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Geotechnical and Geoenvironmental Work

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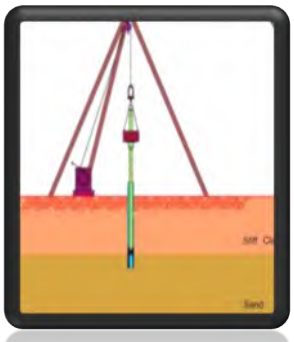
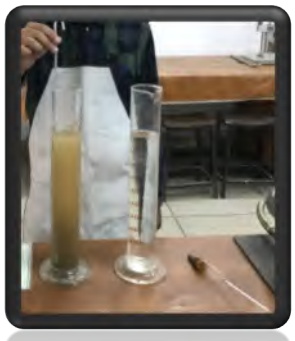
Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

AUGUST-2025





Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan

Authored By: **Muhammad Jamman Shahid**
Senior Geological Engineer

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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:

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:

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/m^3)	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

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.

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.

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

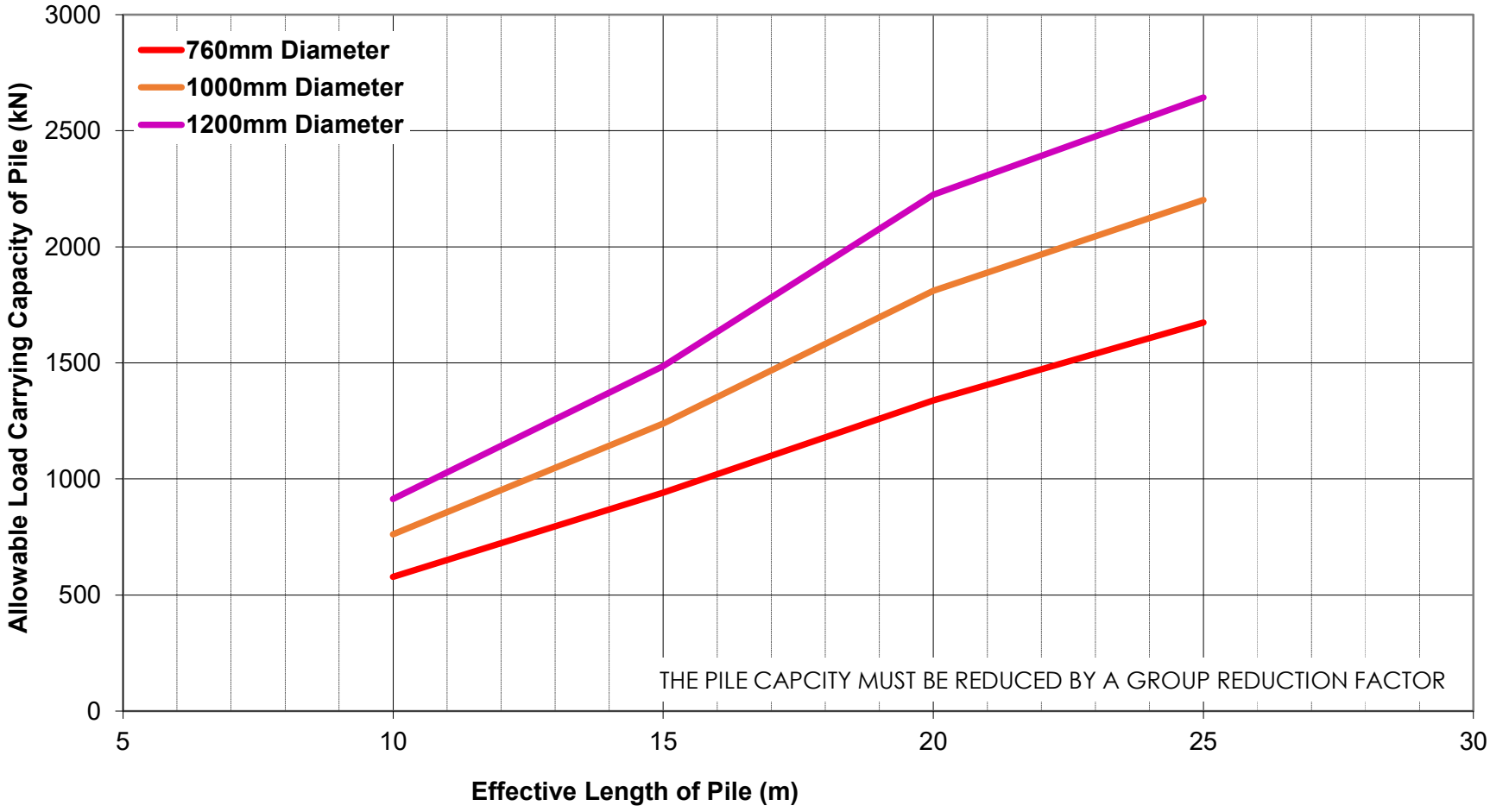


Fig. 1 **Allowable Load Carrying Capacity of Piles in Compression**
Pile Head considered at 1m below EGL

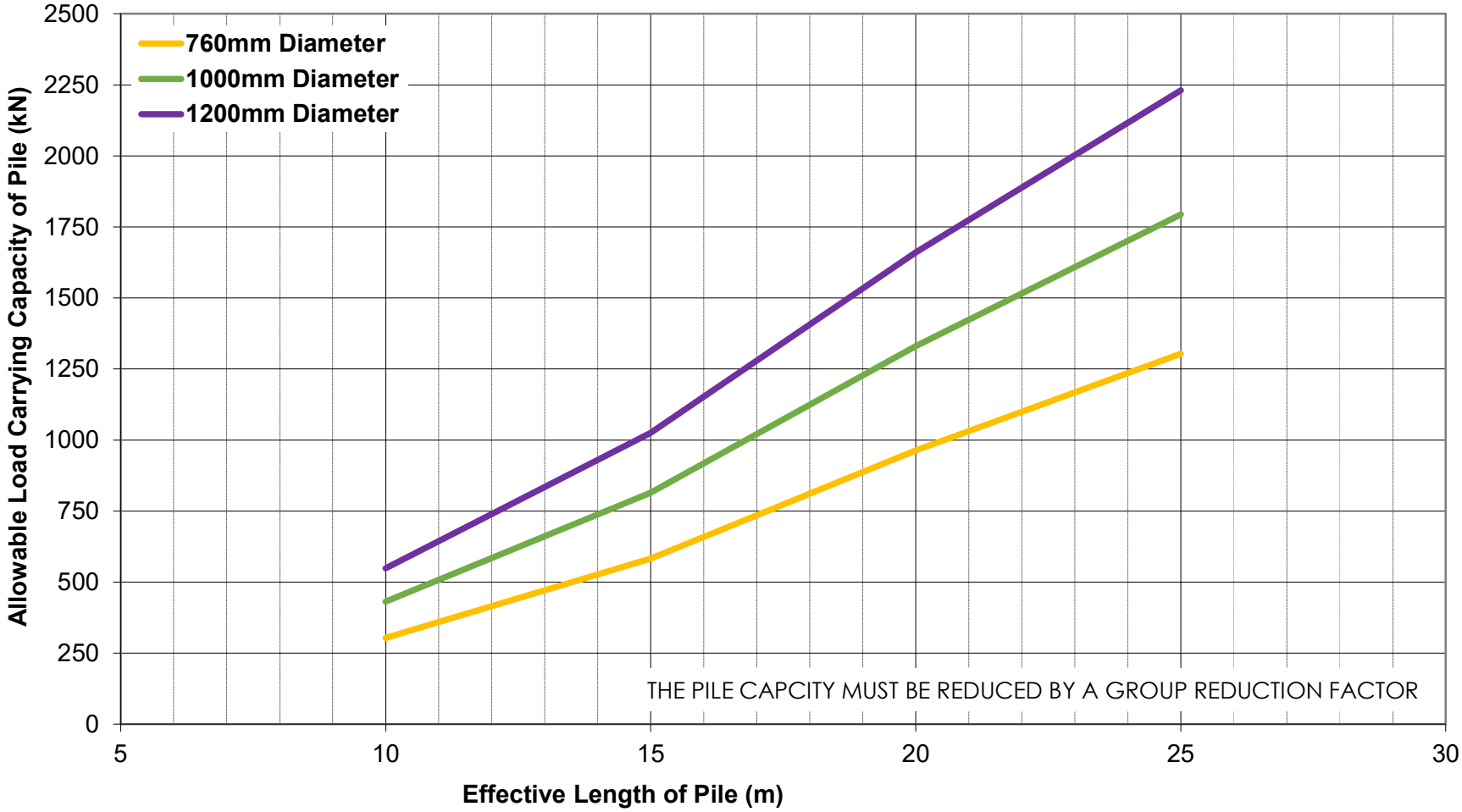


Fig. 2 **Allowable Load Carrying Capacity of Piles in Tension**
Pile Head considered at 1m below EGL

