Block Structure Work

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
CU-1	Excavation in all kind of soils at any level/height including clearing & grubbing, trimming/dressing out,disposal of surplus/unsuitable material at area designated by the Engineer within or outside work site, and i/c all lead & lift, marking alignment for layout by providing permanent benchmarks and alignment pillars including levels and grid lines etc. and necessary protection/ shoring/ stability to excavated areas/sides, dewatering and keeping the area to dry,all operations & arrangements in connection with earth works to complete confirming to the requirements of drawings, specifications and instructions by the Engineer In Charge. REF: Technical Specifications Section - 0100, Section - 0050, Section - 0060.0075,-0730	2,551.98	Cft	Not Applicable		
CU-2	Spraying termite proofing using liquid FMC/ Biflex/Terminix Exin/ Ms Hextar or eq @ spd suspension concentrate (SC), Mixing ability-HEXTAR with Ratio (1:250) = 540 Sq Ft or equivalent liquid applying with shower and certificate will be provided by the contractor for 10-years compere in complete in all respect as approved by the Engineer Incharge. REF: Technical Specifications Section - 0130	2,250.42	Sft	Not Applicable		
CU-3	Providing, laying Engineering Fill shall be well graded and a mixture of non-toxic soil, filling shall be placed in layers not exceeding 6" in compacted thickness, filling shall be compacted to a drey density not less than 95% of maximum dry density (ASTM D-1557), i/c lead and transportation to site, as shown in drawings complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0100	9,833.40	Cft	Not Applicable		
CU-4	Providing & Laying in position, True to line, level, grade, at any height. aggregate (as approved) including screening and washing of aggregate & Sand (as approved), finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140					
	Ratio 1:4:8 Under footing.	967.98	Cft	Not Applicable		
CU-5	Providing & Laying in position light-weight concrete, as approved, finishing smooth, curing, lifting if required, complete in all respect, drawing specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0140	557.23	Cft	Not Applicable		
CU-6	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 3000 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					
CU-6-1	RCC in Footing. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	437.50	Cft	Not Applicable		

CU-6-2	RCC Pads. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	2,214.00	Cft	Not Applicable		
CU-6-3	RCC in Slab. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	2,245.31	Cft	Not Applicable		
CU-7	Providing & Laying in position, True to line, level, Reinforced Cement Concrete cylinder strength of 4500 PSI at 28 days Using 3/4" down gauge graded crushed stone aggregate (as approved), Sand (as approved), SR Cement (where required), as per dimensions and design, as shown on the drawing, mixing with approved mechanical means, finishing smooth, curing, lifting, vibrating, making arrangements for any scaffolding work & fittings using steel plate (Dent free), or wooden ply (laminated) & building paper for form work complete in all respect, as per drawings, specifications as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140, Section - 0200					
CU-7-1	RCC in Beams. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	586.59	Cft	Not Applicable		
CU-7-2	RCC Plinth Beams. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	616.50	Cft	Not Applicable		
CU-7-3	Columns. REF: Technical Specifications Section - 0150, Section - 0145	720.00	Cft	Not Applicable		
CU-8	Providing, fabrication, straightening, cutting, bending, placing, binding with annealed wire, including removal of rust from bars with sand blasting, PCC Spacer block, wastage, etc. complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0150, Section - 0140 - 0145			Not Applicable		
	Grade - 60. REF: Technical Specifications Section - 0145	22,363.59	Kg	Not Applicable		
CU-9	Providing and laying concrete block masonry having 1800 psi compressive cube strength at 28 days for Internal/External walls as in specified thickness & laid in specified cement sand mortar , placed at any height/level masonry to be laid in courses true to line, level and plumb, protected and properly cured including scaffolding, wastage, deep joints to receive rendering, chiseling including all dowels/ steel bars /anchoring/GI wall ties/strip etc., to be installed horizontally/ vertically as specified in general notes/details drawing typical, curing, placing of all embedded items in position i.e. conduits/ sleeves/ anchors/ all other fittings/ accessories etc., as necessary related to MEP provisions. Complete in all respects and conforming to the requirements of drawings, specifications and instructions by the Engineer In charge. REF: Technical Specifications Section - 0200, Section - 0260					
CU-9-1	8" thick. REF: Technical Specifications Section - 0200			Not Applicable		
CU-9-2	Upto Plinth Level. REF: Technical Specifications Section - 0260	779.88	Cft	Not Applicable		
CU-9-3	Above Plinth. REF: Technical Specifications Section - 0260	3,304.44	Cft	Not Applicable		
CU-10	Providing and applying Cement Sand Plaster 1/2" Thick 1:4 Cement Sand Plaster on inner surface using sand (as approved) at any height / depth including making edges, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	7,083.00	Sft	Not Applicable		
CU-11	Providing and applying Cement Sand Plaster 3/4" Thick 1:4 Cement Sand Plaster on external surface sand (as approved) at any height / depth including making edges, groove drip course, corners, mesh where required at abuts of the concrete and brick faces, cleaning, preparation of surface, complete in all respect as per drawing specification and as directed by the Engineer. REF: Technical Specifications Section - 0260	6,984.00	Sft	Not Applicable		

CU-12	Providing and laying 1/2" thick terrazzo flooring over 2" thick RCC screed (1:2:4) reinforced with #3 bars @ 12" c/c, laid over 2" thick isolation sheet (Diamond/Jumbolon), one layer of 500-gauge polythene sheet, and waterproofing treatment (Aqua Seal/Sika or approved equivalent), including all materials, labor, tools, curing, finishing, cutting, joints, and all ancillary works, complete in accordance with the drawings, specifications, and Engineer's instructions, complete in all respects. REF: Technical Specifications Section - 0150, Section - 0145, Section - 0140	4,490.63	Sft	Not Applicable		
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 3 - Architectural & Finishing Works: Summary

S.No.	Description	Amount (PKR)
a	Part A - Finishing Works (ATC Building incl. Utility Services)	
b	Part B - Furniture & Ancillary Equipment	
c	Part C - Gym Equipment	
	Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 3 - Architectural & Finishing Works: Part A - Finishing Works (ATC Building incl. Utility Services)

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
AF-1	Providing and laying floor of 1" Inch thick Terrazzo Tiles 24" x 24" size fine dressed on the surface without winding in ground floor over 1 inch (25 mm) cement mortar 1:2 (one cement, two sand) setting the marble tiles with grey cement slurry including curing and rubbing etc. complete, including the cost of mortar. REF: Technical Specifications Section - 0300, Section - 0270	11,814.32	Sft	Not Applicable		
AF-2	Providing and Applying EPOXY RESIN FLOORING over concrete surface, as per the manufacturer's specifications i/c the cost Cleaning and Preparation of surfaces to remove dust & loose particles , repair of all visible cracks with epoxy mortar or suitable filler , The flooring shall consist of a FLOORING PRIMER to enhance adhesion between substrate and coating ,and two components protective epoxy coating to provide a smooth, durable, and seamless finish. The floor shall be resistant to abrasion, chemicals, stains, and moisture, as per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300, Section - 0330	11,814.32	Sft	Not Applicable		
AF-3	Providing and laying 3/4" inches thick Granite on walls and floors, laid with dry bond over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0280	12,905.19	Sft	Not Applicable		
AF-4	Providing and laying Porcelain Tiles of approved Texture and Size on walls and floors, laid with dry bond over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per drawings and design approved by the Architect and Engineer-in-Charge. (For Room and Offices etc) REF: Technical Specifications Section - 0300	21,446.03	Sft	Not Applicable		
AF-5	Providing and laying Porcelain Tiles of approved Texture and Size on walls and floors, laid with dry bond over a base of 1" thick cement mortar (1:3) including jointing to tiles with joint filler of approved quality as per drawings and design approved by the Architect and Engineer-in-Charge. (For Toilets Blocks) REF: Technical Specifications Section - 0300, Section - 0220	12,325.51	Sft	Not Applicable		
AF-6	Providing and fixing Solid Wooden Flooring in best quality sheesham wood planks 1 inch (25 mm) thick rebated including fixing with brass-screws on deodar wood battens 1-1/2 inches X 2 inches (38 mm X 51 mm) placed at 12 inches (305 mm) centre to centre and filling the gap between plank and concrete base with bitumen and sand mixed in the ratio 9 lbs. (4.1 Kg) of bitumen to one cft. (0.028 cum) of sand etc. complete in any floor. REF: Technical Specifications Section - 0300, Section - 0220	1,541.94	Sft	Not Applicable		
AF-7	Raised Flooring Panels of module 600x600x32mm with Laminate surface. Heavy duty steel and Cement infill core, with metal sheet at both sides with non-conductive antistatic top Laminate surface. with Carpet tiles on top with standard adhesive Pedestals made of galvanized steel with Leveling provision. Pedestals are connected through stringer made of Galvanized pipes and concealed screws. (Fire Rating: 1 Hr) Each Tile: 4 Sq Ft with standard Accessories Pedestal 300mm, Stinger & Wall Angle,as per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	2,981.76	Sft	Not Applicable		

AF-8	Raised Flooring Panels of module 600x600x32mm with Laminate surface. Heavy duty steel and Cement infill core, with metal sheet at both sides with non-conductive antistatic top Laminate surface.Pedestals made of galvanized steel with Leveling provision. Pedestals are connected through stringer made of Galvanized pipes and concealed screws.(Fire Rating: 1 Hr)Each Tile: 4 Sq Ft with standard Accessories Pedestal 300mm,Stinger & Wall Angle,Tile Weight: 13Kg as per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	1,294.64	Sft	Not Applicable		
AF-9	Providing and laying in floor C.C. 1:2:4: tuff paver 80 mm thick of approved design and colour pattern laid on sand cushion filling of joint with sand and warring etc. complete as per direction of Engineer Incharge. (the cost of sand cushion is included) A) Minimum strength 7000 psi. REF: Technical Specifications Section - 0300	2,020.33	Sft	Not Applicable		
				Not Applicable		
AF-10	Providing and Applying Polyurethane Modified Bituminous Coating i/c the cost Cleaning and Preparation of surfaces to remove dust & loose particles ensuring optimal adhesion for the coating high quality advance polymer based cementitious waterproofing coating as a base layer to walls and Floors etc complete in all respect s per Direction by the Architect and Engineer-in-Charge.(For Toilets Block and Rooftop) REF: Technical Specifications Section - 0300-0330, Section - 0220	35,694.53	Sft	Not Applicable		
AF-11	Supply, fabrication, transportation, and installation of façade system comprising approved façade panels (as specified in the drawings), complete with base aluminum framing/support structure, brackets, anchors, fasteners, adhesive, silicone sealant, gaskets, fixing accessories, and all necessary hardware. The work shall include cutting, fabrication, lifting, fixing, alignment, joint treatment, waterproofing, finishing, testing, cleaning, and all labor, materials, equipment, scaffolding, and incidentals required to complete the work in accordance with the approved shop drawings, specifications, and to the satisfaction of the Architect and Engineer-in-Charge. REF: Technical Specifications Section -0300- 0240, Section - 0230			Not Applicable		
	a) Ground Floor. REF: Technical Specifications Section - 0300	11,968.94	Sft	Not Applicable		
	b) First Floor. REF: Technical Specifications Section - 0300	3,625.75	Sft	Not Applicable		
AF-12	Providing and fixing Gypsum board 15mm tiles ceiling approved size tiles/strip ceiling including all accessories and hanging suspension system i.e., pump, rod etc. complete as required in any floor. REF: Technical Specifications Section - 0310, Section - 0290,Section - 0300	32,531.75	Sft	Not Applicable		
AF-13	Supply, Fabrication and Installation of aluminum curtain wall fixed façade with reinforming, wind load bearing system 140km/h, with MS bracket galvanized including anchor bolting (Indux), center bolting stainless steel EPDM/gasket, weather sealant (Dolphins/Sika), including necessary hardware and ironmongery without glass,ALUMINUM THERMAL BREAK STICK SYSTEM) with mullion and Transom anodized coating with glass,Double glazed glass 32mm thick IUG (outer pan 10mm SN-40 (GUARDIAN/SAINT CABIN / AGC) tempered+ AG 12mm+ Inner pan 8mm laminated (4mm +.76 pvb+4mm both are clear with chemical insertion,Flashing /trimming (galvanized sheet 1.5mm with waterproofing membrane 1mm thick including necessary hardware,fire brier with galvanized sheet 2mm with insulation 32 density, including necessary hardware etc complete in all respect s per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250, Section - 0330, Section - 0170	5,081.64	Sft	Not Applicable		

AF-14	Supply, Fabrication and Installation of aluminum curtain wall fixed façade with reinforming, wind load bearing system 140km/h, with MS bracket galvanized including anchor bolting (Indux), center bolting stainless steel EPDM/gasket, weather sealant (Dolphins/Sika), including necessary hardware and ironmongery with glass, ALUMINUM THERMAL BREAK STICK SYSTEM) with mullion and Transom anodized coated with,Triple glazed glass 46mm thick IGU (outer pan 10mm SN-40 (GUARDIAN/SAINT CABIN/ AGC) tempered+ AG 10mm+ middle pan 8mm clear tempered + middle AG10MM + Inner pan 8mm laminated (4mm +.76 pvb+4mm both are clear with chemical insertion,Flashing /trimming (galvanized sheet 1.5mm with waterproofing membrane 1mm thick including necessary hardware,fire brier with galvanized sheet 2mm with insulation 32 density, including necessary hardware etc complete in all respect s per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250, Section - 0170	6,626.40	Sft	Not Applicable		
AF-15	Providing and fixing INTERNAL WALL EXPANSION JOINT complete with compressible filler board, 2-hour fire-resistant elastomeric sealant, aluminum / stainless steel cover plates, anchors, cutting, surface preparation, fixing, and making good, installed full height of structure, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0240, Section - 0230, Section - 0170	920.00	Rft	Not Applicable		
AF-16	Providing and fixing EXTERNAL WALL EXPANSION JOINT complete with compressible filler board, 2-hour fire-resistant elastomeric sealant, aluminum / stainless steel cover plates, anchors, cutting, surface preparation, fixing, and making good, installed full height of structure, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0240, Section - 0230, Section - 0170	184.00	Rft	Not Applicable		
AF-17	Providing and installing HEAVY DUTY FLUSH MOUNTED FLOOR EXPANSION JOINT with load capacity of 30 Tons (Heavy Vehicle Load) and 6.5 Ton (Forklift) system with aluminum cover plate and neoprene / elastomeric insert, suitable for high pedestrian traffic, including joint preparation, sealant, fixing accessories and finishing flush with finished floor level, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0150, Section - 0240, Section - 0230	320.00	Rft	Not Applicable		
AF-18	Providing and installing TOP ROOF EXPANSION JOINT system including waterproof membrane, UV-resistant sealant, metal cover plate, drainage detail, and all accessories, suitable for commercial roofs, etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	160.00	Rft	Not Applicable		
AF-19	Supply and installation of PIR Insulated Panels insulated as per drawing/design/section, complete in all respects as per manufacturer's specifications and as per Direction by the Architect and Engineer -in- Charge. REF: Technical Specifications Section - 0335	26,841.94	Sft	Not Applicable		
AF-20	Providing and laying first class hollow Cement Concrete Block Masonry (1800 Psi) set in cement mortar 1:4 in straight or curved wall 8 inches thick including scaffolding, raking, out joint and curing tc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. (For External Partition Walls) REF: Technical Specifications Section - 0200, Section - 0220	14,912.00	Sft	Not Applicable		
AF-21	Supply and Application of POLYURETHANE FOAM SPRAY with a thickness of 1 inch (2.5cm), 32 to 35 kg / m3 Density with U-Value of 0.36 W / m2k and thermal conductivity 0.03 W / (m K) Thermal Resistance R-Value of 6.5 ensuring excellent thermal insulation. approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0300	14,912.00	Sft	Not Applicable		

AF-22	Providing & Fixing Gypsum board 15 mm thick, fixed with GI approved suspension system & joint taping tc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0310, Section - 0290	14,912.00	Sft	Not Applicable		
	SH:-DOORS AND WINDOWS. REF: Technical Specifications Section - 0300			Not Applicable		
AF-23	Supply and installation of single Leaf UL Listed Doors 3'-6" x 7'-0" with complete UL Accessories (UL Hinges , UL Pnic Bar with trim Handles , Smoke Seal and UL Door Closer only) Fire Rating: Fire Rating upto 90 Mins etc complete as per manufacturer's specification and s per Direction by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0220-0300	5.00	Nos	Not Applicable		
AF-24	Supply and installation of Eco-Friendly WPC Doors of 38 mm thickness and minimum 5 mm shutter thickness ,i/c the cost of door frame , hardware , Hinges ,Tower Bolts, 2.75" border and Executive Polishing complete as per manufacturer specifications ,drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0220, Section - 0180-0300	1,149.00	Sft	Not Applicable		
AF-25	Providing and fixing 1-1/2 inches (38 mm) thick best quality Ash wood solid wood door shutters ,i/c the cost of door frame , hardware , Hinges ,Tower Bolts, 2.75" border and Executive Polishing complete as per manufacturer specifications ,drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0220, Section - 0180	2,394.00	Sft	Not Applicable		
AF-26	P/F 12mm thick tempered glass , swing door,upak made as per approved manufacturers (fixing through their approved fabricators), D- Lock, Silicon moving machines all accessories, cutting holes etc and making good damages etc. complete as required in any floor as per direction of Engineer In Charge. REF: Technical Specifications Section - 0250, Section - 0220	140.00	Sft	Not Applicable		
AF-27	P/F 12mm tempered glass i/c 3mm safety film 175 micron aluminum fixed partition as per approved manufactured (fixing through their approved fabricators), aluminium section D-48(100 mmx38mm and 2mm) thick, i/c the aluminium fittings and S.S. pipe 1.5"x3" (18 gauge) fixe on top will all accessories, cutting holes etc. and making good damages to walls etc. complete as required in any floor as per direction of engineer-in-charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250	175.00	Sft	Not Applicable		
AF-28	Providing and fixing double glazed anodized aluminium of approved colour Sliding windows as per British standard manufactured (fixing through their approved fabricators), Executive model section double glazed 101mm x 37mm and 2mm thick including the cost of aluminium netting ,fitting, with all accessories cutting hole etc. and making good damages to walls and including the cost Tinted glass panes 6mm thick to M.S. Box pipe / Aluminium etc. complete as required in any floor as per direction of engineer-in-charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250	40.50	Sft	Not Applicable		
AF-29	Providing and fixing with C.P. brass screws main door handle type yale lock of approved design,cutting wood etc., to required size, with two operating keys, as per direction of the engineer-in-Charge. REF: Technical Specifications Section - 0220	106.00	Nos	Not Applicable		
AF-30	Providing and fixing with brass or specially supplied screws hydraulic branno door closer of approved design No. 2, Yugoslavia make, cutting wood, etc., to required size and shape of necessary as per direction of the Engineer-in-Charge. REF: Technical Specifications Section - 0300	106.00	Nos	Not Applicable		

AF-31	Distempering with vinyl distemper of approved make and shade in two coats over and including the cost of one priming coat of lime wash including sand papering, dusting, and filling the holes, cracks and inequalities, if any, at any height in any floor. (For Ceiling only) REF: Technical Specifications Section - 0330,0300	16,167.71	Sft	Not Applicable		
AF-32	Painting with plastic emulsion paint VIP of approved shade two coats over and including the cost of one priming coat complete over plastered surface at any height in any floor . (For Walls) REF: Technical Specifications Section - 0330, Section - 0260	71,707.52	Sft	Not Applicable		
AF-33	Supply, fabrication, and installation of motorized vehicle garage rolling shutter of approved size and design, complete with galvanized steel/aluminum slats, guide rails, barrel assembly, electric motor, gearbox, manual override, remote control, locking system, all necessary hardware, testing, commissioning, and finishing, in accordance with approved shop drawings and the instructions of the Architect/Engineer-in-Charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0220, Section - 0180	2,880.00	Sft	Not Applicable		
AF-34	Providing and laying floor of 1" Inch thick Terrazzo Tiles 24" x 24" size fine dressed on the surface without winding in ground floor over 1 inch (25 mm) cement mortar 1:2 (one cement, two sand) setting the marble tiles with grey cement slurry including curing and rubbing etc. complete, including the cost of mortar. REF: Technical Specifications Section - 0300, Section - 0270	3,250.00	Sft	Not Applicable		
AF-35	Distempering with vinyl distemper of approved make and shade in two coats over and including the cost of one priming coat of lime wash including sand papering, dusting, and filling the holes, cracks and inequalities, if any, at any height in any floor. (For Ceiling only) REF: Technical Specifications Section - 0300	2,995.00	Sft	Not Applicable		
AF-36	Painting with plastic emulsion paint VIP of approved shade two coats over and including the cost of one priming coat complete over plastered surface at any height in any floor . (For Walls) REF: Technical Specifications Section - 0330, Section - 0260	5,500.00	Sft	Not Applicable		
AF-37	Providing, fabricating and fixing MS (Mild Steel) door with MS frame, including all hardware (hinges, tower bolts, lock, handles, etc.), anti-rust primer and enamel paint/powder coating, complete in all respects as per approved drawings, manufacturer's specifications, and the directions of the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0330, Section - 0220	520.00	Sft	Not Applicable		
AF-38	Providing and fixing double glazed anodized aluminium of approved colour Sliding windows as per British standard manufactured (fixing through their approved fabricators), Executive model section double glazed 101mm x 37mm and 2mm thick including the cost of aluminium netting ,fitting, with all accessories cutting hole etc. and making good damages to walls and including the cost Tinted glass panes 6mm thick to M.S. Box pipe / Aluminium etc. complete as required in any floor as per direction of engineer-in-charge. REF: Technical Specifications Section - 0240, Section - 0230, Section - 0250	500.00	Sft	Not Applicable		
AF-39	Providing, fabricating, supplying, and installing Aluminium Composite Panel (ACP) cladding comprising PVDF-coated aluminium skins with a non-combustible (A2) or fire-retardant (FR) mineral core, fixed on an aluminium sub-framing system complete with brackets, rails, cleats, stainless steel fasteners, anchor bolts, flashings, trims, sealants, EPDM gaskets, and all necessary accessories, including cutting, fabrication, erection, alignment, waterproof joint sealing, scaffolding, and all incidental works, complete in accordance with the drawings, specifications, and the Engineer's instructions. REF: Technical Specifications Section -0240, 0230					
	a) Ground Floor. REF: Technical Specifications Section - 0240	11,968.94	Sft	Not Applicable		

	b) First Floor. REF: Technical Specifications Section - 0240	3,625.75	Sft	Not Applicable		
AF-40	Providing, fabricating, supplying, and installing manually operated roller blinds using premium-quality imported sunscreen, blackout, or translucent fabric (as specified in the drawings or approved by the Engineer), complete with a 180° manual roll-up mechanism, heavy-duty aluminium roller tube, operating chain, brackets, bottom rail, side guides (where required), mounting accessories, fixings, and all necessary hardware. The work shall include measurement, fabrication, installation, testing, and commissioning, complete in all respects, in accordance with the drawings, specifications, approved shop drawings, and the Engineer's instructions.	750.00	Sft	Not Applicable		
		Total Amount (Rs)			**0.00**	

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International

Bill of Quantities

Bill No. 3 - Architectural & Finishing Works: Part B - Furniture, Ancillary & Gym Equipment

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
AG-1	Supply, delivery, installation and placement of furniture complete in all respects as per approved drawings and furniture layouts, including all accessories, fittings, hardware, upholstery, finishing, transportation and commissioning as per TS. REF: Technical Specifications Section - 0210					
AG-1-1	Executive Table With Side Rack, Model MO-ED-ES-19, Size L 4' x D 2' x H 30", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	2.00	Each	Not Applicable		
AG-1-2	Executive Chair, Model HBC (A2916), Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	2.00	Each	Not Applicable		
AG-1-3	Conference Table, Size L 22' x D 5' x H 30", Model MO-MT-MS-06, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	1.00	Each	Not Applicable		
AG-1-4	Conference Table, Size L 25' x D 5' x H 30", Model MO-MT-MS-06, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	1.00	Each	Not Applicable		
AG-1-5	Genesis Chairs ORTHO HBC, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	14.00	Each	Not Applicable		
AG-1-6	Genesis Chairs, Model Eco LBC, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	13.00	Each	Not Applicable		
AG-1-7	Mesh Chair with flexible back and moveable, Model MBC B-3018, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	40.00	Each	Not Applicable		
AG-1-8	Mesh Chair, Model MBC B-3018, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	23.00	Each	Not Applicable		
AG-1-9	Visitor Chair, Model 01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	32.00	Each	Not Applicable		
AG-1-10	Anatom Reception Chair, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	26.00	Each	Not Applicable		
AG-1-11	Training Chair, Model MO-JUDY, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	65.00	Each	Not Applicable		
AG-1-12	Cafeteria Chair, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	25.00	Each	Not Applicable		
AG-1-13	Single Seater Sofa, Model Aspen, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	1.00	Each	Not Applicable		
AG-1-14	Single Seater Sofa, Model Augusta, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	9.00	Each	Not Applicable		
AG-1-15	Single Seater Sofa, Model Sof-22, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	8.00	Each	Not Applicable		
AG-1-16	Single Seater Sofa Model Sof-01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	12.00	Each	Not Applicable		
AG-1-17	Two Seater Sofa, Model Aspen, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	1.00	Each	Not Applicable		
AG-1-18	Two Seater, Model Chesterfield Sofa, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	8.00	Each	Not Applicable		
AG-1-19	Two Seater Sofa, Model Augusta, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	4.00	Each	Not Applicable		
AG-1-20	Three Seater Sofa, Model Sof-22, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	7.00	Each	Not Applicable		
AG-1-21	Three Seater Sofa, Model Sof-01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	1.00	Each	Not Applicable		
AG-1-22	Sofa Side Table Size L 20" x W 20" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	18.00	Each	Not Applicable		

AG-1-23	Sofa Center Table, Size L 48" x W 20" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	6.00	Each	Not Applicable		
AG-1-24	Sofa Side Table, Size L 18" x W 18" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	6.00	Each	Not Applicable		
AG-1-25	Side Table, Model Linea, Size L:559mm x W356mm x H:610mm, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	2.00	Each	Not Applicable		
AG-1-26	Center Side Table, Size L 40" x W 40" x H 18", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	5.00	Each	Not Applicable		
AG-1-27	Café Table, Size 36" Dia x H30", Model MO-MULLER-MT-01, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	10.00	Each	Not Applicable		
AG-1-28	Single Bed with 6" Mattress with Single Side Table, Table Size L 78" x D 42", Mattress Size 78"x 42"x 6", Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	6.00	Each	Not Applicable		
AG-1-29	Manager Desk, Table Size L 5' x D 2.5', Model MO-MD-BS-12-KENDAL, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	14.00	Each	Not Applicable		
AG-1-30	Office Desk, Size L 4.5' x D 2', Model MO-MD-BS-06, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	10.00	Each	Not Applicable		
AG-1-31	Study Desk, Size L 4' x D 2', Model MO-MD-BS-08, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	14.00	Each	Not Applicable		
AG-1-32	Aluminium Cluster Workstation, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	13.00	Each	Not Applicable		
AG-1-33	Low Height Storage, Size 72x15 H 34, Model MO-SLH-04, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	8.00	Each	Not Applicable		
AG-1-34	OCC / Emergency Operations Centre Workstation, Brand Master Offisys, or equivalent. REF: Technical Specifications Section - 0210	1.00	Each	Not Applicable		
AG-2	Supply, delivery, installation, testing and commissioning of commercial-grade Gym Equipment complete in all respects as per approved layouts and Technical Specification , including all accessories, safety attachments, floor protection mats and instructional signage. The equipment shall include but not be limited to the following: REF: Technical Specifications Section - 0920			Not Applicable		
AG-2-1	Vibe Chest Press, Model VY-61A 04, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-2	Arm Curl Bench, Model VY-61A 37, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-3	Vibe Shoulder Press, Model VY-61A 01, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-4	Vibe Lat Pulldown, Model VY-61A 15, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-5	Vibe Leg Extension, Model VY-61A 24, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-6	Sports Art Prime Line Heavy Duty Treadmill with LCD Console (4HP AC Motor), Model T673L, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	3.00	Each	Not Applicable		
AG-2-7	Vibe Cable Crossover, Model VY-61A 32, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-8	Vibe Multi-Adjustable Bench, Model VY-61A 46B, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	3.00	Each	Not Applicable		
AG-2-9	Spin Bike, Model US-PG1399, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-10	Vibe Air Rowing Machine, Model VY-YR 400, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-11	Vibe Three Station Multi-Gym, Model USBH-143, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		

AG-2-12	Vibe Flat Bench, Model VY-61A 47, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	2.00	Each	Not Applicable		
AG-2-13	12 Edge Premium CPU Dumbbells, Model VN-US1007, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	840.00	Kg	Not Applicable		
AG-2-14	Straight Round Barbells, Model VN-US1301, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	200.00	Each	Not Applicable		
AG-2-15	Vibe Barbell Rack, Model US2031, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
AG-2-16	Vibe Series 3 Tier Dumbbell Rack, Model US 2017, Brand Sportsart, or equivalent. REF: Technical Specifications Section - 0920	1.00	Each	Not Applicable		
					Grand Total (Rs)	**#REF!**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 4 - Roads and Pavement Works

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
R-1	Compaction of natural ground including scarifying, breaking of clods, watering or drying, mixing, grading, levelling and compacting the existing/natural ground to the required density and formation levels, including dressing, proof rolling and field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100, Section - 0075	13,976.29	Sqm	Not Applicable		
R-2	Preparation of subgrade in earth cut including scarifying to the required depth, watering or drying, mixing, grading and shaping to the required camber/crossfall, lines and levels, compacting to the specified degree of compaction, including correction of soft or yielding spots, trimming, dressing, proof rolling and field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	26,680.00	Sqm	Not Applicable		
R-3	Formation of embankment from roadway excavation in common material, including excavation, loading, hauling, unloading, spreading in layers not exceeding 200 mm loose thickness, watering, mixing and compacting each layer to 95% Modified AASHTO MDD, proof rolling, dressing of side slopes (1V:1.5H) and formation to the required lines, grades and levels, including field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	9,769.73	Cum	Not Applicable		
R-4	Formation of embankment from roadway excavation in medium material, including excavation/loosening by suitable mechanical means, loading, hauling, unloading, breaking of clods, spreading in layers not exceeding 200 mm loose thickness, watering, mixing and compacting each layer to 95% Modified AASHTO MDD, proof rolling, dressing of side slopes (1V:1.5H) and formation to the required lines, grades and levels, including field density testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	9,769.73	Cum	Not Applicable		
R-5	Formation of embankment from roadway excavation in hard rock material, including excavation of rock by approved methods, breaking to sizes suitable for placement, loading, hauling, unloading, spreading in layers of specified thickness, watering, compacting each layer to the specified degree of compaction, benching of cut slopes where required, dressing of slopes and formation to the required lines, grades and levels, including testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	2,171.05	Cum	Not Applicable		

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R-6	Providing, laying, spreading, watering, mixing, compacting, finishing, testing, and maintaining 150 mm thick (compacted) Granular Sub-Base (GSB) course of approved material for carriageway and shoulders, laid in layers not exceeding 200 mm loose thickness and compacted to 100% Modified AASHTO Maximum Dry Density (MDD); finished true to the required lines, grades, levels, camber/crossfall, and thickness shown on the drawings; including trimming, surface tolerance checks using a 3 m straightedge, sampling, laboratory and field testing, quality control, and all incidental works necessary to complete the work in accordance with the drawings, Technical Specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Section 0340.	4,994.00	Cum	Not Applicable		
R-7	"Providing, laying, spreading, watering, compacting, finishing, testing and maintaining granular base course of approved material, laid with mechanical paver in layers not exceeding 150 mm loose thickness and compacted to 100% Modified AASHTO MDD, true to the lines, grades, camber/crossfall (-2%) and thickness shown on the drawings, including surface tolerance checks with 3 m straightedge and all sampling and testing, complete in all respects as per drawings, specifications and as directed by the Engineer. Granular Base: 300mm on Carriageway & 380mm on Shoulders REF: Technical Specifications Section - 0340"	11,549.59	Cum	Not Applicable		
R-8	Providing, laying, spreading, watering, compacting, finishing, testing and maintaining crushed aggregate base course of approved material, laid with mechanical paver in layers not exceeding 150 mm loose thickness and compacted to 100% Modified AASHTO MDD, true to the lines, grades, camber/crossfall (-2%) and thickness shown on the drawings, including surface tolerance checks with 3 m straightedge and all sampling and testing, complete in all respects as per drawings, specifications and as directed by the Engineer. ABC: 80mm on Carriageway REF: Technical Specifications Section - 0340	1,104.00	Cum	Not Applicable		
R-9	Providing, laying, and compacting 50 mm thick (compacted) plant-mixed Asphaltic Concrete Wearing Course (Class B) in accordance with the approved Job Mix Formula (JMF), including heating and mixing of aggregates and bituminous binder at an approved asphalt mixing plant; transportation to site; laying with a self-propelled electronic sensor paver true to the required lines, levels, grades, and 2% crossfall (camber); breakdown, intermediate, and finish rolling within the specified temperature limits to achieve the required density and surface finish; construction, trimming, sealing, and painting of longitudinal and transverse joints; preparation and approval of trial section; sampling, laboratory and field testing, quality control, and all incidental works necessary for the construction of the wearing course on carriageway and shoulders, complete in accordance with the drawings, Technical Specifications, and the instructions of the Engineer-in-Charge. Reference: Technical Specifications Sections 0100 and 0340.	3,864.00	Cum	Not Applicable		

R-10	Providing and applying bituminous prime coat using cut-back asphalt of approved grade over the prepared and accepted granular base course surface at the specified rate of application, including cleaning and brooming of surface, heating and uniform spraying by pressure distributor, protection of treated surface and curing for 24–48 hours before overlaying, and making good any defective areas, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340	33,296	Sqm	Not Applicable		
R-11	Providing and applying bituminous tack coat using cut-back asphalt of approved grade over existing bituminous/concrete surfaces and on vertical faces of joints, at the specified rate of application, including cleaning of surface, heating and uniform spraying by pressure distributor and protection until overlaying, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340	33,296	Sqm	Not Applicable		
R-12	Providing and fixing precast concrete kerb in concrete Class A-1, of size H 350 x W 300mm x T 150 mm true to line, level and curvature, including preparation of foundation, cement concrete bedding and haunching/backing, jointing and pointing in cement mortar, curing and making good and paint work, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0150	4,240.00	RM	Not Applicable		
R-13	Providing and applying pavement marking in reflective thermoplastic paint for lines of 20 cm width, including cleaning and preparation of pavement surface, setting out, application of thermoplastic material with reflectorizing glass beads by approved road marking machine to the specified thickness and rates, and protection of markings until fully set, complete in all respects as per drawings, specifications, NHA General Specifications for pavement markings and as directed by the Engineer. REF: Technical Specifications Section - 0340	7,360.00	RM	Not Applicable		
R-14	Providing and laying lean concrete (blinding) of the specified mix and thickness under pavements/structures, including formwork to edges, mixing by approved mechanical means, placing, compacting, levelling and finishing to the required lines and levels, curing and testing, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0150	539.47	Cum	Not Applicable		
R-15	Providing and laying in position, true to line and level, reinforced cement concrete of cylinder strength as mentioned on the drawings, using 3/4″ down gauge graded crushed stone aggregate (as approved), sand (as approved) and SR cement (where required), to the dimensions and design shown on the drawings, including mixing with approved mechanical means, placing, compacting/vibrating, finishing smooth, curing, lifting, all arrangements for scaffolding, and formwork using dent-free steel plates or laminated wooden ply with building paper, complete in all respects as per drawings, specifications and as directed by the Engineer; reinforcement measured and paid separately under the relevant item. (Non Schedule) REF: Technical Specifications Section - 0340	2,706.99	Cum	Not Applicable		

R-16	Providing, cutting, bending, fabricating, placing and fixing in position deformed steel bar reinforcement, Grade 60 conforming to AASHTO M-31, of all required diameters, including binding wire, approved bar chairs/spacers, laps as shown or required, cleaning and maintaining the reinforcement in correct position during concreting, complete in all respects as per bar bending schedules, drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0145	191.22	Ton	Not Applicable		
R-17	Providing, fabricating and fixing M.S. grating for drainage channels comprising 63.5 × 63.5 × 6.3 mm M.S. angle iron frame, 25.4 × 25.4 × 3.1 mm M.S. cramp welded to angle iron frame, 50.8 × 50.8 × 6.3 mm M.S. angle grating members, and RCC Channel No. 3 bars at 8–9 inches c/c, including cutting, welding, grinding, drilling, complete shop fabrication, anti-rust primer, two coats of synthetic enamel paint, lifting arrangements, anchoring, installation, and all necessary hardware, consumables, labour, tools, and accessories, complete in all respects, as per approved drawings and Engineer's instructions.. (Non Schedule) REF: Technical Specifications Section - 0340, Section - 0180	2,208.00	Sqm	Not Applicable		
R-18	Removal of obstructing sand dunes, including excavation by suitable mechanical means, loading, hauling to Engineer-approved disposal/spoil areas, unloading, spreading, levelling and dressing of the disposal areas, complete in all respects as per specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	546,917.00	Cum	Not Applicable		
R-19	Transportation and disposal of unsuitable/surplus excavated material from site to Engineer-approved dumping areas for a lead up to 5 km, including loading, hauling, unloading, spreading, levelling and dressing of the dumped material and maintenance of the disposal areas, complete in all respects as per specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0100	164,479.33	Cum	Not Applicable		
R-20	Supplying, laying and fixing 150 mm diameter PVC conduit/duct pipe of approved make and quality in cable trench within the road cross-section, including cutting, jointing with solvent cement, providing necessary bends, couplers and accessories, provision of draw-wire in each conduit, proper alignment and levelling, and coordination with the utility/MEP works, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0610	5,520.00	RM	Not Applicable		
R-21	Supplying, laying and fixing 100 mm diameter PVC conduit/duct pipe of approved make and quality in cable trench within the road cross-section, including cutting, jointing with solvent cement, providing necessary bends, couplers and accessories, provision of draw-wire in each conduit, proper alignment and levelling, and coordination with the utility/MEP works, complete in all respects as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0340, Section - 0610	5,520.00	RM	Not Applicable		
R-22	Providing and laying Tuff Pavers, having 7000 PSI, crushing strength of approved manufacturer, over 2" to 3" sand cushion i/c grouting with sand in joints i/c finishing to require slope as per Complete in all respect. (50% Grey / 50% Coloured) complete in all respects as per drawings, specifications and as directed by the Engineer. (80mm thick)	5152	Sqm	Not Applicable		

R-23	Providing, fabricating, supplying and installing complete Road Sign Boards, including all signage designs, types, sizes and quantities as indicated on the approved drawings, including posts, frames, reflective sheeting, sign plates, foundations and all fixing accessories, complete in all respects, in accordance with the approved drawings, specifications and the Engineer's instructions.	1	Job	Not Applicable		
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Bill of Quantities

Bill No. 5 - Electrical Work

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	(2)	(3)	(4)	(5)	(6)	(7) = [(5)*280]+(6)]*(3)
E-0.1	Supply at site, installation, testing and commissioning of new step down Oil immerse, naturally cooled, step down 11000/400/230 Volts 50 Cycles, Comprising with high/low voltage compartments and controls Type A excluding cost of Pad Pad Mounted Oil Type Transformer :- 630 kVA Capacity 11KV / 415 Volt (Prime Rating) REF: Technical Specifications Section - 0510, Section - 0490	1.00	No.	Not Applicable		
E-0.2	Supply, Installation & Testing at site of water cooled NEW diesel generating. REF: Technical Specifications Section - 0490, Section - 0500			Not Applicable		
E-0.2-1	150 KVA Prime rating(as per SLD) REF: Technical Specifications Section - 0490	1.00	No.	[Up to 80% Allowed]		
E-0.2-2	300 KVA Prime rating(as per SLD) REF: Technical Specifications Section - 0490	1.00	No.	[Up to 80% Allowed]		
E-0.3	Supply at site installation, testing & commissioning of UPS. REF: Technical Specifications Section - 0490, Section - 0570					
E-0.3-1	UPS "5 KVA-Modular", (1-Phase-In; 1-Phase Out 220V) with 15-30 minutes back-up time with battery module cabinet & IPS Complete with all respect as per SLD. REF: Technical Specifications Section - 0490, Section - 0570	2.00	No.	Not Applicable		
E-0.3-2	UPS "3 KVA-Modular", (1-Phase-In; 1-Phase Out 220V) with 15-30 minutes back-up time with battery module cabinet & IPS Complete with all respect as per SLD. REF: Technical Specifications Section - 0490, Section - 0570	1.00	No.	Not Applicable		
E-1	Fabrication, supply at site, installation at designated location, testing and commissioning of Main Panel Board (MPB) REF: Technical Specifications Section - 0490, Section - 0530, Section - 0540					
E-1-1	Complete as per Single Line Diagram. REF: Technical Specifications Section - 0490	1.00	No.	Not Applicable		
	ACTIVE HARMONIC FILTERS (AHFs) REF: Technical Specifications Section - 0490, Section - 0530					
E-1-2	Supply, installation & connection of Active Harmonic Filters of medium voltage (11KV) with following function: Harmonic Reduction Voltage Stabilization Enhanced Equipment Life Efficiency Improvement Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0530	1.00	No.	Not Applicable		
E-1-2-1	Circuit Point Wiring. REF: Technical Specifications Section - 0490, Section - 0600					
E-2.01	Supply and wiring of light circuit from DB to switchboard with 2x2.5 mm sq single core insulated 300/500 volt grade cables(P+N) and 2.5mm sq cable as circuit protective conductor (CPC) in & including PVC conduit installed/ recessed in walls / R.C.C. Slab, on ceiling or as required as per site conditions. REF: Technical Specifications Section - 0490, Section - 0530, Section - 0540, Section - 0620, Section - 0610, Section - 0600	10,000.00	Rft	Not Applicable		
E-2.02	Supply and wiring of circuit point wiring from switch board to switch board with 2x2.5 mm sq single core insulated 300/500 volt grade cables(P+N) and 2.5mm sq cable as circuit protective conductor (CPC) in & including PVC conduit installed/ recessed in walls / R.C.C. Slab, on ceiling or as required as per site conditions. (Loop Circuit) REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600	6,000.00	Rft	Not Applicable		
E-2.03	Supply and installation of Switch Board with back box. REF: Technical Specifications Section - 0490, Section - 0600					
E-2.03-1	i) 3x3 back box with earthing point and switch board. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	20.00	Each	Not Applicable		
E-2.03-2	ii)6x3 back box with earthing point and switch board. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	79.00	Each	Not Applicable		

E-2.04	Supply and wiring of first light / Exhaust fan point consisting of one point controlled by one switch with 2x1.5mm sq (P+N) PVC insulated 300/500 volt grade wire in and including PVC conduits recessed in walls/R.C.C. slab, on ceilings or as required including all conduit accessories junction boxes, pull boxes, pull wire, 1mm2 cable as CPC complete with 10 Amp. single way switch make as approved by consultant (annexure-A) installed on & including 16 SWG sheet steel boards duly powder coated paint with earth bolt recessed in wall/column complete in all respects as per drawing & specifications. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0560, Section - 0640, Section - 0600	210.00	Each	Not Applicable		
E-2.05	Providing, supplying, wiring, laying, pulling, testing and commissioning of loop circuit point wiring from switch board to switch board, comprising 2 Nos. x 2.5 mm² single-core PVC insulated copper conductor cables, 300/500 V grade, for phase and neutral, along with 1 No. x 2.5 mm² single-core PVC insulated copper conductor as Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including all required PVC conduits, bends, junction boxes, inspection/pull boxes, bushes, saddles, clamps, draw wires, accessories, ferruling, tagging, terminations at both ends, connection with switch boards/accessories, cutting, chasing, making good, testing of continuity, insulation resistance, polarity and earth continuity, complete with all labour, tools, consumables, incidental materials and ancillary works required for a complete, safe and operational loop circuit installation, as shown on drawings, as directed by the Engineer and in accordance with the Technical Specifications, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600, Section - 0640	380.00	Each	Not Applicable		
E-2.06	Supply and wiring of light circuit directly controlled from MCB in DB wired with 2x2.5 mm sq single core insulated 300/500 volt grade cables(P+N) and 2.5mm sq cable as circuit protective conductor (CPC) in & including PVC conduit installed/ recessed in walls / R.C.C. Slab, on ceiling or as required as per site conditions. Complete with all conduit accessories junction boxes, pull boxes as required complete in all respects as per specifications and drawings. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600, Section - 0640	50.00	Each	Not Applicable		
E-2.07	Providing, supplying, wiring, laying, pulling, testing and commissioning of point-to-point loop circuit wiring, comprising 2 Nos. x 2.5 mm² single-core PVC insulated copper conductor cables, 300/500 V grade, for phase and neutral, along with 1 No. x 2.5 mm² single-core PVC insulated copper conductor cable as Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including PVC conduits, bends, sleeves, junction boxes, pull boxes, inspection boxes, adaptable boxes, draw wires, bushes, saddles, clamps, supports, conduit accessories, ferruling, tagging, identification, terminations at both ends, connection with switch boards/accessories, cutting, chasing, making good of walls/slabs/ceilings, testing of continuity, insulation resistance, polarity and earth continuity, complete with all labour, tools, consumables, incidental materials and ancillary works required for a complete, safe and operational loop circuit installation, as shown on drawings, as directed by the Engineer and in accordance with the Technical Specifications, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600, Section - 0640	65.00	Each	Not Applicable		
E-2.08	Supply and wiring of first 3 pin 5 Amps socket outlet point make as approved by consultant from MCB in DB, with single core 2x2.5 mm sq PVC insulated 300/500 volt grade cable in & including PVC conduit recessed in walls/R.C.C. slab, or on surface of ceiling including all conduits accessories, junction boxes, pull boxes etc. 2.5mm sq cable as CPC ; & including 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0610, Section - 0600, Section - 0640	3,500.00	Rft	Not Applicable		
E-2.09	Supply and wiring but outlet to outlet wiring of 5/10 Amps socket outlet. REF: Technical Specifications Section - 0490, Section - 0600	3,500.00	Rft	Not Applicable		
E-2.1	Supply & fixing of 5 Amp 3 Pin Socket 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0600	122.00	Each	Not Applicable		

E-2.11	Supply & wiring of first 15A power sockets outlet from MCB in DB, with 2 x 4 mm sq single core cables (P+N) and 2.5 mmsq as CPC from DB to point, Complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	4,500.00	Rft	Not Applicable		
E-2.12	Providing, supplying, wiring, laying, pulling, testing and commissioning of outlet-to-outlet wiring for 5/10 Amp socket outlet points, comprising approved PVC insulated copper conductor cables of required size as per drawings and load requirement, including phase, neutral and Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including PVC conduits, bends, sleeves, junction boxes, pull boxes, inspection boxes, adaptable boxes, draw wires, bushes, saddles, clamps, supports, conduit accessories, ferruling, tagging, identification, terminations at socket outlets/accessories, cutting, chasing, making good of walls/slabs/ceilings, testing of continuity, insulation resistance, polarity and earth continuity, complete with all labour, tools, consumables, incidental materials and ancillary works required for a complete, safe and operational socket outlet wiring installation, as shown on drawings, as directed by the Engineer and in accordance with the Technical Specifications, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	1,600.00	Rft	Not Applicable		
E-2.13	Supply & fixing of 15 Amp 3 Pin Power Socket 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0600	110.00	Each	Not Applicable		
E-2.14	Supply & wiring of first 13A power sockets outlet from MCB in DB, with 2 x 4 mm sq single core cables (P+N) and 2.5 mmsq as CPC from DB to point, Complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	4,000.00	Rft	Not Applicable		
E-2.15	Providing, supplying, wiring, laying, pulling, testing and commissioning of outlet-to-outlet wiring for 13 Amp power socket outlet circuit, comprising 2 Nos. x 2.5 mm² single-core PVC insulated copper conductor cables for phase and neutral, along with 1 No. x 2.5 mm² single-core PVC insulated copper conductor cable as Circuit Protective Conductor (CPC)/earth continuity conductor, drawn in approved PVC conduit installed concealed/recessed in walls, RCC slabs, ceilings or surface-mounted where required as per site conditions, including PVC conduits, bends, sleeves, junction boxes, pull boxes, inspection boxes, adaptable boxes, draw wires, bushes, saddles, clamps, supports, conduit accessories, ferruling, tagging, identification, terminations at outlet boxes/socket points, cutting, chasing, making good of walls/slabs/ceilings, testing of continuity, insulation resistance, polarity and earth continuity, complete with all labour, tools, consumables, incidental materials and ancillary works required for a complete, safe and operational 13 Amp power socket outlet wiring installation, as shown on drawings, as directed by the Engineer and in accordance with the Technical Specifications, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	3,500.00	Rft	Not Applicable		
E-2.16	Supply & fixing of 13 Amp 3 Pin Power Socket 16 SWG sheet steel board recessed in walls complete in all respects and as per specifications & drawings. REF: Technical Specifications Section - 0490, Section - 0600	173.00	Each	Not Applicable		
E-2.17	Supply & wiring IPS Single Phase of one No. 2x 6mm2 single core cables (P+N) from DB to the point and 4mm2 as CPC including cost of one no. 16 Amps Industrial Power Socket, recessed in walls /columns. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	2.00	Each	Not Applicable		
E-2.18	Supply & wiring IPS Three Phase of one No. 4x 6mm2 single core cables (P+N) from DB to the point and 2x4mm2 as CPC including cost of one no. 16 Amps Industrial Power Socket, recessed in walls /columns. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600	2.00	Each	Not Applicable		
E-2.19	Supply & installation of flexible connection between light point above false ceiling to light fitting in false ceiling with 3 core 23/.076 flexible cable in & including PVC flexible pipe, 15A PVC connector & pipe accessories etc as required. REF: Technical Specifications Section - 0490	600.00	Each	Not Applicable		

E-3.01	Supply at site, installation, testing and commissioning of PVC insulated, PVC sheathed, non-armoured copper conductor low tension power cable, 600/1000 V grade, of specified size/core configuration as mentioned in BOQ/drawings, laid in pre-installed cable tray, trench, conduit or approved route, including cable identification, end termination, cable lugs and connection at both ends, complete in all respects as per drawings, approved manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490					
E-3.01-1	i) 2 core 6mm.sq. REF: Technical Specifications Section - 0490	150.00	Rft	Not Applicable		
E-3.01-2	ii) 2 core 10mm.sq. REF: Technical Specifications Section - 0490	100.00	Rft	Not Applicable		
E-3.01A	Four Core Cable					
E-3.01A-1	i) 4 core 6mm.sq. REF: Technical Specifications Section - 0490	80.00	Rft	Not Applicable		
E-3.01A-2	ii) 4 core 10mm.sq. REF: Technical Specifications Section - 0490	200.00	Rft	Not Applicable		
E-3.01A-3	iii) 4 core 16mm.sq. REF: Technical Specifications Section - 0490	100.00	Rft	Not Applicable		
E-3.01A-4	iv) 4 core 25mm.sq. REF: Technical Specifications Section - 0490	150.00	Rft	Not Applicable		
E-3.01A-5	v) 4 core 95mm.sq. REF: Technical Specifications Section - 0490	0.00	Rft	Not Applicable		
E-3.01A-6	vi) 4 core 120mm.sq. REF: Technical Specifications Section - 0490	250.00	Rft	Not Applicable		
E-3.01A-7	vii) 4 core 150mm.sq. REF: Technical Specifications Section - 0490	0.00	Rft	Not Applicable		
E-3.01A-8	viii) 4 core 240mm.sq. REF: Technical Specifications Section - 0490	150.00	Rft	Not Applicable		
E-3.01A-9	ix) 4 core 300mm.sq. REF: Technical Specifications Section - 0490	200.00	Rft	Not Applicable		
E-3.02	Circuit Protective Conductor (CPC) REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600					
E-3.02-1	i) 1 core 4mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	310.00	Rft	Not Applicable		
E-3.02-2	iii) 1 core 6mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	500.00	Rft	Not Applicable		
E-3.02-3	iii) 1 core 10mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	200.00	Rft	Not Applicable		
E-3.02-4	iv) 1 core 16mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	300.00	Rft	Not Applicable		
E-3.02-5	v) 1 core 50mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	0.00	Rft	Not Applicable		
E-3.02-6	vi) 1 core 70mm sq. PVC insulated colour Green/Yellow. REF: Technical Specifications Section - 0490	1,200.00	Rft	Not Applicable		
E-3.03	Supply at site, installation, testing and commissioning of 20 mm dia rigid PVC conduit for electrical surface and concealed wiring installation, suitable for LV wiring containment, complete with matching PVC bends, tees, couplers, junction boxes, pull boxes, inspection boxes, saddles, clamps, supports, bushes and all required conduit accessories, fixed on surface or concealed/recessed in walls, RCC slabs, ceilings or floors as shown on drawings and as required at site, including alignment, continuity of conduit route and provision for cable pulling, complete in all respects as per drawings, approved material submittal and Technical Specifications.. REF: Technical Specifications Section - 0490, Section - 0610					
E-3.03-1	i) 1-1/2" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	300.00	Rft	Not Applicable		
E-3.03-2	ii) 2" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	400.00	Rft	Not Applicable		
E-3.03-3	iii) 3" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	150.00	Rft	Not Applicable		
E-3.03-4	iv) 4" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	100.00	Rft	Not Applicable		
E-3.04	Supply at site of 6" dia PVC heavy duty pipe make Shavyl, Plasco / Beta Pipes to be installed underground, including cost of excavation of trench 30" deep, including cost of all PVC pipe accessories like bends, sockets, laying of PVC pipe with 4" thick layer of sand beneath pipe, 4" thick layer of brick protection and sand tape above pipe, refilling of excavations with sweet earth, ramming, watering cost of labour, material, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0600, Section - 0100	50.00	Rft	Not Applicable		

E-3.05	Powder Coated Ceiling Suspended / Horizontal Cable Tray in Corridor. Fabrication, supply at site, installation, testing and commissioning of perforated M.S. cable tray with cover, suitable for LV power/control cable routing, complete with approved support arrangement and standard accessories, installed on wall, vertical shaft, ceiling/false ceiling or other approved route as shown on drawings, as directed by the Engineer and in accordance with Technical Specifications, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590					
E-3.05-1	6" X 4" Cable Tray 14 SWG & Cover 18 SWG. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590	650.00	Rft	Not Applicable		
E-3.05-2	12" X 4" Cable Tray 14 SWG & Cover 18 SWG. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590	700.00	Rft	Not Applicable		
E-3.05B	Providing, fixing and installation of Cable ladder of size 28" in width and made with 2"x2" L type angle iron duly galvanized or powder coated in desired colour as approved by the consultant. The space among ladder steps shall not be more than 12", Same as shown in drawings. REF: Technical Specifications Section - 0490, Section - 0640, Section - 0590	100.00	Rft	Not Applicable		
E-3.06	Excavation in ordinary soil up to 2400mm depth x 1800mm wide Trench . The work also includes the site preparation. Complete in all respects. REF: Technical Specifications Section - 0490, Section - 0100	70.00	Cubic meter	Not Applicable		
E-3.07	Making of RCC Manhole 2' x 2' (LW) 2.6' Depth make with 6 inch RCC Wall. heavy duty 2'-6" Square RCC cover, including Ground Excavation of Manholes as per Drawing & details. Complete in all respects. REF: Technical Specifications Section - 0490	10.00	Each	Not Applicable		
E-3.08	Supply at site, installation, testing and commissioning of XLPE insulated, aluminium tape screened, PVC/SWA/PVC armoured aluminium conductor HT power cable, 8.7/15 kV grade, 50 Hz, suitable for three-phase grounded system, laid in prepared trench, duct, conduit, cable tray or approved route as shown on drawings, including cable pulling, identification, end connections and testing, complete in all respects as per drawings, approved manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490					
E-3.08-1	i) 3 core 95mm sq. REF: Technical Specifications Section - 0490	3,280.00	Rft	Not Applicable		
E-3.08-2	ii) 3 core 95mm sq (HT Termination Kits by Raychem/Equivalent) REF: Technical Specifications Section - 0490	2.00	Job	Not Applicable		
E-4.01	Providing ,installation ,testing and commissioning of the following lighting fixture including all accessories like electronic ballast, drivery circuitry , lamps, mountings etc. Complete in all respects , make as approved by consultant. REF: Technical Specifications Section - 0490, Section - 0600					
E-4.01-1	Down lighter covered with glass with 12 Watt Down lamp. REF: Technical Specifications Section - 0490, Section - 0560	89.00	Each	Not Applicable		
E-4.01-2	Rope light with 5 Watt per Rft. REF: Technical Specifications Section - 0490, Section - 0560	200.00	Rft	Not Applicable		
E-4.01-3	Flexible Linear Light 8 Watt per Rft as per instruction of Engineer Incharge. REF: Technical Specifications Section - 0490, Section - 0560	100.00	Rft	Not Applicable		
E-4.01-4	Supply & Installation of 14 Watt Bulkhead Light. REF: Technical Specifications Section - 0490, Section - 0560	10.00	Each	Not Applicable		
E-4.01-5	Supply & Installation of 40 Watt 4 feet Tube Light. REF: Technical Specifications Section - 0490, Section - 0560	323.00	Each	Not Applicable		
E-4.01-6	Supply & Installation of 120 Watt 12 feet (4' with 3) Linear Light. REF: Technical Specifications Section - 0490, Section - 0560	48.00	Each	Not Applicable		
E-4.01-7	LED panel light 2'x2'' with 40 Watt. REF: Technical Specifications Section - 0490, Section - 0560	64.00	Each	Not Applicable		
E-4.01-8	Supply & Installation of self contained Emergency light as approved by the electrical consultant. 2x7 Watt Fluorescent lamp NICAD batteries for 3 hours back up. REF: Technical Specifications Section - 0490, Section - 0560	35.00	Each	Not Applicable		
E-4.01-9	Supply & Installation of self contained exit light as approved by the electrical consultant. 9 Watt Fluorescent lamp NICAD batteries for 3 hours back up. REF: Technical Specifications Section - 0490, Section - 0560	23.00	Each	Not Applicable		
E-4.02	Supply and Installation of Hand dryer Mounted at surface of wall. (Make Siemens or approved brand) REF: Technical Specifications Section - 0490, Section - 0640	6.00	Each	Not Applicable		

E-4.03	Supply at site, installation, testing and commissioning of multimedia projector, Optoma X400LVe or approved equivalent, DLP type, minimum 4,000 ANSI lumens brightness, native XGA resolution 1024x768, contrast ratio not less than 25,000:1, with HDMI/VGA input connectivity, built-in speaker, power supply 100–240 V AC, suitable for meeting/training room presentation use, complete with EPIC gang controller or approved equivalent control switch, HDMI cable, VGA cable, power cable, ceiling/wall mounting bracket where required, connection, configuration, demonstration and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0640	2.00	Each	Not Applicable		
E-4.04	Supply and installation of LED Aviation Obstruction Light 30W.Complete with all respect. REF: Technical Specifications Section - 0490, Section - 0560, Section - 0770	10.00	Each	Not Applicable		
E-4.05	Supply at site, installation, testing and commissioning of LED linear profile light, 8 W per Rft, 220–240 V AC, 50 Hz, complete with aluminium profile/housing, opal/polycarbonate diffuser, LED strip/module, LED driver, end caps, connectors and mounting accessories, suitable for surface, recessed or suspended installation as shown on drawings, including electrical connection, alignment, operational testing and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0560	1,700.00	Rft	Not Applicable		
E-4.06	Supply at site, installation, testing and commissioning of LED up-down wall light, 12 W, IP65 rated, 220–240 V AC, 50 Hz, suitable for indoor/outdoor architectural lighting application, complete with die-cast aluminium or approved weather-resistant housing, LED module, diffuser/lens, integral or external LED driver, mounting plate/bracket, glands, connectors, wiring connection, fixing accessories, operational testing and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0560	73.00	Each	Not Applicable		
E-5.01	Supply & Laying of 1" dia PVC pipe to be laid under floor including floor cutting as required as per drawings & specifications for Computer, Tel, MATV,Networking, UPS, & Power Supply System. REF: Technical Specifications Section - 0490, Section - 0570, Section - 0610, Section - 0800	5,362.50	Rft	Not Applicable		
E-5.02	Supply & Installation of adjustable 12 SWG die cast aluminum 10"x10"x4" Floor boxes having base box of 16 SWG G.I. sheet with 3 sets of 15A PVC connectors, including floor cutting as required as per drawings for following outlets. REF: Technical Specifications Section - 0490					
E-5.02-1	2-13 Amp 3 pin socket outlets. REF: Technical Specifications Section - 0490, Section - 0600	6.00	Each	Not Applicable		
E-5.03	Supply & Installation of adjustable 12 SWG die cast aluminum 15"x15"x4" Tech boxes having base box of 16 SWG G.I. sheet with 3 sets of 15A PVC connectors, including floor cutting as required as per drawings for following outlets. REF: Technical Specifications Section - 0490					
E-5.03-1	2-13 Amp 3 pin socket outlets. REF: Technical Specifications Section - 0490, Section - 0600	62.00	Each	Not Applicable		
E-5.04	Supply and installation of RJ45 data outlet on single/double port faceplate to be installed on wall ,with necessary arrangements complete in all respect complete in all respect.(for Data) REF: Technical Specifications Section - 0490, Section - 0650	75.00	Each	Not Applicable		
E-5.05	Supply and installation of RJ11 Telephone outlet on single/double port faceplate to be installed on wall ,with necessary arrangements complete in all respect complete in all respect.(for Telephone) REF: Technical Specifications Section - 0490, Section - 0650	68.00	Each	Not Applicable		
E-5.06	Supply, Installation & connecting of 4 pair UTP CAT-6 cable from each Data point to Data junction box/patch panel for data system to be drawn in given prepaid PVC pipe complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0640	6,000.00	Rft	Not Applicable		
E-5.06A	Supply, Installation & connecting of 4 pair UTP CAT-6 cable from each telephone to telephone junction box for telephone system to be drawn in given prepaid PVC pipe complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0640	5,440.00	Rft	Not Applicable		
E-5.07	Supply and installation of single mode SFP module Baynet or equivalent including cost of all accessories and materials required. Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0650	10.00	Each	Not Applicable		

E-5.08	Supply and wiring of 12C-9/125µm single mode fiber optical cable OS2 type, in and including cost of 1" dia PVC conduit including cost of all PVC conduit accessories, pull wires, PVC junction boxes, complete in all respect. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0640	1,200.00	Rft.	Not Applicable		
E-5.09	Supply and installation of 24 port rack mounted ODF including cost of all accessories and materials required. Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0650	1.00	Each	Not Applicable		
E-5.10	Supply, Installation & Connecting up of Telephone cables 0.6mm solid conductor, polyethylene insulated, 2 insulated conductors twisted together and PVC sheathed of following pairs: REF: Technical Specifications Section - 0490					
E-5.10-1	i) 100 Pairs cable. REF: Technical Specifications Section - 0490	1,200.00	Rft	Not Applicable		
E-5.11	Supply at site, installation, testing and commissioning of telephone distribution board/cabinet, 100-pair capacity, suitable for termination of telephone points, complete with 5 Nos. 20-pair Krone/IDC termination strips, incoming/outgoing cable termination facility, labeling/numbering arrangement and required 1 m or 3m patch cords with one end RJ45 connector and other end IDC connector for connection between patch panel and Telephone DB, installed in IDF/MDF or approved location as shown on drawings, including termination, testing, identification and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0530, Section - 0540, Section - 0650					
E-5.11-1	i) Telephone DB (100 pair) REF: Technical Specifications Section - 0490	1.00	Each	Not Applicable		
E-5.12	Supply at site, installation, testing and commissioning of following Data Networking switch Layer-2 type for under mentioned nodes, consisting of following Data points to be terminated on modular patch panel, including cost of power bus bar, IDC connectors, all necessary accessories / materials, whether mentioned or not but are required for proper functioning shall be deemed to be included in the cost of this item, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0650					
E-5.12-1	24 Port Data Networking switch Layer-2 POE type. REF: Technical Specifications Section - 0490, Section - 0600	4.00	Nos.	Not Applicable		
E-5.13	Supply, installation of Patch cords of following sizes: REF: Technical Specifications Section - 0490, Section - 0650					
E-5.13-1	1 Meter long. REF: Technical Specifications Section - 0490	50.00	Nos.	Not Applicable		
E-5.13-2	3 Meter Long. REF: Technical Specifications Section - 0490	25.00	Nos.	Not Applicable		
E-5.14	Supply & Installation & connecting of ceiling recessed wifi access point with Dual Band (2.4GHz or 5 GHz) upto Wifi 6 Supported capability and speeds up to 300 Mbps Wi-Fi Protected Access (WPA, WPA2) security and data encryption IPv6 with centralized controller , complete in all respects. REF: Technical Specifications Section - 0490	7.00	Each	Not Applicable		
E-5.15	Supply at site, installation, testing and commissioning of data cabinet make Imported/Equivalent made of M.S sheet, powder coated, having lockable glass door at front, 4 exhaust fans on top, suitable for above mentioned data switches, consisting of the ports to be terminated on modular data cabinet, including cost of all necessary accessories / materials for passive equipment. The data cabinet and all passive equipment shall be complete in all respects including cost of all necessary materials / accessories. Patch panel shall be installed after obtaining necessary permission from the computer specialist of the Client. REF: Technical Specifications Section - 0490, Section - 0560, Section - 0640, Section - 0600, Section - 0650					
E-5.15-1	Supply at site, installation, testing and commissioning of 12U data cabinet, imported or approved equivalent, 19-inch rack type, fabricated from M.S. sheet steel, powder-coated finish, complete with lockable front glass door, side panels, rack mounting rails, cable entry/exit provision, ventilation arrangement, earthing point, fixing hardware and all standard cabinet accessories, suitable for installation of data/ICT equipment, patch panels and network accessories, installed at location shown on drawings, including alignment, fixing, labeling, earthing continuity check and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490	4.00	Each	Not Applicable		

E-5.15-2	Supply at site, installation, testing and commissioning of 6U data cabinet, imported or approved equivalent, 19-inch rack type, fabricated from M.S. sheet steel, powder-coated finish, complete with lockable front glass door, side panels, rack mounting rails, cable entry/exit provision, ventilation arrangement, earthing point, fixing hardware and all standard cabinet accessories, suitable for installation of data/ICT equipment, patch panels and network accessories, installed at location shown on drawings, including alignment, fixing, labeling, earthing continuity check and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490	2.00	Each	Not Applicable		
E-5.15-3	Supply at site, installation, testing and commissioning of 42U floor-standing data cabinet, imported or approved equivalent, 19-inch rack type, fabricated from M.S. sheet steel with powder-coated finish, complete with lockable front glass door, rear/side panels, rack mounting rails, ventilation arrangement, cable entry/exit provision, earthing point, fixing/leveling hardware and standard cabinet accessories, suitable for installation of data/ICT equipment, switches, patch panels, fiber panels, cable managers and network accessories, installed at location shown on drawings, including alignment, fixing, labeling, earthing continuity check and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490	1.00	Each	Not Applicable		
E-5.16	Supply, installation, testing and commissioning of rack mounted Power Distribution Unit (PDU) of following sizes, to be installed on specified location as per advised by architect / engineer's incharge:-. REF: Technical Specifications Section - 0490					
E-5.16-1	Single Cord (1x10A/16A) PDU (1.5 kW) with minimum 10 extensions (meeting or exceeding relevant IEC/ANSI standard) REF: Technical Specifications Section - 0490	8.00	Nos	Not Applicable		
E-5.17	Supply & Installation of "IPTV points wiring 4 pair UTP CAT-6 with all accessories RJ45 single/double port faceplate make Orange / Clipsal/3M to be installed on wall ,with necessary arrangements.(for IPTV) in 1" dia PVC conduit for IPTV outlet board complete in all respect. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0800	18.00	Each	Not Applicable		
E-5.18	Supply at site, installation, testing and commissioning of Cat-6 patch panels (meeting or exceeding relevant ANSI/TIA standards),input / output RJ45 connectors suitable for Cat 6 cables patch guides along with cable managers for under mentioned nodes, including cost of power bus bar, IDC connectors, all necessary accessories / materials, whether mentioned or not but are required for proper functioning shall be deemed to be included in the cost of this item, complete in all respects make Baynet/or approved equivalent. Patch panel shall be installed after obtaining necessary permission from the computer specialist of the Client. REF: Technical Specifications Section - 0490, Section - 0650					
E-5.18-1	i) 24 Ports. REF: Technical Specifications Section - 0490	4.00	Each	Not Applicable		
	TELEPHONE EXCHANGE. REF: Technical Specifications Section - 0490, Section - 0650					
E-5.19	Supply at site, installation, testing and commissioning of electronic telephone exchange / EPABX / IP-PBX system, suitable for project voice communication network, comprising minimum 4 trunk lines and 100 extensions, expandable capacity, operator console, required interface cards/modules, power supply, system software/licenses, programming/configuration, patching and integration with telephone distribution board/structured cabling system, complete with testing, commissioning, demonstration and handing over, as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0650	1.00	Each	Not Applicable		
	Addressable FIRE ALARM SYSTEM. REF: Technical Specifications Section - 0490, Section - 0660					
E-6.01	Supply, installation and connecting of addressable manual call stations press glass type with test dey, suitable for surface or flush mounting make from any one of the manufacturers as specified in Annexure "A" complete in all respects and conforming to general specifications. REF: Technical Specifications Section - 0490, Section - 0660	17.00	Each	Not Applicable		
E-6.02	Supply, installation and connecting of electronic alarm sounders ,complete in all respects and conforming to general specifications. REF: Technical Specifications Section - 0490, Section - 0660	17.00	Each	Not Applicable		

E-6.03	Supply, installation and connecting of addressable optical smoke detectors, complete in all respects and conforming to general specifications. REF: Technical Specifications Section - 0490, Section - 0650, Section - 0660	111.00	Each	Not Applicable		
E-6.04	Same as above 6.03 but heat detector rate of temperature rise type ,complete in all respects. REF: Technical Specifications Section - 0490, Section - 0660	4.00	Each	Not Applicable		
E-6.05	Supply & installation of Media converter complete in all respect. REF: Technical Specifications Section - 0490, Section - 0660	2.00	Each	Not Applicable		
E-6.06	Supply, installation and connecting of addressable fire alarm of following mentioned loops. Short/open circuit indications LED display / power fault, loop isolated test, complete in all respects and conforming to general specifications FACP to be installed at appropriate place as mentioned in drawings. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0660					
E-6.06-1	i) FACP 4 Loops. REF: Technical Specifications Section - 0490	1.00	Each	Not Applicable		
E-6.07	Supply and wiring of Smoke / Heat detector/electrostatic sounder and manual call point 30 min Fire Rated Fire Alarm (FA) 1x2 core (1.23mm2) cable in and excluding cost of 1" dia PVC conduit with all installing accessories, complete in all respect as per drawings and specification. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0660	7,152.00	Rft	Not Applicable		
E-6.08	Supply, installation of fire alarm junction boxes 16 SWG to be concealed in wall with 2 coats of anti rust paint, earthing terminal, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0660, Section - 0640					
E-6.08-1	i)Fire alarm junction boxes of appropriate size 4"x7"x4" deep. REF: Technical Specifications Section - 0490, Section - 0660, Section - 0640	2.00	Each	Not Applicable		
E-6.09	Supply at site of PVC conduit heavy duty, to be installed on RCC slabs, walls, floor or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610					
E-6.09-1	i) 1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	7,152.00	Rft.	Not Applicable		
E-6.1	Programming, configuration, testing, commissioning and handing over of complete Intelligent Addressable Fire Alarm System with read-only status integration to Building Management System (BMS), including Fire Alarm Control Panel (FACP), addressable loops, detectors, manual call points, sounders/strobes, monitor/control modules, annunciation, alarm/trouble/supervisory signals and BMS interface points as per approved cause-and-effect matrix, drawings and system architecture, complete with functional testing, integrated system testing, alarm simulation, verification in the presence of Site Engineer/Engineer's Representative, operator training for Employer's staff and submission of commissioning records, complete in all respects as per Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0660, Section - 0880	1.00	Job	Not Applicable		
E-7.01	Wiring for each IP Based POE CCTV Cameras to be installed on walls / slabs or on false ceiling with cable CAT-6 UTP Cable cable in 1" dia PVC conduit (excluding cost of pipe), complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0670	11,400.00	Rft	Not Applicable		
E-7.02	Supply at site, installation, testing & commissioning of Full HD Indoor dome Type IP Based POE CCTV, Day and Night Type with minimum 4MP resolution pieces IR LED , Vandal proof Body, with at least 20-30 meters IR visibility, Indoor type , including mounting bracket, all fixing and mounting accessories, complete in all respects, including cost of all required accessories / materials. fixed lens. REF: Technical Specifications Section - 0490, Section - 0670	40.00	Each	Not Applicable		
E-7.03	Supply at site, installation, testing & commissioning of Full Outdoor (IP-65) IP Based POE CCTV, Day and Night Type with minimum 4MP resolution pieces IR LED , Vandal proof Body, with at least 20-30 meters IR visibility , including mounting bracket, all fixing and mounting accessories, complete in all respects, including cost of all required accessories / materials. REF: Technical Specifications Section - 0490, Section - 0670	32.00	Each	Not Applicable		

E-7.04	Supply at site, installation, testing & commissioning of Pan ,Tilt & Zoom 360 degree Full HD (16:9 1080p) Camera with minimum 4 MP resolution,32x Optical Zoom, 16x Digital Zoom, Day and Night Type, intelligent video analytics, including fixing and mounting accessories, complete in all respects, including cost of all required accessories / materials. REF: Technical Specifications Section - 0490, Section - 0650	4.00	Each	Not Applicable		
E-7.05	Supply at site, installation, testing & commissioning of Joystick, complete in all respects, including cost of all required accessories / materials. REF: Technical Specifications Section - 0490	1.00	Each	Not Applicable		
E-7.06	Supply at site, installation, testing & commissioning of 32 channel NVR with 512 MBPs network support,4K Video Out on HDMI,12 MP max camera support, Event Trigger (alarm input, video loss), Online 2x Gigabit Ethernet Network Facility,IP Filtering,GUI Interface, Built In Software including cost of 16 terabyte Hard Disk for 90 days recording, all necessary hardware and software accessories and materials, required for NVR, complete in all respects. REF: Technical Specifications Section - 0490	4.00	Each	Not Applicable		
E-7.07	Supply at site, installation, testing and commissioning of latest-generation ultra-slim desktop computer / CPU, HP, Dell, Lenovo or approved equivalent, comprising Intel Core i7 / Intel Core Ultra 7 processor, 14th Generation or latest equivalent, minimum 16GB DDR5 RAM, minimum 1TB NVMe SSD storage, integrated graphics, Gigabit Ethernet, Wi-Fi, Bluetooth, USB/HDMI/DisplayPort connectivity, genuine licensed Windows 11 Pro 64-bit operating system, keyboard, mouse, power cable and required accessories, including installation of operating system/drivers, initial configuration, performance testing, demonstration and handing over, complete in all respects as per approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490	1.00	Each	Not Applicable		
E-7.08	Supply at site, installation,tagging, connections, testing and commissioning of following Ports Data Networking POE switch Layer-2 type, consisting of following Data points to be terminated on modular patch panel, including cost of power bus bar, IDC connectors, all necessary accessories / materials, whether mentioned or not but are required for proper functioning shall be deemed to be included in the cost of this item, complete in all respects make Dlink/Huawei or approved equivalent. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0650, Section - 0670					
E-7.08-1	16 Port Data Networking POE switch Layer-2 type. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0670	0.00	Nos.	Not Applicable		
E-7.08-2	24 Port Data Networking POE switch Layer-2 type. REF: Technical Specifications Section - 0490, Section - 0600, Section - 0670	4.00	Nos.	Not Applicable		
E-7.09	Supply at site, installation, tagging and connections of following port Data Patch panels, installed in Data Rack or as per site. Including cost of all accessories and materials required. Complete in all respect. REF: Technical Specifications Section - 0490, Section - 0650					
E-7.09-1	16 Port Data Patch panels. REF: Technical Specifications Section - 0490, Section - 0650	0.00	Nos.	Not Applicable		
E-7.09-2	24 Port Data Patch panels. REF: Technical Specifications Section - 0490, Section - 0650	4.00	Nos.	Not Applicable		
E-7.1	Supply, installation of Patch cords of following sizes: REF: Technical Specifications Section - 0490, Section - 0650					
E-7.1-1	1 Meter long. REF: Technical Specifications Section - 0490	50.00	Nos.	Not Applicable		
E-7.1-2	3 Meter Long. REF: Technical Specifications Section - 0490	25.00	Nos.	Not Applicable		
E-7.11	Supply at site, installation, testing & commissioning of coloured CCTV monitor 4K LED 43" , including cost of all necessary accessories and materials (like bracket and mounting arrangements), Including cost of 2 HDMI Cable 4K, complete in all respect. REF: Technical Specifications Section - 0490, Section - 0670	3.00	Each	Not Applicable		
E-7.12	if required, for the integration with existing system. Supply at site, installation, testing & commissioning of 256 channel decoder for integration with existing CCTV System , including cost of all necessary accessories and materials (like bracket and mounting arrangements), complete in all respect. REF: Technical Specifications Section - 0490, Section - 0670	1.00	Each	Not Applicable		
E-7.13	Supply and fabrication of close circuit junction boxes 16 SWG to be concealed in wall with 2 coats of anti rust paint, earthing terminal, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0600, Section - 0670, Section - 0640					

E-7.13-1	i)Junction boxes of appropriate size 4"x7". REF: Technical Specifications Section - 0490, Section - 0640	2.00	Each	Not Applicable		
E-7.14	Supply at site of PVC conduit heavy duty to be installed on RCC slabs, walls, floor or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610					
E-7.14-1	i) 1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	11,400.00	Rft.	Not Applicable		
E-7.15	Programming, configuration, testing, commissioning, integration and handing over of complete IP CCTV / Video Surveillance System with Video Management System (VMS), Network Video Recording / Network Attached Storage system and BMS monitoring interface, including configuration of IP cameras, recording schedules, camera naming/location tagging, user access levels, live view, playback, video analytics, alarm/event settings, storage verification, time synchronization, network connectivity and BMS status/alarm interface points, as applicable, complete with integrated system testing in the presence of Site Engineer/Engineer's Representative, operator training for Employer's staff and submission of commissioning/test records, complete in all respects as per drawings, approved system architecture and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0670, Section - 0880	1.00	Job	Not Applicable		
E-8.01	Supply at site, installation and commissioning of speakers wiring, to be wired with PVC insulated, PVC sheathed twin core 2x1.23mm sq 300/500 Volt. Grade, in and Excluding the cost of 1" dia heavy duty PVC conduit, installed on walls with all necessary fixing accessories as required as per site condition, all PVC conduit accessories, pull boxes, steel pull wires, complete in all respects. Wiring to be done considering each floor a separate zone. REF: Technical Specifications Section - 0490, Section - 0610	13.00	Nos	Not Applicable		
E-8.02	Supply at site, installation and commissioning of 15 watts wall speaker ,including cost of all necessary accessories and materials, complete in all respects. recessed/surface mounted Speakers of specified capacity housed in metallic enclosure with built in 70v/100v transformer , aluminium grill, SPL (Sound Pressure Level) (1W / 1M)= 92dB max 99dB, frequency response 130-13 Khz, EN-54 compliant, Including cost of all accessories and materials, complete in all respect. REF: Technical Specifications Section - 0780, Section - 0490	13.00	Nos	Not Applicable		
E-8.03	Supply at site,installation and commissioning of adjustable bidirectional ,low distortion microphone with suitable frequency response, complete in all respects. REF: Technical Specifications Section - 0490	2.00	Nos	Not Applicable		
E-8.04	Supply at site, installation, testing and commissioning of 240 Watt integrated power Amplifier, including cost of all necessary accessories / materials whether mentioned not shall be deemed to be included in the cost of item, complete in all respects. REF: Technical Specifications Section - 0490	1.00	Nos	Not Applicable		
E-8.05	Supply at site, installation, testing and commissioning of 60 Watt integrated power Amplifier, including cost of all necessary accessories / materials whether mentioned not shall be deemed to be included in the cost of item, complete in all respects. REF: Technical Specifications Section - 0490	1.00	Nos	Not Applicable		
E-8.06	Supply at site, installation, testing and commissioning of professional power mixer / PA audio integration mixer for integration of the proposed Voice Alarm and Public Address System with existing PA system / other building PA systems, rack-mounted or approved type, 230V AC, 50 Hz, suitable for 100 V line / PA audio interface as required, with minimum microphone/line inputs, auxiliary input/output, master volume control, tone control, balanced/unbalanced audio output, signal interface and required integration ports/modules as per approved system architecture, complete with HDMI/audio/control cables where applicable, connectors, patch cords, power cable, mounting accessories, configuration, functional testing, integration testing and handing over, complete in all respects as per drawings, approved material submittal, manufacturer's recommendations and Technical Specifications. REF: Technical Specifications Section - 0490, Section - 0780	1.00	Nos	Not Applicable		
E-8.07	Supply at site of PVC conduit heavy duty, to be installed on RCC slabs, walls, floor or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610					
E-8.07-1	i) 1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	1,300.00	Rft.	Not Applicable		

E-9.01	Supply and installation of 99.97% electrolytic copper strip but dia 2x(5.7 x 8mm) or as approved by consultant) copper strip to be installed on columns as “DOWN CONDUCTORS” with saddles from lightning arrestors to earth electrodes including providing test point in each down conductor. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0630	1,000.00	Rft	Not Applicable		
E-9.02	Providing and installation of Earthing Veractor Cone / Spike Size 2" thick, 12" long as shown in drawings or ¾” dia & 10 ft long copper rod as earth electrode 100 ft or upto the water level, below ground level including cost of boring and lowering the rod (100ft / upto the water level) down, complete with clamp and 2x70mm2 stranded copper conductor from rod to ground surface in 2” dia G.I.pipe (EL Class) with watering cap, Manhole with cover as per detail shown in drawings. all earth work should be done according to the advise of electrical consultant. REF: Technical Specifications Section - 0490, Section - 0620	3.00	Each	Not Applicable		
E-9.03	Providing & Fixing of one complete set of "LAS Emission Steamer" Earth pit as shown in drawings and as per the instruction of engineers incharge. REF: Technical Specifications Section - 0490, Section - 0630	3.00	Nos	Not Applicable		
E-9.04	Supply, design, installation, testing and commissioning of Special Lightning Air Terminal System, Controlled Early Streamer Emission (CESE) type, Prevectron 3rd Generation or approved equivalent, suitable for integration with the conventional lightning protection system for protection of rooftop equipment and building structures, complete with air terminal, mounting arrangement, down conductor interface, testing arrangement and all required system accessories, as shown on drawings and as per approved lightning protection design, manufacturer’s recommendations and Technical Specifications.. REF: Technical Specifications Section - 0490, Section - 0630			Not Applicable		
E-9.04-1	Supply, design, installation, testing and commissioning of Prevectron type 3rd Generation Controlled Early Streamer Emission (CESE) lightning air terminal, 2nd Edition, autonomous type, without external power supply/battery, having tinned copper central pick-up rod, protection radius 45 m, Level of Protection I, suitable for NFC 17-102 / UNE 21186 based lightning protection design, complete with factory test certificate, site testing and handing over. REF: Technical Specifications Section - 0490, Section - 0630	4.00	Set	Not Applicable		
E-9.04-2	Supply and installation of GI elevation pole/support assembly for CESE lightning air terminal, 35 mm to 50 mm dia, with threaded top suitable for fixing the air terminal unit, complete with base plate, mounting bracket, clamps, anchors, fasteners and all required fixing accessories. REF: Technical Specifications Section - 0490	4.00	Set	Not Applicable		
E-9.04-3	Supply and installation of down conductor test clamp / inspection joint assembly for lightning protection system, suitable for connecting and disconnecting the down conductor from earth termination for periodic testing and earth resistance measurement, complete with brass alloy clamp, fixing arrangement and required accessories. REF: Technical Specifications Section - 0490, Section - 0630	4.00	Set	Not Applicable		
E-9.04-4	Supply, installation, testing and commissioning of lightning flash counter / performance recording equipment, electronically controlled type, suitable for recording lightning strikes in the range of 1 kA to 100 kA with 8/20 microsecond impulse current waveform, complete with mounting arrangement, connection with down conductor, testing and handing over. REF: Technical Specifications Section - 0490, Section - 0630	4.00	Set	Not Applicable		
E-9.04-5	Supply, installation, testing and commissioning of conventional Franklin rod type lightning air terminal, mounted at the highest approved point of the building structure, complete with PCC base/support, download connection, fixing accessories, testing and handing over, as shown on drawings and as directed by the Engineer. REF: Technical Specifications Section - 0490	4.00	Set	Not Applicable		
E-10.01	Providing and installation of Earthing Veractor Cone / Spike Size 2" thick, 12" long as shown in drawings or ¾” dia & 10 ft long copper rod as earth electrode 100 ft or upto the water level, below ground level including cost of boring and lowering the rod (100ft / upto the water level) down, complete with clamp and 2x70mm2 stranded copper conductor from rod to ground surface in 2” dia G.I.pipe (EL Class) with watering cap, Manhole with cover as per detail shown in drawings. all earth work should be done according to the advise of electrical consultant. REF: Technical Specifications Section - 0490, Section - 0620	12.00	Each	Not Applicable		

E-10.02	Providing, supplying, boring, lowering, installing, testing and commissioning of complete earthing electrode set for Low Voltage, LAN/Data and associated electronic equipment, comprising earthing cone/spike of size 2 inches thick × 12 inches long or 19 mm dia. / 3/4 inch dia. copper-clad steel/copper rod earth electrode, minimum 3.0 m / 10 ft long, driven or lowered up to 100 ft depth or up to permanent water level as shown on drawings and as directed by the Engineer, including boring, lowering, backfilling/treatment of bore, brass/tinned copper clamp, copper lugs, thimbles, nuts, bolts, washers, earth connecting point, inspection/testing arrangement, and connection with 2 × 25 sq.mm PVC insulated copper earth cables laid in 1-1/2 inch dia. G.I. pipe (Electrical Class), complete with excavation, pipe sleeves, supports, clamps, jointing, protection, restoration, testing of earth resistance, continuity testing, and all accessories and incidental works required for a complete functional earthing system. (For Low Voltage & LAN / Data Equipments) REF: Technical Specifications Section - 0490, Section - 0620	1.00	Each	Not Applicable		
E-10.03	Supply and installation of Earth Strips of Size 25x3 mm sq with brass nuts & bolts fitted on cable trays as specified by Engineer Incharge. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0640, Section - 0590	1,800.00	Rft	Not Applicable		
E-10.04	Supply and installation of Earth connecting points comprising of 2”x9”x½” (Width x Length x Thickness) copper plate with brass nuts & bolts fitted on M.S. bracket installed on walls / columns. REF: Technical Specifications Section - 0490	13.00	Each	Not Applicable		
E-10.05	Supply & Installation of following sizes of PVC insulated green color single core copper conductor cables to be drawn in given PVC / M.S. conduits or laid in cable trays or installed on vertical surfaces complete with cable lugs, ties, P.G. clamps markers and accessories as required complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0640, Section - 0590					
E-10.05-1	i) 25mm2. REF: Technical Specifications Section - 0490	150.00	Rft	Not Applicable		
E-10.05-2	ii) 70mm2. REF: Technical Specifications Section - 0490	1,560.00	Rft	Not Applicable		
E-11.01	Wiring for each proximity card reader to be installed on walls with 4 pair Cat. 6, UTP cable with pure copper conductor PVC insulated PVC sheathed in and including cost of 1" dia PVC conduit recessed in walls, columns, slabs, floors or above false ceiling with all necessary fixing accessories as required as per site condition, including cost of all PVC conduit accessories, pull boxes, steel pull wires, powder coated, M.S junction boxes 16 SWG of size 4"x4" with 2 coats of powder coating of orange colour, including cost of all necessary accessories and materials, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0610, Section - 0650, Section - 0790, Section - 0640	540.00	Rft	Not Applicable		
E-11.02	Providing, supplying, installation, laying, dressing, termination, testing and commissioning of wiring/cabling for each emergency push button of Access Control System, using 4-pair Cat. 6 UTP cable with 100% pure copper conductor, drawn through concealed/surface conduit, trunking, cable tray or approved raceway from the emergency push button location up to the access control panel / door controller / nearest approved termination point, including RJ45 / IDC termination, ferrules, tags, labels, sleeves, connectors, cable ties, saddles, pull boxes, junction boxes, glands, supports, fixing accessories, continuity testing, identification, dressing and all necessary accessories and incidental works required for a complete functional wiring installation. REF: Technical Specifications Section - 0490, Section - 0650, Section - 0790	3.00	Nos.	Not Applicable		
E-11.03	Providing, supplying, installation, laying, dressing, termination, testing and commissioning of wiring/cabling for each magnetic drop bolt door lock of Access Control System, using 4-pair Cat. 6 UTP cable with 100% pure copper conductor, drawn through concealed/surface conduit, trunking, cable tray or approved raceway from the magnetic drop bolt lock location up to the access control panel / door controller / power supply unit / nearest approved termination point, including termination at both ends, ferrules, tags, labels, sleeves, connectors, cable ties, saddles, pull boxes, junction boxes, glands, supports, fixing accessories, continuity testing, identification, dressing and all necessary accessories and incidental works required for a complete functional wiring installation. REF: Technical Specifications Section - 0490, Section - 0650, Section - 0790	3.00	Nos.	Not Applicable		

E-11.04	Supply at site, installation, testing and commissioning of RFID Card Reader 125KHz, (for outside door) reading range 6", operating at low voltage DC supply, with mounting base suitable for interior and exterior environment with Door Interface Unit (DIU), dual color LED and speaker for comprehensive audible feedback to user. REF: Technical Specifications Section - 0490, Section - 0790	3.00	Nos.	Not Applicable		
E-11.05	Supply at site, installation, testing and commissioning of Push Button (Exit Switch) suitable for installation on BS standard size back box connected to door controller for access. REF: Technical Specifications Section - 0490, Section - 0600	3.00	Nos.	Not Applicable		
E-11.06	Supply at site, installation, testing and commissioning of Proximity Cards ISO bar code card standard size and thickness, thin, flexible polyvinyl chloride laminated, passive type, easy printable on both sides. REF: Technical Specifications Section - 0490	30.00	Nos.	Not Applicable		
E-11.07	Supply at site, installation, testing and commissioning of following Magnetic Drop Bolt Lock with holder and fixing accessories, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0790					
E-11.07-1	Single Door. REF: Technical Specifications Section - 0490	2.00	Nos.	Not Applicable		
E-11.07-2	Double Door. REF: Technical Specifications Section - 0490	1.00	Nos.	Not Applicable		
E-11.08	Supply at site, installation, testing and commissioning of 4 door controller with Dp fixing accessories,and integrated with Fire Alarm system complete in all respects. REF: Technical Specifications Section - 0490, Section - 0660	5.00	Nos.	Not Applicable		
E-11.09	Supply, installation, configuration, testing and commissioning of Access Control and Time Management Software / Headend Management Software for the complete Access Control System, including licensed software, database setup, user and administrator logins, password-protected role-based access, cardholder enrolment and management, time-zone and access-level scheduling, attendance/time management module, alarm and event monitoring, full alarm and event processing, multi-user / multi-division support, audit trail and event history records, report generation, system backup and restore facility, and integration/interface with access control panels, card readers, emergency release, door locks, fire alarm interface, CCTV alarm call-up and other associated systems where applicable. The item shall include supply of genuine licensed software, installation on the approved workstation/server, software activation, configuration of doors, users, groups, cardholders, access levels, alarm priorities, event logs, SMS/call alert configuration where supported by the system/OEM, testing of all software functions, demonstration to the Engineer/Employer, training of operator staff, submission of software license keys, administrator credentials, configuration backup, O&M manuals and all necessary accessories, tools, patching, programming and incidental works required to make the Access Control and Time Management System complete, operational and ready for use. Complete in all respects as shown on drawings, as specified, as per manufacturer's recommendations and as directed by the Engineer. REF: Technical Specifications Section - 0490, Section - 0790	1.00	Job	Not Applicable		
E-11.1	Supply, installation, configuration, testing and commissioning of operator workstation / desktop computer for Access Control and Security Control System, comprising ultra-slim desktop PC with Intel Core i7 processor or approved equivalent, minimum 8 GB RAM, 2 TB HDD / approved storage, DVD writer where required, genuine Windows Professional 64-bit operating system, keyboard, mouse, display interface, network interface, power cords, required software drivers, antivirus/security utility where applicable, and all necessary accessories required for complete operation of the Access Control and Time Management Software. The item shall include installation of the operating system, device drivers, access control/time management software client or server application as applicable, network configuration, IP addressing, user account setup, connection with access control panels/server/network switches, testing of communication with the access control system, verification of event monitoring, report generation, data backup arrangement, handover of genuine licenses, passwords/credentials, manuals, warranty documents and operator training. Complete with unpacking, placement, fixing/installation at approved location, power and network connection, testing, commissioning and successful demonstration of the workstation with the Access Control / Security Control System, complete in all respects as shown on drawings, as specified and as directed by the Engineer. REF: Technical Specifications Section - 0490	1.00	Job	Not Applicable		

E-11.11	Supply at site, installation of PVC conduit heavy duty buried under ground or as required as per site conditions including cost of all PVC conduit accessories, steel pull wires, all necessary accessories and materials complete in all respect. REF: Technical Specifications Section - 0490, Section - 0610					
E-11.11-1	1" dia. PVC conduit. REF: Technical Specifications Section - 0490, Section - 0610	540.00	Rft.	Not Applicable		
E-11.12	Supply, installation of Access Control Junction boxes 16 SWG to be concealed in wall with 2 coats of anti rust paint, earthing terminal, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0620, Section - 0790, Section - 0640					
E-11.12-1	Access Control Junction Box 4" x 7" x 4" deep. REF: Technical Specifications Section - 0490, Section - 0790, Section - 0640	1.00	Nos.	Not Applicable		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

E-11.13	Programming, configuration, integration, testing, commissioning, demonstration and staff training for the complete Electronic Access Control System integrated with the Building Management System (BMS), including configuration of all access-controlled doors, door controllers, card readers, emergency release / emergency push buttons, magnetic locks / drop bolts, door position contacts, request-to-exit devices, alarm inputs, access levels, time zones, user/cardholder database, alarm priorities, event logs, audit trail, operator rights, password-protected access and system reporting. The scope shall include complete software and controller programming, point-to-point testing of all field devices, verification of communication between access control panels, head-end software, workstation and BMS, integration of door status, lock status, alarm / forced-door / door-held-open signals and other approved monitoring points with BMS for read-only status display and alarm monitoring, coordination with Fire Alarm System interface for automatic door release where applicable, and testing of all access control functions in the presence of the Engineer / Site Engineer. The item shall also include preparation and submission of approved testing and commissioning procedures, I/O point list, BMS integration point schedule, cause-and-effect matrix, as-built configuration backup, test reports, commissioning certificates, operator manuals, administrator credentials and final handover documents. Complete in all respects, including all programming tools, software configuration, testing instruments, specialist engineer attendance, coordination with BMS vendor / system integrator, demonstration and rectification of programming deficiencies until the complete Access Control System and BMS interface are fully operational and accepted by the Engineer. REF: Technical Specifications Section - 0490, Section - 0790, Section - 0880	1.00	Job	Not Applicable		
E-12.01	Supply, Installation & Programming of centralized, IP-based Integrated Building Management System with HVAC, lighting, fire alarms, access control, and CCTV. Including CPU , Mod Bus Communication Port/Bacnet with all accessories, complete in all respects. REF: Technical Specifications Section - 0490, Section - 0660, Section - 0790, Section - 0880	1.00	Job	Not Applicable		
E-13.01	Supply & Installation of Monocrystalline PV modules 250 kW with mounts, sensors, accessories, Cables 25mm sq, Hybrid Inverter linking of Solar PV system with Electrical Synchronizing and Load Sharing Panel with 2 Hrs Backup Time or vary as per site condition with lithium batteries as per solar vendor specification provided,complete in all respect. REF: Technical Specifications Section - 0490, Section - 0570, Section - 0870	1.00	Job	Not Applicable		
E-14	ELEVATORS Lift Type: Traction Type Passenger Lifts Brand Name : OTIS , DOPPLER , KONE , THYSSENKRUPP, SCHINDLER Country of Origin: WESTERN , EUROPE.					
E-14.01	Supply of imported brand new Duplex Elevator, Machine Room Less (MRL Type), heavy duty fully complied and certified by EN 81-20, EN 81-50 and EN 81-70 Standards of minimum features including but not limited to VVVF high efficiency motor, complete inside stainless steel finish,indoor type for ambient condition of 45 °C, capacity of 1000 kg, Cabin Size 1600×1400×2300 (W×D×H) speed, 1 m/s, 11 stops/11 openings, approx. total travel height 42 meter . entrance 900 mm. Lift shall minimum includes car, hoisting machinery, counter-weight, supports, brackets, automatic controls,embedded parts, access ladder, separator screen & trap door, electric overload, shaft lightening, intercom system, gong, emergency operation for cabin/door, emergency rescue device (ups/battery) safety devices & Manual emergency operation lever, all essential spare parts for use for one (01) years of defect liability period complete in all respects as per specification & Drawings and according to EN 81 standard compliance.All taxes/duties shall be included.	2.00	Each	[Up to 80% Allowed]		
E-14.02	Spare Parts for use of 1 year's lifts operation	2.00	Each	Not Applicable		
E-14.03	Installation, testing, and commissioning of imported brand new Duplex Elevator, Machine Room Less (MRL Type),capacity of 1000 kg, Cabin Size 1600×1400×2300 (W×D×H) speed 1 m/s, 11 stops/ 11 openings, approx. total travel height 42 meter . entrance 900 mm. heavy duty fully complied and certified by EN 81-20, EN 81-50 and EN 81-70.	2.00	Each	Not Applicable		
E-14.04	Civil and Allied Works relevant to necessary adjustments which will be required during installation of new equipment. (door chisling, door filling, holes for display & call buttons)	2.00	Each	Not Applicable		

E-14.05	Electrical & Ancillary Works for elevator, fan & AC including outside DB to elevator, breakers cabling and other accessories etc. (Complete in all respect).	2.00	Each	Not Applicable		
E-14.06	Supply and installation of 2 TR cooling capcity air conditioner (AC) for elevator shaft. (Make;Trane/Mitsubishi/Samsung only) AC shall be operatble at ambient temperature of 50°C.	2.00	Each	Not Applicable		
E-14.07	Supply and installation of exhaust fan propeller type of size 800 CFM	2.00	Each	Not Applicable		
E-14.08	Pre-Shipment inspection at factory in country of origin, including boarding, loadging, hotel stay and food (03 inspectors, 05 Nights stay, business class tickets)	1.00	Job	Not Applicable		
E-14.09	Third party validation for Testing & commissioning of elevator in Pakistan	4.00	Each	Not Applicable		
E-14.10	Provision of comprehensive Operation and Maintenance (O&M) services for the installed lifts/elevators for a period of one (01) year, including preventive maintenance, corrective maintenance, routine inspection, lubrication, adjustment, cleaning, breakdown attendance, emergency service, testing, troubleshooting, supply and replacement of all required spare parts and consumables, and deployment of at least one qualified lift technician at site as required for smooth and safe operation. The scope shall include maintenance of lift machine, controller, VVVF drive, doors, door operator, guide rails, ropes/belts, safety devices, indicators, push buttons, interlocks, emergency alarm/communication system and all associated lift components, complete with service records, maintenance logbook, test reports and coordination with OEM/authorized lift supplier. Complete in all respects as per manufacturer's recommendations, Technical Specifications and directions of the Engineer. REF: Technical Specifications Section - 0490, Section - 0690	12.00	Month	Not Applicable		
					Total Amount (Rs)	**0.00**

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N0.	DESCRIPTION (& CODE)	Qty.	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
1	*2*	*3*	*4*	*(5)*	*(6)*	*(7) = [(5)*280]+(6)]*(3)*
M.1	Providing, supplying at site, installation, testing, commissioning and performance verification of Floor-Standing, Forced-Draft, Fire-Tube type dual-fuel (LDO/LPG) Hot Water Generator of minimum 450 kW net output each, complete with burner, operating/safety controls and devices, flue/breaching and fuel connections, insulation, vibration isolation, foundation/support interface, power and control wiring terminations, and all incidental and ancillary works necessary for a complete, functional and operational installation, in accordance with the approved shop drawings and Technical Specification Section. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0150	3.00	Each	[Up to 80% Allowed]		
M.2	Providing, supplying, installing, testing, commissioning and performance verification of factory-assembled, high-efficiency, VFD-controlled, water-cooled electric screw chillers (CH-1 & CH-2), minimum 527 kW cooling capacity each, complete with screw compressors, evaporator, condenser, refrigerant circuit, microprocessor controls, starters, vibration isolators, rigging, piping and electrical terminations, control integration, and all accessories and incidental works, complete in all respects in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550	2.00	Each	[Up to 80% Allowed]		
M33	Providing, supplying, installation, testing and commissioning of Closed-Circuit Cooling Tower (CT) , induced draft cross-flow type, 3-cell assembly (2 Duty + 1 Standby) , with minimum 650 kW heat rejection per cell capacity, complete with heat exchange coils, fans, motors, basins, drift eliminators, VFD controls, spray pumps, all internal piping, supports, isolators, terminations, and all ancillary works for a fully operational system, per Technical Specifications and complete in all respects. Technical Specifications Section - 0720, Section - 0010. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	1.00	Each	[Up to 80% Allowed]		
M.4	Providing, supplying, installing, testing and commissioning of end-suction centrifugal Chilled Water Pump (CHWP), Minimum 567 L/min capacity at 400 kPa head, complete with VFD-compatible motor, common base frame, flexible coupling, coupling guard, vibration isolators, VFD, controls, piping and electrical connections, and all accessories and incidental works, complete in all respects in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	2.00	Each	Not Applicable		

M.5	Providing, supplying, installation, testing and commissioning of end-suction centrifugal, common-base mounted Condenser Water Pump-Motor sets (CWP), VFD-compatible, minimum 1,740 L/min discharge at 320 kPa head, complete with couplings, coupling guards, base frames, vibration isolators, VFDs/controls and accessories; including alignment, piping and electrical terminations, and all incidental and ancillary works for a complete, operational installation, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	2.00	Each	Not Applicable		
M.6	Providing, supplying, installing, testing and commissioning of end-suction centrifugal Hot Water Pump (HWP), Minimum 567 L/min capacity at 400 kPa head, complete with VFD-compatible motor, common base frame, flexible coupling, coupling guard, vibration isolators, VFD, controls, piping and electrical connections, and all accessories and incidental works, complete in all respects in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550, Section - 0880	2.00	Each	Not Applicable		
M.7	Providing, supplying at site, installation, testing and commissioning of complete Closed-Loop Water Treatment and Chemical Feeding System comprising chemical dosing pumps, corrosion/scale inhibitor feeders, pot feeder, water quality monitoring/sampling equipment and accessories; including initial system charging/passivation, chemical dosing schedule, alignment, piping and electrical terminations, and all incidental and ancillary works for a complete, operational installation, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Lot	Not Applicable		
M.8	Providing, supplying, installing, testing and commissioning of Cooling Water Treatment and Feeding System for cooling towers, complete with chemical dosing package, dosing pumps, chemical tank, water quality monitoring and bleed control equipment, initial chemical charging, piping, controls, electrical connections, and all accessories required for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Lot	Not Applicable		
M.9	Providing, supplying at site, installation, testing and commissioning of complete packaged Glycol Make-up and Feed System for initial system filling, pressurization and automatic make-up of closed-loop hot water systems operating in low ambient conditions, complete with glycol concentrate, pumps, storage tank, controls, initial fill and all accessories, including all incidental and ancillary works necessary for a complete and operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0850	1.00	Each	Not Applicable		
M.10	Providing, supplying at site, installation, testing and commissioning of the following auxiliary equipment for the Central Plant Room (CPR), in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720			Not Applicable		

M.10-1	Factory-packaged automatic Pressurization System for closed-loop chilled/hot water hydronic network, comprising duplex pressurization pumps (lead/lag auto alternation), ASME-rated bladder-type Expansion Tank, Air & Dirt Separator, make-up water assembly (PRV, backflow preventer, solenoid valve), safety relief valve, pressure transmitters, and control panel with BAS interface and leak/abnormal make-up alarm; including piping and electrical terminations, testing, commissioning and all incidental and ancillary works, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	1.00	Lot	Not Applicable		
M.10-2	Complete Light Diesel Oil (LDO) underground storage and distribution system comprising double-wall underground storage tank (min. 100-hour continuous full-load capacity) with interstitial leak monitoring and cathodic protection, duplex transfer pumps, indoor insulated day tank (min. 8-hour capacity) with high/low/high-high alarms, heat-traced fuel piping network (-18°C rated) with insulation, fuel filtration, valves, controls, BMS integration, excavation, backfilling, foundations, testing and commissioning, complying with NFPA 30/31, API 650, UL 58, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0150	1.00	Lot	Not Applicable		
M.10-3	Self-regulating parallel-resistance electric heat tracing cable (min. 15–25 W/m) for hot water pipe network freeze protection, maintaining minimum +5°C pipe temperature at -18°C ambient, complete with fluoropolymer jacket, fixing by aluminum adhesive tape, power connection kits, end seals/splice kits, thermostatic controller (energize +4°C/de-energize +10°C), local disconnect, ground fault protection, BMS alarm contacts, weatherproof insulation cladding and all accessories, testing, commissioning and all incidental and ancillary works, per Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Lot	Not Applicable		
M-11	Providing, supplying at site, installation, testing, commissioning and performance verification of chilled/hot water Fan Coil Units, complete with dual-suction multi-blade fan, modulating water control valve, local/centralized controller, drain pan and piping connections, insulation, hangers/supports and all accessories, including all incidental and ancillary works for a complete and operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.11-1	Fan Coil Unit, Code-AA, minimum 4.0 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	3.00	Each	[Up to 80% Allowed]		
M.11-2	Fan Coil Unit, Code-A, minimum 5.7 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	25.00	Each	[Up to 80% Allowed]		
M.11-3	Fan Coil Unit, Code-B, minimum 7.0 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	21.00	Each	[Up to 80% Allowed]		
M.11-4	Fan Coil Unit, Code-C, minimum 10.5 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	26.00	Each	[Up to 80% Allowed]		
M.11-5	Fan Coil Unit, Code-D, minimum 14.5 kW cooling capacity. REF: Technical Specifications Section - 0710, Section - 0720	26.00	Each	[Up to 80% Allowed]		

M.12	Providing, supplying, installing, testing, commissioning and performance verification of DX ducted split air-conditioning units, complete with inverter-driven compressor, indoor and outdoor units, factory controls, refrigerant piping, condensate drain piping, insulation, supports, electrical and control connections, refrigerant charging, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.12-1	Room Inverter Split Unit (RSU + CU), ducted ceiling-concealed type, nominal cooling capacity 3 TR. REF: Technical Specifications Section - 0710, Section - 0720	6.00	Each	Not Applicable		
M.13	Providing, supplying, installing, testing, commissioning and performance verification of Dedicated Outdoor Air System (DOAS) air handling units, 100% outdoor air, heat recovery type, complete with EC supply and exhaust fans, plate heat exchanger, chilled/hot water coils, filters, dampers, controls, drain pan, casing, piping, electrical connections, vibration isolators, supports, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.13-1	DOAS AHU-1 (TFAU-1) - 400 L/s airflow, minimum cooling capacity 12.0 kW. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	[Up to 80% Allowed]		
M.13-2	DOAS AHU-2 (TFAU-2) - 550 L/s airflow, minimum cooling capacity 15.0 kW. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	[Up to 80% Allowed]		
M.13-3	DOAS AHU-3 (TFAU-3) - 2,200 L/s airflow, minimum cooling capacity 55.0 kW. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	[Up to 80% Allowed]		
M.14	Providing, supplying, installing, testing, commissioning and performance verification of Fans and Ventilation Systems, complete with motors, controls, vibration isolators, supports, electrical connections, backdraft dampers, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.14-1	Exhaust Fan EF-GF-1, 1000 CFM @ 1" w.g. ESP. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.14-2	Exhaust Fan EF-F-1, 1500 CFM @ 1" w.g. ESP. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.14-3	Exhaust Fan EF F-2 (1400 CFM @ 1" ESP) REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.14-4	Exhaust Fan EF F-3, kitchen exhaust fan suitable for grease-laden and hot air service (2000 CFM @ 1.5" w.g. ESP) REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.14-5	Vehicle Exhaust Ventilation System (LEV), complete with ductwork, retractable nozzles, hose-reel with pipe/snorkel and extraction fan, including controls, testing, commissioning and all incidental and ancillary works necessary for a complete and operational installation, in accordance with Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0830	1.00	Lot	Not Applicable		

M.14-6	Staircase Pressurization System, comprising 2 fans (1 duty + 1 standby), complete standalone system with controls and pressure sensors, integrated with BMS, including testing, commissioning and all incidental and ancillary works necessary for a complete and operational installation, in accordance with Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Lot	Not Applicable		
M.14-7	Supply Air Fan for CPR, wall mounted type (SF) REF: Technical Specifications Section - 0710, Section - 0720	4.00	Each	Not Applicable		
M.14-8	Energy Recovery Ventilator, 80% efficiency, 1500 CFM, with supply and exhaust fans and plate type heat exchanger. REF: Technical Specifications Section - 0710, Section - 0720	3.00	Each	Not Applicable		
M.15	CHILLED/HOT WATER PIPING WITH FITTINGS Providing, laying, jointing, testing and commissioning of Polypropylene (PP-R / PP-RP (RCT)) pipes and fittings, manufactured from virgin Fusiolen resin with no recycled content, complying with ASTM F2389, CSA B137.11 and ASTM D2774, in SDR 7.4 / 9 / 11 / 17.6 as per manufacturer's instructions, with hydronic hot water/heating lines incorporating a fiber (faser) layer to limit thermal expansion, complete with fittings, fusion jointing, hangers, supports, sleeves and all accessories, backed by manufacturer's 10-year material warranty with Engineer's approvals, including pressure testing, flushing and all incidental and ancillary works,in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.15-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	250.00	RFT	Not Applicable		
M.15-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	800.00	RFT	Not Applicable		
M.15-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	950.00	RFT	Not Applicable		
M.15-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	800.00	RFT	Not Applicable		
M.15-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	980.00	RFT	Not Applicable		
M.15-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	50.00	RFT	Not Applicable		
M.15-7	3" dia. REF: Technical Specifications Section - 0710, Section - 0720	1,200.00	RFT	Not Applicable		
M.15-8	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	750.00	RFT	Not Applicable		
M.15-9	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	750.00	RFT	Not Applicable		
M.15-10	6" dia. REF: Technical Specifications Section - 0710, Section - 0720	250.00	RFT	Not Applicable		
M.16	CONDENSATE DRAIN PIPING - uPVC CLASS E (SCHEDULE 40) Providing, laying, jointing, testing and commissioning of uPVC (unplasticized polyvinyl chloride) Class E/Schedule 40 piping of nominal diameters below, including cost of solvent cement and specials, hangers, supports and all accessories, complete as approved and directed by the Engineer, in accordance with Technical Specification. REF: Technical Specifications Section - 0710, Section - 0720					

M.16-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	290.00	RFT	Not Applicable		
M.16-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	394.00	RFT	Not Applicable		
M.16-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	1,250.00	RFT	Not Applicable		
M.16-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	280.00	RFT	Not Applicable		
M.17	GALVANIZED STEEL PIPE (BS 1387), Providing, supplying, laying, jointing, testing and commissioning of galvanized steel piping, complete with fittings, unions, supports, sleeves, testing and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.17-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	10.00	RFT	Not Applicable		
M.17-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	20.00	RFT	Not Applicable		
M.17-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	30.00	RFT	Not Applicable		
M.17-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	25.00	RFT	Not Applicable		
M.17-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	20.00	RFT	Not Applicable		
M.18	Providing, laying, jointing, testing and commissioning of ¼" dia. hard-drawn copper pipe, ASTM B88 Type L, internally chemically cleaned, with brazed fittings (inert gas purged), hangers, supports and all accessories. REF: Technical Specifications Section - 0710, Section - 0720	20.00	RFT	Not Applicable		
M.19	VALVES AND SPECIALTIES Providing, supplying, installing, testing and commissioning of valves and piping specialties of the types and sizes specified below, complete with companion flanges, unions, gaskets, bolts, supports, identification tags, testing and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-1	Gate Valves. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-1-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	120.00	Each	Not Applicable		
M.19-1-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	80.00	Each	Not Applicable		
M.19-1-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	5.00	Each	Not Applicable		
M.19-1-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-1-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-1-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		

M.19-1-7	3" dia. REF: Technical Specifications Section - 0710, Section - 0720	4.00	Each	Not Applicable		
M.19-1-8	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	9.00	Each	Not Applicable		
M.19-1-9	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	18.00	Each	Not Applicable		
M.19-2	Balancing Valves. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-2-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	60.00	Each	Not Applicable		
M.19-2-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	35.00	Each	Not Applicable		
M.19-2-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-2-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-2-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-2-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.19-2-7	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-2-8	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	4.00	Each	Not Applicable		
M.19-3	Y-Strainers. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-3-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	60.00	Each	Not Applicable		
M.19-3-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	30.00	Each	Not Applicable		
M.19-3-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-3-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-3-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	3.00	Each	Not Applicable		
M.19-3-6	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-3-7	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	4.00	Each	Not Applicable		
M.19-4	Flexible Joints. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-4-1	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	4.00	Each	Not Applicable		
M.19-4-2	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	16.00	Each	Not Applicable		
M.19-5	Check Valves. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-5-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	45.00	Each	Not Applicable		

M.19-5-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	65.00	Each	Not Applicable		
M.19-5-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	5.00	Each	Not Applicable		
M.19-5-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.19-5-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Each	Not Applicable		
M.19-5-6	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.19-5-7	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	4.00	Each	Not Applicable		
M.19-6	Ball Valves / Drain Cocks. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-6-1	1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	20.00	Each	Not Applicable		
M.19-6-2	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	15.00	Each	Not Applicable		
M.19-6-3	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	10.00	Each	Not Applicable		
M.19-7	Automatic Air Vents. REF: Technical Specifications Section - 0710, Section - 0720					
M.19-7-1	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	8.00	Each	Not Applicable		
M.20	Providing, supplying, fabricating, installing, testing and commissioning of galvanized steel ductwork, complete with fittings, flanges, flexible connections, volume control dampers, access doors, hangers, supports, sealants, stiffeners, acoustic lining (where specified), leakage testing, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	18,000.00	Sqft	Not Applicable		
M.21	Providing, supplying at site, fabrication and installation of welded steel Breaching/Flue Stack for Hot Water Generator, minimum 6mm thick plate conforming to ASTM A36 or A283, complete with structural angle flanges at breaching and HWG connections, flue collar interface, supports, joints, stack termination,ealing, access provisions, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	800.00	SFT	Not Applicable		
M.22	FLEXIBLE ROUND DUCT Providing, supplying and installing insulated flexible round duct, complete with factory-applied vapour barrier, clamps, take-offs, connectors, hangers, supports, sealants and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.22-1	6" dia. REF: Technical Specifications Section - 0710, Section - 0720	100.00	RFT	Not Applicable		
M.22-2	8" dia. REF: Technical Specifications Section - 0710, Section - 0720	150.00	RFT	Not Applicable		

M.22-3	10" dia. REF: Technical Specifications Section - 0710, Section - 0720	80.00	RFT	Not Applicable		
M.22-4	12" dia. REF: Technical Specifications Section - 0710, Section - 0720	20.00	RFT	Not Applicable		
M.23	Providing, supplying and installing closed-cell elastomeric thermal insulation for piping, ductwork and equipment, complete with adhesive, vapour barrier sealing, insulation inserts, jackets/protection (where specified), finishing, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	12,000.00	Sqft	Not Applicable		
M.24	INSULATION Providing, supplying and installing thermal and acoustic insulation for ductwork, piping and equipment, complete with adhesives, vapour barriers, protective jacketing/cladding, finishing, supports and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.24-1	1" Glass Fibre Blanket (0.75 lbs/ft³) + 4-Oz Aluminum Canvas Insulation for indoor supply/return air ducts concealed from vision and outdoor air ducts passing through conditioned space. REF: Technical Specifications Section - 0710, Section - 0720	13,500.00	SFT	Not Applicable		
M.24-2	1" Glass Fibre Blanket (0.75 lbs/ft³) + 8-Oz Aluminum Canvas Insulation for indoor supply/return air ducts exposed to vision and in plant rooms, including protection. REF: Technical Specifications Section - 0710, Section - 0720	500.00	SFT	Not Applicable		
M.24-3	1.5 lbs/ft³ Fibre-Glass with Neoprene Scrim Acoustic liner on supply air ducts and sheet metal air plenums. REF: Technical Specifications Section - 0710, Section - 0720	800.00	SFT	Not Applicable		
M.24-4	2" Mineral wool (rock wool) blanket, minimum density 6 lb/ft³ with 24-gauge aluminum jacket Insulation for flue stack. REF: Technical Specifications Section - 0710, Section - 0720	800.00	SFT	Not Applicable		
M.24-5	1" Closed-Cell Elastomeric Foam Insulation for indoor chilled/hot water piping, fittings, accessories and valves. REF: Technical Specifications Section - 0710, Section - 0720					
M.24-5-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	250.00	RFT	Not Applicable		
M.24-5-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	800.00	RFT	Not Applicable		
M.24-5-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	950.00	RFT	Not Applicable		
M.24-5-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	800.00	RFT	Not Applicable		
M.24-5-5	2" dia. REF: Technical Specifications Section - 0710, Section - 0720	980.00	RFT	Not Applicable		
M.24-5-6	2-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	50.00	RFT	Not Applicable		
M.24-5-7	3" dia. REF: Technical Specifications Section - 0710, Section - 0720	1,200.00	RFT	Not Applicable		

M.24-5-8	4" dia. REF: Technical Specifications Section - 0710, Section - 0720	750.00	RFT	Not Applicable		
M.24-5-9	5" dia. REF: Technical Specifications Section - 0710, Section - 0720	750.00	RFT	Not Applicable		
M.24-5-10	6" dia. REF: Technical Specifications Section - 0710, Section - 0720	250.00	RFT	Not Applicable		
M.24-6	1/8" Self-Adhesive Vinyl Aluminum Foam Tape Insulation for cooling coil condensate drain piping, including fittings and accessories. REF: Technical Specifications Section - 0710, Section - 0720					
M.24-6-1	3/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	380.00	RFT	Not Applicable		
M.24-6-2	1" dia. REF: Technical Specifications Section - 0710, Section - 0720	231.00	RFT	Not Applicable		
M.24-6-3	1-1/4" dia. REF: Technical Specifications Section - 0710, Section - 0720	650.00	RFT	Not Applicable		
M.24-6-4	1-1/2" dia. REF: Technical Specifications Section - 0710, Section - 0720	20.00	RFT	Not Applicable		
M.24-7	1" Closed-Cell Elastomeric Foam Insulation for Expansion Tank. REF: Technical Specifications Section - 0710, Section - 0720	1.00	LOT	Not Applicable		
M.24-8	1" Closed-Cell Elastomeric Foam Insulation for Air Separator. REF: Technical Specifications Section - 0710, Section - 0720	1.00	LOT	Not Applicable		
M.24-9	1" Removable Closed-Cell Elastomeric Jackets Insulation for Pumps. REF: Technical Specifications Section - 0710, Section - 0720	6.00	Each	Not Applicable		
M.24-10	1" Polyethylene (PE) Foam (0.040 W/m·K) Insulation for Chiller-Heaters. REF: Technical Specifications Section - 0710, Section - 0720	2.00	Each	Not Applicable		
M.25	Providing, supplying and installing Manual Volume Control Dampers (VCD), complete with galvanized steel frame, opposed-blade damper assembly, locking quadrant with engraved graduated position indicator (0–100% open), operating linkage, bearings, sleeves, fixing hardware, testing, commissioning, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	150.00	SFT	Not Applicable		
M.26	Providing, supplying and installing Fire Dampers (FD), complete with galvanized steel sleeve, retaining angles, fusible link, access door, breakaway duct connection, fixing hardware, testing, commissioning, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	50.00	SFT	Not Applicable		
M.27	Providing, supplying and installing flexible duct connections for vibration isolation, complete with fire-retardant flexible fabric, galvanized steel fixing frames, clamps, fasteners, sealants, and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	76.00	RFT	Not Applicable		

M.28	AIR TERMINAL DEVICES (measurement on SFT of neck area) Providing, supplying, installing, testing, adjusting and balancing of aluminium air terminal devices, complete with powder-coated finish, fixing frames, gaskets, opposed-blade dampers (where applicable), fixing hardware and all accessories necessary for a complete operational installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.28-1	Supply Air Grille (CODE-I), double deflection type, extruded aluminum construction, complete with opposed blade damper. REF: Technical Specifications Section - 0710, Section - 0720	680.00	SFT	Not Applicable		
M.28-2	Filter Back Return Grille (CODE-J), extruded aluminum construction, complete with hinged filter access door, 1" washable filter, opposed blade damper. REF: Technical Specifications Section - 0710, Section - 0720	700.00	SFT	Not Applicable		
M.28-3	Fresh Air Louvers, extruded aluminium weatherproof drainable type with bird/insect screen and washable filter. REF: Technical Specifications Section - 0710, Section - 0720	50.00	SFT	Not Applicable		
M.29	ELECTRICAL EQUIPMENT AND CONTROLS Providing, supplying, installing, testing, commissioning and performance verification of electrical equipment and controls for the HVAC system, complete in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720					
M.29-1	Motor Control Centres (MCCs) and Auxiliary Control Panels (ACPs), floor/wall-mounted, complete with Form-2 or higher compartmentalized enclosures, ACBs/MCCBs/MCBs, VFDs/soft starters (where specified), contactors, relays, meters, surge protection, control transformer, internal wiring, terminals, earthing, labels, BMS interface and all accessories. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0550	1.00	Lot	Not Applicable		
M.29-2	Complete HVAC electrical installation, excluding MCCs and ACPs, comprising power and control cabling, conduits, cable trays, trunking, junction boxes, isolators, earthing, equipment terminations, control wiring, BMS field wiring, testing, commissioning and all accessories for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Lot	Not Applicable		
M.30	AUTOMATION AND CONTROLS Providing, supplying, installing, programming, testing, commissioning and performance verification of the HVAC Building Automation System (BAS), complete in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880					
M.30-1	HVAC Building Automation System (BAS) with BACnet/IP protocol-compatible DDC controls, complete with controllers, operator workstation, software, graphics, licences, sensors, actuators, control valves, control dampers, BMS interfaces, networking, point-to-point testing, system integration and all accessories necessary for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	1.00	Lot	Not Applicable		

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M.30-2	Field installation works for the HVAC BAS, including control cabling, conduits, cable trays, junction boxes, field control panels, power supplies, mounting supports, equipment terminations, testing, commissioning and all accessories necessary for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	1.00	Lot	Not Applicable		
M.30-3	Temperature and pressure instrumentation, comprising thermometers, pressure gauges, thermometer wells, gauge cocks, siphons, isolation valves, fittings, supports, calibration, testing and all accessories necessary for a complete operational installation. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Lot	Not Applicable		
M.31	Providing and constructing reinforced concrete foundations, housekeeping pads, equipment supports, inertia bases, vibration isolators, anchor bolts, non-shrink grout, embedded steelwork, making good and all accessories necessary for complete installation of HVAC equipment, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880, Section - 0150	1.00	Job	Not Applicable		
M.32	Preparation, submission and revision of coordinated shop drawings, coordinated services drawings, and as-built drawings for the complete HVAC installation, Engineer's approvals and record documentation, in accordance with the Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Job	Not Applicable		
M.33	Providing surface preparation, painting, colour coding, tagging and identification of all HVAC equipment, piping and ductwork, complete with direction-of-flow arrows, valve tags, equipment labels, pipe markers and all accessories, in accordance with the approved shop drawings and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Job	Not Applicable		
M.34	Providing Testing, Adjusting and Balancing (TAB), commissioning and performance verification of the complete HVAC system, including complete system cleaning and flushing, pre-commissioning inspections, functional performance testing, air and water balancing using calibrated instruments, adjustment of control settings, submission of TAB and commissioning reports, demonstration of system performance, attendance during Engineer's inspections, and all incidental works necessary for successful acceptance of the installation, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720	1.00	Job	Not Applicable		
M.35	Providing comprehensive Operation and Maintenance (O&M) services for the complete HVAC installation for a period of 365 days from the date of Taking-Over by the Employer, measured on a monthly basis, including provision of qualified operating personnel for continuous daytime operation, preventive and corrective maintenance in accordance with OEM recommendations, lubrication, filter replacement, water treatment and chemical dosing, consumables, minor repairs, fault diagnosis and troubleshooting, tools and test instruments, training of the Employer's personnel, maintenance records, daily/weekly/monthly inspection reports, and all incidental works necessary to maintain the system in a safe, efficient and reliable operating condition, in accordance with the approved shop drawings, project design and Technical Specifications. REF: Technical Specifications Section - 0710, Section - 0720, Section - 0880	12.00	Months	Not Applicable		

Total Amount in Words=		TOTAL Rs.	0.00

1) This BOQ shall be read in conjunction with the Special Provisions, Technical Specifications, Equipment Schedules, Tender Drawings, Conditions of Contract, Employer Requirements , Approved Materials and Manufacturers Lists and all issued addenda.

2) BOQ descriptions are abbreviated and shall not limit the Contractor's obligation to provide complete and fully functional HVAC systems.

3) Rates shall include supply, delivery, storage, installation, testing, adjusting, balancing, commissioning, warranties, O&M manuals, training, as-built drawings and all accessories required for complete operation.

4) Contractor remains responsible for completeness of scope whether or not minor components are expressly identified in individual BOQ descriptions. All these items are on the bases of Supply, installation, testing, commissioning and performance verification complete , including, controls, connections, insulation and accessories in accordance with specifications and schedules. complete in all respect

5) Technical specification references within the item descriptions cite ONLY the documents attached to this tender: "Technical Provisions (ATCT-PAA/HVAC/TP)" - Sections 1 to 13 with Section 2 clauses numbered 2-01 to 2-32; "Special Provisions (ATCT-PAA/HVAC/SP)"; and the "HVAC Equipment Schedule (ATCT-PAA/HVAC/EQUIPMENT SCHEDULE)" - Schedules 1 to 6 plus the water coil schedules. References are for tendering assistance only; the full referenced documents, approved drawings and schedules shall govern. The REMARKS column identifies resolved items (green), pending decisions (yellow) and specification defects requiring addendum (red).

6) R5 note: all references to "Volume-II", four-digit section numbers (0010/0550/0680/0710/0720/0830/0840/0850/0880) and "Annex 2 (A2.x)" that appeared in the R3 draft have been removed - those designations do not exist in any document attached to this tender. Should the Employer issue a Volume-II master document set, citations may be re-indexed accordingly by addendum.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 7 - Plumbing & Fire Fighting Works

Abstract of Cost

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	(2)	(3)	(4)	(5)	(6)	(7) = [(5)*280]+(6)]*(3)
P.1-1	Providing and fixing best quality white glazed earthenware One Piece Toilet Commode MS-New Avante Wall Hung WC (For Seat & Cover Tc281sj#W) (White) i/c the cost of MS-Dual Push Plate (Square Button) (Silver) , MS-Concealed Tank Half Frame and MS-AP Series - Seat & Cover (Soft Closing Model) complete with and internal fittings etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0360	22.00	Nos	Not Applicable		
P.1-2	Cutting of R.C.C slab via core cutter of suitable diameter by using proper technique and equipment for the crossing of utility pipes and its waterproof refilling with useful materials complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	75.00	Nos	Not Applicable		
P.1-3	Providing & fixing best quality earthenware Vanity Basin MS-Square Under Counter (520 X 345 Mm) W/Bracket Tsp0225w (White) and including the cost of ME - Wall Mounted Single Lever Basin Mixer (Chrome) , 1 1/4" rubber plug and chrome plated brass chain pvc waste pipe 1-1/4" dia of approved pattern etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0360	16.00	Nos	Not Applicable		
P.1-4	Providing and fixing kitchen sink with mixer, waste coupling and tee stop cock including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	1.00	Nos	Not Applicable		
P.1-5	Providing and fixing chromium plated toilet paper holder including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	22.00	Nos	Not Applicable		
P.1-6	Providing and fixing looking glass 5mm thick first quality complete with fixing clamps including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	102.00	Sft	Not Applicable		
P.1-7	Providing and fixing of Wall Mounted Shower Set Complete MS-Round Wall Mounted Overhead Shower (220 Mm Dia) (Chrome) i/c the cost of MS-ME - Bath Spout (Chrome) and MS-ME - Concealed Single Lever Bath Mixer (Chrome) etc complete in all respects as per drawings and design approved by the Architect and Engineer-in-Charge. REF: Technical Specifications Section - 0360	18.00	Nos	Not Applicable		

P.1-8	Providing and fixing soap dish including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	14.00	Nos	Not Applicable		
P.1-9	Providing and fixing towel rod including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	14.00	Nos	Not Applicable		
P.1-10	Providing and fixing tap 3/4 inch dia including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360	8.00	Nos	Not Applicable		
P.2-1	Providing, fixing, jointing and testing Polypropylene Random (PPR) PN20 pressure pipe for cold, hot and hot water return water as per DIN 8077-8078 for pipes and DIN 16962,PN25 for fittings (polyfusion welded joints) inside building including fittings and specials (sockets, tees, elbows, bends, crosses, reducers, adaptor, plugs and union etc.) supported on walls or suspended from roof slab or run in chases including pipe hangers, supports, walls cutting for pipelines, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360, Section - 0480					
P.2-1-1	25 mm dia. REF: Technical Specifications Section - 0360	1,020.00	Rft.	Not Applicable		
P.2-1-2	32 mm dia. REF: Technical Specifications Section - 0360	750.00	Rft.	Not Applicable		
P.2-1-3	40 mm dia. REF: Technical Specifications Section - 0360	285.00	Rft.	Not Applicable		
P.2-1-4	50 mm dia. REF: Technical Specifications Section - 0360	320.00	Rft.	Not Applicable		
P.2-1-5	75 mm dia. REF: Technical Specifications Section - 0360	365.00	Rft.	Not Applicable		
P.2-2	Providing, fixing, jointing and testing medium gauge G.I pipes including fittings and specials (sockets, tees, elbows, bends, crosses, reducers, adaptor, plugs and union etc.) supported on walls or suspended from roof slab or run in chases including pipe clamps, pipe hangers, supports, walls cutting and core cutter for cutting of concrete slab with sealing and waterproofing with epoxy grouting for pipelines, thermal insulation with glasswool insulation 65kg/ m^3 density thickness 19 mm, GI 26 gauge cladding, complete in all respects. REF: Technical Specifications Section - 0360, Section - 0480					
P.2-2-1	2 inch dia. REF: Technical Specifications Section - 0360	80.00	Rft.	Not Applicable		
P.2-2-2	2-1/2 inch dia. REF: Technical Specifications Section - 0360	50.00	Rft.	Not Applicable		
P.2-3	Providing and installing gate/ball valves of following nominal dia, of approved make ,including jointing ,fitting, painting, testing, complete in all respects to match with following G.I pipe diameters. REF: Technical Specifications Section - 0440, Section - 0480					
P.2-3-1	2 inch dia. REF: Technical Specifications Section - 0360	4.00	Nos.	Not Applicable		
P.2-3-2	2-1/2 inch dia. REF: Technical Specifications Section - 0360	2.00	Nos.	Not Applicable		

P.3-1	Providing, fixing, jointing and testing uPVC Class-B pipe including all fittings such as tees, bends and reducers. Also it includes the cost of joint solutions & clamping to walls, ceiling hangers, supports, cutting through walls for pipelines and pipe fittings of the following diameters, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0430, Section - 0480-0360					
P.3-1-1	2" dia. REF: Technical Specifications Section - 0360	152.00	Rft.	Not Applicable		
P.3-1-2	4" dia. REF: Technical Specifications Section - 0360	1,450.00	Rft.	Not Applicable		
P.3-1-3	6" dia. REF: Technical Specifications Section - 0360	520.00	Rft.	Not Applicable		
P.3-1-4	8" dia. REF: Technical Specifications Section - 0360	823.00	Rft.	Not Applicable		
P.3-2	Providing and fixing 4" dia Floor Drain with P-trap including Stainless Steel grating and cover of approved make including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360					
P.3-2-1	P-Trap. REF: Technical Specifications Section - 0360	53.00	Nos.	Not Applicable		
P.4-1	Providing, placing sleeves and puddle flange in R.C.C. underground water tank walls, pipe connection (G.I) with inlet / outlet pipe work, manhole covers, floating ball valve etc, including all necessary accessories required for sleeves placing, complete in all respects. REF: Technical Specifications Section - 0450, Section - 0150, Section - 0145, Section - 0460, Section - 0440	1.00	Job	Not Applicable		
P.4-2	Providing, placing sleeves and puddle flange in R.C.C. overhead water tank walls, pipe connection (G.I) with inlet / outlet pipe work, manhole covers, floating ball valve etc, including all necessary accessories required for sleeves placing, complete in all respects. REF: Technical Specifications Section - 0450, Section - 0150, Section - 0145, Section - 0460, Section - 0440- 0360	2.00	Job	Not Applicable		
P.4-3	Providing, installing, testing and commission electric geyser of approved make, complete with inlet, outlet, safety valves complete in all respects. REF: Technical Specifications Section - 0440, Section - 0480					
P.4-3-1	30 Litres. REF: Technical Specifications Section - 0360	8.00	Nos.	Not Applicable		
P.5-1	Providing, installing, testing and commission, centrifugal pumps of make KSB, Grundfos or approved equivalent of capacity 100 gpm each with stainless steel impeller capable of pumping against a total pumping head of 120 ft approx. 5 HP. coupled with water cooled electric motor of 440 volts, 3 - phase, 50 Hz. The pump shall be provided with control panel having auto / manual switches, dry running protection, low / high level water controls with alternative standby duty operation system, complete in all respects. REF: Technical Specifications Section - 0470, Section - 0480	**2.00**	**Nos**	Not Applicable		
P.5-2	Supply and install Tube Well Bore Pump complete with the pump and motor cut-out switches for control panel enclosure, valves, water hammer arrestors and all accessories ready for operation.WTP 01 A/01B : Each 0.5 Cusec ,Head 300 feet approx. 17 HP. as per the Drawings, Specifications and Standards. REF: Technical Specifications Section - 0440, Section - 0470	2.00	Nos	Not Applicable		

P.5-3	Providing, Installing, test and commission non-clogging, centrifugal submersible drainage sump pump 50 gpm against a total pumping head of 25 ft (one running one standby). coupled with water cooled IP Class 68 electric motor of 400 volts, 3 - phase, 50 Hz. of approved make with auto / manual switches, dry running protection, low / high level water controls with alternative standby duty operation system), complete in all respects. REF: Technical Specifications Section - 0470	2.00	Set	Not Applicable		
P.6-1	Providing and fixing Mild Steel Schedule 40 Seamless Pipes including all fittings such as tees, bends and reducers with cost of Painting, clamping to walls and ceiling hangers, supports, cutting through walls and concrete in slabs with core cutter for pipelines and pipe fittings of the following diameters complete in all respect. REF: Technical Specifications Section - 0360					
P.6-1-1	1" dia (25mm) REF: Technical Specifications Section - 0360	4,100.00	Rft.	Not Applicable		
P.6-1-1	1-1/2" dia (40mm) REF: Technical Specifications Section - 0360	1,810.00	Rft.	Not Applicable		
P.6-1-1	2" dia (50mm) REF: Technical Specifications Section - 0360	620.00	Rft.	Not Applicable		
P.6-1-1	2-1/2" dia (63mm) REF: Technical Specifications Section - 0360	1,415.00	Rft.	Not Applicable		
P.6-1-1	3" dia (75mm) REF: Technical Specifications Section - 0360	535.00	Rft.	Not Applicable		
P.6-1-1	4" dia (100mm) REF: Technical Specifications Section - 0360	920.00	Rft.	Not Applicable		
P.6-1-1	6" dia (150mm) REF: Technical Specifications Section - 0360	275.00	Rft.	Not Applicable		
P.6-2	Excavation in all kind of soils at any depth i/c all lead & lift, necessary protection/shoring/ stability to excavated areas/sides, dewatering and keeping the area to dry,all operations & arrangements in connection with earth works to complete confirming to the requirements of drawings, specifications and instructions by the Engineer In Charge. REF: Technical Specifications Section - 0360- 0400	22,500.00	Cft	Not Applicable		
P.6-3	Sand Filling: Providing, laying, compacting and curing sand, compaction, complete in all respect, as per drawings, specifications and as directed by the Engineer. REF: Technical Specifications Section - 0360	7,500.00	Cft	Not Applicable		
P.6-4	Providing, transportation, laying, cutting, butt fusion jointing, testing, commissioning & disinfecting the Polyethylene Pipe (PE-100), PN 16, of SDR 11 of any of the manufacturer DADEX and BETA or approved equivalent including fixing all type of fittings and special such as tee, bend,cross collar, reducer, tail piece, flanged spigot,end cap, flanged socket, taper, angle branch, plug etc complete in all respects (Including Injection moulded fittings) as recommended by the manufacturer. REF: Technical Specifications Section - 0400, Section - 0480					
P.6-4-1	6" dia (150mm) REF: Technical Specifications Section - 0360	3,000.00	Rft.	Not Applicable		
P.6-5	Providing and installing gate/ball valves of following nominal dia, of approved make, including jointing, fitting, painting, testing, complete in all respects to match with following pipe dia meters. REF: Technical Specifications Section - 0440, Section - 0480					
P.6-5-1	2-1/2" dia (63mm) REF: Technical Specifications Section - 0360	8.00	Nos.	Not Applicable		

P.6-6	Providing, Installing and testing (sprinklers) (K 5.6) including jointing, fitting, testing, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480					
P.6-6-1	Ceiling type (Concealed) REF: Technical Specifications Section - 0360	325.00	Nos.	Not Applicable		
P.6-6-2	Upright. REF: Technical Specifications Section - 0360	80.00	Nos.	Not Applicable		
P.6-7	Providing, Installing, testing and commissioning fire hose cabinet Single door, complete mild steel front door. UPPER COMPARTMENT Fire hose reel, 1'' X 30 Mtr. cabinet mounted, swinging manual type with nozzle & valve. LOWER COMPARTMENT 2-1/2'' x 30 Mtr. fire hose synthetic single jacket with quick coupling, 2-1/2'' oblique landing valve, with jet & spray Nozzle including Co2 fire extinguisher, portable pressure type 6kg dry powder type fire extinguisher where indicated on drawings including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480	8.00	Nos.	Not Applicable		
P.6-8	HOSE REEL CABINET(External): Providing, Installing, testing and commissioning fire hose cabinet Single door, complete mild steel front door. Fire hose reel, 1'' X 30 Mtr. cabinet mounted, swinging manual type with nozzle & valve. where indicated on drawings including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480	28.00	Nos.	Not Applicable		
P.6-9	Providing, Installing, testing and commissioning Pillar type fire hydrants with external fire hose cabinet with inlet flange 4" size with double deliveries 2 1/2" female instantaneous coupling with blank cap and chain, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0360, Section - 0380, Section - 0420, Section - 0480	28.00	Nos.	Not Applicable		
P.6-10	Providing, Installing, testing and commissioning Pillar type fire hydrants with external fire hose cabinet with inlet flange 4" size with double deliveries 2 1/2" female instantaneous coupling with blank cap and chain, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480	2.00	Nos.	Not Applicable		

P.6-11	Providing, Installing, testing and commissioning fire fighting zone check assembly & drain test point consisting of Alarm valve, Gate valve, Flow switch, etc complete, at suitable locations as required by NFPA codes for Fire fighting sprinkler - wet pipe system including fire alarm panel, jointing, fitting, testing, including all necessary accessories required for installation, complete in all respect as per specifications and drawings as well as directed by the Engineer. REF: Technical Specifications Section - 0380, Section - 0420, Section - 0480-0360					
P.6-11-1	4" dia (100 mm) REF: Technical Specifications Section - 0360	5.00	Nos.	Not Applicable		
P.6-12	FM-200 System: Design, Supply, installation, testing & commissioning of FM-200 system of specified spaces mentioned on drawings. REF: Technical Specifications Section - 0700, Section - 0480	1.00	Job	[Up to 80% Allowed]		
P.6-13-1	Dry Chemical Powder Fire Extinguisher: Portable, Stored Pressure Type Highly Effective on A, B, C & E Class of Fire, Capacity : 06 Kg Fire Rating : 34A 183B Working Pressure : 14 Bar Tested at Pressure : 30 Bar. REF: Technical Specifications Section - 0380	24.00	Nos.	Not Applicable		
P.6-13-2	CO2 Fire Extinguisher Capacity 5Kg Extinguishing Agent CO2 Operating Temperature -20 to +60 °C Max Allowable Pressure 174 bar Test Pressure 250 bar. REF: Technical Specifications Section - 0380	24.00	Nos.	Not Applicable		
P.6-13-3	ABC Powder Ceiling Mounted Capacity 6Kg Operating Temperature -30 °C to +60 °C Operating Pressure 15 Bar Cylinder Testing Pressure 35 bar for 30 sec. REF: Technical Specifications Section - 0480	3.00	Nos.	Not Applicable		
P.7-1	Providing, Fixing ,testing & installing pump set for fire fighting of following capacities. (Pump must be UL Listed & FM approved) a) Horizontal centrifugal pump set (50Hz x 380V, 3 phase Motor) 750 GPM @ 10 bar complete with automatic control panel , Pressure switch & Pressure gauge. It should be capable of operating 1 remotest 21/2" hydrants 250 GPM @ min. 6.9 bar pressure. b) Horizontal centrifugal engine driven pumpset 500 GPM @ 10 bar complete with automatic control panel , Pressure switch, Pressure gauge & diesel tank. It should be capable of operating 1 remotest 21/2" hydrants 250 GPM @ min. 6.9 bar pressure. c) Jockey electric motor driven pumpset (50Hz x 380 V ,3Ph Motor) 40 GPM @ 10.5 bar complete with automatic control panel, pressure switch and pressure gauge. d) Pump control cabinet for above mentioned pump. e) Pump room fitting and controls i.e. gate valves, NRV, expansion joints,air release valve, headers, pressure relief Valve & pressure gauge, supports and painting. REF: Technical Specifications Section - 0360, Section - 0380, Section - 0420, Section - 0440, Section - 0470, Section - 0480	1.00	Set	Not Applicable		
					Total Amount (Rs)	

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Bill of Quantities

Bill No. 8 - ATC & CNS Equipments

Item No	Description	Quantity	Unit	Rate (USD)	Rate (Rs)	Amount (Rs)
(1)	(2)	(3)	(4)	(5)	(6)	(7) = [(5)*280]+(6)]*(3)
T-1	Provision, installation, Testing & Commissioning of VHF/AM Air Band Multimode Transceiver, frequency range 118–137 MHz, capable of AM voice, ACARS (AM-MSK), and VDL Mode 2 (D8PSK) with lifetime license Features: dual Ethernet ports for VoIP (ED-137 compliant), SNMP remote control, front-panel display, programmable output power up to 50 W, main/standby ready. Including all necessary accessories (power supply, antenna change over relay , RF lightning protector standard 19 inch rack mounting hardware , etc.). Complete in all respect. REF: Technical Specifications Section - 0740	14.00	Job	[Up to 80% Allowed]		
T-2	Provision, installation, Testing & Commissioning of UHF/AM Air Band Digital Transceiver, frequency range 225–400 MHz, output power 50W, with Ethernet connectivity for VoIP (ED-137), SNMP remote control, front-panel display, main/standby ready. Includes all accessories for standard 19 inch rack. Complete in all respect as per Technical Specification CNS-01. REF: Technical Specifications Section - 0740	3.00	Job	[Up to 80% Allowed]		
T-3	Provision, installation, Testing & Commissioning of VHF (AM) Band Pass Dual Cavity Combiner, 2-channel, for combining four VHF transceivers to a single antenna, frequency range 118–137 MHz, 4HU rack-mountable, with front panel. Complete in all respect. REF: Technical Specifications Section - 0740	6.00	Job	[Up to 80% Allowed]		
T-4	Provision, installation, Testing & Commissioning of UHF Dual Cavity Bandpass Filter/Combiner, frequency range 225–400 MHz, 4HU rack-mountable, Complete in all respect. REF: Technical Specifications Section - 0740	2.00	Job	[Up to 80% Allowed]		
T-5	Provision, installation, Testing & Commissioning of VHF Omnidirectional Antenna, dipole, frequency range 118–137 MHz, with appropriate RF connector, suitable for aviation ground station use. Complete in all respect. REF: Technical Specifications Section - 0740	8.00	Job	[Up to 80% Allowed]		
T-6	Provision, installation, Testing & Commissioning of UHF Omnidirectional Antenna, dipole type, frequency range 225–400 MHz, with appropriate RF connector, suitable for aviation ground station use complete in all respect. REF: Technical Specifications Section - 0740	3.00	Job	[Up to 80% Allowed]		
T-7	Provision, installation, Testing & Commissioning of VHF AM 10 watts Vehicle Mounted TX/RX frequency range 118–137 MHz, capable of AM voice 12V DC and (adaptable for vehicles), VoIP complete in all respect. REF: Technical Specifications Section - 0740	5.00	Job	[Up to 80% Allowed]		
T-8	Provision, installation, Testing & Commissioning of VHF AM HANDHELD Walkie Talkie Frequency Range 118 – 137 MHz (aeronautical band) BatteryBuilt in long life rechargeable battery pack (Li ion) REF: Technical Specifications Section - 0740	6.00	Job	[Up to 80% Allowed]		

T-9	Provision, installation, Testing & Commissioning of VHF FM HANDHELD DIGITAL WALKIE TALKIE Frequency Range 146 – 174 MHz (VHF FM) Output Power ≥5 W (adjustable high/low) Battery Built in long life rechargeable battery pack (Li ion) REF: Technical Specifications Section - 0740	10.00	Job	[Up to 80% Allowed]		
T-10	Provision, installation, Testing & Commissioning of HF Transceiver, output power 1 kW, with broadband antenna system covering HF aviation bands, suitable for long-range communication. Complete in all respect. REF: Technical Specifications Section - 0740	2.00	Job	[Up to 80% Allowed]		
T-11	Provision, installation, Testing & Commissioning of HF Transceiver 125 watts , covering HF aviation bands, with broad antenna, for monitoring and replacement in case of main transceiver failure . Complete in all respect. REF: Technical Specifications Section - 0740	3.00	Job	[Up to 80% Allowed]		
T-12	Provision, installation, Testing & Commissioning of Radio Remote Controller System, standalone configuration, comprising: touch-screen display unit, microphone interface with desktop speaker, headset with aviation connector, foot pedal for PTT, monitor arm or desktop mount. The controller shall support ED-137 VoIP, dual LAN redundancy, and be capable of controlling multiple radios , telephone lines and hotlines (Analogue/Digital) Complete in all respect. REF: Technical Specifications Section - 0740	8.00	Job	[Up to 80% Allowed]		
T-13	Provision, installation, Testing & Commissioning of Automatic Low Voltage Control 100 to 230 VAC for (a.) ATC Tower (b.) ECR (c.) OCC Room with at least specification Input Voltage Range: 100-260 VAC Output Voltage 210- 230 VAC or Customized . 50Hz Pure sine wave, Power Factor 90% , Accuracy. +/- 1% Voltage control (this will be read with other applicable technical specifications. REF: Technical Specifications Section - 0740	3.00	Job	Not Applicable		
T-14	Provision, installation, Testing & Commissioning of Earthing / Grounding System including earthing pits for CNS Equipment and other sensitive ICT equipment. Complete in all respect as per Technical Specifications CNS-01. REF: Technical Specifications Section - 0740	1.00	Job	Not Applicable		
T-15	Provision, installation, Testing & Commissioning of AMHS Terminal / Desktop PC along with Compatible Dot Matrix Printer (LQ-310) for AHMS Terminal with redundant lines through PTCL Fiber, Satellite. Complete in all respect. REF: Technical Specifications Section - 0740	1.00	Job	Not Applicable		
T-16	Provision, installation, Testing & Commissioning of Managed Layer 2/3 Ethernet Switch, 48x Gigabit ports, 4x SFP uplink ports, with redundancy features (e.g., dual power supply optional), suitable for rack mounting. Complete in all respect. REF: Technical Specifications Section - 0740	3.00	Job	Not Applicable		
T-17	Provision, installation, Testing & Commissioning of Handheld Capsule Type microphone with bracket. Complete in all respect suitable for aviation RRCU use as per Technical Specifications. REF: Technical Specifications Section - 0740	10.00	Job	Not Applicable		

T-18	Provision, installation, Testing & Commissioning of Gooseneck microphone with suitable connector for RRCU. Complete in all respect as per Technical Specification. REF: Technical Specifications Section - 0740	8.00	Job	Not Applicable		
T-19	Provision, installation, Testing & Commissioning of Aviation headset with noise-canceling microphone and appropriate connector for RRCU & Complete in all respect suitable for aviation use as per Technical Specifications. REF: Technical Specifications Section - 0740	8.00	Job	Not Applicable		
T-20	Provision, installation, Testing & Commissioning of Remote Control and Monitoring System (RCMS) software suite for VHF, UHF, HF radios and DVLS network management, including server software, operator client licenses Qty.04, lifetime device licenses for up to 50 radios , SNMP-based monitoring, alarm management, and reporting. Includes dedicated workstation and laptop (minimum: Intel Core i7 13th Gen. or equivalent, 16GB RAM, 1TB SSD, Windows 11 Pro) for administration. Complete in all respect. REF: Technical Specifications Section - 0740	1.00	Job	Not Applicable		
T-21	Provision, installation, Testing & Commissioning of Low-loss foam dielectric coaxial cable, 50 Ω impedance, ½ inch diameter, suitable for RF feeder runs. Complete in all respect for all systems to be connected and as per Technical Specification. REF: Technical Specifications Section - 0740	1,200.00	meter	Not Applicable		
T-22	Provision, installation, Testing & Commissioning of Digital Voice Logging System (DVLS) with capacity for recording at least 48 channels (analog and VoIP). Dual redundant recording servers operating in parallel (no single point of failure), RAID storage for minimum 31 days recording, synchronized replay capability, NTP synchronization, web-based replay client, and all necessary software and accessories. Shall support ED-137, RTP, SIP, and analog audio inputs. Complete in all respect as per Technical Specification CNS-01. REF: Technical Specifications Section - 0740	1.00	Job	[Up to 80% Allowed]		
T-23	Provision, installation, Testing & Commissioning of DC power supply system with integrated monitoring and charging, using lithium battery bank providing minimum 2 hours backup at full load. Includes rectifiers, distribution, and battery management. Complete in all respect. REF: Technical Specifications Section - 0740	1.00	Job	Not Applicable		
T-24	Provision, installation, Testing & Commissioning of Double conversion online uninterruptible power supply (UPS), capacity suitable for the intended load, with maintenance bypass and battery backup for minimum 60 minutes (or as per site requirement). Complete in all respect. REF: Technical Specifications Section - 0740	3.00	Job	Not Applicable		
T-25	Provision, installation, Testing & Commissioning of Air Traffic Control console furniture for six (6) working positions, ergonomic design, including monitor mounts, keyboard trays, space for remote controllers, and cable management. Materials durable and anti-static. Complete in all respect. REF: Technical Specifications Section - 0740	6.00	Job	Not Applicable		

T-26	Provision, installation, Testing & Commissioning of Automated Weather Observing System (AWOS) for a single runway, meeting ICAO CAT I precision approach requirements. Includes central data unit; sensors for wind speed/direction (ultrasonic or mechanical), barometric pressure (redundant), temperature/humidity, cloud height (ceilometer), visibility/runway visual range (RVR), present weather detector, lightning detector; and appropriate communication interfaces. System shall generate METAR and other aviation reports, and integrate with ATC systems. Includes all accessories, cabling, and mounting hardware. Complete in all respect. REF: Technical Specifications Section - 0740	1.00	Job	[Up to 80% Allowed]		
T-27	Provision, installation, Testing & Commissioning of Desktop Computers (All-In-One) minimum: Intel Core i7 13th Gen. or equivalent, 16GB RAM, 1TB SSD, Windows 11 Pro), and 24 Inch Screen. Complete in all respect. REF: Technical Specifications Section - 0740	3.00	Job	Not Applicable		
T-28	Provision, installation, Testing & Commissioning of FM repeater system for coordination of all area of airport .Complete in all respect. REF: Technical Specifications Section - 0740	1.00	Job	Not Applicable		
T-29	Provision, installation, Testing & Commissioning of ATC Support equipment Complete in all respect as per Technical Specification Section 0740 (SUB-DIVISION 15.2) REF: Technical Specifications Section - 0740	1.00	Lot	Not Applicable		
T-30	Supply, Laying, testing and commissioning of Fiber Cable complete in all respect as per Engineers Instruction. REF: Technical Specifications Section - 0650	1,200.00	meter	Not Applicable		
T-31	Trenching work, including excavation, sand bedding, supply and placement of protection tiles, placement of warning tape, backfilling and compaction complete in all respect as per instruction of Engineer. REF: Technical Specifications Section - 0740	800.00	Cum	Not Applicable		
T-32	Dismantling & re-installation, testing and commissioning of ALCMS in ATCT complete in all respect as per instruction of Engineer. REF: Technical Specifications Section - 0070	1.00	Job	Not Applicable		
T-33	Airfield lighting Control & Monitoring System Relocation Shifting touchscreen, controller, and communication links (fiber/copper).ALCMS Project relocation Programme and ensuring System Transition Support to minimize downtime., complete in all respects. Note:- Above mentioned system should be complete in all respect for proper functioning including cost of items mentioned or not. REF: Technical Specifications Section - 0740, Section - 0770	1.00	Job	Not Applicable		

T-34	Providing, installing, testing and commissioning of Airport Crash Warning System (Crash Horn/Crash Bell Hooter), comprising electronic hooters, central control panel, interface with Air Traffic Control (ATC) console, remote/manual activation stations, control and power cabling, conduits, accessories, terminations, integration, testing, commissioning and all associated works, complete in all respects in accordance with the Drawings and Technical Specifications Section 0910. REF: Technical Specifications Section - 0910	1.00	Job	Not Applicable		
T-35	Providing, installing, testing and commissioning of Aeronautical Beacon, including beacon assembly, mounting structure/supports, obstruction lighting interface (where applicable), power and control cabling, conduits, accessories, earthing, terminations, testing, commissioning and all associated works, complete in all respects in accordance with the Drawings and Technical Specifications Section 0900. REF: Technical Specifications Section - 0900	1.00	Job	Not Applicable		
T-36	FACTORY ACCEPTANCE TEST (FAT):FAT for (03) three PAA officials for (05) five working days at OEM factory (Including Return ticket, Visa fees, insurance, local transport, accommodation & DSA) REF: Technical Specifications Section - 0740, Section - 0010	3.00	Lot	Not Applicable		
T-37	FACTORY TRAINING:Factory Training for (05) five PAA technical Personnel / Engineers for (10) ten working days at OEM factory (including return ticket, visa fees, local transport, accommodation & DSA) REF: Technical Specifications Section - 0740, Section - 0010	4.00	Lot	Not Applicable		
					Total Amount (Rs)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY
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Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Schedule of Daywork Rates

Labour

Item No.	Description	Nominal Quantity	Unit	Rate (USD)	Rate (PKR)	Extended Amount (PKR)
D101	Project Manager	10	Day	Not Applicable		
D102	Site Engineer	10	Day	Not Applicable		
D103	Surveyor	30	Day	Not Applicable		
D104	Foreman / General Foreman	30	Day	Not Applicable		
D105	Charge Hand / Supervisor	30	Day	Not Applicable		
D106	Skilled Mason	50	Day	Not Applicable		
D107	Carpenter	20	Day	Not Applicable		
D108	Steel Fixer	50	Day	Not Applicable		
D109	Electrician	30	Day	Not Applicable		
D110	Plumber	20	Day	Not Applicable		
D111	HVAC Technician	20	Day	Not Applicable		
D112	Welder	40	Day	Not Applicable		
D113	Painter	10	Day	Not Applicable		
D114	Tile Setter	20	Day	Not Applicable		
D115	Machine Operator	10	Day	Not Applicable		
D116	Driver	40	Day	Not Applicable		
D117	Skilled Labour	50	Day	Not Applicable		
D118	Semi-Skilled Labour	50	Day	Not Applicable		
D119	Unskilled Labour	100	Day	Not Applicable		
D120	Watchman / Security Guard	100	Day	Not Applicable		
D121	Cleaner / Helper	100	Day	Not Applicable		
	Subtotal					**0.00**
D122	Allow Fifteen Percent (15%) of Subtotal for Contractor's overheads, profit, taxes, supervision, administrative costs and all other indirect costs, in accordance with Paragraph 3(b) of the Daywork Procedure.				**15% of Subtotal**	**0.00**
	Total for Daywork - Labour (Carried forward to Daywork Summary)					**0.00**

Notes

1.Labour rates shall be deemed to include all wages, salaries, overtime (where applicable), statutory benefits, social security contributions, EOBI contributions, leave pay, insurance, transportation, accommodation, supervision, small tools, personal protective equipment (PPE), compliance with labour laws, and all other direct and indirect costs necessary for the execution of the Daywork.

2.Measurement and payment shall be in accordance with Sub-Clause 13.3 [Variation Procedure] and the Daywork Schedule contained in the Bill of Quantities.

3.Only labour actually employed on Daywork and authorized in writing by the Engineer shall be measured and paid.

4.No payment shall be made for idle time, standby time, inefficiencies, or labour not actually engaged in the authorized Daywork unless otherwise directed in writing by the Engineer.

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Construction of New Air traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Schedule of Daywork Rates

Materials

Item No.	Description	Nominal Quantity	Unit	Rate (USD)	Rate (PKR)	Extended Amount (PKR)
D201	Ordinary Portland Cement (OPC), Type-I, 50 kg bag, ASTM C150 or equivalent	100	bag	Not Applicable		
D202	Coarse Sand (River/Pit), Zone-II grading, free from silt & organic matter	50	m3	Not Applicable		
D203	Coarse Aggregate, crushed stone, 3/4" (20mm) nominal size	50	m3	Not Applicable		
D204	Deformed Reinforcement Steel Bars, Grade 60 (Fy = 60,000 psi), assorted dia. 10mm-25mm	1000	kg	Not Applicable		
D205	Structural Steel Sections (I-Beam / Channel / Angle), Grade A36 or equivalent, assorted sizes	1000	kg	Not Applicable		
D206	Solid Concrete Blocks, 150mm x 200mm x 400mm (6"x8"x16"), min. compressive strength 1,500 psi	500	no.	Not Applicable		
D207	Burnt Clay Bricks (1st Class), standard size 230mm x 115mm x 75mm (9"x4.5"x3"), min. crushing strength 1,500 psi	500	no.	Not Applicable		
D208	Shuttering Plywood, 18mm thick, 1220mm x 2440mm (4'x8') sheet, film-faced	50	sheet	Not Applicable		
D209	Timber (Deodar/Kail), sawn, assorted sections, for formwork/scaffolding	100	cft	Not Applicable		
D210	Binding Wire, GI, 16 SWG	50	kg	Not Applicable		
D211	PVC Conduit Pipe, 3/4" (20mm) dia, heavy gauge, for electrical wiring	500	rft	Not Applicable		
D212	Copper Conductor Cable, PVC insulated, single core, assorted sizes 2.5mm2	1000	rft	Not Applicable		
D213	uPVC Water Supply Pipe, Class-C / Schedule-40, dia 1", threaded/solvent-weld	300	rft	Not Applicable		
D214	uPVC Sewerage Pipe, dia 4", solvent-weld joint	300	rft	Not Applicable		
D215	Waterproofing Membrane, APP/SBS modified bitumen, 3mm thick, torch-applied	200	m2	Not Applicable		
D216	Ceramic / Vitrified Floor Tiles, 600mm x 600mm, Grade-A, matt/glossy finish	200	m2	Not Applicable		
D217	Weather-shield Emulsion Paint, exterior grade	200	ltr	Not Applicable		
D218	Welding Electrodes, E6013/E7018, 3.15mm dia	50	kg	Not Applicable		
D219	Nails, Screws & Assorted Fasteners, GI/MS, various sizes 1"-4"	20	kg	Not Applicable		
D220	Non-Shrink Cementitious Grout, high strength (min. 50 MPa @ 28 days), pre-mixed	100	kg	Not Applicable		
D221	Silicone Sealant, weatherproof grade, 300ml cartridge	50	no.	Not Applicable		
	Subtotal					**0.00**
D222	Allow Fifteen Percent (15%) of Subtotal for Contractor's overheads, supervision, handling, storage, wastage, profit, taxes and all incidental costs in accordance with Paragraph 4(b).				**15% of Subtotal**	**0.00**
	Total for Daywork: Materials (carried forward to Daywork Summary)					**0.00**

Notes:

1. Nominal Quantities are Employer-inserted assumed quantities, provided solely to enable comparison of bidders' rates at tender stage. They do not constitute a guarantee of actual daywork quantities to be instructed during execution.
2. All items are stated in measurable units (weight, volume, length, area, or count) to enable verification of quantities actually consumed on Site as a basis for payment. No item is priced on a lump-sum or "lot" basis, since a lump-sum quantity cannot be physically checked against work done and is a common source of daywork payment disputes.
3. Sizes, grades, and specifications stated against each item are indicative, for the purpose of rate comparability at tender stage. Where a conflict arises between this Schedule and the Technical Specifications or BOQ for the same material, the Technical Specifications/BOQ shall govern.
4. This Schedule is to be read together with the Schedule of Daywork Rates: Labour and the Schedule of Daywork Rates: Contractor's Equipment, and the Daywork Summary, forming part of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Schedule of Daywork Rates

Equipment

Item No.	Description	Nominal Quantity (hours)	Unit	Basic Hourly Rental Rate (USD)	Basic Hourly Rental Rate (PKR)	Extended Amount (PKR)
D301	Concrete Mixer, drum type, 10/7 cft capacity, diesel/electric driven	100	Hour	Not Applicable		
D302	Concrete Vibrator, needle type, 40mm-60mm poker dia, petrol/electric driven	100	Hour	Not Applicable		
D303	Diesel Generator Set, 125 kVA, silent/canopied type, with ATS panel	200	Hour	Not Applicable		
D304	Diesel Generator Set, 30 kVA, silent/canopied type	100	Hour	Not Applicable		
D305	Excavator / Backhoe Loader, bucket capacity 0.9-1.2 m3, engine power 90-100 HP	100	Hour	Not Applicable		
D306	Wheel Loader, bucket capacity 1.5-2.0 m3, engine power 120-150 HP	50	Hour	Not Applicable		
D307	Dump Truck, 10-wheeler, payload capacity 12-16 tons (8-10 m3)	100	Hour	Not Applicable		
D308	Water Bowser / Tanker, capacity 5,000-6,000 litres, truck-mounted	80	Hour	Not Applicable		
D309	Mobile Crane, hydraulic, telescopic boom, 25-ton lifting capacity	60	Hour	Not Applicable		
D310	Tower Crane, max. lifting capacity 6-8 tons, jib length 40-50m	100	Hour	Not Applicable		
D311	Man / Material Hoist, single cage, capacity 1,000-1,200 kg	100	Hour	Not Applicable		
D312	Plate Compactor, plate size approx. 500mm x 400mm, centrifugal force 15-20 kN	50	Hour	Not Applicable		
D313	Road Roller (vibratory), single drum, 8-10 ton static weight	40	Hour	Not Applicable		
D314	Welding Machine, arc/MIG type, 300-400 amp, diesel/electric driven	80	Hour	Not Applicable		
D315	Air Compressor, diesel/electric driven, capacity 150-185 CFM	60	Hour	Not Applicable		
D316	Concrete Pump, boom/trailer mounted, output capacity 30-40 m3/hr	40	Hour	Not Applicable		
D317	Concrete Batching Plant, capacity 30-40 m3/hr, with weigh-batcher	40	Hour	Not Applicable		
D318	Total Station (electronic), with operator, accuracy +/-(2mm + 2ppm)	40	Hour	Not Applicable		
D319	Mobile Lighting Tower, 4 x 1000W metal halide, telescopic mast, diesel-genset mounted	60	Hour	Not Applicable		
	Subtotal					**0.00**
D320	Allow Fifteen Percent (15%) of Subtotal for Contractor's overheads, supervision, mobilisation, demobilisation, fuel, lubricants, maintenance, insurance, operator management, profit, taxes and all incidental costs in accordance with the Contract Data.				**15% of Subtotal**	**0.00**
	Total for Daywork: Contractor's Equipment (carried forward to Daywork Summary)					**0.00**

Notes:

1. Nominal Quantities (hours) are Employer-inserted assumed quantities, provided solely to enable comparison of bidders' rates at tender stage. They do not constitute a guarantee of actual daywork hours to be instructed during execution.
2. Capacities and specifications stated against each item are indicative minimums, for the purpose of rate comparability at tender stage. The Contractor shall deploy equipment of at least the stated capacity, in good working order, suitable for the intended task and Site conditions.
3. A "Subtotal" row has been added before Item D322 for consistency with Schedules 1 (Labour) and 2 (Materials), since the overhead/profit percentage at D322 is expressed as a percentage "of Subtotal." The source Preamble text did not show this row explicitly — please confirm this reflects the intended calculation basis.
4. This Schedule is to be read together with the Schedule of Daywork Rates: Labour and the Schedule of Daywork Rates: Materials, and the Daywork Summary, forming part of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY PPRA EPADS

Construction of New Airtraffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Daywork Summary

Description	Amount (PKR)
1. Total for Daywork: Labour	0.00
2. Total for Daywork: Materials	0.00
3. Total for Daywork: Contractor's Equipment	0.00
Total for Daywork (Provisional Sum) (carried forward to Grand Summary)	**0.00**

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

ESTIMATED PROGRESS PAYMENTS

Bidder's estimate of the value of work which would be executed by him during each of the periods stated below, based on his Programme of the Works and the Rates in the Bill of Quantities, expressed in thousands of PKR:

Quarter	Amounts (1,000 PKR)
1	2
1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	
9th	
Bid Price	

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Section VIII. Special Conditions of the Contract

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Special Conditions of the Contract

The Special Conditions of Contract (SCC) complement the General Conditions of Contract (GCC) to specify data and contractual requirements of the Procuring agency/Employer/ Employer, the engineer, the sector, the overall project, and the works. In the event of a conflict, the provisions herein shall prevail over those in the GCC.

Part A – Contract Data

Contract data of the SCC, includes data to complement the GCC in a manner similar to the way in which the Bid Data Sheet complements the Instructions to Bidders.

SCC Clause Number	GCC Clause Number	Amendments of, and Supplements to, Clauses in the GCC
		General Provision (GCC 1)
1.	1.1.27	Defects Notification Period (DNP): *365 Days*
2.	1.1.31	Employer's name and address: Director P&D *Pakistan Airports Authority (PAA)* *Terminal-1, Head Quarter PAA, JIAP Karachi, Pakistan.*
3.	1.1.35	Engineer's name and address:To be Nominated later
4.	1.1.84	Time for Completion: 730 days for whole of the Work
5.	1.3(a)(ii)	agreed methods of electronic transmission: Email: director.pdev@paa.gov.pk contmgntbranch@gmail.com
6.	1.3(d)	**For notices** Procuring agency/Employer/ Engineer's Authorized representatives name and address: *Director P&D* *Pakistan Airports Authority (PAA)* *Terminal-1, Head Quarter PAA, JIAP Karachi, Pakistan* *Address of Engineer for communications:* *To be communicated later* Contractors Authorized representatives name and address:
7.	1.4	**Governing Law;**

		The Applicable Law shall be: Laws of the Islamic Republic of Pakistan. Ruling language: English **Communication Language:** The Communication Language shall be: English
8.	1.5	As per Form of Contract
The Employer/ Procuring agency/Employer (GCC Clause 2)		
9.	2.1	Time for access to the Site: 03 days after Commencement Date The Site is located within a restricted area of Skardu International Airport. Access to the Site by any person, vehicle, or item of Equipment is subject to: (a) prior approval of the Airports Security Force ("ASF") and issuance of a valid airport entry pass; and (b) where applicable, prior permission of the Pakistan Air Force ("PAF"), in respect of such persons, vehicles, activities, or areas of the Site as may, from time to time, require PAF clearance. Issuance of any such pass, permission, or clearance shall be subject to fulfilment of all applicable requirements prescribed by the ASF, PAF, and any other competent security agency having jurisdiction over the Site, including, without limitation, security vetting and clearance of the Contractor's Personnel, Subcontractors, and their respective personnel. The Contractor shall, at its own cost and expense, be solely responsible for: (i) obtaining and maintaining all airport entry passes, PAF permissions, and other security clearances required for access to, and continued presence on, the Site by the Contractor's Personnel, Subcontractors, and their respective equipment and vehicles; (ii) submitting all applications, documentation, and information required by the ASF, PAF, or any other relevant authority for the issuance of such passes, permissions, and clearances; and (iii) applying for renewal of each airport entry pass and each PAF permission to the relevant issuing authority sufficiently in advance of its expiry, and in any event not later than fourteen (14) days prior to the expiry date thereof, so as to ensure continuity of access without interruption. The Contractor acknowledges that the Works are to be executed

		within an operational international airport where security restrictions, operational requirements, aircraft movements, emergency operations and airside safety considerations may restrict, regulate or temporarily suspend access to all or any part of the Site. Accordingly, notwithstanding Sub-Clause 2.1 or any other provision of the Contract: (a) the Employer may grant access to the Site in sections, phases or specific work areas, and may vary, restrict, suspend or temporarily withdraw access to any part of the Site as may reasonably be required for airport operations, aviation safety, security requirements or operational exigencies; (b) the Contractor shall organize and execute the Works so as to accommodate such phased or restricted access and shall coordinate its activities with the Employer, the Engineer and the relevant airport authorities; (c) the Contractor shall be deemed to have fully inspected the Site and to have taken into account, in the preparation of its Tender and the Accepted Contract Amount, all foreseeable security procedures, operational restrictions, access limitations, phased possession of the Site and other conditions associated with executing the Works within an operational international airport. The Employer shall use reasonable endeavours to provide the Contractor with the maximum practicable access to the Site consistent with the safe, secure and uninterrupted operation of Airport. However, the operational requirements, aviation safety and security of the Airport shall at all times take precedence over the Contractor's activities and shall not constitute grounds for any claim by the Contractor except as expressly provided under the Contract. Except to the extent that any delay in granting access to the Site, or in the issuance, renewal or replacement of any airport entry pass, permit, approval or security clearance, is solely and directly attributable to the Employer's breach of its express obligations under the Contract, the Contractor shall not be entitled to any Cost, additional payment, compensation, idle time charges, standing time charges, prolongation costs, loss of productivity, disruption damages or any other claim or relief whatsoever arising out of or in connection with such restrictions, phased access, security requirements or operational constraints
10.	2.4	Employer’s financial arrangements: Employer’s Own Funds
The Engineer (GCC Clause 3)		
11.	3.2	Engineer’s Duties and Authority:

		Variations resulting in an increase of the Accepted Contract Amount in excess of 1% shall require approval of the Procuring agency / Employer.
The Contractor (GCC Clause 4)		
12.	4.2	**Amount of Performance Security:** Ten percent (10%) of the Contract Price as per Letter of Acceptance. **Form of Performance Security:** An unconditional, irrevocable, on-demand bank guarantee, in the form annexed to the Contract, issued by a Scheduled Bank operating in Pakistan and acceptable to the Employer as per list of approved banks. Where the successful Bidder is a foreign firm without a local presence, the Performance Security shall be issued by a bank incorporated outside Pakistan of international standing acceptable to the Employer, counter-guaranteed by a Scheduled Bank in Pakistan acceptable to the Employer, so that the Performance Security is payable and enforceable within Pakistan on first demand without recourse to foreign jurisdiction. The Performance Security shall be denominated in the currency/currencies of the Contract Price and shall remain valid until the date falling twenty-eight (28) days after the issuance of the Performance Certificate under the Contract, and shall be extended by the Contractor if required to remain valid until such date.
13.	4.7.2(a)	**Clause 4.7 Setting out** Period for notification of errors in the items of reference: Fourteen (14) days
14.	4.20	number of additional paper copies ofprogress reports **Three (3)**, together with one (1) searchable PDF copy and one (1) editable electronic copy in a format provided in the specifications acceptable to the Engineer.
15.	4.22	**Contractor's Operations on site** Site: Skardu International Airport, together with all other areas made available to the Contractor by the Employer or designated in the Contract as forming part of the Site.
Sub-Contracting (GCC Clause 5)		
16.	5.1(a)	Maximum allowable accumulated value of work subcontracted : Thirty Percent (30%)
17.	5.1 (b)	Works for which sub-contracting is not permitted: Civil Works
Staff and Labour (GCC Clause 6)		
18.	6.5	**Normal Working Hours:** 0800 hours to 1700 hours (Pakistan Standard Time), Monday through Saturday, excluding public holidays declared by the Government of Pakistan, unless otherwise approved by the Engineer. Work outside the normal working hours, including night work, work on Sundays or public holidays, shall be subject to the prior written approval of the Engineer and, where applicable, the requisite permissions, security clearances and operational approvals from the Employer and the relevant authorities, including the Airports

		Security Force (ASF), the Pakistan Air Force (PAF), and any other competent authority having jurisdiction over the Site.
Plant, Material and Workmanship (GCC Clause 7)		
19.	7.2	Samples: The Contractor shall, at its own cost, provide all samples required under the Contract, the Specifications, or as reasonably requested by the Engineer for review, testing, approval, or comparison with the Works. All such samples, including their preparation, packaging, transportation, delivery, testing (where specified), replacement and disposal, shall be provided free of cost to the Employer and shall be deemed to be included in the Accepted Contract Amount.
Commencement, Delays and Suspension (GCC Clause 8)		
20.	8.3	Number of additional paper copies of program: **Three (3)**. In addition, the Contractor shall submit one (1) editable electronic copy (Primavera P6 and/or Microsoft Project, as applicable) together with one (1) searchable PDF copy of the Programme and each subsequent revision.
21.	8.8	Delay damages shall be payable for each day of delay shall be ***0.05%*** of the Accepted Contract Amount per day, in the currency and proportions in which the Contract Price is payable. Maximum amount of delay damages is ***10%*** of the Accepted Contract Amount.
Measurement and Valuation (GCC Clause 12)		
22.	12.2	Method of measurement: The Works shall be measured in accordance with the Bill of Quantities, the Specifications and the Drawings. Unless otherwise expressly stated in the Contract, measurement shall be based on the net completed quantities of Permanent Works actually executed, tested (where applicable), and accepted by the Engineer. No allowance shall be made for waste, laps, overlaps, temporary works, or construction methods unless specifically provided for in the Contract.
23.	12.3	Percentage profit: Fifteen percent (15%), which shall be deemed to include all profit, overheads and applicable taxes, duties and levies. No separate payment shall be made in respect thereof.
Variations and Adjustments (GCC Clause 13)		
24.	13.4 (b)(ii)	Percentage rate to be applied to Provisional Sums for overhead charges and profit is Fifteen percent (15%), which shall be deemed to include the Contractor's profit, head office and site overheads, supervision, coordination, administration and all incidental costs associated with the execution of work under the Provisional Sum. No additional allowance for such items shall be payable unless expressly provided elsewhere in the Contract.

25.	13.7	Adjustments for Changes in Cost: The Contract Price shall be adjustable during Contract Execution in accordance with the provisions for Price Adjustment set out in the Contract.
Contract Price and Payment (GCC Clause 14)		
26.	14.2	Mobilization Advance An interest-free Mobilization Advance of up to fifteen percent (15%) of the Accepted Contract Amount, excluding Provisional Sums, shall be paid to the Contractor in two (2) equal instalments, against an Advance Payment Guarantee in the form annexed to the Contract, issued by a Scheduled Bank acceptable to the Employer, subject to the following: (a) First Instalment: The first instalment, equivalent to seven and a half percent (7.5%) of the Accepted Contract Amount excluding Provisional Sums, shall be paid within twenty-one (21) days of the Employer's receipt of the Contractor's Advance Payment Certificate from the Engineer, and of the corresponding Advance Payment Guarantee for the full amount of that instalment. (b) Second Instalment: The second instalment, equivalent to a further seven and a half percent (7.5%) of the Accepted Contract Amount excluding Provisional Sums, shall be paid within forty-two (42) days from the date of payment of the first instalment, subject to the Engineer's satisfaction, evidenced in writing, as to the state of mobilization of the Contractor's Personnel, Equipment, and Temporary Works on Site, and against submission of the corresponding Advance Payment Guarantee for that instalment.
27.	14.2.3	Repayment of Advance payment: The Mobilization Advance shall be repaid by the Contractor through percentage deductions from each Interim Payment Certificate, commencing from the Interim Payment Certificate in which the total of all certified interim payments (excluding the Advance) exceeds fifteen percent (15%) of the Accepted Contract Amount excluding Provisional Sums, at the rate of [twenty percent (20%)] of the amount of each such Interim Payment Certificate, until the Advance has been repaid in full; provided that the Advance shall be fully repaid no later than the date on which eighty percent (80%) of the Accepted Contract Amount excluding Provisional Sums has been certified for payment. Advance Payment Guarantee: The Advance Payment Guarantee for each instalment shall be for an amount equal to that instalment, shall remain valid and enforceable until the Mobilization Advance has been fully repaid, and in any event for a period extending not less than 28 days beyond the stipulated date of completion of the Works, and shall be progressively reduced by the amount of the Advance repaid, as evidenced in the amounts certified in the Interim Payment

		Certificates, provided that the Guarantor agrees that the validity of the Guarantee shall be deemed extended if, on the stated expiry date, the Advance has not been fully repaid
28.	14.3(iii)	**Percentage of Retention:** Ten percent (10%) of the amount of each Interim Payment Certificate, to be deducted by the Engineer until the Retention Money reaches the Limit of Retention Money stated below. **Limit of Retention Money:** Five percent (5%) of the Accepted Contract Amount.
29.	14.5(b)(i)	Imported Plant and Materials: Yes This clause shall be applicable to the following imported Plant and Materials for payment: (a) Chillers (b) Cooling Towers (c) Hot Water Generators (d) Air Handling Units (e) Fan Coil Units (f) DG Sets (g) Solar PV Panels, Inverters and Lithium-Ion Batteries (h) Elevators (i) Fire Fighting Pumping Set (j) FM 200 / Clean Agent Fire System (k) VHF System (l) UHF System (m) HF System (n) DVLS system (o) AWOS (p) RRC System (q) UPS and associated Lithium-Ion Batteries Payment for Imported Equipment and Materials Notwithstanding any other provision of the Contract, payment for imported equipment and materials specifically identified herein shall be made by the Employer through Interim Payment Certificates issued by the Engineer, subject to compliance with the Contract and submission of all documents required under this Clause. The Contractor shall be entitled to payment in the following stages / milestones: (a) Twenty percent (20%) of the Contract Price for the relevant

		imported equipment and/or materials shall be certified for payment upon: (i) approval of the relevant equipment and materials by the Engineer in accordance with the Contract; and (ii) submission by the Contractor of an unconditional, irrevocable, on-demand Bank Guarantee for an equivalent amount issued by a Scheduled Bank in Pakistan acceptable to the Employer (List of approved banks provided in the Contract). The Bank Guarantee shall be valid for a period extending not less than ninety (90) days beyond the anticipated date of shipment, and renewable by the Contractor if that date is delayed. (b) Thirty-five percent (35%) of the Contract Price for the relevant imported equipment and/or materials shall be certified for payment upon submission to the Engineer of satisfactory documentary evidence that the goods have been shipped, including, as applicable: ▪ negotiable Bill of Lading or Air Waybill; ▪ commercial invoice; ▪ packing list; ▪ certificate of origin; ▪ insurance certificate; ▪ manufacturer's inspection or factory acceptance certificates, where specified; and ▪ any other documents required under the Contract. Prior to certification of this payment, the Contractor shall furnish an additional unconditional, irrevocable, Bank Guarantee for the amount payable under this sub-clause, issued by a Scheduled Bank in Pakistan acceptable to the Employer as provided in the Contract. The Bank Guarantee shall be valid for a period extending not less than ninety (90) days beyond the anticipated date of delivery at site, and renewable by the Contractor if that date is delayed. (c) Twenty percent (20%) of the Contract Price for the relevant imported equipment and/or materials shall be certified for payment upon delivery to the Site, verification by the Engineer that the equipment and materials conform to the Contract requirements, and issuance of the Engineer's inspection and acceptance certificate. Upon certification of this payment, the Bank Guarantees submitted under Sub-Clauses (a) and (b) shall be released, provided that all obligations secured thereby have been fulfilled. (d) Twenty percent (20%) of the Contract Price shall be certified for payment upon complete installation of the relevant equipment and materials in accordance with the Contract and after inspection and acceptance by the Engineer. For the imported equipment and

		materials identified under this Clause as eligible for foreign currency adjustment, the Contractor shall also be entitled to payment of the applicable Exchange Rate Adjustment (Dollar Parity) simultaneously with the payment under this Sub-Clause, in accordance with provisions stipulated in Schedule A to the Bid: SCHEDULE OF ADJUSTMENT DATA - Price Adjustment for Imported Equipment (Exchange Rate Variation / Dollar Parity) (e) The remaining five percent (5%) of the Contract Price shall be certified for payment upon successful completion of testing and commissioning, achievement of the specified performance requirements, rectification of all deficiencies identified during commissioning, and issuance of the Taking-Over Certificate by the Engineer in accordance with the Contract. Payment under this Clause shall not constitute acceptance of the equipment or materials, nor relieve the Contractor of any obligation, responsibility, warranty or liability under the Contract. All payments shall be included in Interim Payment Certificates issued by the Engineer and shall be made by the Employer within the period stipulated in the Particular Conditions of Contract. Unless otherwise provided in the Particular Conditions, all certified amounts shall be subject to retention in accordance with the Contract. Ownership, care of the Works, allocation of risk, insurance obligations, certification procedures, time for payment, and all other matters relating to payment shall be governed by the applicable provisions of the Conditions of Contract, except as expressly modified by this Clause.
30.	14.5(c)(i)	**Plant and Materials:** Plant and Materials for payment when delivered to the Site (a) Steel Reinforcement / Steel Structural Members (b) Local Glass (c) Doors & Windows (d) False Ceiling (e) Tile, Marble and Granite (f) Plumbing Fittings and Fixtures (g) Pipes and Conduits (h) Pumps except Fire-Fighting Pumping Set (i) Electric Cables (j) Electric Panels (k) Transformers (l) CCTV Cameras (m)Electric Lights **Advance Payment for Materials Delivered to Site** The Contractor may be certified for an advance payment of up to seventy percent (70%) of the value (quantity delivered to Site ×

		Contract rate) of the relevant Bill of Quantities (BoQ) item, in respect of the above-identified materials delivered to the Site for incorporation into the Permanent Works but not yet incorporated. Such payment shall be certified only where the Engineer is satisfied that: (a) the materials have been delivered to the Site and are intended solely for incorporation into the Permanent Works in accordance with the Contract; Where a BOQ item comprises more than one eligible material, advance payment shall be certified only where all such eligible materials required for that BOQ item have been delivered to the Site in commensurate quantities sufficient for the execution of the corresponding portion of the Works, as determined by the Engineer. No advance payment shall be certified for individual components of a composite BOQ item. (b) the quantity, quality and condition of the materials have been verified by the Engineer, and a Material Inspection Report (MIR) and Material Receipt Certificate have been issued accordingly; (c) the materials are properly stored and adequately protected against loss, damage, deterioration and weather, and are clearly identified and segregated, to the satisfaction of the Engineer; (d) the Contractor maintains records of the requirement, procurement, receipt and use of such materials, identifies their cost and value in its accounting system, and makes such records available for inspection by the Engineer on request; and (e) the Contractor has submitted invoices, delivery challans, manufacturer's certificates, and such other documents as the Engineer may reasonably require to establish ownership and value of the materials. Title to materials so certified shall vest in the Employer in accordance with Sub-Clause 7.7 [Ownership of Plant and Materials], without prejudice to the Contractor's continuing responsibility for their care under Clause 17 [Care of the Works and Indemnities]. The Contractor shall remain solely responsible for the custody, security, preservation, and insurance of all such materials, at its own cost, until they are incorporated into the Permanent Works and taken over in accordance with relevant provision of the Contract. Certification of payment under this Sub-Clause shall not constitute acceptance of the materials, nor relieve the Contractor of any obligation, liability or responsibility under the Contract, and is without prejudice to the Employer's rights under Clause 11 [Defects after Taking Over]. No further advance shall be certified under this Sub-Clause in respect

		of any material for which an advance previously certified remains outstanding, unless and until that material has been incorporated into the Permanent Works and certified as such by the Engineer. **Recovery of Advance** The amount certified under this Sub-Clause shall be recovered by deduction from amounts otherwise due to the Contractor in Interim Payment Certificates (IPCs) issued under Sub-Clause 14.6, in five (5) equal instalments, commencing with the fourth (4th) IPC issued after the IPC in which the advance was first certified. Notwithstanding the foregoing, the advance shall in all cases be fully recovered not later than the date on which eighty percent (80%) of the Accepted Contract Amount excluding Provisional Sums has been certified for payment. Where, at the time recovery is due to commence, fewer than five (5) IPCs remain between such commencement and the Second Last IPC, the instalments shall instead be recalculated, in equal amounts, so as to ensure the advance is recovered in full not later than the date on which eighty percent (80%) of the Accepted Contract Amount excluding Provisional Sums has been certified for payment. **Immediate Recovery** The outstanding balance shall become immediately recoverable if: (a) the Contract is terminated; (b) the relevant Plant or Materials are removed from the Site without the Engineer's prior written approval; or (c) the Plant or Materials are lost, stolen, damaged or otherwise rendered unsuitable for incorporation into the Permanent Works. The Employer may recover the outstanding amount from any monies due or becoming due to the Contractor, from the Performance Security, or by any other remedy available under the Contract or applicable law. **Employer's Lien** Until the advance has been fully recovered or the Plant and Materials have been incorporated into the Permanent Works, whichever occurs first, the Employer shall have a first contractual lien over the Plant and Materials to the extent of the outstanding advance. The Contractor shall not sell, remove, transfer, pledge, charge or otherwise dispose of or encumber such Plant and Materials without the prior written approval of the Engineer.
31.	14.6.2	Withholding (amounts in) an IPC **1%** of the Accepted Contract Amount.
32.	14.7(a)	Period of payment of Advance Payment to the Contractor

		Twenty-eight (28) days
33.	14.7b(i)	Period for the Procuring agency/Employer to make interim payments to the Contractor under Sub-Clause 14.6 (interim Payment) **Twenty-eight (28)** days
34.	14.7b(ii)	Period for the Procuring agency/Employer to make interim payments to the Contractor under Sub-Clause 14.13 (Final Payment) **Fifty-six (56)** days
35.	14.7(c)	Period for the Procuring agency/Employer to make final payment to the Contractor **Fifty-six (56)** days
36.	14.8	Financing charges for delayed payment: **Five percent (5%) simple interest per annum**, calculated on the outstanding amount from the date payment became due until the date of actual payment.
37.	14.11.1(b)	Number of additional paper copies of draft Final Statement: **Three (3)**, together with one (1) searchable PDF copy and one (1) editable electronic copy in a format acceptable to the Engineer.
38.	14.15	**Currencies of Payment** The Accepted Contract Amount is expressed and payable in Pakistan Rupees (PKR) only.
39.	14.15 (a)(i)	Local Currency: One hundred percent (100%) Pakistan Rupees (PKR). Foreign Currency: Not Applicable. Fixed rates of exchange: Not Applicable.
40.	14.15 (c)	Delay Damages shall be payable in Pakistan Rupees (PKR) only.
41.	14.15 (f)	Not Applicable. The Accepted Contract Amount is payable entirely in Pakistan Rupees (PKR).
Insurance (GCC Clause 19)		
42.	19.1	Permitted deductible limits insurance required for the Works: Ten percent (10%) of the amount of each and every loss, subject to a minimum of PKR 2 million and a maximum of PKR 20 million per occurrence. The deductible shall be borne solely by the Contractor and shall not relieve the Contractor of any obligation or liability under the Contract. insurance required for Goods: Nil insurance required for liability for breach of professional duty: Nil

		insurance required against liability for fitness for purpose (if any is required): Nil insurance required for injury to persons and damage to property: Nil insurance required for injury to employees: Nil other insurances required by Laws and by local practice: Nil Periods for submission of insurance: a) evidence of insurance b) relevant policies Not later than twenty eight (28) day from the Commencement Date
43.	19.2.1(b)	Additional amount to be insured: 15% of the Accepted Contract Amount
44.	19.2.1(iv)	List of Exceptional Risks which shall not be excluded from the insurance cover for the Works: Seismic/earthquake events shall be treated as an insured peril under the Works (CAR/EAR) insurance policy and shall not be excluded from cover, given the project's location in Seismic Zone 4. No other Exceptional Risks are excluded.
45.	19.2.2	Extent of insurance required for Goods: from ex-works to delivery at site Amount of insurance required for Goods: Full replacement value, including freight, insurance, and applicable duties/taxes for imported plant, equipment, and materials (including ATC and navigational systems)
46.	19.2.3(a)	amount of insurance required for liability for breach of professional duty: Full replacement value of the Works to be designed by the Contractor.
47.	19.2.3(b)	Insurance required against liability for fitness for purpose Yes Required
48.	19.2.3(c)	Period of insurance required for liability for breach of professional duty: Until the date of issue of the Performance Certificate, plus a minimum run-off (tail) period of three (3) years thereafter.
49.	19.2.4	Amount of insurance required for injury to persons and damage to property: Injury to person and Fatal case: In accordance with the Workmen's Compensation Act, or a minimum sum insured of PKR 3 million per person, whichever is greater Damage to Property: PKR 50 million for each occurrence, with no

		limit on the number of occurrences
50.	19.2.6	**Insurance** <u>Other insurances required by Laws and by local practice</u> All insurances applicable to the extent of project execution under the Federal and Provincial laws of the Islamic Republic of Pakistan, including but not limited to: Contractor's All Risk (CAR)/Erection All Risk (EAR) insurance, Third Party Liability insurance, Workmen's Compensation/Employer's Liability insurance, and Professional Indemnity insurance.
Dispute Avoidance/ Adjudication Board (GCC Clause 21)		
51.	21.1	Time for appointment of DAAB: Within 28 days form the Commencement Date
52.	21.1	The DAAB shall comprise three (03) members.
53.	21.2	Appointing entity (official) for DAAB members: Chairman Pakistan Engineering Council (PEC) from the list of PEC approved arbitrators published at its website
54.	21.6	The arbitration shall be conducted in accordance with the PEC Rules of Conciliation and Arbitration (published by the Pakistan Engineering Council), as in effect on the Base Date. If the PEC Rules are not available or cannot be applied, the arbitration shall be conducted in accordance with the Arbitration Act, 1940 (Act No. X of 1940) of Pakistan, as amended from time to time. The place of Arbitration shall be in the Employer's country: Islamabad, Pakistan

Part-B Special Provisions

GCC Sub-Clause	Amendments of, and Supplements to, Clauses in the GCC
1.1 Definitions	1.1.76 "Specification" Following is added at the end: "and consists of two parts i.e., i) "Part A - Specific Provisions"; and ii) "Part B - Technical Provisions"."
1.2 Interpretation	"and" is deleted from the end of sub-paragraph (i) and added at the end of sub-paragraph (j). Sub-paragraph (k) is added: "(k) The word "tender" is synonymous with "bid", the word "tenderer" with "bidder", the words "tender documents" with "bidding documents" and "Schedule of Prices" with "Bill of Quantities", as applicable."
1.5 Priority of Documents	The documents listed at (a) through **(l)** of this Sub-Clause are deleted and substituted with the following: (a) the Contract Agreement; (b) the Letter of Acceptance; (c) the Letter of Bid; (d) the Particular Conditions Part A - Contract Data; (e) the Particular Conditions Part B - Special Provisions; (f) the General Conditions; (g) The Priced Bill of Quantities including completed Schedules to Bid; (h) the Specification Part A - Specific Provisions; (i) the Specification Part B - Technical Provisions; (j) the Drawings; (k) the JV Undertaking (if the Contractor is a JV); and (l) any other documents forming part of the Contract. The addenda/corrigenda, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.
1.6 Contract Agreement	In the last line of the 1st paragraph the text "shall be borne by the Employer" is substituted by "shall be borne by the Contractor".
3.1 The Engineer	In sub-paragraph (a) the text "as defined in the Pakistan Engineering Council Act, 1975 (Act No. V of 1976)" is added after the words "professional engineer".
3.2	The Engineer shall obtain the consent in writing of the Employer before

Engineer's Duties and Authority

taking action under the following Sub-Clauses of these Conditions:

(a) Consenting to the subcontracting of any part of the Works under Sub-Clause 5.1 *[Subcontractors]*

(b) Any action under Sub-Clauses 8.9 *[Employer's Suspension]* and 8.12 *[Prolonged Suspension]*

(c) Issuance of "Taking Over Certificate" under Sub-Clause 10.1 *[Taking Over the Works and Sections]*.

(d) Issuing the "Performance Certificate" under Sub-Clause 11.9 *[Performance Certificate]*.

(e) Sub-Clause 13.1 *[Right to Vary]*: instructing a Variation, except;

(i) in an emergency situation as determined by the Engineer, or

(ii) if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Contract Data.

(f) Sub-Clause 13.3 *[Variation Procedure]*: approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.3.2 *[Variation by Request for Proposal]* or 13.2 *[Value Engineering]*.

(g) Certifying release of second half of the Retention Money under Sub-Clause 14.9 *[Release of Retention Money]*.

(h) Issuing Final Payment Certificate under Sub-Clause 14.13 *[Issue of FPC]*.

Any such requirement shall not be applied to any action by the Engineer under Sub-Clause 3.7 *[Agreement or Determination]*, as stated in Sub-Clause 3.2 *[Engineer's Duties and Authority]* of the General Conditions.

Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Employer.

Following is added after the words "the Employer's consent is required" in the 4th paragraph:

"stating that the Employer's consent has been obtained for that specified authority"

4.2
Performance Security

4.2.1 Contractor's Obligations

The entity issuing the Performance Security and its form shall be as under:

The Contractor shall provide Performance Security to the Employer in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 28 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 10% of the Contract Price stated in the Letter of Acceptance. Such Security shall be in the form of either (a) bank guarantee from any Scheduled Bank in Pakistan or (b) bank guarantee from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan. The Performance Security shall be binding irrespective of changes in the quantities or variations in the Works or extensions in Time for Completion of the Works which are granted or agreed upon under the provisions of the Contract. The list of approved banks is given in the Volume-II of the Contract Agreement.

In case of Joint Venture, the Performance Security shall be in the name of the Joint Venture or in the name of Lead/either firm of the JV or in ratio of shares of the individual JV partners.

Following paragraph is added at the end of this Sub-Clause:

"The amount of Performance Security shall be reduced to 50% following issue of the Taking-Over Certificate for the whole of the Works under Clause 10 of Conditions of Contract."

4.3
Contractor's Representative

In the second paragraph the text "professional engineer as defined in the Pakistan Engineering Council Act, 1975 (Act No. V of 1976) (having temporary licence in case of foreign engineer under Section 12 of the Pakistan Engineering Council Act, 1975 (Act No. V of 1976))" is added after the words "qualified, experienced".

In the 3rd paragraph the words "28 days" are substituted by "14 days". In the 2nd line of the 4th paragraph the text "or appoint a replacement" is substituted by "except appointment of a suitable temporary replacement is deployed at the Site".

4.4
Contractor's Documents

4.4.2 As-Built Records

The first paragraph is deleted and the text in the last paragraph is substituted with the following:

"The Contractor shall furnish to the Engineer 6 copies, one reproducible and one electronic copy (provided the Engineer has made available to the Contractor editable form of the Drawings) of all Drawings amended to conform to the Works as built. In case the Engineer does not make available to the Contractor editable form of the Drawings, the Contractor shall furnish to the Engineer as-built data for incorporation in the Drawings. Upon receipt of PDF versions of the as-built drawings prepared by the Engineer, the Contractor shall furnish to the Engineer 6 copies and one reproducible of these Drawings. The price of such

Drawings shall be deemed to be included in the Contract Price."

Following Sub-Clause is added:

4.4.4 Shop Drawings

The Contractor shall submit to the Engineer for review 3 copies of all shop and erection drawings applicable to this Contract as per provision of the relevant Sub-Clause of the Contract.

Review and approval by the Engineer shall not exceed 21 days and is not to be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory, and the Engineer's review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

4.8 Health and Safety Obligations

The following text is added at the end of this Sub-Clause:

"In the event of work being carried out outside the normal working hours and in the event of work being carried out at night, the Contractor shall, at his own cost, provide and maintain such good and sufficient light as will enable the work to proceed satisfactorily and without danger. The approaches to the Site and the Works where the night work is being carried out shall be sufficiently lighted. All arrangements adopted for such lighting shall be to the satisfaction of the Engineer."

4.20 Progress Reports

At the end of sub-paragraph (g) the word "and" is deleted, and at the end of sub-paragraph (h) the full stop (.) is replaced with ";", and the following new sub-paragraphs are added:

(i) planned programme for the execution of the Works for the next 56 days, to enable the Engineer to determine its programme of inspection and testing;

(j) monthly summary of daily job record indicating weather conditions, deployment of Contractor's Equipment, labour employment, local material procurement and material import, if any; and

(k) salient contractual and project information.

5.1 Subcontractors

Add the following text at the end of paragraph (ii):

"under Schedule to Bid"

The following is added at the end of the last paragraph of Sub-Clause 5.1:

"All subcontracts relating to the Works shall include provisions which entitle the Employer to require the subcontract to be assigned to the Employer under sub-paragraph (a) of Sub-Clause 15.2.3 *[After Termination]*.

The Contractor shall give reasonable opportunity to contractors from the Islamic Republic of Pakistan for subcontracts for the Works, and endeavour to employ such contractors as Subcontractors."

5.2 **Nominated Subcontractors**	5.2.2 Objection to Nomination In sub-paragraph (c), "and" is deleted from the end of (i); "." at the end of (ii) is replaced with ", and". The following is added as (iii): "(iii) be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under Sub-Clause 5.2.3 *[Payment to nominated Subcontractors]*."
6.1 **Engagement of Staff and Labour**	The following paragraph is added at the end of the Sub-Clause: "The Contractor shall, to the extent practicable and reasonable, employ staff (not less than 50%) and labour (not less than 85%) with appropriate qualifications and experience from sources within the Islamic Republic of Pakistan."
6.7 **Health and Safety of Personnel**	The existing text is substituted with the following: "In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purposes of or in connection with the Contract shall be carried out in compliance with the Safety Requirements of the Government of Pakistan, with such modifications thereto as the Engineer may authorize or direct, and the Contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose. The Contractor shall also provide all other medical services and appoint a health and safety officer at Site if stated in the Specifications. In case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means."
6.8 **Contractor's Superintendence**	Insert at the end of sub-paragraph (a) of this Sub-Clause: "or, if not, the Contractor shall make competent interpreters available during all working hours, in a number sufficient for those persons to properly perform their superintendence duties" The following text is added at the end of this Sub-Clause: "The Contractor's authorized representative and his other engineers working at site shall possess valid registration with the Pakistan Engineering Council. The Contractor's authorized representative at Site shall be authorized to exercise adequate administrative and financial powers on behalf of the Contractor so as to achieve completion of the Works as per the Contract."
6.12 **Key Personnel**	The following is inserted at the end of the last paragraph: "If any of the Key Personnel are not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer." The following Sub-Clauses 6.13 to 6.26 are added at the end of Sub-Clause 6.12:

6.13 **Foreign Personnel**	The Contractor may bring in to the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use all reasonable endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel. The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.
6.14 **Supply of Foodstuffs**	The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.
6.15 **Supply of Water**	The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.
6.16 **Measures against Insect and Pest Nuisance**	The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.
6.17 **Alcoholic Liquor or Drugs**	The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereof by Contractor's Personnel.
6.18 **Arms and Ammunition**	The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.
6.19 **Festivals and Religious Customs**	The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.
6.20 **Funeral Arrangements**	The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of its local employees who may die while engaged upon the Works.
6.21 **Forced Labour**	The Contractor, including its Subcontractors, shall not employ or engage forced labour which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
6.22	The Contractor, including its Subcontractors, shall not employ or engage

Child Labour	child labour in accordance with the relevant law(s) in force in the Islamic Republic of Pakistan.
6.23 Employment Records of Workers	The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 *[Contractor's Records]*.
6.24 Workers' Organizations	The Contractor shall comply with the relevant labour laws of Pakistan which recognize workers' rights to form and to join workers' organizations/Trade Unions of their choosing and to bargain collectively without interference.
6.25 Non-Discrimination and Equal Opportunity	The Contractor shall not make decisions relating to the employment or treatment of Contractor's Personnel on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment of Contractor's Personnel on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination. The Contractor shall provide protection and assistance as necessary to ensure non-discrimination and equal opportunity, including for specific groups such as women, persons with disabilities, migrant workers and children (of working age in accordance with Sub-Clause 6.22).
6.26 Epidemics	In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities for the purpose of overcoming the same.
7.7 Ownership of Plant and Materials	The following is added before the first paragraph: "Except as otherwise provided in the Contract," The following is added at the end of the Sub-Clause: "No Plant and/or Materials that is the property of the Employer shall be removed from the Site. If it becomes necessary to: (i) remove any item of such Plant from the Site for the purposes of repair, the Contractor shall give a Notice, with reasons, to the Engineer requesting consent to remove the defective or damaged item off the Site. This Notice shall clearly identify the item of defective or damaged Plant, and shall give details of: the defect or damage to be repaired; the place to which the defective or damaged item of Plant is to be taken for repair; the transportation to be used

(and insurance cover for such transportation); the proposed inspections and testing off the Site; and the planned duration required before the repaired item of Plant shall be returned to the Site. The Contractor shall also provide any further details that the Employer may reasonably require; or

(ii) replace any item(s) of such Plant and/or Materials, the Contractor shall give a Notice, with reasons, to the Engineer clearly identifying the item(s) of Plant and/or Materials to be replaced, and giving details of the due date of delivery to the Site of the replacement item(s).

Where any item of Plant and/or Materials has become the property of the Employer under this Sub-Clause before it has been delivered to the Site, the Contractor shall ensure that such an item is not moved except for its delivery to the Site.

The Contractor shall indemnify and hold the Employer harmless against and from the consequences of any defect in title or encumbrance or charge (except any reasonable restriction arising from the intellectual property rights of the manufacturer or producer) on any item of Plant and/or Materials that has become the property of the Employer under this Sub-Clause."

7.9
Use of Pakistani Materials and Services

The following Sub-Clause 7.9 is added after Sub-Clause 7.8:

The Contractor shall, so far as may be consistent with the Contract, make the maximum use of materials, supplies, plant and equipment indigenous to or produced or fabricated in Pakistan and services available in Pakistan, provided such materials, supplies, plant, equipment and services shall be of the required standard.

8.1
Commencement of Works

The following is added before the first paragraph:

"After signing of the Contract Agreement by both Parties," and thereafter the word "The" is replaced with the word "the".

8.5
Extension of Time for Completion

The following is added after paragraph (c): "for last five years".

11.12
Supervisory Assistance During DNP

The following Sub-Clause 11.12 is added after Sub-Clause 11.11:

If provided under the Schedule of Prices, the Contractor shall provide supervisory assistance to the Employer during the DNP for the Works. Such supervisory assistance shall be as described in the Specification for the purpose of supporting the Employer's operation and maintenance of the Plant for the period specified in the Schedule of Prices after the Date of Completion.

12.2
Method of Measurement

The following paragraph is added at the end of the Sub-Clause:

"Summary of measured quantity for payment shall be delineated item-wise under four heads, namely: 'Schedule of Prices Quantity', 'Quantity Executed To-date', 'Quantity Certified Previously' and 'Net Quantity Executed under this Certificate'."

12.3
Valuation of the Works

The following text is added at the end of the fifth paragraph of the Sub-Clause:

"Sum of overhead charges and profit for sub-paragraph (a) shall be Fifteen percent (15%)."

13.4
Provisional Sums

The following paragraph is inserted as the penultimate paragraph:

"The Provisional Sum shall be used to cover the Employer's share of the DAAB members' fees and expenses, in accordance with Clause 21. No prior instruction of the Engineer shall be required with respect to the work of the DAAB. The Contractor shall submit the DAAB members' invoices and satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those Statements submitted under Sub-Clause 14.3."

13.6
Adjustments for Changes in Laws

Text is deleted and substituted with the following:

"If, after the date 28 days prior to the latest date for submission of tenders for the Contract, there occur in the country in which the Works are being or are to be executed changes to any National or State Statute, Ordinance, Decree or other Law or any regulation or bye-law of any local or other duly constituted authority, or the introduction of any such State Statute, Ordinance, Decree, Law, regulation or bye-law, which causes additional or reduced cost to the Contractor, other than under Sub-Clause 13.7, in the execution of the Contract, such additional or reduced cost shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be added to or deducted from the Contract Price, and the Engineer shall notify the Contractor accordingly, with a copy to the Employer."

14.1
The Contract Price

The following is added at the end of the Sub-Clause:

"Notwithstanding the provisions of subparagraph (b), Contractor's Equipment, including essential spare parts, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved re-export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts, and callable in the event the Contractor's Equipment is not re-exported from the Country on completion of the Contract. A copy of the bond or bank guarantee endorsed by the customs authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon re-export of individual items of Contractor's Equipment or spare parts, or upon the completion of the Contract, the Contractor shall prepare, for approval by the customs authorities, an assessment of the residual value of the Contractor's Equipment and spare parts to be re-exported, based on the depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable

	Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the Contractor's Equipment and spare parts to be re-exported; and (b) on the initial imported value of the Contractor's Equipment and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining."
14.2 Advance Payment	14.2.1 Advance Payment Guarantee In case of Joint Venture, the Advance Payment Guarantee(s) shall be in the name of the Joint Venture or in the name of Lead/either firm of the JV or in ratio of shares of the individual JV partners.
14.7 Payment	The words "or through crossed cheque in favour of the Contractor or JV partners. The payment to JV partners shall be made at the request of the Joint Venture, if any, in the ratio of their shares specified by them" are added at the end of the Sub-Clause.
14.8 Delayed Payment	In the first paragraph, third line, the words "compounded monthly" are deleted. The text of the 2nd paragraph is deleted and substituted with the following: "The Employer shall pay to the Contractor compensation at the rate stated in the Contract Data."
15.2 Termination for Contractor's Default	15.2.1 Notice Following text is added at the end of sub-paragraph (h) of this Sub-Clause: "For the purposes of this Contract, corrupt and fraudulent practices have been defined in the Public Procurement Rules 2004." 15.2.3 After Termination The word "and" at the end of sub-paragraph (ii) of paragraph (b) is deleted, and the following paragraph is added after sub-paragraph (iii): "(iv) all Employer-Supplied Materials and/or Employer's Equipment made available to the Contractor in accordance with Sub-Clause 2.6 *[Employer-Supplied Materials and Employer's Equipment]*, and" The following text is added at the end of this Sub-Clause: "The Employer shall be entitled to sell any of the Contractor's Equipment, Temporary Works and unused materials and apply the proceeds of sale towards payment of any debt due from the Contractor to the Employer under this Clause, including any outstanding payments to the Subcontractors."
16.2 Termination by	16.2.1 Notice

Contractor	Sub-paragraph (j) is deleted in its entirety. At the end of sub-paragraph (i) "; or" is replaced with ".", and at the end of sub-paragraph (h) ";" is replaced with "; or". In sub-paragraph (f) "84 days" is replaced with "180 days" and the text "for reasons not attributable to the Contractor" is added at the end. Sub-paragraph (c) is deleted and replaced with: "(c) deliver to the Engineer all Employer-Supplied Materials and/or Employer's Equipment made available to the Contractor in accordance with Sub-Clause 2.6 *[Employer-Supplied Materials and Employer's Equipment]*; and (d) remove all other Goods from the Site, except as necessary for safety, and leave the Site." After the two instances of "Goods" in the last paragraph, the words "Employer-Supplied Materials and/or Employer's Equipment" are added.
16.3 **Contractor's Obligations After Termination**	(See amendments to sub-paragraph (c) and the last paragraph, set out above under Sub-Clause 16.2.)
17.7 **Use of Employer's Accommodation/Facilities**	The following Sub-Clause 17.7 is added after Sub-Clause 17.6: The Contractor shall take full responsibility for the care of the items of the Employer's facilities and/or accommodation, if any, as detailed in the Specification, from the date of use and/or occupation by the Contractor until the date on which such use and/or occupation is re-vested in the Employer. If any loss or damage happens to any of the above items during a time while the Contractor is responsible for its care, arising from any cause other than a cause for which the Employer is responsible or liable, the Contractor shall promptly rectify the loss or damage at the Contractor's risk and cost.
18.1 **Exceptional Events**	The words "or disorder" are replaced with "disorder or sabotage" in sub-paragraph (c) of the Clause.
18.4 **Consequences of an Exceptional Event**	The following is added at the end of sub-paragraph (b), after deleting the ".": ", including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Exceptional Events, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 19.2 *[Insurance to be provided by the Contractor]*." In sub-paragraph (c), the words "and necessarily" are added after the words "was reasonably".
19.1 **General Requirements**	Following text is added at the end of the first paragraph: "The Contractor shall, immediately after the date of the Letter of Acceptance, submit the draft of insurance policies for the Employer's

consent."

Following text is added at the end of the third paragraph:

"The Contractor shall, within the respective periods stated in the Contract Data, submit to the Engineer and the Employer (a) evidence that the insurances described in this Clause have been effected, and (b) copies of policies of the insurances described in Sub-Clauses 19.2.1, 19.2.4 and 19.2.5."

19.2 Insurance to be provided by the Contractor

19.2.5 Injury to employees

The words "sickness, disease" are deleted in the third line of the first paragraph.

The following Sub-Clause is added after Sub-Clause 19.2.6:

19.2.7 Insurance Company

"The Contractor shall be obliged to place all insurances described in this Clause with insurers listed in the Contract Data and rated by PACRA/VIS with a rating as provided in the table below:

Accepted Contract Amount (in Eq. million PKR)	Minimum Rating of Insurance Companies
Up to 1000	A (+)
1001 to no limit	AA

21.6 Arbitration

The word "international" is deleted in the sixth line of the first paragraph. The text of sub-paragraph (a) is substituted with the following:

"the Dispute shall be finally settled under the Rules of Arbitration specified in the Contract Data;"

22 Taxes

The following Clause is added after Clause 21:

The Contractor, Subcontractors and their employees shall be liable to pay income tax, withholding tax, super tax and other taxes on income arising out of the Contract. The rates and prices as stated in the Contract shall be deemed to cover all such taxes.

The rates and prices for all items of the Works stated in the Bill of Quantities shall be exclusive of Provincial Revenue Authority Sales Tax on Services.

23 Integrity Pact

If it is found and established at any stage that the Contractor or any of his Subcontractors, agents or servants have violated or been involved in violation of the Integrity Pact signed by the Contractor, then the Employer shall be entitled to:

(a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Subcontractors, agent or servants;

(b) terminate the Contract; and

(c) recover from the Contractor any loss or damage to the Employer as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agent or servants.

The termination under sub-paragraph (b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clause 15.1 to 15.4, and the payment under Sub-Clause 15.4 shall be made after having deducted the amounts due to the Employer under sub-paragraphs (a) and (c) of this Sub-Clause.

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Table: Summary of Sections (if any)

Description of parts of the Works that shall be designated a Section for the purposes of the Contract (Sub-Clause 1.1.73)	Value: Percentage[1] of Accepted Contract Amount (Sub-Clause 14.9)	Time for Completion (Sub-Clause 1.1.84)	Delay Damages (Sub-Clause 8.8)

[1] These percentages shall also be applied to each half of the Retention Money under Sub-Clause 14.9

SECTION IX: CONTRACT FORMS

Notification of Award

(On Procuring agency/Employer's letterhead)

Letter of Acceptance

[Date]. . . . . .

To: . . . . .[Name and address of the contractor]

Subject: . . . . .[Notification of Award Contract No.]

This is to notify you that your Bid dated . . . . …….[date]. . . . . …… for execution of the . . . . .[name of the contract and identification number, as given in the Bid Data Sheet] . . . . . for the Accepted Contract Amount of the equivalent of . . . . . [amount in words and figures and name of currency]. . . . ., as corrected and modified in accordance with the Instructions to Bidders, is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract, using for that purpose the Performance Security Form included in Section 9 (Contract Forms) of the Bidding Document.

Authorized Signature: .....

Name and Title of Signatory: .....

Name of Agency: .....

Attachment: Contract Agreement

Form of Contract

THIS AGREEMENT made the _____ day of _____ 20_____ between *[name and address of Procuring agency/Employer]* of Pakistan (hereinafter called "the Procuring agency/Employer") of the one part and *[name of Contractor]* of *[city and country of Contractor]* (hereinafter called "the ") of Contractor other part:

WHEREAS the Procuring agency/Employer desired that the works *[brief description of works]* should be executed by the contractor, and has accepted a Bid by the contractor for the execution and completion of these works and remedying of any defects therein, in the sum of *[contract price in words and figures]* (hereinafter called "the Contract Price").

NOW THIS CONTRACT WITNESSETH AS FOLLOWS:

1. In this Contract words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Contract, In the event of any ambiguity or conflict between the Contract Documents listed below, the order of precedence shall be the order in which the Contract Documents are listed below:-

   (a) This form of Contract;
   (b) Letter of Acceptance;
   (c) the Form of Bid and the Price Schedule submitted by the Bidder;
   (d) the Works Requirements;
   (e) the Technical Specifications;
   (f) the Drawings;
   (g) the General Conditions of the Contract
   (h) the Special Conditions of Contract,
   (i) the completed schedule including Bill of Quantities; and
   (j) [*add here: any other documents*]

3. In consideration of the payments to be made by the Procuring agency/Employer to the contractor as mentioned in this contract, the contractor hereby covenants with Procuring agency/Employer to execute the works to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Procuring agency/Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Contract to be executed in accordance with their respective laws the day and year first above written.

Signed, sealed, delivered by	Signed, sealed, delivered by

_____the _____ (for the Procuring agency/Employer)	_____the _____ (for the Contractor)
Witness to the signatures of the Procuring agency/Employer ……	Witness to the signatures of the Contractor …… ……

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Form of Performance Guarantee

To: *[name of Procuring agency/Employer]*

WHEREAS *[name of Contractor]* (hereinafter called "the contractor") has undertaken, in pursuance of Contract No. *[reference number of the contract]* dated *[insert date]* for the execution of *[insert name of the works and its brief description] (*hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the contractor shall furnish you with a Bank Guarantee by a reputable bank for the sum specified therein as security for compliance with the Contractor's performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Contractor a guarantee:

THEREFORE, WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Contractor, up to a total of *[amount of the guarantee in words and figures],* and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the Contract and without cavil or argument, any sum or sums within the limits of *[amount of guarantee]* as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the: *[insert date]*

Signature and seal of the Guarantors

_____

[name of bank or financial institution]

_____

[address]

_____

[date]

Advance Payment Security

Demand Guarantee

_____

Beneficiary: _____

Date: _____

ADVANCE PAYMENT GUARANTEE No.: _____

Guarantor: _____

We have been informed that [Inset name of the Contractor] (hereinafter called "the Contractor") has entered into Contract No. _____ dated _____ with the [insert name of the Procuring agency/Employer] (hereinafter called "the Procuring agency/Employer") for the execution of _____ (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, an advance payment in the sum _____ (_____) is to be made against an advance payment guarantee.

At the request of the Contractor, we as Guarantor, hereby irrevocably undertake to pay the Procuring agency/Employer any sum or sums not exceeding in total an amount of _____ upon receipt by us of the Procuring agency/Employer's complying demand supported by the Procuring agency/Employer's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating either that the Applicant:

(a) has used the advance payment for purposes other than the costs of mobilization in respect of the Works; or

(b) has failed to repay the advance payment in accordance with the Contract conditions, specifying the amount which the Contractor has failed to repay.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Procuring agency/Employer's bank stating that the advance payment referred to above has been credited to the Contractor on its account number _____ at _____..

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as specified in copies of interim statements or payment certificates which shall be presented to us.

The Guarantee shall remain valid up to the aforesaid date and shall be null and void after the aforesaid date or earlier if the advance made to the Contractor is fully adjusted against payments from Interim Payment Certificates of the Contractor provided that the Guarantor agrees that the

aforesaid period of validity shall be deemed to be extended if on the above mentioned date the advance payment is not fully adjusted.

_____

[signature(s)]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Bank Guarantee for Payment of Imported Equipment/Materials

Demand Guarantee

Beneficiary: _____

Date: _____

BANK GUARANTEE No.: _____

Guarantor: _____

We have been informed that *[insert name of the Contractor]* (hereinafter called "the Contractor") has entered into Contract No. _____ dated _____ with *[insert name of the Procuring Agency/Employer]* (hereinafter called "the Employer") for the execution of _____ (hereinafter called "the Contract"), and that the Contract provides for payment of ***[thirty-five percent (35%)]*** OR *[twenty percent (20%)]* of the Contract Price for imported equipment and/or materials identified in the Bill of Quantities as imported items, ***[upon submission to the Engineer of satisfactory documentary evidence of shipment]*** OR *[upon approval thereof by the Engineer]*, and against submission of an unconditional, irrevocable, on-demand Bank Guarantee.

Furthermore, we understand that, according to the conditions of the Contract, a payment equivalent to ***[thirty-five percent (35%)]*** OR *[twenty percent (20%)]* of the Contract Price in respect of *[name of the imported equipment and/or materials]*, in the sum of _____ (_____), is to be made against this Bank Guarantee, ***[such payment being due upon submission to the Engineer of satisfactory documentary evidence that the said imported equipment and/or materials have been shipped]*** OR *[such payment being due upon the Engineer's approval of the relevant imported equipment and/or materials in accordance with the Contract, prior to shipment]*.

At the request of the Contractor, we, the Guarantor, hereby irrevocably and unconditionally undertake to pay the Employer, on first written demand and without cavil or argument, any sum or sums not exceeding in total an amount of _____ upon receipt by us of the Employer's complying demand, supported by the Employer's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Contractor:

(a) has failed to ship, deliver or otherwise make available the imported equipment and/or materials in accordance with the Contract; or

(b) has failed to perform its obligations under the Contract relating to the imported equipment and/or materials for which the aforesaid payment has been made; or

(c) has failed to refund or repay the amount required to be refunded or repaid under the Contract, specifying the amount which the Contractor has failed to refund or repay.

A demand under this Guarantee may be presented only after the Employer has made the payment referred to above to the Contractor and shall be accompanied by the Employer's statement referred to herein.

This Guarantee shall remain valid until _____ ("the Expiry Date"), being a date not less than ninety (90) days beyond the anticipated **[delivery to the Site]** OR [shipment] as applicable under the Contract, and shall become null and void after the Expiry Date or earlier upon its release by the Employer.

The Employer shall release this Guarantee upon fulfillment of the obligations secured hereby, including, where applicable, delivery to the Site and acceptance by the Engineer of the imported equipment and/or materials in accordance with the Contract.

Provided that, if the anticipated **[delivery to the Site]** OR [shipment], as applicable, is delayed, the Contractor shall procure an extension of this Guarantee in accordance with the Contract. Any complying demand received by the Guarantor on or before the Expiry Date shall remain valid and payable notwithstanding that payment may be made after such date.

_____

[Signature(s) of Guarantor]

Note: *All italicised and bracketed instructions are for use in preparing this form and shall be deleted from the final executed document. This form is to be issued on the letterhead of the Guarantor (Scheduled Bank in Pakistan acceptable to the Employer) and shall be stamped/sealed and executed in accordance with the Guarantor's usual practice.*

*Use **bold italics** for the 35% payment option; retain those bracketed clauses and delete the 20% alternatives.*
Use normal italics for the 20% payment option; retain those bracketed clauses and delete the 35% alternatives.

Retention Money Security
Demand Guarantee

_____ *[Guarantor letterhead or SWIFT identifier code]*

Beneficiary: _____ *[Insert name and Address of Procuring agency/Employer]*

Date: _____*[Insert date of issue]*

RETENTION MONEY GUARANTEE No.: *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ *[insert name of Contractor, which in the case of a joint venture shall be the name of the joint venture]* (hereinafter called "the Contractor") has entered into Contract No. _____ *[insert reference number of the contract]* dated _____ with the Procuring agency/Employer, for the execution of _____ *[insert name of contract and brief description of* Works*]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, the Procuring agency/Employer retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when the Taking-Over Certificate has been issued under the Contract and the first half of the Retention Money has been certified for payment, payment of *[*insert the second half of the Retention Money *or if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money,* the difference between half of the Retention Money and the amount guaranteed under the Performance Security and, if required, the ES Performance Security*]* is to be made against a Retention Money guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ *[insert amount in figures]* (_____) *[amount in words]* upon receipt by us of the Procuring agency/Employer's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without your needing to prove or show grounds for your demand or the sum specified therein.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Procuring agency/Employer's bank stating that the second half of the Retention Money as referred to above has been credited to the contractor on its account number _____ at _____ *[insert name and address of Contractor's bank]*.

This guarantee shall expire no later than the …. day of ……, 2…, and any demand for payment under it must be received by us at the office indicated above on or before that date.

_____

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

DAAB Agreement

All italicised text and any text within square brackets (except sub-clause headings) in this form of agreement is for use in preparing the form and should be deleted from the final product.

Name and Details of the Contract

This Agreement made the _____ day of *[month]*, *[year]*, between:

Employer — Name and Contact Details

Name _____

Address _____

Telephone _____

Email / other contact details _____

Contractor — Name and Contact Details

Name _____

Address _____

Telephone _____

Email / other contact details _____

DAAB — Name and Contact Details of the Member

Member _____

Address _____

Telephone _____

Email / other contact details _____

(the "DAAB Agreement")

Whereas

A. the Employer and the Contractor have entered (or intend to enter) into the Contract;

B. under the Contract, the "DAAB" or "Dispute Avoidance/Adjudication Board" means the sole member or three members (as stated in the Contract Data of the Contract) so named in the Contract, or appointed under Sub-Clause 21.1 [Constitution of the DAAB] or Sub-Clause 21.2 [Failure to Appoint DAAB Members] of the Conditions of Contract;

C. the Employer and the Contractor desire jointly to appoint the above-named DAAB Member to act on the DAAB as:

i. the sole member of the DAAB, and where this is the case, all references to the "Other Members" do not apply; or

ii. one of three members / chairman [delete the one which is not applicable] of the DAAB and, where this is the case, the other two persons are:

DAAB Member 2	**DAAB Member 3**
_____ (name) _____ (address) _____ (telephone) _____ (email / other contact details)	_____ (name) _____ (address) _____ (telephone) _____ (email / other contact details)

the "Other Members"; and

D. the DAAB Member accepts this appointment.

The Employer, Contractor and DAAB Member jointly agree as follows:

1. The conditions of this DAAB Agreement comprise:

(a) Clause 21 [Disputes and Arbitration] of the Conditions of Contract, and any other provisions of the Contract that are applicable to the DAAB's Activities; and

(b) the "General Conditions of Dispute Avoidance/Adjudication Agreement", which is appended to the General Conditions of the "Conditions of Contract for Construction" Second Edition 2017 published by FIDIC ("GCs"), as amended and/or added to by the following provisions.

2.

[Details of amendments to the GCs, if any. For example: In the procedural rules annexed to the GCs, Rule ___ is deleted and replaced by: " ... "]

---

3. The DAAB Member shall be paid in accordance with Clause 9 of the GCs. The currency of payment shall be:

_____

In respect of Sub-Clauses 9.1 and 9.2 of the GCs, the amounts of the DAAB Member's monthly fee and daily fee shall be:

Monthly fee: _____ per month

Daily fee: _____ per day

(or as otherwise set under Sub-Clause 9.3 of the GCs).

4. In consideration of the above fees, and other payments to be made to the DAAB Member in accordance with the GCs, the DAAB Member undertakes to act as DAAB Member in accordance with the terms of this DAAB Agreement.

5. The Employer and the Contractor shall be jointly and severally liable for the DAAB Member's fees and other payments to be made to the DAAB Member in accordance with the GCs.

6. This DAAB Agreement shall be governed by the law of:

_____

(if not stated, the law that governs the Contract under Sub-Clause 1.4 of the Conditions of Contract).

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Integrity Pact

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS.10.00 MILLION OR MORE

Contract Number: _____ Dated: _____
Contract Value: _____
Contract Title: _____

[Name of Contractor] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoP) through any corrupt business practice.

Without limiting the generality of the foregoing [Name of Contractor] represents and warrants that it has fully declared the brokerage, commission, fee etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultations fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[Name of Contractor] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representative or warranty.

[Name of Contractor] accepts full responsibility and strict liability for making and false declaration, not making full disclosure, misrepresenting fact or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [Name of Contractor] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [Name of Contractor] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.

_____ _____
[Procuring agency/Employer] [Contractor]

Appendix-A

List of Approved Banks by Employer

Sr. No.	Name of Banks
Public Sector Banks	
1	National Bank Of Pakistan
2	Sindh Bank Limited
3	The Bank of Punjab
Private Sector Banks	
4	Allied Bank Limited
5	Askari Bank Limited
6	Bank Al-Habib
7	Faysal Bank Limited
8	Habib Bank Limited
9	Habib Metropolitan Bank Limited
10	JS Bank Limited
11	MCB Bank Limited
12	Samba Bank Limited
13	Soneri Bank Limited
14	Standard Chartered Bank (Pakistan) Limited
15	United Bank Limited
16	Industrial and Commercial Bank of China Limited
Islamic Banks	
17	Al Baraka Bank (Pakistan) Limited
18	Bank Islami Pakistan Limited
19	Dubai Islamic Bank (Pakistan) Limited
20	Meezan Bank Limited

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

PAKISTAN AIRPORTS AUTHORITY
(PAA)

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Volume-II
(Technical Specifications)

July 2026

PROCUREMENT REGULATORY AUTHORITY EPADS

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SECTION 0010 - GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

All civil, structural, architectural, mechanical, electrical, plumbing, fire protection, ICT, and specialist aviation systems as specified herein and shown on Contract Drawings, including all temporary works, testing, commissioning, and rectification of defects. The Contractor shall notify all subcontractors of the provisions of the Conditions of Contract. All Work shall be executed in accordance with these Specifications; inconsistencies shall be referred to the Engineer.

1.02 REFERENCES AND APPLICABLE CODES

A. In the absence of other contractually required standards, all work and materials shall conform to the following codes and standards. Where the Pakistan Building Code (BCP) requires a higher standard, the BCP shall govern.

Reference Standards

Abbreviation	Organization
AASHTO	American Association of State Highway & Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASA	American Standard Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BCP	Building Code of Pakistan
BSI / BSICP	British Standards Institute / Code of Practice
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
NFPA	National Fire Protection Association
PCA	Portland Cement Association
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
PSI / PSQCA	Pakistan Standards Institute / Standards & Quality Control Authority
UBC	Uniform Building Code
UPC	Uniform Plumbing Code

1.02.1 Technical Parameters

PARAMETER	REQUIREMENT
Seismic Zone	BCP Zone-4; Z=0.4. SMRF detailing for ATCT tower shaft minimum.

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Maximum Ambient Temperature (Equipment Qualification)	+50 °C — equipment qualification envelope; refer also to Section 0740 for CNS equipment and Section 0710 and Section 0720 for HVAC summer design
Minimum Ambient Temperature (Equipment Qualification)	–25 °C — equipment qualification envelope. For HVAC and envelope sizing, the design winter dry-bulb temperature shall be taken as –18 °C (99.6 % winter design value) per the HVAC Basis of Design. For CNS and electronic equipment, refer also to Section 0740 §1.3.
Maximum Humidity	90% RH
Snow Load on Roof	50 lbs/ft²
Wind Load	Per ASCE 7 at 2,230 m AMSL; glazing/cladding to resist calculated pressures
Building Envelope U-Value	Below 0.45 W/m²K for all opaque elements
Glazing	Double- or triple-glazed units minimum
UV Resistance	All exposed finishes/sealants/polymers: UV-resistant, high-altitude rated
Air Density Correction	0.79 × sea-level density factor at 2,230 m AMSL (HVAC/generators)

1.03 CODES, STANDARDS, AND CERTIFICATES

A. The Contractor shall maintain on site current editions of all codes and standards referenced herein, manufacturer catalogues, and published recommendations for all products used.

B. The Contractor shall provide the Engineer with manufacturer's or supplier's certificates of compliance for all products required to meet a specific code or standard.

1.04 UNITS OF MEASUREMENT

A. The International System of Units (SI) shall be used throughout the Project unless otherwise specified in the Contract Documents.

1.05 MANUFACTURER'S RECOMMENDATIONS

A. Installation, testing, and commissioning of manufactured items shall comply with manufacturer's recommended procedures or as approved by the Engineer.

1.06 EXISTING CONDITIONS

A. Drawings and information pertaining to existing conditions are provided for reference only. Neither the Employer nor the Engineer warrants their accuracy or completeness.

1.07 PROTECTION AND PRECAUTIONS

A. The Contractor and all subcontractors shall protect existing structures, roads, pavements, and other infrastructure. All damage caused by the Contractor's operations shall be repaired at the Contractor's expense.

B. The Contractor shall maintain unobstructed airside and landside traffic flow at all times and shall provide warning signs, warning lamps, and barricades as required.

C. The Air Traffic Control cabin shall be constructed and finished such that the controller shall have a 360° unobstructed view of both runway thresholds, the apron and the airfield movement areas. No plant, antenna, parapet ornament, light fixture, refrigerant line or any other obstruction shall be located within the line-of-sight cone defined on the architectural drawings.

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Any rooftop equipment shall be located outside this cone and coordinated with the Engineer before installation.

D. Refer also to Section 0750 — Airport Operational Safety Requirements — for additional construction-phase requirements applicable inside the operational area of the aerodrome.

1.08 SETTING OUT OF WORK

1.08. A General

1. Verify layout information shown on Drawings against property surveys and existing benchmarks before commencing layout. Locate and protect all existing benchmarks and control points.

2. Do not change or relocate benchmarks without prior written approval of the Engineer.

3. Promptly report lost or destroyed reference points to the Engineer. Replacements shall be based on original survey control.

4. Establish and maintain permanent benchmarks as directed by the Engineer. Record benchmark data on Project Record Documents.

1.08. B Existing Utilities and Facilities

1. Prior to site work, investigate and verify the location of all underground utilities, equipment, and construction. Record findings on the relevant plan.

2. Verify invert elevations at sanitary, storm, water, electrical, communications, hydrant refueling, airfield lighting, and firefighting utility connection points.

1.08.C Performance

1. Establish benchmarks and markers from property survey lines and levels. Calculate and measure dimensions within tolerances; do not scale Drawings.

2. Maintain a Surveyor's Log of all survey work. Record deviations and advise the Engineer when deviations exceed tolerances.

1.08.D Site Works

1. Prior to Substantial Completion, prepare a final property survey plan signed by the Contractor certifying that principal metes, bounds, lines, and levels are accurately positioned.

1.09 SEQUENCE OF CONSTRUCTION

A. Skardu International Airport is an operational facility. Site possession will be phased to maintain airport operations throughout the construction period. Security clearance of all staff and equipment shall be obtained by Contractor at their own cost per CAA/ASF rules.

B. The Contractor shall submit a proposed sequence of construction including demolition, relocation, rehabilitation, and new construction for Engineer/Employer approval.

C. The Contractor shall give not less than four (4) weeks' prior written notice when requiring possession of any section or portion of the site.

D. The Contractor shall account for weather and site conditions and shall ensure no disturbance to airport operations results from construction activities. The Contractor shall not be entitled to any claim whatsoever on account of disruption caused by weather conditions. The Contractor is expected to plan and sequence the activities according to the prevailing weather pattern of the Skardu to ensure timely completion of the project.

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1.10 LINES AND LEVELS

A. The Engineer has established survey control points. The Contractor shall verify these and shall be responsible for maintaining required locations, lines, and levels throughout execution of the Work.

1.11 PARTIAL POSSESSION

A. The Employer may take possession of or use any portion of the Work deemed suitable for use. Such use does not constitute final acceptance and does not relieve the Contractor of contract obligations.

B. If partial use increases costs or delays remaining Work, the Contractor may be entitled to an equitable adjustment.

C. If a portion proves unsatisfactory due to the Contractor's non-compliance, the Employer may continue use until corrective action is completed, not to exceed twelve (12) months unless mutually agreed in writing.

1.12 EXISTING SERVICES

A. The Contractor shall locate, identify, and protect all wiring, cables, ducts, and pipework within or adjoining the site by careful excavation under QC supervision. The Contractor shall reinstate all exploratory excavations.

B. The Contractor assumes full responsibility for the safety of existing service lines and utility structures. Any damage shall be repaired immediately at the Contractor's cost with prompt notification to the Engineer and relevant authorities.

C. Existing services intended to remain in operation shall be safeguarded, protected from damage, and supported throughout construction.

1.13 PLANT AND EQUIPMENT

A. The Contractor shall submit a detailed equipment list including type, manufacturer, model, identification number, and year of manufacture for Engineer review. All listed equipment shall be on site, inspected, and approved by the Engineer before use.

1.14 CONSTRUCTION AREA AND ACCESS

A. The Contractor shall confine operations to areas made available by the Employer and shall fence such areas accordingly. Access roads, storage areas, and haul routes shall be arranged by the Contractor at his own cost, subject to Engineer approval.

B. Security clearance and police verification of all staff shall be the Contractor's responsibility at their own cost.

1.15 STORAGE AND HANDLING

A. The Employer will provide available space within or near the site for storage of plant, equipment, and materials and for the Contractor's temporary offices. Where space is insufficient, the Contractor shall arrange alternative storage at his own cost.

B. Temporary installations shall not conflict with or interfere with permanent installations, services, or airport operations.

1.16 TESTING LABORATORY AND TESTING

A. Testing shall be performed by an approved testing agency proposed by the Contractor at no extra cost to the Employer, unless otherwise specified. The Engineer may require all testing to be conducted under his direct supervision.

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B. Where an adequate materials testing laboratory is not available nearby, the Contractor shall provide and maintain one in the vicinity of his camp, equipped with all necessary facilities.

C. The Contractor shall supply and maintain all testing equipment, apparatus, gauges, and instruments in sufficient quantities for all specified tests. Valid calibration certificates shall be provided.

D. The Contractor shall maintain complete records of all quality tests and submit them to the Engineer. All testing shall conform to applicable standards and codes.

1.17 QUALITY CONTROL

A. The Contractor shall submit a Construction Management and Quality Control Plan to the Engineer for approval, including methods, standard formats for approvals, material submittals, shop drawings, testing, and labor/equipment information.

B. Approval of the QC Plan by the Engineer does not relieve the Contractor of responsibility under the Contract.

C. The Engineer reserves the right to inspect all parts of the Work. The Contractor shall provide adequate qualified supervision and full access for the Engineer's inspection and measurement.

D. If the Engineer determines that progress is insufficient to meet the Contract schedule, the Contractor shall work overtime or in shifts at no additional cost to the Employer.

1.18 BAR BENDING SCHEDULE

A. The Contractor shall prepare reinforcement bar bending schedules with all drawing details and submit three (3) copies to the Engineer for approval.

PART 2 – SUBMITTALS

2.01 DRAWINGS

2.01.A Bidding Drawing

Drawings in Volume IV are for bidding purposes only and shall not be used as fabrication or construction documents. They may be used for preliminary material ordering subject to revision upon issue of construction drawings.

2.01.B Drawings Issued for Construction (IFC)

After Contract Award, Bidding Drawings are replaced by IFC Drawings, issued by the Engineer within 14 days from the date of commencement date, which form the basis for all shop, fabrication, erection, and installation drawings. The Contractor shall prepare and maintain a schedule of required IFC drawings and submit it to the Engineer immediately following approval of the Construction Programme.

2.01.C Study of Drawings

The Contractor shall study all IFC Drawings promptly upon receipt and immediately notify the Engineer of any errors or discrepancies.

2.01.D Copies

Drawings will be issued to the Contractor free of charge per the provisions of the Conditions of Contract.

2.02 CONTRACTOR-FURNISHED DRAWINGS AND SUBMITTALS

2.02.A Shop Drawings

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The Contractor shall prepare and submit all shop, fabrication, erection, installation, placement, and layout drawings required for the Work. Submittals shall include three (3) hard copies and one (1) soft copy (CAD + PDF). Combined services coordination drawings for all utilities shall also be submitted.

2.02.B Lift and Placement Drawings

Not less than thirty (30) calendar days prior to commencing any concrete lift or placement, the Contractor shall submit lift placement drawings showing all recesses, openings, embedded parts, and reinforcement for Engineer approval.

2.02.C Construction Plant Layout Drawings

Three (3) prints showing the layout of all principal construction plant, offices, storage areas, yards, and unloading facilities shall be submitted to the Engineer for review.

2.03 SUBMISSION AND REVIEW PROCEDURE

A. The Contractor shall prepare and submit material submittals in accordance with the Technical Specifications, the Contract Documents, and the procedures set forth herein. All submittals shall demonstrate full compliance with the specified requirements prior to submission.
   For each material item identified and defined in the Technical Specifications, the Engineer shall not grant approval to more than three (3) material submittals in total. Once three (3) approvals have been issued for a given material item, no further submittal for that material shall be entertained or processed by the Engineer, unless otherwise directed by the Employer in writing.
   Rejected material submittals shall not be counted toward the limit of three (3) approvals specified under Clause B above. The Contractor may resubmit a revised material submittal following rejection, provided the resubmission fully addresses the Engineer's stated reasons for rejection. The total number of submission attempts, whether approved or rejected, shall however not exceed five (5) per material item, after which the Contractor shall revert to the material explicitly specified in the Technical Specifications without substitution.

B. Three (3) hard copies and one (1) soft copy (PDF and CAD) of each drawing and material submittal shall be submitted via transmittal form with Submittal/Transmittal number and revision numbers.

C. The Engineer will return submittals within fourteen days (14) calendar days marked 'Approved', 'Approved/Except as Noted', or 'Revise and Resubmit'. The 14-day period commences upon receipt at the Engineer's office.

D. Upon 'Approved' or 'Approved/Except as Noted' status, the Contractor shall furnish three (3) prints plus one (1) soft copy (CAD and PDF) to the Engineer.

E. Subcontractor submittals shall be routed through the Contractor.

F. Approval of drawings by the Engineer does not constitute a complete design check and does not relieve the Contractor of his obligations to meet all specification requirements or ensure the correctness and fit of his drawings.

G. Out-of-sequence or bulk-submitted documents shall not be subject to the standard 14-day review period; associated delays shall be attributed to the Contractor.

2.04 SUBMISSION REQUIREMENTS

A. The Contractor shall schedule all submissions to arrive at the Engineer's office at least thirty (30) days before the reviewed submittals are required.

B. Each transmittal letter shall include:

- Date and project title/number
- Contractor's name and address

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- Submittal/Drawing numbers and revision numbers
- Notification of deviations from Contract Documents
- Reference to trade/discipline, specification number, and BOQ number
- Other pertinent data

2.05 RESUBMISSION REQUIREMENTS

A. Shop Drawings: Revise as required and resubmit per initial submittal requirements. Cloud all revisions for identification.

B. Product Data and Samples: Submit new data and samples as required. Resubmit within seven (7) days of receipt of Engineer's comments.

2.06 AS-BUILT DRAWINGS

A. The Contractor shall maintain on site one current copy of all Drawings and approved samples, together with applicable codes and standards.

B. The Contractor and all subcontractors shall maintain a separate marked-up set of drawings recording all deviations from the Contract Documents as work progresses.

C. At completion, the Contractor shall furnish six (6) hard copies and two (2) electronic copies (CAD and PDF) of all As-Built Drawings to the Engineer at the Contractor's expense.

2.07 PRODUCT DATA

A. Standard schematic drawings shall be modified to show only project-applicable information. Catalogue sheets and literature shall be clearly marked to identify pertinent materials, models, dimensions, and clearances.

2.08 SAMPLES

A. The Contractor shall furnish all samples as directed or specified, with reasonable promptness at their own cost.

B. Duplicate final approved samples shall be provided: one for the Engineer's office and one for the site.

C. Each sample shall be labeled with material name and quality, manufacturer's name, project name, Contractor's name, submission date, and applicable Specification article number.

D. Manufacturer's installation directions shall accompany each sample. All transportation costs are the Contractor's responsibility.

E. Samples shall be of adequate size and number to permit proper evaluation. Samples shall show the maximum expected range of variation; materials exceeding the approved range shall not be used.

F. A sample room of not less than 30 m² shall be provided for the exclusive use of the Engineer.

PART 3 – EXECUTION

3.01 ACCIDENT PREVENTION AND PROTECTIVE EQUIPMENT

A. The Contractor shall comply with and enforce the highest international standards of safety and accident prevention in conformance with applicable Pakistani laws and ordinances.

B. All workers and staff shall be provided with and required to use safety helmets, boots, gloves, and other appropriate PPE all at the Contractor's cost.

C. Barriers, fences, warning signs (in English and Urdu), and lighting shall be provided and maintained in clean, legible condition at the Contractor's cost.

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3.02 TEMPORARY FACILITIES

A. The Contractor shall provide, erect, maintain, alter as necessary, and remove on completion all temporary facilities and services. The Contractor's temporary site office shall be available within one month of site handover.

3.02.A Temporary Roads

The Contractor shall construct and maintain temporary access roads as required, per Engineer's instructions. Dust suppression by watering shall be provided as directed. Access routes shall be kept free of debris at all times.

3.02.B Temporary Water Supply

The Contractor shall supply adequate potable and construction water for all trades. He shall arrange and pay for installation, maintenance, and removal of the water service and all consumption costs. When the permanent system is operational, it may be used for construction with Engineer and Employer written approval.

3.02.C Temporary Electricity

The Contractor shall arrange, install, operate, and remove a temporary electrical service at his cost for all trades. Where a local grid connection is unavailable or insufficient, the Contractor shall provide his own supply. Temporary wiring shall meet governing code requirements. At completion, temporary services shall be removed and replaced by permanent systems upon written approval of Engineer and Employer.

3.02. D Waste Disposal

The Contractor shall provide temporary measures to dispose of chemicals, fuels, waste, and other materials without site or environmental pollution. Disposal areas shall be as directed by the local authority and approved by the Engineer. Unauthorized dumping shall be remediated by the Contractor at his cost.

3.02. E Fire Protection

Adequate fire protection (extinguishers, fire buckets, water barrels) shall be distributed throughout the site and temporary structures. Flammable liquids shall be stored in Engineer-approved safety containers, not within buildings. Torch-cutting and welding require Engineer approval and a chemical extinguisher on location. The Contractor shall comply with Civil Defence and HSE manual of PAA.

3.03 CONSTRUCTION PROGRAMME AND SCHEDULE

A. The Contractor shall prepare a detailed Construction Programme (Master Programme) using an approved CPM scheduling software (Primavera P6 or MS Project 2019 or later). The programme shall be submitted in editable native format together with a PDF copy and six (6) hardcopy plots within twenty-eight (28) days of the Notice to Proceed. The programme shall represent the full 24-month construction duration .

B. The Master Programme shall include, as a minimum: (i) work breakdown structure to Level 4 (Project — Phase — Discipline — Activity); (ii) start and finish dates for every activity; (iii) logical interdependencies (Finish-to-Start, Start-to-Start, Finish-to-Finish with leads and lags as applicable); (iv) resource loading by trade and by quantity; (v) cost loading aligned with the BOQ for the purpose of progress payment certification; (vi) critical path clearly highlighted; (vii) twenty (20) key project milestones not later than those listed; (viii) procurement schedule for all long-lead items, in particular CNS equipment, HVAC chillers and cooling towers, transformers and switchgear, lifts, and ARFF equipment; (ix) airside coordination calendar (NOTAM windows, ASF pass procurement, OLS-penetrating operations, navigation-aid coordination periods); (x) testing and commissioning sub-schedule covering MEP, ELV, CNS

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and integrated-systems tests; (xi) handover sub-schedule with as-built, O&M and training deliverables; and (xii) Defect Liability Period commencement and milestones.

C. Within fourteen (14) days of Engineer's approval, the Master Programme shall be baselined. No change to the baseline shall be made except by written Engineer's instruction or by an approved variation. The Contractor shall maintain a Baseline copy and a Current copy.

D. The Master Programme shall be updated by the Contractor on a monthly basis and submitted with the Monthly Progress Report. The update shall show actual start and finish dates, percent complete and remaining duration for every activity, and shall recompute the critical path. Any activity forecasting a slippage of more than five (5) working days against the Baseline shall be highlighted with an attached Recovery Plan describing the corrective measures, resource mobilisation, and revised forecast finish.

E. Three-Week Look-Ahead programmes shall be issued by the Contractor every Sunday for the forthcoming three weeks, identifying the activities to be executed, the inspections required, the materials required on site, and the labour and plant deployment. Look-Ahead programmes shall be tabled at the weekly Site Progress Meeting.

F. The Master Programme shall recognise the cold-climate constraints applicable to Skardu. External concrete works, external paving, external waterproofing and external finishing activities shall not be planned for the four-month winter period (typically December through March) when daytime ambient temperatures may fall below –5 °C and night-time below –18 °C, except under the specific cold-weather provisions of Sections 0150, 0340 and 0330 with prior Engineer approval. The dry-in milestone (building envelope weather-tight, roofing and external glazing complete) shall be achieved before the onset of the first winter falling within the construction period.

G. The Master Programme shall further recognise the operational constraints of an active aerodrome, in particular: (i) crane operations and other OLS-penetrating activities shall be planned within agreed NOTAM windows per Section 0750 2.1; (ii) hot work near fuel installations and works within 300 m of operational navigation aids shall be planned to discrete coordination periods with the Aerodrome Operator/ ATC of Skardu Airport; and (iii) all flight-inspection requirements for CNS equipment shall be agreed with the Aerodrome Operator / PAA and shall be programmed not later than 30 days before the Reliability Trial.

B. Delay impact assessment shall use the Window Time Analysis retrospective method or another method approved by the Engineer.

3.04 NOTIFICATION TO ENGINEER

A. The Engineer's Representative shall receive daily written notification of the nature and location of the following day's Work to enable inspection and measurement. The Engineer may require longer advance notice for specific operations.

3.05 NIGHT WORK

A. Night work shall be carried out with lighting from sunset to sunrise as directed by the Engineer. No work shall be performed when, in the Engineer's opinion, weather conditions preclude proper protection of the Work. The Night work shall be subject to approval from the relevant authority, i.e., ASF, PAF, and PAA.

3.06 COORDINATION WITH OTHER CONTRACTORS

A. The Contractor shall coordinate with all other contractors on site and ensure all embedded components (pipes, bases, etc.) are accurately and timely installed. Written sign-off from the authorized representative of other contractors shall be obtained before concreting or compaction.

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B. Losses or rework resulting from the Contractor's negligence in coordination are at the Contractor's cost. Coordination costs are deemed included in the Contract rates.

3.07 MONTHLY PROGRESS REPORTS AND PHOTOGRAPHS

A. The Contractor shall submit monthly progress reports on Engineer-approved forms, plotting actual progress against the approved programme for all contract activities.

B. Commencing after the first month and continuing monthly, the Contractor shall submit progress photographs to the Engineer's Representative.

C. The Contractor shall also submit two (2) copies of a Daily Activity Report to the Engineer's Site Office, including manpower and equipment deployed and expediting status of materials.

3.08 PHOTOGRAPHS

A. From commencement of Work, the Contractor shall provide photographic documentation from positions selected by the Engineer. Each print shall be not less than 297 mm × 210 mm and shall bear a printed description, serial number, and date.

B. Time-lapse photography shall be provided by the Contractor using a specialist photographer and equipment, producing a 3-5 minute construction video from fixed positions at regular intervals. All photography is subject to Employer and security agency approval; confidentiality of images shall be maintained. Complete records shall be submitted to the Employer at Contract completion.

3.09 HEALTH, SAFETY, AND ENVIRONMENTAL REQUIREMENTS

A. The Contractor shall provide all required PPE for Employer, Engineer, Contractor, subcontractor personnel, and visitors throughout the Contract. Minimum requirements include helmets, safety shoes, gloves, harnesses, and respiratory protection.

B. A qualified HSE Engineer shall be deployed at the site during all working hours. HSE requirements shall be integrated into the Project Execution Plan from project commencement.

C. The Contractor shall provide adequate first aid equipment and trained first aid personnel on site during all working hours.

D. All HSE facility costs shall be borne by the Contractor until issuance of the Final Payment Certificate; these costs are deemed included in the Contract rates.

3.10 SURVEY INSTRUMENTS

A. The Contractor shall provide and maintain all survey instruments, equipment, and materials necessary to perform and verify survey work at all times. Equipment shall include but not be limited to:

- Electronic Total Station
- Electronic Data Recorder
- Disto Laser Meter
- Precision Level and Invert Staff
- Automatic Levels and Power Level
- Compass, steel tape, and ranging poles
- GPS and related equipment

3.11 INSPECTION AND TEST REPORTS

A. All equipment and materials are subject to inspection by the Engineer at any time. Acceptance or waiver of inspection does not relieve the Contractor of contractual responsibility.

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B. The Contractor shall provide certified true copies of test reports for all materials in manufactured and fabricated equipment, demonstrating compliance with applicable specifications and codes.

3.12 FACTORY ACCEPTANCE TESTING (FAT)

A. Where FAT is specified, equipment shall be inspected and tested at the point of manufacture by one (1) representative of the Employer and one (1) representative of the Engineer before packing and dispatch.

B. The Contractor shall arrange all facilities, travel, visas, accommodation, and boarding for Employer/Engineer representatives at the Contractor's cost.

C. The Contractor shall provide daily allowances (in cash before departure) as follows, calculated including day of departure and day of arrival back to city of deployment:

Inspection Location	Daily Allowance per Person
Foreign inspection	USD 250 per day
Local (outside city of deployment)	PKR 20,000 per day

D. Test procedures/protocols shall be submitted for Engineer approval at least three (3) weeks before the scheduled inspection date. All relevant submittals and shop drawings shall be approved prior to commencement of production.

3.13 RESTORATION AND CLEANING

A. The Contractor at its own cost, shall perform regular cleaning throughout the Contract and shall remove all rubbish and excess materials upon completion. All temporary construction facilities, foundations, stockpiles, and waste shall be obliterated unless directed otherwise. The site and Works shall be left clean and ready for immediate use and occupation.

3.14 PROTECTION OF WORKS

A. The Contractor shall cover and protect the Works from weather and damage as necessary. Dust sheets, barriers, and guard rails shall be provided and removed upon completion. Warning signs, lamps, and barricades shall be maintained at all dangerous locations.

3.15 PRODUCT QUALITY AND HANDLING

A. Suppliers shall have been engaged in the business of manufacturing, fabricating, installing, and/or servicing the required work for not less than five (5) years. The Engineer may request:

- List of similar installations with project description, scope, and completion date
- Complete technical literature and performance data
- List of service records within Pakistan
- Location of service office capable of maintaining the installation
- Availability of a local representative in Pakistan

B. Installation, fabrication, and testing shall be performed by trained and experienced workmen. No allowance will be made for lack of skill. The Contractor shall protect all materials before, during, and after installation; damage shall be repaired immediately at no additional cost to the Employer.

PART 4 – EMPLOYER AND ENGINEER FACILITIES

4.01 ENGINEER'S SITE OFFICE

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Within thirty (30) days of Contract signing or Notice to Commence (whichever is earlier), the Contractor shall supply, construct, erect, and fully commission pre-engineered/pre-fabricated insulated structures / building complete in all respects, ready for use for the Engineer's Site Office at a location designated by the Engineer as per provided design / drawings. All costs shall be borne by the Contractor. The Engineer's office shall at minimum consist of the following:

Unit	Size	Description	Qty
Office Rooms	Equivalent to 30 m^2	Pre-fabricated insulated structure, individual electrical sockets, individual distribution boards, air-conditioned (heating and cooling), backup generator connection	3
Engineer's Representative Office	Equivalent to 30 m2	Pre-fabricated insulated structure, attached toilet, backup generator connection, full furnishings (executive desk, chairs, filing cabinets, shelving)	1
Toilet Block	Equivalent to 20 m2	Pre-fabricated insulated structure, six (6) toilet cubicles with all sanitary accessories, soakage pits, mechanical ventilation	1
Records Room	Equivalent to 30 m2	Pre-fabricated insulated structure, air-conditioned, backup generator connection, shelving and storage systems	1

B. Minimum furniture for Engineer's offices:

Item	Quantity
Wooden office table 4' × 6' with filing rack and drawers	6
Officer's revolving chairs	6
Wooden visitor chairs with arms	18
Wooden table 3' × 5' with revolving chair, 2 visitor chairs, side and full-height racks	20
Steel filing cabinet (standard size)	10

C. The Contractor shall undertake grading and landscaping of the area around site offices, supply all office consumables and stationery, POL for generators, hire two (2) office boys, provide cleaning and security staff, supply drinking water dispensers, potable water, power, five (5) landline telephone connections, and internet.

D. All facilities shall be maintained by the Contractor until issuance of the Defect Liability Certificate. All the facilities and equipment provided under this clause shall becomes the property of the Employer and shall be handed over in serviceable condition.

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4.02 ENGINEER'S OFFICE EQUIPMENT

A. The following new equipment shall be provided within thirty (30) days of Contract signing and maintained, including consumables, until the Defect Liability Certificate:

Description	Qty
Laptop – Intel Core Ultra 7 / Intel Core i7 (14th Generation or later), minimum 16 GB DDR5 RAM, 1 TB NVMe SSD, 15.6" FHD IPS Display, Wi-Fi 6E, Bluetooth, HD Webcam, Windows 11 Pro, carrying bag (HP/Dell/Lenovo or approved equivalent)Laptop – Core i7, 11th Gen, 8 GB RAM, 512 GB SSD, 15.6" FHD, and Official Microsoft Office Software (HP/Dell or approved equivalent)	03
All-in-One Desktop Computer – Intel Core Ultra 7 / Intel Core i7 (14th Generation or later), minimum 16 GB DDR5 RAM, 1 TB NVMe SSD, integrated graphics, minimum 27-inch Full HD (1920 × 1080) anti-glare display, integrated webcam, speakers and microphone, wireless keyboard and mouse, Gigabit Ethernet, Wi-Fi 6E, Bluetooth, Windows 11 Pro (HP/Dell/Lenovo or approved equivalent)Desktop Computer – Core i7, 11th Gen, 4 GB RAM, 1 TB HDD, with monitor, keyboard, mouse, and Microsoft Office Software (HP/Dell or approved equivalent)	04
Laser MFP (copier/scanner/printer) – HP MFP M725 or approved equivalent	02
Laser Printer – HP LaserJet Pro M402dn or latest model or approved equivalent	02
Color Laser Printer – HP CP5225 or latest model or approved equivalent	01
Large Format Plotter / Technical Printer – Capable of printing engineering drawings, maps and architectural plans up to A0 size (36-inch width minimum), color printing, minimum print resolution 2400 × 1200 dpi, roll-feed and sheet-feed support, network connectivity (Ethernet/Wi-Fi), compatible with AutoCAD, GIS and PDF workflows, complete with stand and starter ink set (HP DesignJet, Canon imagePROGRAF, Epson SureColor or approved equivalent)	01

B. All equipment / computers and laptops shall be networked to the printers. Equipment becomes the Employer's property upon issuance of Defect Liability Certificate and shall be handed over in serviceable condition.

4.03 ENGINEER'S TRANSPORT

A. The Contractor shall provide the following brand-new vehicles with drivers within thirty (30) days of Contract signing:

Vehicle	Qty
Honda BR-V i-VTEC S (CVT) (Brand New)	01
Toyota Hilux Revo Rocco (Brand New)	01

B. The Contractor shall bear all costs for registration, taxes/duties, comprehensive insurance, fuel (250 liters per month per vehicle), maintenance at authorized service centers, and drivers' pay until issuance of the Defects Liability Certificate. Specified vehicles shall continue until the issuance of Defect Liability Certificate. Thereafter, vehicles become the Employer’s property.

4.04 ENGINEER'S ACCOMMODATION

A. The Contractor shall, at its own cost and responsibility, provide fully furnished residential accommodation for the Engineer’s personnel for the entire duration of the Contract up to and including issuance of the Defect Liability Certificate. The accommodation shall be provided in either of the following options, subject to the Employer’s approval:

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Option A:

One (01) fully furnished house comprising not less than ten (10) bedrooms with attached bathrooms, along with one (1) living/sitting/TV room, one (1) dining room, one (1) kitchen, and one (1) store room.

Option B:

Two (02) fully furnished houses, each comprising not less than five (05) bedrooms with attached bathrooms per house. Under this option, at least one (1) house shall additionally include one (1) living/sitting/TV room, one (1) dining room, one (1) kitchen, and one (1) store room.

All accommodation shall be located within reasonable proximity to the Project Site, as approved by the Employer. The Contractor shall be fully responsible for all costs, charges, and liabilities relating to the accommodation, including but not limited to rent, utilities, and operational services. This shall include electricity, gas, potable water, internet services, and uninterrupted power supply through 24-hour generator backup along with fuel (POL) costs or solar system backup. No additional reimbursement shall be admissible on any account whatsoever.

B. All accommodation provided under Sub-clause 4.04A shall be fully furnished, operational, and maintained in habitable condition at all times. As a minimum requirement, each house shall include the following:

- One (01) 72-inch LED television for the living room;
- One (01) 2.0-ton inverter type air conditioner for the living room;
- One (01) 2.0-ton inverter type air conditioner for the dinning room;
- One (01) sofa set (minimum thirteen-seater) for the living room;
- One (01) dining table with seating capacity for at least twelve (12) persons;
- One (01) double bed set per bedroom, including wardrobes/cupboards, dressing table, foam, bed sheets, pillows complete in all respect;
- One (01) large refrigerator at least 15cft;
- One (01) deep freezer;
- One (01) automatic washing machine;
- Television connectivity (cable/satellite) in all rooms.

All equipment shall be new or in “as-new” condition and shall be subject to inspection and acceptance by the Employer.

C. The Contractor shall deploy and maintain adequate trained support staff for housekeeping, catering, maintenance, and security services, including but not limited to cooks, cleaners/sweepers, helpers, and security guards.

Such personnel shall be available on a 24-hour basis as required to ensure cleanliness, safety, and proper functioning of the accommodation facilities.

The Employer reserves the right to inspect, approve, reject, or require replacement of any accommodation, furnishing, equipment, or services that do not comply with these Employer’s Requirements. Any non-compliance shall be rectified by the Contractor at its own cost within a timeframe specified by the Employer.

4.05 EMPLOYER'S SITE OFFICE

Within thirty (30) days of Contract signing or Notice to Commence (whichever is earlier), the Contractor shall supply, construct, erect, and fully commission pre-engineered/pre-fabricated insulated structures / building complete in all respects, ready for use for the Employer's Site Office at a location designated

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by the Engineer as per provided design / drawings. All costs shall be borne by the Contractor. The Employer's office shall at minimum consist of the following

Unit	Description
General Office Rooms	Pre-fabricated insulated structures, air-conditioned, individual electrical sockets and distribution boards, fully furnished (desks, chairs, filing cabinets, computers, printers)
Project Director Office	Pre-fabricated insulated structures, air-conditioned, individual electrical sockets and distribution boards, fully furnished (desks, chairs, filing cabinets, computers, printers)
Conference Room	Pre-fabricated insulated structure with: three (3) 1.5-ton reversible ACs; conference table for 30 persons; 30 executive revolving chairs; 10 low-back chairs; 85-inch QLED screen; multimedia system; video-link; executive bathroom; kitchenette; generator connection. The Conference shall also be equipment with Audio-Video IP Conference System including but not limited to HD camera, microphone array, LED connectivity, decoder, static IP CIR connection, complete AV integration
Toilet Block	Pre-fabricated insulated structure, six (6) toilet cubicles with all sanitary accessories, soakage pits, mechanical ventilation
Record Room	Pre-fabricated insulated structure, air-conditioned, backup generator connection, shelving and storage systems

B. Furniture for Employer's offices:

Item	Quantity
Wooden office table 4' × 6' with filing rack and drawers	6
Officer's revolving chairs	6
Seven Seater Sofa Set	1
Wooden visitor chairs with arms	20
Wooden table 3' × 5' with revolving chair and side/rear racks	12
Steel filing cabinet (standard size)	2

C. The Contractor shall provide cleaning staff, security, drinking water, potable water for sanitation, power, internet, and landline telephone connections with all utility bills paid. All facilities shall be maintained until the Defect Liability Certificate. All facilities shall be maintained by the Contractor until issuance of the Defect Liability Certificate. All the facilities and equipment provided under this clause shall becomes the property of the Employer and shall be handed over in serviceable condition.

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4.06 EMPLOYER'S OFFICE EQUIPMENT

Description	Qty
Laptop – Intel Core Ultra 7 / Intel Core i7 (14th Generation or later), minimum 16 GB DDR5 RAM, 1 TB NVMe SSD, 15.6" FHD IPS Display, Wi-Fi 6E, Bluetooth, HD Webcam, Windows 11 Pro with Official Microsoft Office Software carrying bag (HP/Dell/Lenovo or approved equivalent	05
All-in-One Desktop Computer – Intel Core Ultra 7 / Intel Core i7 (14th Generation or later), minimum 16 GB DDR5 RAM, 1 TB NVMe SSD, integrated graphics, minimum 27-inch Full HD (1920 × 1080) anti-glare display, integrated webcam, speakers and microphone, wireless keyboard and mouse, Gigabit Ethernet, Wi-Fi 6E, Bluetooth, Windows 11 Pro with Official Microsoft Office Software (HP/Dell/Lenovo or approved equivalent)	05
Laser MFP (copier/scanner/printer) – HP MFP M725 or latest approved equivalent; networked to all computers	02
Color Printer A3 – Epson L1800 or latest approved equivalent	01
Heavy Duty Duplex Scanner with Autofeed System – High-volume production scanner, minimum 50 ppm / 100 ipm duplex scanning, 100-sheet automatic document feeder (ADF), daily duty cycle ≥ 8,000 pages, support for mixed media and cardstock, USB 3.0 connectivity (built-in or optional Ethernet), TWAIN/ISIS drivers. (Epson DS-870 or Ricoh fi-8150 or approved equivalent)	02
Photocopier Machine with A4/A3 Copy Capability – Latest generation digital copiermonochrome (as required), minimum 45 ppm A4 copy/print speed, A3 copy / print capability, dual-sided automatic document feeder, network ready, scan to email/folder, duplex printing, 7-inch or larger touch panel. (Canon imageRUNNER ADVANCE DX C5850, Ricoh IM C4510, Xerox AltaLink C8245, or approved equivalent)	01

All equipment becomes the Employer's property upon issuance of the Defects Liability Certificate and shall be handed over in serviceable condition.

4.07 EMPLOYER'S TRANSPORT

Vehicle	Qty
BYD Shark 6 DMO AWD Premium	01
Changan Oshan X7 Future Sense 7-Seat	01
Honda BR-V i-VTEC S (CVT)	01

All costs including registration, taxes/duties, insurance, fuel (250 liter per vehicle per month), maintenance, and drivers' pay are the Contractor's responsibility until the issuance of Defect Liability Certificate. Vehicles become the Employer’s property thereafter.

4.08 EMPLOYER'S ACCOMMODATION

A. The Contractor shall, at its own cost and responsibility, provide fully furnished residential accommodation for the Employer’s personnel for the entire duration of the Contract up to and including issuance of the Defect Liability Certificate. The accommodation shall fully comply with the requirements specified under Clauses 4.04(A), 4.04(B), and 4.04(C), which shall be deemed to form an integral part of and be fully applicable to the accommodation to be provided under this Clause.

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4.09 PENALTIES FOR NON-COMPLIANCE OR DELAYED PROVISION OF FACILITIES

A. In case of non-provision, partial provision, or delayed provision of any facility required under the Contract, the following penalties shall be imposed. The penalties shall apply without prejudice to any other rights or remedies available to the Employer under the Contract:

Sr. No.	Description of Default	Time Allowed	Penalty / Fine
1	Non-provision of Engineer's / Employer's Site Office in accordance with Clauses 4.01 and 4.05, including any substantial part thereof or associated equipment	Within 30 days from issuance of Notice to Commence (NTC)	PKR 1,000,000 per month or part thereof of delay
2	Non-provision of Engineer's / Employer's Office Equipment in accordance with Clauses 4.02 and 4.06, including any individual item or component including subsequent replacement / repair.	Within 30 days from issuance of NTC	PKR 50,000 per month per item or component not provided
3	Non-provision of Engineer's / Employer's Transport in accordance with Clauses 4.03 and 4.07, including any vehicle or unit	Within 30 days from issuance of NTC	PKR 500,000 per month per vehicle not provided
4	Non-provision of Engineer's / Employer's Accommodation in accordance with Clauses 4.04 and 4.08, including any part thereof	Within 30 days from issuance of NTC	PKR 500,000 per month or part thereof of non-compliance
5	Non-availability or interruption of utilities (electricity, gas, internet) for Engineer's or Employer's office	Within 30 days from issuance of NTC / Interruption for more than one day	PKR 100,000 per month or part thereof
6	Failure to pay utility charges for Employer's accommodation	Within 30 days from issuance of NTC / interruption for more than one day / expiry of due date of utility company	PKR 100,000 per month or part thereof
7	Failure to provide required support staff including peons, security staff, cook, drivers and cleaning staff as per Contract requirements	Within 30 days from issuance of NTC / absence of any of the staff for more than 7 days.	PKR 5,000 per day per person not provided

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PART 5 – ADMINISTRATIVE REQUIREMENTS

5.01 PERMITS

A. The Contractor shall secure and pay for all required approvals, permits, and inspections from governmental or other controlling agencies before commencing any Work. Official records of permits shall be turned over to the Engineer/Employer. No reimbursement will be made.

5.02 FAA ADVISORY CIRCULARS

A. In the event of any contradiction between the Drawings and Specifications and FAA Advisory Circular Nos. AC 150/5370-10H, AC 150/5320-6G, and AC 150/5380-6C, the more stringent requirement shall govern as determined by the Engineer, with no financial implications to the Employer. Measurement and payment clauses of respective specification sections shall remain unchanged.

5.03 WARRANTIES

A. The Contractor shall provide equipment warranties as specified in the relevant specification sections. Warranty periods commence from the effective date of the Taking Over Certificate. Warranties shall be endorsed in the Employer's name, with an undertaking from the OEM and local representative to provide warranty services to the Employer.

5.04 MEASUREMENT & PAYMENT OF WORK

The cost of providing and maintenance of above facilities during the construction period and Defects Liability Period shall not be paid separately to the Contractor and all costs shall be deemed to have been included by the Contractor in rates/ amounts of other items of BOQ.

If the aforementioned facilities are not provided within the time specified above, then the Contractor shall bear all expenses, such as rents incurred by the Engineer/ Employer due to the failure of the Contractor to complete and handover the said facilities and any of their fittings, furniture, equipment and associated hiring of staff/ drivers etc.

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0020 - DIVERSION AND TRAFFIC CONTROL PLAN

PART 1 – GENERAL

1.01 SUMMARY

The Contractor shall be responsible to provide a comprehensive traffic control plan for the safety of vehicular and pedestrian traffic during construction. Shop drawing for this purpose shall be submitted to the Engineer for approval. The Traffic Control Devices shall comprise but not be limited to Barricades/Fences, Cones, Warning Signs, Warning Lights etc. The Contractor will specify the number and details of the traffic control devices he intends to use in the traffic control plan. Items that should be considered in preparing traffic control plans include but not limited to the following:

(a) The Contractor shall construct detour roads as per approved road pavement section.

(b) Detour alignment and surface that will allow traffic to pass smoothly around the work zones. The surface of the travelled way, whether located within the construction area or on a detour, should be maintained in a condition that will permit the safe movement of traffic at a reasonable speed.

(c) Adequate tapers are needed for lane drops or at locations where traffic must be shifted laterally.

(d) Adequate traffic control devices and pavement markings for complete day and night effectiveness must be provided, including specification of temporary marking materials that can be removed when traffic lane patterns change.

(e) Roadway illumination and warning lights should be used where required. Steady burning lights are used to delineate a continuous travel path through or around a work zone. The very short "on" time of flashing lights does not enable motorists to focus on the light and make a depth perception estimate. The use of flashers is limited to mark single hazards, marking the start of a section using steady burn lights, and for use with traffic control signs.

(f) The location of cones, delineators, drums, barriers, or barricades, as means of channelizing traffic, should be detailed in the traffic control plans when special conditions exist or it not shown in the standard plans.

(g) If not provided for in the specifications, requirements regarding the removal of signs and markings from the job site, when they are no longer needed, should be noted on the traffic control plans.

PART 2 – SUBMITTALS

2.01 SHOP DRAWINGS

The Contractor shall prepare and submit a comprehensive Traffic Control Plan shop drawing to the Engineer for approval prior to commencement of any work that affects vehicular or pedestrian traffic. The plan shall detail all traffic control devices, their locations, and the sequence of implementation.

PART 3 – EXECUTION

3.01 IMPLEMENTATION

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The Contractor shall implement the approved Traffic Control Plan throughout the duration of construction. All traffic control devices shall be installed, maintained, and removed in accordance with the approved plan and as directed by the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0030 - CONTRACTOR'S CAMP

PART 1 – GENERAL

1.01 SCOPE

The work to be done under this item consists of construction, erection, installation and maintenance of the Contractor's Project Site Offices or main camp and the Contractor's sub-camps or temporary camps, if any, and shall include all offices, shops, warehouses, and other operational buildings; all housing and related facilities including accommodations for the Contractor's personnel. Contractor's Camp may not be located within project site.

1.02 GENERAL

The location of the Contractor's camps, including all buildings, utilities and facilities thereof, and of the camps or establishments of all persons/parties in the vicinity operating or associated with the Contractor shall be subject to approval of the Engineer.

The work to be done under this item will terminate upon the issuance of the Taking over Certificate. However, if directed by the Engineer or the Employer, the Contractor shall continue such work to the extent required by the Contractor's personnel during the Defects Liability Period or until the certification of the final Bill by the Engineer. No compensation shall be paid for the continued operation and maintenance of the Contractor's Camps during the extended Period.

Upon completion of the Works, or at such time within the Defects Liability Period as directed by the Engineer, the Contractor shall remove all buildings, utilities and other facilities from the Site and restore all camp areas to a neat and clean condition. The Employer may opt to retain any or all of the above-mentioned facilities for his use after the completion of the works, in which case the Contractor shall have no claim on these facilities.

Contractor shall protect the environmental interests and HSE (Health, Safety & Environmental) regulations at camp and works sites during execution of the contractual work.

1.03 CODES AND STANDARDS

The construction, operation and maintenance of all camps of the Contractor shall comply with all applicable provisions of current Pakistan Labour Camp Rules.

PART 2 – SUBMITTALS

2.01 SUBMITTALS

The Contractor shall submit to the Engineer for approval the following prior to establishment of camp facilities:

A. Proposed location and layout plan of the Contractor's camp, sub-camps, and all associated facilities.

B. Details of all buildings, utilities, and services proposed for the camp.

C. HSE plan for camp operations.

PART 3 – EXECUTION

3.01 MAINTENANCE

The Contractor shall furnish, make arrangements for, and carry out proper and adequate maintenance of the Contractor's Camp areas at such camp to provide a neat, well-kept camp in all respects with pleasant and healthy surroundings and conditions for all occupants of

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their camp. The Contractor's camp shall be kept clean, well-graded, free from undergrowth and bushes, and adequately drained. Roads and streets shall be kept in good condition. All utilities shall be adequately and properly operated and maintained to provide services and conditions meeting the requirements of these specifications in all respects.

Adequately equipped and properly staffed portable first aid stations or dispensaries shall be provided by the Contractor at camps and other strategic locations to administer first aid treatment at any time required and free of charge to all persons on the Site, including employees of the Engineer and the Employer.

All the facilities developed by the Contractor for his personnel shall be well ventilated and in line with the extreme weather conditions of Skardu. In any case, a steel structure without insulation will not be allowed for office/residential accommodation of the Contractor's Staff. Access of Employer/Engineer to Contractor Camp shall be ensured all times.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0040 - STAKE-OUT SURVEY

PART 1 – GENERAL

1.01 SCOPE

The work to be done under this item the Contractor shall make the stakeout survey for construction purposes with competently qualified men, consistent with the current practices. The work shall proceed immediately upon the award of the Contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stakeout survey. The scope of this section of specifications is covered by detailed specifications as laid down herein.

PART 2 – PRODUCTS

2.01 MATERIAL AND EQUIPMENT

All instruments, equipment, stakes and other material necessary to perform all work shall be calibrated and provided by the Contractor. These instruments and equipment shall be available to Engineer at all times for the purpose of checking the work of the Contract.

All stakes used shall be of a type approved by the Engineer, clearly and permanently marked so as to be legible at all times. It shall be the Contractor's responsibility to maintain these stakes in their proper position and location at all times. Any existing stakes or markers defining property lines and survey monuments which may be disturbed during construction shall be properly tied into fixed reference point before being disturbed and accurately reset in their proper position upon completion of the work.

PART 3 – EXECUTION

3.01 CONSTRUCTION

The Contractor shall trim trees, bushes and other interfering objects, not consistent with the plan, from survey lines in advance of all survey work to permit accurate and unimpeded work by his stake-out survey crews and the Engineer's survey crews. The Contractor shall mark/locate/identify all features/facilities which require to be dismantle and obtain approval of the Engineer before proceeding with the dismantling/relocation activities. The exact position of all work shall be established from control points, which are shown on the plans or modified by the Engineer. Any error, apparent discrepancy in or absence of data shown or required for accurately accomplishing the stakeout survey shall be referred to the Engineer for interpretation or furnishing when such is observed or required.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc. throughout the life of the Contract. Damaged, destroyed, or inaccessible reference points, benchmarks or stakes shall be replaced by the Contractor. Existing or new control points that will be or are destroyed during construction shall be re-established and all reference ties recorded thereon shall be furnished to the Engineer. All stakeout survey work shall be referenced to the centrelines shown on the Plans. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be kept neatly and made available to the Engineer upon request and furnished to the Employer upon Contract completion.

The Engineer may check all, or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be immediately made. Such checking by the Engineer shall not relieve the Contractor of any of his responsibilities for the accuracy or completeness of his work.

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Reference points, base lines, stakes and benchmarks for borrow pits shall be established by the Contractor.

All required right-of-way and easement limits shall be established, staked and referenced by the Contractor concurrent with the construction stakeout survey.

The Contractor shall place at least two offset stakes or references at each centre lines station and at such intermediate stations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly marked with the correct centre line, station number, offset and cut or fill so as to permit the establishment of the true centre line location during construction. He shall locate and place all cut, fill, slope, line grade or other stakes and points as the Engineer may direct to be necessary for the proper progress of the work.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0050 - CLEARING AND GRUBBING

PART 1-GENERAL

1.1 Scope

Clearing and grubbing shall consist of clearing the designated area of all trees, down timber, snags, bush, other vegetation, rubbish and all other objectionable material, and shall include grubbing stumps, roots, and matted roots, and disposal of all spoil material resulting from the clearing and grubbing. It shall also include the removal and disposal of structures that protrude, encroach upon, or otherwise obstruct the work, except when otherwise provided for on the plans or directed by the Engineer to be saved. The scope of this section of specifications is covered with detailed specifications laid down herein.

PART 2-LIMIT OF AREA

The Engineer will define the limit of areas where clearing and grubbing is to be done. Normally it will include all land within the right of way and all other construction area including ditches, detours, minor road crossings and other areas shown on the plans or as specified or as directed by the Engineer. The Engineer will designate the fences, structures and debris and trees and bushes to be cleared where grubbing is not required. It shall not include clearing and grubbing of borrow or other pit areas from which material is secured. It shall include the leveling or removal of all bunds or mounds within the right of way unless otherwise directed by the Engineer.

PART 3-PRODUCTS

Not used

PART 4-EXECUTION

4.1 Grubbing and Cutting

All roots and stumps within the limits of the site shall be grubbed and excavated unless otherwise specified or approved by the Engineer.

4.2 Disposal

The Contractor shall be responsible for disposal of any materials not required at site within specified time after cutting and filling unless otherwise approved. All wood and bushes shall be disposed of within fifteen (15) days after cutting or falling unless otherwise approved. No tree trunks, stumps, debris or other objectionable material shall be left within Site unless approved in writing by the Engineer. The location of disposal areas shall be within the Contract limits of the project or as approved in writing by the Engineer and shall be acquired by the Contractor at his own expense. All materials whatsoever designate as reusable shall be stockpiled or stored safely by the Contractor at approved locations and shall remain the property of the Employer.

4.4 Protection and Restoration

The Contractor shall prevent all damage to pipes, conduits, wires, cables or structures above or below ground. No land monuments, property markers, or official datum points shall be damaged or removed until the Engineer has witnessed or otherwise referred their location and approved their removal. The Contractor shall so control his operations as to prevent damage to trees and shrubs, which are to be preserved. Protection may include fences and boards lashed to trees to prevent damage from machine operations. The Contractor shall protect the environmental interests / conditions of the areas of camp and work site. The existing covered or open benchmarks should be relocated as directed by the Engineer. In the event that anything specified herein to be saved and protected is damaged by the Contractor; such damages shall immediately be repaired or

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replaced by the Contractor at his own cost to the satisfaction of the Engineer. All areas cleared and grubbed must be approved by the Engineer or Engineer's Representative before the start of cleaning operations.

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PART 5- MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0060 - STRIPPING OF TOPSOIL

PART 1-GENERAL

1.1 Scope

The work under this section of the specifications shall consist of furnishing all plant, labor and equipment and performing all operations in connection with stripping of topsoil, removal and disposal of unsuitable and surplus material in accordance with the specification and the lines, grades and levels as shown on the drawings or as directed by the Engineer.

PART 2-PRODUCT

Not used

PART 3-EXECUTION

The Contractor shall jointly survey the area marked on the drawings or designated by the Engineer and prepare the survey drawings showing pre-work levels and cross-section and submit to the Engineer for approval prior to the start of any stripping of top soil up to the depth as shown on drawings or mentioned on BoQ. Any area that shall be stripped to thickness more than the specified thickness shall be approved by the Engineer prior to the start of the work. All related drawings shall be submitted for the approval of the Engineer before stripping operations are started. Approval of the Engineer for further stripping shall be required before proceeding for further stripping if required.

All suitable material from stripping of top soil shall be transported to and placed in fill areas or stock piled as directed by the Engineer. All material declared by the Engineer as unsuitable or surplus shall be removed and disposed of in areas as designated by the Engineer.

Over stripping, unless otherwise directed, shall not be acceptable, and the Contractor shall backfill to the required levels and grades and compact to 90% of maximum dry density as determined by ASTM D 1557 at his own expense. Stripping will not be carried out on areas where rock is exposed on the surface.

The finished grade surface shall be smooth and even, and the tolerance from the required grade shall not be more than 25mm.

Stripping of topsoil beyond the depth of 300 mm shall be treated as excavation and shall not be considered as stripping.

Space created after stripping up to the required depth shall be filled with the material as directed by the Engineer and shall be dealt with separately under the relevant item.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0070 - DEMOLISHING & DISMANTLING WORKS

PART 1 – GENERAL

1.01 SCOPE

The work covered by this Section of the Specifications consists of furnishing all plant, labour, equipment, appliances and performing all operations in connection with demolition/dismantling and removal of existing structures, sheds, asphalt road, pavement, kerbs, medians, foundations, stone pitching, approaches/platforms, buildings, boundary walls, trees, plants, removal of services with accessories and embankments, stone ballast, sub base and base course, plain & reinforced concrete and brick/concrete/block masonry structures within and around the proposed construction area for the New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu, including disposal of demolished/dismantled and removed material to designated places or handing over of useable material to Employer. Whole work shall be done in accordance with these specifications and as directed by the Engineer.

1.02 GENERAL REQUIREMENTS

A. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed, unless otherwise directed. Materials that cannot be removed daily shall be stored in areas specified by the Engineer. In the interest of conservation, salvage shall be pursued to the maximum extent possible. The usable/salvaged material shall become the property of the Employer.

B. Dismantling works including demolition/dismantling of existing pavement, structures, facilities, redundant utility network and manholes (as identified by the Engineer) at any depth & level, stacking of useable material its handing over to Employer and disposal of debris/unused/demolished/removed materials, including loading, unloading and transporting complete in all respect to designated places and up to any lead or as directed by the Engineer. The works shall require to be carried out with reference to the requirements of the particular sections of specifications listed below and without damaging all operational existing utility network/services connections and ensuring uninterrupted airport operations and safe movement within Skardu International Airport during construction of the New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities:

Section 0050 – Clearing and Grubbing
Section 0060 – Stripping of Soil
Section 0070 – Dismantling Works

Contractor shall conduct a pre-work survey of the entire proposed construction area for the ATCT, Fire Station and Allied Facilities and shall submit program for carrying the works specified here for approval of the Engineer prior to execution.

C. All existing structures and utilities obstructing the construction shall be demolished/relocated as directed by the Engineer. For further details and extent of demolition & dismantling works refer to drawings.

PART 2 – SUBMITTALS

2.01 SUBMITTALS

The procedures proposed for the accomplishment of the work shall be submitted for Engineer review prior to commencement.

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The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

PART 3 – EXECUTION

3.01 DUST CONTROL

The amount of dust resulting from demolition shall be controlled using construction safety cloths to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it could result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

3.02 PROTECTION

3.02. A Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

3.02. B Protection of Buildings to be Demolished / Dismantled

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, may be allowed to remain standing without additional bracing, shoring, or lateral support until demolished. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

3.02.C Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the User; any damaged items shall be repaired or replaced as approved by the Engineer. The Contractor shall coordinate the work of this section with all other works and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

3.02. D Protection From the Weather

The usable and salvageable materials shall be protected from the weather at all times until handing over to the Employer.

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The Contractor shall also prevent ingress of rain water/surface runoff or water from any source into excavation/dismantled area.

3.02. E Protection of Trees

Trees within the project site which might be damaged during demolition and which are indicated to be left in place shall be protected by a 1.83 m high fence. The fence shall be securely erected a minimum of 1.5 m from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Engineer.

3.03 BURNING

The use of burning at the project site for the disposal of refuse and debris shall not be permitted.

3.04 USE OF EXPLOSIVES

Use of explosives shall not be permitted.

3.05 PROCEDURES

A. The Engineer will define the limits where demolition/dismantling and removal activity is to be done and shall approve the procedures/methods to be adopted by the Contractor. The Contractor shall layout the boundaries/limits for Engineer's checking and approval before commencing dismantling work.

B. Whole work shall be performed in an orderly manner and the Contractor shall take all necessary precautions and expedients to prevent damages to the adjacent structures, installed equipment/machinery, pipes, conduits, any other installation etc. Any damage caused to the structures and installations due to negligence of the Contractor during demolition/dismantled and removal operations shall be repaired/replaced by the Contractor at his cost and to the satisfaction of the Engineer.

3.06 DEMOLITION OF SHEDS, STRUCTURES, ROADS, PAVEMENTS, MASONRY WORKS, BUILDINGS AND PLAIN/REINFORCED CONCRETE

The Contractor shall demolish sheds, structures, road/pavements, masonry/flooring works, stone pitching, buildings, utilities/networks and plain/reinforced concrete works to the line and depth as shown on the Drawings or as directed by the Engineer within the construction area for the New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport. Explosives shall not be used to remove the plain and reinforced cement concrete or any other material whatsoever. Mechanically operated breakers, concrete saws, chipping hammers or other methods as approved by the Engineer shall be employed for cutting. Care shall be taken that existing services and structures are not damaged. It shall be the responsibility of the Contractor to replace at his cost any service, pavement/PQC and structure damaged by the Contractor due to his negligence during cutting operations or thereafter until the whole of areas are restored to original condition.

3.07 CLEARANCE OF GREEN AREA

The bushes/plants in existing green area shall be cleared off up to the roots and the surface shall smoothen and cleared from all debris and any organic material before receiving new layer after approval of the Engineer.

3.08 SHIFTING / TRANSPLANTING OF EXISTING VEGETATION

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Any existing trees, shrubs or plants within the ATCT, Fire Station and Allied Facilities construction area that are identified by the Engineer for retention or transplanting shall be carefully uprooted and shifted to locations as shown in drawings or as approved by the Engineer, with due care to preserve their root systems and ensure their survival.

3.09 REMOVAL OF EXISTING SERVICES / UTILITIES

The Contractor shall mark all the services/utilities falling within the ROW. After getting approval from the Engineer, the Contractor shall remove all such services/utilities as per the requirement/specifications of the relevant department whose utilities/services are being removed/shifted.

3.10 CLEAN UP

Debris and rubbish shall be removed from site. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

All debris materials resulting from demolition/dismantling works shall be disposed off to places designated by the Engineer in the manner of disposition required and directed by the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0075 - LEVELLING AND GRADING

01. SCOPE

1.1 The work to be done under this section of the specifications consists of performing all earth work required for levelling & grading the area in accordance with required levels, elevations and grades shown on the Drawing/Plans or as established by the Engineer. The work to be done by the Contractor shall include performing the required cutting to line, levels, grade and filling the area to the desired levels and grades; providing and transporting labour, excavating, grading, levelling, and watering and all incidental operations required in performing the work as specified herein.

1.2 Levelling and grading work shall be performed after completing the clearing and grubbing.

1.3 During the progress of the works, if by reason of delay, effects of bad weather; rainfall, or from any cause whatsoever, any levels, grades or profiles of the area are changed, the Contractor shall, at his own cost, be liable to bring the area to the required levels and profiles as shown on the Drawings or as directed by the Engineer.

1.4 Prior to commencement of work the Contractor shall submit for approval of the Engineer complete proposal with regard to methodology to be adopted for cut and fill for levelling and grading works contractor should give due consideration to the site configuration and the required levels and lines shown on the drawing.

02. APPLICABLE STANDARDS

2.1 Materials, construction and testing shall comply with the following codes and standards:

ASTM D 422	Particle size analysis
ASTM D 423 & 424	Test for liquid & Plastic Limit
ASTM D 1556, 1557 & 2167	Compaction

03. GENERAL

3.1 The Contractor shall submit, a detailed list of plant and equipment which he shall undertake to bring to the site and to carry out the work. The list shall satisfy the Engineer as to type, size and quantity.

3.2 The Contractor shall jointly survey the Project area marked on the drawings or any area designated by the Engineer and prepare the survey drawings showing pre work levels of natural ground profile and cross-sections and submit to the Engineer for approval prior to start of any leveling and grading operation. Clearing grubbing shall be done in accordance with the provision of related specification section.

3.3 Existing utilities which are to remain in service or to be relocated and to remain in service until relocation, are to be determined by the Contractor.

3.4 The select material from cut/excavations shall be transported to and placed in fill areas or stockpiled at locations designated by the Engineer.

04. SITE PREPARATION

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4.1 The Contractor shall set out the works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall at his own expense rectify such error.

4.2 The Contractor shall construct and maintain accurate bench marks so that the lines and levels can be easily checked by the Engineer.

4.3 Levelling and grading of the designated area shall be done by means of levelling equipment and grading machines. The Contractor shall be responsible for the required construction and stability of the grades in conformity with the Drawings/Plans or as determined by the Engineer.

05. CUT

5.1 Classifications of Cut

No classification shall be made of any material excavated/ cut as to its class, nature, origin or condition. The excavation will be unclassified as being carried out in all kinds of subsurface material including soil and rock.

Blasting will be permitted only when proper precautions are taken for the safety of all persons, the work, and the property. All damage done to the work or property shall be repaired at the Contractor's expense. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the Engineer. Any approval given, however, will not relieve the Contractor of his/ her responsibility in blasting operations.

In each distinct blasting area, where pertinent factors affecting blact vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the Engineer for approval. This plan must consist of holes size, depth, spacing, one delay period, depth of rock and depth of overburden if any. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the Engineer.

The Contractor shall keep a record of each blast fired – its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period and where necessary, seismograph records identified by instrument number and location.

The Contractor shall build, maintain and operate all berms, channels, flumes, sumps and other temporary diversion and protection works needed to divert the surface water through or around the required excavation.

Prior to commencement of the work, the Contractor shall furnish the Engineer for review and comments with complete plans and sketches for diverting surface water, if any.

Submission for review and comments of the required plans and sketches and any approval from Engineer shall not relieve the Contractor of any of his/ her duties and obligations under the Contract.

5.2 Tolerance

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The surface shall be of smoothness that will not vary more than 50mm from true grade as shown on drawings and decided by the Engineer.

5.3 **Extra Cut/Excavation**

In the event the Contractor cuts/excavates any area to a level lower than the required, he shall re-instate such areas to the required density levels and grades. No extra payment will be made to the Contractor on this account.

06. FILL

6.1 **Fill Materials**

Areas requiring filling shall be filled with select material obtained from the required cut / excavations. The fill material shall be free from objectionable material and to the satisfaction of the Engineer. The gaps between the rock fragments shall be filled with finer material. The earthwork by rock fragments should be kept at lower part of the fill and size of these fragments shall not be larger than 0.06 cu.m. The location of rock fragment dumping shall be subject to the approval of the Engineer.

The Contractor shall not place fill material during periods of rain.

6.2 **Haul**

All hauling will be considered a necessary and incidental part of the work.

6.3 **Tolerances**

Finished surface shall be smooth and even and shall not vary more than 50 mm from elevations/ true grade as shown on drawings.

07. QUALITY CONTROL

Field inspection will be carried out jointly by the contractor and the Engineer. Contractor shall facilitate the inspection and the performance of tests and bear all costs thereof. A copy of all test shall be submitted to the Engineer for approval. Tests shall be performed for each type of the material encountered during excavation in accordance with ASTM D-422 for selecting the material at various fill locations.

08. MEASUREMENT AND PAYMENT

8.1 **General**

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the undermentioned works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective item of the Bills of Quantities.

8.1.1 Any fill with approved material necessitated by over cut/excavation due to fault or convenience of the contractor.

8.1.2 Stock piling of the cut/excavated select material at approved locations within project boundary and transporting back the same to places requiring fill.

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8.1.3 Laboratory and field tests stipulated in these specifications.

8.1.4 Disposal of surplus cut material within 05 kilometers free haulage limit along the most direct route from the boundary of the project.

8.1.5 Transporting approved select fill material from within the project boundary.

8.1.6 Levelling, grading and spreading of cut & fill of soil/rock.

8.2 Levelling and Grading by 'Cutting'

8.2.1 Measurement

Measurement of acceptably completed works of levelling and grading by cutting will be made on the basis of net actual volume of 'cut' as per BOQ in accordance with the line level and grade shown on the drawings or as directed by the Engineer.

Quantities of cutting shall be calculated / measured for payment purposes from the pre-work levels and the levels shown on the drawings.

8.2.2 Payment

Payment will be made for acceptable measured quantity as provided above of levelling and grading in 'cut' on the basis of unit rate as per BOQ quoted in the Bill of Quantities and shall constitute full compensation of all the works related to the item.

8.3 Levelling & Grading by 'Filling'

8.3.1 Measurement

Measurement of acceptably completed works of levelling and grading by 'Filling' will be made on the basis of net actual volume as per BOQ of compacted 'Fill' in accordance with the lines levels and grade as shown on the drawings as directed by the Engineer.

Quantities of 'Filling' shall be calculated / measured for payment purposes from the pre-work levels and the levels shown on the drawings.

8.3.2 Payment

Payment will be made for acceptable measured quantity of levelling and grading in 'Filling' on the basis of unit rate as per BOQ quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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SECTION 0080 - LANDSCAPING

PART 1 -SCOPE

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment appliances, materials and performing all operations in connection with the preparation, placing and final grading of all top soil, furnishing and planting all new trees, lawn, shrubs / creepers and plant material shown on the Drawings and or specified herein and ensuring protection of all existing trees and plantation.

PART 2- APPLICABLE CODES & STANDARDS

A. AASHTO (American Association of State Highway and Transportation Officials)

1. AASHTO T 99 – Standard Method of Test for Moisture Density Relations of Soils.

B. ASTM International:

ASTM A 36/A 36M-05: Specification for Carbon Structural Steel

ASTM A 48/A 48M-03: Specification for Gray Iron Castings

ASTM A 641/A 641 M-03: Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM C 602-95a (Reapproved 2001): Specification for Agricultural Liming Materials

ASTM D 448-03a: Classification for Sizes of Aggregate for Road and Bridge Construction

ASTM D 5268-02: Specification for Topsoil Used for Landscaping Purposes

PART 3-DEFINITIONS

i. **Backfill:** The earth used to replace or the act of replacing earth in an excavation.

ii. **Bagged Stock:** Healthy, vigorous, well-rooted plants grown in polythene plastic bags, with a well-established root system reaching sides of container and maintaining a firm ball when removed from bags.

iii. **Balled and Burlapped Stock:** Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth specified herein for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball.

iv. **Balled and Potted Stock:** Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth specified herein for type and size of plant required.

v. **Bare-Root Stock:** Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread specified herein for type and size of plant required.

vi. **Container-Grown Stock:** Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized as specified herein for type and size of plant required.

vii. **Duff Layer:** The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

viii. **Fertilizers; Chemical fertilizers:** Shall be approved granular fertilizers. Fertilizer may be single element or compound, normal or slow-release compound fertilizers. They shall be stored in waterproof sealed bags under shelter away from water and direct sunlight. Samples shall be submitted to, and approved by the Landscape Architect, before use in the Works.

ix. **Finish Grade:** Elevation of finished surface of soil mix.

x. **Geo-membrane Liner:** A high-density polyethylene liner used a separator between the growing containers and the surface ground to prevent plant root penetration.

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xi. **Green area:** Areas of grassy lawn with or without groundcover.
xii. **Imported grass:** Grass developed in nursery for garden areas like "Korean Grass" (Zoysia/Matrella).
xiii. **Local grass:** Indigenous grass variety like "khabbal grass" (Bermuda grass/Cynodon dactylon).
xiv. **Manufactured Topsoil:** Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic manure to produce topsoil or soil mix. Organic Compost; Organic compost shall be an organic vegetable compost produced through a horticultural or industrial composting process. Compost is to be clean, decomposed, smell free, and free of any debris, refuse, clay or visible fungus. A sample and test data is to be submitted for approval before use. All compost is to be sterilized before being packed for transport. Any odorous materials delivered to site will be rejected. Any vermin resulting from use of organic compost will have to be controlled by the Contractor within 12 hours.
xv. **Mulches:** Mulches shall be an approved friable-composted organic material, mulching material free from soluble salts or toxic materials and resistant to rapid decay.
xvi. **Organic fertilizers (Farmyard manure):** Shall be organic products such as organic liquid fertilizer, pellets or granules manufactured primarily from organic materials. These products are to be from accredited sources and technical data indicating sources of origin and manufacturing process must be submitted and approved before use. Animal by-products must be sterilized before being packed for transport and odorous materials used on site will be rejected.
xvii. **Pesticide:** A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
xviii. **Pests:** Living organisms that occurs where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
xix. **Planting Area:** Areas to be planted.
xx. **Plant; Plants; Plant Material:** These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
xxi. **Project Nursery:** Site procured and maintained for pre-growing of plant materials before transport and installation to the Project Site.
xxii. **Project Site:** Site of final installation of planting materials.
xxiii. **Root Flare:** Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
xxiv. **Sand/Silt/Sweet Soil:** Sand/Silt/Sweet Soil shall be clean, coarse, well graded material mostly quarried from natural river side, free from soluble salts included natural mineral. Particles shall range in size so that 80-100% passes the 1mm sieve and 0-50% passes the 250 micron sieve.
xxv. **Soil mix:** Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers (Natural Manure) to produce a soil mixture best for plant growth.
xxvi. **Soil Conditioner:** Soil Conditioner shall be Peat Moss, organic compost composted rice hulls or other approved fibrous organic matter suitable for mixing with topsoil to make a friable growing medium for plants. It shall be resistant to rapid decay, free from soluble salts (below 900ppm), pH 6-7, free from large lumps or debris.
xxvii. **Source Nursery:** Nursery where plant materials will be procured from.
xxviii. **Stem Girdling Roots:** Roots that encircle the stems (trunks) of trees below the soil surface.

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xxix. **Surface Soil:** Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

xxx. **Watering:** After planting of all plants are to be thoroughly watered using enough water to soak the ground all around the rootball known to be watering.

PART 4 - MATERIALS

4.1 Topsoil

4.1.1 Topsoil shall be provided from approved source, it shall be typical sterile, sandy soil obtained from well-drained areas and possessing characteristics of representative soils in the project vicinity that produce vigorous plant growth. The topsoil shall be free of subsoil, brush, organic materials, objectionable weeds, clods, shale, large stones, stumps, roots or other material 13 mm (1/2") in diameter or more, or any substance which might be harmful to plant growth or be a hindrance to grading, planting and maintenance operations. The topsoil shall be subject to approval by the Engineer.

4.1.2 Careful supervision of excavation, hauling and stockpiling of topsoil is required to avoid contamination with unapproved soils, any soil furnished which does not meet the foregoing requirements and analysis for use as topsoil shall be rejected by the Engineer who may require it to be hauled off-site for disposal at no cost to the Employer.

4.1.3 The Engineer shall have the option to test topsoil and planting mix at any time for conformance to the specifications. Any discrepancies or deficiencies found as a result of these tests shall be corrected by the Contractor at no additional expense to the Employer. Should such test reveal that material does not meet specification requirements, expenses for testing and necessary subsequent testing shall be borne by the Contractor.

4.1.4 Organic Compost; Organic compost shall be an organic vegetable compost produced thorough a horticultural or industrial composting process. Compost is to be clean, decomposed, smell free, and free of any debris, refuse, clay or visible fungus. A sample and test data is to be submitted for approval before use. All compost is to be sterilized before being packed for transport. Any odorous materials delivered to site will be rejected. Any vermin resulting from use of organic compost will have to be controlled by the Contractor within 12 hours.

4.1.5 Sand/Silt /Sweet soil; Sand/silt/Sweet soil shall be clean, coarse, well graded material mostly quarried form natural river side , free from soluble salts included natural mineral. Particles shall range in size so that 80-100% passes the 1mm sieve and 0-50% passes the 250 micron sieve.

Sweet Soil is an old fashioned term used to describe lime rich soil, that has a high level of alkaline and a low level of acid. The pH of 4 indicates slightly alkaline soil and the pH of 6 indicates soil that is very alkaline.

4.1.6 Fertilizers; Chemical fertilizers; shall be approved granular fertilizers. Fertilizer may be single element or compound, normal or slow release compound fertilizers. They shall be stored in waterproof sealed bags under shelter away from water and direct sunlight. Samples shall be submitted to, and approved by the Engineer, before use in the Works.

4.1.7 Organic fertilizers (Farm yard manure); shall be organic products such as organic liquid fertilizer, pellets or granules manufactured primarily from organic materials. These products are to be from accredited sources and technical data indicating sources of origin and

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manufacturing process must be submitted and approved before use. Animal by-products must be sterilized before being packed for transport and odorous materials used on site will be rejected.

4.1.8. Mulches; Mulches shall be an approved friable-composted organic material .mulching material free from soluble salts or toxic materials and resistant to rapid decay.

4.1.9. Soil Conditioner: Soil Conditioner shall be Peat Moss, organic compost composted rice hulls or other approved fibrous organic matter suitable for mixing with topsoil to make a friable growing medium for plants. It shall be resistant to rapid decay, free from soluble salts (below 900ppm), pH 6-7, free from large lumps or debris.

4.1.10 WATERING; after planting of all plants are to be thoroughly watered using enough water to soak the ground all around the rootball known to be watering.

PART 5- SUBMITTALS

Product Data: For each type of product indicated, including soils.

5.1 Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

5.2 Pesticides and Herbicides: Include product label and Manufacturer's application instructions specific to the Project.

5.3 Plant Photographs: Include colour photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

5.4 Samples for Verification: For each of the following:

5.4.1 Trees and Shrubs: Three samples of each variety and size delivered to the site for review. Maintain approved samples on-site as a standard for comparison.

5.4.2 Topsoil, Sand, Soil Conditioner and Organic Mulch: 1-liter volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of colour, texture, and organic makeup.

5.4.3 Light Weight Aggregate and Mineral Mulch: 1.0 kg of each light weight aggregate and mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of colour, texture, and makeup of the material.

PART 6- EXECUTION

6.1 Design & Details

Any discrepancies in the design subject to execution hurdles and alteration required shall be reported to the Engineer for further instructions. Contractor shall have to work only after due approval of the modification.

6.2 Landscape Site Preparation

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The landscape site shall be free of any construction debris or wild vegetation. It shall be responsibility of the Contractor to ensure that the site is in working condition as per instruction of the Engineer. The Contractor shall also ensure proper grading of the landscape site in terms of aesthetics as well as drainage providing mounts and with a gentle slope towards natural drainage direction. All rubbles and debris if any and dispose it of in the suitable location possibly in low lying areas as indentified by the Contractor and approved by the Engineer.

6.3 Soil Testing

The soil to be used as Top Soil (Good Soil/earth) for all plantation works shall be primarily imported fertile soil from agriculture fields off the site.

The Contractor shall get the soil test report and could meet the requirement for additives and soil conditioner to maintain pH value of the soil between 7.0 - 7.5 before plantation works. Also after every 6 months or as required on poor performance of the plantation shall accordingly get the soil tested and measures taken for maintaining the pH value within acceptable range. Also Contractor shall undertake treatment for soil conditioning during the entire maintenance period.

6.4 Manpower Employment

Contractor shall employ qualified & experienced garden supervisors and adequate number of gardeners to maintain the quality of garden and tree plantation. A senior supervisor/well trained Horticulturist with experience of relevant & similar work shall be deputed at site.

6.5 Disposal of Waste-General Cleanliness of Landscape Site

The arrangement of transport for disposal of waste, shifting of plants, etc. has to be made by the Contractor. The generated waste shall be disposed off within 48 hrs of generation or as instructed.

6.6 Provision for Water

The Contractor shall arrange and provide water for irrigation of landscape areas as follows.

6.6.1 Trees and Shrubs

Annually 40 irrigates;
Maximum in summer (once in a week).
Minimum in winter (once in a fortnightly).
Minimum water requirement of each plant is 4 (four) gallons per irrigation.

6.6.2 For Lawns flood irrigation shall be provided @ 25 ltrs /m^2/weekly or appropriate requirement of watering should be provided by the Contractor to keep the lawns green.

Wherever irrigation tap connection is not available, watering should be done with water tankers or appropriate methodology. The maintenance of tankers or any appropriate system shall be integral responsibility of the Contractor to meet the watering requirements of the Trees, shrubs and lawns under any circumstances.

6.7 Electricity:

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It shall be Contractor's responsibility to make arrangement for Diesel Generator set(s) to meet its requirement. The use of electricity if provided by the Employer shall be on chargeable basis. The Contractor shall install electricity meter and shall pay for the metered readings as per the rates settled with the Employer.

6.8 Maintenance

The Contractor shall adhere to the maintenance schedule. During the maintenance period of all the plants, Contractor shall be responsible for any replacement towards mortality and the trees or the area of the plantation under shrubs/creepers/ground covers etc. Plant shall be in healthy condition during the inspection conducted by the Engineer.

Contractor shall maintain record of maintenance & operations on site and submit daily report for all the areas certified for virtual completion of the work. The Contractor shall take note of the observations of the Engineer or his representative/Horticulturist and seek compliance of the same at the earliest before nearest schedule to avoid any penalty as per penalty terms.

6.9 Reports

The Contractor shall submit daily report on the deployment details as well as work planned for the day to the Engineer in prescribed format. All instructions and activities shall be recorded as per the desired format. Any problem or hindrance shall be brought to notice in the daily report along with evidence in form of photographs.

6.10 Nursery Set-up

The Contractor shall be required to set-up. Nursery having good micro-climate to store the supply of the plants.

In case of propagation of the plants in the nursery, the same shall be used on site only.

Laboratory should also be provided by the Contractor.

6.11 Vermi-Composts

Contractor shall mandatorily have Vermi-Composting System developed at appropriate location where all the pruning wastes, organic wastes shall be dumped with weeds, weed seeds or bulbs, stones etc., mix it well in the soil in the ratio (6:1), level as per grade.(point of unloading 0-50m). The process shall require approval of the Engineer and periodic maintenance of the activity. Approval of Engineer prior to dispatch of material for use on site is must.

PART 7- PLANT LOCATIONS

Tree, shrub & ground covers shall to be laid out in accordance with the Drawings.

Layout of bed outlines shall be staked out on the ground and the trees shrubs and ground covers shall be placed in locations as shown on the Drawings. The Engineer will inspect the locations of the bed outline and plants in the field, will direct the Contractor in adjusting the bed outline and the plants to their exact position before planting begins. The Contractor shall give the Engineer 15 day notice before the inspection and planting layout date.

7.1 Planting Pits for Trees and Shrubs & Ground Covers

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Excavation for planting shall include plant pits and planting beds. The minimum depths of plant pits or beds shall be measured from finished grade level as per the drawings.

Plant beds and pits shall be tested for drainage before planting by filling with water twice in succession. Conditions permitting the retention of water in planting beds or pits for more than 24 hours shall be brought to the attention of the Engineer.

If rock, underground construction obstructions, tree roots or other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by the Engineer.

The Contractor shall review the applicable Drawings and shall be familiar with the alignment of utility lines, ducts and buried cables existing in the area. The Contractor shall field check the location of utilities shown on the Drawings before any installation of material or plants. The Contractor shall be responsible for all damage resulting from any neglect or failure to comply with this requirement.

Following excavation of the planting pits (as per Table I to V), the pits shall be back filled with the soil mixture as specified. Three days prior to planting, the pit shall then be filled with water for consolidation of the soil.

PART 8- TREES & SHRUB PLANTATION

8.1 Supply of Trees & Shrub

8.1.1 Physical Condition

All plant materials shall be healthy, sound, vigorous with good foliage, Plants supplied shall be conforming to the names listed on the plant list. No plant materials will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted

8.1.2 Health of Trees

All plant materials shall be free from plant diseases, insect pests, or their eggs, and shall have healthy well-developed root systems. Plant material shall be well formed and shaped true to type and free from disease, insect and defect such as knots, windburn, sun-cold, injuries, abrasion or disfigurement.

8.1.3 Specification of Trees

The specification of the material in terms of height, stem size mentioned in the BOQ's shall only be acceptable for plantation works. In case of non-availability of the particular species or the planting material, the alternate species may be approved by the Engineer.

8.2 Planting of Trees & Shrubs

8.2.1 Pit Size

Minimum Pit Size for all trees should be as per drawings.

8.2.2 Soil Preparation-Preparation of tree pits:

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60% of the soil which has been obtained after digging shall be used for backfilling. 20% shall be approved silt/sweet earth 20% natural organic manures or (farm yard manure) as per Table-I.

8.2.3 Planting of trees

Planting of trees shall be done by stacking / propping to protect the trees from wind. Plants shall be irrigated on need basis. The Contractor shall maintain the tree basins free of weeds by regular hoeing.

Planting the tree with root ball in the pit (tin grown / poly bag grown) after removing carefully and without disturbing the root. Pressing the soil firmly around the tree planted. Preparing the basin around the tree and watering after staking and tying. The plant shall be well maintained, disease free, well trimmed at the time of handing over.

In case of death of the plant the Contractor shall replace the same with well grown healthy plant of similar size.

8.2.4 Insecticides Spray

All the planting materials shall be periodically examined for termite, pest and insect attacks or plant disease. Appropriate measure (i.e. application of liquid manures/ growth regulators/ pesticides as per need, weeding regularly so as to keep the plant healthy all the time) shall be undertaken for entire period of the contract and also during entire defect liability period/maintenance period.

8.2.5 Watering Arrangement

The Contractor shall make basin around trees and shrubs with material of precast fair face concrete Curbing or in pebbles/ random stone. Tools and Tackles/Hose-pipes, tractor mounted Water Tankers or as required all arrangement for water distribution and watering equipments/manpower shall be managed by the Contractor for watering the trees & shrubs.

Table – I: Trees and Shrubs:	
	• Ornamental trees and shrubs shall be planted in pits of size 600 x 600 x 600 mm ft having cylindrical shape.
	• 60% of the soil which has been obtained after digging shall be used for backfilling 20% shall be used rotten leaves mould and 20% natural organic manures or (farm yard manure)
	• Plant shall be spaced as per drawings for different areas as mentioned in the drawings.

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	• A grove (bunch of plants) shall be usually consisting of 3 to 5 plants in a circular / conical shape. The shrubs used for continuous planting in a row shall be spaced as per drawings.
	• Annually 40 irrigates: – Maximum in summer (once in a week). – Minimum in winter (once in a fortnightly). – Minimum water requirement of each plant is 4 (four) gallons per irrigation.

8.2.6 Handing Over of Trees & Shrubs

- Name tag for Trees

  All trees planting shall have plastic/metal name Tag with name of the relevant species well placed on trees with good visual characteristics. In case of row plantation of similar species, the same can be repeated at definite intervals i.e. at every 5th tree from the start.

PART 9- GROUND COVERS PLANTATION

9.1 Supply of Ground Covers

9.1.1 Physical Condition

All plant materials shall be healthy, sound, vigorous with good foliage, and free from plant diseases, insect pests, or their eggs, and shall have healthy well-developed root systems. Plants supplied shall be conforming to the names listed on the plant list. No plant materials will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.

9.1.2 Health of Ground Cover

Plant material shall be well formed and shaped true to type and free from disease, insect and defect such as knots, windburn, sun-cold, injuries, abrasion or disfigurement.

9.1.3 Specification of Ground Cover

The species should be in appropriate specification in terms of height & Foliage as provided in drawings schedule.

9.2 Planting of Ground Covers

9.2.1 Pits

Depth should be minimum 300x300x300mm exclusive of the top 50mm where top edge is defined for watering and flooding as per Table II.

9.2.2 Soil Preparation

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Dig and remove all weeds, debris, rubbles, and stones from surface soil level to be maintained in due course. The 60% of the soil which has been obtained after digging shall be used for backfilling. 20% shall be approved silt/sweet earth and 20% natural organic manure or (farm yard manure).

9.2.3 Planting

Planting Ground cover - Planting of ground cover plants in the ground prepared earlier by filling garden soil and manure. Preparing a pit of require size in the ground. Planting the ground cover plant root ball in the pit after removing carefully and without disturbing the root ball. Pressing the soil firmly around the plant Preparing the basin around the plant in precast fair face concrete Curbing or in pebbles/ random stone for proper watering as mention Drawings. Maintenance of ground cover up to two months by regular watering and attending the inter-cultivation practices such as weeding, raking, gap filling, trimming and pruning etc. The ground cover should be well maintained, disease free, well-trimmed at the time of handing over. In case of death of the plant the contractor shall replace the same with equally well grown healthy plant.

9.2.4 Insecticides

All the planting materials shall be periodically examined for termite attacks or plant disease and appropriate measure (application of liquid manures/ growth regulators/ pesticides as per need, weeding regularly so as to keep the plant healthy all the time) shall be undertaken for entire period of the Contract.

9.2.5 Watering Requirements

Tools and Tackles/Hose-pipes, tractor mounted Water Tankers or as required shall be managed by the Contractor for watering the plants.

Table – II: Ground Covers	
	• In situation where planting of ground covers is required such as slopes and some open spaces, it shall be done with species, which trail along the ground such as petunia, asparagus officialus, climbing rose etc.
	• The spacing between ground covers plants shall be 900 x 900 mm in length/row.
	• The pits to be dug for these plants shall be of size 300 x 300 x 300 mm.
	• Irrigation and rest of the maintenance operation shall be carried out as per Table-I.

9.3 Handing Over of Ground Corus

Name Plate for Ground Cover

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The ground cover planting shall be provided with Name Plate to specify the type of ground cover planted as per the bed and in case of longer beds at appropriate intervals so that the same can be identified at distant observations.

9.4 Maintenance of Ground cover

For details refer Specification Section 0501 Operation and maintenance of Landscaping

PART 10- LAWNS

10.1 Supply of Lawns

10.1.1 Specification of Lawns

Plant material shall be well formed and shaped true to type and free from disease, insect and defect such as knots, windburn, sun-cold, injuries, abrasion or disfigurement.

Supply and planting of lawn: Planting of lawn grass (for imported , Dhaka and local grass) as per drawing without disturbing the desired gradient including its leveling and maintaining (forking, mowing, weeding, fertizer application). Contractor has to make his own arrangement for the water.

10.2 Planting of Lawns

10.2.1 Soil Preparation

The Contractor shall be responsible for the preparation of the lawn areas and planting of the lawn.

The soil shall be “trenched or ploughed” 300 mm (12”) deep over the entire surface. Should the soil be unsuitable, it shall be removed upto 300 mm and replaced with Sweet soil/Silt.

All stones in excess of 25 mm (1”) in diameter and all rubbish materials shall be removed. Contractor shall not spread sweet soil in muddy state.

Top 300 mm depth the soil shall be essentially good earth mixed with 1/3 of decomposed Farm yard manure.

The lawn bed shall be fine graded to remove all ridges and depressions.

Surface irregularities resulting from this or other operations shall be leveled to prevent depressions. Grades shall be adjusted to assure that the grade, after natural settlement and light rolling, will be 25 mm to 40mm below adjoining grade of any paved areas.

Rolling shall be done in two directions at right angles to each other. The roller shall be hand roller weighing not more than 200 pounds nor less than 150 pounds. Rolling shall be in such a manner so as to eliminate the necessity for walking on the finished grade.

Extreme care shall be taken during planting to ensure that no change shall occur in the finished grade.

10.2.2 Planting

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Dibbling of grass: Fine level the soil, apply thin layer of sand Vermi compost mixture of 25mm thickness and dibble the grass at 75mm distance. Roll the lawn after planting. Irrigate the lawn regularly. Remove weeds on periodical basis. Nurture the lawn with organic, bio-insecticides, parasites, predators to protect the lawn from pest and disease. Mow the lawn regularly and maintain the grass at 50 mm height. Trim all the edges after mowing; keep the edges with trees, shrubbery and flower beds clean.

The sweet soil surface shall be moistening with a fine spray immediately before planting.

The lawn shall be planted according to acceptable local standard practice in order to ensure a completely healthy grass cover.

10.2.3 Insecticides

Required at the time of Plantation or as per maintenance schedule.

10.2.4 Watering Requirements

Planting areas shall be maintained by watering, weed eradication, cutting, trimming, repair of all erosion, settlement restacking and reseeding where required establishing a uniform, knitted turf. Initial watering of lawns shall be at 2 day intervals for a period of 18 days from time of planting. At each watering, it shall be applied through flood irrigation.

Watering shall continue after the 18 day period, considering the provision of water according to annual irrigation procedure as previously mentioned, as necessary to maintain turf in a thriving condition. After the grass has matured, all of the areas which fail to show a uniform strand of grass for any reason whatsoever shall be planted repeatedly until all areas are covered with a satisfactory growth of grass.

The equipment necessary to carry out lawn maintenance work shall include but not be limited to: typical large manual/motorized lawn-mowers as used in parks, small manual lawn-mowers for grass cutting in confined area, shovels, rakes, lawn rollers, sprinklers and hoses, trimming shears and wheel barrows.

At the time of the first cutting and at subsequent cuttings, the mower blades shall be set at a minimum height of 50 mm (2”). Grass shall be cut first when it reaches a height of 100 mm (4”). Regular cutting shall be done as per Table-III, IV &V.

On areas of steep slope, place straw to completely cover newly planted area.

Final grading shall be carried out only after a 12 week establishment period. The Contractor shall allow for rolling after a further 3 month period if instructed to do so by the Engineer.

Tools and Tackles/Hose-pipes, tractor mounted Water Tankers etc. as required to be managed by the Contractor for watering as per Table-III, IV &V.

10.2.5 Plant Replacements

Dead plants/lawn patches shall be removed and replaced by the Contractor with healthy seedlings of the same species during the following planting season. Bare lawn or weed infested patches should be replanted by retrenching the area to a depth of 300 mm (12”) and

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repeating the procedures for newly made lawns replacement materials, adjustment or maintenance of lawns shall be done at no additional cost to the Employer.

Table – III: Imported grass (Korean Grass/Zoysia/Matrella)	
	• Deep plowing shall be carried out at least two times.
	• The area shall be cleared of from bushes etc.
	• Farm yard Manure and Sand/Silt/Sweet Soil shall be added to the soil with the following ratio: - 2,000 cft. Sand/silt/sweet soil required for one acre. - 1,000 cft. Farm yard manure for one acre.
	• Area should be leveled and compacted upto desired level given proper slopes to the natural drainage or as specified and shown in the drawings.
	• Korean Grass shall be arranged from local nurseries.
	• Dibbling of Grass shall be carried out in specified areas.
	• Spacing of grass plants shall be kept as 75 x 75 mm in the soil.
	• Irrigation shall be carried out by flood irrigation method which shall be done according to the weather conditions.
	• Generally, during summer weekly irrigation is to be done and during winter the same shall be done fortnightly which approx. 50mm deep.
	• Weeding should also be done regularly at least 2 times in a year or as directed by the Engineer.
	• Machine mowing shall be carried out regularly at least fortnightly to keep the lawn in good condition and shape.

Table – IV: Dhaka Grass (Bent Grass /Agrostis Stolonisera)	
	• Deep plowing shall be carried out at least two times.
	• The area shall be cleaned from bushes etc.
	• Farm yard manure should be added to the soil with the following ratio: – 500 cft. Farm yard manure for one acre.
	• Area should be leveled, compacted upto desired level and given its slope to natural drainage or as specified and shown on the drawings.
	• Dibbling of local grass shall be carried out in specified areas.

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	• Spacing of grass plants shall be kept as 75 x 75mm in the soil.
	• Irrigation shall be carried out by flood irrigation method which shall be done according to the weather conditions.
	• Generally, during summer weekly flood irrigation 50mm deep is to be done and during winter the same shall be done fortnightly.
	• Weeding should also be done regularly at least 2 times in a year or as directed by the Engineer.
	• Machine mowing shall be carried out regularly at least fortnightly to keep the lawn in good condition and shape.

10.2.6 Handing Over of Lawns

The lawn areas should be considered fit once the lawns have settled and the surface starts showing the lawn effect.

10.2.7 Maintenance of Lawns

Lawns should be maintained by regular watering, weeding, replacing dead Spots, applying pesticides etc. so as to grow them vigorously.

Lawns should be regularly mowed and maintained as good green carper till the final completion of the maintenance period or as per the maintenance schedule.

PART 11- PLANTING PRACTICES-APPLICATION

11.1 STAKING & SUPPORTS

11.1.1 General

- Stakes shall always be used when planting trees and tall shrubs as indicated in the drawings.

- Stakes shall be poles, bamboo or equal and shall be appropriate to the size of the plant to be supported.

11.1.2 Single Staking

Plants in the field need supports at least for initial part of their life, till it is fully established with self supporting trunk / stem girth. The Contractor shall select proper stakes and fix them aesthetically as well as purposefully. Stakes shall be made of straight wooden sticks and tied to the plant with strings or which should hold it and have flexibility to allow the stem growth freely. The stakes shall be dug deep enough to hold itself on its own, but shall not harm the roots of the plants.

11.1.3 Climber Wires

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Climber wire for training climbing plants against walls shall be approved lightweight PVC coated wire mesh, fixed at 600mm intervals to GI screw eyes. The climbing plants shall be trained through the wire mesh with the shoots directed upwards and tied.

PART 12- DISEASE CONTROL

The Contractor shall take all necessary precaution to prevent eradicate any outbreak of disease or insect attack.

PART 13- DISEASE CONTROL

13.1 **General**

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective item (s) of the Bill of Quantities.

13.1.1 Excavation of trenches to required depth and width of trees, shrubs and ground covers trending or ploughing of existing ground upto 300 mm thick for planting of lawns.

13.1.2 Scarifying soil at the bottom of the trench and adding and mixing equal amount of prepared soil.

13.1.3 Providing watering for landscaping works.

13.1.4 Preparation of soil mix, puddle and setting plants, shrubs, vines and ground cover.

13.1.5 Compaction of Berms for plants, trees and ground covers.

13.1.6 Guying and stacking propping with bamboo tripod material.

13.1.7 Providing and placing fertilizer in trees, shrubs, ground cover and lawn grass, disucide sprays, pesticides application as required.

13.1.8 Seeds for turf lawn grass and trees. Temporary fencing, barriers, signs and other works required for proper maintenance.

13.1.9 Providing and replacement of dead trees, shrubs, ground cover and lawn grass

13.1.10 Restoration, cleanup and maintenance of tress, plants, ground covers and lawn grass.

13.1.11 Scarifying, disposal of surplus material, filling where extra excavated by Contractor's error or convenience, Bed preparation, seeding mowing & watering the plants, shrubs, lawn grasses.

13.1.12 Gravel mulch as specified on the drawings.

13.1.13 Providing plant photographs in specified format for approval.

13.1.14 Samples of plants/trees/shrubs.

13.1.15 Testing of materials/soils.

13.1.16 Disposal of general waste.

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13.1.17 Name plate for trees/shrubs ground cover

13.2 **Planting**

13.2.1 Measurement

Measurement of acceptably completed works of Planting of trees will be made on the basis of unit number of tree provided, planted and lay in position as shown on the Drawings or as directed by the Engineer.

13.2.2 Payment

Payment will be made for acceptable measured quantity of planting of trees on the basis number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

13.3 **Sand/Silt/Sweet Earth and organic backfill**

13.3.1 Measurement

Measurement of acceptably completed works of Sand/Silt/Sweet Soil / earth will be made on the basis of actual volume in cubic meter of compacted backfill/fill provided and placed in position in accordance with the lines, levels and grade as shown on the drawings or as directed by the Engineer.

13.3.2 Payment

Payment will be made for acceptable measured quantities of Sand/Silt/Sweet Soil on the basis of unit rate per cubic meter quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

13.4 **Korean Grass & Synthetic Turf (Grass)**

13.4.1 Measurement

Measurement of acceptably development of Korean Grass & Synthetic Turf (Grass) will be made on the basis of actual area in square meter of korean grass provided, planted and laid in position as shown on the Drawings or as directed by the Engineer.

13.4.2 Payment

Payment will be made for acceptable measured development of Korean Grass & Synthetic Turf (Grass) on the basis of unit rate per square meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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SECTION 0100 - EARTHWORKS

PART 1 – GENERAL

1.1 SCOPE

The work under this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations for excavation, backfilling, construction of embankments and disposal of unsuitable and surplus excavated material as required in accordance with this section of specifications, the applicable drawings and subject to terms and conditions of the Contract.

PART 2 – APPLICABLE STANDARDS

Materials, construction and testing shall comply with the following latest versions of codes and standards:

ASTM C 136	Sieve Analysis of Fine and Coarse Aggregate
ASTM D 422	Particle Size Analysis of Soils
ASTM D 596	Water Analyses
ASTM D1556	Density and Unit Weight of Soil In-place by the Sand Cone Method
ASTM D1557	Moisture-Density Relation of Soils Using 4.5kg Rammer and 457mm Drop
ASTM D1883	Test Method for California Bearing Ratio (CBR) of Laboratory Compacted Soils
ASTM D 2167	Density of Soil In-place by the Rubber-Balloon Method
ASTM D 2216	Moisture content of soil
ASTM D 4253	Test Method for Maximum Index Density and Unit Weight of Soils
ASTM D 4254	Test Method for Minimum Index Density and Unit Weight of Soils
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soil

PART 3 – GENERAL

i. The Contractor shall acquaint himself with the nature of the ground, existing structures and subsurface materials (soil / rock) which will be encountered during excavation or earthworks. The Employer does not guarantee or warrant in any way that the materials to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Geo-Investigation Report, Drawings or any other documents or to material obtained from boring or trial holes. Shared with the Contractor upon his request, the Contractor shall be deemed to have made local and independent inquiries, and shall take whole risk of the nature of the subsurface materials (soil / rock) to be excavated or penetrated and the Contractor shall not be entitled to receive an extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground and subsurface material.

ii. The Contractor shall submit a detailed list of plant and equipment which he shall undertake to bring to the site and to carry out the work. The list shall satisfy the Engineer as to type, size and quantity of various plant and equipment, the Contractor has planned to bring at site. The Contractor shall place on the site of the work all of the equipment listed and all subsequent equipment required for approval of the detailed program of work and such equipment which may be directed by the Engineer. All equipment which is proposed to be used on the work shall be sufficient size and in such mechanical condition as to meet requirement of work and produce a satisfactory quality of work. In no case shall the Contractor remove from the site the plant and equipment without the written approval of the Engineer. The Contractor shall supply all plant and equipment necessary for the construction of each phase of the work and it must be on site, inspected and approved by the Engineer. If after use of the equipment the Engineer determines that the work provided does not meet the Contract requirement, the equipment

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shall be changed and the deficient work shall be removed and corrected as directed by the Engineer.

iii. All suitable materials from stripping of top soil and excavation shall be used unless otherwise declared unsuitable by the Engineer. The suitable material shall be used in permanent works if it complies with the requirements as specified for the respective works in drawings and specifications.

iv. The Contractor shall jointly survey the area marked for pavements, utilities, service lines, buildings or other structures or any area designated by the Engineer and prepare the survey drawings showing natural ground profile and cross-section and submit to the Engineer for approval prior to start of any earthwork operation.

All suitable material from excavations shall be transported to and placed in fill areas or stockpiled at locations designated by the Engineer. Materials from excavation and stripping shall be stockpiled separately.

Existing utilities which are to remain in service or to be relocated and to remain in service until relocation are to be located and determined by the Contractor. They shall be safeguarded and protected from damage irrespective if they are shown on the As-Built drawings of earlier works or otherwise.

If any existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during the operations, shall be safe guarded, protected from damage and supported as directed by the Engineer.

v. All excavations, cut and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Defect Liability Period the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Defect Liability Period any damage or defects in cuts and fills, in structures and other works, caused by slips, falls of wash-ins or any other ground movement due to the Contractor's negligence shall be made good by the Contractor at his own cost.

PART 4 – SITE PREPARATION

i. The Contractor shall set out the works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall at his own expense rectify such error, to the satisfaction of the Engineer.

The Contractor shall construct and maintain accurate bench marks so that the Lines and Levels can be easily checked by the Engineer. The Contractor shall construct and maintain such temporary drains in addition to those shown on the plans, as will adequately drain areas during construction.

The Contractor shall perform a joint survey with the Engineer's Representative, of the area where earth work is required, plot the ground levels on the drawings and obtain approval from the Engineer before starting the earth work and shall supply a copy to the Employer duly checked, signed and authenticated by the Engineer before start of work.

PART 5 – EXCAVATION

i. No classification shall be made of any material excavated / cut as to its class, nature, origin or condition. The excavation will be unclassified as being carried out in all kinds of subsurface material including soil and rock.

ii. Blasting will not be permitted and other means if mechanical excavation shall be used.

iii. The excavation wherever required will be carried out below ground water level by dewatering the area.

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The Contractor shall build, maintain and operate all berms, channels, flumes, sumps and other temporary diversion and protective works needed to divert the surface water through or around the required excavation. All excavation shall be dewatered and kept free of standing water, water seeping from the sides and bottom of excavation above, the free level. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps and other equipment needed to dewater the excavation areas. Dewatering methods that cause a loss of fines from the bottom and slopes of the excavation will not be permitted.

Prior to commencement of the work, the Contractor shall furnish the Engineer for review and comments with complete plans and sketches for diverting surface water if any and dewatering of the required excavation.

iv. Submission for review and comments of the required plans and sketches and any approval from Engineer shall not relieve the Contractor of any of his duties and obligations under the contract.

PART 6 – EMBANKMENT CONSTRUCTION

6.1 GENERAL REQUIREMENTS

It shall consist of construction of select embankment for paved areas (i.e. runways, taxiways, aprons, shoulders and overruns) and common embankment for unpaved, areas including graded strip. Only approved material shall be used in the construction of embankments.

All embankment construction shall be made to the lines, levels, profiles and grades as shown on the drawings or established by the Engineer. During progress of the work it may be found necessary or desirable by the Engineer to vary the levels, elevations and grades from those shown on the drawings, the Contractor shall perform the embankment construction to the revised grades, levels, elevation as established by the Engineer.

Where embankments are to be placed in water logged areas and which are inaccessible to heavy construction equipment, a working platform shall be first established, consisting of a blanket of fill material placed on the water logged area. The thickness of the working platform shall be about 0.5 meters unless directed otherwise by the Engineer and the width shall be that of the embankment. The placement and compaction of the working platform shall be performed by use of light equipment as directed by the Engineer. No density requirements are specified for the working platform, however, subsequent layers above shall be compacted to densities specified in the relevant items. For over moist clayey silts and silty clay which restrict the compaction of subsequent layers to the required degree of compaction, the Engineer may also instruct for scarifying the soil and let it dry to control moisture in such soils. If the Engineer decides that situation cannot be controlled with this method he can instruct for further removal of such soil upto a depth of maximum 600mm for repeating the process of reduction in moisture.

Benching of sufficient width for slope stability and movement of equipment and machinery shall be carried out for embankment formation in areas of steep slopes.

6.2 SELECT EMBANKMENT

The select embankment shall be constructed under all paved areas. The area shall be prepared (after stripping of top soil) by scarifying the surface to a minimum depth of 150 mm and compacting it to densities mentioned in subsection 6.2.2.

6.2.1 Material

The suitable subsurface material obtained from excavation (except top soil) shall be used in the construction of select embankment or as directed by the Engineer. CBR of material shall not be less than seven (07) percent or as directed by the Engineer, determined in accordance with ASTM D1883. CBR value shall be obtained corresponding to the degree of compaction required for the corresponding layer. At-least one test per 1000 cum of selected embankment material shall be

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conducted. Material of embankment shall also have a Plasticity Index of more then six (6) when determined as per ASTM D4318-17 or as directed by the Engineer. If the material obtained from required excavation does not fulfill the requirement, the material shall be thoroughly mixed with sand of approved gradation at a rate of 80% material obtained from required excavation with 20% sand to achieve required plasticity index unless instructed otherwise by the Engineer.

6.2.2 Formation of Embankment

Before placing and compacting the fill material the ground shall be scarified to a depth of 150 mm and compacted to a dry density of 90% as per laboratory compaction test method ASTM D1557. The moisture content of soil during compaction of scarified layer and successive layers shall be within ±2% of optimum moisture content before rolling to obtain the desired density results.

Embankment shall be formed in successive horizontal layers of not more than 200 mm in loose depth for the full width of the cross-section, unless otherwise approved by the Engineer.

The material placed in layers and the subgrade scarified shall be compacted to the density specified below:

Table 1: Required Compaction in Different Depths for Different Materials

Depth (mm) Below Subgrade Level Cohesive Soil	Depth (mm) Below Subgrade Level Non-Cohesive Soil	% of Max. Dry Density (ASTM D1557) Cohesive Soil	% of Max. Dry Density (ASTM D1557) Non-Cohesive Soil
0 to 300	0 to 600	95%	100%
300 to 750	600 to 1000	93%	95%
Over 750	Over 1000	90%	90%

The maximum density of sand (granular material, if used) shall also be determined as per ASTM D4253 and for other material ASTM D1557 shall be used. The Engineer can instruct for determination of maximum density by both methods and in that case the higher of the two values obtained from ASTM D1557 and ASTM D4253 shall be used to check the relative compaction of the in-place material. If the soil used for embankment contains the coarse grained particle (more than 30% retained on 3/4 inch sieve) then density and moisture tests shall be conducted as per ASHTO T180 Method D and the test frequency shall remain the same.

The moisture content of the material should be controlled to within ±2% of the optimum moisture content. In order to achieve a uniform moisture content throughout, the wetting and drying of the material, and manipulation shall be required when deemed necessary.

Material for each layer should be consolidated with heavy weight vibratory roller until settlement as checked between two consecutive passes of roller is less than 1% of the layer thickness. When rock to be incorporated in fill is composed largely of weak or friable material, the rock shall be reduced to a maximum size not exceeding 50% of the thickness of the layer being placed.

6.3 COMMON EMBANKMENT

6.3.1 Material

The area requiring common embankment, i.e. graded strip, and other unpaved areas shall be constructed from the excavated soil and rock. The top soil obtained from stripping may be used at deeper level with the approval of the Engineer.

6.3.2 Formation of Embankment

Before placing and compacting the fill material the ground shall be scarified to a depth of 150 mm and compacted to a dry density of 90% as per laboratory compaction test method ASTM D1557. The

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moisture content of soil during compaction of scarified layer and successive layers shall be within ±2% of optimum moisture content before rolling to obtain the desired density results. The successive horizontal layers shall be formed in loose depth (200mm) for the full width of the cross section unless otherwise approved by the Engineer. Each layer will be compacted to dry density of 90% as per laboratory compaction test method ASTM D 1557.

The layer thicknesses and compaction requirements shall be the same as specified under 'Select Embankment' for embankment formed by rock fragments.

No rock larger than 80mm in any dimension shall be placed in top three hundred (300) mm of embankment unless allowed by the Engineer.

PART 7 – TOLERANCE FOR EXCAVATION, FILL AND BACKFILL

7.1 SUBGRADE

In those areas upon which a sub-base or base course or lean concrete is to be placed, the top of the subgrade shall be of such smoothness that when tested with a 5.0 m straight edge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 50 mm. The tolerance in elevation range between 0 to -25 mm. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing material; reshaping; and re-compacting by sprinkling and rolling.

On graded strips (safety areas) intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 30 mm from true grade. The finished surface of the subgrade shall range between 0mm to -25mm from the grade line elevations and cross sections shown on the drawings.

7.2 SELECT EMBANKMENT AND COMMON EMBANKMENT

The grade surface of each layer excluding subgrade, shall be smooth and even and tolerance from required grade shall not be more than 20 mm.

PART 8 – QUALITY CONTROL

A testing program and required forms of all the tests shall be submitted by the Contractor. Tests shall be performed by the Contractor to ensure compliance with the specifications as required. A copy of all test reports shall be submitted to the Engineer for approval. The test shall be performed in accordance with the following test procedures and frequency of testing.

Prior to construction of embankment, classification and compaction tests shall be carried out on stock-piled material obtained from stripping of top soil and excavated subsurface material (soil & rock) and improved soil obtained after mixing of sand with material obtained from required excavation. The tests shall be carried out as per ASTM 422, ASTM D4318 and ASTM D 1557 and all the test reports shall comprise of comprehensive data and calculations used in the test with specific mentioning of testing code / standard. A family of laboratory compaction curves as per ASTM D 1557 representing typical material shall be developed for the fill / backfill material.

The frequency of classification tests shall be for every 1000 Cu.m of fill material. The Engineer may alter the frequency of testing depending on the type of material and variation encountered at site.

The field density tests shall be performed as per ASTM D 1556 or ASTM D 2167. The frequency of testing shall be as under:

Sieve Size	Percentage Passing
No. 4 (4.75mm)	100
No. 2 (2mm)	85 – 100
No. 40	30 – 60
No. 200	10 – 20 (non plastic)

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8.1 SELECT EMBANKMENT

Area requiring 90% to 93% compaction – one test in every 350 Sq.m area in each layer

Area requiring 95% & 100% compaction – one test in every 250 Sq.m area in each layer

8.2 COMMON EMBANKMENT

Area requiring 90% compaction – one test in every 750 Sq.m area

For 100% compaction the average of four tests performed in a lot of four adjacent tests are required to be greater than the required compaction and not more than one test be 1.8% less than required percentage of compaction. For the required compaction of 95% to 90% compaction, following are the tolerance in the compaction requirement:

Percentage Compaction	One test in a lot of four adjacent tests not less than
95%	93.5%
90%	89.5%

PART 9 – EARTH WORK FOR STRUCTURES, STORM WATER DRAINS & CULVERTS

9.1 EXCAVATION

Excavation, including dewatering where required, for building/related structures, culverts, storm water drains etc. shall conform to the elevations and dimensions as shown on the drawings and extend to a sufficient distance to permit placing and removal of concrete formwork or other construction.

When determined by the Engineer to be insufficiently firm, excavation bottoms shall be further excavated to reach firm ground or backfilled with suitable material as per the requirements given in section 6.2 of the specifications and compacted to 95% of maximum dry density as per ASTM D-1557.

All excavations in foundations shall be taken as 150 mm above the final excavation elevations shown on the drawings and the last 150 mm shall be trimmed carefully to a smooth surface. Immediately after trimming to final elevation, subsequent layer if engineered fill or a layer of blinding concrete shall be placed to thickness shown on the drawings.

9.2 FILL AND BACKFILL FOR STRUCTURES, SERVICES TRENCHES, STORM WATER DRAINS & CULVERTS

i. After completion of foundation footings, foundation walls and other construction below the elevation of the final grades and prior to start of back-filling, forms shall be removed and the excavation shall be cleaned of trash and debris.
ii. The backfilling/fill shall include filling under the floors where shown or required and around the foundations.
iii. The backfilling/fill shall include loading, unloading transporting, placing, stacking, spread of earth, watering, rolling, ramming and compaction etc. complete as specified herein.
iv. Filling in and around the foundations or under floors shall be placed in 200mm loose layers and compacted at optimum moisture content by mechanical means or other means as approved by the Engineer.
v. Material for backfilling shall be as approved by the Engineer and compacted to produce in-situ dry density not less than 95% of the maximum dry density as achieved by compaction test as per ASTM D-1557 for filling around the foundation, trenches in paved sections of pavements and culverts and all other areas except for trenches backfilled in non-traffic areas.
vi. All care shall be exercised by the Contractor not to disturb works executed in the trenches.

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9.3 SELECT FILL UNDER FOUNDATIONS

The select fill must be well graded granular material. The fines (i.e. particles passing no. 200 sieve) in select fill material should be non-plastic and fines should not be more than 15%. It shall be placed and compacted in layers appropriate to the type and size of compaction equipment, to at least 75% of the relative density determined as per ASTM D-4253 or 95% modified maximum dry density determined as per ASTM D-1557.

The moisture content of the select fill material shall be controlled to within + 2% of the optimum moisture content. The compaction of the select fill material shall be verified by appropriate field testing prior to the placement of foundation.

The gradation of the compacted select fill material is listed in the following table:

Sieve Size	Percent Passing
1" (25 mm)	100
3/4" (19 mm)	75 – 100
No. 4 (4.75 mm)	55 – 100
No. 10 (2 mm)	40 – 100
No. 40 (0.425 mm)	20 – 50
No. 200 (0.075 mm)	5 – 15 (non-plastic)

9.4 SAND CUSHION IN SERVICE TRENCHES

Gradation of the compacted sand cushion / sand surround shall be as under and compacted to degree of compaction based on the location of trenches i.e. in traffic /non traffic area.

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PART 10 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0120 - STONE SOLING

PART 1 – SCOPE

The work under this section of specifications consists of furnishing all plant, labour, equipment, appliances, materials and performance of all operations required in connection with the construction of stone soling for the Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu, in strict accordance with the specifications and Drawings and/or as directed by the Engineer.

PART 2 – MATERIAL

Material shall be of approved quality, it shall be comprised of strong hard durable stone of the approved size free from impurities, quarry sap, dust, dirt and solubility characteristics. The stone shall be obtained from approved quarries and shall be sound, free from laminations and weak cleavages.

PART 3 – QUALITY CONTROL

The quality of material used in stone soling shall conform to the following.

- Maximum Los Angles Abrasion value 35% determined as per ASTM C-535-16 or ASTM C-131-06 whichever is applicable.
- Soundness 5 cycles with sodium sulphate 10% determined as per ASTM C-88-18.
- Specific Gravity shall be not less then 2.65 determined as per ASTM C-127-15.
- Water Absorption shall not be more than 1.5%

PART 4 – CONSTRUCTION

4.1 Preparation of Sub-grade (Substrate)

Sub-grade shall be formed of suitable materials free of clods, sod, roots, stumps, brush or other objectionable material. Sub-grade material shall be placed in successive layers not exceeding 6 inch in thickness and each layer shall be thoroughly compacted at optimum moisture content.

Compaction shall be done by approved methods consistent with the soil/material to be compacted.

The maximum dry weight density of the sub-grade shall not be less than 95% of Modified density determined as per ASTM D1557.

4.2 Stone Ballast / Brick Ballast Soling

The Stone Ballast / Brick Ballast (if allowed by the Engineer) shall be well graded and broken hard of 2" mesh obtained from an approved quarry. The soling stone shall be 50mm in size from an approved quarry.

The stone shall be laid and packed to even grades and well rolled using vibratory roller/plate compactor to a consolidated thickness of not less than 6 inch or as shown on the Drawings.

The whole of the surface of the compacted stone ballast soling will be blinded with murum or any other approved gritty material/ stone dust (Khaka). After the interstices have been filled with smaller size crushed stone, so as to effectively fill in the voids and crevices, soling area may be watered, if necessary and again thoroughly rolled with the same roller to produce a smooth and even surface free from irregularities. true to line and level.

Care is to be taken to avoid any damage to existing structures, mains or pipes while rolling operation is in progress. In places inaccessible for a roller, compaction shall be done by hand tampers weighing not less than 20 lb. or power reamers as directed by the Engineer.

PART 5- MEASUREMENT AND PAYMENT

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No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0130 - TERMITE CONTROL TREATMENT

PART 1 – SCOPE

The scope of work for anti-termite treatment includes injecting insecticide into the sides and bottom of the foundation trenches, spraying it on stockpiled backfill material, and injecting it into the floor subgrade of the building. The scope also covers the treatment of all woodwork with insecticides before installation in position.

PART 2 – MATERIAL

2.1 An emulsible concentrate insecticide shall by used for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a working solution of the following chemical element and concentrations.

BIFLEX with Bifenthrin Tech 25.1% or approved equivalent.

2.2 All mixing shall be done at site and mixing proportion of insecticide with water shall be in accordance with the approved manufacturer's recommendations and shall be verified by the Engineer.

2.3 Pure turpentine shall be used for dilution of insecticide, in approved proportion for application to woodwork.

PART 3 – QUALITY ASSURANCE

3.1 In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for the work, including preparation of substrate and application of insecticide.

3.2 A professional operator shall be engaged who shall have license in accordance with regulations of governing authorities for application of soil treatment solution.

PART 4 – EXTENT OF APPLICATION

4.1 Insecticide solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150 psi to all applications to, on or in earth.

4.2 Soil treatment shall begin after all work of preparation of earth prior to installation of concrete has been done. After application, no additional earth moving or work upon sub grade should be done. No covering of earth or concrete should be applied over soil treatment until at least 24 hours after treatment has been made.

4.3 Insecticide solution should not be applied during wet weather, or when the earth surface is excessively moist. Application should be made to all areas beneath concrete slabs-on-grade, including sidewalks and paving abutting buildings for distance of at least 3 meters beyond building line. Solution shall be applied in amounts of not less than 5 lit./ square meter. or 5 lit./10.76 square feet. of area. If applied over material predominantly gravel or sand, application shall not be less than 7 lit./ square meter or 7 lit./10.76 square feet of area. Insecticide shall penetrate to a depth of 1-inch minimum in porous earth at bottom and 2 inch to 3 inch at sides of excavations.

4.4 Sides of foundation excavations, grade beam, and similar areas shall be treated with solution at a rate of 0.5 lit per square feet upon inner sides of such excavations, and at all locations where concrete slabs for platforms and similar work abut the building. Similar treatment shall be made at all locations where expansion joints, control joints, column bases and similar work occur at or below grade slabs.

4.5 In the areas of application signs shall be fixed to show that soil treatment has been applied. Such signs shall be removed when areas are covered by other construction.

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4.6 Care shall be exercised to ensure that no marks or damage occurs to the finished structure as a result of the work under this section.

4.7 All woodwork for the entire project is to be insecticide or treated (before application of solignum). Insecticide shall be sprayed on all surfaces of all the wooden work including but not limited to door frames, blocking, furring, planks, boards etc. before installation. Spraying is to be done at site, after delivery and before installation. No spraying shall be necessary after field sawing, jointing or installation of such material.

PART 5 – STANDARDS

All methods of termite protection used herein shall be in accordance with the standard practices of National Pest Control Association, U.S.A and the British Wood Preserving Association.

PART 6 – SAMPLES AND TESTS

The Contractor shall supply samples of all the materials to be used for insecticide control for approval of the Engineer and testing in accordance with the specified standards. Rejected materials shall be removed from the site immediately.

PART 7 – GUARANTEE

The Contractor is to guarantee that the building shall be free from termites (white ants), wood bores and other pests, which cause damage to wood or other organic material for 10 years from the date of acceptance of the building.

In the event of any damage caused within the guaranteed period, the Contractor shall replace at his own cost such damaged material, finishes affected and suitably preserve and treat the entire premises with the best method known to the trade to prevent the spreading of termites.

PART 8 - MEASUREMENT AND PAYMENT

8.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost there of shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

8.1.1 Termite control treatment on wood works.

8.1.2 Turpentine & Water required for mixing insecticide solution.

8.1.3 Transportation of material and storage at site.

8.1.4 Anti-termite treatment on stock piled backfill material.

8.1.5 Termite control treatment to vertical surfaces.

8.2 Termite Control Treatment

8.2.1 Measurement

Measurement of acceptably completed works of termite control treatment will be made on the basis of number of square meter of plinth area treated of ground /upper floor by measuring the two dimensions (length & breadth) of treated area. No separate measurement will be made for the vertical or horizontal surfaces of the foundations.

8.2.2 Payment

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8.2.2.1 Payment will be made for acceptable measured quantity of termite control treatment on the basis of unit rate per square meter of plinth area treated for ground /upper floor quoted in the Bills of Quantities & shall constitute full compensation for all the works related to the item.

8.2.2.2 For "Termite Proofing", the rate is for the unit plinth area (measured along the outside of the external walls at DPC or peripheral plinth beam level irrespective of the number of storeys in the building) and covers the followings operations:

i. Treatment of bed and sides of excavated foundation trenches.

ii. Treatment of backfill.

iii. Treatment of filled up earth.

iv. Treatment of timber to be used.

v. Treatment of surrounding areas within 3 meters of the building.

vi. Any other operation which the specialized firm may deem necessary in context to their guaranteed obligations.

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SECTION 0140 - FORMWORK

PART 1 – SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the design, supply and installation of formwork for the purpose of containing concrete during placement and consolidation in the required shape and form.

PART 2 – GENERAL

It shall be the responsibility of the Contractor to perform the work by engaging well trained and experienced staff.

APPLICABLE CODES AND STANDARDS

The latest edition of following ACI, ASTM, Pakistan & British Standard are relevant to these specifications wherever applicable:

2.1 ACI (American Concrete Institute)

- ACI 301 Specifications for Structural Concrete.
- ACI 318 Building Code Requirements for Structural Concrete
- ACI 347 Guide to Formwork to Concrete (ANSI A145.1)

2.2 APA (Engineered Wood Association)

- EWA High Density Overlay Concrete Form, Class 1
- EWA Structural 1, Exterior Quality, Class 1
- EWA Plastic Overlay Plywood Forms

2.3 ANSI (American National Standard Institute)

- NBS PSI Voluntary Product Standard, Structural Plywood (ANSI-A199.1)

Latest editions of the codes/standards shall be used in all cases.

PART 3 – MATERIALS

The Contractor shall use the following materials for different purposes as stated below:

3.1 Timber: Form framing, sheathing and shoring.

3.2 Plywood: Form sheathing and panels.

3.3 Steel

- Heavy forms and false work
- Column and joint forms
- Permanent forms
- Welding of permanent forms

3.4 Form Ties, Anchors and Hangers: For securing formwork against placing loads and pressures.

3.5 Coatings: Facilitate form removal.

3.6 Steel Joints: For formwork support.

3.7 Steel frame shoring: For formwork support.

PART 4 – DELIVERY AND STORAGE

4.1 Delivery

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The delivery of formwork components shall be made in a manner so as not to cause damage.

4.2 Storage

Form work should be stored, after cleaning and preparing for re-use, if used before in such a manner that access to all different component is available.

Form work component which can be affected by weathering shall be stored in appropriate building or under covers and shade.

PART 5 – WORKMANSHIP

5.1 Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

Where required details and locations of special forms to be used are set out on the drawings. The Engineer may reject any formwork in any part of the work which has been constructed with a non-approved formwork. Approval of form work by the Engineer shall be one of these conditions to be fulfilled before concreting. The Engineer may reject any concreting where it does not conform to the approved model.

5.2 Earth cuts shall not be used as forms for vertical surfaces of reinforced concrete work unless required as such or permitted by the Engineer.

5.3 Formwork shall be of timber, steel, plywood, proprietary building boards and such special materials, as may be approved by the Engineer, which give the required finish and shape to the surface of concrete. Wooden formwork shall be free from loose knots and shall be well seasoned.

5.4 The formwork shall conform to the shape, lines and dimensions as shown on the plans, and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete and shall be sufficiently tight to prevent loss of liquid from the concrete.

The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Where necessary, to maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads.

The Contractor shall establish and maintain, in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used as references for checking upon tolerances.

Requirements for 'facing materials' are given in Clause 8, Section 0140 relevant to 'Finishing of Formed Surfaces.'

5.6 Where natural plywood-form-finish, grout-cleaned-finish, smooth-rubbed-finish, scrubbed-finish, or sand-floated-finish is required, forms shall be smooth (faced with plywood, liner sheets, or prefabricated panels) and true to line, in order that the surfaces produced will require little dressing to arrive at true surfaces. Where any as-cast finish is required, no dressing shall be permitted in the finishing operation.

5.7 Where as-cast surfaces, including natural plywood-form-finish are specified, the panels of material against which concrete is cast shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features.

5.8 Where panels for as-cast surfaces are separated by recessed or otherwise emphasized joints, the structural design of the forms shall provide for locating form ties, where possible, within the joints so that patches of tie holes will not fall within the panel areas.

5.9 Forms shall not be re-used if there is any evidence of surface wear and tear or defect which would impair the quality of the surface finish. Forms shall be thoroughly cleaned and properly coated before re-use.

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5.10 Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Unless otherwise specified in the Contract documents chamfer strips shall be placed in the corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such surfaces and the edges of formed joints will not require beveling unless required by the Contract documents.

5.11 Positive means such as wedges or jacks for accurate adjustment and for proper removal of shores and struts shall be provided and all settlement shall be monitored during concrete placing operation. Forms shall be securely braced against lateral deflections.

5.12 Where concreting of thin members is required to be carried out within formwork of considerable depth, temporary openings in the sides of the formwork shall be provided where necessary to facilitate the placing and consolidation of concrete. Small temporary openings shall also be provided at the bottom of the formwork for columns, walls and deep beams to permit the cleaning out of debris and observation immediately before concrete is deposited.

5.13 Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than twice the diameter or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view and in no case shall this distance be less than 20mm. When the formed face of the concrete is not to be permanently exposed to view form ties may be cut off flush with the formed surfaces.

Through bolts may be permitted provided that they are greased to allow for easy withdrawal and the holes subsequently made good. Through bolts are not to be used on water-retaining structures.

5.14 At construction joints contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by no less than 25mm. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint so as to maintain a true surface.

5.15 Wood forms for wall opening shall be constructed to facilitate loosening, if necessary, to counteract swelling of the forms.

5.16 Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check.

5.17 Formwork shall be so anchored to shores or to other supporting surfaces or members that upward or lateral movement of any part of the formwork system during concrete placement will not occur.

5.18 Runways or planks for moving labour and equipment shall be provided with struts or legs and shall be supported directly on the formwork or upon the structural member without resting on the reinforcing steel.

5.19 All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before placing fresh concrete.

5.20 Forms shall be sufficiently tight to prevent leakage of grout or cement paste. Board forms having joints opened by shrinkage of the wood shall be removed and replaced. Plywood and other wood surfaces not subject to shrinkage shall be sealed against absorption of moisture from the concrete by either (1) a field applied, approved form oil or sealer, or (2) a factory applied non-absorptive liner. When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. Excess coating material shall not be allowed to stand in puddles in the forms nor allowed to come in contact with the concrete against which fresh concrete will be placed. Care shall be taken that such approved composition is kept out of contact with the reinforcement. Where as-cast finishes are required, materials,

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which will impart a stain to the concrete, shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surfaces shall be compatible with the type of paint to be used.

5.21 For reinforced concrete, under no circumstances shall forms be struck until the concrete attains strength of at least twice the stress to which the concrete may be exposed at the time of striking.

The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions, and cured under conditions of temperature and moisture similar to those obtaining in the work. Where possible, the formwork should be left for longer time as it would assist the curing.

In normal circumstances (generally where temperature are above 20° C and where ordinary cement is used) forms may be struck after expiry of the following periods:

- Walls, Columns & Vertical Sides of Beams & slab	48 Hours or as may be decided by the Engineer
- Beams Soffits	14 Days (shores or props left under)
- Removal of shores or props to Slabs	14 Days (Spanning up to 4 meters) 16 Days (Spanning up to 5 meters) 18 Days (Spanning up to 6 meters)

For rapid hardening cement 3/7 of the above period will be sufficient in all cases except vertical sides of slabs, beams and columns which should be retained for a minimum of 24 hours.

The number of shores or props, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab and beams, as the case may be.

Proper allowance shall be made for the decrease in rate of hardening of concrete in cold weather and the above minimum duration must be increased when the mean daily temperature is below 20° C.

5.22 When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

5.23 Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such slopping surfaces shall be performed at once and be followed by the specified curing.

5.24 Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete.

5.25 All formwork shall be removed without such shock or vibration as would damage the reinforced concrete. Before the top plank and struts are removed, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. Proper precautions shall be taken to allow for the decrease in the rate of hardening that occurs with all cement in the cold weather.

5.26 When reshoring or repropping is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is underway no live loads shall be permitted on the new construction.

In no case during reshoring shall concrete in beams, slab, columns or any other structural member be subjected to combined dead and construction loads in excess of the load permitted by the Engineer for the developed concrete strength at the time of reshoring.

Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of working day on which stripping occurs.

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Reshores shall be tightened to carry their required loads without overstressing the construction. Reshores shall remain in place at least until tests representative of the concrete being supported have reached the specified strength.

5.27 Floors supporting props or shores under newly placed concrete shall have their original supporting props or shores left in place or shall be reshored. The reshoring system shall have a capacity sufficient to resist the anticipated loads and, in all cases, shall have a capacity equal to at least one half the capacity of the shoring system above. The reshores shall be located directly under a shore position above unless other locations are permitted.

The reshoring or re-propping shall extend over a sufficient number of storeys to distribute the weight of newly placed concrete, forms and live loads in such a manner that the design superimposed loads of the floors supporting shores or props are not exceeded.

5.28 It is generally desirable to give forms for reinforced concrete an upward camber to ensure that the beams or slabs (specially cantilever slabs) do not have a sag when they have taken up their deflection, but this should not be done unless permitted by the Engineer.

5.29 No loads, other than man and light plant required in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland Cement is used and 14 days when rapid hardening Portland Cement is used.

5.30 Prior to placing concrete, all forms shall be inspected and all debris and extraneous matter removed. The form oil or release agent shall not react with concrete to affect the strength, nor shall it give any colour. It shall be applied in such a manner as not to contaminate the reinforcement and other fixtures to be embedded in concrete.

5.31 For formwork of PQC pavements refer Section 0140 of these specifications.

5.32 Forms for fairfaced concrete and pre-cast elements shall be of such type that all the surfaces of concrete once removed from the forms shall be free of all surface blemishes, discoloration, pin holes, edges drop-off and proper beveled surfaces are achieved.

PART 06 - FORMWORK TOLERANCES

Formwork shall be designed, erected, and removed in strict compliance with ACI 347 and the following requirements:

Tolerances for concrete formed surfaces:

— Variation in cross-sectional dimensions: -6 mm / +12 mm

— Variation in floor level (slab soffit): ±10 mm

— Variation from plumb for column and wall faces: 6 mm per 3 m height, 25 mm maximum

At high-altitude low temperatures (below +5°C at Skardu), stripping times shall be doubled unless accelerated curing with heated water or steam is employed and approved by the Engineer. No formwork shall be struck without prior approval of the Engineer in writing.

Exposed concrete formwork shall use high-quality form-ply or steel to produce a smooth, blemish-free finish. Release agent: approved non-staining, non-reactive type applied uniformly to all form surfaces before placing reinforcement

PART 7 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0145 - REINFORCEMENT

PART 1 - GENERAL

1.01 SCOPE

1.01.1 The work under this section of specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in connection with the supply, transporting, cutting, bending and placing steel reinforcement, welded wire-fabric, dowels, tie-bars and assemblies in concrete structures, pavement or elsewhere, as shown in the drawings, as specified herein and as required by the site conditions or as directed by the Engineer.

1.02 APPLICABLE STANDARDS

1.02.1 Latest editions of the following Pakistan, British and ASTM Standards are relevant to these specifications wherever applicable.

Pakistan Standards:

- PS: 2031 – Metallic Materials – Bent Test

- PS 607 – Steel and Steel Product - General technical delivery requirement for steel

- PS 1879 – Deformed and Plain Billet Steel Bars for concrete Reinforcement

- PS 1612 – Steel for the reinforcement of concrete – weldable reinforcement

British Standards:

- BS 4449 – Specifications for Carbon steel bars for reinforcement of concrete

- BS 8666 – Specifications for Scheduling, dimensioning, Bending and Cutting of Steel reinforcement for concrete

ASTM Standards:

- ASTM A615 – Standard specification for deformed and plain Carbon-Steel bars for concrete reinforcement

- ASTM A1064 – Standard Specification for Carbon-Steel wire and welded wire reinforcement, plain and deformed, for concrete

ACI Codes:

- ACI 315 – Details and Detailing of Concrete Reinforcement (ACI Publication SP-66)

- ACI 318 – Building Code Requirements for Structural Concrete

1.02.2 In addition to the above, the latest editions of other Pakistan Standards, British standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other standard as may be specified by the Engineer for Special Material and construction are also relevant.

1.03 SUBMITTALS

1.03.1 Bar Bending Schedules

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The Contractor shall prepare bar bending schedules of all the reinforcing steel bars and shall obtain approval of the Engineer before proceeding with the work. The Engineer's approval, however, will not relieve the Contractor of his responsibility in this regard.

1.03.2 Certificates of Compliance

The Contractor shall submit certificates of compliance from the manufacturer stating that the supplied reinforcement conforms to the Specifications.

1.04 QUALITY ASSURANCE

1.04.1 Wherever and as directed by the Engineer, conformance of the supplied reinforcing bars with the specifications shall be demonstrated by the Contractor through laboratory tests, in accordance with the relevant standards. If the results of such tests show that the sample does not meet with the specifications, the whole consignment shall be rejected and removed from the site at the Contractor's cost.

1.05 DELIVERY, STORAGE AND HANDLING

1.05.1 Delivery

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks as per relevant ASTM standard.

1.05.2 Storage

A. The method of storage shall be approved by the Engineer.

B. Reinforcing bars shall be stored in racks or platforms above the surface of ground and shall be protected free from scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works.

C. Bars of different diameters and grades of steel reinforcement shall be kept separately.
1.05.3 Reinforcement

Materials for reinforcing steel, welded wire fabric, dowels and tie bars, refer relevant specification.

Column Design Schedule

Member	Reinforcement Requirement
Column C1 (24" × 36")	As = 10.60 in²; ρ = 1.23%; ASTM A615 Gr 60; Mu = 192 ft-k; Pu = 223k — SAFE
Column C2 (24" × 36")	As = 21.99 in²; ρ = 2.55%; SMRF detailing required; multiple load combos — SAFE
Column C3 (30" dia circular)	As = 14.14 in²; ρ = 2.00%; Mu = 148 ft-k; Pu = 358k — SAFE
Column C4 (18" × 18")	As = 3.53 in²; ρ = 1.09% — SAFE

Beam Design Schedule

Member	Reinforcement Requirement
Plinth Beam PB1 (18" × 24")	Top: 5-#6; Bottom: 5-#6; Stirrups #3 @ 4" c/c supports, 9" c/c mid-span; V = 47k, M = 144 ft-k — SAFE

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Plinth Beam PB2 (18" × 30")	Top: 6-#6; Bottom: 6-#6; Stirrups #3 @ 4" c/c supports; V = 42k, M = 140 ft-k — SAFE
Beam B1 — Transfer Beam (21" × 45")	Top: 15-#8; Bottom: 15-#8; Stirrups #3 4-legged @ 3.5" c/c; V = 280k, M = 1,942 ft-k — SAFE
Beam B1-a (21" × 24")	Top: 8-#8; Bottom: 4-#8; Stirrups #3 2-legged @ 4" c/c; V = 75k, M = 519 ft-k — SAFE
Beam B2 (18" × 30")	Top: 6-#8; Bottom: 6-#8; Stirrups #3 @ 4" c/c; V = 92k, M = 499 ft-k — SAFE
Beam B3 (18" × 24")	Top: 5-#8; Bottom: 5-#8; Stirrups #3 @ 4" c/c; V = 67k, M = 276 ft-k — SAFE
Beam B4 (12" × 24")	Top: 5-#6; Bottom: 3-#6; Stirrups #3 @ 4" c/c; V = 52k, M = 171 ft-k — SAFE
Beam B5 (18" × 30")	Top: 10-#8; Bottom: 6-#8; Stirrups #3 4-legged @ 4" c/c; V = 150k, M = 793 ft-k — SAFE
Beam B6 (10" × 24")	Top: 3-#6; Bottom: 3-#6; Stirrups #3 @ 4" c/c; V = 15k, M = 114 ft-k — SAFE

Slab Design Schedule

Slab	Thickness / Reinforcement
S1 — Two-Way (24.5' × 29')	t = 7"; Short span: #4@4" neg, #4@6" pos; Long span: #4@5" neg, #4@8" pos; f'c = 3,000 psi — SAFE
S2 — Two-Way (18.5' × 24.25')	t = 6"; Short span: #4@3.5" neg; Long span: per calc; f'c = 3,000 psi — SAFE
Typical slab thickness	7 inches (175 mm) for two-way spanning slabs per ETABS model

PART 2 - PRODUCTS

2.01 REINFORCING STEEL

2.01.1 General

Reinforcement shall be obtained only from manufacturers approved by the Engineer. Each consignment of reinforcement steel shall be accompanied by the manufacturer's certificate or shall refer to a previous certificate, if the consignment is from the same batch, showing that the reinforcement steel complies with the specified requirement. Reinforcement shall be free from all loose or flaky rust and mill scale or coating, and any other substance that would reduce or destroy the bond. Reduced section steel reinforcement shall not be used.

2.01.2 Reinforcing Bars

Unless otherwise specified, all reinforcing bars shall comply with the requirements of ASTM A706 for deformed and plain carbon steel bars hot rolled from new stock billet steel bars and shall have minimum yield strengths of 60,000 psi. Alternatively, ASTM A615 Grade 60 steel with minimum specified yield strength of 60,000 psi (420MPa) and meeting the following limitations can be used:

A. Actual minimum yield strength shall not be less than 60,000 psi (420 MPa) and actual maximum yield strength shall not exceed 78,000 psi (540 MPa).

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B. Ratio of actual tensile strength to actual yield strength shall not be less than 1.25.

2.02 SPACERS AND SUPPORTS

2.02.1 Spacers and supports shall be approved standard products of types best suited for the purpose.

2.03 WELDING MATERIALS

2.03.1 The bars shall not be welded, unless prior approval of the Engineer is obtained in writing. If permitted, welding shall be done in accordance with the latest edition of AWS D 1.4 with proper selection of procedure and filler material according to the chemical composition of the bars being welded together.

PART 3 - EXECUTION

3.01 FABRICATION AND BENDING

3.01.1 Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the bar bending schedule approved by the Engineer.

3.01.2 The cutting tolerance for all reinforcing bars shall be 20 mm.

3.01.3 Fabricating tolerance shall be as per ACI - 315.

3.01.4 Reinforcement shall not be bent or straightened in a manner that will injure the material. No bars shall be bent twice in the same place, nor shall they be straightened after bending. Unless permitted by the Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete.

3.01.5 No splice of reinforcement shall be made except as approved by the Engineer.

3.01.6 Welding of reinforcement shall not be done unless permitted and approved by the Engineer.

3.02 PLACING AND INSTALLATION

3.02.1 Reinforcement shall be accurately placed as shown in drawings and secured against displacement by using 16 gauge steel wire ties or suitable clips at intersections and supported from the formwork by using concrete, metal or plastic chairs, spacers or hangers of an approved pattern.

3.02.2 Where concrete blocks are used for ensuring the cover, they shall be made of mortar not leaner than one part of cement to two parts of sand. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories in contact with the form work shall be galvanized or shall be made of plastic.

3.02.3 Placing tolerances shall be as per ACI-318 & 117.

3.02.4 Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval of the Engineer.

3.02.5 Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.

3.02.6 Exposed reinforcement intended for bonding with future extensions is to be effectively protected from corrosion. Protection is also to be provided to reinforcement partly built into concrete where the exposed part is to be built into later concrete.

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3.02.7 No concreting is to be carried out until the reinforcement has been checked and approved by the Engineer.

3.02.8 All detailing shall be done as per ACI standards ACI-315, ACI-318 & ACI-350R, as and where required.

3.02.9 Standard or actual unit weight whichever is lesser shall be used for calculation of weights.

PART 4 - MEASUREMENT AND PAYMENT

4.1 General

Except otherwise specified herein or elsewhere in the Contract Documents no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

A. Providing and installing chairs, supports, hooks, spacers, binding wires, corrosion protection sleeves, wire cage or basket for tie bars and dowels and laps not shown on drawings including wastage and rolling margin.

B. Testing of mild steel, deformed steel, welded wire fabric, dowels, tie bars and assemblies.

4.2 Reinforcing Bars

MEASUREMENT:

A. Measurement for acceptably completed works of reinforcement shall be made by weight in metric tonne according to bar bending schedules approved by the Engineer.

PAYMENT:

B. Payment will be made for acceptable measured quantity of reinforcement provided and placed in position on the basis of unit rate per metric tonne quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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SECTION 0150 - CONCRETE WORKS

PART 1 GENERAL

1.1 Scope

The work under this section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the supply, manufacture, transporting, placing, consolidating, finishing and curing of plain and reinforced concrete for pavements and other structures as shown on the drawings, as specified herein and as required by the site conditions or as directed by the Engineer, for a complete job. Reinforcement does not form part of this section.

1.2 Applicable Codes and Standards

The latest edition of following ACI, ASTM, FAA & British Standard are relevant to these specifications wherever applicable:

1.2.1 American Concrete Institute (ACI)

Sr. No.	ACI Code	Description
1	ACI 117	Standard Specification for Tolerances for Concrete Construction and Materials
2	ACI 201.2R	Guide to Durable Concrete
3	ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavy Weight and Mass Concrete
4	ACI 214R	Evaluation of Strength Test Results of Concrete
5	ACI 301	Specifications for Structural Concrete
6	ACI 303.1	Standard Specification for Cast-In-Place, Architectural Concrete
7	ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
8	ACI 305R	Hot Weather Concreting
9	ACI 308R	Guide to Curing Concrete
10	ACI 309R	Guide for Consolidation of Concrete
11	ACI 315	Details and Detailing of Concrete Reinforcement
12	ACI 318	Building Code Requirements for Structural Concrete
13	ACI 347	Guide to Formwork for Concrete

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14	ACI 350R	Code Requirement for Environmental Engineering Concrete Structures and Commentary
15	ACI 351.1R	Grouting between Foundation and Bases for Support of Equipment & Machinery
16	ACI 544.1R	State-of-the-Art Report on Fiber Reinforced Concrete

1.2.2 American Society for Testing and Materials (ASTM)

Sr. No.	ASTM Code	Description
1	ASTM A499	Hot-Rolled Rail Carbon Steel Bars and Shapes
2	ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
3	ASTM A675	Steel Bars and Bar Size Shapes, Carbon, Hot-Rolled, Special Quality, Subject to Mechanical Property Requirements
4	ASTM A996/A996M	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
5	ASTM A1064/A1064M	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
6	ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
7	ASTM C33	Standard Specification for Concrete Aggregates
8	ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
9	ASTM C40	Standard Test Method for Organic Impurities in Fine Aggregate for Concrete
10	ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
11	ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading)
12	ASTM C87	Standard Test Method for Effect of Organic Impurities in Fine Aggregates on Strength of Mortar
13	ASTM C88	Standard Test Method for Soundness of Aggregates by use of Sodium Sulphate and Magnesium Sulphate

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14	ASTM C94	Standard Specification for Ready-Mixed Concrete
15	ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in or 50 mm cube specimen)
16	ASTM C117	Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
17	ASTM C123	Standard Test Method for Lightweight Particles in Aggregates
18	ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
19	ASTM C289	Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates
20	ASTM C293	Standard Test Method for Flexural Strength of Concrete (using simple beam with center Point Loading)
21	ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
22	ASTM C321	Standard Test Method for Bond Strength of Chemical Resistant Mortars
23	ASTM C330	Standard Specification for Lightweight Aggregates for Structural Concrete
24	ASTM C332	Standard Specification for Lightweight Aggregates for Insulating Concrete
25	ASTM C348	Standard Test Method for Flexural Strength of Hydraulic Cement Mortars
26	ASTM C494	Standard Specification for Chemical Admixtures for Concrete
27	ASTM C535	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine
28	ASTM C595	Standard Specification for Blended Hydraulic Cements
29	ASTM C596	Standard Test Method for Drying, Shrinkage of Mortar Containing Hydraulic Cement
30	ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
31	ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

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32	ASTM C989	Standard Specification for Slag Cement for use in Concrete and Mortars
33	ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
34	ASTM C1399	Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
35	ASTM D75	Standard Practice for Sampling Aggregates
36	ASTM D512	Standard Test Methods for Chloride Ion in Water
37	ASTM D516	Standard Test Methods for Sulphate Ion in Water
38	ASTM D596	Standard Guide for Reporting Results of Analysis of Water
39	ASTM D1411	Standard Test Method for Water-Soluble Chlorides Present as Admixtures in Graded Aggregate Road Mixes

1.2.3 CRD US Army Corps of Engineers

i. CE CRD C119 Method of Test for Flat and Elongated Particles in Coarse Aggregate
ii. CE CRD C400 Requirements for Water for Use in Mixing and Curing Concrete
iii. CE CRD C513 Specifications for Rubber Water stops
iv. CE CRD C572 Specifications for Polyvinyl Chloride Water stops
v. FF-MM-9650 Epoxy Resin Grout

1.2.4 British Standard (BS)

i. BS EN 197-1 Cement Composition, Specification and Conformity Criteria for Common Cements
ii. BS EN 932-6 Test for General Properties of Aggregates Definition of Repeatability and Reproducibility
iii. BS ISO 3310-2 Test Sieves – Technical Requirement and Testing – Part 2: Test Sieves of Perforated Metal Plate
iv. BS EN 1008 Mixing Water for Concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
v. BS EN 1992-1 Design of Concrete Structures – General Rules and Rules for Buildings

1.2.5 Federal Aviation Administration (FAA)

i. Advisory Circular 150/5320-6G
ii. Advisory Circular 150/5370-10H
iii. Advisory Circular 150/5380-6C

In addition, the latest editions of other ACI, ASTM, FAA & BS and other Standards as may be specified by the Engineer for Special Materials and construction are also relevant.

1.3 Submittals

All submittals shall be in accordance with the schedule of submittals prepared by the Contractor and approved by the Engineer.

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1.4 Proposed Mix Designs

The Contractor shall submit proposed designs for trial design batches for each grade, class or strength of concrete along with samples of proposed material.

The Contractor shall submit proposed final mix designs for each grade of concrete at least 28 calendar days before the date planned for the start of concrete placement, along with samples of proposed materials which differ from those submitted previously, and reports of successful 3, 7, 14 and 28 calendar day strength tests, for Engineer's approval.

PART 2-PRODUCTS

2.1 Material

2.1.1 Cement

1. Cement shall be fresh and of approved origin and manufacture. It shall be one of the following as may be specified by the Engineer or type of Cement as shown on the drawings and/or BoQ.
   a) Ordinary Portland Cement (low alkali) complying with the requirements of BS EN197-1 or ASTM C150 (Type-I).
   b) Ordinary Portland Cement Type II (low alkali) complying with the requirements of ASTM C-150.
   c) Sulphate Resistant Portland Cement (low alkali) complying with the requirements of BS-4027 or ASTM C-150 (Type V).
   d) Ordinary Portland Cement Type III High Early Strength Cement (Rapid Hardening)
   e) Portland Blast-Furnace Slag Cement shall conform to BS EN 197-1 or to ASTM C-595. Slag shall consist of finely ground granulated iron blast-furnace slag and shall conform to ASTM C-989 Grade 80, 100, or 120. The proportioning of OPC and Portland Blast Furnace Slag material shall be in the ratio of 60 OPC to 40 Slag or as approved by the Engineer.
   f) Modified cements (low alkali) as per the requirements of drawings and specifications.

2. Cement shall be tested and allowed to use after receiving satisfactory test reports from reputable laboratory.
3. Unless otherwise specified, ordinary Portland Cement complying with the requirements of BS EN197-1 or ASTM C150 (Type-I) shall be used.
4. The Contractor shall supply to the Engineer at fortnightly intervals, reports of tests for conformance with the relevant specified standard in respect of the samples of cement from the work-site. These tests shall be carried out in a laboratory approved by the Engineer.
5. Only one brand of each type of cement shall be used for concrete in any individual member of the structure. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed.
6. There shall be sufficient cement at site to ensure that each section of work is completed without interruption.
7. Cement reclaimed from cleaning of bags or from leaky containers and silos shall not be used.
8. The Contractor shall provide and erect (at his cost) in a suitable plain, dry, well ventilated, weather-proof and water proof shed of sufficient capacity to store the cement. Storage shall be done in a manner that cement bags stored first shall be used first and only then the next batch of cement shall be used.
9. The cement shall be used as soon as possible after delivery, cement which the Engineer consider has become stale or unsuitable through absorption of moisture from the

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atmosphere or otherwise, shall be rejected and removed immediately from the site at the Contractor's expense. Any cement in containers damaged so as to allow the contents to spill or permitting access of the atmosphere prior to opening of the container at the time of concrete mixing shall be rejected and removed immediately from the site at the Contractor's expense.

10. Low Alkali cements shall only be used for manufacturing of concrete. Only cements, containing less than 0.6%0.6% equivalent alkali or cements that can demonstrate a positive reduction in the expansion created by alkali-silica reactions shall be used. Total Alkalis (Na_2O & K_2O) of the cement secured for the production of concrete shall be verified in accordance with ASTM C114.
11. Mixing of different type and brand of cement shall not be permitted.

2.1.2 Aggregates

The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer.

Aggregates shall conform with ASTM C33 (including applicable ASTM Documents referenced therein) and as specified elsewhere in the Contract. Coarse aggregates shall be well graded from fine to coarse within the prescribed limits of this specification. Fine aggregate shall consist of natural sand, manufactured sand or combination of the two and shall be composed of clean, hard, and durable spherical or cubical particles. Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or a combination thereof and shall be clean, hard, uncoated particles of maximum nominal size as specified for each grade of concrete.

All fine and coarse aggregates shall be clean and free from clay, loam, silt and other deleterious matter. If required, the Engineer reserves the right to have them washed by the Contractor at no additional expense. Coarse and fine aggregates shall be delivered and stored separately at site. Aggregates shall not be stored on muddy ground or where they are likely to become dirty or contaminated. The materials shall be stockpiled for a period before use for at least a day so as to drain nearly to constant moisture content. The grading of the coarse and fine aggregates shall be tested at least once for every 100 tonnes supplied, to ensure that grading is uniform and same as that of the samples used in preliminary tests.

When tested as per BS EN 933 the sulphate content of aggregates shall not exceed 0.40 percent by weight for each individual source of coarse and fine aggregate. The chloride content of aggregates shall not exceed 0.05 percent by weight for each source of coarse and fine aggregate. The total sulphate content of concrete shall not exceed 4.0 percent by weight of the cement. The total chloride content of concrete from all sources shall not exceed 0.40 percent by weight of the cement.

Petrographic analysis of aggregates should be carried out initially for each source and periodically as directed by the Engineer.

Aggregates, when tested in accordance with CRD C119 shall contain no more than 8 percent by weight of thin, flat and elongated particles.

The specific gravities and absorption of aggregates shall be identified in accordance with ASTM C127 and ASTM C128.

Prior to initial use of each source of aggregate, all the specified tests shall be performed on aggregates to verify compliance with those specifications.

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The Fineness Modulus of fine aggregate (sand) shall be not less than 2.6 nor more than 3.1. In at least four out of five successive test samples, the modulus shall vary by not more than 0.20 from the moving average for the last five tests. The gradation of the coarse aggregate will be suitable if the results of four out of the last five consecutive tests comply with the gradation requirements.

Aggregates shall be tested for deleterious reactivity with alkalis in the cement, which may cause excessive expansion of the concrete. Tests of coarse and fine aggregates shall be made in accordance with ASTM C1260. If the expansion of the coarse and/or fine aggregates test specimen, tested in accordance with the ASTM C1260, does not exceed 0.10% at 16 days from casting, then the coarse and fine aggregates shall be accepted.

Prior to the initial use of each source of aggregates, certified tests shall be performed on aggregates to verify compliance with these specifications and submitted for the Engineer's review and approval.

Gradation of coarse aggregates for concrete shall conform to the gradations given in Table-4.

The gradation of combined coarse and fine aggregates shall be within the grading limit specified in Table-5.

The Contractor shall furnish certified test reports for aggregate tests listed in Table-6, Quality Tests.

2.1.3 Water

Only potable water from the sources approved by the Engineer shall be used. The Contractor shall supply sufficient water for all purposes, including mixing the concrete, curing and cleaning plant and tools. Performance requirements for mixing water shall conform to ASTM C1602.

In case of doubt, the Engineer will require that concrete mixed with water proposed to be used should be tested to have a compressive strength not less than 90% of the strength of concrete mixed with distilled water.

2.1.4 Concrete Patching Compound

Use an approved epoxy-resin compound applied according to manufacturer's instructions. Compound shall be paintable material which produces no evidence of bleeding and which, after final set, shall not be affected by high humidity and moisture. Epoxy-resin compound shall comply with FS-MM-G-650, Type 1, Grade C.

2.1.5 Additives

All additives shall be from a manufacturer approved by the Engineer.

Air Entraining Admixtures shall conform to ASTM C260. Other admixtures for water reducing, retarding, accelerating shall conform to ASTM C494.

2.1.6 Vapor Barrier

Geotextile fabric conforming to AASHTO M-288, Class-1.

2.1.7 Grout

i. Damp Pack Bedding Grout: Mix of one part Portland cement and 2 parts of fine aggregate proportioned by weight and not more than 4 gal. (17 liters) of water per bag of cement.
ii. Pre-mixed, Non-Shrink, Non-Metallic Grout: "Masterflow 713" manufactured by Master Builders, "Euco-N.S." manufactured by the Euclid Chemical Company or other approved equivalent.

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iii. Pre-mixed, Non-Shrink, Metallic Grout: "Embeco 636" manufactured by Master Builders, "Firmix" manufactured by the Euclid Chemical Company or approved equivalent.

2.1.8 Waterproofing Admixture

Crystalline Water Proofing Admixture Bitocrete C-16 from Schomburg Germany or approved equivalent as specified in or as shown in drawings.

2.1.9 Corrosion Inhibiting Admixture

Migrating Corrosion Inhibiting admixture shall be used for reinforced concrete works as specified in the drawings and BOQ. Preparation and proportions shall be according to the manufacture's recommendations and ACI 212. The migrating corrosion inhibitor should be organic amine-carboxylate based and applied at a fixed low dosage rate according to ACI 212 and as per manufacturer recommendations, and should have the following qualities:

i. Meet the requirements of ASTM C1582 when tested as per ASTM G109 from 3rd party independent accredited lab and shall meet or exceed the requirements of ASTM C1582.

ii. Must meet the requirements of BS 8443

iii. Be proven effective when tested in accordance to ASTM G109 for a testing period not less than 3 years and proven effective in modified cracked beam testing.

iv. Protect both anodic and cathodic components of the corrosion cell.

v. The manufacturer shall be ISO 9001 and ISO 14001 certified for the design and manufacturing of corrosion protection systems and concrete protection products with valid certificate.

The contractor must submit a certificate of supply for each concrete pour with corrosion inhibitor and must mention the following:

i. Batch numbers and expiry dates of the material

ii. Company Stamp and its authorized representative signature

2.1.10 Cover Material for Curing

Curing material shall conform to the following:

i. Impervious Sheeting: ASTM C171, type optional, except that polyethylene sheeting shall be 0.1mm0.1*mm* minimum thickness, white opaque. Where the work is exposed to high winds the impervious sheeting shall not be used.

ii. Burlap: Cloth made of jute or kenaf shall conform with AASHTO M182 and shall weigh a minimum 0.3kg/m.

iii. Liquid Membrane Forming Compound: ASTM C309, Type 2.

2.1.11 Joint Fillers

ASTM D1751, preformed, resilient bituminous type or ASTM D1752, preformed sponge rubber.

2.1.12 Joint Sealants

ASTM D7116 for PQC Pavements, ASTM D6690 for joints between flexible shoulder pavement & PQC, ASTM C920 for joints in building.

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2.1.13 Waterstops

Provide flat, dumbbell type or center bulb type water stops at construction joints where shown. Web thickness not less than 5mm5*mm* for units up to 125mm125*mm* wide, and not less than 10mm10*mm* for widths over 125mm125*mm*. Provide polyvinyl chloride (PVC) water stops complying with US Corps of Engineers Specification CRD-C-572 or ASTM D-412 or ASTM D-638 of approved manufacturer.

2.1.14 Epoxy Resin

ASTM C881, type, Grade 3, Class C.

Bond Breaking Tape shall conform to ASTM D789.

2.1.15 Formwork

i. **Formwork for Concrete Pavement**

If the concrete is to be laid in panels which require forms, they shall be made of steel of an approved section, with a base width of at least two hundred and fifty (250) millimeters and the depth shall be equal to the thickness of the pavement at the edge as shown on the plans. The forms shall be staked with steel stakes, and stakes shall be of a length approved by the Engineer. Each section of forms shall have a stake pocket at each end and at intervals of not more than one and one-half (1.5) meters between ends. The stake pockets shall have approved devices for locking the form to the steel stakes. Each section of forms shall always be straight and free from bends and warps. No section shall show a variation greater than three (3) millimeter in three (3) meters from a true plane surface on the top of the form, and the inside face shall not vary more than six (6) millimeters from a plane surface.

Before placing forms, the underlying base shall be to the required grade, and shall be firm and compact. The forms shall have full bearing upon the foundation throughout their length and shall be placed with exactness to the required grade and alignment of the edge of the finished pavement. They shall be so supported during the entire operation of placing, tamping and finishing the pavement that they will not deviate vertically at any time more than three (3) millimeters from the proper elevation.

Forms shall not be removed for at least twelve (12) hours after the concrete has been placed. Forms shall be carefully removed in a manner to avoid damage to the pavement especially. dowels. Under no circumstances will the use of pry bars between the forms and the pavement be permitted. Dowels shall be protected from damage during removal of forms and subsequently from traffic until concrete for adjacent panels are casted. All the damaged dowels shall be replaced without any financial implication as per the procedure approved by the Engineer using epoxy bond material for fixing the dowels.

Pavement, which in the opinion of the Engineer, is damaged due to the careless removal of forms shall be repaired by the Contractor, as directed by the Engineer, at the Contractor's own expense.

Forms shall be thoroughly cleaned and oiled each time they are used.

When pavement is placed adjoining existing concrete pavement upon which the finishing machine will travel, any irregularities in the old pavement shall be ground down to a true, uniform surface, of sufficient width to accommodate the wheels of the finishing equipment, if necessary to obtain proper smoothness of the pavement.

ii. **Formwork for Structures**

Material, workmanship etc. of formwork for structures, refer relevant specification.

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2.1.16 Reinforcement

Materials for reinforcing steel, welded wire fabric, dowels and tie bars, refer relevant specification.

Column Design Schedule

Member	Reinforcement Requirement
Column C1 (24" × 36")	As = 10.60 in²; ρ = 1.23%; ASTM A615 Gr 60; Mu = 192 ft-k; Pu = 223k — SAFE
Column C2 (24" × 36")	As = 21.99 in²; ρ = 2.55%; SMRF detailing required; multiple load combos — SAFE
Column C3 (30" dia circular)	As = 14.14 in²; ρ = 2.00%; Mu = 148 ft-k; Pu = 358k — SAFE
Column C4 (18" × 18")	As = 3.53 in²; ρ = 1.09% — SAFE

Beam Design Schedule

Member	Reinforcement Requirement
Plinth Beam PB1 (18" × 24")	Top: 5-#6; Bottom: 5-#6; Stirrups #3 @ 4" c/c supports, 9" c/c mid-span; V = 47k, M = 144 ft-k — SAFE
Plinth Beam PB2 (18" × 30")	Top: 6-#6; Bottom: 6-#6; Stirrups #3 @ 4" c/c supports; V = 42k, M = 140 ft-k — SAFE
Beam B1 — Transfer Beam (21" × 45")	Top: 15-#8; Bottom: 15-#8; Stirrups #3 4-legged @ 3.5" c/c; V = 280k, M = 1,942 ft-k — SAFE
Beam B1-a (21" × 24")	Top: 8-#8; Bottom: 4-#8; Stirrups #3 2-legged @ 4" c/c; V = 75k, M = 519 ft-k — SAFE
Beam B2 (18" × 30")	Top: 6-#8; Bottom: 6-#8; Stirrups #3 @ 4" c/c; V = 92k, M = 499 ft-k — SAFE
Beam B3 (18" × 24")	Top: 5-#8; Bottom: 5-#8; Stirrups #3 @ 4" c/c; V = 67k, M = 276 ft-k — SAFE
Beam B4 (12" × 24")	Top: 5-#6; Bottom: 3-#6; Stirrups #3 @ 4" c/c; V = 52k, M = 171 ft-k — SAFE
Beam B5 (18" × 30")	Top: 10-#8; Bottom: 6-#8; Stirrups #3 4-legged @ 4" c/c; V = 150k, M = 793 ft-k — SAFE
Beam B6 (10" × 24")	Top: 3-#6; Bottom: 3-#6; Stirrups #3 @ 4" c/c; V = 15k, M = 114 ft-k — SAFE

Slab Design Schedule

Slab	Thickness / Reinforcement
S1 — Two-Way (24.5' × 29')	t = 7"; Short span: #4@4" neg, #4@6" pos; Long span: #4@5" neg, #4@8" pos; f'c = 3,000 psi — SAFE
S2 — Two-Way (18.5' × 24.25')	t = 6"; Short span: #4@3.5" neg; Long span: per calc; f'c = 3,000 psi — SAFE
Typical slab thickness	7 inches (175 mm) for two-way spanning slabs per ETABS model

2.1.17 Fibre Reinforced Concrete

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Concrete shall be treated with polypropylene synthetic reinforcing fibers (Duracete or approved equivalent) when indicated on the drawings or as otherwise specified by the Engineer in accordance with the fiber manufacturer's recommendations.

a. Synthetic reinforcing fibers shall be manufactured from virgin polypropylene.

b. The dosage rate shall be 1.8kg/cu.m (3.0 Lb/Cu yd) of concrete.

c. Fiber supplier shall provide technical assistance, if required.

d. All fibers must meet or exceed the standards and specifications set forth in ACI 544, Fiber Reinforced Concrete.

e. Listed below are the minimum properties of the polypropylene fibers for use. All fibers must meet or exceed the characteristics described in ACI-544, IR, Table 1.1, Fiber Reinforced Concrete.

1. Tensile Strength: 58,000 psi (minimum)
2. Elongation at break: 12% (minimum)
3. Fiber: 100% Fibrillated / Monofilament Polypropylene (as per site requirement)
4. Lengths: As per requirement/drawings
5. Absorption: Nil
6. Specific gravity: 0.9
7. Ignition point: 593 °C
8. Melting point: 160-170 °C
9. Heat & UV stabilization: Long term
10. Thermal conductivity: Low
11. Electrical conductivity: Low
12. Salt resistance: High
13. Acid resistance: High
14. Alkali resistance: 100% (alkali proof)

2.1.18 Bond Breaker Tapes

Bond breaking tape or separating material that is a flexible, non-shrinkable, non-absorbing, non-staining, and non-reacting adhesive-backed tape. The material shall have a melting point at least 5◦F 3◦C greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch (3 mm) wider than the nominal width of the joint and shall not bond to the joint sealant.

If required Contractor can use Backer Rod instead of debonding tape or in combination which shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be 25%±5% larger in diameter than the nominal width of the joint.

2.1.19 Cold-Weather and Hot-Weather Concreting Requirements

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Cold-weather concreting (mandatory provision for Skardu winter season applicable when ambient temperature < +5°C):

(a) Concrete shall not be placed on frozen ground. Frozen ground shall be thawed and covered before any placement.

(b) Fresh concrete temperature at point of delivery: maintained between +10°C and +25°C.

(c) Heating of mixing water and aggregates is permitted.

(d) Concrete shall be protected with insulated blankets or heated enclosures for a minimum curing period of 7 days for 4,500 psi concrete.

(e) No calcium chloride accelerating admixture shall be used.

Hot-weather concreting (when ambient temperature exceeds +30°C): Fresh concrete temperature shall not exceed +35°C at point of delivery. Ice may be substituted for part of the mixing water. Additional retarding admixture may be used with Engineer approval.

2.2 Material Testing

2.2.1 Samples and Testing

Samples from stock on the site or suppliers shall be taken by the Contractor in presence of the Engineer. Furnish tests and certificates as specified.

Test	Standard
Compressive Strength (cylinders)	ASTM C39
Slump Test	ASTM C143
Air Content	ASTM C231
Temperature at Delivery	ASTM C1064

2.2.2 Cement

Sampled cement shall be tested by a testing laboratory. Certified copies of laboratory test reports shall be furnished for each lot of cement and shall include all test data, results and certification that the sampling and testing procedures are in conformance with the Specifications for approval. No cement shall be used until test results are satisfactory. Cement that has been stored for longer periods after being tested shall be re-tested before use. Cement found unsatisfactory under test shall be immediately removed from the construction site or supplier stock.

2.2.3 Aggregates

Aggregate sampling shall conform to ASTM D75. Aggregates shall be sampled and tested by a testing laboratory. No aggregate shall be used until all the tests mentioned in these specifications are conducted, reported and found satisfactory to the Engineer.

Table 4: Quality Tests for Aggregates

Material	Test	Requirement	Test Designation
Coarse	Abrasion	Loss 40% max	ASTM C131
Coarse	Absorption	2.0% max	ASTM C127

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Material	Test	Requirement	Test Designation
Coarse	Clay Lumps	1.0% max	ASTM C142
Coarse	Surface Coating	0.5% max	ASTM C117
Coarse and Fine	Soundness	Loss 10% max	ASTM C88
Coarse and Fine	Sieve	As specified	ASTM C136
Fine	Absorption	4.0% max	ASTM C128
Coarse	Cleanness	75% min	CALIF 227
Fine	Sand equivalent	70% min	CALIF 217

2.2.4 Water

Water analysis shall be performed in accordance with ASTM D596, and the report shall be submitted for Engineer's approval. Any change in source of water shall be intimated to the Engineer, and specified testing shall be done as directed by the Engineer. Water shall conform to ASTM C1602 or BS 3148.

2.2.5 Admixtures

Sampling and testing of all admixtures used in concrete mix shall be in accordance with the standard procedure recommended by an approved testing laboratory. No admixture shall be used until test results are satisfactory and approved.

2.2.6 Concrete

i. **Compressive Strength**

Specimens shall be tested in accordance with ASTM C39 or ACI 214. Test specimens shall be evaluated for each grade of concrete specified in conformance with ACI 318, chapter "Concrete Quality". The standard age of concrete for tests shall be 3, 7, 14 and 28 calendar days.

ii. **Flexural Strength**

The flexural strength of concrete for pavement quality concrete shall be 4.5 MPa at 28 days as per ASTM C78. Samples shall be secured in accordance with ASTM C172. Test specimens shall be made and cured in accordance with ASTM C31.

iii. **Slump and Entrained Air**

Slump test and entrained air tests shall be performed in the field under the supervision of the Engineer. Slump test shall conform to ASTM C143 and entrained air content shall be determined in accordance with ASTM C231 or C173 as applicable.

iv. **Concrete removed for the Structure**

When the results of the strength test of the specimen indicate deficiency in specified requirements or where there is other evidence that the quality of concrete is below specified requirements, cores shall

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be obtained through drilling and tested in conformance with ASTM C-42 at the Contractor's expense. If a deficiency is discovered, the Contractor may be allowed to make load test, at his expense, and results shall be evaluated in conformance with ACI 318, Chapter 20. Otherwise, concrete shall be removed / demolished at the Contractor's risk and cost.

v. **Coefficient of Thermal Expansion of Concrete**

For determining Coefficient of Thermal Expansion of Concrete exclusively for pavement quality concrete, four (4) test specimens shall be fabricated from a single batch of concrete to be tested as per AASHTO T 336 initially for field qualification and during regular production of each type of pavement quality concrete, similar number of specimen shall be produced and tested for determining Coefficient of Thermal Expansion of Concrete for every 1000 Cu.m of concrete.

The coefficient of thermal expansion must not exceed 6.0 micro strain / °F. During production, test the coefficient of thermal expansion of the concrete at a frequency of 1 test for each 1,000 Cu.m of paving or concrete pouring but not less than 1 test for a project with less than 1,000 Cu.m of concrete.

2.3 Frequency of Testing

i. All the tests on cement shall be performed initially for approval and afterwards on every ten (10) tonnes of cement arrived at site.

ii. The following tests shall be performed on aggregates and water initially for approval and weekly thereafter:

a. Aggregates ASTM C33

b. Soundness ASTM C88

c. Specific Gravity ASTM C127

d. Absorption ASTM C128

e. Abrasion ASTM C131

f. Gradation ASTM C136

g. Sand Equivalent ASTM C217

h. Cleanness ASTM C227

i. Alkali-Silica Reactivity ASTM C1260

j. Elongation CRD C119

k. Chloride Sulphate tons ASTM D512

l. Water Analysis ASTM D596

All the test reports to be submitted for the works covered under these specifications, shall contain comprehensive data and calculations used in the test with specific mentioning of testing code / standard for that particular testing.

iii. The following tests shall be performed initially for approval and thereafter as mentioned hereunder:

a) Concrete Compressive Strength

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Three sets of specimens for each 125 Cu.m of each grade of concrete placed or at least three sets for each grade per work shift. Compressive strength of each grade of concrete shall be tested as per ASTM C39.

b) Flexural Strength

Three sets of specimens for each 250 Cu.m of concrete placed or at least three sets per work shift. The concrete shall be sampled in accordance with ASTM C172. Flexural strength specimens shall be made in accordance with ASTM C31 and tested in accordance with ASTM C78.

c) Concrete Sulphate and Chloride Content

Sulphate (SO_3) Content, Chloride Content and pH value: One test per month for each grade of concrete. Broken laboratory specimens from strength tests shall be used for hardened concrete Sulphate, Chloride content and pH Value tests.

iv. The following tests shall be performed at the discharge point for each truck load of concrete delivered or at delivery point, as determined by the Engineer.

a) Slump ASTM C143
b) Air Content ASTM C173 or C231

PART 3-EXECUTION

3.1 Submission Requirements

3.1.1 Procedures

Following procedures shall be submitted to the Engineer:

Both hot and cold weather concreting procedures shall be submitted to the Engineer by Contractor regardless of the need for the immediate implementation of such not less than two weeks before beginning the work. Procedures shall include requirements for insulation, enclosures and the like. Finishing procedures and timing and duration of curing shall be described.

Contractor's construction procedures shall be computer word processed procedure and shall include description, charts and diagrams as applicable and necessary, to fully explain the subject procedures, methods and equipment operation in order to allow effective review by the Engineer, assist the Testing Agency's evaluation of the work, and to allow Contractor's personnel to perform work in full conformance to the Contract Stipulations.

iii. Protection of concrete against injury due to mechanical contact and construction operation.
iv. Protection of work by other trades.

v. Any other document demonstrating manufacturing, delivering, transportation and protection of concrete.

3.1.2 Placement Schedule

Submit a placement schedule for approval prior to start of concrete placement operations. Daily concrete pour schedules shall be submitted 24 hours in advance of planned pours.

3.1.3 Formwork

Submit for approval copies of manufacturer's data and installation instructions for proprietary materials including form coatings, manufactured form systems, ties and accessories.

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3.1.4 Certificates of Compliance

Submit certificates of compliance covering cement types, reinforcement, grout materials, additives, sealants, soft board, patch repair materials, epoxy-resin materials etc. The certificates of compliance shall include the material or product manufacturer's statements that supplied items conform to Specifications.

3.1.5 Testing Programme

Submit test programme for all specified requirements along with the testing schedule for approval of the Engineer.

3.1.6 Test Reports

Submit test reports showing the result of required tests and compliance with specified standards and codes, for approval. Test reports shall be certified by the Contractor and the Testing Agency.

3.1.7 Samples

Submit to the Engineer for acceptance prior to purchase, fabrication or delivery, samples of materials for his approval.

Substitute products materials or fixtures proposed by the Contractor shall be submitted as samples for approval. The samples shall be accompanied by detailed information about materials.

3.1.8 Shop Drawings

Shop drawings shall be submitted to the Engineer for approval in accordance with the requirements of the Contract Documents and as specified herein under:

i. Shop drawings furnished for this section shall conform to the best standards of the construction industry. Shop drawings shall be prepared under the supervision of competent engineering personnel. Prior to submittal, the Contractor shall check each shop drawing for compliance with the requirements of the Contract Documents. As evidence of conformance with this requirement, each shop drawing shall bear the seal and the self-written signature of Contractor's registered Professional Engineer.

ii. Shop drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale for all works to be provided. Drawings shall be accurately dimensioned, where applicable, and shall be noted clearly.

iii. Work of Other Trades: Show in the shop drawings, and the names shown, holes required for passage of work of other sections through Cast-In-Place Concrete Work. Prepare and submit to the Engineer field work drawings for holes not shown in shop drawings.

iv. Submit shop drawings for curved and radial concrete formwork and identify the formwork materials proposed for use.

v. Construction Joint, Expansion Joint and contraction Joint Drawings: Show all joints given in the drawings, specified herein, and required by Contractor to provide for the sequence of pouring. Submit in sufficient time to allow the orderly detailing of reinforcing steel. Reinforcement shop drawings shall be prepared in conformance with the accepted Construction Joint, Expansion Joint and contraction Joint Drawings. Measures to control cracks e.g. shrinkage strips, admixture as per relevant ACI codes shall be shown on the drawings.

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vi. Reinforcing Steel, including Welded Wire Fabric (WWF), shall be detailed in strict accordance with the methods and procedures provided in "ACI Detailing Manual". Reinforcing steel drawings shall be submitted simultaneously with related shop drawings. Prepare shop drawings which provide for reinforcement, including dowels, properly positioned in all concrete work, so that material can be properly cut, bent and placed. Form not be removed for at least twelve (12) hours after the concrete has been placed. Forms shall be carefully given in shop drawings. Reinforcing steel drawings shall show, to scale, all concrete work including pits, kerbs, trenches, pads, equipment bases, steps, slopes, radii, curves, openings, holes, block-outs and the like. Provide schedules and details showing placing sequences, bending, lengths and locations of all reinforcement.

vii. Detailing: All reinforcing steel shall be detailed in strict compliance with ACI 318 and ACI 315.

3.1.9 Coordination Drawings

The Contractor shall submit coordinated drawings of the following:

All sleeve locations, whether round or of other shape, penetrating exterior and interior walls, pits, slabs, beams, other structural systems and pavements.

The position of all embedded items required to receive the work of other trade, including details needed to assure correct placement of both the embedded items and the reinforcing steel.

The Contractor shall coordinate and crosscheck for accuracy, completeness and correct relationship to the work of other sections, each shop drawing prepared for the work of this section, including each shop drawing prepared by nominated subcontractors. Contractor's check shall include a verification of strict compliance with the Contract Documents and shall be performed prior to submission of each shop drawing for review by the Engineer. The Contractor shall certify the co-ordination, accuracy, and Contract compliance of each shop drawing by a written statement placed in each drawing and attested by the responsible person in charge of the work for Contractor. The personally inscribed initials of the person(s) preparing each drawing as well as the detailing agency's supervisor and chief checker shall be included in the title block or similar prominent location.

3.1.10 Mill Test Reports

Furnish the Engineer with certified mill test report for cement and for steel reinforcement, including bars, welded wire fabric, dowels, anchors and splices for approval.

3.1.11 Name of Manufacturers/Suppliers

Submit for acceptance by the Engineer:

i. Aggregates

ii. Ready mix concrete

iii. Reinforcing bars

iv. Welded steel wire fabric

v. Concrete accessories

vi. Cement

vii. Admixture

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viii. Joint filler

ix. Joint sealants

x. Water stops

xi. Membrane curing, sealing, hardening compound

xii. Bonding compound

xiii. Form oil

xiv. Anchors

xv. Concrete repair mortars

3.2 Nominal Concrete Mixes

i. The cement, fine aggregate and the coarse aggregate shall be weighed separately. The proportions of cement to fine aggregate and coarse aggregate shall be adjusted as per ACI 211 & ACI 318 so as to provide the concrete of the required crushing strength when tested as set out in Table 3.

ii. The Contractor shall regulate and arrange mixing of the ingredients for the designed mix of the concrete by weight-batching.

iii. **Water/Cement Ratio**

The quantity of water used shall be just sufficient to produce a dense concrete of the specified strength. For all exterior exposed work and foundations, the water/cement ratio shall not exceed 0.45, allowance being made for any water in the fine and coarse aggregates.

iv. **Workability**

Admixtures may be used where necessary to achieve required workability, with the Engineer's approval. For concrete pavements, the mix determined shall be workable concrete having a slump between 13mm13mm and 50mm50mm, as determined by ASTM C143. For other structures the concrete shall be proportioned and produced to have a slump of 75mm75mm or less if consolidation is to be by vibration, and 125mm125mm or less if consolidation is to be by methods other than vibration.

3.3 Strength Requirements for Concrete and Gradation of Aggregate

Strength requirements for concrete are given below:

Table 1: Strength of Different Classes of Concrete

Compressive Strength (MPa)	Approx. Grade (M)	Typical Uses
31 MPa	M30–M35	Heavy-duty RCC, piling works (bored cast-in-situ piles, pile caps)
28 MPa	M25–M30	RCC slabs, beams, columns, rafts
25 MPa	M25	General structural concrete

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21 MPa	M20	Footings, slabs, residential structures
17 MPa	M15	PCC, blinding concrete
14 MPa	M10–M15	Lean concrete, leveling course
10 MPa	M10	Non-structural works, pathways
7 MPa	M7.5	Sub-base, temporary works
5 MPa	M5	Very lean concrete, filler layers

Table 2: Gradation of Concrete Aggregates

Particle Size Square Openings (Equivalent U.S. Sieve Designation)	Percentage by Weight Passing
63.0 mm (2 1/2 in.)	-
50.0 mm (2 in.)	-
37.5 mm (1 1/2 in.)	-
25.0 mm (1 in.)	100
19.0 mm (3/4 in.)	90 - 100
12.5 mm (1/2 in.)	25 - 60
9.5 mm (3/8 in.)	20 - 55
5.0 mm (No.4)	0 - 10
2.36 mm (No.8)	0 - 5
1.18 mm (No.16)	-
0.60 mm (No.30)	-
0.30 mm (No.50)	-
0.15 mm (No.100)	-

Table 3: Gradation of Combined Course and Fine Aggregates for Concrete

Particle Size Square Openings (Equivalent U.S. Sieve Designation)	Percentage by Weight Passing
63.0 mm (2 1/2 in.)	100
50.0 mm (2 in.)	90 - 100

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Particle Size Square Openings (Equivalent U.S. Sieve Designation)	Percentage by Weight Passing
37.5 mm (1 1/2 in.)	70 - 90
25.0 mm (1 in.)	50 - 75
19.0 mm (3/8 in.)	45 - 70
12.5 mm (1/2 in.)	-
9.5 mm (3/8 in.)	38 - 55
5.0 mm (No.4)	30 - 45
2.36 mm (No. 8)	22 - 35
1.18 mm (No. 16)	15 - 27
0.60 mm (No. 30)	10 - 18
0.30 mm (No. 50)	4 - 10
0.15 mm (No. 100)	1 - 3
0.075 mm (No. 200)	0 - 2

The flexural strength of concrete for pavement quality concrete shall be 4.5 MPa at 28 days as per ASTM C78 with minimum cement content of 340kg340*kg* of cement per Cu.m of concrete. The flexural strength requirement is the governing factor, excess cement if any used to achieve the required flexural strength shall not be payable.

i. The Contractor shall adopt all necessary measures as per ACI201.2, like proper grading of aggregates, control of water cement ratio and cement content, proper compaction and curing, to achieve dense and durable concrete.

ii. The Contractor shall submit mix design by weight for each class, strength or grade of concrete at least 45 calendar days before any placement of concrete, along with samples of the proposed materials. Manufacture 12 nos. test cylinders 300mm×150mm300*mm*×150*mm* or beams for flexural strength in accordance with ASTM C-31 and in accordance with the mix design batching by weight and test 3 cylinders or beams each at 3, 7, 14 and 28 days in the presence of Engineer's Representative, in accordance with ASTM C-39 / ASTM C 78 and submit all relevant data and results of tests for approval of the Engineer. The Contractor shall obtain approval from the Engineer in writing for each mix design before producing the actual concrete for the works.

iii. The Contractor is required to submit the 3rd3rd, 7th7th and 14th14th day strength test results soon after its availability but not later than 3 days from the date on which tests are to be conducted for review of the Engineer.

PART 4-BATCHING, MIXING AND DELIVERY

4.1 Batching

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All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement may be taken as 50kg.

Aggregates shall be batched by weight; due allowance being made for water content. Aggregates may be batched by volume only with the prior permission of the Engineer. The apparatus for weight batching may be as integral part of the mixer or a separate unit of a type approved by the Engineer. It shall be accurate within 2%2% and shall be checked for accuracy at least once a week.

The quantity of additives shall be as prescribed by the manufacturer or as directed by the Engineer.

4.2 Mixing

The concrete shall be mixed in an approved batch mixer. It shall be fitted with the manufacturer's plate stating the rates, capacity and the recommended number of revolutions per minute and shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water measuring device.

Mixing shall continue for the period recommended by the mixer manufacturer or until there is apparently a uniform distribution of the materials and the mass is uniform in colour, whichever period is longer. However, minimum mixing time shall not be less than 1-1/2 minutes.

If it is desired to use a mixing period of less than 1-1/2 minutes, the Engineer's approval shall be obtained in writing.

Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.

The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10 percent of their original height.

Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be re-tempered but shall be discarded.

4.3 Transporting

The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means which will prevent segregation or loss of or addition to ingredients. It shall be deposited as nearly as practicable in its final position so as to avoid re-handling or flowing. All skips vehicles, or containers used for transporting the concrete shall be thoroughly clean.

During hot or cold weather, concrete shall be transported in deep containers, on account of their ratios of surface area to mass, which reduces the rate of loss of water by evaporation during hot weather and loss of heat during cold weather.

a) **Batching**
The Contractor shall submit to the Engineer for review the plans and capacity of the concrete batching plant and delivery equipment, which shall comply with ASTM C-94.

The Contractor shall furnish test certificates for the scales and metering devices before producing concrete and at least every six weeks thereafter.

b) **Accuracy of Plant Batching**

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Cement measured by weight in individual batchers shall be within +1.0 percent of the desired intermediate and final weights in cumulative batchers. The minimum batching accuracy shall be +0.3 percent of scale capacity for small loads below 30 percent of scale capacity.

Aggregate measured by weight in individual batchers shall be within +2.0 percent of the desired weight, or within +1.0 percent of the desired intermediate and final weights in cumulative batchers; but in either case, the minimum batching accuracy shall be +0.3 percent of scale capacity for small loads below 15 percent and 30 percent of scale capacity, respectively.

Water measured by volume or by weight shall be within +1.0 percent of the desired amount.

Liquid admixtures measured by volume or by weight shall be within +1.0 percent of the desired amount.

Compensation for changes of moisture content in fine and coarse aggregate shall be made by devices which shall correct the batch water and the weight of the affected aggregate simultaneously without changing the batch setting.

c) **Mixing and Delivery**

Concrete shall be mixed completely in the batching plant. Records shall be kept of water added in normal batching.

Concrete shall be transported to the point of discharge in agitator-mixer trucks, or by other approved means.

Trip tickets shall be provided for each delivery. The tickets shall show the designation of the materials in each batch, measured weight or volume of materials, methods of cooling concrete, class of concrete, batch number, mixer number, batch volume, date and time water was added to the mix, time of discharge from the mixer, and delivery truck number.

When it is necessary to add water to the agitator-mixer, it shall be done in accordance with ASTM C94 and recorded.

PART 5-CONCRETE FOR PAVEMENT

The base upon which the concrete pavement is laid shall have been constructed or prepared under other relevant section of the specifications and shall be smooth, compacted and true to the grade and cross-section shown on the drawing and shall be maintained throughout the period of placing concrete pavement.

To prevent flow of cement slurry from concrete, geotextile fabric conforming to AASHTO M-288 Type-I as vapor barrier, as per relevant section of specifications shall be placed on cement treated base course or lean concrete, prior to placing of concrete.

Pavement concrete can be cast within the forms or preferably concrete paver or should be used for laying the concrete subject to demonstration of suitability of the adopted methodology and ensuring quality of the works. Concrete laying methodology shall be approved.

5.1 Formwork

Before placing forms or laying of concrete through mechanical pavers, the underlying base shall be to the required grade, and shall be firm and compact. The forms shall have full bearing upon the Cement Treated Base-course or lean concrete throughout their length and shall be placed with exactness to the required grade and alignment of the edge of the finished pavement. They shall be so supported

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during the entire operation of placing, tamping and finishing the pavement that they will not deviate vertically at any time more than three (3) mm from the proper elevation.

5.2 Placing Reinforcement

All pavement reinforcement shall be placed as shown on the drawings. All reinforcement required by the works shall be held in proper position by sufficient number of metal bar supports or chairs as approved by the Engineer. The dowels may be installed mechanically by means of equipment and methods approved by the Engineer. The satisfactory placement of the dowels shall depend upon the ability of the mechanical device to place the dowels in their true position. The Engineer may require, when satisfactory placement is not obtained by mechanical means, that the dowels be installed ahead of placing the concrete and that they be securely staked and tied if necessary to hold them in their exact position. The use of removable devices, supporting the bars from the forms, will not be permitted.

If it is observed during the construction that dowels are not placed / installed perpendicular to the vertical face of the PQC if not inserted properly Contractor may suggest post work anchorage of dowels with epoxy without any financial implication.

5.3 Placing Concrete

5.3.1 General

Concrete within Forms: The concrete shall be deposited on the base course or concrete in successive batches for the full width between forms and in a manner which will require as little re-handling as possible. Spreading shall be done by an approved mechanical spreader in a manner that will prevent segregation and separation of the materials. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances. The amount of material deposited shall be sufficiently in excess of that required to form the pavement to the required cross section after consolidation in order to provide a roll of concrete ahead of the front screed of the finishing machine for the full length of the screed.

When concrete is placed adjoining a previously constructed lane of pavement and when mechanical equipment will be operated upon the existing lane of pavement, the concrete shall be at least 7 days old and at a flexural strength approved by the Engineer. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 3 days, if approved by the Engineer.

Concrete shall be thoroughly consolidated against and along the full length and on both sides of all expansion joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly. Damage to joint assemblies caused by dumped concrete shall be repaired immediately, as directed by the Engineer, at the Contractor's expense.

Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by methods approved by the Engineer.

Placement of concrete ahead of the initial spreader strike-off shall not be more than fifteen (15) minutes ahead of final spreader strike-off. If concrete is placed in one (1) layer only, the placement of concrete shall not be more than twenty (20) minutes ahead of the spreader strike-off.

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5.3.2 Slip-form Construction

The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 225mm.The spacing of internal units shall be uniform and shall not exceed 450mm. The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be within 8000 to 12000 cycles per minute and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 300mm300*mm*. The frequency of vibration or amplitude shall vary proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible. And all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Dowels shall be inserted or placed during the laying of concrete by using hydraulic mechanism which pushes them into concrete when its workable. Any other method can be used with the prior approval of the Engineer.

5.3.3 Works in Extreme Weather

Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 4◦C and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 2◦C. When concreting is authorized during cold weather, the Engineer may require the aggregates to be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials. Unless otherwise authorized, the temperature of the mixed concrete shall not be less than 10◦C10◦*C* at the time of placement in the forms.

If the air temperature is 2◦C or less at the time of placing concrete, the Engineer may require the water and/or the aggregate to be heated to not less than 21◦C nor more than 66◦C. Concrete shall neither be placed on frozen sub-grade nor frozen aggregates be used in the concrete.

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During periods of warm weather when the maximum daily air temperature exceeds 30◦C, the following precautions should be taken. The forms and/or the underlying material shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 32◦C. The aggregates and/or mixing water shall be cooled as required.

5.4 Joints

5.4.1 General

Joints shall be constructed exactly in accordance with the details shown on the plans and the Specifications and with the best of workmanship.

5.4.2 Expansion Joints

Expansion joints shall be of the type and dimensions and of the spacing shown on the plans. Joint filler shall be of pre-molded compressible material according to ASTM D1751 or ASTM D1752, and joint sealant material shall be according to ASTM D7116.

The entire joint assembly shall be of a type designated on the plans and shall be installed in such a position that the centreline of the joint assembly is perpendicular to the centerline of the pavement slab and the dowels lie parallel to the centerline of the slab. Finished joints shall not deviate more than six (6) millimeters in the horizontal alignment from a straight line. No plugs of concrete shall be permitted anywhere within the expansion space.

One-half of the length of each dowel bar shall be painted, and then thoroughly coated with hard grease, or lubricant as approved by the Engineer, to prevent the concrete from bonding to that portion of the dowel.

An expansion cap of the dimensions shown on the plans shall be placed on the greased end of each dowel. The greased ends shall be free to slide in the dowel holder and shall extend in the direction as indicated on the plans. Any excess grease on the dowel holder shall be removed.

The joint shall be securely staked or fastened in place prior to placing the concrete and in a manner to ensure that the joint and the dowel bars will remain in their proper position after the concreting and finishing operations are completed.

The paver or finishing machine shall be operated in a manner that will prevent displacement of the joint. If for any reason it is necessary to straighten a joint, any depressions caused by this operation shall immediately be filled with fresh concrete, re-spaded and brought to the original crown in advance of the longitudinal finishers. Any fluid laitance or mortar caused by this operation shall be removed and replaced with fresh concrete.

As the paver or finishing machine approaches the joint on the first trip, the excess concrete shall be shoveled ahead and the tamper and each screed, in turn, shall be lifted over the joint. On the second trip of the finishing machine, the screed may be operated over the joint.

5.4.3 Contraction Joints

Contraction joints shall be of the type and dimensions and at the spacing shown on the plans. Sawed contraction joints shall be cut by means of an approved concrete saw. The joints shall not be sawed until the concrete has hardened to the extent that tearing and raveling is precluded.

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All joints shall be sawed during the initial curing period as described in subsection 4.5.10 of these specifications and the sawing shall begin before the pavement starts shrinking and before uncontrolled cracking takes place.

Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or the removal of the curing media and the cutting of the joints. In no case shall the pavement be left overnight without having the joints sawed.

The joints shall be sawed at the depth, spacing, and lines shown on the plans. Guidelines or devices approved by the Engineer shall be provided to ensure cutting the joint in a straight line and perpendicular to the centerline of the pavement.

The dust resulting from sawing shall be completely removed from the joint and adjacent areas by means of an air jet or a combination of air and water applied under pressure immediately after the joint has been cut, and before filling with joint sealant.

A string line shall be stretched between the pavement forms along the centerline of the joint.

Each dowel shall be painted and thoroughly coated with hard grease, or lubricant, in accordance with the directions shown on the plans or as approved by the Engineer, to prevent the concrete from bonding to that portion of the dowel.

The entire joint assembly shall be an approved type and shall be installed in such a position that the centerline of the joint assembly is perpendicular to the centerline of the pavement and the dowels lie parallel to the pavement surface parallel to the centerline of the pavement.

The greased ends of the dowels shall be placed in the direction as indicated on the plans and shall be free to slide in the dowel holder. Any excess hard grease on the dowel holder shall be removed.

5.4.4 Construction Joints

A butt construction joint shall be made perpendicular to the centerline of the pavement at the close of each day's work and also when the process of depositing concrete is stopped for a length of time such that, in the opinion of the Engineer, the concrete will have taken its initial set. This joint shall be formed by using a clean plank header having a nominal thickness of fifty (50) mm, a width of not less than the thickness of the pavement and a length of not less than the width of the pavement. The header shall be cut true to the cross-section of the finished pavement and shall be accurately set and held in place in a plane at right angles to centerline and perpendicular to the surface of the pavement.

The top surface of the header shall be protected with steel as approved by the Engineer. On the face along the center of the header there shall be fastened a trapezoidal piece of metal or wood the full length of the header. Seventy millimeters wide and at least forty millimeters in depth as per drawing to form a grooved joint. The header shall have drilled holes to accommodate the dowel or tie bars hereinafter specified. Upon resumption of work any surplus concrete remaining upon the base course shall be removed. The header shall then be carefully removed and fresh concrete deposited against the old in such a manner as to avoid injury to the edge of the old concrete. The fresh concrete shall be vibrated into the groove in a manner to ensure an interlocking joint.

Dowel bars or load transfer devices shall be used in all construction joints in accordance with the details shown on the plans. The edges of the joint shall be grooved, edged, and sealed with the material used for sealing expansion and contraction joints.

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No construction joint shall be placed within 3 m of an expansion, contraction, or other construction joint.

5.5 Consolidating and Finishing for Concrete Pavement

5.5.1 Sequence

The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish either using paving medium for in-form placing of concrete or using slip form construction. The addition of superficial water to the surface of the concrete to assist in finishing operations generally will not be permitted. If the application of water to the surface is permitted by the Engineer, it shall be applied as a fog spray by means of approved spray equipment.

5.5.2 Finishing at Joints

The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material; it shall be firmly placed without voids or segregation under and around all load-transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in sub-section 4.5.3. After the concrete has been placed and vibrated adjacent to the joints, the finishing machine shall be operated in a manner to avoid damage or misalignment of joints. If uninterrupted operations of the finishing machine, to over and beyond the joints, cause segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the screed is approximately 200 mm200 mm from the joint. Segregated concrete shall be removed from the front of and off the joint; the screed shall be lifted and set directly on top of the joint, and the forward motion of the finishing machine shall be resumed. Thereafter, the finishing machine may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

5.5.3 Machine Finishing

The concrete shall be spread as soon as it is placed, and it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area as many times and at such intervals as necessary to give the proper consolidation and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. When side forms are used, the tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish. During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. When in operation, the screed shall be moved forward with a combined longitudinal and transverse shearing motion, always moving in the direction in which the work is progressing, and so manipulated that neither end is raised from the side forms during the striking-off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

5.5.4 Hand Finishing

Hand finishing methods will not be permitted, except under the following conditions. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade; in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete when reinforcement is used.

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The screed for the surface shall be at least 600 mm600 mm longer than the maximum width of the pavement to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal or of other suitable material covered with metal. Consolidation shall be attained by the use of a suitable vibrator.

5.5.5 Floating

After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, using one of the following methods:

Hand Method: The hand-operated longitudinal float shall not be less than 3.6 m3.6 m in length and 150mm150mm in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete shall be worked with a sawing motion, while held in a floating position parallel to the pavement centerline and passing gradually from one side of the pavement to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the pavement edge on each pass.

Mechanical Method: The Contractor may use a machine composed of a cutting and smoothing float(s), suspended from an isolated beam and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with, the side forms or pavement subgrade. If necessary, long-handled floats having blades not less than 1500mm1500*mm* in length and 150mm150*mm* in width may be used to smooth and fill in open textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of mechanical methods. When strike-off and consolidation are done by hand and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of a long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating any excess water and laitance shall be removed from the surface of the pavement by a straightedge 3m3*m* or more in length. Success drags shall be lapped one-half the length of the blade.

5.5.6 Panel Size and Numbering

Every panel of pavement quality concrete shall be numbered for their identification and to distinguish them from each other. Size of the outer line of the number shall be 200×300mm and each panel shall have a specific four (04) digit number having a suitable size as approved by the Engineer.

5.5.7 Straight-Edge Testing and Surface Correction

After the pavement has been struck off and consolidated and while the concrete is still plastic, it shall be tested for trueness with a 5m5*m* straightedge. For this purpose, the Contractor shall furnish and use an accurate 5m5*m* straightedge swung from handles 900mm longer than one-half the width of the pavement. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline of the pavement and the whole area, gone over from one side of the pavement to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance shall be removed from the surface of the pavement. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

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5.6 Surface Texture

The surface of the pavement shall be finished with a broom, saw cut groove, plastic groove, or wire combing or burlap drag finish for all newly constructed concrete pavements.

5.6.1 Brush or Broom Finish

If the pavement surface texture is to be a type of brush or broom finish, it shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface, providing corrugations that are uniform in appearance and approximately 2mm in depth. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. Any imperfections resulting from the texturing operation shall be corrected.

5.7 Skid Resistant Surfaces

In addition to either a broom, brush or burlap finish in the plastic concrete pavement (as per sub-section 4.5.6), skid resistant surfaces comprising either saw-cut grooves, plastic grooves or wire combing shall be provided as specified below and as directed by the Engineer.

5.7.1 Saw-Cut Grooves

i. For new concrete pavements that have hardened, transverse grooves shall be saw-cut in the pavement forming a 6×6×31 mm configuration. The grooves shall be continuous for the entire runway length. They shall be saw-cut transversely in the runway pavement to within 3 m3 m of the runway pavement edge to allow adequate space for equipment operation. The maximum transverse saw-cut grooves shall not exceed 40 m40 m. The tolerances for the saw-cut grooves shall meet the following:

i. Alignment tolerance: ±38 mm in alignment for 23 m.

ii. Groove tolerance: Minimum depth 5 mm. Maximum depth 8 mm. Minimum width 5 mm. Maximum width 8 mm.

iii. Center-to-center spacing: Minimum spacing 31 mm31 mm. Maximum spacing 50 mm.

Saw-cut grooves shall not be closer than 76 mm76 mm to transverse paving joints. Grooves may be continued through longitudinal construction joints. Cleanup of waste material shall be continuous during the grooving operation. Waste material may be disposed of by either flushing with water, sweeping, or vacuuming. Waste material must not be allowed to enter the airport storm or sanitary sewer system.

5.7.2 Plastic Grooves

The grooves formed in the plastic concrete shall be 6×6×31 mm. The grooves shall be continuous for the entire runway length and width. The tolerances for the grooves formed in plastic concrete shall meet the following:

i. Alignment tolerance: ±76 mm in alignment for 23 m.

ii. Groove tolerance: Minimum depth 3 mm. Maximum depth 10 mm. Minimum width 3 mm. Maximum width 10 mm.

iii. Center-to-center spacing: Minimum spacing 31 mm31 mm. Maximum spacing 50 mm.

5.7.3 Wire Combing

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The wire combing technique shall use steel combs or tines of various dimensions to form groove-like texture in the plastic concrete pavement and shall provide grooves that are approximately 3×3 mm spaced 13 mm center-to-center.

5.8 Surface Test

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 5 m straightedge or other specified device. Areas in a slab showing high spots of more than 6 mm but not exceeding 13 mm in 5 m shall be marked and immediately ground down with an approved grinding machine to an elevation that will fall within the tolerance of 6 mm or less. Where the departure from correct cross section exceeds 13 mm, the pavement shall be removed and replaced at the expense of the Contractor when so directed by the Engineer.

Any area or section so removed shall not be less than 3 m in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joint that is less than 3 m in length shall also be removed and replaced.

5.9 Removing Forms

Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least twelve (12) hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as specified for the surface. Major honeycombed areas will be considered as defective work and shall be removed and replaced at the Contractor's expense, as directed by the Engineer. Any area or section so removed shall neither be less than 3m3*m* in length nor less than the full width of the paving lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 3m3*m* in length, shall also be removed and replaced.

5.10 Protecting and Curing of Concrete Pavement

5.10.1 Initial Curing

As the surface of the freshly laid pavement is progressively finished, the initial curing and protection operations shall commence.

Upon completion of the finishing operation and while the surface of concrete is still moist, but no free water remains, a liquid curing membrane, as specified in ASTM C309 (Type 2) shall be applied to the exposed surfaces of the pavement at the rate of not less than one (1) liter per three and two-thirds (3-2/3) Sq.m of surface area when mechanical pressure distributors are used. The curing membrane, except on irregular areas, shall be applied by means of approved self-propelled mechanical pressure distributors or approved hand sprays. Satisfactory means shall be provided for thoroughly mixing the curing membrane compound before and during its use.

The mechanical spraying equipment shall include a full width spray bar equipped with multiple nozzles or a traversing spray which travels from one edge of the pavement to the other. In either case the path of adjacent nozzles or passes of the traversing spray shall overlap minimum of one-half (1/2) the width of the spray pattern so that all portions of the surface shall receive double applications from adjacent nozzles or passes. The pumping, pressure, and distribution arrangement shall be correlated with the forward speed to provide adequate and uniform coverage of the pavement at not less than the minimum rate required. Irregular areas to which the mechanical distributor cannot be adapted may be covered with hand sprays.

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When hand sprays are used, the curing membrane shall be applied in two (2) applications, each at a rate of not less than one (1) liter per five (5) Sq.m of surface area so as to provide a total rate of application of one (1) liter per two and one-half (2/3) Sq.m of surface area. The path of the spray on the second application shall be at right angles to the path of the spray on the first application. When hand operated sprays are permitted, the equipment supplying the pressure to the spray nozzle shall be capable of supplying constant and uniform pressure to provide uniform and adequate distribution of the curing membrane compound at the rates required. If from any cause, such as rainfall soon after its application, the curing membrane is damaged, the Contractor shall immediately apply another application of curing membrane to the surface of the pavement. The rate of application for the replacement membrane shall be the same as for the original membrane.

Unless otherwise directed by the Engineer, immediately following the application of the curing membrane, an approved shade structure with canvas shall be placed approximately 300mm above the pavement surface. The shade structure with canvas shall be constructed of materials and in a manner approved by the Engineer. In no case shall any portion of the shade canvas come in contact with the pavement. The concrete pavement shall not be exposed to the direct rays of the sun for more than one (1) hour, within the first twenty-four (24) hours. The initial curing shall be continued for a period of twenty-four (24) hours from the time the curing membrane is applied.

When forms are removed, the edges of the pavement shall receive curing membrane at the rate of coverage specified for the pavement surface.

The curing membrane may be applied to the vertical edges of the pavement by means of hand sprays or by nozzles attached to the mechanical distributor, but the edges of the pavement shall be covered with curing membrane at the rate specified within thirty (30) minutes after removal of the forms.

When hot-poured joint compound is used, all joints shall be sawed during the initial curing period. The shade-canvas may be moved at joint locations for short periods of time to permit the sawing. Before being sealed, the joints shall be thoroughly cleaned of all loose saw dust, laitance, dirt, other foreign matter, and free of water. As the method of final curing is different from that of the initial curing, the cleaning, and sealing of joints shall be performed immediately following the removal of the shade-canvas at the end of the initial curing period and prior to the application of the polyethylene sheeting.

In no case shall any portion of the concrete pavement be exposed to the direct rays of the sun for more than one (1) hour.

5.10.2 Final Curing

Following jointing operations, curing membrane shall be applied to the joint area at the rate specified for the pavement surface.

Upon completion of the initial curing period and after the shade canvas has been removed and jointing operation has been completed including application of curing membrane, the pavement shall be completely covered with white opaque polyethylene film as specified in AASHTO M 171. Adjoining sheets shall be lapped a minimum of four hundred and fifty (450) mm. The sheeting shall be held in place in a manner approved by the Engineer.

Final curing shall be continued until the concrete reaches an age of fourteen (14) days. During this period, the curing membrane and polyethylene film shall be protected from damage from any cause. Any damage from any cause shall be immediately repaired by the Contractor at his expense. No traffic, including workmen shall be allowed on the surface of the pavement until the expiration of the fourteen (14) day curing period, or as directed by the Engineer.

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5.11 Sealing Joints

5.11.1 Materials

Joint sealant shall be hot-poured elastic type compound, fuel-resistant complying with ASTM D7116 for PQC airfield pavements and ASTM D6690 for other pavements.

5.11.2 Execution

After the fourteen (14) day curing period for the pavement has elapsed, the jute or other protective covering shall be removed from the joint and the joint thoroughly cleaned of all loose scale, saw dust, dirt, laitance or other matter.

Cleaning may be accomplished with a compressed air jet, air and water under pressure, wire brushes or in extreme cases the joint shall, when directed by the Engineer, be re-sawed to ensure a completely clean joint. The joint surfaces and adjacent areas of the slab shall be thoroughly cleaned and debonding tape placed at the bottom of the joint completely isolating sealant with the substrate.

The hot-poured joint material shall be heated in an approved twin walled heating unit filled with oil as per manufacturer recommendation to the temperature within the range required as shown by tests. The joint shall be filled from the bottom of the saw cut to the surface of the pavement. Any joint with a depth greater than 25 mm shall be filled with a minimum of two (2) layers, each layer being approximately equal in depth. The material shall be poured within the required temperature in the workman like manner neatly so that it should not spread on the sides of the joint and is evenly placed.

5.12 Protection of Pavement

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc. The Contractor's plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense. In order that the concrete be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all time materials for the protection of the edges and surfaces of the unhardened concrete. Such protective materials shall consist of rolled polyethylene sheeting at least 0.1 mm thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin cover the surface of the unhardened concrete with the protective covering.

5.13 Opening to Traffic

The Engineer shall decide when the pavement shall be opened to traffic. The pavement will not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 550lb / Sq.in550lb / Sq.in (3.792 MPa) when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening to traffic, the pavement shall be cleaned.

5.14 Surface Tolerances

Extreme care must be exercised in all phases of the operation to assure the pavement will pass the specified tolerances. The following tolerances are applicable:

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i. Lateral deviation from established alignment of the pavement edge shall not exceed plus or minus 30mm in any lane.

ii. Vertical deviation from established grade shall not exceed ±6mm at any point.

iii. Surface smoothness deviations shall not exceed 6mm from a 5m straightedge placed in any direction, including placement along and spanning any pavement joint or edge.

5.15 Tolerance in Pavement Thickness

Areas found deficient in thickness by more than 6mm6*mm* shall be evaluated by the Engineer and, if the deficient areas warrant removal or grinding, they shall be ground or removed and replaced with concrete of the thickness shown on the plans. Ground surface shall be made rough with the beveled approved by the Engineer.

5.16 Embedded Items In Pavements

i. Suitable templates or instructions or both shall be provided for setting out items not placed in the forms. Embedded items and other materials for electrical, mechanical or other operations shall have been completed, inspected tested and approved before concrete is placed.

Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective water-tightness fully equal to that of the continuous water-stop material, shall permanently develop mechanical strength not less than that of the parent section, and shall permanently retain their flexibility.

ii. Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than the limits specified as per ICAO requirements.

iii. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

iv. Expansion joint material and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with approved readily removable material to prevent the entry of concrete into the voids.

v. **Non-Shrink Grout**

Grout of placement under base and bearing plates of steel, machinery and equipment, for grouting anchor bars and dowels and for similar uses shall be as specified. The grout shall be used in accordance with the following and as per manufacturer's recommendations, and as directed by the Engineer.

Concrete surfaces to receive non-shrink grout shall be roughened, cleaned and dampened. Form shall be provided to retain the grout until sufficiently hard to support itself. Grout shall be poured in place and thoroughly rodded or strapped to prevent air entrapment and formation of voids. After non-shrink grout has received its initial set, it shall be kept damp for at least 24 hours.

PART 6-CONCRETE FOR STRUCTURES

Removal of existing damaged pavement, casting of PQC and repair of cracks in existing PQC panels.

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Works under this section of specifications shall be executed as per relevant subsections of these specifications and as per FAA Advisory Circular no. 150/5380-6C. In case of any conflict among the specifications and above-mentioned advisory circular the more stringent one shall be applicable as decided by the Engineer.

The repair works are comprises of partial or complete damaged PQC panels along with the joints including dowels, any underneath pavement structure, if required, backfilling, laying and compaction of pavement layers, provision of vapor barrier with the material and work methodology as specified and/or directed by the Engineer, introduction of required joints with complete details. Repair works also include formation of groove right over the crack, its routing, provision of debonding tape, paneling of joint edges etc.

PART 7-CONCRETE FOR STRUCTURES

7.1 Placing

Before placing of concrete, formwork shall have been completed; water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors and other embedded items shall have been kept in position; and the entire preparation shall have been approved.

No concrete shall be placed into the foundation pits and trenches until the ground to receive the same has been examined and approved by the Engineer for this purpose.

Concrete shall be deposited continuously, or in layer of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams, planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the Contract Documents or as approved by the Engineer. Placing shall be carried out at such a rate that the concrete, which is being integrated with fresh concrete, is still plastic. Concrete, which has partially hardened, shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

iii. The actual sequence of construction proposed by the Contractor shall be subject to the Engineer's approval before construction starts on any part of the structure, and this sequence shall not be varied without the Engineer's approval.

iv. The concrete shall be placed as soon after it has been mixed as is practicable. Once the concrete has left the mixer, no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means available.

The time between mixing and placing should be reduced if the mix is richer or the initial workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere.

The Contractor shall ensure that the delay between mixing and placing does not exceed 45 minutes under any circumstances. Any concrete, which does not satisfy this requirement, shall be discarded.

v. Concrete shall be deposited as nearly as possible in its final position to avoid re-handling. In no circumstances may concrete be railed or made to flow along the forms by the use of vibrators.

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Concreting shall be carried on as a continuous operation using methods, which shall prevent segregation or loss of ingredients.

vi. The free fall of concrete shall not be allowed to exceed two meter and where it is necessary for the concrete to be placed more than this depth; it shall not be dropped into its final position, but shall be placed through pipes fed by a hopper. When a pipe is used for placing concrete the lower end shall be kept inside, or close to the freshly deposited concrete. The diameter of the pipe shall be not less than 225mm225mm.

vii. Workmen carrying concrete to the site, and all other workmen, shall move only along runways or planks placed for the purpose and no person shall be allowed to walk on the reinforcement.

7.2 Consolidation

i. All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Only competent workmen shall operate vibrators. Use of vibrators to transport within forms shall not be allowed.

Vibrators shall be inserted and withdrawn at points approximately 450mm450mm apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not excessive so as to cause segregation, generally from 5 to 15 sec. A spare Vibrator shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented, if necessary, by spading to work the coarse aggregate back from the formed surface.

ii. If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to effect an improvement in the quality of the concrete to the satisfaction of the Engineer and in conformity with the provisions of Clause 5.

iii. Mechanical vibrators shall be of a type approved by the Engineer to suit particular conditions.
iv. Over-vibration or vibration of very wet mixes shall be avoided.

7.3 Curing and Protection

i. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury, and shall be maintained with minimum moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of the Engineer.

ii. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing, as approved by the Engineer.

a) Ponding or continuous sprinkling.

b) Application of absorptive mats or fabric kept continuously wet.

c) Application of waterproof sheet materials approved by the Engineer.

d) Application of other moisture-retaining covering as approved.

e) Application of a curing compound conforming to ASTM C309.

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The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheet, which may develop after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.

iii. Moisture loss from surface placed against wooden forms or metal forms, and exposed to heating by the sun, shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the time prescribed as follows by one of the methods specified above.

iv. Curing in accordance with sub-clauses above shall be continued for at least 10 days in the case of all concrete except concrete with rapid-hardening Portland Cement, for which the period shall be at least 3 days. Alternatively, if tests are made of cubes kept adjacent to the structure and cured by the same methods and to the same intensity, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the minimum specified works cube strength. If one of the first four curing procedures specified above is used initially, it may be replaced by one of the other specified procedures any time after the concrete is one-day old provided the concrete is not permitted to become surface dry during the transition.

v. When the mean daily outdoor temperature is less than 5◦C (41◦F), temperature of the concrete shall be maintained between 10 and 20◦C (50◦F−68◦F) for the required curing period specified above.

When necessary, arrangements for heating, covering insulation or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature with measures to avoid concentration of heat. Combustion heaters shall not be used during the first 24 hours, unless precautions are taken to prevent exposure of the concrete to exhaust gasses, which contain carbon dioxide.

When necessary, provision for wind-breaks, shading, spraying, sprinkling, ponding or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operation will allow.

vi. Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 3◦C 5.4◦F in any one hour or 10◦C 18◦*F* in any 24-hour period.

vii. Concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibrations, during the curing period. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

7.4 Works in Extreme Weather

i. Unless adequate protection is provided, and approval is obtained, concrete shall not be placed during rain. Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.

ii. When the temperature of the surrounding air is expected to be below 5◦*C* during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 13◦*C* for sections less than 300*mm* in any dimensions nor 10◦*C* for any other sections.

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iii. When necessary, concrete material should be heated before mixing and carefully protected after placing. In general, heating of mixing water alone to about 60∘*C* may be sufficient for this purpose. Dependence should not be placed on salt or other chemicals.No frozen material or concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 25 liters per bag of cement.

If water or aggregate is heated above 38∘*C*, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38∘*C*.

iv. During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 32∘*C*. For mass concreting, this temperature should not exceed 21∘*C*. When the temperature of the concrete exceeds 32∘*C*, precautionary measures approved by the Engineer shall be put into effect. When the temperature of the steel is greater than 50∘*C*, steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or ice flakes, or well crushed ice may be substituted for all part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.

Other precautions recommended by ACI Standard 305 shall also be adopted.

7.5 Construction Joints

i. Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be approved by the Engineer.

ii. Joints not shown on the drawings shall be so made and located as to least impair the strength of the structures and shall need prior approval of the Engineer. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floor slabs or beams, and at the top of footings or floor slabs. Beams, brackets, column, capitals, haunches and drop panels shall be placed at the same time as slabs. Joints shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

iii. Reinforcing steel shall continue across the joints. Key and inclined dowels shall be provided as and where directed by Engineer. Longitudinal keys at least 40mm40*mm* deep shall be provided in all joints in walls and between walls and slabs or footings.

iv. When the work has to be resumed on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

v. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned herein shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

vi. The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs; and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout similar in proportions to the mortar in the concrete. The grout shall

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be as thick as possible on vertical surfaces and at least 12*mm* thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained initial set.

vii. When the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle, and brushed, care being taken to avoid dislodgement of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150*mm* in thickness, and shall be well rammed against old work, particular attention being paid to corners and closed spots.

viii. Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement passing through them, so that each portion can be positioned and removed separately without disturbance or shock to the reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of the Engineer. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement. Wood strips inserted for architectural treatment shall be inserted to permit swelling without pressure on the concrete.

7.6 Expansion Joints

Expansion joints shall be provided wherever indicated on the Drawings or as directed by the Engineer. In no case shall the reinforcement, or other embedded items be run continuous or through an expansion joint. All expansion joints shall be carefully placed so as not to be displaced during concreting. The method of placing the expansion joints shall be strictly in accordance with the Drawings and/or as directed by the Engineer. All materials for use in the expansion joints shall have prior approval of the Engineer before placing order for supply.

7.7 Embedded Items

Sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

All embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with approved readily removable material to prevent the entry of concrete into the voids.

PART 8-FINISHING OF FORMED SURFACES

8.1 General

i. After removal of forms, the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Contract Documents.

ii. When finishing is required to match a small sample furnished to the Contractor, the sample finish shall be reproduced on an area at least 10 Sq.m in an inconspicuous location Designated by the Engineer before proceeding with the finish in the specified location.

iii. Allowable deviations from plumb or level and from the alignment, profile grades, and dimensions are specified in clause 6. Tolerances for concrete construction defined as 'tolerances', are to be distinguished from irregularities in finish as described herein. The finish requirements for concrete surfaces shall be as generally specified in this clause and as indicated on the Drawings. Finishing of

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concrete surfaces shall be performed only by workmen who are skilled in concrete finishes. The Contractor shall keep the Engineer informed as to when finishing of concrete will be performed. Unless inspection is waived in each specific case, finishing of concrete shall be performed only in the presence of the Engineer. Concrete surfaces will be tested by the Engineer where necessary to determine whether surface irregularities are within the limits herein after specified.

Surface irregularities are classified as abrupt or gradual. Offsets caused by displaced or misplaced form sheathing or lining or sections, or otherwise defective form lumber will be considered as abrupt irregularities and will be tested by direct measurements. All other irregularities will be considered as gradual irregularities, and will be tested by use of a template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template will be 2 m for testing of formed surfaces and 3 m for testing of unformed surfaces.

8.2 As-cast Finishes

Unless otherwise specified or indicated on the Drawings the classes of finish shall apply as follows:

8.2.1 Rough Form Finish

No selected form facing materials shall be specified for rough form finish surfaces. The holes and defects shall be patched. Fins exceeding 5 mm in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

8.2.2 Fair Face Finish

Fair face finish applies to concrete formed surfaces, the appearance of which is considered by the Engineer to be of special importance, such as surfaces of structures prominently exposed to public view. Location of surfaces of concrete structures requiring fair face finish are shown in the Drawings. Surface irregularities, measured as described in subsection 4.8.2.1, 'Rough form finish', shall not exceed 5 mm for gradual irregularities and 2.5 mm for abrupt irregularities, except that abrupt irregularities will not be permitted at construction joints. Abrupt irregularities at construction joints and elsewhere in excess of 2.5 mm and gradual irregularities in excess of 5 mm shall be reduced by grinding so as to conform to the specified limits. Abrupt irregularities at construction joints shall be ground on 1 to 20 ratio of height to length.

Unless otherwise approved, repair of imperfections in formed concrete shall be completed within 24 hours after removal of forms. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, hardboard, metal, plastic paper, or other approved material capable of producing the desired fair face finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edge, patches, dents, or similar defects shall not be used.

PART 9-REPAIR OF DEFECTS

9.1 General

i. Any concrete failing to meet the specified strength or not formed as shown on drawings, concrete out of alignment, concrete with surfaces beyond required tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of the Engineer shall be removed at Contractor's cost.

The Engineer may reject any defective concrete and order it to be cut out in part or in whole and replace at the Contractor's expense.

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ii. All ties, bolt holes, and all repairable defective areas shall be patched immediately after form removal.

9.2 Repair of Defective Areas

i. Defective and honeycombed concrete shall be removed down to sound concrete. The area to be patched and an area at least 150mm150*mm* wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1-part cement to 1-part fine sand passing No.25 BS Sieve and shall then be well brushed into the surface.

ii. The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not less than 1-part cement to 2−1/22−1/2 parts sand by weight. White Portland cement shall be substituted for a part of the gray Portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch.

iii. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

iv. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface to permit initial shrinkage; it shall be left undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for at least 7 days. Metal tools shall not be used in finishing a patch in a formed wall, which will be exposed.

v. Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as-cast surfaces shall not exceed 0.2 Sq.m in each 100 Sq.m of as-cast surface. This is in addition to form tie patches, if the project design permits ties to fall within as-cast areas.

vi. Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determined by trail to obtain a good color match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

vii. Patches in architectural concrete surfaces shall be cured for at least 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

9.3 Tie and Bolt Holes

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar. If architectural appearance requires, these holes may be filled partially creating the desired round clear holes' pattern on surfaces exposed to view.

9.4 Proprietary Materials

If permitted or required by the Engineer, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations with prior approval of the Engineer.

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PART 10-CONCRETE CONSTRUCTION TOLERANCES

All tolerances shall be as per ACI 117.

Where tolerances are not stated in the specifications or drawings for any individual structure or feature thereof, maximum permissible deviations from established lines, grades, and dimensions shall conform to the following. The Contractor is expected to set and maintain concrete forms so as to ensure complete work within tolerance limits. These allowable tolerances shall not relieve the Contractor of his responsibility for correct fitting of indicated materials and components. These tolerances are not cumulative.

10.1 Allowable Variation from the Plumb (or the specified batter for inclined walls)

i. In the lines and surfaces of columns and walls, and in arises In any 3 m of length or height: 6 mm Maximum for the entire length or height: 25 mm

ii. For exposed corner columns, control joint grooves and other conspicuous lines in any bay or 6 m maximum: 6 mm Maximum for the entire length or height: 13 mm

10.2 Variation from the level or from the Grades indicated on the drawings.

In beam soffits, and in arises measured before removal of supporting shores. In any 3 m of length: 6 mm in any bay or in any 6 m maximum: 10 mm Maximum for the entire length: 19 mm

10.3 Variation of the linear structure lines from established position in plan and related position of columns & walls.

In any bay or 6 meters: ± 13 mm Maximum for the entire length: ± 25 mm

10.4 Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs & walls.

Up to 300mm: -6 mm +10 mm More than 300mm: -10 mm +13 mm

10.5 Footings

10.5.1 Variation in Dimensions in Plan

Minus (minus variation applied to concrete only, not to the reinforcing bars or dowels) (formed)

10.5.2 Misplacement or Eccentricity

2 percent of the footing width in the direction of misplacement but not more than (applies to concrete only, not to reinforcing bars or dowels). +50mm

10.5.3 Reduction in Thickness

Minus 5 percent of specified thickness.

PART 11-ACCEPTANCE OF STRUCTURE

11.1 General

i. Completed concrete work, which meets all applicable requirements will be accepted subject to the other terms of the Contract Documents.

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ii. Completed concrete work, which fails to meet one or more of the requirements and which has been repaired to bring it into compliance will be accepted subject to the other terms of the Contract Documents.

iii. Completed concrete work, which fails to meet one or more of the requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that remaining work complies with the requirements.

11.2-Dimensional Tolerances

i. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of sub section 4.10 shall be considered potentially deficient in strength and subject to the provisions of sub section 4.11.4.

ii. Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of sub section 4.10 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this clause.

iii. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected as decided by the Engineer or if misplaced items interfere with other construction.

iv. Inaccurately formed concrete surfaces exceeding the limits of sub section 4.10 or as mentioned in the relevant Section of 'Formwork' shall be removed and replaced, and those that are exposed to view, may be rejected, or shall be repaired, or removed and replaced, as directed by the Engineer.

11.3 Appearance

Architectural concrete with surface defects exceeding the limitations described in relevant Clauses of this section shall be removed and replaced. Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods. Concrete not exposed to view is not subject to rejection for reason of defective appearance.

11.4 Strength of Structure

i. Strength of the structure in place will be considered potentially deficient if it fails to comply with any requirement which is relevant to the strength of the structure, including but not necessarily limited to the following conditions:

a) Concrete strength requirements not considered to be satisfied in accordance.

b) Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements as specified under section 'Reinforcement' or in the Contract Documents.

c) Concrete, which differs from the required dimensions or location in such a manner as to reduce the strength.

d) Curing less than that specified.

e) Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

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f) Mechanical injury, construction fires, premature removal of formwork, likely to result in deficient strength.

g) Poor workmanship likely to result in deficient strength.

ii. Structural computations and/or additional testing may be required when the strength of the structure is considered potentially deficient.

iii. Core tests may be required when the strength of the concrete in place is considered deficient.

iv. If core tests are inconclusive or impractical to obtain or if structural computations do not confirm the safety of the structure, load tests may be required and their results evaluated, in accordance with ACI Standard 318.

v. Concrete work judged inadequate by structural computations or by results of a load test shall be reinforced with additional construction, if so directed by the Engineer or shall be replaced, at the Contractor's expense.

vi. The Contractor shall bear all costs incurred in providing the additional testing and/or computations required by this section.

12. MEASUREMENT AND PAYMENT
12.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

i. All types of formwork.
ii. All types of expansion, construction and contraction joints in pavement quality concrete (PQC) works including joint fillers, sealant, caps, grease, reinforcement in odd shaped panels, dowel bars and its fixing with epoxy grouts, tie bars etc.
iii. All types of expansion, construction, contraction joints in building works including joint assemblies, joint fillers, joint sealants.
iv. All sampling, mixing and testing as specified.
v. Concrete mix design.
vi. Vapour barrier (geotextile fabric) and debonding tape or mechanical insertions.
vii. Impervious sheeting, burlap covering, liquid membranes compound, additives, non-shrink grout, epoxy resins and water stops.
viii. Anchor bolts for temporary structures and other embedded parts.
ix. All submittals including shop drawings, co-ordination drawings etc.
x. Repair and replacement of defective work.
xi. Surface texture, skid resistant surfaces & surface test.
xii. Curing
xiii. Installation/fixing in position of all precast / prefabricated concrete elements, as shown on drawings.
xiv. Panel Numbering of each panel of pavement quality concrete.
xv. Thickness covers in PQC if required to ascertain deficiencies in elevation and PQC.
xvi. Wastage of materials.
xvii. Beveling of edges formed after saw cutting.

12.2 Plain and Reinforced Concrete

12.2.1 Measurement

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Measurement of acceptably completed works of plain, reinforced concrete and PQC will be made on the basis of number of Cu.m of concrete actually provided, placed, consolidated, finished, cured in position, complete as shown on drawings or as specified/directed.

12.2.2 Payment

Payment will be made for the acceptable measured quantity of plain, reinforced concrete and PQC on the basis of unit rate per Cu.m quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.3 Prefabricated Concrete Spiral Stair

12.3.1 Measurement

Measurement of acceptably Completed Work of Prefabricated Concrete spiral stair will be made on the basis of actual number of prefabricated concrete spiral stair provided installed & fixed in position as complete unit as shown on drawings or as directed by the Engineer.

12.3.2 Payment

Payment will be made for the acceptable measured quantity of prefabricated concrete spiral stair on the basis of unit rate per number quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.4 Gate Valve Chamber, Air Release Valve Chamber & Washout Valve Chamber

12.4.1 Measurement
Measurement of acceptably Completed Work of Gate Valve Chamber, Air Release Valve Chamber & Washout Valve Chamber of specified size including earthwork, stone soling, PCC/ RCC, steel reinforcement bars, ladder rugs, bitumen coating, CI cover with frame etc will be made on the basis of actual number of Gate Valve Chamber, Air Release Valve Chamber & Washout Valve Chamber provided installed & fixed in position as complete unit as shown on drawings or as directed by the Engineer.

12.4.2 Payment
Payment will be made for the acceptable measured quantity of Gate Valve Chamber, Air Release Valve Chamber & Washout Valve Chamber on the basis of unit rate per number quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.5 Fire Hydrant Chamber

12.5.1 Measurement
Measurement of acceptably Completed Work of Fire hydrant chamber above ground "Air side apron area" of specified size including earthwork, stone soling, PCC/ RCC, steel reinforcement bars, ladder rugs, bitumen coating, DI/CI cover with frame etc provided installed & fixed in position as complete unit as shown on drawings or as directed by the Engineer.

12.5.2 Payment
Payment will be made for the acceptable measured quantity of G Fire hydrant chamber on the basis of unit rate per number quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.6 Cement Concrete Manhole

12.6.1 Measurement

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Measurement of acceptably Completed Work of cement concrete manhole including earthwork, stone soling, PCC/ RCC, steel reinforcement bars, ladder rugs, bitumen coating, D400 CI/DI manhole cover with frame etc complete unit as shown on drawings or as directed by the Engineer.

12.6.2 Payment

Payment will be made for the acceptable measured quantity of G Fire hydrant chamber on the basis of unit rate per number quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.7 Precast Fair Faced Concrete / Finishing Elements

12.7.1 Measurement

Measurement of acceptably completed works of Precast fair faced Concrete will be made on the basis of number of Cu.m of concrete actually provided, placed, consolidated, finished, cured in position, complete as shown on drawings or as directed.

12.7.2 Payment

Payment will be made for the acceptable measured quantity of Precast fair faced Concrete on the basis of unit rate per Cu.m quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.8 Cement Concrete (Plinth Protection)

12.8.1 Measurement

Measurement of acceptably completed works of cement concrete in (Plinth Protection) including bitumen seal with rubberized material will be made on the basis of actual volume in cubic meter of concrete actually provided and placed in position as shown on drawings or as directed by the Engineer.

12.8.2 Payment

Payment will be made for the acceptable measured quantity of specified cement concrete on the basis of unit rate per cubic meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

12.9 Pavement Quality Concrete (PQC)

12.9.1 Measurement

Measurement of acceptably completed works of PQC laid after dismantling of existing PQC Panels will be made on the basis of number of Cu.m of concrete actually provided, placed, consolidated, finished, cured in position, complete as shown on drawings or as specified / directed.

12.9.2 Payment

Payment will be made for the acceptable completed works of PQC panels on the basis of unit rate per Cu.m quoted in the BoQ and shall constitute full compensation for all the works related to the item.

12.10 Repair of Cracks in PQC Panels

12.10.1 Measurement

Measurement of acceptably completed works of repair of cracks in PQC panels will be made on the basis of length of cracks in meter, complete as shown on drawings or as specified / directed.

12.10.2 Payment

Payment will be made for the acceptable completed works of repair of cracks in PQC panels on the basis of length of cracks in meter quoted in the BoQ and shall constitute full compensation for all the works related to the item.

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SECTION 0160 – STRUCTURAL STEEL WORK

1 SCOPE

The work under this section of the Specifications consists of furnishing all material, labour, plant, equipment and appliances, fabricating, erecting, installing, testing, painting and all other items incidental to Structural steel work for a complete job as shown on the drawings, specified herein and/or as directed by the Engineer.

2.0 APPLICABLE CODES AND STANDARDS

Latest edition of the following codes and standards are applicable to the work of this section:

- AISC, 1969 Specifications for the design, fabrication and erection of structural steel for buildings.
- ANSI / AISC 360 Specification for Structural Steel Buildings.
- AISC 303 Code of Standard Practice, for Steel Buildings and Bridges.
- AISC Specifications for structural joints using ASTM A325 or A490 bolts.
- AISC & SSPC Guide to shop painting of Structural Steel.
- ASTM A6 Standard specifications for general requirements for rolled structural steel bars, plates, shapes and sheet piling.
- ASTM A36 Standard Specification for Carbon Structural Steel.
- ASTM A53 Standard Specification for Pipe, Steel, Black & Hot Dipped, Zinc Coated, Welded and Seamless Steel Pipes.
- ASTM A307 Standard Specification for Carbon steel bolts and studs and threaded bolts 60000 PSI tensile strength.
- ASTM A325 Standard Specification for Structural bolts, Steel, Heat treated withdrawn and replace by ASTM F3125. 120/105 ksi minimum tensile strength.
- ASTM A653 Specifications for steel sheet zinc coated (galvanized) or zinc iron alloy coated galvannealed by the hot dipped process, alloyed coating.
- ASTM A490 Standard Specification for Structural Heavy Hex bolts, alloy steel, heat treated, 150 ksi minimum tensile strength with Type 1 and Type 3 weathering steel bolting class.
- ASTM A354 Standard Specification for quenched and tempered alloy steel bolts, studs and other externally threaded fasteners.
- ASTM A501 / ASME SA501 Standard Specification for Hot formed welded and seamless carbon steel structural tubing.
- ANSI / NAAMM Metal Bar Grating MBG 531
- ASTM A563-07 Standard Specification for Carbon and alloy steel nuts.

3.0 MATERIALS

3.1 Washers

Washers shall conform to the requirements of ANSI B18.22.1 and shall be of structural grade steel appropriate for the type of bolts for which they are used. For oversized holes, the washers shall be large enough to cover the entire hole by at least 6mm or as directed by the Engineer.

3.2 Studs

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Steel Studs / Shear Connectors shall conform to the requirements of Structural Welding Code – Steel, AWS D1.1.

3.6 Paints

3.6.1 All material shall be acceptable, proven first grade products and shall meet or exceed the minimum standards of specified manufacturers like Jotun, SIPCO, PATSA and ICI paints. During painting works an approved Quality Control inspector or a technical representative shall be provided by the manufacturer to oversee the painting and coating application. The Quality Control Inspector shall be liable to confirm in writing to the Engineer of the correct use of their product and the DFT by approved Thickness Gauge Meter, on job site as per Specification.

3.6.2 Anti-corrosive Surface tolerant epoxy primer by JOTUN or approved equivalent.

3.7 Copper Slag Abrasive

Copper Slag abrasive or grit or approved equivalent.

4.0 CONNECTIONS

All connections shall be designed and detailed for 75% of the effective capacity of the member. A minimum of two bolts or equivalent welding shall be used per connection. Shop connection may be welded or bolted. Field connections shall be bolted unless noted otherwise on design drawings or approved by the Engineer.

5.0 ALLOWABLE STRESSES

Allowable design stresses for structural steel members and their connections, including temporary bracings and shoring shall be in accordance with AISC Specifications.

6.0 SHOP DRAWINGS

6.1 Shop drawings shall be submitted by the Contractor, for structural steel works, for acceptance in accordance with the requirements or the Contract Documents.

6.2 Shop drawings furnished for this section shall conform to the best standards of the construction industry. Shop drawings shall be prepared by and under the supervision of competent engineering personnel. Prior to submittal, the Contractor shall check each shop drawing for compliance with the requirements of the Contract Documents.

6.3 Shop drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale, all work to be provided. Drawings shall be accurately dimensioned and shall be noted clearly.

6.4 All connections shall be designed and detailed, per sub-section 4 above, by the Contractor on the shop drawings. Design calculations for connections shall be made as per AISC specifications and shall be submitted along with the shop drawings after checking and signing by the Contractor for approval.

6.5 The shop drawings shall include:

(i) **An erection scheme**, in suitable size, having the following information:

- Location of erection elements in respect of axis and Marks as well as picking points of these elements with respect to each other or with the existing steel or reinforced concrete structures.
- Joints showing erection welding sizes and lengths, bolts diameter and numbers.

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- Chart showing list of assembling marks having columns such as Mark, Description, Quantity, Weight of each Mark, total weight and Remarks with grand total in the end.
- Chart showing List of Erection Bolts, Nuts and Washers in tabulated form, detailing information such as size, quantity, weight and their grand totals.
- Quality of materials.
- Quality and type of welding electrodes.
- Measures to be adopted against unscrewing of bolts.
- Painting instructions.
- Erection sequence.
- References to relevant drawings.
- Except in special cases all scheme drawings shall be made in single fairly thick lines.
- The recommended scale of erection scheme is 1:50, 1:100, 1:200, for joints 1:5, 1:10 or 1:20.

(ii) **Fabrication drawings** in suitable size shall contain the following information:

- Each Shop Assembly (Mark) shall be drawn separately showing necessary lines, elevations, sections with reference to axis, center lines, location of holes, cleats, plates, lugs etc. fully dimensioned with part numbers.
- Bolts and holes sizes.
- Welding symbols and welded joints requirements, in accordance with AISC manual of steel construction and AWS specifications.
- Geometrical Setting out dimensions necessary for the assembly of an element. Location and details of joints as calculated by the Contractor.
- Instruction for welding, dimensions of weld, edge preparations methods of welding, and methods for control of distortions.
- List of symbols for bolts and holes used.
- List of symbols for welds used.
- Edge distance (general).
- Welding sizes and lengths (general).
- Standards and quality of materials.
- Type and quality of welding electrodes.
- Tests for welding.
- Reference to related erection scheme drawings.
- Reference to design and working drawings.
- Parts list.
- Instructions for surface preparation, painting, primer and finish coats.

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- Recommended scales for fabrication drawings are preferably 1:10 or 1:20, and for joints and details 1:1, 1:2, or 1:5.

7.0 FABRICATION

The Contractor shall notify the Engineer about any problems or doubts/errors, if any, in the drawings for clarifications/rectification well in time to prevent any fabrication errors. Fabrication shall not be commenced until approval has been obtained from the Engineer.

7.1 Straightening of Material

Rolled material, before being worked upon shall be straightened within tolerances as per ASTM specifications A6. Straightening necessarily shall be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 1200°F (650°C).

7.2 Cutting

As far as practicable cutting shall be done by shearing. Oxygen cutting shall be done where shear cutting is not practicable and shall preferably be done by Machine. All edges shall be free from notches or burs. If necessary, the same shall be removed by grinding.

7.3 Holes Punching/Drilling

Holes shall be punched where thickness of the material is not greater than the diameter of bolt + 3mm. Where thickness of the material is greater, the holes shall either be drilled or sub-punched and reamed to size. Die for all sub-punched holes and drill for all sub-drilled holes shall be at least 2mm smaller than the nominal diameter of the rivet or bolt.

7.4 Welding

7.4.1 All execution and inspection of welding shall be done in accordance with the provisions of the American Welding Society Specifications. No welding for piping/electrical supports shall be made transversely to any tension flanges or beams or columns.

7.4.2 Maximum and minimum size and lengths of fillet welds shall be in accordance with AISC specifications, or as mentioned on drawing.

7.4.3 Surface to be welded shall be free from loose scale, slag, rust, grease, paint or any other foreign matter.

7.4.4 Butt welds shall be full penetration welds, unless otherwise specified and permitted.

7.4.5 Avoid the use of temporary welded attachments during fabrication as much as possible. After fabrication is completed, remove the weld with the base material without encroaching on the minimum required base material thickness. After the surface has been restored.

7.4.6 Do not begin structural welding until joint elements are tacked in intimate contact and adjusted to dimensions shown with allowance for any weld shrinkage that is expected. Weld heavy sections and those having a high degree of restraint with low hydrogen type electrodes. No member shall be spliced without approval.

7.4.7 For notch-toughness specified material, all weld metal, processes and preheat requirements shall be compatible to assure notch-tough composite weld metal.

7.4.8 Shop splices of webs and flanges in built-up girder shall be made before the webs and flanges are joined to each other.

7.5 Tolerances

Tolerances for Structural Steel shall be as per AISC Specifications unless noted otherwise.

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8.0 WELDER QUALIFICATIONS

8.1 All welders contracted to perform work shall be required to show written evidence that they have been properly tested in compliance with the approved welding procedures.

8.2 Welders shall have been qualified in the proposed procedure by an established laboratory acceptable to the Engineer within the preceding 90 days.

8.3 All welders shall be qualified for the type of weldment, grade of steel, thickness of steel, welding process and welding position that they are employed to weld. Welders and welding operators that have not been performance qualified, for all material and thickness ranges used on the job, shall be restricted to welding only that portion of the work for which they are qualified.

8.4 Engineer reserves the right to have welders or welding operators prequalified or removed from the job as he deems necessary during the progress of work. Engineer's decision regarding the qualifications of any welder shall be final.

9.0 WELDERS IDENTIFICATION

9.1 Each welder shall be assigned a unique identifying number or symbol that he shall use to identify all welding resulting from his skills.

9.2 Stenciled markings shall be applied within 40mm of the weld using low stress concentration dies. Written symbols are also acceptable.

9.3 A record shall be kept of these symbols by the Contractor. The records shall show welder's name, symbol assigned, procedures to which qualified, employment and test dates. This record shall always be available to the Engineer’s Representative.

10.0 TEST ASSEMBLY

10.1 Fabricated components such as Beams, Girders, Bracing, as and where required by planning, shall be test assembled in the shop prior to transportation to site. Test assembly work and procedure should be planned during fabrication process. Each test assembly shall be got inspected from the Engineer's Representative and shall be dismantled only after his approval in writing.

11.0 SURFACE PREPARATION / PAINTING

11.1 Surface Preparation

These Specifications shall govern the procedures and materials required for surface preparation and coating of the specified structures. All fabrication and assembly of a particular section shall be completed before surface preparation begins. All blast cleaning on metal surface should be carried out by Copper Slag abrasive and grit should not be recycled to avoid contamination of surface in accordance with the SSPC specification required for that particular area. Blasting anchor profiles shall be consistent with manufacturer's recommendations. All blasting should be scheduled in a manner which enables paint to be applied in accordance with the manufacturer's recommendations and on the same day as blasting occurs. All welded area and appurtenances shall be given special attention for removal of welding flux in crevices. Welding splatters, slivers, laminations and under laying mill scale exposed during blasting shall be removed or repaired. Bolt holes shall be drilled and de-burred prior to blasting. Sharp edges shall be ground or filed to provide a visible radius. The abrasives used for blasting will be sized to give the specified anchor profile as determined by this specification. A mesh size will be used as prescribed for thickness of paint to be applied. The maximum particle size shall be no larger than that passing a 16 mesh screen. No acid washes or other cleaning solutions or solvents may be used on metal surfaces after being blasted. This includes any inhibitive washes intended to prevent rusting. All oil and/or grease contamination shall be removed by water based degreaser before starting to blast like glo-flo heavy duty degreaser or

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equivalent. No intermediate or finish coating shall be applied prior to fabrication without prior approval from Engineer. Blasting shall be done in an area removed from painting operations and freshly coated surfaces to prevent contamination. Contaminated coatings shall be re-blasted by Contractor to bare metal and reapplied. After blasting Contractor shall thoroughly clean all blast grit and dust from both internal and external surfaces, including removal from crevices, recesses etc.

11.2 Coating Application

Coating application will be done according to paint manufacturer's recommendations included with the materials and will be subject to inspection by Engineer. The blast-cleaned surfaces shall be coated with primer during the same day as blasted and at least one hour prior to sundown of the day, and also before any rusting occurs. A minimum of 150mm (6 inches) around edges of sand blasted area will be left un-primed unless adjoining a coated surface. Any steel/metal that is not primed and is wet by rain or moisture shall be re-blasted prior to application of primer. All coating shall be allowed to dry thoroughly, but not less than the manufacturer's specified time, prior to application of a succeeding coat. The surface shall be clean. All coating materials furnished by Contractor shall be furnished in unopened, clearly identifiable containers. Mixing of different coatings shall not be permitted. Containers shall remain closed until required for use. No paint shall be used that has expired its shelf life. All coating film thickness shall be as specified and shall be checked by the Engineer or his Representative. Damage to intermediate coats, prior to application of the next coat, shall be repaired by Contractor to provide the coating sequence and film thickness as specified. After the prime coat has been applied, all hard-to-spray areas such as corners, edges and welds, may be brush painted with the same paint and film thickness. The finished job shall not contain sags, runs, wrinkles, spots, blister or other application flaws. Holidays in the final coat at edges, corners, welds and inaccessible areas may be protected by spraying or hand brushing an additional layer of topcoat provided excessive build up does not occur. All components shall be thoroughly stirred before, during and after mixing. The mixed coatings shall be continuously stirred by mechanical spray pot agitators or other approved means. The volume to be mixed shall be accurately measured. All mixing shall be done in clean containers, free from traces of grease, other type paints, or other contaminates. All containers shall be kept covered to prevent contamination by dust, dirt or rain.

11.3 Repair of Damaged Area (Touch-Up)

All external surfaces where coating is damaged during fabrication, transportation and erection shall be repaired as follows: Top coat damaged, but base coat undamaged, will be repaired by removing damaged coating with sand paper or other means acceptable to the Engineer (wire brushing will not be acceptable) and applying top coat as specified. Coating damaged to base metal where blasting is not approved shall be mechanically cleaned as specified in other Section and applying a three coats system as specified in relevant sections. Care will be taken to avoid damaging the coatings surrounding repaired areas and to assure complete tie-in of the coating with surrounding areas. Remove damaged areas by spot blast and feather into surrounding coating with sandpaper. Clean all loose materials from surface. Contractor shall repair the coating on all damaged areas prior to final acceptance of the Engineer.

11.4 Galvanizing (Zinc Coating)

Galvanizing, wherever specified, shall be applied in a manner and of a thickness and quality conforming to the requirements of ASTM A123 standard specifications for zinc (Hot dipped galvanized) coating on products fabricated from rolled, pressed and forged steel shapes, plates, parts and strips. Components shall be galvanized i.e. zinc coated after complete fabrication i.e. welding, drilling etc. the process shall consist of removal of rust and mill scale by pickling in hydrochloric acid or sulphuric acid followed by water wash and prefluxing in tanks containing zinc

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ammonium chloride and then fluxing with ammonium chloride. The fluxed components shall then be passed through a drying oven prior to immersion in a bath of virtually pure molten zinc.

12.0 PAINT AND COATING SYSTEMS FOR STEEL GATE AND STEEL METAL WORKS

The paints and coating systems have been specified hereunder for steel/metal works like pipe support, angle iron support in trenches, manufactured by Jotun paint or approved equivalent as approved by the Engineer and all such surfaces as shown on the Drawings and/or as directed by the Engineer. All paint applications to be carried out by airless spray.

12.1 Exterior Paint System for Steel Structures

12.1.1 Surface Preparation

Abrasive blasting to Near White with copper slag in accordance with SSPC-SP10 and SSPC-AB1 to provide 40 to 60 microns anchor profile.

12.1.2 Paint System

- **Primer:** Surface tolerant epoxy mastic to be applied at 70 microns DFT.
- **Intermediate Coats:** Surface tolerant epoxy mastic paint to be applied in two layers, each layer of thickness 100 microns DFT of approved color. (JOTAMASTIC 87 or approved equivalent).
- **Final Coat (Topcoat):** Two components polyurethane enamel of 60 microns DFT of approved color (HARDTOP XP AS or approved equivalent) to applied as topcoat.

13.0 INSPECTION AND TESTS

13.1 Manufacturer's Test Certificate for all material used shall be furnished by the Contractor for Engineer's scrutiny and approval.

13.2 Rolling tolerance of all shapes and profile according to AISC shall be in accordance with the provisions of ASTM A6 specifications. These shall be checked by the Contractor before commencing work and shall be rejected if found not within limits.

13.3 Materials shall be tested for conformance with the specified standards at an approved testing laboratory as and when directed by the Engineer.

13.4 Contact surfaces of connections using high strength bolts in friction type connections shall be got inspected and approved from the Engineer before bolting.

13.5 All bolted connections shall be got inspected and approved from the Engineer for types, size, number of bolts and installation including tightening.

13.6 Inspection and Testing - Welding

13.6.1 General

Welding shall be inspected and tested by an approved testing laboratory during fabrication and erection of structural steel as follows: The testing laboratory shall be responsible for conducting and interpreting the tests. It shall state in each report whether or not the test specimens conform to all requirements of the Contract Document and shall specifically note any deviations therefrom. Certify all welders and make 100 percent visual inspections and tests as follows: Record types and defects found in the welding work. The measures required and performed to correct such defects. In addition to the requirements of AWS D 1.1, paragraph 8.15, each weld shall be visually free of slag, inclusions and porosity. In addition to visual inspection of all welds, magnetic particle, ultrasonic and radiographic inspection shall be made of all welds as specified below. Magnetic particle tests shall be made on the root pass and finished weld. The method of magnetic particle

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test shall be in accordance with ASTM E109. Any type of crack or zone of incomplete fusion or penetration shall not be acceptable. Radiographic testing technique and standards of acceptance shall be in accordance with AWS D 1.1. Ultrasonic testing shall be performed in accordance with AWS D 1.1. Welding inspection and test report showing evidence of the quality of welding shall be submitted by the Contractor. For each section of weld inspected and tested, furnish a report which clearly identifies the work, the welder's identification, the areas of inspections and test, the acceptability of the welds, and signature of the inspector or laboratory incharge. Each report shall be completed at the time of inspection or test. For radiographic examination, furnish a complete set of radiographs in addition to the reports. All inspection and testing shall be carried out in presence of the Engineer or his representative.

13.6.2 Test Methods

Use the following test methods as specified and as per instructions of the Engineer. The following list is in descending order. When a particular test method is specified for a joint and the method is impractical to use, use the next highest method practicable as per instructions of the Engineer. The alternative method will be subject to approval, NDT procedures and techniques shall be in accordance with AWS D 1.1, section 6.7.

a) Radiographic Method: In addition to the requirements of AWS D 1.1, comply with ASTM E94.
b) Ultrasonic method.
c) Magnetic particle method.
d) Liquid Penetration Method: Visible-dye, solvent removable method only.

13.6.3 Members Designated for Tests

a) **Built-up Members:** Examine 100 percent of flange-to-flange and web-to-web welding by the radiographic method. For all web-to-flange and pipe column seam welding, examine ten percent of each welder's work as follows: Full penetration groove welds by the ultrasonic. Fillet welds and partial penetration groove welds by the magnetic particle method.

b) **Moment Connection Joints:** Examine 100 percent of all flange-to-flange and web-to-web welding as follows: Full penetration groove welds by the ultrasonic method or other method as designated by the Engineer. Fillet welds and partial penetration groove welds by the magnetic particle method. For all web-to-flange welding, examine ten percent of each welder's work as follows: Full penetration groove welds by the ultrasonic method or radiographic method as approved by the Engineer. Fillet welds and partial penetration groove welds by the magnetic particle method.

c) **Column Base Plates:** Examine 100% of all welding for connection of base plate to column.

d) **Bracing Connections:** Examine 100 percent of all welding for connection of diagonal bracing as follows: Groove welds by the ultrasonic method. Fillet welds by the magnetic particle method.

13.6.4 Requirement for ten percent Examination

a) Examine a 300mm section of weld in each 3m increment of each welder's work as directed by the Engineer. If the examination meets the acceptance standards of AWS D 1.1, the 3m of weld represented will be accepted.

b) If the examination fails to meet the acceptance standards, examine two additional 300mm sections in the 3m increment as directed by the Engineer. If both of these examinations meet the acceptance standard, the 3m of weld represented will be accepted. Repair the defects detected in the first examination and re-examine.

c) If one or both of the examinations fails to meet the acceptance standards, examine the remaining weld of the 3m increment. Repair the areas that do not meet the acceptance standards and re-examine.

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13.6.5 Repair and Re-Testing of Welds

Repair defective welds in accordance with AWS D 1.1, or replace the weld, and re-test repaired and replaced welds by the same method and acceptance standard used to examine the original weld. In addition, when defective welds are found, the testing laboratory shall determine the cause of the defective welding and institute immediate corrective action. All defective welding shall be repaired or replaced at the Contractor's expense.

13.7 Rejection

Neither the fact that the materials have been tested nor that the manufacturers test certificates have been furnished shall affect the liberty of the Engineer to reject material found not according to these specifications. Materials or workmanship not in conformance with the provisions of these specifications shall be rejected at any time, after delivery or during the progress of the work or the completion and erection at site.

14.0 ERECTION

14.1 Bracing

All steel structures shall be carried up true and plumb within the limits defined in the AISC code of standard practice and temporary bracing shall be introduced wherever necessary to take care of all construction loads to which the structure may be subjected including the equipment and the operation of the same. Such bracing shall be left in place as long as required for safety. Wherever piles of materials, erection equipment and other loads are carried during erection, proper provision shall be made by the Contractor to take care of the stresses resulting from such loads.

14.2 Alignment

No permanent bolting or welding shall be done at site during erection until as much of the structure as will be stiffened thereby has been properly aligned and approved by the Engineer.

14.3 Joints Using High Strength Bolts

All structural joints using high strength bolts shall be executed and inspected in accordance with "AISC Specification for structural joints using ASTM A325 or A490 bolts". High strength bolts and nuts, loosened after tightening, shall be discarded and replaced with unused bolts and nuts.

PART 15 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0170 - STAINLESS STEEL WORK

1. SCOPE

The requirement of this section is to apply to all stainless-steel work which forms a part of the basic design and finish of the project. Certain major items are specified under other sections of these Specifications, in which case applicable portions of this section are included by reference.

Applicable portions of other sections of these Specifications are hereby included by reference to establish minimum quality standards and shall become a part of this section as if written out in full herein.

The work covered by this section of Specifications consists of supply of all material, labour, plant, equipment and appliances including cladding, welding, bolts, nuts, washers, anchor bolts, embedded parts etc, fabrication and erection in accordance with the specifications and as per drawings and as directed by the Engineer.

2. TECHNICAL REQUIREMENTS

A. General

a) Provide units composed of brake formed shapes with visible portions of profile matching detail indicated on the drawings, and free from additional slots, grooves, fins or other.

b) Fabricate and assemble all work in the shop wherever possible and otherwise pre-fit as required to reduce field fabrication to a minimum.

B. Design

Design anchors to allow for horizontal and vertical expansion. Screws, nuts, washers, bolts and reinforcement shall be aluminum, and of adequate strength for the proposed use.

C. Appearance

a) Fit member neatly and to hairline accuracy with profile extending into joints without additional trim. Match flush joints to form perfectly smooth plane; match offset joints to hairline butt fit to flat surface beyond point of tangency of corner radius. Units using extra trim to conceal misalignment will not be acceptable.

b) Make all connections by means of concealed fasteners; exposed fasteners will be permitted where essential. Use countersunk flat head machine screws for exposed fasteners as approved by the Engineer.

c) Where additional strength of section is required to meet structural requirements, provide additional wall thickness or stiffeners inside the extrusion. Width of face (sight line) dimensions indicated on the drawings is maximum permissible exposed surfaces.

d) Manufacturer's standard sections will be acceptable only when such extrusions are substantially in accordance with the profiles indicated on the drawings as accepted by the Supervising Engineer.

3. SUBMITTALS

A. Samples

Submit the following samples of materials and assemblies specified herein:

a) Preliminary Approval Samples: All finishes.

b) Product Samples: Hardware.

c) Range Samples: All finishes.

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d) Test Samples: Upon request.

B. Shop Drawings

a) Project Shop Drawings: All fabricated materials.

4. SAMPLES

A. Samples

Before any work is performed, the following samples shall be submitted:

a) Representative samples of appropriate size of all stainless steel included in this work, to show final finished appearance.

b) Representative samples of welded connections, mired joint, and butt weld and typical brake form and bend for bar sheet stock to show final finished appearance.

c) Representative samples of proposed mechanically fastened connections to show final assembled appearance.

B. All samples shall be labeled to show material finish, thickness and specific use and location on work.

C. For project reference, one set of record samples will be retained by the Supervising Engineer, and kept available at the job site and one returned to the Contractor.

5. SHOP DRAWINGS

Submit shop drawings in accordance with Conditions of Contract. Coordinate shop drawings with material description to show location and extent of various finishes.

6. MAINTENANCE INSTRUCTIONS

Prepare and deliver to the Supervising Engineer a complete maintenance manual.

Such documents are an integral part of the requirements of these Specifications and require close cooperation between the basic metal manufacturer, the fabricator and the finisher.

Maintenance information shall include specific instructions for:

Routine cleaning instructions with recommendations for materials and schedule applicable to locality and exposure.

Recommendations for major cleaning as required to maintain appearance.

7. MATERIALS

A. Stainless Steel

a) Materials not otherwise specified, in accordance with requirements of "Structural Steel Work".

b) All Bar Stock including Shapes: Cold drawn AISI Type 1018 steel.

c) Stainless Steel: ASTM A167 Type 302. Other 300 series stainless steels will be acceptable where required to suit specified fabrication requirements.

d) Stainless steel plates (18/8) conforming to ASTM A167, ASTM A240, ASTM A554 (type 304,309S, 316,307 304L) shall be provided at locations as shown on drawings. The plates shall be provided with suitable anchors where required for embedding in concrete pavement.

B. Support Devices

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a) Reinforcement: Meet requirements of "Reinforcement" section.

b) Fasteners used in assembling sections: Exactly matching adjacent surfaces where exposed or AISI 300 series stainless steel.

c) Steel Anchors: Hot dip galvanized, or AISI 300 series.

d) Inserts: For required anchorage into concrete or masonry work, furnish inserts of cast iron, malleable iron or 2.8 mm steel hot-dip galvanized after fabrication.

e) Expansion Anchor Devices: Fed. Spec. FF-S-325 Group III, Type 4, Class 1, Int. Amendment 3: Molly "Parbabolt" or equal.

C. Paint for Ferrous Metal

Primer as follows: equivalent product manufactured by one of the approved manufacturers listed under "Painting and Finishing"; Fed. Spec.TT-P-86e, Type II, or "Tnemec" cement-in-oil type.

D. Setting Grout

Rapid setting grout warranted by manufacturer to be compatible with aluminum; UPCO "Bostick 275"; similar by Steelcote. Grace or Acme Highway Products using less than full unit of powder so that mixture is pourable; or use L & M Crystex Grout. Metallic grout is not acceptable.

E. Accessory Materials

a) Joint Filler: Expanded cellular neoprene, closed cell, tape, coated with nonstaining adhesive one surface; ASTM D 1056 "Testing Sponge and Expanded Cellular Rubber Products". Type SC-41: shape as required.

b) Protective Coverings: After finishing procedures have been completed, apply protective wrappings of paper or plastic film. Keep material dry until wrappings are removed. Coatings, if used, must be completely removed.

8. STAINLESS STEEL FINISHES

Finish designations are indicated herein in accordance with the standards of the American Iron and Steel Institute.

9. FABRICATION

A. General

Comply with requirements of "Structural Steel Work", Section 0160.

B. Welding and Grinding Stainless Steel

a) All welding shall be in accordance with appropriate recommendations of the American Welding Society and shall be done with electrodes and by methods recommended by the manufacturer of the alloys being welded. Type, size, and spacing of welds shall be as shown on approved shop drawings. All welds behind finished surfaces shall be so done as to minimize distortion or discoloration on the finished side. All weld spatter and welding oxides on finished surfaces shall be removed by descaling or grinding.

b) Unless otherwise shown or specified, all weld beads on exposed polished surfaces shall be ground and polished to match and blend with finish on adjacent parent metal. Grinding and polishing shall be done only with clean wheels and other abrasives free from iron compounds.

c) Thoroughly clean material after grinding or polishing to remove all contaminants which might affect appearance.

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10. PROTECTION AND CLEANING STAINLESS STEEL

All work shall be protected from damage of any kind during handling, transportation and at the project site. All material shall be stored under waterproof cover on wood blocking or on suitable floors.

Finished surfaces shall be covered with protective paper, tape, or other approved strippable coating prior to shipment from the fabricator. Should construction schedules delay removal of protective strippable coating, periodic inspection at increasingly frequent intervals shall be made to be certain coating may be easily removed.

Upon completion, all exposed surfaces shall be thoroughly cleaned in accordance with the recommendations of the stainless-steel producer.

11. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0180 - MISCELLANEOUS STEEL WORK

1.0 SCOPE

The work under this section of Specifications consists of supply of all material, labour, plant, equipment and appliances required for Miscellaneous Steel works such as embedded items, steel pipe railing and any other work shown in the drawings and as directed by the Engineer.

2.0 APPLICABLE STANDARDS

Latest edition of the following standards are relevant to these Specifications, wherever applicable:

AISC Code of Standard practice. ASTM A-36 for structural steel. ASTM A-53 steel pipe for railing. AISC/SSPC Guide to Shop painting for structural steel. AWS D1.1 Structural Welding Code - Steel Specifications for welding of steel structures.

3.0 DRAWINGS.

3.1 DESIGN DRAWINGS

Design working drawings shall be supplied to the Contractor. These shall contain main dimensions, sizes of members, typical details, etc.

3.2 SHOP DRAWINGS

Shop drawings shall be prepared by the Contractor from the construction drawing, taking into consideration the instructions given by the Engineer and submitted to the Engineer for his approval. No work shall commence until shop drawing is approved by the Engineer.

4.0 MATERIAL

Except otherwise stated in the drawings, the material specifications shall conform to the following standards. Wherever necessary the Contractor may use equivalent alternative material subject to approval of the Engineer.

4.1 STRUCTURAL STEEL

Structural Steel shall conform to the requirements of ASTM A-36 or equivalent.

Pipe for handrail shall conform to the requirements of ASTM A-53.

4.2 WELDING

Welding Electrodes shall conform to the specifications for mild steel covered Arc-welding Electrodes, AWS A5.1 latest edition. Equivalent locally manufactured electrodes may be used subject to the approval of the Engineer.

5.0 FABRICATION

The Contractor shall notify the Engineer about any problem or doubts/errors discovered in the drawings supplied by the Engineer for clarification/rectification well in time to prevent any fabrication errors. Fabrication shall not be commenced until approval has been obtained from the Engineer.

5.1 STRAIGHTENING OF MATERIAL

Rolled material, before being worked upon must be straightened. Straightening necessarily shall be done by mechanical means or by the application of a limited amount of localized heat.

5.2 CUTTING

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As far as possible cutting must be done by shearing. Oxygen cutting shall be done where shear cutting is not possible and shall preferably be done by Machine. All edges shall be free from gauges, notches or burs. If necessary, the same shall be removed by grinding.

5.3 HOLES PUNCHING/DRILLING

Holes shall be punched where thickness of the material is not greater than the diameter of bolt by (+1/8) inch. Where the thickness of the material is greater, the holes shall either be drilled or sub-punched and reamed to size. The dia for all sub-punched holes and the dia. of all drilled holes shall be at least 1/12 inch smaller than the nominal diameter of the rivet or bolt.

5.4 WELDING

5.4.1 General: The execution and inspection of welding will be done in accordance with the provisions of the American Welding Society Code for Welding in Building construction, D1.1.

5.4.2 Maximum and minimum size and lengths of fillet welds shall be in accordance with AISC specifications.

Surface to be welded shall be free from loose scale, slag, rust, grease, paint or any other foreign matter except mill scale which withstands vigorous wire brushing.

5.5 Tolerances

The maximum variation in the distance from centre to centre of holes for rivets or bolts shall not be greater than 1mm.

5.6 Methodology

Fabrication shall be carried out using all the necessary tools, plant and equipment in accordance with methodology for fabrication approved by the Engineer.

6.0 INSPECTION AND TESTS

The inspection of welding shall be performed in accordance with the American Welding Society specifications and as directed by the Engineer.

Materials and workmanship not in reasonable conformance with the provisions of these specifications shall be rejected at any time during the progress of the work or the completion and erection at site.

7.0 ERECTION/INSTALLATION

Erection/Installation work shall be carried out by using required tools, plant and equipment in accordance with methodology for erection approved by the Engineer.

8.0 SURFACE PREPARATION/PAINTING

8.1 SURFACE PREPARATION

8.1.1 All steel shall be cleaned free from loose scale, rust, burs, slag, etc. by means of sand / grit blasting and/or other approved means as recommended by the manufacturer of paint.

8.1.2 The sand / grit used for this purpose shall conform to the type as specified in SSPC-SP 6. It should be free from earth, dust, clay and moisture. For this, the Contractor shall submit the gradation (no less than that passing through a 16 mesh screen U.S. sieve series) and source of sand along with the sample for approval of the Engineer prior to commencing the sand blasting operation.

8.1.3 The size of sand particles and air pressure size of the hose nozzle shall be correlated to give proper and acceptable surface.

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8.2 PAINTING

8.2.1 Immediately after surface preparation all material shall be applied with two coats of red lead oxide primer and two coats of synthetic enamel.

8.2.2 One final coat of paint shall be applied after erection of all components is complete.

8.2.3 The type of primer and paints to be applied shall be as specified in section 8.3. The Contractor shall use the best quality of the type of paint specified and shall get the same approved by the Engineer.

8.2.4 All painting shall be in accordance with the paint manufacturer's specification/recommendations.

8.2.5 The above is applicable to all steel work covered under this section of specification.

8.2.6 Steel work/Surfaces not to be painted

i) Steel work to be encased/embedded in concrete or surface in contact with concrete shall not be painted, but shall be given a cement wash after surface preparation.

ii) Bolt and nuts threads shall be protected by greasing till they are tightened and painted.

8.3 PRIMER AND PAINT

All structural steel components, unless specified otherwise, shall be applied with

i. Primer: Surface Tolerant Epoxy of 70 Micron DFT

ii. Intermediate Coats: Surface Tolerant Epoxy mastic paint to be applied in two layers, each layer of thickness 100 micron DFT of approved color. (Jotamastic 87 or approved equivalent)

iii. Final Coat: (Top Coat)

Two component polyurethane enamel of 60 micron DFT of color applied after erection. (Hardtop XP AS approved equivalent)

9.0 GALVANIZING

Steel platform, pipe works supports, ladder, etc. specified as well as screws and nuts associated shall be hot-dip galvanized, electrolytically galvanized or sheradized, as appropriate to the particular element.

Galvanizing shall be performed in accordance with VDE Standard 0210.

Material: For galvanizing, only original blast-furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

for screws, washers, nuts and similar hardware a minimum of 60 micron.

for all other parts, except for parts intermittently or permanently submerged in water, a minimum of 70 micron

for parts intermittently or permanently submerged in water, a minimum of 140 micron, in accordance with "VDEw, Druckrohreitungen - Association of German Electricity Utility Companies, Steel Penstocks".

Cleaning: All material to be galvanized shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign substances. Particular care shall be taken to clean slag from welded areas.

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Galvanizing of plates and shapes: Where pieces are of such lengths that they cannot be dipped in one operation, great care shall be exercised to prevent warping.

Material on which galvanizing has been damaged shall be re-dipped unless the damage is local and can be repaired by soldering or by applying a galvanizing repair compound; in this case, the compound shall be applied in accordance with the manufacturers' instructions.

Soldering shall be done with a soldering iron using 50/50 solder (tin and lead). Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself. Any member on which the galvanized coating becomes damaged after having been dipped twice shall be rejected.

10.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0190 – PILING WORKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with the execution and testing of bored reinforced concrete cast-in-place piles complete and in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the contract.

B. Related Sections:

1. **Section 0150 - Concrete Works**
2. **Section 0100 - Earthwork**

1.2 APPLICABLE STANDARDS

A. British Standards:

B.S.8004 Foundations

B. ASTM Standards:

D 1143 Standard Test Methods for Deep Foundations under Static Axial Compressive Load

D 3689 Standard Test Methods for Deep Foundations under Static Axial Tensile Load

D 3966 Standard Test Methods for Deep Foundations under Lateral Load

D 4945 Standard Test Method for High-Strain Dynamic Testing of Piles

D 5882 Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations

D 6760 Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Cross hole Testing

C. ACI Standards:

ACI 318 Building Code Requirements for Reinforced Concrete

D. In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials.

1.3 SUBMITTALS

The CONTRACTOR shall prepare the following, but not limited to, documents for submission to the ENGINEER for approval prior to any execution of the works.

A. Concrete mix design for all grade of concrete to be used as specified in the Contract Drawings.

B. Manufacturer's certificate and test reports for all products to be used.

C. Method statements for bore piling and concrete casting procedure.

D. Method Statement for Static Load Pile Testing.

E. Method Statement for Non-Destructive Integrity Pile Testing.

PART 2 - PRODUCTS

2.1 MATERIALS

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A. For detail specification of cement, aggregates and concrete refer to Section 0150 - Concrete Works

B. For detail specifications of reinforcement refer to relevant section.

2.2 DESCRIPTION OF PILES

The piles shall be bored cast-in-place, reinforced concrete piles. The pile diameter, working depth, design axial and horizontal loads, group configuration, number of working piles, and the test programme shall be as shown on the Structural Drawings and as summarised in the Pile Schedule that the Contractor shall extract from the Structural Drawings and submit with his Method Statement for the Engineer's approval before any piling work commences. The nominal diameter of piles is defined as the outside diameter of the temporary driving casing which is used to carry out the boring to the elevation required and which is later withdrawn, all as described hereinafter. The pile concrete shall be the grade specified in the Concrete Grade Table consolidated under Section 0150 and shall in no case be lower than 3,000 psi cylinder strength.

The casing shall penetrate to the bottom of the bore hole and not be withdrawn except as stipulated hereinafter. However, depending upon the final and general site conditions the ENGINEER may, at his sole discretion, allow omission of the last portion of the pile near its tip.

Parameter	Specification
Pile Type	Bored Cast-in-Situ Reinforced Concrete Piles
Pile Diameter — All Caps F1, F2, F3, F4	1,000 mm (1.0 m)
Concrete Strength	f'c = 4,500 psi minimum (self-compacting concrete for in-situ placement)
Main Reinforcement	ASTM A615 Grade 60; fy = 60,000 psi
Lateral Ties / Spirals	ASTM A615 Grade 40; fy = 40,000 psi
Minimum Cover to Pile Face	75 mm (3 inches)
Concrete Placement Method	Tremie pipe from bottom of bore upwards (no vibration)

Foundation Ref.	Structure / Cap Size	Nos. of Caps	Piles per Cap	Total Piles	Pile Dia. (mm)	Pile Length (m)	Working Load per Pile (Tons)
ATCT-F1	ATCT — tower core raft, 70'-7" × 37'-6", cap thickness 33"	1	18 (6 × 3)	18	1,000	20	126
ATCT-F2	ATCT — 18' × 18', cap thickness 27"	16	4	64	1,000	15	76
ATCT-F3	ATCT — 18' × 31', cap thickness 27"	4	6 (2 × 3)	24	1,000	15	76
ATCT-F4	ATCT — 6'-6" × 21', cap thickness 21"	4	2	8	1,000	15	76
FS-F1	Fire Station — two-pile cap	6	2	12	1,000	15	76
FS-F2	Fire Station — two-pile cap	8	2	16	1,000	15	76
TOTAL WORKING PILES	**—**	**39**	**—**	**142**	**—**	**—**	**—**

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Foundation Ref.	Structure / Cap Size	Nos. of Caps	Piles per Cap	Total Piles	Pile Dia. (mm)	Pile Length (m)	Working Load per Pile (Tons)
Test piles	Sacrificial initial test piles (Clause 3.12B A)	—	—	2	1,000	As working piles	—
TOTAL PILES	**—**	**—**	**—**	**144**	**—**	**—**	**—**

Notes to the Pile Schedule:

1. All piles are bored cast-in-situ reinforced concrete, nominal diameter 1,000 mm (3'-3"), reinforced with 20 nos. #6 vertical bars with #3 spiral ties throughout the full pile length, in accordance with Sections A-A and B-B of the Structural Drawings.

2. Pile lengths shown are estimated. Final penetration shall be determined in accordance with Clause 2.3 following the results of the initial load tests specified in Clause 3.12A.

3. Foundation references are prefixed ATCT- and FS- to distinguish the two structures, both of which employ foundation marks F1 and F2 on their respective drawing sets (Drawings S-01 to S-14 for the ATCT and S-01U to S-07U for the Fire Station).

4. Working loads for the Fire Station pile types FS-F1 and FS-F2 are not stated on the Structural Drawings and have been taken as 76 tons. [ASSUMPTION – VERIFY with the Structural Consultant prior to issue.]

2.3 PENETRATION OF PILES

The estimated minimum length of piles below the prepared ground level is specified in the Drawings. Depending on the results of pile-loading test described later under this section and depending also on supplementary soil information obtained in the course of execution of the actual pile work, the ENGINEER may at his own discretion order the CONTRACTOR to vary the penetration of some or all of the piles as the case may be.

PART 3 - EXECUTION

3.1 EXECUTION OF BORE HOLE

The CONTRACTOR may use any percussion rotary or vibration method, or any combination thereof for executing the bore hole to the elevation required but the use of water jets or of any other method or methods for the execution of the bore hole which tend to disintegrate or to appreciably loosen the soil strata surrounding the bore hole is expressly prohibited.

3.2 LIMITATION OF BORING SEQUENCE

No boring operations shall take place nearer than 10 ft (3 meters) from any pile for which concreting operations are in progress or from any newly completed pile until at least forty-eight (48) hours have elapsed from the last concreting operation on that pile.

3.3 REMOVAL OF SOIL

The soil inside the bore hole shall be removed by auguring or some similar method. It is expressly prohibited to pump out or to attempt to pump out the water in the bore hole or to use pumping or water-jetting to assist with the removal of soil or any other materials from the casing.

3.4 SAMPLES AND BORE HOLE LOGS

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Two soil samples shall be taken from the bottom 12 inches (300 mm) in each bore hole and shall be preserved in sealed and adequately labeled glass containers until personally inspected by the ENGINEER who shall then issue instructions regarding the further disposal of these samples.

In addition to these two bottom samples which shall be taken from each bore hole, the CONTRACTOR shall also keep a complete bore log with a visual classification supported by an adequate number of samples provided in sealed and adequately labeled glass jars, for not less than two pile bore holes for examination. These bore holes shall be selected at the extreme ends of each pile group, should they show significantly different results. The ENGINEER's Representative may order additional bore hole logs to be kept for intermediate pile bore holes. Adequate number of samples shall mean not less than one sample for every 5 ft (1500 mm) of bore hole and, in addition, not less than two samples at every significant change in the soil strata.

3.5 TOLERANCES

The out-of-position tolerance shall not exceed 2 inches (50 mm) in any direction. The out-of-plumb tolerance shall not exceed 1% (one percent) in any direction.

The bow shall not exceed 2 inches (50 mm) in any direction. In order to control the amount of bow in the piles, exact records shall be kept of the amount of out-of-plumb of each bore hole and the withdrawal of the casing or guide pipe shall be in strict alignment therewith.

3.6 TOP OF THE CASING

In the last stages of the concreting operations described hereinafter, the top of the casing shall be at an elevation of not less than 3 ft (900 mm) above that of the soffit of the pile cap as marked on the drawings for the purpose of making it possible to continue concreting up to that elevation; all as stipulated hereinafter.

3.7 INSPECTION

After the boring has reached its final penetration as stipulated or as may be additionally ordered by the ENGINEER on the basis of the test load results and other data obtained in the field, and after it has been completely cleaned of all earth and otherwise made ready to receive the reinforcement and thereafter the concrete, the CONTRACTOR shall so inform the ENGINEER. The ENGINEER or his deputy shall check the actual penetration achieved, the cleanness of the bore hole and the amount and direction, if any, by which the bore-hole is out of position and/or out of plumb; and having satisfied himself on these and on any other points which he may consider relevant, shall personally sign an acceptance voucher for the bore hole authorizing the CONTRACTOR to proceed with placing the reinforcement. The CONTRACTOR shall under no circumstances proceed with placing the reinforcement in the bore hole, or with the subsequent concreting, without having first obtained this written authority separately for each and every bore hole signed by the ENGINEER.

3.8 PILE REINFORCEMENT

The reinforcement for piles shall be as specified in Drawings. The piles shall be reinforced for the full length of the pile.

The reinforcement for each pile shall be assembled on the ground by means of binding wire in such a manner as to form a rigid cage. Concrete spacer blocks specially precast for this purpose shall be securely attached to the reinforcement at suitable spacing in such a manner as to ensure that the concrete cover is maintained throughout and the reinforcement cage is not displaced in the casing in the course of subsequent concreting operations. Most particular care shall be taken to ensure that none of these spacer blocks can swivel around to the inside of reinforcement cage and that, in general, there are no obstructions of any kind inside the reinforcement cage due to spacer blocks or lapped reinforcement or for any other reason which might interfere with the

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smooth travel of the concreting skip if the underwater method of concreting described hereinafter is to be used. The entire reinforcement cage assembly shall then be carefully lifted and carefully lowered into the bore hole previously made ready to receive it as described in previous sections.

Should the CONTRACTOR prefer to lower the reinforcement cage assembly into the bore hole in two or three sections, he may do so provided he observes the same lapping requirements as for assembly on the ground, namely that the main longitudinal reinforcement shall be lapped for not less than 40 bar diameters. In addition, concrete spacer blocks must be located immediately above the laps at three points spaced around the cage so as to ensure the correct positioning of the reinforcement cage in the bore hole.

Upon completion of this operation, the CONTRACTOR shall notify the ENGINEER or his deputy who shall satisfy himself of the adequacy of this work and shall then issue to the CONTRACTOR, separately for each and every pile, a written authorization to proceed with concreting.

3.9 CONCRETING

Concreting shall be subject to the following specifications in addition to those mentioned for the "Materials" section.

a) Concrete piles may be attacked by ground water containing destructive acids, alkalis or chemical salts but the cause of the most severe damage is usually the rusting of the reinforcement and spalling of the concrete. To minimize these effects, the concrete shall be dense and of high quality, obtained by proper selection of the aggregate and mix design, strict supervision over workmanship in mixing and placing concrete, adequate cover to reinforcement and careful handling of the piles to minimize stresses and formation of cracks during placing.

b) The bottom of the casing should be kept far enough in advance of the boring tool to prevent the entry of soil into the casing, thus preventing the formation of cavities and settlements in the adjoining ground. The joints of the casing should be made as tight as possible to minimize inflow of water or leakage of air, where compressed air is employed to facilitate concreting.

c) Where the concrete is cast-in-place in a tube or casing, its consistency should be suitable to the method of compacting employed in the formation of the piles. Where a casing is withdrawn from cohesive soils for the formation of a cast-in-place pile, the concrete should be used as dry as practicable to minimize the softening of the soil by excess water. Care shall be taken to prevent, as far as possible, the separation of the ingredients in passing the reinforcement.

d) After installation to final depth and immediately before placing the concrete, the inside of the casing or bore shall be free from any foreign matter.

e) Concrete shall be so placed as to fill the entire volume of the casing or bore without the formation of voids caused by faulty consolidation or entrapped air. The column of concrete placed shall be observed in the case of a few piles initially cast and the average figure obtained shall be used to check whether there is undue deviation in the column of the concrete placed for the subsequent piles.

f) When concrete has to be placed through water, it shall be done with necessary precautions with specific approval of the ENGINEER. The most reliable results in concreting underwater in a confined space, followed by early withdrawal of the protective casing, are obtained when the slump of the concrete being deposited is controlled within the limits of between 3 to 4 inches (75 & 100 mm) for a standard slump cone. The mix proportions shall specially have to be designed by the CONTRACTOR for this slump.

g) The concrete shall be placed by means of a skip lowered and raised inside the reinforcement cage by means of a crane, or other appropriate mechanical means. The outer dimensions of the skip shall be such that it can be freely lowered and raised inside the reinforcement cage and the

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manner of lowering and raising it shall be so controlled that the reinforcement cage is not distorted or displaced in the course of concreting.

The bottom of the skip shall be of a conical or appropriate pyramidal shape to enable it to easily penetrate into the previously deposited concrete by a distance of not less than 12 inches (300 mm) and it shall be fitted with an automatic or manually operated device for opening the discharge trap when the skip has achieved that penetration. To ensure the satisfactory placing of concrete in this manner, the skip should be allowed to accelerate or even to drop freely near the bottom of its course whereas the withdrawal of the skip should be gradual in order to ensure that all the concrete in the skip is in fact deposited well below the level of the fresh concrete in the casing.

The success of this method of concreting requires an experienced and conscientious skip operator as well as competent Engineering supervision and the ENGINEER shall satisfy himself on these points before allowing the CONTRACTOR to proceed with this work.

h) Concrete shall be placed in sufficient quantity to ensure that during withdrawal of the casing a sufficient head of concrete is maintained to prevent the inflow of soil and water.

i) The rate of placing concrete shall be such that the casing is filled with concrete at a rate of not less than 30 ft (9 meters) per hour and not more than 50 ft (15 meters) per hour.

j) With the method of placing described above and especially using a concrete with a slump of 3 to 4 inches (75 to 100 mm), no compaction other than the impact of the skip is necessary and none shall be allowed because of the danger of mixing.

k) Concreting shall continue until the concrete has reached an elevation 3 ft (900 mm) higher than the soffit of the pile cap as marked on the drawings.

3.10 WITHDRAWAL OF TEMPORARY CASING

The withdrawal of the temporary casing is a critical operation affecting the soundness of bored cast-in-place reinforced concrete piles. Two conditions are essential for the success of this operation:

Firstly, the direction of withdrawal must be in the strictest alignment with the actual direction of the casing in the ground.

Secondly, the timing of the withdrawal and the method used for the withdrawal of the casing must be such as not to disturb the freshly cast concrete in the piles.

Irrespective of the method used, the technically satisfactory withdrawal of the casing requires adequate equipment, an experienced and conscientious operator and competent Engineering supervision, and the CONTRACTOR shall not be allowed to proceed with this work until the ENGINEER is satisfied with the adequacy of the CONTRACTOR's equipment and with the proficiency of his personnel. The most usual cause of unsatisfactory performance is that the CONTRACTOR's equipment might prove to be insufficiently powerful to achieve withdrawal of the casing by steady pull so that the CONTRACTOR is faced with the choice of either abandoning the casing in the bore hole or attempting to withdraw it by jerking. Jerky withdrawal of the casing, particularly if delayed by breakdowns or mishaps, disturbs the freshly deposited concrete and may grossly impair the strength of the pile. It is consequently expressly stipulated that the CONTRACTOR shall not be allowed to proceed with this work until the ENGINEER is satisfied that all his equipment, including all component parts thereof such as tripods, pulleys, blocks, ropes, hooks, winches and all other sundries, are sufficiently powerful and sturdy to ensure the satisfactory progress of this work without mishaps and difficulties.

3.11 PILE TOPS

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It has been stipulated that the level of the concrete in the piles at the end of the concreting operations must be not less than 3 ft (900 mm) higher than the soffit elevation of the pile cap as marked on the drawings. The concrete in the topmost portion of bored or drilled cast-in-place reinforced concrete piles is never fully satisfactory. The top portions of the piles shall be inspected by the ENGINEER and the CONTRACTOR shall then break back the concrete in the top portion of the piles to final elevation of the top of the piles which is 6 inches (150 mm) above the soffit of the future pile cap, while also exposing the length of pile reinforcement required for lapping and bond within the pile cap. The CONTRACTOR shall check and record the actual findings of the broken-off tops of piles against previously established benchmarks. The tolerance for this final elevation shall be as shown on the drawings.

The CONTRACTOR shall also establish and record the actual coordinates of the centers of the broken-off pile tops with respect to the theoretical center lines of each pile cap as shown on the drawings, and the tolerance in this respect shall not exceed two inches (50 mm) in any direction as stipulated herein before.

The unsatisfactory concrete in the top portions of some or all piles may extend further down than the final elevation of the tops of the piles. In that event the CONTRACTOR shall break back such greater lengths of such piles as may be ordered by the ENGINEER and shall build up such piles to the final elevations required by means of reinforced concrete pedestals with dimensions as required. Should defective concrete or other defects extend to a depth endangering the load bearing capacity of the pile, the ENGINEER may order such further remedial measures as he may see fit, including the provision of additional piles, which may also require extension of the pile caps, all of which shall be at the CONTRACTOR's expense.

It is brought to the notice of the CONTRACTOR that payment for all piling work shall be only as stipulated in the Schedule of Quantities, that is to say, the CONTRACTOR shall be paid only for the actual length of piles in place measured from the soffit of the pile caps and that no payment shall be made either for the demolished upper portions of piles as described above or for any reconstruction, substitution, extension or other extras, wastages or spillage which the CONTRACTOR may incur in executing the work to the complete satisfaction of the ENGINEER.

3.12 LOAD TEST

In general, the load test shall be carried out in accordance with ASTM D 1143 - Standard Test Methods for Deep Foundations under Static Axial Compressive Load.

The load test stipulated herein is intended for the purpose of proving in the field that the penetration of piles is adequate to obtain an ultimate load bearing capacity of the piles of not less than twice the design value. A secondary objective of this pile loading test is to establish whether any significant pile settlements are likely to occur up to the design load values. Load tests may be carried out on index piles and/or on working piles for proof testing.

It is the Contractor's responsibility to employ and compensate a specialized testing firm.

Prior to the acceptance of final pile design and installation of any working piles, the CONTRACTOR shall be required to install index piles and carry out ultimate load tests to obtain the necessary information to confirm the design. All index test piles shall be instrumented. An instrumentation programme to measure the transfer of load from the pile shaft and pile top to the soil is to be proposed by the CONTRACTOR for the approval of the ENGINEER. The test load of an ultimate load test for bored cast-in-place piles shall be three times the designed working load of the pile. It shall be carried out in at least two cycles, the first cycle being to two times the designed working load.

The ultimate compressive or tensile load test pile, to be installed separately from the working piles and in a position selected by the ENGINEER, shall be of the same material and dimensions as the working piles.

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Test Type	Standard
Sonic Integrity Test (SIT)	ASTM D5882
High-Strain Dynamic Test (PDA)	ASTM D4945
Static Compression Load Test	ASTM D1143
Pile Position Survey	Engineering survey

3.12A SCHEDULE OF LOAD TESTS

The CONTRACTOR shall carry out the following minimum programme of pile testing. The quantities stated are minima and shall be read together with the Schedule of Quantities. The ENGINEER may order additional tests where results are inconclusive or where boring records indicate variable strata, and such additional tests shall be valued at the rates tendered for the corresponding test type.

Ref.	Test	Standard	Pile Group	Test Load	Nos.
T1	Initial (ultimate) vertical compression load test on sacrificial pile	ASTM D1143	ATCT-F1	378 tons (3.0 × working load)	1
T2	Initial (ultimate) vertical compression load test on sacrificial pile	ASTM D1143	ATCT-F2, ATCT-F3, ATCT-F4, FS-F1, FS-F2	228 tons (3.0 × working load)	1
T3	Routine (proof) vertical compression load test on working pile	ASTM D1143	ATCT-F1	189 tons (1.5 × working load)	1
T4	Routine (proof) vertical compression load test on working pile	ASTM D1143	ATCT-F2, ATCT-F3, ATCT-F4, FS-F1, FS-F2 — one test per type	114 tons (1.5 × working load)	5
T5	Lateral load test on working pile, applied cyclically	ASTM D3966	ATCT	10% of working load	1
T6	Tension (uplift) load test on working pile	ASTM D3689	ATCT	1.5 × design uplift load	1
T7	Low-strain pile integrity test (PIT)	ASTM D5882	All working piles (100%)	—	142
T8	Crosshole sonic logging (CSL)	ASTM D6760	10% of working piles plus both initial test piles	—	17
T9	High-strain dynamic pile test (PDA) with CAPWAP analysis	ASTM D4945	Distributed across pile types as directed by the Engineer	—	4

3.12B SEQUENCE AND CONDITIONS OF TESTING

A. Initial test piles (T1 and T2) shall be sacrificial piles installed separately from the working piles at positions selected by the ENGINEER, of the same material, diameter, reinforcement and installation method as the working piles. They shall form no part of the permanent works and shall be measured separately in the Schedule of Quantities.

B. Both initial load tests shall be completed and the test reports approved in writing by the ENGINEER before the CONTRACTOR commences installation of any working pile. No claim for delay arising from this requirement shall be entertained.

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C. The reaction system for the initial tests shall be an anchor-pile reaction frame. Kentledge shall not be used for test loads exceeding 200 tons. The CONTRACTOR shall submit full details of the proposed reaction system, including anchor pile design and frame calculations certified by a Professional Engineer, for the ENGINEER's approval prior to testing.

D. Reaction piles for the routine, lateral and tension tests (T3 to T6) shall be working piles. Reaction members shall be located at a clear distance of not less than three times the pile diameter, and in no case less than 3.0 m, from the test pile.

E. Not less than twenty-one (21) days shall elapse between completion of all concreting operations on any test pile and the application of test load, in accordance with Clause 3.14.

F. Load testing shall not be carried out when the ambient air temperature is below −5°C, nor during periods of snowfall or when snow or ice is present at the test station. Where testing extends into the winter period, the CONTRACTOR shall provide enclosure and heating to maintain instrumentation within its calibrated operating range, and shall protect reference beams and datum benchmarks against frost heave. All costs of such provision shall be deemed included in the rates.

G. Access tubes for crosshole sonic logging (T8) shall be four nos. steel tubes of 50 mm internal diameter per pile, installed to the full pile length, secured to the inner face of the reinforcement cage at equal spacing, capped and filled with clean water. Tubes shall be installed in all piles nominated for CSL and in both initial test piles, and the CONTRACTOR shall nominate the piles for the ENGINEER's approval before cage assembly.

H. The tension test (T6) shall be carried out only where net uplift is indicated at the tower core under the governing load combination. The ENGINEER shall confirm the design uplift value in writing before the test is programmed.

I. Where any test result fails to satisfy the acceptance criteria of Clause 3.18, the CONTRACTOR shall carry out such additional testing, remedial work or provision of additional piles as the ENGINEER may direct, entirely at the CONTRACTOR's expense.

3.13 LOCATION OF TEST PILE

The location of the test pile shall be provided by the Engineer.

3.14 TIME OF TESTING

Not less than 21 (twenty-one) days shall elapse between the end of all concreting operations on the test pile and the application of any test loads.

3.15 METHODS OF LOADING

The purpose of the load test is not only to determine the ultimate load bearing capacity of the pile but also to obtain information on settlement and other aspects of the behavior of the pile which may lead to an adjustment of the penetration specified for the permanent piles in the foundations.

The apparatus and methods for the application of test load must be capable of applying known vertical loads to the top of the test pile without inducing any horizontal thrust, twist or movement in the pile. Full details of the proposed apparatus and methods shall be submitted by the CONTRACTOR to the ENGINEER for his prior approval.

The suggested method of applying loads for axial compression load tests is by jacking against a box or platform resting on cribbing constructed over the top of the pile and loaded with suitable kentledge with a total weight of not less than twice the design value.

The suggested methods of applying loads for axial tension load tests are cantilever pulling method or fulcrum pulling method using calibrated jacks or crane and pressure dial or platform load.

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The hydraulic jack should be able to maintain each increment of desired load constant under increasing settlement (for axial tension load tests, settlement means uplift of pile). The jack and the gauge for the jack should be calibrated as a unit not more than two weeks prior to the test and should represent actual loads with an accuracy of ±2 percent. Loading apparatus and methods requiring anchored reaction members shall be located at a sufficient distance from the test pile so as not to affect the results of the tests nor to interfere with any of the permanent works.

The load should be applied to the pile in cumulative, equal increments of 50, 75, 100, 125, 150, 175 & 200 percent of the proposed working load. If the CONTRACTOR possesses equipment or kentledge required for higher loads and the ENGINEER instructs so, further loading increments should be added until failure (as measured by a rapid progressive increase in settlement) occurs.

After completion of the loading cycle the load should be removed and the rebound recorded until there is no further measurable settlement. Measurable settlement shall mean a settlement of 0.001 ft (0.3 mm).

Increments of load less than the proposed working load should remain in place for a period of not less than 1 hour. The proposed working load, and each increment thereafter, should remain in place until there is no measurable settlement in a 2-hour period. The total test load shall remain in place until no measurable settlement occurs in a 2-hour period, but in any case not less than 48 hours.

3.16 OBSERVATION OF SETTLEMENT

The method and apparatus used for the observation and measurement of settlements shall be proposed and supplied by the CONTRACTOR and shall be subject to the ENGINEER's approval. Settlement shall be measured with reference to a steel bolt set in the top of the pile for this purpose. Readings to 0.001 ft (0.3 mm) accuracy should be obtained. During daylight hours three readings shall be taken for each observation. During night hours adequate artificial lighting shall be provided and six readings shall be taken. The settlement values used in plotting the curves specified below shall be the mean value of the readings taken for each observation.

Under each load increment, settlement observations should be made and recorded at 1/2, 1, 2 & 4 minutes and at each 4 minutes thereafter after application of load increment, except in the instance of the total load when after the 4-minute reading, the time interval should be successively doubled until the final settlement limitation is reached and the load is removed. The rebound shall be recorded after each decrement is removed, and the final rebound shall be recorded 24 hours after the entire test load has been removed.

3.17 LOAD TEST REPORT

A load test report shall be submitted by the CONTRACTOR in triplicate and shall contain the following information:

A. The location of the test pile with reference to previously established monuments or other permanent features, drawn in plan to a suitable scale.

B. A bore hole log showing reduced levels of the existing ground levels of the top of the pile, and of the ground water table, and showing also the thickness and reduced levels of various soil strata encountered during boring as well as their visual classification.

C. A detailed test report for the instrumented index piles load test shall be submitted. The test report shall reflect, but not be limited to, the stress/strain relationship of the piles with the surrounding soil, the pile unit skin friction at ultimate load as well as the unit end bearing at ultimate load.

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D. A time-load-settlement graph plotting the time in hours on the horizontal axis, the loads in tons and the recorded settlements in 0.001 ft (0.3 mm) being plotted to a suitable scale on the vertical axis respectively above and below the common time axis.

E. A load-settlement graph with the load in tons plotted on the horizontal axis; and the corresponding settlement in 0.001 ft (0.3 mm) plotted downwards on the vertical axis; all to a suitable scale and annotated with time-critical or otherwise important load values.

F. A report giving a general description of the pile and the load, and copies of the load test log in tabular form with annotations of loads and settlements and time and remarks concerning any unusual or noteworthy occurrence during the testing operation.

3.18 DETERMINATION OF PILE WORKING LOAD FROM TEST RESULTS

The maximum allowable working pile load determined from these load tests shall be taken as the least of the following four values:

i. One half of the load that causes a gross settlement of 3% of pile diameter provided that the load-settlement curve shows no sign of failure within this range.

ii. One half of the load causing a net settlement of 1-1/2% of pile diameter.

iii. One half of the load at the intersection of the tangent lines to the general slopes of the upper and lower portion of the load settlement curve.

iv. Observe the point at which the gross settlement begins to exceed 0.05 in. (1.25 mm) per ton of additional load or at which the net settlement begins to exceed 0.03 in. (0.75 mm) per ton of additional load, and divide by 2. This net settlement is defined as the total settlement under load minus recovery or rebound of the pile after the load is removed.

3.19 NON-DESTRUCTIVE TEST USING LOW STRAIN PILE INTEGRITY TESTING (PIT)

A. General Remarks: Pile Integrity Testing (PIT) is a Non-Destructive integrity test method for foundation piles. It is a "Low Strain" Method (since it requires the impact of only a small hand-held hammer). The evaluation of PIT records is conducted either according to the Pulse-Echo (or Sonic Echo - a time domain analysis) or the Transient Response (frequency domain analysis) Procedure.

B. Description of Method: Low Strain integrity testing may be applied to any concreted pile (e.g., concrete piles, drilled shafts, auger cast piles, concrete filled pipe piles). The test requires the impact of a small hand-held hammer on the shaft top and the measurement of the shaft top motion (acceleration or velocity). The input compression wave from the hammer is reflected from pile toe (or a defect) and returns to the pile top at a time related to the speed of travel of the wave in the pile material.

The pile top velocity is displayed as a function of time with an exponential increasing magnitude where high soil friction forces are present, such that the pile toe reflection is enhanced. Several records with consistent signals are averaged. The averaged, amplified velocity is the standard result of the Pulse-Echo Method. The force as a function of time may also be depicted. The Transient Response Method results in the ratio of transforms for all relevant frequencies. Testing procedures shall conform to ASTM D5882.

C. Test Equipment: The test should be performed using digital data acquisition equipment. The signal conditioning and power supply must have very high signal-to-noise ratios. The analog to digital resolution shall be at least 16 bits, and the sampling frequency at least 40,000 Hz. Data should be stored such that additional processing or further wave analysis is possible.

D. Test Personnel: The field testing shall be performed by an experienced technician with at least one year's experience in integrity testing and shall be submitted to the approval of the ENGINEER.

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The interpretation of the records requires extensive experience by a graduated engineer with at least three years experience in integrity testing.

E. Test Preparation: For cast-in-place piles, integrity testing shall not be performed until the concrete has cured for a minimum of seven (7) days unless otherwise approved by the Engineer. The pile head shall be free from water, dirt or other debris. The concrete at the pile top surface must be relatively smooth with sufficient space for both attachment of the motion-sensing device and hammer impact area. 100% of all piles shall be integrity tested. The location of piles designated for integrity testing shall be specified by the Engineer after pile installation.

F. Result Presentation: The testing engineer shall present a report within 10 working days after performing the field test to provide the initial results and identification/evaluation. For each pile tested, the averaged, amplified velocity versus time record shall be included in the report, with a table summarizing results and conclusions.

G. Acceptance and Rejection: Shafts with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted. Where no clear toe reflection is apparent, the experienced test engineer shall state to which shaft depth the test appears to be conclusive. Where reflections from locations with significant reductions above the pile toe are observed, the pile has a serious defect. If the record is complex, the results may be deemed inconclusive. The decision to reject and replace, or repair, any defective shaft is at the sole responsibility of the Engineer-of-Record for the foundation.

H. Remedial Action: Rejected or questionable piles may be replaced. Questionable piles may also be subjected to further testing, e.g., static load testing, dynamic load testing, core drilling, ultrasonic logging, etc. Remedial action may include pressure grouting through core holes. If the pile top appears questionable, further pile top cut-off and retesting may be advisable. Any cost incurred for remedial action resulting from CONTRACTOR's error in surveying, improper installation, or inadequacy of load testing shall be borne by the CONTRACTOR.

3.20 NON-DESTRUCTIVE TEST USING HIGH-STRAIN DYNAMIC PILE TESTING (PDA)

A. Description: High-strain dynamic testing is performed by obtaining and analyzing records of shaft force and velocity under drop weight impacts for evaluations of shaft load carrying capacity, structural integrity, and load-movement and shaft-soil load transfer relationships. Testing procedures shall conform to ASTM D4945 unless otherwise noted.

B. Equipment: The Contractor shall supply all materials and equipment required to prepare the test shaft, dynamically load the shaft, and return the shaft to a condition suitable for use in the finished structure. Equipment includes: shaft top extension (if permanent casing not used), means to ensure flat and level shaft top, drop weight (1-2% of anticipated pile capacity), guide for variable drop heights (3-7 ft), shaft top cushion of plywood (2-6 inches thick), steel striker plate (minimum 2 inches thick), power supply, surveyor's transit, etc.

C. Dynamic Testing Firm: It is the Contractor's responsibility to employ and compensate a specialized testing firm. Testing is to be performed by an independent testing specialist from a firm with a minimum of five (5) years experience in dynamic shaft load testing. The actual test shall be conducted and/or supervised by a Licensed Professional Engineer with at least two (2) years of dynamic testing or who has achieved Basic Level or better on the Foundation QA Examination for Providers of PDA Testing Services. Selection of the firm must be acceptable to the Engineer.

The independent dynamic testing firm must supply: Pile Driving Analyzer (PDA), four calibrated strain transducers, four calibrated accelerometers. Prior to testing, the Professional Engineer must perform wave equation analyses (using GRLWEAP or equivalent) to determine the suitability of the proposed dynamic loading equipment and acceptable range of ram drop heights.

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D. Procedure: (Summary) Construct test shaft using approved techniques. Provide test area (two shaft diameters length) cased if necessary. Make shaft test area accessible. Cut windows for gage attachment if casing present. Attach gages. Apply plywood cushion and striker plate. Apply at least two hammer impacts, starting with minimal drop height. Upon completion, return pile to acceptable production condition.

E. Reporting of Results: The Professional Engineer shall submit a timely report including field results and at least one CAPWAP analysis. CAPWAP analyses shall be performed by an engineer that has achieved Advanced Level or better on the Foundation QA Examination for Providers of PDA Testing Services. The report must include Wave Equation analysis results, CAPWAP analysis results, measured force, transferred energy, stress, Case Method bearing capacity, and assessment of pile capacity and integrity.

3.21 POWER OF THE ENGINEER

Should the ENGINEER have any reason to doubt the rigorous accuracy and complete reliability of the pile loading test, he may, at his sole discretion and without recourse, reject all the results obtained on the test pile and order the CONTRACTOR to carry out new tests on a new test pile, and the CONTRACTOR shall do so at his own expense without claiming any additional remuneration.

3.22 METHODS OF MEASUREMENTS OF PILING WORKS:

a) General Measurement Rules

Works shall be measured net the fixed in position as per Drawings and instruction of the ENGINEER. Each measurement shall be taken to the nearest 1/2" (12 mm). This rule shall not apply to any dimensions stated in descriptions.

b) Piling Equipment

Unless otherwise specifically stated in the bill of quantities, or herein, the item of allowing for all piling equipment shall be deemed to be inclusive of, but not limited to the following:

Bringing to SITE frames, rigs and all associated equipment for piling. Erecting and setting up frames, rigs and associated equipment for piling and moving to first pile position. Removing from last pile position, dismantling and removing from SITE all piling frames, rigs and associated equipment. Bringing all necessary pile testing equipment to SITE for carrying out the test specified, erecting and assembling as required, and subsequent dismantling and removal from SITE. Temporary ramps, accesses and hard standings, staging, SITE leveling or preparation and all clearance away after completion of piling and testing. All standing time between pile load tests.

c) Bore Hole Measurement

Executing the bore holes for piles shall be measured in linear feet (meter) for the actual length of bore holes measured from the commencing ground surface.

The item shall include, but not to limited to, the following:

Formation of complete bore hole for pile, the provision of all materials for casings, linings and all labor to achieve the complete bore hole.

Overcoming any obstructions (including old foundations) encountered.

Keeping bore holes free from water. Any measures necessary for the satisfactory placing and compaction of concrete below water table. Temporary back-filling of empty bore if so required, and later removal of back-filling. All costs incurred in moving plant from pile position to pile position and

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for its installation to commence work. All costs incurred in traveling time from pile group to pile group etc. No extras will be considered if the setting out of the works is such as to prevent uniform working on pile groups or clusters or if it necessitates moving on and returning later to complete the work. All standing time. Disposal of all surplus material arising to areas of fill or to CONTRACTOR's tip off SITE. Provision where applicable for the inspection of the bore hole or casing including all safety measures and apparatus. Provision of boring records as required.

d) Concrete Measurement

i) Concrete for the piles shall be measured in cubic feet for the specified nominal diameter of piles and the actual length of piles in place measured from the soffit of the pile caps. No payment shall be made either for the demolished upper portions of piles, as described in these Specifications, or for any reconstruction, substitution, extension or other extras, wastages or spillage's which the CONTRACTOR may incur in executing the work to the complete satisfaction of the ENGINEER.

ii) Unless otherwise specifically stated in the bill of quantities, or herein, all items for concrete for piles shall be deemed to be inclusive of, but not limited to the items detailed in specifications Section 0150 - Concrete Works.

e) Reinforcement Measurement

i) Unless otherwise specifically stated in the bill of quantities or herein, all items of reinforcement shall be deemed to be inclusive of, but not limited to, the items detailed in specifications Section 0150 - Concrete Works.

ii) Reinforcement shall be classified and measured as detailed in specifications Section 0150 - Concrete Works.

f) Pile Completion

The item of completing the piles shall be lump sum for each pile. The item shall include, but not be limited to, the following:

Cutting pile tops to expose sound concrete and cleaning away debris, bending reinforcement to position for casting into pile-cap, base or slab.

Any reconstruction, substitution, extension or other extras, wastages, or spillage not covered under these specifications.

g) Load Test Measurement

Load tests shall be measured by enumeration, separately for each test type and test load stated in the Schedule of Quantities, and shall be deemed to include: provision of the test pile where sacrificial; provision of reaction piles, anchors, frames, beams, kentledge and all temporary works; supply, installation, calibration and removal of all jacks, gauges, transducers, dial gauges, reference beams and datum benchmarks; installation of instrumentation for strain and load transfer measurement on initial test piles; supply and installation of crosshole sonic logging access tubes; all loading, unloading, holding and observation periods including standing time; enclosure, heating and weather protection; interpretation; and submission of test reports in triplicate in accordance with Clause 3.17.

No separate payment shall be made for tests repeated as a consequence of unsatisfactory results, defective piles, or rejection of results by the ENGINEER under Clause 3.21.

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SECTION 0200 - BRICK MASONRY

1.0. SCOPE

The work under this section consists of furnishing all plant, labour, equipment, appliances, materials and in performing all operations in connection with supplying and constructing brick masonry, complete in strict accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the Contract. The scope of this section of specification is covered with detailed specification as laid down herein.

2.0 APPLICABLE CODES AND STANDARDS

Latest editions of the following ACI codes and ASTM Standards referred to herein, are applicable to these Specifications.

ACI Codes

ACI 530 Building Code Requirements for Masonry Structures

ACI 530.1 Specifications for Masonry Structures

ASTM Standards

ASTM C 62 Building Bricks (Solid Masonry units made from clay or shale)

ASTM C 207 Specification for Hydrated Lime for Masonry purpose

ASTM C 216 Facing Bricks (Solid Masonry units made from clay or shale)

ASTM C 67 Sampling and Testing Bricks

ASTM C 270 Mortar for Unit Masonry

ASTM A 615 Deformed and plain billet bars for concrete reinforcement

3.0 SUBMITTALS

3.1 Manufacturer's Data

Submit two copies of the manufacturer's specifications and other data for each type of brick and accessory required. Instructions shall be included for handling, storage, installation, and protection of units and accessories.

3.2 Samples

Submit three samples of each type of brick and accuracy required, also samples of the full range of exposed texture to be used in the completed work.

3.3 Test Reports

Reports on compressive strengths of brick and mortar; and tensile tests of reinforcing steel.

3.4 Certificate of Compliance

For Cement. Reinforcing Steel.

4.0 MATERIALS

4.1 Cement & Aggregates

Portland cement shall conform to the requirements of ASTM C 150 Type-1 or BS-12 (low alkali) also refer Section 0150.

White cement shall conform to BS-12 for pigmented mortar.

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All aggregates for mortars shall conform to the requirements of ASTM C 144.

All water used in the manufacture of bricks and in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities. The water shall be tested in accordance with ASTM D 596, where directed by the Engineer.

4.2 Plain & Coloured Mortars

Mortar shall meet the requirements of ASTM C 270. Mortar shall be type S having a minimum compressive strength of 12.4 MPa.

Proportioning of mortar shall be in accordance with the requirements of ASTM C-270. For all types of brick work the proportion of mortar shall not be less than 1 part of type-1 cement, 1/2 part of hydrated lime, to 3 parts of sand or as approved by the Engineer.

For Facing brick use coloured mortar as shown on the drawings. The colour of mortar shall match with the colour of bricks as close as possible and as approved by the Engineer. The proportion of mortar shall not be less than 1 part of white cement, 1/2 part of hydrated lime, to 3 parts of sand or as approved by the Engineer. The colour pigments manufactured by Bayerrox or approved equivalent shall be used.

Methods and equipment used for mixing mortars will be such which will accurately determine and control the amount of each separate ingredient entering into the mortar. Mortar shall be mixed only in sufficient quantities for immediate use and shall be used within 30 minutes after mixing. Stiffened mortars shall be re-tempered by adding water to restore the required consistency. Mortars not used within 2-1/2 hours after initial mixing shall be discarded. The mixers shall be thoroughly cleaned and washed at the end of each day's work.

4.3 Bricks

All bricks shall be first class type and of best quality, conforming to the requirements of ASTM C 62. Size of bricks should be 228 x 144 x 75mm (9 x 4.5 x 3 inches). Contractor shall submit samples of facing and building bricks for approval prior to commencement of work. Defective bricks shall not be used. For Facing bricks, the variation in colour shall be as little as possible and as per approval of Engineer. Bricks shall be selected from the best Bhattas (Kilns) situated in the vicinity of Skardu.

Building bricks shall conform to ASTM C 62, grade MW. Minimum compressive strength of average of 5 bricks is 2500 psi and not less than 2200 psi of individual brick. Maximum water absorption by immersing an oven dry sample in cold water for two hour shall not absorb more than 1/5th of the weight of brick.

Facing bricks shall conform to ASTM C 216, grade MW. Minimum compressive strength of average of 5 bricks is 2500 psi and not less than 2200 psi of individual brick. Maximum water absorption by immersing an oven dry sample in cold water for two hour shall not absorb more than 1/6th of the weight of brick.

4.4 Other Materials

All materials specified hereunder shall be manufactured by either Schomburg, Ressichem, BASF or Patsa.

4.4.1 Salt Neutralizing Solution

Hexafluorosilicate a salt neutralizing solution, to wash brick walls prior to application of cement plaster, waterproof coating, or a water repellant coating.

4.4.2 Non-Staining Water Repellent Coating

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Deep penetrating polysiloxanes base water repellent coating for application on the Facing brick masonry walls.

4.4.3 Water Proofing within the Cavity Walls

Polymer modified cement-based waterproof slurry to form an impervious rigid coating Aquafin-1K of Schomburg or equivalent as specified, applied as first coat.

Polymer modified cement based waterproof slurry to form an impervious flexible coating Aquafin-2C of Schomburg or equivalent as specified, applied as second coat

4.4.4 Joint Sealant

Single component polyurethane joint sealant at flexible joints of the masonry walls as shown in drawings.

4.4.5 Fireproof Coating

Spray Applied Fire Resistive Material (SFRM) ISOLATEK Type 400 or equivalent for application on sealants to protect it from fire.

4.4.6 Stainless Steel Grade 304, Z - Type and Finish Tail Anchors

Anchors shall be fixed within the cavity walls as shown in drawings.

4.4.7 Reinforcement

Reinforcement bars shall be embedded at joints and corners as shown on drawings and material shall follow the relevant section of these specifications.

5.0 PLACING

The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor delay the use of mixed mortar. Bricks shall not be placed during heavy rains to washing away the mortar from the brick. Mortar already spread which becomes diluted by rain shall be discarded and replaced before continuing with work. All bricks to be used in brick masonry shall be soaked in water for three to four hours before they are used to ensure that each brick is thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

Bricks shall be laid "frog" upward (except for lining in drain) with mortar joints and in stretcher bond or as approved by the Engineer. Both bed and vertical joints shall be 8 to 10mm thick in building bricks and 6 to 8mm in facing bricks as shown in the drawings and completely filled with mortar as specified herein. Each brick shall be bedded by firmly tapping with the handle of trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight and flash racked. Weep holes in the cavity walls shall be made as per drawings. Construction debris within the cavity walls shall be removed to keep the cavity thoroughly clean after masonry work has been completed.

Work required to be embedded in the brick masonry should be installed as the work progresses. At the completion of the work, holes or defective mortar joints shall be cut out and re-pointed.

5.1 Pointing for Building Bricks

Bricks shall be laid true to line, level and plump. All joints shall be perfectly straight, parallel and sharp. Brick of irregular shape, size, damaged and defective edges and faces shall be rejected outright. Works done with defective edges and faces shall be rejected and the Contractor shall replace, without additional cost, all defective and unacceptable works.

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Exterior faces of the walls shall be finished by striking the joints as the work proceeds. Tooling shall be done when the mortar is partially set but still sufficiently plastic. The joints shall be struck by raking the green mortar after the brick work has been laid. Finish the joints with a pointing tool. Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints. No pointing is required for the building bricks.

5.2 Pointing for Facing Bricks

To form horizontal and vertical joints in the facing bricks, remove carefully the already cement mortar while it is still green, to a depth of nearly one inch from the face of the brick. Clean the space thoroughly. After the curing period has elapsed, fill the space with colour mortar by compressing and packing into the joint space, and strike with a specially developed tool to form the keyed joints, concave rounded as shown in the drawings and as approved by the Engineer. Contractor shall ensure that the finished concave pointing is in perfect shape, is free of cracks and blemishes. Curing of the freshly laid coloured mortar shall proceed as specified.

6.0 WATERPROOF COATINGS & JOINT SEALANT

6.1 Neutralizing Solution

All brick walls shall be washed with hexafluorosilicate salt neutralizing solution prior to application of cement plaster or a waterproof or water repellant coatings.

6.2 Waterproof Coating within Cavity Walls

Waterproof Coatings shall be applied on internal one side of the cavity wall as shown. Apply first coat with a polymer modified cement based waterproof slurry to form an impervious rigid layer applied @ 1.5 kg per square meter (Aquafin-1K of Schomburg or equivalent as specified) and the second coat with a flexible polymer modified cement based waterproof coating @ 1.5 kg per square meter (Aquafin-2C of Schomburg or equivalent as specified). Both the coats shall be applied in accordance with manufacturer’s recommendations.

6.3 Non-Staining Water Repellant Coating on Facing Walls

Deep penetrating polysiloxanes base water repellent coating shall be applied on the facing brick masonry walls. Prior to the application of the coating Contractor shall ensure that the efflorescence on the bricks has been cleaned thoroughly. Contractor shall allow ample time to dry off the internal moisture of bricks. Atleast 15 days’ time in summer and 30 days in winter shall be given for this purpose after completion of the brick masonry work or as approved by the Engineer.

6.4 Joint Sealant

The top of masonry wall at soffit of the beams or slabs, shall be filled with polyurethane joint sealant as per drawings and manufactured recommendations. Fireproofing coating shall be applied on Polyurethane sealants in fire zone areas.

7.0 CURING AND REPAIR

All brick masonry shall be water cured and shall be kept wet for at least seven days by an approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of the specifications for water used in the manufacture of bricks.

If, after the completion of any brick masonry work, the brick is not in alignment or level or does not conform to the lines and levels shown on the drawings, or shows a defective surface, it shall be removed and replaced by the Contractor, without additional cost to Engineer. Repairing or patching of the defective area will not be acceptable unless allowed, in writing, by the Engineer.

8.0 SCAFFOLDING

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The Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor without additional cost to the Engineer.

Damage to masonry from scaffolding or from any other cause shall be repaired by the Contractor at his own cost.

9.0 TOLERANCES

All tolerances shall be as per requirements of ACI-530.1

10.0 DAMP PROOF COURSES

All damp-proof courses unless otherwise specified shall be 2 inch thick, consisting of cement concrete having a 28-day minimum cube strength of 21 N/mm^2, mixed with approved quality water proofing compound as per manufacturer's specifications and shall be laid at required levels as per drawings and instructions of the Engineer. The damp proof course shall be tamped, consolidated, leveled and edges and corners made to the requirements of the relevant drawings including finishing and curing complete.

11.0 CLEANING AND PROTECTION

At the completion of the work, all holes, and defective mortar joints shall be cut and repointed. Exposed masonry shall be protected against staining or other damage, and excess mortar shall be cleared off the surfaces as the work progresses. All exposed masonry shall be clean, smooth, fine and shall be of acceptable finish approved by the Engineer.

12.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

SECTION 0210 - FURNITURE, PLANTERS, TELEPHONE HOODS, DISPOSAL UNITS, ASHTRAYS, BUMPER RAIL, AND COUNTERS

1. SCOPE

The work under this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with supply and installation of furniture, planner, telephone hoods, disposal units, ashtrays, bumper-rail and counters in accordance with this section of specifications, the applicable drawings and subject to terms and conditions of the Contract.

2. APPLICABLE CODE & STANDARDS

The Code & standards applicable to the works specified in this section are using the code NFPA 101, NFPA 260, NFPA 261, ASTM E1537 and PBS-P100 (Facilities Standards for the Public Buildings Service).

3. SUBMITTALS

The following submittals are required:

A. Manufacturer's catalog or manual

B. Product Data: Manufacturer's data sheets for each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.

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3. Installation methods.

C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections and relationship with adjacent construction.

D. Verification Samples: For each finish product specified, two samples, representing actual product and finish.

E. Mock-up: Submit a mock-up for evaluation of finish quality check.

4. QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years experience manufacturing similar products.

B. Installer Qualifications: Minimum 2 years experience installing similar products.

5. FIRE HAZARD CLASSIFICATION

Provide material which will meet the requirement of fire resistance and comply with applicable codes and standards.

6. FURNITURE AND EQUIPMENT

This section covers the supply, delivery, assembly and installation of all furniture and ancillary equipment for the New Air Traffic Control Tower (ATCT) and ARFF Station at Skardu International Airport, as itemised in the Bill of Quantities and described in the sub-clauses below. All items shall be of Master brand (or approved equivalent), supplied complete with all fittings, fixtures and accessories, and shall carry a minimum one (1) year manufacturer's warranty with lifetime after-sales service.

6.1 EXECUTIVE DESKS AND SIDE RACKS

Supply and installation of executive-grade office desks and side racks, complete in all respects. All units shall be of knock-down (KD) construction with imported hardware, nail-less structure, veneer or laminate finish pressed on MDF with PVC edge-banding, and powder-coated MS substructure where applicable. Colours shall be as approved by the Engineer.

6.1.1 Master Executive Side Rack – Model No. MO-ED-ES-19 (ARFF Office – Mezzanine Floor)

- Table Size: L 4' × D 2' × H 30"; polish finish veneer pressed on substrate.
- Wooden edges, inlay and CNC machining; Handles and Knobs in Antique Brass finish.
- Leatherette padding on top surface; drawer unit with three drawers having noiseless sliding channels and soft-close mechanism.
- Imported KD fittings; colours customisable in available shades.

6.1.2 Master Study Desk – Model No. MO-MD-BS-08 (Male Dormitory – Mezzanine Floor)

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- Table Size: L 4’ × D 2’; laminate finish pressed on MDF; PVC edge banding.
- Nail-less, easy-to-dismantle, MS powder-coated structure; sheet thickness 1 inch; imported KD fittings.

6.1.3 Master Manager Desk – Model No. MO-MD-BS-12 KENDAL (PAA Offices – First Floor)

- Table Size: L 5’ × D 2.5’; laminate finish on MDF; PVC edge banding.
- Nail-less, MS powder-coated structure; sheet thickness 1 inch; imported KD fittings.

6.1.4 Master Office Desk – Model No. MO-MD-BS-08 (Training/Break-Out – First Floor)

- Table Size: L 4’ × D 2’; all features as clause 6.1.2 above.

6.1.5 Master Office Desk – Model No. MO-MD-BS-06 (Training/Break-Out – Second Floor)

- Table Size: L 4.5’ × D 2’; nail-less laminated structure; sheet thickness 1 inch.

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6.2 CONFERENCE TABLES

Supply and installation of executive conference tables with polish-finish veneer on MDF/wood substrate, leatherette top padding, imported KD fittings and wooden structure, in the Conference and OCC Hall (First Floor).

6.2.1 Master Conference Table – Model No. MO-MT-MS-06, Size L 22’ × D 5’ × H 30"

- Polish finish veneer pressed on MDF; wooden structure; leatherette padding on top.
- Imported KD fittings; colours customisable in available shades.

6.2.2 Master Conference Table – Model No. MO-MT-MS-06, Size L 25’ × D 5’ × H 30"

- All features as clause 6.2.1 above.

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6.3 CLUSTER WORKSTATIONS

Supply and installation of aluminium-profile cluster workstations in the Comops Room (First Floor). Each workstation shall include tackable front and side screen panels.

6.3.1 Master Aluminium Cluster Workstation (Comops Room – First Floor)

- Laminate finish as per approved theme; 2 mm PVC lipping on all edges.
- Easy to dismantle; nail-less construction; sheet thickness 1 inch.
- Front aluminium profile and MS powder-coated legs; tackable front and side screens.
- One year warranty and lifetime after-sales services.

6.4 CAFETERIA AND CAFE FURNITURE

6.4.1 Master Café Table – Model No. MO-MULLER-MT-01 (Training/Break-Out – First Floor)

- Table size: 36" Dia × H 30"; laminate finish; PVC edge banding; nail-less structure.
- Imported KD fittings with noiseless hinges; sheet thickness standard.

6.4.2 Master Cafeteria Chair (Training/Break-Out – First Floor)

- Polypropylene shell with foam seat padding; chrome structure; multi-colour options.
- Floor-protective glides; imported chair; one year warranty and after-sales services.

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6.5 EXECUTIVE AND HIGH-BACK CHAIRS (HBC)

Supply and installation of executive high-back revolving chairs featuring lockable revolving and tilting mechanism, gas-lift seat-height adjustment, and castors meeting BIFMA and DIN standards.

6.5.1 Master Executive HBC – Model No. A2916 (ARFF Office – Mezzanine Floor)

- Complete stainless steel structure; imported leatherette seat and back.
- Lockable revolving/tilting mechanism pivoted at front; extra torsion adjustment; fixed-position angle control.
- Gas-lift seat height; swivel; imported twin castor wheels meeting BIFMA and DIN standards.
- Unique curved lumbar-support shells; adjustable PU arm rests.
- Guaranteed imported foam on seat and back; Knee-Tilt Mechanism with lockable positions.

6.5.2 Master Genesis ORTHO HBC (PAA Offices – First Floor)

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- Sleek integral skin with wooden arms; ortho back-seat sheet for posture support; PP wooden armrests.
- Twin-wheel castors (BIFMA/DIN); high-frequency veneer shell compression for posture care.
- Guaranteed PU Master Molty Excel Foam of highest density; Knee-Tilt Mechanism with lockable positions.
- Colour customisable in Master fabric without extra cost.

6.6 VISITOR, RECEPTION AND TRAINING CHAIRS

6.6.1 Master Visitor Chair-01 (ARFF Office – Mezzanine Floor and PAA Offices – First Floor)

- Rosewood, Mahogany or Hard Solid Wood structure; ergonomic and aesthetic design.
- High-frequency compression on multi-layered veneer shell; faux leatherette upholstery on seat and back.
- High-density quick-recovery foam; unique curved shells for lumbar support.
- Premium MoltyFoam seat; flexibility in Master fabric or leatherette upholstery.
- One year warranty and lifetime after-sales services.

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6.6.2 Master Anatom Reception Chair (Male Dormitory Study Area, Training/Break-Out Rooms)

- Lockable revolving/tilting mechanism; sleek integral skin with PP arms; gas-lift seat height.
- Extra torsion adjustment; fixed-position angle control; twin-wheel castors with nylon base (BIFMA/DIN).
- High-frequency veneer shell compression for posture care; unique curved lumbar-support shells; PP armrests.
- Guaranteed PU Master Molty Excel Foam of highest density; Permanent Contact Mechanism with 3 lockable positions.
- Colour customisable in leatherette or Master fabric.

6.6.3 Master Mesh Mid-Back Chair – Model No. B-3018 (Conference and OCC Hall – First Floor)

- Lockable revolving/tilting mechanism; sleek integral skin with PU arms; gas-lift seat height.

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- Twin-wheel castors with nylon base (BIFMA/DIN); breathable fabricated mesh back.
- Unique curved shape with lumbar support; 4-D Polyurethane armrests; imported foam on seat.
- KT Mechanism with desired lockable positions.

6.6.4 Master Genesis Eco Low-Back Chair (Comops Room – First Floor)

- Lockable revolving/tilting mechanism; sleek integral skin with PP arms; gas-lift seat height.
- Twin-wheel castors with nylon base (BIFMA/DIN); high-frequency veneer shell compression for posture care.
- Guaranteed PU Master Molty Excel Foam; Permanent Contact Mechanism with 3 lockable positions.
- Colour customisable in leatherette or Master fabric.

6.6.5 Master Training Chair – Model No. MO-JUDY (Training/Break-Out Rooms – First and Second Floors)

- Ergonomic and aesthetic; fabricated mesh back; fabricated seat with high-density quick-recovery foam.
- MS powder-coated structure; Premium MoltyFoam seat; flexibility in Master fabric or leatherette.

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6.7 SOFA SETS

Supply and installation of sofa sets at locations shown in the BOQ and drawings. All sofas shall incorporate PU Master Molty Excel Foam of highest density (Core Density 34 Kg/m³; ball rebound resilience 32%; Tensile Strength 14.5%; Elongation 125%; Compression 3.4%). Structures shall be of spruce wood with wooden legs unless otherwise stated. Upholstery fabric or leatherette as approved by the Engineer.

6.7.1 Master Two-Seater Sofa Aspen (ARFF Office – Mezzanine Floor)

- Spruce wood structure; wooden legs; sofa cushions included; flexibility in upholstery fabric.

6.7.2 Master Single-Seater Sofa Aspen (ARFF Office – Mezzanine Floor)

- Same construction and specification as clause 6.7.1 above.

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6.7.3 Master Two-Seater Chesterfield Sofa (Lounge – Mezzanine Floor)

- Natural finish and upholstery; base in solid rosewood with natural finish.
- Clean Atlas sofa-set lines; flexibility in upholstery fabric and leatherette.

6.7.4 Master Two-Seater Sofa Augusta (PAA Offices – First Floor)

- Spruce wood structure; wooden legs; sofa cushions; flexibility in upholstery fabric.

6.7.5 Master Single-Seater Sofa Augusta (PAA Offices – First Floor)

- Same construction and specification as clause 6.7.4 above.

6.7.6 Master Three-Seater Sofa – Sof-22 (Male and Female Lounge, ATCT Floor)

- Spruce wood structure; exported quality velvet upholstery; gold accent legs.

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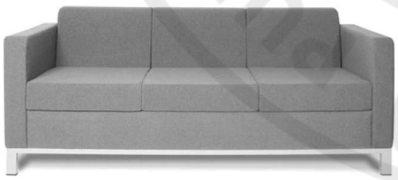
- Hand-upholstered in leatherette with slim, distinct and edgy profile.

6.7.7 Master Single-Seater Sofa – Sof-22 (Male and Female Lounge, ATCT Floor)

- Same construction and specification as clause 6.7.6 above.

6.7.8 Master Three-Seater Sofa – Sof-01 (OCC Waiting and Retrieving Room – First Floor)

- Spruce wood structure; exported quality velvet upholstery; gold accent legs.
- Hand-upholstered in leatherette with slim, distinct and edgy profile; flexibility in upholstery fabric.



6.7.9 Master Single-Seater Sofa – Sof-01 (OCC Waiting and Retrieving Room – First Floor)

- Same construction and specification as clause 6.7.8 above.

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6.8 SIDE TABLES AND CENTRE TABLES

Supply and installation of side tables and centre tables with Al-Noor MDF laminated tops, nail-less structure, 2 mm PVC lipping on all edges and standard sheet thickness.

6.8.1 Master Linea Side Table – L:559 mm × W:356 mm × H:610 mm (ARFF Office and PAA Offices)

- Déco finish on MDF; MS base with matching powder-coated finish; standard sheet thickness.

6.8.2 Master Centre Side Table – L 40" × W 40" × H 18" (Lounge – Mezzanine Floor, ATCT Floor)

- Al-Noor MDF laminated top; nail-less structure; 2 mm PVC lipping on all edges.

6.8.3 Master Sofa Side Table – L 20" × W 20" × H 18" (Lounge, Male/Female Lounge, ATCT Floor)

- Al-Noor MDF laminated top; nail-less structure; 2 mm PVC lipping on all edges.

6.8.4 Master Sofa Centre Table – L 48" × W 20" × H 18" (OCC Waiting and Retrieving Room)

- Al-Noor MDF laminated top; nail-less structure; 2 mm PVC lipping on all edges.

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6.8.5 Master Sofa Side Table – L 18" × W 18" × H 18" (OCC Waiting and Retrieving Room)

- Al-Noor MDF laminated top; nail-less structure; 2 mm PVC lipping on all edges.

6.9 LOW-HEIGHT STORAGE UNITS

6.9.1 Master Low Height Storage – Model No. MO-SLH-04 (PAA Offices – First Floor)

- Size: 72" × 15" × H 34"; laminate finish; PVC edge banding; nail-less structure.
- Imported KD fittings with noiseless hinges; standard sheet thickness.
- Colours customisable in available laminates; one year warranty and lifetime after-sales services.

6.10 DORMITORY FURNITURE

Supply and installation of dormitory furniture for Male and Female Dormitories. Quantities for First Floor dormitory furniture shall be confirmed following review of drawings by the Engineer.

6.10.1 Master Single Bed with 6" Mattress and Single Side Tables (Male Dormitory – Mezzanine Floor)

- Bed Size: L 78" × D 42"; laminate finish with velvet upholstery; easy to dismantle; imported KD fittings.
- Mattress: 78" × 42" × 6" with Molty Gold pillow; complete as per design.
- One year warranty and lifetime after-sales services.

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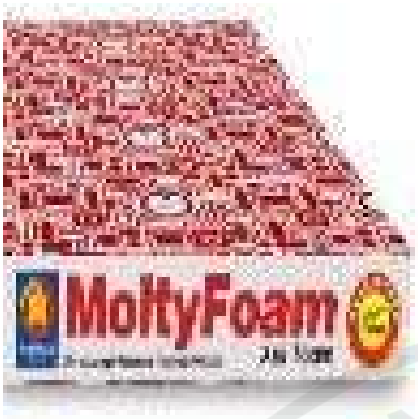

6.10.2 First Floor Male and Female Dormitory Beds and Furniture

Quantities and specifications to be confirmed by the Engineer and updated in the BOQ prior to procurement.

6.11 PRAYER AREA MATS

Supply and installation of prayer area mats at designated prayer rooms within the ATCT facility. Quality, size, pattern and quantities shall be as confirmed by the Engineer. All mats shall be of heavy-duty, durable, cleanable and fire-resistant material suitable for the intended use.

6.12 RECORD ROOM RACKS AND ALMIRAH

Supply and installation of heavy-duty steel or laminate-finish record room racks and almirahs for storage and filing of official documents. Types, sizes and quantities shall be confirmed by the Engineer and updated in the BOQ prior to procurement.

6.13 ATCT CABIN CHAIRS AND ARFF CABIN CHAIRS AND SOFAS

Supply and installation of ergonomic cabin chairs for the ATCT Operations Floor and ARFF cabin areas, including sofa seating for ARFF crew rest areas as shown on drawings. Chair types shall meet the operational ergonomic requirements of the respective areas. Specifications, quantities and approved makes shall be confirmed by the Engineer prior to procurement.

7. EXECUTION

7.1 General Inspection

Examine the areas and conditions under which the furnishings are to be installed. Do not proceed until unsatisfactory conditions have been corrected.

8. INSTALLATION

8.1 Delivery

Deliver furniture and equipment to the locations indicated and place as directed by the Engineer.

8.2 Unpacking

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Unpack and uncreate furniture & equipment and assemble & service as required for use. Vacuum or wipe clean as required. Prepare surface as recommended by the manufacturer.

All packing materials shall be carefully removed and disposed of at designated places without damage to the existing facilities.

8.3 Damage

8.3.1 Furniture: Damaged Furniture shall be repaired only when after repair furniture shall be in perfect useable condition and as approved by the Engineer. Remove damaged furniture, without any additional cost, which cannot be repaired and shall be replaced with new furniture.

8.3.2 Equipment: Replace all damaged and rejected equipment.

8.3.3 Building: Special care shall be taken to avoid damage to the walls, doors, flooring or finishes during delivery and installation of furnishings. Damaged areas shall require to be repaired, without any additional cost, to match with adjacent / surrounding materials.

8.4 Procedure

8.4.1 General: All furniture and equipment shall be fully assembled, adjusted and installed in each room as shown in drawings or as directed by the Engineer. Particular care shall be taken to align and maintain proper spacing between furniture and equipment considering operational and functionality requirement of the particular area.

8.4.2 Leveling: Floor standing units shall be leveled using built-in levelers, properly aligned to allow even installation. Suspended furniture shall be securely attached and set plumb, level and true to line.

8.4.3 Gang Bolting: Wherever two or more units or other like items are located side by side, these items shall be gang bolted together after leveling. Where specified, tops shall be secured to supports, ends and sides shall be flush.

8.4.4 Stability: Seating and other similar items shall be assembled and installed with necessary hardware to ensure stability.

8.4.5 Trim: Miscellaneous trim pieces, filler pieces, special bases, and like items shall be furnished and installed as indicated or required.

8.4.6 Adjustment: Perform necessary adjustments for proper operation.

8.5 Coordination of Telephone and Electrical Equipment

The Contractor shall coordinate with the Engineer for installation of telephone and electrical equipment at each workstation and shall provide a mounting board for telephone equipment as required.

Contractor shall run telephone cable and electrical wires through the raceways.

8.6 Accessories

a) Clearly label each carton or package with the following:

8.6.1 Project name

8.6.2 Item code number

8.6.3 Contractor

8.6.4 Manufacturer

8.6.5 Manufacturer's product designation (name, model or number)

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8.6.6 Destination (facility building)

b) Accessory packages shall be packed in one carton and delivered to location in one cartooned unit. Placed in the designated area immediately prior to acceptance of the area.

9. PROTECTION AND CLEAN-UP

9.1 Protection

All furniture and equipment items shall be protected during transportation with clear polyethylene covers not less than 0.15mm thick, which shall not be removed until completion of installation at final destination and its acceptance by the Engineer.

9.2 Clean-up

No accumulation of packaging or carting materials will be permitted. Remove debris daily. Leave areas clean and ready for use. Remove temporary protection prior to acceptance.

10. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0220 CARPENTRY, JOINERY & MILL WORK

1. SCOPE

The work covered under this section of Specifications consists of providing all material, labour, plant, equipment, appliances and performing all operations in any floor and at any height connected with the fabrication and erection of all woodwork, building carpentry, joinery & mill work, CDF partition, construction assembly, surface finish treatment and building decorative wooden feature and all cabinet type items, construction assembly, surface finish treatment and building in of all cabinet type items, supports etc. of wood or metal and incidentals, associated woodwork appurtenances, procuring and applying preservatives, installation of "Finish Hard Ware" in connection with finish woodwork as per details shown on the Drawings or as directed by the Engineer.

2. APPLICABLE STANDARDS

Latest editions of following British and ISO Standards are relevant to these specifications wherever applicable.

2.1 ISO (International Organization for Standardization)

1891 Bolts, screens, nuts and accessories- Terminology and nomenclature.

1097 Plywood - Measurement of dimensions of panels.

1098 Veneer plywood for general use- General requirements.

2427 Veneer plywood with rotary cut veneer for general use- Classification by appearance of panels with outer veneer of beech.

2429 Plywood - Veneer plywood with rotary cut veneer for general use- Classification by appearance of panels with outer veneers of brand-leaved species of tropical Africa.

3804 Plywood- Determination of dimension of test pieces.

3805 Plywood- Determination of density.

3806 Plywood- Determination of moisture content.

6442 Door leaves- Measurement of defects of general flatness.

6443 Door leaves- Measurement of dimensions and of defects of squareness.

6444 Door leaves- Test of behavior under humidity variations.

2.2 BSI (British Standards Institution)

459 Wooden doors.

1186 Quality of timber and workmanship in joinery.

1127 Hinges

1331 Builder's hardware for housing.

1567 Wood door frames and linings nails.

1202 Nails

1203 Specifications for synthetic resin adhesive for ply wood.

1204 Synthetic resin adhesives for wood.

1282 Guide to choice, use and application of wood preservatives.

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1494 Fixing accessories for building purposes.

1579 Connectors for timber.

3842 Treatment of ply wood with preservatives.

3. MATERIALS

3.1 Timber

3.1.1 Hard Wood:

Hard wood shall comprise of oak, beech, walnut mahogany, teak, iroko and sheesham.

3.1.2 Soft Wood:

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deodar (referred in the document as deodar), wood locally known as 'Partial' to be used in shutter core where specified.

3.1.3 General Characteristics:

All the timber shall be in accordance with the requirements of BSI No: 1186, 'Quality of Timber and Workmanship in Joinery'.

The whole of the timber shall be from the heart of sound and fully grown tree, uniform in substance, straight in fibre, first class quality properly seasoned, free from large or loose dead- knots, open shakes and excessive sapwood. The scantlings of all timbers shall be bright, sound and square edged. The moisture content of timber shall not be more than 10 (ten) percent in case of soft wood and 7 (seven) percent in case of hard wood.

3.1.4 Preservation of Wood:

Prior to installation of all finish wood works in their respective positions, preservatives shall be applied to safeguard the wood work against fungus, termite and bores.

The preservatives shall be of the best available quality as approved by the Engineer. The method of application shall be strictly in accordance with the manufacturer's instructions. The treatment and application of all the preservatives shall comply with the requirements of BS- CP 98:1964.

3.1.5 Adhesive:

The adhesives shall conform to the requirements of BSI No. 745 "Animal Glues for Wood" manufactured by M/s Hoest or approved equivalent.

Nails and Screws:

All nails and screws shall comply with requirements of BSI NO.1202 and 1210 respectively.

3.2 Ply Wood

3.2.1. Grade and Quality

Where plywood is specified, it shall be of first quality grade manufactured from tropical hardwoods in accordance with the provisions in BS 1455 or other approved equivalent standard. It shall be made up of either rotary- cut or sliced veneers bonded together in balanced, multiply construction with an adhesive or WBP (weather and boil- proof) quality.

The veneers shall be reasonably matched for colour and shall be free from knots, worm and beetle holes, splits, dote, glue stains, tilling or inlaying of any kind or other defects. No end joints shall be permitted.

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The plywood shall be highly resistant to weather, micro- organisms, cold and boiling water, steam and dry heat. It shall be free of manufacturing defects such as defective bonding, pleats, overlaps, blisters and gaps.

The ply wood shall comply in all respects with BSI No. 1455:1963. All the ply wood shall only be obtained from manufacturers approved by the Engineer. All plywood shall be manufactured with phenol pharamalldihide or any other approved water proof adhesive but not with urea pharamalldihide.

Ply wood used for doors, and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other similar defects. The surfaces shall be free, smooth for painting or polishing.

3.2.2. Testing Quality of Adhesion in the Plywood

In order to ascertain the bonding quality of the adhesive between successive veneers or layers in the plywood the Contractor shall submit to the Employer for approval test certificates from an approved testing laboratory certifying that the following test requirements have been met.

i) The Wet Test in Hot Water or Steam (Test method to follow Appendix 'B' of BS 1455).

Based on the knife test (Appendix C of BS 1455) no glue line shall have a bond quality less than two, and the average value for all those tested shall not be less than five.

ii) The Wet Test in Water at 15°C (Test Method to follow Appendix BZ of BS 1455).

Based on the knife test, no glue line shall have a bond quality less than two and the average value for all those tested shall not be less than lave.

iii) The Mycological Test (Test Method to follow Appendix B 3 of BS 1455).

At the conclusion of the test, none of the test pieces shall show any delimitation, blistering on the surfaces or separation of the joints between veneers at the edges.

3.2.3. Moisture Content

At the time of leaving the factory, finished boards shall have a moisture content, as determined by the test method described in Appendix D of BS 1455, of 8% to 12%.

3.2.4. Finishing

Boards shall be sanded or scraped on both sides equally.

3.2.5. Delimitation

Any board showing delimitation or blistering shall be deemed not to comply with the requirements of this Specification.

3.3 Medium Density Fibre (MDF) Board

Medium-density fibreboard, laminated or acrylic as shown in the drawing, to be used on the project shall be LASANI manufactured by Al- Noor MDF Board Industries or approved equivalent of thicknesses as specified in the drawings. Board shall be manufactured with water proof resinous glues and shall be guaranteed by the manufacturer. All boards required for the exterior surfaces of cabinets shall be laminated with formica in approved colour and texture in factory as specified

3.4 Compact Density Board (CDF)

Compact high Density Fiber Board of specified thickness (density 1000kg/m3 both sides melamine lamented coating, scratch resistance, splash water resistance and flame retardancy / fire

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resistance for cubicles and wash rooms & other wet areas with complete set of hardware (SS 304 grade) or as specified or as shown in drawing or as recommended by the manufacturer and approved by the Engineer.

3.5 Wood-plastic Composite (WPC) Material

3.5.1 Material

WPC material sections (solid or hollow) should compose of Wood fiber / wood flour and suitable thermoplastic such as polyethylene, polypropylene, polyvinyl chloride, polylactic acid etc. to full the requirements of functionally, environment, fire resistance etc. of the particular product in shapes, sizes, color and texture as shown in drawings, as recommended by the manufacturer and as approved by the Engineer.

WPC section should consist of minimum 55% wood, 30% PVC / PE, 15% binder and additives and in compliance to the requirements of codes / standards listed below. Products should be made up of plastic type High Density Polyethylene (HDPE) material.

a) TSE EN 479 b) TSE EN 317

3.5.2 Fixing and Installation

a) Fixing and installation details / arrangements shall be proposed as necessary to further install / fix features / element as per design as recommended by the fabricator / manufacturer and approved by the Engineer.

4. SAMPLES

All samples of the material used for the work under this Section of Specification shall be approved by the Engineer and same type of material shall be used throughout the work. If the Engineer desires to get the material tested, this will be got done by the Contractor at his own cost from a laboratory approved by the Engineer.

5. FABRICATION

wrought timber shall be used. Sawing shall be done with sufficient oversize margin to finally meet the requirements of specified sizes and dimensions of the finished work.

6. PROTECTION OF MATERIALS

All materials and assembled units shall be protected from weather and stored in such a way as to prevent decay, warping and attack by fungus and termites.

7. WOODEN DOORS

7.1 Materials

7.1.1 First class Teakwood as approved by the Engineer shall be used for door frames and door shutters except the core of shutters which shall be partial wood as specified and shown on drawings.

7.1.2 Architraves, beads, lippings shall be of Teakwood of specified sizes and fixed as per details shown on Drawings.

7.2 Ground, Blocking & Nailing Strips

Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

Except as otherwise shown or specified, ground blocking and nailing strips shall be secured in place as follows:

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7.2.1 To steel- by means of 3/8" diameter bolts spaced not over 3 feet.

7.2.2 To brick wall by the use of cut nails spaced not more than 1.5 feet apart and driven directly into the block.

7.2.3 To poured concrete by means of 1/4" diameter galvanized expansion bolts spaced not more than 1.5 feet part or by any approved method.

7.3 Exterior and Interior Door Frames

All exterior and interior door frames shall be fabricated of wooden sections of first class teakwood frame as shown on drawings.

All exposed surfaces of frames and architraves/beads shall be lacquered finished of approved shade as shown on the drawing or as per the instructions of the Engineer.

The door frames shall be secured in place by means of 4 inches screws or MS holdfast 6 inches thick and matching Rawal plugs and built into the plastered masonry after the same has dried. 4 number screws in each jamb and 2 number for upto 3.5 feet width and 3 number for upto 5 feet width of doors in the head shall be used, alternatively, prefixing of door frame with shim detail of door can be used as instructed by the Engineer. The specified details are for reference only, however, contractor shall submit fixing / hardware details in shop drawings for approval of the Engineer as per hardware details shown in the drawing or as recommended by the manufacturer.

7.4 Door Shutters

The shutters will be fixed to the frames with approved quality fittings as per hardware schedule.

7.4.1 All doors, shutters shall be fabricated in a workman like manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer.

7.4.2 The door shutters shall be built in sections, properly jointed and glued together. The surfaces shall be prepared for painting or polishing.

7.4.3 All door shutters shall be paneled, fabricated from first class teakwood as shown on drawings.

7.4.4 Each door shall be constructed so as to permit the installation of hinges, knobs and locks in the position shown on the Drawings. Lock rails should also be provided with all flush doors.

7.4.5 Completed doors shall be sound, rigid and free from defects and warp. All edges shall be aligned and smooth, joints shall be close fitting, hard wood doweled or mortised framed and of strength to maintain frame and of strength to maintain the structural properties of the member connected. All adjoining faces and edges shall be flush and smooth. Edges shall be rectangular and solid.

7.4.6 All exposed surfaces of wooden frames and wooden shutters shall be painted with lacquered finished or polished finish of approved shade as per the instructions of the Engineer.

7.4.7 Chamfers shall be made as shown on the drawings or as directed by the Engineer.

7.5 Fitting, Hanging and Trimming

All the doors shall be fitted, hung and trimmed as hereinafter specified and as indicated on the Drawings.

Doors shall have a clearance of 1/8" at sides and top unless otherwise directed by the Engineer and shall have 1/2" clearance at bottom. Doors shall be hung and trimmed with hardware as specified. All the locks shall be installed at the same height and shall be located at height as directed by the Engineer. Where directed by the Engineer margin for carpet shall be incorporated in the door shutter.

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Door undercut shall be min. 1/2" and max. 3/4" or as shown on drawing and as approved by the Engineer

7.6 Hardware

Hardware in stainless steel material shall be of premium quality heavy duty and well finished material including hinges, push and pull bars, door locks, door stopper door closures etc. which shall be of make Dorma, Yale or approved equivalent as per attached hardware schedule. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials.

Hardware shall be carefully and securely fitted. Upon handing over the work, hardware shall be demonstrated to operate freely. Keys shall be placed into respective locks and upon acceptance the work keys shall be tagged and delivered to the Engineer.

Contractor may provide suitable alternative hardware solution as per manufacturer recommendation for Engineer's approval.

7.7 Quality Assurance

7.7.1 Tolerances: Doors shall be fabricated to following tolerances

- Size: Plus or minus 1/16 in overall dimensions

- Maximum Warp: 1/8"

- Squareness: Maximum diagonal difference 1/8" of (between length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

7.7.2 Manufacturer's Qualifications: The manufacturer of doors herein specified shall have been in business of manufacturing doors of type specified for minimum period of five years.

7.8 Submittal

7.8.1 Provide manufacturer's literature completely describing products.

7.8.2 Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.

7.8.3 Provide certificates stating that doors were constructed with timber of the species specified having moisture content and meeting equilibrium and relative humidity requirements.

7.8.4 Submit samples of plywood, MDF etc. for selection of colour and grain.

7.8.5 Procurement of materials shall be made only after the shop drawings and samples have been approved by the Engineer.

7.9 Product Delivery, Storage and Handling

7.9.1 Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

7.9.2 Keep products dry, stack products off ground on level platforms, fully protected from weather, including direct sunlight.

7.9.3 Identify type, size and location of each door before delivery in order to permit installation at correct location.

7.10 Installation

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7.10.1 Install doors at correct openings and assure smooth swing and proper closer with frames.

7.10.2 Install finish hardware in accordance with manufacturer directions.

8. LATTICE SCREENS / JAFFREY

8.1 Materials

Well- shaped / cutted teakwood Jaffrey / lattice screen as per design and pattern shown in drawings and as approved by the Engineer shall be used.

8.2 Fixing and Installation

Fixing and installation details / arrangements shall be proposed as necessary to further install / fix lattice member / Jaffrey on the panel or screen as recommended by the fabricator / manufacturer and approved by the Engineer.

9. WOODEN PELMET

9.1 Materials

Well- shaped /cutted Teakwood pelmet (wall mounted) with fixing arrangement as specified and shown on drawings and as approved by the Engineer.

9.2 Fixing and Installation

Fixing and installation details / arrangements shall be proposed as necessary to further install / fix pelmet as recommended by the fabricator / manufacturer and approved by the Engineer.

10. HARD WOOD HANDRAIL & DECORATIVE MOULDING

10.1 Materials

Well- shaped /cutted Teakwood Handrail decorative moulding feature / elements in lacquered finish with complete fixing arrangements shall be provided as approved by the Engineer shall be as specified and shown on drawings:

10.1.1 Glazed panel in Aluminum Channel with rubber packing

10.1.2 Stainless Steel and Teakwood Panel with plywood backing and MS Bar Support

10.2 Fixing and Installation

Fixing and installation details / arrangements shall be proposed as necessary to further install / fix pelmet as recommended by the fabricator / manufacturer and approved by the Engineer.

11. WOODEN CABINETS

All cabinets including fittings, fixtures and hardware shall be supplied of approved manufacturer and shall be of best quality fabricated by using materials and details as shown on the drawings.

11.1 Shop Drawings

The Contractor shall submit detailed shop drawings on the basis of the manufacturer's specifications including all fittings, fixtures and hardware and the same shall be got approved from the Engineer before fabrication. Samples of materials to be used in cabinets together with specifications and literature shall be supplied to the Engineer for his approval prior to start of works. The colour shade shall be as approved.

11.2 Installation

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All cabinets shall be installed in position by the manufacturer's skilled workmen specialized in the job. Works shall be executed in accordance with approved shop drawings and the manufacturer's instructions.

The Contractor shall inspect the delivered cabinets and related parts for indication or location, size required by field measurements, finishing hardware and similar preliminary works. Verify locations for installation, required floor and wall finishes, painting and all other related work. Cabinet shall exactly flush wall surfaces. Cut and fit accurately scribe strips at wall surfaces. Secure wall cabinet to blocking. Concealed fasteners, all joints surfaces shall be smooth and even. Doors and other moving parts shall exactly fit in the frame. Refit, as necessary to ensure proper and easy operation. Refit, if necessary, all cabinet and shelves hardware, test for proper operation, remove for painting and other finishing and properly replace in position with all fittings and accessories.

All work shall be thoroughly protected from damage at all times by suitable methods approved by the Engineer. Adjacent work shall similarly be protected from damage. Any damage or disfigurement shall immediately be corrected at Contractor's expense.

11.3 The works offered under this item should allow a reasonable choice variation of design/colour, etc. to suit individual test/needs, i.e. one standard design may not apply to all buildings of one type.

11.4 Cabinet work, generally all framing will be in treated hardwood with portions etc. in best quality teakwood / deodar and commercial laminated plywood or as shown on the drawing. All exposed surfaces will be covered by approved laminates. Exposed edges, if any, will be covered by polished hardwood / teakwood / deodar wood lipping. Cabinet tops shall be with or without marbles and as per details shown in the drawing or as approved by the Engineer.

12. DEFECTIVE WORK

In the event of non- conformance to specification and drawings, the wood works shall be rejected by the Engineer and the Contractor shall remove and replace the rejected work by new work of same specifications.

13. SURFACE PREPARATION

The surfaces of all wood works shall be prepared in the manner as directed by the Engineer for polishing or painting.

14. MOCK-UP SAMPLE

After approval of shop drawings and tests etc., the contractor shall submit at his own cost one mock- up sample of each type of wood works complete with all fixing, fixtures accessories prior to the actual fabrication of the bulk.

The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

15. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0230 - ALUMINUM DOORS, WINDOWS, VENTILATORS, GLAZED PARTITION, AND COMPOSITE ALUMINUM CLADDING.

1. SCOPE

The work under this section of specification includes furnishing all labour, equipment, appliances and materials and performing all operations in carrying out the work of aluminium doors, windows, ventilators, glazed partition and composite aluminium cladding. All related items such as sealants, rubber gasket for glazing, fly proofing, rollers, latches, fastenings, glazing, anchor bolts and all items supplied by other trades and customarily built in and/or installed in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. APPLICABLE STANDARDS

Latest editions of following ISO and British Standards are relevant to these Specifications wherever applicable.

2.1 ISO (International Organization for Standardization)

1804 - Doors - Terminology

6442 - Door Leaves - Measurement of defects of general flatness

6443 - Door Leaves - Measurement of dimensions and defects of squareness

6444 - Door Leaves - Test of behaviour under humidity variations (successive uniform climates)

6612 - Windows & Doors - wind resistance tests

6613 - Windows & Doors - Air permeability test

2.2 BSI (British Standard Institution)

1227 - Hinges

4873 - Aluminium alloy windows

3. GENERAL

3.1 Doors, windows and ventilators to be provided shall be aluminium doors, windows, partition wall frame and ventilators of profile, pattern and design shown on drawings and shop drawings as approved by the Engineer. The Contractor shall provide manufacture literature completely describing the product instructions for installation and maintenance.

3.2 All the sections used for doors, windows and ventilators shall be of best quality aluminium products such as equal and unequal angles, channels, tubes, corrugated strips, mouldings etc., in accordance with international standards conforming to ASTM B 308 & B 221.

3.3 All doors, windows and ventilators, shall be of type and size indicated on drawings and shall conform to the requirements shown and specified herein.

3.4 Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each doors, windows and ventilators type - at the maker's works or any laboratory specified by the Engineer for the material supplied by the manufacturer.

3.5 The contractor shall submit shop drawings which shall show full construction details, quantities and locations, fastenings and attachment to adjacent construction and materials. Shop drawings shall be submitted at the proper time to allow for checking, revisions, agreement and to permit manufacturer's product delivery and start of site work to suit the building programme. The

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Contractor shall submit representative samples of finished doors, windows and ventilators anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval based on details as specified or as shown in drawings. After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of aluminium works complete with glazing, all components assembly method and required fittings and accessories prior to the actual fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works. Fabricate and assemble all work in the shop of the approved manufacturer to reduce field fabrication to a minimum unless otherwise directed by the Engineer.

3.6 The glass shall conform to specification laid down under chapter 'Glazing section no. 6250' and shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in ventilators members. All the glass shall be best quality of approved manufacture or equivalent standard as approved by the Engineer.

3.7 The structural shape of the Aluminium members shall be of uniform quality, colour and temper, clean, round, commercially straight and free from injurious defects.

3.8 All doors, windows and ventilators shall be fabricated as a complete unit, fully airtight and watertight, including rubber gasket for glazing, rollers, latch, anodized in specified colour, inclusive of glass sheet, all as approved by the Engineer.

3.9 Contractor shall, on request, get certificate signed by the manufacturer stating that each lot has been sampled, tested and inspected and has met the requirements in accordance with these specifications, and the same shall be furnished to the Engineer.

3.10 The shop drawings shall clearly show that there shall be no penetration of rainwater from the exterior to the interior in case of severe wind and rainstorm. This has to be specially ensured in sill section.

4. MATERIAL

4.1 Frames / shutters

The frames of aluminium door, windows and ventilator shall be formed from rolled, strip or extruded aluminium. The thickness of sectional members shall be at least 2.0 mm. All outer / frame sections of openable / fixed windows. Ventilators and louvers curtain wall shall be 4" (100 mm) minimum in width. The Frames for doors and door/windows curtain wall shall be at least 4" (100 mm) in width. As shown on the drawings, aluminium frames shall be provided as per international standard approved by the engineer.

4.3 Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.

4.4 Gaskets shall be vinyl glazing channel gasket to commercial standard CS-230-60.

4.5 Hardware shall be manufacturer's standard hardware. Flush to match doors, windows, ventilators and louvers finish. Floor mounted concealed type double action/swing imported door closures shall be provided to all doors. Heavy-duty in-matching finish stays shall be provided to all openable windows, ventilators and louvers. Stays shall be attached to the window frame so as could be replaced easily.

4.6 Joint sealant shall be approved elastomer.

4.7 All Aluminium sections shall be powder coated in accordance with the standards of Aluminium Association of USA. The anodisation shall be of not less than 70-90 microns. The anodic oxide surface shall be properly sealed.

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4.8 For powder coated finish aluminium sections to be coated shall be mill finish. The sections shall be firstly degreased with a degreasing chemical to remove all/any stains. The sections will then be given a chromating coating and electro static powder coating in the desired colour with a powder-coating machine. After colour coating the sections will be baked at baking temperature of 220 degree Centigrade for 25 minutes PVDF (polyvinylidene fluoride) coatings should be used for protection.

4.9 All sliding/openable windows shall have sliding/openable wire/fly screen shutters in window matching finish with wire/fly screen of size so as not to permit the entry of flies and mosquitoes. The wire mesh shall be 30 SWG. 14 mesh (14 x 14 openings per square inch).

5. DESIGN REQUIREMENT

The Contractor shall design the installation to meet or excel the following requirements.

5.1 Tolerances

The Contractor shall be responsible for agreeing to all dimensions with the Engineer before proceeding with the manufacture and for making provision to allow for building tolerances required by the Engineer. Contractor shall also take site measurements of the structure completed before manufacturing.

5.2 Thermal & Seismic Movements

The window and glazing assemblies are to be constructed and installed in the openings with sufficient tolerance and, where necessary, to provide for joints incorporated in couplings, to provide for expansion and contraction as will be caused by the local seismic and climatic conditions and temperature changes, winter to summer - day to night without buckling, distortion of joints, or other harmful effects.

6. WORKMANSHIP

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workman like manner in accordance with the manufacturer's instruction and as specified herein. The Contractor shall be responsible for the protection of installed items from damage by other trades. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before the final acceptance. The glass panes shall firmly be secured in the rebates with the rubber gasket. Ensure that the beads and grooves are clean, dry and cleaned at the time of glazing. The complete unit shall be airtight and watertight.

7. PRODUCT DELIVERY AND STORAGE

7.1 Deliver doors, windows and ventilators in a manner preventing damage to units. Store materials off the ground under cover in a manner preventing deterioration or damage.

7.2 All embedded parts and anchor bolts shall be delivered to the site carefully and keeping the fabricated shape and configuration. All these parts shall be suitably marked for identification.

8. ERECTION

Rawplugs and anchoring bolts shall be embedded into the concrete or brick masonry for holding the doors, windows and ventilators in their correct positions. Care shall be taken to install the doors, windows and ventilator in line and plumb & solidly anchored in a good workman like manner in accordance with the drawings. Should any scale or scratch appears on the surface of doors, windows and ventilators, the contractor shall at his own expense and at the Engineer's direction have all exposed surfaces cleaned to bare bright specified colour. All works shall be installed strictly in accordance with the manufacturer's printed instructions.

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9. PROTECTION AND CLEANING

9.1 Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of lime mortar.

9.2 Apply coating in the manufacturer's plant to the exposed surfaces of all components.

9.3 Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.

10. DEFECTIVE WORK

In the event of non-conformance to specifications and drawings the aluminium work shall be rejected by the Engineer and the Contractor shall remove and replace the rejected works by new work of same specifications.

11. GUARANTEE

11.1 The manufacturer shall furnish his standard written guarantee against leakage of rain, excessive infiltration of dust and air and all defects in materials and workmanship covering all work under this section.

11.2 Such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturers and the Contractor may have by law or by other provisions of the Contract Documents.

12. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0235 – ARFF GARRAGE DOOR

1. GENERAL

1.1 Scope
This Section specifies the design, manufacture, supply, installation, testing, and commissioning of insulated, power-operated vehicle bay (apparatus/garage) doors for the ARFF (Aircraft Rescue and Fire Fighting) vehicle room of the Fire Station at Skardu International Airport, including all associated hardware, controls, safety devices, and thermal-sealing systems necessary to achieve the operational and environmental performance required herein.

1.2 Reference Standards
The Contractor shall comply with the latest editions of the following, and any conflict shall be resolved in favor of the more stringent requirement, subject to the Engineer's determination:

- FAA Advisory Circular AC 150/5210-15A, Aircraft Rescue and Firefighting Station Building Design (vehicle bay door criteria).
- ICAO Doc 9137, Airport Services Manual, Part 1 — Rescue and Fire Fighting (vehicle readiness and station environmental control provisions).
- ICAO Annex 14, Volume I — Aerodrome Design and Operations.
- ANSI/DASMA 102 and UL 325 (or equivalent recognized standard) for power-operated door safety.
- Building Code of Pakistan, seismic and wind load provisions).

1.3 Site and Environmental Design Conditions
Skardu International Airport is located at approximately 2,228 m (7,310 ft) AMSL in a high-altitude, cold semi-arid mountain climate with a wide diurnal and seasonal temperature range, low ambient humidity, intense solar radiation, and seasonal snowfall. The airfield is a joint civil/military facility. Vehicle bay doors and associated envelope components shall be designed for the following indicative site conditions, to be confirmed by the Contractor against the site-specific meteorological data appended to the bidding documents:

Parameter	Design Value (indicative)
Winter design (outdoor) temperature	-25°C (extreme minima lower)
Summer design (outdoor) temperature	40°C
Required maintained vehicle room (garage) temperature	13°C ± 2°C (per ICAO Doc 9137)
Elevation	≈ 2,230 m AMSL
Snow / frost exposure	Significant seasonal snowfall and freeze-thaw cycling
Wind loading	Per site-specific wind study / Building Code of Pakistan

Note: ICAO Doc 9137, Part 1, recommends that vehicle bay ambient temperature be maintained at approximately 13°C so that ARFF vehicle engines, hydraulic and pneumatic systems, foam concentrate, and batteries remain within their operating range and are capable of achieving the required response readiness at all times, including sub-zero exterior conditions.

1.4 Submittals
- Manufacturer's technical data sheets, U-value/thermal performance certificates, and structural (wind load) calculations.
- Shop drawings showing door assembly, jamb/head/sill details, thermal break, and interface with wall insulation and vapor barrier.
- Control system schematics including safety edge, photo-electric reversing sensors, and interface with the station fire alarm/dispatch system.
- Operation and maintenance (O&M) manuals, spare parts list, and warranty certificates.

2. DESIGN REQUIREMENTS

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2.1 Door Type and Configuration

Provide factory-insulated, sectional (or vertical-lift) power-operated overhead doors purpose-selected for cold-climate ARFF service. Drive-through (bi-directional) bay configuration shall be provided where indicated on the drawings to reduce vehicle turnaround time and minimize door-open duration and associated heat loss.

2.2 Door Sizing

- Minimum clear opening: 16 ft (4.87 m) width × 16 ft (4.87 m) height; standard opening: 18 ft (5.48 m) width × 18 ft (5.48 m) height, sized to suit the largest ARFF vehicle in the current and planned fleet, whichever governs.
- Minimum clearances: 1.8 m between vehicle and walls/storage; 2.4 m between vehicles parked side by side; 1.5 m between vehicles parked end to end; 1.5 m between vehicle and bay doors; adequate overhead clearance above vehicle roof height to clear door tracks/mechanisms and any roof-mounted equipment.

2.3 Operating Speed

- Maximum full-open time: 16 seconds (approximately 0.3 m/second), operable by remote control from the watch/alarm room, by a control station at each door, or automatically via the station alarm system.
- Adjustable auto-close timers shall be provided to minimize heat loss when the bay is unattended, without compromising unobstructed emergency egress.

2.4 Thermal Performance

Given the requirement to maintain the vehicle room at 13°C under Skardu's winter design conditions, the door assembly (not the HVAC system alone) shall contribute materially to the building thermal envelope performance as follows:

- Insulated steel or aluminum sectional panels with rigid polyurethane (CFC-free) core, nominal thickness 40–45 mm.
- Panel thermal transmittance: U-value not exceeding 0.5 W/m²K (or R-value not less than R-16, US units), verified by an independent test certificate.
- Full-perimeter weather seals (head, jamb, astragal/meeting rail, and bottom seal) rated for sub-zero flexibility without hardening or cracking.
- Thermal break at all metal-to-metal contact points in tracks and hardware to minimize condensation and cold bridging.
- Maximum allowable air infiltration rate at the specified design wind pressure, tested per ASTM E283 or equivalent, to be stated by the manufacturer and reviewed by the Engineer.

3. MATERIALS AND CONSTRUCTION

3.1 Panels

- Galvanized/pre-painted steel or marine-grade aluminum skins, minimum 24-gauge (or approved equal), factory finished in a color to match the station facade, resistant to UV degradation from high-altitude solar exposure.
- Vision panels, where required, shall be double-glazed tempered safety glass, insulated, and positioned to allow the driver and station personnel to view the apron from both the vehicle seat and the vehicle room floor.

3.2 Tracks, Springs, and Hardware

- Heavy-duty galvanized steel tracks and torsion springs rated for the specified cycle life (minimum 20,000 cycles) and for continued operation in sub-zero ambient temperatures without lubricant thickening or seizure; cold-weather rated lubricants shall be used.
- All fasteners and hardware shall be corrosion-resistant (stainless steel or hot-dip galvanized) suited to freeze-thaw and de-icing chemical exposure.

3.3 Operators and Controls

- Heavy-duty electric operator sized for the specified door weight and cycle rate, rated for continuous duty ARFF service, with cold-weather rated motor and gear-drive components.

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- Each door shall have an individually operable manual chain/crank override, capable of one-person full-height operation within the 16-second standard, located on the driver's side.
- A separate master override control, capable of opening all bay doors, shall be provided in the apparatus bay and/or the watch/alarm/dispatch room.
- Photo-electric (electric-eye) reversing sensors shall be provided at a height that both protects personnel and reliably detects the forward-most projection of the ARFF vehicle (e.g., bumper or bumper turret).
- A mechanical/electrical safety edge or equivalent contact-sensing auto-reversing device shall be installed on the door bottom bar; pneumatic-only sensing devices are not acceptable given sustained sub-zero conditions.
- A red warning light, clearly visible to ARFF personnel, shall automatically illuminate whenever any bay door is in motion.

4. STRUCTURAL AND SAFETY REQUIREMENTS

- Doors and supporting structure shall be designed for the site-specific wind and seismic loads applicable to Skardu (Gilgit-Baltistan seismic zone) and shall withstand snow/ice accumulation loading on tracks and header assemblies without impairing operation.
- Door assemblies and controls shall comply with a recognized power-operated door safety standard (e.g., UL 325 / ANSI/DASMA 102 or equivalent) for entrapment protection.
- Emergency manual release shall not require special tools and shall be operable from inside the vehicle room at all times, including during a power outage.

5. ENVIRONMENTAL / HVAC COORDINATION

The Contractor shall coordinate the door thermal performance data with the mechanical (HVAC) design of the vehicle room so that the combined envelope and heating system maintain the interior at 13°C ± 2°C under the winter design condition specified in Clause 1.3, in accordance with ICAO Doc 9137. Where the door open-time analysis (based on the 16-second operating standard and expected alarm response frequency) indicates that infiltration heat loss during door cycling would prevent the HVAC system from maintaining 13°C, the Contractor shall propose supplementary measures for the Engineer's review, such as:

- An air curtain (heated, cold-climate rated) mounted at the interior head of each bay door; or
- A vestibule/entry lobby arrangement; or
- Increased in-floor or unit heater capacity local to each bay, coordinated with the HVAC specification.

Any such supplementary measure and its associated BOQ item(s) shall be read together with the HVAC Technical Specification and BOQ for this project, and shall not be considered part of the door supply cost unless separately itemized.

6. INSTALLATION, TESTING AND COMMISSIONING

- Install strictly per the manufacturer's instructions and approved shop drawings, with head, jamb, and sill flashing and air/vapor sealing integrated with the building envelope to avoid thermal bridging or air leakage paths.
- Functionally test each door for full open/close cycle time (≤16 seconds), manual override operation, master override operation, photo-electric and safety-edge reversal, auto-close timer function, and warning light operation.
- Conduct a thermographic (infrared) survey of each installed door and its perimeter seal after installation to confirm the absence of significant thermal bridging, prior to issuance of the taking-over certificate.
- Demonstrate, jointly with the HVAC Contractor, maintenance of the specified 13°C garage set-point over a minimum 48-hour monitoring period spanning at least one door-cycling test regime representative of expected alarm response frequency.

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7. WARRANTY, SPARES, AND MAINTENANCE

- Minimum manufacturer's warranty: 2 years on door panels, hardware, and operator; minimum 5 years on the insulated panel core against delamination.
- Provide a minimum of one complete set of critical spare parts per door (springs, cables, photo-eye pair, seals) and a recommended spares list for a 5-year operating period.
- Provide O&M manuals and on-site training to station maintenance personnel prior to hand-over.

8. MEASUREMENT AND PAYMENT

Payment shall be made on a per square feet basis under the relevant BOQ item(s), and shall be deemed to include supply, delivery, installation, all hardware, controls, safety devices, testing, commissioning, thermographic survey, O&M documentation, training, and warranty as specified herein, unless a separate BOQ item is provided for supplementary heating/air-curtain measures under Clause 5.

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SECTION 0240 - ALUMINUM COMPOSITE PANEL CLADDING SYSTEM

1. SCOPE

Furnish all labour, material, equipment, tools, formwork and services required to complete the works covered in these specifications in accordance with the drawings and as approved by the Engineer.

Aluminum Composite Panel system includes but not limited to the following components:

a. Aluminum composite panel façade with mounting system. Metal stud framing system including anchorages, shims, fuming, fasteners, gaskets and sealants, related flashing adapters, and masking (as required) for a complete watertight installation.

b. Parapet coming, exterior column covers, soffits, sills, border, and filler items indicated as integral components of the panel system.

c. Coordination of the works with other trades/contractors.

2. APPLICABLE STANDARDS

1. Aluminum Association

i. AA-C22-A41: Anodized - Clear Coatings.

ii. AA-C22-A42: Anodized - Integral Color Coatings.

2. American Architectural Manufacturers Association

i. AAMA 508-05; Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems

3. American Society For Testing And Materials

i. E 330 Structural Performance of Exterior Windows, Curtain Walls, and Doors under the influence of wind loads.

ii. E 283 Rate of Leakage through Exterior Windows, Curtain walls, and Doors.

iii. D 1781 Climbing Drum Peel Test for Adhesives

iv. E 84 Surface Burning Characteristics of Building Materials

v. D 3363 Method for Film Hardness by Pencil Test

vi. D 2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (impact).

vii. D 3359 Methods for Measuring Adhesion by Tape Test

viii. D 2247 Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

ix. B 117 Method of Salt Spray (Fog) Testing

x. D 822 Practice for Operating Light and Water Exposure apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products.

3. SUBMITTALS

1. Submittals shall be in conformance with relevant Sections of these specifications.

2. Samples: Panel system assembly: Two samples of each type of assembly; 304mm (12") x 304 mm (12") minimum. Submit samples of typical aluminum composite panel of specified type,

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thickness and color (or finish selected), 100mm (4") x 100 mm (4") minimum, along with framing system.

Shop Drawings: Submit complete shop drawings showing all design calculations, project layout and elevations, detailed scaled drawings, installation, fastening and anchoring methods, detail and location of joints, sealants, and gaskets, including joints necessary to accommodate thermal movement, trim, flashing; and accessories.

3. Affidavit certifying sufficiency and stability of aluminum composite panel system and assuring that system meets project requirements.

4. Manufacturer's Certificate regarding origin and country of manufacturer.

5. Manufacturer's literature for panel material. Panel manufacturer's product data, consisting of complete product description and specification.

6. Submit panel system fabricator's installation manual, indicating the procedures to be followed by the contractor in forming, sealing and installing the attachment system.

7. Method for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

8. Code Compliance: Documents showing product compliance with the national and local building code shall be submitted by the Contractor. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product.

4. QUALITY ASSURANCE

Composite Panel Manufacturer shall have a minimum of 5 years experience in the manufacturing of this product.

Composite Panel Manufacturer shall be solely responsible for panel manufacture and application of the finish.

Fabricator/installer shall be acceptable to the composite panel manufacturer and subjected to the approval of the Engineer.

Fabricator/Installer shall have a minimum 5 years experience of metal panel work similar, in scope and size to this project.

6. Aluminum Composite Panel shall be the product of approved manufacturer only.

7. The panel system shall have been pre-tested by an independent testing laboratory to provide specified resistance to air and water infiltration and structural deflection, when installed.

8. Field measurements should be taken prior to the completion of shop fabrication. Field fabrication may be allowed to ensure proper fit. However, field fabrication shall be kept to an absolute minimum with the majority of the fabrication being done under controlled shop conditions.

9. Shop drawings shall show the preferred joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on the inside face of the panel system as determined by ASTM E 331. Systems not utilizing a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated System) shall provide a means of concealed drainage with baffles and weeps for water which may accumulate in members of the system.

10. Maximum deviation from vertical and horizontal alignment of erected panels; 6mm (1/4") in 6m (20') non-accumulative.

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11. Panel fabricator/installer shall assume undivided responsibility for all components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.

5. PANELS

1. Aluminum Composite Panels / Jaffery

Aluminum composite panel / Jaffery shall be 4 mm thick in approved colour / texture / finish, comprising 3mm noncombustible mineral-filled core sandwich between two skins of 0.5mm thick Aluminum alloy fire rated / resistant.

The surface shall be finished with a high-performance lumifion based fluorocarbon coating / PVDF coating on the topside and service coating on the reverse side.

Composite Aluminum Jaffrey laser cut as cladding / covering material shall be used from approved manufacturer.

2. Product Performance

I) Bond Integrity

When tested for bond integrity, in accordance with ASTM D1781 (simulating resistance to panel delamination), there shall be no adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below the following values;

Peel Strength: 115 N mm/mm (22.5 in lb/in) as manufactured; 115 N mm/mm (22.5 in lb/in) after 21 days soaking in water at 70°F

ii) Fire Performance

ASTM E 84 Flame Spread index, Smoke Developed index.

ASTM D 1929 A self-ignition temperature of 650°F or greater.

ASTM D-635 Requires a CC1 classification.

3. Finishes

Lumifon based metallic color dry film thickness shall be minimum 35µ and consist of conversion coat an inhibitive primer, metallic and clear lumifon based fluorocarbon coat / PVDF color 1.0 mil thickness. The reverse side of the cladding panel surface facing the wall shall have a polyester-based wash coating to protect against corrosion.

a. Hardness: ASTM D-3363; HB minimum using Eagle Turquoise Pencil.

b. Impact:

1) Test method: ASTM D-2794; Gardner Variable impact Tester with 5/8" mandrel.

2) Coating shall withstand reverse impact of 1.5% pounds per mil substrate thickness.

3) Coating shall adhere tightly to metal when subjected to #500 Scotch Tape pick-off test. Slight minute cracking permissible. No removal of film to substrate.

c. Adhesion:

1) Test Method: ASTM D-3359.

2) Coating shall not pick off when subjected to an 11" x 11" x 1/16" grid and taped with #600 Scotch Tape.

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d. Humidity Resistance:

1) Test Method: ASTM D-2247.

2) No formation of blisters when subject to condensing water fog at 100% relative humidity and 100°F for 4000 hours.

e. Salt Spray Resistance:

1) Test Method: ASTM B-117; Expose coating system to 4000 hours, using 5% NaCl solution.

3) Corrosion creepage from scribe line: 1/16" max.

4) Minimum blister rating of 8 within the test specimen field.

i. Weather Exposure:

1) Outdoor:

a. Maximum color change of 5 Delta E units as calculated in accordance with ASTM D-2244.

b. Maximum chalk rating of 8 in accordance with ASTM D-4214.

c. No checking, crazing, adhesion loss.

ii. Chemical Resistance:

1) ASTM D-1308 utilizing 10% Muriatic Acid for an exposure time of 15 minutes. No loss of film adhesion or visual change when viewed by the unaided eye.

2) ASTM D-1308 utilizing 20% sulfuric Acid for an exposure time of 18 hours. No loss of film adhesion or visual change when viewed by the unaided eye.

3) AAMA 2605 utilizing 70% reagent grade Nitric Acid vapor for an exposure time of 30 minutes. Maximum color change of 5 Delta E units as calculated in accordance with ASTM D-2244.

6. PANEL FABRICATION

1. Composition

Two sheets of aluminum sandwiching a 3mm noncombustible mineral filled solid core formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.

2. Aluminum Face Sheets: Thickness: 0.5mm (nominal)

3. Panel Weight: 4mm: 1.12 lbs./ft²

4. Tolerances

i. Panel Bow: Maximum 0.8% of any 1828mm (72") panel dimension.

ii. Panel Dimensions: Field fabrication shall be allowed where necessary but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.

iii. Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

iv. Maximum deviation from panel flatness shall be 1/8" in 5'-0" on panel in any direction for assembled units. (Non-accumulative - No Oil Canning).

5. System Characteristics

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i. Plans, elevations, details, characteristics, and other requirements indicated are based upon standards by one manufacturer. It is intended that other manufacturers, receiving prior approval, may be acceptable, provided their details and characteristics comply with size and profile requirements, and material/performance standards.

ii. System must not generally have any visible fasteners, telegraphing or fastening on the panel faces or any other compromise of a neat and flat appearance.

iii. System shall comply with the applicable provisions of the "Metal Curtain Wall, Window, Storefront, and Entrance Guide Specifications Manual" by AAMA and ANSI/AAMA 302.9 requirements for aluminum windows.

iv. Fabricate panel system to dimension, size, and profile indicated on the drawings based on a design temperature of 70°F.

v. Fabricate panel system so that no restraints can be placed on the panel, which might result in compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature change and at all times remain air and water tight.

vi. The finish side of the panel shall have a removable plastic film applied prior to fabrication, which shall remain on the panel during fabrication, shipping, and erection to protect the surface from damage.

7. SYSTEM PERFORMANCE

1. Composite panels shall be capable of withstanding building movements and weather exposures based on the following test standards required by the Architect and/or the local building code.

a. Wind Load

If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent laboratory, which show compliance to the following minimum standards;

Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 50 pounds per square foot (psf). Wind load testing shall be conducted in accordance with ASTM E330 to obtain the following results.

Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed L/175 or 3/4, whichever is less.

Normal to the plane of the wall, the maximum panel deflection shall not exceed L/60 of the full span.

Maximum anchor deflection shall not exceed 1/16".

At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed 1/16".

b. Air/Water System Test

If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent laboratory, which show compliance to the following minimum standards.

Air Infiltration - When tested in accordance with ASTM E283-84, air infiltration at 10.0 psf must not exceed 0.06 cfm/ft² of wall area.

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Water Infiltration - (ASTM 383) Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. Systems not using a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated Systems) shall be designed to drain any water leakage occurring at the joints. No water infiltration shall occur in any system under a differential static pressure of 15 psf with a water spray rate of 5 gallons per hour per sq.ft. minimum for 15 minutes.

c. Fire Performance Characteristics: Test in accordance with ASTM E84, E108 (modified) & E162.

d. Pressure Equalized Rain Screen Systems shall comply with AAMA 508-05 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.

8. MATERIALS (SYSTEM COMPONENTS)

1. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.

2. Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.

3. Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.

4. Fabricate flashing materials from 0.030" minimum thickness aluminum sheet painted to match the adjacent curtain wall / panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.

5.Fasteners (concealed/exposed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.

9. INSPECTION

1. Surfaces to receive panels shall be even, smooth, sound, clean, dry and free from defects detrimental to work. Notify contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

2. Surfaces to receive panels shall be structurally sound as determined by a registered Architect / Engineer.

10. DELIVERY, STORAGE AND HANDLING

1. Protect finish and edges in accordance with panel manufacturer's recommendations.

2. Store material in accordance with panel manufacturer's recommendations.

11. INSTALLATION

1. Erect panels plumb, level, and true.

2. Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted.

Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.

3. Panels shall be erected in accordance with an approved set of shop drawings.

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4. Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.

5. Conform to panel fabricator's instructions for installation of concealed fasteners. Do not install component parts that are observed to be defective and warped, bowed, dented, abraded, and broken members.

6. Do not cut, trim weld or blaze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for re-fabrication, if possible, or for replacement with new parts.

7. Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

8. Sub-framing for panels will be in standard Aluminum section designed / recommended by manufacturer. Non-standard Aluminum channel will not be acceptable.

12. WARRANTY

The Contractor shall warrant that the system supplied and installed will be free from defects in materials and workmanship for a period of ten (10) years from the date of substantial completion certificate.

13. ADJUSTING AND CLEANING

1. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.

2. Remove masking (if used) as soon as possible after installation. Masking intentionally left in place after panel installation on an elevation, shall become the responsibility of the General Contractor.

3. Any additional protection, after installation, shall be the responsibility of the Contractor.

4. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.

14. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0250 - GLAZING

1. SCOPE
The work under this section of the Specifications consists of furnishing all labour, equipment, tools, appliances, scaffolding and providing glass gaskets, sealants, compound and other materials required for performing all operations in connection with the installation and setting of all types of glass, glazing and glass blocks complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of Specifications is covered with detailed Specifications as laid down herein.

2. APPLICABLE STANDARDS
Latest editions of following British Standards are relevant to these Specifications wherever applicable.

2.1 BSI (British Standards Institution)

952 - Glass for glazing

5051 - Security glazing part I & II

CP.152 - Glazing

3. GENERAL
3.1 Each type of glass shall have the manufacturer's label on each pane, and the labels shall remain on the glass until final cleaning.

3.2 Glazing sealant shall be as recommended by the manufacturer for the particular application.

3.3 Spacer shims (distance pieces) shall be plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on drawings between glass and rebates, bead or cleat. Depth shall give not less than 6 mm cover of glazing sealant.

3.4 Contractor shall submit samples for each type of glass, minimum 1200mm x 1200mm in size with protective edges. Samples of glazing sealant minimum 0.1 liter of specified types shall be submitted. Samples of minimum of three glass blocks shall also be submitted.

3.5 Contractor shall submit 300mm long sample of each type of glazing gasket.

3.6 Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing gaskets, compounds sealant and accessories including description of required equipment and procedures and precautions to be observed.

4. DELIVERY STORAGE AND HANDLING
4.1 Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.

4.2 Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements, which may damage glass.

4.3 Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

5. MATERIALS
5.1 General

Glass shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to fit the rebates so as to have a uniform clearance of 1.6mm round the panes between the edges of glass and the rebates.

5.2 Sheet glass

It shall be first quality clear glass conforming to the applicable requirements of B.S 952 "Glass for Glazing". Unless otherwise indicated glass shall be 5mm thick glass for exterior window except where obscure glass is specified. Glass shall be free from specks, bubbles, deterioration and flows of every kind.

5.3 Frosted Glass

Frosted Glass shall be 6mm thick except as otherwise indicated. Glass shall be of approved pattern.

5.4 Glazing Sealants and Compounds

Contractor shall provide material colored to match frame in which glass is installed. Provide only compounds known to be fully compatible with surfaces which they will contact as follows.

5.5 Laminated Glass

Glass details shall be as follows:

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5.5.1 Glass for internal windows, ventilator & door shall be 12mm thick (6 + 6) laminated glass (clear) and of imported origin.
5.5.2 Glass for internal windows, ventilator & door shall be 12mm thick (6 + 6) laminated glass (tinted) and of imported origin.
5.5.3 Glass for external curtain wall facade (general building areas) shall be 32mm thick double glazed Insulating Glass Unit (IGU) of imported origin (Guardian / Saint-Gobain / AGC or approved equal), comprising: Outer pane: 10mm heat-strengthened tempered glass with SN-40 solar-control coating; Air gap: 12mm argon-gas-filled cavity with warm-edge spacer; Inner pane: 8mm laminated safety glass (4mm + 0.76mm PVB interlayer + 4mm), both lites clear float with chemical interlayer insertion. Glass shall be free from distortion, seeds and blemishes. U-value (centre of glass): not exceeding 1.5 W/m²K. SHGC: 0.25–0.40. VLT: minimum 40%.
5.5.4 Glass for the ATC Tower curtain wall facade shall be 46mm thick triple glazed Insulating Glass Unit (IGU) of imported origin (Guardian / Saint-Gobain / AGC or approved equal), comprising: Outer pane: 10mm heat-strengthened tempered glass with SN-40 solar-control coating; First air gap: 10mm argon-gas-filled cavity with warm-edge spacer; Middle pane: 8mm clear tempered glass; Second air gap: 10mm argon-gas-filled cavity with warm-edge spacer; Inner pane: 8mm laminated safety glass (4mm + 0.76mm PVB interlayer + 4mm), both lites clear float with chemical interlayer insertion. U-value (centre of glass): not exceeding 1.1 W/m²K. SHGC: 0.20–0.35. VLT: minimum 45%. Glass of imported origin.
5.6 Tempered Glass Swing Doors
Tempered glass swing doors shall be 12mm thick fully toughened (tempered) safety glass to BS EN 12150 or ASTM C1048, fabricated by approved manufacturers and installed through their approved fabricators. Each door shall be complete with D-Lock, silicon patch moving machines, floor springs, top pivots, pull handles and all necessary accessories. Cutting of holes, making good of damages and all associated works are included. Glass shall be free of visible defects and edge damage. Each pane shall bear the manufacturer's permanent ceramic-fired mark confirming toughened status and standard of manufacture.
5.7 Tempered Glass Partitions with Safety Film
Internal glass partitions shall be 12mm thick fully toughened (tempered) safety glass, with 3mm anti-shatter safety film (175 micron polyester, optically clear) applied to the protected face. Framing system shall comprise: aluminium section D-48 (100mm × 38mm, 2mm wall thickness), anodized to approved colour; and stainless steel top rail pipe 1.5″ × 3″ (18 gauge), fixed to structural soffit. All aluminium fittings, fixings and accessories are included. Glass cutting and making good of damages to walls are included.
5.8 Double Glazed Aluminium Sliding Windows
Double glazed aluminium sliding windows shall comply with British Standards and shall be of the Executive model section, fabricated from anodized aluminium extrusion 101mm × 37mm, minimum 2mm wall thickness, to approved colour. Each unit shall include aluminium insect mesh (fly) screen, all hardware fittings, weather-stripping, and all accessories. Glazing: 6mm thick tinted float glass panes (double glazed configuration); glass to conform to Clause 5.2 and 5.4 of this Section. Fixing to M.S. box pipe or aluminium surround, including cutting holes and making good damages to walls, complete.
5.9 Aluminium Curtain Wall Framing System
The aluminium curtain wall framing system for facade glazing (Items 15 and 16 of the BOQ) shall be an Aluminium Thermal Break Stick System with mullion and transom members, anodized coating to approved colour, designed for a minimum wind load of 140 km/h. System components shall include: Structural support: M.S. bracket, hot-dip galvanized, with anchor bolt assembly (Indux or approved equal); stainless steel centre bolting; Seals and jointing: EPDM gaskets; weather sealant (Dolphins / Sika or approved equal); Flashings/trimmings: 1.5mm galvanized sheet steel with 1mm thick waterproofing membrane, including all necessary hardware; Fire barriers at each floor slab edge: 2mm galvanized sheet steel with 32 kg/m³ density mineral-wool insulation, including all necessary hardware. All ironmongery and hardware required for a complete, weather-tight and structurally adequate installation shall be included.

6. INSTALLATION OF GLAZING

6.1 Glazing shall comply with the recommendations contained in the "MANUAL of GLAZING" of the Glass Marketing Association or as specifically recommended otherwise by the glass and glazing materials manufacturers.

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6.2 Examine each piece of glass and discard and replace glass with edge damage or face imperfection. All glazing shall be wind tight and fully water tight on completion.
6.3 Clean glazing channels and other framing members indicated to receive glass. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever electrometric sealants are to be used. Apply primer and sealer to joint surfaces wherever recommended by the sealant manufacturer and as shown on the drawings.
6.4 Clean excess glazing materials from surrounding surfaces immediately after installation and eliminate stains and discolorations.
6.5 Cure glazing, sealants and compounds in compliance with manufacturer's instructions to obtain high early bond strength, internal cohesive strength and surface durability.
6.6 While glazing operation is in progress great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be refixed at Contractor's expense.
6.7 No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass and checked by the Engineer for water tightness.

7. PROTECTION AND CLEANING OF GLAZING

7.1 Remove all smears, labels and excess glazing sealant. Leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with new glass at no additional expense to the Employer.
7.2 All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Employer.

8. ATC CONTROL CABIN GLAZING (SPECIAL REQUIREMENTS)

The glazing of the Air Traffic Control cabin shall, in addition to all general requirements of this Section, comply with the following performance criteria, having regard to the operational role of the cabin, the high-altitude location and the wide temperature range of the site:

(a) Insulating glass unit (IGU): triple glazed, 46mm thick overall, comprising: Outer pane — 10mm heat-strengthened tempered glass with SN-40 solar-control low-emissivity coating (Guardian / Saint-Gobain / AGC or approved equal); First cavity — 10mm argon-gas-filled with warm-edge spacer; Middle pane — 8mm clear heat-strengthened tempered float glass; Second cavity — 10mm argon-gas-filled with warm-edge spacer; Inner pane — 8mm laminated safety glass (4mm + 0.76mm PVB interlayer + 4mm), both lites clear float with chemical interlayer insertion (2 plies). Factory pressure-equalised for installation altitude 2,230 m AMSL. Glass of imported origin (Guardian / Saint-Gobain / AGC or approved equal).

(b) Thermal U-value of the IGU: not exceeding 1.1 W/m²K at the centre of glass (triple glazed unit). The overall window system U-value including frame shall not exceed 1.3 W/m²K.

(c) Solar Heat Gain Coefficient (SHGC): 0.30 to 0.40, tuned to the orientation of each façade so as not to cause local over-heating of consoles.

(d) Visible Light Transmission (VLT): not less than 0.50 (50 %) to preserve external scene visibility under all conditions.

(e) Low-emissivity (low-e) coating on surface 2 (cavity side of outer pane). Anti-reflective coating on surface 4 (cabin side of inner pane) to suppress reflection of internal consoles into the controllers' sight-line, in accordance with ICAO Doc 9157 Part 4.

(f) Forward tilt of the cabin glazing as shown on the architectural drawings (typically 15° outward from the vertical) to minimise reflection of cabin interior light onto the line of sight at night.

(g) Factory pressure-equalisation of the IGU certified for an installation altitude of 2,230 m AMSL; capillary tubes (sealed at site after installation) or factory inert-gas equalisation acceptable.

(h) Envelope air-tightness of the cabin assembly: ≤ 1.5 m³/(h·m²) at 50 Pa measured per ASTM E779 or EN ISO 9972.

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(i) A Building Maintenance Unit or davit-and-cradle arrangement shall be provided to permit safe external cleaning of the cabin glazing. The system shall comply with BS EN 1808 and shall be designed for the project snow load on the support beams.

(j) Each IGU shall be marked at the spacer with the manufacturer's identification, the date of manufacture and the project reference. A mock-up assembly of one full cabin panel shall be approved by the Engineer before bulk fabrication.

9. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0260 - CEMENT PLASTER AND EXTERNAL RENDERING

1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height connection with providing and installation of cement plaster, and specified external rendering complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. APPLICABLE STANDARDS

Latest editions of following American Society of Testing and Materials, American National Standard Institute and Metal Lathing/Steel Framing Association are relevant to these Specifications wherever applicable.

2.1 ASTM - American Society for Testing and Materials

ASTM A 109 - Specification for Steel, Carbon, Cold-Rolled Strip

ASTM A 570 - Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM C 28 - Specification for Gypsum Plasters

ASTM C 29 - Test Method for Unit Weight and Molds in Aggregate

ASTM C 35 - Specification for Inorganic Aggregates for Use in Gypsum Plaster

ASTM C 61 - Specification for Gypsum Keene's Cement

ASTM C 150 - Specification for Portland Cement

ASTM C 206 - Specification for Finishing Hydrated Lime

ASTM C 472 - Test Method for Physical testing of Gypsum Plasters and Gypsum concrete

ASTM C 841 - Specification for Installation of Interior Lathing and Furring

ASTM C 842 - Specification for Application of Interior Gypsum Plaster

ASTM C 847 - Specification for Metal Lath

ASTM C 926 - Specification for Application of Portland Cement-Based Plaster

2.2 ANSI - American National Standards Institute Inc.

ANSI A42.1 - Gypsum Plastering

ANSI A42.3 - Lathing and Furring for Portland Cement and Portland Cement-lime, Exterior (Stucco) and Interior

ANSI A42.4 - Specification for Interior Lathing and Furring

2.3 ML/SFA - Metal Lathing/Steel Framing Association

ML/SFA - Specification for metal lathing and furring

3. TRANSPORTATION, HANDLING AND STORAGE

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3.1 Except for sand and water, deliver materials to the site in sealed containers or bags fully identified with manufacturer's name, brand, type and grade. Store materials in a dry, well-ventilated space, under cover, off the ground, and away from surface subject to dampness or condensation.

3.2 Deliver accessories in their original containers bearing the name of the manufacturer and item identification.

4. QUALITY ASSURANCE

4.1 Allowable Tolerance for Finished Work: For flat surfaces, do not exceed 3mm in 3 meters for bow or warp of surface and for plumbness or level.

4.2 Mock-up Installation: Prior to installation of plaster work, provide sample mock-up panels using materials specified for final work. Build sample panels at site, of full thickness and approximately 1.2 x 1.2m. Demonstrate the proposed range of color, texture and workmanship to be expected in the completed work, and submit to Engineer for review. Retain sample panels construction as a standard for judging completed plaster work. Do not alter, move or destroy sample panel until plastering work is completed. Provide a sample panel for interior and exterior Portland cement plaster and plaster on metal lath.

5. JOB CONDITIONS

5.1 Protection: Protect contiguous work from moisture deterioration and soiling, which may result from plastering operations. Provide temporary covering and whatever other provisions may be necessary to minimize harmful spattering of plaster on other work.

Finished door and window frames and other surfaces which do not receive a plaster finish shall be well protected during plaster application.

5.2 Environmental Conditions:

General: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic conditions to prevent rapid dry-out. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combination of these as required.

Ventilation: Provide adequate ventilation to properly dry interior plaster during and subsequent to its application.

6. GENERAL

6.1 Except as may be otherwise shown on surfaces specified, all plaster work, both internal and external shall be ordinary Portland Cement plaster of the required thickness as shown on the drawings.

6.2 Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sorts of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that all such work is carried out by other contractors before starting of plaster work. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.

7. MATERIALS

7.1 PLASTER ACCESSORIES

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7.1.1 Galvanized steel furring, lathing and other plaster accessories shall conform to the material provisions of ASTM C 841 and ANSI A42.3. Plaster accessories shall include but not limited to the following:

a. Metal Corner Beads: Fabricated from galvanized sheet, 5 mm radius bead with 38 mm wide expanded type flanges.

b. Strip Reinforcement: Smooth edge strips of expanded metal lath fabricated from galvanized steel sheet, with uncoated steel painted after fabrication.

c. Casing Beads: Square-edged style, with short or expanded flanges to suit kinds of plaster bases galvanized steel.

d. Curved Casing Beads: Square-edged style, fabricated from aluminum coated with clear plastic, preformed into curve of radius indicated on the Drawings.

e. Control Joints: Prefabricated, galvanized steel one-or two-piece type as required. Provide removable protective tape on plaster face of control joints.

f. Metal Corner Reinforcement: Expanded large mesh diamond lath fabricated from welded wire mesh from 1.2 mm diameter galvanized wire, specially formed to reinforce corners of Portland cement plaster where exposed while allowing full plaster encasement.

g. Expanded Metal Lath: Galvanized steel diamond mesh complying with ASTM C 847 and shall have a minimum weight of 1.85 kg/m².

7.1.2 Coordinate the depth of accessories with the thickness and number of plaster coats required in accordance with the manufacturer's recommendations and as directed by Engineer.

7.2 PORTLAND CEMENT PLASTER

7.2.1 Portland cement plaster shall have a minimum thickness of 20mm in a double coat provided using but not limited to the following materials:

a. Base Coat Cement: Portland cement, conforming to ASTM C 150, Type I.

b. Finish Coat Cement: Portland cement, conforming to ASTM C 150, Type I.

c. Factory-Prepared Finish Coat: Manufacturer's standard product requiring only the addition of water; white in color unless otherwise indicated.

d. Lime: Special hydrated lime for finishing purposes, conforming to ASTM C 206, Type S.

e. Sand Aggregate for Base Coat: Conform to the requirements of ASTM C 897.

f. Aggregate for Finish coat: Conform to ASTM C 897, manufactured or natural sand to match approved sample.

g. Water for Mixing and Finishing Plaster: Potable, free of substances, capable of affecting plaster set or of damaging plaster, lath or accessories.

h. Bonding Agents: Conform to ASTM C 932.

7.2.2 Portland cement plaster mixes and compositions:

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a. General: Comply with ASTM C 926 for Portland cement plaster base and finish coat mixes as applicable to plaster bases, materials and other requirements indicated. Submit samples of materials used for the approval of Engineer as well as mix design.

b. Base Coat: Proportion materials for respective base coats in parts by volume for cementitious materials and in parts by volume for sum of cementitious materials for aggregates to comply with following requirements for each method of application and plaster base as required. Adjust mix proportions indicated herein within the limits specified to attain workability as follows:

c. Two-coat Work over Concrete or Unit Masonry: Base coats shall be one part Portland cement, 3/4 to 1-1/2 parts lime, 3 to 4 parts sand.

d. Finish Coat: Proportion materials for finish coats in parts by volume for cementitious materials for aggregates with one part Portland cement, 3/4 to 1-1/2 parts lime and 3 parts sand.

7.3 GYPSUM PLASTER (FOR INTERNAL PLASTERING)

7.3.1 Gypsum Plaster Materials:

a. Base Coat Plaster: Conform to ASTM C 28, ready-mixed gypsum, high strength gypsum neat plaster with minimum average dry compressive strength of 19.3 MPa according to ASTM C 472 for a mix of 45 kg plaster and 0.19 m^3 of sand.

b. Finish Coat Plaster: Ready-mixed gypsum finished plaster, manufacturer's standard mill-mixed gauged interior finish or high-strength gypsum gauging plaster, conforming to ASTM C 28, with a minimum average dry compressive strength of 34.5 MPa according to ASTM C 472 for neat mix.

c. Lime: Conform to ASTM C 206, hydrated lime, Type S, for finishing purposes, unless otherwise indicated.

d. Aggregates for Base Coat: Conform to ASTM C 35, sand aggregate, unless otherwise indicated.

e. Bonding Agent: Conform to ASTM C 631.

7.3.2 Gypsum plaster mixes and compositions:

a. Plaster Base Coat Compositions: Comply with ASTM C 842 and manufacturer's directions for gypsum plaster base coat proportions which corresponds to application and plaster bases as indicated below:

1. Three-coat Work over Metal Lath: Scratch and brown coats of high strength gypsum gauging plaster with job-mixed sand.

2. Two-Coat Work Over Unit Masonry and Concrete: Base coats of gypsum neat plaster with job-mix sand.

b. Finish Coat: Proportion materials for finish coat to comply with ASTM C 842 for type of finish coat and texture required.

7.4 CEMENT SAND SCREED

7.4.1 Cement Sand screed be composed of a mixture of Portland Cement type I, natural sand, crushed stone or a combination of them, as well as water and other additives as indicated on Drawings and as required by the Engineer.

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7.4.2 Submit the design mix for Engineer's approval. Cement Sand screed shall have minimum thickness of 75mm unless otherwise indicated on Drawings. Provide wire fabric reinforcement, hardener, protection layer, insulation and membrane waterproofing as required.

7.4.3 Test screed for a minimum compressive strength of 22MPa after 28 days.

8. EXECUTION

8.1 INSTALLATION OF LATHING AND FURRING - GENERAL

8.1.1 Install interior lathing and furring materials indicated for plaster to comply with ASTM C 841.

8.1.2 Install lathing and furring materials indicated for Portland cement plaster to comply with ANSI A42.3.

8.1.3 Install supplementary framing, blocking, and bracing at terminations of work for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar work in accordance with details indicated on Drawings or approved shop drawings.

8.1.4 Isolation: Where lathing and metal support system abuts building structure horizontally, and where partition/wall work abuts overhead structure, isolate the work from structural movement sufficiently to prevent transfer of loading into the work from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support.

8.1.5 Frame both sides of control and expansion joints independently, and do not bridge joints with furring and lathing or accessories.

8.2 INSTALLATION OF CEILING SUSPENSION SYSTEMS

8.2.1 Coordinate installation of ceiling suspension system with installation of overhead structural systems, ducting and catwalks to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers in a manner that will develop their full strength and at spacing required to support ceiling.

8.2.2 Furnish concrete inserts, and other devices indicated, to other trades for installations well in advance of time needed for coordination with other work.

8.2.3 Attach hangers to structure above ceiling to comply with ML/SFA - Specifications for Metal Lathing and Furring as well as with referenced standards.

8.2.4 Install ceiling suspension system components of sizes and spacing indicated but not in smaller sizes or greater spacing than that required by the referenced lathing and furring installation standards.

8.3 METAL LATHING

Install expanded metal lath for the applications where plaster base coats are required. Provide appropriate type, configuration and weight of metal lath selected from materials required which comply with referenced lathing installation standards.

8.4 INSTALLATION OF PLASTERING ACCESSORIES

8.4.1 General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster base.

8.4.2 Accessories:

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a. Corner Beads: Install at external corners.

b. Casing Beads: Install at terminations of plaster work, except where plaster passes behind and is concealed by other work and where metal screed, bases or metal frames act as casing beads.

c. Control Joints: Install at locations indicated, or if not indicated, at spacings and locations required by referenced standard and recommended by plaster manufacturer and approved by the Engineer.

d. Corner Reinforcement: Install at external corners.

8.5 PLASTER APPLICATION

8.5.1 Prepare monolithic surfaces for bonded base coats and use bonding compound or agent to comply with requirements of referenced plaster application standards for conditioning of monolithic surfaces.

8.5.2 Tolerances: Do not deviate more than 3mm in 3000mm from a true plane in finished plaster surfaces, as measured by a 3000mm straightedge placed at any location on surface.

8.5.3 Grout hollow metal frames, bases and similar work occurring in plastered areas, with base coat plaster material, and prior to lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout 150mm lengths at each anchorage.

8.5.4 Sequence plaster application with the installation and protection of other work, so that neither will be damaged by the installation of the other.

8.5.5 Plaster finish with metal frames and other built-in metal items or accessories which act as a plaster ground, unless otherwise indicated. Where plaster is not terminated at metal by casing beads, cut base coat free from metal before plaster sets and groove finish coat the juncture with metal.

8.5.6 Apply thickness and number of coats of plaster as indicated or as required by referenced standards, and as per manufacturer's recommendations.

a. Cement Plaster: Base coat shall be 20mm thick for concrete and CMU. Finish coat shall be 3mm.

b. Gypsum Plaster (for internal use): Base coat shall be 12mm thick. Finish coat shall be 3mm.

8.5.7 Concealed Plaster: Where plaster application will be concealed by wood paneling, above suspended ceilings and similar locations, finish-coat maybe omitted. Where plaster application will be concealed behind cabinets and similar furnishings and equipment apply finish-coat. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish-coat and coordinate thickness with overall dimension as shown and comply with tolerances specified.

8.6 CEMENT SAND SCREED

8.6.1 Roughened the concrete slabs to receive screeding before hardening. Clean and wet the hardened base surfaces, preferably overnight prior to laying of screeds.

8.6.2 Batch accurately aggregates and cement by weight at a ratio of cement-aggregate ranging from 1:3 to 1:4.5. Mix screeding material mechanically.

8.6.3 Lay and finish the screed mix carefully to true levels and correct heights for the required thickness. Tolerance in level over a 2 m length shall not exceed plus or minus 3 mm.

8.6.4 Provide adequate means of curing to prevent rapid drying of screed as directed by the Engineer.

8.7 CUTTING AND PATCHING

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8.7.1 Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects and where bond to the substrate has failed.

8.7.2 Sand smooth-trowelled finishes lightly to remove trowel marks and arises.

8.8 CLEANING AND PROTECTION

8.8.1 Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces which are not to be plastered. Repair floors, walls and other surfaces which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean floors of plaster debris.

8.8.2 Provide final protection and maintain conditions which ensure plaster work being without damage or deterioration at the time of substantial completion.

9.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0270 - MARBLE NATURAL STONE SLAB (TOILET COUNTERS, WALL CLADDING, FLOORING, ETC).

1. SCOPE

The work under this section of specifications, consists of providing all material, labour, plant, equipment, appliances in any floor and at any height and performing all operations required for providing and installing marble natural stone slab for toilet counters, where shown on the drawings, complete in strict accordance with this section of the specification and the applicable Drawings.

2. SUBMITTALS

The Contractor shall submit manufacturer's specifications and other product data for each type of marble stone and fixtures required, including instructions for handling, storage, installation and protection.

Shop Drawings shall be submitted showing sizes, dimensions, sections and profiles, arrangement and provisions for jointing, anchoring, fastening and supports and other necessary fixing details. Indicate locations, layouts and pattern arrangements for each stone type and colour.

Submit three ranges samples 300mm x 300mm in size of each type of stone showing colour, grade, finishing and texture for approval of the Engineer.

3. DELIVERY, STORAGE AND HANDLING

Materials shall be protected from damage during loading, shipment, delivery and storage. Non-staining materials for blocking and packing shall be used. Stack marble at site in accordance with manufacturer's recommendations and as required to prevent staining, scratching, etching or breakage.

4. MATERIALS

4.1 GENERAL

Marble shall be compact, dense, metamorphic rock of lime stone origin obtained from quarries within Pakistan. It shall have a specific gravity of 2.7 and hardness number on Moh's scale shall range from 3 to 4.

Obtain each marble stone type from a single quarry and ensure consistent colour range and texture throughout the work. All pieces shall be of uniform thickness and truly square in shape.

Provide marble slabs/sills and tiles of specified sizes in floors, stair tread & risers and counter tops as shown on drawings.

Provide marble slabs/sills and tiles of type, colour and finish for each area as directed by the Engineer.

Provide stone of specified thickness. Saw cut the back surfaces that are meant to be concealed in finished work.

Provide irregular shaped units, staircase units and skirting base units to the profiles of required shapes & sizes and polished exposed surfaces wherever specified.

4.2 MARBLE STONE TYPE

All marble stone types are to be selected as shown in drawings and approved by the Engineer for quality, colour and texture.

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Marble: Marble of approved type and colour of local origin, first class quality and high class finish acceptable to the Engineer.

4.3 BEDS AND BACKINGS

Where applicable, standard cementitious screed and mortar beds and backings, mixed and proportioned by volume shall be as follows:

Grey / White ordinary Portland Cement : 1 part

Sand : 2 parts

Water : Clean, fresh and free from deleterious substances

4.4 ADHESIVES, GROUTS AND SEALANTS

Proprietary adhesives, joint grouts and sealants of approved type as required and recommended by the manufacturer for specific application shall be used. The colour of the joint grout and the sealants shall match with the colour of stone.

5. EXECUTION

5.1 WALL CLADDING

Set in specified cement sand plaster and metallic clamp fixing arrangements as shown in drawings or as approved by the Engineer.

Point joints as soon as possible after initial set. Force grout into joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces while still moist and as the work progresses.

5.2 FLOORING, MOULDING, THRESHOLD, TRIM, SKIRTING / DADO AND STAIR STEPS

Apply cement slurry coat over surfaces of concrete substrate immediately prior to placing setting bed. Limit area of application to avoid premature drying out. Install setting bed of required thickness and set stone units before initial set occurs. Apply a thin layer of cement paste to bottom of each unit. Set stamps and level units immediately. Set units in required pattern with uniform joint widths.

Point joints as soon as possible after initial set. Force grout into joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces while still moist and as the work progresses.

Do not permit traffic on finished surface during setting and for a minimum of 24 hours after final pointing of joints.

5.3 TOILET & KITCHEN COUNTERS TOPS

Toilet & Kitchen counter tops of the specified size shall be installed in areas shown on Drawings with M.S. angle framing and fixing accessories in accordance with approved shop drawing. Joints shall be cement grouted with matching colour or with matching colour sealant.

5.4 REPAIR AND CLEANING

Remove and replace stone units which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units which do not match adjoining stonework or are not in line and level

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as shown on Drawings. Provide new matching units, install and point joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide neat, uniform appearance.

Clean stonework not less than 6 days after completion of work, using clean water and bristle brushes. Do not use wire brushes, acid or caustic type cleaning agents or other cleaning compounds which may be detrimental to the stone finish or joint grout.

5.5 PROTECTION

Provide covers, boards, supports and all other necessary materials to protect finished work from collapse, deterioration, discolouration or damage during installation and until contract completion.

5.6 POLISHING

The finished surface shall be chemically polished, acceptable to the Engineer.

6.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0280 - GRANITE NATURAL STONE SLAB AND TILE FINISHING

1. SCOPE

The work under this section of specifications, consists of providing all material, labour, plant, equipment, appliances and performing all operations required for providing and installation of granite natural stone slab and tile finishing as shown on Drawings including interior and exterior floors and wall finishing, counter tops, division panels and the like, complete in strict accordance with this section of the specification and the applicable Drawings.

2. SUBMITTALS

The Contractor shall submit manufacturer's specifications and other product data for each type of granite stone required, including instructions for handling, storage, installation and protection.

Shop Drawings shall be submitted showing sizes, dimensions, sections and profiles of slab and tile units, arrangement and provisions for joining, anchoring, fastening and supports and other necessary fixing details. Indicate locations, layouts and pattern arrangements for each stone type and colour.

Submit three range samples 300mm x 300mm (1ft x 1ft) in size of each type of stone showing colour, grade, finishing and texture for approval of the Engineer.

3. DELIVERY, STORAGE AND HANDLING

Materials shall be protected from damage during loading, shipment delivery and storage. Non-staining materials for blocking and packing shall be used. Stack granite units at site in accordance with manufacturer's recommendations and as required to prevent staining, scratching, etching or breakage.

Units of cladding granite shall be clearly marked to identify the final position in the structure as indicated in the shop drawings.

4. MATERIALS

4.1 GENERAL

Obtain each stone type from a single quarry and ensure consistent colour range and texture throughout the work.

Provide continuous slabs or tiles for continuous wall areas, intersecting planes, and countertops to provide continuous matching units.

Provide stone of type, colour and finish for each area of use as approved by the Engineer.

Provide stone of thickness as shown in the drawings or as specified. Saw-cut back surfaces which will be concealed in finished work.

4.2 TYPES

All granite stone types as shown in drawings or as specified are to be selected and submitted for quality, colour and texture approval by the Engineer.

4.3 BEDS AND BACKINGS

Where applicable, standard cementitious mortar beds and backings, mixed and proportioned by volume shall be as follows:

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Grey / White ordinary Portland Cement : 1 part

Sand : 2 parts

Water : Clean, fresh and free from deleterious substances

4.4 ADHESIVES, GROUTS AND SEALANTS

Where specified on the drawing or as directed by the Engineer, proprietary adhesives, joint grouts and sealants; suitable types as required and recommended for specific application; colour match joint grout and sealants to colour of stone shall be used.

4.5 DOWELS & ANCHORS

Contractor shall provide necessary loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers and other steel/brass shapes for securing granite units to other supporting and adjacent members. Provide at least two anchors for each piece.

4.6 SETTING SHIMS OR BUTTONS

Lead buttons of the thickness required for the joint size shown or specified and of the size required to maintain uniform joint width.

5. EXECUTION

5.1 PAVING, FLOORING, SKIRTING, COPING AND STAIR STEPS

Apply cement slurry coat over surfaces of concrete substrate immediately prior to placing setting bed. Limit area of application to avoid premature drying out. Install setting bed to thickness required and set stone units before initial set occurs. Set in cement sand mortar including Class C concrete screed of specified thickness, 200 x 200 wire mesh, cement mortar with approved adhesive, 20mm thick 1:3 dry cement mortar binding course and dry cement spread to bottom of each unit. Set, tamp and level units immediately. Set units in pattern required, with uniform joint widths.

Point joints as soon as possible after initial set. Force grout into joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces while still moist and as the work progresses.

Do not permit traffic on finished surface during setting and for a minimum of 24 hours after final pointing of joints.

5.2 GRANITE WALL CLADDING

Internal & External wall cladding shall be executed in accordance with CP.298, approved Shop Drawings and as per direction of the Engineer.

The granite stone of the specified size shall be set in mortar, fixed using brass dowels, brackets, metallic anchors and plugs and as per details / arrangement and in sizes shown in the drawings. The dowels, anchors or tie must not be subjected to any loading until complete hardness has taken place. Holes and mortises shall be carefully drilled or cut to avoid fracture of the tile. Patching will not be permitted and any damaged tiles shall be removed and replaced at the cost of the Contractor.

5.3 COUNTER AND VANITY TOP ALONGWITH APRON

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Counter and Vanity tops along with Apron of the specified size shall be installed in areas shown on Drawings with M.S. angle framing and fixing accessories in accordance with approved shop drawing. Joints shall be cement grouted with matching colour or with matching colour sealant.

5.4 REPAIR AND CLEANING

Remove and replace stone units which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units which do not match adjoining stonework or is not in line and levels as shown on Drawings. Provide new matching units, install and point joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide neat, uniform appearance.

Clean stonework not less than 6 days after completion of work, using clean water and bristle brushes. Do not use wire brushes, acid or caustic type cleaning agents or other cleaning compounds which may be detrimental to the stone finish or joint grout.

5.5 PROTECTION

Provide covers, boards, supports and all other necessary materials to protect finished work from collapse, deterioration, discoloration or damage during installation and until contract completion.

6.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0290 - FALSE CEILING

1. SCOPE

The work under this section of the specifications, consists of furnishing all plant, labour, equipment, appliances and materials in any floor and at any height and in performing all operations in connection with providing and installing different types of false ceiling including suspension system complete, in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. GENERAL

False ceiling shall be installed wherever indicated on the drawings by skilled technicians experienced in this type of work. Installation shall not commence in any room or space before completion of plasterwork on structural roofing/internal walling/external surfaces.

3. MATERIALS

3.1 ALUMINUM TILES

Tiles shall be of approved size, shape, texture, perforations, fire rating and colour with grooved joints and wool sound insulation including architectural features, as specified or as shown in the drawings, as shown on drawing or as approved by the Engineer shall be used.

All four edges shall be revealed to be installed by an approved recessed suspension system, strictly in accordance with the approved shop drawings, manufacturer's recommendations or instructions of the Engineer.

3.2 ALUMINUM PANELS/STRIPS

Aluminum panel / strips shall be linear or flat, perforated or un-perforated with butt joints and wool sound insulation including decorative baffle and other architectural features, in approved size, shape, texture, fire rating and colour as specified or as shown in the drawings, or as approved by the Engineer shall be used.

3.3 POLISHED HARDWOOD AND GYPSUM BOARD

Tiles / Strips shall be installed in the grid system after completion of installation of the suspension of Electrical and HVAC fixtures.

Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per shop drawings approved by the Engineer.

All panels shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

3.4 BOARD BAND/BORDER/BULKHEADS

Board band / Border / Bulk Heads shall be of any of the following type in sizes, shapes and arrangements as shown in drawings

3.4.1 Plastic emulsion painted cement board ceiling, band / border bulkhead with polished wooden / metal edge trim with compatible suspension system and provision for fixing of light and other fixtures etc.

3.4.2 Combination type including Painted-Cement Board Band / Border with polished wooden edge trim.

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3.4.3 Gypsum board ceiling with hardwood polished decorative geometric pattern and textured paint finish with details as shown in drawings.

3.4.4 Aluminum composite panel FR Ceiling // Bulkhead with compatible suspension system.

Laid out in pattern as shown in drawing or as per shop drawings approved by the Engineer.

All Board band / Border / Bulkheads shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

3.5 SUSPENSION SYSTEM

The suspension system for all types of false ceiling shall be in accordance with the recommendations of the approved false ceiling manufacturer and approved shop drawings, consisting of powder coated or galvanized or painted (as applicable or as shown in drawing) steel suspension system including universal U-channels/ main T/Cross-T Bars, wall mouldings/ edge trims, hold down/adjustment clips, galvanized hanger strips, carriers with adjustment mechanism, etc. as shown in drawing, as recommended by the manufacturer and as approved by the Engineer.

4. SUBMITTALS

4.1 Shop drawings shall be submitted showing reflected ceiling plan, locations of built in products and access facilities, dimensions, layout arrangements, hanger locations, structural connection, details of level changes, direction of pattern and panel joint details along with installation details, location and provision of light fixtures, specialized airport system / telecommunication fixtures, HVAC equipment etc. The shop drawings shall require to be approved by the Engineer in advance of undertaking this item of works.

4.2 No materials shall be procured prior to approval of shop drawings and details.

4.3 The Contractor shall incorporate the required access panels of false ceiling as per approved shop drawings.

5. PRODUCT DELIVERY, STORAGE AND HANDLING

5.1 Material shall be delivered in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.

5.2 Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.

5.3 Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

6. JOB SITE CONDITIONS

6.1 Work which will be concealed by false ceilings shall be completed, tested, inspected and accepted before ceiling work is started.

6.2 False ceiling installation shall not begin until the area has been closed in, and temperature and humidity approximate occupancy conditions. Wet work shall be cured and dry before ceiling work is started.

6.3 Surfaces which will support the ceilings, and those to which the ceiling abut, shall be inspected and accepted for completeness and adequacy to receive the ceilings before the work begins.

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7. INSTALLATION AND WORKMANSHIP

False ceiling suspension system and panels shall be installed in accordance with the requirements of BSI-CP.290 and with the manufacturer's recommendations as approved by the Engineer.

7.1 Suspension System

The hangers as specified shall be evenly disposed as per drawings, details and place and position as shown in drawing or as recommended by the manufacturer and approved by the Engineer. The suspension system should be installed by making holes directly in the roof and shall be made good as directed by the Engineer. Their lengths clear of roofing slab shall be as per shop drawing details.

The framing of the specified section and run at spacing as per shop drawings. The jointing of runners to hangers shall be as per approved shop drawing details. The extra framing if required shall be provided for light receptacles as per approved shop drawing details.

Wall hangers shall be positively and rigidly connected to the structure and to cross runners.

7.2 False Ceiling tiles / strips

Tiles shall be installed in the grid system after completion of installation of the suspension of lighting and air conditioning fixtures.

Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per shop drawings approved by the Engineer.

All panels shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

8. FIXTURES

Light & Specialized Airport / Telecommunication System fixtures shall be installed as per approved pattern and supported in accordance with manufacturer's recommendations.

9. FINISHING

After installation, dirty, soiled or discoloured surfaces shall be cleaned and left free from defects and ready to receive any painted finish if required.

The panels which are damaged or improperly installed shall be removed and replaced by the Contractor at his cost.

10. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0300 - CEMENT CONCRETE FLOORS AND FLOOR FINISHES

1. SCOPE

The work under this section of the Specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the installation of cement concrete floors and floor finishes including bases, skirting and external surface treatments, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. MATERIALS

2.1 CEMENT

Cement shall be ordinary Portland cement conforming to B.S. 12 or PS 232.

2.2 SAND

All fine sand shall be obtained from sources approved by the Engineer. The grading shall conform to B.S 882 Grading Zone 1 and 2 of which the gradation limits are as follows:

2.3 COARSE AGGREGATE

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BSS NO.882 and shall be graded as follows:

B.S. Sieve	% passing by weight
1" (25.40 mm)	100
3/4" (19.05 mm)	90-100
3/8" (9.53 mm)	20-55
3/16" (4.765 mm)	0-10

The aggregate shall be stored on properly constructed paving or as directed by the Engineer. There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required, aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer. Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site without delay. Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the Contractor.

2.4 WATER

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes.

2.5 PORCELAIN TILES, SKIRTING, DADO, STAIR STEPS

Porcelain tiles, skirting, dado, stair steps etc. shall be Shabbir tiles and Master or approved equivalent. The tiles shall be of type, sizes, shade and texture as specified on the drawings and shall conform to

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ISO Standard, ISO 13006 for Bla requirements & BS EN 14411:2012 as specified hereunder. Tiles shall be laid in arrangement as shown in the drawing and as per details and fixing arrangements, including provision of thermal expansion, as shown in the drawing or as recommended by the manufacturer approved by the Engineer.

2.6 CERAMIC TILE

Ceramic tiles shall be of type, sizes, shade and texture as specified on the drawings and shall conform to ISO Standard, ISO 13006 for Bla requirements & BS EN 14411:2012. Tiles shall be laid in arrangement as shown in the drawing and as per details and fixing arrangements, filled with acid resistant or any suitable grout and including provision of thermal expansion, as shown in the drawing or as recommended by the manufacturer approved by the Engineer.

2.7 CLEANING COMPOUND

The compound used for all cleaning of terrazzo shall be an approved neutral chemical cleaner free from acid and alkali or any other material that will affect the colour or otherwise damage the terrazzo and shall not affect the conductivity of terrazzo floors.

2.8 TERRAZZO TILE FLOORING / WALL PANELS

Terrazzo tiles / wall panels, pre-polished or polished after installation at place, shall be of type, sizes, shade and texture as specified on the drawings or as approved by the Engineer. Terrazzo tiles shall be first grade mechanically compressed type conforming to PS-531. Tiles shall be laid in arrangement as shown in the drawing and as per details and fixing arrangements, including provision of PVC or Stainless Steel divider strip, as shown in the drawing or as recommended by the manufacturer approved by the Engineer.

2.9 CARPET FLOORING

Carpet flooring of following types shall be provided, laid and set as per details as specified in drawings and as per manufacturer recommendations and shall be in sizes, shade, design and texture approved by the Engineer.

2.9.1 Wall to wall broadloom carpet laid on finished floor of either porcelain tiles or any other type of floor with rubberized underlay forming rows for prayers or for any other purposes as specified or approved by the Engineer.

2.9.2 Heavy duty carpet tiles in shape, sizes, texture, design and fixing / setting arrangements with rubberized underlay over cemented floor as shown in the drawing and as per details and fixing arrangements recommended by the manufacturer and approved by the Engineer.

2.10 WOODEN FLOOR TILES / WALL CLADDING

Laminated parquet wood floor tiles / wall cladding, MDF board plastic laminated sheet of specified thickness machine pressed with teak wood veneer / lipping all around etc. shall be of type, sizes, shade and texture with interlocking laminated wooden strips pasted over foam pads of specified thickness with plastic barrier or water barrier course of approved thickness on cement screed as specified on the drawings or as recommended by the manufacturer and as approved by the Engineer.

2.11 CEMENT SCREED FLOOR

Concrete / cement screed flooring of following types shall be provided as per details as specified in drawings or as per manufacturer recommendations and approved by the Engineer.

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2.11.1 Heavy Duty Cement Screed Floor of specified finish, thickness & panel size with 2mm thick Epoxy Coating.

2.11.2 Cement Concrete Screed (full body) of specified finish, thickness & panel size with hardener.

2.11.3 Cement Concrete Screed (full body) of specified finish, thickness & panel size.

2.12 PVC FLOORING

PVC tiles over abrasive rubber coarse with PVC lining of following types shall be provided and set as per details as specified in drawings and as per manufacturer recommendations shall be in sizes, shade and texture approved by the Engineer.

2.12.1 Wall to wall PVC tiles flooring of specified thickness with rubberized underlayment over screed as shown in the drawing and as per details and fixing arrangements recommended by the manufacturer and approved by the Engineer.

2.12.2 Antistatic Heavy duty PVC tiles flooring of specified thickness with rubberized underlayment over screed as shown in the drawing and as per details and fixing arrangements recommended by the manufacturer and approved by the Engineer.

3. CEMENT CONCRETE FLOORING

The materials for C.C flooring shall be the same as already specified under clause 2, "Materials".

3.1 COMPOSITION OF CONCRETE

Concrete shall be composed of Portland Cement, sand, coarse aggregate and water, all well mixed and brought to the proper consistency. The Contractor shall mix the ingredients as indicated on the Drawings. The proportions of the various ingredients shall be determined from time to time during the progress of the work and tests shall be made of samples of the aggregates and the resulting concrete. The mix proportions and appropriate water-cement ratio will be determined on the basis of the production of concrete having required workability, density, impermeability, durability and required strength.

3.2 MIXING CONCRETE

The concrete ingredients shall be mixed in a batch mixer for not less than 1-1/2 minutes after all ingredients, except the full amount of water, are in the mixer. The Engineer reserves the right to increase the mixing time when the charging and mixing operations fail to produce a concrete batch in which the ingredients are uniformly distributed and the consistency is not uniform. The concrete shall be uniform in composition and consistency from batch to batch except when changes in composition or consistency are required. Water shall be added prior to, during and following the mixer charge. Excessive over-mixing requiring addition of water to preserve the required concrete consistency will not be permitted. The concrete ingredients shall be mixed by volumetric measurement in purpose-made boxes approved by the Engineer.

3.3 CONSTRUCTION

The base course of the floor shall comprise stone ballast of 2 inches (approx. 50mm) mesh size. The base course shall be thoroughly compacted by suitable power rammers to the total consolidated thickness as shown on the Drawings and as approved by the Engineer. The interstices shall be filled with smaller size stones. The base course shall be blinded with sand and the whole surface watered. Over the well compacted base course, a layer of concrete of the required grade and thickness shall be laid, in panels of the sizes as indicated on the Drawing and as approved by the Engineer.

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After the C.C bed has been cured, as directed by the Engineer, it shall be roughened and well watered before floor finishing is laid. The floor finish shall comprise cement concrete of required grade and shall be laid in panels to the required thickness as shown on the Drawings or as directed by the Engineer. The concrete after laying will be thoroughly rammed and mortar worked up to the top and smoothed with a steel trowel. The edge of each section into which the floor is divided should be defined by wooden screeds of the approved width and of a depth equal to the depth of the floor concrete.

Freshly placed concrete floor and completed floor portions as finished shall be protected to prevent loss of water by covering with damp hessian, waterproof paper, damp sand or other approved material, and shall be kept constantly damp for a period of four days or longer after concreting as directed by the Engineer. The concrete shall be allowed to dry out slowly over a period of three days after wet curing is completed.

The expansion joints shall be filled with hot bitumen of the approved grade, as directed by the Engineer.

4. INSTALLATION OF TILE FLOORING

When setting out the tiles, care shall be taken to establish the correct elevation for the floor. A gauge rod shall be used, indicating the overall measurement of a given number of tiles with specified joint width to reduce cutting.

After the floor has been machine finished, it should be covered with white, non-staining sand or rags to protect it while other work is being done. After removal, the floor shall be thoroughly scrubbed.

4.1 GENERAL

The base shall be prepared by laying cement concrete of specified grade and of thickness as shown on the drawings, or specified in the Bill of Quantities.

The curing period of the setting bed shall be as directed by the Engineer. As large an area of setting bed shall be spread at one time as can be covered with tiles before the mortar has set. Surplus mortar shall be removed. The thickness of setting bed in any space shall not be less than 20mm.

Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust, oil and other objectionable matters. Tiles shall be laid out from the centre line of each space in an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles as directed by the Engineer.

Joints between the tiles shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges.

4.2 CERAMIC / PORCELAIN TILES

The ceramic / porcelain tiles shall be laid to the required lines, levels and grades over a setting bed of cement sand mortar comprising one part of cement and 3 parts of sand by volume and the joints filled with neat white or grey cement including vertical and horizontal covers. The tile floor shall be kept wet for at least 72 hours and no traffic should be allowed on the tiles during curing period.

4.3 TERRAZZO TILES FLOORING

The tiles shall be well soaked in water and kept in a vertical position to drain out all surplus water. The bed over which the tiles would be laid shall be 20mm thick cement sand mortar as specified by the Engineer. The cement sand mortar shall be prepared and mixed with clean granular sand in the proportion of 1:3 and spread uniformly on the thoroughly wetted and moist surface. The tiles shall be

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laid so that cement mortar slurry rises up in the joint. The tiles shall be laid in the pattern as specified by the Engineer. The levels and lines shall be checked with very fine white and the defects removed then and there. After 3 or 4 days the slurry from the joints shall be raked out and colored cement of required shade shall be spread in the form of slurry to fill all joints. It shall be neatly wiped off the surface when still wet. After about 10 days the area shall be rubbed and ground with Carborundum stone and the whole surface rendered smooth and washed with plenty of water. After allowing to dry the surface shall be wax polished. The finished surface shall not show any depressions in individual tiles or undulations in the floor.

4.4 Epoxy Resin Flooring

Work under this section shall comprise supply, installation, and finishing of Epoxy Resin Flooring system over prepared concrete substrates, complete in all respects and in strict accordance with the manufacturer's specifications and directions of the Engineer. The scope shall include thorough cleaning and preparation of the substrate surface to remove all dust, laitance, grease, and loose particles, followed by repair of all visible cracks, voids, and surface irregularities using epoxy mortar or an approved compatible filler to achieve a sound, level base. Upon acceptance of the prepared surface, a flooring primer coat shall be applied to enhance bond strength and adhesion between the substrate and the subsequent coating layers. Thereafter, a two-component protective epoxy coating system shall be applied in the specified number of coats to deliver a smooth, seamless, and durable monolithic finish. The completed floor system shall exhibit high resistance to abrasion, chemical attack, staining, and moisture ingress, suitable for the intended service environment. All materials shall be sourced from an approved manufacturer and applied by trained and experienced applicators using appropriate equipment in accordance with the product technical data sheets.

5.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0310 - GYPSUM BOARD DRYWALL SYSTEMS

1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height providing and installation of Gypsum Board for (i) Ceiling suspension system, wall framing and furring systems for dry walls (ii) walls and ceilings (iii) metal deck platform ceiling and ceiling suspension system complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. APPLICABLE STANDARDS

2.1 ANSI - American National Standards Institute, Inc.

A97.1 - Standard Specifications for the Application of Finishing of Wallboard

2.2 ASTM - American Society of Testing and Materials

ASTM A 525 - Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A 641 - Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-dip Process

ASTM C 36 - Specification for Gypsum Wallboard

ASTM C 442 - Specification for Gypsum Backing Board and Core Board

ASTM C 475 - Specification for Joint Compound and Joint Tape for Finishing Gypsum Wallboard Construction

ASTM C 630 - Specification for Water-Resistant Gypsum Backing Board

ASTM C 645 - Specification for Non-Load Bearing (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board

ASTM C 754 - Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum

ASTM C 840 - Specification for Application and Finishing of Gypsum Board

2.3 GA - Gypsum Association

GA 201 - Using Gypsum Board for Walls and Ceilings

GA 216 - Recommended Specifications for the Application and Finishing of Gypsum Board

GA 220 - (Reference)

2.4 BS - British Standards Institute

BS 476 - Fire Tests on Building Materials and Structures

3. SUBMITTALS

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3.1 Product Data: Submit manufacturer's product specification and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these Specifications.

3.2 Samples: Submit manufacturer's samples for the Engineer's approval.

3.3 Shop Drawings: Submit complete shop drawing of layout and details of ceiling and/or partitions for the Engineer's approval.

3.4 Mock-Up: Install a full-size mock-up showing different elements completed for drywall partitions and ceilings.

4. TRANSPORTATION, HANDLING AND STORAGE

Comply with the requirements of transportation, handling and storage specified in ASTM C 840.

5. MATERIALS

5.1 METAL SUPPORT SYSTEM

5.1.1 Ceiling Support System as detailed below or as shown in drawings or as recommended by the manufacturer and approved by the Engineer:

a. Main Runners: Steel channels with rust inhibitive coating (Galvanized), hot or cold-rolled, minimum nominal thickness 0.6mm with 40mm flanges and channel web of suitable size.

b. Hanger Wire: Conform to ASTM A 641, soft, Class 1, galvanized.

c. Hanger Rods and Flats: Mild steel with zinc or equally rust inhibitive coating for rods and zinc or rust-inhibitive paint finish for flats.

d. Furring Members: Conform to ASTM C 645, not less than 0.6mm thick, hat-shaped with 19mm flanges.

e. Furring Anchorage: Conform to ASTM C 754, 1.6mm diameter galvanized wire ties, manufacturer's standard wire-type clips, bolts, nails or screws.

f. Direct Suspension System: Manufacturer's standard zinc-coated or painted steel system of furring runners, tees, and accessories designed for concealed support of gypsum drywall ceilings.

5.1.2 Wall / Partition Support Materials:

Runners, Studs and Furring: Formed from steel sheets conforming to ASTM C 645 with manufacturer's standard hot-dipped galvanized coating to ASTM A653, G60, and minimum 0.7 mm thick with web dimension compatible with thickness of wall as shown on Drawings. Provide holes and knockouts for utilities. Furring members shall be hat-shaped type.

5.2 GYPSUM BOARD

5.2.1 Regular Gypsum Board for General Use: Conform to the requirements of ASTM C 36, Grade R or DIN 18-180, regular, 15 mm thick for ceilings / tile ceilings, board band / borders / bulkhead, walls with tapered or beveled edges (DFB manufacturer or equivalent) as per shapes, dimension, texture and arrangements, fixing details as shown in drawings or as per manufacturer's recommendation and approved by the Engineer in paint or textured finish on to rigid metal concealed suspension system including access panel, trims, edge trims, shadow trims, expansion joints complete in all respect.

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5.2.2 Metal Deck Platform Ceiling: Shall consist of double layer, regular gypsum boards ceiling, 15 mm thick each layer and internal metal decking for use in ceiling of operation theaters and other similar function rooms, as shown on drawings. Construct ceiling system as per approved shop drawings. Gypsum board ceiling shall be fastened to structural steel bulb tees and joists spaced at regular intervals and attached to ceiling suspension system through metal decking on which cast-in-place lightweight concrete slab is poured. Sizes of hanger rods, steel joists, metal decking and bulb tees shall be as recommended by manufacturer and approved by the Engineer. Structural steel members shall conform to ASTM A 36.

5.2.3 Moisture-Resistant Gypsum Board for Toilets, Washroom, Showers, Kitchens, Cafeteria, Ablution Areas and Similar Wet Areas: Conform to ASTM C 630 or DIN 18-180, Type X, 12 mm thick for ceilings and 15 mm thick for walls with tapered or beveled edges.

5.2.4 Fire retardant wallboard: Where indicated on Drawings, use Type X, same requirements as mentioned above.

5.3 MISCELLANEOUS MATERIALS

5.3.1 Fasteners:

5.3.1.1 Screws: Self-drilling, self-tapping bulge head for use with powder-driven tool and of the type recommended by board manufacturer for the intended application.

5.3.1.2 Fasteners for furring members: Type and size shall be as recommended by furring manufacturer for the substrate and intended application.

5.3.2 Joint Treatment Materials:

5.3.2.1 Joint reinforcing tape: Perforated type, width range between 45 mm and 60 mm, and 0.3 mm thick.

5.3.2.2 Joint compound: As recommended by the board manufacturer for the intended application and in accordance with ASTM C 475.

5.3.2.3 Concealed Sealants: Mastic type, non-shrink, non-drying, non-migrating, and non-staining sealant.

5.3.2.4 Exposed Sealant: Acrylic-latex type, permanently elastic and paintable.

5.3.3 Trim Accessories:

5.3.3.1 General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound.

6. EXECUTION

6.1 PREPARATION OF FRAMING SYSTEMS

Ceiling Anchorage: Coordinate work with the structural ceiling work to ensure that the inserts as well as the other structural anchorage provisions have been installed to receive ceiling hangers.

6.2 INSTALLATION OF FRAMING SYSTEMS

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6.2.1 Ceiling Support System: Installation shall conform to ASTM C 754. Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to inserts, clips or other anchorage devices and fasteners as indicated.

6.2.2 Wall Support System: Installation shall conform to ASTM C 754. Align top and bottom tracks to assure plumb wall. Secure track with suitable fasteners at a maximum of 600 mm on center. Position studs in track at 600 mm on center spacing.

6.2.3 Installation of framing system shall comply with requirements of ASTM C840 or GA 216.

6.3 BOARD INSTALLATION

6.3.1 Locate exposed end-butt joints as far from center of walls and ceilings, and stagger not less than 300 mm in alternate courses of board.

6.3.2 Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling.

6.3.3 Install wallboard vertically to avoid end-butt joints wherever possible.

6.3.4 Install boards with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.5 mm open space between boards. Do not force in place.

6.3.5 Installation of ceiling boards shall comply with requirements of ASTM C840 or GA 216.

7. ADJUSTMENT AND CLEANING

7.1 When face of paper for gypsum board is punctured, a new screw shall be driven approximately 30 mm from puncture and fill damaged surface with compound.

7.2 Fill cracks with compound and finish smooth and flush.

8. PROTECTION OF WORK

The required procedures for protecting drywall work from damage and deterioration during remainder of construction period shall be as recommended by board manufacturer or drywall installer and approved by the Engineer.

9. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

SECTION 0320 - DEMOUNTABLE PARTITIONS

1. SCOPE

The work under this section of the Specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the fabricating, furnishing and installing of demountable partitions, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. APPLICABLE CODE & STANDARDS

The codes and standards applicable to only a portion of the work specified in this section are referenced in the relevant paragraphs.

3. SUBMITTALS

The following submittals are required:

3.1 Detail drawings and/or shop drawings.

3.2 Assembly, Erection and Installation Drawings and Manuals.

3.3 Manufacturer's data.

3.4 Certificate of Compliance.

4. MATERIALS & FABRICATION

4.1 MATERIALS:

1. Cement Board Fiber Reinforced partition and door for barricading.

2. Wooden demountable partition and door for offices comprised of wooden framing, cladding with 12mm thick high density fiber board, both sides plastic laminated with machine press and teak wood lipping all around with complete set of hardware.

3. Compact high Density Fiber Board Wall and Door of specified thickness (density 1000 kg/m³) both sides melamine laminated coating, scratch resistance, splash water resistance and flame retardancy / fire resistance for cubicles and wash rooms & other wet areas with complete set of hardware (SS 304 grade) or as specified or as shown in drawing or as recommended by the manufacturer and approved by the Engineer.

4.2 FABRICATION

4.2.1 Substructure

Base, top and wall connecting channels made of roll-formed galvanized steel 1.5mm thick, surface stove enameled dark brown (KAL 8014), recessed 19mm from the surface of the partition.

Studs made of galvanized steel set up at intervals of module size 1,200mm or 1,500mm as shown on drawings.

4.2.2 Cladding

High density laminated chipboard E1 manufactured to DIN standards; holding edges have an easy to maintain laminate (HPL) finish. For special areas cladding with real wood veneer must be possible.

4.3 GLAZING

Where required glazing should be provided. Frame made of aluminium anodized flush with the partition surface.

4.4 DOORS

Door frame made of anodized aluminium, flush with the partition.

Door leaf as 40mm sandwich element coated on both sides to match the partition surface.

- Total thickness partition: 108 mm

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- Skirting height minimal: 80 mm

- Element joints: 6 mm

- Element height: clear room height

- Module: 1,500mm

- Sound insulation value for full wall element (according to DIN 52210): 45 dB

- Fire rating (according to DIN 4102): F 30

5. EXECUTION

5.1 CONDITION OF SURFACES

Examine the substructure, adjoining construction and the conditions under which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

5.2 INSTALLATION

5.2.1 General

a) Install demountable partitions and accessories in accordance with the manufacturer's printed instruction, unless otherwise shown or specified.

b) Space metal studs at centers as recommended by the manufacturer. Align tracks accordingly to the partition layout at both floor and ceiling. Secure floor and ceiling channels as recommended by the manufacturer.

Support end joints on framing members.

Do not align end joints with edges of openings.

Install control joints as shown.

5.2.2 Demountable Partition

a) Floor and Ceiling Attachments: Align and secure runners accurately at the floor and ceiling in accordance with the partition layout as shown.

b) Wall Attachments: Align and secure side angle runners to intersecting walls or columns of other materials.

c) Core Boards: Cut and fit sheets between floor and ceiling runners. Cut necessary openings in core boards to accept electrical services before installation. Install core board sheets vertically.

Place cut to size section of core board over metal door frame header. After core board is installed, spot grout door frame at each anchor clip, using joint compound.

Nail core board panels together at corners and intersection of partitions using 10d minimum common nails spaced 600mm (24 inch) centers.

d) Face Layer: Provide 13mm (1/2 inch) thick face layer sheets on both faces, unless otherwise shown. Cut panels to fit completely inside floor and ceiling runners. Apply joint compound or adhesive to core board or to back of face layer sheet. Apply face layer sheet vertically to core board with vertical joints offset from core board joints. Press face layer firmly against core board to ensure an adequate bond. Secure with drywall screws as recommended by the wall board manufacturer.

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5.3 PROTECTION

Protect the demountable partitions during the construction period so that it will be acceptable without any indication of use or damage at the time of acceptance.

6.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0330 - PAINTING AND COATING

1. SCOPE

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in any floor and at any height in connection with surface preparation, mixing, painting concrete works, gates, frames, walls, ceilings and all such surfaces as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. APPLICABLE STANDARDS

Latest editions of following British Standards are relevant to these specifications wherever applicable.

2.1 BSI (British Standards Institution)

245 - Specification for mineral solvents (white spirits and related hydrocarbon solvents) for paints and other purposes.

2521 - Lead-based priming paint for wood work.

2523 - Lead based priming paint for iron and steel.

2569 - Sprayed metal coatings.

4800 - Paint colours for building purposes.

CP.231 - Painting of building.

CP.3012 - Cleaning and preparation of metal surfaces.

2.2 FS - Federal Specifications

P-W-158E - Wax, General Purpose, Solvent Type

TT-E-489G - Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)

TT-E-506K - Enamel, Alkyd, Gloss, Tints and White (for Interior Use)

TT-E-509B(2) - Enamel, Odorless, Alkyd, Interior, Semi-gloss, White and Tints

TT-E-527C - Enamel, Alkyd, Lusterless

TT-E-543A(1) - Enamel, Interior, Undercoat, White and Tints

TT-F-336E - Filler, Wood, Paste

TT-P-19C(2) - Paint, Acrylic Emulsion; Exterior

TT-P-25E(2) - Primer Coating Exterior (undercoat for Wood, Ready-Mixed, White and Tints)

TT-P-29J(1) - Paint, Latex Base, Interior, Flat, White and Tints

TT-P-30E - Paint, Alkyd, Odorless, Interior, Flat, White and Tints

TT-P-37D - Paint, Alkyd Resin; Exterior Trim, Deep Colors

TT-P-52D(2) - Paint, Oil, (Alkyd-Oil) Wood Shakes and Rough Siding

TT-P-55B(2) - Paint, Polyvinyl Emulsion, Exterior

TT-P-81E - Paint, Oil, Alkyd, Ready Mixed, Medium Shades

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TT-P-641G(1) - Primer Coating; Zinc Dust-Zinc Oxide (for Galvanized Surfaces)

TT-P-645A - Primer Paint, Zinc Chromate, Alkyd Type

TT-P-650C(1) - Primer Coating; Zinc Dust-Zinc Oxide (for Galvanized Surfaces)

TT-P-664C(2) - Primer Coating, Synthetic, Rust-Inhibiting, Lacquer Resisting

TT-S-176E(1) - Sealer, Surface, Varnish Type, Floor, Wood and Cork

TT-S-300A - Shellac, Cut

TT-S-708A(2) - Stain, Oil, Semi-Transparent, Wood, Exterior

TT-S-711C - Stain, Oil-Type, Wood, Interior

TT-V-86C(1) - Varnish, Oil, Rubbing (for Metal and Wood Furniture)

2.3 SSPC - Steel Structures Painting Council

SP-6-63 - Commercial Blast Cleaning

SP-10-63T - Near-White Blast Cleaning

2.4 ASTM - American Society for Testing and Materials

ASTM D 16 - Standard Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products

ASTM D 562 - Consistency of Paints Using the Stromer Viscometer

ASTM D 2833 - Standard Index of Methods for Testing Architectural Paints and Coatings

ASTM D 3276 - Standard Guide for Painting Inspectors (Metal Substrates)

ASTM D 3927 - Standard Guide for State and Institutional Purchasing of Plant

ASTM E 84 - Surface Burning Characteristics of Building Material

3. SUBMITTALS

3.1 Product Data: Submit manufacturers technical information including instructions for thinning, mixing, curing and touch-up.

3.2 Manufacturer's standard color charts.

3.3 Test Reports and certificates of compliance.

3.4 Samples: Prior to beginning work, furnish color chips for surfaces to be painted. Submit samples for the Engineer review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

3.4.1 On 300mm x 300mm hardboard, provide 2 samples of each color and material, with texture to simulate actual conditions. Re-submit samples as requested by Engineer until acceptable sheen, color and texture is achieved.

3.4.2 On wood surfaces, provide 2 samples 100 x 200mm of natural and stained wood finish on actual wood types. Label and identify each as to location and application.

3.4.3 On concrete masonry, provide two 100 mm square samples of masonry for each type of finish and color, defining filler, prime and finish coat.

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3.4.4 On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. Provide full-coat finish samples on at least 9m² of surface, as directed, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.

3.4.5 Final acceptance of colors will be from samples applied on the job.

4. TRANSPORTATION, HANDLING AND STORAGE

4.1 Deliver materials to job site in manufacturer's original new and unopened packages and containers bearing manufacturer's name and label, and following information:

Name or title of material. Manufacturer's stock number and date of manufacture. Manufacturer's name. Contents by volume, for major pigment and vehicle constituents. Thinning instructions. Application instructions. Color name and number.

4.2 Store materials not in actual use in tightly covered containers in a well-ventilated area and protect from moisture, direct sunlight and temperatures below 10°C and above limits recommended by the manufacturer. Maintain containers used in storage of paint in clean conditions, free of foreign materials and residue.

4.3 Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

5. QUALITY ASSURANCE

5.1 Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

5.2 Coordination of Work: Review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

5.3 Material Quality: Provide manufacturer's best quality trade sale paint material of various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

6. JOB CONDITIONS

6.1 Do not paint when air is dust-laden or when weather and temperature conditions are unsuitable. Do not paint exterior surfaces in damp or rainy weather. Comply with manufacturer's recommendations with respect to application and drying period temperatures.

6.2 Apply water-based paints only when temperature of surfaces to be painted and surrounding air temperatures are between 10°C and 32°C unless otherwise permitted by paint manufacturer's printed instructions.

6.3 Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 70°C and 65°C unless otherwise permitted by paint manufacturer's printed instructions. (Note: likely a range error, but kept as original)

6.4 Do not apply paint when relative humidity exceeds 85% or to damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.

6.5 The Contractor shall repair at his own expense all damaged or defective areas of shop-painted metal work and structural steel work. Metal surfaces against which concrete is to be placed will be furnished shop-painted and shall be cleaned prior to being embedded in concrete.

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7. MATERIALS

7.1 Material Quality: Paints (listed below), coatings, and primers shall be ready-mixed at the manufacturer's plant and shall be delivered in sealed containers, labeled and identified. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Paints and finishes shall have Class A rating in accordance with ASTM E 84. Materials without manufacturer's identification as a standard, best-grade product will not be acceptable. Use products of same manufacturer for succeeding coats.

7.1.1 Weather resistant paint over CC Plaster, soft, exposed surfaces.

7.1.2 Epoxy Paint over MS Framing Structures.

7.1.3 Water repellent coatings.

7.1.4 Textured paint over Fair face Precast Elements.

7.1.5 Plastic emulsion paint over CC plaster, fairfaced concrete, exposed surfaces, soft.

7.2 Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

7.3 Color and Texture:

7.3.1 Exterior Painting: Color, and texture of the exterior paint shall be as indicated on Drawings.

7.3.2 Interior Painting: Colors, textures, and degree of luster will be as indicated on the Drawings and as per Specifications. Color selection will include safety colors for hazards in accordance with ANSI Z53.1 Safety Color Code for Marking Physical Hazards. Tint prime and undercoats approximately to the shade of the final coat but with sufficient variation to distinguish them from the preceding coat.

7.4 Mildewcide: Paints shall contain a mildewcide as recommended by the manufacturer.

7.5 Solvents and Thinners: As recommended by the paint manufacturer.

8. PAINTING SCHEDULE

8.1 Exterior Paint Schedule

8.1.1 Concrete, Plaster and Masonry - Smooth:

a. Prime Coat: Acrylic Primer Sealer based on Copolymer Resins.

b. Second Coat: Acrylic Copolymer Exterior Emulsion / Weather Resistant Total Dry Film Thickness (DFT) 30 micron.

c. Finish Coat: Same as for Second Coat.

8.1.2 Concrete, Plaster, and Masonry - Textured:

a. Prime Coat: Acrylic Primer Sealer based on Copolymer Resins.

b. Second Coat: Acrylic Copolymer Exterior Emulsion (Sprayed Applied), Dry Film Thickness (DFT) 50 micron.

c. Finish Coat: Same as for Second Coat.

8.1.3 Waterproof Painting System:

a. Proprietary coating system consisting of synthetic rubber copolymer and suitable for external exposed application.

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b. Prime coats and finish coat shall be applied as per the manufacturer's written recommendations for the intended application.

8.1.4 Ferrous Metals:

a. Prime Coat: Polyamide Cured Epoxy Primer, 50 micron (DFT).

b. Second Coat: High Build Epoxy, 125 micron thick (DFT).

c. Finish Coat: Two-Component Polyurethane, semi-gloss, 50 micron (DFT).

8.1.5 Zinc-Coated Metals:

a. Prime Coat: Acrylic Water Based Primer for GI.

b. Second Coat: Alkyd Enamel, semi-gloss, 30 micron (DFT).

c. Finish Coat: Same as for second coat.

8.1.6 Painted Wood:

a. Prime Coat: Wood Primer based on Alkyd Resins.

b. Second Coat: Wood Filler based on Alkyd Resins.

c. Third Coat: Under coat based on Alkyd Resins.

d. Fourth Coat: Alkyd Enamel, semi-gloss, 30 micron (DFT).

e. Finish Coat: Same as for fourth coat.

8.1.7 Natural Finish Wood:

a. Prime Coat: Wood Stain based on Alkyd Resins.

b. Second Primer: Wood Stain based on Alkyd Resins.

c. Third Coat: Lacquer, semi-gloss, 25 micron (DFT) based on Urethane Alkyd Resins.

d. Finish Coat: Same as for third coat.

8.2 Interior Paint Schedule:

8.2.1 Concrete, Plaster, Gypsum Board, Reinforced Decorative Gypsum and Masonry:

a. Prime Coat: Acrylic Primer Sealer based on Copolymer Resins.

b. Second Coat: Acrylic Copolymer Interior / Plastic Emulsion, eggshell, Dry Film Thickness 25 micron (DFT).

c. Finish Coat: Same as for second coat.

8.2.2 Anti-Bacterial Paint Suitable for Hospital Applications on Concrete, Plaster, Gypsum Board, Reinforced Decorative Gypsum and Masonry:

a. Prime Coat: Anti-Bacterial Acrylic Primer Sealer based on Copolymer Resins, flat.

b. Second Coat: Anti-Bacterial Acrylic Copolymer Interior Emulsion, eggshell, undiluted coats at minimum 50 micron Dry Film Thickness (DFT).

c. Finish Coat: Same as for second coat.

8.2.3 Ferrous Metals: (As specified in Exterior Paint Schedule for ferrous metals)

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8.2.4 Zinc-Coated Metals: Same as specified for Exterior Paint Schedule.

8.2.5 Painted and Natural Finish Wood: Same as specified in Exterior Paint Schedule.

8.2.6 Exposed Metal Pipes, Ducts, and other Metal work: Same as specified in Exterior Paint Schedule for each type of metal.

9. EXECUTION

9.1 INSPECTION

9.1.1 Examine substrate and conditions under which painting will be performed. Proceed with the work only when conditions are satisfactory.

9.1.2 Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

9.2 SURFACE PREPARATION

9.2.1 General:

a. Remove hardware and accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

b. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

c. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

d. Fill dents, cracks, hollow places, open joints, and other irregularities with a filler suitable for the purpose and, after setting sand to a smooth finish.

e. Prime surfaces not more than 8 hours after cleaning. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Engineer in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

9.2.2 Concrete, Masonry and Plaster Works: Prepare surfaces of concrete, concrete masonry cement plaster and gypsum plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze. Use abrasive blast-cleaning methods if recommended by paint manufacturer and approved by Engineer.

a. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

b. Clean concrete floor surfaces scheduled to be painted with a commercial solution of (text incomplete in original, but preserved as is).

9.2.3 Gypsum Board: Repair minor cracks and holes with finishing compound, and sand smooth after drying.

9.2.4 Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended

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knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

9.2.5 Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop coated; remove mortar, plaster, grease, dirt, rust, loose mill scale and other foreign substances by solvent or mechanical cleaning methods that comply with the recommendations of the Steel Structures Painting Council, before priming coat is applied.

9.2.6 Shop-Primed Ferrous Surfaces: Remove grease, oil and other foreign substances with approved type of cleaner manufactured for the purpose. Exercise care to prevent damage to shop coat. Touch-up abraded or marred shop coats with paint used for priming.

9.2.7 Zinc-Coated (Galvanized) Surfaces: Remove grease and oil with a cleaner manufactured for the purpose. Treat surfaces with a chemical compound such as a phosphoric acid wash. Remove the chemical compound completely with clean, fresh water.

9.3 MATERIALS PREPARATION

9.3.1 Mix and prepare painting materials in accordance with manufacturer's directions.

9.3.2 Maintain containers used in mixing and application of paint in clean condition, free of foreign materials and residue.

9.3.3 Stir materials before application to produce mixture of uniform density, stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

9.4 APPLICATION

9.4.1 Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied. Do not exceed manufacturers recommended coverage per gallon. Apply materials with care to a uniform and proper film thickness, showing no runs, holidays, sags, crawls, or other defects. Apply with a minimum of brush marks. Finish surfaces shall be uniform in sheen, color and texture and match approved samples.

9.4.2 Allow coats to dry thoroughly before succeeding coats are applied; allow a minimum of 24 hours between applications on any one surface unless otherwise specified by the paint materials manufacturer.

9.4.3 Sandpaper undercoats on interior metal thoroughly and uniformly to provide a smooth, even surface for finish coats.

9.4.4 Apply paint by brush, roller, spray, or other acceptable practice in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, and high-sheen wool as recommended by the paint manufacturer for material.

9.4.5 Brush-out and work all brush coats into the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Neatly draw all primer or first coats, unless otherwise permitted to use mechanical applicators.

9.4.6 Except as otherwise specified, apply a prime coat to material that is required to be painted or finished.

9.4.7 Apply the first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

9.4.8 Number of coats and paint film thickness required is the same regardless of the application method. Sand between each enamel and varnish coat application with fine sandpaper or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the paint manufacturer's directions.

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9.4.9 Allow sufficient time between successive coatings to permit thorough drying. Do not re-coat until paint does not deform or feel sticky under moderate thumb pressure and the application of loss of adhesion of the undercoat.

9.4.10 Paint type, color, surface treatment shall be as scheduled. Provide finish coats that are compatible with prime paints used.

9.4.11 When undercoats, stains, or other conditions show through the final coat of paint, apply additional coats until the paint film is of uniform finish, color and appearance. Ensure that all surfaces including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

9.4.12 Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only. Exposed surfaces are defined as those areas visible when permanent or built-in fixtures, convector covers, covers for fanned tube radiation, grilles and similar items are in place in areas scheduled to be painted.

9.4.13 Where visible through registers or grilles, paint interior surfaces of ducts and void spaces with a flat, non-specular black paint.

9.4.14 Paint the back sides of access panels and removable or hinged covers to match the exposed surfaces.

9.4.15 Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.

9.4.16 Omit primer on metal surfaces that have been shop-primed and touch-up painted.

9.4.17 Dry Film Thickness: Provide dry film thickness for each finish type, including prime and finish coats, not less than total dry film thickness as specified in painting schedule.

9.4.18 Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

9.4.19 Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable.

9.4.20 Transparent (Clear) Finishes: Use multiple coats to produce glass-smooth surface film.

9.4.21 Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or re-paint work not in compliance with specified requirements.

9.5 CLEAN-UP AND PROTECTION

9.5.1 Clean-Up:

a. During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

b. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

9.5.2 Protection:

a. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable by the Engineer.

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b. Provide Wet Paint signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

c. At completion of work of other trades, touch-up and restore damaged and/or defaced surfaces.

10. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0335 - PIR INSULATED SANDWICH PANELS

1. Scope

The work under this item shall consist of supplying, transporting, handling, storing, installing, fixing, sealing, finishing and protecting PIR insulated sandwich panels for walls/roof or other locations as shown on the drawings, design details and approved shop drawings.

The work shall include all panels, fixing accessories, trims, flashings, sealants, fasteners, supports, cutting, jointing, alignment, sealing, finishing and all incidental works required for a complete, weather-tight, insulated and finished installation, as directed by the Architect and Engineer-in-Charge.

2. Material Requirements

PIR insulated sandwich panels shall be factory-manufactured, rigid, pre-finished insulated panels of approved make and source. Panels shall generally comply with the following minimum requirements unless otherwise shown on drawings:

Panel type: PIR insulated sandwich panel.

Core material: CFC-free Polyisocyanurate/PIR insulation.

Panel thickness: 100 mm, or as shown on drawings/design.

Core density: 38–40 kg/m³ minimum.

External face sheet: 0.5 mm thick pre-painted galvanized iron sheet, low-rib profile, colour as approved by the Architect/Engineer.

Internal face sheet: 0.5 mm thick pre-painted galvanized iron sheet, low-rib profile, colour as approved by the Architect/Engineer.

Panel width: approximately 1000 mm, or as per manufacturer’s standard and approved shop drawings.

Manufacturing: Ozone-friendly cyclopentane-based technology or approved equivalent.

Surface finish: factory pre-painted, uniform colour, free from dents, scratches, stains, rust, delamination and other visible defects.

All materials shall be new, unused, first quality and suitable for the climatic conditions of Skardu, including low temperature, wind exposure, snow load, UV exposure and thermal movement.

3. Accessories

The Contractor shall provide all necessary accessories required for complete installation, including but not limited to:

Panel fixing screws/fasteners with washers;

Jointing accessories;

Trims;

Corner flashings;

End closures;

Ridge/eaves/edge flashings where applicable;

Approved silicone/sealant;

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Foam fillers where required;

Cover strips;

Base channels/support interfaces where shown;

Touch-up paint for minor approved repairs.

All accessories shall be compatible with the panel system and shall be approved by the Engineer before installation.

4. Shop Drawings and Submittals

Before procurement and installation, the Contractor shall submit the following for approval:

Manufacturer's technical data sheet;

Panel samples and colour sample;

Shop drawings showing layout, panel direction, fixing details, joints, trims, flashings, openings and interface with structure;

Method statement for installation;

Material test certificates;

Fire performance certificate/test report;

Thermal insulation data;

Warranty certificate;

Manufacturer's installation manual.

No material shall be ordered or installed without approval of the Engineer.

5. Installation

Panels shall be installed strictly in accordance with the approved shop drawings, manufacturer's recommendations and directions of the Architect/Engineer.

Installation shall include:

Checking of supporting structure before fixing;

Proper alignment, line, level and plumb;

Accurate cutting around openings and edges;

Proper lapping and jointing;

Fixing with approved fasteners at recommended spacing;

Sealing of all joints, corners, flashings and penetrations;

Protection of finished surfaces during and after installation;

Removal of protective film where applicable;

Final cleaning and making good.

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Panels damaged during transport, handling, cutting or installation shall be replaced at the Contractor's cost if rejected by the Engineer.

6. Quality Control

The Engineer may inspect panels at factory or site before installation. Materials shall be rejected if found defective, damaged, deformed, delaminated, rusted, poorly painted or inconsistent with the approved sample.

The completed installation shall be checked for:

Alignment and level;

Firm fixing;

Proper sealing;

Joint finish;

Colour uniformity;

Weather tightness;

Surface cleanliness;

Absence of gaps, leakage paths and visible defects.

7. Warranty

The Contractor shall provide manufacturer's warranty for PIR insulation and panel system. The minimum warranty shall cover manufacturing defects, delamination, insulation failure and installation defects for the period approved under the Contract. Paint/steel sheet warranty shall be as per manufacturer's standard warranty and approved by the Engineer.

8. Measurement and Payment

Measurement shall be made in square feet (Sft) of actual approved installed panel area, measured on the finished surface as shown on drawings and accepted by the Engineer.

The BOQ quantity is 26,841.94 Sft.

The quoted rate shall include supply, transportation, loading, unloading, storage, handling, installation, fixing accessories, trims, flashings, sealants, cutting, wastage, tools, tackles, scaffolding/access arrangement, protection, cleaning, testing, warranty and all incidental works required for complete installation.

No separate payment shall be made for accessories, fasteners, sealants, flashings, trims, cutting, wastage, protection or minor adjustments unless specifically stated in the BOQ.

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SECTION 0340 - ROAD WORKS

PART 01 — GENERAL REQUIREMENTS

1.1 Project Description

This specification covers all road works associated with the construction of the Air Traffic Control Tower (ATCT), Fire Station, and allied facilities at Skardu International Airport, Gilgit-Baltistan, Pakistan. Works include access roads, service roads, and internal circulation roads within the airport boundary as shown on Drawings.

1.2 Scope of Roads

Drawing Ref.	Road Alignment	Length (m)	Road Width (m)	Remarks
R-04 / R-08 / R-09	ATC Tower to Apron	521.97	14.50	Primary access
R-04 / R-09 / R-10	ATC Tower to Old Runway PAA	1,050.60	14.50	Main perimeter road
R-04 / R-09 / R-10	ATC Tower to Old Runway PAA (cont.)	1,050.60	14.50	See profile sheets
R-04 / R-10	PAA Runway to PAF Runway	223.10	14.50	Connector road
R-04	ATC Tower to PAA Runway (N-S link)	~500	14.50	Internal service road

NOTE: All dimensions are in METERS unless indicated otherwise. Coordinate System: WGS84. Pavement Height: 0.95 m above finished grade.

1.3 Road Cross-Section Summary

All roads are dual carriageway, symmetrical about centerline. Total formation width: 14.50 m as shown on Drawings R-06 and R-07.

Element	Width (m)	Cross-fall	Notes
Drain/Curb (each side)	2.00	—	Steel grating drain with Precast PCC kerb (3000 PSI)
Shoulder (shy distance, each side)	1.50	2%	Compacted granular, matchs carriageway crossfall
Carriageway (each side of CL)	3.75	2%	Asphalt pavement; 2% fall away from centerline

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TOTAL ROAD WIDTH	14.50	—	Symmetrical — fill section, cut section, cut & fill
Side Slopes (fill)	1V:1.5H	—	Embankment slopes per Drg. R-06
Side Slopes (cut)	1V:1H	—	Cut slopes per Drg. R-07

1.4 Applicable Standards & References

- Overseas Road Note 31 (TRL, UK) — Primary design standard
- NHA General Specifications (Pakistan, latest edition) — Works execution standard
- AASHTO LRFD Bridge/Highway Design Specifications
- ASTM International — Material testing standards
- Pakistan Standards & Quality Control Authority (PSQCA)
- PAA / ICAO airport pavement design requirements

SUBMITTAL PROCEDURES

1.1 Pre-Construction Submittals

Mobilization Plan, Organizational Chart, Programme of Works (Primavera / MS-Project)

HSE Plan, QA/QC Plan, Traffic Management Plan

Performance Bond and Insurance documents

Plant calibration certificates: Asphalt Batch Mix Plant (third-party, Engineer-approved)

Survey team credentials: Licensed Land Surveyor + 2 assistants; Total Station calibration certificate (≤ 6 months old)

BM register and daily survey log

Job Mix Formula (JMF) + Trial Section report (50 m full width)

1.2 Material Source Approvals (Before Delivery)

Aggregates: LAA, soundness, flakiness, gradation test reports

Bitumen: penetration, softening point, ductility, flash point test reports

Water quality certificate

NOTE: *No material shall be incorporated without Engineer's written approval.*

1.3 During Construction

Daily field test results: FDT, MDD/OMC, layer gradation

AWC plant samples: extraction, gradation, Marshall

Pavement cores: 1 per 500 m² for thickness and density

Weekly QC Report to Engineer

Survey check report on every layer (subgrade, GSB, ABC, AWC)

1.4 At Completion

Full as-built drawings (plan, profile, cross-sections)

All test certificates and QC records

Photographic record

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QUALITY REQUIREMENTS

1.1 Testing Frequencies

Layer / Material	Test Type	Frequency	Standard
Subgrade	FDT (Sand-Cone / Nuclear)	Every 500 m² per layer	Modified AASHTO MDD
Granular Subbase (GSB)	FDT, Gradation, Atterberg	Every 500 m² per layer	AASHTO T180
Aggregate Base Course (ABC)	FDT, Gradation, LAA, PI	Every 500 m² per layer	AASHTO T180
Prime Coat	Application rate check	Each section	MC-30 / MC-70
AWC (plant)	Extraction, gradation, Marshall	Per shift / per 100 tonnes	AASHTO T166, T245
AWC (pavement core)	Thickness, density	1 per 500 m²	AASHTO T230
AWC (survey)	Line, level, crossfall	Every layer, full length	NHA Tolerances

PART 02 EARTHWORK

SITE CLEARING

1.1 Description

Clear, grub, and strip the full formation width including side slopes and drainage channel areas.

2.1 Products — Topsoil

Topsoil stripping minimum 150 mm depth. Stockpile separately for landscaping reuse at an Engineer-approved location with proper drainage and protection.

3.1 Execution

Clear all vegetation, roots, and organic material within the road formation.

Dispose of unsuitable material at Engineer-approved spoil area only.

Do not mix stripped topsoil with sub-soil excavation.

Maintain dust suppression by water bowsing twice daily.

Cover stockpiles in windy conditions.

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EARTHWORK & GRADING

1.1 Summary

Earthwork comprises cut and fill operations to achieve formation levels as shown on the Road Profile and Cross-Section drawings (R-06, R-07, R-08 through R-37).

1.2 Road Profile Data

Longitudinal profiles for each alignment extracted from drawings are summarized below:

Alignment	Start Station	End Station	Start Elev. (m)	End Elev. (m)	Grade (%)
ATC Tower to Apron	0+000	0+521.97	2228.52	~2229.6	+0.27% (approx.)
ATC Tower to Old Runway PAA (Segment 1)	0+000	0+540	2228.52	2230.00	0.00% / flat
ATC Tower to Old Runway PAA (Segment 2)	0+540	1+050.60	2230.00	2218.68	-4.63%
ATC Tower to Old Runway PAA (Segment 3)	1+010	1+050.60	~2219	2218.68	-0.45%
PAA Runway to PAF Runway	0+000	0+223.10	~2219	~2219	Level / minor

NOTE: Vertical Curve data: PVI STA 0+050, PVI Elev. 2230.00, K=185.98, LVC=50 m (start of alignment); PVI STA 0+760, PVI Elev. 2230.00, K=16.20, LVC=75 m (mid-section); Low Point STA 10+024.70, Low PT Elev. 2218.79, PVI STA 0+995.70, PVI Elev. 2216.90, K=11.06, LVC=50 m (end). Refer to profile drawings for all PVI data.

1.3 Embankment (Fill) Sections

Side slopes: 1 Vertical: 1.50 Horizontal (1V:1.5H) for fill areas

Embankment layers: maximum 200 mm loose thickness per compacted layer

Compaction: 95% Modified AASHTO MDD

Proof-roll embankment after every two layers using loaded tipper truck (≥ 10 t axle load)

Do not place embankment on frozen, wet, or soft ground

1.4 Cut Sections

Side slopes: 1 Vertical: 1.00 Horizontal (1V:1H) for cut areas

Side slopes: 1V:1.5H for cut-and-fill transition zones (as shown on Drawing R-07)

Dispose of surplus cut material at Engineer-approved spoil area

Bench cut slopes in hard material where instability risk exists

2.1 Subgrade Requirements

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Parameter	Requirement	Test Method	Reference
CBR (minimum)	5%	AASHTO T193	Drg. R-02, General Note 1c
Compaction depth	Top 300 mm (1.0 ft)	—	Drg. R-02, General Note 3
Compaction standard	95% Modified AASHTO MDD	AASHTO T180	Drg. R-02, General Note 3
FDT frequency	1 per 500 m² per layer	Sand-Cone / Nuclear	Drg. R-03, Section C3
Proof-roll	Required before GSB placement	Loaded truck	Drg. R-03, Section C3

3.1 Execution — Earthwork

Set out centerline, edges, ROW, and toe lines at 20 m intervals and at every PI/PC/PT.

Install reference pegs and offset pillars. Maintain BM register and daily survey log.

Execute cut/fill to formation levels per Plan & Profile drawings.

Correct any soft or pumping spots in subgrade before proceeding.

Verify all BMs and control points jointly with the Engineer (ref. Drawing 0-01).

PART 03 EXTERIOR IMPROVEMENTS

AGGREGATE BASE COURSES

1.1 Summary

This section specifies Granular Subbase Course (GSB) and Aggregate Base Course (ABC) for all road alignments at Skardu Airport.

1.2 Pavement Layer Schedule

Layer	Thickness (mm)	CBR Req.	Zone	Drawing Ref.
Asphaltic Wearing Course (AWC)	50	—	Carriageway (full width)	R-06, R-07
Aggregate Base Course (ABC)	80	≥ 80%	Carriageway (full width)	R-06, R-07
Granular Base	300	—	Carriageway (CL zone)	R-06, R-07

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Granular Base (shoulder zone)	380	—	Outer zones	R-06, R-07
Granular Subbase Course (GSB)	150	≥ 30%	Full width	R-06, R-07
Compacted Subgrade	300 min.	≥ 5%	Full width	R-06, R-07
TOTAL PAVEMENT STRUCTURE	880 (CL) / 960 (shoulder)	—	—	—

2.1 Products — Granular Subbase Course (GSB)

Property	**Requirement**	**Test Standard**
CBR	≥ 30% (minimum)	AASHTO T193
Gradation & PI	Per NHA Schedule	AASHTO T27 / T89
Max. layer thickness (loose)	≤ 200 mm	—
Compaction	100% Modified AASHTO MDD	AASHTO T180
Surface tolerance	± 15 mm	3 m straightedge

2.2 Products — Aggregate Base Course (ABC)

Property	Requirement	Test Standard
CBR	≥ 80% (minimum)	AASHTO T193
Material	Crushed, hard, durable	Visual + AASHTO T96
Los Angeles Abrasion (LAA)	≤ 30%	AASHTO T96
Soundness	≤ 12%	AASHTO T104
Flakiness Index	≤ 25%	BS 812
Plasticity Index (PI)	≤ 6	AASHTO T90
Max. layer thickness (loose)	≤ 150 mm	—

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Compaction	100% Modified AASHTO MDD	AASHTO T180
Surface tolerance	± 10 mm	3 m straightedge

3.1 Execution — Base Courses

Verify and certify subgrade completion before placing GSB.

Place GSB in maximum 200 mm loose layers; compact to 100% Modified AASHTO MDD.

Place ABC in maximum 150 mm loose layers; compact to 100% Modified AASHTO MDD.

Apply prime coat on finished ABC surface before AWC placement.

Maintain crossfall at -2% (away from centerline) throughout construction.

Check surface tolerance against 3 m straightedge after each layer.

PART 04 ASPHALT PAVING

1.1 Summary

Asphaltic wearing course (AWC) for all road surfaces. Design based on Overseas Road Note 31 and NHA specifications. AWC thickness: 50 mm.

2.1 Materials — Prime Coat

Property	Requirement	Notes
Bitumen Grade	Cutback MC-30 or MC-70	NHA Schedule item
Application Rate	0.8–1.2 L/m²	Over dry, broomed ABC
Application Temperature	50–70 °C	Cutback bitumen
Curing Time	24–48 hours minimum	Protect from traffic until absorbed

2.2 Materials — Tack Coat

Property	Requirement	Notes
Bitumen Grade	RC-70 or Emulsion SS-1h	NHA approved
Application Rate	0.25–0.40 L/m²	Between bituminous layers
Surfaces	Between all bituminous layers; vertical faces of joints, kerbs, structures	—

2.3 Materials — Asphaltic Wearing Course (AWC)

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Property	Requirement	Reference
Bitumen Pen. Grade	60/70 pen (ARL / NRL approved)	NHA Schedule
Bitumen Content	4.0–5.5% by weight of mix	Job Mix Formula (JMF)
Aggregate	Per NHA Schedule	Source-approved before use
Design Method	Marshall	AASHTO T245
Marshall Stability	≥ 1,000 kg	AASHTO T245
Marshall Flow	2–4 mm	AASHTO T245
Air Voids (Va)	3–5%	AASHTO T269
VMA	Per NHA Specifications	—
VFA	Per NHA Specifications	—
Compaction (field)	≥ 96% of JMF density	AASHTO T166 / T230
Thickness	50 mm	Drawings R-06, R-07

2.4 Temperature Limits (NHA — Strictly Enforced)

Process	Temperature Limit	Action if Violated
Bitumen storage in tank	Max 165 °C (never exceed 175 °C)	Stop heating, investigate
Aggregate heating in dryer	150–170 °C	Adjust burner
Mixing at plant	150–165 °C	Adjust and re-check
Discharge at paver	≥ 140 °C (reject if < 135 °C)	Reject load, return to plant
Initial / breakdown rolling	≥ 130 °C	Start rolling immediately after paving
Intermediate rolling	100–130 °C	Pneumatic-tyre roller phase
Final rolling	≥ 80 °C	Steel tandem finish pass

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Ambient air temperature	≥ 10 °C and rising	No paving in rain, snow, or on damp / frozen surface

3.1 Execution — Asphalt Paving

Submit and obtain approval for JMF and Trial Section (50 m full width) before regular paving.

Apply prime coat to ABC surface. Allow 24–48 hr curing before placing AWC.

Apply tack coat between all bituminous layers and at vertical faces.

Pave with self-propelled crawler-track paver; minimum working width 2.5 m; electronic grade and slope sensors with averaging ski/beam ≥ 9 m for main road.

Use Material Transfer Vehicle (MTV) to avoid segregation and temperature drop.

Rolling sequence: Breakdown rolling (Steel Tandem 8–10 t) immediately behind paver. Intermediate rolling (Pneumatic-tyre 15–25 t @ 0.55–0.85 MPa tyre pressure). Finish rolling (Steel Tandem 8–10 t).

Longitudinal joints: offset between successive layers ≥ 150 mm. Joints to be hot, vertical, painted with tack coat.

No paving in rain, snow, or when ambient temperature < 10 °C.

PART 05 — CURBS, KERBS & GUTTERS

1.1 Summary

Precast PCC kerb stones and steel grating drainage channels as shown on Drawing R-06 (Typical X-Section of Fill).

2.1 Products — Kerb Stones

Item	Specification	Drawing Reference
Type	Precast PCC Kerb Stone	Drg. R-06 Detail
Concrete Strength	3,000 PSI (≈ 20.7 MPa)	Drg. R-06 Detail
Kerb Dimensions (standard)	150 (base) × 350 (height) mm profile	Drg. R-06 Kerb Stone Detail
Precast PCC Kerb (alternate)	150 × 150 × 100 mm section with lean concrete base PCC (1:4:8)	Drg. R-06 PCC Kerb Detail
Installation	Set on compacted earth with 1.5-inch clear cover reinforcement	Drg. R-06 Section A

2.2 Products — Drainage Channel (Steel Grating)

Item	Specification	Drawing Reference

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Type	Steel Grating Drain	Drg. R-06 Detail 'A'
Drain Width	2.00 m each side (within Drain/Curb zone)	Drg. R-06
Channel Box	PCC 1:2:4 reinforced with #3@9" C/C bars, 4" cover	Drg. R-06 Detail 'A'
Grating Frame	6.35 × 6.35 × 0.63 angle iron welded frame	Drg. R-06 Detail 'A'
Cramp	2.54 × 2.54 × 0.31 cramp welded to 5.08 × 5.08 × 0.63 angle iron frame	Drg. R-06 Detail 'A'

PART 06 — PAVING SPECIALTIES (TUFF PAVERS)

1.1 Summary

Tuff pavers are specified for the pedestrian plaza and entry forecourt areas as shown on the road plan drawing (R-04). Provide interlocking concrete block paving (Tuff Tiles) in designated areas.

2.1 Products

Tuff Paver (Interlocking Concrete Block): minimum compressive strength 35 MPa (5,000 PSI)

Thickness: 60 mm for pedestrian areas; 80 mm for light vehicle areas

Laying pattern: herringbone (45° to traffic direction)

Bedding sand: sharp, clean, 25–50 mm compacted depth

Edge restraint: kerb as specified in Section

3.1 Execution

Prepare base compacted to 95% MDD before laying sand bed.

Lay pavers on compacted sand bed, maintain consistent joint width 2–4 mm.

Fill joints with dry fine sand and vibrate in using plate compactor.

PART 07 — FENCING & SITE FURNISHINGS

1.1 Scope

Provide footpath, road shoulders, and ROW boundary fencing as shown on drawings. Footpaths 5'-0" (1.52 m) wide are indicated along all main road alignments on Drawing R-01.

PART 08— UNDERGROUND UTILITIES IN ROAD CROSS-SECTION

1.1 Summary

The road cross-section incorporates conduits for utilities within the drainage/curb zone on each side of the road as shown on Drawings R-06 and R-07.

2.1 Products

Item	**Specification**	**Location**

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Electrical Conduit	Ø 150 mm PVC/HDPE conduit	Drain/Curb zone, each side
Fibre Optic (FO) Conduit	Ø 100 mm PVC/HDPE conduit	Drain/Curb zone, each side
Depth of Cover	Minimum 600 mm below finished surface	Per utility routing drawings
Bedding	Sand bedding 150 mm all around	Prior to drainage concrete channel

NOTE: *Install all conduits before placing drainage channel concrete. Co-ordinate utility routing with MEP engineer. Provide draw-wire in each conduit.*

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TEMPORARY FACILITIES & CONTROLS

PLANT, MACHINERY & EQUIPMENT

1.1 Minimum Equipment Requirements (NHA Standard)

Equipment	Minimum Specification	Notes
Asphalt Batch Mix Plant	Fully automatic, min 100 TPH; 4 cold-feed bins, rotary dryer, vibrating hot screen, hot bins, mineral-filler silo, bitumen tank ≥ 30 t, bag-house dust collection	Plant calibration cert (third-party) before trial mix
Plant Location	Within 40 km haul distance from laying point; EPA/NOC required	Separate stockpile bays per fraction
Asphalt Paver	Self-propelled crawler-track; hydraulic screed 2.5–6.0 m; electronic grade & slope sensors; avg. ski ≥ 9 m	MTV recommended
Breakdown Roller	Steel Tandem vibratory, ≥ 10 t	AASHTO T177
Intermediate Roller	Pneumatic-tyre 15–25 t @ 0.55–0.85 MPa	Valid calibration required
Finish Roller	Steel Tandem 8–10 t	Valid weight certificate
Earthwork Roller (GSB/ABC)	Vibratory smooth-drum ≥ 10 t	—
Motor Grader	≥ 125 HP	For shaping and grading
Water Bowser	≥ 6,000 L each	One per active section
Bitumen Distributor	Calibrated spray bar (prime/tack coat)	—
Tipper Trucks (HMA)	Insulated body with tarpaulin cover	For hot mix transport
Total Station	Accuracy 1", with Auto Level ≤ 0.5 mm/km	Calib. cert ≤ 6 months
On-site QC Lab	Sieve analysis, Atterberg, MDD/OMC, FDT, CBR, LAA, Marshall, extraction, bitumen pen/softening/ductility, core density	Established before works start

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HSE REQUIREMENTS

HEALTH, SAFETY & ENVIRONMENT

1.1 General

Mandatory PPE: helmet, hi-vis vest, safety boots, gloves, ear protection (near plant).

Traffic management: TCP, signage, flagmen, and lighting during night works.

Dust suppression: water bowsing twice daily; cover stockpiles in windy conditions.

Spill kits at fuel point and bitumen tank at all times.

Mobilize within 14 days of NTP.

Submit HSE Plan, QA/QC Plan, and Traffic Management Plan before commencement.

1.2 Environmental Controls

Stockpile topsoil separately for reuse — no disposal without Engineer approval.

Dispose of unsuitable/surplus material at designated Engineer-approved spoil area.

Obtain EPA/NOC for asphalt plant location before operation.

Plant area to be away from residential zones; paved access road provided.

Separate stockpile bays per aggregate fraction with drainage and fencing.

1.3 Plant Worthiness

All machinery in sound working order with road-worthiness certificates.

All rollers with valid calibration and weight certificates.

Total Station and QC lab equipment calibrated within 6 months.

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APPENDIX A — KEY DRAWING SCHEDULE

Drawing No.	Drawing Title	Content
R-01	ATC Roads Plan (Satellite View)	Overall airport road layout
R-02	General Notes	Design basis, CBR parameters, NHA notes
R-03	General Notes for Contractor	Mobilization, plant, earthworks, pavement, QC, HSE
R-04	Plan	Road alignment plan with stationing
R-05	Route Co-ordinates	WGS84 station co-ordinates for all alignments
R-06	Typical Cross Section (Fill, 14.50 m)	Pavement layers, drain, conduits, kerb details
R-07	Typical Cross Section (Cut & Cut-Fill)	Cut slopes, same pavement structure
R-08 to R-09	ATC Tower to Old Runway PAA (Plan & Profile)	Horizontal + vertical alignment, grade data
R-10	ATC Tower to Old Runway PAA (Profile cont.)	Vertical curve data, elevations
R-11 onwards	Additional road profiles and cross-sections	As listed in drawing register

APPENDIX B — COORDINATE REFERENCE DATA (WGS84)

All coordinates are in WGS84. Station increment: 20.00 m for all alignments. Sample coordinates from Drawing R-05:

Station	Northing (m)	Easting (m)	Alignment
0+000.00	3,909,931.1585	549,195.5965	ATC Tower to Apron
0+521.97	3,910,367.5192	548,909.1714	ATC Tower to Apron (End)
0+000.00	3,909,902.0723	548,200.0759	ATC Tower to Old Runway PAA

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1+050.60	3,910,478.5773	549,078.3653	ATC Tower to Old Runway PAA (End)
0+000.00	3,910,507.0050	549,121.6741	PAA Runway to PAF Runway
0+223.10	3,910,629.4275	549,308.1815	PAA Runway to PAF Runway (End)

NOTE: *Full coordinate tables for all alignments are given on Drawing R-05. All levels and dimensions are in METERS unless otherwise noted.*

Contractor's Geotechnical Investigation

Before commencement of earthwork, road, pavement, foundation, underground tank, retaining wall, utility trench or any substructure work, the Contractor shall carry out confirmatory geotechnical investigation at site and submit the complete subsoil investigation report to the Engineer/Employer for review and confirmation.

The investigation shall include boreholes/test pits, Standard Penetration Tests (SPT), disturbed and undisturbed sampling, groundwater observations, laboratory testing, bore logs, subsoil profiles, CBR values for pavement areas, bearing capacity, settlement assessment, soil classification, chemical analysis of soil/groundwater and recommendations for foundation, subgrade, embankment and pavement works.

Minimum investigation frequency shall be as follows, unless otherwise increased by the Engineer due to weak, variable or doubtful ground conditions:

Work Area / Structure	**Minimum Boreholes / Test Pits**
Road and pavement area	1 borehole/test pit per 2,500 m², minimum 3 locations
Road alignment	1 borehole/test pit at every 250 m interval, minimum 2 locations
ATCT / major building foundation	Minimum 4 boreholes, one near each corner/grid zone
ARFF / service buildings	Minimum 2 boreholes per building block
Underground water tanks / septic tanks / deep structures	Minimum 2 boreholes per structure
Culverts, retaining walls and major drains	Minimum 1 borehole/test pit at each structure location
High embankment or soft/loose soil area	Additional boreholes as directed by the Engineer

Borehole depth shall be adequate to establish the complete subsoil profile and shall not be less than 6 m below proposed formation/foundation level for road and pavement works, and not less than 10 m below foundation level for buildings and underground structures, unless refusal is encountered earlier in rock or otherwise approved by the Engineer.

SPT shall generally be carried out at 1.0 m depth intervals or at change of strata, in accordance with ASTM D1586/NHA practice. Laboratory testing shall be performed in an approved laboratory as per ASTM/AASHTO standards.

No related permanent work shall proceed until the geotechnical report has been submitted and reviewed by the Engineer. Review by the Engineer shall not relieve the Contractor from responsibility for correctness of investigation, interpretation and execution of works.

Unless separately provided in the BOQ, no separate payment shall be made for geotechnical investigation, testing, reporting, reinstatement and all related works; the cost shall be deemed included in the relevant BOQ rates.

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MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0350 – CONSTRUCTION OF TUBEWELL AND PERFORMANCE OF AQUIFER TEST

PART 1 – GENERAL

1.1 SCOPE

This section covers the specifications of the items/works related to construction of Tubewell and performance of Aquifer test.

1.2 PROGRAMME OF WORK

The Contractor shall submit the work programme showing his plan to complete the works within time. The timetable of the work is the essence of the contract. The contract may be terminated if the Contractor falls behind in programme and if it is in the judgment of the Engineer that the measures proposed by the Contractor are inadequate to complete the whole work within the contract period. No payment shall be made to the Contractor in respect to the loss of profits or expenses incurred if the contract is terminated due to the Contractor falling behind in the Programme.

1.2.1 Working Site

Skardu International Airport, Pakistan

1.2.2 Order of the Work

The Engineer will determine the order in which the work is to be carried out.

1.2.3 Machinery and Equipment

The Contractor shall be solely responsible for furnishing at site the drilling rig and related equipment, instruments, appliances, accessories, materials, labour, technicians etc. required to complete the works to the satisfaction of the Engineer.

1.2.4 Drillers and Supervisory Staff

The Contractor shall have at site at all times qualified, experienced and thoroughly competent persons for the execution and supervision of the drilling and related works.

1.3 MOBILIZATION AND DEMOBILIZATION

1.3.1 Mobilization

Mobilization shall include transporting the drilling rig and all related accessories, materials and staff to the site of work.

1.3.2 Material Inspection

Materials supplied by the Contractor must be inspected and approved for construction at the Site(s). The Contractor shall ensure that materials are suitable, comply with technical specifications, and cause no delays due to quality or preparation.

1.3.3 Demobilization

Demobilization shall consist of removal from the site of the drilling rig, related accessories, equipment and extra materials after completion of the work, leaving the Site clear, clean and tidy to the satisfaction of the Engineer. Transportation to Contractor’s store or elsewhere is at Contractor’s expense.

PART 2 – PRODUCTS

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2.1 TUBEWELL CASING COMPONENTS

- **Slotted Tubewell Casing** – PVC Class 'D', against water-bearing formations.
- **Blank Tubewell Casing** – PVC Class 'D', against non-water-yielding formations.
- **Bail Plug** – bottom of casing, PVC Class 'D' with plug.

Casing diameter as specified in Bill of Quantities. Jointing system shall be flush (no collars or bolts protruding).

2.2 GRAVEL SHROUDING MATERIAL

- Clean, washed, water-worn, carbonate-free, hard, well-rounded, no thin/flat particles.
- Source: Skardu nearby quarry or other approved location.
- Gradation for slot sizes 1.0 to 1.5 mm:

U.S. Standard Sieve No.	Sieve Size (mm)	% Passing for slot size 1.00 – 1.5 mm
4	4.75	100
8	2.36	75-91
10	2.00	59-75
12	1.70	38-54
16	1.18	16-32
20	0.85	(as per image)

2.3 TRANSITION SEAL MATERIAL

Coarse bentonite (pellets/chips) to separate filter pack from cement-based seals. Hydration: ~1 gallon water per 2 lb bentonite, allow ~1 hour.

2.4 WELL CAP

Mild steel, 1/4" (6mm) thickness, diameter same as well opening. Prevents entry of surface water, floodwater, persons, or animals.

2.5 PIEZOMETERS (for Aquifer Test)

- Diameter: 125 mm
- Casing material: PVC Class 'B', 75 mm diameter
- Arrangement: one test well + three piezometers at distances of 3 m, 15 m, 30 m from main well.
- Clean hand pump required.

2.6 TESTING EQUIPMENT

- Water-lubricated or oil-lubricated test pump capable of ≥150% of tubewell rated capacity.

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- Valve for fine discharge adjustment.
- Electric measuring device for drawdown.
- Imhoff cone (1000 mm) for sand content.
- Flow measurement devices (orifice, meter, weir box) – remain Contractor's property.

PART 3 – EXECUTION

3.1 CONSTRUCTION OF TUBEWELL – PREPARATION

- Transport all plant, labour, materials to site.
- Prepare site: pit for water storage, arrange drilling water.
- Drill borehole, collect & preserve lithological samples in polyethylene bags (every 5 ft or change of lithology).
- Electric logging (see 3.3).
- Lower blank & slotted casings.
- Place gravel shrouding.
- Verify verticality & straightness.
- Develop and test tubewell.
- Collect water samples for chemical quality testing.

3.2 DRILLING PROCEDURES

- **Method:** Reverse rotary rig.
- **Borehole diameter:** 22/18 inches as per drawing.
- **Verticality tolerance:** deviation ≤ half the borehole diameter over entire length. Pump assembly shall hang exactly vertical.
- **Protection:** Contractor shall prevent caving/sloughing; stabilize unstable materials as approved.
- **Abandonment:** If borehole is lost or abandoned before required depth due to Contractor's negligence, Contractor drills new hole at alternative location at own expense – no payment for abandoned work.
- **Failure to achieve full depth:** Contractor shall drill new borehole until required depth is reached, at own cost.

3.3 ELECTRIC LOGGING

3.3.1 Types of Logs (continuous record)

- Short Normal (406 mm) resistivity
- Long Normal (1626 mm) resistivity
- SP log

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- Gamma log

3.3.2 Measurement Device

Capable of continuous recording to drilled depth; calibrated before work; inspected and approved by Engineer.

3.3.3 Re-measurement (at Contractor's cost)

- Ambiguous data due to poor operation.
- Non-compliance with specifications.

Four copies of final logs with interpretation submitted to Engineer within 7 days of logging.

3.4 INSTALLATION OF CASING AND GRAVEL PACK

- **Casing installation:** PVC Class 'D' blank/slotted sections as directed. Length from top to bottom depth determined by Engineer.
- **Centralizers:** Attached at ~12 m intervals to center casing in borehole.
- **Straightness/plumb:** Entire assembly shall be straight and concentric. Any tubewell not meeting requirement shall be abandoned and replaced at Contractor's expense.
- **Gravel placement:**
    - Thickness ≥ 4.75 mm annular space.
    - Use tremie pipe or similar, introduce at two points 180° apart.
    - Lower tremie to bottom, pour gravel, raise in 1.5 m intervals.
    - Temporary casing (if used) to be withdrawn in 1.5–3 m intervals with gravel filling each stage before withdrawal.
- **Transition seal:** 1.5 m of bentonite pellets/chips above filter pack. Add water for hydration. Allow ~1 hour before placing cement-based seals.
- **Well cap:** Must be installed after drilling – secure, welded as specified.

3.5 DEVELOPMENT AND TESTING

3.5.1 Initial Development

Pump at **150%** of designed capacity. Bail out any sediment. Development complete when water is clear, sand-free, and discharge constant (Engineer's satisfaction).

3.5.2 Final Development & Sand Tests (Summary table from document)

Phase	Activity	Duration
Development	Pump at 75%,100%,125%,150% of rated capacity (one hour each step)	4 hours
1st Recovery	Measure water levels	1 hour

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Phase	Activity	Duration
Sand Test 1	Pump at 150% of rated capacity, measure initial specific capacity	1 hour
Re-development	Pump at 150% of rated capacity, surge/backwash every 5-10 min	3 hours
Re-sand Test	Pump at 150% of rated capacity, measure second specific capacity	1 hour
2nd Recovery	Measure water levels	2 hours

Sand content criteria:

- After first 5 min: < 100 ppm
- After 10 min: < 30 ppm
  If exceeded, Contractor resumes development at own expense until satisfied.

Specific capacity requirement:

If second sand test specific capacity is >10% greater than first sand test, development incomplete – Contractor shall resume development.

3.5.3 Step Test & Final Pumping (after 2-hour recovery)

- Four-hour step test at 75%, 100%, 125%, 150% (one hour each). Last increment at 150%.
- Then pump at 150% of design capacity for 4 hours.

3.5.4 Oil-lubricated pumps precautions

Minimize oil leakage; promptly remove any oil from water surface using detergents or emulsification; otherwise Engineer may restrict to water-lubricated pumps.

3.6 PERFORMANCE OF AQUIFER TEST

Method: Pump-out test – non-steady state formula (Theis 1935, modified by Jacob & Cooper 1946). Compute transmissivity, specific yield, cone of influence.

3.6.1 Pre-pumping Phase

Monitor water levels in test well and three piezometers every 60 minutes. Record variations due to barometric pressure, temperature, traffic, etc. Data attached to final report.

3.6.2 Pumping Phase

Pump at constant discharge **95 m³/hr** for **48 hours continuously**.

Pump capacity sufficient for >95 m³/hr; engine capable of constant speed for 48 hours.

Typical arrangement of Tubewell and piezometers – image (original document, page 9)

3.6.3 Collection and Analysis of Water Sample

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Contractor collects 2 groundwater samples from tubewell; arranges chemical, biological, and arsenic analysis from approved laboratory. Submit results to Engineer.

3.6.4 Data and Records (Contractor's responsibility)

Accurate drilling history, fluid/circulation losses, time log, lithological log with depths. Use Engineer-approved forms. All records become property of Employer. Original data handed over to Engineer.

3.7 SITE CLEANUP

After completing all works, Contractor shall remove all machinery, equipment, plants, waste materials and clear the site to the Engineer's satisfaction.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0360 – PLUMBING

PART 1 – GENERAL

1.1 SCOPE

Providing all material and equipment and performing all work for complete execution and completion, including testing and commissioning of all plumbing works as shown and/or specified. Systems include: Cold and Hot Water Supply, Sanitary Drainage, Roof Drainage.

1.2 GENERAL REQUIREMENTS

All materials and equipment as specified; submit samples, catalogues, sketches, name of manufacturer, guarantee before installation. Approval does not absolve Contractor of responsibility. Contractor responsible for work until final acceptance; replace damaged/lost/stolen items. All openings covered and protected. Open ends of pipes plugged. Misuse of fixtures prohibited. Metal trimmings covered with non-corrosive grease. Upon completion, all fixtures cleaned, polished. Pipes cleaned of oil/grease before erection. Special tools delivered at no additional cost. Pipes installed straight, right angles, parallel to walls, with correct gradients, alignment, inverts.

Minimum distance between services per applicable codes. Pipes supported on hangers and brackets. Waste-water outlet from each fixture individually trapped. Each vent terminal extends to outer air.

Cast iron soil and drainage fittings: vertical to horizontal – short sweep or long-turn for ≥75mm, long sweep or extra-long-turn for <75mm; horizontal to vertical – quarter bend or short turn. All fittings with hubs aligned upstream. No drainage or vent piping drilled. Exterior openings sealed with rodent-proof collars. Roof joints watertight with flashing. Each pipe, fitting, trap, fixture marked with maker's mark, weight, type, class.

Proper size increasers/reducers for dissimilar sizes. Fittings with obstruction to flow prohibited. Each fixture trap water seal 50-100mm. No double trapping. Piping on firm bed. Vertical piping securely held; horizontal supported to prevent sagging. Hangers and anchors metal, securely attached to building.

Piping in concrete/masonry in sleeves for access. Roof drain leaders in columns permanently embedded. Indirect waste from food handling with air gap at least twice effective diameter of drain.

1.2.1 General Requirements for Water Supply:

The following general notes shall apply to all water supply installations throughout the project:

(a) All water supply pipe diameters mentioned are external diameters (OD) unless otherwise mentioned.

(b) Provide isolation gate valve on all cold and hot water supply lines at the inlet to each toilet/fixture group. Valves at accessible locations.

(c) All cold water supply pipes: PPR-PN 25 (Polypropylene Random Pipe, PN 25) unless otherwise stated.

(d) All hot water supply and return pipes: PPR (PN 25) unless otherwise stated.

(e) Provide thermal insulation on all hot water and hot water return pipes.

(f) All pipes suspended along ceiling or concealed in walls and run at high level unless otherwise specified.

(g) All WCs, wash basins, and sinks to be provided with T-stop cock.

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(h) All pumps to be provided with flexible connector at suction and discharge.

(i) Fire water pipe: M.S. Schedule 40 unless otherwise stated.

(j) Provide pressure reducing valves (PRV) on hot and cold water pipes above false ceiling in each bathroom/kitchen; inlet 120 psi, outlet up to 30 psi.

(k) All joints shall be airtight and watertight. Pipe sleeves with caulking for all penetrations through concrete structures.

(l) Seismic restraints per the referenced building code applicable for Skardu (Seismic Zone 4).

(m) Freeze protection: All water, drainage and condensate pipes exposed in unheated spaces or routed through unheated voids shall be insulated (minimum 25 mm closed-cell elastomeric foam with aluminium cladding where externally exposed) and provided with self-regulating electric heat-tracing (10 W/m at 10 °C) controlled by pipe or ambient thermostat at +5 °C. The heat-tracing supply shall be from the emergency generator board. Refer also to Section 0723 — Glycol Freeze-Protection Package — for the hydronic loops.

1.2.2 General Requirements for Sewerage & Drainage:

(a) All soil, waste, and vent pipes: uPVC Class B unless otherwise stated.

(b) All manhole covers: heavy-duty cast iron, Class D400 (40T traffic rated).

(c) All vertical WCs and urinals: provided with Muslim shower.

(d) Rain water disposal pipes: uPVC Class B (vertical); uPVC Class D (horizontal on lower floors).

(e) All sewerage piping from fixtures to manholes and gully traps: uPVC.

(f) Minimum pipe slopes: 1:80 for 100 mm dia.; 1:100 for 150 mm dia.; 1:200 for 225 mm and larger.

(g) Minimum slope of roof valley drainage line: 0.02% to 0.025%.

(h) Long radius bends to be used at the foot of all vertical soil/waste stacks.

(i) Bottle traps to be used with all wash basins.

(j) All completed drainage and storm systems to be tested and approved in accordance with IPC requirements before concealment.

1.3 COLD & HOT WATER PIPES AND FITTINGS – PP-R

PP-R Pipes & Fittings: PP-R (PN25) Polypropylene Random-Copolymer, conforming to ISO 15874, DIN 8077, DIN 8078, DIN 16962 with heat fusion welded joints.

Installation: Runs per drawings; vertical plumb, parallel to wall; horizontal close to walls or hung from roofs. G.I. sleeves for pipes through floors/walls (inside dia ≥15mm > pipe OD). Sleeves in exterior walls and pits with anchor flanges, caulked and sealed watertight.

Pipe work Supports: Mild steel painted with two coats metallic zinc primer. Clips and brackets with 1/3mm rubber liners (shore-hardness A 40-50). Supports allow free expansion/contraction. Supports adjacent to joints, changes of direction, branches. Intervals per manufacturer's recommendation.

PART 2 – PRODUCTS

2.1 Pipe Material Schedule

Service	Material
Cold Water Supply (Internal)	PPR-PN 25
Hot Water Supply (Internal)	PPR-PN 25

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Cold Water Main (External/Buried)	Galvanised Iron (GI) / PE-100
Soil Pipes (Internal)	uPVC Class B
Waste Pipes (Internal)	uPVC Class B
Vent Pipes	uPVC Class B
Storm/Rainwater (Internal Downpipes)	uPVC Class B/D
External Sewer Lines	uPVC Class B
Fire Main Pipe (All)	M.S. Schedule 40 Seamless
Tube Well Column Pipe	GI 4" dia

2.2 Water Storage Tanks

Underground Water Storage Tank:

Parameter	Specification
Tank Dimensions	24'-0" × 24'-0" × 6'-0" deep (7,315 mm × 7,315 mm × 1,829 mm)
Capacity	30,000 Gallons (136,380 litres)
Minimum Domestic Reserve	10,000 Gallons
Construction	RCC, 1:2:4 mix; walls and floor waterproofed with crystalline waterproofing (CJ) and PVC waterstop at construction joints
Internal Finish	1:3 cement plaster, smooth finish
Access Manholes	2 No.; Size: 2'-4" × 4'-0"; heavy-duty cover with frame
Ventilation	2" vent pipe at both ends (typical)
Pump Room	15'-0" × 5' × 5' DEEP, adjacent to tank; booster pump with gate valve, check valve, pressure gauge
Booster Pump	Submersible type; flexible joint at suction and discharge; gate valve and check valve at discharge

Overhead Water Tanks:

Parameter	Specification
Tank Size	7'-6" × 19'-0" × 4'-0" Deep
Capacity	3,000 Gallons (each) / 3,500 Gallons (as noted on plan)
Construction	RCC or masonry; 1/2" thick waterproof terrazzo layer lining
Manholes	2 No. per tank; 24" × 24"; 6mm G.I. cover with frame and hinges
Inlet / Outlet	2" dia inlet; 2.5" dia outlet; 2" spare outlet sleeve; 2" washout; 2" overflow; 2" vent pipes both ends

2.3 Tube Well:

Parameter	Specification
Capacity	0.5 Cusec; Submersible Pump Type
Bore Diameter	20"

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Total Depth	Approximately 640 ft (upper 200 ft + middle 240 ft + variable lower section)
Housing Pipe (Upper ~200 ft)	12" Fiberglass, 6mm wall thickness
Blind Pipe (Middle ~240 ft)	8" blind pipe, 5mm wall thickness
Grouting	Cement-sand mortar (1:2) from surface to 50 ft depth
Column Pipe to UG Tank	4" G.I. pipe
Discharge Header	M.S. plate; 90-degree flanged bend; 4" gate valve; 4" check valve; pressure gauge; flow meter; air release valve

2.4 Septic Tank and Soakage Well

Septic Tank SP-01	
Parameter	**Specification**
Type	Two-chamber RCC septic tank
Plan Dimensions	12'-0" × 13'-6" overall; two chambers of 3'-8" width each, separated by 6" RCC dividing wall
Effective Depth	4'-6"
Construction	RCC walls, 6" thick; blinding concrete below; floor sloped 1:12 toward outlet
Internal Finish	1:3 cement plaster, smooth
Covers	20" dia M.S. steel cover 3mm thick for each chamber; 4" dia access holes; M.S. rungs at 12" c/c
Inlet / Outlet	8" uPVC inlet pipe from building sewer; 8" uPVC outlet to soakage well
Soakage Well	
Parameter	**Specification**
Type	12 ft Diameter Soakage Well
Construction	Brick masonry (1:4) — unplasticized perforated walls to allow seepage; approximately 9" wall thickness
Depth	Sunk up to 4'-0" below finished ground level; total depth per soil conditions
Infill	2" brick ballast inside well for filtration
Top Slab	RCC; #4 bars @ 10" C/C; 4" × 4" × 1/2" angle iron frame at top
Inlet	9" RCC inlet pipe from septic tank

2.5 Domestic Water Transfer Pump

Parameter	**Specification**
Type	Centrifugal pump
Approved Makes	KSB, Grundfos, or Engineer-approved equivalent
Capacity	85 GPM each
Total Pumping Head	110 ft
Impeller	Stainless steel

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Motor	Water-cooled, 440 V, 3-phase, 50 Hz
Configuration	2 Nos. (1 duty + 1 standby); automatic changeover panel

2.6 Drainage Sump Pump

Parameter	Specification
Type	Non-clogging centrifugal submersible drainage sump pump
Capacity	50 GPM against 25 ft total head
Motor	Water-cooled, IP Class 68, 400 V, 3-phase, 50 Hz
Configuration	2 Sets (1 duty + 1 standby); auto/manual switches; dry running protection; low/high level controls

2.7 Rainwater Harvesting System

Parameter	Specification
Harvesting Tank Dimensions	20'-0" × 15'-0" × 10'-0" deep (6,096 mm × 4,572 mm × 3,658 mm)
Capacity	20,000 Gallons (90,920 litres)
Recharge Pit	5'-0" × 15'-0" × 10'-0"; Capacity: 5,000 Gallons
Filter Media (Section A-A)	Bottom: 6" stone layer (3 ft depth); Middle: 3" stone layer (1 ft); Top: 1" crushed stone (1 ft)
Recharge Below Tank	4" × 14" perforated pipe penetrating to water table for groundwater recharge
Pumps	2 No. submersible (1 running + 1 standby); Q = 30 GPM; H = 50 ft; HP = 1.0; 2" force main
Manholes	600 × 600 mm service manholes with covers — 4 No. as shown on plan

2.8 Pipe Support Schedule (Per Drawing PH-MD-01)

Pipe Size	Rail Spacing
1/2" to 3/4"	5'-0" (1,524 mm)
1" to 1.5"	6'-0" (1,829 mm)
2" to 3"	8'-0" (2,438 mm)
4"	10'-0" (3,048 mm)
6" to 8"	10'-0" (3,048 mm)
10" to 12"	12'-0" (3,658 mm)

Synthetic or natural conforming to ASTM standards.

PART 3 – EXECUTION

3.1 INSTALLATION – COLD & HOT WATER PP-R PIPES

Run and arrangement per drawings. All vertical pipes plumb, parallel to wall. Horizontal runs close to walls or hung from roofs. G.I. sleeves for pipes through floors/walls (inside dia ≥15mm > pipe OD). Sleeves in exterior walls and pits with anchor flanges, caulked and sealed watertight. Pipe supports as described.

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3.2 INSTALLATION – G.I. PIPES (if used)

Screwed joints tight without filler except approved jointing compound or tape. Flanged joints to BS 10 Table D. Sleeves as above.

3.3 INSTALLATION – SOIL, WASTE AND VENT uPVC PIPES

Install to lines and grades. Above ground: hangers and supports approved type, not more than 1.5m centers. Steel clamps, hangers, supports: one coat red oxide primer + two coats synthetic enamel paint. Push-fit/solvent cement jointing. Sleeves for pipes through walls/floors. Vent pipes with approved cowl, rise ≥760mm above roof.

3.4 PLUMBING FIXTURES – MATERIALS AND INSTALLATION

All fixtures imported, best quality, approved manufacture. Smooth impervious surfaces, free from defects. Taps and cocks chrome plated. Fixtures installed for easy cleaning. Wall hung fixtures rigidly supported. Fixtures set level, proper alignment. Supply lines prevent backflow.

Wash Basins: Vitreous China (counter top, with/without pedestal). Complete with 20mm CP brass sensor basin mixer or lever type or double knob, 20mm CP stop-cocks, CP brass bottle trap (individual) or CP brass P trap (battery), CP brass strainer, heavy cast iron brackets.

Water Closets (European): Best quality. Low level flush tank with double push button (3L/6L). Seat bakelite, open front. In-wall carrier system for wall-hung toilets.

Bidet: Wall hung vitreous China, 1 hole punched, overflow, fixation set, anti-scale coating, anti-bacterial glazing.

Water Closets (Asian): Vitreous China with cistern 12-15 litre. Foot rests, cast iron P trap.

Kitchen Sink: Stainless steel, double/single deep-bowl. Complete with 20mm CP mixer for hot/cold, CP brass strainer.

Bath Tub: Vitreous China. Complete with 20mm CP mixer or pillar cock, CP brass chain with 40mm rubber plug.

Urinal: wall hung, with CP brass P trap, 15mm CP stop-cock.

Shower Head: CP adjustable, complete with CP extension pipe, CP stop cock.

Mixer for Shower: CP concealed with hot/cold taps, diverter.

Janitor Sink: White fire clay, hardwood pad, stainless steel bucket grid, CP brass bib tap 20mm, CP brass P-trap 50/40.

3.5 MISCELLANEOUS PLUMBING ITEMS – INSTALLATION

Bronze Valves: ≤75mm bronze, PN-16. Accessible with ladder. Open/shut indicators on handle.

Taps and Cocks: Brass, gun metal, chrome plated. Hydraulic test 1.96 MPa, no leak.

Floor Drains/Floor Traps: Cast iron or uPVC, 50mm min water seal, stainless steel grating, P-trap, removable bucket strainer, cleanout.

Cleanouts: Cast iron or uPVC, CP brass cover. Turned up through floors, flush with floor.

Float Valve: Piston type to BS 1212-1, polyethylene float.

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Vent Cowell: Cast iron with stainless steel clamp.

Glass Mirror: Best quality, securely fixed on hard board.

Towel Rail, Toilet Paper Holder, Soap Dispenser/Dish, Grab Bars: CP stainless steel.

Hand Drier: Best quality, infrared proximity switch.

Gully Traps: P-trap 65mm water seal, cast iron frame & cover, internally plastered with pudlo.

Grease Traps: In RCC chamber per drawings.

Fiber Glass Water Tank: Thermosetting polyester resin reinforced with glass fiber, to BS 3496 type E. Manhole opening, outlets, vent pipe with cowl, built-in feet.

Electric Water Heaters: Automatic storage type, 6 bar working, 10 bar test. Thermostatic control, T&P relief valve, high limit control. Inner tank heavy gauge anti-rust G.I., insulation glass wool, outer body 16 gauge MS.

Gas Water Heaters: Automatic storage type. Inner/outer shell thickness per table (14 SWG to 10 SWG inner, 22 SWG outer). Working pressure 5 bar, test 10 bar. Accessories: thermostatic control, safety pilot, T&P relief valve, burner, drain valve, auto-shut off.

3.6 ROOF DRAINAGE – CAST IRON RAIN WATER PIPES

Cast iron pipe to BS 416, below ground to BS 437. Joints lead caulked or elastomeric (rubber ring) to BS 2494. Centrifugally (spun) cast, grade 10 to BSS 1452. Coated pipes: tar basis or natural bitumen. Hydraulic test 0.07 MPa. Installation: clamps ≤1500mm centers. Caulked joints packed with oakum/hemp, filled with molten lead ≥25mm deep. Pipes passing through walls/floors with sleeves. Vent pipes with cowl, rise ≥750mm above roof.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

SECTION 0370 – DUCTILE IRON PRESSURE PIPES AND FITTINGS

PART 1 – GENERAL

1.1 SCOPE

The work under this section includes furnishing all plant, labour, equipment, appliances, materials and performing all operations required in connection with supply, installation, testing, flushing, disinfection and commissioning of Ductile Iron Pressure Pipes and Pipe Fittings as specified herein, in the bill of quantities, as shown on the drawings and/or as directed by the Engineer.

1.2 APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the applicable codes and standards. When the requirements of these specifications or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

1.3 GENERAL REQUIREMENTS

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1.3.1 Pipes and fittings shall be new and unused and of Western European, North American or Japan make origin.

1.3.2 Pipes and fittings shall be UL listed and FM approved for the intended use in firefighting network/system. The Contractor shall provide all necessary documents to confirm the required certification before installation or laying.

1.3.3 Where manufacturers of pipes and fittings are specified, they shall be of the same manufacturers unless otherwise approved by the Engineer.

1.3.4 Where more than one similar item of pipes and fittings are specified, they shall be of the same manufacturer.

1.3.5 The Contractor shall submit to the Engineer for approval the following information:

(i) Name and address of the manufacturer

(ii) Country of origin, make and model

(iii) Dimensions and wall thicknesses of pipes and fittings

(iv) Material and thicknesses of coating and lining

(v) MTC – mill test certificate from the manufacturers

(vi) Method of jointing, testing and commissioning

(vii) Manufacturer accreditations: ISO 9001 and 14001, Third Party International Inspection Certificate before shipment from an agency approved by the Engineer, and manufacturer's QA/QC document.

1.3.6 Approval by the Engineer shall not be construed as authorizing any deviation from the specifications unless specifically brought to notice.

1.3.7 Approval by the Engineer shall not relieve the Contractor of his contractual responsibility regarding satisfactory performance and other requirements.

1.4 SPECIAL REQUIREMENTS

1.4.1 Pipes and fittings shall be suitable for the intended use.

1.4.2 Every pipe shall be tested at the manufacturer's works to specified hydraulic test pressure, maintained sufficiently long for proof and inspection.

1.4.3 Each pipe and fitting shall be permanently marked or engraved with:

- Manufacturer's name or trademark
- Manufacturing date
- Manufacturing number
- Nominal diameter in mm
- Class or pressure rating
- Manufacturer's inspection mark
- Standards according to which the pipes and fittings have been manufactured

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- Heat number embossed on all pipes, fittings and flanges

1.4.4 Unless otherwise specified, diameters of pipes and fittings shall be nominal. Actual inside/outside diameters and tolerances shall be according to the specified standards.

1.4.5 Unless otherwise specified, service ratings of pipes and fittings shall not be less than the maximum pressure, test pressure and expected increase in pressure during testing.

1.4.6 Unless otherwise specified, wall thicknesses shall be according to class, schedule or duty. Wall thicknesses shall be measured at locations excluding jointing ends. Wall thicknesses of fittings shall not be less than those of corresponding pipes.

1.4.7 Pipes and fittings ends shall be matching and compatible with each other and with the ends of valves and appurtenances.

1.4.8 Unless otherwise approved, pipes, fittings and jointing materials (rubber rings, gaskets, nuts, bolts, etc.) shall be from the same manufacturer.

PART 2 – PRODUCTS

2.1 PIPES

Ductile Iron Pressure Pipes shall conform to ISO 2531, K-9.

2.2 FITTINGS

Ductile Iron fittings and specials shall conform to ISO 2531, K-12. They shall have the required shapes, dimensions and ends to be joined with the Ductile Iron pressure pipes.

2.3 INTERNAL LINING

Internal lining of Ductile Iron pipes, fittings and specials shall be cement mortar lined according to ISO 6600. Lining of pipes shall be done in factory using centrifugal method. Lining of fittings and specials shall be done in factory or, if permitted in writing by the Engineer, at Site by an approved method. The lining shall be smooth and must not show visible hair cracks, spitting or honeycombing. Where water contains significant sulphates or chlorides, sulphate resistant cement shall be used.

2.4 EXTERNAL COATING

Ductile Iron pipes and fittings shall be externally coal tar epoxy coated. Coating thickness shall not be less than 100 microns. Manufacturer's recommendations for repair of coatings shall be shared with the Engineer while obtaining approval of the repair method.

2.5 MATERIAL

The material shall consist substantially of ductile iron with only those additives needed to facilitate manufacture of sound, durable pipes and fittings of good surface finish, mechanical strength and corrosion resistance. Additives shall not constitute a toxic hazard or impair chemical/physical properties. The pipe and fitting material shall not have any detrimental effect on water quality.

2.6 JOINTS

Ductile Iron pressure pipes and fittings shall be spigot and socket joined with elastomeric rubber ring. Flanges required for connecting with valves shall conform to B.S. 4504 or approved equivalent. Elastomeric rubber rings shall conform to B.S. 2494 or approved equivalent.

PART 3 – EXECUTION

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3.1 TRENCHING

Pipe trenches shall be excavated to required depth as indicated on the drawings. The bottom shall be carefully levelled. In-situ field density of trench bottom shall be determined and compacted if in-situ density is less than 60% of relative density as determined by ASTM D 1557 & ASTM D 1556. Testing shall generally be carried out at spacing of 250 metres. If soft clayey or loose material is encountered, 300 mm of this material shall be replaced by specified bedding material without extra cost. If excavation is carried below required depth, the excess excavated part shall be refilled with bedding material at no extra cost. No bedding material shall be placed nor any permanent work commenced until the trench has been inspected by the Engineer and permission to proceed is given.

3.2 INSTALLATION

3.2.1 Transportation, Handling and Storage

The Contractor shall be responsible for proper transportation, handling (loading/unloading) and storage of pipes and fittings per manufacturer's recommendations and direction of the Engineer. Crane, rope or nylon slings, lifting beams with flattened hooks or scissor-dogs shall be used; hooks and dogs shall be well padded and fitted with locking devices; steadying ropes are essential. Pipes and fittings damaged during transportation, handling, storage or lowering shall be rejected and replaced at Contractor's expense. Storage of Ductile Iron pipes, fittings, rubber rings and gaskets shall be under shade to prevent damage by sunlight and extreme heat.

3.2.2 Inspection

Pipes and fittings shall be visually inspected for any evidence of damage or hair cracks. The ends shall be inspected for local irregularities that could affect water tightness of joints. Damaged items shall be rejected and replaced at Contractor's expense. Upon arrival of material at site, the Contractor shall request inspection of the complete lot along with necessary documentation.

3.2.3 Laying and Jointing – Above Ground (Unburied)

Pipelines shall be laid true to location, alignment and grade as shown on the drawings and/or as directed. All vertical pipelines shall be erected plumb and parallel to walls and other pipelines. All horizontal pipelines shall be kept close to walls and parallel to floor, ceiling, roof and other pipelines. Deviations require Engineer's approval before installation.

Elastomeric joints shall be made with rubber rings: the ring shall be inserted in the groove of the socket end and the spigot end pushed into the socket end. Flanged joints shall be made watertight with gasket, nuts and bolts.

Pipelines passing through walls, floors or roofs shall be provided with black steel pipe sleeves. The annular space between pipe sleeve and outside diameter of the pipe shall not be less than 15 mm, and shall be filled with approved packing and sealant. Pipelines passing through water-retaining structures shall be provided with black steel puddle (anchor) flange. The Contractor shall submit shop drawings showing dimensions and thicknesses of sleeves and puddle flanges for approval before installation.

3.2.4 Laying and Jointing – Below Ground (Buried)

Pipelines shall be laid in accordance with British Code of Practice CP 2010 (Part 2) in trenches on a bed and surrounded on all sides with well compacted fine sand up to the height shown on drawings or as directed, true to location, alignment and grade.

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Backfilling shall be carried out in specified sequence. Recesses shall be excavated in the bottom and sides of the trench to accommodate joints, fittings and appurtenances; these recesses shall be filled with fine sand and well compacted manually. Great care shall be taken to avoid abrasion. Pipelines with grades or joints disturbed after laying shall be removed and re-laid as per specifications.

Pipes, fittings and specials shall be lowered into the trench with care using tackle, shear legs, mobile crane or approved method. When lifting gear is used, positioning of slings shall be checked for proper balance when the pipe is just clear of the ground.

All debris and foreign material shall be removed from inside the pipe before a joint is made. When laying is not in progress, the open end shall be fitted with a temporary end closure as approved.

Small changes in direction may be made by deflecting the last laid pipe after the joint has been made. If deflections exceed specified limits, standard degree bends or a number of short pipe lengths shall be used.

3.3 TESTING

The completed pipeline or each convenient section (as necessary due to elevation differences) shall be subjected to a hydrostatic pressure test not less than one and a half times the maximum pressure to which the pipeline will be subjected. The proposed fire network shall be pressurized with already installed pumps in the existing pump station for the parking lot. The Contractor shall confirm the pressure rating of these existing pumps and the shut-off head of the jockey pump to determine maximum expected pressure. All fittings, specials, valves and appurtenances shall also be subjected to hydrostatic testing while installed. Maximum test section length shall not exceed 500 metres.

Before testing, the pipeline section shall be cleaned and sufficient backfill material placed over the centre of each pipe to prevent movement under test pressure. Pipe ends shall be properly sealed and adequately secured with temporary anchors. All permanent anchors/thrust blocks shall be in position and shall have developed adequate strength before the test starts.

The section under test shall be filled with water, taking care that all air is displaced through valved vents at high points. After filling, the pipeline shall be left for wetting under a lower pressure for not less than twenty-four hours. After the wetting period, more water shall be pumped in until test pressure is reached, then the section shall be completely cut off. The test pressure shall be maintained for at least two hours or as directed. Field test pressure shall be 1.5 times the normal working pressure of 10 bar in the system. If a drop in pressure occurs, the quantity of water added to re-establish test pressure shall be carefully measured.

If pressure measurements are not made at the lowest point, allowance shall be made for static head between lowest point and measurement point to ensure test pressure is not exceeded at the lowest point.

If any abnormal movement, distortion, squirm or leakage is detected, the test pressure shall be released immediately and the cause investigated and rectified with Engineer’s approval.

3.4 FLUSHING

After installation and testing, pipelines shall be flushed with water until all dust, dirt, scales and extraneous matter are removed. During flushing, all valves and appurtenances shall be closed and opened several times.

3.5 DISINFECTION

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Fire water pipelines and systems shall be disinfected with chlorine or chlorine compound solution. The solution shall be introduced into the pipelines by a suitable method and retained for at least 24 hours. The dosage shall not be less than 50 mg/litre of chlorine. At the end of the test period, the chlorine residual at pipe extremities shall not be less than 25 mg/litre. Following complete disinfection, the pipeline shall be thoroughly flushed until the chlorine residual is less than 1 mg/litre.

3.6 COMMISSIONING

After successful completion of testing, flushing and disinfection (where required), duly approved by the Engineer, the complete pipeline network shall be commissioned. All valves and appurtenances shall be set at proper openings and all parameters set at specified or manufacturers' recommended values.

3.7 PIPEWORK SUPPORTS

All pipework supports in buildings shall be of mild steel rolled sections and shall be painted with two coats of approved rich metallic zinc primer. Straps, rods and hangers shall be of galvanized mild steel.

Straps shall be provided on all pipe supports, with a pair of nuts and washers on each leg and the supporting flange clamped tight between the pair of nuts to form a rigid guide allowing the pipe to slide axially.

Horizontal pipework along walls shall be supported on channel frames securely fixed to the column. All pipes shall slide on pipe supports and straps shall form a rigid guide.

Vertical pipework shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means of support for the riser.

Pipework supports shall be designed and installed to allow free movement due to expansion and contraction. Supports shall be anchored to steel or reinforced concrete columns, walls, beams or slabs. Each support shall independently carry all operational loads of pipework and water.

All pipes shall be individually supported. Pipes shall not be supported from other pipes. Points where pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc., do not constitute points of support.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0380 – FIRE PROTECTION

PART 1 – GENERAL

1.1 SCOPE OF WORK

Furnishing all plant, labour, equipment, appliances and materials for supply and installation of black steel pipes and fittings for fire fighting system, portable fire extinguishers, fire hose cabinets as shown, in compliance with NFPA requirements.

1.1.1 System Description

The fire protection system for the ATCT, ARFF building, and allied facilities at Skardu International Airport consists of a multi-system approach, but is not limited to this:

(a) Wet pipe automatic sprinkler system (NFPA 13) — Fire Station ground floor, mezzanine, first floor, and rooftop occupied areas.

(b) FM-200 (HFC-227ea) gaseous suppression system — ARFF rotating cab and ATCT cab (special hazard areas per Drawings FF-06 and FF-07).

(c) Internal fire hose cabinet system with landing valves, hose reels, dry powder, and CO_2 extinguishers on all floors.

(d) External pillar-type fire hydrant network.

(e) Two-way breeching inlet (fire department pump connection) at ground floor.

(f) Underground water storage tank (dedicated firefighting reserve) with firefighting pump sets.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

Item	Requirement
Fire pipe material	M.S. Schedule 40 seamless pipe; painted red throughout
Maximum line pressure	All fire water lines exceeding 12 bars to have PRVs; no fire water line to have line pressure exceeding 12 bars
Pipe penetrations	Pipe sleeves with approved caulking compound at all floor, roof, and wall penetrations
Expansion joints	Pipe expansion fittings provided at all building expansion joints
Portable extinguishers	Located and sized as indicated on drawings per NFPA 10
Flow and tamper switches	Connected to BMS and Fire Alarm Panel (per NFPA)
Isolation valves	All isolation valves in fire system to comply with NFPA requirements

2.2 UNDERGROUND FIRE FIGHTING WATER TANK

Parameter	Specification
Tank Size	40 ft × 30 ft × 9 ft deep (per Drawings S-30, S-31
Capacity	Approximately 59,900 Imperial Gallons
Construction	Underground RCC; CJ waterproofing with PVC waterstop at all construction joints
Sump Pump in Tank	Size: 2.5 ft × 2.5 ft × 3 ft deep

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Pump Room	30 ft × 12 ft × 11 ft, adjacent to tank
Access	Service manhole 2'-6" × 2'-6" with cast iron cover; 3/2" vent pipe (typical)
Pipe Connections	4" M.S. overflow/washout; 4" M.S. inlet; 4" M.S. fire fighting outlet; 4" M.S. spare; 4" fire test/return
RCC Slab Reinforcement (Base, per S-31)	#4 @ 8" C/C Top and Bottom in both directions; Slab thickness: 12"
RCC Slab Reinforcement (Top, per S-31)	#4 @ 6" C/C longitudinal; #4 @ 9" C/C transverse; Top and Bottom; Slab thickness: 12"
Concrete Grade	f'c = 4,000 psi minimum; ASTM A615 Grade 60 rebar

2.3 FIRE FIGHTING PUMP SET (NFPA 20 Compliant)

Component	Specification
Electric Duty Pump	Horizontal centrifugal; 50 Hz × 380 V, 3-phase; Capacity: 500 GPM @ 9 bar; Capable of operating remotest 2-1/2" hydrant at 250 GPM @ minimum 4.5 bar
Diesel Standby Pump	Horizontal centrifugal, engine-driven; Capacity: 500 GPM @ 9 bar; Automatic control panel, pressure switch, pressure gauge, diesel tank
Jockey Pump	Electric motor-driven; 50 Hz × 400 V, 3-phase; Capacity: 25 GPM @ 9.5 bar; Automatic control panel
Compliance	NFPA 20 — Standard for the Installation of Stationary Pumps for Fire Protection
Pump Room Fittings	Gate valves, NRV, expansion joints, air release valve, headers, pressure relief valve, pressure gauges, supports

2.4 AUTOMATIC SPRINKLER SYSTEM (NFPA 13)

Fully automatic wet-pipe sprinkler system to NFPA 13 (latest edition) for all occupied areas. Dry-pipe or pre-action system in unheated ARFF vehicle bays where ambient temperature may fall below +4°C.

Occupancy	Hazard Classification
Offices, dormitories, ATC areas	Light Hazard per NFPA 13
ARFF Vehicle Bays	Extra Hazard Group 2 (flammable liquids) per NFPA 13
Fuel storage areas	Extra Hazard Group 2 per NFPA 13
Plant rooms, electrical rooms	Ordinary Hazard Group 2 per NFPA 13

Sprinkler heads: concealed or semi-recessed pendant type (K-5.6) in finished areas; upright in ARFF bays. Alarm check valve with pressure gauges, water motor alarm bell, flow switch, and inspector's test connection for each zone. Hydraulic calculations to be submitted for Engineer approval before installation.

2.5 Portable Fire Extinguishers (NFPA 10)

Type	Specification
Dry Chemical Powder (Portable)	Stored pressure; Class A, B, C & E; 6 kg capacity; Fire rating: 34A 183B; Working pressure: 14 bar; Test pressure: 30 bar

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CO_2 (Portable)	5 kg; Operating temperature: -20 to +60°C; Max allowable pressure: 174 bar; Test pressure: 250 bar
Ceiling-Mounted Automatic	6 kg ABC Powder; Operating temperature: -30°C to +60°C; Operating pressure: 15 bar; Sprinkler head activation trigger

2.6 Pillar Type Fire Hydrant (External)

Parameter	Specification
Type	Pillar type fire hydrant (wet-type, above ground)
Inlet	4-inch flanged connection (150 mm, Class 150)
Outlets	Double deliveries, 2-1/2" female instantaneous coupling with blank cap and chain
Body	Mild Steel main body; Butterfly valve: 100mm Ductile Iron; Outlets: Brass
Finish	Red electrostatic powder coating; Nut and bolts: galvanized
Spacing	Maximum 60 m spacing around perimeter of ATCT/ARFF building

PART 3 – EXECUTION

3.1 INSTALLATION OF FIRE HOSE CABINET

Flushed with outside finishes or on wall as approved. Fire hose connected to fire water system through hydrant 65mm x 40mm valve.

3.2 INSTALLATION OF PORTABLE FIRE EXTINGUISHERS

Installed at 1 meter height above finished floor. Fixed to wall/column with painted steel clamps or stored in steel/concrete cabinets. Cabinets with glazed steel door, two coats anti-corrosive signal red enamel over red oxide primer. Lock arrangement: door opened from inside by breaking glass and from outside with key. Validity at least one year after defect liability period.

3.3 MARKINGS ON EXTINGUISHERS

Colour code per NFPA. Information on body: instructions, agent name, weight/volume, gross weight, filling pressure, classes of fires, manufacturer’s name, year of manufacture.

3.4 TESTING AND COMMISSIONING

As per NFPA-10.

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PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0390 – TESTING AND COMMISSIONING

PART 1 – GENERAL

1.1 SCOPE OF WORK

Furnishing all plant, labour, equipment, appliances and materials for testing and commissioning of all water line, drainage system and fixture in parts and as a whole as specified.

1.2 GENERAL

Testing includes complete visual inspection of whole plumbing and fire fighting system and verification of performance. All supply documents, operating instructions, acceptance documentation and maintenance regulations checked.

1.3 FIXTURES AND FITTINGS – TEST PROGRAMME

Check type and catalogue number. Check all equipment for service ability, correct operation, freedom from damage. Flow and water capacity checked on full connection of lavatories, showers, water closets; draining capacity measured.

1.4 POTABLE WATER SUPPLY SYSTEMS (HOT & COLD) – TEST PROGRAMME

Check method of laying and sealing water connections. Visual inspection of entire network for laying, fixing, suspension. Check function of valves, air relief valves, check valves, pressure reducers, thermostats, pumps. Check pipe insulation, equipment labeling, pipes and flanged connections for strain.

Hydraulic Pressure Test: Before insulation. Pump system to required pressure, close valves, disconnect pump. Test pressure as detailed for two hours. No drop in pressure, no leaks = satisfactory. Faults repaired and retested.

Test Pressure and Procedure: Fill pipes slowly with potable water to exclude air. Apply test pressure 5.5 bar (1.5 x max working pressure). No measurable loss of pressure for at least 30 minutes.

1.5 DRAINAGE SYSTEMS – TEST METHODS

Water Testing: Close all openings with testing plugs. Develop min static head 0.5 bar. Fill water, check level for no drop for at least 15-30 minutes. Higher stacks tested in sections from top.

1.6 FIRE FIGHTING SYSTEMS – STAND PIPE SYSTEM

Same hydraulic pressure test as potable water supply.

1.7 COMMISSIONING

After successful testing, contractor shall clean all lines at no extra cost with method approved by site Engineer prior to handing over.

PART 2 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0400 – POLYETHYLENE (PE) PIPES AND FITTINGS

PART 1 – GENERAL

1.1 SCOPE

Furnishing all plant, labor, equipment, appliances, materials for providing and laying of Polyethylene Pipes and Pipe fittings.

1.2 GENERAL REQUIREMENTS

Pipes and fittings new and unused. All HDPE pipe and fittings from single manufacturer with experience. Submittal to Engineer: manufacturer's name, country of origin, pressure rating, SDR ratio, wall thicknesses, MTC, method of jointing, testing, commissioning, manufacturer's accreditations (ISO 9001, 14001, QA/QC). Approval does not relieve Contractor of responsibility.

1.3 SPECIAL REQUIREMENTS

Pipes suitable for intended use. Every pipe tested at manufacturer's works to specified hydraulic test pressure. Each pipe and fitting permanently marked: Manufacturer's name/trademark, manufacturing date, number, nominal diameter, class/pressure rating, inspection mark, standard, heat number embossed. Service ratings ≥1.5 x max working pressure. Wall thicknesses per class. Ends matching and compatible. All jointing materials same manufacturer.

PART 2 – PRODUCTS

2.1 MATERIALS

Manufacturing: Polyethylene with additives to facilitate manufacture. No toxic hazards, no impairment of welding properties or chemical/physical properties.

Pipe: Conform to ISO 4427-2019 or DIN 8074, appropriate class PN-8 to PN-32, test pressure 1.5 x working pressure.

Quality: No detrimental effect on water composition. Toxic substances not exceed ISO 4427 values.

Fittings: Compatible, conform to ISO 4427-3:2019, 3458, 3459, 3501, 3503 or BS 5114.

PART 3 – EXECUTION

3.1 HANDLING AND STORAGE

Proper handling per manufacturer's recommendations. Stack at approved places. Transportation secure, minimal movement. Use cranes for off-loading; rope or nylon slings, lifting beams with flattened hooks or scissor-dog, well padded. Storage under shade, not exposed to sunlight/extreme heat. Damaged pipes rejected and replaced.

3.2 JOINTING

Butt Fusion Joint: For pipes ≤75mm – compression fittings; >75mm – butt fusion. Comply with ISO 4427 and Generic Butt Fusion Joining Procedure. Factory qualified or trained technician. Same class and type of raw material.

Mechanical Joint: Polyethylene flange adapters backed by stainless steel flanges to ANSI B16.5. Corrosion resisting bolts/nuts Type 316 Stainless Steel. Tighten to manufacturer's specified torques; apply bituminous coating after installation. Full-face neoprene gasket.

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3.3 INSTALLATION

Install per manufacturer's instructions, drawings, specification. Factory qualified technician for heat fusion joints. Do not drop pipe or force through directional bore. Use ropes, fabric or rubber protected slings. Store on level ground, free of sharp objects. Lay to lines and grade with bedding and backfill. Open ends closed when not laying. Defective pipe removed and replaced.

Open Trench Installation: Centerline deviation ≤1/16" per foot. Good alignment. Assembly mark aligned. Prevent flotation. Trench boxes not allowed below top of pipe.

Cleaning/Flushing/Disinfection: Clean all new pipe lines by forcing cleaning swab. Flushing velocity ≥2.5 ft/s. Disinfection of potable water lines by chlorination (≥50 mg/l chlorine, retain ≥24 hours, residual ≥25 mg/l). Flush until chlorine residual <1 mg/l.

Hydrostatic Pressure Test: Test pressure ≥1.5 x max working pressure. Fill, leave under low pressure for 2 days. Maintain test pressure ≥2 hours. No abnormal movement, distortion, squirm, or leakage. Submit test plan to Engineer ≥10 days before test.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0410 – STEEL PIPES & FITTINGS

PART 1 – GENERAL

1.1 SCOPE

Furnishing all plant, labor, equipment, appliances, materials for supply, installation, testing, disinfection (potable water only), flushing and commissioning of black steel pipes and pipe fittings, U-turn vent pipes and overflow funnels.

1.2 APPLICABLE CODES AND STANDARDS

ASTM A-53, A-234; ANSI B16.5; B.S.4504 (part1), B.S.534, B.S.1965, B.S.3601, B.S.3063, B.S.4147, B.S.4161, B.S.4515; ISO 898; C.P.2010.

1.3 GENERAL REQUIREMENTS

Pipes and fittings new, unused. Same manufacturers. Submittal: name/address, country of origin, dimensions/wall thicknesses, coating/lining material and thicknesses, MTC, warranty, jointing/testing/commissioning method.

1.4 SPECIAL REQUIREMENTS

Every pipe tested at manufacturer's works. Pipes and fittings permanently marked (make, nominal diameter, class/pressure rating, standard, heat number embossed). Service ratings not less than maximum pressure. Wall thicknesses per class/schedule/duty. Ends matching. All jointing materials same manufacturer.

PART 2 – PRODUCTS

2.1 PIPE

Black steel grade 'B' seamless/spirally welded schedule 40 (or wall thickness per BOQ) conforming to ASTM A53.

2.2 FITTINGS

Conform to ASTM A-234 or ANSI B16.5.

2.3 JOINTS

Welding or flange (except valves and appurtenances). Welded joint to B.S.4515. Flanges to B.S.10. Nuts/bolts hexagon to ISO 898. Gaskets flat to B.S.3063.

2.4 EXTERNAL COATING

FBE (Fusion Bonded Epoxy) minimum 200 microns.

2.5 INTERNAL COATING

Anti-corrosive epoxy coated.

PART 3 – EXECUTION

3.1 TRANSPORTATION, HANDLING AND STORAGE

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Per manufacturer's recommendations. Crane, rope/nylon slings, lifting beams with flattened hooks or scissor-dog, padded. Damaged replaced.

3.2 INSPECTION

Visual for damage or hair cracks. Damaged replaced.

3.3 LAYING AND JOINTING – ABOVE GROUND

Clean interior. Install to lines and grades. Welding by qualified/licensed welders using electric arc welding. Supports: galvanized steel clamps, brackets, hangers. Thrust anchors at changes in pipe diameters/directions, branches, dead ends. Shop drawings for supports and thrust anchors.

Pipes through floors/ceilings/roof/walls in non-water retaining structures: encased in black steel pipe sleeve (annular space ≥1 inch), filled with approved packing, sealed. Through water retaining structures: leak proof puddle flange (flange diameter > pipe OD by ≥100mm for ≤150mm pipe, ≥150mm for >150mm pipe). After installation, exposed bared or damaged surfaces epoxy coated.

3.4 BELOW GROUND

Laying per BS CP2010: Part 4. Lower into trench without abrasion. Lay on specified bedding material. Backfill per specified material and sequence, compacted to 95% of AASHTO modified density. Thickness of compacted layer ≤150mm. Concrete thrust blocks at changes.

3.5 TESTING

Test pressure ≥1.5 x max working pressure. Fill, wet for 24 hours. Maintain test pressure ≥2 hours. Inspect all joints.

3.6 FLUSHING AND COMMISSIONING

Flush with clean water until all dust, dirt, scales removed. Commission after successful testing.

3.7 OVERFLOW FUNNEL

Fabricated from mild steel heavy gauge, welded to M.S. pipe flange.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0420 – STEEL PIPES & PIPE FITTINGS FOR FIREFIGHTING INSIDE BUILDINGS

PART 1 – GENERAL

1.1 SCOPE

Supply, installation, testing, disinfection (potable water), flushing and commissioning of black steel pipes and pipe fittings for firefighting inside buildings.

1.2 APPLICABLE CODES AND STANDARDS

Same as Section 0410 plus NFPA requirements.

1.3 APPLICABLE SECTIONS OF TECHNICAL SPECIFICATIONS

Section 0100 Earthwork, 0140 Formwork, 0150 Concrete Works.

1.4 GENERAL REQUIREMENTS

Same as Section 0410.

1.5 SPECIAL REQUIREMENTS

Compliance with NFPA. Every pipe tested at manufacturer's works. Markings as Section 0410.

PART 2 – PRODUCTS

2.1 PIPE

Black steel to ASTM A53 schedule 40, listed per NFPA.

2.2 FITTINGS

ASTM A-234.

2.3 JOINTS

Welding (except valves). Welded joint to B.S.4515. Flanges to B.S.10. Nuts/bolts ISO 898. Gaskets B.S.3063.

PART 3 – EXECUTION

3.1 TRANSPORTATION, HANDLING AND STORAGE

Per Section 0410.

3.2 INSPECTION

Same as Section 0410.

3.3 LAYING AND JOINTING – ABOVE GROUND

Clean interior. Install to lines and grades. Welding by qualified/licensed welders. Supports: galvanized steel clamps, brackets, hangers. Thrust anchors at changes. After installation, pipes, fittings, supports, anchors painted with two coats red oxide or zinc chromate primer + two coats synthetic enamel.

3.4 BELOW GROUND

Same as Section 0410.

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3.5 TESTING AND FLUSHING

Same as Section 0410.

3.6 COMMISSIONING

Same as Section 0410.

PART 4 - MEASUREMENT AND PAYMENT

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SECTION 0430 – UNPLASTICISED POLYVINYL CHLORIDE (uPVC) PIPES AND PIPE FITTINGS (SEWER/GRAVITY)

PART 1 – GENERAL

1.1 SCOPE OF WORK

Furnishing all uPVC pipes, plant, labor, equipment, appliances, materials for installing and testing of sewer pipes.

1.2 APPLICABLE CODES AND STANDARDS

B.S.3505, P.S.3051, B.S.4346.

1.3 GENERAL REQUIREMENTS

Pipes new, unused. Same manufacturers. Submittal: name/address, country of origin, dimensions/wall thicknesses, MTC, method of jointing/testing/commissioning.

1.4 SPECIAL REQUIREMENTS

Pipes suitable for intended use. Every pipe tested at manufacturer's works. Each pipe permanently marked (manufacturer's name/trademark, date, number, nominal diameter, class/pressure rating, inspection mark, standard, heat number embossed). Service ratings not less than max pressure. Wall thicknesses per class. Ends matching. Jointing materials same manufacturer.

PART 2 – PRODUCTS

2.1 PIPES

uPVC Sewerage Pipes to B.S.3505 or P.S 3051.

2.2 MATERIAL

Substantially polyvinyl chloride with additives for manufacture. No toxic hazard, no impairment of welding or chemical/physical properties. No detrimental effect on water composition. Lead, tin, other toxic substances within B.S 3505 limits.

2.3 JOINTS

Solvent cement to B.S.4346.

PART 3 – EXECUTION

3.1 FACTORY TESTS

Contractor informs Engineer of schedule. Engineer may visit factory. Contractor arranges tests: dimension measurements (wall thickness, diameter, length), visual inspection. Pipes marked with embossed number for project consignment. MTC submitted.

3.2 SITE DEMONSTRATION TEST

Contractor arranges manufacturer's representative to explain and demonstrate pipe jointing, laying, hydraulic pressure testing procedure for all pipe sizes. Separate demonstration per size. Pipes and rubber rings selected at random by Engineer. Whole stock rejected if demonstration fails.

3.3 HANDLING AND STORAGE

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Proper handling per manufacturer's recommendations. Stack at approved places. Transportation secure. Off-loading with cranes, rope/nylon slings, lifting beams with flattened hooks or scissor-dog, padded. Storage under shade, not exposed to sunlight/extreme heat. Damaged rejected and replaced.

3.4 LAYING AND INSTALLATION

Trenching: Excavate to required depth. Bottom leveled. If soft clay or loose material encountered, replace 300mm with specified bedding material.

Bedding Material: Sand, well graded, passing #200 ≤10%, free from boulders, clay, cinder, ashes, rubbish.

Laying: Start at lowest point. Socket upstream. Each length straight, true alignment, position, gradient, invert per drawings. Openings tightly closed when not in progress. Prevent floating. Lower into trench with derricks, ropes, belt slings (no dropping). Full length resting on prepared bed.

Jointing: Solvent cement type. Jointing surfaces dry, clean, free from oil, grease, tar, mud, sand.

3.5 TESTING

Infiltration (crown of pipe below water table): Empty pipe, close ends, measure depth after 1 hour. Infiltration not exceed allowable limits.

Ex-filtration (water table below crown): Isolate section between manholes. Internal pressure test 1.20m head above crown at high end (max 6.0m at low end). Measure water quantity after 1 hour.

Allowable Limits: ≤6 litres per mm diameter per km of sewer per 24 hours.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0440 – VALVES & APPURTENANCES

PART 1 – GENERAL

1.1 SCOPE

Supply, installation, testing and commissioning of valves and appurtenances.

1.2 GENERAL REQUIREMENTS

Renowned manufacturers. New, unused. Valves for firefighting: UL listed and FM approved. Material suitable for pipeline, similar to pipeline. Service ratings not less than 10 bars. Valve ends appropriate class/material/type. Install per drawings. Clean interior before installation. Test pressure not less than 1-1/2 x working pressure; no leakage. Adequately supported and labeled. Manufacturer's literature and operation manual provided.

PART 2 – PRODUCTS

2.1 CAST IRON GATE VALVES

Flanged ends, wheel handle, to B.S.5150. Flanges to B.S.4504 Part 1 or EN1092-1. Working pressure 10-25 bars. Close clockwise. Valve body cast iron, flanges cast iron, shaft stainless steel, disc stainless steel with bronze trim, seat cast iron with bronze trim. Inside surfaces enameled, outside epoxy coated.

2.2 CAST IRON CHECK VALVES

Non-slam, swing type, flanged ends, to B.S.5153. Flanges to B.S.4504 Part 1 or EN1092-1. Working pressure 10-25 bars. Direction of flow permanently marked. Body cast iron, flanges cast iron, shaft/spring stainless steel, disc/seat stainless steel with bronze trim, disc/shaft seal rubber (O-ring). Inside enameled, outside epoxy coated.

2.3 DUCTILE IRON GATE VALVES

Flanged ends, wheel handle, to B.S.5150 or EN1171. Flanges to B.S.4504 Part 1 or EN1092-1. Working pressure 10-25 bars. Body, bonnet, wedge of ductile iron; wedge seat bronze; stem stainless steel; hand wheel ductile iron; body seat bronze. Inside enameled, outside epoxy coated.

2.4 BRONZE GATE VALVES

To B.S.5154. Working pressure 10-25 bars. Ends flanged to B.S.4504 Part 1 or EN1092-1. Hose bibs with concrete pedestal as shown.

2.5 BRONZE CHECK VALVES

To B.S.5154. Same ratings.

2.6 BUTTERFLY VALVES

To B.S.5155. Working pressure 10-25 bars. Flanges to B.S.4504 Part 1 or EN1092-1. Direction permanently marked. Body cast iron/ductile iron (per BOQ), seat ring EPDM, disc stainless steel with bronze trim, stem S.S Cr.13, lever/gear cast iron/ductile iron. Stem O-ring EPDM.

2.7 SURGE RELIEF VALVES

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Spring operated globe type to ISO or equivalent. Body cast iron with stainless steel trim. Spring stainless or high tensile steel. Flanges to B.S.4504 Part 1 or EN1092-1. Working pressure min 16 bars. Adjustable.

2.8 DUCTILE IRON DOUBLE ACTING AIR VALVE

Automatic air release with small and large orifices. EN 1074-4. Ductile iron body, cover, flange; stainless steel ball floats; epoxy powder coating min 300 micron. For pipelines 150-300mm: double air valve DN50. At all high points. Firefighting: UL listed and FM approved per BOQ.

2.9 FLOAT VALVES

Copper alloy piston type to BS 1212. Float copper to BS 1968.

2.10 PRESSURE REDUCING VALVE

Screwed, brass body/screws, spring/bonnet/regulation handle synthetic, valve insert corrosion resisting synthetic, mesh strainer with stainless steel mesh (0.16mm), strainer chamber transparent synthetic, ½" connection for pressure gauge both sides, two pressure gauges (0-16 bar). Double socket wrench.

2.11 ABOVE GROUND FIRE HYDRANTS

Ductile Iron body to AWWA C502-80. PN16, test 1.5 x working. Lower part ductile iron with drain opening. Upper part ductile iron with one 100mm outlet and two 65mm outlets. Connection between upper and lower as security break device. 100mm coupling to BS 750, 65mm couplings brass quick release/instantaneous. Inside coating pure enamel or epoxy resin. Outside bright red (RAL 3000) epoxy resin.

2.12 BELOWGROUND FIRE HYDRANTS

Type per drawing, vertical on ductile iron tee. EN 14339:2005 and BS 750. Ductile iron body. PN16, test 1.5 x working. Exterior surfaces two coats black bituminous enamel. Installed in watertight chamber. Letter "F" or "FIRE" inscribed on cover.

PART 3 – EXECUTION

3.1 INSTALLATION OF VALVES

Install in chambers with watertight covers or above grade per drawings. Before installation: clean interior, inspect components, test to 1-1/2 x working pressure, coat internally/externally. After installation: securely anchor, test, retouch damaged paint, label.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0450 – MANHOLES AND VALVE CHAMBERS

PART 1 – GENERAL

1.1 SCOPE

Construction of manholes/valve chambers including providing and fixing C.I/D.I or RCC cover and frame, ladder rungs, etc.

1.2 APPLICABLE SECTIONS OF SPECIFICATION

Section 0100 Earth Work, 0140 Form Work, 0150 Concrete Works, 0200 Brick Masonry, 0460 Cast Iron Covers with Frames and ladder rungs.

PART 2 – PRODUCTS

2.1 CONSTRUCTION

Manholes and valve chambers of reinforced cement concrete top, walls, base slab of RCC per drawings.

PART 3 – EXECUTION

3.1 CONSTRUCTION

Excavation, backfilling, disposal of surplus/rejected earth, plain and reinforced cement concrete, formwork, reinforcement, C.I/D.I or RCC cover and suitable frame, ladder rungs, benching per specifications. C.I. frame and ladder rungs set in place at time of pouring concrete.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0460 – CAST IRON/DUCTILE IRON COVERS WITH FRAMES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Installation of Cast Iron/Ductile Iron Cover with Frame, Gratings and ladder rungs.

1.2 APPLICABLE CODES AND STANDARDS

BS EN 124 “Gully Tops and Manhole Tops for Vehicular and Pedestrian Areas”.

PART 2 – PRODUCTS

2.1 CAST IRON/DUCTILE IRON COVERS WITH FRAME

Sizes and duty per drawings. Cover complete with frame. Top roughened, name/logo of Employer marked, locking and lifting arrangement. Class and test load:

- A15: 15 KN
- B125: 125 KN
- C250: 250 KN
- D400: 400 KN
- E600: 600 KN
- F900: 900 KN

2.2 CAST IRON/DUCTILE IRON GRATING AND FRAME

Sizes and duty per drawings. Class and test load per above table.

2.3 LADDER RUNGS

Galvanized steel ladder rungs with epoxy coating, size per drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

Frame set in place at pouring of concrete. Cover tightly fit in frame.

PART 3 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0470 – PUMPING MACHINERY

PART 1 – GENERAL

1.1 SCOPE

All labor, materials, and equipment to furnish and install pumps and triturator along with motors and all other accessories.

1.2 REFERENCES

ASTM A36 (Structural Steel), A48 (Gray Iron Castings), A53 (Pipe), A108 (Steel Bars), A276 (Stainless Steel Bars), A297 (Steel Castings), A536 (Ductile Iron Castings).

1.3 SPECIAL REQUIREMENTS

Furnish with each pump/triturator properly identified characteristic curves (capacity, head, efficiency, brake horsepower). Stable throttling curves, suitable for unrestricted parallel operation. Electric driven per BOQ. Not overload or trip when operating against zero pressure. No cavitation damage. Bearings suitable for continuous/intermittent operation without external sealing/cooling. Capable of delivering specified quantity at specified pressure. Factory tested for FAT in presence of Employer/Engineer. Installed at positions shown, perfect alignment. Provide reducer/enlarger if necessary.

1.4 SUBMITTALS

Product Data (specifications, installation/start-up instructions, pump characteristic curves). Shop Drawings (dimensions, weight loadings, clearances, assembly methods). Wiring Diagrams. Certificate of Compliance. Maintenance Data (trouble-shooting guide).

1.5 TRANSPORTATION, HANDLING AND STORAGE

Deliver in manufacturer’s original protective packing. Handle carefully, do not install damaged. Store in clean dry place, protect from weather, dirt, fumes, water, debris.

1.6 WARRANTY

All pumping assemblies guaranteed min 1 year after satisfactory installation, testing, commission, acceptance. Water pressure booster system as a whole also guaranteed 1 year.

1.7 QUALITY ASSURANCE

Manufacturer regularly engaged in manufacture of pumps/triturator with characteristics, sizes, capacities required, products in satisfactory use for not less than 5 years. Performance certified by pump manufacturer. Single source responsibility for all components.

PART 2 – PRODUCTS

2.1 GENERAL

Materials new and unused. Statistically and dynamically balance rotating parts. Construction permits complete servicing without breaking piping or motor connections. Pumps/triturator connections flanged. Non-overloading characteristics. Stable characteristic curve; head increases with decrease in delivery; max head at zero flow not exceed discharge pressure at rated duty by more than 25%.

2.2 HORIZONTAL CENTRIFUGAL PUMPS & MOTOR (FOR POTABLE WATER)

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Horizontal centrifugal pump and motor of specified capacity/head. Totally enclosed, fan cooled, squirrel cage induction motors. Body cast iron, impeller bronze or stainless steel, pump shaft stainless steel, shaft sleeve stainless steel. Mechanical seal. Suction/discharge flanges rated ≥1.5 x working pressure. Efficiency not less than 60%. Motor 3-phase, 415/380 volts, 50 Hz, protected against low voltage, overheating, phase failure.

2.3 POTABLE WATER BOOSTER PUMP SET

Hydro-pneumatic pressure tank of specified capacity with neoprene rubber diaphragm. Skid mounted with automatic motor control for dry run protection. Stainless steel piping. L/C flexible pipe, gate valve, non-return valve, pressure switch & gauge. Tank rated working pressure 6 kg/cm², test 9 kg/cm², comply with ASME Code for Pressure Vessel.

Pump sleeve, intermediate chamber/guide vanes, impeller, suction inter-connector, spline shaft cover plates of stainless steel. Base plate painted steel. Gate and check valve on pump discharge, gate valve and foot valve on pump suction. Minimum run timer adjustable 0-6 min. Low water level cut-off switch.

2.4 SUBMERSIBLE BOREHOLE PUMP & MOTOR (FOR TUBEWELL)

Stainless Steel 304 or above. Pump casing, impeller, shaft, wear ring, diffuser all stainless steel. Motor 3-phase, 415/380 volts, 50 Hz, protected. Work out actual flow and head based on exploratory bore. Pump size with respect to bore casing.

2.5 HORIZONTAL CENTRIFUGAL SEWAGE PUMPS & MOTOR (FOR WASTEWATER)

Horizontal non-clogging sewage pump. Body cast iron, impeller stainless steel, pump shaft stainless steel, shaft sleeve stainless steel. All wetted materials suitable for chemical attack from municipal sewage & blue wastewater (from aircraft). Mechanical seal. Efficiency ≥55%. Non-clog impeller allows sizable spherical solids to pass. Operate through level switches in wet pit.