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

Modulus of Horizontal Subgrade Reaction

(Ref. Page 7.2.235-236 of Naval Facilities Engineering Command)

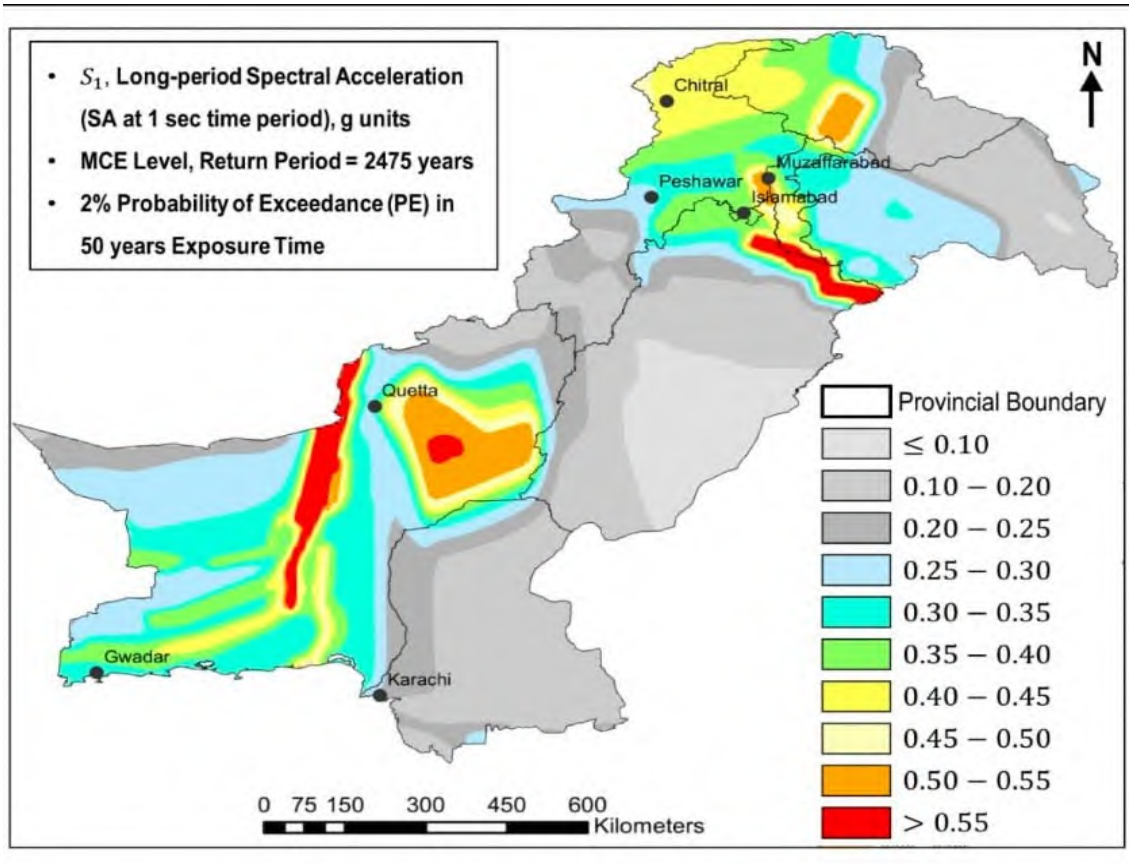
Pile head from 1m below EGL	Horizontal Modulus of Subgrade Reaction (kN/m^3)		
(m)	760mm	1000mm	1200mm
0	0	0	0
1	2281	1733	1444
2	4561	3466	2889
3	6842	5200	4333
4	9122	6933	5777
5	11403	8666	7222
6	21893	16639	13866
7	25542	19412	16177
8	29191	22185	18487
9	32840	24958	20798
10	36488	27731	23109
11	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

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.



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

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

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	

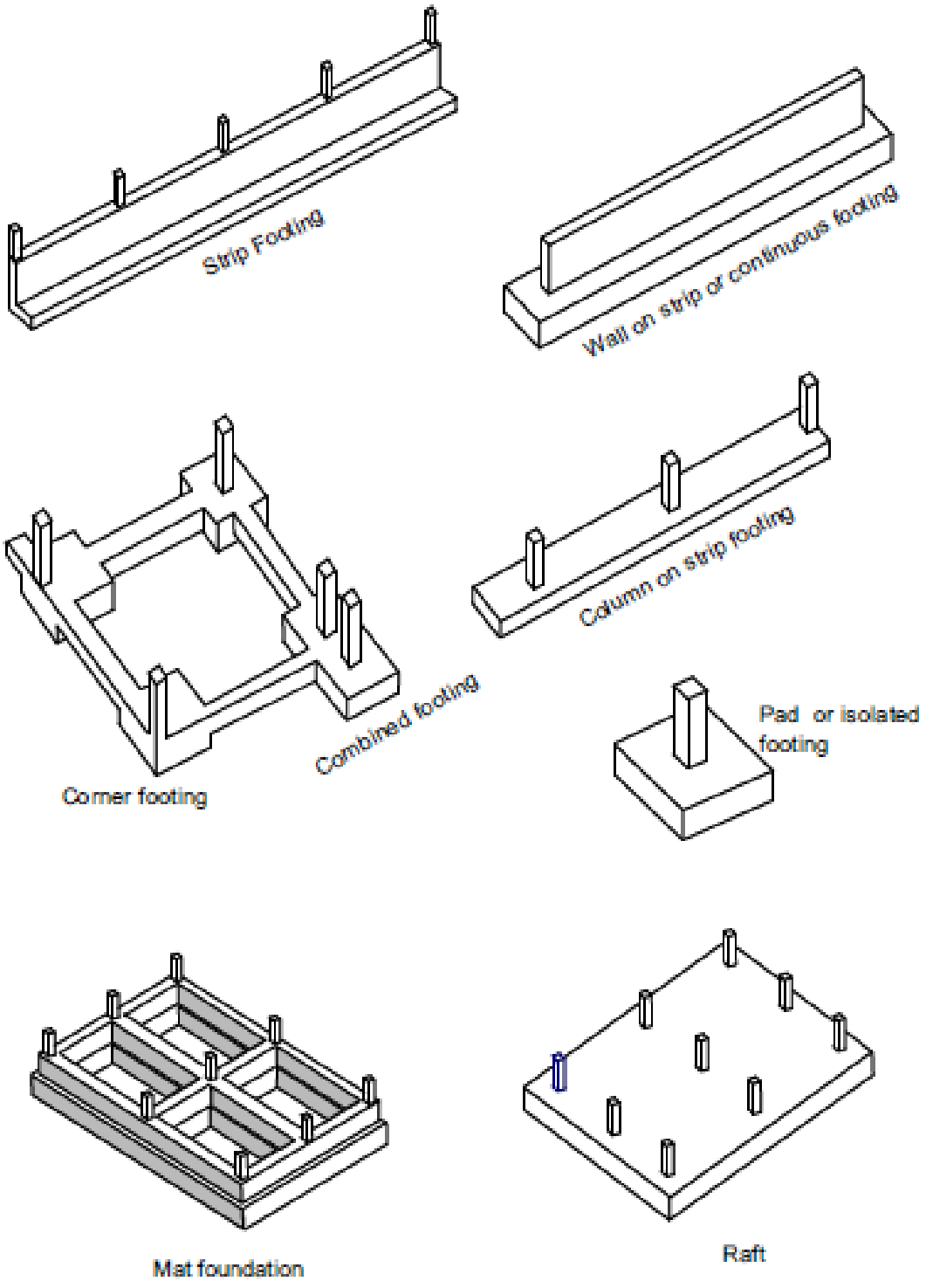


Figure 2. Types of Shallow Foundations


Geotechnical Investigation
Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan
Legend
BOREHOLE
BH-2
BH-1
N
30 m
Google Earth
Image © 2025 Airbus