2.6 SUBMERSIBLE PUMP & MOTOR (FOR WASTEWATER)

Integral sealed unit with strainer. Body cast iron, impeller stainless steel, shaft stainless steel, bearings pre-lubricated, motor air filled water tight. Discharge flange threaded to BS 21, working pressure 10 kg/cm². Motor built-in overload protection, low voltage, over-heating, phase failure. Automatic operation per levels in wet pit. Suction/discharge flanges steel drilled to B.S 4504 or B.S 10, working pressure 10 bars.

2.7 TRITURATOR / MACERATOR (FOR BLUE WATER DISPOSAL)

Minimum flow rate 100 m³/hr, continuous operation for 08 hrs/day. Cutterhead casing Gray Cast Iron (EN-JL 1040), connection DN150 PN16 DIN EN 1092, shear plate Molybdenum high speed steel (1.3343/AISI M2 hardened), headstock unalloyed structural steel 1.0570, cutter material hard metal AISI 1045, bearing housing Gray Cast Iron. Mechanical seal silicon carbide, FPM elastomer. All wetted parts suitable for chemical attack. Operate through level switches in wet pit or manually.

2.8 PUMP ACCESSORIES

Pressure switches, pressure transducers, level switches, reducer/enlarger.

2.9 MOTOR PROTECTION

Motors ≤3kw direct on line; larger star-delta starter. Protection against under voltage, overvoltage, overload, over-heating, phase failure. Rated for voltage fluctuation ±10%, frequency fluctuation ±2Hz.

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2.10 CONTROL

Potable Water Supply Pumps: Manual and automatically controlled by level switches in Overhead Water Tank. **Wastewater Pumps:** Manual and controlled by level switches in wet pit. **Triturator/Macerator:** Through level switches in wet pit or manually.

2.11 PRESSURE GAUGES

Copper alloy, bourdon tube, 100mm dial face, engraved 0-16 bar or 1.5 x working pressure. Installed with isolating plug/ball valve.

2.12 WATER LEVEL INDICATOR

230V AC, 50 Hz, complete with float, float chains, counter-weights, chain clamps, mounting brackets, chain guide roller. At least 5 switch-contacts.

2.13 LEVEL SWITCHES

At least 3 switch-contacts, suitable for specific gravity of fluid.

2.14 FOOT VALVE FOR PUMPS

Brass, integral strainer, spring loaded vertical check disc.

2.15 BELL MOUTH SUCTION FITTING

Same material as suction pipe.

2.16 CHAIN AND PULLEY BLOCK ARRANGEMENT

Capable to lift specified load. I-beam standard AISI girder. Travel wheels of dia-forged steel on ball/roller bearings. Chain block capable of standard clearance/lift. Subject to no-load and full-load tests.

2.17 BAR RACK/SCREEN

Mild Steel, rectangular bars 12mm x 50mm, 50mm c/c. Bolts, anchor bolts, washers submerged: Type 316 stainless steel. All anchors stainless steel. Protective coating epoxy min 200 microns.

2.18 MAINTENANCE MANUALS AND TOOLS

Comprehensive manual for assembly, operation, lubrication, adjustment, repair, with parts list. Special tools for maintenance and repair. Manufacturer’s recommended spare parts list submitted for approval.

PART 3 – EXECUTION

3.1 INSTALLATION

Examine area and conditions. Provide access around pumps per drawings (not less than manufacturer’s recommendation). Install on minimum 100mm high concrete base with anchor bolts poured in place. Submersible drainage non-clogging pumps installed in sum pits per drawings.

3.2 SHOP TESTING

Pump performance tests per HI E35.01, E37.01, E39.01. Five points from shut-off head to run-out including guaranteed point. All pumps hydrostatically tested for leaks at 1.5 x design pressure. Submit manufacturer’s test certificates.

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3.3 FIELD TESTING

Field performance test witnessed by Engineer.

3.4 ADJUSTING AND CLEANING

Check alignment, realign within tolerances. Lubricate before start-up. Clean factory-finished surfaces; repair marred surfaces with touch-up paint.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0480 – FLUSHING, TESTING, DISINFECTION AND COMMISSIONING OF PIPELINE

PART 1 – GENERAL

1.1 SCOPE OF WORK

Flushing, testing, disinfection and commissioning of all water lines and system.

1.2 WATER FOR FLUSHING AND TESTING

Contractor arranges required quantity of water.

1.3 FLUSHING

Flush section by section (normal length 500m). Flushing velocity ≥2.5 ft/s. Continue until clean water flows. Dispose flushed water as directed.

1.4 PRESSURE AND LEAKAGE TEST

Follow relevant specifications for various types of pipes and fittings. Contractor locates and repairs defective joints/pipes at own expense.

1.5 DISINFECTION

Potable water lines only. Chlorination: ≥50 mg/l chlorine, retain ≥24 hours, residual ≥25 mg/l at pipe extremities. Flush until residual <1 mg/l.

1.6 COMMISSIONING

Commission after successful testing. Remove all temporary arrangements.

1.7 TESTING OF FIREFIGHTING SYSTEM/NETWORK

Test per NFPA standards. Submit Testing Protocol and Procedure for approval. Testing assembly arranged by Contractor.

PART 2 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0490 – GENERAL REQUIREMENTS FOR ELECTRICAL WORKS

PART 1 – GENERAL

1.1 SCOPE OF WORK

The works related to the Electrical system included in the scope of this Contract are shown on the Drawings, stated in the Specifications and Bill of Quantities, and explained in these specifications. The works shall broadly include but not be limited to:

Item	Description
a.	Main Panel Board (LT Switchboard) — indoor, floor-mounted, factory-assembled
b.	Distribution Boards (DBs) — free-standing and wall-mounting types
c.	Internal Wiring — PVC conduit and cable installation throughout
d.	LED Light Fittings and Fixtures (all new lighting shall be LED type)
e.	Cables, Conduits and Cable Trays — PVC conduit, power cables, underground armoured cables
f.	Earthing System — earth electrodes, CPCs, earth bars, equipotential bonding
g.	Telephone System — outlets, distribution boards, junction boxes
h.	Computer / Data System — CAT-6A UTP cabling, data outlets, network switches, Wi-Fi
i.	CCTV System — IP cameras, NVR, monitors; minimum 30-day retention
j.	Fire Alarm System — addressable smoke/heat detectors, break glass, sounders, FACP
k.	Public Address System — amplifiers, speakers, wiring in PVC conduit
l.	Access Control System — RFID card/biometric readers, control panels
m.	MATV System — TV outlet points, junction boxes, splitters
n.	Lightning Protection System — air terminals, down conductors, earth electrodes
o.	UPS System — online double-conversion for all ATC critical systems; min. 30 min backup
p.	Emergency Lighting System — battery-backed LED emergency luminaires
q.	Diesel Standby Generator Sets — 300 KVA (primary) + 150 KVA (secondary/backup)

The Contractor shall also supply any other equipment not specifically mentioned but necessary for proper operation of the system as intended. The Contractor shall be solely responsible for ensuring proper functional requirements and for furnishing any additional equipment and modifications as desired and/or approved by the Engineer.

The Contractor shall timely carry out field survey to identify the route of feeders and exact location of new 11 KV VCB Panels to be connected with the existing 11KV buses through bus bar extension work. The utility company is to take up the extension work within the Grid station. However, the Contractor is fully responsible to ensure timely coordination and approval from the utility related to termination of required number of 11 KV feeders through extension on both 11 kV busses of the existing 11KV switch gears to erect an 11 KV ring circuit.

The Contractor shall have good knowledge of International Civil Aviation Organization/Federal Aviation Authority (ICAO/FAA) recommendations and shall ensure implementation along with any additional requirements as per tender documents or these authorities.

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1.2 RULES AND REGULATIONS

The entire electrical installation/work shall be carried out by a licensed Contractor authorized to undertake such work under the provisions of the Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified up to date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers – London, the Tender Documents, The Electricity Rules 1937, and bye-laws in force. Any discrepancy shall be brought to the notice of the Engineer for instructions; the Engineer's decision shall be final.

The Contractor shall ensure that the connection of the 11 kV cable with the existing 11 kV switchgear at the grid station is certified by, and acceptable to, the Water and Power Department of the Government of Gilgit-Baltistan (GB Power Department), which is the electricity supply authority for Skardu.

1.3 AMBIENT CONDITIONS

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise:

Parameter	Value
Maximum indoor ambient temperature	40°C
Minimum indoor ambient temperature	-20°C
Maximum outdoor ambient temperature	50°C
Minimum outdoor ambient temperature	-20°C
Maximum relative humidity	100%
Minimum relative humidity	20%
Maximum altitude of project	2230 meters
Design basic wind speed	70 miles/hr
Fastest mile wind velocity	As per ASCE 7-22 with altitude correction at 2,230 m AMSL; refer to Section 0010 §1.02.1
Seismic Zone	Zone 4 per Building Code of Pakistan; Z = 0.4; ASCE 7-22 with Risk Category IV (Ip = 1.5 for non-structural components)

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The atmospheric condition is highly humid. Wind loading shall also be considered as per applicable local Codes and Standards. All offered/supplied electrical equipment, devices and material shall be strictly in line with the project site conditions.

1.4 STANDARDS

The latest standards, codes and recommendations of reputable institutions (BSS, VDE, IEC, NEC, NFPA, ICAO, FAA, etc.) shall be applicable. Where the Specifications differ from standards, the equivalent or better specifications shall govern. Wherever applicable, equipment shall also conform to Pakistan Standards and Quality Control Authority (PSQCA) and Pakistan Standard Institution (PSI). The Contractor shall maintain at the site office one copy of the standards/codes/recommendations applicable to the works and will furnish the same as required by the Engineer/Employer.

1.4.1 Licensing Requirements

All electrical work shall be carried out only by a licensed contractor authorised under the Electricity Act 1910 and the Electricity Rules 1937, as adopted in Gilgit-Baltistan. The Contractor shall sign a formal contract with the electrical sub-contractor. The final electrical installation shall be inspected and passed by the Electric Inspector designated by the Government of Gilgit-Baltistan before commissioning.

1.5 SYSTEM DATA

Unless otherwise specified, all equipment and material shall be designed to operate satisfactorily with the following minimum requirements without de-rating:

- **HT Voltage:** 11kV, 3 phase ±10%
- **LT Voltage:** 400V, 3 phase ±10%; 230V, 1 phase ±10%
- **Frequency:** 50 Hz ±2 Hz

Colour coding for live parts shall be according to IEC 60445:2017 & BS7671:2008:

Network	Conductor	Coding	Colour
A.C.	Phase 1 (L1)	–	red
	Phase 2 (L2)	–	yellow
	Phase 3 (L3)	–	blue
	Neutral (N)	–	black
D.C.	Positive (L+)	–	white
	Negative (L-)	–	black
Earthing	Protective Earth (PE)	–	green/yellow
	Earth (E)	–	green/yellow

Control Cables: Shall be manufactured according to specifications for L.T. Cables, multi-core, PVC insulated, withstanding site conditions. Cross section as per system requirement. All cores shall be numbered and/or colour coded. At least 20% spare cores shall be provided in all Control Cables.

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1.5.1 Electrical Load Data:

Load Category	Connected Load / Capacity
Lights and Power (connected)	225.97 kW (demand: 123.00 kW)
Lift	30.00 kW
Public Health (plumbing pumps, etc.)	15.00 kW
HVAC System	200.00 kW
Total Diversified Demand (80% diversity)	294.40 kW
Transformer Capacity Required	630 KVA (460 KVA at 0.8 PF; 368 kW at 80% load factor)
Generator Capacity — Primary	300 KVA (with AMF panel and ATS; transfer time ≤ 10 seconds)
Generator Capacity — Secondary / Backup	150 KVA

1.5.2 ATC Cab Lighting Requirements

ATC cab lighting shall be fully dimmable (0–100%), non-reflective in glass, and energy efficient. Colour rendering index (CRI): minimum Ra 80. Illuminance at ATC control positions: 500 lux. Night vision protection mode: switchable to low-level red lighting. Dimmer controls: Polaron Controls UK, Strand Lighting, Altenburger, or Engineer-approved equivalent. All lighting in the ATC Visual Control Room shall comply with ICAO Doc 9157 requirements for control room lighting.

1.5.3 Earthing System Requirements

Comprehensive earthing system per BS 7671 / IEC 60364-5-54. Earth electrode: copper-bonded steel rods, minimum 2.4 m long. Target earth resistance: ≤ 1 Ohm for the ATC Tower (critical aviation facility). Multiple rods in parallel if required. All metalwork, conduits, cable trays, trunking, switchboard enclosures, and structural steelwork bonded to the main earthing terminal (MET). Green-yellow CPCs in all conduits (14 SWG minimum).

1.6 EQUIPMENT

1.6.1 Equipment Manufacturer

All equipment and material shall be standard products of reputable and ISO certified manufacturers with similar manufacturing experience of at least five years.

For imported equipment, only authorized local distributors/suppliers of the Original Equipment Manufacturer (OEM) shall be considered. For all OEM equipment, the Contractor shall clearly identify the brand, country of manufacture, and the local agent in Pakistan who can provide local maintenance assistance. Local agent reference shall include: company name, address in Pakistan, contact persons, phone numbers, valid email, reference in similar fields, authorized distribution certificate from OEM, and certified engineer’s certificate. After-sales service, spares and support shall be available with the manufacturer/authorized distributors.

1.6.2 Country of Origin

Equipment manufactured in Israel and India is not acceptable. The Contractor shall clearly mention origin of equipment in his bid. Subassembly or part assembly from other countries must be disclosed. No relaxation will be entertained after award of Contract.

1.6.3 Quality Assurance

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All materials and equipment shall be new, unused and of best quality. Standard components of regularly engaged manufacturers shall be offered. All equipment and components shall have been thoroughly tested and proven in actual use. Equipment shall have current year of manufacturing. Manufacturers' quality control shall be in accordance with ISO 9000 series (or DIN equivalent). Manufacturers with quality control certified according to ISO 9000 series will only be acceptable; certified copy shall be attached to bid.

1.6.4 IP Degree of Protection

The equipment shall have IP degree of protection as follows unless mentioned otherwise:

- IP 42 for indoor areas
- IP 54 for indoor damp areas
- IP 65 for outdoor areas

After installation, the Contractor shall provide high performance epoxy paint on all Switchboards and related electrical equipment. If properly rated equipment is not available, the Contractor shall provide field enclosures to attain the required IP degree of protection. Cooling/exhaust fans and/or anti-condensate heaters shall also be provided if necessary. No separate payment shall be made; it is deemed included in the relevant BOQ item.

1.6.5 Protective Paint Coating for Electrical Equipment Components

Indoor sheet steel metal works (all types of Electrical Switchgears/Distribution Boards, RMU, Kiosk Type Substation, Transformers, DG Sets, Cable trays, etc.) shall be coated with a protective paint system in accordance with ISO 12944 Corrosivity Category "C2" with Medium Durability. Priming coat(s) shall be epoxy based; top coat shall be polyurethane based with colour shade RAL 7032/7035 or as approved.

Outdoor metal works (transformer, cable trays, outdoor LT Distribution Boards, lighting poles, etc.) shall be coated with protective paint system in accordance with ISO 12944 Corrosivity Category "C3" with Medium Durability. Priming coat(s) epoxy based; top coat polyurethane based with colour shade RAL 7032/7035 or as approved. Appropriate bonding/adhesion material such as Etch Primer is recommended for galvanized surfaces before application.

The Contractor shall submit to the Engineer for approval:

- Paint manufacturer's confirmation that proposed paint system is compatible with the intended surface.
- Paint manufacturer's confirmation that proposed paint products are compatible with each other.
- Paint products catalogues.
- OEM's recommended surface preparation methodology.
- Number of coats.
- DFT per coat.

1.6.6 Nameplate

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All equipment shall have stainless steel name plates mounted in a visible position. Entries shall be indelibly marked in English by engraving and include data per applicable IEC and other standards, plus any specified requirements. The Contractor shall also supply all labels, instruction and warning plates (English and where specified Urdu) necessary for identification and safe operation. All labels, nameplates, instructions and warning plates shall be securely fixed with stainless steel rivets, plated self-tapping screws or other approved means (adhesives not permitted).

1.6.7 Identification & Labeling

All devices, meters, cabling, wiring and auxiliaries shall be properly labelled for identification using flameproof material with indelible ink/marking. Labeling shall ensure uniformity and facilitate study of control diagrams during operation and maintenance. Labels shall be of suitable size to be visible from operating conditions/positions.

1.6.8 Lamp Test Facility

All equipment / Switchboards / Motor Control Centers, etc. shall be provided with common lamp test facility.

1.6.9 Climatic Design Conditions for Electrical Equipment

Parameter	Design Value
Maximum Ambient Temperature	+40 °C — refer to project-wide design temperatures in Section 0010 §1.02.1. All electrical equipment shall be qualified for continuous operation at this maximum value.
Minimum Ambient Temperature	–25 °C — equipment qualification minimum. Cold-start capability mandatory for generators, switchgear, motors and transformers. Refer to project-wide design temperatures in Section 0010 §1.02.1.
Maximum Relative Humidity	90% — tropical-grade insulation and anti-condensation heaters in all switchgear
Altitude Correction	All electrical equipment rated at 2,230 m AMSL; de-rate per IEC standards (approximately 0.79 × sea-level air density)

1.7 SHOP DRAWINGS, MATERIAL SUBMITTALS, AND TECHNICAL DATA

1.7.1 Required Submittals

The Contractor shall submit for each electrical equipment as a minimum:

- Structural drawings (foundations, RCC details, dimensional plans, elevation, sections, loading details).
- Electrical drawings: line/schematic diagrams for HT Switchboards, LT Switchboards/ATS/Synchronization Panel, LT Outdoor Distributors, LT Distribution Boards, Motor Control Centers; detailed wiring/control diagrams, elevations, internal component layout, top/bottom/side views.
- Complete shop drawings with execution/fixing/installation details (number of wires, conduit size, cable routes, cable schedules) for Lighting Layouts (including Façade Lighting), Power Layouts, Cable Tray Layouts, Grounding Layouts, Lightning Protection System Layouts, Ground Powering Unit (400Hz), Cathodic Protection System (CPS), Solar Power System

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(SPS), DC Supply System, MV and LV cabling details, Manhole/Duct works, Danger Sign Board dimensional and installation details, Combined and Coordinated Ceiling Layouts.

- Equipment installation details for Power Transformer, LV DG Set, Kiosk type substation, HT Switchboard(s), LT Switchboard(s)/ATS/Synchronization Panel, LT Outdoor Distribution Board(s), LT Distribution Board(s), Motor Control Centre(s), Ground Powering Units, Cathodic Protection System, Solar Power System, DC Supply System.
- Airfield Lighting System drawings: line diagrams of Distribution Boards, Constant Current Regulators with detailed wiring diagrams; Airfield Lighting Layouts; cabling, grounding/earthing; integration with existing ALCMS and ILCMS details; conduit & pipes layout; dismantling and reinstallation details.
- Apron Flood Lighting drawings: line diagrams of Apron Distribution Boards with wiring diagrams; Apron Lighting Layouts; lighting distribution calculation sheets with lux levels marked grid-wise; power/earthing layout; integration of control & monitoring with existing ALCMS.
- Advance Visual Docking Guidance System drawings.
- Technical literature and manufacturer's characteristic data with description of materials and weights.
- As-Built Drawings of existing conditions.
- Combined Services Layout Diagrams (coordinated with existing services).
- Foundation and Trench Arrangement Drawings.
- Technical submittals for: LV D.G. Set, Power Transformer, HT Switchboard, Ring Main Unit, KIOSK type Substation, LT Switchboards/ATS/Synchronization Panel, Motor Control Centres, LT Outdoor Distribution Boards / LT Distribution Boards, UPS System, Airfield Lighting System, Apron Flood Lighting System, A-VDGS, Solar Power System components, Cathodic Protection System components, DC Supply System components, Miscellaneous Items (Lighting Poles).
- Technical submittals with material samples for: Light Fixtures, HT/LT Cables, Wiring Accessories, Conduits/Pipes & Fittings, Earthing & Lightning Protection System, Miscellaneous Items (Cable Trays/Ladders, Under floor metal trunking, Ceiling/Bracket Fans, Switch disconnector/LBS with weatherproof enclosure box), 400Hz GPU, CPS, SPS, DCSS.
- Testing and commissioning time table and protocols.
- Design calculations/software-based simulations: illumination calculations, voltage drop calculations, comprehensive short circuit software simulations, selective coordination analysis, thermal soil resistivity measurement, lightning protection risk assessment and rolling sphere analysis, earthing calculations based on measured thermal soil resistivity, and simulations for 400Hz GPU, CPS, SPS, DC supply system.

No separate payment shall be admissible for software-based simulations, design calculations, analysis, measurement, field testing, etc.; cost shall be deemed included in the relevant BOQ item.

1.7.2 Submission and Review Process

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At least three (3) copies of shop drawings, submittals and/or technical data shall be submitted to the Engineer for review and approval. The Engineer will review all documents and make changes as required. The Contractor shall ensure full compliance with comments.

Engineer's approval must be obtained before any equipment, device or material is purchased or fabrication commenced. Approval is general and does not relieve Contractor of responsibility.

Each drawing/document will be returned marked:

- (a) "APPROVED"
- (b) "APPROVED EXCEPT AS NOTED"
- (c) "REVISE AND RESUBMIT"
- (d) "NOT APPROVED"

"NOT APPROVED" documents are rejected; Contractor shall offer alternates and resubmit four copies. "REVISE AND RESUBMIT" documents shall be corrected and resubmitted (four copies). For "APPROVED EXCEPT AS NOTED", the Contractor may proceed but shall incorporate changes; resubmission may be required if Engineer considers necessary. Revised submittal within 7 days.

The Contractor must allow 28 working days for Engineer's review (as specified in Section 0010). The Contractor is responsible for discrepancies, errors or omissions in his drawings even if reviewed. Any delay in approval caused by incompleteness, shortcomings, non-submission of required information, etc., is attributable to the Contractor and will not be a reason for extension of time (EOT).

Symbols for electrical equipment shall conform to NFPA, NEC, IEEE, IEC, and/or DIN. Soft copies of all applicable codes/standards will be provided by the Contractor to the Engineer. All circuit diagrams shall be drawn so they can be assembled in a standard hard-core, non-detachable binder and unfolded without being detached.

1.8 MANUFACTURER'S INSTRUCTIONS

The Contractor shall supply to the Engineer six (6) properly bound copies of manufacturer's instruction manuals for installation, testing, commissioning, operation and maintenance of the specified equipment, including spare parts and tools manuals. At least two copies shall be original. Installation instructions shall be submitted 2 weeks prior to commencement of installation; operation and maintenance instructions at commissioning. Failure to provide documents shall result in withholding of certificates and deduction of suitable amount from payments.

1.9 GUARANTEE

The Contractor shall furnish written guarantee of the manufacturer or supplier with respect to satisfactory performance of each equipment. Guarantee shall cover replacement and repair of parts or whole equipment defective in material or workmanship for the Defects Liability Period as defined in the Conditions of Contract. The Contractor shall be fully responsible for timely repair or replacement.

1.10 DANGER BOARDS, SIGNS, SHOCK/FIRST AID CHARTS AND FIRE FIGHTING EQUIPMENT

Danger Boards having signs and designation of the room shall be installed on the external door of DG Set Room, HT, LT, and Power transformer rooms. Painted Danger Sign and Designations shall be provided on Kiosk Type Substation. Shock/First Aid Charts shall be installed in H.T, L.T, Low Voltage DG Set, Transformer Rooms and Kiosk Type Substation. Portable firefighting extinguishers suitable for electrical fire shall be provided in H.T, L.T, Power Transformer Rooms and Kiosk Type Substation.

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1.11 ASSOCIATED CIVIL WORKS

Except where separately stated in the Bill of Quantities, the cost of all civil works associated with any BOQ item of electrical works (excavation, backfilling, compaction, foundation pads, thrust boring, chiseling, making openings, etc.) shall be deemed included in the price quoted against respective electrical items.

All openings made in external/internal walls, slab, ceiling, etc. for electrical works shall be filled after installation with suitable heat and fire-resistant mortar, suitably rated with respect to building fire zones, to ensure no ingress of water or spread of fire. All unutilized conduit/pipe/slab openings shall be sealed with same material. Repair of any damage to civil works caused by the Contractor during installation is included. No separate payment shall be made.

PART 2 – PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

All equipment and material shall conform to the standards, ratings, and quality requirements specified in Part 1. Specific product requirements for each system (DG Sets, Transformers, Switchboards, Cables, etc.) are detailed in their respective sections of the Specifications. The Contractor shall provide only products that are new, of current manufacture, and from approved manufacturers with ISO 9000 certification.

2.2 PROTECTIVE PAINTING

As specified in clause 1.6.5, all indoor and outdoor metal works shall be coated with protective paint systems per ISO 12944 Corrosivity Category C2 (indoor) or C3 (outdoor), with epoxy primer and polyurethane top coat, colour RAL 7032/7035 or approved. Etch primer for galvanized surfaces.

2.3 NAMEPLATES AND LABELS

Stainless steel nameplates with engraved English text; labels, instruction and warning plates in English (and Urdu where specified), fixed with stainless steel rivets or plated self-tapping screws.

2.4 CONTROL CABLES

Multi-core, PVC insulated, with at least 20% spare cores, numbered and/or colour coded.

PART 3 – EXECUTION

3.1 INSTALLATION INSTRUCTIONS – GENERAL

The Contractor shall install all system components and appurtenances in accordance with manufacturer’s recommendations and provide all necessary interconnections, services and adjustments for a complete functional system.

The Contractor shall provide instrumentation and communication grounding as necessary. All penetrations shall be sealed to preclude water entry using silicone material.

The Contractor shall furnish all labour, materials, tools and equipment required to install, connect, test and commission all electrical equipment specified herein, whether or not furnished by him or others. The Contractor shall supply and install all erection materials (foundation bolts, washers, nuts, etc.) without additional cost.

The Contractor shall set out the works as per Specifications and Drawings and properly position equipment on specified foundation/location. Manufacturer’s instructions for installation shall be

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followed. Any defect or faulty operation due to not following manufacturer's instructions shall be corrected at Contractor's own cost.

Deviation from working drawings deemed necessary due to site conditions shall be submitted for Engineer's approval before starting work.

3.2 FACTORY ACCEPTANCE TESTS (FAT)

3.2.1 Scope

Factory tests are to be carried out in the presence of both the Employer and the Engineer. All type and routine tests on DG Sets, HT Switchboards, Power Transformers / Kiosk type Substations, LT Switchboard, ATS, Synchronization Panel, LT Distribution Boards, Motor Control Centers, HT Cables, LT Cables, Control Cables, Cathodic Protection System (CPS), 400Hz Aircraft Ground Power Units System, Solar Power System (SPS), Advance Visual Docking Guidance System (AVDGS), Airfield Lighting System equipment, and all other equipment shall be performed at the manufacturer's works in the presence of the Engineer and the Employer or their representative.

Type tests may be waived if test certificates are submitted from an Engineer-approved standard laboratory of international repute, but routine tests shall still be carried out.

The Contractor shall submit the test procedure to the Engineer/Employer for approval at least 4 weeks before carrying out the tests. Factory test procedures shall be drawn in accordance with relevant code/standards, standard practices and manufacturer's recommendation.

The Contractor shall inform the Engineer/Employer about date and time of test of each equipment at least two weeks in advance. This shall be after test procedures are approved.

The Contractor shall make necessary arrangements and provide all facilities for representatives of Employer/Engineer for conducting inspection, at Contractor's cost. Travel, visa, boarding, lodging costs shall be Contractor's responsibility. The Contractor shall provide daily allowance (as specified in section 0010) for out-of-pocket expenses to each representative, in cash (US$) before travel.

The Contractor shall submit tests procedures for approval well in advance. All relevant submittals, shop drawings and requisite technical data shall be approved prior to start of production. The Contractor shall give at least 3 weeks' notice for attending inspections/tests.

All domestic and foreign FATs shall be carried out in presence of Employer and Engineer or their representatives.

3.2.2 Transformer Tests (minimum per IEC 60076)

- Measurement of Polarity and Phase relationship
- Measurement of Load Losses & Current
- Measurement of No-load losses & Current
- Induced Over-Voltage Withstand Test
- Separate Source Voltage Withstand Test
- Measurement of Winding resistance for both MV & LV
- Measurement of Insulation resistance using megger
- Measurement of Short Circuit Impedance and Load Losses

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- Measurement of Dielectric Strength of Oil
- Functional Test of Buchholz Relay

3.2.3 Diesel DG Set – Standard Witness Test

The approved DG Set shall be subject to inductive load duration tests at manufacturer's premises per applicable codes/standards:

- Inspection of Generator Set prior to Set Test
- Load Acceptance demonstration (single step load application)
- Load Duration Test: 1 hour at 100% rated at 0.8pf (45 min at 100% + 15 min at 110%), then 1 hour at 100% rated at 1.0pf (45 min at 100% + 15 min at 110%)
- During load test, record every 15 minutes: Time, kW, Power Factor, all L-L voltages, line currents, frequency, oil pressure, engine coolant temperature, alternator temperatures.
- Demonstrate: Manual Control, Automatic Starting and Rest Attempts, Emergency Stop Control (Local & Remote), Automatic Mode, Cooling Run.

Documentation to be provided: Extended Load Run Certificate, Standard Factory Test Certificate, Certificate of Inspection, Engine Test Certificate, Alternator Test Certificate, Transient graphs, Calibration Certificates.

3.2.4 HT Switchboards, LT Switchboards, ATS, Synchronization Panel, LT Outdoor Distribution Boards / Distribution Boards, Motor Control Centres (MCC) / Apparatus Control Panel (ACP)

Contractor shall submit proforma/list for essential routine tests per IEC 62271-1 & 62271-200 for HT Switchboard, and per IEC 61439 for LT Switchboard, ATS, Synchronization Panel, to be carried out at manufacturer's/assembler's premises during FAT.

Routine tests for LT Distribution Boards, LT Outdoor Distribution Boards, MCC, ACP shall be carried out per relevant international standards.

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked. Phases shall be properly identified. Trip circuits checked. Correct size/function of fuses, disconnect switches, interlocks, indicating lights, alarms, remote control devices shall be per approved drawings. Nameplates checked. Protective relays tested and set at site prior to commissioning. Lamp test facility checked.

3.2.5 HT Cables / LT Cables

Contractor shall submit proforma/list for essential routine tests per IEC 60502-2 for 8.76/15kV grade HT Cables; per IEC 60502-1 / BS 6346 for 600/1000V grade multicore LT Cables; per BS 6004 for 450/750V grade single-core LT Cables and 300/500V grade single-core/multicore LT Cables.

3.2.6 Solar Power System

Factory Acceptance tests are to be carried out in presence of Employer and Engineer. Type and routine tests on Solar PV Panels, DCDB/SCB/SMB, String Inverters, ACSB/ACCB, low tension cables (DC and AC), etc.

3.3 SITE ACCEPTANCE TEST (SAT) / FIELD TESTING

3.3.1 Scope

Upon completion of installation, the Contractor shall perform field tests on all equipment, cables, materials and systems in presence of Engineer or his representative. The Contractor shall submit for approval complete test details (procedure, observations, expected results). The Contractor shall furnish all tools, instruments, test equipment, materials and qualified personnel.

All tests shall be made with proper regard for protection of personnel and equipment. Cost of damages or rectification due to accidents shall be Contractor's responsibility. The Contractor shall record all test values and provide four (4) copies certified by Engineer, including test method, equipment, diagrams. Witnessing by Engineer does not relieve Contractor of guarantees or other obligations.

3.3.2 Low Voltage D.G. Set

Prior to tests, submit manufacturer's detailed test procedures for approval. Carry out full site load and no-load tests per applicable IEC, ISO, IEEE, BS standards. Tests shall include:

Basic Tests: Insulation Resistance, Earth Continuity, Earth Loop Impedance, Polarity, Phase Rotation, Voltage and Frequency, Starting System, Protection Equipment.

Battery: Nominal Voltage, Discharge Voltage, Specific Gravity of Electrolyte, Level of Electrolyte, Charging System.

Lubrication: Check as required by manufacturer.

Operational Check at Start-up: Oil Pressure, Fuel Oil Leaks, Operation of Safety Devices, Operational Speed, Automatic Control, Instrument Check, Exhaust Check, Undue Vibration.

Operational Check after one hour run: Oil Pressure, Oil Leaks, Cooling System, Oil Temperature.

Commissioning Test: 25% full load 2 hrs, 50% full load 5 hrs, 75% full load 8 hrs, 100% full load 8 hrs, 110% full load 1 hr.

All results recorded and compared with design data. If required load not available, Contractor shall provide dummy load at no extra cost. Correct functioning of control equipment shall be proved.

3.3.3 Battery Charger

Static type, trickle and boost charging, capacity to fully recharge completely discharged batteries within four hours at boost charge.

3.3.4 Control Panel

Provide all necessary control and monitoring devices for Diesel Generating Sets as specified.

3.3.5 Airfield Lighting System

Test per ICAO recommendations and FAA Specifications regarding light intensity and light emission. Perform and record in presence of Engineer:

- Visual inspection of all light fixtures and constant current regulators (CCR)
- Visual inspection of isolating transformers and arrangement in pits/housing
- Insulation resistance tests of all individual and switching circuits (phase to earth) using 5kV megger – reading not less than 1 mega Ohm
- Operation test of all lights from existing ALCMS and ILCMS

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- Switching of all brightness steps from control workstation
- Operating tests on CCR for each switching circuit
- Operating test including all controls on control workstation
- Operating tests of modular system
- Operating tests of lamp failure alarm
- Test of lamp failure alarm, total power failure, secondary circuit failure on all circuits

3.3.6 Insulation Resistance Test

Make insulation resistance test on all electrical equipment using megger:

- 500 volts for circuits up to 250V
- 1000 volts for circuits 250-500V
- Up to 5 kV for 11 kV circuits (as advised by equipment manufacturer)

Values shall be as per BSS, IEEE, NEC, ICEA and Pakistan Electricity Rules.

Before connections at cable ends or joints, test each cable section. All cables subject to high voltage test per standard. Each conductor of multi-core cable tested against others and earth. If readings below minimum, replace cable and retest. If joint provided, test sections; joint made only after tests satisfactory. Finally test completed cable including joints.

Switchgears: insulation resistance measurement after installation but before wiring. Test between open contacts of circuit breakers, switches, and between each phase and earth. If low, determine and remove cause (dry-out by heaters if moisture). Corrective measures: repeat readings twice at 12-hour intervals; maximum range not exceed 20% of average value. After tests, reconnect equipment. Polarity test on single pole switching devices.

3.3.7 Earth Resistance Test

Make earth resistance tests, separating and reconnecting each earth connection. Soil treatment or corrective measures as determined by Engineer.

Electrical resistance of ECC together with earthing leads from earth electrode to any other position shall not exceed 1 ohm. Test per Electrical Inspector’s requirements. Where multiple earth electrodes, measure each electrode using resistance bridge instrument.

Lightning protection system: test for continuity and earth resistance. Combined earth resistance at any point shall not exceed 10 ohms.

3.3.8 Special System Test

Test components of DC supply, Cathodic Protection, Lightning Protection, Solar Power System, 400Hz GPU, AVDGS, etc., per respective technical specification sections. Any specific test recommended by OEM/Local Vendor/Govt. inspector shall also be carried out as approved by Engineer without additional cost.

3.3.9 Completed Tests

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After equipment is tested and accepted by Engineer, the Contractor is responsible for its proper protection so that subsequent testing does not cause damage.

3.3.10 Expenses

All expenses (travel, documentation, boarding, lodging, allowances, etc.) for carrying out tests and witnessing by Engineer and Employer shall be borne by Contractor and deemed included in BOQ rates.

3.4 SPARE PARTS

Contractor shall provide spare parts as identified in Appendix-D. Total amount carried to relevant BOQ item.

3.5 SPECIAL TOOLS

Contractor shall provide special tools as indicated in Appendix-C and as may be deemed essential for assembly, adjustment, dismantling, installation and operation & maintenance (O&M). Total amount carried to relevant BOQ item.

3.6 STATEMENT OF COMPLIANCE

Contractor shall submit an overall in-writing compliance signed and stamped with the items of these specifications in the form of Statement of Compliance (required at bidding stage). During material submittal review stage, Contractor shall submit his own proposal and OEM's para-wise compliance of relevant specification section with each material submittal. Absence of such compliance will lead to rejection.

3.7 WARRANTY OF GOODS

Contractor shall provide warranty of equipment as specified under respective sections, for the period defined. Effectiveness of warranty from OEM commences from effective date of Taking Over Certificate issued by Engineer. All warranties are to be endorsed in Employer's name, and an undertaking shall be submitted from OEM and local representatives for ensuring compliance of services during Warranty Period.

3.8 APPENDICES TO BE FILLED IN BY TENDERER

Details regarding equipment manufacturers, deviations, technical data, special tools, spare parts, etc., shall be furnished in the appendices attached with form of tenders, in accordance with the "Requirements of Electrical Works" in the instructions to Tenderer.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0500 – LOW VOLTAGE DIESEL GENERATOR SET

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of complete Diesel Generator set including Synchronizing/Load Sharing Panel, ATS/AMF Panel and other equipment.

1.2 GENERAL

Standard design of reputed manufacturer, brand new, current year. Prime duty rating per ISO 8528, indoor installation IP23. Capable for unbalance loads up to 30%, operation at -25°C and altitude 2230m. Prime rated power output with overload capability 10% above rated for 1 hour in any 12 hours per ISO 3046, BS 5514. Direct coupled engine-generator, 1500 rpm. Capable of sustaining 25% overspeed. Suitable for full load starting, max transient voltage drop 15%, restore to 97% within 1.5 sec. Capable for parallel operation.

1.3 APPLICABLE STANDARDS/CODES

BS 5514, BS 4999, BS 5000-99, IEC 60034.

1.4 WARRANTY

Min 2 years from OEM, commencing from Taking Over Certificate.

PART 2 – PRODUCTS

2.1 DIESEL ENGINE

Four stroke, compression ignition, prime duty. Electric starter, DC lead acid batteries. Alternator type automatic charging system and static battery charger in control panel. Engine rated for prime duty with overload 10% for 1 hour in 12 hours.

Air Intake: Turbo charger, dry type filter, attenuators.

Lubrication: Gear type positive pressure pump, 230V AC mains operated heater with thermostat in crankcase. Constant oil level regulator.

Cooling: Forced air draft, water-cooled radiator, 50°C ambient, engine driven centrifugal pump, thermostatically controlled, shut down timer.

Exhaust: Residential type silencer, flexible connector, thermal insulation over entire length.

Speed Governor: Electronic, maintain frequency ±2%, stable speed within 15 sec, ±5% variation during load change.

Fuel Day Tank: Skid mounted, 8-hour capacity. Level switch for low fuel (annunciation, prevent start, stop). Overflow, vent, supply, discharge valves, inspection cover, drain valve, glass sight gauge.

2.2 GENERATOR

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Synchronous. 10% overload for 1 hour in 12 hours. Permanent magnet excitation, brushless rotating diodes. Two-third pitch winding, Class-F insulation, temperature rise per Class-B. Anti-condensate heaters thermostatically controlled. Thermistors for winding protection.

Voltage Regulation: ±2.5% no-load to full load. Transient voltage drop <15% at full load 0.8 PF. Restore within 10 sec.

Deviation Factor: ≤0.1.

2.3 GENERATOR CONTROL PANEL

Front access, assembled, wired, tested. Circuit breaker triple pole with adjustable releases. Instrumentation: LED/LCD for AC metering (Volts, Amps, Frequency, kW, kVA, kVAr, PF, kWh, kVArh) and DC metering (Battery Volts, Engine hours, Temperatures, Pressures, Speed, Fuel Level). Safety devices (A=Alarm, SD=Shutdown, TD adjustable): Engine over/under speed (A SD), Low lube oil pressure (A SD), High water temperature (A SD), Over/under voltage (A SD), Reverse Power (A SD), Low/High fuel level (A SD), Battery charger failure (A), Winding temperature high (A SD), Over crank (A SD), etc. Controls: Auto-Manual-Test-Stop, Lamp test, Alarm acknowledge, Emergency stop. Static battery charger for trickle and boost.

2.4 SYNCHRONIZING / LOAD SHARING PANEL AND ATS/AMF PANEL

Designed for: Mains failure (360-440V adjustable), D.G Sets start and synchronize. Open incoming ACB. Close D.G Set ACB. Synchronize Genset-1 and Genset-2, close ACB. Load sharing proportional. If total load <80% of rating, one set shuts down after 5 min delay. If load increases or operating set fails, idle unit starts, parallels, shares load. Transfer load back to mains when voltage returns and persists for 3 min. Four-position selector switch (Test-Manual-Automatic-Stop/Maintenance). Duty Selection Switch for Duty-I or Duty-II. Potential free contacts for remote indication.

2.5 GENERATOR NEUTRAL DISCONNECTING SWITCH

Motorized for each D.G. Set neutral earthing. Rated for max fault current.

2.6 TECHNICAL SPECIFICATION GENERATOR:

Supply, Installation & Testing at site of water cooled NEW diesel generating sets suitable for operation at 50oC and 90% relative humidity manufactured by any one of the manufacturers as specified in annexure “A” assembled in accordance with their provided drawings / manuals and consisting of painted welded steel bed plate frame work to accommodate engine alternator complete with electronic governor to give regulation to BS: 514 class A1, balanced flywheel, water jacket heaters energized by the incoming main supply, heavy duty starting batteries, battery charger, set of spare oil/fuel filters engine panel with oil pressure and water temperature gauge, alternator electronic voltage regulator, radio interference suppressors, electronic tachometer frequency meters voltmeter, Ammeters, hour runs meter, KWH meter, KW (total and per phase) KVA total and per phase.

Power factor (Ave, total and per phase. KVAR (total) KVAR hour % of rated load, emergency stop push button, radiator, with water level switch, fuel tank, piping works, consisting of black steel pipe schedule 40, fuel pump, exhaust system residential type silencer, suitable for following prime rating, 400 / 230 volts, 50 cycles/second, at 1500 rpm, for 3 phase 4 wire system, including cost of all necessary material/accessories alongwith sound proof canopy,day tank/piping with filters and RCC foundation pads as per specification of engineer incharge, complete in all respects.

PART 3 – EXECUTION

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3.1 INSTALLATION

Install at location shown. Concrete foundation pad (civil works coordinated by Contractor). Foundation bolts grouted with non-shrinkable material. Erect per manufacturer's instructions. Connect incoming/outgoing cables per cable manufacturer, cable armour connected to ground. Generator body connected to earth per Section 0620.

3.2 TESTING

Tests per Section 0490.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0510 – INDOOR POWER TRANSFORMER

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing, connecting and commissioning of complete Indoor Power Transformer.

1.2 APPLICABLE STANDARDS/CODES

IEC 60076-1,2,3,4,5,7,8,10,12; IEC 60296; IEC 60815; IEC 60137; DIN 42561; NFPA-70; ISO-12944.

1.3 WARRANTY

Min 2 years from OEM from Taking Over Certificate.

PART 2 – PRODUCTS

2.1 POWER TRANSFORMER CONSTRUCTION

Tank welded boilerplates, external radiating tubes. Anti-corrosive painting per ISO 12944 Corrosivity Category C2, Medium Durability (Epoxy primer, polyurethane top coat, RAL 7032 or 7035). Conservator tank with silica gel breather, oil level indicator. Core non-aging cold-rolled electrical silicon steel. Windings high-grade electrolytic copper. H.T. lead on porcelain insulator bushings, protective arcing horn spark gaps. L.T and neutral leads terminated at porcelain insulator bushings. Off-load tap changer on H.T side. Double float Buchholz relay.

Principal Data: Capacity per drawings/BOQ; 11000/415 Volts; 50 Hz; Dyn 11; Off load tapping +2.5%,+5%,-7.5%; 11 kV Delta; 415V with grounded star point; Temperature rise oil 40°C max, winding 50°C max; Impedance voltage 4-6% max; Regulation ≤2.5%; BIL 95 kV; Cooling mineral oil immersed ONAN.

Accessories: Oil drain valve, filling hole, conservator, oil level indicator, corrugated fins/cooling tubes, silica gel breather, inspection hole, bi-directional roller wheels, lifting lugs, earthing terminals (2 diagonally), stainless steel rating plate, “Electrical hazard” labels, off-circuit tapping links with padlocking, HV cable box, LV connections from above, marshalling box, double float Buchholz relay, max oil temperature relay, dial type thermometer, pressure release safety valve.

2.2 TECHNICAL SPECIFICATION TRANSFORMER:

No. of phases: 3

Frequency: 50Hz

Type of cooling: ONAN/ONAF

Rated Voltage (HV) : 11KV

Rated Voltage (LV) : 415V

System Highest Voltage(V) : 12KV

No load losses(V): As per IEC-60076-11

Load Losses(V) : As per IEC-60076-11

Method of connection-HV : Delta

Method of connection-LV : Wye

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Neutral grounding : Solidly Earthed

Method of connection-LV : Wye

No. of bushings-HV : 3

No. of bushings-LV : 4

Impulse Withstand Voltage : 95KV (1.2/50 us)

Powe Frequency Withstand Voltage : 36KV

Vector Group : DYN-11

Impedence Voltage At Rated Current : 6%

Efficiency At Rated Load & Unity Power Factor : Per IEC

Efficiency At 75% Load & Unity Power Factor : Per IEC

Note: It is important to understand before the qouting of the price of the Tx; that supplier shall be responsible to check & verify the standards and other related parameter at the testing floor of the manufacturing industory prior to despatch of the consignment to the site or consignee. In this regards the said expances of boarding & lodgging arrangments for bringing the cocnern verfication authorities (atleast 2 persons) to the manfacturing floor shall be borned by the supplier .

PART 3 – EXECUTION

3.1 INSTALLATION

Install and anchor on concrete bases per manufacturer’s instructions and seismic codes. Permanently fitted lifting lugs. Removable bi-directional or steerable rollers, lockable. Connection methods per IEC 60076. HV and LV cable boxes on opposite sides. Earthing terminal on supporting steel work. Terminal marking per IEC 60076.

3.2 RATING PLATES

Per IEC 60076-1

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PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0520 – HIGH TENSION SWITCHBOARD / RING MAIN UNIT (RMU) / KIOSK TYPE SUBSTATION

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing, connecting, commissioning of complete HT Switchboard, Ring Main Unit (RMU), and KIOSK type substations.

1.2 GENERAL

Sheet steel fabricated, cubicle type, totally enclosed, dust tight vermin proof. Type-tested per IEC 62271. Loss of service continuity LSC 2B, partition class PM, Internal Arc Classified IAC. Front operation only. Incoming/outgoing connections from bottom. Rear accessibility. Anti-condensate heater in each enclosure. Stainless steel name plate.

Capacity and Basic Data: As shown on drawings; 50 Hz; 11 kV; Power frequency withstand 28kV for 1 minute; Short circuit capacity 500 MVA at 11kV; Short time withstand 25kA/1 sec; Peak withstand 63kA; Breaking/Making 25kA/63kA; Ambient 45°C; Impulse withstand 95kV; IP-4X; LSC2B; PM; IAC; Control voltage 110V DC (indication/metering and tripping), 220V AC (heaters/audible).

1.3 APPLICABLE STANDARDS/CODES

IEC 62271-1,-100,-101,-102,-103,-105,-200; IEC 61869-1,-2,-3; IEC 60051-2,1,3,4,8,9; IEC 60099-4; BS EN 13601; ISO 12944.

1.4 WARRANTY

Min 2 years from OEM from Taking Over Certificate.

PART 2 – PRODUCTS

2.1 HT SWITCHBOARD – SHEET METAL WORK

Angle-iron framework, 12 SWG sheet steel or as per type-tested design. Protective paint per ISO 12944 Category C2 (indoor) or C3 (outdoor), Epoxy primer, polyurethane top coat RAL 7032/7035.

Compartments: Busbar, H.T cable connection, low voltage for instruments. Earth bar full length, doors grounded by flexible copper braid. Mimic diagram on front of each cubicle (busbars, circuit breakers, earthing switch, transformer symbols).

Bus Bars: 99.99% pure electrolytic tinned copper, completely insulated by heat shrink coloured sleeves (red, yellow, blue). Porcelain/epoxy resin insulators.

Circuit Breaker: Triple pole, withdrawable, vacuum arc interruption. Motor spring operating mechanism. Rollout trucks, safety shutters. ON/OFF/TRIPPED/TEST POSITION indication. Luminous LEDs. Min 3 NC and 3 NO auxiliary contacts.

Earthing Switches: Triple pole make-proof type, interlocked with circuit breaker. Type tested per IEC 62271-102.

Instrument Transformers: Type tested per IEC 61869-2 (CT) and -3 (PT). CT accuracy 5P20 (protection) and 0.5M5 (metering). PT accuracy 1.0.

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Protective Relays: Numerical static type, inverse definite minimum time, draw-out feature. Self-powered. Phase fault setting 50-200%, instantaneous 200-800%, ground-fault 20-80%.

Capacitor Shunt Trip Unit: 110V DC trip coils, fed from PT, capable of two successive trips within five minutes.

Meters: Operating hours counter, switching frequency meter, ammeter (0-15kV), voltmeter, kWh and kVArh meters. Selector switches R-Y-B-OFF.

Surge Protection: 11 kV surge arrester (12 kV rms, 11/√3 kV rms).

Tools: Complete set for routine operation, setting, maintenance.

Insulation Mat: 1m wide, 6mm thick, 15kV working.

2.2 RING MAIN UNIT (RMU) – OUTDOOR

Fixed type. Enclosure lockable. Protective paint per ISO 12944 Category C3, Epoxy primer, polyurethane top coat.

Switches: Maintenance-free, low pressure SF6 gas, three positions (open-disconnected, closed, earthed). Natural interlocking. Fuses in sealed chambers, striker pin causes three-phase opening.

Circuit Breakers: Withdrawable, SF6, vertical mount. Sealed pressure system, 30 year life. Stored energy operating mechanism.

LV Compartment: For motor mechanism and auxiliary equipment.

Earthing Switch: Short-circuit making capacity per IEC 62271-102, visible through transparent covers.

Protective Relay: Integrated electronic/micro-processor, self-powered, phase-phase and phase-earth overcurrent.

Voltage Indicators: Per IEC 62271-206. Fault Passage Indicator (FPI) for short circuit and earth faults.

Cable Insulation Testing: Test voltage 42 kV DC for 10 min.

2.3 KIOSK TYPE SUBSTATION

Outdoor metal works per ISO 12944 Category C3. Includes MV Compartment (11kV 400A load break switches), Transformer Compartment (mineral oil immersed power transformer per Section 0510), LV Compartment (circuit breakers with thermal/magnetic tripping). Control voltage from 110V secondary of PT and 110V DC from capacitor trip unit. Relays self-powered.

PART 3 – EXECUTION

3.1 INSTALLATION (H.T SWITCHBOARDS, RING MAIN UNIT AND KIOSK TYPE SUBSTATION)

Install at location shown. Cable trenches civil works. Contractor coordinates foundation details. Foundation bolts grouted with non-shrinkable material. Erect per manufacturer’s instructions. Cable termination kits per recommendations. Cable armour connected to earth. Body earthed per Section 0620. Testing per Section 0490.

PART 4 - MEASUREMENT AND PAYMENT

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No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0530 – LOW TENSION SWITCHBOARDS / LT OUTDOOR DISTRIBUTION BOARDS

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing, connecting, commissioning of LT Switchboards/LT Outdoor Distribution Boards.

1.2 GENERAL

Factory manufactured/assembled/routine tested per IEC 61439, Form-3b (or as approved). Designed to be fully compatible with Solar Power System (third party validation by AEDB listed qualified vendor). Sheet steel fabricated, floor/wall mounting, cubicle type. IP54 indoor, IP65 outdoor. Protective paint per ISO 12944 Category C2 (indoor), C3 (outdoor), Epoxy primer, polyurethane top coat RAL 7032/7035.

Design verification per IEC 61439: Temperature rise, short circuit withstand strength, etc.

1.3 APPLICABLE STANDARDS/CODES

IEC 61439 (all parts), 60947-3, 60947-2, 60831, 60073, 61869-2, 61869-3, 60051-1,2,3,5,8, 60898-1, 60871-1, 60947-4-1; BS EN 60529, 13601; BS 88-2; ISO-12944-2.

PART 2 – PRODUCTS

2.1 SHEET METAL WORK

14 SWG MS sheet, angle iron framework. Suitably divided into panels/compartments. Earth bar, two external earth terminals. Doors earthed by flexible copper strip. Cabling numbered and harnessed.

2.2 COMPONENTS

Bus Bars: 99.99% pure electrolytic tinned copper, heat shrink coloured sleeves (red, yellow, blue, black, green). Temperature rise ≤30°C. Neutral same cross section as phase; earth half cross section.

Circuit Breakers: Triple/four pole, current limiting, manually or motor operated, spring charged. Incoming: Air Circuit Breaker or moulded case; outgoing: moulded case. LSIG protection for ACB. Withdrawable type entire main LT Switchboard. ON-TRIP-OFF indication.

Switch-Fuse Units: Triple pole on load isolating switch with HRC fuses to BS-88 Class Q1.

Three Phase Energy Meters: 50 Hz, accuracy class 1.0, dust proof case.

Ammeters and Voltmeters: Flush mounting, moving iron, spring controlled, 96x96mm, accuracy class 1.5.

Current Transformers: Ring type, accuracy class 1.0, 5A secondary.

Selector Switches: R-Y-B-OFF for ammeters, RY-YB-BR-RN-YN-BN-OFF for voltmeters.

Air Break Contactors: Triple pole 400V AC, utilization Category AC3 (AC6b for capacitor switching). 230V AC operating coil.

HRC Fuses: Per BS 88, Class Q1.

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Power Factor Improvement Plant: Automatic-cum-manual. Blocked during DG Set operation. Capacitors 440/415V, 50 Hz, self-cooled. Control panel with main circuit breaker, multi-stage correction relay, PF indicator, CT. Each bank: triple pole contactor AC6b, detuned harmonic filter reactor (resonance frequency 189Hz, p=7%), HRC back-up fuses, selector switch, ON/OFF lamps.

2.2 TECHNICAL SPECIFICATION

Fabrication, supply at site, installation at designated location, testing and commissioning of Main Panel Board (MPB) comprising of cubicles, frame made of sheet steel 12 SWG and doors of 14 SWG, with flexible earthing straps, degreased and de-rusted, finished with electro-static powder coating of 50 micron thickness in approved color panel housing to comply with protection class IP-54, indoor floor mounting, in free standing design, with hinged door, lockable handle, all auxiliaries, internal wiring, designation labels on MCCBs, earthing bar, numbering beads on the control wires, panel suitable for system Voltage 415 V, 50 Hz, 3 Phase and neutral bus bars of 99.8% purity electrolytic copper with tin plating, including cost of cable termination lugs, brass cable glands for incoming & outgoing cables, wiring from breakers, indication lamps, instruments and control all accessories complete in all respects.All incoming and outgoing breakers shall be accessible by opening the front door having additional M.S. sheet cover. Gaskits shall also be provided where necessary. All MCCBs shall be suitable to operate without any de-rating at 50°C ambient temperature and shall be of one make only and not a mixture of more than one make. The front and back sides of MPB shall also have louvers at bottom and sides of panel for hot air exhaust. The panel shall have a front access. Circuits layout shall conform to the single line diagrams. Main Panel Board shall be manufactured by any one of the manufacturer as mentioned in List.

Also note that For Control Purpose 2Amps SP MCBs should be used & RS-485 Terminals should be provided for remote monitoring though EAs.

Surge Protection: 440V rms, 400/1.732 kV rms per IEC.

PART 3 – EXECUTION

3.1 INSTALLATION

Install at location shown or as advised. Concrete pedestal per civil works. Foundation bolts grouted with non-shrinkable material. Erect per manufacturer’s instructions. Loose parts installed per assembly drawing. Connect incoming/outgoing cables per cable manufacturer, colour sleeves on lugs, cable armour connected to ground. Control system installed per manufacturer. Tested prior to energizing per Section 0490.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0540 – LOW TENSION DISTRIBUTION BOARDS

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing, commissioning of LT Distribution Boards.

1.2 GENERAL

Sheet steel fabricated, surface/recessed mounting on wall or floor standing. IP54 indoor, IP65 outdoor. Protective paint per ISO 12944 Category C2 (indoor), C3 (outdoor). Front operation. Rated service short circuit breaking capacity (Ics) at 400V per IEC 60947-2.

1.3 APPLICABLE STANDARDS/CODES

IEC 61439, 60947-2, 60073, 60831, 60051-1,2,3,5,8; BS 88; BS EN 61869-2, 60529, 13601; IEC 60898-1, 60269; ISO-12944-2.

PART 2 – PRODUCTS

2.1 SHEET METAL WORK

16 SWG sheet steel. Component mounting plate, screw front plate, rubber gasketing, lockable hinged door with cam fastener. Earth bar connected to body at two points.

2.2 COMPONENTS

Bus Bars: 99.9% pure electrolytic tinned copper, temperature rise ≤30°C.

MCCB/MCB: Triple pole 440V or single/double pole 250V. Fixed magnetic short circuit and adjustable/fixed thermal overload. MCB to IEC 60898.

Energy Meters: Same as Section 0530.

Ammeters/Voltmeters: Same as Section 0530.

Current Transformers: Same as Section 0530.

Selector Switches: Same as Section 0530.

Air Break Contactors: Same as Section 0530.

Push Buttons: Illuminated, momentary or latch type.

Indicating Lamps: LED, flush mounting.

Surge Protection: Same as Section 0530.

PART 3 – EXECUTION

3.1 INSTALLATION

Actual location determined at site. Recessed mounting: installed before plastering, door flush with wall. Outdoor distribution on pedestal. All screws/nuts/bolts galvanized. Cable entry from top or bottom as approved. Testing per Section 0490.

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PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0550 – MOTOR CONTROL CENTRES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing, connecting, commissioning of complete Motor Control Centres (MCCs).

1.2 GENERAL

Sheet steel fabricated, floor/wall mounting, cubicle type, totally enclosed. IP54 indoor, IP65 outdoor. Protective paint per ISO 12944 Category C2 (indoor), C3 (outdoor). Front operation. Rated Ics at 400V per IEC 60947-2.

1.3 APPLICABLE STANDARDS/CODES

Same as Section 0530 plus IEC 60947-4-1 for contactors and motor-starters.

PART 2 – PRODUCTS

2.1 SHEET METAL WORK

14 SWG MS sheet, angle iron framework. Cable clamping channels, brass cable glands. Earth bar, two external earth terminals.

2.2 COMPONENTS

Auxiliary relays (230V AC), programme selector switches, operation hour counters, alarm hooter. **Air Break Automatic Star-Delta Starters:** line contactor, star contactor, delta contactor, time element. Delayed thermal overcurrent relay or electronic overcurrent relay (EOCR). Utilization category AC3, Type-2 coordination. **Direct-On-Line (DOL) Starters:** for full voltage starting, Type-2 coordinated. **Circuit Breakers:** Moulded case, ON-TRIP-OFF indication. **HRC Fuses:** per BS 88 Class Q1.

2.3 FIELD SENSOR / LEVEL TRANSMITTER / FLOAT SWITCHES

Control cabling from field devices to MCC in suitably sized surface mounted steel conduit. Level transmitter (230V AC, 50Hz, ≥3 switch-contacts). Float switch (SIEMENS type 6KCI or approved, IP65).

2.4 LOCKABLE MUSHROOM SWITCH

Inside MCC or remote location. IP65 casing. Red push button min 30mm dia, rotor lock-turn reset.

2.5 SEQUENCE OF OPERATION

For MCC-FW/MCC-PW coordinated with relevant specialty drawings.

2.6 WARRANTY

Min 2 years from OEM from Taking Over Certificate.

PART 3 – EXECUTION

3.1 INSTALLATION AND TESTING

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Install per Section 0540. Loose parts per assembly drawing. Level transmitter, float switch, pressure switch properly aligned and adjusted. Sequential testing in presence of Engineer.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0560 – LIGHT FIXTURES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of light fixtures and accessories.

1.2 GENERAL

Submit certified photometric data and type test certificates. Submit at least one sample of each fixture. All fixtures finished in standard color schemes per manufacturer's catalogue. Warranty min 2 years from OEM from Taking Over Certificate.

1.3 APPLICABLE STANDARDS/CODES

IEC 60598-1,2-1,2-2,2-3,2-5, 62471, 62031, 62262; BS EN 55015, 61547, 61000-3-2, 61000-3-3, 62493; LM79/LM80/LM82; BS 5266.

LED Driver Standards: BS-EN 61347-1, 61347-2-11/13; BS EN 62384.

PART 2 – PRODUCTS

2.1 LED WEATHER-PROOF BATTEN LIGHT FIXTURE

IP rating as per drawing. CCT 4000K, CRI >80, colour consistency <3 SDCM. Lumen maintenance L70B50, useful life ≥50,000 hours. Housing and optic polycarbonate. IK08 impact.

2.2 LED BATTEN TYPE LIGHT FIXTURE (INDOOR)

Housing SPCC cold rolled steel, optic polycarbonate opal finish. CCT 4000K, CRI >80, colour consistency <5 SDCM. IK03.

2.3 LED WALL/BULKHEAD LIGHT FIXTURE

Polycarbonate housing with frosted diffuser. CCT 4000K, CRI ≥70, colour consistency <6 SDCM. Life ≥30,000 hours. IK06.

2.4 CORROSION RESISTANT LED FLOOD LIGHT FIXTURE (FACADE LIGHTING)

Submit Natural Salt Spray Test Report. CCT 3000K, CRI >80, colour consistency <4 SDCM. Life ≥50,000 hours, ambient up to +50°C. Die cast aluminium housing, PMMA lenses, silicon gasket, tempered glass. IK06.

2.5 CORROSION RESISTANT LED FLOOD LIGHT FIXTURE (OUTDOOR)

Salt spray tested. CCT 4000K, CRI >70, colour consistency <5 SDCM. Non-corrosive aluminium die cast, polycarbonate lens. 15kV built-in surge protection. IK08.

2.6 CORROSION RESISTANT LED STREET LIGHT FIXTURE

Salt spray tested. CCT 4000K, CRI >70. Life ≥100,000 hours. Programmable driver. IK08.

2.7 LED EMERGENCY LIGHT FIXTURE

Maintained type, self-contained Ni-Cd battery, backup ≥3.0 hours. Polycarbonate body with clear diffuser.

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2.8 LED PANEL LIGHT FIXTURE

CCT 4000K, CRI ≥80, colour consistency ≤4 SDCM. Life ≥50,000 hours, ambient up to +45°C. Aluminium housing, polystyrene optic. IK03.

2.9 LED SURFACE MOUNTED DOWN LIGHT FIXTURES

Die cast aluminium rear housing, polycarbonate front. CCT 4000K, CRI >80. IK02.

2.10 LED RECESSED DOWN LIGHT FIXTURES

CCT 4000K, CRI >80, colour consistency ≤5 SDCM. Die cast aluminium with polycarbonate diffuser. IK02.

2.11 LED RECESSED CANOPY / HIGH-BAY LIGHT FIXTURE

CCT 4000K, CRI >80. Die cast aluminium, polycarbonate optic, tempered glass. IK07.

2.12 LED STRIP LIGHT FIXTURE FOR COVE LIGHTING

CCT 3000K, CRI ≥70. Ambient -20°C to +40°C.

PART 3 – EXECUTION

3.1 INSTALLATION

Mounting heights per drawings. Uniform installation with respect to dimensions. Modifications approved by Engineer. Wiring with 3-core 1.0/1.5 sq.mm flexible copper conductor. Internal wiring with heat resistant cables. All fixtures earthed.

Surface/Wall Mounted: Back flush with ceiling/wall surface, nylon plugs and galvanized bolts.

Recessed Mounted: Installation coordinated with false ceiling design, weight not transferred to false ceiling.

Flood Light Fixture: On lighting poles or roof as shown, hot dipped galvanized MS poles, corrosion resistant brackets.

Street Light Fixture: On poles with high-performance epoxy paint.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0570 – UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of Uninterruptible Power Supply (UPS) system.

1.2 WARRANTY

Min 2 years from OEM from Taking Over Certificate.

1.3 APPLICABLE STANDARDS/CODES

EN 50091; BS EN 62040; IEC/EN 62040-1, 60950; IEC 60947-2; BS EN ISO 1461; BS EN 15630; ISO-12944-2.

PART 2 – PRODUCTS

2.1 UPS SYSTEM OPERATION – DOUBLE CONVERSION ON-LINE

Normal: Rectifier/charger draws AC power, supplies DC to inverter while float charging battery. Inverter supplies clean AC to load.

Emergency: Inverter continues from battery without interruption.

Battery Recharge: When mains restored, rectifier/charger supplies inverter and recharges battery.

Automatic Bypass: Static bypass transfer switch transfers load to bypass source without interruption on overloads or inverter shutdown.

Manual Bypass: Mechanical bypass for maintenance, isolate inverter and static switch while maintaining load power.

Operation Without Batteries: Circuit breaker to isolate battery for maintenance; UPS continues to supply load except during mains outage.

2.2 ELECTRICAL CHARACTERISTICS

Input Power (Three Phase): 380/400/415V AC ±10%, 3 phase 4 wire + earth, 50 Hz ±5%, PF 0.8.
Input Power (Single Phase): 220/230/240V AC +10%/-15%, 1 phase 2 wire + earth, 50 Hz ±5%, PF 0.8.

Rectifier/Charger: “Soft start” power walk-in in 10 seconds. Charging current self-limited. DC voltage regulated <1%.

Battery Panel: Lead acid, maintenance-free, matching enclosures. Sizing based on operating temperature up to 40°C.

Inverter: Rated load at least 0.9 pf. Voltage regulation steady state ±1%, transient ±5% for 100% load step. Voltage distortion with linear load <1-2%, with non-linear load <3% phase-phase, <5% phase-neutral. Output frequency 50 Hz, synchronised to bypass within ±0.5 Hz, free-running ±0.1%. Overload: 110% for 10 min, 125% for 1 min.

Static Bypass: Independent, zero millisecond synchronized transfer, 20 ms unsynchronized.

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Mechanical Features: Sheet steel enclosure, protected against corrosion. Space saving modular, removable panels. Cable entry bottom/rear. Ventilation fans with low noise, standby fans with failure annunciation. Max sound level 65 dBA at 1m.

2.3 CONTROLS, INDICATIONS, PROTECTION

Controls: UPS to BYPASS switching, Rectifier/Charger ON/OFF, Inverter ON/OFF, Self-test, remote control.

Indications/Alarms: Mains status, battery status, rectifier/charger ON, load on inverter, load on bypass, charger fault, inverter overheating, fan fault, battery overloading/autonomy, bypass defect, overload.

Protection: Input over voltage, load short circuits, over temperature, emergency stop from fire alarm control panel (signal), DC voltage low.

Metering: Mains input voltage, rectifier/charger current, battery voltage and current, inverter output voltage/frequency/current.

2.4 TECHNICAL SPECIFICATION

Supply at site installation at designated location, connection of cables, testing and commissioning of Online-Inverter (UPS) with Dry Batteries Bank (as specified below) suitable for operation at 50◦ C (Max) and 90% relative humidity manufactured by any one of the manufacturers as specified in LAM assembled in accordance with their provided drawings / manuals and consisting of painted welded steel bed plate frame work to accommodate (built-in) power transformer complete with electronic safeties to give standard regulation, energized by the in coming main supply, battery charger, set of spare Copper battery thimble, radio interference suppressors, voltmeter displays and other allied safeties.

Suitable for 400 / 230 volts, 50 cycles/second, including cost of all necessary material / accessories, conforming to technical specifications mentioned below.

Technical Specification of Inverter:

Prime Rating:

On-Line, Normal and Bypass AC inputs, Interface Port

Output:

Efficiency at Full Load :=(should not less than) >92%

Load Power Factor: =(should not less than) >0.9

Output Voltage Distortion :Less than 2%

Output Frequency (sync to mains) :50/60 Hz +/- 3 Hz user adjustable +/- 0.1

Output Voltage Regulation: +-1%

Waveform Type :True Sine wave

Efficiency at full load: =(should not less than) >90%

Bypass :Internal Bypass (Automatic and Manual)

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Input

Total Harmonic Distortion Index < 3%

Bypass :Internal Bypass (Automatic and Manual)

Input

Batteries & Runtime

Battery Type :Maintenance-free sealed deep discharged GEL Type built-in battery built-in

Control panel

LED status display

Alarm when on battery : distinctive low battery alarm : overload continuous tone alarm

Emergency Power Off (EPO) :Yes

Rack Height :6U

Surge Protection & Filtering

Warranty:Minimum 1 Year

PART 3 – EXECUTION

3.1 INSTALLATION

Per manufacturer's recommendations. All earthing, power and control cables, conduit, trunking provided by Contractor. Angle iron supports at base for UPS and stabilizer.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0580 – HIGH TENSION CABLE

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of High Tension (HT) cable and accessories.

1.2 GENERAL

15kV cable: three core, copper conductor, XLPE insulated, shielded, armoured or unarmoured as required. Continuous operation at conductor temperature ≥90°C, 8.7/15 kV, 50 Hz, three phase grounded system per IEC 60502. Airfield primary cable: 5kV to earth, copper conductor, XLPE insulated, screened, shielded, overall sheathed. Vermin proofing.

1.3 APPLICABLE STANDARD/CODES

IEC 60502, 540; ICAO Aerodrome Design Manual Part5; FAA L824 AC 150/5345-7; FAA L823 AC 150/5345-26 (Class A & B); IEC 60228, 60332-1-2, 60332-3, 60227, 60446; BS EN 50266.

PART 2 – PRODUCTS

2.1 15kV CABLE

Conductor: Stranded copper per IEC60228.

Insulation: XLPE, colour coded red, yellow, blue, nominal thickness ≥4.5mm per IEC 60502.

Screening: individual cores – conductor screen (extruded semi-conducting compound) and insulation screen (non-metallic semi-conducting layer + metallic layer).

Shielding: bare copper tape over semi-conducting insulation.

Assembly: three insulated conductors with PVC or non-hydroscopic filler, bounded with tape.

Armor: single layer galvanized steel wire.

Oversheath: PVC jacket ≥2.5mm, black. Embossed marking every 3m: manufacturer, year, size, voltage grade, Cu/XLPE/SWA/PVC.

2.2 AIRFIELD PRIMARY CABLE

Per FAA L824 AC 150/5345-7 and ICAO Design Manual Part5. Stranded tinned copper, 6 sq.mm/7 strands, single core. Insulation XLPE 5kV/2.3mm. Shielding brass tape 0.08mm, concentric brass braid. Over sheathing PE 1.2mm, black, termite repellent. Marking every 0.6m.

2.3 STRAIGHT-THROUGH CABLE JOINT

Only in pits/trench, not in ducts. Prior permission required.

2.4 JOINT BOXES

Horizontal, straight through, split type. Ground straps on inside.

2.5 TERMINATION KITS

Indoor/outdoor, hot or cold shrink, per IEC 60060, 60230, 60270.

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2.6 CABLE MARKERS

2.7 TECHNICAL SPECIFICATION

Supply, installation, testing and commissioning of XLPE insulated, Aluminum tape screened PVC / SWA / PVC, 15 KV-Aluminum conductor cable manufactured by any one of the manufacturers Pakistan Cable, Fast Cable & Newage Cable to be laid in prepared trenches / in pre-laid conduits including cost of connections. Actual length of cables to be installed shall be practically measured at site by the Contractor, duly authenticated by the employers electrical engineer before placing the order with the manufacturer, however, approximate length of cables are shown herewith. Payments shall be made as per actual length installed.

Reinforced concrete Grade-25, at max 100m intervals along straight trench, each bend and joint box. Letters and symbols engraved. At joint box, symbol beneath letters. Dimensions per drawing.

PART 3 – EXECUTION

3.1 INSTALLATION

Underground Cables: Depth 900mm min below finished ground level. Trench bed: 100mm fine sand (max particle 1.3mm). Covers: fine sand 100mm above cable, then concrete protective bricks (Class-C, 50mm thick, 300x300mm) or good quality bricks. PVC warning tape yellow with black danger/voltage marking at 300mm below ground level. Cable identification tags water resistant at max 20m intervals. Slack ~3% extra length.

Cable Markers: On finally compacted trench at mentioned distances. On airside (runway/taxiway/apron): flat in ground, top ≈2.5cm above grade, 60m spacing straight runs, each change in direction and each splice. Painted bright orange after 24hrs.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0590 – LOW TENSION CABLES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of Low Tension (LT) cables and accessories.

1.2 GENERAL

Multi-core/single core PVC insulated and sheathed cables for light/socket circuits: 300/500V. Single core PVC insulated non-sheathed: 450/750V. Power cables (main feeders, power equipment): 600/1000V, armoured or unarmoured. Conductors stranded high conductivity soft annealed copper. All cables vermin proofed.

1.3 APPLICABLE STANDARDS/CODES

BS 6004, 6346, 7846, 7889; IEC 60227, 60332; BS 6746; BS EN 60228, 50525, 61386, 50618; ICAO Aerodrome Design Manual Part5; FAA L824 AC 150/5345-7.

PART 2 – PRODUCTS

2.1 CABLE TYPES

Conduit or Channel Wiring: single core PVC insulated.

Surface/Concrete Trenches/Trays: single or multi-core PVC insulated and PVC sheathed.

Solid Bottom M.S Trunking/Under Floor Metal Trunking: 3 core PVC insulated PVC sheathed, high temperature resistant (red phase, black neutral, green/yellow earth).

Inside Lighting Column: 3 core as above.

Underground: PVC insulated, PVC sheathed, armoured with galvanized steel/aluminium wire.

2.2 AIRFIELD SECONDARY CABLE

Per FAA L824 AC 150/5345-7. Stranded tinned copper, 2.5/4.0 sq.mm, 2 core. Insulation Ethylene propylene rubber (EPR). Outer sheath polychloroprene (PCP). Temperature 90°C. Marking every 0.6m.

2.3 DC CABLE FOR SOLAR POWER SYSTEM

Tinned fine copper strands Class 5 per IEC 60228. Insulation XLPO, flame retardant, halogen free. Outer sheath XLPO, flame retardant, halogen free, UV/weather resistant. Temperature -40°C to +120°C for 20,000 hrs. Rated 1500VDC, max 1800VDC.

2.4 CABLE MARKERS

Same as Section 0580, letters “LV”.

2.5 TECHNICAL SPECIFICATION

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Supply at site, installation, testing and commissioning of PVC insulated PVC sheathed non armoured copper conductor power cable 600 / 1000 Volt grade manufactured by any one of the manufacturers as mentioned in Annexure in preinstalled cable tray / trenches cables to be installed as per routes shown on drawings including cost of all necessary materials, connections of cables and identification tags at both ends, cables lugs properly crimped at both ends for the following sizes complete in all respects. Actual length of cables to be installed shall be practically measured at site by the Contractor, duly authenticated by the employers electrical engineer before placing the order with the manufacturer, however, approximate length of cables are shown herewith. Payments shall be made as per actual length installed.

PART 3 – EXECUTION

3.1 INSTALLATION

Conduit or Channel Wiring: Pull wires with care, no lubricant unless approved. All wires of same circuit in one conduit. No joints. Min 150mm extra length at each termination.

Surface/Trenches/Trays/Ladders: Fix to surface with galvanized steel clips secured to steel channel. Distance between clips to support weight, clearance between cables and surface ≥50mm.

Underground Cables: Same as Section 0580.

DC Cable for Solar Power System: Run in appropriately sized cable trays/trunkings on roof, fixed with saddles, min distance equal to cable diameter.

Airfield Secondary Cables: In PVC protective pipes/saw cuts from transformer pit/housing to light fixtures in runway/taxiway/apron. **In Saw Cuts (existing pavement):** Diamond blade saws, cut not less than 1cm wide, 2cm deep. Sandblast to remove foreign material, flush with high-speed water/steam jet, dry with air. No splicing. Wedges/clips spaced ~1m apart. Cables encased in polyethylene flexible tubing ≥0.3m at pavement joints. Seal saw cut with adhesive compound (min elongation 45%). **In Pipes (new pavement):** pipes from shallow base to transformer housing. 2-pole secondary receptacles and plugs per FAA.

Cable Marker: As Section 0580.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0600 – WIRING ACCESSORIES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, commissioning of wiring accessories including switches, switch sockets, etc.

1.2 APPLICABLE STANDARDS/CODES

BS 7671; BS EN 60669-1; IEC 60309; BS EN 60384-14; BS 67, 546, 1362, 4573; IEC 60884-1; CEE 7; BS EN 60529.

PART 2 – PRODUCTS

2.1 SWITCHES/BLANK FACE PLATES

Single pole, rated 10A, 250V AC. Thermoplastic body, flush mounting. Gang type with silver tipped contacts, snap action. Weather proof or metal front plates where specified.

2.2 13A/16A INTERNATIONAL SWITCH-SOCKET OUTLETS

13/16 Amps 250V AC, heavy-duty, sheltered live contacts. Weather proof: polycarbonate, IP65 min.

2.3 16A SCHUKO SOCKET OUTLETS

2 pin + earth German type, heavy-duty.

2.4 1-PHASE 3-PIN / 3-PHASE 5-PIN INDUSTRIAL SOCKET OUTLETS

250V/500V, weather proof per IEC, heavy-duty, polycarbonate enclosure, gasketed cover, captive cover screw. Supplied with matching plugs.

2.5 CONNECTION UNIT

13A/20A, 250V AC spur outlet with neon lamp indicator (if required). 20A Double Pole Switch with brass/phosphor bronze contacts, neon indicator.

2.6 FAN DIMMERS

Low voltage electronic components, radio frequency compressor. Smooth speed control. Same make/colour as approved wiring accessories.

2.7 SHEET STEEL BACK BOXES

16 SWG sheet steel. Earth terminal for at least three 4-sq.mm earth wires. For surface wiring: cover plates same gauge, counter sunk screws, powder-coated.

2.8 CEILING ROSES

5 amps 250V, white plastic moulded base plate, copper/brass terminals suitable for at least two 2.5 sq.mm wires.

2.9 15 AMPS SWITCH SOCKET OUTLETS

Round 3 pin, 15 Amps, 250V AC, polycarbonate, neon indication.

2.10 UNDER FLOOR SERVICE BOX

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Heavy duty stainless steel, pre-galvanized steel infill plate. Types: A (2x16A Schuko, 1xRJ-45 simplex, 1xRJ-45 duplex); B (2x16A Schuko, 1x duplex fiber optic); C (blank plate). IP30, perforation for trunking/knockout holes, disposable lid.

PART 3 – EXECUTION

3.1 INSTALLATION

Mounting heights per drawings. All wiring accessories installed on 16 SWG sheet steel box recessed in wall/column/floor. Faceplate fixed with flat head galvanized/brass screws sunk flush. Matching screw caps. Industrial sockets in polycarbonate enclosure on wall/floor. Floor outlet box on floor as shown.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0610 – CONDUITS AND PIPES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, commissioning of conduits and pipes.

1.2 APPLICABLE STANDARD/CODES

BS 61386; BS 4607; BS EN ISO 1452-1:2009; IEC 60614; BS3505.

PART 2 – PRODUCTS

2.1 GALVANIZED IRON (G.I.) CONDUITS AND ACCESSORIES

Medium gauge mild steel, hot dip galvanized inside and outside. Threaded ends. Round junction boxes: ceiling – 64mm dia x 64mm depth; wall – 64mm dia x 40mm deep. One piece cover plate with brass screws.

2.2 PVC CONDUITS AND ACCESSORIES

PVC bends with enlarged ends. Round PVC junction boxes: ceiling – 63mm dia x depth; wall – 63mm dia x 38mm deep. PVC cover plate with brass screws.

2.3 INSPECTION/PULL AND ADAPTABLE BOXES

Inspection/Pull Boxes: Rectangular 16 SWG sheet steel, painted inside/outside red oxide primer. Surface type cover same gauge; concealed type white plastic sheet cover.

Adaptable Boxes: 16 SWG sheet steel. Depth: conduits ≤25mm – 50mm min; ≤32mm – 65mm min; ≤50mm – 90mm min; >50mm – 2x dia.

2.4 uPVC PIPES AND FITTINGS

Class D (WP 12 bar) and Class-B (WP 6 bar) per BS EN ISO 1452-1:2009. Smooth bends only. Hard PVC pipe range spacers with locking, distance ≤2m.

2.5 PIPE END MARKER

Concrete slab marker. Information impressed: word ‘PIPE’, number of layers X number of pipes in each layer (diameter).

PART 3 – EXECUTION

3.1 G.I. CONDUITS (SURFACE)

Install parallel/perpendicular to surfaces. C.I. saddles and clamps, supported at max 1m spacing horizontal/vertical.

3.2 PVC CONDUITS (CONCEALED)

Minimum 32mm cover of concrete from top of conduit to finished surface. In RCC, laid before pouring concrete. No chases in RCC after pouring. Conduit on top of bottom reinforcement. Outlet boxes flush with soffit. Termination ends plugged. Under floor: min 50mm depth, installed empty with 18 SWG steel wire.

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3.3 PVC CONDUITS (SURFACE)

PVC saddles and clamps, supported at max 1000mm spacing.

3.4 uPVC PIPES (UNDERGROUND)

Depth: under roads/pavements 900mm below finished surface; under drain/culvert 1000mm below bottom slab; crossing other services 250/500mm vertical/horizontal. Trench bottom leveled, 100mm fine sand bed. Clearance between pipes ≥50mm using pipe range spacers. Backfill with sand ≥100mm above topmost pipes, then selected earth in layers compacted. Warning tape at 300mm depth. End caps watertight.

3.5 PIPE END MARKERS

Installed flat in ground, top ≈5cm above finished grade. After 24hrs, top surface painted bright orange.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PART 5 – TECHNICAL SPECIFICATION OF CABLE TRAY

Fabrication, supply at site and installation of perforated cable tray made of M.S. sheet 14 SWG 8 ft. to 10 ft. long with sides 4" high with cover of cable tray made of 18 SWG M.S sheet to be installed on wall, or in vertical, or above false ceiling in horizontal position or as shown on drawing, including cost of the following:-
-2 M.S threaded hanging rod 1/2" dia. Length 12" or as required as per site.
-M.S strip 2" wide x 1/4" thick.
-Hilti rawal bolts as per required quantity & size.
-2 coats of antirust paint.
-2 coats of enamel paint (Oven hot) or powder coating of approved colour.
-Complete hanging system shall be installed at every 36".

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SECTION 0620 – EARTHING / GROUNDING SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of complete Earthing system.

1.2 GENERAL

Dedicated earthing grid underground in vicinity of buildings/structures. All mechanical and electrical systems solidly connected. Main distribution, connection pit, earth connecting point, lightning protection system integrated. Overall earthing resistance ≤1 ohm.

1.3 APPLICABLE STANDARDS/CODES

BS 7430, 951; BS EN 12163, 50522, 13601, 60228, 12164, 12167; IEEE Std.80; BS 6346, 6004; BS EN 62561-5.

PART 2 – PRODUCTS

2.1 EARTH ELECTRODES

Plate Type: 600x600x3mm 99.9% pure high conductivity electrolytic copper, tinned. Four terminals. 50mm dia G.I. pipe from inspection chamber to earth plate with 10mm dia holes at 500mm centers. Concrete inspection chamber with cast iron cover, hinged, flush with ground.

Copper Clad Steel Rod Type: 3m long, 19mm dia, flat head at drive end, pointed conical tip hardened. Brass clamp for bolted connections.

2.2 EARTHING LEADS

Stranded electrolytic copper, bare tinned or PVC insulated (green or green/yellow).

2.3 EARTH CONTINUITY CONDUCTORS (ECC)

Stranded bare tinned copper or single core PVC insulated copper (green or green/yellow). Thimbles, lugs, sockets, nuts, washers included.

2.4 COUNTERPOISE CONDUCTOR

Hard drawn high conductivity bare stranded copper, 16 sq.mm.

2.5 EQUIPMENT GROUND LEAD

10 sq.mm single core stranded copper PVC insulated. Connected per ICAO Aerodrome Design Manual Part5, equipotential method.

2.6 EARTH CONNECTING POINTS (ECPs)

Tinned copper bar, rectangular 50x6mm, 300mm long, min six terminals. Brass or tinned copper bolts, nuts, washers.

2.7 ELECTROMAGNETIC PROTECTION NETWORK

Building perimeter ground loop: flat bare copper wire buried 1m deep, 1m from building wall, 3m x 19mm copper-clad steel ground rods every 6-12m. Building steel bonded at every column.

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Data center grounding infrastructure (CBN per IEEE 1100): Copper conductor, insulated, size as shown. Electrically continuous access-floor system bonded. Each equipment cabinet/rack grounding connection with two-hole lugs, bare metal-to-metal contact, antioxidant.

PART 3 – EXECUTION

3.1 INSTALLATION

Earth resistance ≤1 ohm. All connections with copper brazing (no soldering) using copper or brass sockets, thimbles, lugs. Copper brazing with oxide inhibiting compound. No twisting of earth conductors. Alternative path to earth when disconnecting for testing.

Plate Type Electrode: Installed at min depth 16.5 ft (5m) or 4 inches below permanent water level. Min horizontal distance between electrodes 10 ft (3m). Lime and charcoal mixture buried with plate.

Copper Clad Steel Rod Type: Hammered in soil until top ~300mm below finished ground level, or pit excavated and backfilled in 500mm layers compacted.

ECC: Installed along cable runs, connected to earthing bar/terminals in equipment. Bodies of equipment and switchboards connected.

Counterpoise Conductor: Along airfield primary cable route between earth's surface and underground cables. Continuous, connected to earth terminal on transformer housings, cable tray inside transformer pits, secondary earthing terminal of isolating transformer, and earth electrodes.

Equipment Ground Lead: In pipes/conduit/saw cuts from earth point on cable tray in transformer pit/earth terminal on transformer housing to earth terminal on isolating transformer, light monitoring switch, light bases, mounting stakes/poles/baseplates.

ECPs: On wall surface with brass screws, nuts, washers, porcelain insulators.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0630 – LIGHTNING PROTECTION SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of complete Lightning Protection System.

1.2 GENERAL

Earthing resistance ≤10 ohms at any point. Roofs equipped with lightning arresters/air terminals/roof conductors. Inspection/measuring joints in down conductors. Integrate lightning protection system to reinforcement bars of column and foundation. Submit Risk Assessment per IEC 62305 compliant software. Rolling sphere method & protection angle method analysis.

1.3 APPLICABLE STANDARDS/CODES

IEC 62305-2; BS EN 62561-1,2,4; BS EN 13601; BS 6346; BS EN 60228; BS 7884, 6004.

PART 2 – PRODUCTS

2.1 LIGHTING ARRESTOR/AIR TERMINAL SYSTEM

Solid tinned copper 2m long, 10mm dia (or as per rolling sphere/protection angle analysis). Base suitable for roof/down conductors.

2.2 DOWN / ROOF CONDUCTORS

Tinned copper strip. Cad welded at top/bottom with reinforcing bars. Structure's concrete column reinforced steel bars used as down conductors. Reinforced concrete foundations as earth termination network.

2.3 TESTING TERMINALS

For each tinned copper strip down conductor and every third reinforcement bar used as down conductor, installed 1.5m above finished floor. Removable connections. Enclosed in 16 SWG MS Powder Coated enclosure box with protective cover.

2.4 GROUNDING CONDUCTOR MESH

Stranded circular bare tinned copper conductor or tinned flat copper strip. Cad welded at intersections. Connected via PVC insulated stranded copper conductor to ECP at 300mm above finished floor.

2.5 EARTH ELECTRODE (COPPER CLAD STEEL ROD TYPE)

3m long, 19mm dia, copper clad (1.5m sections with copper coupling). Brass clamp. Concrete inspection pit with C.I. cover (Medium/Heavy Duty).

2.6 EXOTHERMIC CAD-WELDING CONNECTIONS & ACCESSORIES

Connections: Bar to Bar (Straight, T, Cross), 25x3mm flat copper strip to 70 sq.mm conductor, Bar to Cable T joint, Bar to Rebar, Cable to Rebar. Exothermic powder, handle clamps, moulds, tools.

2.7 TECHNICAL SPECIFICATION

Supply, Design & Testing of Prevectron type 3rd Generation Controlled Early Streamer Emission (CESE) 2nd eddition (UNE21186:1996)lightning conductor equipped with a tinned copper central pick

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up rod. Full electrical continuity between the tip and the earth point shall be ensured. Fully autonomous (no battery, no external power supply required) which shall collect ambient energy through a lower series of electrodes. Timing of the streamer emission controlled with an electronic device that detects the lightning and triggers a streamer (3.5 KV and 20 A).

Manufactured as per NFC 17-102.

A tester/ testing process corresponding specifically to the airterminal shall be available for the maintenance and ensure the healthiness of the unit.

Protection Radius = 45 meter

Level of Protection: Level 1

The base of the down conductor should be protected from accidental knocks and other damage by means of a 2 meters stainless-steel or PVC protection sheath fixed to the structure.) (5meter ht. considered

PART 3 – EXECUTION

3.1 INSTALLATION

Lightning Arrestor/Air Terminal: Installed by specialist supplier. Base properly fixed to roof.

Down Conductor: Shortest possible route from roof to earth electrode. Fixed with Omega type pads in tinned copper by stainless steel screws. Continuous – no joints; if necessary, straight joints bolted with anti-corrosive paint. Reinforcement bar connected to roof conductor with pre-welded tails (500/1000mm long) and 2x70sqmm PVC insulated copper cable. All metallic projections on roof bonded. Flexible copper braids (25x3mm) at expansion joints.

Testing Terminals: Removable terminal at ~1.5m height from finished ground level at every third column with reinforced steel bars and at every tinned copper strip down conductor.

Grounding Conductor Mesh: Laid in soil below foundation reinforced steel bars at same depth as earth pits. Connected to ECP via PVC insulated stranded copper conductor raised along columns.

Earth Electrode (Rod): Hammered in soil until top ~300mm below finished ground level, or pit excavated and backfilled in 500mm layers compacted.

Exothermic Cad-Welding: Installed by specialist qualified supplier.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0640 – MISCELLANEOUS ITEMS

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, testing and commissioning of Miscellaneous Items.

1.2 WARRANTY

Ceiling Fans and Wall Bracket fans: min 2 years from OEM from Taking Over Certificate.

1.3 APPLICABLE STANDARDS/CODES

IEC 60947-3; BS EN ISO 1461, 15630, 50085, 61537, 4678-2; IEC 61084-2-2; BS EN 60335-2-80, 124; ISO-12944-2; BS EN 60529.

PART 2 – PRODUCTS

2.1 CEILING FAN

Capacitor type, 250V AC. Air displacement 12,000 cfm for 56” sweep, 10,000 cfm for 48” sweep. Fan regulator low voltage electronic. Fan hook: 16mm dia mild steel rod, loop ~75mm long, 50mm wide, extensions ≥200mm. Fan rod G.I 20mm dia.

2.2 WALL BRACKET FAN

Capacitor type, 250V AC. Regulator in fixed portion. Rotating mechanism for swinging on vertical axis.

2.3 SWITCH DISCONNECTOR / LOAD BREAK SWITCH IN WEATHERPROOF ENCLOSURE BOX

Triple pole 500V / single pole 250V. AC-23 utilization category. IP65. 16 SWG sheet steel weather proof box. Copper/brass links for earth/neutral. Door cam locks, hinge type. Protective paint per ISO 12944 Category C3, Epoxy primer, polyurethane top coat RAL 7032/7035.

2.4 HOT DIPPED GALVANIZED M.S. CABLE TRAYS / TRUNKING / LADDERS WITH PROTECTIVE PAINT SYSTEM

14 SWG M.S. sheets. Fabricated in sections ≤3m. Flexible expansion couplers at building expansion joints. Indoor: ISO 12944 Category C2; Outdoor: Category C3. Etch primer for galvanized surfaces.

2.5 UNDER FLOOR METAL TRUNKING

Pre-galvanized sheet steel, 1.2mm thick, ≥2 compartments (power & telecom). Tested to 30 kN concentrated load. Channel method construction. Accessories: floor pedestal boxes, round grommets, extension screw terminals, offsets, clamping saddles, connecting saddles. Sections ≤2.3-2.44m.

2.6 MANHOLES/HANDHOLES WITH COVER & FRAME

Per Civil Specifications. Covers roughened, watertight. Label “E” (Electrical), “T” (Telecommunication), “AFL” (Airfield Lighting). Loading capacity per BS EN124.

2.7 STREET LIGHTING COLUMN

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Steel tubular tapered/octagonal per BS EN 40-5, longitudinally welded (no circumferential weld). Hot dip galvanized full bath, then protective paint ISO 12944 Category C3. Anchor bolts threads re-cut and greased after galvanizing. Door lockable (tamper proof), size 120x350mm min. Inside: baseboard with channel for cable termination and circuit breaker/MCB block. Earth terminal screw M8 min.

PART 3 – EXECUTION

3.1 CEILING FAN

Fan hooks installed in RCC ceiling before pouring concrete. Down rod with long threads, check nuts, split pin at fan body end and clamp. Wiring between ceiling rose and fan terminals with ≥3 core 1.0 sq.mm PVC insulated PVC sheathed flexible cable.

3.2 WALL BRACKET FAN

Install on wall with flat head galvanized screws. Wiring as above.

3.3 SWITCH DISCONNECTOR / LOAD BREAK SWITCH ENCLOSURE

Installed inside 16 SWG sheet steel box, fixed with screws. White faceplate fixed with flat head galvanized screws flush with wall.

3.4 CABLE TRAYS / TRUNKING / LADDERS

Installed on supports fixed to wall/ceiling/trusses with Rawl bolts. Span ≤2m. Supports at each bend/change of direction. Straight joints, bends fixed without sharp edges. Copper earth braid with lugs at each joint and bend.

3.5 UNDER FLOOR METAL TRUNKING

Floor slab level and smooth. Humps hacked to level to maintain min screed thickness 38mm over trunking. Use layout drawing to select starting point. Use connecting/clamping saddles to secure. Box covered with disposable lid, taped to prevent cement ingress. After screed dried, remove lid, fit interiors, use levelling system to adjust height.

3.6 MANHOLES/HANDHOLES

Construct per Civil Specifications. Proper curing ≥15 days. Submit shop drawing for approval. Cement sulfate resistant.

3.7 STREET LIGHTING COLUMN

Foundation reinforced concrete Class ‘B’ (grade 25) per structural calculation. Submit civil drawing for approval. Cable opening and gaps filled with watertight material. At least 10 setting templates for each size.

3.7 TELEPHONE EXCHANGE TECHNICAL SPEC

PABX (4 Trunk lines and 100 extensions).

2 extension interfaces for multi-line executive telephone sets.

1 x Operator console with 2 lines LCD display, 15 programmable keys, USB interface, powered from the PABX.

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Maintenance free batteries for power backup.

Music on hold with auto-reverse cassette player.

Integrated UCD functionality.

Integrated Ethernet interface for LAN based administration.

Servo motor controlled voltage stabilizer.

Make Panasonic / Samsung.

PART 4 - MEASUREMENT AND PAYMENT

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SECTION 0650 – STRUCTURED CABLING NETWORK

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, connecting, programming, configuring, integration, testing, commissioning, training and completion for Structured Cabling Network.

1.2 GENERAL

Passive equipment from one manufacturer. System supports Gigabit and 10 Gigabit Ethernet. Star topology: horizontal cable, consolidation point cable (CP), Multi-user Telecommunications Outlet (MUTO), Telecommunication outlet (TO). Ensure compatibility of active equipment with existing makes.

1.3 APPLICABLE STANDARDS AND CODES

ISO/IEC 11801, 8802-3, 61935-1; IEC 60364-1, 60950; EN50173, 50174-1, 50174-2; ANSI/TIA/EIA-568, -569; TIA/EIA TSB-72, TSB-75.

1.4 WARRANTY

Min 1 year warranty after TOC for Ethernet & Fiber Switches, Transceivers, Wireless Controller, Network Security Firewall, Wireless Access Point.

PART 2 – PRODUCTS

2.1 LAYER-3 MANAGED MODULAR FIBER SWITCH

Min 8 slots for up to 4 line cards. Communication Manager/Routing Engine Module Line Card min 32 x 10G SFP+ Ports. Backplane capacity up to 4 Tbps, up to 1.5 Tbps (full duplex) per slot fabric capacity. 1+1 fabric redundancy. 1 million IPv4 RIB, 1 million IPv6 RIB. Routing: RIP v1/v2, OSPF v1/v2/v3, VRRP, BFD, BGP, IS-IS, GRE tunnels, MPLS, Ethernet VPNs. Multicast: up to 256k IPv4/IPv6 routes, IGMP v1/v2/v3. Min 16k policers for QoS. Dual power supply, fans.

2.2 LAYER-2 MANAGED ETHERNET SWITCH (24 PORT)

24 x 10/100/1000 ports PoE+, 4 x 1G/10G fixed uplinks, 2 x 40G QSFP stacking ports. Switching capacity 144 Gbps, processing 214 Mpps. Stacking up to 10 units. 32000 MAC addresses. VLAN IDs 4000. Features: LACP, MSTP, IEEE 802.1w, 802.1x, 802.3ad, 802.3at PoE+, 802.3af, 802.1d, 802.1p, 802.1q, LLDP, Jumbo frames 9198 bytes, port security, SNMP v1/v2/v3, NTP, DHCP relay, RIP v1/v2, OSPF v2.

2.3 FIREWALL

8x GE SFP slots, 2x 10 GE SFP+ slots, 20x GE RJ45 ports, 2x GE RJ45 management ports, console port. Firewall throughput 36 Gbps, NFFW throughput 4 Gbps, Threat Protection throughput 3 Gbps. TLS 1.3 support. IPS, SSL inspection, AI-powered threat protection, dynamic WAN path steering, cloud-on-ramp, DNS filtering.

2.4 WIRELESS CONTROLLER

4 x Gigabit Ethernet ports. WPA, WPA2, 802.1H, TKIP, AES. L3/4 based. Supporting up to 1,024 APs, 25,000 clients per device cluster up to 4 units (3+1). Rogue AP detection, interference detection, band

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steering, airtime fairness, role-based user policies, per-user rate-limiting, hotspot, guest networking. Capacity-based client admission control, band balancing, internal captive portal (Radius, AD, LDAP, Local DB).

2.5 WIRELESS ACCESS POINT

2 x 1GbE ports, PoE in. 802.11a/b/g/n/ac Wave 2. MU-MIMO 2x2. WPA-PSK, WPA-TKIP, WPA2 AES, WPA3, 802.1H, Dynamic PSK. WIPS/WIDS, captive portal, 802.1Q, VLAN pooling, port-based, tunnel L2TP/GRE. Operating temperature 0°C to 50°C, max power 12.6W.

2.6 COPPER CONNECTORS (RJ45 JACKS)

EN 60603-7 and EN 28877. Insulation displacement, 0.50-0.65 solid and 7x0.15-0.20 mm stranded. Tool less assembly, 568B/568A, Category 6A, integral shutter. Performance at 500 MHz: Attenuation <11.2dB, Return loss ≥12.6dB, NEXT ≥32.3dB.

2.7 FIBER CONNECTORS

IEC 61754. Small form factor, duplex, high density, field terminated under two minutes, integral shutter.

2.8 TELECOMMUNICATION WALL OUTLETS

RJ45 / Duplex LC Fiber Connectors, flush mounting, space for labelling.

2.9 PATCH PANELS

19” panels. Copper: 16/24 per panel. Fiber: 12,24,48 per panel (sliding or front loading). Cable management, slack storage, labelling. Colored identifiers for jacks/sockets.

2.10 PATCH CORD MANAGEMENT

1U with min 5 rings to accommodate up to 72 patch cords.

2.11 PATCH CABLES

RJ-45 copper: Category 6A, stranded wires. **Fiber:** duplex ruggedised, core/cladding sizes matching permanent link.

2.12 COPPER CABLE (CATEGORY 6A)

100 Ohm. Conductor 24 AWG (0.560mm), resistance <98.6 Ω/km, dielectric strength 1kV/1 min, insulation resistance >5000 MΩ/km, characteristic impedance 100±15% from 1 to 100 MHz. LSZH sheath.

2.13 OPTICAL FIBER CABLE

50µm/125µm Multimode (OM4) LSZH or 9µm/125µm Single mode (OS2) LSZH indoor. Single mode performance at 1310/1550nm: attenuation <0.4/0.4 dB/km. Multimode at 850/1300nm: <2.7/0.8 dB/km. Min bend radius: indoor 20x cable diameter (install), 10x (after); indoor/outdoor 25x (install), 20x (after). TO min bend radius 20mm. Operating temp -10 to +60°C.

2.14 19” CABINET

Colour black or as required. Plexiglass door. Frame thickness 2mm, mounting rail 2mm, roof 1.63mm, rear door 1.63mm, side panels 1.2mm. At least two cooling fans. Cable entries top and bottom. Cabling guide system inside. Earthing point. Door lock with key. Power distribution unit (PDU): ≥2 extra sockets, industrial male plug, two PDUs per rack for dual power supply equipment.

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PART 3 – EXECUTION

3.1 INSTALLATION

Per manufacturer's guidelines and relevant specification. Provide test report to ensure cabling meets Class E. No distribution cabling alongside power lines. Correct cable baskets/trays per IEC 50174-1. Pulling tensions not exceeded. Plug conduits/entrance holes with re-ununutterable duct seal or flame retardant putty. Proper grounding, bonding to main electrical ground.

3.2 INSTALLATION HANDOVER

Documentation includes evidence of conformance, delivery information, cable acceptance test records.

3.3 FINAL CABLE DOCUMENTATION

Site plans, as-built information (nodal, route, cable connectivity), installed cabling acceptance test records, evidence of conformance to installation specification, handover certificate, earthing/equipotential bonding details.

3.4 TESTING AND COMMISSIONING

Horizontal copper cabling (Level II field tester per ISO/IEC 11801): Headroom report, wire map, resistance, link length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, ACR, PS ACR, delay skew, impedance, DC loop resistance.

Fibre permanent links: Light source/power meter or OTDR at 850nm and/or 1300nm. 100% of installed links tested. Confirm continuity, link length, radius of curvature, cable preparation, cable ties, insulation continuity, earthing and bonding.

Labels: Computer generated or typewritten.

Commissioning: After handover, probationary period. All components from one manufacturer to guarantee Category-6A performance end-to-end.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0660 – INTELLIGENT ADDRESSABLE FIRE ALARM SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, configuring, programming, integration, testing, commissioning, training for Fire Alarm System complete in all respect.

1.2 GENERAL

System operates on 24 VDC from battery charger with standby batteries. Incoming supply 230 VAC from emergency circuit. All active items product of single manufacturer. Provide wall chart near FACP (layout, standby battery spec, operating/maintenance instructions in black, emergency instructions in red, servicing contractor's name/address/phone). Interface with Public Address / Voice Alarm System (per Section 0651 and EN 54-16) and the Access Control System (per Section 0652). The FACP shall be provided with a remote-parallel-monitoring interface for connection to the ATC operational annunciation panel. The Contractor shall coordinate the routing of all FACP and BMS interface cabling with the Engineer and with the Pakistan Airports Authority (PCAA) operational staff for the airside cable trench provision.

1.3 APPLICABLE STANDARDS/CODES

BS 5839; NFPA 72; NFPA 101. All items LPCB/EN54 approved or British Standard.

PART 2 – PRODUCTS

2.1 ANALOGUE ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)

Functions: Supervise all intelligent addressable detectors/modules. Detect activation, location, operate notification appliances and auxiliary devices. Visually/audibly annunciate trouble/supervisory/alarm conditions. LCD display, local audible device, printing/history storage. Acknowledge switch (silences local panel piezo, changes LEDs from flashing to steady). Signal silence switch (programmable). Drill switch (activates all programmed notification circuits). System reset switch. Lamp test. Scroll display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, OTHER EVENTS. Print screen.

System Capacity: Each module loop supports min 127 analog/addressable devices. Backlit LCD, QWERTY keypad. Programming without special equipment, without interrupting alarm monitoring. Automatic smoke detector test function per NFPA 72. On-line or off-line programming. History file (alarms, troubles, operator actions, programming entries). Drill (activate all silenceable fire output circuits). Two password levels (master, user), min 4 user passwords. Environmental drift control (maintenance alert/urgent warning).

Loop Control Module: monitors/controls 127 devices, contains own microprocessor for local/degrade mode. Single pair of wires, NFPA Style 4 (Class B). Receives analog/digital information from detectors, adjusts for environmental factors, dust accumulation.

Enclosures: 0.060 steel, key lock, transparent opening for indicators, modular structure.

Power Supply: 230 VAC, 50 Hz. Battery charger for 24 hours standby (48 hour recharge). Very low frequency sweep earth detect circuit.

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Printer: Automatic, printing code, time, date, location, category, condition. 80 characters per line. Strip printer can be mounted in main FACP enclosure (alarms in RED, other messages in BLACK). Adequate printer paper rolls.

Field Programming: Programmable, configurable, expandable without special tools or laptop. Via standard FACP keyboard. Non-volatile memory.

2.2 NOTIFICATION APPLIANCES

Audible visual sounders 24 VDC. Field programmable, ≥10 dBA above ambient noise. Strobe lights per ADA, UL 1971, fully synchronized. Max pulse duration 1 second.

2.3 ADDRESSABLE DEVICES – GENERAL

Address-setting via rotary decimal switches. Analog and addressable. Integral short circuit isolator (isolate fault in <1 sec). LED flashes normal, steady on alarm. Detector sensitivity adjustment field programmable; automatic compensation for dust accumulation. Detectors listed by UL for calibrated sensitivity test (NFPA 72 Chapter 7). Ceiling-mount with twist-lock base (tamper proof). Bases: sounder base (85 dBA min), Form-C relay base (30VDC, 2.0A), isolator base. Test means: magnetic switch at detector or remote command from panel.

Addressable Manual Call Station: Key operated test-reset lock. After emergency operation, cannot be restored without key. Lexan, operating instructions on cover. “FIRE” in raised letters, 44mm or larger.

Intelligent Addressable Multi Optical and Heat Detector: Photoelectric and thermal technologies in single device. Microprocessor to determine environment and choose sensing settings. Sensitivity 1-4% per foot obscuration. Combine thermal and photoelectric signals for fire detection; distinguish false alarms.

Intelligent Addressable Thermal/Heat Detector: 135°F (58°C) fixed, rate-of-rise 15°F (9.4°C) per minute.

Flame Detector: Class 1 per BS EN54-10:2002 high sensitivity. Detection range 25m, 90° cone. Loop powered interface module.

Addressable Dry Contact Monitor Module: Connects one supervised IDC zone of conventional alarm initiating devices (N.O. dry contact) to SLC. Mounts in 4” square, 2-1/8” deep box. LED flashes normal.

Addressable Control Module: Supervises and controls one conventional NAC (24VDC). For fan shutdown, can operate as dry contact relay (Form-C, rated ≥0.6A at 30VDC).

Addressable Relay Module: Form C, min 2.0A resistive or 1.0A inductive. Magnetically latched.

Agent Release Module (ARM): Allows Gas Cartridge Actuators for Clean Agent containers to be wired in parallel, Class A or B wiring.

Abort Switch: Within protected area, near egress. Requires constant manual pressure to cause abort. Manual control overrides abort. Audible and visual indication of impairment.

Zone Disable Switch: Momentary push button, delays agent release circuit when operated prior to circuit actuation.

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Manual Release Station: Dual actuation, pull spring clip safety pin (breaking seal) and depress button. Remains engaged until unlocked with key. Stainless steel housing, red plastic release button with black trim.

LCD Alphanumeric Display Annunciator: Supervised, back-lit LCD, min 160 characters. Displays all alarm/trouble conditions. Up to 32 annunciators per EIA 485 interface. Mimics main control panel 80 character displays. Switches for Global Acknowledge, Silence, Reset (can be disabled or key lockout).

2.4 BATTERIES AND EXTERNAL CHARGER

Batteries: 12 volt, Gell-Cell. Capacity for 24 hours + 5 minutes alarm upon AC power failure. Maintenance free. External Battery Charger: Automatic, constant potential. 120/240V 50/60 Hz. Fully charge discharged battery within 48 hours while supplying loads. Overload and short circuit protection.

2.5 WIRING AND CABLING

1.5 mm² / 2.5 mm² fire resistant enhanced (120 min) cables with LSZH outer sheath. All wiring on terminal blocks. Cable joints only on detector bases.

PART 3 – EXECUTION

3.1 INSTALLATION

Per manufacturer's instructions. Testing per relevant standards: operational safety, regular functioning, protection against false alarms. Detectors subjected to basic tests and sensitivity tests.

3.2 TRAINING

By fully qualified representative of equipment manufacturer/supplier. Training includes: wall chart explanation, function of each control switch, periodic operational testing, maintenance of fire log book, actions upon signals (false alarm, trouble, common alarm/trouble, low battery), field modifiable programming.

3.3 WARRANTY

Min 1 year after TOC for all detectors, sounders, modules, control panel, repeater panel, computer, software.

PART 4 - MEASUREMENT AND PAYMENT

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SECTION 0670 – CLOSED CIRCUIT TELEVISION SYSTEM (CCTV)

PART 1 – GENERAL

1.1 SCOPE OF WORK

Supplying, installing, connecting, configuring, programming, testing, commissioning and training for complete IP CCTV system.

1.2 GENERAL

All active items product of single manufacturer. Power to rack from UPS with min 30 minutes autonomy. Open standard based integrated system with IP network centric architecture. Colour Video Cameras with individual IP address, Fixed or P/T/Z Lens, Server, Network Attached Storage (NAS)/Raid backup, Application Software, Colour Video displays, Keyboards with Joystick Controllers, software based Video Matrix Switcher, Workstation for System Administration/Management/Maintenance. Central Management Server and Network Storage management for video stream and storage management. Recording frame rate & resolution programmable. Recorded video cannot be altered (audit trail). Storage calculation: H.264/H.265 compression, 1080p recording at 30 fps, 24 hour operation, 30 days storage, 25% expansion capacity. Video analytics for abandoned object, intrusion, wrong direction, loitering, object removal, camera sabotage, tail-gating, unattended baggage, queuing analysis, intruder detection. Watermarking/digital certificate for tamperproof recording. Camera ID, location/area, date/time stamp programmable by system administrator. Triplex (Viewing, Recording, Reply simultaneously). Export clipping to portable hard drive, viewable on standard PC. PTZ cameras 64+ pre-defined positions. LAN connectivity for remote monitoring anywhere in Airport. All control equipment in standard 19” racks.

1.3 APPLICABLE STANDARDS AND CODES

IEC 801-2 (Electrostatic discharges), 801-3 (Radiated EMI), 801-4 (Voltage transients). Dust/rain resistance IP67 for outdoor cameras. Salt mist per IEC 68-2-11, Vibration IEC 68-2-6, Bump test IEC 68-3.

PART 2 – PRODUCTS

2.1 IP FIXED COLOUR BULLET VARIFOCAL CAMERA

1/2.9” CMOS, 3072(H)x1728(V) 5MP or better. Built-in varifocal auto iris, 3.2-10mm or better. 25 fps, 0.0 lux with IR. SNR >55dB, WDR 120dB. H.265/H.264. PoE. IP rating per BOQ.

2.2 IP FIXED COLOUR DOME VARIFOCAL CAMERA

Same specs as bullet.

2.3 IP PTZ DOME COLOUR VIDEO CAMERA

1/2.8” CMOS. Focus 4.5-135mm, optical zoom 30x, digital 12x. Resolution 1920x1080 (2MP). 0 lux with IR. Pan 360° continuous, 256 presets. H.265/H.264/M-JPEG. WDR 90dB. IP rating per BOQ.

2.4 CENTRAL MANAGEMENT SERVER on H.264/H.265 Compression

Simultaneous playback and recording full duplex. Windows/Linux OS. User management for security level control. Latest generation processor, redundant hot pluggable power supply. Network protocols: TCP/IP, CIFS, NFS, HTTP/HTTPS, FTP, NTP, SNMP, SMTP, DHCP, DNS. KVM switch.

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2.5 WORKSTATION

Latest industrial standard, 21" LED display, wireless keyboard/mouse, video/sound card, 10/100/1000 Base-T Ethernet port, latest OS, CCTV software, antivirus.

2.6 NETWORK VIDEO STORAGE on H.264/H.265 compression

As per manufacturer's recommendation for operation of CCTV system.

2.7 CAMERA HOUSING & MOUNT

Same make as camera or with manufacturer's authenticity document. Compact, indoor/outdoor as required. Support weight in any position.

2.8 SPEED DOME CONTROLLER / PTZ CONTROLLER

Variable speed joystick, LCD display for programming.

2.9 FULL HIGH DEFINITION (FHD) LED DISPLAY

42" Colour LCD. Resolution 1928x1080, contrast 4000:1, 16:9, luminance 500 cd/m². HDMI, DVI, VGA.

2.10 CONSOLE

Ergonomic design, adjustable work surface. High-pressure plastic laminate veneer. Static load 50 lb/linear ft (max 250 lb per surface). Frame assembled profiles with angle brackets. Integrated screens, PTZ controller, mouse, telephone, keyboards drawers, headset panels, lighting panel.

PART 3 – EXECUTION

3.1 VIDEO SURVEILLANCE APPLICATION SOFTWARE

Open architecture for integration with perimeter safety, access control, public address, fire/safety systems. Display and manage entire system. Flexible windows split (1/2/4/16) on 42" screen. PTZ control, iris, focus, color balance, presets, video tour. Reports of stored device configuration. Alarm and alarm log. User authority configurable per device or group. User activity log (audit trail). Administrator add/edit/delete users with rights. Minimum 3 hierarchical security levels. Recording modes: continuous, manual, programmed (date, time, camera-wise). Search and replay by date, time, camera. Motion detection area-wise. Pre-record duration 0 seconds to 5 minutes. Browser-based system for remote users. Retrieval instantaneous or via search. Backup on CD/DVD/Blue Ray or other device. Storage for 24 hour operation, 30 days recording, all cameras at 1080p, 30 fps, H.264/H.265, 25% expansion. Artificial intelligence: image tracking, stationary object detection, abandoned object, intrusion, wrong direction, loitering, object removal, camera sabotage, vehicle detection, tail-gating, unattended baggage, queuing analysis, intruder detection.

3.2 INSTALLATION

Per manufacturer's recommendations.

3.3 TRAINING

By fully qualified representative of equipment manufacturer/supplier.

3.4 WARRANTY

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Min 1 year after TOC for all cameras, LED display, computer with software, NVR, CMS, PTZ controller, Ethernet switches, transceivers.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0680 – FUEL STORAGE AND SUPPLY SYSTEM TO DG SETS

PART 1 – GENERAL

1.1 GENERAL

Fuel storage and supply system to DG sets. Contractor engages specialized Sub-Contractor/Authorized Distributor ('Supplier'). Submittals: technical data sheets, outline drawing, printed technical literature.

1.2 DESCRIPTION

Fuel transferred in underground storage tank (UST) via fuel bowsers. UST filling: operator sees level on indicator at fuel filling cabinet. Fuel transferred from UST to D.G. set day/base tanks using fuel transfer pumps (duty + standby) through piping with valves, instruments, accessories. Transfer pumps with automatic controls: start pumps and open solenoid valve when low level sensed in day/base tank; shut-off when high level achieved.

1.3 SCOPE OF WORK

Fabrication, supply, installation, testing & commissioning of USTs and aboveground day tanks. Supply, installation, testing of fuel transfer pumps (1 duty + 1 stand-by) with explosion proof motors. Fuel supply piping network (pipes, fittings, supports, drains, gauge stick port cap, painting, coating, wrapping, vents with bird screen). Valves (ball, gate, foot, check, strainer, solenoid, pressure relief). Instrumentation (level transmitters, flow switches, flow meters, pressure gauges). Fuel filling point cabinet (SS cabinet, filling pipe with coupler & cap, level indicator, alarm system). Fuel monitoring & control panel + pump/motor control panel. Labour, materials, equipment for complete installation. Design & execution of related civil & electrical works (pump foundation, day tank foundations & dike/bund wall, pipe supports, caution signs, power & control wiring in conduits).

1.4 ORIGIN OF SUPPLY

Complete equipment/instruments (pumps, valves, strainers, flow switches, flow meters, pressure gauges, level sensors, level indicators, alarm system, breakers, PLC, relays, contactors, selector switches, HMI) imported from USA, Europe, Korea or Japan. Steel storage tanks fabricated locally. Electric control panel steel box/enclosure, fuel filling point steel cabinet may be local. Steel pipes may be local.

1.5 CODES AND STANDARDS

ANSI B16.5, B16.22, B16.39; API 5L, 6D, 610, 674, 676, 1104, 1110; ASTM A53, A126, A234; ASME B31.3, ASME Code Sec VIII Div.I, Sec IX; DIN 6608, 6616; NFPA 30.

PART 2 – PRODUCTS

2.1 FUEL STORAGE TANK

Design: UST per DIN 6608. Aboveground per DIN 6616. Connection nozzles for fuel filling, supply, vent, instruments, drain. Inspection manhole and dip stick. Lifting eyes. Steel access ladder with bolts/nuts where necessary. Thickness increased by 2mm for corrosion allowance. Nameplate per code: manufacturer, year, serial number, design/test pressure, design temperature, code stamp, fluid, capacity, dimensions.

Welding: Butt welded with full penetration. Non-destructive testing per ASME Code Sec VIII DIV-I.

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Surface Preparation and Painting: Commercial sandblast per SSPC-SP5. **Internal Coating:** Fuel resistant primer or anti-corrosive material if specified. **External Coating (Above Ground):** Polyamine cured epoxy mastic primer (200µm DFT) + Polyurethane Top Coat (50µm DFT) – total 250µm min. **External Coating (Underground/Buried):** Epoxy Primer (75µm), High Build Epoxy (175µm), Coal Tar Epoxy (200µm) – total 400µm min.

Tank Calibration: Provide calibrated dip stick with graduations and calibration chart.

Installation: UST buried inside RCC pit with pedestals, suitable slope. Concrete beams/saddles or hold-down straps to resist flotation. Aboveground tank on RCC pedestals or steel support structure with slope. Spill/leakage containment bund of 110% capacity. Spill containment ditches below drain valves, fuel supply/filling connection points. Security fence with access gate and sign boards.

Testing: NDT of ≥10% weld length by radiography. Hydrostatic testing per DIN or ASME. Holiday test for external coating. DFT measurement.

2.2 FUEL DAY TANK

Skid Mounted Base Tank: Coordinate with generator set manufacturer for high/low level sensors.

Free Standing Day Tank: Supported over fabricated steel structure or saddles. Connections for filling, supply, return, overflow, vent with bird screen, instruments, drain. Lifting eye, inspection cover, emergency vent, glass sight gauge (if applicable), graduated dip stick, access ladder (if applicable). Level sensors with level indicator. Fabrication, coating, calibration, installation, testing as per aboveground storage tank. Dike/bund walls around day tanks for 110% of total diesel stored. Vent pipe extended to outside of room.

2.3 FUEL PIPING NETWORK

Lines: filling, vent (UST and AST), pumps suction, pumps discharge, overflow, pumps relief, drain point, fuel supply to DG sets, fuel return from DG sets, solenoid bypass, day tank drain. Full flow Y-strainer before suction of each pump. Filling hose coupler in filling point cabinet, locking arrangement.

Materials: Black steel schedule 40 seamless ASTM A53 Type-S Grade-B or API-5L Grade B. Threaded fittings up to 1½" forged steel; 2" and larger socket/butt-welded per ASME B16.9, ASTM A234 Gr. WPB. Elbows long radius 1.5D. Steel flanges ASME B16.5, ASTM A105, Class 150, Slip-On or Weld Neck with Raised Face. Flanged ball and check valves per data sheet. Flanged Y-type strainers per data sheet. Vent terminals full size, recessed cast bronze, bird/insect screen, weatherproof vent cap. Filling hose coupler stainless steel. Foot valve per data sheet. Flow meter with totalizer.

Installation: Per ASME B31.3. Underground or aboveground with min 0.5% slope. Automatic air release valves at high points. Buried pipe ≥300mm below finished ground level in non-traffic areas; ≥1000mm in traffic areas. Minimum 300mm from other services. Soft sand padding below/above pipelines in rocky soil.

Surface Preparation and Painting: Underground: primer + three ply polyethylene tape + two ply polyethylene tape. Above ground: epoxy primer coat + high build epoxy.

Testing: Hydraulic test to 1.5 x working pressure per API 1110. Welding per API 1104.

2.4 FUEL TRANSFER PUMP

Electric Motor Operated Pump: Skid mounted positive displacement (PD), capacity/head per drawings/BOQ. Data sheet per clause 12.1.

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Hand Operated Pump: Stand-by, capacity to refill empty day/base tank within two hours.

Installation: On concrete foundation with spill containment. Priming arrangement if non-self priming. Pressure Relief Valves inline at pump discharge, outlet routed back to fuel supply tank/suction line. Strainers on pump suction. Pressure gauges 4" dia, dial graduated to 1.5 x working pressure, with isolating plug/ball valve. Eccentric reducers if connection sizes differ.

Pump Operation: Duty pump selectable via selector switch. Stand-by. Automatic duty change on each start/stop cycle. Pump starts when low level sensor in day/base tank activated; stops when high level sensor activated. Pump not start (alarm) if low level sensor in UST activated.

2.5 CONTROLS AND EQUIPMENTS

Level transmitter (continuous) for UST with indicators on control panel in generator room and fill point cabinet (% full display), audible/visual alarm. Level transmitter for day tanks with indicator on control panel, audible/visual alarm. Pump Control panel & Fuel Monitoring Panel. Control cabling with conduits.

Operation Scheme & Interlocks (per table):

- UST filling: high level – warning (visual+audible) at panel + filling point.
- Decanting UG to Day: low level in UG – pumps shutdown + alarm; high level in day tank – pumps shutdown + alarm; high level + pump shut-off failure + overflow – pumps shutdown.
- Fuel transferring Day to DG: low level in day tank – pumps start & solenoid valve open; low level + pump start-up failure – alarm only.

Pump Control Panel: Per manufacturer's recommendation. Motor control, safeties, automatic duty changeover, operational status display, manual operation switches, emergency stop.

Fuel Monitoring Panel: PLC controlled with HMI for digital indication of tank contents (liters) for each tank. Alarm sounder/horn for events per operation scheme. Indication lamps, test/reset buttons. Interfaced with pump control panel. Features: power supply module, main circuit breaker, CPU, memory card, PLC, digital/analog I/O modules, HMI/touch panel 9" LCD, alarms/sounders, software, internal cabling. Enclosure: surface or semi-flush, corrosion protected, 14 gauge SMG steel, key lock with 9" touch LCD, IP54, pocket for documents.

Fuel Filling Cabinet: Outdoor near UST. Stainless steel ASTM A316, 12 gauge, size 800x600x300mm (or approved), satin/hairline finish. Partial glass/polycarbonate front door. Lockable, side hinged. Single point 45° angular filling coupler of 65mm with SS filler cap. Bottom entry. Lever ball valve 65mm threaded. Removable drip tray. Dial Type Contents Gauge (% filled). Overfill alarm at 90% (also to control panel). Grounded per NFPA 780.

2.6 DATASHEETS (summarized)

Pumps (P-201, P-202): Quantity 2 with motors. Rotary vane/gear positive displacement, self-priming, horizontal. Housing cast iron, gears stainless steel/bronze, mechanical seal. Capacity 100 L/min. Internal relief valve. Motor explosion proof, TEFC, 400VAC or 230VAC, 50Hz.

UST (V101): 25,000 liters, DIN 6608, horizontal with 2:1 elliptical dish head, atmospheric. Material HR235/ASTM A36, shell/dish head thickness 8mm. Test pressure 1.5 bar hydrostatic.

Aboveground Day Tank (V301, V302): 3,000 liters each, DIN 6616. 1,250x2,600 mm, shell/dish head 6mm.

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Pressure Gauge (PI301): IP55, ASME B40.100, direct reading, SS316 case, 4" dial, ½" NPT male, Bourdon tube, 0-2 bar/0-30 psi, glycerin filled. With ball valve + snubber + pressure limiting valve.

Flow Meter with Totalizer (FQI301): ATEX/IEC Ex, CE, explosion proof IP65. Turbine type, SS316 body. Range 5-250 L/min, LCD display, totalizer. Flange type ANSI 150# RF or threaded, 40mm.

Flow Switch (FS): ATEX/IEC Ex, CE, explosion proof IP65. Paddle type, gives signal to panel when flow detected. Horizontal pipe, lower mount, plastic/metal case, SS316 paddle, threaded 40mm.

Level Transmitters/Sensors (LT): ATEX/IEC Ex, CE, explosion proof IP68. Submersible continuous leveling. SS316 housing, SS316L cells. Accuracy ±0.5% FS. Output 4-20mA. For UST (2500mm range) and AST (1250mm range).

Solenoid Valves (SV1, SV2): ATEX/IEC Ex, CE, explosion proof IP65. Direct acting, normally closed. 2 ports/2 switching, 40mm threaded, operating pressure 0-4 bar. Body CSteel ASTM A216 WCB or SS316. Seal FKM. Max flow 250 L/min.

Strainers (YS1, YS2): Y Type, before pump suction. 50mm flanged RF, ANSI 150#, SS316 filter (400µm). Body CSteel ASTM A216 WCB or SS316.

Check Valves (CV1-CV5): Swing type, 40mm female threaded. CSteel or SS316.

Foot Valve (FV1): Spring loaded type, double poppet, 50mm female threaded. CSteel or SS316 with strainer.

Ball Valves: 50mm (flanged RF, full bore, lockable handle), 40mm/25mm/20mm (female threaded), 65mm (female threaded). CSteel or SS316, reinforced PTFE seat.

Gate Valve (GV1): Non-rising stem, multi turn, 25mm female threaded.

Relief Valve (PRV1, PRV2): Spring loaded, auto inline, 40mm female threaded. Body CSteel or SS316, seat/disc SS316. Operating pressure approx 2.5 barg, max flow >250 L/min.

PART 3 – EXECUTION

3.1 TESTING & COMMISSIONING OF FUEL SUPPLY NETWORK

Field tests in presence of Engineer. Contractor records all values, provides 3 certified copies.

3.2 TRAINING REQUIREMENTS

Operational training to each shift of Employer/End user: Control Panel operation, manual and abort functions, trouble procedures, supervisory procedures, auxiliary functions, emergency procedures.

3.3 OPERATION AND MAINTENANCE MANUALS

Four copies. Piping isometrics, written description, checklists, troubleshooting.

3.4 AS-BUILT DRAWINGS

Four copies. One reproducible engineering drawing.

3.5 WARRANTY

Min 1 year replacement warranty for equipment including motors, pumps, valves, strainers, flow meter, sensors, flow switch, pressure gauge, control. After-sales service, trouble shooting, parts replacement included.

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PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0690 – LIFTS

PART 1 – GENERAL

1.1 GENERAL

Lifts as indicated. Contractor engages specialized Sub-Contractor/Authorized Distributor ('Supplier'). Submittals: technical data sheets, outline drawing, printed technical literature.

1.2 SCOPE OF WORK

Two lift (Duplex arrangement). Capacity 1000kg, 11 stops/11 openings, speed 1 m/s, cabin size 1600×1400×2300mm (W×D×H), entrance width 900mm, approx. total travel height 42m. MRL type, indoor type suitable for ambient condition of 45°C. Scope includes design, supply, installation, testing, commissioning, maintenance during defect liability period: hoisting machinery, sheaves, girders, controller, car, ropes, counterweights, supports, brackets, guides, car & landing doors, door operator, switches & control, safety devices, signals, governor, safety gears, buffers, pit screens, separator beams, well trimming girders, pit access ladder. All labour, erection plant, tools, embedded parts. Civil works for embedded parts and making good. Electrical cabling from designated power supply point. Maintenance during defect liability period. Training. Operating and Maintenance manuals (3 copies each).

1.3 APPLICABLE CODES AND STANDARDS

BS 5655/EN 81 Parts 5,6,8,9,10 with Appendices, EN 81-20, 81-50 and 81-70; ISO 4190-1; AWS B3.0, D1.1; NEMA-1CS6; NFPA 70, ANSI-A17.1; AISC Manual; Building Code of Pakistan (Seismic Provisions 2007) Chapter 11; International Building Code (IBC) Chapter 30.

1.4 ORIGIN OF SUPPLY

KONE, SCHINDLER, OTIS, DOPPLER, THYSSENKRUPP. Major components manufactured in manufacturer's own plants.

ORIGIN: WESTERN EUROPE

PART 2 – PRODUCTS

2.1 PAINTING

Preparation: Blast cleaning to remove rust/grit. Stainless steel, aluminium, bronze, machined surfaces protected. **Application:** Dry, dust-free, temperature ≥45°F. First coat immediately after cleaning. Each coat thoroughly dried before next.

2.2 MATERIALS & WORKMANSHIP

Highest grade, unused. Workmanship per best modern practice. All parts accurate to American Standard or approved gauge.

Structural Metal Work: Per AISC Specifications. Surface finish ANSI B64.1. No sharp kinks, bends. Shearing accurate. Re-entrant cuts filleted. Bends with approved dies or rolls. Low-carbon steel may be flame-cut.

2.3 LIFT CAR

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Car Frame & Platform: Welded or bolted steel channel sections. Deflection under contract load ≤1/1000 of span under static conditions. Guides mounted on car frame. Platform fabricated frame, sheet steel underside. Rubber pads for sound/vibration isolation. Aluminum sill with grooves, toe-guard.

Car Body Work: Steel construction. Roof withstand weight of two men without deformation. Roof trap door with micro-switch, emergency communication. 3 pin socket outlet on car top, two outdoor protected lights at bottom and top operated via MCB.

Finish: Recessed kick plate 100-150mm stainless steel on three walls. Floor sheet steel sound-isolated platform with granite flooring. Rear wall laminated safety glass 12.5mm where required. Ceiling removable with modular light fittings, emergency exit with safety switch. Handrails on side walls stainless steel hollow section. Protective padded canvasses for cargo lift (hook-on type) with stainless steel hooks.

Telephone: Telephone compartment in front return panel above car operating buttons. Stainless steel satin/hairline finish, hinged door. Telephone set connected to control room via controller (or intercom with auto dialing).

Car Ventilation: Motor-driven propeller fan, discharge through concentric ring louver in ceiling center. Rubber mounting. Fan motor 220V, 1Ph, 50Hz with manually operating switch in car station.

2.4 LANDING DOORS

Two-panel centre or side opening stainless steel doors per technical data sheet. Frames and architrave stainless steel satin/hairline finish. Fire resistance rating ≥1 hour. Toe-guard apron at hoistway entrance (sheet steel, ≥16 gauge, extends ≥50mm beyond jamb each side, ≈600mm deep). Frames 14 SWG min, panels/fascia/toe-guards/hanger covers 16 SWG. Interlock per code, prevents movement until doors locked, prevents opening from corridor side unless car at landing or in leveling zone. Unlocking device per ANSI A17.1 or BS 5655 part 1.

2.5 CAR DOORS

Two-panel centre or side opening stainless steel. Door-gear operated by VWF AC drive. Retractable car door coupling. Door frame stainless steel satin/hairline. Full Width Light Curtain: from 25mm above floor to 1600mm, transmitter/receiver strips, reverses door motion if any ray interrupted; self-calibration. Door opening timing feature (adjustable reduced hold open time; buzzer and reduced speed close if door remains open). Door operator variable speed variable voltage, smooth acceleration/retardation, no dashpots. Closing force per BS 5655 Part 1.

2.6 HOISTING EQUIPMENT

MRL type. Permanent magnet gearless drive with motor, brake, other parts on steel bed plates. Manual operation with smooth-rimmed detachable spoke-less wheel.

Motor: VVVF, duty cycle min 180 starts per hour. Drip proof enclosure, force ventilated if needed. Leveling accuracy ±5mm.

Brakes: Spring actuated, electrically released. Two self-aligning shoes. Instantly applied on power interruption. Capable of bringing car to rest smoothly at max load and speed, sustain static load 150% of contract load.

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Controller: Fully microprocessor based, full collective mode. Features: correction drive, phase failure detection, recall drive, drive time supervision, door zone indication, elevator position synchronizing, accurate re-leveling, stuck push button supervision. Meets EN-81.

2.7 HOIST-WAY EQUIPMENT

Suspension Ropes: High-grade steel per BS EN 12385-5, material per BS EN 10264-1. Rope terminals per BS 461. Independent adjustment for each rope. Automatic device for equalizing tensions.

Guides: High quality T section steel. Joints spigotted, machined steel fish plates. Securely fixed by steel brackets bolted to metal inserts. Deflection ≤3mm under normal operation.

Counterweight: Weight equal to car + 40-50% specified load. Structural steel frame, cast iron weights. Guide shoes.

Safety Gear and Governor: Friction type progressive safety-gear actuated by centrifugal over speed governor, bolted to car frame under platform. Governor wire rope ≥8mm. Tension weight with electrical safety device. Two electrical switches: first reduces speed, second cuts off power and applies brakes if speed not controlled. Mechanical trip causes governor jaws to grip rope, bringing safety gear into operation, bringing car to rest gradually.

Buffers: Oil buffers of spring-return type in pit under car and counterweight. Stroke based on retardation of 10 m/sec² at 115% contract speed. Max retardation 25 m/sec². Mounted on continuous channels anchored to pit floor. Self-setting with safety device.

Final Limit Switches: Automatic device to bring car to stop at terminal landings independent of regular operating devices. Conform to BS 5655 Part I.

2.8 CONTROL SYSTEM

Microprocessor based electronic solid state. Operational mode per technical data sheet with emergency operation and fireman switch. Parking feature returns car to main floor when no calls. Load weighing: dispatching in advance when car filled to ~80% capacity; buzzer for overload. Automatic leveling within ±6mm. Independent operation from car buttons only (key operated switch). Emergency features: emergency power transfer (stand-by generator), intercom with control room, earthquake control (seismic detector brings cars to stop at next floor, opens doors), automatic power evacuation device (brings car to next floor, opens doors on power failure), hand winding system for manual operation, fireman switch at ground floor lobby (cancels all calls, stops at designated parking floor, opens doors, alarm sounds).

2.9 SIGNALS & FIXTURES

Integrated Hall Indicator: Digital car position indicator, illuminated/digitalized arrows, two-tone electronic gong.

Landing Call Station: Call buttons micro-movement, stainless steel pressel, translucent surround illuminates on call acceptance. Faceplate stainless steel 2mm thick, tamper resistant screws.

Car Station: Integral with front return, 1.6mm stainless steel satin/hairline. Hinged full height front panel with secret release. Features: alarm button, floor buttons for each floor, open door/hold-on button, key operated car independent service switch, key operated fan switch, digital car position indicator and direction arrows. Car call cancellation feature (press floor button twice).

2.10 TECHNICAL DATA (per lift type)

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Lift Type: Traction type passenger lift, Duplex, MRL. Quantity: 2 Nos. Capacity: 1000 kg. Cabin Size: 1600×1400×2300mm (W×D×H). Speed: 1 m/s. Stops/Openings: 11/11. Approx. total travel height: 42m. Entrance width: 900mm. Machine: Permanent magnet gearless VVVF drive. Control System: Microprocessor based, full collective. Standards: EN 81-20, EN 81-50, EN 81-70. Ambient design condition: 45°C (indoor). Shaft Ventilation & Cooling: Air conditioning unit of 2 TR cooling capacity per lift shaft, operable at ambient temperature of 50°C (Make: Trane/Mitsubishi/Samsung); propeller-type exhaust fan of 800 CFM per lift shaft.

PART 3 – EXECUTION

3.1 INSTALLATION

Comply with applicable standards, manufacturer's instructions. Electrical work per NFPA 70 or approved equivalent. Civil works: cutting holes, chases, openings, making good. Supports, beams, ladders for machinery, guide brackets, doors, buffers. Cement/concrete for grouting-in brackets, bolts. Scaffolding and protection. Welded construction for installation unless bolted connections required. Welding per AWS. Rotating/vibrating equipment on vibration-absorption mounts. Lubrication per manufacturer. Alignment of hoistway entrances with guide rails. Sill unit set accurately aligned, slightly above structural floor. Painting, retouching, refinishing after installation.

3.2 TESTING AND INSPECTION

Per BS 5655 Part 10. Tests include: functioning of all systems/devices and controller, operational test of all safeties, motor test, earth fault test, insulation resistance test. Periodic re-examination during defect liability period.

3.3 WARRANTY

Min 1 year replacement warranty from TOC for complete equipment including machine, controls, other components.

PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0700 – FM-200® FIRE SUPPRESSION SYSTEM AND FIRE ALARM & DETECTION SYSTEM

PART 1 – GENERAL

1.1 GENERAL

FM-200® Fire Suppression System and Fire Alarm & Detection System. Contractor engages specialized Sub-Contractor/Authorized Distributor ('Supplier'). Submittals: technical data sheets, outline drawing, printed technical literature.

1.2 SCOPE OF WORK

Fire Alarm & Detection System complete with control panel, automatic detectors, manual pull station, notification appliances, abort switch, zone disable switch, manual release station, agent release module, relay module, monitor module, remote alarm LED. FM-200® or HFC-227ea total flooding fire suppression system complete with cylinder assembly, cylinder manifold, factory filled containers equipped with discharge valve, safety plug/burst disc, fill port, impulse valve operator/solenoid valve, low pressure supervisory switch, discharge pressure switch, liquid level indicator, pressure gauges, discharge nozzles, black steel schedule 40 piping with accessories, painting/finishing, caution signs, performing room pressurization tests, coordination with general contractor for closure of openings/leakages and sealing of protected spaces.

1.3 APPLICABLE STANDARDS AND PUBLICATIONS

NFPA 2001 (Clean Agent Fire Extinguishing Systems), NFPA 70 (National Electrical Code), NFPA 72 (National Fire Alarm Code), NFPA 101 (Life Safety Code), FM Approvals, Underwriters Laboratory.

1.4 QUALITY ASSURANCE

Manufacturer: Min 10 years experience. All devices/equipment UL listed or FM approved. Locks for all cabinets keyed alike.

Installer: Trained by supplier. Certified special hazard designer. Min 5 years experience. Access to clean agent recharging station. Authorized stocking distributor. 24/7 emergency service.

1.5 SUBMITTALS

Field installation layout drawings (scale ≥1/8"=1'-0"). Separate layouts for each level. Isometric details of agent storage containers, pipe runs, sizes, material, gauge. Hydraulic flow calculations from UL/FM Approved Flow Calculation Program (total discharge time by zone). Description of occupancies and hazard. Electrical layout drawings with point-to-point conduit runs. Internal control panel wiring diagram. Battery standby power calculation. Sequence of operation. Submit to local Fire Prevention Agency and authorities having jurisdiction.

1.6 ORIGIN OF SUPPLY

Imported from USA, Western Europe or Japan, or license from same with guarantee. All devices UL listed or FM approved.

PART 2 – PRODUCTS

2.1 FM-200® FIRE SUPPRESSION SYSTEM

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System Description: Total flooding, uniform concentration per NFPA 2001. Minimum design concentration 8.1% by volume, max 10.5% in occupied spaces unless evacuation provided. Includes agent storage containers, FM-200® agent, system actuation equipment, discharge nozzles, pipe and fittings, caution/advisory signs, functional checkout, testing, training. Capable to shut down HVAC power, HVAC dampers, ventilation, lighting, electronics per NFPA-2001. Minimum two inspections in first year (6 month intervals). Contractor responsible for sealing protected spaces against agent loss during 10 minute "hold" period.

Sequence of Operation:

- One detector: "ALARM" lamp, alarm bell/visual indicator, auxiliary functions (door closures, signal to fire alarm system, HVAC shutdown).
- Second detector: "PRE-DISCHARGE" lamp, pre-discharge horn/strobe, HVAC shutdown, time-delay sequence (≤60 seconds), abort enabled.
- After time-delay: "RELEASE" lamp, shutdown of high-voltage equipment, visual indicator outside hazard, "System Release" audible.
- Manual actuation bypasses time delay and abort functions. Manual discharge station electrical actuation type, supervised.
- "PRE-ALARM" feature for early warning.

Parameter	Specification
Agent	FM-200 (HFC-227ea) — Clean Agent per NFPA 2001
Protected Areas	ARFF Cab (Drawing FF-06) and ATCT Cab (Drawing FF-07) — both circular plan areas
Application Method	Total flood system for specified enclosed spaces
Scope	Supply, installation, testing and commissioning — complete system
Pre-discharge Alarm	Minimum 30-second pre-discharge alarm with manual abort at each protected space
Compliance	NFPA 2001 — Standard on Clean Agent Fire Extinguishing Systems

Material and Equipment: Pipe: ASTM A106 Gr. B, Schedule 40, seamless black steel. Fittings: ASTM A-105/A-234 standard, Class 300. Nozzles: manufacturer's standard stainless steel or aluminum, 360° or 80° pattern, UL/FM/LPCB approved. Signs: instruction signs per NFPA, durable plastic with adhesive.

FM-200® Storage and Distribution: Each protected area separate supply. Welded steel painted containers, UL/FM approved. Discharge valve assembly with fast acting rupture disc, safety plug, fill port, pressure gauge, low pressure supervisory switch, discharge pressure switch, level indicator. Steel retaining brackets. Discharge nozzles distribute agent. Piping per NFPA, securely supported with UL listed hangers. Reducing fittings only (no reducing bushings). All pipe reamed, blown clear, swabbed with solvents before assembly.

Caution and Advisory Signs: Entrance sign at each entrance, Manual Discharge sign at each manual discharge station, Flashing Light sign at each exit from protected space.

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Room Data Sheet: Primary Data Center (Level-2 including room void & ceiling void), Secondary Data Center (Level-2 including room void & ceiling void).

2.2 FIRE DETECTION AND ALARM SYSTEM

Addressable Fire Alarm & Fire Suppression Control Panel: Supervise monitors detectors and modules. Detect activation location, operate notification appliances and auxiliary devices. Annunciate trouble/supervisory/alarm. Acknowledge, signal silence, system reset switches. Expandable, each loop supports min 127 analog/addressable devices.

Enclosures: UL-listed cabinet, 0.060 steel, key lock, transparent opening, right or left hinged, modular. Power Supply: 230V AC, 50 Hz. Battery charger for 24 hours standby (48 hour recharge). Low frequency sweep earth detect circuit. Remote alarm and fault monitoring at main fire alarm control panel.

Notification Appliances: 24 VDC, field programmable, ≥90 dBA at 10 ft. Strobe lights per UL 1971, fully synchronized, max pulse duration 1 second.

Addressable Devices – General: Rotary decimal address switches. Analog and addressable. Integral short circuit isolator (isolate fault in <1 sec). Status LED (flashes normal, steady on alarm). Detector sensitivity adjustment field programmable; automatic compensation for dust accumulation. Listed by UL for calibrated sensitivity test per NFPA 72 Chapter 7. Ceiling-mount with twist-lock base (tamper proof). Test via magnetic switch at detector or remote command.

Intelligent Photoelectric Smoke Detector: Photoelectric (light-scattering) principle.

Intelligent Thermal Fixed Plus Rate of Rise Detector: 135°F (58°C), rate-of-rise 15°F (9.4°C) per minute.

Addressable Monitor Module: Connects one supervised IDC zone of conventional 2-wire smoke detectors or N.O. dry contact devices. 4” square box. Class A or B (Style D or B). LED flashes normal.

Addressable Control Module: Supervises and controls one conventional NAC of 24VDC polarized audio/visual appliances. For fan shutdown, can operate as dry contract relay. 4” square box. NAC Style Z or Y (Class A/B), up to 1A inductive, 2A resistive. Relays Form-C, magnetically latched.

Addressable Relay Module: Form C, min 2.0A resistive or 1.0A inductive. Magnetically latched.

Agent Release Module (ARM): Allows Gas Cartridge Actuators for Clean Agent containers wired in parallel, Class A or B.

Abort Switch: Within protected area near egress, requires constant manual pressure. Manual control overrides abort. Audible and distinct visual indication of impairment.

Zone Disable Switch: Momentary push button, delays agent release circuit when operated prior to circuit actuation.

Manual Release Station: Dual actuation, pull spring clip safety pin (breaking seal), depress button, remains engaged until unlocked with key. Stainless steel housing, red plastic release button with black trim.

LCD Alphanumeric Display Annunciator: Supervised, back-lit LCD, min 160 characters. Displays all alarm/trouble. Up to 32 annunciators per EIA 485 interface. Switches for System Acknowledge, Silence, Reset (programmable for control).

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2.3 BATTERIES AND EXTERNAL CHARGER

Same as Section 0660.

2.4 WIRING AND CABLING

1.5 mm² fire resistant cables with LSZH outer sheath, 120 minutes in fire condition.

2.5 ROOM DATA SHEET

Same as suppression system: Primary and Secondary Data Centers.

PART 3 – EXECUTION

3.1 SYSTEM INSPECTION AND CHECKOUT

Entire system checked out, inspected, functionally tested by qualified trained personnel per manufacturer's procedures and NFPA. All cylinders and distribution piping checked for proper mounting and installation. Complete system functionally tested in presence of Employer/Engineer at least 5 days prior to final acceptance tests. Testing of fire alarm equipment per relevant standards (operational safety, regular functioning, protection against false alarms). Detectors subjected to basic and sensitivity tests.

3.2 TRAINING REQUIREMENTS

Operational training to each shift: Control Panel operation, manual and abort functions, trouble procedures, supervisory procedures, auxiliary functions, emergency procedures. Detailed explanation of wall charts, function of each control switch, periodic operational testing, maintenance of fire logbook, actions upon signals (false alarm, trouble, common alarm/trouble, low battery, field modifiable programming).

3.3 OPERATION AND MAINTENANCE MANUALS

Four copies. All aspects of system operation and maintenance detailed, including piping isometrics, written description, checklists, troubleshooting.

3.4 AS-BUILT DRAWINGS

Four copies, plus one reproducible engineering drawing. Show actual installation details, equipment locations, piping and wiring details, room/facilities modifications.

3.5 ACCEPTANCE TESTS

Submit Test Plan with step-by-step description, type and location of test apparatus. Room pressurization test in each protected space using Door Fan system with integrated computer program per NFPA 2001. If openings found, contractor coordinates with general contractor for sealing. Additional tests at no cost until successful.

3.6 WARRANTY

Min 1 year replacement warranty from TOC for cylinders, valves, switches, sensors, pressure gauges, indicators, detectors, monitor modules, controls, all components.

3.7 SYSTEM INSPECTIONS DURING WARRANTY

Two inspections (6 month and 12 month intervals) per manufacturer's guidelines and NFPA 2001. Certificates submitted.

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PART 4 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

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SECTION 0710 – SPECIAL PROVISIONS (HVAC)

SP-01 GENERAL

SP-01.1 Location of Project

The HVAC system shall be installed at Skardu Airport, Skardu, Pakistan.

SP-01.2 Building for the Project

The building is under construction and HVAC Contractor shall be responsible to point to engineer any omission during Civil Construction with respect to provision of space, Openings in walls floors and roof slabs, false ceilings, drain points and electrical requirements for HVAC Works.

SP-01.3 Use of Building

The Skurdu Airport building will have offices, Meeting Rooms, Cafeteria, Executive offices, Non-AC areas, Parking Garages (Fire-Trucks).

HVAC Central Plant Room(CPR) shall be located in another building near the ATCT building, within the utilities building as shown on drawing.

The Contractor is advised to study the architectural, structural electrical and plumbing drawings along-with the specification documents to familiarize himself with the Building Plans/Layout.

SP-01.4 HVAC System Concept

Type of System

The HVAC system for ATCT building is consisting of following HVAC Systems.

a. Water Cooled Water Chiller-Electric (Summer)

The building will be served by a central chilled water system utilizing water-cooled electric chillers during the summer season. This system will provide chilled water to Fan Coil Units (FCUs) and Air Handling Units (AHUs), ensuring consistent and efficient cooling throughout the facility.

b. Hot-Water Generators(HWG)

Given the project's exposure to extreme winter conditions, a hot water generation system will also be incorporated to support heating requirements. During winter operation, hot water will be circulated through the same FCUs and AHUs, maintaining comfortable indoor conditions despite low outdoor temperatures.

The integration of both chilled and hot water systems allows the building to operate efficiently across all seasons. This approach ensures thermal comfort, system flexibility, and reliable performance by using centralized distribution to airside equipment for both cooling and heating functions

c. Ventilation Fans

All Non- AC areas will be ventilated through Supply and exhaust air fans with air ducts.

d. Parking Ventilation

The project location have an extreme winter history, considering this historical weather data the parking is equipped with the FCU;s to maintain indoor temperature slightly higher for vehicle garage,

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to maintain the temperature and vehicle exhaust keeping out of the area, special exhaust system shall be provided to remove the vehicle smoke directly connected with the vehicle exhaust.

This project incorporates a dedicated vehicle exhaust extraction system, commonly used in garage and maintenance workshop applications, adapted here for the airport control tower and fire truck parking areas.

Considering the site's history of extreme winter conditions, the parking facility is equipped with Fan Coil Units (FCUs) to maintain indoor temperatures slightly above ambient levels, ensuring reliable vehicle readiness and operational efficiency.

To maintain acceptable indoor air quality alongside temperature control, a specialized exhaust extraction system will be provided. This system will be directly connected to vehicle exhaust outlets, allowing for the effective removal of fumes at the source and preventing the buildup of harmful emissions within the enclosed space.

This integrated approach ensures both thermal comfort and a safe, well-ventilated environment within the facility.

System Operation

The system will operate from dawn to dusk.

SP-01.5 Service Conditions for Auxiliaries

a) Power Supply

Electrical Circuit Voltages:

Nominal, 3-phase: 415 volts.

1-phase: 240 volts.

For equipment ratings, 3-phase: 400 volts.

1-phase: 230 volts.

Fluctuation in voltage applied (+/-) 10%

to equipment of equipment rated voltage.

Frequency: 50 HZ.

b) Water Supply will be available as directed by the project engineer.

c) Water Disposal: Floor drains provided by others will be connected to sewerage system of the Building.

SP-01.6 Units

The units used in these specifications are as under:

Unit System: British

Gauge: U.S.Gauges as per ASTM

TR: Ton of refrigeration equivalent to 12000 BTUH.

SP-02 WORK BY CONTRACTOR

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SP-02.1 Scope of Work

a) The work under this Contract comprises of all HVAC works including supply, installation, commissioning, balancing, testing and operation /maintenance during Defects Liability Period.

b) The Contractor shall furnish all labour, materials, equipment, tools, appurtenances, services, temporary work and storage necessary to completely supply, install, commission, test, operate and maintain the heating, ventilating and air-conditioning (HVAC) system and associated works, all in perfect operating condition in accordance with these Specifications and Drawings. The Contractor shall also adjust, balance, and readjust all the air and water systems as specified and shown. The Contractor shall operate and maintain all the system for a period specified elsewhere in these Specifications under Defects Liability Period.

c) Coordination with other contractors/agencies.

d) The contractor shall not withhold or delay any of the HVAC works which is independent of the other building trades without prior approval of the Engineer and ensure to swiftly complete the activities during the execution.

e) Specifications are only general guidelines and by no means cover detail of each equipment. These only spell out the intent of the requirement. The details have to be provided by the Contractor along with details of performance, construction and technical literature with the Tender. The specifications are to be read in conjunction with Drawings.

f) All equipment and materials shall be brand new bearing stamped ratings as required by Equipment Schedules and must be approved by the Engineer prior to their use. Any doubts about the practicability and implementation of Specifications and details shown in Drawings must be expressed along with submission of Tender. Inability of the Contractor to implement these specifications after the acceptance of the Contract shall be considered breach of Contract.

g) <u>Following information shall be provided with tender document for Technical evaluation.</u>

a. Computer Selection Sheet with Details Listed Below

    1. Model Number and Series
    2. Power Consumption (Actual)
    3. Energy Efficiency Ratio (EER)
    4. Seasonal Energy Efficiency Ratio (SEER)
    5. Ambient Temp

b. Make of Equipment

c. Country of Manufacture

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d. Model Series

e. Dimensions of Foot Print & Height

f. Nominal Power Consumption, kW

g. Energy Efficiency Ratio (EER)

h. Compliance Sheet shall be furnished, with reference to Specifications and Equipment Schedule, Clause by Clause Compliance Statement with list of deviations if any

i. Confirmation that detailed technical submittal as specified hereunder will be furnished after Acceptance of Offer for approval by the Consultant.

II. Technical information Required After Award

a. Technical Submittal for approval

b. Foundation requirements & sketch

c. CFD analysis for Parking Ventilation and Smoke Clearance system.

SP-02.2 Services by the Contractor

a) Erection Supervisor

The Contractor shall provide competent HVAC Erection Supervisor to direct and be responsible for the erection, starting and operation of the Equipment supplied by the Contractor until issue of Substantial Completion Certificate. Further details concerning Erection Supervisors are covered in Clause SP-17, Erection Supervisors and operating staff".

b) Operation During Defect Liability Period:

If so desired by the Employer, the Contractor shall operate service and maintain complete HVAC system for a period mentioned in and as per requirements of Clause SP-22, Defect Liability Period. The Contractor shall provide all personnel for operation and maintenance including one HVAC Supervisor. Qualifications and experience and number of all these personnel shall be subject to Engineer's approval.

SP-02.3 Erection Plant

Under this clause Contractor will provide erection plant and tools for his own use during erection period only, he would take back these tools on completion.

Tools for maintenance after completion are to be provided under clause TP-10-04, if so desired by the Employer.

The Contractor shall furnish special erection plant and tools in accordance with the requirements of Clause SP-15, "Installation Erection and Maintenance Plant and Tools".

SP-02.4 Related Works

The Contractor shall provide all works related to HVAC system, whether specifically mentioned or not, except those specifically stated in exclusion Clause SP-03, "Work Not Included". These related works shall include, but not limited to :

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a) Power supply and earthling shall be provided by the Employer and incoming power feeders and earth continuity conductors shall be terminated at location as shown on Drawings and/or as stated in Technical Provisions, Section 7, Electrical Equipment and Controls. All electrical works from these points onward shall be the responsibility of the Contractor including electrical works for Employer-Furnished Equipment.

b) Water supply shall be provided by others from overhead tank or city water main, in each AHU room and at roof.

c) All works related to water and cooling coil condensate disposal from HVAC system up to nearest floor drains shall be the responsibility of the Contractor.

d) Cutting, patching and repairing in accordance with Section 1.0 of Technical Provision (except cutting in concrete walls, floor or roof slabs).

e) Providing written information regarding location and sizes of door louvers, where required, to the persons responsible for door louvers, through the Engineer. This information shall be provided within 7 days of issue of Engineer's Order to Commence Work.

f) All wood-work required for satisfactory completion of the project as specified except decorative wood work provided to conceal HVAC equipment. the wood shall be anti-termite treated and should be of suitable type and strength to serve the required purpose with degradation and deterioration under climatic effect.

g) Providing shop drawings at scale 1/4"=1 Ft (1:50). Design Drawings are indicative only and for bidding purpose. These are not meant for construction / fabrication / installation.

h) Providing steel frames for inertia pads.

i) All foundations for HVAC equipment including concrete foundations, housekeeping pads and inertia pads (where required) shall be provided by the HVAC Contractor. Engineer's approval shall be obtained on foundation drawings before construction of foundations. Catalogue cuts showing foundation details will not be accepted.

j) Coordination with other contractors/agencies.

k) Contractor shall be responsible for completing and isolating the identified HVAC zones by providing and installing the required hidden minor partition walls etc. Any major and substantial such omission/s shall be timely identified and brought into the knowledge of the Engineer for handling the matter.

SP-03 WORK NOT INCLUDED

Work listed here under which may be required for satisfactory completion of the Project are not included in this Contract and will be provided by the Employer or other contractors appointed by the Employer:

a) Decorative concealment of HVAC equipment and wood paneling.

b) Door Louvers

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c) Protective fencing around HVAC equipment, if required.

d) Provision of Chases in Concrete Walls/Floors.

SP-04 DEFINITIONS

Not Used

SP-05 DRAWINGS, EQUIPMENT SUBMITTALS, INFORMATION MANUALS, SAMPLES AND CONTRACTOR'S OTHER SUBMISSIONS

SP-05.1 General

All drawings, other information and samples must be supplied to the Engineer as laid down in these Specifications and as and when agreed during site meetings, in the Progress Chart or as instructed by the Engineer.

The Contractor shall submit, for approval, detailed submittals as specified and no material or equipment may be delivered to the job site or installed until the Contractor has in his possession the approved Data Sheet, Catalogue cuts or samples of particular material. Approval rendered on submittals shall not be considered as a guarantee of measurements or building conditions.

Where submittals are approved, said approval does not in any way relieve the Contractor from his responsibility for necessity of furnishing material or performing work as required by the Drawings and Specifications.

Failure of the Contractor in providing submittals in ample time for checking shall not entitle him to an extension of Contract time and no claim for extension by reason of such default will be allowed.

SP-05.2 Omitted Particulars

All works and matters omitted from the Contract but which may reasonably be implied or inferred from them and in the opinion of the Engineer obviously are necessary for the efficiency, stability, completion and maintenance of the works and which are ordered by the Engineer to be carried out shall be executed by the Contractor accordingly as if they had been expressly described in or shown on the Contract documents and the costs thereof shall be deemed to be included in and covered by the Contract Price.

SP-05.3 Drawings

The Drawings show the Scope of Work to be performed by the Contractor. These Drawings shall not be used as a basis for fabrication, construction or installation but shall be used for estimation for bidding purpose only. These drawings are not to be considered defining the design of HVAC equipment to be furnished or defining the exact details of the installation under this Contract, but are only illustrative of the Specifications and HVAC System and show the general layout of the equipment forming part of HVAC System and schematic diagrams explaining the system flow, controls and sequence of operation. These drawings are not to be scaled.

These Drawings do not show every offset, bend or elbow which may be required in the piping or ductwork for installation in the space provided. The routes and sizes (if shown) of ductwork, piping, air inlets and outlets shown on these Drawings are subject to change depending upon the make of major HVAC equipment to be provided by the Contractor. These design parameters shall be adjusted at the shop drawing stage.

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Work shown on the HVAC Drawings and not mentioned in the Specifications, or described in the Specifications without being shown on HVAC Drawings shall nevertheless be held to be included in the Contract in the same manner as if they had been specifically shown upon the Drawings and described in the Specifications.

SP-05.4 Drawings Supplied by Engineer

The Engineer may supply to the Contractor after signing the contract working drawings/detail drawings and instructions as may be necessary for preparing shop drawings and for the guidance of the Contractor in the construction, completion and maintenance of the works, and the Contractor shall execute, obey and be bound by the same.

The Contractor shall not be entitled to any payment in addition to the Contract Price in respect of any work shown or directed to be done by such working/detail drawings or instructions unless the Engineer shall have given and approved a variation order for the same.

Any additional drawings found necessary or desirable by the Contractor to show different combinations of drawings supplied by the Engineer shall be prepared by the Contractor at his own expense. The Contractor shall carefully check all drawings and advise the Engineer of any errors or omissions discovered. The Contractor shall be furnished with one copy of all detail drawings and graphic instructions prepared by the Engineer. Additional copies, within reasonable quantity, will be furnished to the Contractor, upon request, at cost.

The Contractor shall be furnished with one copy of all textual instructions as may be issued by the Engineer.

SP-05.5 Shop Drawings

The Contractor shall make detailed analysis of the requirements of work. Based upon such analysis and working drawings supplied by the Engineer, he shall revise and amplify the Drawings and shall prepare detailed Shop Drawings at his own cost for complete HVAC System and Equipment. Initially he shall submit 2 preliminary copies each of all such Shop Drawings to the Engineer for obtaining approval. Once basic agreement is reached with the Engineer regarding the details then the Contractor shall submit 6 copies each of all such Shop Drawings and one reproducible to the Engineer for record/distribution by the Engineer. After obtaining approval and after having in possession these approved Shop Drawings, the Contractor shall use these Shop Drawings for fabrication, construction and installation.

The work described on any shop drawing submitted shall carefully be checked by the Contractor for all clearances, field conditions, maintenance of architectural conditions and proper coordination with all trades on the job. To this end, the Contractor during the shop drawing stage, shall ensure that he receives drawings of all other trades that might interfere with the proper installation of his work. No payment shall be made for any variations or alterations on site due to lack of knowledge of other trades. Any unresolved conflict between trades shall be referred to the Engineer for decision.

Equipment layout is to be detailed on shop drawings, showing the exact method of installing and clearly illustrating components to be used in making all connections.

The Contractor shall submit shop drawings of all sheet metal work for approval, before work is fabricated and installed. All dampers, splitter dampers, fresh air inlets, exhaust outlets, connections to equipment and methods of support and any other details necessary for the satisfactory installation of the system must be indicated. Each type of grille, register, diffuser and louver is to be referenced in a

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schedule and the type and size clearly indicated at each location. Taper and flat sides of ductwork at all transitions must be indicated, and all equipment piping and ductwork must be located exactly by showing exact dimensions with column lines or other reference lines.

Ductwork drawings must show Clearances between ductwork and masonry. Duct bottom and piping centre-line height from finished floor level shall be marked with every change in level.

Position of hangers and supports with type and method of installation of each hanger shall be given, detailing the type of hanger fixing with a reference number for each type.

Piping drawings must be fully detailed, showing all piping in double line and indicating the precise size of fittings, valves and equipment. Positions of hangers and supports with reference numbers must be given showing the type and method of installation of each hanger detailing the type of hanger fixings with a reference number for each type.

All general layout drawings shall be drawn to 1:50 scale. Details of hangers, methods of fixing of pipes and ducts, detailed cross section of pipe, ducts and risers, details of control and piping hook-ups to equipment shall be drawn to 1:10 scale.

The Contractor shall prepare Drawings and Schedules showing precise details of holes in concrete, masonry, etc. and necessary sleeves required for passage of ducts and pipes and fitting of grills, register diffusers. Louvers, plant, plant supports etc. Drawings and Schedules, approved by the Engineer must be available before any structural work requiring holes or other modifications, is constructed.

Signed and approved drawings shall not be departed from unless a signed variation order or site instruction is issued in writing by the Engineer. Drawings returned to the Contractor for alteration or amendments are to be resubmitted for approval. Amended or altered drawings shall show the nature of the amendment or alteration in a revision block on the drawing, together with revision number or letter and the date of the revision.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him whether such drawings and particulars have been approved by the Engineer or not, provided that such discrepancies, errors, or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor by the Engineer.

SP-05.6 As-Built Drawings /Documents

Before issuance of Substantial Completion Certificate the Contractor shall supply to the Engineer a set of "As-Built" drawings showing the Contract works as installed, together with any other information necessary for operation and maintenance. Six copies of each drawing and other information to be supplied, along with a soft copy (ACADD Format). The Contractor shall also submit 3 sets of bound copies the following for all equipment installed by him:

- 3 sets of bound copies of Manufacturers Equipment DATA/catalogues with final Site settings / adjustment data, Addresses of Source of spare parts and operating parameters and other relevant information
- System Start up Sequence (Summer & Winter)
- Electrical Data / power consumption of each equipment
- Power ratings of each device installed in ACPs / MCCs

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- Preventive Maintenance Schedule

SP-05.7 Manufacturer's Data

Manufacturer's performance data, certified factory drawings and/or curves of apparatus giving full information as to capacity, performance at different operating and ambient conditions, dimensions, materials electrical data and all information pertinent to the adequacy of the submitted equipment shall be submitted for approval. One original and 5 copies of catalogues and other information shall be submitted.

Manufacturers' names, sizes, catalogue numbers and/ or samples of all materials shall also be submitted for approval.

Orders for equipment submitted for approval must be accompanied by relevant drawings, curves, technical data, catalogues and samples. Where data, certified drawings or other required information is not available until after orders have been placed, the Engineer shall give provisional approval until all requested drawings and information have been supplied to the Engineer and approved by him. It is the Contractor's responsibility to ensure that all necessary information is supplied to the Engineer in accordance with the progress of works.

Should the Engineer give provisional approval only for an order due to lack of complete information and should the missing information not eventually meet with the approval, the Engineer shall not be held responsible for any delay incurred. For equipment where information from the manufacturers is likely to be delayed, it is essential that the contractor places provisionally approved orders at the earliest possible date so as to ensure approval of orders in complete conformity with the progress of the works.

Submittals and shop drawings should, as far as possible, be complementary so that drawings and submittals can be cross-checked.

SP-05.8 Samples

Contractor shall provide at his cost, samples of materials, instruments, gauges and electrical items, for approval by the Engineer before order is placed for the same. Engineer may waive this requirement, if detailed published catalogues submitted by the contractor, provides sufficient information for approval. These samples shall include, if specified, but not limited to:

i) G.I. Sheet, each gauge to be used.

ii) Pipes and Fittings.

iii) Valves, strainers, pressure gauges, thermometers

iv) Duct insulation, liner and covering.

v) Pipe insulation, and covering.

vi) Insulation adhesive and tapes.

vii) Diffusers, grilles and registers

viii) OA/EA Louvers.

ix) All types of dampers.

x) Power and Control Cables.

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xi) Electrical items; push buttons, HOA and toggle switches, pilot lamp.

xii) Vibration isolating springs, pipe hangers and rollers.

xiii) Flexible duct connections.

xiv) Pipe flexible connection/expansion joints (when specified local)

xv) Air filters (when specified local)

xvi) Electrical conduits and fittings.

xvii) Paints

xviii) Anchor bolts, studs, etc. for hanging arrangements.

xix) Any other item required by the Engineer

SP-05.9 Copies of Drawings and Specifications

One set of Tender Documents and Drawings will be issued by the Employer to the Contractor free of cost after award of Contract. Additional sets will be provided at cost upon written request to the Engineer by the Contractor. Soft copies in PDF format will also be issued, however copies in A-CAD format will not be issued

SP-05.10 Sound Absorption Data

The Contractor shall provide data for sound from HVAC machinery, air terminals, etc.

SP-05.11 Photographs and Progress Reports.

The Contractor shall arrange, at his cost, colour photographs of Works in progress at Site. At least six photographs per month shall be taken from approved locations, commencing with the first month up to the completion of The Works. A professional camera shall be used. The Contractor shall submit, not later than seventh of each month, a soft copy and six prints of 250x200 mm of each photograph taken during the previous month, with brief report indicating progress of Works to date.

SP-06 APPROVAL OF MATERIALS AND EQUIPMENT

As soon as practicable after award of Contract, the Contractor shall submit for the approval of the Engineer specifications, drawings, catalogue - cuts, diagrams and other descriptive data for all materials, components and equipment which the Contractor proposes for use under this Contract. For certain materials and equipment, data may be required to be submitted in accordance with a detailed form furnished by the Engineer. Items submitted shall be properly labeled to indicate the Contract number, project, manufacturer, source of supply, Contract Item number, and other data required by the Specifications. All items shall be submitted in sufficient time to permit proper consideration and action thereon without delaying the construction schedule.

SP-07 TIME FOR DELIVERY

All equipment plant and machinery shall be delivered at Site on such dates so as to ensure adherence to scheduled dates stated in program of works submitted by the contractor and approved by the Engineer subsequent to award of contract. The Contractor shall keep the Engineer informed of the progress of the shipment and notify them approximately 2 weeks in advance, in writing, as to when the equipment will be ready for inspection at Site by the Engineer and shall supply lists covering each

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consignment in sufficient detail to enable Engineer to check the contents of the packages, if he so desires.

SP-08 STANDARDS AND CODE REQUIREMENTS

SP-08.1 All equipment and materials under HVAC Scope of Works shall be furnished in conformity with latest edition of Applicable Standards of ASME, ASHRAE, ARI, SMACNA, TIMA AMCA CTI and applicable Government and Local Codes governing the same. In case of conflict, the stricter requirements shown/specified shall govern.

SP-08.2 Abbreviations for Codes and Standards referred in the Contract are as under:

ASME - American Society of Mechanical Engineers

1. ASTM - American Society for Testing & Materials
2. ASHRAE - American Society of Heating, Refrigerating and Air-conditioning Engineers
3. NFPA - National Fire Protection Association, USA
4. AHRI - Air-conditioning, Heating and Refrigeration Institute, USA
5. CTI – Cooling Tower Institute
6. SMACNA - Sheet Metal and Air-conditioning Contractors National Association, USA
7. GOVERNMENT- Government of Pakistan
8. LOCAL - Local authorities of the city where Project is located
9. I.E.E. - Institute of Electrical Engineers, London
10. NEMA - National Electrical Manufacturers Association, USA
11. AMCA - Air Moving and Control Association Inc., USA
12. P.S. - Pakistan Standards.
13. B.S. - British Standards.
14. TIMA - Thermal Insulation Manufacturer's Association, USA

SP-09 STANDARDS OTHER THAN THOSE SPECIFIED

Where the specifications provide requirements for material or equipment by specifying a standard such as for example, one of the American Society of Heating, Refrigerating and Air conditioning Engineers which has its origin in one country, it is not the intention to restrict the requirements solely to that standard and that country. Other standards, including standards of other countries, will be accepted provided the requirements thereof, in the sole opinion of the Engineer are at least equal to the requirements of the standards specified. The Contractor may propose to the Engineer an equivalent standard other than that specified, in which case he shall submit the proposed standards and all other information to demonstrate and prove his proposed standard is equivalent in all significant respects to the standard specified. All submissions must be made in the English language.

SP-10 PERMITS

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The Contractor shall secure and pay for any necessary approvals, permits and inspections from Government or other controlling agencies where applicable as required by law, before commencing any work so as to avoid all delays during erection and turn over the official records of granting of permits to the Engineer. No reimbursements shall be made for such payments.

SP-11 SHOP INSPECTION AND MATERIAL ORDERS

SP-11.1 Inspection

All major equipment to be supplied under this Contract which has been manufactured or shop-assembled in or outside Pakistan shall be subject to inspection (if the Employer so desires) by Employer or its authorized representative at its point of original manufacture or final shop assembly before its dispatch to SITE. The Contractor shall make necessary arrangements and provide all the facilities required for such inspection. Responsibility for the cost of travel, boarding and lodging of Employer, his authorized representative or the Engineer shall be as stated in the Contract.

SP-11.2 Material Orders

Triplicate copies of material or equipment orders required in this Contract shall be furnished to the Engineer. All orders shall state the specification designation under which the material is to be furnished and shall bear reference to the drawing number, if any, pertinent thereto. Orders shall also state that material is subject to inspection and testing and shall show the required date of delivery of the material to destination.

SP-11.3 Acceptance of Materials

The acceptance of any material or equipment prior to shipment shall in no way relieve the Contractor of any of his responsibilities for meeting all of the requirements of the specifications and shall not prevent subsequent rejection if such material or equipment is later found to be defective.

SP-11.4 WITNESSING FACTORY TESTS

The Employer will nominate two inspectors to witness the factory tests of following imported equipment in the country of their manufacture:

- Water Cooled Chiller
- Hot-Water Generator
- Cooling Tower (Closed Circuit)

Please refer to Section 0010 for further details.

SP-12 NAMEPLATES

The Contractor shall ensure affixation of the OEM nameplate to each major piece of equipment, a SS metal name and rating plate to be approved by the Engineer, giving the name and address of the manufacturer, the date and rating data. All ratings shall be in the British system. Large lettering on any of the parts will not be permitted.

SP-13 DIRECTED AND REQUIRED ETC.

Unless otherwise stated, wherever in the Specifications or upon the Drawings the words, "directed", "required", "permitted", "ordered", "designated", "prescribed" or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer is intended, and similarly the words "approved", "accepted", "satisfactory", or words of like

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import shall mean approved by, or acceptable or satisfactory to the Engineer unless otherwise indicated.

SP-14 SEQUENCE OF ERECTION

The sequence of erection of the Equipment shall conform to the requirements of the civil construction and of the Erection Instructions. Such information will be furnished to the Contractor by the Engineer upon request.

SP-15 FABRICATION, ERECTION, TESTING AND MAINTENANCE TOOLS PLANT & INSTRUMENTS

SP-15.1 The Contractor shall furnish special plant and tools for the complete and proper fabrication erection and maintenance tools, plant and instruments of the HVAC Equipment. Tools shall include the type of tools not normally available in the market as standard tools and is generally manufactured especially for use with the HVAC Equipment. All lifting devices shall be accurately machined to fit the parts to be handled. The wrenches and tools for maintenance, insofar as practicable, shall be mounted on a suitable hardwood or steel board arranged for wall mounting and provided with means for ready identification. The Contractor shall also provide refrigerant charging Plant/ vacuum pump if and when required. No separate payment shall be made for providing Plant and Tools and the Contractor may withdraw the Plant and Tools after its use.

SP-15.2 The Contractor shall furnish and install sign board showing information about the project, name of Employer, Consultant, Engineer and the Contractor, as directed by the Engineer.

SP-16 MATERIALS AND EQUIPMENT TO BE IMPORTED

Not Used

SP-17 ERECTION SUPERVISORS AND OPERATING STAFF

SP-17.1 General

The Contractor shall provide the services of Erection Supervisors and Operating Staff in accordance with the requirements of the Conditions of Contract, of sub- clause SP-02.2 Services by the Contractor, and as specified herein.

SP-17.2 Work by Erection Supervisor

a) The Erection Supervisor shall direct the activities of Contractor's employees as they concern the installation, commissioning balancing and testing of the Equipment furnished under this Contract and Employer-Furnished Equipment. The Contractor through his Erection Supervisor shall cooperate with other Contractors to whatever extent is necessary to produce an installation satisfactory to the Engineer in accordance with the requirements of the time schedule, the Drawings and the Specifications.

b) Erection Supervisor shall be present from the Commencement of Work and remain on Site until the issuance of substantial completion certificate by the Engineer.

c) Should a disagreement arise between other Contractors and the Erection Supervisor, the matter shall be submitted without delay to the Engineer for his decision. Upon such decision, the Erection Supervisor shall proceed with the work in accordance therewith, immediately.

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d) Erection Supervisor shall be a graduate HVAC or mechanical engineer, registered with Pakistan Engineering Council, having at least 7-8 years' experience in HVAC installation works of similar nature.

e) If the Contractor fails to fulfil his obligations under clause SP-02.2(a) and also fails to provide the Services of the Erection Supervisor having the minimum qualifications as stated in sub-clause (d) of this Clause then the Contractor would be obligated to pay to the Employer an amount of Rs 50000/- per day for the number of days when the services of such Erection Supervisor are not provided. The Employer would be entitled to deduct the amount due from the Contractor in this regard from his running Bill/any payable sums.

f) Provision of (e) above shall not apply when the Erection Supervisor is on authorized legal leave (casual) , sick leave and official holidays only. His absence upto a period of 10 (ten) days will also be allowed when the contractor intends to replace the Erection Supervisor with the consent of the Engineer.

SP-17.3 Operating Staff

The Contractor shall provide staff to operate the HVAC system continuously for 24 hours a day during the Defect Liability Period including weekly and other gazetted holidays. Operating supervisor shall be a graduate HVAC or mechanical engineer, registered with Pakistan Engineering Council having at least 5 years experience in HVAC operation of similar plant or a 3-year diploma holder from Government College of Technology in HVAC Technology having at least 10 years experience of similar plants with DDC controls. A separate operator of DDC Controls shall also be provided The Contractor shall also arrange to provide proper and complete training comprising of theory class and hand-on practical sessions to Employer's staff to operate, maintain, diagnose and find faults, troubleshoot and repair the HVAC system to the entire satisfaction of the Employer. The training manuals/ course details and the qualified trainers details should be provided to Employer for prior approvals. All costs incidental to providing operating staff including staff salaries shall be deemed to be included in relevant item of Bills of Quantities. No separate payment shall be made to the Contractor for fulfilment of his obligations under this clause.

SP-18 RIGHT TO OPERATE PLANT

The Employer reserves the right to operate any and all Equipment after it has been Commissioned and prior to substantial completion of whole Works. All repairs or alterations found to be necessary during such operation, and required of the Contractor, shall be made by the Contractor at such time as directed by the Engineer. The repairs or alterations shall be made in such a manner and at such a time as will cause the minimum interruption in the use of the Equipment by the Employer.

All operator, maintenance and administrative level passwords shall be shared with Employer.

SP-19 ERECTION INSTRUCTIONS

Erection Instructions in form of published installation manual, as furnished by the manufacturer of all HVAC equipment (when specified) listed hereunder shall be provided by the Contractor.

1) Water-Cooled Water Chillers

2) Cooling Towers (Close-Circuit)

3) Hot Water Generators (HWG)

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4) Pumps

5) Pressure Boosting System

6) Air Handling Units (AHUs)

7) Fan Coil Units (FCUs)

8) Parking Jet fans

9) Fans.

10) Automatic Controls

These instructions shall include full and detailed instructions for the guidance of the Erection Supervisor as to all procedures and precautions to be observed in erecting, assembling and adjusting the Equipment and as to the use of the Erection Plant. It shall include or be accompanied by drawings, clearly showing erection marking and particularly any matchmaking and shall embody in particular a full statement as to erection tolerances to be observed.

These shall also include full instructions for the complete operations and maintenance of the Equipment not only during the period of Contractor's liability but more particularly during its operating life. The directions shall be set out simply, clearly and systematically. In particular this section shall include a full list of all routine checks and their timing, directions as to fault finding, detail of all routine attentions (such as greasing), in the form of check sheets for daily, weekly, monthly, quarterly, half-yearly, yearly and any other periodic checks recommended by the manufacturer. This section should also provide detailed and complete instructions for trouble shooting, maintenance and all necessary adjustments to the Equipment Technical leaflets and brochures in respect of all equipment supplied under the Contract including all relays, instruments, switches, controllers, regulators, software, hardware etc., should be supplied with the erection instruction. This should also include complete catalogue of spare parts with exploded views of the equipment and relevant part numbers to facilitate identification and ordering of spares throughout the operating life of the Equipment. The set of operational parameters lists comprising of normal ranges, alert and alarm/ tripping thresholds shall be provided to Employer.

The Contractor shall submit 3 copies to the Engineer for approval.

SP-20 WATER, POWER AND GAS DURING ERECTION AND TESTING

Water, and power supply FOR ERECTION AND Preliminary TESTS shall be the responsibility of the Contractor unless otherwise stated in conditions of Contract. Water, power and gas supply for Balancing & Commissioning, Performance Tests and Reliability Trial Tests and operation during Defects Liability Period will be provided by the Employer. Contractor shall be responsible for the efficient and scarce utilization of these resources.

SP-21 SPARE PARTS

The Contractor shall furnish the essential spare parts as directed by the Engineer and agreed by the Contractor before award of the Contract. The Contractor shall also furnish recommended spare parts selected by the Employer at the applicable unit rates, from the lists provided by the Tenderer. Payment for recommended spare parts will be made from the amount set out in Bill of Quantities against items "Provisional Sum for Recommended Spare Parts". The spare parts listed shall serve all Equipment furnished.

These spare parts shall not be used during Defects Liability Period, or earlier.

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The Contractor shall supply, at his own cost any spare parts required during the Defects Liability Period.

The contractor shall also submit the list of OEM's recommended and critical spares of the plant equipment, mentioning Ex-factory prices to Employer whenever demanded.

SP-22 DEFECT LIABILITY PERIOD

The Contractor shall operate, service and maintain complete HVAC System in accordance with OEM instructions and best engineering practice for a period of 365 days after date of issuance of Certificate of Completion as per directions of the Employer. The plant shall be operated in accordance with provisions of Clause SP-02.2(b), SP-17.3 and as specified herein, and shall include supply of operating staff, consumables, all necessary adjustments, greasing, oiling and cleaning and the furnishing of necessary tools, instruments supplies and parts to keep the system in perfect operation, except such parts made necessary by misuse or neglect not caused by the Contractor. All costs incidental to the above specified Servicing and Maintenance shall be deemed to be included in other items of the Bill of Quantities and no separate payment shall be made to the Contractor for fulfilment of his obligations under this clause with respect to Servicing and Maintenance. The Contractor may withdraw maintenance tools and instruments at the completion of Defects Liability Period.

The cost of operating the plant during Defect Liability Period shall be paid by the Employer to the Contractor under BOQ item named "HVAC System Operation During Defects Liability Period As specified"

SP-23 LICENSE FROM GOVERNMENT

The Contractor shall arrange and be responsible for all tests, test reports and approvals regarding electrical works under this contract, any other works under this Contract requiring tests/Government approvals. All the requirements to be completed for this purpose, whether specified or not shall be at the cost of the Contractor. The Contractor shall handover all test results and approval certificates to the Engineer within one week of obtaining such approval.

SP-24 PERFORMANCE GUARANTEE:

The Contractor shall be required to furnish a Performance Guarantee in accordance with Conditions of Contract.

SP-25 SITE FACILITIES

Except for the Site facilities specifically stated in Conditions of Contract and/or Special Provisions, no other site facility shall be provided by the Employer to the Contractor.

SP-26 SUFFICIENCY OF RATES AND CURRENCY FOR PAYMENT

All the rates and amounts filled in BOQ of the Tender and Appendices by the Contractor shall be deemed to include but not limited to, the cost of items, Import duties taxes and surcharges, Freight, Insurance, local duties taxes and surcharges, clearance charges, inland transportation and insurance, Octroi etc. All payments whatsoever to the Contractor shall be made in Pakistani Rupees, except that letter of Credit for following equipment will be established by the Employer and the equipment will be delivered to the Contractor at site for incorporation in permanent works

- Chiller
- Cooling Towers

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- Hot Water Generators
- Air Handling Units
- Controls
- Pumps
- Fan Coil Units
- Parking Ventilation System
- Staircase Pressurization System

SP-27 IMPORT LICENSE

The Contractor will arrange the import licenses if required for all the imported Equipment, Plant, Tools and Machinery to be incorporated in permanent works except for the items listed in SP-26. All the costs and charges for arranging import licenses for items to be imported by the Contractor will be paid by the Contractor.

SP-28 GUARANTEES AND WARRANTIES

SP-28.1 Performance Guarantee

The contractor shall guarantee the performance of the complete HVAC system, viz.-a viz. his workmanship for the work executed at site, and quality of material, as specified. He shall replace the material/workmanship, whenever found not meeting the specified requirements, at his own cost.

SP-28.2 Manufacturer's Warranties

a) The contractor shall obtain manufacturer's standard warranties for all equipment extended for a period up to completion of Defects Liability Period at his own cost. In case the completion of Defects Liability Period is delayed, the contractor should obtain further extension of warranties. The contractor shall be responsible for cost of such extension, if the delay is due to his fault, otherwise the cost of such extension shall be reimbursed to him on production of acceptable documentary evidence of such costs.

SP-29 INSPECTIONS AND TESTS

SP-29.1 Inspection by Engineer at Site

The Engineer shall inspect the works in progress at site as and when considered necessary by the Engineer and the Contractor shall provide full access and assistance to the Engineer for carrying out inspection to verify the conformity of works to general lay-out of HVAC System as designed and as shown on Drawings and as specified. Such inspection if made shall not relieve the Contractor from any obligations under the Contract.

SP-29.2 Tests

A) General

i) All Tests as specified shall be carried out unless otherwise specified. The Engineer shall witness the tests.

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ii) All the equipment related testing shall be carried out in the neat and clean environment. Contractor shall be solely responsible for ensuring the required site readiness and environmental conditions to prevent any damage or contamination of the system being tested.

iii) Any type of filters soiled or contaminated during testing shall be replaced or made good without any addition cost.

ii) The Contractor shall give the Engineer at least seven days' notice in writing of the date on which any equipment will be ready for inspection and/or testing as provided in the Specifications and unless the Engineer shall attend within seven days of the date which the Contractor has stated in his notice the Contractor may proceed with the tests in the Engineers absence and shall forthwith forward to the Engineer five duly certified copies of test readings, on the forms prescribed by the Engineer. The Engineer shall give twenty-four hours' notice in writing of his intention to attend any test.

iii) The Contractor shall provide all labour, materials, electricity, fuel, stores, apparatus machines and instruments as may be necessary to carry out tests, unless otherwise specified.

iv) The cost of all tests carried out by the contractor under this Clause shall be borne by the Contractor if such tests are clearly intended by or provided for in the Specifications or Bill of Quantities.

v) As and when any equipment or HVAC System or part thereof shall have passed any inspection/test the Engineer shall furnish to the Contractor a certificate in writing to that effect.

vi) The Engineer may reject any part or parts of Equipment, and HVAC System which he shall after inspection/ testing decide is not in accordance with the Specifications and Drawings and he shall give to the Contractor within fourteen days of such inspection/ testing notice in writing of such rejection stating therein the grounds upon which his decision is based.

vii) The test results shall be filled out by the Contractor in the forms proposed by the Contractor and approved by the Engineer. Six copies of filled out forms shall be submitted to the Engineer for review and approval.

viii) In case any re-testing is required, same should be conducted as per testing requirements without any additional cost.

B) Once the inspection/test certificate has been obtained by the contractor, as stated in A(v) above, the contractor shall test and balance the system in accordance with NEBB (National Environmental Balancing Bureau), USA, code of practices. The Contractor shall be responsible for all remedial measures if any, required. The Contractor shall also be responsible for the following:

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i) Supply and fixing of any test hole covers, paint, gauges, gadgets, testing and balancing instruments, or any such thing which is necessary to carry out this work.

ii) To provide all supervision, labour and materials required to carry out these balancing works.

C) Preliminary Inspection & Tests

Preliminary Inspection/Tests as specified in Technical Specifications shall be carried out on all or any major HVAC equipment (including Employer-Furnished Equipment) and such other equipment as the Engineer may require, on completion of installation of that equipment or at such time which the Engineer may require.

D) Balancing & Commissioning

Balancing and Commissioning shall be carried out on all or any major equipment (including Employer-Furnished equipment), as Specified in Technical Specifications, when such is ready for operation.

E) Performance Tests.

These tests as specified in Technical Provisions shall be carried out on each equipment of HVAC system after successful completion of Commissioning of that equipment, during appropriate season, on the dates proposed by the Contractor and approved by the Engineer. The Engineer keeping in view the weather conditions may fix the test date on any equipment of HVAC system within 6 months of Completion of Commissioning of that equipment.

F) Reliability Trial Tests

i) During the Defects Liability Period the Contractor shall inform the Engineer in writing of his readiness to commence the Reliability Trial Test of HVAC System or part thereof. Cooling or Heating Tests shall be carried in appropriate season and the Engineer shall, within fourteen days of receipt of such information shall forward his consent for commencement of Reliability Trial Test as specified in Technical Specifications, after having satisfied that all the requirements for such Tests have been completed.

ii) If any Reliability Trial Test be not fulfilled to the satisfaction of the Engineer, such test shall be repeated at such time as the Engineer may direct.

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SECTION 0720 – TECHNICAL PROVISION (HVAC)

SECTION 1 - GENERAL REQUIREMENTS

1-01 MATERIALS

All materials shall be of the highest grade, free from defects and imperfections, of recent manufacture and unused, and of the classification and grades designated, conforming to the requirements of the latest issue of the appropriate specifications cited herein. All materials, supplies, and articles forming part of major equipment and not fabricated by the principal manufacturer of the equipment, shall be the products of the recognized reputable manufacturers.

1-02 WORKMANSHIP

Workmanship and general finish shall be of the highest grade, in accordance with the requirements specified herein, and the best modern standard practice.

1-03 EQUIPMENT

For equipment requirements refer to clause Section 2

1-04 CHASSES AND OPENINGS

The Contractor shall provide shop drawings, templates or details for chases and openings to be left in concrete walls, concrete partitions, floor, and roof slabs to accommodate work under HVAC scope of works. Chases and openings in masonry walls shall be provided and closed by the Contractor.

1-05 PROTECTION

The Contractor shall keep pipe, duct and other openings closed to prevent entry of foreign matter. All fixtures, equipment and apparatus shall be covered and protected against dirt, water, chemical or mechanical damage, before and during the construction period. All fixtures, apparatus, or equipment damaged including damaged shop coats of paint shall be restored to original conditions prior to Commissioning and also again prior to Final Acceptance. All bright finished shafts bearings housings and similar items shall be protected until in service: no rust will be permitted.

1-06 CUTTING, PATCHING AND REPAIRING (EXCEPT CUTTING IN CONCERETE)

Required for proper installation and completion of HVAC works, including masonry work, carpentry work, painting and re-painting shall be performed by skilled craftsmen in respective trades, at expense of the Contractor. Construction shall be cut only after obtaining written permission from the Engineer.

1-07 LINES AND LEVELS

The Contractor shall check dimensions at the building site and establish lines and levels for work specified in Specifications. The Contractor shall check work of other trades to ensure proper clearance of piping, ductwork, conduit and other HVAC items, and report to the Engineer in case he foresees any potential problem in executing his work

1-08 MACHINERY GUARDS

All moving parts of machinery are to be protected by strong guards to adequately protect all personnel working on or in the vicinity of equipment.

Wherever possible, moving parts should be protected by guards supplied by the equipment manufacturer. All guards must be strongly attached to equipment and should be designed for easy removal for access, servicing, adjustment and maintenance.

1-09 not used

1-10 ACOUSTIC TREATMENT

The noise criteria for different areas as per ASHRAE recommendations are to be obtained.

Sound measurements will be made at approximately 1.50 meters above floor level in the occupied area served and not more than 1.50 meters from the grills, diffusers or other air devices being tested. Instruments for sound measurement shall be provided by the Contractor.

All equipment installed should not be audible inside the occupied areas and the Contractor must ensure that all equipment he is offering is quiet and have satisfactory sound levels.

Provision is to be made to minimize noise and vibration. However, different manufacturers equipment have varying sound and vibration characteristics and it is, therefore, the responsibility of the Contractor to ensure that the requirements in these specifications are fully met by the equipment he is offering. If the Contractor has any requirements for additional vibration or sound isolation to meet specified noise criteria, these must be incorporated into the price quoted. Where silencers are required, these must be incorporated into the price quoted.

1-11 ACCESS PANELS

The Contractor shall mark locations of, and give sizes of, access panels required in false ceiling and wall panelling (where applicable) for adjustment and maintenance of HVAC Equipment, such as Dampers, Fire Dampers, valves, ceiling-hung equipment, etc. This information shall be provided to the Engineer before commencement of false ceiling work by the concerned persons.

1-12 SEALING OF OPENINGS

The contractor shall seal all openings in external walls and roof where HVAC ducts/pipes penetrate in external membrane. The sealing shall be air tight and water tight and non-deteriorating type to prevent penetration of outside air and water into building. The method and materials for sealing shall be subject to Engineer's approval. All these sealings shall be subjected to wet testing and satisfactory performance.

SECTION 2 - EQUIPMENT

2-01 GENERAL

2-01.1 General Requirements

All equipment shall be of such overall dimensions, operating weights, service area requirements and configuration that it can be located where shown on the plans without any adverse effect on its performance and clearance requirements. Any change in other trades work, anticipated by offering alternate equipment, shall be estimated by the Contractor and its cost shall be included in the quoted price for HVAC Works.

Provision for clearance and service spaces shall be made around all mechanical equipment as recommended by equipment manufacturers.

All equipment supplied under this section shall be brand new, factory manufactured and factory assembled (unless otherwise specified) and complete in all respects. The type, characteristics, capacity ratings, component sections of all equipment shall be as Scheduled.

All equipment furnished by the Contractor shall include vibration isolation mounting pads, anchor bolts, frames or any other mounting or supporting accessories.

All power-driven equipment shall include drives, motors and adjustable motor foundation bases and accessories including machinery guards where applicable.

All equipment shall be complete with all accessories necessary to serve the intended purpose, whether specified or not.

All equipment installed on roof or intermediate floors shall include suitable vibration isolators to prevent any vibration traveling to building structure.

The Heating, Ventilation and Air Conditioning (HVAC) systems shall be designed, selected, and installed to operate satisfactorily under the climatic and environmental conditions prevailing at Skardu International Airport, ensuring continuous, reliable, and energy-efficient operation throughout the year. All HVAC equipment capacities and performance ratings shall be corrected for the reduced atmospheric pressure and air density associated with the project site elevation. The minimum outdoor design conditions shall be as follows:

Summer Design Condition
- Dry Bulb Temperature: 34°C
- Wet Bulb Temperature: 18°C
- Mean Daily Range: 16–18°C
- Relative Humidity: 25% (approx.)

Winter Design Condition
- Dry Bulb Temperature: −18°C
- Wet Bulb Temperature: −18°C
- Relative Humidity: 50–60% (approx.)

Site Elevation: Approximately 2,230 m above Mean Sea Level

Indoor Conditions:
- Indoor Cooling Condition: 24°C ±1°C.

- Indoor Heating Condition: 22°C ±1°C.

All HVAC equipment shall be selected and rated for operation at the project site elevation. The Contractor shall submit manufacturer-certified performance data and capacity correction calculations demonstrating compliance with the specified design conditions. HVAC systems serving critical operational areas, including the ATC Operations Room, Equipment Rooms, UPS Rooms, and Communication Rooms, shall be designed for continuous 24/7 operation.

2-01.2 Equipment Requirements

a) For ratings and characteristics of manufactured equipment, Equipment Schedule as appended to Technical Provisions shall be followed.

b) All equipment shall be manufactured by companies which have had at least ten years previous experience in the design and manufacture of equipment of comparable type, capacity and operating conditions, having same distributor for last 5 years in Pakistan. Contractor shall procure all imported equipment through local distributor. The Engineer may issue a waver to this clause if considered necessary by him

c) Where the requirement of this Clause make any equipment proprietary or non-obtainable, the Engineer reserves the right to waive any portion or portions of it as required to obtain the intent of the technical specifications (s).

d) When a manufacturer's product is specified by name, or equivalent, it shall be in the sole judgment of the Engineer as to acceptability of any product which is offered as equal to that specified.

e) Where two or more units of the same class of equipment are furnished, product of the same manufacturers shall be used, unless otherwise approved by the Engineer: component parts of entire system need not be product of same manufacturer.

2-02 WATER COOLED SCREW TYPE WATER CHILLER

2.02.1 General

a) The Water-Cooled packaged chillers shall be High Efficiency type robust construction units & shall consist to Twin Screw serviceable semi-hermetic rotary Screw CE listed compressors, factory mounted and tested variable frequency drive, cooler, condenser & Micro-processor based controls.
b) All controls necessary for automatic operation shall be mounted, on each machine. Each machine shall be shipped completely charged with refrigerant & with lubricating oil.
c) The chillers shall be suitable for installation in the spaces provided & spring vibration isolators supplied by the manufacturer of chiller shall be included.
d) Each Chiller shall have independent refrigeration circuit. Refrigerant circuit shall have a removable core filter drier in the liquid line, moisture indicating sight glass & electronic expansion valves. The chiller’s performance shall be AHRI or EUROVENT, ETL certified & should be tested at certified test bench. The Chillers to be charged with eco-friendly R-134a Refrigerant.

e) Origin / country of manufacture & make of chiller shall be as specified / as scheduled unless otherwise approved by the consultant / Project Director. The chiller should have a capacity & characteristics as shown in equipment scheduled,
f) All chillers shall be commissioned under supervision & guidance of commissioning engineer trained in chiller manufacturer factory & certified by manufacturer as commissioning engineer & should have capability to trained Project Director nominated personnel regarding operation of chiller through a minimum 10 days at site training program after successful commissioning of chiller.
g) All chiller parts shall be painted using standard painting methods of the manufacturer.

2.02.2 Compressor

a) The packaged chiller shall be furnished with Semi-hermetic Screw type compressor with part winding or star delta and shall have internal thermal contacts for overheat protection. Further the compressor, having improved efficiency, high reliability & lower sound level.
b) The motor in each compressor shall be cooled by suction gas and shall have additional thermal contacts for motor overheat protection, Compressor shall include integral oil separation system, oil sump & oil filter.
c) The oil differential pressure shall be controlled during operation to maintain proper oil lubrication throughout the lubrication system. An electric oil heater shall be supplied with each compressor to maintain oil temperature during shutdown period. The heater shall be energized when the chiller is switched off. Compressor shall have a sight glass, suction check valve, suction filter, suction service valve, a discharge check valve & a discharge service valve.
d) Capacity control shall be step-less type fully automatic with manual option, and shall be fail-safe. Capacity control shall be operated through Modulating expansion valve. Machine shall shut down for oil pressure, chilled water low temperature, refrigerant low pressure, condenser high pressure, compressor discharge high temperature.
e) Controls shall ensure through lubrication of compressor prior to start and during coast-down after machine stop. Motor shall be protected against drawing more than rated full load amperes.
f) Controls shall prevent machine restart until after a safe pre-set time.
g) All controls shall be in a weather tight enclosure, and shall include, but not limited to, power controls for starters, low-voltage control power transformers, terminal strip relays, high pressure and low-pressure controls, low temperature control, motor protection oil pressure control and chilled water temperature controllers.
h) The compressor motor shall be hermetic refrigerant gas cooled, 2 pole, & squirrel cage induction type with class H insulation. Motor winding shall have thermistors embedded in the motor windings to protect motor from overheating. The thermistors shall be wired to the solid-state motor protection module.
i) Compressor should have low noise & sound compartment to dampen the sound levels. Sound attenuation compartment should have removable insulated panels with minimum 1” thick insulation & powder coated on external side.

<u>Following should be standard features of compressor.</u>

- Integral high efficiency oil separator
- Suction check valve & service valve
- Integral lubrication system using pressure differential
- Discharge check valve
- Compressor vapor injection available

- Compressor oil sump heater(s)
- Compressor motor protector
- Optical oil level sensor
- Suction Filter

2.2.3 Cooler

a) Evaporator vessel shall be ASME Stamped in AHRI case & PED, CE in Eurovent compliant cleanable shell & tube, Shell shall be fabricated from rolled carbon steel sheet with fusion welded seams or carbon steel standard pipes. End plates shall be of carbon steel with precision drilling, reamed in order to accommodate tubes. Intermediate tube support shall be in place to provide required tube support between tube sheets.
b) Tubes shall be of copper, seamless, high efficient, internally enhanced & externally finned, mechanically expanded into fixed steel tube sheets. Tube dia shall be ¾ inch & thickness shall be 0.025 inch.
c) The evaporator shall have a built in distributor for feeding refrigerant evenly under the tube bundle to produce a uniform boiling action & baffle plates shall be provided to ensure vapor separation. Water box /Head Plate shall be removable for tube cleaning, shall have stub out water connections with Victaulic grooves in compliance to ANSI. Evaporators to be two pass design. Vent & drain plugs are to be provided in water box. The shell side of the evaporator shall have pressure relief valve with provision for refrigerant venting.
d) Evaporator's refrigerant side shall be designed constructed in accordance with the ASME, PED for Unfired Pressure Vessels. Evaporator shell side shall undergo pneumatic pressure test at 220psi, shall be designed for working pressure up to 200psi. Tube side shall undergo hydrostatic pressure test at 195psi, shall be designed for 150psi working pressure.
e) The evaporator shall have an efficient & reliable oil recovery system. The oil recovery system will ensure the evaporator is operating at peak efficiency at all times & provide optimal energy efficiency during extended periods of part load. All low temperature surfaces shall be factory insulated with 25mm thick Polyethylene resin having K factor of 0.26 btu-in / hr – ft² – °F, Following should be standard features of Evaporator.
    - Evaporator Designed for higher capacity & easy maintenance
    - Cleanable integral fin copper tubes for easy serviceability
    - 1"thick PE foam closed cell evaporator insulation, thermal conductivity 0.040W/m.K at 40°C(0.28Btu in/hr.ft²F at 104 F .)
    - Removable water heads
    - Victaulic groove water connections
    - Drain & vent plugs
    - Carbon steel header ,shell & tube sheet

f) The cooler shall be equipped with marine water box.

2.2.4 Condenser

g) Condenser vessel shall be cleanable shell & tube. Shell shall be fabricated from rolled carbon steel sheet with fusion welded seams or carbon steel standard pipes. End plates shall be of carbon steel with precision drilling, reamed in order to accommodate tubes. Intermediate tube support shall be in place to provide required tube support between tube sheets.
h) Tubes shall be of copper, seamless, high efficiency & externally finned, mechanically expanded into fixed steel tube sheets. Tube dia shall be ¾ inch & thickness shall be 0.025 inch. Water box/ Head shall be removable for tube cleaning, shall have stub out water connections with Victaulic grooves in compliance to ANSI / AWWAC-606. They are to be available in

one, two or three pass design as required on the drawings. Vent & drain plugs are to be provided in water box.

i) The shell side of the condenser shall have pressure relief valve with provision for refrigerant venting. Condenser refrigerant side shall be designed, constructed in accordance with the ASME/PED Code for Unfired Pressure Vessels. Condenser shell side shall undergo pneumatic pressure test at 220psi, shall be designed for working pressure upto 200psi. Tube side shall undergo hydrostatic pressure test at 195psi, shall be designed for 150psi working pressure. The condenser shall be sized for full pump down capacity. Following should be standard features of condenser.

1. Condenser Designed for higher capacity & easy maintenance
2. Full pump down capacity in condenser
3. Cleanable integral fin copper tubes for easy serviceability
4. Removable water heads
5. Victaulic groove water connections
6. Drain & vent plugs
7. Carbon steel header, shell & tube sheet.

Following shall be standard features of condenser.

1. Liquid level float control
2. High Pressure relief valves
3. Economizer usage to boost capacity
4. Refrigerant charge
5. Sight glass with moisture indicator
6. Oil Charge
7. V.I check valves on multiple compressor units
8. Discharge check valves on multiple compressor units
9. Replaceable core filter drier
10. Automatic oil balancing control
11. Charging & gauge connections

j) The condenser shall be equipped with marine water box.

2.2.5 Refrigerant Circuit

a) The refrigerant circuit shall include suction & discharge service valves (which facilitate compressor isolation), oil filter, replaceable filter drier on oil return line, sight glass on liquid line, economizer, pressure relief valves on the cooler & condenser, liquid line angle valve for refrigerant charging.

b) The packaged chiller shall be furnished with electronic expansion valve for precise modulation of refrigerant flow control & improve efficiency by optimizing the suction & discharge superheat while protecting compressors. In addition, the refrigerant control system shall monitor the liquid refrigerant level in the evaporator & restrict refrigerant flow entering the evaporator upon a rise in the level, protecting the compressor from slugging liquid refrigerant. Fixed orifice control systems will not be acceptable. (Option Hot gas bypass shall be factory installed for operation down to approximately 10% of full load.)

2.2.6 Motors & Starters

Motors & Starters shall conform to the Electrical clauses of these Specifications. Full load operation of the motor shall not under any circumstances exceed nameplate KW rating. The chiller manufacturer

shall provide suitable part winding starter for the compressor motor in order to minimize the starting current. The starter shall be factory mounted, wired to the motor & controller. The starter shall be able to provide adequate starting torque & the required acceleration for the compressor during starting. NEMA-1 electrical panel compartment shall include following.

- Compressor MCCB & contactors
- Single point power connection
- Compressor solid state overloads
- Control circuit transformer
- Low voltage/phase failure/phase reversal relay
- Current transformer
- On-off switch in the unit control circuit & each compressor control circuit
- Under voltage/Phase Failure-Phase sequence relay.
- Indicating lights for Compressor overloads High pressure, low pressure, & freeze High motor temperature, Control power
- Safety Protections for High & low pressures, High discharge temperature, freeze protection, Low pressure differential, Low oil level, Compressor run error & over current, Chilled water flow loss, Compressor anti-recycle, Sensor error, Evaporator & condenser refrigerant pressure, Compressor amps (each compressor), Water sensor: Evaporator leaving -Standard sensor to provide temperature readout for water leaving the evaporator

2.2.7 Microprocessor Controller

a) The packaged chiller shall be equipped with stand along proactive advance controller which adapts to abnormal operation conditions.
b) Chiller microprocessor-based controller shall be Factory installed, wired & tested RS 485 serial interface with capability of communication with building automation, centralized systems and supervision networks
c) The unit algorithm program & operating parameters shall be stored in flash-memory. Battery back-up is not acceptable. 115V Power supply to the controller shall be provided by a control transformer provided with the panel. External power source to the controller is not acceptable.
d) The controller shall be equipped with a user-friendly terminal with color touch screen LED back lit graphical display & dedicated touch keys that provides easy access to the unit operating parameters, control set points & alarm history.
e) There shall be dedicated physical buttons & touch keys enable user to access information, based on security level of password. There shall be min three level of password for operator, service personnel & for the critical manufacturer settings in order to protect the chiller controller from unauthorized access.
f) The controller board shall be provided with a set of terminals that connected to various devices such as temperature sensors, pressure transducers, current transducers, solenoid valves, compressor contactors, electronic expansion valve, & controls relays. The controller should be able to configure & connected multiple unit that allow sequencing control without additional hardware.
g) The controller shall be able to carry out all program operations; it shall be able to display unit operating parameters, compressor information, alarm history & shall able to modify the parameters.
h) The controller shall be able to carry out its own diagnose test on the controller & the connected devices & alarm messages shall be displayed

automatically on faulty devices. All messages shall be displayed in English language & shall be displayed either in Imperial or SI units. Leaving chilled water temperature control shall be accomplished by entering the water temperature set point with accuracy to 0.8°F & placing the controller automatic control mode.

i) The controller shall monitor all control functions & move the compressor slide valve to the calibrated position. The compressor loading cycle shall be programmable & shall be adjusted to the building load requirement. The loading adjustable range shall be from 0.1% to 0.4% per increment to prevent excessive demand hike at start up.
j) The controller shall continuously monitor evaporator leaving water temperature, rate of change of chilled water leaving temperature, evaporator & condenser pressure; compressor amp draw; & discharge refrigerant temperature.
k) In case of multiple chillers, the controller shall have provision of Master & slave option.
l) The controller shall be complete with all hardware & software necessary to enable remote monitoring of all data through the addition of an optional web card if accessing the controller via web or network cards if linking chiller to the Building Management Systems. The controller shall be complete with a RS485 long distance differential communications port; the remote connection shall be established by a twisted pair of wire. The electrical control panel shall be wired to permit fully automatic operation during - initial start-up, normal operation, & shutdown conditions.
m) The control system shall contain the following control, displays & safety devices:

Manual Controls

- Auto/Local/Remote switch
- Control circuit stop & start switches
- Compressor enable switch
- Compressor over current
- Compressor anti-recycle
- Programmable with Seven-day operation cycle

Automatic Controls

- Compressor motor increment contactors
- Start delay timer
- Anti-recycle timer
- Oil sump heater interlock relays
- Mater & Slave

Refrigerant Flow Controls

- Refrigerant flow control shall be carried out electronically by a precision EEV
- Liquid refrigerant level sensor for evaporator
- Compressor loading & unloading solenoid valves
- Refrigerant isolation valve package.

Microprocessor Display information

- Leaving chilled water temperature
- Leaving chilled water temperature derivative
- Evaporator pressure
- Condenser pressure

- Compressor amps draw for each compressor
- Compressor elapsed run time of each compressor
- Compressor start status
- Oil level sensor status
- Water flow switch status
- External start/stop command status
- Trend graph for leaving chilled water temp
- Percentage of compressor capacity
- Electronic expansion valve percentage of opening.
- Fault Log & minimum four-week History

2.2.8 Accessories

Following accessories shall be included: -

- Spring vibration isolators for unit frame
- Suction & discharge gauges, oil pressure gauge
- Unit mounted disconnect switch
- Water side flow switch with communication cable
- Victaulic grove coupling for water side connections.
- Built-in pump down unit with complete isolation valve package or provide portable pump down unit with all high-pressure hoses, electric and water connections.
- Portable Compressor oil charging pump

2.2.8 Commissioning & Testing

a) The pre-commissioning check list to be provided by the commissioning engineer prior commissioning to the installer for proper installation & pre-check the installation prior to start commissioning without any extra charge.
b) The Contractor shall provide a factory authorized & trained commissioning Engineer, employed by the chiller manufacturer, to perform &/or supervise chiller pressure test (when required), Top-up chiller with refrigerant, place unit into operation, & calibrate all controls in accordance with the manufacture's written start-up, operating, & maintenance instructions.
c) The Commissioning Engineer shall furnish a start-up log indicating that proper operation conditions, operating sequences & operating & safety control functions are obtained.
d) The Commissioning Engineer of chiller may recommend specified tests & these test reports shall be submitted to the Consultants by the Contractor in suitable test forms.
e) Once the chillers) shall be successfully commissioned & the report prepared by the factory authorized commissioning engineer, the final report handed over to the client shall be countersigned by the factory' engineer (placed in the manufacturing plant) for its performance authenticity as per the design performance requirements.
f) Contractor will ensure that, after unit start-up has been performed & witnessed by client, the Authorized Commissioning Engineer shall be available on site for a period of instruction not to exceed accumulative 36 working hours to instruct the owner's personnel in the proper start-up, operating, & maintenance procedures & hands on training.
g) All chilled water supply/return connections, power line connections, valves installation, valves & pipeline tagging, electric power & control wiring/cabling to be provided by the installation contractor.
h) The start-up shall include detailed briefing to operators on chiller operations & maintenance as well.
i) Installation contractor shall also be responsible to ensure all control interfaces complete in all respect to connect chillers, pumps, VFD's or with any related equipment etc.

2-03 Not-used

2-04 Not-used

2-05 CLOSED CIRCUIT COOLING TOWERS

2-05.1 GENERAL

Provide factory assembled closed circuit cooling towers Provide factory assembled induced draft closed circuit cooling towers suitable for continuous outdoor operation. The cooling tower shall be complete with heat exchange coil, recirculating spray water system, axial fans, drift eliminators, air inlet louvers, casing, basin, pumps, access doors, and all accessories required for a complete operating system.

Automatic blow-down based on pre-defined TDS/ Salinity value and auto re-filling adjustable float arrangement should be provided with each individual tower. A suitable equalizer line with isolation provision shall be provided.

Units shall be induced draft evaporative fluid cooler type suitable for continuous outdoor duty.

Cooling towers shall comply with latest applicable standards:

- CTI STD-201 Thermal Certification
- CTI Acceptance Test Code
- ASHRAE Standards
- JCI/ JIS, SMACNA and AMCA applicable provisions

Thermal capacity shall not be less than 100% of published ratings under certified conditions.

2-05.2 Construction

Cooling tower casing, fan deck, access panels, and structural members shall be heavy gauge hot dip galvanized steel (minimum casing 14 SWG and galvanization thickness min. 700 g/ sq. meter) , stainless steel 304 or better, or FRP construction unbreakable under wind pressure of minimum 1500 Pa suitable for corrosive outdoor environment.

The unit shall be fully weatherproof and UV resistant.

Access doors shall permit inspection of coil, spray nozzles, drift eliminators, and basin.

2-05.3 Heat Exchange Coil

The cooling coil shall be continuous serpentine type fabricated from seamless steel tube hot dip galvanized after fabrication or stainless-steel construction.

Coils shall be designed for minimum 10 bar working pressure and factory hydrostatically tested.

Coil circuiting shall allow complete drainage and venting.

2-05.4 Spray Water System

Provide heavy duty non-metallic and UV resistant spray piping with removable non-clog polypropylene or ABS nozzles.

Spray pump shall be centrifugal type suitable for continuous operation.

Water distribution shall ensure complete wetting of the coil surface at all operating conditions.

2-05.5 Basin

Cold water basin shall include:

- Make-up connection
- Overflow
- Drain connection
- Strainer
- Anti-vortex suction outlet
- Equalizing connection for multi-cell towers

Basin shall be sloped for complete drainage and cleaning.

2-05.6 Drift Eliminators

Provide multi-pass PVC drift eliminators designed to limit drift loss to maximum 0.001% of circulating water flow.

Eliminators shall be removable for maintenance.

2-05.7 Fans and Motors

Fans shall be axial propeller type with adjustable pitch FRP or aluminium blades.

Motors shall be TEFC minimum efficiency class IE-4, weatherproof type suitable for 415V/3Ph/50Hz operation with Class-F insulation and IP55 protection minimum.

Drive system shall be direct drive or industrial gear drive type. Belt drive shall not be acceptable unless specifically approved.

2-05.8 Access Ladders

a) An access ladder constructed of hot dipped galvanized iron (700 gm / sq. m) shall be provided for gaining access to the water distributing system & fans. In multiple cell towers where single point access is provided, a safety rail made of hot dipped galvanized iron shall be provided around the tower top periphery.

B) Provide an access door adequately sized to allow entry into the tower. Alternative means of access shall be provided as appropriate to suit the tower configuration. In multi-cell Towers access door in internal partitions shall also be provided to access middle side cells for maintenance.

2-05.9 Freeze Protection

Provide basin heaters, electric heat tracing, and low temperature controls where ambient conditions require freeze protection.

Fan cycling or VFD control shall prevent icing during winter operation.

2-05.10 Sound Control

Cooling tower sound levels shall comply with project acoustic requirements.

Low sound fans, attenuators, or discharge silencers shall be provided where required.

2-05.11 EXECUTION

Install cooling towers in accordance with manufacturer recommendations and approved shop drawings. Provide adequate service clearances for maintenance and coil removal. Mount units on reinforced concrete foundations with vibration isolation supports where specified.

2-05.12 Performance criteria

a) Contractor shall furnish manufacture certificate that relate performance of cooling towers will meet contract document requirements, stating entering air wet bulb temperature, entering & leaving condenser water temperature, water flow rates, fan KW (Horsepower), & pump head at base of tower, certification shall be made at the time of submittal.
b) The cooling tower shall have been tested, rated & certified in accordance with cooling tower institute (CTI) standard 201 or latest JCI standard & shall bear the CTI / JCI certification label & shall be listed in the CTI directory of certified cooling towers.

2-05.13 Testing and Commissioning

Cooling towers shall be factory tested prior to shipment. Contractor shall verify:

Water flow rates
Fan rotation
Motor current
Basin operation
Vibration levels
Freeze protection controls
Sound levels

Manufacturer shall submit certified performance data indicating:

Entering and leaving fluid temperatures
Wet bulb temperature
Fluid flow rate
Fan motor kW
Pressure drop through coil
Airflow rate

2-05.14 Warranty

Provide minimum five (5) years warranty for fan assembly, drive system, and structural components.

Coil shall be warranted against leakage and material defects.

2-05.15 Spare Parts

Provide manufacturer recommended spare parts list for minimum two years operation including:

Spray nozzles
Fan belts (if applicable)
Bearings
Float valves
Drift eliminator sections
Motor protection devices

2-06 Not-used

2-07 HOT WATER GENERATORS (HWG)

2-07.1 General

The Hot Water Generator (HWG) shall be a fully automatic, forced-draft, dual-fuel fired unit capable of operating on both Natural Gas and Light Diesel Oil (LDO), complete with automatic fuel changeover and all associated burners, controls, safety devices, and accessories. The HWG shall have the heating capacity as specified in the Equipment Schedule and Drawings and shall be factory assembled, tested, and suitable for continuous operation under the specified design conditions.

The HWG shall be of welded steel construction with high-efficiency heat transfer surfaces comprising water tubes or an equivalent approved design. The heat exchanger shall be designed for high thermal efficiency, ease of inspection, cleaning, and maintenance. All heat transfer tubes or equivalent heat exchange elements shall be individually replaceable without requiring major dismantling of the unit. The combustion chamber and heat transfer surfaces shall be readily accessible through removable access doors for inspection, cleaning, maintenance, and tube replacement, where applicable.

The complete hot water generation system, including the hot water generator, fuel storage and distribution system, piping, valves, controls, instrumentation, and all associated equipment, shall be provided with adequate freeze protection measures to ensure safe, reliable, and uninterrupted operation at ambient temperatures down to –25°C. Freeze protection shall include, as a minimum, thermal insulation, heat tracing, enclosure heating, and any other measures necessary to prevent freezing of water and fuel systems.

2-07.2 Trim

The H.W.G. trim shall consist of, but not be limited to, the following items:

- Low water cutoff.
- ASME rated relief valve.
- Automatic gas valve.

- Gas shut off controls in case of failure of ignition.
- Water temperature controls to regulate burner operation.
- Gas line shut off valve
- Gas Pressure Regulator
- Gas Strainer
- Gas Pressure Gauge

2-07.3 Heating Surface

H.W.G. shall be rated not less than 5 Square feet of heating surface per rated H.W.G. horsepower. H.W.G. shall be complete package ready for field installation.

2-07.4 Burner

The burner shall be dual fired and shall be suitable for natural gas with a calorific value of (915 Btuh/cu. ft) and Light Diesel Fuel. The burner shall be integral with the front head of the H.W.G. and shall be high radiant annular entry type for gas. The burner shall burn fuel without objectionable vibration or pulsation with no carbon monoxide in the flue gases. Burner shall have full modulation with automatic return to low fire position on every gas cutoff for re-ignition. The ignition/ pilot shall auto-ignite on the command.

2-07.5 Oil Burner

A single tip retractable nozzle is used for the low-pressure air atomizing burner. Flexible hosed allow easy removal of the nozzle for inspection when it is placed in the vice jaws located on the front door of the unit. The operation range of the oil burner shall be ether automatically variable between 35 and 100 per cent of the hot water generator or be equipped with an automatic two or three stage power control, depending on the power demand of the hot water generator. This will result in a higher fuel efficiency during off-peak periods.

2-07.6 Oil Pump

An oil pump with a capacity of approximately twice the maximum burning rate is included. The oil pump is integral with the burner.

2-07.7 Oil Burner Piping

Fuel oil piping on the unit includes oil pressure regulating devices, oil metering controls, solenoid shutoff valves, pressure gauges and fuel strainer, all integrally mounted on the unit. Piping material shall be copper with hard soldered connections.

2-07.8 Diesel Oil Supply System and Safety Arrangement

Diesel valve shall be motorized controlled, spring loaded to close automatically in the event of power failure. The diesel train shall include manual shut-off valve, UV flame detector and diesel manifold pressure gauge. A pre-mix type diesel pilot with automatic electric ignition and

high-tension transformer shall be provided. An electronic detector shall prevent the opening of diesel valve in the absence of pilot flame. Low fire ignition interlock and air flow safety switch shall be provided. An emergency power shut-off switch shall be provided at the entrance door outside the H.W.G. room.

2-07.9 Gas Supply System and Safety Arrangement

Gas valve shall be motorized remote controlled, spring loaded to close automatically in the event of power failure. The gas train shall include manual shut-off valve, pressure regulator, and gas manifold pressure gauge.

A pre-mix type gas pilot with automatic electric ignition and high-tension transformer shall be provided. An electronic detector shall prevent the opening of gas valve in the absence of pilot flame. Low fire ignition interlock and air flow safety switch shall be provided.

2-07.10 Controls

H.W.G. controls to be of a manufacturer, which is adequately represented in Pakistan. A certificate to this effect from H.W.G. controls manufacturer and local agent shall be submitted. H.W.G. controls shall be suitable for intermittent start-stop operation of H.W.G. as the H.W.G. will not be operating 24 hours a day.

2-07.11 Flue Collar

H.W.G. shall have flue collar for connection to Bracing with structural angle flange and bolts.

2-07.12 Controls Panel

The control panel shall be factory fabricated supplied by the manufacturer of H.W.G., mounted on the H.W.G. panel shall include, but not be limited to, control circuit transformer, relays, starters, timers, terminal strip, control circuit fuse, internal wiring, on-off switch, indicating lights, meters for operating hours and number of starts.

2-07.13 Breaching / Stack

The Contractor shall provide welded steel breaching/ stack for size and configuration as required and as per recommendations of the manufacturer. Fabrication shall be by welding using no less than 6mm thick plate conforming to ASTM A36 or A283. Structural angle flanges for breaching and H.W.G. connection shall be provided. Stack shall be terminated as shown on the Drawings

2-08 Diesel Oil Storage and supply system

2-08.1 GENERAL

Provide a complete, fully integrated, factory-engineered Light Diesel Oil (LDO) storage and fuel oil transfer system intended for continuous and reliable operation of mission-critical heating and standby power

systems in severe cold climate and high-altitude environments with outdoor ambient temperatures down to minus 18°C or lower.

The system shall include underground bulk diesel storage tanks, duplex transfer pumps, fuel filtration assemblies, leak detection systems, day tanks, heat-traced piping networks, thermal insulation, controls, monitoring panels, fuel recirculation arrangements, emergency shutoff systems, venting systems, containment provisions, and all accessories necessary for safe, code-compliant, and uninterrupted operation.

The design intent is to maintain diesel fuel fluidity, pumpability, viscosity stability, and combustion reliability under sub-zero ambient conditions while minimizing risk of waxing, gelling, condensation, water contamination, fuel degradation, and operational interruption.

The Contractor shall provide complete design, engineering, coordination, fabrication, installation, testing, commissioning, and documentation in accordance with internationally recognized engineering practices, peer-reviewed industry guidance, manufacturer recommendations, and latest applicable editions of governing codes and standards.

Trace heating systems shall maintain minimum fuel temperature above diesel cloud point and pour point throughout all operational and standby conditions. Heat tracing shall be self-regulating electric type specifically listed for hazardous locations and low-temperature fuel oil applications.

2-08.2 APPLICABLE CODES AND STANDARDS

System shall comply with latest editions of:

1. NFPA 30 – Flammable and Combustible Liquids Code
2. NFPA 31 – Installation of Oil Burning Equipment
3. NFPA 70 – National Electrical Code
4. API 650 – Welded Steel Tanks for Oil Storage
5. API 2610 – Design and Construction of Terminal Facilities
6. UL 58 – Steel Underground Tanks for Flammable Liquids
7. UL 1746 – External Corrosion Protection Systems
8. ASME B31.3 – Process Piping
9. ASME B31.9 – Building Services Piping
10. IEC 60079 – Hazardous Area Classification
11. SSPC/NACE Corrosion Protection Standards
12. International Fire Code (IFC)
13. Local Environmental Regulations
14. Manufacturer’s written recommendations

2-08.3 Fuel storage and tank engineering practices

2-08.4 SYSTEM DESCRIPTION

Supply, installation, testing, and commissioning of complete Light Diesel Oil (LDO) underground storage and distribution system including double-wall underground storage tank with leak detection and cathodic protection, duplex transfer pumps, indoor day tank, fuel piping network, self-regulating electric heat

tracing for sub-zero ambient operation (-18°C), thermal insulation, fuel filtration system, valves, controls, alarms, BMS integration, excavation, foundations, supports, commissioning, sizing and all associated accessories in accordance with project specifications, NFPA 30 requirements, and approved shop drawings.

2-08.4.1 UNDERGROUND STORAGE TANK

Provide double-wall underground diesel storage tank complete with:

- Interstitial leak monitoring
- Anti-corrosion coating
- Cathodic protection
- Manway access
- Emergency vent
- Normal vent
- Fill connection
- Level transmitter
- Overfill prevention valve
- Water monitoring probe
- Sloped bottom for drainage
- Thermal insulation where required

Minimum storage capacity shall not be less than 100 hours continuous full-load operation unless noted otherwise.

2-08.4.2 DAY TANK SYSTEM

Provide indoor insulated day tank with:

- Minimum 8-hour operational storage
- Duplex fuel transfer pumps
- Automatic refill controls
- High- and low-level alarms
- Emergency high-high shutdown
- Overflow return line
- Leak containment basin
- Local and remote indication
- Fuel polishing connection

Day tank shall be installed within mechanical room protected from freezing conditions.

2-08.4.3 HEAT-TRACED FUEL PIPING

All exposed diesel piping, valves, filters, pump casings, and accessories subject to low ambient temperatures shall be provided with electric self-regulating heat tracing and closed-cell insulation.

Heat tracing system shall:

- Maintain fuel temperature minimum 10°C above cloud point
- Operate continuously during winter mode
- Be suitable for hazardous classified areas
- Include thermostatic control
- Include circuit monitoring panel

- Include GFCI protection
- Prevent fuel waxing and viscosity increase

2-08.4.4 PIPING MATERIALS

- Underground piping: Double-wall HDPE or coated carbon steel
- Indoor piping: Schedule 40 black steel
- Flexible connectors: Stainless steel braided
- Valves: Full-port ball valves
- Insulation: Closed-cell elastomeric minimum 50 mm thick
- Jacketing: Aluminium weatherproof cladding outdoors

2-08.4.5 CONTROLS AND SAFETY

Provide complete automatic control and monitoring system including:

- Fuel leak detection
- Low temperature alarm
- Tank overfill alarm
- Pump failure alarm
- Emergency stop stations
- BMS integration
- Fuel level trending
- Redundant power supply
- Audible and visual alarms

System shall automatically maintain fuel circulation during extreme low ambient conditions to prevent localized fuel gelling.

2-08.4.6 TESTING AND COMMISSIONING

Contractor shall perform:

1. Hydrostatic and pressure testing
2. Leak testing of double-wall piping
3. Heat tracing continuity testing
4. Insulation resistance testing
5. Functional testing of alarms and controls
6. Fuel transfer performance testing
7. Full operational commissioning under simulated winter conditions

Submit complete commissioning reports, as-built drawings, fuel calculations, equipment data sheets, and O&M manuals prior to handover.

2-08.5 DAILY USE DIESEL STORAGE TANK

The tank shall be horizontal cylindrical storage type with dished heads. The daily use tank shall be mounted on saddles.

Provide a 2700 Liters capacity cylindrical type daily use tank constructed of 4mm thick steel sheet, with channel side saddle supports, 1" NPT drains, 4" NPT inspection/emergency vent ports,

visual fuel level gauge and vent cap as shown on the drawing. Tank exterior shall be finished with oil-resistant textured enamel paint.

Tank connections shall include fuel inlet, fuel supply, vent opening, manual fill, and overflow as shown on the drawing. The tank shall also be provided with a man-hole on the top side for cleaning purpose of adequate size.

Day tanks in buildings and on roofs should be provided with gravity overflow pipes to the bulk tank for failsafe overfill protection. Return flow pumps may be allowed by some codes, however for this application a failsafe method of protection is justified.

The tank shall be installed at the roof of the HVAC plant room on a 4-inch-high concrete pad of base size according to the tank's supports size.

Tank shall be provided with factory fitted ultra-sonic level control sensors along-with the necessary cables to connect with the diesel oil pump set.

The day tank shall be complete in all respect and shall comply all relevant and latest codes and standards Particularly the followings and others. No-Waiver shall be given to contractor/supplier. In-case of any conflict among these, the stringent requirement shall govern.

1. NFPA 30 *Flammable and Combustible Liquids Code*
2. NFPA 30 Flammable and Combustible Liquids Code
3. UL 80 UL Standard for Safety Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids
4. UL-142 UL 142 Aboveground Flammable Liquid Tanks
5. International Fire Code, 2000 Edition
6. Uniform Fire Code, 2000 Edition

2-08.6 DUPLEX PUMP SET FOR DIESEL OIL TRANSPORTATION

Provide and install a factory assembled "Packaged" Duplex Fuel Oil Pump Set. The set shall have all components mounted on a steel base support fabricated of 3/16" steel plate with 3" steel side rails sealed to form a containment basin with 1/2" NPT plugged drain connection. Containment basin shall encompass the entire perimeter of the duplex pump set and no components or factory piping shall overhang. Pipe shall be schedule 40, ASTM Grade A-53 Black pipe with 150#. (Option: Provide a float operated leak sensor with protective shroud in the pump set containment basin to shut off the pumps and energize an audible and visual alarm should a leak be detected.)

Provide bucket oil strainer, sized to produce less than 1/2 PSI pressure drop, through a clean strainer basket with the maximum anticipated flow. Strainer shall be of one-piece cast iron and come complete with level wrench handle.

Provide two (2) Pedrollo peripheral impeller fuel oil pumps, each with a capacity of not less than 50 Lit/Min @ 40 PSIG discharge pressure when operating with No. 2 oil (HSD). Each pump shall be close coupled

to a 1.1 HP 2,900 RPM totally enclosed fan-cooled motor, capable of operating on 220/400 volt, single or 3 phase, 50 HZ electrical service.

Provide two (2) in-line, check valves with metal-to-metal lapped seat and 316 stainless steel springs. Check valve is to have a minimum of 1/2 PSI cracking pressure and to be located on the discharge side of each pump.

Carbon steel ball valves, class 150 shall be provided on both the suction and discharge of each pump to provide pump isolation for service.

One (1) 2 1/2" compound gauge shall be provided on the suction side of system. Gauge shall be liquid filled to dampen pulsation, with bright finish stainless steel case, brass movement, and bronze bourbon tube. Gauge shall read 30" vacuum - 60 PSIG and shall be mounted with isolation ball valve.

Two (2) 2 1/2" dial pressure gauges to be placed on discharge side of each pump. The gauges shall be liquid filled to dampen pulsation, have bright finished stainless steel case, brass movement and bronze bourbon tube. Gauge range shall be based on the fuel oil system operating pressure and shall be mounted with isolation ball valves.

Provide pump set mounted system control cabinet to monitor and control the fuel oil delivery system in response to day tank demand. Cabinet shall be completely pre-wired, tested and shipped as an integrated system to insure jobsite reliability. Control strategy shall be microprocessor-based and utilize a PLC (Programmable Logic Controller). Relay logic is not acceptable. Cabinet enclosure shall be constructed of a minimum of 18-gauge steel, continuously welded and constructed to NEMA 3R standards. Cabinet interior and exterior shall be primed and finished in durable chemical-resistant enamel suitable for industrial environments. PLC shall have sufficient I/O to accomplish all necessary control functions. The control strategy shall be burned into an EPROM at the factory, and shall be safeguarded against re-configuration by unauthorized or unqualified personnel. All cabinet front devices shall be identified by black labels with engraved white lettering. Cabinet shall consist of but not be limited to the following:

- Microprocessor based PLC with pump alternation
- Magnetic motor starters with overload protection
- Motor circuit breakers
- Manual-Off-Auto illuminated mode selector switch for each pump
- Press to test button for all alarms and indicating lights
- Alarm silence / System reset push-button
- Alarm buzzer
- Discrete output for common alarm to interface with the BMS
- System indicating alarms as follows:
- Power on
- Pump set leak detected
- Day tank high level alarm
- Day tank low level alarm
- Day tank rupture basin leak detected alarm

The duplex packaged pump set shall be from Pedrollo West Europe or Simplex USA or equal.

2-09 not-used

2-10 PUMPS

2-10.1 CENTRIFUGAL WATER PUMPS.

Base-Mounted, Flexible Coupled, End suction Pump

Pumps shall be of type as specified in Equipment Schedule with casings designed for working pressure at least one and a half times the total pressure on the casing. Flange connections shall correspond to casing working pressure.

Certified test curves of pump performance shall be furnished for approval showing horsepower, total dynamic head, efficiency versus water flow.

Each pump shall be driven by a Variable speed VFD compatible motor through a flexible coupling. Motor horsepower shall be selected in a way that the motor shall not be overloaded at any point on the characteristic curve when operating at design speed. Electric Motors must meet NEMA MG 1 and be the wattage horsepower, speed, and voltage indicated. Motor enclosure must be open drip proof [totally enclosed fan cooled]. Motor must have heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Open drip proof motor efficiencies must comply with ASHRAE 189.1. [Totally enclosed fan cooled motor efficiencies must comply with NEMA MG 1.]. Motor shall be VFD compatible, Motor shall be suitable for variable and low speed operation. Motor shall have shaft grounded ring to mitigate the VFD harmonics.

Each pump shall be guaranteed to circulate not less than the quantity of water against the required circulating head when operating continuously, without overheating the motor or bearings, etc. When more than one pumps are required to operate in parallel, the pumps performance curves when operating in parallel shall be provided to show that required flow at the specified head will be obtained. Pumps shall not transmit vibration to the building and shall operate without producing noise, audible anywhere in the building, outside the space in which the pumps are installed.

Chilled/ hot water and condenser water pumps shall have stainless steel shaft and mechanical seals. Pump impellor shall be Hydraulically and dynamically balance to HI 9.6.4 balance grade G6.3, closed, overhung, single suction, fabricate from cast bronze, key to shaft and secured by a locking cap screw.

Pumps and motor shall be mounted on common base frame and shall have been manufacturer’s factory aligned. Baseplate must be of steel construction fully enclosed at sides and ends with welded cross members and fully open grouting area for field grouting. Minimum base plate stiffness must conform to HI 1.3 for horizontal baseplate design standards.

Equip with an integrally flushed mechanical seal assembly or a positive pressure external seal flushing line. Provide a mechanical seal with ceramic seal seat and carbon seal ring. Seal assembly must be rated up to 107 degrees C 225 degrees F.

Provide pumps with capacities as indicated; base mounted, separately-coupled, end suction designed with volute housing mounted to the frame to allow for pump service without relocating the motor or disturbing piping connections. Bearings and seals must be serviceable without disturbing piping. Pump must be factory

hydrostatically tested in accordance with Hydraulic Institute standards and thoroughly cleaned. Incorporate maintenance free, permanently lubricated and sealed bearings in the pump bearing frame. [Regreasable ball bearing type with provision for purging or flushing through the bearing surface and greased while running after start-up.]

Provide a flexible-type coupler between the pump and motor, capable of absorbing torsional vibration and variable speed operation between the pump and motor. The coupler must allow replacement with no need to move the hubs. Coupler must have natural rubber or neoprene type element materials with a maximum misalignment capability of 4 degrees angular and 3 mm 0.125 inches parallel. Couplers shall be rated for required maximum rpm, amperage horsepower and torque. The coupler shall be shielded by a coupler guard securely fastened to the base.

1. The Contractor shall submit all technical data sheets to provide and install end suction centrifugal pumps as scheduled and shown on plans as specified below meeting scheduled capacities and characteristics upon approval of his submission by consultant.
2. Pumps shall be end-suction centrifugal type with casings designed for working pressure at least one & a half times the total pressure on the casing. Flange connections shall correspond to casing working pressure.
3. Each pump shall be driven by a constant speed TEFC squirrel cage motor (Sized 10% higher than the rated pump load) through a flexible coupling. Motor horsepower shall be selected in a way that the motor shall not be overloaded at any point on the characteristic curve when operating at design speed.
4. Each pump shall be guaranteed to circulate not less than the quantity of water against the required circulating head when operating continuously, without overheating the motor or bearings, etc. When more than one pump is required to operate in parallel, the pumps performance curves when operating in parallel shall be provided to show that required flow at the specified head will be obtained.
5. Pumps shall not transmit vibration to the building & shall operate without producing noise, audible anywhere in the building, outside the space in which the pumps are installed. Flexible connections shall be provided at pump suction & discharge.
6. Chilled water, hot water & condenser water pumps shall have bronze impeller, stainless steel shaft, factory painted, safety mesh, & guard with mechanical seals.
7. Pump & motor shall be mounted on machine finished common base frame & shall have been factory aligned & tested for vibration, sound & any abnormal operational signs.
8. All pumps greater than 11 KW (15hp) shall be of horizontal, single stage, double suction (preferably), volume type.
9. Outdoor installed pumps shall be provided with rain protected canopy to avoid the entry of rain water & to avoid the weather effects.
10. Pump efficiency when operating at the specified duty, shall be within 5% of the maximum available efficiency for the particular pump.
11. All pumps, drives & accessories shall be of the highest commercial standard & shall be designed, constructed, rated & tested in accordance with BS 559, Hydraulic institute standards of the USA, latest edition.
12. Pump motor shall be supported by a separate steel base plate & the drive shaft shall be completely protected by a mesh safety screen.
13. The Contractor shall be required to commission the pump as per manufacturer's recommendations. The pump test runs shall be carried out by the contractor & comparison with operational curves submitted to the consultants.

14. The chilled/hot condenser water pump with motor shall be of make & origin as specified.
15. The nominal speed of the pump shall be 1500 RPM, insulation class F and minimum efficiency class IE-4.
16. The contractor shall supply the following information for each pump dully Screw / Revit on pump identification plate of brass / aluminium construction.
    1. Make & model No._____
    2. Flow rate, US G.P.M._____
    3. Discharge head FT _____
    4. Size / RPM _____
    5. Impeller Size _____
    6. Manufacturing Date & Place _____
    7. B.H.P. _____
    8. Type of motor & pump _____
    9. Manufacturer performance guarantees certificate & compliance certificate

2-11 Pressurization System

The pressurization system shall be provided as a complete automatic packaged assembly forming an integral part of the closed-loop chilled water and hot water hydronic network. The system shall maintain stable operating pressure throughout all modes of operation, compensate for thermal expansion and contraction of system fluid, absorb minor water losses, and ensure reliable circulation under varying temperature and load conditions.

The pressurization system is intended to protect the hydronic network from low-pressure conditions, air ingress, vapor formation, cavitation, and hydraulic instability while maintaining the minimum static pressure required at the highest point of the piping system. The system shall automatically regulate pressure through the coordinated operation of expansion tanks, pressurization pumps, pressure sensors, and automatic make-up assemblies.

The pressurization system shall form a fully integrated part of the closed-loop chilled water and hot water hydronic network, designed to maintain stable operating pressure, absorb thermal expansion, eliminate entrained air, and ensure continuous, safe, and energy-efficient system performance under all operating conditions. The system shall maintain the minimum static pressure at the highest point of the network while preventing cavitation, vacuum formation, oxygen ingress, flashing, and hydraulic instability throughout seasonal operation.

The complete system shall include duplex pressurization pumps with automatic lead-lag alternation, ASME-rated diaphragm expansion tanks, pressure reducing valves, backflow preventers, make-up water assembly, pressure transmitters, safety relief valves, air separators, automatic air vents, suction diffusers, strainers, thermometers, gauges, drain valves, and chemical dosing or glycol charging connections. The control panel shall include automatic pressure monitoring, low/high-pressure alarms, pump protection, phase failure protection, auto/manual operation, BACnet/BMS interface, and abnormal make-up consumption alarm to indicate potential leakage conditions.

Automatic make-up water or glycol solution shall compensate only for minor operational losses. The system shall include abnormal make-up

alarm monitoring to identify leakage or pressure decay conditions. Expansion tanks shall be sized to accommodate the total thermal expansion volume of the system fluid, considering operating temperature range, glycol concentration, and design pressure conditions.

Expansion tanks shall be sized based on total system volume, fluid temperature range, glycol concentration, and maximum operating pressure. Pressurization equipment shall be installed at the point of no pressure change near the circulation pump suction to ensure hydraulic stability and proper air elimination.

Installation shall include vibration isolation, housekeeping pads, insulated piping, service clearance, flushing connections, drain routing, and complete commissioning. Final commissioning shall include pressure testing, system flushing, venting, balancing, expansion tank pre-charge verification, control calibration, safety valve testing, glycol concentration verification, and operational demonstration prior to handover.

2-11.1 System Components

1. Pressurization pumps (duplex, lead/lag auto alternation).
2. ASME bladder-type expansion tank.
3. Make-up water assembly with:
   a) Pressure reducing valve,
   b) Double check/backflow preventer,
   c) Water meter,
   d) Isolation valves,
   e) Solenoid make-up valve.
4. Air and Dirt separator with automatic air vent.
5. Safety relief valve piped to drain.
6. Suction diffuser/Y-strainer.
7. Pressure gauges, thermometers, and pressure transmitters.
8. Low-pressure, high-pressure, and low-water alarms.
9. Electrical control panel with VFD (if applicable), HOA selector, phase protection, and BAS integration.
10. Chemical pot feeder/glycol charging connection for water treatment.

2-11.2 Expansion Tanks

- The Contractor shall provide and install single Package Expansion Tank as shown on plans and specified below meeting scheduled capacities and characteristics.
- Tank shall be procured & provided upon approval of manufacturer data sheets approval by consultant and shall be installed as per manufacturer recommendation in connection with the details shown on drawings.
- Tank should be pre-charged vertical / horizontal steel expansion tank with replaceable heavy-duty bladder.
- Tank shall be fitted or dully Screw / Revit minimum information of Tank Actual Volume, Operational Pressure Ratings, Manufacturer Model, Year of Manufacturing, Origin.
- The tank shall be of Welded Steel design and shall be built, tested and stamped in accordance with the ASME BPV Code Section VIII, Division 1 and rated for working pressure upto 160 psi and working temperatures of 03°C-80°C.
- The shell of the tank shall be constructed with carbon steel finished with grey primer finish.

- The tank shall have top mounted carbon steel connection with flexible internal flow tube.
- The bladder shall be nontoxic replaceable type manufactured with high quality butyl rubber; acceptable volume of bladder shall not accede to 90% of tank capacity.
- Tank shall be externally finished with superior quality long-lasting epoxy paint finish to ensure greater protection against atmospheric corrosion.
- The tank shall also have Air Troll fitting with tank drainer.
- The tank shall also have top mounted auto air vent with air charging valve of dia ¼" protected with guard.

2-11.3 Air & Dirt Separators

- Furnish & install centrifugal Air Separator as required.
- Contractor shall be responsible to select and submit technical literature with calculation procedure to consultant for its review and approval before ordering and supply of air separator.
- The unit shall have screwed connection upto dia 2 ½" pipe size & flanged for larger inlet & outlet.
- Connections shall be tangential to the vessel shell.
- Vessel shell diameter to be at-least three times of the nominal inlet/outlet pipe diameter.
- The unit shall have an internal air collector tube with 5/32" (3.9mm) diameter perforation & 60% open area designed to direct accumulated air to the compression tank via screwed connection at the top of the unit.
- The unit shall hare removable stainless steel or brass strainer with 3/16" diameter preformation & a free area of not less than five times the cross-sectional area of the connecting pipe.
- A drain connection with drain valve shall be provided.
- The air separator shall be suitable for l25psi (8.5 bars) S\VP & 180°C (350°F) in accordance with the Section VIII, Division-I of ASME boiler & pressure vessel code.
- The air separator shall be provided with two coats of anti-rust primer & two coats of stove enamelled paint.

2-11.4 Functional Requirements

- Maintain minimum pressure at highest point of system.
- Prevent pump suction pressure from falling below cavitation limit.
- Accommodate full thermal expansion volume.
- Automatic make-up shall compensate minor system losses only.
- Provide alarm for abnormal make-up frequency indicating leakage.

2-11.5 Installation & Commissioning

- Install at point of no pressure change near pump suction.
- Flush, vent, pressure test, and chemically treat system before operation.
- Verify tank pre-charge, pressure settings, sensor calibration, and relief valve operation.
- Installation shall comply with ASHRAE hydronic design practices.
- The air separator shall be installed in strict accordance with manufacturer recommendations.
- The contractor shall be responsible for the commissioning & testing of the air separator to the satisfaction of the consultants.

2-12 Water Treatment System

2-12.1 Chemical Dosing Units

2-12.2 COOLING WATER DOSING SYSTEM

- The Contractor shall provide continuous drip injection pump type chemical feeder for condenser water system.
- The chemical feeder make shall be subject to Employer's/Consultant's approval.
- Sufficient chemicals for Preliminary Tests, Pre-start & Commissioning Tests & for one year of plant operation after commissioning shall be provided.

2-12.3 CHILLED WATER DOSING SYSTEM

- The contractor shall provide technical data and bases of proposed chemicals and its feeders along with dosing system for consultant review and acceptance prior procuring and solution.
- The contractor shall provide gravity bypass type chemical feeder for chilled water system. Feeders shall be installed as shown on Drawings.
- Gravity Bypass Feeder shall be of 5 US gallon capacity cast iron construction (or MS construction with inside epoxy lining), complete with bottom drain tapping & couplings.
- The make of Feeder shall be subject to Employer's/Consultant's approval.
- Sufficient chemicals for Preliminary Tests, Pre-start & Commissioning Tests & for one year of plant operation after commissioning shall be provided.

2-13 GLYCOL feed system (MAKE-UP AND PRESSURIZATION)

2-13.1 GENERAL

Provide complete factory-fabricated and factory-assembled glycol make-up and pressurization system for closed-loop heating water systems serving air handling units, fan coil units, radiators, heat exchangers, terminal heating devices, and associated hydronic piping systems. The system shall be designed to maintain system pressure, accommodate thermal expansion, compensate for minor fluid losses, provide glycol charging capability, and ensure reliable and stable hydronic operation under all operating conditions.

The Contractor shall furnish all labour, materials, equipment, controls, accessories, supports, interconnecting piping, electrical components, and appurtenances necessary for a complete and fully operational installation.

2-13.2 PRODUCTS

The glycol make-up and pressurization system shall include, but shall not be limited to, the following components:

- Glycol storage and mixing tank complete with calibrated level indication and sealed access cover.
- Duplex glycol feed pumps arranged as one duty and one standby unit with automatic alternation.
- Pressure reducing, regulating, and automatic make-up assembly.
- Expansion tank connection assembly.
- Air separator with automatic air elimination devices.
- Safety relief valve, drain valves, balancing valves, check valves, isolation valves, and Y-strainers.
- Flexible pipe connectors and vibration isolation devices.
- Pressure gauges, thermometers, and pressure sensing devices.

- Low-level switch, overflow alarm, and dry-run pump protection.
- Factory-wired electrical control panel complete with HOA selector switches, alarm indication, automatic sequencing, and BAS interface capability.
- First-fill charging connection with quick-connect hose assembly.
- Chemical pot feeder and glycol sampling/test station.

2-13.3 GLYCOL SOLUTION

Provide inhibited propylene glycol specifically formulated for HVAC hydronic systems. Glycol concentration shall be selected based on project freeze protection requirements and anticipated operating temperatures. The glycol solution shall contain corrosion inhibitors, scale inhibitors, and biological growth inhibitors compatible with system piping, valves, pumps, seals, and heat transfer equipment.

2-13.4 INSTALLATION AND WORKMANSHIP

Install equipment on reinforced concrete housekeeping pads with adequate service and maintenance clearances. Provide complete pipe insulation, supports, anchors, identification labels, flushing connections, drain piping, and venting arrangements. Installation shall be executed in a neat and professional manner consistent with recognized HVAC industry standards and manufacturer recommendations.
Upon completion, the entire system shall be flushed, cleaned, pressure tested, vented, balanced, commissioned, and verified for proper glycol concentration and control operation prior to final acceptance and handover.

2-14 ELECTRIC HEAT TRACE SYSTEM FOR PIPING

2-14.1 GENERAL

Provide complete self-regulating electric heat tracing system for freeze protection of exposed hydronic heating piping, valves, strainers, expansion tanks, pumps, and associated accessories installed in outdoor or unconditioned areas subject to ambient temperatures down to -18°C and high-altitude operation. System shall maintain minimum pipe temperature of +5°C under worst-case ambient conditions. Heat tracing system shall include:

- Self-regulating heating cable
- Power connection kits
- End seals and splice kits
- Thermostats and control panels
- High temperature alarms
- Junction boxes
- Weatherproof insulation cladding
- Identification labels

Heat tracing system shall comply with applicable electrical and energy code requirements.

2-14.2 Heating Cable

Heating cable shall be self-regulating parallel resistance type capable of automatically varying heat output based on pipe temperature. Cable shall be:

- UV resistant
- Moisture resistant
- Suitable for outdoor installation
- Rated for minimum 250V operation
- Suitable for continuous energized operation

Minimum heat output shall be:

- 15–25 W/m for insulated steel piping
- Increased as required by pipe size and insulation thickness

Cable outer jacket shall be fluoropolymer or thermoplastic suitable for wet and corrosive environments.

2-14.3 Controls

Provide electronic temperature controllers with ambient sensing thermostat. System shall energize automatically at +4°C and de-energize at +10°C adjustable setpoint. Provide:

- Local disconnect switch
- Pilot lights
- Ground fault protection
- Alarm contacts for BMS integration

2-14.4 Insulation

All heat-traced piping shall be insulated with closed-cell elastomeric or mineral wool insulation with aluminium weatherproof cladding. Minimum insulation thickness:

- 50 mm for piping up to 50 mm dia
- 75 mm for larger piping
- All insulation joints shall be vapor sealed.

2-14.5 INSTALLATION

Install heat tracing in accordance with manufacturer recommendations. Heating cable shall be installed continuously along bottom quadrant of piping and additionally spiral wrapped where required.
Provide separate tracing for valves, strainers, pumps, and flanges. Do not install tracing over expansion joints unless approved connection kits are provided.

2-14.6 TESTING & COMMISSIONING

Contractor shall perform:

- Insulation resistance testing
- Continuity testing
- Functional thermostat testing

- Ground fault testing

Submit commissioning reports and as-built routing drawings.

2-14.7 Not-used

2-15 Not used

2-16 Not used

2-17 TREATED FRESH AIR HANDLING UNITS

2.17.1 Scope

The scope of this section comprises of the supply of double-skin “Treated Fresh Air Units conforming to the following specifications. The manufacturer or their principals shall have at least 10 years of designing and manufacturing experience directly in the product i.e. energy recovery devices, with a two tier, two air stream unit design. The heat recovery wheel and box should be from the same manufacturer.

2.17.2 Type

The Treated Fresh Air units shall conform to Eurovent or AHRI standards and shall be suitable for outdoor installation, each TFAU unit shall be two stream units in double skin construction, comprising of supply air section, return air section and Heat Recovery Section. The supply air section shall include the following sections if defined in the Schedule: Cooling/Heating Section, Microvee filter section, Mixing Box Section, UVG Section, Sound Attenuator Section, Damper Section, Humidifier Section, and Inspection Section. Option shall be available for Digital Air Flow Measurement, Pressure Transmitter And Filter Cleaning Alarm if required in the Schedule.

2.17.3 Capacity

The Treated Fresh Air units shall be of such capacities and static pressures as mentioned in the equipment schedules.

2.17.4 Casing

Casing shall be double skin type from hot dip galvanized and shall have a raised insulation consisting of a factory applied polyurethane layer injected between the panels having a minimum density of 2.5 lbs./ft3 (40 Kg/m3) be made of sheet steel minimum thickness 0.6 mm and finished with electo-statically coated powder baked paint. The unit frame-work shall consist of powder coated or hot-dip galvanized multi-angle sectional elements, assembled with reinforced corners. Re-location of fan section in relation with coil section shall be possible to achieve up-blast, down-blast, top horizontal and bottom horizontal discharge, and vertical or horizontal arrangement of AHU. Factory assembly shall be as scheduled. If scheduled, Treated Fresh AHU shall include factory assembled mixing box with RA and OA inlet connection, and RA/OA dampers.

If TFU are to be installed outdoors (if scheduled), then the outdoor units shall be equipped with a canopy made of galvanized steel sheet. Access

doors shall be equipped with robust quick release locks and hinged doors with handles for easier opening.

2.17.5 Supply Air Section

The supply air section shall comprise of the following:

Fan Section

The fan shall be centrifugal forward curved or backward curved, double inlet double width type. The impeller and the fan casing shall be made of hot galvanized sheet steel. The impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearing. The impeller shall be statically and dynamically balanced. Fan housing and motor shall be mounted on a common galvanized steel or aluminium block base which can be drawn out from side for ease of maintenance. Quarter pins lock arrangement between the slide and guide pin lock arrangement between Fan and TFA outlet should be provided.
All fresh air induction inlets shall be equipped with bird mesh, decorative louvers and rain protection hood.

Motor And Drive

Motors shall be 3-phase totally enclosed, minimum protection IP-55, IE4, insulation class F, fan cooled with dynamically balanced rotors and per-lubricated ball bearings. They shall be mounted on an adjustable base for belt tensioning. Drive shall be provided through belt – drive arrangement. Belts will be of oil-resistant type.

Filter Section

The filter section shall be normally designed for deep folded disposable synthetic pre-filters for Class G-3. The filter elements shall be mounted on rails and shall be easily pulled out for replacement. Pressure drop at 500 fpm shall not exceed 0.05” wg. The rails shall be factory built of 16-gauge galvanized steel with seal or efficient gaskets to minimize the risk of leakage. If mentioned in the Bill of Quantities the section shall be designed to include filters up to class F-8 in accordance with latest ASHRAE standards for filter efficiency.

2.17.6 Return Air Section

The return air section shall comprise of above sections. The specification for this section shall remain same as defined above.
All exhaust air outlet discharge shall be equipped with bird mesh, decorative louvers and rain protection hood. Suitable distance shall be provided between inlet and discharge inlets and outlets.

2.17.6.1 UV Light Section

- UV lights shall be installed at locations shown in TFU sectional arrangement, Lamps and fixture shall be configured in sufficient quantity and in such a manner so as to provide an equal distribution of UVC energy. Each lamp shall contain no more than 5.5 milligrams of mercury consistent with current

environmental practices while procuring the specified output at 500 fpm in temperatures of 60-135°F.

- Fixtures shall be constructed of aluminium with UVC proof metal bases & UL approved fixtures for mechanical and electrical connections that facilitate proper installation and coupling to A/C power from one end.
- Each fixture shall be equipped with an electrical interlock, which shall not allow the fixture to energize unless it's properly installed to its factory supplied and manufacturer recommended track.
- All access panels and doors to the UVC assembly and/or within view of the fixture shall include mechanical interlock switched to de-energize the UVC assembly when any of this access is opened.
- Lamp life shall be 9000 hours with no more than 20% output loss at the end of one year of continuous use.
- Door safety switches shall be provided on all doors in unit to de-energize the UV lights when an access door is opened. In addition, safety labels shall be located on all doors that have a door safety switch. If the segment does not have door, a label will be added to segment panel.
- A NEMA-3R UV control panel turn off the UV lights shall be factory tested and installed; the control panel shall disconnect the UV lighting circuit before opening of an access door. Should an access door be opened before disconnecting the UV circuit, the door safety switches shall turn off UV lights automatically.

2.17.6.2 Heat Recovery Section

The Heat Recovery section shall include 'ECOFRESH' make enthalpy wheels and shall have minimum recovery of 75 % of total heat, i.e. both sensible and latent (each being 75 %). The recovery of sensible and latent shall be equal. Necessary computerized selection of the wheel should be provided along with the bid to justify the same. The wheel shall be made of pure aluminium foil coated with molecular sieve desiccant "Ecosorb 300" with pore diameter of 3oA. The cross contamination between the two air streams shall be nil and leakage less than 0.04%. The vertical and radial run of the wheel shall be less than 1 mm per meter of diameter. The wheels shall have non-contact labyrinth seals for effective sealing between the two air streams.

Detailed specification for the wheel shall be as per 8.0 i.e. "HEAT RECOVERY WHEEL"

2.17.8 Heat Recovery Wheel specifications

Rotor/wheel matrix shall be of "Ecofresh" make —
The substrate: The substrate or wheel matrix should be only of pure aluminium foil so as to allow.

a) Quick and efficient uptake of thermal energy.
b) Sufficient mass for optimum heat transfer
c) Maximum sensible heat recovery at a relatively low rotational speed of 20 to 25 rpm.

Non-metallic substrates made from paper, plastic, synthetic or glass fibre media, will therefore, not be acceptable.

The substrate shall not be made from any material which is combustible or supports combustion like synthetic fibrous media.

The wheel has to be certified as per DIN EN ISO 846 with 0% fungal and bacterial growth at 95% Relative humidity and above.

Fire Rating

NFPA - 90A certification with 0% for Flame spread classification should be confirmed by manufacturer.

Pressure Drop

The pressure drop across the rotary heat exchanger shall not exceed 0.1 inch for every 100 FPM face velocity, or part thereof, for the minimum stated / required Latent recoveries / efficiencies

necessary software selection of the wheel has to be enclosed to justify the pressure drop and efficiency calculations.

The Desiccant

The desiccant should be water molecule selective and non-migratory.

The desiccant should be molecular sieve 3Å (Ecosorb 300), so as to keep the cross contamination to absolute minimum and also ensure the exclusion of contaminants from the air streams, while transferring the water vapor molecules.

The desiccant, of sufficient mass which should not be less than 5 kg per 1000 Cfm of air, should be coated with non-masking porous binder adhesive on the aluminium substrate so as to allow quick and easy uptake and release of water vapours. A confirmation has to be provided by manufacturer of wheel to this effect. A matrix with desiccants impregnated in non-metallic substrates, such as synthetic fibre, glass fibre, etc. will not be accepted.

The rotor/wheel matrix shall have equal sensible and latent recovery.

The weight of desiccant coating and the mass of aluminium foil shall be in a ratio so as to ensure equal recovery of both sensible and latent heat over the operating range.

Accordingly, a rotor matrix which has an etched or oxidized surface to make a desiccant on a metal foil and results in insufficient latent recovery and hence unequal recovery, or a rotor matrix made from desiccant integrated in a synthetic fiber matrix which results in insufficient sensible recovery, high rotation speed, and unequal recovery, will not be accepted.

Rotor

1. With optimum heat and mass through matrix formed by desiccant, of sufficient mass, coated on an aluminium foil, the rotor should rotate at lower than 20 to 25 RPM, thereby also ensuring long life of belts and reduced wear and tear of seals.
2.
3. The rotor shall be made of alternate flat and corrugated aluminium foil of uniform width. The rotor honeycomb matrix foil should be so wound and adhered as to make a structurally very strong and rigid

media which shall not get cracked, deformed etc. due to change of temperature or humidity.

4.
5. The rotor having a diameter up to 2800 mm shall have spokes to reinforce the matrix. From 2000 mm diameter upwards, the option of a special wing structure, to prevent the rotors from wobbling or deforming due to the successive pressure differentials, will be available.
6. Sectioned wheels, with pie segments, capable of being assembled in the field, shall be available as an option, above 2000 mm in diameter.
7. The surface of the wheel/rotor should be highly polished to ensure that the vertical run out does not exceed + 1 mm for every 1-meter diameter, thereby ensuring, negligible leakage, if labyrinth non-contact seals are provided, and minimal drag, if contact wiper seals are provided.
8. The radial run out also shall not exceed + 1 mm for every 1-meter diameter, thereby minimizing the leakage/drag on the radial seals, and minimizes the fluctuation in the tension of the drive belt.
9. The number of wraps (of alternative corrugated and flat foil) for every inch of rotor radii shall be very consistent so as to ensure uniform air flow and performance over the entire face in the air stream. Flute height and pitch will be consistent to a very tight tolerance to ensure uniform pressure drop and uniform airflows across the rotor face.
10. The rotor shall be a non-clogging aluminium media, having a multitude of narrow aluminium foil channels, thus ensuring a laminar flow, and will allow particles up to 800 microns to pass through it.
11. The media shall be cleanable with compressed air, or low-pressure steam or light detergent, without degrading the latent recovery.

The Cassette / Casing.

The recovery wheel cassette/casing shall be manufactured from tubular / sheet metal structure to provide a self-supporting rigid structure, complete with access panels, purge sector, rotor, bearings, seals, drive mechanism complete with belt.

The rotor/wheel should have a field adjustable purge mechanism to provide definite separation of airflow minimizing the carryover of bacteria, dust and other pollutants, from the exhaust air to the supply air. It shall be possible, with proper adjustment, to limit cross contamination to less than 0.04% of that of the exhaust air concentration.

The face and radial seals shall be four (4) pass non-contact labyrinth seals / brush seals for effective sealing between the two air streams, and also for a minimum wear and tear ensuring long life of the seals.

2.17.9 Commissioning & Testing.

12. The pre-commissioning check list to be provided by the commissioning engineer prior commissioning to the installer for proper installation & pre-check the installation prior to start commissioning without any extra charge.
13. The Contractor shall provide a factory authorized & trained commissioning Engineer, employed by the manufacturer, to perform &/or supervise pressure test (when required), Top-up chiller with refrigerant, place unit into operation, & calibrate all controls in

accordance with the manufacture's written start-up, operating, & maintenance instructions.

14. The Commissioning Engineer shall furnish a start-up log indicating that proper operation conditions, operating sequences & operating & safety control functions are obtained.
15. The Commissioning Engineer of chiller may recommend specified tests & these test reports shall be submitted to the Consultants by the Contractor in suitable test forms.
16. Once the chillers) shall be successfully commissioned & the report prepared by the factory authorized commissioning engineer, the final report handed over to the client shall be countersigned by the factory' engineer (placed in the manufacturing plant) for its performance authenticity as per the design performance requirements.
17. Contractor will ensure that, after unit start-up has been performed & witnessed by client, the Authorized Commissioning Engineer shall be available on site for a period of instruction not to exceed accumulative 36 working hours to instruct the owner's personnel in the proper start-up, operating, & maintenance procedures & hands on training.
18. All chilled water supply/return connections, power line connections, valves installation, valves & pipeline tagging, electric power & control wiring/cabling to be provided by the installation contractor.
19. Installation contractor shall also be responsible to ensure all control interfaces complete in all respect to connect AHU, Chillers, Pumps; VFD's or with any related equipment etc.

2-18 Chilled/ Hot water Fan coil units (FCU)

2-18.1

Each unit shall be selected as the requirement of the cooling load and interior layout in the respective space to be air-conditioned. The unit shall be equipped with an electronic expansion valve, which can communicate with the VRF controller motorized control valve in the condensing unit.

The fan shall of the dual suction multi blade type and statically and dynamically balanced to ensure low noise and vibration free operation.

Each indoor unit shall be equipped with cordless local control unit for setting the operating parameters. The address of the indoor unit shall be set automatically in case of individual and group control. Option of centralized control should also be achievable. Controls shall be provided to maintain the set room temperature within close tolerance limits.

2-18.2 REMOTE CONTROL UNIT:

A Remote-Control Unit shall be provided for the system, suitable to be mounted near the entrance door of the premises. It should be possible to operate the entire air conditioning system and set working parameters of all indoor units and the VRF outdoor unit from this control unit. The unit shall be equipped with self-diagnosis for easy and quick maintenance and service. The remote controller shall memorize the latest malfunction code for easy maintenance. The Controller shall be equipped with a battery back-up and a real time clock.

It should be possible to control several number of indoor units and change fan speed and angle of swing flap individually and in group.

2-18.3 DRAIN PIPING

The drain piping shall be made out of rigid PVC pipes of 10 Kg/cm2 class. The piping shall be supported by clamping on MS angle 25mm x 3mm running continuously below the pipe. The piping shall be insulated with 6mm thick closed cell nitrile rubber sleeves.

The drain pans of IDUs shall be connected to rigid PVC pipe by braided PVC flexible pipe with appropriate adapters. U trap shall be providing in the drain connection of each IDU. All pipes support/clamps shall be painted with red oxide primer followed by two coats of synthetic enamel finish paint.

2-19 Variable Refrigerant Flow Systems (VRF)

2-19.1 GENERAL

The system shall be air-cooled, direct expansion type central air conditioning system consisting of one or more Variable Refrigerant Flow Condensing unit (Outdoor Unit) and connected to it one or more Evaporator (indoor) units.

VRF systems must comply with ASHRAE Standard 15 (packaged with Standard 34): Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants. This addresses refrigerant capacities and possible leakage, especially if the system serves small rooms, which could cause oxygen depletion. According to Standard 15, a VRF system is classified as a direct system/high-probability system where a refrigerant leak can potentially enter into the occupied space.

ASHRAE Standard 15 requirements should be applied to each VRF system design in the following steps:

- Determine the occupancy classification for the rooms
- Calculate room volume
- Determine the amount of refrigerant in the system including the outdoor unit, indoor units, and associated piping
- Verify that the room is not too small using the following formula:

2-19.2 CONDENSING UNIT (OUTDOOR UNIT):

The condensing unit shall be capable of assessing the requirement of liquid refrigerant volumetric flow of each evaporating unit at all times by means of a sophisticated microprocessor controller and generating the required total volume of refrigerant liquid for supply to the evaporator units.

The condensing unit shall be a factory-assembled unit housed in a sturdy weatherproof casing constructed from rust proof galvanized powder coated steel panels. The noise level of the unit shall not be more than 70dB (A) measured horizontally 1 m away and 1.5 m above base level.

The compressors shall be hermetically sealed Inverter driven variable speed type scroll type, capable of changing the capacity in accordance to the cooling load requirement.

The condenser coils shall be constructed out of copper tubes mechanically bonded to aluminium fins.

The surface of the condenser coil shall be coated with suitable chemical coating to prevent deterioration due to coastal climate.

All necessary safety devices shall be provided to ensure safe operation of the system.

Unit should be equipped with a highly efficient oil separation system to ensure stable operation with long refrigerant piping.

The VRF condensing unit shall be located in open on a terrace with adequate clearance from nearby objects to ensure unobstructed air flow and easy approach for maintenance.

The VRF condensing unit for AHUs shall be complete in all respects including AHU Control Kit, Automatic Controls, Communication and integration etc.

2-19.3 INDOOR UNITS (EVAPORATING UNITS):

Each unit shall be selected as the requirement of the cooling load and interior layout in the respective space to be air-conditioned. The unit shall be equipped with an electronic expansion valve, which can communicate with the VRF controller in the condensing unit.

The fan shall of the dual suction multi blade type and statically and dynamically balanced to ensure low noise and vibration free operation.

Each indoor unit shall be equipped with cordless local control unit for setting the operating parameters.

The address of the indoor unit shall be set automatically in case of individual and group control.

Option of centralized control should also be achievable.

Controls shall be provided to maintain the set room temperature within close tolerance limits.

Each indoor unit shall be equipped with Electrical Safety fuse and Isolation switch.

2-19.4 REMOTE CONTROL UNIT:

A Remote-Control Unit shall be provided for the system, suitable to be mounted near the entrance door of the premises. It should be possible to operate the entire air conditioning system and set working parameters of all indoor units and the VRF outdoor unit from this control unit. The unit shall be equipped with self-diagnosis for easy and quick maintenance and service. The remote controller shall memorize the latest malfunction code for easy maintenance. The Controller shall be equipped with a battery back-up and a real time clock.

It should be possible to control several numbers of indoor units and change fan speed and angle of swing flap individually and in group.

2-19.5 REFRIGERANT PIPING:

The refrigerant piping interconnecting to indoor & outdoor units shall be made out of hard copper tubes, in brazed construction. The refrigerant line sizing should be designed to achieve minimum pressure drop and avoid oil return problem. The pipe sizes and connections shall be designed such that the

evaporator units do not face back pressure due to the functioning of the evaporator next to it.

All suction piping shall be insulated with closed cell elastomeric class 'O' nitrile rubber foam tubes of suitable diameter and thickness.

All piping shall be neatly laid and supported on galvanized perforated sheet metal trays and clamped firmly. Piping should be shrouded, where necessary, to protect it from accidental damage/leaks during work by any agencies.

All the wiring interconnecting the indoor and outdoor units shall be PVC insulated copper conductor flexible wires of appropriate rating, and shall be laid through PVC conduits.

The refrigerant piping for the VRF system shall be of minimum wall thickness as per copper pipe-ASTM B88, L-Type standard HARD drawn copper pipes. The copper pipe shall be internally chemically cleaned, free of dirt, dust, oxidation and any other deposits. All joints shall be made by brazing. Inert gas purging shall be used during the brazing process to prevent oxidation.

Suction line shall be insulated with 19mm thick sleeve made out of closed cell elastomeric nitrile rubber foam insulation of fire retardant 'O' class. Wiring interconnecting the indoor and outdoor unit shall be done with PVC insulated copper conductor flexible wires of appropriate rating.

U-bends shall be provided for efficient oil return in suction line, at appropriate locations.

All piping shall be supported on GI perforated cable trays, and covered by GI sheet channels from the top, to prevent accidental damage during work of other agencies. The GI covers and trays shall be fixed to MS angle supports by bolting, to facilitate removal of the trays for verification of pipe leaks.

All pipe supports/clamps shall be painted with red oxide primer followed by 2 coats of synthetic enamel finish paint.

The piping and wiring shall be laid such that it does not spoil the aesthetics of the premises, and is safe, secure and approachable for leak detection/repair/replacement.

2-19.5 DRAIN PIPING

The drain piping shall be made out of rigid PVC pipes of 10 Kg/cm2 class. The piping shall be supported by clamping on MS angle 25mm x 3mm running continuously below the pipe. The piping shall be insulated with 6mm thick closed cell nitrile rubber sleeves.

The drain pans of IDUs shall be connected to rigid PVC pipe by braided PVC flexible pipe with appropriate adapters. U trap shall be providing in the drain connection of each IDU. All pipes support/clamps shall be painted with red oxide primer followed by two coats of synthetic enamel finish paint.

2-20 Split Units

2-20.1 GENERAL

Provide complete factory-assembled inverter-driven ducted split air-conditioning and heat pump system suitable for continuous cooling and heating operation under extreme ambient conditions, including low ambient winter operation down to -18°C outdoor temperature. System shall be suitable

for commercial, institutional, residential, or mission-critical applications requiring concealed ducted indoor installation.

2-20.2 SYSTEM DESCRIPTION

The system shall consist of:

1. Outdoor air-cooled inverter condensing unit.
2. Concealed ducted indoor fan coil unit.
3. Variable-speed inverter compressor.
4. Electronic expansion valve (EEV).
5. R410A or R32 refrigerant.
6. Wired programmable controller with heating/cooling auto changeover.
7. Refrigerant piping, controls, drain piping, and accessories.

2-20.3 DESIGN CONDITIONS

1. Indoor Cooling Condition: 24°C ±1°C.
2. Indoor Heating Condition: 22°C ±1°C.
3. Unit shall maintain stable heating capacity at low ambient using inverter compressor technology and intelligent defrost control.

2-20.4 PERFORMANCE REQUIREMENTS

- Minimum Energy Efficiency: IEER/COP as per applicable ASHRAE and local energy codes.
- Inverter compressor shall modulate capacity from 20% to 100%.
- Heating operation shall remain functional at -18°C ambient without compressor damage.
- System shall include low ambient protection, crankcase heater, compressor insulation jacket, and intelligent defrost cycle.

2-20.5 OUTDOOR UNIT

- Heavy-duty galvanized steel casing with epoxy coating.
- DC inverter rotary or scroll compressor.
- Low-noise condenser fan with ECM motor.
- Factory-installed crankcase heater.
- Anti-corrosion coated condenser coil.
- Refrigerant leak protection and high/low pressure safety controls.

2-20.6 INDOOR DUCTED UNIT

- Concealed ceiling mounted type.
- Double-skin insulated drain pans.
- ESP suitable for ducted distribution system.
- Washable synthetic air filters.
- Low-noise centrifugal fan with multi-speed ECM motor.

2-20.7 CONTROLS

- Microprocessor-based control system.
- Weekly programmable thermostat.
- Automatic restart after power failure.
- Heating/cooling mode lockout capability.

- BACnet/Modbus gateway compatibility.

2-20.8 INSTALLATION REQUIREMENTS

- Refrigerant piping insulation shall be UV-resistant closed-cell elastomeric type.
- Condensate drain piping shall be insulated and trapped.
- Outdoor unit supports shall include vibration isolation mounts.
- Heat trace shall be provided for condensate drains exposed to freezing conditions.

2-20.9 TESTING & COMMISSIONING

Contractor shall perform:

- Refrigerant leak testing.
- Vacuum dehydration.
- Functional testing in cooling and heating modes.
- Verification of operation at low ambient conditions.
- Airflow balancing and controls calibration.

2-20.10 WARRANTY

Provide minimum:

- 5 years compressor warranty.
- 1-year parts and labour warranty.

Recommended efficient thermostat settings for operation shall comply with recognized HVAC practices

2-21 Not used

2-22 Not used

2-23 Not used

2-24 Not used

2-25 Not used

2-26 Not used

2-27 Not used

2-28 Not used

2-29 Not used

2-30 FANS (ventilation Equipment)

General

These specifications are for all fans other than fitted inside Roof Top and/or FCUs. All fans shall be of make and origin as mentioned in Equipment Schedules unless otherwise approved by the Engineer.

All fans shall have been rated per AMCA standard 210- 74 or ASHRAE standard 51-75 or equivalent. Wheels shall be heavily rigidly constructed and accurately balanced both statically and dynamically, and be free from objectionable vibration or noises. Actual brake horsepower of fan and drive shall not exceed nameplate rating of motor driving fan. Motor shall be included.
h the factory balanced and tested fan wheels and casing (Complete).

2-30.1 Centrifugal Fans

These shall be centrifugal type, of characteristics and capacities as Scheduled. Fans shall be belt driven as Scheduled. Fan motors above 1/2 HP shall be 3-phase induction type and 1/2 HP or smaller shall be single phase split capacitor. Centrifugal impeller shall be attached to the motor shaft end. Motors for belt driven fans shall be mounted on fan casing. Motor base shall be adjustable type with pivot at one end for easy and accurate belt adjustment. The fan inlet shall have an aerodynamic design to ensure turbulence free air flow at discharge. Centrifugal impeller blades shall be backward inclined or aero foil type. Fan impeller shall be made of heavy gauge steel. Impeller shall be dynamically balanced and shall have cast iron hub. The fan bearings shall be self-aligning ball bearing type. Fans shall be complete with cabinet casing, mounting frames, brackets for ceiling suspension, bolts and accessories, including belt guard and spring vibration isolators as required. Access doors will be provided with double hinges. Weather proof junction box for electric connection will be provided with each unit.

All supply fans shall be supplied with the factory installed washable filters will be provided by manufacturer. Contractor shall supply/exhaust centrifugal fans.

2-30.2 Staircase Pressurization System

The contractor shall supply, install, commission, test and set to work stair case pressurization systems in accordance with the requirements relevant codes and standards.

The contractor shall be responsible to verify the Stair case fan sizing and ESP required to maintain the pressure in stair case, considering the changes during construction of Building.

In brief the system shall comprise but not be restricted to the following:

- Inverter controlled fans as required complete with all duct work and ancillaries to ensure effective operation.
- Inverter controlled soffit mounted low profile induction fans finished to suit the Staircase/Stairwell pressurization application.
- Master control panel incorporating automatic changeover switch (power supplies by others)
- Manual override control Interfaces between all panels and with the BMS for fault reporting
- An addressable multi-criteria smoke detection system

- Fault detection link to a central control panel as installed by the contractor.
- Anti-vibration mounts and all supporting materials (all isolation must achieve 99% efficiency)
- Identification of all plant and equipment
- Installation of fans, ducts, detectors, controls, electrical wiring, cable tray, all associated support steelwork and fixings. (complete I all respects)
- Full commissioning of fan systems, controls and detection systems to include witnessing by

2-30.2.1 MOTOR:

1. Motors power supply is are 400 V, 50 Hz.
2. Motors should suitable for DOL (direct on line) start.
3. Motor protection is IP 55 and the insulation is class F or H, depending on model.
4. Energy efficiency class IE-4 motor.

2-30.2.2 INSTALLATION:

1. Each jet fan should supply with fixing brackets, for ceiling (or wall) installation.
2. Jet fans need to be installed at least 0.5 m from beams on the inlet side and at least 2.0 m from beams on the outlet side (beam height: 400 mm).

2-30.3 Vehicle Exhaust Ventilation System (LEV)

The following codes, regulations and guidelines are to be considered part of these specifications and are a minimum standard of evaluation for this Hazardous Material Exhaust System.

- NIOSH
- Underwriters Laboratory (UL)
- National Fire Protection Agency (NFPA)
- National Electric Code (NEC)
- NFPA 1500 – 2002 Edition
- Air Movement and Control Association International Inc.(AMCA)
- International Mechanical Code (IMC)
- Uniform Mechanical Code (UMC)
- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)

2-30.3.1 The system shall meet the following minimum performance criteria:

1. The exhaust removal system must provide virtually 100% complete evacuation of all vehicle emissions (particulate, gasses and fumes) at the source from start up to exit of the apparatus from the fire station. Independent certification documents shall be provided and attached to the bid proposal.

2. The exhaust system shall not block doorways, exits, and aisles in the apparatus bay, which could endanger the welfare of fire personnel or visitors.

2-30.3.2 Standard Products:

Equipment and materials provided for the system installation(s) shall be manufactured and provided by the supplier of primary exhaust removal system (Equipment Manufacturer) and be a standard product of manufacturer currently engaged in the manufacture of Vehicle Exhaust Extraction Systems. Where the requirement calls for a packaged exhaust system to be provided, all items shall be the standard product of the manufacturer. The Vehicle Exhaust Extraction System Manufacturer has provided Vehicle Exhaust Systems for a minimum period of ten (10) years.

2-30.3.3 Quality Assurance:

The manufacturer must be ISO 9001:2000, certificate must state for the Design, Assembly, Marketing and Sales of Extraction and Filtration Systems and Equipment. UL and CUL Certified and certified by the Air Movement and Control Association (AMCA) to ensure quality, consistency and reliability of products. Certification documents shall be provided and attached to the bid proposal. All Workmanship, manufacturing procedures, airflow design and materials shall be performance guaranteed. If any performance as outlined in the performance/technical specifications, the bidder shall remove and replace at his expense the materials in question.

2-30.3.4 Manufacturers Qualifications:

Bids shall only be accepted from bidder's supplying equipment from manufacturers that have an established reputation in the business of manufacturing Vehicle Exhaust Extraction Systems for a minimum of no less than ten (10) years. System bid shall have a life of service of no less than ten (10) years to establish proof of quality, longevity and service. Equipment life of service shall meet the department's expectations for similar types of equipment.

2-30.3.5 Requirement of Exhaust Extraction System:

Upon emergency vehicle(s) starting, the exhaust ventilation fan shall be automatically energized by the output pressure generated by any internal combustion engine and evacuate the toxic exhaust fume.

The nozzle must release and disconnect near the threshold of the exit door regardless of the speed the vehicle may exit the door.

Systems which limit the exiting speed are not acceptable as they can limit emergency response time.

Due to harmful effects of diesel exhaust, the system must be designed and capable of virtually capturing 100% of the exhaust gases and particulate even in the event of a complete power failure. Stand-alone system with no additional wiring to make it operate.

The system will not detach itself from the apparatus for any reason during a power failure other than normal exiting of the apparatus bay.

Systems that require additional or alternate power source to eliminate detaching during power failure are not acceptable due to additional maintenance requirements.

To protect the apparatus electrical system from any possible damage, the system bid shall not incorporate any type of electromagnetic device that requires the apparatus to be utilized as an electrical ground for the system's operation.

The system will not incorporate any electromagnetic or magnetic devices that require either fastening or drilling into the side body panels or tailpipes of the fire apparatus, which could affect vehicle warranty. A pneumatic system is preferred.

The nozzle release mechanism must be external on the system to insure safe disconnect of nozzle from tailpipe.

The upper hose assembly must be rated for 600˚F continuous, 700˚F intermittent temperature to ensure the exhaust fume does not deteriorate the hose and leak. The lower hose assembly must be rated for 900˚F continuous, 1221˚F intermittent.

A safety disconnect handle shall completely separate the lower nozzle section from the upper hose assembly.

All electronic and electrical components shall be UL listed and shall provide documentation of such. Control panel must meet NFPA 74 for arc flash protection and panel shall be manufactured in a 508A panel shop.

The upper and lower hose sections must be capable to swivel 360 degrees, (if swivel is incorporated in design) allowing free flowing system operation, thus allowing no tension on the hose attachment and the hose release features.

Systems that utilize adaptors which mate with Magnetic type nozzle connection in order to secure the nozzle to exhaust pipe in a fastening mode must be metal to metal connection.

Systems which require disconnection of nozzle from vehicle when working on vehicle's fuel system, recharging batteries or whenever there is a risk of inflammable dust or explosive gases, are not acceptable.

Manufacturer must be an ISO 9001:2000 Certified Company with Certification issued to United States Facility. Certification bust be accompanied with bid.

Attachment shall be made in any direction of the nozzle, no attachment point mandated. It may be a Clip and Go.

Due to safety of fire personnel, systems which require tailpipes or their adapters to protrude beyond the outside edge of the chassis are no acceptable due to NFPA 1901, 2009 requirements.

The transition from the Magnetic nozzle to the flexible hose (if used) shall be one piece welded construction to prevent leaks of exhaust fumes. The transition shall be made of stainless steel for durability.

All components used along the track and in system shall be of non-rusting material. Components shall be set at heights to not impede movement of apparatus.

Nozzle construction at point of contact to exhaust pipe must be metal to metal connection.

System must allow in station pump test for 15 minutes / 1500 RPMs, this feature must be printed on Control Center for System Operation procedures.

Tailpipe Adapters (if used) must be bolted onto the exhaust system, welded on adapters will not be acceptable.

Control panel must have system indicator lights and AUTO START-STOP-MANUAL RUN controls.

Controls that require electrical or pneumatic devices installed to exhaust blower must not cause interference with any equipment.

System shall have an automatic timer set to properly operate for the duration of the 100% exhaust capture. After the time has expired, the exhaust blower will shut off.

Blower must provide design flow for use. Specifications will be supplied by bidder for use design.

Duct work shall be designed to meet extraction system.

All non-welded ductwork, fittings and joints must be securely fastened and sealed with a mechanical Teflon duct collar with locking bolt mechanism as required by the International Mechanical Code and the Uniform Mechanical Code.

Back-draft damper exhaust rain cap must provide protection from rain and other inclement weather.

Silencer/Muffler must be connected to exhaust discharge to reduce discharge air noise for all fans to reduce noise decibels to 64dba.

System must be covered for warranty of not less than 5 years of full parts and labour complete. Submitting company must include service center location within IL and provide such address and contact information. Training to be provided by Bidder at the time of installation to the Fire Staff for the use and operation of the Vehicle Exhaust Extraction System to all three shifts.

Bidder must make an on-site survey of the facility and provide a layout drawing showing location of vehicles and equipment to be supplied. This is a mandatory requirement to ensure the proposed system meets the intent of the specifications and fits within the building space. Drawing must be included with the bid.

2-30.4 Parking Ventilation and Smoke extraction System

The contractor shall design, supply, install, commission, test and set to work vehicle smoke extraction systems in accordance with the requirements of Parts B and F of the building regulations which are summarised as follows:

Fire condition:

The system shall be capable of providing a minimum of 10 air changes per hour (or 12 air changes per hour in order to incorporate the use of 2 speed fans if this presents a cost saving). The smoke outputs and ventilation requirements shall be assessed in accordance with BS7346 Part 7.

The contractor shall carry out CFD modelling to demonstrate to building control as required that both car park and common area ventilation methodologies achieve the requirements of Parts F and B of the building regulations as appropriate. Use CFD (Computational Fluid Dynamic) software is to analyse complex systems and make a precise model of the airflow (direction and speed), of the pressure and of the temperature in each point of the system. Submit the same for approval.

Care should be taken to ensure that there are no stagnant areas in either daily ventilation or smoke ventilation operational mode. Provision should be made for the supply of replacement air to the car park. All fans intended to move or exhaust hot gases used within a car park ventilation system should be tested in accordance with EN 12101-3. Each item shall be CE marked in compliance with EN 12101-2 and shall be in line with BS 9991 and BS 9999.

The contractor shall liaise electrical contractor to coordinate services generally, locations of power supplies, containment and outlets as required.

The car park ventilation will be provided to achieve two purposes, day to day ventilation of the car park and protection of the building and fire fighters in the event of a fire and is described below.

There shall be at least two fans capable of extracting 50% of the required rates and able to operate independently or simultaneously. Each fan shall be rated to run at 300°C for a minimum of 2 hours as shall all connecting ductwork and any other ancillaries and support mechanisms. Final openings to the external atmosphere are shown on drawings these will be assessed by the smoke ventilation specialist to ensure cohesion with the ventilation design.

The resistance to airflow and turbulence caused by down stand beams and any other obstruction should be taken into account when placing the jet fans.

Care should be taken to ensure that the number of jet fans activated will not induce the movement of a volume of air greater than that which the main extract fans are capable of extracting.

Where a sprinkler system is to be installed, the location of the sprinkler heads and jet fans should be co-ordinated to ensure that the effect of the jet fans on the spray pattern of the sprinklers is minimized.

In brief the system shall comprise but not be restricted to the following:

- Inverter controlled car park extract fans and attenuation as required complete with all duct work and ancillaries to ensure effective operation
- Car park extract fans to be completed with acoustic fan jacket to ensure noise criteria.
- Inverter controlled soffit mounted low profile induction fans finished to suit the car park environment

- Master control panel incorporating automatic changeover switch (power supplies by others)
- Manual override control
- Interfaces between all panels and with the BMS for fault reporting
- CO detectors with a minimum life of 6 years with link to control panel indicating expiry
- An addressable multi-criteria smoke detection system
- Fault detection link to a central control panel.
- Anti-vibration mounts and all supporting materials (all isolation must achieve 99% efficiency)
- Identification of all plant and equipment
- All plant and distribution support systems and containment

The services associated with the installation shall comprise but not be restricted to the following:

a. Installation of fans, ducts, detectors and controls
b. Installation of electrical wiring and cable tray
c. Installation of all associated support steelwork and fixings
d. Full commissioning of fan systems, controls and detection systems to include witnessing by the appropriate authorities – allow for separate visits for commissioning and handover.
e. The design requirements associated with the installation shall comprise but not be restricted to the following:
    - Full CFD analysis – to prove system design is suitable to meet the requirements of AD B3 and to prove general effectiveness of ventilation with regards to AD F1
    - Compliance with BS 7671 (17th Ed)
    - Controls system software design
    - All wiring diagrams
    - Control schematics

Components

An integral fireman's key switch will be provided on the fire alarm indicator panel. This key switch will be a 3-position switch with the following designations:

- Auto
- Off
- Fans on

The fireman's key switch will be hard wired to the smoke vent control panel which will directly control all smoke system's operation via override relays without software intervention. On each jet fan, terminal box should supply as standard.

MOTOR:

1. Motors power supply is are 400 V, 50 Hz.
2. Motors should suitable for DOL (direct on line) start.
3. Motor protection is IP 55 and the insulation is class F or H, depending on model.
4. Motor efficiency class IE-4.

INSTALLATION:

1. Each jet fan should supply with fixing brackets, for ceiling (or wall) installation.
2. Jet fans need to be installed at least 0.5 m from beams on the inlet side and at least 2.0 m from beams on the outlet side (beam height: 400 mm).

2-30.5 Axial Fans

Axial Long Case Non-Decorative Fans For Parking.

The contractor shall furnish & install, Axial flow aerofoil long case axial fans unit with manufacturer specified construction meeting specified schedule and specifications, All fans shall be of long case either single or multi stage to suit the performance & duty specified meeting EN-12101-3-2002 and suitable for 2h operation under 400°C.

The fans shall be installed in casing that shall extend over the motor & fan assembly, two stage fans shall have contra-rotating impellers & each impeller shall be driven by a separate motor. Axial flow fans shall be of the non-overloading direct driven type, with impeller secured to the motor shaft by means of a key & lockout.

The fan blade shall be aerofoil & shall be of the adjustable pitch type, the pitch angle of the blades shall be readily & accurately adjustable in the factory. Axial flow aerofoil fan shall be selected with minimum efficiency of 70% at the design air flow rate as determined by the contractor. The impeller & hub shall be statically & dynamically balanced, made of die cast aluminium alloy to BS 1490-1970 & examined by X-Ray to ensure flawless casting.

Fan casings shall be fitted with wire guards where shown on drawings & as necessary to provide full protection where fan inlet are accessible. Fan casing shall be fitted with coned inlets where shown on drawings & where necessary for the achievement of the rated fan performance. The fan housing or casing shall be of heavy galvanized steel sheet construction of the 'L' type hot dip galvanized after manufacture & shall be rigidly constructed & correctly proportioned to allow optimum performance, The housing shall be made with drilled flanges at each joint & joints shall be made alright with natural rubber or neoprene gaskets. The fan casing shall be fitted with an electrical terminal box complying BS 4999 for dust, fire & waterproof conditions. Access panel shall be provided in fan casing for all fans having impellers 500mm diameter & above. Access panel shall be fitted in a readily accessible position, shall be large enough to permit ease for maintenance & shall be securely bolted to the casing with studs & wing nuts.

Axial Fan drive shaft & IP 44 squirrel cage motor shall be selected & designed such that to suit continuous operation and shaft speed at 130% & motor power at 120% respectively with an operational temperature range 0°C-400°C with 2hrs fire rating.

2-30.6 Inline Fans

Duct In-line Centrifugal Fans

The contractor shall furnish & install duct mounted inline supply/exhaust air fans where shown on the drawings of capacity & characteristics as schedule. The in-line fans shall be direct driven centrifugal type light weight compact units.

The fan housing shall be galvanized steel skin securely attached to a galvanized steel frame work. Easy access to motor, impeller & bearing for inspection & repair through the door at the side of the fan shall be provided. Inlet venturi to be precision spun for exact matching of the inlet to the wheel inlet.

The aluminium wheel is to have backward inclined blades designed for maximum efficiency & is to be dynamically balanced with permanently affixed balance weights. Motors shall be open drip-proof type of the voltage & phase as schedule. Units shall be AMCA certified for air & sound performance.

2-30.7 Not used

2-30.8 Not used

2-30.9 Not used

2-30.10 Jet Fans / Tunnel Ventilation Fans

2-30.10.1 Uni Directional Jet Fans

Jet fans shall be either single or multi stage to suit the performance & duty specified. The fans shall be installed in casing that shall extend over the motor & fan assembly, Fan shall be of the non-overloading direct driven type, with impeller secured to the motor shaft by means of a key & lockout.

The fan impeller shall be aerofoil & shall be of the adjustable pitch type, the pitch angle of the blades shall be readily & accurately adjustable in the factory. Fan casing shall be fitted with flat inlets where shown on drawings & where necessary for the achievement of the rated fan performance. The fan housing or casing shall be of heavy galvanized steel sheet construction of continuous weld of the 'L' type hot dip galvanized after manufacture & shall be rigidly constructed & correctly proportioned to allow optimum performance.

The fan casing shall be fitted with an electrical terminal box complying BS 4999 for dust & waterproof conditions. Fan drive shaft & IP 55 squirrel cage two speed motor shall be 3 phase fully enclosed selected & designed such that to suit shaft speed at 130% & motor power at 120% respectively.

All bearings are lubricated for life. The bearing life time is min. 20000 hours. The halogen free and flame resistant power cables are connected to the external terminal box. Under normal duties the jet fan has to be designed to run at temperatures between 0 and +50°C. In the event of a fire, the jet fan has to withstand a temperature of up to 250°C for 90 minutes. In order to prove this, for the relevant parts like the impeller, motor, terminal box and terminals a heat test according to EN 12101-3 of a complete unit has to be conducted. The test must be certified by an independent laboratory. Testing of single parts e.g. impeller blades is not valid or sufficient. If the manufacturer cannot provide a suitable certificate, then the costs for a heat test must be included in the quoted price.

2-30.10.2 Accessories

The jet fans should be equipped with the following minimum accessories.

2-30.10.3 Mounting structure

The jet fans would be mounted in parallel to the tunnel axis at the ceiling. The mounting structure is made of stainless steel 1.4571 in a welded construction. Between the mounting structure and jet fan, suitable vibration attenuators have to be provided.

2-30.10.4 Safety wires

In case the mounting structures collapse, the fan is secured from falling down by safety wires, made from stainless steel 1.4401. A slack of about 10 mm must be kept.

2-30.10.5 Tear of guard

The mounting structure is guarded against tear of by an inductive proximity switch in IP65.

2-31 Not used

2-32 Energy Recovery Units (HRU/ERV)

The Contractor shall provide Energy Recovery type ventilators for providing fresh air in the conditioned area where shown on the drawings.

2-32.1 High Efficiency Plate Heat Exchanger

The equipment shall be equipped with cross flow heat exchanger having a high efficiency central core which recover energy from the indoor air and transfer it to the fresh incoming air without mixing stale air with the fresh air. The heat exchanger shall be total enthalpy type to recover both sensible & latent heat from the outgoing exhaust air.

2-32.2 Construction

The heat exchanger shall be constructed with a group of plates located diagonally in the unit casing which is formed of high moisture permeability ER paper sheets jointed together to have good air tightness, excellent tear resistance and aging resistance. To achieve air tightness silicon seal shall be applied generously. The clearance between the fibres shall be so small so only the moisture molecules of small diameter can pass through. The lower part of the casing shall form a watertight pan to recover possible condensate.

2-32.3 Efficiency

ERV shall be 75% efficient at 115 F ambient temperature, ERV fan shall be 75% efficient. Access doors shall be provided with double hinges. Fans for ERV shall be statically and dynamically balanced and factory tested.

SECTION 3 - FOUNDATIONS AND SUPPORTS

3-01 GENERAL

All equipment, piping and ductwork where used shall be mounted on or suspended from foundations and supports, all as specified, as shown and as required. All concrete foundations where required, including thickened structural slab, housekeeping pads and concrete for inertia pads will be provided by the Employer or other Contractor engaged by the Employer or HVAC Contractor as described in Special Provisions Clauses SP-02 & SP-03.

Shop drawings, other information and templates for all concrete foundations where used, shall be provided by Contractor as per recommendations of the manufacturer of the equipment. Necessary integral steel framings, concrete reinforcing rods welded to frame, required anchor bolts, spring mountings, and neoprene pads, shall be provided by the Contractor. The Contractor shall cooperate with those doing the flooring work to ensure proper installation of all these elements.

Foundations and vibration isolation mountings for various equipment, piping, and ductwork where used shall be as per requirements specified. Vibration isolators where used shall be of approved make.

All reinforced concrete inertia pads shall have a minimum 4" thickness. On all corners of inertia concrete pads and integral rigid structural steel bases supporting mechanical equipment, install angles with snubbers. These shall be built up from 3 thicknesses of neoprene waffle pad bonded with suitable adhesive and fixed to angles.

All ceiling hung equipment having fans and motor as integral part of equipment shall have adequate vibration isolators.

Flexible duct connections, as specified elsewhere, shall be fitted wherever ducts cross building expansion joints, at suction and discharge end of each ducted air handling unit and ducted fan, and/or wherever shown on the drawings. Supply outlet of concealed ceiling-mounted fan coil unit shall also be connected to Fan-coil with flexible connection.

Details of all vibration isolators, flexible connections and bases shall be submitted to the Engineer for approval.

3-02 MOUNTING OF EQUIPMENT

3-02.1 Floor or roof mounted equipment

All floor or roof mounted equipment shall be placed on 4" concrete housekeeping pads, unless otherwise indicated. Special attention shall be given to the equipment at roof and intermediate floors and manufacturer's recommendations for prevention of vibration and noise travel to the structure shall be adopted. The foundation details shall be subject to the approval of the Engineer.

3-02.2 Walls Mounted Equipment

All equipment installed through wall shall have 20-gauge galvanized sheet metal which shall remain in place permanently. Sleeves shall be packed

with non-combustible glass fibre insulation minimum of 1.5 lb/cu.ft density and sealed with sealant. Equipment installed through walls shall have supporting wall brackets.

3-02.3 Air inlets/outlets

All air devices including EA/OA louvers shall be fixed to wooden/ metallic frames provided by HVAC Contractor and not to the ceiling material/wall masonry.

3-02.4 Ceiling-hung equipment

All ceiling-hung equipment shall be hung from ceiling (concrete slab) and shall not rest on false ceiling.

3-02.5 Floor mounted equipment

All floor-mounted equipment shall be resting directly on the raised floor pad (or supported from wall when approved by the Engineer).

3-03 VIBRATION ISOLATION

Vibration isolation bases shall be provided and installed under all pumps (where used), to prevent the transmission of vibration to the building structure, as shown on Drawings.

Where fans and motors are integral parts of factory assembled air handling units and the fans and motors are not spring isolated from the air handling unit, the entire unit shall be mounted on vibration isolators.

Inertia pads where indicated shall be reinforced cement concrete pad, at least 4" thick with 4" steel channel all around to protect concrete edges. Reinforcing rods shall be welded to channel frame.

Floor mounted Fans with belt drives shall be mounted on continuous rails with sliding base for motor adjustment and fan-rails shall be mounted on vibration isolators as specified above. When shown on Drawings, continuous rails shall be mounted on Inertia pads and pads shall be mounted on vibration isolators.

Flexible pipe connectors shall be installed in piping to prevent vibration and noise travel. Location and construction of these connectors are specified in Section on "Piping, Fittings, Valves and Specialties."

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SECTION 4 - DUCTING AND SHEET METAL WORK

4-01 GENERAL

4-01.1 Ducting Material

All duct work shall be of galvanized steel sheet unless otherwise indicated on Drawings. Galvanized steel shall be of lock forming quality (LFQ) and shall have a galvanized coating of 8 oz total for both sides of one square meter of a sheet.

Galvanized steel sheet shall be Cut Lengths Coated by the Hot-Dip Method and manufactured per ISO Standard 3575-76 zinc coating designation Z-275, and base metal quality 02.

4-01.2 Structural Steel

Structural Steel shall be M.S. members rolled from Pakistan Steel billets or equivalent conforming to ASTM designation A-36 standard specifications for structural steel.

4-01.3 Canvas Cloth

Canvas Cloth shall have specified weight with flame retardant quality.

4-01.4 Painting

All steel work in connection with supports for ductwork etc. exposed to the elements is to be painted with two coats of an approved rust preventive paint.

All exposed metal surface of hangers, brackets, etc. must be painted with two under-coats and two finishing coats of enamel paint of approved colour. G.I. sheet is not to be painted. However, all uninsulated pipe work and valves are to be painted as stated above.

Identification bands shall be painted on uninsulated ducting, or on insulation at frequent intervals. Lettering shall be agreed with the Engineer.

All duct hangers in concealed locations shall be given one coat of black asphalt paint before being concealed.

4-02 DUCT FABRICATION

All sheet metal duct work shall be of a standard construction and erected in a first-class workmanlike manner. The site storage for Duct shall be a clean and dry environment where the ductwork is protected from dust, must be provided for the storage of ductwork prior to installation; all sealed ends shall be visually examined and if damaged resealed with an appropriate material.
The duct work shall be constructed as per SMACNA Low Velocity Duct Construction Standards.

During Construction the contractor shall cover the openings of duct work to prevent the entry of dust and debris into the duct. All self-adhesive labels for part identification are to be applied to external surfaces only; to maintain

cleanliness during transportation, all ductwork shall be sealed either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping.

Where specified, duct work shall be provided with interior insulation. Ducts shall be straight and smooth on the side, with joints neatly finished. Where ducts are lined with interior insulation, the dimensions required shall be for the net free area after insulation is applied. Ducts shall be anchored securely to the structure in an approved manner and shall be installed so as to be completely free from vibration under all conditions of operation.

Sheet metal ducts shall be properly braced and reinforced with steel angles, or other structural members approved by the Engineer Unless otherwise required, the internal ends of all slip joints shall be installed in the direction of flow.

Finished work shall show no flaking or peeling within 1/4" of a cut edge. The construction and gauge of material, size and spacing of stiffeners for duct work shall be as follows:

Larger Dim. of Duct (in.)	Gauge (US)	Traverse Joint Type /Size (in.)	Interm Bracing, Angle Size (in.)	Max. Spacing Between Trav. Joint and/or Interm Reinforcement (ft.)
Thru 10	26	Drive slip/-	-	-
10 thru 18	24	-do-	-	-
19 thru 30	24	Pocket Lock/1	1x1x1/8	5
31 thru 42	22	Pocket Lock/1	1x1x1/8	5
43 thru 54	22	Pocket Lock/1-1/2	1-1/2 x 1-1/2 x1/8	5
55 thru 60	20	Pocket Lock/1-1/2	1-1/2 x 1-1/2 x1/8	5
61 thru 84	20	Angled Reinforced Standing Seam	1-1/2 x 1-1/2 x1/8	5
85 thru 96	18	-do-	1-1/2 x 1-1/2 x1/4	2.5
over 96	18	-do-	1-1/2 x 1-1/2 x1/4	2.5

Other types of Traverse joints allowed as per ASHRAE/ SMACNA Standards shall be acceptable, subject to Approval of Engineer, in places where pocket lock is not possible due to tight space.

All angles for bracing shall be painted with one coat of approved rust-inhibitive paint before fixing to duct.

All duct work in the finished areas shall be run parallel to the beams wherever possible. All outlet opening and open ends shall be kept closed with sheet metal caps during construction. Rectangular duct shall be constructed by breaking the corners and grooving the longitudinal seams. Elbows and transformation sections may be formed with Pittsburgh corner seams but complicated fittings shall be constructed with double seams. Angle bracing shall be of steel and shall be carried out on all four sides of the ducts. All bracing is to be in accordance with the current addition of the ASHRAE Hand Book/ SMACNA Standards.

4-03 ELBOWS

Ducts shall be built with curves and bends, where required, to affect an easy flow of air. Curved elbows shall have a centre line radius at least equal to 150% of the width of the duct unless otherwise indicated. All duct curves having an inside radius smaller than the width of the curve shall be equipped with approved single thickness vanes.

Vertical ducts shall have full size bends where horizontal branches are taken off unless otherwise indicated, and/or approved.

Where square elbows are used in changing directions, approved and aerodynamically correct vanes as per latest SMACNA Duct Construction Standards shall be used.

These turning vanes must be free from vibration when the system is in operation.

4-04 HANGERS

Hangers and supports shall be fastened to the structure in a manner approved by the Engineer All fastening shall be such as to ensure permanent stability and to be capable of supporting at least three times the applied load.
Galvanized sheet metal ducts less than 20" in width (larger dimension) may be suspended by means of galvanized iron straps extended along the bottom of the duct to form a trapeze, only if hanger length above the duct is not more than 12".

All other ducts shall be suspended by means of iron bars securely fastened to the angle iron bracing or angle iron placed under the duct. Bars shall be fastened to bracing only on un-insulated ducts.

Bars shall be welded to angles at ceiling, attached therein by anchor screws and heavy iron washers. Where horizontal ducting is fixed to walls, columns, supported from floor slabs, etc. angle iron frames are to be fabricated and fitted to support rectangular ductwork and associated equipment.

Vertical ducts are to be supported by steel angles bolted to at least two sides of the duct and on the complete circumference of the ducts where the larger duct dimension is greater than 24".

Angle iron extensions shall be either grouted or bolted to the structure.

Hangers spacing and sizes shall be as follows.

Larger duct dim. (in)	Strap Size (in)	Bar Dia (in)	Bottom Angle Size (in)	Maximum Spacing (ft)
Thru 20	1x1/8	3/8	1-1/2 x 1-1/2x1/8	10
21 thru 60	-	3/8	2 x 2 x 1/8	10
61 thru 84	-	3/8	2 x 2 x 2/8	10
85 thru 96	-	3/8	2 x 2 x 2/8	10
over 96	-	3/8	2 x 2 x 2/8	7

Hanger rods shall be cross-braced whenever the length of rod above duct work is more than 3 ft. to prevent swing of ducts.

All structural steel including hanger rods and angle iron shall be painted with one coat of approved rust- inhibitive paint before installing.

4-05 QUADRANTS FOR VOLUME DAMPERS

All dampers other than dampers behind registers and diffusers shall be fitted with substantial locking quadrants, mounted outside the duct in an accessible position. On insulated ducts the quadrants shall be fastened to bearing plates flush with the outside finish of the insulation.

4-06 DAMPERS

4-06.1 Volume Dampers (V.D)

A substantially constructed manual volume damper of the butterfly or multiple blade type as per latest SMACNA Duct Construction Standards shall be fitted where shown on the Drawings and at all branch entries or exits with main ducts for balancing purposes. Dampers shall have galvanized or painted steel interlocking blades of 8" maximum blade width. Blades shall be fabricated from 16-gauge steel with seamed edges and a maximum length of 4 ft. It should be noted that these dampers, shall be separate and independent from the dampers, hereinafter specified. Volume Dampers are not required where splitter Dampers, as specified hereinafter, are installed.

4-06.2 Splitter Dampers (S.D)

At each point of division in a supply trunk duct where a branch is taken off a trunk duct, an adjustable splitter or deflecting damper, one gauge heavier than the duct with operating rod and locking quadrant as above, shall be installed. These deflecting dampers shall be permanently set and locked in position after completion of the installation and adjustment with fans running.

Operating rods are to be full blade length extending through the duct to externally mounted bearing plates. Construction shall be as per latest SMACNA Duct Construction Standards.

4-06.3 Fire Dampers (F.D)

Fire dampers are to installed at SA /RA duct penetration of building envelope membrane.

Frame shall be 2”x1/2”x1/8” galvanized steel channel with 16 gauge thick blades. Blades shall have an overlap of 1” and shall be fixed on self-lubricating bronze type bearings.

Dampers shall be complete with linkage rod and fusible link rated at 160 deg F. Damper construction shall meet NFPA 90-A requirements, and shall have the “hour” fire-rating not less than the fire rating of the plane where installed. Fire dampers shall be air tight when in close position.

4-07 FLEXIBLE DUCT CONNECTIONS

Flame proof flexible connections shall be furnished and installed on all suction and discharge connections of fans and air-conditioning units for prevention of transmission of vibration through the ducts to occupied spaces.

Flexible connections also be provided wherever ducts cross building expansion joints.

Flexible connections shall be factory fabricated of imported origin, made from chemically impregnated canvas or other material approved by the Engineer. Connections shall fit closely and are to be secured in an airtight fashion at connections to ductwork, fans and apparatus. The unclamped section of the flexible connection between apparatus and ductwork shall not be less than 6" in length. Flexible connections shall not be painted or insulated. Samples of the material shall be presented to the Engineer for approval before installation.

4-08 ACCESS DOORS AND PANELS

Wherever necessary, suitable access openings, doors and frames to permit inspection, operation and maintenance of all filters, controls, dampers, bearings or other apparatus shall be provided in ducting. Doors shall be of double construction, of not lighter than 20-gauge metal sheet and shall have neoprene gaskets around their entire perimeter. On insulated duct work the space between the inner and outer door sheets shall be insulated as specified for the ductwork. All access doors in sheet metal shall have air tight seal, shall be hung on heavy flat hinges and shall be secured in the closed position by means of wing type nuts and screws or coin operated catches.

4-09 SLEEVES

Where ducts pass through walls, partitions, or floors, wooden sleeves shall be provided by the Contractor and these sleeves shall remain in place permanently. Sleeves shall be packed with non-combustible glass- fibre insulation, minimum of 1.5 lbs/cu.ft. density and sealed with sealant.

4-10 TEST WELLS

The Contractor shall provide test wells for measurement of air velocity and static pressure for balancing purpose. These wells made up of a brass nipple with screwed caps are to be fixed into the duct or casing on the downstream sides of each fan, filter, PU, FCU and branch volume damper in each branch supply duct, and on upstream side of branch volume damper in each branch return. The design of test well shall be subject to Engineer's approval.

SECTION 5 - PIPING, FITTINGS

5-01 PIPING, FITTINGS & ACCESSORIES

5-01.1 Refrigerant Piping:

The refrigerant piping interconnecting to indoor & outdoor units shall be made out of hard copper tubes, in brazed construction. The refrigerant line sizing should be designed to achieve minimum pressure drop and avoid oil return problem. The pipe sizes and connections shall be designed such that the evaporator units do not face back pressure due to the functioning of the evaporator next to it.

All piping shall be neatly laid and supported on galvanized perforated sheet metal trays and clamped firmly. Piping should be shrouded, where necessary, to protect it from accidental damage/leaks during work by any agencies.

The refrigerant piping for the VRF system shall be of minimum wall thickness as per copper pipe-ASTM B88, L-Type standard HARD drawn copper pipes. The copper pipe shall be internally chemically cleaned, free of dirt, dust, oxidation and any other deposits. All joints shall be made by brazing. Inert gas purging shall be used during the brazing process to prevent oxidation.

U-bends shall be provided for efficient oil return in suction line, at appropriate locations.

All pipe supports/clamps shall Hot-Dip Galvanized, Pipe support system shall be as per approved manufacturer.

The piping and wiring shall be laid such that it does not spoil the aesthetics of the premises, and is safe, secure and approachable for leak detection/repair/replacement.

5-01.2 Refrigerant Piping Brazing and Handling

All joints are brazed in the field. Multi V Water Mini refrigeration system components contain very small capillary tubes, small orifices, electronic expansion valves, oil separators, and heat exchangers that can easily become blocked. Proper system operation depends on the installer using best practices and utmost care while assembling the piping system.
Store pipe stock in a dry place; keep stored pipe capped and clean.
Blow clean all pipe sections with dry nitrogen prior to assembly.

- Proper system operation depends on the installer using best practices and the utmost care while assembling the piping system.
- Use adapters to assemble different sizes of pipe.

Always use a non-oxidizing material for brazing. Do not use flux, soft solder, or anti-oxidant agents. If the proper material is not used, oxidized film may accumulate and clog or damage the compressors. Flux can harm the copper piping or refrigerant oil.
• Use a tubing cutter, do not use a saw to cut pipe. De-bur and clean all cuts before assembly

- Use a dry nitrogen purge operating at a minimum pressure of three (3) psig and maintain a steady flow.

- Use a 15% silver phosphorous copper brazing alloy to avoid overheating and produce good flow.
- Protect isolation valves, electronic expansion valves, and other heat-sensitive control components from excessive heat with a wet rag or heat barrier spray.

5-01.3 Drain Piping

The drain piping shall be made out of rigid PVC pipes of 10 Kg/cm2 class. The piping shall be supported by clamping on MS angle 25mm x 3mm running continuously below the pipe. The piping shall be insulated with 6mm thick closed cell nitrile rubber sleeves.

The drain pans of IDUs shall be connected to rigid PVC pipe by braided PVC flexible pipe with appropriate adapters. U trap shall be providing in the drain connection of each IDU. All pipes support/clamps shall be painted with red oxide primer followed by two coats of synthetic enamel finish paint.

5-01.3.1 Pipe Schedule

S. No	Service	Size	Specifications
b)	Galvanized Steel	All sizes	Galvanized steel, Light Quality BSS 1387
(i)	Cooling Coil condensate Drain		

5-01.3.2 Fittings Schedule

S. No.	Service	Size	Specifications
b)	Galvanized Steel Piping		
(i)	Cooling Coil condensate Drain	All sizes	150 lb malleable iron galvanized screwed fittings to ANSI B16.3

SECTION 6 - INSULATION

6-01 GENERAL

6-01.1 The Contractor shall provide insulation for the services and equipment specified hereafter. Insulation shall be as per following Insulation Schedule.

6-01.2 Insulation material shall be complete with vapour barrier protection covering and jacketing (where specified), adhesives, insulation tape, duct sealer and/or sealing tape, fastening material, and jacketing for outdoor ducting and piping.

6-01.3 Identification bands shall be painted on insulation at frequent intervals. Lettering shall be agreed with the Engineer.

6-02 INSULATION SCHEDULE NBR or similar material,

	Service	Thick ness (inch)	Insulation type	Vpour barrier	Protection
1		2	3	4	5
a)	Indoor Supply Return/OA Duct: duct passing through con-ditioned space				
i)	Concealed to vision	1	Glass fibre blanket	Reinforced-Aluminium foil	4-Oz Canvas.
ii)	Exposed to vision	1	Glass fibre blanket	Reinforced-Aluminium foil.	8-Oz Canvas.
b)	Outdoor SA / RA Ducts	2	Glass fibre blanket	Reinforced-Aluminium foil.	8-Oz Canvas. With 26 Ga GI Sheet Jacketing
c)	Cooling Coil Condensate Drain Piping	1/8	(Self-adhesive Vinyl Alum. Tape)	Reinforced Aluminium foil.	-

6-03 INSULATION MATERIALS

6-03.1 Duct Insulation

Insulation material for ducts and sheet metal air plenums shall be flexible glass fibre, 0.75 lbs/cu.ft. density and maximum conductivity of 0.27 Btu/hr.sq.ft./inch at 75 deg F

6-03.2 Vapour Barrier for Duct Insulation

Vapour barrier when specified shall be factory applied flame retardant reinforced aluminium foil, 0.02 mils thick.

6-03.3 Acoustic Liner Material

Acoustic liner shall be 1.5 lbs/cu.ft. density fibre-glass with neoprene scrim on inside surface and thermal conductivity value shall not exceeding 0.27 Btu/hr.sft Deg F/inch at 75 Deg F. Material shall conform to TIMA Standard AHC- 101-1975 with latest revisions.

6-03.4 Cooling Coil Condensate Pipe Insulation

Shall be 1/8" thick pipe insulation vinyl aluminium 'foram' with aluminium foil self-adhesive tape 3" wide.

6-03.5 Insulation Protection Material and Accessories

a. Canvas

4 Oz or 8 Oz per sq.ft. as specified in Insulation Schedule.

b. Jacket

24 gauge (US) galvanized steel sheet or aluminium sheet.

c. Water Proof Paint

As approved by the Engineer

d. Wire Netting

1" hexagonal mesh, 20 gauge (US), galvanized.

e. Metal Lath

Expanded metal lath with 1/2 inch diamond mesh.

f. Banding

1/2" x 1/48" galvanized steel or aluminium bands.

g. Insulation Tape

Insulation tape for joints shall be of aluminium foil type, 2 inch wide, equivalent to Scotch No.473.

h) Adhesive

Adhesive for thermal insulation and acoustic liner shall be Zahbia make suitable for hospital application and approved by Engineer.

i) Duct Sealer

Sealer for duct joints shall be butyl rubber caulking, weather proof and water resistant.

j) Duct Sealing Tape

Duct sealing tape shall be 3-inch-wide self-adhesive vinyl cloth tape.

6-04 INSULATION APPLICATION

6-04.1 General

All Thermal and acoustic insulating materials shall be installed as specified hereinafter.

Insulation shall be installed in a smooth, clean, workmanlike manner and joints shall be tight and finished smooth.

All surfaces to be insulated shall be dry and free from loose scale, dirt, oil or water when insulation is applied. Insulation shall be applied in such a manner that there will be no air circulation within the insulation or between the insulation and the surface to which it is applied.

Surface imperfections in the insulation such as clipped edges, small joints or cracks and small voids, or holes not over 1 inch square shall be filled with like insulating material.

Where a vapour barrier is fixed on site it shall be fixed in such a manner as to obviate the possibility of moisture penetration. It shall be fixed where required by means of an approved type bituminous compound or approved equal for tightness.

Insulation for all services shall only be applied until after testing and approval for tightness obtained from the Engineer, unless otherwise instructed in writing by the Engineer.

Insulation for all services shall be continued through sleeves. The insulation on exposed risers shall extend through the floor. Where insulated pipes are indicated on drawings as embedded in the thickness of walls, the insulation thickness may be reduced to 1 inch only.

Insulation is to be applied where indicated on the drawings or called for in these specifications.

6-04.2 Duct Insulation

Before applying insulation, either sealing tape or duct sealer shall be applied on all corners of traverse joints for air tightness.

The insulation shall be fixed on ducts with a suitable adhesive as specified. Adhesive shall be applied on at least 75% surface area. In addition to the fixing by adhesives, insulation on the underside of ducts exceeding 18 inch width must have mechanical fasteners of an approved pattern to prevent insulation sagging, or alternatively bands as specified above shall be used at intervals not exceeding 4 feet.

All joints on the insulation shall be sealed with 2 inch aluminium foil tape. The tape shall only be fixed to the vapour seal and not to the bare insulation

and, therefore, joints in the insulation shall not occur longitudinally at corners of ducts. If it is unavoidable to have joints at longitudinal corners then the insulation must be cut back and the vapour seal folded over the bare edge of the insulation so that the tape adheres only to the vapour seal.

6-04.3 Duct Insulation Protection

Indoor Exposed Duct: Insulation shall be covered over the vapour seal with a single layer of canvas with generous overlaps. The canvas shall be fixed with an approved adhesive.

6-04.4 Condensate Drain Piping

Self-adhesive pipe insulation tape, as specified above, shall be spiral-wrapped around pipe, with 50% overlap.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 7 - ELECTRICAL EQUIPMENT AND CONTROLS

7-01 SCOPE

The Contractor shall supply all panel boards, starting equipment, circuit breakers, busses, isolators, for each electrically operated HVAC equipment. He shall also provide power cables & earthing conductors between HVAC equipment and termination points of electrical contractor as specified in clause 7-02

7-02 DISTRIBUTION & CONTROL SCHEME

The Employer, through other contractor, will provide incoming power cables and earthing conductors from dual source LT panel to HVAC Motor Control Centre (MCC) at roof (or other location identified by the Employer) From MCC onward to each electrically operated HVAC equipment at location identified by Engineer and/or as shown on drawings shall be furnished and installed by HVAC Contractor, sized to handle respective HVAC equipment load The HVAC Contractor will make connections to respective equipment with necessary circuit breakers and other devices housed in Motor Control Centre.
HVAC contractor shall be responsible to provide and install the complete power network with suitable isolation provisions for all indoor units including but not limited to FCUs, DX/VRF Split Indoor Units, all types of Fans, AHUs at suitable stage during construction in coordination with other trades.,

7-03 GENERAL

All electrically operated equipment shall comply in all respects with the relevant B.S.Standards including dimensional standards where these exist, except in so far as this Specification is at variance therewith.

All electrically operated equipment shall be so designed that it will continue to function without damage to itself or otherwise, if the voltage and/or frequency vary within the following tolerances.

Voltage plus or minus TEN per cent.

Frequency plus or minus SIX percent.

The entire installation shall be in accordance with the requirements and to the entire approval of the Electricity Department of the Government and the approval of the Engineer.

All electrically operated equipment shall be suitable for continuous and prolonged operation in an ambient temperature 115deg F. This temperature makes no allowance for local rises in air temperatures due to the operation of the equipment itself or of heat produced in or by adjacent equipment such as compressors, condensers or heaters. The maximum operating temperature in standards specified shall be observed. Allowance for local high ambient temperature shall be made by reducing the permitted rises of temperature above ambient.

7-04 WIRING

All power wiring and operating control wiring shall run in conduits. All wiring conduits shall be PVC in concealed to vision spaces and G.I. pipe if exposed to vision. Make of cables shall be Pakistan Cables or approved equal. Material and application specifications for wiring accessories shall be subject to Engineer's approval.

7-05 LABELS

Each piece of equipment on the panel and each component in the panel shall be identified by a nameplate. Nameplates may be laminated plastic or metal with 1/4 inch high etched letters and attached to the panel or integral with it. Lettering shall be cut into the plate to a depth of not less than 1/64 inch and shall show a contrasting colour produced by filling with enamel or lacquer or by use of a laminated material. Painting of lettering directly on the surface of the plate or panel will not be permitted.

7-06 EARTHING

7-06.1 General

For scope of work refer to clauses 7-01 and 7-02.

All HVAC equipment with electricity connection and all Motor Control Centres (MCCs), Apparatus Control Panels (ACPs) and Local Isolation Switches (LISs) panels shall have their frames, carcasses and all metal parts not normally carrying current, effectively and continually connected to the general mass of the earth. Each equipment and panel shall be separately connected to a main earth continuity conductor.

7-06.2 Earth Continuity Conductor

Earth continuity conductor shall be round, hard drawn, bare electrolytic copper wire of appropriate sizes as approved by the Engineer. All fixing accessories, earthing clips, sweating sockets, lugs, thimbles, etc., shall be provided for earthing installation.

7-07 CONDUITS AND CONDUIT ACCESSORIES

7-07.1 Material Description

The conduit for wiring shall be of polyvinyl-chloride material for use in concealed to vision locations and G.I. pipe in exposed locations including vertical shafts. All other accessories shall be subject to Engineer's Approval.

7-07.2 Application of PVC Conduit

Manufactured smooth bends shall be used where conduit changes direction. Bending of conduit by heating or otherwise shall be allowed at special situation only, for which approval of Engineer shall be necessarily required. The use of sharp 90-degree bend and tees shall not be allowed. The bends shall have enlarged end to receive conduit without any reduction in the internal diameter at joint. Round Junction Boxes shall be provided with one piece PVC Cover plate which shall be installed on the box by means of galvanized screws. Pull box shall be installed in conduit runs, wherever required to limit the pulling length of cables. Pull Boxes should be installed in conduit runs to limit the pulling lengths as required. The

rectangular inspection or pull boxes shall be 16 S.W.G. thick sheet steel having nipples to receive PVC conduit with force fit. The sheet steel box shall be painted inside and outside with black enamel paint over a base coat of red oxide antirust paint, as approved by Engineer. The minimum length of inspection box shall not be less than four times the cables manufacturer's recommended bending radius of the cable. Bushes shall be used at pipe terminations and PVC solution for jointing of pipes.

7-07.3 Application of G.I. Conduit

Application of G.I. conduit shall be similar to PVC conduit as specified above, except that pipes shall have threaded socket connections. Pipes and fittings shall be as specified in Piping Section, finished with 2 coats of aluminium paint.

7-08 MOTOR CONTROL CENTRE

The Contractor shall supply and install the Motor Control Center (MCC) for all equipment installed in Control Room or as directed by Engineer. The panel shall be of sufficient size and dimensions to house the various starting and control equipment for the installation. The panel shall be provided with lock and double set of keys. The Motor Control Centre shall be suitable for operating at the voltage, frequency and the starting method specified. It shall be of the unit construction single fronted or double fronted type with a common set of busbars. It shall be made up of any number of steel plate cubicles with turned edges mounted side by side sub-divided into compartments to suit the control gear items, all bolted together to form a self-contained switchboard. It shall be constructed such that all doors are interlocked, preventing access to the starter until the corresponding isolating switch is in the "off" position. All equipment shall be inspected or maintained from the front of the switchboard, the main cables to the motor control centre and all outgoing cables from it may enter from top, bottom, or rear, depending on the location and convenience with provisions of steel removable panels covering the cable compartment.

Components shall be mounted in a logical order based on the sequence of operation, all components requiring frequent inspection shall be mounted between 2 ft. and 6 ft. above floor level.

This panel will contain the following equipment (but not limited to):

- VFD with accessories inside ventilated enclosure of required rating
- Circuit Breaker on incoming line
- Copper busbars with suitable porcelain isolators.
- Circuit breakers, one on each outgoing line.
- Push button stations, one for each starter. (including starters in remote ACPs if used)
- Pilot lights, one for each incoming main lead, red, yellow and blue to indicate live phases.
- Pilot lights, one for each starter, red for equipment operating. (including starters in remote ACPs if used)
- Ammeters, one for each main incoming lead and one for each starter.
- Starters with thermal overload protection.
- Voltmeter with commutator.
- Toggle switches, labels.

All internal wiring and accessories for the interlocking of the various components, clipped individually to the panel, and arranged parallel or at right angles.

All indications shall be visible from front of the panel. Prior to installation, the Contractor shall submit for approval to the Engineer the electrical diagram of the whole installation and the suggested panel layout showing the arrangement of electric components with samples of instruments and components.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 8 – TEMPERATURE & HUMIDITY CONTROLS

8.01 GENERAL

8.01.1 OVERVIEW

Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature, relative humidity & pressure control system, utilizing Direct Digital Controls, electronic interfaces and actuation devices, as shown on the drawings and/or as described herein. Drawings (when provided) are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, those are required to meet the functional intent, shall be provided without additional cost to the Employer.

These specifications are general in nature & Items of Hardware described in these specifications shall be furnished when project specific requirement necessitates supply of such item of hardware. All necessary BMS hardware components shall be provided either specifically shown on drawings or not in order to make the system operate properly.

8.01.2 CONTROL SPECIALIST FIRM AS SUB-CONTRACTOR

Sub-Clause SP-02.1(d) of Special Provisions apply

8.01.3 SPECIFICATION NOMENCLATURE

BMS	Building Management System
BMSS	Building Management System Supplier
SDC	Standalone Digital Controller
GDC	Gateway Digital Controller
GP	Graphical Programmer
HMI	Human Machine Interface
PAC	Personnel Access Controller
GUI	Graphical User Interface

8.01.4 INSTALLATION

All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the BMS system manufacturer or its exclusive factory authorized installing contracting field office/representative (referred hereinafter as BMSS, i.e. Building Management System Supplier). The BMSS shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the BMSS relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local BMSS's office.

The controls specialist firms having experience on SKMH projects may be given preference by the engineer while approving the sub-contractor for BMS work.

8.01.5 CONTROL WIRING

a) All electrical control wiring and power wiring to the BMS control panels & components of the BMS system shall be the responsibility of the BMSS.
b) The Contractor (HVAC) shall furnish all power wiring to electrical starters, VFDs, Electric duct heaters, Humidifiers, condensing unit and motors for their operation.
c) All wiring shall be in accordance with the Project Electrical Specifications.

8.01.6 **UNACCEPTABLE BUILDING MANAGEMENT SYSTEM SUPPLIER**

Wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing or installing automatic temperature control systems shall not be acceptable as BMSS. Technical Submittals that are not complete in their response to these documents or take exception to any of the capabilities defined within these documents will be rejected.

8.01.7 **SUBMITTALS**

a) Technical Submittals of the entire control system shall be submitted and shall consist of system Architecture schematic, a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the drawings. A complete written Sequence of Operation as well as a hard copy graphical depiction of the application control programs shall also be included with the submittal package.

b) Upon completion of the work, provide a complete set of drawings and application software on magnetic floppy disk media. Drawings shall be provided as AutoCAD files.

8.01.8 **MATERIALS**

All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.

8.01.9 **WARRANTY**

a) The BMSS shall provide a one-year warranty that will commence from the commissioning of Control System

8.01.10 **SOFTWARE LICENSE AGREEMENT**

The BMSS shall provide standard software under the manufacturer's standard software and firmware licensing agreement. Such license shall grant use of all programs and application software to Employer

The software shall have Lifetime availability and min 10 years free unlimited upgrades.

Availability of hardware shall be guaranteed for minimum 10 years by the OEMs.

8.01.11 **SPECIFICATION COMPLIANCE REVIEW**

The BMSS shall supply, at the time of providing Technical Submittal, a paragraph by paragraph specification compliance report. The report shall indicate for each numbered paragraph, how the BMSS meets the criteria of the paragraph. The following format must be utilized in completing the compliance report:

a) Comply - without exception.

b) Qualify - meet the functional intent. For each paragraph, the BMSS shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.

c) Does not comply – cannot meet specified function.

8.02 Integrated Building Automation System

8.02.1 Standard Terms

A) Standard

- ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
- AHU: Air Handling Unit
- BACnet: Building Automation Controls Network
- BMS: Building Management System
- DDC: Direct Digital Control
- EIA: Electronic Industries Alliance
- GUI: Graphical User Interface
- HVAC: Heating, Ventilation, and Air Conditioning
- IEEE: Institute Electrical Electronic Engineers
- MER: Mechanical Equipment Room
- PID: Proportional, Integral, Derivative
- VAV: Variable Air Volume Box

B) Communications and protocols

- ARP: Address Resolution Protocol
- CORBA: Common Object Request Broker Architecture
- CSMA/CD: Carrier Sense Multiple Access/Collision Detect
- DDE: Dynamic Data Exchange
- FTT: Free Topology Transceivers
- HTTP: Hyper Text Transfer Protocol

- IIOP: Internet Inter-ORB Protocol
- LAN: Local Area Network
- LON: Echelon Communication – Local Operating Network
- MS/TP: Master Slave Token Passing
- ODBC: Open Database Connectivity
- ORB: Object Request Broker
- SNVT: Standard Network Variables Types
- SQL: Structured Query Language
- UDP: User Datagram Protocol
- XML: eXtensible Markup Language

C)Controllers

- ASD: Application Specific Device
- AAC: Advanced Application Controller
- ASC: Application Specific Controller.
- CAC: Custom Application Controller.
- DCU: Distributed Control Unit
- LCM: Local Control Module
- MC: MicroControllers
- MCI: MicroInterface
- MZ-II: Microzone II direct digital controller
- MN-FLO: Micronet 2000 Pressure Independent VAV Controller
- NSC: Network Server Controller
- PEM: Package Equipment Module
- PPC: Programmable Process Controller
- SDCU: Standalone Digital Control Units
- SLC: Supervisory Logic Controller
- UEC: Unitary Equipment Controller
- VAVDDC: Variable Air Volume Direct Digital Controller

D)Tools and Software

- AMBCx: Automated Monitoring Based Commissioning

- APEO: Automated Predictive Energy Optimization
- DR: Demand Response
- CCDT: Configuration, Commissioning and Diagnostic Tool
- BPES: BACnet Portable Engineering Station
- LPES: LON Portable Engineering Station
- POT: Portable Operator's Terminal

8.02.2 PRODUCTS

A. Pre-approved Manufacturers/Installers

i. Honeywell USA
ii. Schneider electric, USA
iii. Johnson control, USA

B. Scope of Work

i. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as approved by the engineer. All components of the system – application controllers, unitary controllers, etc. shall communicate using the BACnet/IP protocol. No gateways shall be used for communication to controllers furnished under this section. At a minimum, provide controls for the following:

Air handling units

Exhaust and supply fans

Zone temperature, relative humidity & differential pressure, Electric duct heaters Smoke extraction sequence of AHUs.

The AHUs, Treated FAHUs and FCUs (if applicable) shall be interlocked with the fire alarm and detection system. In case of any fire alarm/ the HVAC equipment serving that zone shall be stopped. The restoration of the particular zone equipment operation shall be made after physical inspection and physical reset of the alarm/ switch.

Maximum Operations, Controls, System Settings and status monitoring (On, Off, Trip, Interlock and Fault etc) of complete HVAC system and equipment should be provided.

8.02.3 DDC Sensors and Point Hardware

i. Temperature Sensors

A. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- 0.5 degrees F over a range of 40 to 100 degrees F.

B. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless-steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet.

C. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet.

The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing.

D. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F.
E. Not Used
F. A pneumatic signal shall not be allowed for sensing temperature.

ii. Humidity Wall Transmitter

A. Transmitters shall be accurate to +/- [1] % at full scale.
B. Transmitter shall have replaceable sensing element.
C. Sensor type shall be thin-film capacitive.
D. Sensor element shall contain multipoint calibration on-board in non-volatile memory
E. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F
F. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
G. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
H. Transmitter shall be available in an enclosure made of high impact ABS plastic for mounting on a standard electrical box.
I. Transmitter shall have LCD display
J. Transmitter shall be available with a certification of NIST calibration
K. Transmitter shall have integrated temperature sensor

iii. Humidity Duct Transmitter

A. Transmitters shall be accurate to +/- [1] % at full scale.
B. Transmitter shall be fully encapsulated in potting material within a stainless-steel probe.
C. Transmitter shall have replaceable sensing element.
D. Sensor type shall be thin-film capacitive.
E. Sensor element shall contain multipoint calibration on-board in non-volatile memory
F. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
G. Output shall be 4-20 mA or 0-5/0-10 VDC.
H. Transmitter shall accept 12-30 VDC or 24 VAC supply power.

I. Transmitter shall be available with a certification of NIST calibration
J. Transmitter shall have integrated temperature sensor

iv. Humidity Outdoor Transmitter

A. Transmitters shall be accurate to +/- 2% at full scale.
B. Transmitter shall be fully encapsulated in potting material within a stainless-steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
C. Transmitter shall have replaceable sensing element.
D. Sensor type shall be thin-film capacitive.
E. Sensor element shall contain multipoint calibration on-board in non-volatile memory
F. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
G. Output shall be 4-20 mA or 0-5/0-10 VDC.
H. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
I. Transmitter shall be available with a certification of NIST calibration
J. Transmitter shall have integrated temperature sensor

v. Not used

vi. Not used

vii. Air Pressure Transmitters.

A. Sensor shall be microprocessor profiled ceramic capacitive sensing element
B. Transmitter shall have 14 selectable ranges from 0.1 – 10” WC
C. Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
D. Transmitter shall be field configurable to mount on wall or duct with static probe
E. Transmitter shall be field selectable for Unidirectional or Bidirectional
F. Maximum operating pressure shall be 200% of design pressure.
G. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
H. Transmitter shall accept 12-30 VDC or 24 VAC supply power
I. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
J. Transmitter shall have an LCD display
K. Units shall be field selectable for WC or PA

L. Transmitter shall have provision for zeroing by pushbutton or digital input.
M. Transmitter shall be available with a certification of NIST calibration

viii. Not used

ix. Not Used

x. Current Sensors
A. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analogue signal to the automation system.

xi. Not Used

xii. Not Used

xiii. Not Used

xiv. Not Used

xv. Not Used

xvi. Not Used

xvii. Not Used

xviii. Not Used

xix. Not Used
.

xx. Smoke Detectors
A. Air duct smoke detectors shall be by Air Products & Controls or approved equivalent. The detectors shall operate at air velocities from 300 feet per minute to 4000 feet per minute.
B. The smoke detector shall utilize a photoelectric detector head.
C. The housing shall permit mechanical installation without removal of the detector cover.
D. The detectors shall be listed by Underwriters Laboratories and meet the requirements of UL 268A.

xxi. Not Used

xxii. Variable air volume Box

xxiii. Not used

xxiv. Room differential Pressure Sensor

The Room differential pressure sensor shall be provided with display.
It shall be capable of sensing at 0.5 %, (± 0.25 %) full scale accuracy and with a display resolution up to 0.1 pascal
It should meet the requirement of pressure critical healthcare space, biocontainment clean rooms and any application where very low room pressure sensing required.

xxv. Not Used

8.02.4 Not Used

8.02.5 Software Installation

i. General.

A. The Contractor shall provide all labour necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third-party software necessary for successful operation of the system.

8.02.6 Database Configuration.

i. The Contractor will provide all labour to configure those portions of the database that are required by the points list and sequence of operation.

8.02.7 Color Graphic Displays.

i. Unless otherwise directed by the owner, the Contractor will provide color graphic displays for all systems in the HVAC drawings for each system and floor plan. For each AHU, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.

8.02.8 Reports.

i. The Contractor will configure a minimum of 4 reports for the owner. These reports shall, at a minimum, be able to provide:

C. Trend comparison data
D. Alarm status and prevalence information
E. Energy Consumption data
F. System user data

8.02.9 Documentation

i. As built software documentation will include the following:

A. Descriptive point lists
B. Application program listing
C. Application programs with comments.
D. Printouts of all reports.
E. Alarm list.
F. Printouts of all graphics
G. Commissioning and System Startup

8.02.10 Point to Point Checkout.

i. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the owner or owner's representative.

8.02.11 Controller Checkout.

i. A field checkout of all BMS system shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project.

8.02.12 System Acceptance Testing

i. All application software will be verified and compared against the sequences of operation approved by the engineer.

ii. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

iii. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (HMI display, workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Arrangement for audible alarm in case of detection of smoke shall be provided also be provided. Submit a Test Results Sheet to the owner.

iv. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.

v. Perform an operational test of each third-party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

8.02.13 SEQUENCE OF OPERATION

The controls specialist firm to propose the sequence of operation and is subject to engineer's approval.

8.02.14 Indication

Following equipment shall have the indication at the controller / display.

EQUIPMENT	TYPE	INDICATION	
• Fan status			
• Condensing units			
• Smoke detector;	DI	SMOKE/NO SMOKE	
• Room Differential Pressure	AI	Digital pascal +/-	
• Room/Zone Rel. Humidity DIGITAL %RH		AI	
• Room/zone Air Temp. DIGITAL DEG C		AI	
• Supply Air dischargeTemp. DIGITAL DEG C		AI	
• Air Filter P.D.	DI	DIRTY/CLEAN	
• Supply Air Fan	DO	ON/OFF	
• Supply Air Fan P.D.	DI	NO-PRESS/NRML	
• Mixed Air temp.(on-coil) Deg C		AI	Digital
• Return Air Temp.	AI	Digital Deg C	
• Supply Air Temp. (off-coil) Deg C		AI	Digital
• Humidifiers	DO	ON/OFF	
• Re-Heat / heating Coil ON/OFF		DO	

Data to be available at HMI Touchscreen display (Min. 12”, colored display) shall include, but not limited to parameters listed for local controller & additional data as follows

On/off status of each operating equipment /component of equipment, zone temperatures, zone Rh, differential pressures of zones. Also refer to controls schematic diagram for details.

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SECTION 9 – AIR INLETS AND OUTLETS

9-01 GENERAL

Before placing orders for these items, the Contractor shall check that all items to be supplied by the manufacturer complies for spread, throw, drop and noise, with capacities and characteristics as indicated on the drawings and schedules. All outlets shall be specifically selected for their particular application and designed for quite operation. All items are to be approved by the Engineer.

All air inlets/outlets shall be of material as indicated on the Drawings and Schedules, and/or as specified.

Colours and finish shall be subject to Engineer's approval. Ceiling diffuser face and margin sizes and styles shall be coordinated with false ceiling/boxing type. All devices shall have substantial approved gaskets to completely prevent streaking on walls or ceilings due to leakage.

Where ceiling panels and ceiling diffusers are of different size, ceiling diffuser shall be centered in ceiling panel. Routing of ducts concealed above false ceiling may slightly be adjusted, if necessary, for this purpose or duct drops for diffuser necks may be offset upto a max. of 30 degrees. or diffuser locations having requirement of greater than 30 degrees offset, flexible round insulated duct connection shall be used.

All wooden frames for wall inlets/outlets (where not mounted directly on the duct) shall be 3/4" thick set permanently in the walls. These frames shall be provided by the Contractor. The Contractor shall be responsible for all cuttings of walls, fixing of wooden frames in walls and repair of masonry/plaster required for fixing side-wall inlets/outlets. The Contractor shall furnish wooden frames for wall inlets/outlets to those responsible for civil construction for installation at locations indicated on shop drawings prepared by the Contractor for this purpose.

Ceiling inlets/outlets shall not be supplied on false-ceiling. Cutting of false ceiling (tiles), where applicable, shall be the responsibility of the HVAC Contractor.

Manufacturer's certified free area for each type and size of grille, register, linear/square diffuser and louver shall also be provided for the purpose of air balancing.

9-02 GRILLES / REGISTERS

All side wall outlets and inlets shall be of sizes and characteristics as scheduled and shown on the Drawings.

Double deflection type grilles shall have vertical front bars and horizontal back bars.

All supply outlets shall have opposed blade dampers, finished in black paint, fixed to the outlet and shall be operatable with a removable key inserted from front of the grille.

All return and/or exhaust inlets shall have similar dampers if scheduled.

9-03 CEILING DIFFUSERS

Ceiling diffusers shall be of the sizes and characteristics as scheduled and shown on the Drawings.

Ceiling diffusers shall be furnished with volume dampers furnished by the diffuser manufacturer, finished in black paint.

Volume control for these diffusers shall be accessible through the diffuser from below the ceiling and shall maintain their setting when adjusted. Each diffuser shall be provided with sponge rubber or felt gasket. Return diffusers shall be similar to supply diffusers unless otherwise indicated. Inner core shall be removable and shall be mounted on outer frame. (Throw pattern for supply diffusers shall be as shown on Drawings by arrows or as shown in schedule, or as directed by the Engineer.)

Ceiling diffusers intended for use with flexible round insulated duct shall have suitable inlet box with butterfly damper at side / top inlet (as required), finished in black paint.

9-04 EA/OA LOUVERS

All louvers shall be of approved construction as per AMCA standard 500-74. All louvers shall be fitted with aluminium mesh bird and anti vermin screens. The design of the OA inlet louver blades shall be suitable to arrest rain water, sand and dust from incoming outdoor air, and shall include channels for filter insertion. Sizes are to be as given on the Drawings. Louvers shall be complete in all respects with mounting accessories. Louvers shall be of Scheduled material and finish. Design of OA and EA louvers shall be similar. All EA louvers shall have backdraft dampers upstream of louvers.

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SECTION 10 - INSTRUMENTS AND GAUGES

10-01 GENERAL

All necessary indicating and measuring instruments as required, specified and shown shall be furnished and installed by the Contractor. All thermometers shall have labels indicating their function.

These instruments shall be installed as specified / shown on drawings. Portable testing and maintenance instruments shall be supplied in carrying cases.

Duct thermometers shall be installed at PU inlets and outlets

10-03 THERMOMETERS

Calibrations shall be in degrees Fahrenheit with suitable increments. Range shall place operating temperature at or near the middle of scale. Range shall not be less than one and half times the maximum operating temperature.

Thermometers for ducts shall be dial type
Valid calibration certificates should be provided and the instrument should be tagged with calibration tags.

10-04 not used

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SECTION 11 - PAINTING & EQUIPMENT IDENTIFICATION

11-01 GENERAL

All material and labour for painting and identification of services shall be provided by the Contractor, as specified hereunder:

11-02 PAINTING

All steel work in connection with supports for ductwork etc. exposed to the elements is to be painted with two coats of an approved rust preventive paint.

All exposed metal surface of hangers, brackets, etc. must be painted with two under-coats and two finishing coats of enamel paint of approved colour. G.I. sheet is not to be painted.

All machinery and equipment which have been painted in factory to the satisfaction of the Engineer shall have a finishing coat of paint before Final Acceptance if the factory paint is damaged during transportation, storage or installation.

Identification bands shall be painted on uninsulated ducting, or on insulation at frequent intervals. Lettering shall be agreed with the Engineer

Internal surfaces of grilles, diffusers and register boxes and connections visible to occupants of rooms, shall be painted by Air Distribution Contractor with two coats of dull black paint or other colour as directed by the Engineer.

All duct hangers in concealed locations shall be given one coat of black asphalt paint before being concealed.

All cradles, vibration isolation rails that will be covered, partially covered, set in cement or fill, or not accessible when the installation is completed, shall be given two coats of black asphalt paint.

11-03 MANUFACTURER'S NAMEPLATES

Each unit or equipment shall be identified by a permanently attached nameplate made of brass or other corrosion resistant material. Plates shall not be less in size than 1.5" x 3" Plates shall bear information pertaining to unit as follows:

- System and unit designation from Schedule of Equipment.
- Manufacturer's name and address (only distributor's or agent's name and address will not be accepted).
- Rated capacity.
- Temperature, pressure or other limitations.
- Electrical Data

Dampers and controls shall be designated by distinguishing numbers in English on the charts or diagrams. The Contractor shall provide stamped

brass tags for all designated items with numbers corresponding to those on the charts.

The tags shall be not less in size than 1.5" in diameter with depressed black numbers of 1/2" height.

The Contractor shall provide separate lists designating the location and function of each damper and control.

The charts, diagrams and lists shall be of sizes, type and character as approved.

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SECTION 12- INSPECTION TESTING AND COMMISSIONING

12-01 GENERAL

12-01.1 The whole of the works supplied under this Contract shall be subject to inspection and tests by the Employer and/or Engineer should he so require, during manufacturing erection and after completion. The inspection and tests shall include, but not be limited to, the requirements of this Section of the Specifications.

12-01.2 For this purpose the Engineer shall, at all reasonable times, be allowed free and ready access to the Contractor's shop and the shops of his suppliers for the purpose of inspecting the specified equipment components, or any other parts, and obtaining information as to the progress of the work. Failure on the part of the Engineer at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

12-01.3 Specific tests required by the various items of the Plant, Parts, materials and equipment shall be treated in accordance with the specifications of the corresponding clauses of the Specifications.

12-01.4 The Contractor shall submit to the Engineer, one month prior to the date of commencement of the balancing and performance tests, six (6) copies of the complete test procedure. The procedure, method and points of measurement as well as the method of calculation shall be approved by the Engineer before any test is carried. Six (6) copies of the test results shall be furnished to the Engineer for his approval.

12-01.5 The Contractor shall supply all necessary testing and balancing instruments, which shall include, (but not limited to) the instruments listed in Section 10, INSTRUMENTS AND GAUGES, and carryout any test of any kind on a piece of equipment, apparatus part of system or on a complete system if the Engineer requests such a test for determining specified or guaranteed data, as given in the Specifications or in the Schedule of Equipment. Necessary skilled staff shall be provided by Contractor.

12-01.6 Any damage resulting from the test shall be repaired and/or damaged material replaced with intimation to the Engineer, all to the satisfaction of the Engineer, and at no extra cost to the Employer. Skilled staff shall again be provided by the Contractor.

12-01.7 In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommenced after the adjustment or repairs have been completed.

12-01.8 All testing, balancing and final adjustment shall be in accordance with the provision of the applicable ASHRAE Standards, or other approved relevant standards.

12-01.9 The Contractor shall test a piece of equipment, apparatus, parts of system or a complete system in accordance to determine Specified or Guaranteed data, given in the Specifications, Schedule of Equipment and Equipment Supplier’s Data Sheets.

12-01.10 The contractor shall be responsible for carrying out tests on the material/equipment/installation furnished by him and or Equipment Supplier.

12-02 PRELIMINARY INSPECTION & TESTS

12-02.1 General

All equipment shall be inspected and tested to determine the completeness and general conformance to specified requirements, when operated independent of overall HVAC System, for noise, vibration, and electrical data.

12-02.2 Piping Works

All copper piping shall be tested with nitrogen pressure of 1-1/2 times the operating pressure for sufficient time to detect leaks and defects. All leaks and defects shall be made good in a proper workmanlike approved manner. If necessary, piping shall be taken down and re-erected, and any make-shift or temporary repair of leaks will not be permitted.

The Contractor shall, during construction, properly cap pipes and ducts to prevent the entrance of dirt, etc. Each ducting and piping circuit shall be blown through, after completion, for as long a time as necessary to thoroughly clean that circuit.

12-02.3 Ductwork

Inspection on ductwork shall be carried out by Contractor's supervisor in the presence of Engineer's representative to the satisfaction of the Engineer.

All joints in ducts and at outlets shall be physically inspected for air leakage. All dampers shall be tested for proper operation.

Ducts, plenums and casing shall be inspected and made substantially air tight before covering with insulation or concealing in the masonry. The terms substantially airtight, shall be construed to mean that no air leakage will be noticeable through the senses of feeling or hearing.

After the entire installation has been completed, the Contractor shall commission the equipment, making all necessary adjustments in the equipment, plants, air dampers, air devices, etc., as called for and submit reports of performance tests as specified elsewhere in this specification.

All seams and joints shall be checked and all audible and noticeable leaks repaired in a good workman like manner, by filling with an approved sealant to the inside of the joint, so that the air pressure tends to force the sealant into the joint. A cfm leakage upto 5% of the volume of the duct section under test shall be permissible.

The Contractor shall, during construction, properly cap pipes and ducts to prevent the entrance of dirt, etc. Each ducting and piping circuit shall be blown through, after completion, for as long a time as necessary to thoroughly clean that circuit.

All air ducting sections shall be given a pressure test before fixing insulation and cutting openings for branches and air devices. Any opening made shall be sealed off with airtight metal caps, balloons or any other convenient device for giving the pressure test.

The ducts shall be pressurized with a rotary blower or nitrogen cylinder.

a. Low pressure ducts upto 2" wg.

b. Medium pressure ducts upto 6" wg, and

c. High pressure ducts upto 8" 0 wg.

In case the Consultant directs the Contractor to carry out final measured leakage test for medium or high-pressure ducting, he will follow SMACNA procedure for leak testing.

12-02.4 Equipment

All HVAC equipment shall be inspected for visible damage, operation of moving parts, noise and vibration. Tests shall be carried out with readings of RPM, ampere, voltage, etc. to verify the name plate data.

12-02.5 Electrical Equipment

All electrical panels shall be cleaned and adjusted on site before application of power. The following tests shall be carried out:

Wire and cable continuity tests.

Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using 500 volts megger. The megger reading shall not be less than one meg.ohm.

Earth resistance between metallic conduit systems and earth must not exceed half (1/2) ohm.

Phasing out and phase rotation tests.

Operating tests on all protective relays to prove their correct operation before energizing the main equipment.

Operating tests on all starters, circuit breakers, etc.

12-03 BALANCING AND COMMISSIONING

12-03.1 Air Balancing

All air handling and ventilating equipment, ductwork air inlet and outlets, air volume control dampers, shall be adjusted and balanced to deliver within 10% of the specified quantities indicated on the Drawings. Where the

equipment or systems depend upon controls for proper operation, functioning and performance, the Engineer may ask the Contractor that the later shall be operated simultaneously with the equipment or system during tests.

If the air quantities cannot be delivered without exceeding the speed range of the sheaves or the available horsepower, the Engineer shall be notified before proceeding with the balancing of air distribution system.

Any addition/replacements required to meet the specified flow rates shall be the responsibility of the Equipment Supplier

12-03.2 Commissioning

Upon completion of air balancing and when the whole or part of HVAC System is substantially complete and ready for operation as specified, the Contractor shall carry out Commissioning. Appropriate Seasons are not necessary and the purpose of the commissioning is to start-up the whole or part of HVAC System with manual and/or automatic controls and to put the whole or part of HVAC plant in operation to make it ready to provide cooling and/or heating.

The Commissioning shall be considered completed when complete HVAC plant put into operation and made ready to provide either cooling or heating as directed by the Engineer. The Engineer may direct the Contractor to commission part of central plant along with part of PUs, and distribution network. This will be considered as partial commissioning.

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SECTION 13 - MEASUREMENTS AND PAYMENTS

13-01 GENERAL

The Contractor shall furnish all labour, materials, equipment, and service necessary for a complete and operating HVAC system, as shown on the drawings and/or as specified. Tender Drawings are diagrammatic only. Equipment and labour not specifically referred to herein or on the plans, that is required to meet the functional intent, shall be provided without additional cost to the Employer.

Unless expressly excluded, the cost of all materials, equipment and works required by Special Provisions and Technical Provisions of Specifications, acceptably furnished, installed and tested as Specified, shall be considered to be included in the amounts tendered against the item listed in the Bill of Quantities.

13-02 BOQ ITEMS with Unit as 'EACH'

13-02.1 Measurement

Measurement will be made of each item and all associated accessories and work acceptably furnished, installed and tested as individual units.

13-02.2 Payment

Payment of these items will be made at the Contract Unit Rates for these items entered in Bill of Quantities.

13-03 BOQ ITEMS with Unit as 'LOT'

13-03.1 Measurement

No measurement will be made of the items mentioned above.

13-03.2 Payment

Payment will be made at a Contract Lumpsum Price entered for the respective item in Bill of Quantities.

13-04 BOQ ITEMs Ducting & sheet metal work, with unit as 'sft'

13-04.1 Measurement

Measurement will be made for surface area of installed, sheet metal ducting and plenums for different gauges. No measurement will be made for wastage, bracing flanges, hangers and supports, fasteners, anchor bolts air-turning vanes, splitter dampers, and duct protection.

13-04.2 Payment

Payment will be made for the number of units measured as provided above at the Contract Unit Rates as entered in BOQ.

13-05 BOQ ITEMs insulation with unit as 'sft'

13-05.1 Measurement

Measurement will be made of the area of sheet metal to which the acoustic Liner or insulation is applied. No measurement will be made for accessories and adhesive.

13-05.2 Payment

Payment or deduction will be made for the number of units measured as above at the Contract Unit Rates entered in BOQ.

13-06 BOQ ITEMs filters, dampers, air inlets/outlets with unit as 'sft'

13-06.1 Measurement

Measurement will be made of the core area of the respective item acceptably furnished, installed and tested. No measurement will be made of frames, accessories and attachments.

13-06.2 Payment

Payment will be made for the number of units measured as provided above at the Contract Unit Rates as entered in BOQ.

13-07 BOQ ITEMs, flex duct connection, with unit as 'rft'

13-07.1 Measurement

Measurement will be made of the length of pipe/flex. round duct/ flex. duct connection with route at centre line of pipe/ duct, for the piping/ ducting, fittings and accessories, acceptably furnished, installed and tested. No measurement will be made for fittings, accessories, attachments, hangers, nuts and bolts.

13-07.2 Payment

Payment will be made for the number of units measured as provided above at the Contract Unit Rates as entered in BOQ.

13-08 BOQ ITEMs insulation with unit as 'rft'

13-08.1 Measurement

Measurement will be made of the length of piping at centre line, to which the insulation is applied. No measurement will be made for accessories, adhesive, etc.

13-08.2 Payment

Payment will be made for the number of units measured as above at the Contract Unit Rates entered in BOQ.

EQUIPMENT SCHEDULES

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SCHEDULE OF WATER-COOLED SCREW WATER CHILLER

S.NO.	DESCRIPTION	
1	CODE	CH-1, CH-2
2	QUANTITY	2
3	TYPE	HIGH EFFICIENCY MICROPROCESSOR BASED VFD CONTROLLED WATER COOLED SCREW TYPE CHILLERS
4	COOLING CAPACITY AT SPECIFIED CONDITIONS (KW)	527
5	MINIMUM ACCEPTABLE **IPLV** AT SPEFICIED CONDITIONS	4.5 (AT FULL LOAD)
6	CHILLED WATER	
	a) LITER/MIN	567
	b) MAX. PD, IN EVAPORATOR Kpa	65
	c) EWT, deg C	12
	d) LWT, deg C	6
7	CONDENSER WATER	
	a) LITER/MIN	1730
	b) MAX. PD, IN EVAPORATOR Kpa	75
	c) EWT, deg C	38
	d) LWT, deg C	32
8	POWER SUPPLY	415 V/3-PH/50 HZ
9	EQUIPMENT POWER RATING	400 V/3-PH/50 HZ
10	TYPE OF REFRIGERANT	R134a, R407C or R410a
11	FOULING FACTOR (M^2. ºC/KW)	
	a) EVAPORATOR	0.088
	b) CONDENSER	0.176
12	ALTITUDE (METER)	2500
13	TYPE OF CONTROLS	MANUFACTURER'S STANDARD
14	ACCESSORIES	AS SPECIFIED
15	REMARKS	--

NOTES:

1- IF CHILLERS OF EXACT CAPACITY ARE NOT AVAILABLE THEN NEXT LARGER UNIT SHALL BE PROVIDED.

2- CHILLERS SHALL BE **EUROVENT, JIS OR AHRI** CERTIFIED.

SCHEDULE OF HOT WATER GENERATOR

S.NO.	DESCRIPTION	
1	CODE	**HWG - 1 , HWG -2, HWG-3**
2	TYPE	TYPE FIRE TUBE HOT WATER GENERATOR
3	QUANTITY	3 Nos. (as per BoQ)
4	NET OUTPUT KW (MIN. ACCEPTABLE)	450
5	LEAVING WATER TEMP., (deg C)	80
6	WATER TEMP. RISE, (deg C)	20
7	WATER QUANTITY, Lit/Min	550
8	MAX. OPERATING PRESSURE (K.Pa)	600
9	BURNER TYPE	OIL/GAS BURNER (DUAL FUEL)
10	TYPE OF FUEL	LIGHT DIESEL OIL/ LPG
11	CALORIFIC VALUE OF DIESEL OIL (KJ/Kg)	44,800
12	ALTITUDE	2500 METERS
13	POWER SUPPLY	415V/3 Ph/50 Hz
14	STACK HEIGHT (m)	3
15	MAX. PD. (K.Pa)	860
16	TYPE OF CONTROLS	MANUFACTURER STANDARD
17	ACCESSORIES	AS SPECIFIED
18	REMARKS	BURNER PILOT SHALL BE DIESEL FIRED

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SCHEDULE OF COOLING TOWERS

1	**CODE**	**CT-1, Qty.1**
2	TYPE	INDUCED VERTICAL DISCHARGE CROSS FLOW SQUARE MULTI-CELL TYPE CLOSE-CIRCUIT COOLING TOWER WITH INTERNAL PIPING FOR WATER INLET
3	Cooling Capacity	MINIMUM 650 KW HEAT REJECTION PER CELL CAPACITY
	CASING	GI-CONSTRUCTION
4	WATER FLOW RATE (Lit/Min)	1740
5	ENTERING WATER TEMPT. (deg C)	38
6	LEAVING WATER TEMPT. (deg C)	32
7	AMBIENT AIR TEMPT. (deg C)	28.9
8	FAN DRIVE	BELT DRIVE
9	MIN. NO. OF CELLS (N+1)	2-DUTY+1 STANBY
10	MOTOR	IE-4 efficiency class
(a)	POWER SUPPLY SYSTEM	415V/3-PH/50HZ OR VFD
(b)	EQUIPMENT VOLTAGE RATING	400V
(c)	MAX. RPM	1400
11	DIMENSIONAL LIMITATION (MM x MM)	4300 x 7300
12	ACCESSORIES	VIBRATION ISOLATORS
13	REMARKS	CLOSE-CIRCUIT COOLING TOWER INCLUDING ALL ACCEESORIES AND COMPONENT SUCH AS SPRAY PUMP, NOZZELS, HEAT-EXCHANGE COIL, VFD FAN ETC

NOTE:

1- WHEN COOLING TOWER UNIT WITH EXACT APACITY IS NOT AVAILABLE THEN NEXT LARGER MODEL SHALL BE PROVIDED

2- IN MULTICELL TOWERS, EACH TOWER CELL SHALL HAVE INDEPENDENT BASIN AND FULL HEIGHT PARTITION.

3- WATER BASIN SHALL HAVE ENOUGH CAPACITY TO ACCOMMODATE THE WATER QUANTTY TRANSFERRED FROM UPPER TRAYS DURING POWER FAILURE AVOIDING WATER SPILL OVER FROM BASIN.

SCHEDULE OF PUMPS

1	CODE	CWP-1, CWP-2 Qty. = 2	CHP-1, CHP-2 Qty. = 2	HWP-1, HWP-2 Qty. = 2
2	TYPE	END SUCTION, CENTRIFUGAL COMMON-Long BASE MOUNTED PUMP-MOTOR SET	END SUCTION, CENTRIFUGAL COMMON-BASE MOUNTED PUMP-MOTOR SET	END SUCTION, CENTRIFUGAL COMMON-BASE MOUNTED PUMP-MOTOR SET
3	MAKE	KSB/B&G / Grundfos OR APPROVED EQUAL	KSB/B&G / Grundfos OR APPROVED EQUAL	KSB/B&G / Grundfos OR APPROVED EQUAL
4	MODEL FOR REFERENCE ONLY	ETA (KSB)	ETA (KSB)	ETA (KSB)
5	**MOTOR**			
	MAKE	SIEMENS	SIEMENS	SIEMENS
	MOTOR COMPATIBILITY	VFD RATED AND COMPATIBLE. IE-4 EFFICIENCY CLASS	VFD RATED AND COMPATIBLE. IE-4 EFFICIENCY CLASS	VFD RATED AND COMPATIBLE. IE-4 EFFICIENCY CLASS
	c) POWER SUPPLY	415V/3-PH/50 HZ	415V/3-PH/50 HZ	415V/3-PH/50 HZ
	d) VOLTAGE RATING	400 V	400 V	400 V
6	SERVICE	COOLING WATER CIRCUIT	CHILLED/HOT WATER CIRCUIT	CHILLED/HOT WATER CIRCUIT
7	DISCHARGE (L/M)	1740	567	567
8	CIRCULATING HEAD, Kpa	320	400	400
P	PRESSURE RATING, PSIG	125	125	125
13	**REMARKS**	PARALLEL PUMP OPERATION	PARALLEL PUMP OPERATION	PARALLEL PUMP OPERATION

NOTES:

1. WHEN TWO PUMPS OPERATE IN PARALLEL, PUMP SELECTION SHOULD BE MADE BASED ON PARALLEL PUMP CURVE DRIVED FROM CATALOGUED SINGLE PUMP CURVE. OPERATING POINT FOR TOTAL SYSTEM GPM AT INDICATED HEAD MUST LIE ON DEVELOPED PARALLEL PUMP CURVE, AND MOTOR HP SHALL BE SELECTED ACCORDINGLY.
2. CONTRACTOR /SUPPLIER SHALL RECALCULATE THE PUMPS HEAD BEFORE SUBMITTAL SUBMISSION AND ALONGWITH THE CALCULATIONS.

SCHEDULE OF RECOVERY TYPE 100% FRESH AIR UNITS(DOAS)

CODE	TYPE	QTY.	SUPPLY FAN DATA		MAX. OA (L/S)	RETURN AIR (RA) (L/S)	RETURN AIR FAN DATA		ENERGY RECOVERY WHEEL DATA				DISCH ARR.	REMARKS
									EXHAUST AIR		FRESH AIR			
			SUP AIR (L/S)	EXT SP (PASCAL)			RETURN AIR (L/S)	ESP (PASCAL)	AIR (L/S)	TEMP. (C)	AIR (L/S)	TEMP. (C) (DB/WB)		
ENERGY RECOVERY BASED AIR HANDLING UNITS														
TFAU-1	FLOOR MOUNTED HORIZONTAL DRAW THRU CENTRIFUGAL TYPE DOUBLE SKIN WITH RETURN FAN, RECOVERY WHEEL AND CHILLED WATER COIL	1	400	448	400	350	350	448	350	24	400	34 / 18	TD	SEE NOTES BELOW
TFAU-2		1	550	448	550	500	500	448	500	24	550	34 / 18	TD	
TFAU-3		1	2200	448	2200	2000	2000	448	2000	24	2200	34 / 18	TD	

NOTES:

1- FOR COIL DATA SEE SCHEDULE OF CHILLED/HOT WATER COILS.

2- THE TFU SHALL HAVE FOLLOWING MINIMUM SECTIONS

i) SUPPLY & RETURN AIR FAN SECTIONS

ii) COIL SECTION INCLUDING CHILLED/HOT WATER COIL

iii) FILTERS SECTION INCLUDING FOLLOWING FILTER MEDIA INSTALLED UP-STREAM OF THE FAN SECTION

a) 50MM THICK WASHABLE FILTER OF CLASS G4

b) THERMO WELDED SYNTHETIC FIBREGLASS BAG FILTERS (CLASS F7) OF MEDIUM LENGTH

4- THE PRESSURE DROP ACROSS THE ENERGY WHEEL SHALL NOT ACCEED TO 187 PASCAL.

5- TFAUs SHALL HAVE 50MM THICKNESS OF TFAU WALLS CONSTRUCTED WITH INJECTED POLYURETHANE

6- TFAUs SHALL BE SELECTED FOR ALTITUDE 2,230 METER ABOVE MEAN SEA LEVEL.

7- OFFERED EQUIPMENT SHALL BE AHRI OR EUROVENT CERTIFIEED.

8- ENERGY RECOVERY WHEEL SHALL BE AHRI CERTIFIED SEPARATELY.

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SCHEDULE OF WATER COILS FOR AIR HANDLING UNITS

SR. NO.	CODE	INSTALLED IN AHU NO.	QTY.	AIR THRU COIL L/S	MAX. COIL FV M/SEC	COOLING COIL (AIR SIDE)						COOLING COIL (WATER SIDE)				COIL HEATING DATA				FRESH AIR L/S
						TC (kW)	SHC (kW)	EDB deg C	EWB deg C	LDB deg C	LWB deg C	EWT deg C	LWT deg C	MAX.FLOW RATE Liter/Min	MAX. PD K.Pa	TH (kW)	EWT deg C	MAX.FLOW RATE Liter/Min	MAX. PD K.Pa	
18	CCHC-1	TFAU-1	1	400	2.8	12	9.5	25.5	16.2	11.2	10.3	6	12	MFR	60	20	60	MFR	60	400
19	CCHC-2	TFAU-2	1	550	2.8	15	12.7	30.6	24.6	23.1	22.5	6	12	MFR	60	25	60	MFR	60	550
20	CCHC-3	TFAU-3	1	2200	2.8	55	46.7	30.6	24.6	23.1	22.5	6	12	MFR	60	80	60	MFR	60	2200

ABBRIVIATIONS:

CCHC:	COMBINATION COOLING HEATING COIL	EWB:	ENTERING AIR WET BULB TEMPERATURE
AHU:	AIR HANDLING UNIT	LDB:	LEAVING AIR DRY BULB TEMPERATURE
TC:	TOTAL COOLING CAPACITY	LWB:	LEAVING AIR WET BULB TEMPERATURE
SHC:	SENSIBLE COOLING CAPACITY	EWT:	ENTERING WATER TEMPERATURE
EDB:	ENTERING AIR DRY BULB TEMPERATURE	LWT:	LEAVING WATER TEMPERATURE

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SCHEDULE OF FAN COIL UNITS

CODE	TYPE	SUPPLY FAN		ACCESSORIES	REMARKS
		AIR FLOW (L/S)	EXT SP (Pa)		
FCU-AA	HORIZONTAL CONCEALED CEILING SUSPENDED DUCT CONNECTED LOW STATIC TYPE WITH FILTER	190	57	SEE NOTES BELOW	FOR COIL DATA SEE SCHEDULE OF WATERCOILS FOR FAN COIL UNITS
FCU-A	-------DO-------	283	57	-------DO-------	-------DO-------
FCU-B	-------DO-------	377	57	-------DO-------	-------DO-------
FCU-C	-------DO-------	566	150	-------DO-------	-------DO-------
FCU-D	-------DO-------	755	50	-------DO-------	-------DO-------

NOTE

1- All FCUs shall be selected at medium speed.
2- FCUs motor shall be single phase, three speed type. Anti -corrosive body and drain pan
3- The FCUs noise level (DB) shall not be exceed to 60 DB.
4- ALL FCUs SHALL BE SUPPLIED WITH MATCHING TWO WAY MODULATION VALVE AND BACNET COMPATIBLE-THERMOSTAT

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SCHEDULE OF WATER COIL FOR FAN COIL UNITS

SR. NO.	CODE	INSTALLED IN FCU NO.	AIR THRU COIL L/S	MAX. COIL FV M/S E C	COOLING (AIR SIDE)						COOLING (WATER SIDE)				COIL HEATING DATA			
					TC (kW)	SHC (kW)	EDB deg C	EWB deg C	LDB deg C	LWB deg C	EWT deg C	LWT deg C	MAX.FLOW RATE Liter/Min	MAX. PD K.Pa	TH (kW)	EWT deg C	MAX.FLOW RATE Liter/Min	MAX. PD K.Pa
1	CCHC-1	FCU-AA	190	2.8	4	3.4	25.9	16.3	12.5	11.8	6	12	17.1	45	7	60	17.1	45
2	CCHC-2	FCU-A	283	2.8	5.7	4.8	24.6	16.5	12.5	11.7	6	12	14.7	45	9.5	60	14.7	45
3	CCHC-3	FCU-B	377	2.8	7	5.9	24.7	17.0	13.0	12.3	6	12	9.0	45	12	60	9.0	45
4	CCHC-4	FCU-C	567	2.8	10.5	8.8	24.7	17.0	13.0	12.3	6	12	9.0	45	15	60	9.0	45
5	CCHC-5	FCU-D	755	2.8	14.5	12.3	25.9	17.2	12.8	12.0	6	12	12.1	45	18	60	12.1	45

CCHC: COMBINE COOLING HEATING COIL
FCU : FAN COIL UNIT
TC : TOTAL COOLING CAPACITY
SHC : SENSIBLE COOLING CAPACITY
EWB : ENTERING WET BULB TEMPERATURE
EWT : ENTERING WATER TEMPERATURE
LWT : LEAVING WATER TEMPERATURE
TH : TOTAL HEATING CAPACITY
EAT : ENTERING AIR TEMPERATURE
LAT : LEAVING AIR TEMPERATURE
FV : COIL FACE VELOCITY
PD : PRESSURE DROP

NOTE

1- All coils shall be selected at 0.45 mm thickness of copper tube.
2- FCUs motor shall be single phase, three speed type.
3- FCU-A (to be installed in ATC cabin and ARFF cabin) shall have maximum noise level of not exceeding 45dBA measured at 1.5 meters distance.
4- The FCUs noise level (DB) shall not be exceed to 50 DB for all other types

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

AIR INLETS / OUTLETS – EQUIPMENT SCHEDULE

1	Type	Equipment Schedule	Service	Material	Reference Make / Model	Finish	Colour	Accessories
A	Ceiling Supply Diffuser	Square, removeable cone type	Supply	Aluminium Extruded	Tuttle & Bailey, TROX, AirMate, Krueger, Nailor	Anodized	As required by Engineer	As specified
B	Ceiling Return Diffuser	Square, removeable cone type	Return	Aluminium Extruded		Anodized	As required by Engineer	As specified
C	Supply Air Register	Side Wall adjustable vertical & horizontal bars register	Supply	Aluminium Extruded		Anodized	As required by Engineer	As specified
D	Return Air Register	Side Wall adjustable vertical & horizontal bars register	Return	Aluminium Extruded		Anodized	As required by Engineer	As specified
E	Return Air Grille	Deflected fixed horizontal Bar Grille	Return	Aluminium Extruded		Anodized	As required by Engineer	As specified
F	Transfer Grille	Deflected fixed horizontal Bar Grille	Return	Aluminium Extruded		Anodized	As required by Engineer	As specified
G	OA Louver	Outdoor Air Intake Louvre	Intake	Aluminium Extruded		Anodized	As required by Engineer	Insect Screen & Filter
H	EA Louver	Exhaust Air Outlet Louvre	Exhaust	Aluminium Extruded		Anodized	As required by Engineer	Relief Damper
I	—	—	—	Aluminium Extruded		Anodized	As required by Engineer	As specified
J	Filter-Back Return Grille	FCU Return	Return	Aluminium Extruded		Anodized	As required by Engineer	—
K	Supply Air Grille	Adjustable vertical & horizontal bars grille	Supply	Aluminium Extruded		Anodized	As required by Engineer	—
L	Linear Return Grille	Continuous Linear Grille for Return Air	Return	Aluminium Extruded	T & B Imperialine 6000, slots as per Drg, TROX, AirMate, Krueger, Nailor	Anodized	As required by Engineer	—
M	Linear Supply Grille *(drawing shows "LIEAR")*	Continuous Linear Air Grille for Supply Air	Supply	Aluminium Extruded		Anodized	As required by Engineer	With Pattern Controller
N	Wire Mesh	Wire mesh at duct opening	Return / Exhaust	GI ½" × ½" wire mesh	—	—	—	—
Z	Supply Air	Eye Ball Jet Diffuser (Adjustable)	Supply	Aluminium Extruded	T & B, TROX, AirMate, Krueger, Nailor	Anodized	As required by Engineer	—

PROCUREMENT REGULATORY AUTHORITY EPADS

SECTION 0730 – SPECIAL PROVISIONS FOR MECHANICAL WORKS

PART 1 – GENERAL

1.1 SCOPE OF WORK

Design, preparation of installation/erection drawings, obtaining government/Employer approvals/certificates, fabrication, installation, testing, commissioning, maintenance for stipulated period, training of Employer's staff. All miscellaneous equipment/work to render equipment ready. All wiring and controls beyond power supply point. Inspection of already constructed civil works. Cutting, patching, repairing. Provide installation, operation, maintenance manuals, spares lists, drawings, diagrams, test certificates. Training. Maintenance during defects liability period (365 days after handing over).

1.2 CODES AND STANDARDS

ASME, BS/EN, AWS, NFPA, ASTM, NEMA, IEE, AISC, ICC, Building Code of Pakistan.

1.3 QUALITY STANDARD

If equipment not from recommended manufacturers, only manufacturers with proven record considered.

Manufacturer: Equipment of USA, Western Europe & Japan origin only (or license from same with guarantee). Min 30 years' experience. Name, part numbers, serial numbers on major components. At least 30 offered units successful operation in Pakistan for min 3 years. New, latest design.

Installer/Supplier: Authorized sole distributor/dealer/agency holder from manufacturer. PEC Registration in relevant category, NTN certificate. Successful experience of supply/installation of offered equipment: average min 20 units over last five years. Successful experience of maintenance: average min 15 units over last five years.

1.4 PRODUCT HANDLING AND STORAGE

Contractor entire responsibility.

1.5 INSPECTION AND CONTROL

Engineer may inspect at any time. **Pre-shipment Inspection** for Passenger Lifts, Escalators, Passenger boarding bridges, Baggage handling system, Hydrant Refueling System. One Employer rep + one Engineer rep. Contractor provides travel, visas, boarding, lodging, daily allowance. Submit test procedures/protocols for approval. 3 weeks notice. **Inspection at Site Works:** Engineer inspects after delivery. **Damages:** Contractor responsible for damage during transport, storage, installation.

1.6 DRAWINGS AND SUBMITTALS

Technical Data Sheets: Completed with technical literature. **Outline Drawings:** Arrangement of equipment and electrical installations. **Design Drawings/Shop Drawings:** Allow 3 weeks for review. Show final arrangement, max dynamic/static loads, dimensions/locations of services/embedded parts/electrical connections, wiring/control logic diagrams. **As Built / As-Installed Drawings:** Size A1 min. All items legible. **Installation, Operating and Maintenance Manuals:** Four sets. Contents: Index, general description, fault detection, emergency directions, safety control settings, equipment

list with manufacturer/agent/nameplate data, dismantling/installation/operating/maintenance instructions, list of spare parts, list of essential tools, as-installed drawings.

1.7 OPERATION AND MAINTENANCE

Maintenance During Defects Liability Period: Remedy/replace defective parts. Continuous weekly routine service, emergency service short notice. Skilled personnel. Includes inspection, lubrication, supply of consumables, oil/grease, cotton waste, running adjustments, cleaning. **Register of Service and Maintenance:** Record of all services, maintenance, repair work in duplicate.

1.8 SPARES AND TOOLS FOR SERVICING AND MAINTENANCE

Spare Parts: Consumables for 2 years operational duties. Normal spares recommended for 2 years after DL period. **Tools & Instruments:** Complete set in tool boxes not used by Contractor during installation/testing/commissioning/DLP. List includes flat/ring spanner sets, screw driver set, allen key set, T socket spanner set, tester, nose plier, plier, cutter plier, hammer (2 lb), adjustable wrench, Fluke digital multimeter, hacksaw frame with blade, 5m measuring tape, head held LED torch, insulation tape set (red,yellow,blue,green), grease gun, oiling can, toolbox. Quantity 4 each.

1.9 PAINTING & FINISHES

Thoroughly cleaned, freed from oil/grease. Approved primer, undercoats, finishing coats. Stainless steel finish No.4 unless specified.

1.10 TESTING AND COMMISSIONING

Contractor gives 7 days notice. If fails, Engineer may call upon Contractor under 7 days notice; if still fails, tests by other agency at Contractor’s expense. Contractor supplies utilities, labour, apparatus, instruments. Each section to operate within specified limits for 1 year after Testing and Commissioning (under Contractor’s charge).

1.11 TEST CERTIFICATES AND REPORTS

Copies of test certificates/reports: critical materials, factory tests, pre-shipment test report, testing & commissioning report.

1.12 TRAINING

Free training and instruction for Employer’s maintenance staff. Instructor competent and experienced. Syllabus details, hours, field instruction, number of Employer’s personnel included with Bid.

1.13 FITNESS CERTIFICATE

Written guarantee endorsed in Employer’s name that material and workmanship conform to international standards. During last month of Defect Liability Period, demonstrate all equipment operating as per specifications. If equipment out of order >10 days (or as per Conditions of Contract), DLP extended.

1.14 WARRANTY

Per respective sections, from TOC, endorsed in Employer’s name.

PART 2 - MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0740 - CNS EQUIPMENT
DIVISION 01 – GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE OF WORK

The Contractor shall undertake the complete planning, design, engineering, manufacturing, supply, installation, integration, testing, commissioning, and handover of all Communication, Navigation, and Surveillance (CNS) equipment required for the Air Traffic Control (ATC) Tower and Fire Station at Skardu Airport. The work shall be executed on a turn-key basis and shall ensure full compliance with the technical specifications, drawings, applicable international standards, and the Bill of Quantities (BOQ).

The scope includes, but is not limited to:

- **VHF (AM) Air Band Communication System** – transceivers configured in main/standby pairs with dual-cavity combiners and omnidirectional antennas.
- **UHF (AM) Air Band Communication System** – transceivers configured in main/standby pairs with associated filters and antennas.
- **HF Communication System** – transceivers (1 kW) and transceiver 125 watts with broadband antennas.
- **Radio Remote Controllers** – with touch-screen, headset, foot pedal, and UPS backup.
- **Remote Control and Monitoring System (RCMS)** – software suite with workstation and laptop, quantity 4 user and 50 device licenses.
- **Digital Voice Logging System (DVLS)** – dual redundant 48-channel recorder with synchronized replay, 31-day online storage.
- **Antenna Systems, Combiners, Filters, and RF Distribution** – including VHF dual-cavity combiners, UHF dual filters, VHF/UHF antennas, low-loss coaxial cable, etc.
- **Power Supply Systems** – 13.4 to 48 VDC (adjustable) power system with lithium battery bank (≥2 hours backup), double conversion online UPS, and low power control AVR/UPS.
- **Network Infrastructure** – managed Layer 2/3 Ethernet switches with dual LAN redundancy capability.
- **Automated Weather Observing System (AWOS)** – single-runway ICAO CAT I system including sensors, central data unit, and integration.
- **ATC Console Furniture** – ergonomic working positions with integrated monitor mounts and cable management.
- **AMHS Terminal** – all-in-one desktop computer and dot-matrix printer with redundant lines through PTCL Fiber and Satellite.
- OCC room with all required equipment.
- Separate earth pit for CNS equipment and building with lightning arrester.

- Any other system required for complete functioning of ATC equipment installed.
- Factory Acceptance Tests (FAT), Site Acceptance Tests (SAT), and training – as detailed in the BOQ.

All equipment and materials shall be new, of proven technology, and shall have been successfully deployed in civil aviation environments with similar operational and climatic conditions.

1.2 CONTRACTOR'S RESPONSIBILITY AND INTEGRATION

The Contractor shall act as the **General Integrator** for all subsystems within this scope and shall bear full system-wide responsibility for the design, selection, supply, installation, and integration of all components. The Contractor shall ensure that all subsystems (VHF, UHF, HF, recording, remote control, monitoring, weather, power, etc.) work together as a single, fully functional, and interoperable system.

The Contractor shall coordinate with other contractors (e.g., for civil works, fire telephone system, master clock system) and shall provide all necessary interface control documents (ICDs) to ensure seamless integration.

1.3 AMBIENT CONDITIONS

All equipment shall be designed and tested to operate without derating under the following ambient conditions at Skardu Airport:

Parameter	Value
Maximum outdoor temperature	50°C
Minimum outdoor temperature	–25°C
Maximum indoor (non-AC) temperature	40°C
Maximum indoor (air-conditioned) temperature	30°C
Maximum relative humidity	100% (at 43°C)
Altitude	2230 m above mean sea level
Wind velocity	180 km/h
Seasonal snow	Up to 6 inches

1.4 POWER SUPPLY CONDITIONS

Equipment shall operate satisfactorily with the following power supply variations without any derating:

- **AC Supply:** 100-260 V ±10%, single phase; 400 V ±10%, three phase; frequency 50 Hz ±2 Hz.
- **DC Supply:** 13.4 to 48 V DC adjustable ±20% (or as required by equipment).

1.5 QUALITY ASSURANCE

The Contractor's quality management system shall be ISO 9001 certified. All equipment shall be manufactured under a certified quality assurance program. Certificates of conformity shall be provided.

1.6 EQUIVALENT PRODUCTS AND MINIMUM OEM QUALIFICATION CRITERIA

1.6.1 General Requirement

Equivalent products shall be considered only where they demonstrably meet or exceed all specified technical requirements, performance parameters, environmental conditions, applicable international standards, and interoperability requirements defined in these Specifications. Compliance shall be established through complete and verifiable technical documentation submitted with the bid.

1.6.2 Proven Technology and Application

The offered product shall be of proven design and mature technology, and shall have been in successful operational service in civil aviation environments (preferably CNS/ATC applications) under similar environmental and operational conditions.

1.6.3 Original Equipment Manufacturer (OEM) Experience

The manufacturer (OEM) of the offered product shall have a minimum of ten (10) years' continuous experience in the design, engineering, and production of same equipment.

1.6.4 Supply and Operational Track Record

The OEM shall have supplied, installed, and commissioned not less than five hundred (500) units of the same or substantially similar product worldwide during the last five (5) years. Out of these, a minimum of fifty (50) installations shall be in active and satisfactory operational service.

1.6.5 Documentation and Evidence

The bidder shall submit comprehensive documentary evidence in support of compliance, including but not limited to:

(a) Type test reports and certificates of compliance with applicable international standards (e.g., IEC, ICAO, EUROCAE, IEEE, ETSI, or equivalent);
(b) Detailed technical datasheets and performance specifications;
(c) Client references with contact details and evidence of satisfactory operation;
(d) Supply, installation, and commissioning records; and
(e) Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) procedures and reports, where applicable.

1.6.6 Product Lifecycle and Support

The offered product shall be in current production and shall not be based on prototype, developmental, obsolete, or end-of-life technology. The OEM shall guarantee availability of spare parts, technical support, and software/firmware updates for a minimum period of ten (10) years from the date of Final Acceptance.

1.6.7 Right of Verification and Rejection

The Employer/Engineer reserves the right to verify all submitted information and supporting documents. Any product for which the information is found to be incomplete, inconsistent, misleading, or unverifiable shall be rejected. Failure to comply with any requirement of this Clause shall render the bid non-responsive and liable to rejection without further evaluation.

DIVISION 02 – ELECTRICAL

PART 1 – GENERAL

1.1 SCOPE

This section specifies general electrical requirements common to all electrical work within the CNS equipment installation at Skardu Airport. This includes power distribution, wiring methods, circuit protection, identification, and associated accessories necessary for a complete and fully functional electrical infrastructure supporting all communication, navigation, surveillance, and weather systems.

The Contractor shall provide all labor, materials, equipment, and services required for the complete electrical installation in accordance with the contract documents, applicable codes, and industry best practices. All work shall be performed in a professional manner to ensure reliability, safety, and maintainability consistent with critical air traffic control applications.

1.2 REFERENCES

The electrical installation shall comply with the latest editions of the following standards, codes, and regulations. Where conflicts exist, the more stringent requirement shall apply.

Standard/Code	Title	Application
International		
IEC 60364	Electrical Installations of Buildings	Overall electrical installation
IEC 60446/60445	Basic and Safety Principles for Man-Machine Interface, Marking and Identification	Conductor identification
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)	Enclosure ratings
IEC 61000 Series	Electromagnetic Compatibility (EMC)	Immunity and emissions
IEC 62305	Protection Against Lightning	Lightning protection
IEC 60950 / 62368-1	Safety of Information Technology Equipment	Equipment safety
IEEE 1100	Recommended Practice for Powering and Grounding Electronic Equipment	Power quality and grounding
IEEE C62.41	Surge Voltages in Low-Voltage AC Power Circuits	Surge protection
National / Local		

Standard/Code	Title	Application
Pakistan Electric Power Code (PEPC)	As adopted by NEPRA	Local regulatory compliance
Pakistan Engineering Council (PEC)	Building and Electrical Codes	Local engineering practice
Water and Power Department, Government of Gilgit-Baltistan (GB Power)	Distribution Standards	Utility interface requirements
Industry Best Practices		
Schneider Electric	Cahier Technique	Power distribution design
Eaton	Bussmann Series SPD Handbook	Surge protection coordination
Siemens	Low-Voltage Switchgear and Distribution	Panel design standards
Rittal	Enclosure and Climate Control Guidelines	Cabinet ventilation and protection

The Contractor shall also comply with any additional requirements specified by the equipment manufacturers regarding power quality, grounding, and environmental conditions.

1.3 SUBMITTALS

The Contractor shall submit the following documents for review and approval by the Engineer prior to commencement of any electrical work:

a) Shop Drawings:

- Single-line diagrams (SLD) showing all power distribution from utility entry to final equipment outlets.
- Riser diagrams indicating vertical distribution.
- Panel schedules detailing circuit numbers, loads, breaker sizes, and wire gauges.
- Conduit routing plans with raceway sizes and locations.
- Receptacle and equipment outlet layouts.
- Lighting layout (if applicable).
- Load calculations for all distribution panels, UPS, and DC systems.

b) Wiring and Connection Diagrams:

- Interconnection diagrams between panels, UPS, DC systems, and CNS equipment.
- Terminal strip layouts and wiring details.
- Control wiring schematics for remote monitoring and alarm interfaces.

c) Product Data:

- Manufacturer's catalogue cuts and technical data for all electrical components:
    - Distribution panels and circuit breakers
    - Conduit, fittings, and boxes
    - Wiring devices (receptacles, switches)
    - Surge protective devices (SPDs)
    - Cable tray systems
    - Labelling systems

d) Nameplate Schedules:

- Schedule of all electrical panels, cabinets, and major equipment with designated identification numbers.
- Nameplate content and format for all panels and devices.

e) Test and Commissioning Plans:

- Electrical testing procedures and acceptance criteria.
- Insulation resistance test records.
- Continuity and polarity test records.
- Ground resistance test reports.

f) As-Built Documentation:

- Final as-built drawings reflecting all field modifications.
- Updated single-line diagrams and panel schedules.
- Cable and conduit as-built routing.

PART 2 – PRODUCTS

2.1 WIRING AND CONDUCTORS

2.1.1 General Requirements

- All conductors shall be **copper**, stranded, with insulation rated for 600 V, 90°C minimum.
- Conductor sizes shall be based on the calculated load, voltage drop, and short-circuit rating, but in no case smaller than:
    - Lighting circuits: 2.5 mm²

- Power circuits (general): 4 mm²
- Feeder circuits: As calculated (minimum 6 mm²)

- Conductors shall be sized for a maximum voltage drop of 2% at the furthest outlet and 3% total from service entry.

2.1.2 Conductor Insulation Types

- **General purpose:** PVC insulated, 600 V, 90°C (e.g., IEC 60227 / BS 6004).
- **Fire-resistant circuits:** LSZH (Low Smoke Zero Halogen) or similar where required for safety circuits.
- **Flexible connections:** Multi-strand flexible cord with appropriate strain relief.

2.1.3 Cable Types

- **Single-core cables:** For panel wiring and conduit installations.
- **Multi-core cables:** For multi-circuit runs where grouped.
- **Armored cables:** For outdoor or exposed runs where mechanical protection is required (e.g., SWA).

2.1.4 Manufacturer Standards

Acceptable manufacturers include, but are not limited to: Prysmian, Nexans, LS Cable & System, General Cable, Pak Cables (subject to meeting all technical requirements), or equivalent meeting specification requirements as per Clause 1.6 of Division 01 General Requirements.

2.2 CONDUITS, RACEWAYS, AND FITTINGS

2.2.1 Conduit Types

Location	Conduit Type	Standard	Application
Exposed (equipment rooms)	Rigid Steel Conduit (RGS)	IEC 61386 / UL 6	Maximum mechanical protection
Concealed (walls, ceilings)	Electrical Metallic Tubing (EMT)	IEC 61386 / UL 797	Lightweight, protected locations
Underground (exterior)	Rigid PVC (Schedule 80)	IEC 61386 / UL 651	Corrosion resistant, direct burial
Flexible connections	Liquid-tight Flexible Metal Conduit (LFMC)	IEC 61386 / UL 360	Final connections to equipment
Cable tray	Perforated or solid bottom ladder tray	IEC 61537 / NEMA VE 1	Large cable runs

2.2.2 Conduit Sizing

- Conduits shall be sized per NEC/IEC requirements with a minimum fill of 40% for power conductors and 50% for control conductors.
- Minimum conduit size: 20 mm (¾") for branch circuits.

2.2.3 Fittings and Accessories

- All fittings shall be of the same material as the conduit.
- Boxes shall be galvanized steel with appropriate knockouts.
- Pull boxes and junction boxes shall be sized for the number and size of conductors.

2.2.4 Manufacturer Standards

Acceptable manufacturers include Atkore (Allied, Calbrite), Legrand (Wiremold, Ortronics), Schneider Electric (Square D), Eaton (Crouse-Hinds), or equivalent meeting Clause 1.6.

2.3 DISTRIBUTION PANELS AND CIRCUIT BREAKERS

2.3.1 Panelboards

- **Type:** Dead-front, circuit breaker type, suitable for location (indoor/outdoor, NEMA 1 / IP31 or NEMA 12 / IP54 as required).
- **Construction:** Heavy-gauge steel, powder-coated finish.
- **Main breaker:** Molded case circuit breaker (MCCB) with adjustable trip settings.
- **Branch breakers:** Miniature circuit breakers (MCBs), thermal-magnetic, 10 kAIC minimum.
- **Busbars:** Copper, sized for the panel rating.
- **Neutral and ground bars:** Isolated neutral (floating) and separate equipment ground bars.