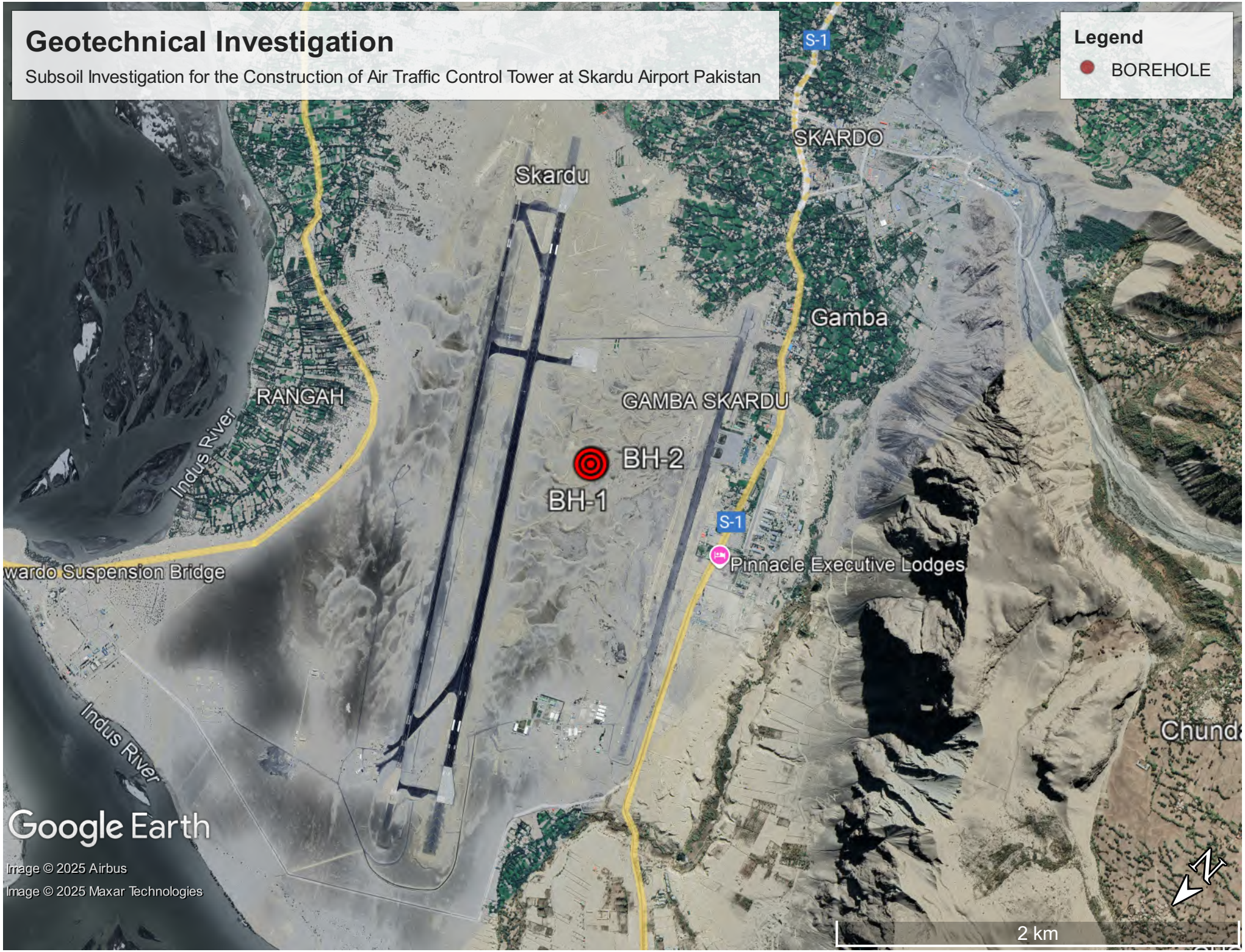

Geotechnical Investigation
Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan
Legend
BOREHOLE
S-1
SKARDO
Skardu
Gamba
RANGAH
GAMBA SKARDU
Indus River
BH-2
BH-1
S-1
Pinnacle Executive Lodges
wardo Suspension Bridge
Indus River
Google Earth
Image © 2025 Airbus
Image © 2025 Maxar Technologies
2 km

Figure 3. Field Testing in Progress

APPENDIX-A
(Borehole Logs)

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	

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	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					○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			

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 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							
21.0	SPT-6					5	
24.0	SPT-7		CL-ML	Light brown to brown, very stiff, Silty Clay		23	
27.0							
30.0	SPT-8					25	
33.0			SM/ SP-SM	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					12	
42.0							
45.0	SPT-11T					15	
48.0							
51.0	SPT-12T					18	

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

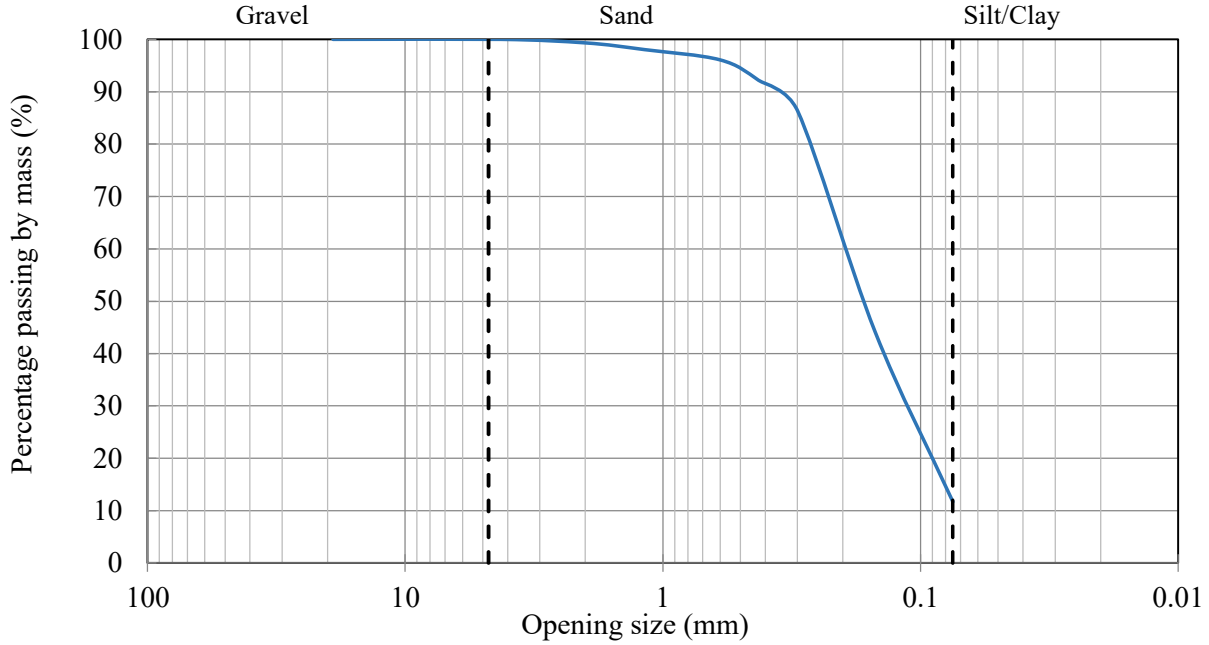
Coordinates - Ground Elevation above 30 ft from RL Date 02-08-2025 To 05-08-2025

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			

APPENDIX-B
(Sieve Analysis)