2.3.2 Circuit Breaker Characteristics

- **Voltage rating:** 230/400 V, 50 Hz.
- **Current rating:** As per load calculations.
- **Interrupting capacity:** Minimum 10 kA (higher where available fault current exceeds).
- **Tripping characteristics:** Type C for general circuits, Type D for motor loads.

2.3.3 Manufacturer Standards

Acceptable manufacturers include Schneider Electric (Square D, Merlin Gerin), Eaton (Cutler-Hammer), Siemens (Sentron), ABB (S series), or equivalent meeting Clause 1.6.

2.4 SURGE PROTECTIVE DEVICES (SPDs)

2.4.1 AC Power SPDs

- **Type 1 (10/350 µs):** Installed at main distribution panel. Voltage protection level (Up) ≤2.5 kV. Nominal discharge current (In) ≥20 kA per phase.
- **Type 2 (8/20 µs):** Installed at sub-panels and UPS outputs. Up ≤1.5 kV, In ≥20 kA per phase.

- **Type 3:** Installed at sensitive equipment outlets (as required).

2.4.2 Data and Signal SPDs

- **Ethernet:** CAT6/6a shielded, with gas discharge tube and clamping diodes.
- **RF Coaxial:** In-line, frequency-specific (118-137 MHz, 225-400 MHz, 2-30 MHz), with low insertion loss.
- **Control signals:** Multi-pair protectors for analog and digital lines.

2.4.3 Manufacturer Standards

Acceptable manufacturers include DEHN, Phoenix Contact, Citel, Raycap, Eaton Bussmann, or equivalent meeting Clause 1.6.

2.5 WIRING DEVICES

2.5.1 Receptacles

- **Type:** Industrial grade, 13 A, 230 V AC, switched.
- **Configuration:** UK-type (BS 1363) for general use; IEC 60309 (CEE 17) for high-current equipment.
- **Enclosure:** Flush or surface mount as required.

2.5.2 Switches

- **Type:** Industrial grade, 10 A, 230 V AC, single-pole or multi-way as required.
- **Configuration:** Toggle or rocker as per architectural finish.

2.5.3 Manufacturer Standards

MK Electric (Honeywell), Legrand, Schneider Electric (Lisse, Clipsal), Hager, or equivalent meeting Clause 1.6.

2.6 CABLE TRAY AND SUPPORTS

2.6.1 Cable Tray

- **Type:** Ladder tray, galvanized steel, with 4” side rails.
- **Finish:** Hot-dip galvanized or pre-galvanized.
- **Accessories:** Splices, drop-outs, covers where required.

2.6.2 Supports

- Unistrut or equivalent channel strut system for equipment mounting and cable support.
- Threaded rod and trapeze hangers for overhead runs.

2.6.3 Manufacturer Standards

Unistrut (Atkore), Eaton (B-Line), Thomas & Betts (ABB), or equivalent meeting Clause 1.6.

2.7 IDENTIFICATION AND LABELING

2.7.1 Labelling System

- **Panel labels:** Engraved laminated plastic, 2 mm thick, black lettering on white background.
- **Circuit labels:** Heat-shrink sleeve or self-laminating wrap-around type.
- **Cable labels:** Durable nylon or vinyl tags with heat-shrink tubing.

2.7.2 Label Content

- **Distribution panels:** “P-XXX” – main distribution, “PP-XXX” – sub-panel.
- **Circuits:** Panel designation, circuit number, load description (e.g., “P-01-C12 – VHF Cabinet 1”).
- **Conductors:** Phase and neutral identification.

2.7.3 Manufacturer Standards

Brady (BMP series), Panduit, Dymo (Industrial), or equivalent meeting Clause 1.6.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

3.1.1 Coordination

- The Contractor shall coordinate electrical installation with other trades (civil, mechanical, data communications, etc.).
- Rough-in shall be completed prior to ceiling and wall finishes.
- All electrical work shall be scheduled to minimize disruption to airport operations.

3.1.2 Workmanship

- All work shall be performed by licensed electricians with demonstrated experience in industrial and airport environments.
- Installations shall be neat, symmetrical, and accessible for maintenance.
- Conduits shall be run parallel or perpendicular to building lines unless otherwise approved.

3.2 RACEWAY INSTALLATION

3.2.1 Conduit Installation

- Conduits shall be installed with proper supports at intervals not exceeding:
    - EMT: 3 m (10 ft)
    - RGS: 3.5 m (12 ft)
    - PVC: 1.5 m (5 ft)
- Bends shall be made with a conduit bender; no kinking or flattening.
- Conduit ends shall be reamed to remove burrs.
- Threaded connections shall be made with appropriate couplings and bonding jumpers.

3.2.2 Underground Conduits

- Trenches shall be excavated to depth of 600 mm minimum.
- PVC conduits shall be bedded in 100 mm of sand, covered with warning tape, and backfilled.
- Conduits shall be sealed at ends to prevent water ingress.

3.2.3 Cable Tray Installation

- Cable tray shall be installed on top roof of control tower to ECR for CNS installations.
- Cable trays shall be installed level and straight, supported at 1.5 m intervals.
- Trays shall be bonded to the grounding system at intervals not exceeding 15 m.
- Cables shall be neatly laid with appropriate separation between power and data.

3.3 CONDUCTOR INSTALLATION

3.3.1 Pulling

- Conductors shall be pulled using approved lubricants (for PVC, not for rubber).
- Pulling tensions shall not exceed manufacturer recommendations.
- Conductors shall not be pulled over sharp edges.

3.3.2 Terminations

- Conductors shall be terminated with compression lugs or screw terminals as appropriate.
- Torque values shall follow manufacturer specifications.
- No conductors shall be nicked or cut during stripping.

3.3.3 Spare Conductors

- Minimum 20% spare conductors shall be provided in each conduit (subject to fill calculations).
- Spare conductors shall be terminated and labelled.

3.4 PANELBOARD INSTALLATION

3.4.1 Mounting

- Panels shall be mounted plumb and level.
- Panels shall be installed with clear working space of 1 m in front.
- Panels shall be labelled with circuit directory.

3.4.2 Wiring

- Branch circuits shall be neatly arranged and bundled.
- Neutral and ground conductors shall be terminated on separate bars.
- All connections shall be torqued per manufacturer’s requirements.

3.5 SURGE PROTECTIVE DEVICE INSTALLATION

3.5.1 AC SPDs

- Type 1 SPDs shall be installed at the main distribution panel with conductor length minimized (<0.5 m).
- Type 2 SPDs shall be installed at sub-panels and UPS outputs.
- All SPDs shall have indicator lights showing status.

3.5.2 Data and Signal SPDs

- Ethernet SPDs shall be installed at building entry and at equipment cabinets.
- Coaxial SPDs shall be installed at the point of entry for all antenna feeders.
- Grounding conductors for SPDs shall be as short and direct as possible.

3.6 LABELING

3.6.1 Panel Labels

- Each panel shall have a permanent nameplate with panel designation and voltage rating.
- Circuit directories shall be completed and inserted in clear plastic holders.

3.6.2 Conduit and Cable Labels

- Each conduit run shall be identified with a tag at both ends.
- Each cable shall be identified with heat-shrink labels at termination points.
- Labels shall be legible from a distance of 1 m.

3.7 ELECTRICAL TESTING

3.7.1 Pre-Energization Tests

- **Insulation resistance:** Test each circuit at 500 V DC; minimum 1 MΩ.
- **Continuity:** Verify all circuit conductors and grounding.
- **Polarity:** Verify correct phase and neutral connections.
- **Ground resistance:** Measure earth electrode system resistance; ≤1 Ω.

3.7.2 Post-Energization Tests

- **Voltage measurement:** Verify voltage levels at all outlets (±5% of nominal).
- **Phase rotation:** Verify correct rotation for three-phase equipment.
- **SPD operation:** Verify status indicators.
- **Load testing:** Verify circuit breakers do not trip under normal load.

3.7.3 Test Equipment

- All test equipment shall be calibrated and traceable to national standards.
- Test results shall be documented and submitted to the Engineer.

3.8 FINAL ACCEPTANCE

3.8.1 Documentation

- Submit as-built drawings showing actual conduit routes, panel schedules, and cable terminations.
- Provide test reports for all circuits.

3.8.2 Inspection

- The Engineer shall inspect all electrical work prior to covering (rough-in) and after completion.
- Any deficiencies shall be corrected at no additional cost.

PART 4 – SPECIAL PROVISIONS FOR CNS EQUIPMENT

4.1 POWER QUALITY REQUIREMENTS

Given the sensitive nature of CNS equipment, the following additional requirements shall apply:

4.1.1 Voltage Regulation

- Power supplied to VHF/UHF radios, DVLS servers, RCMS workstations, and AWOS shall be within ±5% of nominal.
- UPS systems shall provide clean, conditioned power meeting IEC 62040-3 Class 1 (voltage and frequency independent).
- Low voltage control AVR 80 to 260 VAC necessary.

4.1.2 Harmonic Distortion

- Total Harmonic Distortion (THD) at the input to CNS equipment shall not exceed 5%.
- The Contractor shall verify compatibility between UPS output and equipment power supplies.

4.1.3 EMI/RFI Protection

- Power feeders to CNS equipment shall be separated from data and RF cables by a minimum of 300 mm.
- Where crossing is unavoidable, crossing shall be at 90°.
- All power circuits serving CNS equipment shall have surge protection as specified.

4.2 DEDICATED CIRCUITS

- Each radio transceiver, transmitter, receiver, and recorder server shall be served by a dedicated circuit breaker.
- Circuits shall be clearly labeled with the equipment designation.
- No other equipment shall be connected to these circuits.

4.3 DC POWER DISTRIBUTION

- DC power (48 V) from the rectifier system shall be distributed to radios via fused distribution panels.

- DC cabling shall be color-coded: red for positive (+), black for negative (-), green/yellow for ground.
- DC circuits shall be sized for a voltage drop ≤2% from battery to load.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DIVISION 03 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

PART 1 – GENERAL

1.1 SCOPE

This section specifies the requirements for double-conversion online uninterruptible power supply (UPS) systems that provide conditioned, continuous power to critical CNS equipment at Skardu Airport, including:

- ATC Tower (remote controllers, displays, communications equipment)
- Radio Equipment Room (VHF/UHF/HF radios, DVLS servers, RCMS, network switches)
- Fire Station (compact radio controllers, communications equipment)
- OCC room for emergency handling
- CNS technical workshop

The UPS systems shall protect against all nine power disturbances defined by IEEE 1159. The systems shall provide seamless transition between utility power, battery power, and bypass modes, ensuring zero transfer time for critical loads.

The Contractor shall be responsible for the complete engineering, supply, installation, testing, and commissioning of all UPS systems, including batteries, battery cabinets, input/output distribution, remote monitoring interfaces, and all necessary accessories.

1.2 REFERENCES

The UPS systems and associated components shall comply with the latest editions of the following standards.

Standard	Title	Application
IEC 62040-1	Uninterruptible Power Systems – General and Safety Requirements	Overall UPS safety
IEC 62040-2	Uninterruptible Power Systems – EMC Requirements	Electromagnetic compatibility
IEC 62040-3	Uninterruptible Power Systems – Performance and Test Requirements	Performance, efficiency, test methods
IEC 62040-4	Uninterruptible Power Systems – Environmental Aspects	Environmental requirements
IEC 60950-1 / 62368-1	Safety of Information Technology Equipment	Equipment safety
IEC 61000-4 Series	Electromagnetic Compatibility – Testing and Measurement Techniques	Immunity and emissions

Standard	Title	Application
IEEE 519	Harmonic Control in Electrical Power Systems	Harmonic distortion limits
IEEE 446	Recommended Practice for Emergency and Standby Power Systems	Industrial/commercial applications
IEEE 1100	Recommended Practice for Powering and Grounding Electronic Equipment	Power quality and grounding
Telecommunications Standards		
GR-63-CORE	NEBS Requirements: Physical Protection	Environmental (if applicable)
GR-1089-CORE	NEBS Requirements: EMC and Electrical Safety	EMC (if applicable)
Industry Best Practices		
Eaton	UPS Application Guide	Installation and configuration
Schneider Electric	UPS Handbook	Design and selection
Vertiv	Power and Thermal Management Guide	Battery and thermal management

1.3 SUBMITTALS

The Contractor shall submit the following documents for review and approval prior to procurement and installation:

a) UPS System Data Sheets:

- Manufacturer's technical specifications for the UPS model offered.
- Efficiency curves at various load levels.
- Output voltage regulation and harmonic distortion specifications.
- Overload and short-circuit characteristics.
- Acoustic noise levels (dB) at full load.
- Cooling requirements and airflow diagrams.
- Dimensions and weight (with and without batteries).
- Color finish and enclosure rating.

b) Battery System Submittals:

- Battery type, capacity (Ah), quantity, and configuration (series/parallel).
- Battery manufacturer and model number.
- Battery life expectancy (cycles and years) at operating temperature.
- Discharge curves at various load levels.
- Recharge time to 90% capacity after full discharge.
- Battery management system (BMS) specifications (if lithium-ion).
- Safety certifications (UL, IEC, etc.).
- Battery cabinet dimensions, ventilation requirements, and weight.

c) System Architecture and Coordination:

- Single-line diagram showing UPS input, output, bypass, and distribution.
- Coordination study with upstream and downstream protective devices.
- Load analysis confirming UPS capacity sizing.
- Run-time calculations at full load and actual load.
- Floor plan showing UPS and battery cabinet placement, including clearance requirements.
- Thermal management plan (cooling and ventilation).

d) Remote Monitoring and Control:

- SNMP card datasheet and supported MIBs.
- Web interface screenshots.
- Alarm and trap configuration details.
- Integration with the overall RCMS (if applicable).

e) Installation and Commissioning:

- Installation instructions and mounting details.
- Cable termination details (input, output, battery, control).
- Commissioning test procedures.
- Factory test reports (if available).
- Site acceptance test (SAT) plan.

f) Operation and Maintenance Manuals:

- User manual for normal operation (soft in USB & hard copy).
- Maintenance manual with schedules, procedures, and troubleshooting guides (soft in USB & hard copy).
- Battery maintenance and replacement guidelines.

- Spare parts list (minimum 5-year recommended).

PART 2 – PRODUCTS

2.1 UPS SYSTEM – GENERAL REQUIREMENTS

2.1.1 Type and Topology

- **Type:** Double-conversion online (VFI – Voltage and Frequency Independent) per IEC 62040-3.
- **Output waveform:** Pure sine wave with <3% total harmonic distortion (THD) for linear loads; <5% for non-linear loads.
- **Transfer time:** Zero (0) milliseconds for normal operation (battery mode).
- **Bypass:** Automatic static bypass and manual maintenance bypass.
- **Redundancy:** N+1 redundancy, ensuring no single point of failure for critical loads associated with CNS/ATC operations.

2.1.2 Operating Modes

Mode	Description	Transition
Normal (On-Line)	Inverter supplies conditioned power; battery float charged	Continuous
Battery	Inverter draws from battery; utility fails or out of tolerance	Zero transfer time
Bypass (Automatic)	Load transfers to utility via static bypass; UPS fault or overload	<2 ms
Bypass (Manual)	Load transferred to utility via maintenance bypass; UPS maintenance	Seamless (make-before-break)

2.1.3 Input Specifications

Parameter	Requirement
Nominal voltage	230 V (single-phase) or 400 V (three-phase) as required
Voltage tolerance	±10% (without battery discharge)
Frequency	50 Hz ±5%
Power factor	≥0.99 at full load
Current THD	≤5% at full load
Input protection	Circuit breaker with magnetic/thermal trip

2.1.4 Output Specifications

Parameter	Requirement
Nominal voltage	230 V (single-phase)
Voltage regulation	±1% static; ±5% transient (load step 0-100%)
Frequency	50 Hz ±0.1% (inverter mode); ±5% (bypass mode)
Output power factor	≥0.9 (leading or lagging)
Overload capability	125% for 10 minutes; 150% for 60 seconds (on-line mode)
Crest factor	≥3:1
Efficiency	>93% at full load; >90% at 50% load (on-line mode)
THD (output)	<3% for linear loads; <5% for non-linear loads

2.1.5 Environmental and Physical Requirements

Parameter	Requirement
Operating temperature	–20°C to 40°C (full performance); derate above 40°C
Storage temperature	–20°C to 60°C
Relative humidity	0% to 95% (non-condensing)
Altitude	Up to 2230 m (AMSL) without derating; derate 1% per 100 m above
Acoustic noise	≤55 dBA at 1 m (in normal operation)
Enclosure rating	IP20 minimum for indoor equipment rooms; IP31 for areas with potential dust
Color	RAL 7035 (light grey) or as per site standard
Cooling	Forced air with redundant fans (or as per manufacturer standard)

2.2 UPS SYSTEM – SIZING AND CAPACITY

The Contractor shall perform a detailed load analysis for each location to determine the appropriate UPS capacity. Minimum recommended capacities:

Location	Minimum Recommended Capacity	Notes
ATC Tower	5 kVA – 10 kVA	Powers 6 remote controllers, monitors, AMHS terminal, small network equipment
Radio Equipment Room	10 kVA – 20 kVA	Powers VHF/UHF/HF radios (10+ units), DVLS servers (2), RCMS, network switches (3+), DC rectifier
Fire Station	3 kVA – 5 kVA	Powers 3 compact controllers, radio(s), associated equipment

Final capacities shall be confirmed during detailed design based on actual equipment loads.

2.3 BATTERY SYSTEM

2.3.1 General Requirements

Parameter	Requirement
Backup runtime	Minimum 2 hours at full rated load
Battery type	Lithium Iron Phosphate ($LiFePO_4$) with integrated BMS or equivalent
Design life	Lithium: 10-15 years at 20°C ambient
Charging method	Temperature-compensated, three-stage (bulk, absorption, float)
Recharge time	≤8 hours to 90% capacity after full discharge
Protection	Overcurrent, overvoltage, undervoltage, overtemperature, short circuit

2.3.2 Lithium Battery Requirements (Preferred)

- **Chemistry:** Lithium Iron Phosphate ($LiFePO_4$) – preferred for safety and thermal stability.
- **Battery Management System (BMS):** Integrated with cell voltage balancing, overcharge protection, over-discharge protection, short circuit protection, temperature monitoring, communication (CAN bus, RS485, or Modbus) to UPS.
- **Enclosure:** Metal housing with flame-retardant materials.
- **Safety Certifications:** UL 1973, IEC 62619, or equivalent.

Acceptable Manufacturers: Eaton (xStorage), Schneider Electric (Lithium Battery Systems), Vertiv (Lithium-Ion Battery Cabinets), Tesla (Powerwall), BYD, Deutsche Power or equivalent meeting Clause 1.6.

2.3.3 Battery Cabinets

- **Type:** Dedicated battery cabinet(s) matching UPS form factor (tower or rack).
- **Construction:** Heavy-gauge steel, powder-coated finish.
- **Ventilation:** Passive or forced ventilation as required.
- **Access:** Lockable front door with viewing window.
- **Cabling:** Pre-wired with appropriate DC circuit breakers or fuses.

2.3.4 VRLA Battery Requirements (Not to be used)

- **Construction:** Sealed, maintenance-free, with recombination technology.
- **Case:** Flame-retardant (UL94 V-0) ABS.
- **Terminals:** Heavy-duty, corrosion-resistant.
- **Interconnections:** Copper busbars or insulated cables with compression lugs.
- **Safety:** Pressure relief valves, spark arrestors.

Acceptable Manufacturers (Not to be Used):

- **Enersys** (Genesis, PowerSafe)
- **C&D Technologies**
- **Trojan**
- **Exide** (industrial division)
- **GS Yuasa**
- **Or equivalent** meeting specification requirements as per Clause 1.6 of Division 1 General Requirements.

2.4 MAINTENANCE BYPASS

2.4.1 Manual Maintenance Bypass (MMB)

Each UPS shall be equipped with an integral or external manual maintenance bypass switch to allow complete isolation of the UPS for maintenance without interrupting power to the load.

Requirement	Detail
Configuration	Make-before-break (closed transition) to prevent load interruption
Switching mechanism	Rotary switch with clear position indication (UPS / Bypass / Test)
Lockout/Tagout	Provisions for padlocking in maintenance position

Requirement	Detail
Indicators	LED or mechanical indicators for bypass status
Enclosure	IP20 minimum, with clear labelling

2.5 MONITORING AND COMMUNICATIONS

2.5.1 SNMP/Web Interface

Each UPS shall be equipped with a communication card providing:

- **Protocols:** SNMPv1/v2c/v3, HTTP/HTTPS, Modbus TCP, and email alerting.
- **Features:** Remote monitoring of all UPS parameters, shutdown coordination, event logging, firmware upgrade capability.
- **Compatibility:** Shall integrate with the overall RCMS system via SNMP traps.

2.5.2 Dry Contacts

Minimum four (4) programmable dry contact outputs for remote alarm indication: mains failure, battery low, UPS fault, bypass active.

2.5.3 Display

- **Type:** LCD or color touch-screen, backlit, multi-language support (English).
- **Information:** Mimic diagram, voltage/current readings, load percentage, battery runtime, alarm status, event log.
- **Controls:** Menu navigation for configuration and diagnostics.

2.6 FORM FACTOR AND MOUNTING

Location	Preferred Form Factor	Mounting
ATC Tower	Tower or rack-mount	Free-standing or in equipment rack
Radio Equipment Room	Rack-mount (19-inch)	In 19-inch equipment cabinet
Fire Station	Tower or wall-mount	Compact, space-saving

The UPS units shall be supplied with all necessary mounting hardware, brackets, and interconnecting cables.

2.7 ACCEPTABLE MANUFACTURERS

Acceptable manufacturers include Eaton (9PX, 9SX, 93E, 93PM), Schneider Electric (Galaxy VS, Galaxy VL, Smart-UPS On-Line), Vertiv (Liebert PSI, Liebert GXT, Liebert EXM), Socomec (Modulys, Netys, Masterys), Riello (Master MHE, Master HE, Sentinel), Deutsche Power or equivalent meeting Clause 1.6.

PART 3 – EXECUTION

3.1 SITE PREPARATION

3.1.1 Environmental Conditions

- UPS and battery rooms shall be clean, dry, and well-ventilated.
- Ambient temperature shall be maintained within the manufacturer's specified range (typically 20°C to 25°C for optimal battery life).
- The Contractor shall coordinate with the HVAC contractor to ensure adequate cooling and ventilation.

3.1.2 Floor Loading

- Floor loading capacity shall be verified prior to installation.
- Equipment pads or bases shall be provided as required to distribute weight.

3.1.3 Access and Clearance

- Minimum clearances shall be maintained per manufacturer's requirements (typically 1 m front, 0.5 m rear and sides).
- Access for battery replacement and maintenance shall be provided.

3.2 INSTALLATION

3.2.1 UPS Mounting

- UPS units shall be installed plumb and level.
- Rack-mounted units shall be secured with appropriate rails and fasteners.
- Tower units shall be placed on stable, vibration-damped surfaces.

3.2.2 Battery Cabinet Installation

- Battery cabinets shall be placed adjacent to or near the UPS.
- DC cabling between UPS and batteries shall be sized for the maximum discharge current with a voltage drop ≤1%.
- Battery cabinets shall be secured to the floor or rack as required.

3.2.3 Cabling and Termination

Circuit	Conductor Requirements
Input (Utility)	Copper, sized for 125% of UPS input current, with appropriate overcurrent protection
Output (Load)	Copper, sized for output current, with distribution to load panels or direct equipment
DC (Battery)	Flexible copper, sized for maximum discharge current, with DC-rated breakers or fuses

Circuit	Conductor Requirements
Control and Monitoring	Shielded twisted pair or CAT6 as required

- All terminations shall be torqued to manufacturer specifications.
- Cables shall be labelled at both ends with circuit identification.

3.2.4 Ventilation

- For lithium batteries, follow manufacturer's thermal management requirements (may require forced cooling).

3.3 BATTERY MANAGEMENT AND SAFETY

3.3.1 Battery Handling

- Batteries shall be handled with appropriate PPE (gloves, eye protection).
- Lifting equipment shall be used for heavy battery modules.
- Batteries shall be stored in a cool, dry location prior to installation.

3.3.2 Battery Connections

- Connections shall be clean, tight, and protected against corrosion.
- Anti-oxidation compound shall be applied to terminals.
- Torque values shall be recorded and submitted.

3.3.3 Battery Labelling

- Each battery string shall be labelled with voltage, polarity, and installation date.
- Warning labels shall be placed on battery cabinets indicating electrical and chemical hazard.

3.4 COMMISSIONING AND TESTING

3.4.1 Pre-Energization Checks

- Verify all connections are tight and correct.
- Measure insulation resistance (≥1 MΩ) between conductors and ground.
- Verify proper grounding of UPS chassis and battery cabinets.
- Check battery interconnections for correct polarity.

3.4.2 Functional Tests

- Energize UPS in bypass mode; verify input voltages.
- Transfer to normal (on-line) mode; verify output voltage and frequency.
- Perform battery discharge test at 50% and 100% load for 5 minutes; verify runtime and transfer.

- Test static bypass operation (simulate UPS fault).
- Test manual maintenance bypass (simulate UPS maintenance).
- Verify all alarms and indicators function.

3.4.3 Load Bank Test

- If the actual load is less than 50% of UPS capacity, a load bank shall be used to test at 100% load for 15 minutes.
- Load bank shall be provided by the Contractor.

3.4.4 Remote Monitoring Test

- Verify SNMP card configuration and connectivity.
- Generate test traps and verify receipt by RCMS.
- Test email alerts.

3.5 DOCUMENTATION

The Contractor shall provide upon completion:

- As-installed single-line diagrams.
- UPS and battery cabinet layout drawings (as-built).
- Commissioning test report with all recorded measurements.
- Battery installation date and expected end-of-life.
- Maintenance schedule.
- Operation and maintenance manuals (3 hard copies + digital).

PART 4 – SPECIAL PROVISIONS FOR CNS APPLICATIONS

4.1 CRITICAL LOAD CONSIDERATIONS

4.1.1 Inrush Current Capability

The UPS shall handle the inrush current of all connected equipment simultaneously, including radio transmitters switching to transmit mode, DVLS servers spinning up disks, and switch/router power-on surges.

4.1.2 Noise and Interference

The UPS shall not introduce conducted or radiated interference that affects radio receiver sensitivity. The Contractor shall provide EMC test reports confirming compliance with IEC 62040-2.

4.1.3 Synchronization

UPS output shall be synchronized with utility frequency (50 Hz) in normal mode to facilitate seamless bypass transfer.

4.2 COORDINATION WITH GENERATOR (IF APPLICABLE)

If the site is equipped with a standby generator, the UPS input shall be coordinated with the generator to ensure compatibility: the UPS shall accept generator power without nuisance transfers, and input current THD shall not cause generator instability.

4.3 INTEGRATION WITH RCMS

The SNMP interface shall provide to the RCMS system: UPS status (On-Line, Battery, Bypass, Fault), load percentage, battery runtime remaining, temperature (internal), and active alarms. The Contractor shall configure SNMP traps to align with RCMS alarm categories.

PART 5 – WARRANTY AND MAINTENANCE

5.1 WARRANTY

- **UPS Unit:** Minimum 2 years (24 months) from Final Acceptance.
- **Lithium Batteries:** Minimum 5 years (60 months) or as per manufacturer's warranty. The Contractor shall provide warranty support including on-site replacement of defective components.

5.2 SPARE PARTS

The Contractor shall supply a recommended list of spare parts for 5 years of operation, including input/output fuses, cooling fans, communication card, and battery replacement set (or battery module for lithium).

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DIVISION 04 – POWER CONDITIONING AND BATTERY SYSTEMS (DC POWER)

PART 1 – GENERAL

1.1 SCOPE

This section specifies the requirements for a complete, high-reliability DC power system with lithium battery backup for all CNS equipment at Skardu Airport. The DC system shall provide continuous, regulated between range of 19.2 to 32 V or better range DC power to:

- VHF Air Band Multimode Transceivers (18 units: 10 operational + 4 spare + 4 OCC)
- UHF Air Band Digital Transceivers (4 units)
- HF Transceivers (2 x 1 kW main/standby + 2 x 125 W monitoring)
- Digital Voice Logging System (DVLS) servers
- Network switches and other IP-based equipment
- Any other equipment requiring DC power as required by design

The DC power system shall be designed for mission-critical availability, incorporating N+1 rectifier redundancy, lithium iron phosphate ($LiFePO_4$) battery technology with integrated BMS, and comprehensive remote monitoring capabilities, providing a minimum of **2 hours of backup power** at full load.

1.2 REFERENCES

The DC power system shall comply with the latest editions of IEC 62368-1, IEC 61000 Series, IEC 62040, IEC 60204-1, IEC 60950-22, ETSI EN 300 132-2, ETSI EN 300 119, GR-1089-CORE, GR-63-CORE, IEC 62619, IEC 62620, UL 1973, UN 38.3, and industry best practices (Eltek, Vertiv, Delta).

1.3 SUBMITTALS

The Contractor shall submit rectifier system data sheets, battery system submittals, distribution panel submittals, monitoring and control submittals, system design documentation (SLD, load analysis, battery capacity calculation, voltage drop calculations, grounding diagram, thermal calculations), installation and commissioning plans, and operation/maintenance manuals.

PART 2 – PRODUCTS

2.1 DC POWER SYSTEM – GENERAL REQUIREMENTS

2.1.1 System Voltage and Capacity

Parameter	Requirement
Nominal voltage	48 VDC (nominal)
Voltage range	Between range of 19.2 to 32 VDC or wider range adjustable
System capacity	Sufficient for full load plus battery charging (minimum 8 kW or as calculated)

Parameter	Requirement
Load capacity	To be calculated based on all connected CNS equipment

The system shall be designed with a minimum **20% growth margin** for future expansion.

2.1.2 Rectifier System

Parameter	Requirement
Topology	High-frequency switching, power factor corrected (PFC)
Rectifier modules	Modular, hot-swappable, N+1 redundancy
Module capacity	1 kW – 3 kW per module (as required)
Number of modules	N+1 where N = number required for full load + battery recharge
Input voltage	230 V AC (single-phase) or 400 V AC (three-phase) ±20%, 50 Hz ±5%
Input power factor	≥0.99 at full load
Input current THD	≤5% at full load (EN 61000-3-2 compliant)
Output voltage	Adjustable 42 – 58 V DC; factory set to 53.5 V (float) for $LiFePO_4$
Output voltage regulation	±1% (static); ±5% (transient 0-100% load)
Output ripple	≤50 mV peak-to-peak (with battery connected)
Efficiency	≥94% at 50% load; ≥92% at 100% load
Cooling	Forced air with redundant fans (or natural convection for low-power modules)
Operating temperature	–20°C to +65°C (full output up to 55°C, derated above)
MTBF	≥200,000 hours per module (Telcordia SR-332)
Protection	Overvoltage, overcurrent, overtemperature, reverse polarity
Hot-swap capability	Modules replaceable without interrupting DC output

Acceptable Rectifier Manufacturers: Eltek (Flatpack series), Vertiv (NetSure series), Delta (DPR series), ABB (MNS series), Schneider Electric, or equivalent meeting Clause 1.6.

2.1.3 Battery System – Lithium Iron Phosphate ($LiFePO_4$)

Parameter	Requirement
Battery chemistry	Lithium Iron Phosphate ($LiFePO_4$)
Nominal voltage	48 V (typically 15 or 16 cells in series)
Capacity	Calculated to achieve ≥2 hours at full load, with 20% safety margin
Cycle life	≥3,000 cycles at 80% depth of discharge (DoD)
Calendar life	≥10 years at 25°C
Operating temperature	–10°C to +50°C (charge); –20°C to +60°C (discharge)
Energy density	≥100 Wh/kg (typical)
Safety certifications	IEC 62619, UL 1973, UN 38.3

Battery Management System (BMS) Requirements:

- Cell monitoring (individual cell voltage, temperature, balancing)
- State of Charge (SoC) accurate within ±3%
- State of Health (SoH) estimation
- Overvoltage, undervoltage, overcurrent, short circuit, overtemperature protection
- Communication: CAN bus, Modbus RTU/TCP, or RS485
- Active or passive cell balancing
- DC-rated contactors for disconnection
- Dry contacts for critical alarms

Battery Cabinet Requirements:

- Enclosure: Heavy-gauge steel, powder-coated (RAL 7035)
- Mounting: 19-inch rack-mount or free-standing
- Ventilation: Passive or forced with temperature-controlled fans
- Access: Lockable front door with viewing window
- Internal cabling: Pre-wired with DC-rated cables and connectors
- Safety: Fire-retardant materials, emergency disconnect

Acceptable Lithium Battery Manufacturers: Eltek (SmartPack), Vertiv, Delta, Eaton (xStorage), BYD, CATL, Deutsche Power (Lithium Battery System) or equivalent meeting Clause 1.6.

2.1.4 DC Distribution Panel

Parameter	Requirement
Panel type	19-inch rack-mount or wall-mount as per site
Busbars	Copper, tinned, sized for total load
Main input	From rectifier/battery bus (with main DC circuit breaker)
Output circuits	Minimum 20 outputs (expandable)
Protection	Each output with fuse (T-Lag) or DC-rated circuit breaker
Fuse/breaker rating	As calculated per load (6A, 10A, 16A, 20A, 32A)
Indication	LED indicator for each fuse/breaker (open/closed)
Monitoring	Voltage and current measurement per circuit (optional)
Labelling	Clear labelling for each output (equipment designation)

Typical distribution panel configuration (to be confirmed as per design):

Output	Equipment	Protection
1-10	VHF Transceivers (18 units) + 4 spare + 4 OCC	10A fuse each
11-14	UHF Transceivers (4 units)	15A fuse each
15-18	HF Transceivers (2 x 1 KW + 2 x 125W monitoring)	20A fuse each or as required
19-20	DVLS Servers (2 units + accessories)	10A fuse each
21-23	Network Switches (3 units)	5A fuse each
24-30	Spare (for future expansion)	10A fuse each

2.2 SYSTEM CONTROLLER AND MONITORING

Parameter	Requirement
Controller type	Microprocessor-based, with local LCD display
Display	LCD or touch-screen showing system voltage, load current, battery current, temperature, alarms, event log

Parameter	Requirement
Control functions	Rectifier module control, battery charge profile, alarm thresholds
Data logging	Minimum 1,000 events (time-stamped)
Remote monitoring	SNMPv1/v2c/v3, Modbus TCP, web interface
Dry contacts	Minimum 8 programmable outputs for remote alarms
Alarm categories	Mains failure, rectifier fault, battery low, battery disconnect, distribution fault, overtemperature, etc.
Integration	Shall interface with RCMS via SNMP traps

Acceptable Manufacturers: Eltek (SmartPack2, MiniPack), Vertiv (NetSure NCU, SCC), Delta, Schneider Electric, or equivalent.

2.3 BATTERY CHARGING PROFILE

The rectifier system shall be configured with a charge profile optimized for $LiFePO_4$:

Stage	Voltage	Current	End Condition
Bulk	Constant current	Up to rectifier capacity (C/2 to C/5)	Reaches absorption voltage
Absorption	56.8 V (3.55 V per cell)	Tapering current	Current drops to C/20 or timer
Float	53.5 V (3.35 V per cell)	Minimal	Continuous

PART 3 – EXECUTION

3.1 SITE PREPARATION

- Install DC system in a clean, dry, well-ventilated equipment room. Ambient temperature maintained within 15°C to 30°C for optimal battery life.
- Verify floor loading capacity; provide equipment pads or leveling feet; seismic bracing if required.
- Maintain minimum clearances: 1 m front, 0.5 m rear and sides.

3.2 INSTALLATION

- Install DC system cabinets (rectifier, battery, distribution) in a dedicated battery cabinet as required. Secure cabinets to building structure.

- Install rectifier modules in designated slots; blanking panels for empty slots.
- AC input connections with appropriately sized cables, protected by dedicated circuit breaker.
- Install battery modules per manufacturer's instructions; series/parallel connections with pre-cut insulated cables and compression lugs; torque to manufacturer specifications; verify polarity before connection; connect BMS to system controller.
- Install distribution panel adjacent to rectifier cabinet; size DC feeder cables from rectifier/battery bus to distribution panel for voltage drop ≤1%; route output circuits to individual equipment; color-code cables: red (+), black (-), green/yellow (PE); label at both ends.
- Ground DC system; system positive (+) may be grounded as per manufacturer's recommendation; all cabinets bonded to Main Grounding Busbar (MGB) with 25 mm² conductor.
- Route DC cables in separate conduits or trays from AC power and data cables; bundle with Velcro ties; maintain minimum bend radius.

3.3 COMMISSIONING AND TESTING

Pre-Energization Checks: Verify all connections tight and correct; measure insulation resistance (≥1 MΩ); verify correct polarity; verify BMS communication; verify safety warnings/labels.

Rectifier Functional Tests: Energize AC input; verify input voltage and phase rotation; verify rectifier modules power up; measure output voltage and adjust to float setting (53.5 V); verify load sharing between modules (±5%); hot-swap test: remove one module, verify remaining modules support load.

Battery Tests: Connect battery after verifying voltage and polarity; verify battery accepts charge current; battery discharge test: disconnect AC input, verify load transfers to battery without interruption; measure discharge time at full load (or load bank) for 15 minutes minimum; extrapolate to 2 hours; verify BMS alarms; recharge test: verify recharge to 90% within manufacturer's specified time.

Distribution Tests: Verify each output circuit has correct voltage at equipment termination; verify fuse/breaker coordination; measure voltage drop at farthest load (≤5% from rectifier output).

Monitoring and Alarm Tests: Verify SNMP communication with RCMS; generate test alarms (simulate mains failure, rectifier failure, battery low) and verify traps received; test dry contact outputs.

3.4 DOCUMENTATION

Provide as-installed single-line diagrams, cabinet layout drawings (as-built), commissioning test report, battery installation date/serial numbers/expected end-of-life, BMS configuration settings, operation/maintenance manuals (3 hard copies + digital), spare parts list with manufacturer part numbers.

PART 4 – SYSTEM OPERATION AND MAINTENANCE

4.1 NORMAL OPERATION

Under normal conditions, rectifiers supply load while maintaining batteries at float voltage. System controller continuously monitors and logs system parameters. Alarms reported locally and via SNMP to RCMS.

4.2 BATTERY OPERATION

Upon AC mains failure, batteries supply load without interruption. BMS monitors battery condition and disconnects battery if any cell reaches critical limits. When AC returns, rectifiers recharge batteries with programmed profile.

4.3 MAINTENANCE

Monthly: Inspect for loose connections, dust accumulation, abnormal noises; verify display readings against measured values; check alarm logs.

Semi-Annual: Test battery discharge (10 minutes or as per manufacturer) and document capacity; clean air filters and fans; verify fuses/breakers operational; test remote monitoring and alarm functions.

Battery Replacement: Replace lithium batteries when SoH falls below 80% or at end of calendar life (10 years). Contractor shall provide replacement battery modules as required during warranty period.

PART 5 – SPARE PARTS AND WARRANTY

5.1 SPARE PARTS

Contractor shall supply for 5 years of operation:

- Rectifier module (same as installed): 1 unit (10% of installed modules, minimum 1)
- System controller (if hot-swappable): 1 unit
- DC distribution fuses (all ratings): 2 of each rating
- Cooling fans (rectifier cabinet): 2 units
- BMS communication module: 1 unit

5.2 WARRANTY

- Rectifier modules and system controller: 24 months (2 years) from Final Acceptance.
- Lithium batteries: 60 months (5 years) or as per manufacturer’s warranty, whichever longer.
- Distribution panel and components: 24 months (2 years) from Final Acceptance.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DIVISION 05– GROUNDING AND BONDING

PART 1 – GENERAL

1.1 SCOPE

This section specifies the complete grounding and lightning protection system for all CNS equipment, antennas, AWOS sensors, and associated infrastructure at Skardu Airport. The system shall provide a low-impedance path for fault currents, lightning strikes, and electromagnetic interference, ensuring personnel safety, equipment protection, and reliable operation of sensitive electronic systems.

1.2 REFERENCES

The system shall comply with IEC 62305 (all parts), IEC 61000-4-5, ITU-T K.56, ITU-T K.66, IEEE 1100, IEEE 142, ANSI/TIA-607-B, NFPA 780.

1.3 SUBMITTALS

- Grounding system design drawings (single-line, layout, details)
- Earth resistance test reports
- Surge protection coordination study (SPD selection and placement)
- As-built documentation (drawings, test results)
- Material certificates (rods, conductors, connectors, SPDs)
- Installation photographs (critical connections)

PART 2 – PRODUCTS

2.1 EARTH ELECTRODE SYSTEM (GROUNDING PITS)

2.1.1 Earth Rods

- **Type:** Copper-bonded steel (minimum 250 µm copper coating)
- **Length:** 2.5 m or 3.0 m (drive length) or as per design
- **Diameter:** 16 mm (minimum)
- **Tensile strength:** ≥600 N/mm²
- **Connection:** Threaded couplings for extension (if required)

2.1.2 Earth Enhancement Compound

- **Type:** High-conductivity cementitious or bentonite-based compound
- **Resistivity:** ≤0.5 Ω·m (when mixed)
- **Corrosion:** Non-corrosive to copper and steel
- **Environment:** Non-toxic, environmentally safe

2.1.3 Inspection Pits

- **Material:** Polymer concrete or heavy-duty PVC (UV-stabilized)

- **Cover:** Lockable, load-bearing (Class D or higher for vehicle traffic)
- **Internal busbar:** Tinned copper, 50 mm × 6 mm, with connection points
- **Dimensions:** Minimum 300 mm × 300 mm × 300 mm (depth)

2.1.4 Main Grounding Busbar (MGB)

- **Material:** Tinned copper
- **Dimensions:** 300 mm × 50 mm × 10 mm (minimum)
- **Mounting:** Insulated standoffs (ceramic or plastic)
- **Connection points:** Drilled and tapped (M10 or M12) at 50 mm intervals
- **Location:** In equipment room, accessible for maintenance

2.2 GROUNDING CONDUCTORS

Application	Material	Size	Insulation
Main earthing conductor	Bare tinned copper	95 mm²	–
Equipment cabinet bonding	Insulated (green/yellow)	25 mm²	PVC, 600 V
Antenna mast bonding	Bare tinned copper	50 mm²	–
Surge arrestor bonding	Insulated (green/yellow)	16 mm²	PVC, 600 V
Cable tray bonding	Bare or insulated	16 mm²	As required
Building structural bonding	Bare tinned copper	50 mm²	–

Connection Method: Exothermic welding (preferred) or compression lugs with anti-oxidation compound.

2.3 SURGE PROTECTIVE DEVICES (SPDs)

2.3.1 AC Power SPDs

- **Type 1 (10/350 µs):** Main distribution panel – Imax ≥25 kA, Up ≤2.5 kV
- **Type 2 (8/20 µs):** Sub-panels, UPS outputs – Imax ≥20 kA, Up ≤1.5 kV
- **Type 3:** Equipment outlets (optional) – Imax ≥10 kA, Up ≤1.0 kV

2.3.2 RF Coaxial SPDs

- **Type:** Gas discharge tube (GDT) with λ/4 or broadband design
- **Frequency bands:** VHF (118-137 MHz), UHF (225-400 MHz), HF (2-30 MHz)
- **Insertion loss:** ≤0.2 dB
- **VSWR:** ≤1.2:1

- **Discharge current:** ≥20 kA (8/20 µs)
- **Connectors:** N-type female (or 7/16 DIN for high power)

2.3.3 Ethernet SPDs

- **Type:** Shielded, CAT6a rated
- **Configuration:** 4-pair protection with gas tube and diodes
- **Data rate:** Up to 1 GbE (10 GbE optional)
- **Insertion loss:** ≤0.5 dB
- **Clamping voltage:** ≤100 V
- **Connectors:** RJ-45 shielded (in/out)

2.3.4 Signal/Control SPDs

- Multi-pair or single-pair as required; voltage 12 V, 24 V, 48 V as required.

Acceptable SPD Manufacturers: DEHN, Phoenix Contact, Citel, Raycap, Eaton Bussmann, or equivalent meeting Clause 1.6.

PART 3 – EXECUTION

3.1 EARTH ELECTRODE SYSTEM

- Construct a minimum of **two (2) earth pits** (or more as required to achieve ≤1 Ω).
- Drive earth rods vertically to depth of 2.5-3.0 m; where bedrock encountered within 1.5 m, install horizontal radial electrodes in trenches (10 m minimum per radial, 600 mm depth, 95 mm² bare tinned copper).
- Backfill with earth enhancement compound mixed with water to form slurry.
- Install inspection pit with busbar; connect earth rods and radials to busbar.
- Interconnect all earth pits with 95 mm² bare tinned copper conductor (ring earth) buried at 600 mm depth around building perimeter.
- Connect to building structural steel at multiple points.

3.2 MAIN GROUNDING BUSBAR (MGB)

- Mount MGB in equipment room on insulated standoffs.
- Connect main earthing conductor from earth pits to MGB using exothermic welding.
- Connect building structural steel to MGB (multiple points).
- Bond all equipment cabinets to MGB with dedicated 25 mm² conductors.

3.3 EQUIPMENT GROUNDING

- Each equipment cabinet bonded to MGB with 25 mm² green/yellow conductor.
- Cabinets in a row interconnected with ground bus (copper bar) along the row.

- Doors and removable panels bonded to frame with flexible copper braid (6 mm² minimum).
- Each radio, server, switch, and other electronic device bonded via chassis ground screw to cabinet ground bus.

3.4 ANTENNA GROUNDING

- Each antenna mast bonded to grounding system with 50 mm² bare tinned copper conductor at base using exothermic welding or compression lug. If mast exceeds 20 m height, intermediate bonding at 20 m intervals.
- Surge arrestors installed at point where coaxial cable enters building, mounted on grounded plate or directly to MGB; grounding conductor ≤0.5 m.
- Coaxial shield grounding kit installed at antenna mast base; shield grounding conductor 16 mm² minimum.

3.5 SURGE PROTECTION COORDINATION

AC Power:

- Main distribution panel: Type 1 SPD, parallel connection, conductor length ≤0.5 m
- UPS Input/Output: Type 2 SPD at UPS bypass panel
- Equipment cabinets: Type 2 SPD in cabinet or adjacent panel

RF Coaxial: SPD at building entry for each antenna feeder, grounded to MGB with 16 mm² conductor.

Ethernet: SPD at building entry for external cables; SPD at equipment cabinet for internal runs (optional).

Signal/Control: SPD at building entry for external sensors (AWOS, etc.).

3.6 TESTING

3.6.1 Earth Resistance Measurement

- **Method:** Fall-of-potential (three-point) per IEEE 81
- **Test equipment:** Calibrated earth tester
- **Acceptance:** ≤1 Ω (after interconnection of all pits and ring earth)
- Test shall be performed during dry season for worst-case condition.

3.6.2 Continuity Testing

- Test all bonding connections between MGB and cabinets, masts, structural steel.
- **Acceptance:** Resistance ≤0.1 Ω

3.6.3 SPD Verification

- Verify SPD status indicators (green = normal).
- Document SPD models, locations, and ratings.

3.6.4 Insulation Resistance

- Test between grounding system and live conductors (disconnected).
- **Acceptance:** ≥1 MΩ

PART 4 – DOCUMENTATION

The Contractor shall provide:

- As-built grounding drawings (earth pit locations, interconnections, MGB, mast bonding, surge arrestor locations)
- Earth resistance test report (including weather conditions, date, time)
- Continuity test results
- SPD coordination study
- SPD data sheets and installation instructions
- Photographs of critical connections (exothermic welds, MGB, surge arrestors)

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DIVISION 06 – COMMUNICATIONS (STRUCTURED CABLING)

PART 1 – GENERAL

1.1 SCOPE

This section specifies the complete structured cabling infrastructure required to support all CNS equipment at Skardu Airport, including:

- **Data Cabling:** Shielded twisted-pair cabling for Ethernet/IP connectivity supporting ED-137 VoIP, SNMP monitoring, and network management.
- **RF Cabling:** Low-loss coaxial cabling for VHF, UHF, and HF antenna systems.
- **Fiber Optic Cabling:** For backbone connections and long-distance runs where required.

The structured cabling system shall provide a reliable, high-performance, and scalable infrastructure supporting dual LAN redundancy (LAN A and LAN B) for all critical CNS equipment, VoIP communication per EUROCAE ED-137C, remote monitoring and control via SNMP, and future expansion.

1.2 REFERENCES

Cabling shall comply with ISO/IEC 11801 (all parts), IEC 60793, IEC 60794, TIA/EIA-568-C, TIA/EIA-569-C, TIA/EIA-606-B, TIA/EIA-607-B, IEC 61196, IEC 60169, and industry best practices (BICSI TDMM).

1.3 SUBMITTALS

- Cable test reports (manufacturer’s data sheets, Fluke or equivalent test results for copper and fiber, VSWR test results for RF, insertion loss, return loss)
- As-built cable routing diagrams (floor plans, cable schedules, riser diagrams, patch panel layouts)
- Labelling schedule (naming convention, sample labels, implementation plan)
- Installation documentation (pulling plans, conduit fill calculations, bonding/grounding diagrams)
- Test equipment calibration certificates

PART 2 – PRODUCTS

2.1 DATA CABLING – COPPER

2.1.1 Cable Type and Performance

- **Cable type:** Shielded twisted pair (FTP or S/FTP)
- **Category:** Category 6A (or higher) for future 10 GbE support
- **Conductor:** 23 AWG solid bare copper (not copper-clad aluminium)
- **Shielding:** Overall foil shield with drain wire (FTP) or braid + foil (S/FTP)
- **Impedance:** 100 Ω ±15%

- **Frequency rating:** 500 MHz minimum
- **Fire rating:** LSZH (Low Smoke Zero Halogen) per IEC 61034 for indoor installations; plenum rating as required.
- Meets ISO/IEC 11801 Class EA and TIA/EIA-568-C Category 6A.

2.1.2 Connectors and Hardware

- **Connector type:** RJ-45, shielded, Category 6A rated
- **Termination:** 110 IDC or tool-less
- **Shielding continuity:** 360° shielding coverage
- **Patch panels:** 19-inch rack-mount, 1HU, with shielded RJ-45 ports, grounding bar
- **Outlets:** Shielded modular jacks with faceplates or surface-mount boxes
- **Patch cords:** Shielded, Category 6A, factory-terminated, various lengths

2.1.3 Acceptable Manufacturers

CommScope (SYSTIMAX GigaSPEED X10D), Panduit (TX6A 10Gig Shielded), Belden (10GXS), Siemon, R&M, or equivalent meeting Clause 1.6. All components from same manufacturer.

2.2 RF CABLING – COAXIAL (50 Ω)

2.2.1 Coaxial Cable – VHF/UHF (118-400 MHz)

- **Type:** Low-loss foam dielectric, 50 Ω
- **Size:** ½" (12.7 mm) diameter nominal
- **Inner conductor:** Copper or copper-clad aluminium (solid or corrugated)
- **Dielectric:** Foam polyethylene
- **Outer conductor:** Corrugated copper tube
- **Jacket:** Black polyethylene, UV-resistant, flame-retardant
- **Attenuation:** ≤2.7 dB/100 m at 150 MHz; ≤4.8 dB/100 m at 450 MHz
- **Velocity of propagation:** ≥88%
- **Capacitance:** ≤76 pF/m
- **Impedance:** 50 Ω ±2 Ω

Acceptable Manufacturers: Andrew/CommScope (LDF4-50A Heliax), RFS (Cellflex ½"), Times Microwave (LMR-600), Huber+Suhner (SUCONET), or equivalent.

2.2.2 Coaxial Cable – HF (2-30 MHz)

- Low-loss, 50 Ω, ½" or ⅞" depending on length; attenuation ≤1.0 dB/100 m at 30 MHz; UV-resistant jacket suitable for outdoor burial.

2.2.3 RF Connectors

- **N-type:** VHF/UHF antennas, combiners, filters; female and male, 50 Ω, weatherproof, silver or gold plated.
- **7/16 DIN:** High-power applications; 50 Ω, low PIM, weatherproof.
- **BNC (if required):** Test points, internal rack connections; 50 Ω, crimp or clamp.

Requirements: soldered or crimped center conductor; corrosion-resistant plating; weatherproofing with self-amalgamating tape and heat-shrink; low PIM (≤ –150 dBc) for UHF applications.

2.2.4 RF Surge Arrestors

- Gas discharge tube, coaxial in-line, frequency range DC to 3 GHz, insertion loss ≤0.2 dB, VSWR ≤1.2:1, discharge current ≥20 kA (8/20 µs), N-type female/female, integral ground lug.

Acceptable Manufacturers: PolyPhaser (Transtector), Huber+Suhner, Andrew/CommScope, Citel, or equivalent.

2.3 FIBER OPTIC CABLING

2.3.1 Fiber Optic Cable

- **Type:** Single-mode, OS2
- **Core/Cladding:** 9/125 µm
- **Attenuation:** ≤0.4 dB/km at 1310 nm and 1550 nm
- **Wavelengths:** 1310 nm and 1550 nm (bidirectional)
- **Construction:** Loose tube or tight-buffered; aramid yarn strength members; LSZH jacket (indoor), UV-resistant (outdoor); fire rating OFNP or OFNR.

2.3.2 Fiber Optic Connectors and Hardware

- **Connector type:** LC duplex (small form factor)
- **Connector polish:** UPC
- **Insertion loss:** ≤0.3 dB per connection
- **Return loss:** ≥55 dB
- **Patch panels:** 19-inch rack-mount, with splice trays and pigtails
- **Patch cords:** LC to LC, OS2, various lengths

2.3.3 Acceptable Manufacturers

CommScope (SYSTIMAX LazrSPEED), Panduit (Opticom Fiber System), Corning (SMF-28e), Belden, or equivalent.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- Coordinate with other trades; conduits and cable trays installed prior to finishing work.
- Cable segregation:

Cable Type	Separation from Power Cables
Data (shielded Cat6a)	≥150 mm (6 inches)
Fiber optic	≥50 mm (2 inches)
RF coaxial	≥300 mm (12 inches)
Power cables	Grouped separately

Crossing at 90° unavoidable.

- Cable trays; conduits sized for 40% fill (power) or 50% fill (data/fiber); sweeps for fiber and RF.
- Minimum bend radii:

Cable Type	Installation	Permanent
Cat6a shielded	4 × cable diameter	4 × diameter
Fiber optic	20 × diameter	10 × diameter
½" coaxial	250 mm (10 inches)	125 mm (5 inches)

3.2 DATA CABLING INSTALLATION

- Maximum pulling tension 110 N (25 lbf); use lubricant; no kinks; support at ≤1.5 m.
- Termination: strip jacket exposing shield drain wire; bond shield 360° per manufacturer; maintain pair twists to within 13 mm of termination point.
- Patch panels in racks with proper labelling; service loops; Velcro ties.

3.3 RF CABLING INSTALLATION

- Antenna feeder installation: clamps every 1.5-2 m; drip loops before building entry; fire-stop and weather seal at entry.
- Connector installation per manufacturer's instructions; weatherproofing: clean/dry, anti-oxidation compound, self-amalgamating tape (50% overlap), PVC electrical tape, heat-shrink.
- Grounding and bonding: coaxial cables grounded at antenna mast and building entry; surge arrestors at point of entry; grounding kits at intervals not exceeding 50 m.

3.4 FIBER OPTIC CABLING INSTALLATION

- Maximum pulling tension ≤600 N; pulling eye or swivel; no sharp edges; maintain bend radius.
- Termination and splicing: precision cleave; fusion splicing for permanent connections (splice loss ≤0.1 dB); pigtails spliced to cable fibers in splice trays; connectors field-terminated with epoxy/polish.

- Fiber patch panels: 19-inch rack-mount with dust caps; patch cords routed with slack management.

3.5 LABELING

- Naming convention consistent with TIA/EIA-606-B (example: ER-XX for equipment room, C-XX for cabinet, PP-XX for patch panel, P-XX for port, SRC-DEST-XXX for cable).
- Label types: wrap-around self-laminating for cables; laminated plastic for patch panels and faceplates; permanent marker or heat-shrink for fiber splice trays.
- Placement: within 50 mm of termination both ends; clearly visible on patch panel face; above/beside outlets; on conduits within 1 m of ends and every 10 m.

3.6 TESTING

3.6.1 Copper Data Cabling

- **Test Equipment:** Fluke DSX-5000 or equivalent (calibrated)
- **Tests:** Wire map, length, insertion loss, NEXT, PSNEXT, ACRF, PSACRF, return loss, propagation delay, delay skew
- **Acceptance:** Pass all Category 6A requirements per ISO/IEC 11801
- **Documentation:** Electronic test results for each link

3.6.2 RF Cabling Testing

Test	Method	Acceptance Criteria
Continuity	Visual and multimeter	All conductors continuous
VSWR	Network analyzer (e.g., Anritsu Site Master)	≤1.5:1 across operating frequency
Insertion loss	Network analyzer	≤ calculated budget
DC resistance	Multimeter	≤ calculated per manufacturer

3.6.3 Fiber Optic Testing

Test	Method	Acceptance Criteria
Continuity	Visual fault locator (VFL)	Visible light through fiber
Insertion loss	Optical loss test set (OLTS)	≤ calculated budget (connectors + splice loss)
OTDR trace	Optical time domain reflectometer	Trace for each fiber; no excessive loss events
Polarity	Light source and power meter	Correct transmit/receive pairing

PART 4 – INTEGRATION WITH CNS SYSTEMS

4.1 DUAL LAN REDUNDANCY

- Each equipment cabinet shall have separate cable bundles for LAN A and LAN B.
- LAN A and LAN B cables routed via separate pathways where possible.
- Redundant switches (LAN A and LAN B) cabled to all dual-homed equipment.
- Cables labelled to clearly indicate LAN A or LAN B.

4.2 RF CABLING FOR ANTENNA SYSTEMS

System	Antennas	Cable Runs	Connectors
VHF (5 channels)	6 antennas	Radio room to antenna masts	N-type
UHF (2 channels)	2 antennas	Radio room to antenna masts	N-type
HF & HF (Monitoring)	3 broadband antennas	Radio room to antenna masts	N-type or 7/16 DIN

4.3 EMC CONSIDERATIONS

- Shielded Cat6a cabling bonded to equipment cabinet ground at one end only.
- Coaxial cable shields grounded at building entry and antenna mast.
- All metallic cable trays bonded to grounding system.

PART 5 – DOCUMENTATION AND CLOSEOUT

- As-built cable routing diagrams (CAD format)
- Updated cable schedule with actual lengths and termination points
- Patch panel mapping (port to cable to equipment)
- Test results (electronic format with summary report)
- Label schedule and photos of labelled cables

Spare parts for 5 years: Cat6a shielded patch cords (20), RJ-45 shielded connectors (50), N-type connectors (20 each), coaxial surge arrestors (2), fiber optic patch cords LC-LC (10), cable labels (5 rolls).

DIVISION 07 – VHF AIR BAND RADIO SYSTEM

PART 1 – GENERAL

1.1 SCOPE

Complete VHF air band communication system for ATC Tower and Fire Station, including eighteen (18) VHF/AM 50 W multimode transceivers configured in five (5) main/standby pairs (10 operational + 4 spare + 4 OCC), cable tray 1x1 feet from top roof of ATC tower to ECR, separate earth pit for CNS equipment, seven (7) VHF band pass dual cavity filter/combiners (5+2 spare), eight (8) VHF omnidirectional antennas (6+2 spare), all associated RF cabling, connectors, surge arrestors, mounting hardware, antenna masts, grounding, and lightning protection.

System fully compliant with ICAO Annex 10, EUROCAE ED-137C, and ETSI EN 300 676. Supports voice (AM) and data (ACARS, VDL Mode 2), fully integrated with VoIP-based ATC network.

1.2 REFERENCES

ICAO Annex 10 Volume V, EUROCAE ED-137C, ETSI EN 300 676, EUROCAE ED-138, IEC 62368-1, IEC 61000-4 Series.

1.3 SUBMITTALS

- Technical data sheets (transceivers, combiners, antennas)
- Factory test reports (power output, sensitivity, modulation, VoIP latency, combiner VSWR/insertion loss, antenna patterns)
- Configuration details (frequency assignment plan, output power settings, SNMPv3 configuration, ED-137C VoIP parameters)
- System design documentation (block diagram, rack layout, antenna mast details, grounding scheme)
- Installation and testing plans

PART 2 – PRODUCTS

2.1 VHF/AM MULTIMODE TRANSCEIVER

Parameter	Requirement
Frequency Range	118 – 137 MHz
Channel Spacing	25 kHz / 8.33 kHz (selectable per channel)
Modulation Modes	AM voice, ACARS (AM-MSK), VDL Mode 2 (D8PSK) – all licenses included
Output Power	1 – 50 W adjustable
Receiver Sensitivity	≤ –107 dBm for 6 dB SINAD (AM)

Parameter	Requirement
Adjacent Channel Selectivity	≥60 dB at ±25 kHz
Spurious Emissions	≤ –60 dBc (ETSI EN 300 676)
VoIP Interface	Two independent 10/100/1000Base-T Ethernet ports (LAN A / LAN B); ED-137C compliant RTP streams; up to 4 simultaneous VCS streams + 4 recorder streams; G.711 μ-law/A-law and G.729 (optional); adaptive jitter buffer
Remote Management	SNMPv3 (MD5/SHA, DES/AES); full MIB; built-in web server
Local Interface	OLED graphical display, menu buttons; built-in speaker; local configuration
Redundancy	Main/standby ready; external control inputs (e.g., ACU-3); separate analog control at ATC tower for VoIP failure
BITE	Continuous monitoring of power output, VSWR, voltages, currents, temperatures, synthesizer lock, RSSI/AGC; alarms via SNMP and front panel
MTBF	≥50,000 hours
Start-Up Time	≤10 seconds
VoIP Round Trip Delay	≤30 ms (optimized mode)
Power Supply	Integrated, between 19.2 to 32 V DC (nominal) or wider range & 230 V AC; redundant power input
Physical	3U, 19-inch rack-mountable; depth ≤350 mm; weight ≤15 kg
Environmental	Operating –20°C to +55°C; storage –40°C to +70°C; humidity 0-95% non-condensing
Compliance	ICAO Annex 10, ETSI EN 300 676, ED-137C, RoHS, REACH

Accessories per transceiver: rack-mounting kit, AC power cord or DC connector, RJ-45 Ethernet cables (2), documentation (hard copy and USB), configuration software with life-time licenses.

Acceptable Manufacturers: Jotron, Rohde & Schwarz, or equivalent meeting Clause 1.6.

2.2 VHF BAND PASS DUAL CAVITY FILTER / COMBINER

Parameter	Requirement
Type	2-channel, dual cavity band pass filter combiner
Frequency Range	118 – 137 MHz (field-tunable or factory-tuned)
Number of Inputs	2 (Main/Standby per channel)
Number of Outputs	1 (to antenna)
Isolation	≥70 dB between input ports, Filter Selectivity (dB) at mid band with I.L.: 2 dB @ f0 ± 1% f0 > 44
Insertion Loss	≤3.5 dB per path
Power Handling	≥50 W per input (continuous)
VSWR	≤1.3:1 (input and output)
Impedance	50 Ω
Connectors	N-type female (or 7/16 DIN)
Rack Mount	4HU, 19-inch, front tuning access
Temperature Stability	Frequency drift ≤2 ppm/°C

Acceptable Manufacturers: Polomarconi, Sinclair Technologies, Telemac, or equivalent.

2.3 VHF (AM) OMNIDIRECTIONAL ANTENNA

Parameter	Requirement
Type	½ dipole, omnidirectional
Frequency Range	118 – 137 MHz
Gain	≥2 dBi (nominal)
VSWR	≤1.5:1 across full range
Polarization	Vertical
Impedance	50 Ω
Power Handling	≥100 W (continuous)
Lightning Protection	Integrated DC ground or surge arrestor

Parameter	Requirement
Connector	N-type female (weatherproofed)
Mounting	Mast or tower mounting kit (1.5-2.5 m diameter)
Material	Aluminium or stainless-steel elements, UV-resistant radome
Environmental	IP65, corrosion-resistant, wind loading ≥180 km/h, temperature –30°C to +60°C

Accessories: mounting bracket with U-bolts, surge arrestor, grounding kit, installation hardware.

Acceptable Manufacturers: Kathrein, Procom, Sinclair Technologies, Polomarconi, or equivalent.

2.4 LOW-LOSS COAXIAL CABLE (½" foam dielectric, 50 Ω as specified in 2.2.1)

PART 3 – EXECUTION

3.1 INSTALLATION

- Transceivers mounted in 19-inch cabinets in radio equipment room as main/standby pairs.
- Each transceiver connected to LAN A, LAN B, DC power, combiner input, and ACU-3 (if external).
- Combiners mounted in same or adjacent cabinets; output to antenna feeder cable.
- Antenna masts installed at approved locations (tower roof or dedicated mast); bonded to grounding system; oriented for vertical polarization and aligned for maximum coverage.
- Surge arrestors at building entry (coaxial surge arrestor on grounded plate, bonded to MGB).
- Coaxial feeders secured with weatherproof clamps at ≤1.5 m intervals; maintain bend radius; label at both ends.
- Antenna mast bonded to building grounding system with 50 mm² copper; coaxial shield grounding kits at mast base and building entry; surge arrestors bonded to MGB with 16 mm² minimum conductor; ground connections exothermically welded or crimped.

3.2 TESTING

3.2.1 Factory Acceptance Test (FAT)

- Full functional test of each transceiver (all modes)
- VoIP latency and ED-137C compliance
- SNMPv3 configuration and trap generation
- Combiner VSWR and insertion loss measurement
- Antenna pattern verification (if available)

3.2.2 Site Acceptance Test (SAT)

Test	Method	Acceptance Criteria
Visual Inspection	Walk-down	Installed per drawings; labels in place; cabling neat
Continuity	Multimeter	All cables continuous
VSWR	Network analyzer (Site Master)	≤1.5:1 at operating frequency
Transmitter Power	Power meter / spectrum analyzer	Within ±1 dB of programmed power
Receiver Sensitivity	Signal generator	≤ –107 dBm for 6 dB SINAD
VoIP Connectivity	Packet analyzer	ED-137C RTP streams; dual LAN redundancy verified
SNMP Communication	SNMP manager	All traps received; configuration changes successful
Redundancy Test	Manual failover	Main fails; standby takes over without interruption
BITE Alarms	Simulate fault	Alarms reported locally and via SNMP

3.3 DOCUMENTATION

- As-built cabling diagrams (RF and data)
- VSWR test reports for all antenna feeders
- Transmitter power and frequency records
- Configuration files for all transceivers (backup)
- SNMPv3 user and trap configuration
- Antenna mast grounding resistance test results

DIVISON 08 – UHF AIR BAND RADIO SYSTEM

PART 1 – GENERAL

1.1 SCOPE

Complete UHF air band communication system for ATC Tower, including four (4) UHF/AM digital transceivers configured in two (2) main/standby pairs, two (2) UHF dual cavity band pass filters, three (3) UHF omnidirectional antennas, and all associated RF cabling, connectors, surge arrestors, and mounting hardware.

1.2 REFERENCES

ICAO Annex 10 Volume V, EUROCAE ED-137C, ETSI EN 302 617, IEC 62368-1.

1.3 SUBMITTALS

Transceiver data sheets, filter performance curves (insertion loss, rejection), antenna radiation patterns and gain measurements, splitter insertion loss and isolation measurements, factory test reports, system block diagram and redundancy architecture.

PART 2 – PRODUCTS

2.1 UHF/AM DIGITAL TRANSCEIVER

Parameter	Requirement
Frequency Range	225 – 400 MHz (continuous coverage)
Channel Spacing	25 kHz
Modulation	AM (voice)
Output Power	Programmable 1 – 50 W in 1 W steps
VoIP Interface	Two independent 10/100/1000Base-T Ethernet ports (LAN A/B), ED-137C compliant RTP streams
Remote Management	SNMPv3
Front Panel	OLED display, local controls, status indicators
Redundancy	Main/standby ready; external changeover unit (e.g., ACU-3)
BITE	Continuous monitoring of power output, VSWR, temperatures, synthesizer lock
Duty Cycle	100% continuous @ ambient temperature <40°C
Protection	Over-temperature, over-voltage, high VSWR (automatic power reduction)

Parameter	Requirement
Power Supply	19.0–32.0 VDC (nominal) or wider range and 230VAC.
Physical	3U, 19-inch rack-mountable
Environmental	–20°C to +55°C operating

Acceptable Manufacturers: Jotron, Rohde & Schwarz, or equivalent.

2.2 UHF/AM DIGITAL RECEIVER

Parameter	Requirement
Frequency Range	225 – 400 MHz
Modulation	AM
Sensitivity	≤ –107 dBm for 6 dB SINAD
Adjacent Channel Selectivity	≥60 dB at ±25 kHz
Spurious Response Rejection	≥80 dB
Audio Output	Balanced analog (600 Ω) and VoIP (RTP streams)
VoIP Interface	Two Ethernet ports, ED-137C compliant
Remote Management	SNMPv3
Squelch	Adjustable (noise-based and level-based)
Power Supply	Between range of 19.2 to 32 V DC or wider range (nominal)
Physical	3U, 19-inch rack-mountable

Acceptable Manufacturers: Jotron, Rohde & Schwarz, or equivalent.

2.3 UHF DUAL CAVITY BAND PASS FILTER

- Function: Band-pass for transmitter combiner path; frequency 225-400 MHz (factory-tuned); insertion loss ≤1.5 dB per channel; rejection ≥60 dB at ±5 MHz; power handling ≥50 W; VSWR ≤1.3:1; impedance 50 Ω; connectors N-type female; rack mount 4HU.

Acceptable Manufacturers: Polomarconi, Telewave, Tlemec, or equivalent.

2.4 UHF OMNIDIRECTIONAL ANTENNA

- Type: Dipole, omnidirectional; frequency 225-400 MHz; gain ≥2 dBi; VSWR ≤1.5:1; vertical polarization; 50 Ω; power handling ≥100 W; N-type female weatherproofed; mast mounting kit; surge arrestor in-line.

2.5 RF SPLITTER

- Passive 2-way, 50 Ω, 225-400 MHz; insertion loss ≤3.5 dB; isolation ≥20 dB; VSWR ≤1.3:1; power handling ≥10 W; N-type female; 19-inch rack or cabinet mounting.

PART 3 – EXECUTION

3.1 INSTALLATION

- Transceivers configured as two main/standby pairs (Pair 1: TX1 Main + TX2 Standby; Pair 2: TX3 Main + TX4 Standby). Each main/standby pair connects to a dual cavity filter, then to a dedicated antenna.
- Both antennas physically separated to minimize desensitization; masts bonded to grounding system.
- Surge arrestors at building entry for all antenna feeders.
- All RF connections use ½" low-loss coaxial cable; connectors weatherproofed; cables labelled with channel identification.

3.2 TESTING

Test	Method	Acceptance Criteria
Transmitter Power	Power meter	Within ±1 dB of programmed power
Receiver Sensitivity	Signal generator	≤ –107 dBm for 6 dB SINAD
VSWR (Antenna)	Network analyzer	≤1.5:1
Filter Insertion Loss	Network analyzer	≤1.5 dB
Splitter Isolation	Network analyzer	≥20 dB
VoIP Connectivity	Packet analyzer	ED-137C streams established
Redundancy	Simulated failure	Standby takes over without interruption

DIVISION 09 – HF COMMUNICATIONS SYSTEM

PART 1 – GENERAL

1.1 SCOPE

HF communication system for long-range backup communications, including two (2) HF transceivers with 1 kW output power, two (2) broadband HF antennas with automatic tuning units, and two (2) HF transceivers 125 watts for monitoring with broadband antenna.

1.2 REFERENCES

ICAO Annex 10 Volume V, ITU-R Recommendations, RTCA DO-186.

1.3 SUBMITTALS

Transceiver/receiver data sheets, antenna tuning unit specifications, antenna radiation patterns, factory test reports.

PART 2 – PRODUCTS

2.1 HF TRANSCEIVER (VoIP Supported)

Parameter	Requirement
Frequency Range	2 – 30 MHz (continuous, with ITU-assigned aeronautical bands)
Output Power	1 kW PEP (nominal)
Modulation	USB (J3E), AME, compatible with ATC voice
Receiver Sensitivity	≤ –110 dBm for 10 dB SINAD (USB)
Antenna	Broadband with automatic antenna tuning unit (ATU)
Remote Control	Ethernet (SNMP) and/or serial (RS-232/485); VoIP supported
Front Panel	LCD display with controls
Frequency Stability	±1 ppm
Compliance	ICAO Annex 10, ITU-R
Power Supply	230 V AC or between range of 19.2 to 32 V DC or wider range
Environmental	0°C to 50°C operating

Accessories per transceiver: ATU, broadband antenna (e.g., log-periodic or whip), coaxial feeder, remote control cable (if applicable), 19-inch rack-mounting kit.

Acceptable Manufacturers: Rohde & Schwarz, Barrett Communications, Codan, JRC, Sunair, or equivalent.

2.2 HF RECEIVER (VoIP Supported)

Parameter	Requirement
Frequency Range	2 – 30 MHz
Modulation	USB, AME
Sensitivity	≤ –110 dBm for 10 dB SINAD
Antenna	Dedicated receiving antenna (whip or broadband)
Audio Output	Balanced analog (600 Ω) and speaker
Remote Control	Ethernet/SNMP (optional); VoIP supported
Power Supply	230 V AC or between range of 19.2 to 32 V DC or wider range

Acceptable Manufacturers: Rohde & Schwarz, Barrett Communications, Icom, or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

- HF transceivers and receivers installed in radio equipment room.
- ATU near antenna base (weatherproof enclosure).
- Broadband antennas on dedicated masts with proper grounding and lightning protection.
- Coaxial feeders low-loss, 50 Ω, with surge arrestors at building entry.
- All outdoor equipment rated IP65 minimum.

3.2 TESTING

Test	Method	Acceptance Criteria
Transmitter Power	Power meter	1 kW ±0.5 dB
Receiver Sensitivity	Signal generator	≤ –110 dBm
Antenna Tuning	ATU auto-tune	VSWR ≤1.5:1 at tuned frequency
VoIP/Control	Ethernet test	Remote control and audio established

DIVISION 10 – RADIO REMOTE CONTROLLERS

PART 1 – GENERAL

1.1 SCOPE

VoIP-based radio remote controllers for ATC tower and fire station, providing operators with full control of VHF, UHF, and HF radios over the IP network.

1.2 REFERENCES

EUROCAE ED-137C, SNMPv3, ITU-T G.711/G.729.

1.3 SUBMITTALS

Controller data sheets, UPS specifications, headset/microphone specifications, integration details with VCS (if applicable).

PART 2 – PRODUCTS

2.1 RADIO REMOTE CONTROLLER SYSTEM (supporting VHF, UHF, HF, hot lines, SIP telephone lines)

Component	Requirement
Display Unit (JDU)	>10” touch-screen, 800×480 resolution minimum, capacitive or resistive (aviation glove compatible), swivel arm or desktop mount
Microphone Interface (JMI-111A or equivalent)	Desktop unit with integrated loudspeaker (≥2 W), XLR or aviation microphone connector, volume control knob, PTT button
Foot Pedal	Heavy-duty PTT footswitch with 2.5 m cable, momentary contact
Headset	Aviation headset with noise-canceling electret microphone, 10-pin push-pull connector, over-ear or on-ear, impedance 150-300 Ω
UPS	2000 VA online double-conversion UPS with external battery pack providing ≥3 hours backup at full controller load
VoIP	ED-137C compliant; two independent 10/100/1000Base-T Ethernet ports for LAN A / LAN B redundancy
Control Capacity	Minimum 10 radio control, hot lines, telephone lines (digital/analog) or SIP phone
Security	Hardened Linux OS; SNMPv3 monitoring; role-based access control
Audio Codecs	G.711 μ-law/A-law, G.729 optional
Power	12 - 32 VDC or wider range or 230 V AC via UPS
Physical	Desktop or ATC console fitting

Acceptable Manufacturers: Jotron, Rohde & Schwarz, or equivalent meeting Clause 1.6.

PART 3 – EXECUTION

3.1 INSTALLATION

- Six main controllers at six ATC console positions, integrated into console furniture.
- Three compact controllers at fire station and other designated positions.
- Each controller connected to both LAN A and LAN B switches with shielded Cat6a cables.
- UPS units for ATC tower controllers installed under desks or in dedicated racks, with power distribution to each controller.

3.2 TESTING

Test	Method	Acceptance Criteria
Controller boot	Power-on	Boots to operational state within 60 seconds
LAN redundancy	Remove LAN A	Continues operation on LAN B
PTT function	Simulate transmit	Radio transmits; audio quality clear
Audio quality	Test call	No distortion, latency ≤30 ms
UPS backup	Remove mains	Controllers remain operational for ≥3 hours

PROCUREMENT REGULATORY AUTHORITY PUBLIC (PPRA) EPADS

DIVISION 11 – REMOTE CONTROL AND MONITORING SYSTEM (RCMS)

PART 1 – GENERAL

1.1 SCOPE

RCMS software and hardware for centralized management of all radios (VHF, UHF, HF) and associated equipment.

1.2 SUBMITTALS

Software installation media and license certificates, user manuals (operator and administrator), SNMP MIB files, hardware specifications for workstation and laptop.

PART 2 – PRODUCTS

2.1 RCMS SOFTWARE SUITE (1 Lot)

Component	Requirement
RCMS Server	Linux-based / Windows based OS; SNMPv1/v2c/v3 management; alarm logging with historical database; event archiving; multi-site support
Client Licenses	Minimum 5 concurrent operator clients with life-time license
Device Licenses	50 devices (each radio counts as one device)
Workstation	Industrial PC: Intel Core i7 (13th Gen or equivalent), 16 GB RAM, 1 TB SSD (NVMe), Windows 11 Pro, 24” LCD monitor, keyboard, mouse
Laptop	Same specification, portable (Quantity 2)
Features	Real-time status (PTT, squelch, alarms); remote configuration (frequency, power, squelch); BITE monitoring; historical reporting; remote audio monitoring; SNMP trap forwarding

2.2 RCMS CAPABILITIES

Function	Description
System Status	Frequency, serial numbers, firmware, timers; operational status; live PTT and squelch; active alarms; voltages, currents, temperatures; monitoring and controlling all transceiver features
System BITE	Power output, reflected power, VSWR; analogue line levels; modulation levels; RSSI and AGC; frequency accuracy

Function	Description
Maintenance	Activation of test tones; remote audio monitoring; calibration adjustments; event log viewing
Configuration	Frequency, offset, channel space; modulation parameters; audio and PTT sources; output power; squelch adjustments; VoIP parameters (codec, jitter buffer)
Reporting	Availability reports; alarm history; configuration change logs

PART 3 – EXECUTION

3.1 INSTALLATION

- RCMS server software installed on dedicated industrial PC in equipment room.
- RCMS workstation installed at ATC tower or administration area.
- All radios configured with SNMPv3 credentials; SNMP traps directed to RCMS server IP address.

3.2 TESTING

Test	Method	Acceptance Criteria
Server installation	Software load	Server boots, services running
Device discovery	SNMP scan	All 50 devices discovered and displayed
Real-time monitoring	Observe status	PTT, squelch, alarms update in real time
Remote configuration	Change frequency	Radio frequency changes successfully
Alarm generation	Simulate fault	Trap received, alarm displayed, logged
Report generation	Generate availability report	Report produced with correct data

DIVISION 12 – DIGITAL VOICE LOGGING SYSTEM (DVLS)

PART 1 – GENERAL

1.1 SCOPE

Dual redundant voice recording system for recording all ATC communications (VHF, UHF, HF, ambient microphones, telephone lines) with synchronized replay capability.

1.2 REFERENCES

EUROCAE ED-111, CAP670, ICAO Annex 10, EUROCAE ED-137C.

1.3 SUBMITTALS

Recorder server data sheets, storage capacity calculations, replay software specifications, NTP synchronization details, test procedures.

PART 2 – PRODUCTS

2.1 DUAL REDUNDANT 48-CHANNEL RECORDER (Ricochet equivalent) (1 Lot)

Parameter	Requirement
Architecture	Two independent recording servers (A and B) operating in parallel; no single point of failure; both record all sources simultaneously
Channel Capacity	Minimum 48 channels, each configurable for analog (balanced/unbalanced) or VoIP (ED-137C, RTP, SIP)
Analog Inputs	Balanced, 600 Ω, adjustable gain 0 to +20 dB
VoIP Recording	Passive recording of RTP streams; supports ED-137C metadata (PTT, squelch, channel ID)
Storage	RAID 5 or RAID 10 with hot-spare; minimum 31 days online storage at 15% activity per channel
Synchronization	NTP client; GPS optional; timestamp accuracy ≤1 ms
Replay Client	Web-based or standalone with synchronized replay of multiple channels, timeline navigation, bookmarking, export (audio files, impound, archive)
Offline Player	Standalone version for impounded files (Catch Offline equivalent)
Network	Dual 1 GbE ports per server for redundancy
Management	SNMP alarms; user access control (role-based); audit trail; event logging
Servers	Industrial rack-mount (2U), redundant power supplies, hot-swappable drives
NTP Clock	Meinberg or equivalent, with GPS antenna (optional)

Parameter	Requirement
Console	Keyboard, mouse, monitor for local access
Speakers	Powered speakers for replay audio

2.2 RECORDING SOURCES

Source Type	Quantity	Interface
VHF Radios	10	VoIP (RTP) and/or analog
UHF Transmitters	4	VoIP (RTP)
UHF Receivers	4	VoIP (RTP)
HF Transceivers	2	VoIP (RTP) or analog
HF Receivers	5	VoIP (RTP) or analog
Ambient Microphones	2	Analog (balanced)
Telephone Lines / Hot lines	4	SIP or analog

2.3 ACCEPTABLE MANUFACTURERS

Jotron, Exacom, Ascend/Redbox, Voxtronic, Rohde & Schwarz, or equivalent meeting Clause 1.6.

PART 3 – EXECUTION

3.1 INSTALLATION

- Servers mounted in recorder cabinet (dedicated 19-inch rack).
- Both servers connected to LAN A and LAN B for redundancy.
- Analog audio inputs terminated on Krone or equivalent patch panels.
- VoIP recording configured to passively capture RTP streams from network.
- NTP client synchronized to site master clock or GPS.
- Replay workstation installed in ATC tower or administration area.

3.2 TESTING

Test	Method	Acceptance Criteria
Channel configuration	Software setup	All 48 channels configured with correct source types

Test	Method	Acceptance Criteria
Recording verification	Speak/test tone on each source	Audio recorded on both servers
Synchronization	Replay same time on multiple channels	Audio aligned within 1 ms
Storage capacity	Monitor disk usage	Calculated capacity ≥31 days
Redundancy	Power off Server A	Server B continues recording without loss
Replay	Retrieve historical recording	Audio plays with correct time stamp
Export	Export audio file	File plays in standard media player
NTP sync	Check time stamps	Synchronized to NTP source

3.3 DOCUMENTATION

- Channel configuration table
- NTP synchronization configuration
- Replay user manual
- Maintenance procedures (backup, drive replacement)

DIVISION 13 – OPERATIONAL CRISIS CONTROL (OCC) ROOM EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE

Supply, installation, testing, and commissioning of equipment for the Operational Crisis Control (OCC) Room at Skardu Airport, including dedicated communication systems: telephony (PABX), VHF AM mobile radios, VHF AM handheld radios, VHF FM handheld radios, and associated infrastructure. The OCC Room shall be located within the ATCT building as per approved layout.

1.2 RELATED SECTIONS

Voice Communications Systems, DVLS, (UPS), ATC Console Furniture, Electrical.

1.3 SUBMITTALS

- Equipment data sheets (PABX, radios, accessories)
- System architecture drawings (block diagram integration with airport PABX, PSTN, VCCS, recording)
- Installation drawings (OCC room layout, console, PABX rack, telephone/radio positions)
- Cable schedules
- Factory test reports
- Operation and maintenance manuals (including programming software)

1.4 QUALITY ASSURANCE

All equipment new, proven design. PABX system availability ≥99.98% over 10 years. Equivalent products meet Clause 1.6.

PART 2 – PRODUCTS

2.1 OCC PRIVATE AUTOMATIC BRANCH EXCHANGE (PABX)

2.1.1 General

Digital communication system with stored program control, IP-enabled, dedicated to OCC Room.

2.1.2 System Capacity and Configuration

Parameter	Minimum Requirement
Analog subscribers	Up to 20 (expandable to 30)
Digital subscribers	Up to 20 (expandable to 30)
IP subscribers	Up to 30 (expandable to 45)
Digital operator consoles	Minimum 4
V.24 interfaces	Minimum 2

Parameter	Minimum Requirement
ISDN PRI (30 channels)	As specified in BOQ (minimum 1 PRI)
Direct Inward/Outward Dialing	On all PRI channels
Redundancy	Redundant power supply and processor cards

2.1.3 Technical Features

- Digital transmission: PCM A-law (ITU-T G.711, G.712)
- Time-out and release facilities
- Backup memory: non-volatile (Flash, EPROM), automatic reload within 1 minute
- Self-diagnostics with alarm output
- Traffic performance: non-blocking, ≥600 Erlang
- MTBF ≥10 years

2.1.4 Regulatory Compliance

EN 60950-1, EN 61000-6-2, EN 55024, ITU-T, ETSI, ISO.

2.1.5 Interfaces and Trunks

- Connections to Airport PABX: minimum 10 analog two-wire tie lines/trunks
- Connections to PSTN: minimum 20 analog trunk lines (or ISDN PRI)
- ISDN PRI two-way with DID/DOD, auto-plug-and-play

2.1.6 Attendant Consoles

- PC-based attendant console (1 unit) with handset/headset, PC (Core i5, 8 GB RAM, 256 GB SSD, Windows 10/11 Pro, Ethernet), software with telephone directory, extension status, call management
- Desktop digital console (1 unit) with DSS (minimum 40 keys)

2.1.7 Telephone Sets

- Normal telephone sets (analogue/digital): push-button, adjustable receive volume, with/without CLI, wall-mountable option.
- Executive telephone sets: intelligent voice terminals with hands-free intercom, auto-dial, multi-line backlit LCD, CLI display, status indication.

2.1.8 Call Logging and Accounting

- PC-based call logging (Core i7, 16 GB RAM, 1 TB SSD, Windows 11 Pro, Ethernet) with storage for ≥12 months call records including CLI.
- Call accounting software for reports by extension, trunk, cost center.

2.1.9 Power Supply and Battery Backup

- Primary power 230 V AC, 50 Hz.
- Battery backup: external maintenance-free dry batteries (lithium) with built-in charger; **no external stand-alone UPS**; ≥3 hours backup for PABX and connected telephone sets under full load.
- Provision for –48 V DC external supply.

2.1.10 Alarms and Test Facilities

- Audible/visual alarms for power failure, card failure, trunk failure, processor faults.
- Minimum three RS-232 (V.24) or Ethernet ports for local maintenance PC, traffic/call detail output, remote maintenance (modem supplied).
- Remote maintenance capability for programming, class of service changes, diagnostics.

2.1.11 Mechanical and Environmental

- Cabinet: free-standing, enclosed, IP42 minimum, vermin-proof, ventilated, lockable, cable entry from bottom.
- Rack-mountable sub-racks; front access preferred.
- Module identification: keyed edge connectors.
- Operating: +5°C to +40°C, 5-85% RH non-condensing.

2.1.12 Software Features (Minimum)

- Call handling: call detail, call tracing, CLI, closed numbering, connection restriction, cyclic/linear hunt groups, digit prefixing, distinctive ringing, hotline, multiple trunk groups, music on hold, night service, trunk access restrictions, extension relocate, timed disconnect, voice calling.
- Extension features: automatic callback, busy override, call forwarding/pickup/transfer, callback on no answer, do not disturb, DTMF dialing, emergency disconnect/override, executive/secretary, hold toggle, number redial, PIN/Follow me, release/disable call waiting, system speed dialing, 3- and 8-party conference, timed reminder.
- Attendant console features: assigning outgoing trunk calls, attendant busy override, call distribution by queue, call forwarding on no answer, concentrated answering for trunks, extending tie-trunks and internal calls, toggling between connections, night service options.

2.1.13 Acceptable Manufacturers

Alcatel-Lucent Enterprise (OmniPCX Enterprise), NEC (Univerge SV), Avaya (IP Office or CM), Siemens (Unify OpenScape Voice), Panasonic or equivalent meeting Clause 1.6.

2.2 VHF AM MOBILE RADIOS (Quantity: 5)

Parameter	Requirement
Frequency Range	118 – 137 MHz (aeronautical band)

Parameter	Requirement
Modulation	AM
Output Power	Adjustable 10 watts
Power Supply	12 V DC and 24 V DC (adaptable for vehicles)
Channels	Minimum 2 preset (121.500 MHz, 123.100 MHz); programmable up to 10
Receiver Sensitivity	≤6 dBµV for 12 dB SINAD
Adjacent Channel Selectivity	≥70 dB
Spurious Response Rejection	≥70 dB
Intermodulation	≥60 dB
Frequency Stability	±1.5 kHz
Environmental	Suitable for vehicle installation; operating –20°C to +55°C
Accessories	Microphone, mounting bracket, power cable, antenna with cable (vehicle-type)

Acceptable Manufacturers: Jotron, Rohde & Schwarz, Icom (commercial grade), Motorola (with appropriate AM capability), or equivalent.

2.3 VHF AM HANDHELD RADIOTELEPHONES (Quantity: 6)

Parameter	Requirement
Frequency Range	118 – 137 MHz (aeronautical band)
Modulation	AM
Output Power	≥5 W (adjustable low/high)
Channels	Minimum 2 preset (121.500, 123.100 MHz); programmable up to 10
Battery	Built-in long-life rechargeable Li-ion pack
Receiver Sensitivity	≤6 dBµV for 12 dB SINAD
Adjacent Channel Selectivity	≥70 dB

Parameter	Requirement
Spurious Response Rejection	≥70 dB
Intermodulation	≥60 dB
Audio Output	≥200 mW (<10% THD)
Water Resistance	Immersion to 1 m for 5 minutes (IP67 or equivalent)
Environmental	Operating –20°C to +55°C; resistant to sea water, oil, sunlight
Accessories	Belt clip, antenna, drop-in charger, AC adapter, rechargeable battery pack

Acceptable Manufacturers: Icom (A-series), Vertex Standard, Motorola, or equivalent.

2.4 VHF FM HANDHELD RADIOTELEPHONES (Quantity: 10)

Parameter	Requirement
Frequency Range	146 – 174 MHz (VHF FM)
Modulation	FM
Output Power	≥5 W (adjustable high/low)
Channels	Minimum 99 programmable
Channel Spacing	5, 10, 12.5, 25 kHz selectable
Battery	Built-in long-life rechargeable Li-ion
Receiver Sensitivity	≤0.25 µV (12 dB SINAD)
Adjacent Channel Selectivity	≥60 dB (12.5 kHz) / ≥70 dB (25 kHz)
Intermodulation	≥60 dB
Audio Output	≥500 mW
Environmental	Operating –20°C to +55°C; water resistant IP54 minimum
Accessories	Belt clip, antenna, drop-in charger, AC adapter, rechargeable battery pack

Acceptable Manufacturers: Motorola, Kenwood, Icom, Vertex Standard, Hytera, or equivalent.

2.5 INTEGRATION AND RECORDING

All communications equipment (PABX telephone lines, VHF AM mobile radios, VHF AM handheld radios when used in OCC, VHF FM handheld radios) shall be connected to the DVLS. Contractor shall provide all necessary interface cables, splitters, impedance matching devices. OCC PABX shall provide dedicated audio output port (balanced or VoIP) for each extension/trunk required to be recorded.

PART 3 – EXECUTION

3.1 INSTALLATION

- PABX main cabinet installed in OCC equipment room (as per layout), securely anchored, cables entered from bottom. MDF with Krone or similar connectors.
- Telephone sets installed at OCC workstations and other designated locations.
- Attendant console PCs installed on OCC console with neat cabling.
- VHF AM mobile radios: coordinate with vehicle supplier or install base station in OCC; for vehicle installation, provide complete kits including antennas and power cabling.
- Handheld chargers installed in OCC on dedicated charging rack powered from OCC UPS.
- All voice/data cabling .
- Trunk connections from PSTN and airport PABX terminated on PABX.
- Recording feeds run from PABX and radio equipment to DVLS termination point using shielded twisted pair or as required.
- PABX powered from dedicated AC source and its integral battery system (no external UPS). Radio equipment powered from OCC UPS.
- All equipment bonded to grounding system .

3.2 TESTING AND COMMISSIONING

3.2.1 Factory Acceptance Test (FAT)

Perform FAT for PABX at manufacturer’s facility: all hardware/software features, redundancy, DID/DOD, call logging/accounting, battery backup and automatic reload, interface to trunk lines (simulated).

3.2.2 Site Acceptance Test (SAT)

Test	Method	Acceptance Criteria
PABX Basic Operation	Place internal/external calls	Dial tone, clear voice, successful connection
DID/DOD	Call from PSTN to OCC extension; call from OCC to PSTN	Call reaches correct extension; CLI displayed; outward call completed
Attendant Console	Answer, transfer, hold, conference	Features work per manufacturer specification

Test	Method	Acceptance Criteria
Call Logging	Generate call records	Records show CLI, duration, cost codes
Battery Backup	Remove AC power	PABX operates on battery; after AC restoration, system reloads within 1 minute
Radio Transmit/Receive	Test each radio unit	Audio clarity, output power within tolerance
Recording Interface	Make calls and radio transmissions	Audio recorded in DVLS with correct time-stamp and channel ID
System Integration	Coordinate with VCCS if used	OCC telephone lines accessible from VCCS if required

PART 4 – DOCUMENTATION

Contractor shall provide as-built wiring diagrams (extension numbers, trunk assignments, recording feeds), PABX configuration files (software backup), programming guides (user and administrator), radio programming software and frequency lists, operation manuals, maintenance logbook for OCC equipment.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DIVISION 14– METEOROLOGICAL SYSTEMS

SUB-DIVISION 14.1 – AUTOMATED WEATHER OBSERVING SYSTEM (AWOS) – CAT I

PART 1 – GENERAL

1.1 SCOPE

Complete Automated Weather Observing System (AWOS) for Skardu Airport meeting ICAO CAT I precision approach requirements for a single runway, providing real-time meteorological data for ATC, flight planning, and aeronautical information services. Scope includes Central Data Unit (CDU) with dual redundancy, full sensor suite, sensor masts, enclosures, communication interfaces, cabling, integration with ATC displays/AMHS/recording system, and complete grounding/lightning protection.

1.2 REFERENCES

ICAO Annex 3, ICAO Doc 9837, ICAO Doc 8896, WMO No. 8, WMO No. 49, ISO 28902, IEC 60945, FAA Order 6560.10C, EUROCAE ED-111.

1.3 SUBMITTALS

System design documentation (block diagram, sensor siting plan, mast/mounting details, cable routing, power distribution), sensor data sheets, CDU submittals (hardware, software, redundancy, communication protocols), factory test reports (sensor calibration, CDU validation), installation/calibration plans, acceptance test procedures.

PART 2 – PRODUCTS

2.1 AWOS CENTRAL DATA UNIT (CDU)

Parameter	Requirement
Architecture	Dual redundant configuration with automatic failover (or single unit with fully redundant internal components)
Processor	Industrial-grade, minimum 4 cores, 3.0 GHz or equivalent
Memory	Minimum 16 GB RAM
Storage	RAID 1 (mirrored) or RAID 5 with hot-spare; minimum 1 TB usable; capacity for ≥31 days raw sensor data, reports, logs
Data Processing	Real-time sensor acquisition (≤1 second update); data validation; meteorological calculations (QNH, QFE, dew point, density altitude, etc.)
Report Generation	METAR (hourly/on-demand), SPECI, trend reports (TREND), RVR for CAT I; automated voice output (optional), TDZ and MID etc
Reporting Formats	ICAO METAR code; IWXXM (XML); plain text for ATC displays
Time Synchronization	GPS receiver or NTP client; timestamp accuracy ≤1 second UTC

Parameter	Requirement
Interfaces	AMHS (serial/TCP/IP); ATC display systems (serial/TCP/IP/discrete); SNMP (remote monitoring); analogue/digital outputs for alarm indicators
User Interface	Graphical display of all sensors with real-time values, alarms, system status, configuration menus, data review/export
Alarms	Configurable thresholds for all sensors; equipment failure alarms; communication loss alarms; visual/audible (local)
Remote Monitoring	SNMPv3 for integration with RCMS; web-based interface (optional)
Physical	19-inch rack-mount (2U or 4U); front panel display or remote console
Power Supply	230 V AC with internal or external UPS; backup runtime ≥30 minutes (or as per site UPS)
Environmental	Operating –25°C to 50°C; humidity 0-95% non-condensing

Acceptable Manufacturers: Vaisala, Sutron, Campbell Scientific, All Weather Inc., or equivalent meeting Clause 1.6.

2.2 SENSOR SUITE

2.2.1 Wind Speed and Direction Sensor (Quantity: 1)

- 2D Ultrasonic (preferred) or mechanical (cup and vane); speed range 0-50 m/s, direction 0-360°; accuracy ±0.5 m/s (≤20 m/s), ±3% (>20 m/s), direction ±3° (minimum) ; resolution 0.1 m/s / 1°; output RS-485/RS-232/analog 4-20 mA; integrated de-icing heating; IP66, operating –40°C to +60°C; mounted on mast at 10 m height (or per ICAO).

Acceptable Manufacturers: Vaisala, Campbell Scientific, Young, or equivalent.

2.2.2 Barometric Pressure Sensor (Quantity: 2 – Redundant)

- Digital barometer with internal temperature compensation; range 800-1100 hPa; accuracy ±0.3 hPa; resolution 0.01 hPa; long-term stability ≤0.1 hPa/year; output RS-232/RS-485/SDI-12; operating –40°C to +60°C, IP65.

Acceptable Manufacturers: Vaisala, Paroscientific, Campbell Scientific, or equivalent.

2.2.3 Temperature and Humidity Sensor (Quantity: 1)

- Temperature range –40°C to +60°C, accuracy ±0.2°C, resolution 0.1°C; humidity range 0-100% RH, accuracy ±2% RH (0-90%), ±3% RH (90-100%); output RS-485/SDI-12; with radiation shield; IP65.

Acceptable Manufacturers: Vaisala (HMP155 with DTR503), Rotronic (HC2 series), Campbell Scientific (EE181), or equivalent.

2.2.4 Cloud Height Ceilometer (Quantity: 1 at TDZ)

- Laser-based LIDAR; range 0-7,500 ft (0-2,500 m) minimum; resolution 50 ft (15 m); accuracy ±50 ft (≤1,000 ft), ±10% (>1,000 ft); outputs cloud layers (up to 3), vertical visibility, backscatter profile; laser Class 1M or 3B with eye-safe interlocks; operating –40°C to +60°C; IP66 with window de-icing; output RS-232/RS-485/Ethernet.

Acceptable Manufacturers: Vaisala, Campbell Scientific, Lufft, or equivalent.

2.2.5 Visibility / Runway Visual Range (RVR) Sensor (Quantity: 1 at TDZ)

- Forward scatter sensor (preferred for CAT I) or transmissometer; range 10-2,000 m (RVR) or 10- 20,000m visibility; accuracy ±10%; scattering angle 40°-45°; output RS-232/RS-485/analog; integrated heating for optics; operating –40°C to +60°C, IP66; MTBF ≥50,000 hours; factory calibrated with field verification kit.

Acceptable Manufacturers: Vaisala, Biral, Lufft, or equivalent.

2.2.6 Present Weather Detector (Quantity: 1)

- Optical or combined optical/impact sensor; detectable phenomena: rain, snow, drizzle, freezing rain, hail, fog, mist, haze; output weather code (WMO table), precipitation type, intensity; precipitation rate range 0-99 mm/h; type accuracy ≥90% correct; operating –40°C to +60°C, IP66; output RS-232/RS-485/digital. (Function may be integrated into visibility sensor.)

Acceptable Manufacturers: Vaisala, Biral, Lufft, or equivalent.

2.2.7 Lightning Detector (Quantity: 1)

- Field mill or electrostatic detection; detection range ≥20 km radius; output Cloud and Cloud-to-Ground, Lightning within 30NM, More than 95% thunderstorm detection within 10NM (3 or more cloud discharge); dry contacts (alarm), RS-232, or Ethernet; adjustable distance thresholds (5,10,20 km); outdoor IP66, lightning-resistant; power 12/24 V DC or 230 V AC.

Acceptable Manufacturers: Vaisala, Biral, Campbell Scientific, or equivalent.

2.3 SENSOR MASTS AND ENCLOSURES

- Mast type: Galvanized steel, self-supporting or guyed, height as required (10 m for wind, 2-3 m for others)
- Foundation: Concrete footing with anchor bolts; grounding electrode integrated
- Enclosures: Weatherproof (IP65) for sensors with local electronics; lockable, with ventilation
- Cabling: Armored or conduit-protected; shielded twisted pair for data; proper termination in junction boxes

2.4 COMMUNICATION AND DATA INTERFACES

- Sensor to CDU: RS-485, RS-232, or Ethernet (Modbus, SDI-12, or proprietary)
- CDU to ATC displays: Serial (RS-232) or TCP/IP with defined data format
- CDU to AMHS: TCP/IP with IWXXM (XML) or legacy text formats
- CDU to RCMS: SNMPv3
- CDU to DVLS: Analog or VoIP for voice-generated weather broadcast (if required)

PART 3 – EXECUTION

3.1 SITING AND INSTALLATION

- Sensor siting per ICAO Annex 3, ICAO Doc 9837, and approved site-specific siting plan:

Sensor	Location	Height
Wind	Touchdown Zone (TDZ) – 300 m from threshold, 120 m from centerline	10 m AGL
Barometric Pressure	Near midpoint of runway, indoors if possible	1-2 m AGL
Temperature/Humidity	TDZ, away from buildings/paved surfaces	1.5-2 m AGL
Ceilometer	TDZ, clear view of sky, ±300 m from threshold	Ground-based
Visibility/RVR	TDZ, 120 m from centerline, clear view of runway	2-5 m AGL
Lightning Detector	Clear of obstructions, away from power lines	On mast or roof

- Masts installed on concrete foundations designed for wind loading (≥180 km/h); each mast bonded to grounding system with 50 mm² copper conductor; surge arrestors at base of each mast for all cables.
- Sensor cables in rigid PVC conduits (Schedule 80) buried at minimum 600 mm depth with sand bedding and warning tape; cables entering buildings through surge arrestors and sealed against moisture; cable trays within buildings for exposed runs.
- CDU installed in equipment room (or ATC tower) in 19-inch rack or dedicated cabinet; redundant CDU (if separate) in separate location or same rack with independent power; CDU connected to airport network for AMHS and ATC display integration.

3.2 CALIBRATION AND VERIFICATION

- Factory calibration with traceability to national/international standards; certificates provided.
- Field verification:

Sensor	Verification Method	Acceptance
Wind	Compare with portable reference	±0.5 m/s / ±5°
Pressure	Compare with portable barometer	±0.3 hPa
Temp/Humidity	Compare with portable reference	±0.2°C / ±2%
Ceilometer	Compare with known cloud heights (visual or reference)	±50 ft up to 1,000 ft
Visibility/RVR	Compare with reference sensor or known RVR	±10%

Sensor	Verification Method	Acceptance
Present Weather	Visual observation of weather events	Correct identification
Lightning	Simulate or verify with network data	Alarm activation at set thresholds

- Ongoing calibration schedule and procedures provided for warranty period.

3.3 INTEGRATION WITH CNS SYSTEMS

- The AWOS should have its own workstations and display screens, and shall also output meteorological data to ATC display systems (tower display, approach radar) in agreed format.
- AWOS generates METAR, SPECI, trend reports in ICAO format and transmits to AMHS terminal via TCP/IP.
- Ambient audio (if recorded) time-synchronized with AWOS data; AWOS may generate voice-synthesized weather broadcasts for recording.
- AWOS CDU supports SNMPv3 for remote monitoring; alarms (sensor failure, communication loss, thresholds exceeded) forwarded to RCMS.

PART 4 – TESTING AND ACCEPTANCE

4.1 FACTORY ACCEPTANCE TEST (FAT)

Performed at manufacturer's facility for CDU and all sensors: sensor calibration verification, CDU data processing, report generation, communication interfaces. Witnessed by Employer and Engineer representatives (as per BOQ).

4.2 SITE ACCEPTANCE TEST (SAT)

Provisional SAT (PSAT): Verify all sensors installed per siting plan; cabling and grounding; power up; communication between sensors and CDU; data validity and report generation; alarms and interfaces.

Operational Readiness Demonstration (ORD): 60-day continuous operation; compare AWOS reports with manual observations or reference instruments; log alarms and events; Contractor corrects deficiencies.

Final SAT (FSAT): Repeat PSAT tests; verify calibration after ORD; demonstrate full functionality: METAR/SPECI generation, RVR calculation, alarm handling, remote monitoring, interface to ATC displays and AMHS.

PART 5 – DOCUMENTATION

Contractor shall provide as-built siting plan (coordinates, heights), cable routing and conduit diagrams, calibration certificates for all sensors, test reports (FAT, PSAT, FSAT), operation and maintenance manuals, spare parts list (recommended for 5 years), historical logbook for AWOS.

DIVISION 15 – AIRPORT SYSTEMS

SUB-DIVISION 15.1 – ATC CONSOLE FURNITURE

PART 1 – GENERAL

1.1 SCOPE

ATC console furniture for six working positions in the Skardu Airport control tower cab, providing ergonomic, durable, and functional workstations accommodating all CNS equipment including radio remote controllers, monitors, keyboards, fire alert panel, backup telephone, master clock, and ancillary equipment.

1.2 REFERENCES

FAA Order 6480.4, ISO 9241, EN 527, IEC 60950 (adapted).

1.3 SUBMITTALS

Detailed console drawings (plan, elevation, sections), material specifications and finishes, integration details for RRC, fire alert panel, backup telephone, master clock, cable management design, ergonomic assessment report.

PART 2 – PRODUCTS

2.1 CONSOLE FURNITURE (6 working positions)

2.1.1 General Configuration

- **Number of positions:** Six (6)
- **Layout:** Curved or linear arrangement per tower cab layout; positions grouped in two groups of three or continuous run
- **Dimensions per position:** Minimum 1.2 m width, 0.9 m depth (work surface)
- **Height:** Adjustable (electric or manual) 650-800 mm

2.1.2 Structure

- **Frame:** Heavy-duty steel, welded or bolted, powder-coated finish (RAL 7035 or as specified)
- **Work Surface:** High-pressure laminate (HPL) or solid surface, anti-static, scratch-resistant, rounded edges
- **Modesty Panel:** Steel or laminate, with cable access cutouts
- **Base:** Adjustable leveling feet or locking castors

2.1.3 Monitor Mounts

- Articulating arms (gas spring or mechanical), VESA 75/100 compatible; capacity three (3) monitors per position minimum; mounting at rear of work surface or integrated into console; adjustability in height, tilt, swivel, rotation.

2.1.4 Keyboard and Mouse Trays

- Pull-out tray with mouse platform (right or left); steel or aluminium, with wrist rest (optional); ball-bearing slides.

2.1.5 Equipment Integration

- RRC (6 units): Flush-mounted into console face with cut-outs to size; front access for operation.
- Fire alert panel, backup telephone, master clock: cut-out and mounting provisions.

2.1.6 Cable Management

- Integrated horizontal and vertical cable ducts (steel or plastic); front and rear access panels; separate channels for power (230 V AC) and data (Ethernet, audio); cable entry grommets at work surface; under-console trays.

2.1.7 Ergonomics and Finish

- Conforms to ISO 9241; adjustable for 5th to 95th percentile users.
- Anti-static (ESD-safe) work surface and components.
- Materials meet flame-retardant standards (UL 94 V-0 or equivalent).
- Color: RAL 7035 (light grey) or as per tower cab design.

2.1.8 Acceptable Manufacturers

Evans Consoles, Winsted, Hergo, Kustom, or equivalent meeting Clause 1.6.

PART 3 – EXECUTION

3.1 INSTALLATION

- Verify tower cab floor level and capable of supporting console weight; identify cable entry locations.
- Assemble consoles on-site by qualified technicians; join sections securely; level and align work surfaces.
- Flush-mount RRC controllers in designated cut-outs; attach monitors to articulating arms; install keyboard trays; install fire alert panel, backup telephone, master clock per coordination with other contractors.
- Route all cables through integrated ducts; separate power and data; use Velcro ties (no zip ties for service loops); provide service loops.

3.2 TESTING

- Verify all monitors and controllers securely mounted.
- Test adjustability of monitor arms and keyboard trays.
- Verify cable management allows maintenance access.

SUB-DIVISION 15.2 – ATC SUPPORT EQUIPMENT (MISCELLANEOUS)

PART 1 – GENERAL

1.1 SCOPE

Miscellaneous support equipment for ATC Tower: ergonomic chairs (10), storage lockers (4), binoculars (2), hand-held ATC signal light gun (1), and test equipment/tools for commissioning, maintenance, and troubleshooting of CNS systems.

1.2 REFERENCES

ISO 9241, EN 1335, EN 16122, IEC 60950 (adapted), ICAO Annex 10, FAA Order 6480.4.

1.3 SUBMITTALS

Product data (catalogue cuts, specifications, colors/finishes), shop drawings (locker placement), sample materials, test equipment list (manufacturer, model, specifications, intended use), operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 ATC ERGONOMIC CHAIRS (Quantity: 10)

- Conforms to ISO 9241; adjustable seat height, seat depth, backrest angle, armrest height.
- Seat width ≥500 mm, depth adjustable 450-500 mm; upholstered with breathable, anti-static fabric; color approved.
- Backrest height adjustable 600-700 mm with lumbar support; tilt lock and free-float mechanism.
- Five-star base polished aluminium or heavy-duty nylon; rolling castors (≥50 mm) suitable for carpeted and hard floors.
- Synchronous mechanism linking seat and backrest; weight-adjustable tension control.
- Weight capacity minimum 150 kg.
- Tested to EN 1335; minimum 10-year warranty for mechanical components.
- Upholstery flame-retardant (BS 5852, CAL 117).
- Color approved by Engineer (dark grey, black, or blue).

Acceptable Manufacturers: Herman Miller (Aeron, Embody), Steelcase (Gesture, Leap), HÅG (Capisco), RH (Futu), or equivalent.

2.2 STORAGE LOCKERS (Quantity: 4)

- Welded steel frame, powder-coated paint (RAL 7035 or approved).
- Dimensions: width 2,000 mm (±100 mm), height 2,100 mm (±100 mm), depth 500 mm (±25 mm).
- Minimum 7 adjustable heavy-gauge steel shelves; filing rails for suspended files (A4/legal) on at least two shelves.
- Horizontal folding doors (bi-fold or sliding) with lockable handles; individual or master key.
- Perforated or slotted ventilation.

- Anti-tip brackets and floor anchors included.
- Suitable for indoor use, corrosion-resistant finish.

Acceptable Manufacturers: Local reputable suppliers (subject to material specifications) or Spacesaver, Lista, etc.

2.3 BINOCULARS (Quantity: 2)

- Magnification 15× or higher; aperture 50 mm; field of view ≥60 m at 1,000 m.
- High-contrast, phase-coated, anti-reflective lenses.
- Central focus wheel with auto-focus or precision manual focus.
- Optical or electronic image stabilization.
- Roof prism (preferred) or Porro prism; eye relief ≥15 mm.
- Waterproof, fog-proof, nitrogen or argon sealed.
- Accessories: soft carry case, lens caps, neck strap, cleaning cloth, lens cleaning pen.
- Operating temperature –20°C to +50°C.

Acceptable Manufacturers: Zeiss, Leica, Swarovski, Fujinon, Canon (with IS), Nikon, or equivalent.

2.4 HAND-HELD ATC SIGNAL LIGHT GUN (Quantity: 1)

- Light colors: green, white, red (independently selectable).
- White light range ≥10 miles (16 km) in daylight, good visibility.
- Cordless, rechargeable internal Li-ion or NiMH battery; battery life ≥8 hours continuous operation.
- Mains-powered charger (110-240 V AC, 50/60 Hz) included; one spare battery pack included.
- Ergonomic pistol-grip design with trigger for each color; momentary or latching optional.
- Rugged, weather-resistant housing (IP54 minimum); weight <1.5 kg.
- Eye-safe at intended distances; comply with relevant safety standards.
- Accessories: carrying case, neck strap, cleaning cloth, instruction manual.

Acceptable Manufacturers: Honeywell (Whelen), Carmanah, Federal Signal, or equivalent ATC-certified suppliers.

2.5 TEST EQUIPMENT AND TOOLS (Minimum required)

Item	Quantity	Minimum Specification
Oscilloscope	1	100 MHz, 2-channel, digital storage, with probes
RF Power Meter / Wattmeter	1	2-500 MHz, power range 1 mW-100 W, directional, with adapters

Item	Quantity	Minimum Specification
Radio Communications Test Set	1	Covers VHF (118-137 MHz) and UHF (225-400 MHz); supports AM, FM, VoIP; signal generator, spectrum analyzer, modulation analyzer
Audio Frequency Generator	1	10 Hz-20 kHz, sine/square wave, adjustable output
Frequency Counter / Meter	1	10 Hz-3 GHz, accuracy ±1 ppm
Digital Multimeters	2	True-RMS, CAT III 600 V, AC/DC voltage, current, resistance, capacitance, frequency
Analog Voltmeters	2	Portable, AC/DC ranges, high impedance
Clamp-on Ammeters	2	AC/DC, 0-200 A, with DC current capability
Cable Test Set (end-to-end)	1	For copper and RF cables; tests continuity, length, VSWR (optional)
Fiber Optic Tester	1	OTDR or light source/power meter for single-mode OS2; includes launch cable, adapters
VSWR / Return Loss Meter	1	Field-portable (e.g., Anritsu Site Master) covering VHF/UHF; with calibration kit
Ethernet Cable Qualifier	1	For Cat6a shielded cabling; tests wiremap, length, insertion loss, NEXT, etc.
Spectrum Analyzer	1	Portable, 9 kHz-3 GHz, with tracking generator (optional)
Tool Sets (electronics)	2 sets	Precision screwdrivers, pliers, cutters, soldering station, desoldering tools, anti-static mat, wrist strap
Tool Sets (electrical/mechanical)	2 sets	Combination wrenches, socket set, hex keys, wire strippers, crimping tools (coaxial and data), torque wrench

All test equipment supplied with manufacturer's calibration certificates traceable to national/international standards; include carrying cases, adapters, cables, consumables.

Acceptable Manufacturers: Anritsu, Rohde & Schwarz, Keysight, Fluke, Tektronix, Bird, Aeroflex (Viavi), or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

- Chairs delivered fully assembled; placed at designated ATC working positions.

- Lockers installed in approved locations; secured to floor or wall with anti-tip brackets; level and aligned.
- Binoculars stored in control cab at secure location; mounting brackets (if required) per manufacturer.
- Light gun provided with charging station installed in control cab or designated area; charging station connected to AC outlet and grounded; spare battery stored same location.
- Test equipment delivered in appropriate carrying cases; stored in designated cabinets or lockers; Contractor shall inventory all items and provide list with serial numbers.

3.2 ACCEPTANCE AND DEMONSTRATION

- Chairs: verify adjustability, ergonomic comfort, no defects.
- Lockers: verify dimensions, shelving, locking mechanism, finish.
- Binoculars: demonstrate image quality, stability; verify accessories.
- Light gun: demonstrate all three colors; verify daylight visibility (simulated); test battery charging and spare battery operation.
- Test equipment: demonstrate basic functions of each instrument; present calibration certificates.

3.3 WARRANTY AND SPARE PARTS

- Chairs: manufacturer’s warranty ≥5 years for mechanical parts.
- Light gun: 2 years warranty on electronics and battery.
- Test equipment: 1-year warranty (or per manufacturer) with calibration validity at delivery. Contractor to provide list of recommended spare parts for test equipment (leads, fuses, connectors) for 2 years.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

DIVISION 16 – SPECIAL SECTIONS (Testing, Training, Documentation)

SUBDIVISION 16.1 – QUALITY CONTROL (TESTING AND ACCEPTANCE)

PART 1 – GENERAL

1.1 SCOPE

Testing and acceptance requirements for all CNS equipment, AWOS, and associated systems, including Factory Acceptance Tests (FAT), Site Acceptance Tests (SAT), Operational Readiness Demonstration (ORD), and flight checks (if applicable).

1.2 SUBMITTALS

Document	Submission Timing
FAT Plan and Procedures	30 days prior to FAT
SAT Plan and Procedures	30 days prior to PSAT
Test Records	Within 10 days after each test phase
Acceptance Certificates	Upon successful completion

PART 2 – PRODUCTS

(Not applicable)

PART 3 – EXECUTION

3.1 FACTORY ACCEPTANCE TEST (FAT)

3.1.1 General

- FAT performed at OEM manufacturing facility for each major system: VHF/UHF/HF Radios, DVLS, RCMS, AWOS.
- Employer and Engineer representatives (as per BOQ Table No. 2) witness.
- Contractor provides all test equipment, power, consumables.

3.1.2 FAT Plan and Procedures

Includes test schedule, step-by-step procedures with pass/fail criteria, test equipment list (with calibration certificates), configuration details.

3.1.3 FAT Content

System	Tests to be Performed
VHF/UHF Radios	Power output, sensitivity, modulation, VoIP (ED-137C) latency, SNMPv3, main/standby redundancy, BITE alarms

System	Tests to be Performed
DVLS	Channel recording, timestamp accuracy, synchronized replay, RAID redundancy, failover, NTP sync
RCMS	Device discovery, SNMP trap generation, remote configuration, report generation, user access control
AWOS	Sensor calibration verification, CDU data processing, METAR generation, RVR calculation, alarm handling
Integration	End-to-end scenarios (radio transmission, recording, RCMS alarm)

3.1.4 FAT Completion

- All test results recorded and signed.
- Deficiencies corrected prior to shipment.
- FAT Certificate issued upon successful completion.

3.2 SITE ACCEPTANCE TEST (SAT)

3.2.1 General

SAT conducted in three phases:

- PSAT (Provisional SAT): installation verification, basic functionality
- ORD (Operational Readiness Demonstration): 60 days continuous operation under normal conditions
- FSAT (Final SAT): repeat critical tests, full system demonstration

3.2.2 PSAT (Provisional SAT)

- **Installation Verification:** visual inspection (mounting, labelling, cabling), grounding continuity tests, power supply verification, network connectivity.
- **Functional Tests:** VHF/UHF/HF power output, receiver sensitivity, VoIP streams; remote controllers PTT, audio quality, LAN redundancy; DVLS channel recording/replay; RCMS device status/alarms; AWOS sensor data acquisition/report generation; UPS/DC power transfer to battery, runtime verification.

3.2.3 ORD (Operational Readiness Demonstration)

- 60-day continuous operation.
- System operated by Employer personnel (with Contractor support).
- All failures, alarms, anomalies logged.
- Contractor corrects all deficiencies within specified response times.
- Acceptance: no unresolved critical deficiencies after 60 days.

3.2.4 FSAT (Final SAT)

- Repeat all PSAT functional tests.
- Demonstrate full system integration: radio → RCMS → DVLS (recorded audio); AWOS → ATC display → AMHS.
- Verify all ORD deficiencies corrected.
- Submit final test records.
- FSAT Certificate issued upon successful completion.

3.3 FLIGHT CHECK (IF APPLICABLE)

- If navigation aids (ILS, DME, DVOR, NDB) included, Contractor coordinates flight inspection with civil aviation authority at no additional cost to Employer. Any deficiencies corrected by Contractor.

DEMONSTRATION AND TRAINING

PART 1 – GENERAL

1.1 SCOPE

Factory and on-site training for Employer personnel to operate, maintain, and troubleshoot supplied systems.

1.2 SUBMITTALS

Document	Submission Timing
Training Curriculum	60 days prior to training
Training Schedule	30 days prior to training
Training Materials	At start of training
Training Completion Reports	After each training session

PART 2 – PRODUCTS

(Not applicable)

PART 3 – EXECUTION

3.1 FACTORY TRAINING

- Conducted at OEM manufacturing facility per BOQ Table No. 1.
- Instruction in English.
- Contractor provides travel, accommodation, DSA as per BOQ.

Training Content:

System	Topics
VHF/UHF/HF Radios	System architecture, installation, configuration, Level 1/2 maintenance, troubleshooting, VoIP/SNMP setup
DVLS	Recording configuration, replay operations, system administration, backup/restore, maintenance
RCMS	Server/client configuration, SNMP management, alarm handling, report generation
AWOS	Sensor calibration, CDU operation, report generation, troubleshooting
General	Preventive maintenance schedules, use of test equipment, fault isolation to module level

- Format: Classroom (theory) 50%, hands-on practical 50%. Each trainee receives training manuals and course materials.
- Evaluation and completion certificates provided.

3.2 SITE TRAINING

- Conducted at Skardu Airport after installation.
- Covers both operations and maintenance personnel.

Operations Training: Normal system operation, emergency procedures, alarm recognition and response, use of remote controllers, DVLS replay client, RCMS monitoring.

Maintenance Training: Daily/weekly/monthly preventive maintenance, troubleshooting procedures, module replacement, software updates, use of diagnostic tools.

- Format: On-the-job training with actual equipment; demonstration and supervised practice.

DIVISION 17 – CLOSEOUT SUBMITTALS (DOCUMENTATION)

PART 1 – GENERAL

1.1 SCOPE

Final documentation to be delivered by Contractor upon project completion.

1.2 SUBMITTALS

All documentation submitted before Final Acceptance.

PART 2 – PRODUCTS

(Not applicable)

PART 3 – EXECUTION

3.1 AS-BUILT DRAWINGS

Three (3) hard copies and one (1) digital copy (PDF and editable CAD format) of:

- System block diagrams (as-built)
- Equipment layout drawings (cabinets, racks, consoles)
- Cable routing diagrams (RF, data, power)
- Grounding and lightning protection drawings
- Antenna mast installation drawings
- AWOS sensor siting plan
- Conduit and cable tray routing

3.2 OPERATION AND MAINTENANCE MANUALS

Three (3) hard copies and one (1) digital copy of:

- **Functional Design Manual:** System overview, block diagrams, operational scenarios, interface control documents
- **Hardware Manuals:** Installation instructions, schematics, parts lists, alignment procedures
- **Software Manuals:** Installation, configuration, backup/recovery, software version control
- **Operator Manuals:** Step-by-step operation, alarm handling, normal and emergency procedures
- **Maintenance Manuals:** Preventive maintenance schedules, fault finding flowcharts, module replacement

All manuals in English, bound in hardback loose-leaf binders with tabbed sections.

3.3 HISTORICAL LOGBOOKS

- One (1) hardbound logbook per site (equipment room, ATC tower, AWOS).
- Used to record installation, commissioning, maintenance, failures, modifications.

- Contractor records initial entries (installation dates, test results, configuration details).

3.4 CERTIFICATE OF COMPLIANCE

Certificate signed by Contractor and OEM confirming all equipment conforms to specifications, covering any modifications made during installation.

3.5 TEST RECORDS

- FAT reports for all systems
- PSAT, ORD, and FSAT reports
- Ground resistance test reports
- VSWR and RF test reports
- AWOS calibration certificates

3.6 SPARE PARTS LIST

- Recommended spare parts for 5 years of operation
- Manufacturer part numbers, descriptions, quantities, recommended storage conditions

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0750 — AIRPORT OPERATIONAL SAFETY REQUIREMENTS

PART 1 — GENERAL

1.1 SCOPE

This Section sets out the airport-specific safety, security and coordination requirements applicable to all Works carried out within, or in the vicinity of, the operational area of Skardu International Airport. These requirements are additional to, and not in substitution of, the general Health, Safety and Environment requirements of Section 0010. Where any conflict arises between this Section and any other Section of Volume-II, the requirements of this Section shall govern in matters of aerodrome operational safety.

1.2 DEFINITIONS

Aerodrome Operator means the Pakistan Airports Authority through the Aerodrome Manager, Skardu International Airport. CAA means the Civil Aviation Authority of Pakistan. ASF means the Airport Security Force. NOTAM means a Notice to Airmen issued by the Air Traffic Services unit. OLS means the Obstacle Limitation Surfaces as defined in ICAO Annex 14 Volume I Chapter 4. OFZ means the Obstacle-Free Zone. FOD means Foreign Object Debris.

PART 2 — REQUIREMENTS

2.1 NOTAM AND CRANE OPERATIONS

The Contractor shall not erect or operate any crane, hoist, scaffold, mast or other equipment that penetrates the Obstacle Limitation Surface of the active runway without prior written approval of the Aerodrome Operator and the issue of a NOTAM by the Air Traffic Services unit. Crane sweep diagrams, height above runway elevation, proposed operating hours and the corresponding NOTAM text shall be submitted to the Engineer and to the Aerodrome Operator not less than fourteen (14) calendar days before the planned operation. All operations shall be conducted under continuous two-way radio contact with ATC on a frequency designated by the Aerodrome Operator. The Contractor shall install red obstruction lights on the top of any crane operating overnight inside the aerodrome perimeter, at his own cost.

2.2 AIRSIDE ACCESS AND SECURITY

All personnel and vehicles entering the airside shall hold a valid Airport Security Pass issued by the ASF and the Aerodrome Operator. All Contractor vehicles operating airside shall be escorted by an Aerodrome Operator representative. The Contractor shall nominate a Security Officer who shall be responsible for the daily roster of passes, the surrender of passes on completion of the work, and the immediate reporting of lost or stolen passes. The pass register shall be available for inspection by the Engineer, ASF and the Aerodrome Operator at all times.

2.3 FOREIGN OBJECT DEBRIS (FOD) CONTROL

The Contractor shall maintain FOD discipline at all times. All tools, fasteners, nuts, bolts and small components carried airside shall be accounted for at the start and at the end of each shift. A daily FOD walk shall be conducted on all airside roads and apron areas under the Contractor’s control. Loose granular materials, off-cuts, packaging and waste shall be removed from airside the same day they are generated. Wheel washes shall be installed at every boundary between the construction area and any airside surface. Any FOD incident shall be reported immediately to the Aerodrome Operator.

2.4 FRANGIBILITY

All items installed within the Object-Free Zone of any runway or taxiway shall be frangible in accordance with ICAO Annex 14 Volume I Chapter 9 and ICAO Doc 9157 Part 6, and shall break, distort, yield or otherwise give way upon impact by an aircraft without imposing dangerous loads. This requirement applies, in particular, to signage, light pole bases, antenna masts, fences, conduits and any temporary works within the OFZ. Drawings for items located within the OFZ shall carry the legend “FRANGIBLE — ICAO Doc 9157 Part 6”.

2.5 COORDINATION WITH NAVIGATION AIDS AND RADIO FACILITIES

Where the Works are within 300 m of any operational ILS, VOR, NDB, DME, or VHF air-ground antenna of the Aerodrome Operator, the Contractor shall obtain a separate Method Statement approval from the Aerodrome Operator before bringing metallic plant or scaffolding into the area. The Aerodrome Operator shall monitor RF interference, signal reflection and ground-plane disturbance during the activity and may require flight inspection of any disturbed aid; flight-inspection cost arising from the Contractor’s activity shall be borne by the Contractor.

2.6 WILDLIFE AND BIRD MANAGEMENT

The Contractor shall not create any condition attractive to birds or wildlife on the site, including standing water, food waste, exposed waste bins or fruit-bearing plantation. Closed waste skips shall be used and removed daily. The Contractor shall report any bird strike on Contractor vehicles, or any observed concentration of birds attributable to construction activity, immediately to the Aerodrome Operator’s Wildlife Hazard Management focal point.

2.7 HOT WORK NEAR FUEL

No hot work (welding, cutting, grinding, brazing) shall be performed within 25 m of any fuel installation, fuel hydrant pit, fuel-storage tank, or active fueling vehicle without a written Hot Work Permit issued by the Aerodrome Operator and the attendance of a stand-by ARFF appliance at the Contractor’s cost. The 25 m exclusion shall be increased to 50 m for grinding operations producing spark showers.

2.8 DUST, BLAST AND VIBRATION CONTROL

Construction activity shall not cause dust plumes that intrude into the visual cone of the existing or the new ATC cabin, nor onto the active runway or taxiways. Blasting is prohibited within the aerodrome perimeter without specific written approval and, where approved, shall be conducted under a separate Method Statement coordinated with the Aerodrome Operator. Peak particle velocity at any operational navigation aid foundation shall not exceed 25 mm/s; the Contractor shall monitor and record this.

2.9 EMERGENCY COORDINATION

The Contractor shall participate in the Aerodrome Emergency Plan exercises convened by the Aerodrome Operator during the construction period, and shall provide a 24-hour emergency contact who is authorised to halt construction works on instruction from the Aerodrome Operator or from the Air Traffic Services unit.

SECTION 0760 — FIRE STOPPING OF PENETRATIONS

PART 1 — GENERAL

1.1 SCOPE

This Section covers the supply and installation of fire-stop systems for all penetrations of fire-rated walls, floors and ceilings by services (pipes, conduits, cable trays, ducts), and the firestopping of joints,

voids and gaps in the fire-rated construction. The fire-resistance rating of each penetration seal shall equal or exceed the rating of the construction it penetrates.

1.2 STANDARDS

All fire-stop systems shall be third-party certified to one of the following: ASTM E814 / UL 1479; BS EN 1366-3 and BS EN 1366-4; ISO 10295-1. Acceptable performance categories are F-rating equal to the construction rating, and T-rating where life-safety occupancy lies on the unexposed side. Smoke leakage (L-rating) shall meet UL 1479 Annex C ≤ 5 cfm/ft² at 0.30 in. WC.

1.3 SUBMITTALS

- System type-test certificates and design listings for every penetration condition on the project.
- Manufacturer's installation instructions and method statement.
- Schedule of all penetrations cross-referenced to construction drawings.
- Sample installation for Engineer's inspection in each typical condition before bulk installation.

PART 2 — PRODUCTS

2.1 FIRE-STOP MATERIALS

- Intumescent sealant for cable and small-pipe penetrations.
- Mortar (gypsum-cement) for large openings and floor penetrations.
- Mineral-wool batts with elastomeric coating on both faces for cable-tray and duct penetrations.
- Intumescent pipe collars or wraps for plastic pipes (PVC, uPVC, PE) per BS EN 1366-3.
- Fire-rated dampers (UL 555 / EN 1366-2) in HVAC ducts crossing rated walls or floors, with thermal-release link and electric position monitor wired to the BMS.

2.2 ACCEPTABLE MANUFACTURERS

Hilti (Firestop systems), 3M (Fire Barrier), Promat (Promaseal), Rockwool / Rockflam, Nullifire, or equivalent meeting Section 0010 §1.06.

PART 3 — EXECUTION

3.1 INSTALLATION

Fire stops shall be installed by personnel trained and certified by the system manufacturer. Each installed seal shall be tagged with an identification label showing the date, the installer's name, the rating and the certified system reference. Records of every installed penetration, with photographs before and after installation, shall be kept by the Contractor and submitted with the As-Built drawings.

3.2 INSPECTION

The Engineer or the manufacturer's representative shall inspect a random 10% of all penetrations before close-out of the rated barrier (false ceiling, ductwork enclosure, etc.). Any non-conforming installation shall be removed and reinstalled at the Contractor's cost, and the inspection sample doubled for the area concerned.

SECTION 0770 — AIRCRAFT WARNING AND OBSTRUCTION LIGHTING

PART 1 — GENERAL

1.1 SCOPE

This Section covers the supply, installation, testing and commissioning of the aircraft warning and obstruction lighting on the New Air Traffic Control Tower and on any other structure or appurtenance designated as an obstacle by the Aerodrome Operator under ICAO Annex 14 Volume I Chapter 6 and CAA-Pakistan CAR Part 139.

1.2 STANDARDS

ICAO Annex 14 Volume I, Chapter 6, latest amendment; ICAO Aerodrome Design Manual Doc 9157 Part 4; FAA AC 150/5345-43 (LED obstruction lights, where applicable); CAA-Pakistan CAR Part 139, Aerodrome Standards. Where conflicts arise, ICAO Annex 14 and CAR Part 139 shall govern.

1.3 SUBMITTALS

- Photometric data for proposed luminaires demonstrating compliance with ICAO Annex 14 Table 6.3.
- Coordination drawings showing the lights placed against the OLS analysis.
- Failure-mode and alarm-interface drawings to the BMS and to the RCMS.

PART 2 — PRODUCTS

2.1 TOP-MOST OBSTRUCTION LIGHT

Medium-Intensity Type A obstruction light at the top of the tower mast: LED, white flashing 20–60 fpm, peak intensity 20,000 cd day / 2,000 cd twilight / 2,000 cd night, photocell or BMS day/night switching, dual-lamp head with automatic switch-over on lamp failure, IP66, operating range –40 °C to +55 °C, individual lamp failure monitoring with dry contact for BMS.

2.2 INTERMEDIATE OBSTRUCTION LIGHTS

Low-Intensity Type B fixed-red obstruction lights at intermediate levels (where the tower height exceeds 45 m above ground), LED, peak intensity 32 cd, dual-lamp head, IP66, operating range –40 °C to +55 °C, mounted at the levels notified by the Aerodrome Operator after the OLS analysis. Number of lights and their levels shall be confirmed before installation.

2.3 MASTER CONTROL UNIT

Master control unit located in the Equipment Control Room (ECR) with day/night automatic switching via photocell with manual override; alarm contacts (lamp failure, panel failure, supply failure) wired to the BMS and to the Remote Control and Monitoring System (RCMS) of Section 0740; dual feed from the emergency board and from the UPS to ensure no-break operation.

PART 3 — EXECUTION

3.1 INSTALLATION

Luminaires shall be installed on hot-dip galvanised steel brackets, with vibration isolators where mounted on antenna masts. Cable to the top-most luminaire shall be a single continuous run from the ECR with no joints; cable type LSZH, fire-rated to BS 6387 Cat. C/W/Z.

3.2 TESTING AND COMMISSIONING

Night-time inspection from at least three approach bearings shall be performed by the Engineer and the Aerodrome Operator. A failure-mode test by removal of one lamp shall verify the automatic switch-over and the alarm at the ECR and the BMS. The system shall be left running continuously for 30 days as part of the Reliability Trial.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0780 — VOICE ALARM AND PUBLIC ADDRESS SYSTEM

PART 1 — GENERAL

1.1 SCOPE

A combined Voice Alarm (VA) and Public Address (PA) system serving the ATC Tower, the Fire Station, and allied facilities, with full integration to the Fire Alarm Control Panel (Section 0660) and to the BMS (Section 0710 §1.5). The system shall transmit pre-recorded evacuation messages, live announcements from a fire-brigade microphone, and routine paging announcements, with priority override of routine traffic by emergency messages.

1.2 STANDARDS

EN 54-16 (Voice Alarm Control and Indicating Equipment); EN 54-24 (Voice Alarm Loudspeakers); NFPA 72 Chapter 24 (Emergency Communication Systems); IEC 60268-16 (Speech Transmission Index); EN 50849 (Sound Systems for Emergency Purposes). All active components shall be third-party certified to EN 54.

PART 2 — PRODUCTS

2.1 CENTRAL RACK

19-inch rack with redundant amplifiers (N+1) Class-D, digital message store (minimum 16 messages of up to 90 seconds each), routine paging microphone with zone selection, fire-brigade microphone with priority override (red, hinged-cover, lockable), end-of-line monitoring of every loudspeaker circuit per EN 54-16, A and B paths with line-fault diagnosis, integral 24 V DC back-up battery for 30 minutes of full-alarm load after 24 hours quiescent supervision.

2.2 LOUDSPEAKERS

Ceiling and wall-mounted loudspeakers as appropriate, all EN 54-24 certified, 100 V line, with ceramic thermal fuses providing line-integrity preservation under fire conditions. Loudspeakers in ARFF apparatus bays shall be IP65 horn type with a sound power level adequate to override running vehicle noise.

2.3 ZONING

Minimum zoning: ATCT ground / mezzanine / first floor; ATC cab; ECR/OCR; ARFF apparatus bay; ARFF ancillary areas; OCC; multipurpose hall; external announcement (apron and access road). Each zone individually addressable from the routine microphone and overridable by the fire-brigade microphone.

PART 3 — EXECUTION

3.1 INSTALLATION AND COMMISSIONING

Sound pressure level at 1.0 m above floor: minimum 65 dB(A) in occupied office spaces, minimum 75 dB(A) in plant rooms and vehicle bays, with a Speech Transmission Index (STI) of not less than 0.50 measured per IEC 60268-16. Commissioning shall include audibility and STI measurement at one sample point per 50 m² of occupied area; results documented and signed off by the Engineer.

SECTION 0790 — ACCESS CONTROL SYSTEM

PART 1 — GENERAL

1.1 SCOPE

An electronic Access Control System for the ATC Tower, the Fire Station and the Utility Building, providing access regulation, audit trail, anti-passback, and integration with the Fire Alarm and BMS systems. The system shall cover all external doors, all rooms designated security-controlled on the architectural drawings (ATC cab, ECR, OCC, OCR, server room, ARFF bays, archive, fuel store), and the gates of the airside compound.

1.2 STANDARDS

EN 60839-11-1 (Electronic Access Control Systems); UL 294 (Access Control System Units); ISO/IEC 14443 (Contactless Identification Cards); ASF and CAA-Pakistan requirements for airport access control.

PART 2 — PRODUCTS

2.1 READERS

Multi-class proximity readers (ISO/IEC 14443A/B + MIFARE Plus or DESFire EV2), with optional biometric (fingerprint or palm-vein) for highest-security doors (ATC cab, ECR, server room, fuel store). All readers IP65 for external use, operating range –20 °C to +60 °C, vandal-resistant polycarbonate housing, integral LED and beeper, anti-tamper switch.

2.2 CONTROLLERS

Distributed IP controllers, each supporting up to 8 doors with local decision-making and 50,000-event offline buffer; communication to head-end over the structured cabling network (Section 0650), with encrypted protocol; battery back-up of 4 hours minimum.

2.3 ELECTRIC LOCKS

Fail-safe electric strikes or electromagnetic locks on all egress doors (so that loss of power releases the door). Fail-secure locks permitted only on secure storerooms with manual key override. All electromagnetic locks rated 600 lbf minimum, with bond sensor and door-position sensor.

2.4 HEAD-END SOFTWARE

Server-based management software with role-based administration, audit trail with 365-day retention, anti-passback, time-zone scheduling, photo-ID badging, and integration interface to the FACP (automatic release of all locks on FACP general alarm, with override on fire-brigade input only), to the CCTV (camera call-up on alarm), and to the BMS for status display.

SECTION 0800 — MATV / IPTV SYSTEM

PART 1 — GENERAL

1.1 SCOPE

A combined Master Antenna Television (MATV) and IPTV system for the distribution of free-to-air and licensed television channels, plus internal channels (ATC operational displays, CCTV viewing, airport public-information channel), to TV outlet points in the dormitories, common areas, cafeteria, OCC, ARFF rest areas and ATC briefing areas indicated on the electrical drawings.

PART 2 — PRODUCTS

2.1 HEAD-END

Satellite head-end with prime-focus dish (1.2 m minimum), LNB, multi-input receiver, IRD, IP/RF transcoder for IPTV streaming over the structured cabling network. Free-to-air channels and licensed channels as agreed with PAA. Head-end rack mounted in the ECR with conditioned power from the UPS board.

2.2 DISTRIBUTION

Co-axial RG-11 trunk, RG-6 drops; or, where IPTV is adopted exclusively, distribution over Cat 6A to set-top boxes at each TV outlet. Outlets located on the architectural drawings (Drawings E-01 through E-67 as applicable). Output level at TV outlet: 60 ± 5 dBµV for analogue, BER ≤ 1×10^{-9} for IPTV.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0810 — MASTER CLOCK SYSTEM

PART 1 — GENERAL

1.1 SCOPE

A precision master-clock system distributing a common, traceable time reference to all systems on the project that require a synchronised time-stamp: the Air Traffic Control consoles, the CNS voice recorders (DVLS), the Remote Control and Monitoring System (RCMS), the CCTV, the Fire Alarm Control Panel, the Access Control System, and the BMS.

1.2 STANDARDS

ICAO Annex 11 (UTC for ATC); IEEE 1588 (Precision Time Protocol); RFC 5905 (NTP v4); ITU-T G.811 / G.812 (clock accuracy). Time reference UTC.

PART 2 — PRODUCTS

2.1 MASTER CLOCK

GPS-disciplined master clock with internal Rubidium or OCXO holdover oscillator providing accuracy better than 1×10^{-12} over 24 hours of GPS loss; outputs: NTP server (dual Ethernet ports), PTP master (IEEE 1588v2), IRIG-B (coded analogue), and dry contact 1 pulse per second. GPS antenna roof-mounted with lightning arrestor and surge suppressor. Dual master-clock units in hot-standby (Master + Backup) with automatic failover.

2.2 SLAVE CLOCKS

Digital slave clocks in all operational rooms (ATC cab, ECR, OCR, OCC, ARFF watch-room, ARFF apparatus bay, multipurpose hall) and analogue slave clocks in administrative offices, all synchronised over NTP/PoE. Display: 6-digit (hh:mm:ss) for operational rooms, 4-digit (hh:mm) for administrative.

PART 3 — EXECUTION

3.1 DISTRIBUTION

All time-stamping systems on the project shall be configured to take their time reference from the master clock NTP server. The Contractor shall produce a Time Distribution Schedule listing every device, its IP address and its NTP polling interval. Time-stamp consistency between FACP, DVLS, CCTV, Access Control and BMS shall be verified during commissioning by injecting a simulated event into the FACP and checking that the timestamps recorded on the other systems are within ± 100 ms of each other.

EPADS

SECTION 0820 — AUTOMATIC FIRE DETECTION SYSTEM (AFDS)

PART 1 — GENERAL

1.1 SCOPE

An Aerodrome Fire Detection System providing automatic detection of fire along both runway ends, as required by the Terms of Reference. The system shall annunciate at the ATC cab, the ARFF watch-room and the BMS, and shall be integrated with the building Fire Alarm Control Panel (Section 0660).

1.2 STANDARDS

ICAO Doc 9137 Part 1 (Rescue and Fire Fighting); NFPA 415 (Aircraft Fuel Servicing and ARFF Building); EN 54-22 (Linear Heat Detectors); EN 54-26 (Carbon Monoxide Detectors); UL/FM listed video flame and smoke detection.

PART 2 — PRODUCTS

2.1 DETECTION TECHNOLOGIES

The AFDS shall employ a combination of the following, as agreed in the technical bid evaluation: (a) Linear Heat Detection cable (analogue addressable) along the runway shoulder cable trench; (b) UV/IR video flame detectors at the runway end safety areas (RESA), with cone of vision covering the threshold and the first 300 m of runway; (c) Aspirated smoke detection in the ARFF apparatus bay and in any aviation fuel storage area within the project; (d) Hydrocarbon vapour detection at any fuel handling area. All field devices shall operate over the temperature range –40 °C to +75 °C and shall be sealed to IP67.

2.2 CONTROL PANEL

Dedicated AFDS control panel in the ARFF watch-room with mimic display of the airfield layout, annunciation of every detection zone, dry contacts to the building FACP for cross-alarm, and a network interface to the ATC cab for visual and audible alert. Power supply from emergency board with battery back-up to maintain operation for at least 24 hours of mains failure.

PART 3 — EXECUTION

3.1 FIELD INSTALLATION

Linear heat detection cable installed in HDPE conduit in the cable trench along the runway shoulder, at depth and offset agreed with the Aerodrome Operator. Junction boxes flush with grade and frangible per Section 00750 §2.4. Video flame detectors on frangible masts of height not exceeding 3 m, located outside the OFZ.

3.2 TESTING

Functional test by controlled application of a calibrated heat source to the linear cable and a calibrated flame source within the video field of view. All annunciation paths (AFDS panel → FACP → ATC cab → ARFF watch-room) shall be verified. Tests shall be repeated by the Aerodrome Operator during the Reliability Trial.

SECTION 0830 — ARFF VEHICLE EXHAUST VENTILATION

PART 1 — GENERAL

1.1 SCOPE

Dedicated vehicle-exhaust ventilation for the ARFF apparatus bay, designed and installed entirely independent of the comfort HVAC and smoke-control systems, in accordance with the HVAC Basis of Design. The system shall capture diesel exhaust gases at the tail-pipe of stationary or starting vehicles, and shall provide general dilution ventilation during routine operations.

1.2 STANDARDS

ACGIH “Industrial Ventilation” Manual; NFPA 88B / NFPA 30A (where applicable); ASHRAE 62.1 for dilution component; OSHA 1910.146; AMCA 99/210/300 for fans.

PART 2 — PRODUCTS

2.1 SOURCE CAPTURE

Tail-pipe capture system with reel-mounted high-temperature flexible hose (rated 250 °C continuous, 600 °C peak), tail-pipe adaptor sized for the ARFF vehicle exhaust diameter, automatic disconnect with vehicle motion, manual reel for retraction. One source-capture point per vehicle bay, mounted on the bay structure clear of the door opening sweep.

2.2 DILUTION VENTILATION

General dilution ventilation rate not less than 6 air changes per hour (ACH) under normal operation, increasing to 12 ACH on demand from CO/NO_2 sensors, by a step-controlled or VFD-controlled exhaust fan installation. The fan installation shall be N+1 with one duty and one standby fan; both fans wired to the emergency board.

2.3 MONITORING

Carbon monoxide sensors (alarm at 25 ppm 8-hour TWA), nitrogen dioxide sensors (alarm at 3 ppm), and combustible gas sensors (alarm at 10% LEL diesel vapour), all wired to a dedicated annunciator in the ARFF watch-room and to the BMS.

2.4 DISCHARGE

Exhaust discharge location coordinated with the Aerodrome Operator: located clear of the ATC cabin visual cone (no plume across the controllers’ line of sight) and separated by not less than 10 m from any fresh-air intake per ASHRAE 62.1.

SECTION 0840 — SMOKE MANAGEMENT

PART 1 — GENERAL

1.1 SCOPE

Smoke-management systems comprising (a) staircase pressurisation of the tower stair core, (b) smoke exhaust of the multipurpose hall and any atrium / double-height space identified on the architectural drawings, and (c) automatic shut-down of comfort HVAC and DOAS on Fire Alarm general signal.

1.2 STANDARDS

NFPA 92 (Standard for Smoke Control Systems); NFPA 92A (Smoke Control Systems for Stair-tower Pressurisation); BS EN 12101-6 (Pressure Differential Systems); ASHRAE Smoke Control Design Guide.

PART 2 — PRODUCTS

2.1 STAIR PRESSURISATION

Dedicated fan supplying air to the tower stair core to maintain a positive pressure of 50 Pa (± 12.5 Pa) relative to adjacent spaces with the stair door open at the discharge floor and a 0.83 m² vent open on the fire floor. Fan shall be located at the top of the stair shaft, duty/standby configuration not required by code but a single fan of robust class is acceptable; VFD modulating the fan speed against pressure sensors at three levels. Supply from emergency generator board.

2.2 SMOKE EXHAUST

Where the multipurpose hall or any other space exceeds the area or height thresholds of NFPA 92, a smoke-exhaust system shall be provided with a calculated exhaust rate to maintain the smoke layer 1.8 m above the highest occupied floor. Make-up air through automatic dampers or doors. Fan: 250 °C / 2-hour rated; supply from emergency generator board.

2.3 HVAC SHUT-DOWN ON FIRE

All AHUs, FCUs and DOAS shall be hard-wired to shut down automatically on general fire-alarm signal from the FACP. Fire-rated dampers shall close automatically at every penetration of a fire-rated barrier.

PART 3 — EXECUTION

3.1 COMMISSIONING

Stair pressurisation: door-open and door-closed tests at every floor with pressure-difference measurement at three points; fan-failure test verifying alarm. Smoke exhaust: hot-smoke test (or full-scale smoke test) witnessed by the Engineer and by the Aerodrome Operator. All HVAC shut-down interlocks tested by injection of a simulated fire signal at the FACP.

SECTION 0850 — GLYCOL FREEZE-PROTECTION PACKAGE

PART 1 — GENERAL

1.1 SCOPE

Freeze protection of the chilled-water and condenser-water hydronic loops at Skardu International Airport, where the winter design temperature is –18 °C and the equipment qualification envelope reaches –25 °C. Without active freeze protection these loops will rupture during the first winter shut-down. The Section covers the glycol fluid, the automatic make-up unit, the immersion heaters in the hydronic loops, the self-regulating heat-tracing on exposed pipework, the expansion provision for glycol volumetric change, and the BMS interface.

1.2 STANDARDS

ASHRAE Handbook — Refrigeration, Chapter 31 (Secondary Coolants); ASTM D1384 (glycol-based corrosion test); ISO 21055 (heat-tracing equipment); IEEE 515.1 (heating cables for industrial applications).

PART 2 — PRODUCTS

2.1 GLYCOL FLUID

USP-grade propylene glycol (not ethylene glycol) mixed with treated water to give a freeze point of –20 °C and a burst point below –40 °C, with a corrosion-inhibitor package compatible with copper, brass, mild steel and stainless steel. Glycol concentration 35–40% by volume.

2.2 MAKE-UP UNIT

Factory-packaged automatic glycol make-up unit comprising: 200-litre minimum storage tank, stainless-steel pump, suction strainer, pressure switch, level switches (low / high / low-low), discharge pressure gauge, integral controller with dry-contact alarm output, and manual fill connection. Make-up to the loop on falling system pressure.

2.3 IMMERSION HEATERS

Electric immersion heaters with Incoloy 800 sheath, mounted in dedicated wells on both the chilled-water and the condenser-water headers in the Utility Building. Heater rating sized to maintain the loop above +2 °C with the chillers off and no fluid movement at the design winter ambient. Thermostatic control at +5 °C, with a separate high-limit cut-out at +15 °C and a low-temperature alarm at 0 °C wired to the BMS.

2.4 PIPE HEAT-TRACING

Self-regulating heat-tracing cable rated 10 W/m at 10 °C, applied to the underside of the pipe insulation on all hydronic, water-supply, drainage and condensate pipework exposed to ambient temperatures below +4 °C. Cable temperature controlled by ambient or pipe thermostat set at +5 °C with a high-limit at +35 °C, supplied from the emergency generator board through a dedicated panel.

2.5 EXPANSION AND VENTING

Closed expansion tank, bladder type, sized for the additional volumetric expansion of the glycol mix over the full operating temperature range. Air separator and automatic air vent at every high point of the system.

2.6 BMS INTERFACE

Alarms reporting to the BMS: glycol concentration low (refractometer or alternative), loop low-temperature at any sensor, immersion-heater failure, heat-trace circuit continuity loss, make-up running for excessive time (leak indication).

PART 3 — EXECUTION

3.1 COMMISSIONING

The glycol mix shall be tested by refractometer before and after charging; results shall be recorded for each circuit. Heat-trace continuity shall be tested before insulation is applied. Immersion heaters shall be functionally tested by simulating loop low-temperature. The expansion tank pre-charge shall be verified before commissioning.

3.2 DEFECT-LIABILITY MAINTENANCE

The Contractor shall check glycol concentration and inhibitor reserve at six-monthly intervals during the Defect Liability Period and shall top-up or replace the fluid as required, at his own cost. Records shall be furnished to the Engineer.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0860 — PRECISION COOLING FOR ATC EQUIPMENT AND DATA-CENTRE SPACES

PART 1 — GENERAL

1.1 SCOPE

Dedicated precision cooling (CRAC / CRAH) of the ATC Equipment Room, the Communication Operations Room (OCR), the Data-Centre / IDF Rooms and any other mission-critical, continuously-occupied equipment space identified on the architectural and HVAC drawings. The systems shall operate independently of the building occupancy schedule, 24 hours per day, every day, and shall be supported by emergency power and UPS for controls and alarms.

1.2 STANDARDS

ASHRAE TC 9.9 “Thermal Guidelines for Data Processing Environments”; AHRI 1361 (Computer Room Air Conditioners); EN 14511 (Performance ratings); EN 60204-1 (electrical safety).

PART 2 — PRODUCTS

2.1 UNIT TYPE

Chilled-water-cooled CRAH units, with internal DX backup coil where indicated on drawings, 20 kW to 80 kW per unit per the cooling load calculation. Units configured for in-row, perimeter or under-floor delivery as shown on the drawings; hot-aisle / cold-aisle containment in the Data Centre. Set-point: 22 ± 1 °C, 45–55 % RH.

2.2 REDUNDANCY

N+1 per cooling sub-system. The failure of any one unit shall not result in a temperature excursion outside the ASHRAE TC 9.9 “Allowable” envelope for the equipment class concerned.

2.3 MONITORING

Each unit shall be fitted with: condensate pump (with high-level alarm); under-floor or in-cabinet leak-detection cable; supply, return and rack-inlet temperature sensors; humidity sensors; airflow proving switch; filter dirty switch; refrigerant leak detector (where DX backup fitted). All alarms wired to the BMS and to the RCMS of Section 0740.

2.4 POWER

Each precision cooling unit shall be supplied from a dedicated MCB on the emergency-generator board. Control transformers and alarm circuits shall be on UPS supply to ensure that alarm and monitoring continue through the generator transfer.

PART 3 — EXECUTION

3.1 COMMISSIONING

Functional test of each unit, redundancy test by simulated failure of the lead unit (the standby unit shall take over within 30 seconds without the rack-inlet temperature rising above 27 °C), alarm path test for every monitored point. Twenty-four-hour soak test under simulated heat load (load bank) verifying temperature and humidity stability.

SECTION 0870 — SOLAR PHOTOVOLTAIC (PV) SYSTEM

PART 1 — GENERAL

1.1 SCOPE OF WORK

This Section covers the complete design, supply, installation, testing, commissioning, and integration of a Grid-Tied Solar Photovoltaic (PV) System with Battery Energy Storage System (BESS) for the Air Traffic Control Tower (ATCT), Fire Station, and Allied Facilities at Skardu International Airport. The system shall supplement utility (WAPDA) power and provide reliable backup power for critical loads including ATCT operational equipment, emergency lighting, and fire station functions. The BOQ requirement is 250 kWp with 10-hour backup (BOQ Item 14.01).

The work shall include, but shall not be limited to, the following:

- Solar PV array: monocrystalline silicon modules on purpose-built galvanized steel mounting structures
- Hybrid grid-tied inverters with MPPT and anti-islanding protection
- Battery Energy Storage System (BESS) — Lithium Iron Phosphate (LiFePO4) technology
- DC and AC distribution boards, wiring, and protection devices
- Surge protection devices (SPDs) for DC and AC sides
- Earthing and lightning protection dedicated to the PV system
- Remote monitoring and supervisory control system with data logging
- Integration with the Building Management System (BMS) per Section 0880 of this document
- As-built drawings, O&M manuals, and operator training

1.2 REFERENCE STANDARDS

Standard / Code	Scope of Application
IEC 61215	Crystalline Silicon Terrestrial PV Modules — Design Qualification and Type Approval
IEC 61730	PV Module Safety Qualification
IEC 62109-1/2	Safety of Power Converters for Use in PV Power Systems
IEC 60364-7-712	Electrical Installations — Solar Photovoltaic Systems
IEC 62548	PV Array Design Requirements
IEC 62116	Test Procedure for Grid-Connected Inverter Anti-Islanding Protection
IEC 62619	Safety Requirements for Secondary Lithium Cells and Batteries (BESS)
IEC 61643-11/31	Surge Protective Devices — AC and DC sides
BS 7671	IET Wiring Regulations — Requirements for Electrical Installations
IEEE 1547	Standard for Interconnection of Distributed Energy Resources
ICAO Annex 14	Aerodrome Design and Operations — Electrical Supply Provisions
NEPRA Net Metering Rules 2015	WAPDA Grid Connection and Net Metering Regulations (with amendments)
Pakistan Electricity Rules 1937	As adopted and modified by Government of Pakistan

Standard / Code	Scope of Application
BCP	Building Code of Pakistan

1.3 CLIMATIC AND SITE CONDITIONS

All PV system equipment shall be designed and rated to operate reliably under the following Skardu site conditions without developing any defect or reduction in performance:

Parameter	Design Value
Maximum Ambient Temperature	41°C (105°F)
Minimum Ambient Temperature	-20°C (-04°F)
Maximum Relative Humidity	90% — Non-condensing
Altitude above MSL	Approximately 2,228 m (7,310 ft) — altitude de-rating to be confirmed
Seismic Zone	Zone 4 (High Seismicity) — BCP-SP-07 compliance mandatory for mounting structures
Design Wind Speed (Gust)	150 km/h — IBC / ASCE 7 or BCP-SP-07 for structural mounting design
Snow Load	Minimum 1.5 kN/m² — panels tilted ≥ 10° to allow snow shedding
Peak Sun Hours (PSH)	Minimum 5.5 PSH/day (annual average) — PVsyst simulation required
Solar Irradiance (GHI)	Minimum 5.0 kWh/m²/day (design basis)

1.4 SYSTEM PERFORMANCE REQUIREMENTS

The Solar PV system shall be designed to meet the following minimum performance requirements. The BOQ mandates 250 kWp installed capacity with 10-hour battery backup; the contractor shall confirm sizing through a formal load analysis and energy yield simulation (PVsyst or equivalent):

Parameter	Minimum Requirement
Installed PV Capacity	250 kWp minimum (BOQ Item 14.01) — exact number of modules per detailed design
System Configuration	Hybrid grid-tied with Battery Energy Storage — synchronised with WAPDA and generator
Battery Backup Duration	Minimum 10 hours for critical loads (BOQ requirement); at 50% DoD
System Efficiency (Overall)	≥ 83% — PV module DC output to AC bus
Performance Ratio (PR)	≥ 0.78 at Standard Test Conditions (STC)
Voltage THD at AC Output	≤ 3% at rated output
Current THD at AC Output	≤ 5% at rated output
Anti-Islanding Response Time	≤ 2 seconds per IEC 62116

Parameter	Minimum Requirement
Design Life — PV Modules	Minimum 25 years
Design Life — BESS	Minimum 10 years / 4,000 cycles
Monitoring Data Granularity	15-minute interval data logging; 5-minute resolution for alarm events

1.5 SUBMITTALS

The Contractor shall submit the following for the Engineer's written approval prior to commencing procurement or installation. All submittals in triplicate hard copy and electronic format:

- System design report: load analysis, PV array sizing, shading analysis, energy yield simulation (PVsyst), BESS sizing for 10-hour backup
- Complete equipment data sheets and manufacturer's technical brochures for all major items
- Structural design calculations for PV mounting systems — signed and stamped by a registered structural engineer
- Electrical design drawings: single-line diagram, array layout, conduit routing, earthing scheme
- Shop drawings for all installations; load balancing chart for solar AC distribution board
- Factory test certificates for PV modules, inverters, and BESS
- Proposed commissioning and testing procedures
- Operation and Maintenance (O&M) manuals in English and Urdu
- Operator training program outline

1.6 QUALITY ASSURANCE

Installer Qualifications: The PV system installation shall be performed by a firm with a minimum of five (5) years' experience in commercial or industrial PV system installation. The installation team shall include at least one engineer holding a recognised PV system design certification (PVTEC, TÜV, or equivalent).

Manufacturer Qualifications: All major equipment manufacturers shall hold ISO 9001 certification. PV module manufacturers shall additionally hold IEC 61215 and IEC 61730 type-test certifications.

1.7 GUARANTEE AND WARRANTY

Item	Warranty Requirement
PV Module — Power Output Warranty	≥ 90% of rated power at Year 10; ≥ 80% of rated power at Year 25
PV Module — Product Warranty	Minimum 12 years against manufacturing defects
Inverter Warranty	Minimum 5 years; extendable to 10 years preferred
Battery Energy Storage System (BESS)	Minimum 10 years or 4,000 full cycles at 80% capacity retention — whichever is first
Mounting Structure — Structural Integrity	25 years against structural failure
Mounting Structure — Galvanising	10 years hot-dip galvanising integrity
Overall System Workmanship	12 months from issue of Completion Certificate per Contract Conditions

PART 2 — PRODUCTS

2.1 PV MODULES

PV modules shall be monocrystalline PERC (Passivated Emitter and Rear Cell) or HJT (Heterojunction) type, new and unused, meeting the following minimum specifications at STC (1,000 W/m², AM 1.5, 25°C):

Parameter	Specification
Cell Technology	Monocrystalline PERC or HJT (Heterojunction) — bifacial permitted if yields better performance
Nominal Peak Power (Pmax)	≥ 450 Wp per module at STC; tolerance 0/+5%
Module Efficiency	≥ 20.5% at STC
Open Circuit Voltage (Voc)	≥ 49 V
Short Circuit Current (Isc)	≥ 11.5 A
Maximum Power Point Voltage (Vmp)	≥ 41 V
Maximum Power Point Current (Imp)	≥ 11.0 A
Temperature Coefficient — Pmax	≤ -0.35% / °C
Temperature Coefficient — Voc	≤ -0.28% / °C
NOCT (Nominal Operating Cell Temp.)	≤ 45°C ± 2°C
Junction Box IP Rating	IP68
Mechanical Load Resistance	≥ 5,400 Pa front load / 2,400 Pa rear load per IEC 62773
Frame Material	Anodised aluminium alloy; ≥ 40 mm frame height
Front Glass	High-transmission tempered solar glass ≥ 3.2 mm; anti-reflective coating
Back-Sheet / Rear	Fluoropolymer composite or glass (for bifacial)
Connector Type	MC4 or compatible IP67-rated
Certification	IEC 61215, IEC 61730, MCS or equivalent, ISO 9001
Acceptable Manufacturers	Jinko Solar, LONGi, Trina Solar, Canadian Solar, or approved equivalent

2.2 PV MOUNTING STRUCTURES

Mounting structures shall be designed specifically for the roof/ground conditions at Skardu Airport and shall accommodate the seismic zone, wind, and snow loading requirements of Clause 1.3. Structural design calculations signed by a registered structural engineer are mandatory before fabrication.

Parameter	Specification
Material	Hot-dip galvanised structural steel (minimum 85 µm zinc coating) or Aluminium alloy 6005A-T5

Parameter	Specification
Tilt Angle	Fixed — optimised for Skardu latitude (~35°N); exact angle per PVsyst simulation
Azimuth	South-facing (180° ± 5°)
Inter-Row Spacing	Calculated to avoid shading at winter solstice (sun elevation angle < 20°)
Foundation Type	Reinforced concrete footings for ground mount; ballasted or anchor-bolted for flat roofs — per structural design
Wind Load Design	150 km/h design gust — IBC / ASCE 7 or BCP-SP-07
Snow Load Design	1.5 kN/m² minimum; panels tilted ≥ 10° for self-clearing
Seismic Design	Zone 4 per BCP-SP-07; base shear and connection forces per structural calculations
Corrosion Protection	All fasteners and hardware: stainless steel 304/316 SS; dissimilar metal contacts isolated with neoprene or PTFE pads
Cable Management	Integrated cable clips, conduit channels, and pull-out access points in mounting rails
Aesthetic	Uniform finished appearance; no exposed raw cut edges; all cable runs concealed
Structural Warranty	25 years against structural failure; 10 years hot-dip galvanising

2.3 GRID-TIED / HYBRID INVERTERS

Inverters shall be string type or central type as determined by the system design, and shall support both grid-connected and battery-storage (hybrid) operation:

Parameter	Specification
Inverter Type	Three-phase grid-tied / hybrid string inverter with independent MPPT trackers
AC Output Voltage	415 V, 3-Phase, 4-Wire, 50 Hz (±2%)
MPPT Voltage Range	200 V – 800 V DC (minimum operating window)
Maximum DC Input Voltage	1,000 V DC (IEC standard) or 1,500 V DC as per detailed design
Maximum DC Input Current per MPPT	Per detailed string design — typically ≥ 12.5 A
European Weighted Efficiency (ηEU)	≥ 97%
CEC / California Weighted Efficiency	≥ 97%
Power Factor Range	Adjustable 0.8 leading to 0.8 lagging; unity at full rated load
Isolation Method	Transformer-isolated or transformerless with ground fault monitoring — as per design

Parameter	Specification
Protection Features	Anti-islanding (IEC 62116), over/under voltage, over/under frequency, DC overvoltage, DC reverse polarity, short circuit, earth fault, PV insulation monitoring
Display / HMI	Colour LCD with real-time energy production, battery SoC, grid status
Communication Interfaces	RS485 Modbus RTU; Ethernet Modbus TCP/IP; CAN Bus (for BESS); optional Wi-Fi
Enclosure Rating	IP65 minimum — rated for outdoor installation
Operating Temperature Range	-25°C to +50°C
Altitude De-rating	Rated performance up to 2,000 m; de-rating calculation submitted for Skardu (2,228 m)
Standards / Certification	IEC 62109-1/2, IEC 62116, CE, VDE-AR-N 4105
Acceptable Manufacturers	SMA, Fronius, ABB/FIMER, Huawei, Sungrow, or approved equivalent
Inverter Warranty	Minimum 5 years from Completion Certificate; extendable to 10 years (preferred)

2.4 BATTERY ENERGY STORAGE SYSTEM (BESS)

The BESS shall provide a minimum 10 hours of backup at rated critical load (BOQ Item 14.01). Chemistry shall be Lithium Iron Phosphate (LiFePO4) for inherent thermal stability and safety:

Parameter	Specification
Battery Chemistry	Lithium Iron Phosphate (LiFePO4) — inherently thermally stable; non-toxic; non-flammable electrolyte
Total Usable Energy Capacity	Sized per detailed load analysis for 10-hour critical load backup — minimum 200 kWh usable at project BOQ scale; exact capacity per design
Depth of Discharge (DoD)	Maximum 80% for daily cycling; minimum SoC maintained at 20% for cell protection
Round-Trip Efficiency (RTE)	≥ 95% at standard conditions
Cycle Life	≥ 4,000 full discharge cycles at 80% depth while retaining ≥ 80% rated capacity
Battery Management System (BMS)	Integrated; cell-level voltage, temperature, and SoC monitoring; automatic cell balancing; overcharge, over-discharge, over-temperature, short-circuit protection
Communications	CAN Bus (internal); RS485 Modbus RTU; optional Ethernet (Modbus TCP/IP) to BMS/inverter
Operating Temperature — Charging	-15°C to +45°C

Parameter	Specification
Operating Temperature — Discharging	-20°C to +55°C
Storage Temperature	-20°C to +50°C
Enclosure Rating	IP55 minimum; metal cabinet construction
Fire Safety Compliance	Thermal management with active cooling; integrated smoke and temperature sensors; NFPA 855 compliant installation room
Installation Requirements	Dedicated, well-ventilated room; minimum 0.9 m maintenance clearance; NFPA 855 safety signage
Certification	IEC 62619 (safety), UN 38.3 (transport testing), UL 9540A (fire safety)
Acceptable Manufacturers	CATL, BYD, Pylontech, Sungrow (SBR series), or approved equivalent
BESS Warranty	Minimum 10 years or 4,000 cycles at 80% capacity retention — whichever first

2.5 DC DISTRIBUTION AND PROTECTION

Component	Specification
DC String Combiner Boxes	IP65 rated; individual string-level fusing (per IEC 60269-6); string monitoring (current and voltage); MC4-compatible cable entries; surge protection included
DC Surge Protection Devices (SPDs)	Type 2 SPDs on positive and negative conductors per IEC 61643-31; Class II transient voltage protection; replaceable modules
DC Disconnect Switches	Lockable load-break isolating switches; rated for DC operating voltage of the array; one per inverter/array segment
DC Circuit Breakers	IEC 60947-3 rated for DC service; appropriate voltage class; UV-stabilised enclosure where roof-mounted
DC Cable	UV-resistant, halogen-free, single-core PV cable; TÜV 2 Pfg 1169 certified; minimum 4 mm² or as designed; rated at 1,500 V DC
Cable Routing	Positive and negative conductors in same conduit run — minimum 25 mm UV-resistant PVC conduit; separate from AC conduit system
Connectors	MC4 or compatible IP67-rated field-installable connectors; no un-insulated connections permitted anywhere in DC system

2.6 AC DISTRIBUTION AND PROTECTION

Component	Specification
AC Main Disconnect / MCCB	MCCB rated per detailed design; 415 V, 3-phase; integrated with Main LT Switchboard per Electrical Design Report Section 9
AC Distribution Board (Solar DB)	As per Electrical Design Report Section 11; separate dedicated solar AC DB

Component	Specification
AC Cables	PVC/XLPE insulated copper conductor per Electrical Design Report Section 3 and BOQ (25 mm² as specified in Item 14.01)
AC Surge Protection Devices (SPDs)	Type 1+2 combined SPD at main DB per IEC 61643-11; Class I + II combined protection
Earth Leakage Protection	RCCB/ELCB as per Electrical Design Report Section 11; sensitivity as designed
Grid Synchronisation	Auto-synchronisation with WAPDA supply; load sharing panel per BOQ Item 14.01

2.7 MONITORING AND SUPERVISORY CONTROL SYSTEM

A comprehensive monitoring, data acquisition, and remote supervisory control system shall be provided as an integral part of the PV system:

- Central data logger with local colour display; minimum 1-year on-board data storage at 15-minute resolution
- Revenue-grade energy meters on AC output: Class 0.5 per IEC 62053; Modbus RTU communication
- String-level DC current and voltage monitoring via combiner boxes — all strings individually monitored
- Ambient temperature sensor and pyranometer (Class A preferred per ISO 9060) for irradiance measurement
- Module temperature sensors: minimum one Pt100 sensor per PV array string group
- BESS data integration: state of charge (SoC), cell voltages, temperatures, cycle count, alarms — via CAN/Modbus
- Web-based remote monitoring portal with email and SMS alarm notifications; access via secure HTTPS
- Modbus TCP/IP communication protocol for BMS integration per Section 0880 of this document
- Real-time dashboard and historical data: daily/monthly/annual energy production, self-consumption, export/import
- Performance ratio (PR) and specific yield reporting; automated monthly energy report generation

PART 3 — EXECUTION

3.1 INSTALLATION

All installation shall comply with the requirements of Section 1 (General) of the Electrical Design Report — including prequalification, rules and regulations, climatic conditions, and submittal requirements — which are incorporated herein by reference. The following additional requirements apply:

Site Assessment and Preparation

- Prior to installation, the Contractor shall conduct a site survey and verify roof/ground structural load capacity for PV mounting. Written sign-off from a registered structural engineer is required before any mounting work commences.
- Shading analysis shall be performed using a solar path analyser at the proposed installation location to confirm no significant shading during the peak generation months.

PV Module Handling and Installation

- Modules shall be handled strictly per manufacturer guidelines at all times. Walking on, standing on, or placing heavy objects on modules is strictly prohibited.
- Temporary protective covers shall protect installed modules from construction dust and debris until final commissioning.
- All module frames shall be bonded to the mounting structure earthing system using stainless steel earthing clips and copper wire per IEC 60364-7-712.

Conduit and Cable Management

- DC wiring shall be installed in separate conduit from AC wiring throughout the entire system — no shared conduit runs between DC and AC circuits.
- Minimum conduit size for PV DC wiring: 25 mm UV-resistant PVC conduit for all exposed outdoor runs.
- All outdoor conduit entry points into junction boxes and combiner boxes shall be sealed with waterproof compound to prevent moisture ingress.
- Cable dressing in mounting rails shall be neat, supported at maximum 400 mm intervals, and free from abrasion points.

BESS Installation

- BESS cabinets shall be installed in a dedicated, well-ventilated room with forced exhaust ventilation; room shall have appropriate fire detection and suppression.
- Minimum 0.9 m clearance shall be maintained on all service-access sides of BESS cabinets.
- BESS room signage per NFPA 855: 'ENERGY STORAGE SYSTEM — LITHIUM ION BATTERIES' and emergency contact information.
- BESS cabinets shall be seismically restrained per Zone 4 BCP-SP-07 requirements.

Earthing and Bonding

- Complete equipotential bonding of all metallic components — module frames, mounting structures, inverter enclosures, BESS cabinets — per IEC 60364-7-712, BS 7430, and Electrical Design Report Section 16.
- A separate dedicated earth electrode shall be provided for the PV system unless combined earthing is specifically approved in writing by the Engineer.

Labeling

- All DC cables, AC cables, combiner boxes, inverters, disconnects, and BESS cabinets shall be permanently labeled with durable, UV-resistant engraved or embossed nameplates.
- DC positive and negative conductors shall have colour coding or permanent ferrule labels throughout their length.
- Warning labels: 'DUAL SOURCE — DISCONNECT BOTH INVERTER AND GRID BEFORE WORKING' at all relevant points.

3.2 TESTING AND COMMISSIONING

Prior to energisation, the Contractor shall perform and document the following tests in the presence of the Engineer:

Test	Acceptance Criterion / Method
Insulation Resistance — DC Cables	Minimum 500 V DC Megger; IR ≥ 10 MΩ on each string before connection to inverter
Insulation Resistance — AC Cables	500 V AC Megger; IR ≥ 5 MΩ per Electrical Design Report Section 17

Test	Acceptance Criterion / Method
Array Voc Verification	Measured open-circuit voltage per string compared against calculated value at measured cell temperature; accept within ±2%
Array Isc Verification	Short-circuit current per string compared against calculated value; accept within ±5%
Earth Continuity	All bonded metallic components: ≤ 1 Ω per Electrical Design Report Section 17
Anti-Islanding Function Test	Disconnect grid supply and verify all inverters shut down within 2 seconds per IEC 62116
BESS Charge/Discharge Cycle Test	Verify correct operation at 20%, 50%, and 80% DoD; verify BMS alarms function at set points
Grid Synchronisation Test	Verify auto-synchronisation with WAPDA supply; confirm load sharing panel operation
Monitoring System Validation	Verify all data points (string, inverter, BESS, weather) displayed correctly; trigger alarms and verify notifications
Power Quality Measurement	Measure voltage THD, current THD, power factor, and frequency at AC output during normal operation
Performance Ratio (PR) Measurement	7-day continuous baseline monitoring period; PR ≥ 0.78 required before final acceptance

3.3 TRAINING

The Contractor shall provide a minimum of two (2) days of comprehensive operator training for the Employer's designated personnel, covering: system operation and monitoring, routine preventive maintenance, fault diagnosis and alarm response, inverter reset procedures, safety procedures (DC arc flash, electrical isolation), monitoring system usage, and emergency shutdown procedures. Training materials shall be provided in both English and Urdu.

3.4 MEASUREMENT AND PAYMENT

The complete solar PV system shall be measured and paid as a lump sum per BOQ Item 14.01, which includes PV modules (250 kWp), mounting structures, hybrid inverter, BESS (10-hour backup), Electrical Synchronising and Load Sharing Panel, 25 mm² AC cables, DC cables, combiner boxes, SPDs, earthing, monitoring system, and commissioning. Civil works for foundations and BESS room are included unless separately itemised in the BOQ.

SECTION 0880 — BUILDING MANAGEMENT SYSTEM (BMS)

PART 1 — GENERAL

1.1 SCOPE OF WORK

This Section covers the complete design, supply, installation, testing, commissioning, and training for a fully integrated Building Management System (BMS), also referred to as Building Automation System (BAS), for the Air Traffic Control Tower (ATCT), Fire Station, and Allied Facilities at Skardu International Airport. The BMS shall provide centralised monitoring, control, alarm management, and data logging for all major building services systems. Refer to BOQ Item 12.01.

The BMS shall integrate the following building services as a minimum:

- HVAC systems — air handling units (AHUs), fan coil units (FCUs), split AC units, ventilation systems, chilled water/DX plant
- Electrical power systems — main LT switchboard, sub-main distribution boards (monitoring only, no control)
- Solar PV and Battery Energy Storage System (BESS) — integration with Section 0870 of this document via Modbus TCP/IP
- Diesel generator sets — status, run hours, fuel level, electrical load, alarms
- Uninterruptible Power Supply (UPS) — status, battery health, input/output voltage, alarms
- Fire detection and alarm system — read-only status integration only (per NFPA/EN 54 system requirements)
- Lighting control system — scheduled switching, daylight harvesting, occupancy-based control
- Water supply and sanitary systems — pump status, tank levels, water meters
- Access control and security system — door status monitoring, alarm zones (read-only integration)
- Energy metering — kWh, kVAR, power factor monitoring per major feeder

1.2 REFERENCE STANDARDS

Standard / Protocol	Application
ASHRAE Guideline 13	Specifying Direct Digital Control (DDC) Systems
ASHRAE 135 (BACnet)	Data Communication Protocol for Building Automation and Control Networks — primary protocol
ISO 16484-2	Building Automation and Control Systems (BACS) — Part 2: Hardware
ISO 16484-5	BACS — Part 5: Data Communication Protocol (BACnet)
IEC 62443	Industrial Communication Networks — Network and System Security (Cybersecurity)
IEC 60364	Electrical Installations of Buildings — wiring of BMS control panels
EN 50090	Home and Building Electronic Systems (HBES)
LONworks / KNX	Open field bus protocols — accepted as alternative to BACnet MS/TP for field devices
Modbus RTU / TCP	Serial and Ethernet data communication — for sub-system integration (meters, UPS, Solar, Generator)

Standard / Protocol	Application
OPC Unified Architecture (OPC-UA)	Process data exchange for higher-level integration
BS 7671	IET Wiring Regulations — Low Voltage Installations — BMS panel wiring

1.3 SYSTEM ARCHITECTURE REQUIREMENTS

The BMS shall be a distributed, open-protocol system based on BACnet/IP (ASHRAE 135) as the primary communication protocol. Proprietary closed systems requiring exclusive service agreements or proprietary-only hardware are NOT acceptable. The architecture shall comprise three tiers:

Tier	Description
Tier 1 — Field Level	Field sensors, actuators, meters, and Local Controllers (DDC/PLCs) communicating via BACnet MS/TP, Modbus RTU, LONworks, or KNX over field buses
Tier 2 — Automation Level	Floor-level or system-level Advanced Application Controllers (AACs) and Application Specific Controllers (ASCs) communicating via BACnet/IP over Ethernet LAN
Tier 3 — Management Level	Central BMS Operator Workstation (OWS) with supervisory control, graphical user interface (GUI), historian database, alarm management, energy reporting, and remote access via secure VPN

1.4 PREQUALIFICATION AND QUALIFICATIONS

The BMS Contractor or Sub-Contractor shall be a recognised system integrator formally authorised by the BMS manufacturer. The following shall be submitted with the tender bid: evidence of manufacturer authorisation, a minimum of five (5) completed BMS projects of comparable scale in commercial or institutional buildings, and the BMS project engineer's BACnet International certification or equivalent recognised credential.

1.5 SUBMITTALS

The Contractor shall submit the following for the Engineer's written approval before commencing any work:

- BMS design report: system architecture, complete points list (minimum 300 I/O points), control strategies narrative, integration interfaces with Solar PV, generators, UPS, fire alarm, and access control
- Complete equipment data sheets: controllers, I/O expansion modules, operator workstation hardware and software
- BACnet/IP network diagram and IP addressing scheme — including VLAN design
- Graphic screen layouts for each major system (minimum draft before installation; final before commissioning)
- Control Sequence of Operations (CSO) document for each HVAC system and controlled sub-system
- Wiring diagrams and control panel layout drawings (submitted before fabrication)
- Factory Acceptance Test (FAT) procedure — to be reviewed and approved by Engineer
- Site Acceptance Test (SAT) procedure and test record forms

- Cybersecurity plan per IEC 62443: network segmentation, access control, patch management

1.6 GUARANTEE AND WARRANTY

Item	Warranty Requirement
BMS Software and Licenses	Minimum 5 years software maintenance and license support; no time-expiring licenses for basic operational functionality
BMS Hardware — Controllers and I/O Modules	Minimum 2 years manufacturer warranty on all hardware components
Operator Workstation Hardware	Minimum 2 years manufacturer warranty
Workmanship	12 months from issue of Completion Certificate per Contract Conditions
Spare Parts Availability	Manufacturer shall guarantee availability of all spare parts for minimum 10 years from date of system installation

PART 2 — PRODUCTS

2.1 BMS CONTROLLERS

2.1.1 Advanced Application Controller (AAC)

AACs shall provide supervisory and coordination functions for each major building system or floor zone:

Parameter	Specification
Processor	32-bit RISC processor; dedicated embedded BMS controller — not a general-purpose PC
Communication Ports	Minimum: 2× Ethernet RJ45 (BACnet/IP), 1× RS485 (BACnet MS/TP or Modbus RTU), 1× USB (local programming / firmware update)
Onboard I/O	As required per detailed design; all I/O fully expandable via I/O expansion modules
Flash Memory	Non-volatile flash ≥ 8 MB for program storage; retains programming on power loss
RAM	≥ 256 MB for runtime operation and data buffering
Real-Time Clock	Hardware RTC with integrated battery backup; NTP synchronisable over Ethernet
Communication Protocols	BACnet/IP (primary mandatory); Modbus TCP/RTU, LONworks, KNX as integration gateways
Enclosure	DIN-rail mounted; NEMA 1 (IP30 minimum) lockable powder-coated steel panel
Power Supply	24 V AC/DC; all critical controllers backed by UPS for minimum 2 hours autonomy
Operating Temperature	0°C to +50°C

Parameter	Specification
Certifications	BACnet Testing Laboratories (BTL) listed — mandatory; CE; UL 916 or equivalent

2.1.2 Application Specific Controller (ASC)

ASCs (e.g., VAV box controllers, FCU controllers, fan coil unit controllers) shall be BTL listed, factory pre-configured, BACnet MS/TP protocol, and physically and electrically interchangeable with other controllers of the same type from the same manufacturer. Manufacturer interoperability declaration (PICS) required.

2.2 INPUT / OUTPUT MODULES

I/O Type	Specification
Analog Inputs (AI)	Input types selectable via software: 0–10 V DC, 4–20 mA, thermistor (10 kΩ NTC/PTC), RTD (Pt100/Pt1000)
Analog Outputs (AO)	0–10 V DC, 4–20 mA; 10-bit minimum resolution; short-circuit protected
Digital Inputs (DI)	Volt-free dry contact (status/alarm); opto-isolated; pulsed input for energy meter pulse output
Digital Outputs (DO)	Relay SPDT output ≥ 5 A at 230 V AC; or solid-state triac output for lighting/fan control
I/O Isolation	Minimum 1,500 V isolation between field circuits and internal logic circuits
Module Protection	Surge protection on all I/O field terminals; short-circuit protection on all output modules
Hot-Swap Capability	I/O modules shall be hot-swappable without power-down of the controller

2.3 OPERATOR WORKSTATION (OWS)

Parameter	Specification
Computer Hardware	Industrial-grade PC or workstation; Intel Core i7 (10th Generation or later); 16 GB DDR4 RAM; 512 GB NVMe SSD; Windows 10/11 Pro (64-bit)
Monitor	Minimum 27" colour LED monitor; 1920 × 1080 resolution; dedicated solely for BMS operation
BMS Software	Fully licensed SCADA/HMI software suite; open-licence models permitted; 5-year annual maintenance and support included
Graphic Screens	Minimum one screen per major system; ATCT floor-by-floor electrical and HVAC overview; airport site plan overview with colour-coded zone status
Alarm Management	Prioritised alarm list with four severity levels (Critical, High, Medium, Low); time-stamped alarm log; email and SMS notification with configurable escalation
Trending and Data Logging	All analog BMS points trended at 15-minute intervals minimum; 2-year on-site compressed archive storage; export to CSV/Excel

Parameter	Specification
Reporting	Automated daily, weekly, and monthly energy consumption and fault reports; export in PDF and Excel formats
Remote Access	Secure VPN-based remote access for Employer's designated staff and factory technical support; role-based access
Cybersecurity	Role-based access control (RBAC); encrypted communications (TLS 1.2 minimum); network segmentation per IEC 62443; audit trail logging
Database Backup	Automatic daily database backup to internal redundant storage; cloud backup optional

2.4 NETWORKING EQUIPMENT

Component	Specification
BMS LAN	Dedicated VLAN logically separated from IT/corporate network on campus switch infrastructure — OR independent Cat6 STP cabling to BMS devices
Network Switches	Industrial-grade managed Ethernet switches; DIN-rail mountable; operating range -40°C to +70°C; PoE+ where required for field devices
Cabling	CAT6 STP (Shielded Twisted Pair) for BMS LAN; minimum performance Category 6 per TIA-568; armoured cable in EMI-prone areas (near transformers, VFDs)
IP Router / Firewall	Dedicated stateful-inspection firewall between BMS network and corporate/IT network; default-deny rule set; IEC 62443-compliant configuration
BMS Conduit	Dedicated separate conduit system from all power wiring; minimum 20 mm PVC conduit per Electrical Design Report Section 2; minimum 150 mm separation from LV power cables

2.5 FIELD INSTRUMENTATION AND SENSORS

All field instruments and sensors shall be compatible with the BMS controller I/O specifications and shall comply with applicable IEC or BS standards. The following types are required as a minimum:

Sensor Type	Specification
Temperature Sensors — Water Systems	Immersion type; Pt1000 RTD; stainless steel pocket; 4–20 mA or 0–10 V output; IP65; range -10°C to +120°C
Temperature Sensors — Air / Duct	Duct-mount or space type; Pt100 or 10 kΩ NTC; 4–20 mA output; IP54; range -30°C to +80°C
Temperature Sensors — Outdoor	Wall-mount; IP65; 4–20 mA; sun shield provided
Humidity Sensors	Capacitive type; ±2% RH accuracy; 0–100% RH range; 4–20 mA or 0–10 V output; duct or wall-mount
Pressure / DP Transmitters	Piezoresistive type; 4–20 mA; IP65; range and span per system requirements; for water, air, and refrigerant circuits

Sensor Type	Specification
Flow Meters — Water	Electromagnetic type (no moving parts); pulse or 4–20 mA output; accuracy ±0.5%; flanged connections per pipe size
Energy Meters	kWh / kVAR / PF / current / voltage; Class 0.5 per IEC 61557-12; Modbus RTU RS485; DIN-rail; 3-phase 4-wire; MID-approved
CO_2 / Air Quality Sensors	NDIR (Non-Dispersive Infrared) type; 0–2,000 ppm range; ±50 ppm accuracy; wall-mount; for all occupied spaces in ATCT and offices
Occupancy Sensors	PIR (Passive Infrared) type; ceiling-mount; 360° coverage; integrated with lighting control and HVAC setback mode

2.6 HVAC CONTROL VALVES AND ACTUATORS

- Control valves shall be brass or stainless steel body, modulating (equal percentage characteristic), pressure-independent where possible, suitable for the HVAC system fluid, temperature, and pressure rating at Skardu conditions.
- Actuators for heating/cooling coil valves shall be spring-return, fail-safe type — fail to a defined safe position (open or closed as required) on loss of power or BMS signal.
- Damper actuators for outdoor air, exhaust air, zone control, and smoke control shall be direct-coupled, modulating 0–10 V or 2-position as required by the control sequence.
- All actuators shall provide position feedback signal (0–10 V or end-switch) to the BMS for monitoring and control loop verification.
- All actuators rated for continuous duty; minimum 50,000 cycle life; IP54 minimum.

PART 3 — EXECUTION

3.1 INSTALLATION

- BMS controllers shall be installed in dedicated, lockable, powder-coated steel control panels. Panel layout drawings shall be submitted for approval per Clause 1.5 before fabrication.
- All wiring within control panels shall be fully numbered with printed ferruled wire markers, neatly bundled with separate cable ducts for power wiring and signal/data wiring.
- All field wiring shall be run in dedicated conduit, separate from high-voltage power wiring. Minimum separation: 150 mm from 11 kV circuits; 50 mm from LV power circuits — per Electrical Design Report Section 2.
- All I/O field wiring shall be screened twisted pair (STP) cable. Cable screen shall be grounded at the controller panel end only (single-point earthing) to prevent ground loops.
- Conduit fill shall not exceed 40% of internal cross-sectional area for BMS/control cables. Pull boxes shall be provided per Clause 2.4.6 of the Electrical Design Report.
- All controllers shall be connected to a UPS capable of maintaining BMS operation for a minimum of 2 hours on loss of mains power.
- BMS network cabling shall be fully tested for continuity, crosstalk, and attenuation using a Category 6 field certification tester. Certificates shall be submitted to the Engineer.

3.2 PROGRAMMING AND COMMISSIONING

- All control sequences shall be programmed and individually tested offline by the BMS Contractor's qualified engineer before site acceptance testing (SAT) commences.
- Factory Acceptance Test (FAT): The Contractor shall conduct a complete FAT covering controller programming logic, graphic screen operation, and alarm annunciation at the BMS supplier's works. Engineer shall be invited minimum 2 weeks in advance per Electrical Design Report Clause 1.19.

- Site Acceptance Test (SAT): Point-by-point demonstration of all BMS input and output points, alarm functions, trending, and reporting in the presence of the Engineer. Written SAT record sheet to be completed and co-signed.
- Control loop tuning: All PID control loops shall be tuned on site under actual operating conditions with the building occupied/operational. Final tuning parameters shall be documented in the as-built CSO document.
- BMS graphic screens shall be reviewed by the Employer's representative after commissioning and revised as required at no additional cost before final acceptance.

3.3 TRAINING

The Contractor shall provide a minimum of three (3) days of on-site training for the Employer's designated operators and facility management staff, covering: system navigation and daily operation, alarm acknowledgment and response procedures, trending and energy reporting, basic controller re-programming for setpoint adjustment, fault-finding and diagnostic tools, and maintenance procedures. Training documentation in English and Urdu.

3.4 TESTING REQUIREMENTS

All testing shall be per Electrical Design Report Section 17, supplemented by the following BMS-specific tests:

Test Type	Acceptance Criterion
Insulation Resistance	≥ 5 MΩ for all field wiring to earth — per Electrical Design Report Section 17
Network Communication Test	All BACnet objects respond correctly; packet loss ≤ 0.1% over 1-hour test; latency ≤ 100 ms
Alarm Response Test	All alarm types generated (critical, high, medium, low); correct annunciation at OWS; email and SMS notifications verified
Trend Data Validation	Continuous 24-hour trend data integrity test; verify no data gaps; compare logged values against calibrated reference instruments
Fail-Safe Mode Test	Simulate controller failure (power removal); verify all output devices move to programmed fail-safe positions
Integration Tests	Solar PV data appears in BMS; generator alarms appear in BMS; UPS status visible; fire alarm integration (read-only) verified
Energy Meter Accuracy	BMS energy readings compared against certified reference meter; ±1% accuracy required

3.5 DOCUMENTATION

The following shall be delivered to the Engineer in both hard copy (3 sets, A3/A4 as appropriate) and electronic format (USB drive and PDF):

- As-built BMS drawings: point-by-floor panel wiring diagrams, BACnet network diagram, field device location plan (floor plans), I/O schedule with final tag numbers
- As-built points list with final BACnet address mapping, I/O type, engineering units, and setpoint values
- As-built Control Sequences of Operations (CSO) — marked up from submitted CSO to reflect any site changes
- Calibration records for all instruments (date calibrated, reference instrument used, as-found and as-left readings)

- Test and commissioning records (FAT, SAT sign-off sheets, loop test records)
- BMS software backup: controller programs, OWS database, graphic files, configuration — archived on USB drive
- Operations and Maintenance manuals for all equipment including replacement procedures

3.6 MEASUREMENT AND PAYMENT

The BMS shall be measured and paid as a lump sum per BOQ Item 12.01. The BOQ may be broken out into sub-items by system or by building area at the Employer's discretion. All civil works for conduit routing, cable trays, and control room modification are included unless separately itemised.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0890 — INFORMATION TECHNOLOGY (IT) SYSTEMS

PART 1 — GENERAL

1.1 SCOPE OF WORK

This Section covers the complete design, supply, installation, testing, commissioning, and integration of all Information Technology (IT) Systems for the ATCT, Fire Station, and Allied Facilities at Skardu International Airport. Systems covered include:

- Structured Cabling System (SCS) — horizontal copper, backbone optical fibre, telecommunications rooms (MDF/IDF)
- Local Area Network (LAN) — Layer 2/3 managed switches, wireless access points (Wi-Fi 6)
- Wide Area Network (WAN) / Internet connectivity — interface provisions only
- Voice Over IP (VoIP) Telephone System — IP PBX / EPABX and handsets (BOQ Item 5.18)
- Uninterruptible Power Supply (UPS) for IT equipment — online double-conversion
- Server Room / Network Operations Centre (NOC) — racks, cooling, power infrastructure
- ATC Ground-Air Communication Infrastructure Provisions — passive conduit, earthing, antenna mounts only (primary ATC equipment is separate CAA/PANS procurement)
- Public Address (PA) and General Intercom System (BOQ Section 8)
- CCTV and Video Surveillance System (BOQ Section 7) — supplements Electrical Design Report Section 12
- Master Antenna Television (MATV) Distribution System

1.2 REFERENCE STANDARDS

Standard / Authority	Application
TIA-568.2-D	Balanced Twisted-Pair Telecommunications Cabling and Components
TIA-568.3-D	Optical Fiber Cabling and Components Standard
TIA-606-C	Administration Standard for Telecommunications Infrastructure
TIA-942-B	Telecommunications Infrastructure Standard for Data Centers
TIA-607-C	Generic Telecommunications Bonding and Grounding (Earthing)
ISO/IEC 11801 Ed.3	Generic Cabling for Customer Premises — Class EA / OM4 / OS2
ISO/IEC 14763-3	Implementation and Operation of Customer Premises Cabling — Testing
IEC 61300-3-35	Optical Fibre Connectors — End-face Inspection
IEEE 802.3	Ethernet Standard: 100BASE-T, 1000BASE-T, 10GBASE-T
IEEE 802.11ax	Wi-Fi 6 Wireless LAN Standard
IEEE 802.1Q	Virtual Bridged Local Area Networks (VLANs)
IEEE 802.3at	PoE+ Power over Ethernet (30 W)
ITU-T G.711	Pulse Code Modulation of Voice Frequencies — VoIP quality baseline
IEC 62368-1	Audio/Video, IT and Communications Equipment Safety
IEC 61000-4	Electromagnetic Compatibility — Testing and Measurement
ICAO Annex 10 Vol. II	Communication Procedures — Aeronautical Telecommunications

Standard / Authority	Application
ICAO Doc 9161	Manual on Frequency Assignment for Ground-Air Communications
Pakistan Telecom Authority (PTA)	Applicable Telecommunications Regulations
T&T Department NOC	NOC from Director General T&T, Ministry of Communications per Elec. Design Report Clause 1.26

1.3 GENERAL REQUIREMENTS

All IT systems shall be designed to meet the operational requirements of an ICAO-compliant Air Traffic Control environment. The following overarching requirements apply to all systems in this Division:

- Critical IT systems (LAN core, server room, VoIP PBX) shall incorporate N+1 redundancy as a minimum.
- All active IT equipment shall be powered through online double-conversion UPS systems providing minimum 60 minutes autonomy.
- The T&T Department NOC shall be obtained by the Contractor as required per Clause 1.26 of the Electrical Design Report before commencement of any telecommunications work.
- Wi-Fi access points shall NOT be installed within 10 m of ATC radio equipment rooms to prevent RF interference — coordinate installation locations with CAA/PANS.
- Server room / MDF shall be maintained at 18–24°C and 40–60% RH by dedicated precision air conditioning.
- All IT structured cabling shall be installed by a manufacturer-certified installer to qualify for the 25-year channel warranty.

1.4 SUBMITTALS

- Structured cabling design drawings: floor plans showing outlet locations, cable routes, TR/MDF/IDF locations, rack elevations
- Network architecture diagram: logical and physical topology, VLAN plan, IP addressing scheme, routing design
- Equipment data sheets for all active and passive IT equipment
- Server room / NOC detailed layout: power, cooling, cable management, rack configuration
- Factory test certificates and third-party performance test reports for all structured cabling components
- VoIP/PBX configuration design and dial plan
- UPS sizing calculations for all IT loads (kVA, runtime, de-rating at site altitude)
- IT security architecture document: firewall rules, network segmentation, access control matrix
- CCTV camera schedule and coverage diagram (floor plans with camera FoV overlays)
- PA system design with SPL calculations and EASE or equivalent simulation

1.5 CLIMATIC CONDITIONS

All IT equipment installed outside air-conditioned server rooms shall be rated for operation in the ambient conditions of Clause 1.7 of the Electrical Design Report (41°C max, -10°C min, 90% RH). Equipment in server rooms and MDF shall benefit from dedicated precision air conditioning maintaining 18–24°C.

1.6 GUARANTEE AND WARRANTY

Item	Warranty Requirement
Structured Cabling System — Channel	25-year end-to-end system warranty — manufacturer-backed; requires certified installer
Structured Cabling — Components	Manufacturer's standard product warranty (typically lifetime for passive components)
Active LAN / WAN Equipment	Minimum 5 years hardware warranty with next-business-day (NBD) advance replacement
VoIP PBX System	3 years hardware; 1 year software maintenance (extendable)
UPS Systems — IT	2 years on inverter/charger hardware; battery replacement per manufacturer's schedule (typically 3–5 years for VRLA)
CCTV System	2 years on all cameras, NVR, and accessories
PA System	2 years on all amplifiers, speakers, and accessories
Workmanship	12 months from issue of Completion Certificate per Contract Conditions

PART 2 — PRODUCTS

2.1 STRUCTURED CABLING SYSTEM (SCS)

2.1.1 Horizontal Cabling — Copper

Parameter	Specification
Cable Category	Category 6A (Cat6A), augmented; 10 Gbps capable; 500 MHz bandwidth
Cable Type	U/FTP (individually foil-shielded pairs) or F/UTP — as determined by detailed design; consistent throughout
Conductor	23 AWG solid copper; annealed; 100% copper — no CCA (Copper-Clad Aluminium) permitted
Jacket	HDPE primary insulation; CMR/LSZH outer jacket — Low Smoke Zero Halogen is MANDATORY for all areas within ATCT building
Fire Rating	IEC 60332-3-24 (flame retardant, limited fire spread); LSZH per IEC 60754-1 and IEC 60754-2
Maximum Horizontal Run	90 m permanent link + 10 m patch cords = 100 m total channel (per TIA-568.2-D)
Performance Standard	ISO/IEC 11801 Class EA; TIA-568.2-D Category 6A
Minimum Bend Radius	4× OD for patch cords; 8× OD for horizontal cable — never exceeded during or after installation
Maximum Pull Tension	110 N for 4-pair horizontal cable — pull tension gauge required
Test Requirement	100% channel certification per Level VI (or higher) field tester (e.g., Fluke DSX-8000); all parameters: wire map, length, IL, NEXT, PS-NEXT, ELFEXT, PS-ELFEXT, return loss, delay, delay skew, DC resistance — pass/fail report for every installed link submitted to Engineer
Acceptable Cable Brands	Belden, Panduit, Nexans, Brand-Rex, Draka, or approved equivalent with valid TIA/ISO test reports

Parameter	Specification
BOQ Quantities	Data cable 6,000 Rft (Item 5.05); Telephone cable 5,440 Rft (Item 5.05'); 1" dia. PVC conduit 5,362.5 Rft (Item 5.01)

2.1.2 Backbone Cabling — Optical Fibre

Parameter	Specification
Fibre Type (BOQ 5.07 — 1,200 Rft)	OS2 single-mode 9/125 µm for inter-building backbone; OM4 multimode 50/125 µm for intra-building backbone
Fibre Count	12 fibres per intra-building backbone; 24 fibres for main campus backbone — as per detailed design
Connectors	LC duplex (OM4 multimode); LC duplex APC (OS2 single-mode)
ODF (BOQ 5.08 — 1 No.)	24-port rack-mounted Optical Distribution Frame (ODF); front-access sliding drawers; fully populated with pre-terminated pigtails
SFP Modules (BOQ 5.06' — 10 No.)	Single-mode SFP; LC connector; Baynet or approved equivalent; compatible with installed LAN switches
Test Requirement	OTDR trace both directions at all operational wavelengths (850/1,300 nm for OM4; 1,310/1,550 nm for OS2); insertion loss per ISO 14763-3; end-face inspection per IEC 61300-3-35; all test results submitted
Underground Runs	Armoured cable; minimum 900 mm burial depth; sand bedding as per Electrical Design Report Section 8
Indoor Runs	Blown-in fibre through pre-installed duct preferred for long runs; or manual installation with proper support every 1 m in trays/conduit

2.1.3 Telecommunications Outlets and Floor/Tech Boxes

Component / BOQ Reference	Specification
RJ-45 Data Outlets (BOQ 5.03 — 75 No.)	Cat6A keystone jack; IDC tool-free or 110-type punchdown; 2-port faceplate minimum; flush wall-mounted; labeled per TIA-606-C; 300 mm AFF for workstation locations
RJ-11 Telephone Outlets (BOQ 5.04 — 68 No.)	IDC-type telephone keystone jack; 2-port faceplate; flush wall-mounted; labeled
Floor Boxes (BOQ 5.01' — 6 No.)	12 SWG die-cast aluminium; 10"×10"×4" depth; GI base box 16 SWG; 3 sets 15A PVC connectors; 1 data + 1 5A + 2 13A sockets per box; including floor-cutting
Tech Boxes (BOQ 5.02 — 62 No.)	Same as floor boxes but 15"×15"×4"; higher socket count per box
IPTV Outlets (BOQ 5.16 — 18 No.)	Cat6 UTP cable; RJ-45 faceplate (Orange/Clipsal/3M); 1" PVC conduit; in recreation, lounge, and briefing rooms

2.1.4 Telecommunications Rooms — MDF and IDF

Component	Specification
MDF / Server Room	Dedicated locked room; minimum 15 m² floor area for ATCT; 19" open racks or closed server cabinets; precision air conditioning N+1; raised access floor minimum 300 mm

Component	Specification
IDF Spaces	Per floor or building; minimum 2.4 m × 1.8 m dedicated lockable space; floor-mounted or wall-mounted racks
Racks / Cabinets (BOQ 5.13')	42U × 600 mm × 1,000 mm (D) 19" EIA steel network cabinets (1 No.); 12U cabinets (4 No.); 6U cabinets (2 No.); IP20; RAL7021; front/rear lockable doors; included in BOQ Item 5.14
Power in TR / MDF	Dedicated UPS-backed 15A/20A circuits per rack; smart metered PDU per rack
Cooling	Dedicated precision air conditioning; N+1 redundancy; 18–24°C; 40–60% RH
Cable Management	Horizontal and vertical cable managers per rack; blanking panels for all unused rack units
Earthing / Grounding	Dedicated Telecom Bonding Backbone (TBB) copper bus bar per TIA-607-C; bonded to building earth
Telephone DB (BOQ 5.10 — 1 No.)	100-pair; 20-pair Krone strips; patch cords (1 m and 3 m) — installed in IDF

2.2 LOCAL AREA NETWORK (LAN) — ACTIVE EQUIPMENT

2.2.1 LAN Switches

Parameter	Specification
Type	Layer 2 managed switch with PoE+ — 24-port
Uplink Ports	4× 10G SFP+ uplinks minimum per switch
Access Ports	24× 1G RJ45 PoE+ (IEEE 802.3at, 30 W per port) minimum
Switching Capacity	≥ 176 Gbps non-blocking switching fabric
PoE Budget	≥ 740 W per switch (sufficient for full 24 ports at 30 W)
Protocols	VLAN (IEEE 802.1Q), MSTP/RSTP, LACP (802.3ad), SNMP v3, RMON, SSH v2, RADIUS/TACACS+ authentication
Management	Web GUI; CLI via SSH; SNMP v3 trap; out-of-band management port; syslog
Redundancy	Dual redundant hot-swap power supplies; stacking or ring topology for N+1
Operating Temperature	0°C to +50°C
Certifications	CE, UL/CSA, RoHS, IPv6 ready
Acceptable Makes	Cisco Catalyst / Meraki, Juniper, Aruba / HPE, Huawei, or approved equivalent

2.2.2 Wireless LAN — Wi-Fi Access Points

Parameter	Specification
Wi-Fi Standard	IEEE 802.11ax (Wi-Fi 6) — dual-band 2.4 GHz and 5 GHz simultaneous
Throughput	≥ 1.8 Gbps aggregate per AP (5 GHz band) + 600 Mbps (2.4 GHz band)

Parameter	Specification
Simultaneous Clients	Minimum 100 concurrent clients per AP
Security	WPA3 Enterprise (802.1X / EAP-TLS); guest VLAN with isolation
Management	Cloud-managed or on-premise controller; centralised SSID, VLAN, and policy management; seamless roaming per 802.11r/k/v
Power	IEEE 802.3at PoE+ via LAN switch — no local PSU required
Coverage Design	Designed to provide minimum -65 dBm RSSI at all occupied areas; coverage map submitted to Engineer
Mounting	Ceiling-recessed or surface-mount; flush aesthetics in ATCT operational areas
ATC RF Safety Rule	APs shall NOT be installed within 10 m of ATC radio equipment rooms — coordinate with CAA; document in shop drawings
Acceptable Makes	Cisco Meraki, Aruba (HPE), Ubiquiti (enterprise UniFi), Huawei, or approved equivalent

2.2.3 Patch Panels and Cabinets

Component / BOQ Reference	Specification
Cat6 Patch Panels (BOQ 5.17 — 4 No., 24-port)	TIA/ANSI standard; Category 6 rated IDC punchdown; RJ-45 ports front; with integrated cable manager; Baynet or approved equivalent
Patch Cords (BOQ 5.12)	1 m (50 No.) and 3 m (25 No.); Cat6 UTP, factory-terminated, booted, colour-coded
PDUs (BOQ 5.15 — 8 No.)	Rack-mounted; 1× 10A/16A single cord; 1.5 kW minimum; ≥ 10 AC outlets per PDU; IEC/ANSI standard metered

2.3 VoIP TELEPHONE SYSTEM / EPABX

Supply, installation, and commissioning of an electronic PABX / IP PBX system:

Parameter	Specification
PABX System (BOQ 5.18 — 1 No.)	Electronic PABX; 4 trunk lines; 100 extensions minimum — VentiluxINC / Panasonic / Samsung or approved equivalent
System Capacity	100 SIP extensions (on-site BOQ baseline); expandable to 200 without hardware change
PSTN Interface	E1/PRI or SIP trunk via VoIP gateway; minimum 4 simultaneous PSTN calls
Extension Interfaces	2 multi-line executive telephone set interfaces
Operator Console	2-line LCD display; 15 programmable function keys; USB interface; powered from PABX
IP Handsets	Executive phones (colour display, 6 lines) for key ATCT and management staff; standard IP desk phones for general staff; per BOQ
DECT Wireless Handsets	For maintenance and fire station duty personnel — number per BOQ

Parameter	Specification
Emergency Analog Phones	Red loop-powered emergency phones for ATCT operational positions; connected via ATA adapter
Battery Backup	Maintenance-free batteries within PABX for minimum 2-hour power backup
Features	Auto-attendant, voicemail-to-email, call recording (ATC operational lines), conferencing, hot-standby failover, music-on-hold
Power	PoE-powered handsets per IEEE 802.3af/at via LAN switches; PABX server on UPS
Servo Stabiliser	Motor-controlled voltage stabiliser included
Compliance	PTA regulations; T&T Department NOC per Clause 1.26 of Electrical Design Report
Call Recording	All ATC operational line recordings retained for minimum 30 days

2.4 UNINTERRUPTIBLE POWER SUPPLY (UPS) — IT SYSTEMS

Parameter	Specification
Topology	Online double-conversion (VFI) per IEC 62040-3 — mandatory for all IT UPS
Configuration	N+1 parallel redundant UPS modules for main MDF/server room UPS; individual rack-mount UPS for IDF spaces
Autonomy — MDF / Server Room	Minimum 60 minutes at full rated IT load
Autonomy — IDF UPS	Minimum 30 minutes at full rated load
Output Power Factor	≥ 0.9 PF at rated output
Output Voltage	230 V AC single-phase 50 Hz; or 415 V 3-phase per rack PDU design as required
Battery Type	VRLA sealed maintenance-free (Valve Regulated Lead Acid); or Lithium-Ion preferred for longer life and reduced footprint
Communication	SNMP v1/v2c/v3 network management card; Modbus TCP/IP for BMS integration per Section 0880 of this document
Altitude De-rating	De-rating calculation for 2,228 m altitude submitted with submittal — confirm sizing is adequate after de-rating
Seismic Restraint	UPS installed with seismic restraints per BCP-SP-07 Zone 4
Standards / Certification	IEC 62040-3 (VFI classification), CE, RoHS
Acceptable Makes	APC (Schneider Electric), Eaton, Socomec, Vertiv, or approved equivalent

2.5 PUBLIC ADDRESS (PA) AND INTERCOM SYSTEM

Component / BOQ Reference	Specification
System Type	Digital networked PA — IP-based or conventional 100 V line audio distribution

Component / BOQ Reference	Specification
Coverage Zones	Minimum 5 zones: (1) ATCT Operations, (2) Fire Station, (3) Offices/Admin, (4) External/Apron areas, (5) Emergency — all zones simultaneous
Emergency Priority Override	Evacuation announcements automatically override all other channels; EN 54-16 compliant for life safety function
Speaker Wiring (BOQ 8.01 — 13 Zones)	PVC insulated, twin-core 2×1.23 mm², 300/500 V grade; separate shielded cable in dedicated 1" PVC conduit; zone-by-floor wiring
Wall Speakers (BOQ 8.02 — 13 No.)	15 W; 100 V line; surface or recessed mount; metal enclosure; aluminium grill; built-in 70/100 V transformer; SPL 92 dB (1W/1m) — max 99 dB; frequency response 130 Hz–13 kHz; EN 54 compliant
Outdoor Horn Speakers	IP65 rated; 30 W nominal; 100 V line; -20°C to +55°C; for external apron areas
Microphones (BOQ 8.03 — 2 No.)	Adjustable bidirectional; low distortion; suitable frequency response; at ATCT operations desk and fire station duty room
Power Amplifier 240 W (BOQ 8.04 — 1 No.)	Integrated rack-mount amplifier; backup amplifier provision; all accessories included
Power Amplifier 60 W (BOQ 8.05 — 1 No.)	Integrated; for smaller zones
Power Mixer (BOQ 8.06 — 1 No.)	For integration with existing PA system if required on site
PA PVC Conduit (BOQ 8.07 — 1,300 Rft)	1" diameter heavy duty PVC conduit; wall and slab-mounted
Intercom	Door video intercom at ATCT security entry (preferred); audio intercoms at main entrance, ATCT access doors, fire station

2.6 CCTV AND VIDEO SURVEILLANCE SYSTEM

The CCTV system shall comply with and expand upon Electrical Design Report Section 12. IP-based technology throughout — no analogue cameras:

Component / BOQ Reference	Specification
Indoor Dome IP Camera (BOQ 7.02 — 40 No.)	PoE; minimum 4 MP resolution; Day/Night mode; IR LED ≥ 20–30 m; Vandal-proof IK10; IP67; fixed lens; -30°C to +60°C; auto-heated housing for winter; mounting bracket included
Outdoor IP Camera (BOQ 7.03 — 32 No.)	PoE; minimum 4 MP; Day/Night; IP65; IR illumination ≥ 20–30 m; weather-resistant; mounting bracket
PTZ Camera (BOQ 7.04 — 4 No.)	360° pan/tilt/zoom; min. 4 MP; 32× optical + 16× digital zoom; Day/Night; Full HD 1080p; intelligent video analytics; speed dome housing
Joystick Controller (BOQ 7.05 — 1 No.)	For PTZ camera manual control at monitoring station

Component / BOQ Reference	Specification
NVR (BOQ 7.06 — 4 No.)	32-channel; 512 Mbps network throughput; 4K HDMI output; 12 MP max camera resolution; H.265+ compression; RAID-5 storage; Event trigger (alarm input, video loss); 16 TB HDD per NVR (minimum 90-day retention at all cameras full resolution)
VMS Software	ONVIF-compliant; minimum 3 simultaneous live-view workstations; remote access via encrypted VPN; motion detection, line crossing, intrusion zone, facial recognition option
NVR CPU Workstation (BOQ 7.07 — 1 No.)	Latest generation PC workstation for VMS client
CCTV Monitors (BOQ 7.10 — 3 No.)	4K LED 43" colour display; 2 HDMI 4K cables per monitor; wall bracket/VESA mount included
CCTV Integration Decoder (BOQ 7.11 — 1 No.)	256-channel decoder for integration with existing CCTV system if required
PoE Switches for CCTV (BOQ 7.08 — 4 No.)	24-port PoE+ Layer 2; D-Link / Huawei or approved equivalent; dedicated CCTV network switch
CCTV Patch Panels (BOQ 7.09 — 4 No. × 24-port)	24-port data patch panels; in CCTV rack / data cabinet
Cat6 Cabling (BOQ 7.01 — 11,400 Rft)	UTP Cat6 for PoE camera connections; in 1" PVC conduit (BOQ 7.13 — 11,400 Rft)
Storage Capacity	Minimum 20 TB RAID-5 protected per NVR group — expandable; 30-day full-resolution retention verified by test
Outdoor Camera Housing	IP67, IK10; auto-heated housing for Skardu winter conditions (-30°C operation)
Acceptable Camera Makes	Axis, Hanwha, Bosch, Dahua (IFS channel), Hikvision (IFS/BIS channel), or approved equivalent
System Warranty	2 years on all cameras, NVRs, and accessories

2.7 ATC GROUND COMMUNICATIONS INFRASTRUCTURE PROVISIONS

Provision	Specification
Conduit Provisions	Minimum four (4) runs of 50 mm HDPE conduit from the communications equipment room to ATCT cab level; pull string installed; both ends sealed after installation
Earthing Busbars	Dedicated copper earthing bus bars (300 × 50 × 6 mm) in the communications room; bonded to main earthing system per Electrical Design Report Section 16; earth resistance to main earth ≤ 0.5 Ω
Antenna Mounts	Hot-dip galvanised steel pipe mounts (50 mm dia., wall thickness ≥ 3 mm) with base flanges on ATCT cab roof; minimum four (4) positions for future antenna installations; structural loads verified by structural engineer

Provision	Specification
Dedicated Cable Trays	300 mm wide perforated galvanised steel cable trays in communications room and cab level — separate from IT LAN cable trays; labelled 'ATC COMMS — RESERVED'
Power Provisions	Dedicated 30A, 3-phase feeder from generator-backed DB; terminated in distribution board in communications room; circuits labelled and reserved for CAA equipment; circuits isolated and locked off until CAA installation
EMI Shielding	Communications room walls, floor, and ceiling lined with minimum 1 mm hot-dip galvanised steel sheet to form a Faraday cage; bonded to earthing busbar at minimum four (4) points per wall; all penetrations sealed with bonded glands

2.8 MASTER ANTENNA TELEVISION (MATV) SYSTEM

Parameter	Specification
Head End	Programmable satellite receiver/modulator; minimum 10 channels; installed in MDF room
Distribution	100 Ω coaxial tree-and-branch; RG-6 coaxial cable per Electrical Design Report Section 12; tap-off at each floor level
TV Outlets	F-type coaxial connectors; flush wall-mounted; in recreation room, lounge, and briefing rooms
Signal Level at Outlet	60–80 dBµV at all outlets — verified by signal level meter at commissioning
Future Provision	Conduit stub-outs at all outlet boxes for future upgrade to fibre-based IPTV distribution

PART 3 — EXECUTION

3.1 INSTALLATION

Structured Cabling

- All structured cabling shall be installed by a manufacturer-certified installer — mandatory for 25-year channel warranty qualification.
- Cable routing: minimum 50 mm separation from 230 V power cables; minimum 150 mm from fluorescent or LED lighting fixtures (EMI per TIA-568.2-D).
- Cables shall never exceed minimum bend radius: 4× OD for patch cords; 8× OD for horizontal cable — enforced during and after installation.
- Pull tension shall not exceed 110 N for 4-pair horizontal cable. Pull tension gauge to be used on all cable runs.
- Telecommunications outlets installed per Electrical Design Report Section 4: 16 SWG sheet steel outlet boxes recessed in walls, with conduit entries; coordinate with BMS and electrical outlet locations.
- All conduit work for IT systems: comply with Electrical Design Report Section 2 — minimum 20 mm PVC conduit; pull boxes at ≤ 20 m; maximum 2 quarter-bends between pull points.

Optical Fibre

- Fibre optic cables: sweep radius ≥ 30× OD at all bends. Fibre shall not be subjected to tensile load during installation — blown-in fibre preferred for all runs > 30 m.
- Fibre splices shall be fusion spliced only — no mechanical splices; average splice loss ≤ 0.1 dB.

Server Room / MDF

- All cable entry points through raised floor or slab shall be sealed with fire-rated intumescent putty or pillows after cable installation — fire compartmentalisation maintained.
- UPS systems installed on manufacturer-rated floor loading. Seismic restraints per BCP-SP-07 Zone 4 required on all UPS equipment.

3.2 TESTING AND CERTIFICATION

Test Category	Method and Acceptance Criterion
Copper Cabling — 100% Channel Certification	Level VI field tester minimum (Fluke DSX-8000 or equivalent); full suite per TIA-568.2-D: wire map, length, IL, NEXT, PS-NEXT, ELFEXT, PS-ELFEXT, return loss, propagation delay, delay skew, DC loop resistance, DC resistance imbalance; pass/fail report for every installed link — submitted to Engineer before acceptance
Optical Fibre Testing	OTDR trace both directions at all operational wavelengths (850/1,300 nm OM4; 1,310/1,550 nm OS2); insertion loss per ISO 14763-3; end-face visual inspection per IEC 61300-3-35 on 100% of connectors; all results submitted
LAN / Network Testing	VLAN segmentation verification (no inter-VLAN leakage); bandwidth and latency test (iperf3 or equivalent); PoE output power verification per IEEE 802.3at on all PoE ports
VoIP / PBX Testing	End-to-end call quality MOS ≥ 4.0; emergency line test to PSTN; call recording system verification; T&T NOC compliance verification
UPS Testing	Load bank test at 100% rated load for minimum 30 minutes; battery autonomy test at full IT load; SNMP/Modbus communication verification with BMS
CCTV Testing	Camera FoV verification against submitted coverage diagram on-site; 30-day recording continuity test; remote VPN access verification; analytics alarm function test (motion, intrusion zone)
PA System Testing	SPL measurement at minimum 3 representative points per zone using calibrated sound level meter; compare against EASE simulation; emergency override test; audio feedback/squeal test

3.3 LABELING AND DOCUMENTATION

All labeling shall comply with TIA-606-C throughout:

- Every cable, patch panel port, keystone jack outlet, and active equipment port shall be permanently labeled per the agreed labeling convention before acceptance.
- Cable labels: heat-shrink type or UV-resistant permanent adhesive for outdoor, machine-printed — no hand-written labels.
- All LAN equipment: asset tag and IP address label affixed to front panel.
- As-built drawing package shall include: floor plan cable routes, rack elevation diagrams, logical network diagram, VLAN map, IP address schema, Wi-Fi channel plan, CCTV camera FoV overlay, PA speaker layout — all in PDF and AutoCAD DWG-compatible formats on USB drive.

3.4 TRAINING

The Contractor shall provide minimum three (3) days of on-site training covering: LAN administration (VLAN management, switch CLI, Wi-Fi controller), VoIP PBX administration (extension programming, call routing, recording retrieval), NVR/VMS operation and video retrieval, UPS monitoring and battery maintenance, PA/intercom operation, and structured cabling documentation (how to read test reports and as-builts). Training materials in English and Urdu.

3.5 MEASUREMENT AND PAYMENT

IT systems shall be measured and paid per the Bill of Quantities, broken out as: structured cabling (per outlet/per linear run — BOQ Items 5.01–5.17); LAN equipment (per item — BOQ Items 5.11–5.14); VoIP/PABX system (lump sum — BOQ Item 5.18); CCTV system (per camera plus NVR lump sum — BOQ Items 7.01–7.14); PA system (lump sum — BOQ Items 8.01–8.07). All conduit work and civil works associated with IT systems are included unless separately itemised.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0900 – AERONAUTICAL BEACON SYSTEM

PART 1 – GENERAL

1.01 GENERAL

A. Section Includes

This Section specifies requirements for the provision, installation, testing, and commissioning of a complete Aeronautical Beacon System at the Air Traffic Control Tower (ATCT) at Skardu International Airport, including all associated civil, electrical, and control works, as follows:

1. LED aerodrome beacon unit, complete with lamp, optical system, and weatherproof housing.
2. Beacon controller with integrated photocell and fault alarm relay.
3. ATC console remote control interface with activation buttons, status indication, and pilot relay contacts.
4. Power supply, UPS back-up, and all associated electrical distribution.
5. Power and control cabling in conduits with terminations and labelling.
6. Earthing system including earth electrode installation and bonding.
7. Lightning protection system in accordance with IEC 62305.
8. Reinforced concrete foundation, mounting structure, levelling, and alignment.
9. Pre-commissioning, operational testing, and ATC integration testing.
10. As-built drawings, O&M manuals, and commissioning certificate.

B. Related Sections

1. Section 0010 – General Requirements
2. Section 0150 – Concrete Works
3. Section 0620 – Earthing / Grounding System
4. Section 0490 – General Requirements for Electrical Works
5. Section 0530 – Low Tension Switchboards / LT Outdoor Distribution Boards
6. Section 0630 – Lightning Protection System
7. Section 0740 – CNS Equipment (ATC Systems Integration)

1.02 APPLICABLE STANDARDS AND REFERENCES

All work shall conform to the latest edition of the following standards, codes, and directives. In the event of conflict, the order of precedence shall be as listed:

Reference	Document Title / Application

ICAO Annex 14 Vol. I	Aerodrome Design and Operations, 9th Edition – §4.7 Aerodrome Beacon; §8 Visual Aids for Navigation
ICAO Doc 9157	Aerodrome Design Manual, Part 4 – Visual Aids
ICAO Doc 9184	Airport Planning Manual
PAA Technical Directive	Pakistan Airports Authority Technical Directives for Visual Aids – latest issue
PCAA ANO-013	Pakistan Civil Aviation Authority Airspace and Aerodrome Standards
BCP-SP-40-2007	Building Code of Pakistan – Seismic Provisions (Seismic Zone 4)
BS EN 62305 / IEC 62305	Protection against Lightning (all parts)
IEC 61936-1	Power Installations Exceeding 1 kV AC – Earthing Systems
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60364	Electrical Installations of Buildings (all relevant parts)
IEC 60598-2	Luminaires – Part 2: Particular requirements
IEC 61000	Electromagnetic Compatibility (EMC)
BS 7430	Code of Practice for Protective Earthing
PEC Wiring Rules	Pakistan Engineering Council – Wiring Rules (current edition)
FIDIC Red Book	Conditions of Contract for Construction (MDB Harmonised Ed.)
PPRA Rules 2004	Public Procurement Rules – measurement and payment provisions

1.03 DEFINITIONS

Term	Definition
Aerodrome Beacon	A visual NAVAID exhibiting flashes of white (or alternating white and coloured) light to indicate the location of the aerodrome to aircraft, per ICAO Annex 14 §4.7.
Effective Intensity	The intensity of a fixed point light source that would produce the same visual effect as the flashing beacon, calculated per ICAO method (typically Blondel-Rey formula).
Flash Rate	Number of complete flash cycles per minute (fpm).
Photocell	Automatic daylight sensor controlling beacon ON/OFF switching based on ambient lux level.
Beacon Controller	Electronic unit controlling the flash rate, power regulation, fault detection, and remote interface of the beacon.
ATC Console Interface	Panel or sub-panel in the ATC working position providing remote ON/OFF activation and status monitoring of the beacon.

Pilot Relay	Relay contact within the controller providing a volt-free status signal for integration with the ATC system and/or airport management system.
Earthing System	Network of conductors and electrodes providing a low-impedance path to earth for fault current and lightning discharge.
LPL	Lightning Protection Level – classification (I through IV) per IEC 62305 indicating the probability of interception for lightning protection design.
AMSL	Above Mean Sea Level.
Engineer	The Engineer appointed by PAA under the Contract, or his authorised representative.

1.04 SUBMITTALS

A. Pre-Construction Submittals

The Contractor shall submit the following to the Engineer for review and approval not less than 28 days before commencement of works:

1. Product data sheets for beacon unit, controller, photocell, cabling, conduit, earthing electrodes, and lightning protection components – including manufacturer's catalogue numbers, certifications, and compliance statements against this Specification.
2. Earthing system design: electrode configuration, spacing, target resistance (≤5 Ω), soil resistivity survey results, and calculation method per IEC 61936-1 Annex B.
3. Lightning protection design: risk assessment per IEC 62305-2, air termination layout, down conductor routing, bonding scheme, and SPD specifications.
4. Shop drawings: foundation plan, reinforcement detail, mast arrangement, cable routes, conduit layout, and ATC console interface panel arrangement.
5. Installation and testing methodology statement covering: sequence of civil and electrical construction activities; concrete curing programme with minimum 28-day hold before mast erection; mast erection method statement including crane or lifting equipment details and load calculations; cable installation and termination procedure; earthing system installation and sequential resistance test programme; and commissioning test programme with responsible persons named for each test activity.

B. Post-Commissioning Submittals (Closeout)

Within 30 days of successful commissioning, the Contractor shall submit:

1. As-built drawings (AutoCAD and PDF format): foundation detail, cable route plan, earthing layout, lightning protection layout, and ATC interface wiring diagram.
2. Complete Operation and Maintenance (O&M) Manual per Clause 1.07.
3. Manufacturer’s type test certificate for the beacon unit confirming photometric output ≥2,000 cd effective white-flash intensity at 2,230 m AMSL per ICAO Doc 9157 Part 4; calibration certificate for the photocell confirming ON/OFF switching thresholds as set and verified in the

final installed position at Skardu elevation; and beacon controller routine test certificate confirming functional compliance with all parameters specified in Clause 2.02.A.

4. Commissioning test records (complete test matrix with actual measured values).
5. Signed Commissioning Certificate per Clause 3.06.
6. Photometric measurement report with actual candela values measured at site.
7. Earth resistance test report (initial and post-backfill measurements).
8. Flash rate verification report.
9. Spare parts list with OEM part numbers and recommended quantities.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The beacon unit shall be sourced from a manufacturer with a minimum of ten (10) years' demonstrated experience in the production of ICAO-compliant aeronautical beacons.
2. The manufacturer shall hold ISO 9001 (Quality Management) certification.
3. The manufacturer shall provide evidence of installations at a minimum of five (5) international airports, at least two (2) of which are at an elevation exceeding 2,000 m AMSL.

B. Installer Qualifications

1. Electrical installation works shall be carried out by a firm holding a valid PEC licence (Category EE or as applicable).
2. The lead installation engineer shall be a registered engineer with PEC and shall have experience of at least one (1) comparable aerodrome visual aid installation.
3. Civil works for foundation shall be supervised by a qualified Civil Engineer registered with PEC.

C. Regulatory Compliance

1. All works shall comply with PCAA ANO-013 and shall be subject to PCAA inspection and approval prior to activation.
2. The Contractor shall obtain all permits and clearances required by PCAA and PAA for installation and commissioning of the beacon system.

1.06 DELIVERY, STORAGE AND HANDLING

1. Equipment shall be delivered in original manufacturer's packaging with adequate protection against impact, moisture, and dust.
2. LED beacon heads and optical components shall be transported in shock-absorbing packaging; optics and lens assemblies shall not be stacked.
3. On-site storage shall be in a dry, clean, covered, and lockable store at or near the site office.

4. Temperature and humidity during storage shall remain within manufacturer's stated limits.
5. Cabling drums shall be stored upright on hard standing and shall not be stacked more than two (2) drums high.
6. Earthing materials (copper conductors, rods) shall be stored to prevent contamination that would impair electrical continuity.

1.07 OPERATION AND MAINTENANCE (O&M) MANUAL

The O&M Manual shall be submitted in both printed (two bound copies) and electronic (PDF) form and shall include, as a minimum:

1. System overview, functional description, and operating principles.
2. Component descriptions with manufacturer's data sheets and part numbers.
3. Normal operating procedure: power-up, activation, photocell override, ATC console remote control.
4. Fault identification and troubleshooting guide (with fault codes, causes, and corrective actions).
5. Preventive maintenance schedule including:
   a. Monthly: Visual inspection, clean lens/reflector, check fixings.
   b. 6-Monthly: Photocell threshold verification, controller functional test, earth resistance check.
   c. Annually: Full photometric output measurement, flash rate verification, insulation resistance test, SPD inspection.
6. LED module replacement procedure (high-altitude safety precautions, work-at-height protocol).
7. Calibration procedure for photocell threshold.
8. Spare parts list with minimum on-hand inventory: LED module (1 No.), photocell (1 No.), controller PCB (1 No.), SPD modules (2 sets), fuses (1 set).
9. Wiring diagrams and cable schedules (as-built).
10. Health & Safety requirements (high-voltage warnings, working at height, lone-worker protocol).
11. Emergency shutdown procedure.

1.08 WARRANTY AND GUARANTEE

A. Equipment Warranty

1. The Contractor shall provide a manufacturer's warranty of not less than three (3) years from the date of the commissioning certificate for the beacon unit, controller, and photocell.
2. The LED module shall be warranted for a minimum service life of 50,000 hours at rated operating conditions.

3. The warranty shall cover replacement of defective parts and labour during normal working hours.

B. Installation Defects Liability

1. The defects liability period (DLP) for all installation works shall be twelve (12) months from the date of the commissioning certificate, in accordance with the Contract Conditions.
2. Any defect arising during the DLP which is attributable to defective materials, equipment, or workmanship shall be rectified at the Contractor's expense within 48 hours of notification for faults affecting beacon operability, and within 7 days for non-critical defects.

PART 2 – PRODUCTS

NOTE: All equipment performance parameters specified herein reflect Skardu site conditions (elevation 2,230 m AMSL). Manufacturers shall confirm in their technical submittals that stated performance is achievable at this altitude without derating, or shall provide derated values for Engineer's review.

2.01 LED BEACON UNIT

A. Type and Standard

1. The beacon shall be an aerodrome beacon of the rotating or directional (sequenced) type designed to produce the visual effect of flashing light, in full conformance with ICAO Annex 14, Volume I, §4.7 (Aerodrome Beacon).
2. The beacon shall be a high-intensity LED type; incandescent lamp units are not acceptable.
3. For Skardu International Airport (IFR capable airport): the beacon shall produce white flashes, or alternating white and green flashes if directed by the Engineer, at a flash rate of 20 to 30 flashes per minute.

B. Performance Parameters

Parameter	Requirement
Beacon type	ICAO aerodrome beacon – LED, rotating or electronically sequenced
Flash colour	White (alternating White/Green as directed by Engineer for IFR designation)
Flash rate	20 to 30 flashes per minute (fpm) – adjustable; factory-set at 24 fpm
Effective intensity (white)	≥ 2,000 candela (cd) effective intensity at site elevation (2,230 m AMSL)
Effective intensity (green)	≥ 200 cd effective intensity (if green flash specified)
Photometric calculation	Blondel-Rey method per ICAO Doc 9157, Part 4

Horizontal coverage	360° (full azimuth)
Vertical coverage	1° to 10° above horizontal plane (adjustable ±1°)
LED drive current	Constant current; ≤ 80% of rated maximum for thermal protection
LED colour temperature	≥ 6,000 K (white); CIE x/y coordinates within ICAO/IALA tolerance box
LED rated life	≥ 50,000 hours at rated conditions (L70 criterion)
Altitude correction	Performance figures certified at or corrected to 2,230 m AMSL; submit correction factor data

C. Mechanical and Enclosure Requirements

Parameter	Requirement
Drive mechanism	Brushless DC motor with optical encoder for position feedback (rotating type); or solid-state electronic sequencing (no moving parts preferred)
Enclosure protection rating	IP 66 minimum (IEC 60529); IP 67 preferred – for Skardu precipitation and snow ingress
Enclosure material	Marine-grade aluminium alloy or stainless steel; UV-stabilised polycarbonate lens/dome acceptable
Lens/dome material	Borosilicate glass or impact-resistant UV-stabilised polycarbonate; scratch-resistant coating
Mounting interface	Flanged base plate for bolted connection to mounting mast; stainless steel fasteners
Operating temperature	−30°C to +55°C (Skardu min recorded: −20°C; include 10°C margin)
Storage temperature	−40°C to +70°C
Wind loading design	Structural integrity up to 160 km/h wind speed (equivalent to 3-second gust at site)
Snow/ice load	Lens and housing designed to shed ice; no ice bridging across optical path
Weight	Submit; mounting structure shall be designed for actual beacon mass plus 25% dynamic factor
Colour finish	White or light grey; UV-stable, corrosion-resistant paint or anodising

D. Electrical Requirements – Beacon Head

Parameter	Requirement
Supply voltage (beacon head)	24 VDC or 48 VDC (SELV) from controller; or direct 230 VAC 50 Hz (as per selected manufacturer)
Power consumption	≤ 150 W (steady state, full intensity)
Power factor	≥ 0.90 at rated load
Thermal management	Active or passive cooling; LED junction temperature shall not exceed manufacturer's rated maximum at +55°C ambient
Surge protection	Integral SPD on power supply input: 6 kV/3 kA minimum per IEC 61643-11
EMC compliance	Compliant with IEC 61000-6-2 (immunity) and IEC 61000-6-3 (emission)

2.02 BEACON CONTROLLER AND PHOTOCELL

A. Controller

The beacon controller shall be a dedicated microprocessor-based unit, housed in a wall-mounted IP 54-rated steel enclosure, installed within the ATCT plant/equipment room. The controller enclosure shall be lockable and shall bear clear warning labels for high voltage.

Parameter	Requirement
Supply input	230 V AC ±10%, single phase, 50 Hz ±3%
UPS back-up	Integral or external UPS providing minimum 4 hours' continuous operation of beacon on mains failure; battery: VRLA type; auto-recharge on mains restoration
Output to beacon	As required by beacon head (24/48 VDC or regulated 230 VAC); stabilised, monitored
Flash rate control	Electronically programmable 20–30 fpm; factory-set 24 fpm; locked against unauthorised adjustment
Photocell input	Analogue or digital input from external photocell; configurable ON threshold and OFF threshold independently
Photocell hysteresis	Minimum 20% lux difference between ON and OFF switching thresholds to prevent hunting

Manual override	Key-switch for manual ON / AUTO / manual OFF; override shall be logged
Fault detection	Open-circuit LED/lamp fault, over-temperature, over-current, supply failure, UPS fault, photocell fault; each fault individually annunciated
Fault alarm output	Volt-free relay contacts (NO and NC), rated 5 A / 250 VAC, for each major fault category
Remote control input	Hardwired interface to ATC console (see Clause 2.03)
Status output to ATC	Volt-free contacts: BEACON ON, BEACON FAULT – minimum one (1) Form-C relay each
Data logging	Non-volatile event log: minimum 1,000 events with timestamp (fault, power cycle, manual override)
Operating temperature	0°C to +50°C
Enclosure IP rating	IP 54 (controller cabinet); IP 65 for any external control components

B. Photocell

Parameter	**Requirement**
Type	Solid-state silicon photodiode with temperature-compensated amplifier
Mounting	External, on ATCT roof or unobstructed external location – not shaded by building or beacon mast
ON switching threshold	Lux level at which beacon activates (sunset / overcast): adjustable 15–50 lux; factory-set 30 lux
OFF switching threshold	Lux level at which beacon deactivates (sunrise): adjustable 50–200 lux; factory-set 100 lux
Altitude note	At 2,230 m AMSL, solar irradiance is approximately 10–15% higher than at sea level; photocell shall be calibrated at site after installation
Response time	5 to 60 seconds (programmable); prevents false switching due to cloud transients
Spectral response	Photopic (CIE Standard Observer curve)
Enclosure IP rating	IP 66 minimum
Operating temperature	−30°C to +55°C
Cable	Shielded, outdoor-rated, UV-resistant 2-core (minimum) cable from photocell to controller

Fail-safe	On loss of photocell signal, controller shall switch to manual-ON or alarm, as configured – NOT to automatic OFF

2.03 ATC CONSOLE REMOTE CONTROL INTERFACE

A. Interface Panel

A remote-control interface panel or sub-panel shall be provided for mounting in or adjacent to the ATC working position console (exact location to be confirmed with Engineer and Air Traffic Services before fabrication). Panel shall be clearly labelled 'AERODROME BEACON' in English, with professionally engraved or printed labels – no adhesive labels.

Parameter	Requirement
Panel material	Brushed stainless steel or anodised aluminium; minimum 2 mm thick
Panel finish	Consistent with existing ATC console aesthetics – submit sample for Engineer's approval
Activation switch	Illuminated push-button or key-switch: BEACON ON / OFF; green LED when ON, amber LED when FAULT
Status indicators	LED type: BEACON ON (green), BEACON FAULT (amber/red), MAINS FAIL (red), UPS ACTIVE (yellow)
Pilot relay activation	Dedicated push-button for pilot relay (where specified): 'PILOT ON/OFF'; with separate status LED
Indicator lamp voltage	≤ 24 VDC SELV – no mains voltage on ATC console panel
Wiring to controller	Hardwired shielded multi-core cable from ATC console to beacon controller in ATCT plant room
Cable routing	In dedicated signal cable conduit, segregated from power cables per IEC 60364-5-52
Interface polarity protection	All interface signals shall be protected against reverse polarity and short circuit

B. Pilot Relay

Where directed by the Engineer, a pilot relay shall be provided to output a volt-free contact signal indicating BEACON ACTIVE status for integration with the aerodrome management system or AFIS/ATC operations board. Relay rating: minimum 5 A / 250 VAC; Form-C contacts (NO + NC + COM). Pilot relay shall operate simultaneously with beacon activation; there shall be no manual-only relay activation without beacon energisation.

2.04 POWER AND CONTROL CABLING

A. Power Cable – Mains to Controller

Parameter	Requirement
Cable type	Armoured, copper conductor, XLPE/SWA/PVC (CU/XLPE/SWA/PVC) to BS 5467 / IEC 60502
Voltage rating	600/1000 V
Conductor size	Minimum 4 mm² per phase (calculate for actual load with ≤ 3% voltage drop); not less than 4 mm²
Armour	Galvanised steel wire armour (SWA)
Outer sheath colour	Black (power cable)
Short circuit rating	Calculated and stated in submittals

B. Output Cable – Controller to Beacon Head

Parameter	Requirement
Cable type	Armoured copper conductor, appropriate voltage rating for beacon supply type (SELV or 1000V rating)
Conductor size	As designed for actual current and voltage drop; minimum 2.5 mm²
Armour	SWA; double-insulated where exposed above ground
UV resistance	UV-stabilised outer sheath for exposed sections

C. Control and Signal Cables

Parameter	Requirement
Cable type	Shielded, twisted pair, multi-core: OS/CY or equivalent to BS 5308 Part 2
Conductor size	Minimum 1.5 mm² for control; 0.75 mm² for signal pairs
Shield	Overall braided screen; drain wire provided; shield earthed at one end only (controller end)
Outer sheath colour	Grey (control/signal cable – distinct from power)
Cable identification	Each cable tagged at both ends with unique cable reference per cable schedule

D. Cable Installation Requirements

1. Underground cables shall be armoured type laid at minimum 600 mm depth in sand bedding, with cover tiles and warning tape.
2. All cables shall be installed in conduit – no direct-buried cables without conduit.
3. Maximum cable drum length without joint: cable runs from controller to beacon shall be continuous without intermediate joints unless approved by the Engineer.
4. Cable terminations shall use crimped copper lugs with heat-shrink sleeves; no bare twists.
5. All cable entries to enclosures shall use IP-rated cable glands appropriate to the enclosure IP rating.

2.05 CONDUIT SYSTEM

Parameter	Requirement
Type – underground	Rigid HDPE (high-density polyethylene) conduit, Class 450 N, minimum 50 mm ID; orange outer colour (electrical services)
Type – above ground / within building	Rigid galvanised steel conduit (GRC) to BS 4568; minimum 25 mm ID for control; 32 mm for power; threaded couplings
Fill ratio	Maximum 40% of conduit cross-sectional area occupied by cables
Bends	Factory-made long-radius bends (radius ≥ 8× conduit OD) – no site-bent conduit for underground runs
Draw wires	Polypropylene draw wire left in all conduit runs for future use
Separation	Power cables and signal/control cables in separate conduits with minimum 150 mm clear spacing (underground) and 100 mm (above ground)
Conduit supports – above ground	GRC conduit fixed to structure at maximum 1,200 mm spacing with approved saddles
Conduit sealing	Conduit ends at equipment entries sealed with approved fire-rated sealant or conduit plugs to prevent gas, moisture, or vermin ingress
Labelling	Conduit labelled at each end and at intermediate points at maximum 10 m intervals, with cable number and service

2.06 EARTHING SYSTEM

A. System Configuration

1. A dedicated earthing system shall be provided for the aeronautical beacon, bonded to the building main earthing terminal (MET) and to the lightning protection system.
2. The earthing system shall be designed to achieve a system earth resistance (Rearth) of ≤ 5 Ω measured at the MET, per IEC 61936-1, Annex B.

3. If soil resistivity measurement confirms that ≤ 5 Ω cannot be achieved with a conventional rod system, a counterpoise ring electrode or chemical electrode system shall be used, subject to Engineer's approval.

B. Earth Electrode

Parameter	Requirement
Type	Copper-bonded steel earth rods – minimum 17 mm diameter × 1,500 mm long; extensible
Minimum installation depth	1,800 mm below finished ground level
Number	Minimum 2 (two) rods in parallel; spacing ≥ twice rod length (3,600 mm minimum)
Conductor to rods	35 mm² bare stranded copper conductor (hard-drawn); exothermic (Cadweld) or compression connections – no solder
Soil resistivity survey	Contractor shall conduct a Wenner 4-pin soil resistivity measurement prior to final electrode design; submit results with earthing design
Earth test point	Removable link earth test point provided at each electrode to allow individual resistance measurement
Corrosion protection	All underground connections protected with anti-corrosion bituminous tape and proprietary compound

C. Equipotential Bonding

1. The beacon mounting structure (mast/pedestal), controller enclosure, conduit system, and cable armour shall all be bonded to the earthing system with 25 mm² minimum green/yellow copper conductor.
2. Bonding connections shall be made with bolted or compression-type terminals; no twist connections.

2.07 LIGHTNING PROTECTION SYSTEM

A. Design Basis

1. The lightning protection system shall be designed in accordance with IEC 62305 (all parts), for Lightning Protection Level III (LPL III) as a minimum, or as determined by the risk assessment per IEC 62305-2 (whichever is more stringent).
2. Skardu is located in a region of moderate-to-high keraunic level (thunder-day frequency); Contractor shall obtain local meteorological data from PMD (Pakistan Meteorological Department) for Skardu and confirm LPL in the design submission.

B. Air Termination

1. The top of the beacon mast shall be treated as a terminal for natural air termination or an air terminal (Franklin rod) shall be provided 300 mm above the beacon head, so that the beacon lies within the protected zone per IEC 62305-3.
2. Air terminal: copper or stainless steel, minimum 16 mm² cross-section; secured against the wind loads specified.

C. Down Conductors

1. Minimum one (1) dedicated down conductor from air termination to earth electrode ring, run down the mast exterior in a straight vertical path where possible.
2. Conductor: 50 mm² copper flat tape or round conductor per IEC 62305-3.
3. Test joint with measurement clamp at 600 mm above ground level.

D. Surge Protection Devices (SPDs)

Parameter	Requirement
Location 1: Mains input to controller	Combined Type 1+2 SPD per IEC 61643-11; Up ≤ 2.5 kV; discharge current Iimp ≥ 12.5 kA (10/350 µs)
Location 2: Controller output to beacon cable (external)	Type 2 SPD; Up ≤ 1.5 kV; Imax ≥ 40 kA (8/20 µs)
Location 3: Signal cables from photocell and ATC interface	Type 2/3 signal SPD appropriate to cable type; Up ≤ 80 V (signal circuits)
SPD status indication	Visual indication (cartridge colour / LED) for blown condition; accessible for inspection without dismantling
Replacement SPD modules	Two (2) complete replacement sets of each SPD type to be provided as part of the spare parts kit

2.08 FOUNDATION AND MOUNTING STRUCTURE

A. Foundation

1. A reinforced concrete (RC) foundation shall be designed and constructed specifically for this beacon installation, taking account of all applicable loads.
2. The foundation and mounting structure shall be structurally designed to resist the following simultaneous design actions
   a. Seismic Zone 4 per BCP-SP-40-2007 (design PGA 0.40g at Skardu).
   b. Design wind speed 160 km/h (3-second gust) per ICAO Doc 9157 and local meteorological data.
   c. Snow load per IS/BS applicable standard for Skardu conditions (reference PMD Skardu snow depth records).
   d. Dead load of beacon + mast + ancillaries with a minimum 25% dynamic magnification factor.

3. Foundation dimensions, reinforcement, and concrete grade shall be shown on approved shop drawings.
4. Concrete works shall comply with Section 0150 – Concrete Works of this Volume.
5. Anchor bolts: stainless steel Grade 316, sized per structural design; installed with bolt templates during concrete pour.
6. Foundation top surface: levelled to ±2 mm in any 1,000 mm using a precision levelling instrument; bearing surface clean and free from irregularities.

B. Mounting Mast / Pedestal

Parameter	Requirement
Material	Hot-dip galvanised structural steel (S275 or S355) or marine-grade aluminium alloy 6061-T6
Height above finished ground / roof level	As per drawings and ICAO Annex 14 §4.7 siting requirements; Engineer's approval required
Surface treatment	Hot-dip galvanised and painted white or light grey; UV-stable 2-pack epoxy topcoat; minimum total DFT 250 µm
Cable access	Watertight cable entry point at base; internal cable duct or surface channel to beacon head; rodding eye at bends
Access for maintenance	If mast height > 3 m: provide fall-arrest anchor point; if height > 6 m: fixed ladder with safety cage per EN ISO 14122
Levelling	Adjustable base plate with levelling bolts; final levelled and grouted with non-shrink epoxy grout
Vibration isolation	Anti-vibration pads between mast base plate and foundation where rotating beacon is used

PART 3 – EXECUTION

3.01 EXAMINATION AND PRE-WORK CONDITIONS

1. Before commencing work, the Contractor shall inspect and confirm: proposed beacon location is consistent with ICAO Annex 14 §4.7 siting criteria (unobstructed 360° horizontal visibility, not in OLS surfaces, not within restricted areas requiring additional clearance); coordinate with Engineer and PCAA to confirm siting is approved.
2. Soil conditions at the proposed foundation location shall be inspected; if unsuitable bearing material is encountered, notify the Engineer immediately.
3. Existing underground services at the cable route shall be identified and located using a cable/pipe detection survey. The Contractor assumes responsibility for any damage to unmarked services if this survey has not been completed.

4. The Contractor shall verify that the mains power supply available at the ATCT switchboard is adequate for the beacon controller connection (circuit rating, RCD protection, isolator).
5. No work shall proceed until the Engineer confirms the inspection as satisfactory in writing.

3.02 FOUNDATION AND MAST INSTALLATION

A. Foundation Works

1. Excavate to the dimensions and levels shown on the approved shop drawings.
2. Compact sub-grade to 95% Modified Proctor density; notify Engineer for inspection before blinding layer.
3. Blinding layer: 75 mm C10 lean concrete on undisturbed formation.
4. Install reinforcement cage per structural drawings; maintain minimum 50 mm cover on all sides; cover spacers shall be plastic, not timber.
5. Set anchor bolt template to exact plan position and plumb with a spirit level; check and lock before concrete pour.
6. Place and vibrate C25/30 concrete; cure for minimum 7 days before any load application; cure for 28 days before mast erection.
7. Concrete test cubes: take minimum one (1) set of three (3) cubes per pour; test at 7 and 28 days; submit results to Engineer.

B. Mast Installation and Alignment

1. Erect mast on anchor bolts with correct washers and nuts; do not tighten fully until levelling is verified.
2. Level the mast to within ±0.1° of vertical (plumb) in two orthogonal planes using a precision spirit level or digital inclinometer.
3. Once levelled, tighten anchor bolts to specified torque (per structural design); apply thread-locking compound.
4. Fill void under base plate with non-shrink epoxy grout; allow to cure before applying full load.
5. Apply sealant bead around perimeter of base plate to exclude water.

C. Beacon Head Mounting and Alignment

1. Mount beacon head on mast per manufacturer's installation instructions.
2. Connect all cables before final tightening of beacon mounting bolts.
3. Level/align beacon head per manufacturer's instructions such that the optical beam centre is directed as required; check vertical angle of beam centre (target: 2–5° above horizontal for typical airport configuration – confirm with Engineer).
4. Apply anti-seize compound to all stainless fasteners.

5. Do not leave beacon lens/dome uncovered during installation; reinstall all covers and seals before any test.

3.03 EARTHING AND LIGHTNING PROTECTION INSTALLATION

1. Drive earth rods vertically at approved locations; do not use hammers that will distort the rod coupling threads.
2. Make all underground connections by exothermic welding (Cadweld or approved equivalent); inspect and photograph each connection before backfilling.
3. Measure earth resistance of each rod individually before connection to ring, and of the complete system after connection – record all values.
4. If system resistance exceeds 5 Ω, install additional rods or a deep-driven rod until target is achieved; notify Engineer before backfilling.
5. Backfill trenches in layers of maximum 150 mm; compact each layer. For rods in rocky ground, use approved low-resistivity soil enhancement compound (bentonite or equivalent) to reduce contact resistance.
6. Install all bonding conductors; make bonding connections before installing SPDs.
7. Install SPDs as specified in Clause 2.07.D; connect in accordance with manufacturer's instructions and IEC 62305-3 for separation distances from main conductors.
8. Install air termination and down conductor; fasten with approved copper or stainless-steel cleats at maximum 1,000 mm spacing.
9. After full system installation, perform final earth resistance measurement and record; submit test certificate.

3.04 CABLING AND CONDUIT INSTALLATION

1. Install all conduit before pulling cable; prove each conduit run by rodding through with the largest mandrel specified.
2. Lay underground HDPE conduit in clean sand bedding (150 mm below, 150 mm above); cover tiles and orange warning tape at 300 mm above conduit.
3. Pull cables with a calibrated pulling grip; maximum pulling tension shall not exceed cable manufacturer's stated limit.
4. Provide minimum 10% spare length (slack loop) at each termination point.
5. Terminate all conductors with appropriate copper lugs; crimp with a ratchet crimping tool. No open twist connections.
6. Apply heat-shrink insulation sleeves over crimp lugs; label each terminal per the wiring schedule.
7. Megger test all power cables at 500 V DC before connection to equipment; minimum insulation resistance: 100 MΩ; record all values.

8. Megger test all control/signal cables at 250 V DC; minimum insulation resistance: 100 MΩ; record all values.
9. Cable screen (shield) shall be earthed at the controller end only (single-point earthing); insulate screen at the remote end.
10. After termination, continuity test each cable core; verify polarity at both ends.
11. Apply permanent cable tags at both ends of each cable; tags to be stainless steel or UV-stable nylon, engraved or UV-printed – no hand-written or adhesive labels.

3.05 CONTROLLER, PHOTOCELL, AND ATC INTERFACE INSTALLATION

1. Mount controller cabinet on approved wall brackets in the designated plant/equipment room of the ATCT; height of work-access 1,200–1,500 mm above finished floor level for the main operating controls.
2. Controller cabinet shall be fixed with anti-vibration mounts where structure-borne vibration is possible from HVAC equipment.
3. Mount photocell on external bracket in a location with clear view of sky, unshaded from sunrise to sunset, and inaccessible to casual tampering.
4. Route photocell cable in weatherproof conduit from photocell to controller; conduit entry to controller via an IP-rated cable gland.
5. Install ATC console interface panel at the agreed location within the ATC working position; route control cable in dedicated trunking or conduit, clearly labelled and segregated from other cables.
6. After installation, verify correct polarity and cable identity at all termination points before energising.

3.06 PRE-COMMISSIONING, OPERATIONAL TESTING, AND ATC INTEGRATION TESTING

A. Pre-Commissioning Checks

Before energising, the Contractor shall complete and record all of the following:

Test / Check	Acceptance Criterion
Insulation resistance – power cables	≥ 100 MΩ at 500 V DC
Insulation resistance – control cables	≥ 100 MΩ at 250 V DC
Cable continuity and polarity	Zero resistance path; correct polarity at both ends
Earth resistance – individual rods	Record actual value (informational)

Earth resistance – complete system	≤ 5 Ω
Bonding continuity	< 0.1 Ω between beacon base and MET
Mast plumb / vertical alignment	≤ 0.1° deviation in both planes
Beacon head optical alignment	Beam centre 1°–10° above horizontal (verify with inclinometer)
Conduit installation and sealing	All conduit entries sealed; warning tape installed
SPD installation check	All SPD modules installed; cartridges intact; connections per manufacturer's drawing
Controller wiring check	All terminals correctly labelled; connections per wiring schedule

B. Operational Commissioning Tests

1. **Initial Energisation**: Apply mains power under supervision; verify no earth faults, no tripped circuit breakers, no blown fuses; measure supply voltage at controller input terminals and record.
2. **Beacon start-up**: Activate beacon via ATC console; verify beacon illuminates within 5 seconds of activation command; record start-up time.
3. **Flash rate verification**: Using a calibrated photometer or stroboscope, measure flash rate over a minimum 3-minute period; record value – acceptable range: 20–30 fpm (factory set: 24 fpm ±1 fpm).
4. **Photometric output measurement**: Using a calibrated luminance meter / illuminance meter at a known distance (minimum 100 m), measure effective intensity of white beam; correct to 2,230 m AMSL atmospheric conditions per ICAO Doc 9157 §4.3 – minimum acceptable effective intensity: 2,000 cd.
5. **360° coverage check**: Conduct azimuth sweep (minimum 8 measurement positions at 45° intervals) to confirm uniform 360° coverage with no dark sectors exceeding 10° arc.
6. **Photocell auto-switching test**: Cover photocell with opaque material (simulate darkness); verify beacon activates automatically within the programmed response time. Remove cover; verify beacon deactivates. Record switching lux thresholds.
7. **Manual override test**: Test manual-ON and manual-OFF key-switch functions independently of photocell; verify correct operation.
8. **Fault alarm test**: Disconnect beacon head supply cable at controller (simulate open-circuit fault); verify fault alarm relay operates; verify alarm indication at ATC console within 5 seconds.

9. **UPS/battery backup test**: Isolate mains supply to controller; verify beacon continues to operate on UPS backup power; verify UPS ACTIVE indication at ATC console; measure actual backup duration – minimum required: 4 hours continuous operation at full load; record measured duration.
10. **Mains restoration test**: Restore mains supply; verify beacon remains ON and UPS commences recharge; verify no interruption to beacon during changeover.
11. **72-Hour Soak Test**: Operate beacon continuously in AUTO (photocell) mode for a minimum of 72 hours; Engineer to inspect at commencement and at conclusion; record any faults or anomalies.

C. ATC Integration Testing

1. With ATC console interface connected and powered: verify all status indicators on the ATC panel operate correctly (BEACON ON, BEACON FAULT, MAINS FAIL, UPS ACTIVE).
2. Test each ATC console activation button for correct beacon response.
3. Test pilot relay operation: activate beacon from ATC console; verify pilot relay closes and status is correctly output to the aerodrome management system or ATC operations board (as applicable); verify relay opens when beacon deactivates.
4. With a representative from Air Traffic Services present: conduct a walk-around visibility test, confirming beacon is visible from all traffic circuit positions and approach areas.
5. The Engineer and PAA/ATC representative shall sign the Integration Test Record before the commissioning certificate is issued.

D. Commissioning Certificate

The commissioning certificate shall be issued by the Engineer upon successful completion of all pre-commissioning checks, operational tests, and ATC integration tests. The certificate shall record:

1. Date of commissioning.
2. Identification of all equipment installed (manufacturer, model, serial numbers).
3. Summary of all test results with actual measured values versus acceptance criteria.
4. List of any outstanding items (if any) with agreed completion dates – no major items shall remain open.
5. Signatures: Contractor, Engineer, PAA Representative, ATC Representative.

3.07 ADJUSTING AND ALIGNMENT VERIFICATION

1. After the 72-hour soak test, re-verify beacon head alignment with an inclinometer; re-level if any settlement has occurred.
2. Re-verify photocell lux threshold calibration in the final installed position in daylight; adjust if required.
3. Confirm all cable labels and conduit labels are still legible and correctly positioned after construction activity; replace any damaged labels.

3.08 CLEANING

1. Clean beacon lens/dome and optical surfaces with manufacturer's approved cleaning solution immediately before commissioning photometric test.
2. Remove all construction debris, packaging, and waste material from the installation area.
3. Touch up any damaged paint or galvanising on mast/structure before handover.
4. Verify all waterproof seals and gaskets are undamaged and correctly seated.

3.09 MEASUREMENT AND PAYMENT

A. Measurement

The aeronautical beacon system shall be measured as a single lump-sum item (1 No. – Complete System) and shall be deemed to include all works described in this Section and all associated incidentals. No separate measurement shall be made for the following, which shall be included in the rate:

1. All excavation, backfill, reinstatement, and disposal.
2. Concrete blinding, foundation (RC), and curing.
3. Anchor bolts, levelling bolts, epoxy grout, and sealants.
4. Mast / pedestal, access provisions, and anti-corrosion treatment.
5. Beacon head, controller, photocell, and ATC console interface panel.
6. All cabling, conduits, cable glands, lugs, labels, and trays.
7. Earthing system and lightning protection system (including SPDs and spare SPD sets).
8. All pre-commissioning tests, operational tests, ATC integration tests, and 72-hour soak test.
9. All submittals including shop drawings, test certificates, as-built drawings, O&M manuals, and commissioning certificate.
10. All permits, clearances, inspection fees, and PCAA coordination.
11. Spare parts kit as specified in Clause 1.07.
12. All temporary works, scaffolding, tools, and equipment necessary for installation.

B. Payment

Payment shall be made against the contract BOQ item rate as a single lump-sum. Interim payments may be approved by the Engineer in the following approximate proportions:

SECTION 0910 – AIRPORT CRASH ALARM AND EMERGENCY ALERTING SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

This Section specifies the design, supply, installation, testing, and commissioning of a complete Airport Crash Alarm and Emergency Alerting System (hereinafter 'the System') for the Air Traffic Control Tower (ATCT) and Aircraft Rescue and Fire Fighting (ARFF) Station at Skardu International Airport, Gilgit-Baltistan, Pakistan.

The System shall provide immediate, reliable multi-modal (audible and visual) alerting to all ARFF personnel and vehicles upon receipt of any declared aircraft emergency or accident, conforming to the alerting standards and response-time objectives prescribed by ICAO Doc 9137 Part 1 and FAA Advisory Circular 150/5210-7D.

Work under this Section includes but is not limited to:

1. Crash Alarm Control Panel (CACP), including built-in uninterruptible power supply and battery backup.
2. Crash alarm push-button initiation stations at the ATC Tower Watch Supervisor Console and at crash-gate locations.
3. Electronic hooters, sirens, and crash bells at the ARFF appliance bays, watch room, dormitory, and external facade.
4. Amber stroboscopic visual alarm beacons at ARFF station interior and exterior locations.
5. Dedicated direct-line crash telephone (hotline) between the ATC Tower and the ARFF Station Watch Room.
6. Remote annunciator panel at the ATC Tower base lobby.
7. All associated conduit, cable, junction boxes, supports, labelling, earthing, testing, documentation, and commissioning.

B. Related Sections

1. Section 0010 – General Requirements
2. Section 0150 – Concrete Works
3. Section 0620 – Earthing / Grounding System
4. Section 0490 – General Requirements for Electrical Works
5. Section 0530 – Low Tension Switchboards / LT Outdoor Distribution Boards
6. Section 0740 – CNS Equipment
7. Section 0660 – Intelligent Addressable Fire Alarm System
8. Section 0500 – Low Voltage Diesel Generator Set

9. Section 0570 – Uninterruptible Power Supply (UPS) System
10. Section 0590 – Low Tension Cables
11. Section 0610 – Conduits and Pipes
12. Section 0630 – Lightning Protection System
13. Section 0780 – Voice Alarm and Public Address System
14. Section 0820 – Automatic Fire Detection System (AFDS)
15. Section 0880 – Building Management System (BMS)
16. Section 0900 – Aeronautical Beacon System

1.02 REFERENCES

The following standards and codes shall apply to the latest edition in force at the date of tender, unless a specific edition is cited. In case of conflict, the more stringent requirement shall govern. Where ICAO Standards and Recommended Practices (SARPs) conflict with any national or British standard, the ICAO SARPs shall prevail for aerodrome-safety-critical systems.

Standard / Code	Title / Description
ICAO Doc 9137 Part 1	Airport Services Manual – Rescue and Fire Fighting
ICAO Annex 14 Vol. I	Aerodromes – Aerodrome Design and Operations
ICAO Doc 9157 Part 4	Aerodrome Design Manual – Visual Aids
FAA AC 150/5210-7D	Aircraft Rescue and Fire Fighting Communications
FAA AC 150/5220-4B	Water Supply Systems for Aircraft Fire and Rescue Protection
NFPA 72	National Fire Alarm and Signaling Code (Latest Edition)
NFPA 403	Standard for Aircraft Rescue and Fire Fighting Services at Airports
NFPA 101	Life Safety Code
BS EN 54-1	Fire Detection and Fire Alarm Systems – Introduction
BS EN 54-2	Fire Detection and Fire Alarm Systems – Control and Indicating Equipment
BS EN 54-16	Fire Detection and Fire Alarm Systems – Voice Alarm Control & Indicating Equipment
IEC 60849	Sound Systems for Emergency Purposes
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
BS 5839 Part 1	Fire Detection and Fire Alarm Systems for Buildings
IEEE Std 446	Recommended Practice for Emergency and Standby Power Systems

BCP 2021	Building Code of Pakistan – Seismic Provisions (Seismic Zone 4)
Pakistan Electricity Act 1910 / Rules 1937	Local Electrical Regulatory Requirements
IEE Wiring Regulations	Institution of Electrical Engineers Wiring Regulations (Latest)

1.03 DEFINITIONS

1. **ARFF**: Aircraft Rescue and Fire Fighting, as defined in ICAO Doc 9137 Part 1.
2. **ATC**: Air Traffic Control. For this project, refers to the new ATCT at Skardu International Airport.
3. **Crash Alarm**: An audible and/or visual signal activated to alert ARFF personnel to an aircraft emergency or accident requiring an immediate emergency response.
4. **Crash Bell / Hooter**: Generic terms for the electromechanical bell (motorised gong) or electronic sounder (siren/hooter) that generates the crash alarm audible signal.
5. **CACP**: Crash Alarm Control Panel – the central supervisory unit that monitors alarm inputs, executes alarm logic, activates all outputs, and provides status indication.
6. **Direct-Line (Crash) Telephone**: A dedicated, permanently-connected telephone circuit (hotline) between the ATC Watch Supervisor position and the ARFF Watch Room. No dialling is required; lifting the handset initiates connection.
7. **Level of Protection (LoP)**: The ICAO ARFF category assigned to the aerodrome (Level 4 assumed for Skardu; to be confirmed by PAA/CAA). The System shall be scalable for higher LoP.
8. **LSZH**: Low-Smoke, Zero-Halogen – cable jacket compound producing minimal smoke and no halogenic gases when exposed to fire.
9. **Engineer**: The Engineer or his duly authorised representative appointed by the Employer under the Contract.

1.04 SYSTEM DESCRIPTION

A. Functional Overview

1. The System shall be a self-contained, supervised, dedicated aerodrome crash-alarm installation entirely separate from the building fire detection and alarm system. It shall not share field devices, cabling, or control panels with the NFPA 72 building fire alarm system specified under Section 0660 – Intelligent Addressable Fire Alarm System.
2. Upon activation of any initiation device, the CACP shall simultaneously and within three (3) seconds:
   a. Activate all audible alarm devices (hooters, sirens, and crash bells) at the ARFF Station.
   b. Activate all visual strobe beacons at the ARFF Station.
   c. Illuminate all alarm-level LED indicator lamps and text annunciators on the CACP and on the remote annunciator panel.
   d. Record the event in the non-volatile event log with date, time, initiating device identity, and alarm level.

e. Transmit a dry-contact (volt-free) output for integration with the BMS for supervisory monitoring.

B. Alert Levels

The System shall support the following graduated alert levels in accordance with ICAO Doc 9137 Part 1, Section 2, and FAA AC 150/5210-7D. Each level shall produce a distinctive audible tone sequence and distinct LED colour coding as tabulated below.

Alert Level	Definition	ARFF Action Required
STANDBY	Aircraft in distress (precautionary); ATC notified. One (1) alarm tone pulse.	ARFF crew at stations, vehicles ready
LOCAL STANDBY	Aircraft experiencing non-critical difficulty; ARFF vehicles move to designated hold points.	Vehicles staged at runway threshold
FULL EMERGENCY	Aircraft has declared emergency; potential crash or overrun imminent.	All ARFF vehicles respond; crash gates open
AIRCRAFT ACCIDENT	Aircraft has crashed on or near the aerodrome.	Maximum response; mutual aid activated
ALL CLEAR / CANCEL	Emergency resolved; stand down all ARFF units.	Return to station; log entry required

Audible differentiation between alert levels shall be achieved by the following tone sequences, programmable via the CACP operator interface:

1. STANDBY: One (1) continuous 3-second tone burst, repeated at 30-second intervals.
2. LOCAL STANDBY: Two (2) alternating tone bursts (whoop-whoop), repeated continuously.
3. FULL EMERGENCY: Continuous fast-rate warble tone (Hi-Lo, 600/1000 Hz), no interruption.
4. AIRCRAFT ACCIDENT: Continuous fast-rate warble tone plus manual PA voice announcement capability activated on same channel.
5. ALL CLEAR / CANCEL: Three (3) short beeps followed by silence; automatically silences all audible outputs.

C. Initiation Points

Alarm initiation shall be possible from the following points:

1. ATC Watch Supervisor Console (primary initiation): Dedicated crash alarm push-button panel, key-switch protected, located within immediate reach of the Watch Supervisor.
2. Crash Gate Stations: Remote push-button stations at each manned or remotely supervised crash gate to allow ground observers to initiate an alarm.
3. Direct-Line Crash Telephone: Lifting the ARFF Watch Room crash telephone handset shall automatically illuminate an incoming-call indicator at the ATC Tower; the ATC Watch Supervisor may verbally declare the alarm level, which the ARFF crew then inputs to the CACP.
4. Manual Override at CACP: The ARFF Watch Room Officer-in-Charge shall be able to initiate or escalate any alarm level directly at the CACP front panel, independent of ATC.

D. System Supervision

1. The CACP shall continuously monitor all field device circuits for open-circuit, short-circuit, and ground-fault conditions. Any fault shall generate a distinct FAULT indication (amber LED + audible buzzer) at the CACP and at the remote annunciator panel, without initiating an alarm.

2. A daily automated self-test shall be programmable to activate each output device for two (2) seconds between 08:00 and 08:30 local time, with all events recorded in the log. Manual self-test shall also be available at all times.

1.05 SUBMITTALS

Within 28 days of award, the Contractor shall submit the following for the Engineer's review and approval before procurement or installation commences:

1. Detailed system design drawings including single-line block diagram, riser/schematic diagram, device location plan overlaid on architectural drawings, and conduit routing plan.

2. Equipment data sheets and manufacturers' catalogues for all components, cross-referenced to the equipment schedule in Clause 2.01.

3. Cable schedule identifying cable type, size, route, and length for every circuit.

4. Alarm tone sequence programming proposal for Engineer's approval against ICAO Doc 9137 criteria.

5. Battery sizing calculation demonstrating 24-hour standby plus 30-minute full-alarm capacity per NFPA 72 Chapter 10.

6. Acoustic calculation confirming audible levels in all occupied ARFF spaces meet the 15 dB above ambient margin.

7. Manufacturer’s type test and routine test certificates demonstrating conformance to: EN†54-2 (CACP control and indicating equipment), EN†54-3 (electronic hooters and sirens), EN†54-23 (strobe visual alarm beacons), BS 5839 Part 1 (crash bells), and IEC†60849 (crash telephone circuit). Each certificate shall be cross-referenced to the corresponding item in the Equipment Schedule (Clause 2.01.A).

8. Commissioning and testing plan including pre-commissioning checks, functional test matrix, and acceptance test procedures.

9. Operation and Maintenance (O&M) manuals – draft prior to commissioning, final within 14 days of acceptance.

10. As-Built drawings on reproducible media and in AutoCAD/DWG format – submitted prior to final payment.

1.06 QUALITY ASSURANCE

1. The Contractor shall be a licensed electrical contractor authorised under the Electricity Act 1910 and Electricity Rules 1937 of Pakistan.

2. The crash alarm system installer shall have a minimum of five (5) years' verifiable experience in the installation and commissioning of aerodrome alerting or equivalent emergency notification systems, and shall furnish references upon request.

3. All equipment shall be new, un-used, and free from defects. Equipment from a single manufacturer shall be preferred for the CACP and all field devices to ensure system-wide compatibility and single-vendor accountability.

4. All equipment shall be CE-marked and/or listed to UL, FM, or equivalent third-party certification body acceptable to the Engineer. Equipment conforming to EN 54-16 (voice alarm) and EN 54-2 (control panels) is preferred.

5. All equipment shall be supported by manufacturer’s routine test certificates and, where applicable, type test certificates in accordance with the standards cited in Clause 1.02. Certificates shall be submitted as part of the equipment data package under Clause 1.05 and are mandatory for equipment approval prior to delivery to site.

1.07 DELIVERY, STORAGE AND HANDLING

1. All equipment shall be delivered to site in original manufacturers' packaging with documentation intact. The Contractor shall verify quantities and check for transit damage upon delivery and notify the Engineer immediately of any discrepancies.

2. Equipment shall be stored in a dry, weather-protected, heated (minimum 5°C) storeroom. Battery modules shall not be stored at temperatures below 5°C and shall be maintained on trickle charge from date of delivery.

3. Given the remote location and altitude of Skardu (2,228 m MSL), the Contractor shall account for high-altitude de-rating of electronic equipment and ensure all selected equipment is rated for operation at or above 2,500 m MSL.

1.08 SITE CONDITIONS

1. Skardu International Airport, Gilgit-Baltistan, Pakistan. Latitude approximately 35.3°N, Longitude 75.6°E. Elevation 2,228 m (7,310 ft) MSL.

2. Ambient temperature range: −10°C to +41°C per Electrical Design Report. All equipment shall be rated for this full range without derating below specification.

3. Maximum humidity: 90% RH non-condensing.

4. Seismic Zone 4 per Building Code of Pakistan (BCP 2021). All panel racks, wall-mounted units, and cable tray shall be seismically braced and anchored per BCP seismic provisions.

5. Snow loading is significant in winter months. All outdoor-mounted or roof-mounted components shall be designed for a snow load of not less than 2.0 kPa on any horizontal surface, with drainage details to prevent ice bridging over cable entry points.

6. The site is subject to strong katabatic winds. All external enclosures shall be mechanically fastened and gasketed for wind-driven rain resistance equivalent to IP 65.

1.09 WARRANTY

1. The Contractor shall provide a written warranty, from the equipment manufacturer, covering defects in materials and workmanship for a minimum period of twenty-four (24) months from the date of the Completion Certificate issued by the Engineer.

2. During the warranty period, the Contractor shall respond to any system fault or failure within forty-eight (48) hours and restore full system operability within seventy-two (72) hours. ARFF response capability shall be maintained at all times during any maintenance or repair.

3. A list of recommended spare parts for two (2) years' operation, with unit prices, shall be submitted with the O&M manual.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Equipment Schedule

The minimum equipment to be supplied, installed, and commissioned under this Section is tabulated below. Quantities are indicative; the Contractor shall verify quantities from coordinated architectural and electrical drawings.

Tag	Equipment Item	Location	Quantity
CACP-01	Crash Alarm Control Panel	ARFF Fire Station – Equipment Room	1 No.
CAP-01	Crash Alarm Push Button (ATC)	ATC Tower – Watch Supervisor Console	1 No.
CAP-02	Crash Alarm Push Button (Remote)	Crash Gate No. 1	1 No.
CAP-03	Crash Alarm Push Button (Remote)	Crash Gate No. 2 (if provided)	1 No.
HO-01	Electronic Hooter / Siren (110 dB)	ARFF Station – Appliance Bay (East)	1 No.
HO-02	Electronic Hooter / Siren (110 dB)	ARFF Station – Appliance Bay (West)	1 No.
CB-01	Crash Bell (200mm gong)	ARFF Station – Watch Room	1 No.
CB-02	Crash Bell (200mm gong)	ARFF Station – Rest Room / Dormitory	1 No.
STR-01	Visual Strobe Beacon (Amber)	ARFF Station – External Facade	2 No.
STR-02	Visual Strobe Beacon (Amber)	Appliance Bay Interior, each bay	2 No.
TP-01	Crash Telephone (Direct Line)	ATC Tower – Watch Supervisor Console	1 No.
TP-02	Crash Telephone (Direct Line)	ARFF Station – Watch Room	1 No.
PSU-01	Dedicated Power Supply Unit + 24hr Battery Backup	ARFF Station – Equipment Room	1 No.
ANN-01	Annunciator / Repeater Panel	ATC Tower Base / Entry Lobby	1 No.

B. Performance Envelope

All system components shall comply with the following performance parameters as a minimum:

Parameter	Requirement
Operating Temperature	−10°C to +41°C (Site ambient per Electrical Design Report)
Altitude	≥ 2,228 m MSL – equipment rated for high-altitude operation; de-rating applied where required
Humidity (max.)	90% RH non-condensing
Seismic	Seismic Zone 4 per BCP 2021; all racking and mounting to resist 0.3g horizontal acceleration
Audible Level – Hooter/Siren	Minimum 110 dB(A) at 1 m; minimum 15 dB(A) above ambient in all occupied ARFF spaces
Audible Level – Crash Bell	Minimum 90 dB(A) at 1 m
Visual Beacon Flash Rate	60–120 flashes per minute per NFPA 72
Panel Response Time	Alarm activation to all outputs within 3 seconds of pushbutton operation
Backup Power Duration	Minimum 24 hours standby followed by 30-minute alarm condition per NFPA 72
Cable Insulation Rating	Minimum 450/750 V; fire-rated (LSZH) for all alarm circuits
Enclosure – External devices	Minimum IP 65 per IEC 60529
Enclosure – Indoor panel	Minimum IP 41 per IEC 60529; dust and vermin proof
MTBF (minimum)	50,000 hours for control panel and all field devices
Warranty	Minimum 24 months from date of Completion Certificate

2.02 CRASH ALARM CONTROL PANEL (CACP)

A. General

The CACP shall be the central intelligence and power distribution unit of the System. It shall be a microprocessor-based unit specifically designed for aerodrome crash-alarm or equivalent industrial emergency alerting applications.

B. Enclosure

1. Wall-mounted, sheet steel, minimum 1.5 mm thick, powder-coated RAL 7035 light grey.
2. Hinged lockable door with internal illumination.
3. Minimum IP 41 per IEC 60529, dust-proof and vermin-proof.
4. Equipped with perforated bottom cable entry plate with removable blanking plugs.
5. Minimum internal dimensions: 600 mm (H) × 500 mm (W) × 200 mm (D). Final dimensions to accommodate all internal components with 30% spare space.

C. Control and Indication

The CACP front panel shall provide as a minimum:

1. Alarm-level selector pushbuttons (one per level) with illuminated surround and mechanical guards to prevent accidental activation.
2. Individual LED status indicators per field circuit (green = healthy, amber = fault, red = active alarm), minimum 5 mm diameter LEDs.
3. POWER ON indicator (green).
4. MAINS FAIL indicator (amber) with battery voltage digital display.
5. SYSTEM FAULT indicator (amber) with audible buzzer and silence pushbutton.
6. ALARM ACTIVE indicator (red, flashing) with manual reset pushbutton (key-switch protected).
7. ALL CLEAR / CANCEL pushbutton (key-switch protected) to silence all outputs and reset the system.
8. LCD alphanumeric display, minimum 4 lines × 40 characters, backlit, displaying real-time event status and event log.
9. USB port and/or Ethernet port for event-log download and remote monitoring.

D. Processing and Logic

1. The CACP shall incorporate dual redundant microprocessors (active-standby configuration) so that failure of any single processor does not impair system functionality.
2. All alarm logic (input prioritisation, output sequencing, zone mapping) shall be field-configurable via password-protected software accessible through the front panel LCD and keypad or via a laptop connected to the service port. No proprietary programmer shall be required for routine reprogramming.
3. The CACP shall maintain a non-volatile event log with a minimum capacity of 5,000 events, each entry recording: date, time (to 1-second resolution), event type, device identity, and operator ID (if applicable). The log shall be downloadable to standard CSV format.

E. Input / Output Capacity

1. Minimum supervised input circuits: 8 addressable or zoned, expandable to 16.
2. Minimum supervised output circuits: 8, each rated minimum 2 A at 24 V DC, expandable to 16.
3. Dry-contact (volt-free) relay outputs: minimum 4, rated 5 A / 250 V AC, for BMS integration and remote annunciator.
4. All input and output circuits shall be end-of-line (EOL) resistor-supervised for open and short circuit, with each fault condition individually annunciated.

2.03 ALARM INITIATION DEVICES – CRASH ALARM PUSH-BUTTON STATIONS

1. Push-button stations shall be specifically manufactured for aerodrome crash-alarm applications. Each station shall comprise:
   a. Stainless steel or ABS front plate, flush or surface mounting.

b. Minimum one (1) illuminated pushbutton per alert level, RED in colour, 40 mm minimum diameter, recessed 3 mm behind flush guard to prevent accidental activation.
c. Key-switch (RESET / CANCEL) for authorised cancellation of alarm.
d. Integral alarm-level selector (or selector at CACP with remote push-button activation).
e. Separate acknowledgement (ACK) button.
f. Weatherproof to IP 54 minimum for crash-gate stations; IP 41 for indoor ATC console stations.

2. The push-button at the ATC Watch Supervisor Console shall be integrated into the console furniture with a lockable clear polycarbonate hinged cover engraved 'CRASH ALARM – LIFT COVER TO OPERATE'.

3. Remote crash-gate push-button stations shall be housed in a bright-red powder-coated steel enclosure, mounted at 1,400 mm above finished floor level, with 100 mm high retroreflective label reading 'CRASH ALARM'.

2.04 AUDIBLE ALARM DEVICES

A. Electronic Hooters / Sirens

Electronic hooters/sirens shall be self-contained units designed for high-ambient-noise industrial or aerodrome environments. Technical requirements:

1. Output: minimum 110 dB(A) at 1 m, measured in a free field at the rated supply voltage.
2. Tone patterns: minimum 10 programmable tone patterns including continuous, pulsed, warble (Hi-Lo), and swept-frequency whoop.
3. Frequency range: 400 Hz to 3,200 Hz (primary fundamental), selectable.
4. Supply voltage: 24 V DC from the CACP, supervised circuit.
5. Current draw: not exceeding 500 mA at rated output.
6. Enclosure: minimum IP 65 per IEC 60529; UV-stabilised ABS or die-cast aluminium; operating range −20°C to +55°C.
7. Mounting: wall/ceiling bracket with 360° horizontal adjustment; cable entry from rear or base with IP-rated gland.
8. Colour: red or orange RAL 2009, as approved by the Engineer.
9. Certification: CE-marked; FM or UL listed; or equivalent to EN 54-3 (Fire Alarm Sounders).

B. Electromechanical Crash Bells

Crash bells shall be motorised gong-type electric bells suitable for aerodrome and fire-station applications. Technical requirements:

1. Gong diameter: minimum 200 mm (8 inches) chrome-plated steel.
2. Striking mechanism: self-interrupting solenoid or motor-driven, continuous operation rated.
3. Sound output: minimum 90 dB(A) at 1 m.
4. Supply voltage: 24 V DC, supervised circuit from CACP.

5. Enclosure: weather-resistant die-cast aluminium or brass housing; minimum IP 54.
6. Colour: bright red or fire-engine red; gong and hammer exposed for visual confirmation of operation.
7. Mounting: wall or ceiling bracket with screwed conduit entry; vibration-absorbing pad between bell body and mounting surface.
8. Conformance: manufactured and tested in accordance with BS 5839 Part 1 or equivalent.

2.05 VISUAL ALARM DEVICES – STROBOSCOPIC BEACONS

Visual alarm beacons shall supplement audible devices in high-noise environments (appliance bays) and provide visual alerting where hearing protection is worn. Requirements:

1. Light source: high-intensity Xenon strobe or LED array.
2. Colour: Amber (yellow) per NFPA 72 Table 18.5.5.5 for non-fire emergency visual signals; must be distinctly different from red fire alarm strobes. [NOTE: Confirm colour coding with PAA/ATC authority prior to procurement]
3. Flash rate: 60 to 120 flashes per minute per NFPA 72.
4. Luminous intensity: minimum 15 candela (cd) in all directions of the protected space; calculation to demonstrate compliance with NFPA 72 photometric requirements.
5. Supply voltage: 24 V DC, supervised circuit from CACP.
6. Enclosure: minimum IP 65 for external-facade units; minimum IP 41 for indoor units.
7. Mounting: surface or conduit-entry box; 360° lens for corridor/appliance bay wide-angle coverage preferred.
8. Certification: CE-marked; listed to EN 54-23 (Visual Alarm Devices) or UL 1971.

2.06 DIRECT-LINE CRASH TELEPHONE (HOTLINE)

1. The crash telephone system shall provide a dedicated, always-available, no-dial voice circuit between the ATC Watch Supervisor position and the ARFF Watch Room, conforming to FAA AC 150/5210-7D requirements for aerodrome emergency communications.
2. The crash telephone shall be:
   a. A two-wire dedicated private line (not routed through the PABX or public exchange) – separate physical pair.
   b. Designed so that lifting either handset automatically establishes the connection and rings the opposite instrument.
   c. Equipped with a loud ringing alert (minimum 85 dB(A) at 1 m) and a flashing visual indicator (red LED ring around handset base).
   d. Provided with a backup internal battery capable of maintaining the telephone circuit operational for a minimum of 4 hours on loss of mains power, in addition to the CACP backup battery.
   e. Housed in a distinctive red handset cradle/case labelled 'CRASH PHONE – DO NOT USE FOR ROUTINE CALLS' in both English and Urdu.
   f. Wall-mounted at 1,200 mm AFFL, within 600 mm of the Watch Supervisor chair position at the ATC console.

3. Cable: Dedicated 2-core LSZH telephone cable (minimum 0.5 mm² conductors, 300 V rated) installed in separate conduit from all other systems.

2.07 POWER SUPPLY AND BATTERY BACKUP

1. The CACP shall incorporate a dedicated regulated dual-source power supply unit (PSU) comprising:
   a. Mains Input: 230 V AC ±10%, 50 Hz single phase, from a dedicated ARFF station circuit breaker on the distribution board.
   b. DC Output: 24 V DC ±5% regulated, ripple < 100 mV rms.
   c. Output Current: Sufficient to power all connected field devices at rated output simultaneously, plus 25% spare capacity.
   d. Battery Charger: Intelligent float/equalise charger with automatic boost charge after discharge, temperature-compensated.

2. Standby Battery:
   a. Sealed valve-regulated lead-acid (VRLA) or equivalent maintenance-free technology.
   b. Capacity: Sized to maintain the System in STANDBY mode for a minimum of 24 hours, followed by a minimum of 30 minutes in full ALARM condition, per NFPA 72 Chapter 10.
   c. Battery sizing calculation shall be submitted with the system design documentation as required under Clause 1.05.
   d. Battery ambient temperature at the installation location: 5°C to 35°C; de-rating applied for temperatures outside the 20°C nominal range per manufacturer's data.
   e. Battery shall be housed within the CACP enclosure or in an adjacent battery cabinet on the same wall with inter-connecting LSZH cable.

3. An automatic voltage-regulator / surge-protection device (SPD) shall be installed at the mains input to the CACP, rated for Category III per IEC 61643-11, to protect against voltage surges and lightning-induced transients.

4. Loss of mains power shall be indicated immediately on the CACP front panel and transmitted to the BMS via volt-free contact without activating the alarm.

2.08 WIRING AND CABLES

1. All wiring shall comply with the general requirements of Section 0610 – Conduits and Pipes and Section 0590 – Low Tension Cables of this Volume, with the additional requirements below.

2. Field device circuits (alarm output and initiation input loops) shall use:
   a. LSZH-sheathed multi-core twisted pair cable, minimum 1.5 mm² stranded copper conductors, rated 300/500 V, with overall screen (drain wire, foil).
   b. Cable to be fire-resistant in accordance with IEC 60331-2, maintaining circuit integrity for minimum 60 minutes at 750°C (equivalent to BS 7629 or EN 50200 Category PH 60).

3. Crash telephone circuit cable: dedicated 2-core LSZH, 0.5 mm² minimum, 300 V, as specified in Clause 2.06.3.

4. All field device circuit cables shall be enclosed in dedicated steel or HDPE conduits. Crash alarm cables shall not share conduit with power circuits (230 V or 415 V), fire alarm cables, or IT/data cables.

5. Minimum conduit size: 20 mm diameter; no conduit shall carry more circuits than permitted by IEE Wiring Regulations (50% fill rule for multi-core cables in dedicated conduits).

6. All cables shall be labelled at both ends and at every junction box with a durable cable tag bearing circuit designation per the cable schedule. Cable tags shall be of the clip-on or tie-on type, heat-stamped or engraved; hand-written tags are not acceptable.

2.09 CONDUITS, JUNCTION BOXES, AND ENCLOSURES

1. Conduit shall comply with Section 0610 – Conduits and Pipes of this Volume. For the crash alarm system, rigid steel conduit (RSC) shall be used in all exposed or vulnerable locations (appliance bays, external, underground). HDPE heavy-duty conduit may be used underground with prior Engineer approval.

2. Junction boxes shall be:
   a. 16 SWG sheet steel (internal), hinged and gasketted for IP 54 minimum. External junction boxes: die-cast aluminium or GRP, IP 65 minimum.
   b. Labelled on the cover with engraved label: 'CRASH ALARM – AUTHORISED ACCESS ONLY'.
   c. Each box shall contain an EOL resistor in a labelled resistor holder as applicable.

3. All entry points for conduit, cables, and wiring to the CACP and field devices shall use IP-rated brass cable glands with PVC shroud, sized to maintain the enclosure IP rating.

2.10 EARTHING AND BONDING

1. The crash alarm system shall comply with Section 0620 – Earthing / Grounding System of this Volume. Additionally:
   a. The CACP chassis and all metallic field device enclosures shall be bonded to the building earth system via a dedicated 4 mm² green/yellow PVC-insulated copper earth conductor.
   b. Cable screens shall be earthed at one end only (CACP end) to avoid earth loops; the field end shall be left insulated, sleeved, and identified.
   c. The crash telephone dedicated pair cable screen shall be earthed at the ATC Tower end only.
   d. Earth resistance from any bonded component to the nearest earth electrode shall not exceed 1 Ω, per Section 0620 testing requirements.

2.11 SPARE PARTS

The following minimum spare parts shall be supplied with the System and handed over to the Owner at the time of acceptance:

1. Fuses: 100% of each type and rating used in the System.
2. EOL resistors: 200% of each value used.
3. Indicator LEDs: 200% of each type used on the CACP front panel.
4. Complete replacement hooter/siren: 1 No.
5. Complete replacement crash bell: 1 No.
6. CACP processor/controller board: 1 No. (or equivalent module per manufacturer's recommendation).

PART 3 – EXECUTION

3.01 EXAMINATION

1. The Contractor shall inspect all areas where the System is to be installed prior to commencement. Any condition detrimental to the installation – including uncompleted civil or structural works, inadequate access, or interference from other services – shall be reported to the Engineer in writing before work commences.

2. Commencement of installation shall constitute the Contractor's acceptance that existing conditions are satisfactory.

3.02 INSTALLATION

A. General

1. Installation shall be carried out by competent, licensed electricians supervised by a qualified engineer. The Contractor shall keep pace with the Civil Contractor's programme and shall coordinate all conduit embedment prior to concrete pours as specified in Section 0610 – Conduits and Pipes of this Volume.

2. Installation shall conform to the approved shop drawings, relevant IEE Wiring Regulations, the Pakistan Electricity Act/Rules, and the requirements of ICAO Doc 9137 Part 1.

B. Crash Alarm Control Panel

1. The CACP shall be mounted in the ARFF Station Equipment Room at a height with the centre of the display at approximately 1,500 mm AFFL. The wall construction shall be verified to support the panel weight plus battery cabinet; additional blocking or steel framing shall be provided if required.

2. A minimum 300 mm clear service space shall be maintained around all sides of the CACP and battery cabinet.

3. The CACP shall be earthed as described in Clause 2.10.

C. Field Devices

1. Hooters and crash bells shall be mounted at a minimum height of 2,400 mm AFFL in appliance bays and at 2,100 mm AFFL in the watch room and dormitory, positioned for maximum acoustic coverage and unobstructed sound propagation.

2. Strobe beacons in appliance bays shall be located so that the light source is visible from anywhere within the bay; multiple units shall be installed if single-unit coverage is insufficient per NFPA 72 photometric tables. Beacons shall not be aimed directly at vehicle operators' eye level.

3. External strobe beacons on the ARFF station facade shall be mounted at a height of minimum 3,000 mm above external finished ground level and shall be aimed to be visible from the crash-gate approach roads.

4. Push-button stations shall be accessible without obstruction at all times. Crash-gate stations shall be mounted on a separate post or on the gate control column, not on the gate itself.

D. Cables and Conduits

1. All cable installation shall comply with Section 0590 – Low Tension Cables of this Volume, with the additional LSZH and fire-resistance requirements of Clause 2.08.

2. Where crash alarm cables pass through walls or floor slabs, fire-rated duct sealant (intumescent type, minimum 2 hours' fire resistance) shall be applied around every cable penetration.

3. A minimum separation of 150 mm shall be maintained between crash alarm conduits and power conduits (230 V/415 V circuits). Where they must cross, crossing shall be at 90° with 50 mm clear separation.

3.03 FIELD QUALITY CONTROL

A. Pre-Commissioning Checks

Prior to energisation, the Contractor shall carry out the following checks and record results:

1. Visual inspection of all conduit, cable, junction boxes, and field devices for correct installation per approved drawings.

2. Continuity test of every circuit conductor from CACP terminal to field device terminal.

3. Insulation resistance test on every circuit at 500 V DC; minimum acceptable reading: 5 MΩ per Section 0490 – General Requirements for Electrical Works of this Volume.

4. Earth continuity test: ≤ 1 Ω from every bonded enclosure to main earth point per Clause 2.10.

5. Polarity check of all DC circuits.

6. Battery: Verify correct seating, terminal connection, and initial capacity by discharge test at rated load.

B. Functional Testing

After energisation and CACP programming, the Contractor shall conduct a comprehensive functional test in the presence of the Engineer, verifying each of the following:

1. Each initiation push-button activates the correct alarm level at the CACP within 3 seconds.

2. All hooters, sirens, crash bells, and strobe beacons activate simultaneously for every alarm level.

3. Correct tone patterns and alarm-level differentiation for each alert level.

4. CACP front-panel indicators, LCD display, and event log record each event correctly with accurate date and time.

5. Remote annunciator panel reflects all status changes.

6. Circuit fault simulation: each field-circuit EOL resistor removed in turn; CACP annunciates correct fault without initiating alarm.

7. Short-circuit simulation: each field circuit shorted in turn; CACP annunciates correct fault.

8. Mains power removed: CACP transfers seamlessly to battery; no alarm activation; MAINS FAIL indicator illuminates.

9. Battery capacity verification: system maintained under simulated standby load for 24 hours, followed by 30-minute full alarm load; voltage remains above CACP minimum operating voltage throughout.

10. ALL CLEAR / CANCEL function: all outputs extinguish; reset requires key-switch operation.

11. BMS dry-contact output verified to operate correctly at the BMS panel.

12. Crash telephone: both ATC and ARFF handsets tested for call initiation, audibility (speech quality), and visual ring indicator operation.

13. Acoustic measurement: sound level meter readings taken at representative positions in each protected space; minimum 15 dB above measured ambient documented.

3.04 COMMISSIONING AND ACCEPTANCE

1. Commissioning shall not commence without the Engineer's written approval of all pre-commissioning check results and all required submittals listed in Clause 1.05.

2. All functional test results shall be recorded on a test sheet signed by both the Contractor's commissioning engineer and the Engineer's representative. Three (3) copies of all test records shall be submitted to the Engineer within seven (7) days of test completion.

3. The Contractor shall demonstrate that each alarm level produces the correct response in an integrated manner with the ARFF crew at the ARFF Station. A live drill simulating a full emergency (FULL EMERGENCY level) shall be conducted at the request of the Engineer, with PAA ARFF management present.

4. The System shall not be accepted until all functional tests have been completed successfully. Any item failing to meet specification shall be rectified and re-tested at the Contractor's cost.

3.05 TRAINING

1. Prior to or concurrent with system acceptance, the Contractor shall provide formal training to the Employers' designated ARFF and ATC staff. Training shall cover:
   a. System overview, design intent, and alarm level philosophy per ICAO Doc 9137 Part 1.
   b. Operation of the CACP: alarm initiation, escalation, cancellation, and reset procedures.
   c.Daily self-test procedure.
   d. Fault indication recognition and basic fault investigation.
   e. Battery maintenance checks and replacement procedure.
   f. Use of the crash telephone hotline.
   g. Event log download and review.

2. Training sessions shall be a minimum of four (4) hours duration. The Contractor shall provide printed training materials in English. A training attendance register shall be signed by all trainees and submitted to the Engineer.

3.06 AS-BUILT DOCUMENTATION

1. The Contractor shall maintain accurate as-built records throughout installation, recording all deviations from the approved shop drawings. As-built drawings shall be submitted for Engineer's approval before the final payment certificate is issued.

2. As-built drawings shall include: system block diagram, riser/schematic diagram, device location plan (on coordinated architectural background), cable schedule, conduit routing plan, and CACP wiring diagram showing as-installed circuit connections.

3. Reproducible tracings and digital AutoCAD/DWG files shall be submitted. These drawings become the property of the Owner upon approval.

3.07 PROTECTION

1. The Contractor shall protect all installed System components from damage during subsequent construction activities. Protective covers shall be fitted over field devices until final acceptance. Any component damaged during construction shall be replaced at the Contractor's cost.

2. The crash alarm system shall remain operational (or be immediately restorable to operational status) at all times during the construction and commissioning phases, given that the ARFF facility may be required to support ongoing airport operations at Skardu International Airport.

PART 4 – MEASUREMENT AND PAYMENT

1. For the purpose of measurement and payment, the Airport Crash Alarm and Emergency Alerting System shall be treated as a lump-sum item inclusive of:
   a.All equipment, materials, labour, transport, and tools.
   b.All conduit, cable, junction boxes, supports, labels, and earthing.
   c.CACP programming, commissioning, and functional testing.
   d. Training, as-built documentation, O&M manuals, and spare parts.

2. Any items not explicitly listed in the Bill of Quantities but necessary for a complete, fully functional, and ICAO-compliant crash alarm system shall be deemed included in the Contractor's lump-sum rate.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SECTION 0920 – GYM AND EXERCISE EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

Scope: A.

This Section covers the supply, delivery, installation, testing and commissioning of commercial-grade gym and exercise equipment for the staff recreational gymnasium at Skardu International Airport, Gilgit-Baltistan. The equipment shall include cardiovascular machines, strength training systems, free weights and accessories, functional training equipment, gym flooring, mirrors, and fitness assessment devices as itemised in the Bill of Quantities (BOQ Section 2, Items i through xxviii).

Related Sections: B.

- Section 0010 – Submittal Procedures
- Section 0010 – Closeout Submittals
- Section 0150 – Resilient Sheet Flooring (for subfloor preparation)
- Section 0490 – Low-Voltage Electrical Distribution (for powered equipment circuits)
- Section 0010 – Site Office Facilities (for facility context)

1.2 REFERENCES AND APPLICABLE STANDARDS

All equipment shall comply with the latest editions of the following standards, as applicable to each equipment type:

STANDARD / CODE	TITLE / APPLICATION
ASTM F1250	Standard Specification for Motor-Driven Treadmill
ASTM F2115	Standard Specification for Stationary Bikes
ASTM F1749	Standard Terminology for Exercise Equipment
EN ISO 20957-1	Stationary Training Equipment — General Safety Requirements and Test Methods
EN ISO 20957-2	Strength Training Equipment — Safety Requirements and Test Methods
EN ISO 20957-5	Stationary Cycling Machines — Additional Safety Requirements
EN ISO 20957-6	Treadmills — Additional Safety Requirements
EN ISO 20957-7	Rowing Machines — Additional Safety Requirements
EN ISO 20957-10	Exercise Bikes with Fixed Wheels — Additional Safety Requirements
UL 1816 / IEC 60335	Safety of Household and Similar Electrical Appliances (motorised equipment)
CPSC 16 CFR Part 1207	Consumer Product Safety Standards for Exercise Equipment
BS EN 1177	Impact Attenuating Playground Surfacing — Determination of Critical Fall Height
ASTM F1292	Standard Specification for Impact Attenuation of Surfacing Materials within the Use Zone

Pakistan Electricity Rules 1937	For all electrically powered equipment connections
NEPRA Standards	For electrical installations within Pakistan

1.3 SUBMITTALS

The Contractor shall submit the following in accordance with Section 0010:

A. Product Data: Manufacturer's technical data sheets for each item of equipment, including dimensions, weight, electrical requirements (voltage, amperage, circuit type), structural loading, material specifications and finish options. Submit minimum 4 weeks before delivery.

B. Shop Drawings: Floor plan layout showing equipment placement, clearances, anchor locations, cable/power chase routing, and mirror mounting details. Drawn to minimum 1:50 scale.

C. Certificates: Copies of applicable EN ISO 20957, CE, UL, or ASTM certification for each equipment item from an accredited third-party testing laboratory. Equipment without valid certification shall not be accepted.

D. Samples: Colour/finish samples for frame powder-coat, upholstery, gym flooring, and mirror frame (where applicable) for Engineer's approval before bulk order.

E. Warranties: Executed manufacturer's warranty documents for each item, per Clause 1.6.

F. Operation and Maintenance Manuals: Manufacturer's manuals (in English) covering operating procedures, routine maintenance schedules, lubrication requirements, and spare parts list. Submit at Practical Completion.

G. Training Records: Written confirmation that operator training has been completed per Clause 3.5.

1.4 QUALITY ASSURANCE

Commercial Grade: A.

All equipment shall be of commercial grade, rated for continuous multi-user operation not less than 8 hours per day, 365 days per year. Residential or light-commercial grade equipment is not acceptable.

Manufacturer Qualification: B.

Each item shall be manufactured by a firm with a minimum of 5 years' experience producing commercial fitness equipment. Manufacturer shall have an established after-sales service and spare-parts network in Pakistan.

Installer Qualification: C.

Installation shall be carried out by personnel trained and authorised by the equipment manufacturer or their authorised distributor. Proof of authorisation shall be submitted to the Engineer prior to commencement of installation.

Pre-delivery Inspection: D.

The Engineer reserves the right to inspect equipment at the Contractor's storage facility or at the manufacturer's premises prior to delivery to site.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment in manufacturer's original packaging, clearly labelled with item description, model number, serial number, and weight.

B. Store in a clean, dry, weather-tight enclosure at site at temperatures between 5°C and 40°C. Equipment shall not be exposed to rain, condensation, or direct sunlight during storage.

C. Handle equipment using appropriate mechanical aids to prevent damage to frames, upholstery, electronic consoles, and finish surfaces. Do not drag equipment across finished floors.

D. Gym flooring and rubber mats shall be stored flat or on rolls as recommended by manufacturer; do not store under heavy loads.

E. Deliver mirrors in manufacturer's protective crates; handle with trained mirror-handling personnel. Do not store mirrors without edge protection.

1.6 WARRANTY

The Contractor shall provide manufacturer's written warranties as follows:

ATTRIBUTE	MINIMUM WARRANTY PERIOD
Structural/frame welds — cardiovascular machines	Lifetime of product (or min. 10 years)
Structural/frame welds — strength equipment	Lifetime of product (or min. 10 years)
Mechanical components (belts, bearings, pulleys, cables)	3 years
Electronic components / display consoles	3 years
Upholstery and upholstered pads	2 years
Treadmill drive motor	5 years
Treadmill running belt and deck	3 years
Gym flooring / rubber tiles	5 years
Wall-mounted mirrors (delamination, edge seal)	5 years
Free weights (barbells, dumbbells, plates, kettlebells)	5 years against cracking/deformation
Labour (all items)	1 year from date of Practical Completion

Warranty periods commence from the date of Practical Completion (TOC) of the Works. During the warranty period the Contractor shall replace defective parts and carry out all repairs at no cost to the Employer.

1.7 MAINTENANCE

A. Submit a 12-month preventive maintenance schedule with the O&M Manuals covering: lubrication intervals, belt tension checks, pad inspection, calibration of monitoring equipment, and electrical safety checks.

B. Contractor shall carry out a maintenance service visit at 6 months and 12 months after TOC as part of the Contract obligations.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR ALL EQUIPMENT

A. All exposed steel frames shall be finished with minimum 2-coat thermosetting powder-coat paint, minimum 60–80 microns total dry film thickness, hardness ≥ 2H pencil, cross-hatch adhesion Class 0 per ISO 2409.

B. All bolted connections shall use stainless steel or zinc-plated hardware. Anti-loosening provisions (nylon-insert nuts, thread-lock adhesive, or split washers) shall be used on all vibration-prone joints.

C. Upholstery for pads, seats and back-rests: minimum 8 lb/ft³ high-density foam with anti-microbial, moisture-resistant vinyl or commercial gym upholstery fabric. Stitching: double-stitched with UV-stable polyester thread.

D. All motorised equipment shall be rated for the local electrical supply: 220–240 V / 50 Hz / single-phase or 380–415 V / 50 Hz / three-phase as stated per item. Equipment shall include built-in surge protection and emergency stop feature.

E. Digital consoles (where specified) shall display: elapsed time, distance, speed/resistance, calories, heart rate input (contact grip and/or wireless), and programme selection.

F. Approved manufacturers include but are not limited to: Sports Art, Vibe Fitness, Life Fitness, Technogym, Precor, Matrix Fitness, Hammer Strength, Cybex, Star Trac, Body-Solid (commercial range), Concept2, StairMaster, or approved equal of equivalent commercial quality. The Contractor shall supply equipment from the confirmed quotation by Sports Art / Vibe (Quotation Ref: 26GE-Ahmad_Ali-Vibe_Quote-03072026) or approved equivalent meeting these specifications.

2.2 CARDIOVASCULAR EQUIPMENT

2.2.1 Commercial Motorized Treadmill [BOQ Item 2-i] — Basis of Design: Sports Art Prime Line T673L

Provide commercial-grade motorised treadmill with the following minimum specifications:

ATTRIBUTE	MINIMUM REQUIREMENT
Motor	4.0 HP continuous-duty AC drive motor; 5.0 HP peak (Sports Art T673L: 4HP AC Motor)
Running Surface	Minimum 560 mm × 1,520 mm (22" × 60") orthopaedic running belt
Speed Range	0.8 – 20 km/h in 0.1 km/h increments
Incline Range	0 – 15% in 0.5% increments; motorized
Max. User Weight	180 kg (400 lbs) minimum
Console	LCD/LED touchscreen; programmes: Manual, Interval, HRC, Custom (≥ 10 programmes)
Heart Rate	Contact grip sensors + wireless telemetry (ANT+/Bluetooth compatible)
Safety	Magnetic safety key tether with auto-stop; emergency stop button
Frame	Commercial-grade steel, powder-coated; foldable only with Engineer approval
Drive System	DC drive with eddy-current braking; low-noise belt system
Electrical	220–240 V / 50 Hz / single-phase; 20 A dedicated circuit
Certification	CE marked; EN ISO 20957-6; ASTM F1250 compliant

2.2.2 Stationary Spin Bike [BOQ Item 2-ii] — Basis of Design: Vibe US-PG1399

ATTRIBUTE	MINIMUM REQUIREMENT

Flywheel	Minimum 18 kg (40 lb) chrome-balanced flywheel; perimeter-weighted
Resistance	Magnetic resistance; minimum 32 levels; micro-adjustable
Drive	Belt drive (poly-V); maintenance-free; bidirectional
Pedals	Dual-sided: SPD clip-in + standard cage; Q-factor ≤ 155 mm
Saddle	4-way adjustable (fore/aft + height); quick-release; padded gel saddle
Handlebar	Multi-position; 2-way adjustable (height); clip-on aero bars acceptable
Max. User Weight	150 kg (330 lbs) minimum
Frame	Welded steel; powder-coated; oversized base frame for stability
Console	Backlit LCD: RPM, power (watts), speed, distance, time, calories, HR
Certification	CE marked; EN ISO 20957-10

2.2.4 Rowing Machine – Commercial Grade [BOQ Item 2-iv] — Basis of Design: Vibe Air Rowing Machine VY-YR 400

ATTRIBUTE	MINIMUM REQUIREMENT
Resistance Type	Air resistance; adjustable damper setting (Vibe VY-YR 400: fan-based air resistance)
Frame	Anodized aluminium or powder-coated steel rail; foldable optional
Seat	Contoured, high-density moulded seat; sealed cartridge bearings on slides
Handle	Ergonomic D-handle or straight handle; bungee cord return
Footrests	Adjustable with heel-cup and Velcro strap; pivoting footrests
Monitor	Backlit PM5 equivalent: stroke rate, pace, watts, calories, time, distance
Connectivity	Bluetooth / ANT+ compatible with fitness apps
Max. User Weight	180 kg minimum; usable inseam: 140 cm minimum
Certification	CE; EN ISO 20957-7; Concept2 PM5 monitor or equivalent

2.3 STRENGTH TRAINING EQUIPMENT Note: Additional selectorized strength machines from quotation (Chest Press VY-61A 04, Shoulder Press VY-61A 01, Lat Pulldown VY-61A 15, Leg Extension VY-61A 24, Arm Curl Bench VY-61A 37, Three Station Multi-Gym USBH-143) shall comply with Section 2.3 general requirements and manufacturer's published specifications.

2.3.3 Functional Trainer / Cable Crossover Machine [BOQ Item 2-ix] — Basis of Design: Vibe Cable Cross-Over VY-61A 32

ATTRIBUTE	MINIMUM REQUIREMENT

Weight Stacks	Dual independent stacks; minimum 90 kg (200 lbs) each
Cable Ratio	1:1 direct-pull or 2:1 ratio; clearly labelled
Pulley Travel	Full-height adjustable pulley (floor to ceiling rail); minimum 20 positions
Cables	Aircraft-grade stainless steel cables; minimum 900 kg tensile strength
Attachment Points	Dual rotating swivel D-ring carabiners on each side
Accessories	Minimum 8 attachments: straight bar, rope, D-handle ×4, ankle cuff ×2, lat bar
Frame	11-gauge steel; floor-bolt base; powder-coated
Footprint	Maximum 1,600 mm × 1,000 mm; height ≤ 2,400 mm
Certification	CE; EN ISO 20957-2

2.3.4 Multi-Adjustable Weight Bench [BOQ Item 2-x] — Basis of Design: Vibe Multi-Adjustable Bench VY-61A 46B

ATTRIBUTE	MINIMUM REQUIREMENT
Type	Fully adjustable FID (Flat / Incline / Decline)
Back Pad Positions	Minimum 7 positions: decline −10°, flat 0°, incline 30°/45°/60°/75°/85°
Seat Pad Positions	Minimum 4 positions to prevent sliding
Frame	11-gauge steel; rated ≥ 360 kg total load (user + weights)
Upholstery	High-density foam ≥ 8 lb; commercial vinyl; 75 mm pad thickness minimum
Width	Minimum 290 mm pad width for stability
Wheels	Integrated transport wheels; no permanent anchor required
Certification	CE; EN ISO 20957-2

2.3.5 Flat Weight Bench [BOQ Item 2-xi] — Basis of Design: Vibe Flat Bench VY-61A 47

ATTRIBUTE	MINIMUM REQUIREMENT
Type	Commercial utility flat bench; no adjustment
Frame	11-gauge minimum steel; rated ≥ 360 kg; 4-leg or I-beam design
Upholstery	High-density foam ≥ 8 lb; commercial vinyl; 65 mm pad thickness
Pad Width	Minimum 290 mm
Pad Length	Minimum 1,070 mm (42")
Certification	CE; EN ISO 20957-2

FREE WEIGHTS AND STORAGE

2.4.1 Straight Barbell Set [BOQ Item 2-xii] — Basis of Design: Vibe Straight Round Barbells VN-US1301

ATTRIBUTE	MINIMUM REQUIREMENT
Bar Length	2,200 mm (86") standard Olympic length
Bar Diameter	28–29 mm shaft; 50 mm sleeve (Olympic standard)
Bar Weight	20 kg (men's standard)
Tensile Strength	Minimum 190,000 PSI (1,310 MPa) steel
Knurling	Medium knurling; dual knurl marks (power + Olympic)
Sleeves	Rotating sleeves; needle or bushing bearings; chrome or hard-chrome finish
Collar Snap	Minimum 2 pairs spring collars; quick-release
Certification	IPF or IWF specification compliant; CE

2.4.3 Dumbbell Set [BOQ Item 2-xiv] — Basis of Design: Vibe 12 Edge Premium CPU Dumbbells VN-US1007

ATTRIBUTE	MINIMUM REQUIREMENT
Type	12-Edge (dodecagonal) cast iron CPU dumbbells; anti-roll head; rubber end-cap protection
Range	Complete set as per BOQ quantity; 12-sided (dodecagon) anti-roll head design; Vibe 12 Edge Premium CPU pattern (VN-US1007)
Head Material	Solid cast iron; fully rubber encased; virgin rubber minimum 5 mm thick
Handle	Contoured ergonomic chrome or knurled steel; 30–35 mm diameter
Weight Tolerance	±2% of stated weight
Colour Coding	Weight increments colour-coded or weight-stamped on end-cap
Certification	CE; EN ISO 20957-2

2.4.4 Dumbbell Storage Rack [BOQ Item 2-xv] — Basis of Design: Vibe Series 3 Tier Dumbbell Rack US2017

ATTRIBUTE	MINIMUM REQUIREMENT
Type	3-tier inclined A-frame saddle rack (Vibe Series 3 Tier Dumbbell Rack US2017)
Capacity	Minimum 15 pairs (5 per tier) covering full dumbbell set
Tier Angle	Inclined saddle angled ≥ 15° for easy grab
Frame	11-gauge square steel tube; welded construction; powder-coated

Load Rating	Static load rating ≥ 1,000 kg total
Rubber Liner	Rubber-lined or UHMW-PE lined saddles to protect dumbbell finish

2.4.5 Barbell / Weight Plate Storage Rack [BOQ Item 2-xvi] — Basis of Design: Vibe Barbell Rack US2031

ATTRIBUTE	MINIMUM REQUIREMENT
Type	Vertical A-frame or Christmas-tree; minimum 10 pegs
Peg Diameter	50 mm (Olympic) to accept all weight plates in set
Peg Length	Minimum 400 mm per peg
Frame	Welded steel; powder-coated; stable base; non-tip design
Load Rating	Minimum 300 kg total

PART 3 – EXECUTION

3.1 EXAMINATION

A. Before commencing installation, verify that the gym room is fully enclosed, weathertight, all wet trades complete, final floor screed laid and cured, mechanical and electrical services roughed-in and tested, and adequate ventilation/HVAC operational.

B. Verify room dimensions against approved equipment layout drawings. Report discrepancies of more than 50 mm to the Engineer before proceeding.

C. Inspect subfloor for levelness: maximum deviation 3 mm under a 3 m straightedge. Notify Engineer of any deviation exceeding this tolerance.

D. Verify electrical circuit provisions: dedicated circuits with correct amperage, voltage, and earthing for each motorised equipment item.

3.2 INSTALLATION

3.2.1 General

A. Install all equipment strictly in accordance with the manufacturer's installation instructions and the approved equipment layout drawing.

B. Maintain minimum clearances: 900 mm around all equipment sides and rear; 1,500 mm at access/egress ends of treadmills and steppers; as per manufacturer recommendation where greater than above.

C. All equipment requiring floor anchoring shall be anchored using the manufacturer's specified anchor kit. Anchor bolt type, size and embedment depth shall be confirmed against the structural slab design. Do not core-drill without written consent.

D. Level all equipment using adjustable levelling feet where provided. Maximum out-of-level: 2 mm in any 600 mm run.

3.2.2 Cardio Equipment

A. Connect motorised equipment to dedicated electrical circuits via NEMA 5-20 or IEC 60309 receptacles as appropriate. Do not share circuits between units.

B. Install treadmills with safety key attached and magnetic clip verified functional before powering on.

C. Run all power cords through provided cord management channels or surface conduit; no trailing cables across floor.

3.2.3 Strength Equipment and Free Weights

A. Install power rack and smith machine with all J-hooks, safety bars and pull-up attachments before handover.

B. Arrange dumbbells and kettlebells on storage racks in ascending weight order from left to right when facing the rack.

C. Plate storage trees shall be loaded symmetrically to prevent tipping.

3.2.4 Gym Flooring

A. Install flooring after all wall finishes, painting, mirror installation and mechanical/electrical work is complete.

B. Dry-lay interlocking tiles on clean, dry, level subfloor. Begin from a central datum line and work outward to minimise cut pieces at perimeter.

C. Cut tiles using a utility knife and straight edge, or power saw with fine-tooth blade. All cut edges at room perimeter shall be concealed under skirting or bevelled edge strip.

D. At perimeter and under fixed equipment bases, apply double-sided flooring tape or adhesive per manufacturer's specification to prevent tile migration.

3.2.5 Mirrors

A. Install mirrors after gym flooring is laid but before equipment is placed.

B. Apply mirror adhesive to back face in 300 mm vertical ribbons at 400 mm centres. Allow adhesive to form skin before placing mirror.

C. Support each mirror panel with J-channel bottom support rail installed level at 300 mm above finished floor; use spirit level.

D. Apply minimum 2 security mirror clips per panel at top edge.

E. Ensure minimum 25 mm ventilation gap at top and bottom of mirror wall.

F. Seal all vertical joints between mirror panels with clear neutral-cure silicone sealant; maximum 2 mm joint width. Tooled flush.

3.3 FIELD QUALITY CONTROL — TESTING AND COMMISSIONING

A. Cardio Equipment: Run each motorised unit through full speed and incline range. Verify emergency stop, safety key, display functions, all programme modes, and heart-rate receiver. Run treadmill at maximum speed for minimum 5 minutes.

B. Strength Equipment: Load test each cable machine and functional trainer to 110% of rated stack weight. Inspect cable routing, pulleys and attachments.

C. Power Rack and Smith Machine: Verify all J-hooks, safeties, and pull-up bars are secure. Test safety catch function by loading barbell into catches.

D. Gym Flooring: Walk entire installed area; check for lifted edges, unlocked tiles, or hollow sounds indicating adhesion failure.

E. Mirrors: Check for plumb (≤ 2 mm per 1 m height), secure fixing, distortion-free reflection, and sealant continuity at joints.

F. Fitness Assessment Equipment: Power on all electronic items; verify calibration of body composition analyser against known reference weights; test connectivity of HR monitors to compatible display units.

G. Document all commissioning tests in a Commissioning Record and submit to Engineer for countersignature at Practical Completion.

3.4 CLEANING

A. Remove all packaging, strapping, cardboard, and polythene wrap from the gym upon completion of installation.

B. Wipe down all equipment frames, upholstery and consoles with manufacturer-approved cleaning solution.

C. Clean gym flooring per manufacturer's instructions; remove installation adhesive residue.

D. Wipe mirrors clean with glass cleaner; remove all adhesive smears and fingerprints.

3.5 OPERATOR TRAINING

A. Before Practical Completion, provide a minimum half-day (4-hour) structured training session for PAA-nominated gym staff, covering: safe operation of all equipment, routine daily/weekly maintenance checks, cleaning protocols, and emergency procedures.

B. Training shall be conducted by a certified fitness equipment technician from the manufacturer or authorised distributor.

C. Provide printed Quick-Reference Cards (laminated A4) for each major equipment item, to be mounted adjacent to the equipment.

D. Provide two copies of all O&M manuals in English, bound and indexed.

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ANNEX 1 — CONSOLIDATED DESIGN PARAMETERS

The following table consolidates the project-wide design parameters and shall be read in conjunction with the corresponding tables in Section 0010 §1.02.1, Section 0490 §1.3, Section 0710 §3.3 and Section 0740 §1.3. Where any apparent conflict remains between the individual Section tables and this Annex, the values in this Annex shall govern.

Parameter	Value	Application / Basis
Seismic zone (structural)	BCP Zone-4, Z = 0.4	Structural Design Report; BCP 2007
Seismic — non-structural components	ASCE 7-22 Ch. 13, Ip = 1.5 (Risk Category IV)	ICAO Annex 14 essential facility
Wind	Per ASCE 7-22 with altitude correction at 2,230 m AMSL	Structural Design Report
Snow load (roof)	50 lbs/ft² (2.4 kPa)	Structural Design Report
Winter design dry-bulb (99.6 %)	−18 °C	HVAC envelope and plant sizing
Summer design dry-bulb (0.4 %)	+34 °C	HVAC plant sizing
Equipment qualification envelope	−25 °C to +50 °C	Electrical, electronic and CNS equipment
Site elevation	2,230 m AMSL	Site survey
Air-density correction (HVAC, generators)	0.79 × sea-level	Sec 0710 §1.4
Envelope U-value — opaque wall	≤ 0.30 W/m²K	Cold-climate practice
Envelope U-value — roof	≤ 0.20 W/m²K	Cold-climate practice
Envelope U-value — glazing	≤ 1.3 W/m²K (low-e, argon, warm-edge)	Cold-climate practice
Glazing SHGC — ATC cabin	0.40–0.55 (orientation tuned)	ICAO Doc 9426
Glazing VLT — ATC cabin	≥ 0.50	ICAO Doc 9426
Envelope air leakage	≤ 1.5 m³/(h·m²) at 50 Pa	ASTM E779 / EN ISO 9972
Building Risk Category	IV (Essential Facility — ATC)	ASCE 7-22 Table 1.5-1
Electricity supply authority	Water and Power Department, Government of Gilgit-Baltistan (GB Power)	Site authority
Indoor — ATC control cabins	22 ± 1 °C; 45–55 % RH	HVAC BOD
Indoor — ATC equipment / server rooms	22 ± 1 °C; 45–55 % RH; continuous	ASHRAE TC 9.9 Allowable

Indoor — offices	23 ± 1 °C; ≤ 60 % RH	HVAC BOD
Indoor — dormitories	22–24 °C; ≤ 60 % RH	HVAC BOD
Indoor — fire truck station	18–20 °C, minimum +13 °C for freeze protection	HVAC BOD

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ANNEX 2 — HVAC EQUIPMENT SCHEDULES

Equipment and material shall be supplied only from the approved sources noted below. However, in all cases, the contractor shall submit complete technical details of the equipment, material and obtain consultant's approval prior to purchase/ delivery on site.

Sr.	Description of Equipment / Material	Approved Manufacturer	Country of Origin
1	**Chillers**	Trane/York/ Carrier / Daikin	USA / EU / Japan (Western) (AHRI/ Eurovent Certified Only)
2	**Cooling Tower (Closed Circuit)**	BAC / YH / QCR / Baltimore Aircoil Company, GEA Polacel / Kelvin, SPX / Marley, EVAPCO, Kuken or equivalent	China
3	**Air Handling Units (AHU's)**	Trane/ York/ Untes / Daikin / TROX / Carrier / International Environmental Corporation	USA / EU/ Turkey / Japan (Western) (AHRI/ Eurovent and AMCA Certified Only)
4	**Fan Coil Units (FCU's)**	Trane/ York/ Untes / Daikin / TROX / International Environmental Corporation	USA / EU / Turkey / Japan (Western) (AHRI/ Eurovent and AMCA Certified Only)
5	**Fans**		
	Centrifugal/ Propeller/ Axial	Green-Heck/ Pennberry / S&P / Kayi	USA / EU / Turkey (AMCA Certified Only)
	Parking Fan System	Green-Heck/ Pennberry / S&P / Kayi	USA / EU / Turkey (AMCA Certified Only)
6	**Support System, Anchors and Concrete Fastner**		
	Pipe Support System	Hilti / Fischer / Incofix	USA / EU
7	**Ducting & Accessories**		
	Sheet Metal	Pakistan Steel/ Approved Equivalent	Pakistan / Imported
	Volume Dampers	Steel Craft / Thermec / EAP / Approved Equivalent	Pakistan
	Fire Dampers	Steel Craft / Thermec / EAP / Approved Equivalent	Pakistan
	Air Devices (Grills, Diffusers and Louvre)	Steel Craft / Thermec / EAP / Approved Equivalent	Pakistan
8	**Insulations**		
	Duct Insulation	Afico / Kimco /Owens Corning / Incotech	KSA / Kuwait / Turkey
	Canvas Jacket	Approved	Pakistan
	Insulation adhesive	Zahabiya / Duct mate	Pakistan, USA

	Closed Cell Pipe Insulation with Vapor	Aero flex	Thailand
	Adhesive for Pipe Insulation	Zahabiya / Duct mate	Pakistan , USA
	Closed Cell Insulation	Aeroflex	Thailand
9	**Piping & Fittings**		
	PPRC	Aquatherm	Germany
	Strainers, check valves, butterfly valves, ball valves	SCON	Pakistan
	Refrigerant pipes	Mueller / Golden Dragon	Uk / China
	Tray for refrigerant piping (roof only)	Approved	Pakistan
	G.I. Pipe	IIL	Pakistan
	UPVC	Popular, Beta and Master	Pakistan
	Flexible connectors & pipe Expansion	Approved	Imported
10	**Pumps**		
	End suction Centrifugal	KSB / Grundfoss/ TACO / WILO	Pakistan , USA, Germany
11	**Paints**	Berger, ICI, Jotun, Nippon	Pakistan
12	**Fire shop**	Hilti, Fischer	USA/EU/Japan
13	**Motors**	Siemens, ABB	USA , Europe, China, Japan
14	**Thermometers/ Pressure Guages**	Dwyer, Weiss, Trerice	USA/EU/Japan
15	**Hot Water Generator**	Unical/ Bosch / Cleaver Brooks / TICA Climate Solutions	USA/EU/Japan/China
16	**Variable Refrigerant Flow (VRF) Units**	Toshiba, Mitsubishi, Daikin, Hitachi, Trane, York, LG	China, EU, Korea, Japan, USA

ANNEX 3 — MONTHLY PROGRESS REPORT

PAKISTAN AIRPORTS AUTHORITY

Planning & Development Directorate

MONTHLY PROGRESS REPORT

UPGRADATION OF SKARDU INTERNATIONAL AIRPORT

Report No.	MPR – [Sequential No., e.g., MPR-01]
Period Covered	[DD Month YYYY] to [DD Month YYYY]
Reporting Month	[Month, Year]
PC-I No. / ADP No.	[PC-I Reference Number]
Contract No.	[Contract / Agreement Number]
Contract Commencement	[DD Month YYYY]
Original Completion Date	[DD Month YYYY]
Revised Completion Date	[DD Month YYYY] / Not Applicable
Total Contract Duration	[X] Months (Original) / [X] Months (Revised)
PC-I Approved Cost	PKR [Amount in figures] (PKR [Amount in words])
Contractor	[Full Name of Contractor]
PMC / Consultant	[Full Name of PMC / Consultant]
Client / Employer	Pakistan Airports Authority (PAA)
Prepared by	[Name], [Designation] – [Organisation]
Date of Issue	[DD Month YYYY]

DOCUMENT REVISION HISTORY

Rev.	Date	Description of Revision	Revised By
00	[Date]	Initial Issue	[Name / Designation]
01	[Date]	[Description]	[Name / Designation]

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0. PROJECT DASHBOARD (SNAPSHOT)

This single-page snapshot is for senior management. Complete all cells before distribution.

0.1 Overall Progress Indicators

Indicator	Planned (%)	Actual (%)	Variance (%)	Remarks
Overall Physical Progress (Cumulative)	[ ]	[ ]	[ ]	[ ]
Physical Progress – This Month Only	[ ]	[ ]	[ ]	[ ]
Financial Progress (Cumulative)	[ ]	[ ]	[ ]	[ ]
ADP Utilisation – Current Year (%)	[ ]	[ ]	[ ]	[ ]

0.2 RAG Status

Parameter	Status	Remarks / Basis
Schedule	GREEN	[Remarks / basis for status]
Cost / Budget	AMBER	[Remarks / basis for status]
Quality	GREEN	[Remarks / basis for status]
HSE	GREEN	[Remarks / basis for status]
Submittals	AMBER	[Remarks / basis for status]
Procurement / Supply Chain	RED	[Remarks / basis for status]

RAG Key: GREEN = On Track | AMBER = At Risk, Monitoring Required | RED = Delayed / Off Track, Immediate Action Required

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1. EXECUTIVE SUMMARY

1.1 Project Scope & Salient Features

Provide a brief description of project scope, key deliverables, and major contract features (2–4 sentences).

[Scope description]

1.2 Key Achievements This Month

- [Achievement 1 – be specific, measurable]
- [Achievement 2]
- [Achievement 3]

1.3 Major Challenges & Issues

- [Challenge / issue 1 – note impact on schedule / cost / quality]
- [Challenge / issue 2]

1.4 Critical Activities Undertaken

- [Critical activity 1 – include location and quantities]
- [Critical activity 2]

1.5 Scope / Schedule / Resource Changes

Note any formal Variation Orders, Extensions of Time, or resource re-deployments issued or under review this month.

[Detail any changes, or state 'No changes to scope, schedule or resources this month.']

1.6 Major Targets for Next Month

- [Target 1 – link to baseline schedule milestone]
- [Target 2]
- [Target 3]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

2. FINANCIAL PROGRESS SUMMARY

All amounts in Pakistani Rupees (PKR) unless otherwise stated. Round to nearest thousand.

Financial Parameter	Amount (PKR)	% of PC-I Cost
Total Approved PC-I Cost	[Amount]	100%
Expenditure up to End of Last Financial Year	[Amount]	[ ]%
ADP Allocation – Current Financial Year	[Amount]	[ ]%
Expenditure in Current Financial Year (to date)	[Amount]	[ ]%
ADP Utilisation – Current Year (%)	—	[ ]%
Total Cumulative Expenditure / Payment to Date	[Amount]	[ ]%
Amount Accrued / Payable – This Month	[Amount]	[ ]%
Amount Accrued / Payable – Cumulative to Date	[Amount]	[ ]%
Retention Money Deducted (Cumulative)	[Amount]	[ ]%
Pending Invoices / Claims Under Review	[Amount]	—
Remaining Budget (PC-I Cost – Total Expenditure)	[Amount]	[ ]%
Projected Cash Flow – Next Month	[Amount]	—
Re-appropriation / Additional Funds Required	[Amount] / NIL	—

Attach financial bar chart (Planned vs. Actual vs. Remaining Budget) as Attachment F-1.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

3. PHYSICAL PROGRESS ACHIEVED THIS MONTH

3.1 Progress Summary Narrative

Provide a 2–3 paragraph narrative per major sub-head summarising achievements and explaining variances.

[Narrative – Sub-Head 1]

[Narrative – Sub-Head 2]

3.2 Detailed Progress Table

Unit of Measurement (UOM) is mandatory. Cumulative (Previous Month) column enables independent verification.

Sr.	Sub-Head	BOQ Code	UOM	Activity / Work Description	Total Approved Qty	Cum. Qty (Prev. Month)	Planned Qty (This Month)	Actual Qty (This Month)	Cum. Qty (This Month)	Progress vs. Planned (%)	Progress vs. Total (%)	Reason for Variance
1	[Sub-Head]	[Code]	[UOM]	[Description of Work]	[Qty]	[Qty]	[Qty]	[Qty]	[Qty]	[ ]%	[ ]%	[If <90%, state reason]
2	[Sub-Head]	[Code]	[UOM]	[Description of Work]	[Qty]	[Qty]	[Qty]	[Qty]	[Qty]	[ ]%	[ ]%	[If <90%, state reason]
3	[Sub-Head]	[Code]	[UOM]	[Description of Work]	[Qty]	[Qty]	[Qty]	[Qty]	[Qty]	[ ]%	[ ]%	[If <90%, state reason]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

4. LOOK-AHEAD PLAN

4.1 One-Month Look-Ahead Target Table

Flag critical-path activities (CP = Yes). State responsible party and resources required.

Sr.	Sub-Head	BOQ Code	UOM	Activity / Work Description	Total Approved Qty	Cum. Qty to Date	Target Qty – Next Month	CP? (Y/N)	Predecessor Activity	Responsible Party	Resources Required (Man / Plant)
1	[Sub-Head]	[Code]	[UOM]	[Description]	[Qty]	[Qty]	[Qty]	[Y/N]	[Activity No.]	[Name / Team]	[Numbers]
2	[Sub-Head]	[Code]	[UOM]	[Description]	[Qty]	[Qty]	[Qty]	[Y/N]	[Activity No.]	[Name / Team]	[Numbers]
3	[Sub-Head]	[Code]	[UOM]	[Description]	[Qty]	[Qty]	[Qty]	[Y/N]	[Activity No.]	[Name / Team]	[Numbers]

4.2 Three-Month Rolling Look-Ahead Narrative

Provide a strategic narrative covering months T+1, T+2, and T+3 with focus on critical path activities, procurement milestones, and resource planning.

[Month T+1 – Key activities and targets]

[Month T+2 – Key activities and targets]

[Month T+3 – Key activities and targets]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

5. EARNED VALUE ANALYSIS (EVA)

Populate all EVM metrics. Attach trend charts (SPI and CPI over time) as Attachment EV-1.

Ref.	EVM Metric	Formula	Value (PKR / Index)	Interpretation
BAC	**Budget at Completion**	Total Project Budget	[Value]	Baseline cost
PV	**Planned Value**	Budgeted cost of work scheduled	[Value]	Work planned by today
EV	**Earned Value**	Budgeted cost of work performed	[Value]	Work actually done
AC	**Actual Cost**	Actual cost of work performed	[Value]	Money spent to date
SV	**Schedule Variance**	EV − PV	[Value]	+ Ahead / − Behind
CV	**Cost Variance**	EV − AC	[Value]	+ Under / − Over
SPI	**Schedule Performance Index**	EV / PV	[Value]	>1 Ahead; <1 Behind
CPI	**Cost Performance Index**	EV / AC	[Value]	>1 Under; <1 Over
EAC	**Estimate at Completion**	BAC / CPI	[Value]	Projected final cost
ETC	**Estimate to Complete**	EAC − AC	[Value]	Remaining cost
VAC	**Variance at Completion**	BAC − EAC	[Value]	+ Saving / − Overrun
TCPI	**To-Complete Performance Index**	(BAC−EV)/(BAC−AC)	[Value]	Efficiency needed

5.1 EVM Trend Analysis

Comment on SPI and CPI trends over the last 3 months and actions taken to recover if indices are below 1.0.

[EVM trend narrative and recovery actions]

Attach: (a) SPI/CPI trend graph over project duration | (b) S-Curve (Planned vs. Actual physical & cost) – Attachment EV-1 & EV-2

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

6. S-CURVE

Attach two S-Curve graphs as Attachment SC-1 and SC-2 respectively:

- SC-1: Cumulative Physical Progress (%) – Planned Baseline vs. Actual vs. Forecast
- SC-2: Cumulative Financial Progress (PKR) – Planned Baseline vs. Actual Expenditure vs. Cash Flow Forecast

Both curves shall be updated monthly against the approved baseline schedule. Deviations of more than 5% from the baseline shall be annotated with a cause and recovery note.

[Insert S-Curve graphs here or cross-reference Attachment SC-1 and SC-2]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

7. MANPOWER & EQUIPMENT

7.1 Manpower Deployment Summary

Compare deployed manpower against the approved baseline resource histogram. Highlight shortfalls.

Category	Planned (Peak)	Deployed This Month	Variance	Peak This Month	Remarks
Engineers / Technical Staff	[ ]	[ ]	[ ]	[ ]	[ ]
Supervisors	[ ]	[ ]	[ ]	[ ]	[ ]
Skilled Labour	[ ]	[ ]	[ ]	[ ]	[ ]
Unskilled Labour	[ ]	[ ]	[ ]	[ ]	[ ]
Machinery Operators	[ ]	[ ]	[ ]	[ ]	[ ]
Sub-contractor Personnel	[ ]	[ ]	[ ]	[ ]	[ ]
Total	[ ]	[ ]	[ ]	[ ]	[ ]

7.2 Key Equipment Deployment & Productivity

Report availability (%), utilisation (%), and output. Flag underperforming equipment.

Equipment Type	No. on Site	No. Working	Monthly Op. Hours	Availability (%)	Utilisation (%)	Output Rate (per Hr/Day)	Total Output	Remarks / Issues
Concrete Batching Plant	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Asphalt Batching Plant	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Concrete Pavers	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Asphalt Pavers	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Excavators	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Dump Trucks	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Compactors	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Cranes	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other Key Plant	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

PROCUREMENT REGULATORY AUTHORITY PPRA EPADS

8. HEALTH, SAFETY & ENVIRONMENT (HSE)

8.1 HSE Performance Statistics

HSE Metric	This Month	Cumulative to Date
Total Man-Hours Worked	[ ]	[ ]
Fatalities	[ ]	[ ]
Lost Time Injuries (LTI)	[ ]	[ ]
Medical Treatment Cases (MTC)	[ ]	[ ]
Near Misses Reported	[ ]	[ ]
Unsafe Acts / Conditions Reported	[ ]	[ ]
Accident Frequency Rate (AFR)	[ ]	[ ]
Accident Severity Rate (ASR)	[ ]	[ ]
HSE Inspections Conducted	[ ]	[ ]
Toolbox Talks Conducted	[ ]	[ ]
HSE Trainings Conducted	[ ]	[ ]
Non-Conformances (NCRs) Issued	[ ]	[ ]
NCRs Closed	[ ]	[ ]
Environmental Incidents	[ ]	[ ]

8.2 HSE Observations & Environmental Compliance

Note any significant HSE incidents, corrective actions, and ESMP compliance status.

[HSE narrative and corrective actions]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

9. CLIMATIC / WEATHER CONDITIONS

Record daily climatic data. Skardu is high-altitude (approx. 2,228 m ASL) – temperature, snowfall, and wind are critical. Provide a monthly summary row at the bottom.

Date	Max Temp (°C)	Min Temp (°C)	Avg Temp (°C)	Humidity (%)	Wind Speed (km/h)	Wind Direction	Rainfall / Snowfall (mm)	Site Working? (Y/N)	Remarks / Impact on Work
[Date]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[Date]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[Date]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
MONTHLY SUMMARY	[Average / Total]	[Average / Total]	[Average / Total]	[Average / Total]	[Average / Total]	[Average / Total]	[Average / Total]	[Average / Total]	[Average / Total]

Note: Record number of working days lost due to adverse weather. Attach meteorological records if available.

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

10. LABORATORY / TESTING DETAILS

Reference the applicable test standard/specification for each test type. Failed tests must have a Corrective Action noted.

Test Type	Test Standard / Spec. Ref.	Required Frequency	Tests This Month	Tests Passed	Tests Failed	Cum. Pass Rate (%)	Status	Corrective Action / Remarks
Soil Compaction (Proctor)	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]
Concrete Compressive Strength	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]
Asphalt Core / Marshall Test	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]
Aggregate Grading & Quality	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]
Concrete Mix Design Verification	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]
Rebar Tensile Test	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]
Other	[ASTM / BS ref.]	[Freq.]	[ ]	[ ]	[ ]	[ ]%	[Pass / Fail / Pending]	[Action if failed]

10.1 Quality Trends & Analysis

Identify any recurring failure trends and their impact on schedule and quality. Note corrective measures.

[Quality trend narrative]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

11. SUBMITTAL STATUS

Track both Material Submittals and Method Statement / Shop Drawing submittals separately. Per Contract Clause [X.X], a maximum of three (3) approvals are permitted per material item and total submission attempts shall not exceed five (5).

11.1 Material Submittals – Current Status

Sub. No.	Material Description	Submission Date	Engineer Response Date	Status (Approved / Rejected / Pending)	Attempt No. (1st/2nd/3rd)	Remaining Attempts	Resubmission Target Date	Reason for Rejection (if any)	Impact on Progress if Unresolved	Remarks
[S-001]	[Material Name]	[Date]	[Date]	[Status]	[1st]	[2]	[Date]	[Reasons stated by Engineer]	[High / Medium / Low]	[ ]
[S-002]	[Material Name]	[Date]	[Date]	[Status]	[1st]	[2]	[Date]	[Reasons stated by Engineer]	[High / Medium / Low]	[ ]
[S-003]	[Material Name]	[Date]	[Date]	[Status]	[1st]	[2]	[Date]	[Reasons stated by Engineer]	[High / Medium / Low]	[ ]

11.2 Method Statements & Shop Drawings – Current Status

Sub. No.	Description	Submission Date	Engineer Response Date	Status	Resubmission Target Date	Impact of Delay	Remarks
[MS-001]	[Method Statement / Shop Drawing Title]	[Date]	[Date]	[Approved/Rejected/Pending]	[Date]	[High/Medium/Low]	[ ]
[MS-002]	[Method Statement / Shop Drawing Title]	[Date]	[Date]	[Approved/Rejected/Pending]	[Date]	[High/Medium/Low]	[ ]

11.3 Next Month – Target Submittals

Sub. No.	Description	Type (Material / MS / SD)	Target Submission Date	Target Approval Date	Impact if Delayed	Remarks / Dependencies
[S-004]	[Description]	[Type]	[Date]	[Date]	[High/Medium/Low]	[ ]
[S-005]	[Description]	[Type]	[Date]	[Date]	[High/Medium/Low]	[ ]
[S-006]	[Description]	[Type]	[Date]	[Date]	[High/Medium/Low]	[ ]

12. CHALLENGES, RISKS & MITIGATION MEASURES

Link each entry to the Project Risk Register. Assign a Risk Owner and Target Resolution Date.

Sr.	Risk Reg. Ref.	Category	Probability (H/M/L)	Impact (H/M/L)	Description	Impact on Project (Time / Cost / Quality)	Mitigation Measures (Implemented / Planned)	Risk Owner	Target Resolution Date	Status (Open / Closed)
1	RR-001	Challenge	H	H	Material delivery delays – supply chain constraints	Time – schedule slippage	Engage alternate suppliers; adjust work sequencing	Contractor PM	[Date]	Open
2	RR-002	Challenge	M	H	Adverse weather – high-altitude Skardu conditions	Time / Cost	Reschedule critical activities; deploy protection	Site Engineer	[Date]	Open
3	RR-003	Risk	M	M	Design modifications during execution	Cost / Time	Early design reviews; streamline approval workflow	Consultant	[Date]	Open
4	RR-004	Risk	L	H	Regulatory / authority approval delays	Time	Continuous liaison; early submission of documents	Project Director	[Date]	Open

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

13. OPPORTUNITIES & RECOMMENDATIONS

Sr.	Opportunity Identified	Potential Benefit (Time / Cost / Quality / Efficiency)	Recommended Action Steps	Responsible Party	Target Date
1	Integrated PM software for real-time tracking	Efficiency – better monitoring	Implement digital project monitoring tools	Contractor / PMC	[Date]
2	Framework agreements for procurement	Cost / Time – reduced delays	Digitise procurement & establish supplier agreements	Contractor	[Date]
3	Enhanced stakeholder coordination	Quality / Time	Regular coordination meetings; centralised comms	PMC / PAA	[Date]
4	Prefabrication for repetitive elements	Time / Quality	Pilot prefab components; assess cost-benefit	Contractor	[Date]
5	Staff training & certification	Quality / Efficiency	Targeted training programmes on critical skills	Contractor	[Date]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

14. CORRESPONDENCE & CONTRACTUAL EVENTS

Record all formal correspondence, instructions, and contractual events issued or received during the reporting month.

Sr.	Ref. No.	Type (VO / EOT / ITT / NCR / Letter)	Date Issued	Issued By	Description / Subject	Impact (Time / Cost)	Status (Open / Closed / Under Review)
1	[Ref.]	[Type]	[Date]	[Party]	[Subject / Brief Description]	[Impact]	[Status]
2	[Ref.]	[Type]	[Date]	[Party]	[Subject / Brief Description]	[Impact]	[Status]
3	[Ref.]	[Type]	[Date]	[Party]	[Subject / Brief Description]	[Impact]	[Status]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

15. ATTACHMENTS CHECKLIST

Tick each attachment included with this report. Unticked items must be noted as 'N/A' or 'Deferred to MPR [No.]'.

Att. Ref.	Included? (Y/N/NA)	Description	No. of Pages / Sheets	Remarks
GC-1	Y/N	Updated Master Programme (Primavera / MS Project extract with progress lines vs baseline)	[ ]	[ ]
GC-2	Y/N	Project Gantt Chart – Critical Path highlighted	[ ]	[ ]
GC-3	Y/N	Meeting Minutes – Monthly Progress Review Meeting	[ ]	[ ]
F-1	Y/N	Financial Bar Chart – Planned vs. Actual vs. Remaining Budget	[ ]	[ ]
EV-1	Y/N	EVM Trend Graph – SPI and CPI over project duration	[ ]	[ ]
EV-2	Y/N	S-Curve – Cumulative Physical Progress (Planned vs. Actual vs. Forecast)	[ ]	[ ]
SC-1	Y/N	S-Curve – Cumulative Financial Progress (Planned vs. Actual vs. Cash Flow)	[ ]	[ ]
MP-1	Y/N	Manpower Deployment Records (Attendance Sheets – Monthly Compiled)	[ ]	[ ]
PH-1	Y/N	Site Photographs (labelled with location, date and activity)	[ ]	[ ]
QA-1	Y/N	Laboratory / Testing Records and Test Reports	[ ]	[ ]
QA-2	Y/N	Non-Conformance Reports (NCRs) – Open and Closed This Month	[ ]	[ ]
HSE-1	Y/N	HSE Inspection Reports and Toolbox Talk Records	[ ]	[ ]
HSE-2	Y/N	Accident / Incident Reports (if any)	[ ]	[ ]
SUB-1	Y/N	Submittal Register – Updated	[ ]	[ ]
VAR-1	Y/N	Variation Orders / Change Orders Issued or Under Review This Month	[ ]	[ ]
CORR-1	Y/N	Formal Correspondence Register – Monthly Update	[ ]	[ ]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

16. CERTIFICATION & SIGN-OFF

This Monthly Progress Report has been prepared, reviewed, and approved by the authorised representatives of the respective organisations as indicated below. The information contained herein is certified to be accurate and complete to the best of the signatory's knowledge.

Role	Name	Designation	Organisation	Signature	Date
Prepared by	[Full Name]	Resident Engineer / Project Manager	Contractor		
Reviewed by	[Full Name]	Project Manager / Senior Engineer	PMC / Consultant		
Endorsed by	[Full Name]	Project Director	PAA – P&D Directorate		
Approved by	[Full Name]	Director (Planning & Development)	Pakistan Airports Authority		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

LIST OF APPROVED MANUFACTURERS

OF AIR TRAFFIC CONTROL TOWER AT SKARDU INTERNATIONAL AIRPORT.

(To be signed by the Bidder)

The Contractor should note that only material from those manufacturers specified in the list of approved manufacturers shall be allowed to be used on this Project. The Contractor shall submit literature/catalogue/samples etc. of all the items from each of the specified manufacturer to the Engineer who shall then decide and approve the sample and the manufacturer. Where the item involves any finishes such as paints, external coatings, etc. the Contractor shall erect mock-up samples of the specified manufacturers for the selection and approval of the Engineer.

The responsibility lies with the Contractor for establishing the genuineness of any materials/products/items for its make and origin as specified below.

CIVIL WORKS		
Sr. No.	**Materials / Items**	**Name of Manufacturer/ Suppliers**
1	Cement	1. DG Cement 2. Maple Leaf Cement 3. Pioneer Cement 4. Best way Cement 5. Lucky Cement.
2	Steel (60 Grade & 40 Grade)	1. Sheikhoo Steel 2. FF Steel 3. Moiz Steel 4. Ittefaq Steel 5. Nomee Steel 6. Amreli Steel
3	Aluminum Works (Aluminum Doors & Windows)	1. Chawala Aluminum 2. Prime Aluminum
4	Glass	1. Guardian Glass 2. Emirates Glass 3. Saint Gobain Glass 4. AGC Glass
5	U.P.V.C Windows	1. Wintech, 2. Veka 3. Yagmur Pen
6	Paints	1. ICI Paints 2. Happilac Paints 3. Nippon Paints 4. Jotun Paints
7	Wall Coatings	1. Rock Shield 2. Fanaan by Brighto 3. Happilac 4. Nova Color
8	Thermal Insulation	1. Diamond Jumbolon

9	Glass Mosaic Tile	1. AMC Art Design 2. MEC Mosaic.
10	Concrete Floor Tiles. Pavers &. Paving Blocks	1. Concrete Concept 2. ENVICRETE 3. Fine Concrete
11	Porcelain Tiles on Floor & Toilets	1. Fifi Ceramic by S. Abdullah 2. Porcelanosa by AW 3. Atlas Concorde by AW 4. Novus by H-Verse 5. Monalisa by H-Verse 6. Aura by Hadayat Sons 7. Aive by H-verse 8. Orient Ceramics
12	Ceramic Tiles in Toilets	1. Fifi Ceramic 2. Porcelanosa by AW 3. Atlas Concorde by AW 4. Novus by H-Verse 5. Monalisa by H-Verse
13	PVC Tiles (Static)	1. Marflex 2. Sarina Flooring
14	PVC Tiles (Non-Static)	1. Marflex 2. Sarina Flooring
15	Water Stopper	3. Marflex
16	Epoxy Coating / Flooring	1. Aqua Seal 2. Sika 3. Vertex 4. Happilac
17	Facade Tile / System	1. Novus by H-verse 2. Kuthaya by S-Abdullah 3. Sinterflex Turkish
18	Termite Proofing (For Soil)	1. Agenda by Jaffer Brothers 2. BruckMann 3. Safe Posion by Mass Brown
19	Termite Proofing (For Wood)	1. Bio-Wood 2. Kanzo (Urban Pest) 3. Power-Max 4. Dow Agro Sciences 5. Solegnium 6. Jaffer Brothers
20	Water Proofing	1. Aqua Seal 2. Sika
21	Aluminum Lineal False Ceilings	1. Daiken (Japan) 2. Dampa (Denmark) 3. Owa (Germany)
22	Doors, Kitchen Cabinets	1. Interwood 2. Naeem Trading Company 3. Buro Kitchen
23	WPC Doors	1. Esta Doors

24	EPC Panels	2. Banu Mukhtar 3. EPC Solution Pakistan
25	Door Locks &Door Closer	1. Yale 2. Abloy
26	Tile Grout	1. Happilac 2. Sika
27	Tile Bond	1. Happilac 2. Sika
28	Gypsum Board Ceiling and Panel	1. United Gypsum 2. Elephant 3. Lodhiya Gypsum
29	Fire Doors	1. Haseen Habib 2. Khokhar Group
30	Terrozzo Tiles	1. Punjab Tiles
31	Expension Joints	4. ARFEN 5. Asteknik 6. Mesihuo
32	Expanded Polystyrene (EPS) / PIR Panel	1. Banu Mukhtar 2. EPS Pakistan 3. Izhar Foster
33	Space Frame Structure	1. OHC Construction China 2. ABC Engineering Company China 3. Jazari Steel Pvt Ltd
WATER SUPPLY & SANITARY FITTINGS		
Sr. No.	**Materials / Items**	**Name of Manufacturer/ Suppliers**
1	G.I. Pipes	1. M/S International Industries Limited (IIL)
2	G.I. Pipe Fittings	1. M/S HE China, M/S TG China.
3	CPVC Pipes	1. Prestige Plastic Pipes 2. Labrasol 3. Steelex Pipes
4	Sanitary Fixtures	1. TOTO by AW 2. Verona by H2O 3. Bleen by H-Verse 4. Sera by S-Abdullah
5	Kitchen Sinks	1. RAK 2. Fotile 3. Franke
6	Sanitary Fittings	1. TOTO by AW 2. Hans Grohe by H-Verse 3. SERA by S- Abdullah
7	Valves	1. Kitz-Japan
8	Geyser	1. Ekotherm 2. CANNON 3. Veissman

9	Water Cooler	1. Deluxe, 2. Ambassador, 3. CANON
10	C.I. Covers With Frame Floor Drains & Floor Cleanouts	1. Alpine Steel (Pvt.) Ltd. 2. Sandal Engineering (Pvt.) Ltd. 3. Central Mechanical Engineering (CME) Company (Pvt.) Ltd.
11	Fire Hose Cabinet And Extinguishers + Fire Doors	1. M/S Haseen Habib (Pvt.) Ltd. 2. MESI GROUP
12	UPVC , HDPE & PPRC Pipes and Fittings	1. M/S Shafisons Engineering (Pvt.) Ltd. (Beta Pipes). 2. IIL 3. Master Pipes (Faisalabad), 4. Popular Pipes
13	Electric Water Heaters.	1. CANON 2. Nas Gas
14	Water Filters	1. M/S So-Safe 2. M./S Aqua Safe 3. Culligan 4. Teka

ELECTRIC MATERIAL		
Sr. No.	**Materials / Items**	**Name of Manufacturer/ Suppliers**
1	Light Fixture	1. Impulse 2. Watts and Luxes 3. Fast Lighting 4. Matrix Led
2	Distribution Boards, Main & Sub-Main Panel Boards	1. Bilal Switch Change 2. Electrech 3. Volamp Engineering 4. Capital Switch gear
3	Cables And Wires	1. Pakistan Cables 2. Newage Cables 3. Fast Cables 4. CopperGat Cables
4	PVC Conduit & Accessories	1. Beta 2. Master Pipes (Faisalabad)
5	Steel Conduit & Accessories	1. M/S International Industries Limited (IIL)
6	Switches. Sockets Etc.	1. ORANGE 2. Legrand 3. Schneider
7	Back Boxes, Pull Boxes, Etc.	1. Bosch 2. Milano 3. Legrand 4. ORANGE
8	Telephone Cables Dish Antenna Cables	1. Siemens Germany 2. Comscope USA & 3 M

		3. Ventilex
9	Telephone Junction Boxes	1. Panasonic 2. Huawei
10	Fans	1. GFC Fans 2. Lahore Fans 3. Royal Fans
11	MCCBS And MCBS	1. Marlin Gerlin (MG) (France) 2. Siemens (Germany) 3. ABB (Italy) 4. Schneider Electric (Germany) 5. ORANGE
12	ACBS	1. Siemens (Germany) 2. ABB (Italy)
13	Generator Set	1. Caterpillar 2. Siemens 3. Power zone by Mecatech
14	Transformer	1. Siemens 2. PEL
15	CCTV System & Public Address System	1. Hik Vision 2. Samsung 3. Sony 4. Dahua
16	DC Inverter and Air Conditioner	1. Trane 2. TCL 3. Hitachi 4. Daikin
17	Solar System Panels	1. Longi Solar 2. Jinko Solar 3. Canadian Solar
18	Solar System Inverter	1. Solis 2. Huawei
19	Net Working Cables	1. ORANGE 2. 3M

Authorized Signature and official Seal: _____

Name: _____

Date: _____

PAKISTAN AIRPORTS AUTHORITY

پاکستان ایئرپورٹس اتھارٹی

CONSTRUCTION OF NEW AIR TRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES AT SKARDU INTERNATIONAL AIRPORT

(DETAILED ARCHITECTURAL DRAWINGS)

ISSUE FOR TENDER

MAIN CONSULTANT:

Anwar Ali Architects (Pvt.) Ltd.

Formerly Anwar Ali & Associates Since March 2006 to June 2018

Consulting Architects, Engineers, Planners & Management Consultants

JV CONSULTANT:

leit-werk

COMRADES CONSULTANTS

MARCH : 2026

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CONSTRUCTION OF NEW AIR TRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES AT SKARDU INTERNATIONAL AIRPORT

(LIST OF DRAWINGS)

(ARCHITECTURAL)

NO.	DRAWING NO.	DATE OF DRAWING	AMENDED UPTODATE	DESCRIPTION
01	AW-01	MARCH:2026		ATC TOWER LOCATION PLAN & PROFILE
02	AW-02	MARCH:2026		ATC TOWER LINE OF SIGHT ANALYSIS
03	AW-03	MARCH:2026		LAYOUT PLAN
04	AW-04	MARCH:2026		ATC GRADING PLAN & XSECTION
05	AW-05	MARCH:2026		ATC GRADING ROAD PAVEMENT
06	AW-06	MARCH:2026		ATC ROAD PLAN
07	AW-07	MARCH:2026		GROUND FLOOR FURNITURE PLAN
08	AW-08	MARCH:2026		MEZZANINE FLOOR FURNITURE PLAN (ARFF)
09	AW-09	MARCH:2026		FIRST FLOOR PLAN FURNITURE PLAN
10	AW-10	MARCH:2026		ROOF FLOOR PLAN
11	AW-11	MARCH:2026		ARFF CONTROL CABIN FLOOR PLAN
12	AW-12	MARCH:2026		ATCT CONTROL CABIN FLOOR PLAN
13	AW-13	MARCH:2026		GROUND FLOOR WORKING PLAN
14	AW-14	MARCH:2026		MEZZANINE FLOOR WORKING PLAN (ARFF)
15	AW-15	MARCH:2026		FIRST FLOOR WORKING PLAN
16	AW-16	MARCH:2026		ROOF FLOOR WORKING PLAN
17	AW-17	MARCH:2026		ARFF CONTROL CABIN WORKING PLAN
18	AW-18	MARCH:2026		ATCT CONTROL CABIN WORKING PLAN
19	AW-19	MARCH:2026		TOWER CAB ROOF WORKING PLAN
20	AW-19A	MARCH:2026		TOP ROOF WPRKING PLAN
21	AW-20	MARCH:2026		FRONT ELEVATION
22	AW-21	MARCH:2026		REAR ELEVATION
23	AW-22	MARCH:2026		LEFT & RIGHT ELEVATION
24	AW-23	MARCH:2026		SECTION A-A
25	AW-24	MARCH:2026		SECTION B-B
26	AW-25	MARCH:2026		SECTION C-C & D-D
27	AW-26	MARCH:2026		SECTION E-E & F-F
28	AW-27	MARCH:2026		SECTION G-G & H-H
29	AW-28	MARCH:2026		SECTION I-I & J-J
30	AW-28A	MARCH:2026		DOOR's DETAIL'S
31	AW-29	MARCH:2026		WINDOW's DETAIL'S
32	AW-29A	MARCH:2026		PIT DETAIL
33	AW-30	MARCH:2026		GROUND FLOOR PATTERN PLAN
34	AW-31	MARCH:2026		MEZZANINE FLOOR PATTERN PLAN
35	AW-32	MARCH:2026		FIRST FLOOR PATTERN PLAN
36	AW-32A	MARCH:2026		ATC EQUIPMENT ROOM RAISED FLOOR DETAIL
37	AW-33	MARCH:2026		ROOF FLOOR PATTERN PLAN
38	AW-34	MARCH:2026		ARFF FLOOR PATTERN PLAN
39	AW-35	MARCH:2026		ATCT FLOOR PATTERN PLAN
40	AW-36	MARCH:2026		GROUND FLOOR CEILING PLAN
41	AW-37	MARCH:2026		MEZZANINE FLOOR CEILING PLAN
42	AW-38	MARCH:2026		FIRST FLOOR CEILING PLAN
43	AW-39	MARCH:2026		ROOF TOP FLOOR CEILING PLAN
44	AW-40	MARCH:2026		ARFF FLOOR CEILING PLAN
45	AW-40A	MARCH:2026		ATCT FLOOR CEILING PLAN
46	AW-40B	MARCH:2026		STAIR DETAIL-1
47	AW-41	MARCH:2026		STAIR DETAIL-2
48	AW-42	MARCH:2026		STAIR DETAIL-3
49	AW-43	MARCH:2026		LIFT DETAIL
50	AW-44	MARCH:2026		EXPANSION JOINT AND TYPICAL DETAIL
51	AW-45	MARCH:2026		GROUND FLOOR TOILET DETAIL
52	AW-46	MARCH:2026		MEZZANINE FLOOR TOILET DETAIL
53	AW-47	MARCH:2026		FIRST FLOOR MALE TOILET DETAIL
54	AW-48	MARCH:2026		FIRST FLOOR FEMALE TOILET DETAIL
55	AW-49	MARCH:2026		GROUND FLOOR FIRE EXIT PLAN
56	AW-50	MARCH:2026		MEZZANINE FLOOR FIRE EXIT PLAN
57	AW-51	MARCH:2026		FIRST FLOOR FIRE EXIT PLAN
58	AW-52	MARCH:2026		MEZZANINE FLOOR FIRE EXIT PLAN
59	AW-53	MARCH:2026		ARFF FLOOR FIRE EXIT PLAN
60	AW-54	MARCH:2026		ATCT FLOOR FIRE EXIT PLAN
61	AW-55	MARCH:2026		MISCELLANEOUS DETAIL-1
62	AW-56	MARCH:2026		MISCELLANEOUS DETAIL-2
63	AW-57	MARCH:2026		MISCELLANEOUS DETAIL-3
64	AW-58	MARCH:2026		MISCELLANEOUS DETAIL-4
65	AW-59	MARCH:2026		U.G.W.TANK DETAIL
66	AW-59A	MARCH:2026		FIRE FIGHTING WATER TANK & SEPTIC TANK DETAIL
67	AW-59B	MARCH:2026		RAIN WATER HARVESTING TANK DETAIL
68	AW-60	MARCH:2026		TOWER (ATCT), FIRE STATION ELECTRICAL LAYOUT PLAN
69	AW-61	MARCH:2026		TOWER (ATCT), FIRE STATION LT PANEL ROOM
70	AW-62	MARCH:2026		HVAC LAYOUT PLAN
71	AW-63	MARCH:2026		UTILITY BLOCK GROUND FLOOR PLAN
72	AW-64	MARCH:2026		UTILITY BLOCK ROOF PLAN
73	AW-65	MARCH:2026		UTILITY BLOCK ELEVATION-1&2
74	AW-66	MARCH:2026		UTILITY BLOCK ELEVATION-3&4
75	AW-67	MARCH:2026		UTILITY BLOCK SECTION-A-A & B-B
76	AW-68	MARCH:2026		UTILITY BLOCK DOOR'S & WINDOW DETAIL
77	AW-69	MARCH:2026		3D VIEW-I
78	AW-70	MARCH:2026		3D VIEW-II
79	AW-71	MARCH:2026		3D VIEW-III
80	AW-72	MARCH:2026		3D VIEW-IV
81	AW-73	MARCH:2026		3D VIEW-V
82	AW-74	MARCH:2026		3D VIEW-VI
83	AW-75	MARCH:2026		3D VIEW-VII
84	AW-76	MARCH:2026		3D VIEW-VIII
85	AW-77	MARCH:2026		3D VIEW-IX
86	AW-78	MARCH:2026		3D VIEW-X
87	AW-79	MARCH:2026		MOOD BOARD

ISSUE FOR TENDER

MAIN CONSULTANT:

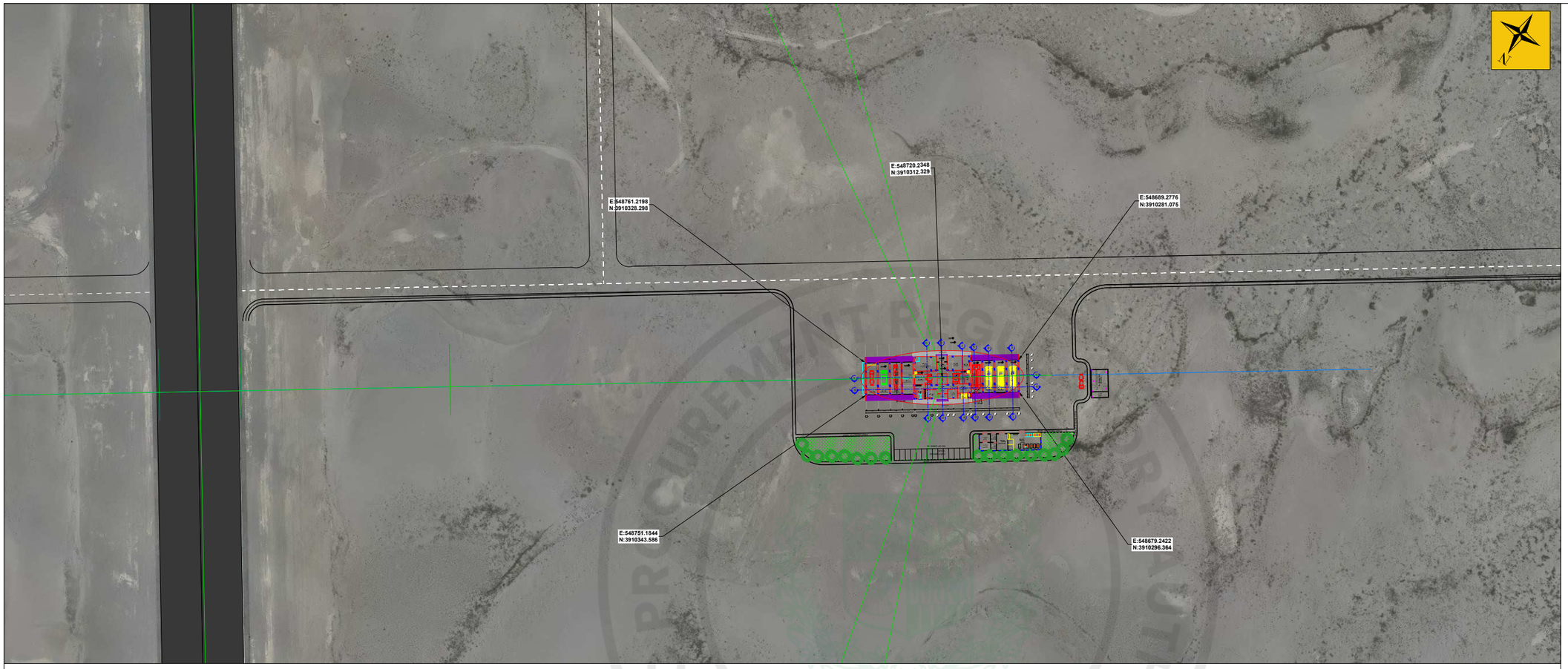
Anwar Ali Architects (Pvt.) Ltd.
Formerly Anwar Ali & Associates Since March 2006 to June 2018
Consulting Architects, Engineers, Planners & Management Consultants

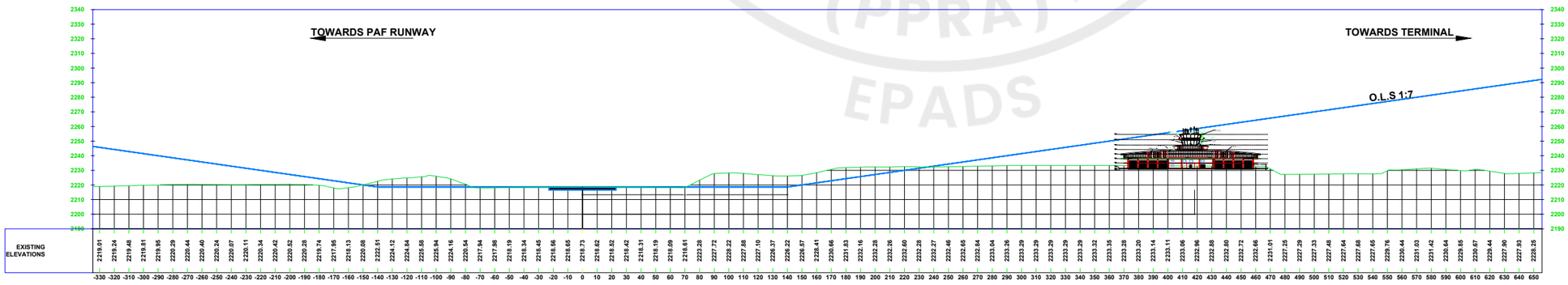
JV CONSULTANT:

leit-werk

COMRADES CONSULTANTS

MARCH : 2026





NOTES:

REV. NO.	MODIFICATIONS	DATE	DRAWN

CLIENT:

CONSULTANT:

PROJECT :
Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

STATUS : ISSUED FOR INFORMATION

DRAWING TITLE :
ATC TOWER LOCATION PLAN & PROFILE

JOB No. :
SCALE :
SIZE A0

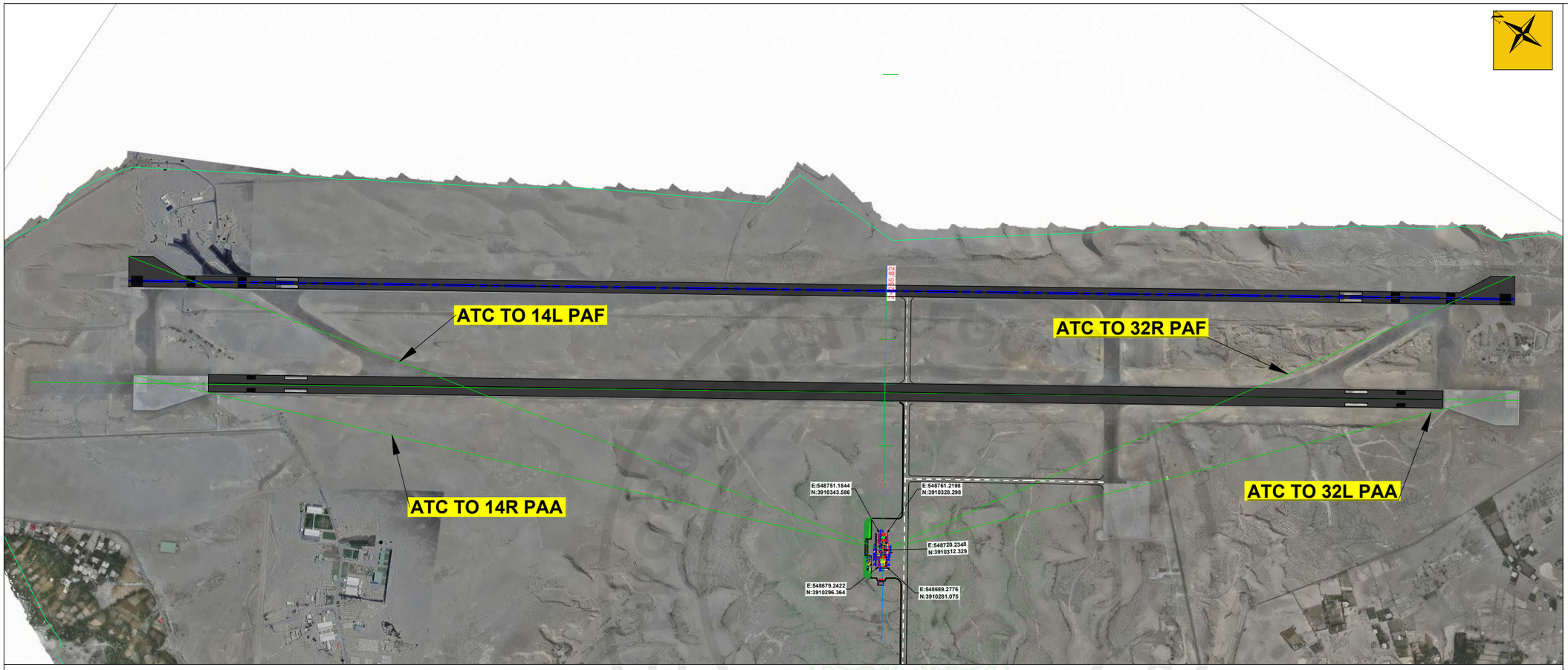
	NAME	DATE
DSGN		
DRWN		
CHKD		
APPD		

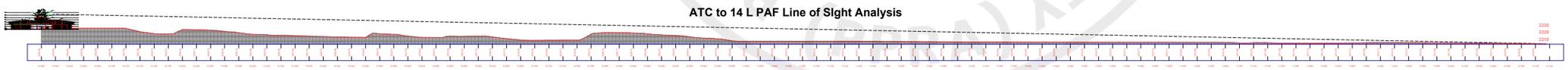
PROJECTION

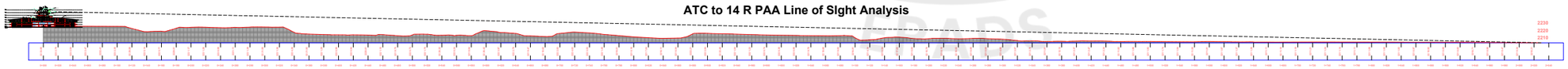
DRAWING NO.
REV:

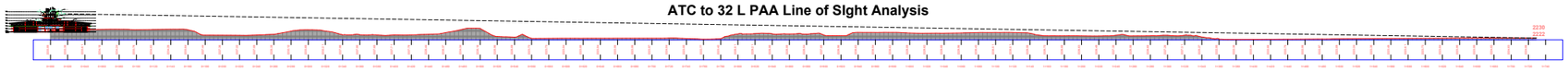
RELEASED FOR
☒ INFORMATION ☐ TENDER ☐ APPROVAL ☐ CONSTRUCTION ☐ AS BUILT

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS









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NOTES:

REV. NO.	MODIFICATIONS	DATE	DRAWN

CLIENT:

CONSULTANT:

PROJECT :
Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

STATUS :
ISSUED FOR INFORMATION

DRAWING TITLE :
ATC TOWER LINE OF SIGHT ANALYSIS

JOB No. :			SCALE :
	NAME	DATE	SIZEA0
DSGN			PROJECTION
DRWN			
CHKD			
APPD			

DRAWING NO. | REV:

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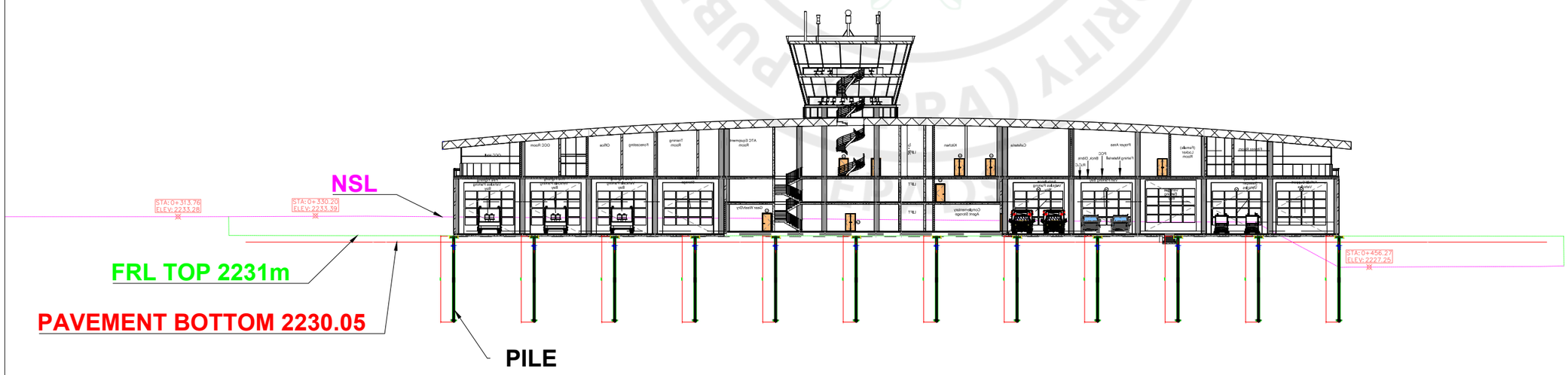

ISSUE FOR TENDER

NOTES:

1-ALL DIMENSIONS ARE IN METERS

2-COORDINATE SYSTEM IS WGS84

3-PAVEMENT HEIGHT IS 0.95m

REV-NO.	MODIFICATIONS	DATE	DRAWN

CLIENT: PAA

CONSULTANT: Anwar Ali Architects (Pvt.) Ltd. · leit-werk · COMRADES

PROJECT :

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

STATUS : ISSUED FOR INFORMATION

DRAWING TITLE :

ATC GRADING PLAN & XSECTION

JOB No. :			SCALE :
	NAME	DATE	SIZEA0
DSGN			PROJECTION
DRWN			
CHKD			
APPD			

DRAWING NO. | REV:

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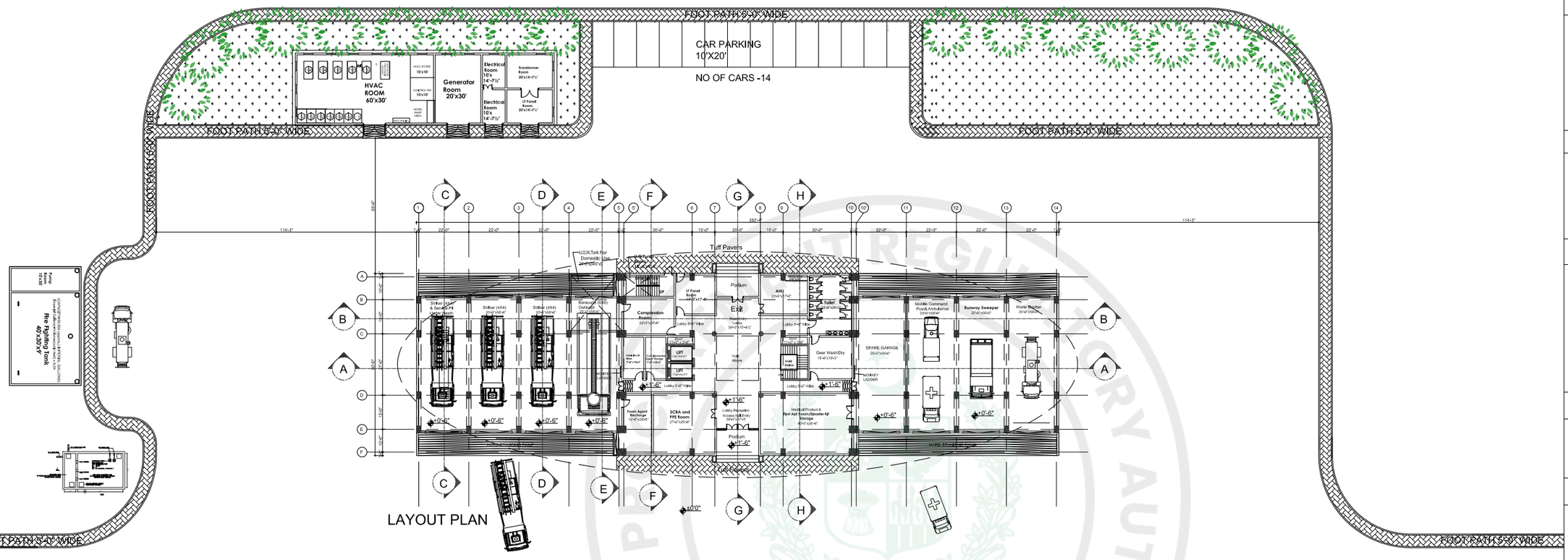

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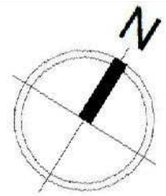
COMRADES CONSULTANTS
leit-werk

STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

LAYOUT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-03 @A3

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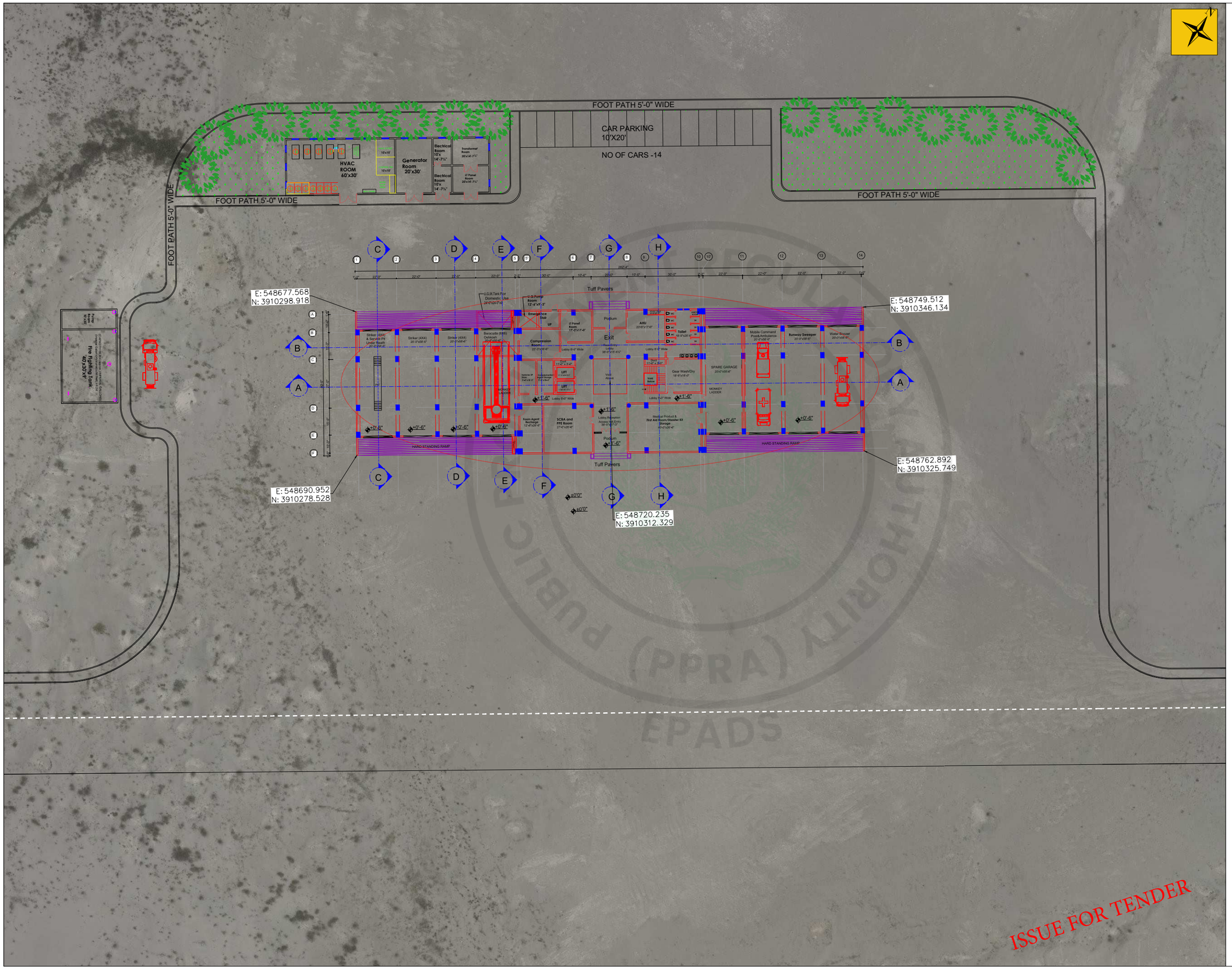
FOOT PATH 5'-0" WIDE
CAR PARKING
10'X20'
NO OF CARS -14
FOOT PATH 5'-0" WIDE
FOOT PATH 5'-0" WIDE
FOOT PATH 5'-0" WIDE
HVAC ROOM 60'x30'
Generator Room 20'x30'
Electrical Room 10'x 14'-7½"
Electrical Room 10'x 14'-7½"
Transformer Room 20'x14'-3½"
LT Panel Room 20'x14'-3½"
Fire Fighting Tank 40'x30'x9'
Pump House 10'x20'
E: 548677.568
N: 3910298.918
E: 548749.512
N: 3910346.134
E: 548762.892
N: 3910325.749
E: 548690.952
N: 3910278.528
E: 548720.235
N: 3910312.329
Tuff Pavers
Tuff Pavers
HARD STANDING RAMP
HARD STANDING RAMP
Podium
Podium
Exit
Lobby
Lobby
Lobby

NOTES:

1-ALL DIMENSIONS ARE IN METERS

2-COORDINATE SYSTEM IS WGS84

3-PAVEMENT HEIGHT IS 0.95m

REV-NO.	MODIFICATIONS	DATE	DRAWN

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CONSULTANT:

Anwar Ali Architects (Pvt.) Ltd.

leit-werk

COMRADES

PROJECT :

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

STATUS : ISSUED FOR INFORMATION

DRAWING TITLE :

ATC ROADS PLAN

JOB No. :

SCALE :

SIZEA0

	NAME	DATE
DSGN		
DRWN		
CHKD		
APPD		

PROJECTION

DRAWING NO.

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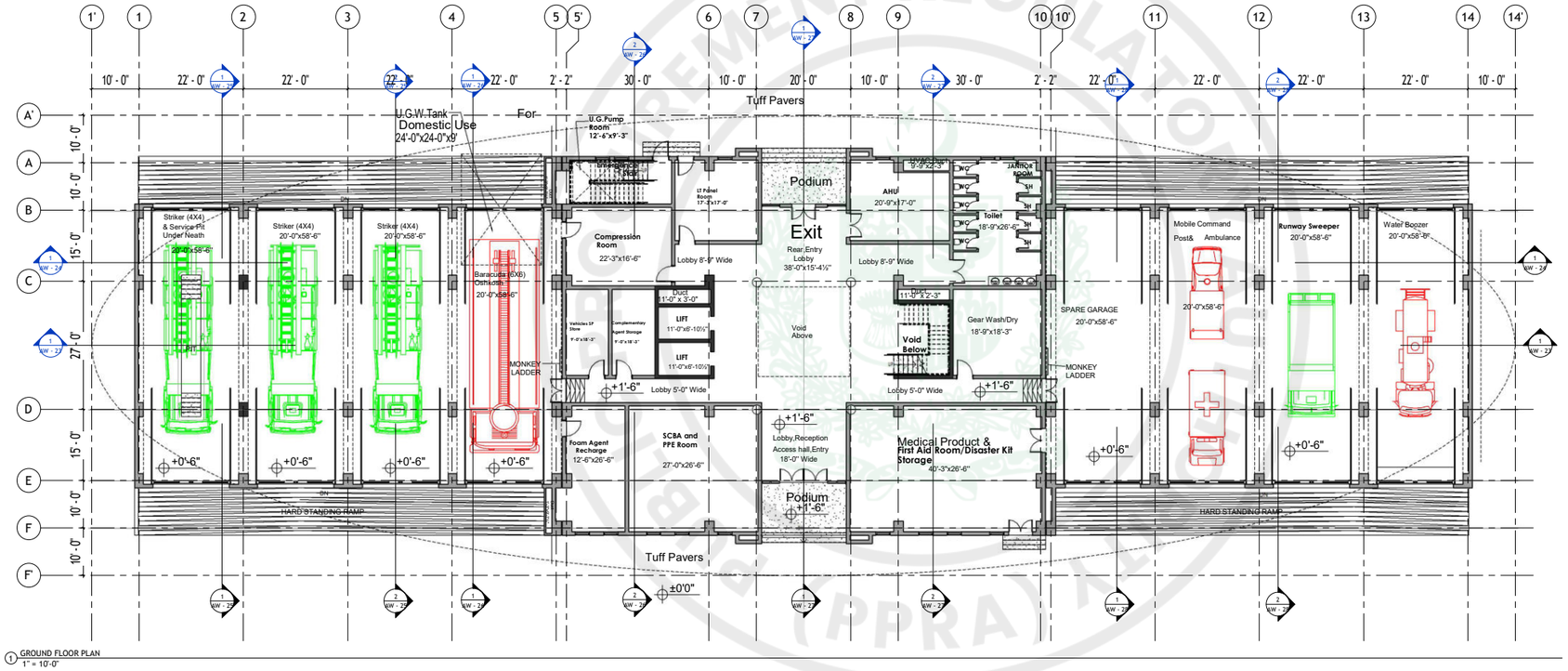

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JV MEMBERS

COMRADES CONSULTANTS
leit-werk

Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

GROUND FLOOR PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 07

Scale @ 42" X 30" 1" = 10'-0"

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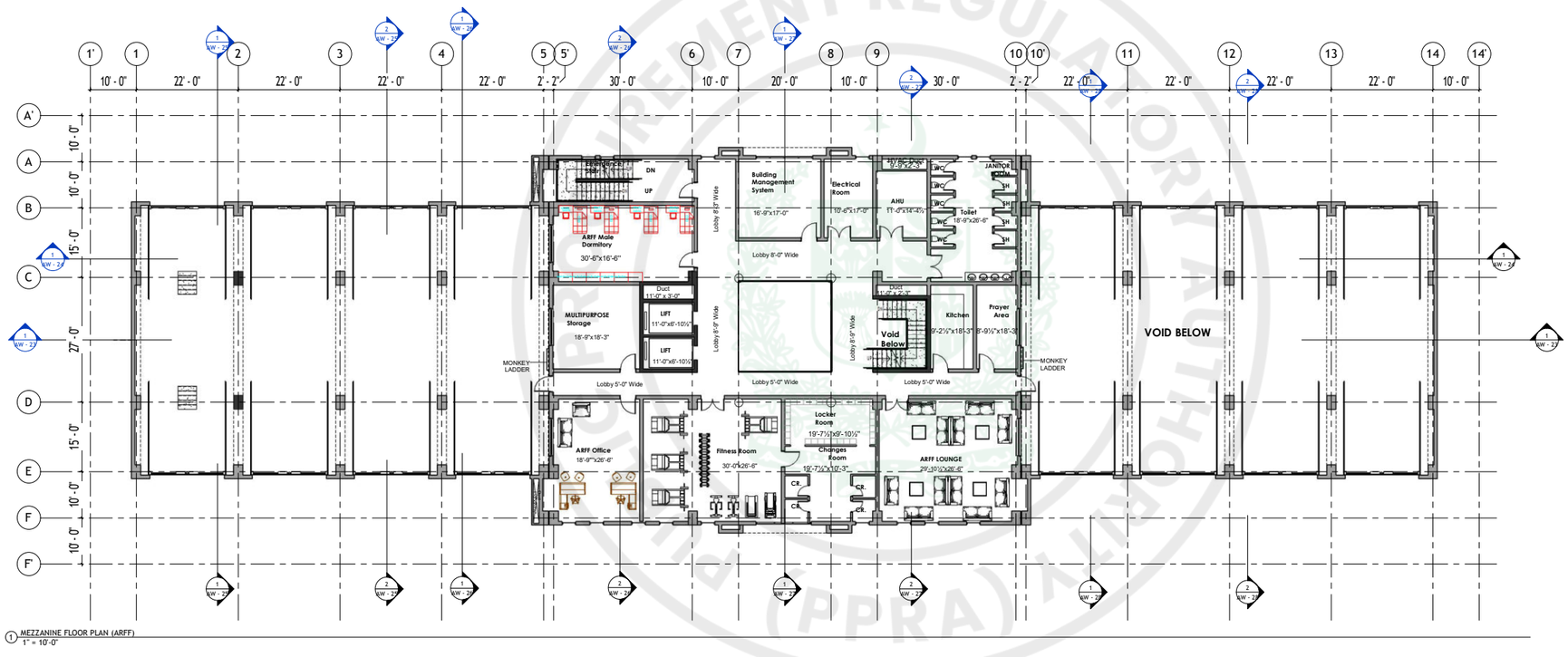

1 MEZZANINE FLOOR PLAN (ARFF)
1" = 10'-0"

CONSULTANTS PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS

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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

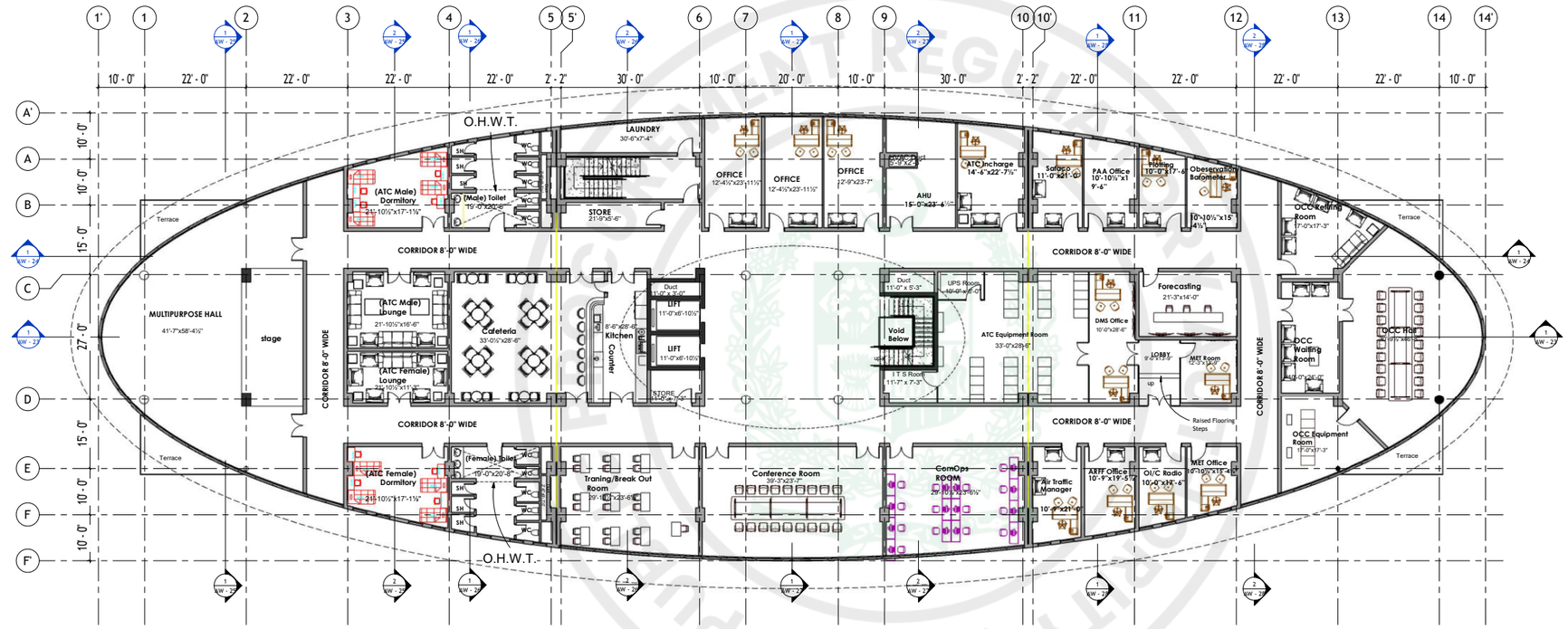
Detailed Architectural Design Drawings

MEZZANINE FLOOR PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 08

Scale @ 42" X 30" 1" = 10'-0"



1 FIRST FLOOR PLAN
1" = 10'-0"

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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

FIRST FLOOR PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 09

Scale @ 42" X 30" 1" = 10'-0"

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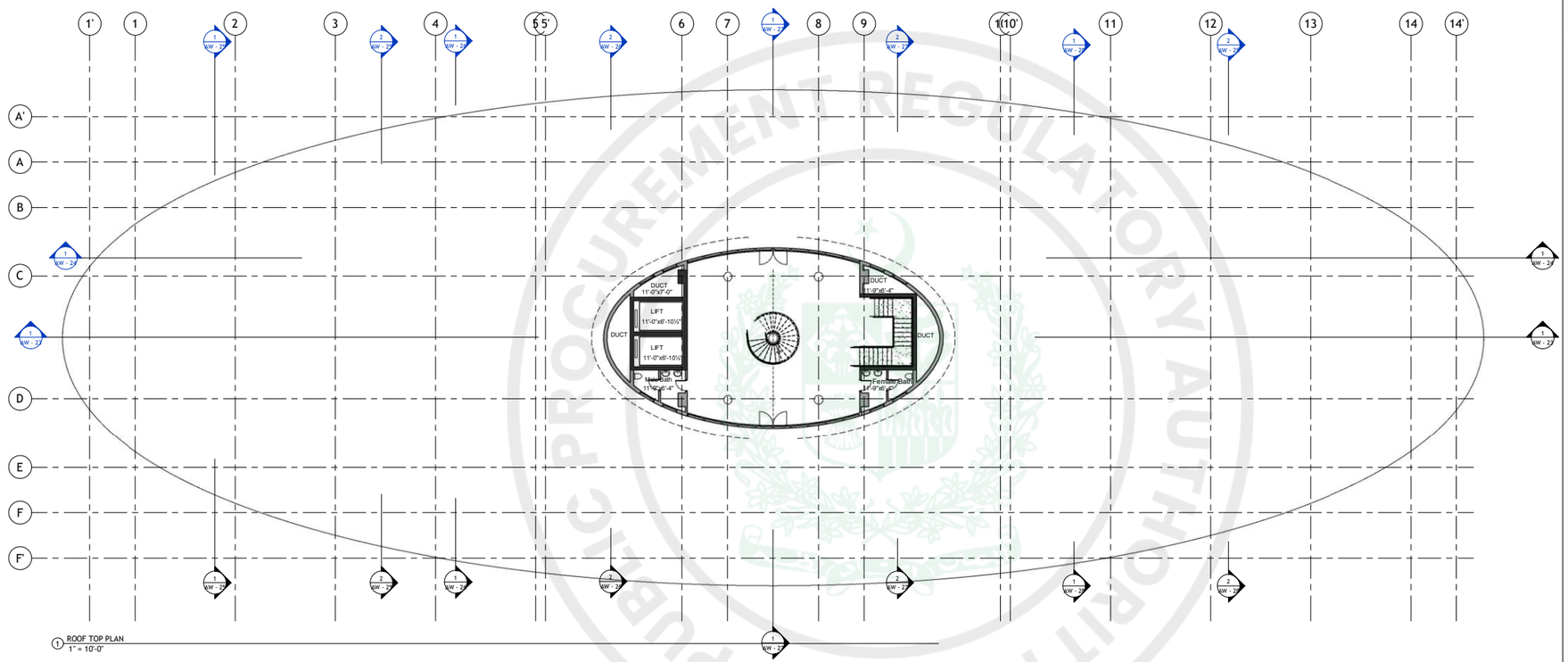

PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS

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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

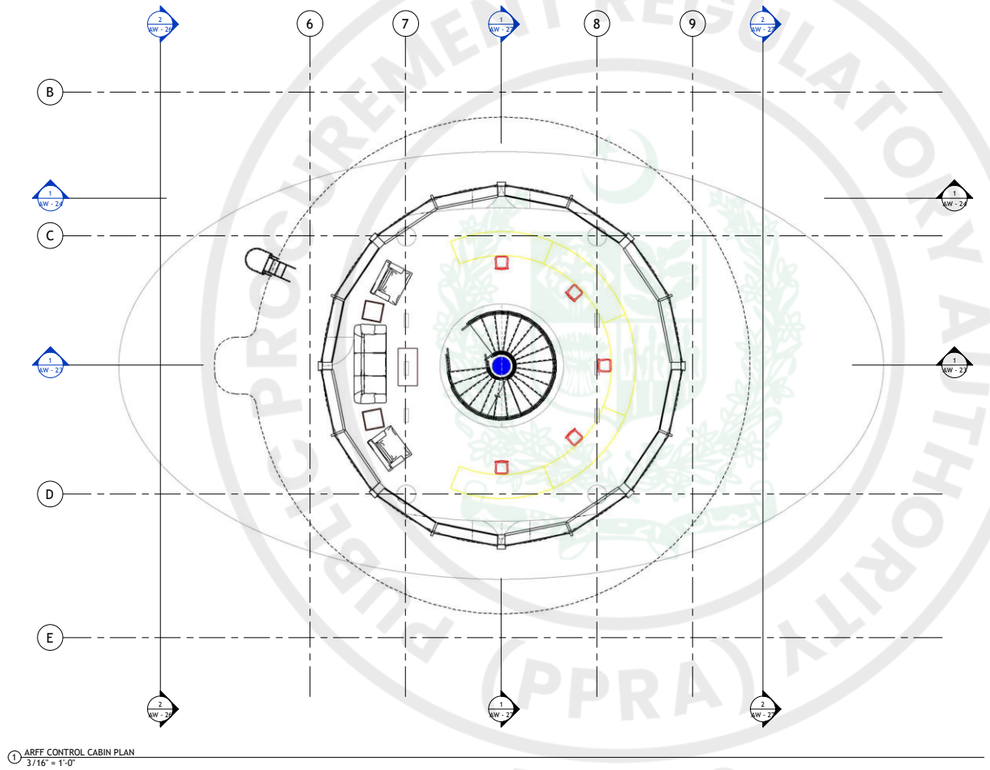
Detailed Architectural Design Drawings

ROOF TOP FLOOR PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 10

Scale @ 42" X 30" 1" = 10'-0"



1 ARFF CONTROL CABIN PLAN
3/16" = 1'-0"

ISSUE FOR TENDER

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COMRADES CONSULTANTS
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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

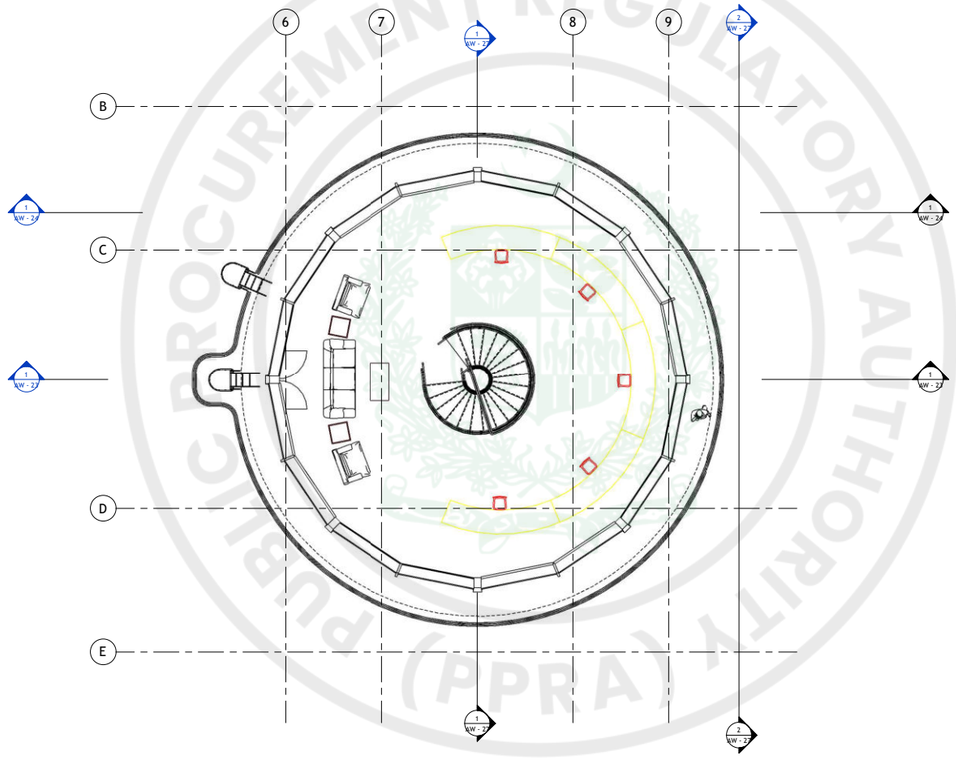
ARFF CONTROL CABIN FLOOR PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 11

Scale @ 42" X 30" 3/16" = 1'-0"

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



1 ATCT CONTROL CABIN PLAN
3/16" = 1'-0"

PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS

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leit-werk

Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

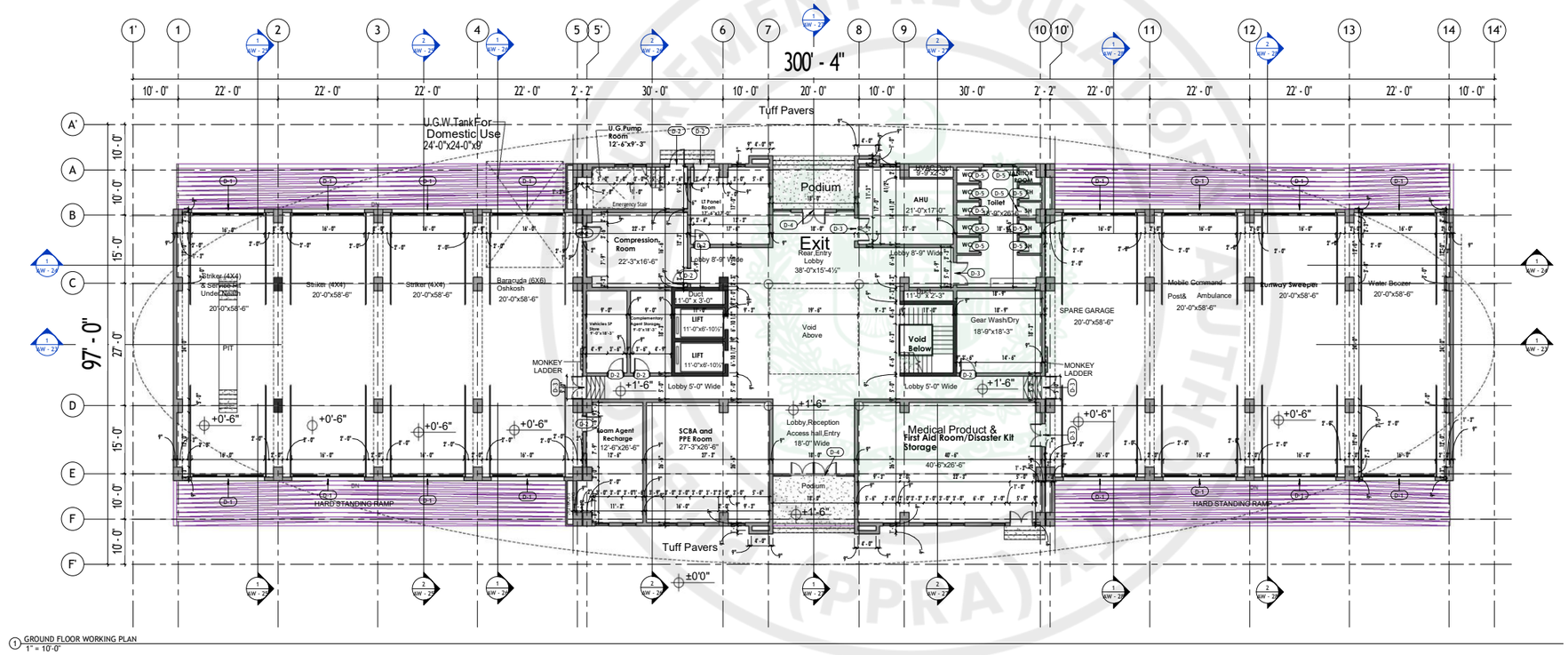
Detailed Architectural Design Drawings

ATCT CONTROL CABIN FLOOR PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 12

Scale @ 42" X 30" 3/16" = 1'-0"



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JV MEMBERS

COMRADES CONSULTANTS
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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

GROUND FLOOR WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 13

Scale @ 42" X 30" 1" = 10'-0"

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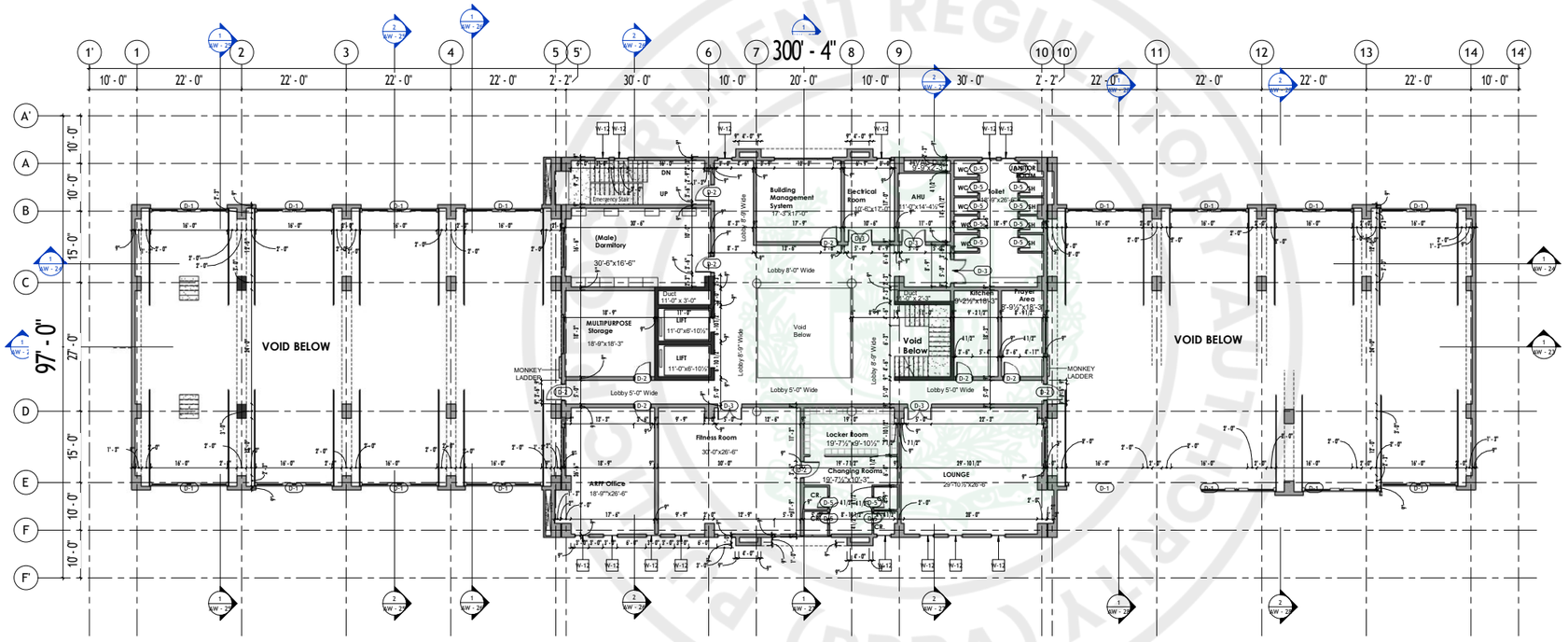

1 MEZZANINE FLOOR WORKING PLAN (ARFF)
1" = 10'-0"

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Project Name

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Detailed Architectural Design Drawings

MEZZANINE FLOOR WORKING PLAN (ARFF)

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 14

Scale @ 42" X 30" 1" = 10'-0"

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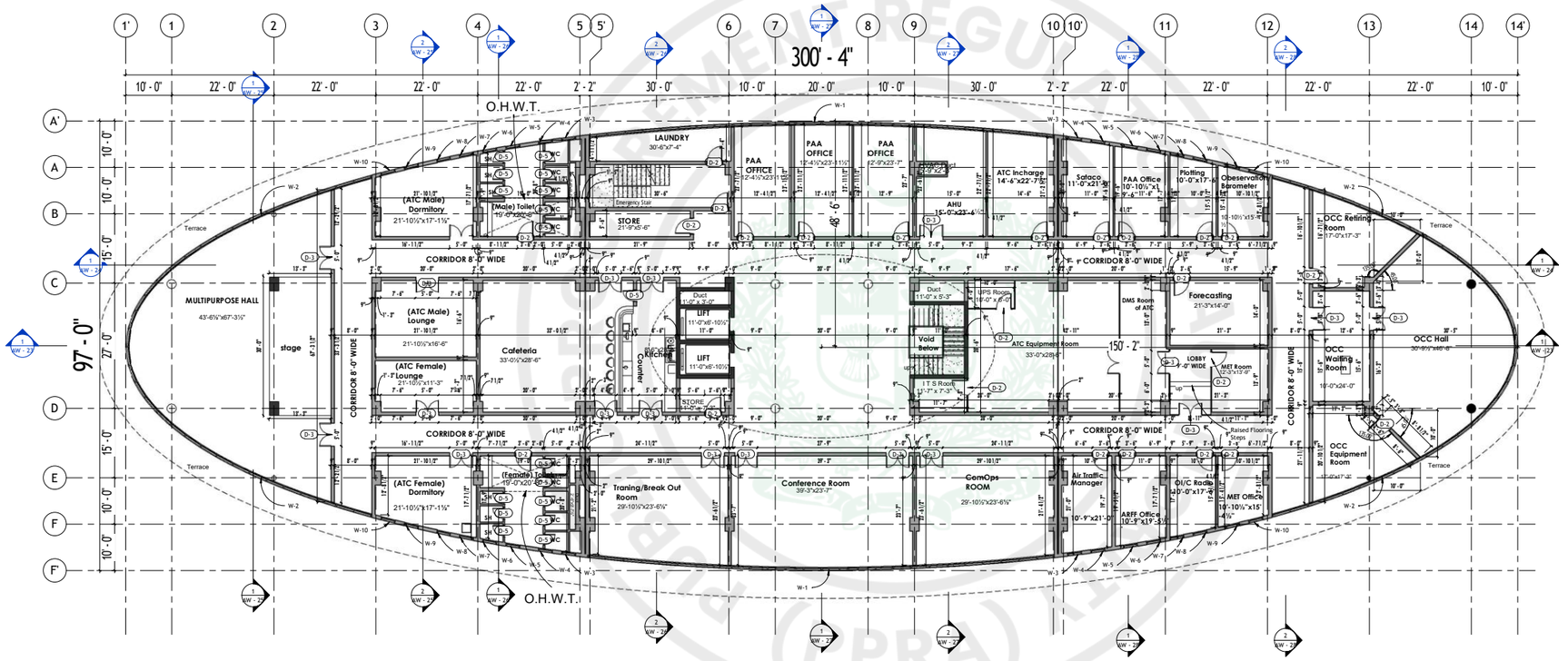

1 FIRST FLOOR WORKING PLAN
1" = 10'-0"

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Project Name

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Detailed Architectural Design Drawings

FIRST FLOOR WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 15

Scale @ 42" X 30" 1" = 10'-0"

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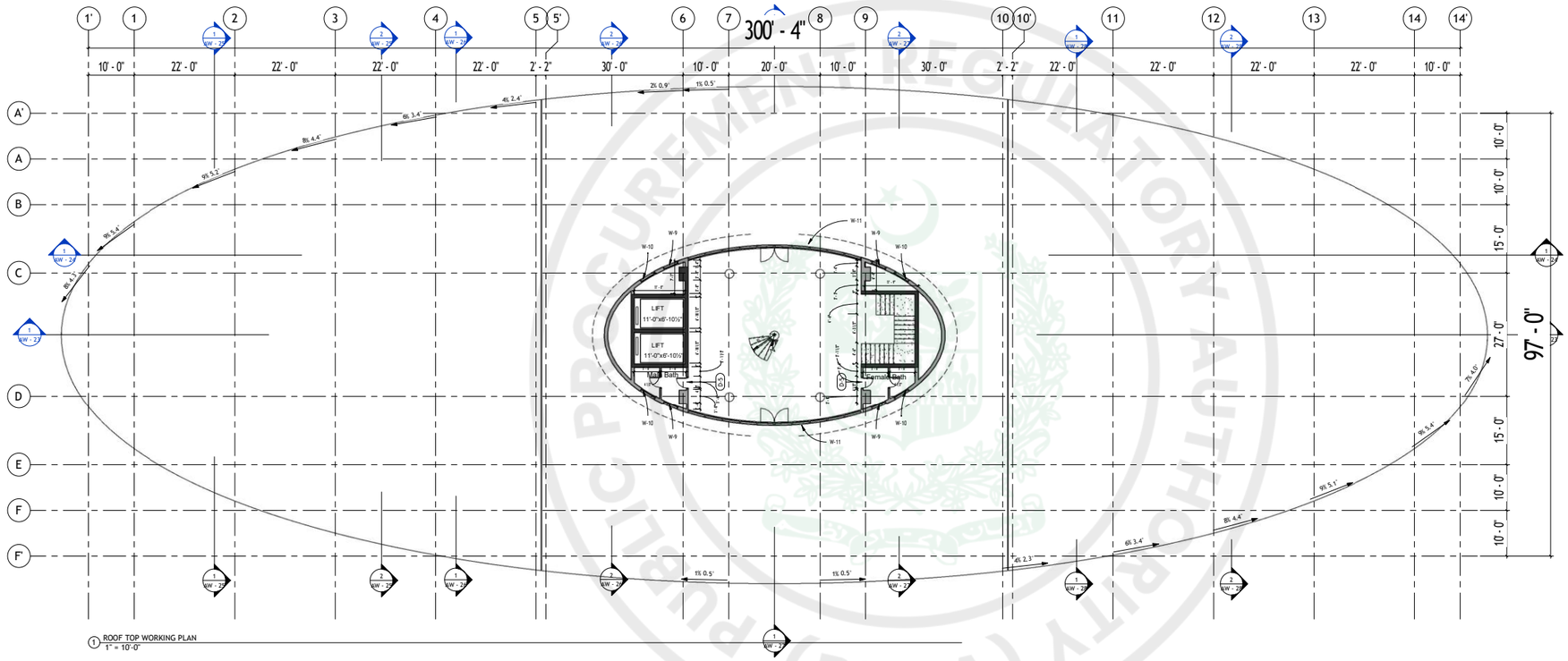

1 ROOF TOP WORKING PLAN
1" = 10'-0"

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Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

ROOFTOP FLOOR WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 16

Scale @ 42" X 30" 1" = 10'-0"

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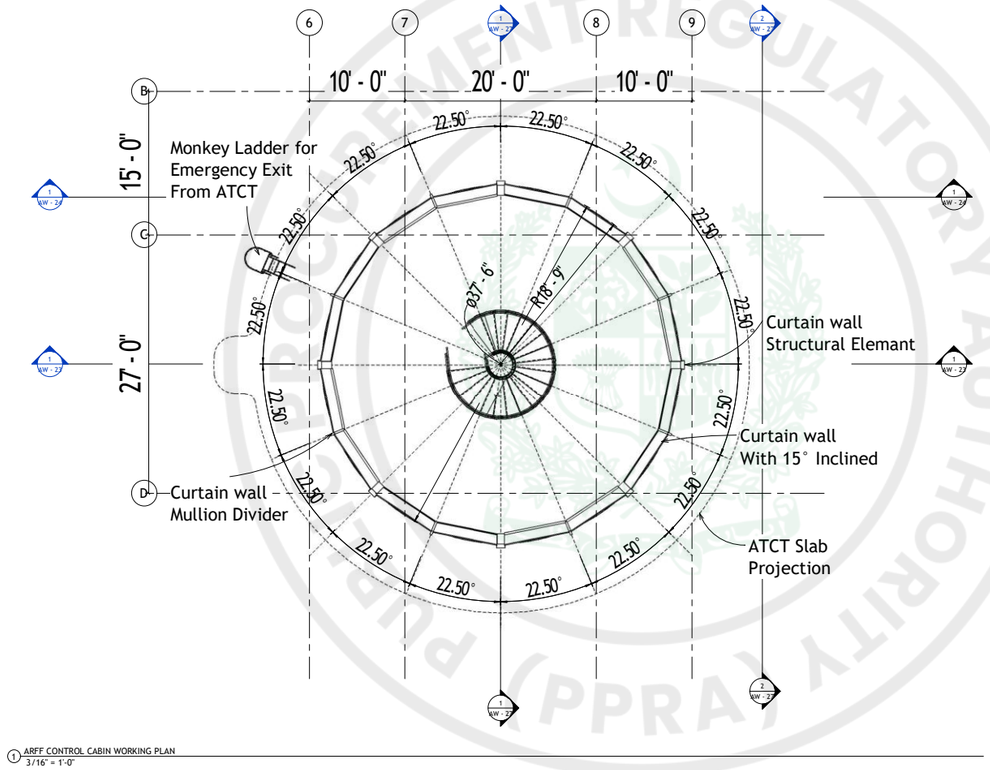

1 ARFF CONTROL CABIN WORKING PLAN
3/16" = 1'-0"

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Project Name

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Detailed Architectural Design Drawings

ARFF CONTROL CABIN WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 17

Scale @ 42" X 30" 3/16" = 1'-0"

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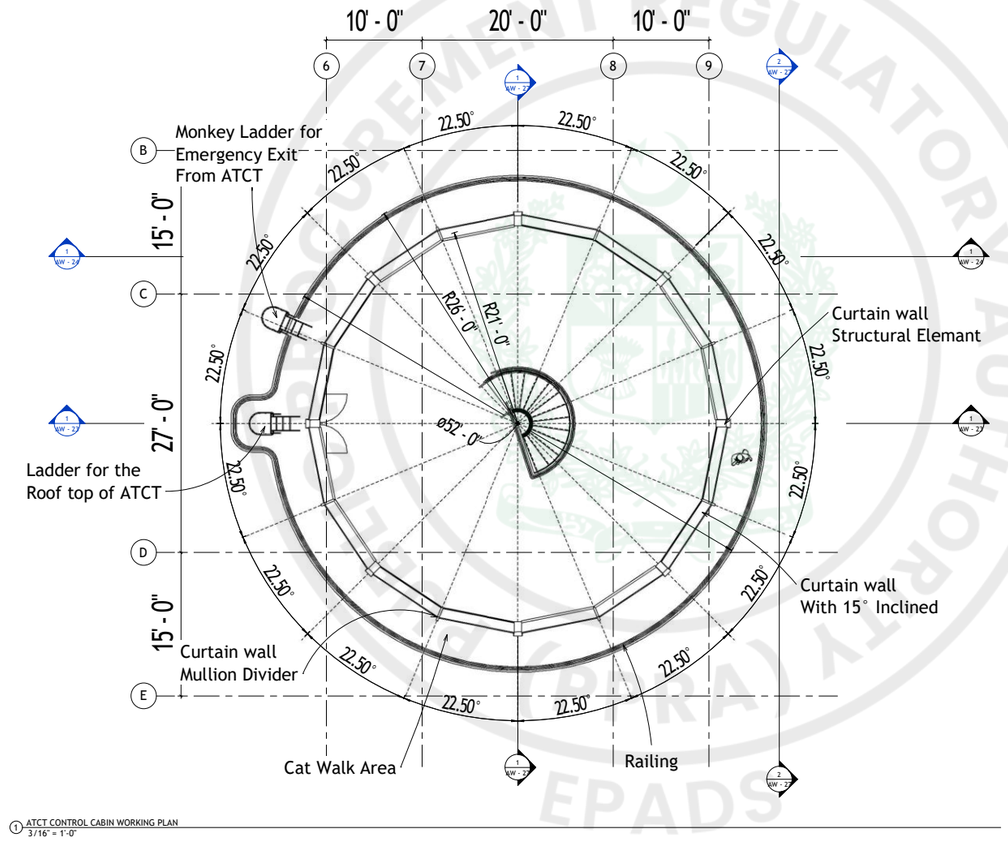

1 ATCT CONTROL CABIN WORKING PLAN
3/16" = 1'-0"

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Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

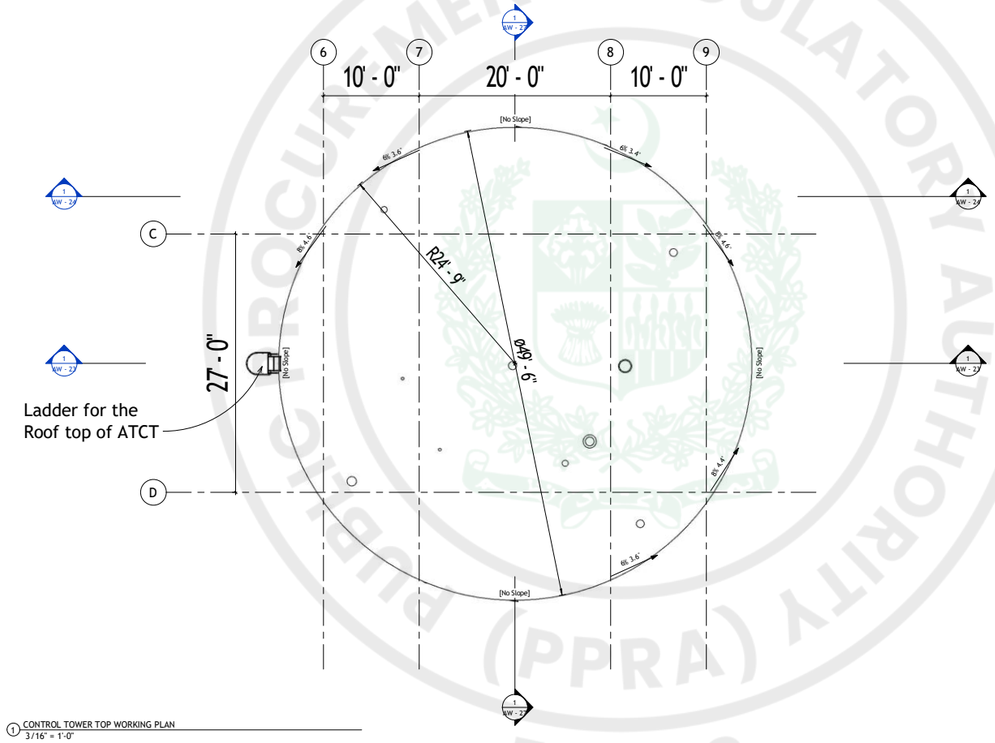
Detailed Architectural Design Drawings

ATCT CONTROL CABIN WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 18

Scale @ 42" X 30" 3/16" = 1'-0"



1 CONTROL TOWER TOP WORKING PLAN
3/16" = 1'-0"

PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS

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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

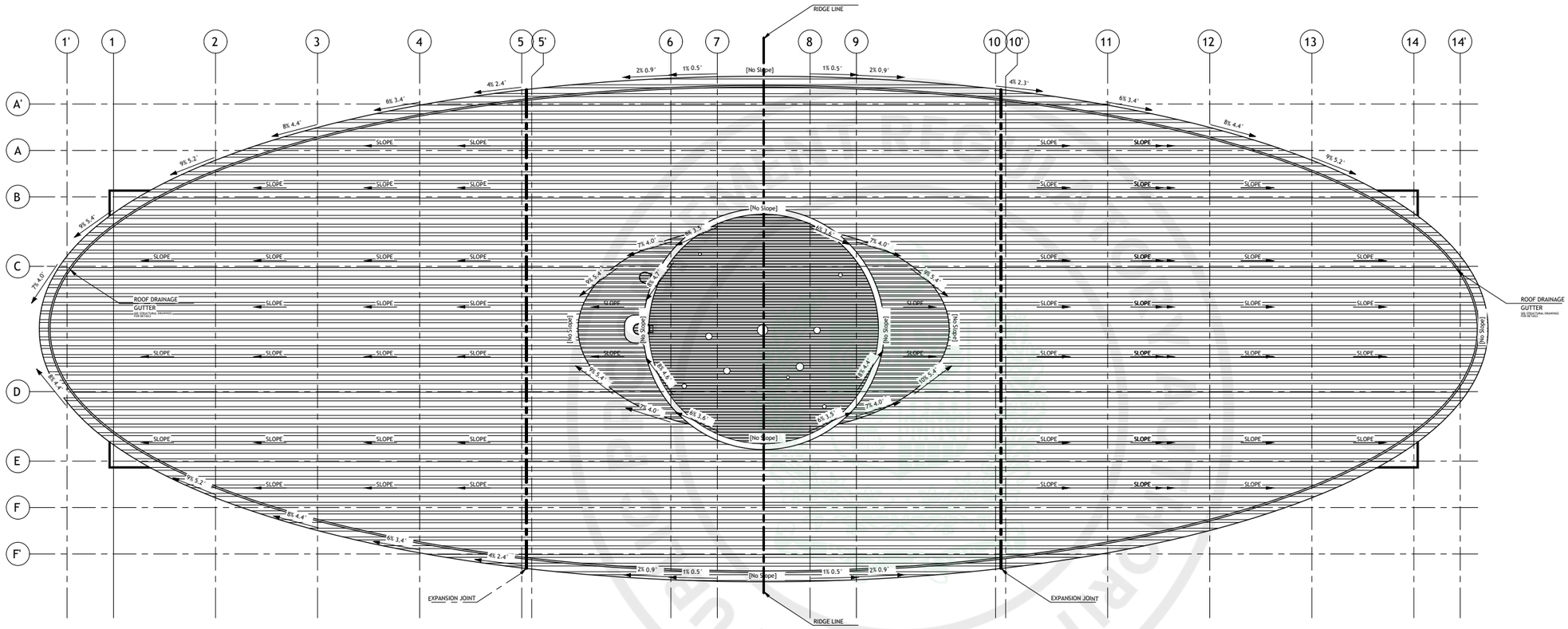
Detailed Architectural Design Drawings

ROOF TOP
WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 19

Scale @ 42" X 30" 3/16" = 1'-0"



1 Site Plan
1" = 10'-0"

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Structural Consultant

North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

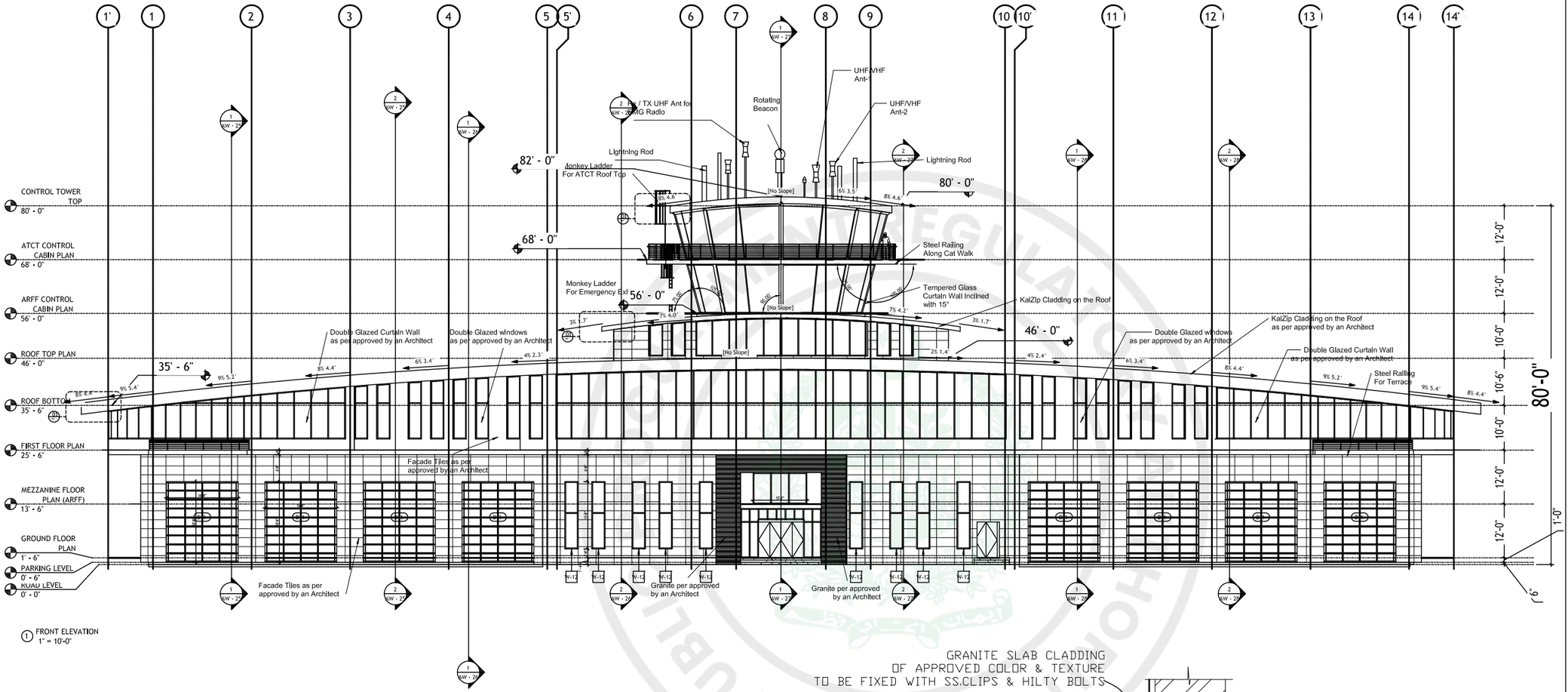
TOP ROOF PLAN
WORKING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

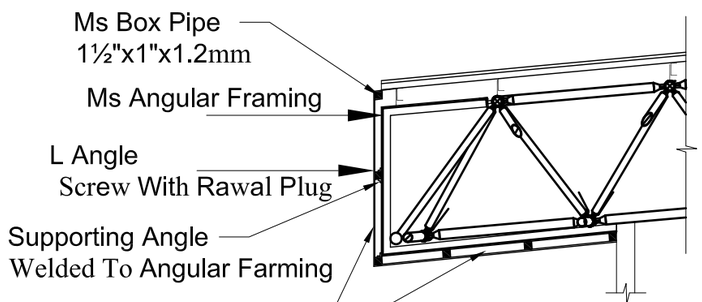
AW - 19A

Scale @ 42" X 30" 1" = 10'-0"

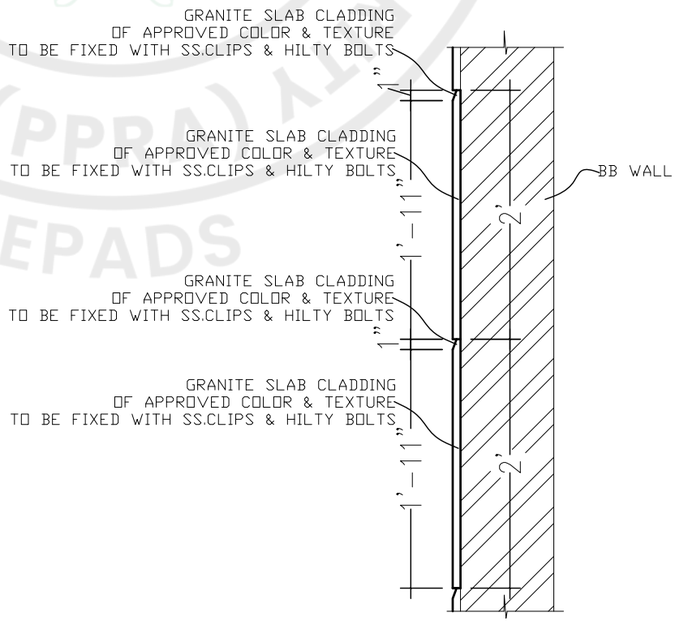
Public Procurement Regulatory Authority (PPRA) EPADS



1 FRONT ELEVATION
1" = 10'-0"



ACP CLADDING DETAIL
Section-"1"



GRANITE FIXED DETAIL

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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

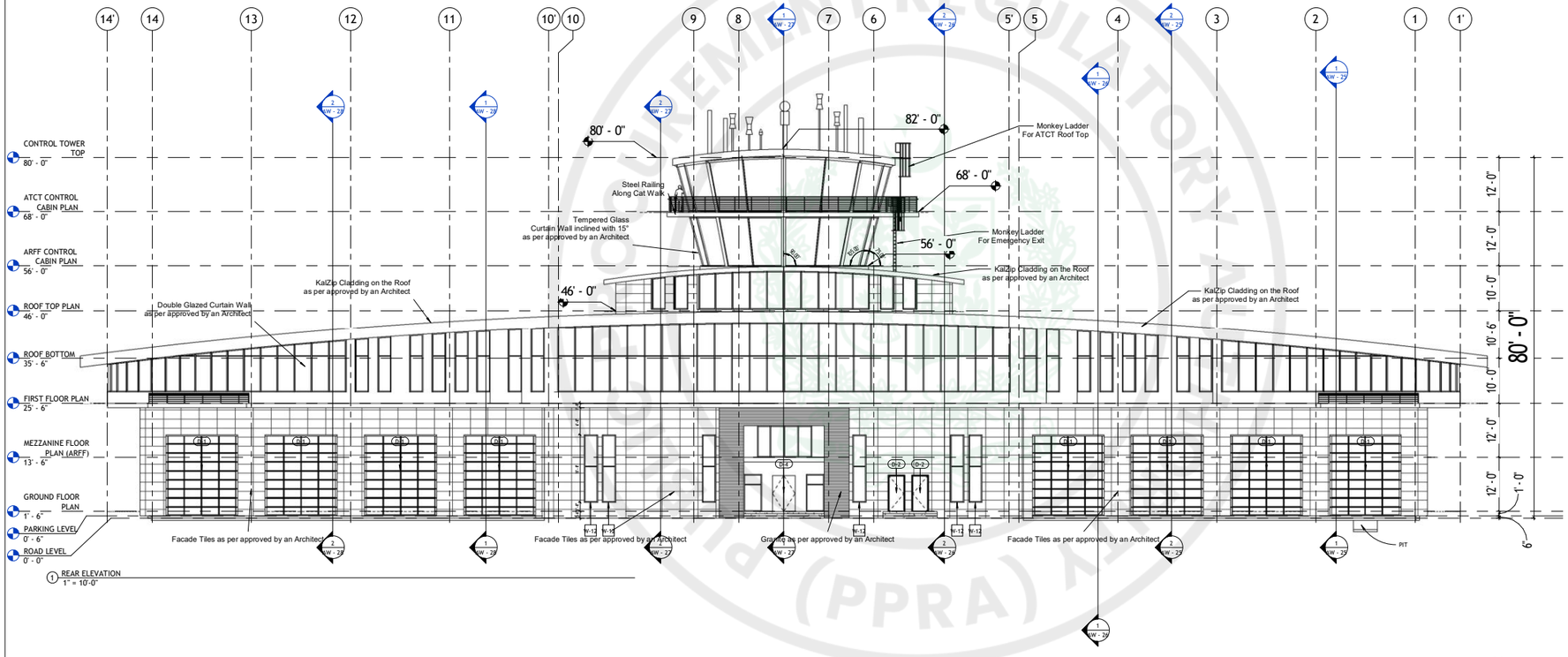
FRONT ELEVATION

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 20

Scale @ 42" X 30" 1" = 10'-0"

PUBLIC PROPERTY (PPRA) EPADS



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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

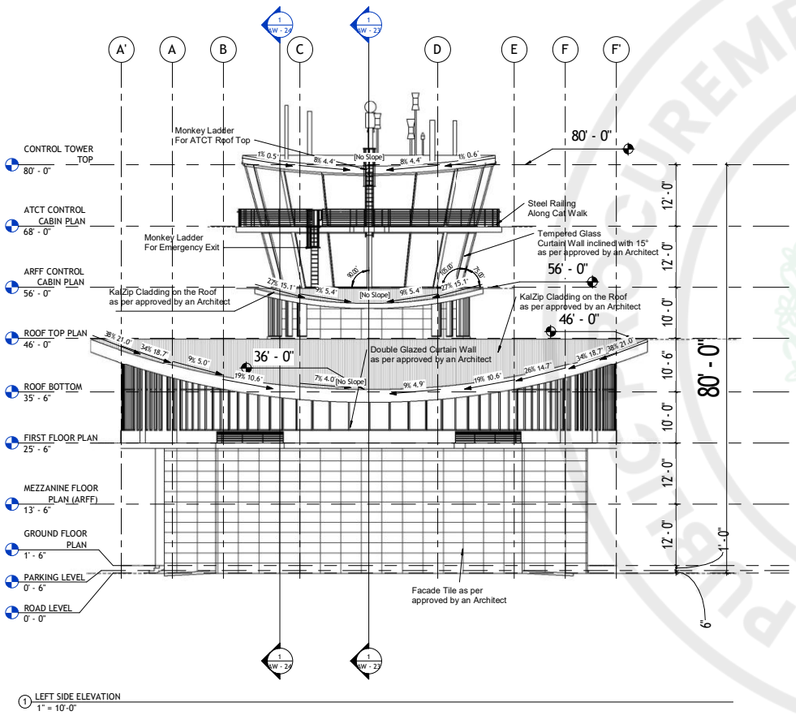
REAR ELEVATION

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

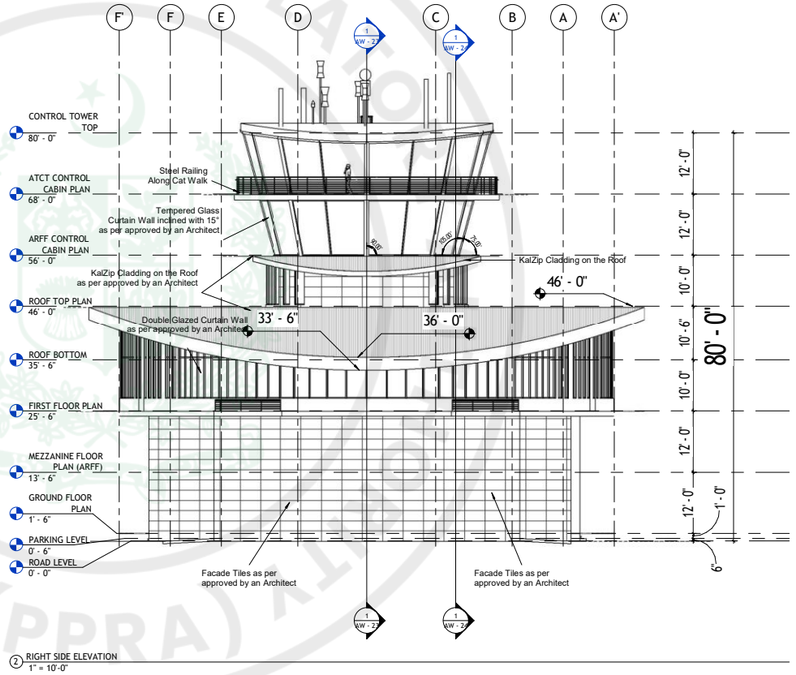
AW - 21

Scale @ 42" X 30" 1" = 10'-0"

Government Regulatory Authority (PPRA) EPADS



1 LEFT SIDE ELEVATION
1" = 10'-0"



2 RIGHT SIDE ELEVATION
1" = 10'-0"

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Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

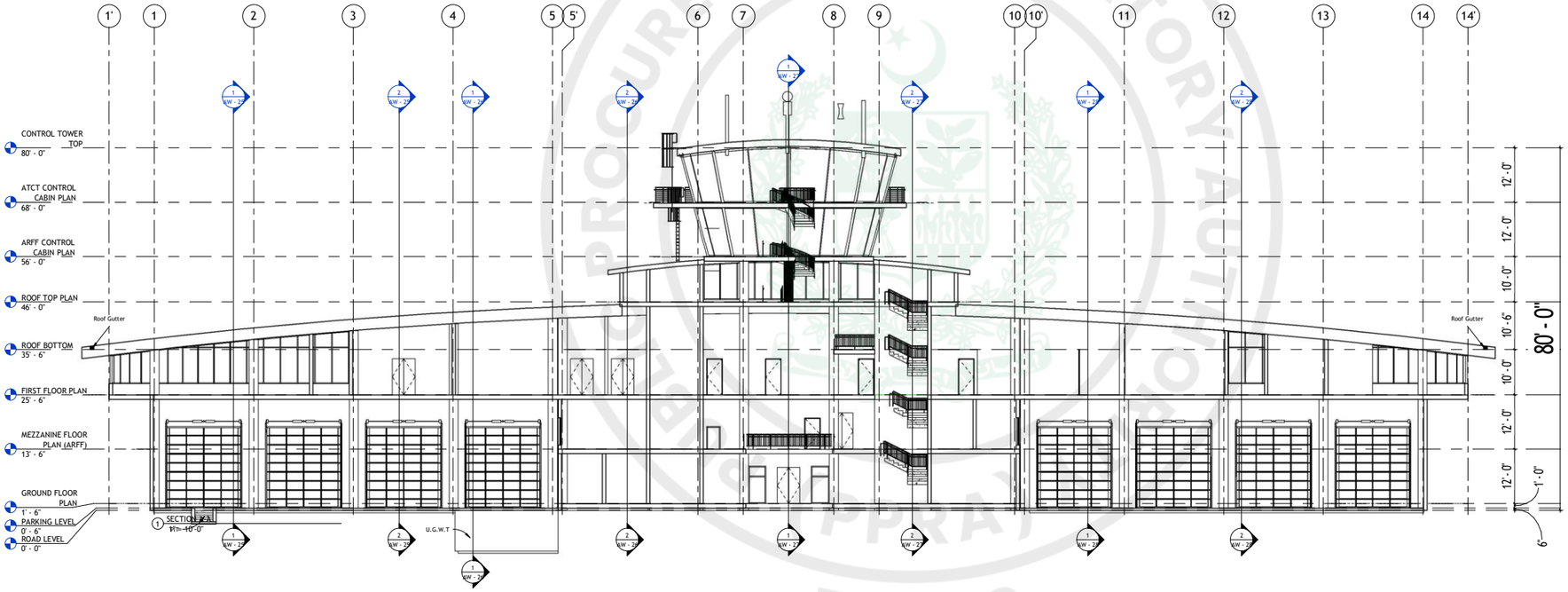
LEFT & RIGHT SIDE ELEVATION

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 22

Scale @ 42" X 30" 1" = 10'-0"

PPRA EPADS



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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

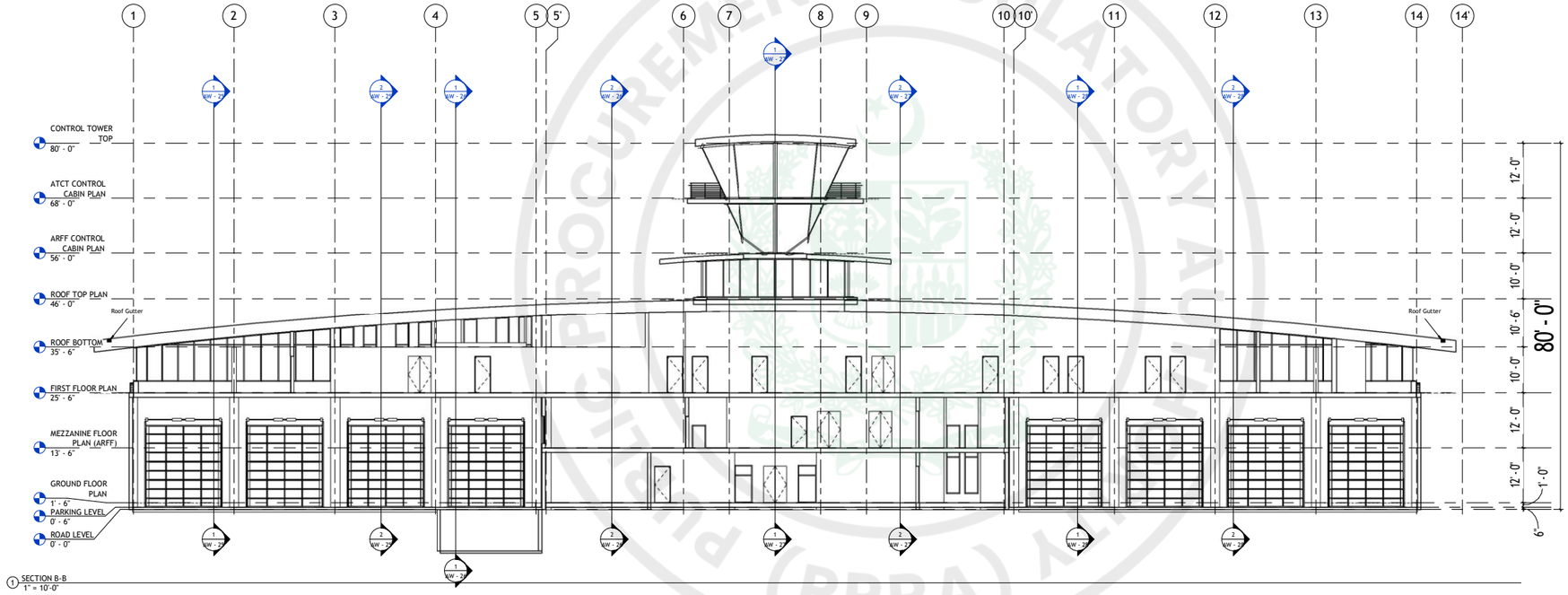
Detailed Architectural Design Drawings

SECTION A-A

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 23

Scale @ 42" X 30" 1" = 10'-0"



1 SECTION B-B
1" = 10'-0"

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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

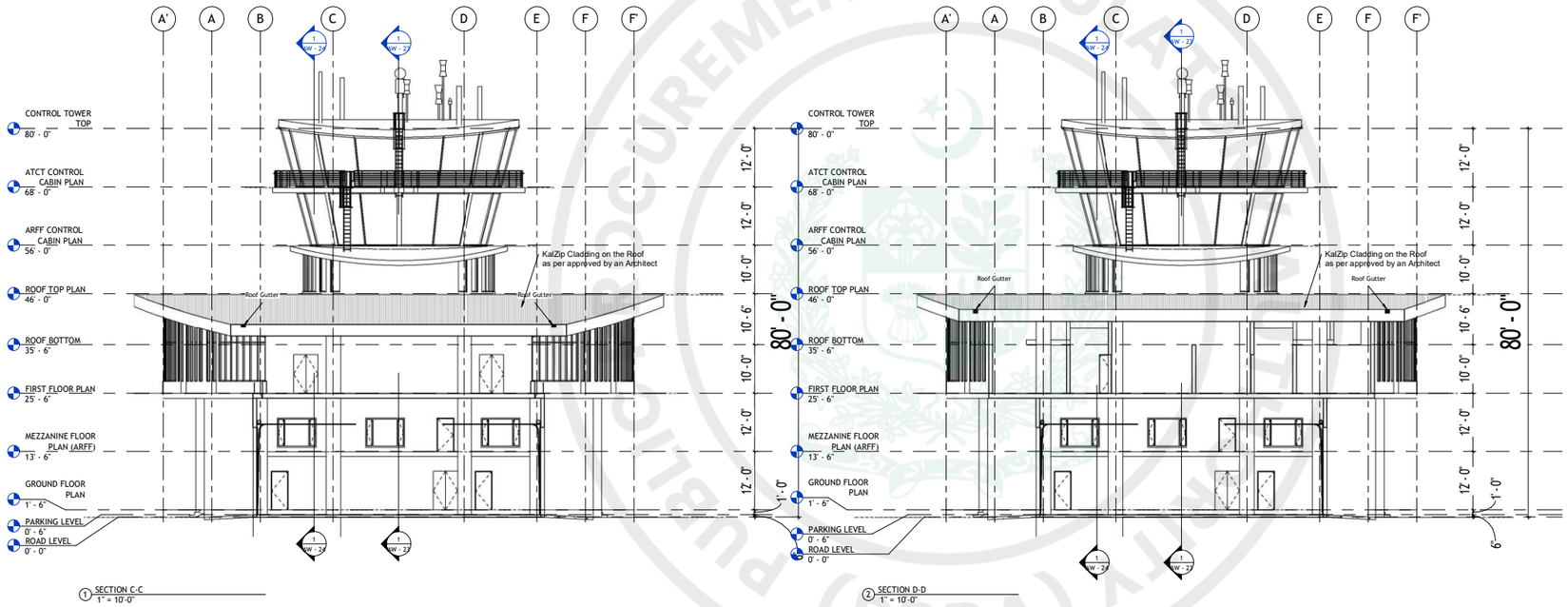
Detailed Architectural Design Drawings

SECTION B-B

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 24

Scale @ 42" X 30" 1" = 10'-0"



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leit-werk

Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

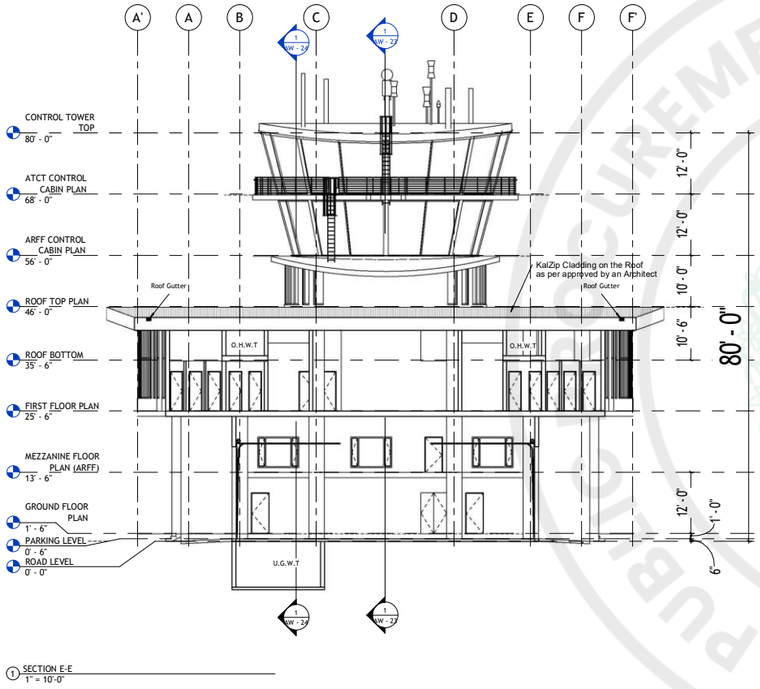
SECTION C & D

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

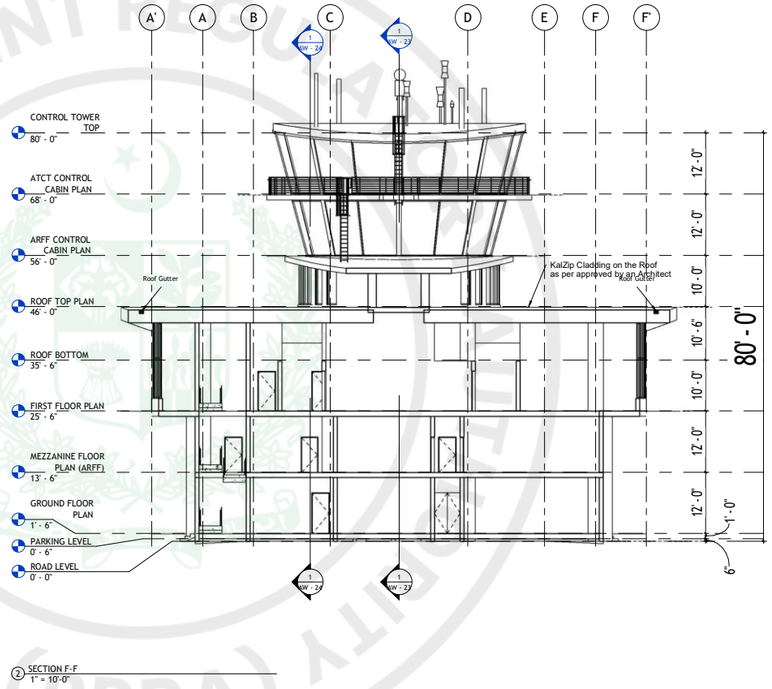
AW - 25

Scale @ 42" X 30" 1" = 10'-0"

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



1 SECTION E-E
1" = 10'-0"



2 SECTION F-F
1" = 10'-0"

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Structural Consultant

Project Name

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Detailed Architectural Design Drawings

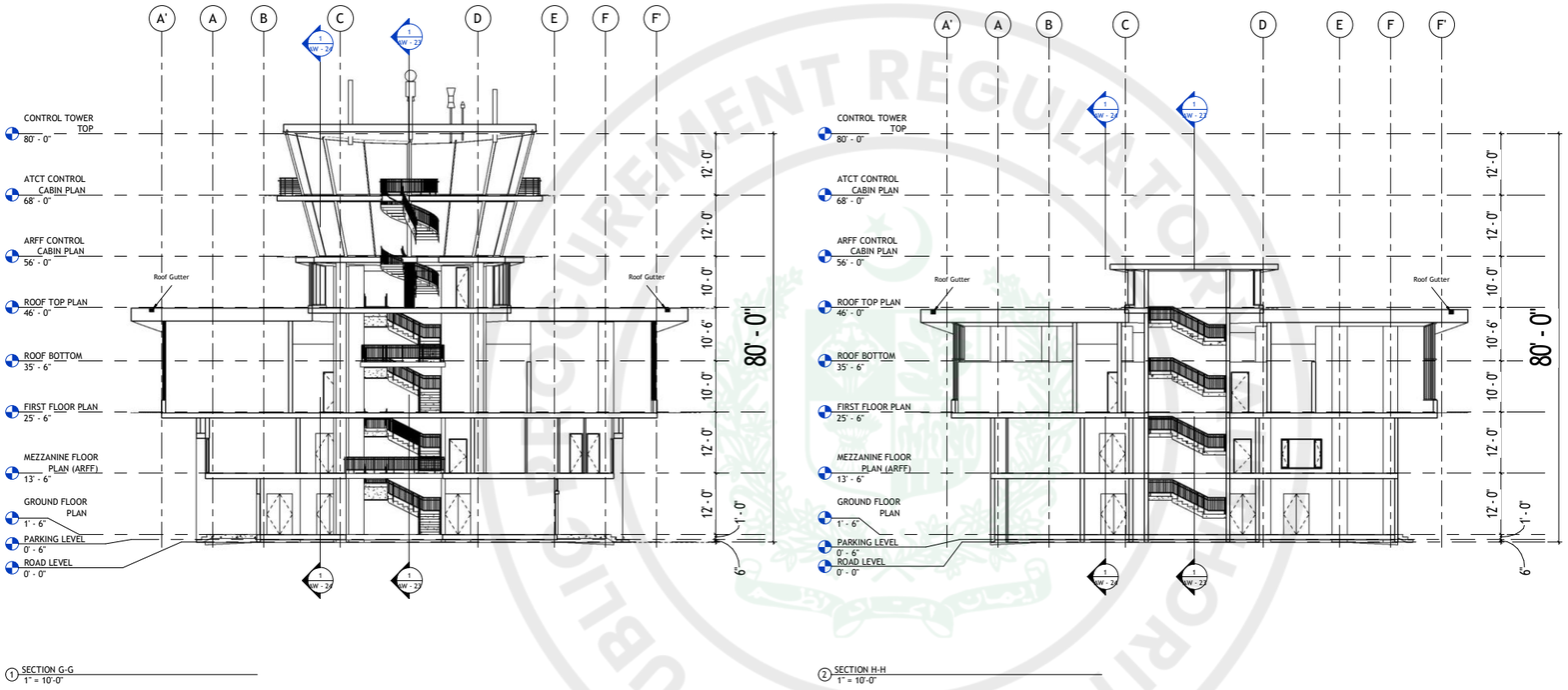
SECTION E & F

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 26

Scale @ 42" X 30" 1" = 10'-0"

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



1 SECTION G-G
1" = 10'-0"

2 SECTION H-H
1" = 10'-0"

PROCUREMENT REGULATORY AUTHORITY
PUBLIC (PPRA)
EPADS

ISSUE FOR TENDER

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Consulting Architects, Engineers, Planners & Management Consultants

JV MEMBERS

COMRADES CONSULTANTS
leit-werk

Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

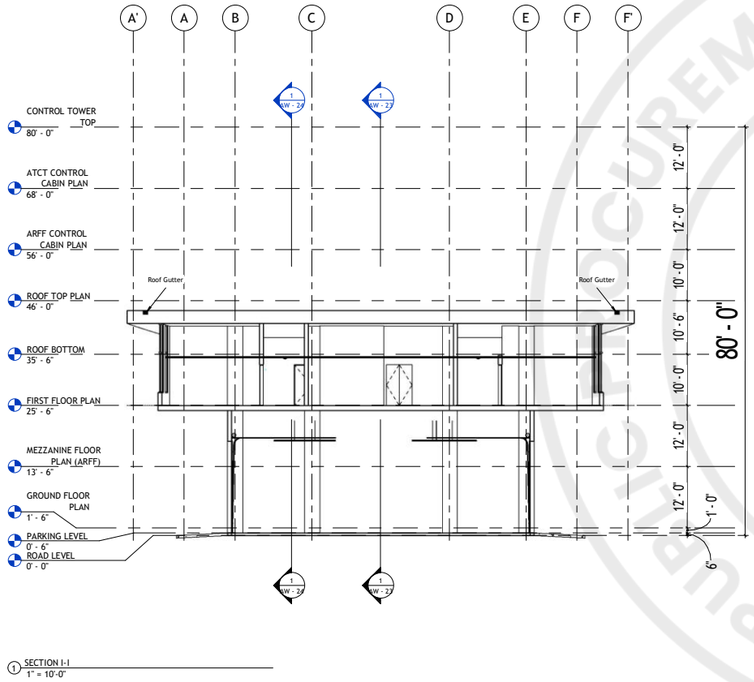
Detailed Architectural Design Drawings

SECTION G & H

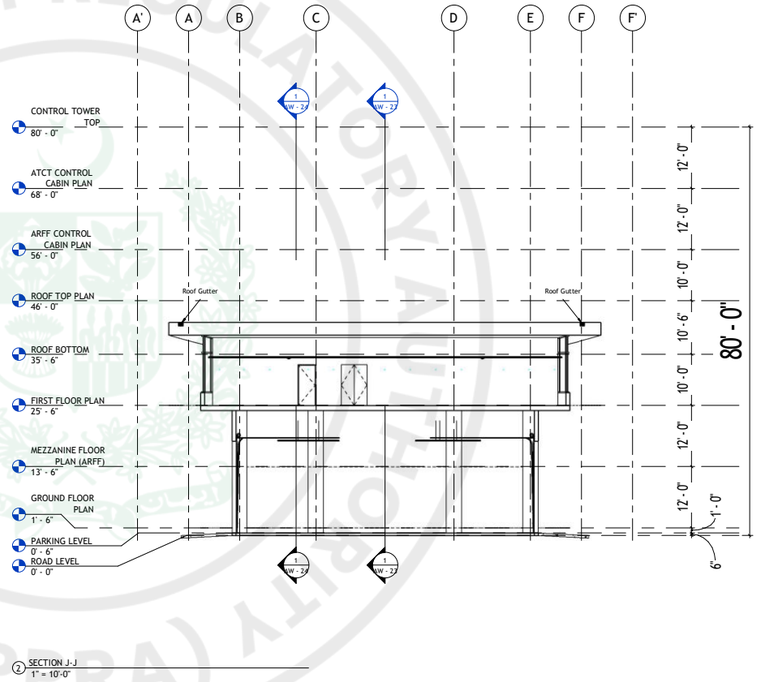
Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 27

Scale @ 42" X 30" 1" = 10'-0"



1 SECTION I-I
1" = 10'-0"



2 SECTION J-J
1" = 10'-0"

ISSUE FOR TENDER

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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

SECTION I & J

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

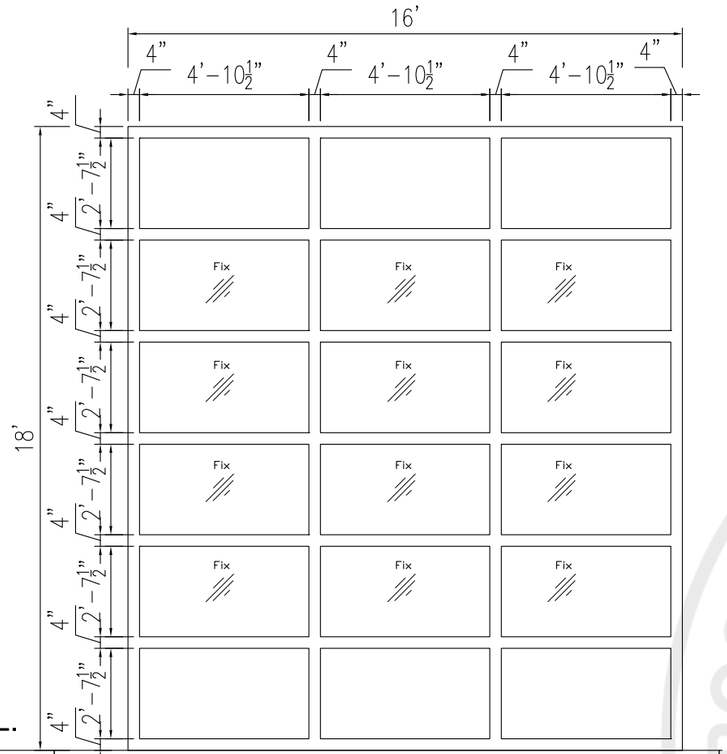
AW - 28

Scale @ 42" X 30" 1" = 10'-0"

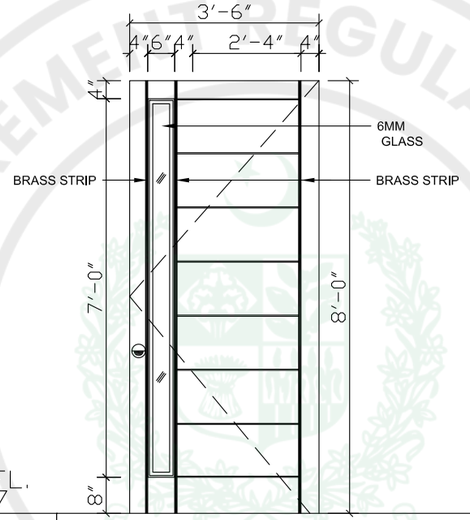
PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

SCHEDULE OF OPENINGS

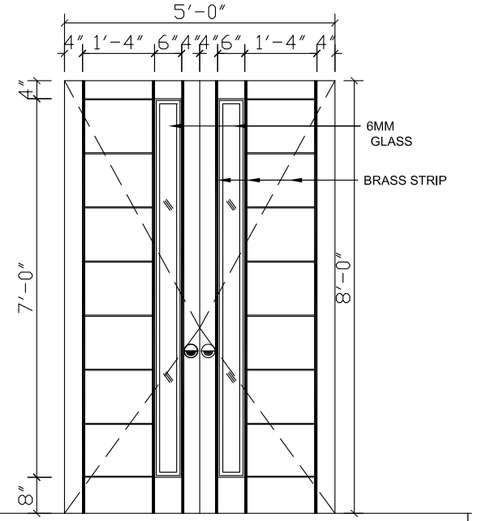
TYPE	Width	Height	SILL	REMARKS
D1	16'-0"	x 18'-0"	0'-0"	Aluminum Roller Shutter
D2	3'-6"	x 8'-0"	0'-0"	Solid Wood Door
D3	5'-0"	x 8'-0"	0'-0"	〃 〃
D4	10'-0"	x 8'-0"	0'-0"	Aluminum Glass Door
D5	2'-6"	x 7'-0"	**0'-0"**	Wpc Door
D6	3'-6"	x 8'-0"	0'-0"	Steel Door



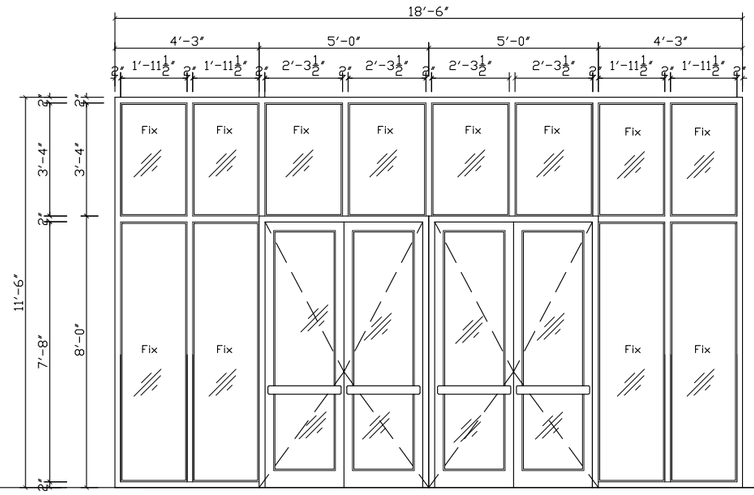
TYPE	SPECIFICATION
D-1	16'-0"X18'-0" Sectional (overhead) or Aluminum Roller Shutter, Aluminum Alloy Or Steel, Often With Anodized Finishes For Durability,Good Thermal Performance Sealed For Weatherproofing,Photocell Sensors, Safety Edges And Manual Release Systems For Power Outages,Rubber Gaskets Around Edges,Servo motors (380v) for automatic operation, with manual overrides.



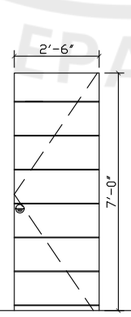
TYPE	SPECIFICATION
D2	3'-6"x8'-0" Single Leaf Panel Door As Per Elevation,complete With Locks, Handles, Stops And Four Pairs Of Heavy Duty Brass Hinges With Wooden Dolly Frame as Specified



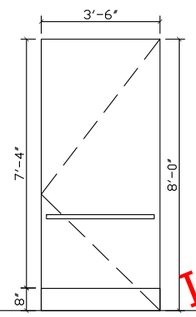
TYPE	SPECIFICATION
D3	4'-0"x8'-0" Double Leaf Panel Door As Per Elevation,complete With Locks, Handles, Stops And Four Pairs Of Heavy Duty Brass Hinges With Wooden Dolly Frame as Specified



TYPE	SPECIFICATION
D-4	10'-0"X8'-0" DOUBLE LEAF ALUMINUM GLASS DOOR & 18'-6"X11'-6" WINDOW AS PER ELEVATION, COMPLETE WITH LOCKS, HANDLES, STOPS AND FOUR PAIRS OF HINGES WITH ALUMINUM ANODIZE BRONZE (DELUXE MODEL).



TYPE	SPECIFICATION
D5	2'-6"X7'-0" SINGLE LEAF WPC DOOR SHUTTER 38MM THICK. WITH 8MM WPC SKIN ON BOTH FACES.AS PER ELEVATION,COMPLETE WITH LOCKS, HANDLES, STOPS AND FOUR PAIRS OF HEAVY DUTY BRASS HINGES



TYPE	SPECIFICATION
D6	3'-6"X8'-0" SINGLE LEAF STEEL DOOR FACE & BACK 1.2MM GALVANIZED STEEL INTERLOCKED SUB FRAME 2MM FOLDED GALVANIZED STEEL U-CHANNEL, KICK PLATES,COMPLETE WITH LOCKS, HANDLES, STOPS AND FOUR PAIRS OF HEAVY DUTY BRASS HINGES

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

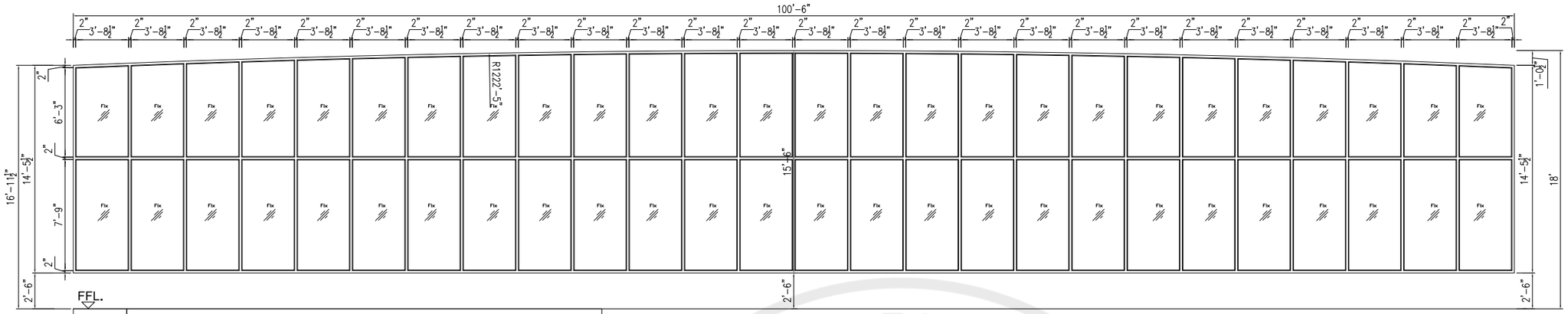
Detailed Architectural Design Drawings

Sheet Name

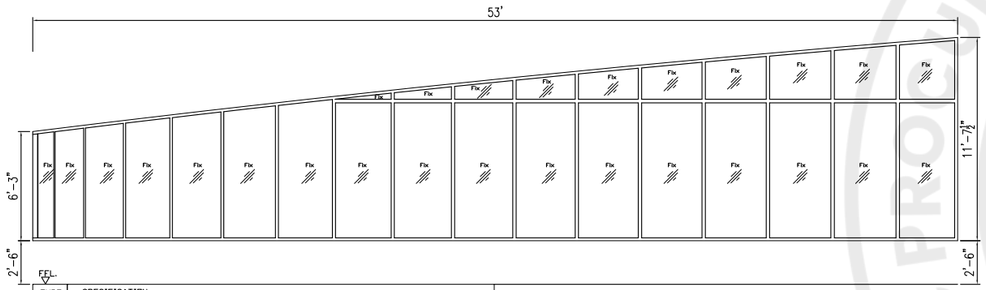
DOOR'S DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-28a @A3

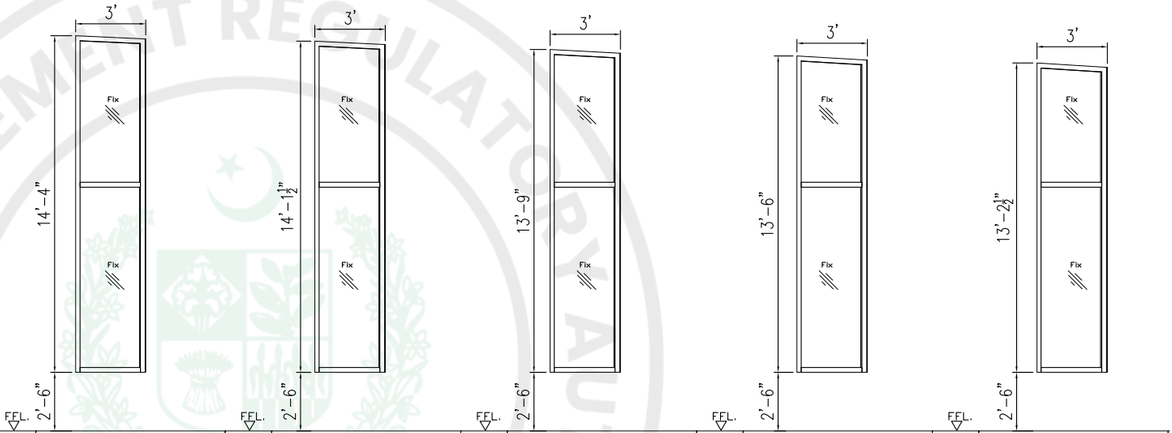
PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



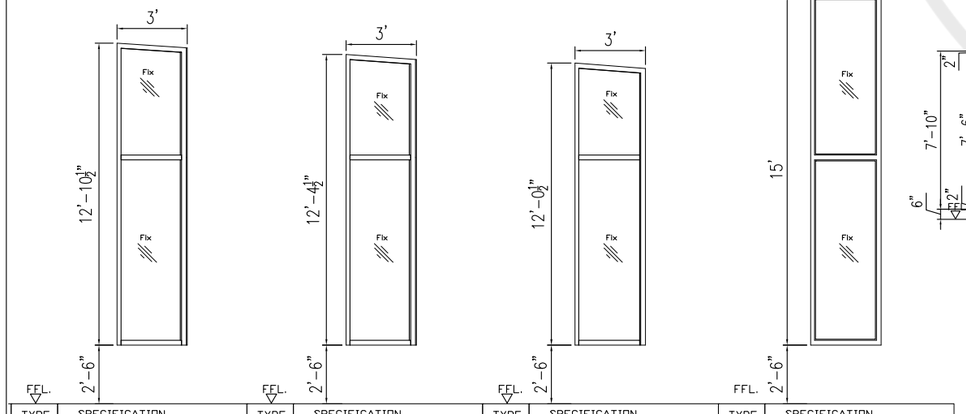
TYPE	SPECIFICATION
W1	Aluminum Bronze Anodized Fix Window (Economy Model 2mm Thick 50mm Wide Section) 12mm Thick Tempered Glass.



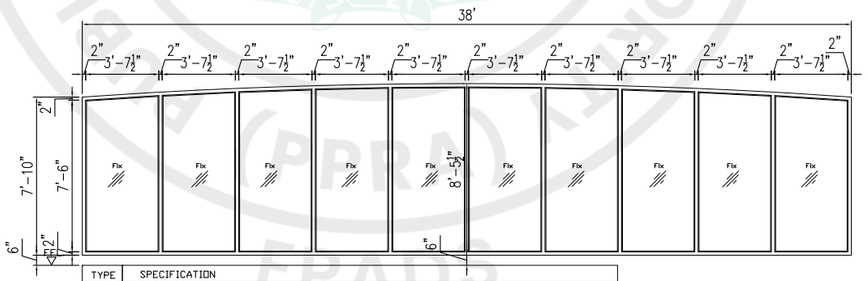
TYPE	SPECIFICATION
W2	Aluminum Bronze Anodized Fix Window (Economy Model 2mm Thick 50mm Wide Section) 12mm Thick Tempered Glass.



TYPE	SPECIFICATION	TYPE	SPECIFICATION	TYPE	SPECIFICATION	TYPE	SPECIFICATION	TYPE	SPECIFICATION
W3	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W4	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W5	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W6	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W7	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.



TYPE	SPECIFICATION	TYPE	SPECIFICATION	TYPE	SPECIFICATION	TYPE	SPECIFICATION
W8	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W9	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W10	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.	W12	3'-0" Aluminum Bronze Anodized Fix Window (Economy Model 1.2mm Thick 100mm Wide Section) 5mm Thick Imported Tinted Glass.



TYPE	SPECIFICATION
W11	Aluminum Bronze Anodized Fix Window (Economy Model 2mm Thick 50mm Wide Section) 12mm Thick Tempered Glass.

SCHEDULE OF OPENINGS

TYPE	Width	Height	SILL	REMARKS
				Aluminum window
W1	100'-6"	x 15'-6"	2'-6"	〃 〃
W2	53'-0"	x 11'-7½"	2'-6"	〃 〃
W3	3'-0"	x 14'-4"	2'-6"	〃 〃
W4	3'-0"	x 14'-1½"	2'-6"	〃 〃
W5	3'-0"	x 13'-9"	2'-6"	〃 〃
W6	3'-0"	x 13'-6"	2'-6"	〃 〃
W7	3'-0"	x 13'-2½"	2'-6"	〃 〃
W8	3'-0"	x 12'-10½"	2'-6"	〃 〃
W9	3'-0"	x 12'-4½"	2'-6"	〃 〃
W10	3'-0"	x 12'-0½"	2'-6"	〃 〃
W11	38'-0"	x 8'-5½"	0'-6"	〃 〃
W12	3'- 0"	x 15'-0"	2'-6"	〃 〃

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

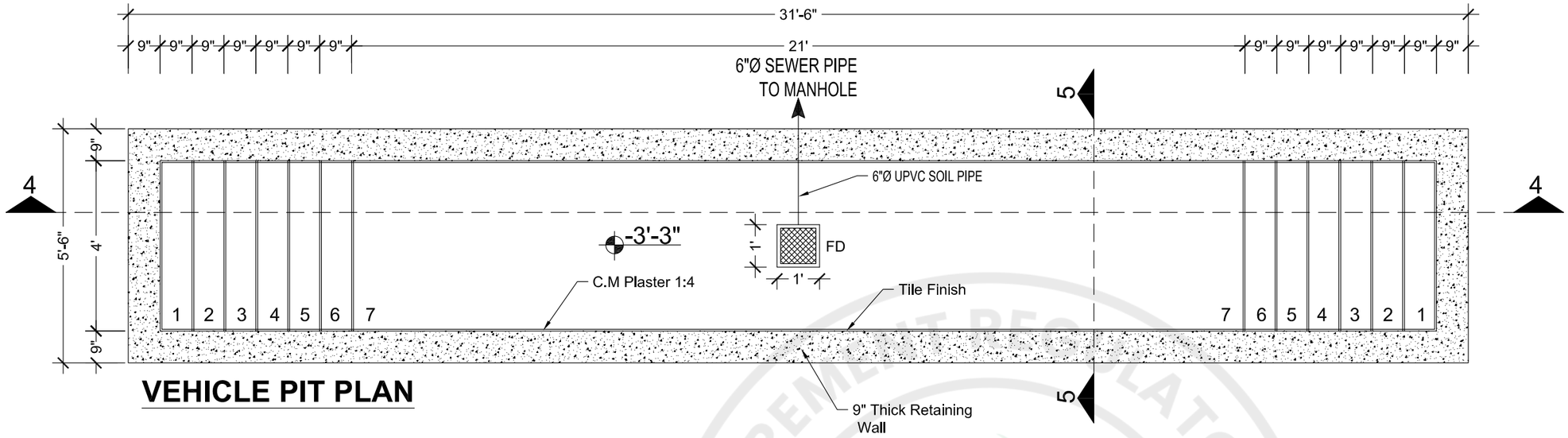
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

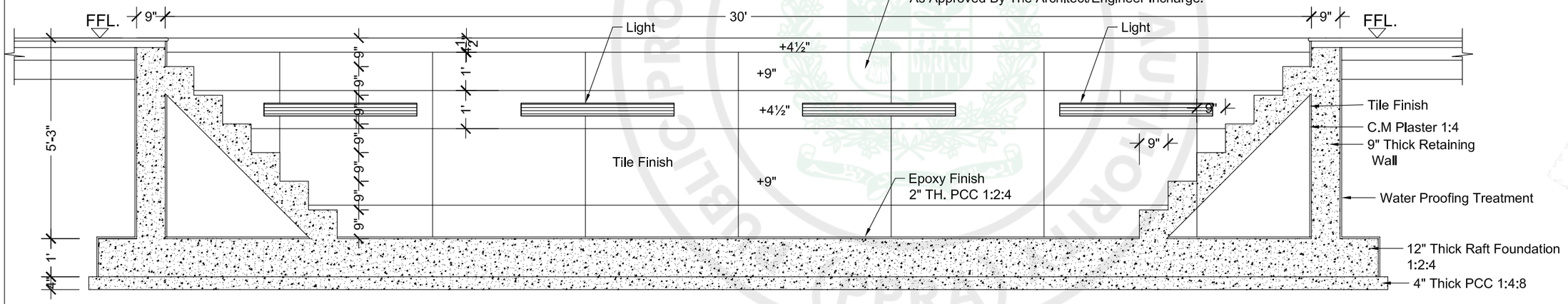
Sheet Name

WINDOW'S DETAIL

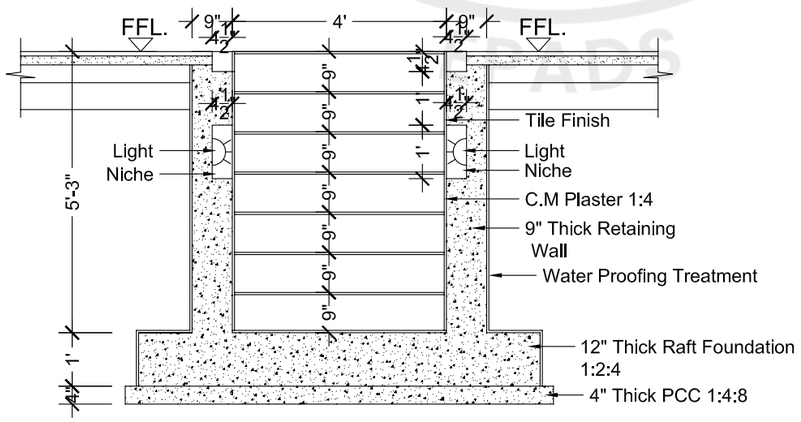
Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-29 @A3



VEHICLE PIT PLAN



PIT SECTION 4-4



PIT SECTION 5-5

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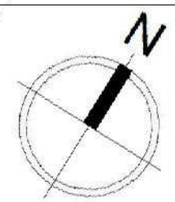


Project Name

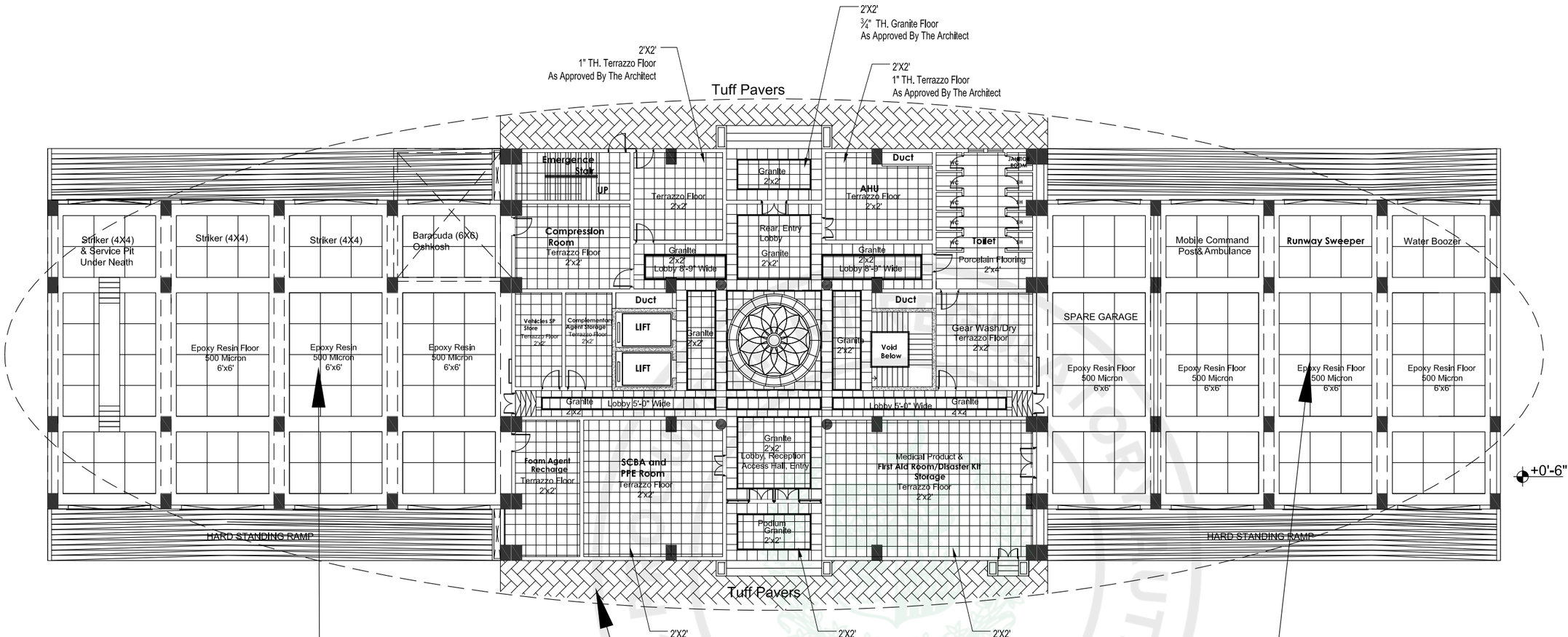
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

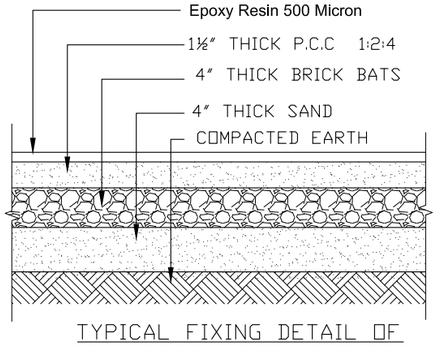
Sheet Name

VEHICLE PIT DETAIL

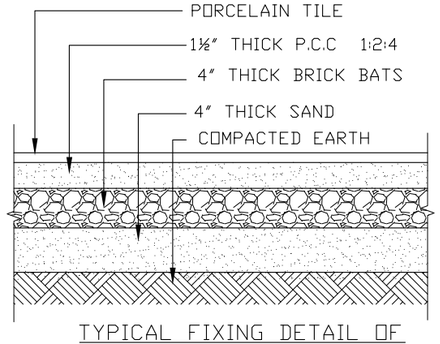
Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-29a @A3



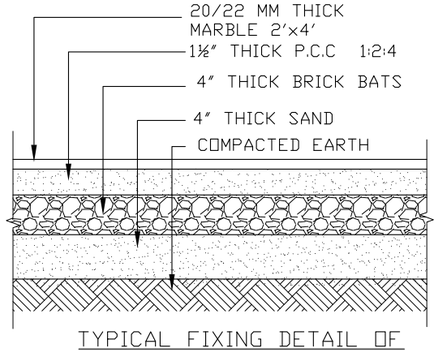
GROUND FLOOR PLAN



TYPICAL FIXING DETAIL OF
EPOXY RESIN (GROUND FLOOR)



TYPICAL FIXING DETAIL OF
PORCELAIN TILE (GROUND FLOOR)



TYPICAL FIXING DETAIL OF
MARBLE (GROUND FLOOR)

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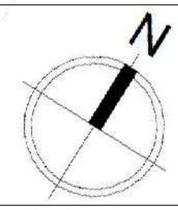
NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

GROUND FLOOR PATTERN

Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-30 @A3

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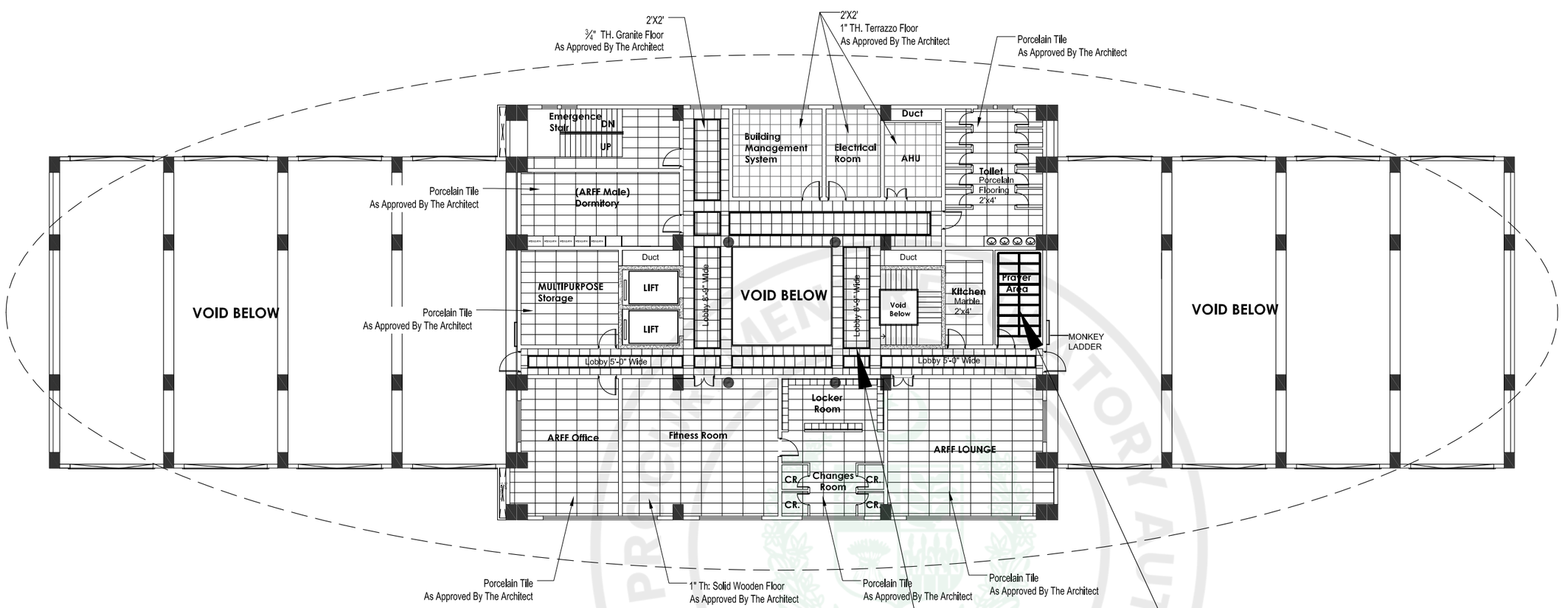
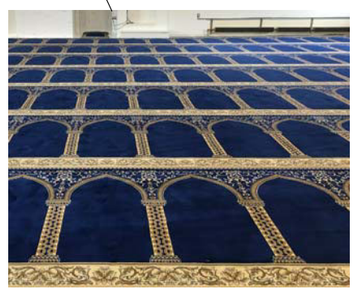
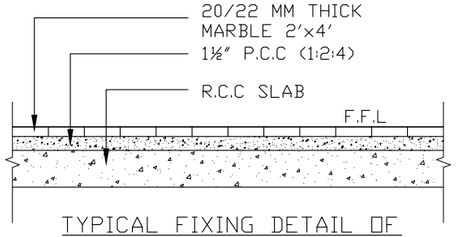
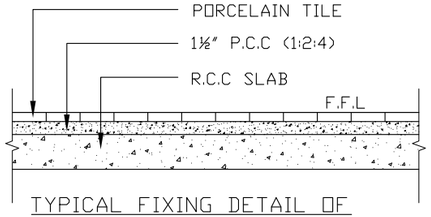


ARFF FLOOR
MEZZANINE FLOOR PLAN





TYPICAL FIXING DETAIL OF
MARBLE AT (MEZZANINE FLOOR)



TYPICAL FIXING DETAIL OF
PORCELAIN TILE AT (FIRST FLOOR)

ISSUE FOR TENDER

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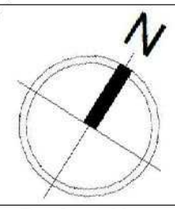
STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MEZZANINE FLOOR PATTERN

Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-31 @A3

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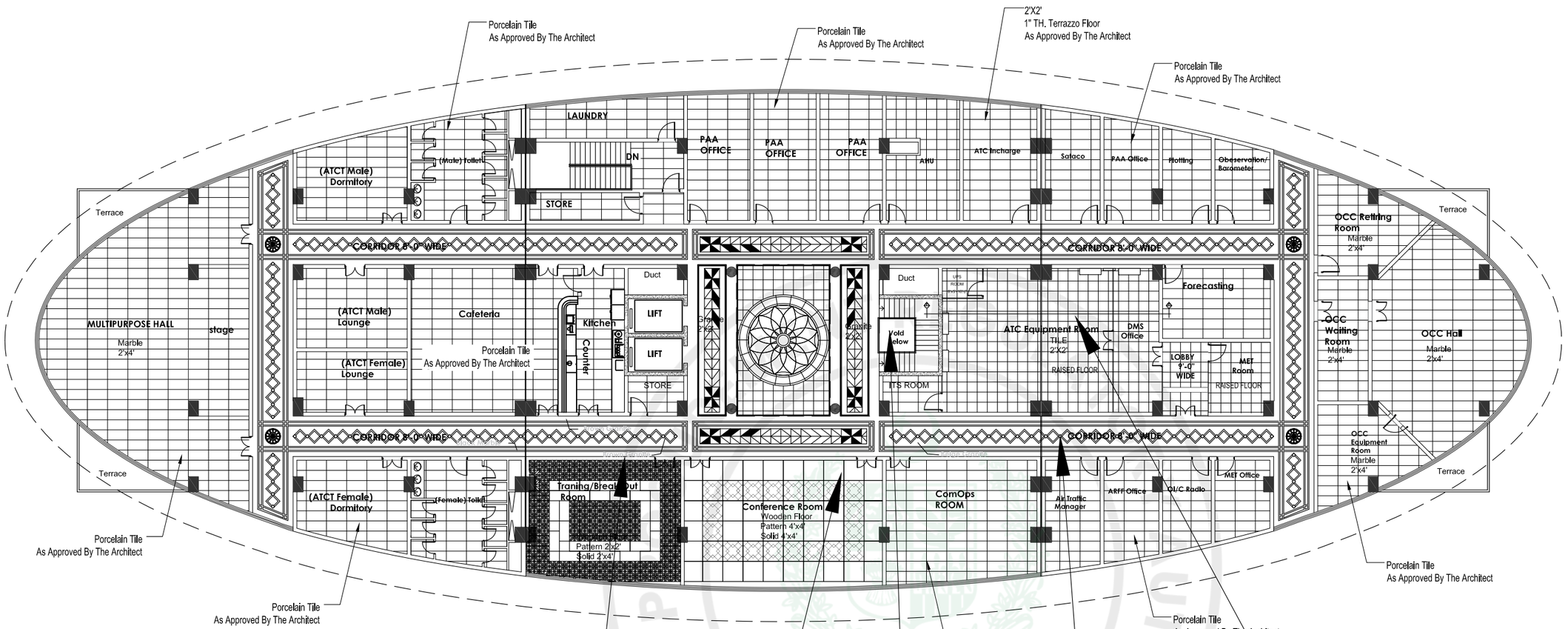
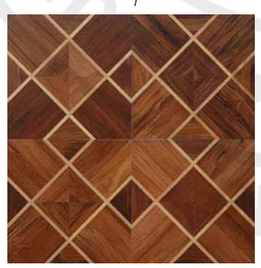
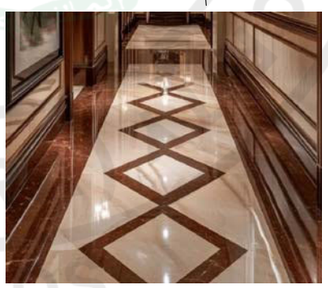
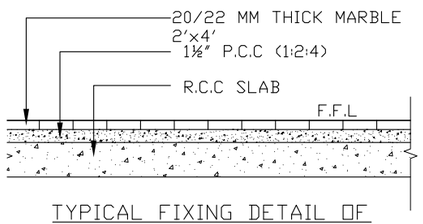


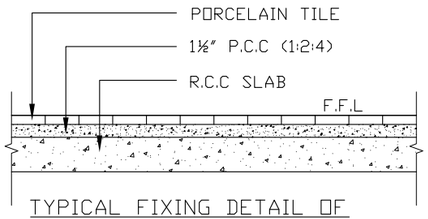
FIRST FLOOR PLAN







TYPICAL FIXING DETAIL OF MARBLE AT (FIRST FLOOR)



TYPICAL FIXING DETAIL OF PORCELAIN TILE AT (FIRST FLOOR)

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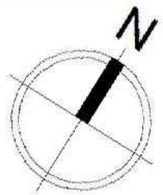
NORTH ORIENTATION



Project Name

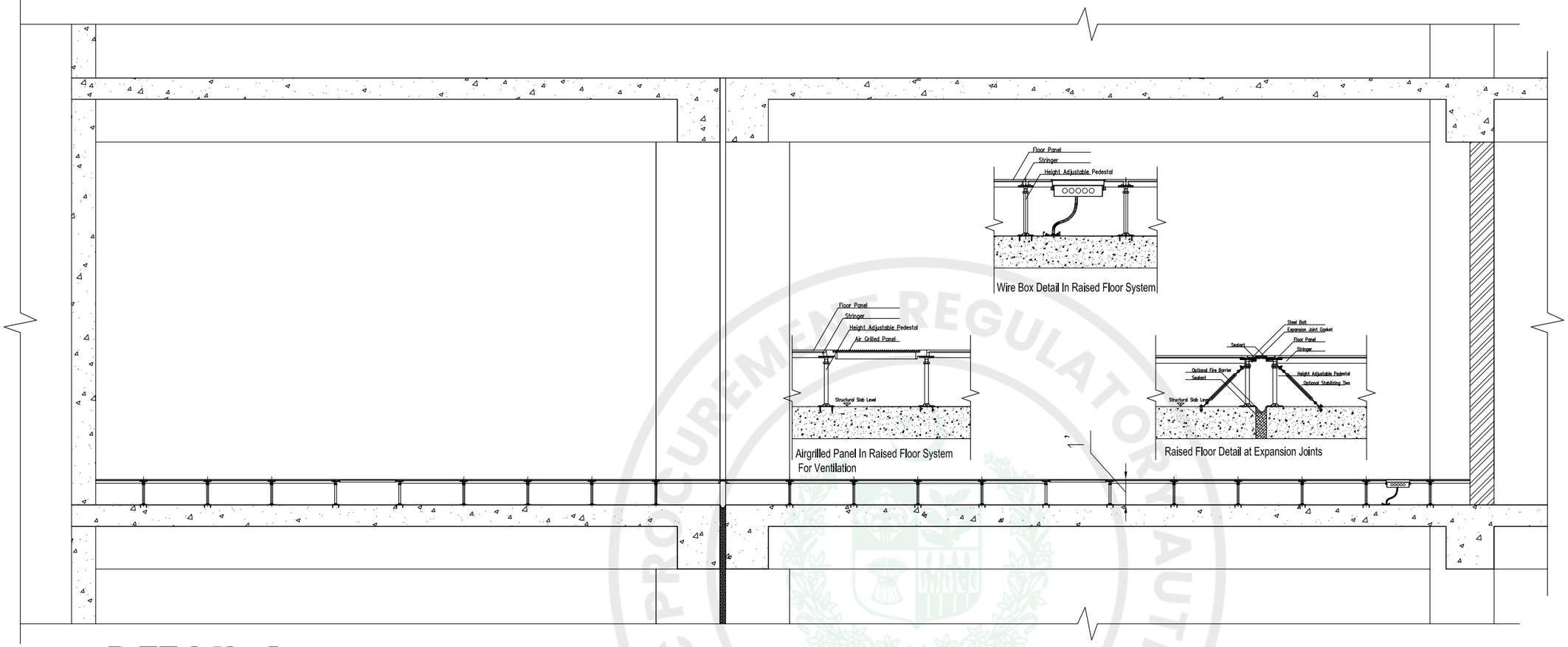
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

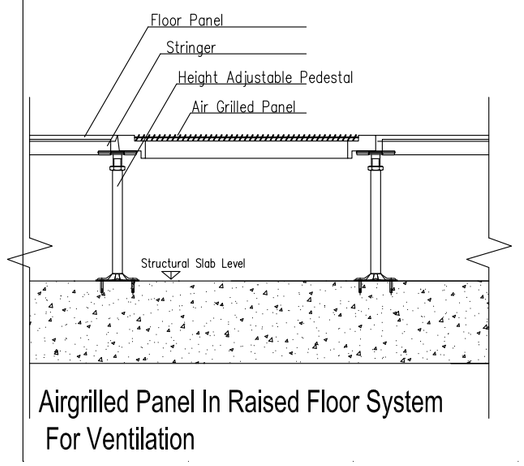
Sheet Name

FIRST FLOOR PATTERN

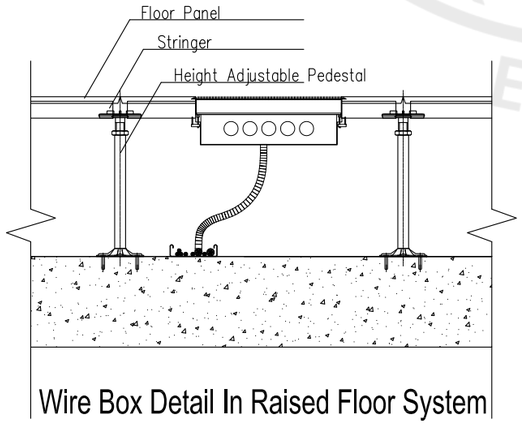
Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-32 @A3



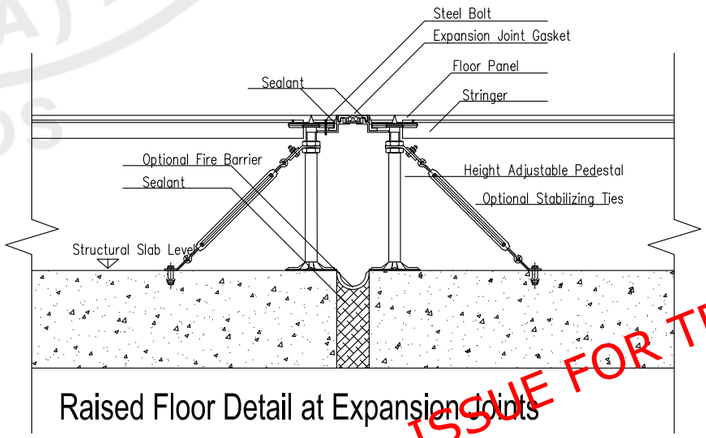
DETAIL-1
ATC Equipment Room
RAISED FLOOR



Airgrilled Panel In Raised Floor System
For Ventilation



Wire Box Detail In Raised Floor System



Raised Floor Detail at Expansion Joints

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

ATC EQUIPMENT ROOM
RAISED FLOOR DETAIL

Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-32a @A3

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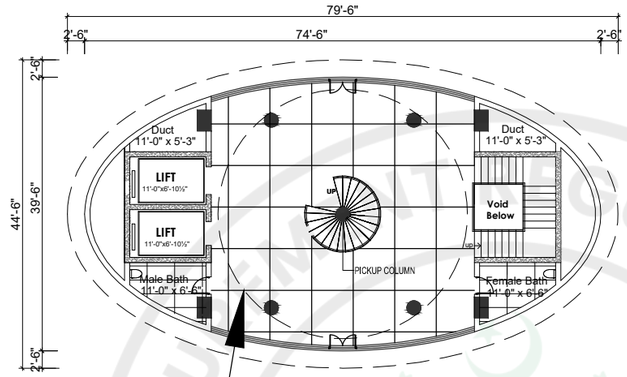

ROOF FLOOR PLAN LEVEL AT 46'-0"

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

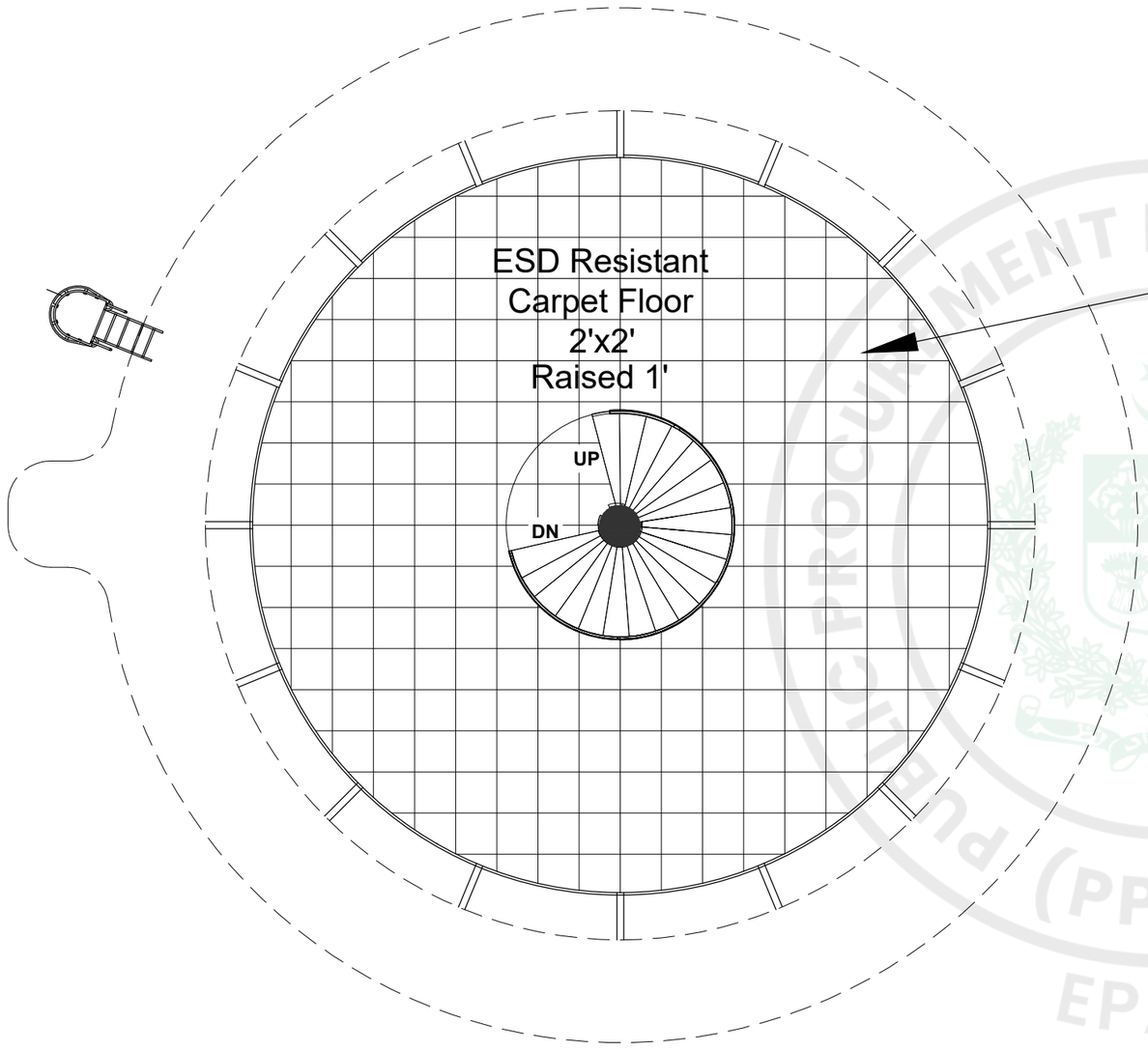
Detailed Architectural Design Drawings

Sheet Name

ROOF FLOOR PATTERN

Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-33 @A3

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ARFF FLOOR PLAN LEVEL AT 56'-0"

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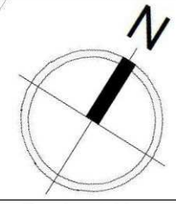

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

ARFF FLOOR PATTERN

Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-34 @A3

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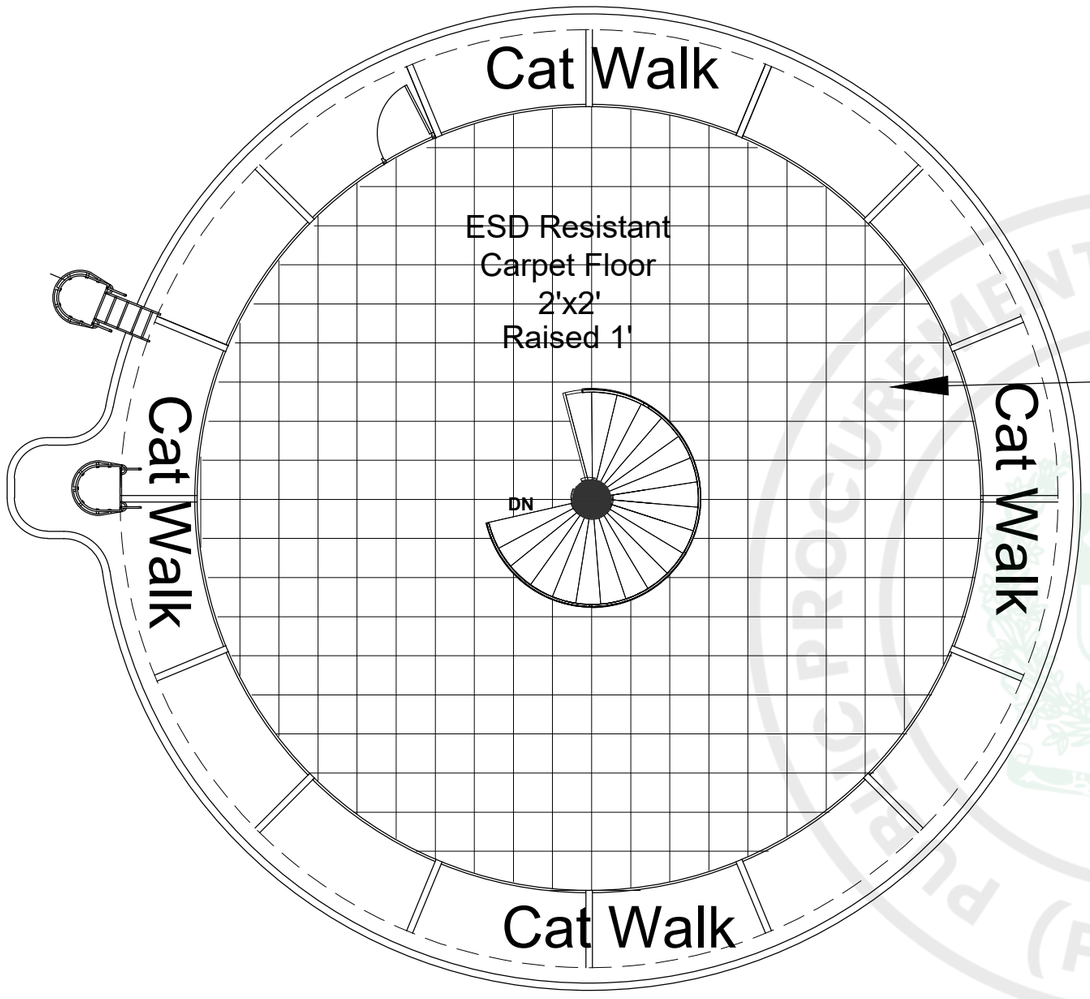

ATCT FLOOR PLAN LEVEL AT 68'-0"

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

ATCT FLOOR PATTERN

Date	14 JANUARY, 2026
Scale	NTS
Drawn by	Ar. Sidra Tabassum
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-35 @A3

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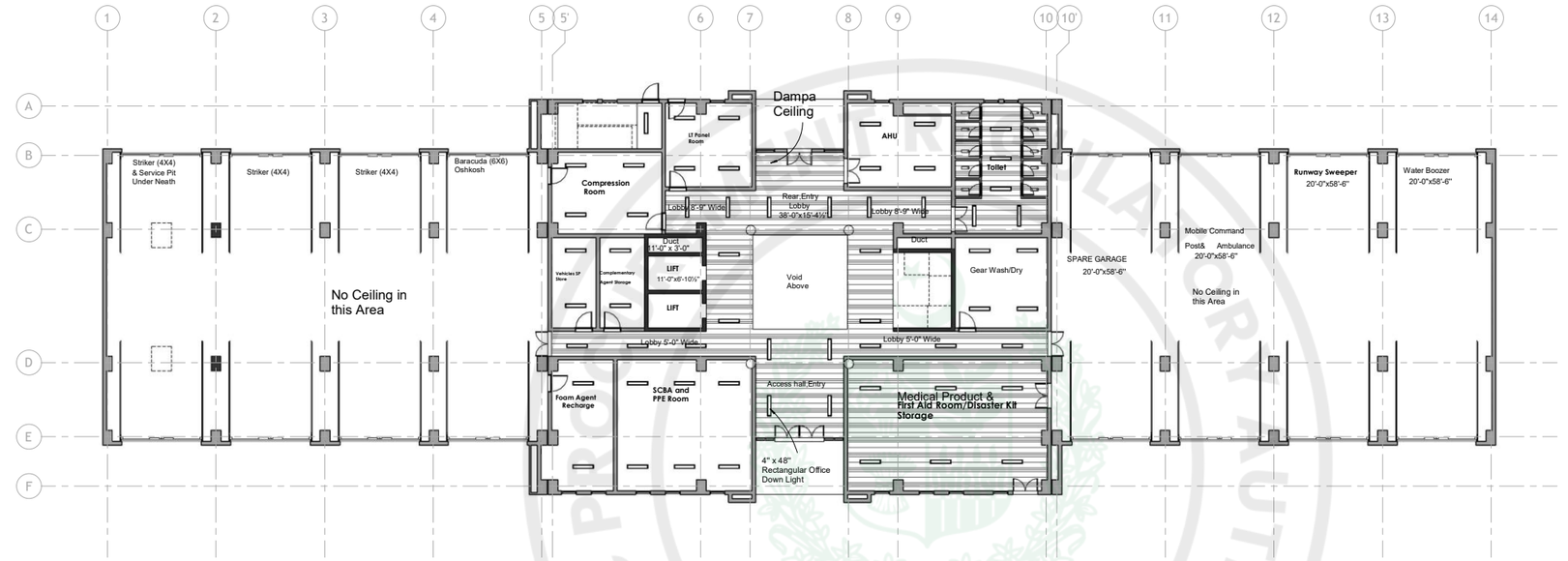
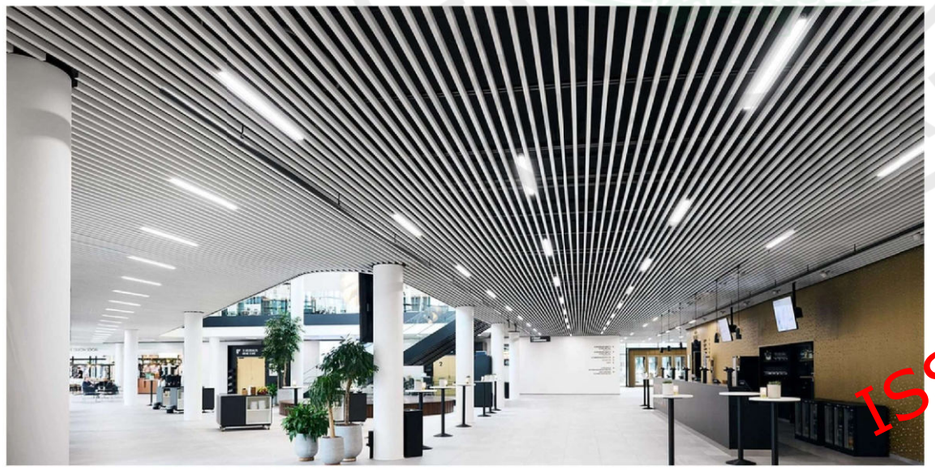


1 GROUND FLOOR PLAN
1" = 10'-0"



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Ground Floor Ceiling Design Reference

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North Orientation

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

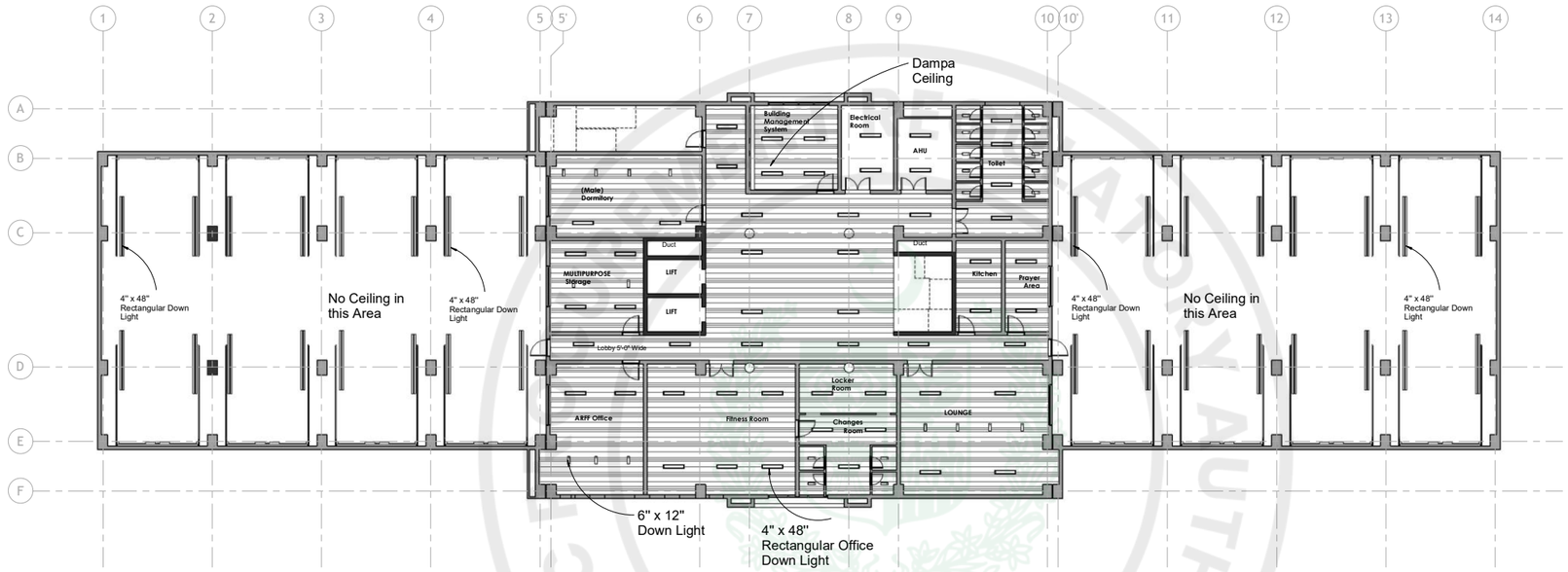
Detailed Architectural Design Drawings

GROUND FLOOR CEILING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 36

Scale @ 42" X 30" 1" = 10'-0"



1 MEZZANINE FLOOR PLAN (ARFF)
1" = 10'-0"

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Hanging Lights for Parking Bays

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North Orientation

Project Name

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Detailed Architectural Design Drawings

MEZZANINE FLOOR CEILING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 37

Scale @ 42" X 30" 1" = 10'-0"

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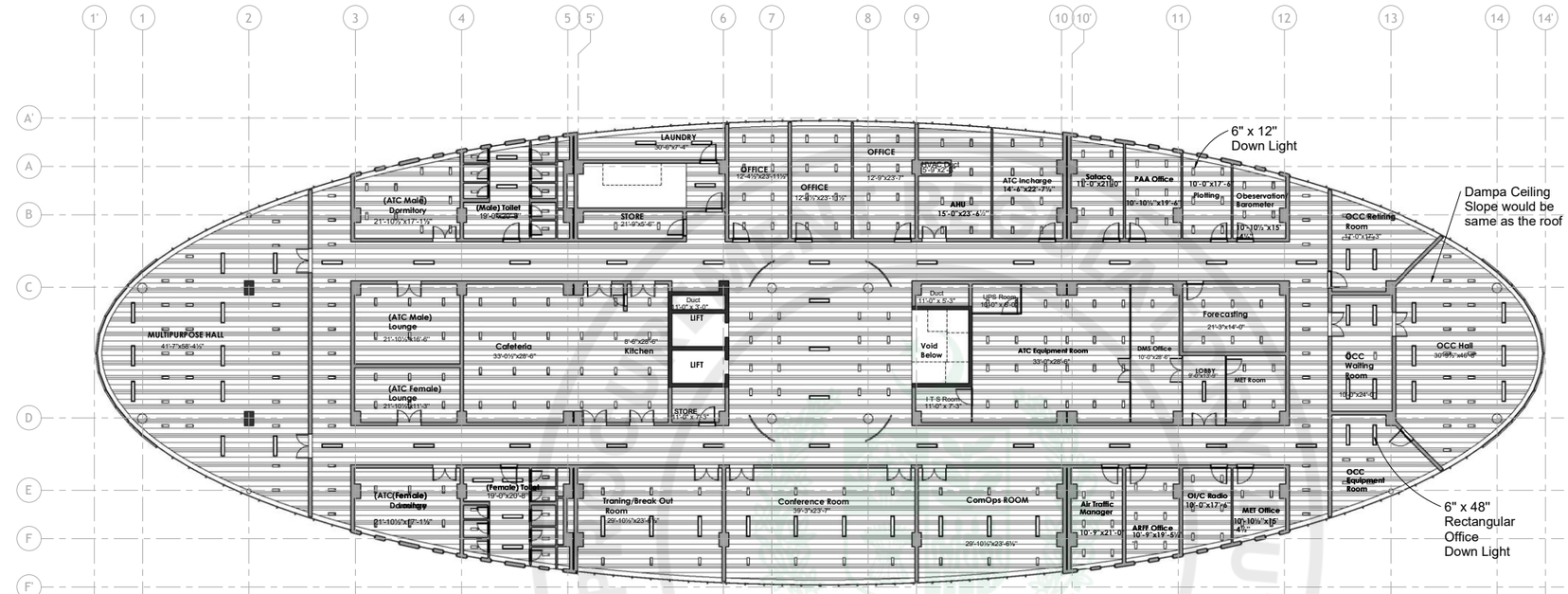

1 FIRST FLOOR PLAN
1" = 10'-0"

First Floor Ceiling Design Reference

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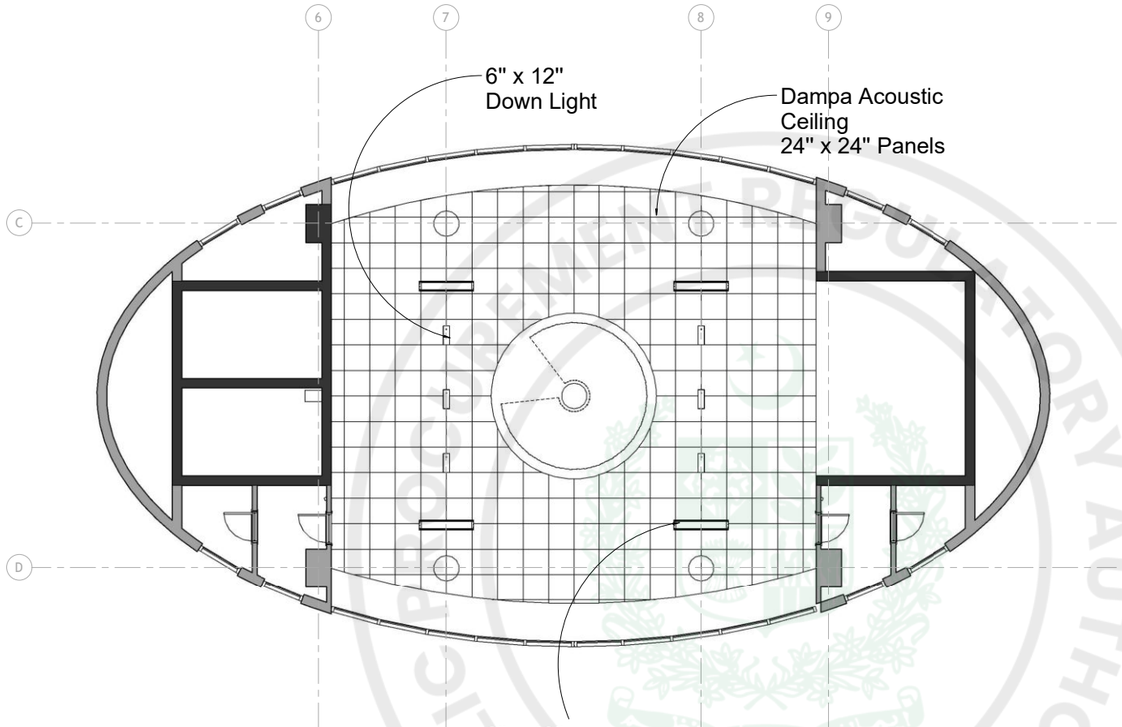
Detailed Architectural Design Drawings

FIRST FLOOR CEILING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 38

Scale @ 42" X 30" 1" = 10'-0"



1 ROOF TOP PLAN
1/4" = 1'-0"

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Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

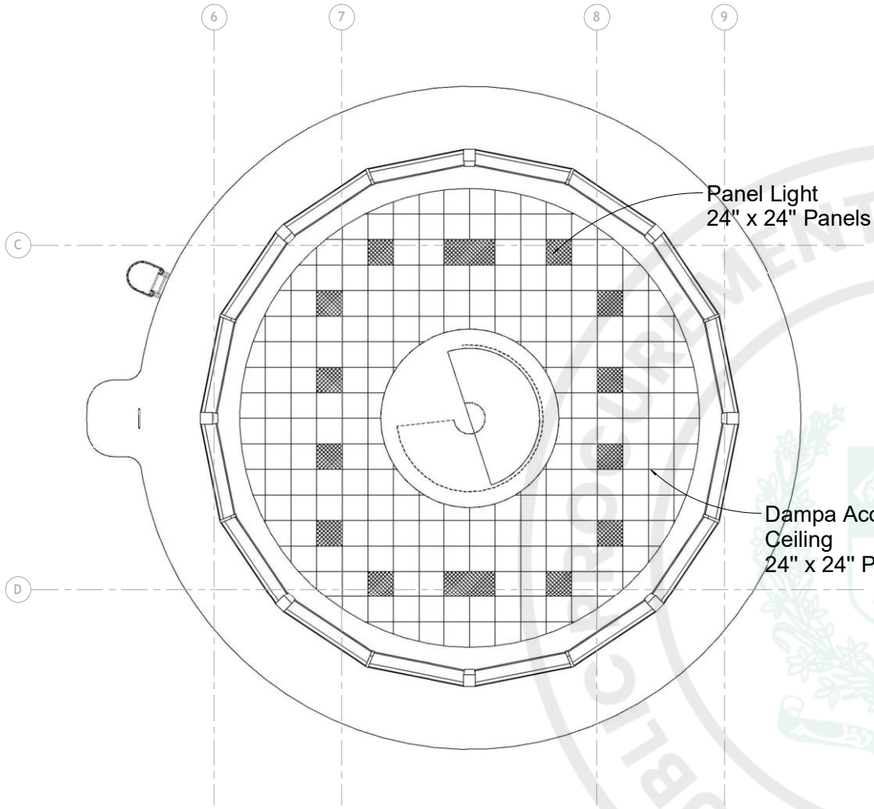
Detailed Architectural Design Drawings

ROOF TOP CEILING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 39

Scale @ 42" X 30" 1/4" = 1'-0"



1 ARFF CONTROL CABIN PLAN
1/4" = 1'-0"

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ARFF Floor Ceiling Design Reference

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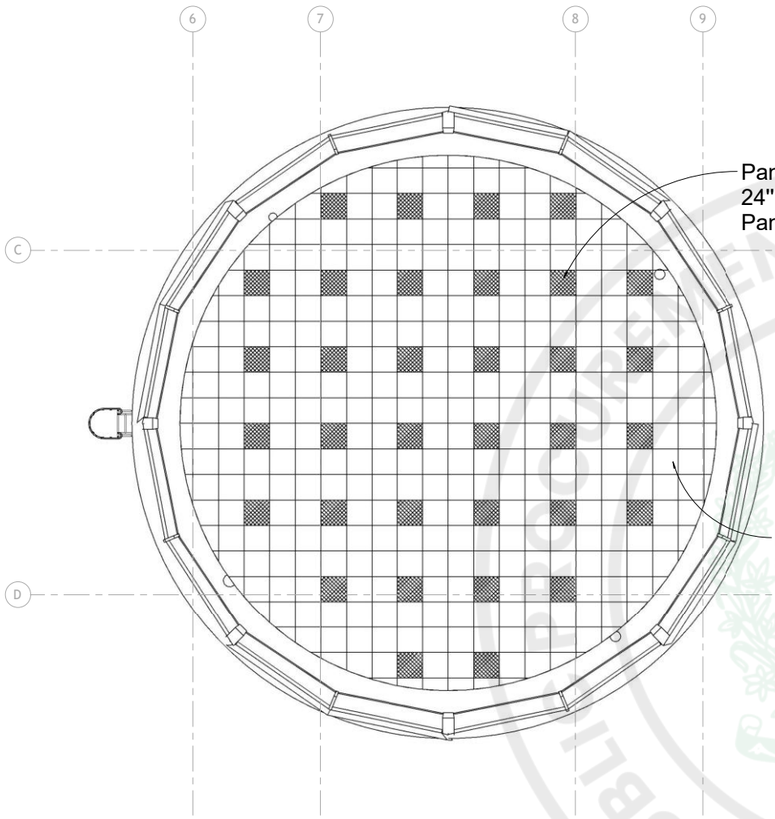
Detailed Architectural Design Drawings

ARFF CONTROL CABIN CEILING PLAN

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 40

Scale @ 42" X 30" 1/4" = 1'-0"



1 ATCT CONTROL CABIN PLAN
1/4" = 1'-0"

ISSUE FOR TENDER

ARFF Floor Ceiling Design Reference

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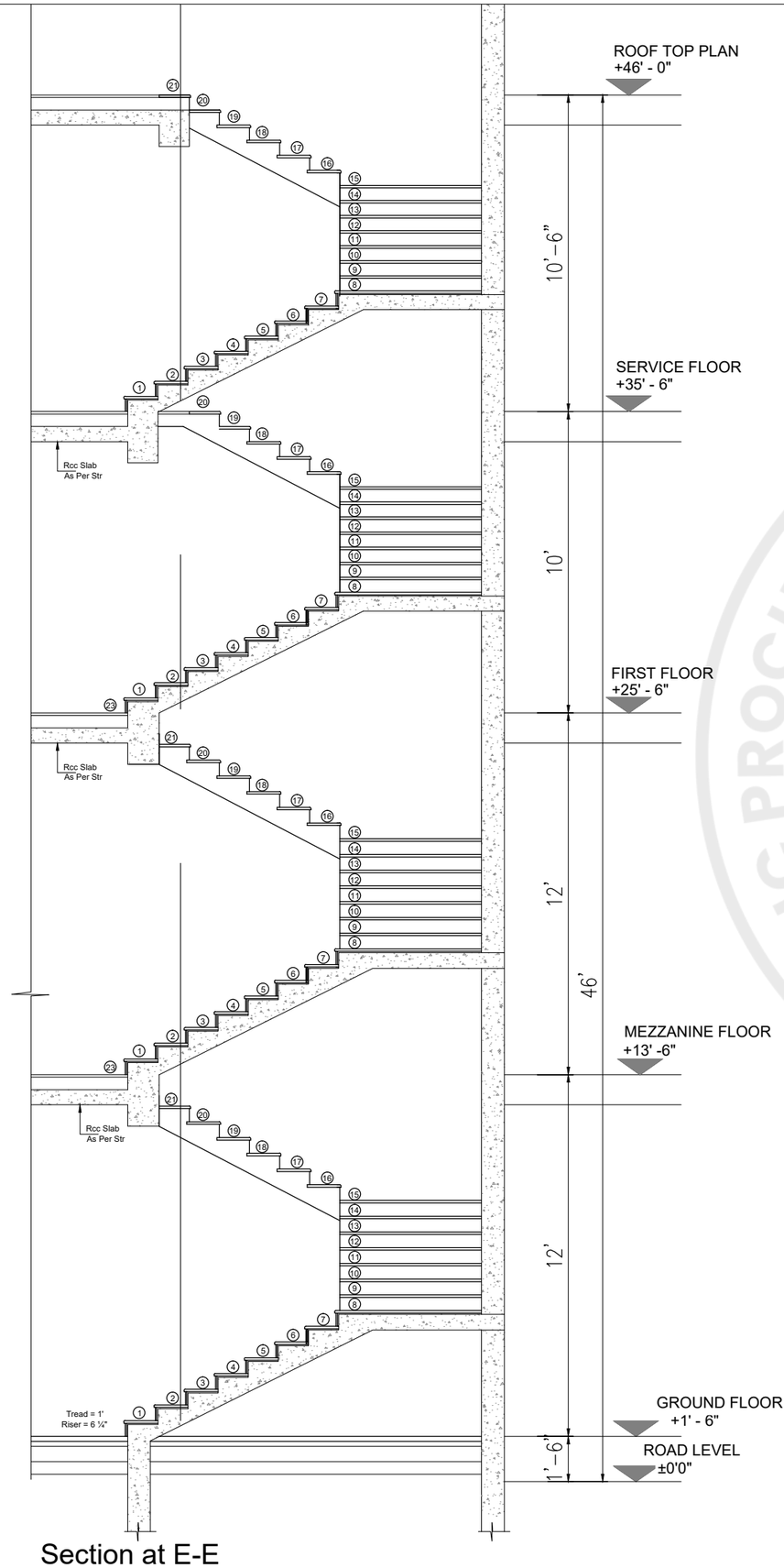
Detailed Architectural Design Drawings

ATCT CONTROL CABIN CEILING PLAN

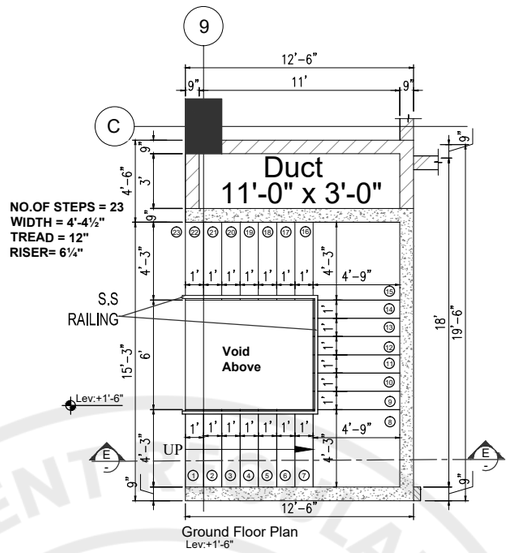
Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 40-A

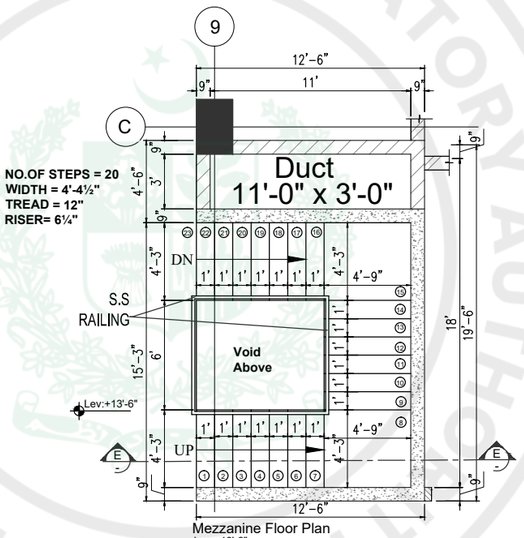
Scale @ 42" X 30" 1/4" = 1'-0"



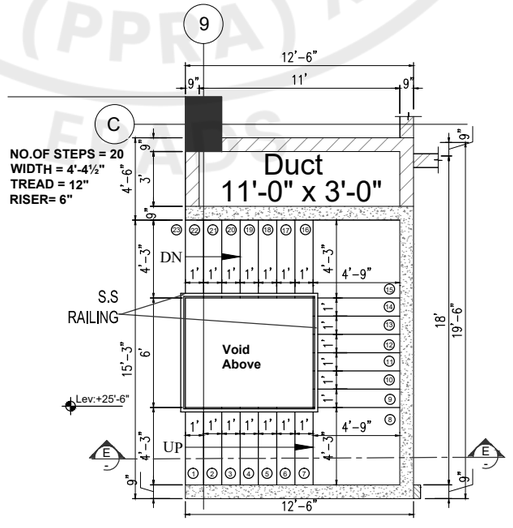
Section at E-E



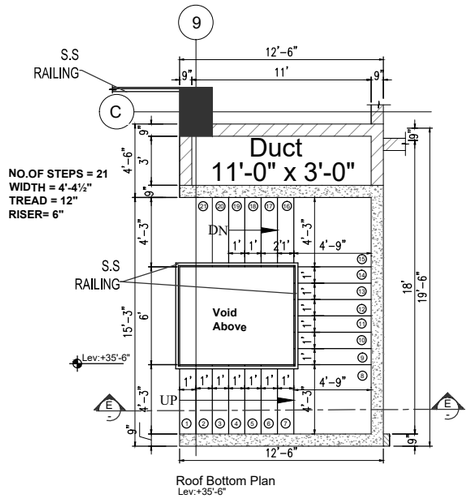
Ground Floor Plan
Lev:+1'-6"



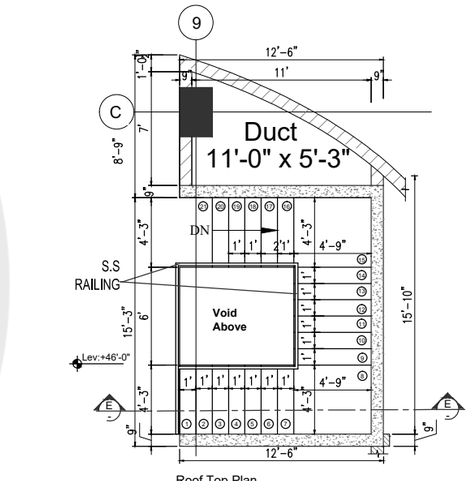
Mezzanine Floor Plan
Lev:+13'-6"



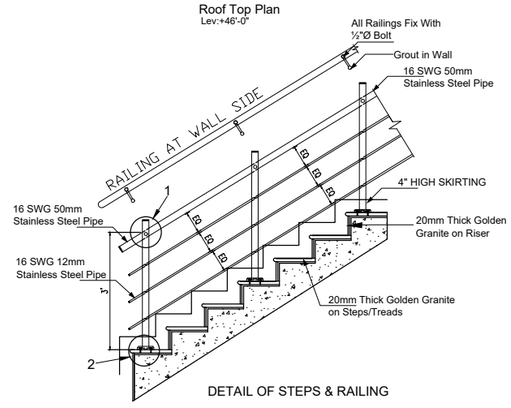
First Floor Plan
Lev:+25'-6"



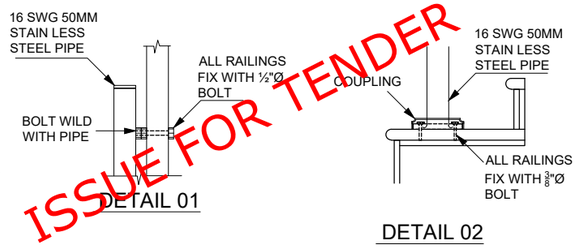
Roof Bottom Plan
Lev:+35'-6"



Roof Top Plan
Lev:+46'-0"



DETAIL OF STEPS & RAILING



DETAIL 01

DETAIL 02

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MAIN CONSULTANT

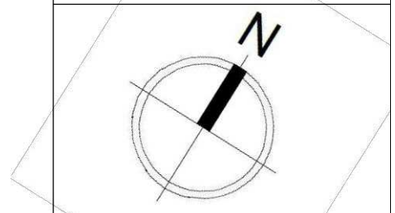
Anwar Ali Architects (Pvt.) Ltd.
Formerly Anwar Ali & Associates Since March 2006 to June 2018
Consulting Architects, Engineers, Planners & Management Consultants

JV MEMBERS

COMRADES CONSULTANTS
leit-werk

STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

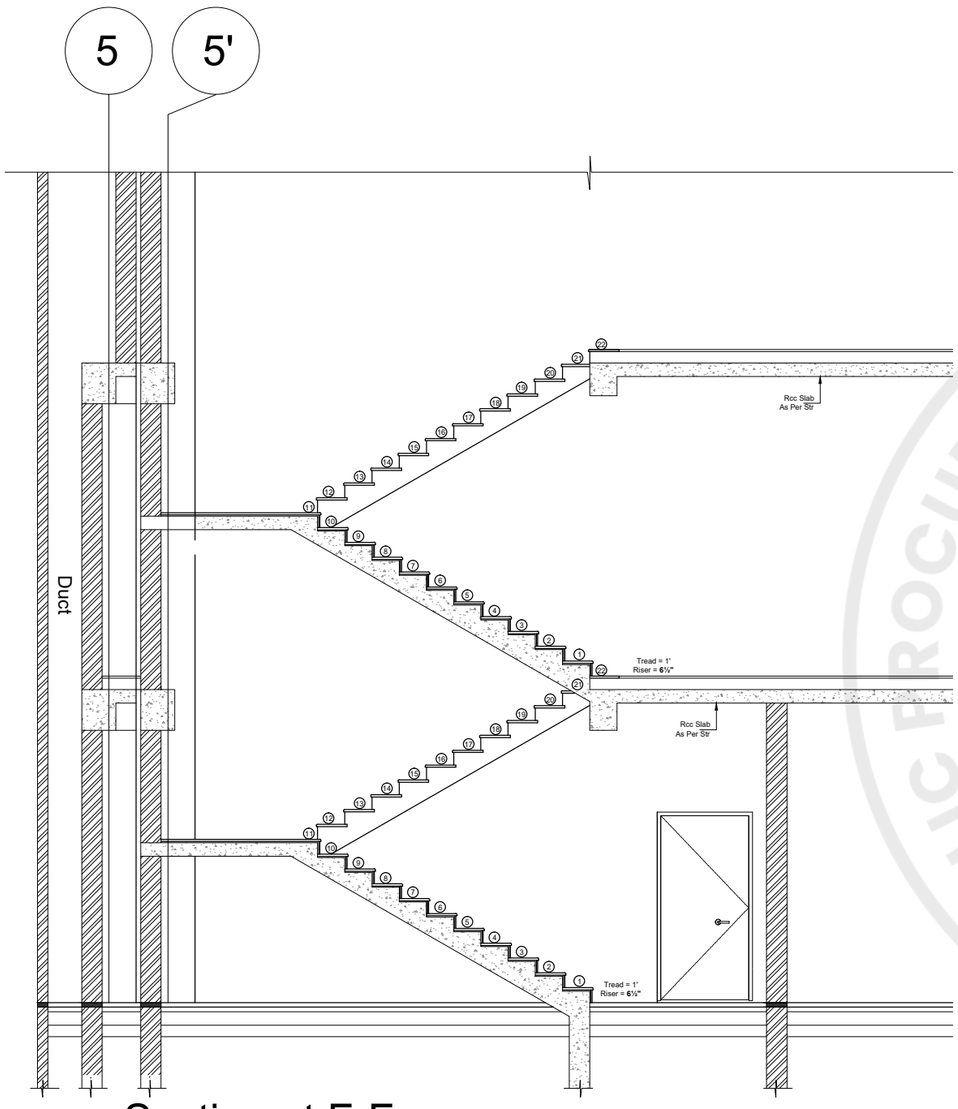
Detailed Architectural Design Drawings

Sheet Name

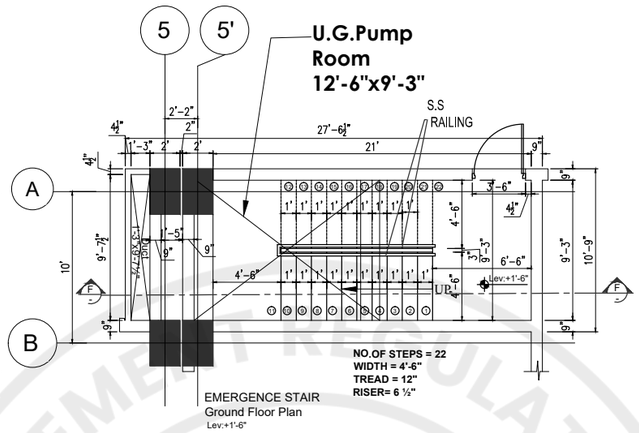
STAIR DETAIL-1

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-40b @A3

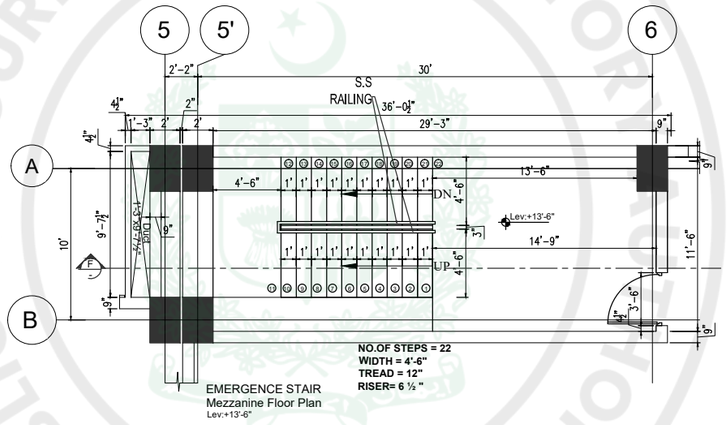
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA)



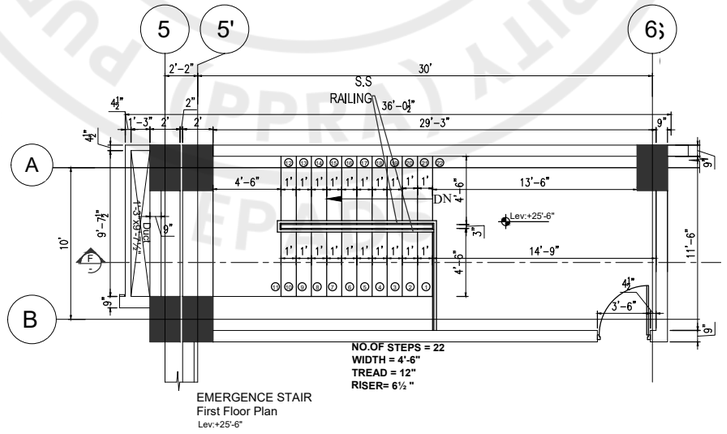
Section at F-F



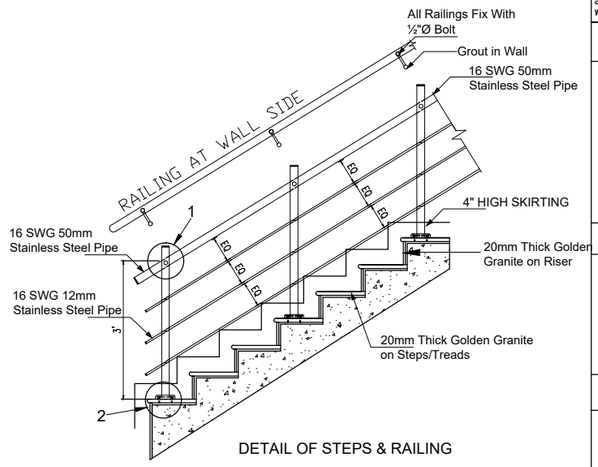
EMERGENCE STAIR
Ground Floor Plan
Lev:+1'-6"



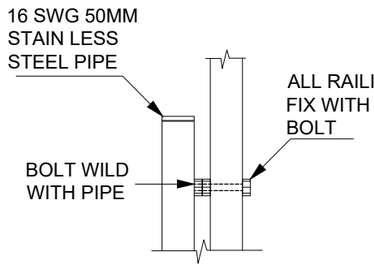
EMERGENCE STAIR
Mezzanine Floor Plan
Lev:+13'-6"



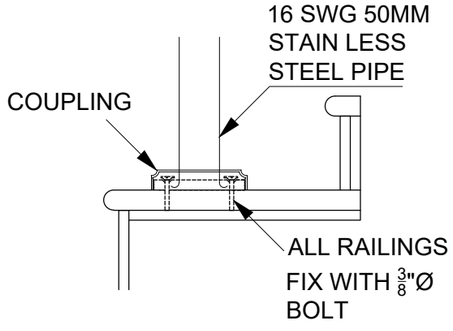
EMERGENCE STAIR
First Floor Plan
Lev:+25'-6"



DETAIL OF STEPS & RAILING



DETAIL 01



DETAIL 02

ISSUE FOR TENDER

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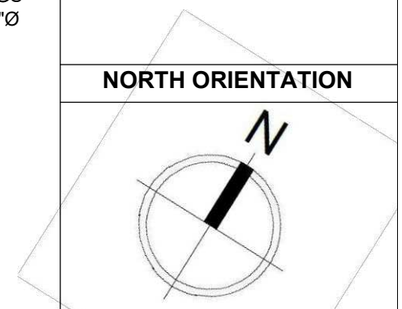
COMRADES CONSULTANTS
leit-werk

STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

EMERGENCE STAIR DETAIL-2

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-41 @A3

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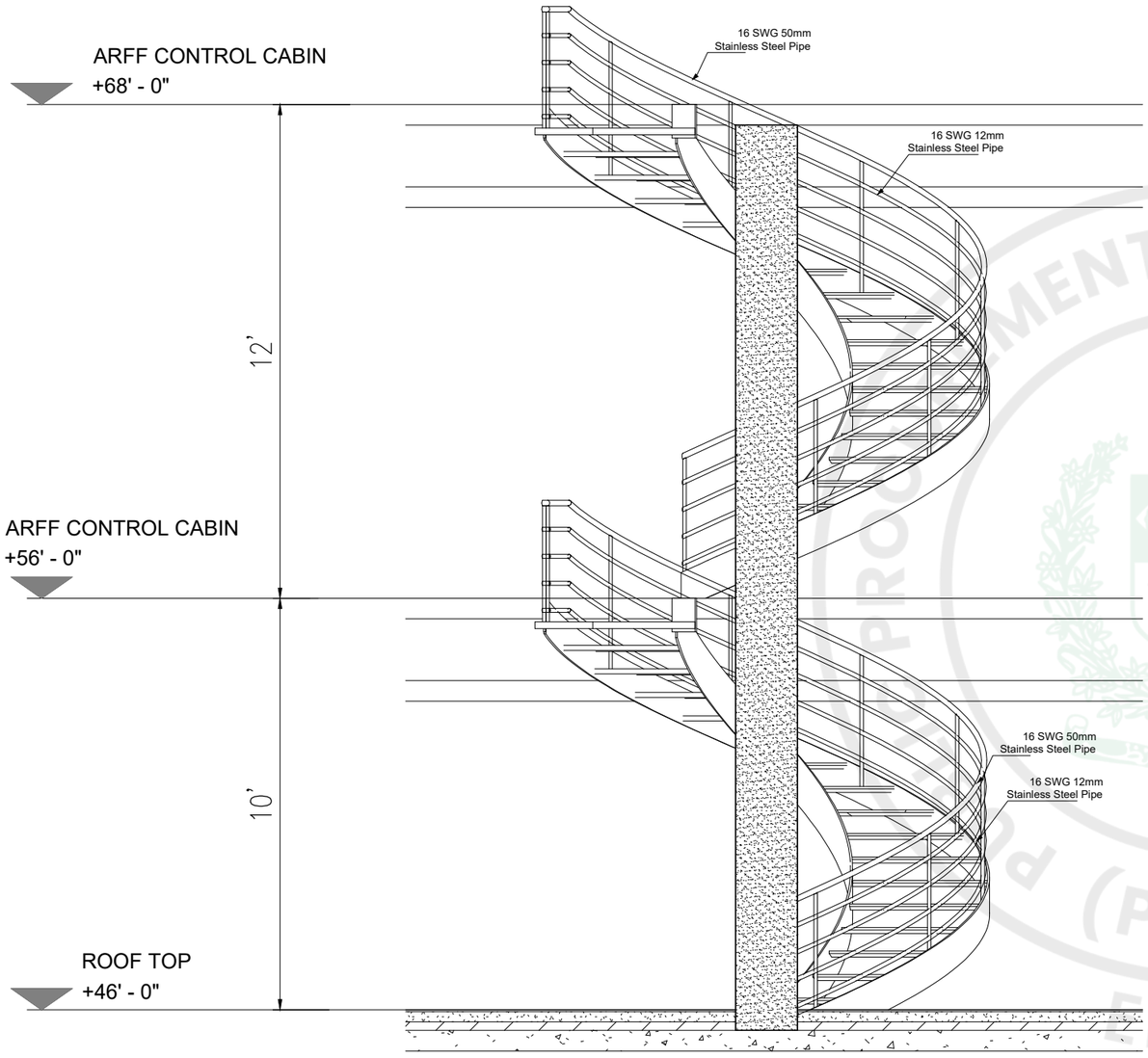
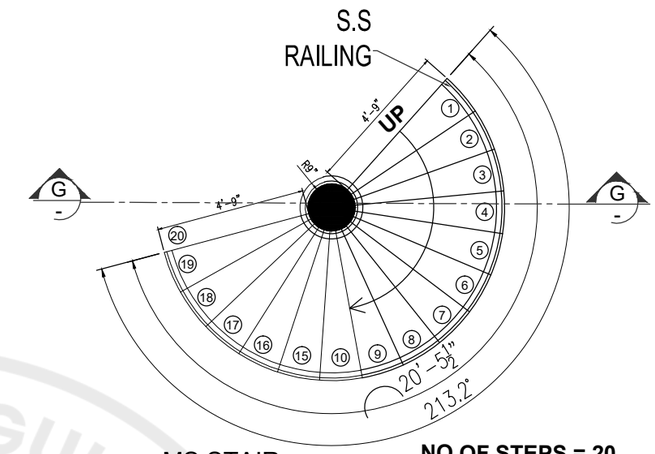
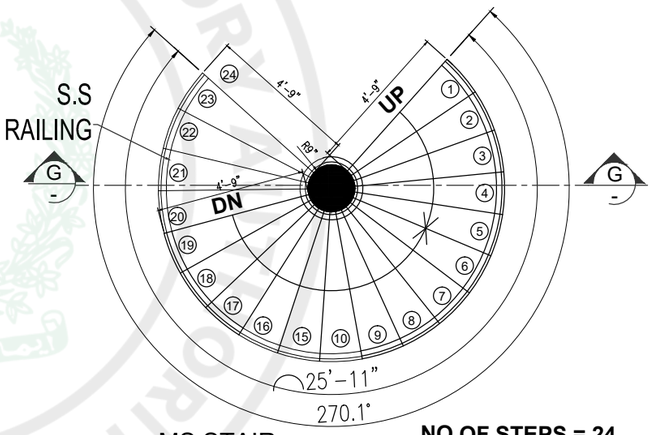


Section at G-G



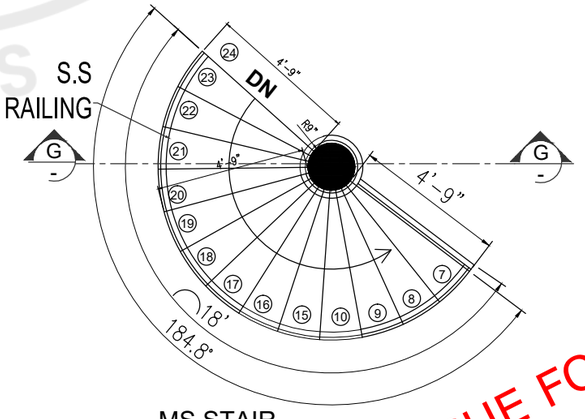
MS STAIR
Roof Plan
Level At +46' - 0"

NO.OF STEPS = 20
WIDTH = 4'-9"
TREAD = 10"
RISER= 6 "



MS STAIR
ARFF Control Cabin
Level At +56' - 0"

NO.OF STEPS = 24
WIDTH = 4'-9"
TREAD = 10"
RISER= 6 "



MS STAIR
ATCT Control Cabin
Level At +68' - 0"

ISSUE FOR TENDER

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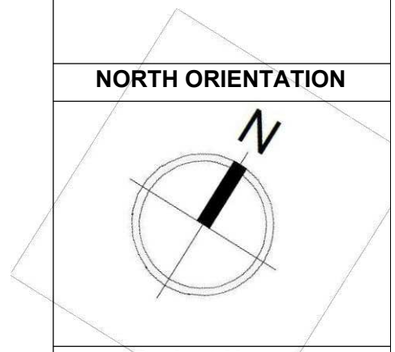
leit-werk

STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MS STAIR
DETAIL-3

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-42 @A3

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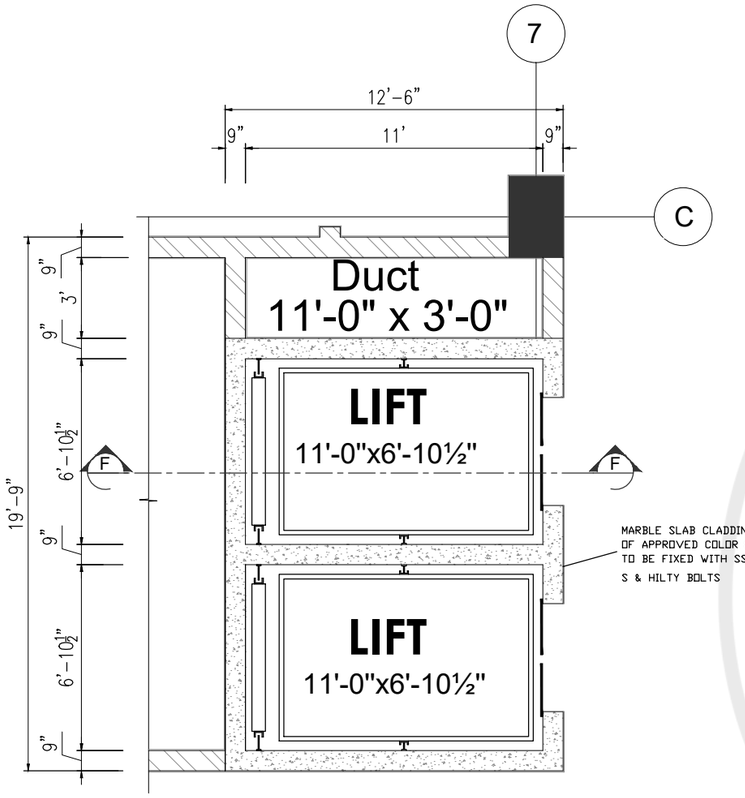
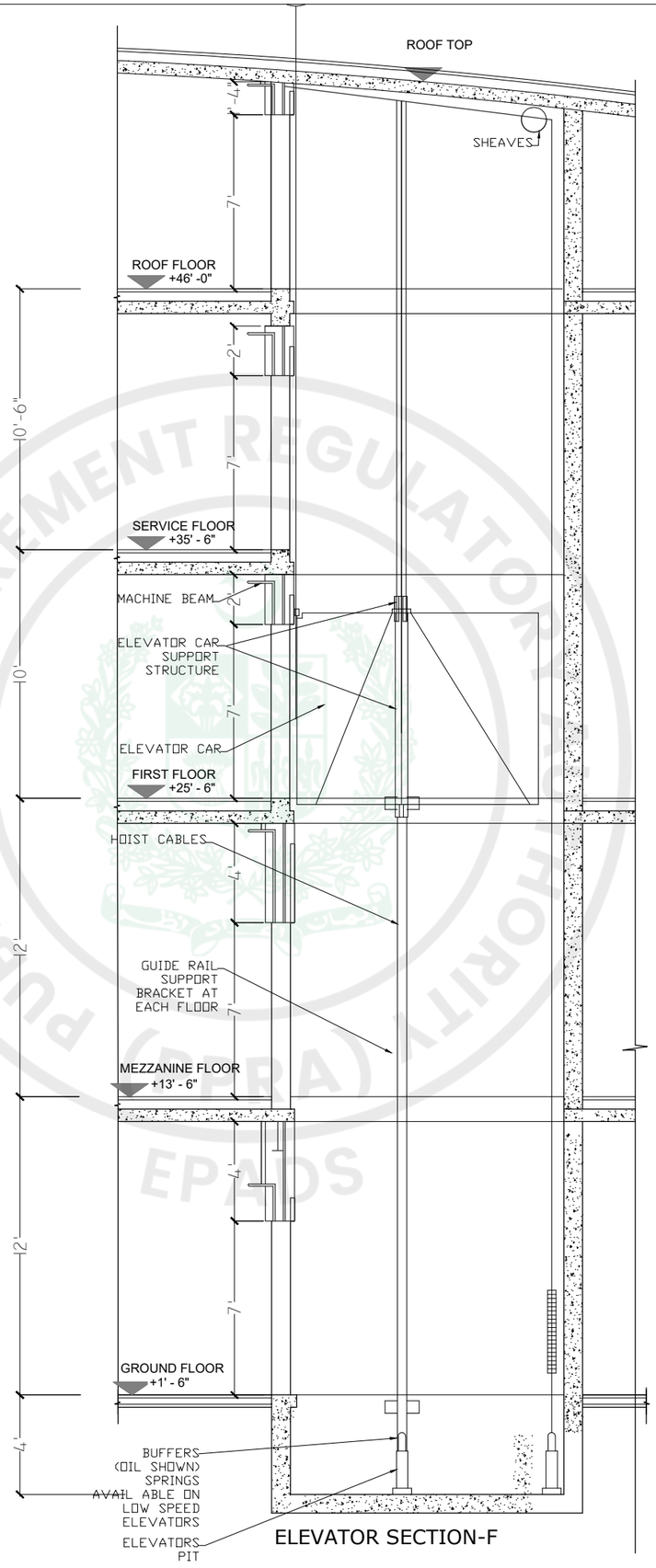


PASSENGER & GOOD
LIFT PLAN



ELEVATOR SECTION-F

ISSUE FOR TENDER

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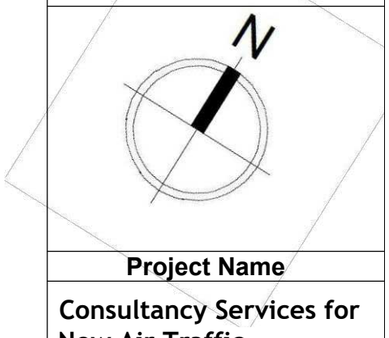
STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

LIFT DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-43 @A3

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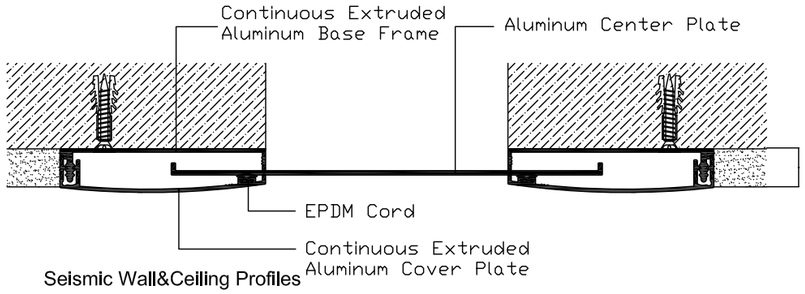
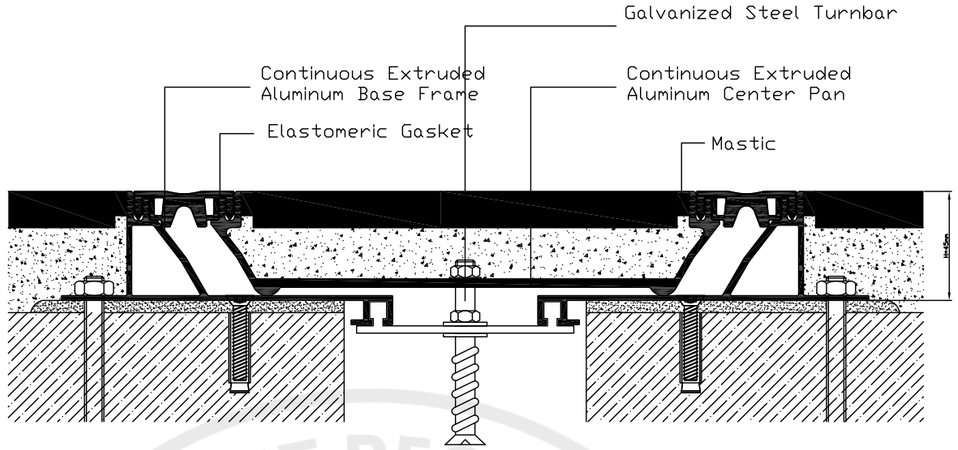
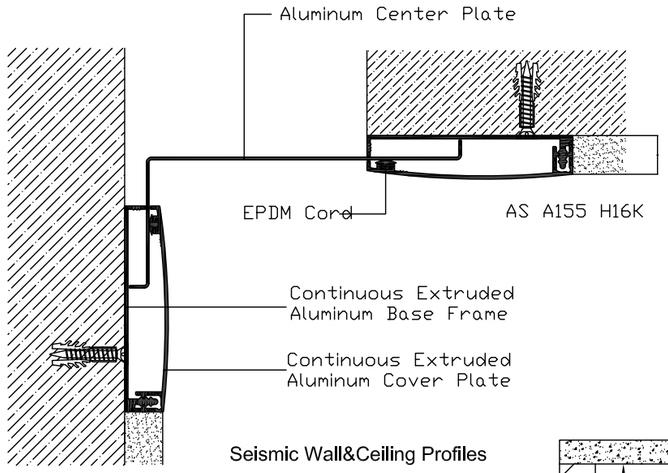


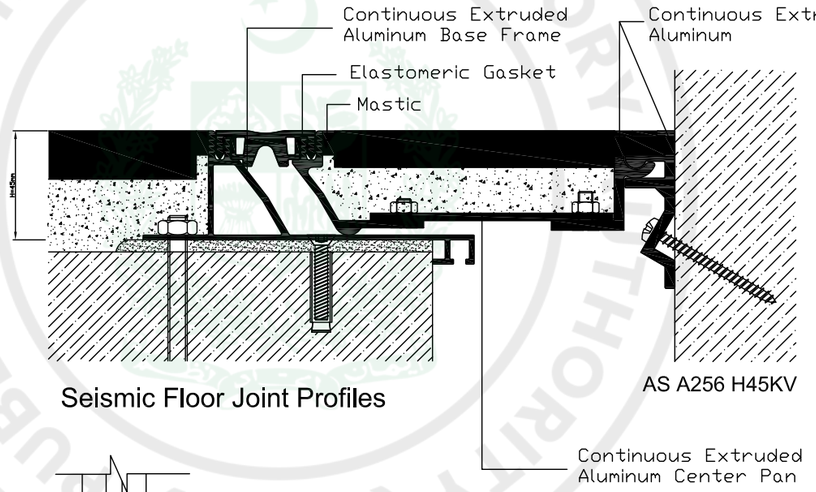
Seismic Wall&Ceiling Profiles



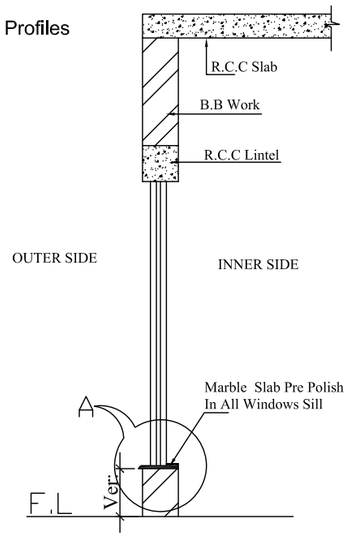
Seismic Floor Joint Profiles



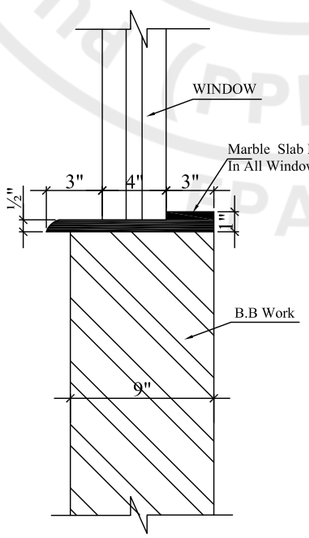
Seismic Wall&Ceiling Profiles



Seismic Floor Joint Profiles



TYPICAL DETAIL OF MARBLE SLAB



DETAIL-A

ISSUE FOR TENDER

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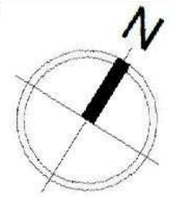
STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

EXPANSION JOINT & TYPICAL DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-44 @A3

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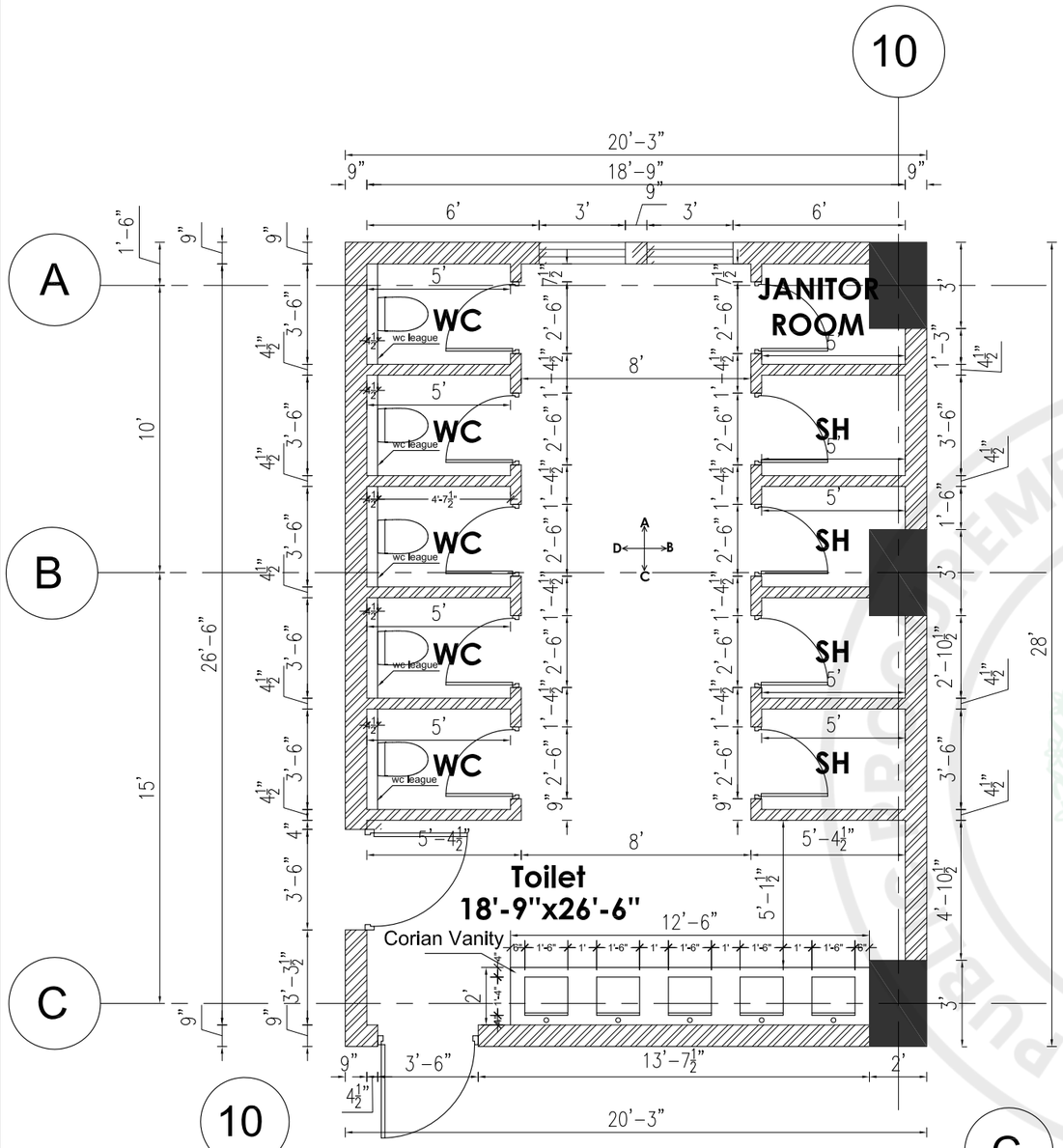
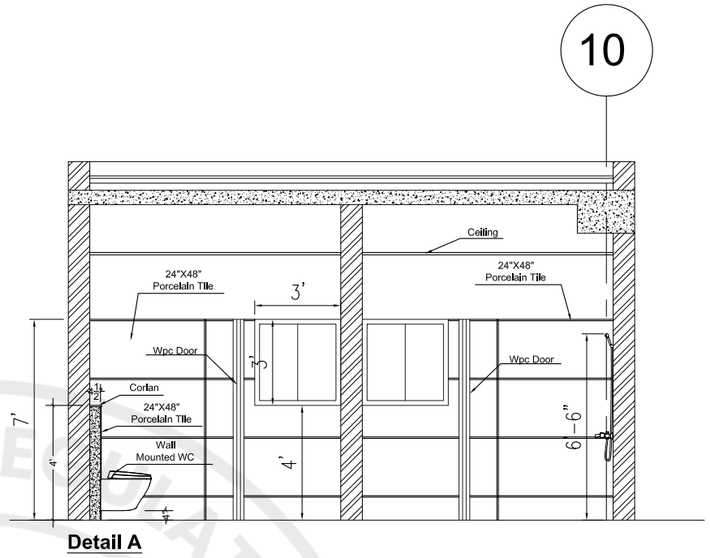
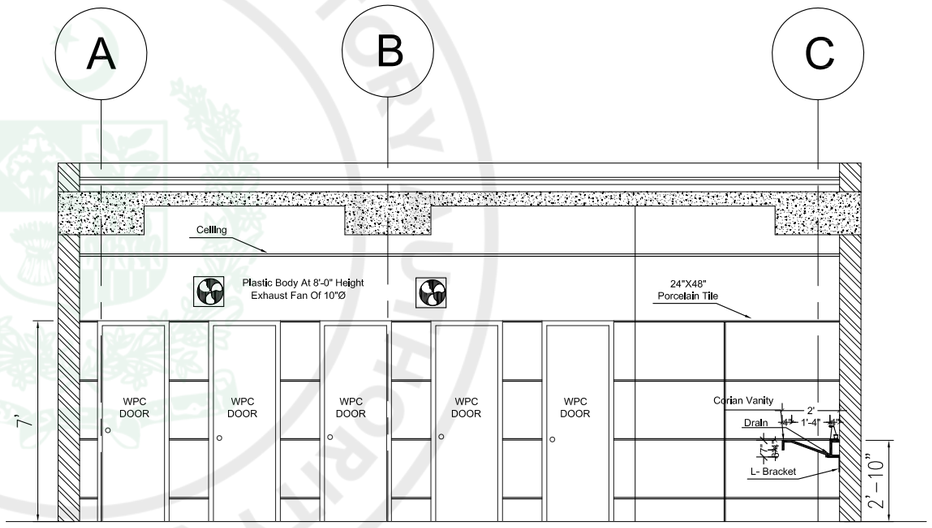


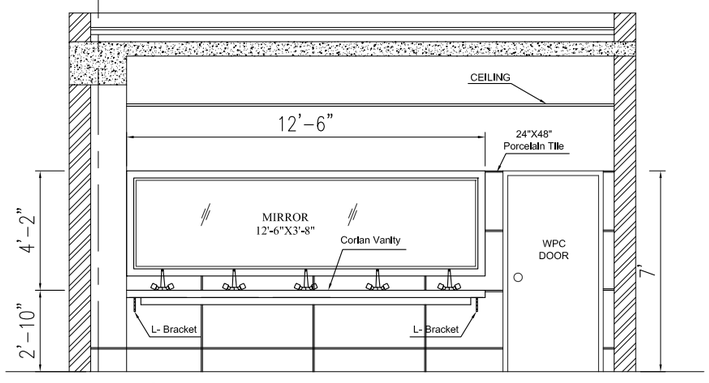
GROUND FLOOR TOILET PLAN



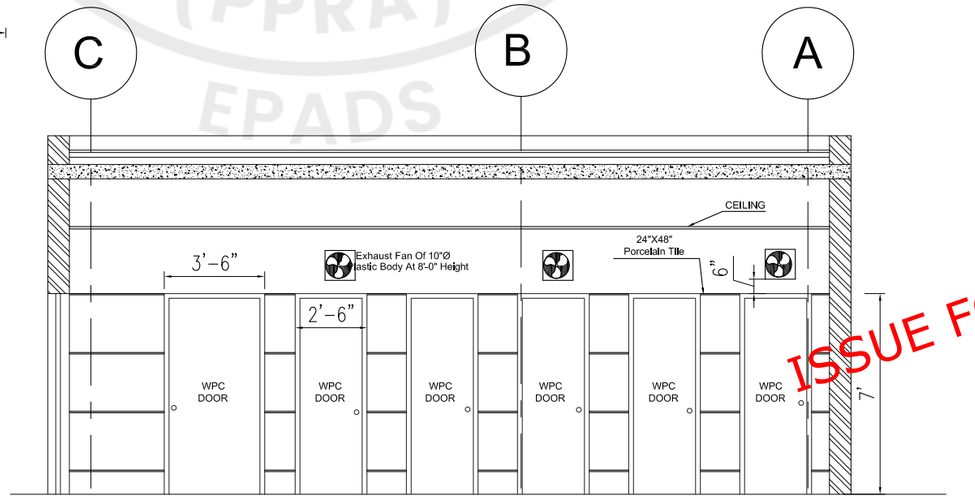
Detail A



Detail B



DETAIL C



Detail D

ISSUE FOR TENDER

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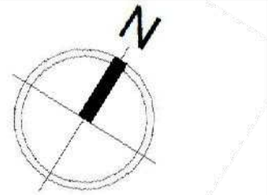
STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

TOILET (GROUND FLOOR PLAN & SECTION)

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-45 @A3

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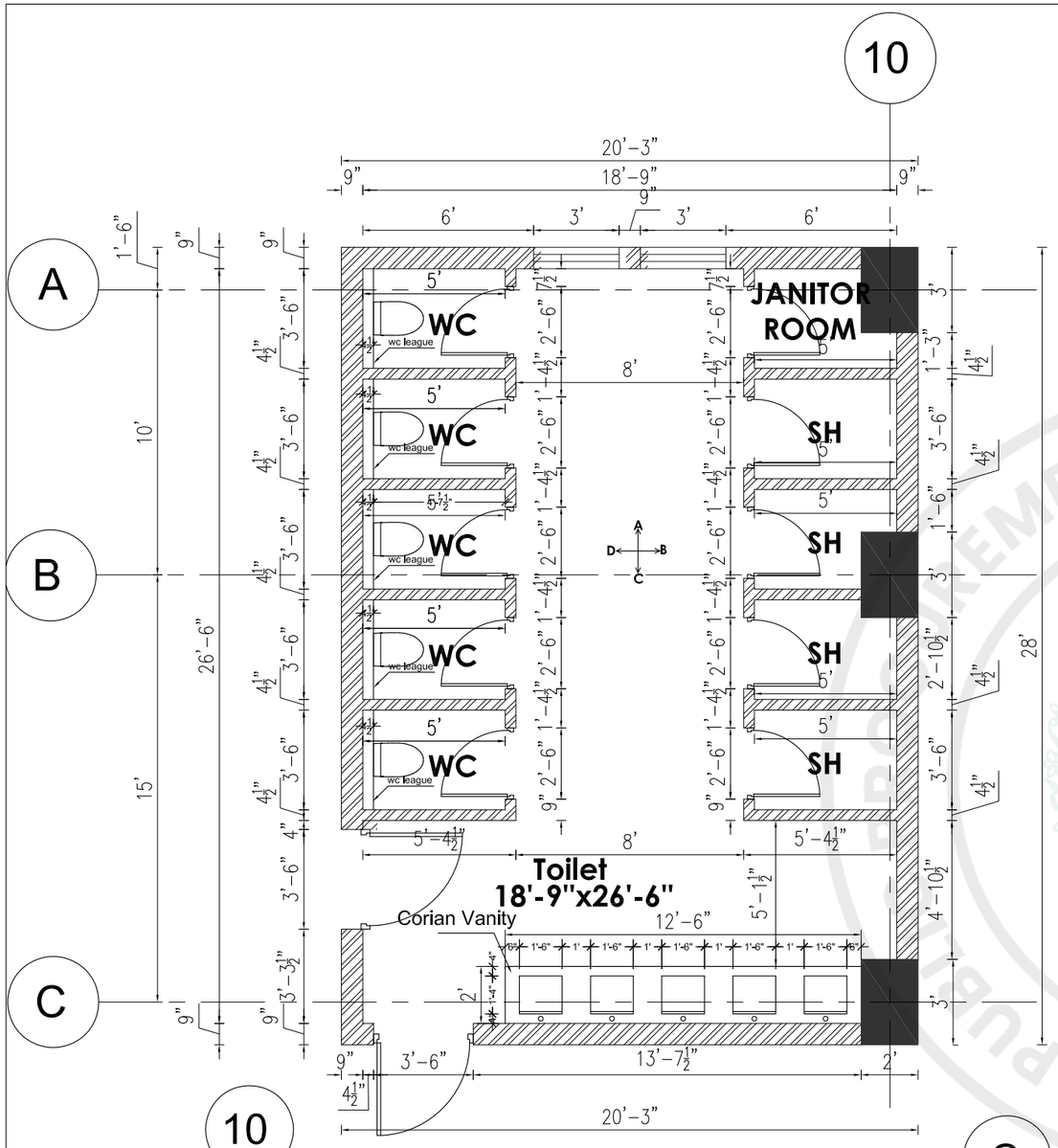
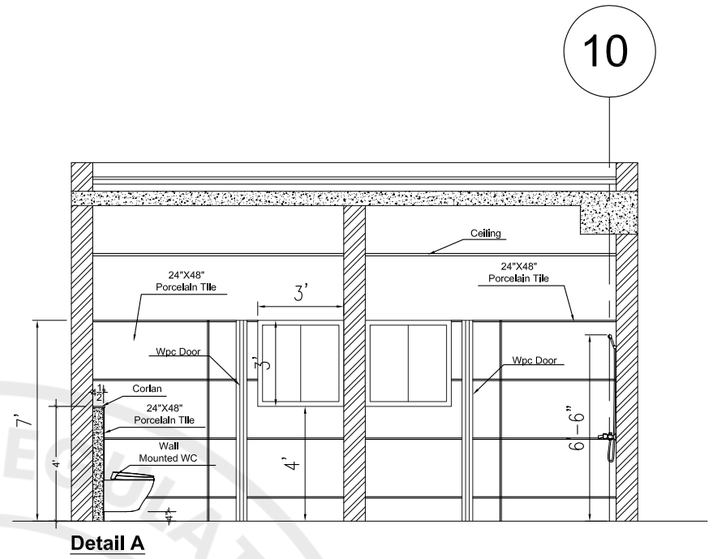
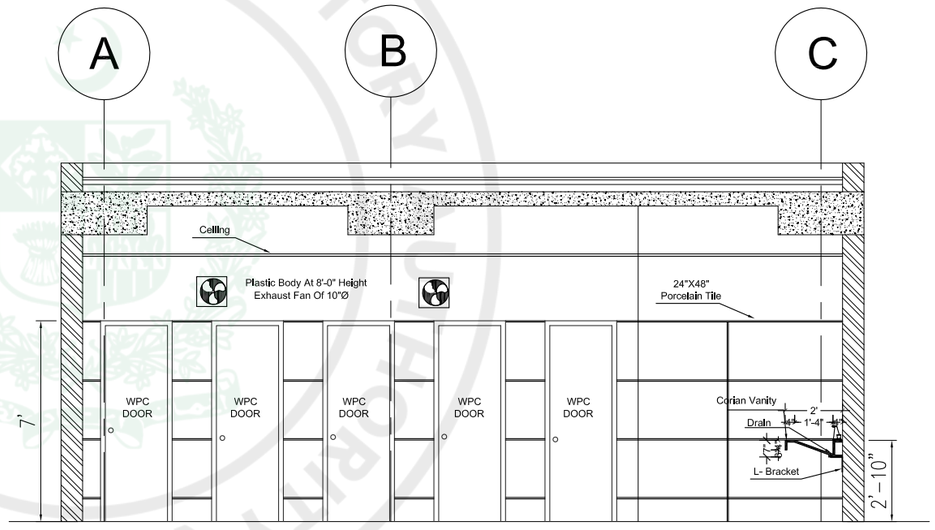


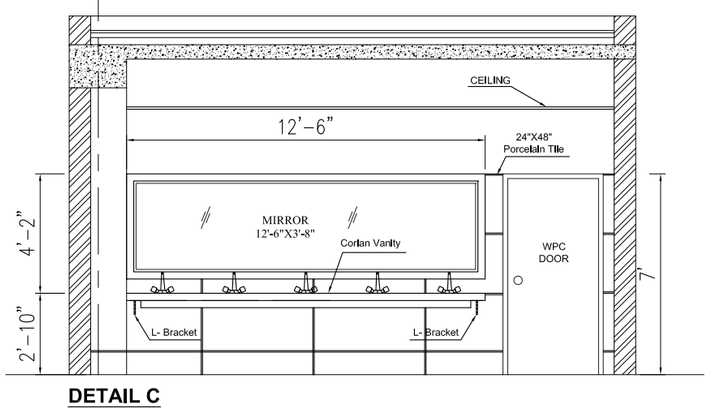
MEZZANINE FLOOR TOILET PLAN



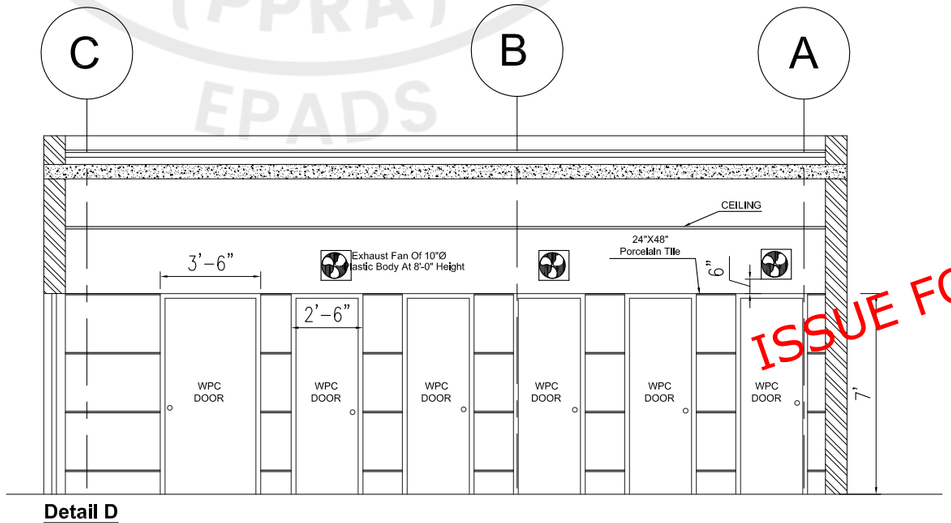
Detail A



Detail B



DETAIL C



Detail D

ISSUE FOR TENDER

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COMRADES CONSULTANTS
leit-werk

STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

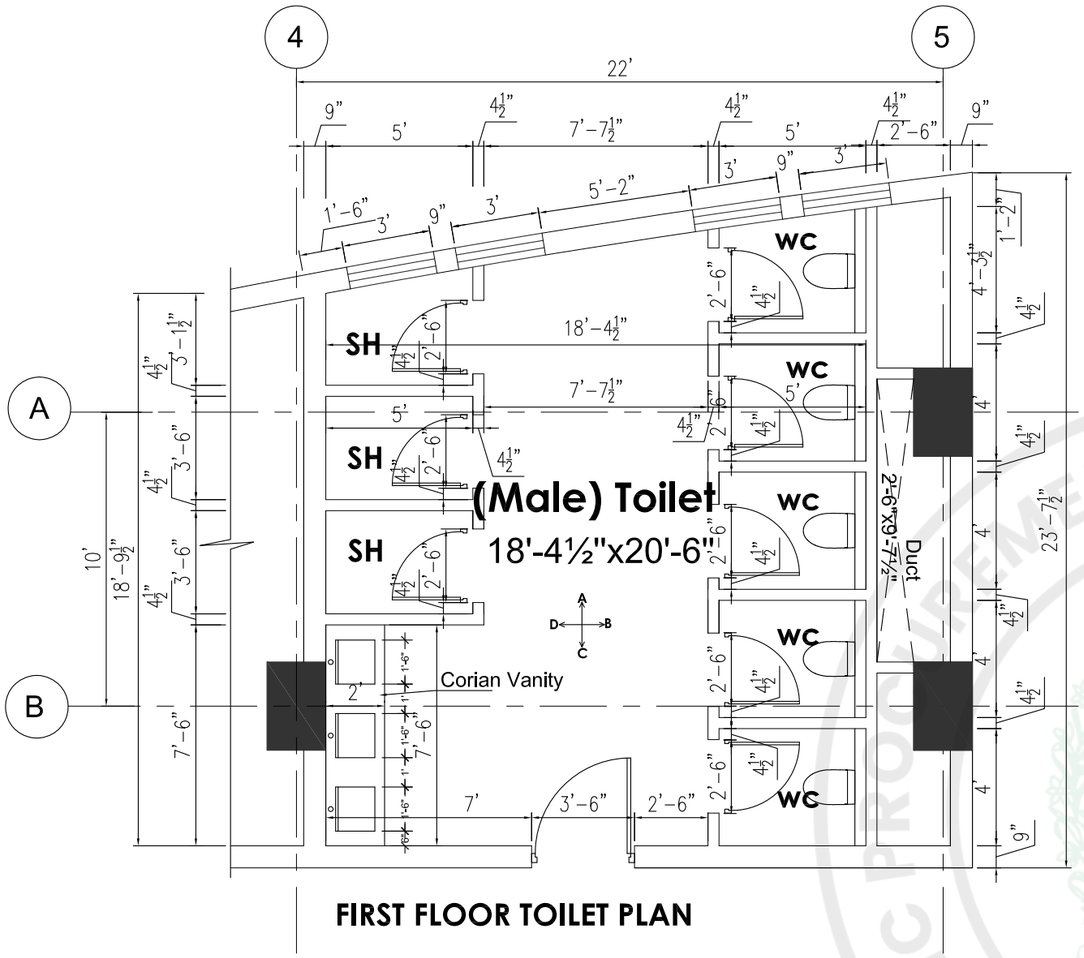
Detailed Architectural Design Drawings

Sheet Name

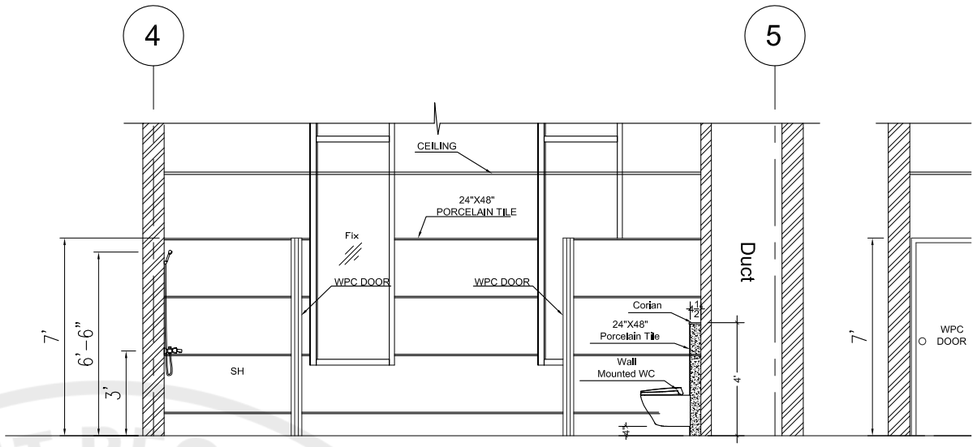
TOILET (MEZZANINE FLOOR PLAN & SECTION)

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-46 @A3

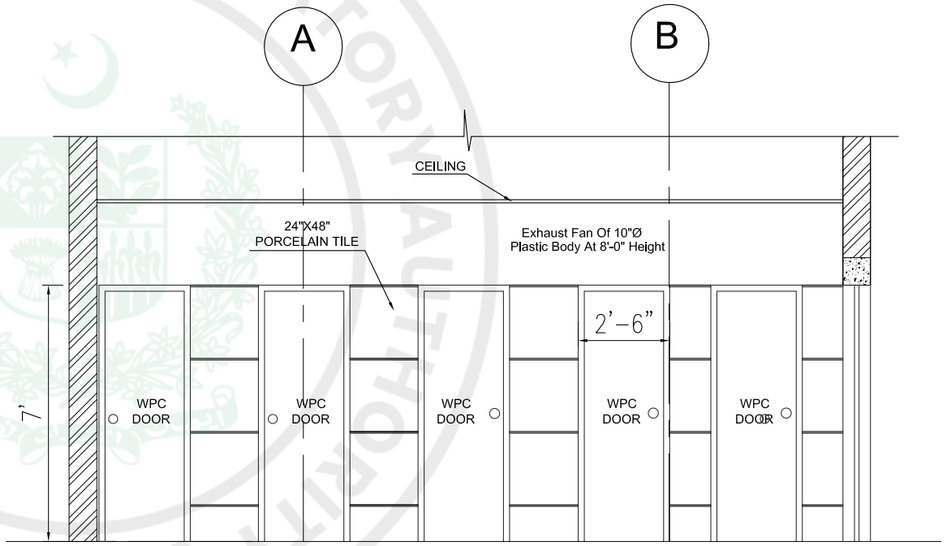
Pakistan Public Procurement Regulatory Authority (PPRA) EPADS



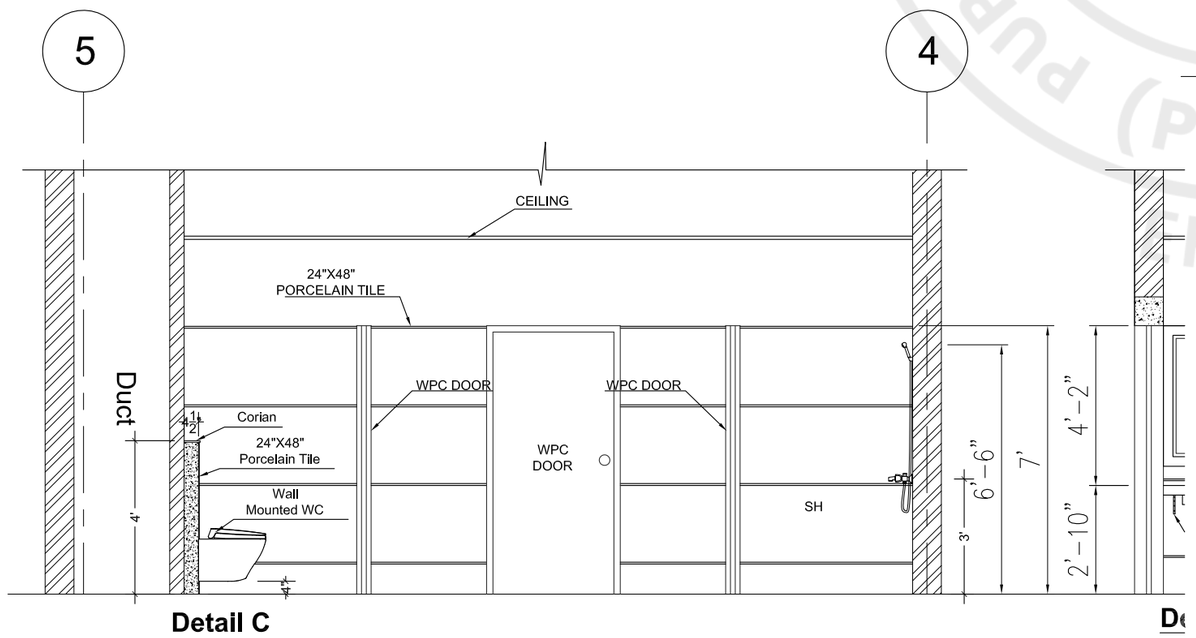
FIRST FLOOR TOILET PLAN



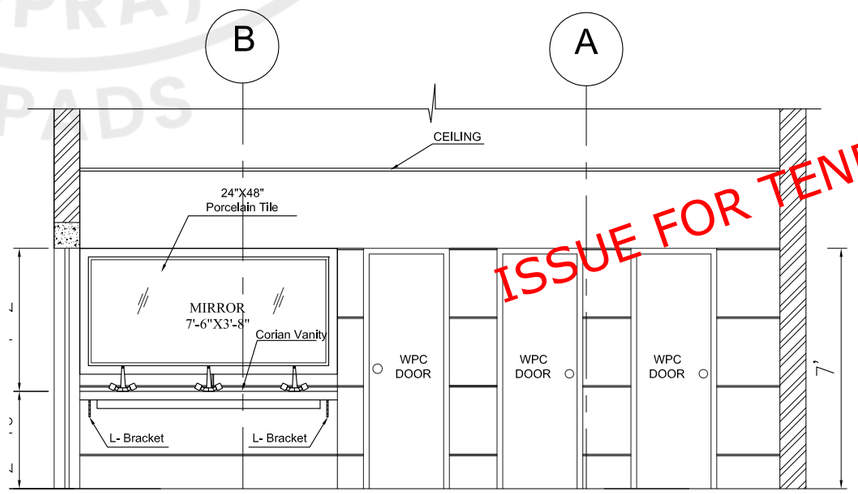
Detail A



Detail B



Detail C



Detail D

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NORTH ORIENTATION

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MALE TOILET (FIRST FLOOR PLAN & SECTION)

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-47 @A3

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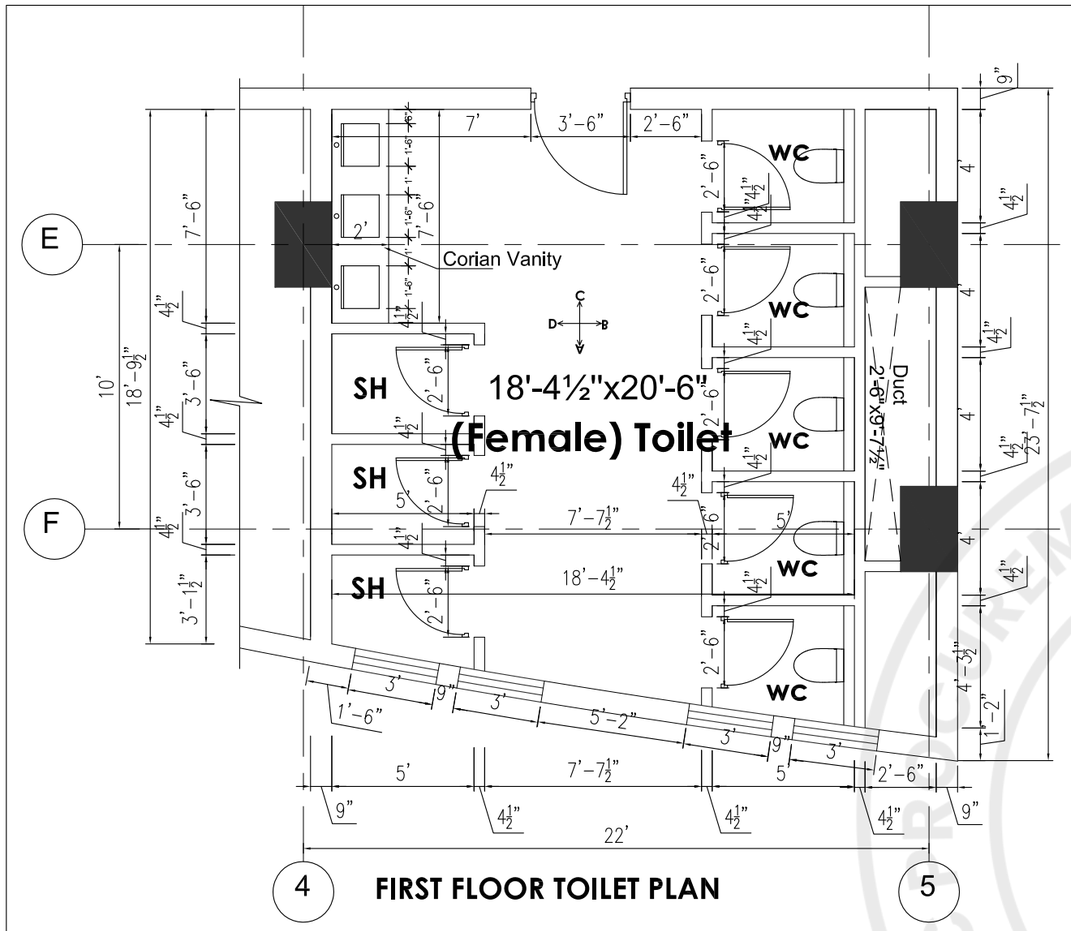
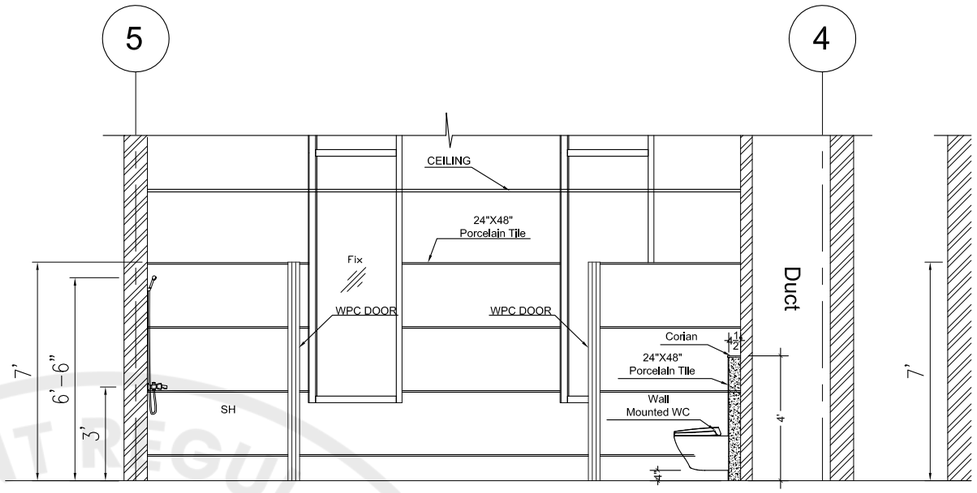
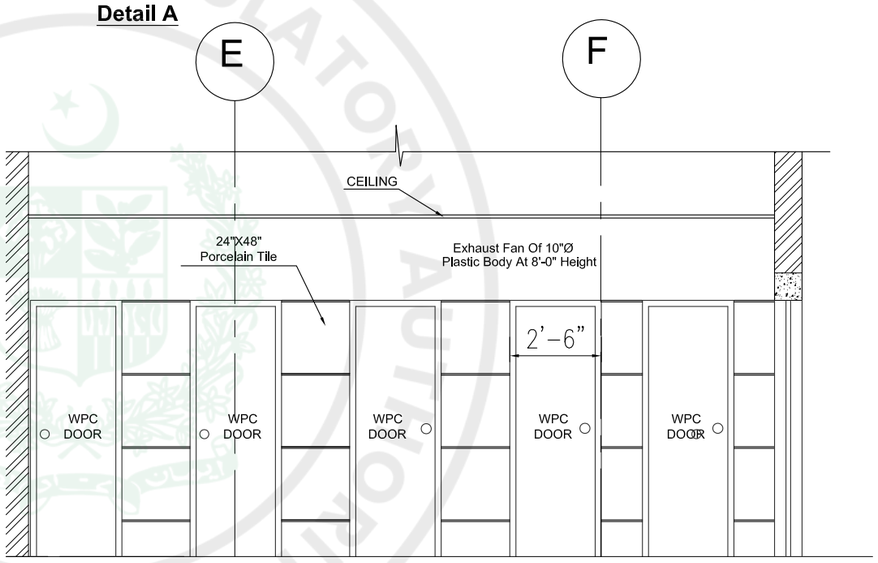
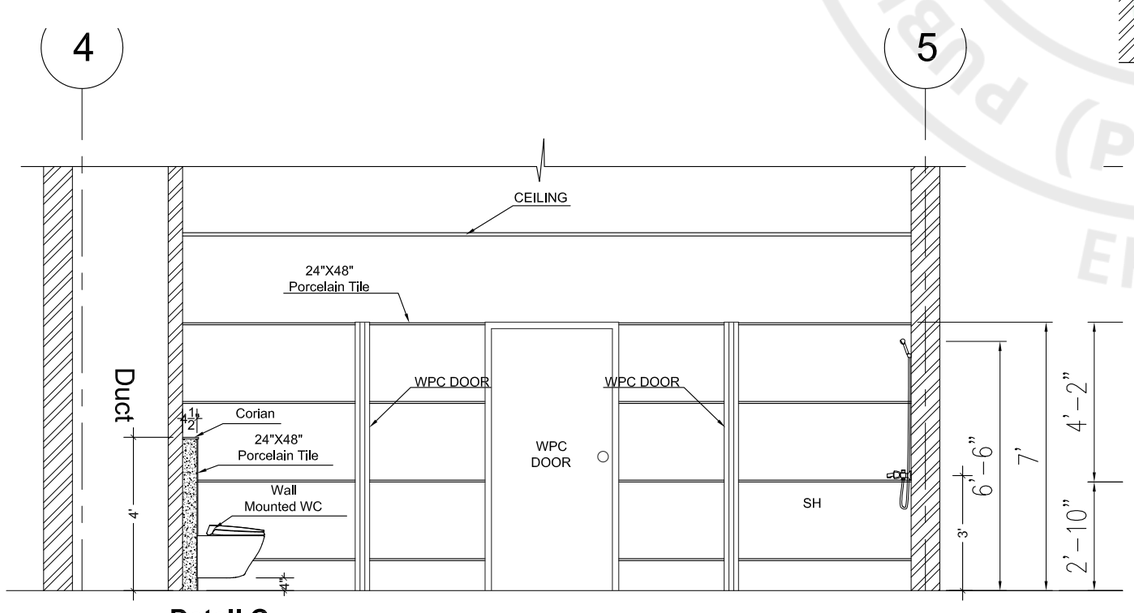




Detail A



Detail B



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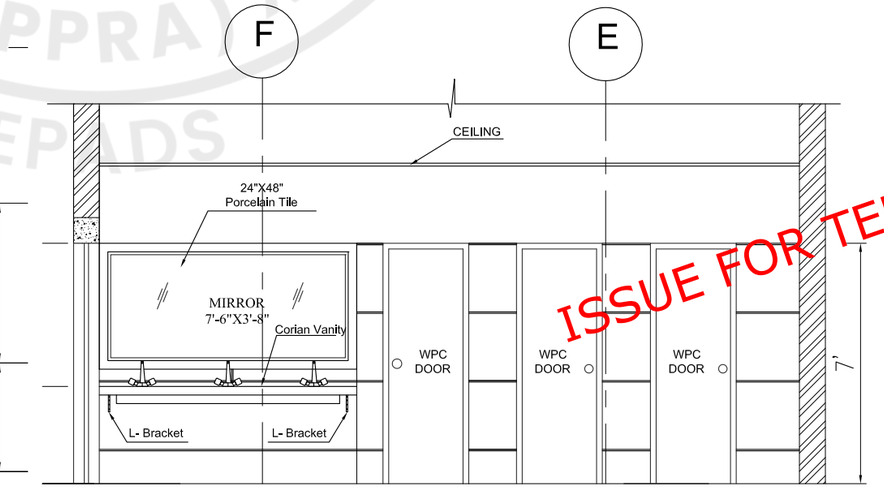

Detail D

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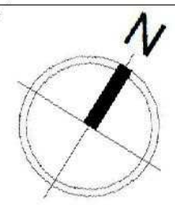

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

FEMALE TOILET (FIRST FLOOR PLAN & SECTION)

Date	14 November, 2025
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-48 @A3

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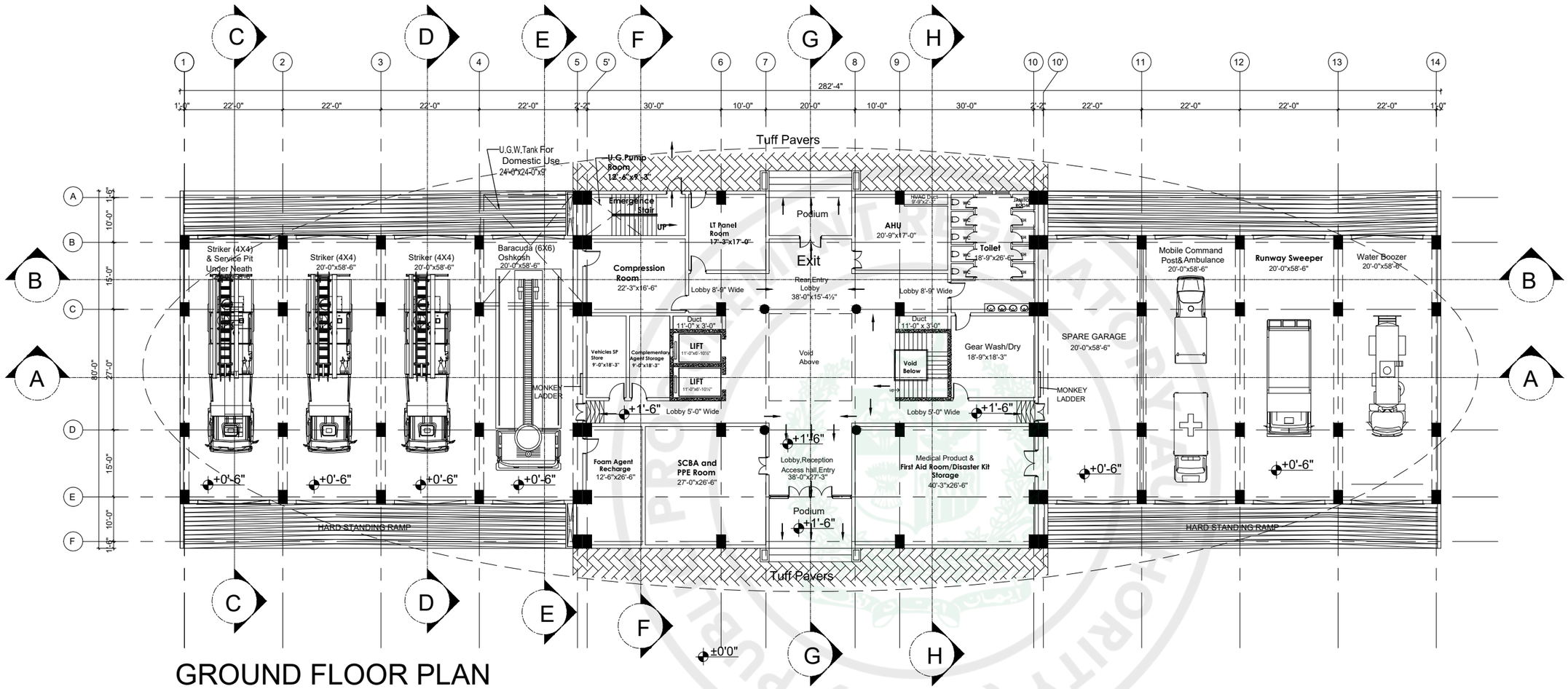

GROUND FLOOR PLAN

G.F Covered Area =	23332 Sft
M.F Covered Area =	9064 Sft
F.F Covered Area =	27439 Sft
R.F COVERED AREA	2792 Sft
ARFF COVERED AREA	1277 Sft
ATCT COVERED AREA	1809 Sft
TOTAL COVERED AREA	65713 SFT

ISSUE FOR TENDER

Minimum Fleet Requirement For Fire Station Vehicles

1) 03 For ARFF Vehicles - Striker 4x4
2) 01 For Water Bowzer
3) 01 For Domestic Fire Tender
4) 01 For Fire Crash Ambulance
5) 01 For Mobile Command Post Vehicle

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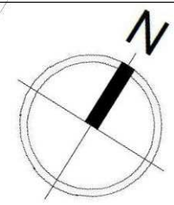


Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

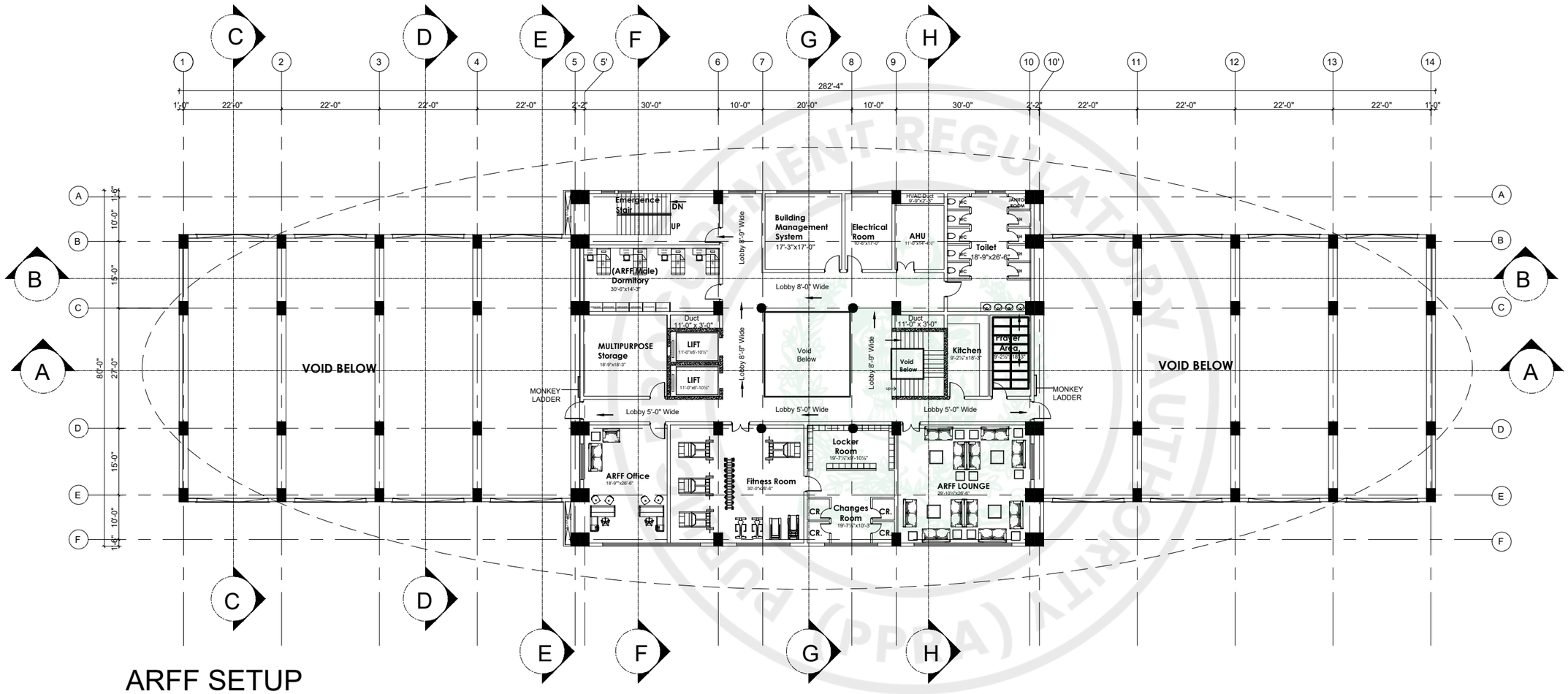
Detailed Architectural Design Drawings

Sheet Name

GROUND FLOOR FIRE EXIT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-49 @A3

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ARFF SETUP
MEZZANINE FLOOR PLAN

Covered Area = 9064 Sft

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MEZZANINE FLOOR
FIRE EXIT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-50 @A3

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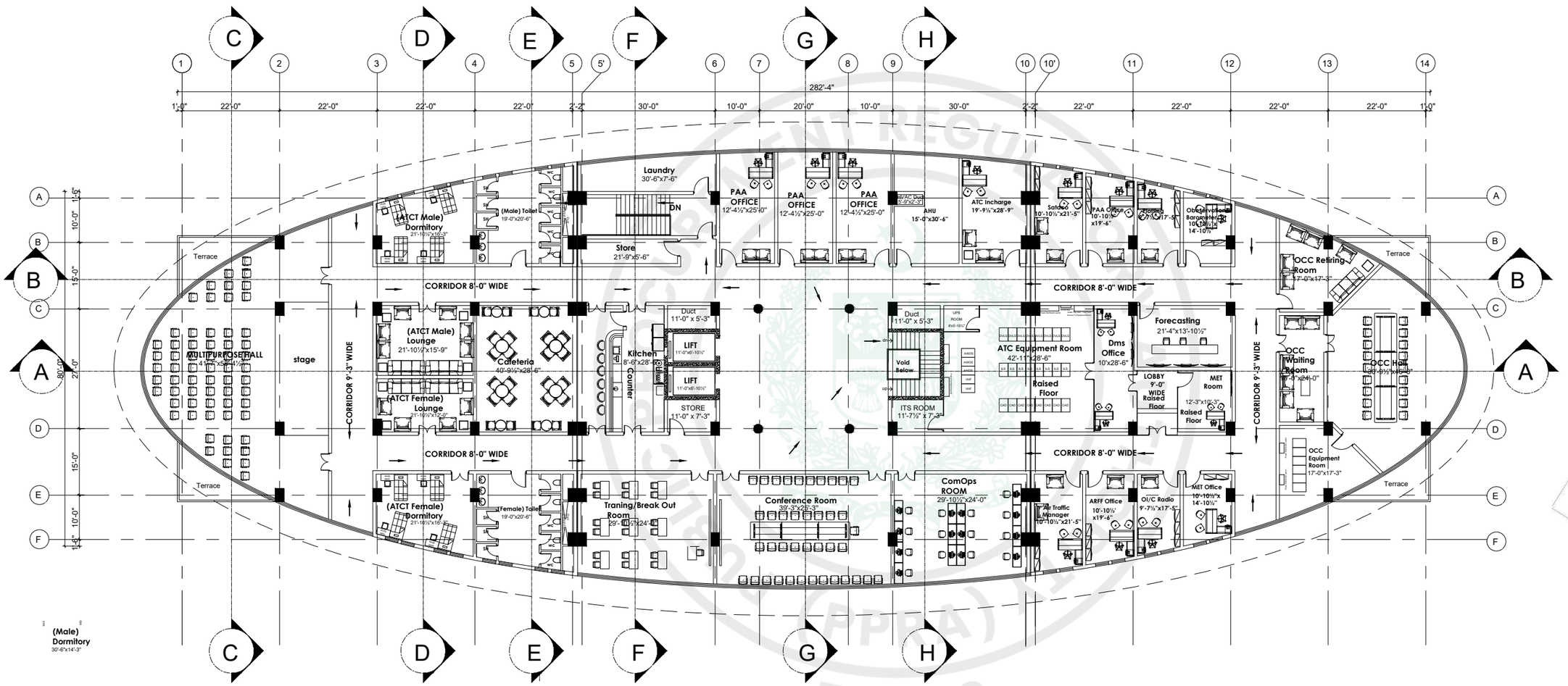

FIRST FLOOR PLAN

Covered Area = 27439 Sft

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

FIRST FLOOR
FIRE EXIT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-51 @A3

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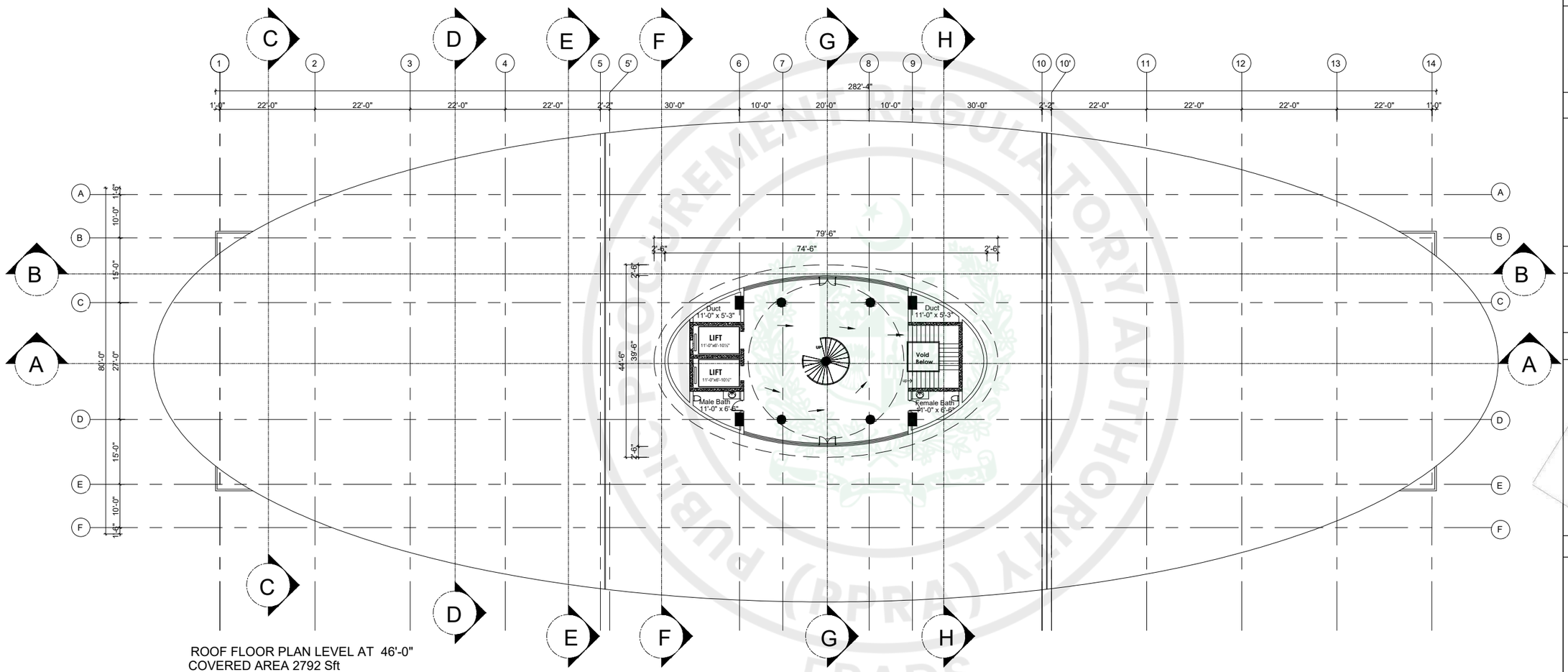

ROOF FLOOR PLAN LEVEL AT 46'-0"
COVERED AREA 2792 Sft

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

ROOF FLOOR LEVEL AT 46'-0"
FIRE EXIT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-52 @A3

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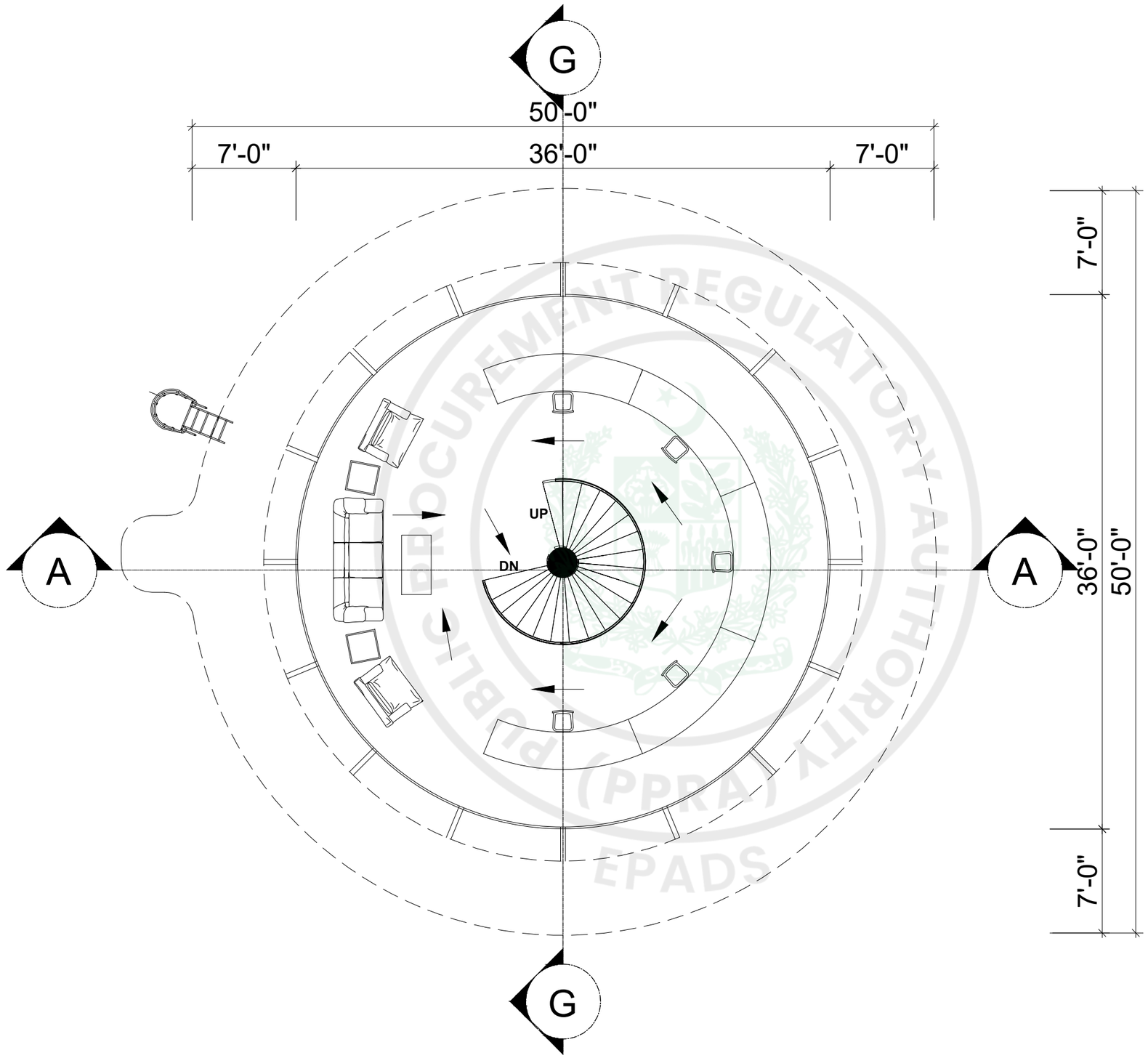

ARFF FLOOR PLAN LEVEL AT 56'-0"

COVERED AREA 1277 Sft

ISSUE FOR TENDER

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

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Project Name

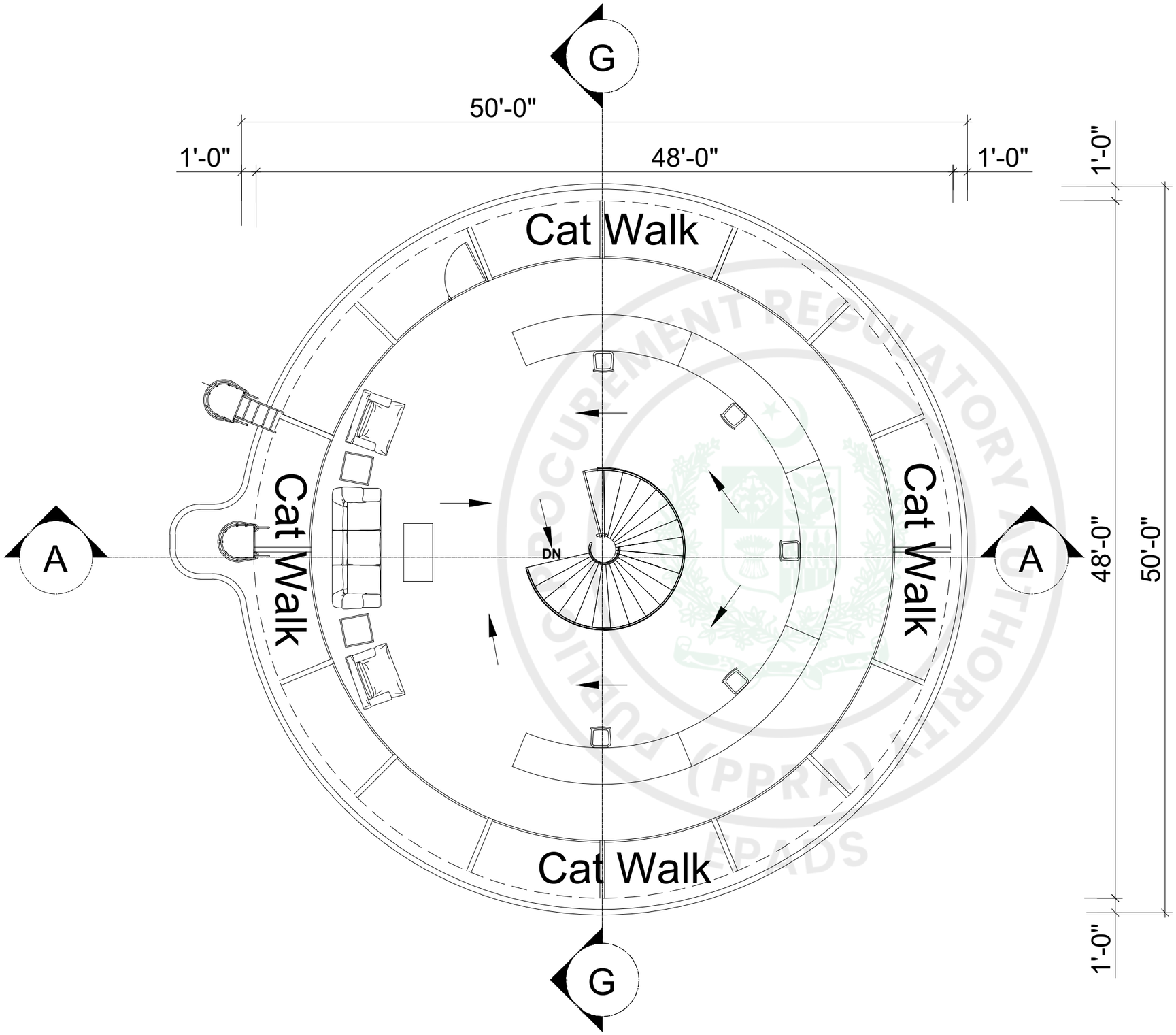
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

ARFF FLOOR LEVEL AT 56'-0"
FIRE EXIT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-53 @A3



ATCT FLOOR PLAN LEVEL AT 68'-0"

COVERED AREA 1809 Sft

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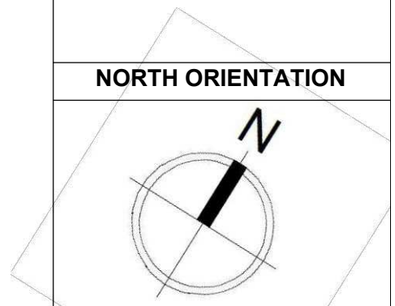

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

ATCT FLOOR LEVEL AT 68'-0"
FIRE EXIT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-54 @A3

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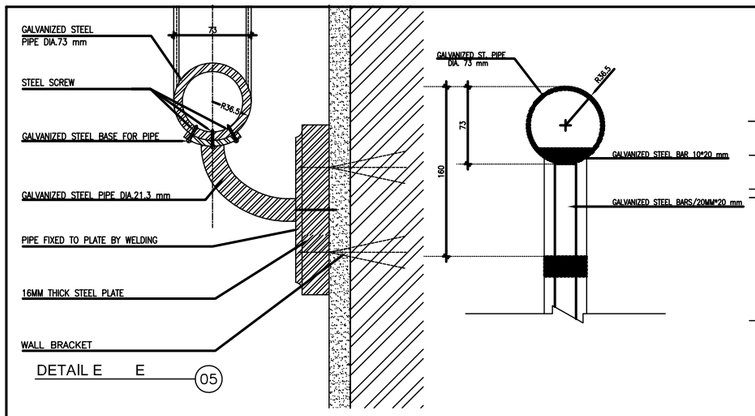
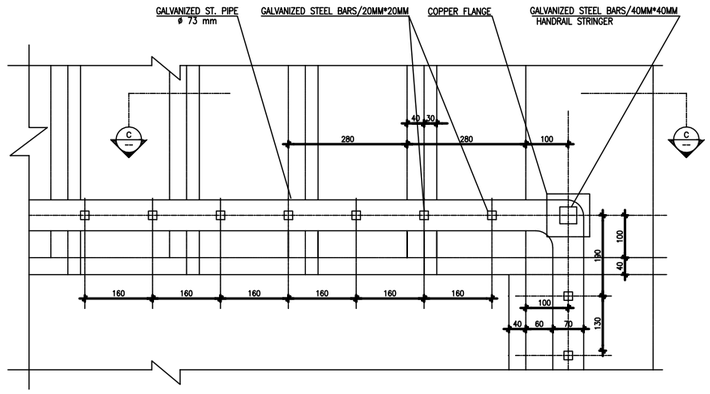
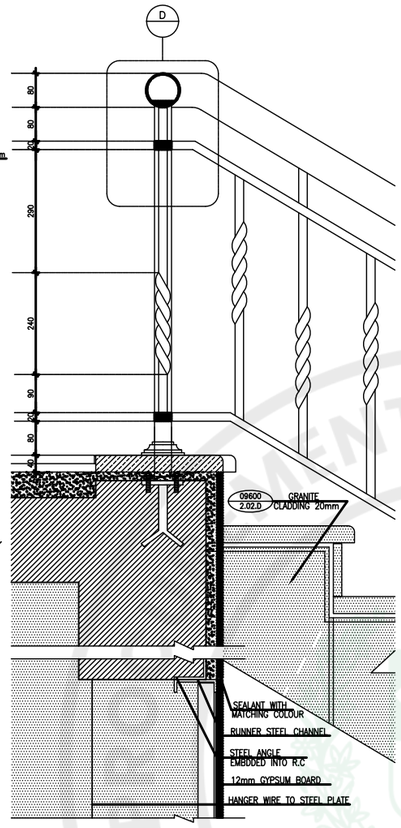


DETAIL E E 05



DET. PLAN 06



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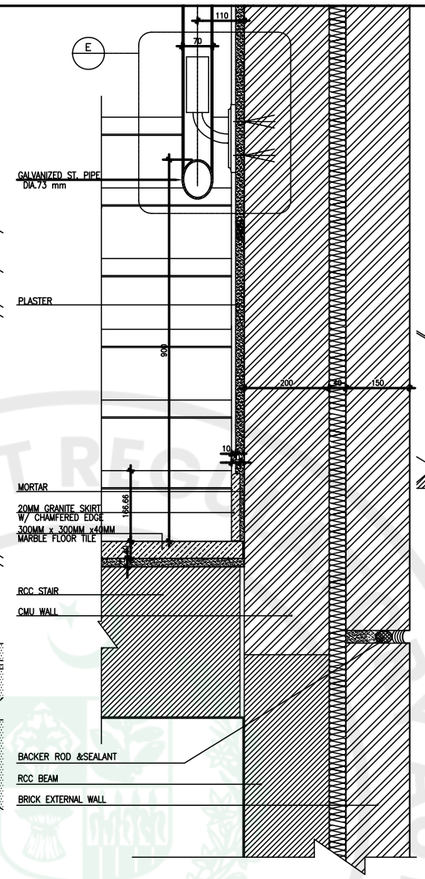

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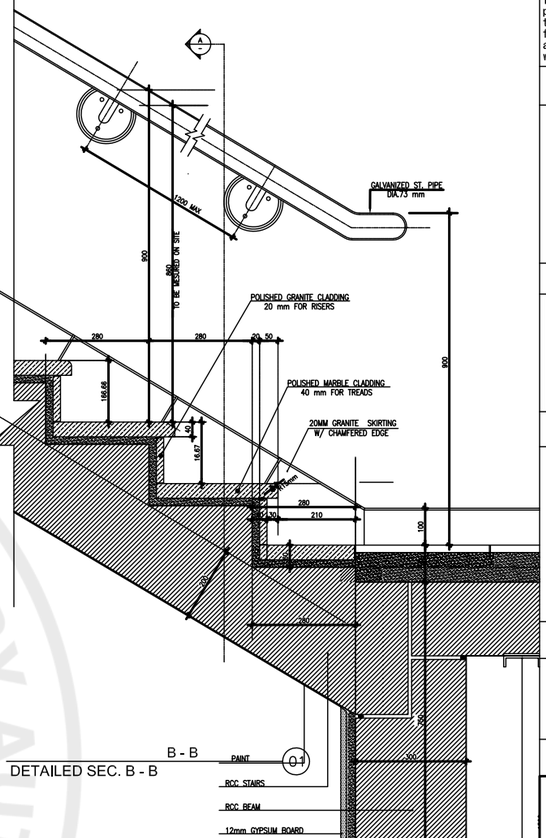
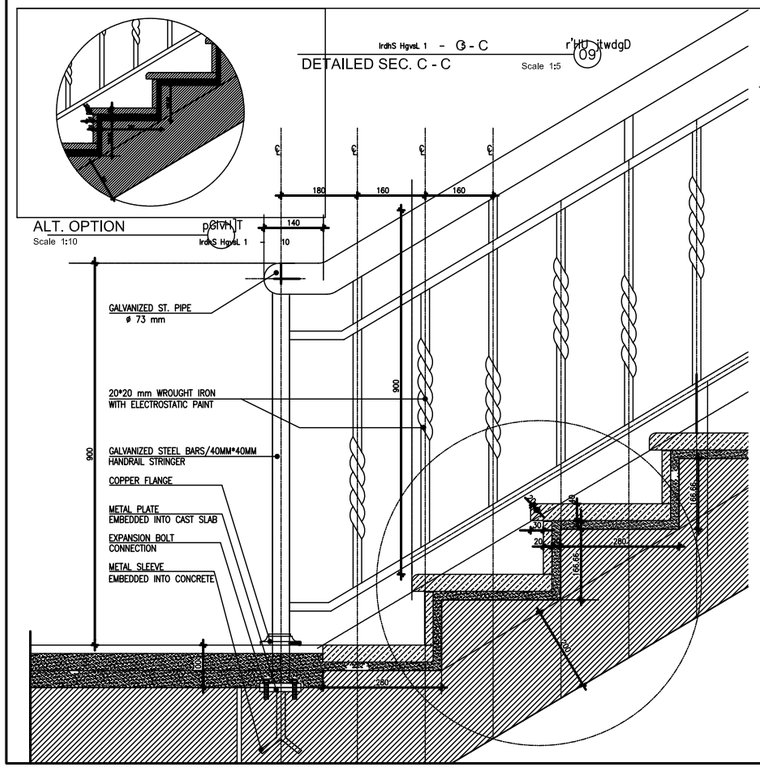
DETAILED SEC. A - A 02

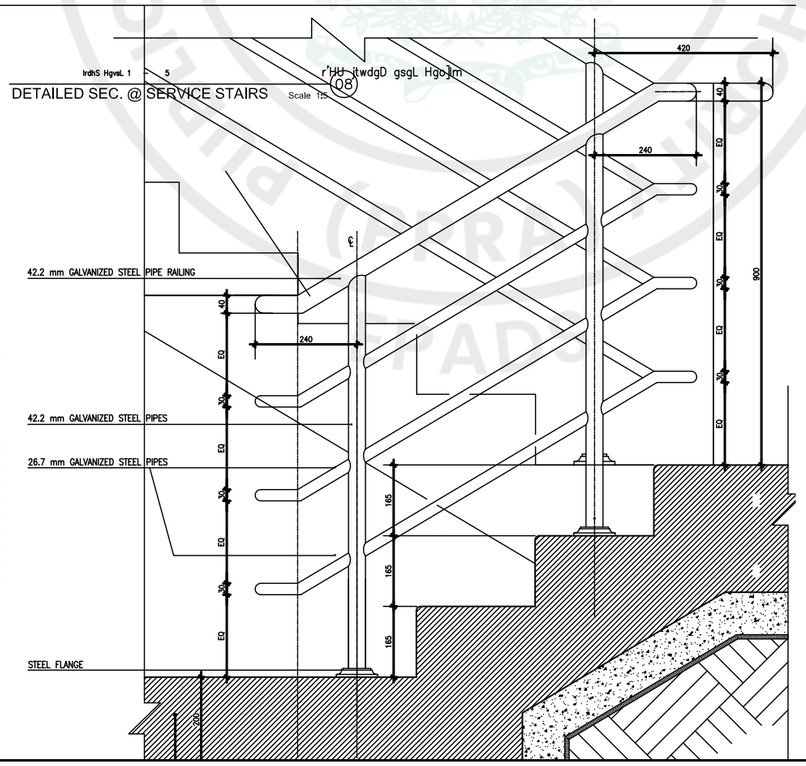


B - B
DETAILED SEC. B - B 01

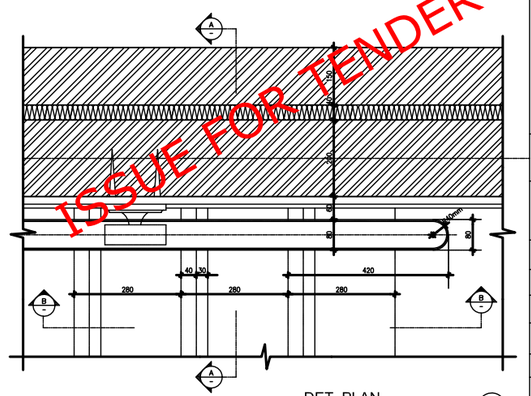
ALT. OPTION
Scale 1:10



DETAILED SEC. C - C
Scale 1:5 09



DETAILED SEC. @ SERVICE STAIRS
Scale 1:5 08



DET. PLAN 07

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MISCELLANEOUS DETAILS-1

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-55 @A3

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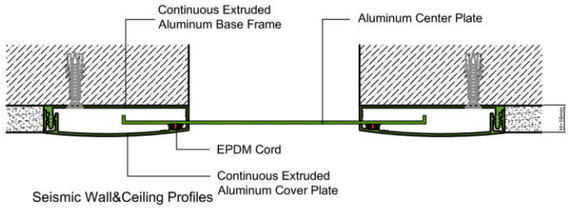
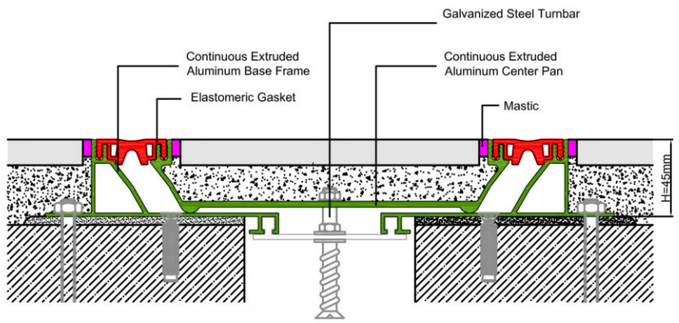
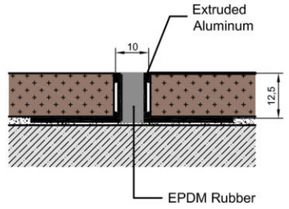


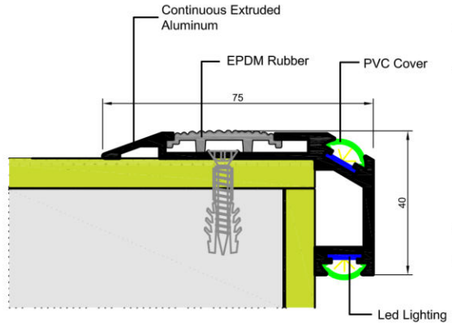
Seismic Wall&Ceiling Profiles



Seismic Floor Joint Profiles



Vulcanized Movement Control Joints



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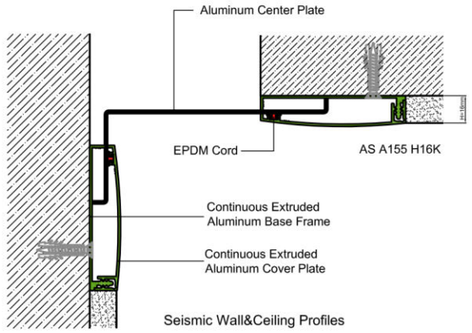
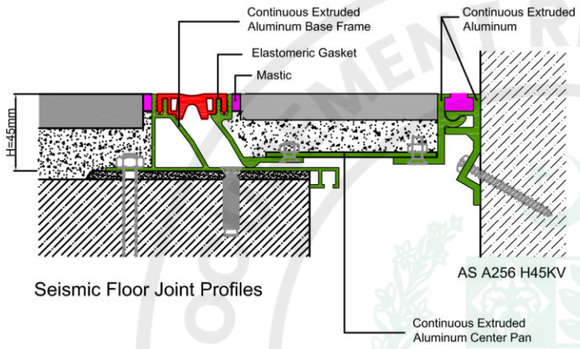
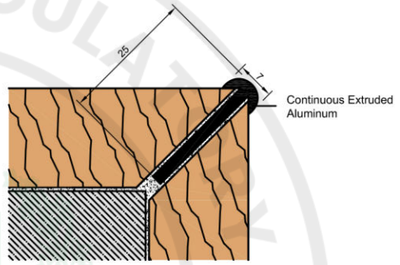


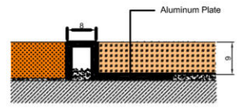
Seismic Wall&Ceiling Profiles

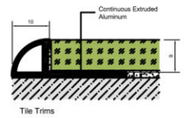


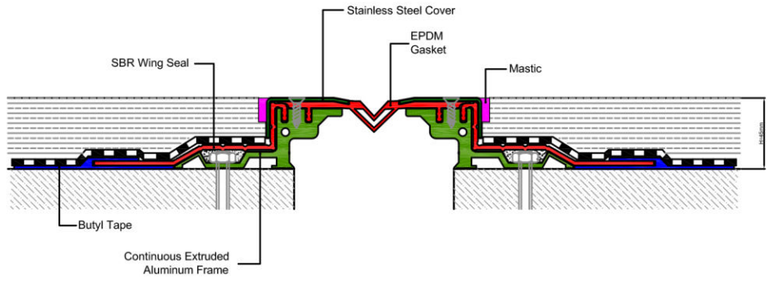
Seismic Floor Joint Profiles

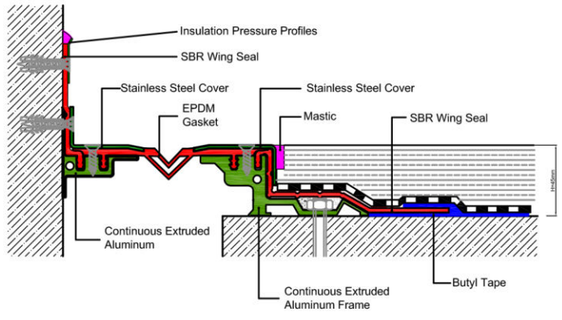


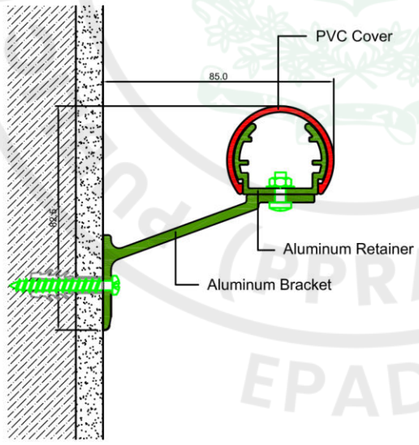
External Corner Profiles

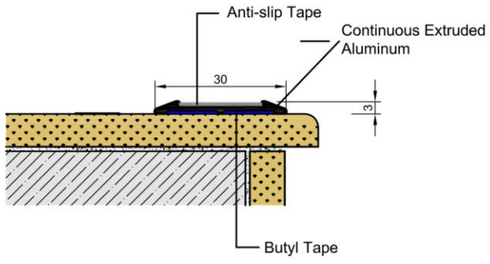


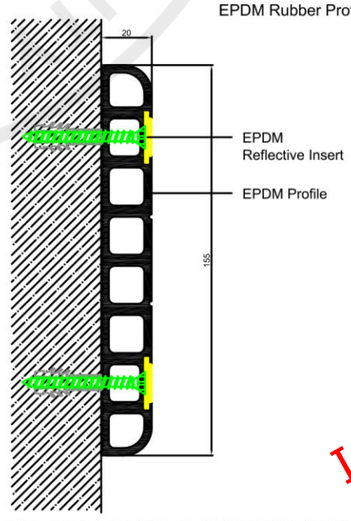




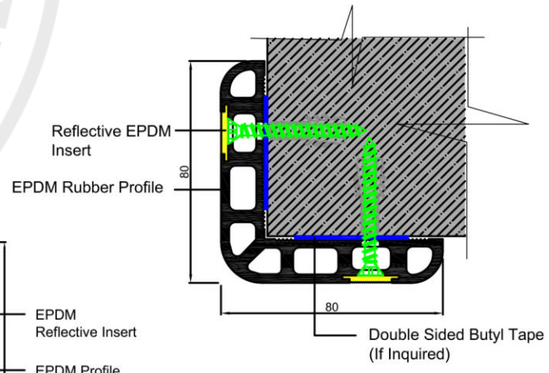








ON CIRCULAR COLUMNS ONLY



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JV MEMBERS

COMRADES CONSULTANTS
leit-werk

STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MISCELLANEOUS DETAILS-4

Date	14 November, 2025
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-56 @A3

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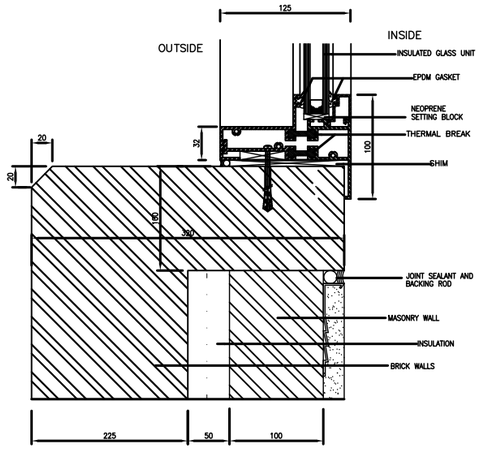
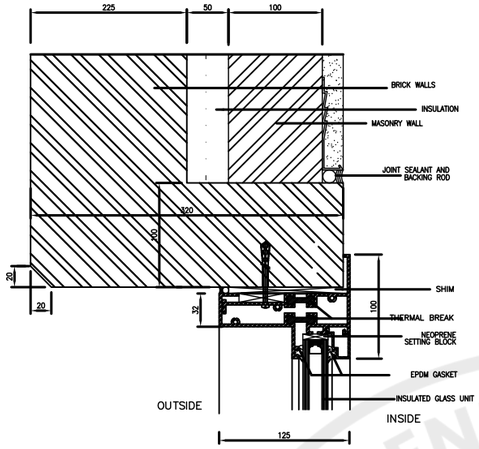
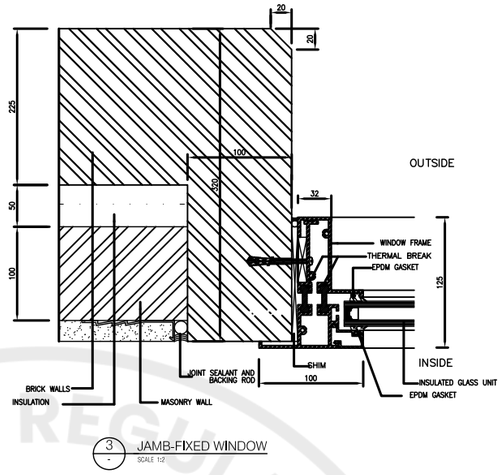


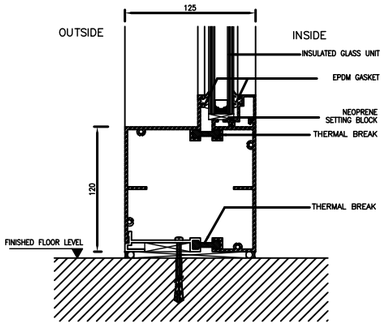
1 - SILL-FIXED WINDOW
SCALE 1:2



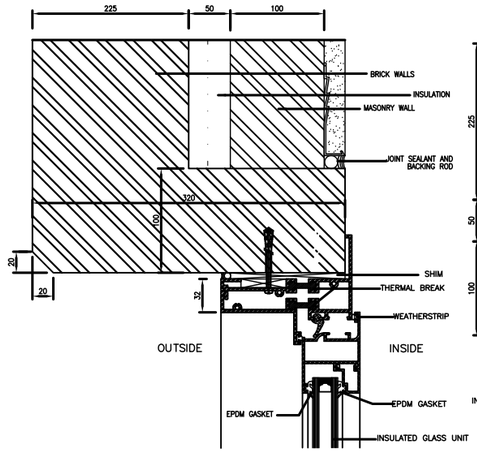
2 - HEAD-FIXED WINDOW
SCALE 1:2



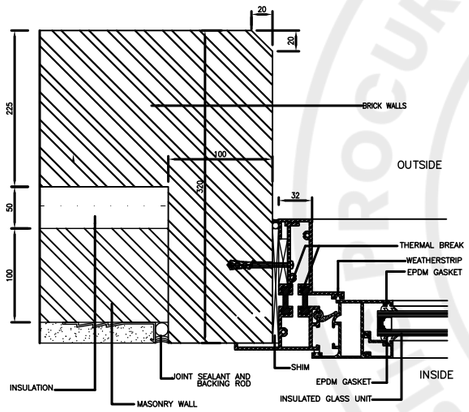
3 - JAMB-FIXED WINDOW
SCALE 1:2



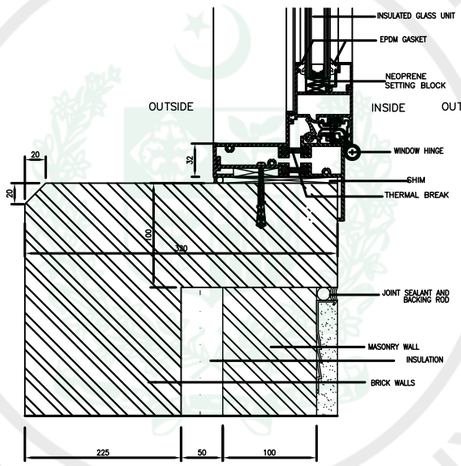
4 - FLOOR SILL-FIXED WINDOW
SCALE 1:2



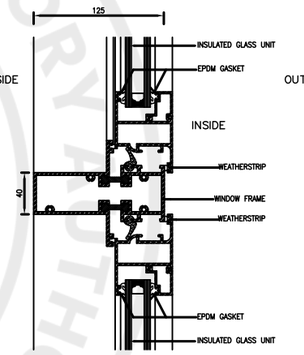
5 - HEAD-OPERABLE WINDOW
SCALE 1:2



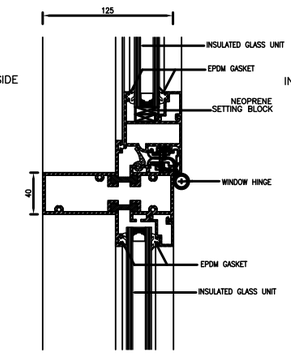
6 - JAMB-OPERABLE WINDOW
SCALE 1:2



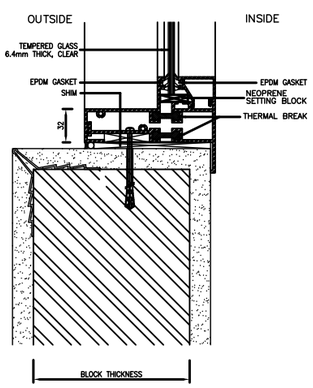
7 - SILL-OPERABLE WINDOW
SCALE 1:2



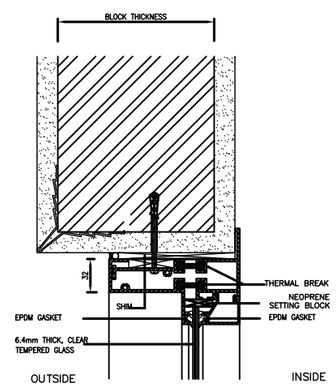
8 - MULLION-OPERABLE WINDOW
SCALE 1:2



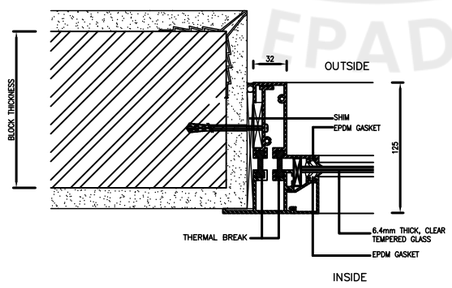
9 - SILL-OPERABLE WITH FIXED WINDOW
SCALE 1:2



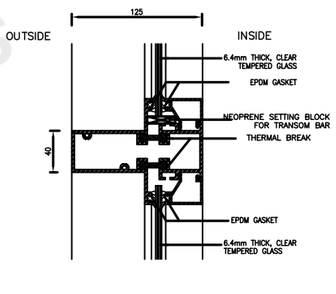
10 - SILL-FIXED WINDOW
SCALE 1:2



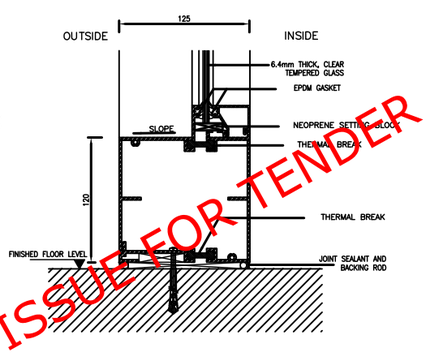
11 - HEAD-FIXED WINDOW
SCALE 1:2



12 - JAMB-FIXED WINDOW
SCALE 1:2



13 - TRANSOM/MULLION-FIXED WINDOW
SCALE 1:2



14 - FLOOR SILL-FIXED WINDOW
SCALE 1:2

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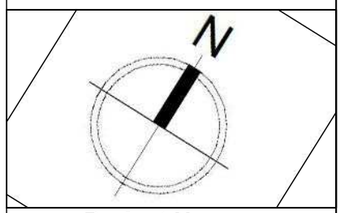
STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

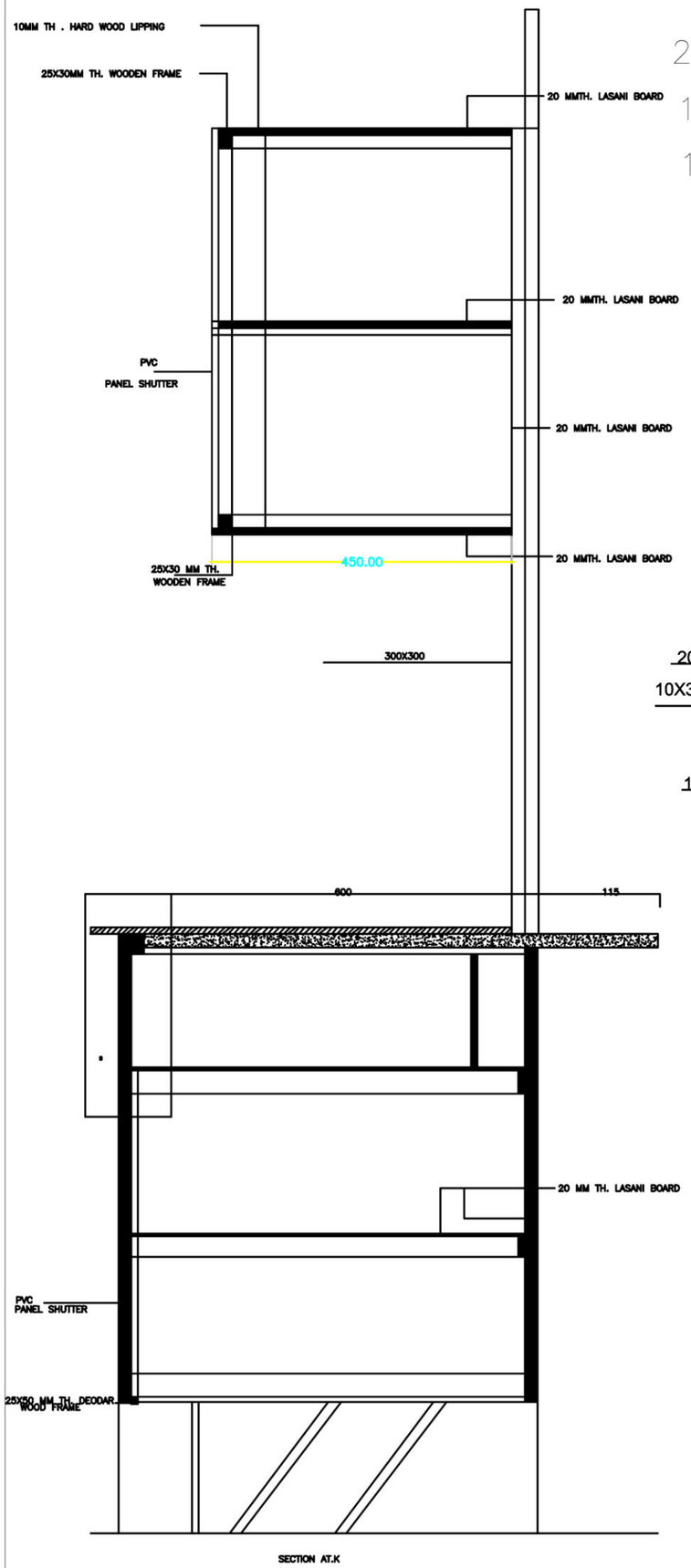
Detailed Architectural Design Drawings

Sheet Name

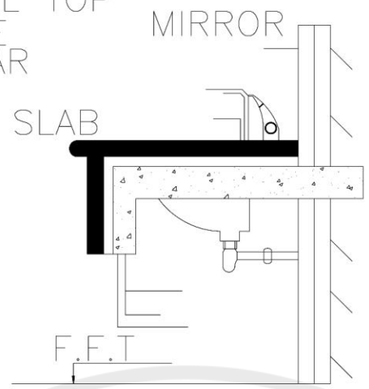
MISCELLANEOUS DETAIL-3

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-57 @A3

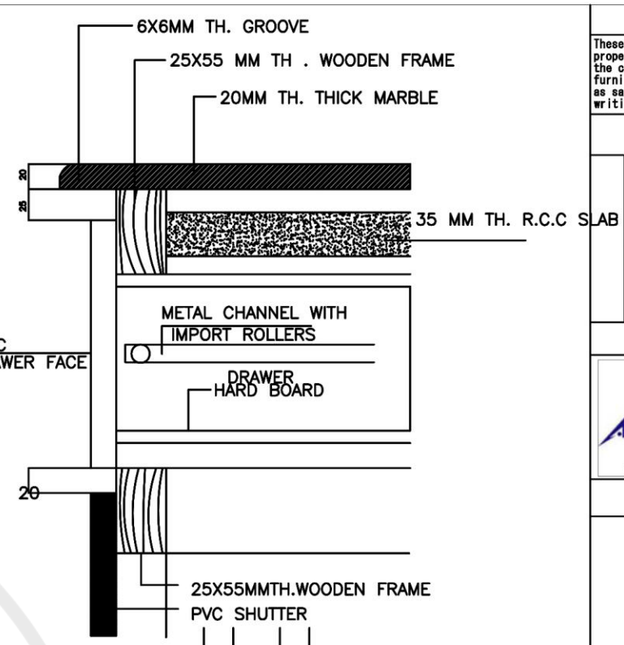
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

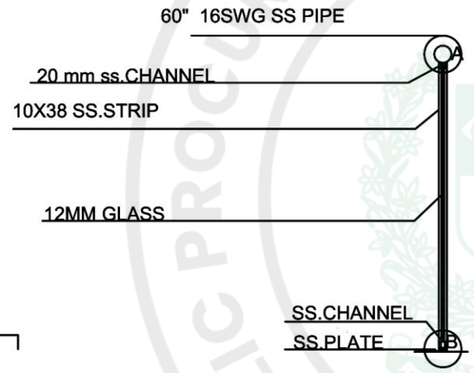


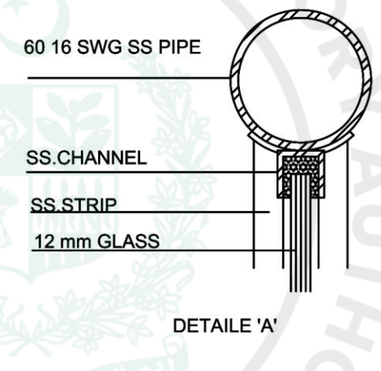
20MM TH. MARBEL TOP
ONE PIECE
12. THICK MORTAR
12. THICK R.C.C SLAB

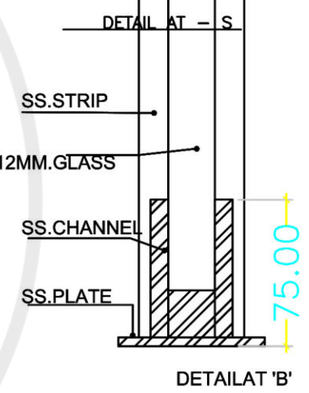


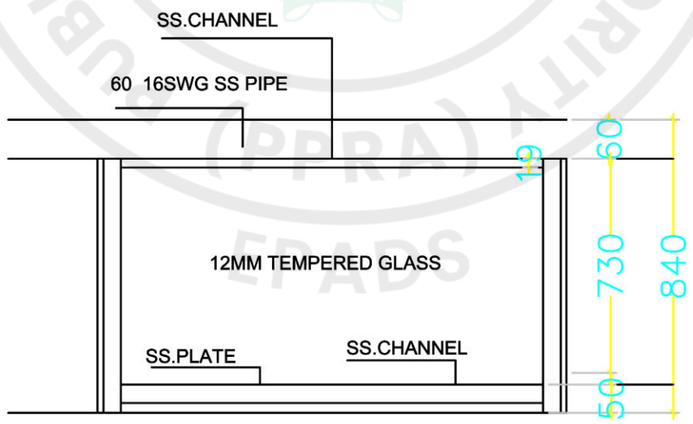
SEC.THU.VANITY











S.S RAILING FOR VOID AREAS

S.S RAILING FOR VOID AREAS

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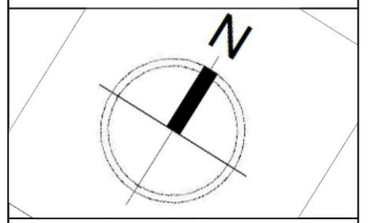
STRUCTURAL CONSULTANT

NORTH ORIENTATION



Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

MISCELLANEOUS DETAIL-4

Date	14 November, 2025
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-58 @A3

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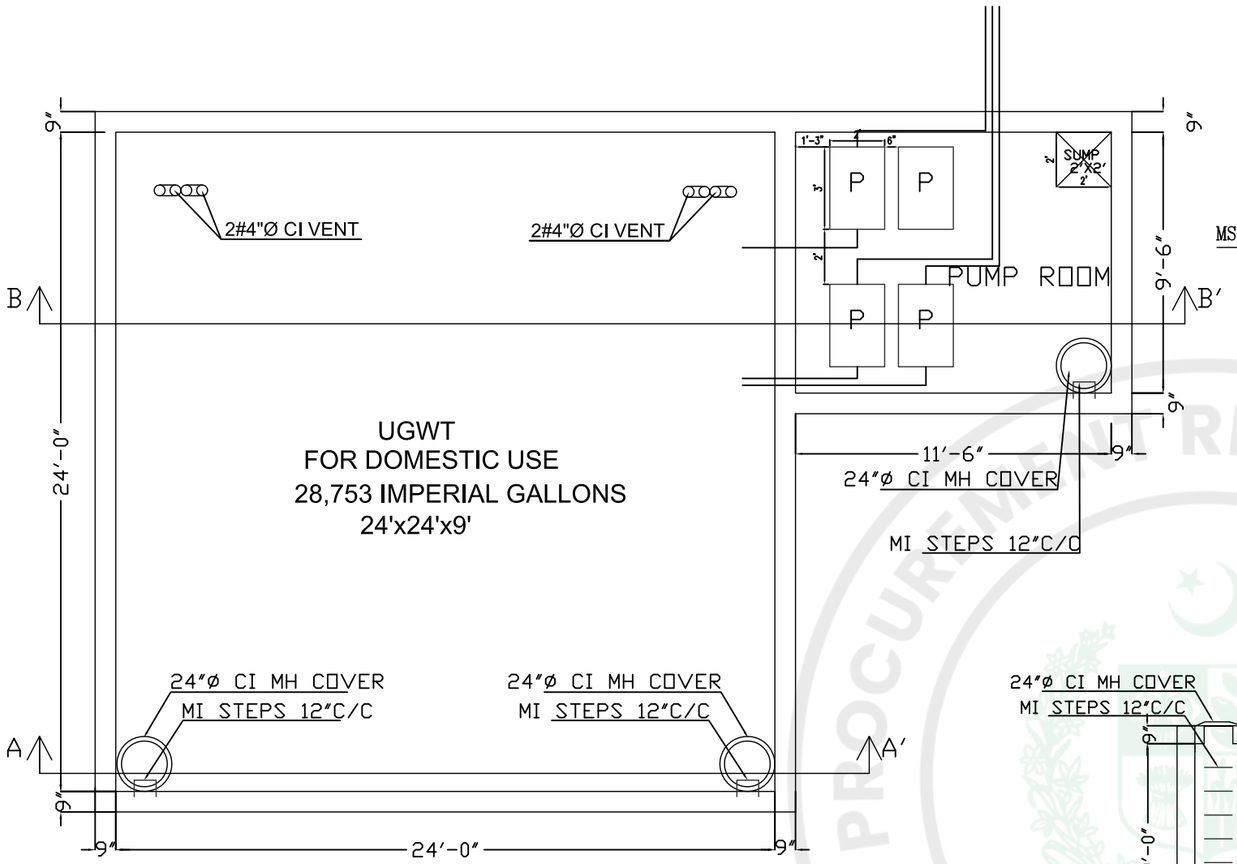
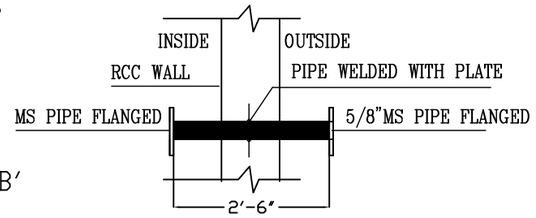
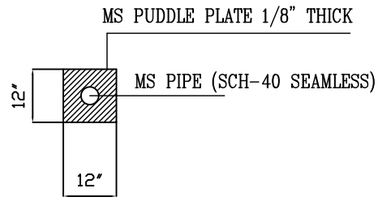


PLAN OF UGWT

(Imperial Gallons)=Volume(cubic feet) x 6.24
(CAPACITY=28,753(Approx.) IMPERIAL GALLONS)

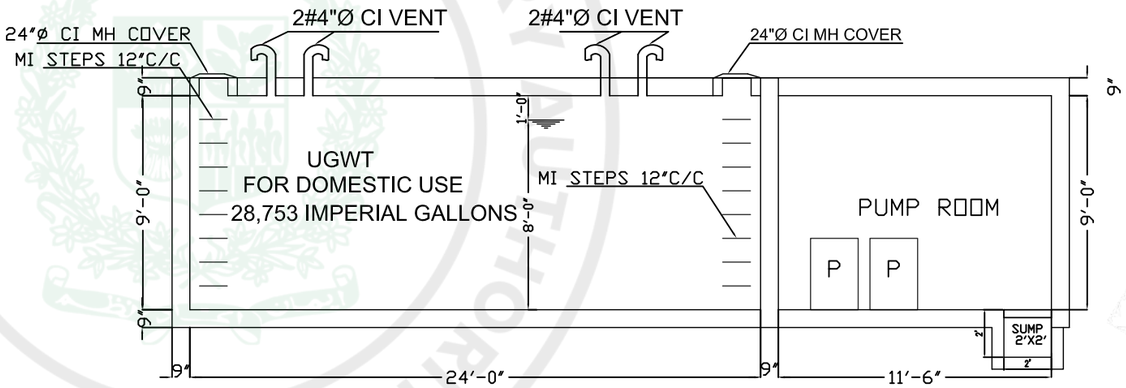


PLAN OF PUDDLE PLATE

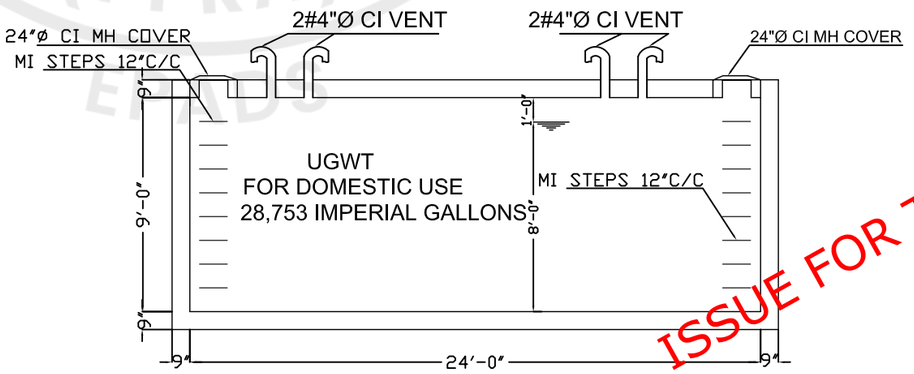


SECTION

NOTE: PUDDLE PLATES ARE TO BE PLACED
WHERE PIPE CROSSES THE RCC WALL OR ROOF SLAB



SECTION B-B'



SECTION A-A'

ISSUE FOR TENDER

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

U.G.W.TANK DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-59 @A3

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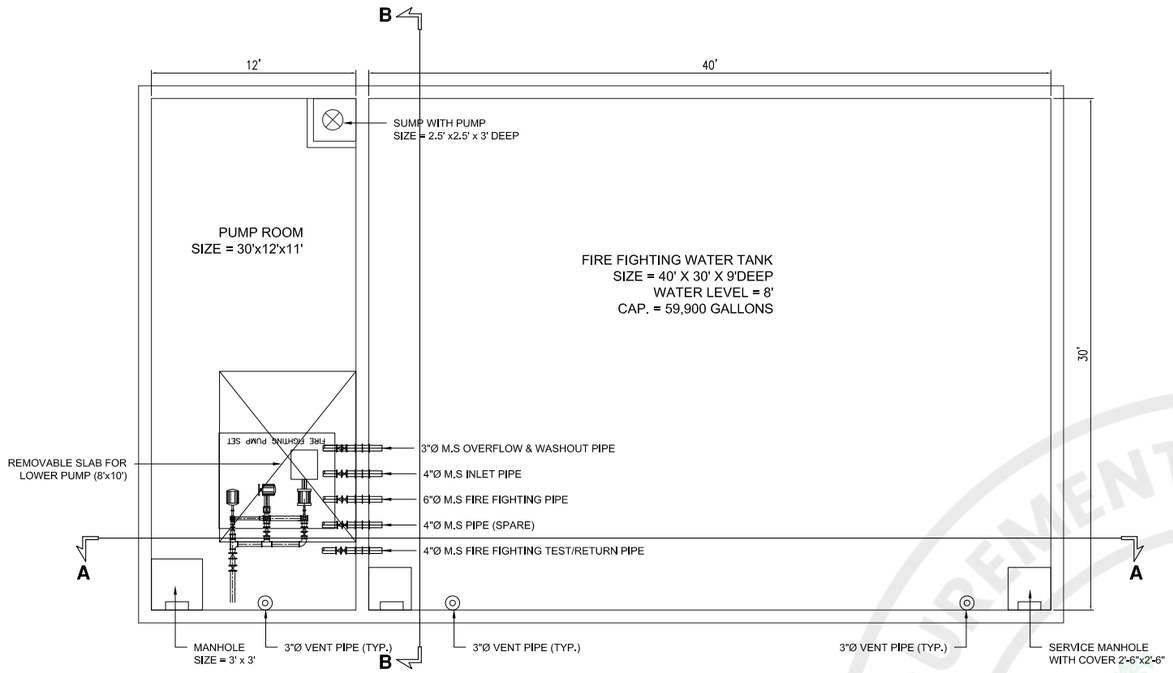
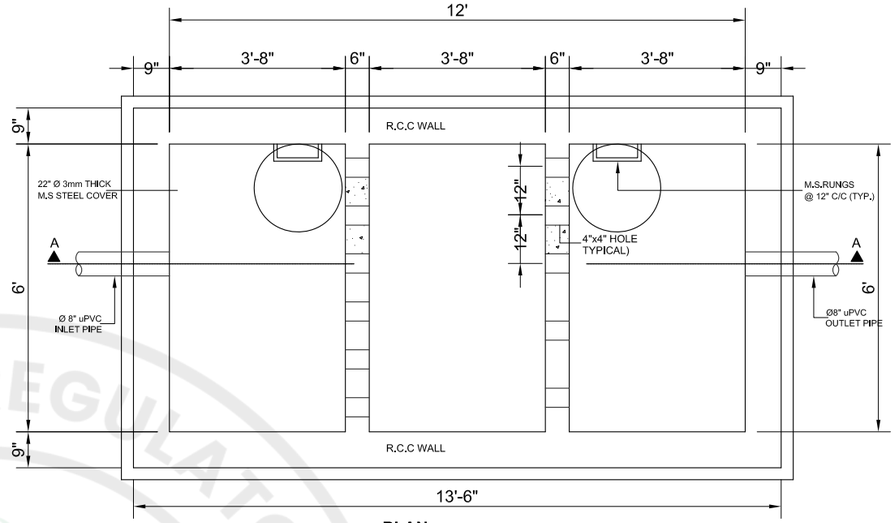
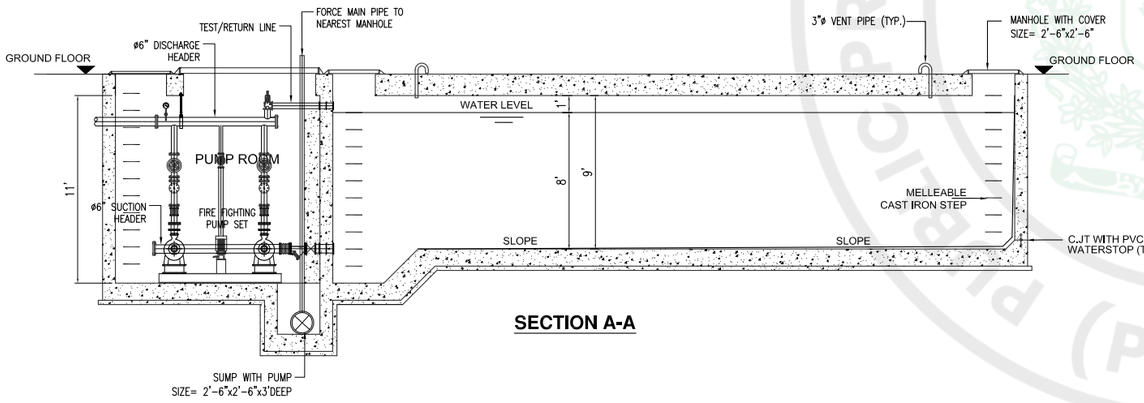


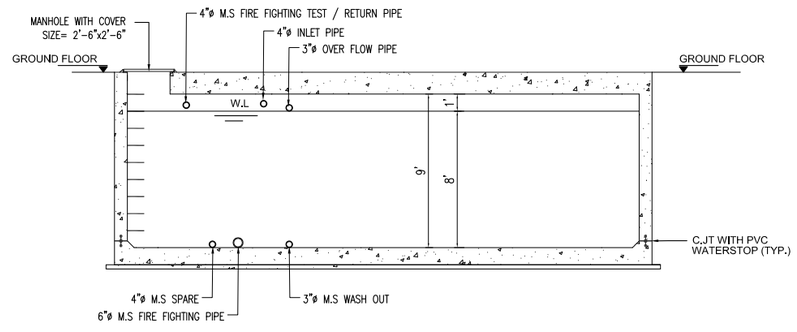
UNDER GROUND WATER TANK WITH PUMP ROOM



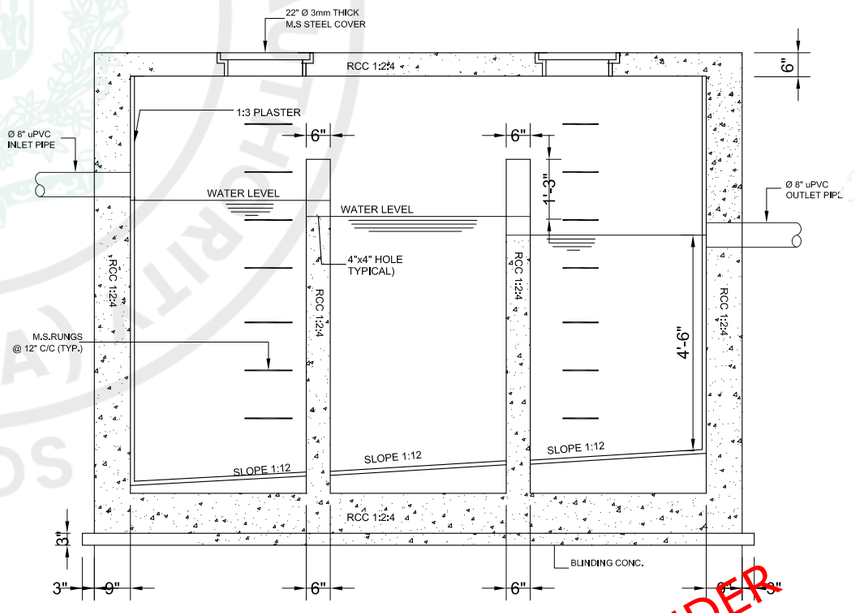
PLAN
SEPTIC TANK



SECTION A-A



SECTION B-B



SECTION A-A

ISSUE FOR TENDER

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

FIRE FIGHTING WATER TANK & SEPTIC TANK DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-59a @A3

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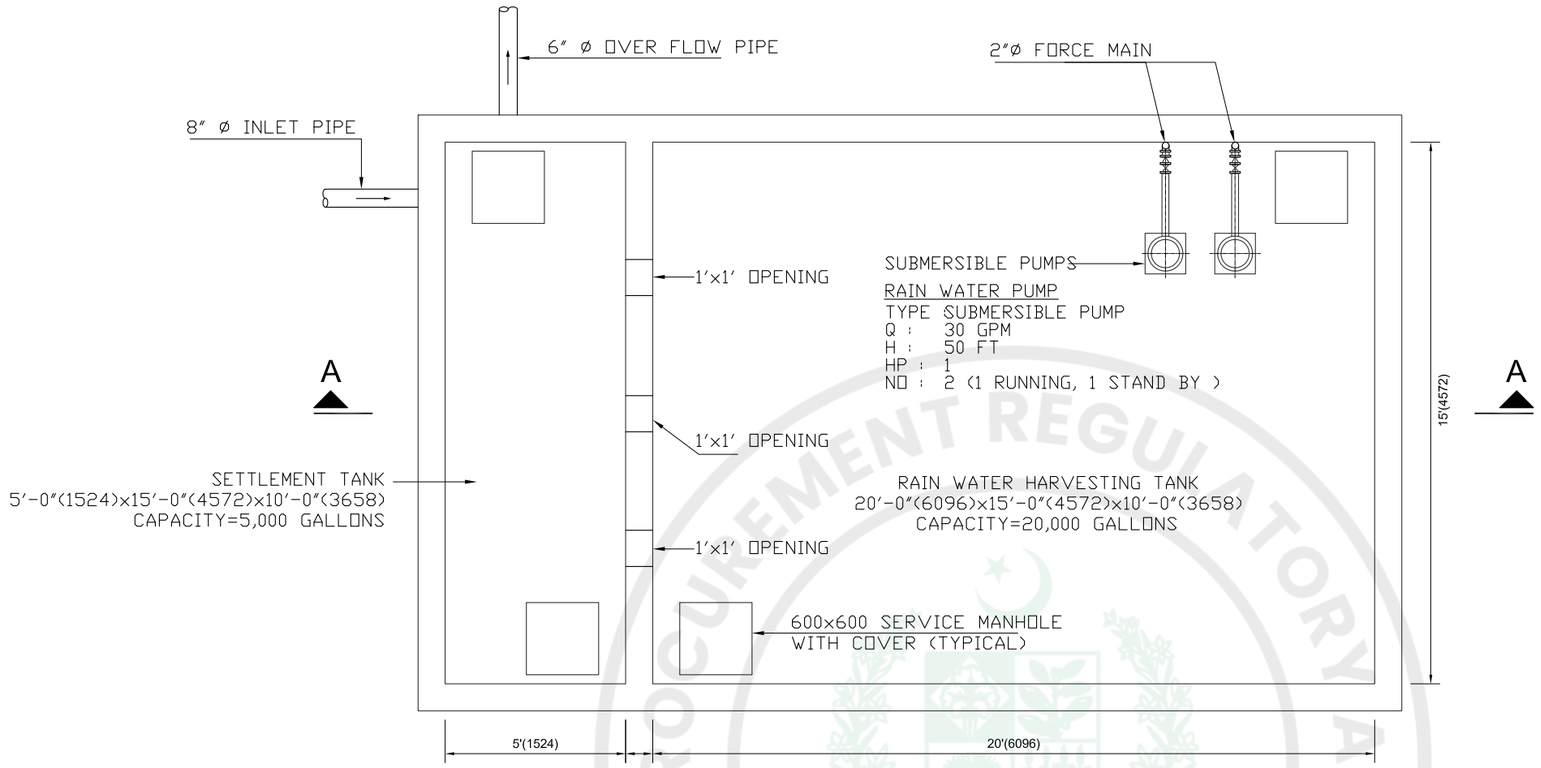
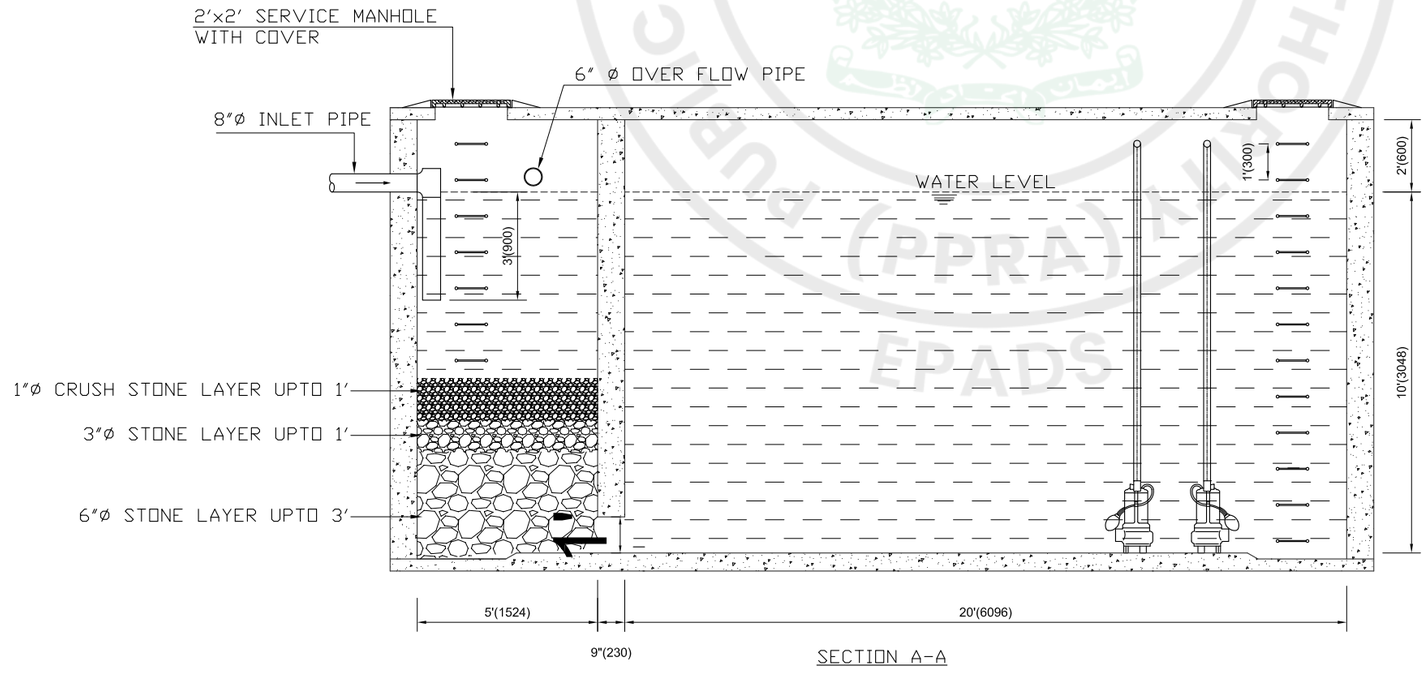


PLAN



SECTION A-A

RAIN WATER HARVESTING TANK

ISSUE FOR TENDER

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

RAIN WATER HARVESTING TANK DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-59b @A3

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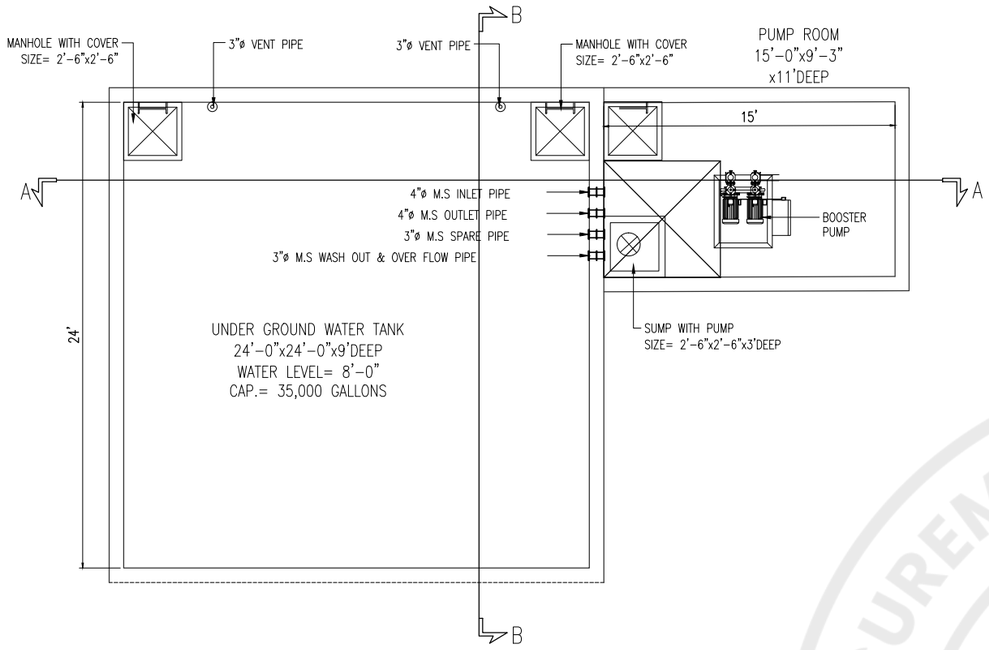
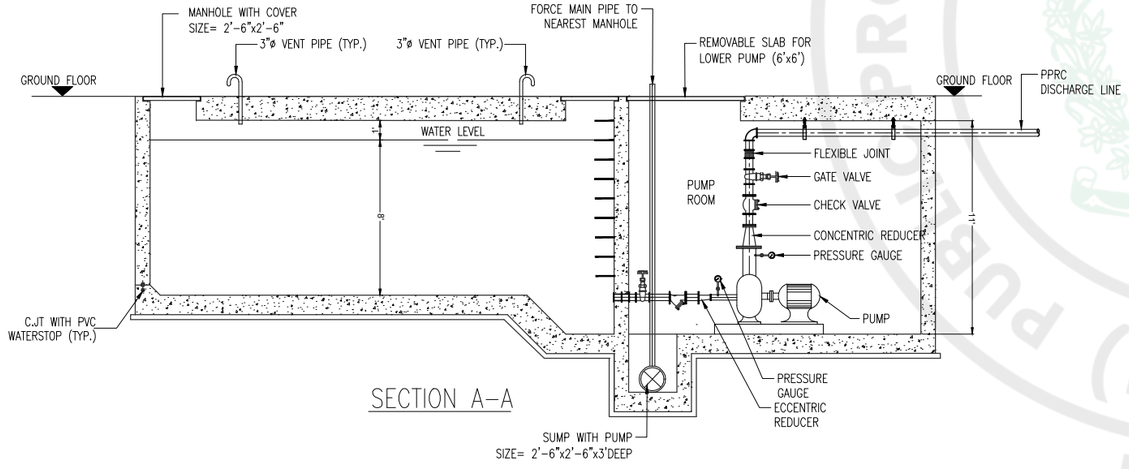
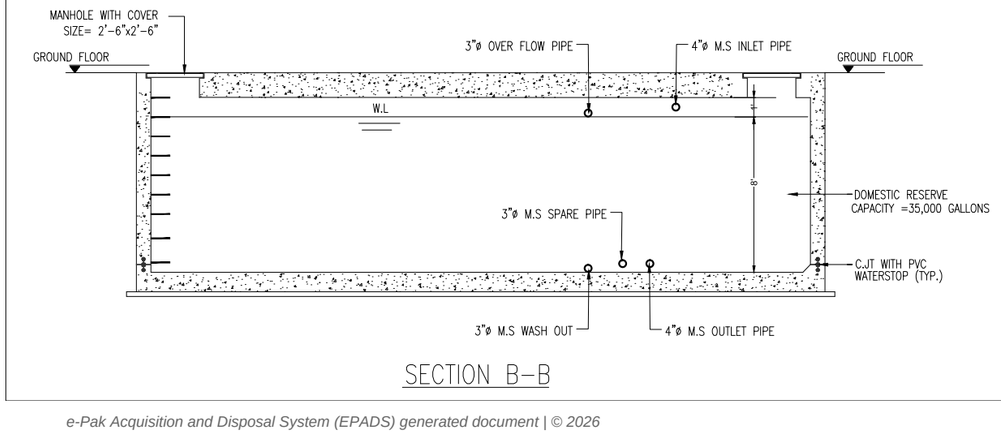


UNDER GROUND WATER TANK

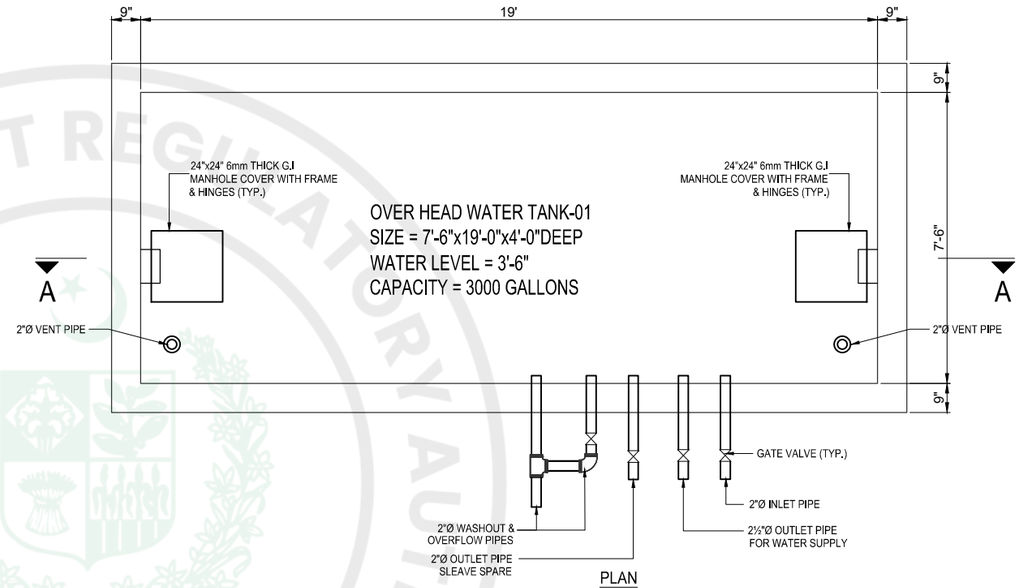
PLAN



SECTION A–A



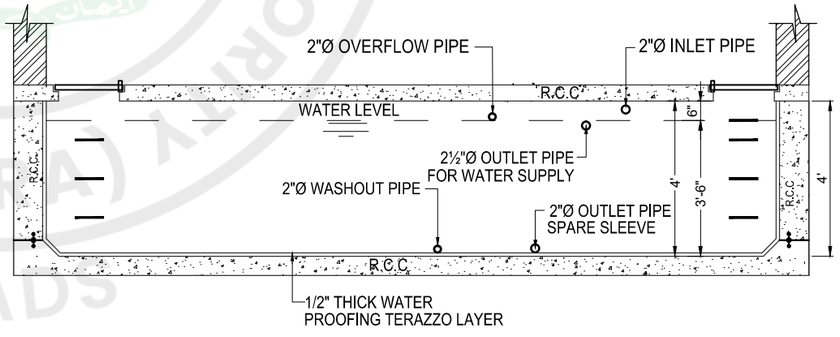
SECTION B–B



PLAN

OVERHEAD WATER TANK

(CAPACITY= 3500 GALLONS)



SECTION A-A

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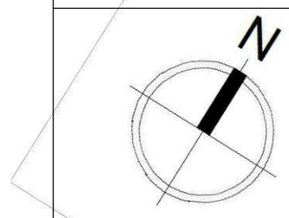

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

U.G.W.TANK & O.H.W.TANK DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-59c @A3

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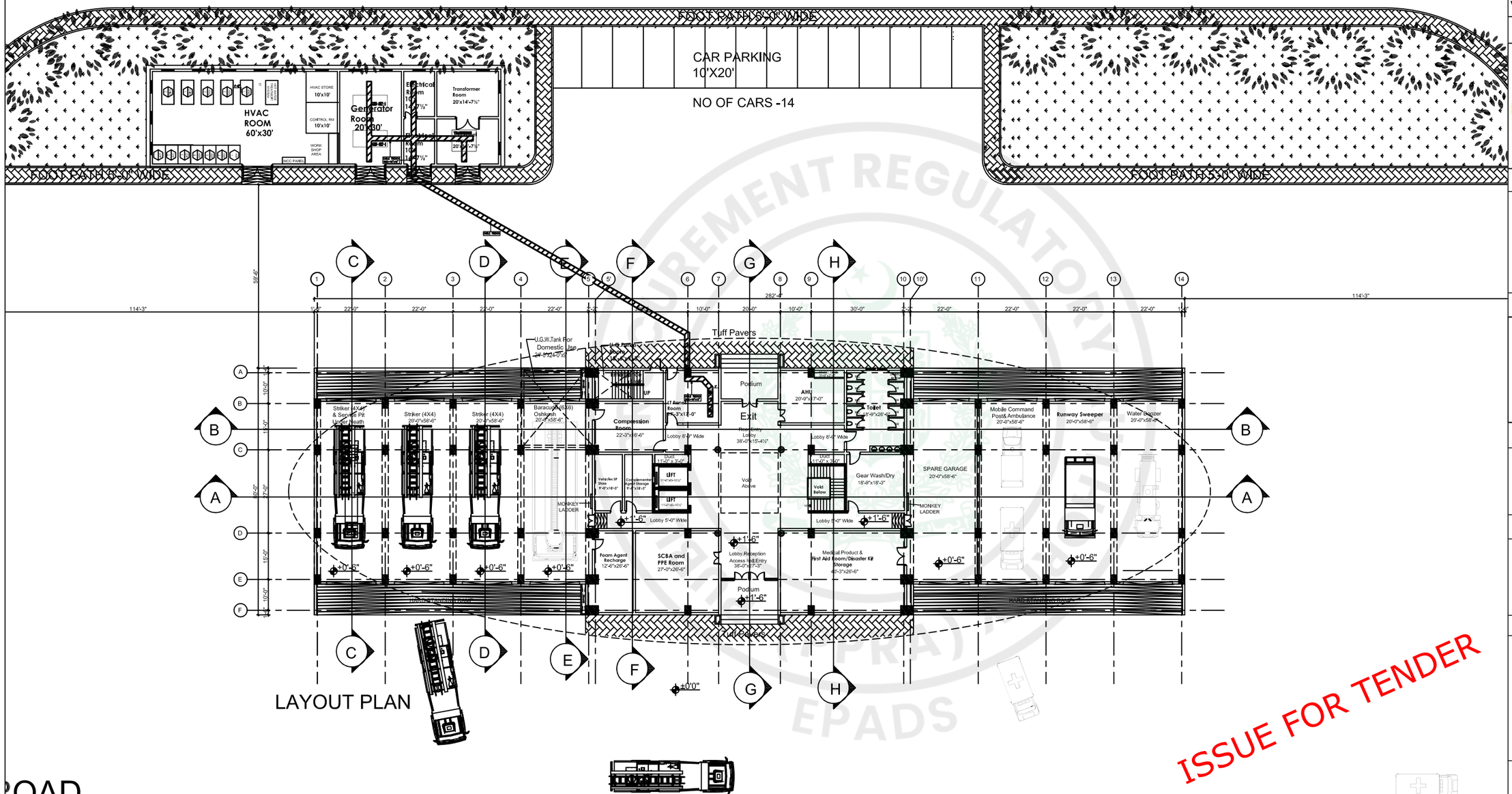

LAYOUT PLAN

ISSUE FOR TENDER

ROAD

L BUILDING

WIDE

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STRUCTURAL CONSULTANT

MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

Tower (ATCT), Fire Station Electrical Layout Plan

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-60 @A3

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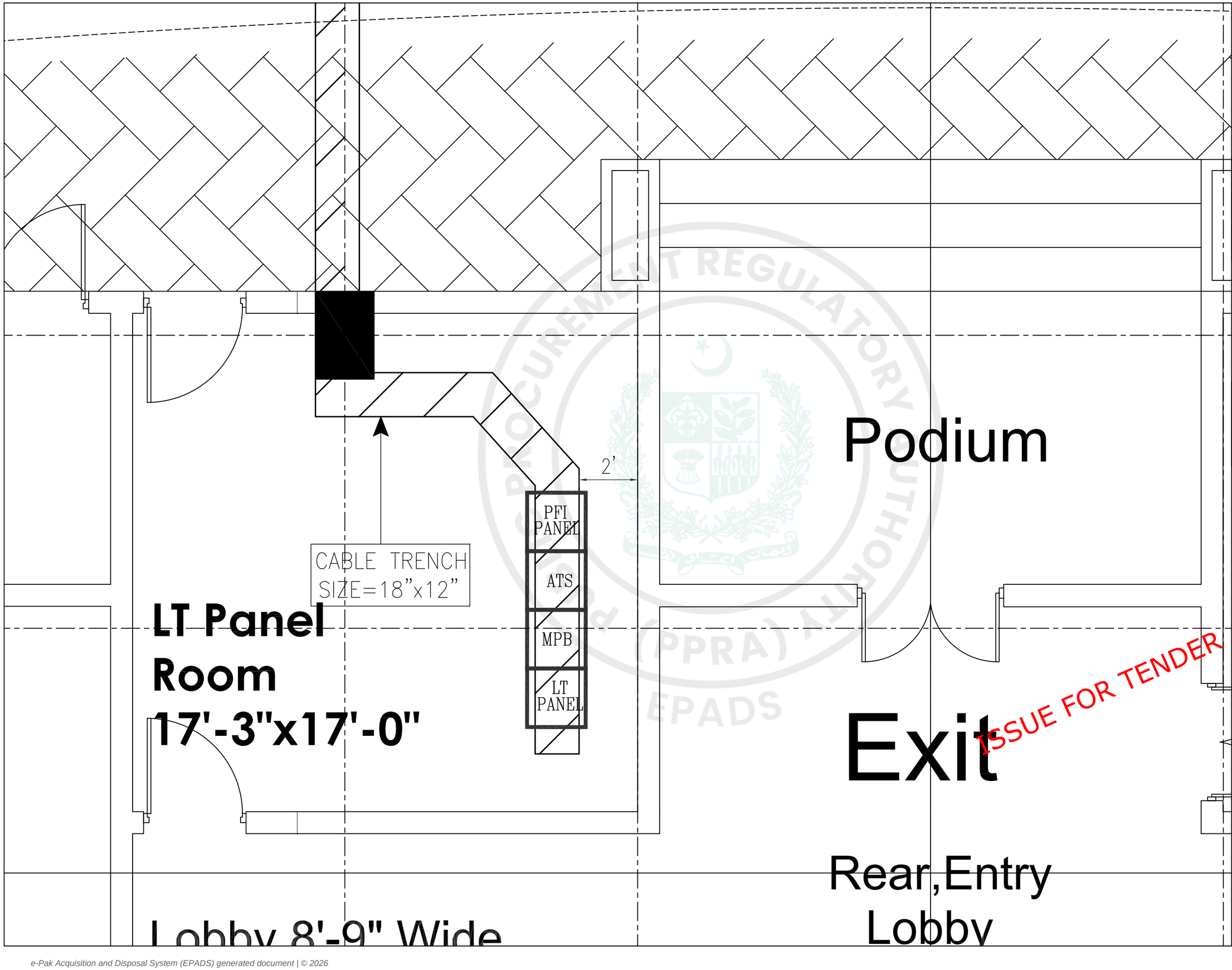

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

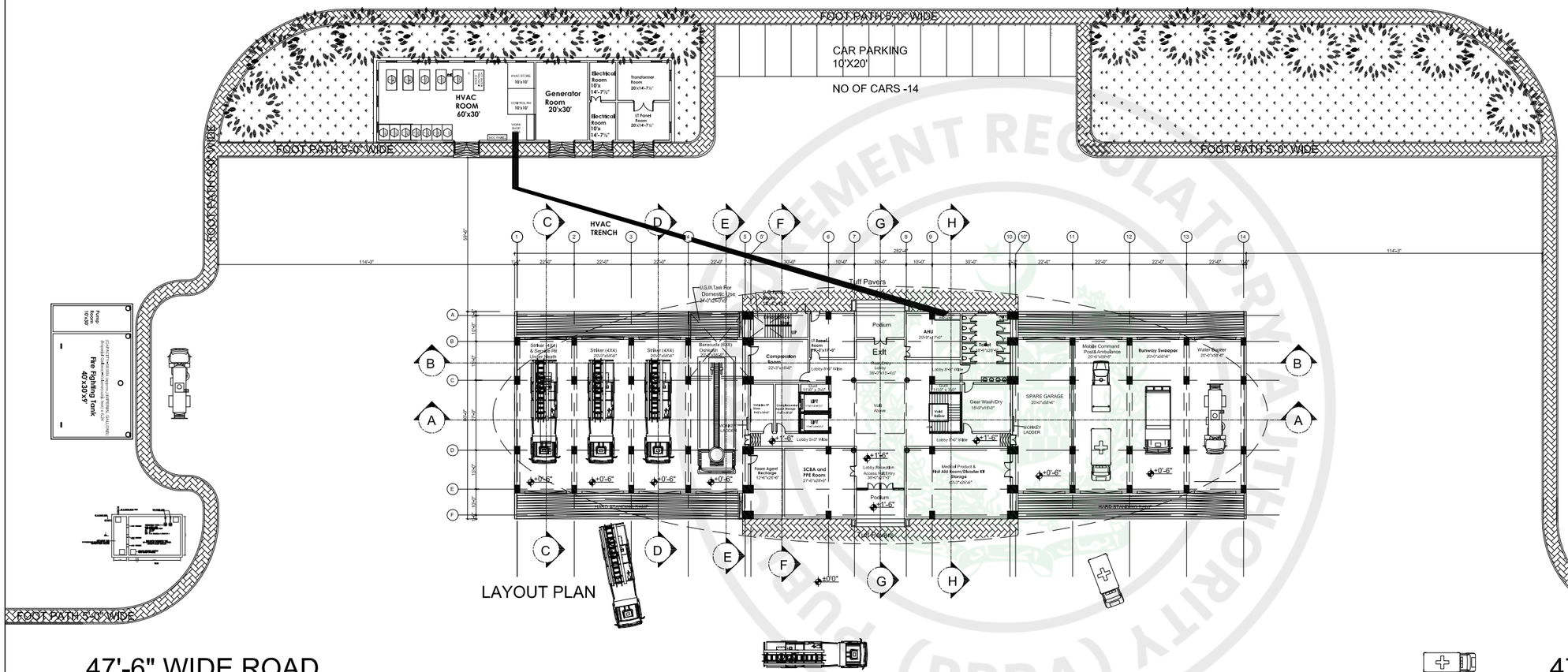
ISSUE FOR TENDER

Detailed Architectural Design Drawings

Sheet Name

Tower (ATCT), Fire Station
LT Panel Room

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-61 @A3



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NORTH ORIENTATION

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

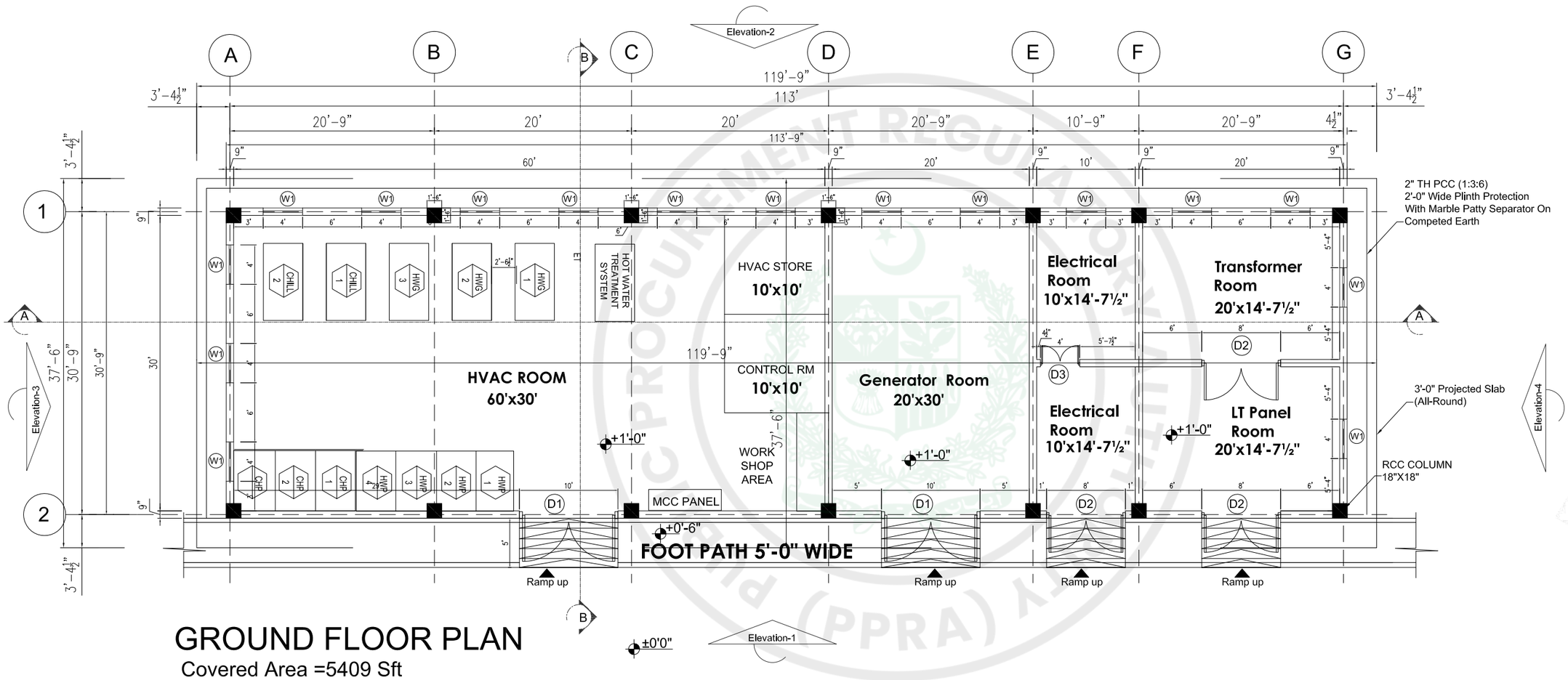
Detailed Architectural Design Drawings

Sheet Name

HVAC LAYOUT PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-62 @A3

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



GROUND FLOOR PLAN

Covered Area =5409 Sft

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NORTH ORIENTATION

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

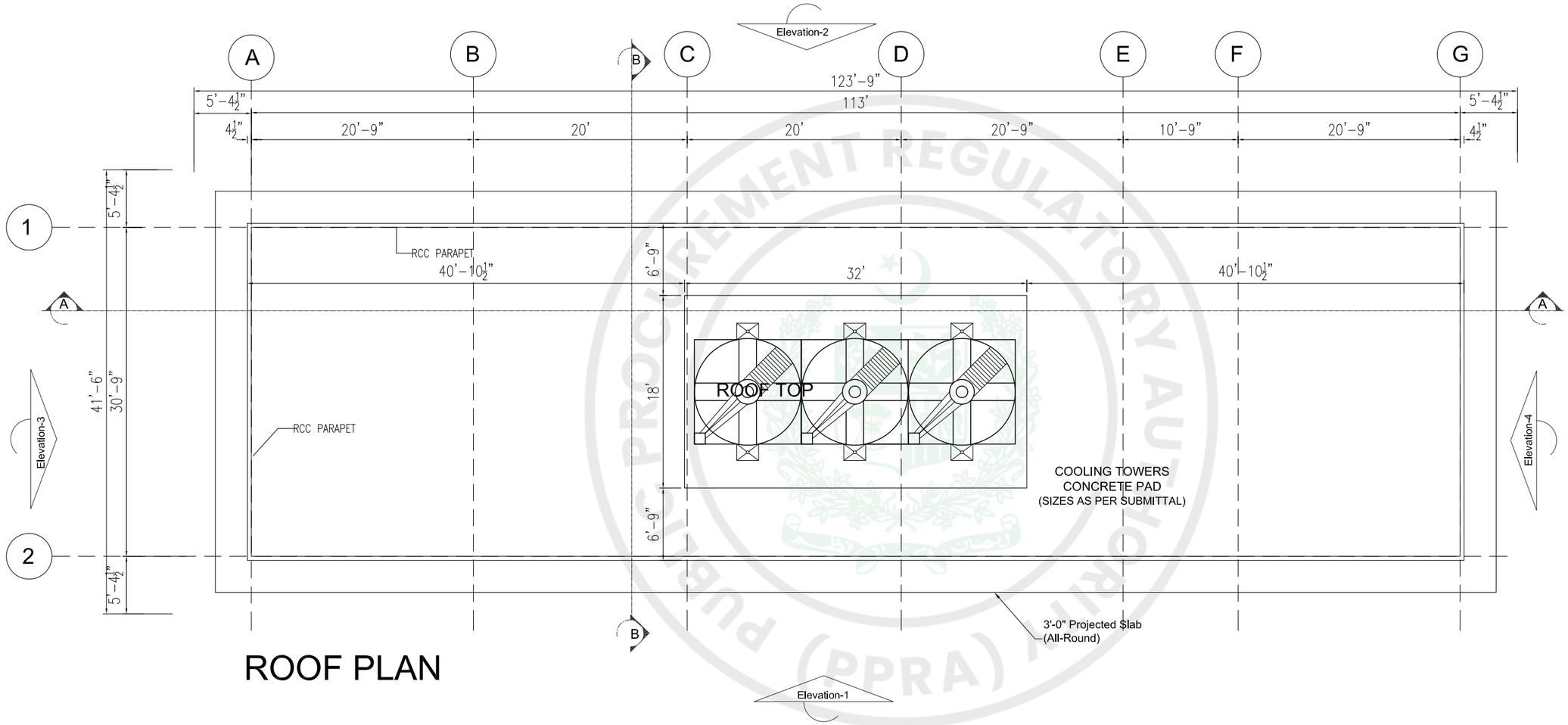
Detailed Architectural Design Drawings

Sheet Name

UTILITY BLOCK
GROUND FLOOR PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-63 @A3

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ROOF PLAN

ISSUE FOR TENDER

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

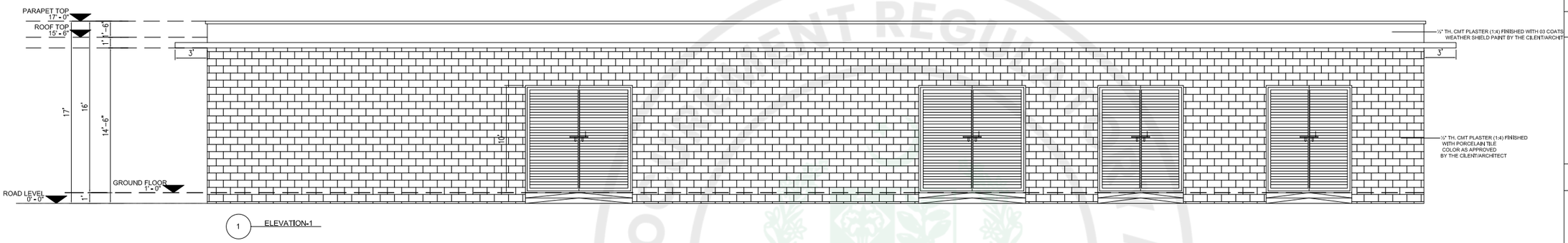
Detailed Architectural Design Drawings

Sheet Name

UTILITY BLOCK
ROOF PLAN

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-64 @A3

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



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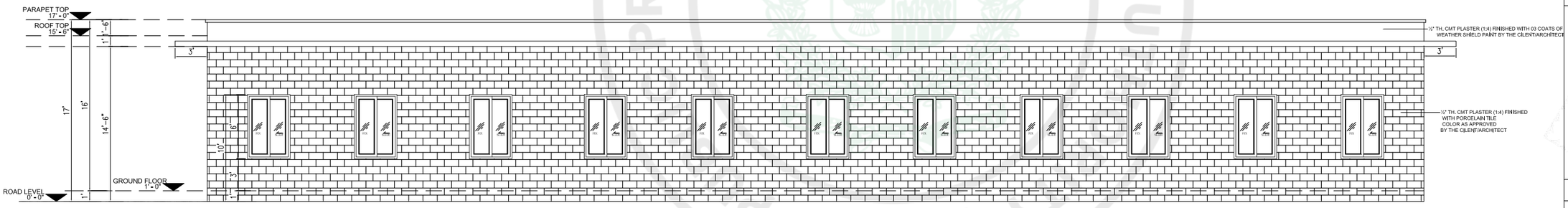

2 ELEVATION-2

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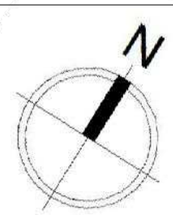

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

UTILITY BLOCK
ELEVATION-1 & 2

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-65 @A3

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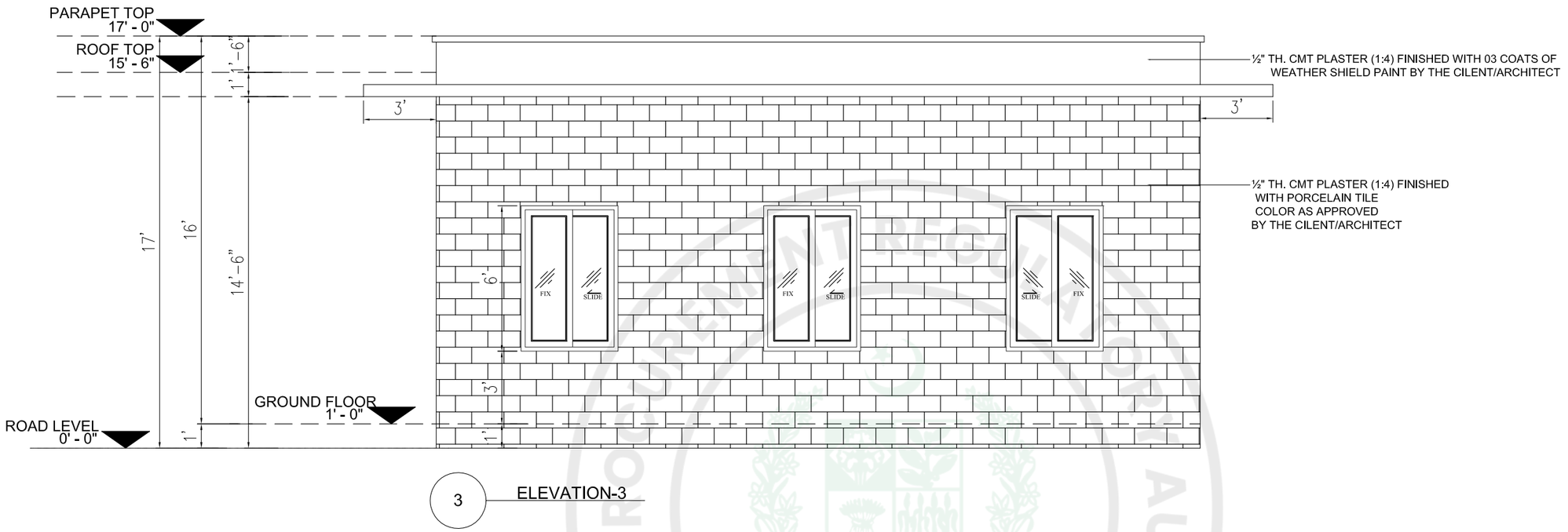
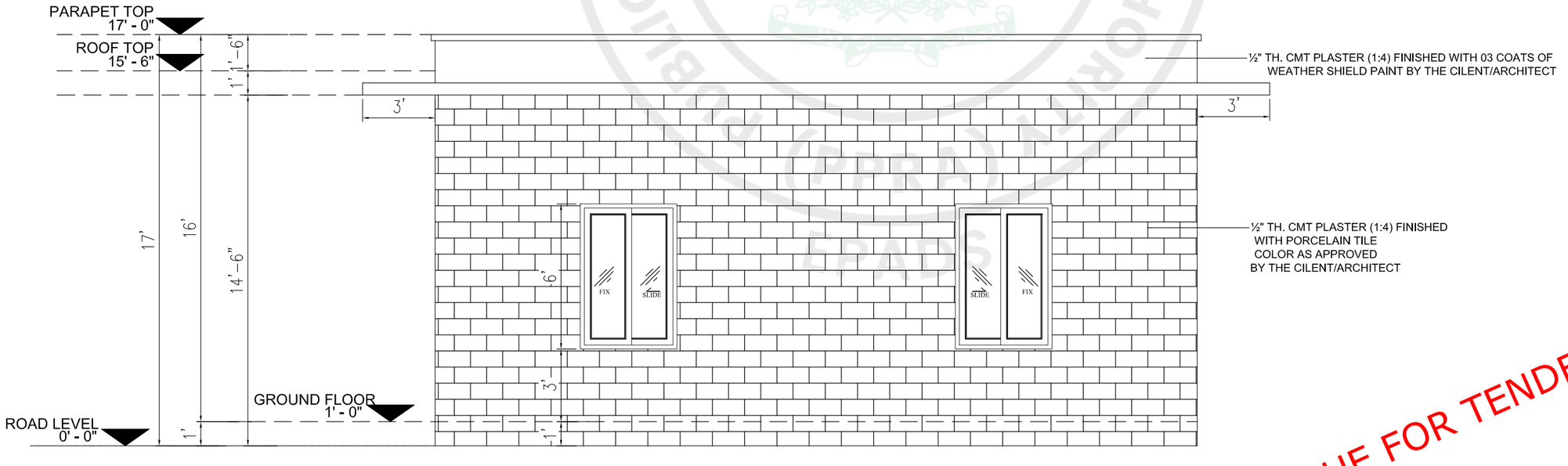


3 ELEVATION-3



4 ELEVATION-4

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NORTH ORIENTATION

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

UTILITY BLOCK
ELEVATION-3 & 4

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-66 @A3

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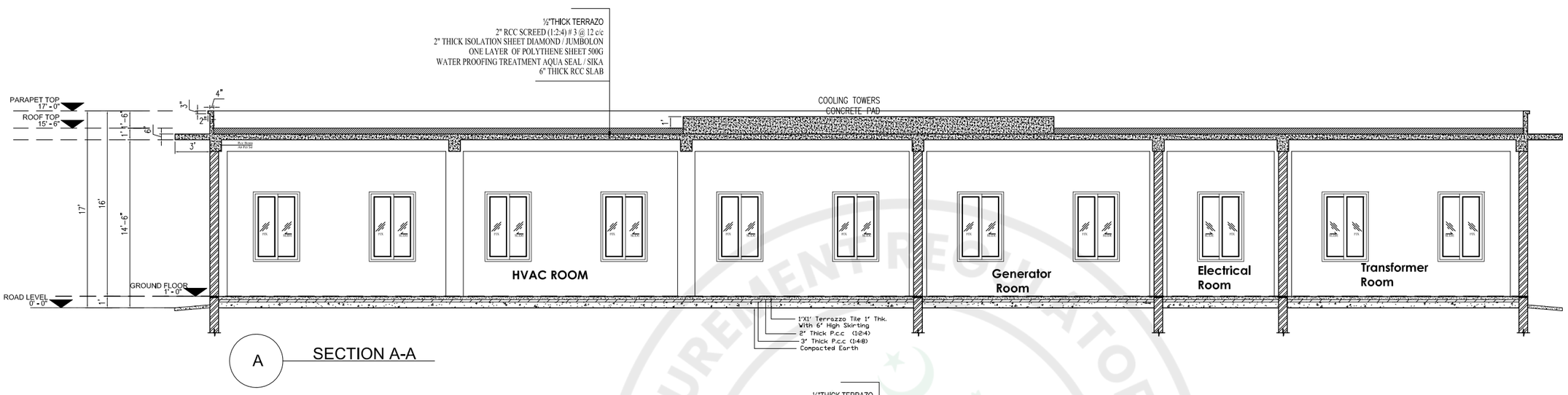
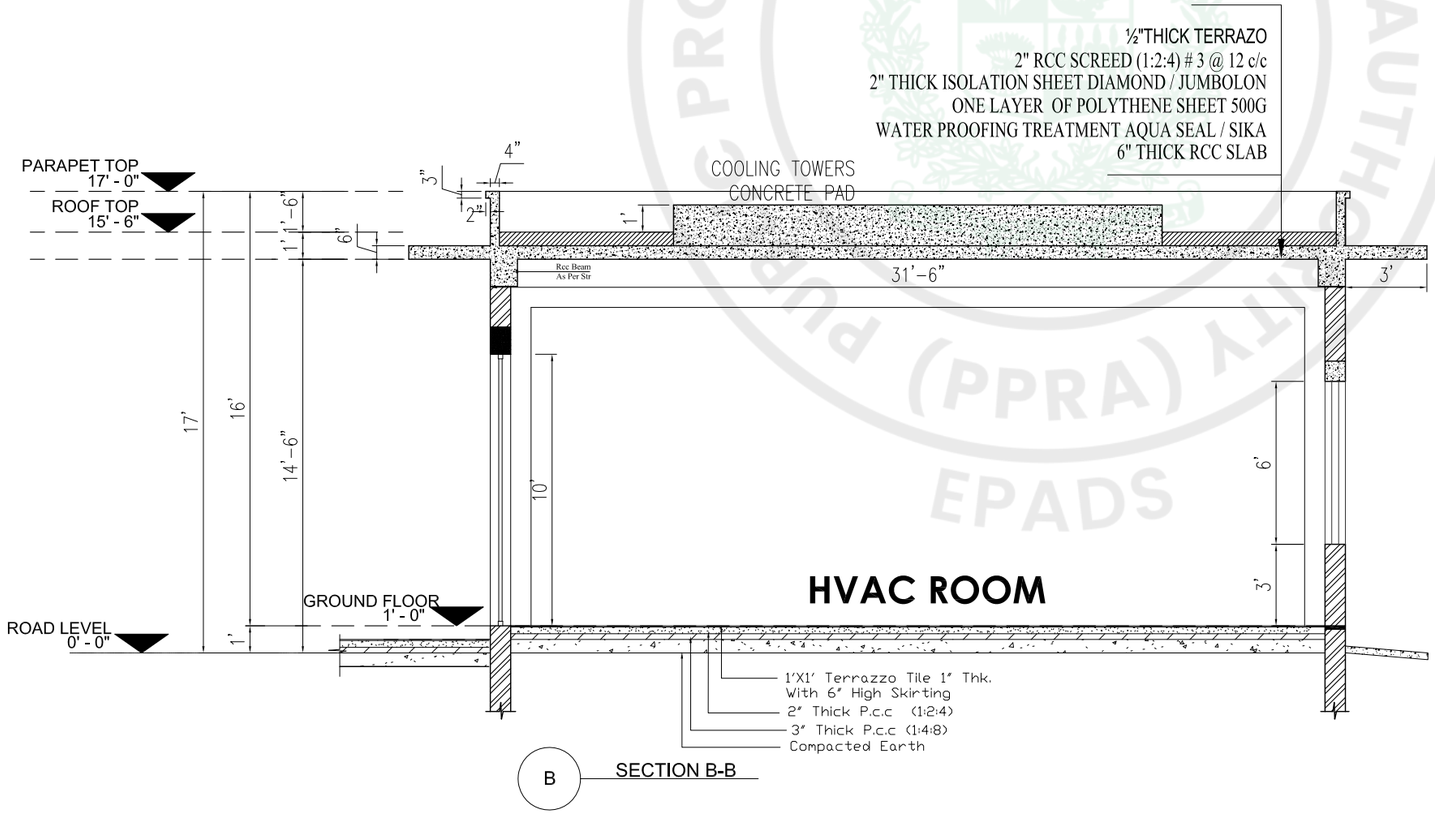


A SECTION A-A



B SECTION B-B

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NORTH ORIENTATION

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

UTILITY BLOCK
SECTION A-A & B-B

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-67 @A3

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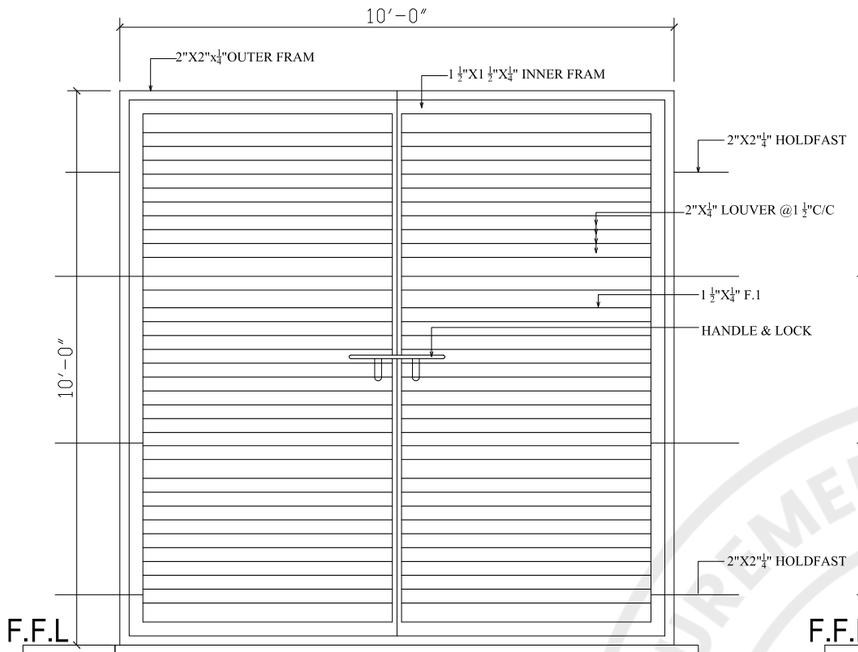
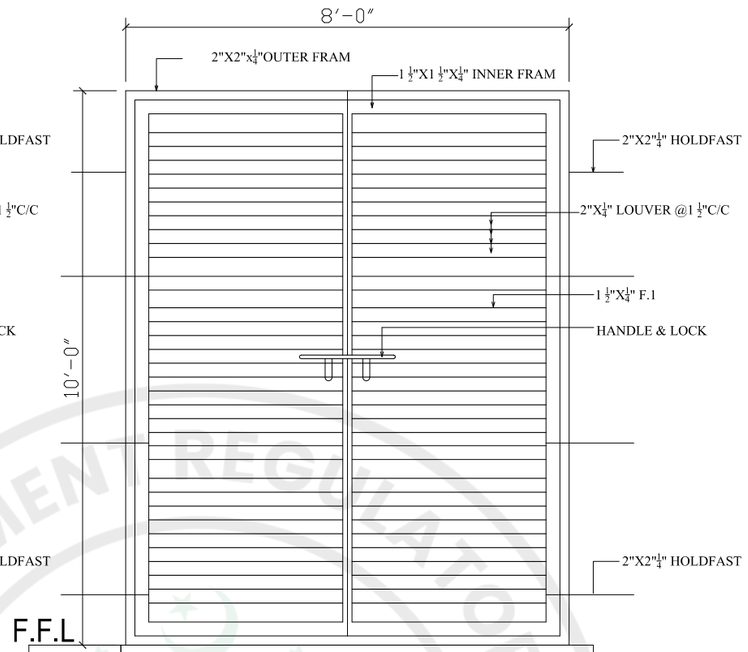
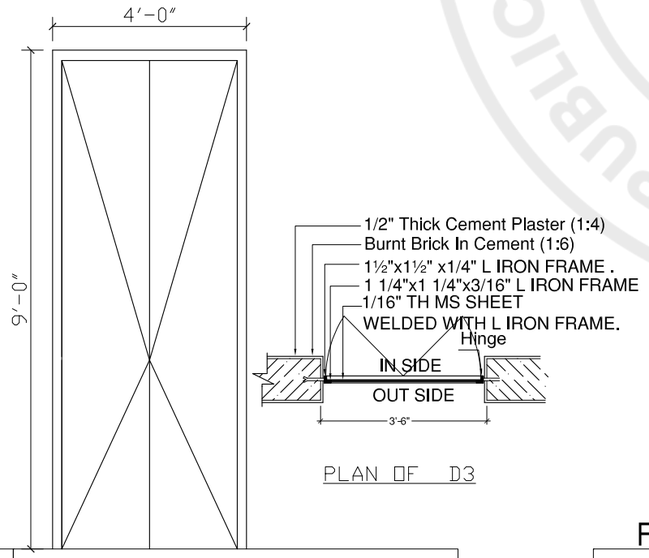


TYPE	SPECIFICATION
D1	8'-0"X10'-0" DOUBLE LEAF STEEL DOOR 2"X2"X¼" L IRON OUTER FRAME . 1½"X1½"X ¼" L IRON INNER FRAME 2"X¼" LOUVER @1 ½"C/C WELDED WITH L IRON FRAME. COMPLETE WITH LOCKS, HANDLES, STOPS AND HOLDFAST

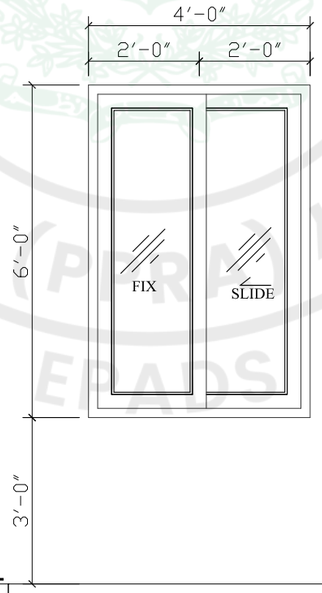


TYPE	SPECIFICATION
D2	8'-0"X10'-0" DOUBLE LEAF STEEL DOOR 2"X2"X¼" L IRON OUTER FRAME . 1½"X1½"X ¼" L IRON INNER FRAME 2"X¼" LOUVER @1 ½"C/C WELDED WITH L IRON FRAME. COMPLETE WITH LOCKS, HANDLES, STOPS AND HOLDFAST



PLAN OF D3

TYPE	SPECIFICATION
D3	4'-0"X9'-0" DOUBLE LEAF STEEL DOOR 1½"X1½" X1/4" L IRON OUTER FRAME . 1 1/4"X1 1/4"X3/16" L IRON INNER FRAME 1/16" TH MS SHEET WELDED WITH L IRON FRAME.



TYPE	SPECIFICATION
W1	4'-0"x6'-0" ALUMINUM BRONZE ANODIZED SLIDING VENTILATOR. (DELUXE MODEL 1.6mm THICK 100 mm WIDE SECTION) 5mm THICK TINTED GLASS,WITH ALUMINUM SCREENING IMPORTED MESH FOR SLIDING OPEN ABLE RUBBER PACKING AND SEALANT.

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STRUCTURAL CONSULTANT

NORTH ORIENTATION

N

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

Sheet Name

UTILITY BLOCK
DOOR'S & WINDOW DETAIL

Date	12 January, 2026
Scale	NTS
Drawn by	Asad
Checked by	Ar. Ahmed Ali
Approved by	Ar. Anwar Ali
Drawing No.	AW-68 @A3

PUBLIC PROCUREMENT REGULATORY AUTHORITY EPADS

PROCUREMENT REGULATORY AUTHORITY
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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

3D VIEW

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 69

Scale @ 42" X 30"

ISSUE FOR TENDER

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Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

3D VIEW

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 70

Scale @ 42" X 30"

PROCUREMENT REGULATORY AUTHORITY
EPADS

ISSUE FOR TENDER

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CLIENT NAME

PAA
پاکستان ایئر پورٹس اتھارٹی

MAIN CONSULTANT

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Formerly Anwar Ali & Associates Since March 2006 to June 2018
Consulting Architects, Engineers, Planners & Management Consultants

JV MEMBERS

COMRADES CONSULTANTS
leit-werk

Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

3D VIEW

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 71

Scale @ 42" X 30"

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS

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Scale @ 42" X 30"

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Checked By	Ar. Ahmed Ali
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Date	March 2026

AW - 77

Scale @ 42" X 30"

PROCUREMENT REGULATORY AUTHORITY

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Detailed Architectural Design Drawings

3D VIEW

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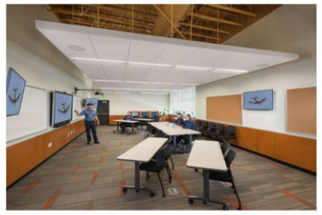
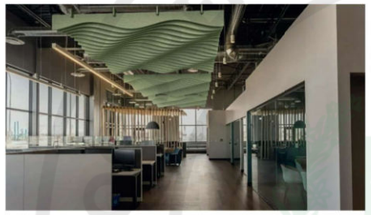
Date	March 2026

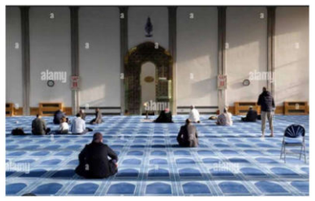
AW - 78

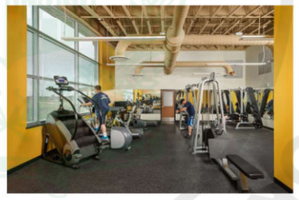
Scale @ 42" X 30"

Building envelop: Insulated aluminium roof, ATC Tower Glazing with external rotating maintenance access; Aluminium panel facade and timber windows at first floor, garage doors

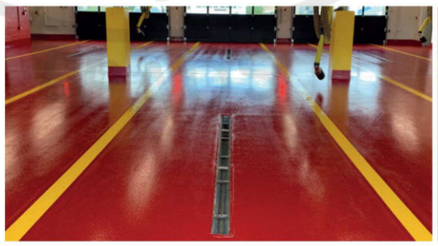
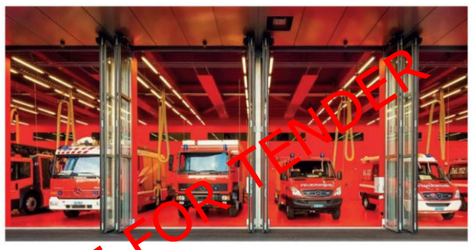
Ceilings: Small accustic panels for small offices, larger suspended acoustic panels for class room; suspended panels in office floor, canteen and prayer room; roller blinds and ceiling for the ATCT/ARFF watch room
Below: Prayer room, washrooms and changing rooms; Entrance lobby and open ceiling gym





Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

Mood Board

Floors: Wood in first floor, granite tiles in entrance lobby, epoxy resin for garages

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Project Name

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Detailed Architectural Design Drawings

MOOD BOARD

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 79

Scale @ 42" X 30"

CONSTRUCTION OF NEW AIR TRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES AT SKARDU INTERNATIONAL AIRPORT

(LIST OF DRAWINGS)

STRUCTURAL

NO.	DRAWING NO.	DATE OF DRAWING	AMENDED UPTODATE	DESCRIPTION
01	S-01	APRIL:2026		GENERAL NOTES
02	S-02	APRIL:2026		PILES, FOUNDATIONS, COLUMNS LAYOUT PLAN
03	S-03	APRIL:2026		PILES, FOUNDATIONS, DETAIL
04	S-04	APRIL:2026		COLUMNS & FOUND. DETAIL
05	S-05	APRIL:2026		PLINTH BEAMS DETAIL
06	S-06	APRIL:2026		MEZZANINE BEAMS DETAIL
07	S-07	APRIL:2026		FIRST FLOOR BEAMS DETAIL
08	S-08	APRIL:2026		MEZZANINE FLOOR SLAB DETAIL
09	S-09	APRIL:2026		MEZZANINE FLOOR SLAB DETAIL
10	S-10	APRIL:2026		FIRST FLOOR SLAB DETAIL
11	S-11	APRIL:2026		FIRST FLOOR SLAB DETAIL
12	S-12	APRIL:2026		FIRST FLOOR SLAB DETAIL
13	S-13	APRIL:2026		LIFT WELL REINFORCEMENT DETAIL
14	S-14	APRIL:2026		LIFT WELL REINFORCEMENT DETAIL
15	S-15	APRIL:2026		ISO VIEW SPACE FRAME
16	S-16	APRIL:2026		BASE PLATE & COL LAYOUT
17	S-17	APRIL:2026		SPACE FRAME LAYOUT
18	S-18	APRIL:2026		ROOF SHEETING PLAN
19	S-19	APRIL:2026		LONGITUDINAL SECTION
20	S-20	APRIL:2026		SECTIONS
21	S-21	APRIL:2026		SECTIONS
22	S-22	APRIL:2026		SIDE ELEVATION
23	S-23	APRIL:2026		DETAILS
24	S-24	APRIL:2026		DETAILS
25	S-25	APRIL:2026		COL & BASE PLATE PLAN
26	S-26	APRIL:2026		ATC CABIN FLOOR PLAN
27	S-27	APRIL:2026		ATC ROOF FRAMING PLAN
28	S-28	APRIL:2026		ATCT STRUCTURE SECTION
29	S-29	APRIL:2026		CONNECTIONS DETAIL
30	S-30	APRIL:2026		FIRE FIGHTING WATER TANK
31	S-31	APRIL:2026		FIRE FIGHTING WATER TANK
32	S-32	APRIL:2026		UNDER GROUND WATER TANK
33	S-33	APRIL:2026		UNDER GROUND WATER TANK
34	S-34	APRIL:2026		OVER HEAD WATER TANK
35	S-35	APRIL:2026		OVER HEAD WATER TANK
36	S-36	APRIL:2026		RAIN WATER HARVEST TANK
37	S-37	APRIL:2026		RAIN WATER HARVEST TANK
38	S-38	APRIL:2026		SEPTIC TANK
39	S-39	APRIL:2026		SEPTIC TANK

ISSUE FOR TENDER

STRUCTURAL GENERAL NOTES

1. COORDINATION

1. ALL WORK SHALL CONFORM TO MINIMUM STANDARDS OF UNIFORM BUILDING CODE-97 AND ACI-318-08
2. DESIGN LOADS ARE IN ACCORDANCE WITH UBC 97 AND ASCE-7
3. EVERY REASONABLE EFFORTS HAS BEEN MADE TO BOUND STRUCTURAL SPECIFICATIONS. SHOULD THERE BE ANY DESCREPANCIES, THE CONTRACTOR SHALL REQUEST A CLARIFICATION IN WRITING FROM THE ENGINEER
4. ALL STRUCTURAL DRAWING SHOULD BE READ IN CONJUNCTION WITH ARCHITECTURAL AND OTHER RELEVANT DRAWINGS.
5. STRUCTURAL DRAWINGS WILL GOVERN THE SIZE & LOCATION OF THE STRUCTURAL COMPONENTS OVER OTHER DRAWINGS

2. GENERAL

1. THE CONTRACTOR SHALL REVIEW DRAWINGS AND DETERMINE THAT DIMENSIONS ARE COORDINATED BETWEEN ARCHITECTURAL AND, STRUCTURAL DRAWINGS PRIOR TO FABRICATION OR START OF CONSTRUCTION.
2. NO STRUCTURAL MEMBER SHALL BE CUT, NOTCHED OR OTHERWISE REDUCED IN STRENGTH.
3. THE CONTRACTOR SHALL COORDINATE ARCHITECTURAL & OTHER MECHANICAL, AND ELECTRICAL DRAWINGS FOR ANCHORED,EMBEDDED AND SUPPORTED ITEMS WHICH AFFECT THE STRUCTURAL DRAWINGS AND NOTIFY THE EGINEER OF ANY DISCREPANCY.
4. ALL SECTIONS AND DETAILS WILL BE AS PER DETAILS GIVEN ON RESPECTIVE DRAWINGS. IN CASE OF ANY PROBELM IN UNDERSTANDING OF DETAILS CONTRACTOR SHOULD IMMEDIATELY REFER TO THE ENGINEER.
5. ANY CONFLICTS BETWEEN THE SPECIFICATIONS AND DESIGN DRAWINGS SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ENGINEER. THE CONTRACTOR BEFORE GOING FOR PURCHASE OF MATERIAL WILL ENSURE THAT THE SPECIFICATIONS HAVE BEEN UNDERSTOOD AND COMPARED WITH DRAWINGS. ANY DISCREPANCY WILL BE REPORTED TO ENGINEER BEFORE ACTUALLY GOING FOR PURCHASE

4. REINFORCED CONCRETE

1. CONCRETE WORK SHALL CONFORM TO ACI 301 SPECIFCATION FOR STRUCTURAL CONCRTE FOR BUILDING (LATEST EDITION).
2. STRUCTURAL DESIGN IS BASED ON THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE OF AMERICAN CONCRETE INSTITUTS (ACI 318-05).
3. NO CONCRETING SHALL BE CARRIED OUT UNTIL PERMISSION IS GIVEN IN WRITING.
4. CONCRETE SHALL HAVE A MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS AS FOLLOWS:

(28Th DAY CYLINDRICAL COMPRESSIVE STRENGTH)

RCC (1 : 1.5 : 3)	COLUMNS, LIFT WALLS, BEAMS & WATER RETAINING STRUCTURES	4500 (f'c)
RCC (1 : 2 : 4)	SLABS, AND REMAINING MEMBERS	3000 (f'c)
PCC (1 : 4 : 8)	WHERE SPECIFIED UNDER STRUCTURES	1000 (f'c)
SPECIAL PROVISION: APPROPRIATE TYPE OF PLASTICIZER, AS APPROVED BY SITE ENGINEER, CAN BE USED UP TO A QUANTITY OF 2% BY WEIGHT OF CEMENT		

5. THE RATIOS MENTIONED ARE THE QUANTITIES SUFFICIENT FOR ACQUIRING REQUIRED STRENGTH. HOWEVER, THE ACTUAL QUANTITIES WILL BE FINALIZED THROUGH MIX DESIGN, WHICH WILL BE CARRIED OUT AT CONTRACTORS COST. THE RESULTS WILL BE PRESENTED TO THE ENGINEER AT SITE WHO WILL COLLECT SAMPLES AND GET THE STRENGTH CONFIRMATION FROM HIS SOURCE AT CONTRACTORS COST.
6. ALL DESIGN DETAIL, MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH RELEVANT ACI, ASTM, UBC CODES AND STANDARDS.
7. ALL NON LOAD BEARING MASONARY WALLS SHALL BE PLACED AFTER THE REMOVAL OF FORM WORK.
8. ALL SLABS WILL BE CAST MONOLITHIC WITH THEIR BEAMS AND OVER HANGS. HOWEVER, PARAPET WALLS AND ALL NON STRUCTURAL MEMBERS CAN BE CAST SUBSEQUENTLY. IN SUCH CASE STRENGTH GAIN OF PRIMARY COMPONENTS WILL BE ASCERTAINED.

5. REINFORCEMENT

1. REINFORCEMENT STEEL SHALL BE OF LOW ALLOY STEEL AS PER ASTM A615 HAVING MINIMUM YIELD STRENGTH OF 60,000 PSI. HOWEVER STIRRUPS CAN BE OF 40,000 PSI YIELD STRENGTH. FABRICATED STEEL BEAMS SHALL BE OF 36 KSI
2. TOP REINFORCEMENT BARS OF BEAMS TO BE CURTAILED AS SHOWN/REQUIRED.
3. ALL LAPS OF THE REINFORCEMENT SHOULD BE PROVIDED OUTSIDE HINGE ZONE
4. ALL REINFORCING STEEL SHALL BE ACCURATELY LOCATED IN THE FORMS AND HELD FIRMLY IN PLACE BEFORE & DURING THE PLACEMENT OF CONCRETE, BY MEANS OF WIRES AND SUPPORTS ADEQUATE TO PREVENT DISPLACEEMENT DURING THE COURSE OF CONSTRUCTION.
5. MAINTAIN MINIMUM CONCRETE COVERAGE FOR REINFORCING STEEL AS FOLLOWS UNLESS OTHERWISE NOTED IN DRAWING.

CLASS-C SLABS & FOOTINGS	
COLUMNS	= 1.5 inch
BEAMS	= 1.5 inch
SLABS	= 3/4 inch
WALLS FRONT FACE	= 1 inch
WALLS EARTH FACE	= 2 inch

6. SHUTTERING/ FORM WORK

1. SHUTTERING FOR ALL PROJECTIONS SHALL BE INSTALLED AND REMOVED ALONG WITH SLAB. THE TYPE OF SHUTTERING WILL ALSO BE SAME AS FOR MAIN SLAB
2. LOAD BEARING MASONARY WALLS SHALL BE BUILT BEFORE PLACING OF FORM WORK FOR SLAB / ROOF SLAB.

7. CONCRETE CONSTRUCTION

1. ALL STRUCTURE SURFACES, AGAINST WHICH EARTH IS TO FILLED MAY BE COATED WITH TWO COATS OF HOT BITUMEN OF 10/20 GRADE AT THE RATE OF OF 0.4 lbs /Sft /coat. OTHER TREATMENTS AS PER DRAWINGS AND INSTRUCTION OF THE SITE ENGINEER SHALL ALSO BE EMPLOYED
2. BEFORE CASTING OF ANY STRUCTURAL MEMBER. THE CONTRACTOR SHALL ENSURE THAT ALL EMBEDDED ITEM FOR ELECTRICAL, MECHANICAL, HVAC, PLUMBING STRUCTURAL STEEL AND OTHER WORKS ARE PROPERLY LOCATED AND FIRMLY SECURED IN PLACE. THE CONTRACTOR SHALL BE RESPONSIBLE TO GET ALL EMBEDDED ITEMS CHECKED BY SITE ENGINEER BEFORE CASTING.

8. PARTITION WALLS

1. THE PARTITION WALLS WILL CONSTRUCTED AS PER DRAWINGS. THE PARTITION WALLS WILL CONTAIN REINFORCEMENT WHERE SPECIFIED.

9. LOAD BEARING WALLS

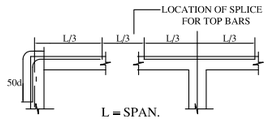
1.GENERALLY THE STRUCTURE HAS BEEN DESIGNED AS FRAME STRUCTURE. BUT WHERE LOAD BEARING WALLS HAVE BEEN SPECIFIED THESE WILL BE INSTALLED BEFORE THE INSTALLATION OF SHUTTERING. THE SPECIFICATION OF BEARING WALLS WILL BE STRICTLY FOLLOW.

10. LAP SPLICE

1. SCHEDULE "I" APPLIES FOR THE FOLLOWING TYPES OF BARS,
   - BOTTOM HORIZONTAL BARS OF BEAMS AND WALLS.
   - TOP HORIZONTAL BARS OF SLABS 14" OR LESS IN DEPTH.
   -VERTICAL BARS.
2. SCHEDULE "II" APPLIES FOR THE FOLLOWING TYPES OF BARS,
   - TOP HORIZONTAL BARS OF BEAMS.
   - TOP HORIZONTAL BARS OF SLABS GREATER THAN 14" DEEP.
   -ALL HORIZONTAL WALL REINFORCEMENT (EXCEPT BOTTOM BARS).
3. ALL LAP SPLICES SHALL BE WIRED IN CONTACT.
4. ALL LAP SPLICES SHALL BE CLASS B" U.N.O. IN CONTACT.
5. ALL SPLICES OF WALL AND SLAB REINFORCEMENT SHALL BE STAGGERED AS NORMAL PRACTICE.
6. THE LAP SPLICE LENGH FOR BIGGER BAR BE USED WHEN SPLICING TWO DIFFERENT SIZE BARS.
   ADJUSTMENT (S) TO GIVEN LAP LENGTHS.
7. LAP LENGTHS GIVEN ARE FOR A CONCRETE COMPRESSIVE STRENGTH, f'c, OF 3000 PSI & 3750 PSI NOTIFY ENGINEER FOR OTHER STRENGTHS
8. IF REINFORCING IS SPECIFIED AS EPOXY COATED INCREASE LENGTHS BY 50%
9. IF LIGHTWEIGHT AGGREGATE IS SPECIFIED, INCREASE LENGTHS BY 30%
10. LAP LENGTHS SCHEDULE ASSUMES:
    A. CLEAR COVER IS GREATER THAN BAR DIAMETER.
    B. CLEAR SPACING BETWEEN BAR IS GREATER THAN 2 BAR DIAMETERS.
    C.TRANSVERSE REINFORCEMENT INDEX, Ktr,IS ZERO.

IF EITHER CONDITION A OR B IS NOT MET, FOR A GIVEN BAR, INCREASE THE SCHEDULED LAP LENGTH BY 50%

11. LAP LENGTH SCHEDULED ARE FOR Gr 60 REINFORCEMENT (fy = 60 k.s.i.).
    (A) FOR BOTTOM BARS. LOCATE SPLICES OVER SUPPORTS UNO.
    (B) TOP BARS, LOCATE SPLICES AT MID-SPAN. OR WITHIN CENTER



12. ALL REINFORCING BARS TO BE FABRICATED AS PER THE BENDING SCHEDULES PREPARED BY THE CONTRACTOR AND CHECKED BY ENGINEER.
13. THE ADDITIONAL QUANTITY OF STEEL AT LOCATION OF LAP SHALL NOT BE CONSIDERED SEPARATE FOR PAYMENT.
14. IN CASE MINIMUM REQUIREMENT OF LAP IS NOT MET THE FIXED STEEL WILL BE REPLACED BY CORRECTED LENGTH AND SIZE AT THE COST OF CONTRACTOR.

NOTE:
THE DESIGN PRESENTED HERE IS BASED ON THE SOIL REPORT AND DATA PROVIDED BY CLIENT. THE ACCURACY OF WHICH IS ENTIRE RESPONSIBILITY OF CLIENT.

GENERAL NOTES
INSTRUCTIONS TO CONTRACTOR

EARTHQUAKE ZONE AS PER BUILDING CODE OF PAKISTAN 3

SPLICE LENGTHS

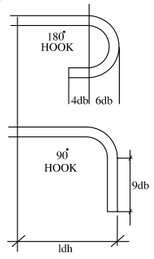
SCHEDULE I - BOTTOM BARS					SCHEDULE II - TOP BARS				
f' c	3000 p.s.i		4500 p.s.i		f' c	3000 p.s.i		4500 p.s.i	
BAR SIZE	CLASS A	CLASS B	CLASS A	CLASS B	BAR SIZE	CLASS A	CLASS B	CLASS A	CLASS B
#3	17"	22"	15"	20"	#3	22"	28"	20"	25"
#4	22"	29"	20"	26"	#4	29"	37"	26"	34"
#5	28"	36"	25"	32"	#5	36"	47"	32"	42"
#6	33"	43"	30"	39"	#6	43"	56"	39"	50"
#7	48"	63"	43"	56"	#7	63"	81"	56"	73"
#8	55"	72"	49"	64"	#8	72"	93"	64"	83"
#9	62"	81"	56"	72"	#9	81"	105"	72"	94"
#10	70"	91"	62"	80"	#10	91"	118"	80"	104"
#11	78"	101"	68"	88"	#11	101"	131"	88"	114"

SCHEDULE III - DEVELOPMENT LENGTH

BAR DIA	F' c	3000 PSI		4500 PSI	
		BOTTOM BARS	TOP BARS	BOTTOM BARS	TOP BARS
3	-	17	22	15	20
4	-	22	29	20	26
5	-	28	36	25	32
6	-	33	43	30	39
7	-	48	63	43	56
8	-	55	72	49	64
9	-	62	81	56	72
10	-	69	90	62	80
11	-	76	98	68	88

BAR DIA	HOOKS					
	180°			90°		
	ldh	round	extn	ldh*	ldh	extn
3	6.75	2.25	2.5	5.75	5.75	4.5
4	8.75	3	2.5	7.75	7.75	6
5	11	3.75	2.5	9.75	9.75	7.5
6	13.25	4.5	3	11.5	11.5	9
7	15.5	5.25	3.5	13.5	13.5	10.5
8	17.5	6	4	15.5	15.5	12
9	19.75	6.75	4.5	17.25	17.25	13.5

ldh* = when cover is not less then 2.5 inches



ISSUE FOR TENDER

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Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

GENERAL NOTES

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-01

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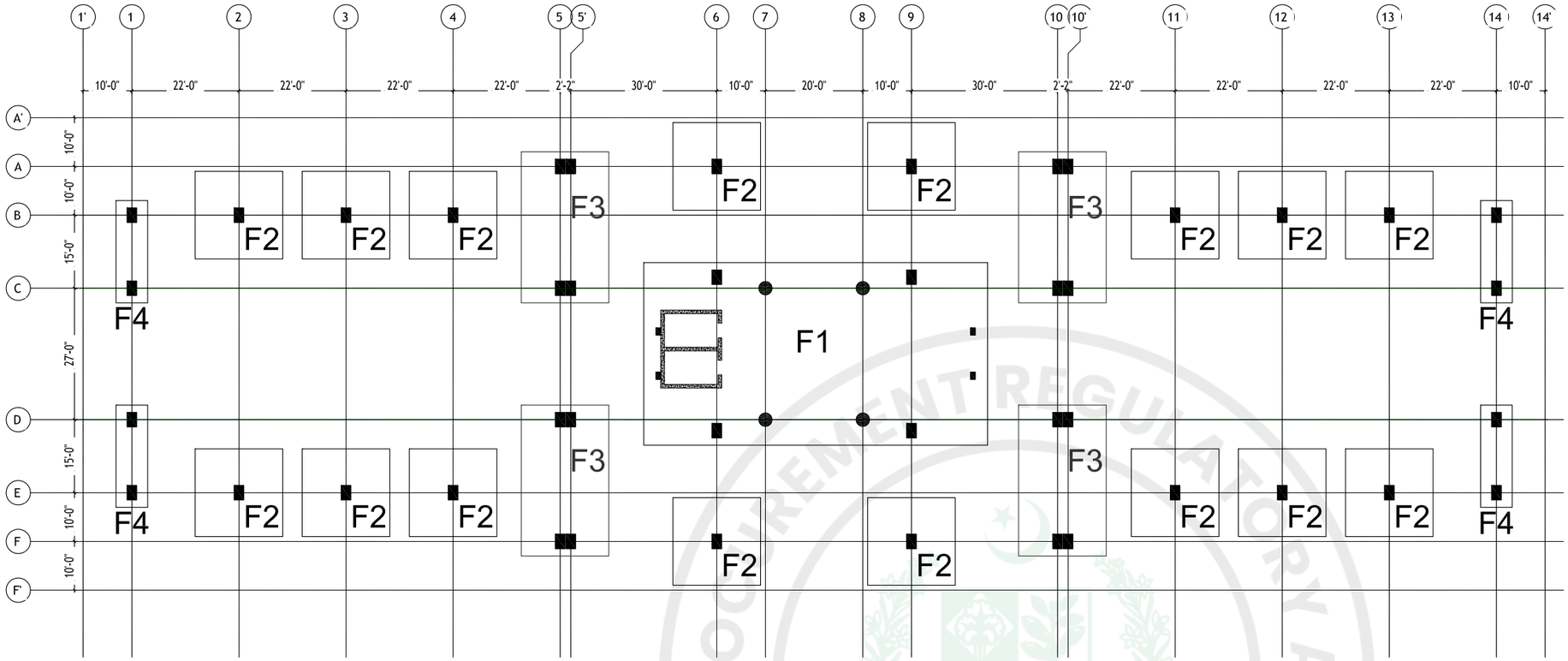
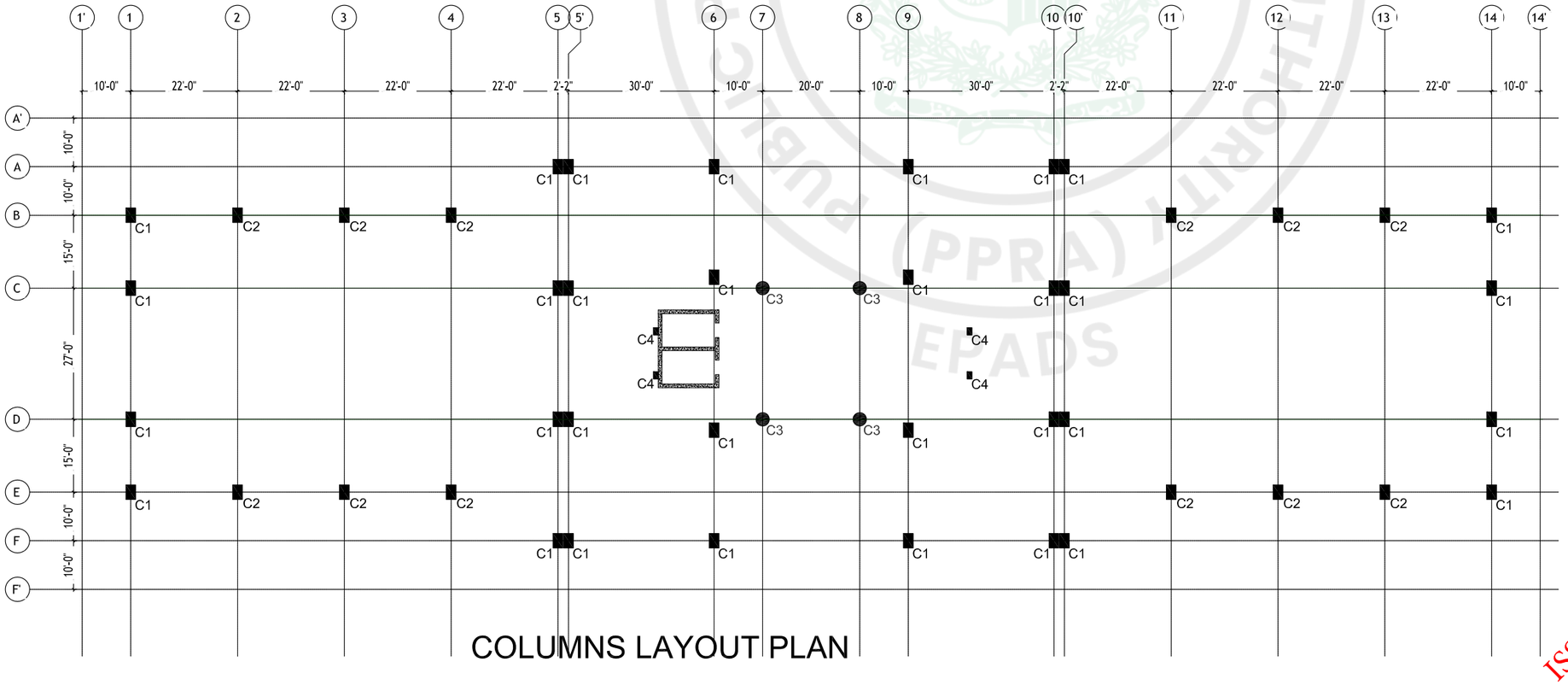


FOUNDATIONS & PILES LAYOUT PLAN



COLUMNS LAYOUT PLAN

ISSUE FOR TENDER

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

PILES, FOUNDATIONS, COLUMNS LAYOUT PLAN

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-02

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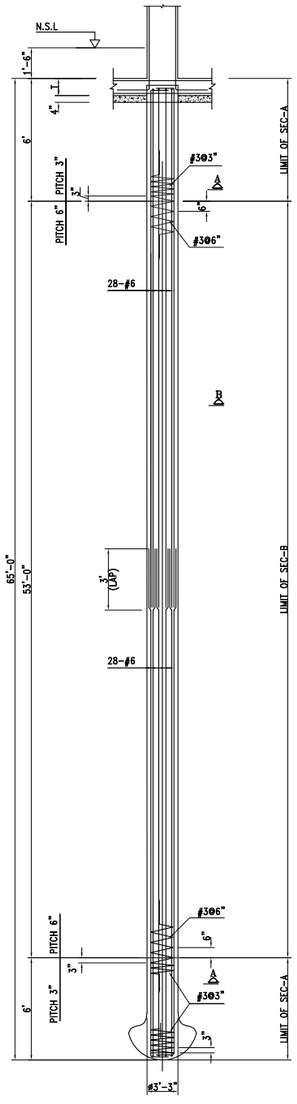
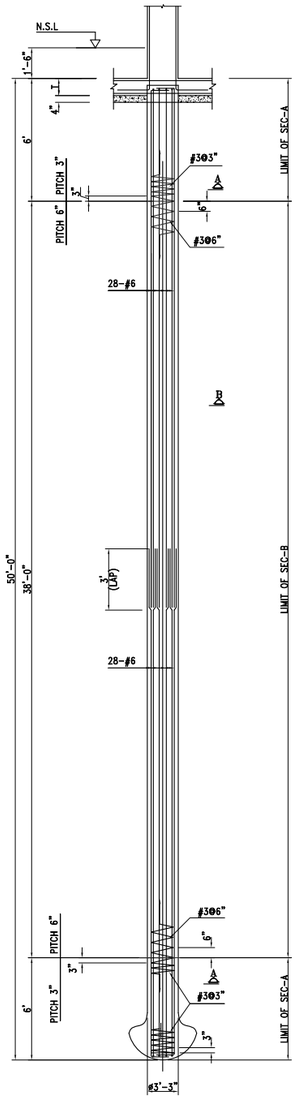
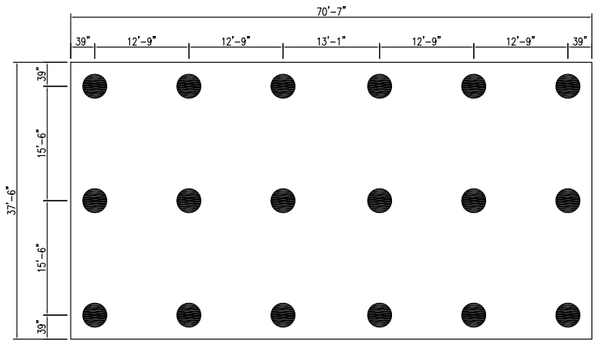


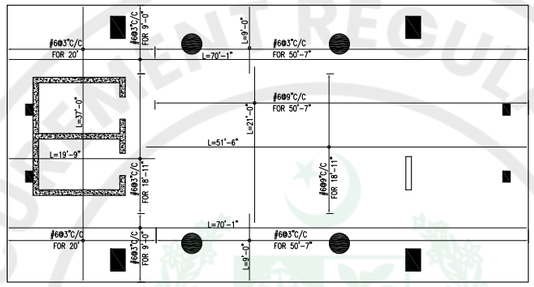
TYP SEC OF PILE
FOUNDATION F1



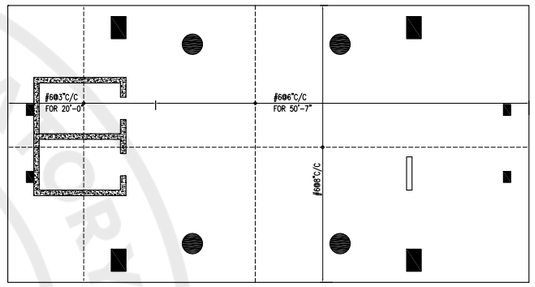
TYP SEC OF PILE
FOUNDATION F2, F3, F4



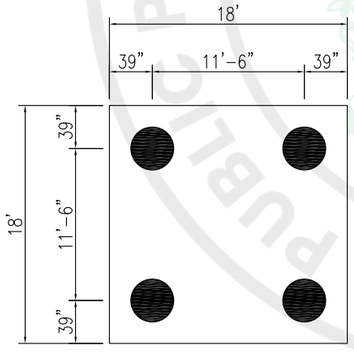
FOUNDATION F1 PILES LAYOUT PLAN
SLAB THICKNESS = 33"



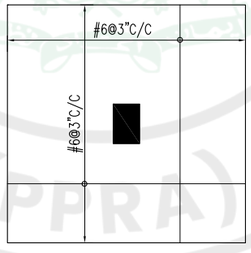
FOUNDATION F1 BOTTOM
REINFORCEMENT PLAN
SLAB THICKNESS = 33"



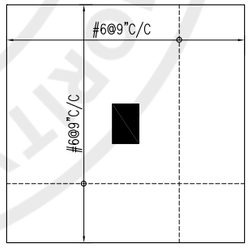
FOUNDATION F1 TOP
REINFORCEMENT PLAN
SLAB THICKNESS = 33"



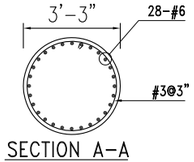
FOUNDATION F2 PILES LAYOUT PLAN
SLAB THICKNESS = 27"



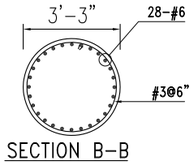
FOUNDATION F2 BOTTOM
REINFORCEMENT PLAN
SLAB THICKNESS = 27"



FOUNDATION F2 TOP
REINFORCEMENT PLAN
SLAB THICKNESS = 27"

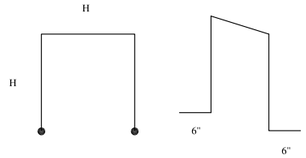


SECTION A-A



SECTION B-B

ISSUE FOR TENDER



IN ORDER TO SUPPORT NEGATIVE REINFORCEMENT MESH,
PROVIDE TIES USING #4 BARS AT 2' SPACING.