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

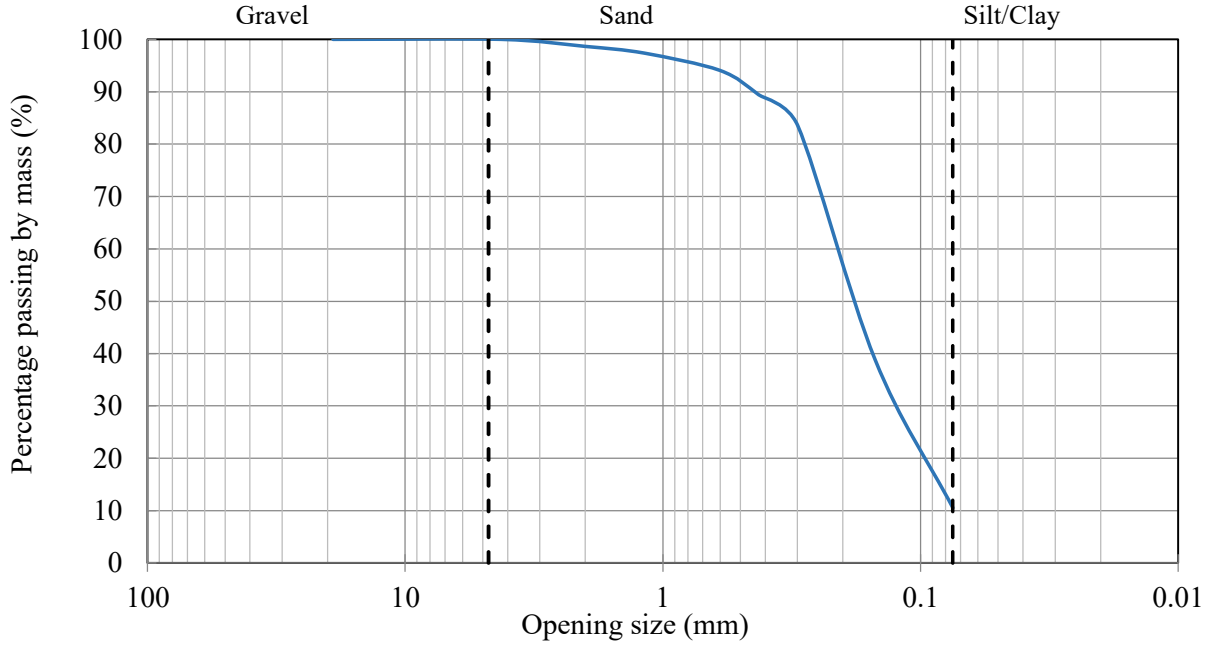


YASIN ENTERPRISES PAKISTAN

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

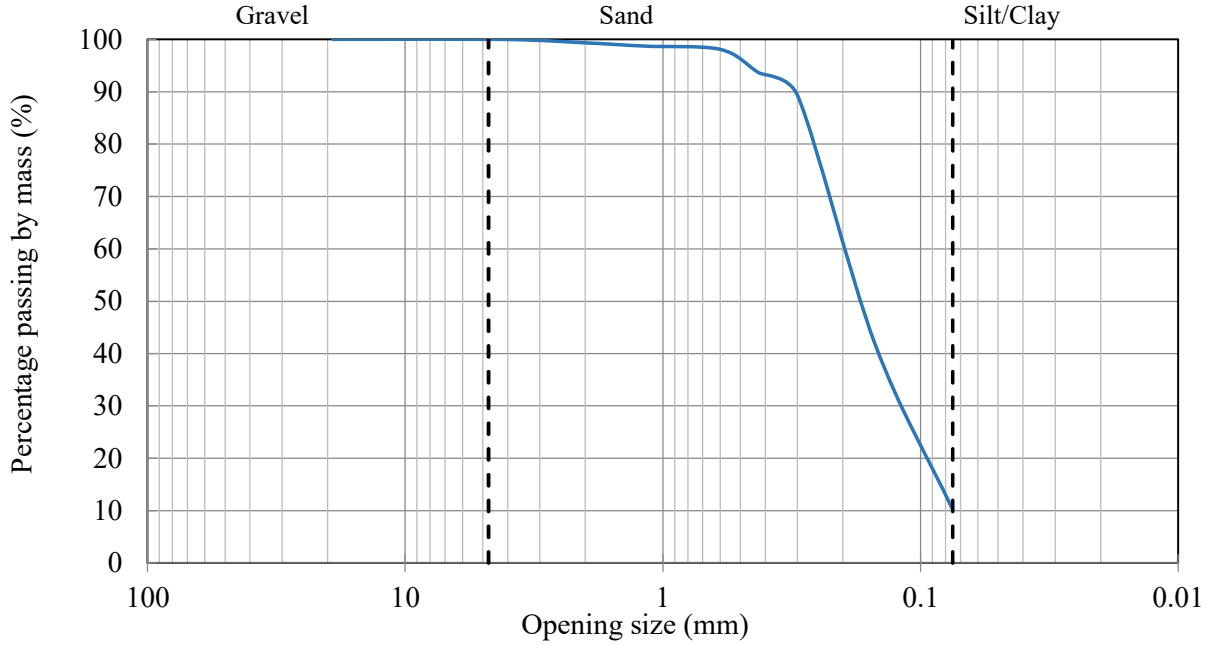


YASIN ENTERPRISES PAKISTAN

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

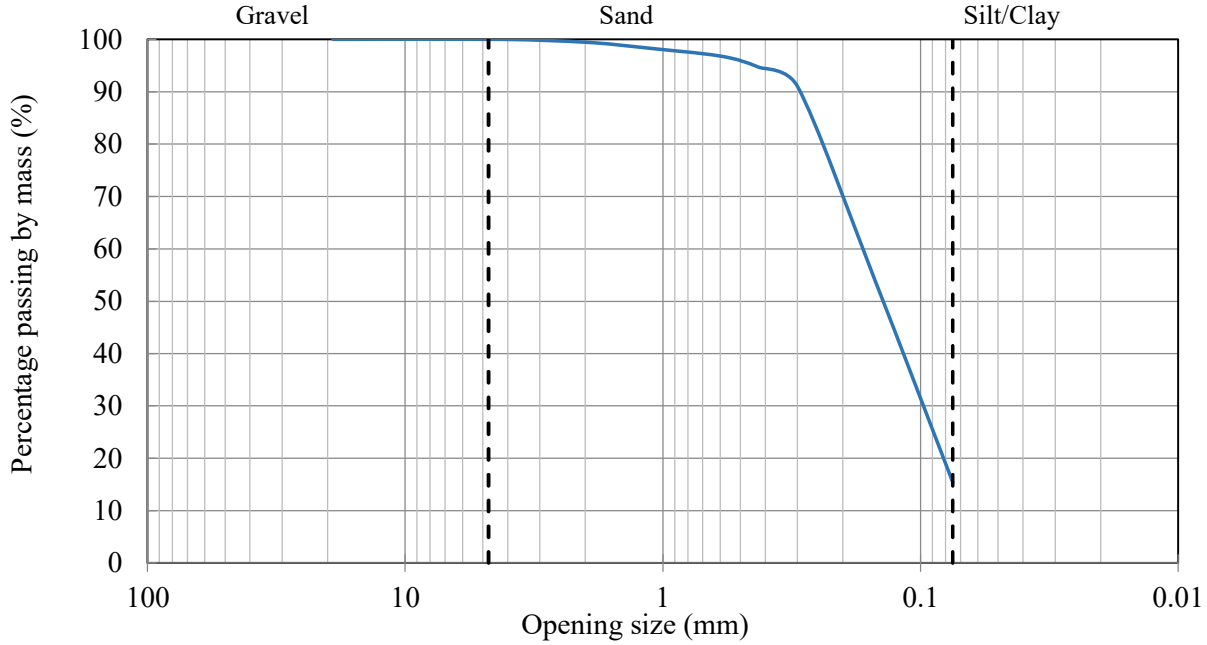


YASIN ENTERPRISES PAKISTAN

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
1.00	0.075	15.3

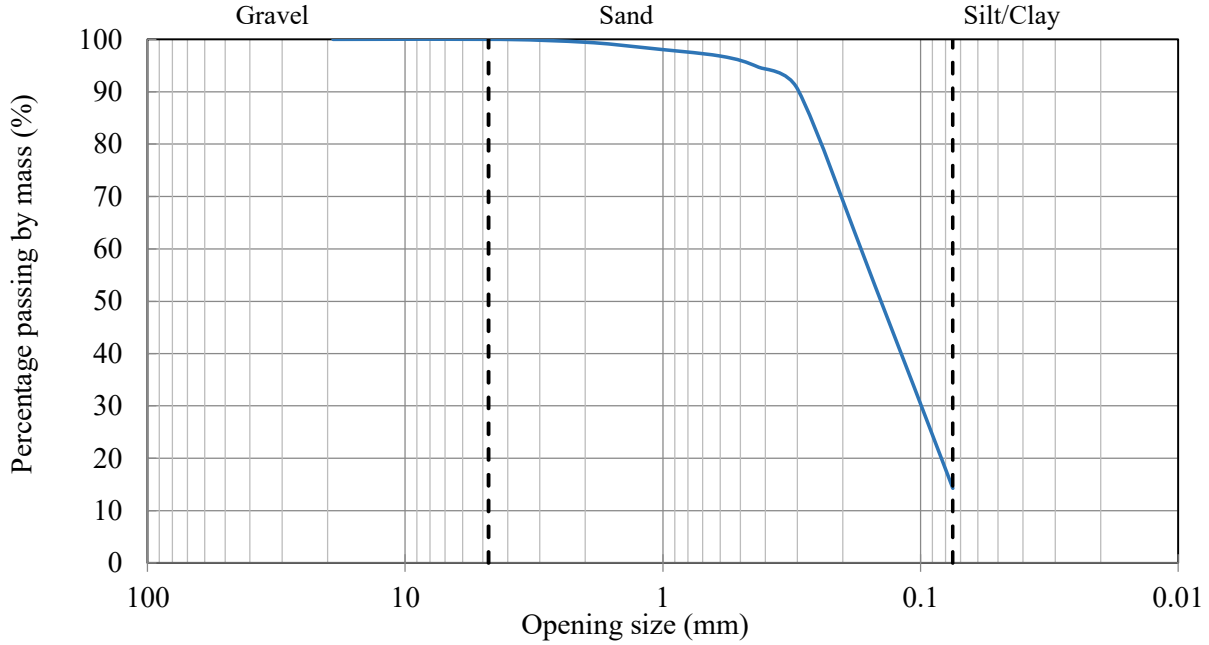


YASIN ENTERPRISES PAKISTAN

DETERMINATION OF SIEVE ANALYSIS

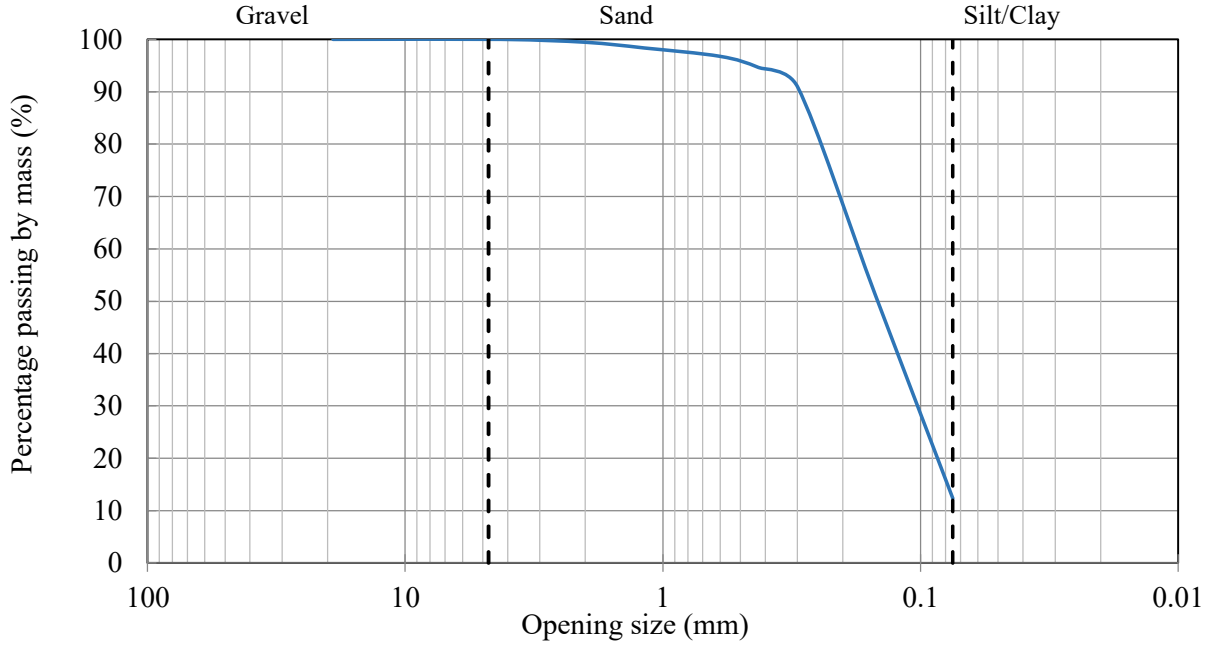
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	15 ft	Saturday, August 16, 2025

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



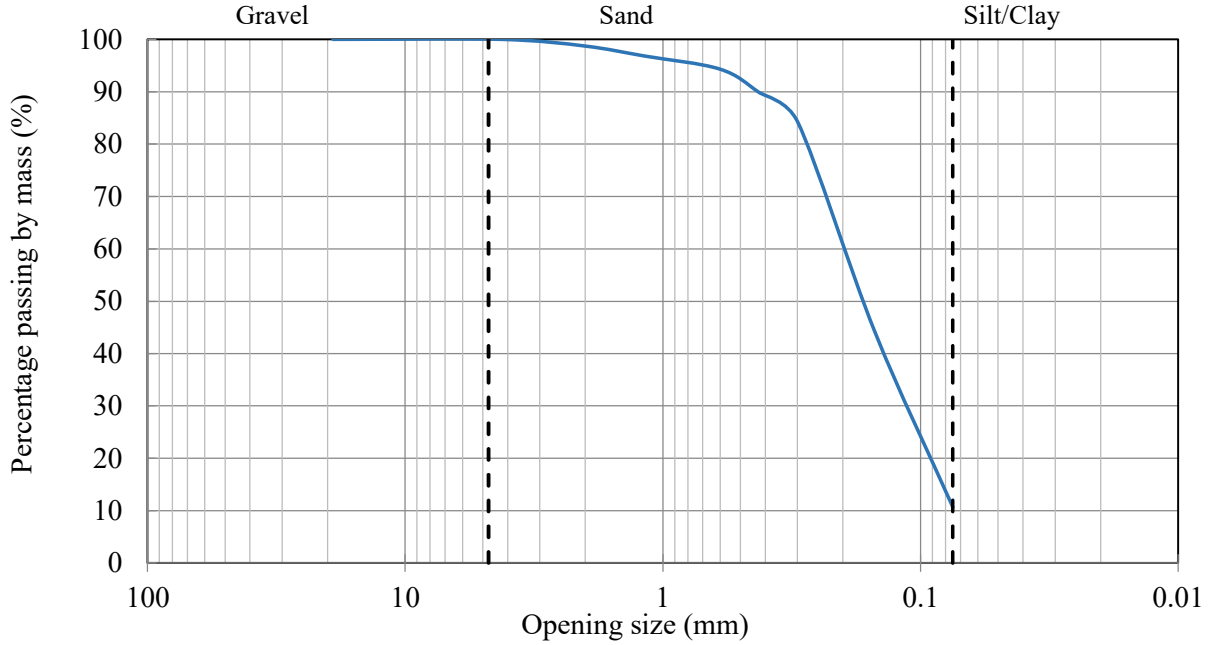
YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	20 ft	Saturday, August 16, 2025