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MEP CONSULTANT

Project Name

Consultancy Services for
New Air Traffic Control Tower
(ATCT), Fire Station and Allied
Facilities at Skardu
International Airport

Detailed Structural Design Drawings

Sheet Name

PILES, FOUNDATIONS, DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-03

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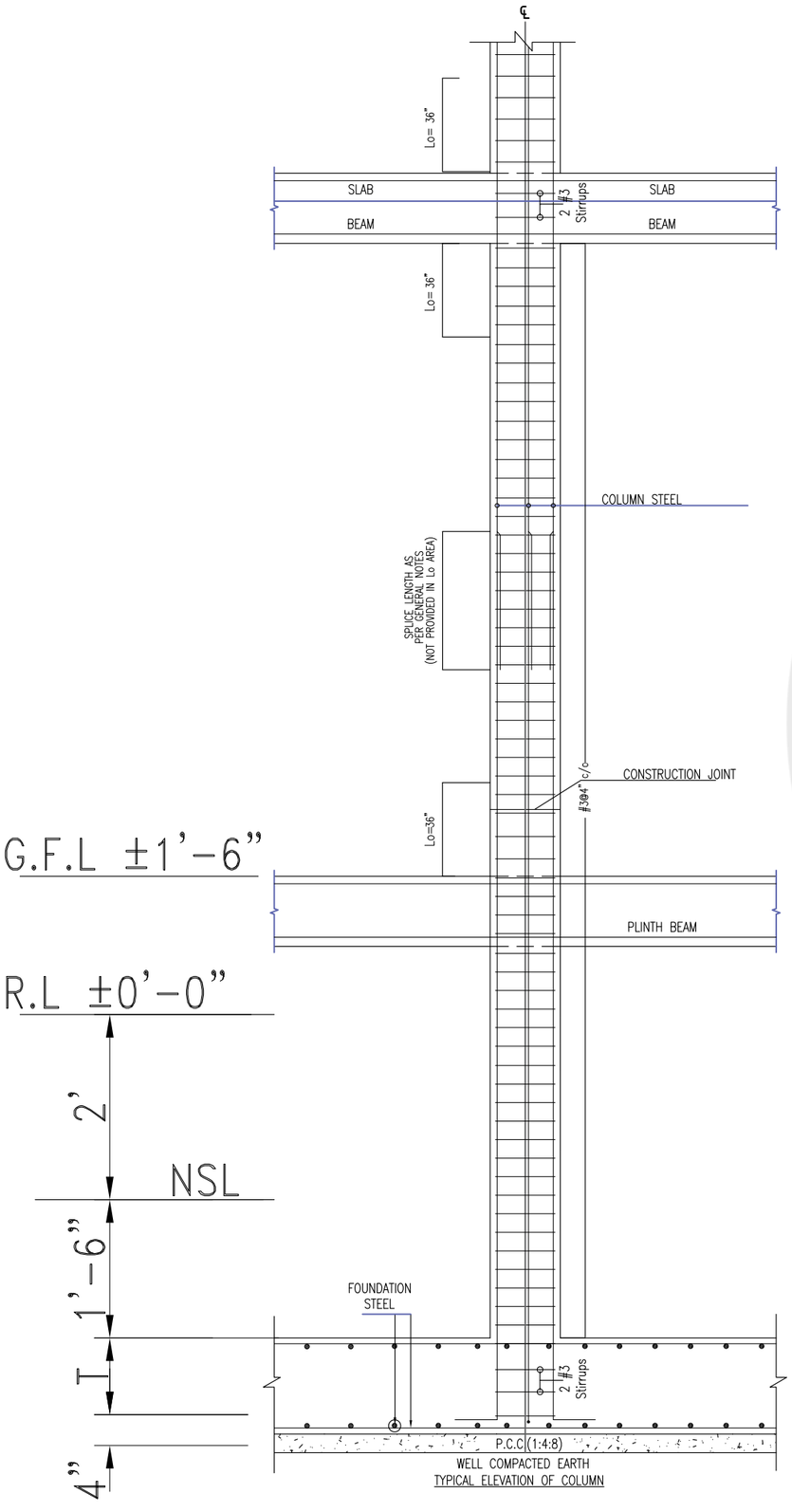
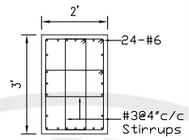
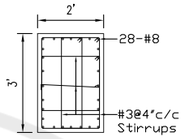
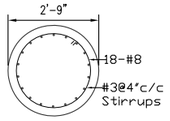
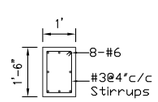
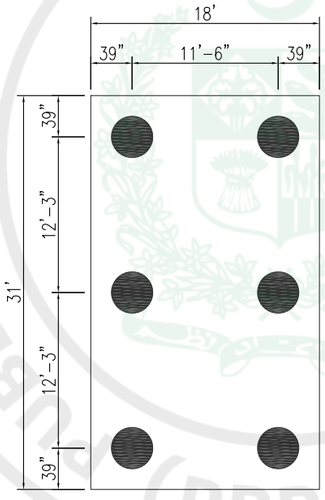


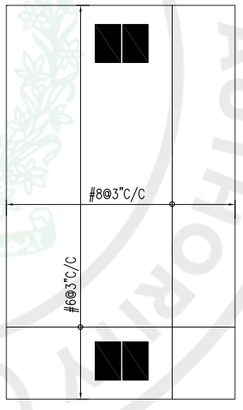
TYPICAL ELEVATION OF COLUMN

S C H E D U L E O F C O L U M N S

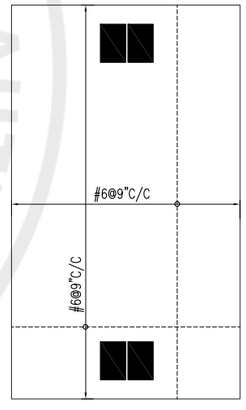
FLOOR'S	COL. 1	COL. 2	COL. 3	COL. 4
UP TO G.F SLAB				



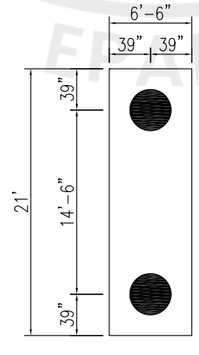
FOUNDATION F3 PILES LAYOUT PLAN
SLAB THICKNESS = 27"



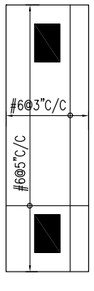
FOUNDATION F3 BOTTOM REINFORCEMENT PLAN
SLAB THICKNESS = 27"



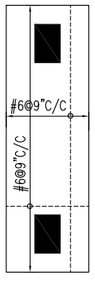
FOUNDATION F3 TOP REINFORCEMENT PLAN
SLAB THICKNESS = 27"



FOUNDATION F4 PILES LAYOUT PLAN
SLAB THICKNESS = 18"



FOUNDATION F4 BOTTOM REINFORCEMENT PLAN
SLAB THICKNESS = 21"



FOUNDATION F4 BOTTOM REINFORCEMENT PLAN
SLAB THICKNESS = 21"

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

COLUMNS & FOUND. DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-04

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PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA)
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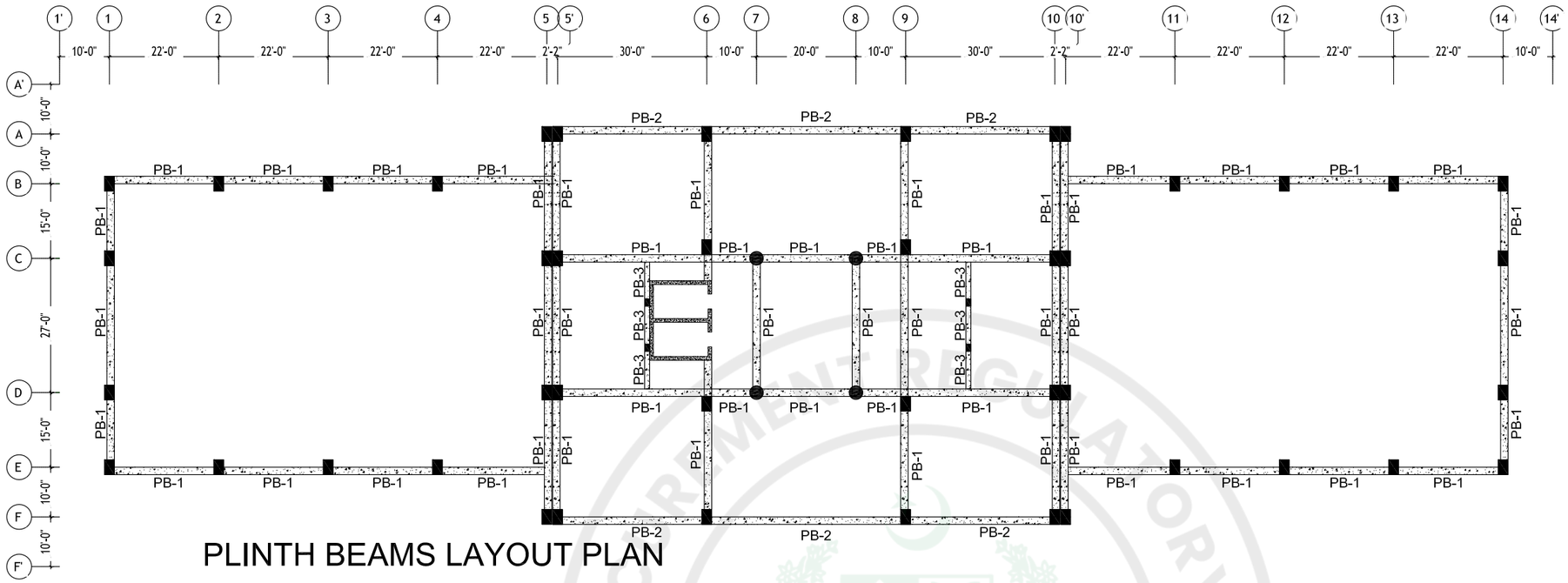
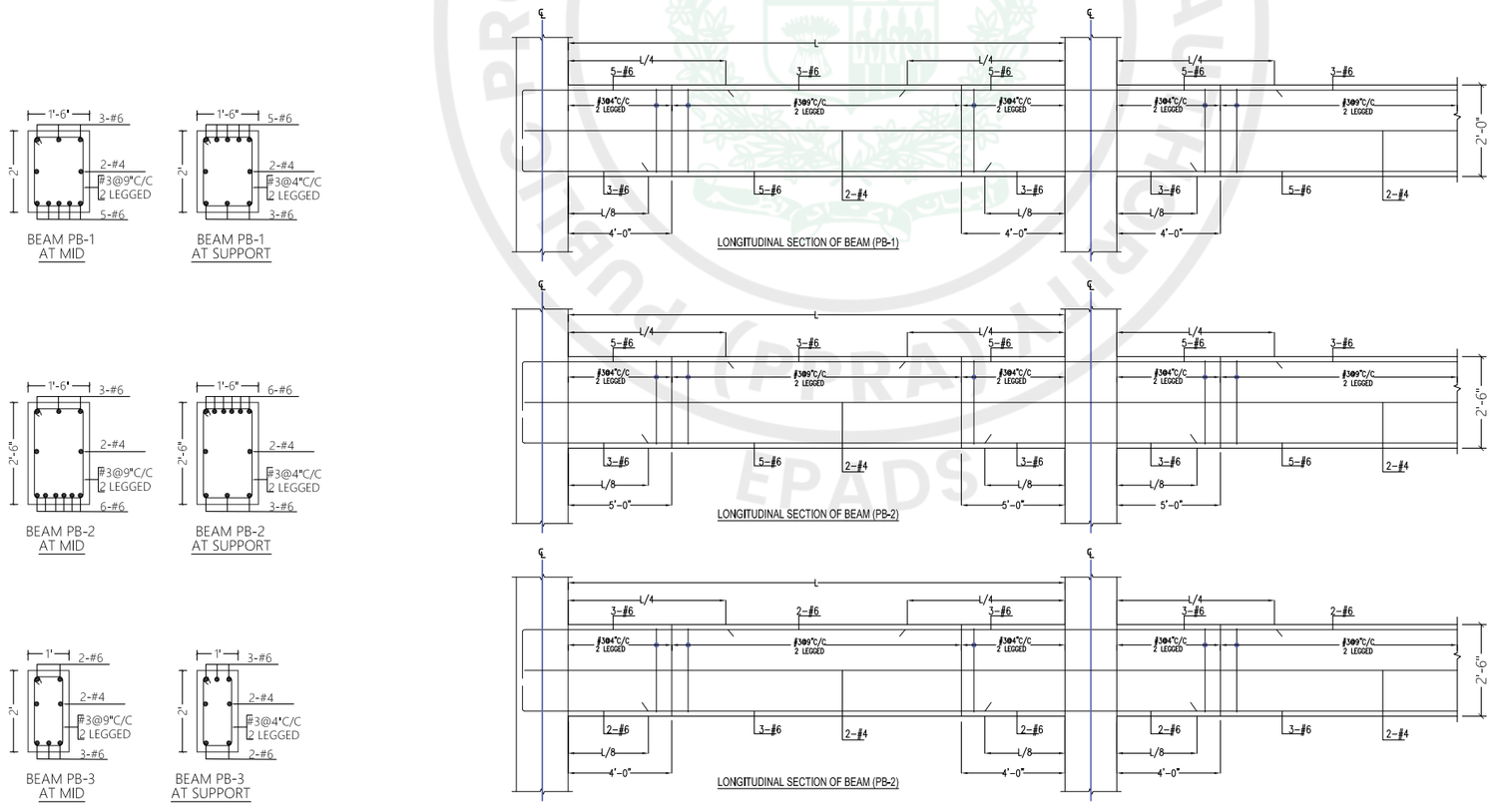


PLINTH BEAMS LAYOUT PLAN



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Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

PLINTH BEAMS DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-05

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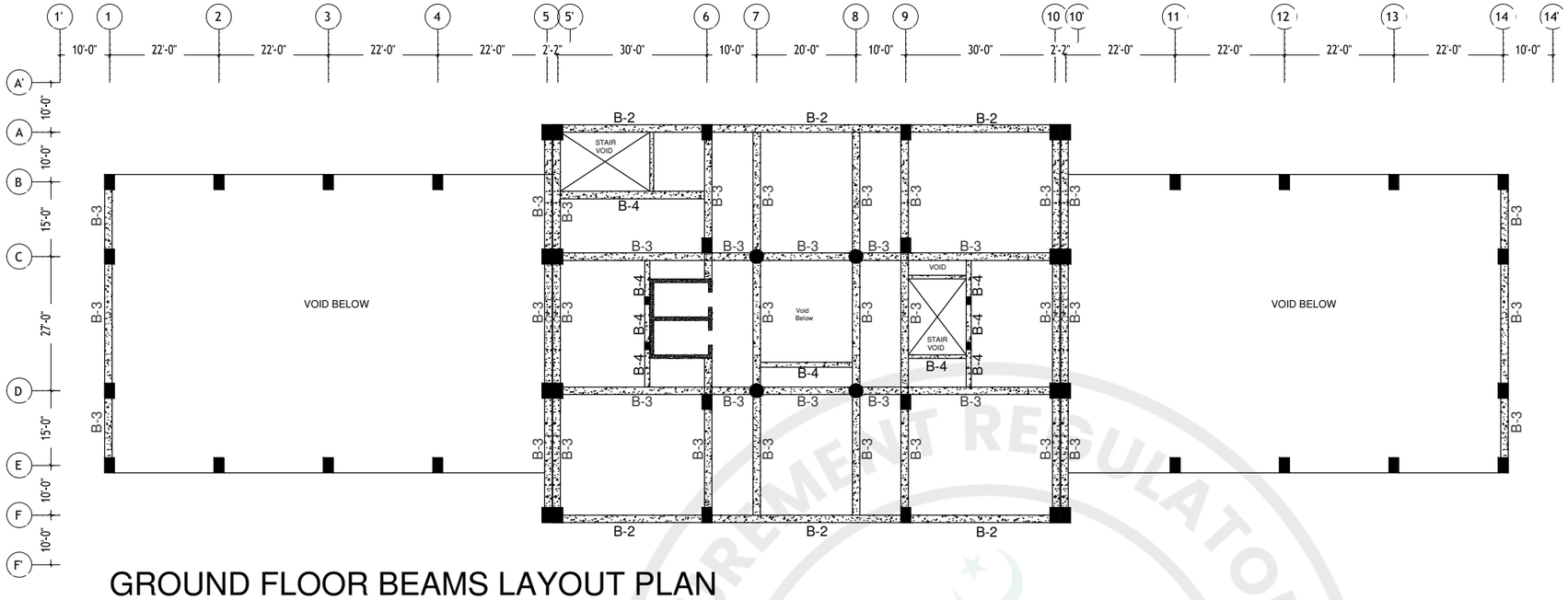
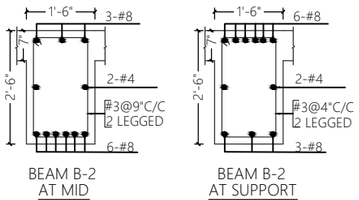
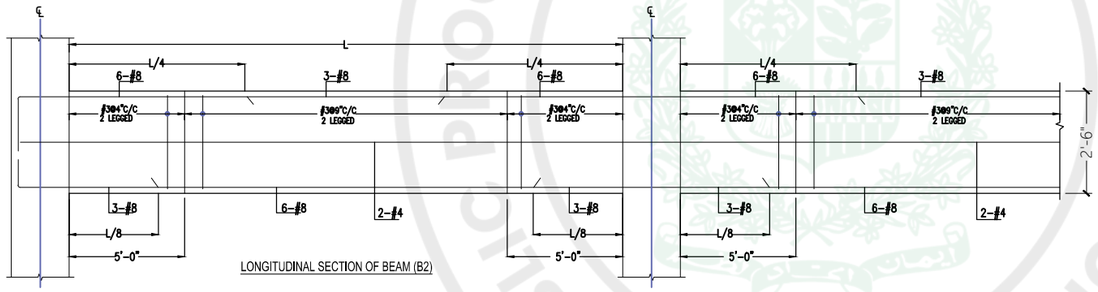
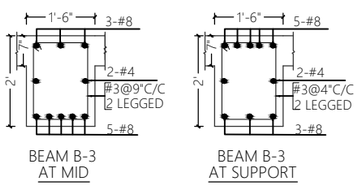


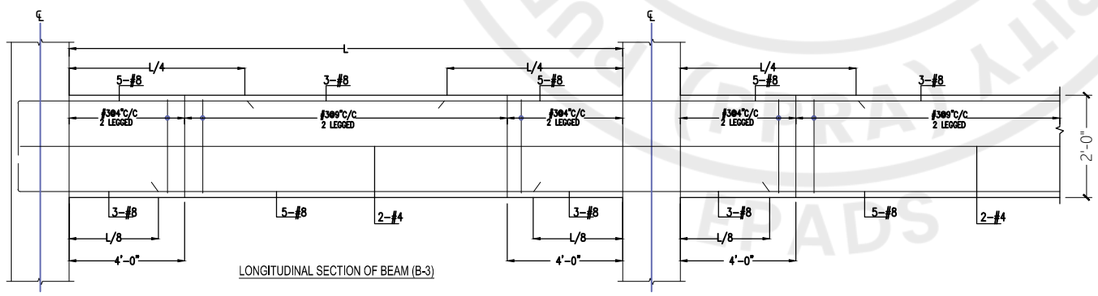
GROUND FLOOR BEAMS LAYOUT PLAN



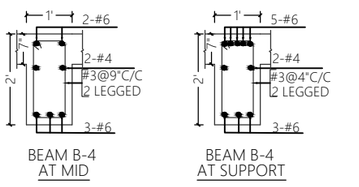


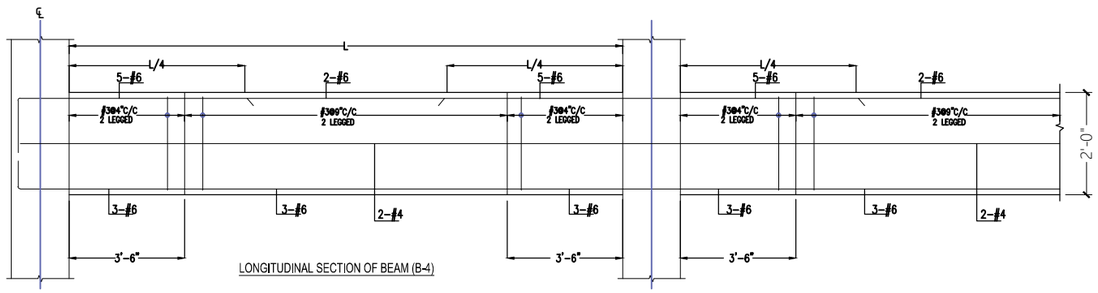
LONGITUDINAL SECTION OF BEAM (B2)





LONGITUDINAL SECTION OF BEAM (B-3)





LONGITUDINAL SECTION OF BEAM (B-4)

ISSUE FOR TENDER

NOTE:
-THE BARS WILL CONTINUE IN CONTINUOUS BEAMS AS PER REQUIREMENT OF STEEL OR CUT AT DEVELOPMENT LENGTH
-FIRST RING IS PLACED AT 2" FROM THE FACE OF THE SUPPORT
-CLEAR COVER OF 1.5" IS PROVIDED. AT INTERSECTIONS, STEEL OF BEAMS IN SHORTER DIRECTION IS REDUCED TO PASS THROUGH INTERSECTION
-PROVIDE 4" STIRRUPS UPTO A DISTANCE EQUAL TO TWICE THE MEMBER'S DEPTH ON BOTH SIDES OF BEAM TO BEAM INTERSECTION
-BEAM'S POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME
-THE BARS WILL BEND IN COLUMNS IF THE BEAM IS DISCONTINUED

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Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

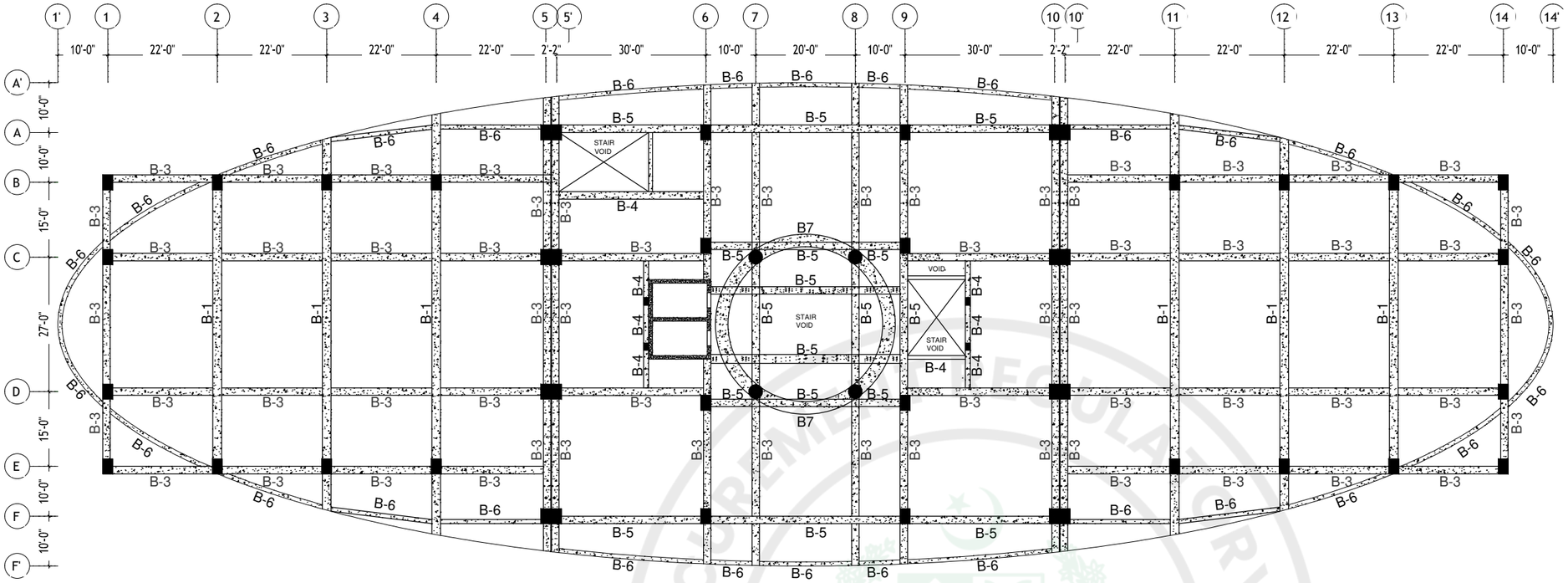
Detailed Structural Design Drawings

Sheet Name

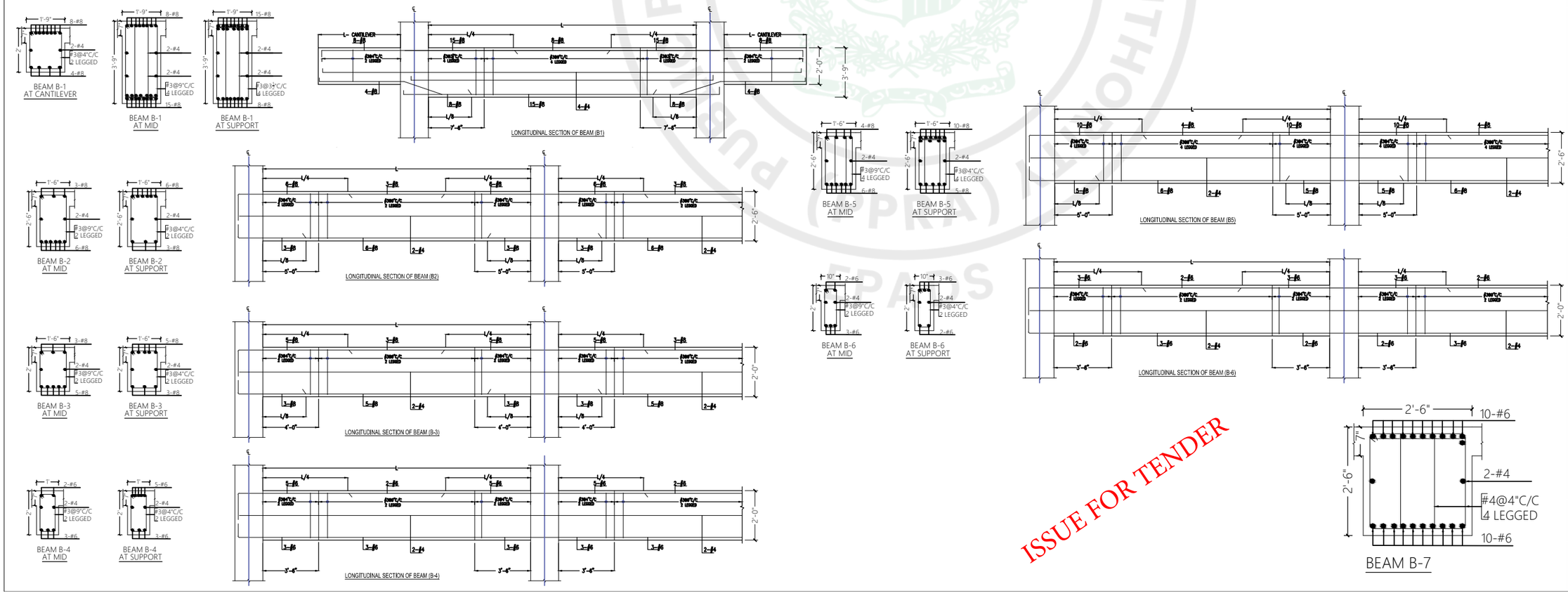
GROUND BEAMS DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-06

PROCUREMENT REGULATORY AUTHORITY
EPADS



MEZZANINE FLOOR BEAMS LAYOUT PLAN



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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

MEZZANINE BEAMS DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-07

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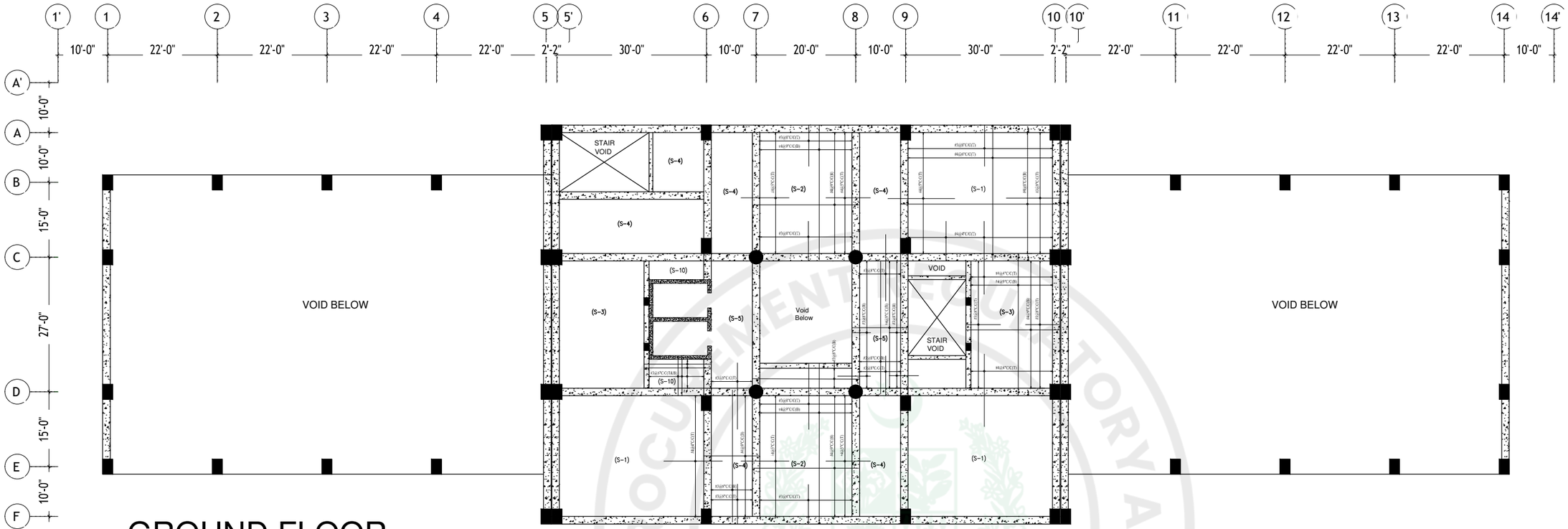

GROUND FLOOR SLAB REINFORCEMENT PLAN THICKNESS 7"

NOTE:

-PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
-PROVIDE 3#6 BARS WITH BOTTOM REINFORCEMENT UNDER THE WALLS IF CONSTRUCTED DIRECTLY ON SLAB
-ALT BOTTOM STEEL IS CURTAILED AT L/8 AND TOP STEEL IS CUT AT L/3 OF THE SPAN
-CONSIDER CONTINUOUS AND DIS-CONTINUOUS EDGES WHILE LAYING TOP STEEL BARS
-FOR DIS-CONTINUOUS EDGE, BEND THE END OF BARS WITHIN SLAB THICKNESS
-FOR POSITIVE REINFORCEMENT, PLACE BARS ALONG LONGER SPAN ON TOP OF BARS PLACED ALONG SHORTER SPAN
-BEAMS POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME

ISSUE FOR TENDER

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

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Project Name

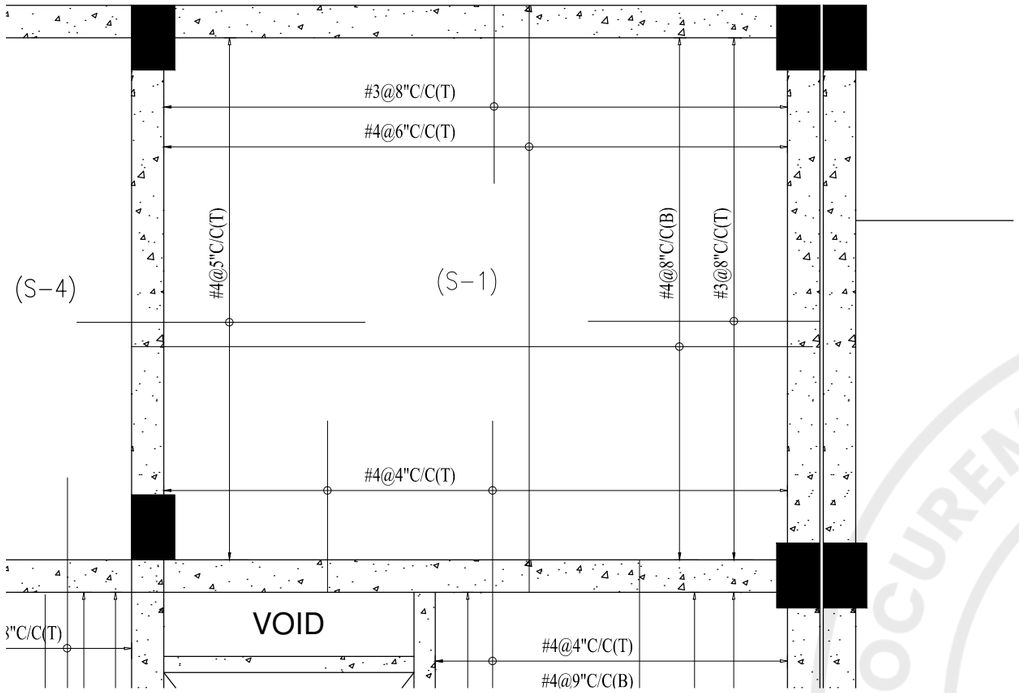
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

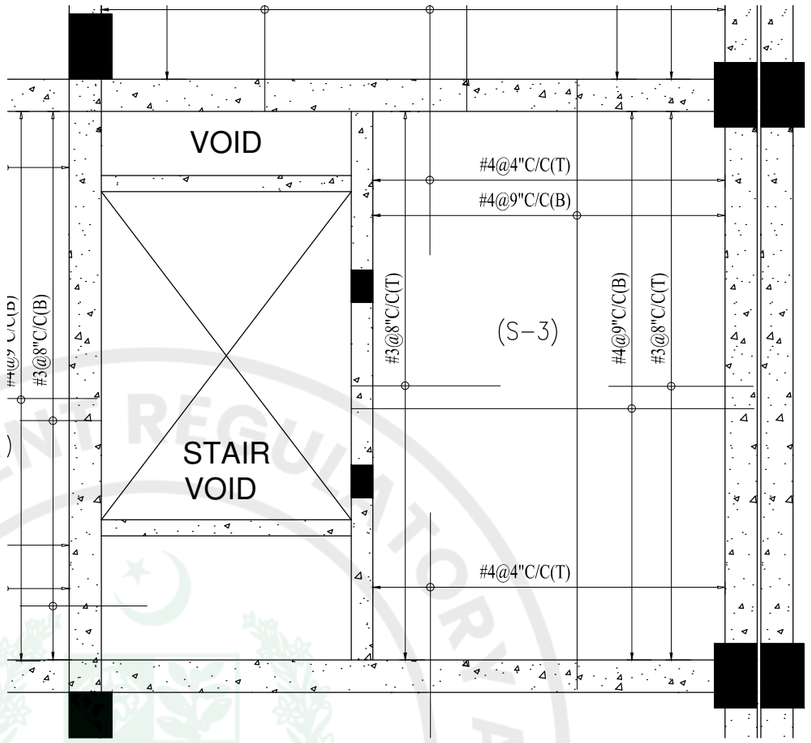
Detailed Structural Design Drawings

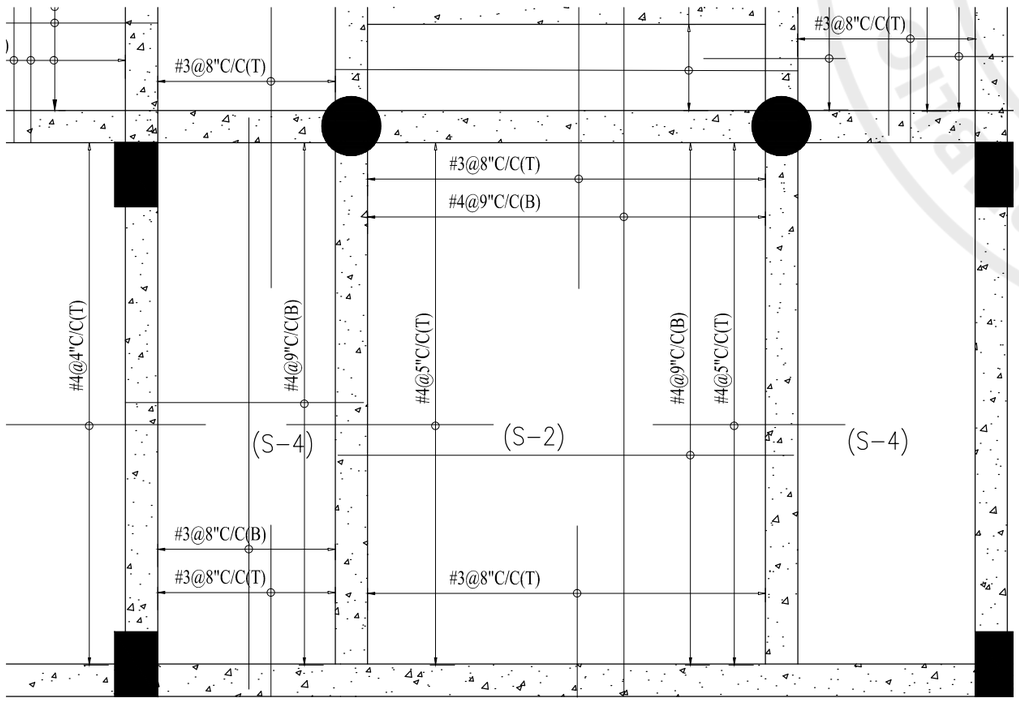
Sheet Name

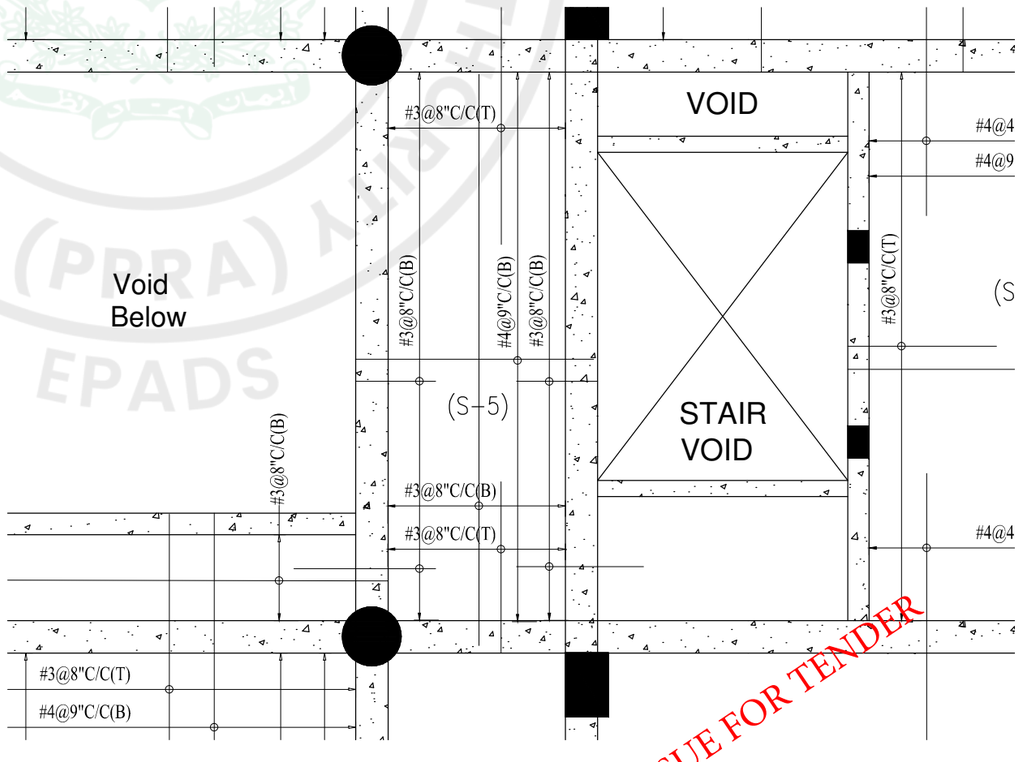
GROUND FLOOR SLAB DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-08









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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

GROUND FLOOR SLAB DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-09

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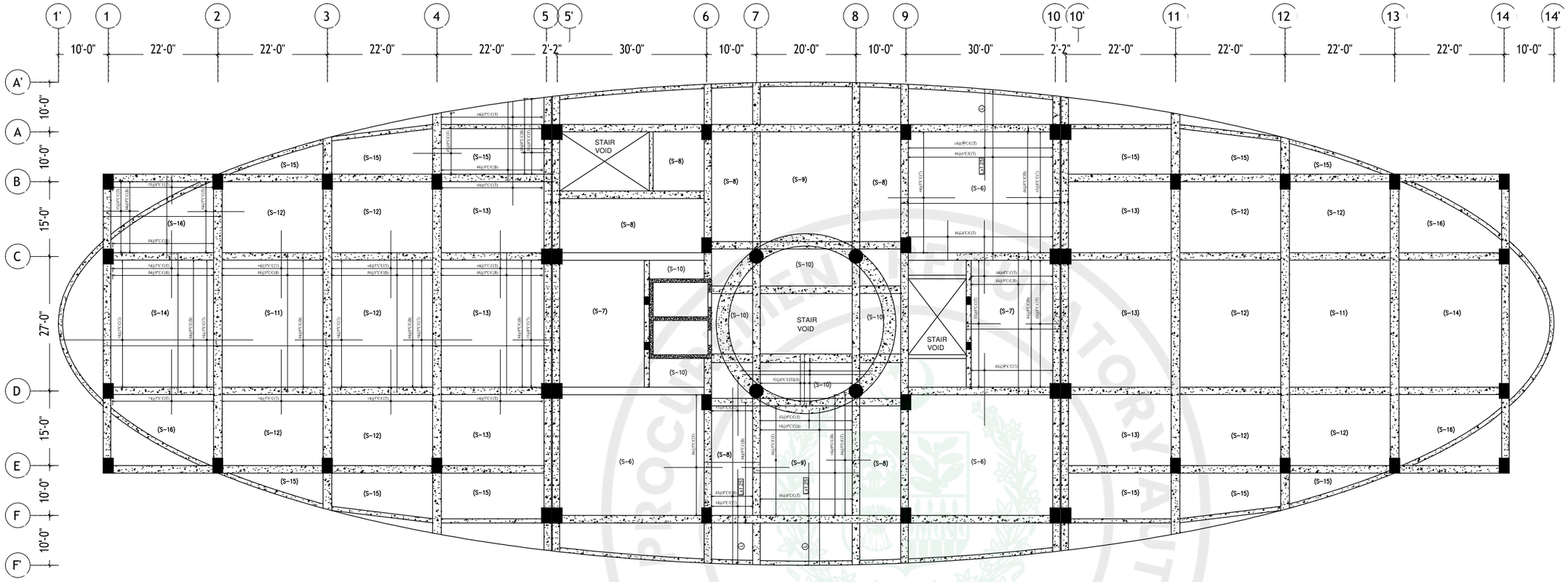

MEZZANINE FLOOR SLAB REINFORCEMENT PLAN THICKNESS 7"

NOTE:

-PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
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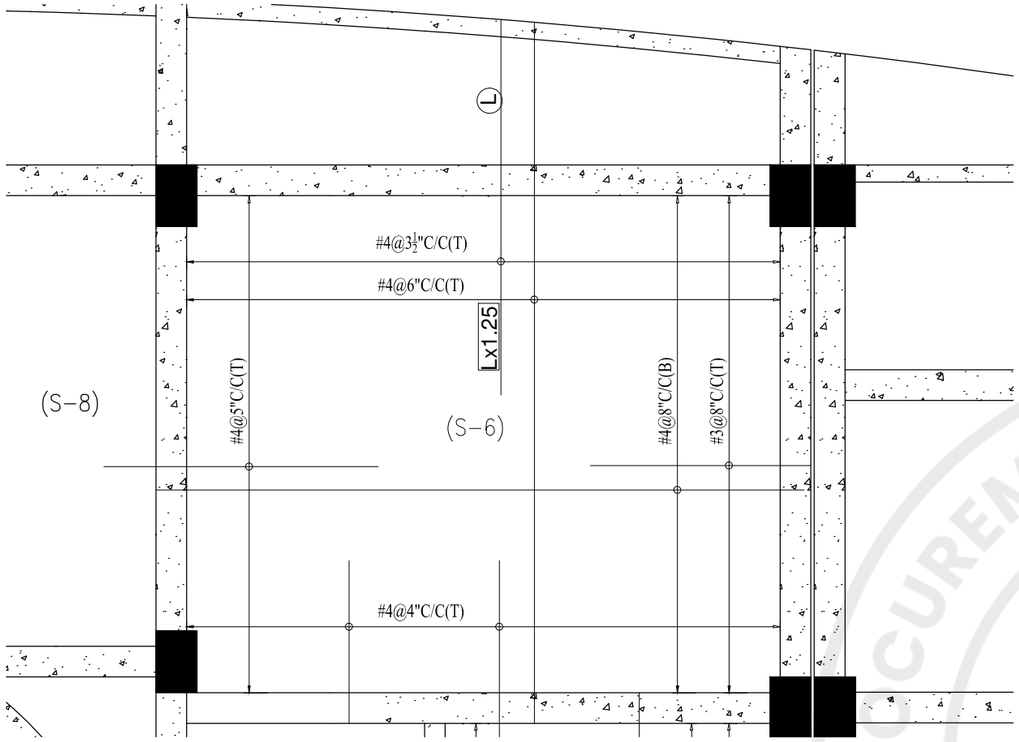
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

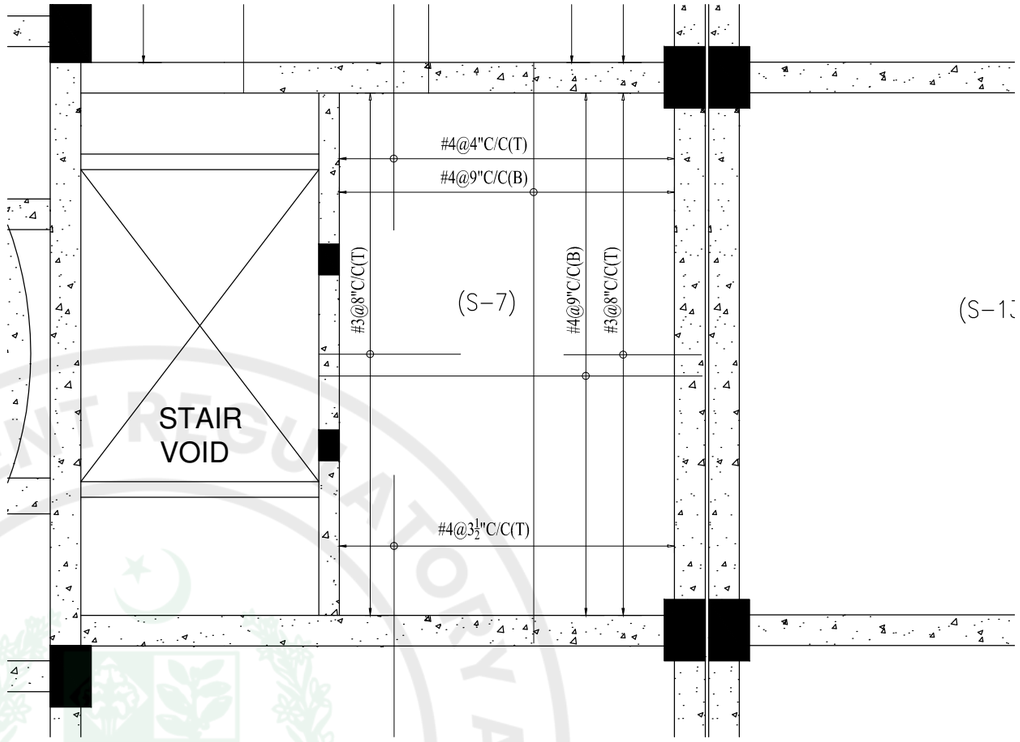
Detailed Structural Design Drawings

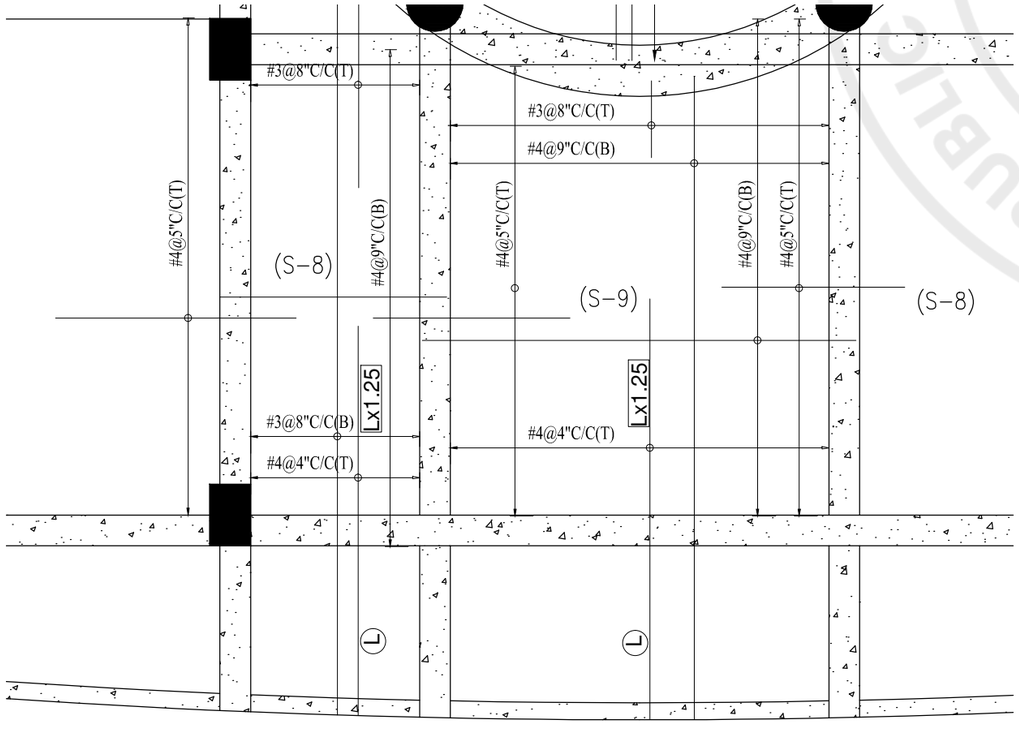
Sheet Name

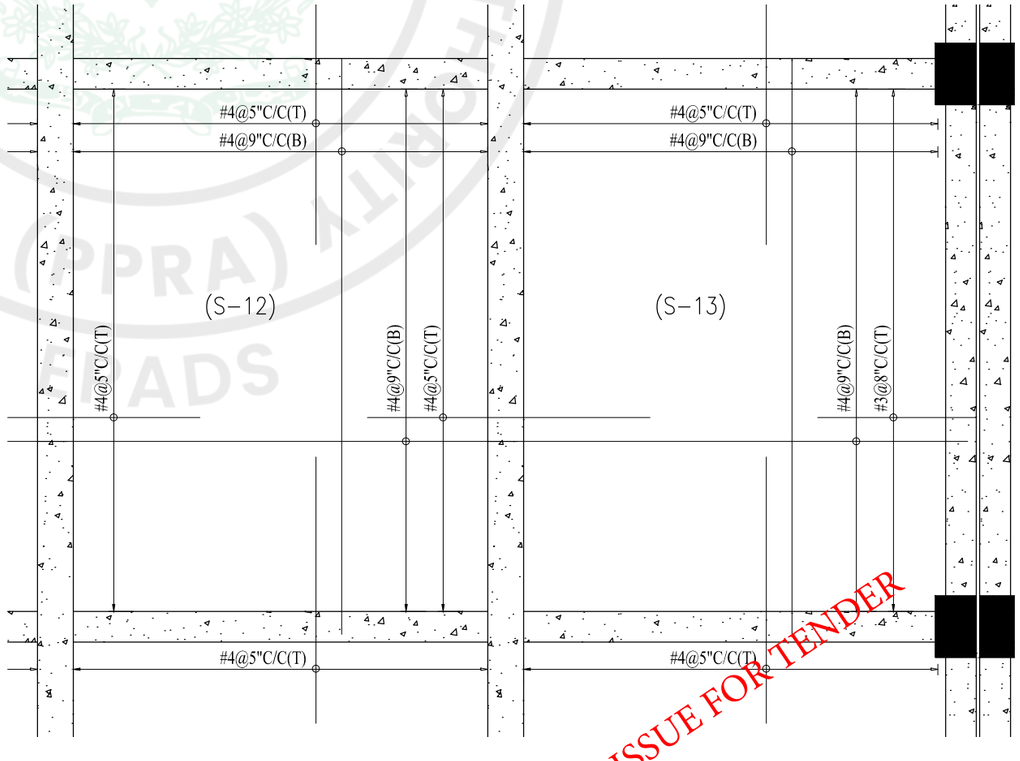
MEZZANINE FLOOR SLAB DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-10









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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

MEZZANINE FLOOR SLAB DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-11

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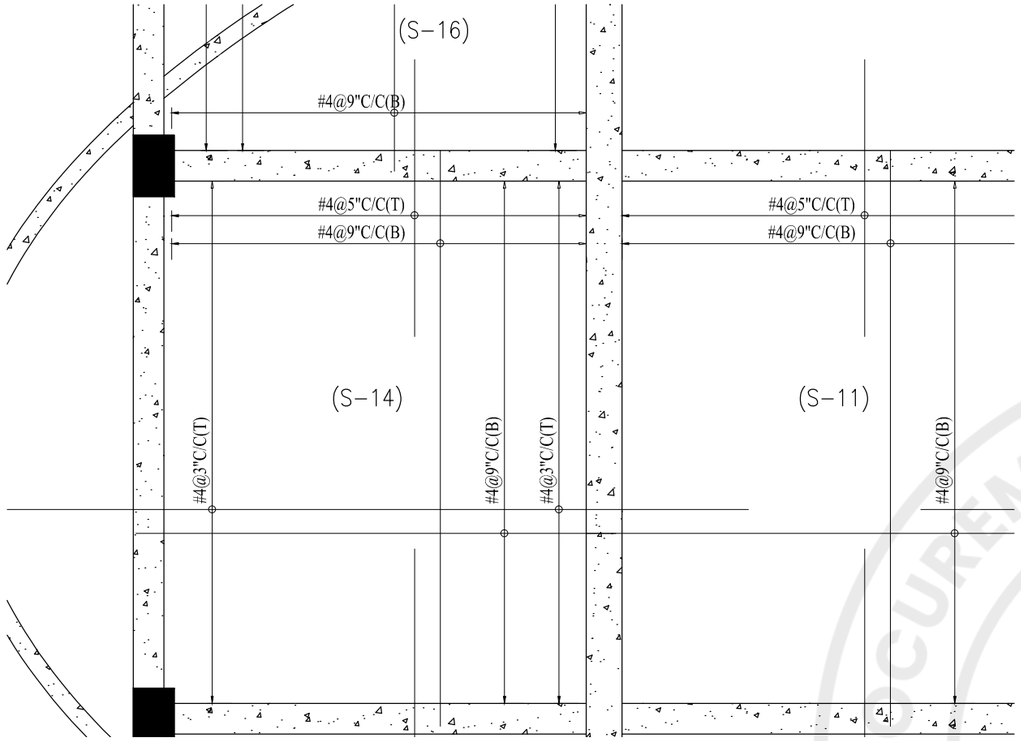

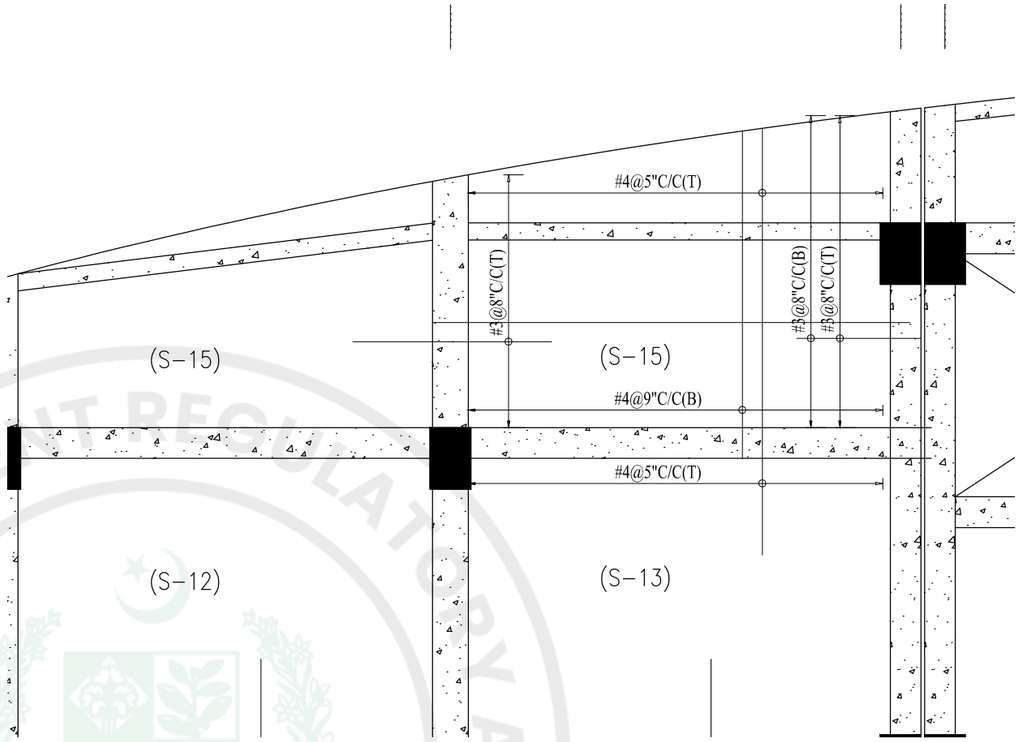

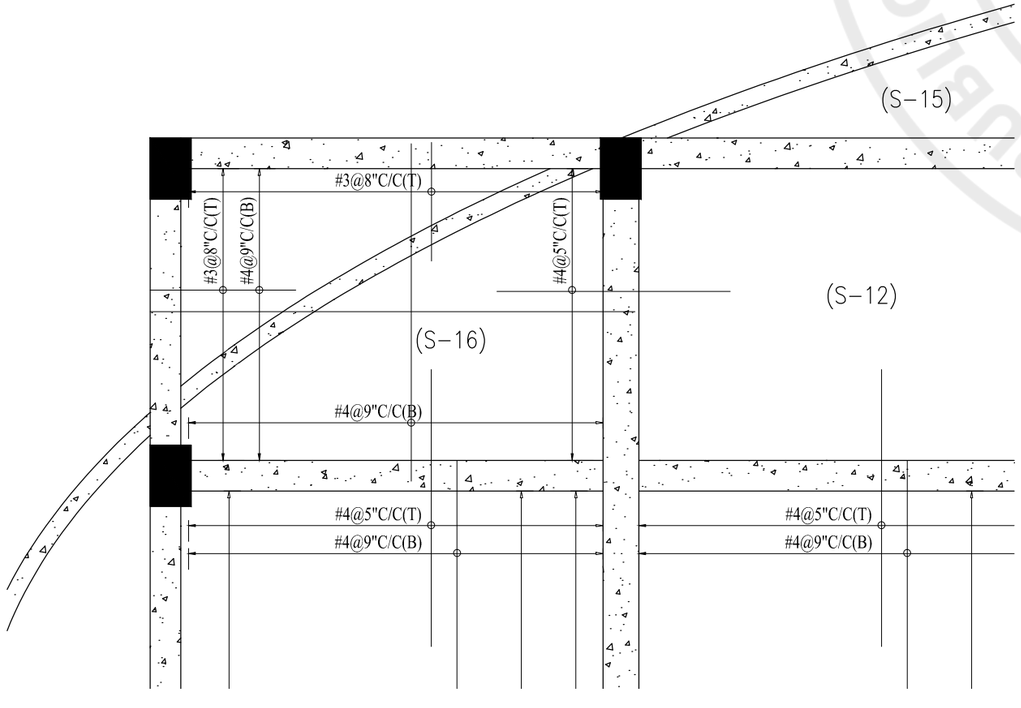

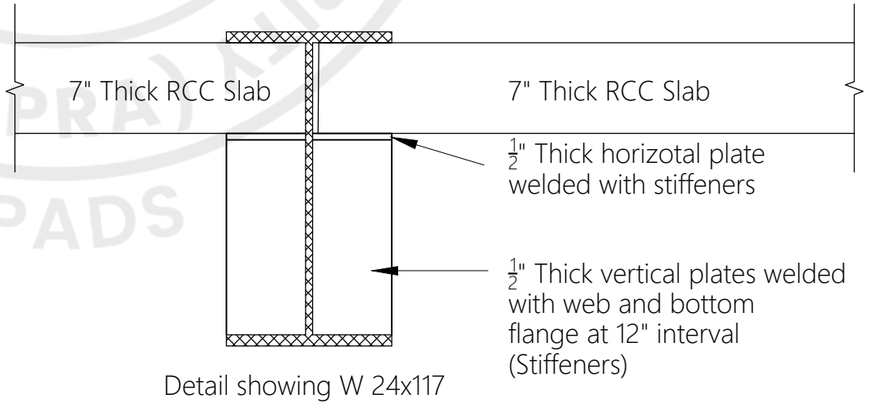

Detail showing W 24x117 supporting RCC slab

ISSUE FOR TENDER

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

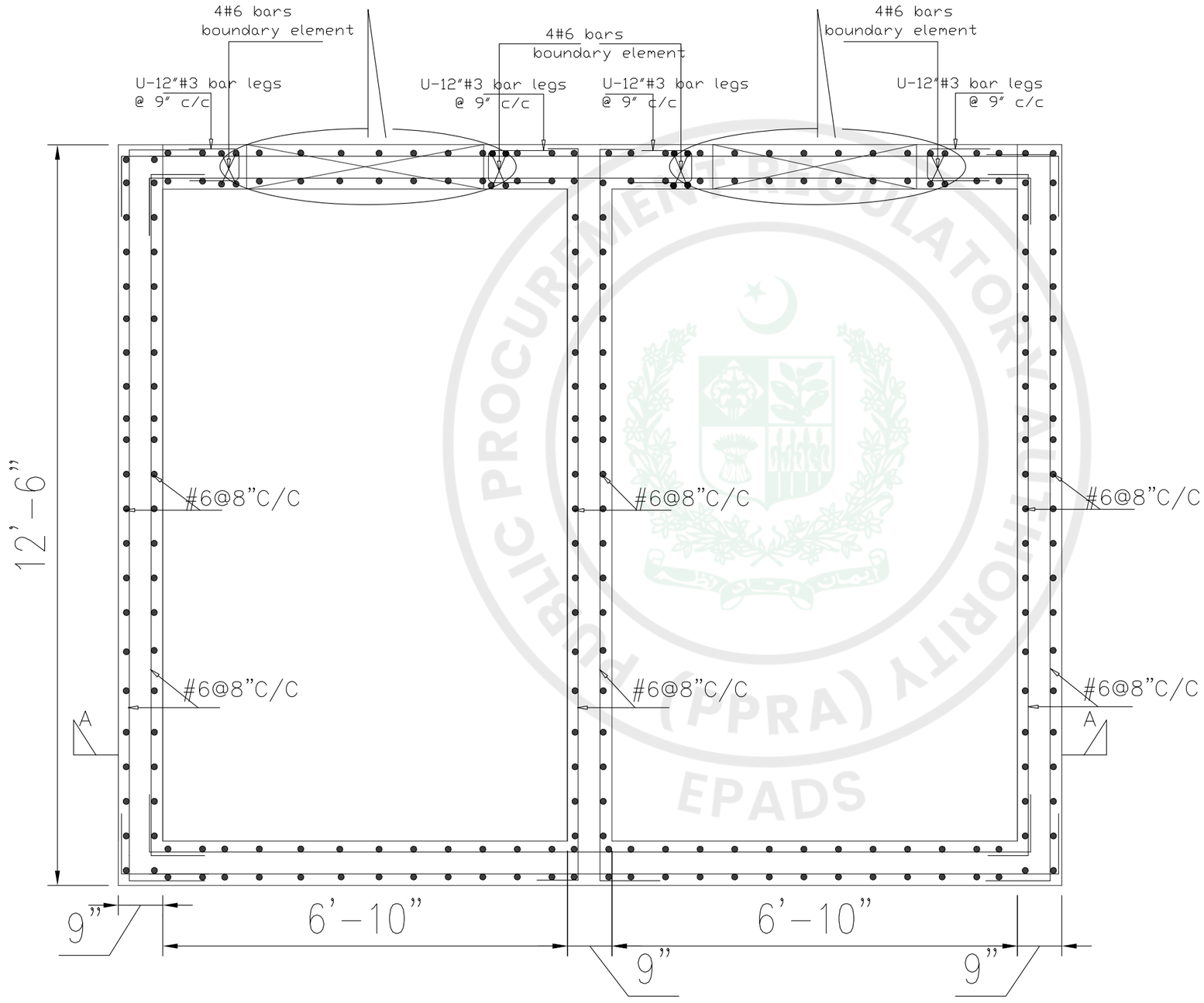
Sheet Name

MEZZANINE FLOOR SLAB DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-12

PROVIDE HORIZONTAL BORDER ELEMENT
IN BORDER ELEMENT AT DOOR OPENING.
REINFORCEMENT WILL BE CURTAILED
BOUNDARY ELEMENT IS 9"X12"
ON TOP OF DOOR OPENINGS, CONTAINING
4#4 BARS TIED WITH #3 RINGS AT
9" C/C AND EXTENDING 9" FROM

PROVIDE HORIZONTAL BORDER ELEMENT
IN BORDER ELEMENT AT DOOR OPENING.
REINFORCEMENT WILL BE CURTAILED
BOUNDARY ELEMENT IS 9"X12"
ON TOP OF DOOR OPENINGS, CONTAINING
4#4 BARS TIED WITH #3 RINGS AT
9" C/C AND EXTENDING 9" FROM



LIFT WELL REINFORCEMENT PLAN

ISSUE FOR TENDER

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International Airport

Detailed Structural Design Drawings

Sheet Name

LIFT WELL REINFORCEMENT DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-13

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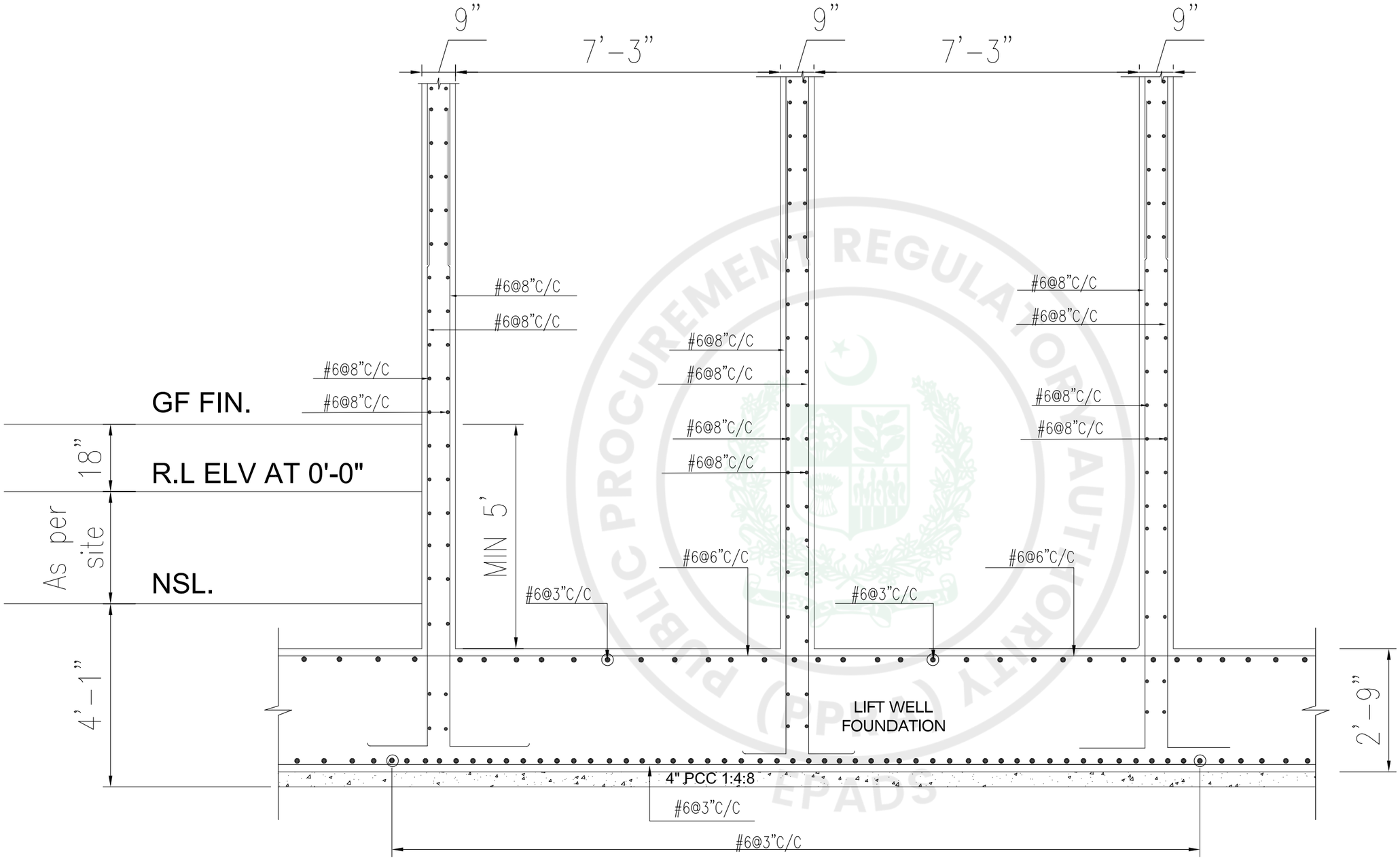

SECTION OF LIFT WELL AT A-A

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Detailed Structural Design Drawings

Sheet Name

LIFT WELL REINFORCEMENT DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-14

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1. ALL DIMENSIONS, SPACING ARE IN MM & UNLESS OTHERWISE SPECIFIED.

LIST OF DRAIWNGS

S-1	ISO VIEW PLAN
S-2	BASE PLATE LAYOUT PLAN
S-3	SPACE FRAMING LAYOUT PLAN
S-4	ROOF SHEETING PLAN
S-5	LONGITUDINAL SECTION
S-6	LONGITUDINAL SECTION DETAILS
S-7	CROSS SECTION DETAILS
S-8	SIDE ELEVATION
S-9	SPACE FRAME TYP. CONNECTION DETAILS
S-10	ROOF SHEETING DETAILS

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Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

BUILDING COVERED AREA STATEMENT

REV	DRAWN BY	CHECKED BY	SUBMITTED DATE
0	HUZIAFA.K		15-01-2026

ISSUED FOR APPROVAL

SENT ON .....

IN ORDER TO SCHEDULE THIS PROJECT IN THE MOST EFFICIENT MANNER, RETURN THESE DOCUMENTS, MARKED WITH YOUR COMMENTS, WITHIN ONE WEEKS FROM THE ABOVE MENTIONED DATE

ANY CHANGES MADE AFTER APPROVAL OF THESE DRAWINGS MAY DELAY

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   NO CHANGES. PROCEED WITH CONSTRUCTION.
2. ☐ APPROVED AS NOTED
   EXECUTION MAY PROCEED ON THE BASIS OF CORRECTIONS INDICATED.
3. ☐ NOT APPROVED, RE-SUBMIT FOR APPROVAL.
4. ☐ THESE DRAWINGS ARE NOT FOR CONSTRUCTION.

REVIEWED BY .....

NAME

..... SIGNATURE

..... DATE

BUILDING LOADS & DESIGN CODES:

1.	BUILDING CODE	AISC-LRFD
2.	DESIGN LIVE LOAD	0.570 KN/m²
3.	DEAD LOAD (KN/m²)	SELF WEIGHT
4.	CO-LATERAL LOAD	0.1 KN/m²
5.	WIND SPEED (km/h)	160
6.	SNOW LOAD	N/A
7.	SEISMIC ZONE	2B
8.	CLOSURE	ENCLOSED
9.	EXPOSURE	C

ISSUE FOR TENDER

DESIGN DRAWINGS

STRUCTURE TYPE:

SPACE FRAME STRUCTURE

PROJECT:

SPACE FRAME STRUCTURE
ATCT

LOCATION:

SKARDU , PAKISTAN

CLIENT:

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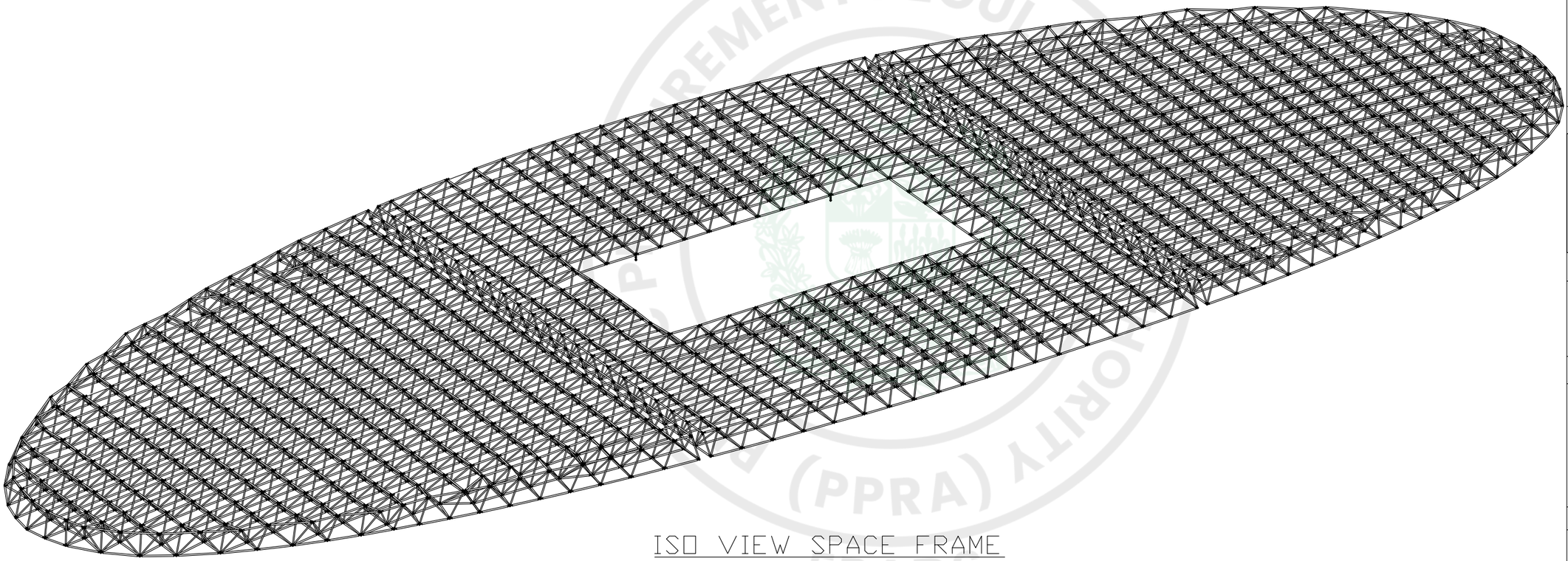

ISO VIEW SPACE FRAME

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

ISO VIEW SPACE FRAME

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-15

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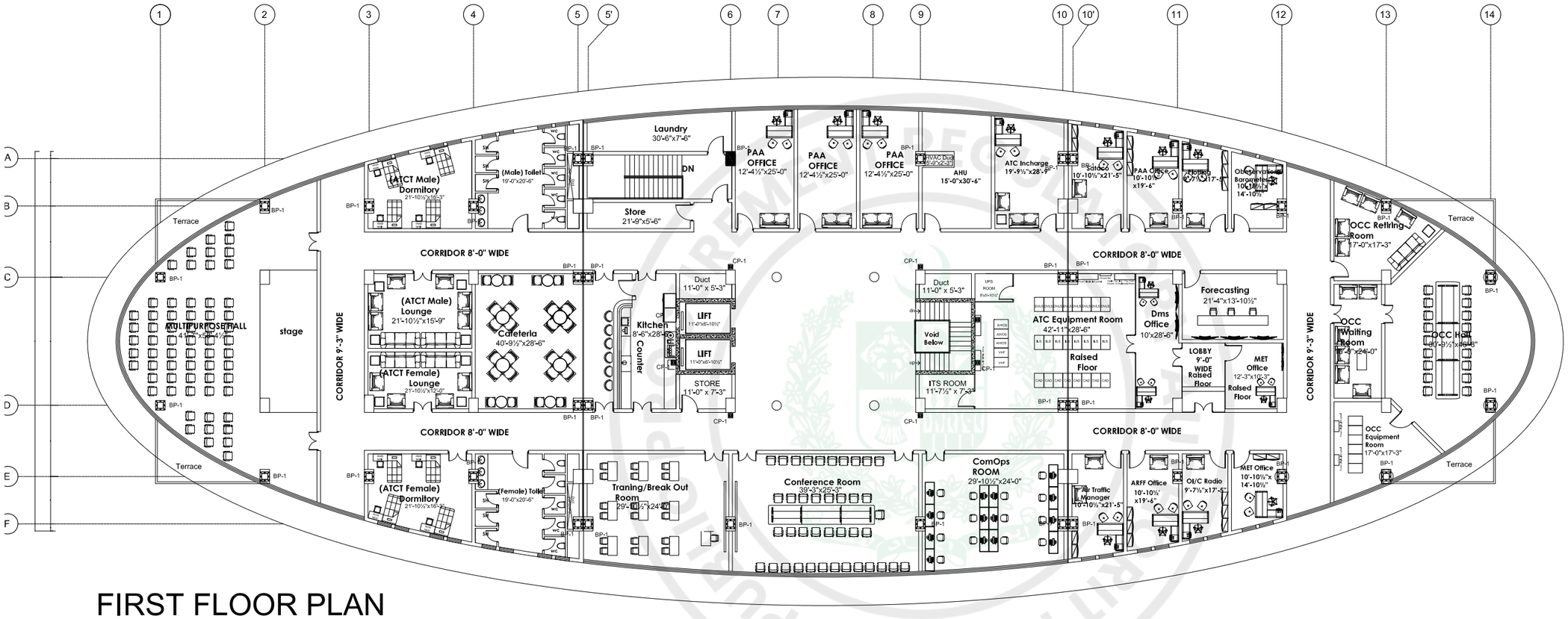
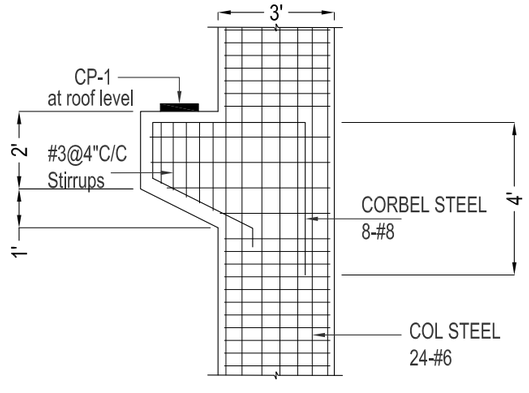


FIRST FLOOR PLAN

Covered Area = 27439 Sft

BASE PLATE & COLUMN LAYOUT PLAN



DETAIL "1"

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

BASE PLATE & COL LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-16

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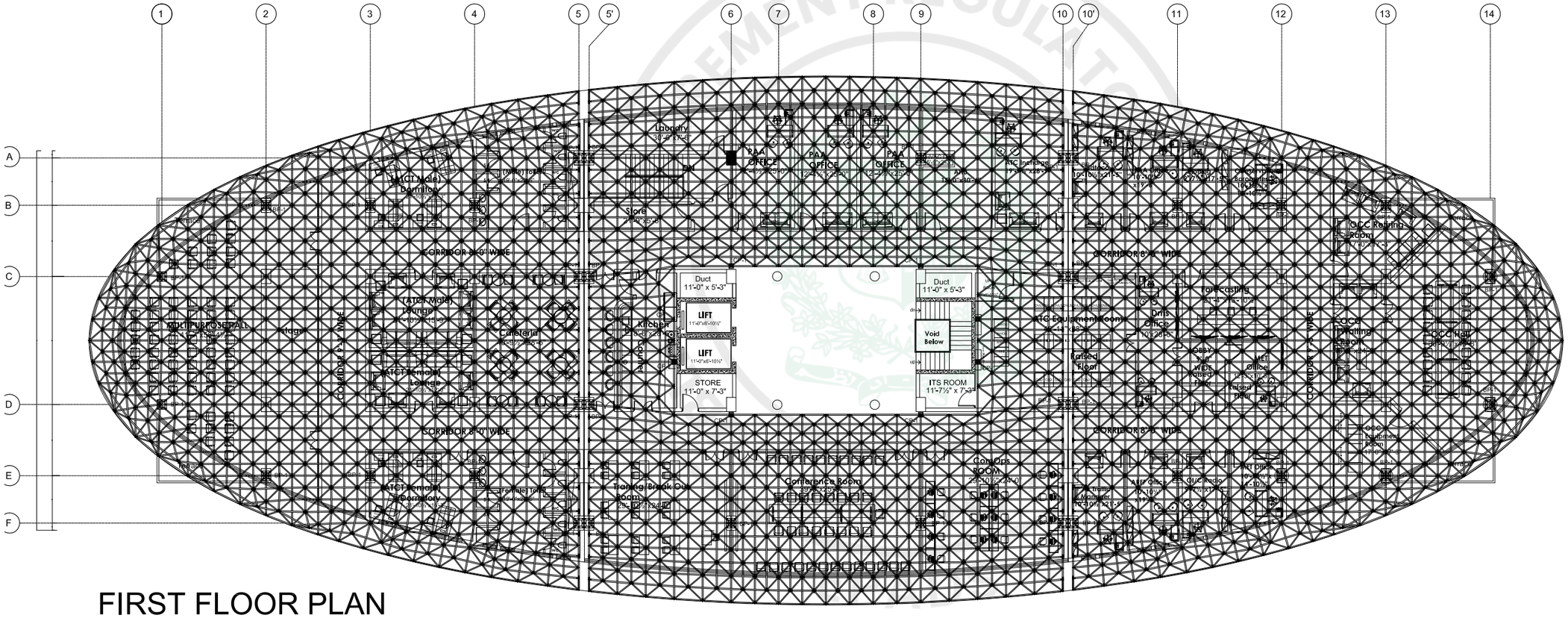

FIRST FLOOR PLAN

Covered Area = 27439 Sft

SPACE FRAMING LAYOUT PLAN

ISSUE FOR TENDER

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Detailed Structural Design Drawings

Sheet Name

SPACE FRAME LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-17

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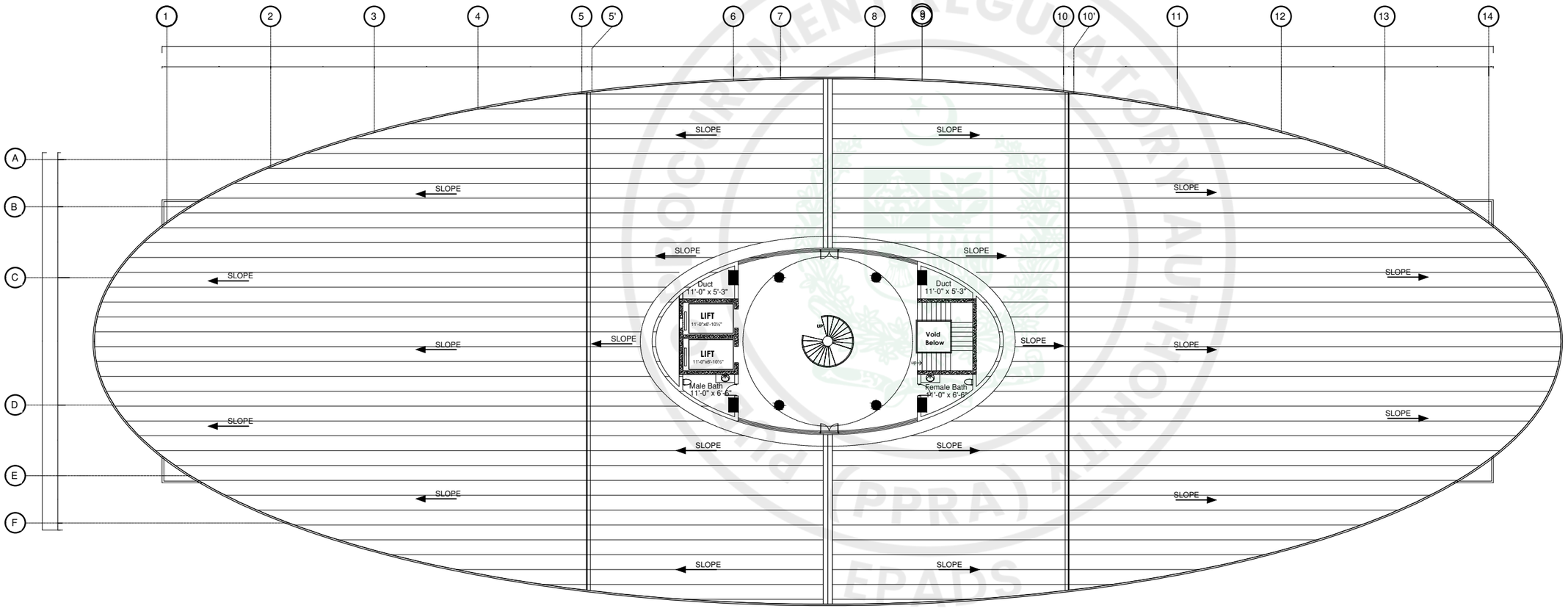

ROOF FLOOR PLAN LEVEL AT 46'-0"
COVERED AREA 2792 Sft

ROOF SHEETING PLAN

ISSUE FOR TENDER

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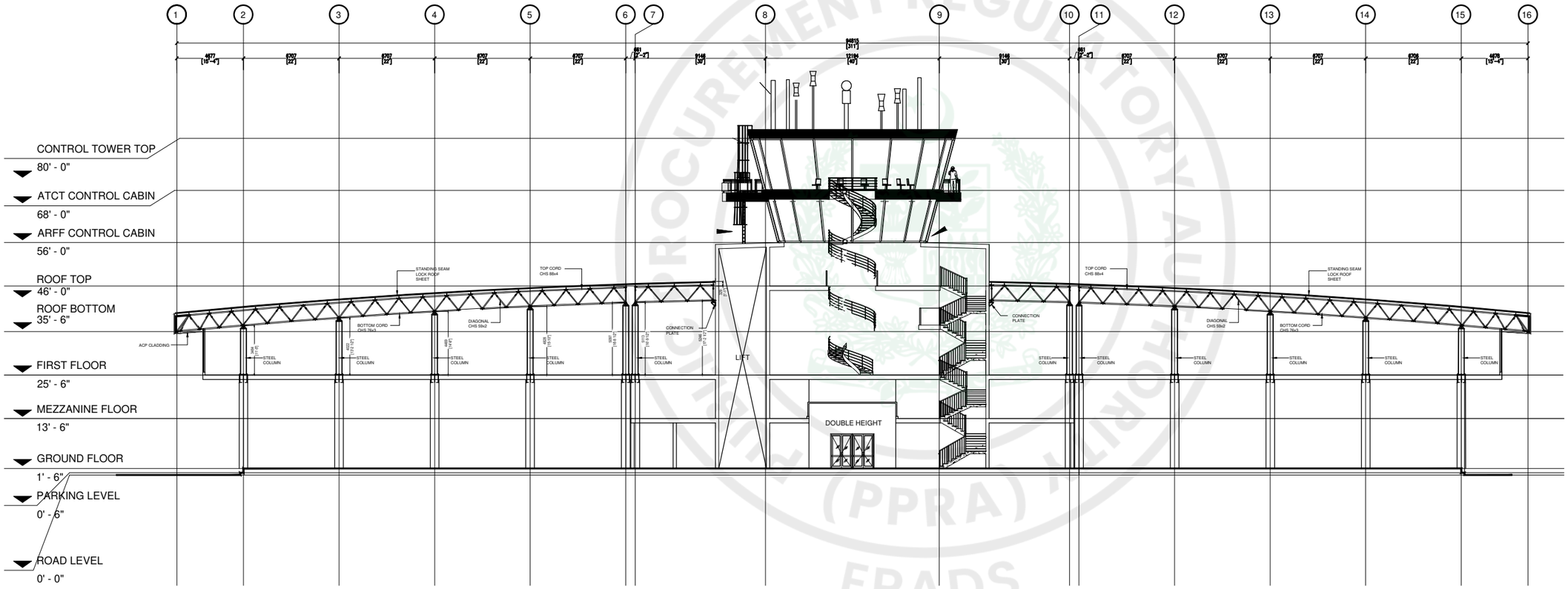
New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

ROOF SHEETING PLAN

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-18



LONGITUDINAL SECTION

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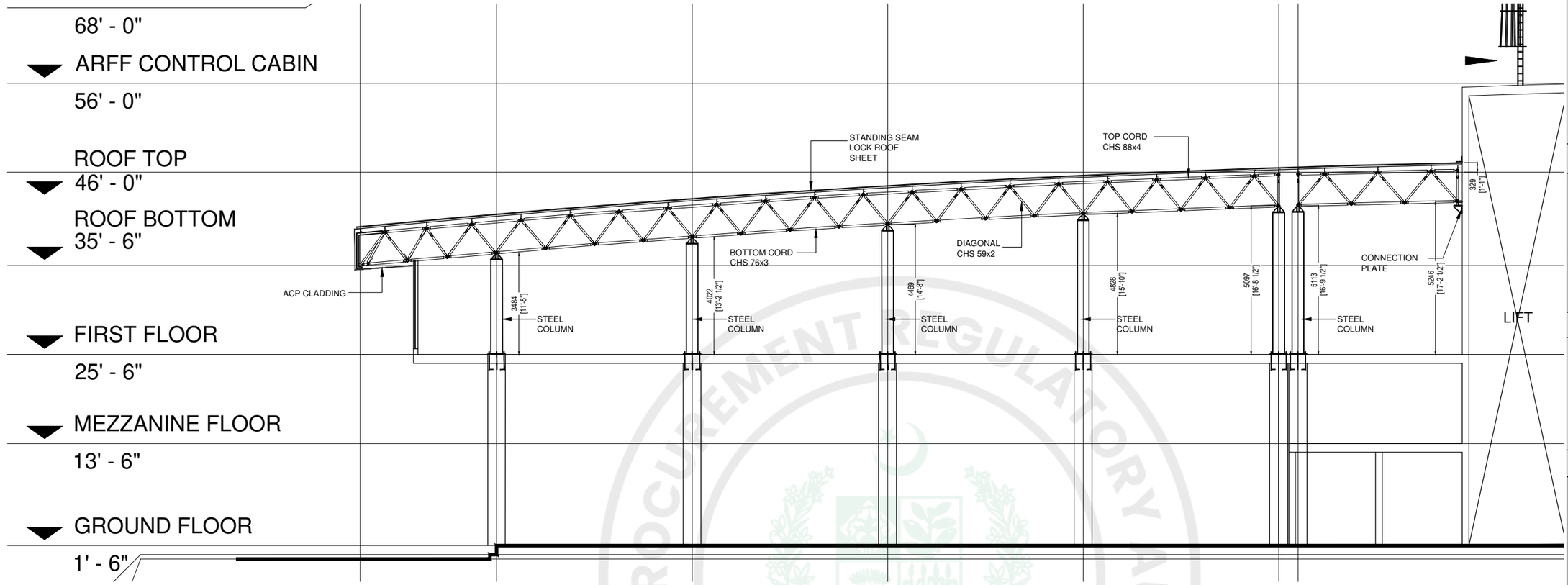
Detailed Structural Design Drawings

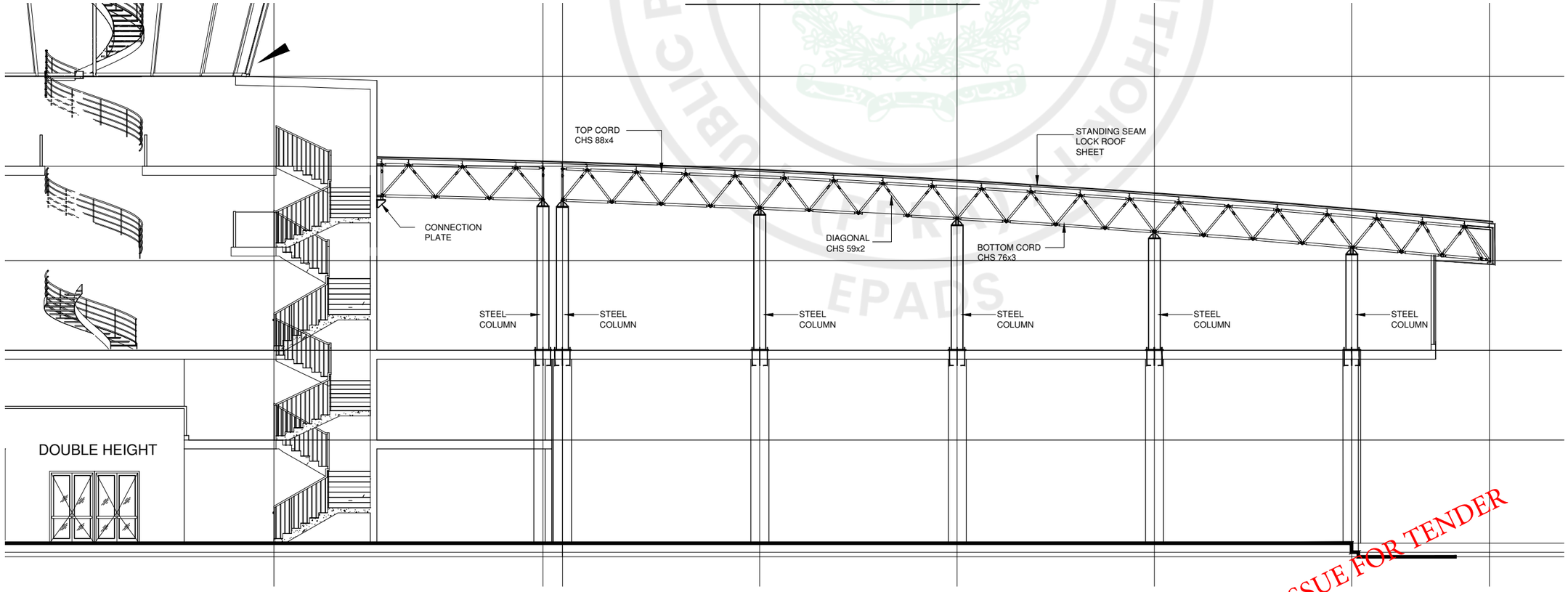
Sheet Name

LONGITUDINAL SECTION

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-19



LONGITUDINAL SECTION



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Project Name

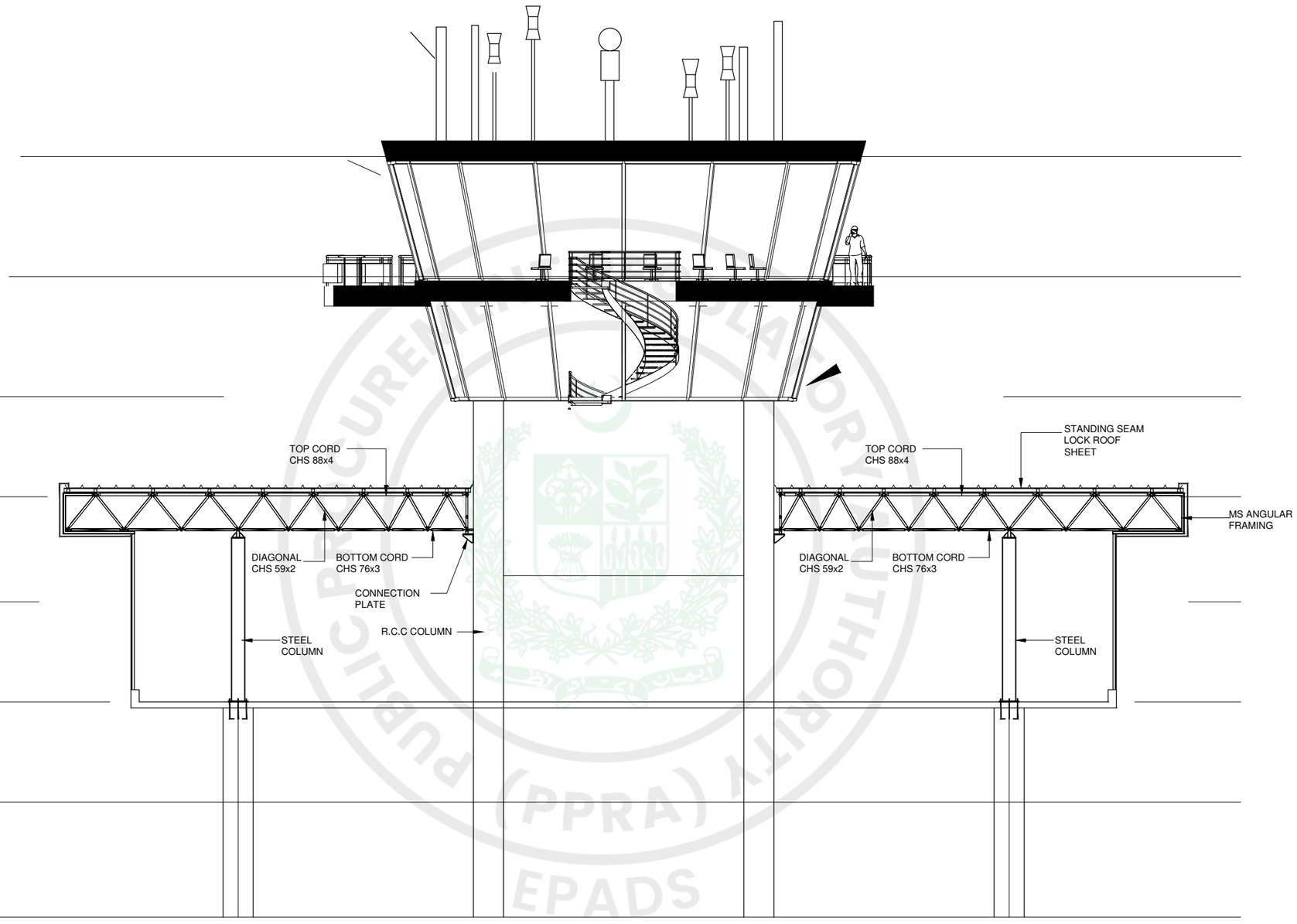
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

SECTIONS

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-20



CROSS SECTION

ISSUE FOR TENDER

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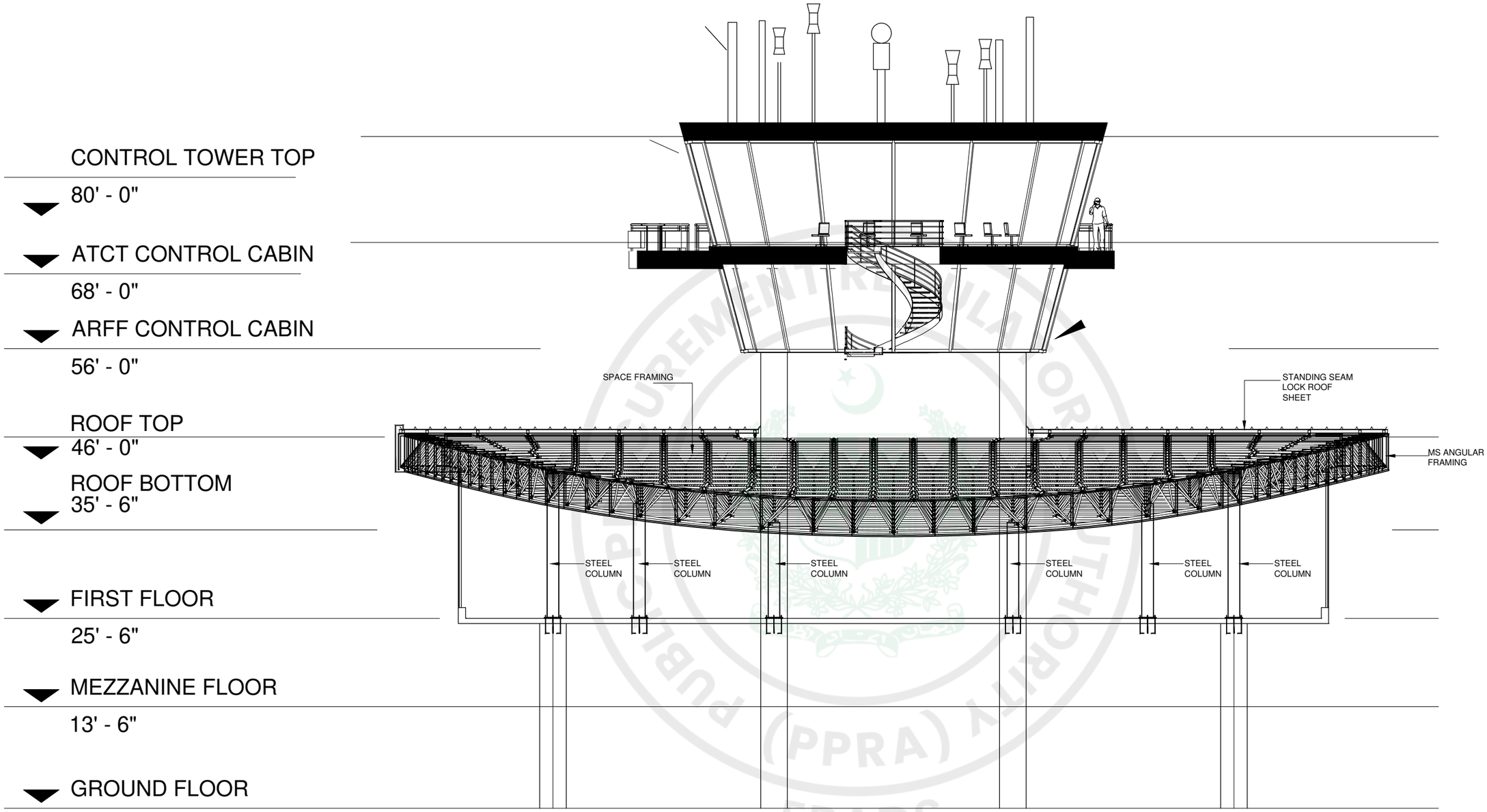
Detailed Structural Design Drawings

Sheet Name

SECTIONS

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-21



SIDE ELEVATION

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

SIDE ELEVATION

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-22

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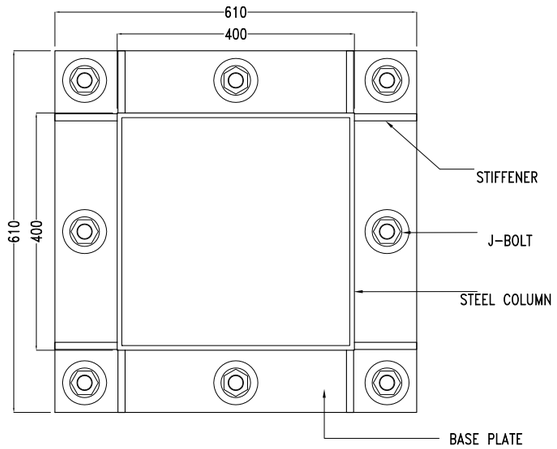
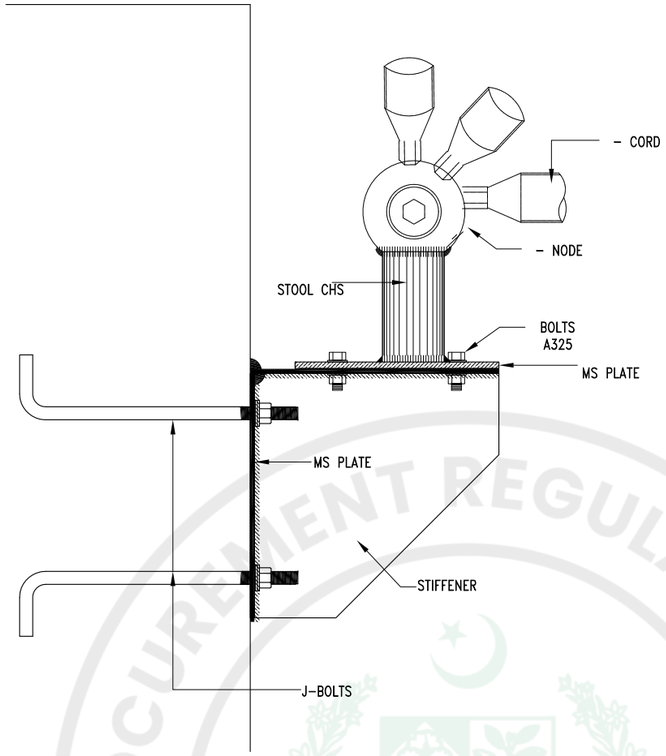
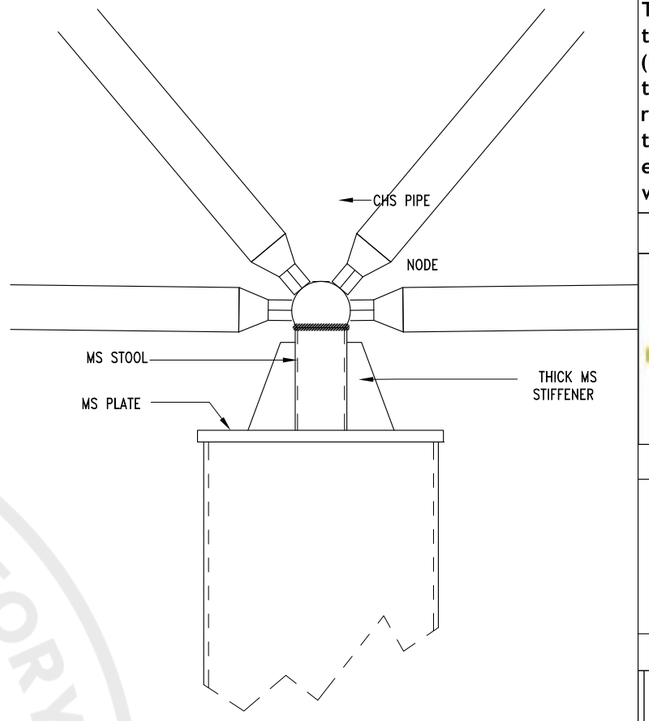


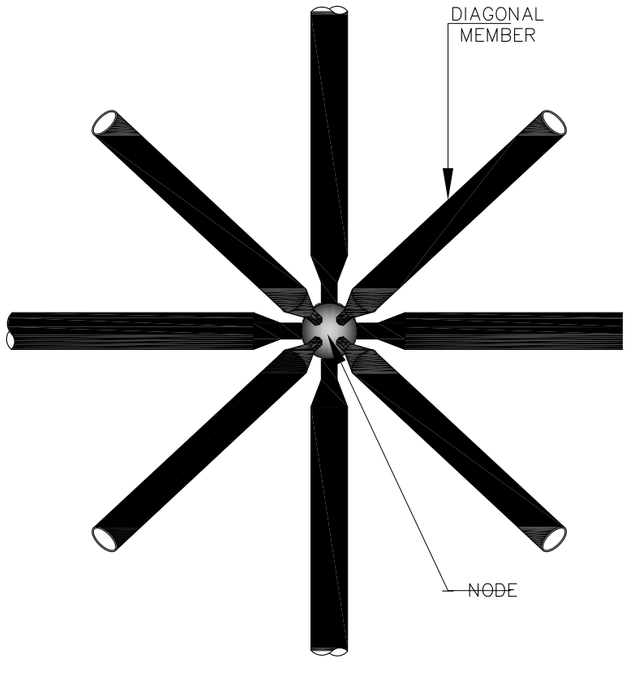
BASE PLATE -1
(BP-1)



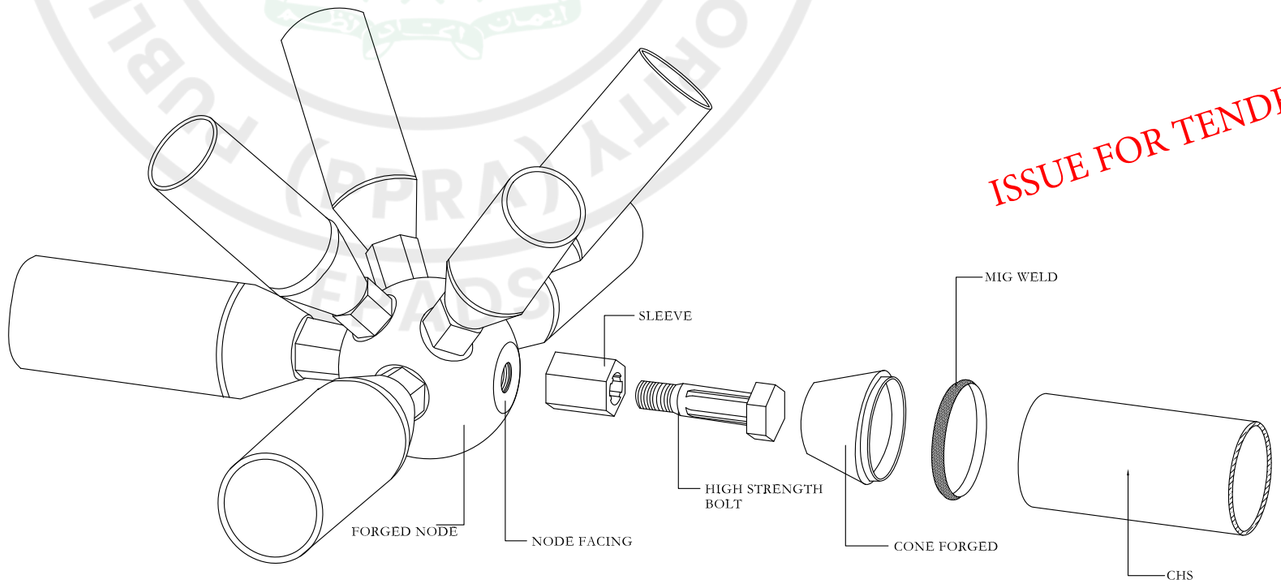
CONNECTION PLATE -1
(CP-1)



SUPPORTING COLUMN DETAIL



CORD CONNECTION PLAN



CORD CONNECTION DETAIL

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Detailed Structural Design Drawings

Sheet Name

DETAILS

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-23

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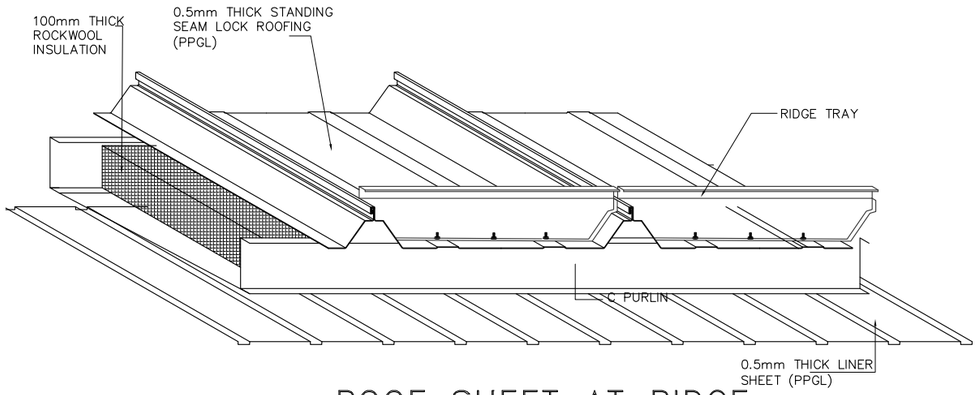
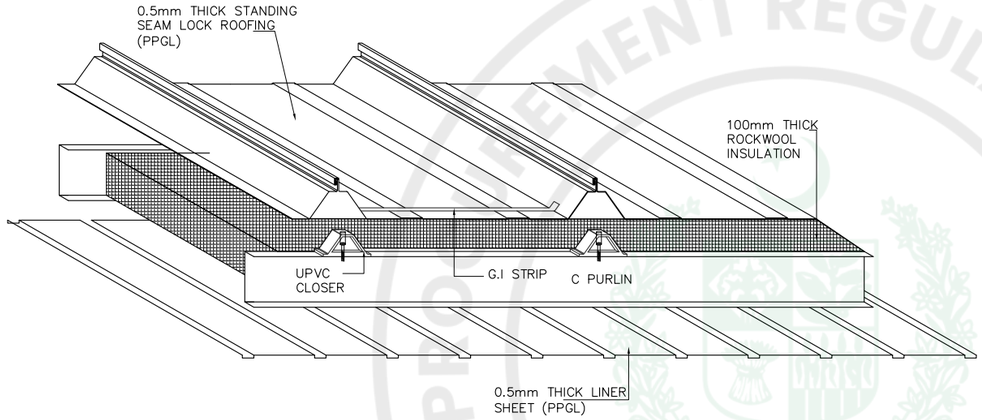
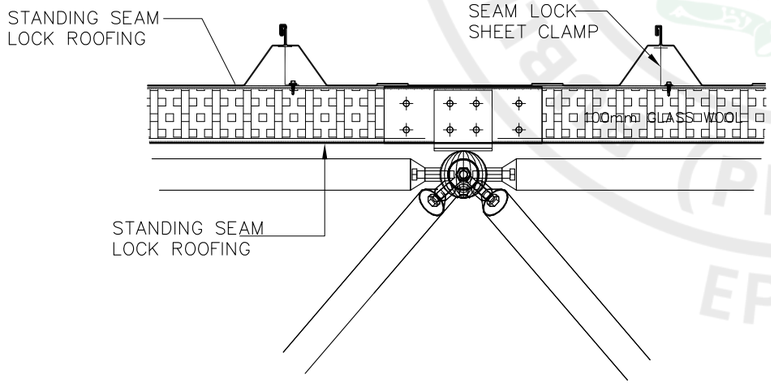
STEEL COLUMN



ROOF SHEET AT RIDGE



ROOF SHEET AT EAVE



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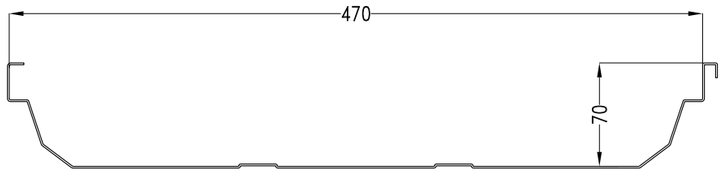
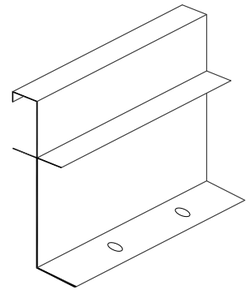
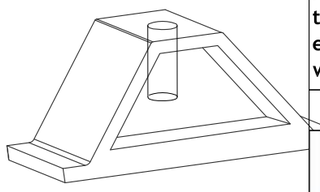


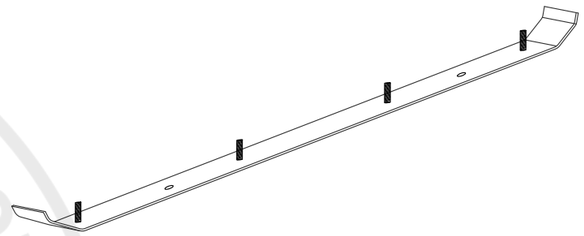
STANDING SEAM LOCK SHEET PROFILE



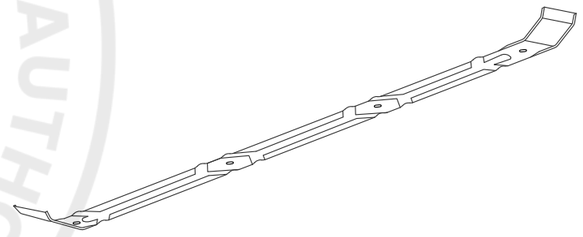
SEAM LOCK CLAMP



PVC STOPPER



G-I BOLT STRIP



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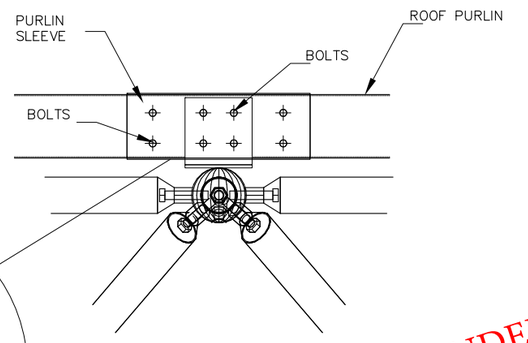

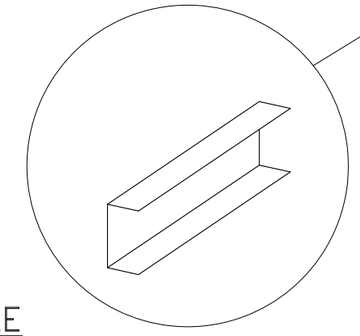

PURLIN CONNECTION

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Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

DETAILS

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-24

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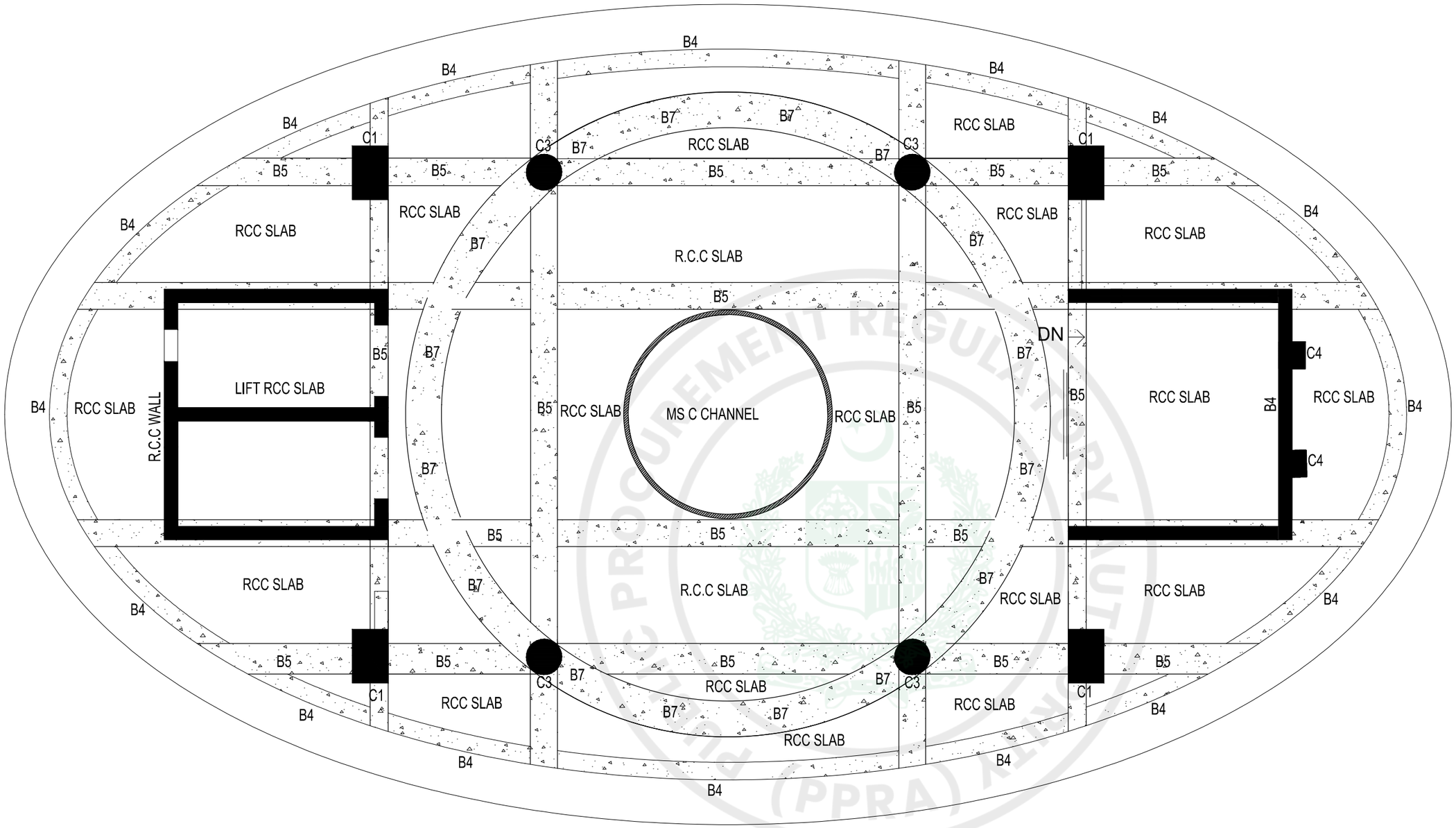

REF DWGS: S-4, S-6, S-7 for RCC COLUMNS & BEAMS

SLABS AND BEAMS ARE CURVED AS PER ARCHITECTURAL DRAWINGS

RCC SLABS ARE 7" THICK WITH #4@6"C/C DOUBLE MESH BOTH WAYS

LIFT SLAB IS 9" THICK WITH #6@6"C/C DOUBLE MESH BOTH WAYS

ISSUE FOR TENDER

RCC BEAM PLAN

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MEP CONSULTANT

Project Name

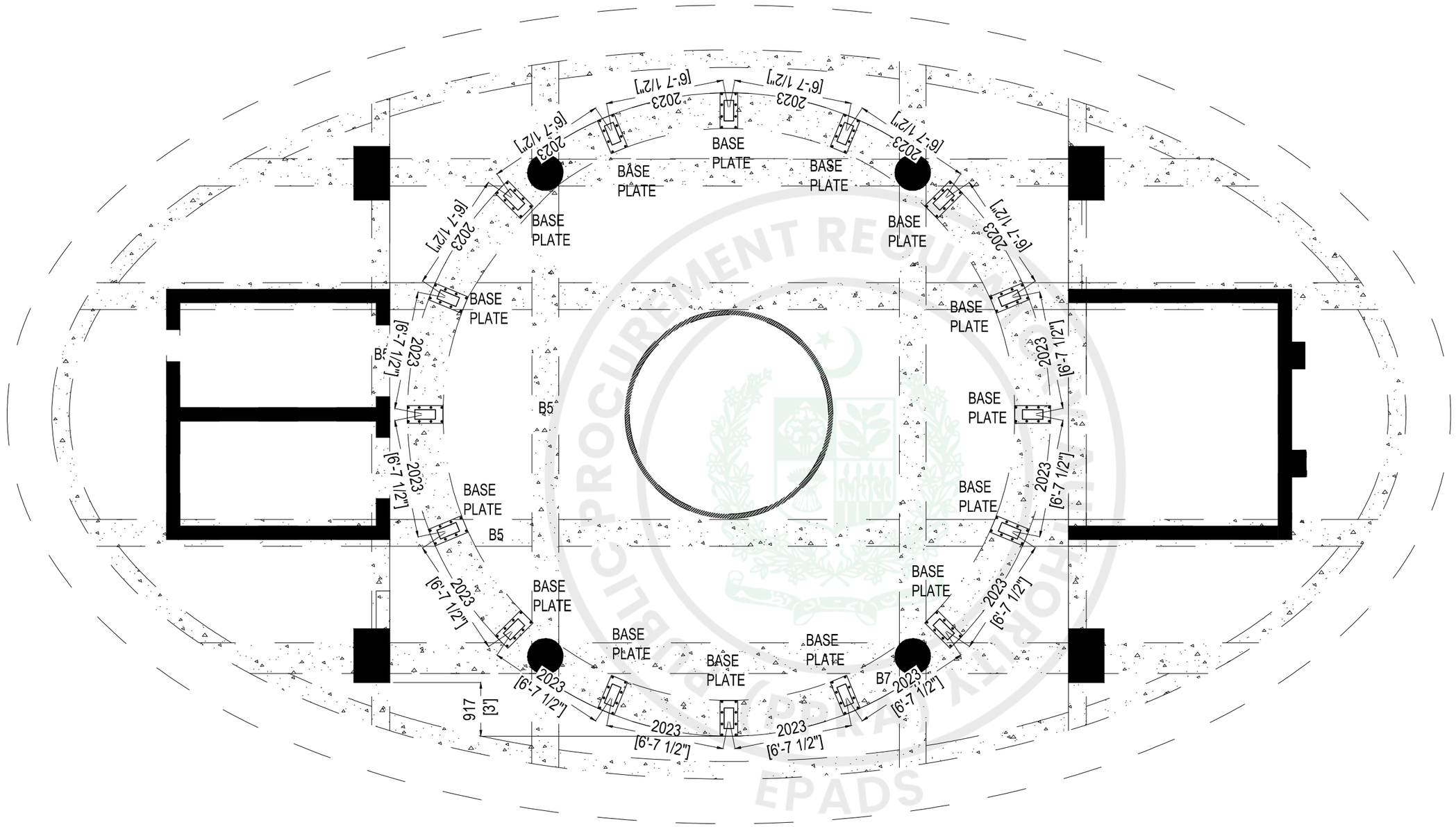
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

RCC BEAM PLAN

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-25



ISSUE FOR TENDER

COLUMN SCHEDULE			
	SIZE	T	GRADE
RHS- COLUMN	300x175	16mm	50

COLUMNS & BASE PLATE PLAN

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MEP CONSULTANT

Project Name

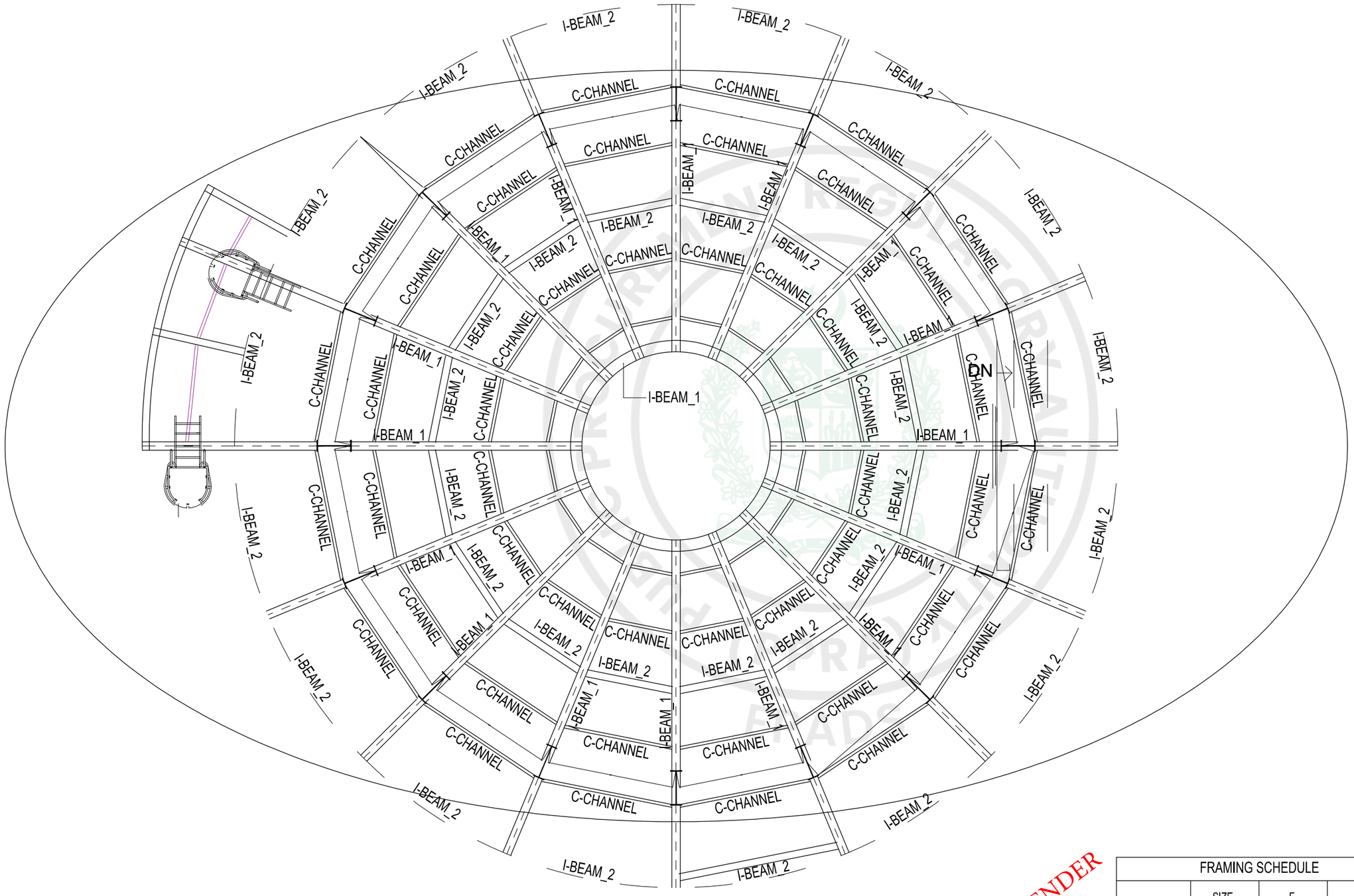
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

COL & BASE PLATE PLAN

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-25A



ATCT CABIN FLOOR PLAN

ISSUE FOR TENDER

FRAMING SCHEDULE			
	SIZE	F	W
I- BEAM -1	400x150	150x21mm	358x13mm
I- BEAM -2	300x125	125x12mm	276x9mm
C- CHANNEL	C8x11.5	-	-

NOTES:

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

ATC CABIN FLOOR PLAN

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-26

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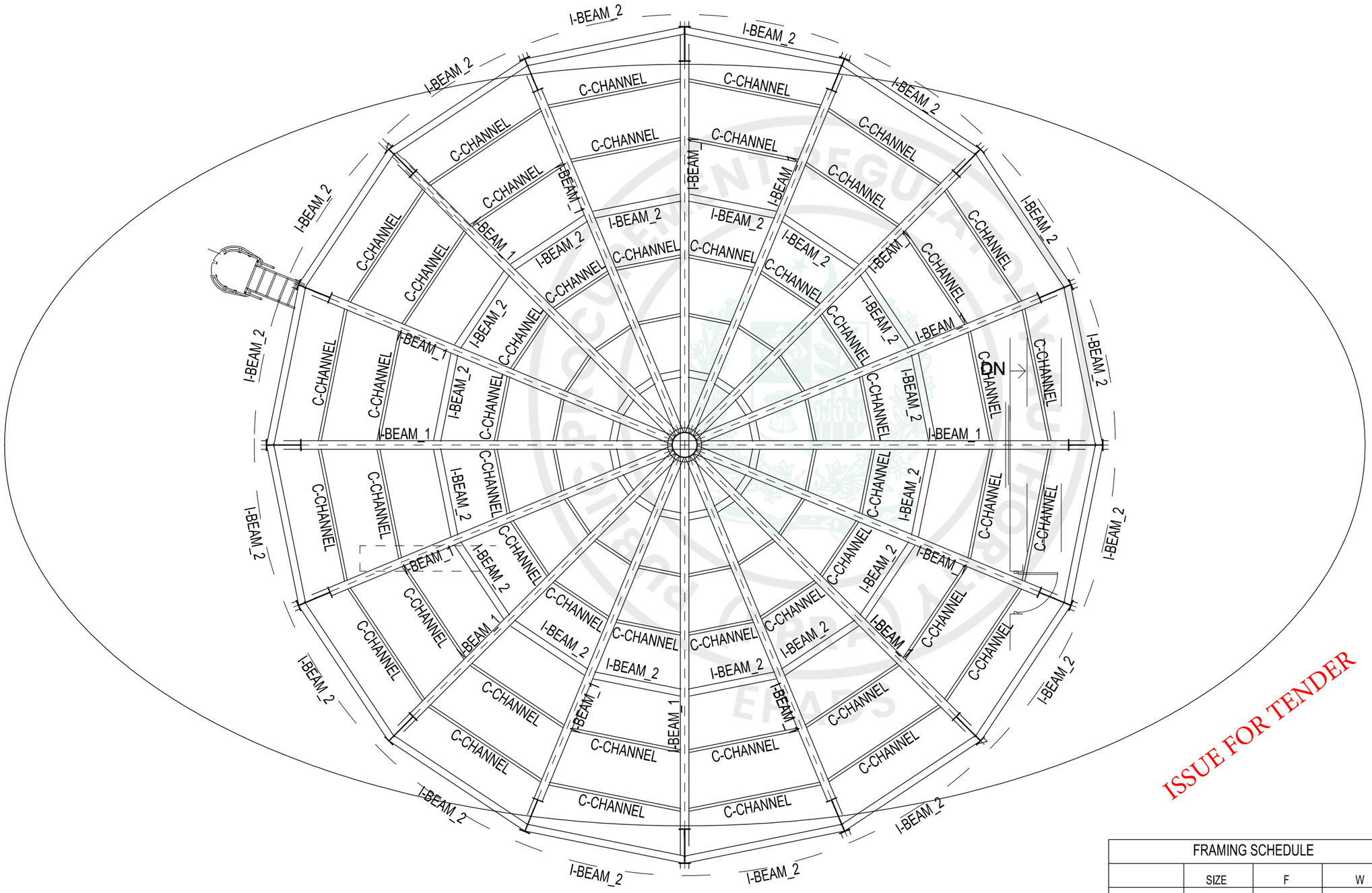

ISSUE FOR TENDER

FRAMING SCHEDULE			
	SIZE	F	W
I- BEAM -1	400x150	150x21mm	358x13mm
I- BEAM -2	300x125	125x12mm	276x9mm
C- CHANNEL	C8x11.5	-	-

ATCT ROOF FRAMING PLAN

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MEP CONSULTANT

Project Name

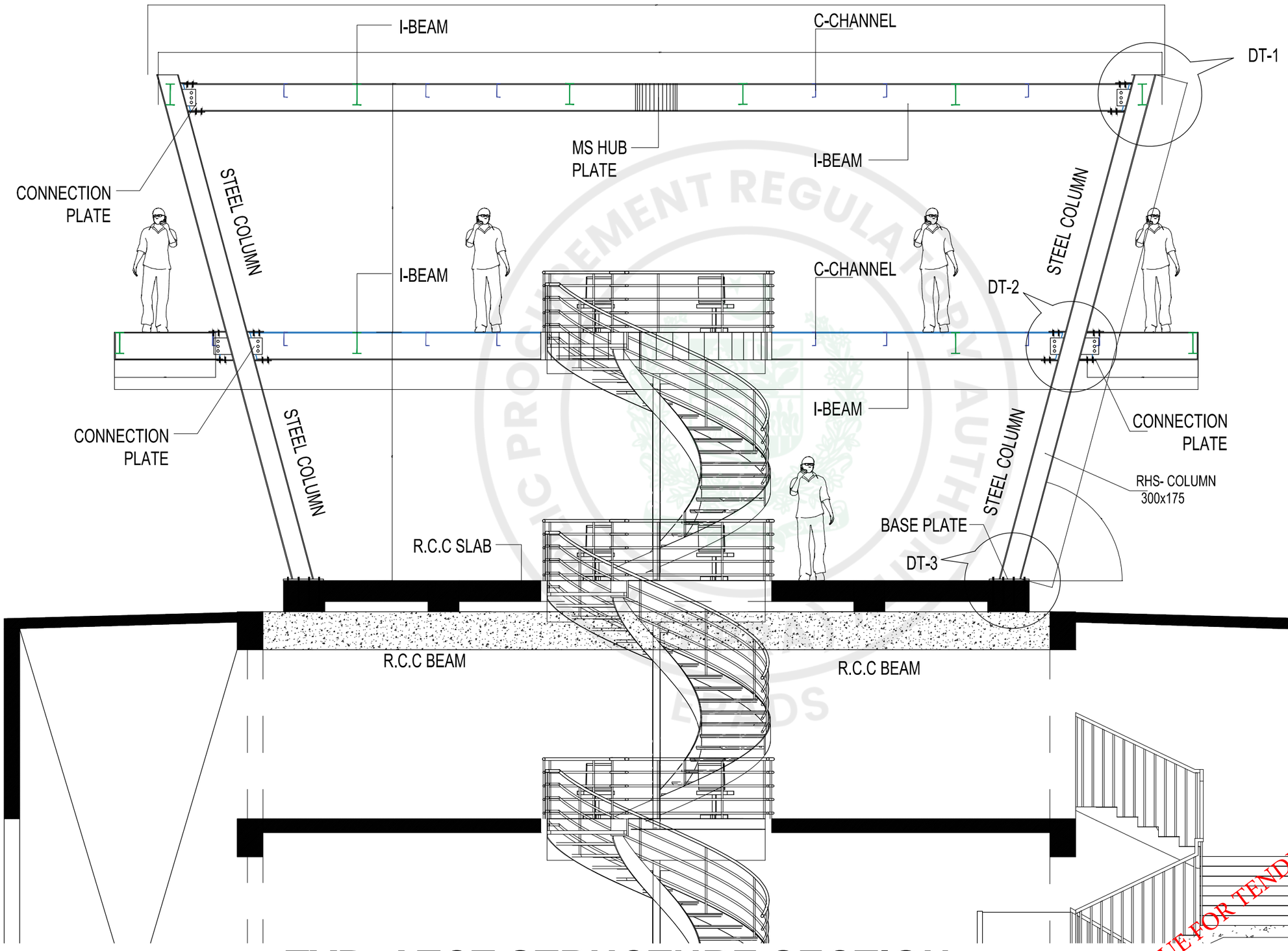
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

ATC ROOF FRAMING PLAN

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-27



TYP. ATCT STRUCTURE SECTION

ISSUED FOR TENDER

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MEP CONSULTANT

Project Name

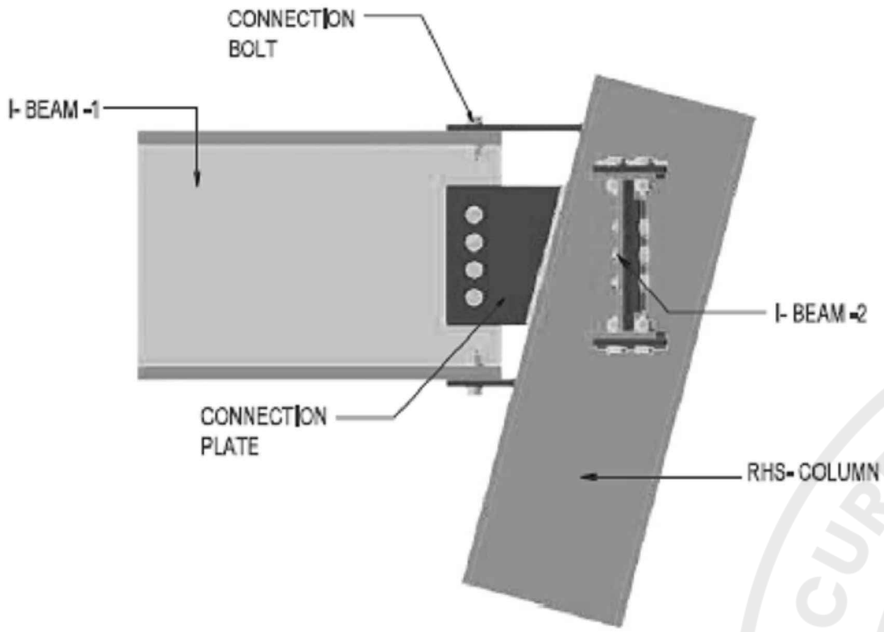
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

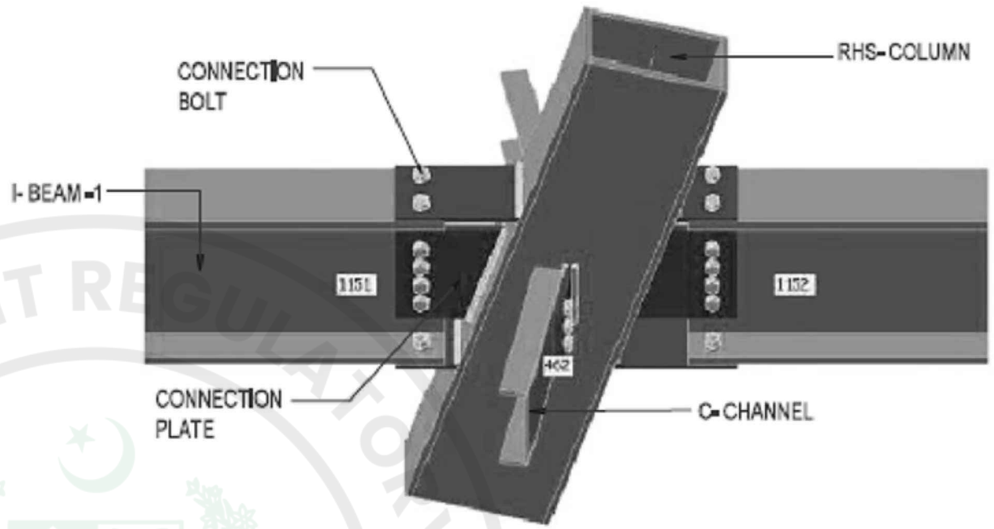
Sheet Name

ATCT STRUCTURE SECTION

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-28



DETAIL-1 CONNECTION



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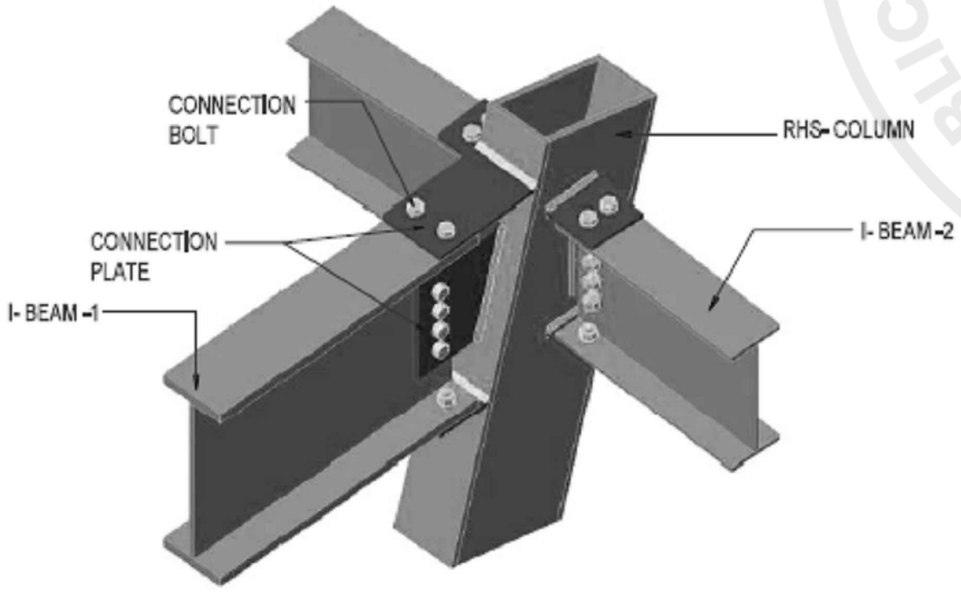

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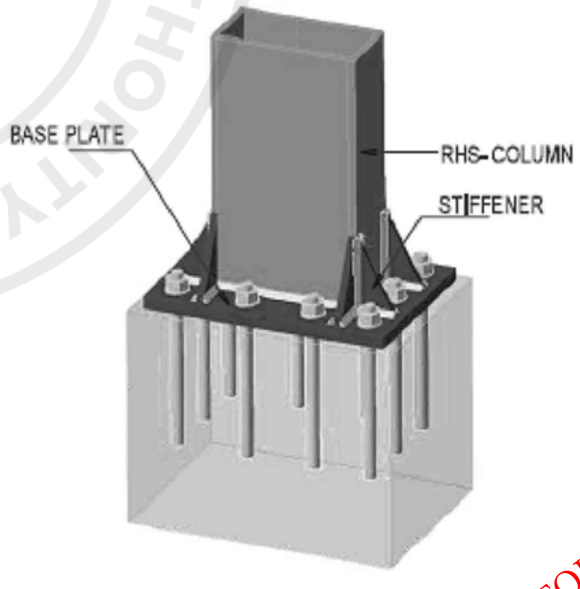

DETAIL-3 BASE CONNECTION

CONNECTIONS DETAIL

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

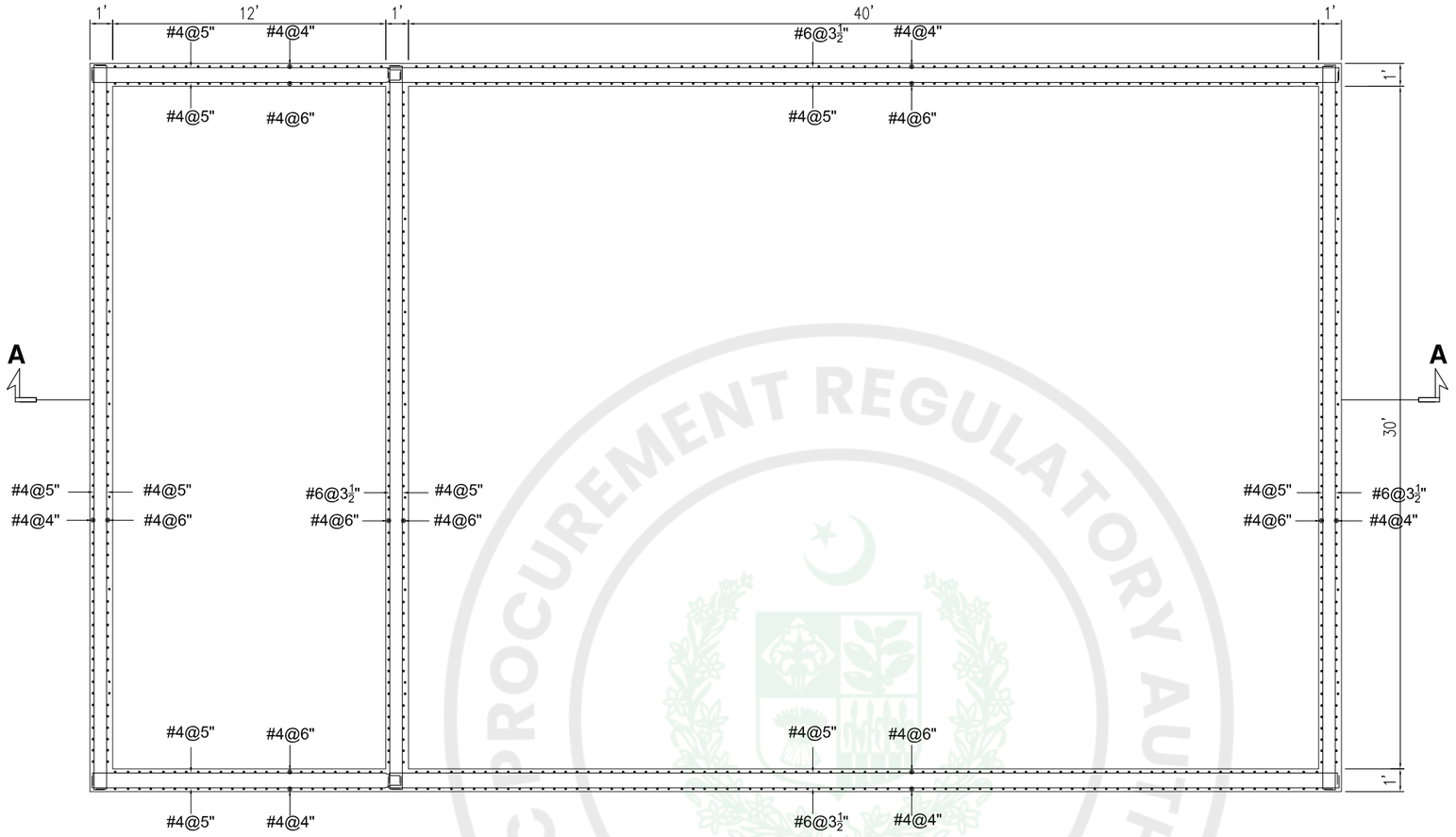
Detailed Structural Design Drawings

Sheet Name

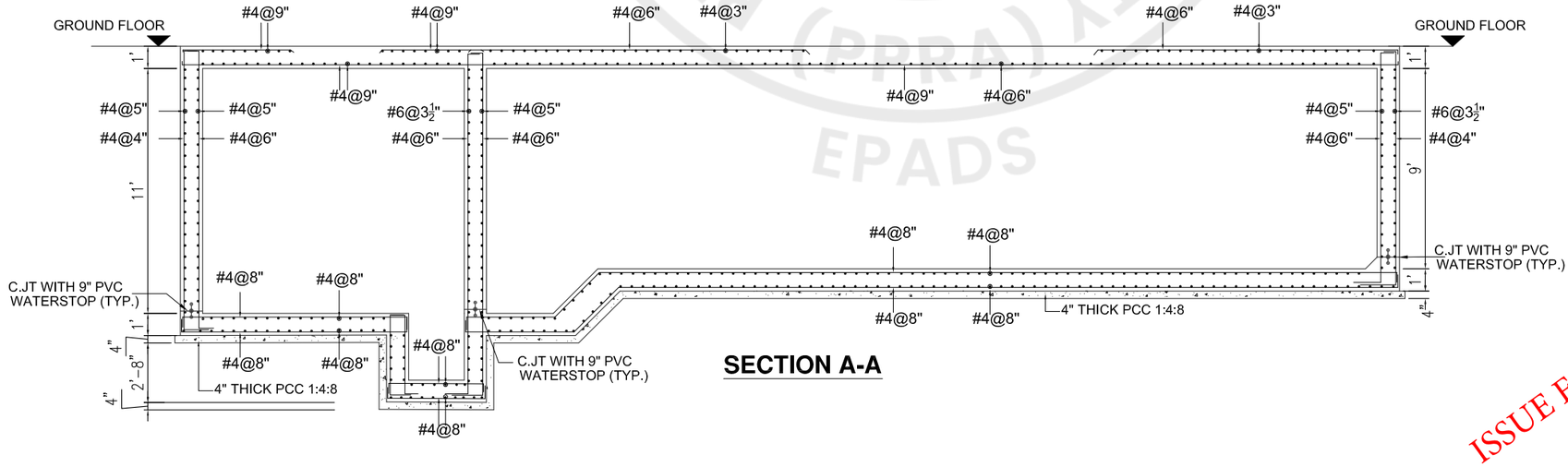
CONNECTIONS DETAIL

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/5917)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-29

ISSUE FOR TENDER



REINFORCEMENT PLAN OF UNDER GROUND WATER TANK FOR FIRE FIGHTING



SECTION A-A

ISSUE FOR TENDER

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

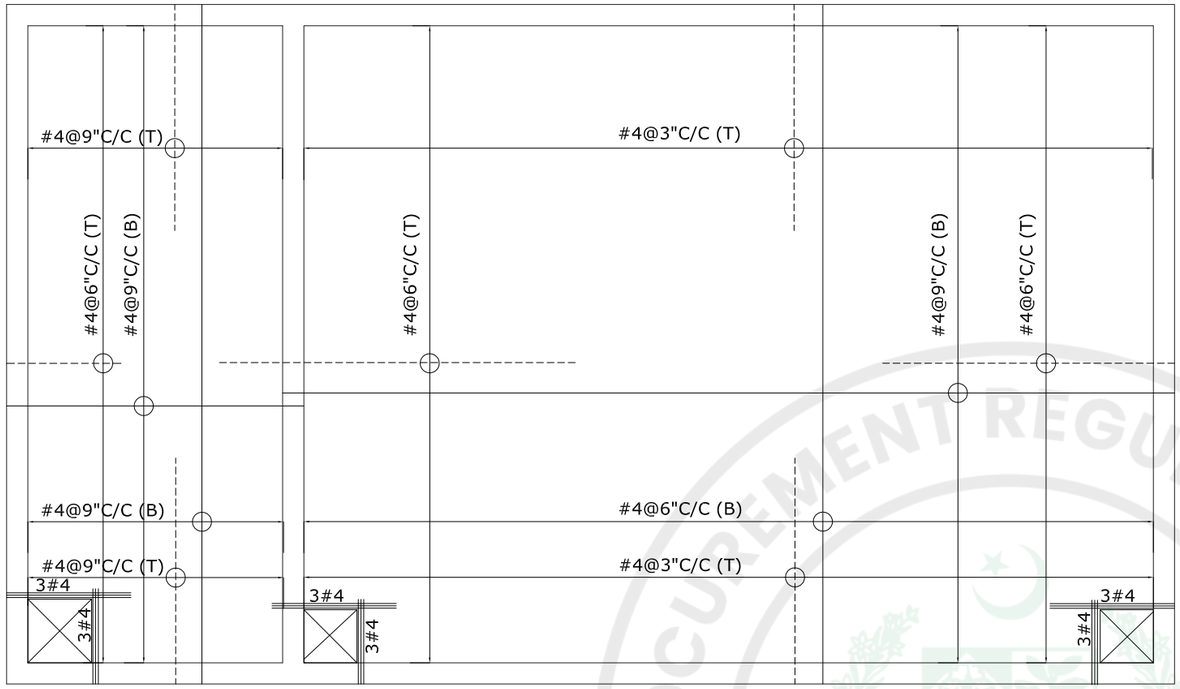
Detailed Structural Design Drawings

Sheet Name

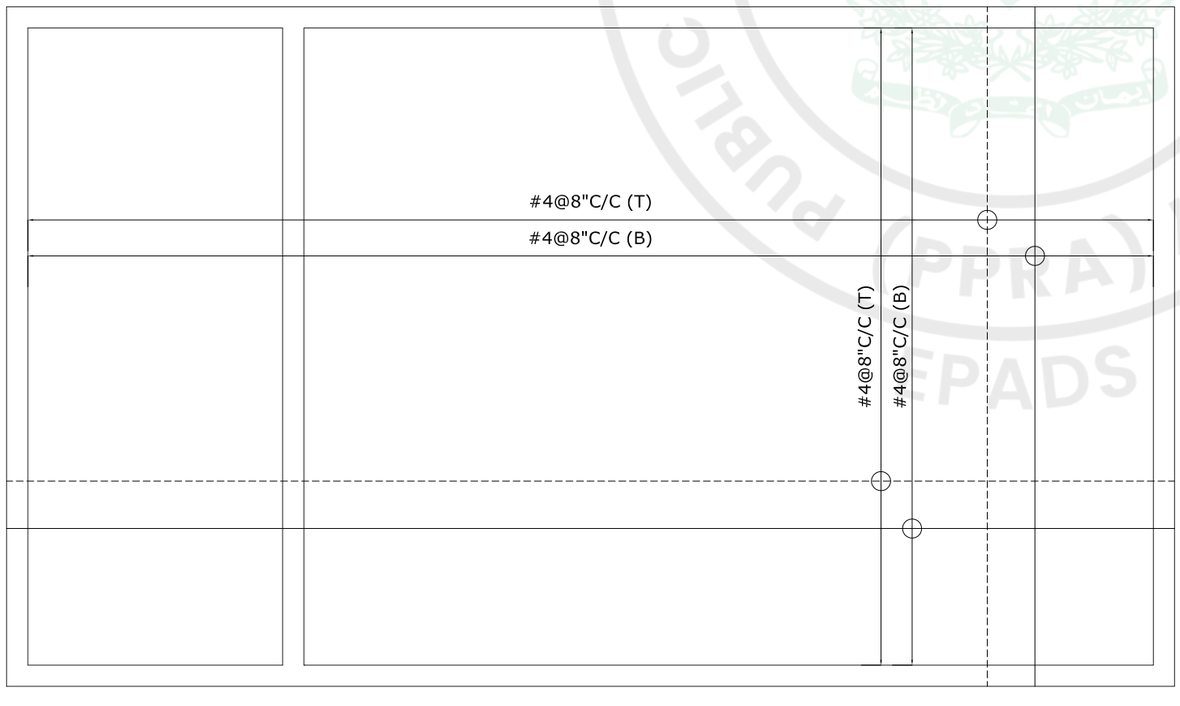
FIRE FIGHTING WATER TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-30

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



TOP SLAB REINFORCEMENT PLAN
SLAB THICKNESS = 12"



BASE SLAB REINFORCEMENT PLAN
SLAB THICKNESS = 12"

ISSUE FOR TENDER

NOTE:
-PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
-PROVIDE 3#6 BARS WITH BOTTOM REINFORCEMENT UNDER THE WALLS IF CONSTRUCTED DIRECTLY ON SLAB
-ALT BOTTOM STEEL IS CURTAILED AT L/8 AND TOP STEEL IS CUT AT L/3 OF THE SPAN
-CONSIDER CONTINUOUS AND DIS-CONTINUOUS EDGES WHILE LAYING TOP STEEL BARS
-FOR DIS-CONTINUOUS EDGE, BEND THE END OF BARS WITHIN SLAB THICKNESS
-FOR POSITIVE REINFORCEMENT, PLACE BARS ALONG LONGER SPAN ON TOP OF BARS PLACED ALONG SHORTER SPAN
-BEAMS POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME
-BOTTOM BARS ARE REPRESENTED BY (B) AND TOP BARS BY (T)

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

FIRE FIGHTING WATER TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-31

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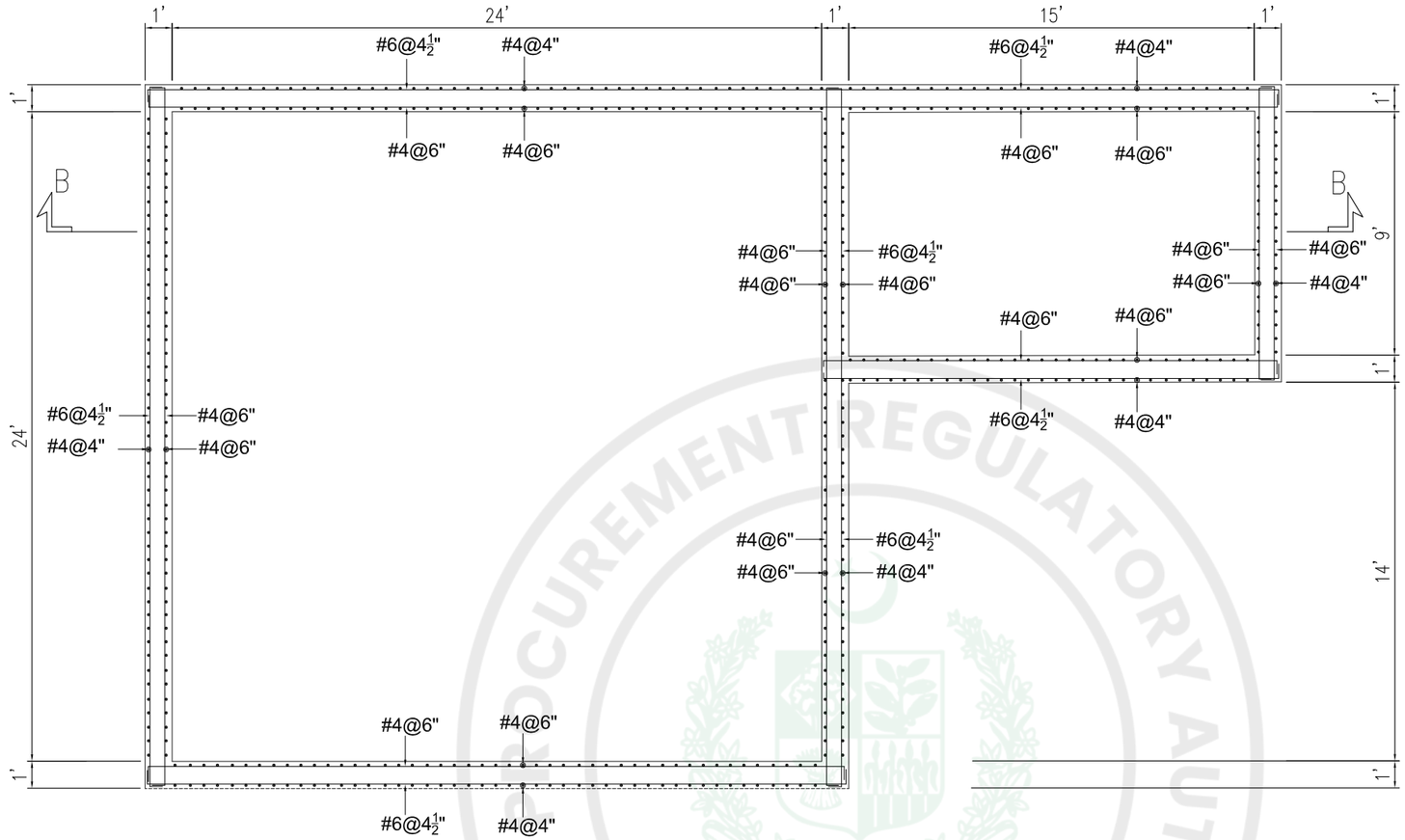
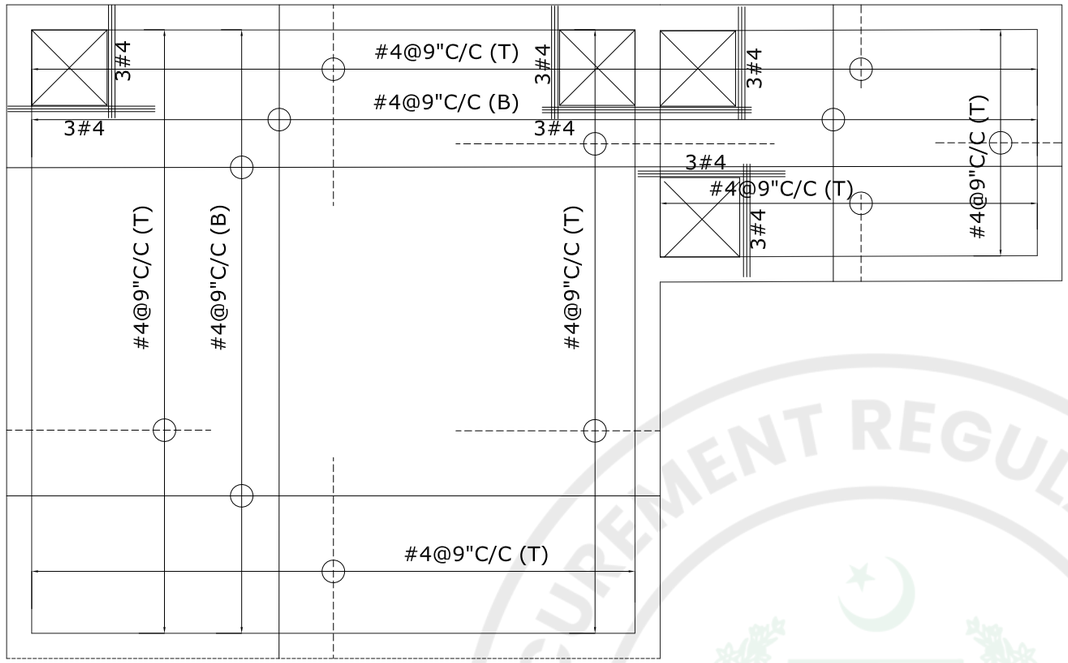
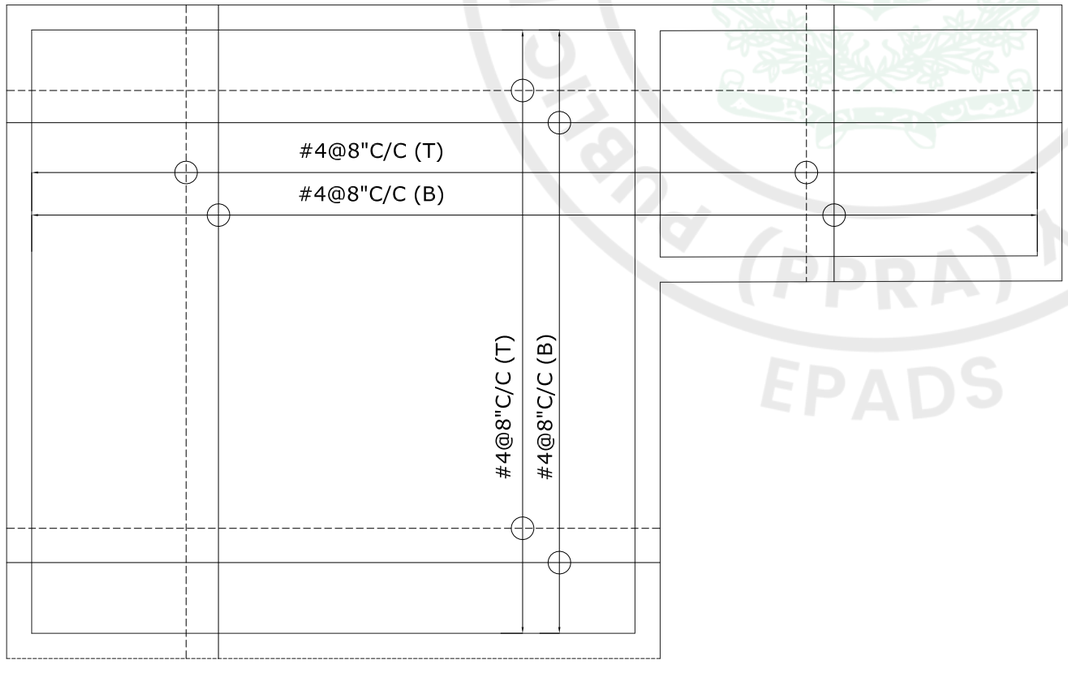

1'
24'
1'
15'
1'
#6@4½"
#4@4"
#4@6"
#4@6"
B
B
9'
24'
14'
1'
#6@4½"
#4@6"
#4@4"
#4@6"
#4@6"
#4@6



TOP SLAB REINFORCEMENT PLAN
SLAB THICKNESS = 8"



BASE SLAB REINFORCEMENT PLAN
SLAB THICKNESS = 12"

NOTE:
-PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
-PROVIDE 3#6 BARS WITH BOTTOM REINFORCEMENT UNDER THE WALLS IF CONSTRUCTED DIRECTLY ON SLAB
-ALT BOTTOM STEEL IS CURTAILED AT L/8 AND TOP STEEL IS CUT AT L/3 OF THE SPAN
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-FOR DIS-CONTINUOUS EDGE, BEND THE END OF BARS WITHIN SLAB THICKNESS
-FOR POSITIVE REINFORCEMENT, PLACE BARS ALONG LONGER SPAN ON TOP OF BARS PLACED ALONG SHORTER SPAN
-BEAMS POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME
-BOTTOM BARS ARE REPRESENTED BY (B) AND TOP BARS BY (T)

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

UNDER GROUND WATER TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-33

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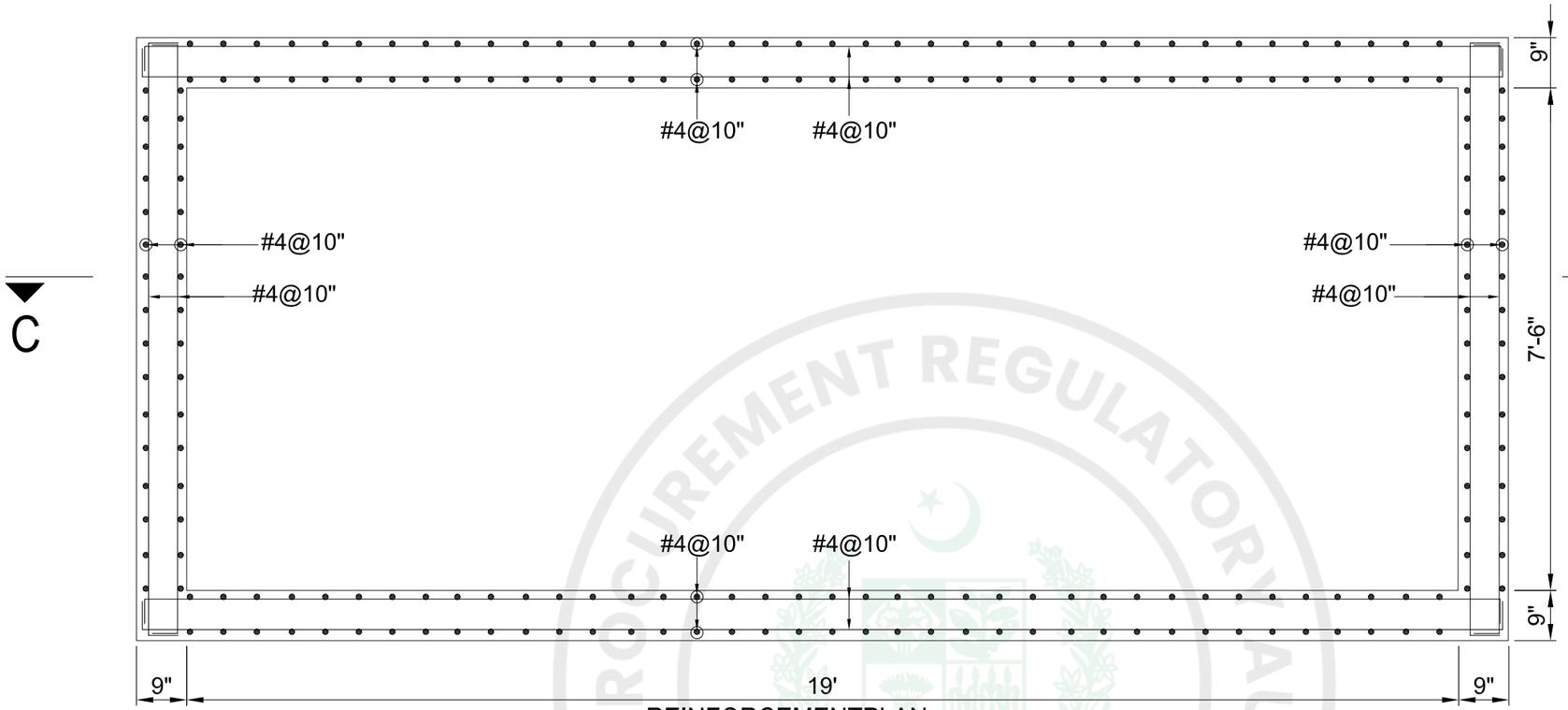
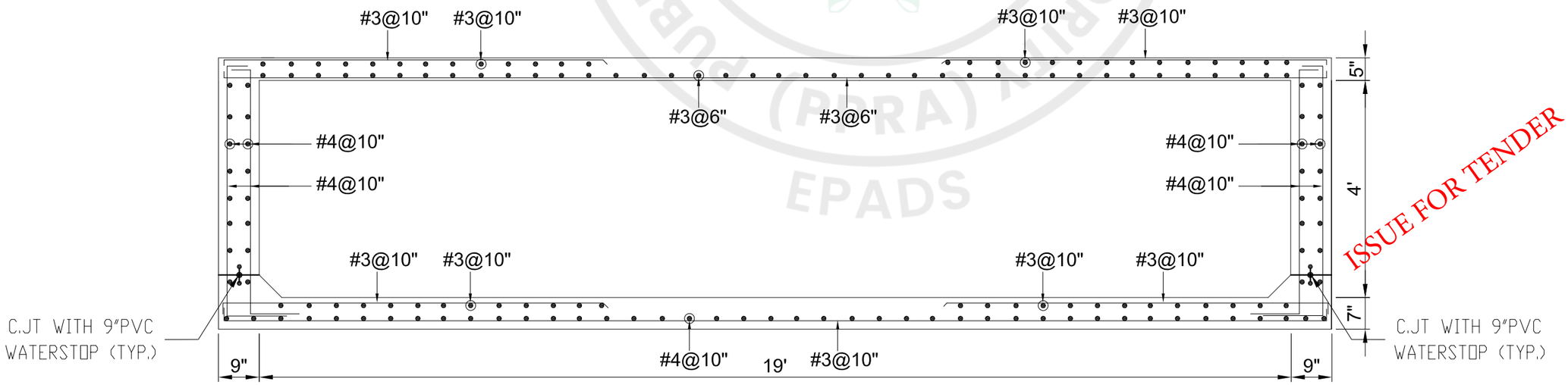


REINFORCEMENTPLAN

OVERHEAD WATER TANK



SECTION AT C-C

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MEP CONSULTANT

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Structural Design Drawings

Sheet Name

OVER HEAD WATER TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-34

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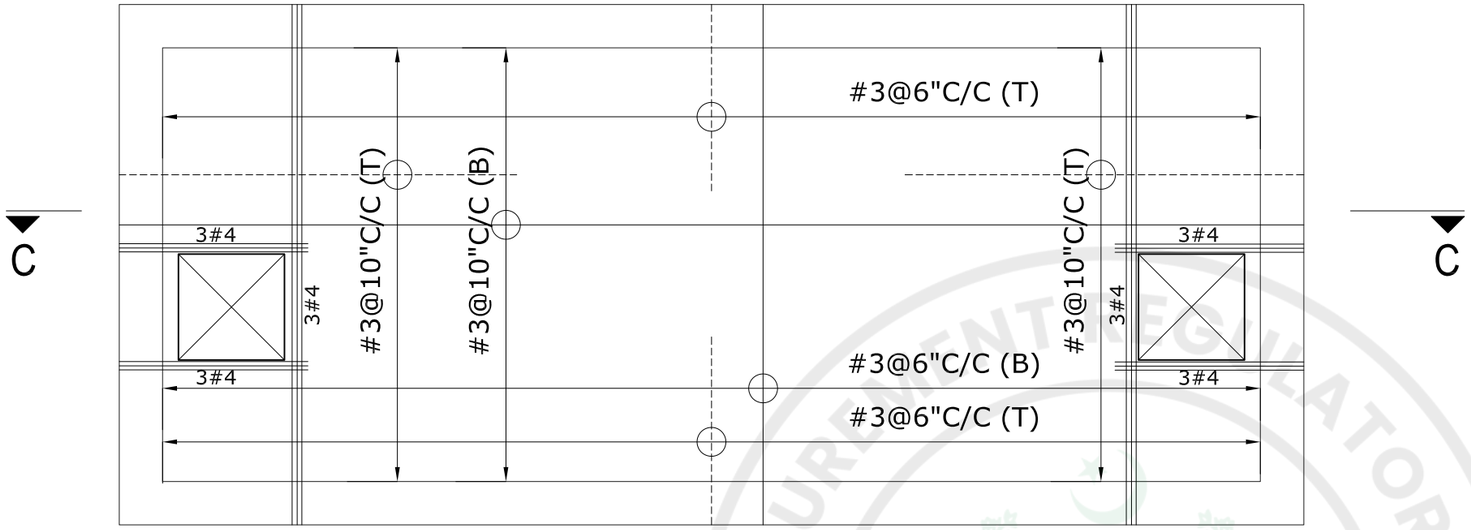
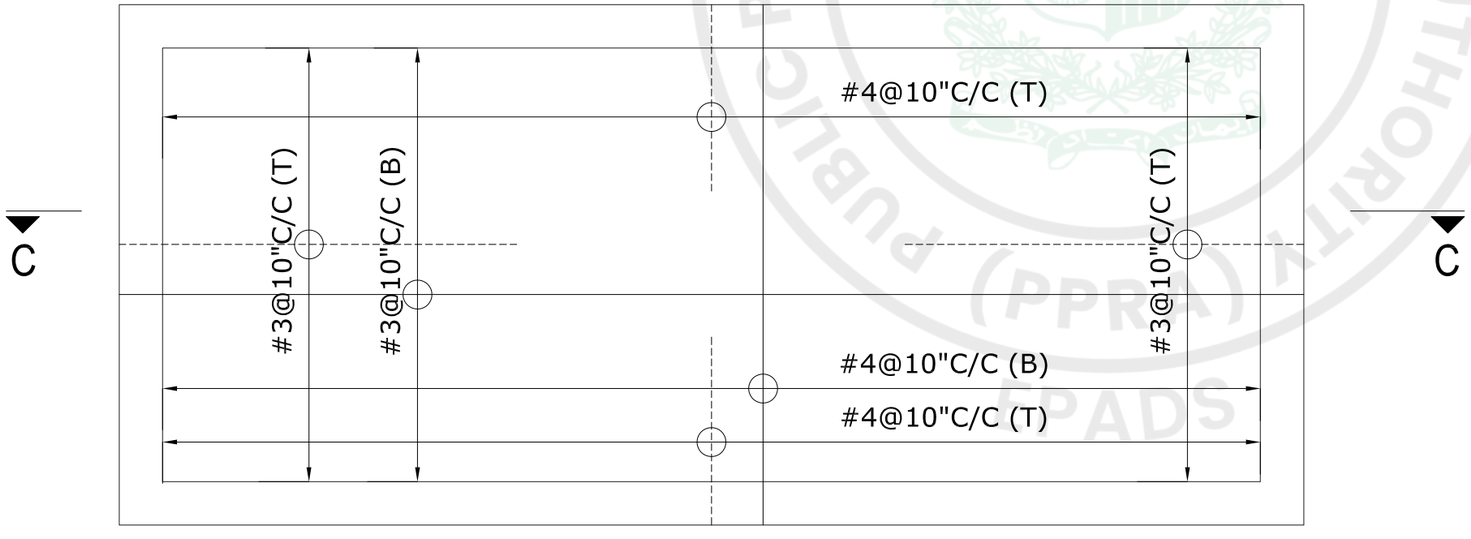


TOP SLAB REINFORCEMENTPLAN

SLAB THICKNESS = 5"



BASE SLAB REINFORCEMENTPLAN

SLAB THICKNESS = 7"

ISSUE FOR TENDER

NOTE:
- PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
- PROVIDE 3#6 BARS WITH BOTTOM REINFORCEMENT UNDER THE WALLS IF CONSTRUCTED DIRECTLY ON SLAB
- ALT BOTTOM STEEL IS CURTAILED AT L/8 AND TOP STEEL IS CUT AT L/3 OF THE SPAN
- CONSIDER CONTINUOUS AND DIS-CONTINUOUS EDGES WHILE LAYING TOP STEEL BARS
- FOR DIS-CONTINUOUS EDGE, BEND THE END OF BARS WITHIN SLAB THICKNESS
- FOR POSITIVE REINFORCEMENT, PLACE BARS ALONG LONGER SPAN ON TOP OF BARS PLACED ALONG SHORTER SPAN
- BEAMS POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME
- BOTTOM BARS ARE REPRESENTED BY (B) AND TOP BARS BY (T)

NOTES:

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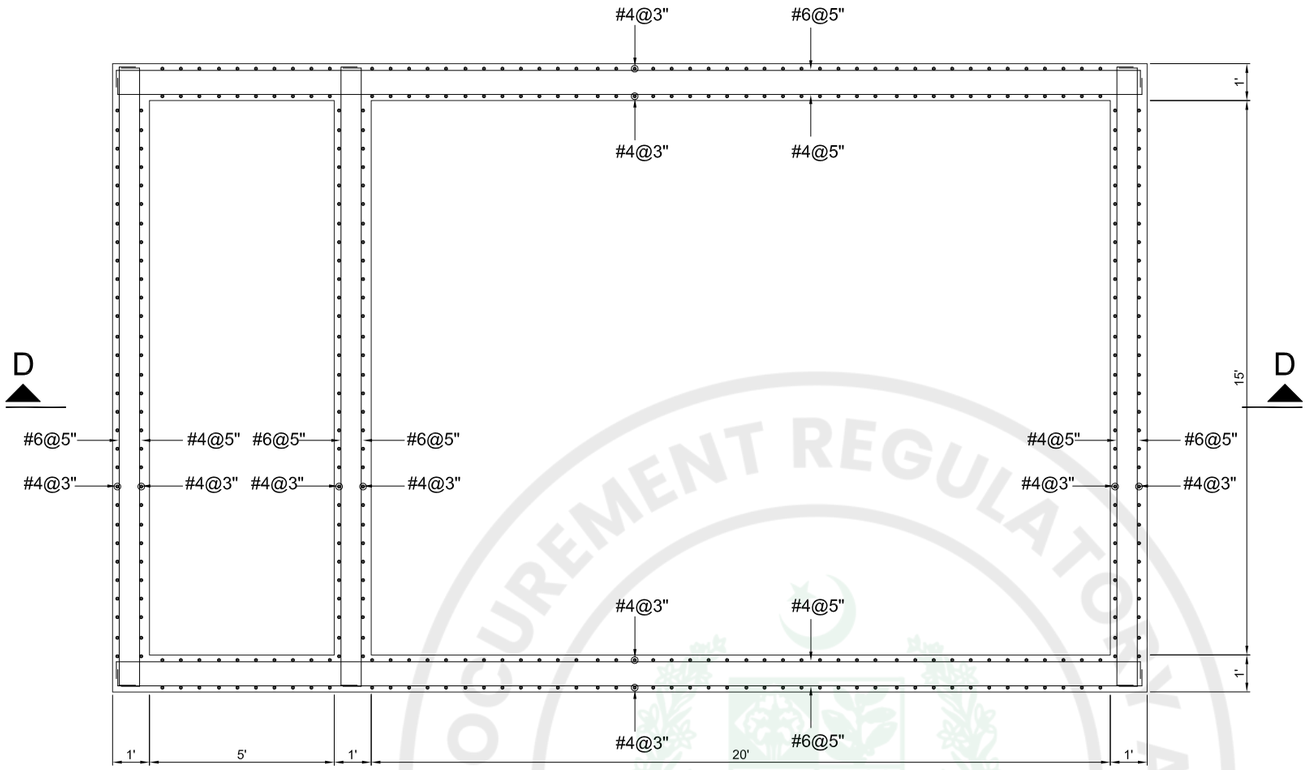
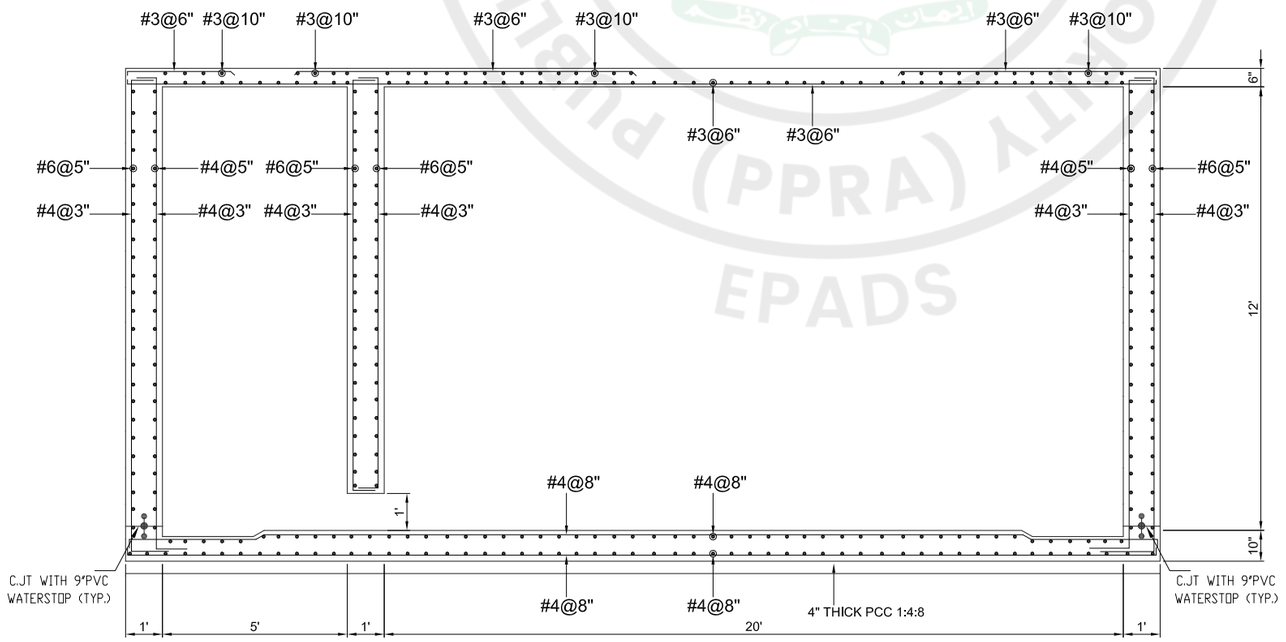
Sheet Name

OVER HEAD WATER TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-35



REINFORCEMENT PLAN
RAIN WATER HARVESTING TANK



SECTION D-D

ISSUE FOR TENDER

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RAIN WATER HARVEST TANK

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Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-36

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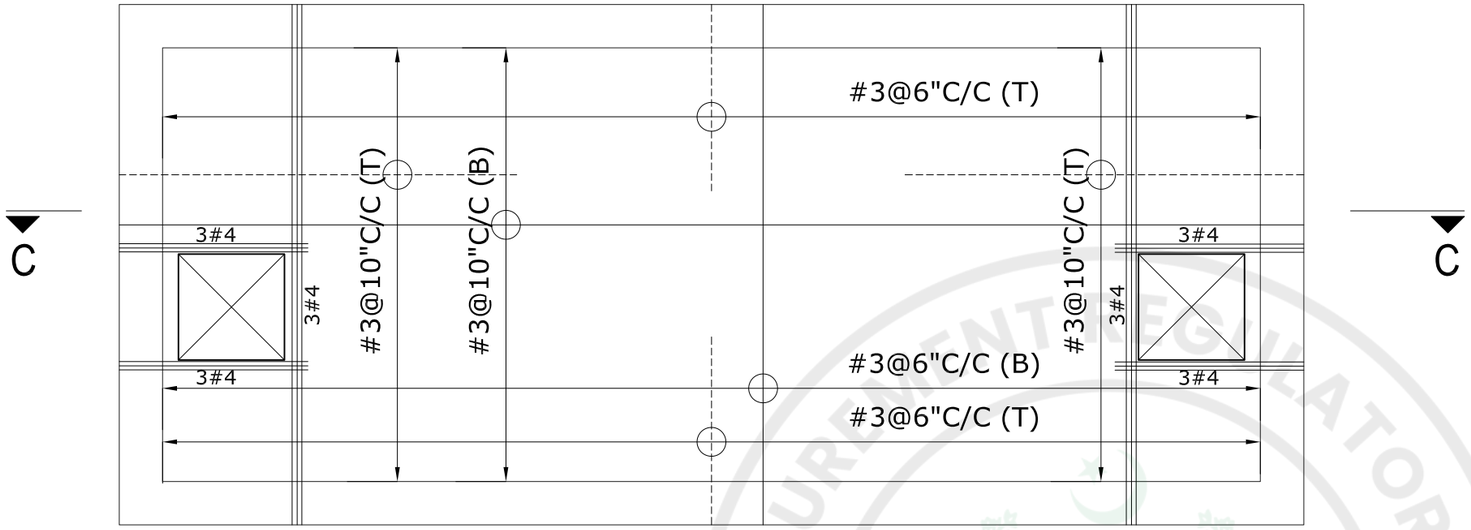
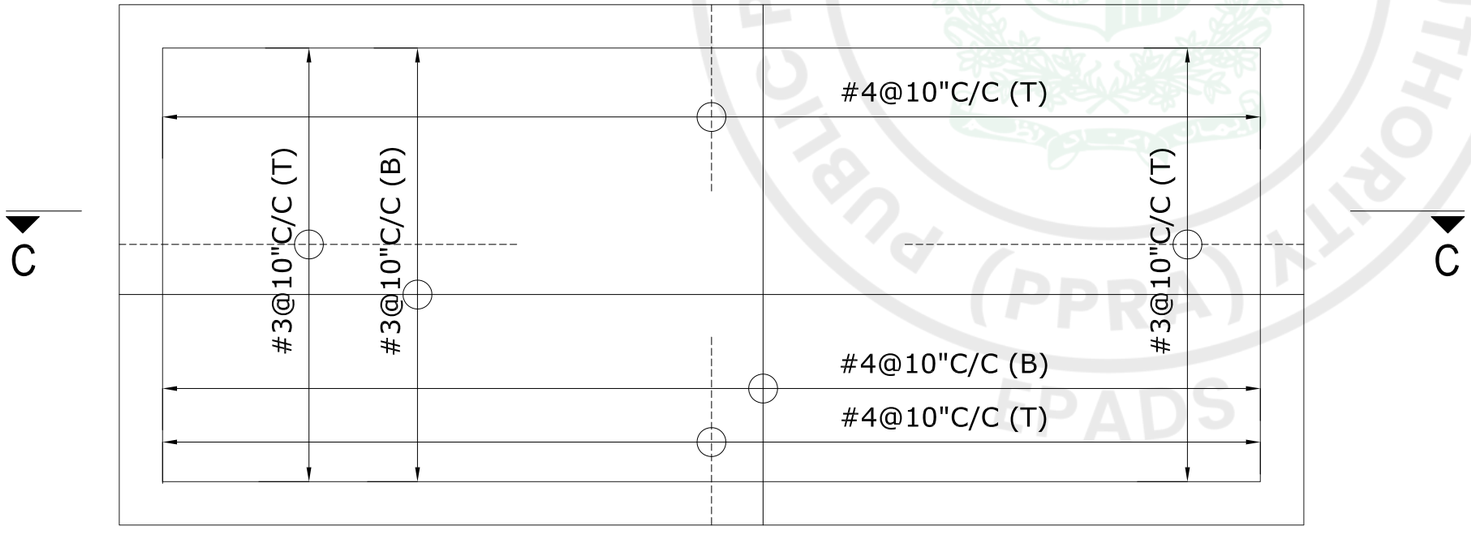


TOP SLAB REINFORCEMENTPLAN

SLAB THICKNESS = 5"



BASE SLAB REINFORCEMENTPLAN

SLAB THICKNESS = 7"

ISSUE FOR TENDER

NOTE:
-PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
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Detailed Structural Design Drawings

Sheet Name

RAIN WATER HARVEST TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-37

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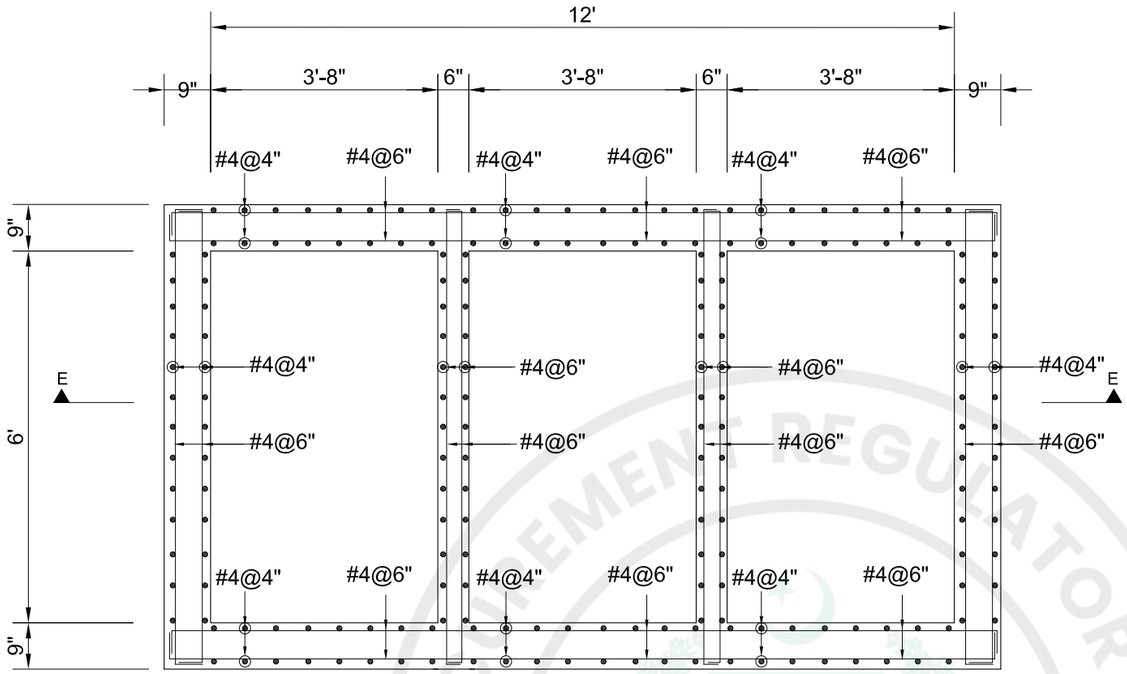
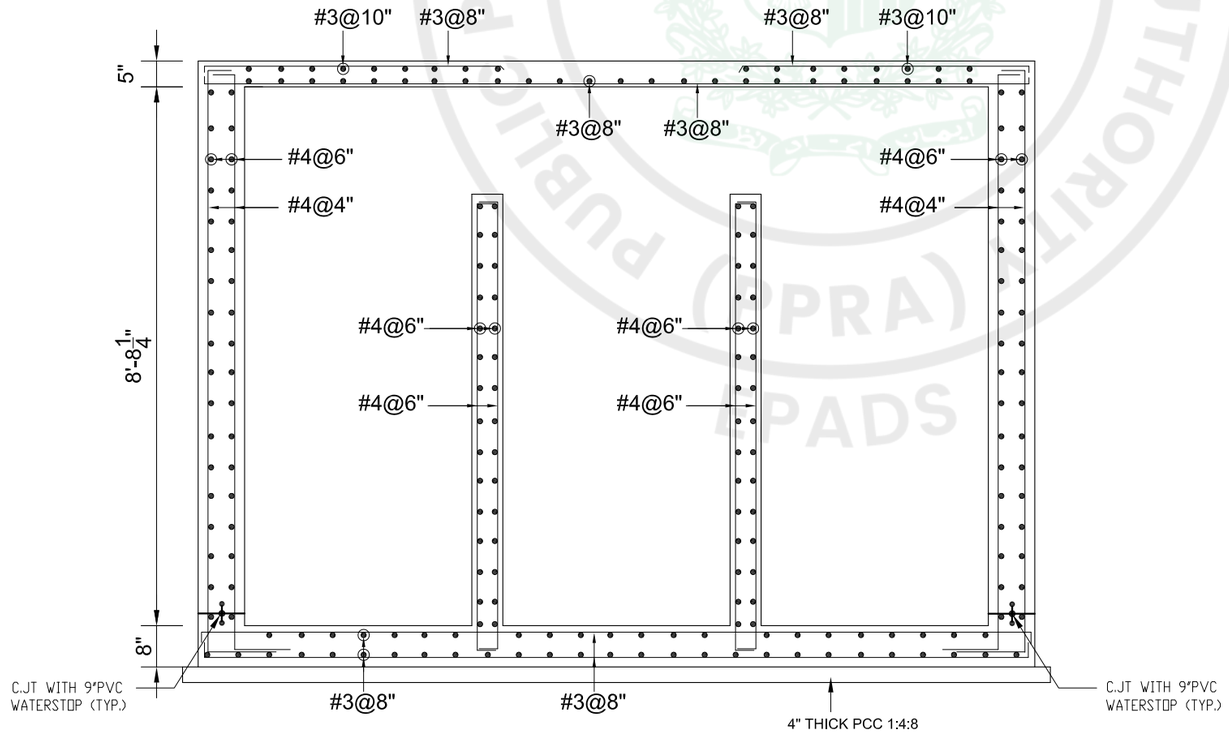


REINFORCEMENT PLAN
SEPTIC TANK



SECTION E-E

ISSUE FOR TENDER

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Detailed Structural Design Drawings

Sheet Name

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Date	April, 2026
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Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-38

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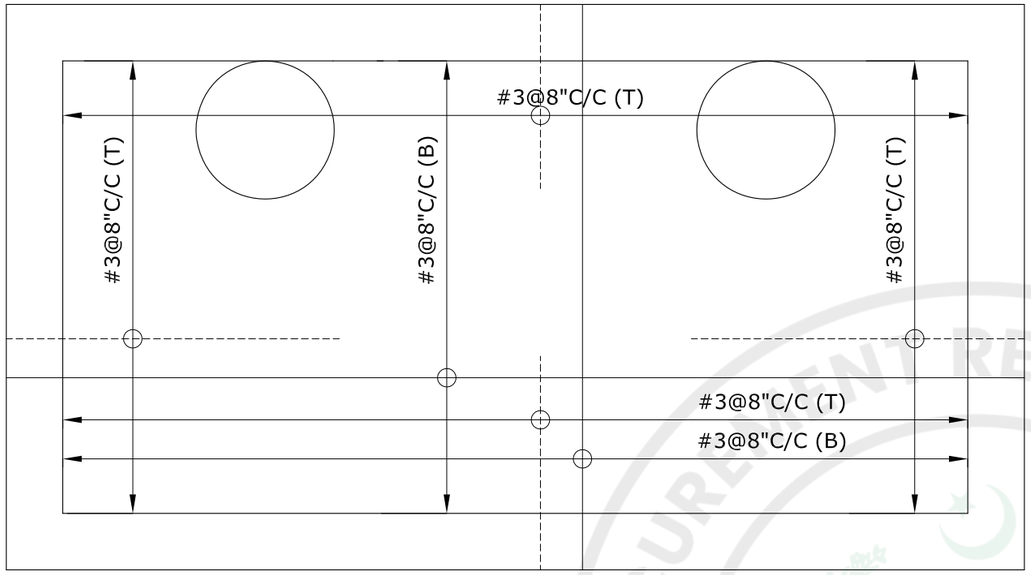
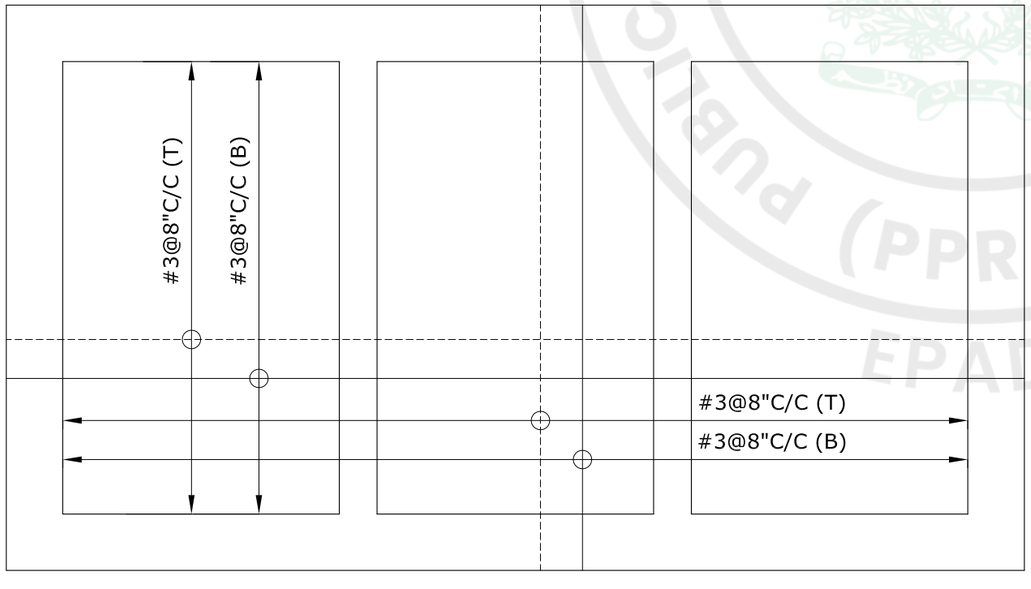


TOP SLAB REINFORCEMENT PLAN
SLAB THICKNESS = 5"

Note:
Provide extra 3-#4 bars
around manholes



BOTTOM SLAB REINFORCEMENT PLAN
SLAB THICKNESS = 8"

ISSUE FOR TENDER

NOTE:
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Detailed Structural Design Drawings

Sheet Name

SEPTIC TANK

Date	April, 2026
Scale	NTS
Drawn by	Engr. ABDULLAH JAVAID (Civil/59178)
Checked by	Engr M. Aamir (Civil/10584)
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-39

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STRUCTURAL GENERAL NOTES

1. COORDINATION

1. ALL WORK SHALL CONFORM TO MINIMUM STANDARDS OF UNIFORM BUILDING CODE-97 AND ACI-318-08
2. DESIGN LOADS ARE IN ACCORDANCE WITH UBC 97 AND ASCE-7
3. EVERY REASONABLE EFFORTS HAS BEEN MADE TO BOUND STRUCTURAL SPECIFICATIONS. SHOULD THERE BE ANY DESCREPANCIES, THE CONTRACTOR SHALL REQUEST A CLARIFICATION IN WRITING FROM THE ENGINEER
4. ALL STRUCTURAL DRAWING SHOULD BE READ IN CONJUNCTION WITH ARCHITECTURAL AND OTHER RELEVANT DRAWINGS.
5. STRUCTURAL DRAWINGS WILL GOVERN THE SIZE & LOCATION OF THE STRUCTURAL COMPONENTS OVER OTHER DRAWINGS

2. GENERAL

1. THE CONTRACTOR SHALL REVIEW DRAWINGS AND DETERMINE THAT DIMENSIONS ARE COORDINATED BETWEEN ARCHITECTURAL AND, STRUCTURAL DRAWINGS PRIOR TO FABRICATION OR START OF CONSTRUCTION.
2. NO STRUCTURAL MEMBER SHALL BE CUT, NOTCHED OR OTHERWISE REDUCED IN STRENGTH.
3. THE CONTRACTOR SHALL COORDINATE ARCHITECTURAL & OTHER MECHANICAL, AND ELECTRICAL DRAWINGS FOR ANCHORED,EMBEDDED AND SUPPORTED ITEMS WHICH AFFECT THE STRUCTURAL DRAWINGS AND NOTIFY THE EGINEER OF ANY DISCREPANCY.
4. ALL SECTIONS AND DETAILS WILL BE AS PER DETAILS GIVEN ON RESPECTIVE DRAWINGS. IN CASE OF ANY PROBELM IN UNDERSTANDING OF DETAILS CONTRACTOR SHOULD IMMEDIATELY REFER TO THE ENGINEER.
5. ANY CONFLICTS BETWEEN THE SPECIFICATIONS AND DESIGN DRAWINGS SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ENGINEER. THE CONTRACTOR BEFORE GOING FOR PURCHASE OF MATERIAL WILL ENSURE THAT THE SPECIFICATIONS HAVE BEEN UNDERSTOOD AND COMPARED WITH DRAWINGS. ANY DISCREPANCY WILL BE REPORTED TO ENGINEER BEFORE ACTUALLY GOING FOR PURCHASE

4. REINFORCED CONCRETE

1. CONCRETE WORK SHALL CONFORM TO ACI 301 SPECIFCATION FOR STRUCTURAL CONCRTE FOR BUILDING (LATEST EDITION).
2. STRUCTURAL DESIGN IS BASED ON THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE OF AMERICAN CONCRETE INSTITUTS (ACI 318-05).
3. NO CONCRETING SHALL BE CARRIED OUT UNTIL PERMISSION IS GIVEN IN WRITING.
4. CONCRETE SHALL HAVE A MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS AS FOLLOWS:

(28Th DAY CYLINDRICAL COMPRESSIVE STRENGTH)

RCC (1 : 1.5 : 3)	COLUMNS, LIFT WALLS, BEAMS & WATER RETAINING STRUCTURES	4500 (f'c)
RCC (1 : 2 : 4)	SLABS, AND REMAINING MEMBERS	3000 (f'c)
PCC (1 : 4 : 8)	WHERE SPECIFIED UNDER STRUCTURES	1000 (f'c)
SPECIAL PROVISION: APPROPRIATE TYPE OF PLASTICIZER, AS APPROVED BY SITE ENGINEER, CAN BE USED UP TO A QUANTITY OF 2% BY WEIGHT OF CEMENT		

5. THE RATIOS MENTIONED ARE THE QUANTITIES SUFFICIENT FOR ACQUIRING REQUIRED STRENGTH. HOWEVER, THE ACTUAL QUANTITIES WILL BE FINALIZED THROUGH MIX DESIGN, WHICH WILL BE CARRIED OUT AT CONTRACTORS COST. THE RESULTS WILL BE PRESENTED TO THE ENGINEER AT SITE WHO WILL COLLECT SAMPLES AND GET THE STRENGTH CONFIRMATION FROM HIS SOURCE AT CONTRACTORS COST.
6. ALL DESIGN DETAIL, MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH RELEVANT ACI, ASTM, UBC CODES AND STANDARDS.
7. ALL NON LOAD BEARING MASONARY WALLS SHALL BE PLACED AFTER THE REMOVAL OF FORM WORK.
8. ALL SLABS WILL BE CAST MONOLITHIC WITH THEIR BEAMS AND OVER HANGS. HOWEVER, PARAPET WALLS AND ALL NON STRUCTURAL MEMBERS CAN BE CAST SUBSEQUENTLY. IN SUCH CASE STRENGTH GAIN OF PRIMARY COMPONENTS WILL BE ASCERTAINED.

5. REINFORCEMENT

1. REINFORCEMENT STEEL SHALL BE OF LOW ALLOY STEEL AS PER ASTM A615 HAVING MINIMUM YIELD STRENGTH OF 60,000 PSI. HOWEVER STIRRUPS CAN BE OF 40,000 PSI YIELD STRENGTH. FABRICATED STEEL BEAMS SHALL BE OF 36 KSI
2. TOP REINFORCEMENT BARS OF BEAMS TO BE CURTAILED AS SHOWN/REQUIRED.
3. ALL LAPS OF THE REINFORCEMENT SHOULD BE PROVIDED OUTSIDE HINGE ZONE
4. ALL REINFORCING STEEL SHALL BE ACCURATELY LOCATED IN THE FORMS AND HELD FIRMLY IN PLACE BEFORE & DURING THE PLACEMENT OF CONCRETE, BY MEANS OF WIRES AND SUPPORTS ADEQUATE TO PREVENT DISPLACEEMENT DURING THE COURSE OF CONSTRUCTION.
5. MAINTAIN MINIMUM CONCRETE COVERAGE FOR REINFORCING STEEL AS FOLLOWS UNLESS OTHERWISE NOTED IN DRAWING.

CLASS-C SLABS & FOOTINGS	
COLUMNS	= 1.5 inch
BEAMS	= 1.5 inch
SLABS	= 3/4 inch
WALLS FRONT FACE	= 1 inch
WALLS EARTH FACE	= 2 inch

6. SHUTTERING/ FORM WORK

1. SHUTTERING FOR ALL PROJECTIONS SHALL BE INSTALLED AND REMOVED ALONG WITH SLAB. THE TYPE OF SHUTTERING WILL ALSO BE SAME AS FOR MAIN SLAB
2. LOAD BEARING MASONARY WALLS SHALL BE BUILT BEFORE PLACING OF FORM WORK FOR SLAB / ROOF SLAB.

7. CONCRETE CONSTRUCTION

1. ALL STRUCTURE SURFACES, AGAINST WHICH EARTH IS TO FILLED MAY BE COATED WITH TWO COATS OF HOT BITUMEN OF 10/20 GRADE AT THE RATE OF OF 0.4 lbs /Sft /coat. OTHER TREATMENTS AS PER DRAWINGS AND INSTRUCTION OF THE SITE ENGINEER SHALL ALSO BE EMPLOYED
2. BEFORE CASTING OF ANY STRUCTURAL MEMBER. THE CONTRACTOR SHALL ENSURE THAT ALL EMBEDDED ITEM FOR ELECTRICAL, MECHANICAL, HVAC, PLUMBING STRUCTURAL STEEL AND OTHER WORKS ARE PROPERLY LOCATED AND FIRMLY SECURED IN PLACE. THE CONTRACTOR SHALL BE RESPONSIBLE TO GET ALL EMBEDDED ITEMS CHECKED BY SITE ENGINEER BEFORE CASTING.

8. PARTITION WALLS

1. THE PARTITION WALLS WILL CONSTRUCTED AS PER DRAWINGS. THE PARTITION WALLS WILL CONTAIN REINFORCEMENT WHERE SPECIFIED.

9. LOAD BEARING WALLS

1.GENERALLY THE STRUCTURE HAS BEEN DESIGNED AS FRAME STRUCTURE. BUT WHERE LOAD BEARING WALLS HAVE BEEN SPECIFIED THESE WILL BE INSTALLED BEFORE THE INSTALLATION OF SHUTTERING. THE SPECIFICATION OF BEARING WALLS WILL BE STRICTLY FOLLOW.

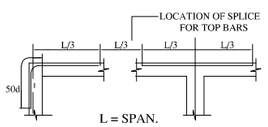
10. LAP SPLICE

1. SCHEDULE "I" APPLIES FOR THE FOLLOWING TYPES OF BARS,
   - BOTTOM HORIZONTAL BARS OF BEAMS AND WALLS.
   - TOP HORIZONTAL BARS OF SLABS 14" OR LESS IN DEPTH.
   -VERTICAL BARS.
2. SCHEDULE "II" APPLIES FOR THE FOLLOWING TYPES OF BARS,
   - TOP HORIZONTAL BARS OF BEAMS.
   - TOP HORIZONTAL BARS OF SLABS GREATER THAN 14" DEEP.
   -ALL HORIZONTAL WALL REINFORCEMENT (EXCEPT BOTTOM BARS).
3. ALL LAP SPLICES SHALL BE WIRED IN CONTACT.
4. ALL LAP SPLICES SHALL BE CLASS B" U.N.O. IN CONTACT.
5. ALL SPLICES OF WALL AND SLAB REINFORCEMENT SHALL BE STAGGERED AS NORMAL PRACTICE.
6. THE LAP SPLICE LENGH FOR BIGGER BAR BE USED WHEN SPLICING TWO DIFFERENT SIZE BARS.

   ADJUSTMENT (S) TO GIVEN LAP LENGTHS.
7. LAP LENGTHS GIVEN ARE FOR A CONCRETE COMPRESSIVE STRENGTH, f'c, OF 3000 PSI & 3750 PSI NOTIFY ENGINEER FOR OTHER STRENGTHS
8. IF REINFORCING IS SPECIFIED AS EPOXY COATED INCREASE LENGTHS BY 50%
9. IF LIGHTWEIGHT AGGREGATE IS SPECIFIED, INCREASE LENGTHS BY 30%
10. LAP LENGTHS SCHEDULE ASSUMES:
    A. CLEAR COVER IS GREATER THAN BAR DIAMETER.
    B. CLEAR SPACING BETWEEN BAR IS GREATER THAN 2 BAR DIAMETERS.
    C.TRANSVERSE REINFORCEMENT INDEX, Ktr,IS ZERO.

IF EITHER CONDITION A OR B IS NOT MET, FOR A GIVEN BAR, INCREASE THE SCHEDULED LAP LENGTH BY 50%

11. LAP LENGTH SCHEDULED ARE FOR Gr 60 REINFORCEMENT (fy = 60 k.s.i.).
    (A) FOR BOTTOM BARS. LOCATE SPLICES OVER SUPPORTS UNO.
    (B) TOP BARS, LOCATE SPLICES AT MID-SPAN. OR WITHIN CENTER



12. ALL REINFORCING BARS TO BE FABRICATED AS PER THE BENDING SCHEDULES PREPARED BY THE CONTRACTOR AND CHECKED BY ENGINEER.
13. THE ADDITIONAL QUANTITY OF STEEL AT LOCATION OF LAP SHALL NOT BE CONSIDERED SEPARATE FOR PAYMENT.
14. IN CASE MINIMUM REQUIREMENT OF LAP IS NOT MET THE FIXED STEEL WILL BE REPLACED BY CORRECTED LENGTH AND SIZE AT THE COST OF CONTRACTOR.

NOTE:
THE DESIGN PRESENTED HERE IS BASED ON THE SOIL REPORT AND DATA PROVIDED BY CLIENT. THE ACCURACY OF WHICH IS ENTIRE RESPONSIBILITY OF CLIENT.

GENERAL NOTES
INSTRUCTIONS TO CONTRACTOR

EARTHQUAKE ZONE AS PER BUILDING CODE OF PAKISTAN 3

SPLICE LENGTHS

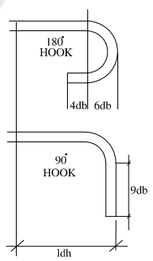
SCHEDULE I - BOTTOM BARS					SCHEDULE II - TOP BARS				
f' c	3000 p.s.i		4500 p.s.i		f' c	3000 p.s.i		4500 p.s.i	
BAR SIZE	CLASS A	CLASS B	CLASS A	CLASS B	BAR SIZE	CLASS A	CLASS B	CLASS A	CLASS B
#3	17"	22"	15"	20"	#3	22"	28"	20"	25"
#4	22"	29"	20"	26"	#4	29"	37"	26"	34"
#5	28"	36"	25"	32"	#5	36"	47"	32"	42"
#6	33"	43"	30"	39"	#6	43"	56"	39"	50"
#7	48"	63"	43"	56"	#7	63"	81"	56"	73"
#8	55"	72"	49"	64"	#8	72"	93"	64"	83"
#9	62"	81"	56"	72"	#9	81"	105"	72"	94"
#10	70"	91"	62"	80"	#10	91"	118"	80"	104"
#11	78"	101"	68"	88"	#11	101"	131"	88"	114"

SCHEDULE III - DEVELOPMENT LENGTH

BAR DIA	F' c	3000 PSI		4500 PSI	
		BOTTOM BARS	TOP BARS	BOTTOM BARS	TOP BARS
3	-	17	22	15	20
4	-	22	29	20	26
5	-	28	36	25	32
6	-	33	43	30	39
7	-	48	63	43	56
8	-	55	72	49	64
9	-	62	81	56	72
10	-	69	90	62	80
11	-	76	98	68	88

BAR DIA	HOOKS					
	180°				90°	
	ldh	round	extn	ldh*	ldh	extn
3	6.75	2.25	2.5	5.75	5.75	4.5
4	8.75	3	2.5	7.75	7.75	6
5	11	3.75	2.5	9.75	9.75	7.5
6	13.25	4.5	3	11.5	11.5	9
7	15.5	5.25	3.5	13.5	13.5	10.5
8	17.5	6	4	15.5	15.5	12
9	19.75	6.75	4.5	17.25	17.25	13.5

ldh* = when cover is not less then 2.5 inches



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Detailed Architectural Design Drawings

CLIENT NAME

MAIN CONSULTANT

Anwar Ali Architects (Pvt.) Ltd.
Consulting,Architects,Engineers
Planners & Management Consultants
06 HBFC BLOCK A FAISAL TOWN LAHORE

JV MEMBERS

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Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

GENERAL NOTES

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Ur M- Rizwan
Drawing No.	S-01U

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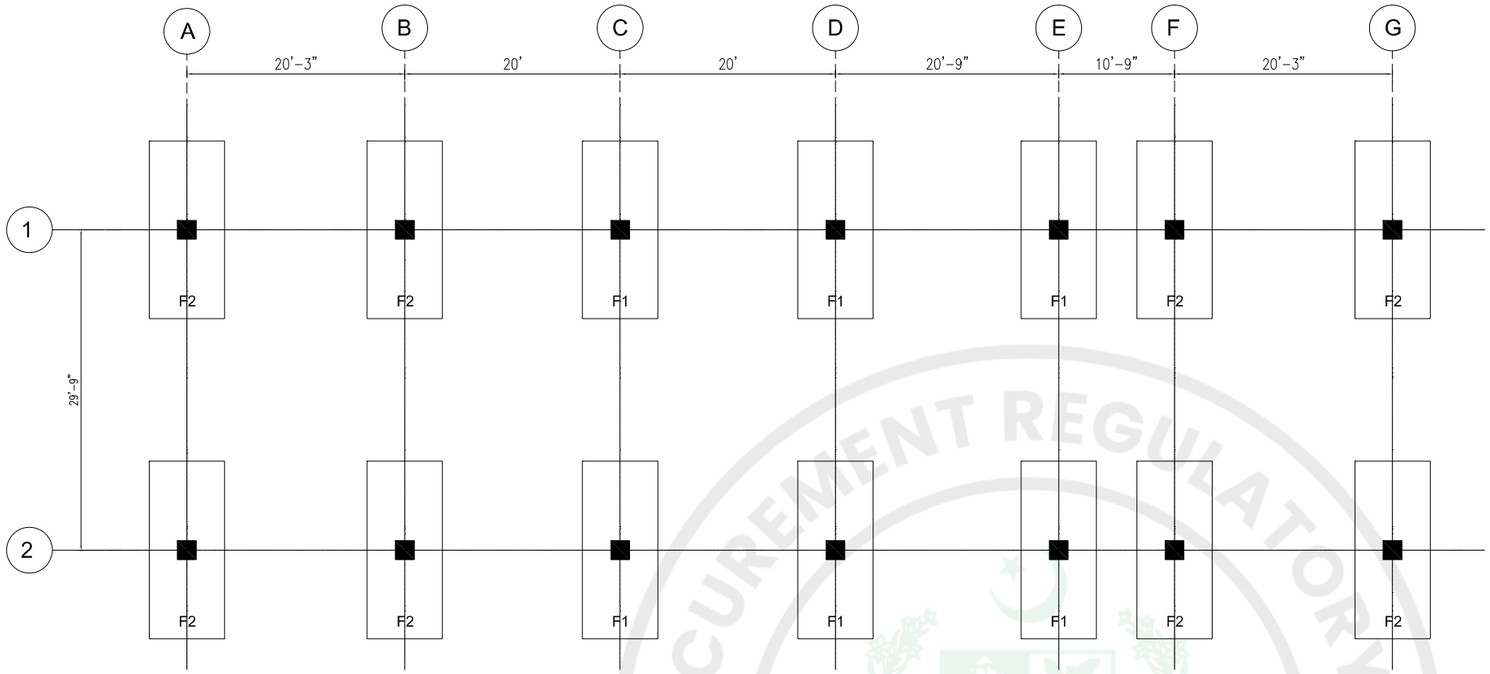
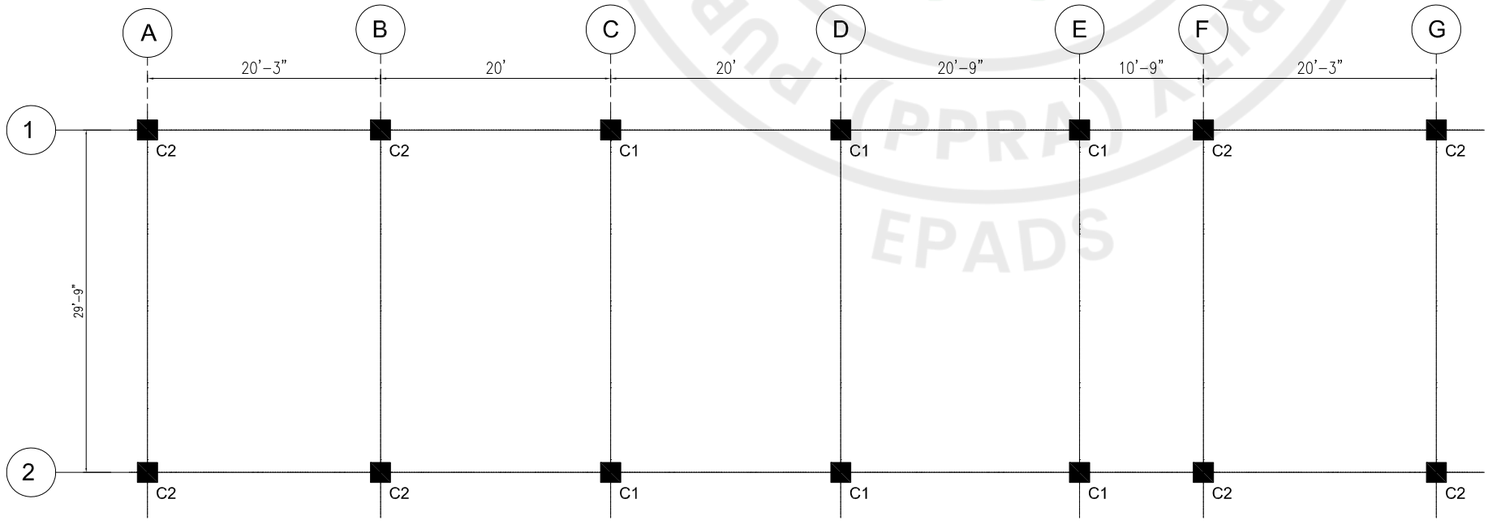


FOUNDATIONS & PILES LAYOUT PLAN



COLUMNS LAYOUT PLAN

ISSUE FOR TENDER

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Detailed Architectural Design Drawings

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MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

PILES, FOUNDATIONS, COLUMNS LAYOUT PLAN

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-02U

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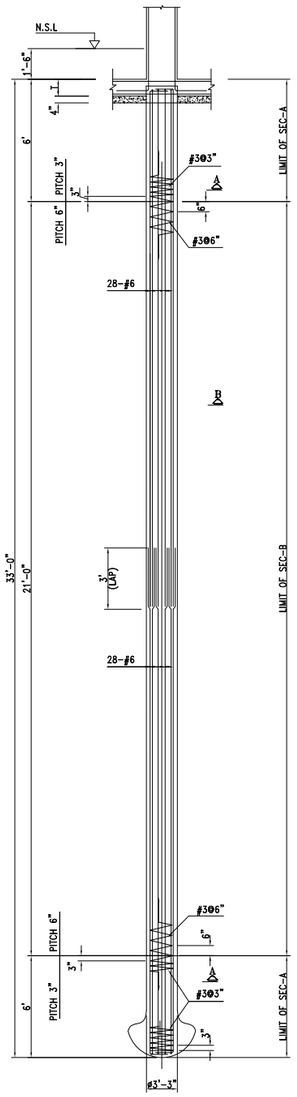
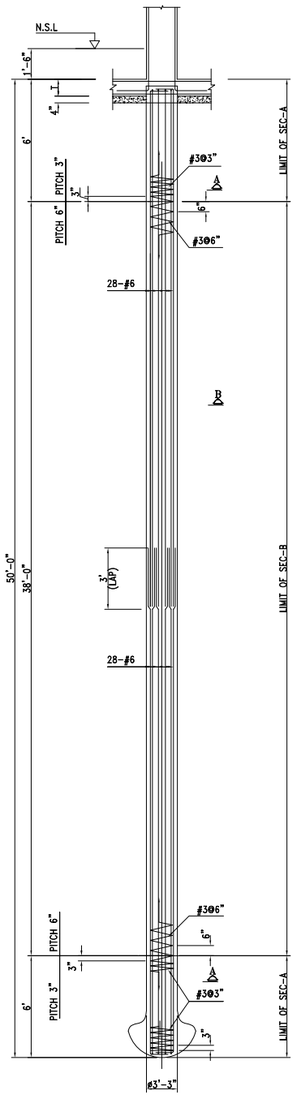
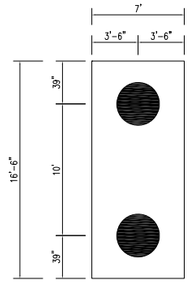


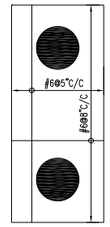
TYP SEC OF PILE
FOUNDATION F2



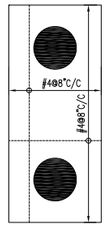
TYP SEC OF PILE
FOUNDATION F1



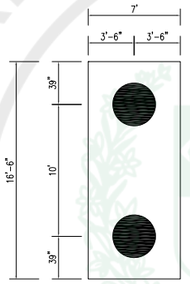
FOUNDATION F1 PILES
LAYOUT PLAN
SLAB THICKNESS = 24"



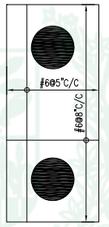
FOUNDATION F1 BOTTOM
REINFORCEMENT PLAN
SLAB THICKNESS = 24"



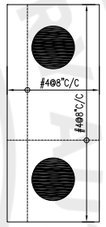
FOUNDATION F1 TOP
REINFORCEMENT PLAN
SLAB THICKNESS = 24"



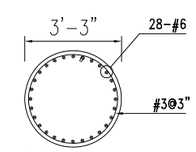
FOUNDATION F2 PILES
LAYOUT PLAN
SLAB THICKNESS = 18"



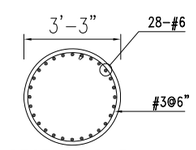
FOUNDATION F2 BOTTOM
REINFORCEMENT PLAN
SLAB THICKNESS = 18"



FOUNDATION F2 TOP
REINFORCEMENT PLAN
SLAB THICKNESS = 18"

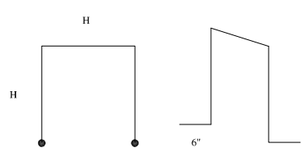


SECTION A-A



SECTION B-B

ISSUE FOR TENDER



IN ORDER TO SUPPORT NEGATIVE REINFORCEMENT MESH,
PROVIDE TIES USING #4 BARS AT 2' SPACING.

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Detailed Architectural Design Drawings

CLIENT NAME

MAIN CONSULTANT

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MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

PILES, FOUNDATIONS, DETAIL

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-03U

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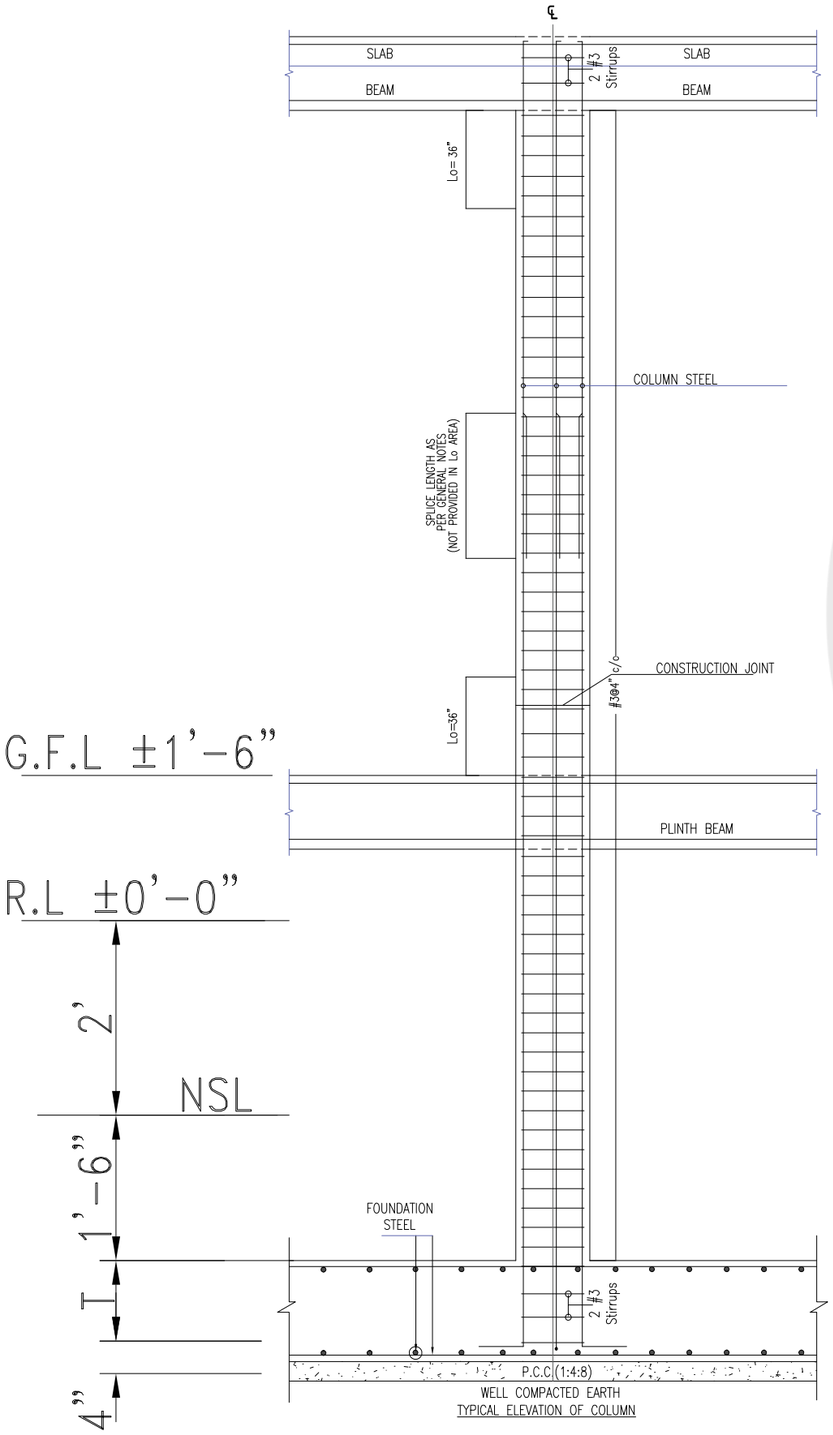

TYPICAL ELEVATION OF COLUMN

SCHEDULE OF COLUMNS

FLOOR'S	COL. 1	COL. 2
UP TO GF SLAB	1'-9" × 1'-9", 18-#8, #3@4"c/c Stirrups	1'-9" × 1'-9", 16-#6, #3@4"c/c Stirrups

ISSUE FOR TENDER

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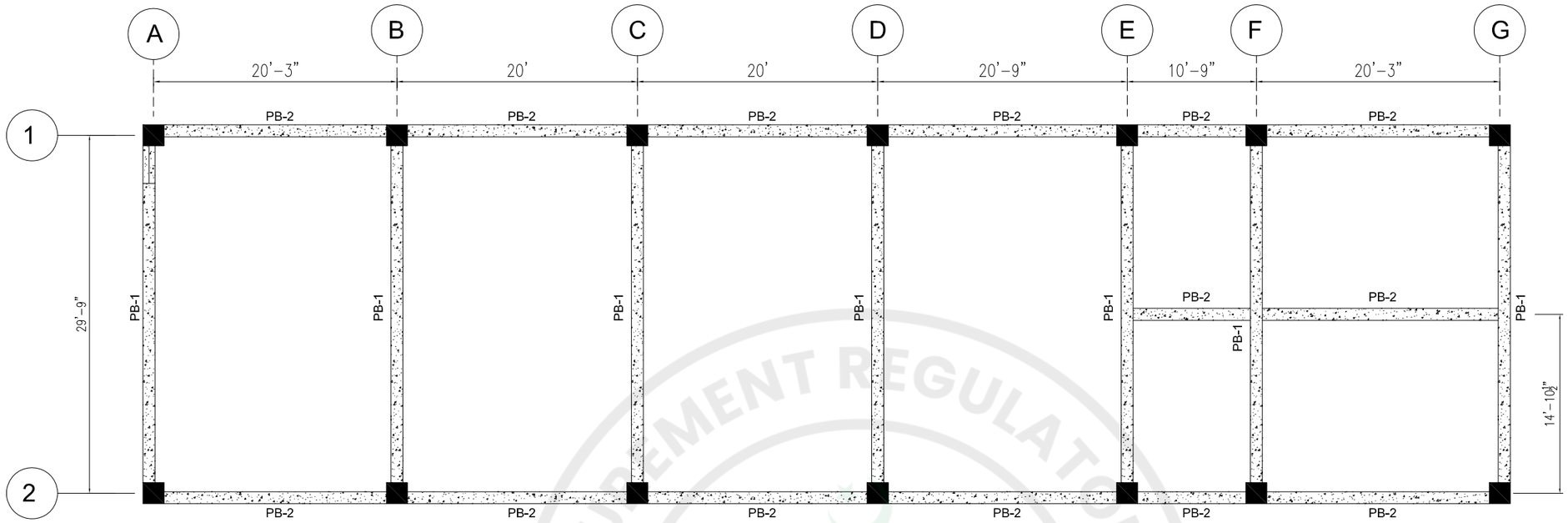
Sheet Name

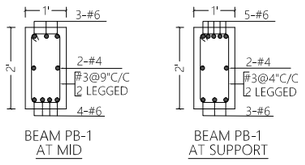
COLUMNS & FOUND. DETAIL

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-04 U

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

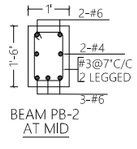


PLINTH BEAMS LAYOUT PLAN

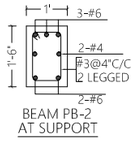


BEAM PB-1
AT MID

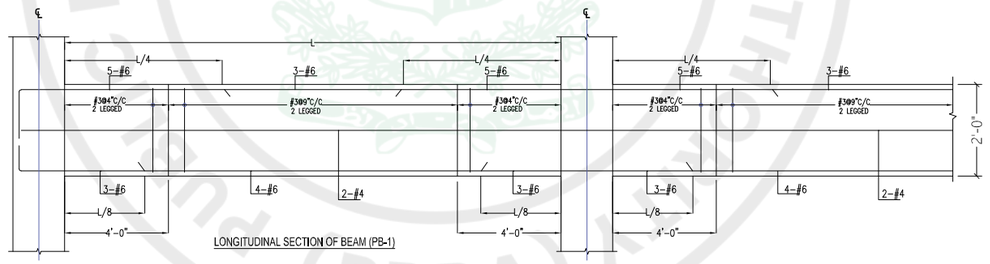
BEAM PB-1
AT SUPPORT



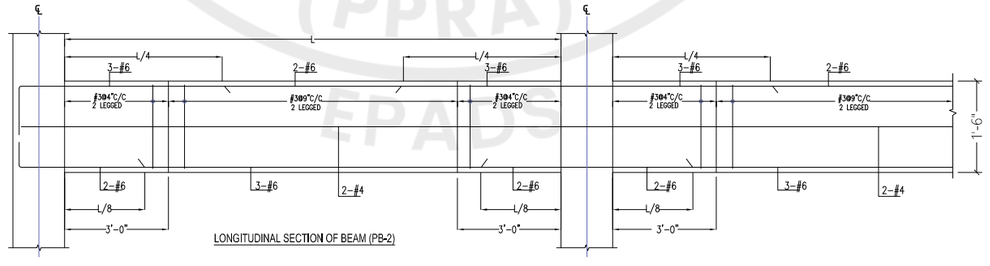
BEAM PB-2
AT MID



BEAM PB-2
AT SUPPORT



LONGITUDINAL SECTION OF BEAM (PB-1)



LONGITUDINAL SECTION OF BEAM (PB-2)

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Detailed Architectural Design Drawings

CLIENT NAME

MAIN CONSULTANT

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06 HBFC BLOCK A FAISAL TOWN LAHORE

JV MEMBERS

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MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

PLINTH BEAMS DETAIL

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-05 U

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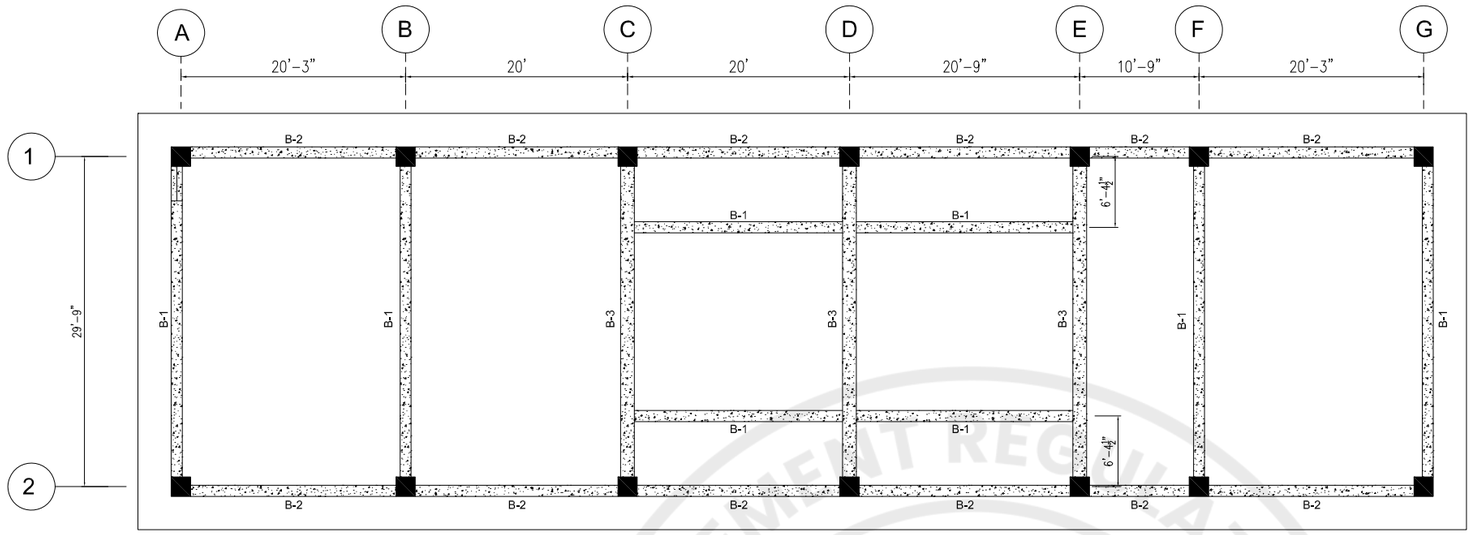
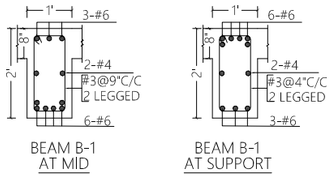
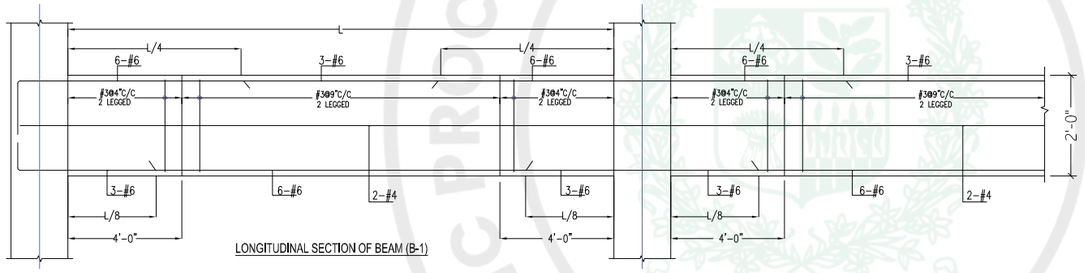


GROUND FLOOR BEAMS LAYOUT PLAN

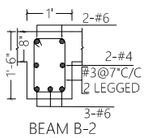


BEAM B-1
AT MID

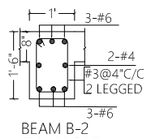
BEAM B-1
AT SUPPORT



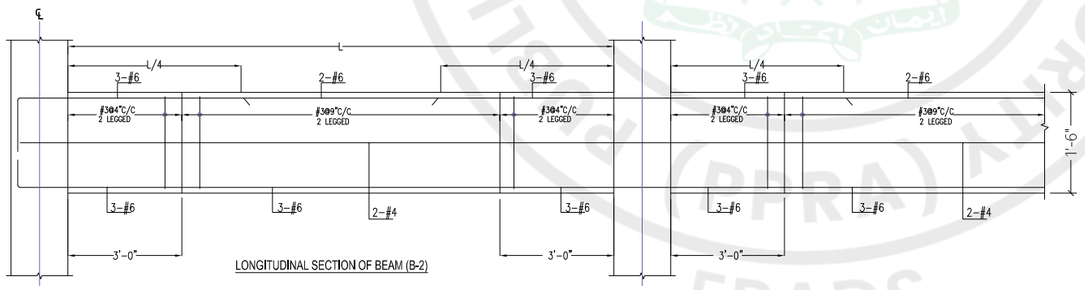
LONGITUDINAL SECTION OF BEAM (B-1)



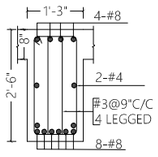
BEAM B-2
AT MID



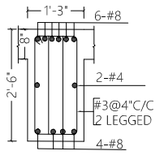
BEAM B-2
AT SUPPORT



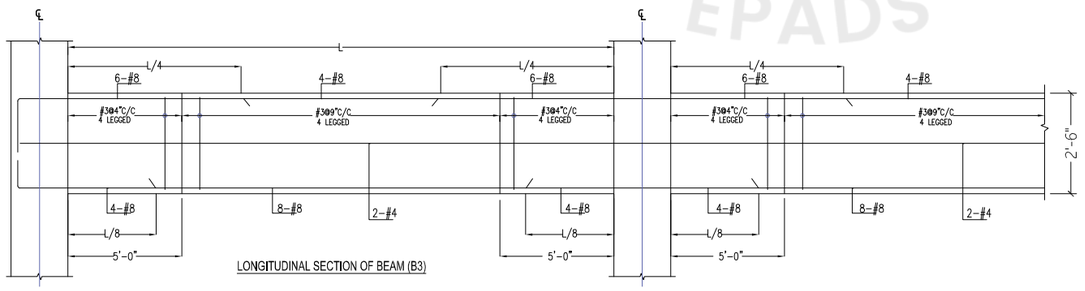
LONGITUDINAL SECTION OF BEAM (B-2)



BEAM B-3
AT MID



BEAM B-3
AT SUPPORT



LONGITUDINAL SECTION OF BEAM (B3)

NOTE:
-THE BARS WILL CONTINUE IN CONTINUOUS BEAMS AS PER REQUIREMENT OF STEEL OR CUT AT DEVELOPMENT LENGTH
-FIRST RING IS PLACED AT 2" FROM THE FACE OF THE SUPPORT
-CLEAR COVER OF 1.5" IS PROVIDED. AT INTERSECTIONS, STEEL OF BEAMS IN SHORTER DIRECTION IS REDUCED TO PASS THROUGH INTERSECTION
-PROVIDE 4" STIRRUPS UPTO A DISTANCE EQUAL TO TWICE THE MEMBER'S DEPTH ON BOTH SIDES OF BEAM TO BEAM INTERSECTION
-BEAM'S POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME
-THE BARS WILL BEND IN COLUMNS IF THE BEAM IS DISCONTINUED

ISSUE FOR TENDER

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MEP CONSULTANT

Project Name

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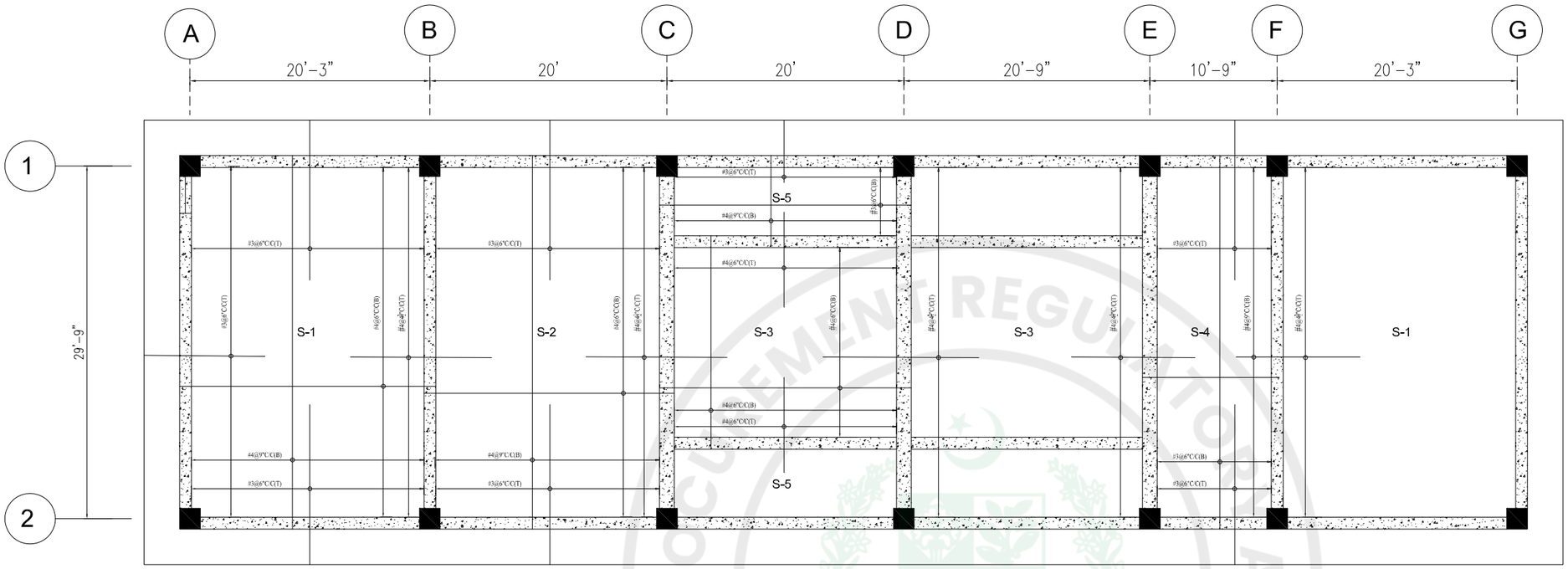
Sheet Name

GF BEAMS DETAIL

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-06U



GROUND FLOOR SLAB REINFORCEMENT PLAN
THICKNESS 8"

NOTE:
- PROVIDE #3 @ 10" C/C DISTRIBUTION STEEL WITH TOP (NEGATIVE) REINFORCEMENT OF ALL SLABS
- PROVIDE 3#6 BARS WITH BOTTOM REINFORCEMENT UNDER THE WALLS IF CONSTRUCTED DIRECTLY ON SLAB
- ALT BOTTOM STEEL IS CURTAILED AT L/8 AND TOP STEEL IS CUT AT L/3 OF THE SPAN
- CONSIDER CONTINUOUS AND DIS-CONTINUOUS EDGES WHILE LAYING TOP STEEL BARS
- FOR DIS-CONTINUOUS EDGE, BEND THE END OF BARS WITHIN SLAB THICKNESS
- FOR POSITIVE REINFORCEMENT, PLACE BARS ALONG LONGER SPAN ON TOP OF BARS PLACED ALONG SHORTER SPAN
- BEAMS POSITIONS MAY BE ADJUSTED AS PER ARCHITECTURAL REQUIREMENT WITHOUT CHANGING BEAM COLUMN FRAME
- BOTTOM BARS ARE REPRESENTED BY (B) AND TOP BARS BY (T)

PROCUREMENT REGULATORY AUTHORITY
PUBLIC (PPRA)
EPADS

ISSUE FOR TENDER

NOTES:

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Detailed Architectural Design Drawings

CLIENT NAME

MAIN CONSULTANT

Anwar Ali Architects (Pvt.) Ltd.
Consulting,Architects,Engineers
Planners & Management Consultants
06 HBFC BLOCK A FAISAL TOWN LAHORE

JV MEMBERS

STRUCTURAL CONSULTANT

AR ENGINEERS
Architects, Stuctural, Earthquake Engineering, Geo Technical, Public Health, Highway, Electrical Design Solution.
Office # 4, 2nd Floor,Sultana Arcade Firdous Market, Gulberg-III, Lahore.
Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

GROUND FLOOR SLAB DETAIL

Date	November, 2025
Scale	NTS
Drawn by	Abdullah
Checked by	Engr M. Aamir
Approved by	Engr. Dr M- Rizwan
Drawing No.	S-07 U

SKARDU AIRPORT ROADS

LIST OF DRAWINGS

S.NO	TITLE OF DRG	SHEET NO.
1	ATC ROADS PLAN	R-01
2	GENERAL NOTES	R-02,03
3	PLAN	R-04
4	ROADS COORDINATES	R-05
5	TYPICAL CROSS SECTION	R-06,07
6	PLAN & PROFILE	R-08,09 &10
7	PAVEMENT MARKING	R-11,12
8	PAA RUNWAY TO PAF RUNWAY PLAN & PROFILE	R-13
9	SECTION	R-14 to 30
10	ATCT PLATFORM GRADING	R-31 to 36

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

NOTES:

1-ALL DIMENSIONS ARE IN METERS

2-COORDINATE SYSTEM IS WGS84

3-PAVEMENT HEIGHT IS 0.95m

REV-NO.	MODIFICATIONS	DATE	DRAWN

CLIENT:

CONSULTANT:

PROJECT :

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

STATUS : ISSUED FOR INFORMATION

DRAWING TITLE :

ATC ROADS PLAN

JOB No. :			SCALE :
	NAME	DATE	SIZEA0
DSGN			PROJECTION
DRWN			
CHKD			
APPD			

DRAWING NO. REV:

RELEASED FOR

☒ INFORMATION ☐ TENDER ☐ APPROVAL ☐ CONSTRUCTION ☐ AS BUILT

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General Notes:

1. Design is based on Overseas Road Note 31 using following parameters:-
   a. Aggregate Base Course CBR 80% (min)
   b. Granular Subbase Course CBR 30% (min)
   c. Subgrade CBR 5%
2. Subgrade to be compacted as per NHA Schedule as applicable.
3. Field Executives to ensure that top 1.0 ft of the subgrade, both in cut and fill shall be compacted at 95% of Modified AASHTO Density.
4. Material and quality requirements of Aggregate Base Course should be as per NHA Schedule as applicable.
5. Material and quality requirements of Subbase Course should be as per NHA Schedule as applicable.
6. Prime coat to be provided on Aggregate Base Course layer as per relevant item of NHA Schedule.
7. Asphaltic Wearing Course (AWC) shall be based on Job Mixed Formula (JMF).
8. Minor adjustment in levels/profile can be made by field executives as per site requirement, if deemed necessary.

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

HORIZONTAL 1:1000

VERTICAL 1:100

CLIENT:

CONSULTANTS

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

General Notes

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 10/03/2026
DRAWING NO: R-02	SHEET: 01

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SKARDU AIRPORT ROADS — GENERAL NOTES FOR CONTRACTOR (MOBILIZATION, PLANT & WORKS EXECUTION — NHA STANDARD)

Design basis: Overseas Road Note 31 | Specifications: NHA General Specifications (latest edition) & relevant ASTM/AASHTO | All levels & dimensions in METER unless noted

A. MOBILIZATION, SURVEY & SITE SETUP

A1 Mobilize within 14 days of NTP. Submit Mobilization Plan, Org-chart, Programme of Works (Primavera/MS-Project), HSE Plan, QA/QC Plan, Traffic Management Plan, Performance Bond and Insurances for Engineer's approval prior to commencement of any physical works.

A2 Establish site office with adjacent Engineer's office, labour camp, fuel point, first-aid post, fire-fighting facility, standby DG set, and material storage yard with proper drainage and fencing.

A3. SURVEY TEAM: minimum one (1) Licensed Land Surveyor + 2 assistants, equipped with calibrated Total Station (accuracy 1"), Auto Level (≤ 0.5 mm/km), prism set and accessories. Calibration certificates (≤ 6 months) to be submitted to the Engineer.

A4 Verify all BMs and control points jointly with the Engineer (ref. Drg. 0-01). Set out centerline, edges, ROW and toe lines; install reference pegs and offset pillars at 20 m intervals and at every PI / PC / PT. Maintain BM register and daily survey log.

A5 Establish on-site QC laboratory equipped for: sieve analysis, Atterberg limits, MDD/OMC (Modified AASHTO), FDT (Sand-Cone & Nuclear gauge), CBR, LAA, soundness, flakiness, Marshall, extraction, bitumen penetration / softening point / ductility, and core density.

B. PLANT, MACHINERY & EQUIPMENT (per NHA General Specifications)

B1 ASPHALT BATCH MIX PLANT: fully automatic, minimum production capacity 100 TPH; with 4 cold-feed bins, rotary dryer, vibrating hot screen, hot bins, mineral-filler silo, bitumen storage tank ≥ 30 ton with thermostatic heating (max 175 °C), bitumen-aggregate weigh hoppers, and bag-house dust collection. Plant calibration certificate (third-party, Engineer-approved) to be submitted before trial mix.

B2 PLANT LOCATION: Engineer-approved site, EPA / NOC obtained, located so that maximum haul distance to the laying point does NOT exceed 40 km (to maintain mix temperature ≥ 140 °C at paver). Plant area to be away from residential zones, with paved access road, separate stockpile bays for each aggregate fraction, drainage and fencing.

B3 PAVING TRAIN: Self-propelled crawler-track Asphalt Paver with hydraulic extendable vibrating-tamping screed (working width 2.5–6.0 m), electronic grade & slope sensors with averaging ski/beam (≥ 9 m) for runway-side / main road. Material Transfer Vehicle (MTV) recommended to avoid segregation and temperature drop.

B4 ROLLERS (NHA Spec): Earthworks/GSB/ABC — Vibratory smooth-drum roller ≥ 10 ton. AWC — Steel Tandem roller 8–10 ton (breakdown rolling) + Pneumatic-tyre roller 15–25 ton @ 0.55–0.85 MPa tyre pressure (intermediate rolling) + Steel Tandem 8–10 ton (final/finish rolling). All rollers shall have valid calibration & weight certificates.

B5 SUPPORT FLEET: Motor grader ≥ 125 HP, water bowsers ≥ 6,000 L (one per active section), bitumen distributor with calibrated spray bar (for prime/tack coat), tipper trucks with insulated body and tarpaulin cover for hot mix, front-end loaders, mechanical brooms. All machinery shall be in sound working order with road-worthiness certificates.

C. EARTHWORKS & SUBGRADE

C1 Clear, grub and strip topsoil minimum 150 mm; stockpile separately for landscaping reuse. Dispose unsuitable material at Engineer-approved spoil area only.

C2 Execute cut/fill to formation levels per Section, Plan & Profile drawings. Side slopes 1V:1.5H (fill) and 1V:1H (cut) unless directed otherwise. Embankment in layers ≤ 200 mm loose, compacted to 95% Modified AASHTO MDD.

C3 SUBGRADE: CBR ≥ 5%. Top 1.0 ft (300 mm) in both cut and fill compacted to 95% Modified AASHTO MDD. FDT (Sand-Cone / Nuclear) at every 500 m² per layer. Proof-roll finished subgrade in presence of Engineer; rectify any soft / pumping spots before placing GSB.

D. PAVEMENT — MATERIAL, COMPACTION & TEMPERATURE (NHA Spec)

D1 GRANULAR SUBBASE (GSB): CBR ≥ 30%, gradation & PI per NHA Schedule. Layer thickness ≤ 200 mm loose, compacted to 100% Modified AASHTO MDD. Surface tolerance ± 15 mm.

D2 AGGREGATE BASE COURSE (ABC): CBR ≥ 80%, crushed material, LAA ≤ 30%, soundness ≤ 12%, flakiness ≤ 25%, PI ≤ 6. Layer ≤ 150 mm loose, compacted to 100% Modified AASHTO MDD. Surface tolerance ± 10 mm under 3 m straightedge.

D3 PRIME COAT: Cutback bitumen MC-30 / MC-70 @ 0.8–1.2 L/m² over dry, broomed and shaped ABC. Application temperature 50–70 °C. Allow 24–48 hr curing; protect from traffic until fully absorbed.

D4 TACK COAT: RC-70 / emulsion (SS-1h) @ 0.25–0.40 L/m² between bituminous layers and against vertical faces of joints, kerbs and structures.

D5 ASPHALTIC WEARING COURSE (AWC): bitumen 60/70 pen (ARL/NRL/Attock approved) @ 4.0–5.5% by weight, aggregate per NHA Schedule. Submit JOB MIX FORMULA (JMF) + Trial Section (50 m × full width) for Engineer's written approval before regular paving.

D6 TEMPERATURE LIMITS (NHA — strictly enforced):

- Bitumen heating in tank: max 165 °C (never exceed 175 °C).
- Aggregate heating in dryer: 150–170 °C.
- Mixing temperature at plant: 150–165 °C.
- Discharge temperature at paver: ≥ 140 °C (reject if < 135 °C).
- Initial / breakdown rolling: ≥ 130 °C.
- Intermediate rolling: 100–130 °C. Final rolling: ≥ 80 °C.
- Ambient air temperature for laying: ≥ 10 °C and rising. NO paving in rain, snow, or on damp / frozen surface.

D7 AWC COMPACTION & MARSHALL: ≥ 96% of JMF density. Marshall — Stability ≥ 1000 kg, Flow 2–4 mm, Air Voids 3–5%, VMA & VFA per NHA. Joints to be hot, vertical, painted with tack coat; longitudinal joints offset between successive layers ≥ 150 mm.

E. QUALITY CONTROL, TESTING & SUBMITTALS

E1 Source approval mandatory before delivery — aggregates (LAA, soundness, flakiness, gradation), bitumen (penetration, softening point, ductility, flash point), filler, and water. No material shall be incorporated without Engineer's written approval.

E2 Daily field tests: FDT, MDD/OMC, layer gradation. AWC — extraction, gradation, Marshall on plant samples; pavement cores at 1 per 500 m² for thickness & density.

E3 Survey check on every layer (subgrade, GSB, ABC, AWC) — line, level, thickness, crossfall (typically 2.0% normal crown). Tolerances per NHA Specs. Submit Weekly QC Report and full as-built drawings on completion.

F. HSE & GENERAL

F1 Mandatory PPE: helmet, hi-vis vest, safety boots, gloves, ear protection (near plant). Traffic management with TCP, signage, flagmen and lighting during night works. Dust suppression by water bowsing twice daily; cover stockpiles in windy conditions; spill kits at fuel point and bitumen tank.

F2 All levels and dimensions are in METER unless noted otherwise. Minor field adjustments in levels/profile may be made by the Engineer's representative if site conditions warrant — any such deviation requires written approval before execution. Drawings to be read in conjunction with Specifications, BoQ and Conditions of Contract.

CONTRACTOR: M/s _____	CLIENT: PAKISTAN AIRPORTS AUTHORITY	PROJECT:CONSTRUCTION OF ATCT, FIRE STATION & ALLIED FACILITIES — SKARDU INTL. AIRPORT	DRAWING TITLE: GENERAL NOTES — CONTRACTOR MOBILIZATION & WORKS (ROADS)	DRAWN: ENGR. U. MANZOOR CHECKED: ENGR. MURTAZA SCALE: N.T.S. | 29/04/2026	Project Director PAA Check: _____

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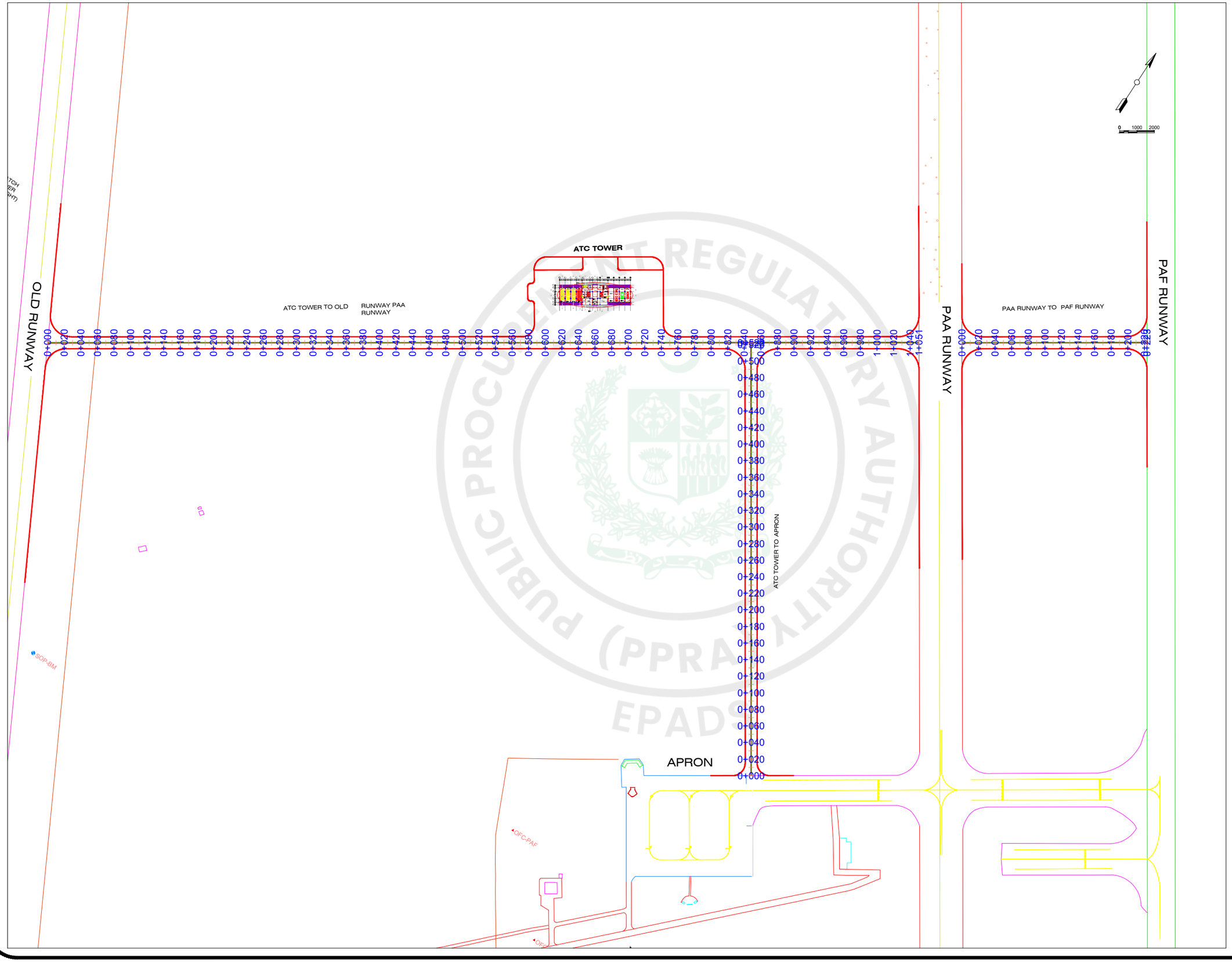


General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

PLAN

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 28/12/2025
DRAWING NO: R-04	SHEET: 01

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Alignment Name: ATC TOWER TO APRON			
Station Range: Start: 0+000.00, End: 0+521.97			
Station Increment: 20.00			
Station	**Northing**	**Easting**	**Tangential Direction**
0+000.00	3,909,931.1585m	549,195.5965m	N33° 16' 51"W
0+020.00	3,909,947.8783m	549,184.6217m	N33° 16' 51"W
0+040.00	3,909,964.5982m	549,173.6468m	N33° 16' 51"W
0+060.00	3,909,981.3180m	549,162.6720m	N33° 16' 51"W
0+080.00	3,909,998.0379m	549,151.6972m	N33° 16' 51"W
0+100.00	3,910,014.7577m	549,140.7224m	N33° 16' 51"W
0+120.00	3,910,031.4776m	549,129.7475m	N33° 16' 51"W
0+140.00	3,910,048.1974m	549,118.7727m	N33° 16' 51"W
0+160.00	3,910,064.9173m	549,107.7979m	N33° 16' 51"W
0+180.00	3,910,081.6371m	549,096.8231m	N33° 16' 51"W
0+200.00	3,910,098.3569m	549,085.8482m	N33° 16' 51"W
0+220.00	3,910,115.0768m	549,074.8734m	N33° 16' 51"W
0+240.00	3,910,131.7966m	549,063.8986m	N33° 16' 51"W
0+260.00	3,910,148.5165m	549,052.9238m	N33° 16' 51"W
0+280.00	3,910,165.2363m	549,041.9489m	N33° 16' 51"W
0+300.00	3,910,181.9562m	549,030.9741m	N33° 16' 51"W
0+320.00	3,910,198.6760m	549,019.9993m	N33° 16' 51"W
0+340.00	3,910,215.3959m	549,009.0245m	N33° 16' 51"W
0+360.00	3,910,232.1157m	548,998.0496m	N33° 16' 51"W
0+380.00	3,910,248.8356m	548,987.0748m	N33° 16' 51"W
0+400.00	3,910,265.5554m	548,976.1000m	N33° 16' 51"W
0+420.00	3,910,282.2752m	548,965.1252m	N33° 16' 51"W
0+440.00	3,910,298.9951m	548,954.1503m	N33° 16' 51"W
0+460.00	3,910,315.7149m	548,943.1755m	N33° 16' 51"W
0+480.00	3,910,332.4348m	548,932.2007m	N33° 16' 51"W
0+500.00	3,910,349.1546m	548,921.2259m	N33° 16' 51"W
0+520.00	3,910,365.8745m	548,910.2510m	N33° 16' 51"W
0+521.97	3,910,367.5192m	548,909.1714m	N33° 16' 51"W

Alignment Name: ATC TOWER TO OLD RUNWAY PAA RUNWAY			
Station Range: Start: 0+000.00, End: 1+050.60			
Station Increment: 20.00			
Station	**Northing**	**Easting**	**Tangential Direction**
0+000.00	3,909,902.0723m	548,200.0759m	N56° 43' 09"E
0+020.00	3,909,913.0471m	548,216.7957m	N56° 43' 09"E
0+040.00	3,909,924.0220m	548,233.5156m	N56° 43' 09"E
0+060.00	3,909,934.9968m	548,250.2354m	N56° 43' 09"E
0+080.00	3,909,945.9716m	548,266.9553m	N56° 43' 09"E
0+100.00	3,909,956.9465m	548,283.6751m	N56° 43' 09"E
0+120.00	3,909,967.9213m	548,300.3949m	N56° 43' 09"E
0+140.00	3,909,978.8961m	548,317.1148m	N56° 43' 09"E
0+160.00	3,909,989.8709m	548,333.8346m	N56° 43' 09"E
0+180.00	3,910,000.8458m	548,350.5545m	N56° 43' 09"E
0+200.00	3,910,011.8206m	548,367.2743m	N56° 43' 09"E
0+220.00	3,910,022.7954m	548,383.9942m	N56° 43' 09"E
0+240.00	3,910,033.7702m	548,400.7140m	N56° 43' 09"E
0+260.00	3,910,044.7451m	548,417.4339m	N56° 43' 09"E
0+280.00	3,910,055.7199m	548,434.1537m	N56° 43' 09"E
0+300.00	3,910,066.6947m	548,450.8735m	N56° 43' 09"E
0+320.00	3,910,077.6695m	548,467.5934m	N56° 43' 09"E
0+340.00	3,910,088.6444m	548,484.3132m	N56° 43' 09"E
0+360.00	3,910,099.6192m	548,501.0331m	N56° 43' 09"E
0+380.00	3,910,110.5940m	548,517.7529m	N56° 43' 09"E
0+400.00	3,910,121.5688m	548,534.4728m	N56° 43' 09"E
0+420.00	3,910,132.5437m	548,551.1926m	N56° 43' 09"E
0+440.00	3,910,143.5185m	548,567.9125m	N56° 43' 09"E
0+460.00	3,910,154.4933m	548,584.6323m	N56° 43' 09"E
0+480.00	3,910,165.4681m	548,601.3522m	N56° 43' 09"E
0+500.00	3,910,176.4430m	548,618.0720m	N56° 43' 09"E
0+520.00	3,910,187.4178m	548,634.7918m	N56° 43' 09"E

Alignment Name: ATC TOWER TO OLD RUNWAY PAA RUNWAY			
Station Range: Start: 0+000.00, End: 1+050.60			
Station Increment: 20.00			
Station	**Northing**	**Easting**	**Tangential Direction**
0+540.00	3,910,198.3926m	548,651.5117m	N56° 43' 09"E
0+560.00	3,910,209.3674m	548,668.2315m	N56° 43' 09"E
0+580.00	3,910,220.3423m	548,684.9514m	N56° 43' 09"E
0+600.00	3,910,231.3171m	548,701.6712m	N56° 43' 09"E
0+620.00	3,910,242.2919m	548,718.3911m	N56° 43' 09"E
0+640.00	3,910,253.2667m	548,735.1109m	N56° 43' 09"E
0+660.00	3,910,264.2416m	548,751.8308m	N56° 43' 09"E
0+680.00	3,910,275.2164m	548,768.5506m	N56° 43' 09"E
0+700.00	3,910,286.1912m	548,785.2704m	N56° 43' 09"E
0+720.00	3,910,297.1660m	548,801.9903m	N56° 43' 09"E
0+740.00	3,910,308.1409m	548,818.7101m	N56° 43' 09"E
0+760.00	3,910,319.1157m	548,835.4300m	N56° 43' 09"E
0+780.00	3,910,330.0905m	548,852.1498m	N56° 43' 09"E
0+800.00	3,910,341.0653m	548,868.8697m	N56° 43' 09"E
0+820.00	3,910,352.0402m	548,885.5895m	N56° 43' 09"E
0+840.00	3,910,363.0150m	548,902.3094m	N56° 43' 09"E
0+860.00	3,910,373.9898m	548,919.0292m	N56° 43' 09"E
0+880.00	3,910,384.9646m	548,935.7490m	N56° 43' 09"E
0+900.00	3,910,395.9395m	548,952.4689m	N56° 43' 09"E
0+920.00	3,910,406.9143m	548,969.1887m	N56° 43' 09"E
0+940.00	3,910,417.8891m	548,985.9086m	N56° 43' 09"E
0+960.00	3,910,428.8640m	549,002.6284m	N56° 43' 09"E
0+980.00	3,910,439.8388m	549,019.3483m	N56° 43' 09"E
1+000.00	3,910,450.8136m	549,036.0681m	N56° 43' 09"E
1+020.00	3,910,461.7884m	549,052.7880m	N56° 43' 09"E
1+040.00	3,910,472.7633m	549,069.5078m	N56° 43' 09"E
1+050.60	3,910,478.5773m	549,078.3653m	N56° 43' 09"E

Alignment Name: PAA RUNWAY TO PAF RUNWAY			
Station Range: Start: 0+000.00, End: 0+223.10			
Station Increment: 20.00			
Station	**Northing**	**Easting**	**Tangential Direction**
0+000.00	3,910,507.0050m	549,121.6741m	N56° 43' 09"E
0+020.00	3,910,517.9798m	549,138.3940m	N56° 43' 09"E
0+040.00	3,910,528.9546m	549,155.1138m	N56° 43' 09"E
0+060.00	3,910,539.9294m	549,171.8337m	N56° 43' 09"E
0+080.00	3,910,550.9043m	549,188.5535m	N56° 43' 09"E
0+100.00	3,910,561.8791m	549,205.2733m	N56° 43' 09"E
0+120.00	3,910,572.8539m	549,221.9932m	N56° 43' 09"E
0+140.00	3,910,583.8288m	549,238.7130m	N56° 43' 09"E
0+160.00	3,910,594.8036m	549,255.4329m	N56° 43' 09"E
0+180.00	3,910,605.7784m	549,272.1527m	N56° 43' 09"E
0+200.00	3,910,616.7532m	549,288.8726m	N56° 43' 09"E
0+220.00	3,910,627.7281m	549,305.5924m	N56° 43' 09"E
0+223.10	3,910,629.4275m	549,308.1815m	N56° 43' 09"E

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:

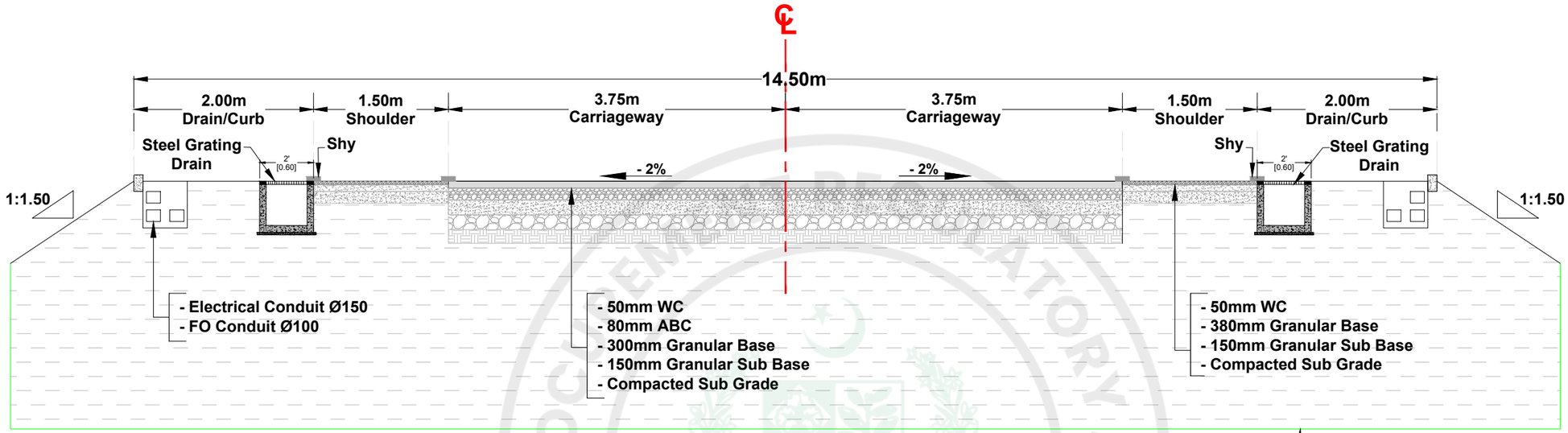
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

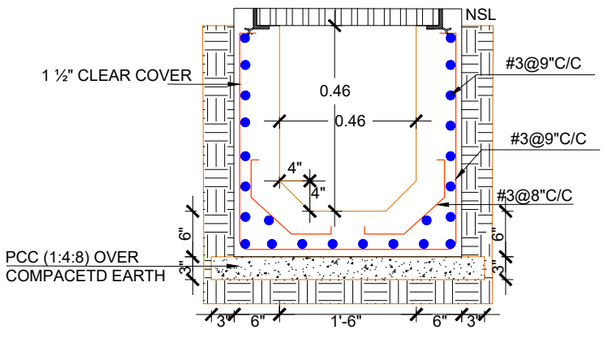
Roads Coordinates

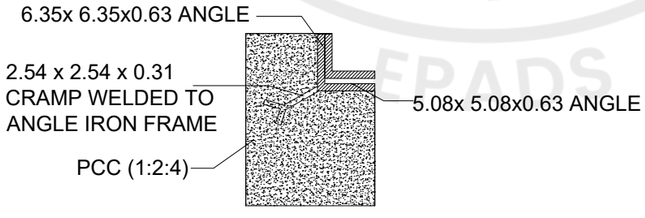
DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 26/12/2025
DRAWING NO: R-05	SHEET: 01

EPADS

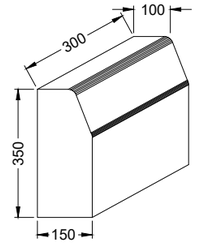


Road Typical X-Section of Fill (14.50m)

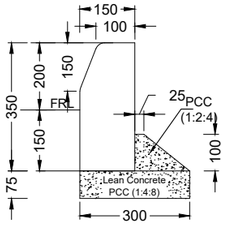




DETAIL 'A'



KERB STONE
PRECAST P.C.C (3000 PSI)



PRECAST P.C.C
KERB STONE (3000 PSI)

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

HORIZONTAL 1:1000

VERTICAL 1:100

CLIENT:

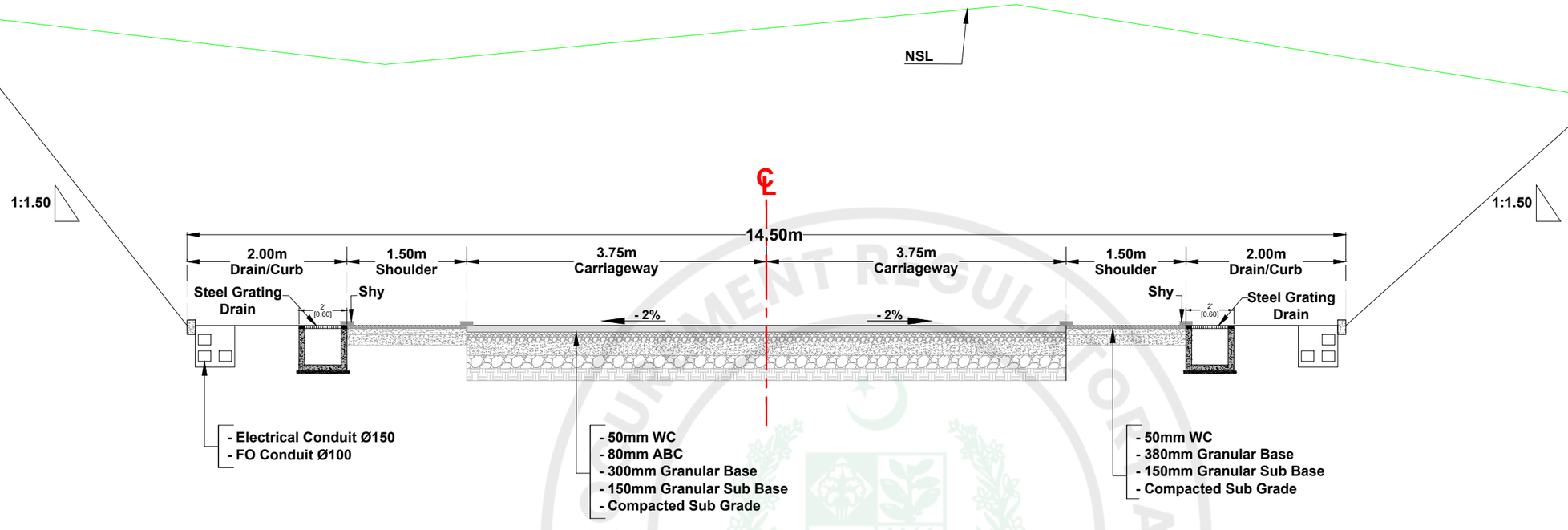
CONSULTANTS

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

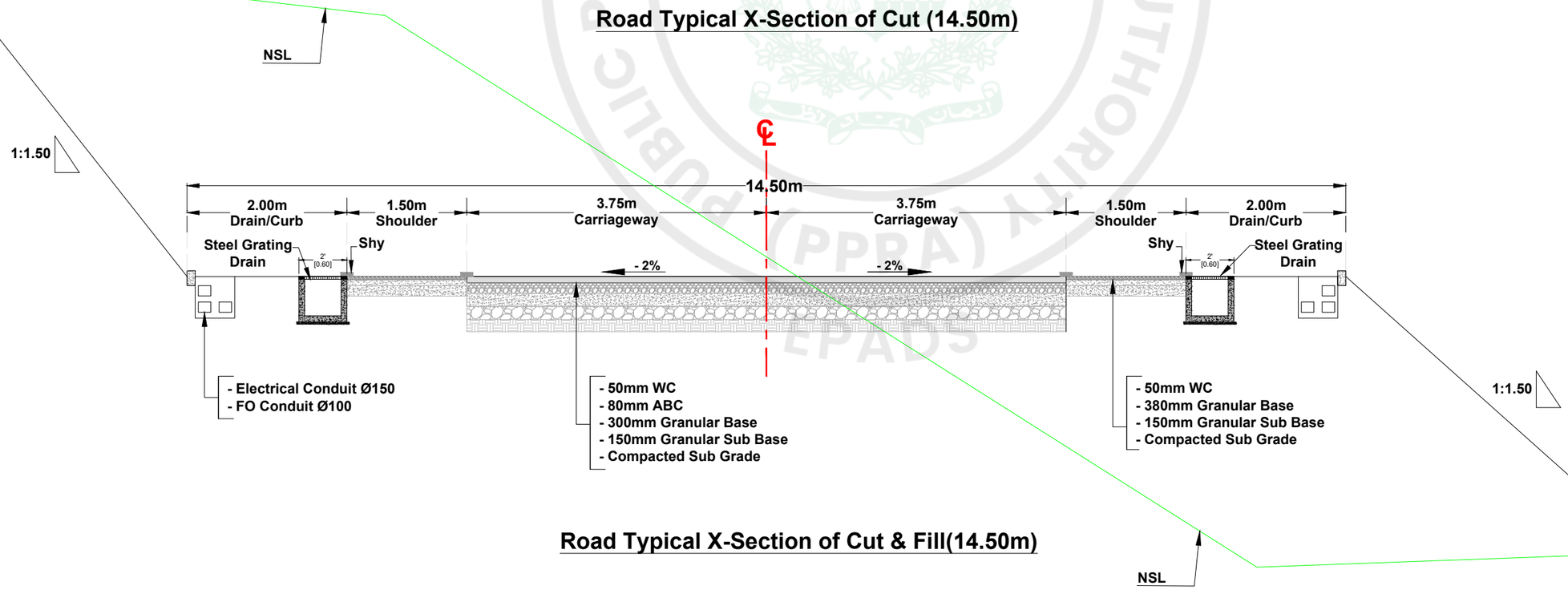
DRAWING TITLE:
TYPICAL CROSS SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 10/03/2026
DRAWING NO: R-06	SHEET: 01

PROCUREMENT AUTHORITY (PPRA) PUBLIC EPADS



Road Typical X-Section of Cut (14.50m)



Road Typical X-Section of Cut & Fill(14.50m)

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

HORIZONTAL 1:1000

VERTICAL 1:100

CLIENT:

CONSULTANTS

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

TYPICAL CROSS SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 10/03/2026
DRAWING NO: R-07	SHEET: 02

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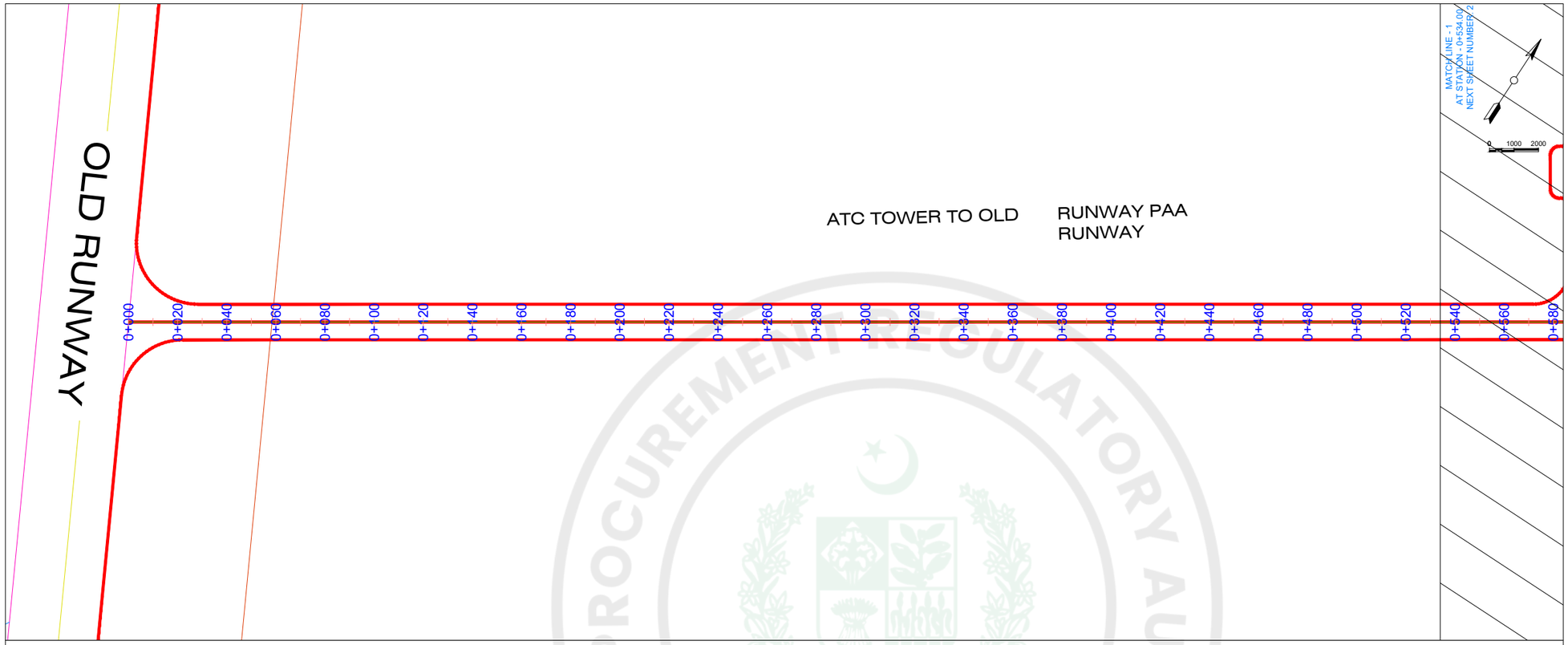
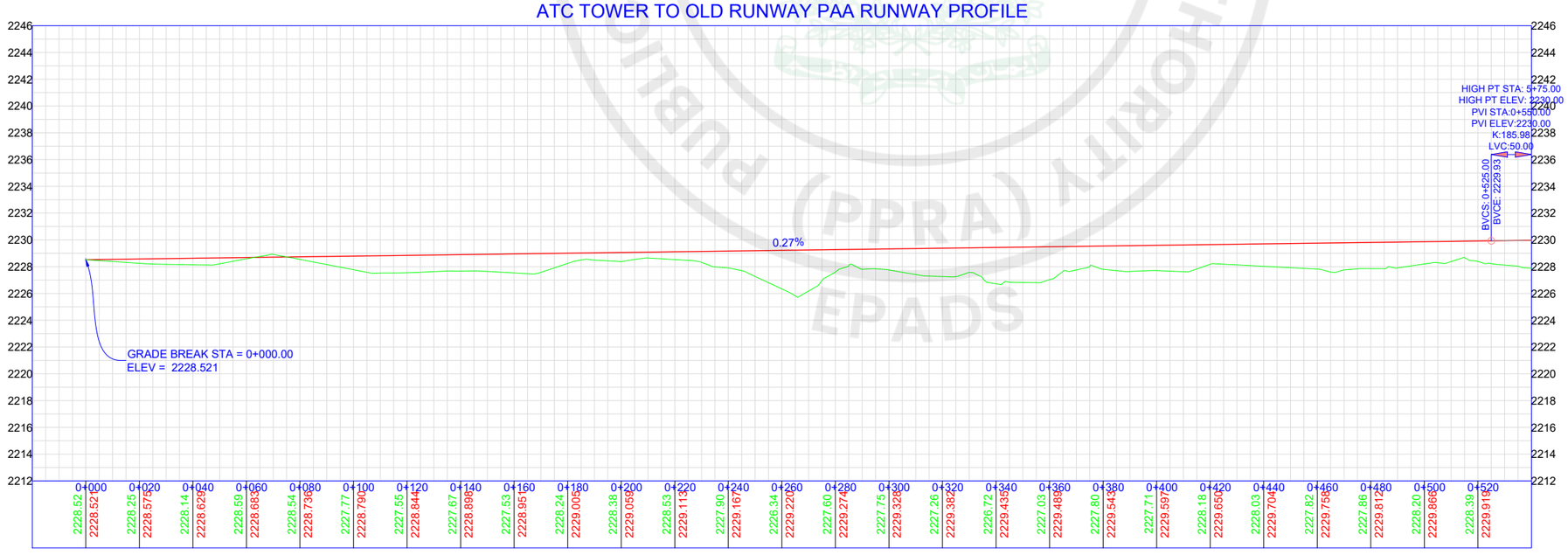


ATC TOWER TO OLD RUNWAY PAA RUNWAY PROFILE



General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:

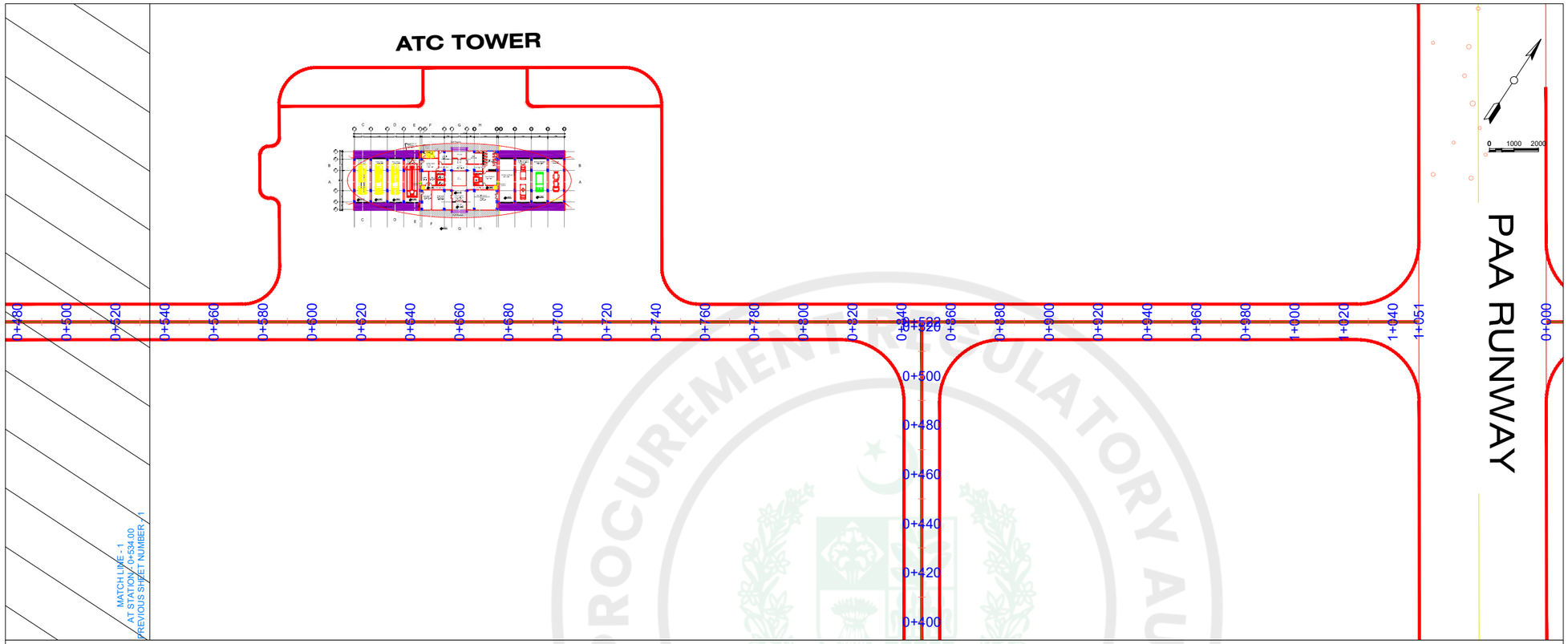
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

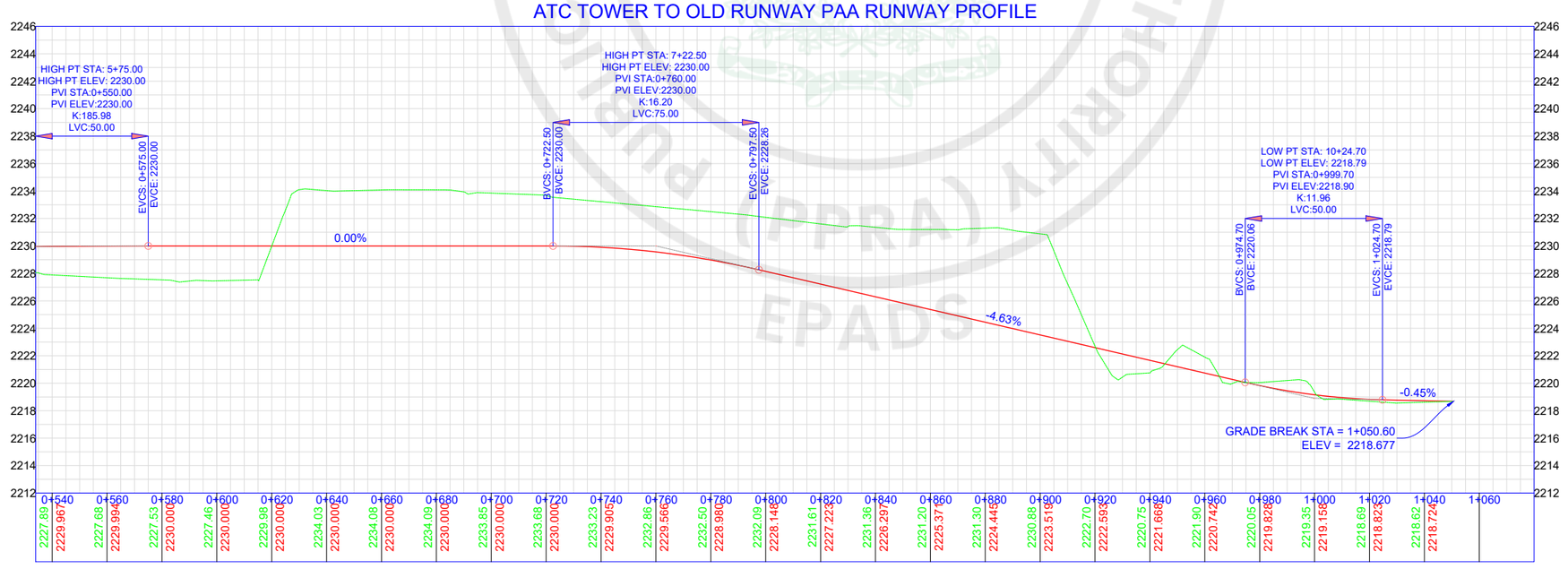
ATC TOWER TO OLD RUNWAY PAA RUNWAY PLAN & PROFILE

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-08	SHEET: 01

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ATC TOWER TO OLD RUNWAY PAA RUNWAY PROFILE



General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئر پورٹس اتھارٹی

CONSULTANTS

Ahmad Ali Architects (Pvt) Ltd.

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER TO OLD RUNWAY PAA RUNWAY PLAN & PROFILE

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 26/12/2025
DRAWING NO: R-09	SHEET: 02

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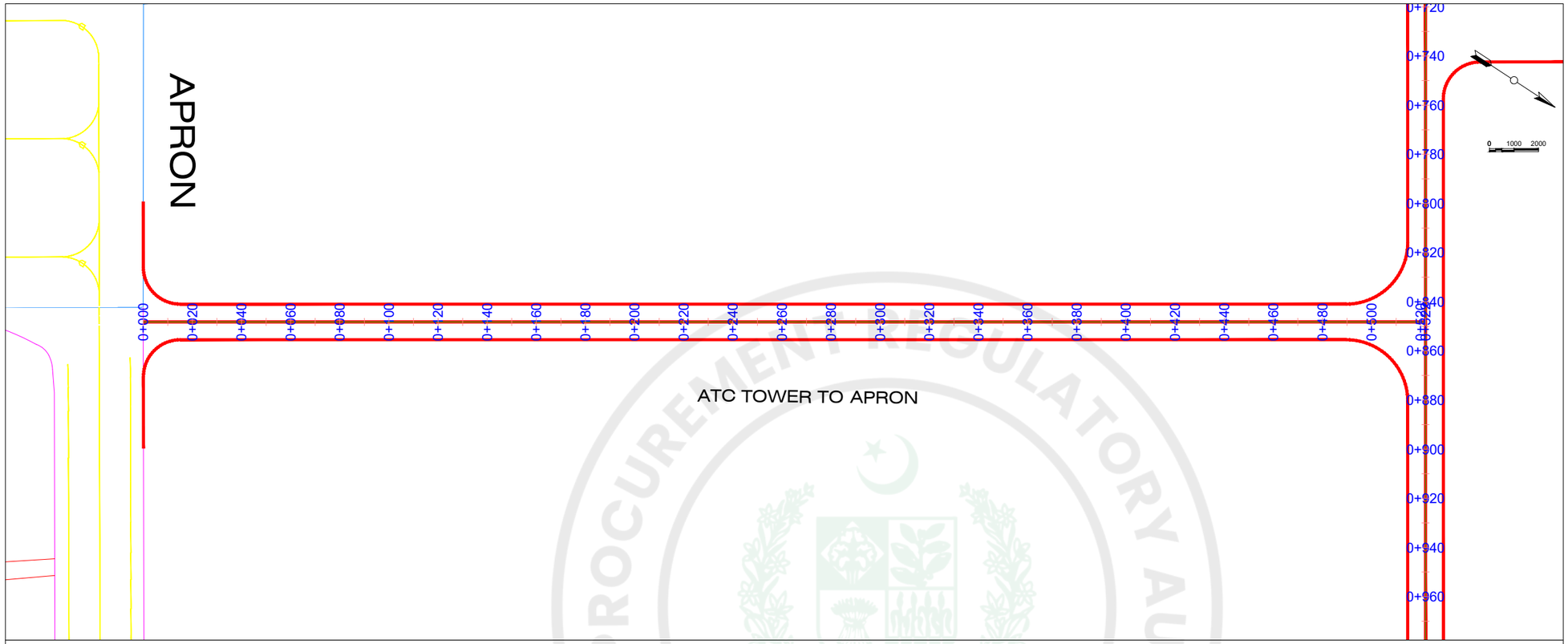
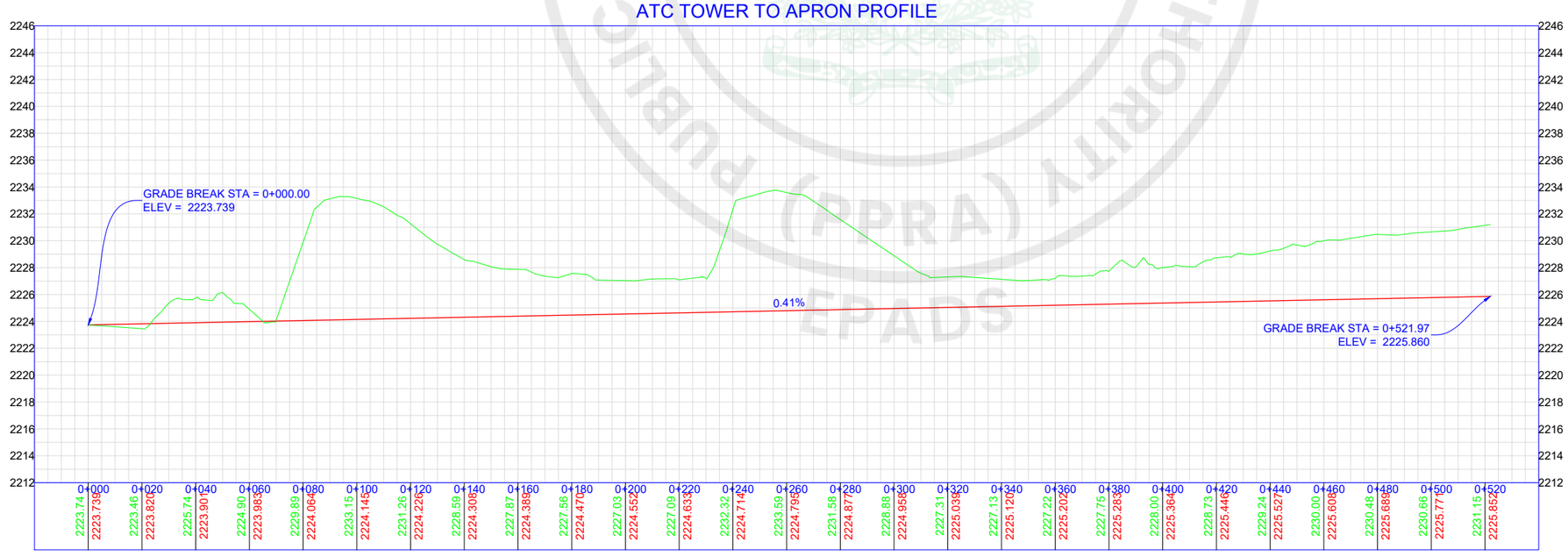


ATC TOWER TO APRON PROFILE



General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Ali Architects (PVT) Ltd.
leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER TO APRON PLAN & PROFILE

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-10	SHEET: 03

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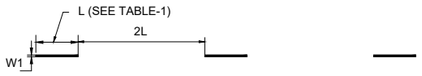
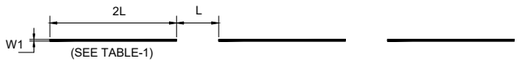
PAVEMENT MARKING LINES

FOR DIMENSIONS L & W1 TO W5, SEE TABLE-1



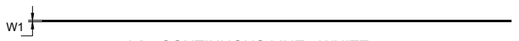
L1 - BROKEN GUIDE LINE-WHITE

AT CENTERLINE OF DIVIDED 2-LANE RAMPS AND LANE SEPARATION OF ROAD



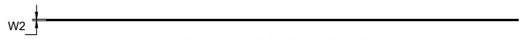
L2 -BROKEN WARNING LINE -WHITE

AT APPROACHES TO DANGER (e.g Roundabouts,T-junctions and steep slopes at ramps)



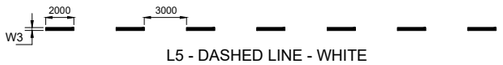
L3 - CONTINUOUS LINE - WHITE

AT NO PASSING ZONES ALONG RAMPS & FLYOVER



L4 - CONTINUOUS EDGE LINE -YELLOW

AT EDGE OF PAVEMENT AT ALL LOCATIONS

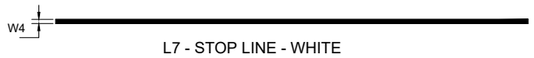


L5 - DASHED LINE - WHITE

AT SEPARATION OF THROUGH LANES FROM ACCELERATION LANE

L6 - DOTTED LINE - WHITE

FOR DEFINING VEHICLE PATHS WITHIN INTERSECTIONS AT RAMPS



L7 - STOP LINE - WHITE

AT INTERSECTIONS ACROSS PAVEMENT AT RAMPS

L8 - TRANSVERSE YIELD LINE - WHITE

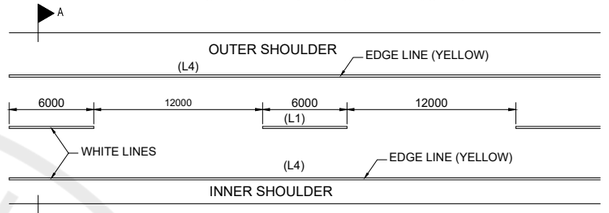
AT INTERSECTIONS ACROSS PAVEMENT IN THE SAME POSITION AS L7 LINE

TO INDICATE GIVE WAY

L9 - DOTTED LINE - YELLOW

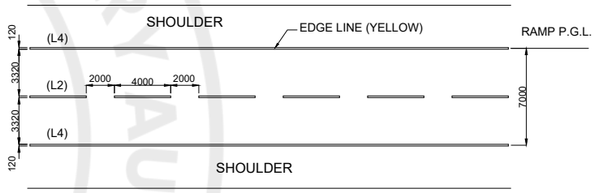
FOR EDGE LINE WHERE PARKING BAYS ARE PROVIDED OUTSIDE THE LANE

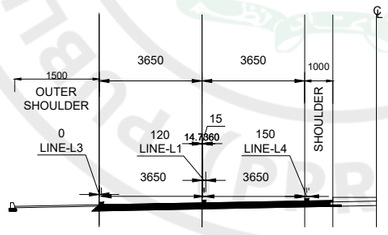
TYPICAL MARKING AT ROAD



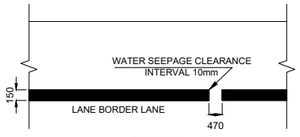
TYPICAL MARKING AT TWO LANE

RAMP (AT APPROACHES TO HAZARDS)





SECTION A–A



DETAIL - A

TABLE – 1

ROADWAY TYPE	L (mm)	W1	W2	W3	W4	W5
ROAD	6000	120	150	450	-	-

NOTE :–

1- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

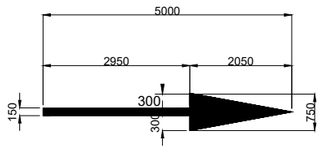
Pavement Marking

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2023
DRAWING NO: R-11	SHEET: 01

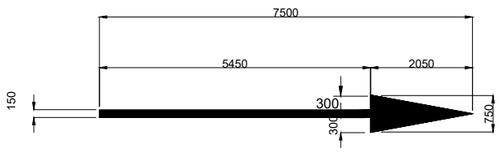
PROCUREMENT REGULATORY AUTHORITY (PRA) EPADS

LANE SELECTION ARROWS – WHITE

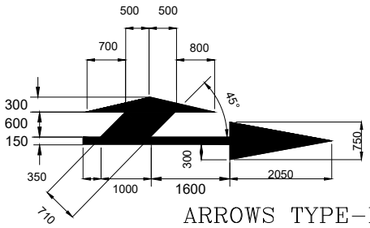
(ACCESS RAMPS)

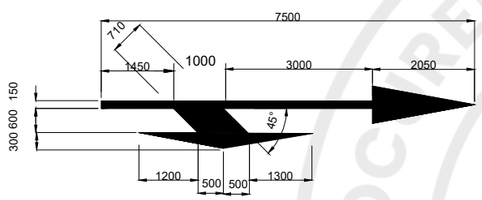


(ROADS)

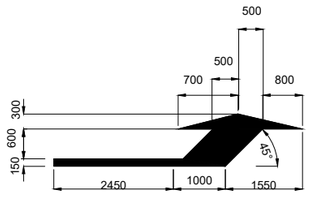


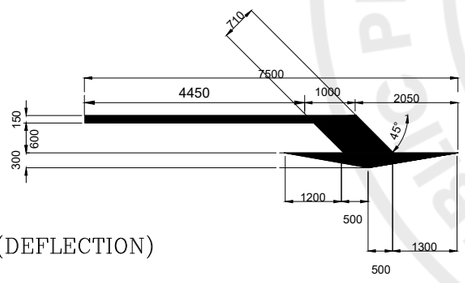
ARROWS TYPE–I (STRAIGHT)



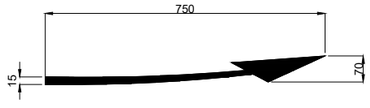


ARROWS TYPE–II (COMBINED)

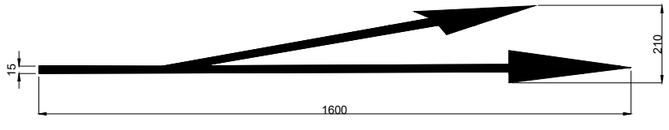




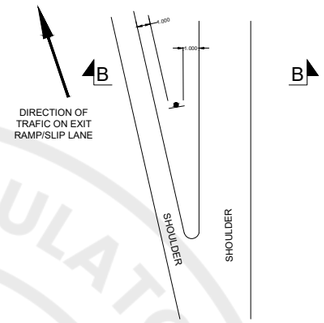
ARROWS TYPE–III (DEFLECTION)



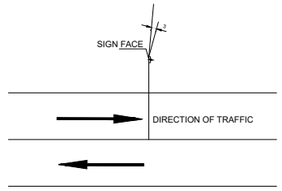
ORIENTATION ARROW



ORIENTATION ARROW



PLACING OF SIGN AT NOSE



ORIENTATION OF SIGN IN PLAN
RELATED TO DIRECTION OF TRAFFIC

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:

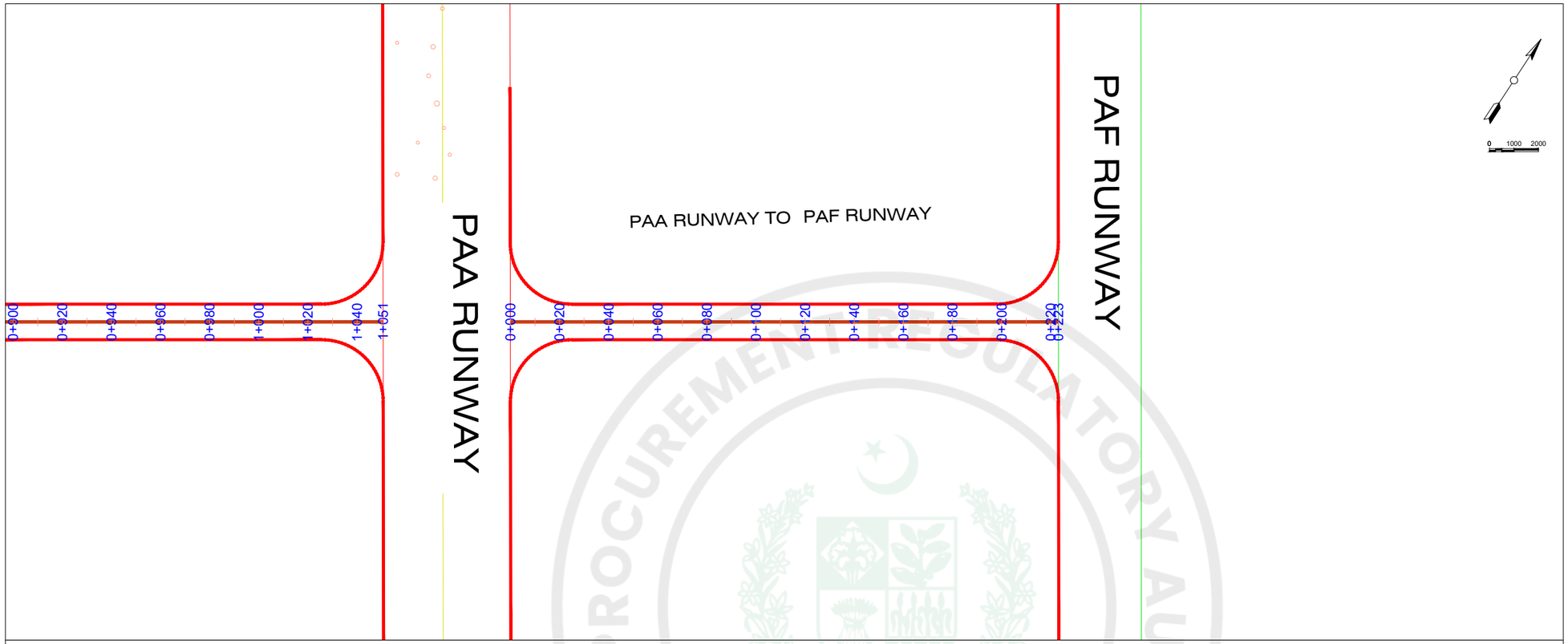
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

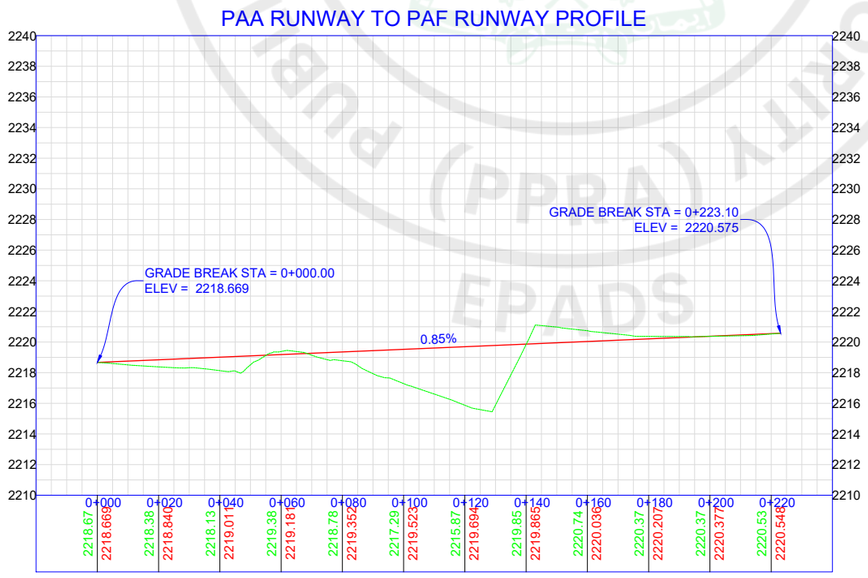
DRAWING TITLE:

Pavement Marking

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 26/12/2025
DRAWING NO: R-12	SHEET: 02

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS





General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
PAA RUNWAY TO PAF RUNWAY PLAN & PROFILE

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-13	SHEET: 04

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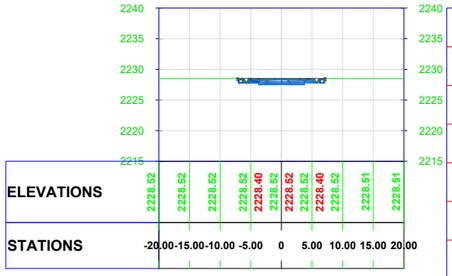
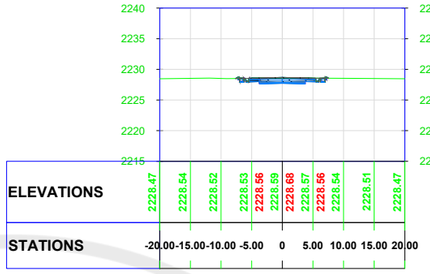
0+000.00

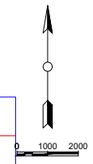


Total Volume at Station 0+000.00	
Cut Area	1.70
Fill Area	0.04
Cut Vol	0.00
Fill Vol	0.00
Cum Cut Vol	0.00
Cum Fill Vol	0.00
Net Vol	0.00

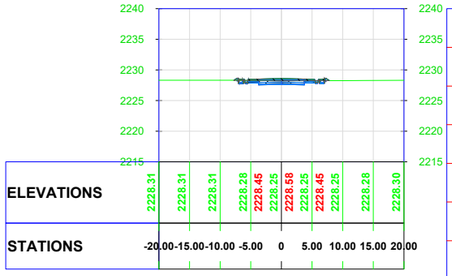
0+060.00



Total Volume at Station 0+060.00	
Cut Area	0.65
Fill Area	0.82
Cut Vol	8.08
Fill Vol	67.07
Cum Cut Vol	34.23
Cum Fill Vol	196.30
Net Vol	-162.07

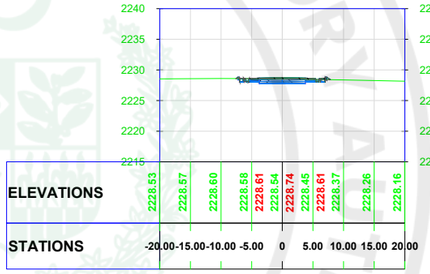


0+020.00



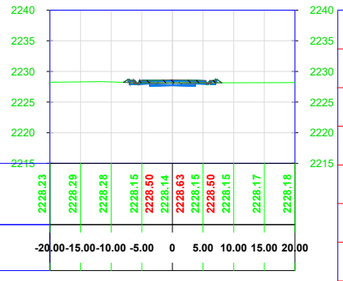
Total Volume at Station 0+020.00	
Cut Area	0.38
Fill Area	3.50
Cut Vol	20.75
Fill Vol	35.37
Cum Cut Vol	20.75
Cum Fill Vol	35.37
Net Vol	-14.61

0+080.00



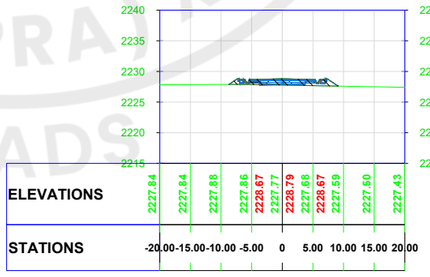
Total Volume at Station 0+080.00	
Cut Area	0.50
Fill Area	2.06
Cut Vol	11.49
Fill Vol	28.80
Cum Cut Vol	45.72
Cum Fill Vol	225.10
Net Vol	-179.38

0+040.00



Total Volume at Station 0+040.00	
Cut Area	0.16
Fill Area	5.89
Cut Vol	5.40
Fill Vol	93.86
Cum Cut Vol	26.15
Cum Fill Vol	129.23
Net Vol	-103.08

0+100.00



Total Volume at Station 0+100.00	
Cut Area	0.00
Fill Area	14.97
Cut Vol	5.02
Fill Vol	170.26
Cum Cut Vol	50.74
Cum Fill Vol	395.36
Net Vol	-344.62

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Architects (PVT) Ltd.

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-14	SHEET: 01

Skardu Airport Road Section cut &fill (28 Apr 26).dwg

18.12.2009

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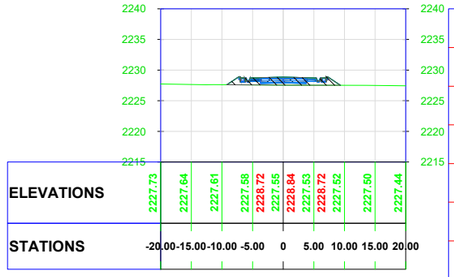
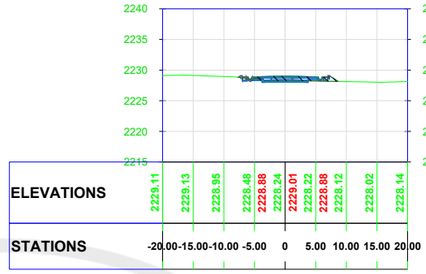
0+120.00

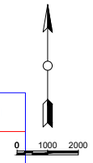


Total Volume at Station 0+120.00	
Cut Area	0.00
Fill Area	19.81
Cut Vol	0.00
Fill Vol	347.77
Cum Cut Vol	50.74
Cum Fill Vol	743.13
Net Vol	-692.39

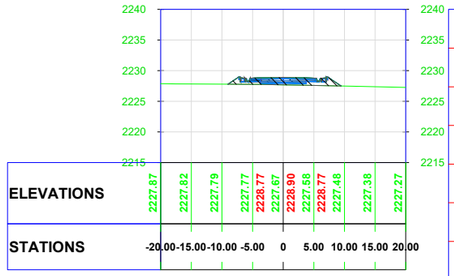
0+180.00



Total Volume at Station 0+180.00	
Cut Area	0.12
Fill Area	9.24
Cut Vol	1.18
Fill Vol	309.82
Cum Cut Vol	51.92
Cum Fill Vol	1842.80
Net Vol	-1790.88

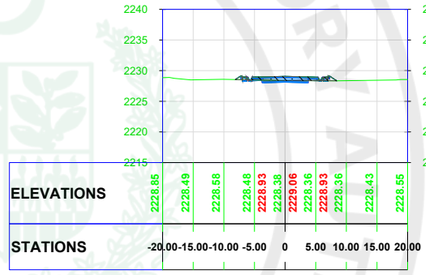


0+140.00



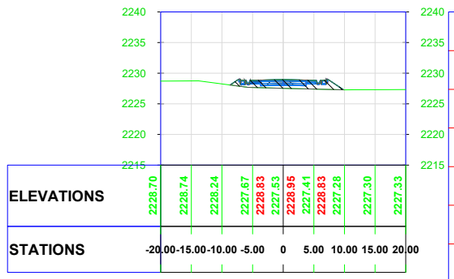
Total Volume at Station 0+140.00	
Cut Area	0.00
Fill Area	18.71
Cut Vol	0.00
Fill Vol	385.25
Cum Cut Vol	50.74
Cum Fill Vol	1128.39
Net Vol	-1077.65

0+200.00



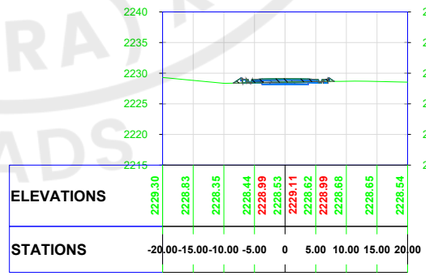
Total Volume at Station 0+200.00	
Cut Area	0.04
Fill Area	8.56
Cut Vol	1.56
Fill Vol	177.95
Cum Cut Vol	53.48
Cum Fill Vol	2020.75
Net Vol	-1967.27

0+160.00



Total Volume at Station 0+160.00	
Cut Area	0.00
Fill Area	21.75
Cut Vol	0.00
Fill Vol	404.60
Cum Cut Vol	50.74
Cum Fill Vol	1532.99
Net Vol	-1482.25

0+220.00



Total Volume at Station 0+220.00	
Cut Area	0.08
Fill Area	7.55
Cut Vol	1.21
Fill Vol	161.09
Cum Cut Vol	54.69
Cum Fill Vol	2181.84
Net Vol	-2127.15

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Ali Architects (PVT) Ltd.
leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

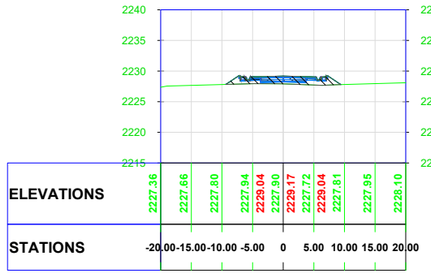
DRAWING TITLE:

ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-15	SHEET: 02

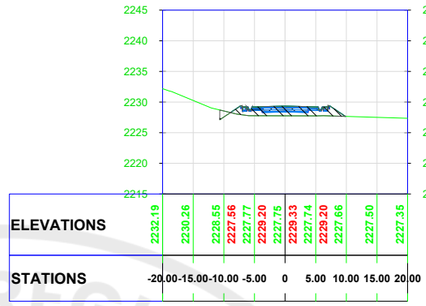
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

0+240.00



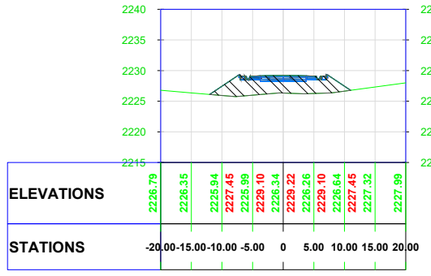
Total Volume at Station 0+240.00	
Cut Area	0.00
Fill Area	20.53
Cut Vol	0.84
Fill Vol	280.80
Cum Cut Vol	55.52
Cum Fill Vol	2462.64
Net Vol	-2407.12

0+300.00



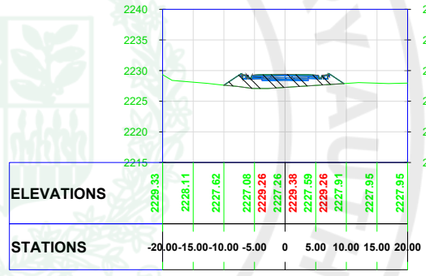
Total Volume at Station 0+300.00	
Cut Area	1.40
Fill Area	24.40
Cut Vol	61.25
Fill Vol	523.32
Cum Cut Vol	164.05
Cum Fill Vol	4599.04
Net Vol	-4434.99

0+260.00



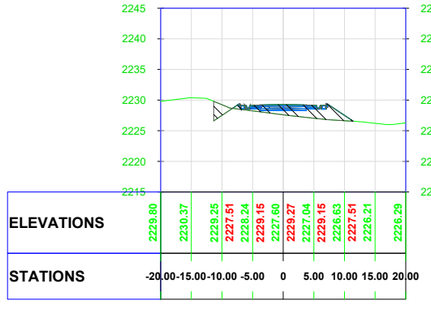
Total Volume at Station 0+260.00	
Cut Area	0.00
Fill Area	56.42
Cut Vol	0.00
Fill Vol	769.52
Cum Cut Vol	55.52
Cum Fill Vol	3232.16
Net Vol	-3176.63

0+320.00



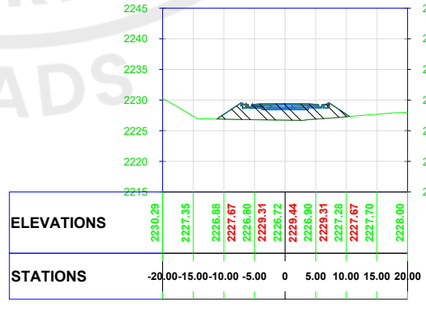
Total Volume at Station 0+320.00	
Cut Area	0.00
Fill Area	33.03
Cut Vol	13.97
Fill Vol	574.31
Cum Cut Vol	178.02
Cum Fill Vol	5173.35
Net Vol	-4995.33

0+280.00



Total Volume at Station 0+280.00	
Cut Area	4.73
Fill Area	27.93
Cut Vol	47.28
Fill Vol	843.56
Cum Cut Vol	102.80
Cum Fill Vol	4075.72
Net Vol	-3972.92

0+340.00



Total Volume at Station 0+340.00	
Cut Area	0.00
Fill Area	45.79
Cut Vol	0.00
Fill Vol	788.19
Cum Cut Vol	178.02
Cum Fill Vol	5961.55
Net Vol	-5783.53

0 1000 2000

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Ali Architects (PVT) Ltd.
leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

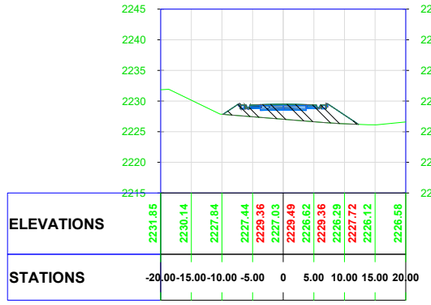
DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-16	SHEET: 03

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

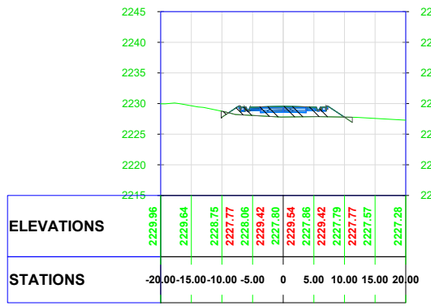
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

0+360.00



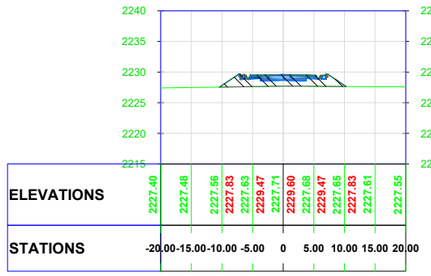
Total Volume at Station 0+360.00	
Cut Area	0.00
Fill Area	44.41
Cut Vol	0.00
Fill Vol	901.94
Cum Cut Vol	178.02
Cum Fill Vol	6863.49
Net Vol	-6685.46

0+380.00



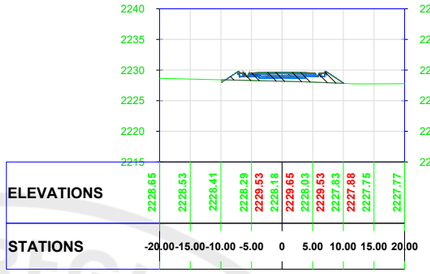
Total Volume at Station 0+380.00	
Cut Area	1.22
Fill Area	25.64
Cut Vol	12.16
Fill Vol	700.48
Cum Cut Vol	190.19
Cum Fill Vol	7563.97
Net Vol	-7373.78

0+400.00



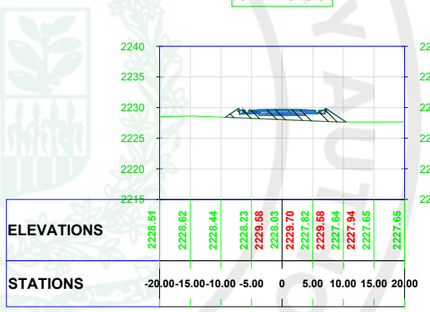
Total Volume at Station 0+400.00	
Cut Area	0.00
Fill Area	32.55
Cut Vol	12.16
Fill Vol	581.87
Cum Cut Vol	202.35
Cum Fill Vol	8145.84
Net Vol	-7943.49

0+420.00



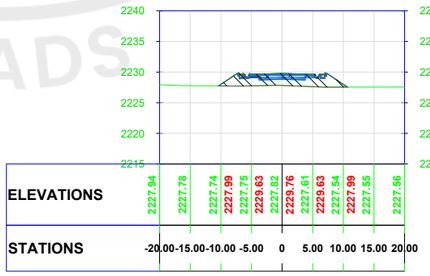
Total Volume at Station 0+420.00	
Cut Area	0.13
Fill Area	23.75
Cut Vol	1.32
Fill Vol	562.93
Cum Cut Vol	203.67
Cum Fill Vol	8708.76
Net Vol	-8505.09

0+440.00



Total Volume at Station 0+440.00	
Cut Area	0.00
Fill Area	27.42
Cut Vol	1.32
Fill Vol	511.68
Cum Cut Vol	205.00
Cum Fill Vol	9220.44
Net Vol	-9015.44

0+460.00



Total Volume at Station 0+460.00	
Cut Area	0.00
Fill Area	34.97
Cut Vol	0.00
Fill Vol	623.94
Cum Cut Vol	205.00
Cum Fill Vol	9844.38
Net Vol	-9639.38

0 1000 2000

General Notes

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CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-17	SHEET: 04

Skardu Airport Road Section cut &fill (28 Apr 26).dwg
18.12.2009

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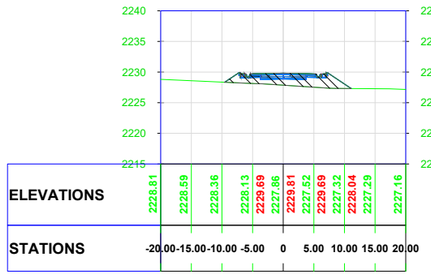
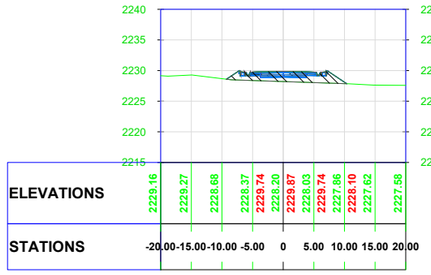
PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

0+480.00



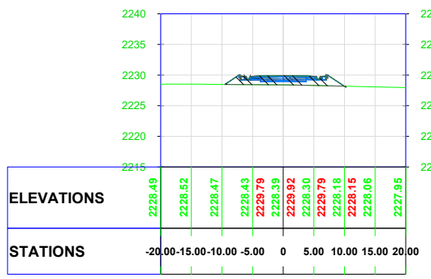
Total Volume at Station 0+480.00	
Cut Area	0.00
Fill Area	33.71
Cut Vol	0.00
Fill Vol	686.77
Cum Cut Vol	205.00
Cum Fill Vol	10531.15
Net Vol	-10326.15

0+500.00



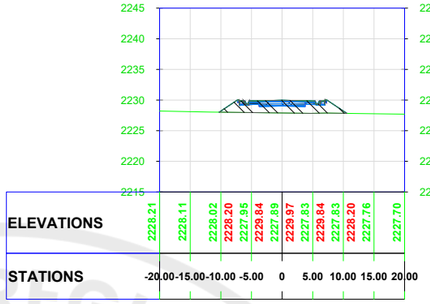
Total Volume at Station 0+500.00	
Cut Area	0.00
Fill Area	27.09
Cut Vol	0.00
Fill Vol	607.92
Cum Cut Vol	205.00
Cum Fill Vol	11139.07
Net Vol	-10934.08

0+520.00



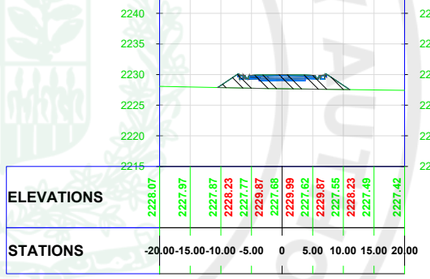
Total Volume at Station 0+520.00	
Cut Area	0.03
Fill Area	24.86
Cut Vol	0.32
Fill Vol	519.48
Cum Cut Vol	205.31
Cum Fill Vol	11658.55
Net Vol	-11453.24

0+540.00



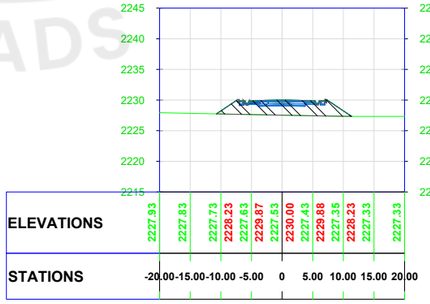
Total Volume at Station 0+540.00	
Cut Area	0.00
Fill Area	35.04
Cut Vol	0.32
Fill Vol	598.97
Cum Cut Vol	205.63
Cum Fill Vol	12257.52
Net Vol	-12051.89

0+560.00



Total Volume at Station 0+560.00	
Cut Area	0.00
Fill Area	40.10
Cut Vol	0.00
Fill Vol	751.34
Cum Cut Vol	205.63
Cum Fill Vol	13008.87
Net Vol	-12803.24

0+580.00



Total Volume at Station 0+580.00	
Cut Area	0.00
Fill Area	43.81
Cut Vol	0.00
Fill Vol	839.12
Cum Cut Vol	205.63
Cum Fill Vol	13847.99
Net Vol	-13642.36

0 1000 2000

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Arnold & Architects (Pvt.) Ltd.
leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-18	SHEET: 05

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

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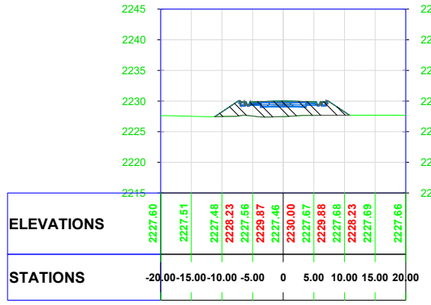
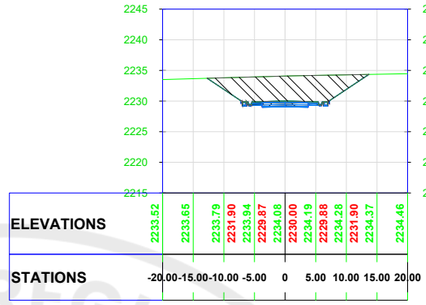
0+600.00

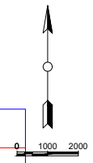


Total Volume at Station 0+600.00	
Cut Area	0.00
Fill Area	43.01
Cut Vol	0.00
Fill Vol	868.23
Cum Cut Vol	205.63
Cum Fill Vol	14716.22
Net Vol	-14510.59

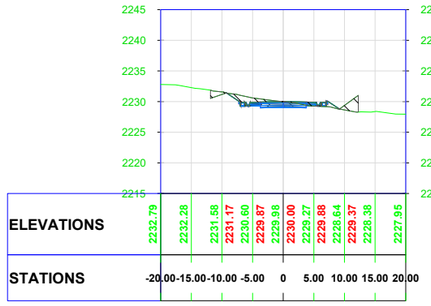
0+660.00



Total Volume at Station 0+660.00	
Cut Area	84.41
Fill Area	0.00
Cut Vol	1680.48
Fill Vol	0.00
Cum Cut Vol	2859.98
Cum Fill Vol	15302.81
Net Vol	-12442.84

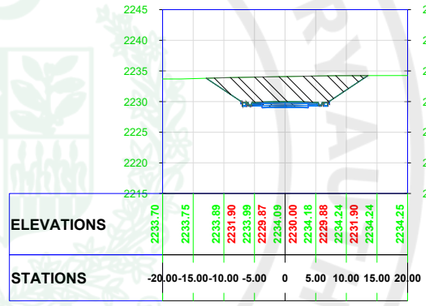


0+620.00



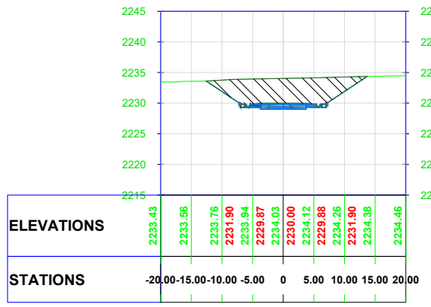
Total Volume at Station 0+620.00	
Cut Area	6.87
Fill Area	7.82
Cut Vol	68.73
Fill Vol	508.35
Cum Cut Vol	274.36
Cum Fill Vol	15224.57
Net Vol	-14950.21

0+680.00



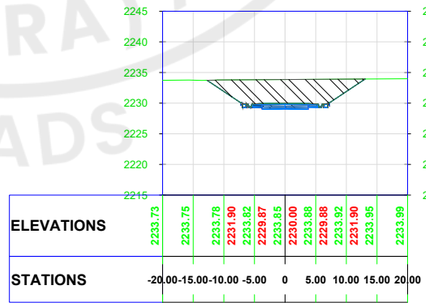
Total Volume at Station 0+680.00	
Cut Area	84.89
Fill Area	0.00
Cut Vol	1692.99
Fill Vol	0.00
Cum Cut Vol	4552.97
Cum Fill Vol	15302.81
Net Vol	-10749.84

0+640.00



Total Volume at Station 0+640.00	
Cut Area	83.64
Fill Area	0.00
Cut Vol	905.14
Fill Vol	78.25
Cum Cut Vol	1179.50
Cum Fill Vol	15302.81
Net Vol	-14123.32

0+700.00



Total Volume at Station 0+700.00	
Cut Area	78.94
Fill Area	0.00
Cut Vol	1638.33
Fill Vol	0.00
Cum Cut Vol	6191.30
Cum Fill Vol	15302.81
Net Vol	-9111.51

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Arrow Architects (Pvt.) Ltd.

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-19	SHEET: 06

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

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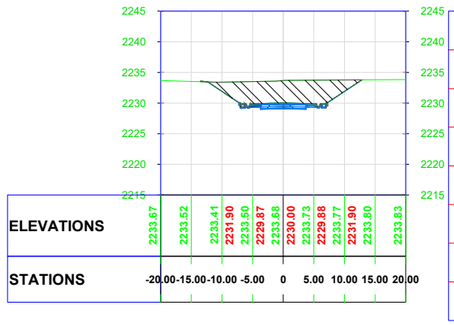
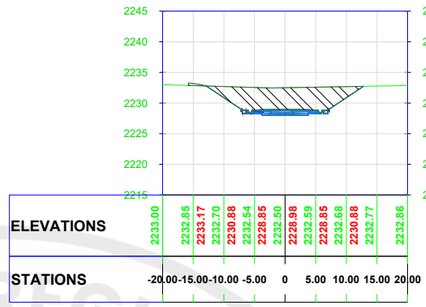
0+720.00



Total Volume at Station 0+720.00	
Cut Area	72.99
Fill Area	0.08
Cut Vol	1519.30
Fill Vol	0.81
Cum Cut Vol	7710.60
Cum Fill Vol	15303.62
Net Vol	-7593.02

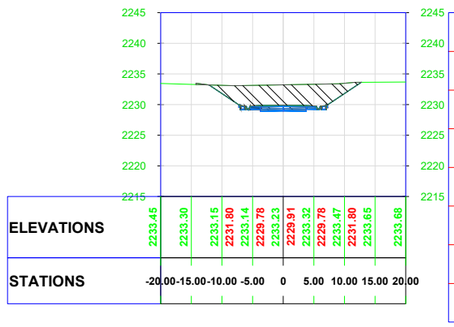
0+780.00



Total Volume at Station 0+780.00	
Cut Area	73.21
Fill Area	0.70
Cut Vol	1395.74
Fill Vol	11.65
Cum Cut Vol	11831.56
Cum Fill Vol	15325.47
Net Vol	-3493.91

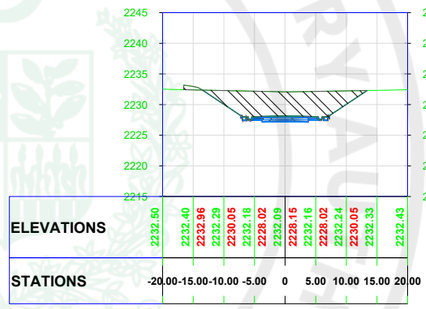
0 1000 2000

0+740.00



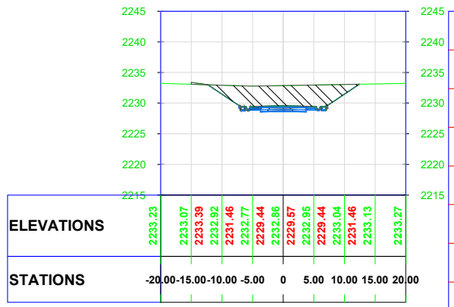
Total Volume at Station 0+740.00	
Cut Area	66.59
Fill Area	0.24
Cut Vol	1395.75
Fill Vol	3.19
Cum Cut Vol	9106.35
Cum Fill Vol	15306.81
Net Vol	-6200.46

0+800.00



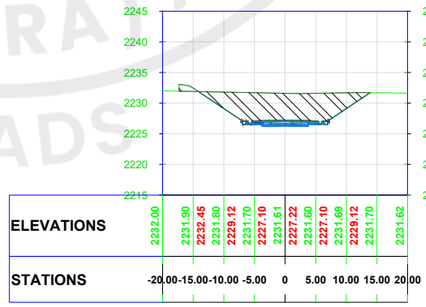
Total Volume at Station 0+800.00	
Cut Area	84.30
Fill Area	1.55
Cut Vol	1575.10
Fill Vol	22.55
Cum Cut Vol	13406.66
Cum Fill Vol	15348.01
Net Vol	-1941.35

0+760.00



Total Volume at Station 0+760.00	
Cut Area	66.36
Fill Area	0.46
Cut Vol	1329.47
Fill Vol	7.00
Cum Cut Vol	10435.82
Cum Fill Vol	15313.81
Net Vol	-4877.99

0+820.00



Total Volume at Station 0+820.00	
Cut Area	95.58
Fill Area	2.40
Cut Vol	1798.81
Fill Vol	39.57
Cum Cut Vol	15205.47
Cum Fill Vol	15387.58
Net Vol	-182.11

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-20	SHEET: 07

Skardu Airport Road Section cut &fill (28 Apr 26).dwg
18.12.2009

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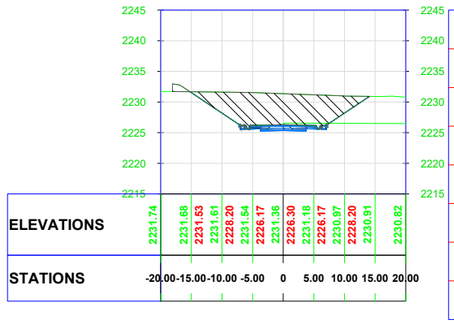
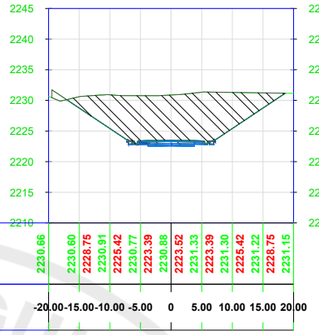
Skardu Airport Road Section cut &fill (28 Apr 26).dwg
18.12.2009

0+840.00



Total Volume at Station 0+840.00	
Cut Area	111.84
Fill Area	2.28
Cut Vol	2074.21
Fill Vol	46.88
Cum Cut Vol	17279.68
Cum Fill Vol	15434.46
Net Vol	1845.22

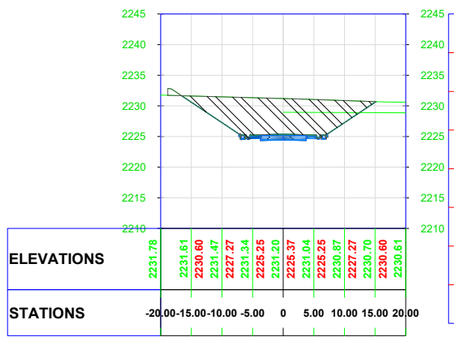
0+900.00



Total Volume at Station 0+900.00	
Cut Area	191.67
Fill Area	2.01
Cut Vol	3659.33
Fill Vol	20.11
Cum Cut Vol	26514.05
Cum Fill Vol	15508.05
Net Vol	11006.01

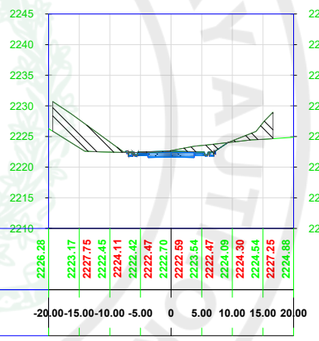
0 1000 2000

0+860.00



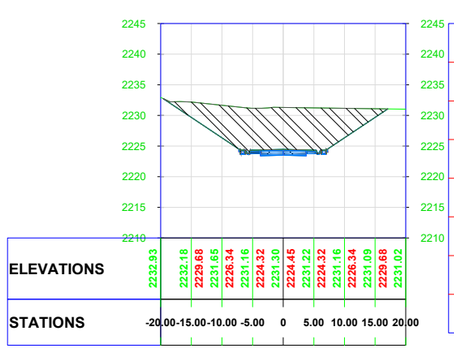
Total Volume at Station 0+860.00	
Cut Area	135.70
Fill Area	1.53
Cut Vol	2475.41
Fill Vol	38.16
Cum Cut Vol	19755.10
Cum Fill Vol	15472.62
Net Vol	4282.48

0+920.00



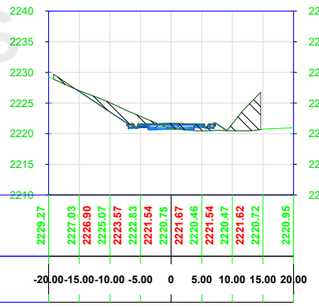
Total Volume at Station 0+920.00	
Cut Area	7.48
Fill Area	50.61
Cut Vol	1991.59
Fill Vol	526.24
Cum Cut Vol	28505.64
Cum Fill Vol	16034.29
Net Vol	12471.35

0+880.00



Total Volume at Station 0+880.00	
Cut Area	174.26
Fill Area	0.00
Cut Vol	3099.63
Fill Vol	15.32
Cum Cut Vol	22854.72
Cum Fill Vol	15487.94
Net Vol	7366.78

0+940.00



Total Volume at Station 0+940.00	
Cut Area	15.12
Fill Area	28.78
Cut Vol	226.01
Fill Vol	793.90
Cum Cut Vol	28731.65
Cum Fill Vol	16828.19
Net Vol	11903.46

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئر پورٹس اتھارٹی

CONSULTANTS

Anwar & Architects (Pvt) Ltd.
leit-werk

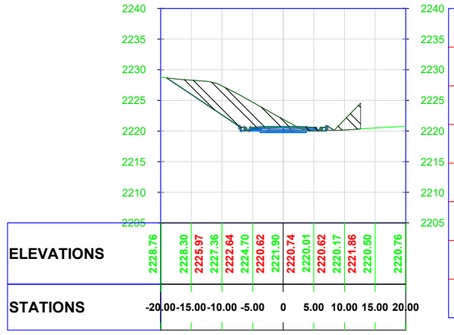
PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-21	SHEET: 08

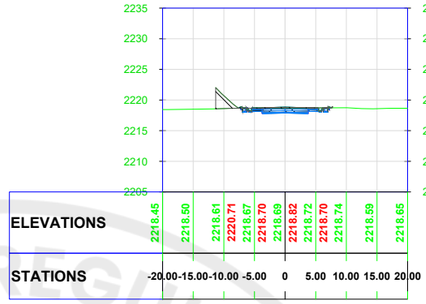
PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

0+960.00



Total Volume at Station 0+960.00	
Cut Area	62.02
Fill Area	11.77
Cut Vol	771.33
Fill Vol	405.45
Cum Cut Vol	29502.98
Cum Fill Vol	17233.64
Net Vol	12269.34

1+020.00



Total Volume at Station 1+020.00	
Cut Area	0.68
Fill Area	7.05
Cut Vol	60.96
Fill Vol	211.05
Cum Cut Vol	30350.05
Cum Fill Vol	17983.27
Net Vol	12366.77

0 1000 2000

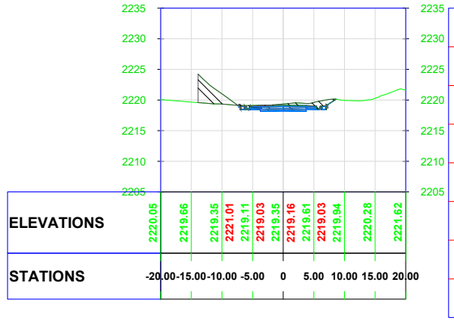
0+980.00

Total Volume at Station 0+980.00	
Cut Area	5.59
Fill Area	14.02
Cut Vol	676.05
Fill Vol	257.86
Cum Cut Vol	30179.03
Cum Fill Vol	17491.50
Net Vol	12687.53

1+040.00

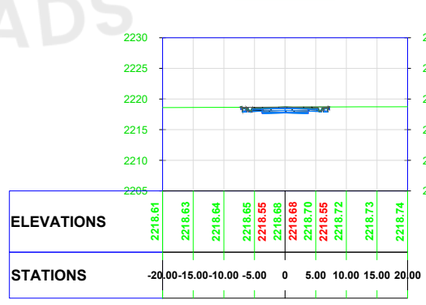
Total Volume at Station 1+040.00	
Cut Area	0.76
Fill Area	1.45
Cut Vol	14.36
Fill Vol	84.97
Cum Cut Vol	30364.41
Cum Fill Vol	18068.25
Net Vol	12296.16

1+000.00



Total Volume at Station 1+000.00	
Cut Area	5.42
Fill Area	14.05
Cut Vol	110.05
Fill Vol	280.72
Cum Cut Vol	30289.09
Cum Fill Vol	17772.22
Net Vol	12516.87

1+050.60



Total Volume at Station 1+050.60	
Cut Area	1.69
Fill Area	0.04
Cut Vol	12.93
Fill Vol	7.87
Cum Cut Vol	30377.34
Cum Fill Vol	18076.11
Net Vol	12301.23

General Notes

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CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar & Architects (Pvt) Ltd.

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO OLD RUNWAY PAA RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-22	SHEET: 09

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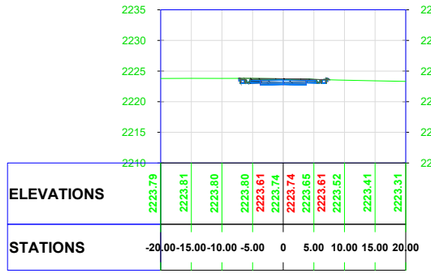
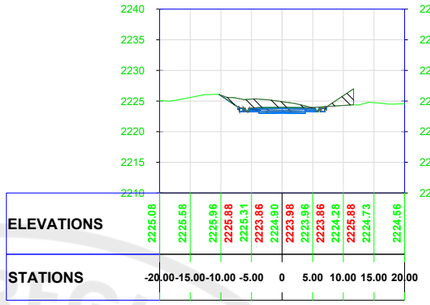
0+000.00

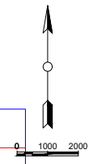


Total Volume at Station 0+000.00	
Cut Area	1.56
Fill Area	0.10
Cut Vol	0.00
Fill Vol	0.00
Cum Cut Vol	0.00
Cum Fill Vol	0.00
Net Vol	0.00

0+060.00



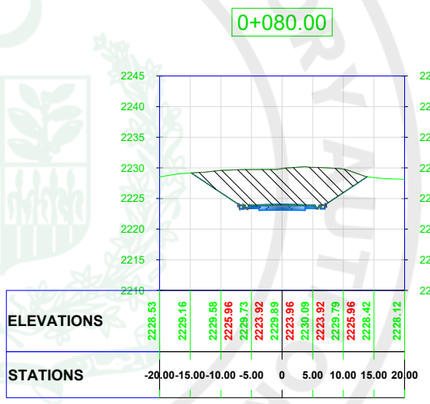
Total Volume at Station 0+060.00	
Cut Area	14.98
Fill Area	5.62
Cut Vol	403.84
Fill Vol	57.45
Cum Cut Vol	679.36
Cum Fill Vol	145.98
Net Vol	533.38



0+020.00

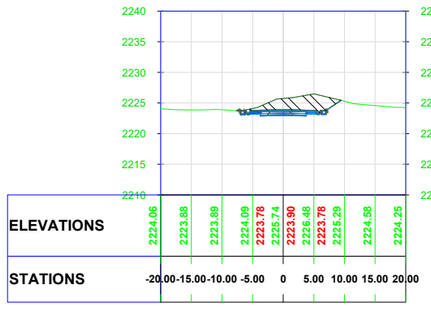
Total Volume at Station 0+020.00	
Cut Area	0.29
Fill Area	4.31
Cut Vol	18.56
Fill Vol	44.13
Cum Cut Vol	18.56
Cum Fill Vol	44.13
Net Vol	-25.58

0+080.00



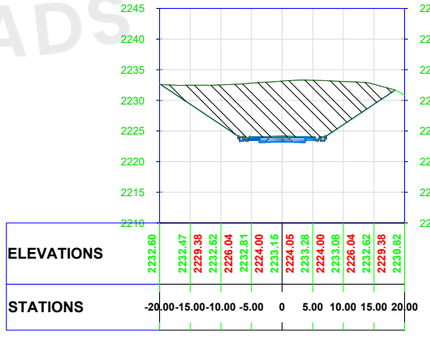
Total Volume at Station 0+080.00	
Cut Area	129.42
Fill Area	0.00
Cut Vol	1443.96
Fill Vol	56.15
Cum Cut Vol	2123.31
Cum Fill Vol	202.13
Net Vol	1921.18

0+040.00



Total Volume at Station 0+040.00	
Cut Area	25.40
Fill Area	0.13
Cut Vol	256.96
Fill Vol	44.39
Cum Cut Vol	275.52
Cum Fill Vol	88.52
Net Vol	187.00

0+100.00



Total Volume at Station 0+100.00	
Cut Area	237.51
Fill Area	0.00
Cut Vol	3669.26
Fill Vol	0.00
Cum Cut Vol	5792.57
Cum Fill Vol	202.13
Net Vol	5590.44

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER TO APRON RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-23	SHEET: 01

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

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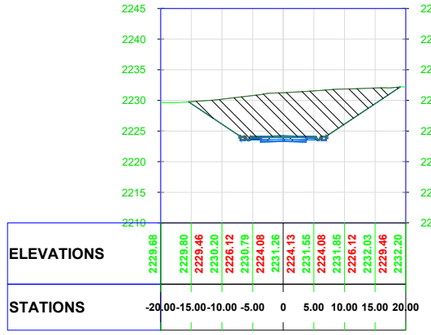
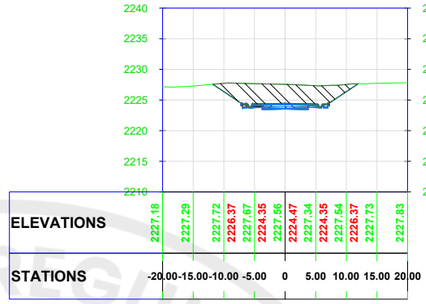
0+120.00



Total Volume at Station 0+120.00	
Cut Area	172.94
Fill Area	0.00
Cut Vol	4104.48
Fill Vol	0.00
Cum Cut Vol	9897.05
Cum Fill Vol	202.13
Net Vol	9694.92

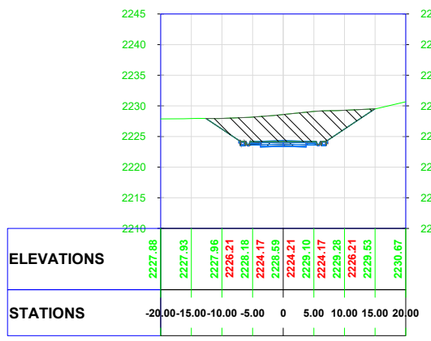
0+180.00



Total Volume at Station 0+180.00	
Cut Area	60.26
Fill Area	0.00
Cut Vol	1241.62
Fill Vol	0.00
Cum Cut Vol	15373.13
Cum Fill Vol	202.13
Net Vol	15171.00

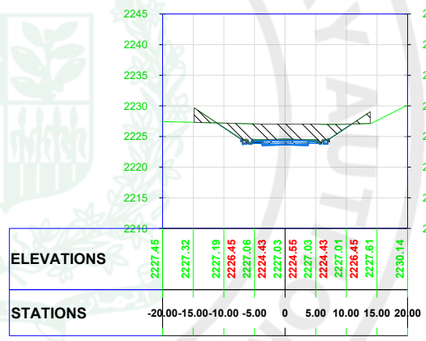
0 1000 2000

0+140.00



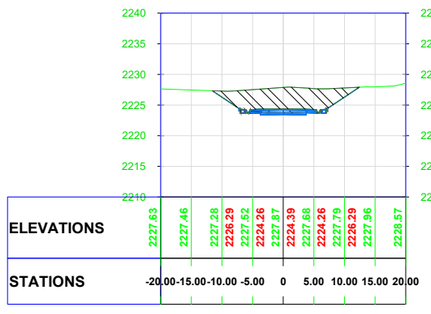
Total Volume at Station 0+140.00	
Cut Area	93.30
Fill Area	0.00
Cut Vol	2662.40
Fill Vol	0.00
Cum Cut Vol	12559.45
Cum Fill Vol	202.13
Net Vol	12357.32

0+200.00



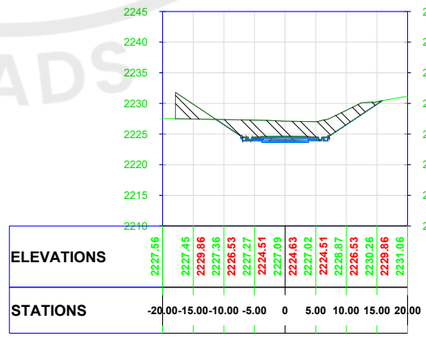
Total Volume at Station 0+200.00	
Cut Area	46.84
Fill Area	7.26
Cut Vol	1071.00
Fill Vol	72.60
Cum Cut Vol	16444.13
Cum Fill Vol	274.73
Net Vol	16169.41

0+160.00



Total Volume at Station 0+160.00	
Cut Area	63.90
Fill Area	0.00
Cut Vol	1572.06
Fill Vol	0.00
Cum Cut Vol	14131.51
Cum Fill Vol	202.13
Net Vol	13929.38

0+220.00



Total Volume at Station 0+220.00	
Cut Area	59.26
Fill Area	14.24
Cut Vol	1061.00
Fill Vol	215.01
Cum Cut Vol	17505.13
Cum Fill Vol	489.74
Net Vol	17015.40

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Architects (Pvt) Ltd

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

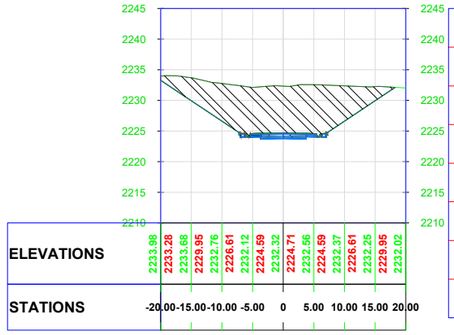
DRAWING TITLE:
ATC TOWER TO APRON RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-24	SHEET: 02

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

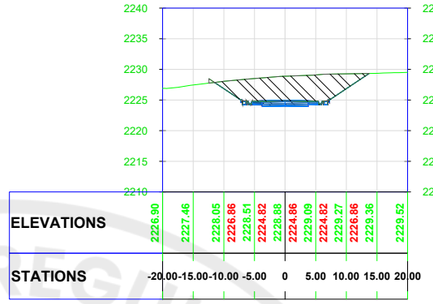
Public Procurement Regulatory Authority EPADS

0+240.00



Total Volume at Station 0+240.00	
Cut Area	210.19
Fill Area	0.00
Cut Vol	2694.52
Fill Vol	142.41
Cum Cut Vol	20199.66
Cum Fill Vol	632.15
Net Vol	19567.51

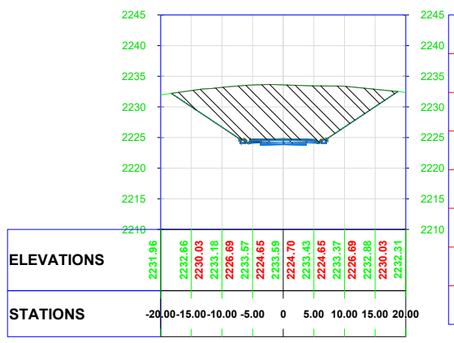
0+300.00



Total Volume at Station 0+300.00	
Cut Area	79.39
Fill Area	0.33
Cut Vol	2373.82
Fill Vol	3.28
Cum Cut Vol	30800.53
Cum Fill Vol	635.43
Net Vol	30165.10

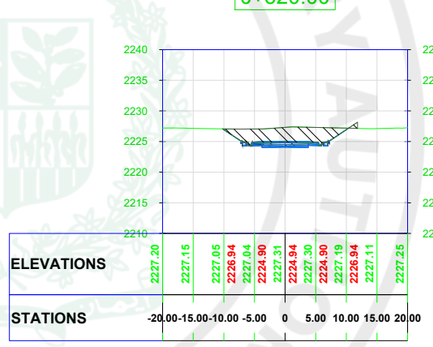
0 1000 2000

0+260.00



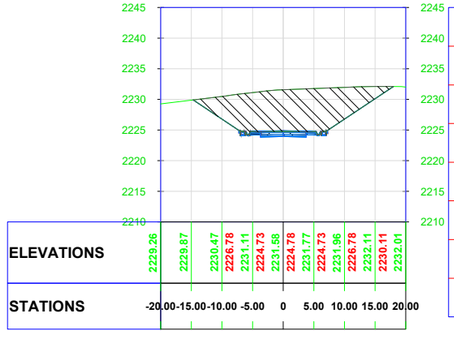
Total Volume at Station 0+260.00	
Cut Area	227.26
Fill Area	0.00
Cut Vol	4374.56
Fill Vol	0.00
Cum Cut Vol	24574.21
Cum Fill Vol	632.15
Net Vol	23942.06

0+320.00



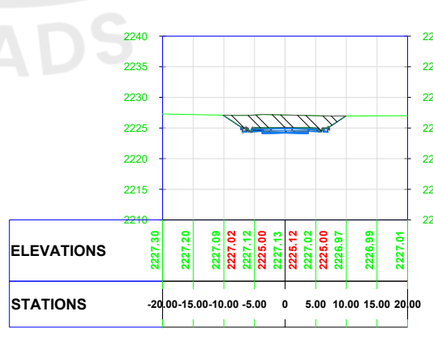
Total Volume at Station 0+320.00	
Cut Area	40.27
Fill Area	0.74
Cut Vol	1196.64
Fill Vol	10.66
Cum Cut Vol	31997.17
Cum Fill Vol	646.09
Net Vol	31351.08

0+280.00



Total Volume at Station 0+280.00	
Cut Area	157.99
Fill Area	0.00
Cut Vol	3852.49
Fill Vol	0.00
Cum Cut Vol	28426.70
Cum Fill Vol	632.15
Net Vol	27794.56

0+340.00



Total Volume at Station 0+340.00	
Cut Area	35.30
Fill Area	0.00
Cut Vol	755.72
Fill Vol	7.37
Cum Cut Vol	32752.89
Cum Fill Vol	653.46
Net Vol	32099.43

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

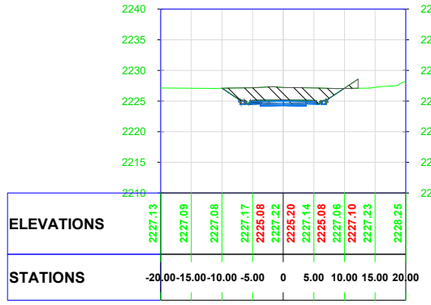
DRAWING TITLE:
ATC TOWER TO APRON RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 28/12/2025
DRAWING NO: R-25	SHEET: 03

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

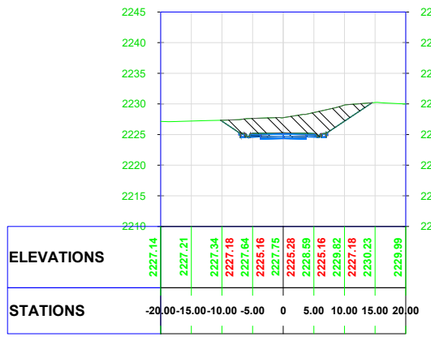
Procurement Regulatory Authority (PPRA) EPADS

0+360.00



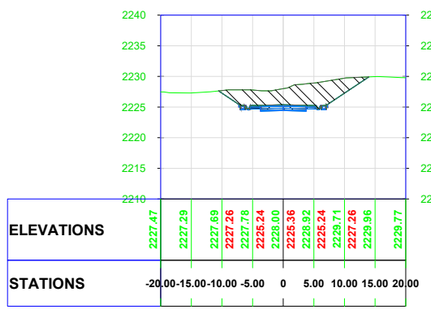
Total Volume at Station 0+360.00	
Cut Area	35.48
Fill Area	1.71
Cut Vol	707.79
Fill Vol	17.09
Cum Cut Vol	33460.68
Cum Fill Vol	670.55
Net Vol	32790.13

0+380.00



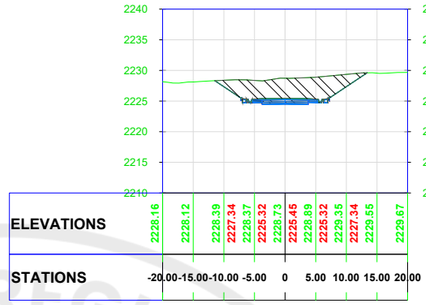
Total Volume at Station 0+380.00	
Cut Area	59.05
Fill Area	0.00
Cut Vol	945.26
Fill Vol	17.09
Cum Cut Vol	34405.94
Cum Fill Vol	687.63
Net Vol	33718.31

0+400.00



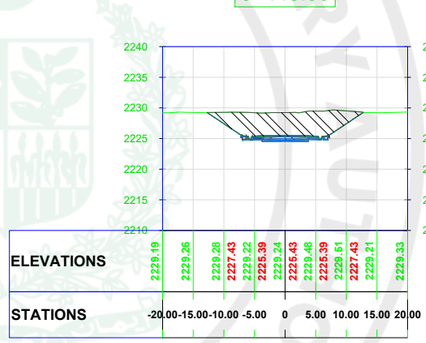
Total Volume at Station 0+400.00	
Cut Area	61.06
Fill Area	0.00
Cut Vol	1201.04
Fill Vol	0.00
Cum Cut Vol	35606.98
Cum Fill Vol	687.63
Net Vol	34919.35

0+420.00



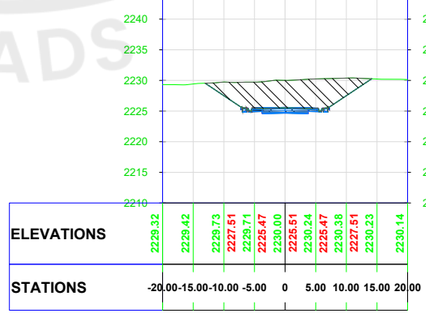
Total Volume at Station 0+420.00	
Cut Area	65.80
Fill Area	0.00
Cut Vol	1268.59
Fill Vol	0.00
Cum Cut Vol	36875.57
Cum Fill Vol	687.63
Net Vol	36187.94

0+440.00



Total Volume at Station 0+440.00	
Cut Area	78.98
Fill Area	0.00
Cut Vol	1447.79
Fill Vol	0.00
Cum Cut Vol	38323.36
Cum Fill Vol	687.63
Net Vol	37635.72

0+460.00



Total Volume at Station 0+460.00	
Cut Area	94.43
Fill Area	0.00
Cut Vol	1734.06
Fill Vol	0.00
Cum Cut Vol	40057.42
Cum Fill Vol	687.63
Net Vol	39369.79

0 1000 2000

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar & Architects (Pvt.) Ltd.

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

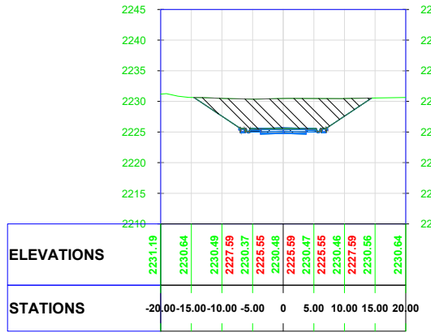
DRAWING TITLE:
ATC TOWER TO APRON RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-26	SHEET: 04

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

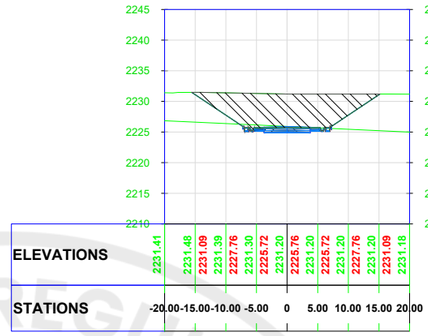
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

0+480.00



Total Volume at Station 0+480.00	
Cut Area	105.38
Fill Area	0.00
Cut Vol	1998.14
Fill Vol	0.00
Cum Cut Vol	42055.56
Cum Fill Vol	687.63
Net Vol	41367.93

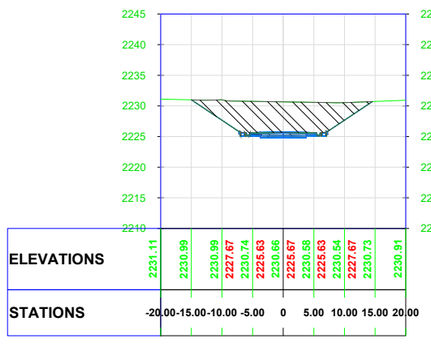
0+521.97



Total Volume at Station 0+521.97	
Cut Area	123.97
Fill Area	0.00
Cut Vol	241.36
Fill Vol	0.00
Cum Cut Vol	46757.86
Cum Fill Vol	687.63
Net Vol	46070.23

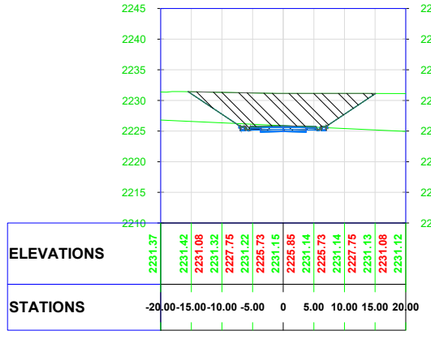
0 1000 2000

0+500.00



Total Volume at Station 0+500.00	
Cut Area	109.66
Fill Area	0.00
Cut Vol	2150.45
Fill Vol	0.00
Cum Cut Vol	44206.02
Cum Fill Vol	687.63
Net Vol	43518.39

0+520.00



Total Volume at Station 0+520.00	
Cut Area	121.39
Fill Area	0.00
Cut Vol	2310.49
Fill Vol	0.00
Cum Cut Vol	46516.51
Cum Fill Vol	687.63
Net Vol	45828.87

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Ali Architects (Pvt) Ltd.

leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

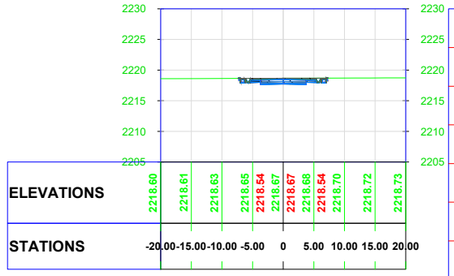
DRAWING TITLE:
ATC TOWER TO APRON RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-27	SHEET: 05

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

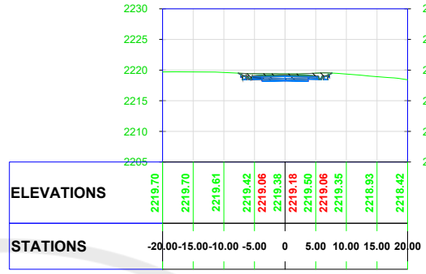
Procurement Regulatory Authority (PPRA) EPADS

0+000.00

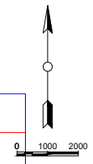


Total Volume at Station 0+000.00	
Cut Area	1.66
Fill Area	0.04
Cut Vol	0.00
Fill Vol	0.00
Cum Cut Vol	0.00
Cum Fill Vol	0.00
Net Vol	0.00

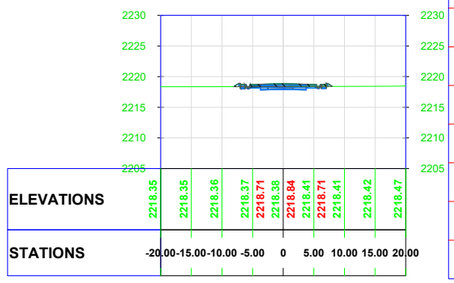
0+060.00



Total Volume at Station 0+060.00	
Cut Area	5.36
Fill Area	0.00
Cut Vol	53.65
Fill Vol	122.61
Cum Cut Vol	74.14
Cum Fill Vol	355.97
Net Vol	-281.83

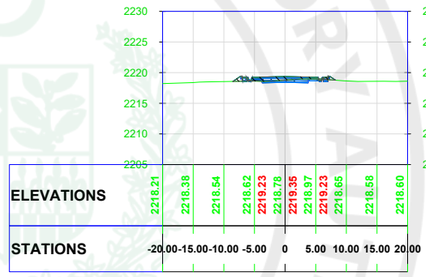


0+020.00



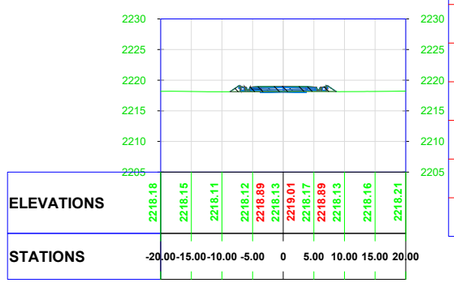
Total Volume at Station 0+020.00	
Cut Area	0.19
Fill Area	5.52
Cut Vol	18.57
Fill Vol	55.58
Cum Cut Vol	18.57
Cum Fill Vol	55.58
Net Vol	-37.00

0+080.00



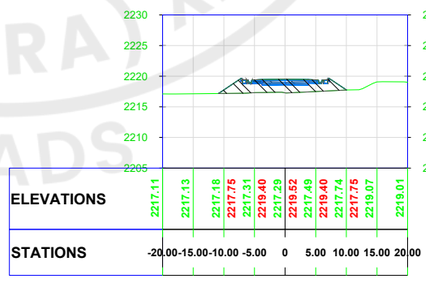
Total Volume at Station 0+080.00	
Cut Area	0.13
Fill Area	7.61
Cut Vol	54.95
Fill Vol	76.07
Cum Cut Vol	129.09
Cum Fill Vol	432.04
Net Vol	-302.95

0+040.00



Total Volume at Station 0+040.00	
Cut Area	0.00
Fill Area	12.26
Cut Vol	1.92
Fill Vol	177.78
Cum Cut Vol	20.49
Cum Fill Vol	233.36
Net Vol	-212.87

0+100.00



Total Volume at Station 0+100.00	
Cut Area	0.00
Fill Area	36.60
Cut Vol	1.30
Fill Vol	442.04
Cum Cut Vol	130.39
Cum Fill Vol	874.08
Net Vol	-743.69

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA

CONSULTANTS

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

PAA RUNWAY TO PAF RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-28	SHEET: 01

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

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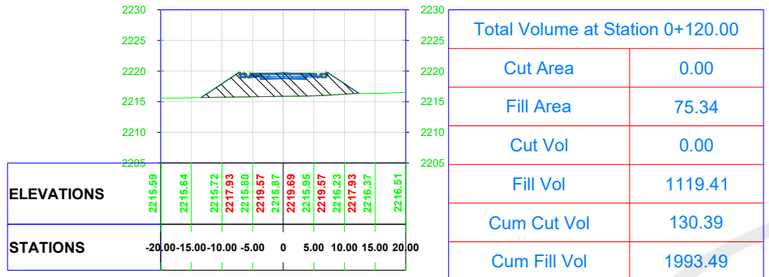
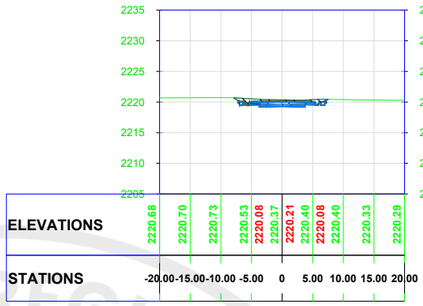
0+120.00

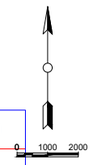


Total Volume at Station 0+120.00	
Cut Area	0.00
Fill Area	75.34
Cut Vol	0.00
Fill Vol	1119.41
Cum Cut Vol	130.39
Cum Fill Vol	1993.49
Net Vol	-1863.10

0+180.00



Total Volume at Station 0+180.00	
Cut Area	5.03
Fill Area	0.00
Cut Vol	190.59
Fill Vol	0.00
Cum Cut Vol	611.54
Cum Fill Vol	2944.31
Net Vol	-2332.77



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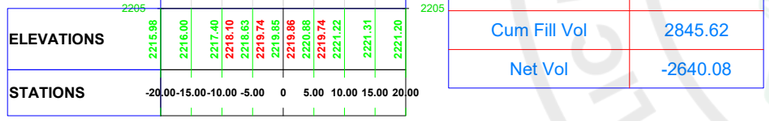
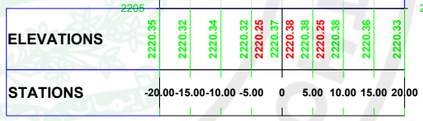


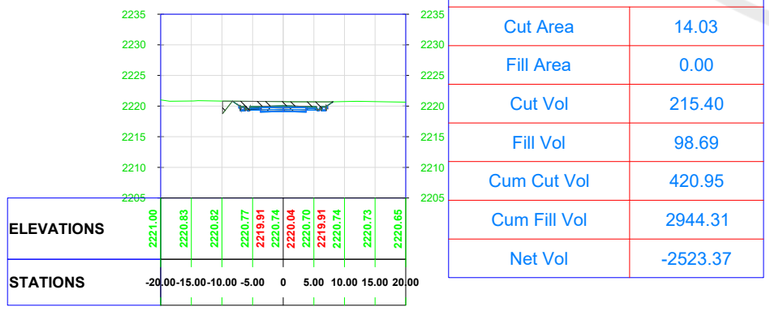
Total Volume at Station 0+140.00	
Cut Area	7.52
Fill Area	9.87
Cut Vol	75.15
Fill Vol	852.13
Cum Cut Vol	205.54
Cum Fill Vol	2845.62
Net Vol	-2640.08

0+200.00



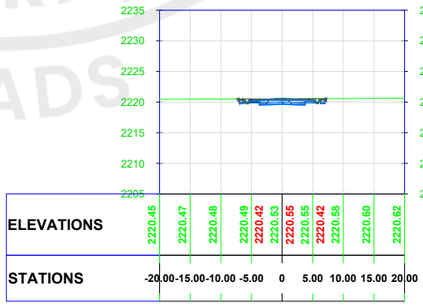
Total Volume at Station 0+200.00	
Cut Area	1.39
Fill Area	0.07
Cut Vol	64.23
Fill Vol	0.70
Cum Cut Vol	675.77
Cum Fill Vol	2945.02
Net Vol	-2269.25

0+160.00



Total Volume at Station 0+160.00	
Cut Area	14.03
Fill Area	0.00
Cut Vol	215.40
Fill Vol	98.69
Cum Cut Vol	420.95
Cum Fill Vol	2944.31
Net Vol	-2523.37

0+220.00



Total Volume at Station 0+220.00	
Cut Area	1.37
Fill Area	0.09
Cut Vol	27.62
Fill Vol	1.55
Cum Cut Vol	703.38
Cum Fill Vol	2946.57
Net Vol	-2243.19

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
پاکستان ایئرپورٹس اتھارٹی

CONSULTANTS

Anwar Architects (Pvt) Ltd.
leit-werk

PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
PAA RUNWAY TO PAF RUNWAY SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-29	SHEET: 02

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

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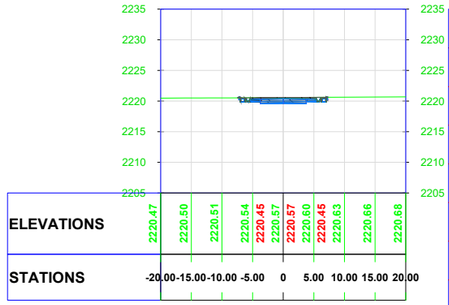
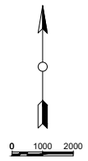
0+223.10



Total Volume at Station 0+223.10	
Cut Area	1.64
Fill Area	0.04
Cut Vol	4.67
Fill Vol	0.20
Cum Cut Vol	708.05
Cum Fill Vol	2946.77
Net Vol	-2238.72



General Notes

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CLIENT:

CONSULTANTS

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

PAA RUNWAY TO PAF RUNWAY SECTION

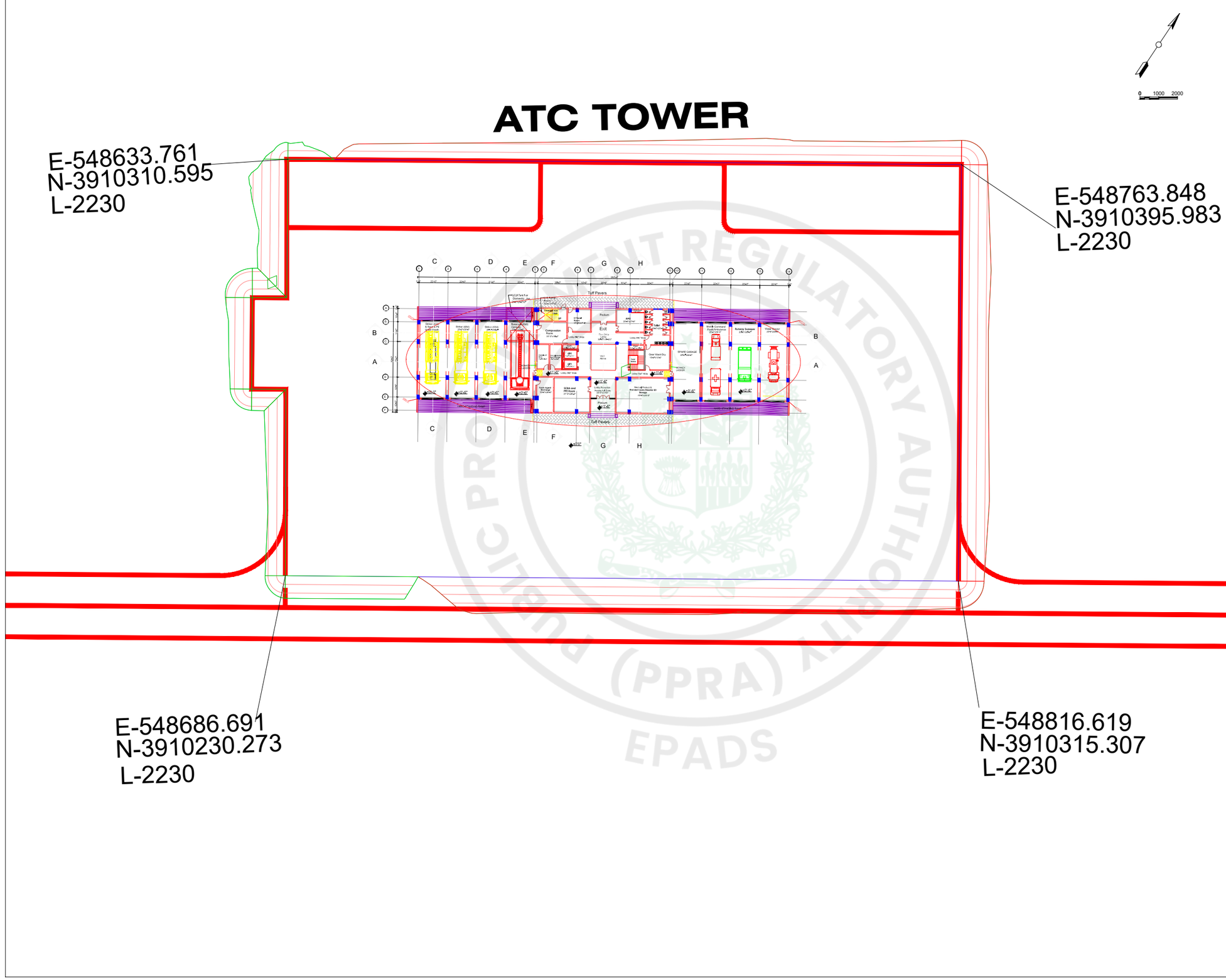
DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 28/12/2025
DRAWING NO: R-30	SHEET: 03

18.12.2009 Skardu Airport Road Section cut &fill (28 Apr 26).dwg

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

ATC TOWER



General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE.
CONTOURS INTERVAL @ 300mm

CLIENT:

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CONSULTANTS

Anwar Architects (Pvt) Ltd.
leit-werk

PROJECT:

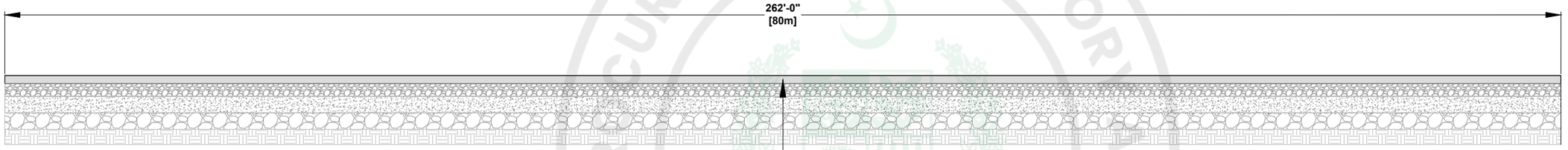
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER PLAN

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\ NA	DATE: 26/12/2025
DRAWING NO: R-31	SHEET: 01

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



- 50mm WC
- 80mm ABC
- 300mm Granular Base
- 150mm Granular Sub Base
- Compacted Sub Grade

ATCT Platform Typical X-Section

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

HORIZONTAL 1:1000

VERTICAL 1:100

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CONSULTANTS

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATCT PLATFORM TYPICAL SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 10/03/2026
DRAWING NO: R-31a	SHEET: 02

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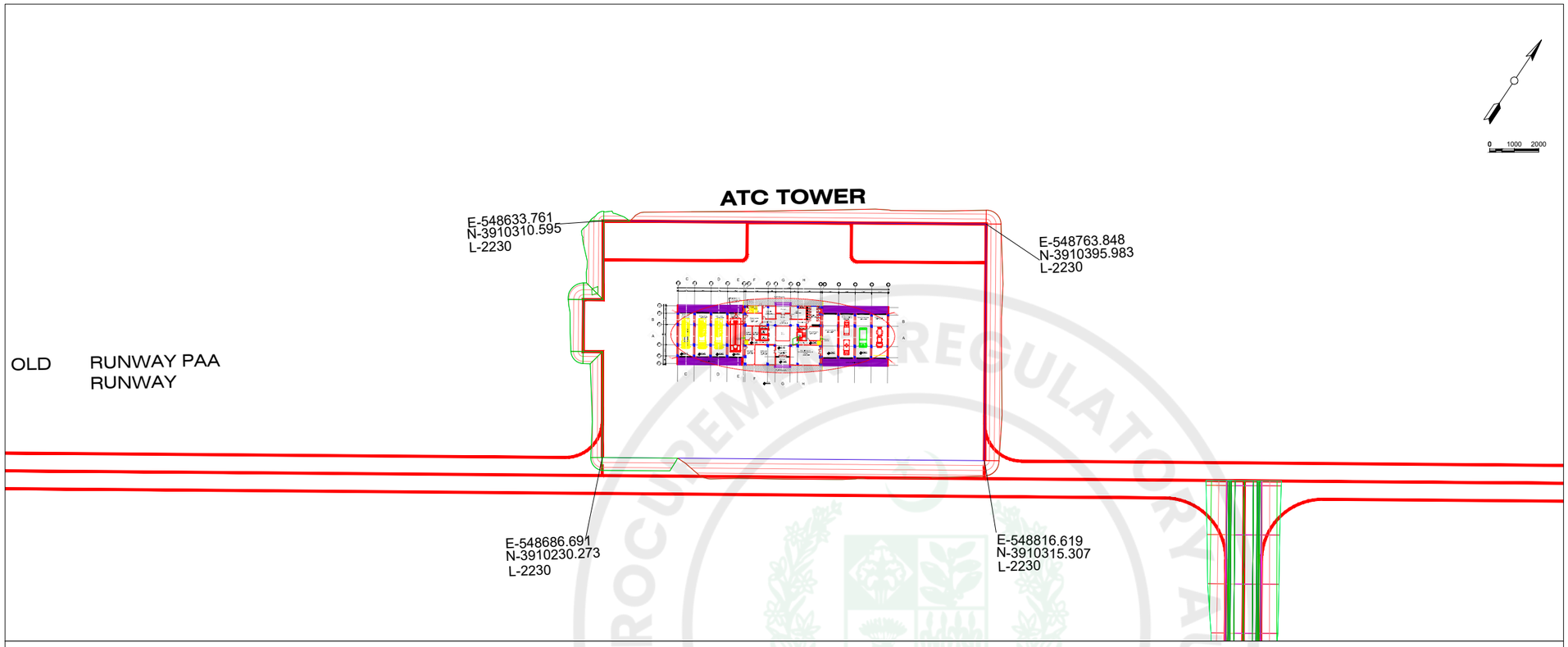

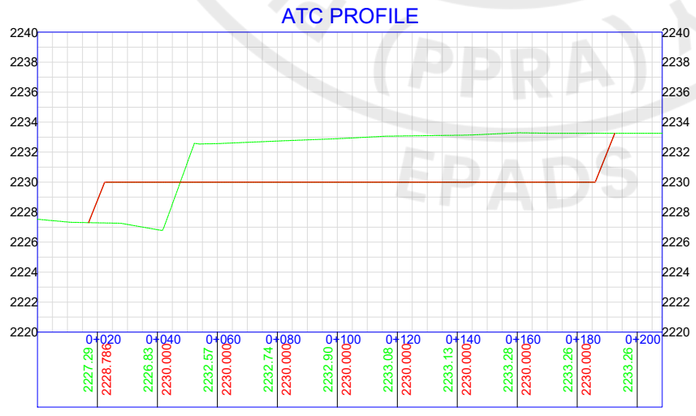

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

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CONSULTANTS

Arwan & Architects (Pvt) Ltd

leit-werk

PROJECT:

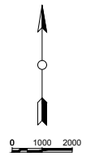
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER PLAN & PROFILE

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 26/12/2025
DRAWING NO: R-32	SHEET: 01

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



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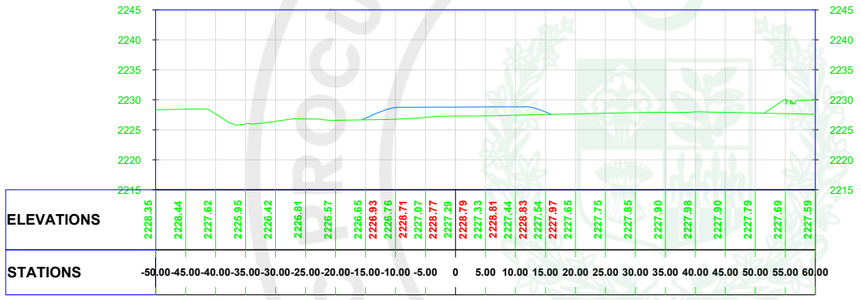

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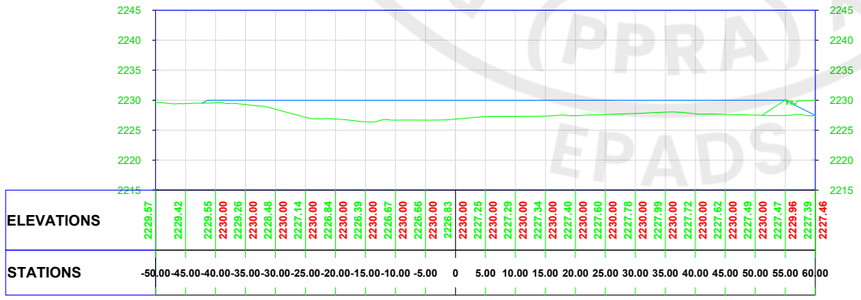

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

CONSULTANTS

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 26/12/2025
DRAWING NO: R-33	SHEET: 01

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

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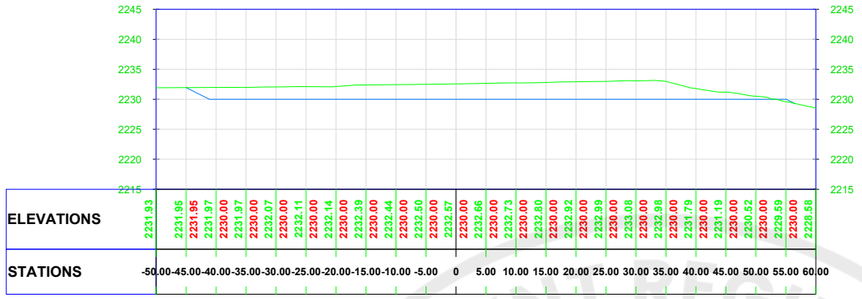

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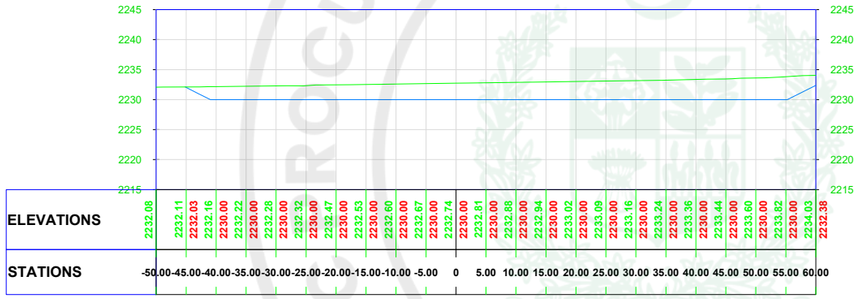

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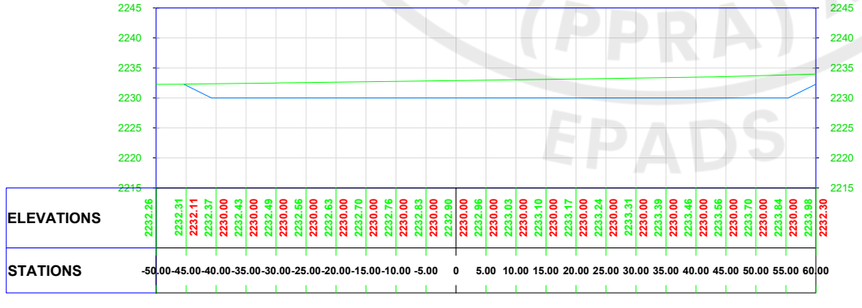

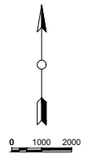

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

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PROJECT:
CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:
ATC TOWER SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 26/12/2025
DRAWING NO: R-34	SHEET: 02

Drawing Plan (26 Apr 26).dwg
19.12.2025
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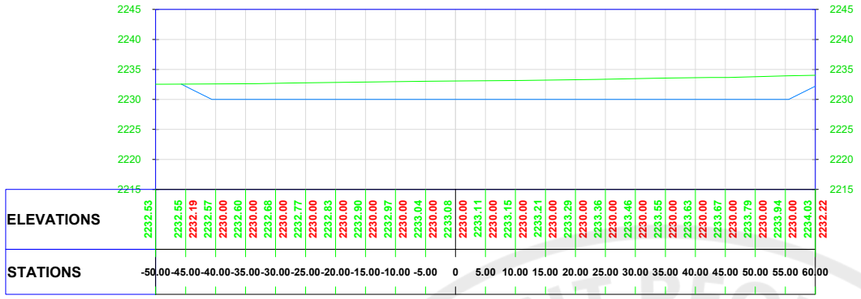

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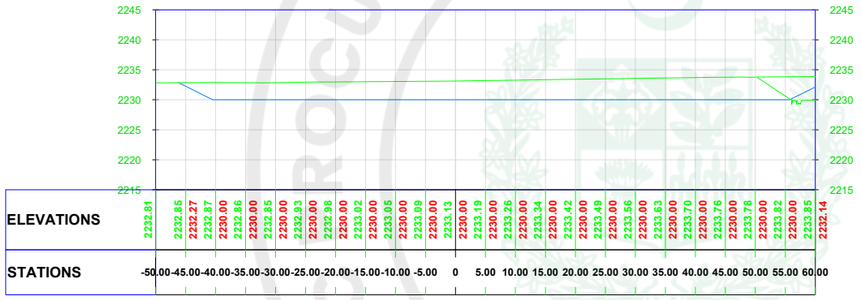

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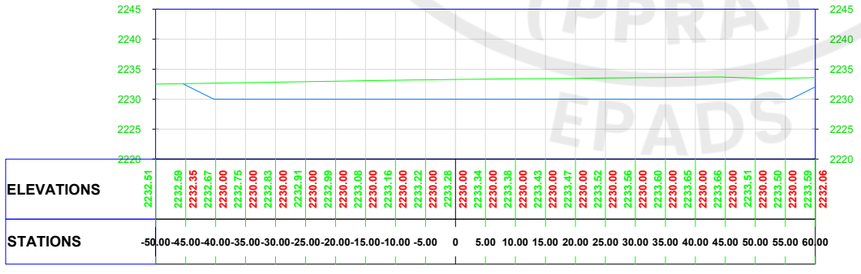

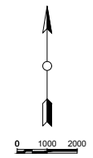

General Notes

ALL LEVELS AND DIMENSIONS ARE IN METER UNLESS INDICATED OTHERWISE. CONTOURS INTERVAL @ 300mm

CLIENT:

PAA
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CONSULTANTS

leit-werk

PROJECT:

CONSULTANCY SERVICES FOR THE PREPARATION OF DETAILED DESIGN,PROCUREMENT SUPPORT AND CONSTRUCTION SUPERVISION OF NEW AIRTRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES ATSKARDU INTERNATIONAL AIRPORT, SKARDU

DRAWING TITLE:

ATC TOWER SECTION

DRAWN BY: ENGR.UZAIR MANZOOR	
CHECKED BY: ENGR. MURTAZA	SCALE:
FILE PATH: D:\NA	DATE: 26/12/2025
DRAWING NO: R-35	SHEET: 03

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

CONSTRUCTION OF NEW AIR TRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES AT SKARDU INTERNATIONAL AIRPORT

(LIST OF DRAWINGS)

ELECTRICAL

NO.	DRAWING NO.	DATE OF DRAWING	AMENDED UPTODATE	DESCRIPTION
01	E-01	MARCH:2026		MAIN LEGEND
02	E-02	MARCH:2026		GENERAL WIRING NOTES AND EARTHING DETAIL
03	E-03	MARCH:2026		SECTION & DETAILS
04	E-04	MARCH:2026		CEILING CO-ORDINATION
05	E-05	MARCH:2026		CEILING CO-ORDINATION
06	E-06	MARCH:2026		CEILING CO-ORDINATION
07	E-07	MARCH:2026		CEILING CO-ORDINATION
08	E-08	MARCH:2026		CEILING CO-ORDINATION
09	E-09	MARCH:2026		CEILING CO-ORDINATION
10	E-10	MARCH:2026		LIGHTING LAYOUT
11	E-11	MARCH:2026		LIGHTING LAYOUT
12	E-12	MARCH:2026		LIGHTING LAYOUT
13	E-13	MARCH:2026		LIGHTING LAYOUT
14	E-14	MARCH:2026		LIGHTING LAYOUT
15	E-15	MARCH:2026		LIGHTING LAYOUT
16	E-16	MARCH:2026		EMERGENCY & EXIT LIGHT LAYOUT
17	E-17	MARCH:2026		EMERGENCY & EXIT LIGHT LAYOUT
18	E-18	MARCH:2026		EMERGENCY & EXIT LIGHT LAYOUT
19	E-19	MARCH:2026		POWER SOCKETS LAYOUT
20	E-20	MARCH:2026		POWER SOCKETS LAYOUT
21	E-21	MARCH:2026		POWER SOCKETS LAYOUT
22	E-22	MARCH:2026		POWER SOCKETS LAYOUT
23	E-23	MARCH:2026		POWER SOCKETS LAYOUT
24	E-24	MARCH:2026		UPS POWER SOCKETS LAYOUT
25	E-25	MARCH:2026		UPS POWER SOCKETS LAYOUT
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27	E-27	MARCH:2026		UPS POWER SOCKETS LAYOUT
28	E-28	MARCH:2026		UPS POWER SOCKETS LAYOUT
29	E-29	MARCH:2026		DATA NETWORKING LAYOUT
30	E-30	MARCH:2026		DATA NETWORKING LAYOUT
31	E-31	MARCH:2026		DATA NETWORKING LAYOUT
32	E-32	MARCH:2026		DATA NETWORKING LAYOUT
33	E-33	MARCH:2026		DATA NETWORKING LAYOUT
34	E-34	MARCH:2026		TELEPHONE & TV SYSTEM LAYOUT
35	E-35	MARCH:2026		TELEPHONE & TV SYSTEM LAYOUT
36	E-36	MARCH:2026		TELEPHONE & TV SYSTEM LAYOUT
37	E-37	MARCH:2026		TELEPHONE & TV SYSTEM LAYOUT
38	E-38	MARCH:2026		TELEPHONE & TV SYSTEM LAYOUT
39	E-39	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
40	E-40	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
41	E-41	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
42	E-42	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
43	E-43	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
44	E-44	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
45	E-45	MARCH:2026		POWER CABLE TRAY LAYOUT
46	E-46	MARCH:2026		POWER CABLE TRAY LAYOUT
47	E-47	MARCH:2026		POWER CABLE TRAY LAYOUT
48	E-48	MARCH:2026		ELV CABLE TRAY LAYOUT
49	E-49	MARCH:2026		ELV CABLE TRAY LAYOUT
50	E-50	MARCH:2026		ELV CABLE TRAY LAYOUT
51	E-51	MARCH:2026		ELEVATION LIGHTING LAYOUT
52	E-52	MARCH:2026		ELEVATION LIGHTING LAYOUT
53	E-53	MARCH:2026		LIGHTNING PROTECTION SYSTEM LAYOUT
54	E-54	MARCH:2026		EARTHING DETAILS SYSTEM LAYOUT
55	E-55	MARCH:2026		FIRE ALARM RISER DIAGRAM
56	E-56	MARCH:2026		CCTV RISER DIAGRAM
57	E-57	MARCH:2026		TELEPHONE RISER DIAGRAM
58	E-58	MARCH:2026		DATA NETWIRKING RISER DIAGRAM
59	E-59	MARCH:2026		CABLE TRENCH LAYOUT
60	E-60	MARCH:2026		MAIN LEGEND
61	E-61	MARCH:2026		LIGHTING LAYOUT PLAN
62	E-62	MARCH:2026		POWER SOCKETS LAYOUT
63	E-63	MARCH:2026		FIRE ALARM & CCTV SYSTEM LAYOUT
64	E-64	MARCH:2026		CABLE TRENCH LAYOUT
65	E-65	MARCH:2026		ELECTRICAL SUBSTATION
66	E-66	MARCH:2026		SOLAR SYSTEM LAYOUT

ISSUE FOR TENDER

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LIGHT FIXTURES

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		6"x12" DOWN LIGHT FIXTURE WITH 12 WATT	FALSE CEILING OR SLAB
2		6"/4"X48" DOWN LIGHT RECTANGULAR OFFICE 40W	FALSE CEILING OR SLAB
3		4 COMBINED RECTANGULAR HANGING LIGHT 120W	FALSE CEILING OR SLAB
4		CARVE LIGHT 20W LED	FALSE CEILING OR SLAB
5		RECESSED TYPE 2'X2' LED LIGHT PANEL 40 WATT	FALSE CEILING OR SLAB
6	EXIT	BATTERY OPERATED EXIT LIGHT	12" ABOVE ON DOOR
7	EXIT	BATTERY OPERATED DIRECTIONAL EXIT LIGHT	HANGING ON SLAB
8		BATTERY OPERATED EMERGENCY LIGHT FIXTURE WITH 2X7 WATT LED	2'-0" BELOW CEILING/SLAB
9		DISTRIBUTION BOARD FOR LIGHTING CIRCUIT & SMALL POWER	2'-6" F.F.L OR IN FLOOR

TELEPHONE SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		INDICATES TELEPHONE OUTLET WITH RJ-11 ON M.S JUNCTION BOX 3"x3"	2'-6" F.F.L OR AS REQ.
2		INDICATES TELEPHONE OUTLET WITH RJ-11 ON M.S JUNCTION BOX 3"x3"	0'-9" F.F.L OR AS REQ.
3		INDICATES WIRING IN 1"ø PVCC FOR TELEPHONE SYSTEM	IN WALL,SLAB OR FLOOR
4	TJB	TELEPHONE JUNCTION BOX	12" F.F.L OR AS REQ.
5	TDB	TELEPHONE DISTRIBUTION BOARD	12" F.F.L OR AS REQ.
6		CAT-6 4P CPT 75 OHM 23 AWG, LSZH TYPE	IN CONDUIT

ACCESS CONTROL

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1	CR	CARD READER	ON WALL
2		UNLOCK PUSH POINT	ON WALL
3	ACP	ACCESS CONTROL PANEL	WALL MOUNTED
4	ACJB	ACCESS CONTROL JUNCTION BOX	WALL MOUNTED

WIRING ACCESSORIES

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		10 AMPS, ONE WAY AND TWO WAYS GANG TYPE SWITCH NUMBER OF SWITCHES ON SWITCH PLATE	3'-6" F.F.L
2		UNIVERSAL/MULTI PIN SWITCH SOCKET UTILITY	3'-6" F.F.L
3		UNIVERSAL/MULTI PIN SWITCH SOCKET UTILITY	0'-9" F.F.L
4		UNIVERSAL/MULTIPIN SWITCH SOCKET-UPS	0'-9" F.F.L
5		15 AMPS 3-ROUND PIN SWITCH SOCKET	0'-9" F.F.L
6		15 AMPS 3-ROUND PIN SWITCH SOCKET	3'-6" F.F.L
7		20 AMPS 3-ROUND PIN SWITCH SOCKET	3'-6" F.F.L
8		INDUSTRIAL POWER SOCKET (THREE-PHASE)	0'-9" F.F.L
9		INDUSTRIAL POWER SOCKET (SINGLE-PHASE)	0'-9" F.F.L
10		TECHNOLOGY BOX MADE OF M.S SHEET OF 16 SWG OF SIZE 14"X4", CONSISTING OF 1- UNIVERSAL/MULTI PIN SWITCH SOCKET UTILITY 2- UNIVERSAL/MULTIPIN SWITCH SOCKET-UPS 3- RJ-45 DUPLEX, 1 NO. FOR DATA	2'-6" F.F.L
11		WIRING IN 1"DIA PVC CONDUIT	IN WALL, SLAB OR FLOOR

FIRE ALARM SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1	H	HEAT DETECTOR RATE OF TEMPERATURE TYPE	ON FALSE CEILING
2	S	SMOKE DETECTOR NON IONIZATION TYPE.	ON FALSE CEILING
3		ALARM SOUNDER	7'-0"F.F.L
4	M	MANUAL BREAK GLASS UNIT	3'-6"F.F.L
5	FAJB	FIRE ALARM JUNCTION BOX	6" TO 9" BELOW SLAB BUT ABOVE FALSE CEILING
6	FACP	FIRE ALARM CONTROL PANEL	4'-0"F.F.L
7		WIRING IN 1"DIA PVC FOR FIRE ALARM SYSTEM	ON SLAB AFC

PUBLIC ADDRESS SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		WALL SPEAKER	ON WALL
2	AMP	AMPLIFIER	-FLOOR MOUNTED -WALL MOUNTED
3		WIRING IN 1"ø PVC FOR PUBLIC ADDRESS SYSTEM	BIS OR ON SLAB AFC
4	PAJB	PUBLIC ADDRESS JUNCTION BOX	4'-0"F.F.L OR AS REQ

DATA SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		DATA OUTLET WITH RJ-45 SOCKET	2'-6" F.F.L OR IN FLOOR
2		WIFI POINT	ON SLAB
3		WIRING IN 1"ø PVC FOR COMPUTER SYSTEM	IN WALL,SLAB OR FLOOR
4	DNS	DATA NETWORK SWITCH	4'-0" F.F.L OR AS REQ.
5	DJB	DATA JUNCTION BOX	4'-0" F.F.L OR AS REQ.
6		CAT-6 4P UTP CABLE 23 AWG, LSZH TYPE, 0.56 mm BARE CU	IN CONDUIT

CLOSE CIRCUIT T.V SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1	CCTV	CLOSE CIRCUIT TV CAMERA	-ON WALL 7'-0" -ON SLAB
2		WIRING IN 1"DIA PVCC FOR CCTV SYSTEM	IN WALL, SLAB OR FLOOR
3	CCJB	CCTV JUNCTION BOX (IF REQ.)	6" TO 9" BELOW SLAB BUT ABOVE FALSE CEILING
4	NVR	NETWORK VIDEO RECORDER	AS PER SITE
5		CAT-6 4P UTP CABLE 23 AWG, LSZH TYPE	IN CONDUIT

MATV SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		TV OUTLET POINT	0'-9" F.F.L
2		WIRING IN 1"ø PVC FOR TV CABLE SYSTEM	IN WALL, SLAB OR FLOOR
3	TVJB	TV JUNCTION BOX	4'-0" F.F.L
4	TVS	TV SPLITTER	4'-0" F.F.L
5		CAT-6 4P UTP CABLE 23 AWG, LSZH TYPE	IN CONDUIT

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

MAIN LEGEND

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-01

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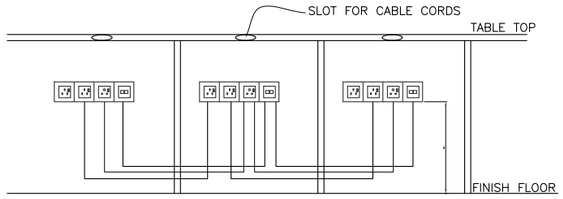
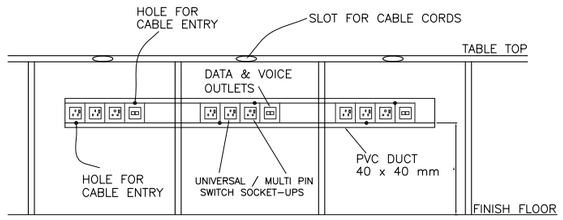
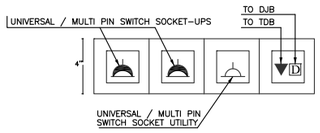


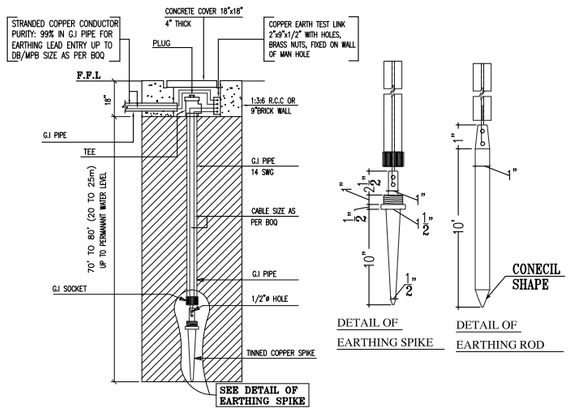
TYPICAL ARRENGMENTS OF TECHNOLOGY BORAD & CONDUITS FIXED ON WORK STATION



TYPICAL ARRENGMENTS OF TECHNOLOGY BORAD &PVC DUCTS FIXED ON WORK STATION



EARTHING DETAIL BORE TYPE

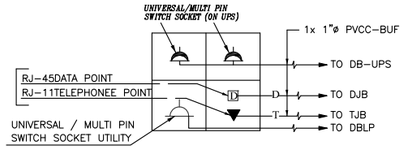


GENERAL & WIRING NOTES:-

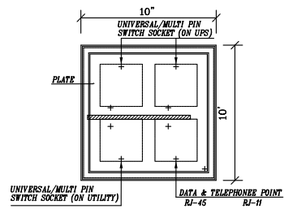
1. ALL ELECTRICAL WORKS PERTAINING TO WIRING OF ELECTRICAL SYSTEMS SHALL STRICTLY CONFORM TO I.E.E LATEST EDITION OF RULES & REGULATIONS.
2. ALL WIRING SHALL BE DONE IN PVC CONDUIT TO BE CONCEALED IN WALLS, SLABS,COLUMNS AND FLOOR OR AS SHOWN ON DRAWINGS.
3. THE WIRING SHOULD BE STARTED ONLY AFTER THE CONDUIT SYSTEM HAS BEEN COMPLETED AND ALL OUTLET BOXES ARE FIXED AT THEIR RESPECTIVE POSITIONS.
4. ALL PVC CONDUITS SHALL BE OF 1"ø (DEPENDING UPON NUMBER OF WIRES) FROM SWITCH BOARD TO LIGHT POINTS & 1" D1A FROM DBs TO SWITCH BOARDS AND POWER SOCKETS OR AS SHOWN ON DRAWINGS.
5. LIGHT / FAN POINT CONTROLLED BY ONE WAY SWITCH. WIRED WITH 2x1.5mm sq FOR(P+N) 1x2.5mmsq AS EARTH(E) WIRE.
6. LIGHTING CIRCUITS FROM RESPECTIVE DB TO SWITCH SOCKET WIRED WITH 3x2.5mm sq AS P+N+E
7. SOCKETS WIRED IN PARALLEL WITH 3x2.5mm sq AS P+N+E
8. POWER SOCKETS WIRED WITH 3x4mmSq AS P+N+E
9. SA/C 1–1.5 TON WIRED WITH 3x6mmSq AS P+N+E
10. SA/C 2– 2.5 TON WIRED WITH 3x6mmSq AS P+N+E
11. NO LUBRICATION EXCEPT AS RECOMMENDED BY MANUFACTURER SHALL BE USED FOR PULLING OF WIRES IN PVC CONDUITS. NO OIL OF ANY KIND SHALL BE USED.
12. COLOUR CODING FOR WIRING SHALL BE AS FOLLOWS: RED, YELLOW AND BLUE FOR PHASES, BLACK FOR NEUTRAL AND GREEN / YELLOW FOR CPC (EARTH).
13. ALL LIGHT POINTS AND POWER SOCKETS SHALL BE PROPERLY EARTHED WITH 2.5mm sq PVC INSULATED WIRES OF COLOUR GREEN–YELLOW.
14. THE NUMBER OF WIRES TO BE PULLED IN ANY CONDUIT FOR WIRING PURPOSES SHALL CONFORM TO IEE. TABLE
15. 1" DIA PVC CONDUIT SHALL BE USED FOR WIRING OF ALL OTHER SYSTEMS UNLESS OTHERWISE MENTIONED ON PLANS OR AS SPECIFIED IN BOQ.
16. ELECTRICAL CONTRACTOR TO CONSULT ELECTRICAL CONSULTANT/ENGINEER FOR ANY FURTHER CLARIFICATIONS. NO ASSUMPTIONS SHOULD BE MADE.