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



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

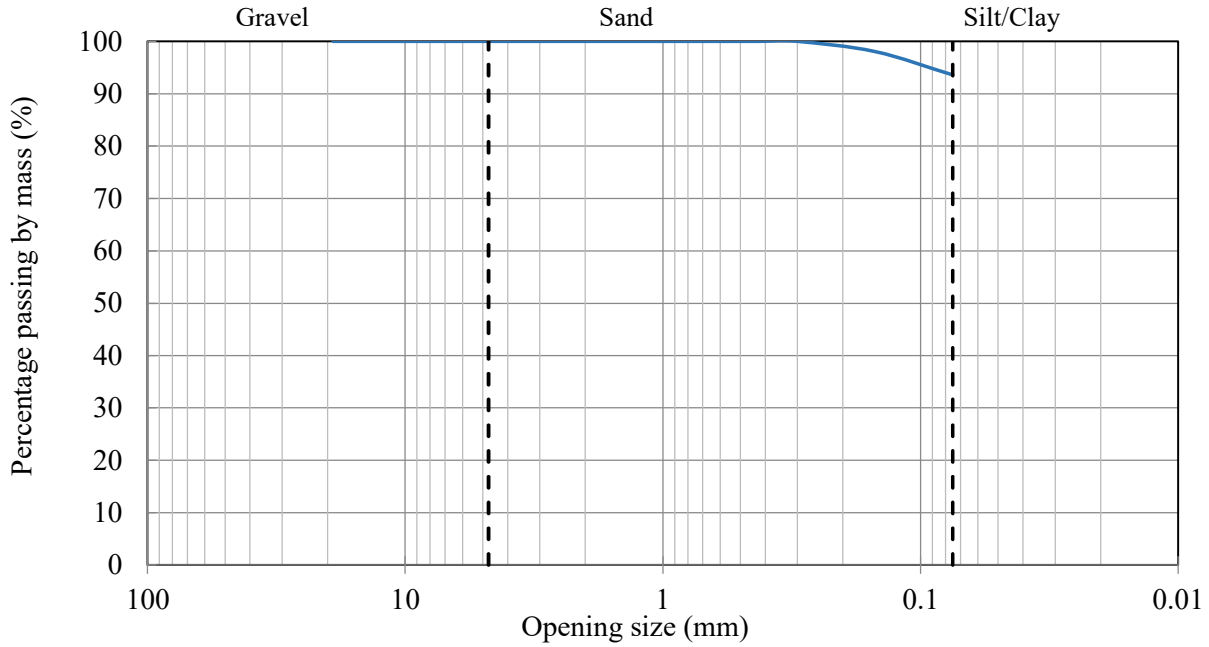


YASIN ENTERPRISES PAKISTAN

DETERMINATION OF SIEVE ANALYSIS

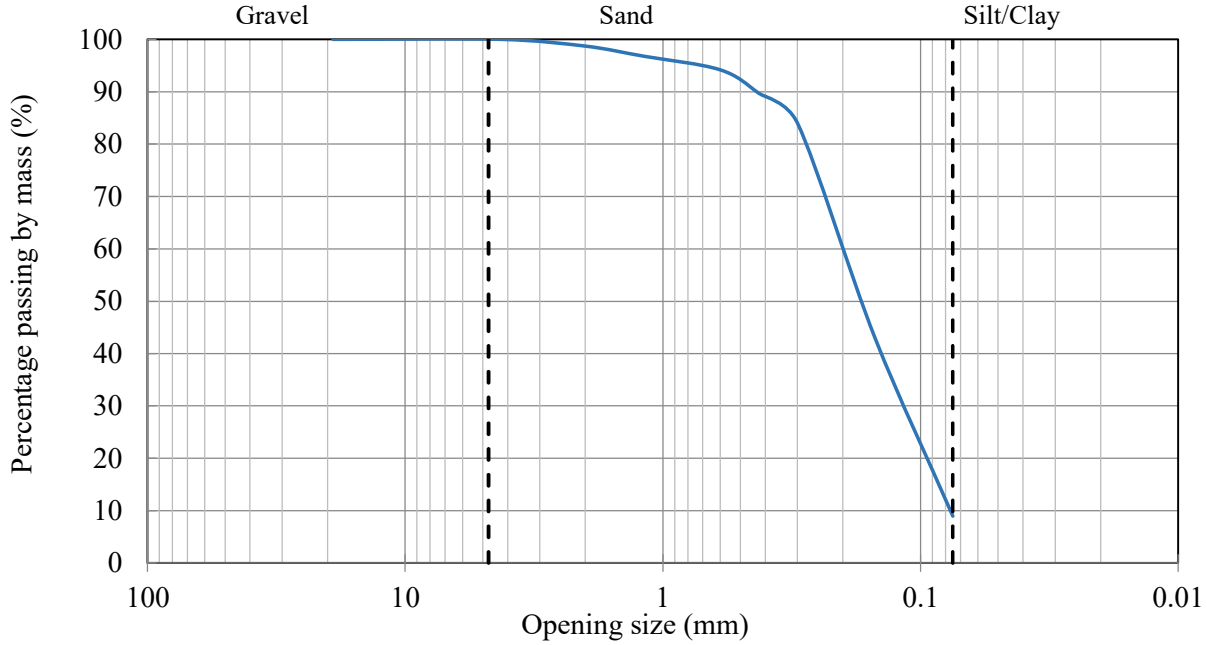
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	30 ft	Saturday, August 16, 2025

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



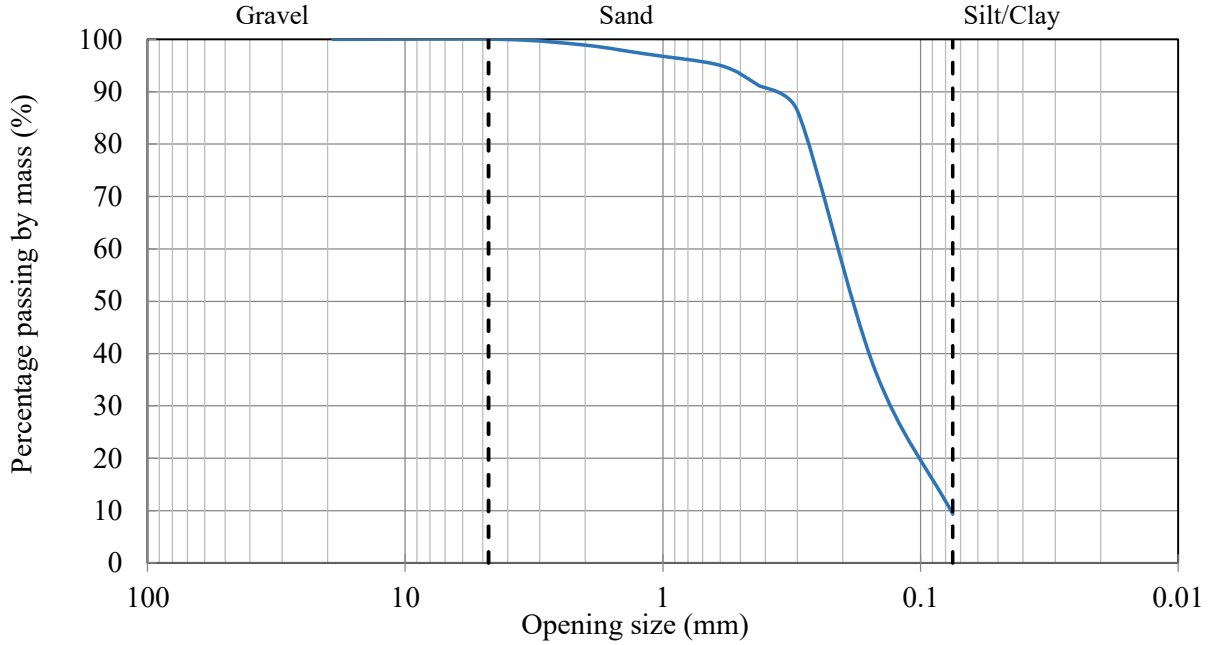
YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	1	**DEPTH**	35 ft	Saturday, August 16, 2025

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



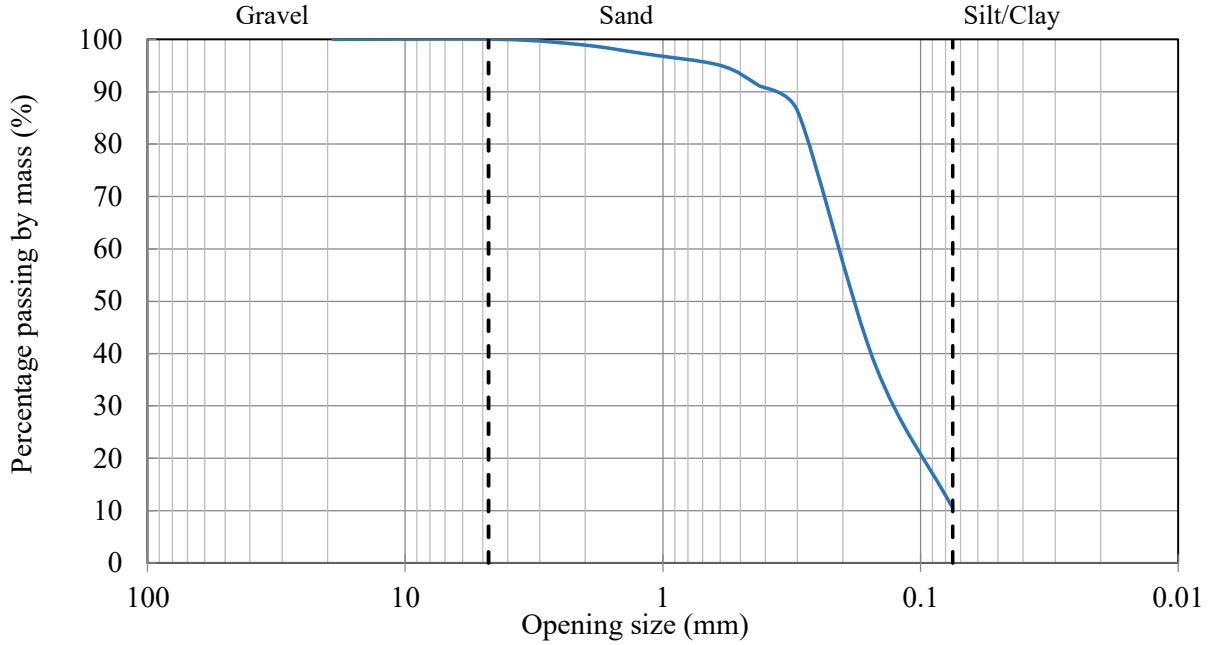
YASIN ENTERPRISES PAKISTAN	DETERMINATION OF SIEVE ANALYSIS			
PROJECT NAME:	**Subsoil Investigation for the Construction of Air Traffic Control Tower at Skardu Airport Pakistan**			**Date**
BORE HOLE NO:	2	**DEPTH**	40 ft	Saturday, August 16, 2025

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



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

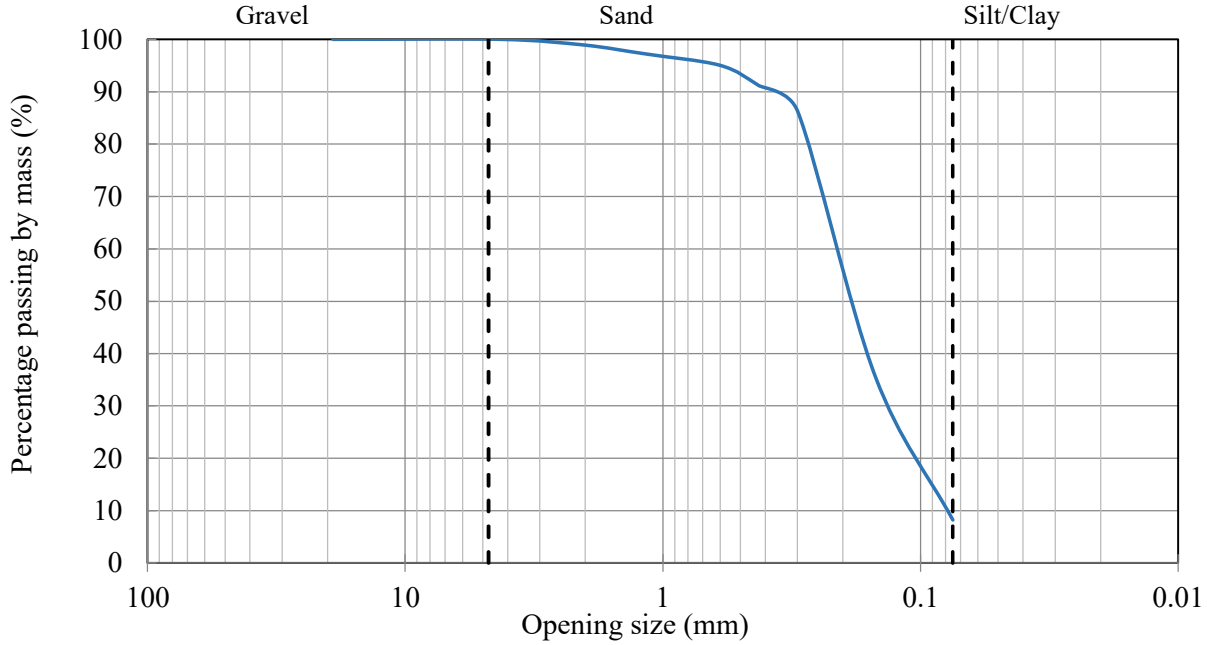


YASIN ENTERPRISES PAKISTAN

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

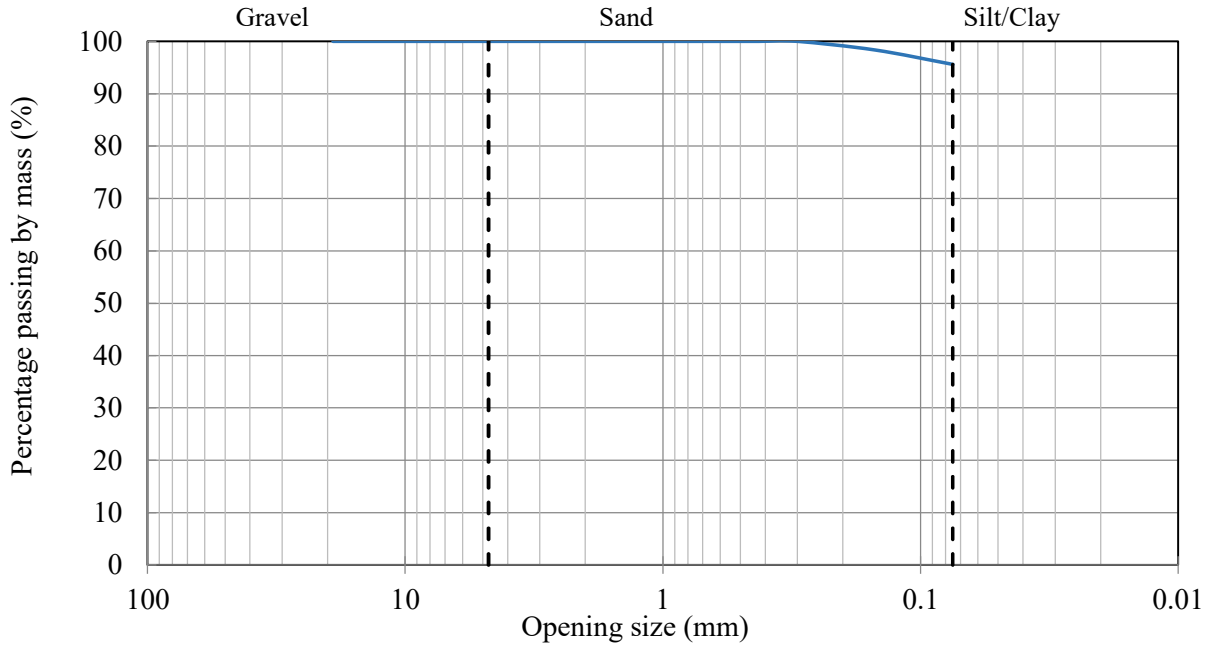


YASIN ENTERPRISES PAKISTAN

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

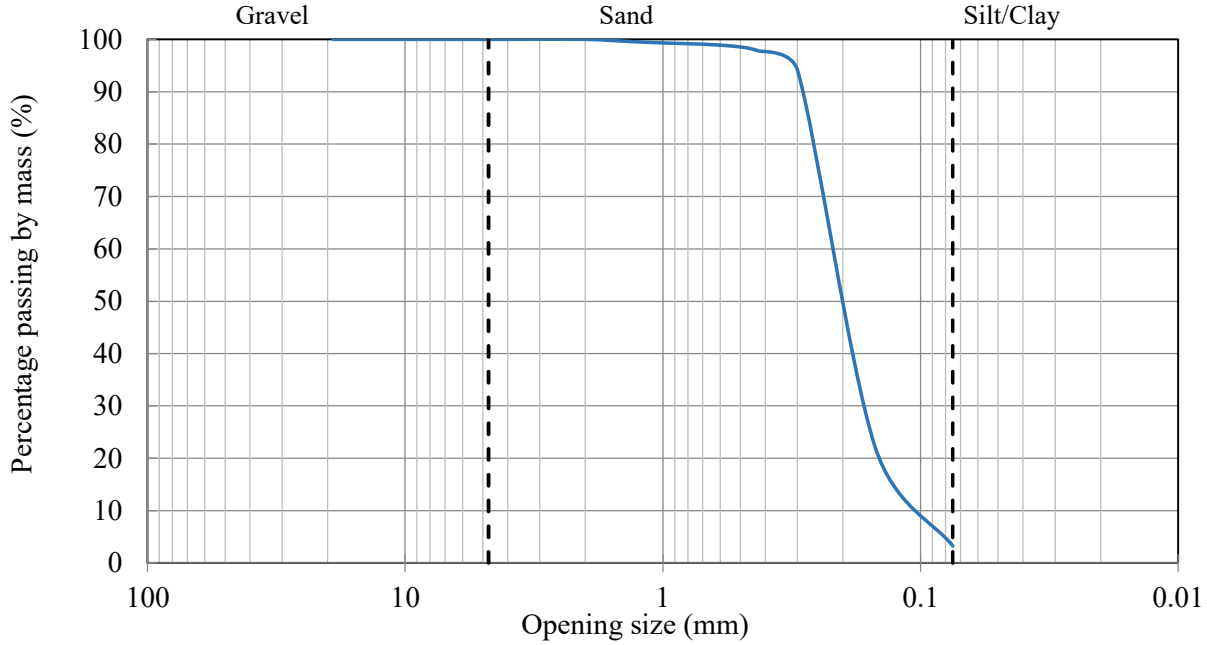


YASIN ENTERPRISES PAKISTAN

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



ATTERBERG LIMITS

CLIENT	CONSULTANT	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

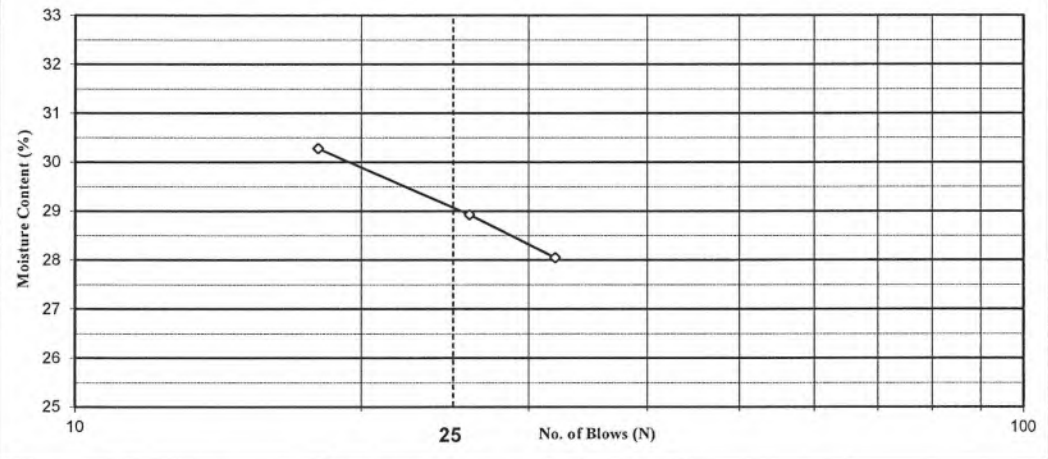
Project	Construction of Air Traffic Control Tower	**decon**
Location	Skardu Airport Pakistan	**Geotechnical Testing Laboratory**

BH / TP No.	BH-01	**Job No.**	-
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

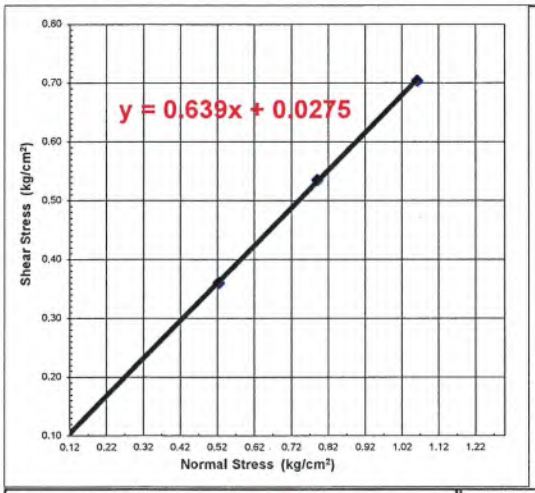
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