NOTES FOR EARTHING SYSTEM

1. EARTH BORE SHALL BE MADE AT 6'–0" AWAY FROM FOUNDATION.
2. DISTANCE BETWEEN 2 EARTH BORES SHALL NOT BE GREATER THEN 10ft (3m)
3. COPPER CONDUCTOR AT TOP OF G.I. PIPE SHALL BE BOLTED WITH THIMBLES, BRASS NUTS, BOLTS ETC.
4. JOINTS SHALL BE COVERED WITH BITUMEN
5. CONTRACTOR TO MEASURE EARTHING RESISTANCE IN THE PRESENCE OF SITE ENGINEER. BOTH THE SITE ENGINEER AND CONTRACTOR SHALL SIGN THE EARTH TESTING RESULT AND SUBMIT IT TO THE CONSULTANT.



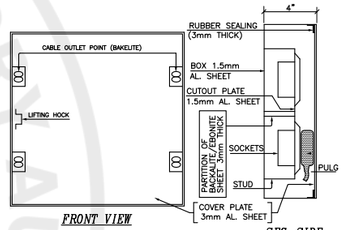
TENTATIVE DETAIL OF FLOOR OUTLET PLATE.



FRONT VIEW
COVER PLATE REMOVED

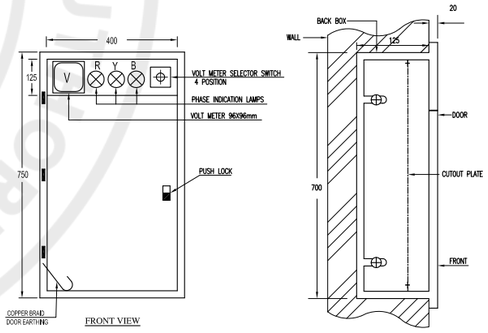
TENTATIVE DETAIL OF M.S FLOOR OUTLET BOX- (FOB)

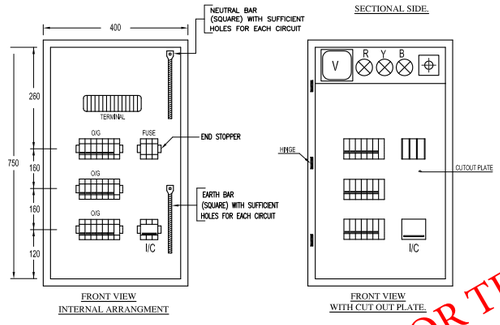
- BURIED FLUSH WITH FINISHED FLOOR LEVEL
- SAMPLE TO BE SUBMITTED TO CONSULTANT FOR APPROVAL SEE BOQ.



FRONT VIEW

SEC. SIDE





TENTATIVE CONSTRUCTIONAL DETAIL OF:- DISTRIBUTION BOARD (DB) RECESSED TYPE.

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

GENERAL WIRING NOTES AND EARTHING DETAIL

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-02

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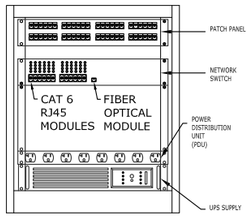
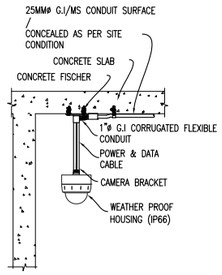
1



TYPICAL COMMUNICATION RACKS

2



TYPICAL CAMERA MOUNTING DETAIL

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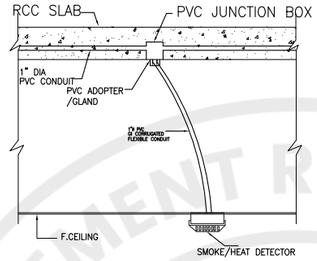
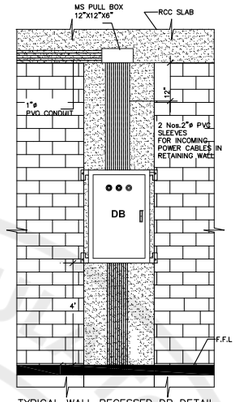


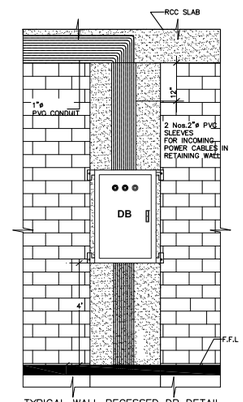
TYPICAL SMOKE DETECTOR MOUNTING DETAIL

4



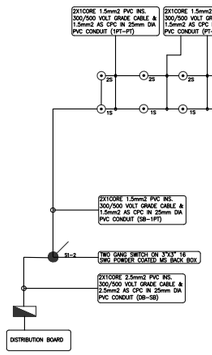
TYPICAL WALL RECESSED DB DETAIL

5



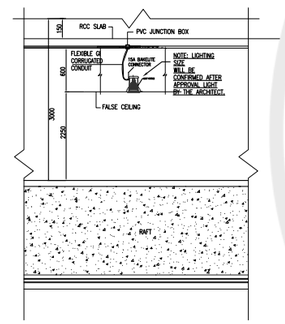
TYPICAL WALL RECESSED DB DETAIL

6 TYPICAL WIRING DETAIL FOR SWITCH BOARD TO FIRST LIGHT POINT AND POINT TO POINT.



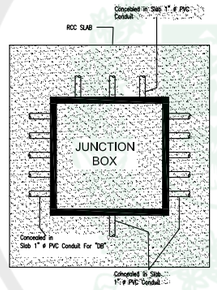
TYPICAL LIGHT WIRING DETAILS

7



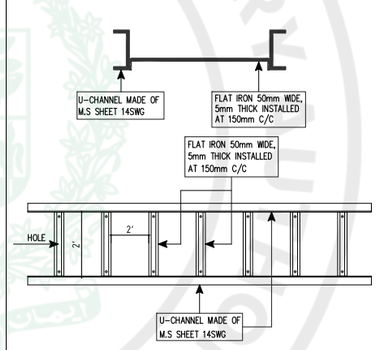
TYPICAL LIGHT POINT ON FALSE CEILING DETAIL

8



TYPICAL WALL/SLAB JUNCTION BOX DETAIL

9



TYPICAL CABLE LADDER DETAIL

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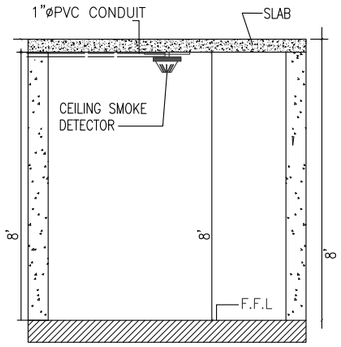
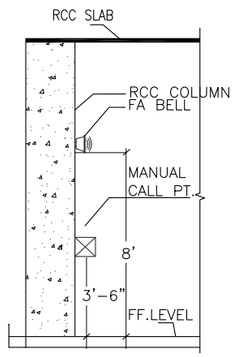


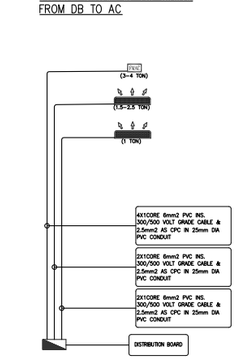
TYPICAL SMOKE DETECTOR MOUNTING DETAIL

11



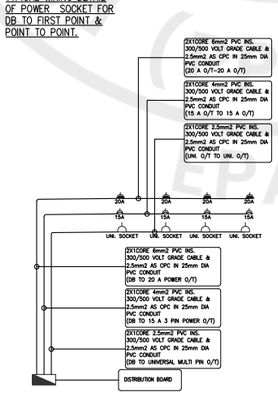
TYPICAL MANUAL CALL POINT & BELL MOUNTING DETAIL

12 TYPICAL DETAIL OF AC WIRING FROM DB TO AC



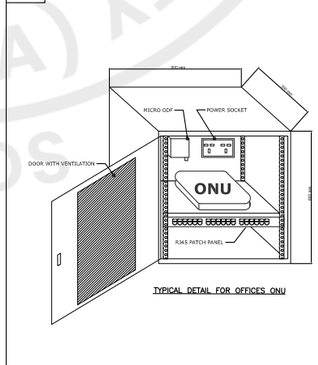
TYPICAL AC WIRING DETAILS

13 TYPICAL WIRING DETAIL OF POWER SOCKET FOR DB TO FIRST POINT & POINT TO POINT.



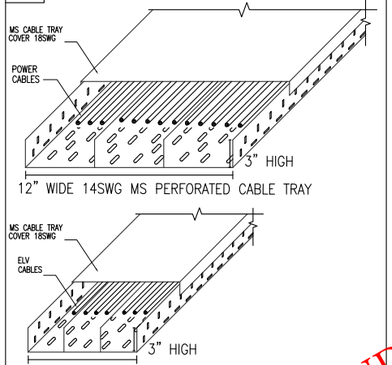
TYPICAL POWER WIRING DETAILS

14



TYPICAL DETAIL FOR OFFICES ONU

15



TYPICAL DETAIL FOR CABLE TRAY

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

SECTION & DETAILS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-03

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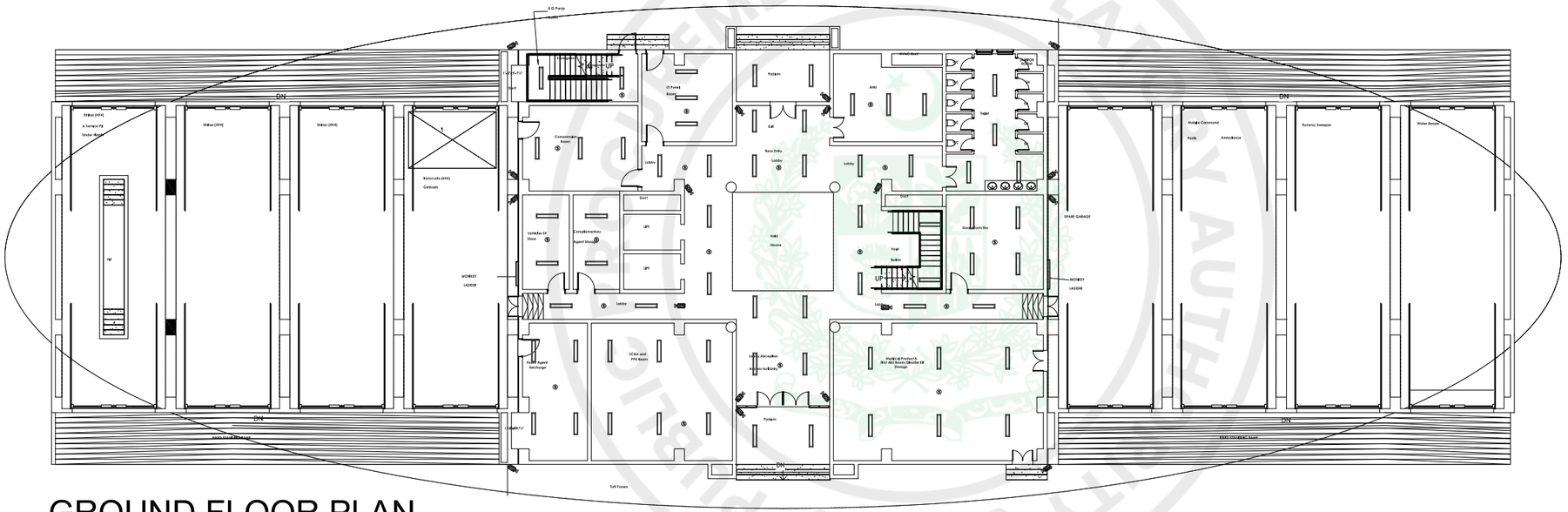

GROUND FLOOR PLAN

ISSUE FOR TENDER

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA)
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Project Name

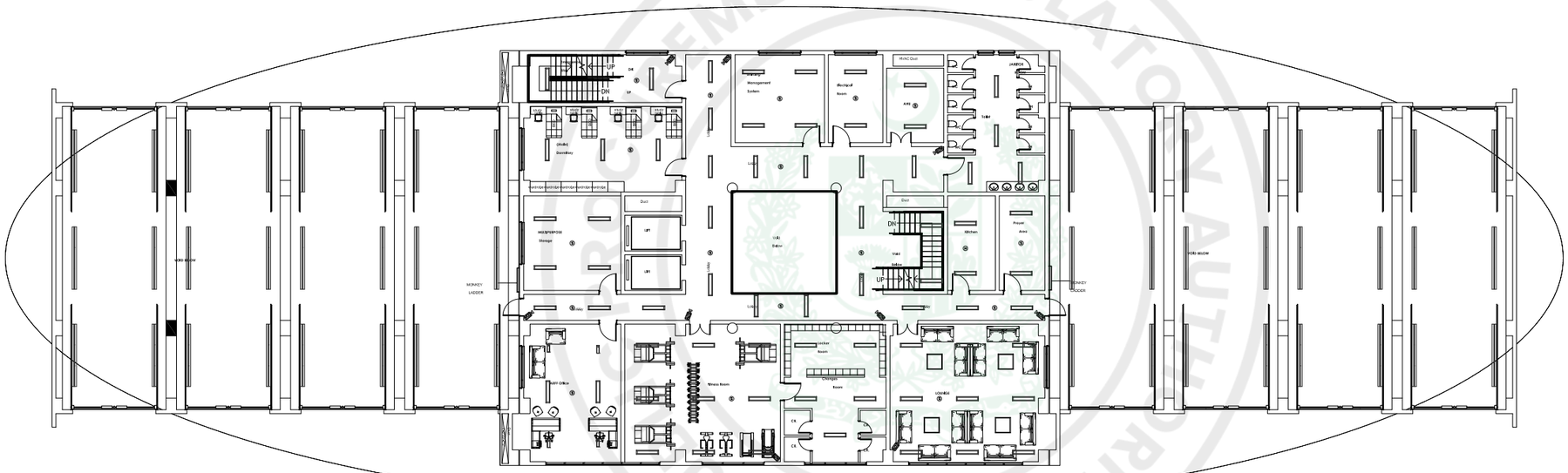
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

CEILING CO-ORDINATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-04



ARFF FLOOR
MEZZANINE FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for
New Air Traffic Control Tower
(ATCT), Fire Station and Allied
Facilities at Skardu
International Airport

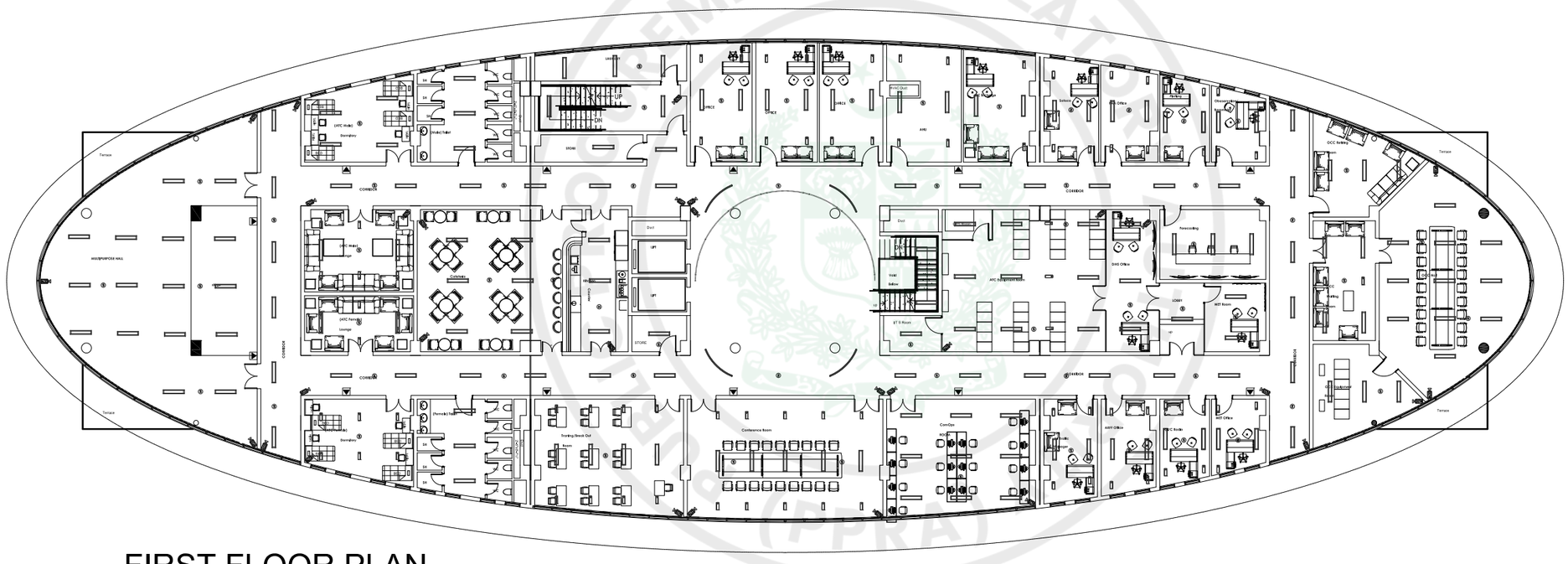
DETAILED ELECTRICAL Design Drawings

Sheet Name

CEILING CO-ORDINATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-05

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

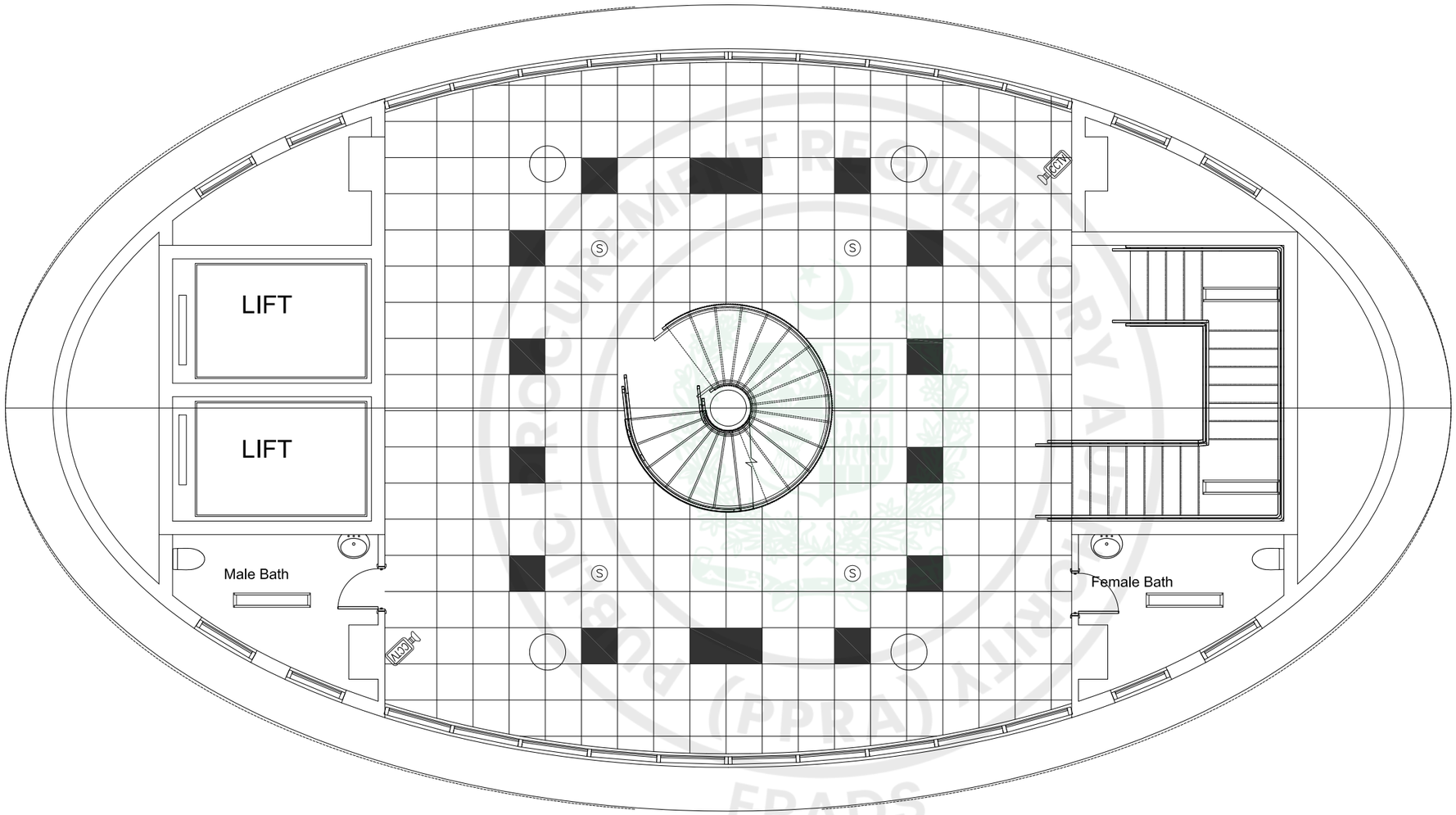
DETAILED ELECTRICAL Design Drawings

Sheet Name

CEILING CO-ORDINATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-06

EPADS



ROOF FLOOR PLAN LEVEL AT 43'-6"
COVERED AREA 2802 Sft

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

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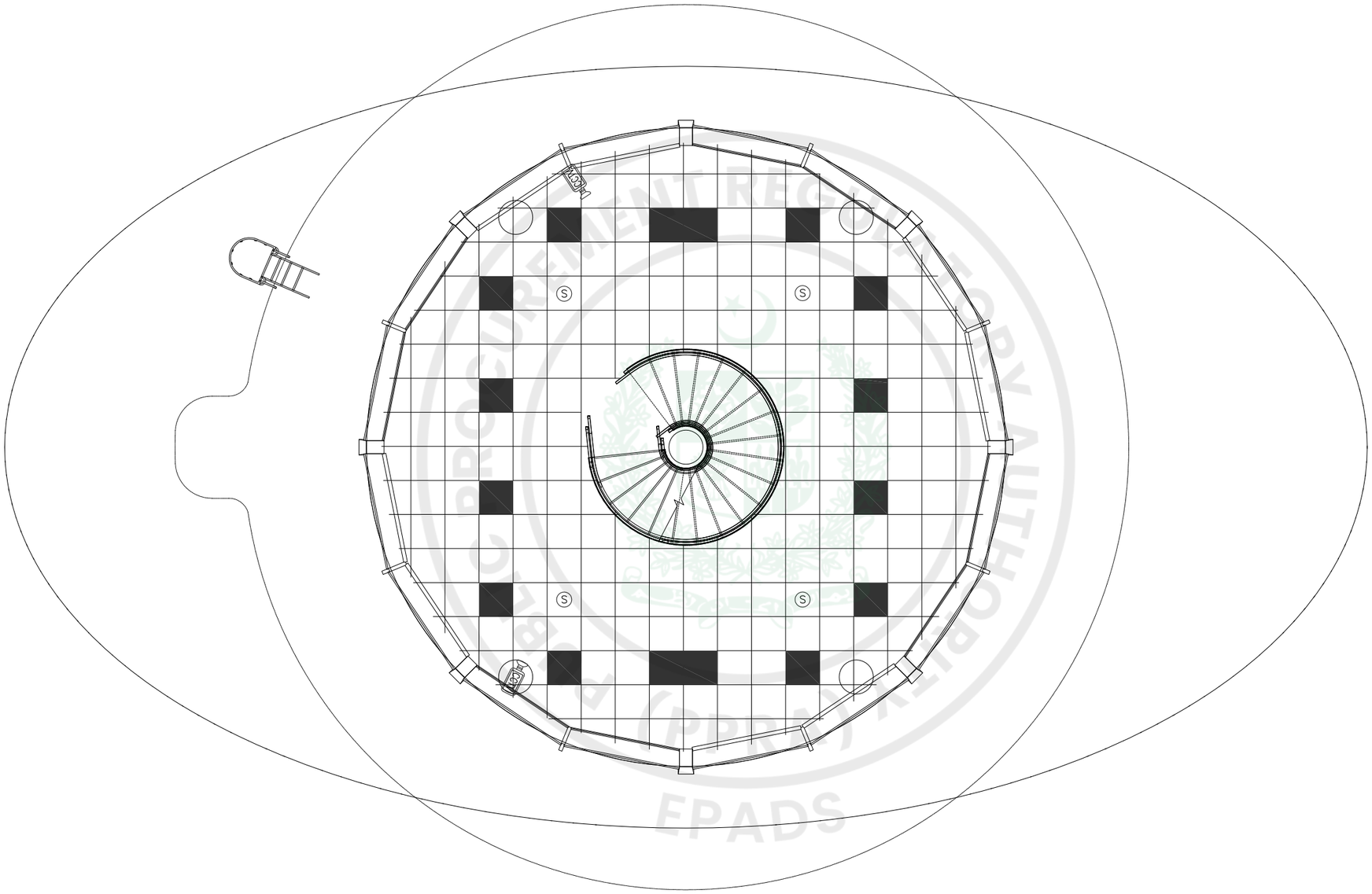
Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-07



ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

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Date	April, 2026
Scale	NTS
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Approved by	M.F
Drawing No.	E-08

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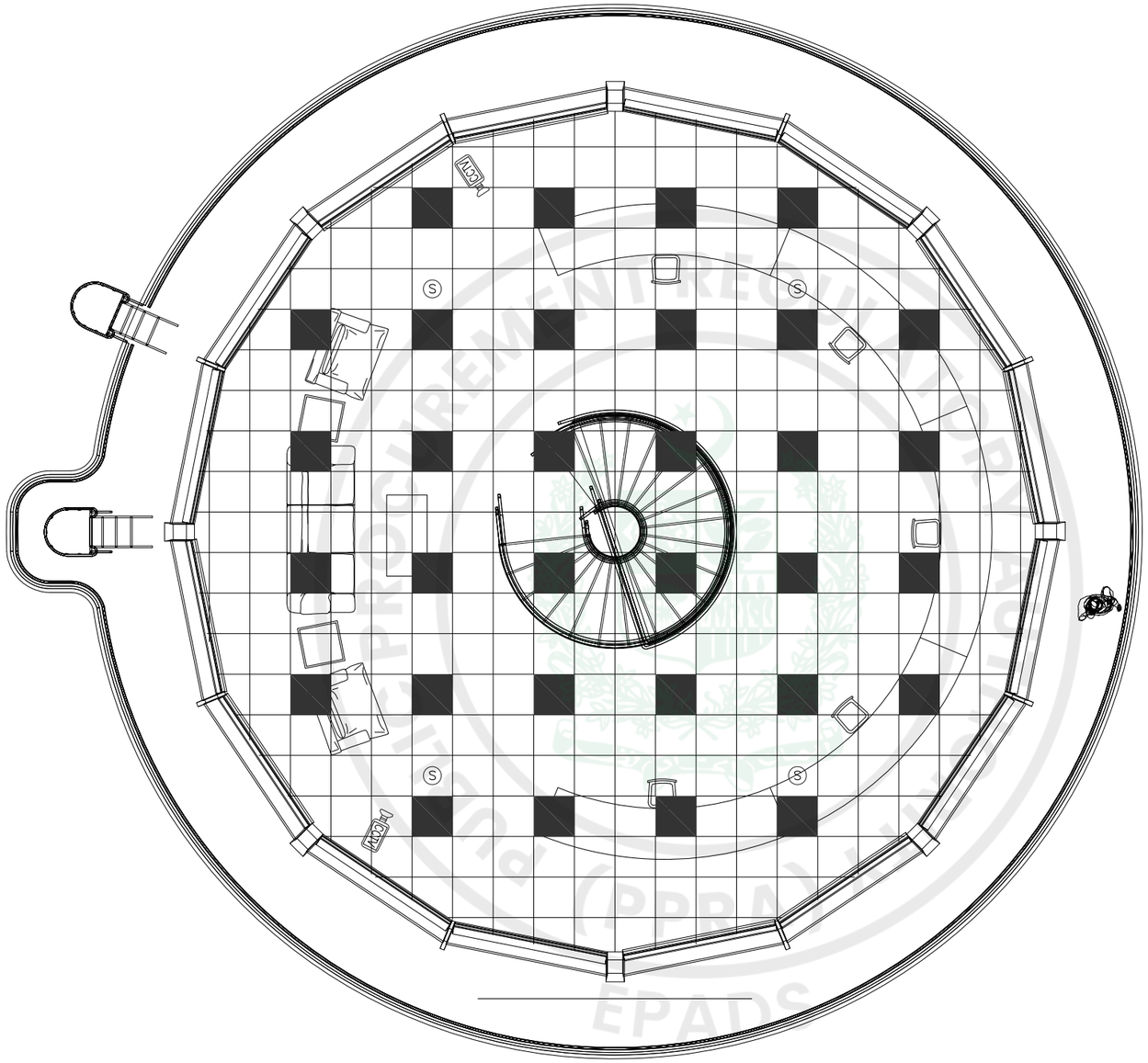

ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

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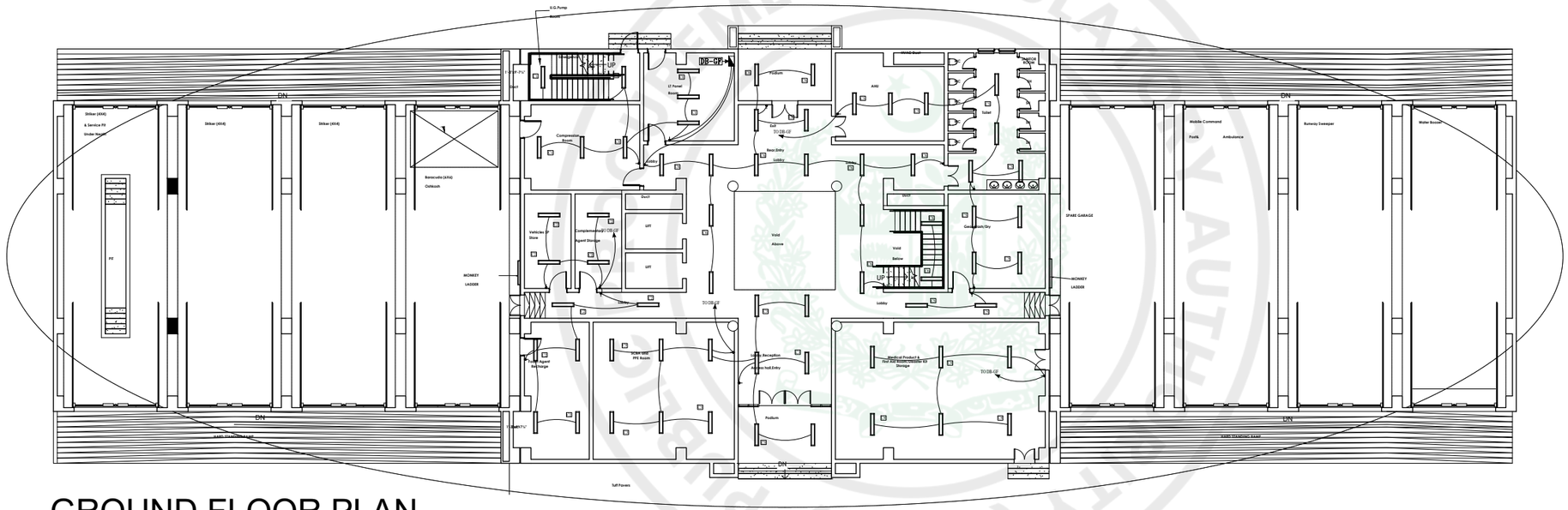
Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-09



GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-10

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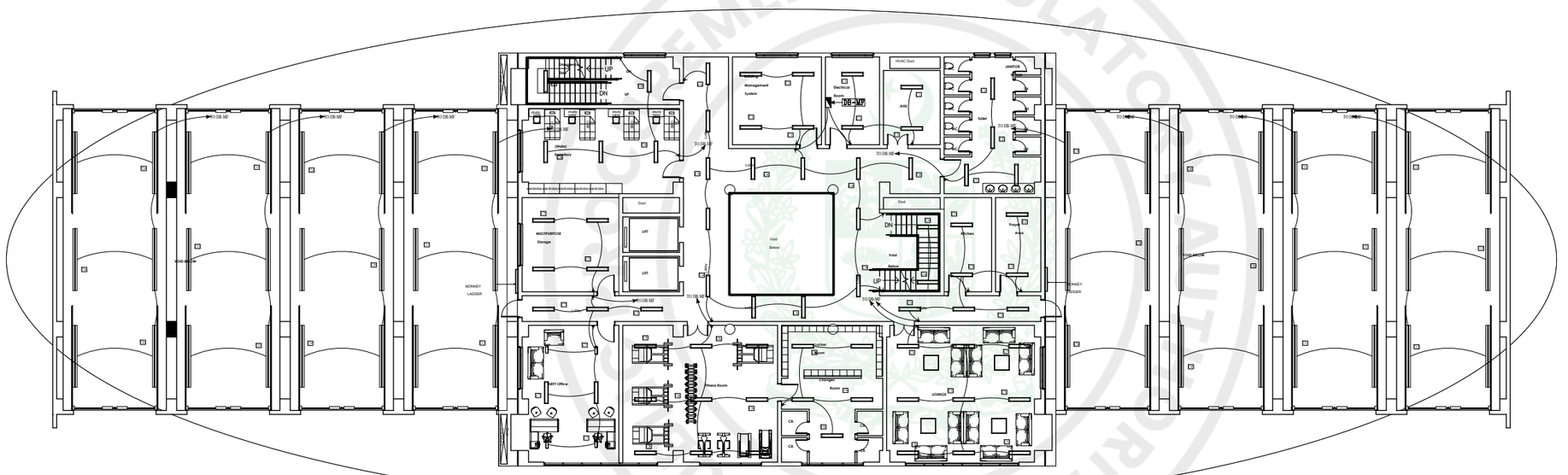

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
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Approved by	M.F
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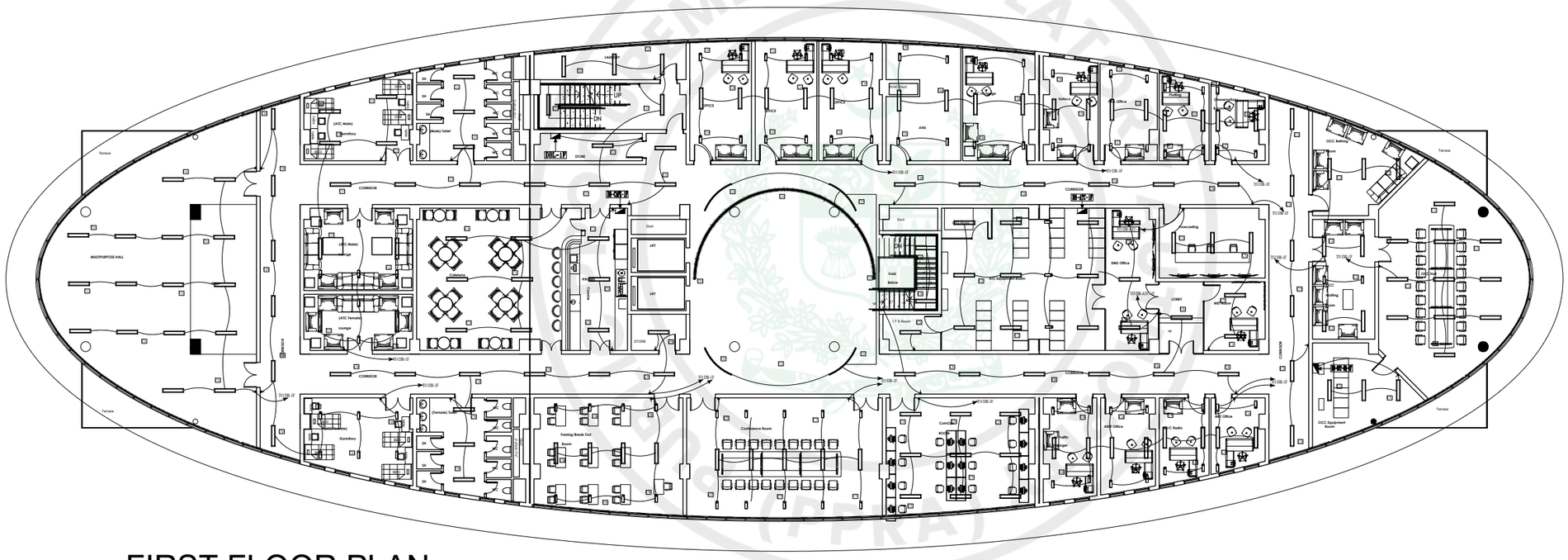
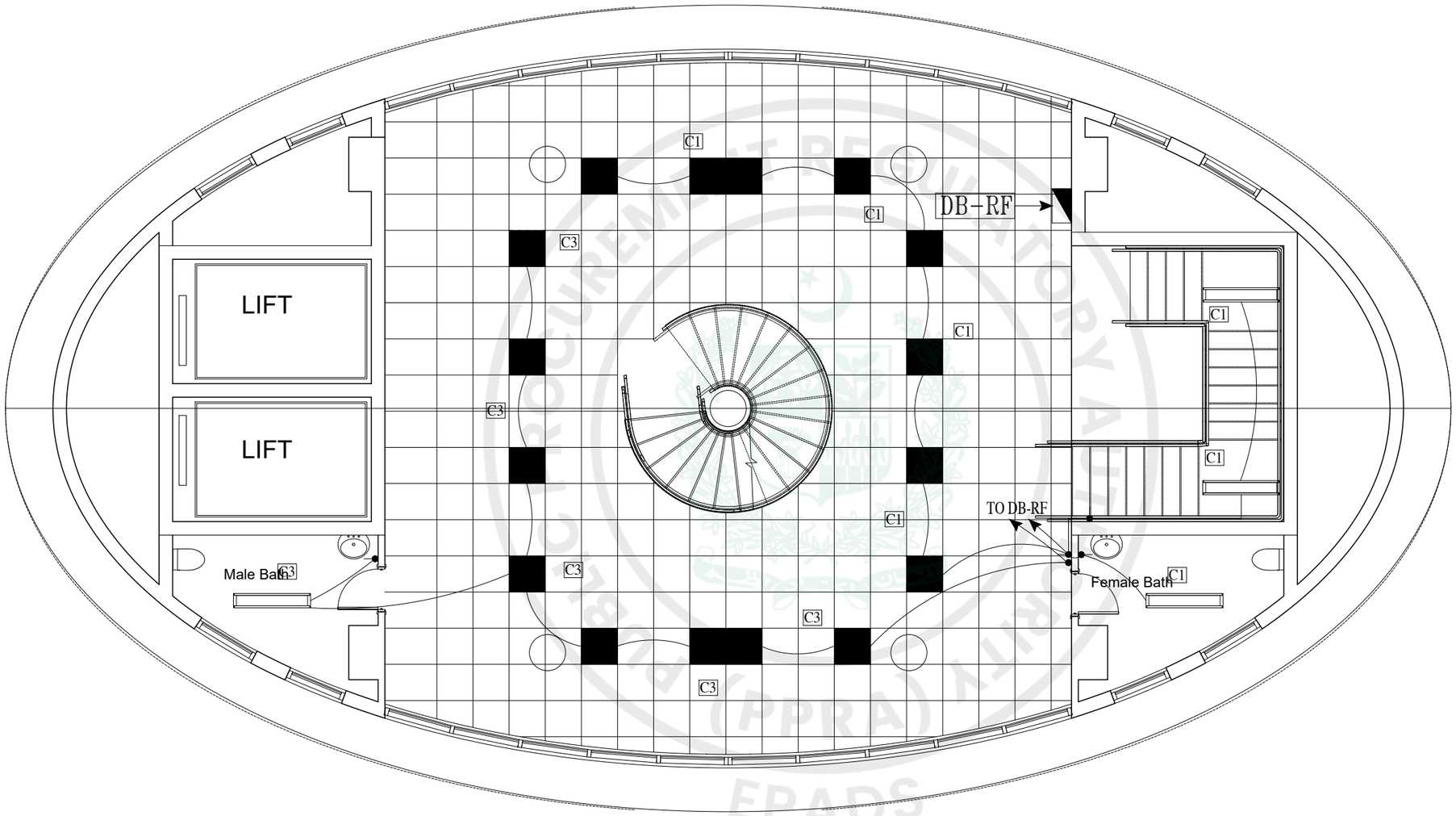

Terrace
MULTIPURPOSE HALL
Terrace
Terrace
Terrace



ROOF FLOOR PLAN LEVEL AT 43'-6"
COVERED AREA 2802 Sft

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
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Drawing No.	E-13

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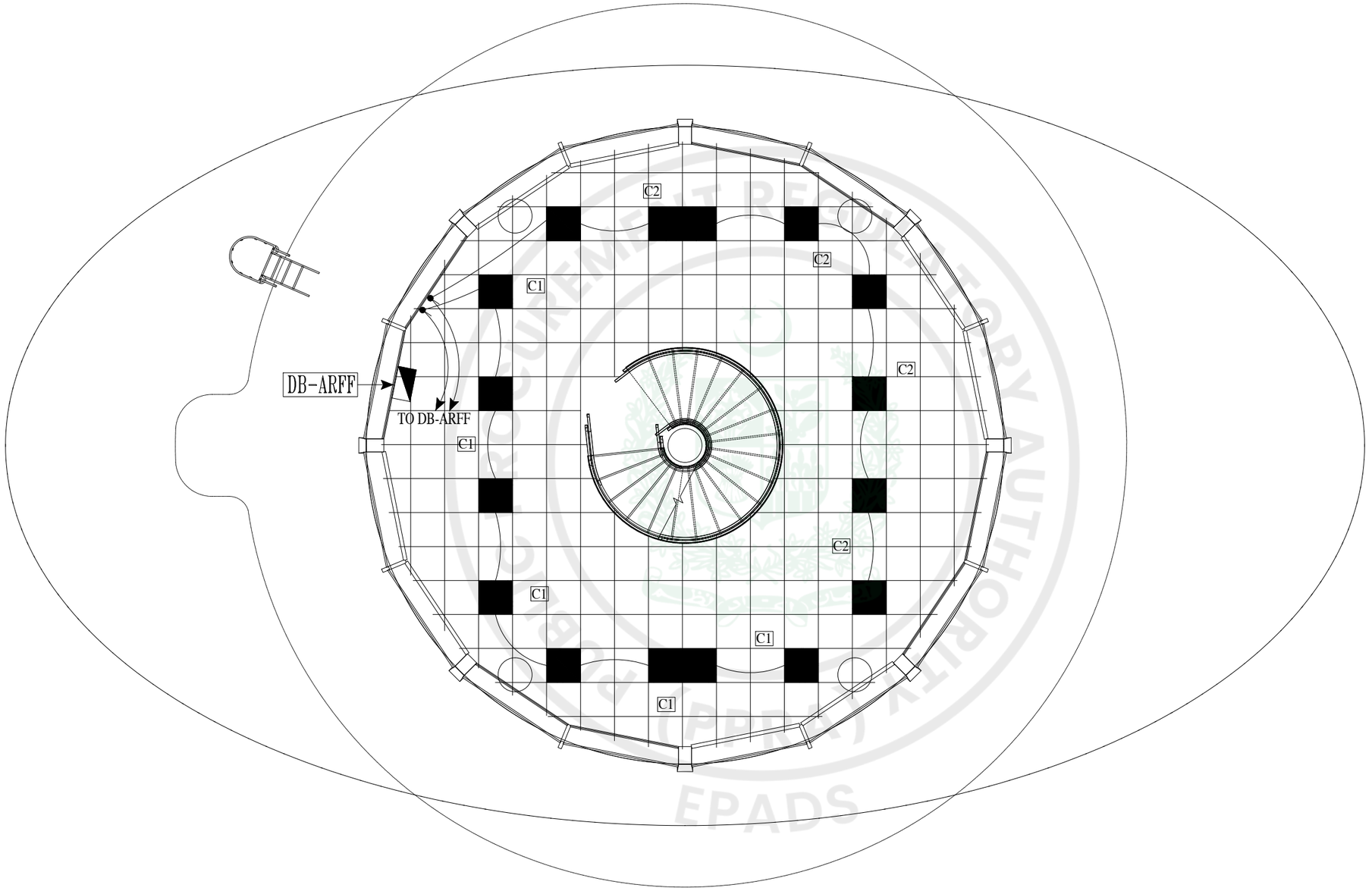

ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
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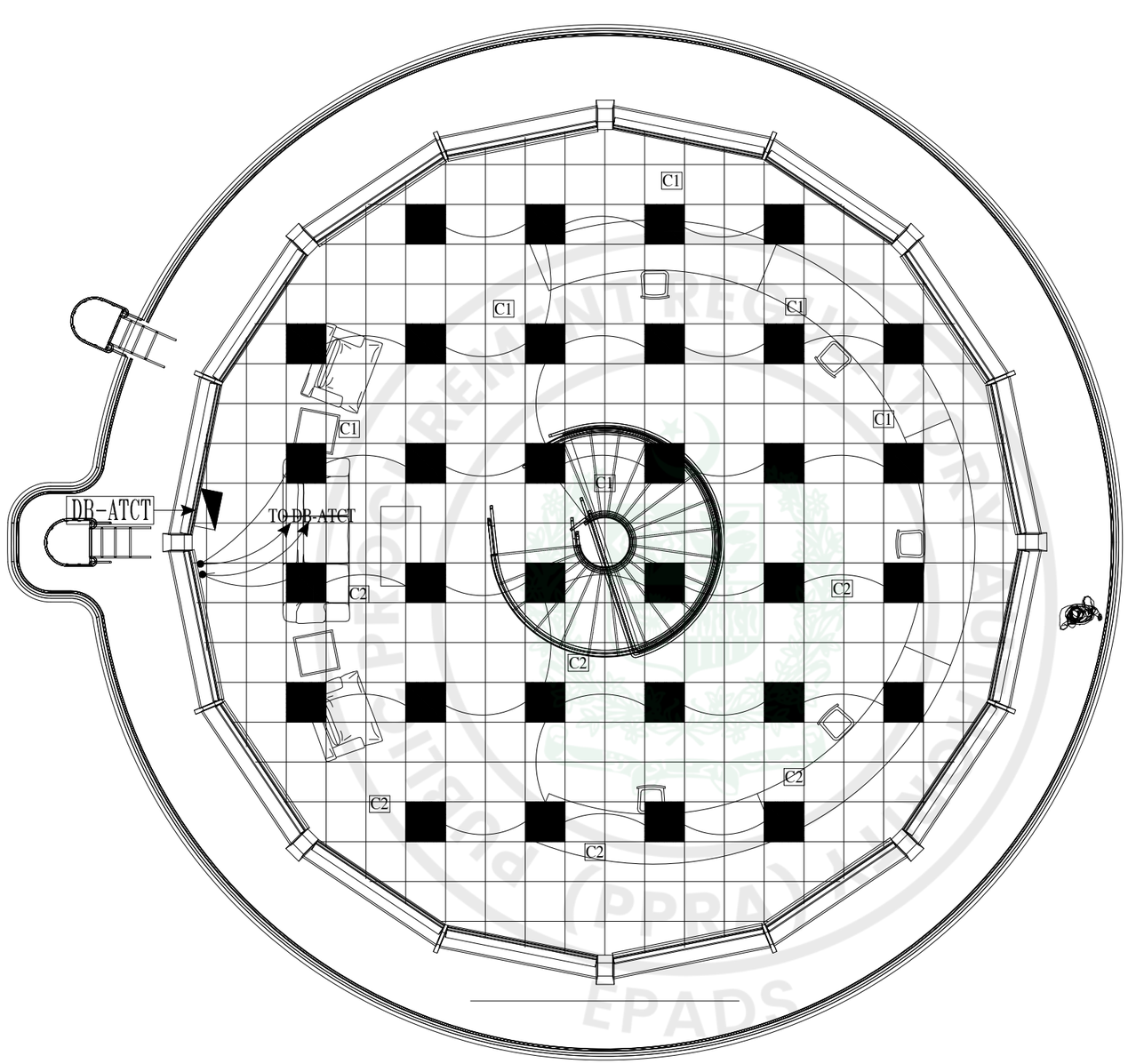
Approved by	M.F
Drawing No.	E-14



ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
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Drawing No.	E-15

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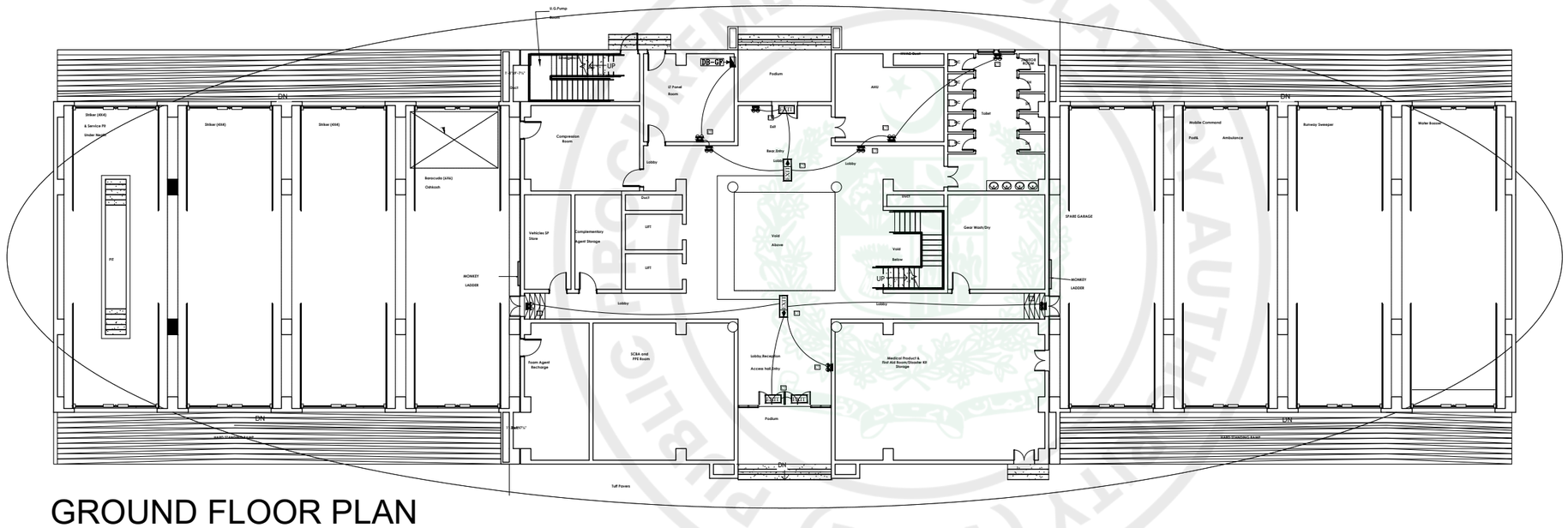

GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

EMERGENCY & EXIT LIGHT LAYOUT

Date	April, 2026
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Checked by	M.K
Approved by	M.F
Drawing No.	E-16

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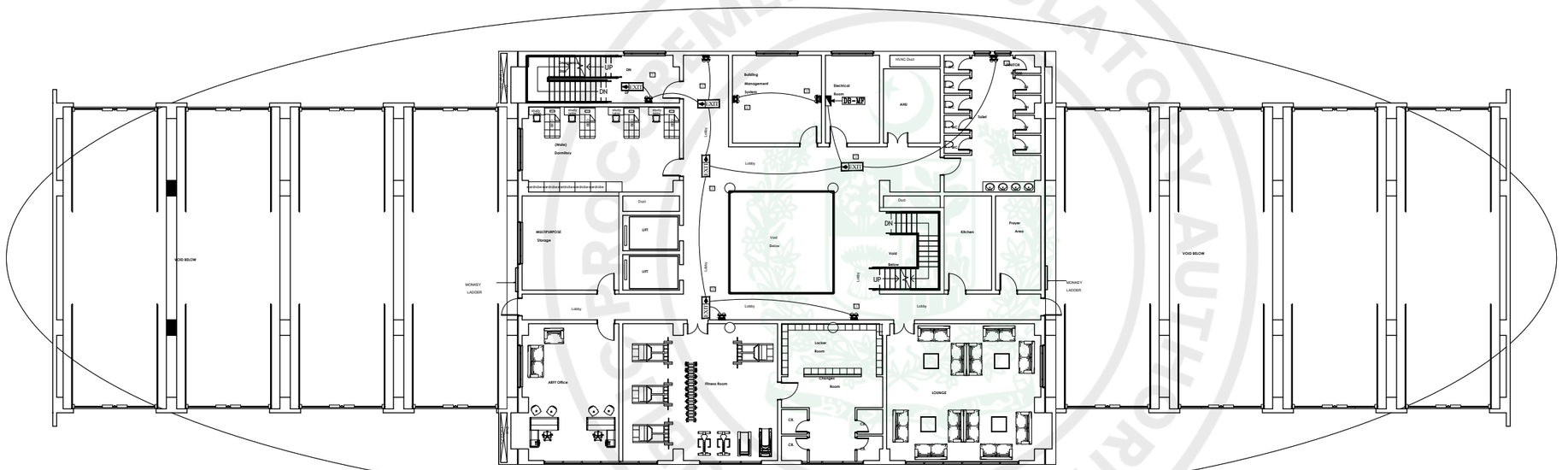

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

EMERGENCY & EXIT LIGHT LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-17

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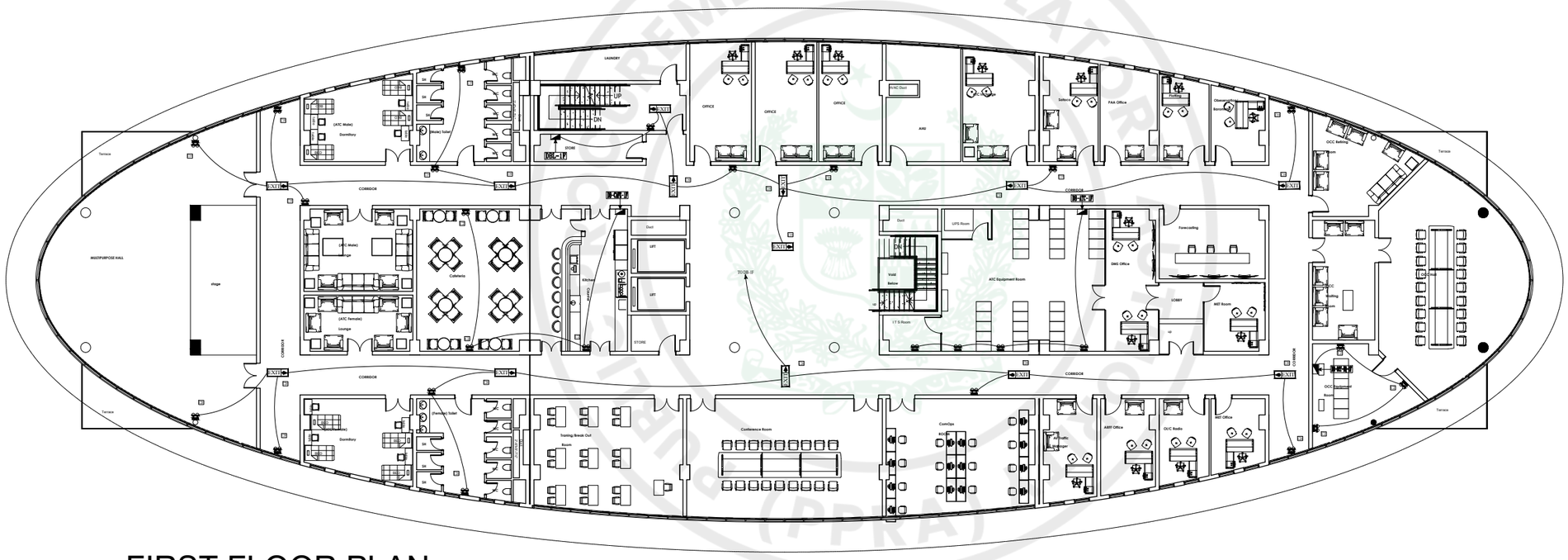

FIRST FLOOR PLAN

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Project Name

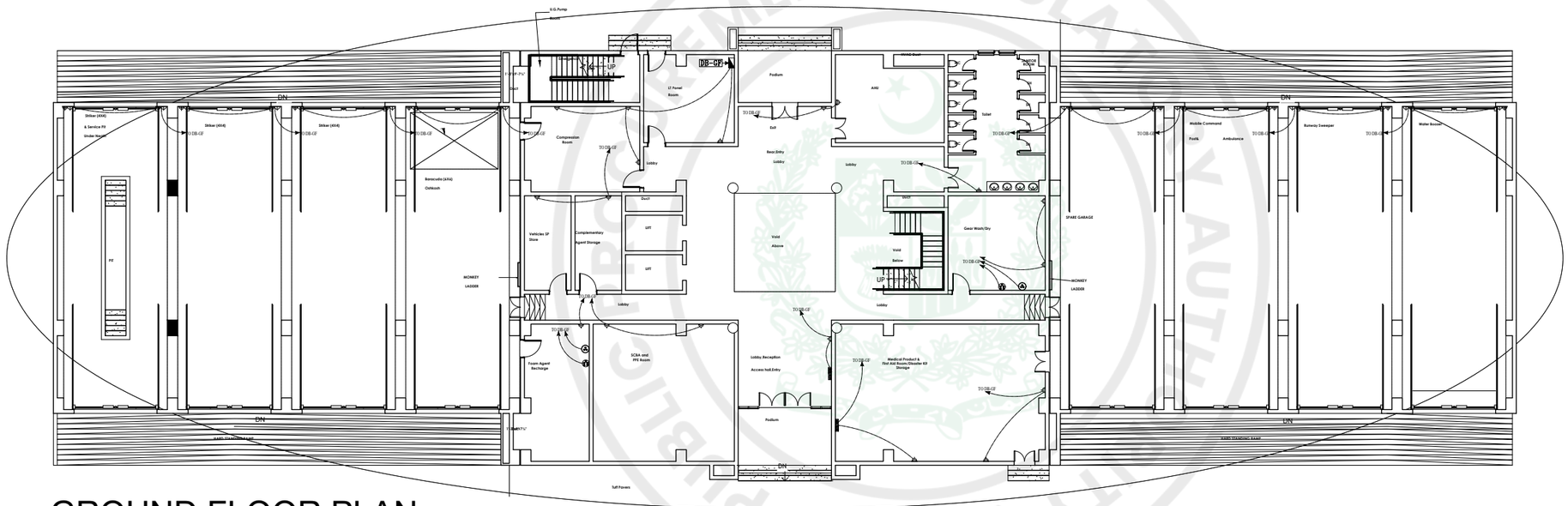
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

EMERGENCY & EXIT LIGHT LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-18



GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

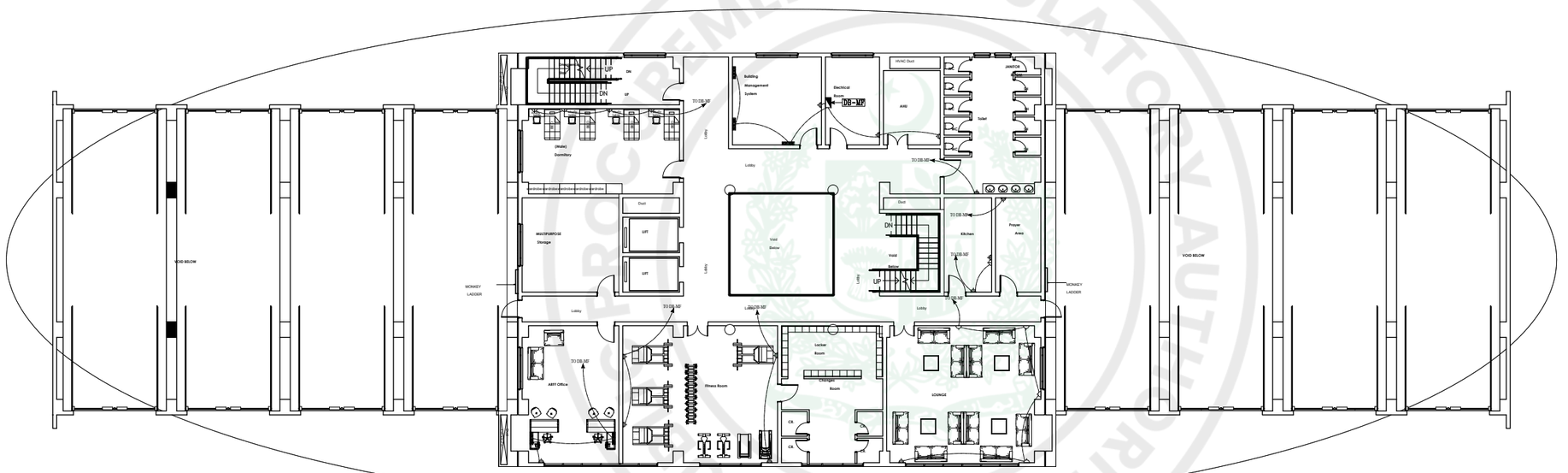
DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-19

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ARFF FLOOR
MEZZANINE FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

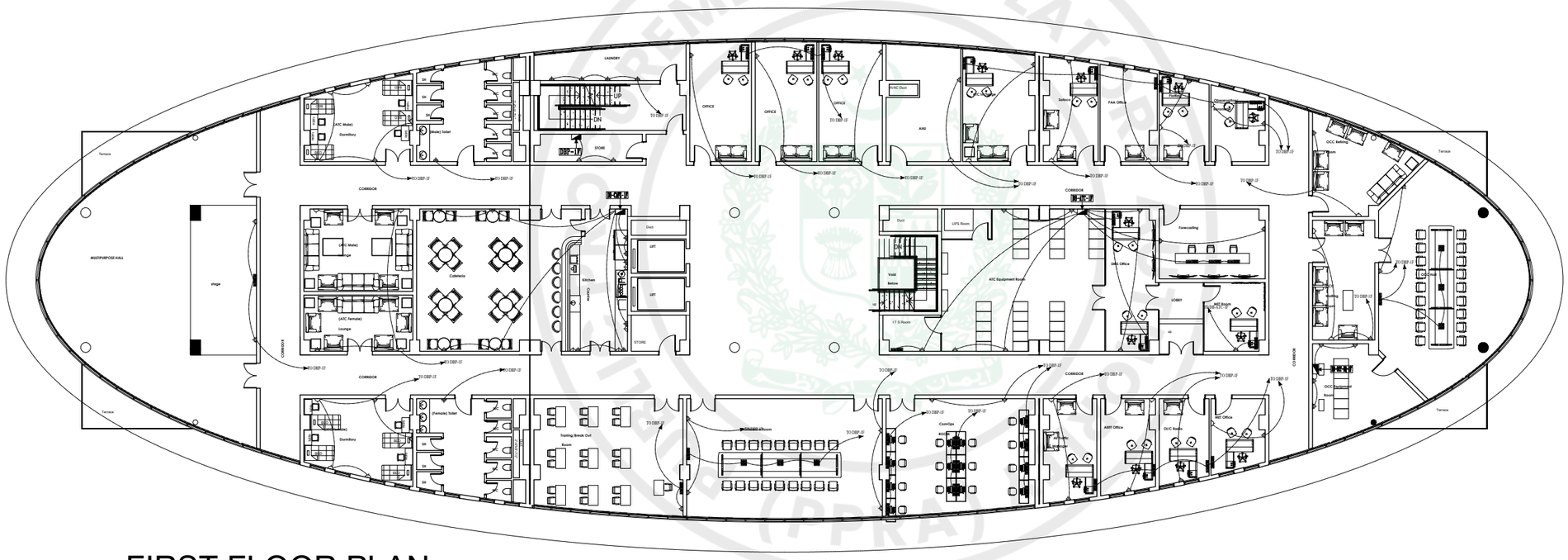
DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-20

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-21

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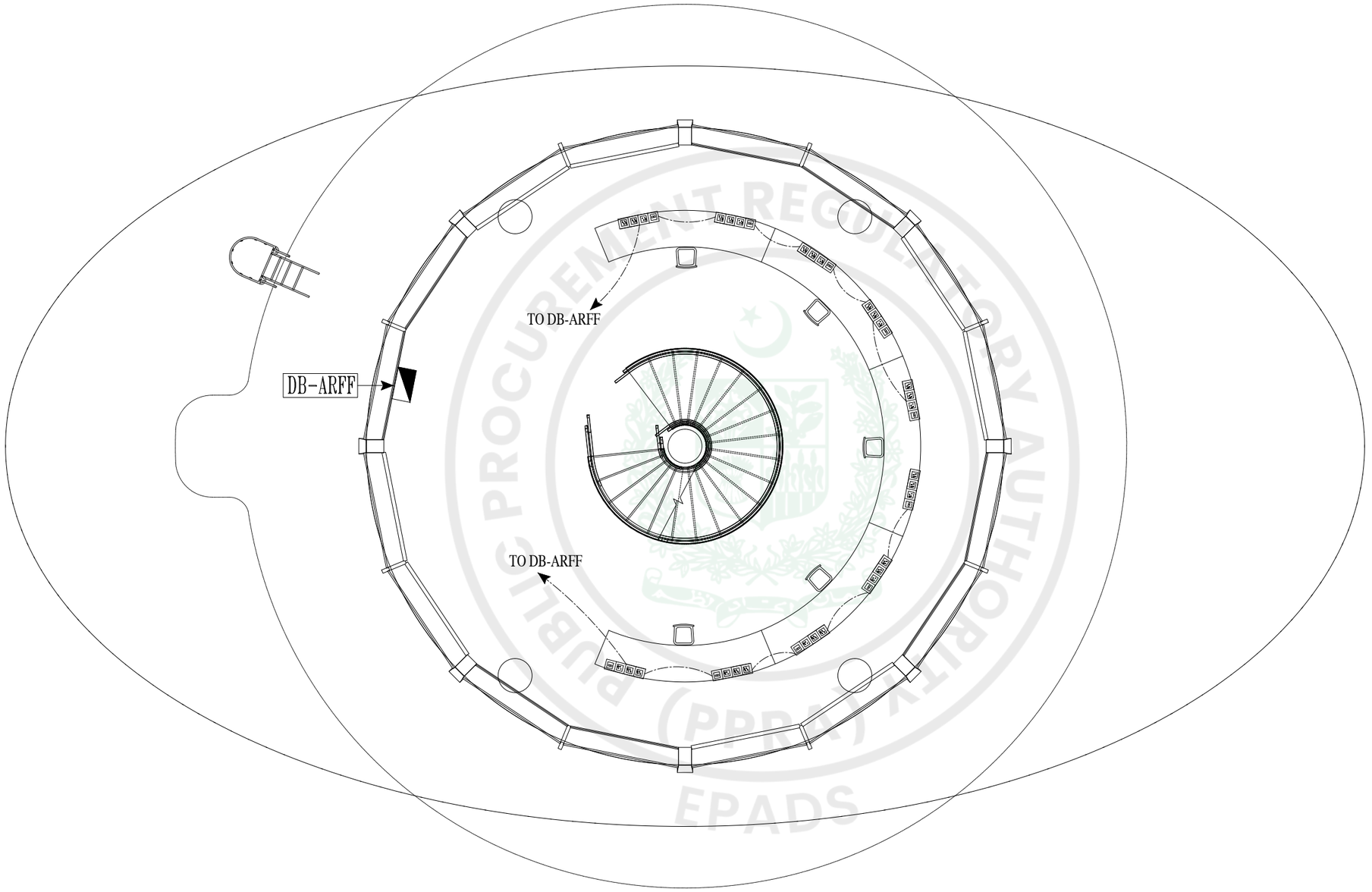

ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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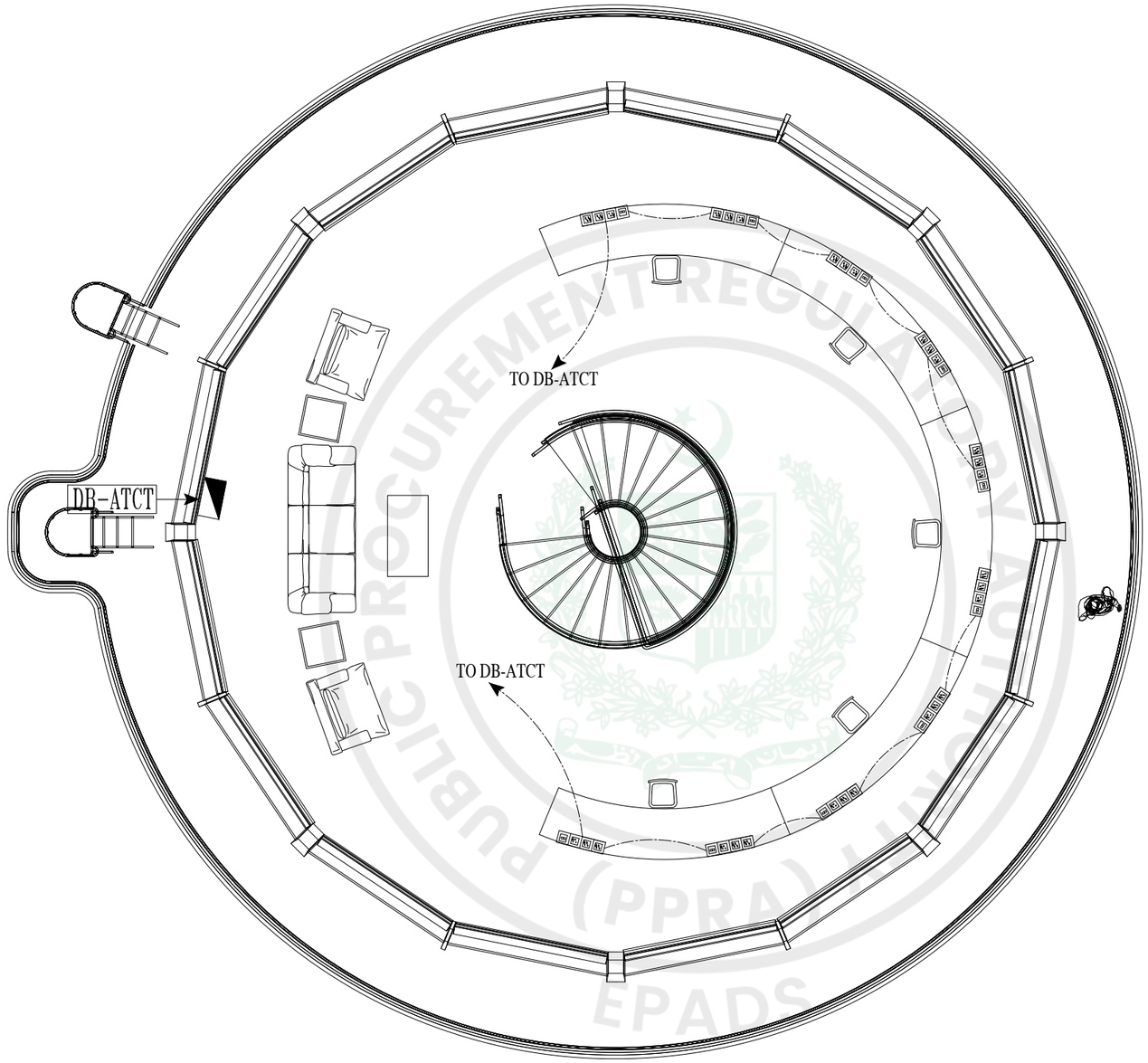
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-22



ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-23

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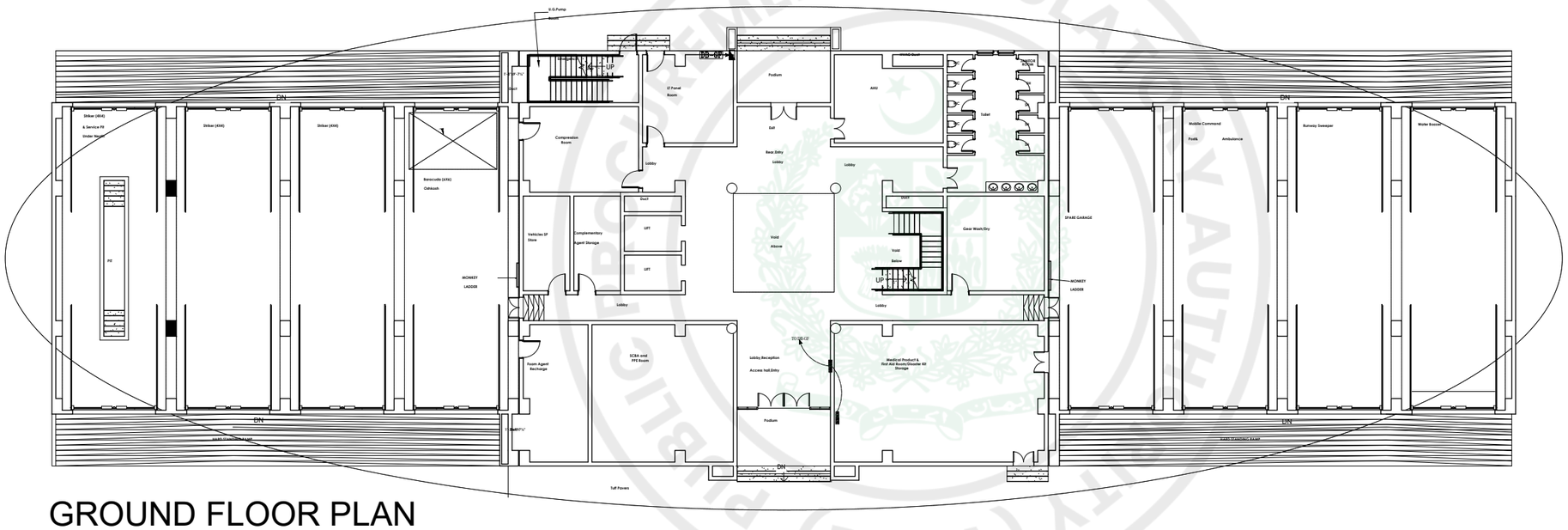

GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

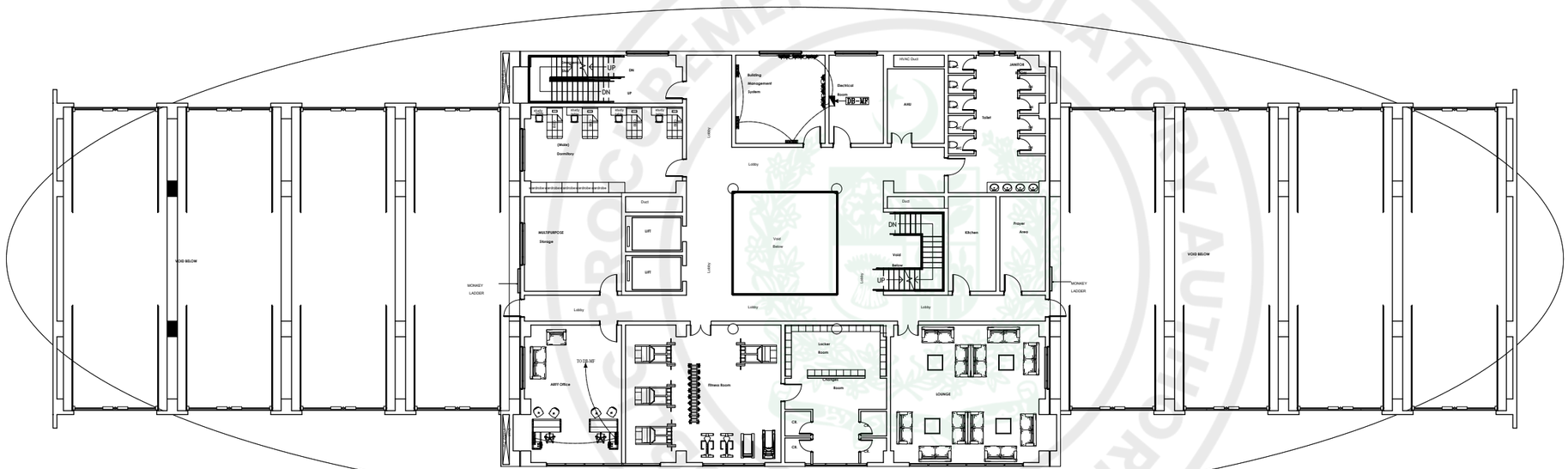
DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-24

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ARFF FLOOR
MEZZANINE FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-25

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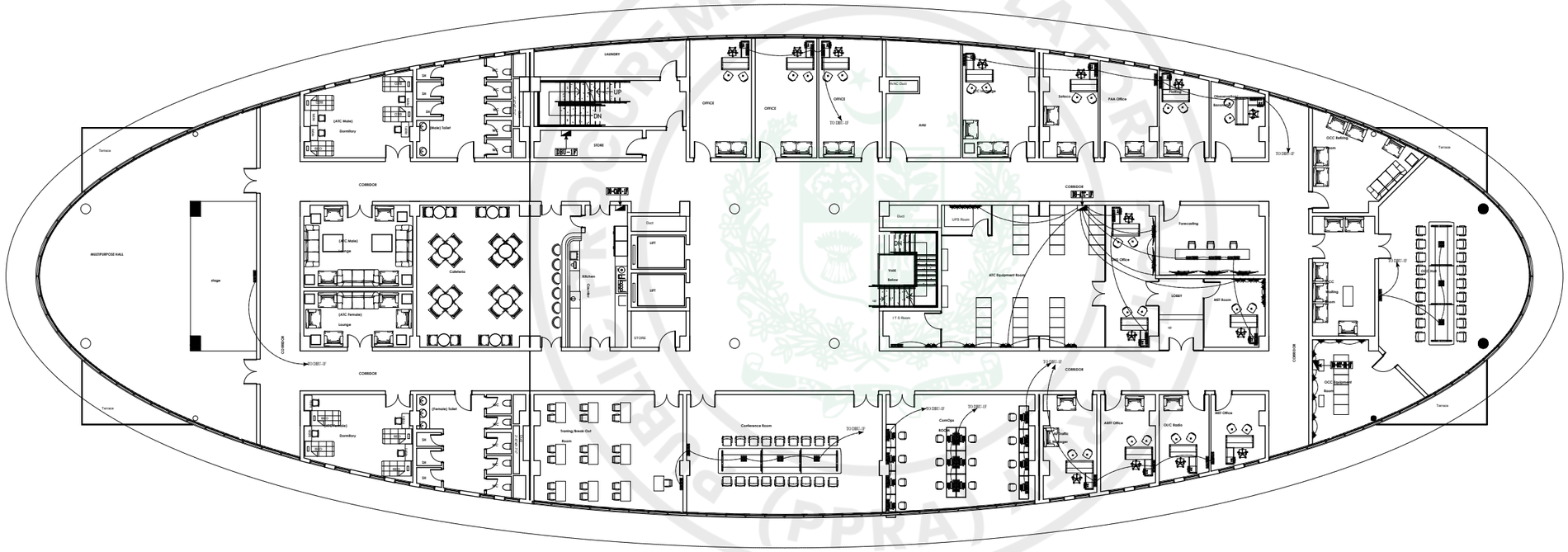

FIRST FLOOR PLAN

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Project Name

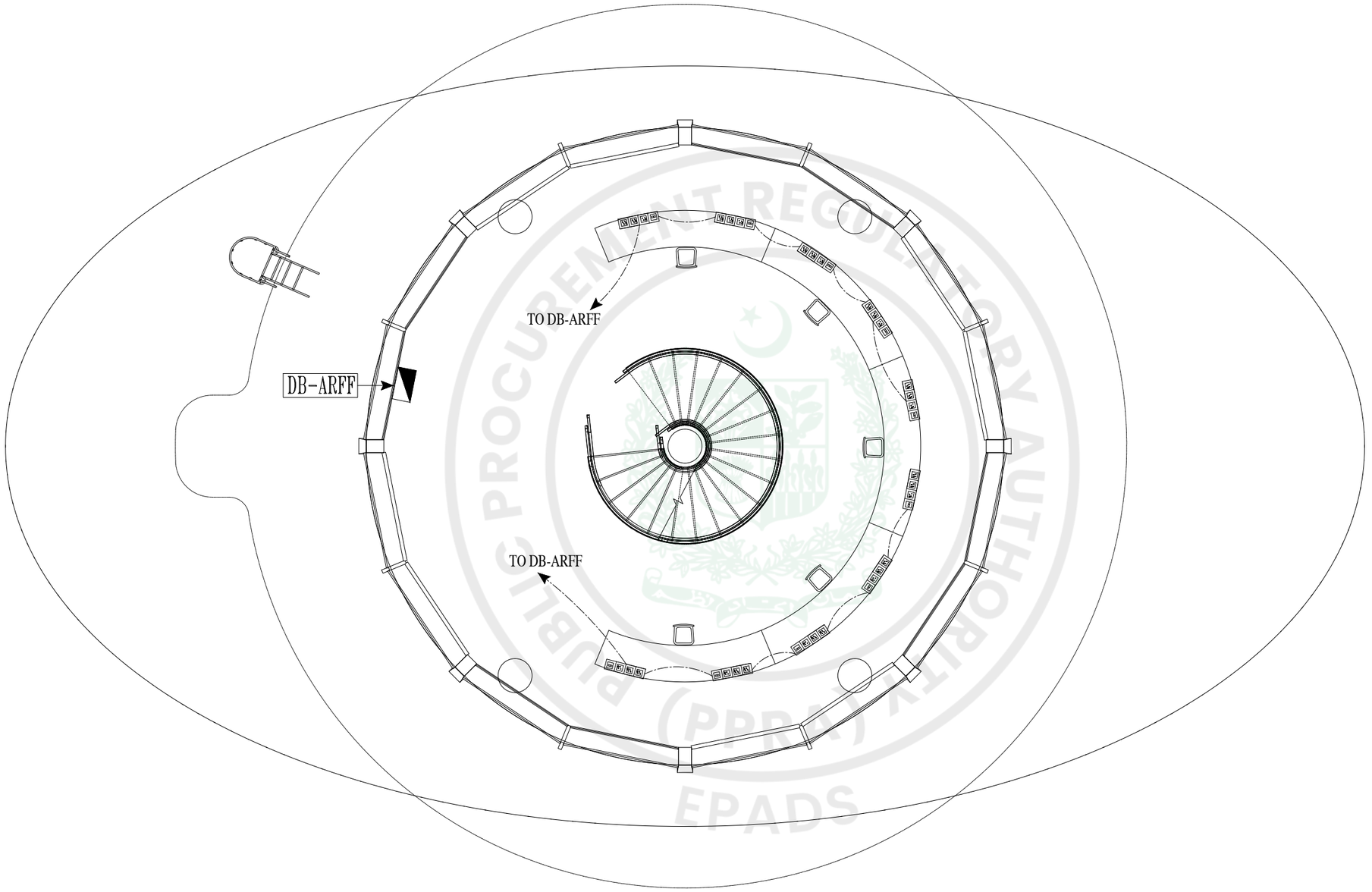
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-26



ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-27

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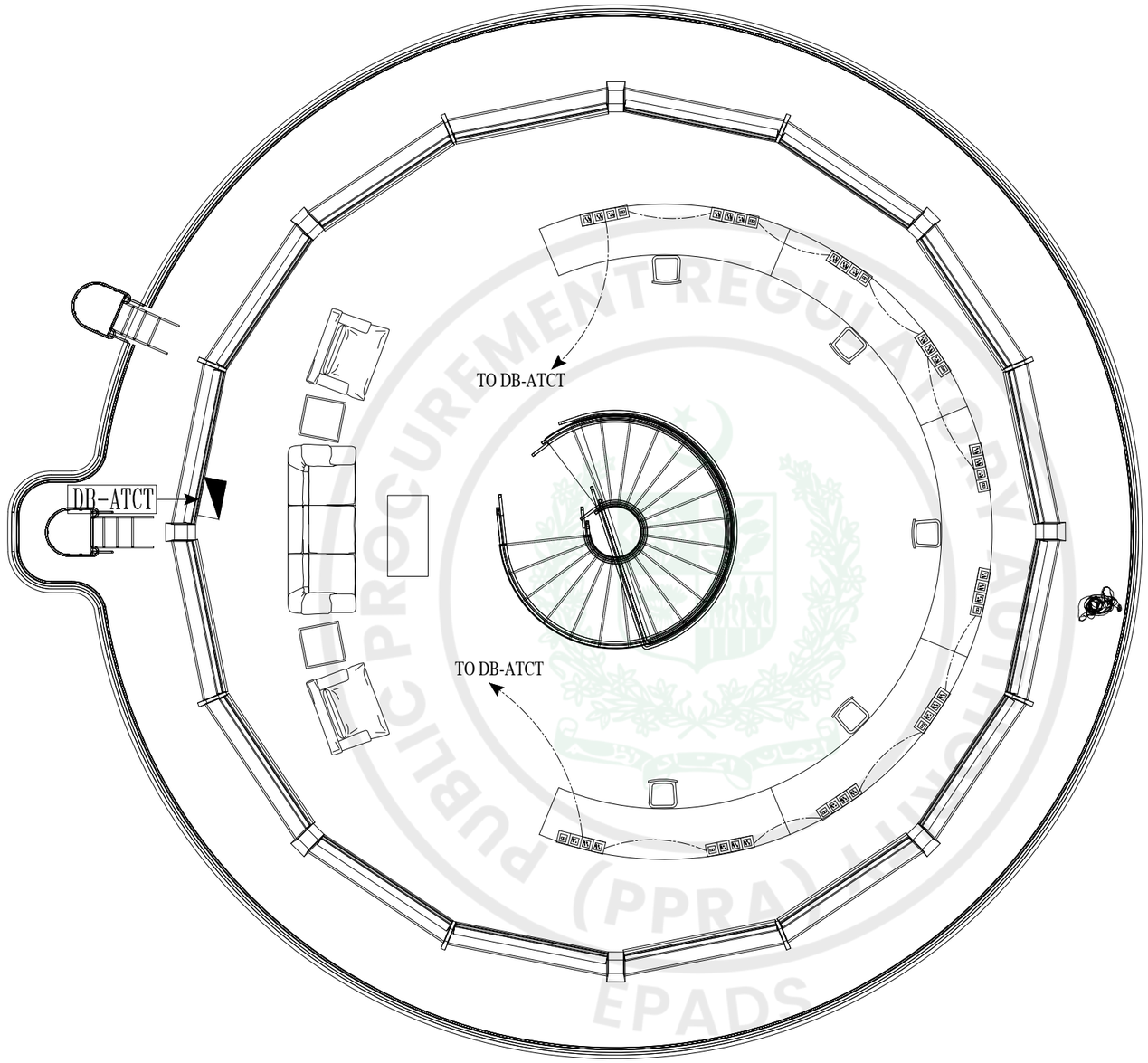

ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-28

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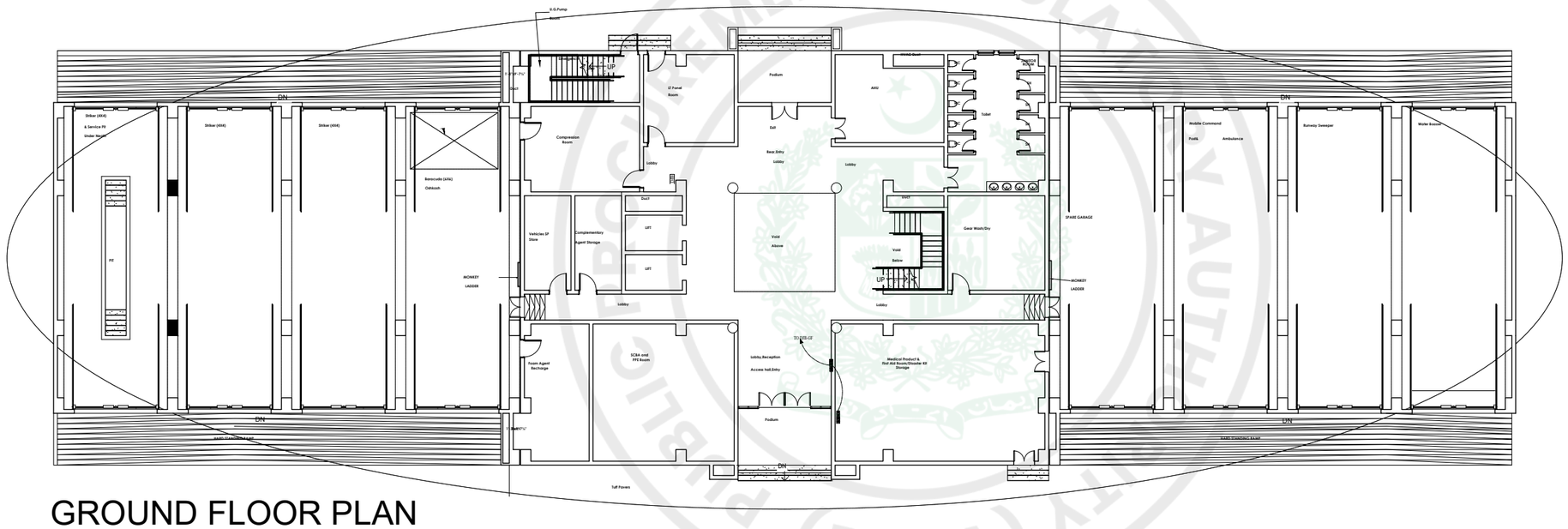

GROUND FLOOR PLAN

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Project Name

Consultancy Services for
New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-29

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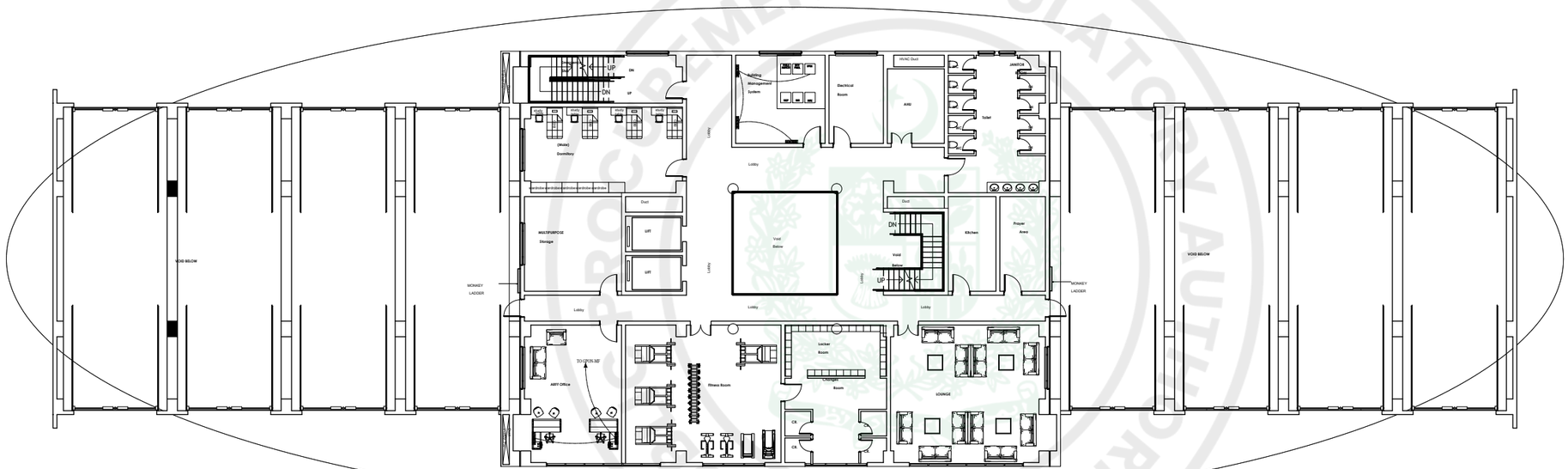

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Project Name

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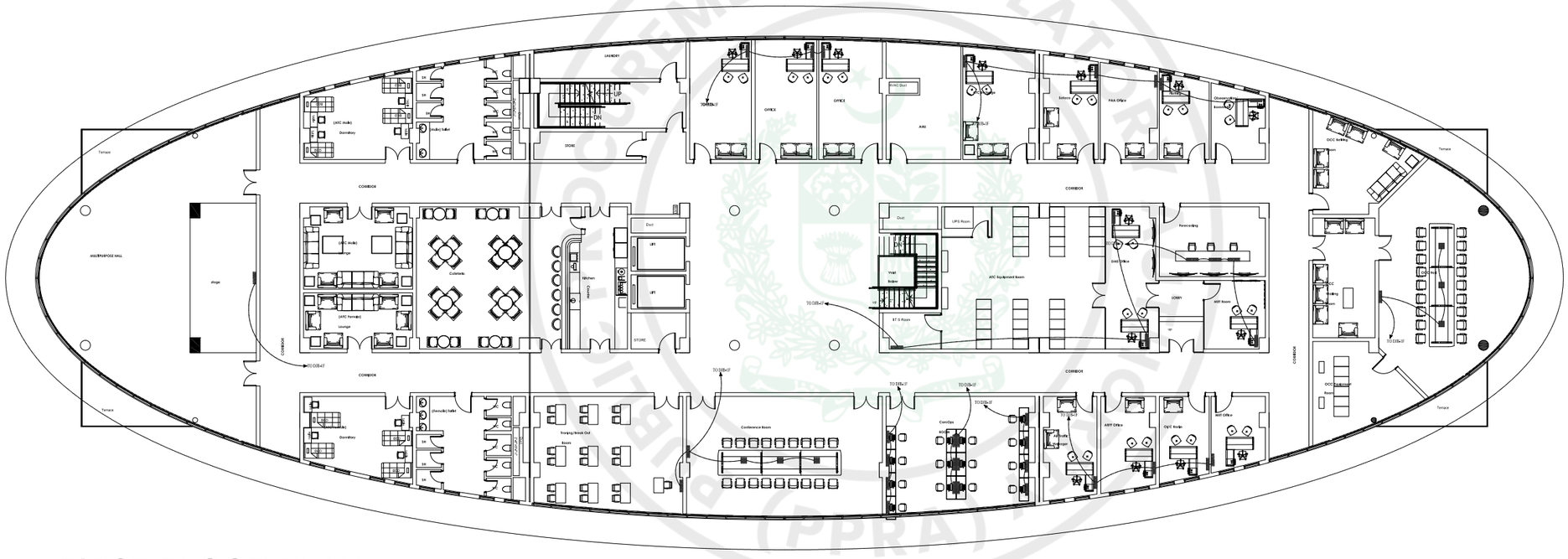
DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-30

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

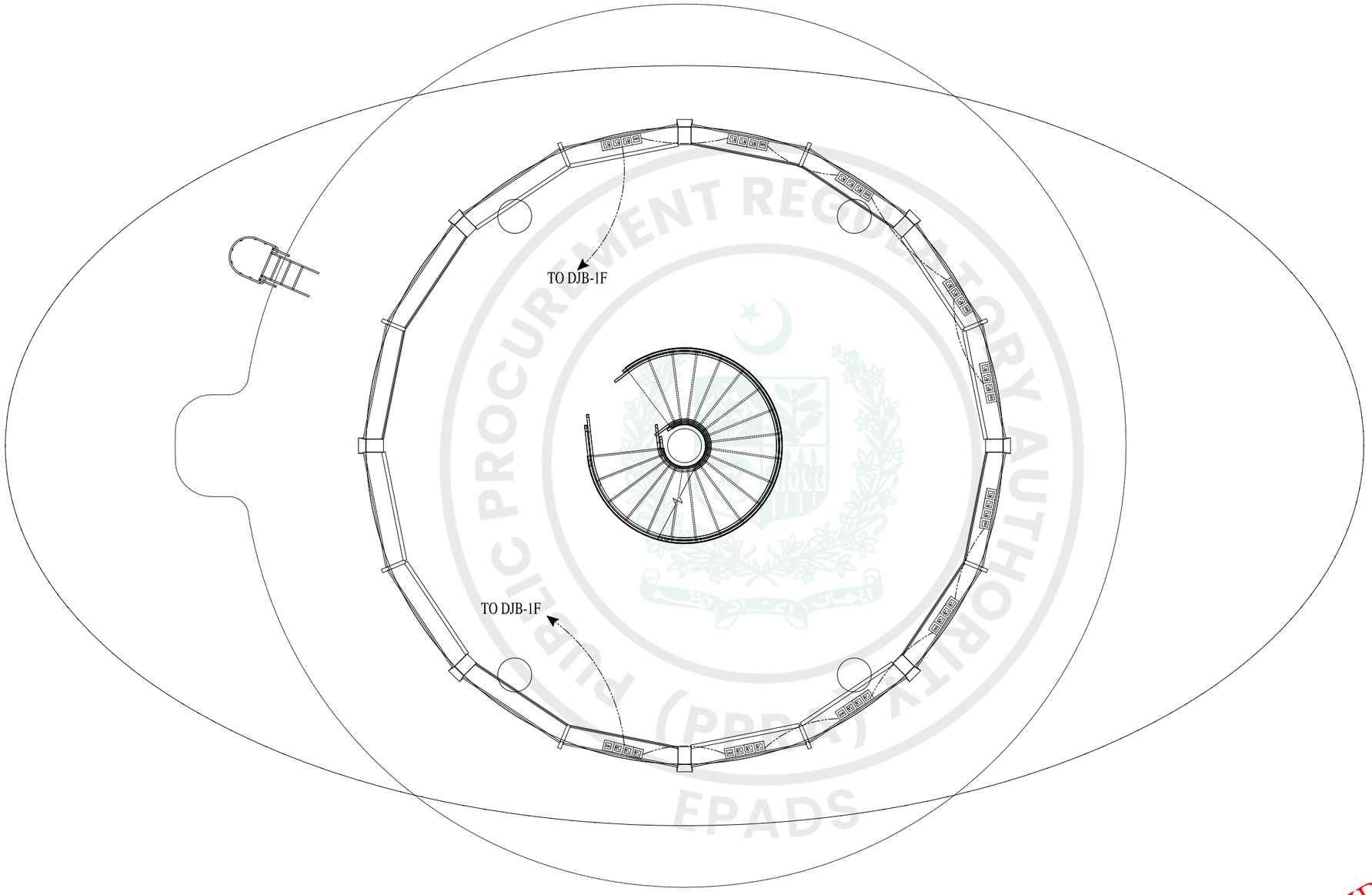
DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-31

EPADS PPRA GOVERNMENT REGULATORY



ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

ISSUE FOR TENDER

PROCUREMENT REGULATORY AUTHORITY
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS

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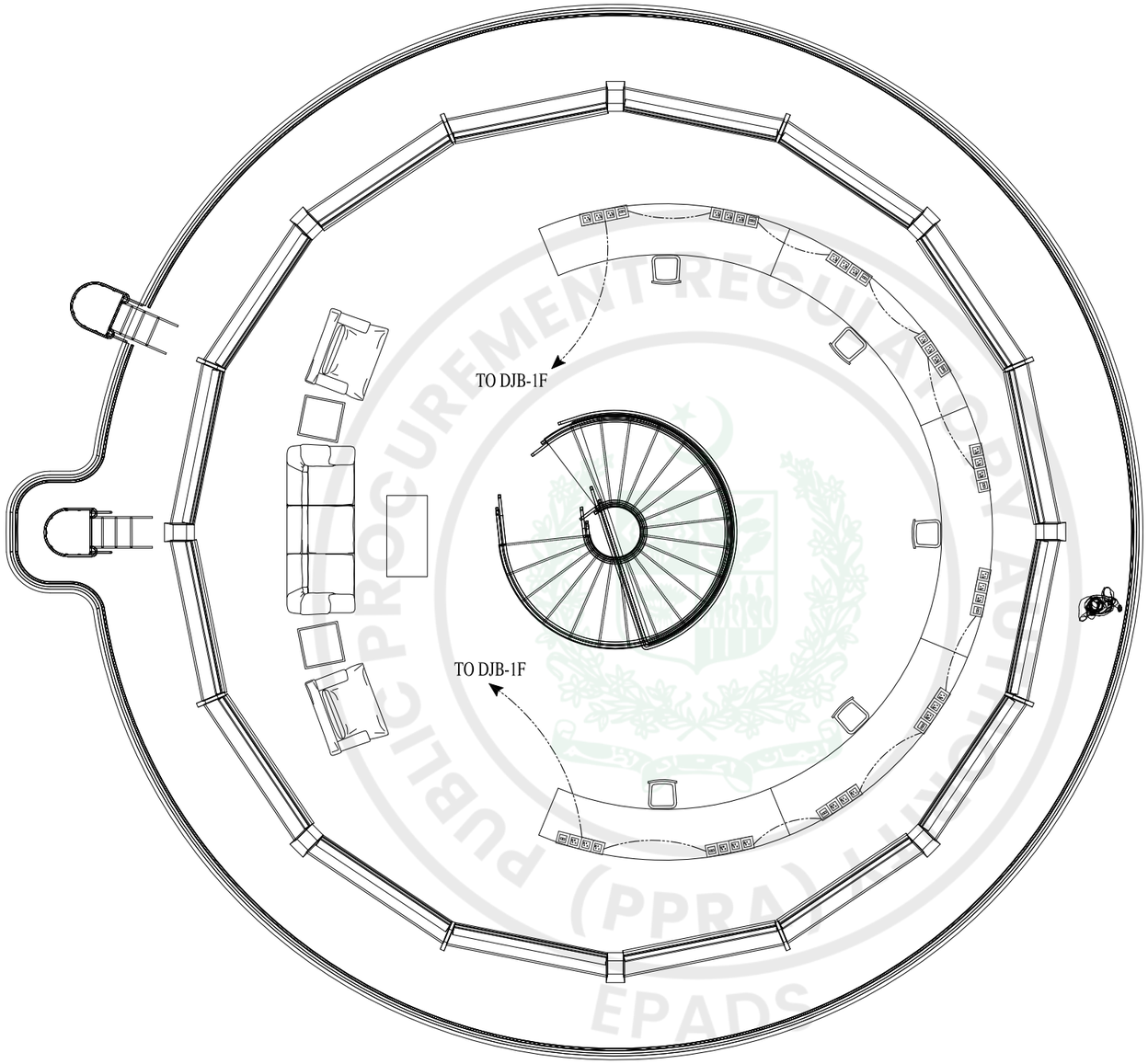
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-32



ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-33

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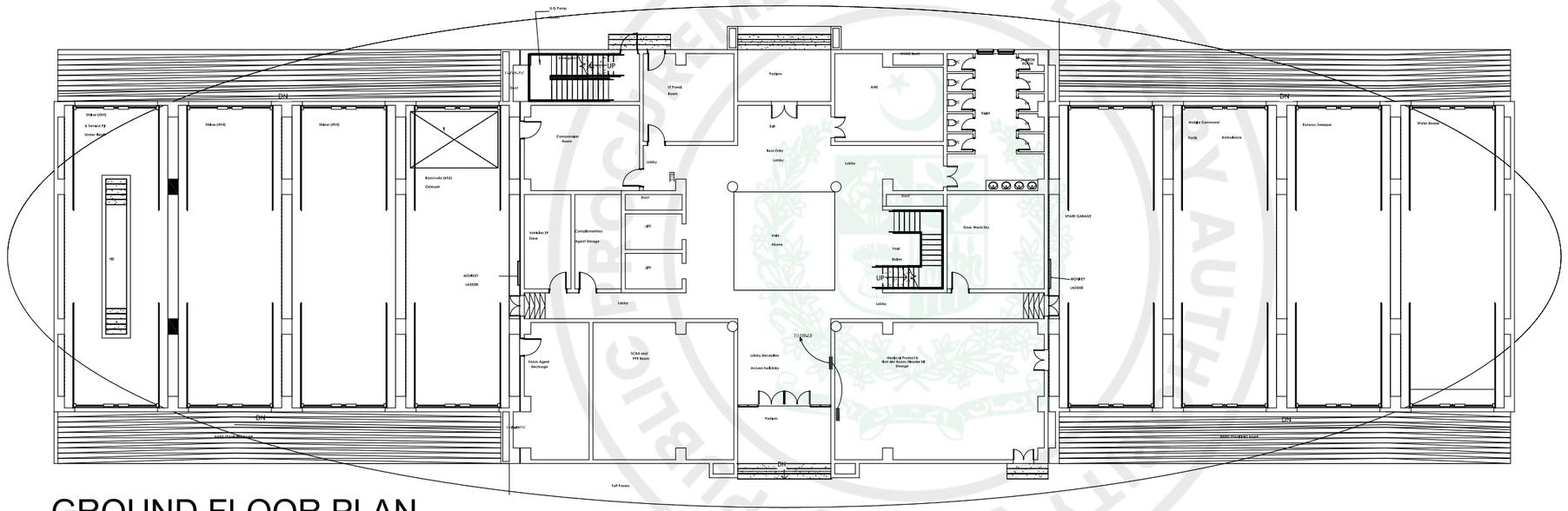

GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

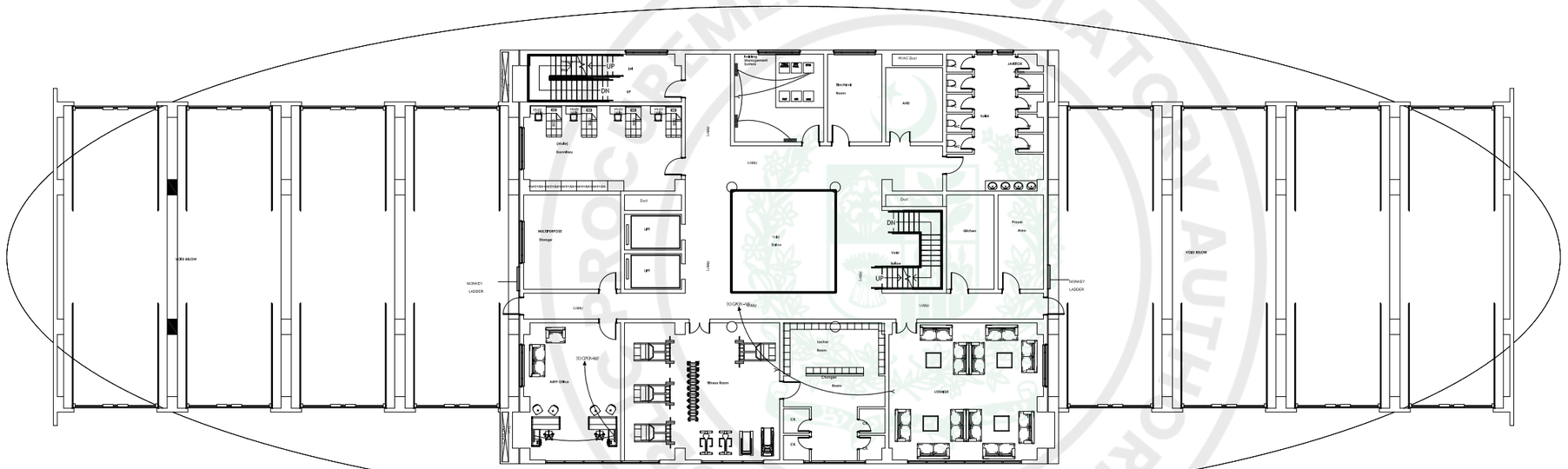
DETAILED ELECTRICAL Design Drawings

Sheet Name

TELEPHONE & TV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-34

PROCUREMENT REGULATORY AUTHORITY (PPRA) PUBLIC EPADS



ARFF FLOOR
MEZZANINE FLOOR PLAN

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

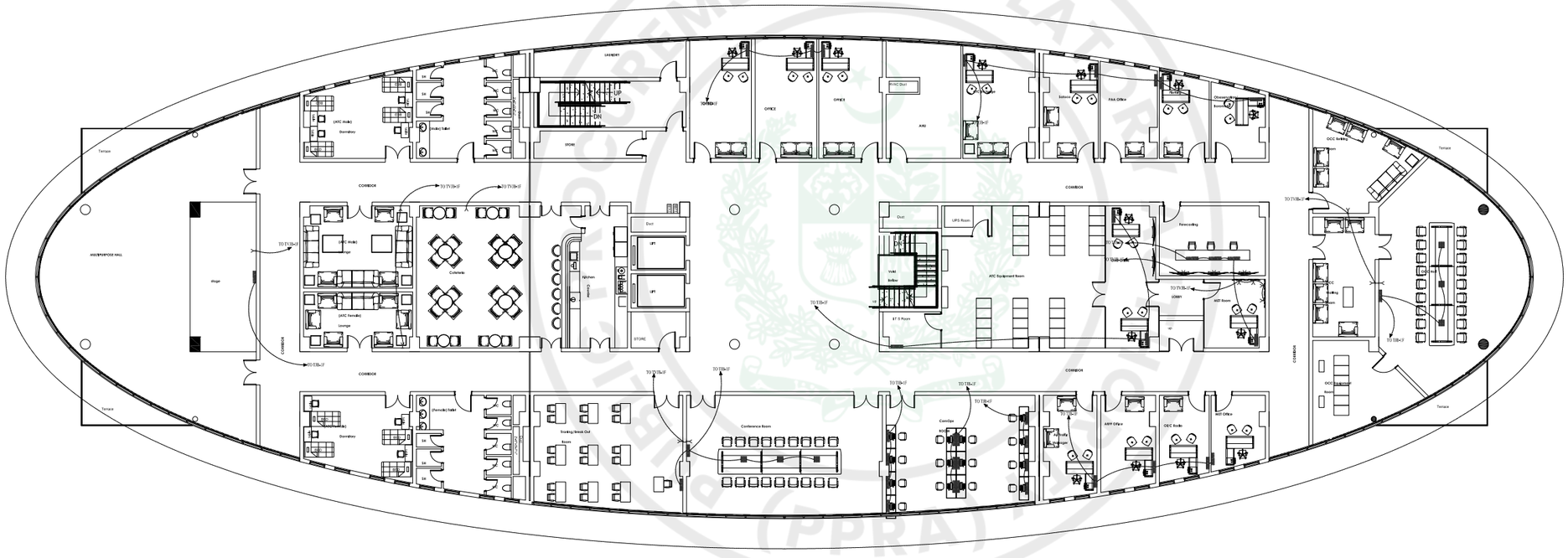
DETAILED ELECTRICAL Design Drawings

Sheet Name

TELEPHONE & TV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-35

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

ISSUE FOR TENDER

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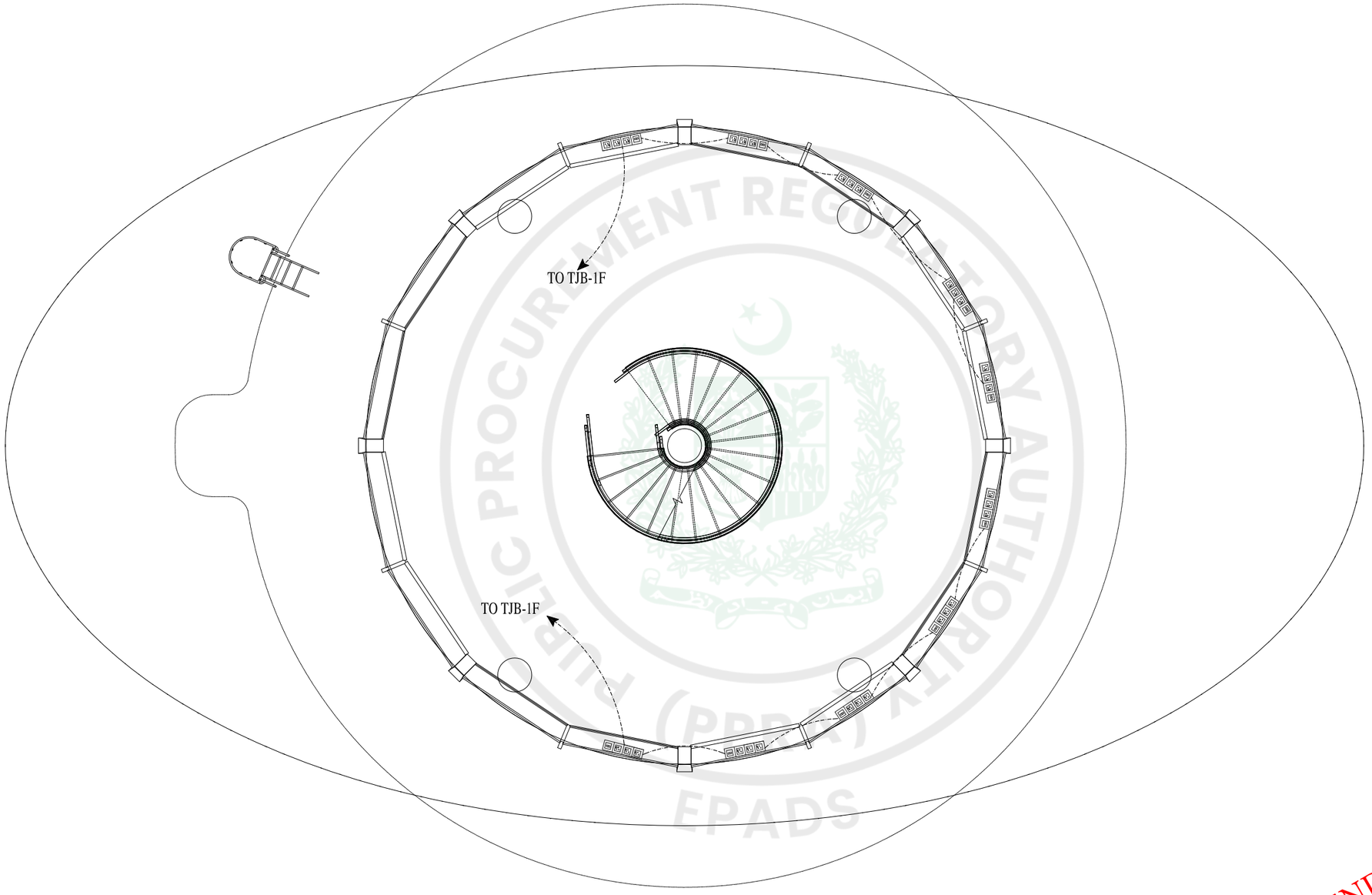
Consultancy Services for
New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

TELEPHONE & TV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-36



ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

TELEPHONE & TV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-37

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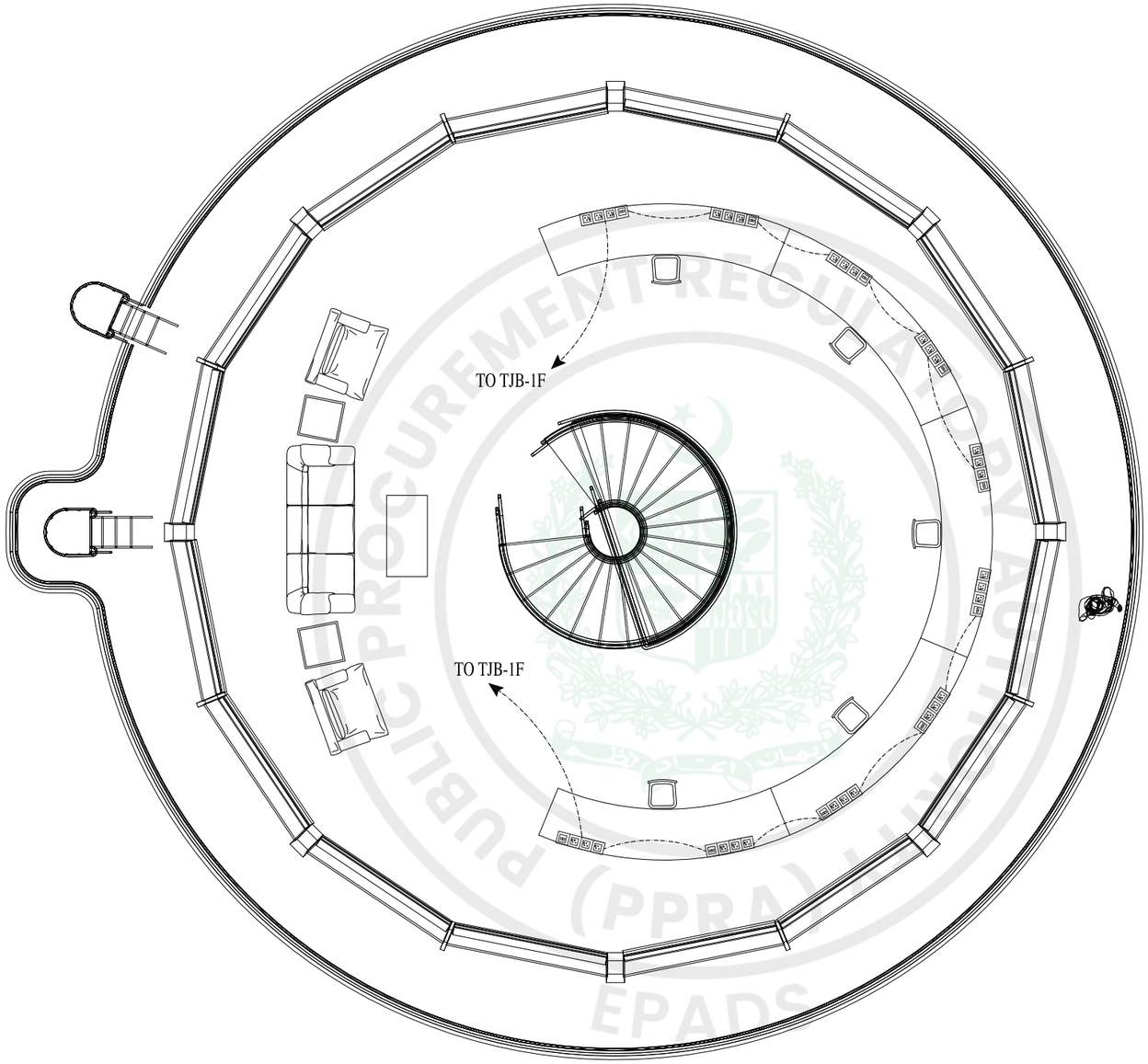

ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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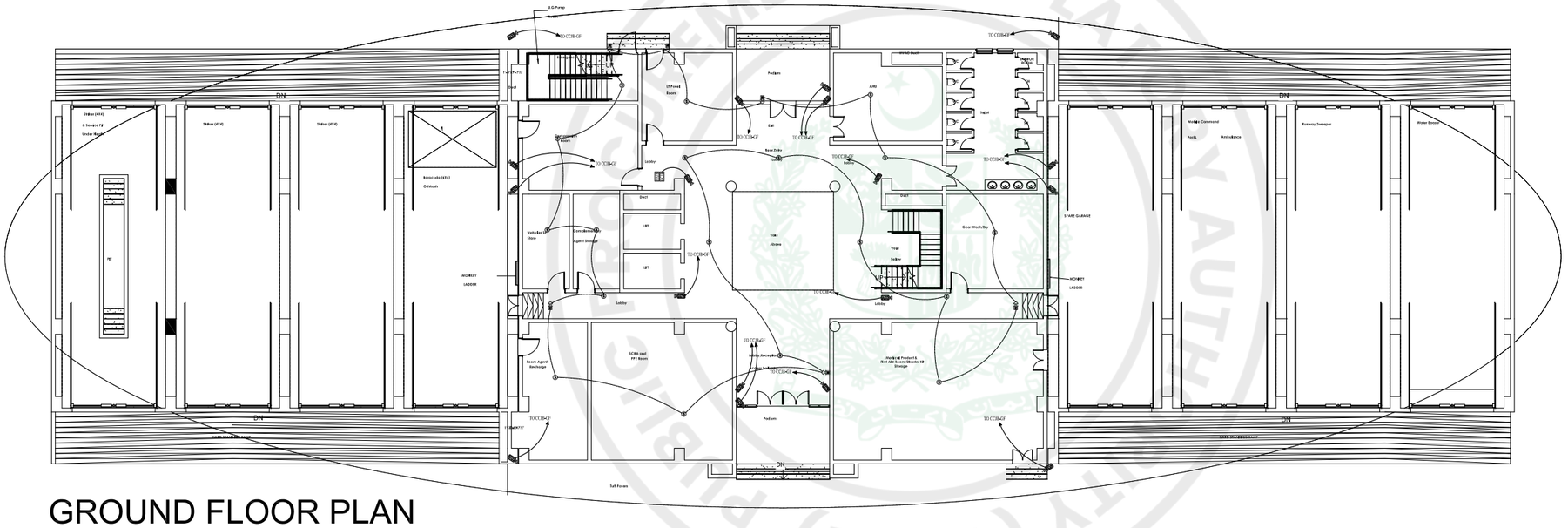
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

TELEPHONE & TV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-38



GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-39

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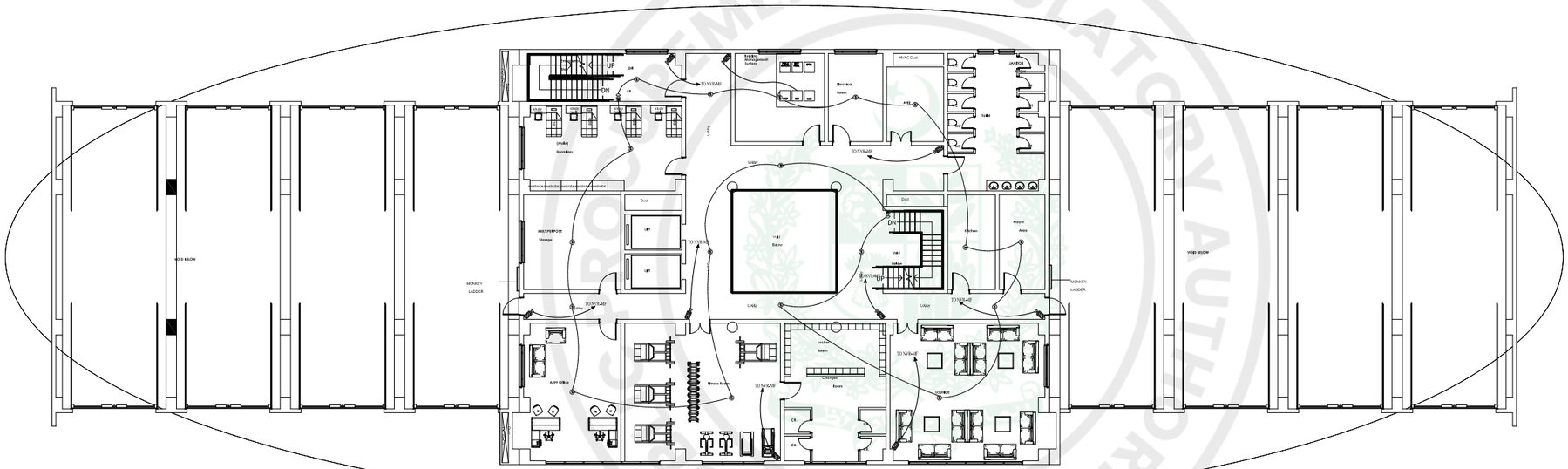

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-40

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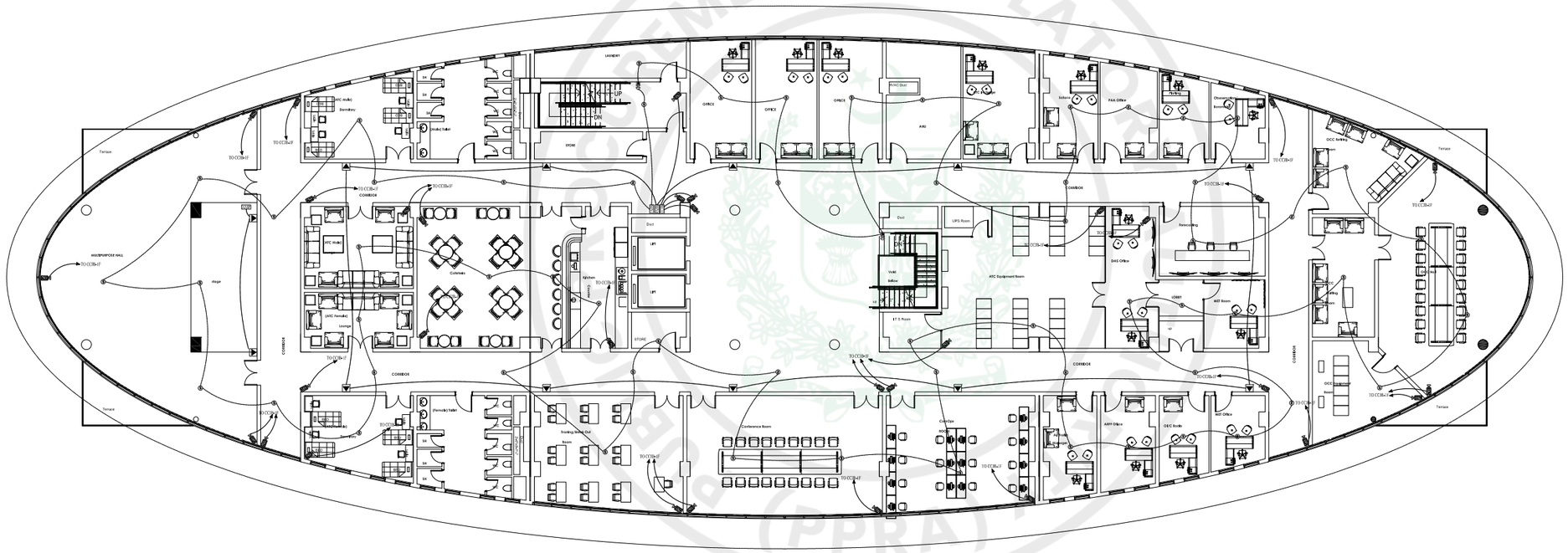

FIRST FLOOR PLAN

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-41

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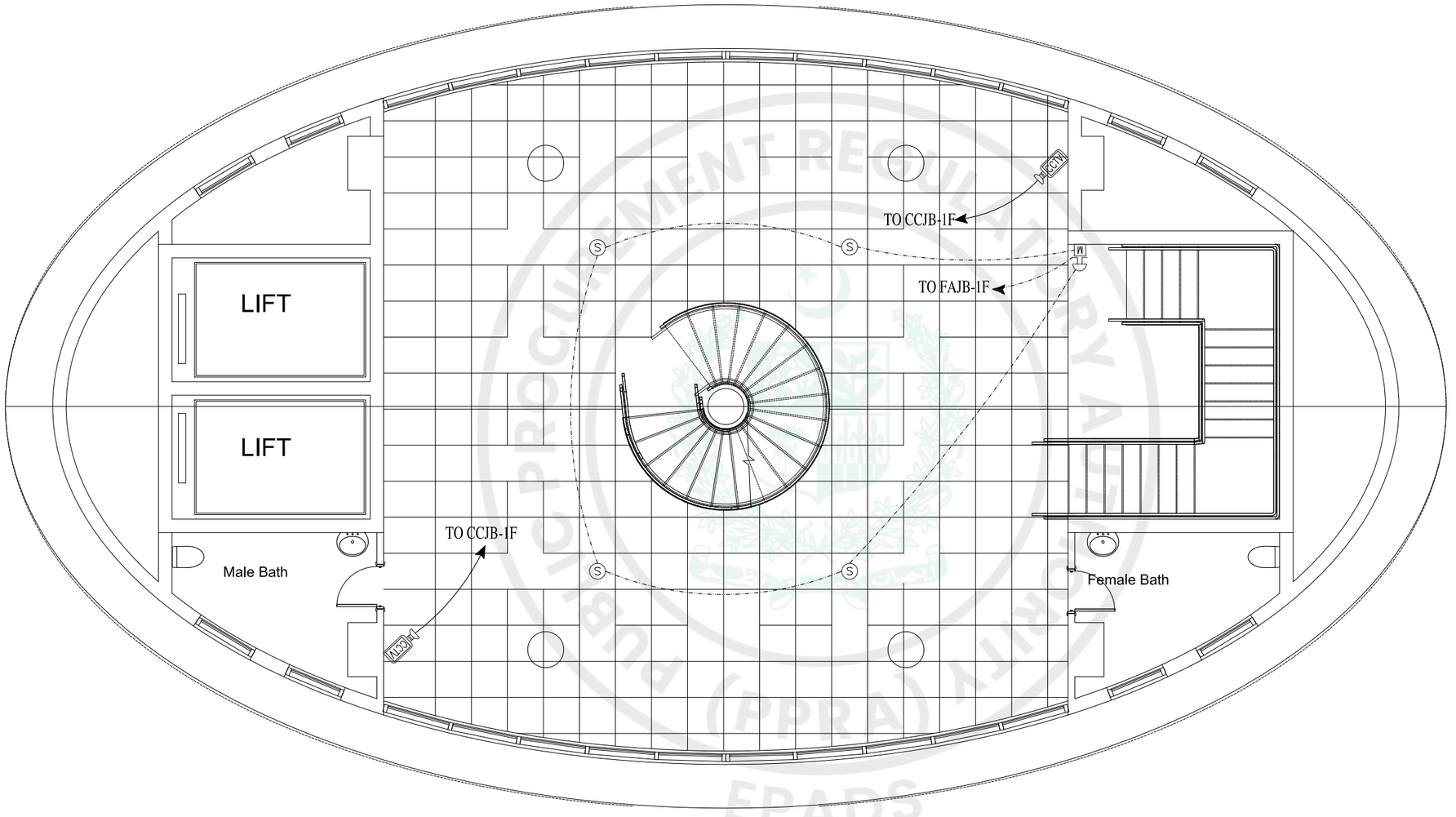

ROOF FLOOR PLAN LEVEL AT 43'-6"
COVERED AREA 2802 Sft

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DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-42

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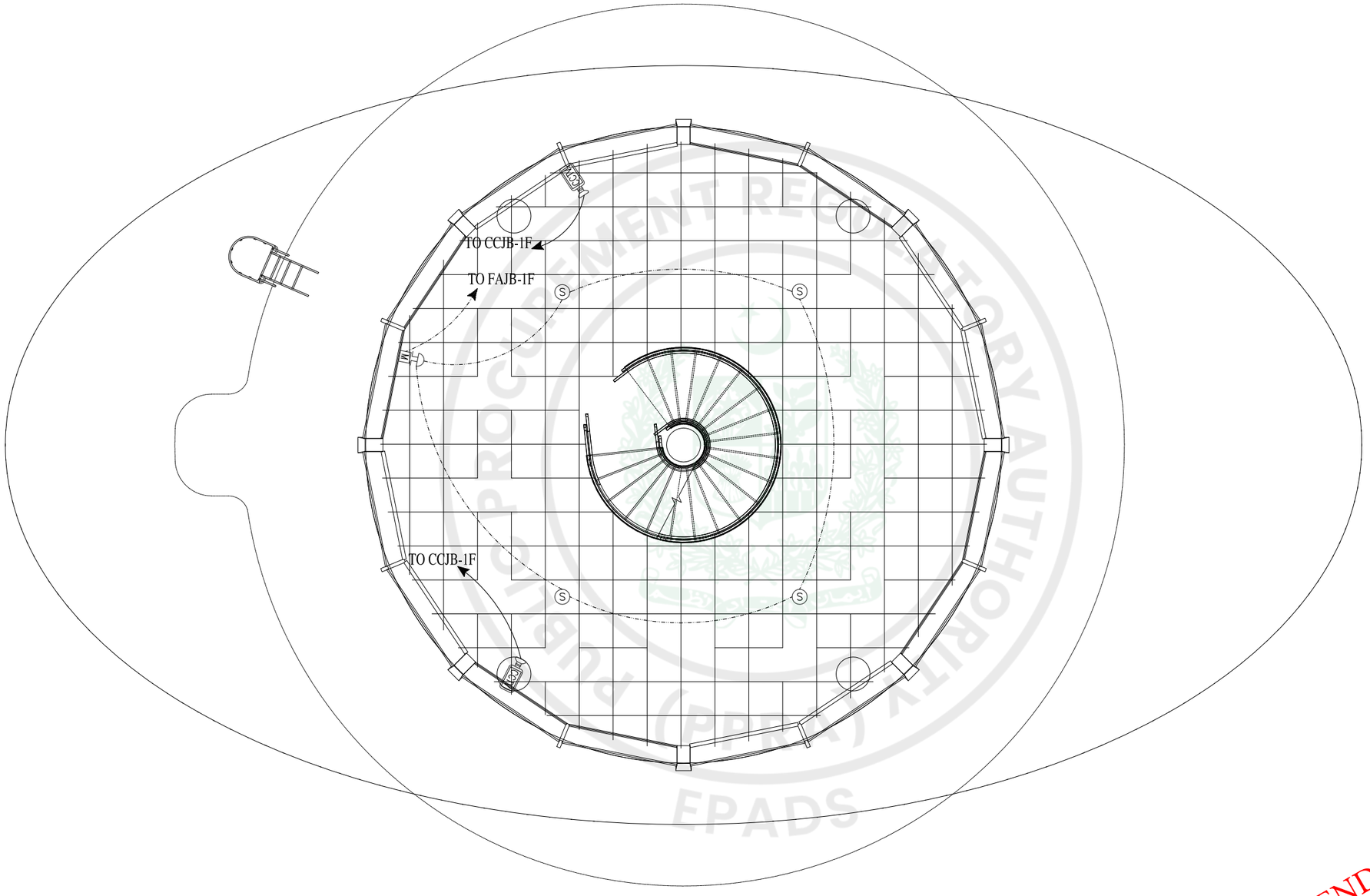

ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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E-mail: abstractorseng@gmail.com

Project Name

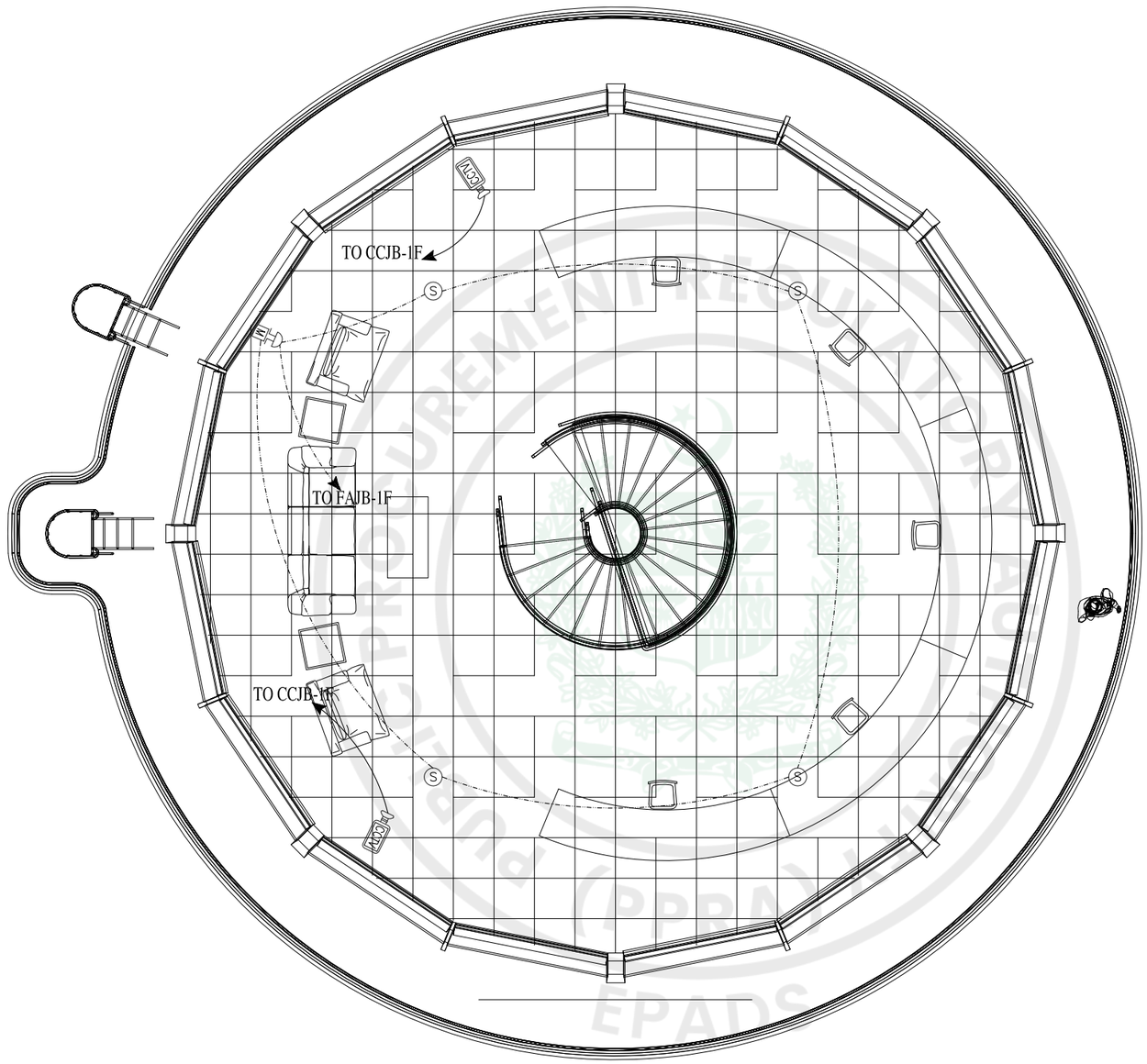
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-43



ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

ISSUE FOR TENDER

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DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-44

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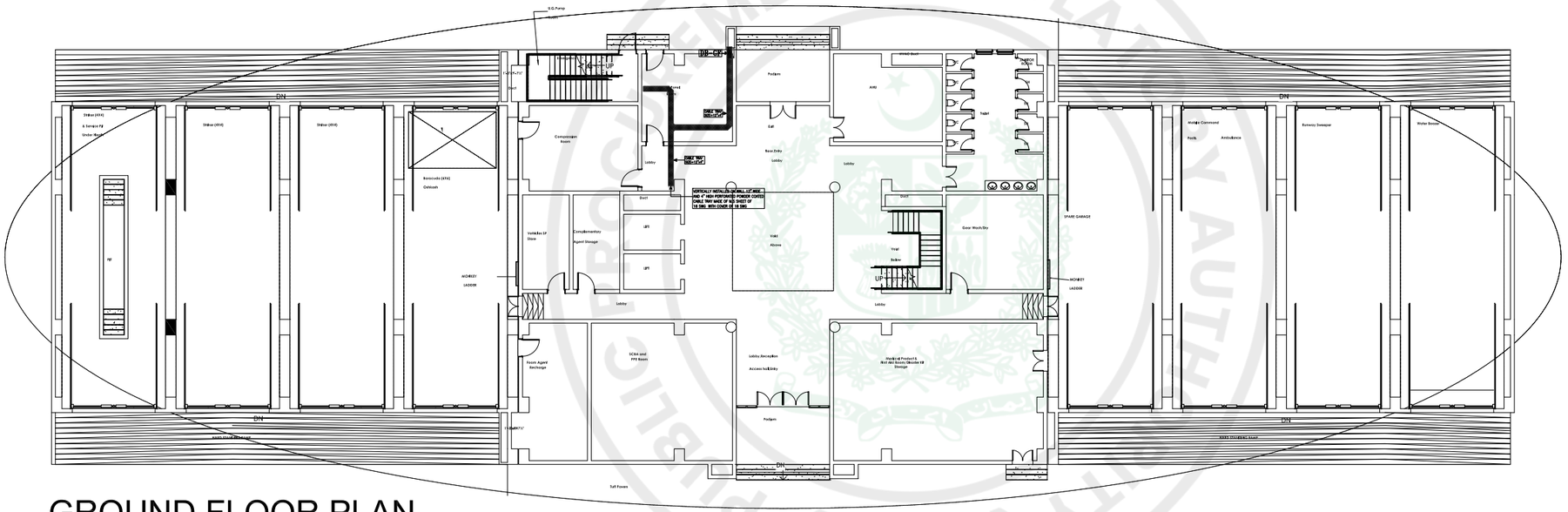
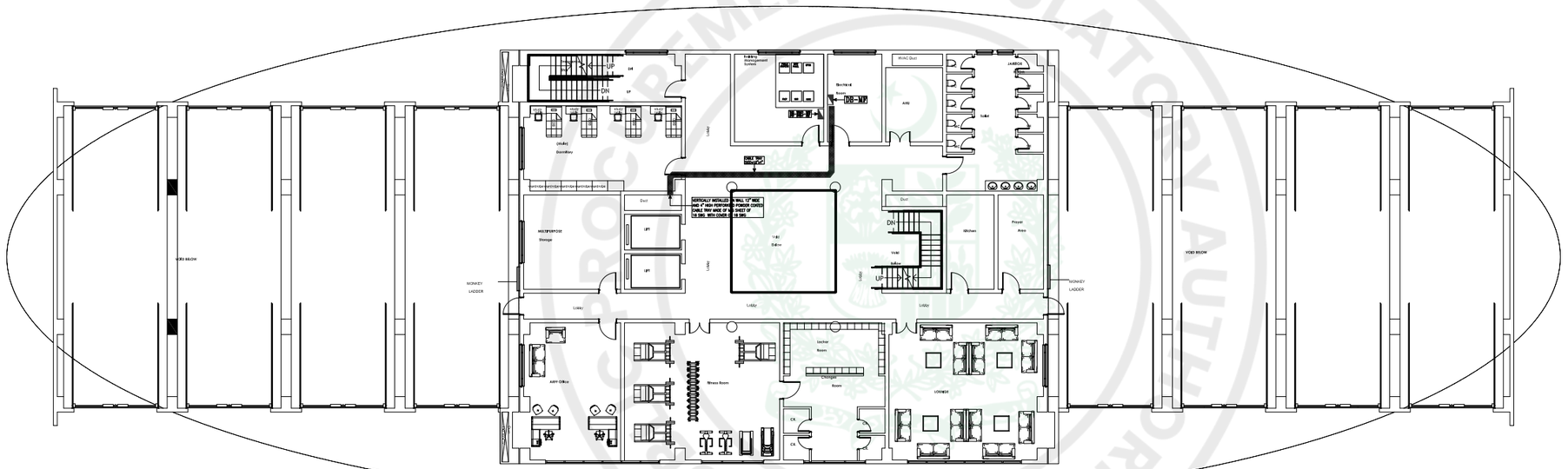

UP
DN
UP
DN
UP
DN



ARFF FLOOR
MEZZANINE FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

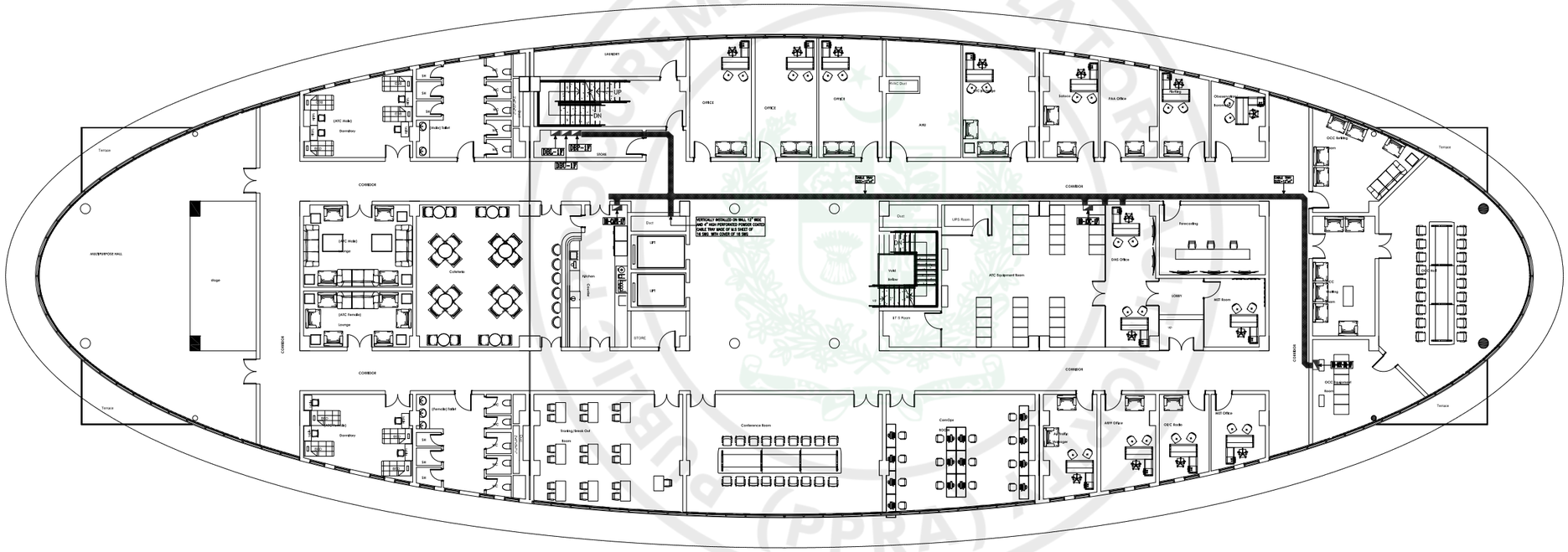
DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER CABLE TRAY LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-46

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

ISSUE FOR TENDER

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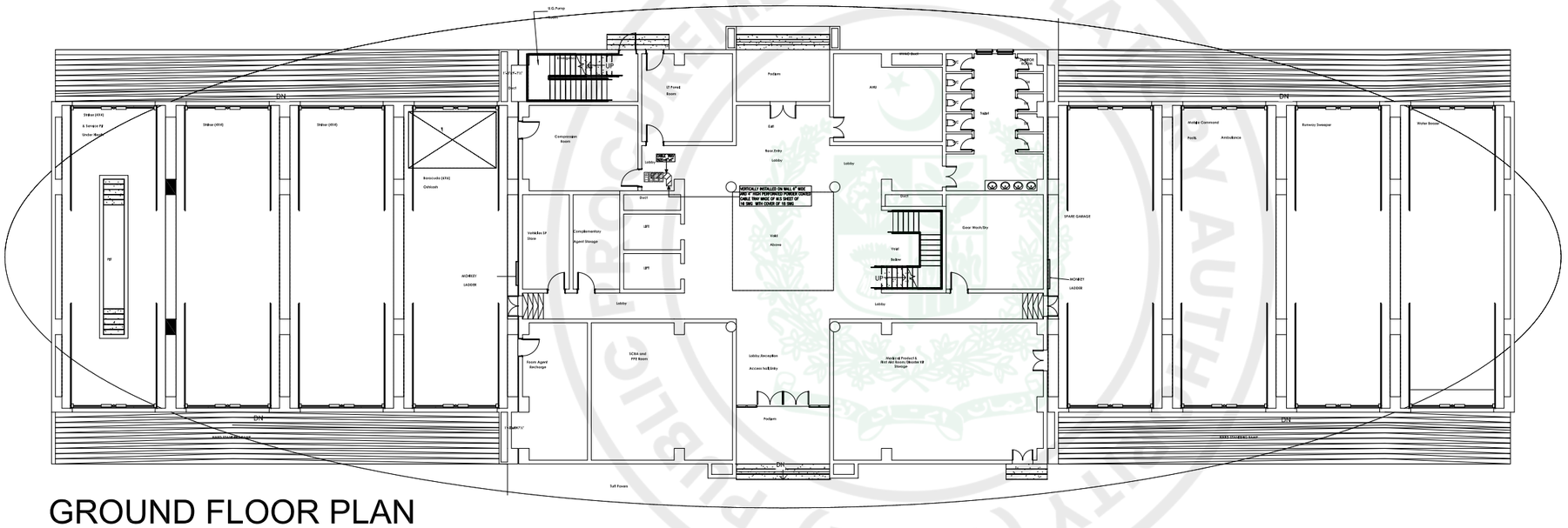
DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER CABLE TRAY LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-47



GROUND FLOOR PLAN

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

ELV CABLE TRAY LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-48

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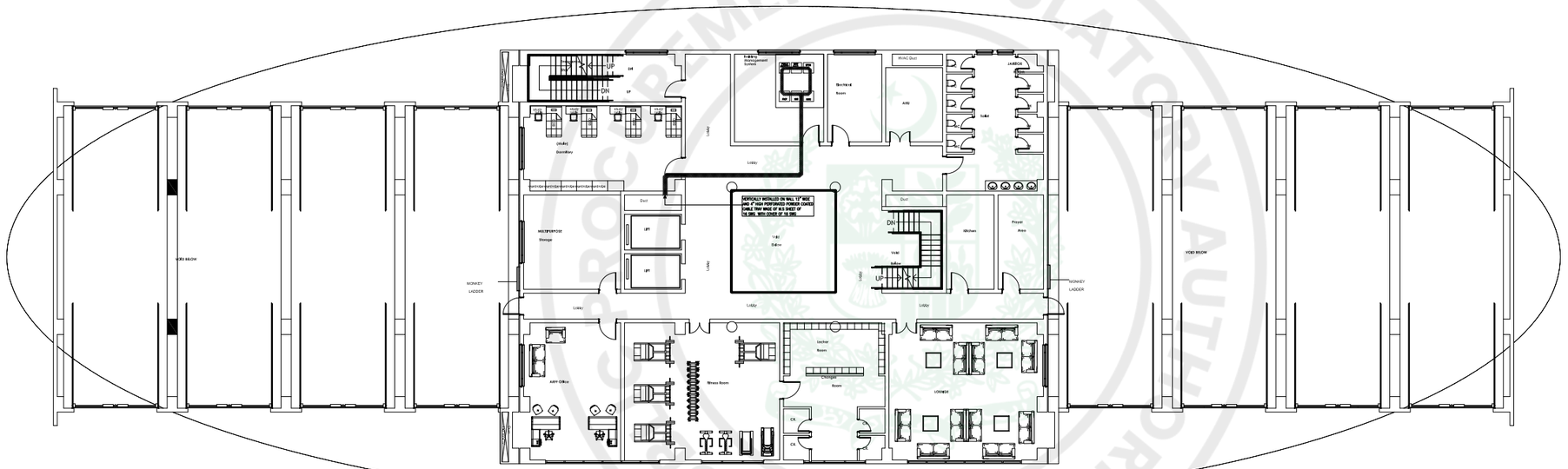
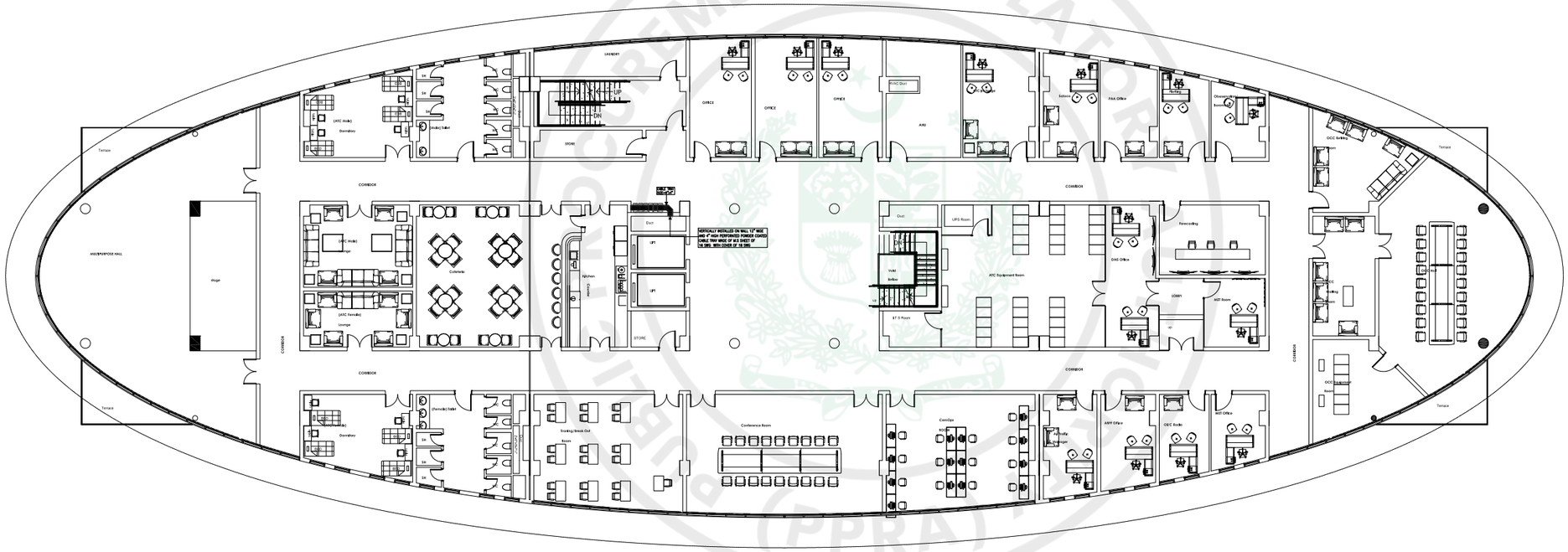

VOID BELOW
VOID BELOW
MONKEY LADDER
MONKEY LADDER
UP
DN
UP
DN
UP
DN
UP
DN
VERTICALLY INSTALLED ON WALL 12" WIDE MM 4" HIGH PERFORATED POWDER COATED CABLE TRAY MADE OF M.S SHEET OF 18 SWG. WITH COVER OF 18 SWG
Duct
Duct
Lobby
Lobby
Lobby



FIRST FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

ELV CABLE TRAY LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-50

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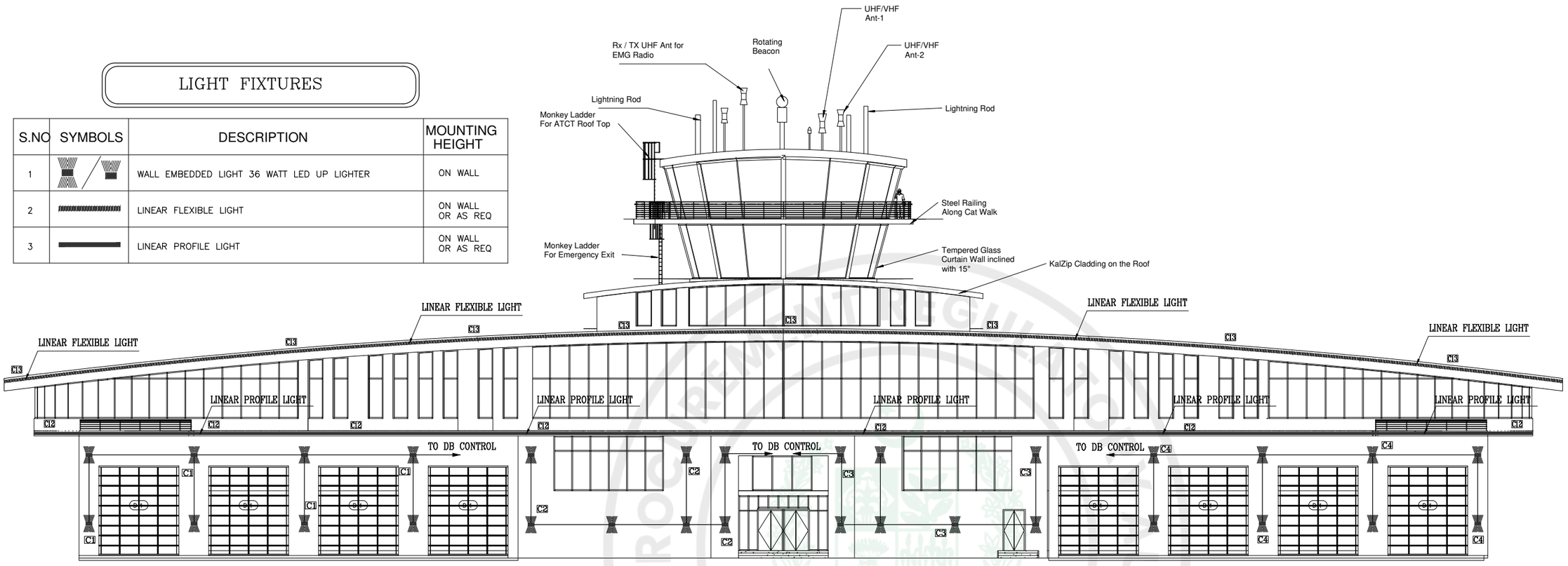
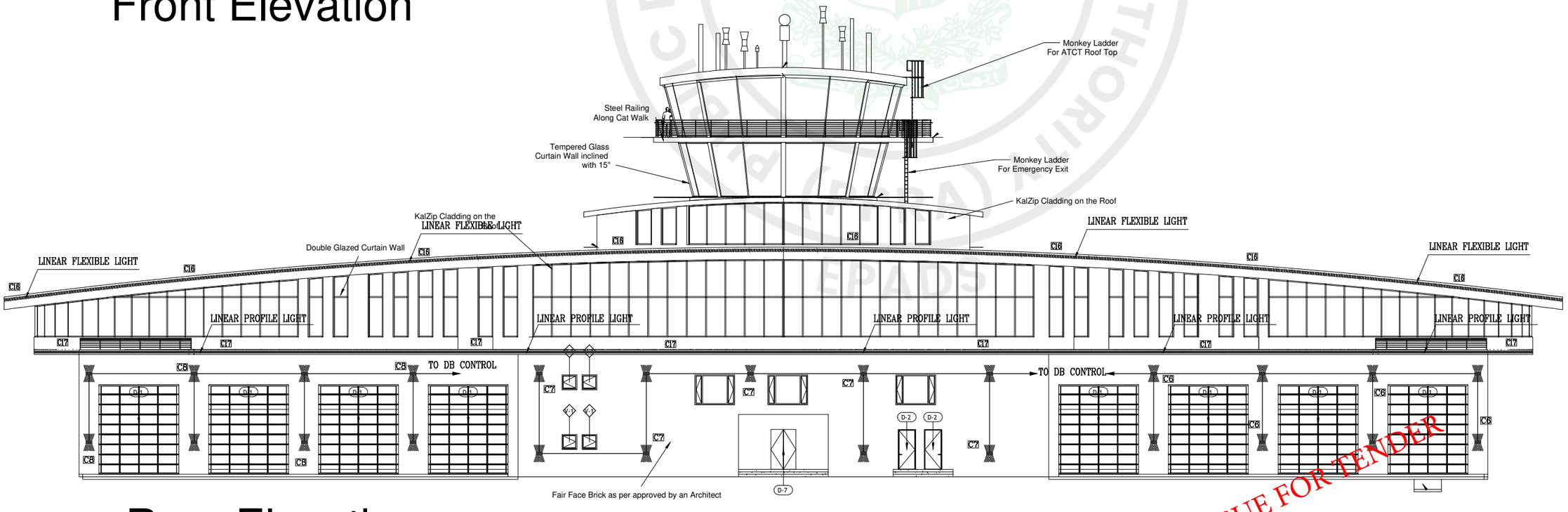
LIGHT FIXTURES

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		WALL EMBEDDED LIGHT 36 WATT LED UP LIGHTER	ON WALL
2		LINEAR FLEXIBLE LIGHT	ON WALL OR AS REQ
3		LINEAR PROFILE LIGHT	ON WALL OR AS REQ



Front Elevation



Rear Elevation

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

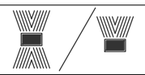
DETAILED ELECTRICAL Design Drawings

Sheet Name

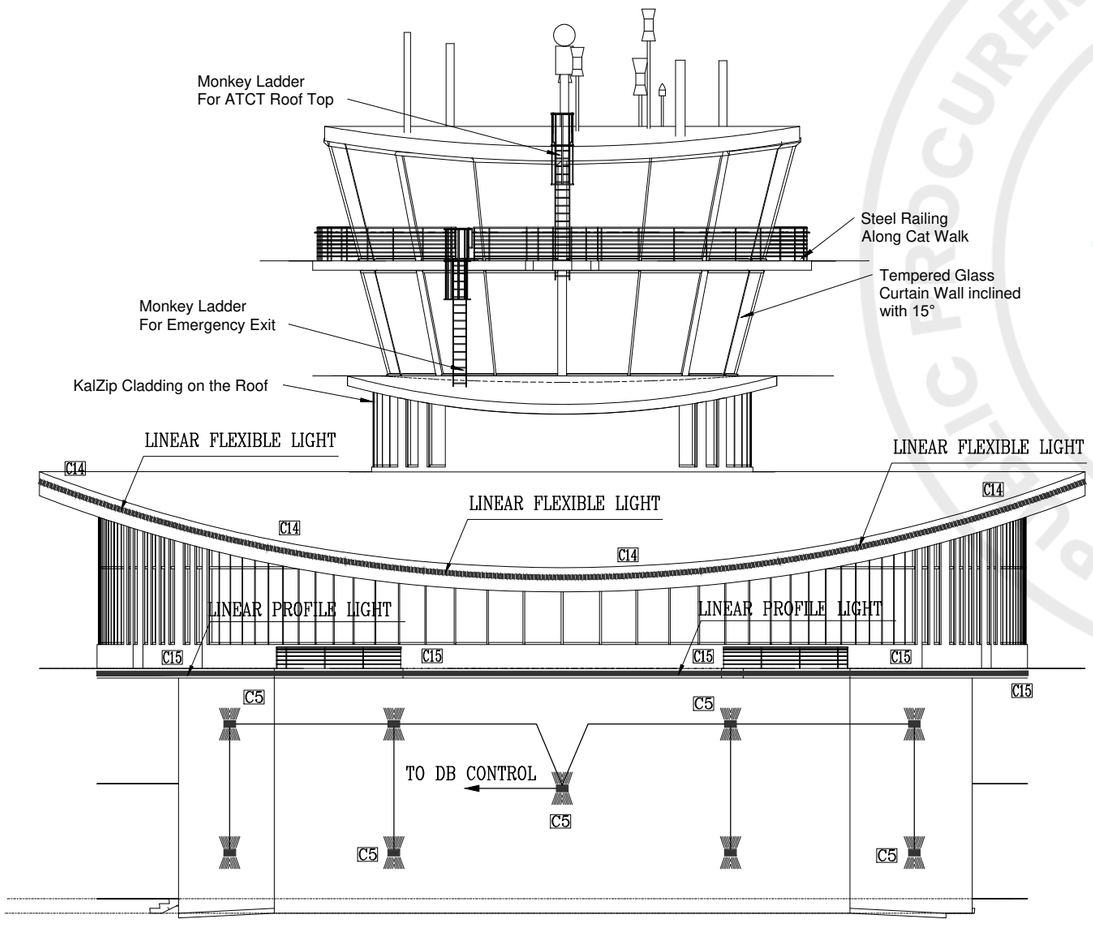
ELEVATION LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-51

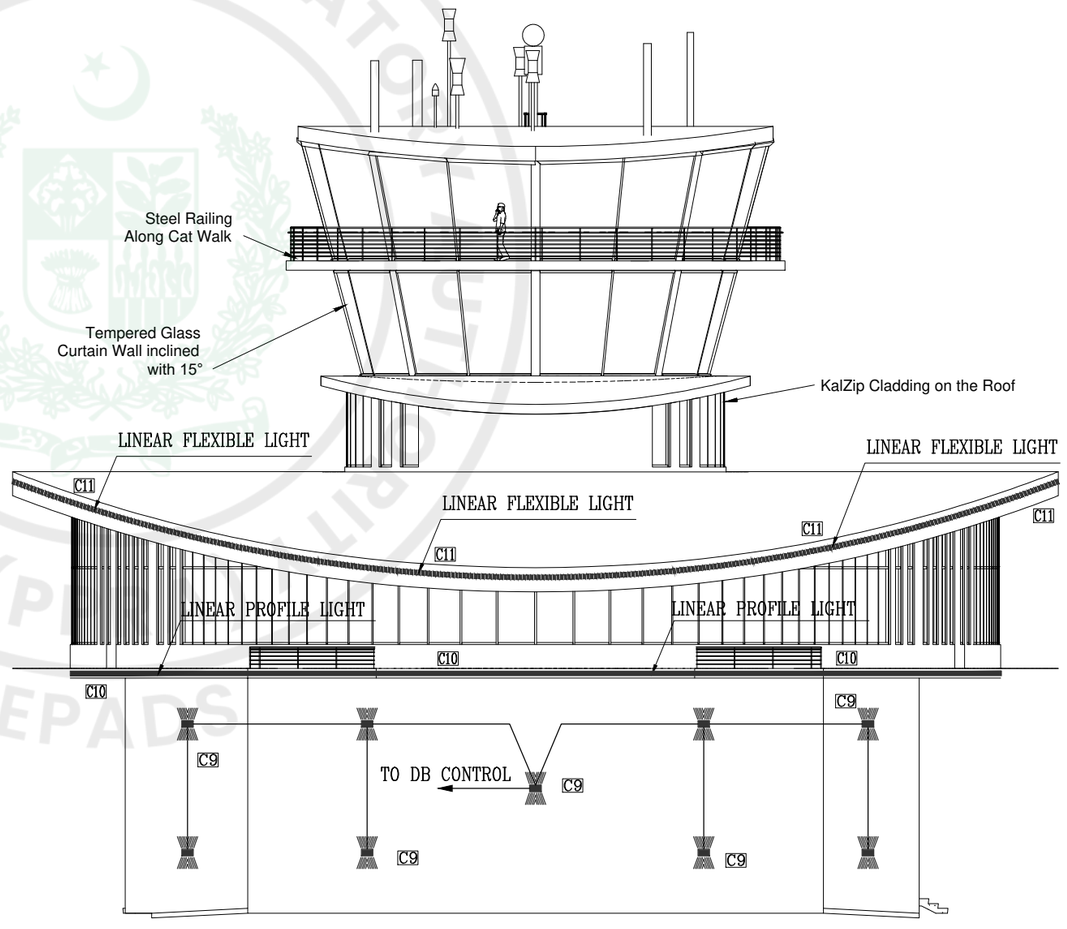
LIGHT FIXTURES

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		WALL EMBEDDED LIGHT 36 WATT LED UP LIGHTER	ON WALL
2		LINEAR FLEXIBLE LIGHT	ON WALL OR AS REQ
3		LINEAR PROFILE LIGHT	ON WALL OR AS REQ

ISSUE FOR TENDER



Left Side Elevation



Right Side Elevation

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

ELEVATION LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-52

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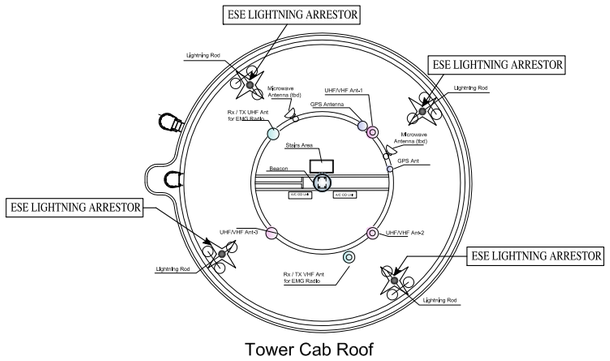
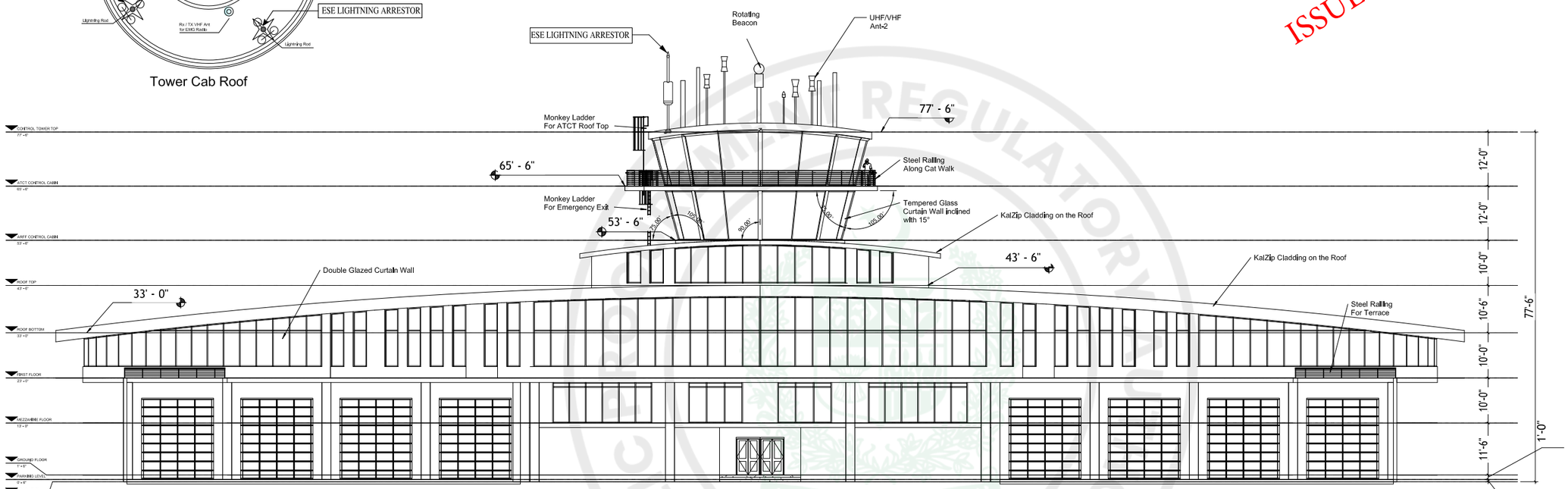
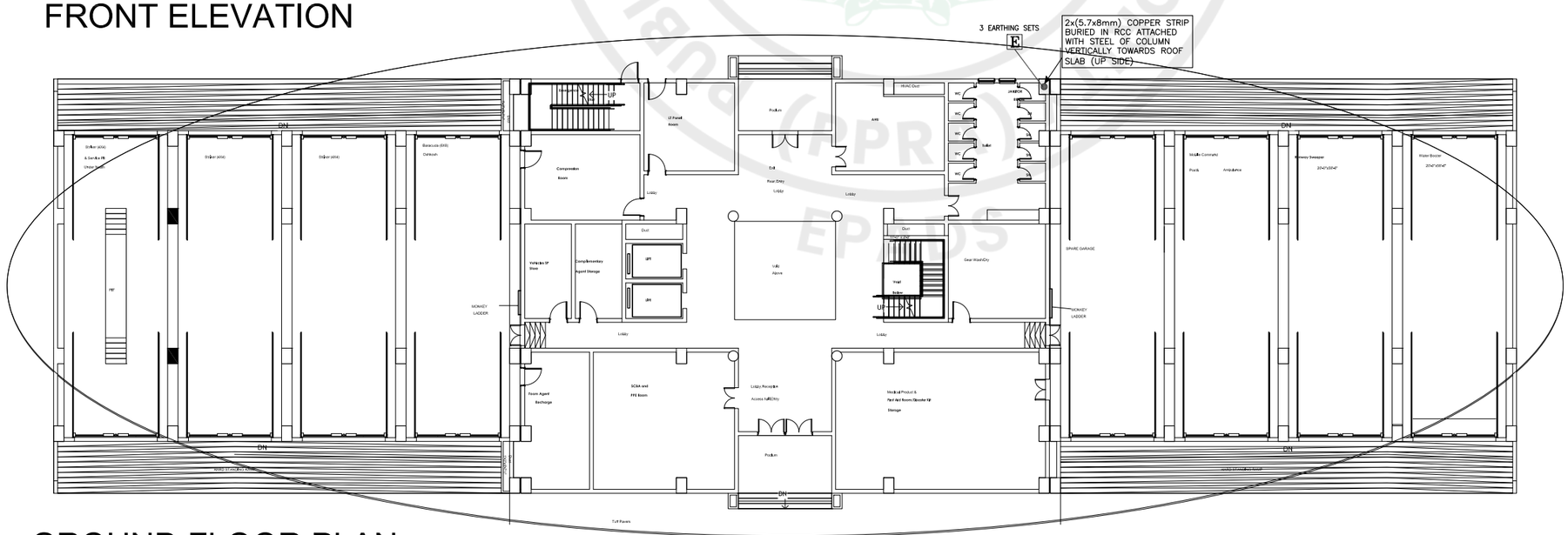


Tower Cab Roof



FRONT ELEVATION



GROUND FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

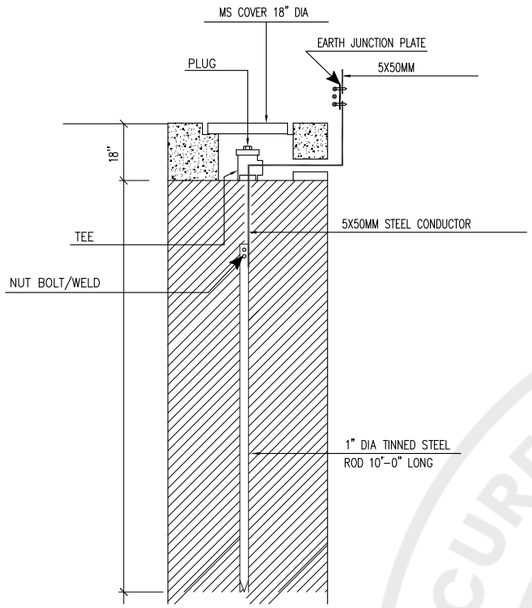
DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTNING PROTECTION SYSTEM LAYOUT

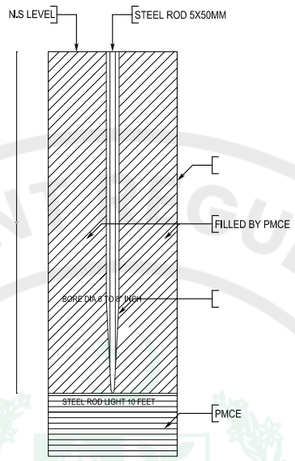
Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-53

"L" TYPE EARTHING



NOTES FOR EARTHING SYSTEM

1. EARTH BORE SHALL BE MADE AT 6'-0" AWAY FROM FOUNDATION.
2. DISTANCE BETWEEN 2 EARTH BORES SHALL NOT BE LESS THEN 10 ft (3m)
3 JOINTS SHALL BE COVERED WITH BITUMEN
4 CONTRACTOR TO MEASURE EARTHING RESISTANCE IN THE PRESENCE OF SITE ENGINEER. BOTH THE SITE ENGINEER AND CONTRACTOR SHALL SIGN THE EARTH TESTING RESULT AND SUBMIT IT TO THE CLIENT FOR RECORD.



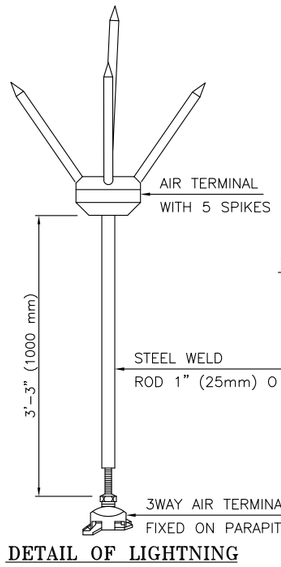
EARTHING DETAIL

FOR LIGHTNING ARRESTER SYSTEMS

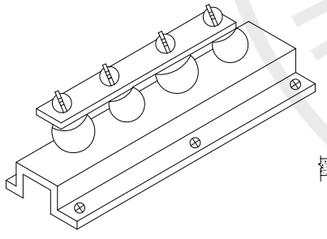
"L" TYPE EARTHING QTY-4

L EARTH POINT

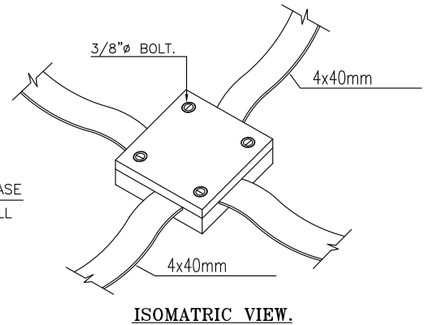
LAE LIGHTNING ARRESTER EARTH



DETAIL OF LIGHTNING ARRESTOR

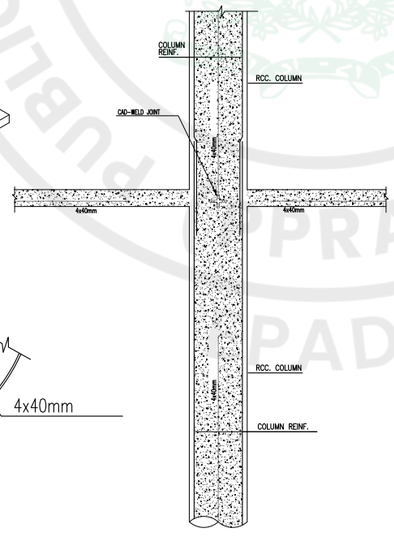


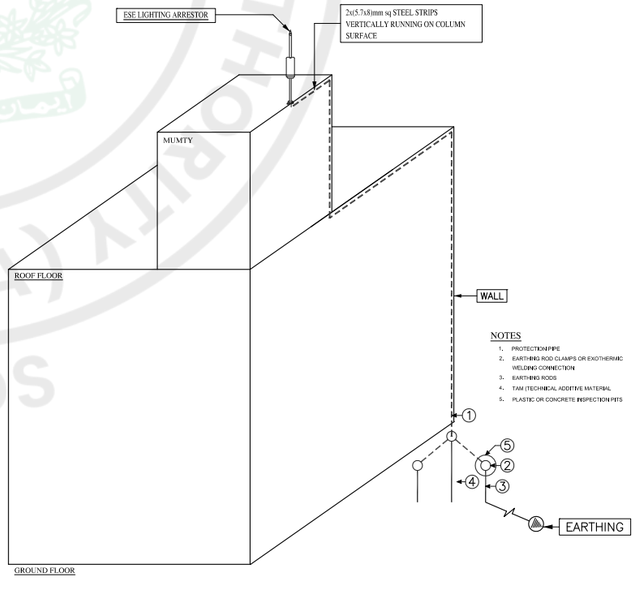
DISCONNECTING LINK



ISOMATRIC VIEW.

DETAIL FOR CROSSING OF STEEL STRIP.





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E-mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

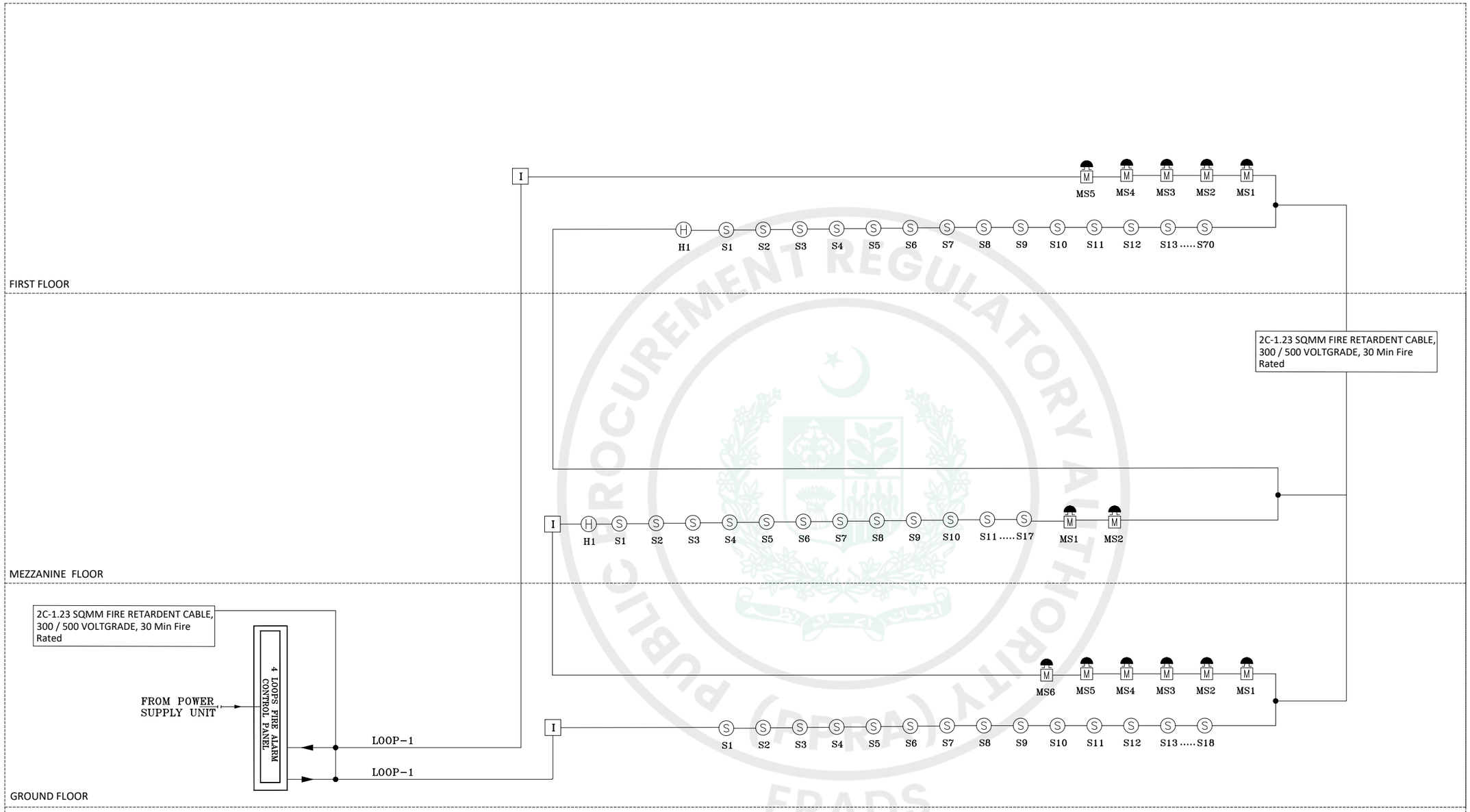
DETAILED ELECTRICAL Design Drawings

Sheet Name

EARTHING DETAILS SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-54

PUBLIC PROCUREMENT REGULATORY AUTHORITY PADS



RISER DIAGRAM FIRE ALARM OF ATC TOWER

ISSUED FOR REVIEW

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DETAILED ELECTRICAL DESIGN DRAWINGS

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

FIRE ALARM RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-55

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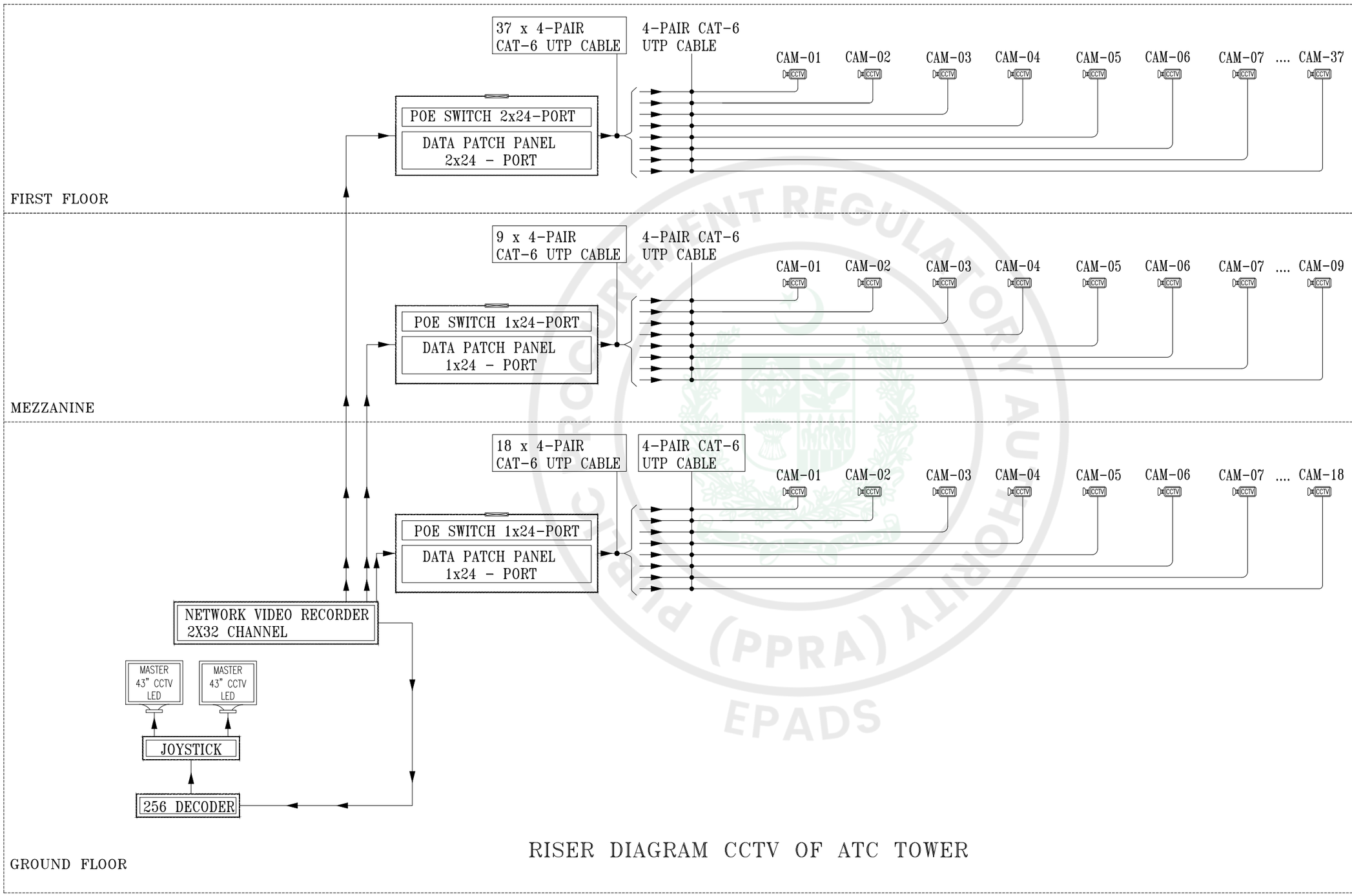

RISER DIAGRAM CCTV OF ATC TOWER

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Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

CCTV RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-56

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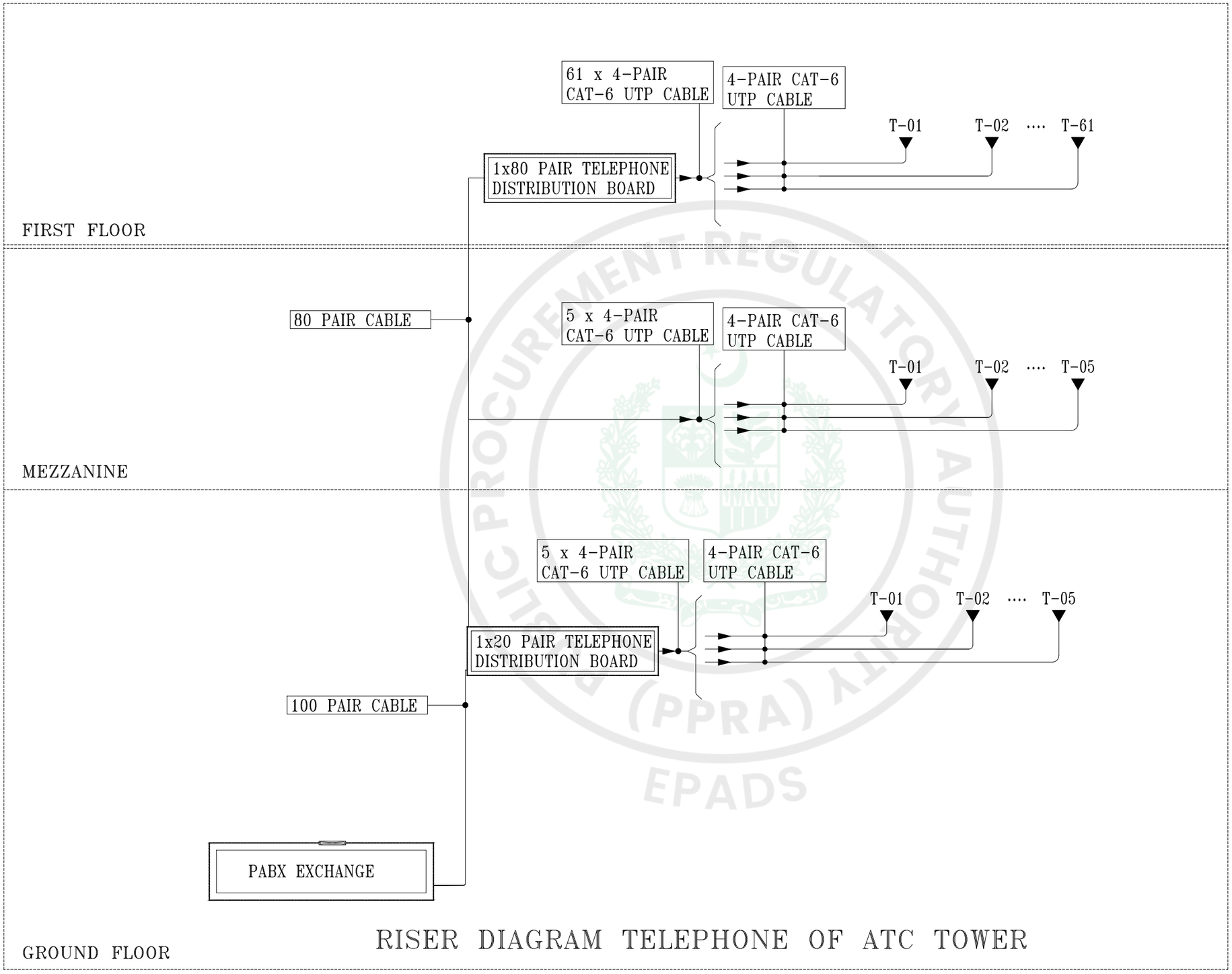

RISER DIAGRAM TELEPHONE OF ATC TOWER

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

TELEPHONE RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-57

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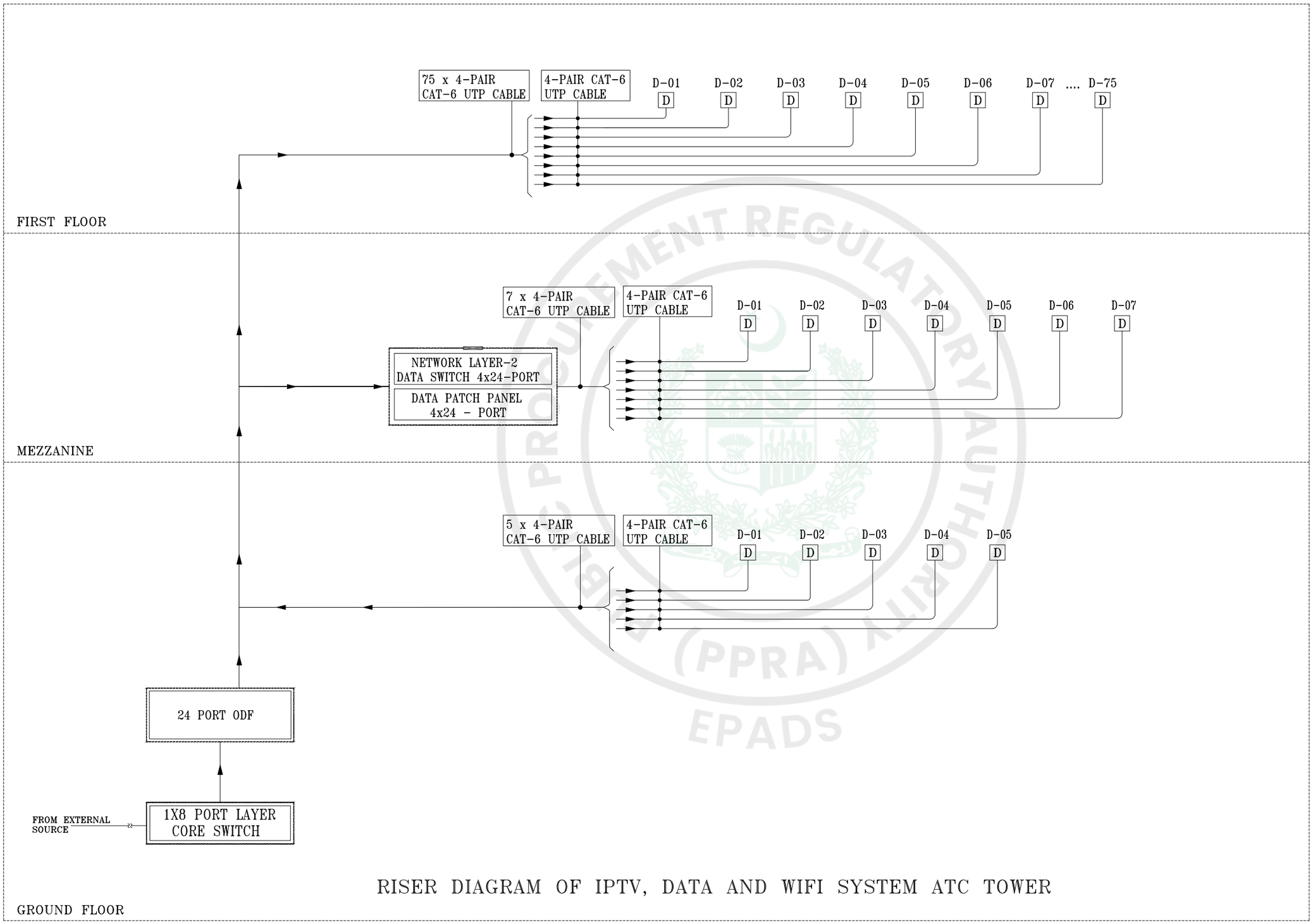

RISER DIAGRAM OF IPTV, DATA AND WIFI SYSTEM ATC TOWER

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

DATA NETWIRKING RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-58

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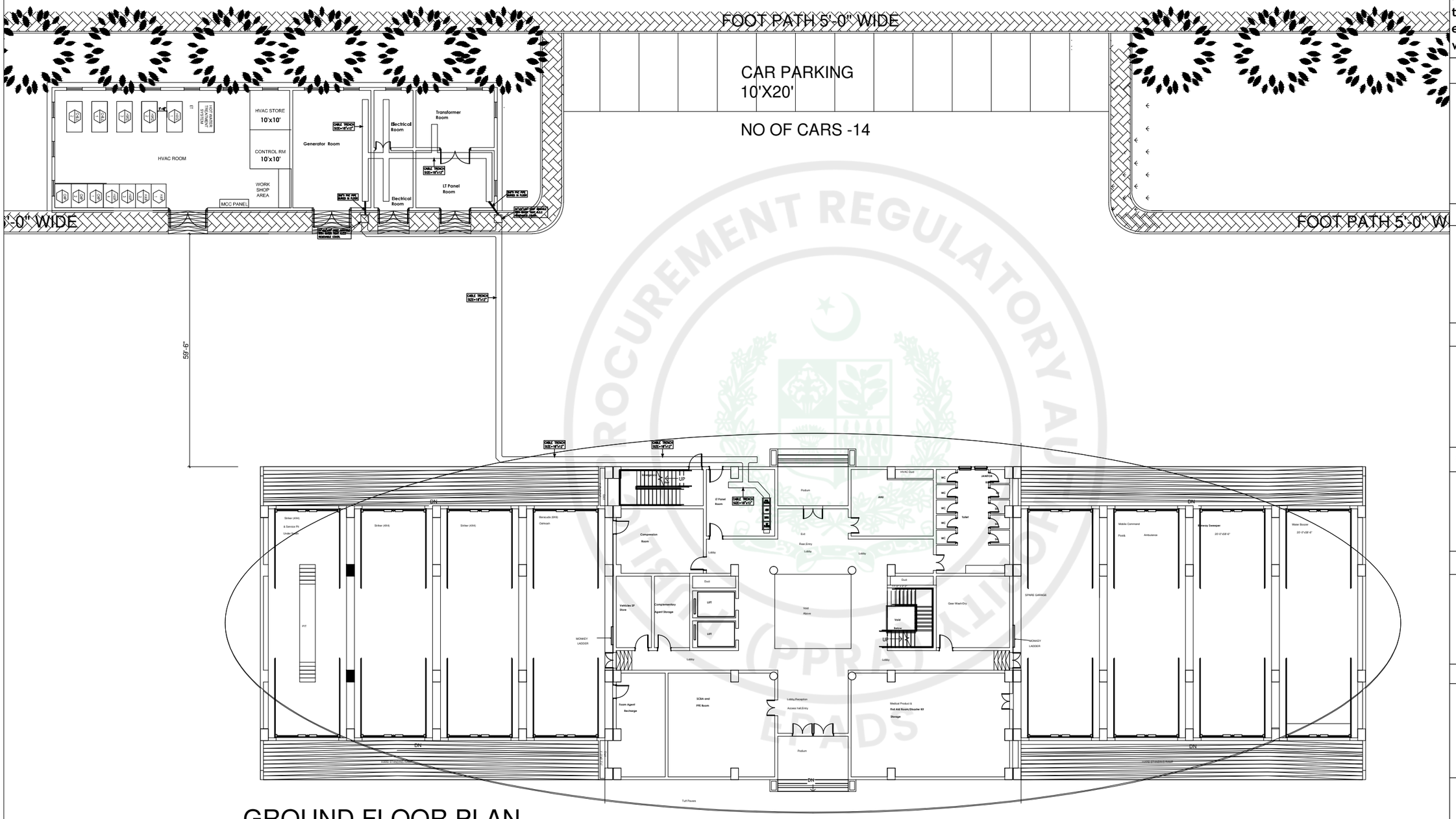

GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

CABLE TRENCH LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-59

LIGHT FIXTURES

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		6"/4''X48'' DOWN LIGHT RECTANGULAR OFFICE	FALSE CEILING OR SLAB
2		DISTRIBUTION BOARD FOR LIGHTING CIRCUIT & SMALL POWER	2'–6" F.F.L OR IN FLOOR

WIRING ACCESSORIES

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1		10 AMPS, ONE WAY AND TWO WAYS GANG TYPE SWITCH NUMBER OF SWITCHES ON SWITCH PLATE	3'–6" F.F.L
2		UNIVERSAL/MULTI PIN SWITCH SOCKET UTILITY	3'–6" F.F.L
3		UNIVERSAL/MULTI PIN SWITCH SOCKET UTILITY	0'–9" F.F.L
4		UNIVERSAL/MULTIPIN SWITCH SOCKET–UPS	0'–9" F.F.L
5		15 AMPS 3–ROUND PIN SWITCH SOCKET	0'–9" F.F.L
6		15 AMPS 3–ROUND PIN SWITCH SOCKET	3'–6" F.F.L
7		20 AMPS 3–ROUND PIN SWITCH SOCKET	3'–6" F.F.L
8		INDUSTRIAL POWER SOCKET (THREE–PHASE)	0'–9" F.F.L
9		INDUSTRIAL POWER SOCKET (SINGLE–PHASE)	0'–9" F.F.L
10		TECHNOLOGY BOX MADE OF M.S SHEET OF 16 SWG OF SIZE 14"X4", CONSISTING OF 1– UNIVERSAL/MULTI PIN SWITCH SOCKET UTILITY 2– UNIVERSAL/MULTIPIN SWITCH SOCKET–UPS 3– RJ–45 DUPLEX, I NO. FOR DATA	2'–6" F.F.L
11		WIRING IN 1"DIA PVC CONDUIT	IN WALL, SLAB OR FLOOR

FIRE ALARM SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1	H	HEAT DETECTOR RATE OF TEMPERATURE TYPE	ON FALSE CEILING
2	S	SMOKE DETECTOR NON IONIZATION TYPE.	ON FALSE CEILING
3		ALARM SOUNDER	7'–0"F.F.L
4	M	MANUAL BREAK GLASS UNIT	3'–6"F.F.L
5	FAJB	FIRE ALARM JUNCTION BOX	6" TO 9" BELOW SLAB BUT ABOVE FALSE CEILING
6	FACP	FIRE ALARM CONTROL PANEL	4'–0"F.F.L
7		WIRING IN 1"DIA PVC FOR FIRE ALARM SYSTEM	ON SLAB AFC

CLOSE CIRCUIT T.V SYSTEM

S.NO	SYMBOLS	DESCRIPTION	MOUNTING HEIGHT
1	CCTV	CLOSE CIRCUIT TV CAMERA	–ON WALL 7'–0" –ON SLAB
2		WIRING IN 1"DIA PVCC FOR CCTV SYSTEM	IN WALL, SLAB OR FLOOR
3	CCJB	CCTV JUNCTION BOX (IF REQ.)	6" TO 9" BELOW SLAB BUT ABOVE FALSE CEILING
4	NVR	NETWORK VIDEO RECORDER	AS PER SITE
5		CAT–6 4P UTP CABLE 23 AWG, LSZH TYPE	IN CONDUIT

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

MAIN LEGEND

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-60

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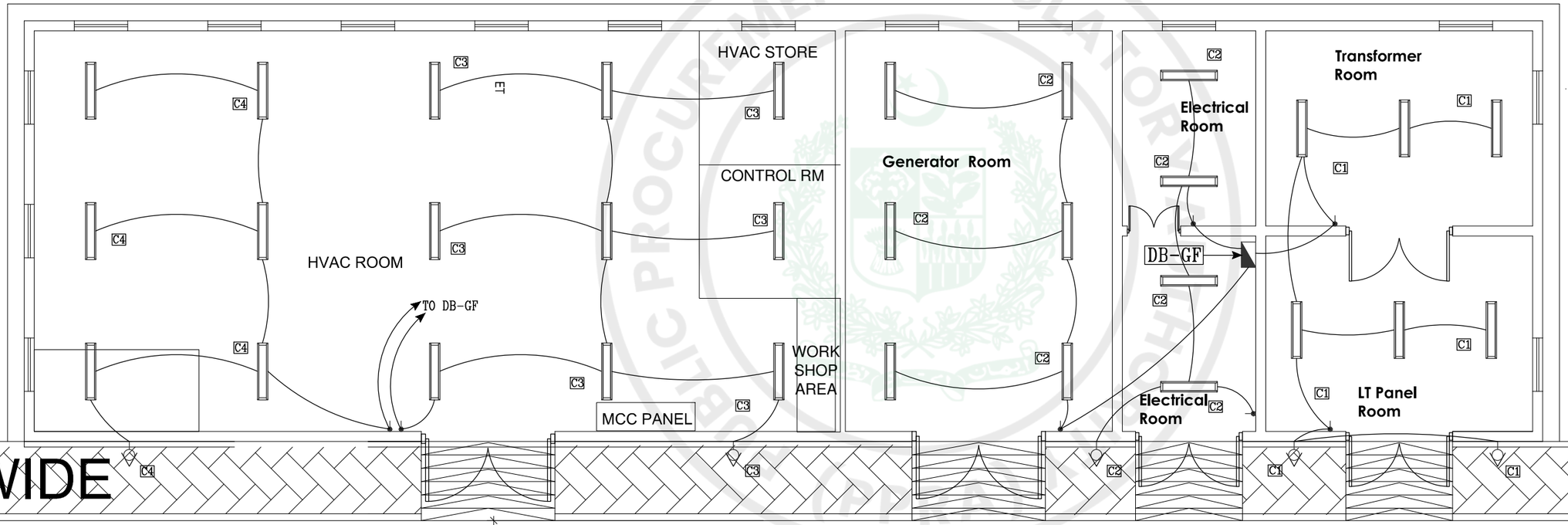

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-61

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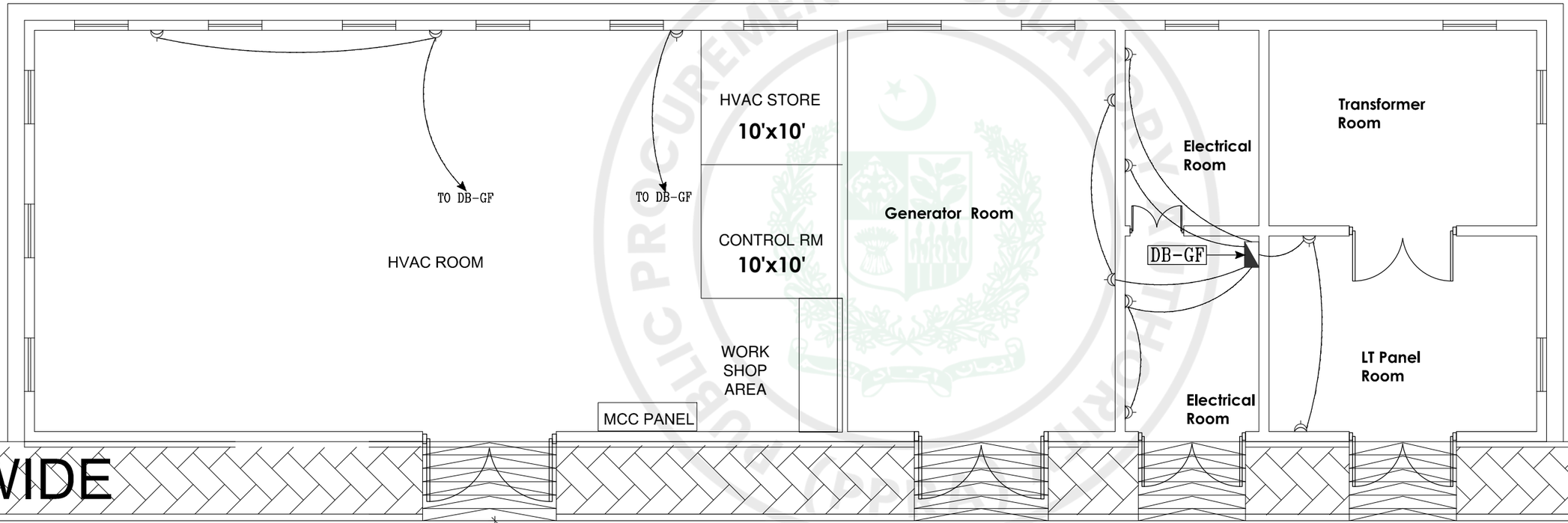

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-62

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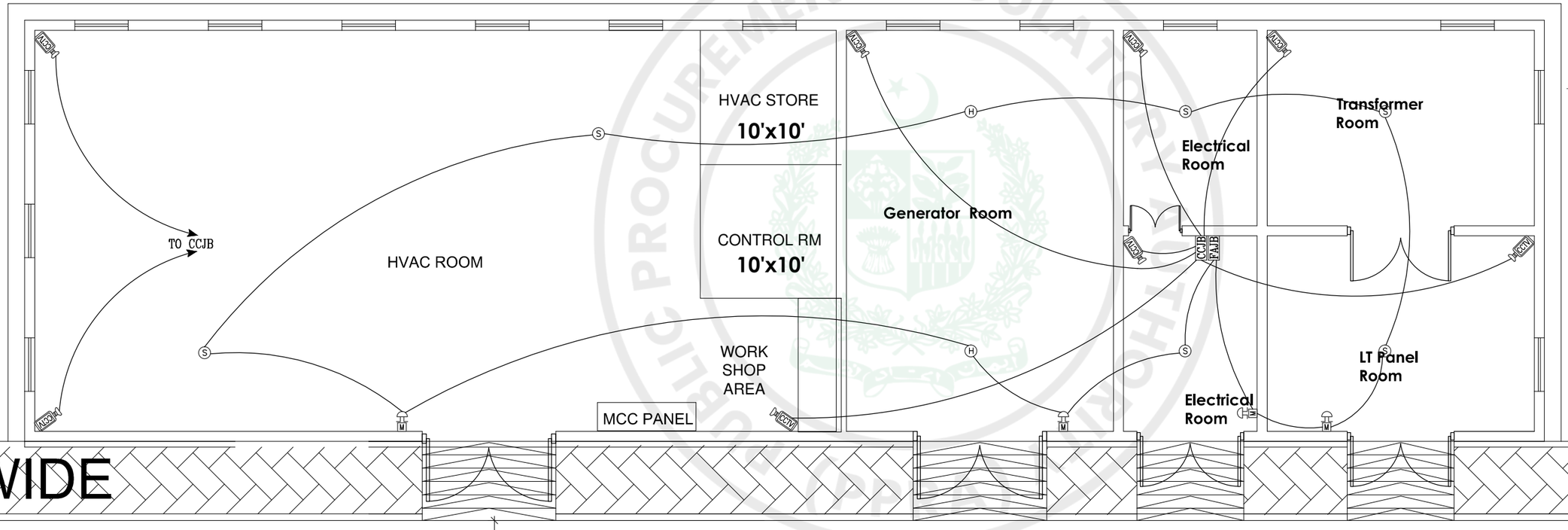

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

FIRE ALARM & CCTV SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-63

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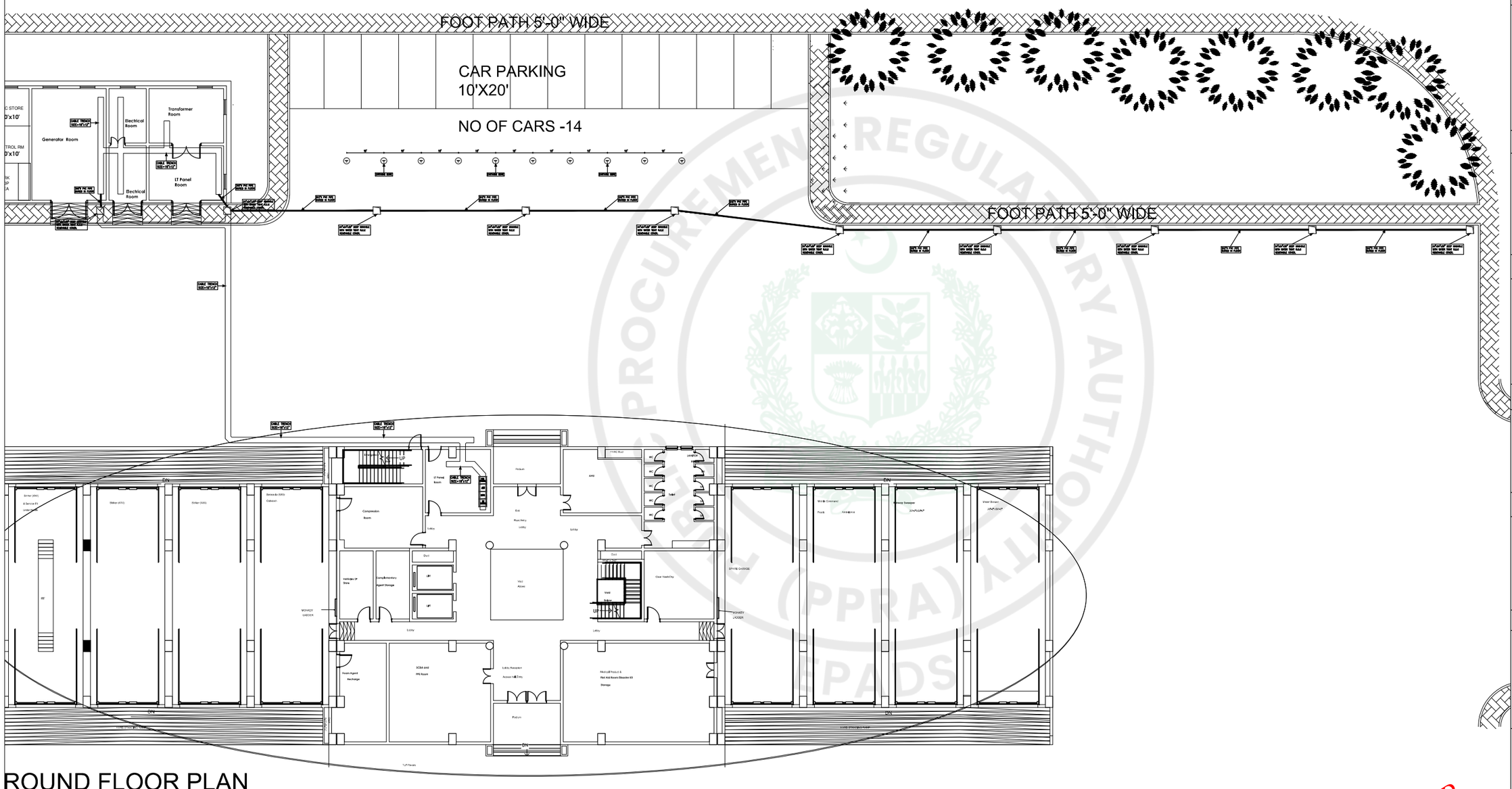
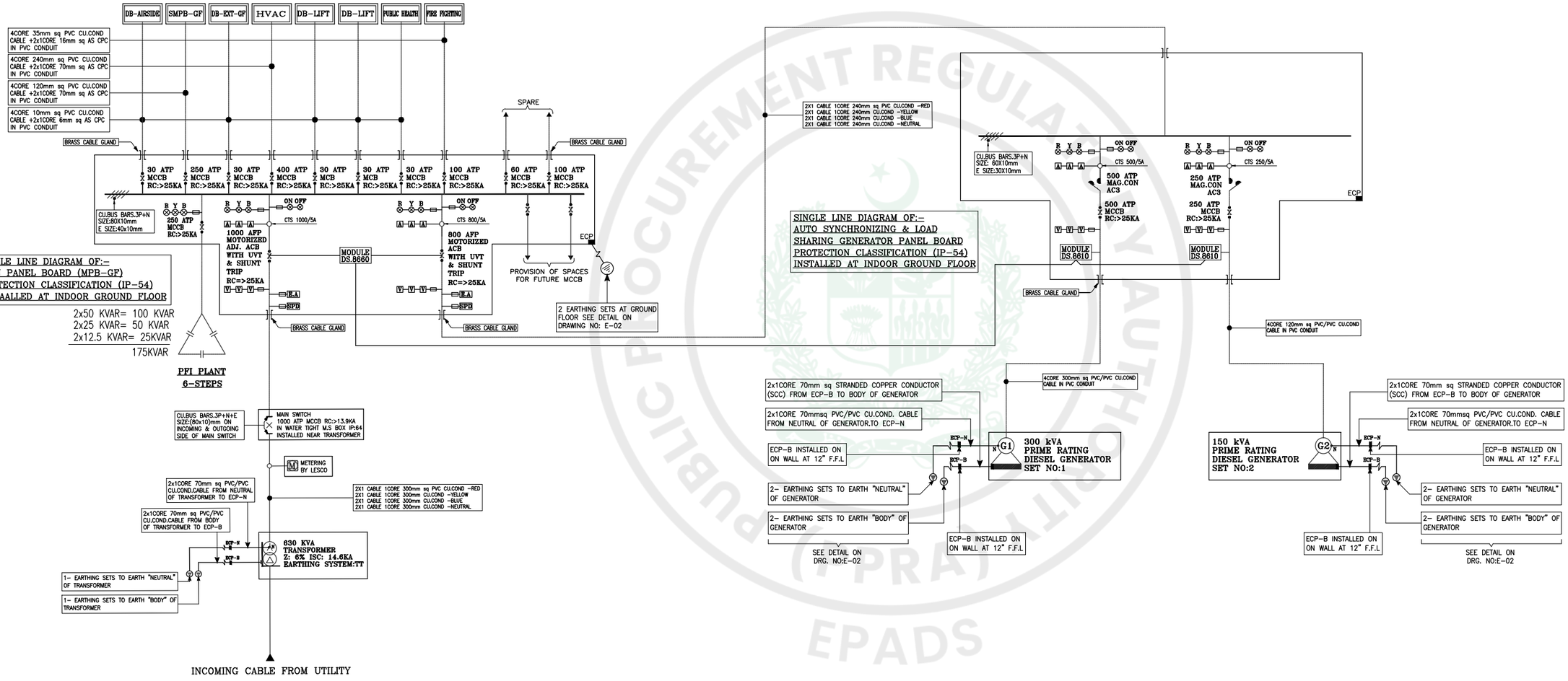

FOOT PATH 5'-0" WIDE
CAR PARKING
10'X20'
NO OF CARS -14
FOOT PATH 5'-0" WIDE
Generator Room
Electrical Room
Transformer Room
Electrical Room
LT Panel Room
CABLE TRENCH 600×610
Compression Room
Toilet
Lobby
Lobby
Lobby



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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

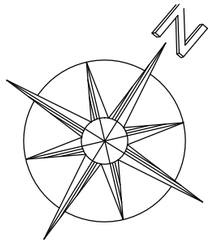
Sheet Name

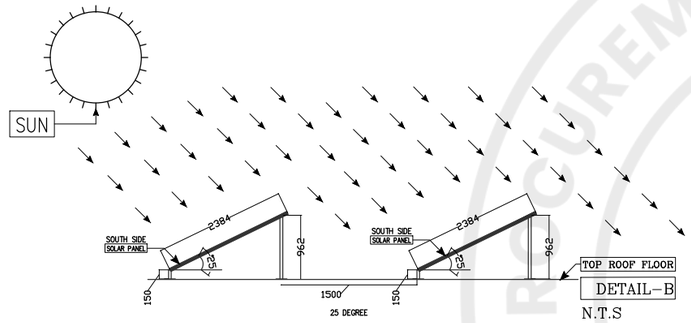
ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-65

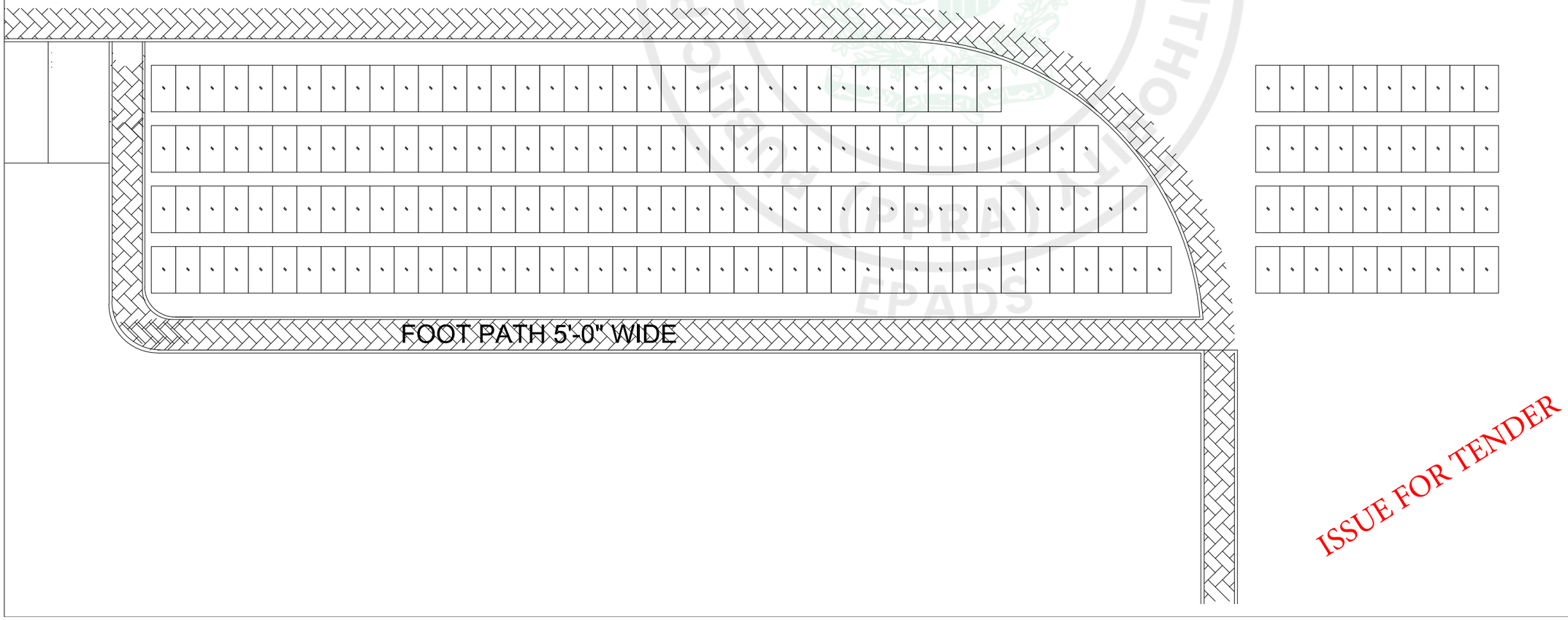
SOLAR SYSTEM

S.NO	NO OF PV PLATES	PER PV PLATE WATTAGE	TOTAL PRODUCTION IN WATTS	KW	AVERAGE EFFICIENCY AT 75%
1	197	700W	700 x 169 = 137,900W	137.9	137.9 x 0.75 = 103.4KW





DETAIL-B
N.T.S



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پاکستان ایئرپورٹس اتھارٹی

MAIN CONSULTANT

Anwar Ali Architects (Pvt.) Ltd.
Consulting,Architects,Engineers
Planners & Management Consultants
06 HBFC BLOCK A FAISAL TOWN LAHORE

JV MEMBERS

leit-werk

COMRADES

STRUCTURAL CONSULTANT

AR ENGINEERS
Architects, Stuctural, Earthquake Engineering, Geo Technical, Public Health, Highway, Electrical Design Solution.
Office # 4, 2nd Floor,Sultana Arcade Firdous Market, Gulberg-III, Lahore.
Ph: 042-35831906 03008813921, E-mail: arengineers786@gmail.com

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SUITE-14,3RD FLOOR JINNAH MALL IZMIR TOWN, LHR
Cell no: 0322-3924199
E-mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

SOLAR SYSTEM LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-66

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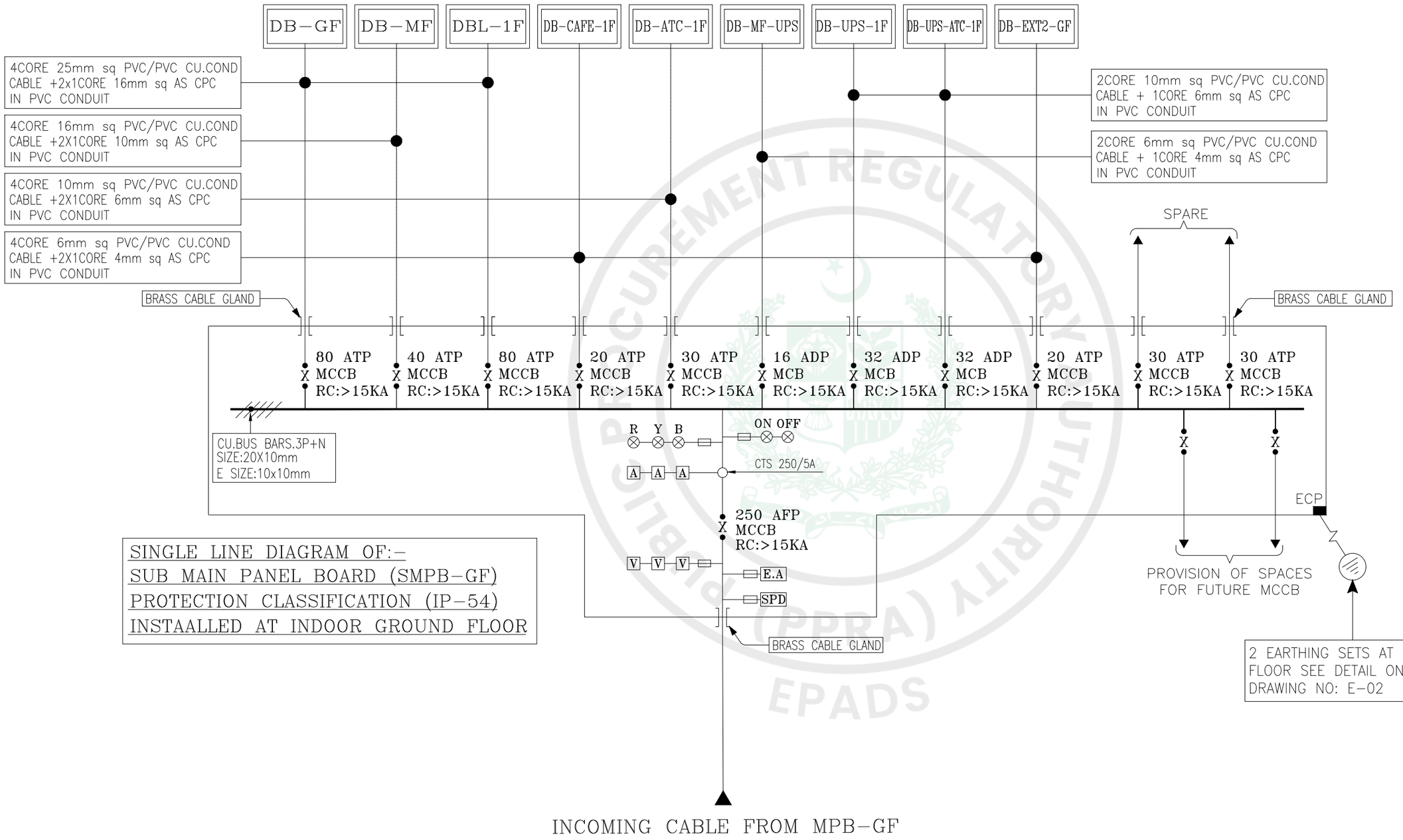

SINGLE LINE DIAGRAM OF:−
SUB MAIN PANEL BOARD (SMPB−GF)
PROTECTION CLASSIFICATION (IP−54)
INSTAALLED AT INDOOR GROUND FLOOR

NOTES:

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Cell no: 0322−3924199
E−mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-67

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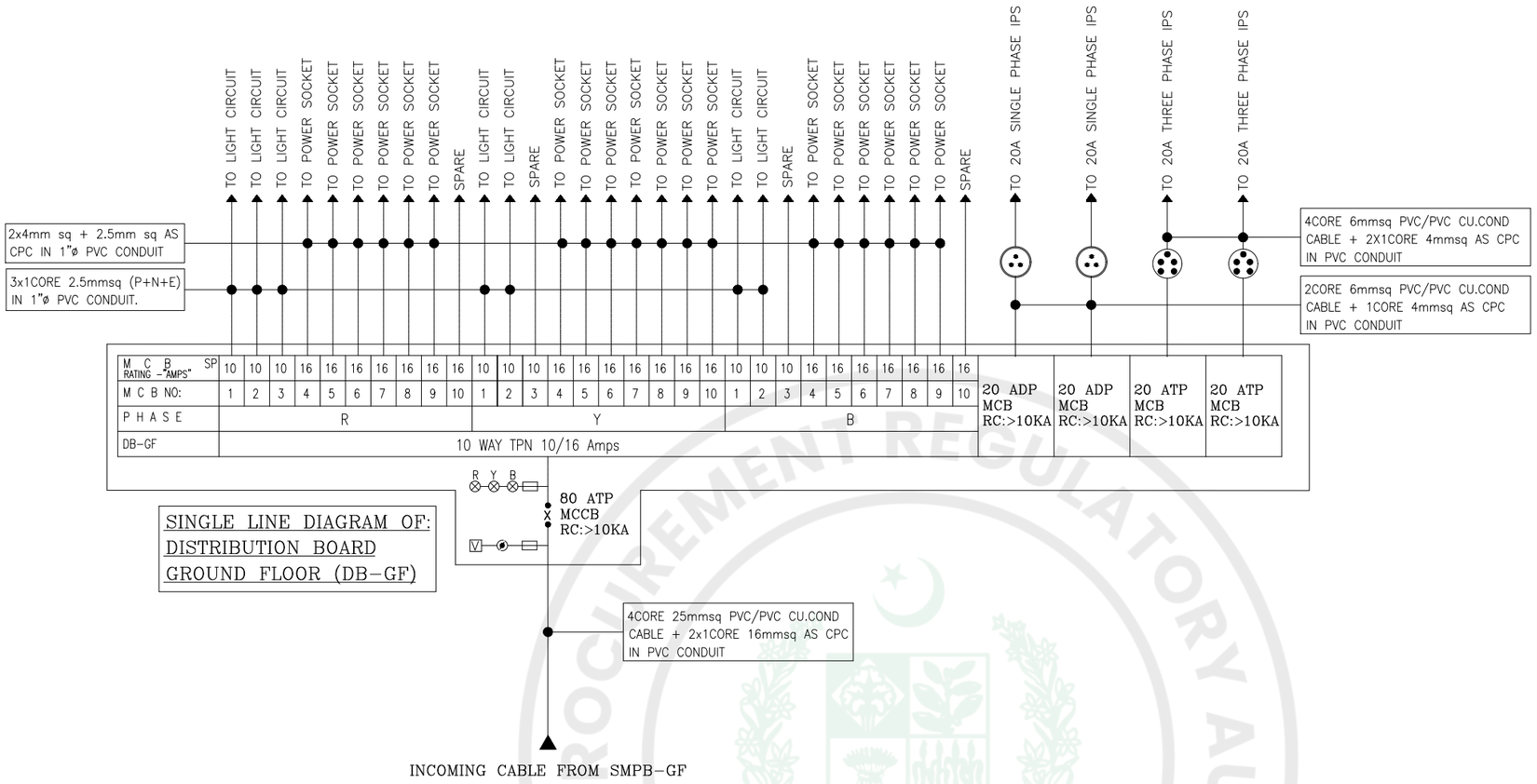

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Project Name

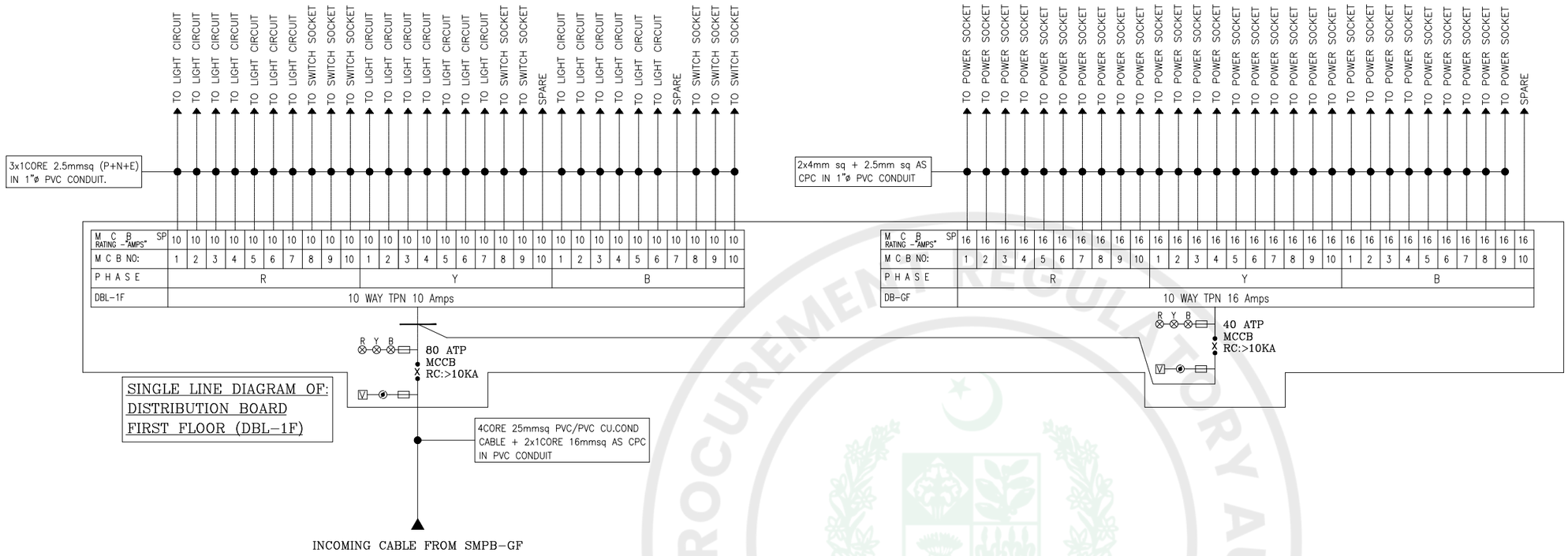
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

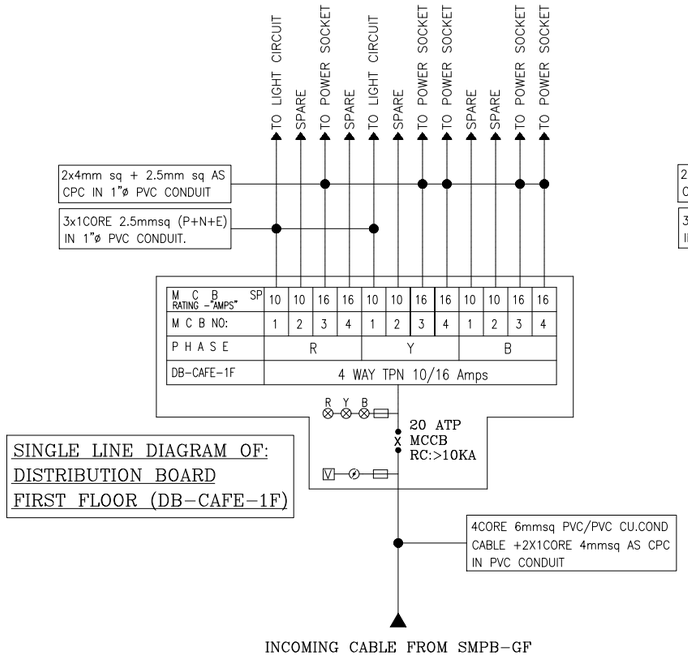
DETAILED ELECTRICAL Design Drawings

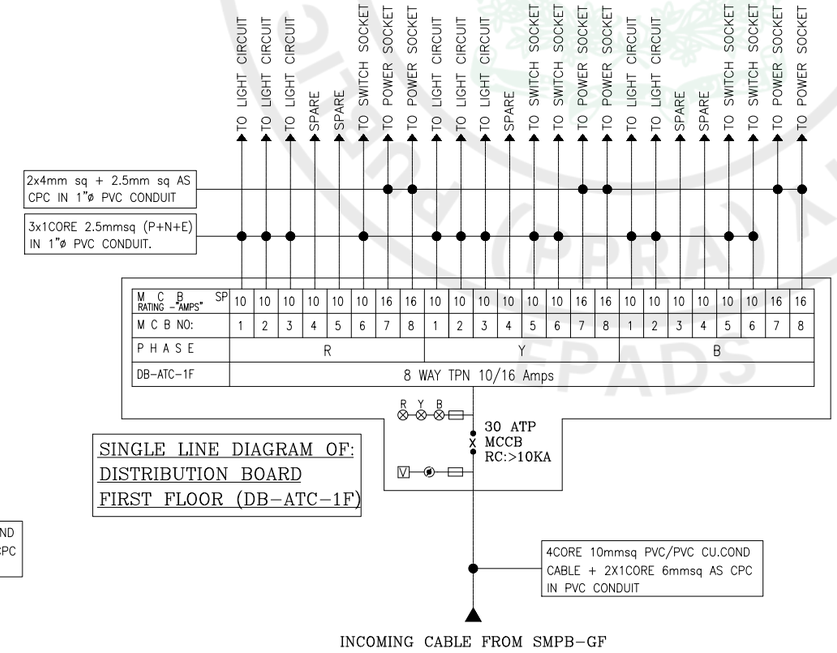
Sheet Name

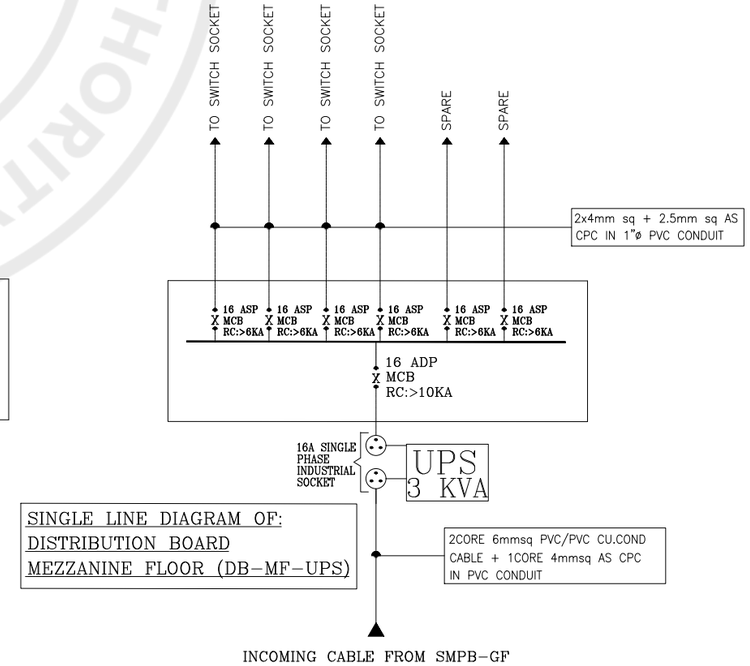
ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-68









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E-mail: abstractorseng@gmail.com

Project Name

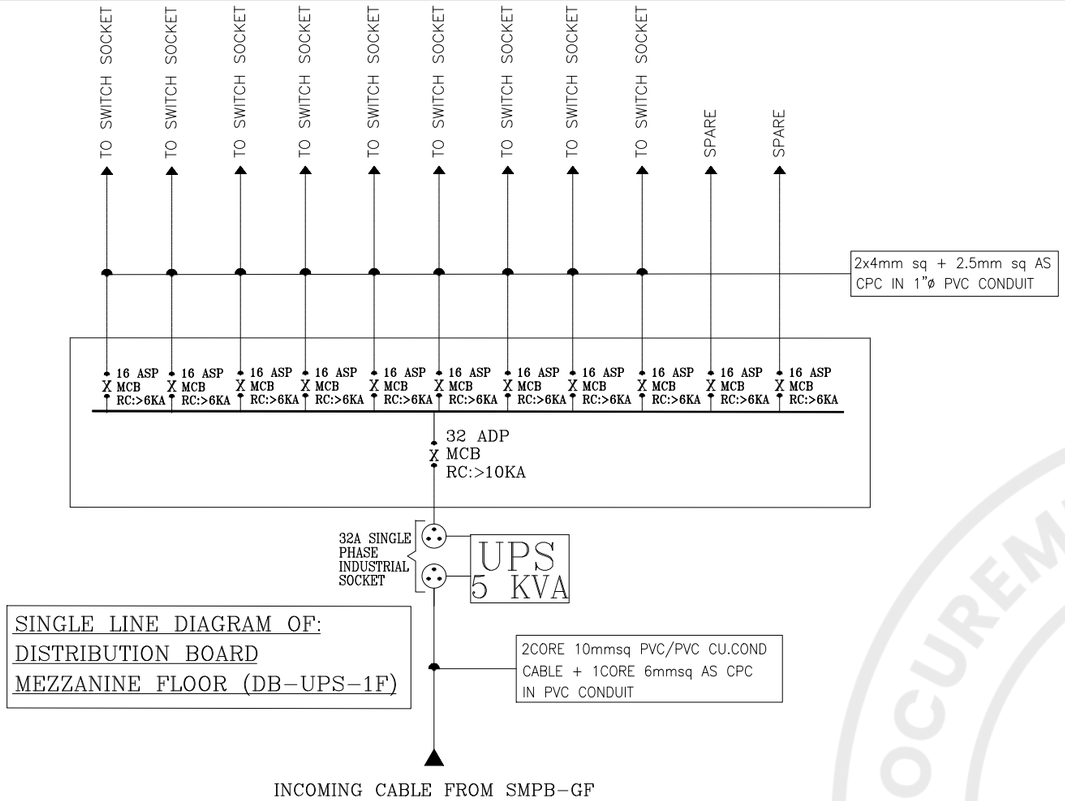
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

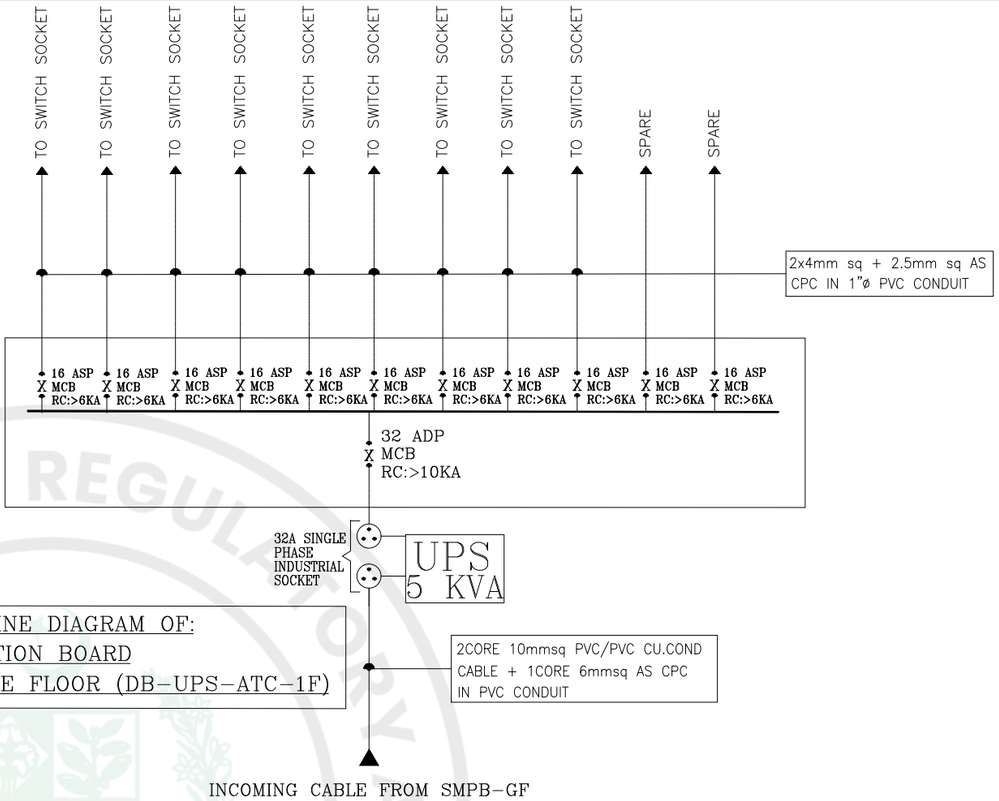
Sheet Name

ELECTRICAL SUBSTATION

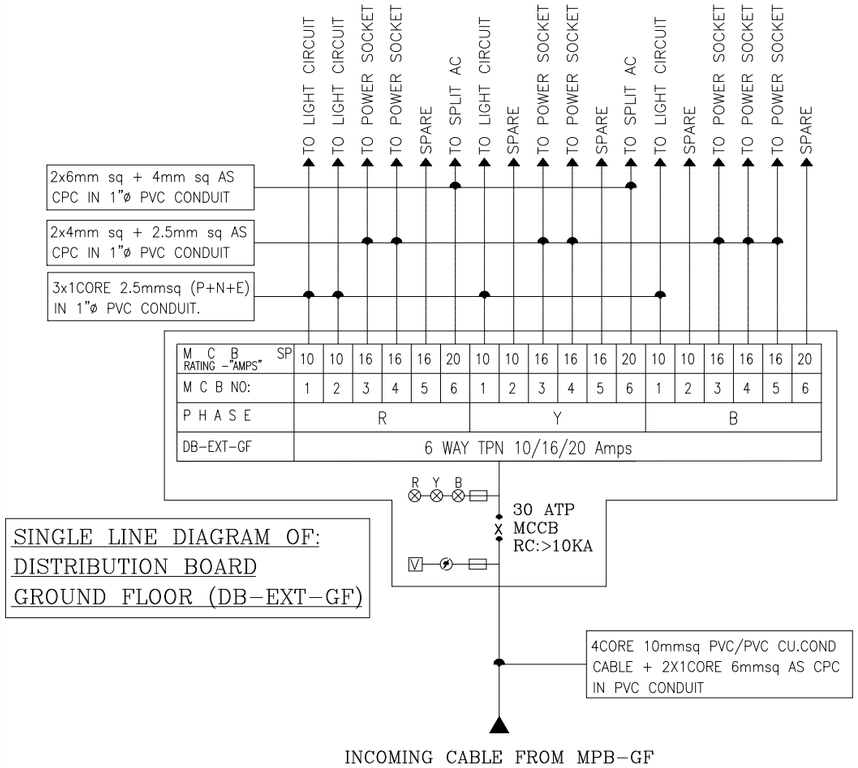
Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-69



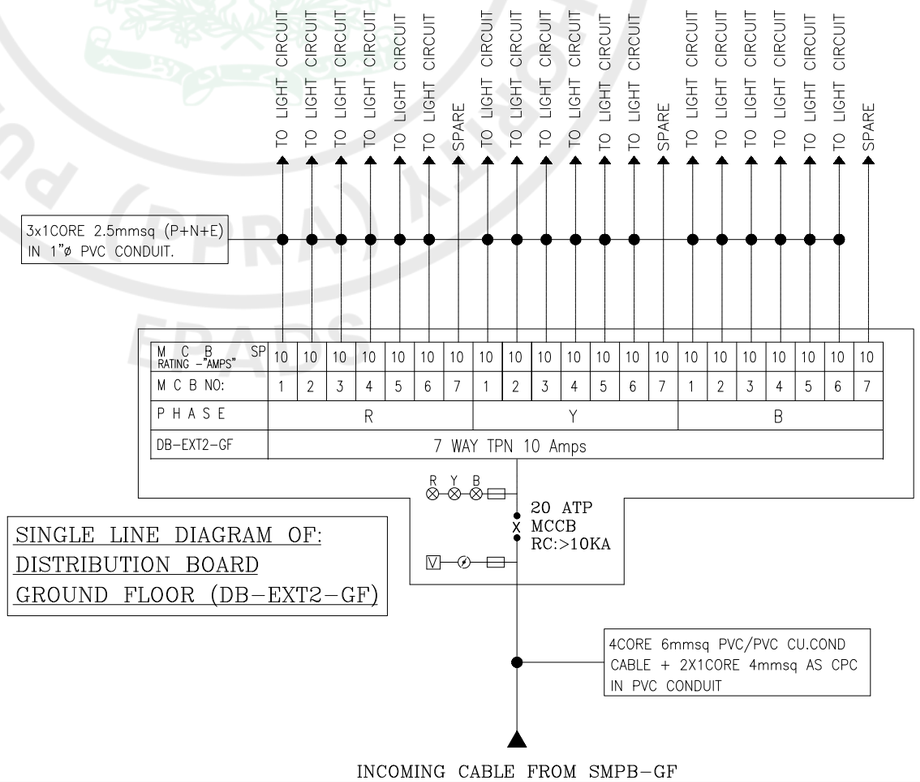
SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
MEZZANINE FLOOR (DB-UPS-1F)



SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
MEZZANINE FLOOR (DB-UPS-ATC-1F)



SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
GROUND FLOOR (DB-EXT-GF)



SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
GROUND FLOOR (DB-EXT2-GF)

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-70

PUBLIC PROCUREMENT REGULATORY AUTHORITY

LIST OF APPROVED MANUFACTURERS (M)					(Annexure-A)
Sr #	**Particulars**	**Manufacturers / Vendors**	**Origin**	**Landline**	**Mobile / Cell**
1	**LT / HT PANELS & DB's / STREET LIGHT POLES**				
i	Quality Switchgear Pvt Ltd.	Quality Switchgear	Pakistan		0300-8404301
ii	Bilal Engineering	Bilal Engineering	Pakistan		0313-4444029
iii	Ghafoor Engineering	Ghafoor Engineering	Pakistan		0320-7780309
iv	PEMPAK	PEMPAK	Pakistan		
v	South Asian Electric (SAEC)	South Asian Electric	Pakistan		0300-8477067
2	**CIRCUIT BREAKERS**				
	MCB/MCCB/ACB/ELCB/RCBO				
i)	Schneider	Oliver General Trading	France		0324-4475372
ii)	ABB	Trade Ventures	EU		0303-4443327
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
3	**MAGNETIC CONTACTORS**				
i)	Schneider	Oliver General Trading	France		0324-4475372
ii)	ABB	Trade Ventures	EU		0303-4443327
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
4	**SELECTOR SWITCHES**				
i)	Sinusoid	Eyelogy	CAD/CHN		0336-4452231
ii)	KRAUS & NAIMER	E-Links	EU		0321-4404025
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
5	**ENERGY & NETWORK ANALYZERS / VOLTMETERS / AMPEREMETERS**				
i)	Smart Controller	Index Technology	UK		0300-8184203
ii)	Lovato	Jubliee Corporation	Italy		0300-8548550
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
5a	**DUAL SOURCE ENERGY METERS**				
i)	Lovato	Jubliee Corporation	Italy		0300-8548550
ii)	ABB	ABB	EU		0303-4443327
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
iv)	Schneider	Oliver General Trading	France		0324-4475372
6	**PFI RELAYS**				
i)	Shizuki	Sheikh Waliyat & Sons	Thailand		0307-5553960
ii)	BTB	Eyelogy	Turkey		0336-4452231
iii)	Nokian	Jubliee Corporation	Finland		0300-8548550
iv)	Sigma	Jawad Electric	Turkey		0322-8061111
7	**TERMINAL BLOCKS**				

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i)	Klemsan	E-Links	Turkey	0321-4404025
ii)	Onka	Pyramid	Turkey	
iii)	Sigma	Jawad Electric	Turkey	0322-8061111

8 PFI CAPACITORS

i)	BTB	Eyelogy	Turkey	0336-4452231
ii)	Nokian	Jubliee Corporation	Finland	0300-8548550
iii)	Shizuki	Sheikh Waliyat & Sons	Thailand	0307-5553960

9 CURRENT TRANSFORMERS

i)	Revalco/Saci	Jubliee Corporation	Italy / EU	0300-8548550
ii)	Hubit	E-Links	UK	0321 4404025
iii)	Lovato	Jubliee Corporation	EU	0300-8548550
iv)	Entes	Shahid International	Turkey	0321-8472264
v)	Sigma	Jawad Electric	Turkey	0322-8061111

10 VOLTAGE MONITORING RELAYS

i)	Entes	Shahid International	Turkey	0321-8472264
ii)	Emirel	Jubliee Corporation	Italy	0300-8548550
iii)	ABB	ABB	EU	0303-4443327
iv)	Sinusoid	Eyelogy	CAD/CHN	0336-4452231
v)	Sigma	Jawad Electric	Turkey	0322-8061111

11 LOAD BREAK SWITCHES / CHANGE OVER SWITCHES

i)	Socomec	Jubliee Corporation	France	0300-8548550
ii)	ABB	ABB	EU	0303-4443327
iii)	Schneider	Oliver General Trading	France	0324-4475372
iv)	Sigma	Jawad Electric	Turkey	0322-8061111

12 INDICATION LIGHTS

i)	Telemechanique	Schneider Pakistan	EU	
ii)	GGT	E-Links	EU	0321 4404025
iii)	Sigma	Jawad Electric	Turkey	0322-8061111

13 SWITCHES & SOCKETS

i)	Clipsal Vivace Series	Clipsal Pakistan	Vietnam	0322-2880057
ii)	Legrand	Shahid International	EU	0321-8472264
iii)	Orange Switches	Orange Electric		0322-4834937
iv)	Riva	Eyelogy		0336-4452231

14 LT/HT CABLES

i)	Fast Cables	Fast Cables	Pakistan	0320-8080046
ii)	Newage Cables	Newage Cables	Pakistan	0333-478210
iii)	Pakistan Cables	Pakistan Cables	Pakistan	0321-2304494

15 EARTHING CONDUCTORS

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i)	Fast Cables	Fast Cables	Pakistan	0320-8080046
ii)	Newage Cables	Newage Cables	Pakistan	0333-4748210
iii)	Pakistan Cables	Pakistan Cables	Pakistan	0321-2304494

16 PVC CONDUIT & ACCESSORIES

i)	PLASCO PIPE	PLASCO PIPE	Pakistan	0321 4113938
ii)	BETA PIPES	BETA PIPES	Pakistan	
iii)	Dadex Pipes	Dadex Pipes	Pakistan	

17 LIGHTING FIXTURES

i)	Vlux	Index Techhnologies		0300-8184203
ii)	Osram	Osram		0312-4732209
iii)	Opple Lights	Opple Lighting		0301-8440368
iv)	Avada	Avada		0300-0840008
v)	Coarts	Coarts Lighting Pvt.Ltd		0331-2273277

18 FANS

i)	Lahore Fan	Lahore Fan	Pakistan	042-35113741
ii)	Royal Fans	Royal Fans	Pakistan	042 - 35761308

19 TELEPHONE CABLES

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN Cabels	Index Technologies	USA	0300-8184203
iii)	Clipsal	Clipsal Pakistan	Australia	0322-2880041
iv)	Comscope	Netsoft	USA	0321-8480227

20 DATA CABLES (CAT-6 UTP/STP/FTP)

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN Cabels	Index Technologies	EU	0300-8184203
iii)	Clipsal	Clipsal Pakistan	China	0322-2880057
iv)	Molex	Netsoft	USA	0321-8480227
v)	Corning	ESP Solutions	USA	0333-4666946

21 CO-AXIAL CABLES (RG-6/7)

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN Cabels	Index Technologies	EU	0300-8184203
iii)	Clipsal	Clipsal Pakistan	China	0322-2880057

22 TELEPHONE,JUNCTION BOXES & PATCH PANELS

i)	TESCO	Index Technology	USA	0300-8184203
ii)	3M	ESP Solutions		0333-4666946

23 TELEPHONE OUTLETS

i)	CLIPSAL-Vivace Series	Clipsal Pakistan	China	0322-2880041
ii)	Legrand	Shahid International	EU	0321-8472264
iii)	Orange Switches	Orange Electric		0322-4834937

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24 FIRE ALARM SYSTEM

i)	DETNOV	Index Technology	Spain	0300-8184203
ii)	ALCO (fire & security)	Index Technology	USA	0300-8184203
iii)	Honeywell	Notifier	UK	
iv)	Bosch	ESP Solutions	Germany	0333-4666946

24 a FIRE ALARM SYSTEM CABLING

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	Elan	Index Technologies	Italy	0300-8184203
iii)	Cavicell	C-XOR Engineering	Italy	0300-8477751

25 CCTV SYSTEM

i)	SAMSUNG	Vital International	Korea	0306-6831111
ii)	ALCO	Index Technology	USA	0300-8184203
iii)	Bosh	ESP Solutions	Germany	0333-4666946
iii)	Honeywell		USA	

25 a CCTV SYSTEM CABLING

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN	Index Technologies	EU	0300-8184203
iii)	Clipsal	Clipsal Pakistan	China	0322-2880057
iv)	Molex	Netsoft	USA	0321-8480227
v)	Corning	ESP Solution	USA	0333-4666986

26 PUBLIC ADDRESS SYSTEM

i)	TOA	Index Technology	Japan	0300-8184203
ii)	ITC	Index Technology	China	0300-8184203
iii)	Bosch	Bosch Invented	Germany	0321-6447170

26 a PUBLIC ADDRESS SYSTEM CABLING

i)	Ventilux	Index Technology	UK	0300-8184203
ii)	ELAN	Index Technology	EU	0300-8184203
iii)	Corning	ESP Solution	USA	0333-4666986

27 CABLE TRUNKING / LADDERS

i	Quality Switchgear Pvt Ltd.	Quality Switchgear	Pakistan	0300-8404301
ii	Bilal Engineering	Bilal Engineering	Pakistan	0331-4999119
v	Ghafoor Engineering	Ghafoor Engineering	Pakistan	0320-7780309
vii	Power-EM	Power-EM	Pakistan	0300-9430832
viii	M-Tech	M-Tech	Pakistan	0301-8472264
ix	Power Tech	Power Tech	Pakistan	0321-5234202
x	PEMPAK	PEMPAK	Pakistan	

28 BUS TIE DUCT (BTD)

i)	Pogillano	Jubliee Corporation	EU	0300-8548550
ii)	Legrand	C-XOR Engineering	EU	0300 8477751

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iii)	Power Plug	C-XOR Engineering	Malaysia	0300 8477751
iv)	Megaduct	ERCON	Malaysia	0300-0406941
v)	EAE	Libra Engineering	Turkey	0318-2070520

29 LIGHTNING PROTECTION SYSTEMS

Early Streamer Emission With Accessories (Active)

i)	Application Tech	C-Xor Engineering	Spain	0300-8477751
ii)	Jeflash	Eyelogy	Turkey	0322-8092588
iii)	INGESCO	Electrokraft	Italy	

Conventional System With Accessories (Passive)

i)	ABB	ABB	EU	0303-4443327
ii)	Dehn	Jubliee Corporation	EU	0300-8548550

30 MV SWITCHGEAR / 11KV RMU / LBS

i)	Hyundai	PEL	Korea	
ii)	ABB	ABB	EU	0303-4443327
iv)	Siemens	Siemens	EU	

31 TRANSFORMERS (DRY TYPE)

i)	Trafo Elettro	C-Xor Engineering	EU	0300 8477751
ii)	Legrand	C-Xor Engineering	EU	0300 8477751
iii)	ABB	ABB	EU	0303-4443327
iv)	TMC	Jubliee Corporation	EU	0300-8548550
v)	Power Go	Rachena Corp	EU	0321-840078
vi)	Fedral	Eyelogy	EU	0336-4452231

32 TRANSFORMERS (OIL TYPE)

i)	Pak Electron Limited (PEL)	Pak Electron Limited (PEL)	Pakistan	0300-8406508
ii)	ELMETEC	ELMETEC	Pakistan	0302-4712772
iii)	Hammad Engineering	Hammad Engineering	Pakistan	0302-4712772
iv)	Transfo Power	Transfo Power	Pakistan	0320-7889283

33 GENERATORS

i)	Cummins	Orient Energy	EU/US/CN	0300-8440430
ii)	Starkat	Innovative Engergy Sol	EU	0333-0525552
iii)	Scania	KAN Engineering	Sweden/EU	0301-8402312
iv)	Onis Visa / Volvo	VPL	EU	0301-8445026
v)	Aksa	Aksa Generators	Turkey	0302-8282690
vi)	Perkins	Power Zone		0321-4462651
vii)	Perkins	Multiline		0301-8665069
viii)	Kohler SDMO	Greaves		0345-4014588
ix)	Cummins	Power Vision	EU/US/CN	0300-9439310

34 GENERATOR CONTROL MODULES

i)	SICES	HUB ENGINEERING	EU	0301-6020372
ii)	DEEP SEA	PYRAMID AUTOMATION	UK	0333-4561619
iii)	EURO GEN	EURO GEN	FRANCE	0333-4561619

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35 OCCUPANCY SENSOR

i)	Ventilux	Index Technology	UK	0300-8184203
ii)	Clipsal/Schneider Electric	Clipsal Pakistan		0322-2880057

36 WIFI ROUTER

i)	Ruckus	Netsoft	Australia	0321-8480227
ii)	Huawei	CMC	China	0330-7470125
iii)	Allied Telesis	ESP SOLUTIONS		0333-4666946

37 GPON ACTIVE EQUIPMENT

i)	CORNING	ESP SOLUTIONS	USA	0333-4666986
ii)	HUAWEI	OCTO	CHINA	0330-7470125

38 GPON PASSIVE EQUIPMENT

i)	Molex	Netsoft	Aus	0321-8480227
ii)	Corning	ESP Solutions	USA	0333-4666946
iii)	Comscope	Netsoft	USA	0321-8480227

39 LIFTS / ESCALATORS / DUMP WAITERS

i)	Fuji	Innovative Energy Sol.	Japan	0300-8504838
ii)	Sanyo	DWP Technologies	Japan	0302-8445225
iii)	OTIS	Royal Systems		0300-8548002
iv)	Euksali	Mesi Group	Turkey	0300-8446992
v)	Mitsubishi			

40 ACCESS CONTROL / DOOR LOCKS

i)	Salto	ESP Solutions	UK	0333-4666946
ii)	ANVIZ	INEX Technology	USA/CHN	0300-8184203

41 INVERTER

i)	APC by Schneider	Octo	EU/CHINA	0330-7470125
ii)	ABB	SM JAFFER	EU	0333-0321284

42 INDUSTRIAL POWER SOCKETS (IPS)

i)	Clipsal	Clipsal Pakisan	China	0322-2880057
ii)	FAMATEL	JUBLIEE CORPORATION	SPAIN	0300-8548550

43 SURGE PROTECTION DEVICES

i)	ABB	ABB	EU	0303-4443327
ii)	Dehn	Jubliee Corporation	EU	0300-8548550
iii)	Sigma	Jawad Electric	Turkey	0322-8061111

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LIST OF DRAWINGS

SR.NO.	DWG. NO.	DESCRIPTION
		FIRE FIGHTING TITLE PAGE
01	LOD-01	LIST OF DRAWINGS
02	GN-01	PUBLIC HEALTH LEGENDS, GENERAL NOTES & ABBREVIATIONS
03	FF-00	FIRE FIGHTING SYSTEM MASTER PLAN
04	FF-01	FIRE FIGHTING SYSTEM LAYOUT PLAN
05	FF-02	FIRE FIGHTING SYSTEM GROUND FLOOR PLAN
06	FF-03	FIRE FIGHTING SYSTEM MEZZANINE FLOOR PLAN
07	FF-04	FIRE FIGHTING SYSTEM FIRST FLOOR PLAN
08	FF-05	FIRE FIGHTING SYSTEM ROOF TOP PLAN
09	FF-06	FIRE FIGHTING SYSTEM ARFF FLOOR PLAN
10	FF-07	FIRE FIGHTING SYSTEM ATCT FLOOR PLAN
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12	FF-09	FIRE FIGHTING MISCELLANEOUS DETAILS
13	FF-10	FIRE FIGHTING UNDER GROUND WATER TANK DETAIL

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED FIRE FIGHTING Design Drawings

Sheet Name

LIST OF DRAWINGS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	LOD-00

GENERAL NOTES FIRE PROTECTION SYSTEM

1 DIMENSIONS ARE IN INCHES UNLESS OTHERWISE STATED.

2 THE FIRE FIGHTING DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE APPROPRIATE ARCHITECTURAL CIVIL, STRUCTURAL, ELECTRICAL AND OTHER MECHANICAL DRAWINGS AND EQUIPMENT SCHEDULES.

3 ALL MATERIALS AND METHODS OF INSTALLATION SHALL COMPLY FULLY WITH THE REQUIREMENTS OF THE SPECIFICATION.

4 ALL MATERIALS AND EQUIPMENT SHALL BE NEW AND FREE FROM ANY DEFECTS AND SHALL BE MAINTAINED AS SUCH DURING THE CONSTRUCTION PERIOD.

5 PIPES PENETRATING THROUGH FLOORS, ROOFS AND WALLS SHALL BE PROVIDED WITH PIPE SLEEVES WITH ANNULAR SPACES FILLED WITH APPROVED COMPOUND AND SHALL BE TIGHTLY CAULKED.

6 ALL PIPES FITTINGS SHALL BE THROUGHLY PROTECTED FROM ANY HAZARDS AND SHALL HAVE SUPPORTS, ANCHORS OR HANGER AS DEEMED NECESSARY AS REQUIRED BY THE TECHNICAL SPECIFICATIONS.

7 INSTALLATION OF THE EQUIPMENT, PIPE AND FITTINGS UNDER FIRE FIGHTING SHALL BE EXECUTED IN FULL COORDINATION WITH THE ARCHITECTURAL, LANDSCAPE, STRUCTURAL, ELECTRICAL AND OTHER MECHANICAL DRAWINGS AND SCHEDULES.

8 THE MECHANICAL CONTRACTORS SHALL PROVIDE ELECTRICAL WIRING OF THE MECHANICAL EQUIPMENT UP TO THE ISOLATORS PROVIDED BY THE ELECTRICAL CONTRACTORS. THE MECHANICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE MOTOR CONTROL CENTERS AND CONTROL PANELS OF HIS SUPPLIED EQUIPMENT.

9 THE FIRE & DOMESTIC WATER STORAGE TANK SHALL INCLUDE FLOAT VALVE FLOAT BALL, FOOT VALVE WITH STRAINER AT PUMP SUCTION LINE, RELIEF VENTS, ACCESS LADDER OR CLIMBING RUNGS, OVERFLOW PIPE, HIGH AND LOW CUT–OFF LEVEL SWITCHES, MANHOLES WITH AIR TIGHT COVERS, AND PROVISIONS FOR PIPE CONNECTIONS.

10 DIFFERING MATERIALS IN CONTACT WITH EACH OTHERS SHALL BE FULLY COMPATIBLE AND SHALL NOT PRODUCE ANY ELECTROLYTIC ACTION BETWEEN THEM.

11 ALL FASTENINGS AND SUPPORTS SHOWN ON THE DRAWINGS ARE INDICATIVE ONLY THE SIZING, SPACING AND TYPES OF FASTENINGS AND SUPPORTS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS AND TO THE APPROVAL OF THE ENGINEER OR HIS APPROVED REPRESENTATIVE.

12 ALL EQUIPMENT AND ACCESSORIES UNDER FIRE FIGHTING ENGINEERING SERVICES SHALL BE INSTALLED IN SUCH A MANNER TO ALLOW ADEQUATE SPACE FOR SERVICING MAINTENANCE AND REPLACEMENT.

13 INSTALLATION OF FIRE PROTECTION SYSTEM SHALL BE IN ACCORDANCE TO THE LATEST EDITION OF NFPA STANDARDS.THE SYSTEM SHALL INCLUDE DEDICATED FIRE PUMPS.FIRE HOSE REELS,FIRE PROTECTION SPRINKLERS AND PORTABLE FIR EXTINGUISHER.

14 FIRE PROTECTION PIPES SHALL BE M.S SCHEDULE 40 SEAMLESS PIPE. PIPES SHALL BE PAINTED.

15 ALL ISOLATION VALVES IN THE FIRE PROTECTION SYSTEM SHALL COMPLY WITH NFPA REQUIREMENT.

16 FLOW AND TAMPER SWITCHES SHALL BE CONNECTED TO THE BUILDING MANAGEMENT SYSTEM AND THE FIRE ALARM PANEL. FIRE ALARM SYSTEM TO BE CONNECTED WITH FIRE FIGHTING SYSTEM.

17 PIPES PASSING THROUGH BUILDING'S EXPANSION JOINTS SHALL BE PROVIDED WITH PIPE EXPANSION FITTINGS.

18 PORTABLE FIRE EXTINGUISHERS SHALL BE LOCATED AND SIZED AS INDICATED ON THE DRAWING AND SHALL BE IN ACCORDANCE WITH NFPA.

19 FIRE WATER LINES HAVING PRESSURES MORE THAN 12 BARS SHALL BE PROVIDED WITH PRESSURE REDUCING VALVES. IN NO INSTANCE THAT A FIRE WATER LINE SHALL HAVE LINE PRESSURE MORE THAN 12 BARS.

FIRE SYSTEM COMPONENTS

- STANDARD UPRIGHT SPRINKLER HEAD
- PENDANT HEAD MOUNTED ON CEILING
- UPRIGHT SPRINKLER ON RISER NIPPLE (SPRIG)
- SIDEWALL SPRINKLER HEAD (H) HORIZONTAL
- AV — ALARM VALVE
- (DV) DELUGE VALVE

FIRE DEPARTMENT PUMPER CONNECTIONS

- 2–WAY BREECHING INLET

ABBREVIATIONS:

LEGENDS & ABBEREVIATIONS	
	CO_2 EXTINGUISHER
	DRY POWDER EXTINGUISHER
	GATE VALVE (GV)
S.D	SMOCK DETECTOR
E.L	EMERGENCY LIGHT
	SAND BUCKETS
F.S	FIRE SPRINKLES
	FIRE GOOGLES
	FIRE HELLMAT
	BREETHING
	MONKEY LADDER
	FIRST AID BOX
	SMOKE MASK
	FIRE BLANKET
	FIRE HOSE CABINET WITH LANDING VALVE, HOSE REEL,DRY POWDER & CO_2 EXTINGUISHER
	SPRINKLER CONCEALED PENDANT TYPE

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

LEGEND & GEN. NOTES

Date	April, 2026
Scale	NTS
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Checked by	M.K
Approved by	M.F
Drawing No.	GN-00

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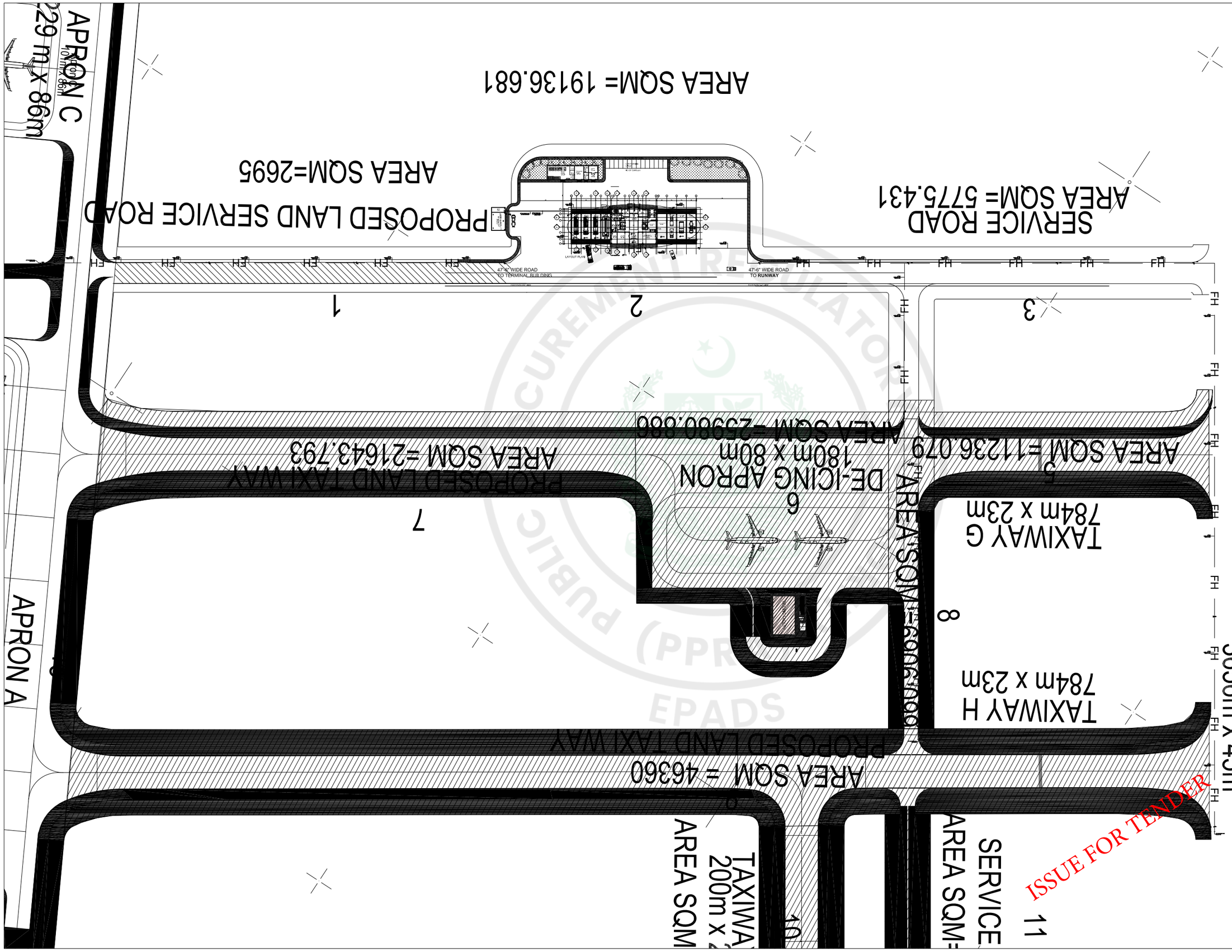

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM MASTER PLAN LAYOUT PLAN

Date	April, 2026
Scale	NTS
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Checked by	M.K
Approved by	M.F
Drawing No.	FF-00

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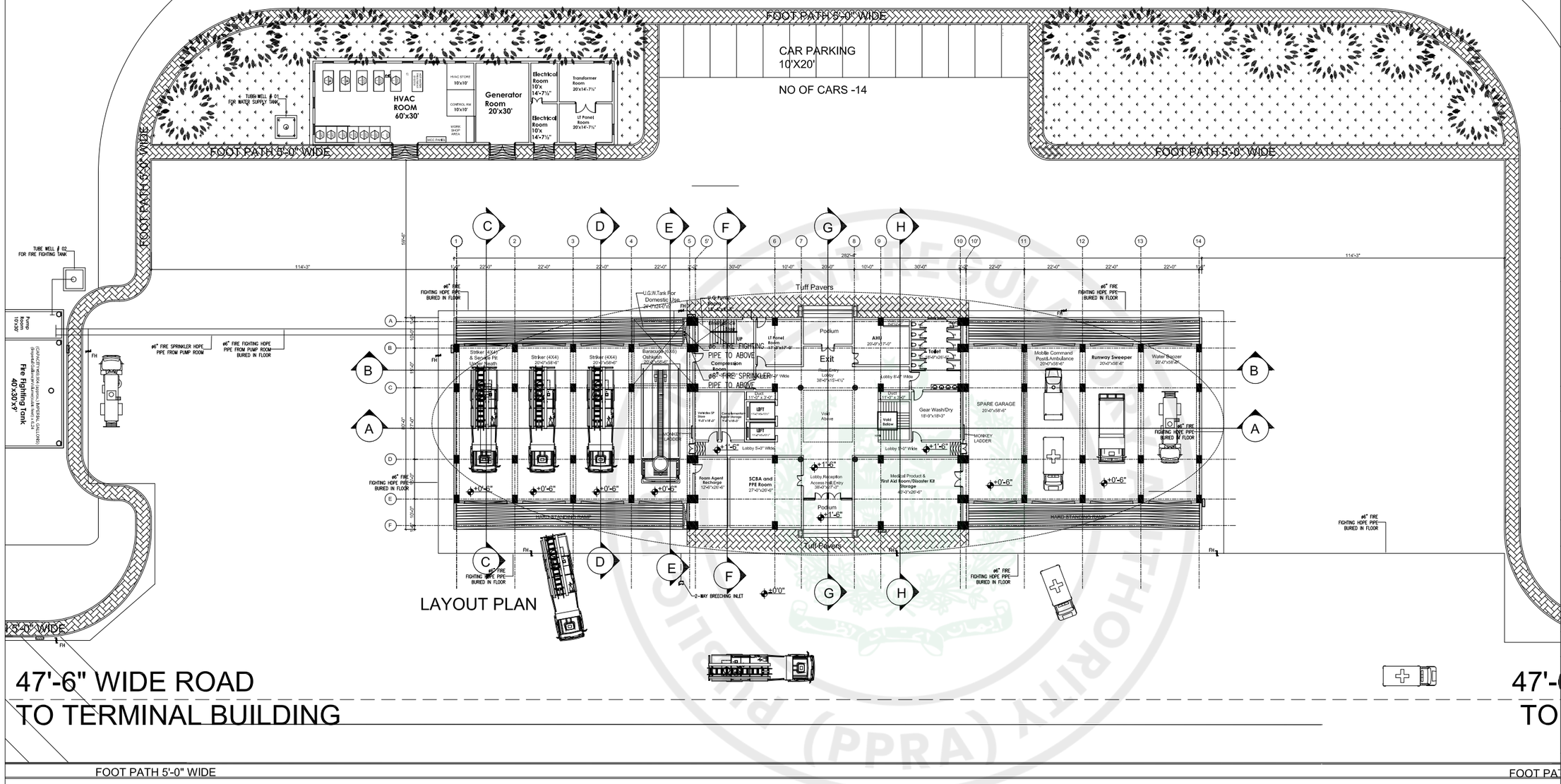

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM LAYOUT PLAN

Date	April, 2026
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Approved by	M.F
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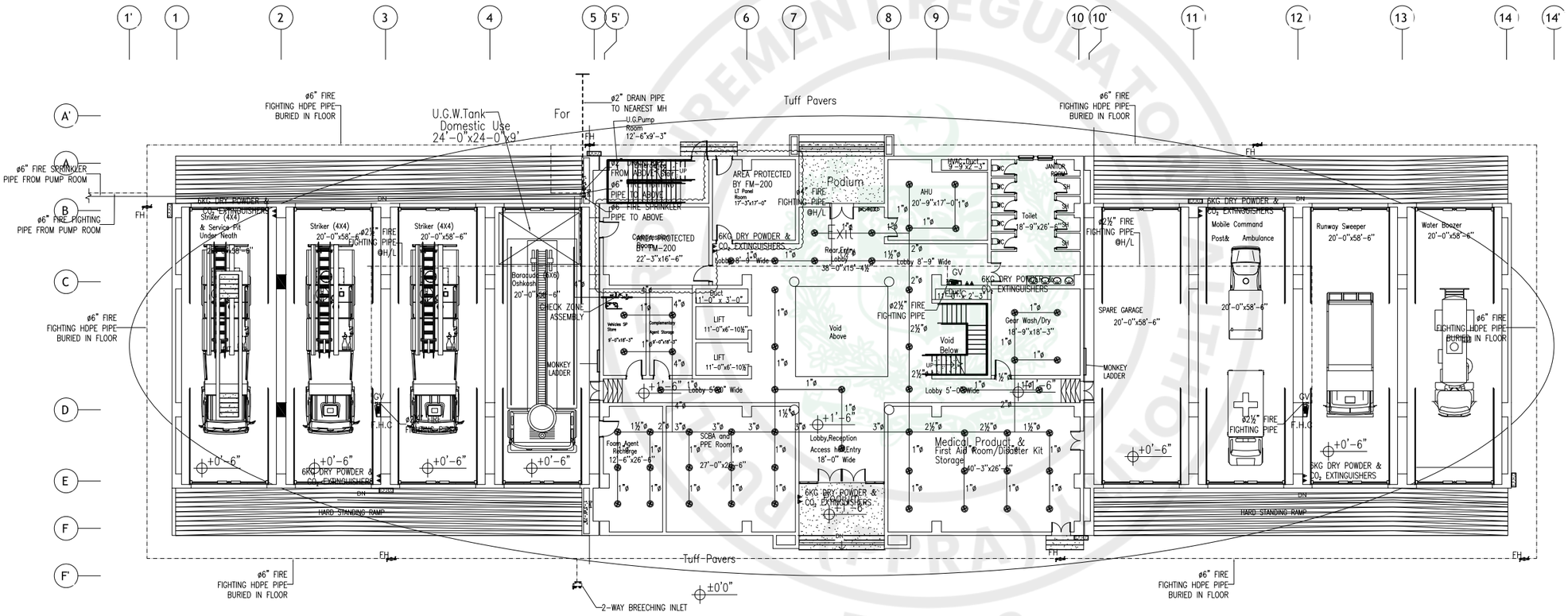

GROUND FLOOR PLAN

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM GROUND FLOOR PLAN

Date	April, 2026
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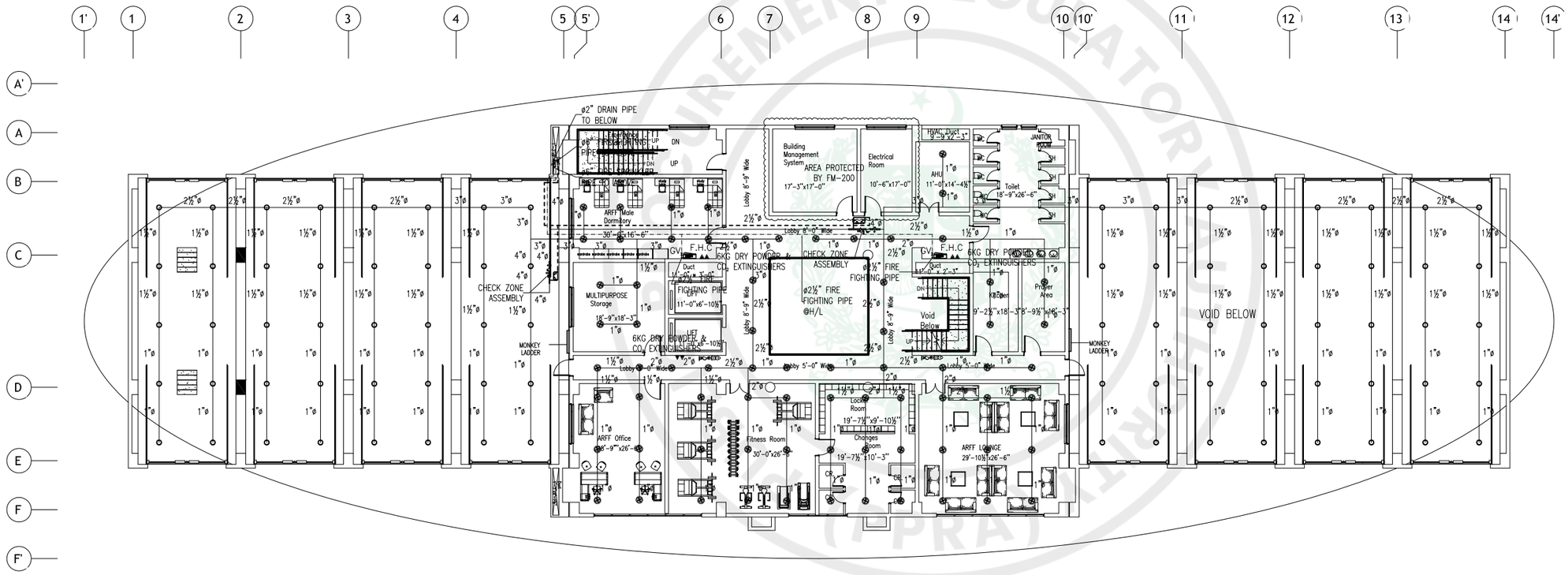

MEZZANINE FLOOR PLAN

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM MEZZANINE FLOOR PLAN

Date	April, 2026
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Approved by	M.F
Drawing No.	FF-03

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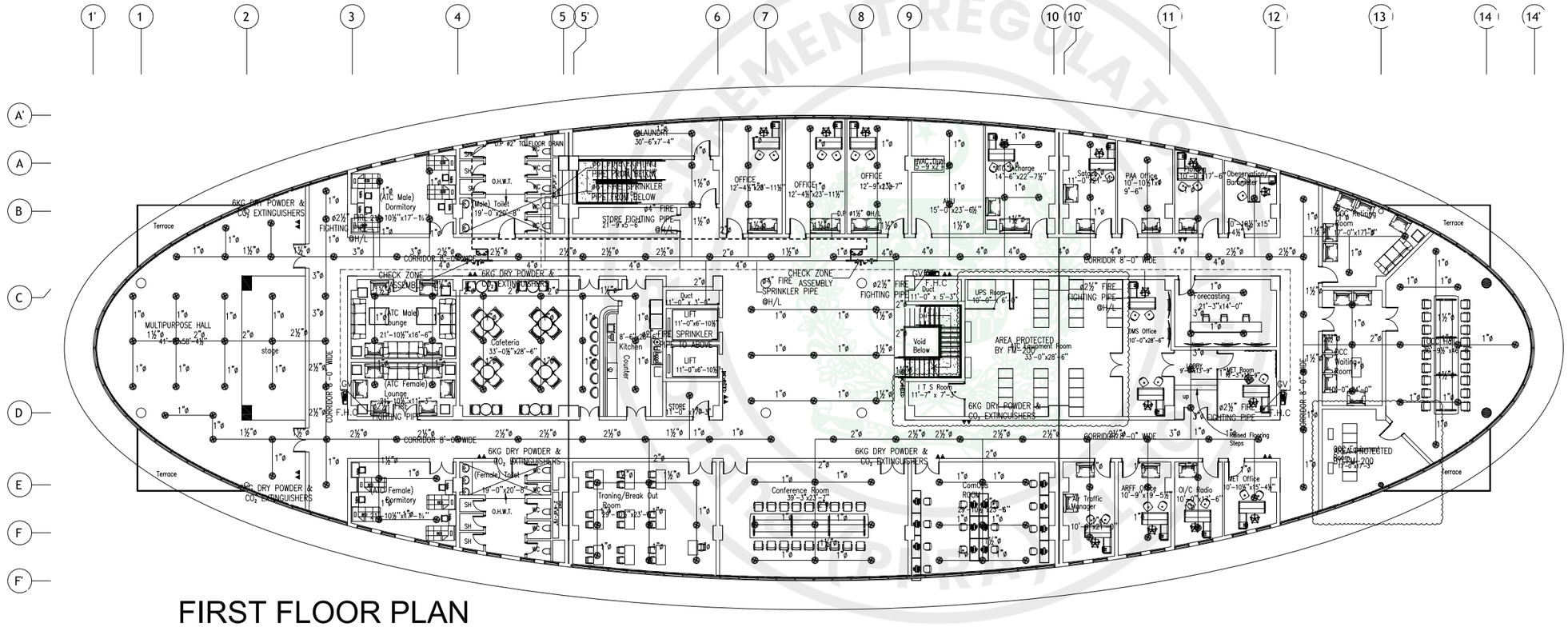

FIRST FLOOR PLAN

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM
FIRST FLOOR PLAN

Date	April, 2026
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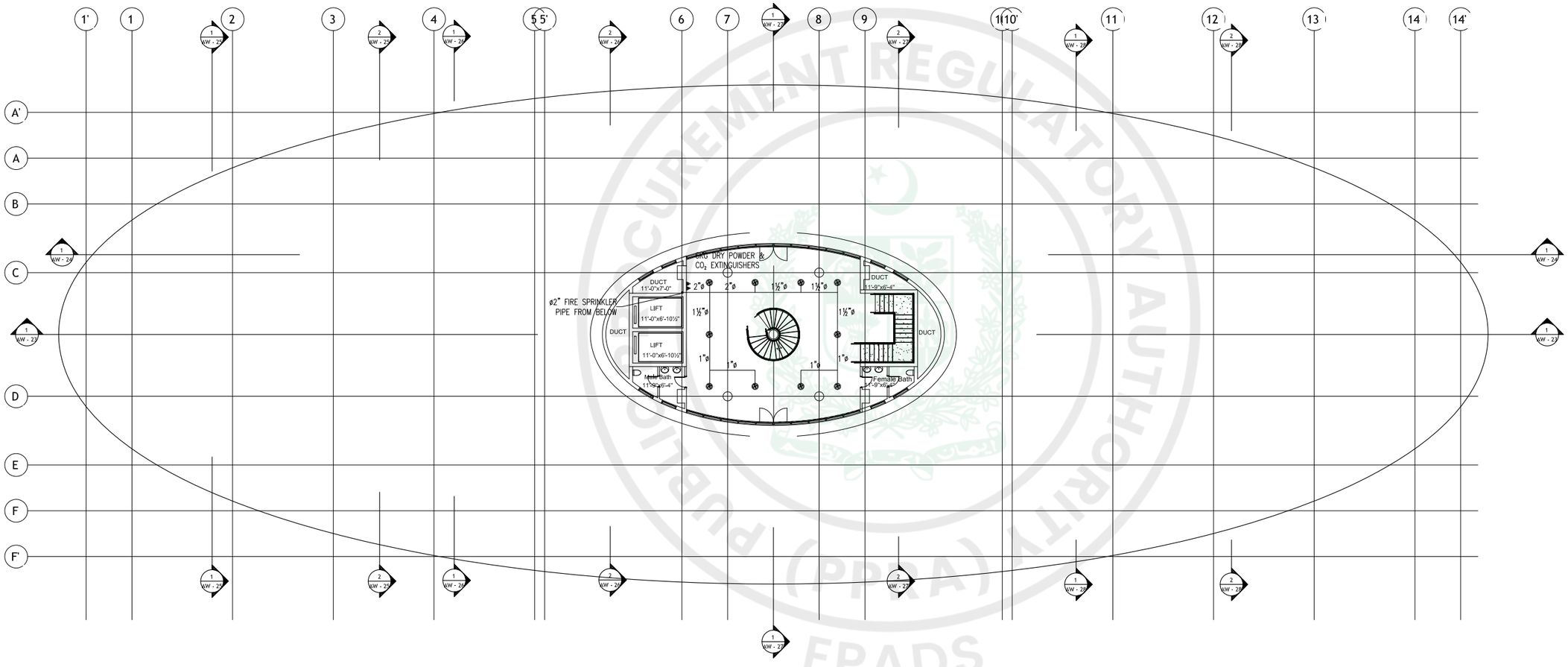

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM
ROOP TOP

Date	April, 2026
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Drawing No.	FF-05

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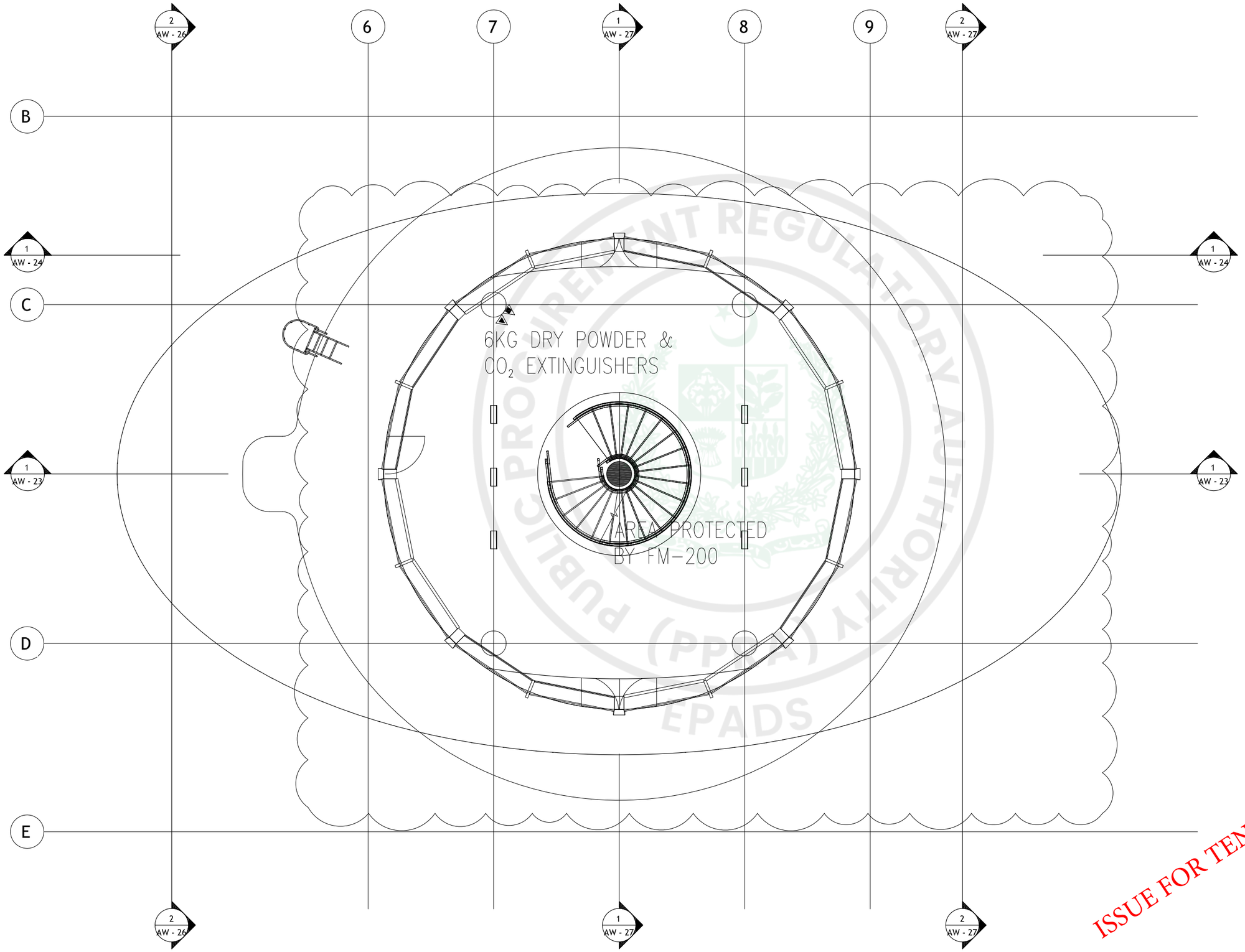

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM
ARFF FLOOR PLAN

Date	April, 2026
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Drawing No.	FF-06

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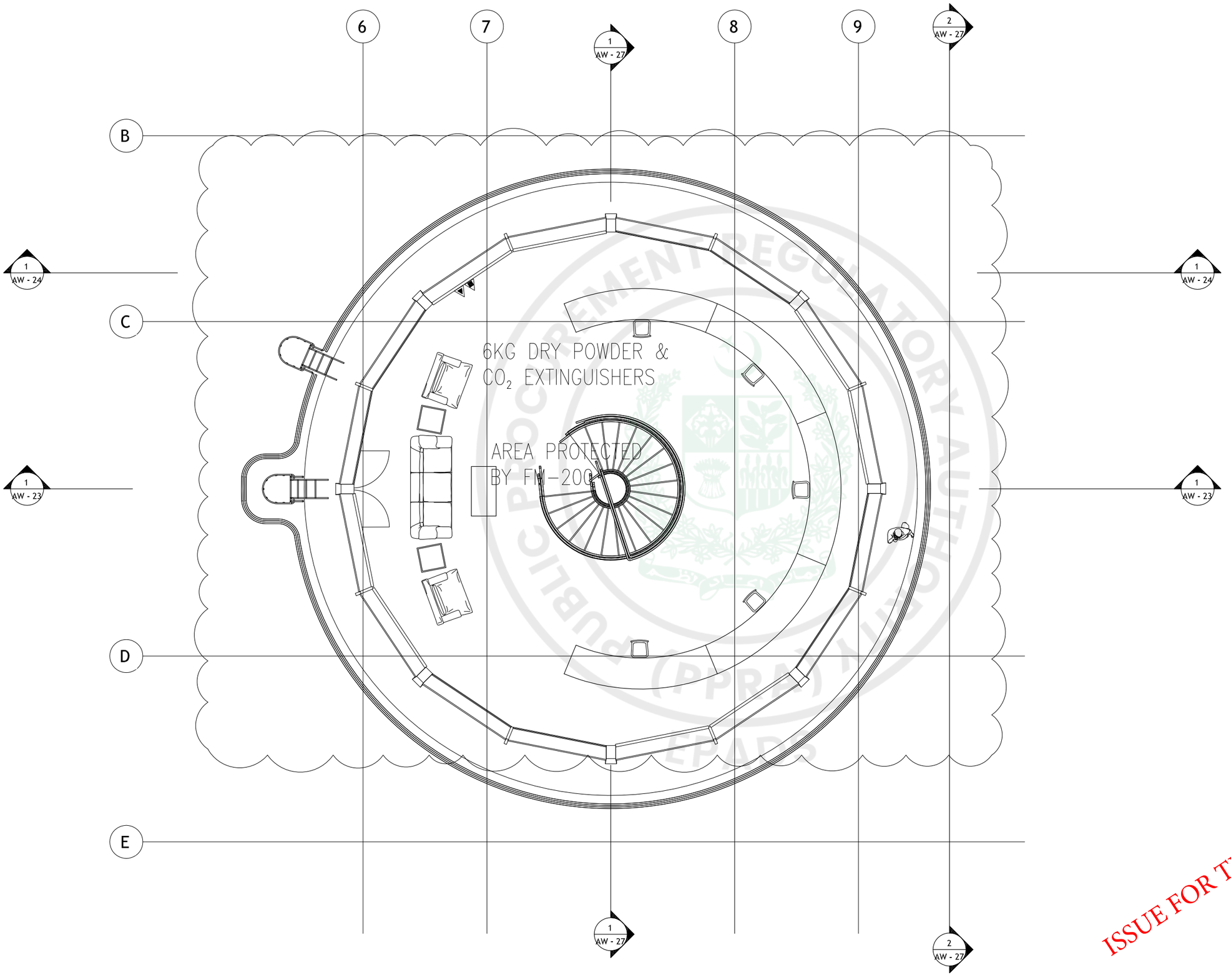

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM
ATCT FLOOR PLAN

Date	April, 2026
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Approved by	M.F
Drawing No.	FF-07

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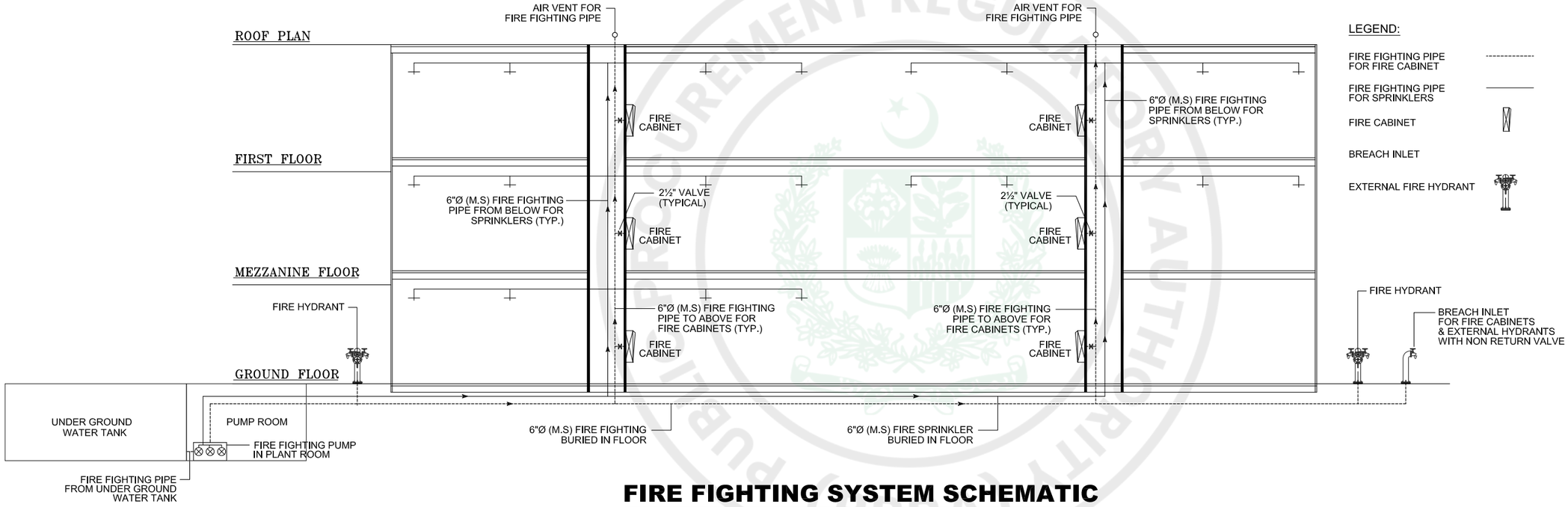

FIRE FIGHTING SYSTEM SCHEMATIC

LEGEND:

- FIRE FIGHTING PIPE FOR FIRE CABINET
- FIRE FIGHTING PIPE FOR SPRINKLERS
- FIRE CABINET
- BREACH INLET
- EXTERNAL FIRE HYDRANT

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DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM SCHEMATIC DIAGRAM

Date	April, 2026
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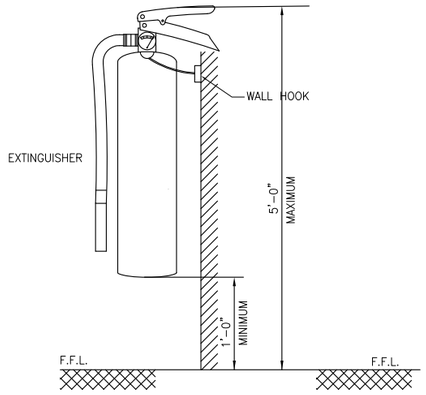
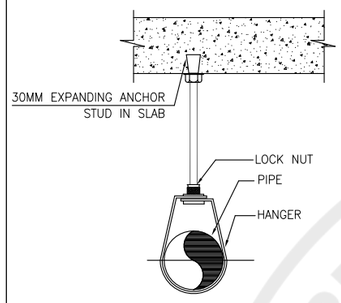
Drawing No.	FF-08

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

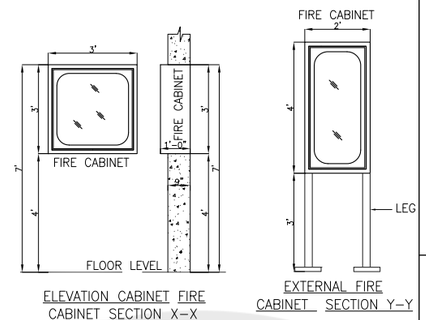


FIRE EXTINGUISHER SURFACE MOUNTED

PIPE SIZE (INCHES)	(mm)	ROD mm
1	(25)	(10)
1 1/4	(32)	(10)
1 1/2	(40)	(10)
2	(50)	(10)
2 1/2	(65)	(10)
3	(80)	(10)
4	(4")	(10)
6	(150)	(12)

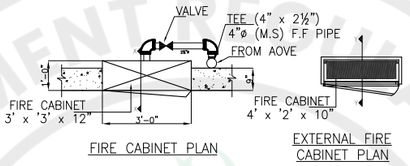


PIPE HANGING SUPPORT



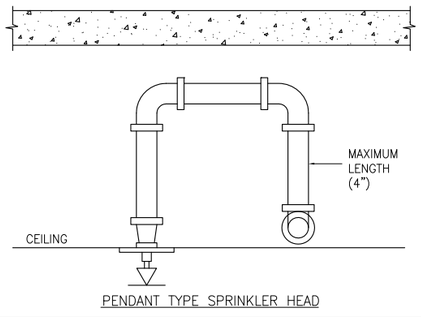
ELEVATION CABINET FIRE CABINET SECTION X–X

EXTERNAL FIRE CABINET SECTION Y–Y

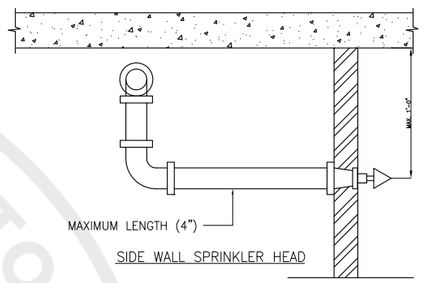


FIRE CABINET PLAN

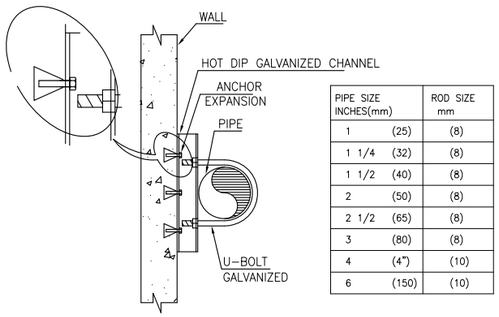
EXTERNAL FIRE CABINET PLAN



PENDANT TYPE SPRINKLER HEAD

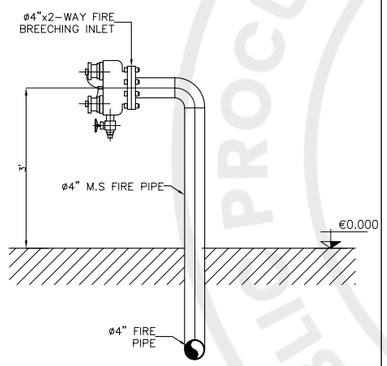


SIDE WALL SPRINKLER HEAD

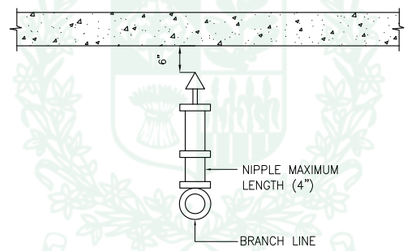


PIPE SIZE INCHES(mm)		ROD SIZE mm
1	(25)	(8)
1 1/4	(32)	(8)
1 1/2	(40)	(8)
2	(50)	(8)
2 1/2	(65)	(8)
3	(80)	(8)
4	(4")	(10)
6	(150)	(10)

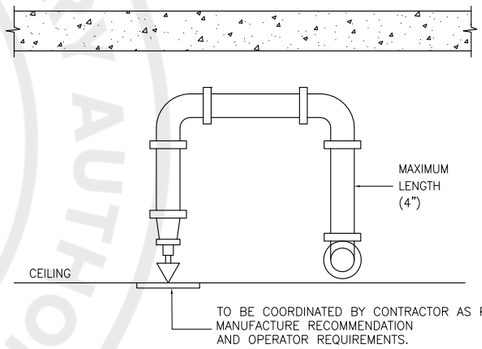
RISER SUPPORT DETAIL



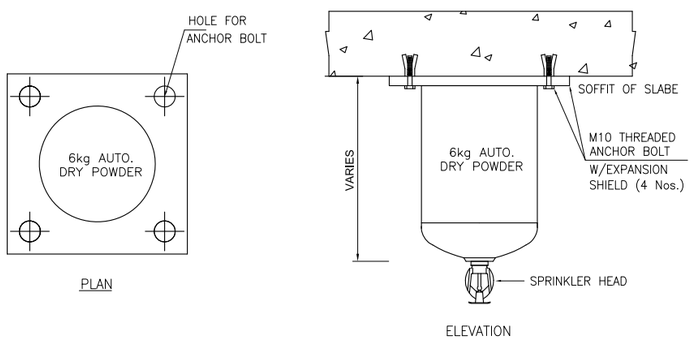
2–WAY BREECHING INLET



UPRIGHT TYPE SPRINKLER HEAD

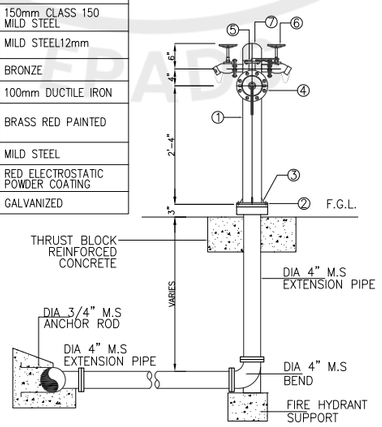


CONCEALED TYPE SPRINKLER HEAD
(WHERE IS APPLICABLE)

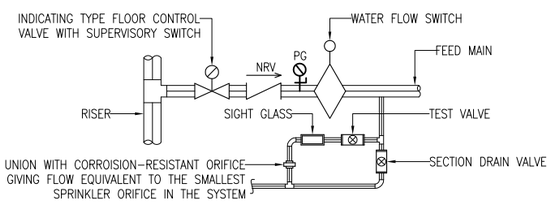


CEILING MOUNTED AUTOMATIC FIRE EXTINGUISHER

WET TYPE FIRE HYDRANT		
S.NO.	DESCRIPTION	SPECIFICATION
1	MAIN BODY	MILD STEEL
2	INLET FLANGE	150mm CLASS 150 MILD STEEL
3	TRIANGLE SUPPORT MAIN PIPE TO FLANGE	MILD STEEL12mm
4	PUMPER CONNECTION	BRONZE
5	BUTTERFLY VALVE	100mm DUCTILE IRON
6	OUTLET 2x2½" LANDING VALVE WITH FEMALE INSTANTANEOUS OUTLET TO BS 336 WITH CAP & CHAIN	BRASS RED PAINTED
7	END CAP	MILD STEEL
8	PAINT	RED ELECTROSTATIC POWDER COATING
9	NUT & BOLTS	GALVANIZED



DETAIL OF ABOVE GROUND FIRE HYDRANT



ZONE CONTROL VALVE ASSEMBLY

ISSUE FOR TENDER

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JV MEMBERS

leit-werk

COMRADES

STRUCTURAL CONSULTANT

AR ENGINEERS
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MEP CONSULTANT

ABSTRACTORS
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Cell no: 0322–3924199
E–mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

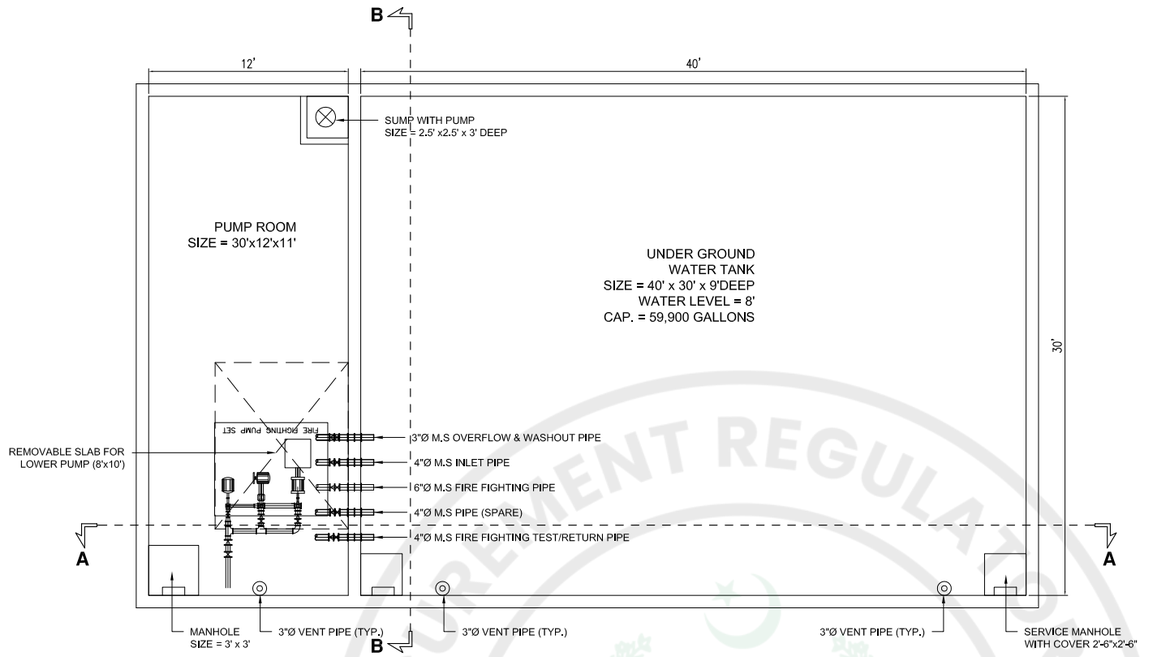
DETAILED FIRE FIGHTING Design Drawings

Sheet Name

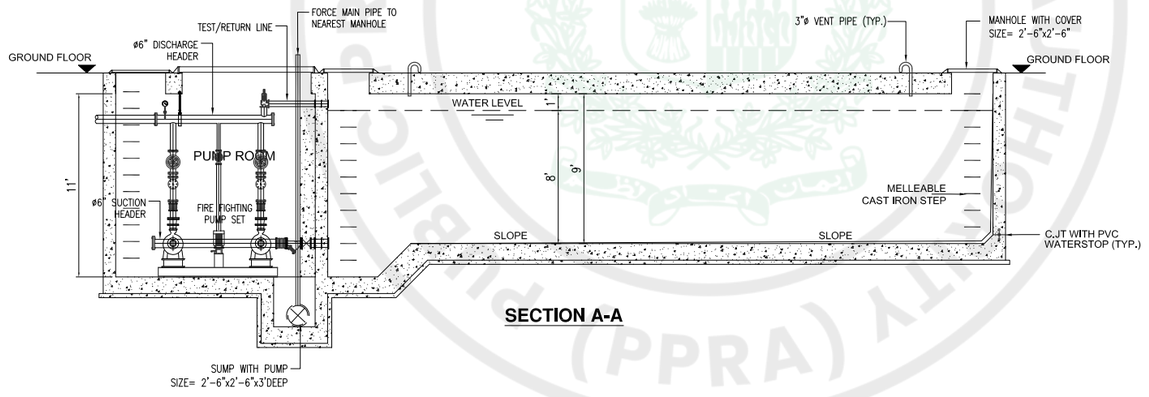
FIRE FIGHTING SYSTEM MISC. DETAILS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	FF-09

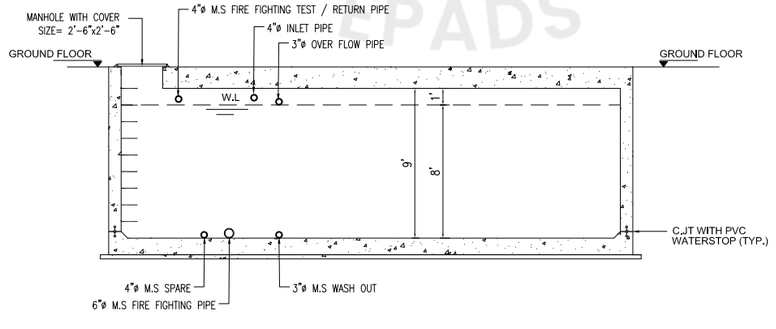
PROCUREMENT REGULATORY AUTHORITY (PPRA) PAAA



UNDER GROUND WATER TANK WITH PUMP ROOM



SECTION A-A



SECTION B-B

ISSUE FOR TENDER

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Project Name

Consultancy Services for
New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED FIRE FIGHTING Design Drawings

Sheet Name

FIRE FIGHTING SYSTEM
UNDER GROUND WATER TANK

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	FF-10

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

LEGEND AND ABBREVIATIONS

SYMBOL	ABRV.	DESCRIPTION
36x12		AIR DUCT FIGURE IS DIMENSION OF SIDE SHOWN
		DUCT TURNING UP (SUPPLY)
		DUCT TURNING UP (RETURN/EXUAUST)
		DUCT TURNING DOWN (SUPPLY)
		DUCT TURNING DOWN (RETURN/EXUAUST)
	VD	VOLUME DAMPER
	MVD	MOTORISED VOLUME DAMPER
	FD	FIRE DAMPER
	AL	ACCOUSTIC LINING SIZE SHOWN IS CLEAR INSIDE DIMENSIONS
	FC	FLEXIBLE DUCT CONNECTION
R(D)		INCLINED RISE (DROP) IN THE DIRECTION OF FLOW
	TV	ELBOW WITH TURNING VANES
		SECTION THRU SUPPLY/O.A. DUCT
48x12		SECTION THRU EXHAUST/RETURN DUCT ARROW SIZE WRITTEN FIRST
		FLEXIBLE CONNECTION IN PIPING
		CHECK VALVE
		CIRCUIT SETTER TYPE BALANCING VALVE
		GATE VALVE
		GLOBE VALVE
		STEAM TRAP
NC NO		PRESSURE RELIEF VALVE
		3 WAY AUTOMATIC CONTROL VALVE. C. COMMON NO. NORMALLY OPEN , NC NORMALLY CLOSED
		VALVE OPEN
		VALVE CLOSED
		PRESSURE REDUCING VALVE
		DRAIN COCK
	TF	WELL FOR TEST FITTING
		STRAINER
		SECTION THRU PIPE
		REDUCER IN PIPE
H		HOT WATER PIPE
HR		HOT WATER RETURN PIPE
C		CONDENSER WATER SUPPLY PIPE
CR		CONDENSER WATER RETURN PIPE
CH		WATER PIPE, SUPPLY (LETTER IDENTIFY THE FLUID)
CHR		WATER PIPE, RETURN (LETTER IDENTIFY THE FLUID)
CD		CONDENSATE DRAIN
RD		REFRIGERANT DISCHARGE
RS		REFRIGERANT SUCTION
AP	AP	ACCESS PANEL IN FALSE CEILING
AHU 3		EQUIPMENT IDENTIFICATION AIR HANDLING UNIT NO.3
3 02		REFER TO DETAIL 3 OF DRAWING NO.2
4 M5		SECTION LINE, SECTION DRAWN AS 4 OF DRAWING NO.5
		PUMP
	MRD	MOTORISED RELIEF DAMPER
		FILTER
	TG	TRANSFER GRILLE
		VIBRATION ISOLATOR
	BDD	BACK DRAFT DAMPER
		THERMOMETER IN PIPE
		FLOW MEASURING INSTRUMENT
	MCC	MOTOR CONTROL CENTRE
	ACP	APPARATUS CONTROL PANEL
	EF	EXHAUST FAN
	EF	EXHAUST FAN WITH BACK DRAFT DAMPER
PR	PR	PRESSURE SWITCH
	CH	CHILLED/HOT WATER SUPPLY

SYMBOL	ABRV.	DESCRIPTION
	P	PUMP
	B	STEAM BOILER
	HX	HEAT EXCHANGER
	CRP	CONDENSATE RETURN PUMP
	CF	CHEMICAL FEEDER
	CT	COOLING TOWER
	ET	EXPANSION TANK
	AS	AIR SEPARATOR
	CHR	CHILLED WATER RETURN
T		THERMOSTAT
S		SENSOR
		PRESSURE GAUGE
24x18 500 A		SUPPLY AIR OUTLET,24x18INCH CORE SIZE-500 CFM CODE "A" AS LISTED IN EQUIPMENT SCHEDULE
40x12 800 J		RETURN/EXHAUST AIR INLET,40x12INCH CORE SIZE SIZE 800 CFM CODE "J" AS LISTED IN EQUIPMENT SCH.
	O.A	O.A INLET/EA OUTLET LOUVRE
DL 45		DOOR LOUVRE AREA IN SQUARE FT
CU		UNDER CUT-1 INCH(25mm) MIN.
	SIS	SECONDARY CIRCUIT NO. 1 SUPPLY
	SIR	SECONDARY CIRCUIT NO. 1 RETURN
	C	CONDENSER WATER SUPPLY
	CR	CONDENSER WATER RETURN
	PLS	LOW PRESSURE STEAM
	LPCR	LOW PRESSURE CONDENSATE RETURN
	F.B	FILTER BOX
	FS	FAN SECTION
	MXB	MIXING BOX
	(TYP.4)	QUANTITY 4 OF TYPICAL CHARACTERISTICS
		TWO WAY CONTROL VALVE
	PU	PRESSURRIZATION UNIT
	HUM	HUMIDIFIER
CF	CF	CHEMICAL FEEDER
	FCU	FAN COIL UNIT
	EA	EXHAUST AIR
	SA	SUPPLY AIR
	RA	RETURN AIR
	OA	OUTDOOR AIR
		MANUAL VOLUME DAMPER
		MOTORISED FACE & BYPASS DAMPER
T		DUCT TEMPERATURE SENSOR
MRD		MOTORISED RELIEF DAMPER
FS		FLOW SWITCH WATER
FRS		FIRE STAT
FST		FAN STARTER
SD		SMOKE DETECTOR
PDS		PRESSURE DIFFERENTIAL SWITCH
	ES	ENTHALPY SENSOR
	CHC	COOLING-HEATING COIL
	RHC	RE-HEAT COIL
M		MOTOR
MD		MOTORISED DAMPER

SYMBOL	ABRV	DESCRIPTION
	EF	EXHAUST FAN WITH BACK DRAFT DAMPER
	PR	PRESSURE SWITCH
	CH	CHILLED/HOT WATER SUPPLY
	RHC	RE-HEAT COIL
M		MOTOR
MD		MOTORISED DAMPER
DDC		DIRECT DIGITAL CONTROL
ZT		ZONE/SPACE TEMP SENSOR/THERMOSTAT
		3-WAY MOTORISED VALVE
D19		SPACE NUMBERS
R-30		RISER NO.
	AHFC	AIR HANDLER FAN COIL
	CPR	CENTRAL PLANT ROOM

LIST OF DRAWINGS

SR. NO.	DRAWING NO.	REV NO.	DRAWING TITLE	REMARKS
1	IEST/310/AAA/TD/01	1	HVAC – LEGEND, LIST OF DRAWINGS AND GENERAL NOTES	
2	IEST/310/AAA/TD/02	1	HVAC – GROUND FLOOR PLAN	
3	IEST/310/AAA/TD/03	1	HVAC – MEZZANINE FLOOR PLAN	
4	IEST/310/AAA/TD/04	1	HVAC – FIRST FLOOR PLAN	
5	IEST/310/AAA/TD/05	1	HVAC – CONTROL CABIN (AT LEVEL 43'-6")	
6	IEST/310/AAA/TD/06	1	HVAC – CONTROL CABIN (AT LEVEL 53'-6")	
7	IEST/310/AAA/TD/07	1	HVAC – CONTROL CABIN (AT LEVEL 65'-6")	
8	IEST/310/AAA/TD/08	1	HVAC – PIPING SCHEMATIC FOR BUILDING	
9	IEST/310/AAA/TD/09	1	HVAC – PIPING SCHEMATIC FOR CENTRAL PLANT ROOM	
10	IEST/310/AAA/TD/10	1	HVAC – CENTRAL PLANT ROOM (CPR)	
11	IEST/310/AAA/TD/11	1	HVAC – CENTRAL PLANT ROOM ROOF (CPR)	
12	IEST/310/AAA/TD/12	1	HVAC – ELECTRICAL & CONTROL SCHEMATIC	
13	IEST/310/AAA/TD/13	1	HVAC – DETAILS I	
14	IEST/310/AAA/TD/14	1	HVAC – DETAILS II	

NOTES:

1. THESE DRAWINGS ARE ONLY FOR BIDDING PURPOSE. THE LAYOUTS SHOWN ON THESE DRAWINGS ARE INDICATIVE ONLY. SHOP DRAWINGS. FOR INSTALLATION SHALL BE PREPARED BY THE CONTRACTOR
2. ALL DIMENSIONS ARE IN INCHES UNLESS INDICATED OTHERWISE .
3. READ THIS DRAWING IN CONJUNCTION WITH ALL RELEVANT PROJECT DRAWINGS. INCLUDING ARCHITECTURAL , STRUCTURAL , ELECTRICAL PLUMBING, INTERIORS.
4. FOR ELEVATIONS AND SECTIONS OF THE BUILDING REFER TO RELEVANT ARCHITECURAL DRAWINGS.
5. FALSE CEILING/ BULKHEAD(BOXING) TO BE PROVIDED BY OTHERS TO CONCEAL HVAC DUCTS, PIPING AND EQUIPMENTS.
6. ACCESS PANEL SHALL BE PROVIDED BY OTHERS IN FALSE CEILING/BULKHEAD BOXING AT ALL EQUIPMENTS, DAMPERS AND VALVES LOCATIONS – HVAC CONTRACTOR TO GIVE SIZE AND LOCATIONS.
7. WATER SUPPLY POINTS SHALL BE PROVIDED BY OTHERS, INSIDE PLANT ROOM, AND NEAR EACH AHU
8. ALL DRAIN PIPING REQUIRED FROM EQUIPMENT IN CENTRAL PLANT ROOM AND OTHER EQUIPMENT SHALL BE TERMINATED AT PLUMBING DRAIN POINTS BY HVAC CONTRACTOR.
9. 33x18 INCHES INSIDE CLEAR BULKHEADS FOR CONCEALMENT OF FCU's WILL BE PROVIDED BY OTHERS. FOR DETAILS SEE ARCH DRGS.
10. SUPPLY GRILLES OF FCU WILL BE SAME AS FCU DISCHARGE SIZE UNLESS OTHERWISE INDICATED.
11. RETURN AIR GRILLE FOR FCUs HINGED WITH FILTER SHALL BE INSTALLED AT BOTTOM OF BULKHEAD , UNLESS OTHERWISE SPECIFIED/SHOWN.
12. DOOR LOUVERS OF SIZES SPECIFIED/SHOWN WILL BE PROVIDED BY OTHERS.
13. ROOM THERMOSTAT AND TEMP SENSORS FOR FCU SHALL BE INSTALLED AT HEIGHT BETWEEN 4FT TO 6FT FROM FLOOR AT LOCATIONS ADVISED BY ARCHITECT.
14. CONDEENSATE DRAIN PIPING OF AHUs/FCUs (CD) SHALL BE TERMINATED IN NEAREST TOILET AREA AS SHOWN, AT CEILING HEIGHT. FROM THIS POINT ONWARD IT WILL BE PICKED UP BY OTHERS UNDER PLUMBING SPECS FOR APPROPRIATE DISPOSAL.
15. ALL HVAC DRAWINGS ARE ISSUED TO DEFINE DESIGN INTENT ONLY. ALL EQUIPMENT LOCATIONS, ROUTING, AND LAYOUTS SHOWN ARE INDICATIVE AND SCHEMATIC UNLESS EXPLICITLY DIMENSIONED.
16. HVAC LAYOUTS ARE BASED ON INFORMATION AVAILABLE AT THE TIME OF DESIGN. ANY SUBSEQUENT ARCHITECTURAL, STRUCTURAL, OR SERVICES CHANGES SHALL BE COORDINATED THROUGH SHOP DRAWINGS. DO NOT SCALE DRAWINGS. ONLY WRITTEN DIMENSIONS, LEVELS, AND SCHEDULES SHALL GOVERN.
17. LOCATIONS OF AHUS, FCUS, FAHUS, EXHAUST FANS, PUMPS, CHILLERS, AND ALL HVAC EQUIPMENT SHOWN ON DRAWINGS ARE CONCEPTUAL PLACEHOLDERS FOR DESIGN REFERENCE ONLY.
18. CONTRACTOR IS FULLY RESPONSIBLE FOR FINALIZING EXACT EQUIPMENT LOCATIONS, SERVICE CLEARANCES, ACCESS FOR INSTALLATION AND MAINTENANCE, AND COORDINATION WITH ALL OTHER TRADES. EQUIPMENT SHALL NOT BE INSTALLED UNTIL COORDINATED SHOP DRAWINGS ARE PREPARED AND REVIEWED.
19. CONTRACTOR SHALL COORDINATE HVAC WORKS WITH ARCHITECTURAL, STRUCTURAL, ELECTRICAL, PLUMBING, FIRE PROTECTION, AND CEILING LAYOUTS.
20. NO PENETRATIONS OR OPENINGS SHALL BE MADE IN STRUCTURAL OR ARCHITECTURAL ELEMENTS WITHOUT PRIOR COORDINATION AND APPROVAL.
21. ANY DISCREPANCY BETWEEN HVAC AND OTHER DISCIPLINE DRAWINGS SHALL BE REPORTED BEFORE EXECUTION. CONFLICTS BETWEEN HVAC AND OTHER DISCIPLINES SHALL BE RESOLVED THROUGH COORDINATED SHOP DRAWINGS PRIOR TO INSTALLATION. INSTALLATION WITHOUT COORDINATION SHALL BE ENTIRELY AT THE CONTRACTOR'S RISK.
22. AHU ROOMS SHALL PROVIDE MINIMUM SERVICE CLEARANCES AS PER MANUFACTURER'S RECOMMENDATIONS, INCLUDING ACCESS FOR FILTER REMOVAL, COIL WITHDRAWAL, FAN AND MOTOR SERVICING.
23. FCUS ABOVE CEILINGS SHALL BE COORDINATED WITH CEILING GRIDS, LIGHTING, SPRINKLERS, AND ACCESS PANELS. ADEQUATE ACCESS SHALL BE PROVIDED FOR VALVES, FILTERS, AND CONTROLS.
24. CONTRACTOR SHALL SUBMIT FULLY COORDINATED HVAC SHOP DRAWINGS SHOWING EXACT EQUIPMENT LOCATIONS, ROUTING, SUPPORTS, ACCESS CLEARANCES, AND INTERFACES WITH OTHER TRADES.
25. SHOP DRAWINGS SHALL BE COORDINATED WITH ALL DISCIPLINES PRIOR TO SUBMISSION. WHERE SPACE LIMITATIONS EXIST, THE CONTRACTOR SHALL PROPOSE SOLUTIONS THROUGH SHOP DRAWINGS.
26. NO REDUCTION IN ACCESS OR SERVICE CLEARANCE SHALL BE PERMITTED WITHOUT WRITTEN APPROVAL.
27. MANUFACTURER'S DATA, DIMENSIONS, WEIGHTS, AND INSTALLATION REQUIREMENTS SHALL BE SUBMITTED FOR ALL MAJOR EQUIPMENT.
28. INSTALL HVAC SYSTEMS IN ACCORDANCE WITH APPROVED SHOP DRAWINGS, MANUFACTURER'S INSTRUCTIONS, AND APPLICABLE CODES.
29. PROVIDE VIBRATION ISOLATION, FLEXIBLE CONNECTIONS, AND ACOUSTIC TREATMENT WHERE REQUIRED.
30. ROUTE PIPING, DUCTS, DRAINS, AND CABLING NEATLY WITH PROPER SLOPES, INSULATION, AND ACCESSIBILITY.
31. CONTRACTOR SHALL VERIFY SITE CONDITIONS PRIOR TO FABRICATION AND INSTALLATION. ANY FIELD MODIFICATION REQUIRED DUE TO SITE CONSTRAINTS SHALL BE COORDINATED AND APPROVED BEFORE EXECUTION.
32. UNAUTHORIZED DEVIATIONS SHALL BE CORRECTED AT THE CONTRACTOR'S COST.
33. PROVIDE COMPLETE AS-BUILT HVAC DRAWINGS REFLECTING ACTUAL INSTALLED CONDITIONS.
34. AS-BUILT DRAWINGS SHALL INCLUDE FINAL EQUIPMENT LOCATIONS, ROUTING CHANGES, VALVES, AND ACCESS PANELS.
35. APPROVAL OF DRAWINGS DOES NOT RELIEVE THE CONTRACTOR OF COORDINATION, CONSTRUCTABILITY, AND COMPLIANCE RESPONSIBILITY. APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR THE ACCURACY, COORDINATION, COMPLIANCE WITH CODES AND SPECIFICATIONS, AND, FITNESS FOR PURPOSE
36. FCU AT CONTROL TOWER CABIN SHALL BE DUCTED TYPE, INSTALLATION NEED CONSULTANT APPROVAL.

ISSUE FOR TENDER

GOVERNMENT REGULATORY AUTHORITY EPADS

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TITLE PAGE:

HVAC DESIGN DRAWINGS

CLIENT NAME

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E-mail: abstractorseng@gmail.com

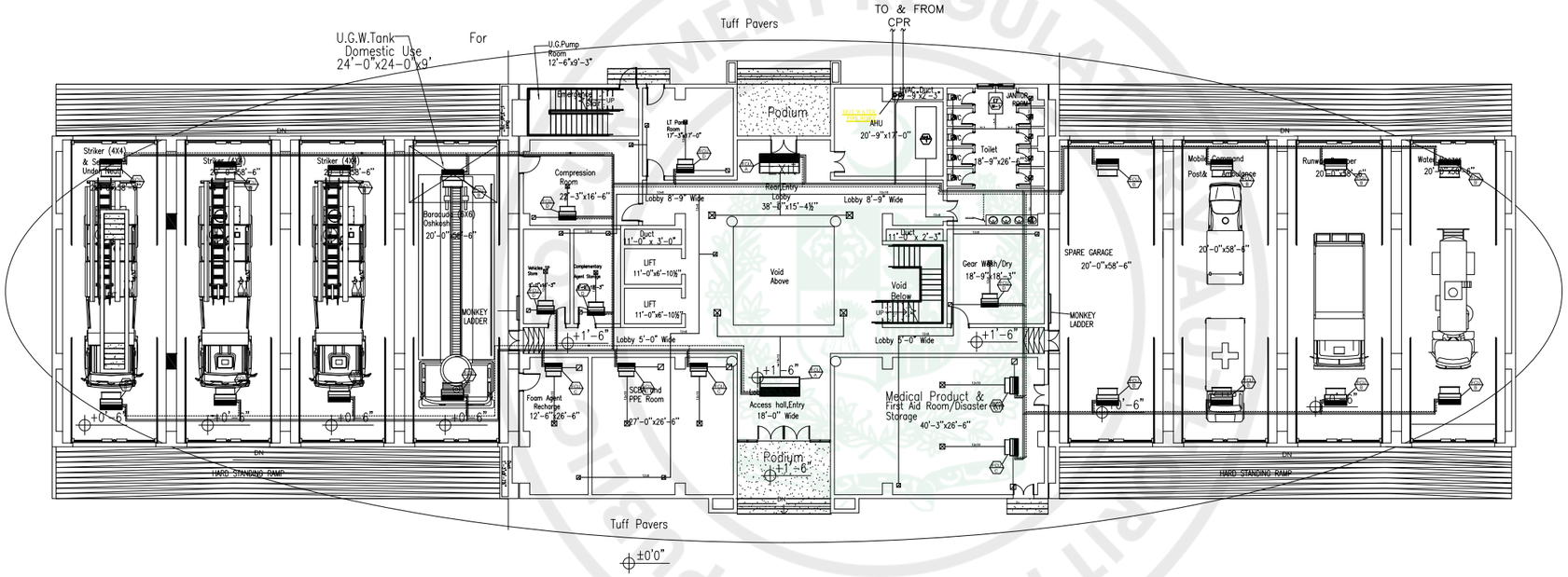
Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

LEGENDS, LIST OF DRAWING & GENERAL NOTES

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/01



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Anwar Ali Architects (Pvt.) Ltd.
Consulting,Architects,Engineers
Planners & Management Consultants
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JV MEMBERS

leit-werk
COMRADES

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Project Name

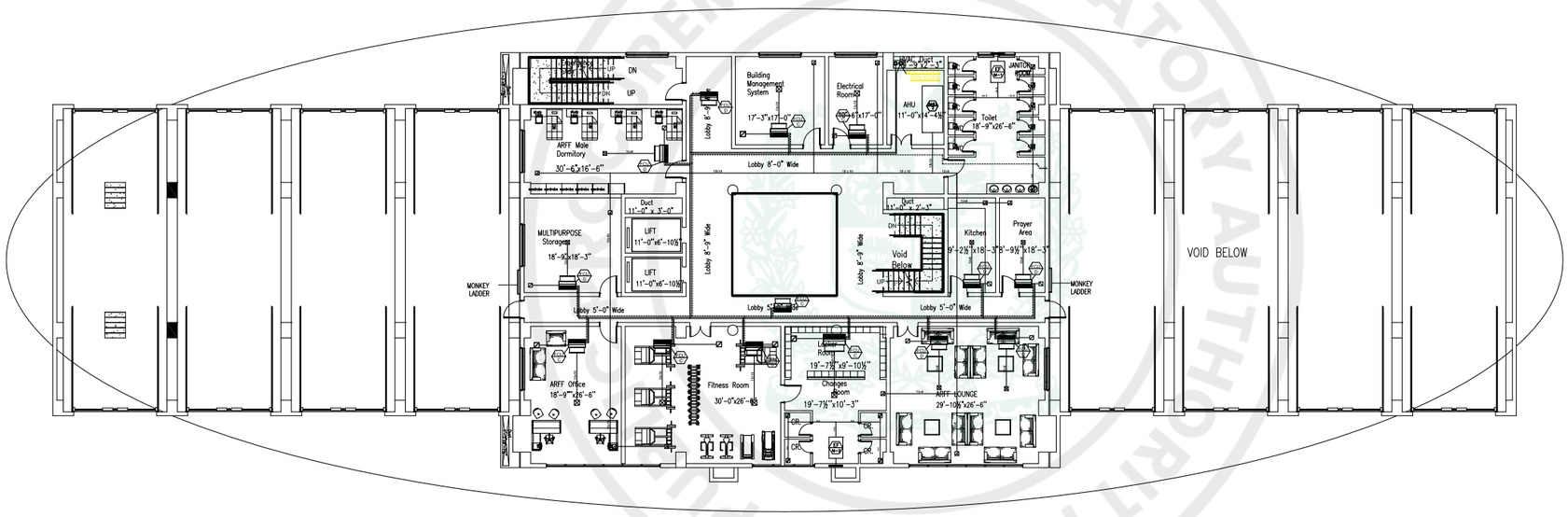
Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - GROUND FLOOR PLAN

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/02

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



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Project Name

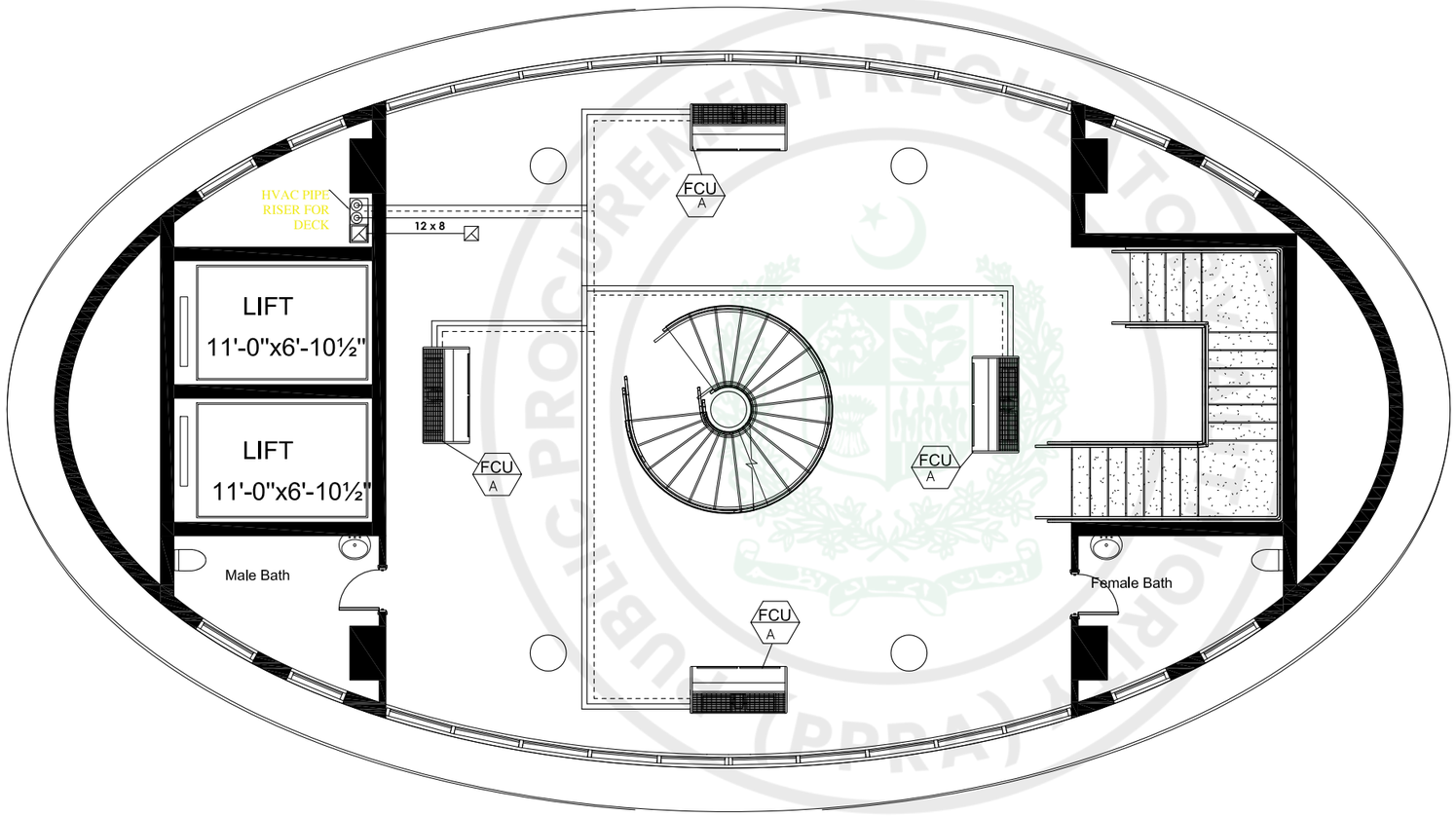
Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - MEZZANINE FLOOR PLAN

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/03

Public Procurement Regulatory Authority (PPRA) EPADS



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PUBLIC (PPRA)
EPADS

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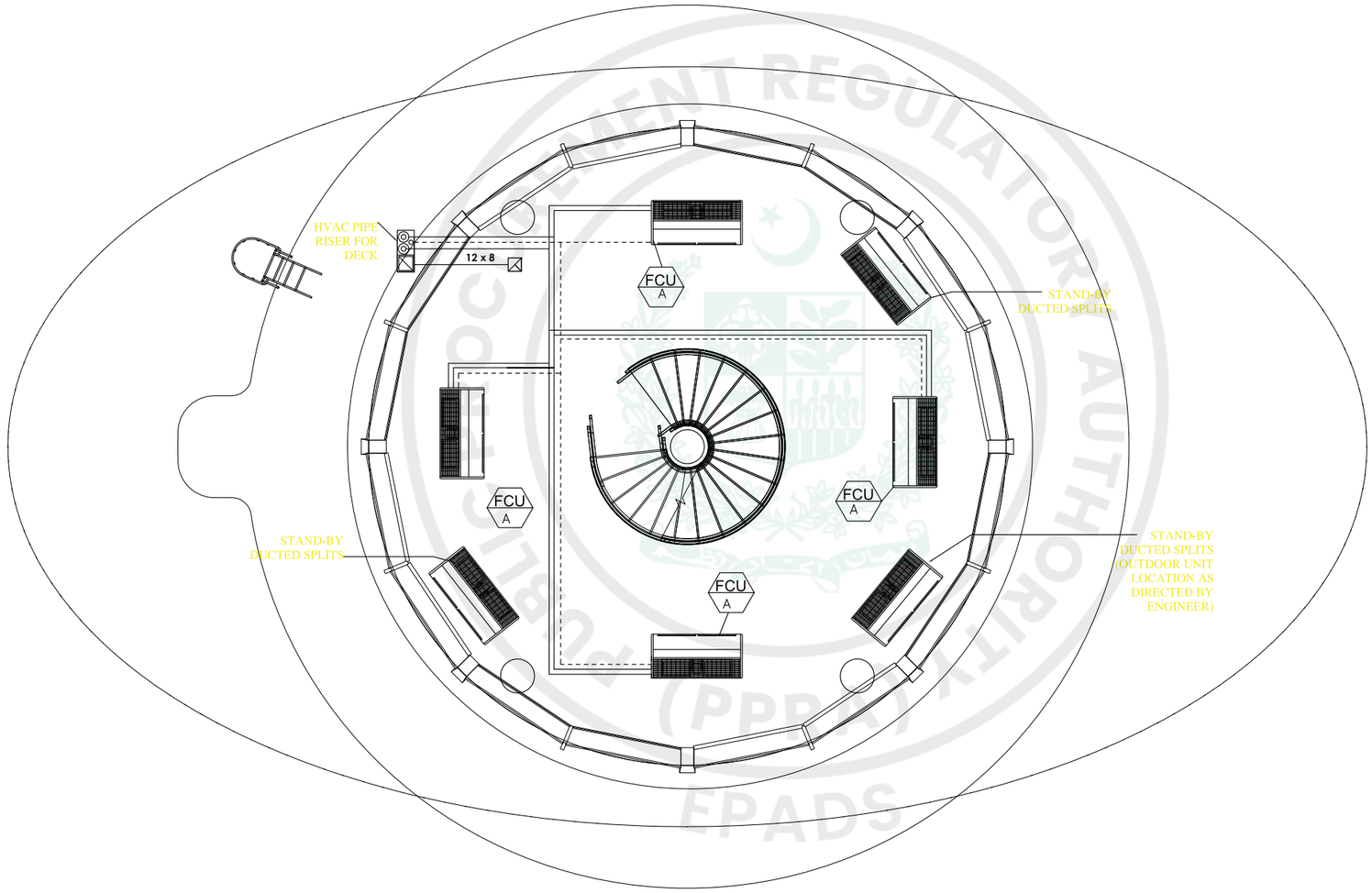
Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - ROOF & CONTROL CABIN

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/05



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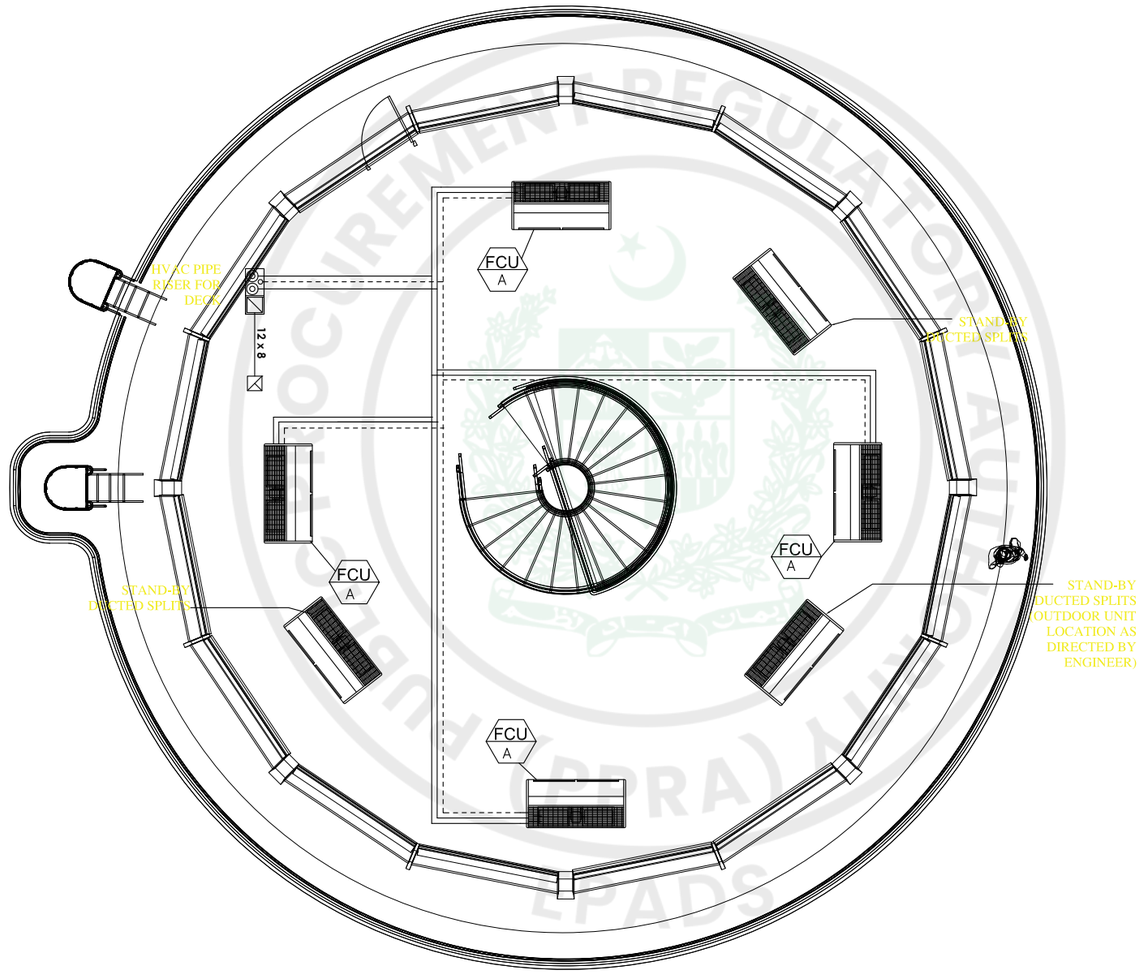
Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - ARFF CABIN

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/06



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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - ATCT CABIN

Date	27 April, 2026
Scale	NTS
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FLOOR AT 65′-6″

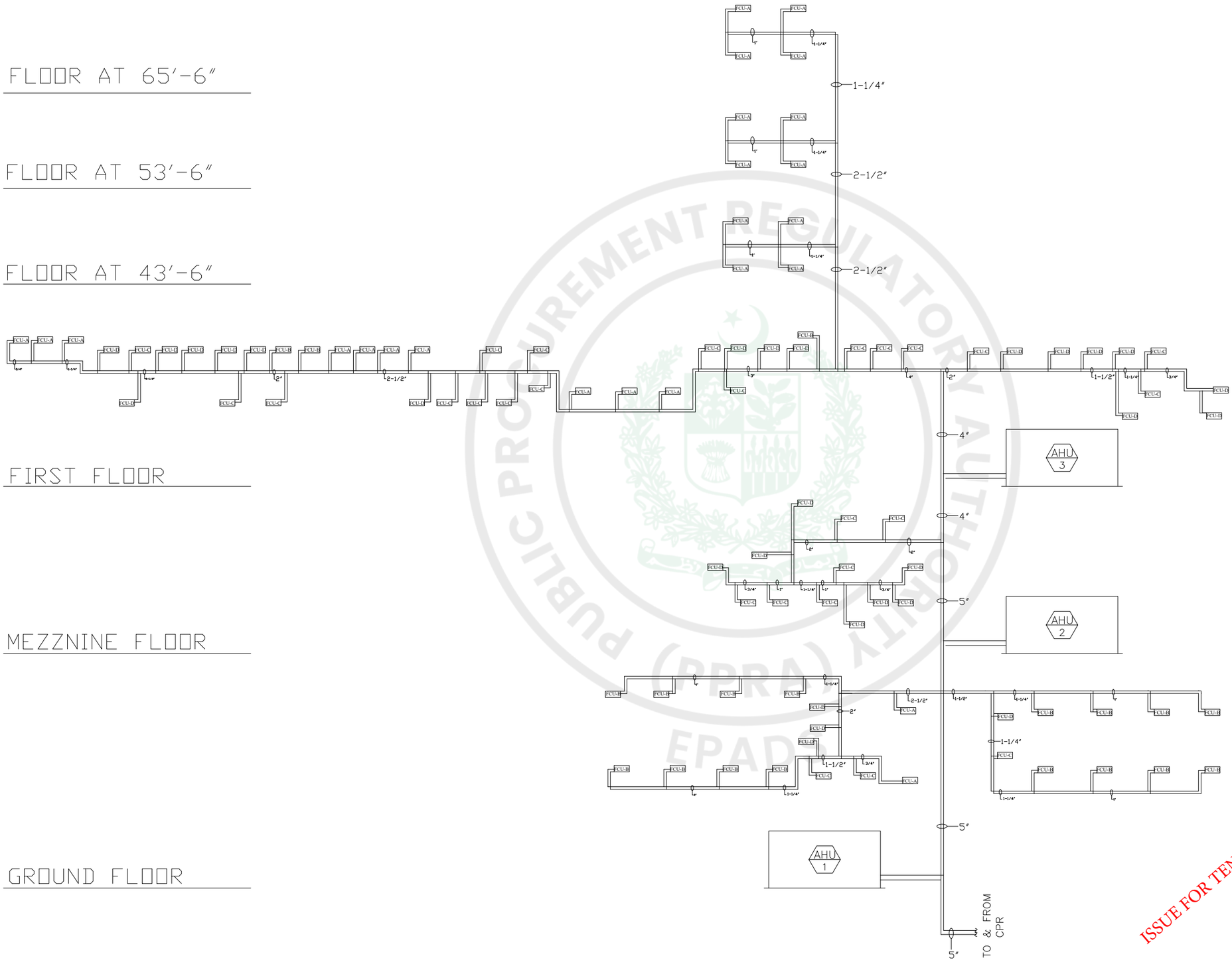
FLOOR AT 53′-6″

FLOOR AT 43′-6″

FIRST FLOOR

MEZZNINE FLOOR

GROUND FLOOR



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MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - PIPING SCHEMATIC

Date	27 MARCH, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/08

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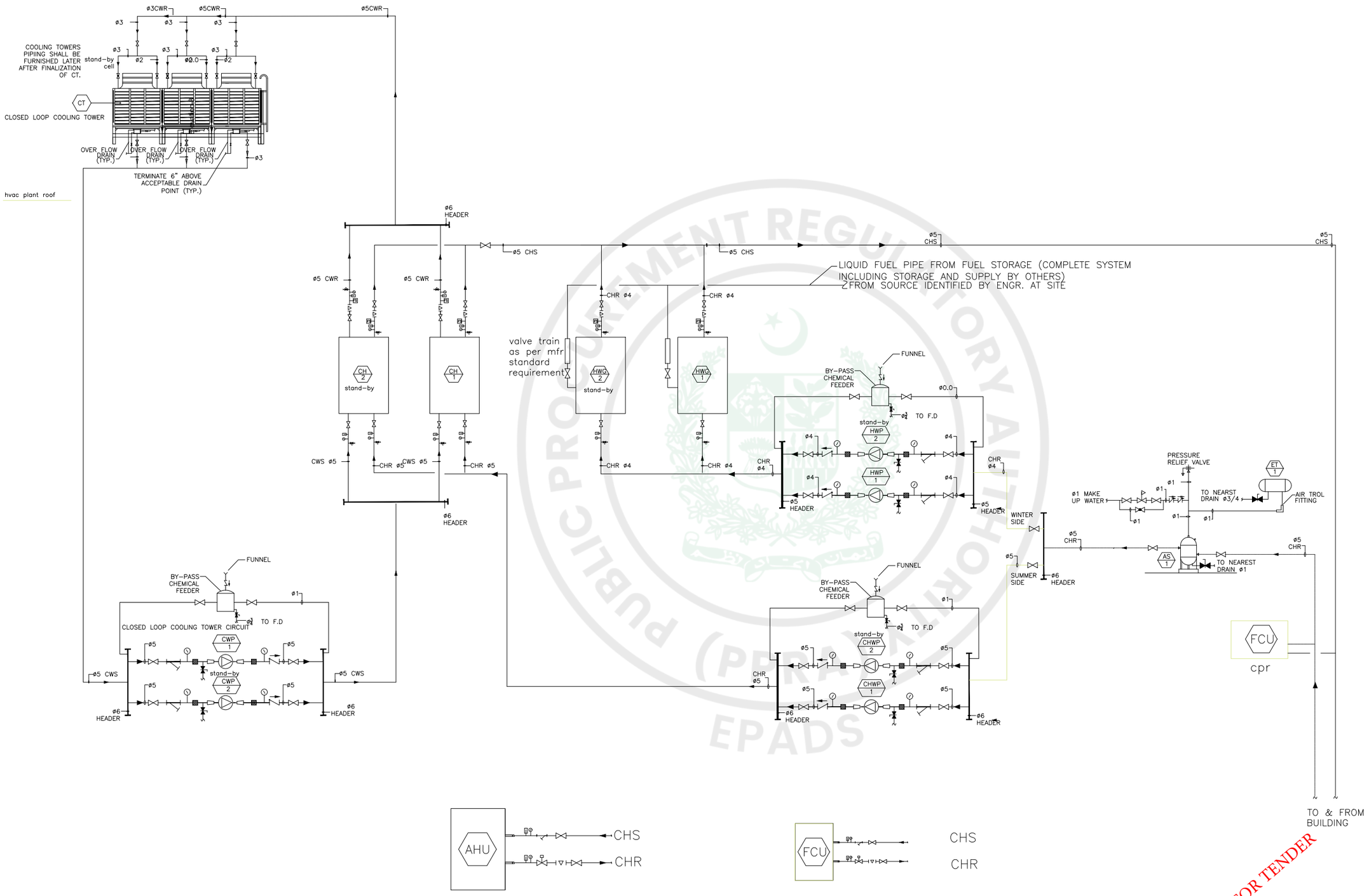

TYPICAL AHU

TYPICAL FCU

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STRUCTURAL CONSULTANT

MEP CONSULTANT

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Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC-PIPING SCHEMATIC FOR CENTRAL PLANT ROOM (CPR)

Date	27 MARCH, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/09

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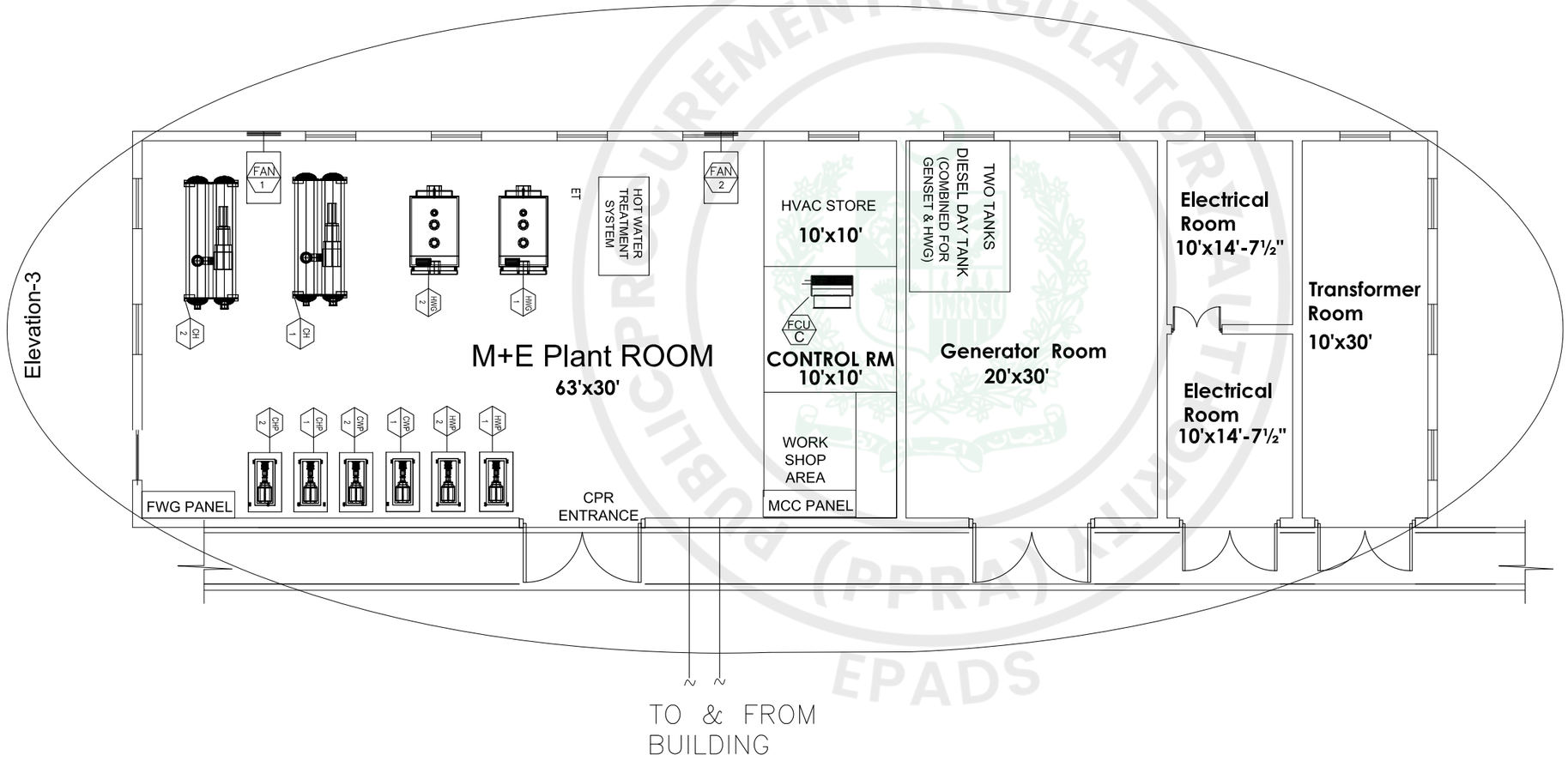

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - CENTRAL PLANT ROOM (CPR)

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/10

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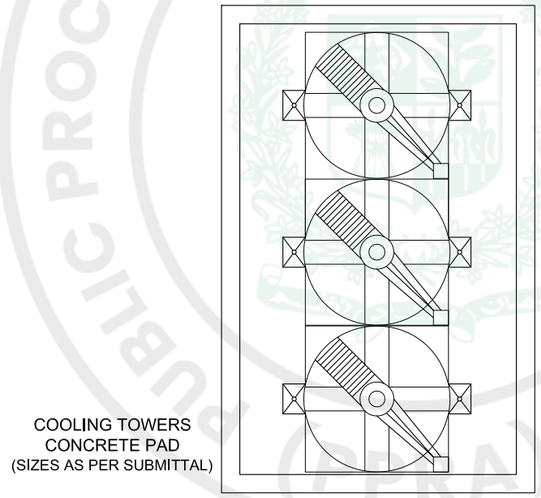

COOLING TOWERS
CONCRETE PAD
(SIZES AS PER SUBMITTAL)

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Project Name

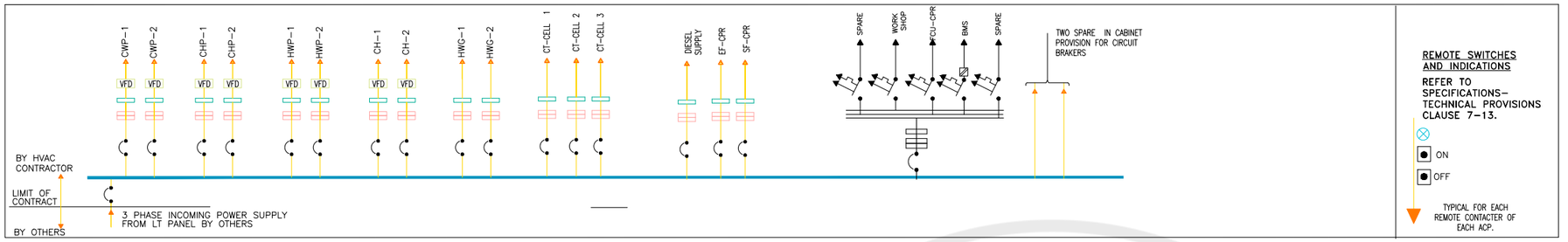
Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - CENTRAL PLANT ROOM ROOF

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/11

PROCUREMENT REGULATORY AUTHORITY
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA)
EPADS



REMOTE SWITCHES AND INDICATIONS

REFER TO SPECIFICATIONS–TECHNICAL PROVISIONS CLAUSE 7-13.

ON

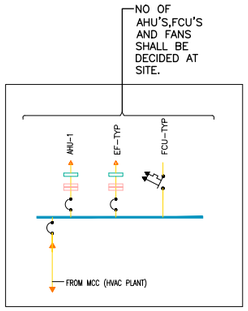
OFF

TYPICAL FOR EACH REMOTE CONTACTER OF EACH ACP.

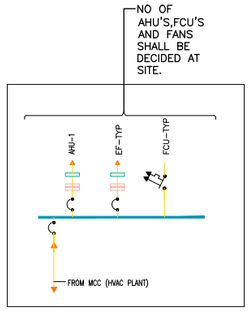
LEGEND:

- CIRCUIT BREAKER (3 PHASE)
- CIRCUIT BREAKER (1 PHASE)
- CONTACTOR
- RELAY
- BUS BAR
- LOCAL ISOLATING SWITCH
- VOLTAGE STABILIZER
- INDICATING LIGHT
- SUPPLY

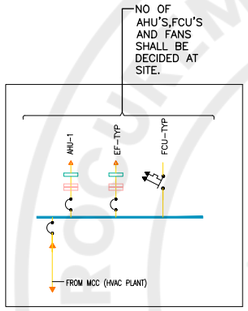
01/08 MCC
LOCATION: PLANT ROOM



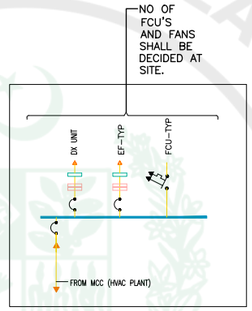
02/06 ACP FIRE STATION
LOCATION: GROUND



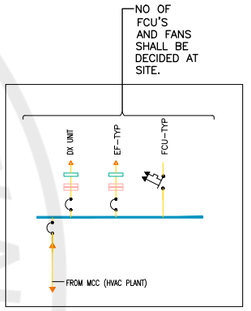
03/06 ACP
LOCATION: MEZANINE



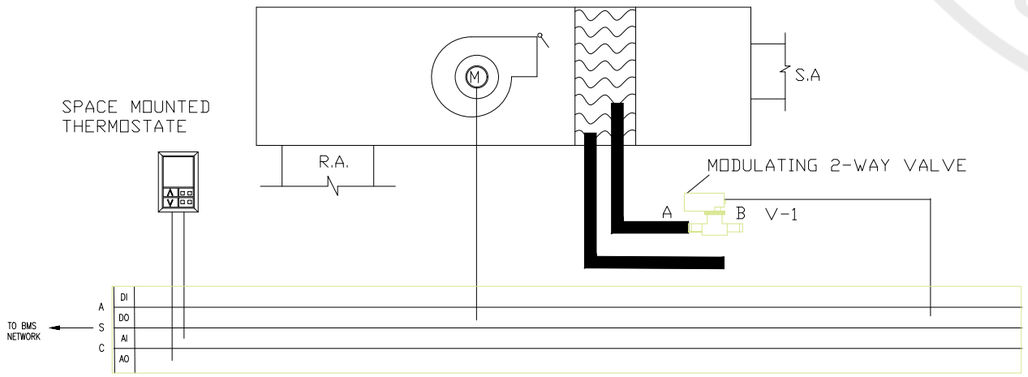
04/06 ACP OFFICES
LOCATION: FIRST



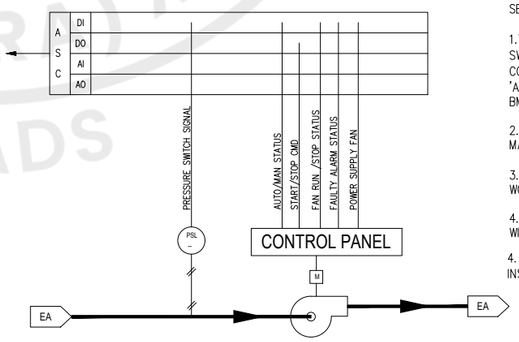
05/06 ACP CABINS
LOCATION: AS DIRECTED



06/06 ACP CABINS
LOCATION: AS DIRECTED



06/06 FCU CONTROL SCHEMATIC
NTS



06/06 EXHUAST FAN CONTROL SCHEMATIC
NTS

SEQUENCE OF OPERATIONS:

1.THE FAN(START/STOP) IS CONTROLLED BY THREE POSITION SWITCH 'ON-OFF-AUTO'. IN 'ON' POSITION, THE FAN OPERATE CONTINUOUSLY, IN 'OFF' POSITION, THE FAN WILL STOP, IN 'AUTO' POSITION, THE START/STOP IS CONTROLLED BY THE BMS.