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

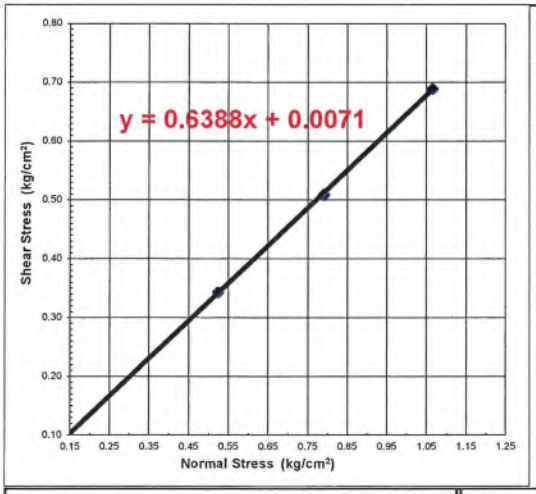
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

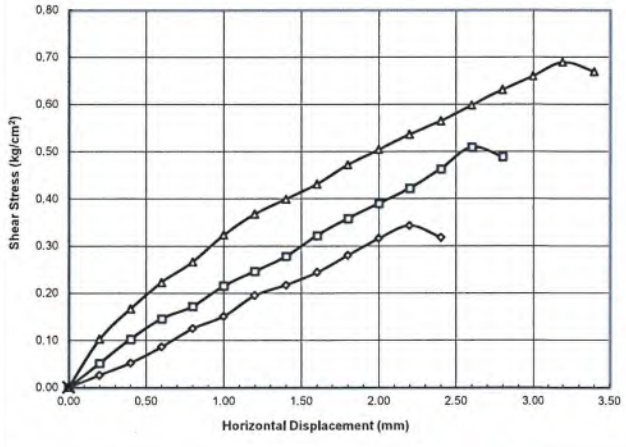
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-01	Job No.	-	Test Conditions
Sample No.	SPT-05	Lab No.	1033	UNSOAKED
Sample Depth (ft)	15.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	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

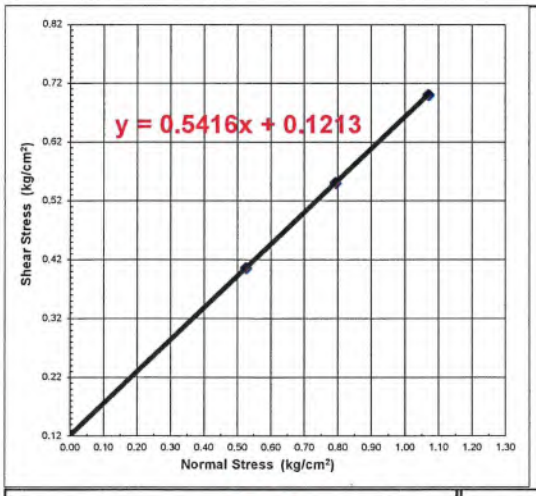
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

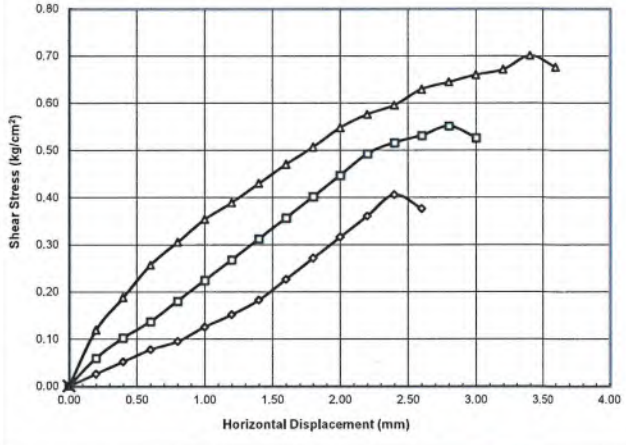
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-02	Job No.	-	Test Conditions
Sample No.	SPT-07	Lab No.	1033	UNSOAKED
Sample Depth (ft)	25.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	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/cm²**	Angle of Internal Friction (Φ)	**28 °**

Tested By	Checked By	Approved By
Nasrullah khan	Jawad Nasir	Shahzaib Khalid

FIRM decon International (Pvt) Ltd.

Shahzaib

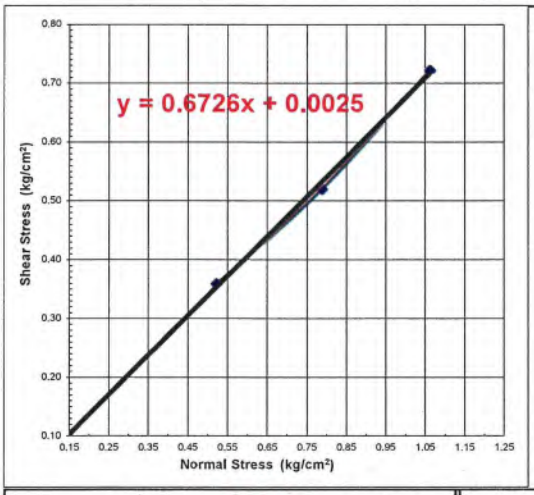
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

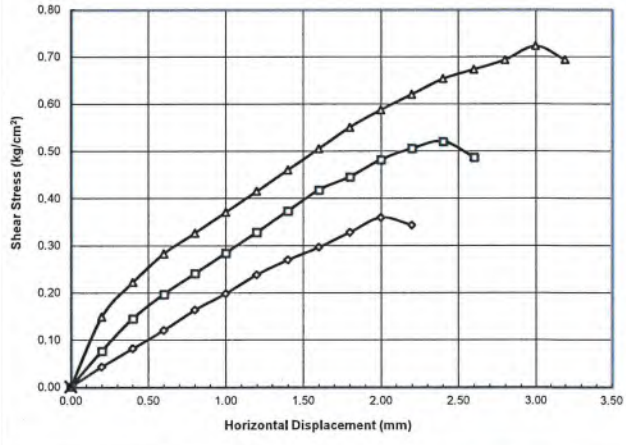
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-02	Job No.	-	Test Conditions
Sample No.	SPT-07	Lab No.	1033	UNSOAKED
Sample Depth (ft)	40.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	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

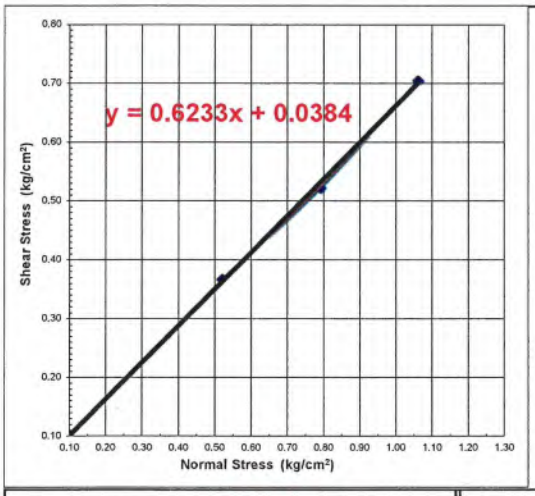
CLIENT	CONSULTANTS	CONTRACTOR
-	-	M/s Yasin Enterprises Pakistan

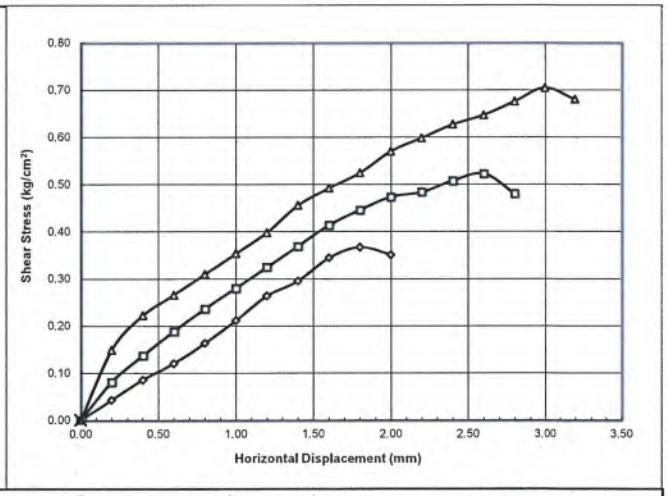
Project	Construction of Air Traffic Control Tower			**decon** Geotechnical Testing Laboratory
Location	Skardu Airport Pakistan			
BH / TP No.	BH-01	Job No.	-	Test Conditions
Sample No.	SPT-12	Lab No.	1033	UNSOAKED
Sample Depth (ft)	50.00	Test Started	August 28, 2025	Proving Ring Factor
Sampled Date	-	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