2. THE EXHAUST AIR FAN SHALL BE ENERGIZED EITHER MANUALLY OR BY THE BMS.

3. DURING 'FIRE MODE',THE EXHAUST FAN ARE CONTINUOUSLY WORK.

4. DIFFERENTIAL PRESSURE SWITCH INSTALLED ACROSS THE FAN WILL MONITOR THE FAN FLOW STATUS.

4. THE CONTRACTOR SHALL SUBMIT ALL THE SUBMITTAL BEFORE INSTALLATION FOR CONSULTANTS'S APPROVAL

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Consulting,Architects,Engineers
Planners & Management Consultants
06 HBFC BLOCK A FAISAL TOWN LAHORE

JV MEMBERS

STRUCTURAL CONSULTANT

MEP CONSULTANT

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

ELECTRICAL & CONTROL SCHEMATIC

Date	27 MARCH, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/12

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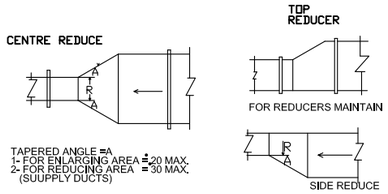
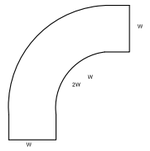
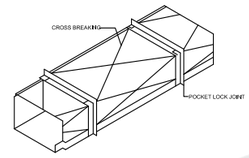


1 N.T.S DUCT TRANSITION FABRICATION



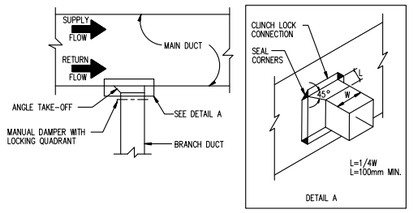
2 N.T.S RADIUS ELBOW



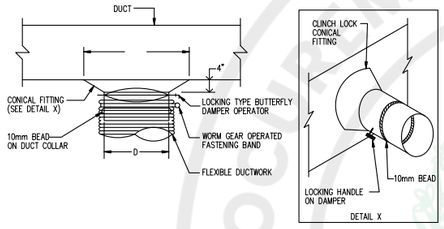
3 N.T.S CROSS BREAKING DETAIL

1 N.T.S TRANSVERSE SEAMS

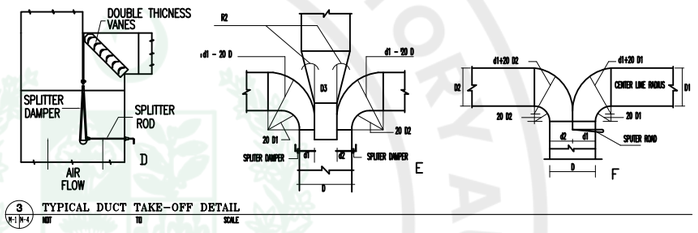
2 N.T.S LONGITUDINAL SEAMS



4 N.T.S BRANCH DUCT CONNECTION



5 N.T.S FLEXIBLE DUCT CONNECTION TO SUB-BRANCH



3 N.T.S TYPICAL DUCT TAKE-OFF DETAIL

SCHEDULES:-

GJ DUCT FABRICATION SCHEDULE

RECTANGULAR DUCTING TO To 8" LARGER DIMENSION	
8"-27"	26 GAUGE
28"-51"	24 GAUGE
52"-81"	22 GAUGE
82" TO ABOVE	20 GAUGE

JOINTS TYPE FOR GJ DUCTS

LONGITUDINAL:-
i) PITTSBURGH LOCK, DOUBLE SEAM, OR GROOVED SEAM

CIRCUMFERENTIAL:-
i) DUCT UPTO 23" DRIVE SLIP
ii) 24"-42" 1" HIGH POCKET LOCK OR STANDING SEAM
iii) 43"-72" 1-1/2" HIGH POCKET LOCK OR STANDING SEAM

BRACING SCHEDULE

24"-30"	1"x1"x1/8" C.C. 8'
31"-42"	1"x1"x1/8" C.C. 4'
43"-72"	1-1/2"x1-1/2"x1/8" C.C. 5'
73"-96"	1-1/2"x1-1/2"x1/4" C.C. 2'-0"

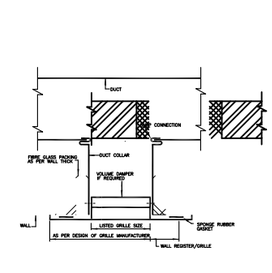
RIVETING ALL FOUR SIDES AT 6" C.C (MAX)

BUTTOM SUPPORT SCHEDULE

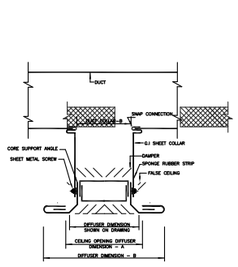
UP TO LARGER DIMENSION	1"x1"x1/8" ANGLE OR 1-1/4"x1/4" M.S FLAT
13"-30"	1-1/2"x1-1/4"x1/8" ANGLE
31"-72"	1-1/2"x1-1/2"x1/8" ANGLE
73"-96"	2"x 2"x3/16" ANGLE

HANGER ROD SCHEDULE

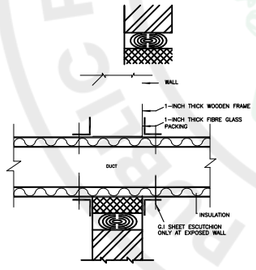
UP TO 30"	#3/8" ROD
31"-72"	# 1/2" ROD OR (1-1/2"x1/8" M.S FLAT BAR)
73"-96"	#1-1/2" X3/16" M.S FLAT BAR



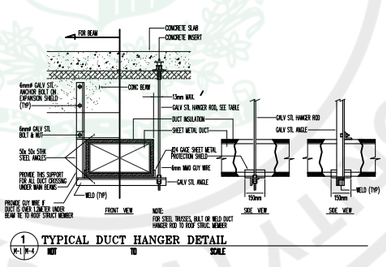
1 N.T.S WALL REGISTER/GRILLE INSTALLATION



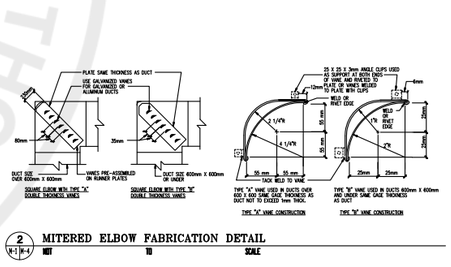
2 N.T.S DIFFUSER INSTALLATION



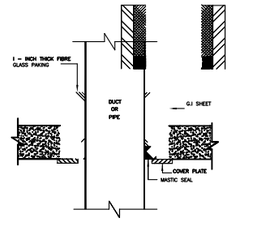
3 N.T.S DUCT THRU WALL



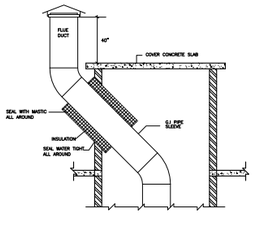
1 N.T.S TYPICAL DUCT HANGER DETAIL



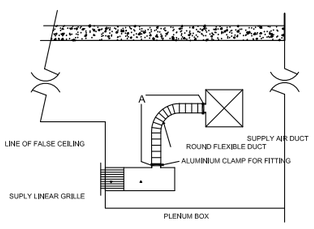
2 N.T.S MITERED ELBOW FABRICATION DETAIL



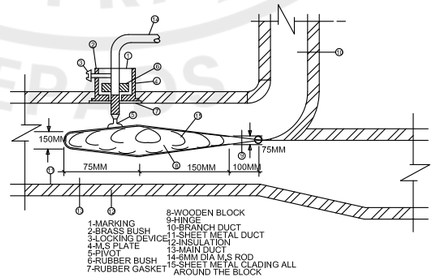
4 N.T.S DUCT THRU ROOF



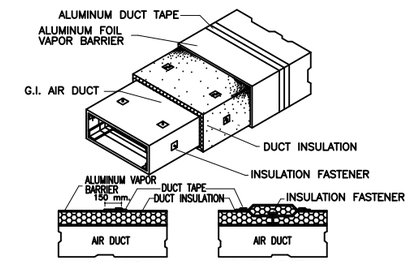
5 N.T.S FLUE DUCT THRU SLAB & WALL



6 N.T.S LINEAR GRILLE INSTALLATION DETAIL



3 N.T.S SPLITER DAMPER DETAIL



4 N.T.S DUCT INSULATION DETAIL

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TITLE PAGE:

HVAC
DESIGN DRAWINGS

CLIENT NAME

PAA
پاکستان ایئرپورٹس اتھارٹی

MAIN CONSULTANT

Anwar Ali Architects (Pvt.) Ltd.
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JV MEMBERS

leit-werk
COMRACES

STRUCTURAL CONSULTANT

AR ENGINEERS
Architects, Stuctural, Earthquake Enghneering, Geo Technical, Public Health, Highway, Electrical Design Solution.

MEP CONSULTANT

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC -DETAIL 1

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/13

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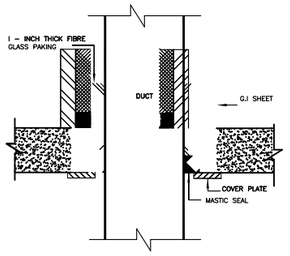
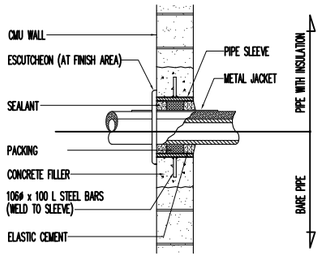


1 PIPE THRU ROOF DETAIL
NOT TO SCALE



2 PIPE SLEEVE DETAIL
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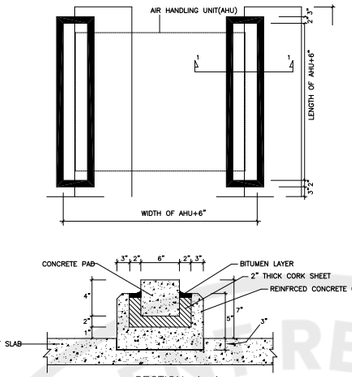
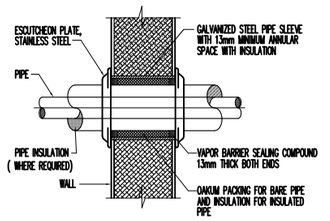
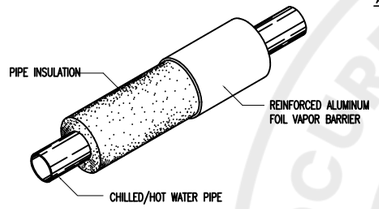
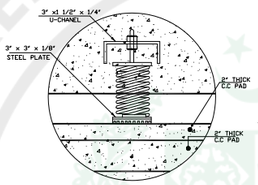


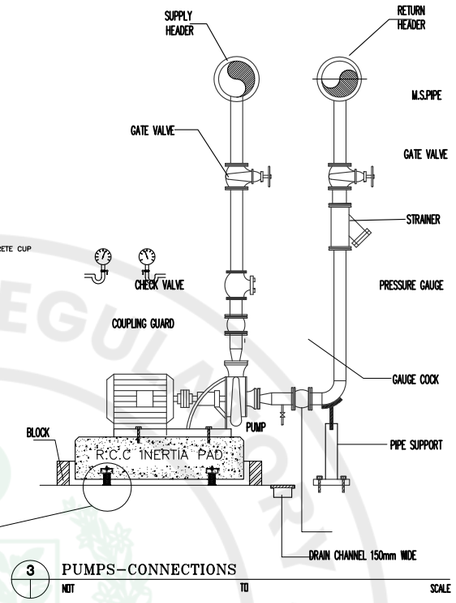


3 PIPE THRU WALL DETAILS
NOT TO SCALE



4 PIPE INSULATION DETAILS
NOT TO SCALE





3 PUMPS–CONNECTIONS
NOT TO SCALE

SCHEDULES:–

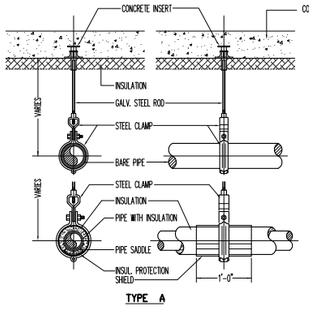
PIPE SUPPORT SCEDULE "A"

PIPE SIZE	U BOLT	HANGER ROD	ANGLE SIZE
1/2" TO 3/4"	1/4"	3/8"	1-1/2" X 1-1/2" X 3/16" THK
1" TO 1-1/4"	3/8"	3/8"	2" X 2" X 1/4" THK
1-1/2" TO 2-1/2"	1/2"	1/2"	2-1/2" X 2-1/2" X 1/4"THK
3" TO 4"	1/2"	1/2"	2-1/2" X 2-1/2" X 3/8"THK
5" TO 6"	1/2"	1/2"	3" X 3" X 3/8"THK

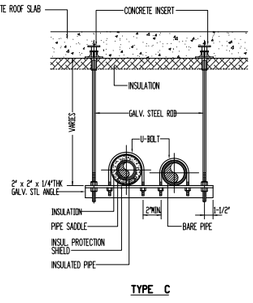
PIPE SUPPORT SCEDULE "B" (HORIZONTAL LINE)

NOMINAL PIPE SIZE		1/2" TO 1"	1-1/4"	1-1/2"	2"
MAX SPAN OF SUPPORT	STEEL PIPE	8'	8'	8'	10'
	COPPER TUBE	6'	—	—	—

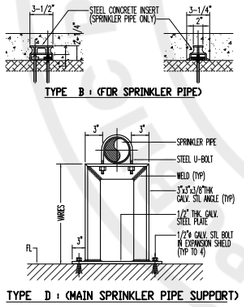
NOMINAL PIPE SIZE		2-1/2"	3"	4"	5"	6"
MAX SPAN OF SUPPORT	STEEL PIPE	10'	10'	10'	10'	10'
	COPPER TUBE	—	—	—	—	—



TYPE A

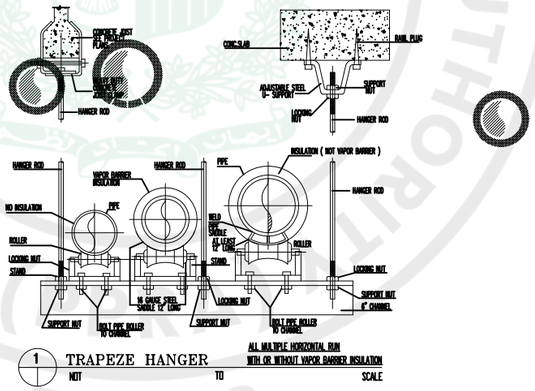


TYPE C

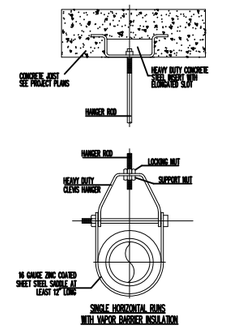


TYPE B : (FOR SPRINKLER PIPE)

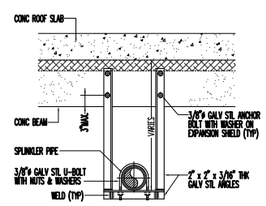
TYPE D : (MAIN SPRINKLER PIPE SUPPORT)



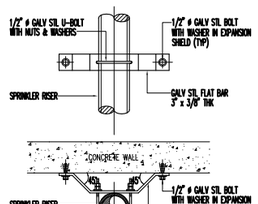
1 TRAPEZE HANGER
ALL MULTIPLE HORIZONTAL RUN WITH OR WITHOUT VAPOR BARRIER INSULATION
NOT TO SCALE



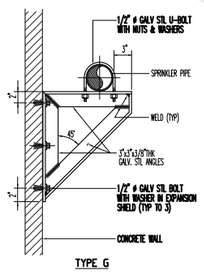
2 CLEVIS HANGER
NOT TO SCALE



TYPE E (2-WAY BRACE)

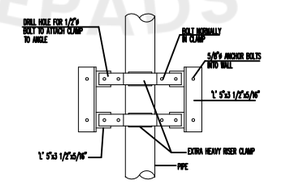


TYPE F (4-WAY BRACE)

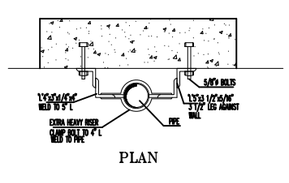


TYPE G

1 TYPICAL PIPE SUPPORT DETAILS
NOT TO SCALE



3 ANCHOR TO CONCRETE BEAM
NOT TO SCALE



PLAN

4 ANCHOR TO VERTICAL WALL
NOT TO SCALE

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TITLE PAGE:

HVAC DESIGN DRAWINGS

CLIENT NAME

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JV MEMBERS

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COMRADES

STRUCTURAL CONSULTANT

AR ENGINEERS
Architects, Stuctural, Earthquake Engineering, Geo Technical, Public Health, Highway, Electrical Design Solution.

MEP CONSULTANT

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E-mail: abstractorseng@gmail.com

Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

HVAC

HVAC - DETAIL 2

Date	27 April, 2026
Scale	NTS
Drawn by	IBRAHIM
Checked by	FAHEEM
Approved by	MUBASHIR
Drawing No.	IEST/310/AAA/TD/14

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LIST OF DRAWINGS

SR.NO.	DWG. NO.	DESCRIPTION
	PUBLIC HEALTH	
01	LOD-00	LIST OF DRAWINGS
02	GN-00	PUBLIC HEALTH LEGENDS, GENERAL NOTES
03	SE-00	SEWERAGE SYSTEM MASTER PLAN
04	SE-01	SEWERAGE SYSTEM GROUND FLOOR PLAN
05	SE-02	SEWERAGE SYSTEM MEZZANINE FLOOR PLAN
06	SE-03	SEWERAGE SYSTEM FIRST FLOOR PLAN
07	SE-04	SEWERAGE SYSTEM ROOF TOP PLAN
08	SE-05	SEWERAGE SYSTEM ARFF FLOOR PLAN
09	SE-06	SEWERAGE SYSTEM ATCT PLAN
10	SE-07	SEWERAGE SYSTEM ATCT ROOF TOP PLAN
11	SE-08	SEWERAGE SYSTEM SECTIONAL DETAILS
12	DD-01	DRAINAGE SYSTEM (MASTER PLAN)
13	WS-01	WATER SUPPLY SYSTEM GROUND FLOOR PLAN
14	WS-02	WATER SUPPLY SYSTEM MEZZANINE FLOOR PLAN
15	WS-03	WATER SUPPLY SYSTEM FIRST FLOOR PLAN
16	WS-04	WATER SUPPLY SYSTEM FIRST FLOOR PLAN (HIGH LEVEL PLAN)
17	WS-05	WATER SUPPLY SYSTEM ROOF FLOOR PLAN
18	PH-MD-01	PUBLIC HEALTH MISCELLANEOUS DETAILS
19	OHWT-01	OVER WATER TANK DETAIL
20	SP-01	SEPTIC TANK DETAIL
21	UG-01	UNDER GROUND WATER TANK DETAIL
22	SO-01	SOAKAGE PIT DETAIL
23	SC-01	WATER SUPPLY SYSETM SCHEMATIC DIAGRAM
24	SC-02	SEWERAGE SYSETM SCHEMATIC DIAGRAM
25	TW-01	TUBE WELL DETAILS
26	RW-01	RAIN WATER TANK DETAILS

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ABSTRACTORS
MEP CONSULTANT
SUITE-14,3RD FLOOR JINNAH MALL IZMIR TOWN, LHR
Cell no: 0322-3924199
E-mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

LIST OF DRAWINGS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	LOD-00

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WATER SUPPLY NOTES

1. ALL WATER SUPPLY PIPE DIAMETERS MENTIONED ARE EXTERNAL DIAMETERS UNLESS OTHERWISE MENTIONED.

2. PROVIDE ISOLATION (GATE) VALVE ON ALL COLD & HOT WATER SUPPLY LINES AT THE INLET TO EACH TOILET. VALVES SHALL BE INSTALLED AT ACCESSIBLE LOCATIONS.

3. ALL WATER SUPPLY PIPES ARE POLYPROPYLENE RANDOM PIPE (PPR-PN 20) UNLESS OTHERWISE MENTIONED.

4. ALL WATER SUPPLY PIPES FITTINGS SUCH AS BENDS, TEES, SOCKETS, ARE PPR (PN 25) UNLESS OTHERWISE MENTIONED.

5. PROVIDE THERMAL INSULATION ON ALL HOT WATER & HOT WATER RETURN PIPES.

6. ALL WATER SUPPLY PIPES ARE SUSPENDED ALONG CEILING OR CONCEALED IN WALLS.

7. ALL WATER SUPPLY PIPES WITHIN THE BUILDING SHALL RUN AT HIGH LEVEL UNLESS OTHERWISE SPECIFIED.

8. ALL WCs, WASH BASINS AND SINKS TO BE PROVIDED WITH T STOP COCKS.

9. CONTRACTOR SHALL VERIFY THE PUMPING FOR ALL PUMPS AS PER THE SITE CONDITION AND SHALL INFORM TO THE ENGINEER FOR ANY VARIATION.

10 ALL PUMP SHALL BE PROVIDED WITH FLEXIBLE CONNECTOR AT SUCTION AND DISCHARGE.

11. PROVIDE ISOLATION / STOP COCKS AT ALL GAS CONNECTIONS BURNERS.

12. FIRE WATER PIPE SHALL BE M.S SCHEDULE 40 UNLESS OTHER WISE MENTIONED.

13. PROVIDE PRESSURE REDUCING VALVES (PRV) ON HOT & COLD WATER PIPES ABOVE FALSE CEILING IN EACH BATHROOM, KITCHEN, etc WITH INLET PRESSURE AT 120 PSI AND OUT PRESSURE UPTO 30 PSI.

14. ALL JOINTS IN PIPE WORK AND JOINTS OF PIPE WORK TO APPLIANCES SHALL BE AIRTIGHT AND WATERTIGHT AND SHALL REMAIN SO DURING USE. CARE SHALL BE TAKEN TO ENSURE THAT NO JOINING MATERIAL PROJECTS INSIDE THE CORE OF THE PIPE. SOME FLEXIBILITY IS DESIRABLE WHERE THERE IS A POSSIBILITY OF MOVEMENT IN A PIPELINE OR BETWEEN THE PIPE AND THE APPLIANCE AND PROVISION SHALL BE MADE IN ASSEMBLY OF SANITARY PIPE WORK TO ACCOMMODATE AND CONTROL THERMAL MOVEMENT.

15. ALL PIPE PENETRATION THROUGH ROOF AND EXTERIOR WALLS SHALL BE FULLY WATERPROOFED.

16. COMPLETED PLUMBING SYSTEM INSTALLATIONS SHALL BE TESTED IN ACCORDANCE WITH ACCEPTED CODES AND STANDARD TESTING PROCEDURE.

17. ALL ITEMS TO BE INSTALLED SHALL IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS.

18. SEISMIC RESTRAINTS WILL BE PER THE REFERENCED BUILDING CODE

SEWERAGE NOTES

1. ALL PIPE DIAMETERS ARE IN INCHES UNLESS OTHERWISE MENTIONED.

2. ALL SOIL, WASTE AND VENT PIPES ARE UPVC (UNPLASTICIZED POLYVINYL CHLORIDE) CLASS B UNLESS OTHERWISE MENTIONED.

3. ALL MANHOLE COVERS SHALL BE OF HEAVY DUTY CAST IRON.

4. INVERT LEVELS WILL BE ADJUSTED AS PER SITE CONDITION.

5. ALL DIAMETERS MENTIONED ARE NOMINAL DIAMETERS.

6. ALL VERTICAL WC'S & URINALS WILL BE PROVIDED WITH MUSLIM SHOWER.

7. ALL RAIN WATER DISPOSAL PIPES SHALL BE OF uPVC CLASS-B & HORIZONTAL (ON LOWER FLOOR) SHALL BE uPVC CLASS D.

8. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS.

9. ALL SEWERAGE PIPING FROM FIXTURES TO MANHOLES AND GULLY TRAPS SHALL BE OF uPVC.

10. ALL CLEAN OUTS & FLOOR DRAINS SHALL BE COORDINATE WITH INTERIOR.

11. MINIMUM SLOPE OF SOIL AND WASTE PIPES ARE AS SHOWN IN BELOW TABLE.

12. SLOPE OF ROOF VALLEY LINE SHOULD BE BETWEEN 0.02% TO 0.025%.

13. BOTTLE TRAP SHALL BE USED WITH ALL WASH BASIN.

14. MINIMUM SLOPE OF SOIL AND WASTE PIPES ARE AS UNDER.

15. DRAINAGE AND STORM SYSTEMS WITHIN THE INTERIOR OF THE BUILDING SHALL BE TESTED AND APPROVED BY OWNER IN ACCORDANCE WITH THE PROVISIONS OF THE PLUMBING CODE.

16. ALL PIPES RUN SHOWN ARE ABOVE FALSE CEILING LEVEL UNLESS OTHERWISE MENTIONED.

17. CONNECTION OF HORIZONTAL DRAINAGE LINES WITH OTHER HORIZONTAL DRAINAGE LINES SHALL BE MADE USING 45 DEGREE "Y" BRANCHES, COMBINATION "Y" AND 1/8 BEND BRANCHES OR OTHER APPROVED FITTINGS OF EQUIVALENT SWEEP, UNLESS SPECIFIED OTHERWISE.

18. CHANGES IN DIRECTION OF DRAINAGE PIPING SHALL BE MADE BY THE APPROPRIATE USE OF APPROVED FITTINGS AND SHALL BE OF THE ANGLES PRESENTED BY 1/16 BEND, 1/8 BEND OR 1/6 BEND OR OTHER APPROVED FITTINGS OF EQUIVALENT SWEEP.

19. HORIZONTAL PIPING SHALL BE SUPPORTED AT SUFFICIENTLY CLOSE INTERVALS TO MAINTAIN PIPE ALIGNMENT AND PREVENT SAGGING.

20. PROVIDE ESCUTCHEONS ON ALL EXPOSED PIPING PASSING THROUGH WALLS, FLOORS, PARTITIONS AND CEILINGS HELD IN PLACE BY INTERNAL SPRING TENSION OR SET SLEEVES.

21. RODDING ACCESS TO BE LOCATED ON WALL OF DUCT SHAFTS AND COORDINATED WITH ARCHITECT (TYPICAL TO ALL DUCT SHAFTS).

22. TRAP ALL FIXTURES AS REQUIRED BY CODES & STANDARDS

23. EXACT ROUTE AND LOCATION OF EACH PIPELINE SHALL BE DETERMINED IN COORDINATION WITH OTHER TRADES PRIOR TO INSTALLATION.

24. PROVIDE PIPE SLEEVE WITH CAULKING FOR ALL PIPES PENETRATING THROUGH CONCRETE STRUCTURES.

25. THE CONTRACTOR MUST FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR FIXTURES PRE-INSTALLATION.

26. UNLESS OTHERWISE SHOWN, ALL PLUMBING MATERIALS SHALL BE AS SPECIFIED.

27. LONG RADIUS BEND SHALL BE USED AT THE FOOT OF VERTICAL SOIL / WASTE STACKS.

28. COMPLETED PLUMBING SYSTEM INSTALLATIONS SHALL BE TESTED IN ACCORDANCE WITH ACCEPTED CODES AND STANDARD TESTING PROCEDURE.

LEGEND FOR SEWERAGE & DRAINAGE SYSTEM

WATER SUPPLY & SEWERAGE LEGENDS				SCHED. OF PIPE DIA		
	TEE STOP COCK		FLOOR DRAIN WITH P-TRAP	OUTER DIA (mm)	INTERNAL DIA (mm)	(INCH)
	MUSLIM SHOWER					
	MIXER		6KG DRY POWDER	20	13.2	0.52
	ELECTRIC WATER GEYSER		CO2EXTINGUISHERS	25	16.4	0.65
	NON RETURN VALVE	GT	GULLY TRAP	32	21.2	0.83
	FLOAT SWITCH	GRT	GREASE TRAP	40	26.6	1.05
	FLOAT VALVE	MH	MANHOLE	50	33.2	1.31
	GAS & ELECTRIC GEYSER	DIA & SLOPE		63	42	1.65
	GATE VALVE	3"	1:50	75	50	1.97
	SUBMERSIBLE PUMP	4"	1:100	90	60	2.36
	RAIN DRAIN	6"	1:150	110	73.2	2.88
	LINE CLEANOUT	8"	1:200			

WATER SUPPLY & SEWERAGE LEGENDS			
CW	COLD WATER	CO	CLEAN OUT
HW	HOT WATER	LCO	LINE CLEAN OUT
HWR	COLD WATER RETURN	SP	SOIL PIPE
DN	DOWN	WP	WASTE PIPE
@H/L	HIGH LEVEL	VP	VENT PIPE
GV	GATE VALVE	RWP	RAIN WATER PIPE
NRV	NON RETURN VALVE	C.P	CATCH PIT
STR	STRAINER	RD	RAIN DRAIN
BV	BALL VALVE	FT	FLOOR DRAIN WITH P-TRAP
FA	FROM ABOVE	BT	BOTTLE TRAP
FB	FROM BELOW	IL	INVERT LEVEL
TA	TO ABOVE	FL	FLOOR LEVEL
TB	TO BELOW	LOD	LIST OF DRAWINGS
GN	GENERAL NOTES	T.W	TUBE WELL

———	SOIL PIPE	———	COLD WATER SUPPLY
- - - - - - -	WASTE PIPE	- - - - - - -	HOT WATER SUPPLY
———	SEWER PIPE	—·—·—·—	HOT WATER RETURN
———	VENT PIPE	———	GAS SUPPLY PIPE

ISSUE FOR TENDER

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Project Name

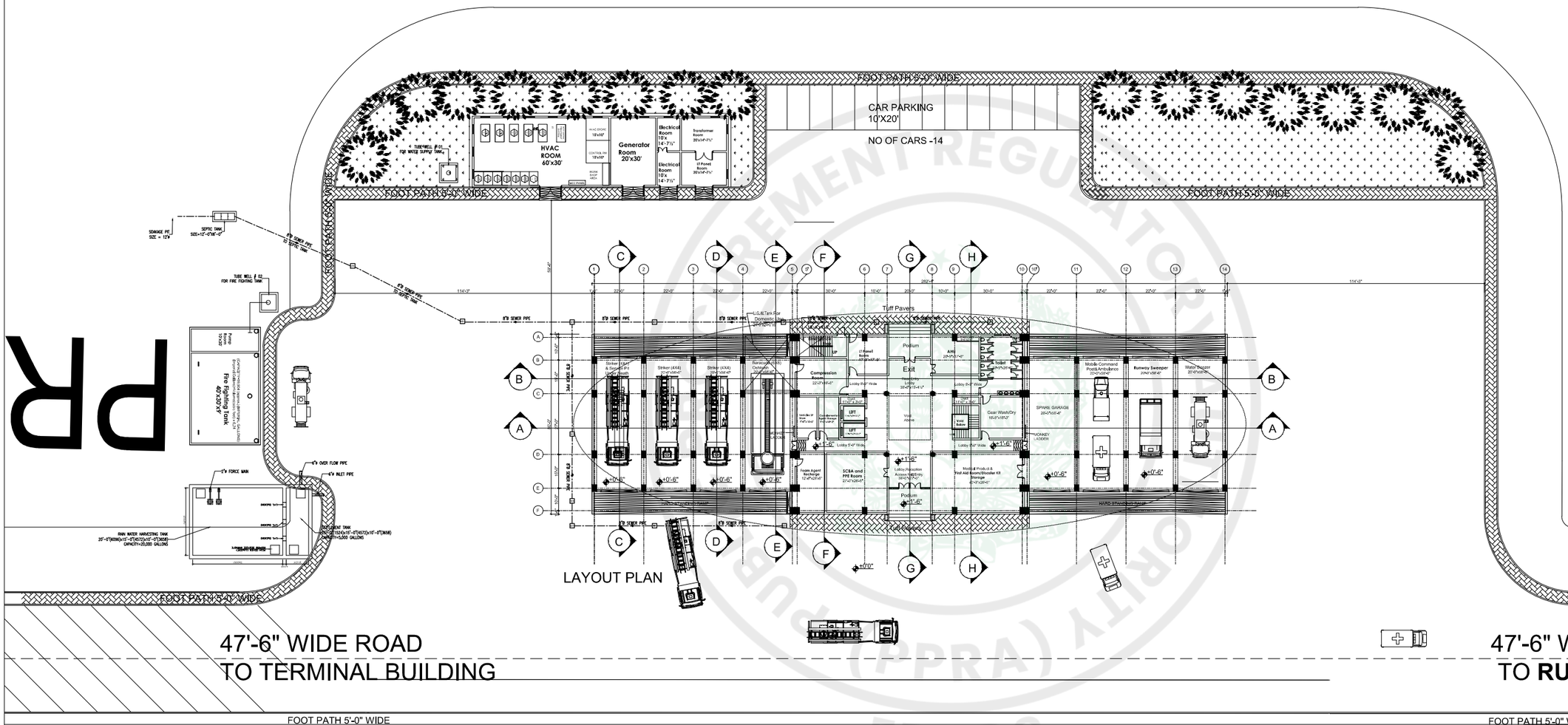
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

LEGEND & GEN. NOTES

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	GN-00



PR

2

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RAIN WATER HARV

20'-0"(6096)x15'-0"(4

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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
MASTER PLAN LAYOUT PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-00

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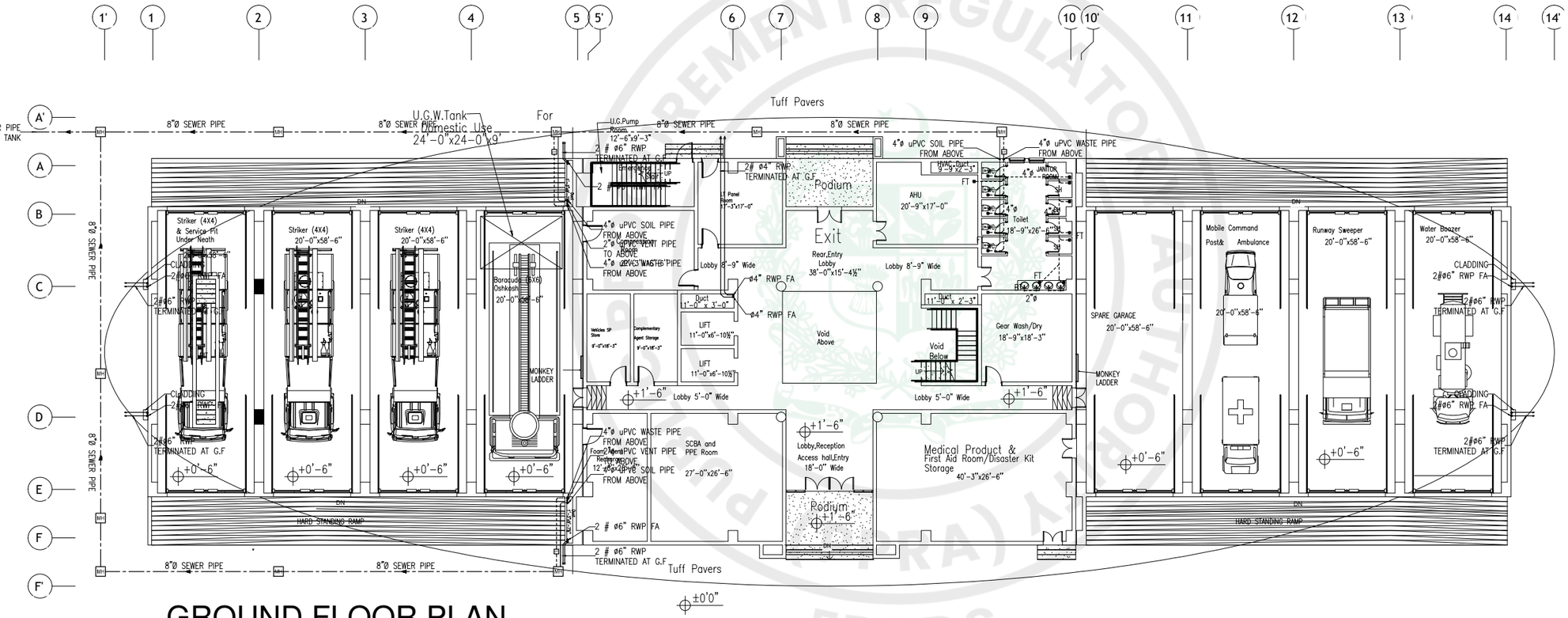

GROUND FLOOR PLAN

ISSUE FOR TENDER

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
GROUND FLOOR PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-01

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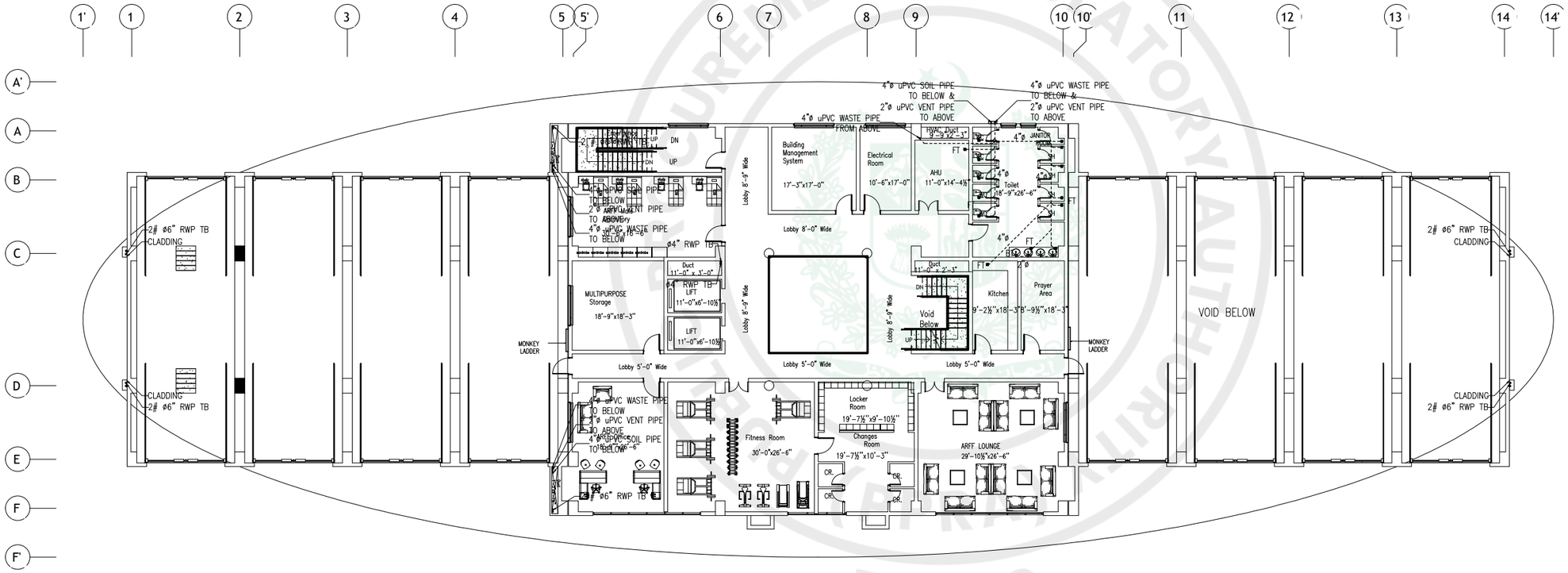

MEZZANINE FLOOR PLAN

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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
MEZZANINE FLOOR PLAN

Date	April, 2026
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Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-02

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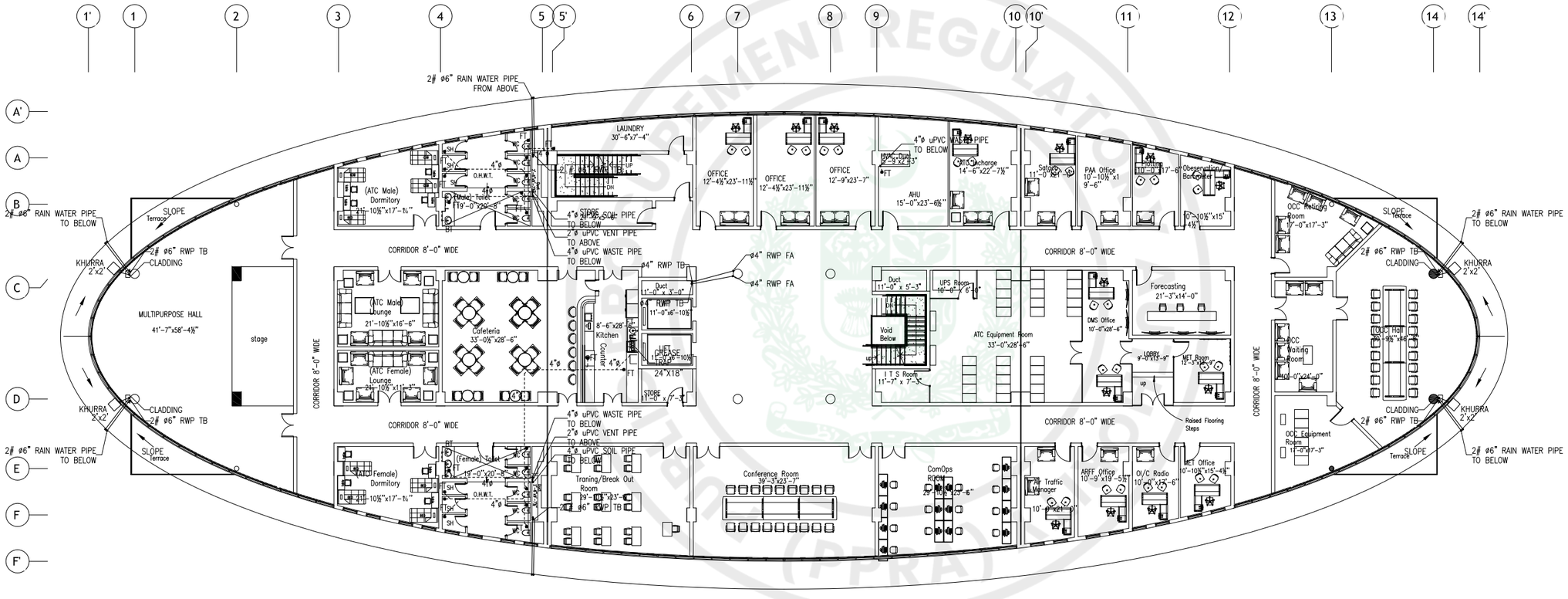

FIRST FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM FIRST FLOOR PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-03

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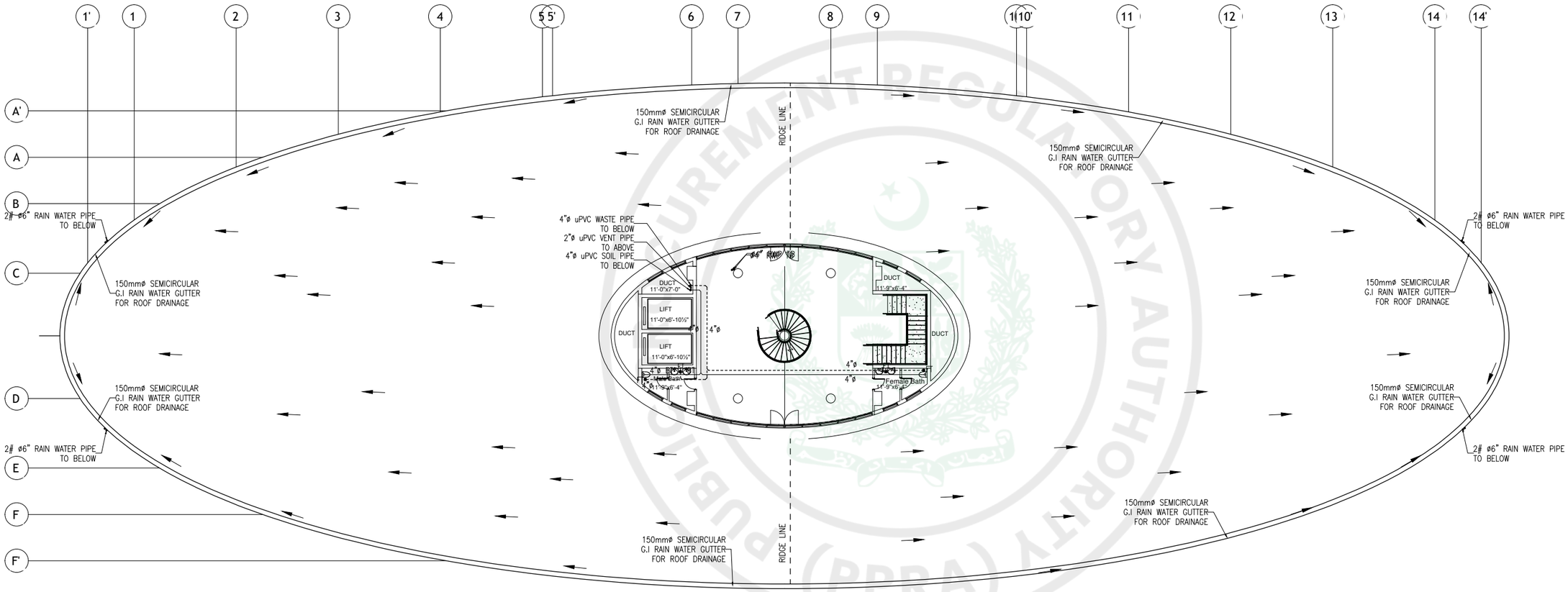

ROOF TOP FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
ROOF TOP PLAN

Date	April, 2026
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Drawing No.	SE-04

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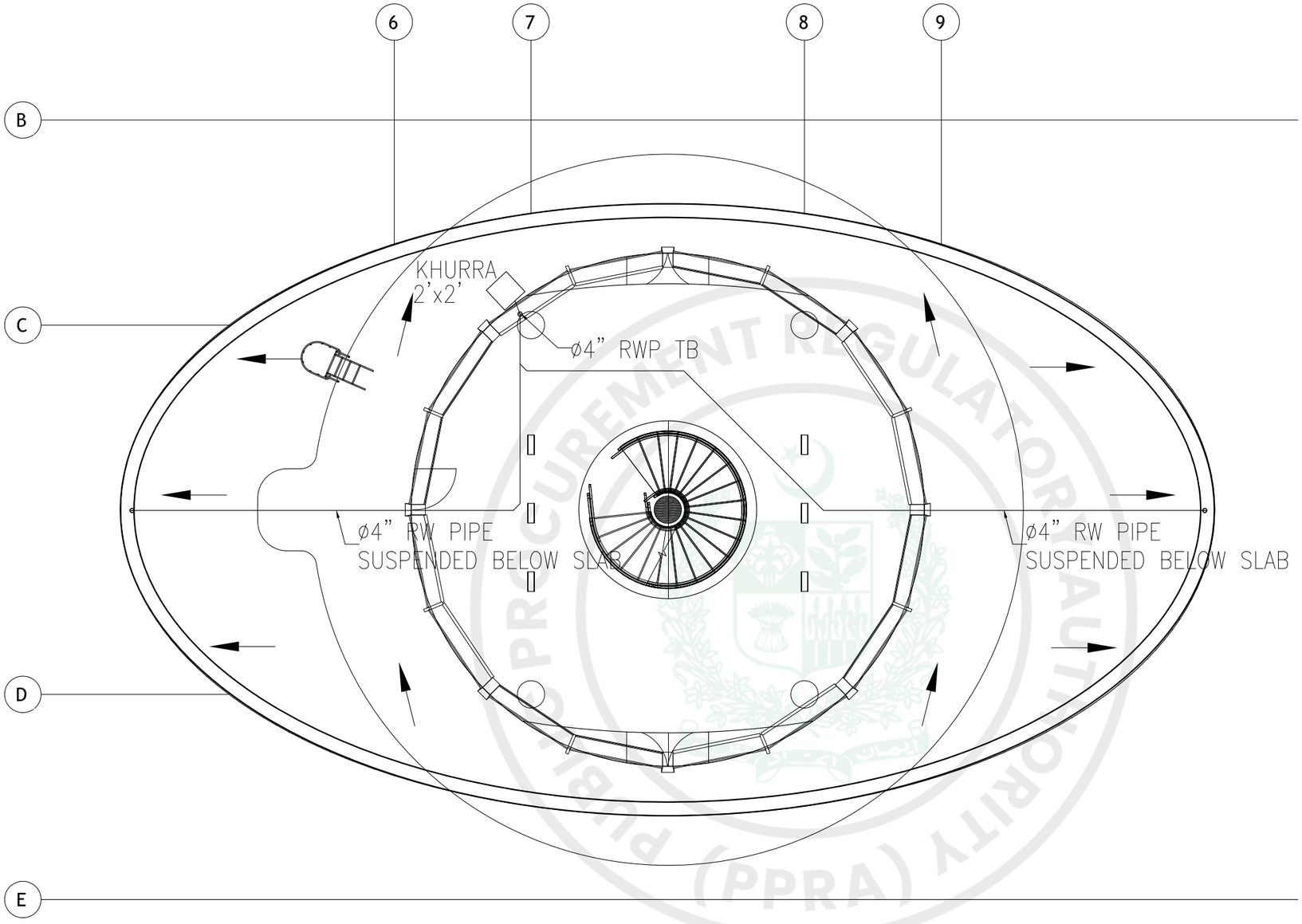

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ARFF FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
ARFF FLOOR PLAN

Date	April, 2026
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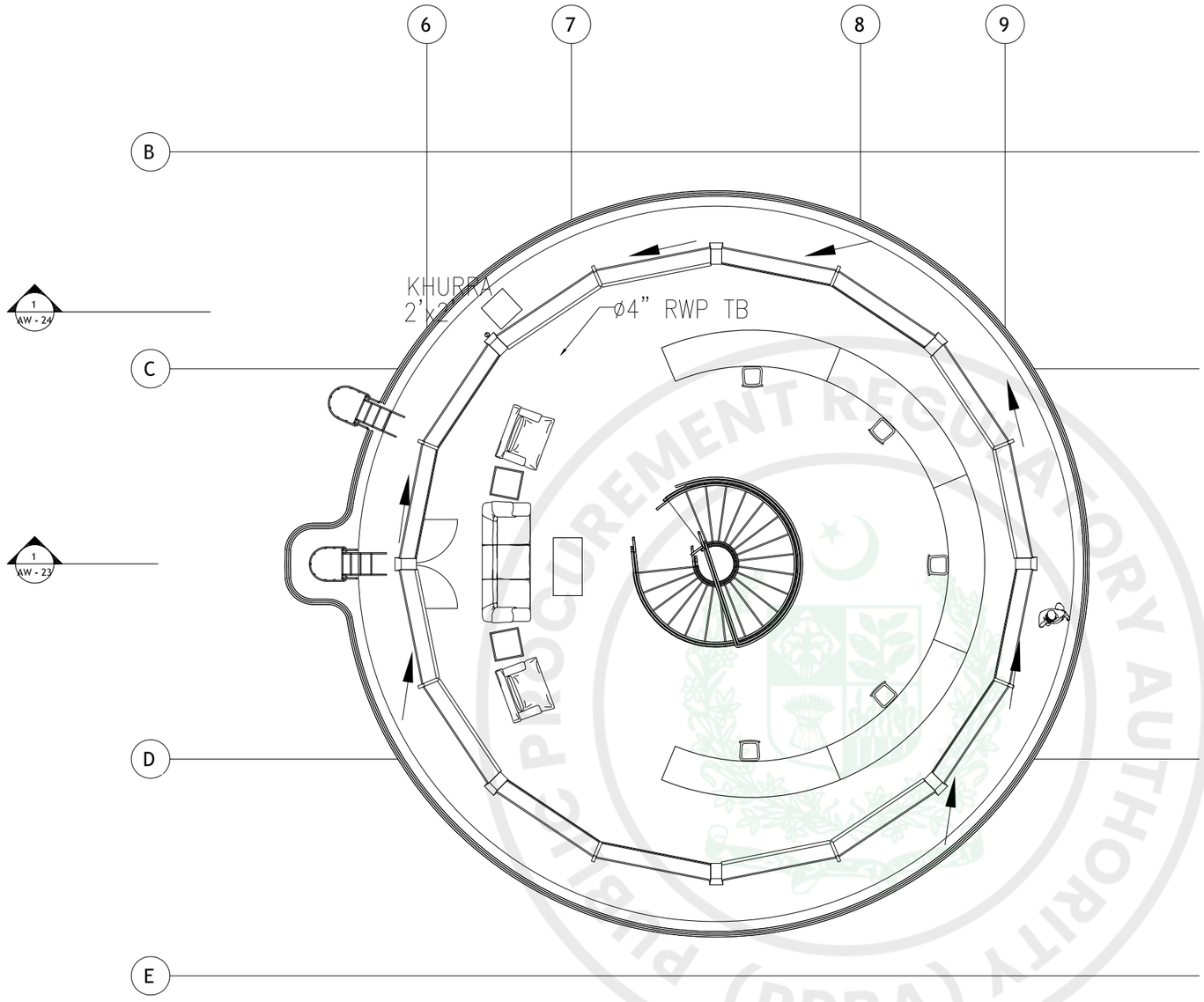
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-05



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ATCT FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
ATCT FLOOR PLAN

Date	April, 2026
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Approved by	M.F
Drawing No.	SE-06

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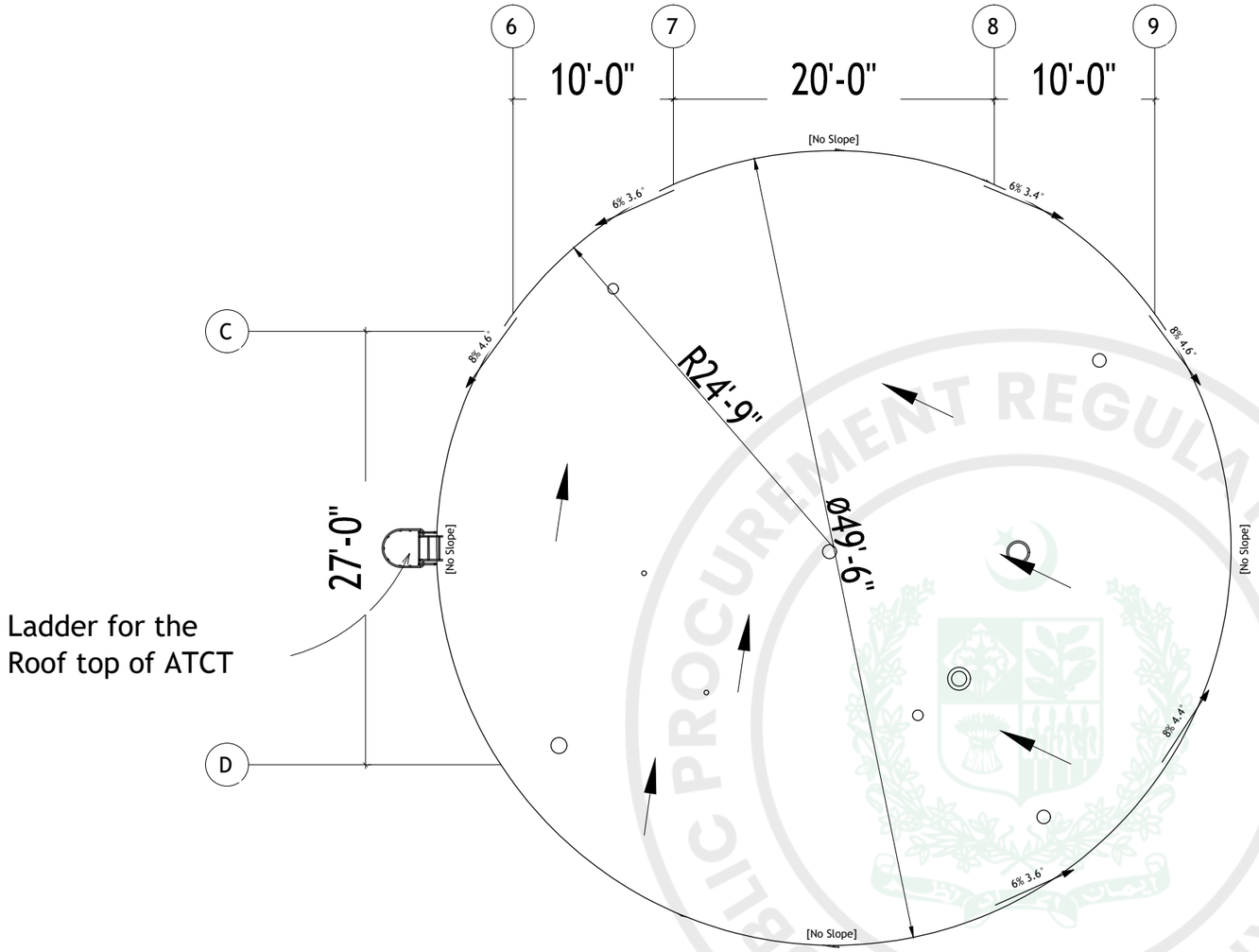

Ladder for the
Roof top of ATCT

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ROOFTOP FLOOR PLAN

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Project Name

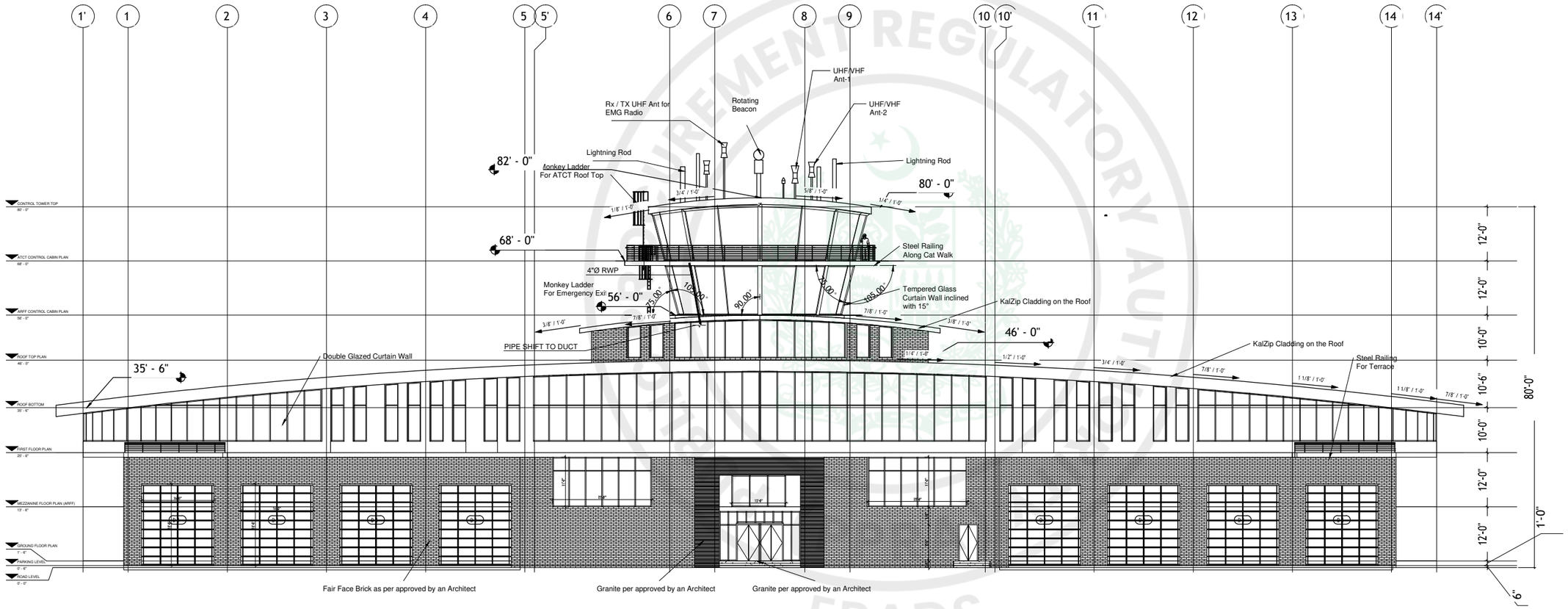
Consultancy Services for
New Air Traffic Control Tower
(ATCT), Fire Station and Allied
Facilities at Skardu
International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
ATCT ROOF TOP PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-07



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Project Name

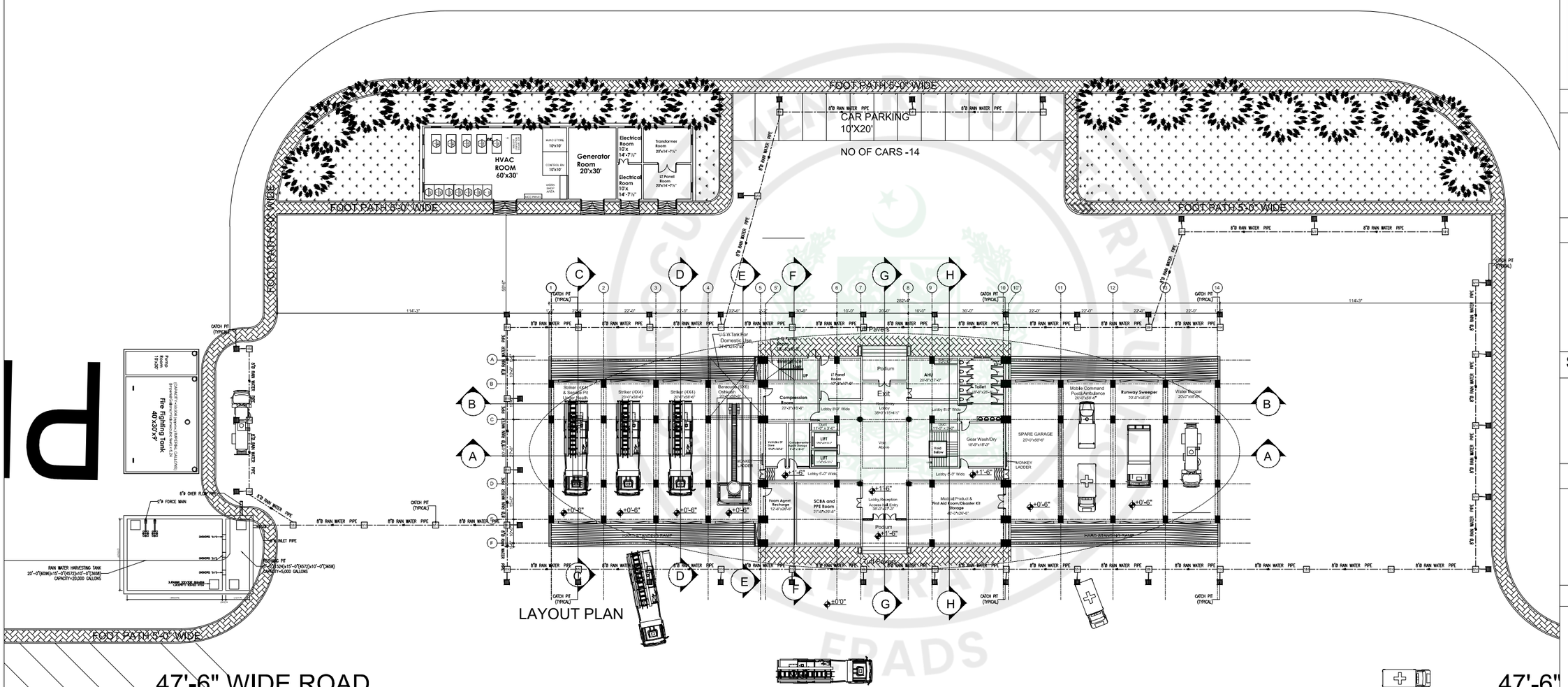
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

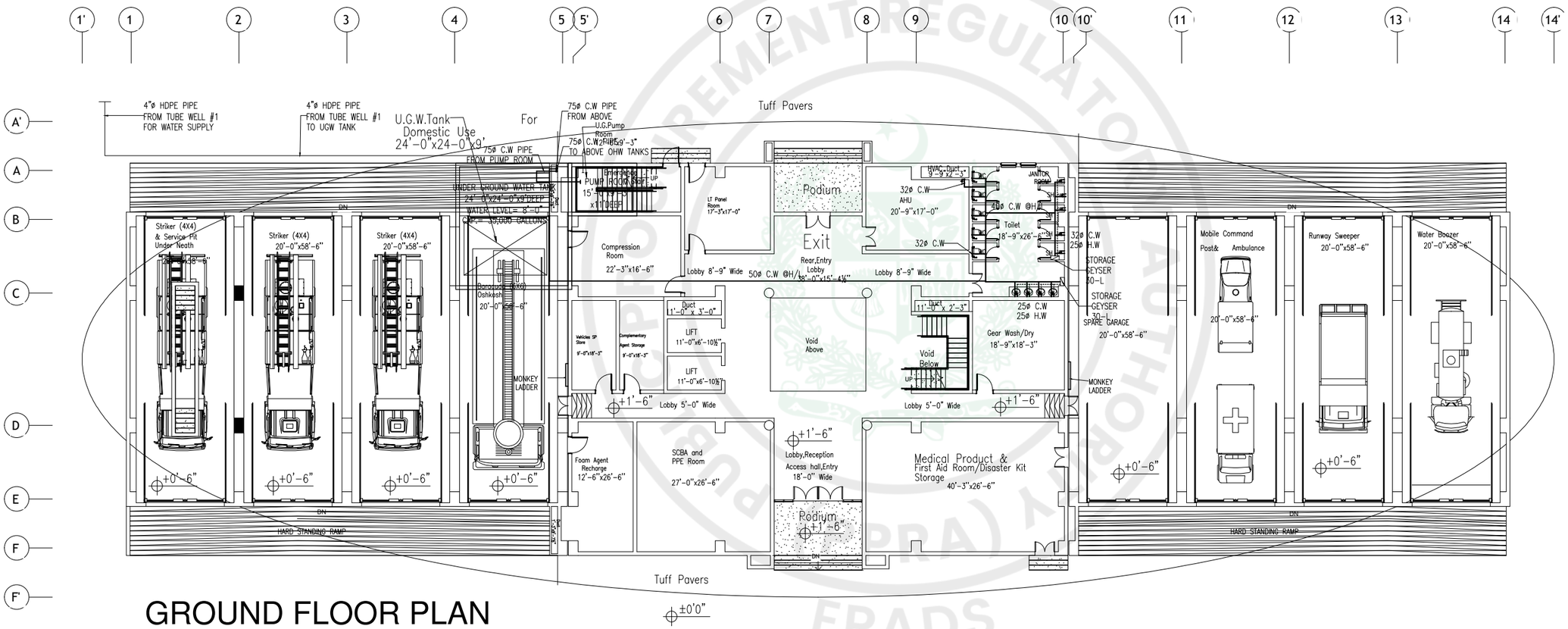
DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM FRONT ELEVATION DETAILS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SE-08


FOOT PATH 5'-0" WIDE
CAR PARKING
10'X20'
NO OF CARS -14
HVAC ROOM 60'x30'
Generator Room 20'x30'
Electrical Room 10'x 14'-7½"
Transformer Room 20'x14'-7½"
Electrical Room 10'x 14'-7½"
LT Panel Room 20'x14'-7½"
8"Ø RAIN WATER PIPE
CATCH PIT (TYPICAL)
Pumping Room 15'x30'
Fire Fighting Tank 40'X30'X9'
6"Ø OVER FLOW PIPE
2"Ø FORCE MAIN
INLET PIPE
RAIN WATER HARVESTING TANK 20'-0"(6096)x15'-0"(4572)x10'-0"(3658) CAPACITY=20,000 GALLONS
SUCTION PIT 20'-0"(6096)x15'-0"(4572)x10'-0"(3658) CAPACITY=15,000 GALLONS
U.G.W.Tank For Domestic Use Capacity=40,000 Gallons
U.G.Pump Room
Tri Pavers
Podium
Exit
Compression Room
Lobby 8'6" Wide
Lobby 5'-0" Wide
Lobby 11'-0" Wide
Lobby 8'-0" Wide
Lobby 6'-0" Wide
Lobby 5'-0" Wide
Lobby 7'-0" Wide
Lobby 5'-0" Wide
Lobby 5'-0" Wide
Lobby 5



GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

WATER SUPPLY SYSTEM GROUND FLOOR PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	WS-01

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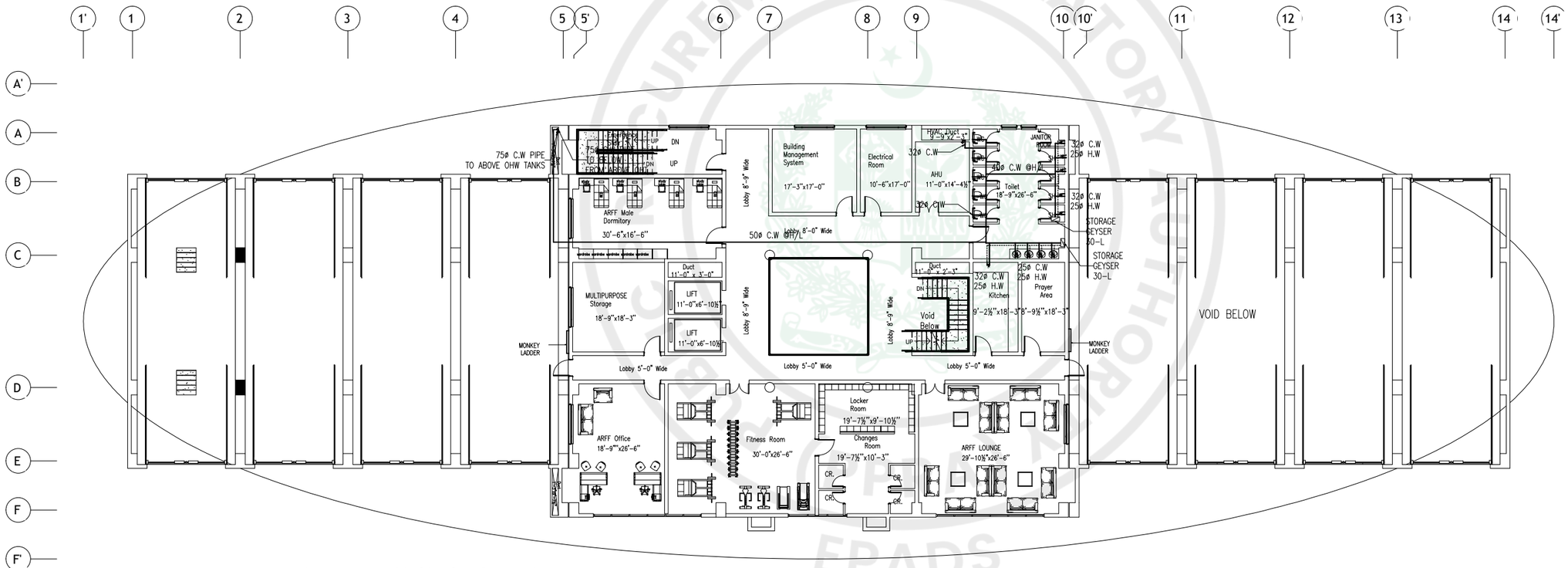

MEZZANINE FLOOR PLAN

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

WATER SUPPLY SYSTEM
MEZZANINE FLOOR PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	WS-02

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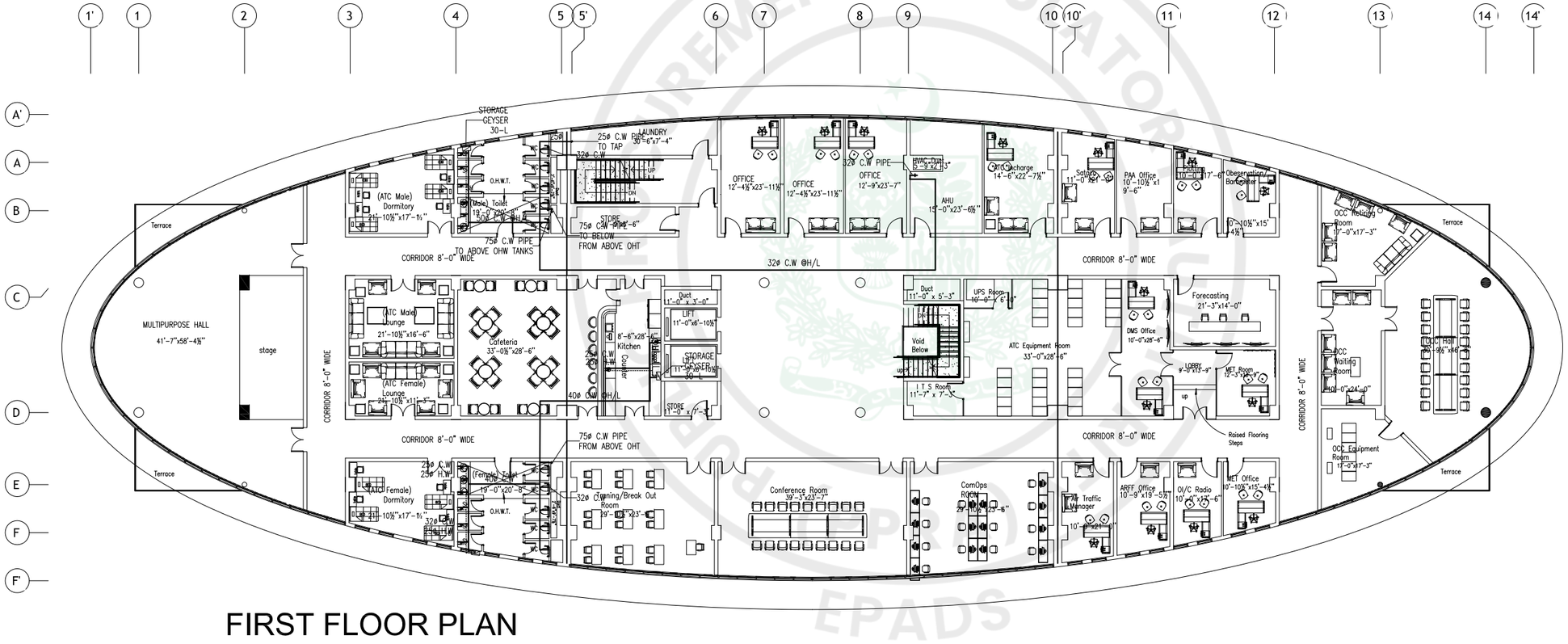

FIRST FLOOR PLAN

ISSUE FOR TENDER

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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM
FIRST FLOOR PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	WS-03

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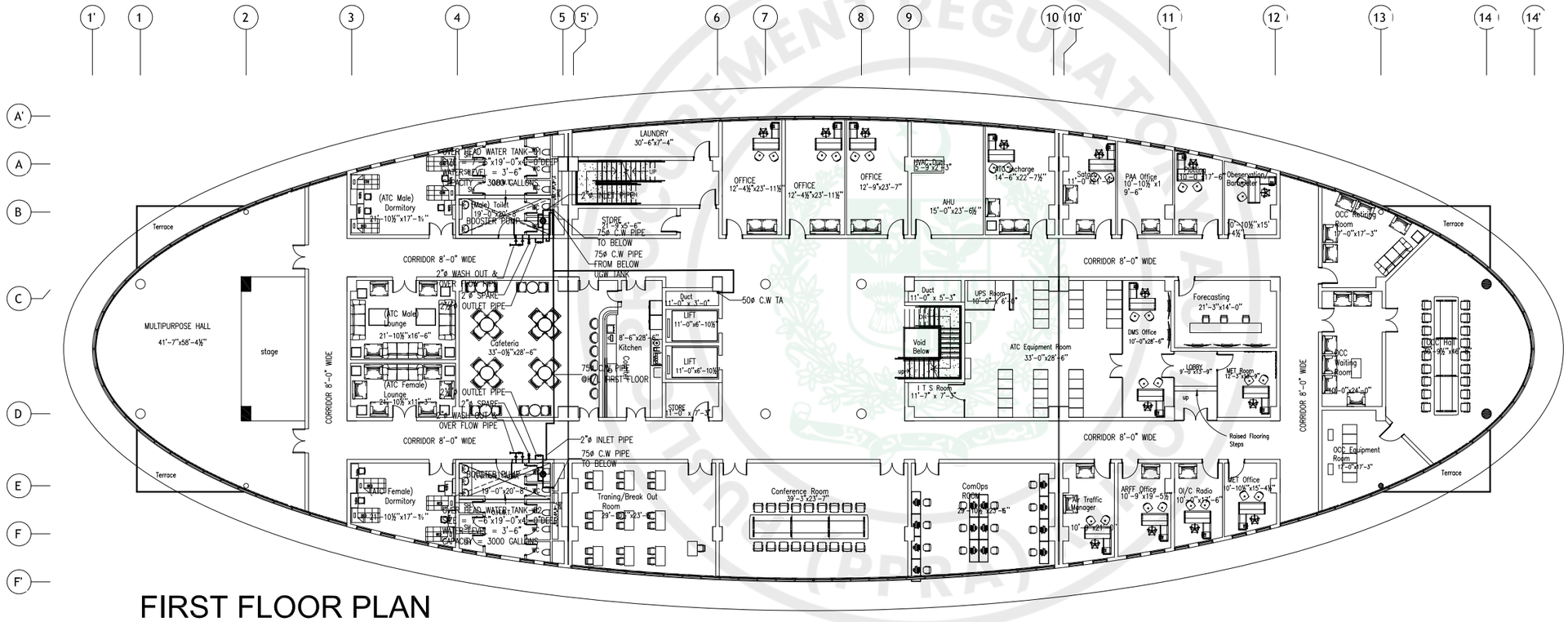

FIRST FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

WATER SUPPLY SYSTEM
FIRST HIGH LEVEL PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	WS-04

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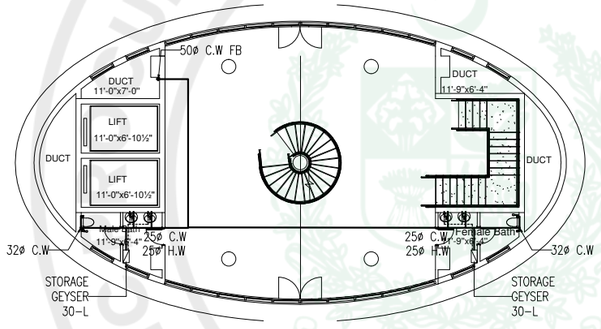

ROOF TOP FLOOR PLAN

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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

WATER SUPPLY SYSTEM ROOF PLAN

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
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Approved by	M.F
Drawing No.	WS-05

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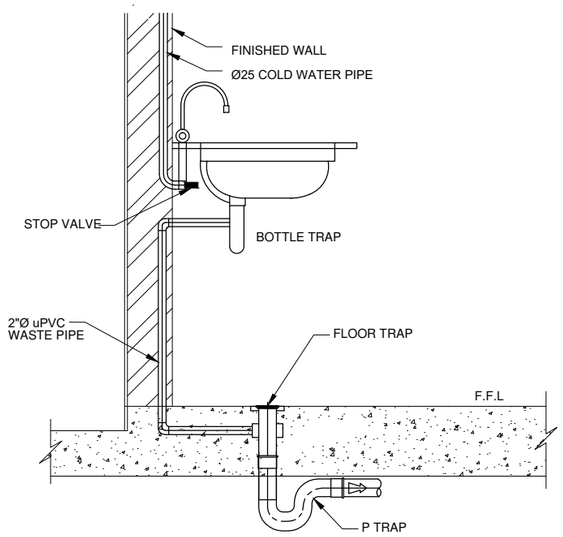
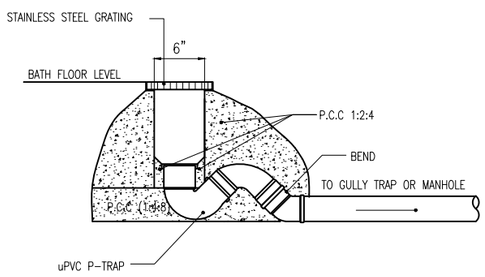


DETAIL OF BASIN CONNECTION WITH FLOOR TRAP



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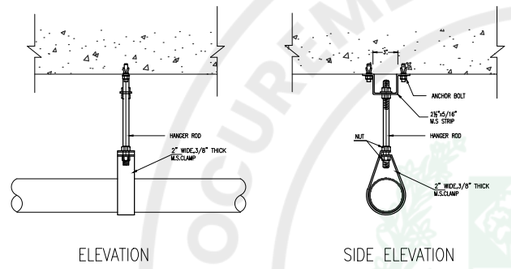
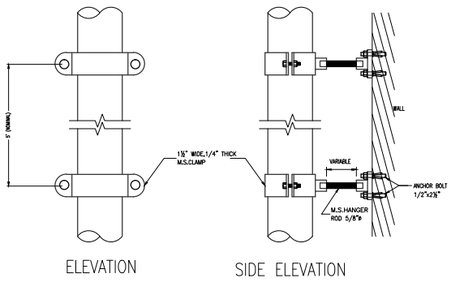


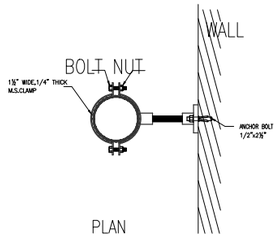
ELEVATION SIDE ELEVATION

HORIZONTAL PIPE HANGER

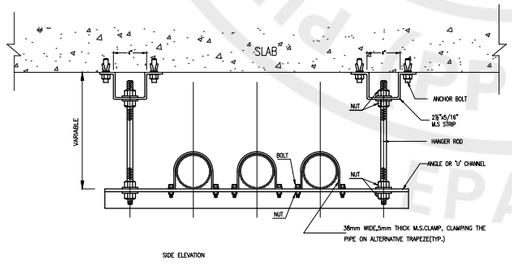
PIPE SIZE	MAX. SPACING	HANGER ROD Ø	ANCHOR BOLT
3/4" — 2"	5'-0"	1/2"	1/2" x 2½"
2½" — 3"	6'-0"	5/8"	1/2" x 2½"
4" — 6"	6'-0"	3/4"	5/8" x 3"



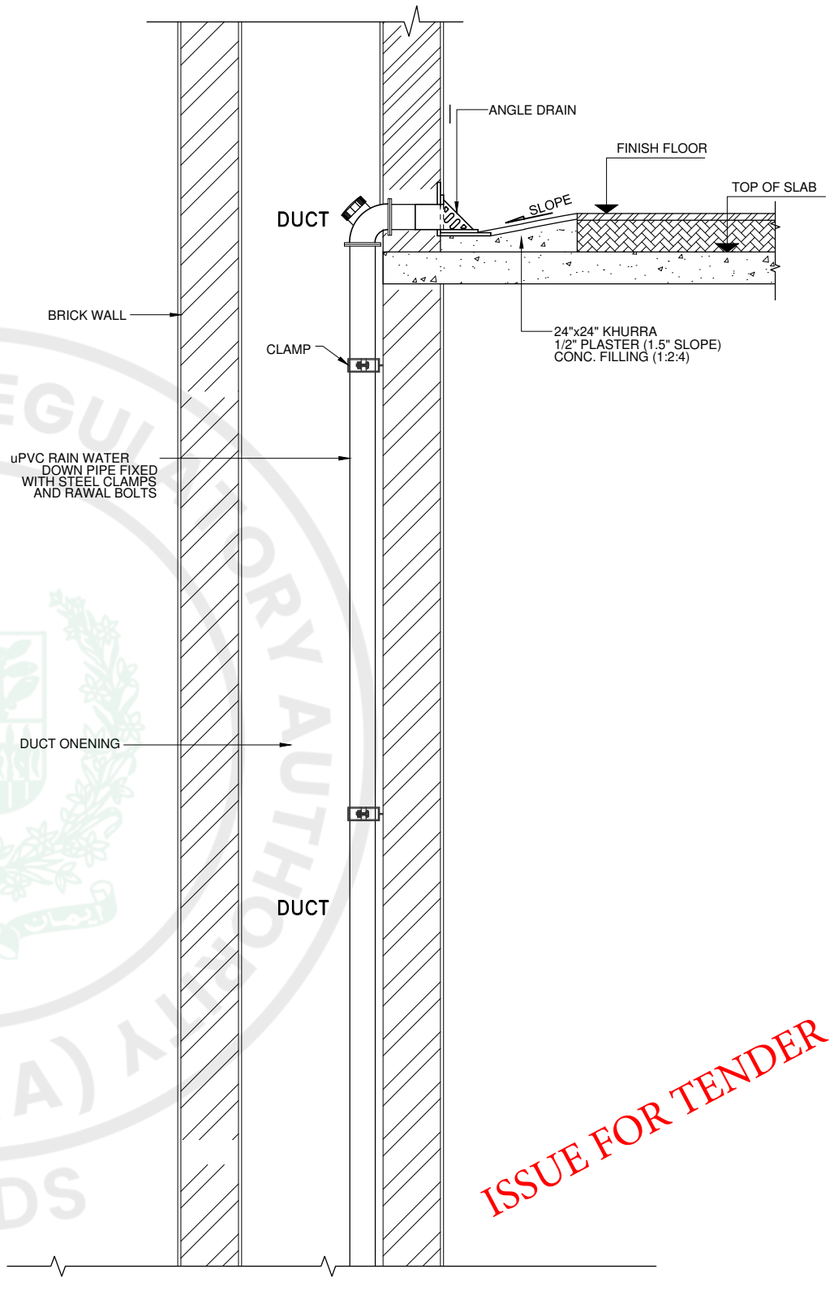
ELEVATION SIDE ELEVATION



PLAN

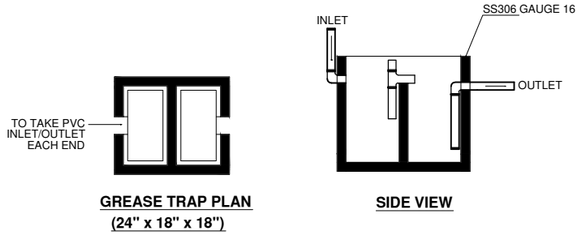


SIDE ELEVATION



ISSUE FOR TENDER

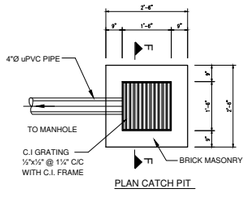
VERTICAL PIPE HANGERS (UP TO 4"ø PIPE)



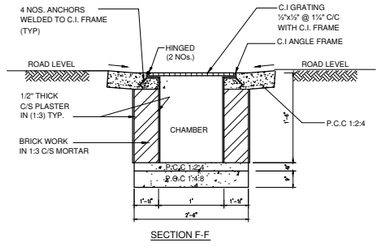
GREASE TRAP PLAN (24" x 18" x 18") **SIDE VIEW**

HORIZONTAL PIPE HANGER (TRAPEZE)

PIPE SUPPORT SCHEDULE					
PIPE SIZE	HANGER ROD Ø	ANGLE SIZE	U-CHANNEL	SPACING	ANCHOR BOLT
1/2 TO 3/4"	3/8"	1½"x1½"x3/16"	--	5'	1/2" x 2½"
1" TO 1¼"	3/8"	2"x2"x1/4"	--	5'	1/2" x 2½"
1½" TO 2½"	1/2"	2½"x2½"x1/4"	--	6'	1/2" x 2½"
3" TO 4"	1/2"	2½"x2½"x3/8"	--	6'	5/8" x 3"
5"	3/4"	3"x3"x3/8"	--	6'	3/4" x 4"
6"	1"	--	3"x1½"x1/4"	7'	3/4" x 4"
8"	1"	--	4"x1¾"x5/16"	7'	3/4" x 4"
10"	1"	--	4"x1¾"x5/16"	7'	3/4" x 4"
12"	1¼"	--	4"x1¾"x5/16"	7'	3/4" x 4"



PLAN CATCH PIT



SECTION F-F

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

PUBLIC HEALTH SYSTEM MISC. DETAILS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	PH-MD-01

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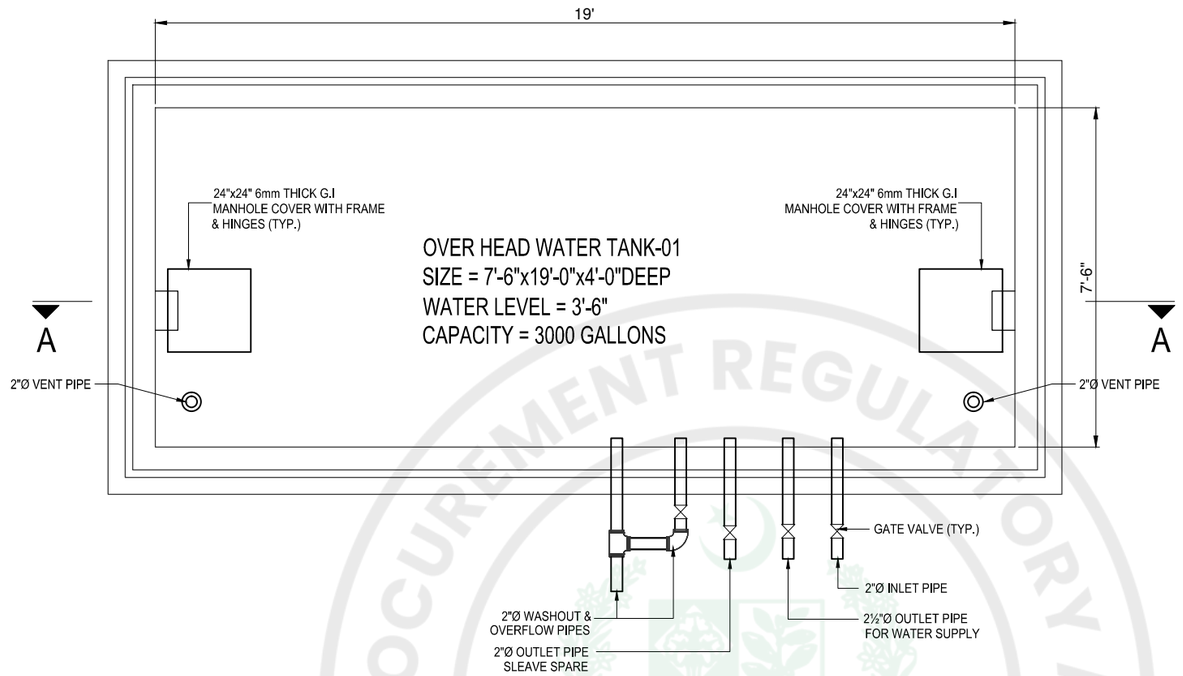
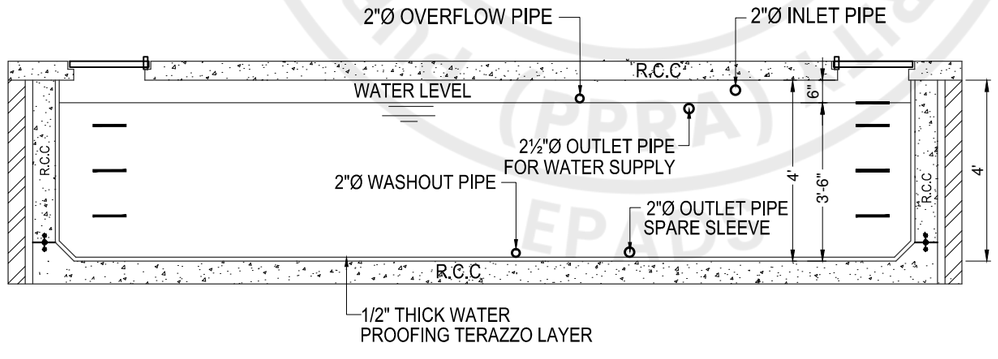


PLAN

OVERHEAD WATER TANK

(CAPACITY= 3500 GALLONS)



SECTION A-A

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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

OVER HEAD WATER TANK DETAIL

Date	April, 2026
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Approved by	M.F
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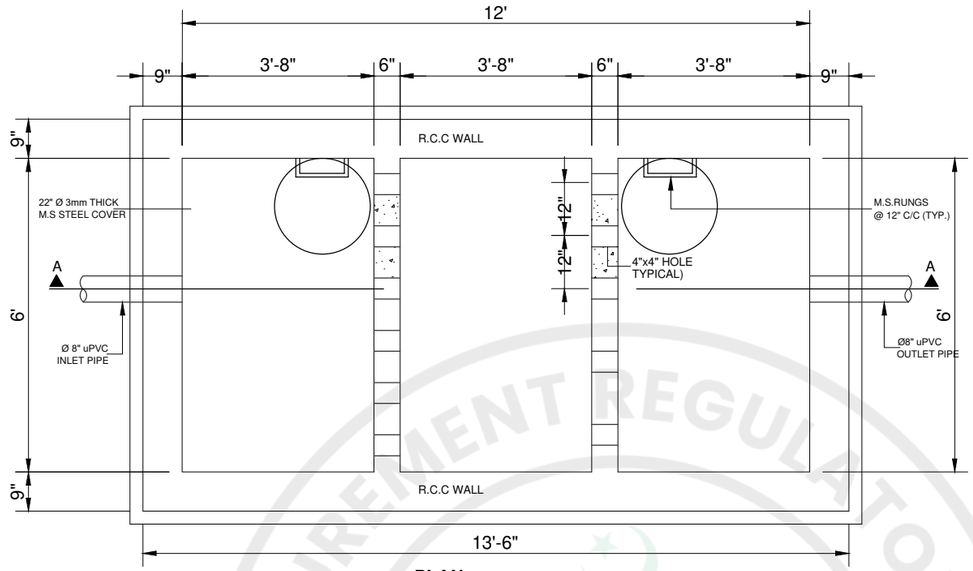
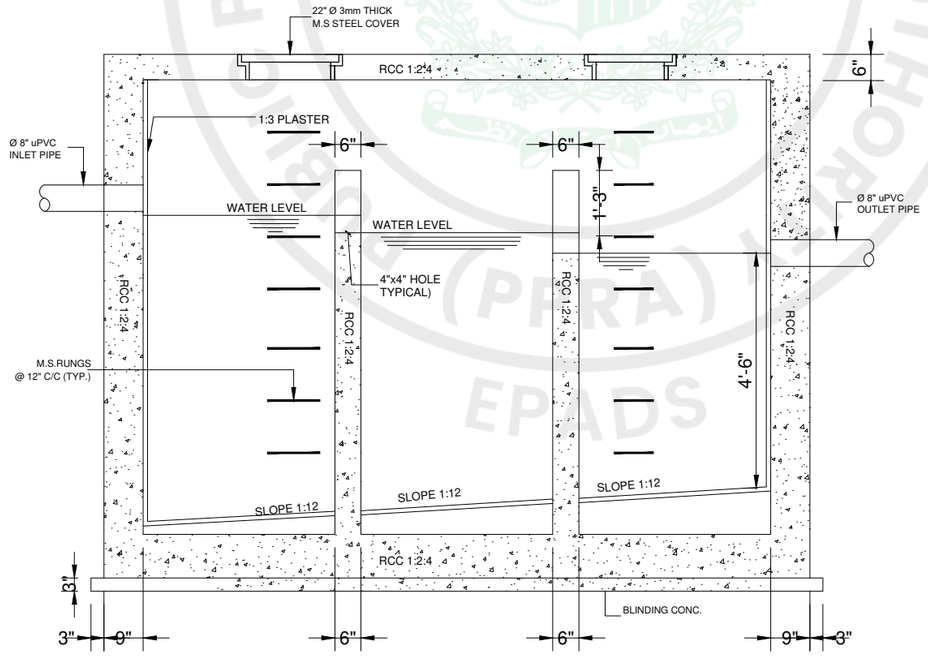


PLAN
SEPTIC TANK



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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEPTIC TANK DETAIL

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Approved by	M.F
Drawing No.	SP-01

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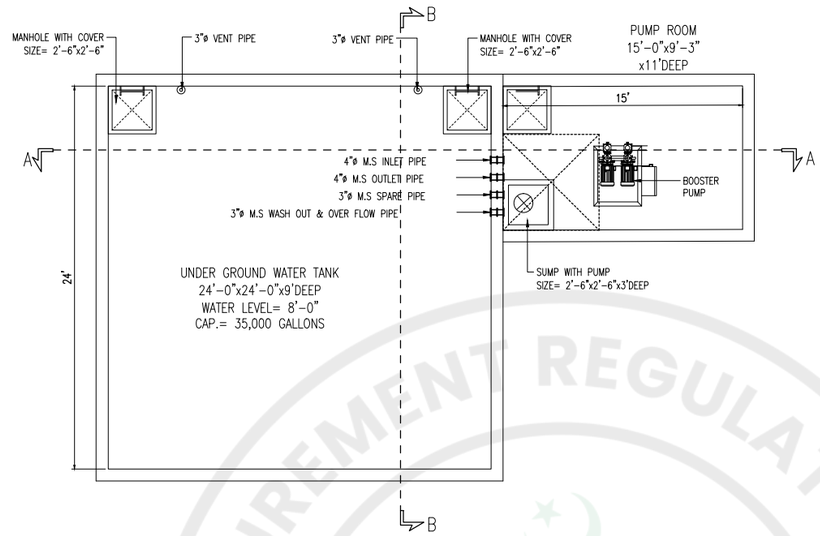
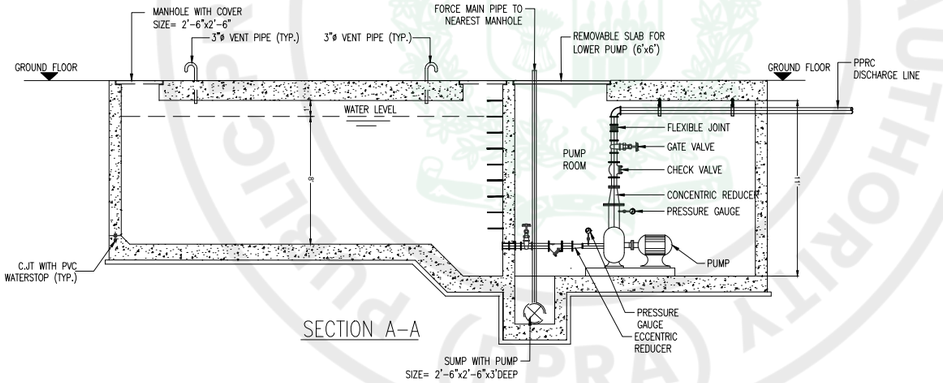


UNDER GROUND WATER TANK
PLAN



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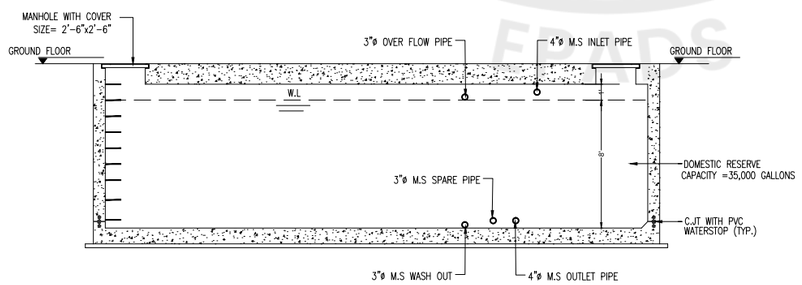

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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

UNDER GROUND TANK DETAIL

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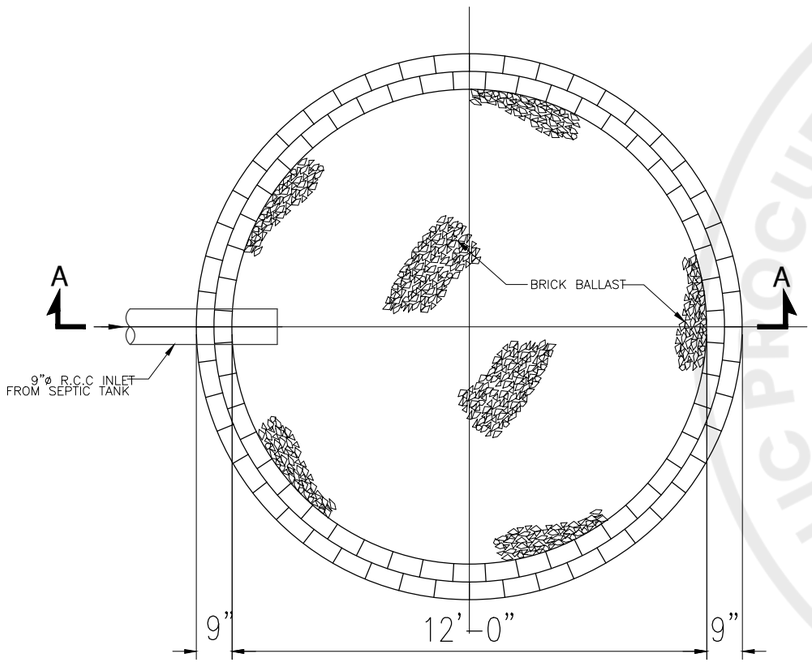

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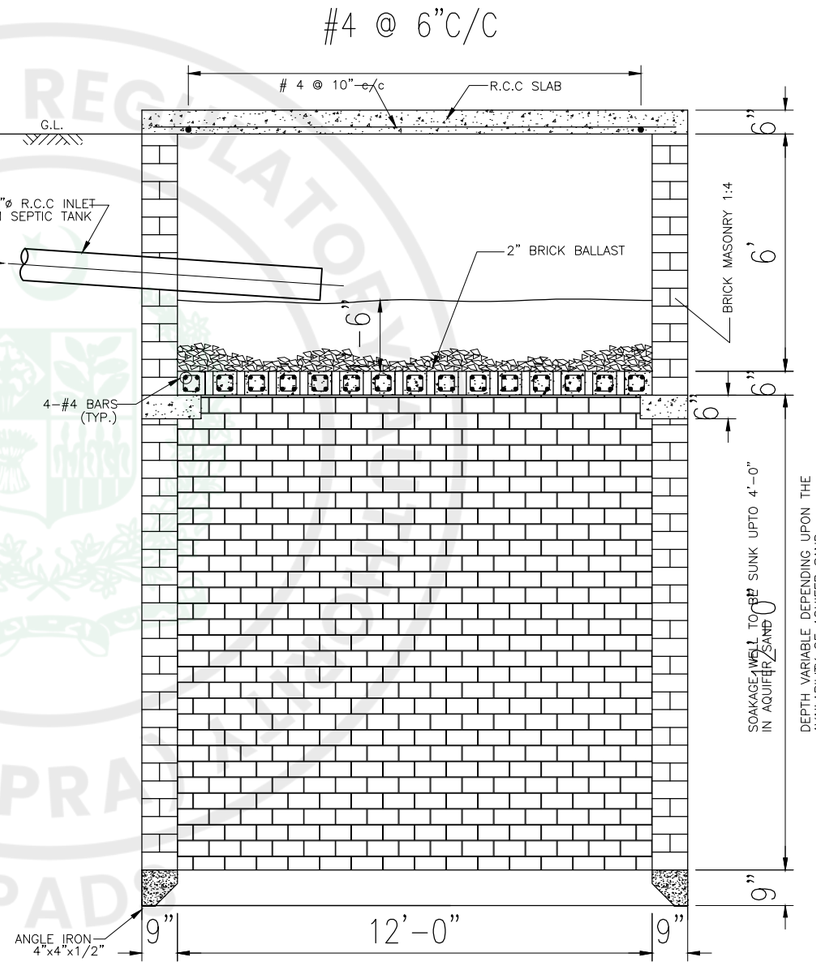

SECTION A-A

12' DIA
SOAKAGE WELL

ISSUE FOR TENDER

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Project Name

Consultancy Services for
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DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SOAKAGE PIT DETAIL

Date	April, 2026
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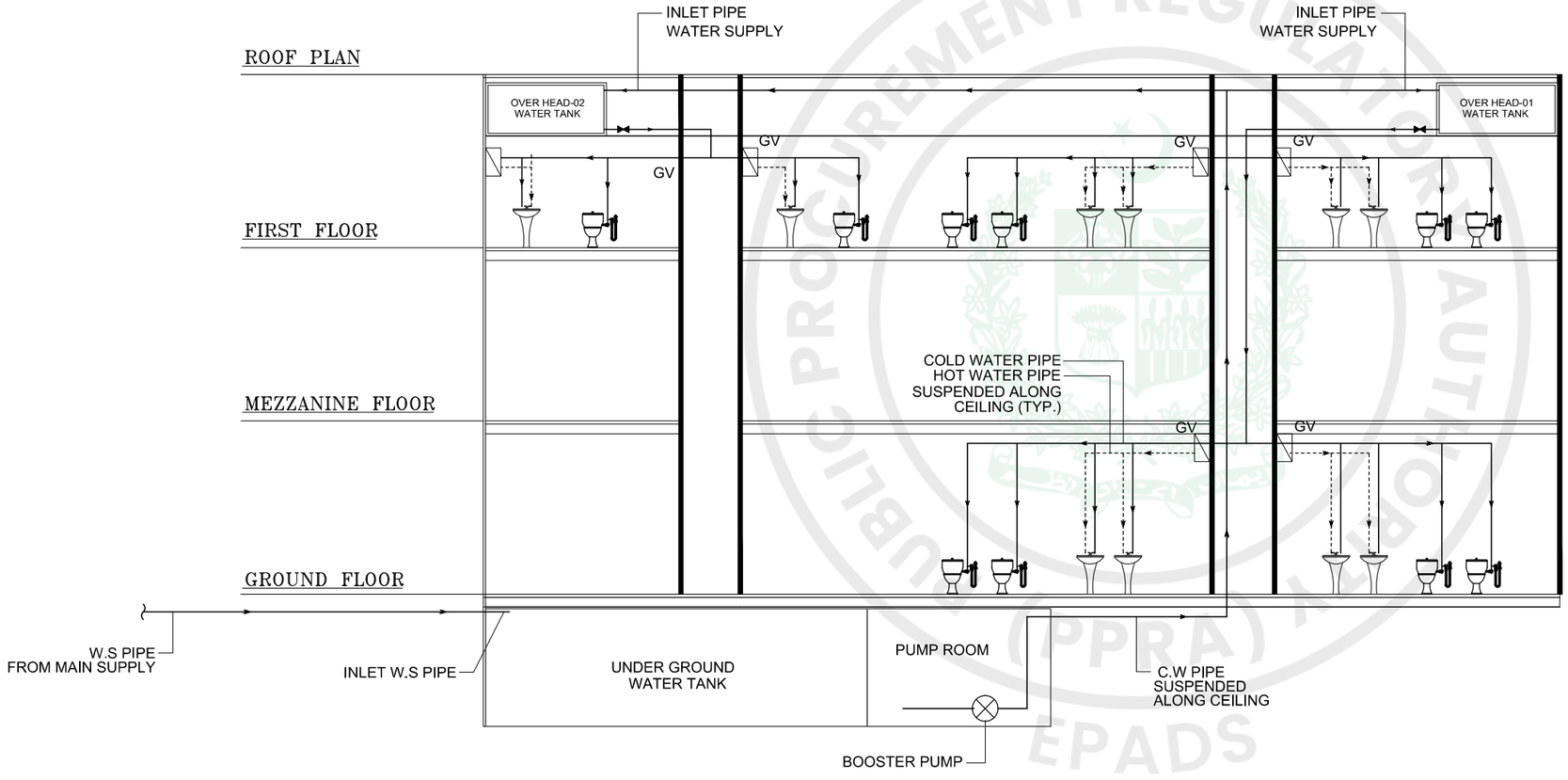
Checked by	M.K
Approved by	M.F
Drawing No.	SO-01



LEGEND:

- COLD WATER PIPE (C.W) ——————
- HOT WATER PIPE (H.W) ----------
- ELECTRIC GEYSER
- WASH BASIN
- WATER CLOSET (WC) EUROPEAN
- GATE VALVE (GV)

WATER SUPPLY SYSTEM SCHEMATIC

ISSUE FOR TENDER

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Planners & Management Consultants
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JV MEMBERS

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MEP CONSULTANT

ABSTRACTORS
MEP CONSULTANT
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Cell no: 0322-3924199
E-mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

WATER SUPPLY SYSTEM SCHEMATIC DIAGRAM

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SC-01

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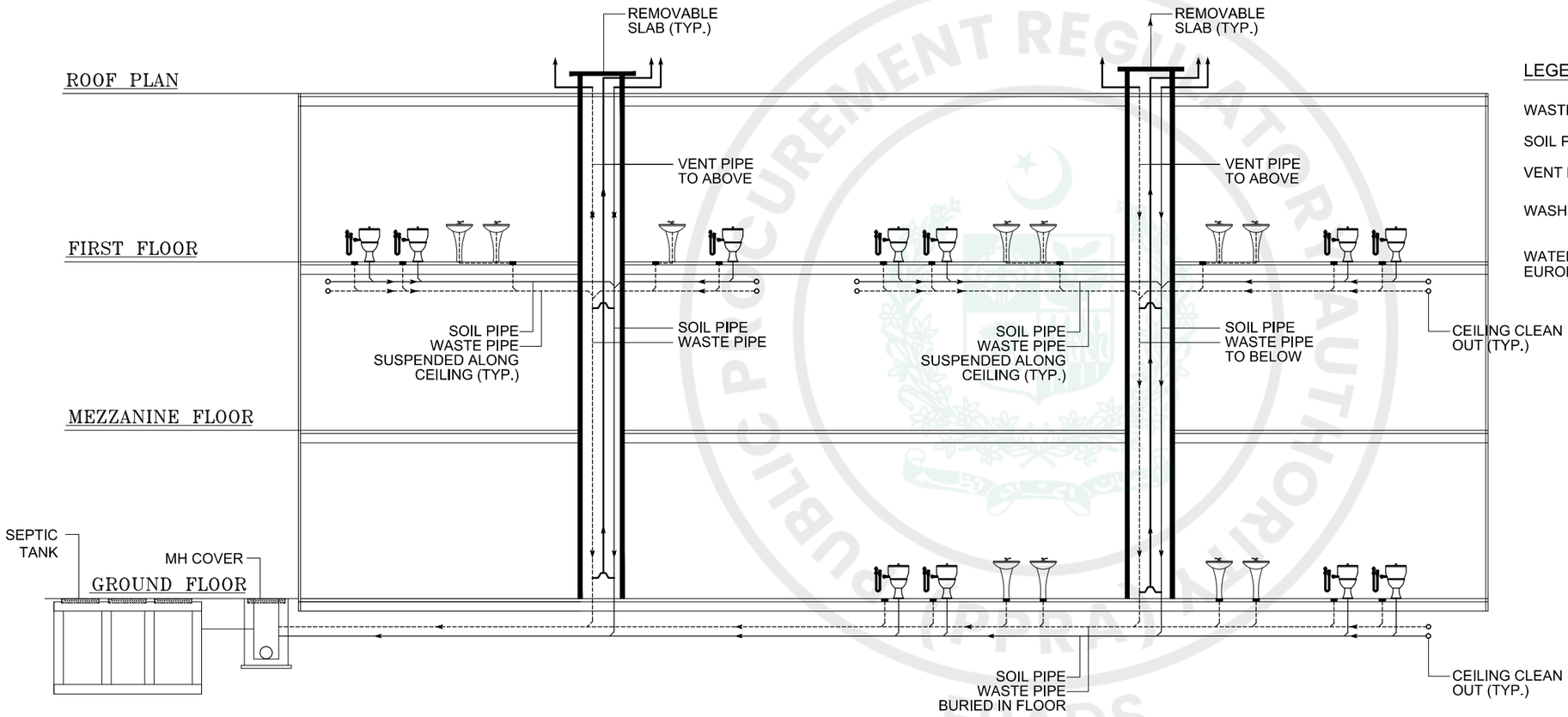

SEWERAGE SYSTEM SCHEMATIC

ISSUE FOR TENDER

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

SEWERAGE SYSTEM SCHEMATIC DIAGRAM

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	SC-02

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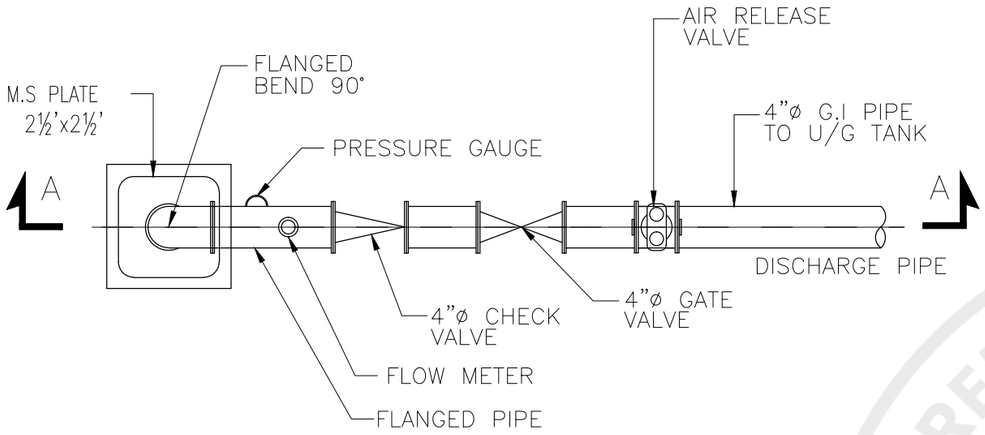
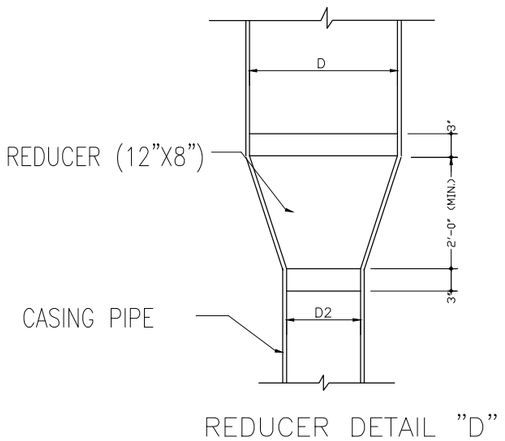


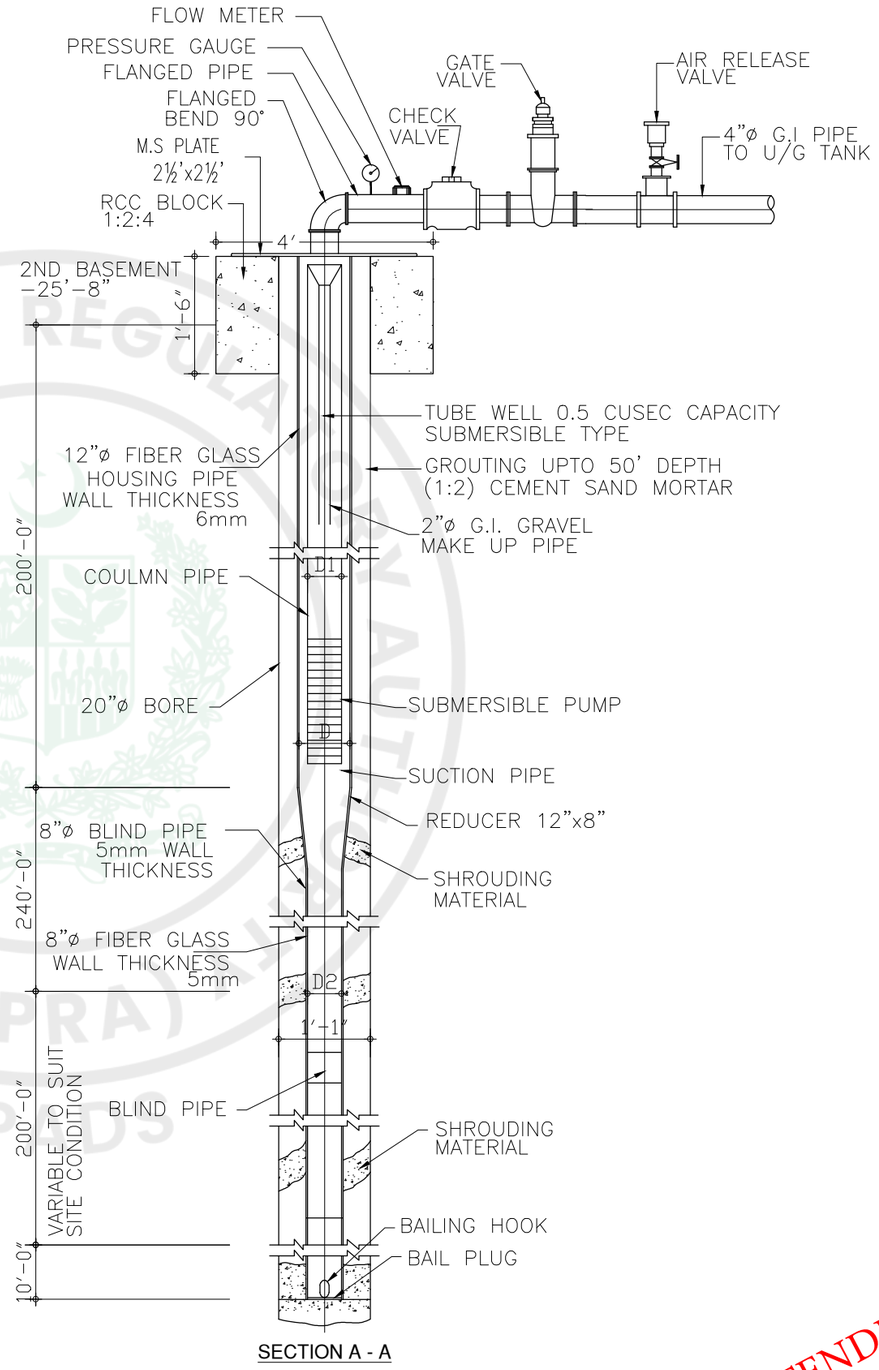
PROPOSED DRAWING FOR
0.5 CUSEC TUBE WELL



REDUCER DETAIL "D"

DESCRIPTION	PIPE DIA
D	12"
D1	4.875"
D2	8"
LENGTH OF STRAINER (APPROX)	90'±
REDUCER SIZE	12" x 8"

NOTE
1:SUBJECT TO MODIFICATION IN ACCORDANCE WITH ACTUAL FIELD CONDITION ENCOUNTERED DURING DRILLING OF BORE HOLES 2: DRAWING IS NOT TO SCALE



SECTION A - A

ISSUE FOR TENDER

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Project Name

Consultancy Services for
New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

TUBE WELL DETAILS

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	TW-01

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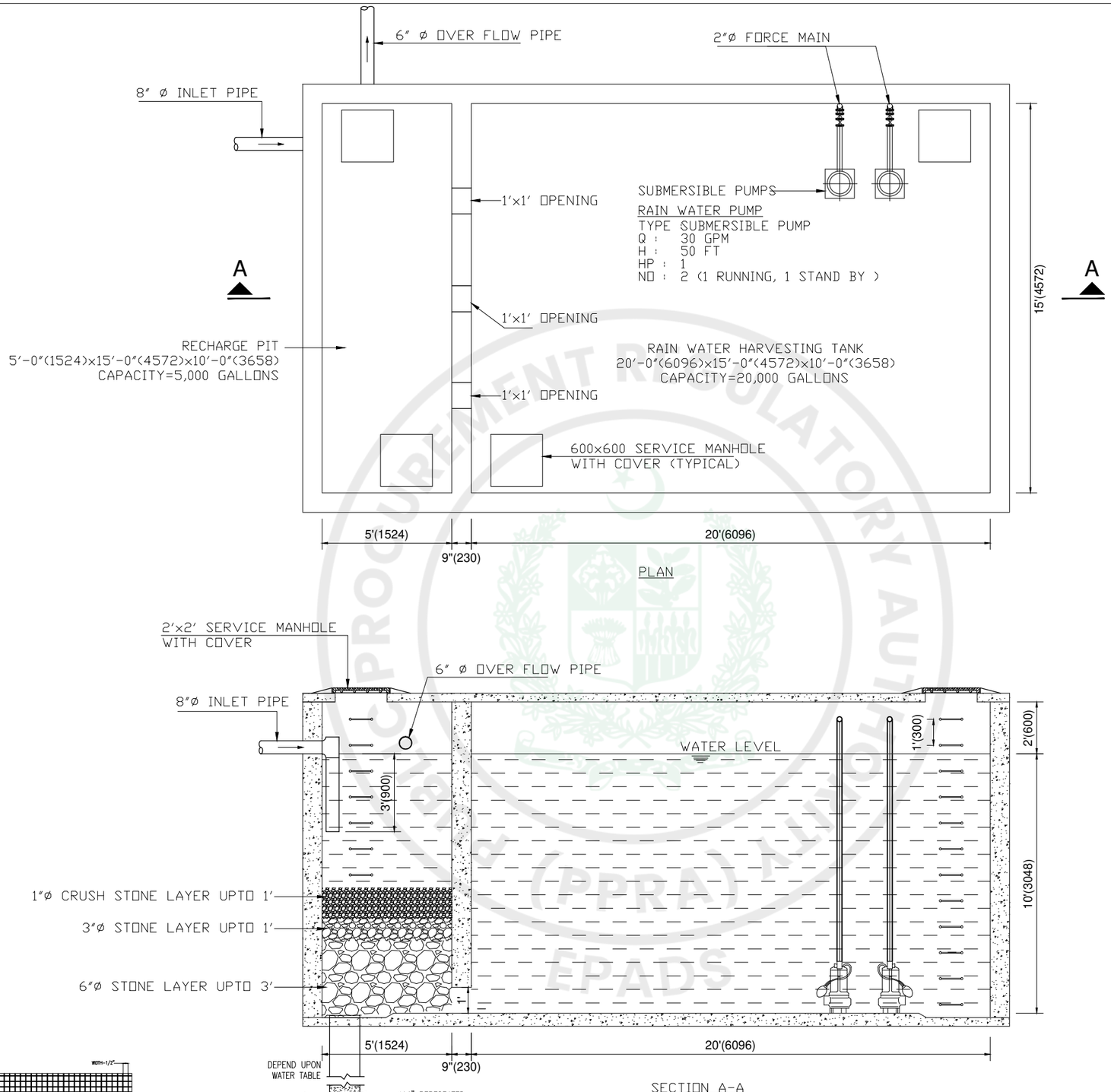

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Project Name

Consultancy Services for
New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED PUBLIC HEALTH Design Drawings

Sheet Name

RAIN HARVESTING WATER TANK DETAIL

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	RW-01

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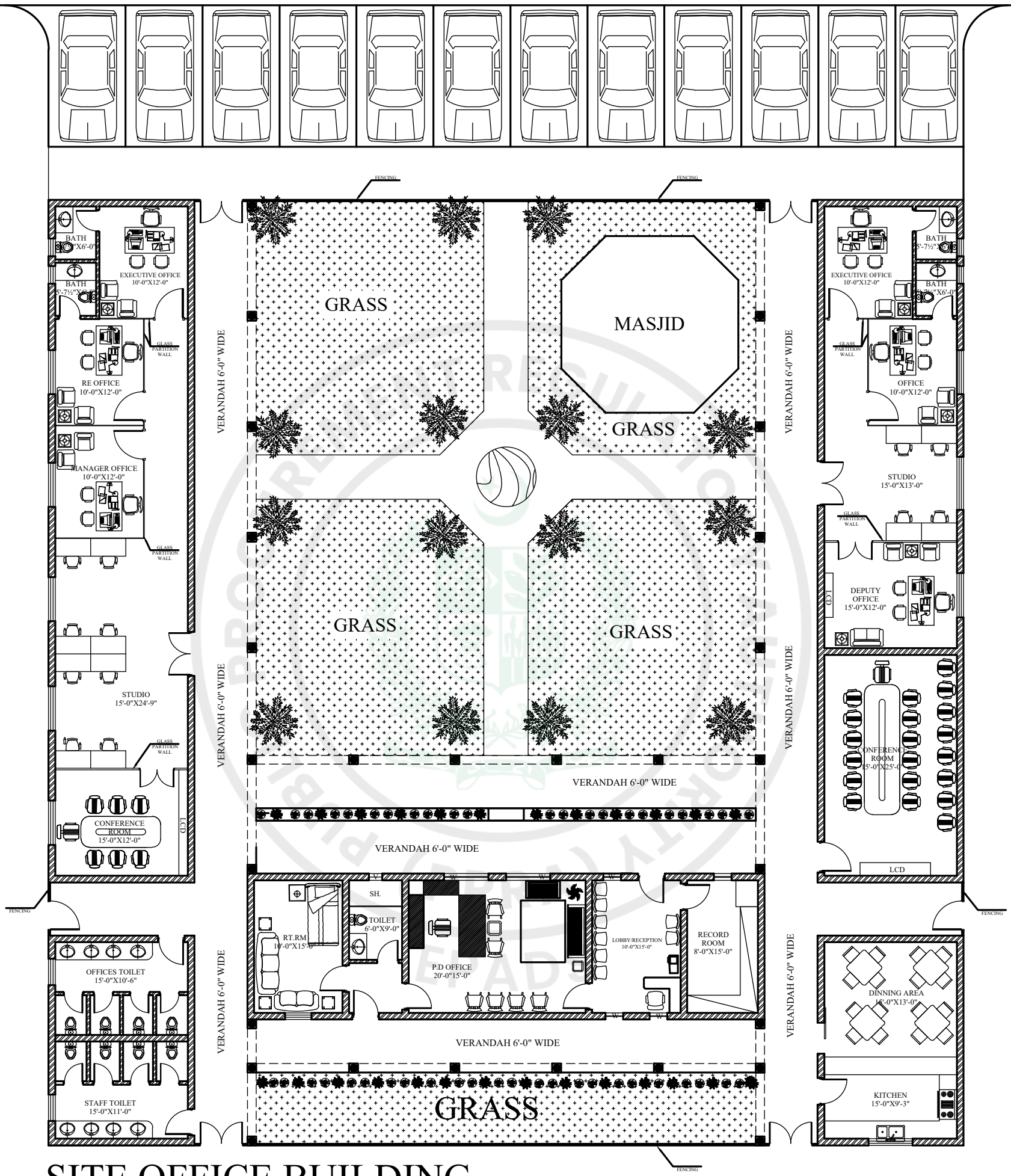
ROAD



SITE OFFICE BUILDING

PMU OFFICE=1282 SFT
RE OFFICE=1282 SFT
PD OFFICE=965 SFT
TOILETS AREA=392 SFT
DINNING & KITCHEN AREA=392 SFT
VERANDAH COVERED AREA = 2372 SFT
MASJID COVERED AREA = 350 SFT

DATE: 14-01-2026

PROPOSED SITE OFFICE FOR ATC TOWER PROJECT STAFF AT SKARDU AIRPORT.

MAIN CONSULTANTS:
Anwar Ali Architects (Pvt.) Ltd.
Consulting,Architects,Engineers
Planners & Management Consultants
06 HBFC BLOCK A FAISAL TOWN LAHORE

PAKISTAN AIRPORTS AUTHORITY (PAA)

CONSTRUCTION OF NEW AIR TRAFFIC CONTROL TOWER (ATCT), FIRE STATION AND ALLIED FACILITIES AT SKARDU INTERNATIONAL AIRPORT, SKARDU

PREAMBLE TO CORRIGENDUM NO. 1

August 2026

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

PAKISTAN AIRPORTS AUTHORITY (PAA)

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

BIDDING AND CONTRACT DOCUMENTS

TABLE OF CONTENT

S. No.	Description
1.	Corrigendum No. 1 — Amendments to Volume I, Volume II and Volume III
	Attachments — Amended Pages of Volume I, Volume II and Volume III

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

PAKISTAN AIRPORTS AUTHORITY

Construction of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport, Skardu

BIDDING AND CONTRACT DOCUMENTS

CORRIGENDUM # 1

Bidders shall take into consideration the following additions/deletions/amendments/clarifications in the Bidding and Contract Documents of the subject work issued to them.

1. Bid Data Sheet (Clause 24.1)

The deadline for submission of proposals has been extended as follows:

- Previous Deadline: 27th August 2026
- Revised Deadline: 17th September 2026 at 11:00 AM
- Opening Time: 17th September at 12:30 PM
- Venue: Unchanged (as specified in the original document)

2. Qualification and Evaluation Documents

a) Section V, Sub-Clause 1.4.1 (Financial Capability), the table of criteria shall be deleted and replaced with the following:

Sr.	Description	Max.	Criteria for Marks
(a)	Available Bank Credit Facility (latest)	100	Fifty (50) marks will be given if the available Bank Credit Line Limit is equal to PKR 1,000 million. Ten (10) additional marks will be given for every PKR 200 million increase in the Credit Line. Full marks (100) will be given if the Credit Line Limit is ≥ PKR 2,000 million. No marks will be given if the Credit Line Limit is less than PKR 1,000 million.
(b)	Average Working Capital (from Audited Financial Statements of last three (03) years)	100	Fifty (50) marks will be given if the Average Working Capital for last three years is equal to PKR 1,000 million. Ten (10) additional mark will be given for every PKR 100 million increase in Working Capital. Full marks (100) will be given if the Average Working Capital is ≥ PKR 1,500 million. No marks will be given if the Average Working Capital is less than PKR 1,000 million.
(c)	Average Annual Turnover (from Audited Financial Statements of last three (03) years)	100	Fifty (50) marks will be given if the Average Annual Turnover for the last three years is equal to PKR 5,000 million. Ten (10) additional mark will be given for every PKR 500 million increase in Average Annual Turnover. Full marks (100) will be given if the Average Annual Turnover is ≥ PKR 7,500 million. No marks will be given if the Average Annual Turnover is less than PKR 5,000 million.

b) Section V, Sub-Clause 1.4.2 (Experience Capability), Sr. No. 1, shall be deleted and replaced with the following:

"1. Projects of airport Building (e.g., ATC towers, terminal buildings) having a minimum project cost of PKR 2,000 million, successfully completed during the last

ten (10) years. [50 marks for each successfully completed project] — Max. Marks: 100"

c) Section V, Sub-Clause 1.4.2 (Experience Capability), Sr. No. 3, shall be deleted and replaced with the following:

"3. Projects including roads, bridges, runways, taxiways, and apron works, successfully completed with a minimum project cost of PKR 3,000 million during the last ten (10) years. [50 marks for each successfully completed project] — Max. Marks: 100"

d) Amended pages of Volume I, Section V are attached with this Addendum No. 1.

3. VOLUME II (Technical Specifications)

a) Section 0490 (General Requirements for Electrical Works), Clause 1.3 "Ambient Conditions", the table shall be deleted and replaced with the following:

Parameter	Value
Maximum indoor ambient temperature	40°C
Minimum indoor ambient temperature	−20°C
Maximum outdoor ambient temperature	50°C
Minimum outdoor ambient temperature	−20°C
Maximum relative humidity	100%
Minimum relative humidity	20%
Maximum altitude of project	2230 meters
Design basic wind speed	70 miles/hr
Fastest mile wind velocity	As per ASCE 7-22 with altitude correction at 2,230 m AMSL; refer to Section 0010 §1.02.1
Seismic Zone	Zone 4 per Building Code of Pakistan; Z = 0.4; ASCE 7-22 with Risk Category IV (Ip = 1.5 for non-structural components)

b) Section 0490, Clause 1.6.9 "Climatic Design Conditions for Electrical Equipment", the table shall be deleted and replaced with the following:

Parameter	Design Value
Maximum Ambient Temperature	+40°C — refer to project-wide design temperatures in Section 0010 §1.02.1. All electrical equipment shall be qualified for continuous operation at this maximum value.
Minimum Ambient Temperature	−25°C — equipment qualification minimum. Cold-start capability mandatory for generators, switchgear, motors and transformers. Refer to project-wide design temperatures in Section 0010 §1.02.1.
Maximum Relative Humidity	90% — tropical-grade insulation and anti-condensation heaters in all switchgear
Altitude Correction	All electrical equipment rated at 2,230 m AMSL; de-rate per IEC standards (approximately 0.79 × sea-level air density)

c) Section 0190 (Piling Works), Clause 2.2, the Pile Schedule table and Notes to the Pile Schedule shall be deleted and replaced with the following:

Foundation Ref.	Structure/Cap Size	Nos. of Caps	Piles per Cap	Total Piles	Dia. (mm)	Length (m)	WL/Pile (T)
ATCT-F1	ATCT — tower core raft, 70'-7" × 37'-6", cap thickness 33"	1	18 (6×3)	18	1,000	20	126
ATCT-F2	ATCT — 18' × 18', cap thickness 27"	16	4	64	1,000	15	76
ATCT-F3	ATCT — 18' × 31', cap thickness 27"	4	6 (2×3)	24	1,000	15	76
ATCT-F4	ATCT — 6'-6" × 21', cap thickness 21"	4	2	8	1,000	15	76
FS-F1	Fire Station — two-pile cap	6	2	12	1,000	15	76
FS-F2	Fire Station — two-pile cap	8	2	16	1,000	15	76
TOTAL WORKING PILES	—	39	—	142	—	—	—
Test piles	Sacrificial initial test piles (Clause 3.12B A)	—	—	2	1,000	As working piles	—
TOTAL PILES	—	—	—	144	—	—	—

Notes to the Pile Schedule: 1. All piles are bored cast-in-situ reinforced concrete, nominal diameter 1,000 mm (3'-3"), reinforced with 20 nos. #6 vertical bars with #3 spiral ties throughout the full pile length, in accordance with Sections A-A and B-B of the Structural Drawings. 2. Pile lengths shown are estimated. Final penetration shall be determined in accordance with Clause 2.3 following the results of the initial load tests specified in Clause 3.12A. 3. Foundation references are prefixed ATCT- and FS- to distinguish the two structures, both of which employ foundation marks F1 and F2 on their respective drawing sets (Drawings S-01 to S-14 for the ATCT and S-01U to S-07U for the Fire Station). 4. Working loads for the Fire Station pile types FS-F1 and FS-F2 are not stated on the Structural Drawings and have been taken as 76 tons. [ASSUMPTION — VERIFY with the Structural Consultant prior to issue.]

d) Section 0190, new Clause 3.12A "Schedule of Load Tests" shall be inserted, reading as follows:

The CONTRACTOR shall carry out the following minimum programme of pile testing. The quantities stated are minima and shall be read together with the Schedule of Quantities. The ENGINEER may order additional tests where results are inconclusive or where boring records indicate variable strata, and such additional tests shall be valued at the rates tendered for the corresponding test type.

Ref.	Test	Standard	Pile Group	Test Load	Nos.
T1	Initial (ultimate) vertical compression load test on sacrificial pile	ASTM D1143	ATCT-F1	378 tons (3.0× WL)	1
T2	Initial (ultimate) vertical compression load test on sacrificial pile	ASTM D1143	ATCT-F2, ATCT-F3, ATCT-F4, FS-F1, FS-F2	228 tons (3.0× WL)	1
T3	Routine (proof) vertical compression load test on working pile	ASTM D1143	ATCT-F1	189 tons (1.5× WL)	1
T4	Routine (proof) vertical compression load test on working pile	ASTM D1143	ATCT-F2, ATCT-F3, ATCT-F4, FS-F1, FS-F2 — one test per type	114 tons (1.5× WL)	5
T5	Lateral load test on working pile, applied cyclically	ASTM D3966	ATCT	10% of working load	1
T6	Tension (uplift) load test on working pile	ASTM D3689	ATCT	1.5× design uplift load	1
T7	Low-strain pile integrity test (PIT)	ASTM D5882	All working piles (100%)	—	142
T8	Crosshole sonic logging (CSL)	ASTM D6760	10% of working piles plus both initial test piles	—	17
T9	High-strain dynamic pile test (PDA) with CAPWAP analysis	ASTM D4945	Distributed across pile types as directed by the Engineer	—	4

e) Section 0190, new Clause 3.12B "Sequence and Conditions of Testing" shall be inserted, reading as follows:

A. Initial test piles (T1 and T2) shall be sacrificial piles installed separately from the working piles at positions selected by the ENGINEER, of the same material, diameter, reinforcement and installation method as the working piles. They shall form no part of the permanent works and shall be measured separately in the Schedule of Quantities.

B. Both initial load tests shall be completed and the test reports approved in writing by the ENGINEER before the CONTRACTOR commences installation of any working pile. No claim for delay arising from this requirement shall be entertained.

C. The reaction system for the initial tests shall be an anchor-pile reaction frame. Kentledge shall not be used for test loads exceeding 200 tons. The CONTRACTOR shall submit full details of the proposed

reaction system, including anchor pile design and frame calculations certified by a Professional Engineer, for the ENGINEER's approval prior to testing.

D. Reaction piles for the routine, lateral and tension tests (T3 to T6) shall be working piles. Reaction members shall be located at a clear distance of not less than three times the pile diameter, and in no case less than 3.0 m, from the test pile.

E. Not less than twenty-one (21) days shall elapse between completion of all concreting operations on any test pile and the application of test load, in accordance with Clause 3.14.

F. Load testing shall not be carried out when the ambient air temperature is below −5°C, nor during periods of snowfall or when snow or ice is present at the test station. Where testing extends into the winter period, the CONTRACTOR shall provide enclosure and heating to maintain instrumentation within its calibrated operating range, and shall protect reference beams and datum benchmarks against frost heave. All costs of such provision shall be deemed included in the rates.

G. Access tubes for crosshole sonic logging (T8) shall be four nos. steel tubes of 50 mm internal diameter per pile, installed to the full pile length, secured to the inner face of the reinforcement cage at equal spacing, capped and filled with clean water. Tubes shall be installed in all piles nominated for CSL and in both initial test piles, and the CONTRACTOR shall nominate the piles for the ENGINEER's approval before cage assembly.

H. The tension test (T6) shall be carried out only where net uplift is indicated at the tower core under the governing load combination. The ENGINEER shall confirm the design uplift value in writing before the test is programmed.

I. Where any test result fails to satisfy the acceptance criteria of Clause 3.18, the CONTRACTOR shall carry out such additional testing, remedial work or provision of additional piles as the ENGINEER may direct, entirely at the CONTRACTOR's expense.

f) The Approved Manufacturers/Suppliers Schedule (Civil Works), Item 32, shall be deleted and replaced with the following:

Item	Category	Approved Manufacturers
32	Expanded Polystyrene (EPS) / PIR Panel	1. Banu Mukhtar 2. EPS Pakistan 3. Izhar Foster

g) The Approved Manufacturers/Suppliers Schedule (Civil Works), new Item 33, shall be inserted, reading as follows:

Item	Category	Approved Manufacturers
33	Space Frame Structure	1. OHC Construction China 2. ABC Engineering Company China 3. Jazari Steel Pvt Ltd

h) Amended pages of Volume II are attached with this Addendum No. 1.

4. VOLUME III (Bill of Quantities)

a) Bill No. 2A — Pile Work, the following items shall be inserted:

Item	Description	Qty	Unit
CP-3	Initial (ultimate) vertical compression load test on sacrificial Ø1000 mm bored cast-in-situ pile to 378 tons (3.0 x working load of 126 tons), by anchor-pile reaction frame, in two loading cycles, instrumented for shaft friction and end bearing, in accordance with ASTM D1143 and Section 0190 Clause 3.12. Rate to include provision of the sacrificial test pile, reaction piles, reaction frame, instrumentation, loading, monitoring, standing time and submission of test report in triplicate.	1	No.
CP-4	Ditto Item 1, but test load 228 tons (3.0 x working load of 76 tons), covering pile types ATCT-F2, ATCT-F3, ATCT-F4, FS-F1 and FS-F2.	1	No.
CP-5	Routine (proof) vertical compression load test on working Ø1000 mm bored cast-in-situ pile of Foundation Type ATCT-F1 to 189 tons (1.5 x working load), in accordance with ASTM D1143. Rate to include reaction arrangement, instrumentation, loading, monitoring, standing time and test report.	1	No.
CP-6	Ditto Item 3, but test load 114 tons (1.5 x working load), on Foundation Types ATCT-F2, ATCT-F3, ATCT-F4, FS-F1 and FS-F2 - one test per foundation type.	5	No.
CP-7	Lateral load test on working Ø1000 mm bored pile of ATCT at 10% of working load, applied cyclically, in accordance with ASTM D3966. Rate to include reaction pile, instrumentation and test report.	1	No.
CP-8	Tension (uplift) load test on working Ø1000 mm bored pile of ATCT to 1.5 x design uplift load, in accordance with ASTM D3689. Rate to include reaction arrangement, instrumentation and test report. To be executed only where net uplift is confirmed in writing by the Engineer.	1	No.
CP-9	Low-strain pile integrity test (PIT) on Ø1000 mm bored piles in accordance with ASTM D5882 and Section 0190 Clause 3.19, including pile head preparation, testing, interpretation and report. (100% of working piles.)	142	No.
CP-10	Crosshole sonic logging (CSL) of Ø1000 mm bored piles in accordance with ASTM D6760, including supply and installation of four nos. 50 mm dia. steel access tubes per pile to full pile length, capping, water filling, testing, interpretation and report. (10% of working piles plus both initial test piles.)	17	No.
CP-11	High-strain dynamic pile test (PDA) with CAPWAP analysis on Ø1000 mm bored pile in accordance with ASTM D4945 and Section 0190 Clause 3.20, complete in all respects including wave equation analysis and test report.	4	No.
CP-12	Extra over the pile installation items for provision of 2 nos. sacrificial initial test piles, Ø1000 mm bored cast-in-situ, of the same length, reinforcement and installation method as the working piles, installed at positions selected by the Engineer and forming no part of the permanent works.	2	No.

b) Amended pages of Volume III, Bill No. 2A, are attached with this Addendum No. 1.

*****End of Addendum No. 1*****

ATTACHMENTS

[Sr. No. 1]

Amended Pages

[Volume I — Section V, Evaluation and Qualification Criteria]

[Sr. No. 2]

Amended Pages

[Volume II — Section 0190 and Section 0490, Technical Specifications; Approved Manufacturers Schedule]

[Sr. No. 3]

Amended Pages

[Volume III — Bill of Quantities, Bill No. 2A — Pile Work]

[Sr. No. 4]

[Volume IV — Drawings for Addendum]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

[Sr. No. 1]

Amended Pages

[Volume I — Section V, Evaluation and Qualification Criteria]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Category	Maximum Marks	Minimum Acceptable Marks (50%)
Experience Capability	400	200
Personnel Capability	150	75
Equipment Capability	150	75
TOTAL	**1000**	**700 (aggregate)**

To qualify, Bidders must receive not less than fifty percent (50%) minimum acceptable marks in each category and minimum aggregate of not less than seven hundred (700) marks. The Bidders are required to provide substantial documentary evidence in each case for marking under the Qualification Criteria. Where substantial evidence is not provided, marks shall not be awarded.

5.4.1 Financial Capability (Minimum 700 Marks)

The Bidder shall demonstrate that it has access to, or has available, liquid assets, lines of credit, and other financial means sufficient to meet the cash flow requirements for the execution of the Works (Letter issued by Banks for showing unutilized credit line) The Audited Balance Sheets of the last three (03) financial years (Forms FDS-3.1 and FDS-3.2) from a Chartered Accountant firm must be submitted and shall demonstrate the soundness of the Bidder's financial position, showing long-term profitability. Where necessary, the Procuring Agency may make inquiries with the Bidder's bankers, financial institutions, and auditors.

Marks shall be awarded under this category based on the following criteria:

Sr. No.	Description	Max. Marks	Criteria for Marks
(a)	Available Bank Credit Facility (Letter)	100	Fifty (50) marks will be given if the available Bank Credit Line Limit is equal to PKR 1,000 million. Ten (10) additional marks will be given for every PKR 200 million increase in the Credit Line. Full marks (100) will be given if the Credit Line Limit is ≥ PKR 2,000 million. No marks will be given if the Credit Line Limit is less than PKR 1,000 million.
(b)	Average Working Capital (from Audited Financial Statements of last three (03) years)	100	Fifty (50) marks will be given if the Average Working Capital for last three years is equal to PKR 1,000 million. ten (10) additional mark will be given for every PKR 100 million increase in Working Capital. Full marks (100) will be given if the Average Working Capital is ≥ PKR 1,500 million. No marks will be given if the Average Working Capital is less than PKR 1,000 million.

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Sr. No.	Description	Max. Marks	Criteria for Marks
(c)	Average Annual Turnover (from Audited Financial Statements of last three (03) years)	(08)	Fifty (50) marks will be given if the Average Annual Turnover for the last three years is equal to PKR 5,000 million. Ten (10) additional mark will be given for every PKR 500 million increase in Average Annual Turnover. Full marks (500) will be given if the Average Annual Turnover is ≥ PKR 7,500 million. No marks will be given if the Average Annual Turnover is less than PKR 5,000 million
Total Marks Allocated		**500**	No marks shall be awarded for financial capability below the specified minimum limits

1.4.3 Experience Capability (Maximum 400 Marks)

Experience for similar/comparable projects completed (Forms EXP-4.1 and EXP-4.2) will be evaluated on the basis of the following marks. Bidders shall refrain from referring to the same project under multiple categories below, to ensure a comprehensive evaluation of the firm's capabilities across different domains.

Information regarding similar/comparable nature projects shall be supported by documentary evidence such as Letter of Award and Taking-Over Certificate/Defects Liability Certificate/Substantial Completion Certificate issued by the Client. No marks shall be awarded if such documentary evidence is not attached.

Sr. No.	Experience Capability	Max. Marks
i.	Projects of airport Building (e.g., ATC towers, terminal buildings) having a minimum project cost of PKR 2,000 million, successfully completed during the last ten (10) years. [80 marks for each successfully completed project]	(80)
ii.	Projects of similar nature including piling works for high-rise buildings, successfully completed with a minimum project cost of PKR 1,000 million during the last ten (10) years. [50 marks for each successfully completed project]	(80)
iii.	Projects including roads, bridges, runways, taxiways, and apron works, successfully completed with a minimum project cost of PKR 5,000 million during the last ten (10) years. [50 marks for each successfully completed project]	(80)
iv.	Projects of similar nature executed on Steel Structure / pre-engineered building with at least 20,000 SH (net plan), successfully	(80)

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[Sr. No. 2]

Amended Pages

[Volume II — Section 0190 and Section 0490, Technical Specifications; Approved Manufacturers Schedule]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Foundation Ref.	Structure / Cap Size	Nos. of Caps	Piles per Cap	Total Piles	Pile Dia. (mm)	Pile Length (m)	Working Load per Pile (Tons)
Test piles	Sacrificial instrumented piles (Clause 3.12E.6)	—	—	2	1,000	As working piles	—
TOTAL PILES	—	—	—	**144**	—	—	—

Notes to the Pile Schedule:

1. All piles are bored cast-in-situ reinforced concrete, nominal diameter 1,000 mm (3'-3"), reinforced with 20 nos. #8 vertical bars with #3 spiral ties throughout the full pile length, in accordance with Sections A-A and B-B of the Structural Drawings.

2. Pile lengths shown are estimated. Final penetration shall be determined in accordance with Clause 3.3 following the results of the initial load tests specified in Clause 3.12A.

3. Pile-station references are prefixed ATCT- and FS- to distinguish the two structures, both of which employ foundation marks F1 and F2 on their respective drawing sets (Drawings S-F1 to S-F4 for the ATCT and S-01U to S-07U for the Fire Station).

4. Working loads for the Fire Station pile types FS-P1 and FS-P2 are not stated on the Structural Drawings and have been taken as PE items. [ASSUMPTION — VERIFY with the Structural Consultant prior to issue.]

3.3 PENETRATION OF PILES

The estimated minimum lengths of piles below the prepared ground level is specified in the Drawings. Depending on the results of pre-loading test described later under this section and depending also on supplementary soil information obtained in the course of execution of the actual pile work, the ENGINEER may at his own discretion order the CONTRACTOR to vary the penetration of some or all of the piles as the case may be.

PART 3 - EXECUTION

3.1 EXECUTION OF BORE HOLE

The CONTRACTOR may use any percussive rotary or vibration method, or any combination thereof for sinking the bore hole to the elevation required but the use of water jets or of any other method or methods for the execution of the bore hole which tend to disintegrate or to appreciably loosen the soil inside surrounding the bore hole is expressly prohibited.

3.2 LIMITATION OF BORING SEQUENCE

No boring operations shall take place nearer than 10ft (3 meters) from any pile for which concreting operations are in progress or from any newly completed pile until at least forty-eight (48) hours have elapsed from the last surrounding operation on that pile.

3.3 REMOVAL OF SOIL

The soil inside the bore hole shall be removed by augering or some similar method. It is expressly prohibited to pump out or to attempt to pump out the water in the bore hole or to use pumping or water jetting to assist with the removal of soil or any other materials from the casing.

3.4 SAMPLES AND BORE HOLE LOGS

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A. For detail specification of cement, aggregates and concrete refer to Section 5150 - Concrete Works

B. For detail specifications of reinforcement refer to relevant section.

2.2 DESCRIPTION OF PILES

The piles shall be bored cast in place, reinforced concrete piles. The pile diameter, working depth, design axial and torsional loads, group configuration, number of working piles, and the test programme shall be as shown on the Structural Drawings and as summarized in the Pile Schedule. But the Contractor shall extract from the Structural Drawings and submit with the Method Statement for the Engineer's approval before any piling work commences. The nominal diameter of piles is defined as the outside diameter of the temporary casing which is used to carry out the boring to the excavation required and which is later withdrawn as far as practicable during the placing of concrete. The pile concrete shall be the grade specified in the Concrete Grade Table contained under Section 5150 and shall in no case be lower than 3,000 psi cylinder strength.

The casing shall penetrate to the bottom of the bore hole and not be withdrawn except as stipulated hereinafter. However, depending upon the final and general site conditions the ENGINEER may at his sole discretion, allow withdrawal of the last portion of the pile shaft by up to

Parameter	Specification
Pile Type	Bored Cast-in-Situ Reinforced Concrete Piles
Pile Diameter — All Caps P1, P2, P3, P4	1,000 mm (1.0 m)
Concrete Strength	f_c' = 4,000 psi minimum (self-compacting concrete for in-situ placement)
Main Reinforcement	ASTM A615 Grade 60, f_y = 60,000 psi
Lateral Ties / Spirals	ASTM A615 Grade 60, f_y = 40,000 psi
Minimum Cover to Pile Face	75 mm (3 inches)
Concrete Placement Method	Tremie pipe from bottom of bore upwards (no elevation)

Foundation Ref.	Structure / Cap Size	Nos. of Caps	Piles per Cap	Total Piles	Pile Dia. (mm)	Pile Length (m)	Working Load per Pile (Tons)
ATCT-P1	ATCT — Basin core wall, 75'-7" × 37'-6", cap thickness 3'-7"	1	18 (9 × 2)	18	1,000	28	100
ATCT-P2	ATCT — 12' × 10' cap, thickness 3'-0"	16	4	64	1,000	15	70
ATCT-P3	ATCT — 18' × 21' cap, thickness 3'-7"	4	6 (3 × 2)	24	1,000	16	70
ATCT-P4	ATCT — 8'-6" × 21' cap, thickness 2'-7"	4	3	6	1,000	15	70
FS-P1	Fire Station — two-pile cap	6	2	12	1,000	15	70
FS-P2	Fire Station — two-pile cap	8	2	16	1,000	15	70
TOTAL WORKING PILES	—	**39**	—	**182**	—	—	—

Test Type	Standard
Sonic Integrity Test (SIT)	ASTM D5882
High-Strain Dynamic Test (PDA)	ASTM D4945
Static Compression Load Test	ASTM D1143
Pile Position Survey	Engineering survey

3.12A SCHEDULE OF LOAD TESTS

The CONTRACTOR shall carry out the following minimum programme of pile testing. The quantities stated are indicative and shall be read together with the Schedule of Quantities. The ENGINEER may order additional tests where results are inconclusive or where boring records indicate variable strata; and such additional tests shall be valued at the rates tendered for the corresponding test type.

Ref.	Test	Standard	Pile Group	Test Load	Nos.
T1	Initial (preliminary) vertical compression load test on sacrificial pile	ASTM D1143	ATCT-F1	270 tons (3.0 × working load)	1
T2	Initial (alternate) vertical compression load test on sacrificial pile	ASTM D1143	ATCT-F2, ATCT-F3, ATCT-F4, FB-F1, FB-F2	225 tons (3.0 × working load)	1
T3	Routine (proof) vertical compression load test on working pile	ASTM D1143	ATCT-F1	180 tons (1.5 × working load)	1
T4	Routine (proof) vertical compression load test on working pile	ASTM D1143	ATCT-F2, ATCT-F3, ATCT-F4, FB-F1, FB-F2 — one test per size	114 tons (1.5 × working load)	3
T5	Lateral load test on working pile against cantilever	ASTM D3966	ATCT	15% of working load	1
T6	Tension (uplift) load test on working pile	ASTM D3689	ATCT	1.5 × design uplift load	1
T7	Low-strain pile integrity test (PIT)	ASTM D5882	All working piles (100%)	—	142
T8	Crosshole sonic logging (CSL)	ASTM D6760	10% of working piles plus both initial test piles	—	17
T9	High-strain dynamic pile test (PDA) with CAPWAP analysis	ASTM D4945	Distributed across pile types as directed by the Engineer	—	4

3.12B SEQUENCE AND CONDITIONS OF TESTING

A. Initial test piles (T1 and T2) shall be sacrificial piles installed separately from the working piles at positions selected by the ENGINEER, of the same material, diameter, reinforcement and installation method as the working piles. They shall form no part of the permanent works and shall be measured separately in the Schedule of Quantities.

B. Both initial load tests shall be completed and the test reports approved in writing by the ENGINEER before the CONTRACTOR commences installation of any working pile. No claim for delay arising from this requirement shall be entertained.

C. The reaction system for the initial tests shall be an anchor-pile reaction frame. Kentledge shall not be used for test loads exceeding 200 tons. The CONTRACTOR shall submit full details of the proposed reaction system, including anchor pile design and frame calculations certified by a Professional Engineer, for the ENGINEER's approval prior to testing.

D. Reaction piles for the routine, lateral and tension cases (T3 to T5) shall be working piles. Reaction members shall be located at a clear distance of not less than three times the pile diameter, and in no case less than 1.2 m from the test pile.

E. Not less than twenty-one (21) days shall elapse between completion of all concreting operations on any test pile and the application of test load, in accordance with Clause 3.11.

F. Load testing shall not be carried out when the ambient air temperature is below +4°C, nor during periods of snowfall or when snow or ice is present at the test station. Where testing extends into the winter period, the CONTRACTOR shall provide enclosure, heating to maintain such a temperature within its anticipated operating range, and shall protect reference beams and dial-gauge benchmarks against frost heave. All costs of such provision shall be deemed included in the rates.

G. Access tubes for cross-hole sonic logging (T6) shall be four nos. steel tubes of 50 mm internal diameter per pile, installed to the full pile length, secured to the inner face of the reinforcement cage at equal spacing, capped and filled with clean water. Tubes shall be installed in all piles nominated for CSL and in both initial test piles, and the CONTRACTOR shall demonstrate the grout for the ENGINEER's approval before cage assembly.

H. The tension test (T5) shall be carried out only where net uplift is indicated at the tower core under the governing load combination. The ENGINEER shall confirm the design uplift value in writing before the test is programmed.

I. Where any test result fails to satisfy the acceptance criteria of Clause 3.10, the CONTRACTOR shall carry out such additional testing, remedial work or provision of additional piles as the ENGINEER may direct, entirely at the CONTRACTOR's expense.

3.13 LOCATION OF TEST PILE

The location of the test pile shall be provided by the Engineer.

3.14 TIME OF TESTING

Not less than 21 (twenty-one) days shall elapse between the end of all concreting operations on the test pile and the application of any test loads.

3.15 METHODS OF LOADING

The purpose of the load test is not only to determine the ultimate load bearing capacity of the pile but also to obtain information on settlement and other aspects of the behavior of the pile which may lead to an adjustment of the penetration specified for the permanent piles in the foundations.

The apparatus and methods for the application of test load must be capable of applying known vertical loads to the top of the test pile without introducing any lateral thrust, twist or movement in the pile. Full details of the proposed apparatus and methods shall be submitted by the CONTRACTOR to the ENGINEER for his prior approval.

The suggested method of applying loads for axial compression load tests is by jacking against a box or platform resting on scaffolding constructed over the top of the pile and loaded with suitable kentledge with a total weight of not less than 1½ times the design value.

The suggested methods of applying loads for axial tension load tests are cantilever pulling method or fulcrum pulling method using cable-stall jacks or chains and pressure ram or platform load.

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1.2 RULES AND REGULATIONS

The entire electrical installation/work shall be carried out by a licensed Contractor authorized to undertake such work under the provisions of the Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified up to date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers – London, the Tender Documents, The Electricity Rules 1937, and bye-laws in force. Any discrepancy shall be brought to the notice of the Engineer for instructions, the Engineer's decision shall be final.

The Contractor shall ensure that his connection of the 11 kV cable with the existing 11 kV switchgear at the grid station is certified by, and acceptable to, the Water and Power Department of the Government of Gilgit-Baltistan (GB Power Department), which is the electricity supply authority for Skardu.

1.3 AMBIENT CONDITIONS

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise:

Parameter	Value
Maximum indoor ambient temperature	40°C
Minimum indoor ambient temperature	-20°C
Maximum outdoor ambient temperature	50°C
Minimum outdoor ambient temperature	-20°C
Maximum relative humidity	100%
Minimum relative humidity	20%
Maximum altitude of project	2230 meters
Design basic wind speed	75 miles/hr
Factored site wind velocity	As per ASCE 7-22 with altitude correction at 2,230 m AMSL, refer to Section 0810 §1.02.1
Seismic Zone	Zone 4 per Building Code of Pakistan; Z = 0.4, ASCE 7-22 with Risk Category IV (Ip = 1.5 for non-structural components)

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All equipment shall have stainless steel name plates mounted in a visible position. Entries shall be indelibly marked in English by engraving and include data per applicable IEC and other standards, plus any specified requirements. The Contractor shall also supply all labels, instruction and warning plates (English and where specified Urdu) necessary for identification and safe operation. All labels, nameplates, instructions and warning plates shall be securely fixed with stainless steel rivets, plated self-tapping screws or other approved means (adhesives not permitted).

1.6.7 Identification & Labeling

All devices, meters, cabling, wiring and auxiliaries shall be properly labelled for identification using flameproof material with indelible inscription. Labeling shall ensure uniformity and facilitate study of control diagrams during operation and maintenance. Labels shall be of suitable size to be visible from operating conditions/positions.

1.6.8 Lamp Test Facility

All equipment / Switchboards / Motor Control Centers, etc. shall be provided with separate lamp test facility.

1.6.9 Climatic Design Conditions for Electrical Equipment

Parameter	Design Value
Maximum Ambient Temperature	+45 °C — refer to project-wide design temperatures in Section 0010 §1.02.1. All electrical equipment shall be qualified for continuous operation at this maximum value.
Minimum Ambient Temperature	–25 °C — equipment qualification minimum. Cold-start capability mandatory for generators, switchgear, cables and transformers. Refer to project-wide design temperatures in Section 0010 §1.02.1.
Maximum Relative Humidity	95% — tropical-grade insulation and anti-condensation heaters in all switchgear.
Altitude Correction	All electrical equipment rated at 3,230 m AMSL; de-rate per IEC standards (approximately 3.79 × sea-level air density).

1.7 SHOP DRAWINGS, MATERIAL SUBMITTALS AND TECHNICAL DATA

1.7.1 Required Submittals

The Contractor shall submit for each electrical equipment as a minimum:

- Structural drawings (foundations, RCC details, dimensional plans, elevation, sections, loading details).
- Electrical drawings: line/schematic diagrams for HT Switchboards, LT Switchboards/ATS/Synchronization Panel, LT Outdoor Distribution, LT Distribution Boards, Motor Control Centers; detailed wiring/control diagrams, elevations, internal component layout, top/bottom/cable entries.
- Complete shop drawings with execution/Routing/installation details (number of wires, conduit size, cable routes, cable schedules) for Lighting Layouts (including Façade Lighting), Power Layouts, Cable Tray Layouts, Grounding Layouts, Lightning Protection System Layouts, Ground Powering Unit (400Hz), Cathodic Protection System (CPS), Solar Power System

24	EPC Panels	2. Bano Mukhtar 3. EPC Solution Pakistan
25	Door Locks & Door Closer	1. Yale 2. Alkey
26	Tile Grout	1. Hepolite 2. Sika
27	Tile Bond	1. Hepolite 2. Sika
28	Gypsum Board Ceiling and Panel	1. United Gypsum 2. Elephant 3. Lucky's Gypsum
29	Fire Doors	1. Hasan Abdo 2. Khokhar Group
30	Terrazzo Tiles	1. Punjab Tiles
31	Expansion Joints	4. ARPEN 5. Asbokrik 6. Mashkul
32	Expanded Polystyrene (EPS) / PIR Panel	1. Bano Mukhtar 2. EPS Pelican 3. Shah Foods
33	Space Frame Structure	1. CHC Construction China 2. ABC Engineering Company China 3. Jubail Steel Pvt Ltd

WATER SUPPLY & SANITARY FITTINGS

Sr. No.	Materials / Items	Name of Manufacturer/ Suppliers
1	G.I Pipes	1. IMS International Industries Limited (IIL)
2	G.I. Pipe Fittings	1. MS HE China, MS TS China.
3	CPVC Pipes	1. Prestige Plastic Pipes 2. Lubmin/ 3. Skelco Pipes
4	Sanitary Fixtures	1. TOTO by AW 2. Ventura by KDO 3. Bijen by H-Varsa 4. Sara by S-Abdullah
5	Kitchen Sinks	1. SOS 2. Pakla 3. Prestige
6	Sanitary Fittings	1. TOTO by AW 2. Hasa Centre by H-Varsa 3. SERA by S- Abdullah
7	Valves	1. Kitz Japan
8	Geyser	1. Ekotherm 2. CANNON 3. Velarstan

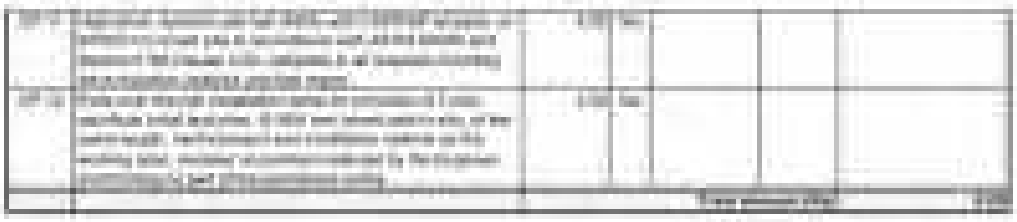
[Sr. No. 3]

Amended Pages

[Volume III — Bill of Quantities, Bill No. 2A — Pile Work]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Item No.	Description	Quantity	Unit	Rate (Rs)	Total Rs.	Amount (Rs.)



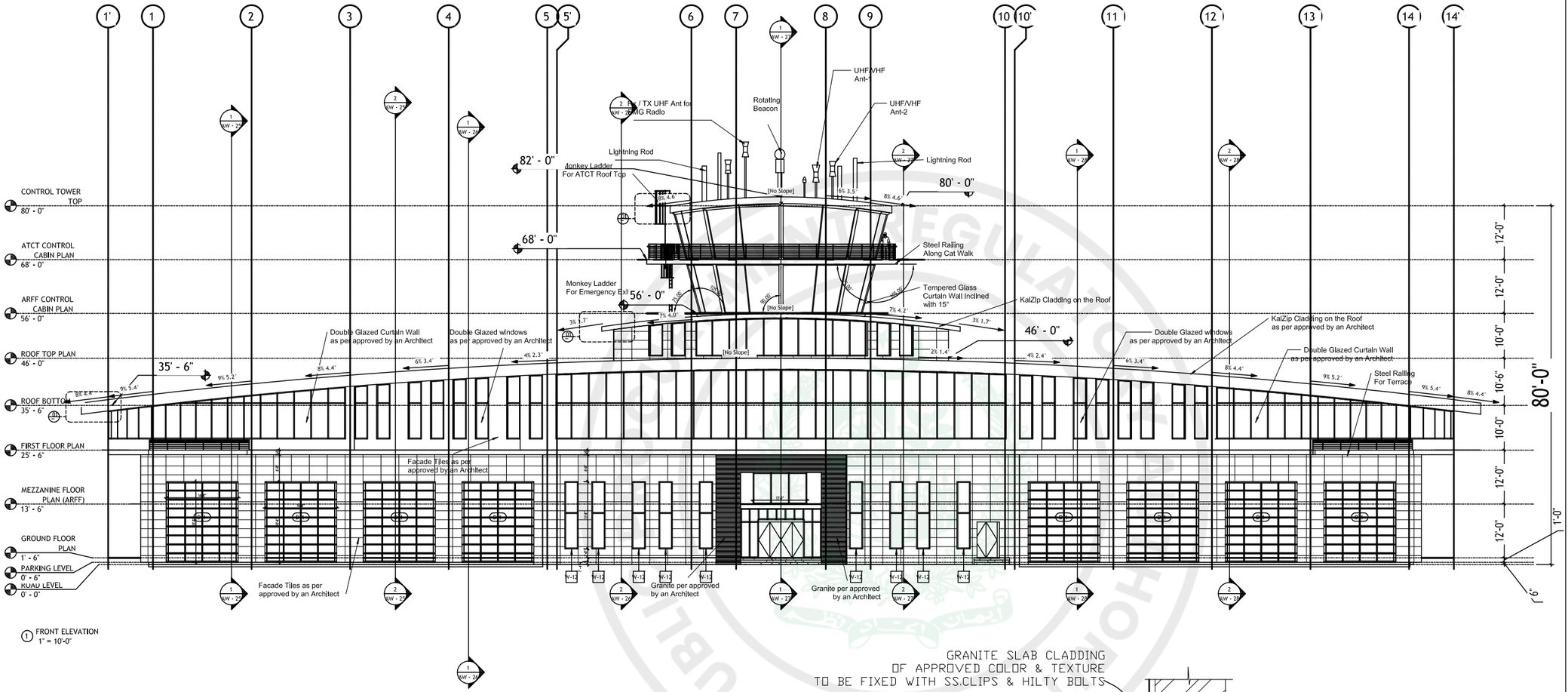
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

[Sr. No. 4]

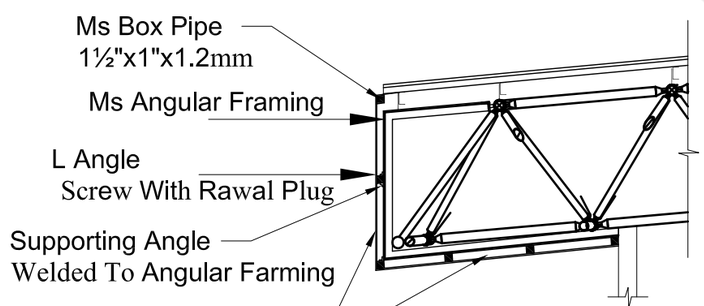
[Volume IV — Drawings for Addendum]

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

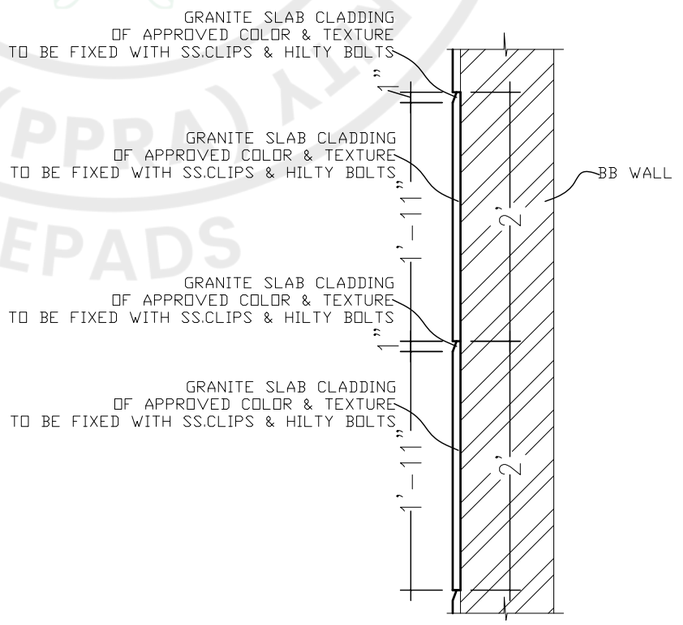
PUBLIC PROCUREMENT REGULATORY AUTHORITY
(PPRA)
EPADS



1 FRONT ELEVATION
1" = 10'-0"



ACP CLADDING DETAIL
Section-"1"



GRANITE FIXED DETAIL

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CLIENT NAME

PAA
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MAIN CONSULTANT

Anwar Ali Architects (Pvt.) Ltd.
Formerly Anwar Ali & Associates Since March 2000 to June 2018
Consulting Architects, Engineers, Planners & Management Consultants

JV MEMBERS

COMRADES CONSULTANTS
leit-werk

Structural Consultant

Project Name

Consultancy Services for the Design of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Detailed Architectural Design Drawings

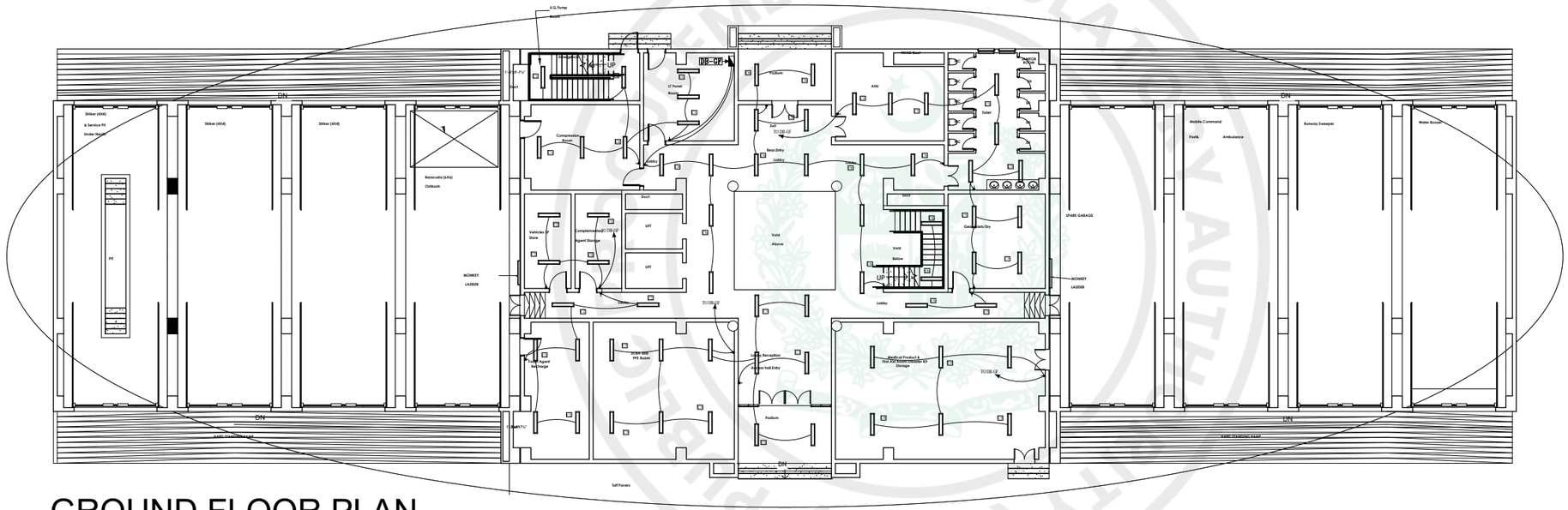
FRONT ELEVATION

Design By	Ar. Henrik Rothe
Checked By	Ar. Ahmed Ali
Approved By	Ar. Anwar Ali
Drawn By	Ar. Muhammad Tayyab
Date	March 2026

AW - 20

Scale @ 42" X 30" 1" = 10'-0"

PUBLIC PROPERTY (PPRA) EPADS



GROUND FLOOR PLAN

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MAIN CONSULTANT

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JV MEMBERS

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STRUCTURAL CONSULTANT

AR ENGINEERS
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E-mail: abstractorseng@gmail.com

Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

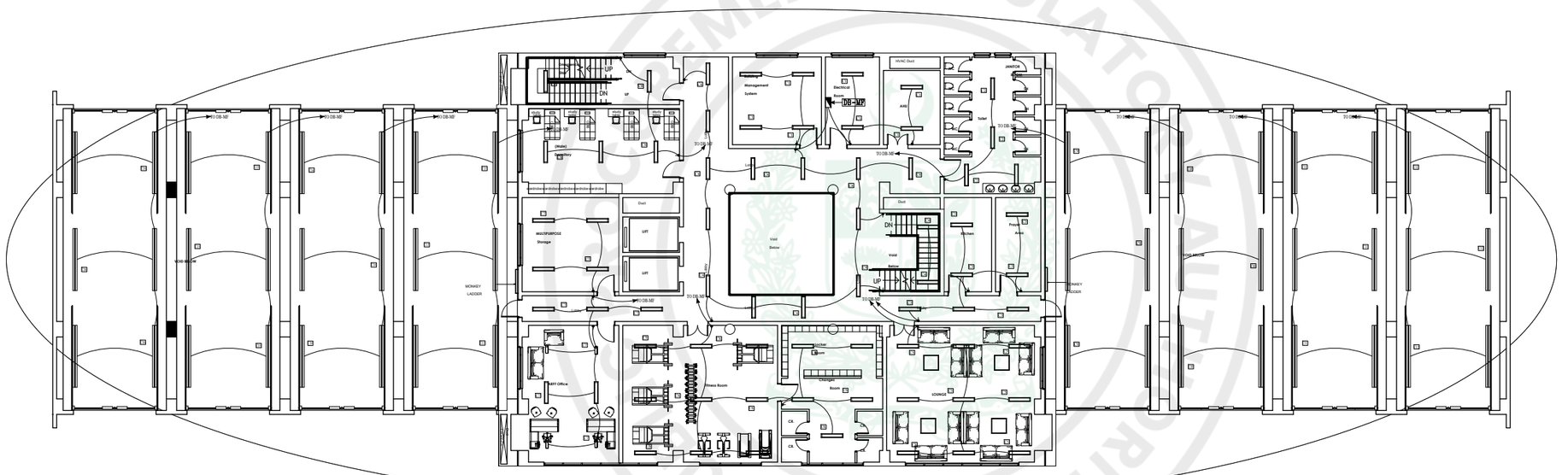
DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-10

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ARFF FLOOR
MEZZANINE FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

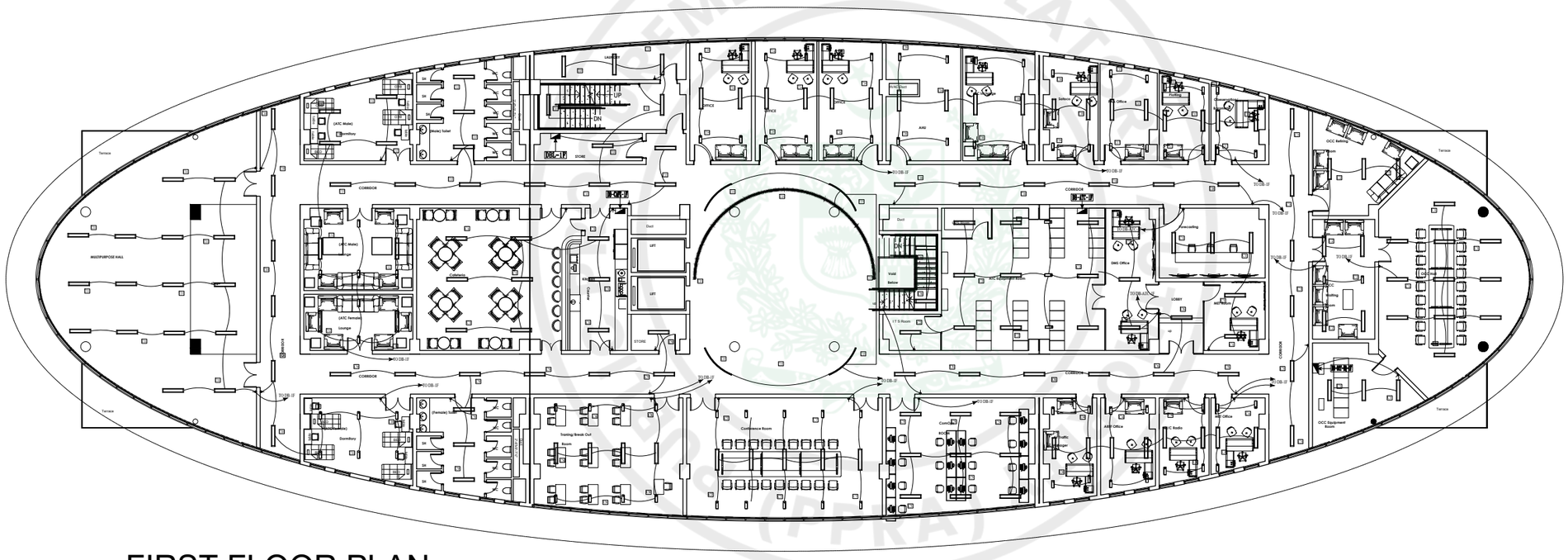
DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-11

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

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CLIENT NAME

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MAIN CONSULTANT

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JV MEMBERS

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Cell no: 0322-3924199
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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-12

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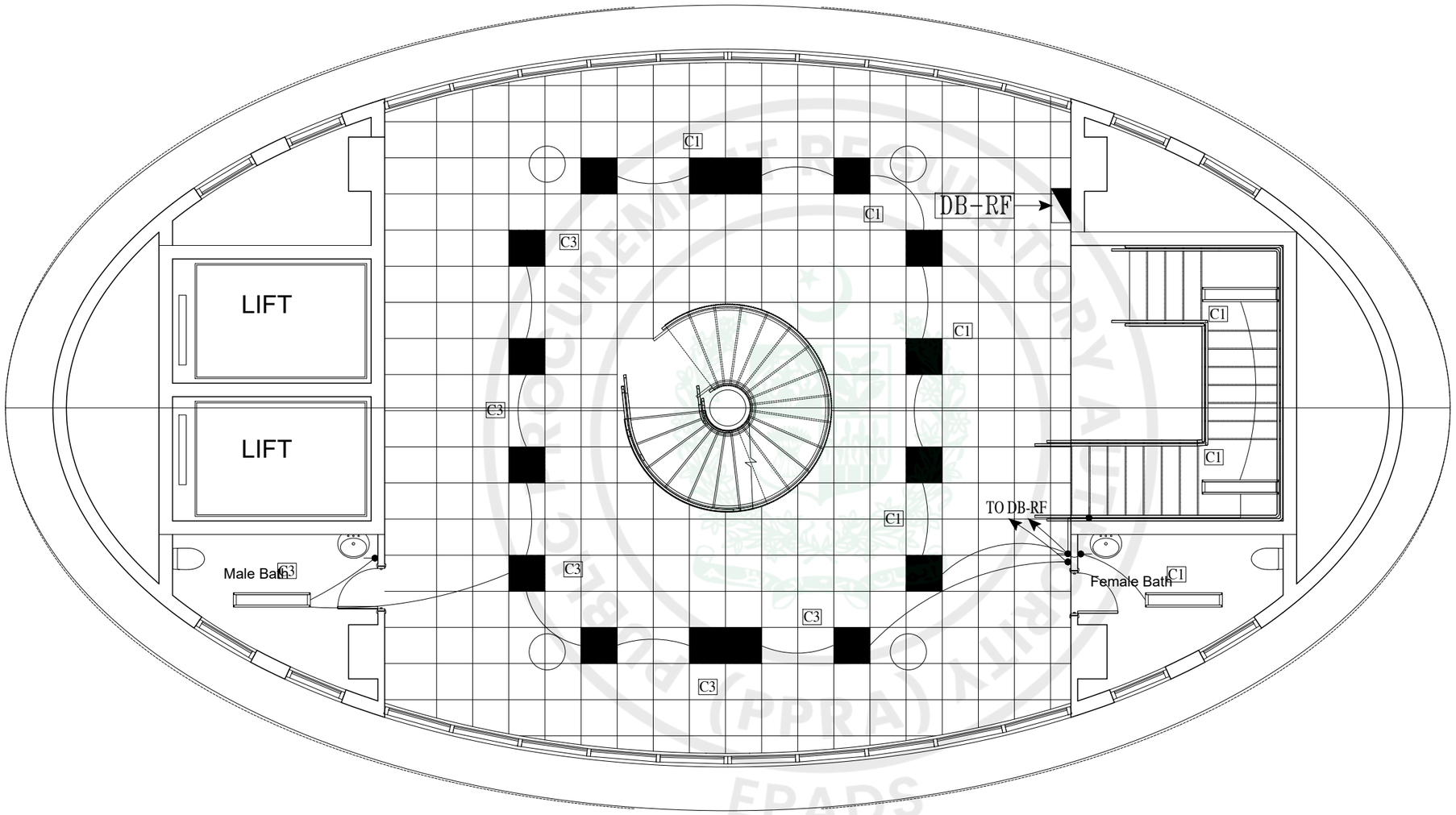

ROOF FLOOR PLAN LEVEL AT 43'-6"
COVERED AREA 2802 Sft

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-13

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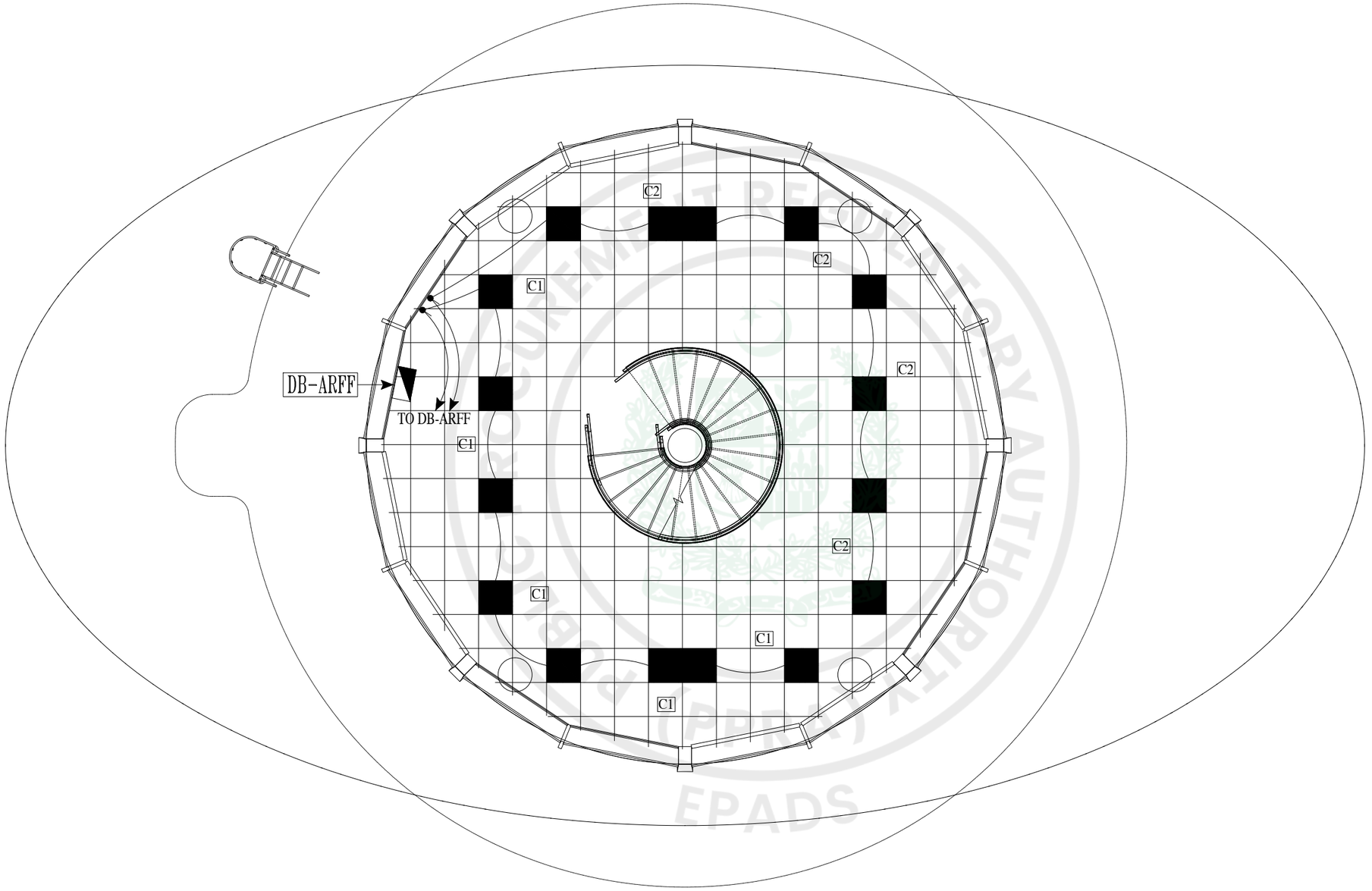

ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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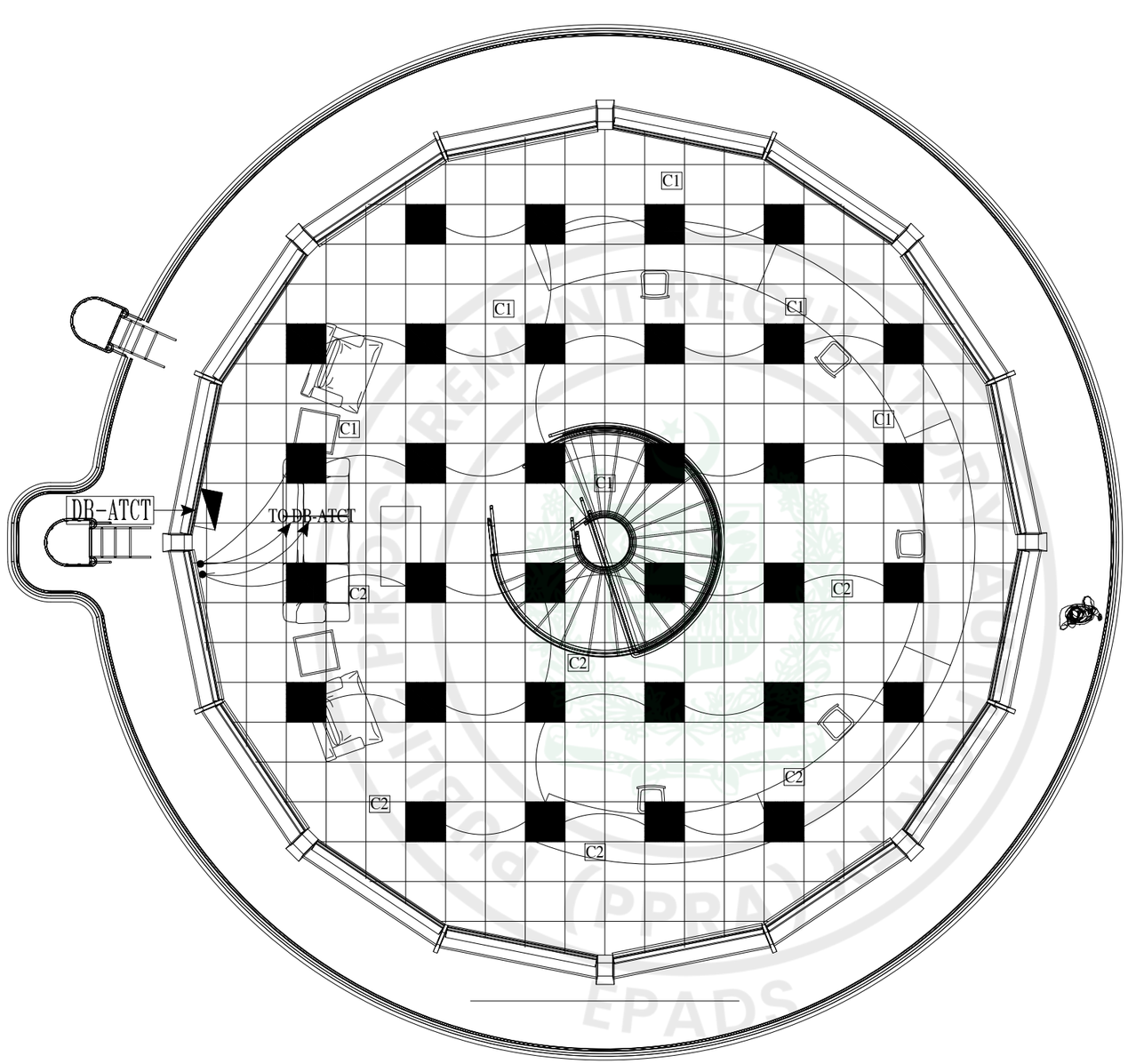
DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-14



ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

LIGHTING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-15

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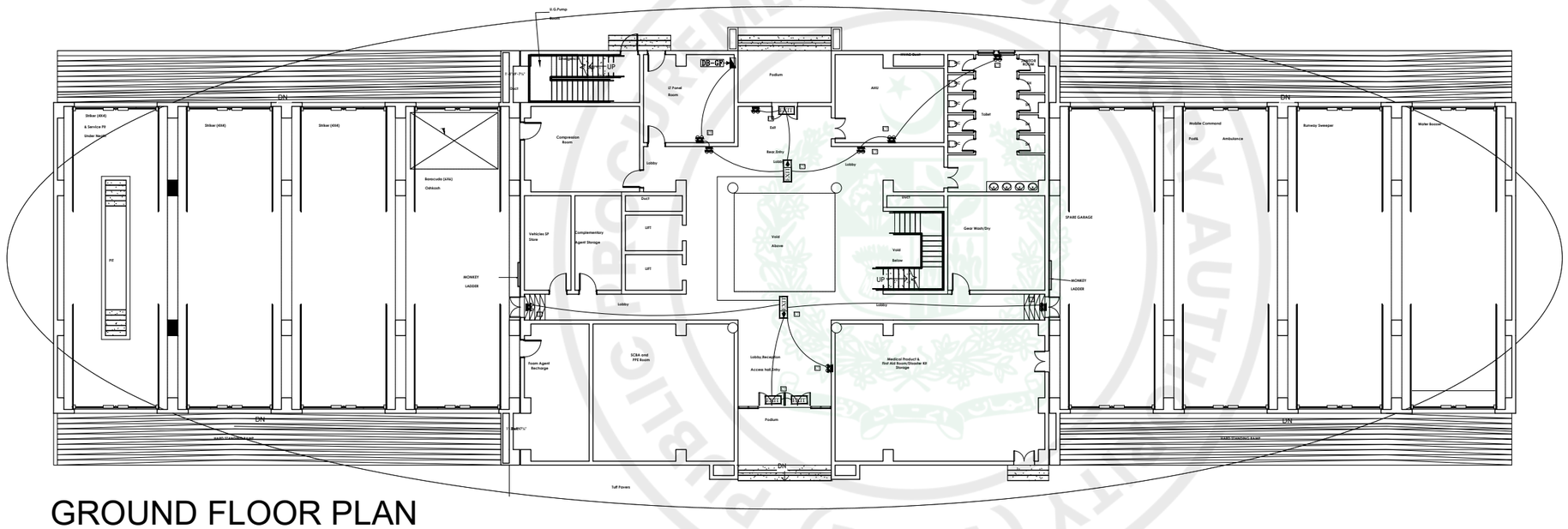

GROUND FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

EMERGENCY & EXIT LIGHT LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-16

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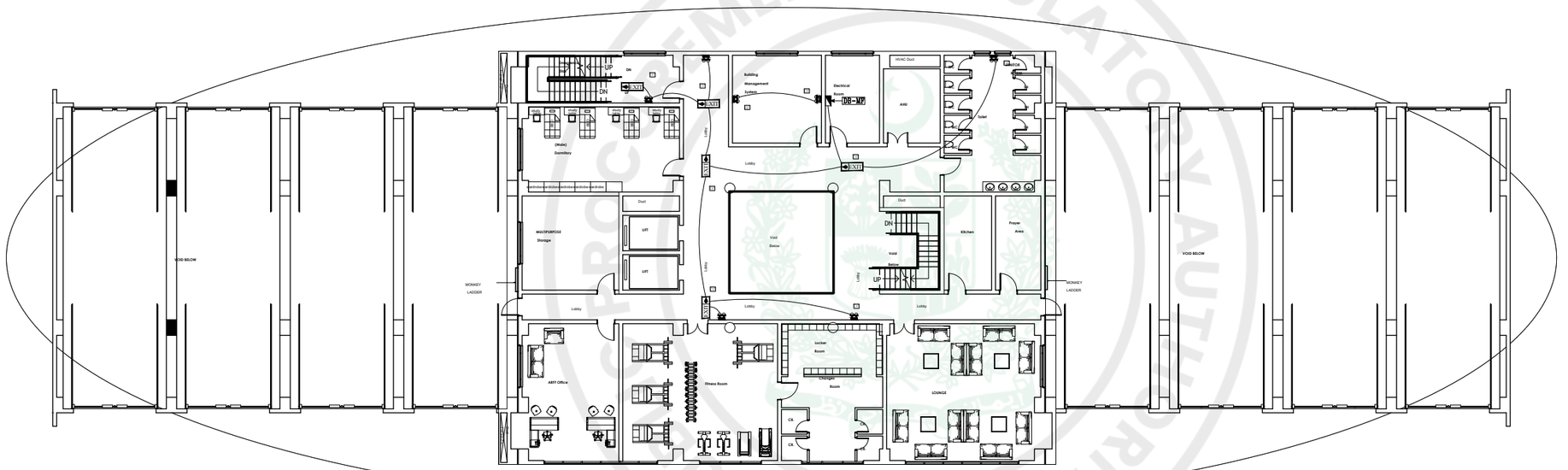

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

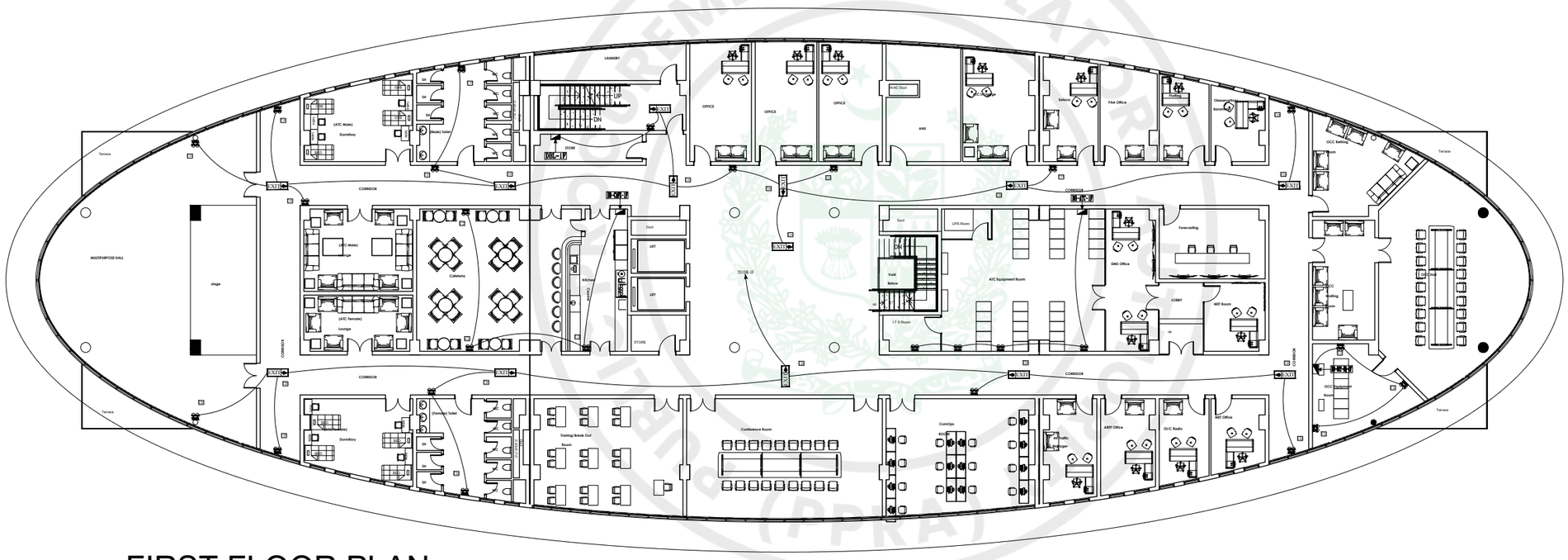
DETAILED ELECTRICAL Design Drawings

Sheet Name

EMERGENCY & EXIT LIGHT LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-17

PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

EMERGENCY & EXIT LIGHT LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-18

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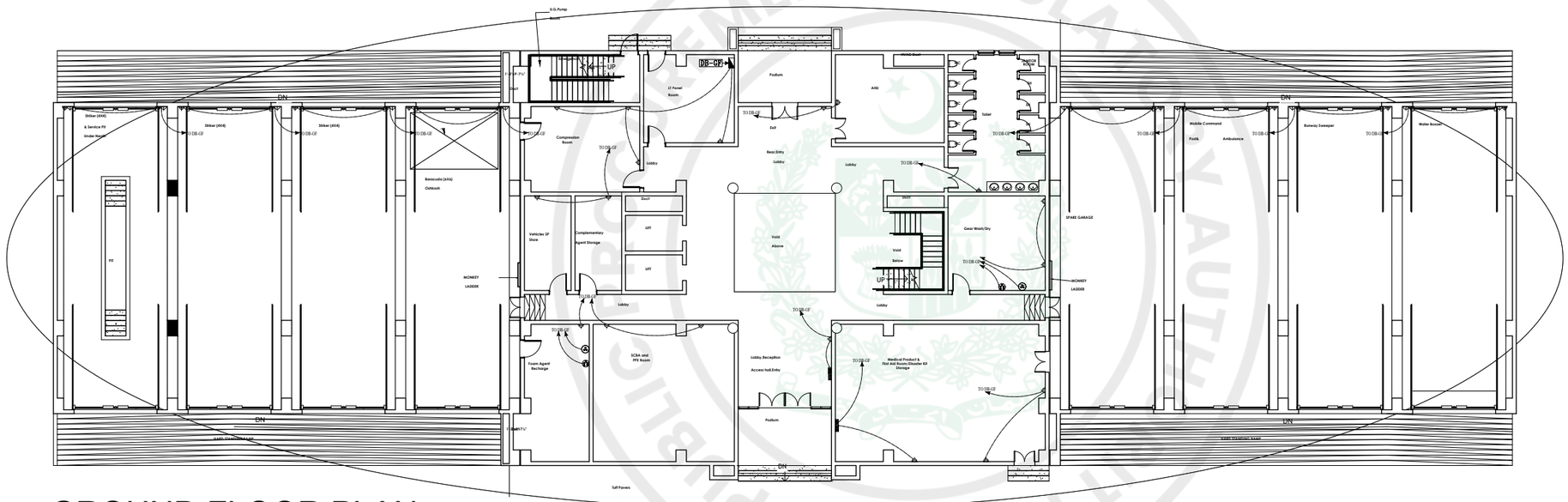

GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-19

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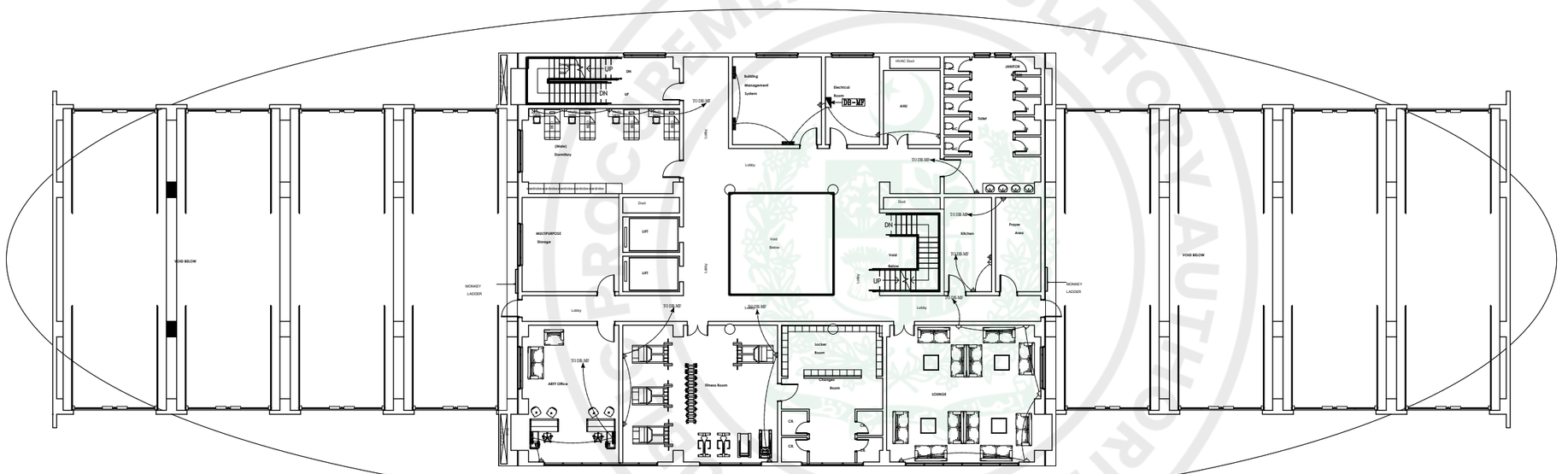

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-20

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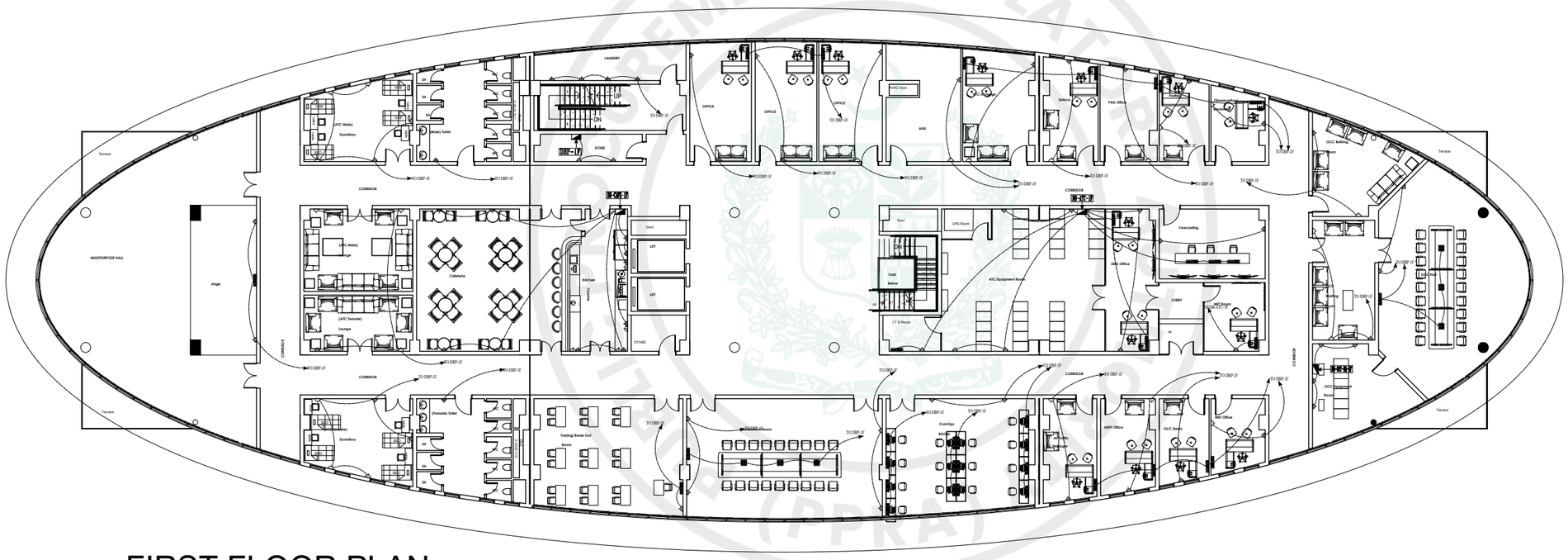

FIRST FLOOR PLAN

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-21

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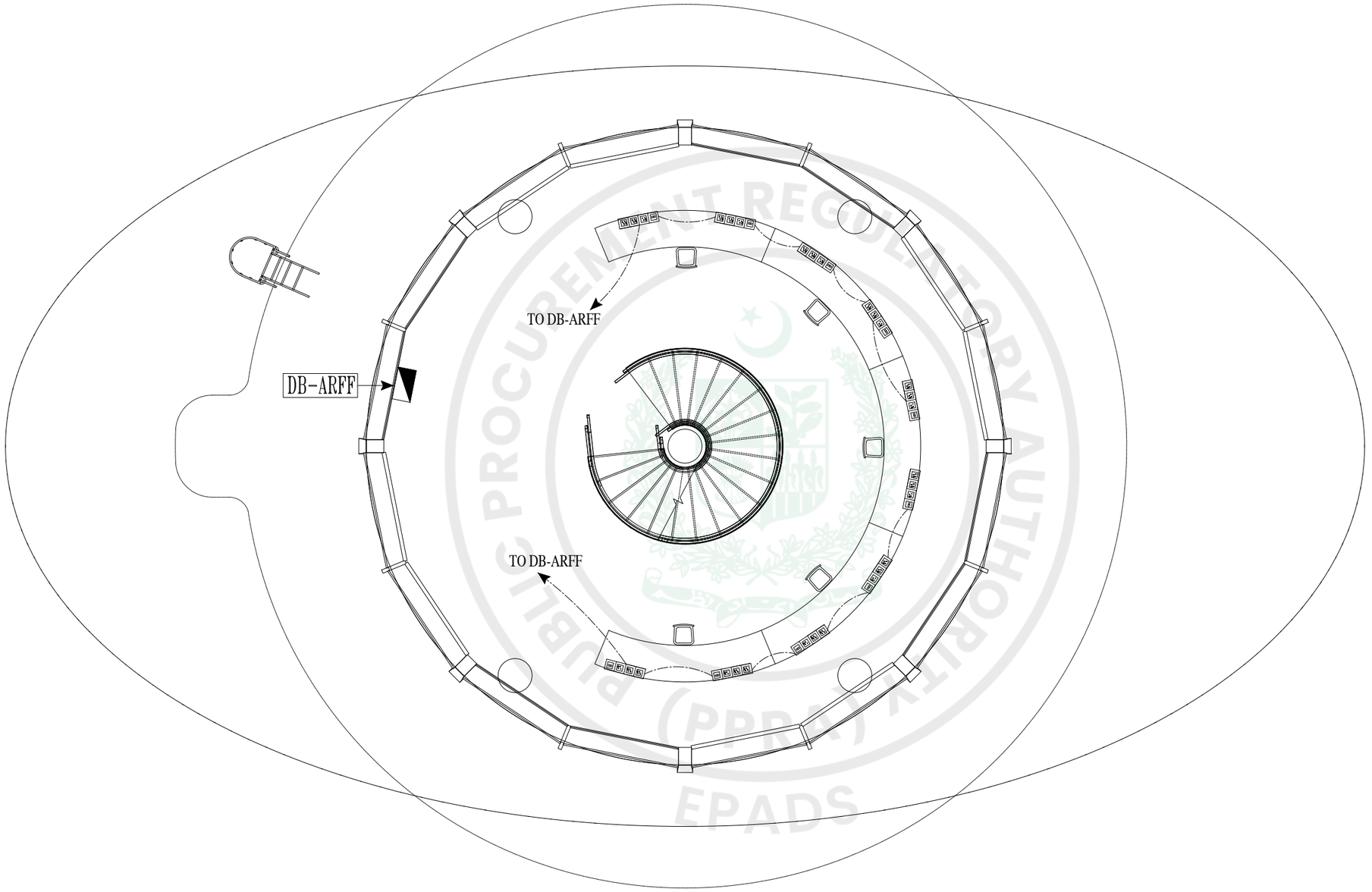

ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
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Checked by	M.K
Approved by	M.F
Drawing No.	E-22

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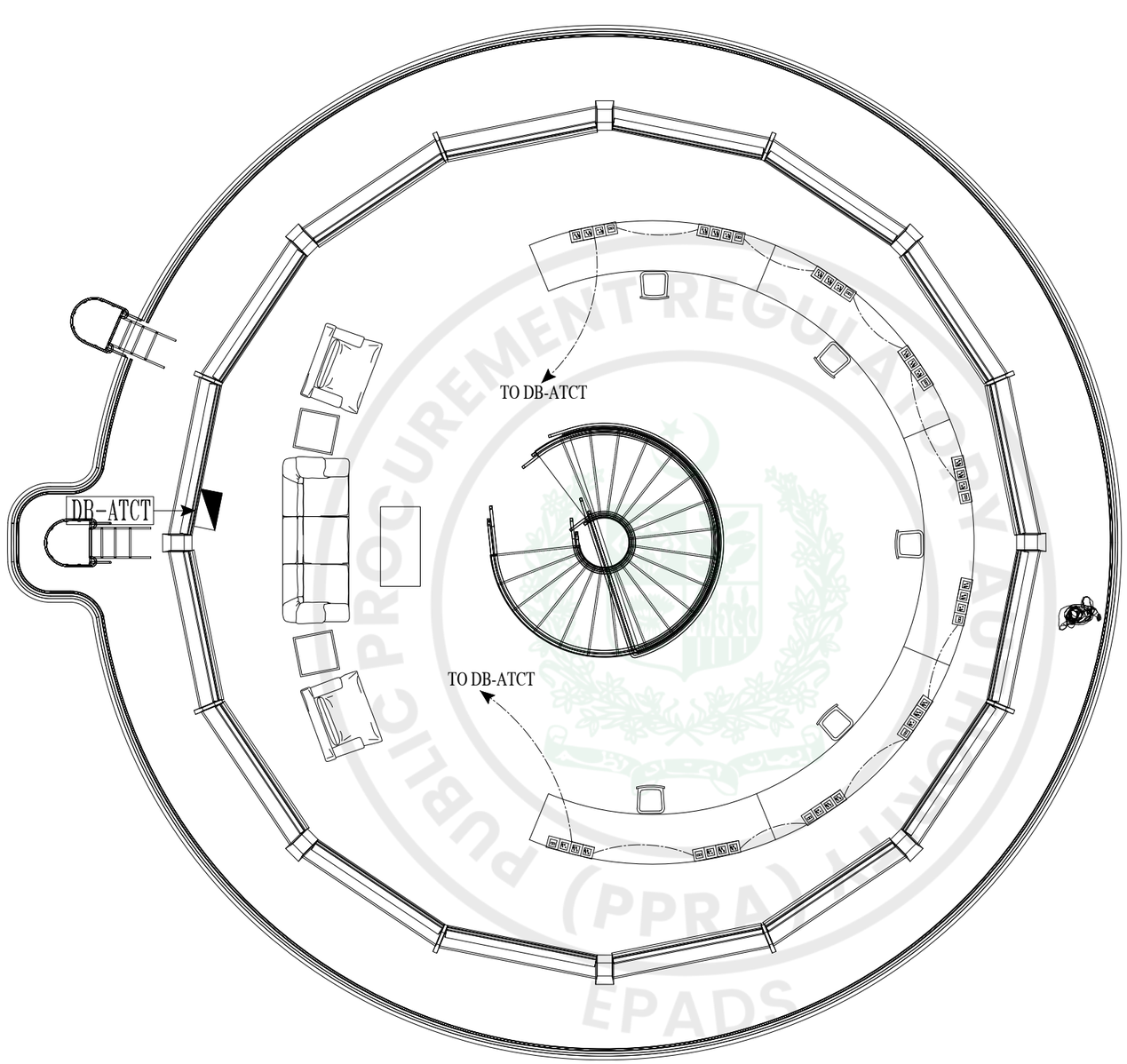

ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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DETAILED ELECTRICAL Design Drawings

Sheet Name

POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
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Checked by	M.K
Approved by	M.F
Drawing No.	E-23

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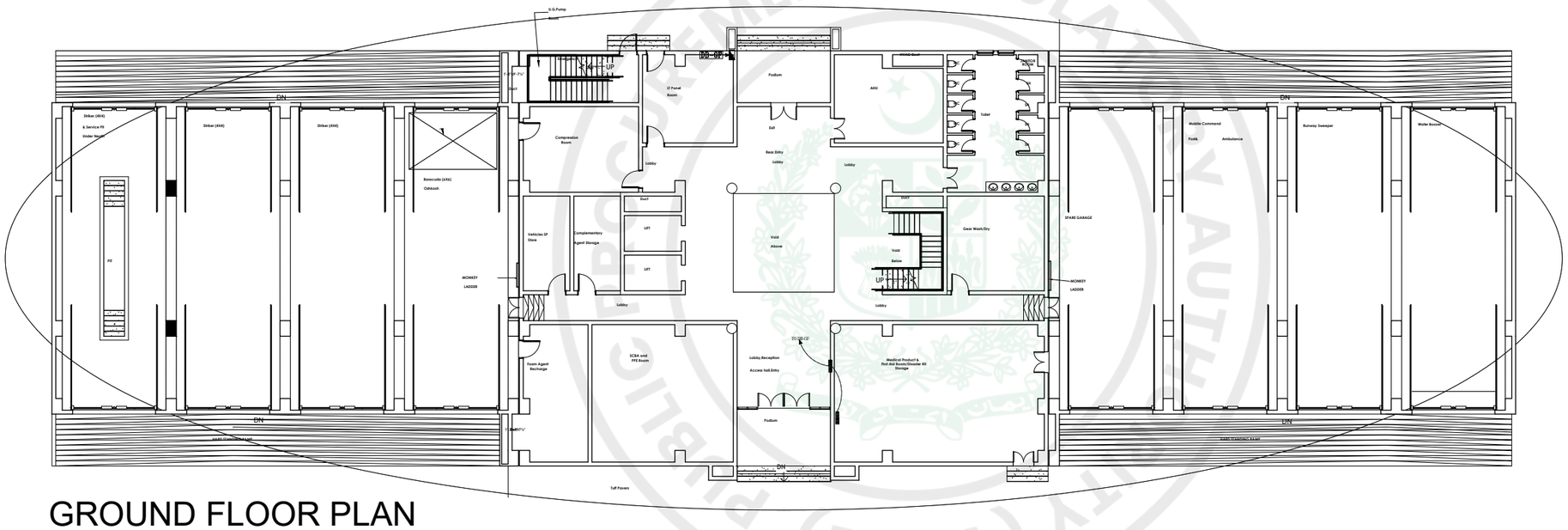

GROUND FLOOR PLAN

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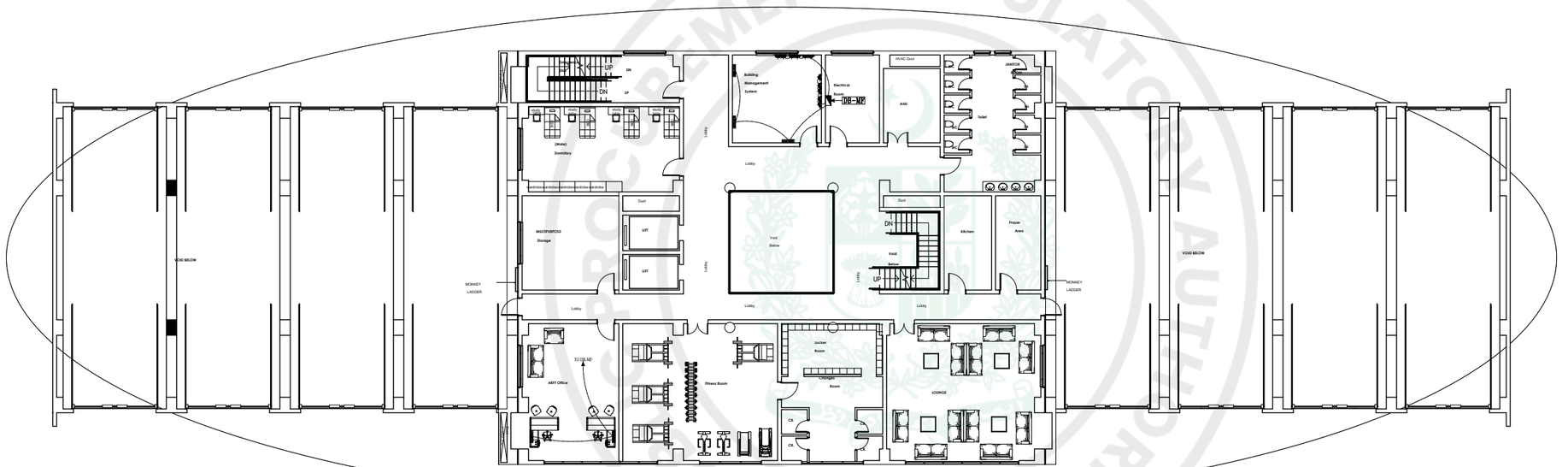
DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-24

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



ARFF FLOOR
MEZZANINE FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

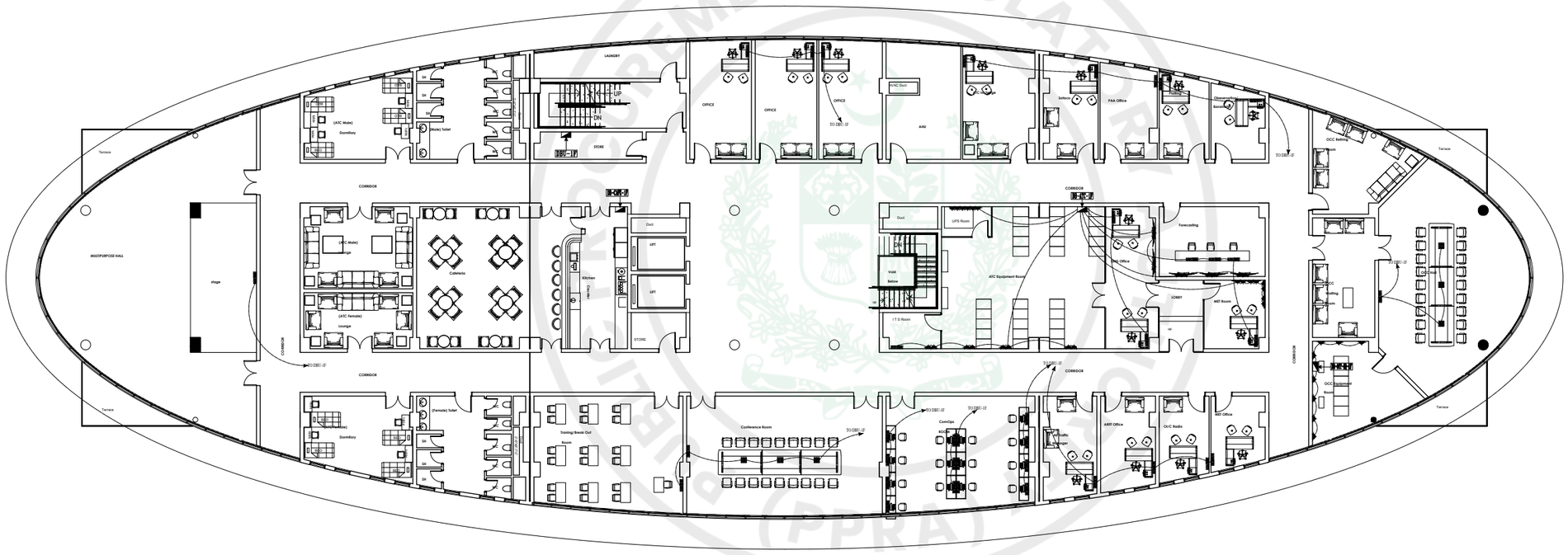
DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-25

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS



FIRST FLOOR PLAN

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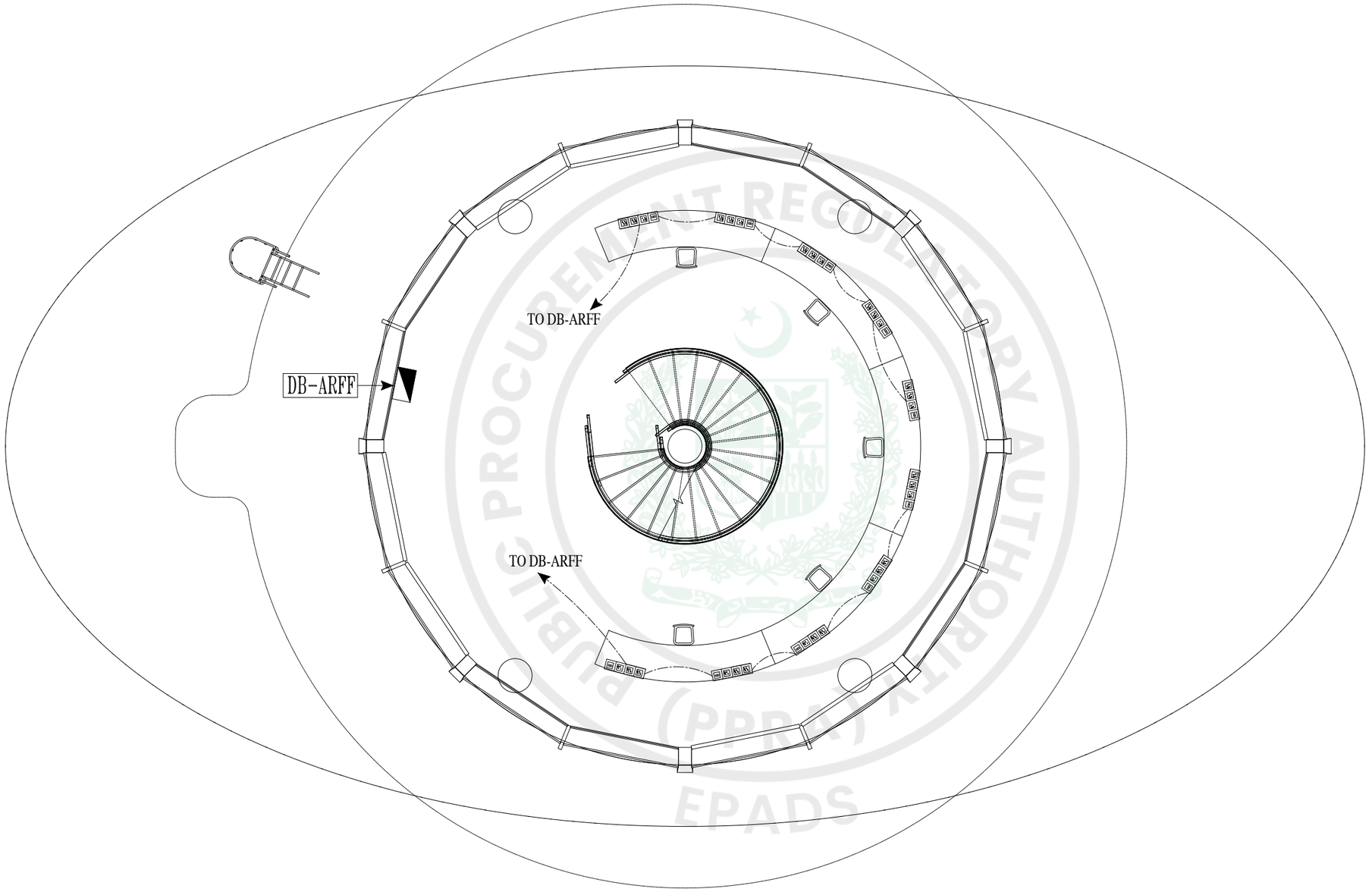
DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-26



ARFF FLOOR PLAN LEVEL AT 53'-6"

COVERED AREA 2123 Sft

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DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
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Checked by	M.K
Approved by	M.F
Drawing No.	E-27

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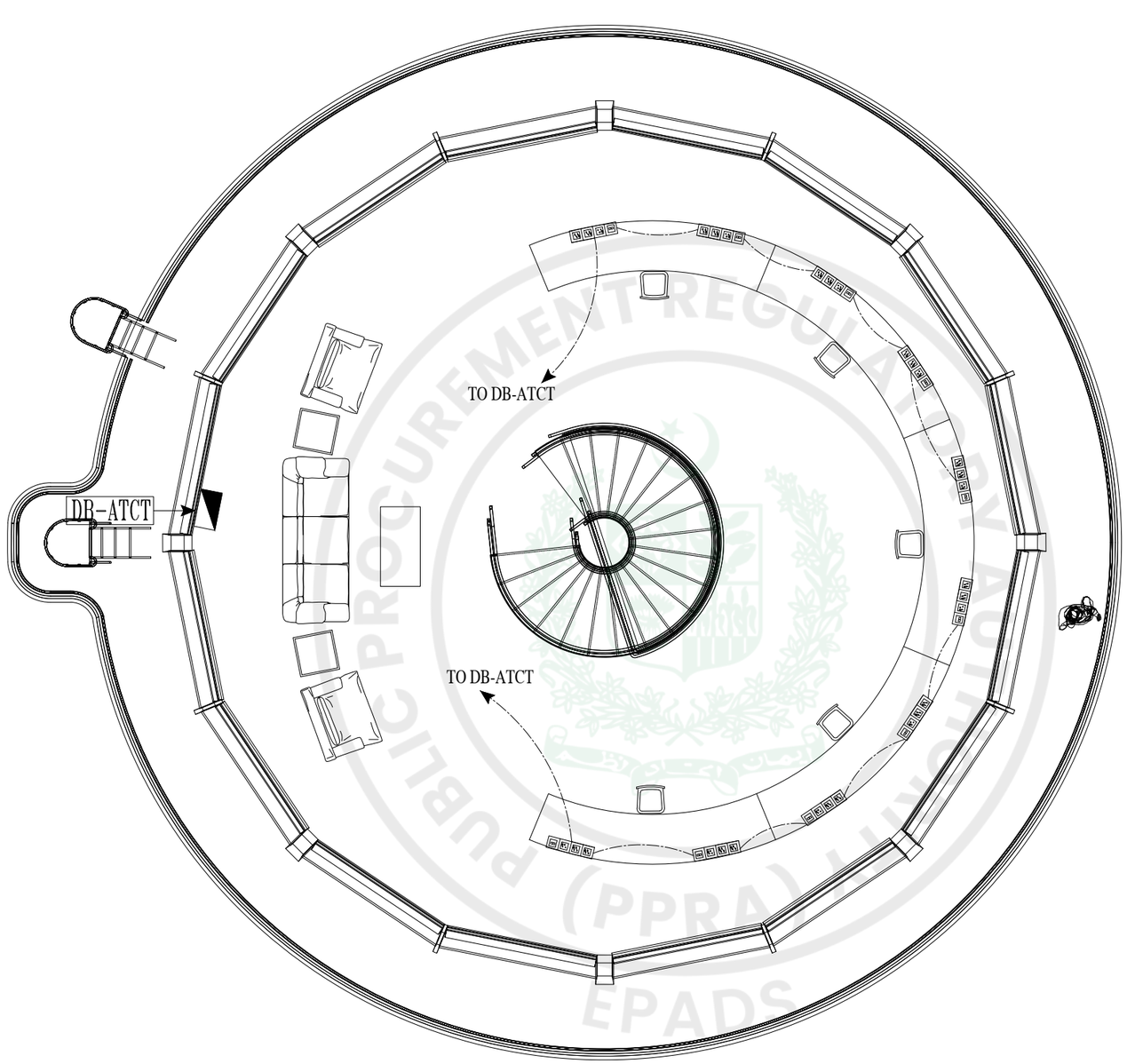

ATCT FLOOR PLAN LEVEL AT 65'-6"

COVERED AREA 1548 Sft

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Project Name

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DETAILED ELECTRICAL Design Drawings

Sheet Name

UPS POWER SOCKETS LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-28

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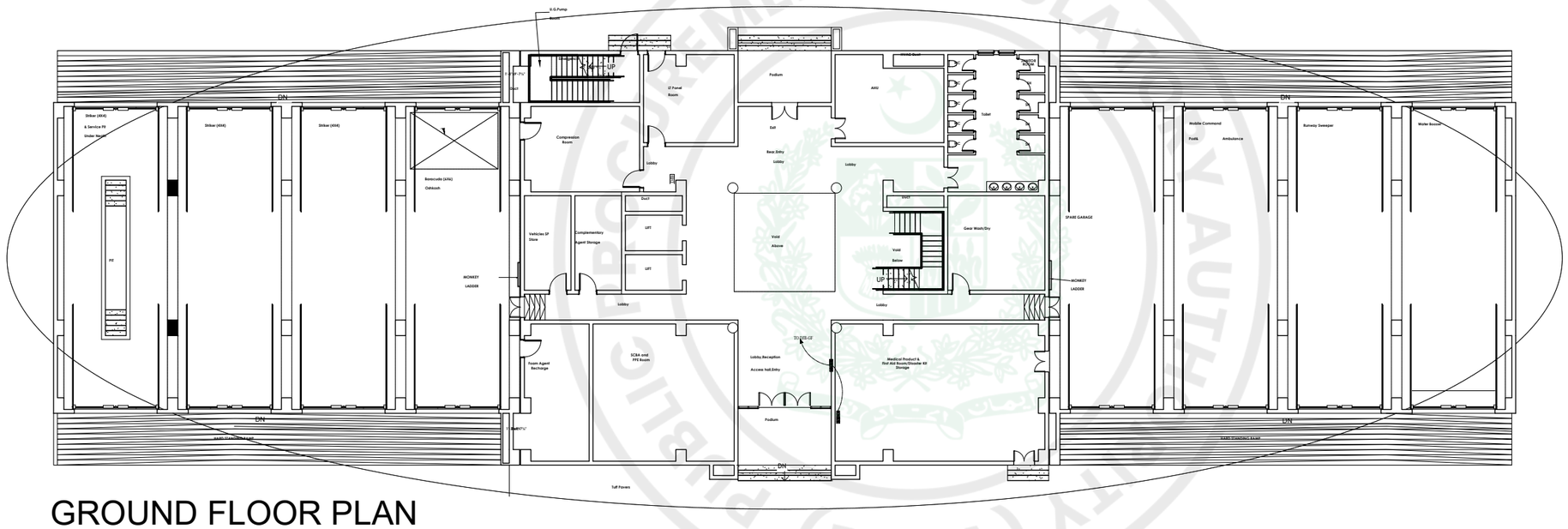

GROUND FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-29

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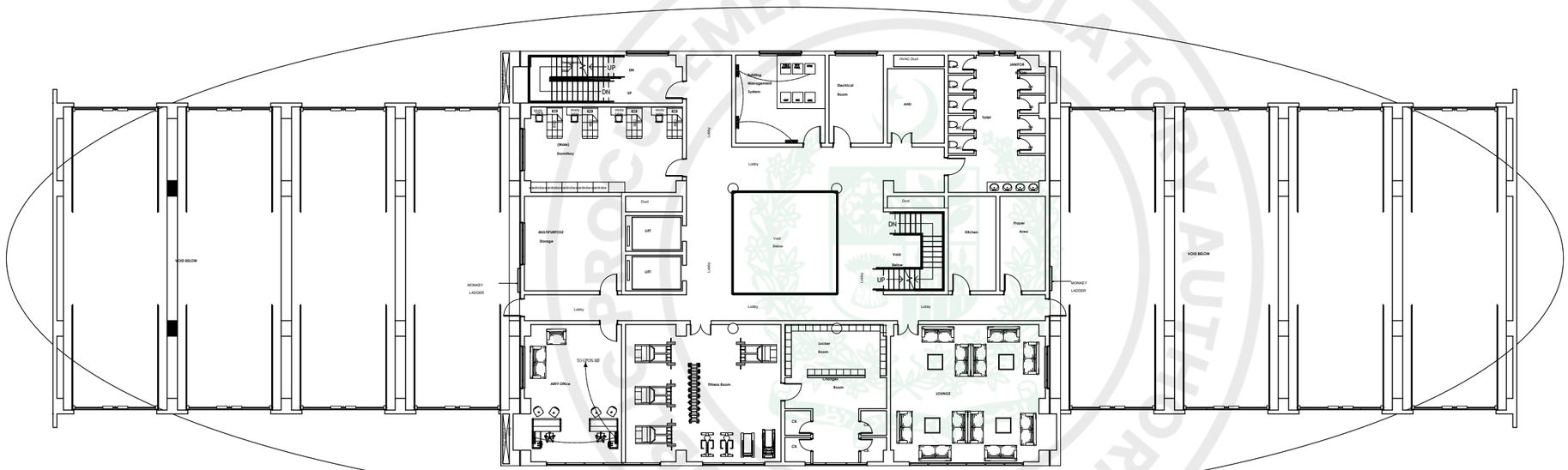

ARFF FLOOR
MEZZANINE FLOOR PLAN

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Project Name

Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

Sheet Name

DATA NETWORKING LAYOUT

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-30

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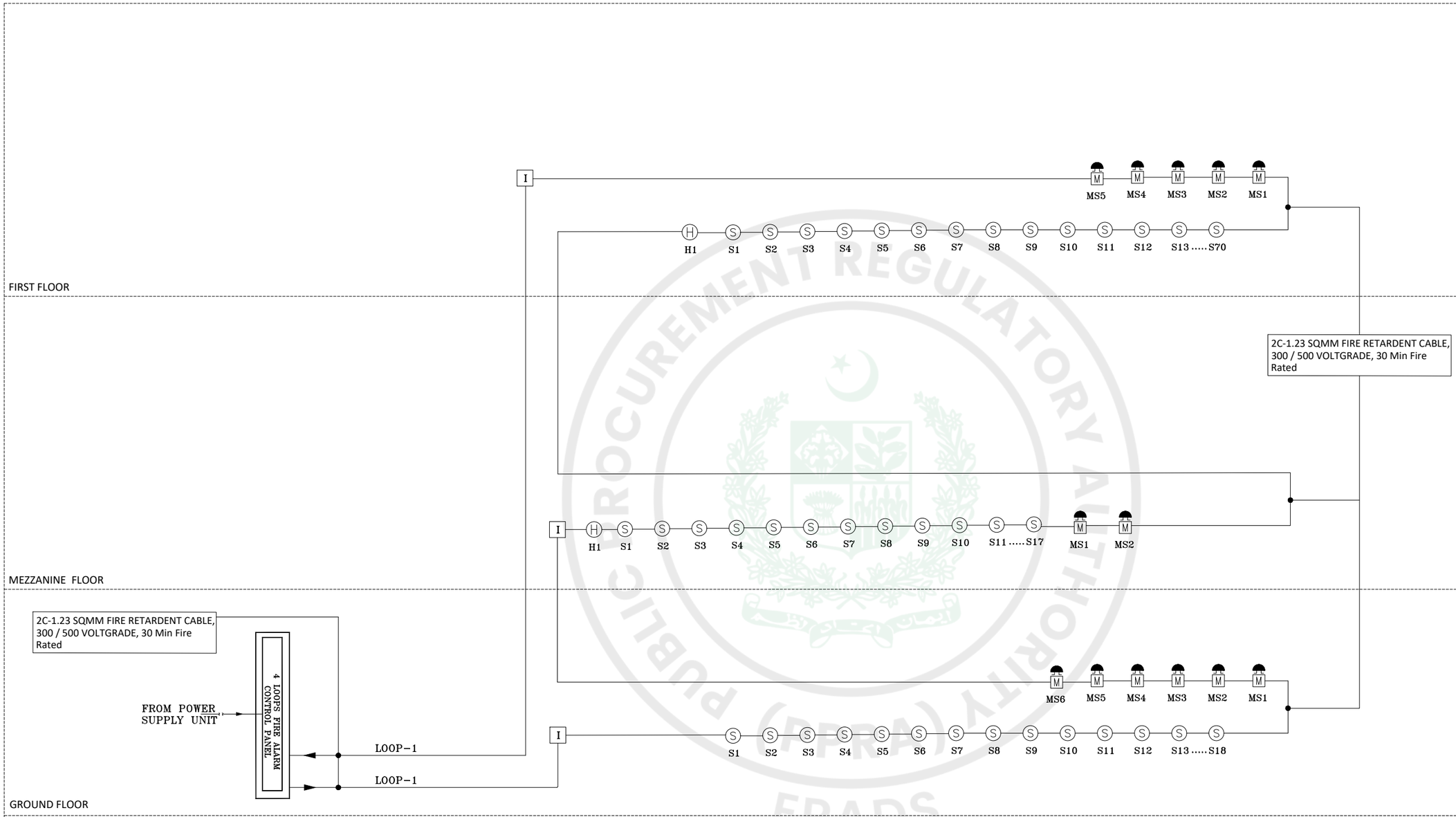

RISER DIAGRAM FIRE ALARM OF ATC TOWER

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Project Name

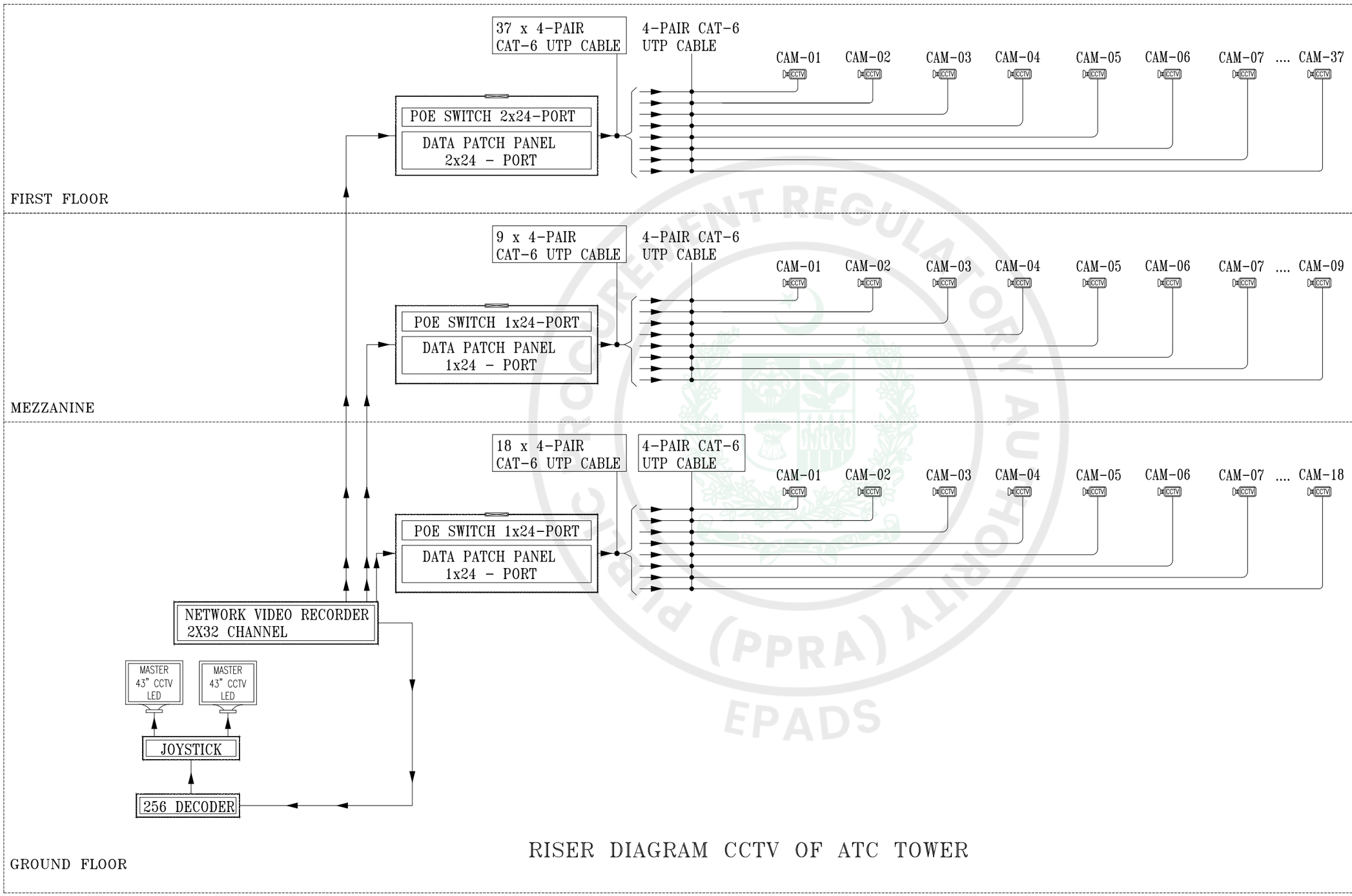
Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

FIRE ALARM RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-55

PROCUREMENT REGULATORY AUTHORITY PUBLIC PROCURING AGENCY (PPRA) EPADS



RISER DIAGRAM CCTV OF ATC TOWER

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Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

CCTV RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-56

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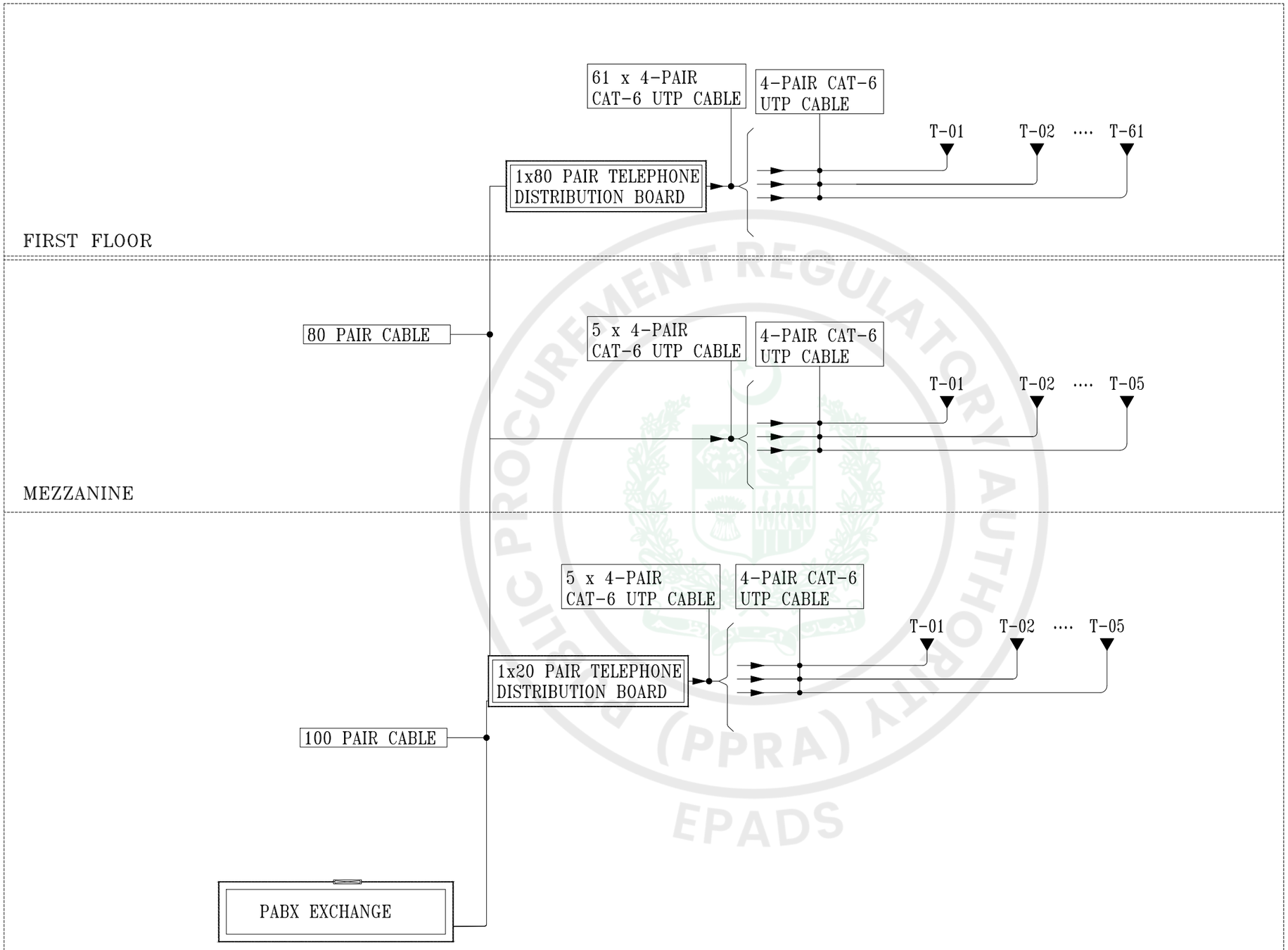

RISER DIAGRAM TELEPHONE OF ATC TOWER

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

TELEPHONE RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-57

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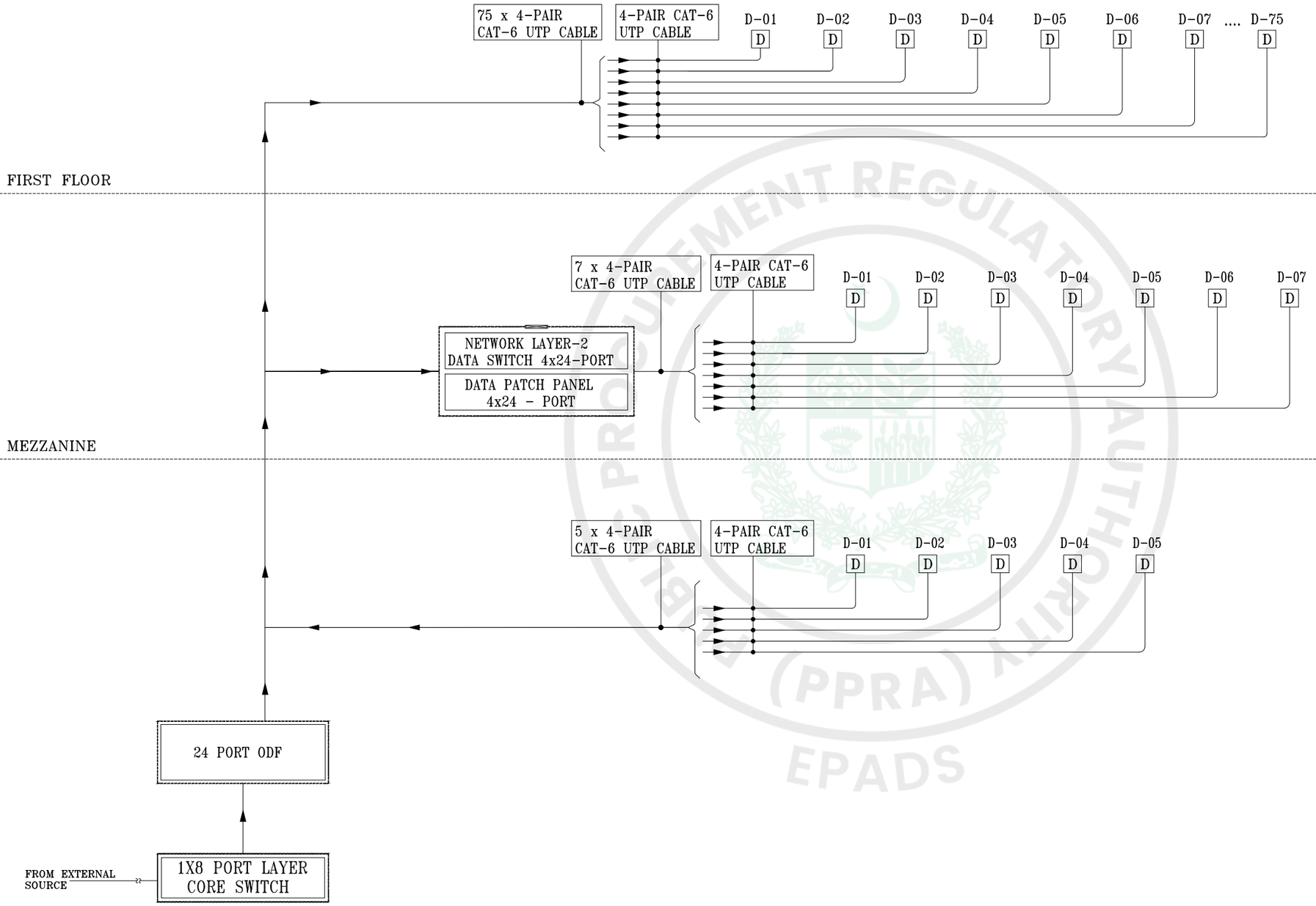

RISER DIAGRAM OF IPTV, DATA AND WIFI SYSTEM ATC TOWER

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Project Name

Consultancy Services for the Preparation of Detailed Design, Procurement Support and Construction Supervision of New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

Sheet Name

DATA NETWIRKING RISER DIAGRAM

Date	APRIL, 2026
Scale	NTS
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Checked by	M.K
Approved by	M.F
Drawing No.	E-58

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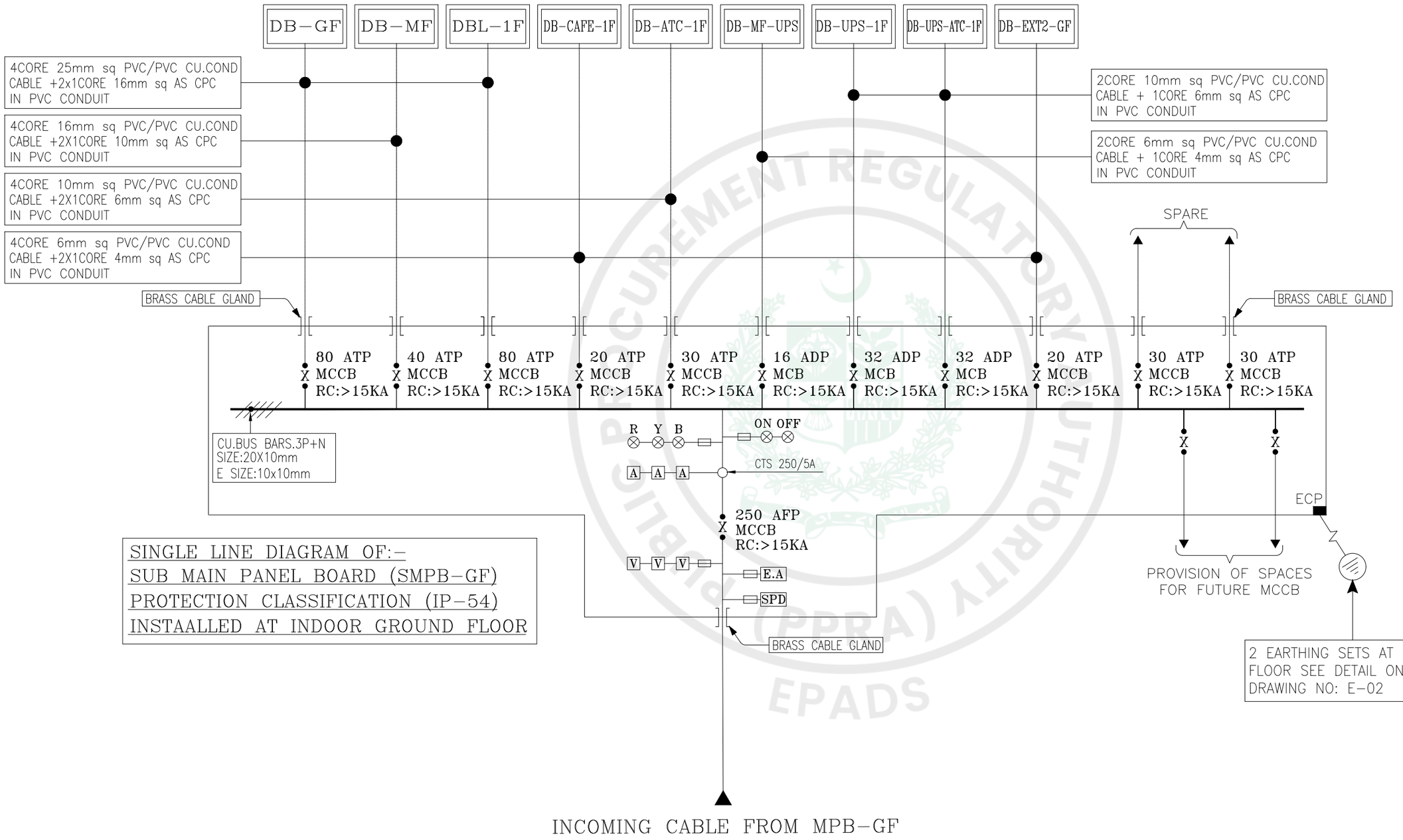

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DETAILED ELECTRICAL Design Drawings

Sheet Name

ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
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Approved by	M.F
Drawing No.	E-67

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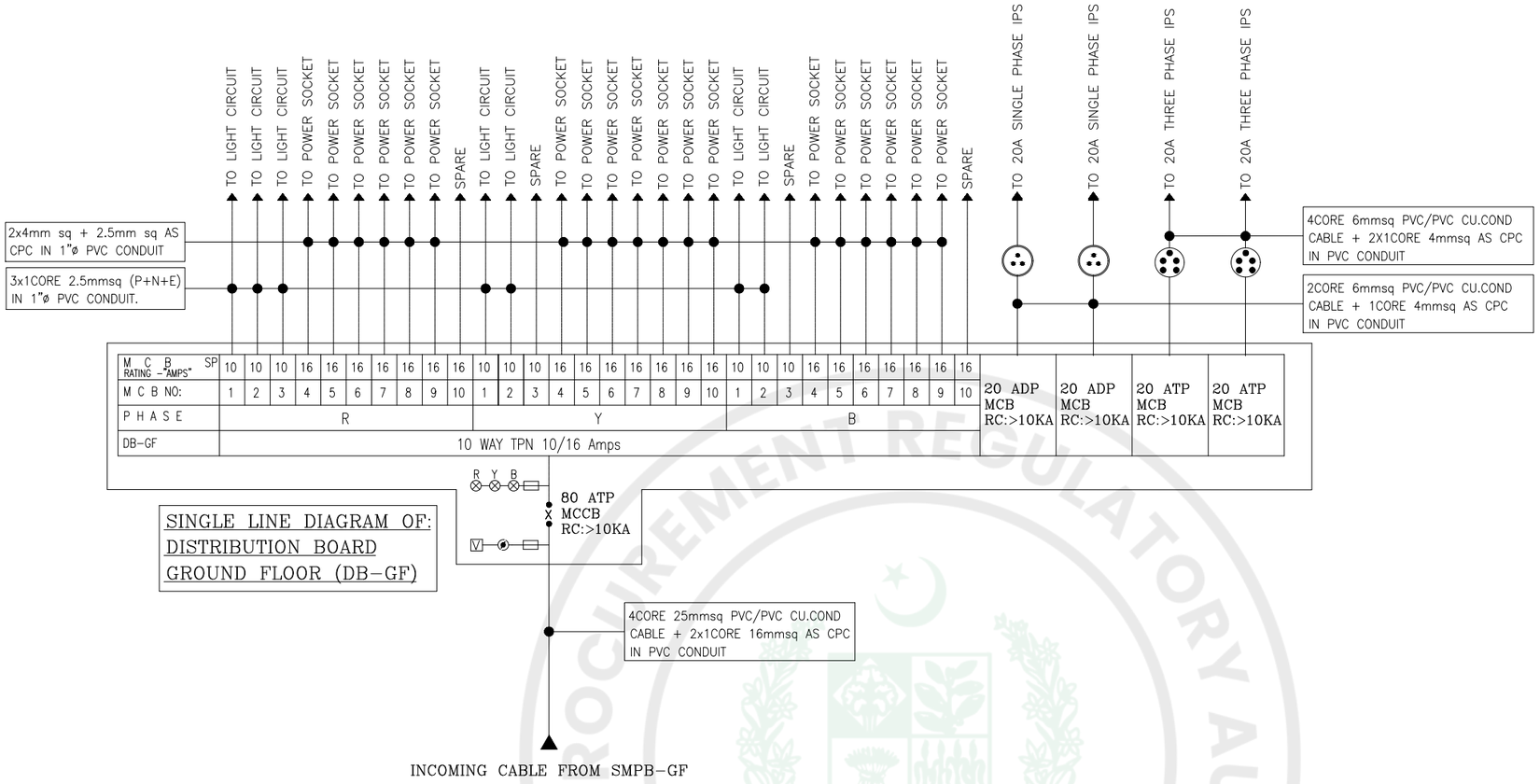

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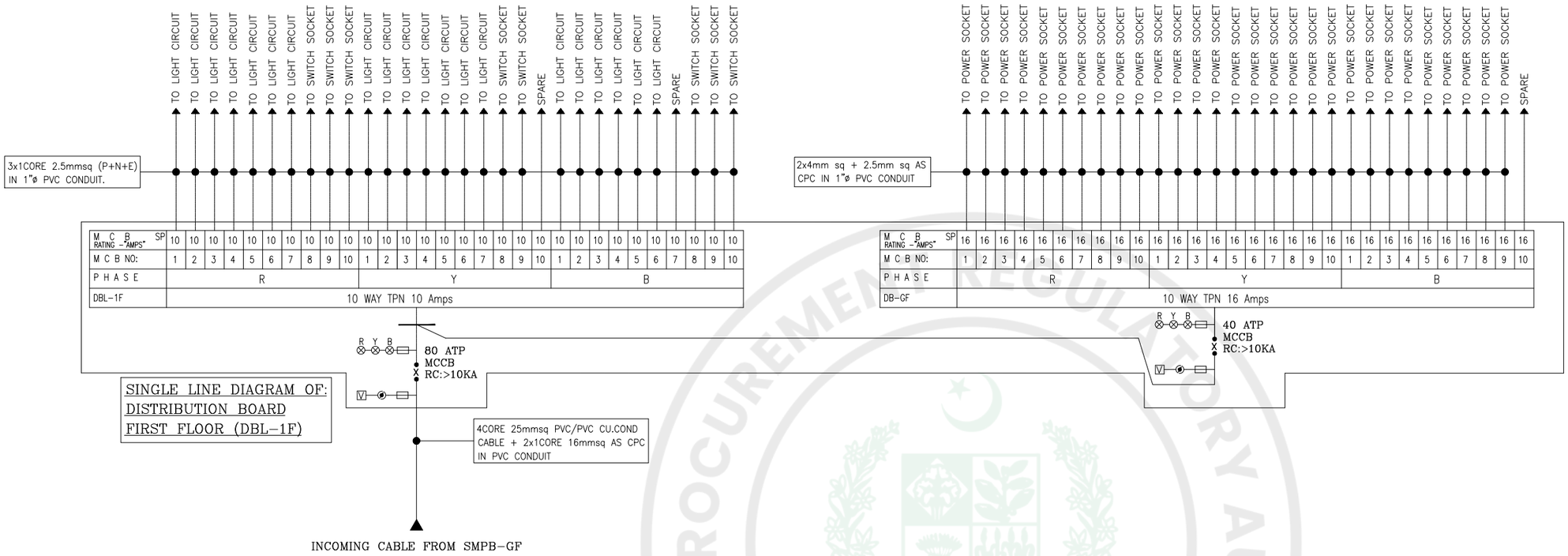
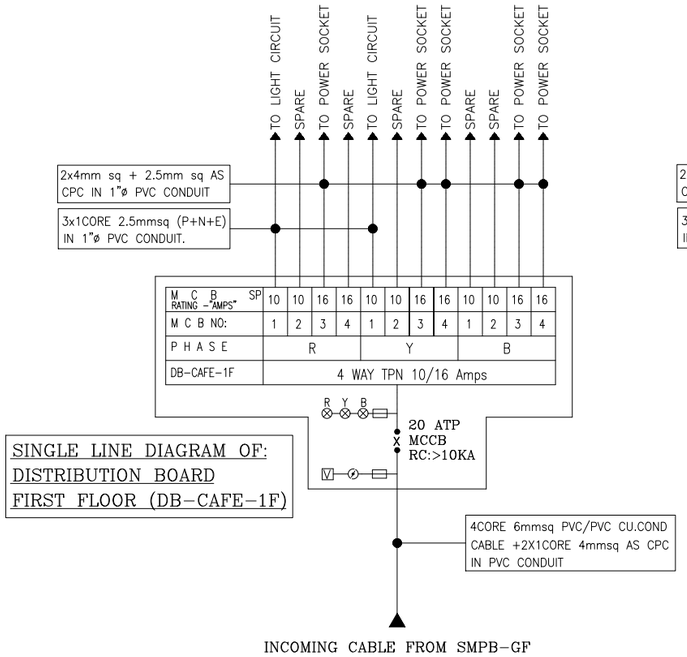
DETAILED ELECTRICAL Design Drawings

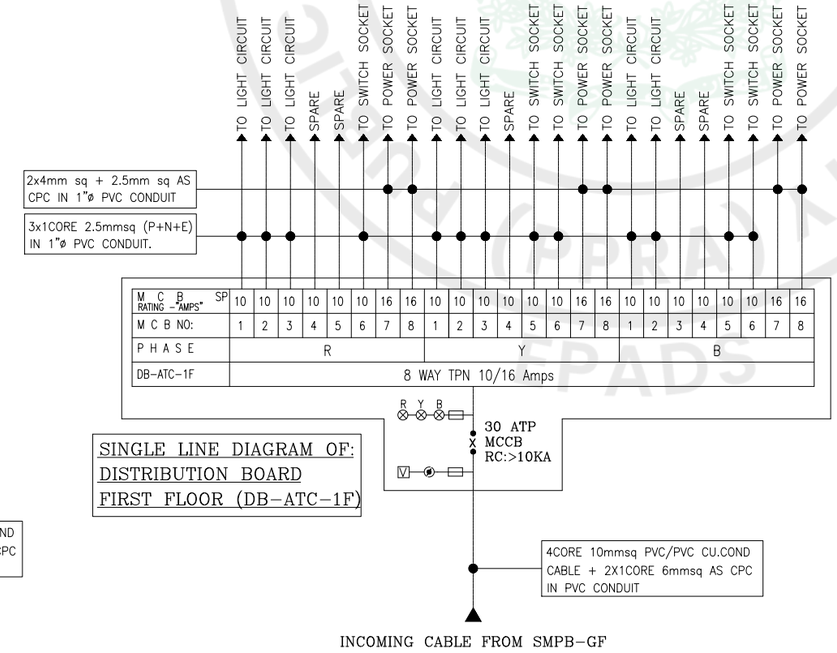
Sheet Name

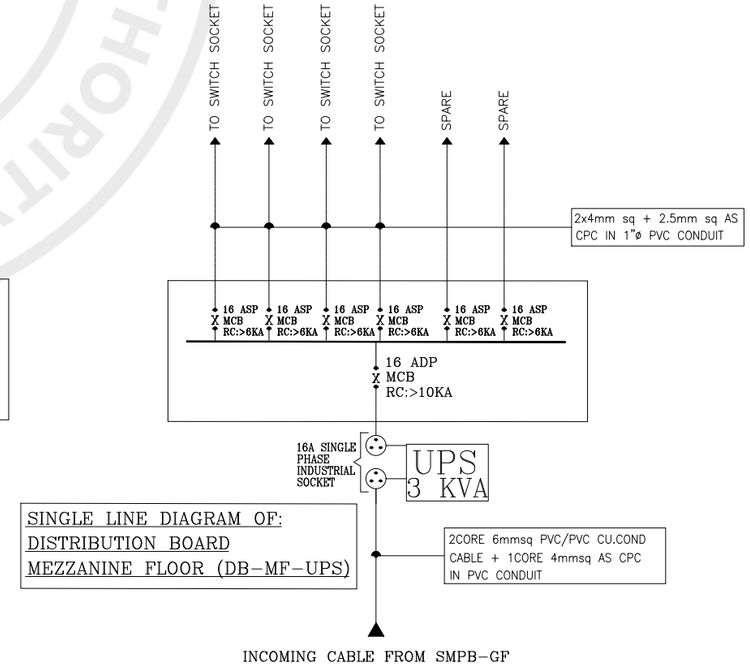
ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-68









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JV MEMBERS

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Project Name

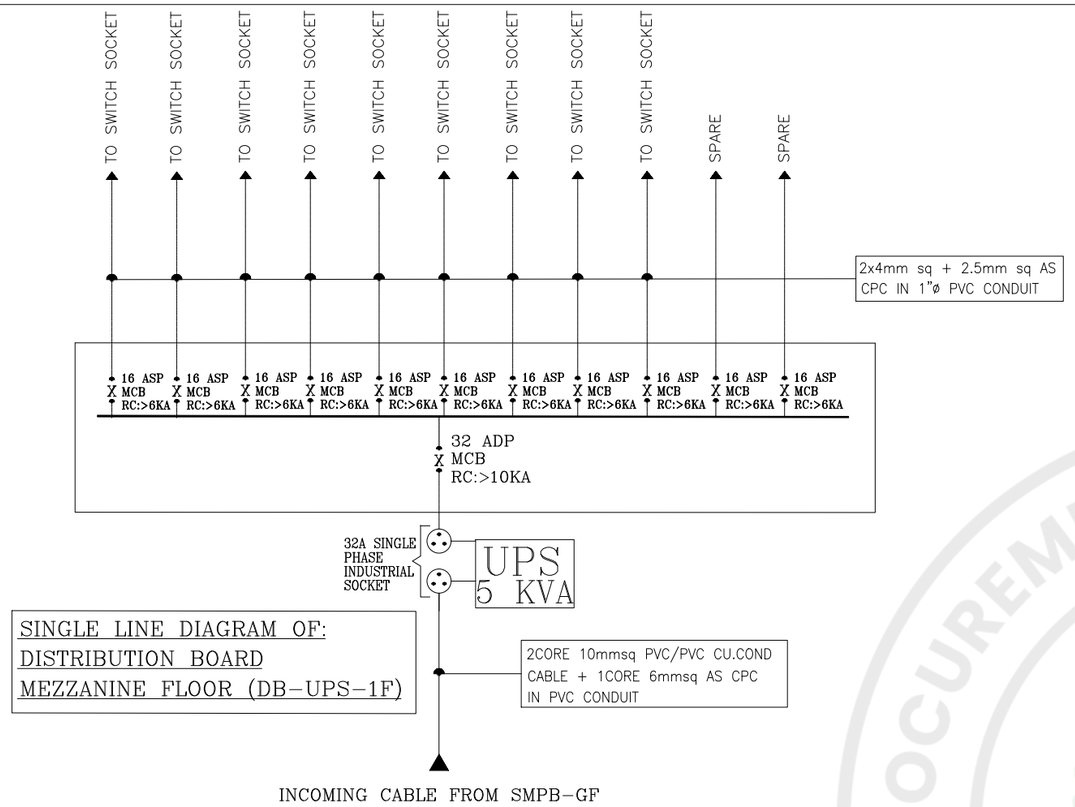
Consultancy Services for New Air Traffic Control Tower (ATCT), Fire Station and Allied Facilities at Skardu International Airport

DETAILED ELECTRICAL Design Drawings

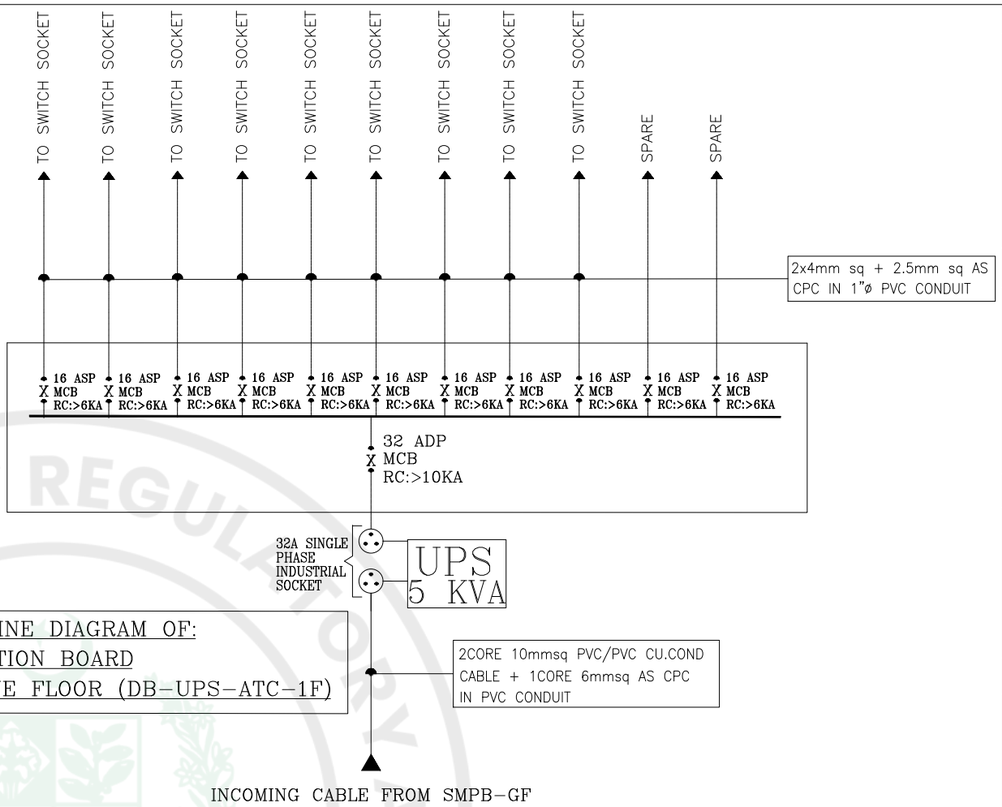
Sheet Name

ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-69



SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
MEZZANINE FLOOR (DB-UPS-1F)



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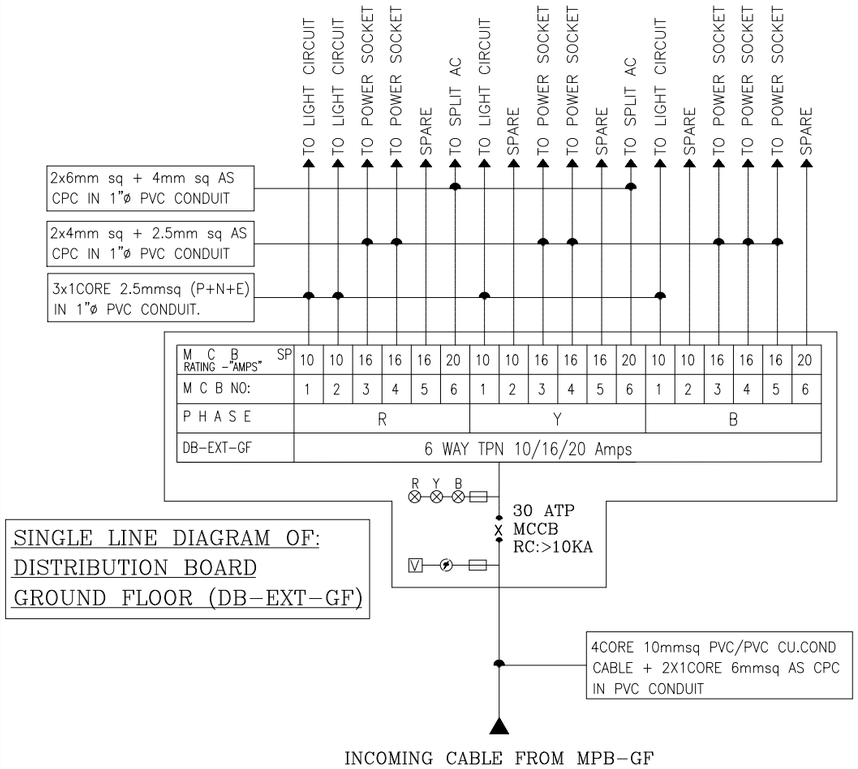
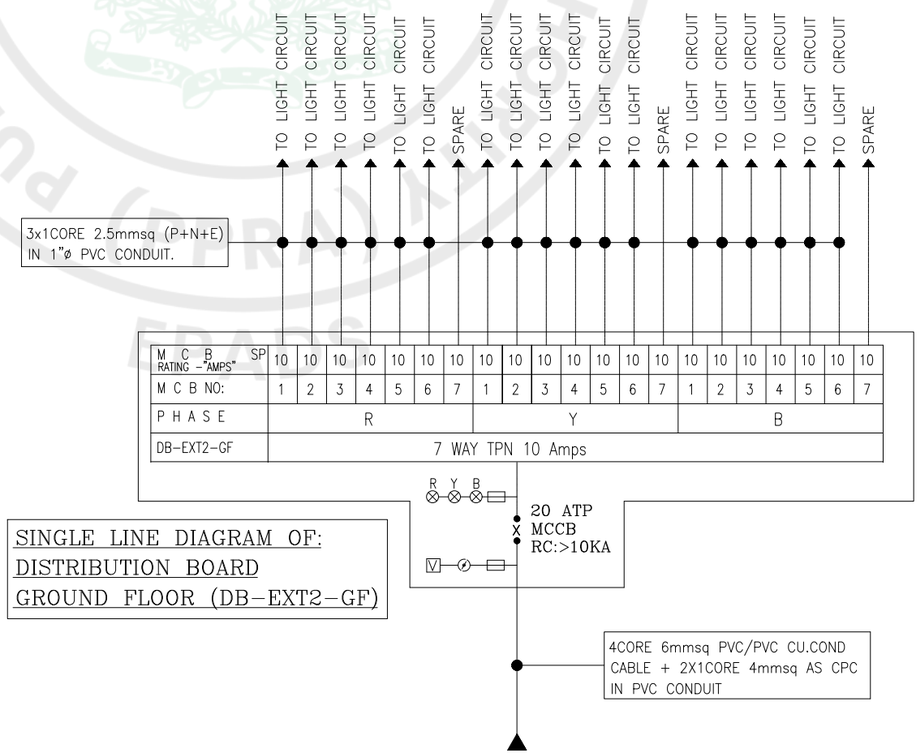
DISTRIBUTION BOARD
MEZZANINE FLOOR (DB-UPS-ATC-1F)



SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
GROUND FLOOR (DB-EXT-GF)



SINGLE LINE DIAGRAM OF:
DISTRIBUTION BOARD
GROUND FLOOR (DB-EXT2-GF)

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Project Name

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DETAILED ELECTRICAL Design Drawings

Sheet Name

ELECTRICAL SUBSTATION

Date	April, 2026
Scale	NTS
Drawn by	A.S.B
Checked by	M.K
Approved by	M.F
Drawing No.	E-70

PUBLIC PROCUREMENT REGULATORY AUTHORITY

LIST OF APPROVED MANUFACTURERS (M)					(Annexure-A)
Sr #	**Particulars**	**Manufacturers / Vendors**	**Origin**	**Landline**	**Mobile / Cell**
1	**LT / HT PANELS & DB's / STREET LIGHT POLES**				
i	Quality Switchgear Pvt Ltd.	Quality Switchgear	Pakistan		0300-8404301
ii	Bilal Engineering	Bilal Engineering	Pakistan		0313-4444029
iii	Ghafoor Engineering	Ghafoor Engineering	Pakistan		0320-7780309
iv	PEMPAK	PEMPAK	Pakistan		
v	South Asian Electric (SAEC)	South Asian Electric	Pakistan		0300-8477067
2	**CIRCUIT BREAKERS**				
	MCB/MCCB/ACB/ELCB/RCBO				
i)	Schneider	Oliver General Trading	France		0324-4475372
ii)	ABB	Trade Ventures	EU		0303-4443327
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
3	**MAGNETIC CONTACTORS**				
i)	Schneider	Oliver General Trading	France		0324-4475372
ii)	ABB	Trade Ventures	EU		0303-4443327
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
4	**SELECTOR SWITCHES**				
i)	Sinusoid	Eyelogy	CAD/CHN		0336-4452231
ii)	KRAUS & NAIMER	E-Links	EU		0321-4404025
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
5	**ENERGY & NETWORK ANALYZERS / VOLTMETERS / AMPEREMETERS**				
i)	Smart Controller	Index Technology	UK		0300-8184203
ii)	Lovato	Jubliee Corporation	Italy		0300-8548550
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
5a	**DUAL SOURCE ENERGY METERS**				
i)	Lovato	Jubliee Corporation	Italy		0300-8548550
ii)	ABB	ABB	EU		0303-4443327
iii)	Sigma	Jawad Electric	Turkey		0322-8061111
iv)	Schneider	Oliver General Trading	France		0324-4475372
6	**PFI RELAYS**				
i)	Shizuki	Sheikh Waliyat & Sons	Thailand		0307-5553960
ii)	BTB	Eyelogy	Turkey		0336-4452231
iii)	Nokian	Jubliee Corporation	Finland		0300-8548550
iv)	Sigma	Jawad Electric	Turkey		0322-8061111
7	**TERMINAL BLOCKS**				

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i)	Klemsan	E-Links	Turkey	0321-4404025
ii)	Onka	Pyramid	Turkey	
iii)	Sigma	Jawad Electric	Turkey	0322-8061111

8 PFI CAPACITORS

i)	BTB	Eyelogy	Turkey	0336-4452231
ii)	Nokian	Jubliee Corporation	Finland	0300-8548550
iii)	Shizuki	Sheikh Waliyat & Sons	Thailand	0307-5553960

9 CURRENT TRANSFORMERS

i)	Revalco/Saci	Jubliee Corporation	Italy / EU	0300-8548550
ii)	Hubit	E-Links	UK	0321 4404025
iii)	Lovato	Jubliee Corporation	EU	0300-8548550
iv)	Entes	Shahid International	Turkey	0321-8472264
v)	Sigma	Jawad Electric	Turkey	0322-8061111

10 VOLTAGE MONITORING RELAYS

i)	Entes	Shahid International	Turkey	0321-8472264
ii)	Emirel	Jubliee Corporation	Italy	0300-8548550
iii)	ABB	ABB	EU	0303-4443327
iv)	Sinusoid	Eyelogy	CAD/CHN	0336-4452231
v)	Sigma	Jawad Electric	Turkey	0322-8061111

11 LOAD BREAK SWITCHES / CHANGE OVER SWITCHES

i)	Socomec	Jubliee Corporation	France	0300-8548550
ii)	ABB	ABB	EU	0303-4443327
iii)	Schneider	Oliver General Trading	France	0324-4475372
iv)	Sigma	Jawad Electric	Turkey	0322-8061111

12 INDICATION LIGHTS

i)	Telemechanique	Schneider Pakistan	EU	
ii)	GGT	E-Links	EU	0321 4404025
iii)	Sigma	Jawad Electric	Turkey	0322-8061111

13 SWITCHES & SOCKETS

i)	Clipsal Vivace Series	Clipsal Pakistan	Vietnam	0322-2880057
ii)	Legrand	Shahid International	EU	0321-8472264
iii)	Orange Switches	Orange Electric		0322-4834937
iv)	Riva	Eyelogy		0336-4452231

14 LT/HT CABLES

i)	Fast Cables	Fast Cables	Pakistan	0320-8080046
ii)	Newage Cables	Newage Cables	Pakistan	0333-478210
iii)	Pakistan Cables	Pakistan Cables	Pakistan	0321-2304494

15 EARTHING CONDUCTORS

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i)	Fast Cables	Fast Cables	Pakistan	0320-8080046
ii)	Newage Cables	Newage Cables	Pakistan	0333-4748210
iii)	Pakistan Cables	Pakistan Cables	Pakistan	0321-2304494

16 PVC CONDUIT & ACCESSORIES

i)	PLASCO PIPE	PLASCO PIPE	Pakistan	0321 4113938
ii)	BETA PIPES	BETA PIPES	Pakistan	
iii)	Dadex Pipes	Dadex Pipes	Pakistan	

17 LIGHTING FIXTURES

i)	Vlux	Index Techhnologies		0300-8184203
ii)	Osram	Osram		0312-4732209
iii)	Opple Lights	Opple Lighting		0301-8440368
iv)	Avada	Avada		0300-0840008
v)	Coarts	Coarts Lighting Pvt.Ltd		0331-2273277

18 FANS

i)	Lahore Fan	Lahore Fan	Pakistan	042-35113741
ii)	Royal Fans	Royal Fans	Pakistan	042 - 35761308

19 TELEPHONE CABLES

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN Cabels	Index Technologies	USA	0300-8184203
iii)	Clipsal	Clipsal Pakistan	Australia	0322-2880041
iv)	Comscope	Netsoft	USA	0321-8480227

20 DATA CABLES (CAT-6 UTP/STP/FTP)

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN Cabels	Index Technologies	EU	0300-8184203
iii)	Clipsal	Clipsal Pakistan	China	0322-2880057
iv)	Molex	Netsoft	USA	0321-8480227
v)	Corning	ESP Solutions	USA	0333-4666946

21 CO-AXIAL CABLES (RG-6/7)

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN Cabels	Index Technologies	EU	0300-8184203
iii)	Clipsal	Clipsal Pakistan	China	0322-2880057

22 TELEPHONE,JUNCTION BOXES & PATCH PANELS

i)	TESCO	Index Technology	USA	0300-8184203
ii)	3M	ESP Solutions		0333-4666946

23 TELEPHONE OUTLETS

i)	CLIPSAL-Vivace Series	Clipsal Pakistan	China	0322-2880041
ii)	Legrand	Shahid International	EU	0321-8472264
iii)	Orange Switches	Orange Electric		0322-4834937

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24 FIRE ALARM SYSTEM

i)	DETNOV	Index Technology	Spain	0300-8184203
ii)	ALCO (fire & security)	Index Technology	USA	0300-8184203
iii)	Honeywell	Notifier	UK	
iv)	Bosch	ESP Solutions	Germany	0333-4666946

24 a FIRE ALARM SYSTEM CABLING

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	Elan	Index Technologies	Italy	0300-8184203
iii)	Cavicell	C-XOR Engineering	Italy	0300-8477751

25 CCTV SYSTEM

i)	SAMSUNG	Vital International	Korea	0306-6831111
ii)	ALCO	Index Technology	USA	0300-8184203
iii)	Bosh	ESP Solutions	Germany	0333-4666946
iii)	Honeywell		USA	

25 a CCTV SYSTEM CABLING

i)	Ventilux	Index Technologies	UK	0300-8184203
ii)	ELAN	Index Technologies	EU	0300-8184203
iii)	Clipsal	Clipsal Pakistan	China	0322-2880057
iv)	Molex	Netsoft	USA	0321-8480227
v)	Corning	ESP Solution	USA	0333-4666986

26 PUBLIC ADDRESS SYSTEM

i)	TOA	Index Technology	Japan	0300-8184203
ii)	ITC	Index Technology	China	0300-8184203
iii)	Bosch	Bosch Invented	Germany	0321-6447170

26 a PUBLIC ADDRESS SYSTEM CABLING

i)	Ventilux	Index Technology	UK	0300-8184203
ii)	ELAN	Index Technology	EU	0300-8184203
iii)	Corning	ESP Solution	USA	0333-4666986

27 CABLE TRUNKING / LADDERS

i	Quality Switchgear Pvt Ltd.	Quality Switchgear	Pakistan	0300-8404301
ii	Bilal Engineering	Bilal Engineering	Pakistan	0331-4999119
v	Ghafoor Engineering	Ghafoor Engineering	Pakistan	0320-7780309
vii	Power-EM	Power-EM	Pakistan	0300-9430832
viii	M-Tech	M-Tech	Pakistan	0301-8472264
ix	Power Tech	Power Tech	Pakistan	0321-5234202
x	PEMPAK	PEMPAK	Pakistan	

28 BUS TIE DUCT (BTD)

i)	Pogillano	Jubliee Corporation	EU	0300-8548550
ii)	Legrand	C-XOR Engineering	EU	0300 8477751

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iii)	Power Plug	C-XOR Engineering	Malaysia	0300 8477751
iv)	Megaduct	ERCON	Malaysia	0300-0406941
v)	EAE	Libra Engineering	Turkey	0318-2070520

29 LIGHTNING PROTECTION SYSTEMS

Early Streamer Emission With Accessories (Active)

i)	Application Tech	C-Xor Engineering	Spain	0300-8477751
ii)	Jeflash	Eyelogy	Turkey	0322-8092588
iii)	INGESCO	Electrokraft	Italy	

Conventional System With Accessories (Passive)

i)	ABB	ABB	EU	0303-4443327
ii)	Dehn	Jubliee Corporation	EU	0300-8548550

30 MV SWITCHGEAR / 11KV RMU / LBS

i)	Hyundai	PEL	Korea	
ii)	ABB	ABB	EU	0303-4443327
iv)	Siemens	Siemens	EU	

31 TRANSFORMERS (DRY TYPE)

i)	Trafo Elettro	C-Xor Engineering	EU	0300 8477751
ii)	Legrand	C-Xor Engineering	EU	0300 8477751
iii)	ABB	ABB	EU	0303-4443327
iv)	TMC	Jubliee Corporation	EU	0300-8548550
v)	Power Go	Rachena Corp	EU	0321-840078
vi)	Fedral	Eyelogy	EU	0336-4452231

32 TRANSFORMERS (OIL TYPE)

i)	Pak Electron Limited (PEL)	Pak Electron Limited (PEL)	Pakistan	0300-8406508
ii)	ELMETEC	ELMETEC	Pakistan	0302-4712772
iii)	Hammad Engineering	Hammad Engineering	Pakistan	0302-4712772
iv)	Transfo Power	Transfo Power	Pakistan	0320-7889283

33 GENERATORS

i)	Cummins	Orient Energy	EU/US/CN	0300-8440430
ii)	Starkat	Innovative Engergy Sol	EU	0333-0525552
iii)	Scania	KAN Engineering	Sweden/EU	0301-8402312
iv)	Onis Visa / Volvo	VPL	EU	0301-8445026
v)	Aksa	Aksa Generators	Turkey	0302-8282690
vi)	Perkins	Power Zone		0321-4462651
vii)	Perkins	Multiline		0301-8665069
viii)	Kohler SDMO	Greaves		0345-4014588
ix)	Cummins	Power Vision	EU/US/CN	0300-9439310

34 GENERATOR CONTROL MODULES

i)	SICES	HUB ENGINEERING	EU	0301-6020372
ii)	DEEP SEA	PYRAMID AUTOMATION	UK	0333-4561619
iii)	EURO GEN	EURO GEN	FRANCE	0333-4561619

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35 OCCUPANCY SENSOR

i)	Ventilux	Index Technology	UK	0300-8184203
ii)	Clipsal/Schneider Electric	Clipsal Pakistan		0322-2880057

36 WIFI ROUTER

i)	Ruckus	Netsoft	Australia	0321-8480227
ii)	Huawei	CMC	China	0330-7470125
iii)	Allied Telesis	ESP SOLUTIONS		0333-4666946

37 GPON ACTIVE EQUIPMENT

i)	CORNING	ESP SOLUTIONS	USA	0333-4666986
ii)	HUAWEI	OCTO	CHINA	0330-7470125

38 GPON PASSIVE EQUIPMENT

i)	Molex	Netsoft	Aus	0321-8480227
ii)	Corning	ESP Solutions	USA	0333-4666946
iii)	Comscope	Netsoft	USA	0321-8480227

39 LIFTS / ESCALATORS / DUMP WAITERS

i)	Fuji	Innovative Energy Sol.	Japan	0300-8504838
ii)	Sanyo	DWP Technologies	Japan	0302-8445225
iii)	OTIS	Royal Systems		0300-8548002
iv)	Euksali	Mesi Group	Turkey	0300-8446992
v)	Mitsubishi			

40 ACCESS CONTROL / DOOR LOCKS

i)	Salto	ESP Solutions	UK	0333-4666946
ii)	ANVIZ	INEX Technology	USA/CHN	0300-8184203

41 INVERTER

i)	APC by Schneider	Octo	EU/CHINA	0330-7470125
ii)	ABB	SM JAFFER	EU	0333-0321284

42 INDUSTRIAL POWER SOCKETS (IPS)

i)	Clipsal	Clipsal Pakisan	China	0322-2880057
ii)	FAMATEL	JUBLIEE CORPORATION	SPAIN	0300-8548550

43 SURGE PROTECTION DEVICES

i)	ABB	ABB	EU	0303-4443327
ii)	Dehn	Jubliee Corporation	EU	0300-8548550
iii)	Sigma	Jawad Electric	Turkey	0322-8061111

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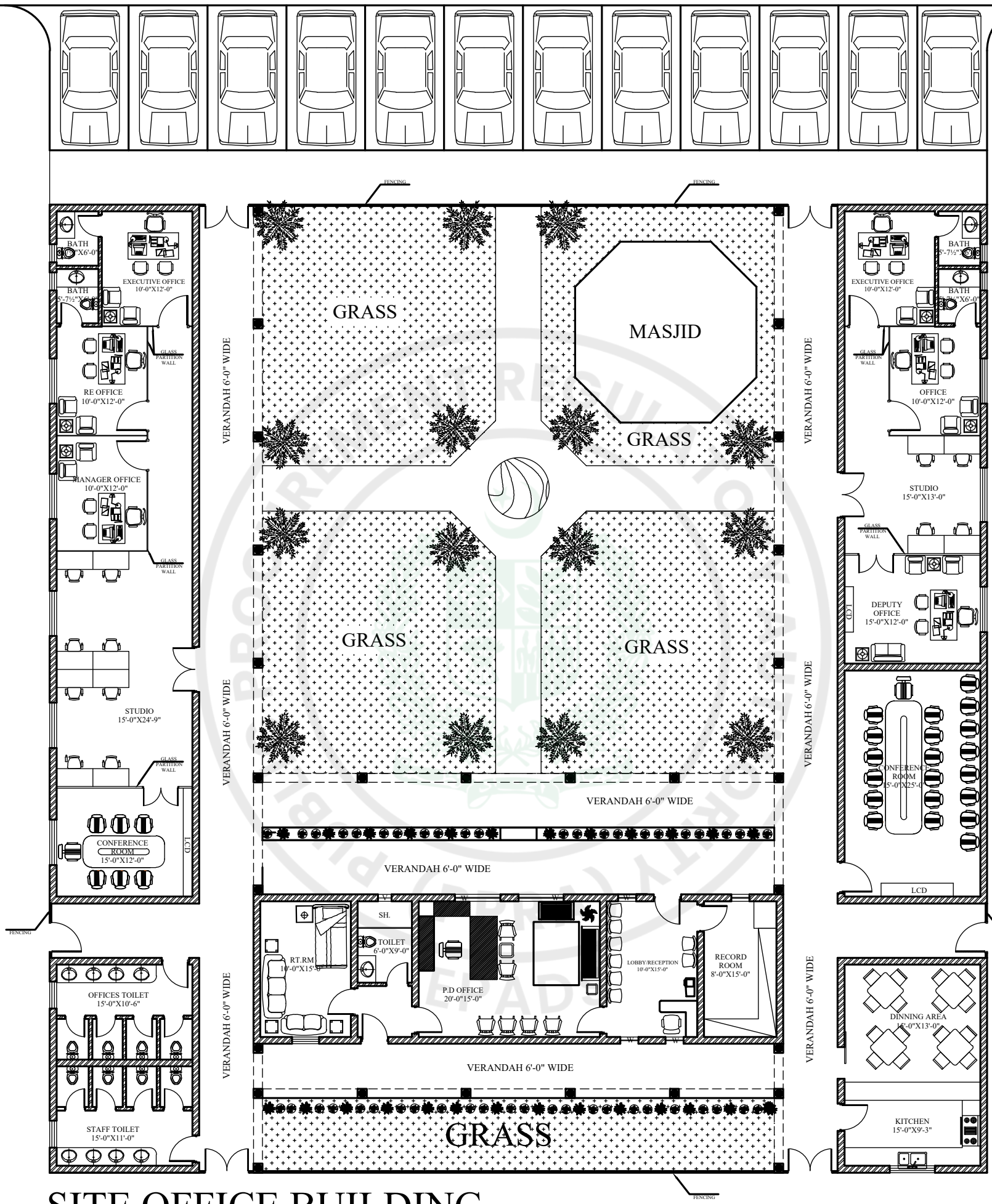
ROAD



SITE OFFICE BUILDING

PMU OFFICE=1282 SFT
RE OFFICE=1282 SFT
PD OFFICE=965 SFT
TOILETS AREA=392 SFT
DINNING & KITCHEN AREA=392 SFT
VERANDAH COVERED AREA = 2372 SFT
MASJID COVERED AREA = 350 SFT

DATE: 14-01-2026

PROPOSED SITE OFFICE FOR ATC TOWER PROJECT STAFF AT SKARDU AIRPORT.

MAIN CONSULTANTS:
Anwar Ali Architects (Pvt.) Ltd.
Consulting,Architects,Engineers
Planners & Management Consultants
06 HBFC BLOCK A FAISAL TOWN LAHORE

Yasin Enterprises Pakistan

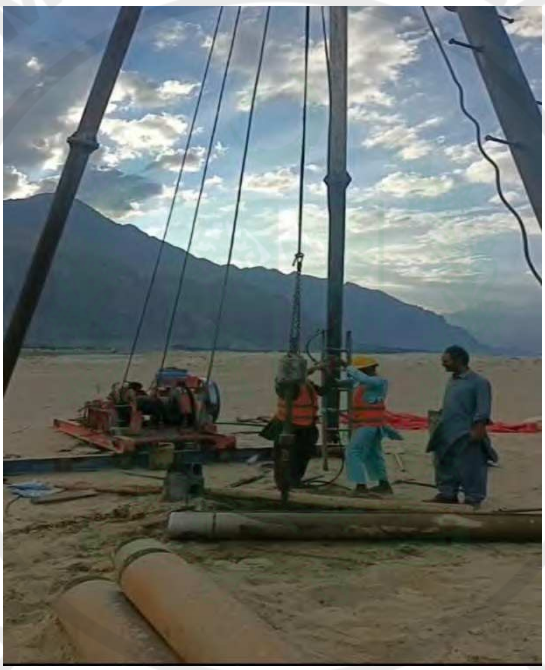
Geotechnical and Geoenvironmental Work

209-C, Green View Society, Faisal Town, Lahore

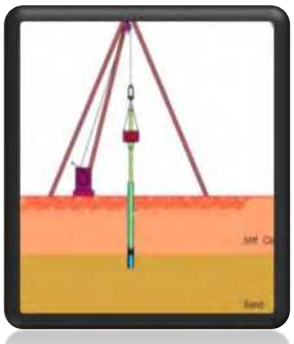
info@yasinenterprises.com;

0092-42-35167290

Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan



AUGUST-2025



Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

Authored By: **Muhammad Jamman Shahid**
Senior Geological Engineer

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

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1. INTRODUCTION

1.1 General

M/S Anwar Ali Architect requested to M/S Yasin Enterprises Pakistan, for the preparation of subsoil investigation report for the construction of ATC Tower at Skardu Airport Pakistan. Yasin Enterprises Pakistan was engaged to prepare an interpretive report on the subsurface soil investigations carried out at the project site for designing an appropriate foundation system for the required structure. Field investigations were carried out through two number of the exploratory borehole, up to a maximum depth of 86 ft below the existing ground surface level (or Natural Ground Surface Level), approximately. Borehole locations are shown in Figure 1. The fieldwork was carried out on 29-05/07-08/2025 by M/S Yasin Enterprises Pakistan and laboratory testing on the representative soil samples was also arranged by the same entity. This report presents the findings of the geotechnical investigations carried out in relation to a specific site, location and purpose.

1.2 Purpose and Scope of Work

The primary objective of these investigations was to determine appropriate parameters for the design of the foundation for the construction of ATC Tower at the project site. For this purpose, the following aspects were determined/evaluated:

a) Subsurface stratigraphy within the limits of exploratory boring.

b) Geotechnical characteristics of the subsurface materials (strata) encountered.

c) Evaluation of subsurface soil parameters, recommendations for appropriate type and depth of foundation, and allowable bearing capacity value to be used in the design of foundation for the required facility.

Borehole log and laboratory test results are presented in Appendices following the main text.

2. EXPLORATION METHODOLOGY

Field exploration were carried out at the site through two number of boreholes, up to a maximum depth of 86 ft with reference to the existing footprint at locations shown in Figure-1 (Illustrations) while the coordinates of these locations are mentioned on BH logs. The water table was not encountered at a depth of 86 ft exploration in site area at the time of these investigations. Brief details of the methodology of the investigation are outlined in the following sections:

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2.1 Exploratory Boring & Sampling

The boring was advanced using mechanically operated heavy percussion techniques. Disturbed subsurface soil samples were recovered using the Standard Penetration Test (SPT) split spoon sampler in accordance with ASTM D 1586. For both of the boreholes, the SPT's were conducted at an interval of ***3 ft to 10 ft*** up to the final depth of exploration of 86 ft. Disturbed soil samples obtained through SPT spoon sampler were preserved in polythene bags for testing in the laboratory as per standard practice.

The SPT-Resistance values (N-values), a detailed description of the subsurface soils encountered and the depth at which soil samples were procured are shown on the boring log (Appendix-A). Soil descriptions on the boring log are a compilation of the field and laboratory testing data. The stratification lines represent the approximate boundary between soil types and transitions may be assumed gradual. The engineering/mechanical properties of soils including the angle of internal friction (ϕ'), moist unit (γ_b) weight, relative density (D_r) and unconfined compressive strength (q_u) can be evaluated on the basis of SPT 'N' values. For this purpose, in the existing literature different ranges of the SPT 'N' values have been identified to differentiate the numerical values of the above-mentioned engineering/mechanical properties. Table 1 can be used to evaluate such properties for a particular SPT 'N' value as recommended by *Terzaghi* and others.

2.2 Laboratory Testing

Selected representative subsurface soil samples were tested in the laboratory to determine the various geotechnical characteristics. The following tests were conducted according to the standard methods.

- Particles Size Analysis
- Atterberg's Limit
- Natural Moisture Content (NMC)
- Direct Shear Test

Table 2 (Illustrations) presents a summary of laboratory test results.

2.3 Discussion on Field and Laboratory Test Results

The field and laboratory testing findings are summarized below:

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Bore hole No.	Lithology	Depth (ft)
01	Silty Sand to Poorly Graded Sand with Silt	0-63
01	Silty Clay	63-72
01	Poorly Graded Sand	72-86
02	Silty Sand to Poorly Graded Sand with Silt	0-24
02	Silty Clay	24-32
02	Silty Sand to Poorly Graded Sand with Silt	32-63
02	Silty Clay	63-72
02	Poorly Graded Sand	74-86

3. GEOTECHNICAL EVALUATIONS

Subsurface soils disclosed by two exploratory borehole shows that soil can be categorized as the cohesive and non-cohesive strata. The actual thickness of each stratum along with SPT resistance (N-values) is shown on the borehole log, (Appendix-A). Ground Water Table (GWT) was not encountered at a depth of 86 ft of exploration at the time of these investigation

Type of Material	Thickness of Layer (m)	Field SPT N Value	Bulk Unit Weight (KN/m³)	Cohesion (Kpa)	Angle of Internal Friction (degree)
SM/SP-SM	0-6	4	17	-	28
SM/SP-SM	6-12	8	17.5	-	30
SM/SP-SM	12-20	19	20	-	33
CL-ML	20-22	-	19	100	-
SP	22-26	40	21	90	35

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4. FOUNDATIONS DESIGN RECOMMENDATIONS

4.1 Foundation Design Requirements

Foundations of a structure should meet the following minimum design criteria:

i. Foundations should be safe against the shear failure of the supporting ground. A factor of safety of 3.0 to 4.0 is generally adopted for this purpose.

ii. Foundations should not settle excessively under the service loads. Settlement of 25 mm is usually taken as permissible for strip footing and 50 mm for the raft.

iii. Foundations must stay safe under tensile, lateral, moment and earthquake loadings.

4.2 Foundation Design Suggestions

Figure 2 represents the various types of shallow foundation systems. It should be an emphasis that allowable bearing capacity of the strata basically depends upon the foundation type, foundation depth, foundations dimensions and the applied loading conditions, among other determinant factors. Keeping in view the possibility/requirement of the subject structure, the following types of foundation systems are suggested.

4.2.1 Raft Footing

The recommended value of net allowable bearing capacity for a raft foundation when placed at a depth of 1 meter below the *NSL* can be found from the table given below. This value of allowable bearing capacity is based on the assumption that the trend of SPT 'N' value will prevail even below the exploratory borehole depth of 26 meter from the existing foot-print (NSL). The compaction activity should be carried out under the supervision of qualified staff along with quality control checks.

- Provide a well-compacted layer of 04-meter-thick granular material, compacted not more than 6-inch thickness and underlain it by at least 6 inches thick well-compacted pad of 1:4:8 P.C.C. Raft footing should bear on this P.C.C pad.

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Footing Type	Foundation Size (meter)	Width (meter)	Net Bearing Capacity (KPa)	Modulus Of Subgrade Reaction (KN/m³)
Raft Footing	26 x 65	26	215	8600

Additionally, damp-proofing measures including geo-textiles, polyethene sheets etc. should be applied below the RCC Raft slab. Concrete walls should also be coated with the bituminous coating, acrylic modified cement, surface bonding mortar or any material permitted for waterproofing. However, explicit application recommendations for the specific treatment provided by the manufactures should be keenly observed. The above mentions measures are more specifically intended when the rise of the water table is expected with seasonal weather conditions. The use of ordinary Portland cement is the existing standard practice in the project area

4.2.2 Pile Bearing Capacity

- Pile Capacities must be confirmed by full-scale pile load tests.
- Full-scale pile load test must be carried out before construction.
- Pile construction must be carried out as per guidelines provided in drilled Shaft construction procedure and design method.
- Pile Capacities have not been reduced by the group efficiency factor, which shall be picked from the chart.
- Working piles to 3.0 times the design load to finalize the design.
- The construction of the foundation must be done in the supervision of an experienced geotechnical engineer.
- To provide stability against lateral and seismic loads.
- Foundations must stay safe under tensile, lateral, moment and earthquake loadings.

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SUMMARY OF PILE LOAD CARRYING CAPACITIES			
Pile Dia	**Pile Length**	**Allowable Load Carrying Capacity in Compression**	**Allowable Load Carrying Capacity in Tension**
mm	**m**	**kN**	**kN**
760	10	579	303
	15	941	583
	20	1338	963
	25	1674	1304
1000	10	761	431
	15	1238	815
	20	1811	1331
	25	2202	1794
1200	10	914	548
	15	1486	1025
	20	2224	1660
	25	2643	2230

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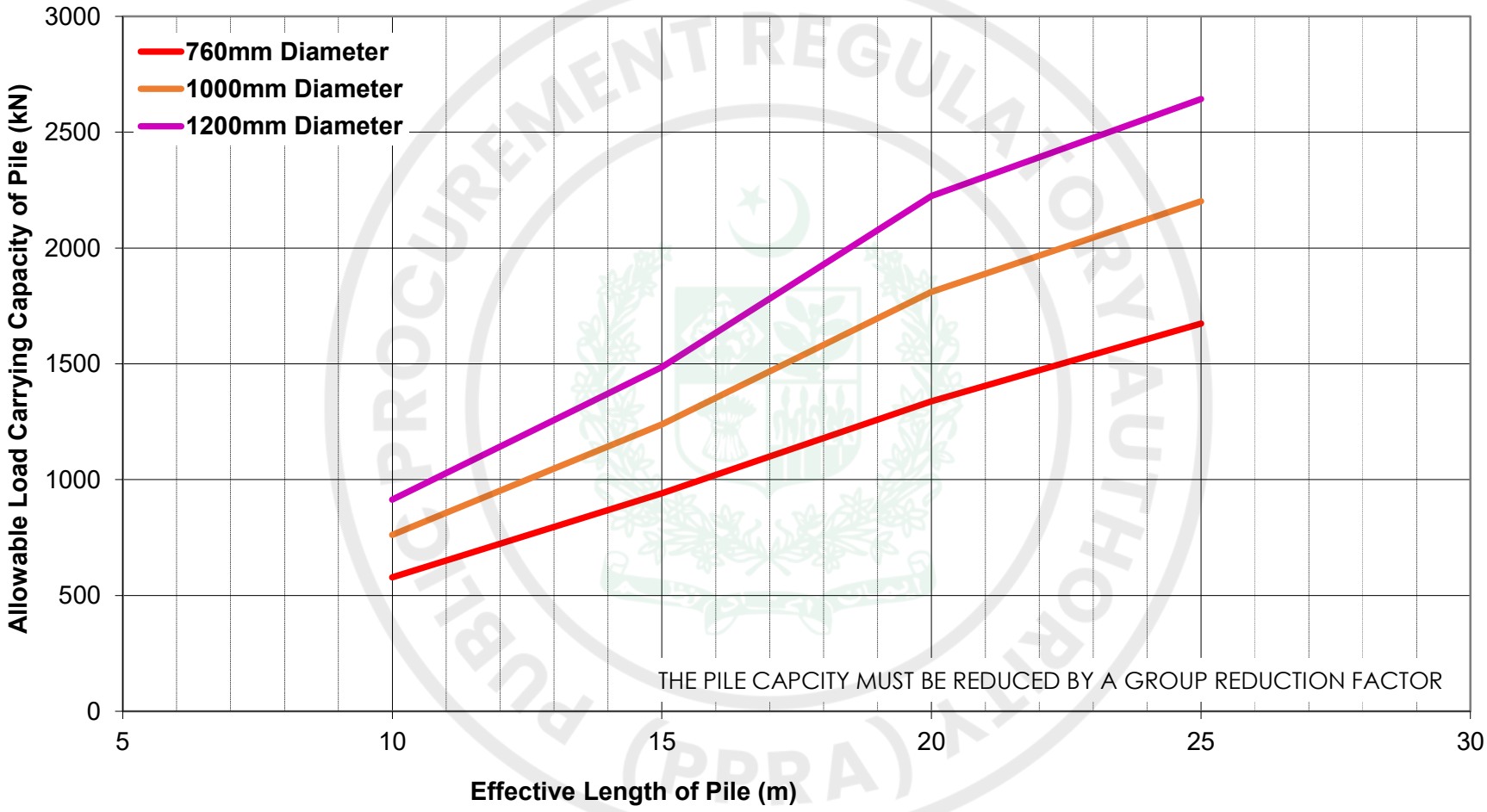


Fig. 1 **Allowable Load Carrying Capacity of Piles in Compression**
Pile Head considered at 1m below EGL

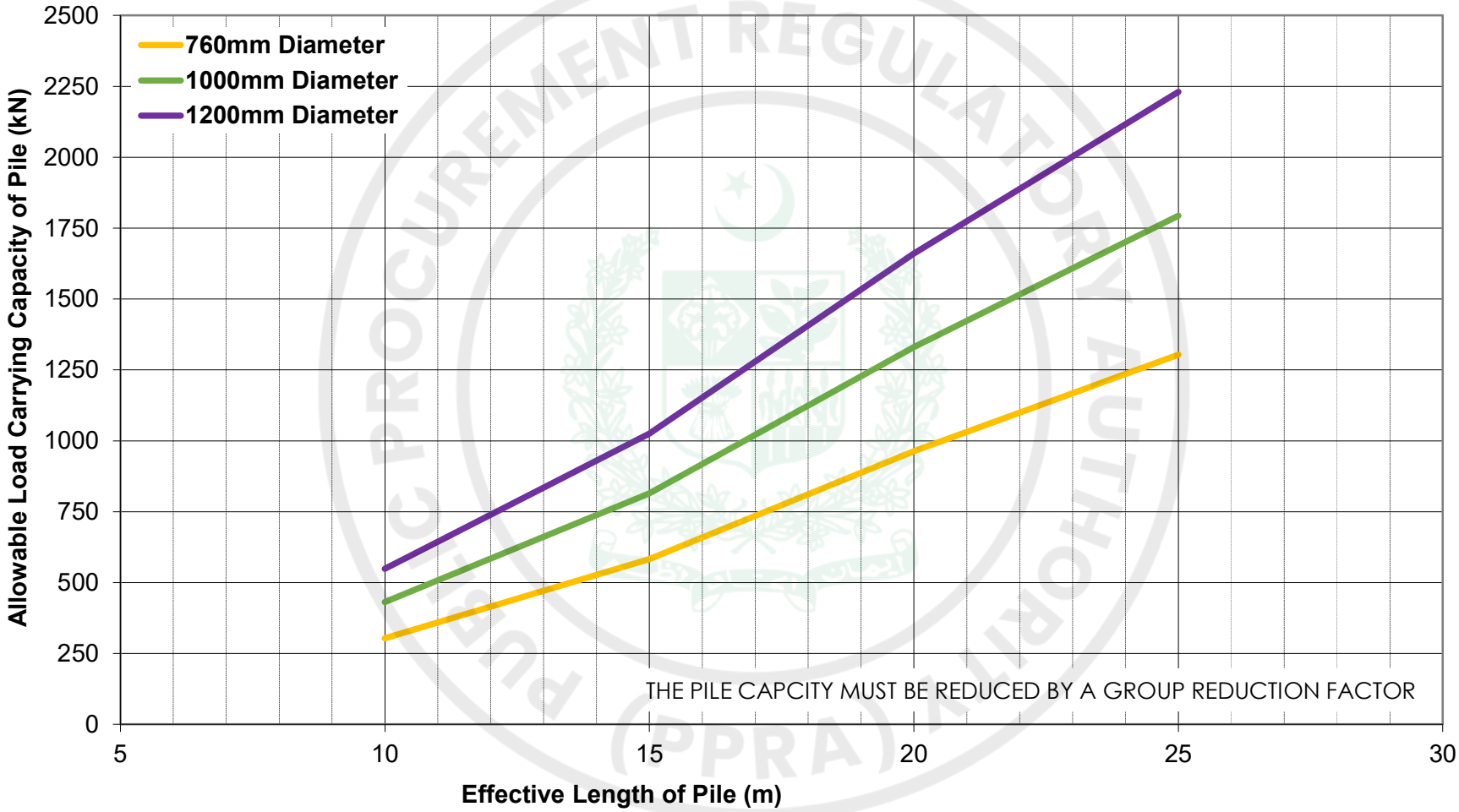


Fig. 2 Allowable Load Carrying Capacity of Piles in Tension
Pile Head considered at 1m below EGL

Modulus of Vertical Subgrade Reaction

(Ref. FHWA-HRT-04-043; Chapter # 7)

Pile head from 1m below EGL	Vvertical Modulus of Subgrade Reaction		
	760mm	1000mm	1200mm
0	0	0	0
1	36995	29626	25601
2	36995	29626	25601
3	36995	29626	25601
4	36995	29626	25601
5	36995	29626	25601
6	36995	29626	25601
7	36995	29626	25601
8	36995	29626	25601
9	36995	29626	25601
10	36995	29626	25601
11	36995	29626	25601
12	69493	55651	48092
13	69493	55651	48092
14	69493	55651	48092
15	69493	55651	48092
16	69493	55651	48092
17	69493	55651	48092
18	69493	55651	48092
19	69493	55651	48092
20	51167	40975	35409
21	51167	40975	35409
22	112157	89816	77616
23	112157	89816	77616
24	112157	89816	77616
25	112157	89816	77616
K_s (*Tip*)	272645	358743	430491

EPADS

Modulus of Horizontal Subgrade Reaction

(Ref. Page 7.2.235-236 of Naval Facilities Engineering Command)

Pile head from 1m below EGL	Horizontal Modulus of Subgrade Reaction (kN/m^3)		
(m)	760mm	1000mm	1200mm
0	0	0	0
1	2281	1733	1444
2	4561	3466	2889
3	6842	5200	4333
4	9122	6933	5777
5	11403	8666	7222
6	21893	16639	13866
7	25542	19412	16177
8	29191	22185	18487
9	32840	24958	20798
10	36488	27731	23109
11	40137	30504	25420
12	114939	87353	72794
13	124517	94633	78861
14	134095	101912	84927
15	143673	109192	90993
16	153251	116471	97059
17	162830	123750	103125
18	172408	131030	109192
19	181986	138309	115258
20	91221	69328	57773
21	95782	72794	60662
22	100343	76261	63551
23	524521	398636	332197
24	547326	415968	346640
25	570132	433300	361083

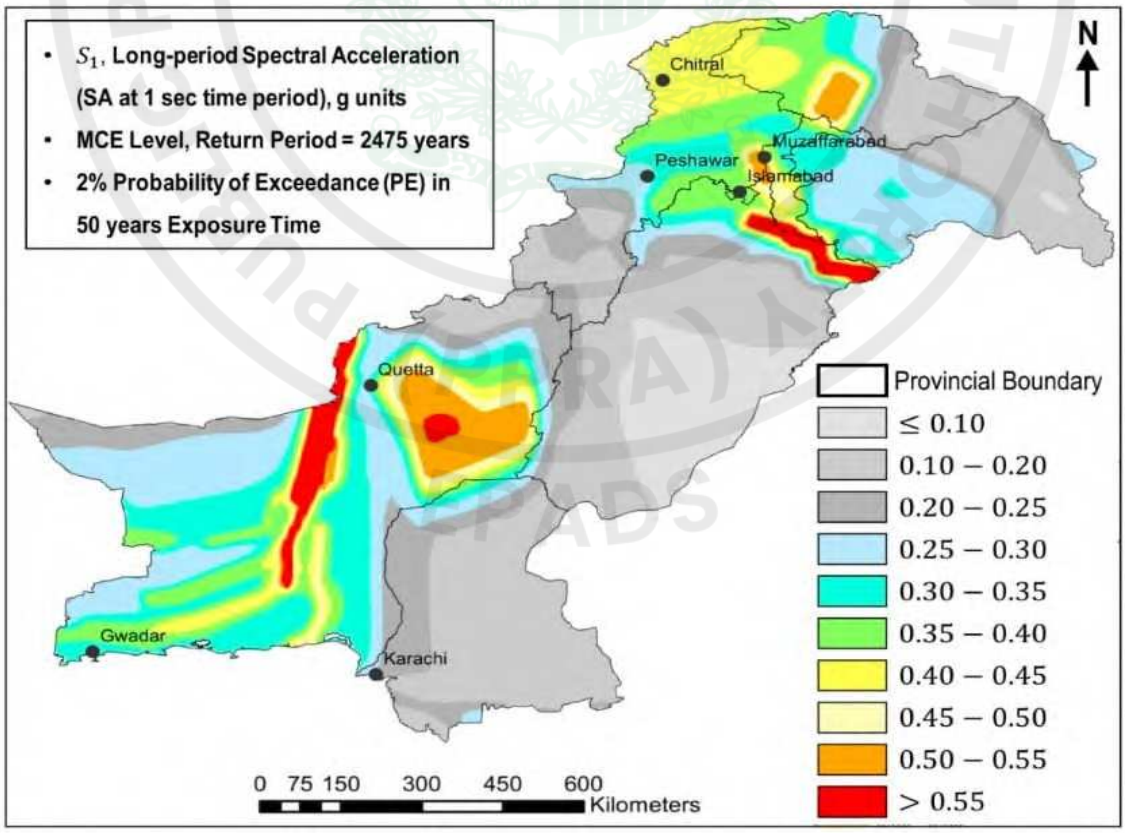
PROCUREMENT REGULATORY AUTHORITY (PRA) EPADS

4.3 Liquefaction Potential

Groundwater was not encountered during the subsurface investigation up to the explored depth. The site, however, experiences seasonal snowfall, and subsequent snowmelt may temporarily increase the soil moisture content in the near-surface layers. Despite this, in the absence of a persistent groundwater table, the sand deposits remain in a moist to partially moist condition and are not expected to reach full saturation. Therefore, the soil strata are not considered susceptible to liquefaction under the design earthquake as per BCP-2021. Nonetheless, if future conditions or prolonged snowmelt result in a significant rise in subsurface water levels within the loose sand deposits, the liquefaction potential should be reassessed.

4.4 Seismicity

The project site (Skardu city) lies in Zone 03, as per the Building Code of Pakistan (2021) of the Building Code of Pakistan. This shows the probability of slight damage under the earthquakes and corresponds to horizontal peak ground acceleration (PGA) of 0.24g to 0. 32g.



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4.5 Some Constructional Aspects

We recommend the following measures during the construction of the subject building/facility:

- Piled foundation (preferred) single or group bored cast-in-situ piles transferring load to dense sand / stiff clay at ~20 m to 26 m. Best for overturning, settlement control and seismic performance.
- Piled-raft (economical alternative) — shallow raft working with piles to share load and reduce pile number. Good if allowable settlement target must be met and some settlement can be tolerated.
- Large shallow raft alone — NOT RECOMMENDED given loose top sands and large settlements calculated.
- Type: Bored cast-in-situ reinforced concrete piles (drilled shafts) or CFA if contractor experienced.
- Diameter: typical 760–1200 mm. For ATC tower, select 800–1000 mm for balance of capacity and constructability.
- Target pile tip depth: ~20–25 m (r stiff clay / dense sand).
- Estimated spacing: center-to-center = 3D to 4D (i.e., 2.4–4.0 m for 800–1000 mm piles) to limit group interaction.
- Number of piles: depends on tower design loads—tower is point load; use pile group to provide axial capacity + overturning resistance.
- Concrete: C30/37 minimum; tremie pour if under slurry; design cover for durability (chloride/sulfate exposure likely low but use standard protection).
- Proper surface drainage should be provided in the area and the area should be graded to keep the surface runoff away from the structure.
- To reduce ingress of water to foundation soils, *plinth protection slab* sloping away from the structure in unpaved portion should be provided to ensure positive protection, the plinth protection slab should extend beyond such portion of the structure at least 2.5 ft from the face of the walls. A PCC layer, 4 inches thick, may be provided for this purpose.
- An experienced engineer should observe/monitor the construction activities to check that the works are performed in accordance with the plans and specifications. Field and

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laboratory tests should be performed to confirm that the material quality, compaction and strength to meet the project specifications.

5. GENERAL COMMENTS AND LIMITATIONS

Following are the comments and limitations of our report:

- This report presents results of the geotechnical investigations, conducted through two number of the exploratory borehole up to a maximum depth of ***86 ft*** below the existing ground surface level.
- The analyses, conclusions and recommendations contained in this report are based on site conditions, as they existed at the time of field investigations and further on the assumption that the exploratory boring is representative of the subsurface conditions throughout the site area.
- If there is a substantial lapse of time between submission of this report and the start of work at the site and conditions have changed due to either natural causes or due to construction operation at or adjacent to the site, we urge that we be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.
- This report has been prepared on the bases of experimental data collected in the field and laboratory by the staff of M/S Yasin Enterprises Pakistan for the recommendation of foundation types for the construction of *Building*. Paragraphs, statements, test results, boring logs, diagrams etc., should not be taken out of the context and should not be utilized for any other structure at any site even in the close vicinity of the proposed project locations discussed in this report.

******End of Main Text of the Report******

Note: Errors and omissions are excepted, if any

Illustrations

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Table 1. Empirical values for φ, q_u, D_r and unit weight of soil based on SPT

GRANULAR SOILS

Description	Very Loose	Loose	Medium	Dense	Very Dense
Relative density, D_r	0 – 0.15	0.15 – 0.35	0.35 – 0.65	0.65 – 0.85	0.85 – 1.00
Standard Penetration Test value, *N*	0 – 4	5 – 10	11 – 30	31 – 50	51 – UP
Approximate angle of internal friction, ϕ (degree)	25 – 28	28 – 30	30 – 35	35 – 40	38 – 43
Approximate range of moist unit weight, γ (pcf)	70 – 100	90 – 115	110 – 130	110 – 140	130 – 150
Submerged unit weight, γ_{sub}	60	55 – 65	60 – 70	65 – 85	85

COHESIVE SOILS

Description	Very Soft	Soft	Firm	Stiff	Very Stiff	Hard
Unconfined compressive strength, q_u (tsf)	0 – 0.25	0.25 – 0.5	0.5 – 1.0	1.0 – 2.0	2.0 – 4.0	4.0 – UP
Standard Penetration Test value, *N*	0 – 2	3 – 4	5 – 8	9 – 16	17 – 32	33 – UP
Approx. range of saturated unit weight, γ_{sat} (pcf)	100 – 120		100 – 130	120 – 140		130+

Table 2 Summary of Laboratory Test Results

Borehole No.	Depth (ft.)	N.M.C	Particle Size Distribution (%)			Plastic	
			Gravel	Sand	Silt & Clay	LL	PL
01-02	3	9.50	0	88.3	11.7	Non-Plastic	
	6	8.98	0	89.5	10.5	Non-Plastic	
	9	7.36	0	89.9	10.1	Non-Plastic	
	12	9.47	0	84.7	15.3	Non-Plastic	
	15	10.23	0	85.7	14.3	Non-Plastic	
	20	10.85	0	87.7	12.3	Non-Plastic	
	25	12.21	0	89.3	10.7	Non-Plastic	
	30	18.15	0	6.4	93.6	Plastic	
	35	-	0	91.0	9.0	Non-Plastic	
	40	15.98	0	90.7	9.3	Non-Plastic	
	50	-	0	89.6	10.4	Non-Plastic	
	60	15.88	0	91.8	8.2	Non-Plastic	
	70	16.82	0	4.4	95.6	Plastic	
	80	-	0	96.8	3.2	Non-Plastic	

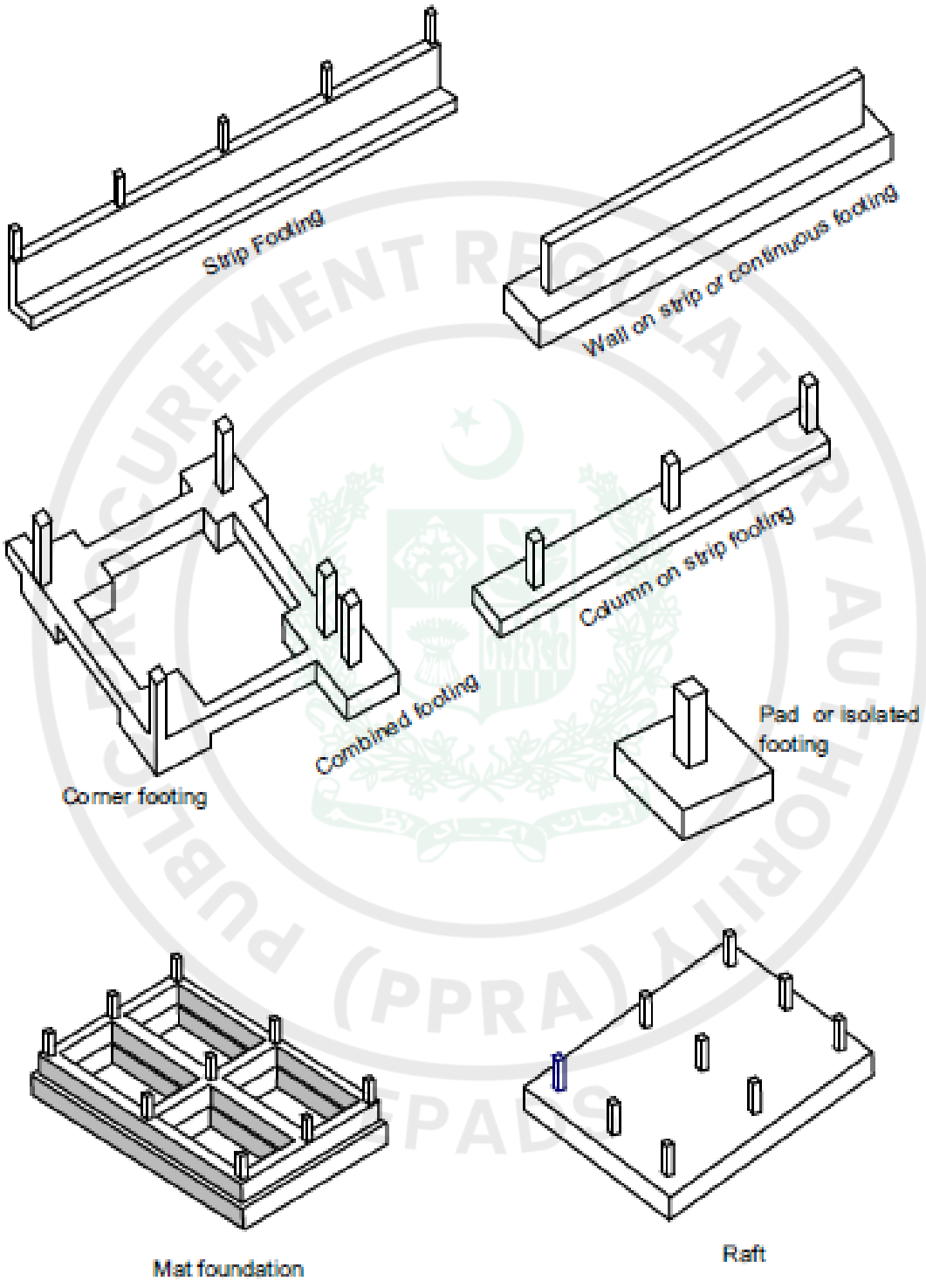

Figure 2. Types of Shallow Foundations

Geotechnical Investigation

Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

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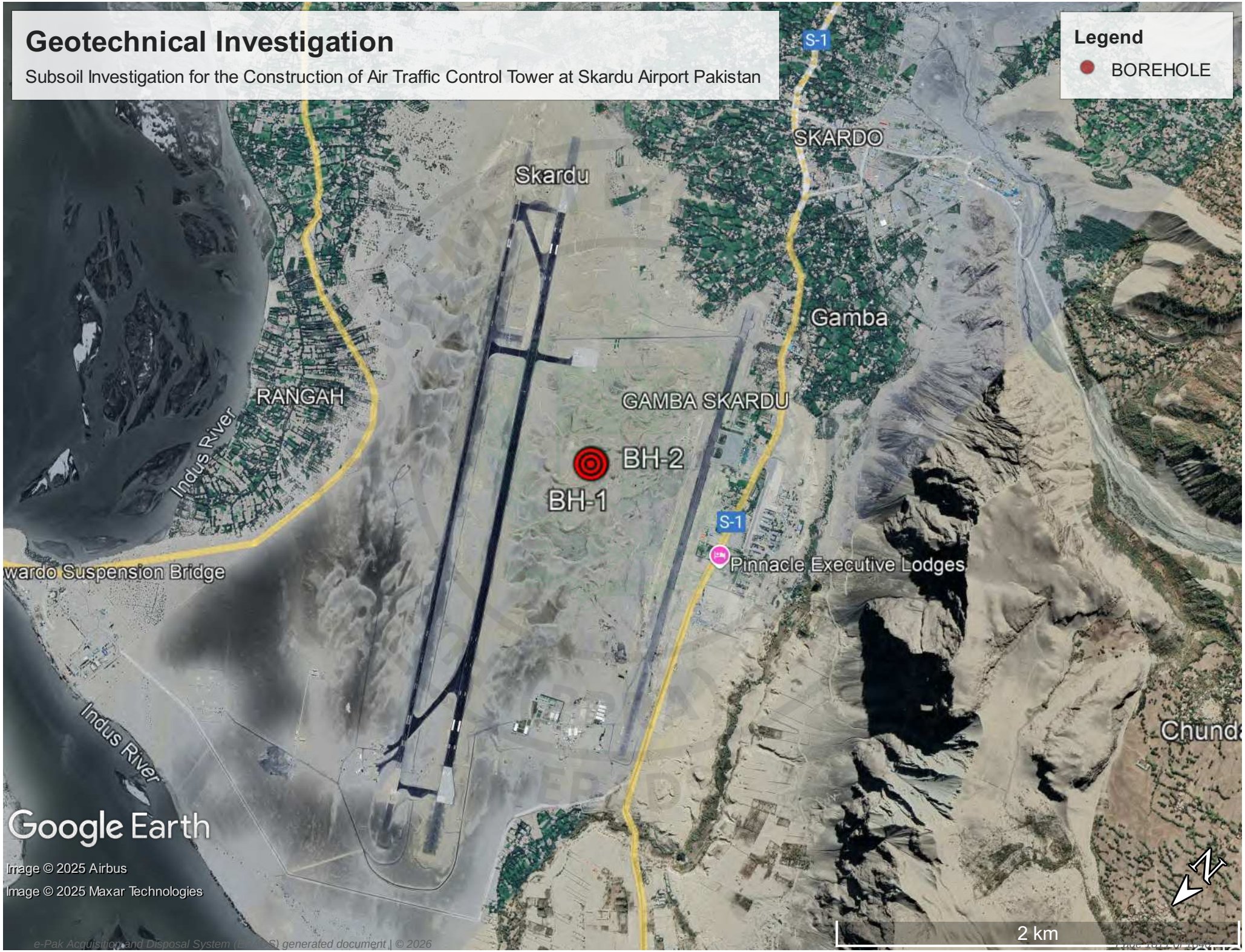

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Figure 3. Field Testing in Progress

APPENDIX-A
(Borehole Logs)

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

BOREHOLE NO. BH-01

SHEET 1 OF 2

BOREHOLE LOG

Job No. 5025 Project Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

Site Incharge Abdur Rehman Client Name M/S Anwar Ali Architect Contractor M/S YEP, Lahore

Type of boring Heavy Percussion Drilling Fluid Water Ground Water Depth Not Encountered

Coordinates _____ Ground Elevation ~ Above 30 ft from RL Date 02-08-2025 To 05-08-2025

Depth (ft.)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. o — SPT Blows/30cm (10 20 30 40 50 60 70 80 90 100)	Remarks
0.0				Light gray to gray, very loose to medium dense, Silty Sand to Poorly Graded Sand with Silt.	100 mm		
3.0	SPT-1		SM/ SP-SM			1	
6.0	SPT-2					2	
9.0	SPT-3					5	
12.0	SPT-4					4	
15.0	SPT-5					5	
18.0							
21.0	SPT-6					8	
24.0	SPT-7					7	
27.0							
30.0	SPT-8					10	
33.0							
36.0	SPT-9					12	
39.0	SPT-10T					12	
42.0							
45.0	SPT-11T					16	
48.0							
51.0	SPT-12T					19	

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

BOREHOLE NO. BH-01

SHEET 2 OF 2

BOREHOLE LOG

Job No. 5025 Project Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

Site Incharge Abdur Rehman Client Name M/S Anwar Ali Architect Contractor M/S YEP, Lahore

Type of boring Heavy Percussion Drilling Fluid Water Ground Water Depth Not Encountered

Coordinates - Ground Elevation above 30 ft from RL Date 02-08-2025 To 05-08-2025

Depth (ft.)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm (P.L. ▽, N.M.C. x, L.L. ○)	Remarks
50.0				Light gray to gray, medium dense, Poory Graded Sand with Silt	100 mm		
55.0	SPT-13T		SP-SM			22	
60.0	SPT-14T					32	
65.0			CL-ML	Light brown to brown, very stiff to hard, Silty Clay			
70.0	SPT-15T					45	
75.0			SP	Light gray to gray, dense, Poory Graded Sand.			
80.0	SPT-16T					40	
85.0				BOTTOM OF BOREHOLE			

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

BOREHOLE NO. BH-02

SHEET 1 OF 2

BOREHOLE LOG

Job No. 5025 Project Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

Site Incharge Abdur Rehman Client Name M/S Anwar Ali Architect Contractor M/S YEP, Lahore

Type of boring Heavy Percussion Drilling Fluid Water Ground Water Depth Not Encountered

Coordinates _____ Ground Elevation ~ Above 30 ft from RL Date 02-08-2025 To 05-08-2025

Depth (ft.)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. o SPT Blows/30cm (10 20 30 40 / 10 20 30 40 50 60 70 80 90 100)	Remarks
0.0							
3.0	SPT-1		SM/ SP-SM	Light gray to gray, very loose to loose, Silty Sand to Poorly Graded Sand with Silt.	100 mm	2	
6.0	SPT-2					2	
9.0	SPT-3					4	
12.0	SPT-4					5	
15.0	SPT-5					4	
18.0	SPT-6					5	
21.0							
24.0	SPT-7		CL-ML	Light brown to brown, very stiff, Silty Clay		23	
27.0							
30.0	SPT-8					25	
33.0				Light gray to gray, loose to medium dense, Silty Sand to Poorly Graded Sand with Silt.			
36.0	SPT-9					8	
39.0	SPT-10T		SM/ SP-SM			12	
42.0							
45.0	SPT-11T					15	
48.0							
51.0	SPT-12T					18	

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

BOREHOLE NO. BH-02

SHEET 2 OF 2

BOREHOLE LOG

Job No. 5025 Project Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

Site Incharge Abdur Rehman Client Name M/S Anwar Ali Architect Contractor M/S YEP, Lahore

Type of boring Heavy Percussion Drilling Fluid Water Ground Water Depth Not Encountered

Coordinates - Ground Elevation above 30 ft from RL Date 02-08-2025 To 05-08-2025

Depth (ft.)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ SPT Blows/30cm (10 20 30 40 50 60 70 80 90 100)	Remarks
50.0				Light gray to gray, medium dense, Poory Graded Sand with Silt.	100 mm		
55.0	SPT-13T		SP-SM			22	
60.0	SPT-14T					29	
65.0				Light brown to brown, very stiff to hard, Silty Clay			
70.0	SPT-15T		CL-ML			50	
75.0				Light gray to gray, dense, Poory Graded Sand.			
80.0	SPT-16T		SP			40	
85.0				BOTTOM OF BOREHOLE			

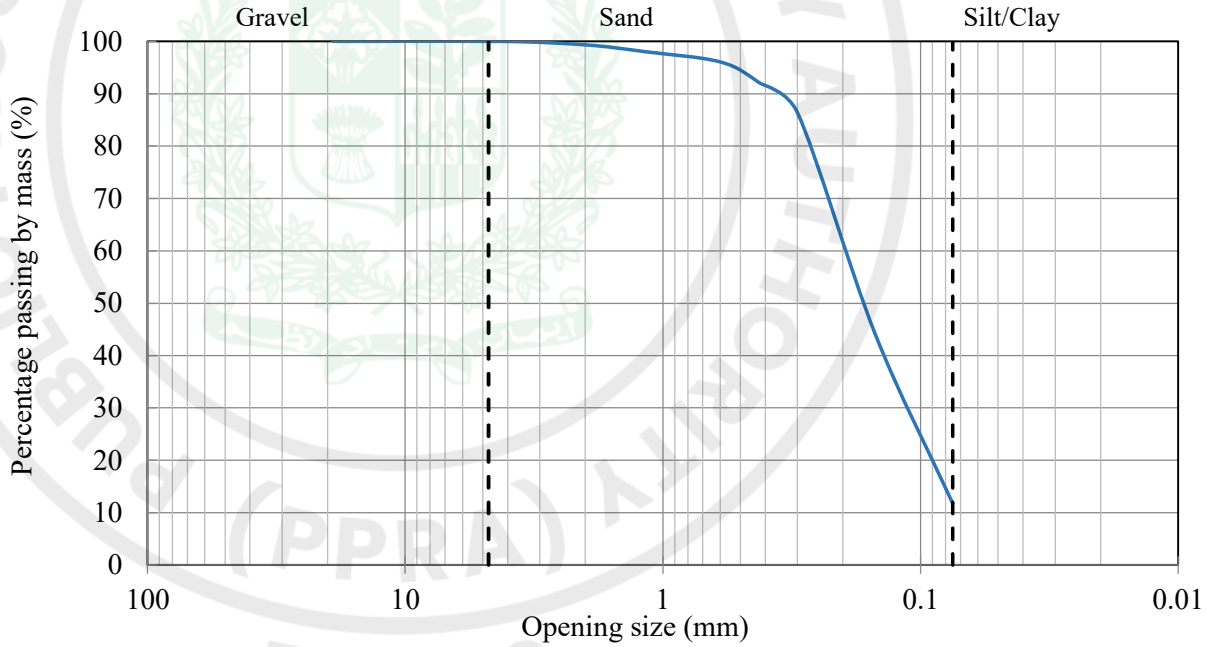
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

APPENDIX-B
(Sieve Analysis)

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	03 ft	Saturday, August 16, 2025

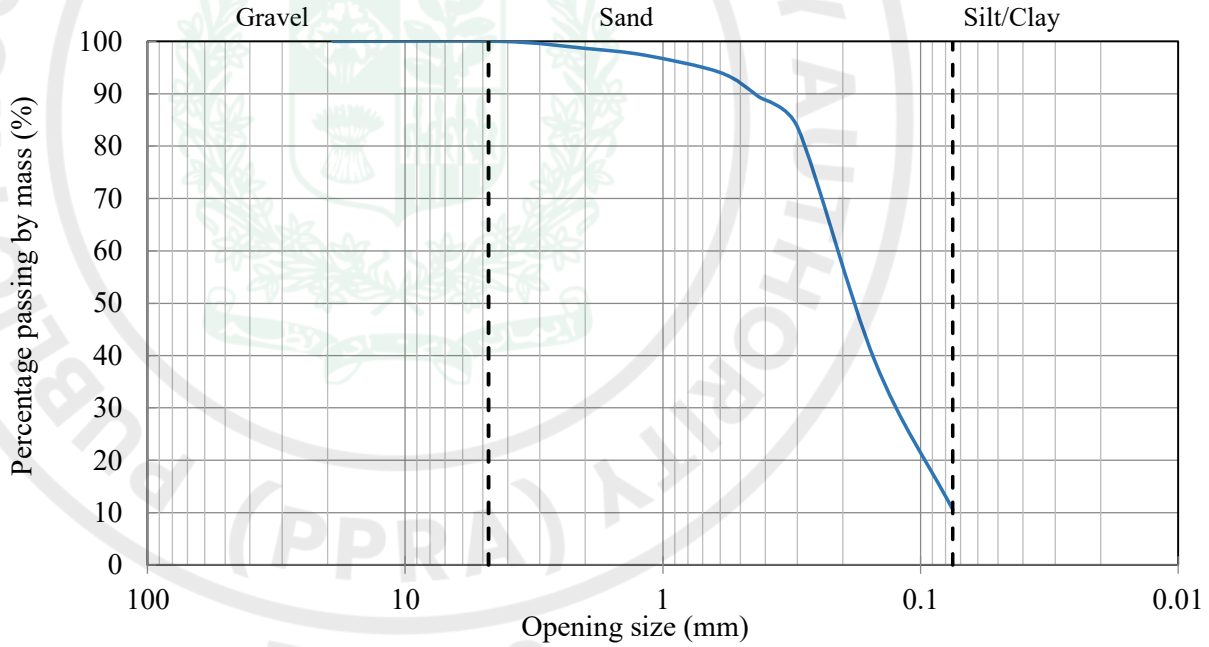
Gravel (%)	0.0
Sand (%)	88.3
Silt & Clay (%)	11.7
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	99.4
1.18	98.1
0.6	96.1
0.425	92.2
0.3	86.4
0.15	44.2
0.075	11.7



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	06 ft	Saturday, August 16, 2025

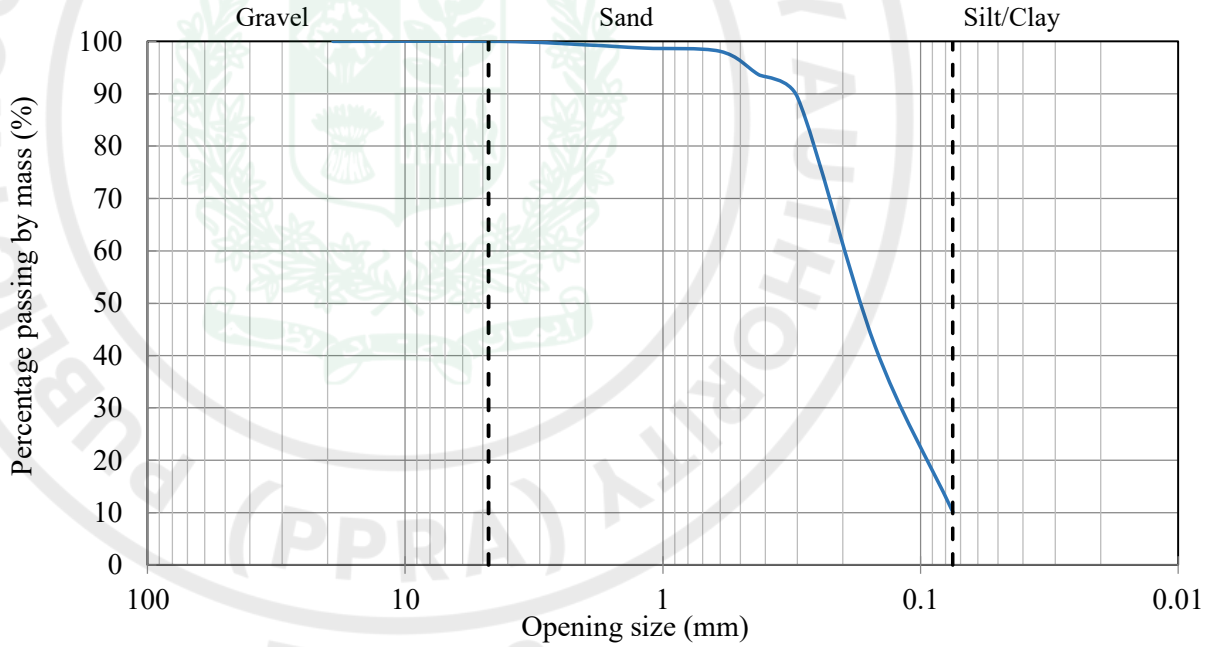
Gravel (%)	0.0
Sand (%)	89.5
Silt & Clay (%)	10.5
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	98.7
1.18	97.4
0.6	94.1
0.425	89.5
0.3	83.6
0.15	38.8
0.075	10.5



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	09 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	89.9
Silt & Clay (%)	10.1
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	99.4
1.18	98.7
0.6	98.1
0.425	93.7
0.3	89.2
0.15	41.8
0.075	10.1

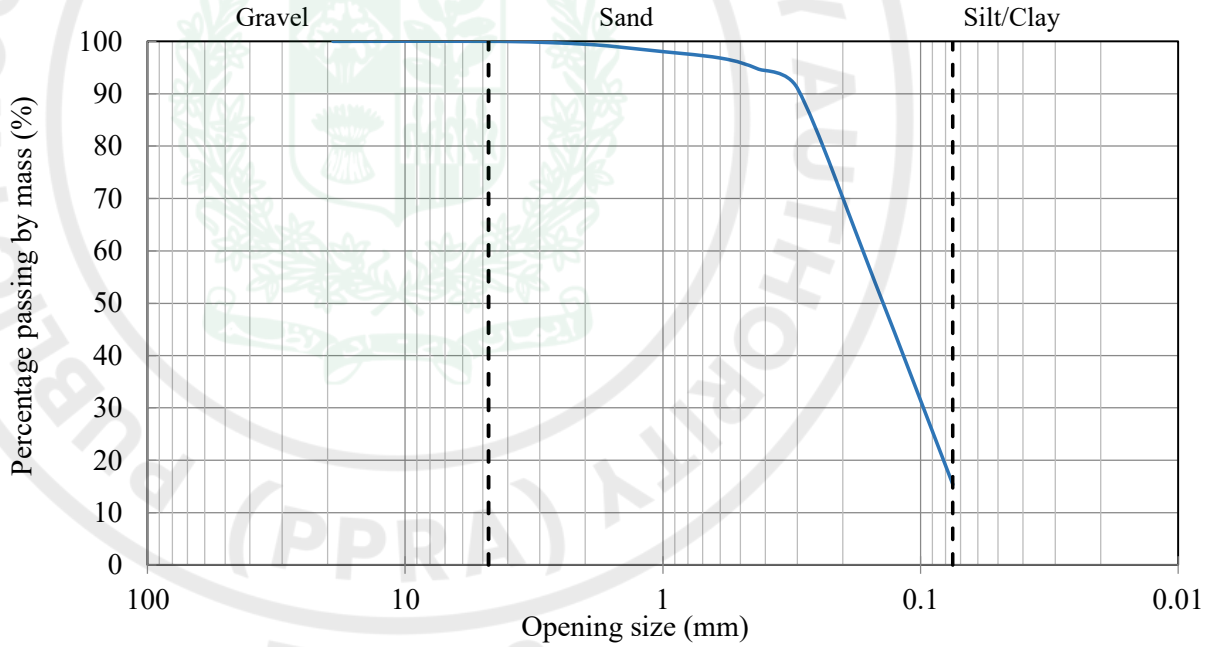


PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	12 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	84.7
Silt & Clay (%)	15.3
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	99.5
1.18	98.4
0.6	96.8
0.425	94.7
0.3	91.0
0.15	54.0
0.075	15.3

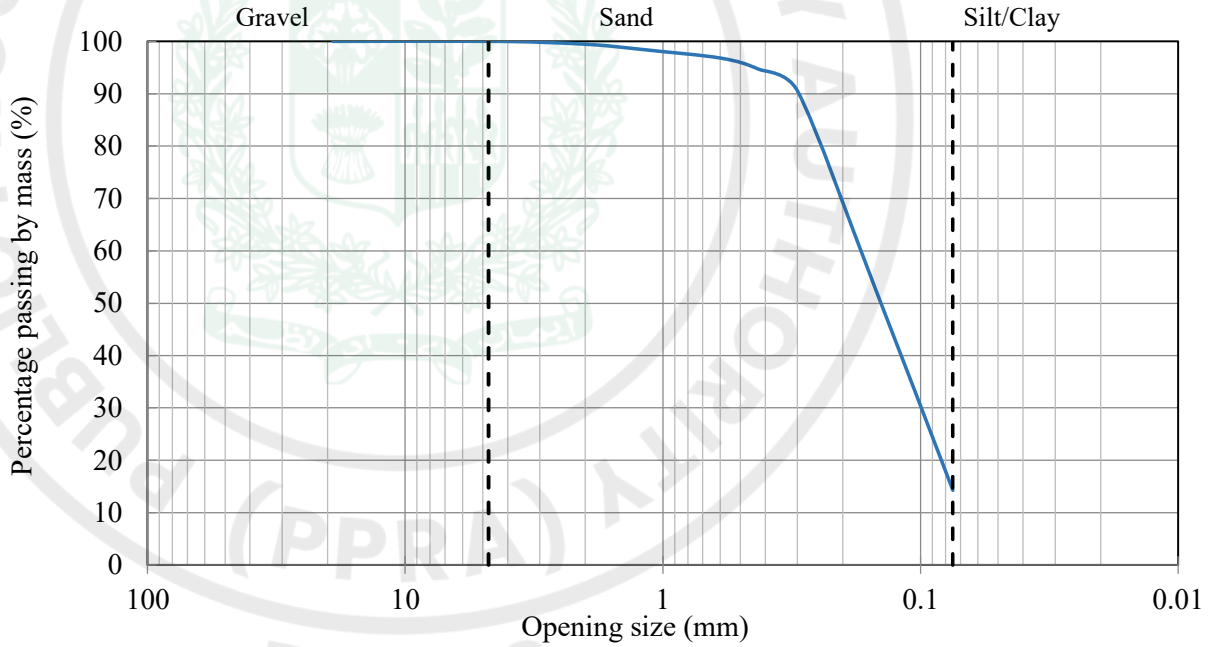
1.00



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	15 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	85.7
Silt & Clay (%)	14.3
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	99.5
1.18	98.4
0.6	96.8
0.425	94.7
0.3	90.5
0.15	52.9
0.075	14.3



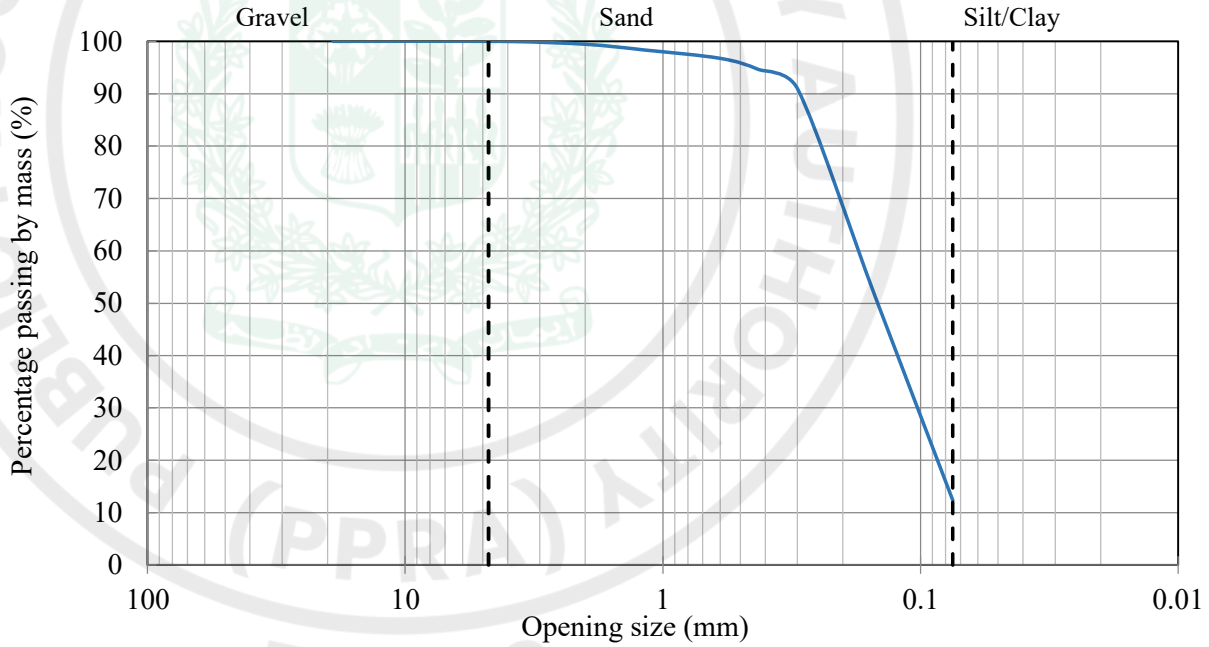
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

DETERMINATION OF SIEVE ANALYSIS

PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	20 ft	Saturday, August 16, 2025

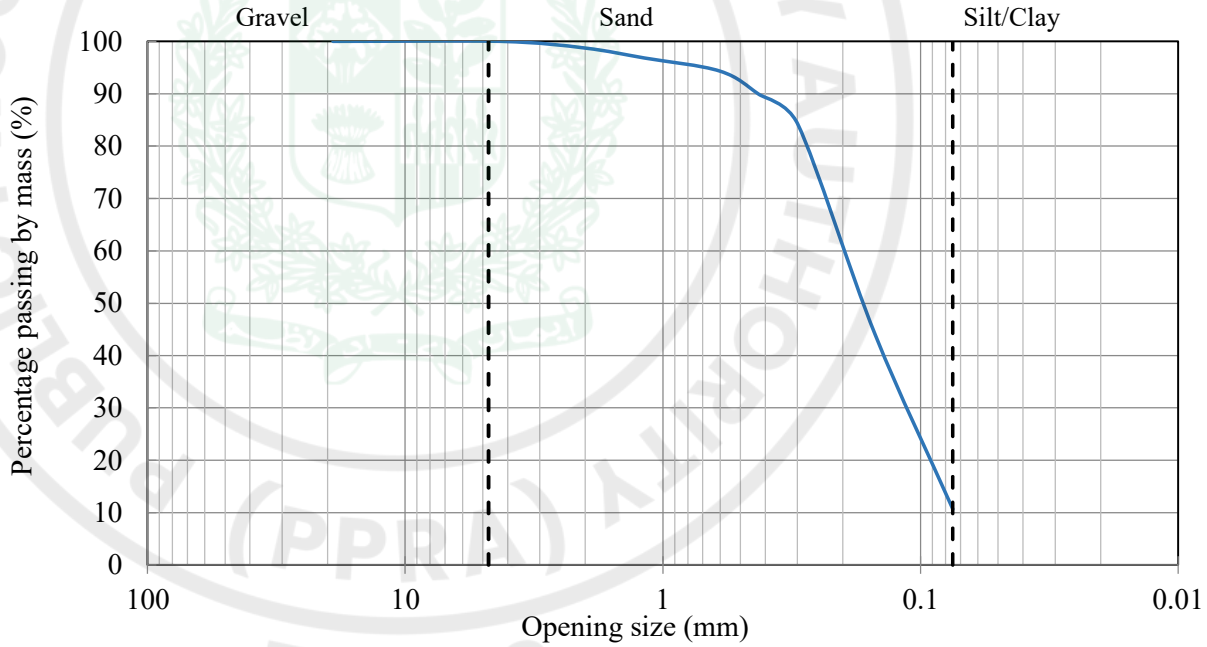
Gravel (%)	0.0
Sand (%)	87.7
Silt & Clay (%)	12.3
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	99.5
1.18	98.4
0.6	96.8
0.425	94.7
0.3	90.9
0.15	51.3
0.075	12.3



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	25 ft	Saturday, August 16, 2025

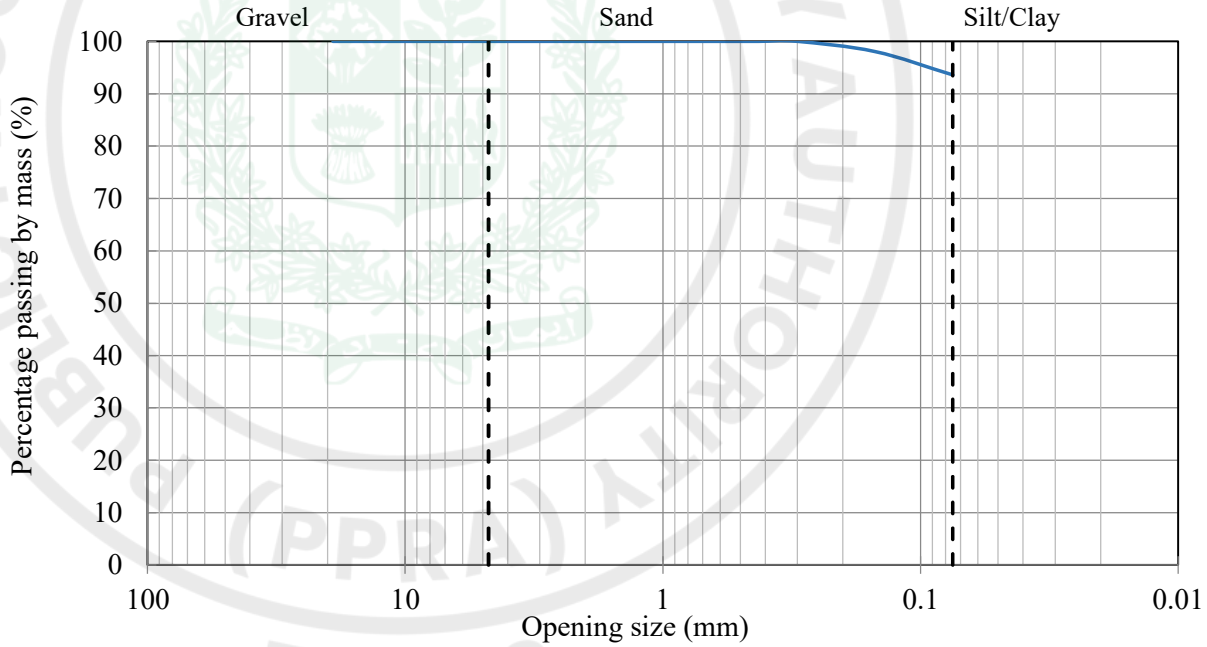
Gravel (%)	0.0
Sand (%)	89.3
Silt & Clay (%)	10.7
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	98.7
1.18	96.9
0.6	94.3
0.425	89.9
0.3	84.3
0.15	44.0
0.075	10.7



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	30 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	6.4
Silt & Clay (%)	93.6
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	100.0
1.18	100.0
0.6	100.0
0.425	100.0
0.3	100.0
0.15	98.1
0.075	93.6



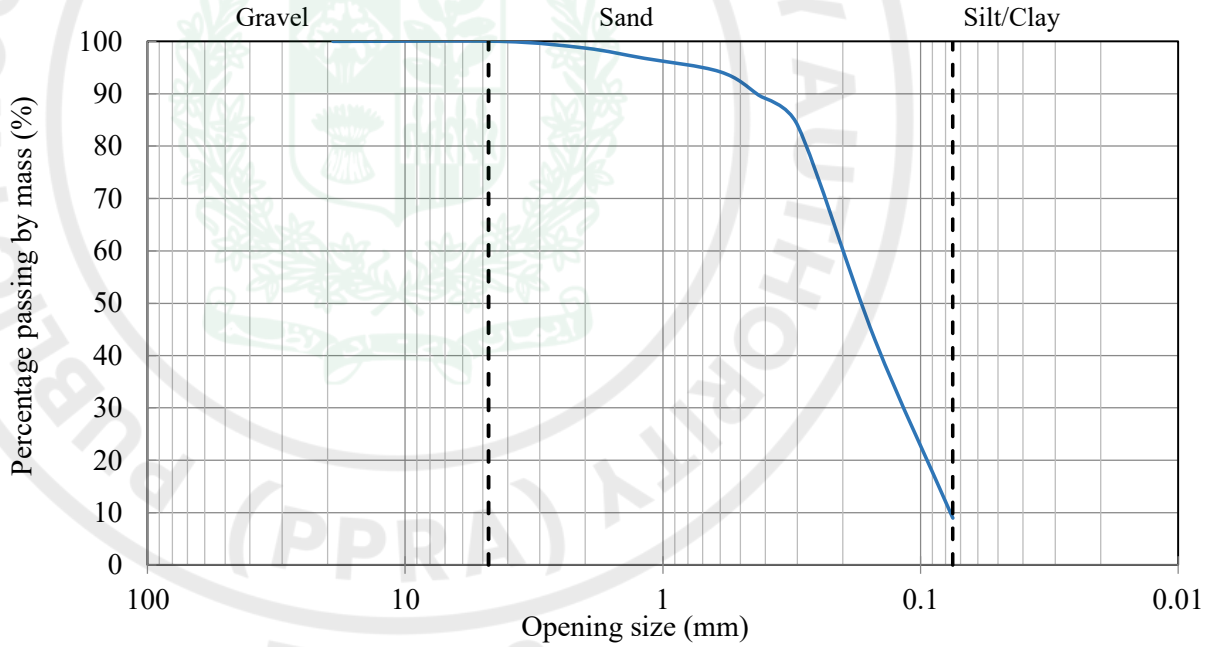
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

DETERMINATION OF SIEVE ANALYSIS

PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	35 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	91.0
Silt & Clay (%)	9.0
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	98.7
1.18	96.8
0.6	94.2
0.425	89.7
0.3	84.0
0.15	42.9
0.075	9.0



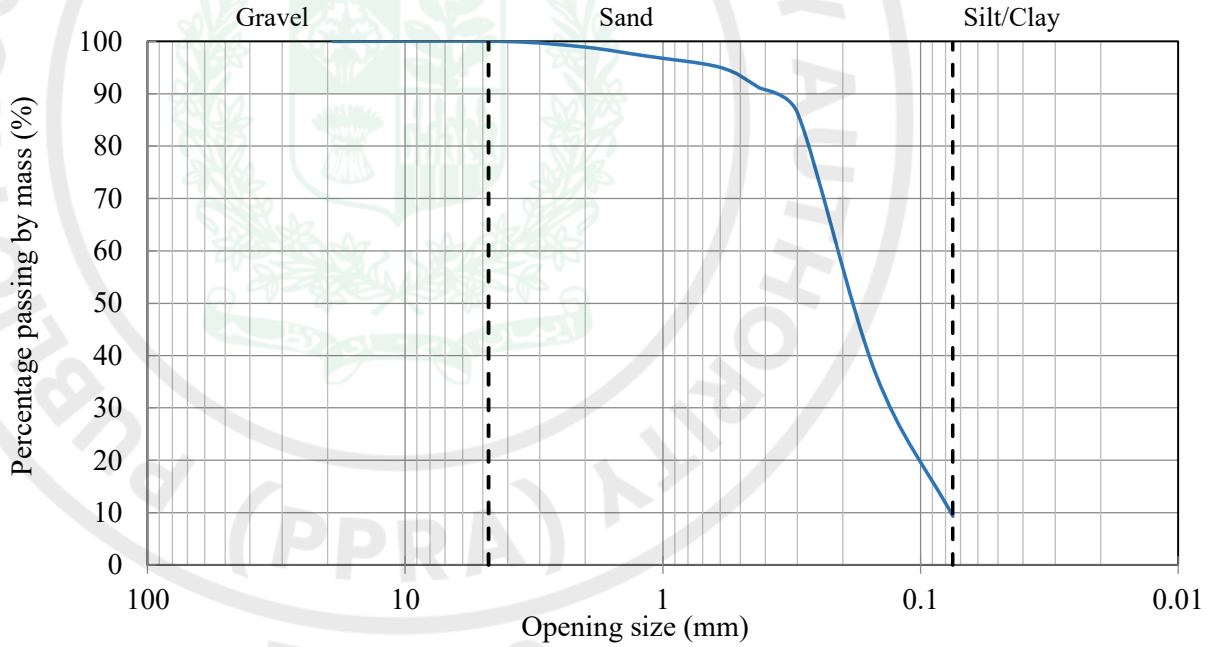
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

DETERMINATION OF SIEVE ANALYSIS

PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	40 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	90.7
Silt & Clay (%)	9.3
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	98.9
1.18	97.3
0.6	95.1
0.425	91.2
0.3	86.3
0.15	36.8
0.075	9.3



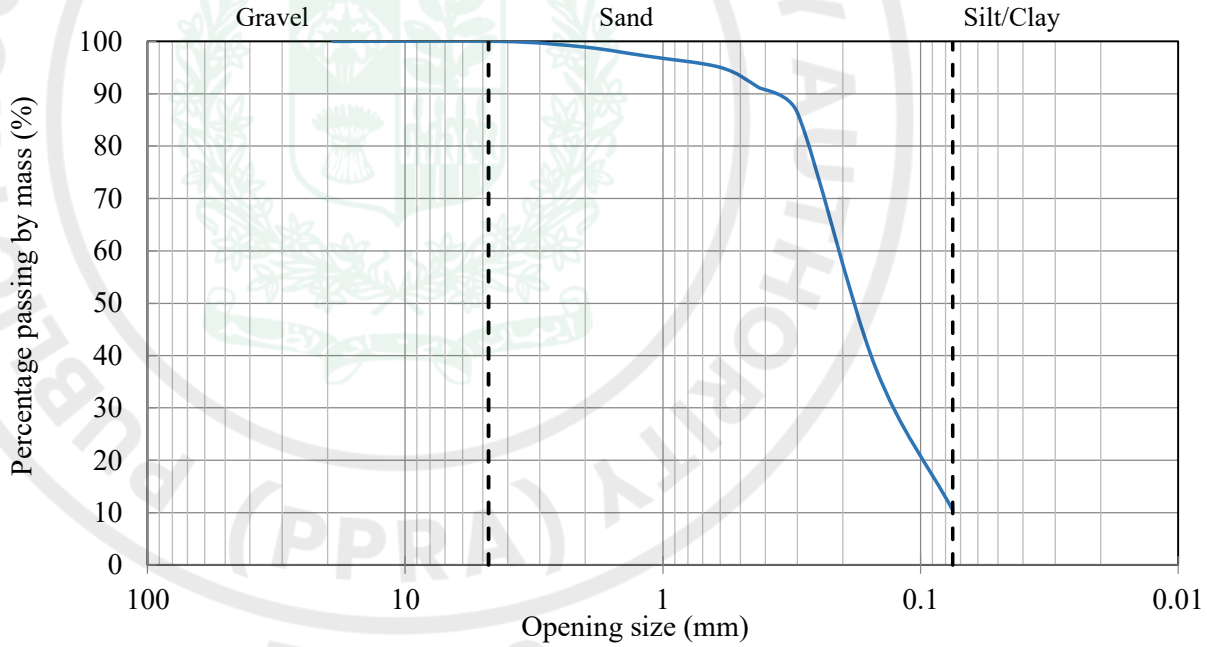
PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN

DETERMINATION OF SIEVE ANALYSIS

PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	50 ft	Saturday, August 16, 2025

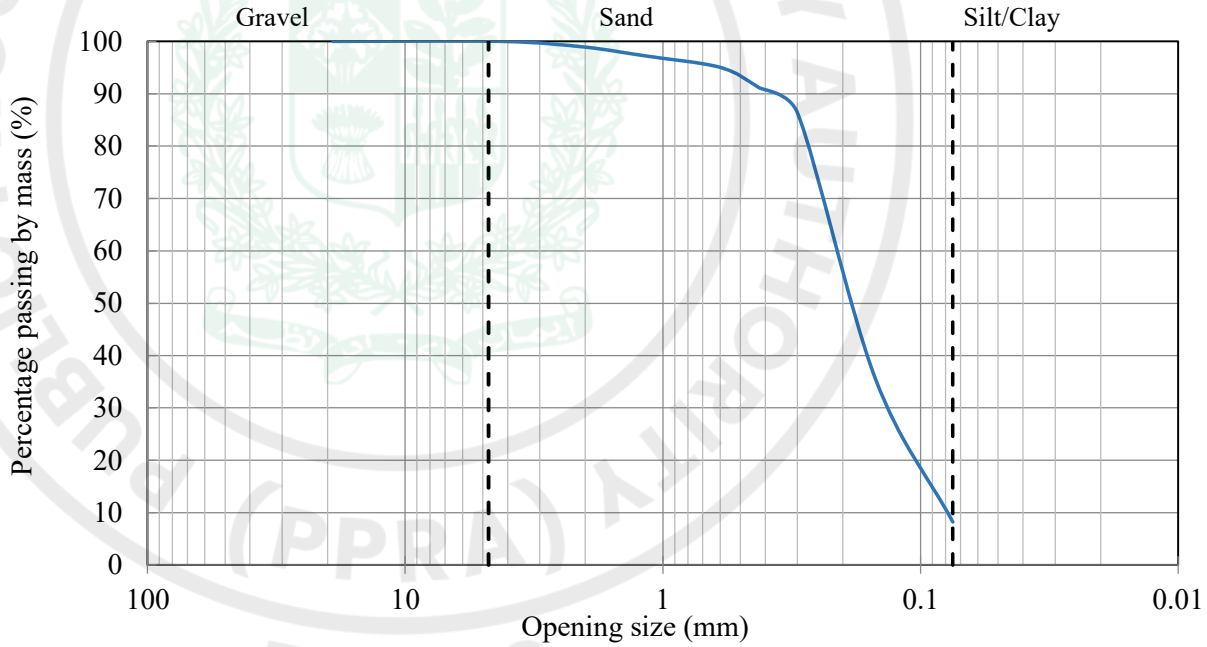
Gravel (%)	0.0
Sand (%)	89.6
Silt & Clay (%)	10.4
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	98.9
1.18	97.3
0.6	95.1
0.425	91.2
0.3	86.3
0.15	37.9
0.075	10.4



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	60 ft	Saturday, August 16, 2025

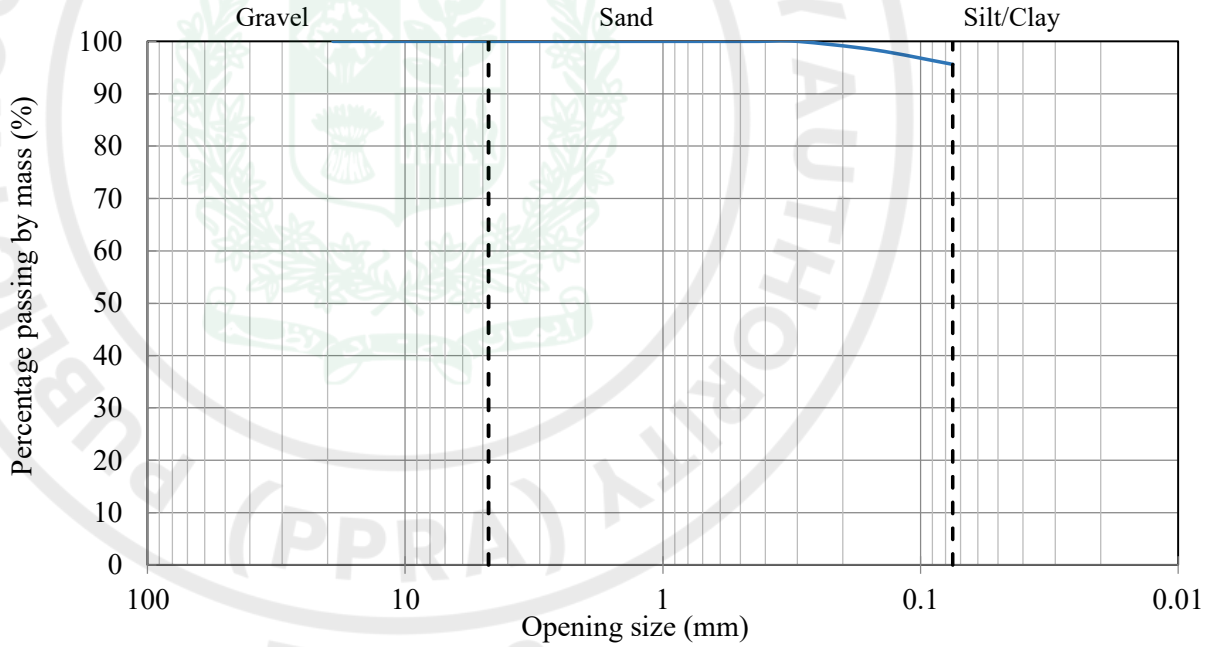
Gravel (%)	0.0
Sand (%)	91.8
Silt & Clay (%)	8.2
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	98.9
1.18	97.3
0.6	95.1
0.425	91.2
0.3	86.3
0.15	35.7
0.075	8.2



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	70 ft	Saturday, August 16, 2025

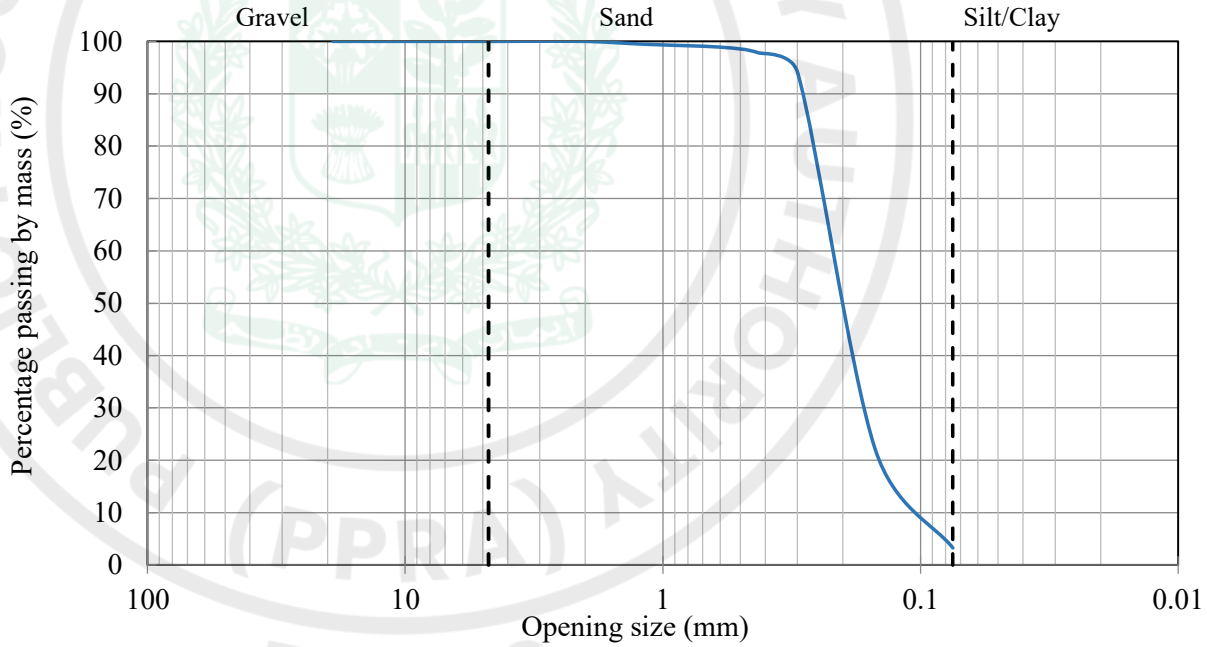
Gravel (%)	0.0
Sand (%)	4.4
Silt & Clay (%)	95.6
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	100.0
1.18	100.0
0.6	100.0
0.425	100.0
0.3	100.0
0.15	98.4
0.075	95.6



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	80 ft	Saturday, August 16, 2025

Gravel (%)	0.0
Sand (%)	96.8
Silt & Clay (%)	3.2
Sieve Size	Passing
(mm)	(%)
19.05	100.0
4.25	100.0
2	100.0
1.18	99.5
0.6	98.9
0.425	97.8
0.3	94.1
0.15	22.2
0.075	3.2



PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

ATTERBERG LIMITS

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

CLIENT	CONSULTANT	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

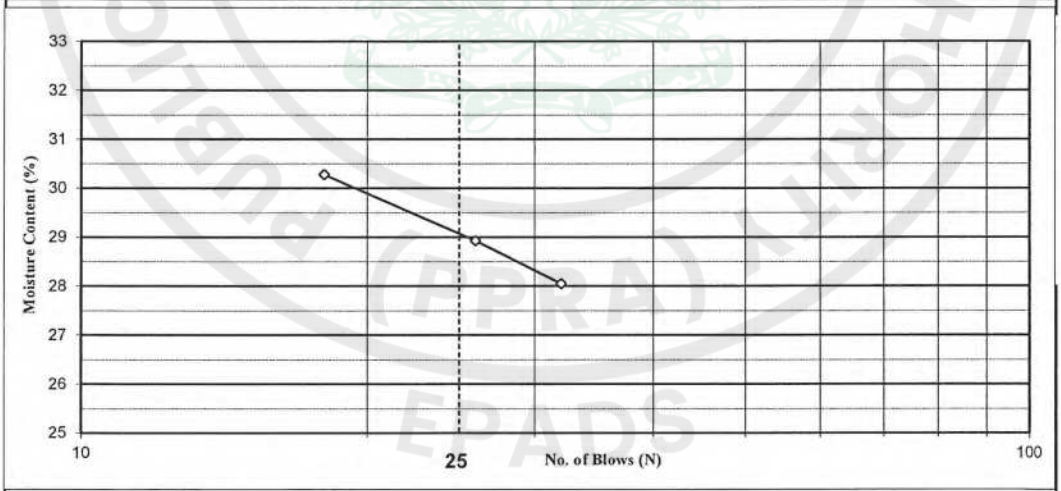
Project	Construction of Air Traffic Control Tower	**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan	

BH / TP No.	BH-01	**Job No.**	-
Sample No.	SPT-15	**Lab No.**	1033
Sample Depth (ft)	70.00	**Test Started**	28-Aug-25
Sampled Date	-	**Test Completed**	30-Aug-25

ATTERBERG LIMITS (ASTM D 4318)

	LIQUID LIMIT					PLASTIC LIMIT	
No. of Blows (N)	18	26	32				
Container No.	D-17	D-32	D-23			D-68	D-104
Weight of Container (g)	18.71	18.10	17.92			11.22	11.38
Weight of Container + Wet Soil (g)	31.49	32.72	29.15			17.29	17.89
Weight of Container + Dry Soil (g)	28.52	29.44	26.69			16.27	16.80
Weight of Dry Soil (g)	9.81	11.34	8.77			5.05	5.42
Weight of Water (g)	2.97	3.28	2.46			1.02	1.09
Moisture Content (%)	30.28	28.92	28.05			20.20	20.11

Liquid Limit	29	**Plastic Limit**	20	**Plasticity Index**	9



Tested By	Checked By	Approved By
Nasrullha Khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib

DIRECT SHEAR

PPRA EPADS

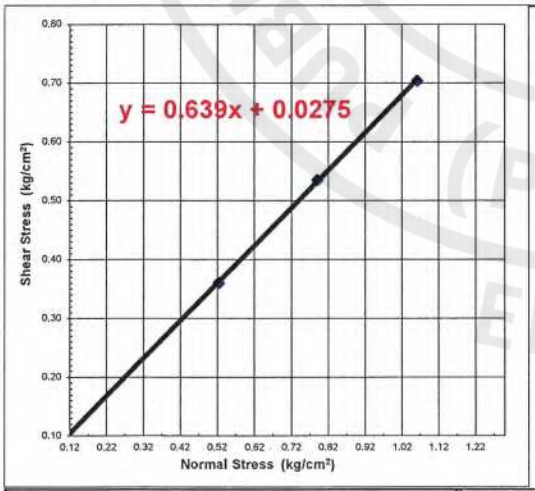
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-02	Job No.	-	Test Conditions
Sample No.	SPT-03	Lab No.	1033	UNSOAKED
Sample Depth (ft)	9.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	Test Completed	August 30, 2025	0.336

DIRECT SHEAR TEST (ASTM D 3080)

Details	Initial	Final (A)	Final (B)	Final (C)
Sample Area (cm^2)	36.00			
Sample Height (mm)	20.00			
Sample Volume (cm^3)	72.00			
Weight of Sample (g)	125.42			
Moisture Content (%)	17.53			
Bulk Density (g/cm^3)	1.742			
Dry Density (g/cm^3)	1.482			
Specific Gravity (assumed)	2.654			
Void Ratio	0.791			
Degree of Saturation (%)	58.842			
Height of Solids (mm)	11.169			

Vertical Load	Vertical Stress	Peak Shear		Rate of Displacement	Total Displacement
(lb)	(kg/cm^2)	Reading	(kg/cm^2)	(mm/min)	(mm)
40	0.523	82	0.360	0.400	2.200
60	0.790	121	0.535	0.400	2.600
80	1.061	158	0.704	0.400	3.000



Cohesion (c)	0.0275 kg/cm²	Angle of Internal Friction (Φ)	33 ⁰

Tested By	Checked By	Approved By
Nasrullah khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib

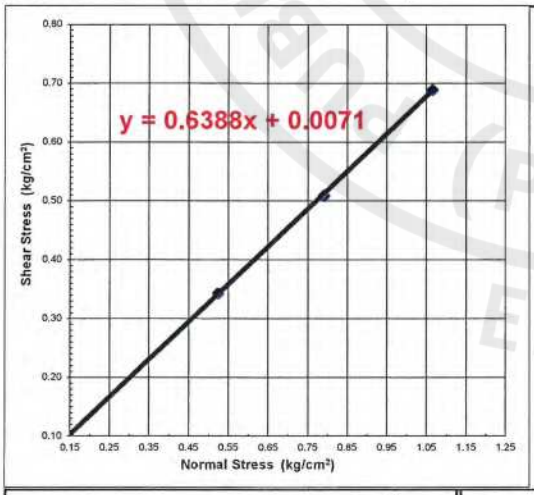
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

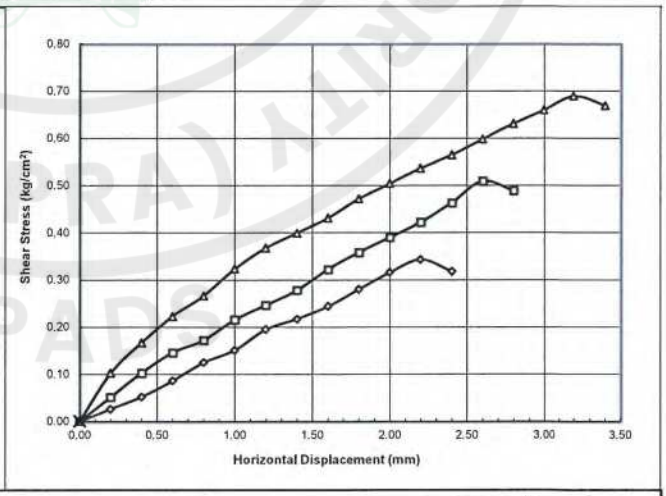
Project	Construction of Air Traffic Control Tower			**decon**
Location	Skardu Airport Pakistan			Geotechnical Testing Laboratory
BH / TP No.	BH-01	Job No.	-	Test Conditions
Sample No.	SPT-05	Lab No.	1033	UNSOAKED
Sample Depth (ft)	15.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	Test Completed	August 30, 2025	0.336

DIRECT SHEAR TEST (ASTM D 3080)

Details	Initial	Final (A)	Final (B)	Final (C)
Sample Area (cm^2)	36.00			
Sample Height (mm)	20.00			
Sample Volume (cm^3)	72.00			
Weight of Sample (g)	125.21			
Moisture Content (%)	16.24			
Bulk Density (g/cm^3)	1.739			
Dry Density (g/cm^3)	1.496			
Specific Gravity (assumed)	2.652			
Void Ratio	0.773			
Degree of Saturation (%)	55.741			
Height of Solids (mm)	11.283			

Vertical Load (lb)	Vertical Stress (kg/cm^2)	Peak Shear Reading	Peak Shear (kg/cm^2)	Rate of Displacement (mm/min)	Total Displacement (mm)
40	0.523	78	0.343	0.450	2.200
60	0.790	115	0.509	0.450	2.600
80	1.065	154	0.689	0.450	3.200





Cohesion (c)	0.0071 kg/cm^2	Angle of Internal Friction (Φ)	33 ^{0}

Tested By	Checked By	Approved By
Nasrullah khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib

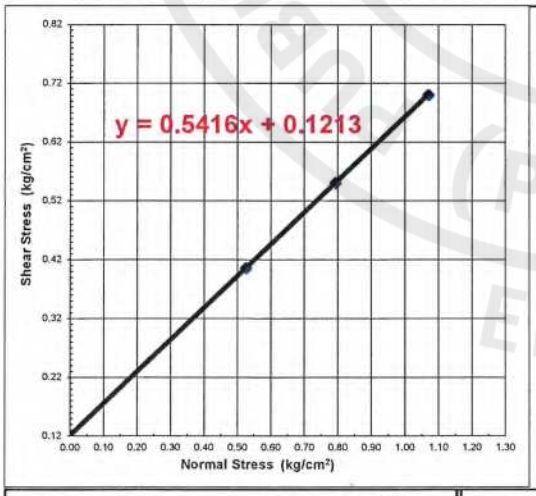
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

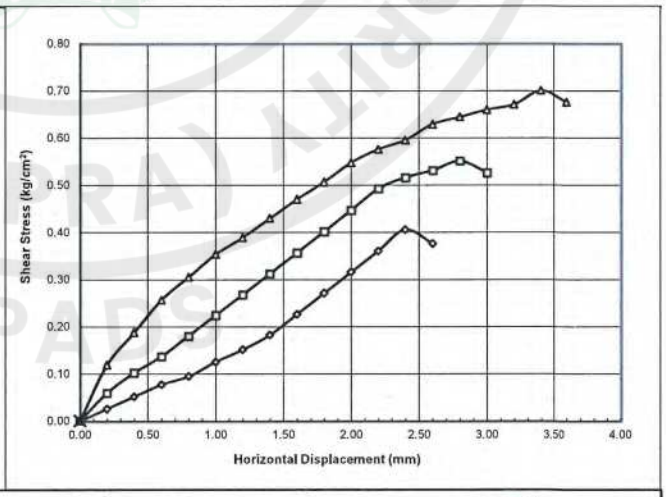
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-02	Job No.	-	Test Conditions
Sample No.	SPT-07	Lab No.	1033	UNSOAKED
Sample Depth (ft)	25.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	Test Completed	August 30, 2025	0.336

DIRECT SHEAR TEST (ASTM D 3080)

Details	Initial	Final (A)	Final (B)	Final (C)
Sample Area (cm^2)	36.00			
Sample Height (mm)	20.00			
Sample Volume (cm^3)	72.00			
Weight of Sample (g)	134.14			
Moisture Content (%)	16.69			
Bulk Density (g/cm^3)	1.863			
Dry Density (g/cm^3)	1.597			
Specific Gravity (assumed)	2.672			
Void Ratio	0.674			
Degree of Saturation (%)	66.208			
Height of Solids (mm)	11.950			

Vertical Load (lb)	Vertical Stress (kg/cm^2)	Peak Shear Reading	Peak Shear (kg/cm^2)	Rate of Displacement (mm/min)	Total Displacement (mm)
40	0.525	92	0.406	0.050	2.400
60	0.793	124	0.551	0.050	2.800
80	1.069	156	0.700	0.050	3.400





Cohesion (c)	0.1213 kg/cm^2	Angle of Internal Friction (Φ)	28 ^{0}

Tested By	Checked By	Approved By
Nasrullah khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib

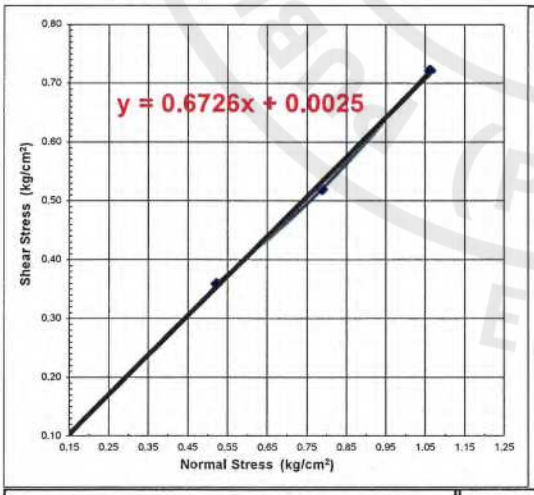
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

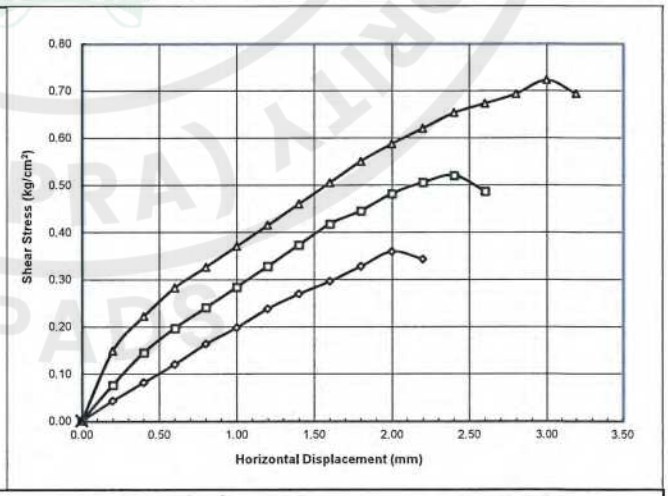
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-02	Job No.	-	Test Conditions
Sample No.	SPT-07	Lab No.	1033	UNSOAKED
Sample Depth (ft)	40.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	Test Completed	August 30, 2025	0.336

DIRECT SHEAR TEST (ASTM D 3080)

Details	Initial	Final (A)	Final (B)	Final (C)
Sample Area (cm^2)	36.00			
Sample Height (mm)	20.00			
Sample Volume (cm^3)	72.00			
Weight of Sample (g)	123.98			
Moisture Content (%)	17.19			
Bulk Density (g/cm^3)	1.722			
Dry Density (g/cm^3)	1.469			
Specific Gravity (assumed)	2.650			
Void Ratio	0.804			
Degree of Saturation (%)	56.694			
Height of Solids (mm)	11.090			

Vertical Load (lb)	Vertical Stress (kg/cm^2)	Peak Shear Reading	Peak Shear (kg/cm^2)	Rate of Displacement (mm/min)	Total Displacement (mm)
40	0.521	82	0.359	0.600	2.000
60	0.787	118	0.520	0.600	2.400
80	1.061	162	0.722	0.600	3.000





Cohesion (c)	0.0025 kg/cm²	Angle of Internal Friction (Φ)	34 ⁰

Tested By	Checked By	Approved By
Nasrullah khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib

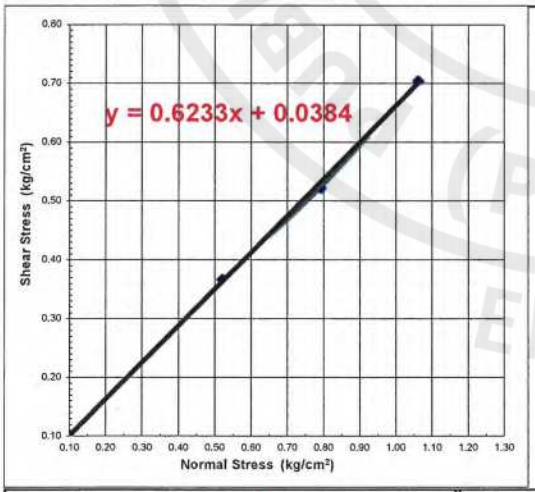
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

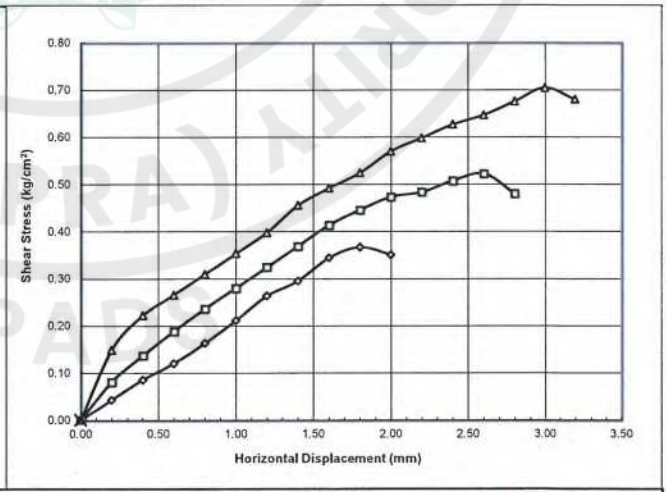
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-01	Job No.	-	Test Conditions
Sample No.	SPT-12	Lab No.	1033	UNSOAKED
Sample Depth (ft)	50.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	Test Completed	August 30, 2025	0.336

DIRECT SHEAR TEST (ASTM D 3080)

Details	Initial	Final (A)	Final (B)	Final (C)
Sample Area (cm^2)	36.00			
Sample Height (mm)	20.00			
Sample Volume (cm^3)	72.00			
Weight of Sample (g)	124.92			
Moisture Content (%)	15.39			
Bulk Density (g/cm^3)	1.735			
Dry Density (g/cm^3)	1.504			
Specific Gravity (assumed)	2.658			
Void Ratio	0.768			
Degree of Saturation (%)	53.280			
Height of Solids (mm)	11.314			

Vertical Load (lb)	Vertical Stress (kg/cm^2)	Peak Shear Reading	Peak Shear (kg/cm^2)	Rate of Displacement (mm/min)	Total Displacement (mm)
40	0.520	84	0.367	0.500	1.800
60	0.790	118	0.522	0.500	2.600
80	1.061	158	0.704	0.500	3.000





Cohesion (c)	0.0384 kg/cm²	Angle of Internal Friction (Φ)	32 ⁰

Tested By	Checked By	Approved By
Nasrullah khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib