

Ministry of Ports and Shipping

**TECHNICAL ASSISTANCE
FOR
CONNECTIVITY FACILITIES
BETWEEN
COAL HANDLING TERMINAL
AROUND PORT QASIM
AND
RAILWAYS IN PAKISTAN**

FINAL REPORT

**APPENDIX
VOLUME-1**

June 2016

Japan International Cooperation Agency (JICA)

NIPPON KOEI CO., LTD.

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Appendix-1

Geotechnical Investigation Report



NIPPON KOEI CO.LTD.



Feasibility Study on Coal Transportation Between Port Qasim Coal Unloading Terminal and Pakistan Railway Main Line in Pakistan



Project Name: Coal Transportation from Port Qasim Unloading Terminal and Pakistan Railway Main Line in Pakistan
 Project ID: PK-1185-101
 Base Hole: 08
 Coordinates: 08
 Elevation: 12.24
 Sample No: SPT # 6 depth 9.0m
 Sample Date: 15/02/16
 Core Date: 15/02/16
 Driller: M. A. Khan
 Date: 15/02/16

Run 3
 12.24 0.00 1.17
 2.00 1.17 0.21
 Run 3
 12.24 0.00 1.17
 2.00 1.17 0.21
 SUPERVISOR: J. LESMAN (TRINAM)

Project Name: Coal Transportation from Port Qasim Unloading Terminal and Pakistan Railway Main Line in Pakistan
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Geotechnical Investigation Report February 2016



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EXECUTIVE SUMMARY

Geotechnical Investigation for feasibility study on Coal transportation b/w Port Qasim Coal Unloading Terminal and Pakistan Railway, Karachi was carried out in order to determine geotechnical parameters of subsurface deposits. Scope of work included drilling of thirty five (35) boreholes up to the depth of 30 meters or more if applicable below the existing ground level. Twenty six (26) boreholes were drilled at ordinary site while nine (09) boreholes were drilled at seaside. Three hundred and six (306) Standard Penetration tests (SPTs) were performed and three (03) undisturbed samples were also taken from soft cohesive strata. Soil, rock, and ground water samples were collected during field investigation. Laboratory testing of these samples has been carried out in the Soil Testing Services' laboratory, Karachi.

The deposition of the area mainly consists of loose to very dense sand, soft to hard silt, very soft to hard clay, highly weathered and fractured sandstone, extremely weak to weak shale and extremely weak to strong siltstone. Groundwater table was encountered in nine seaside boreholes and their current depth ranges from 3.3 meters to 14.0 meters below the existing ground level in the boreholes. Ground water monitoring wells (piezometers) have been installed at site the seaside boreholes and long term monitoring shall be carried out as per project specifications.

Keeping these conditions under consideration:

- Allowable bearing pressures have been given for shallow foundations at a depth of 1.5m below existing ground level.
- Allowable pile capacities for bored cast in-situ pile have been provided for various diameters and depths.
- Seismic soil profile has been recommended as 'S_C' for entire site except for four boreholes at seaside i.e. BH-7A, BH-8A, BH-9A and BH-10A that are classified as 'S_D' in accordance with UBC-97.

The exposure of underground concrete to aggressive chemicals is found to be 'negligible' for soil and 'moderate' for ground water, for sulphates and chlorides. Therefore Ordinary Portland cement may be used for shallow foundations constructed above ground water level whereas for deep foundation (pile foundations), it is recommended to use Ordinary Portland Cement with appropriate cement replacement material like GGBFS, fly ash, micro silica, etc. The cement replacement material should have the quality to increase density of the concrete matrix.

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1. INTRODUCTION

M/s. Japan international Cooperation Agency (JICA) in collaboration with M/s Nippon Koei Co. Ltd is carrying out the feasibility study on Coal transportation b/w Port Qasim Coal Unloading Terminal and Pakistan Railway Main line Karachi. M/s. Soil Testing Services (STS) was hired by the project consultants M/s Techno Consult International (Pvt.) Ltd, as geotechnical contractor for determination of geotechnical design parameters both for ordinary and seaside locations.

Scope of field work included drilling of thirty five (35) boreholes up to the depth of 30 meters or more if applicable below the existing ground level. Twenty six (26) boreholes were drilled at ordinary site while nine (09) boreholes were drilled at seaside. In each borehole, Standard penetration tests were carried out along with the collection of soil samples via split spoon sampler. Boreholes in rock were advanced through continuous coring. Rock core samples was carried out with the help of core barrel. Ground water samples were also collected from the boreholes drilled at site. Three hundred and six (306) Standard Penetration tests (SPTs) were performed and three (03) undisturbed samples were also taken from soft cohesive strata. The samples retrieved from the field work were tested in the laboratory and this report is prepared from the information obtained from the field and laboratory tests.

The report consists of five chapters with Chapter 2 describing the site's existing condition, Chapter 3 discusses the subsurface deposits in detail, Chapter 4 includes the recommendations for foundation design, and Chapter 5 contains a summary of conclusions regarding the ground conditions, with respect to geotechnical engineering for this project.

2. THE SITE

The site is located at North West Industrial zone, Port Qasim in the neighbourhood of Bhains Colony along Mehran Highway, Karachi. Nearby landmarks include Tri-Pack films Ltd., Pharma Evo Co., and Pakistan International Bulk Terminal.

Port Qasim is located, adjacent to the Bin Qasim town, in the southern part of Malir district, Karachi division, in Sindh. It is located in an old channel of the Indus River at a distance of 35 kilometres east of Karachi city centre.

The topography of the terrain is plain with no significant changes in elevation observed across the site. Bushes and different types of wild plants were also found across the seaside borehole locations. Figure 2.1 shows the google image of site.



Figure 2.1 Google image of site

3. GROUND CONDITIONS

The subsurface deposits up to the explored depth consist of the following units:

- Filled material
- Sand
- Silt
- Clay
- Sandstone
- Claystone
- Shale

Following sub-sections describe the strength characteristics of the geological units and the groundwater conditions.

3.1 SAND

Deposits of sand were encountered in all boreholes. State of compactness according to SPT 'N' counts has been determined as 'very loose to very dense'. According to Unified Classification System (UCS), these deposits lie in categories; 'SM', 'SP', 'SP-SM' and 'SW-SM'. Table 3.1 summarizes the details of these deposits.

Table 3.1 Deposits of Sand

Borehole No.	Depth (meters)
BH-01	0.0 – 4.5
	10.5 – 15.0
BH-02	0.0 – 9.0
BH-02 A	7.5 – 12.0
BH-02 B	0.0 – 13.5
BH-03	0.0 – 15.0
	0.0 – 1.5
BH-03 A	6.0 – 12.0
	0.0 – 7.5
BH-03 B	9.0 – 14.0
	0.0 – 7.5
BH-04	0.0 – 7.5
BH-04 A	4.0 – 13.5
BH-04 B	0.0 – 13.5

Borehole No.	Depth (meters)
BH-05	0.0 – 6.0
	8.0 – 12.0
BH-05 A	0.0 – 1.5
	4.5 – 6.0
BH-05 B	0.0 – 7.5
	10.5 – 14.0
BH-06	0.0 – 7.5
	10.5 – 14.0
BH-06 A	0.0 – 9.0
BH-06 B	0.5 – 13.5
BH-07	0.0 – 10.5
BH-07 A	0.0 – 7.5
BH-08	0.0 – 9.0
	0.0 – 7.5
BH-08 A	10.5 – 12.0
BH-08 B	0.0 – 15.0
	0.0 – 12.0
BH-09	0.0 – 12.0
	3.0 – 6.0
BH-09 A	9.0 – 12.0
BH-10	0.0 – 9.2
	10.5 – 15.0
BH-10 A	3.0 – 6.0
	10.5 – 12.0
BH-11	0.0 – 3.0
	4.5 – 7.7
BH-12	12.0 – 15.0
	0.0 – 6.0
BH-13	9.0 – 11.0
	0.0 – 7.9
	9.0 – 12.0

Borehole No.	Depth (meters)
BH-14	0.0 – 7.5 10.5 – 15.0
BH-15	0.0 – 6.0 7.5 – 15.0
BH-16	0.0 – 15.0
BH-17	0.0 – 14.0
BH-18	0.0 – 11.0
BH-19	0.0 – 10.0
BH-20	0.0 – 15.0

3.2 SILT

Deposits of silt were encountered in almost all the boreholes drilled at the site except BH-06, BH-06 A, BH-06 B, BH-08 B, BH-10, BH-13, and BH-16 to BH-20 drilled at the site. State of compactness according to SPT 'N' counts has been determined as 'soft to hard'. These deposits lie in 'ML' and 'CL-ML' categories according to UCS. Table 3.2 summarizes the details of these deposits.

Table 3.2 Deposits of Silt

Borehole No.	Depth (meters)
BH-01	4.5 – 10.5
BH-02	9.0 – 12.0
BH-02 A	0.0 – 7.5 12.0 – 15.0
BH-02 B	13.5 – 14.0
BH-03	15.0 – 15.45
BH-03 A	1.5 – 6.0

Borehole No.	Depth (meters)
BH-03 B	7.5 – 9.0 14.0 – 15.0
BH-04	12.0 – 15.0
BH-04 A	0.0 – 4.0
BH-04 B	13.5 – 15.0
BH-05	12.0 – 14.0
BH-05 A	1.5 – 4.5 6.0 – 18.0
BH-05 B	7.5 – 10.5
BH-06	7.5 – 9.0
BH-07	10.5 – 14.0
BH-07 A	7.5 – 10.5
BH-08	9.0 – 11.0
BH-08 A	7.5 – 10.5
BH-09	12.0 – 15.0
BH-09 A	6.0 – 9.0 12.0 – 15.0
BH-10 A	6.0 – 9.0
BH-11	3.0 – 4.5
BH-12	6.0 – 9.0
BH-14	7.5 – 10.5
BH-15	6.0 – 7.5

3.3 CLAY

Deposits of clay were encountered in all boreholes drilled at sea side. State of compactness according to SPT 'N' counts has been determined as 'medium stiff to hard'. According to UCS, these deposits lie in 'CL' categories. Table 3.3 summarizes the details of these deposits.

Table 3.3 Deposits of Clay

Borehole No.	Depth (meters)
BH-04	7.5 – 12.0
BH-05	6.0 – 8.0
BH-05 A	18.0 – 21.0

3.4 SHALE

Deposits of highly weathered and fractured shale were encountered in three boreholes drilled at site. According to BS 5930, these deposits are classified as 'extremely weak to weak' rock. The details of these deposits are presented in Table 3.4.

Table 3.4 Deposits of Shale

Borehole No.	Depth (meters)
BH-03 A	16.5 – 19.5 22.0 – 28.5
BH-04 A	13.5 – 30.0
BH-05	14.0 – 15.0

3.5 CLAYSTONE

Deposits of highly weathered and fractured claystone were encountered in six boreholes drilled at the site. According to BS 5930, these deposits are classified as 'extremely weak to weak' rock. The details regarding these deposits have been summarized in Table 3.5.

Table 3.5 Deposits of Claystone

Borehole No.	Depth (meters)
BH-02	12.0 – 15.0
BH-02 B	14.0 – 15.0
BH-06	12.0 – 15.0
BH-08 A	12.0 – 21.0
BH-09 A	15.0 – 16.5
BH-12	11.0 – 15.0

3.6 SANDSTONE

Deposits of highly weathered and fractured sandstone were encountered in twenty boreholes drilled at site. According to BS 5930, these deposits are classified as ‘extremely weak to strong’ rock. The details regarding these deposits have been summarized in Table 3.6.

Table 3.6 Deposits of Sandstone

Borehole No.	Depth (meters)
BH-02	15.0 – 30.0
BH-03 A	12.0 – 16.5
	19.5 – 22.0
	28.5 – 30.0
BH-05 A	21.0 – 30.0
BH-05 B	14.0 – 15.0
BH-06	9.0 – 10.5
BH-06 A	9.0 – 30.0

Borehole No.	Depth (meters)
BH-06 B	13.5 – 15.0
BH-07	14.0 – 15.0
BH-07 A	10.5 – 30.0
BH-08	11.0 – 15.0
BH-08 A	21.0 – 30.0
BH-09 A	16.5 – 30.0
BH-10	9.20 – 10.5
BH-10 A	12.0 – 30.0
BH-11	7.7 – 12.0
BH-13	7.9 – 19.0 12.0 – 15.0
BH-17	14.0 – 15.0
BH-18	11.0 – 15.0
BH-19	10.0 – 15.0

3.7 GROUNDWATER CONDITIONS

Groundwater table was encountered in nine seaside boreholes and their depth ranges from 3.3 meters to 14.0 meters below the existing ground level in the boreholes at the time of investigation. However, this may fluctuate due to tidal, seasonal and other environmental variations. Ground water monitoring wells (piezometers) have been installed at site the seaside boreholes and long term monitoring shall be carried out as per project specifications.

4. ENGINEERING DESIGN CONSIDERATIONS

Foundation type for a structure depends on the expected loads taken by the foundation and the type of soil underlying it. The characteristics of subsurface soil deposits have been discussed in the previous section. Keeping in view the subsoil conditions prevailing at the site and the loads expected to be transferred to the foundations and as per the requirement of the client recommendations for both shallow foundations (including isolated and raft footings) and deep foundations (including pile foundations) are provided. Following sections gives the allowable bearing pressure and capacities for shallow and deep foundations, respectively.

4.1 SHALLOW FOUNDATIONS - ALLOWABLE BEARING PRESSURES

The gross allowable bearing pressure has been calculated following shear strength determination, through in-situ field tests. Table 4.1 gives the net allowable bearing pressures for isolated and raft foundations at the depth of 1.5 meters below existing ground level (EGL).

Table 4.1 Net Allowable Bearing Pressures

Marking	Minimum Embedment below EGL (m)	Isolated Foundation (kPa)	Raft Foundation (kPa)
BH-01	1.5	90	240
BH-02	1.5	200	320
BH-02 A	1.5	150	250
BH-02 B	1.5	90	250
BH-03	1.5	180	290
BH-03 A	1.5	150	250
BH-03 B	1.5	160	260
BH-04	1.5	180	300
BH-04 A	1.5	150	250

Marking	Minimum Embedment below EGL (m)	Isolated Foundation (kPa)	Raft Foundation (kPa)
BH-04 B	1.5	105	300
BH-05	1.5	190	350
BH-05 A	1.5	50	80
BH-05 B	1.5	220	400
BH-06	1.5	200	400
BH-06 A	1.5	200	350
BH-06 B	1.5	220	400
BH-07	1.5	100	300
BH-08	1.5	220	400
BH-08 B	1.5	214	400
BH-09	1.5	220	400
BH-10	1.5	80	350
BH-11	1.5	120	350
BH-12	1.5	130	400
BH-13	1.5	120	400
BH-14	1.5	120	325
BH-15	1.5	200	400
BH-16	1.5	90	260
BH-17	1.5	260	400
BH-18	1.5	200	400
BH-19	1.5	200	400
BH-20	1.5	130	400

Proper drainage shall be provided to avoid infiltration of water into foundation soil. The settlement of shallow foundations due to allowable pressure has been estimated within allowable limit of 25 mm and 50mm for isolated and raft foundation, respectively.

4.1.1 MODULUS OF SUBGRADE REACTION

Designing of floor slab system requires the modulus of subgrade reaction at the depth at which it is to be placed. Table 4.2 shows the values of modulus of subgrade reaction for given pressure.

Table 4.2 Modulus of subgrade reaction based on net allowable bearing pressure

Marking	Minimum embedment (meters)	k_s for shallow foundation (MN/m ³)
BH-01	1.5	14.4
BH-02	1.5	19.2
BH-02 A	1.5	15.0
BH-02 B	1.5	15.0
BH-03	1.5	17.4
BH-03 A	1.5	15.0
BH-03 B	1.5	15.6
BH-04	1.5	18.0
BH-04 A	1.5	15.0
BH-04 A	1.5	18.0
BH-04 B	1.5	21.0
BH-05	1.5	4.80
BH-05 A	1.5	24.0
BH-05 B	1.5	24.0
BH-06	1.5	21.0
BH-06 A	1.5	24.0
BH-06 B	1.5	18.0
BH-07	1.5	13.5
BH-07 A	1.5	24.0
BH-08	1.5	24.0
BH-08 B	1.5	24.0

Marking	Minimum embedment (meters)	k_s for shallow foundation (MN/m ³)
BH-09	1.5	21.0
BH-10	1.5	21.0
BH-11	1.5	24.0
BH-12	1.5	24.0
BH-13	1.5	19.5
BH-14	1.5	24.0
BH-15	1.5	15.6
BH-16	1.5	24.0
BH-17	1.5	24.0
BH-18	1.5	24.0
BH-19	1.5	24.0
BH-20	1.5	18.0

4.2 DEEP FOUNDATIONS - ALLOWABLE PILE CAPACITIES

The allowable pile capacities have been calculated following shear strength determination, through in-situ field tests and unconfined compression strength test of collected rock core samples. Table 4.3 gives the pile capacities for all borehole locations.

Table 4.3 Allowable Pile Capacities

Borehole No . (mm)	Pile Diameter (mm)	Effective	Tension Q_{skin} (kN)	Compression $Q_{skin} + Q_{end}$ (kN)
		Length (Embedment) (m)		
BH-01	760	12	379	1436
		15	530	1870
	1000	12	498	2329
		15	697	3018
BH-02	760	15	558	664
	1000	15	734	918

		20	537	651
	760	25	654	768
BH-02 A		30	771	885
		20	552	750
	1000	25	706	904
		30	860	1058
BH-02 B	760	15	506	751
	1000	15	666	1090
BH-03	760	13	306	1468
		15	411	1762
	1000	13	306	2317
		15	411	2750
BH-03 A		20	408	490
	760	25	492	574
		30	576	657
		20	427	569
	1000	25	537	679
		30	647	789
BH-03 B	760	15	825	1029
	1000	15	1085	1438
BH-04	760	13	627	1799
		15	733	2094
	1000	13	825	2854
		15	965	3321
BH-04 A		20	620	825
	760	25	829	1034
		30	1038	1243
		20	411	765
	1000	25	620	974
		30	829	1183

BH-04 B	760	12	268	1335
		15	420	1771
	1000	12	352	2200
		15	553	2891
BH-05	760	12	489	1569
		15	643	2006
	1000	12	643	2513
		15	846	3206
BH-05 A	760	25	2359	2416
		30	2417	2474
	1000	25	2865	2964
		30	3103	3202
BH-05 B	760	15	407	571
	1000	15	536	819
BH-06	760	15	604	767
	1000	15	795	1077
BH-06 A		20	418	541
	760	25	543	666
		30	669	791
		20	385	597
	1000	25	550	762
		30	715	927
BH-06 B	760	15	441	767
	1000	15	580	1145
BH-07	760	15	669	873
	1000	15	881	1234
BH-07 A		20	407	456
	760	25	457	506
		30	507	556

		20	522	607
	1000	25	535	620
		30	601	686
BH-08	760	15	348	491
	1000	15	458	705
BH-08 A		20	491	581
	760	25	583	673
		30	675	765
		20	622	778
	1000	25	646	802
		30	767	923
BH-08 B	760	12	272	1342
		15	425	1778
	1000	12	358	2210
		15	559	2901
BH-09	760	15	688	2049
	1000	15	906	3262
BH-09 A		20	180	229
	760	25	231	280
		30	281	330
		20	224	309
	1000	25	237	322
		30	303	388
BH-10	760	12	198	1286
		15	353	1724
	1000	12	261	2144
		15	464	2838
BH-10 A		20	192	258
	760	25	259	325
		30	326	392
		20	179	292
	1000	25	192	306
		30	259	372

BH-11	760	12	241	1356
		15	399	1798
	1000	12	317	2248
		15	525	2947
BH-12	760	12	287	572
		15	462	748
	1000	12	377	872
		15	608	1103
BH-13	760	13	285	350
		15	312	377
	1000	13	375	488
		15	410	523
BH-14	760	12	270	1343
		15	423	1779
	1000	12	356	2212
		15	557	2904
BH-15	760	12	270	1343
		15	423	1778
	1000	12	355	2212
		15	556	2903
BH-16	760	12	265	1325
		15	416	1759
	1000	12	348	2183
		15	548	2872
BH-17	760	12	275	1360
		15	430	1798
	1000	12	362	2241
		15	565	2934
BH-18	760	12	236	277
		15	261	302
	1000	12	311	382
		15	344	415
BH-19	760	12	228	350
		15	303	425

	1000	12	299	511
		15	398	610
	760	12	272	1349
		15	425	1786
BH-20	1000	12	272	2137
		15	425	2781

4.3 RECOMMENDED DRILLING METHOD AND CONFIRMATORY TESTING

The recommended drilling method for the construction of bored cast in-situ piles is straight rotary. Tentative pile capacity values given in table 4.3 have been computed by static formulae which suffer from limitations. As such capacity values shall be verified by full scale load tests under the guidance of geotechnical engineer. Pile capacity shall be suitably adjusted if warranted by results of load tests. This report will be valid only if requirement of pile load tests is fulfilled.

4.4 PILE CONSTRUCTION

Allowable pile capacities have been derived from combination of end bearing and skin friction components. It is, therefore, essential to adopt the following construction methodology to satisfy following requirements:

1. Excessive disturbance to sub-surface along shaft and pile tip shall be avoided during the course of drilling.
2. The bottom of pile shall be cleaned of all loose materials which may accumulate during the course of drilling.

Pile concreting shall be undertaken only when above conditions are fulfilled.

It is understood that subsurface materials will be carefully examined during pilling and it shall be ensured that all piles are placed in proper stratum. This exercise will serve as safeguard against variations in quality and level of occurrence of rock or dense stratum

4.5 LIQUEFACTION POTENTIAL OF SOIL

The potential for liquefaction at this project site was evaluated using Peysanj software. This program is based on the most recent publications of the NCEER Workshop and Seed and Idriss Implementation. The method evaluates liquefaction potential based on

soil type and density, groundwater conditions, peak surface acceleration, magnitude of the design earthquake.

The method is used to compare the cyclic shear stresses indicated during the design earthquake, with those that would be required to cause liquefaction to determine whether any zone exists within the soil where liquefaction may be expected.

A peak ground acceleration of 0.20g was evaluated based on PBC Seismic provision 2007 for design, and has been adopted for the current study. We based our liquefaction analyses for an earthquake magnitude of $M = 6.6$.

Using the design parameters and procedures discussed above, the factors of safety against liquefaction of every borehole is calculated. The factor of safety against liquefaction is observed as greater than 1.0 for all borehole locations except for four boreholes, BH-7a, BH-8A, BH-9A and BH-10A for earthquakes of magnitude 6.6. The subsurface deposits from 6 to 9 meters near these boreholes are susceptible to liquefaction.

To increase the safety factor against liquefaction either ground improvement techniques may be employed or deep foundations should be provided for structures near these borehole locations. The results of liquefaction analysis are provided in appendix F of this report

4.6 SOIL PROFILE TYPE (ACCORDING TO UBC-97)

Chapter 16, Division V, Section 1636 of UBC-97 deals with the determination of Soil Profile Types. Design practice involves using seismic parameters of zone 2B for the area under consideration.

4.6.1 SEISMIC ZONE FACTOR

Table 16-I of UBC-97 defines the seismic zone factor to be used in choosing seismic coefficients for a location. The seismic zone factor "Z" will be taken as 0.20.

4.6.2 SOIL PROFILE TYPE

Table 16-J of UBC-97 defines the soil profile types to be used for determining seismic coefficients. Seismic soil profile has been recommended as 'S_c' for entire site except for four boreholes at seaside i.e. BH-7A, BH-8A, BH-9A and BH-10A that are classified as 'S_D' in accordance with UBC-97.

4.6.3 SEISMIC COEFFICIENTS

Seismic coefficients are as under:

For S_c: C_a = 0.24 & C_v = 0.32

S_D: C_a = 0.28 & C_v = 0.40

4.7 TYPE OF CEMENT

The exposure of underground concrete to aggressive chemicals is found to be 'negligible' for soil and 'moderate' for ground water, for sulphates and chlorides. Therefore Ordinary Portland cement may be used for shallow foundations constructed above ground water level whereas for deep foundation (pile foundations), it is recommended to use Ordinary Portland Cement with appropriate cement replacement material like GGBFS, fly ash, micro silica, etc. The cement replacement material should have the quality to increase density of the concrete matrix.

5. CONCLUSIONS

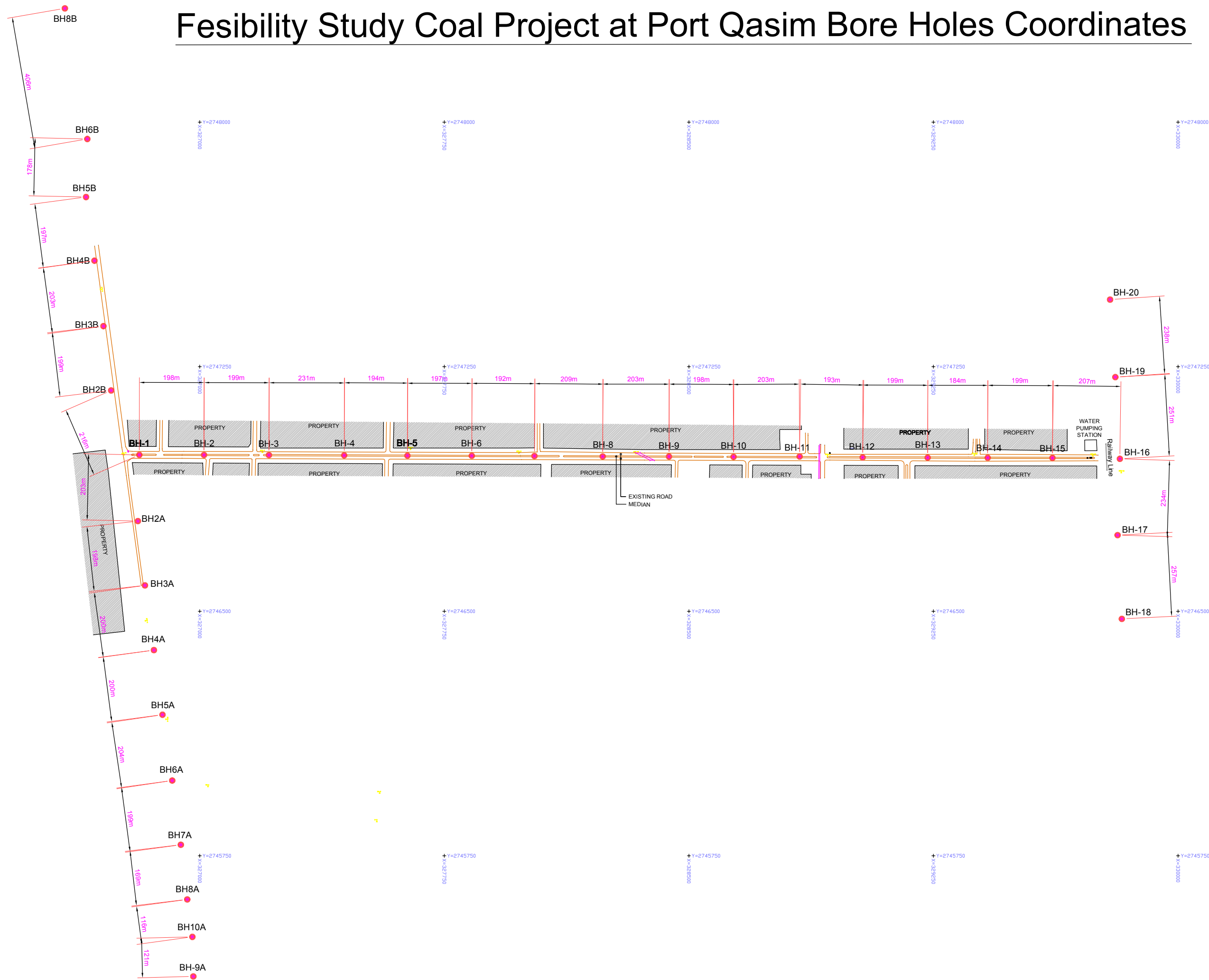
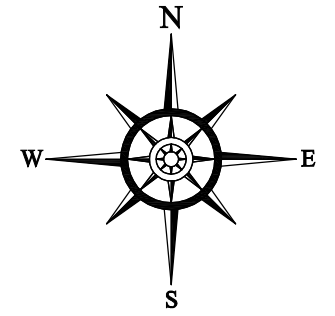
Geotechnical Investigation for feasibility study on Coal transportation b/w Port Qasim Coal Unloading Terminal and Pakistan Railway, Karachi was carried out in January - February, 2016. Scope of work included drilling of thirty five (35) boreholes up to the depth of 30 meters or more if applicable below the existing ground level. Twenty six (26) boreholes were drilled at ordinary site while nine (09) boreholes were drilled at seaside. Three hundred and six (306) Standard Penetration tests (SPTs) were performed and three (03) undisturbed samples were also taken from soft cohesive strata. Laboratory testing of soil, rock and groundwater samples has been carried out in the lab and includes determination of index properties through grain-size analysis, Atterberg's limits, natural moisture content, density, specific gravity, angle of internal friction through direct shear test, unconfined compressive strength, water absorption etc. Chemical characteristics of soil and water samples have also been assessed through determination of total dissolved solids, sulphate content, chloride content and pH.

Keeping in view, the results from field, and laboratory tests and the expected loads being transferred to the founding stratum, allowable bearing capacities for shallow and deep foundations are given. Subsurface deposits from 6 to 9 meters near BH-7A, BH-8A, BH-9A and BH-10A are susceptible to liquefaction. To mitigate the effects of liquefaction, either soil improvement should be performed before placement of shallow foundations or provide deep foundations of adequate depth.

The exposure of underground concrete to aggressive chemicals is found to be 'negligible' for soil and 'moderate' for ground water, for sulphates and chlorides. Therefore Ordinary Portland cement may be used for shallow foundations constructed above ground water level whereas for deep foundation (pile foundations), it is recommended to use Ordinary Portland Cement with appropriate cement replacement material like GGBFS, fly ash, micro silica, etc. The cement replacement material should have the quality to increase density of the concrete matrix.

Borehole Location Plan

Fesibility Study Coal Project at Port Qasim Bore Holes Coordinates



S.No	Description	X= Easting	Y= Northing
1	BH-1	326814.6757	2746979.3931
2	BH-2	327013.0285	2746979.2112
3	BH-3	327212.0814	2746978.7550
4	BH-4	327442.8445	2746977.9941
5	BH-5	327636.7811	2746977.1256
6	BH-6	327834.1683	2746976.7892
7	BH-7	328026.3296	2746975.9743
8	BH-8	328235.7130	2746974.6196
9	BH-9	328636.9458	2746974.3453
10	BH-10	327013.0285	2746973.4181
11	BH-11	328839.5589	2746971.7337
12	BH-12	329032.9825	2746971.7337
13	BH-13	329232.2844	2746971.0231
14	BH-14	329416.3391	2746970.7294
15	BH-15	329614.9429	2746970.0576
16	BH-16	329821.7550	2746976.4114
17	BH-17	329814.6573	2746733.4310
18	BH-18	329827.6976	2746476.5680
19	BH-19	329807.8335	2747218.0260
20	BH-20	329791.6972	2747455.6970

S.No	Description	X= Easting	Y= Northing
1	BH2A	326831.9990	2746776.4580
2	BH3A	326831.9990	2746579.1850
3	BH4A	326859.4748	2746380.8610
4	BH5A	326885.6080	2746182.6510
5	BH6A	326915.5476	2745980.8100
6	BH7A	326944.2316	2745782.6750
7	BH8A	326963.1578	2745612.1940
8	BH9A	326980.3220	2745380.0480
9	BH10A	326977.3078	2745501.3770

S.No	Description	X= Easting	Y= Northing
1	BH2B	326728.3249	2747177.1050
2	BH3B	326704.7009	2747374.2810
3	BH4B	326677.0348	2747575.0650
4	BH5B	326651.1889	2747770.1600
5	BH6B	326655.0872	2747948.2650
6	BH8B	326655.0872	2747948.2650

Borehole Logs

Log BH-1

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 23.01.2016
 Logged By: AL

Elevation: 29.637-m
 Easting: 326814.6757
 Northing: 2746979.393
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Yellowish brown, fine to coarse grained			0																				
1		U		* 11		1	SM	10	72.9	17.1		NLL	-	NPI	6.4	1.6	1.7						7.4	0.03	0.26	SPT-1
2		U	SAND Yellowish brown, medium dense, fine to coarse grained, little silt & gravel			2																				
3		U		* 17		3																				SPT-2
4		U		* 36		4	ML		20.5	50.6	28.9	NLL	-	NPI	9.6	1.58	1.73									SPT-3
5		U	SILT Yellowish brown, hard, some clay & sand			5																				
6		U		* 50		6																				SPT-4
7		U	SILT Yellowish brown, hard, fine grained sandy, little clay & traces of gravels			7																				
8		U		* 43		8																				SPT-5
9		U		* 50		9	ML	1.1	37.8	43.8	17.3	NLL	-	NPI	14.7	1.54	1.77									SPT-6 SPT Drive-330mm

Sample Types	● Disturbed	U SPT Sample	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	Water Sample	PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	Shelby / U4	Groundwater Level	PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	Core Cutter		NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-1

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 23.01.2016
 Logged By: AL

Elevation: 29.637-m
 Easting: 326814.6757
 Northing: 2746979.393
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
10		U	SILT Yellowish brown, hard, fine grained sandy, little clay & traces of gravel	* SPT 10 20 30 40 50	* 50	10																			10	SPT-7 SPT Drive-130mm	
11		U	SAND Yellowish brown, very dense, fine to coarse grained, little gravel & traces of silt		* 50	11																			11	SPT-8 SPT Drive-140mm	
12		U			* 50	12																			12	SPT-8 SPT Drive-140mm	
13		U			* 50	13																			13	SPT-9 SPT Drive-100mm	
14		U			* 50	14																			14	SPT-9 SPT Drive-100mm	
15		U	End of Log @ 15 (m)		* 50	15	SP-SM	16.1	78.9	5		NLL	-	NPI	4.4	1.61	1.68								15	SPT-10 SPT Drive-180mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-2

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 21.01.2016
 Logged By: AL

Elevation: 29.784-m
 Easting: 327013.0285
 Northing: 2746979.211
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm ²)	F _i (o)	C _c	C _s	P _c (kg/cm ²)	qu (kg/cm ²)	PH		
10		U	SILT Yellowish brown, hard, clayey, traces of fine sand	* SPT 10 20 30 40 50 * 50.		10																			10	SPT-7 SPT Drive - 210mm	
12		U +	CLAYSTONE Yellowish brown, extremely weak, highly weathered & fractured, closely jointed, very thickly bedded, very poor quality of	* 50.		12	ML	7	50.7	42.3	35.1	27	8.1	13.1	1.4	1.58									12	SPT-8 RUN - 1 CR- 51% / RQD- 18% UDC- 1 (12.5 m-12.67 m)	
13		+				13																			13		
14		+				14																			14	RUN - 2 CR- 58% / RQD- 16% UDC- 2 (13.6 m-13.82 m)	
15			End of Log @ 15 (m)			15																			15		

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations U U SPT Sample W Water Sample G Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	C _c : C _c C _s : C _s P _c : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-2(A)

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 30 (m)
 GWL: 12.15 (m)
 Drill Date: 22.01.2016
 Logged By: AL

Elevation: 27.711-m
 Easting: 326831.9990
 Northing: 2746776.458
 Rev. BY: MZS

Company Info.

Soil Testing Services
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments			
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH			SO3	CL	
0			SILT Brownish grey, some clay, little medium to coarse grained sand & gravels	* SPT 10 20 30 40 50	U	0																								
1		U			* 50	1																						SPT-1 SPT Drive - 120mm		
2		U	SILT Brownish grey, hard, some clay, little medium to coarse grained sand & gravels		* 50	2																							SPT-2 SPT Drive - 150mm	
3		U			* 50	3	ML	10.5	15.6	50.5	23.4	NLL	-	NPI	7.4	1.45	1.56												SPT-3 SPT Drive - 210mm	
4		U			* 50	4	ML	17.5	25.2	38.8	18.5	NLL	-	NPI	13.5	1.45	1.65													SPT-4 SPT Drive - 190mm
5		U	SILT Brown, hard, non-plastic, some fine to coarse sand, little gravel & clay		* 50	5																								SPT-5 SPT Drive - 70mm
6		U			* 50	6																								SPT-6 SPT Drive - 150mm
7		U			* 50	7																								
8		U	SAND Brownish grey, very dense, fine to coarse grained, some silt		* 50	8																								
9		U			* 50	9	SM	73.4	26.6			NLL	-	NPI	9.7	1.54	1.69													
10					* 50	10																								

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Field Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Atterberg Limits Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Consolidation CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-2(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 12.15 (m)
 Drill Date: 22.01.2016
 Logged By: AL

Elevation: 27.711-m
 Easting: 326831.9990
 Northing: 2746776.458
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm ²)	F _i (o)	C _c	C _s	P _c (kg/cm ²)	qu (kg/cm ²)		
10		U	SAND <i>Brownish grey, very dense, fine to coarse grained, some silt & little gravel</i>	* SPT 10 20 30 40 50 * 50		10	SM	14.8	72.4	12.8		NLL	-	NPI	12.5	1.51	1.7								10	SPT- 7 SPT Drive - 90mm
12		U	SILT <i>Brownish grey, hard, some clay, little fine to coarse grained sand</i>	* SPT 10 20 30 40 50 * 50		12	ML		13	59.1	27.9	NLL	-	NPI	16.2	1.54	1.79								12	SPT- 8 SPT Drive - 240mm
13		U		* SPT 10 20 30 40 50 * 50		13																			13	SPT- 9 SPT Drive - 250mm
15		+	SANDSTONE <i>Greyish brown, extremely weak, closely jointed, very thickly bedded, highly fractured & weathered, friable, argillaceous</i>			15																			15	RUN - 1 CR - 76% / RQD - 36% UDC - 1 (15.5m - 15.62m)
17		+				17																			17	RUN - 2 CR - 93% / RQD - 75% UDC - 2 (17.6m - 17.78m)
18		+				18																			18	RUN - 3 CR - 100% / RQD - 74% UDC - 3 (18.8m - 19.03m)
19		+	(continued ...)			19																			19	RUN - 4 CR - 80% / RQD - 73%
20		+				20																			20	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-2(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 12.15 (m)
 Drill Date: 22.01.2016
 Logged By: AL

Elevation: 27.711-m
 Easting: 326831.9990
 Northing: 2746776.458
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests					Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments									
				* SPT 10 20 30 40 50								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3			CL								
20			SANDSTONE Brownish grey, extremely weak, closely jointed, very thickly bedded, good quality, highly fractured & weathered, interlayered with shale																																					20	UDC - 4 (19.8m - 20.03m)
21		+									21																												21	RUN - 5 CR - 53% / RQD - 11% UDC - 5 (22.30m - 22.42m)	
22		+									22																												22	RUN - 6 CR - 100% / RQD - 50%	
23		+									23																												23	UDC - 6 (22.6m - 22.98m)	
24		+									24																												24	RUN - 7 CR - 100% / RQD - 52%	
25		+									25																												25	UDC - 7 (24.4m - 24.65m)	
26		+									26																												26	RUN - 8 CR - 100% / RQD - 56%	
27		+									27																												27	UDC - 8 (26.10m - 26.45m)	
28		+									28																												28	RUN - 9 CR - 62% / RQD - 40%	
29		+									29																												29	UDC - 9 (27.3m - 27.52m)	
30		+							30																												30	RUN - 10 CR - 64% / RQD - 41%			

End of Log @ 30 (m)

- | | | | | | | |
|---|--|--|--|---|--|--|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | Abbreviations
 SPT Sample
■ Water Sample
▽ Groundwater Level | Abbreviations
LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | Field Tests
C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Atterberg Limits
Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | Unit Weight
w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | Consolidation
CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|--|--|---|--|--|

Log BH-2(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 23.01.2016
 Logged By: AL

Elevation: 28.922-m
 Easting: 326728.3249
 Northing: 2747177.150
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests				Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments		
				* SPT							Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	F _i (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH			SO3	CL
				10	20	30	40																									
0			SAND Yellowish brown, fine to coarse grained, some silt & traces of gravels																								0					
1		U							SM	4.5	66.9	28.6	NLL	-	NPI	7.9	1.52	1.64								7.6	0.02	0.29	1	SPT - 1		
2		U	SAND Yellowish brown, loose to very dense, fine to coarse grained, some silt & traces of gravels																										2			
3		U																											3	SPT - 2 SPT Drive - 300mm		
4		U																											4	SPT - 3 SPT Drive - 150mm		
5		U																											5			
6		U							SM	5.6	66.8	27.6	NLL	-	NPI	9	1.42	1.55											6	SPT - 4 SPT Drive - 200mm		
7		U																											7	SPT - 5 SPT Drive - 400mm		
8		U																											8			
9		U																											9	SPT - 6 SPT Drive - 320mm		

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ▬ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-3

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15.45 (m)
 GWL: Not Encountered
 Drill Date: 20.01.2016
 Logged By: AL

Company Info.

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Yellow, fine to coarse grained, little silt	* SPT 10 20 30 40 50		0																				
1		U				1																				SPT - 1
2		U	SAND Yellow, medium dense to very dense, gravelly fine to coarse grained, little silt	* 29		2																				SPT - 2
3		U		* 28		3																				SPT - 2
4		U		* 50		4	SM	34.7	52.9	12.4	NLL	-	NPI	7.9	1.66	1.79										SPT - 3 SPT Drive - 390mm
5		U				5																				
6		U		* 17		6																				SPT - 4
7		U		* 32		7																				SPT - 5
8		U				8																				
9		U	SAND Yellowish brown, dense, silty fine to medium grained, traces of gravel	* 46		9	SM	1.3	64.7	34	NLL	-	NPI	10.9	1.66	1.84										SPT - 6
10						10																				

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Field Tests U U SPT Sample ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-3

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15.45 (m)
 GWL: Not Encountered
 Drill Date: 20.01.2016
 Logged By: AL

Elevation: 29.800-m
 Easting: 327212.0814
 Northing: 2746978.755
 Rev. BY: MZS

Company Info.

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm ²)	F _i (o)	C _c	C _s	P _c (kg/cm ²)	qu (kg/cm ²)	PH		
10		■	SAND Yellowish brown, very dense, silty fine to medium grained, traces of gravel	* SPT 10 20 30 40 50	■	10																			10	Run - 1 CR - 15% / RQD - NIL	
11						11																			11		
12		U			U	12																			12	SPT - 7 SPT Drive - 310mm	
13		U			U	13																			13	SPT - 8 SPT Drive - 250mm	
14		U			U	14																			14		
15		U	SILT Yellowish brown, hard, clayey, little fine sand End of Log @ 15.45 (m)		U	15	ML	12.2	48.6	39.2	36.8	30.7	6.1	14	1.68	1.92									15	SPT - 9	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Field Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Atterberg Limits Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Consolidation CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-3(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 14 (m)
 Drill Date: 23.01.2016
 Logged By: AL

Elevation: 25.842-m
 Easting: 326831.9990
 Northing: 2746579.185
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Yellow, silty fine to coarse grained			0																				
1		U		* 42		1																				SPT - 1
2			SILT Yellow, hard, some clay & little fine to coarse grained sand, traces of gravels			2																				
3		U		* 50		3	ML	2.2	17.8	52.4	27.6	NLL	-	NPI	5.7	1.66	1.75									SPT - 2 SPT Drive - 300mm
4		U		* 50		4																				SPT - 3 SPT Drive - 250mm
5						5																				
6		U	SAND Yellow, very dense, fine to coarse grained, some silt, traces of gravels	* 50		6	SM	1.9	74.1	24		NLL	-	NPI	15.9	1.66	1.92									SPT - 4 SPT Drive - 150mm
7		U		* 50		7																				SPT - 5 SPT Drive - 150mm
8						8																				
9		U	SAND Off white, very dense, fine to coarse grained, little silt & gravels	* 50		9	SM	16.4	67.4	16.2		NLL	-	NPI	8.7	1.7	1.85									SPT - 6 SPT Drive - 150mm
10						10																				

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Legend U SPT Sample ■ Water Sample □ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-3(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 14 (m)
 Drill Date: 23.01.2016
 Logged By: AL

Elevation: 25.842-m
 Easting: 326831.9990
 Northing: 2746579.185
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests					Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
				* SPT	Gravel (%)	Sand (%)	Silt (%)	Clay (%)				LL (%)	PL (%)	PI (%)	Dry	Bulk	Test Type	C (kg/cm2)		Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH	SO3	CL				
10		UU	SAND <i>Off white, very dense, fine to coarse grained, little silt & gravels</i>	50																								10	SPT - 7 SPT Drive - 100mm RUN - 1 CR - 17% / RQD - NIL		
12		+	SANDSTONE <i>Grey, extremely weak, very closely jointed, poor quality, highly weathered & fractured, interlayered thinly bedded shale</i>																					1.01				12	RUN - 2 CR - 97% / RQD - 31% UDC - 1 (12.53m - 12.69m)		
14		+																									14	RUN - 3 CR - 72% / RQD - 27% UDC - 2 (13.5m - 13.71m)			
15		+																									15	RUN - 4 CR - 65% / RQD - 38% UDC - 3 (15.59m - 15.75m)			
17		+	SHALE <i>Grey, extremely weak, very poor quality, very thickly bedded, highly weathered & fractured, interlayered thinly bedded sandstone at places</i>																						6.05			17	RUN - 5 CR - 73% / RQD - 53% UDC - 4 (16.5m - 16.68m)		
18		+																									18	RUN - 6 CR - 93% / RQD - 12% UDC - 5 (18.33m - 18.44m)			
19		+	(continued ...)																								19	RUN - 7 CR - 90% / RQD - 37%			
20		+																						100.35			20				

Sample Types	● Disturbed	UU SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	Shelby / U4	Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-3B

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 26.01.2016
 Logged By: AL

Elevation: 30.934-m
 Easting: 326704.7009
 Northing: 2747374.2810
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation		Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)			qu (kg/cm2)
0			SAND Yellowish brown, fine to coarse grained, little silt, traces of gravel			0																				
1		U	SAND Yellowish brown, very dense, fine to coarse grained, little silt, traces of gravel	* 50		1																			SPT - 1	
2						2																				
3		U		* 50		3	SM	2.5	82.8	14.7		NULL	-	NPI	10.9	1.66	1.84					7.5	0.09	0.36	SPT - 2 SPT Drive - 350 mm	
4		U		* 50		4																			SPT - 3 SPT Drive - 300 mm	
5						5																				
6		U		* 50		6																				SPT - 4
7						7																				
8		U	SILT Yellowish brown, hard, sandy fine to coarse grained, little clay, traces of gravel	* 50		8	ML	1.9	41.7	36.9	19.5	NULL	-	NPI	20.5	1.5	1.81									SPT - 5
9						9																				
10		U	SAND Yellowish brown, very dense, gravelly fine to coarse grained, traces of silt	* 50		10																				SPT - 6

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-3B

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 26.01.2016
 Logged By: AL

Elevation: 30.934-m
 Easting: 326704.7009
 Northing: 2747374.2810
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	F1 (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10		U	SAND Yellowish brown, very dense, gravelly fine to coarse grained, traces of silt	* SPT 10 20 30 40 50		10																		10	SPT - 7 SPT Drive - 75 mm	
11		U		11																					11	
12		U		12		SP	40.2	59.6	0.2		NLL	-	NPI	5.9	1.67	1.77									12	SPT - 8 SPT Drive - 60 mm
13		U	13																				13	SPT - 9 SPT Drive - 60 mm		
14		U	SILT Yellowish brown, hard, clayey, some gravel			14																	14	SPT - 10		
15		U	End of Log @ 15 (m)			15	ML	11.2	51.8	37	NLL	-	NPI	19.3	1.56	1.86								15		

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ▬ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-4

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 20.01.2016
 Logged By: AL

Elevation: 30.056-m
 Easting: 327442.8445
 Northing: 2746977.9941
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Yellowish brown, fine to coarse grained, little silt, traces of gravels	* SPT 10 20 30 40 50		0																				
1		U				1																				SPT - 1
2		U	SAND Yellowish brown, dense to very dense, fine to coarse grained, little silt, traces of gravels		* 49	2																				
3		U			* 50	3	SM	5.6	74.8	19.6		NULL	-	NPI	5.2	1.56	1.64						7.4	0.05	0.54	SPT - 2
4		U			* 50	4																				SPT - 3
5		U			* 50	5																				
6		U			* 50	6																				SPT - 4 SPT Drive - 220mm
7		U			* 50	7																				
8		U	CLAY Yellowish brown, hard, silty, traces of fine sand		* 50	8	CL		2.8	43.4	53.8	38.7	21.6	17.1	15.6	1.52	1.76									SPT - 5
9		U			* 50	9																				
10					* 50	10																				SPT - 6 SPT Drive - 220mm

Sample Types
 ● Disturbed
 + Undisturbed
 □ Shelby / U4
 ■ Core Cutter

Abreviations
 LL : Liquid Limit
 PL : Plastic Limit
 PI : Plastic Index
 NPI : None PI

Field Tests
 C : Cohesion
 Phi : Friction Angle
 C' : Cohesion (CU)
 Phi' : Friction Angle (CU)

Atterberg Limits
 Cc : Cc
 Cs : Cs
 Pc : Pre-Consolidation Pressure
 K : Permeability Coeff.

Unit Weight
 w : Moisture Content
 qu : Unconfined Compression qu
 F : Fast
 S : Slow

Consolidation
 CD : Consolidated, Drained
 UU : Unconsolidated, Undrained
 CU : Consolidated, Undrained

Log BH-4

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 20.01.2016
 Logged By: AL

Elevation: 30.056-m
 Easting: 327442.8445
 Northing: 2746977.9941
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10		U	CLAY Yellowish brown, hard, silty, traces of fine sand	* SPT 10 20 30 40 50		10																		10	SPT - 7	
11						11																		11		
12		U	SILT Yellowish brown, hard, clayey, traces of fine sand			12	ML	9	53.1	37.9	42.7	28.7	14	10.2	1.61	1.77								12	SPT - 8	
13		U				13																		13	SPT - 9	
14		U				14																		14	SPT Drive - 200mm	
15		U	End of Log @ 15 (m)			15																		15	SPT - 10 SPT Drive - 130mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ▬ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-4(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 12.5 (m)
 Drill Date: 26.01.2016
 Logged By: AL

Elevation: 22.731-m
 Easting: 326859.4748
 Northing: 2746380.8610
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			SILT Brown, hard, some fine to coarse grained sand & clay, little gravels	* SPT 10 20 30 40 50		0																					
1		U				1	ML	14.1	23	38.8	24.1	NLL	-	NPI	6.6	1.86	1.98										SPT - 1 SPT Drive - 150mm
2		U				2																					
3		U				3																					SPT - 2 SPT Drive - 90mm
4		U	SAND Brownish grey, very dense, fine to coarse grained, some silt, little gravels			4																					SPT - 3 SPT Drive - 90mm
5		U				5																					
6		U				6	SM	10.5	67.3	22.2		NLL	-	NPI	11.9	1.59	1.78										SPT - 4 SPT Drive - 90mm
7		U				7																					SPT - 5 SPT Drive - 70mm
8		U				8																					
9		U				9																					SPT - 6 SPT Drive - 60mm
10						10																					

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Field Tests	U SPT Sample Water Sample Groundwater Level	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Strength Parameters	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Consolidation	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Moisture	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Drainage	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-4(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 12.5 (m)
 Drill Date: 26.01.2016
 Logged By: AL

Elevation: 22.731-m
 Easting: 326859.4748
 Northing: 2746380.8610
 Rev. BY: MZS

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm ²)	Fi (o)	Cc	Cs	Pc (kg/cm ²)	qu (kg/cm ²)	PH		
10		U	SAND <i>Brownish grey, very dense, fine to coarse grained, some silt, little gravel</i>	* SPT 10 20 30 40 50		10																			10	SPT(C) - 1 SPT Drive - 80mm	
11		U				11																			11		
12		U				12																			12	SPT - 7 SPT Drive - 60mm	
13		U				13																			13		
14		U	SHALE <i>Brownish grey, extremely weak, moderately weathered & fractured, closely jointed, very thickly bedded, excellent quality, embedded with thin layer of friable sandstone</i>			14																			14	SPT - 8 SPT Drive - 60mm Run - 1 CR - 100% / RQD - 93% UDC - 1 (14.55m - 14.68m)	
15		U				15																			15	Run - 2 CR - 100% / RQD - 80% UDC - 2 (15.26m - 15.39m)	
16		U				16																			16		
17		U				17																			17	Run - 3 CR - 100% / RQD - 88% UDC - 3 (16.52m - 16.89m)	
18		U	SHALE <i>Brownish grey, extremely weak, moderately weathered & fractured, closely jointed, very thickly bedded, excellent quality, interbedded with thin layer of limestone</i>			18																			18	Run - 4 CR - 100% / RQD - 88% UDC - 4 (18.51m - 18.67m)	
19		U				19																			19		
20		U	(continued ...)			20																			20	Run - 5 CR - 100% / RQD - 94%	

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-4(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 12.5 (m)
 Drill Date: 26.01.2016
 Logged By: AL

Elevation: 22.731-m
 Easting: 326859.4748
 Northing: 2746380.8610
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
20			SHALE Brownish grey, extremely weak, moderately weathered & fractured, closely jointed, very thickly bedded, good quality	* SPT 10 20 30 40 50		20																			20	UDC - 5 (19.8m - 20.19m)	
21		+					21																			21	Run - 6 CR - 100% / RQD - 86% UDC - 6 (21.34m - 21.49m)
22		+					22																			22	Run - 7 CR - 100% / RQD - 84% UDC - 7 (22.57m - 22.72m)
23		+					23																			23	Run - 8 CR - 83% / RQD - 76% UDC - 8 (24.28m - 24.43m)
24		+					24																			24	Run - 9 CR - 80% / RQD - 53% UDC - 9 (25.9m - 26.09m)
25		+					25																			25	Run - 10 CR - 73% / RQD - 56% UDC - 10 (27.21m - 27.39m)
26		+					26																			26	Run - 11 CR - 100% / RQD - 80% UDC - 11 (28.67m - 28.89m)
27		+					27																			27	
28		+					28																			28	
29		+					29																			29	
30							30																			30	

End of Log @ 30 (m)

- | | | | | | | |
|---|--|---|--|--|--|--|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | Abbreviations
 SPT Sample
■ Water Sample
▽ Groundwater Level | Abreviations
LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|---|--|--|--|--|

Log BH-4(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 28.01.2016
 Logged By: AL

Elevation: 32.188-m
 Easting: 326677.0348
 Northing: 2747575.065
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
0			SAND Yellowish brown, fine to coarse grained, some silt, traces of gravel			0																					
1		U		* 14		1	SM	1.8	69.3	28.9		NLL	-	NPI	7.8	1.6	1.72							7.4	0.04	0.41	SPT - 1
2		U	SAND Yellowish brown, medium dense to very dense, fine to coarse grained, some silt, traces of gravel			2																					
3		U				3																					SPT - 2 SPT Drive - 290mm
4		U		* 27		4																					SPT - 3
5		U				5																					
6		U				6																					SPT - 4
7		U				7																					SPT - 5 SPT Drive - 390mm
8		U				8																					
9		U				9	SM	2.3	72.1	25.6					10.8	1.7	1.88										SPT - 6 SPT Drive - 390mm
10						10																					

Sample Types	● Disturbed	U SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-4(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 28.01.2016
 Logged By: AL

Elevation: 32.188-m
 Easting: 326677.0348
 Northing: 2747575.065
 Rev. BY: MZS

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Remarks & Comments			
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	F1 (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		PH	SO3	CL
10		U	SAND Yellowish brown, very dense, fine to coarse grained, little gravel, traces of silt		* 50	10	SP	13.7	83	3.3		NLL	-	NPI	6.1	1.66	1.76										10	SPT - 7 SPT Drive - 70mm
11		U			* 50	11																					11	
12		U			* 50	12																					12	SPT - 8 SPT Drive - 50mm
13		U			* 50	13																					13	
14		U	SILT Yellowish brown, hard, some fine to coarse grained sand & clay, little gravel		* 50	14	ML	17.4	21.8	39.9	20.9	NLL	-	NPI	10.9	1.69	1.87										14	SPT - 9 SPT Drive - 180mm
15		U	End of Log @ 15 (m)		* 50	15																					15	SPT - 10 SPT Drive - 230mm

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-5

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 26.01.2016
 Logged By: AL

Elevation: 29.859-m
 Easting: 327636.7811
 Northing: 2746977.1256
 Rev. BY: MZS

Company Info.
Soil Testing Services
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	
0			SAND Yellowish brown, fine to coarse grained, little gravel, traces of silt			0																			
1		U	SAND Yellowish brown, very dense, fine to coarse grained, little gravel, traces of silt	* 50		1	SW-SM	18.9	72.7	8.4		NLL	-	NPI	5.6	1.58	1.67							SPT - 1	
3		U		* 50		3																		SPT - 2 SPT Drive - 100mm	
4		U		* 50		4																		SPT - 3 SPT Drive - 130mm	
6		U	CLAY Yellowish brown, hard, silty, some sand & traces of gravel	* 50		6																		SPT - 4 SPT Drive - 180mm	
7		U		* 40		7	CL	5	23	31.2	40.8	27.4	19.6	7.8	10.8	1.55	1.72							SPT - 5	
8		U	SAND Yellowish brown, very dense, fine to coarse grained, little gravel, traces of silt	* 50		8																		SPT - 6 SPT Drive - 300mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-5(A)

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 30 (m)
 GWL: 11 (m)
 Drill Date: 13.02.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation		Chemical Tests			Depth (m)	Remarks & Comments		
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)			qu (kg/cm2)	PH
0			SAND Yellowish brown, silty fine to coarse grained, some gravel	* SPT 10 20 30 40 50		0																					
1		U	CLAY/SILT Brown, stiff, clayey silt / silty clay, some sand	* 15		1	CL-ML	25.2	33.9	40.8	20.4	14.3	6.1	16.8	1.57	1.83					8	0.07	0.29	0	SPT - 1		
2		U		* 18		2																			2	SPT - 2	
3		U				3																				3	SPT - 3
4		U	SAND Brown, medium dense, fine to coarse grained silty	* 30		4	SM	59.4	40.6		NLL	-	NPI	21.3	1.49	1.81										4	SPT - 3
5		U				5																				5	
6		U	SILT Brown, hard, some sand & clay & traces of gravel	* 50		6	ML	6.8	25.8	44.1	23.3	21.8	18.1	3.7	10.9	1.65	1.83									6	SPT - 4 SPT Drive - 150mm
7		U				7																				7	
8		U				8																				8	SPT - 5 SPT Drive - 90mm
9		U				9																				9	SPT - 6 SPT Drive - 110mm

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-5(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 11 (m)
 Drill Date: 13.02.2016
 Logged By: AL

Elevation: 20.561-m
 Easting: 326885.6080
 Northing: 2746182.6510
 Rev. BY: MZS

Company Info.
Soil Testing Services
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests				Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
				* SPT 10 20 30 40 50							Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
10		U	SILT <i>Brown, hard, some sand & clay & traces of gravel</i>																								10	SPT - 7 SPT Drive - 90mm		
11		K																										11		
12		U																										12	SPT - 8	
13		U																										13		
14		U																										14	SPT(C) - 1 SPT(C) Drive - 110mm	
15		U																										15	SPT(C) - 2 SPT(C) Drive - 90mm	
16		U																								16				
17		U																								17	SPT - 9 SPT Drive - 120mm			
18		U	CLAY <i>Brown, very hard, silty, little sand</i>					/ / / / /																		18	SPT - 10 SPT Drive - 150mm			
19		U																									19			
20		U								CL		12.8	39.4	47.8	22.8	15.4	7.4	17.6	1.74	2.05								20	SPT - 11 SPT Drive - 150mm	

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Legend	U SPT Sample Water Sample Groundwater Level	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion	Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc	Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content	qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained	UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-5(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 01.02.2016
 Logged By: AL

Elevation: 33.961-m
 Easting: 326651.1889
 Northing: 2747770.160
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation		Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)		
0			SAND Yellowish brown, fine to coarse grained	* SPT 10 20 30 40 50		0																			
1		U				1																			
2		U	SAND Yellowish brown, dense to very dense, fine to coarse grained, little silt & traces of gravel		* 50	2																			SPT - 1
3		U			* 35	3	SM	4.3	76.2	19.5		NULL	-	NPI	10.5	1.66	1.83								SPT - 2
4		U			* 50	4																			SPT - 3
5		U			* 50	5																			SPT Drive -130mm
6		U			* 50	6																			SPT - 4
7		U			* 50	7																			SPT - 5
8		U	SILT Yellowish brown, hard, fine to coarse grained sandy, some clay		* 50	8	ML		41.1	35.6	23.3	NULL	-	NPI	13	1.57	1.77								
9		U			* 50	9																			SPT - 6
10						10																			SPT Drive - 210mm

Sample Types	● Disturbed	U SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-5(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 01.02.2016
 Logged By: AL

Elevation: 33.961-m
 Easting: 326651.1889
 Northing: 2747770.160
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)		Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH	SO3	CL		
10		U	SILT Yellowish brown, hard, fine to coarse grained sandy, some clay	* SPT 10 20 30 40 50 * 50		10	SM	23.3	62.7	14		NLL	-	NPI	11.8	1.66	1.86										10	SPT - 7 SPT Drive - 40mm
11			SAND Yellowish brown, very dense, gravelly fine to coarse grained, little to traces of silt			11																					11	
12		U				12	SP	30.9	67	2.1		NLL	-	NPI	10	1.71	1.88										12	SPT - 8 SPT Drive - 40mm
13		U				13																					13	
14		■	SANDSTONE Brownish grey, extremely weak, highly weathered & fractured, thickly bedded, very poor quality of friable			14																					14	Run - 1 CR - 51% / RQD - Nil
15			End of Log @ 15 (m)			15																					15	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-6

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 20.01.2016
 Logged By: AL

Elevation: 29.895-m
 Easting: 327834.1683
 Northing: 2746976.7892
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			SAND Brown, fine to coarse grained, traces of silt			0																					
1		U		* 35		1																				SPT - 1	
2			SAND Brown, dense to very dense, fine to coarse grained, little silt & trace of gravel			2																					
3		U		* 50		3	SM	5.2	75	19.8	NLL	-	NPI	5.1	1.6	1.68										SPT - 2	
4		U		* 50		4																					SPT - 3
5				* 50		5																					
6		U		* 50		6																					SPT - 4 SPT Drive - 250mm
7		U		* 41		7																					SPT - 5 SPT Drive - 350mm
8			CLAY / SILT Brown, hard, silty clay / clayey silt, traces of sand			8	CL-ML	9.6	54	36.4	27.1	20.1	7	16.8	1.65	1.93											
9		+	SANDSTONE Brown, very weak, highly weathered & fractured, very closely jointed, medium bedded, fair quality of, interlayered clay			9																					Run - 1 CR - 76% / RQD - 33.5% UDC - 1 (9.35m - 9.55m)

Sample Types	● Disturbed	U SPT Sample	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample	PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level	PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter		NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-6

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 20.01.2016
 Logged By: AL

Elevation: 29.895-m
 Easting: 327834.1683
 Northing: 2746976.7892
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH			SO3
10		UU	SANDSTONE Brown, very weak, highly weathered & fractured, very closely jointed, medium bedded, fair quality of, interlayered clay	* SPT 10 20 30 40 50 * 47		10	SM	3.5	55	41.5		NLL	-	NPI	15.2	1.63	1.88										10	SPT - 6
11			SAND Yellow, dense, silty fine to coarse grained, traces of gravel			11																					11	
12		UU + ■	CLAYSTONE Brown, very weak, highly weathered & fractured, closely jointed, thickly bedded, very poor quality of, interbedded with sandstone	* 50		12																					12	SPT - 7
13						13																					13	Run - 2 CR - 50% / RQD - 25% UDC - 2 (12.3m - 12.45m)
14						14																					14	Run - 3 CR - 52% / RQD - Nil
15			End of Log @ 15 (m)			15																				15		

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations UU SPT Sample ■ Water Sample ▬ Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-6(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 6.7 (m)
 Drill Date: 27.01.2016
 Logged By: AL

Elevation: 16.170-m
 Easting: 326915.5476
 Northing: 2745980.810
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
0			SAND Yellow, fine to coarse grained gravelly	* SPT 10 20 30 40 50		0																					
1		U				1																					
2		U	SAND Yellow, medium dense to very dense, fine to coarse grained, little silt & gravel	* 35		2	SM	12.6	74.2	13.2		NLL	-	NPI	4.7	1.54	1.61										SPT - 1
3		U		* 46		3																					SPT - 2
4		U		* 27		4																					SPT - 3
5		U				5																					
6		U		* 50		6																					SPT - 4
7		U				7																					SPT Drive - 150mm
8		U	SAND Yellow, very dense, fine to coarse grained, some silt & traces of gravel	* 50		8	SM	5.6	65.2	29.2		NLL	-	NPI	5.7	1.54	1.63										SPT - 5
9		■				9																					Run - 1
10		■	SANDSTONE Greyish brown, highly weathered & fractured, thickly bedded, very closely jointed, very poor quality of, interlayered shale			10																					CR - 50% / RQD - Nil
																											Run - 2
																											CR - 50% / RQD - Nil

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-6(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 6.7 (m)
 Drill Date: 27.01.2016
 Logged By: AL

Elevation: 16.170-m
 Easting: 326915.5476
 Northing: 2745980.810
 Rev. BY: MZS

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			qu (kg/cm ²)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm ²)	Fi (o)	Cc	Cs		Pc (kg/cm ²)	PH	SO ₃		
10		■	SANDSTONE Greyish brown, highly weathered & fractured, thickly bedded, very closely jointed, very poor quality of, interlayered shale	* SPT 10 20 30 40 50		10																					10	Run - 3 CR - 51% / RQD - Nil
11						11																					11	
12		■				12																					12	Run - 4 CR - 73% / RQD - Nil
13						13																					13	
14		+	SANDSTONE Brown, medium strong, highly weathered & fractured, very poor quality, closely jointed, very thickly bedded			14																	318.34				14	Run - 5 CR - 60% / RQD - 10% UDC - 1 (13.5m - 13.82m)
15		+				15																					15	Run - 6 CR - 57% / RQD - 11% UDC - 2 (15.6m - 15.75m)
16		■				16																					16	
17		+				17																					17	Run - 7 CR - 58% / RQD - 16% UDC - 3 (16.81m - 16.92m)
18		■	SANDSTONE Brown, extremely weak, highly weathered & fractured, closely jointed, very thickly bedded, very poor to excellent quality of, interlayered with shale			18																					18	Run - 8 CR - 85% / RQD - 30% UDC - 4 (18.65m - 18.83m)
19		■				19																					19	
20		+				20																					20	Run - 9 CR - 60% / RQD - 10%

Sample Types	● Disturbed	⌋ SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	⊞ Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	≡ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-6(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 6.7 (m)
 Drill Date: 27.01.2016
 Logged By: AL

Elevation: 16.170-m
 Easting: 326915.5476
 Northing: 2745980.810
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3		
20			SANDSTONE <i>Brown, extremely weak, highly weathered & fractured, closely jointed, very thickly bedded, very poor to excellent quality of, interlayered with shale</i>	* SPT 10 20 30 40 50		20																				20	UDC - 5 (19.5m - 19.61m)	
21		+		21																							21	Run - 10 CR - 55% / RQD - 23% UDC - 6 (21.5m - 21.75m)
22		+		22																							22	Run - 11 CR - 79% / RQD - 38% UDC - 7 (22.71m - 22.92m)
23		+		23																							23	Run - 12 CR - 100% / RQD - 98% UDC - 8 (24.5m - 24.72m)
24		+		24																							24	Run - 13 CR - 96% / RQD - 44% UDC - 9 (25.9m - 26.12m)
25		+		25																							25	Run - 14 CR - 87% / RQD - 37% UDC - 10 (27.8m - 28.02m)
26		+		26																							26	Run - 15 CR - 73% / RQD - Nil
27		+		27																							27	
28		+		28																							28	
29		+		29																							29	

End of Log @ 30 (m)

- | | | | | | | |
|---|--|---|---|--|--|--|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | Abbreviations
 SPT Sample
■ Water Sample
▽ Groundwater Level | LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|---|---|--|--|--|

Log BH-6(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 22.01.2016
 Logged By: AL

Elevation: 34.639-m
 Easting: 326655.0872
 Northing: 2747948.265
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			Fill Material Yellowish Brown, gravels & sand			0																					
0			SAND Yellowish brown, very dense, fine to coarse grained, little silt & gravel			0																					
1		U		* 50		1	SM	19.2	64.9	15.9		NLL	-	NPI	2.6	1.6	1.64							7.5	0.09	0.52	SPT - 1
2		U		* 50		2																					SPT - 2
3		U		* 50		3																					SPT Drive - 210mm
4		U		* 50		4																					SPT - 3
5		U		* 50		5																					SPT Drive - 250mm
6		U		* 50		6																					SPT - 4
7		U		* 50		7																					SPT Drive - 310mm
8		U		* 50		8																					SPT - 5
9		U		* 50		9																					SPT - 6
10						10																					SPT Drive - 130mm

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Field Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Consolidation Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Chemical Tests CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-6(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 22.01.2016
 Logged By: AL

Elevation: 34.639-m
 Easting: 326655.0872
 Northing: 2747948.265
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10		U	SAND Yellowish brown, very dense, fine to coarse grained, little silt & gravel	* SPT 10 20 30 40 50 * 50		10																		10	SPT - 7 SPT Drive - 50mm	
12		U	SAND Yellowish brown, medium dense, fine to coarse grained, some silt	* 20		12	SM	76.7	23.3		NLL	-	NPI	16.8	1.54	1.8								12	SPT - 8 SPT Drive - 40mm	
14		U	SANDSTONE Grey, extremely weak, closely jointed, very poor quality, highly fractured & weathered, friable	* 50		14																	14	SPT - 9 SPT Drive - 100mm		
15			End of Log @ 15 (m)			15																	15	Run - 1 CR - 92% / RQD - 33% UDC - 1 (13.8m - 13.95m)		

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U Undisturbed W Water Sample G Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-7

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 18.01.2016
 Logged By: AL

Company Info.

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments			
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH	SO3	CL
0			SAND Yellowish brown, fine to coarse grained			0																							
1		U		* 11		1	SM	3.3	77.8	18.9		NLL	-	NPI	4.4	1.56	1.63							7.8	0.02	0.23	SPT - 1		
2		U	SAND Yellow, medium dense, fine to coarse grained, little silt, traces of gravels			2																							
3		U		* 17		3																						SPT - 2	
4		U				4																							
5		U	SAND Yellow, medium dense to very dense, gravelly fine to coarse grained, traces of silt			5	SW-SM	33.6	58.2	8.2		NLL	-	NPI	9.2	1.84	2.01											SPT - 3 SPT Drive - 200mm	
6		U				6																						SPT - 4 SPT Drive - 190mm	
7		U				7																							SPT - 5 SPT Drive - 200mm
8		U				8																							
9		U				9																							SPT - 6

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample	⊔ Water Sample ⊔ Groundwater Level	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-7

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 18.01.2016
 Logged By: AL

Elevation: 29.349-m
 Easting: 328026.3296
 Northing: 2746975.9743
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
10		U	SAND Yellow, dense, gravelly fine to coarse grained, traces of silt	* SPT 10 20 30 40 50 * 34		10	ML	3.6	22	38.8	35.6	39.1	26	13.1	18.6	1.66	1.97									10	SPT - 7
11		U	SILT Yellowish brown, hard, clayey, some fine to coarse grained sand, traces of gravel			11																				11	
12		U	SILT Yellowish brown, hard, clayey, some gravel, traces of sand	* 33		12	ML	21.6	2.8	41	34.6	41.7	26.5	15.2	20.8	1.63	1.97									12	SPT - 8
13		U				13																				13	SPT - 9
14		+	SANDSTONE Brown, extremely weak, closely jointed, highly fractured & weathered, thickly bedded, excellent quality of			14																				14	Run - 1
15			End of Log @ 15 (m)			15																				15	CR - 96% / RQD - 95% UDC - 1 (14.56m - 14.78m)

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-7(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 4.5 (m)
 Drill Date: 30.01.2016
 Logged By: AL

Elevation: 11.026-m
 Easting: 326944.2316
 Northing: 2745782.675
 Rev. BY: MZS

Soil Testing Services
 Geotechnical Engineers and
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments		
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH			SO3	CL
0			SAND Yellow, fine to coarse grained gravelly			0																							
1		U		* 13		1	SM	25	61	14		NULL	-	NPI	3.9	1.74	1.81											SPT - 1	
2		U	SAND Brown, medium dense to dense, fine to coarse grained, some gravel, little silt			2																							
3		U		* 22		3																							SPT - 2
4		K U		* 38		4																							SPT - 3
5						5																							
6		U		* 21		6																							SPT - 4
7		U				7																							
8		U	SILT Brown, stiff to hard, fine to coarse grained sandy clayey, traces of gravels	* 11		8	ML		38.2	33.5	28.3	19.8	16.3	3.5	12.2	1.66	1.86												SPT - 5
9		U		* 6		9	ML	0.7	31.3	34.1	33.9	19.7	16.3	3.4	10.2	1.55	1.71												SPT - 6

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Field Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Atterberg Limits Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Consolidation CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-7(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 4.5 (m)
 Drill Date: 30.01.2016
 Logged By: AL

Elevation: 11.026-m
 Easting: 326944.2316
 Northing: 2745782.675
 Rev. BY: MZS

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
10		UU	SILT <i>Brown, hard, fine to coarse grained sandy clayey</i>	* SPT 10 20 30 40 50 * 38		10																			10	SPT - 7	
11		+	SANDSTONE <i>Brown, extremely weak, highly fractured & weathered, closely jointed, massive, very thickly bedded, argillaceous, very poor to fair quality of, interlayered with shale at places</i>			11																			11	Run - 1 CR - 60% / RQD - 17% UDC - 1 (11.0m - 11.15m)	
12		+				12																			12	Run - 2 CR - 63% / RQD - 37% UDC - 2 (12.10m - 12.25m)	
13		+				13																			13	Run - 3 CR - 98% / RQD - 56% UDC - 3 (13.60m - 13.79m)	
14		+				14																			14	Run - 4 CR - 83% / RQD - 61% UDC - 4 (15.10m - 15.28m)	
15		+				15																			15	Run - 5 CR - 85% / RQD - 51% UDC - 5 (17.0m - 17.19m)	
16		+				16																			16	Run - 6 CR - 50% / RQD - Nil	
17		+				17																			17	Run - 7 CR - 60% / RQD - 28%	
18		+				18																			18		
19		+				19																			19		
20		+				20																			20		

Sample Types	● Disturbed	UU SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	Shelby / U4	Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-7(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 4.5 (m)
 Drill Date: 30.01.2016
 Logged By: AL

Elevation: 11.026-m
 Easting: 326944.2316
 Northing: 2745782.675
 Rev. BY: MZS

Soil Testing Services
 Geotechnical Engineers and
 Material Testing Laboratory



Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3		
20			SANDSTONE Brown, extremely weak, highly fractured & weathered, closely jointed, massive, very thickly bedded, argillaceous, very poor to fair quality of, interlayered with shale at places	* SPT 10 20 30 40 50		20																					UDC - 6 (20.0m - 20.15m)	
21		+					21																					Run - 8 CR - 50% / RQD - 9% UDC - 7 (21.20m - 21.31m)
22		■					22																					Run - 9 CR - 50% / RQD - Nil
23							23																					
24		+					24																					Run - 10 CR - 85% / RQD - 20% UDC - 8 (24.0m - 24.15m)
25		■					25																					Run - 11 CR - 50% / RQD - Nil%
26							26																					
27		+					27																					Run - 12 CR - 52% / RQD - 11% UDC - 9 (27.10m - 27.23m)
28		■					28																					Run - 13 CR - 50% / RQD - 10% UDC - 10 (29.50m - 29.64m)
29							29																					
30							30																					

End of Log @ 30 (m)

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|---|--|--|--|--|--|--|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | Abbreviations
 SPT Sample
■ Water Sample
▭ Groundwater Level | Abbreviations
LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|--|--|--|--|--|

Log BH-8

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 16.02.2016
 Logged By: AL

Elevation: 29.335-m
 Easting: 328235.7130
 Northing: 2746974.619
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			SAND <i>Brown, fine to coarse, traces of silt</i>	* SPT 10 20 30 40 50		0																					
1		U	SAND <i>Brown, very dense, silty fine to coarse, traces of gravel</i>		* 50	1	SM	5.6	57.2	37.2		NLL	-	NPI	8	1.66	1.79						7.6	0.05	0.35	SPT - 1 SPT Drive - 350mm	
2		U				2																					
3		U				3																					SPT - 2 SPT Drive - 110mm
4		U				4																					
5		U	SAND <i>Brown, very dense, fine to coarse grained, little gravel, traces of silt</i>		* 50	5	SP	18.8	78.4	2.8		NLL	-	NPI	18.4	1.55	1.84									SPT - 3 SPT Drive - 70mm	
6		U				6																					SPT - 4 SPT Drive - 70mm
7		U				7																					SPT - 5 SPT Drive - 60mm
8		U				8																					
9		U	SILT <i>Brownish grey, hard, fine to coarse grained sandy clayey</i>		* 50	9	ML	35.2	33.9	30.9					13.6	1.76	2									SPT - 6 SPT Drive - 150mm	
10						10																					

Sample Types	● Disturbed	U SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-8

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 16.02.20.16
 Logged By: AL

Elevation: 29.335-m
 Easting: 328235.7130
 Northing: 2746974.619
 Rev. BY: MZS

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments		
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH	SO3
10		+	SILT <i>Brownish grey, hard, fine to coarse grained sandy, clayey, traces of gravel</i>	* SPT 10 20 30 40 50 50		10	ML	0.5	33.4	40	26.1			14	1.74	1.98										10	SPT - 7 SPT Drive - 110mm	
11		+	SANDSTONE <i>Brown, extremely weak, highly fractured & weathered, closely jointed, massive, very thickly bedded, argillaceous, poor to good quality of friable</i>			11																			11	Run - 1 CR - 50%/ RQD - 31% UDC - 1 (11.00 - 11.15m)		
12		■		12																						12	Run - 2 CR - 64%/ RQD - 60% UDC - 2 (12.00 - 12.63m)	
13		+		13																							13	
14		+		14																							14	Run - 3 CR - 100%/ RQD - 53% UDC - 3 (13.90 - 14.02m) UDC - 4 (14.50 - 14.64m)
15			End of Log @ 15 (m)			15																			15			

Sample Types	● Disturbed	⊓ SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	⊓ Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	⊓ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-8(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 4.4 (m)
 Drill Date: 03.02.2016
 Logged By: AL

Elevation: 9.737-m
 Easting: 326963.1578
 Northing: 2745612.194
 Rev. BY: MZS

Company Info.
Soil Testing Services
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			SAND <i>Brown, fine coarse grained gravelly</i>	* SPT 10 20 30 40 50		0																					
1		U				1																					
2		U	SAND <i>Brown, medium dense, fine to coarse grained, some silt, traces to little gravel</i>	* 22		2	SM	12.6	64.7	22.7		NLL	-	NPI	14.4	1.54	1.76							7.6	0.03	0.25	SPT - 1
3		U		* 25		3																					SPT - 2
4		K				4																					
5		U		* 18		5	SM	0.4	70.8	28.8		NLL	-	NPI	15.6	1.52	1.76										SPT - 3
6		U		* 22		6																					SPT - 4
7		U				7																					
8		U +	SILT <i>Brown, soft to medium stiff, clayey, traces of sand</i>	* 2		8	ML	1.8	40	58.2	40.8	25.7	15.1	27.9	1.45	1.85							0.27				SPT - 5 UDS - 1 (7.80m - 8.25m)
9		U		* 7		9																					SPT - 6

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Field Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Atterberg Limits Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Consolidation CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-8(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 4.4 (m)
 Drill Date: 03.02.2016
 Logged By: AL

Elevation: 9.737-m
 Easting: 326963.1578
 Northing: 2745612.194
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm ²)	F _i (o)	Cc	Cs	Pc (kg/cm ²)	qu (kg/cm ²)	PH		
20		+	CLAYSTONE <i>Brown, extremely weak, highly weathered & fractured, very thickly bedded, closely jointed, good to very good quality,</i>	* SPT 10 20 30 40 50		20																			20	UDC - 5 (20.2m - 20.41m)	
21		+	SANDSTONE <i>Brown, extremely weak, highly weathered & fractured, closely jointed, very thickly bedded, poor quality</i>			21																			21	Run - 7 CR - 74% / RQD - 47% UDC - 6 (21.0m - 21.28m)	
22		+				22																			22	Run - 8 CR - 56% / RQD - 36% UDC - 7 (23.5m - 23.68m)	
23		+				23																			23	Run - 9 CR - 85% / RQD - 20% UDC - 8 (24.8m - 24.92m)	
24		+				24																			24	Run - 10 CR - 73% / RQD - 39% UDC - 9 (26.5m - 26.6m)	
25		+				25																			25	Run - 11 CR - 73% / RQD - 52% UDC - 10 (27.6m - 27.8m)	
26		+				26																			26	Run - 12 CR - 81% / RQD - 33% UDC - 11 (29.5m - 29.61m)	
27		+				27																			27		
28		+	SANDSTONE <i>Brown, extremely weak, highly weathered & fractured, closely jointed, very thickly bedded, poor quality, interbedded with shale</i>			28																			28		
29						29																			29		
30						30																			30		

End of Log @ 30 (m)

- | | | | | | | |
|---|--|--|--|--|--|---|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | Abbreviations
 SPT Sample
■ Water Sample
▬ Groundwater Level | LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|--|--|--|--|---|

Log BH-8(B)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: 2.5 (m)
 Drill Date: 03.02.2016
 Logged By: AL

Elevation: 36.531-m
 Easting: 326655.0872
 Northing: 2747948.265
 Rev. BY: MZS

Company Info.
Soil Testing Services
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH		
0			SAND Yellowish brown, fine to coarse gravelly			0																					
1		U		* 35		1	SW-SM	28.7	60.7	10.6	NLL	-	NPI	5	1.45	1.52							7.8	0.06	0.34	SPT - 1	
2		U	SAND Yellowish brown, dense to very dense, fine to coarse grained, some gravels, little silt			2																					
3		U		* 50		3																				SPT - 2	
4		U		* 50		4																				SPT - 3	
5		U		* 50		5																				SPT Drive - 210mm	
6		U		* 50		6																				SPT - 4	
7		U		* 30		7																				SPT Drive - 230m	
8		U				8																				SPT - 5	
9		U	SAND Yellowish brown, very dense, silty fine to coarse grained	* 29		9	SM	70	30		NLL	-	NPI	21.2	1.56	1.89										SPT - 6	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Field Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	USCS Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Consolidation CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-8(B)

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: 2.5 (m)
 Drill Date: 03.02.20.16
 Logged By: AL

Elevation: 36.531-m
 Easting: 326655.0872
 Northing: 2747948.265
 Rev. BY: MZS

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Field Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Atterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10		UU	SAND Yellowish brown, very dense, silty fine to coarse grained	* SPT 10 20 30 40 50	* 50	10																		10	SPT - 7 SPT Drive - 120mm	
12		UU	SAND Yellowish brown, very dense, fine to coarse grained, little silt		* 50	12	SM	80.2	19.8	NLL	-	NPI	21.5	1.42	1.73									12	SPT - 8 SPT Drive - 350mm	
13		UU			* 50	13																		13	SPT - 9 SPT Drive - 340mm	
15		UU	End of Log @ 15 (m)		* 50	15																		15	SPT - 10 SPT Drive - 320mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample UU Water Sample Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-09

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 14.01.2016
 Logged By: AL

Elevation: 29.406-m
 Easting: 328636.9458
 Northing: 2746974.619
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Brown, fine to coarse grained, traces of gravel & silt	* SPT 10 20 30 40 50		0																				
1		U				1																				SPT - 1 SPT Drive - 190mm
2		U	SAND Brownish yellow, very dense, gravelly fine to coarse grained, traces of silt	* 50		2																				SPT - 2 SPT Drive - 60mm
3		U				3																				SPT - 3 SPT Drive - 240mm
4		U				4	SP-SM	35.8	57.1	7.1	NLL	-	NPI	10	1.89	2.08							7.3	0.05	0.29	SPT - 4 SPT Drive - 60mm
5		U				5																				SPT - 5 SPT Drive - 80mm
6		U				6																				SPT - 6 SPT Drive - 70mm
7		U				7																				
8		U	SAND Brown, very dense, fine to coarse grained, some silt & traces of gravel	* 50		8	SM	2.4	74.8	22.8	NLL	-	NPI	11.8	1.6	1.79										
9		U				9																				
10						10																				

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▽ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-09

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 14.01.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10		U	SAND <i>Brown, very dense, fine to coarse grained, some silt & traces of gravel</i>	* SPT 10 20 30 40 50		10																		10	SPT - 7 SPT Drive - 450mm	
11						11																		11		
12		U	SILT <i>Brownish grey, very hard, clayey, some sand & traces of gravel</i>			12	ML	4.4	23	72.6	35.8	25.1	10.7	17.5	1.57	1.84								12	SPT - 8 SPT Drive - 450mm	
13		U				13																		13	SPT - 9 SPT Drive - 100mm	
14						14																		14		
15		U	End of Log @ 15 (m)			15																		15	SPT - 10 SPT Drive - 250mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▽ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-09(A)

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 30 (m)
 GWL: 3.3 (m)
 Drill Date: 03.02.2016
 Logged By: AL

Elevation: 7.255-m
 Easting: 326980.3220
 Northing: 2745380.0480
 Rev. BY: MZS

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			Fill Material Brownish grey, gravelly fine to coarse grained sand, some silt	* SPT 10 20 30 40 50	[Symbol]	0																				
1		U		* 12	[Symbol]	1	SM	8.1	50.1	41.8		NLL	-	NPI	10.4	1.57	1.73									SPT - 1
2					[Symbol]	2																				
3		U	SAND Brownish grey, medium dense, silty fine to coarse grained, traces of gravel	* 12	[Symbol]	3																				SPT - 2
4		U		* 17	[Symbol]	4																				SPT - 3
5					[Symbol]	5																				
6		U	SILT Grey, soft, clayey, traces of sand	* 2	[Symbol]	6	ML	1.4	58.3	40.3	35.9	26.1	9.8	20.9	1.6	1.93									SPT - 4	
7					[Symbol]	7																				
8		U		* 3	[Symbol]	8																				SPT - 5
9		U	SAND Grey, medium dense, silty fine grained	* 26	[Symbol]	9																				SPT - 6
10					[Symbol]	10																				

Sample Types	● Disturbed	U SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-09(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 3.3 (m)
 Drill Date: 03.02.2016
 Logged By: AL

Elevation: 7.255-m
 Easting: 326980.3220
 Northing: 2745380.0480
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH			SO3
20		+	SANDSTONE Yellowish brown, extremely weak, highly weathered & fractured, very thickly bedded, poor to good quality of argillaceous	* SPT 10 20 30 40 50		20																			20	UDC - 4 (20.00 - 20.22m)		
21		+		21																							21	Run - 5 CR - 73% / RQD - 10% UDC - 5 (21.30 - 21.42m)
22		+		22																							22	Run - 6 CR - 100% / RQD - 46%
23		+		23																				0.64			23	UDC - 6 (22.90 - 23.19m)
24		+		24																							24	Run - 7 CR - 73% / RQD - 31% UDC - 7 (24.70 - 24.85m)
25		+		25																							25	Run - 8 CR - 95% / RQD - 60%
26		+		26																				4.07			26	UDC - 8 (25.65 - 25.97m)
27		+		27																							27	Run - 9 CR - 100% / RQD - 77% UDC - 9 (27.15 - 27.37m)
28		+		28																							28	Run - 10 CR - 100% / RQD - 76%
29		+		29																							29	UDC - 10 (29.60 - 29.80m)
30		+	30																						30	0.7		

End of Log @ 30 (m)

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|---|--|--|--|--|--|--|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | Abbreviations
 SPT Sample
■ Water Sample
▽ Groundwater Level | LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|--|--|--|--|--|

Log BH-10

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 12.01.2016
 Logged By: AL

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments			
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH	SO3	CL
0			SAND <i>Brown, silty fine grained</i>	* SPT 10 20 30 40 50		0																							
1		U	SAND <i>Greyish brown, loose to very dense, fine to coarse grained, some silt & traces of gravel</i>	* 8		1																			1	SPT - 1			
2		U				2																				2	SPT - 2		
3		U		* 50		3	SM	8.8	66.1	25.1		NLL	-	NPI	9.4	1.66	1.82							7.3	0.07	0.65	3	SPT - 3 SPT Drive - 90mm	
4		U		* 50		4																					4	SPT - 4 SPT Drive - 110mm	
5		U		* 50		5																						5	SPT - 5 SPT Drive - 90mm
6		U		* 50		6																						6	SPT - 6 SPT Drive - 80mm
7		U		* 50		7	SM	3.9	68.1	28		NLL	-	NPI	13	1.66	1.88											7	SPT - 7 SPT Drive - 80mm
8		U		* 50		8																						8	
9		U		* 50		9																						9	
10		+	SANDSTONE <i>Yellowish brown, extremely weak, highly weathered &</i>			10																		0.2				10	SPT - 7 Run - 1 CR - 51% / RQD - 41% UDC - 1 (0.58 - 0.69m)

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-10

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 12.01.2016
 Logged By: AL

Elevation: 29.371-m
 Easting: 327013.0285
 Northing: 2746973.4181
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10			fractured, very thickly bedded, poor to good quality of argillaceous of argillaceous	* SPT 10 20 30 40 50		10																		10		
11			SAND Brownish grey, very dense, fine to coarse grained, some silt & traces of gravel			11																		11	SPT Drive - 120mm	
12		U				12	SM	1.6	73.1	25.3	NLL	-	NPI	9.5	1.66	1.82								12	SPT - 8 SPT Drive - 250mm	
13		U				13																		13	SPT - 9 SPT Drive - 200mm	
14		U				14																		14		
15		U	End of Log @ 15 (m)			15																		15	SPT - 10 SPT Drive - 30mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U Undisturbed W Water Sample G Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-10(A)

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 30 (m)
 GWL: 3.8 (m)
 Drill Date: 06.02.2016
 Logged By: AL

Elevation: 8.657-m
 Easting: 326977.3078
 Northing: 2745501.377
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	F _i (o)	Cc	Cs		Pc (kg/cm2)	PH	SO ₃			CL
20			SANDSTONE <i>Yellowish brown, extremely weak, highly weathered & fractured, very thickly bedded, closely jointed, fair to good quality of argillaceous, friable</i>	* SPT 10 20 30 40 50	SANDSTONE	20																				20	UDC - 6 (19.60 - 19.97m)		
21		+					21																					21	Run - 7 CR - 70% / RQD - 53% UDC - 7 (21.00 - 21.25m)
22		+					22																					22	Run - 8 CR - 77% / RQD - 52% UDC - 8 (22.35 - 22.55m)
23							23																					23	
24		+					24																					24	Run - 9 CR - 82% / RQD - 62% UDC - 9 (24.15 - 24.37m)
25							25																					25	Run - 10 CR - 84% / RQD - 78% UDC - 10 (26.60 - 26.85m)
26							26																					26	
27		+					27																					27	Run - 11 CR - 100% / RQD - 82% UDC - 11 (28.10 - 28.40m)
28							28																					28	Run - 12 CR - 100% / RQD - 84% UDC - 12 (29.10 - 29.61m)
29		+					29																					29	

End of Log @ 30 (m)

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|---|--|--|--|--|--|--|
| Sample Types
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter | SPT Sample
▬ Water Sample
▬ Groundwater Level | Abbreviations
LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
NPI : None PI | C : Cohesion
Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU) | Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff. | w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow | CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained |
|---|--|--|--|--|--|--|

Log BH-11

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 15.01.2016
 Logged By: AL

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Yellowish brown, silty fine to coarse grained,			0																				
1		U	SAND Brown, medium dense, silty fine to coarse grained,	* 20		1	SM	63.5	36.5		NLL	-	NPI	4.3	1.75	1.83										SPT - 1
2		U	SILT Brown, hard, non-plastic, some sand & traces of gravel	* 35		2	ML	0.4	26.3	73.3	NLL	-	NPI	12	1.66	1.86										SPT - 2
3		U	SAND Brown, dense to very dense, fine to coarse grained, little to some silt & traces of gravel	* 50		3	SM	7.3	77.7	15	NLL	-	NPI	12.8	1.72	1.94										SPT - 3
4		U				4																				
5		U				5																				
6		U				6	SM	1.2	76.9	21.9	NLL	-	NPI	9.1	1.66	1.81										SPT - 4
7		U				7																				
8		U	SANDSTONE Yellowish brown, extremely weak, highly weathered & fractured, very thickly bedded, poor to excellent quality of friable	* 43		8																				SPT - 5
9		+				9																				Run - 1
10		+				10																				CR - 67% / RQD - 35% UDC - 1 (8.15 - 8.39m)
																										Run - 2
																										CR - 100% / RQD - 87% UDC - 2 (9.60 - 9.85m)

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample	⌚ Water Sample ⌚ Groundwater Level	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-11

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 19.5 (m)
 GWL:- Not Encountered
 Drill Date: 15.01.2016
 Logged By: AL

Elevation: 29.240-m
 Easting: 328839.5589
 Northing: 2746971.733
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		PH
10		■	SANDSTONE Yellowish brown, extremely weak, highly weathered & fractured, thickly bedded, poor to excellent quality of friable			10																		Run - 3 CR - 95% / RQD - 96% UDC - 3 (11.02 - 11.21m)		
11		+				11																				
12		U	SAND Brown, dense, silty fine to coarse grained, traces of gravel	* 45		12	SM	2.2	63.4	34.4		NLL	-	NPI	18.5	1.67	1.98							SPT - 6		
13		U		* 44		13																		SPT - 7		
14		U				14																				
15		U	CLAY / SILT Greyish brown, very hard, silty clay / clayey silt, traces of fine grained sand	* 50		15	CL-ML	16	39.9	44.1	25.4	20.6	4.8	12.7	1.67	1.88								SPT - 8 SPT Drive - 350mm		
16		U		* 50		16																		SPT - 9 SPT Drive - 200mm		
17		U		* 50		17																		SPT - 10 SPT Drive - 250mm		
18		U		* 50		18																		SPT - 11 SPT Drive - 240mm		
19		U	SAND Greyish brown, very dense fine to coarse grained, little silt	* 50		19																				
			End of Log @ 19.5 (m)																							

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations U U SPT Sample ■ Water Sample □ Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-12

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 14.01.2016
 Logged By: AL

Elevation: 29.155-m
 Easting: 329032.9825
 Northing: 2746971.733
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND <i>Brown, fine to coarse grained, some gravel</i>	* SPT 10 20 30 40 50		0																				
1		U	SAND <i>Greyish brown, medium dense to dense, silty fine to coarse grained</i>	* 24		1	SM	64.9	35.1		NLL	-	NPI	8.2	1.6	1.73						7.3	0.07	0.37	SPT - 1	
2		U				2																				
3		U		* 38		3																			SPT - 2	
4		U		* 48		4																			SPT - 3	
5		U				5																				
6		U	SILT <i>Yellow, hard, fine to coarse grained sandy, some clay</i>	* 50		6	ML	45.6	32.7	21.7	NLL	-	NPI	14.5	1.67	1.91									SPT - 4	
7		U		* 50		7																			SPT - 5	
8		U				8																			SPT Drive - 60mm	
9		U	SAND <i>Brown, very dense, silty fine to coarse grained, traces of gravel</i>	* 50		9																			SPT - 6	
10						10																			SPT Drive - 60mm	

Sample Types	● Disturbed	U SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-12

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 14.01.2016
 Logged By: AL

Elevation: 29.155-m
 Easting: 329032.9825
 Northing: 2746971.733
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
10		U	SAND Brown, very dense, silty fine to coarse grained, traces of gravel	* SPT 10 20 30 40 50		10	SM	3.3	62.6	34.1				20.6	1.74	2.1									10	SPT - 7
11		+	CLAYSTONE Brown, extremely weak to very weak, highly weathered & fractured, very thickly bedded, very poor to fair quality of, interbedded with thin layers of shale			11																		11	SPT Drive - 60mm Run - 1 CR - 87% / RQD - 09% UDC - 1 (11.50 - 11.80)	
12		U		12																					12	SPT - 8
13						13																		13		
14		+				14																		14	Run - 2 CR - 100% / RQD - 66% UDC - 2 (13.75 - 13.91m)	
15			End of Log @ 15 (m)			15																		15		

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations U SPT Sample ■ Water Sample □ Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-13

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 12.01.2016
 Logged By: AL

Elevation: 29.050-m
 Easting: 329232.2844
 Northing: 2746971.0231
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Brown, silty fine grained			0																				
1		U		* 21		1	SM	0.8	59.3	39.8		NLL	-	NPI	12.6	1.66	1.87									SPT - 1
2		U	SAND Yellowish brown, medium dense to dense, silty fine to coarse grained, traces of gravel			2																				SPT - 2
3		U		* 46		3																				SPT - 2
4		U		* 50		4																				SPT - 3
5		U	SAND Yellowish brown, very dense, fine to coarse grained, little gravel, traces of silt			5	SP	14.3	82.1	3.6		NLL	-	NPI	16.6	1.84	2.15									SPT Drive - 250mm
6		U		* 50		6																				SPT - 4
7		U		* 50		7																				SPT - 5
8		U	SANDSTONE Yellowish brown, extremely weak, highly weathered & fractured, thickly bedded, fair quality of argillaceous			8																				Run - 1 CR - 100% / RQD - 51% UDC - 1 (8.10 - 8.35m)
9		U	SAND Yellowish brown, very dense, fine to coarse grained, some silt & traces of silt			9																				SPT - 6 SPT Drive - 350mm
10						10																				

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-13

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 12.01.2016
 Logged By: AL

Elevation: 29.050-m
 Easting: 329232.2844
 Northing: 2746971.0231
 Rev. BY: MZS

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
10		UU	SAND Yellowish brown, very dense, fine to coarse grained, some silt & traces of gravel	* SPT 10 20 30 40 50 * 50		10	SM	4.5	69.2	26.2		NLL	-	NPI	14.6	1.66	1.9									10	SPT - 7
12		■	SANDSTONE Yellowish brown, extremely weak, highly weathered & fractured, thickly bedded, poor to fair quality of argillaceous			12																				12	Run - 2 CR - 80% / RQD - 27% UDC - 2 (13.35 - 13.60m)
14		+				14																				14	Run - 3 CR - 93% / RQD - 70% UDC - 3 (14.29 - 14.49m)
15			End of Log @ 15 (m)			15																				15	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations UU : SPT Sample ■ Water Sample □ Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-14

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 10.01.2016
 Logged By: AL

Elevation: 29.011-m
 Easting: 329416.3391
 Northing: 2746970.729
 Rev. BY: MZS

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			SAND <i>Brown, fine to coarse grained, some silt</i>	* SPT 10 20 30 40 50		0																					
1		U	SAND <i>Brown, medium dense to very dense, fine to coarse grained, some silt & traces of gravel</i>	* 14		1	SM	3.2	72.1	24.7		NLL	-	NPI	8.2	1.89	2.04							7.6	0.12	0.66	SPT - 1
2		U		* 16		2																					SPT - 2
3		U				3																					SPT - 3
4		U		* 50		4																					SPT Drive - 60mm
5		U				5																					SPT - 4
6		U		* 50		6																					SPT Drive - 350mm
7		U	SILT <i>Brown, dense to very dense, fine to coarse grained sandy, little clay</i>	* 35		7	ML	32.4	47.7	19.9		NLL	-	NPI	15.2	1.66	1.91										SPT - 5
8		U				8																					SPT - 6
9		U		* 50		9																					SPT Drive - 60mm
10						10																					

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-14

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 16 (m)
 GWL:- Not Encountered
 Drill Date: 10.01.2016
 Logged By: AL

Elevation: 29.011-m
 Easting: 329416.3391
 Northing: 2746970.729
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3		
10		U	SILT Brown, medium dense to very dense, fine to coarse grained sandy, little clay	* SPT 10 20 30 40 50	* 50	10																					10	SPT - Drive - 350mm
11		U	SAND Brown, dense to very dense, silty fine to coarse grained, traces of silt		* 44	11																					11	
12		U			* 50	12	SM	1.3	55.5	43.2	NLL	-	NPI	21.3	1.66	2.01										12	SPT - 8	
13		U			* 50	13																				13	SPT - 9	
14		U			* 50	14																				14		
15		U			* 50	15																				15	SPT - 10 SPT Drive - 260mm	
16		U	End of Log @ 16 (m)		* 50	16																				16	SPT - 11 SPT - Drive 150mm	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-15

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 05.01.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments		
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm ²)	Fi (o)	Cc	Cs	Pc (kg/cm ²)	qu (kg/cm ²)			PH	SO ₃
0			SAND <i>Brown, silty fine to coarse grained, traces of gravel</i>	* SPT 10 20 30 40 50		0																						
1		U				1																						
2		U	SAND <i>Brown, dense to very dense, silty fine to coarse grained</i>	* 33		2	SM	65.6	34.4		NLL	-	NPI	6.1	1.85	1.96							7.6	0.06	0.55	SPT - 1		
3		U		* 38		3																					SPT - 2	
4		U				4																						
5		U		* 50		5																						SPT - 3
6		U	SILT <i>Brown, very hard, clayey, some sand</i>	* 50		6	ML	22	45.3	32.7	NLL	-	NPI	9.6	1.66	1.82											SPT - 4 SPT Drive - 60mm	
7		U				7																						
8		U	SAND <i>Brown, very dense, silty fine to coarse grained, traces of gravel</i>	* 50		8																						SPT - 5 SPT Drive - 30mm
9		U				9																						
10				* 50		10																						SPT - 6 SPT Drive - 50mm

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U U ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-15

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 05.01.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3			CL
10		U	SAND <i>Brown, very dense, silty fine to coarse grained, traces of gravel</i>	* SPT 10 20 30 40 50		10	SM	2.5	62.1	35.4	NLL	-	NPI	16.4	1.87	2.18										10	SPT - 7 SPT Drive - 60mm		
11		U		11		12																				12		12	SPT - 8 SPT Drive - 60mm
13		U		13		13																				13		13	SPT - 9 SPT Drive - 60mm
14		U		14		14																				14		14	SPT - 10 SPT Drive - 60mm
15		U	End of Log @ 15 (m)	* 50		15																			15				

Sample Types	● Disturbed	U SPT Sample	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample	PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level	PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter		NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-16

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 03.01.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments			
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	F1 (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH	SO3	CL
0			SAND <i>Brown, silty fine grained</i>			0																							
1		U	SAND <i>Brown, loose to very dense, fine to coarse grained, traces of gravel & silt</i>	* 9		1																				SPT - 1			
2		U		* 11		2																							
3		U		* 17		3	SM	13.6	66.6	19.8		NLL	-	NPI	4.8	1.57	1.65									SPT - 2			
4		U		* 50		4																							
5		U	SAND <i>Brown, very dense, fine to coarse grained, some silt & little gravel</i>	* 50		5	SM	17.1	60.7	22.2		NLL	-	NPI	12.4	1.85	2.08									SPT - 3 SPT Drive - 200mm			
6		U		* 50		6																				SPT - 4 SPT Drive - 20mm			
7		U		* 50		7																					SPT - 5 SPT Drive - 30mm		
8		U		* 50		8																							
9		U	SAND <i>Brown, very dense, silty fine to coarse grained</i>	* 50		9	SM		69.6	30.4		NLL	-	NPI	15	1.75	2.01									SPT - 6 SPT Drive - 30mm			
10						10																							

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample U Undisturbed W Water Sample G Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-16

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 03.01.2016
 Logged By: AL

Elevation: 30.044-m
 Easting: 329821.7550
 Northing: 2746967.411
 Rev. BY: MZS

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3		
10		U	SAND Brown, very dense, silty fine to coarse grained	* SPT 10 20 30 40 50		10																			10	SPT - 7 SPT Drive - 20mm		
11							11																				11	
12		U					12																				12	SPT - 8 SPT Drive - 60mm
13		U					13																				13	SPT - 9 SPT Drive - 60mm
14		U					14																				14	SPT - 10 SPT Drive - 60mm
15			End of Log @ 15 (m)			15																			15			

Sample Types	● Disturbed	U SPT Sample	Abbreviations	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
	+ Undisturbed	W Water Sample		PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
	□ Shelby / U4	∇ Groundwater Level		PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
	■ Core Cutter			NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-17

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 03.02.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments					
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH	SO3	CL		
0			SAND Greyish yellow, fine to coarse grained, little silt	* SPT 10 20 30 40 50		0																									
1		U	SAND Yellow, very dense, fine to coarse grained, little silt & traces of gravel	* 50		1	SM	7.8	77.7	14.5		NLL	-	NPI	4.4	1.89	1.97									7.5	0.05	0.67	SPT - 1 SPT Drive - 330mm		
2		U				2																									
3		U				3																									SPT - 2 SPT Drive - 350mm
4		U	SAND Yellow, dense, fine to coarse grained, little gravel & traces of silt	* 35		4	SW-SM	16	75.2	8.8		NLL	-	NPI	2.9	1.66	1.71													SPT - 3	
5		U				5																									
6		U				6																									SPT - 4
7		U	SAND Yellowish brown, dense to very dense, silty fine to coarse grained, traces of gravel	* 46		7																									
8		U				8	SM	2.4	67.2	30.4		NLL	-	NPI	7	1.6	1.71													SPT - 5	
9		U				9																									
10						10																									SPT - 6 SPT Drive - 230mm

<p>Sample Types</p> <ul style="list-style-type: none"> ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter 	<p>Abreviations</p> <ul style="list-style-type: none"> U U SPT Sample W Water Sample Δ Groundwater Level 	<p>LL : Liquid Limit</p> <p>PL : Plastic Limit</p> <p>PI : Plastic Index</p> <p>NPI : None PI</p>	<p>C : Cohesion</p> <p>Phi : Friction Angle</p> <p>C' : Cohesion (CU)</p> <p>Phi' : Friction Angle (CU)</p>	<p>Cc : Cc</p> <p>Cs : Cs</p> <p>Pc : Pre-Consolidation Pressure</p> <p>K : Permeability Coeff.</p>	<p>w : Moisture Content</p> <p>qu : Unconfined Compression qu</p> <p>F : Fast</p> <p>S : Slow</p>	<p>CD : Consolidated, Drained</p> <p>UU : Unconsolidated, Undrained</p> <p>CU : Consolidated, Undrained</p>
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Log BH-17

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 03.02.2016
 Logged By: AL

Elevation: 30.276-m
 Easting: 329814.6573
 Northing: 2746733.431
 Rev. BY: MZS

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm ³)		Direct Shear Test		Consolidation			qu (kg/cm ²)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm ²)	Fi (o)	Cc	Cs		Pc (kg/cm ²)	PH	SO3		
10		UU	SAND Yellowish brown, dense to very dense, silty fine to coarse grained, traces of gravel	* SPT 10 20 30 40 50	* 50	10																				10	SPT - 7 SPT Drive - 50mm	
11		UU			* 50	11																				11		
12		UU			* 50	12																				12	SPT - 8 SPT Drive - 60mm	
13		UU			* 50	13																				13		
14		+	SANDSTONE Yellowish brown, extremely weak, highly weathered & fractured, thickly bedded, poor quality of friable		* 50	14																	0.99				14	SPT - 9 SPT Drive - 60mm Run - 1 CR - 75% / RQD - 27%
15			End of Log @ 15 (m)			15																				15	UDC - 1 (13.80 - 14.10m)	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations UU : SPT Sample ■ Water Sample ▬ Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-18

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 19.02.2016
 Logged By: AL

Elevation: 25.503-m
 Easting: 329827.6976
 Northing: 2746476.568
 Rev. BY: MZS

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
0			SAND Brownish yellow, silty fine to coarse grained, traces of sand	* SPT 10 20 30 40 50		0																					
1		U	SAND Brownish yellow, dense to very dense, medium to coarse grained, traces of silt & gravel	* 32		1	SP	5.8	91	3.2		NLL	-	NPI	1.2	1.69	1.71									SPT - 1	
2		U				2																					SPT - 2
3		U				3																					SPT - 3
4		U				4																					SPT Drive - 350mm
5		U				5																					SPT - 4
6		U	SAND Yellowish brown, very dense, fine to coarse grained, little gravel & traces of silt	* 50		6	SP-SM	12.7	79.7	7.6		NLL	-	NPI	13.9	1.86	2.12										SPT Drive - 150mm
7		U				7																					SPT - 5
8		U				8																					SPT Drive - 70mm
9		U				9																					SPT - 6
10		U				10																					SPT Drive - 350mm

Sample Types	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample	⊞ Water Sample ⊞ Groundwater Level	Abbreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-18

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 19.02.2016
 Logged By: AL

Elevation: 25.503-m
 Easting: 329827.6976
 Northing: 2746476.568
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers &
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3		
10		+	SAND Yellowish brown, very dense, silty fine to coarse grained, little gravel	* SPT 10 20 30 40 50 * 50		10	SM	13.8	40.8	45.4		NLL	-	NPI	20.8	1.69	2.04										10	SPT - 7 SPT Drive - 90mm Run - 1 CR - 69% / RQD - 20% UDC - 1 (10.80 - 11.00m)
11		+	SANDSTONE Brownish grey, extremely weak, highly weathered & fractured, very thickly bedded, poor quality of argillaceous			11																					11	
12		+				12																					12	Run - 2 CR - 66% / RQD - 21% UDC - 2 (12.60 - 12.76m)
13		+				13																					13	
14		+				14																					14	Run - 3 CR - 93% / RQD - 33% UDC - 3 (14.00 - 14.18m)
15			End of Log @ 15 (m)			15																					15	

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	Filed Tests C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	USCS Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	Unit Weight w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	Consolidation CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-19

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 06.02.2016
 Logged By: AL

Elevation: 29.729-m
 Easting: 329807.8335
 Northing: 2747218.026
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers &
 Material Testing Laboratory
 www.sts.com.pk



Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Yellowish brown, fine to coarse grained, trace gravels			0																				
1		U	SAND Yellowish brown, dense, fine to coarse grained, little gravel & silt	* 31		1	SM	13	66.7	20.3		NLL	-	NPI	6.4	1.66	1.77						7.6	0.15	0.66	SPT - 1
3		U	SAND Yellowish brown, dense, fine to coarse grained, little gravel & traces of silt	* 50		3	SW-SM	15	77.4	7.6		NLL	-	NPI	11.4	1.55	1.73									SPT - 2 SPT Drive - 380mm
4		U		* 50		4																				SPT - 3 SPT Drive - 200mm
6		U		* 50		6																				SPT - 4 SPT Drive - 250mm
7		U		* 50		7																				SPT - 5 SPT Drive - 150mm
9		U		* 42		9	SM	22.6	51.2	26.2		NLL	-	NPI	13.2	1.57	1.78									SPT - 6

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	U SPT Sample ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-19

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 06.02.2016
 Logged By: AL

Elevation: 29.729-m
 Easting: 329807.8335
 Northing: 2747218.026
 Rev. BY: MZS

Company Info.
Soil Testing Services
 Geotechnical Engineers &
 Material Testing Laboratory
 www.sts.com.pk



Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs		Pc (kg/cm2)	PH	SO3		
10		■	SANDSTONE <i>Greyish brown, extremely weak, highly weathered & fractured, very thickly bedded, very poor quality of argillaceous</i>	* SPT 10 20 30 40 50				50																				
11		+																						1.68				Run - 1 CR - 62% / RQD - 16% UDC - 1 (10.95 - 11.25m)
12		U																										SPT - 7 SPT Drive - 300mm
13		+																						3.22				Run - 2 CR - 63% / RQD - 28% UDC - 2 (13.28 - 13.49m)
14		+																								Run - 3 CR - 58% / RQD - 15% UDC - 3 (14.10 - 14.36m)		
15			End of Log @ 15 (m)																									

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	Abbreviations U SPT Sample W Water Sample G Groundwater Level	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-20

Project Info.

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.

Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 12.02.2016
 Logged By: AL

Company Info.

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)		
0			SAND Brownish yellow, fine to coarse, grained, some gravels & silt	* SPT 10 20 30 40 50		0																				
1		U				1																				
2		U	SAND Brownish yellow, medium dense to very dense, fine to coarse grained, traces of gravel & silt	* 25		2	SP	5.1	92.4	2.5		NLL	-	NPI	12.3	1.69	1.9						7.8	0.02	0.16	SPT - 1
3		U				3																				SPT - 2 SPT Drive - 450mm
4		U				4																				SPT - 3 SPT Drive - 250mm
5		U				5																				SPT - 4 SPT Drive - 450mm
6		U				6																				SPT - 5 SPT Drive - 350mm
7		U				7																				SPT - 6 SPT Drive - 150mm
8		U	SAND Yellowish brown, very dense, silty fine to coarse grained	* 50		8	SM	56.2	43.8			NLL	-	NPI	11	1.46	1.62									
9		U				9																				
10						10																				

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ▬ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Log BH-20

Project Info.
 Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Location : Port Qasim
 Job No.: K15-1185-101

Borehole Info.
 Depth: 15 (m)
 GWL: Not Encountered
 Drill Date: 12.02.2016
 Logged By: AL

Elevation: 28.304-m
 Easting: 329791.6972
 Northing: 2747455.697
 Rev. BY: MZS

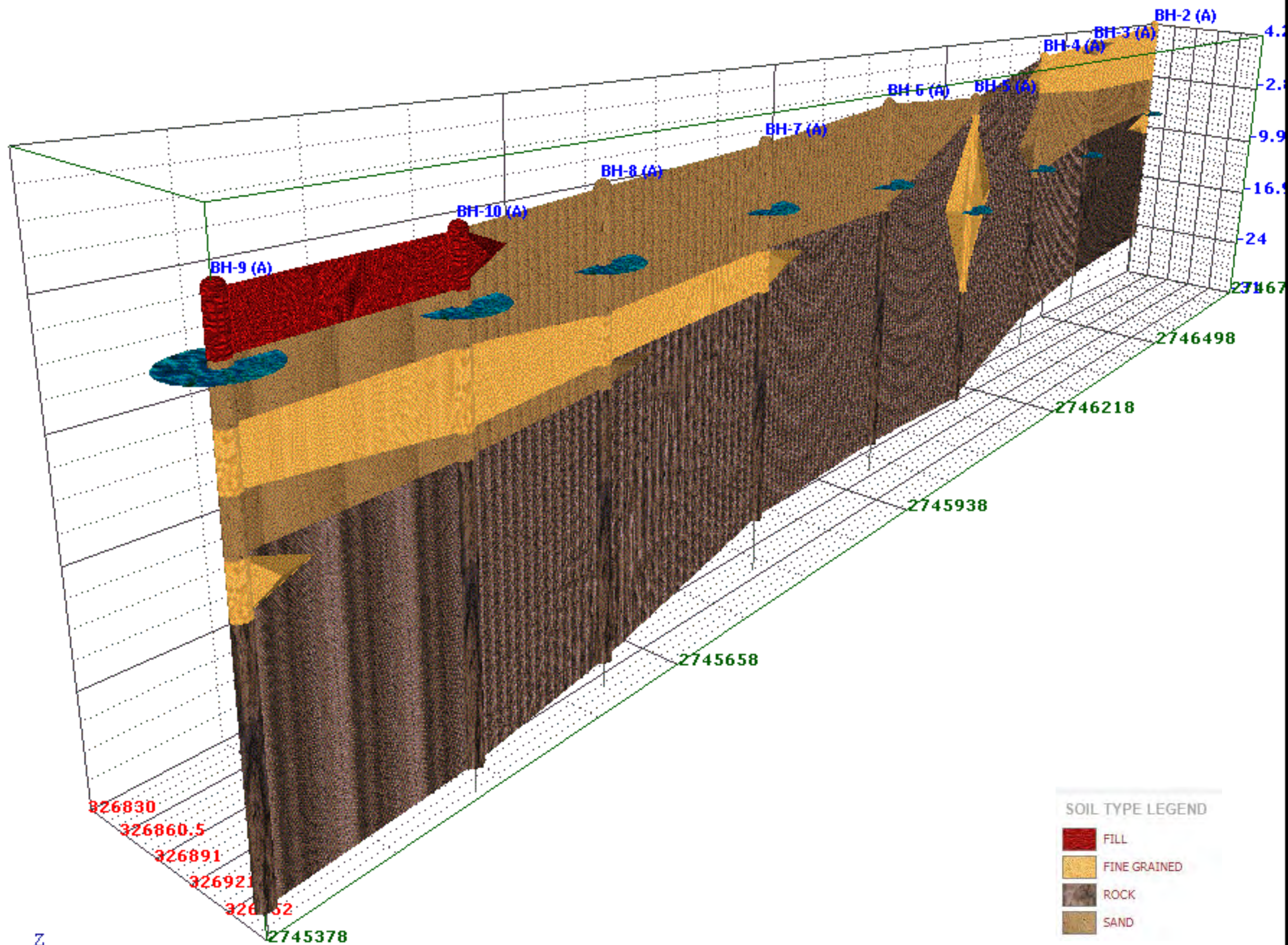
Company Info.
Soil Testing Services
 Geotechnical Engineers &
 Material Testing Laboratory
 www.sts.com.pk

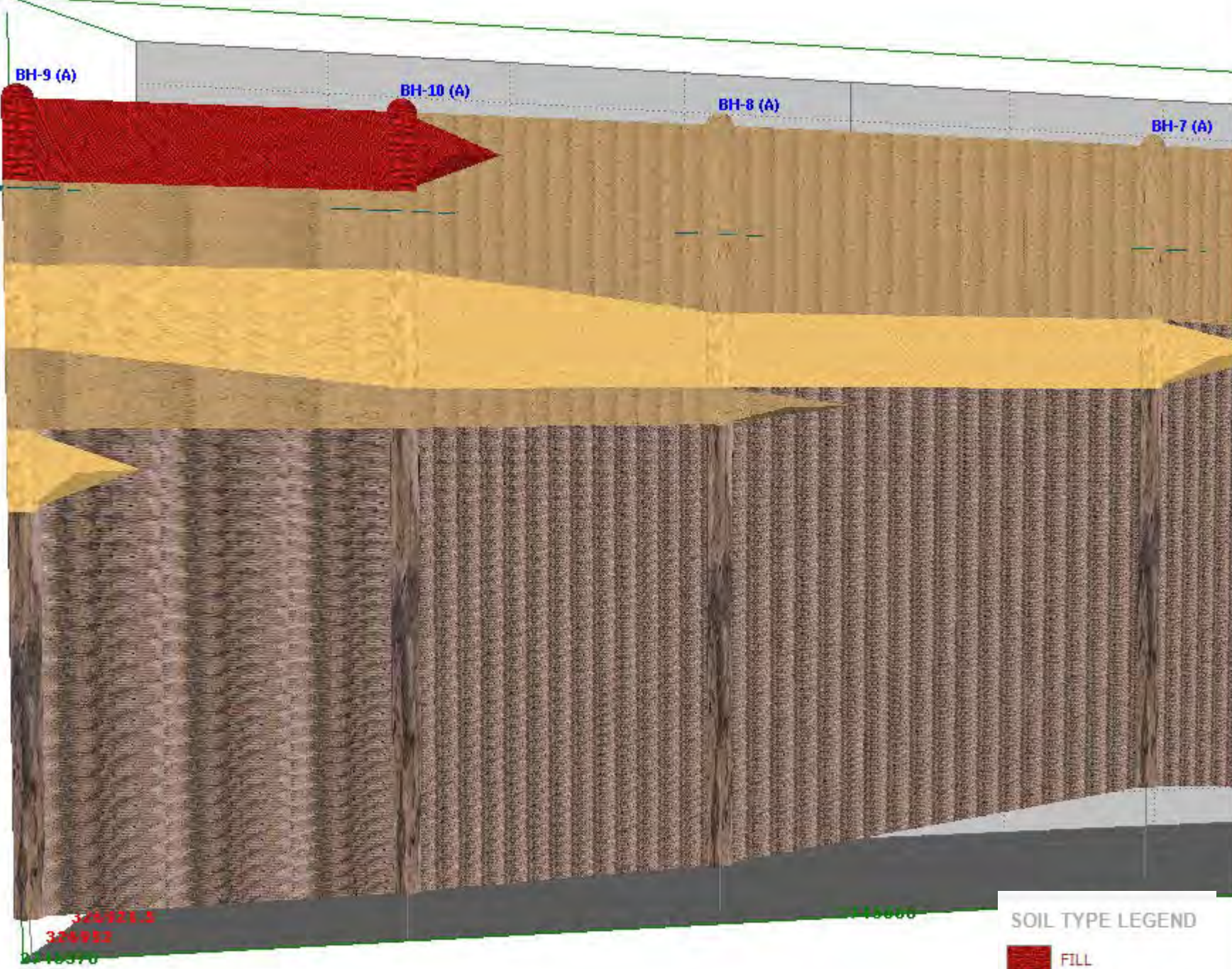


Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			Unit Weight (gr/cm3)		Direct Shear Test		Consolidation			Chemical Tests			Depth (m)	Remarks & Comments	
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)			PH
10		U	SAND Yellowish brown, very dense, silty fine to coarse grained	* SPT 10 20 30 40 50		10	SM	82.7	17.3			NLL	-	NPI	24.2	1.52	1.89									10	SPT - 7 SPT Drive - 350mm
11		U	SAND Yellowish brown, very dense, fine to coarse grained, little silt			11																				11	
12		U				12																				12	SPT - 8 SPT Drive - 450mm
13		U				13																				13	SPT - 9 SPT Drive - 90mm
14		U				14																				14	
15		U	End of Log @ 15 (m)			15																				15	SPT - 10 SPT Drive - 70mm

Sample Types ● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	SPT Sample ▬ SPT Sample ■ Water Sample ▬ Groundwater Level	Abbreviations LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained
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Soil Profile

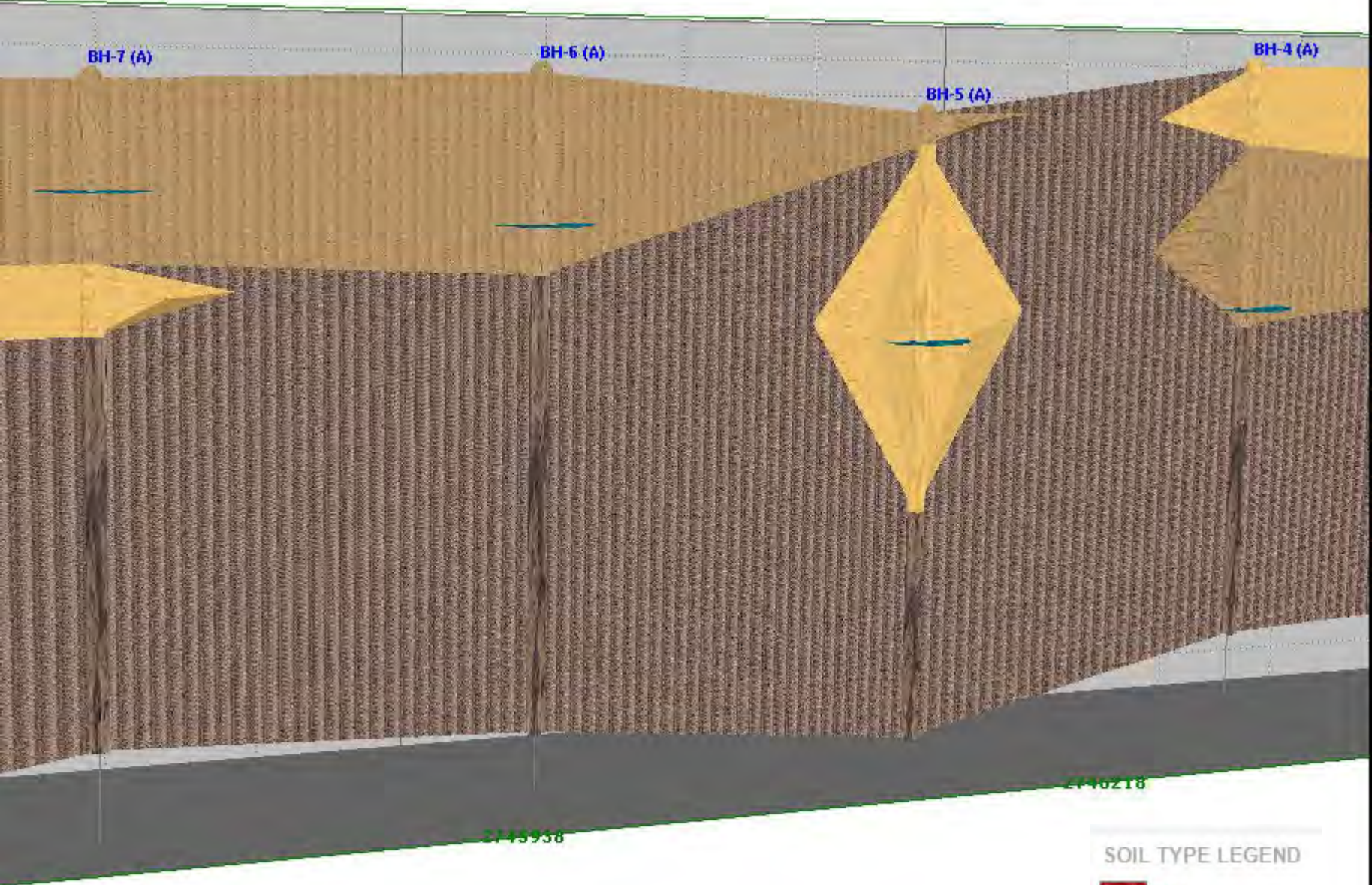




SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND





SOIL TYPE LEGEND

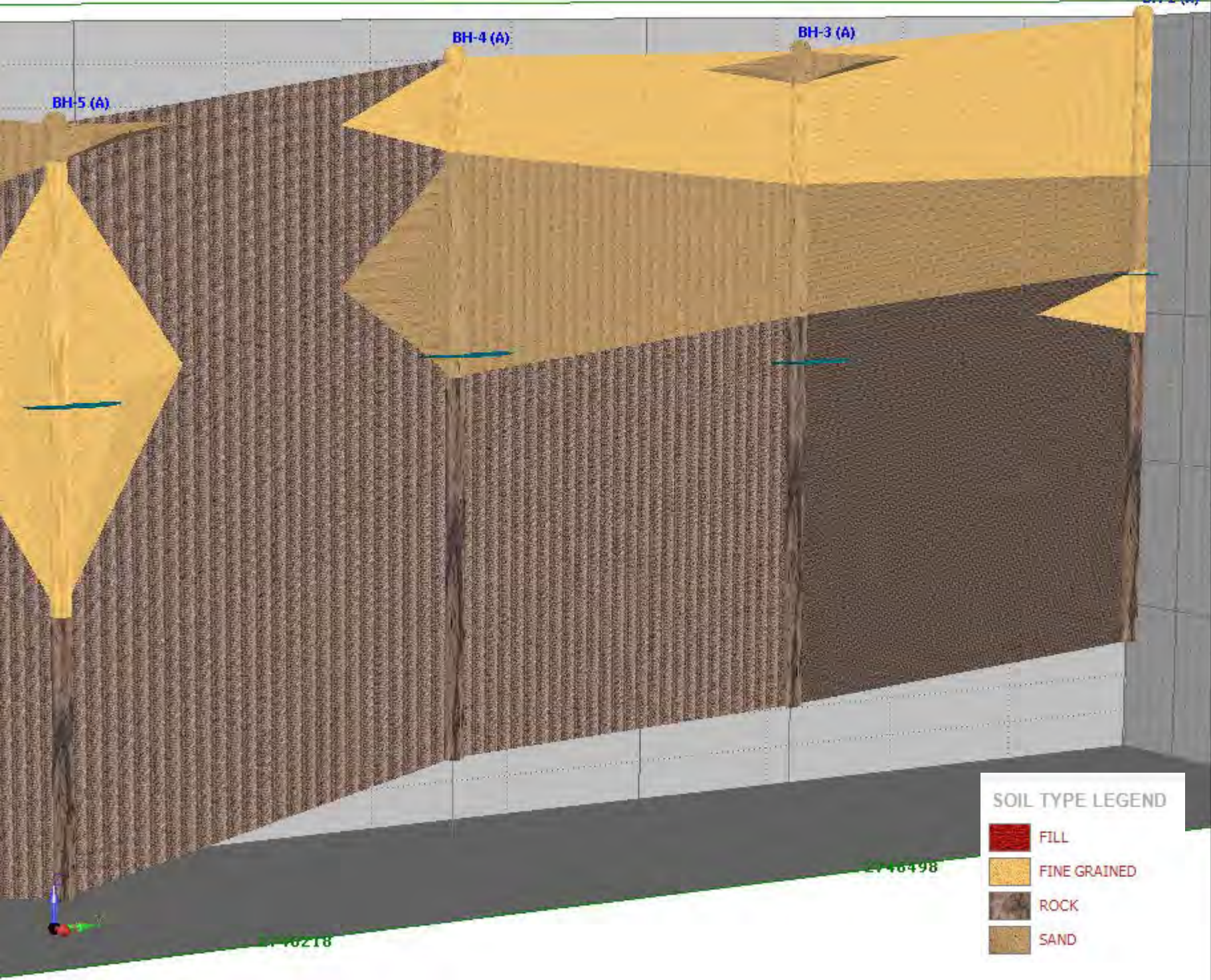
-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



BH-4 (A)

BH-3 (A)

BH-5 (A)

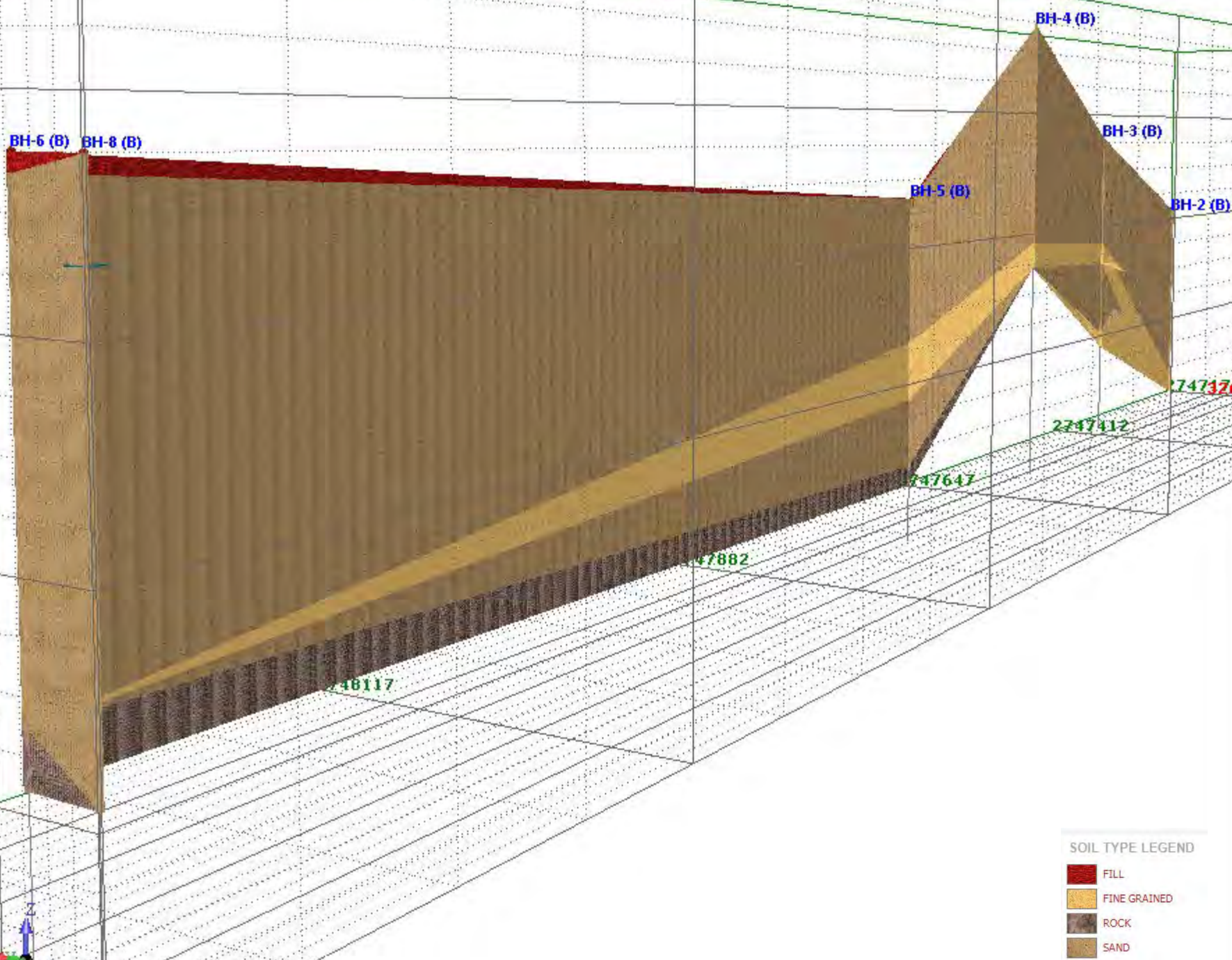


SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND

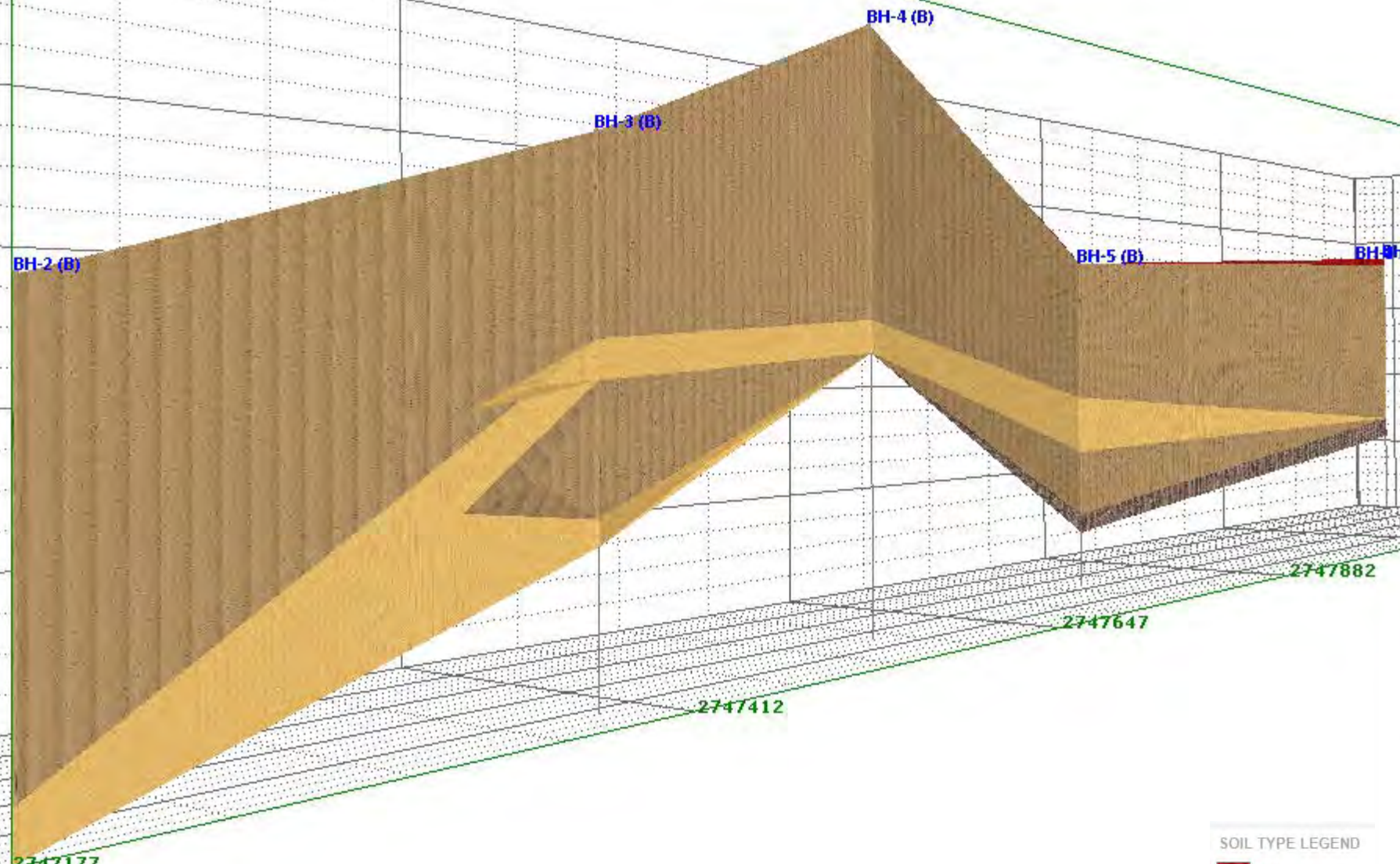
2746498

2746218



SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



SOIL TYPE LEGEND

	FILL
	FINE GRAINED
	ROCK
	SAND



BH-8 (B)

BH-6 (B)



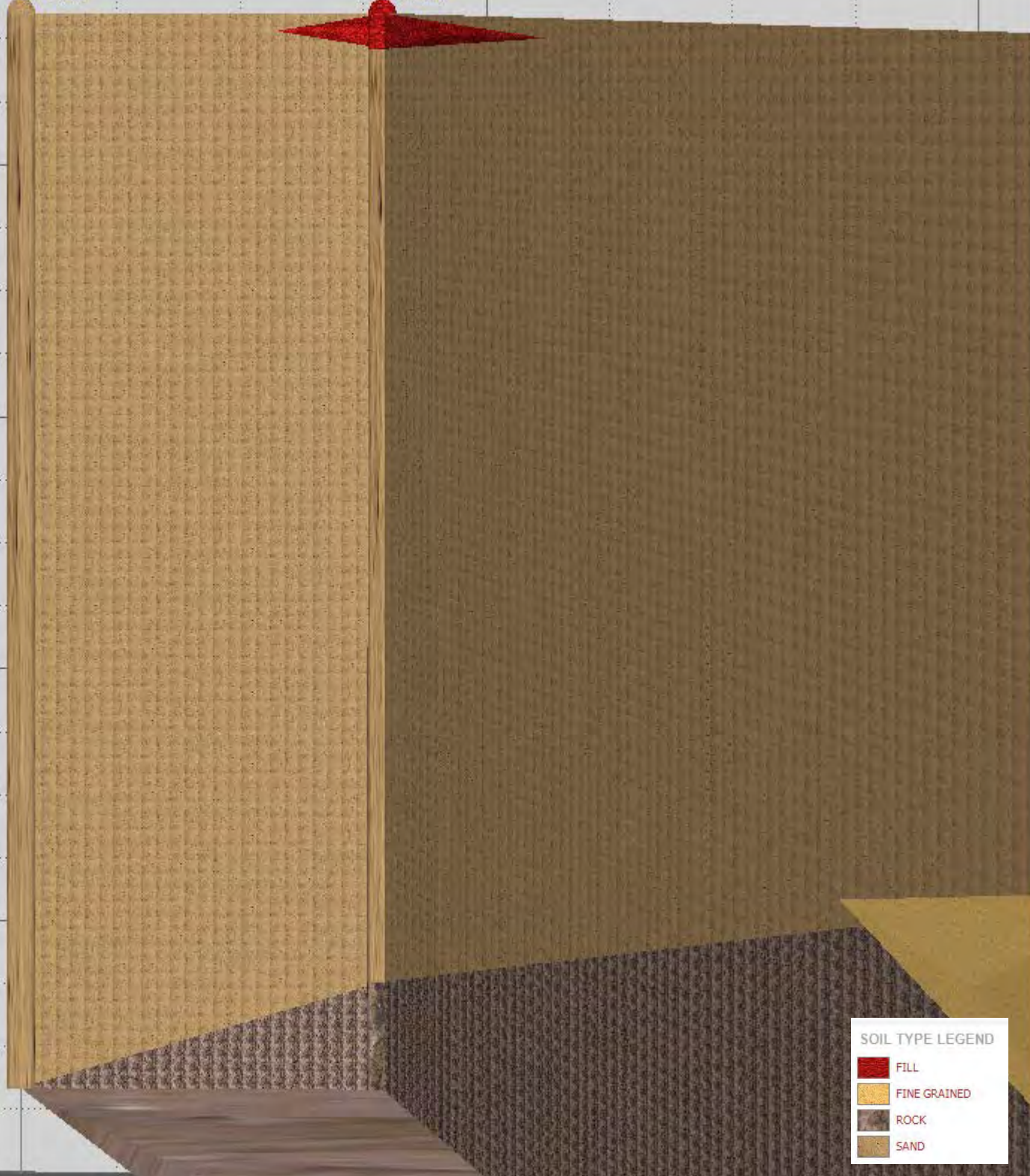
SOIL TYPE LEGEND

	FILL
	FINE GRAINED
	ROCK
	SAND



BH-8 (B)

BH-6 (B)



SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND

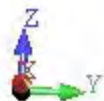


BH-5 (B)

BH-5 (B)

2747882

2748117



SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND

BH-4 (B)

BH-5 (B)



SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND

2747647

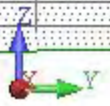


BH-3 (B)



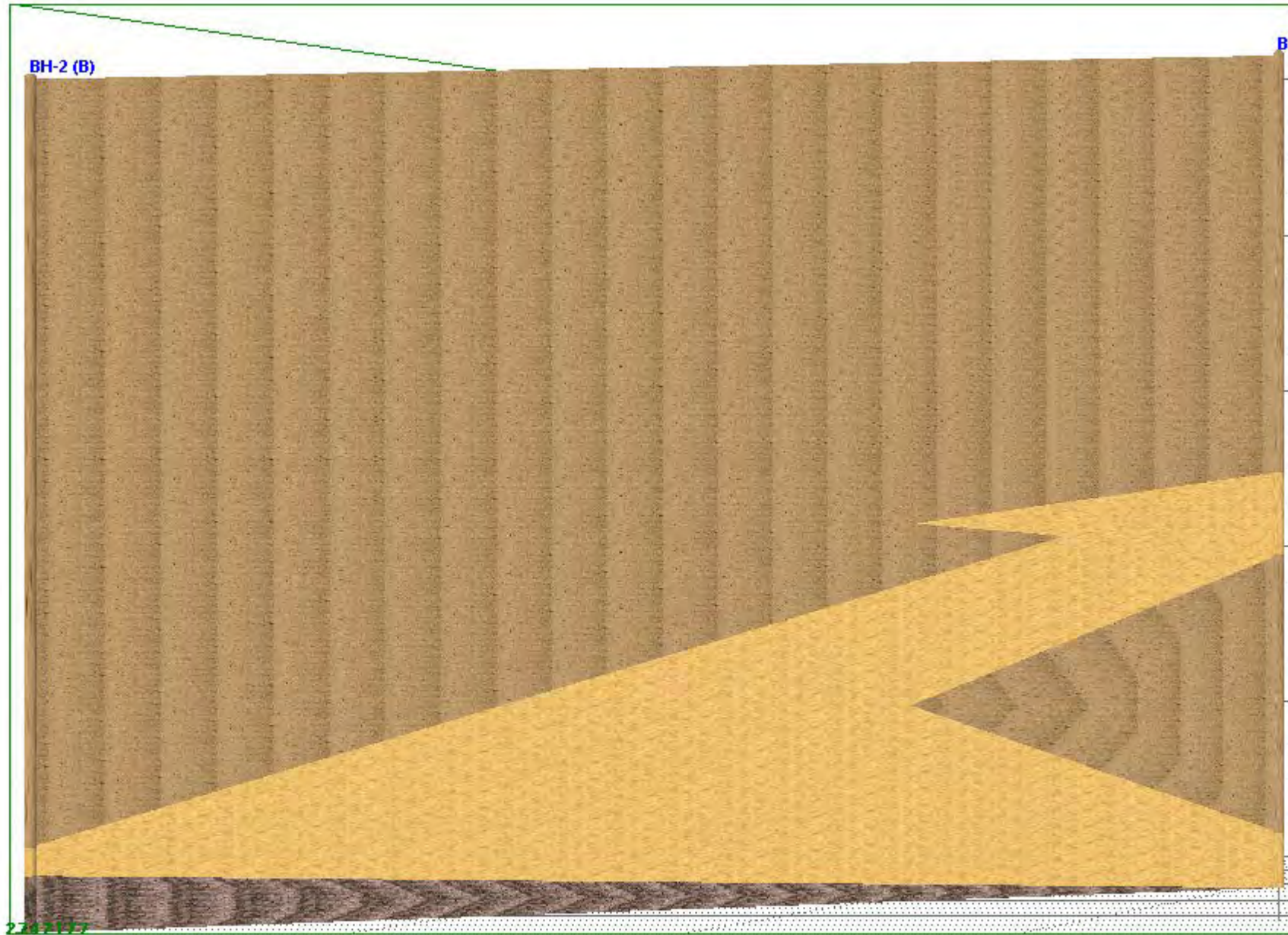
SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



2747412

BH-2 (B)

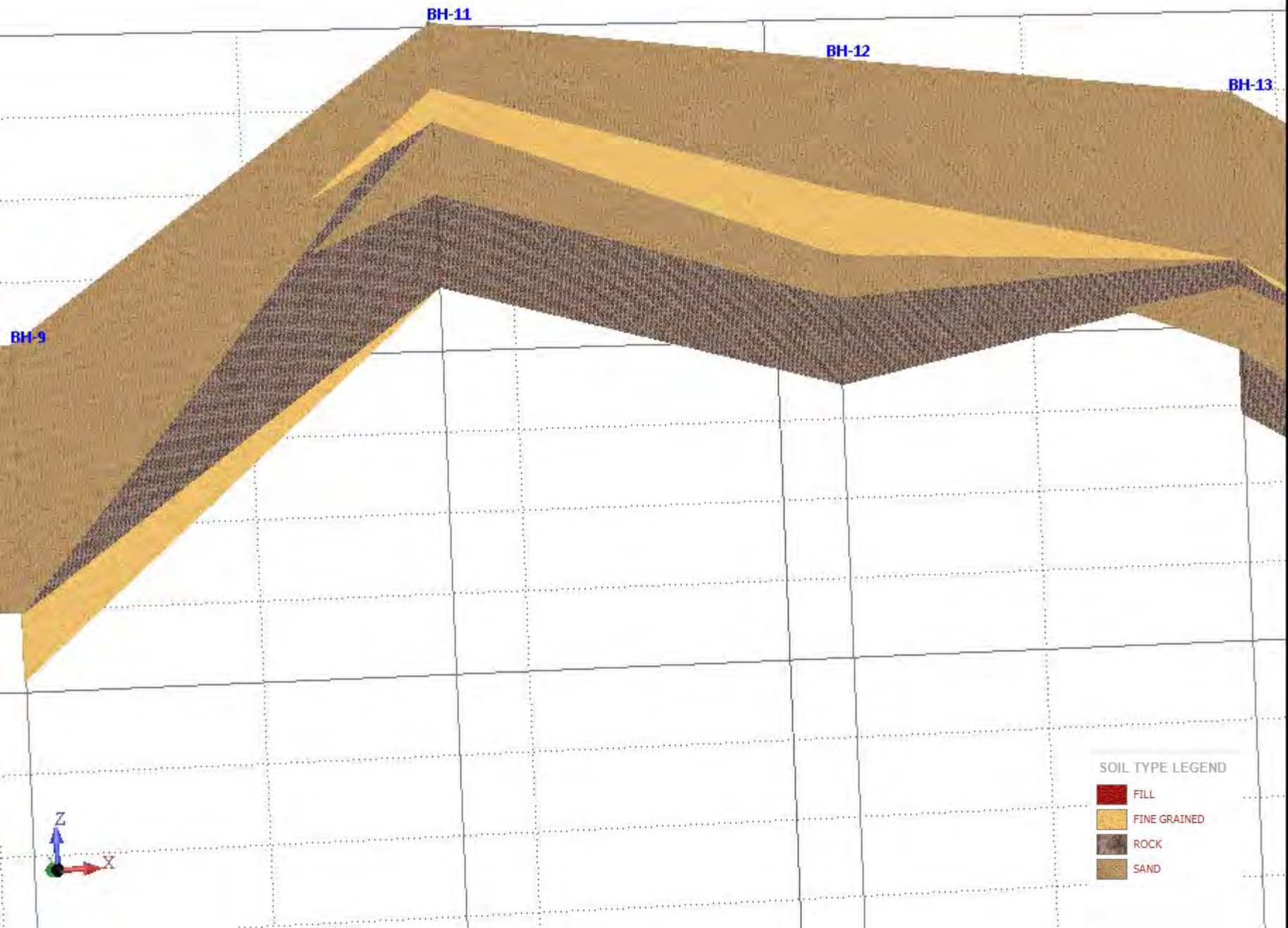


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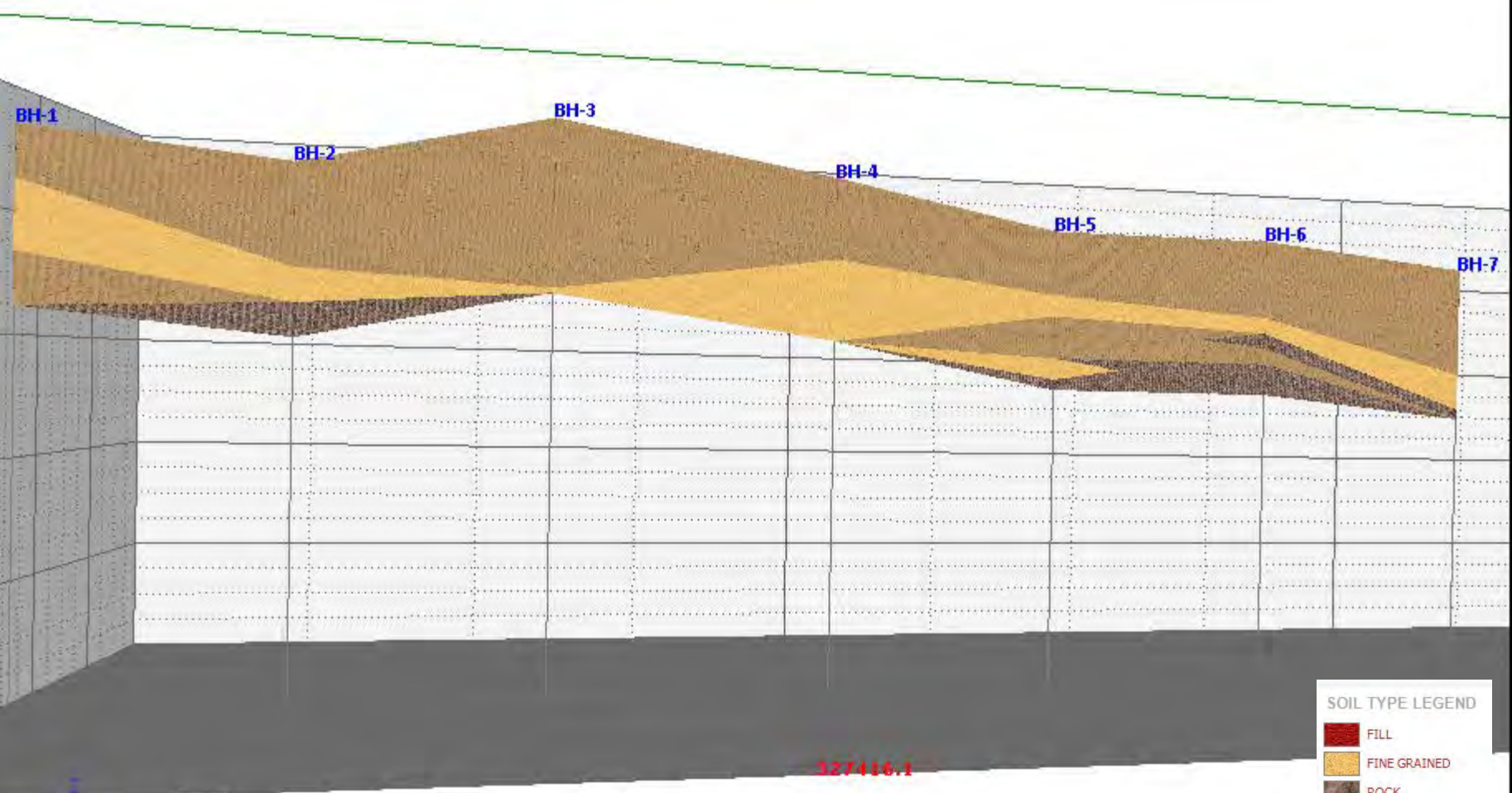
SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



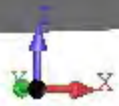
SOIL TYPE LEGEND

	FILL
	FINE GRAINED
	ROCK
	SAND



SOIL TYPE LEGEND

	FILL
	FINE GRAINED
	ROCK
	SAND



72

63.8

55.6

BH-20

BH-19

BH-16

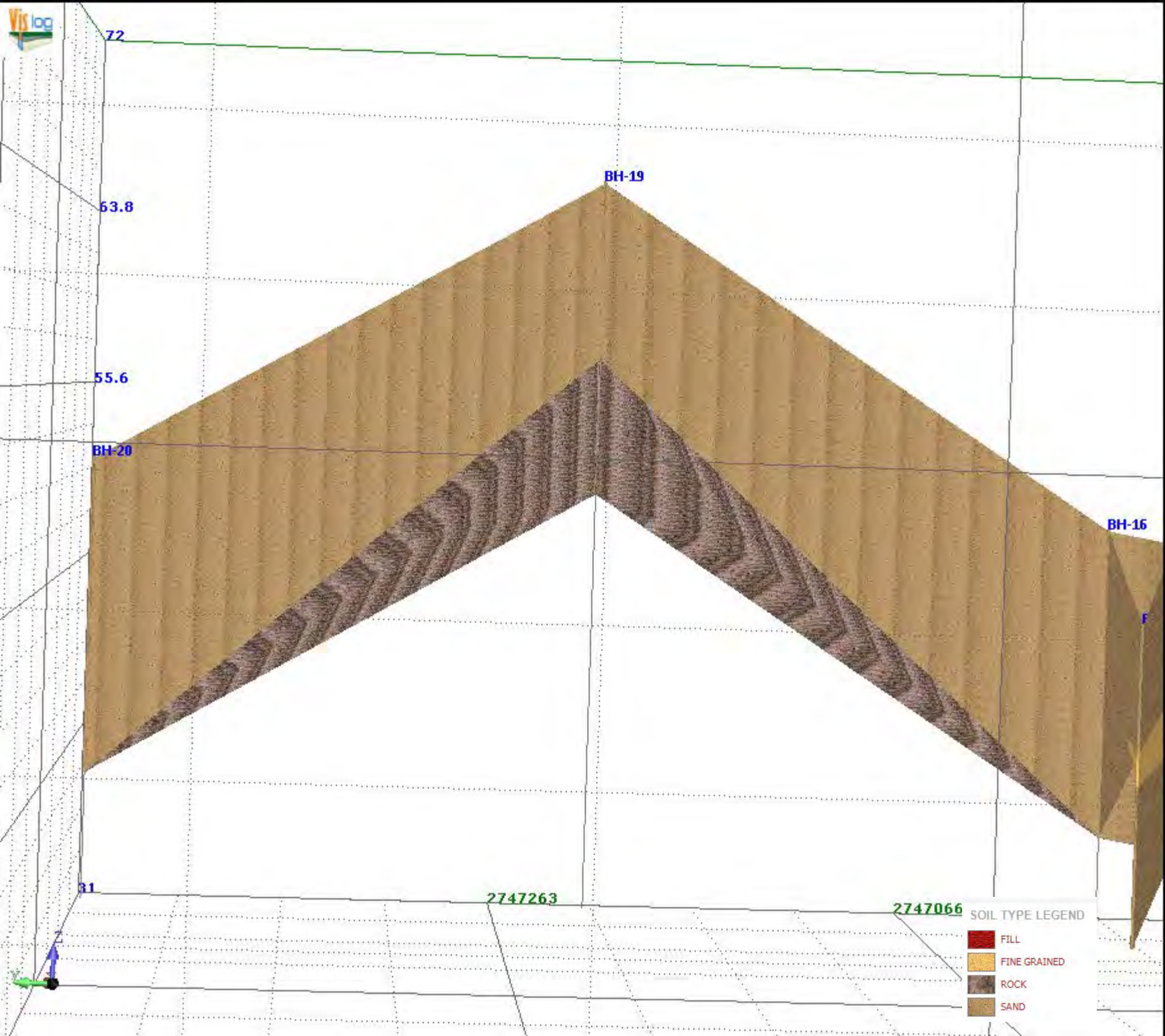
31

2747263

2747066

SOIL TYPE LEGEND

- FILL
- FINE GRAINED
- ROCK
- SAND



BH-18

BH-17 26812.7

BH-3

BH-13

BH-4

BH-2

BH-5

BH-1

BH-14

BH-15

BH-16

2746498

-2746672

2746869

SOIL TYPE LEGEND

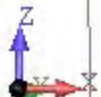
-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



BH-12

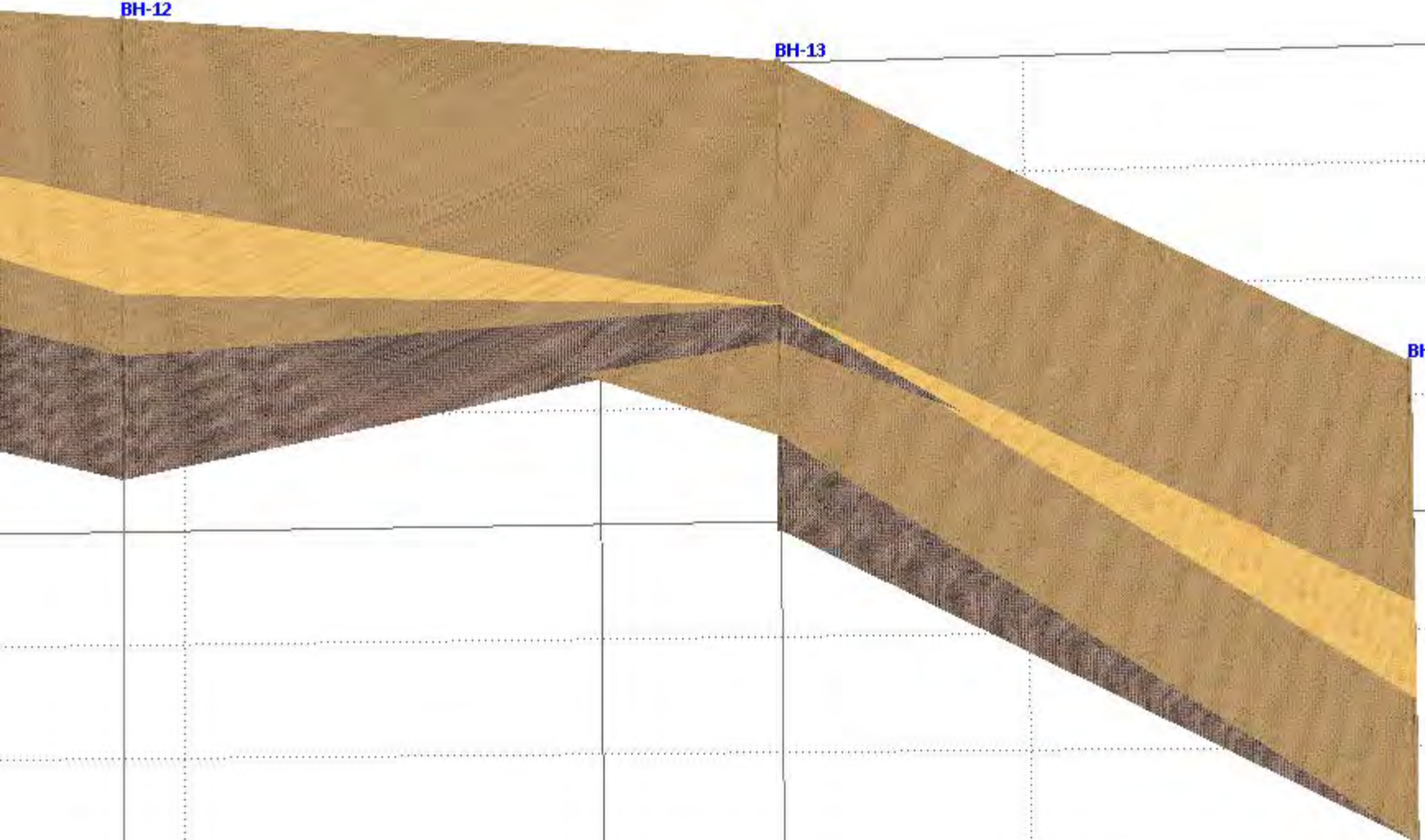
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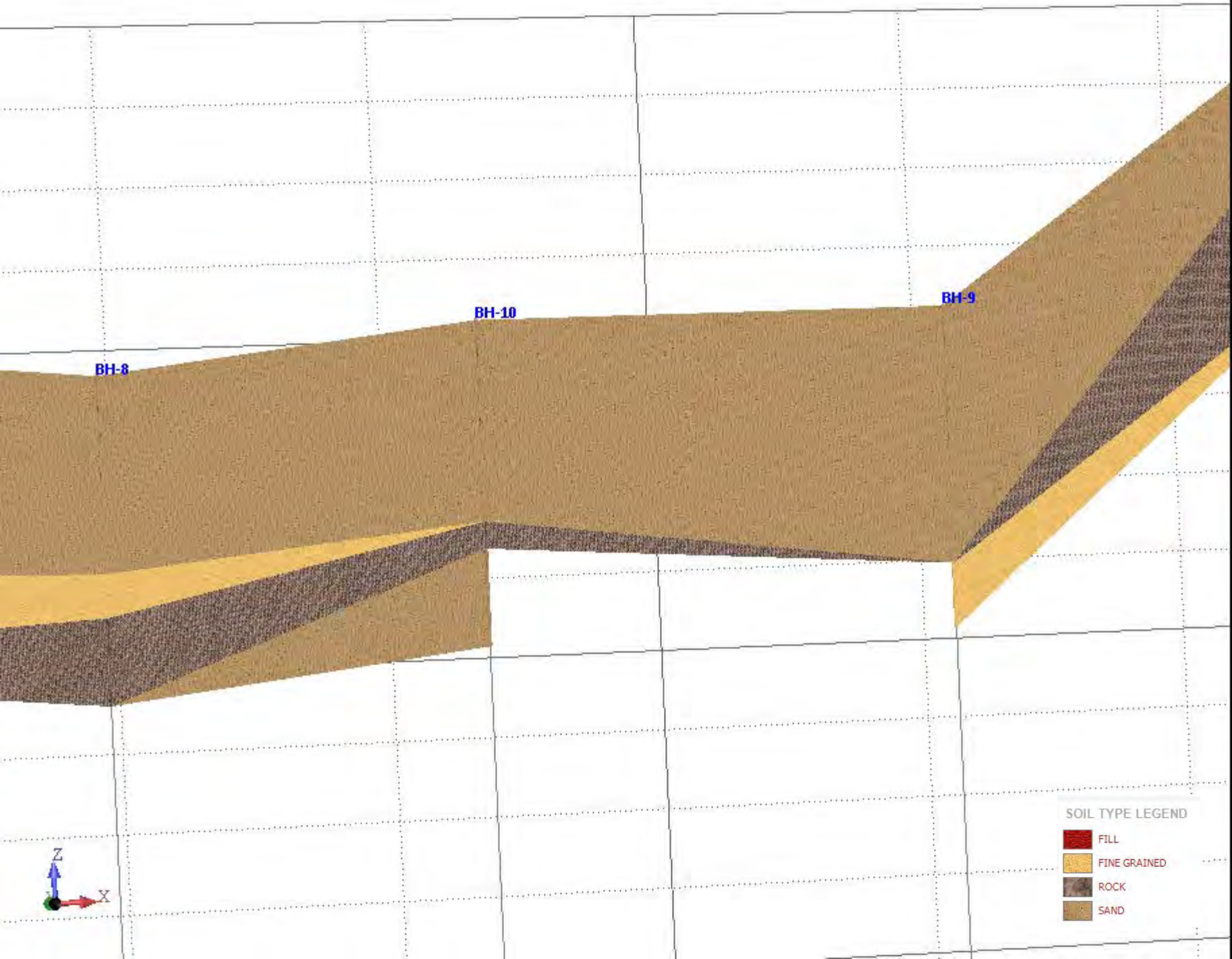
BH-14



SOIL TYPE LEGEND

- FILL
- FINE GRAINED
- ROCK
- SAND

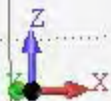
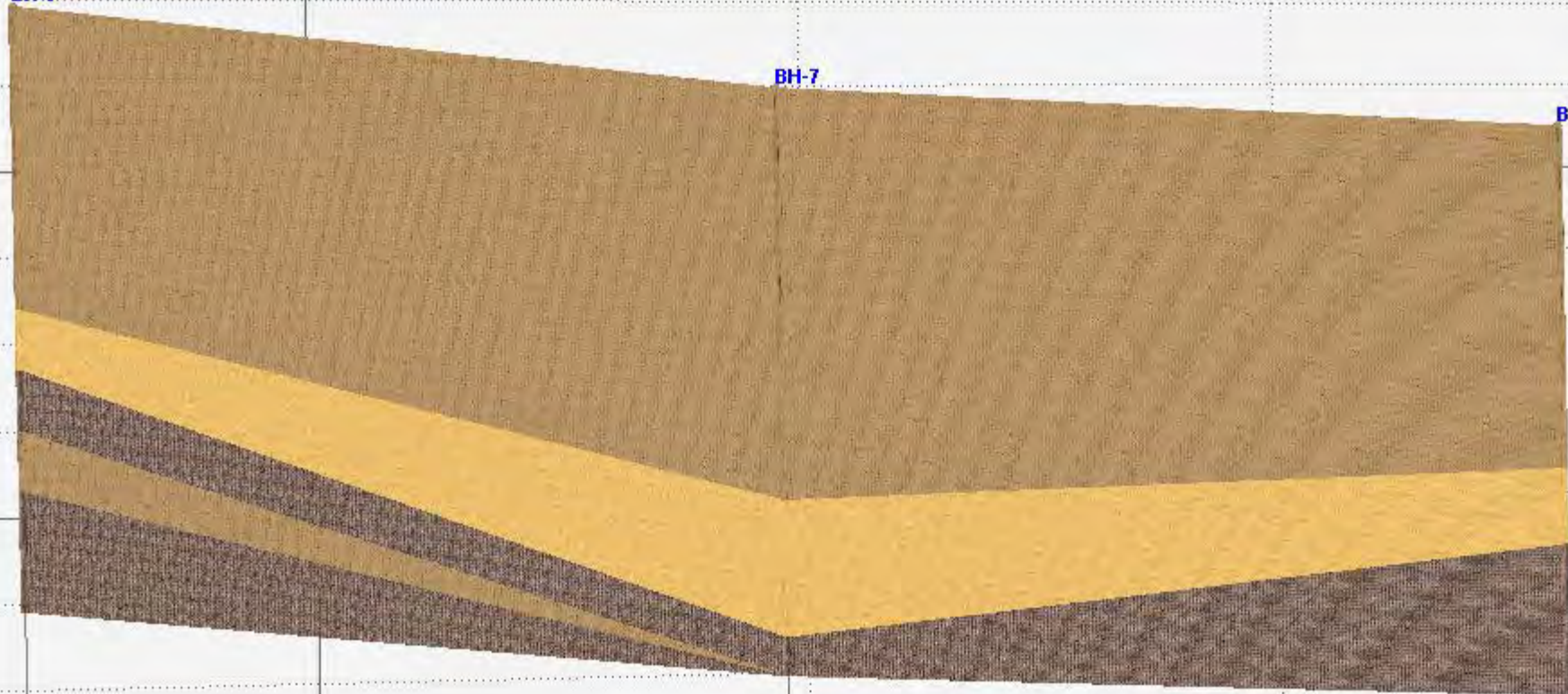








BH-6

BH-7

BH-8

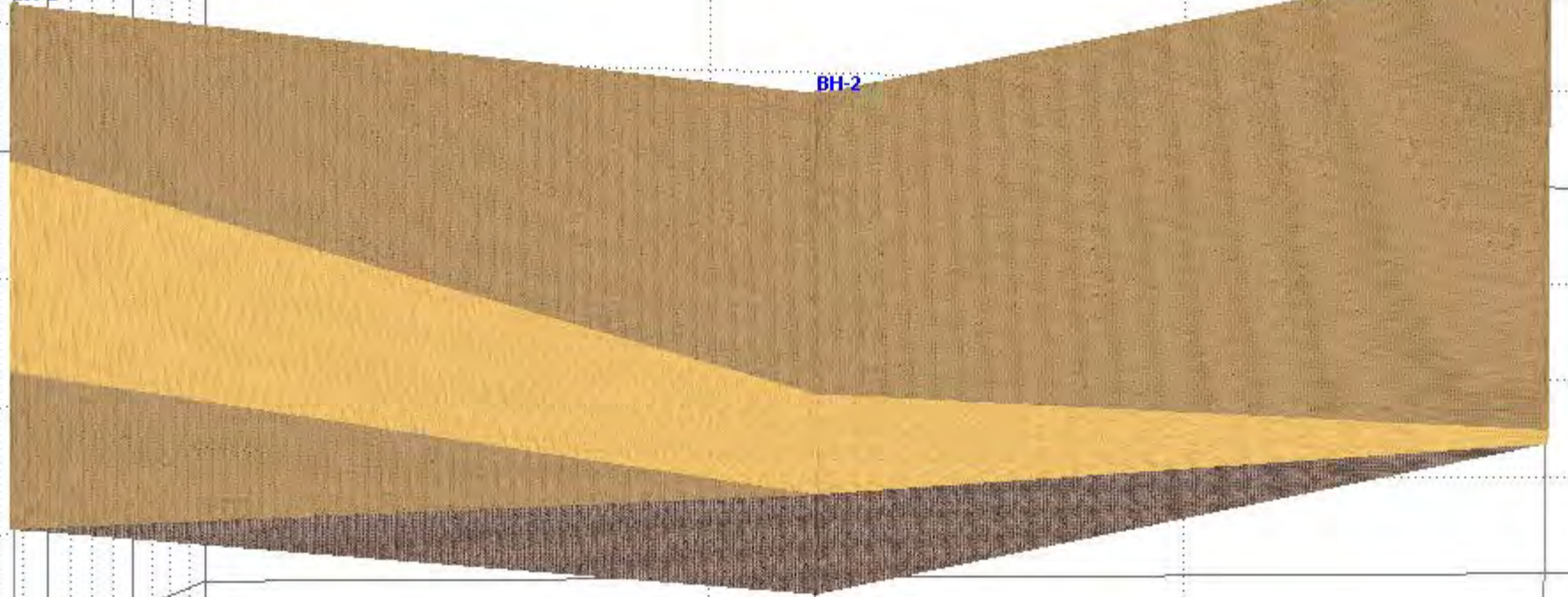


SOIL TYPE LEGEND	
	FILL
	FINE GRAINED
	ROCK
	SAND

BH-1

BH-2

BH-3

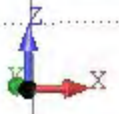
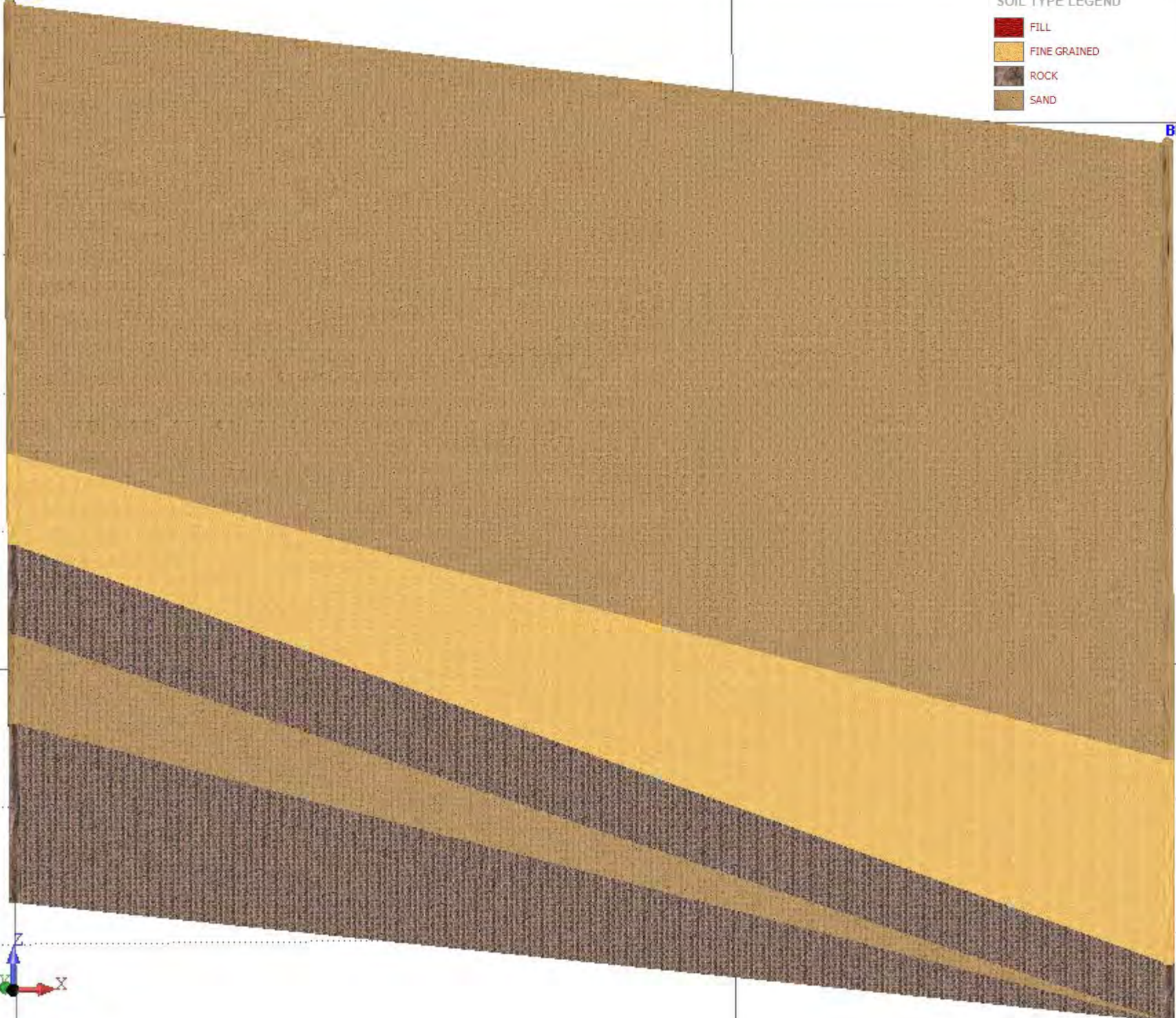


0H-6

SOIL TYPE LEGEND

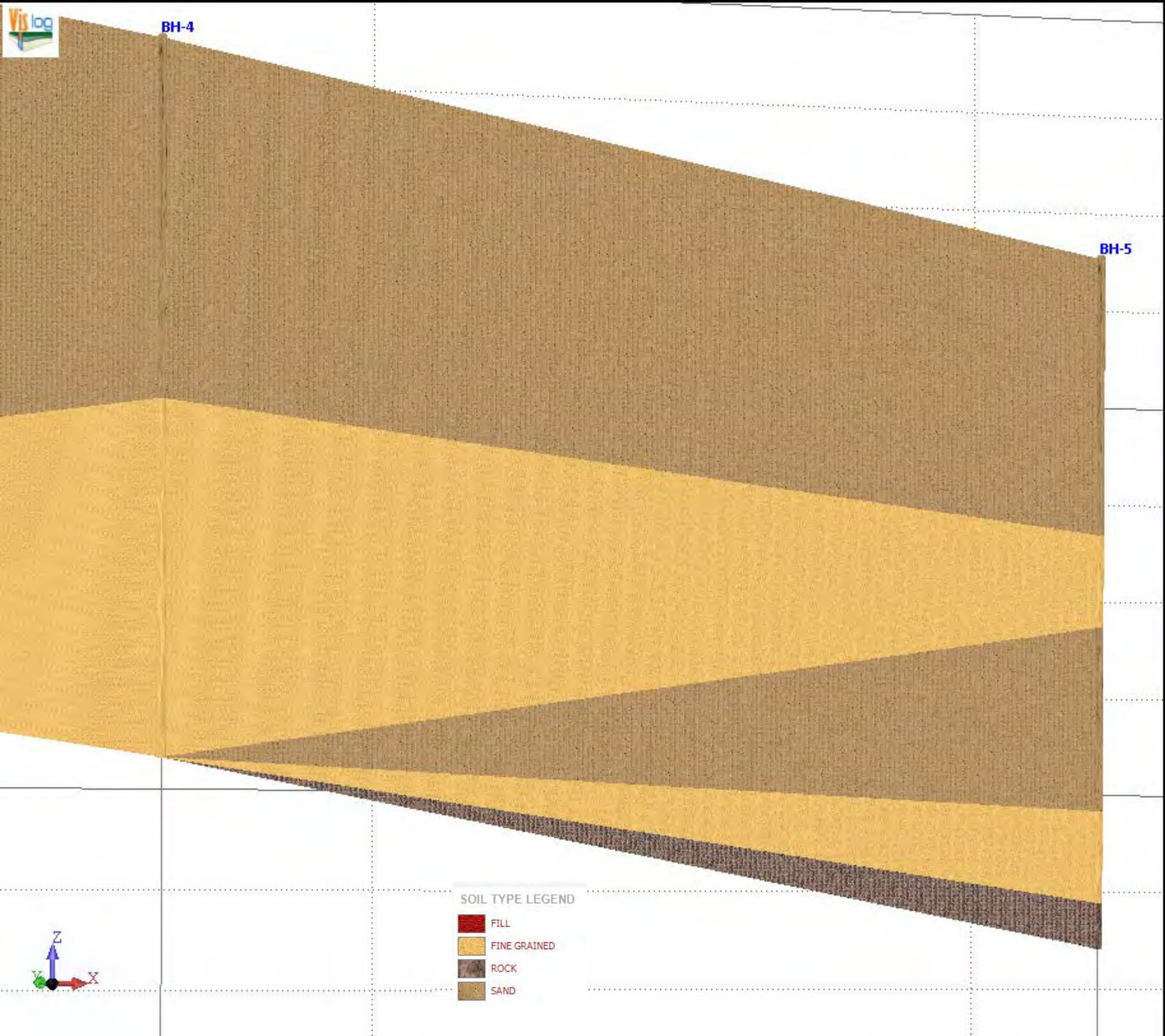
-  FILL
-  FINE GRAINED
-  ROCK
-  SAND

BH-7



BH-4

BH-5



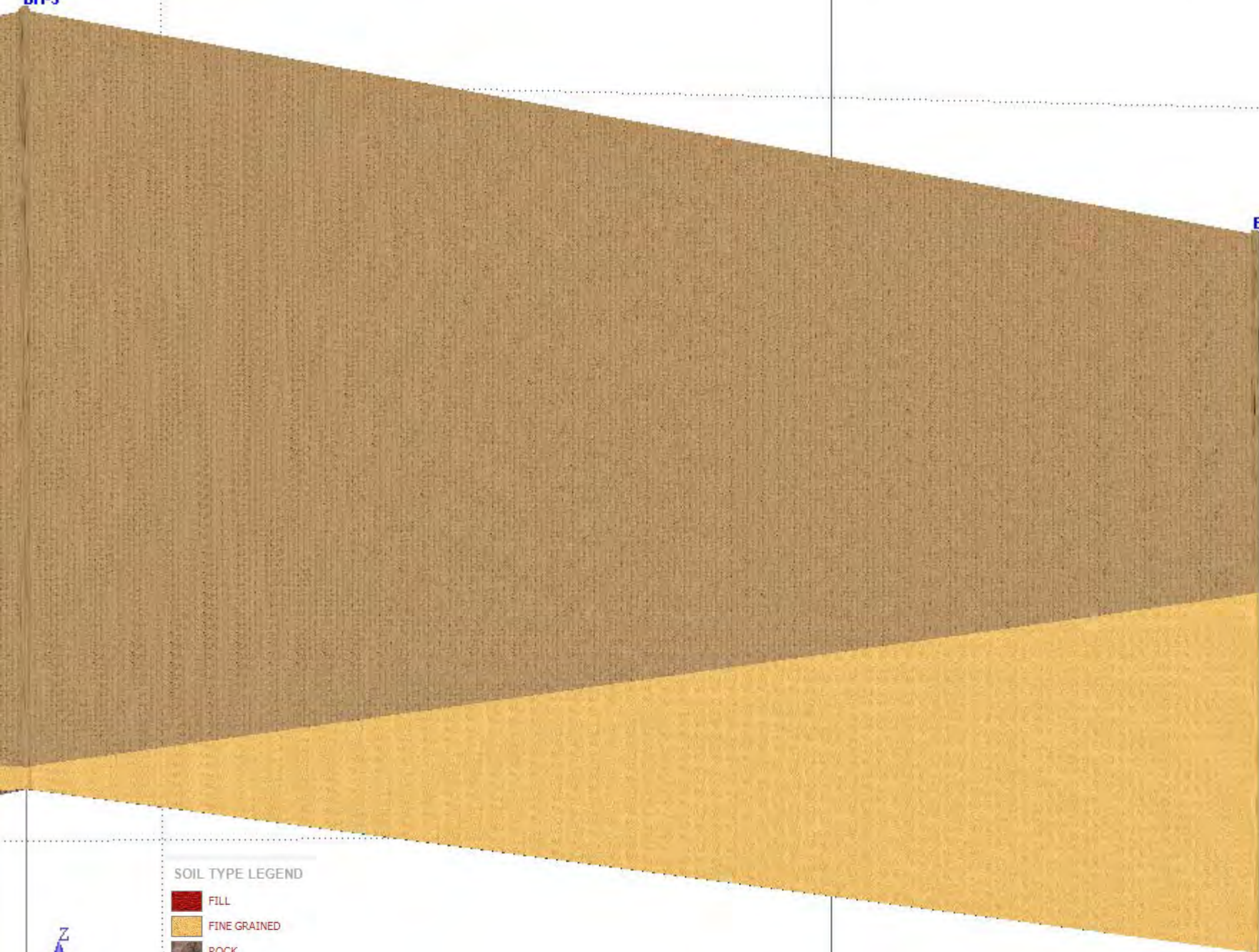
SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



BH-3

BH-4

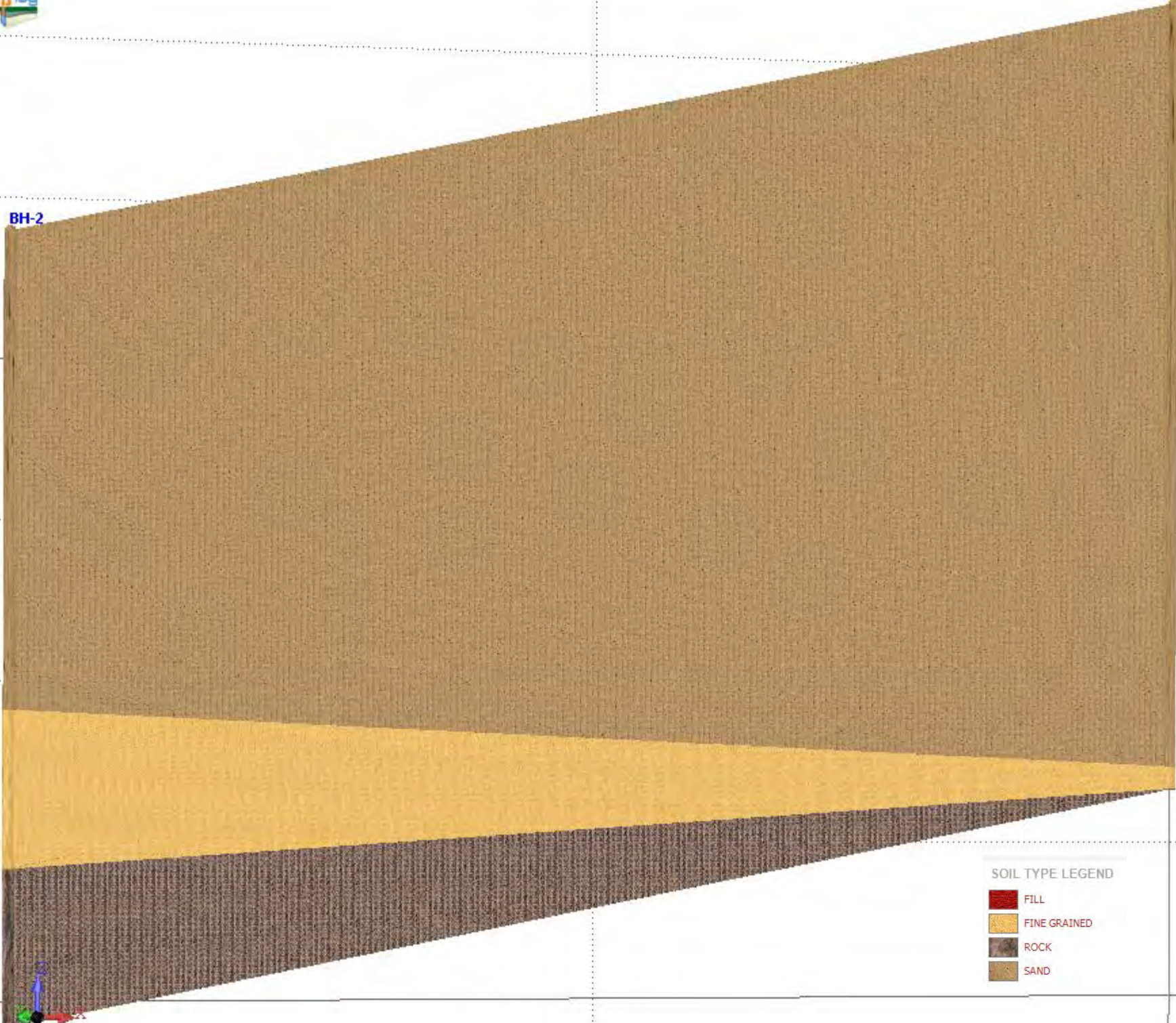


SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND

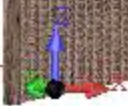


BH-2



SOIL TYPE LEGEND

-  FILL
-  FINE GRAINED
-  ROCK
-  SAND



Appendix D

Laboratory Test Results

Summary of Lab. Tests

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Sieve Analysis Test

Borehole	Sample Depth (m)	Soil Class	D10	D30	D60	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	LL	PL
BH-1	1.5	SM (A-2-4)		0.183	0.781		17.1	72.9	10		-1	-1
BH-1	4.5	ML (A-4)				28.9	50.6	20.5			-1	-1
BH-1	9	ML (A-4)				17.3	43.8	37.8	1.1		-1	-1
BH-1	15	SP-SM (A-2-4)	0.867	1.95	3.336		5	78.9	16.1		-1	-1
BH-2	1.5	SW-SM (A-2-4)	0.151	0.582	1.823		7.6	71.9	20.5		-1	-1
BH-2	6	SM (A-2-4)			0.145		35	65			-1	-1
BH-2	12	ML (A-4)				42.3	50.7	7				
BH-2(A)	3	ML (A-4)				23.4	50.5	15.6	10.5		-1	-1
BH-2(A)	4.5	ML (A-4)	0.001	0.001	0.09	18.5	38.8	25.2	17.5		-1	-1
BH-2(A)	9	SM (A-2-4)		0.087	0.195		26.6	73.4			-1	-1
BH-2(A)	10.5	SM (A-2-4)		0.666	2.056		12.8	72.4	14.8		-1	-1
BH-2(B)	1.5	SM (A-2-4)		0.081	0.242		28.6	66.9	4.5		-1	-1
BH-2(B)	6	SM (A-2-4)		0.083	0.279		27.6	66.8	5.6		-1	-1
BH-2(B)	13.5	ML (A-4)				50.8	46.8	2.4				
BH-3	4.5	SM (A-2-4)		0.477	3.556		12.4	52.9	34.7		-1	-1
BH-3	9	SM (A-2-4)			0.119		34	64.7	1.3		-1	-1
BH-3	15	ML (A-4)				39.2	48.6	12.2			36.8	30.7
BH-3(A)	3	ML (A-4)				27.6	52.4	17.8	2.2		-1	-1
BH-3(A)	6	SM (A-2-4)		0.109	0.233		24	74.1	1.9		-1	-1
BH-3(A)	9	SM (A-2-4)		0.29	2.277		16.2	67.4	16.4		-1	-1
BH-3B	3	SM (A-2-4)		0.169	0.309		14.7	82.8	2.5		-1	-1
BH-3B	7.5	ML (A-4)			0.085	19.5	36.9	41.7	1.9		-1	-1
BH-3B	12	SP (A-2-4)	1.608	2.857	1		0.2	59.6	40.2		-1	-1
BH-3B	15	ML (A-4)				37	51.8	11.2			-1	-1
BH-4	3	SM (A-2-4)		0.389	0.945		19.6	74.8	5.6		-1	-1
BH-4	7.5	CL (A-6)				53.8	43.4	2.8			38.7	21.6
BH-4	12	ML (A-7-6)					91	9			42.7	28.7
BH-4(A)	1.5	ML (A-4)				24.1	38.8	23	14.1		-1	-1
BH-4(A)	6	SM (A-2-4)		0.219	1.601		22.2	67.3	10.5		-1	-1
BH-4(B)	1.5	SM (A-2-4)		0.077	0.146		28.9	69.3	1.8		-1	-1
BH-4(B)	9	SM (A-2-4)		0.089	0.201		25.6	72.1	2.3			
BH-4(B)	10.5	SP (A-2-4)	0.839	2.016	3.317		3.3	83	13.7		-1	-1
BH-4(B)	13.5	ML (A-4)				20.9	39.9	21.8	17.4		-1	-1
BH-5	1.5	SW-SM (A-2-4)	0.103	0.737	2.472		8.4	72.7	18.9		-1	-1

Summary of Lab. Tests

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	D10	D30	D60	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	LL	PL									
BH-5	7.5	ML (A-4)	0.076	0.212	1.134	41.7	72	23	5		39.7	28.8									
BH-5	13.5	ML (A-6)																			
BH-5(A)	1.5	SW-SM (A-2-4)																			
BH-5(A)	4.5	SM (A-4)																			
BH-5(A)	6	ML (A-4)																			
BH-5(B)	3	SM (A-2-4)																			
BH-5(B)	7.5	ML (A-4)																			
BH-5(B)	10.5	SM (A-2-4)																			
BH-6	3	SM (A-2-4)											0.177	0.805	19.8	75	5.2			-1	-1
BH-6	7.5	CL-ML (A-4)																			
BH-6	10.5	SM (A-4)																			
BH-6(A)	1.5	SM (A-2-4)																			
BH-6(A)	7.5	SM (A-2-4)																			
BH-6(B)	1.5	SM (A-2-4)																			
BH-6(B)	12	SM (A-2-4)																			
BH-7	1.5	SM (A-2-4)	0.145	0.849	3.939	8.2	58.2	33.6		-1	-1										
BH-7	4.5	SW-SM (A-2-4)																			
BH-7	10.5	ML (A-6)																			
BH-7	12	ML (A-7-6)																			
BH-7(A)	1.5	SM (A-2-4)																			
BH-7(A)	7.5	ML (A-4)																			
BH-7(A)	9	ML (A-4)																			
BH-8	1.5	SM (A-4)										0.361	0.914	2.6	2.8	78.4	18.8		-1	-1	
BH-8	4.5	SP (A-2-4)																			
BH-8	9	ML (A-4)																			
BH-8	10.5	ML (A-4)																			
BH-8(A)	1.5	SM (A-2-4)																			
BH-8(A)	4.5	SM (A-2-4)																			
BH-8(A)	7.5	ML (A-7-6)																			
BH-8(B)	1.5	SW-SM (A-2-4)																			
BH-8(B)	9	SM (A-2-4)																			
BH-8(B)	12	SM (A-2-4)																			

ATTERBERG LIMITS TEST

Borehole	Sample Depth (m)	Soil Class	Liquid Limit (LL)	Plastic Limit (PL)
BH-2	12	ML (A-4)	35.1	27

Summary of Lab. Tests

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	Liquid Limit (LL)	Plastic Limit (PL)
BH-2(B)	13.5	ML (A-4)	32.5	23.2
BH-3	15	ML (A-4)	36.8	30.7
BH-4	7.5	CL (A-6)	38.7	21.6
BH-4	12	ML (A-7-6)	42.7	28.7
BH-5	7.5	ML (A-4)	27.4	19.6
BH-5	13.5	ML (A-6)	39.7	28.8
BH-5(A)	6	ML (A-4)	21.8	18.1
BH-6	7.5	CL-ML (A-4)	27.1	20.1
BH-7	10.5	ML (A-6)	39.1	26
BH-7	12	ML (A-7-6)	41.7	26.5
BH-7(A)	7.5	ML (A-4)	19.8	16.3
BH-7(A)	9	ML (A-4)	19.7	16.3
BH-7(A)	10.5		33.6	25.8
BH-8(A)	7.5	ML (A-7-6)	40.8	25.7

Density & Moisture Test

Borehole	Sample Depth (m)	Soil Class	Moisture Content (%)	Dry Density (gr/cm3)
BH-1	1.5	SM (A-2-4)	6.44	1.6
BH-1	4.5	ML (A-4)	9.6	1.58
BH-1	9	ML (A-4)	14.67	1.54
BH-1	15	SP-SM (A-2-4)	4.38	1.61
BH-2	1.5	SW-SM (A-2-4)	7.41	1.48
BH-2	6	SM (A-2-4)	9.14	1.5
BH-2	12	ML (A-4)	13.07	1.4
BH-2(A)	3	ML (A-4)	7.45	1.45
BH-2(A)	4.5	ML (A-4)	13.54	1.45
BH-2(A)	9	SM (A-2-4)	9.69	1.54
BH-2(A)	10.5	SM (A-2-4)	12.48	1.51
BH-2(B)	1.5	SM (A-2-4)	7.87	1.52
BH-2(B)	6	SM (A-2-4)	8.95	1.42
BH-2(B)	13.5	ML (A-4)	20.1	1.42
BH-3	4.5	SM (A-2-4)	7.87	1.659
BH-3	9	SM (A-2-4)	10.92	1.656
BH-3	15	ML (A-4)	14.01	1.685
BH-3(A)	3	ML (A-4)	5.68	1.662
BH-3(A)	6	SM (A-2-4)	15.86	1.659
BH-3(A)	9	SM (A-2-4)	8.71	1.705
BH-3B	3	SM (A-2-4)	10.93	1.659
BH-3B	7.5	ML (A-4)	20.46	1.499
BH-3B	12	SP (A-2-4)	5.92	1.667
BH-3B	15	ML (A-4)	19.26	1.556
BH-4	3	SM (A-2-4)	5.25	1.56
BH-4	7.5	CL (A-6)	15.62	1.52
BH-4	12	ML (A-7-6)	10.21	1.61
BH-4(A)	1.5	ML (A-4)	6.63	1.856
BH-4(A)	6	SM (A-2-4)	11.86	1.587
BH-4(B)	1.5	SM (A-2-4)	7.75	1.597
BH-4(B)	9	SM (A-2-4)	10.84	1.698
BH-4(B)	10.5	SP (A-2-4)	6.12	1.658
BH-4(B)	13.5	ML (A-4)	10.89	1.688
BH-5	1.5	SW-SM (A-2-4)	5.6	1.58

Summary of Lab. Tests

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	Moisture Content (%)	Dry Density (gr/cm3)
BH-5	7.5	ML (A-4)	10.85	1.55
BH-5	13.5	ML (A-6)	14.17	1.49
BH-5(A)	1.5	SW-SM (A-2-4)	16.83	1.569
BH-5(A)	4.5	SM (A-4)	21.26	1.487
BH-5(A)	6	ML (A-4)	10.91	1.654
BH-5(B)	3	SM (A-2-4)	10.52	1.659
BH-5(B)	7.5	ML (A-4)	13.02	1.569
BH-5(B)	10.5	SM (A-2-4)	11.79	1.663
BH-6	3	SM (A-2-4)	5.12	1.597
BH-6	7.5	CL-ML (A-4)	16.84	1.654
BH-6	10.5	SM (A-4)	15.24	1.627
BH-6(A)	1.5	SM (A-2-4)	4.67	1.54
BH-6(A)	7.5	SM (A-2-4)	5.7	1.54
BH-6(B)	1.5	SM (A-2-4)	2.63	1.6
BH-6(B)	12	SM (A-2-4)	16.8	1.54
BH-7	1.5	SM (A-2-4)	4.41	1.559
BH-7	4.5	SW-SM (A-2-4)	9.18	1.845
BH-7	10.5	ML (A-6)	18.63	1.658
BH-7	12	ML (A-7-6)	20.79	1.633
BH-7(A)	1.5	SM (A-2-4)	3.88	1.745
BH-7(A)	7.5	ML (A-4)	12.24	1.656
BH-7(A)	9	ML (A-4)	10.25	1.547
BH-8	1.5	SM (A-4)	8.02	1.665
BH-8	4.5	SP (A-2-4)	18.44	1.547
BH-8	9	ML (A-4)	13.57	1.755
BH-8	10.5	ML (A-4)	13.96	1.744
BH-8(A)	1.5	SM (A-2-4)	14.39	1.54
BH-8(A)	4.5	SM (A-2-4)	15.58	1.52
BH-8(A)	7.5	ML (A-7-6)	27.88	1.45
BH-8(B)	1.5	SW-SM (A-2-4)	4.99	1.45
BH-8(B)	9	SM (A-2-4)	21.23	1.56
BH-8(B)	12	SM (A-2-4)	21.47	1.42

Unconfined Compression Test

Borehole	Sample Depth (m)	Soil Class	Diameter (cm)	Height (cm)	qu (kg/cm2)
BH-2	12.6		7.455	9.561	1.55
BH-2	13.8		7.33	9.654	1.37
BH-2(A)	16.8		5.929	8.356	1.14
BH-2(A)	19.8		6.137	9.734	1.91
BH-2(A)	22.8		5.421	9.238	3.66
BH-2(A)	27.3		6.225	10.31	3.07
BH-2(B)	14.3		6.618	9.574	3.08
BH-3(A)	12.3		6.8	9.482	1.01
BH-3(A)	16.8		5.922	11.539	6.05
BH-3(A)	19.8		6.191	10.287	100.35
BH-3(A)	22.8		5.369	6.7	7.44
BH-3(A)	27.3		5.641	10.696	10.35
BH-4(A)	14		6.208	9.813	2.59
BH-4(A)	18.3		6.503	9.821	2.43
BH-4(A)	22.8		6.546	10.336	2.88
BH-5	14.1		5.985	8.548	0.42

Summary of Lab. Tests

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	Diameter (cm)	Height (cm)	qu (kg/cm ²)
BH-5(A)	21.3		6.404	9.94	0.76
BH-5(A)	28.8		6.104	12.249	500.07
BH-6	9.3		4.599	10.458	13.76
BH-6	12.6		5.708	12.259	21.34
BH-6(A)	13.8		5.902	9.543	318.34
BH-6(A)	18		6.012	9.564	0.9
BH-6(A)	18.5		6.644	10.169	1.5
BH-6(B)	13.9		5.242	8.982	4.11
BH-7	14.7		6.025	9.586	0.82
BH-7(A)	12.5		6.405	9.885	1.47
BH-7(A)	16.8		6.054	9.149	0.77
BH-7(A)	27.2		6.588	9.215	0.58
BH-8	11		8.654	6.087	4.46
BH-8	13.9		10.088	6.381	1.75
BH-8(A)	7.8		7.063	10.907	0.27
BH-8(A)	12.6		6.86	10.454	1.18
BH-8(A)	21.3		6.805	11.868	1.89
BH-8(A)	25.8		6.926	10.566	3.2
BH-8(A)	28.8		5.91	6.931	2.8

Chemical Test Results

Borehole	Sample Depth (m)	Soil Class	#	Value
BH-1	1.5	SM (A-2-4)	9	0.26
BH-1	1.5	SM (A-2-4)	2	7.45
BH-1	1.5	SM (A-2-4)	6	0.03
BH-2	1.5	SW-SM (A-2-4)	9	0.31
BH-2	1.5	SW-SM (A-2-4)	6	0.05
BH-2	1.5	SW-SM (A-2-4)	2	7.65
BH-2(A)	3	ML (A-4)	6	0.02
BH-2(A)	3	ML (A-4)	2	7.56
BH-2(A)	3	ML (A-4)	9	0.25
BH-2(B)	1.5	SM (A-2-4)	9	0.29
BH-2(B)	1.5	SM (A-2-4)	6	0.02
BH-2(B)	1.5	SM (A-2-4)	2	7.55
BH-3	4.5	SM (A-2-4)	6	0.06
BH-3	4.5	SM (A-2-4)	2	7.71
BH-3	4.5	SM (A-2-4)	9	0.33
BH-3(A)	3	ML (A-4)	9	0.21
BH-3(A)	3	ML (A-4)	6	0.03
BH-3(A)	3	ML (A-4)	2	7.4
BH-3B	3	SM (A-2-4)	9	0.36
BH-3B	3	SM (A-2-4)	6	0.09
BH-3B	3	SM (A-2-4)	2	7.54
BH-4	3	SM (A-2-4)	2	7.45
BH-4	3	SM (A-2-4)	6	0.05
BH-4	3	SM (A-2-4)	9	0.54
BH-4(A)	1.5	ML (A-4)	9	0.45
BH-4(A)	1.5	ML (A-4)	6	0.09
BH-4(A)	1.5	ML (A-4)	2	7.58
BH-4(B)	1.5	SM (A-2-4)	6	0.04
BH-4(B)	1.5	SM (A-2-4)	2	7.44

Summary of Lab. Tests

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	#	Value
BH-4(B)	1.5	SM (A-2-4)	9	0.41
BH-5	3		2	7.65
BH-5	3		6	0.07
BH-5	3		9	0.32
BH-5(A)	1.5	SW-SM (A-2-4)	9	0.29
BH-5(A)	1.5	SW-SM (A-2-4)	2	7.95
BH-5(A)	1.5	SW-SM (A-2-4)	6	0.07
BH-5(B)	3	SM (A-2-4)	2	7.59
BH-5(B)	3	SM (A-2-4)	6	0.05
BH-5(B)	3	SM (A-2-4)	9	0.46
BH-6	3	SM (A-2-4)	9	0.32
BH-6	3	SM (A-2-4)	2	7.88
BH-6	3	SM (A-2-4)	6	0.08
BH-6(A)	1.5	SM (A-2-4)	9	0.41
BH-6(A)	1.5	SM (A-2-4)	2	7.62
BH-6(A)	1.5	SM (A-2-4)	6	0.06
BH-6(B)	1.5	SM (A-2-4)	2	7.52
BH-6(B)	1.5	SM (A-2-4)	6	0.09
BH-6(B)	1.5	SM (A-2-4)	9	0.52
BH-7	1.5	SM (A-2-4)	2	7.8
BH-7	1.5	SM (A-2-4)	6	0.02
BH-7	1.5	SM (A-2-4)	9	0.23
BH-7(A)	1.5	SM (A-2-4)	2	7.89
BH-7(A)	1.5	SM (A-2-4)	9	0.52
BH-7(A)	1.5	SM (A-2-4)	6	0.07
BH-8	1.5	SM (A-4)	9	0.35
BH-8	1.5	SM (A-4)	6	0.05
BH-8	1.5	SM (A-4)	2	7.56
BH-8(A)	1.5	SM (A-2-4)	2	7.58
BH-8(A)	1.5	SM (A-2-4)	6	0.03
BH-8(A)	1.5	SM (A-2-4)	9	0.25
BH-8(B)	1.5	SW-SM (A-2-4)	2	7.85
BH-8(B)	1.5	SW-SM (A-2-4)	6	0.06
BH-8(B)	1.5	SW-SM (A-2-4)	9	0.34

Summary of Lab. Tests

Project : GI for Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Sieve Analysis Test

Borehole	Sample Depth (m)	Soil Class	D10	D30	D60	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	LL	PL
BH-09	4.5	SP-SM (A-2-4)	0.169	0.796	4.08		7.1	57.1	35.8		-1	-1
BH-09	7.5	SM (A-2-4)		0.165	0.495		22.8	74.8	2.4		-1	-1
BH-09	12	GM (A-6)			2.639		45.4	23	31.6		35.8	25.1
BH-09(A)	1.5	SM (A-4)			0.288		41.8	50.1	8.1		-1	-1
BH-09(A)	6	ML (A-4)				40.3	58.3	1.4			35.9	26.1
BH-09(A)	12	ML (A-4)				29.3	59.7	10	1		-1	-1
BH-10	3	SM (A-2-4)		0.15	0.603		25.1	66.1	8.8		-1	-1
BH-10	7.5	SM (A-2-4)		0.079	0.166		28	68.1	3.9		-1	-1
BH-10	12	SM (A-2-4)		0.164	0.539		25.3	73.1	1.6		-1	-1
BH-10(A)	1.5	SP (A-2-4)	0.839	1.974	4.8		0.3	59.4	40.3		-1	-1
BH-10(A)	6	ML (A-4)				35.2	54.4	9.4	1		32.6	25.2
BH-10(A)	8	ML (A-4)				45	54.6	0.4			38.4	29.8
BH-10(A)	9	CL (A-4)				55.3	43.5	1.2			31.3	21.9
BH-11	1.5	SM (A-4)			0.211		36.5	63.5			-1	-1
BH-11	3	ML (A-4)					73.3	26.3	0.4		-1	-1
BH-11	4.5	SM (A-2-4)		0.165	0.294		15	77.7	7.3		-1	-1
BH-11	6	SM (A-2-4)		0.115	0.201		21.9	76.9	1.2		-1	-1
BH-12	1.5	SM (A-4)			0.199		35.1	64.9			-1	-1
BH-12	6	ML (A-4)			0.146	21.7	32.7	45.6			-1	-1
BH-13	1.5	SM (A-4)			0.136		39.8	59.3	0.8		-1	-1
BH-13	4.5	SP (A-2-4)	0.096	0.194	0.588		3.6	82.1	14.3		-1	-1
BH-13	10.5	SM (A-2-4)		0.092	0.777		26.2	69.2	4.5		-1	-1
BH-14	1.5	SM (A-2-4)		0.11	0.301		24.7	72.1	3.2		-1	-1
BH-14	7.5	ML (A-4)				19.9	47.7	32.4			-1	-1
BH-14	13.5	SM (A-4)			0.113		43.2	55.5	1.3		-1	-1
BH-15	1.5	SM (A-2-4)			0.208		34.4	65.6			-1	-1
BH-15	6	ML (A-4)				32.7	45.3	22			-1	-1
BH-15	13.5	SM (A-4)			0.175		35.4	62.1	2.5		-1	-1
BH-16	3	SM (A-2-4)		0.246	1.724		19.8	66.6	13.6		-1	-1
BH-16	5	SM (A-2-4)		0.152	1.482		22.2	60.7	17.1		-1	-1
BH-16	9	SM (A-2-4)			0.16		30.4	69.6			-1	-1
BH-17	1.5	SM (A-2-4)		0.202	0.771		14.5	77.7	7.8		-1	-1
BH-17	4.5	SW-SM (A-2-4)	0.105	0.634	1.899		8.8	75.2	16		-1	-1
BH-17	7.5	SM (A-2-4)			0.191		30.4	67.2	2.4		-1	-1
BH-18	1.5	SP (A-2-4)	0.159	0.224	0.459		3.2	91	5.8		-1	-1

Summary of Lab. Tests

Project : GI for Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	D10	D30	D60	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	LL	PL
BH-18	6	SP-SM (A-2-4)	0.116	0.247	0.769		7.6	79.7	12.7		-1	-1
BH-18	10.5	SM (A-4)			0.224		45.4	40.8	13.8		-1	-1
BH-19	1.5	SM (A-2-4)		0.195	0.947		20.3	66.7	13		-1	-1
BH-19	3	SW-SM (A-2-4)	0.119	0.73	1.973		7.6	77.4	15		-1	-1
BH-19	9	SM (A-2-4)		0.108	0.537		26.2	51.2	22.6		-1	-1
BH-20	1.5	SP (A-2-4)	0.857	1.571	2.678		2.5	92.4	5.1		-1	-1
BH-20	7.5	SM (A-4)			0.151		43.8	56.2			-1	-1
BH-20	10.5	SM (A-2-4)		0.154	0.207		17.3	82.7			-1	-1

ATTERBERG LIMITS TEST

Borehole	Sample Depth (m)	Soil Class	Liquid Limit (LL)	Plastic Limit (PL)
BH-09	12	GM (A-6)	35.8	25.1
BH-09(A)	6	ML (A-4)	35.9	26.1
BH-10(A)	6	ML (A-4)	32.6	25.2
BH-10(A)	8	ML (A-4)	38.4	29.8
BH-10(A)	9	CL (A-4)	31.3	21.9

Density & Moisture Test

Borehole	Sample Depth (m)	Soil Class	Moisture Content (%)	Dry Density (gr/cm3)
BH-09	4.5	SP-SM (A-2-4)	10.02	1.888
BH-09	7.5	SM (A-2-4)	11.83	1.597
BH-09	12	GM (A-6)	17.49	1.569
BH-09(A)	1.5	SM (A-4)	10.45	1.569
BH-09(A)	6	ML (A-4)	20.94	1.598
BH-09(A)	12	ML (A-4)	24.54	1.697
BH-10	3	SM (A-2-4)	9.44	1.659
BH-10	7.5	SM (A-2-4)	12.98	1.659
BH-10	12	SM (A-2-4)	9.48	1.659
BH-10(A)	1.5	SP (A-2-4)	9.78	1.698
BH-10(A)	6	ML (A-4)	12.16	1.654
BH-10(A)	8	ML (A-4)	20.05	1.569
BH-10(A)	9	CL (A-4)	25.13	1.588
BH-11	1.5	SM (A-4)	4.32	1.754
BH-11	3	ML (A-4)	12.03	1.659
BH-11	4.5	SM (A-2-4)	12.76	1.719
BH-11	6	SM (A-2-4)	9.1	1.659
BH-12	1.5	SM (A-4)	8.22	1.598
BH-12	6	ML (A-4)	14.51	1.666
BH-13	1.5	SM (A-4)	12.65	1.658
BH-13	4.5	SP (A-2-4)	16.55	1.845
BH-13	10.5	SM (A-2-4)	14.65	1.659
BH-14	1.5	SM (A-2-4)	8.17	1.888
BH-14	7.5	ML (A-4)	15.16	1.659
BH-14	13.5	SM (A-4)	21.27	1.659
BH-15	1.5	SM (A-2-4)	6.1	1.854
BH-15	6	ML (A-4)	9.61	1.659

Summary of Lab. Tests

Project : GI for Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	Moisture Content (%)	Dry Density (gr/cm3)
BH-15	13.5	SM (A-4)	16.37	1.874
BH-16	2		4.81	1.569
BH-16	5	SM (A-2-4)	12.35	1.854
BH-16	9	SM (A-2-4)	14.99	1.754
BH-17	1.5	SM (A-2-4)	4.35	1.886
BH-17	4.5	SW-SM (A-2-4)	2.87	1.66
BH-17	7.5	SM (A-2-4)	6.99	1.597
BH-18	1.5	SP (A-2-4)	1.25	1.688
BH-18	6	SP-SM (A-2-4)	13.91	1.857
BH-18	10.5	SM (A-4)	20.75	1.688
BH-19	1.5	SM (A-2-4)	6.45	1.659
BH-19	3	SW-SM (A-2-4)	11.35	1.547
BH-19	9	SM (A-2-4)	13.18	1.565
BH-20	1.5	SP (A-2-4)	12.28	1.689
BH-20	7.5	SM (A-4)	10.98	1.458
BH-20	10.5	SM (A-2-4)	24.25	1.524

Unconfined Compression Test

Borehole	Sample Depth (m)	Soil Class	Diameter (cm)	Height (cm)	qu (kg/cm2)
BH-09(A)	7.5		6.996	12.274	0.05
BH-09(A)	15.65		5.848	9.811	4.1
BH-09(A)	22.9		6.493	9.588	0.64
BH-09(A)	25.65		6.397	10.39	4.07
BH-09(A)	29.6		6.545	9.051	0.7
BH-10	9.59		5.818	7.06	0.2
BH-10(A)	7.5		6.561	12.448	0.11
BH-10(A)	12.3		6.648	11.459	3.36
BH-10(A)	15.3		6.264	10.147	1.03
BH-10(A)	21.2		6.332	10.827	1.84
BH-10(A)	24.15		6.32	8.753	0.86
BH-10(A)	29.1		6.448	11.571	1.16
BH-11	8.15		5.903	11.67	14.21
BH-11	9.6		5.554	11.78	22.44
BH-11	11.02		7.61	15.049	1.61
BH-12	11.5		6.326	11.236	3.52
BH-12	13.75		7.77	15.4	12.43
BH-13	8.1		5.808	9.599	0.83
BH-13	13.35		5.273	7.966	1.22
BH-13	14.29		5.825	6.786	10.81
BH-17	14.2		5.789	8.66	0.99
BH-18	12.6		6.512	8.078	0.62
BH-18	14		6.343	9.415	0.5
BH-19	10.95		6.554	10.266	1.68
BH-19	13.28		6.245	10.547	3.22
BH-19	14.1		5.662	8.67	8.49

Chemical Test Results

Borehole	Sample Depth (m)	Soil Class	#	Value
BH-09	4.5	SP-SM (A-2-4)	6	0.05
BH-09	4.5	SP-SM (A-2-4)	9	0.29
BH-09	4.5	SP-SM (A-2-4)	2	7.3

Summary of Lab. Tests

Project : GI for Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



Borehole	Sample Depth (m)	Soil Class	#	Value
BH-09(A)	1.5	SM (A-4)	2	7.82
BH-09(A)	1.5	SM (A-4)	6	0.15
BH-09(A)	1.5	SM (A-4)	9	0.79
BH-10	3	SM (A-2-4)	2	7.3
BH-10	3	SM (A-2-4)	6	0.07
BH-10	3	SM (A-2-4)	9	0.65
BH-10(A)	1.5	SP (A-2-4)	9	0.88
BH-10(A)	1.5	SP (A-2-4)	2	7.3
BH-10(A)	1.5	SP (A-2-4)	6	0.17
BH-11	1.5	SM (A-4)	9	0.27
BH-11	1.5	SM (A-4)	6	0.09
BH-11	1.5	SM (A-4)	2	7.4
BH-12	1.5	SM (A-4)	9	0.37
BH-12	1.5	SM (A-4)	6	0.07
BH-12	1.5	SM (A-4)	2	7.3
BH-13	1.5	SM (A-4)	6	0.07
BH-13	1.5	SM (A-4)	2	7.6
BH-13	1.5	SM (A-4)	9	0.55
BH-14	1.5	SM (A-2-4)	6	0.12
BH-14	1.5	SM (A-2-4)	9	0.66
BH-14	1.5	SM (A-2-4)	2	7.6
BH-15	1.5	SM (A-2-4)	2	7.6
BH-15	1.5	SM (A-2-4)	9	0.55
BH-15	1.5	SM (A-2-4)	6	0.06
BH-16	3	SM (A-2-4)	2	7.66
BH-16	3	SM (A-2-4)	9	0.24
BH-16	3	SM (A-2-4)	6	0.05
BH-17	1.5	SM (A-2-4)	9	0.67
BH-17	1.5	SM (A-2-4)	6	0.05
BH-17	1.5	SM (A-2-4)	2	7.46
BH-18	1.5	SP (A-2-4)	9	0.49
BH-18	1.5	SP (A-2-4)	2	7.9
BH-18	1.5	SP (A-2-4)	6	0.06
BH-19	1.5	SM (A-2-4)	9	0.66
BH-19	1.5	SM (A-2-4)	2	7.6
BH-19	1.5	SM (A-2-4)	6	0.15
BH-20	1.5	SP (A-2-4)	6	0.02
BH-20	1.5	SP (A-2-4)	9	0.16
BH-20	1.5	SP (A-2-4)	2	7.81

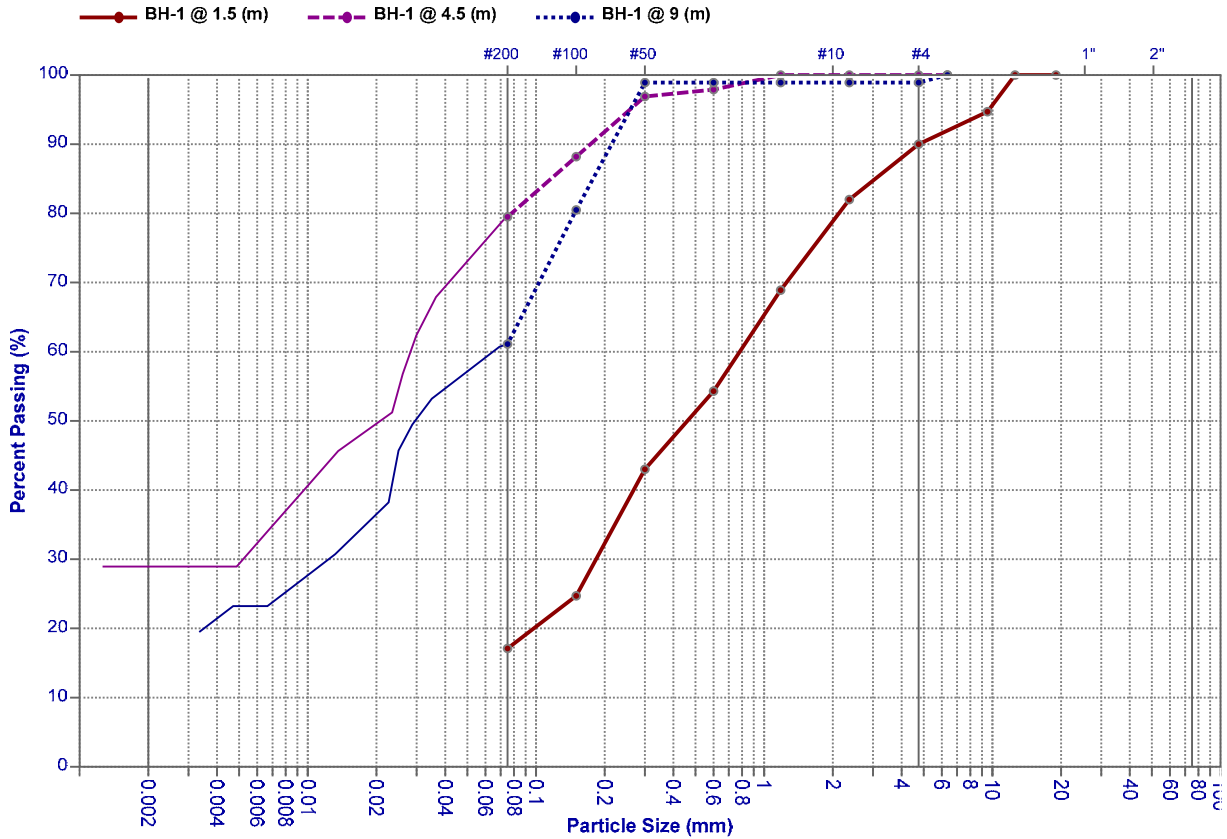
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	17.1	72.9	10	.
28.9	50.6	20.5	-	.
-	61.1	37.8	1.1	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-1	1.5	-	0.183	0.461	0.781	0.572	-	-	-	N/A	SM	A-2-4
BH-1	4.5	0.001	0.005	0.021	0.028	0.893	28	-	-	N/A	ML	A-4
BH-1	9	-	-	-	-	-	-	-	-	N/A	ML	A-4

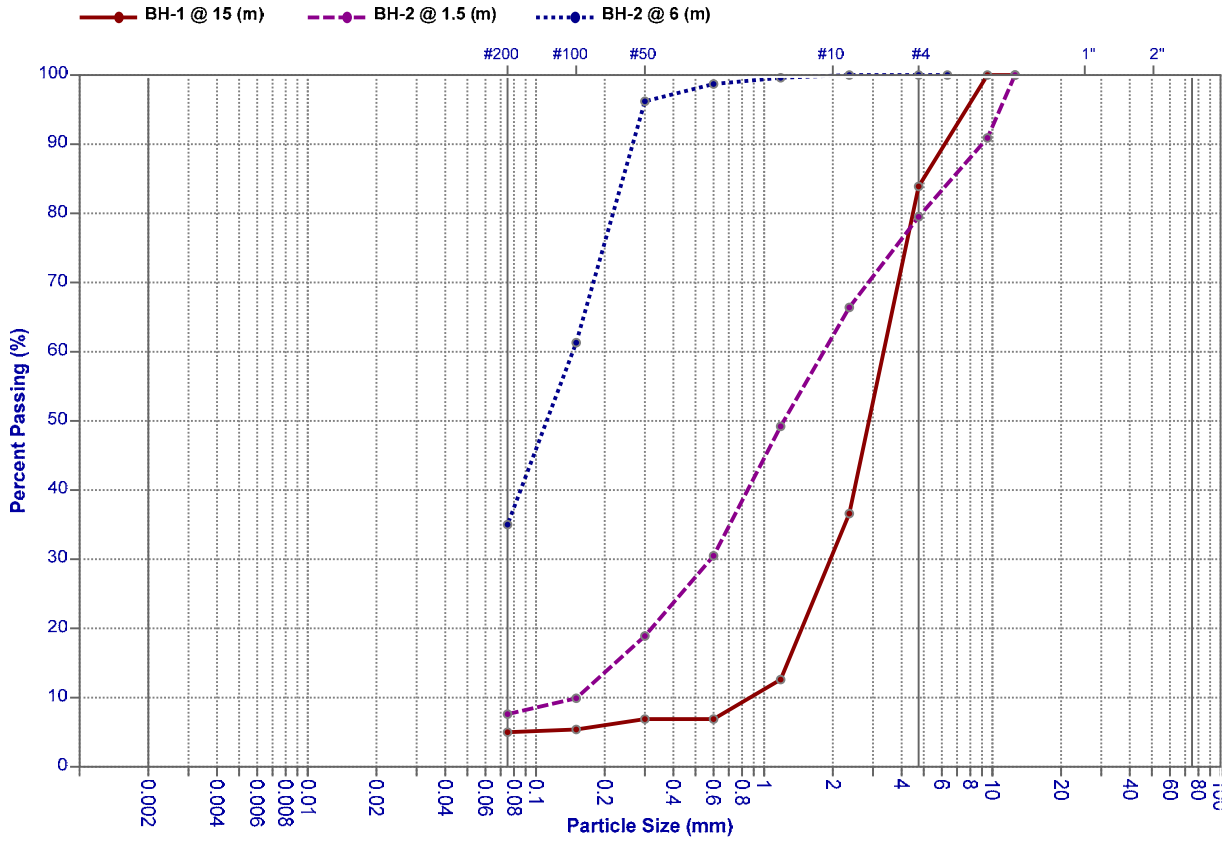
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Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	5	78.9	16.1	-
-	7.6	71.9	20.5	-
-	35	65	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-1	15	0.867	1.95	2.877	3.336	1.315	3.848	-	-	N/A	SP-SM	A-2-4
BH-2	1.5	0.151	0.582	1.219	1.823	1.231	12.073	-	-	N/A	SW-SM	A-2-4
BH-2	6	-	-	0.111	0.145	-	-	-	-	N/A	SM	A-2-4

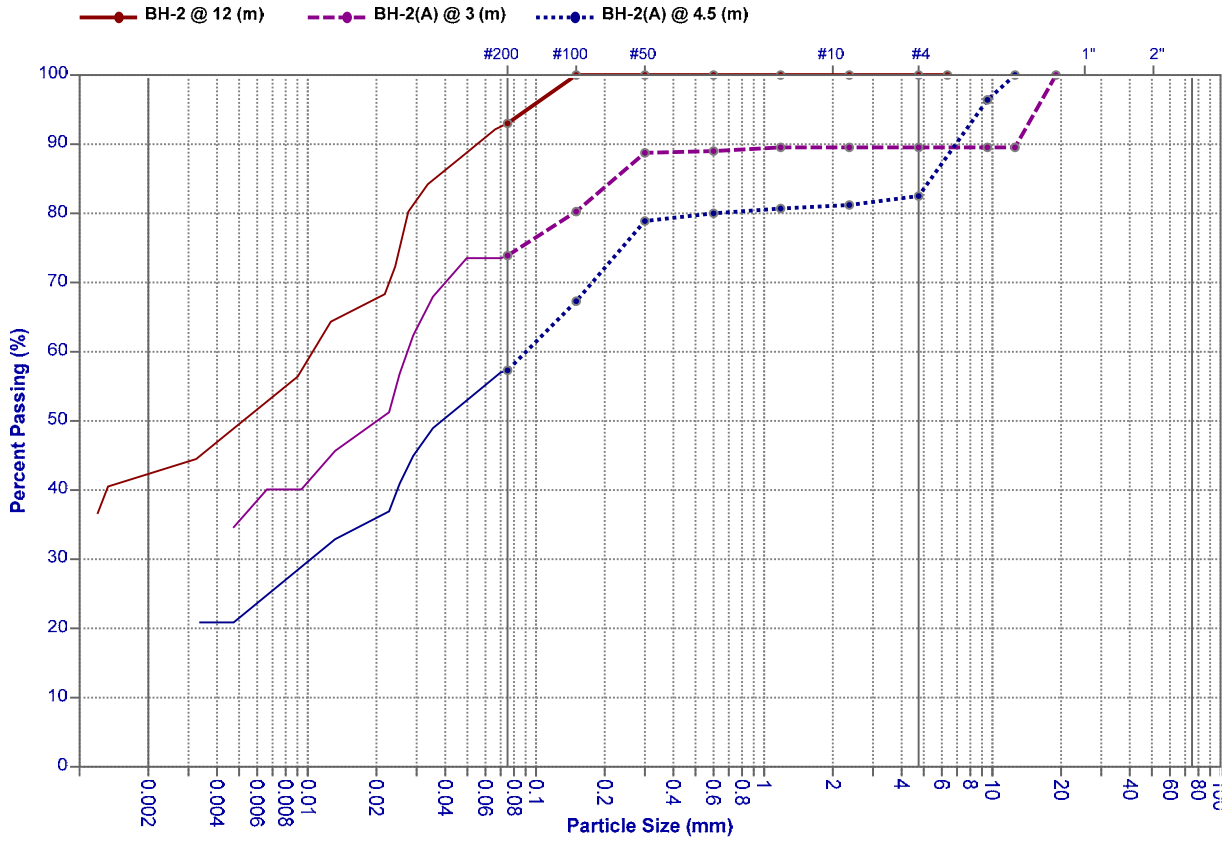
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Project : Coal Unloading Terminal
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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
42.3	50.7	7	-	-
-	73.9	15.6	10.5	-
-	57.3	25.2	17.5	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-2	12	0.001	0.001	0.005	0.01	0.1	10	-	-	N/A	ML	A-4
BH-2(A)	3	-	-	-	-	-	-	-	-	N/A	ML	A-4
BH-2(A)	4.5	-	-	-	0.09	-	-	-	-	N/A	ML	A-4

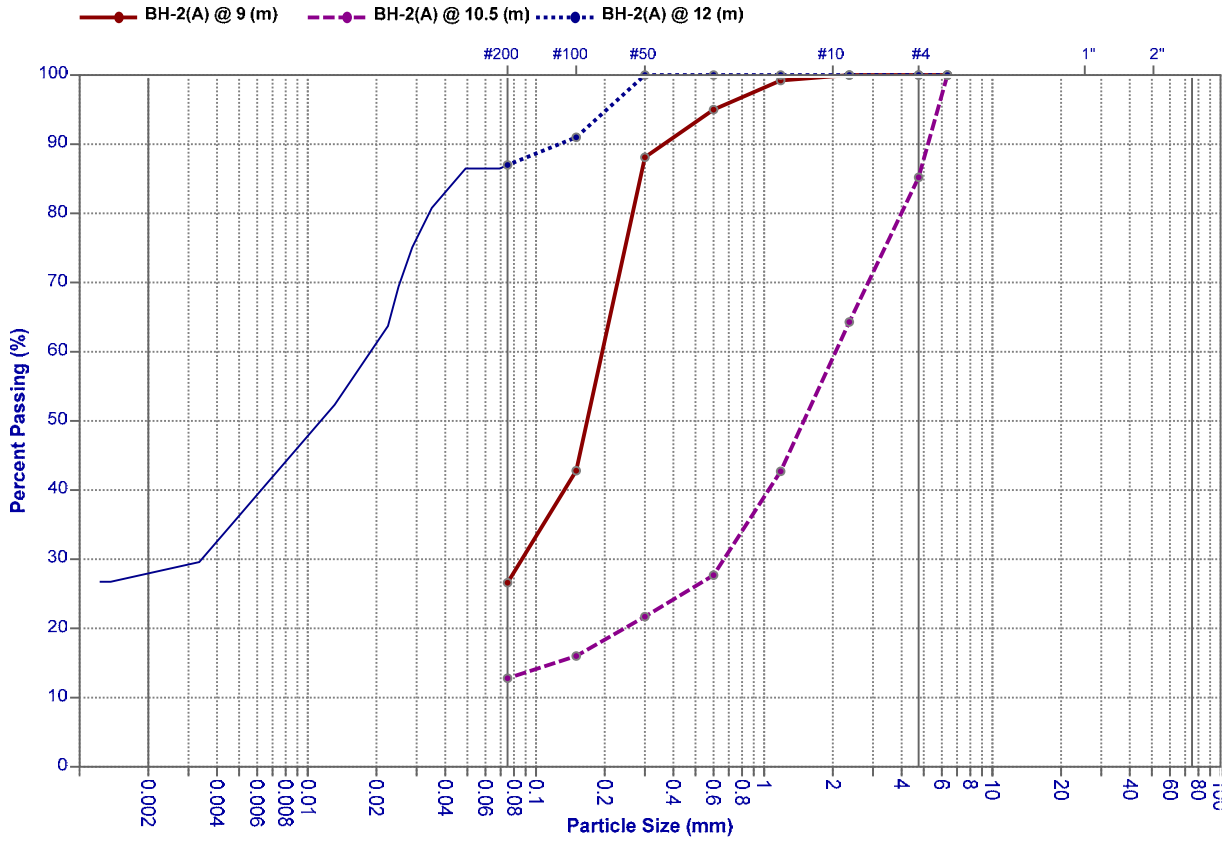
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Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	26.6	73.4	-	-
-	12.8	72.4	14.8	-
27.9	59.1	13	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-2(A)	9	-	0.087	0.167	0.195	0.518	-	-	-	N/A	SM	A-2-4
BH-2(A)	10.5	-	0.666	1.491	2.056	2.839	-	-	-	N/A	SM	A-2-4
BH-2(A)	12	0.001	0.003	0.011	0.019	0.474	19	-	-	N/A	ML	A-4

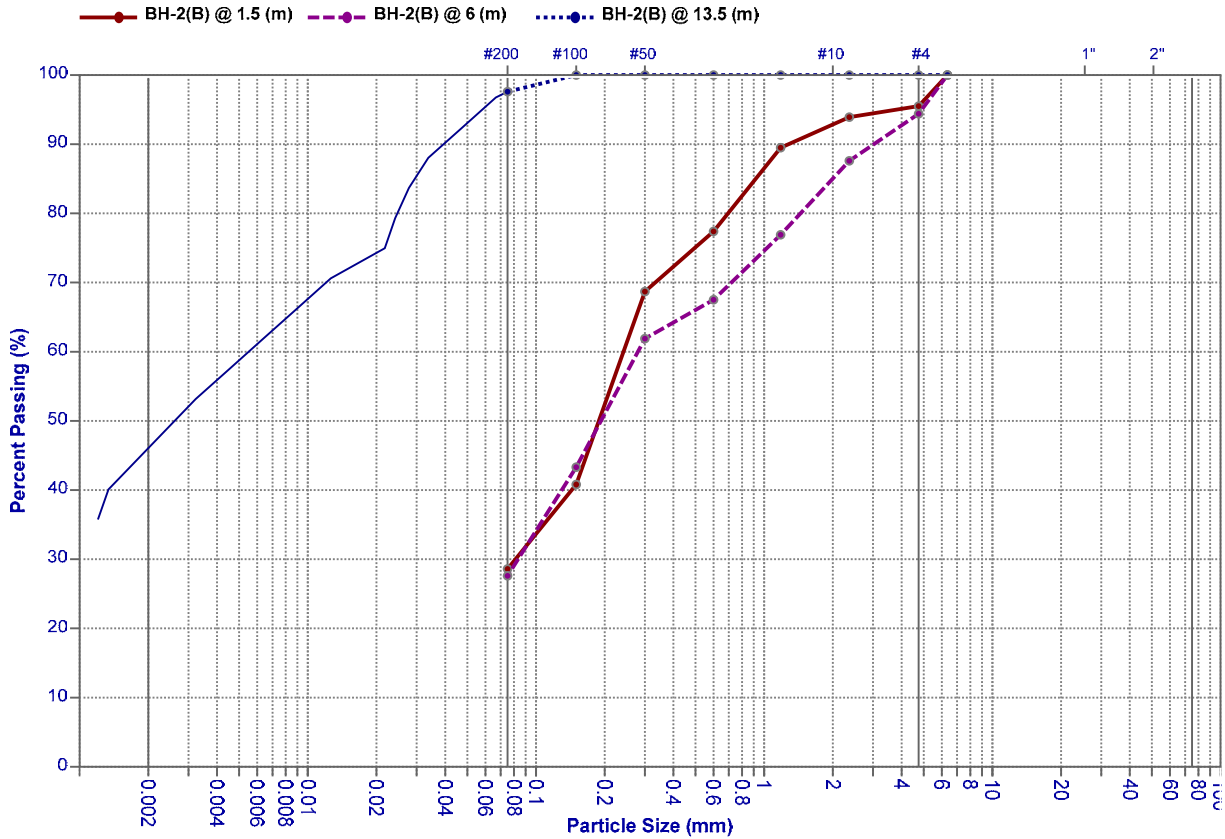
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Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	28.6	66.9	4.5	-
-	27.6	66.8	5.6	-
46.1	51.5	2.4	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-2(B)	1.5	-	0.081	0.189	0.242	0.361	-	-	-	N/A	SM	A-2-4
BH-2(B)	6	-	0.083	0.193	0.279	0.329	-	-	-	N/A	SM	A-2-4
BH-2(B)	13.5	0.001	0.001	0.003	0.006	0.167	6	-	-	N/A	ML	A-4

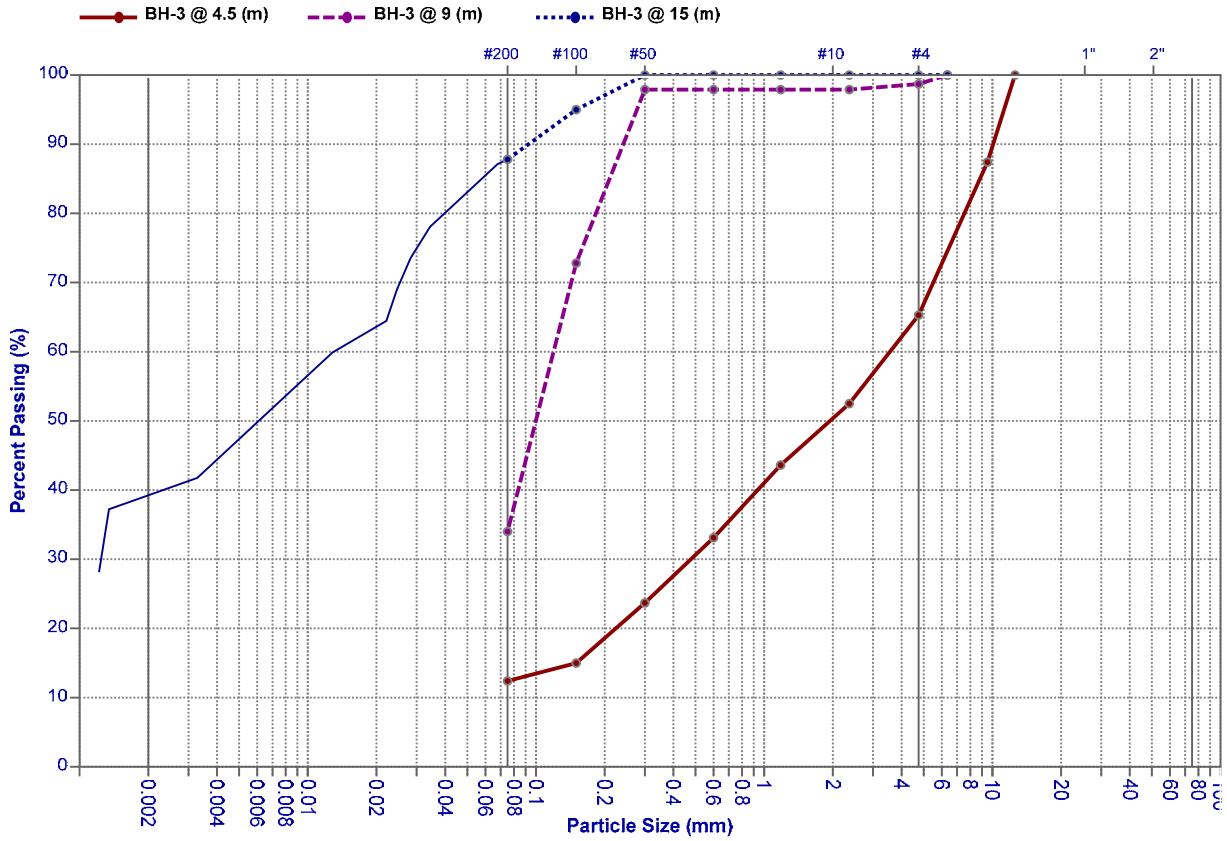
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Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	12.4	52.9	34.7	-
-	34	64.7	1.3	-
39.2	48.6	12.2	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-3	4.5	-	0.477	1.942	3.556	0.842	-	-	-	N/A	SM	A-2-4
BH-3	9	-	-	0.1	0.119	-	-	-	-	N/A	SM	A-2-4
BH-3	15	0.001	0.001	0.006	0.013	0.077	13	36.8	6.1	N/A	ML	A-4

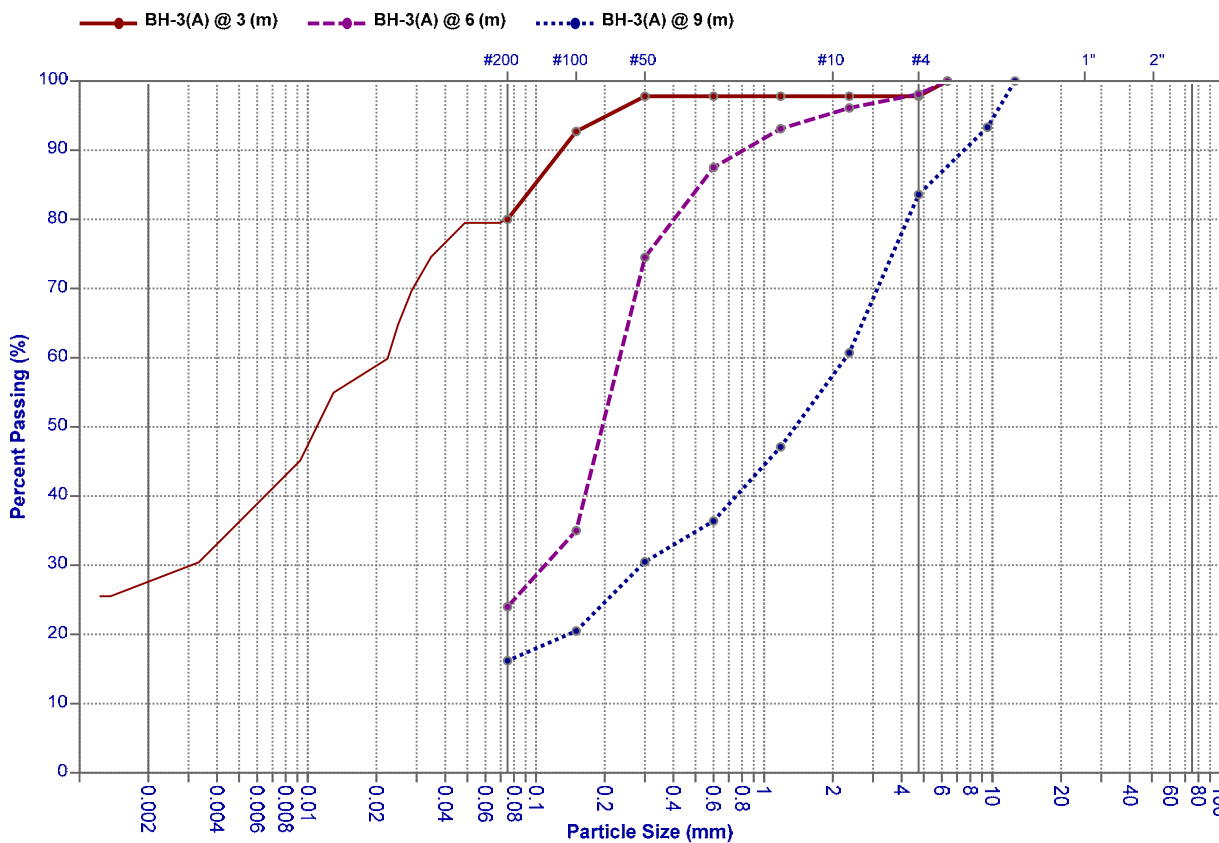
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 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
27.6	52.4	17.8	2.2	-
-	24	74.1	1.9	-
-	16.2	67.4	16.4	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-3(A)	3	0.001	0.003	0.011	0.022	0.409	22	-	-	N/A	ML	A-4
BH-3(A)	6	-	0.109	0.195	0.233	0.68	-	-	-	N/A	SM	A-2-4
BH-3(A)	9	-	0.29	1.368	2.277	0.486	-	-	-	N/A	SM	A-2-4

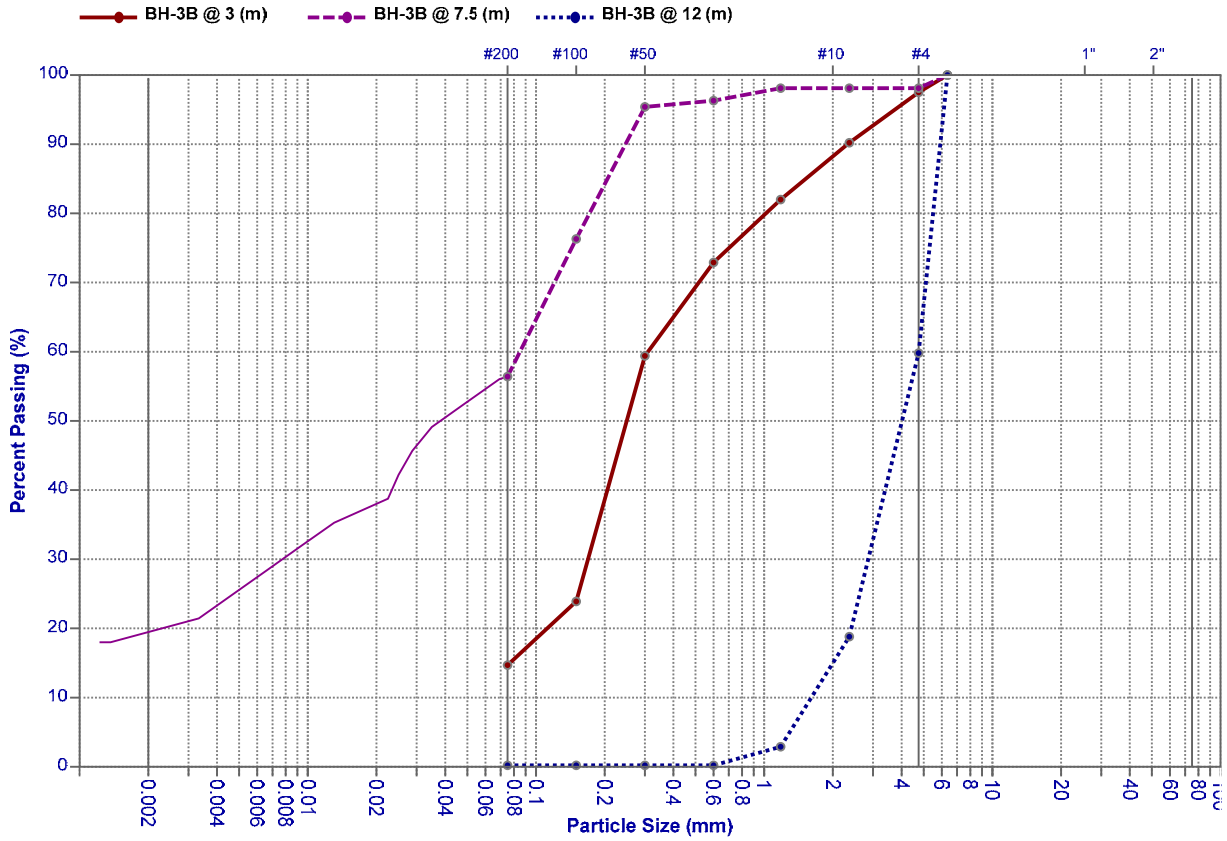
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 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	14.7	82.8	2.5	.
19.5	36.9	41.7	1.9	.
-	0.2	59.6	40.2	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-3B	3	-	0.169	0.25	0.309	1.216	-	-	-	N/A	SM	A-2-4
BH-3B	7.5	0.001	0.008	0.038	0.085	0.753	85	-	-	N/A	ML	A-4
BH-3B	12	1.608	2.857	4.019	1	5.076	0.622	-	-	N/A	SP	A-2-4

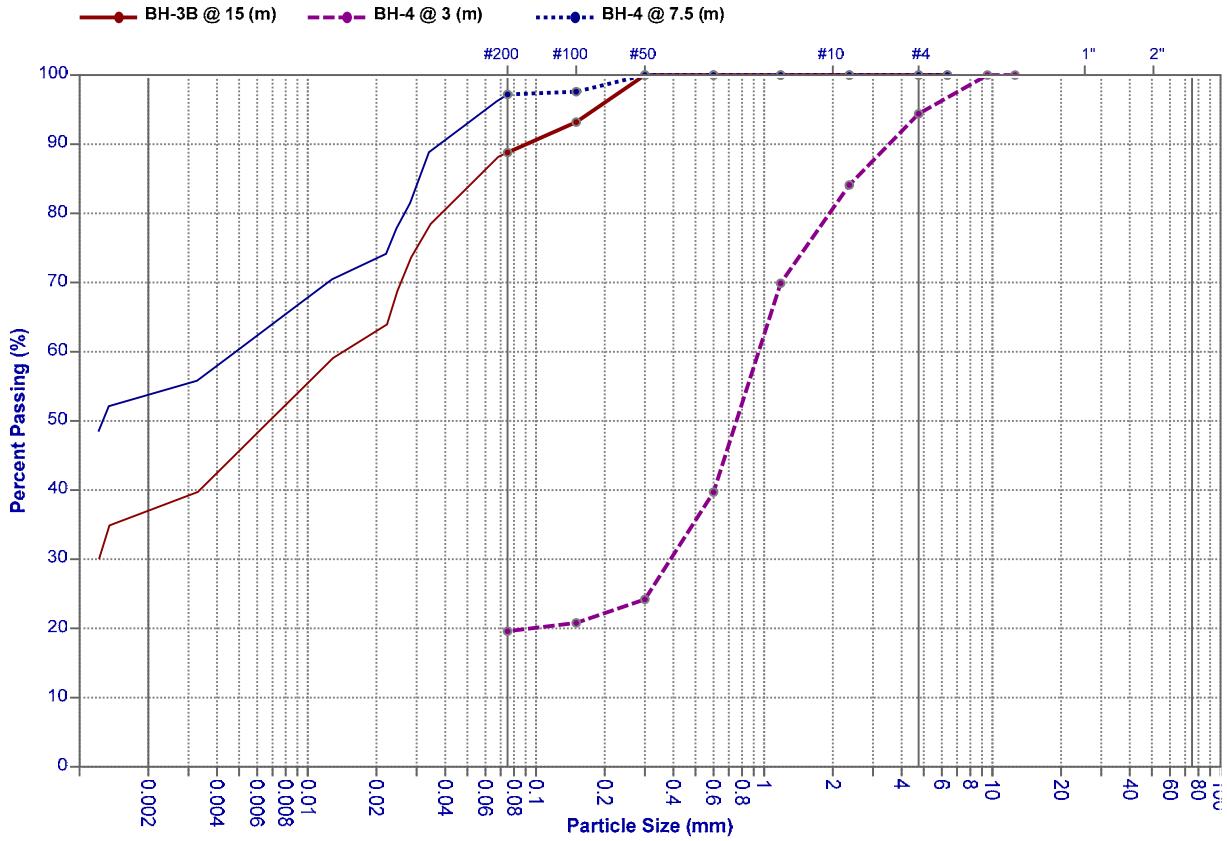
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
37	51.8	11.2	-	-
-	19.6	74.8	5.6	-
53.8	43.4	2.8	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-3B	15	0.001	0.001	0.007	0.014	0.071	14	-	-	N/A	ML	A-4
BH-4	3	-	0.389	0.756	0.945	2.135	-	-	-	N/A	SM	A-2-4
BH-4	7.5	0.001	0.001	0.001	0.005	0.2	5	38.7	17.1	N/A	CL	A-6

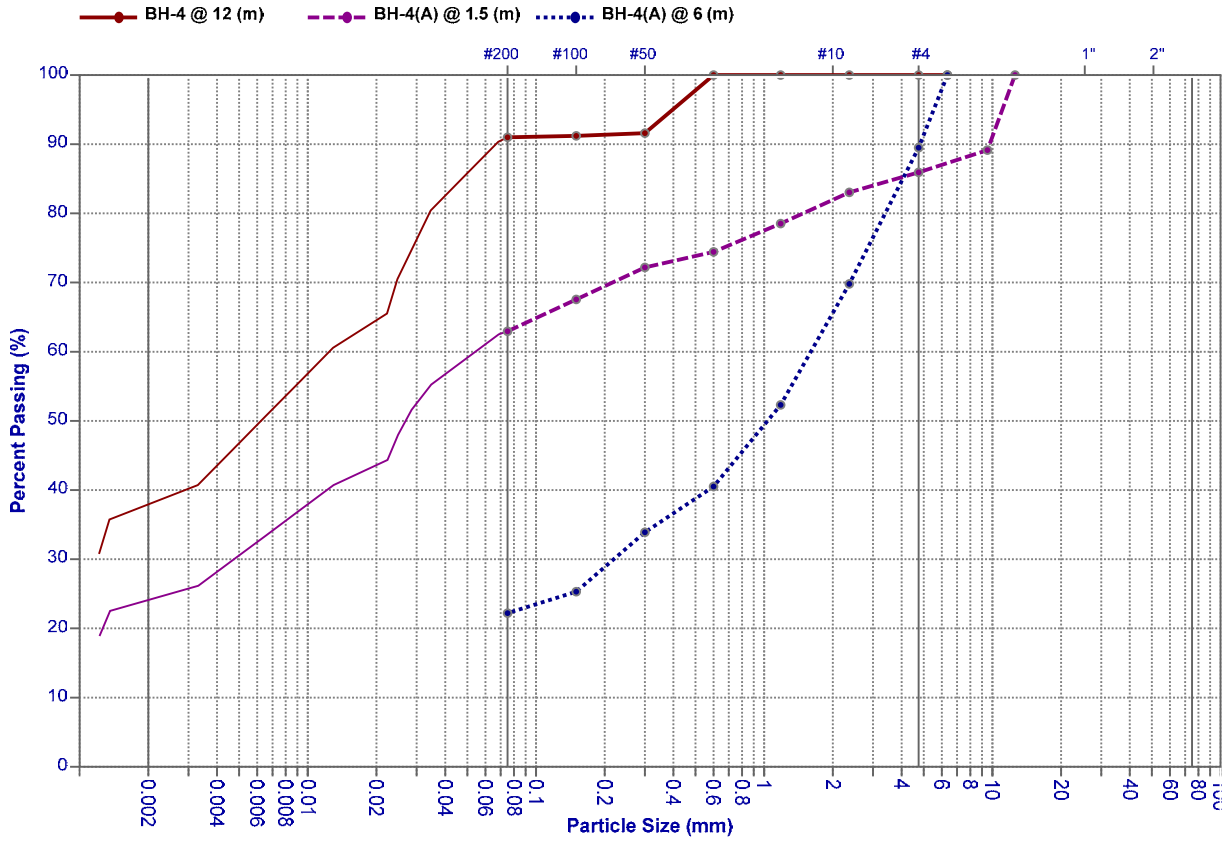
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
37.9	53.1	9	-	.
24.1	38.8	23	14.1	.
-	22.2	67.3	10.5	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-4	12	0.001	0.001	0.006	0.012	0.083	12	42.7	14	N/A	ML	A-7-6
BH-4(A)	1.5	0.001	0.005	0.027	0.054	0.463	54	-	-	N/A	ML	A-4
BH-4(A)	6	-	0.219	1.034	1.601	0.399	-	-	-	N/A	SM	A-2-4

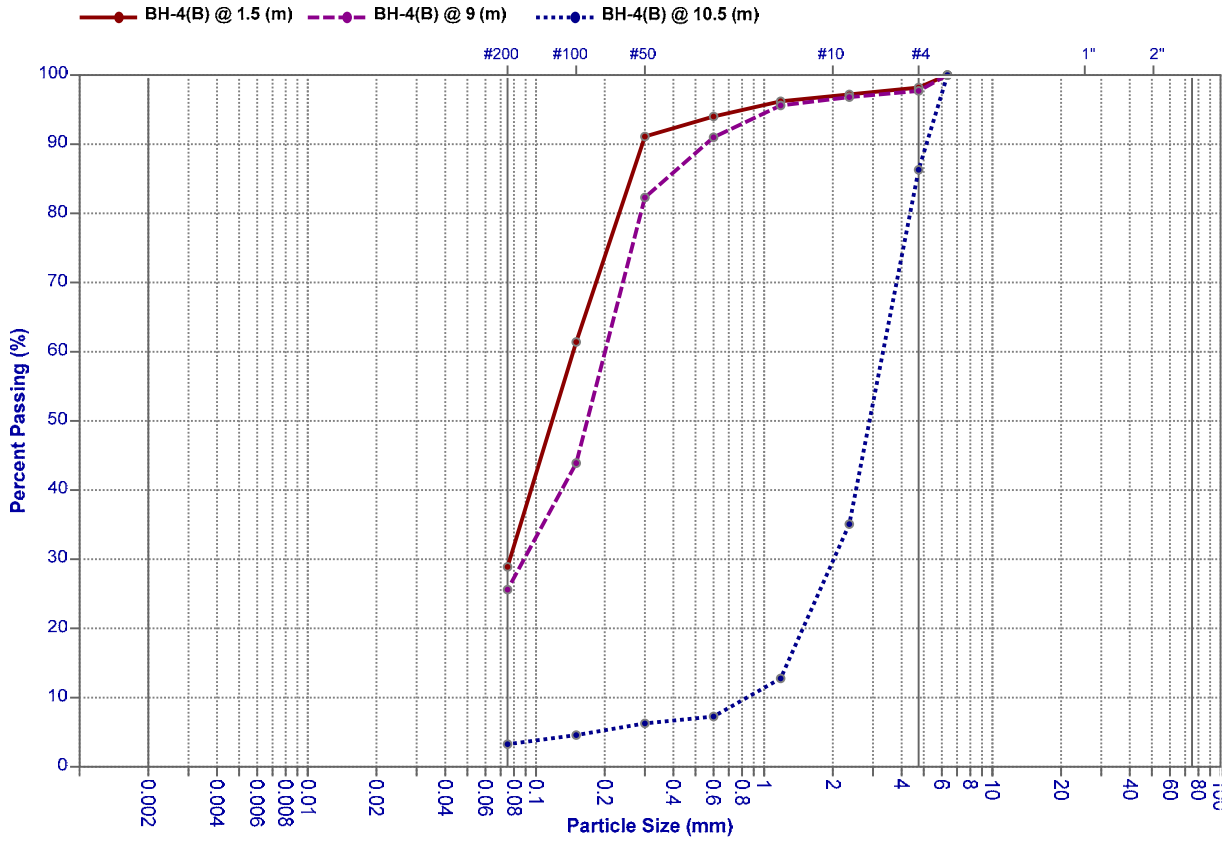
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	28.9	69.3	1.8	.
-	25.6	72.1	2.3	.
-	3.3	83	13.7	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-4(B)	1.5	-	0.077	0.118	0.146	0.541	-	-	-	N/A	SM	A-2-4
BH-4(B)	9	-	0.089	0.167	0.201	0.525	-	-	-	N/A	SM	A-2-4
BH-4(B)	10.5	0.839	2.016	2.894	3.317	1.46	3.954	-	-	N/A	SP	A-2-4

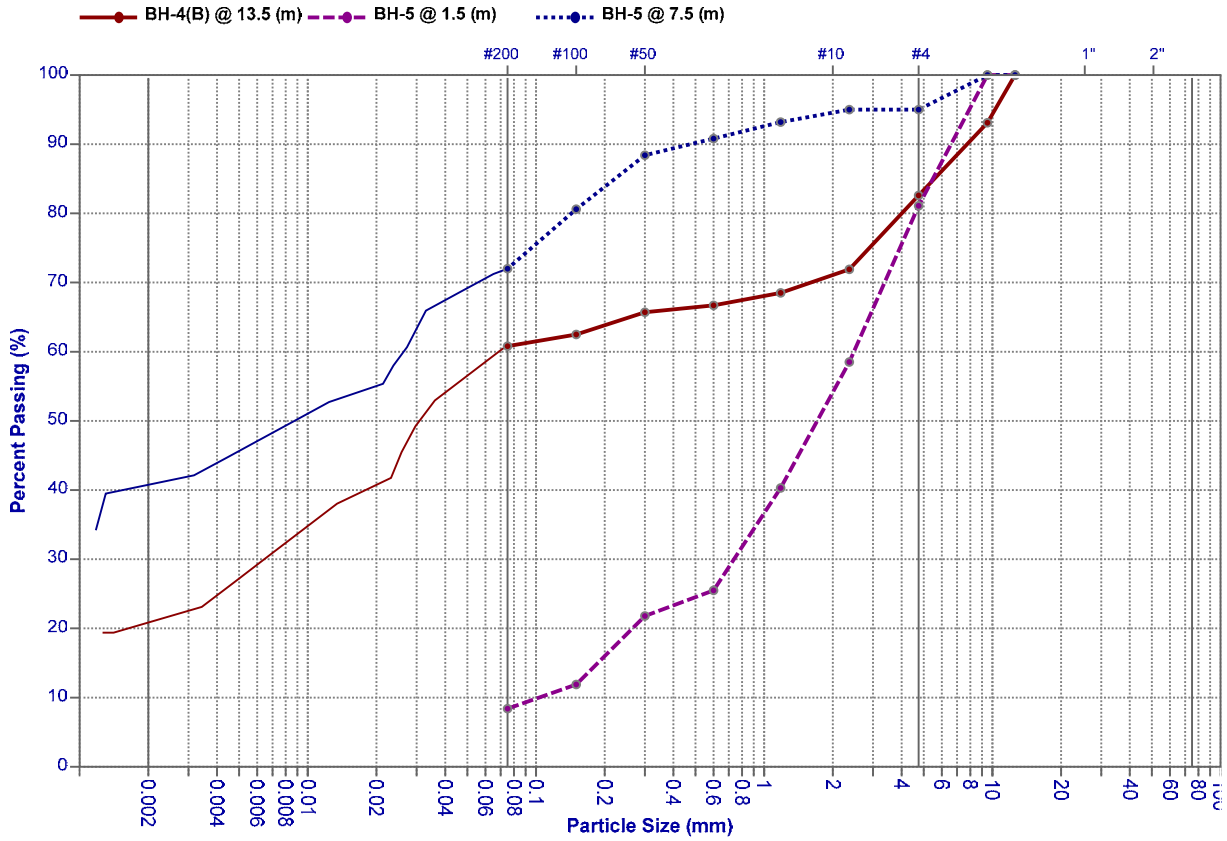
Sieve Analysis Test

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 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
20.9	39.9	21.8	17.4	.
-	8.4	72.7	18.9	.
40.8	31.2	23	5	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-4(B)	13.5	0.001	0.006	0.031	0.069	0.522	69	-	-	N/A	ML	A-4
BH-5	1.5	0.103	0.737	1.707	2.472	2.133	24	-	-	N/A	SW-SM	A-2-4
BH-5	7.5	0.001	0.001	0.009	0.026	0.038	26	27.4	7.8	N/A	CL	A-4

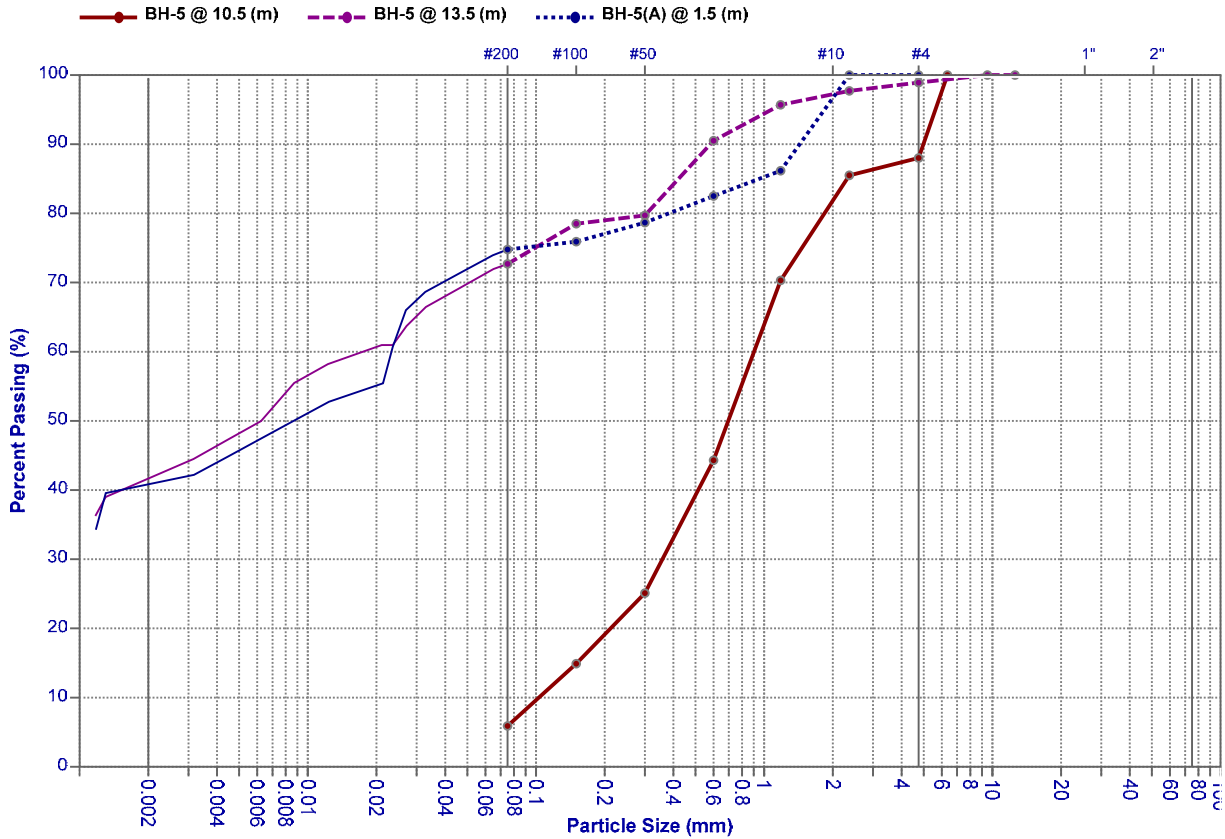
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	5.9	82.1	12	.
41.7	31	26.2	1.1	.
40.8	33.9	25.2	-	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-5	10.5	0.103	0.358	0.696	0.903	1.378	8.767	-	-	N/A	SW-SM	A-2-4
BH-5	13.5	0.001	0.001	0.006	0.017	0.059	17	39.7	10.9	N/A	ML	A-6
BH-5(A)	1.5	0.001	0.001	0.009	0.023	0.043	23	20.4	6.1	N/A	CL-ML	A-4

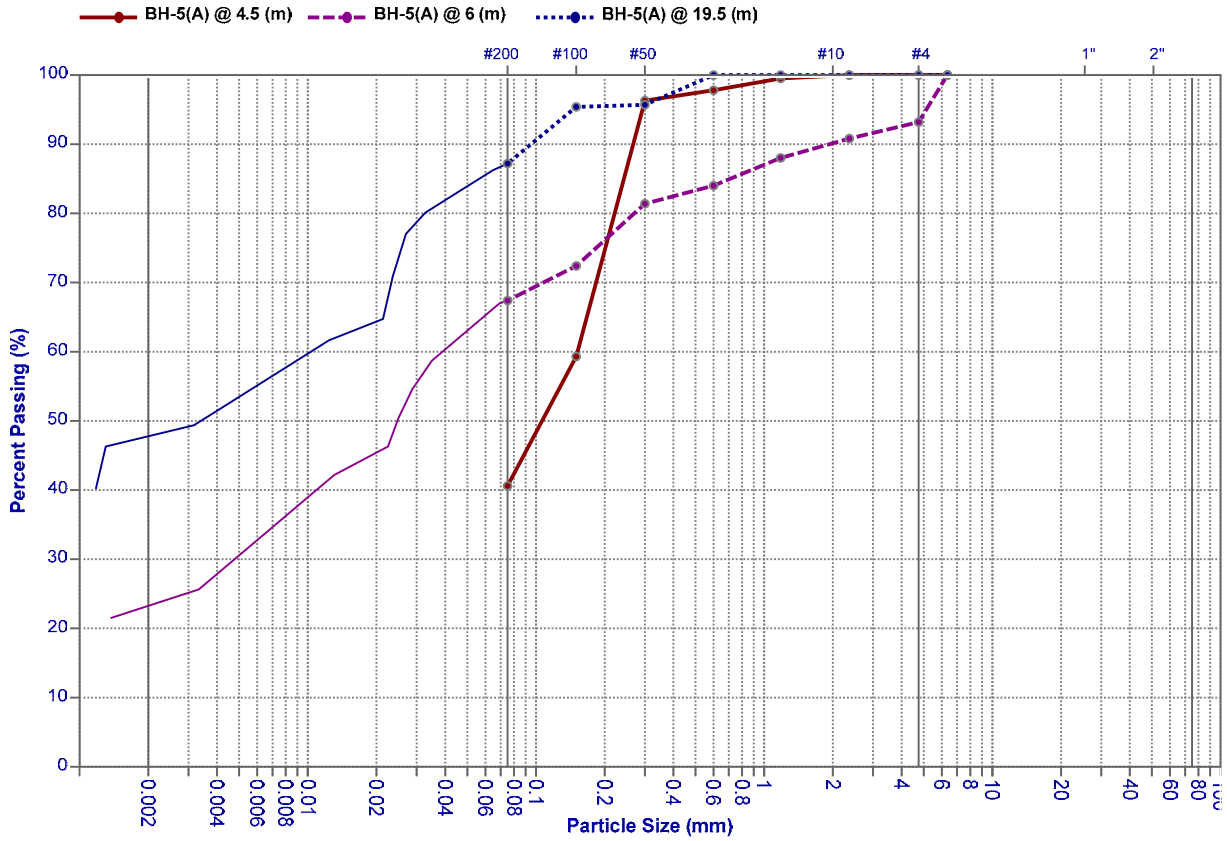
Sieve Analysis Test

Project : Coal Unloading Terminal
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 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	40.6	59.4	-	-
23.3	44.1	25.8	6.8	-
47.8	39.4	12.8	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-5(A)	4.5	-	-	0.106	0.152	-	-	-	-	N/A	SM	A-4
BH-5(A)	6	0.001	0.005	0.025	0.039	0.641	39	21.8	3.7	N/A	ML	A-4
BH-5(A)	19.5	0.001	0.001	0.003	0.01	0.1	10	22.8	7.4	N/A	CL	A-4

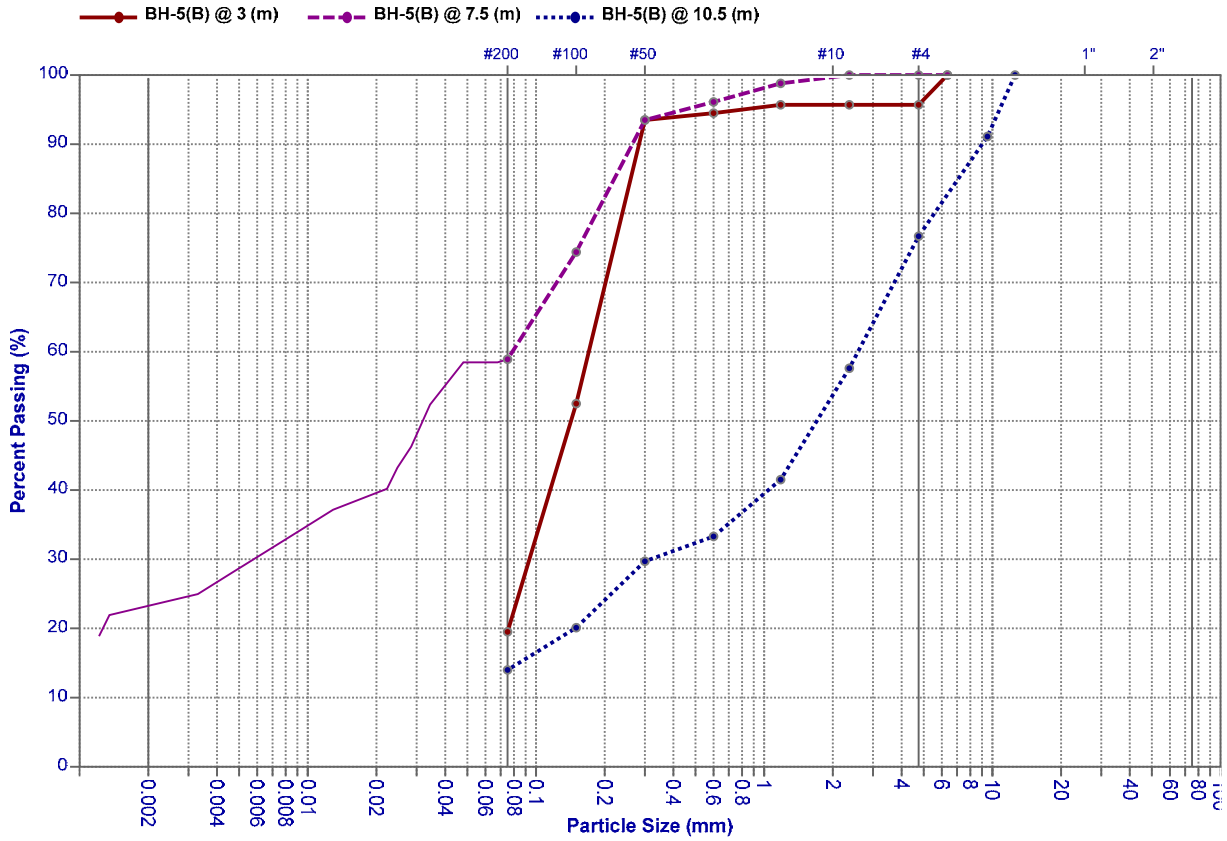
Sieve Analysis Test

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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	19.5	76.2	4.3	-
23.3	35.6	41.1	-	-
-	14	62.7	23.3	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-5(B)	3	-	0.094	0.142	0.17	0.693	-	-	-	N/A	SM	A-2-4
BH-5(B)	7.5	0.001	0.006	0.032	0.079	0.456	79	-	-	N/A	ML	A-4
BH-5(B)	10.5	-	0.318	1.701	2.577	0.516	-	-	-	N/A	SM	A-2-4

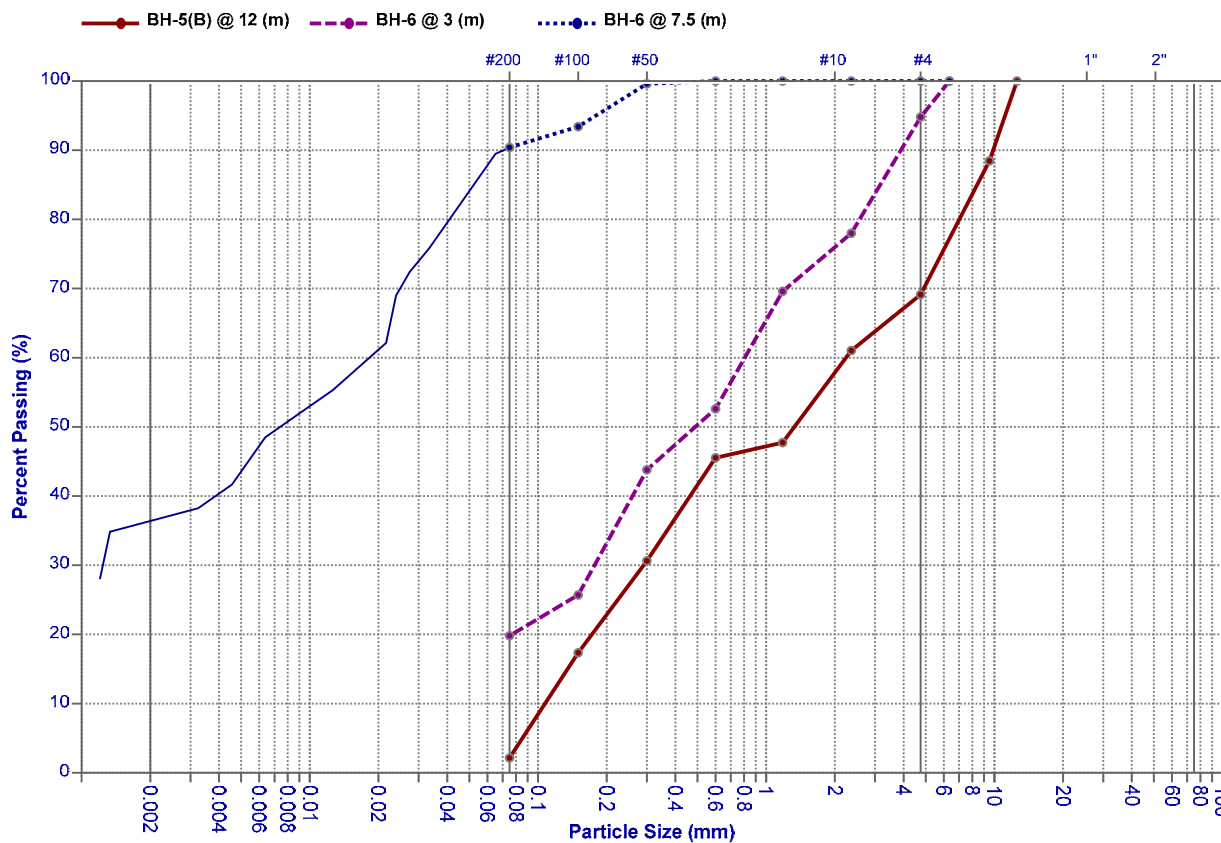
Sieve Analysis Test

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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	2.1	67	30.9	-
-	19.8	75	5.2	-
36.4	54	9.6	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-5(B)	12	0.107	0.29	1.327	2.235	0.352	20.888	-	-	N/A	SP	A-2-4
BH-6	3	-	0.177	0.489	0.805	0.519	-	-	-	N/A	SM	A-2-4
BH-6	7.5	0.001	0.001	0.007	0.018	0.056	18	27.1	7	N/A	CL-ML	A-4

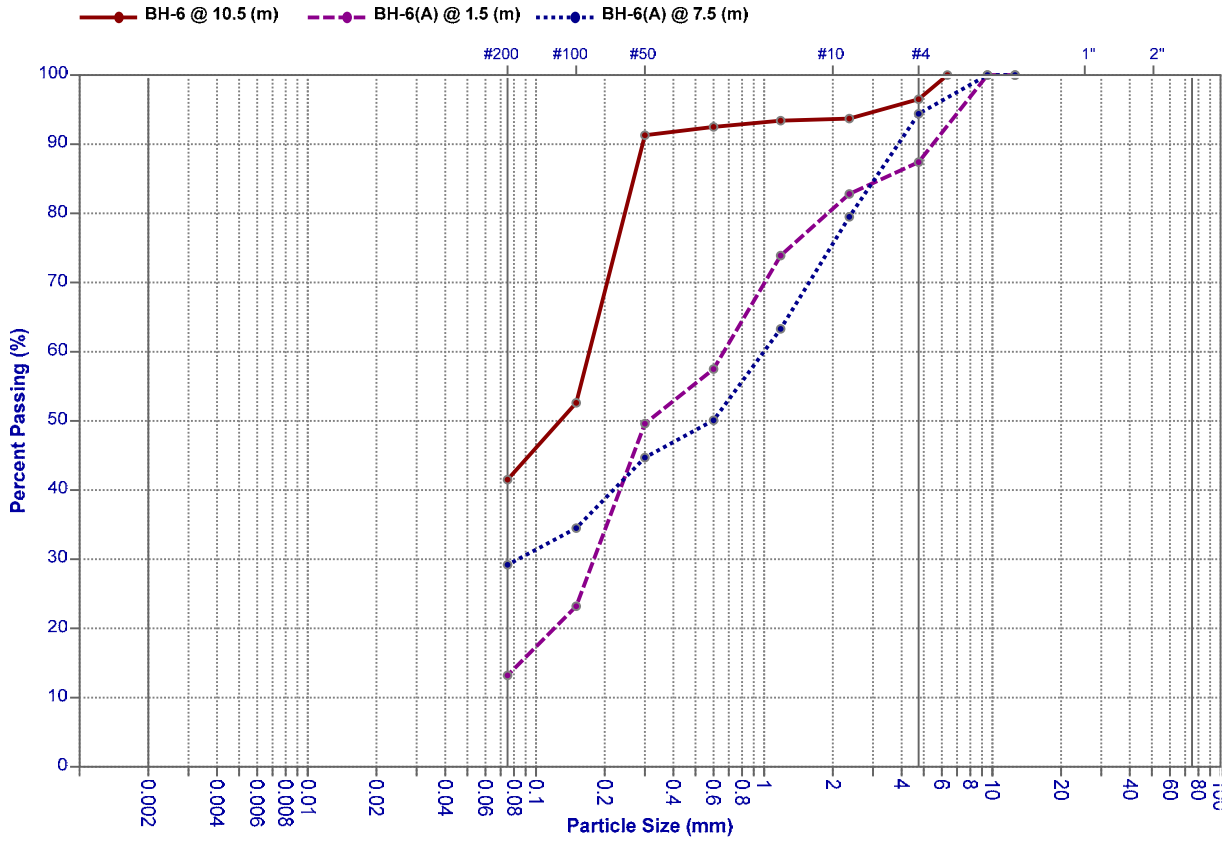
Sieve Analysis Test

Project : Coal Unloading Terminal
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Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	41.5	55	3.5	.
-	13.2	74.2	12.6	.
-	29.2	65.2	5.6	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-6	10.5	-	-	0.128	0.171	-	-	-	-	N/A	SM	A-4
BH-6(A)	1.5	-	0.179	0.311	0.665	0.634	-	-	-	N/A	SM	A-2-4
BH-6(A)	7.5	-	0.083	0.592	0.996	0.092	-	-	-	N/A	SM	A-2-4

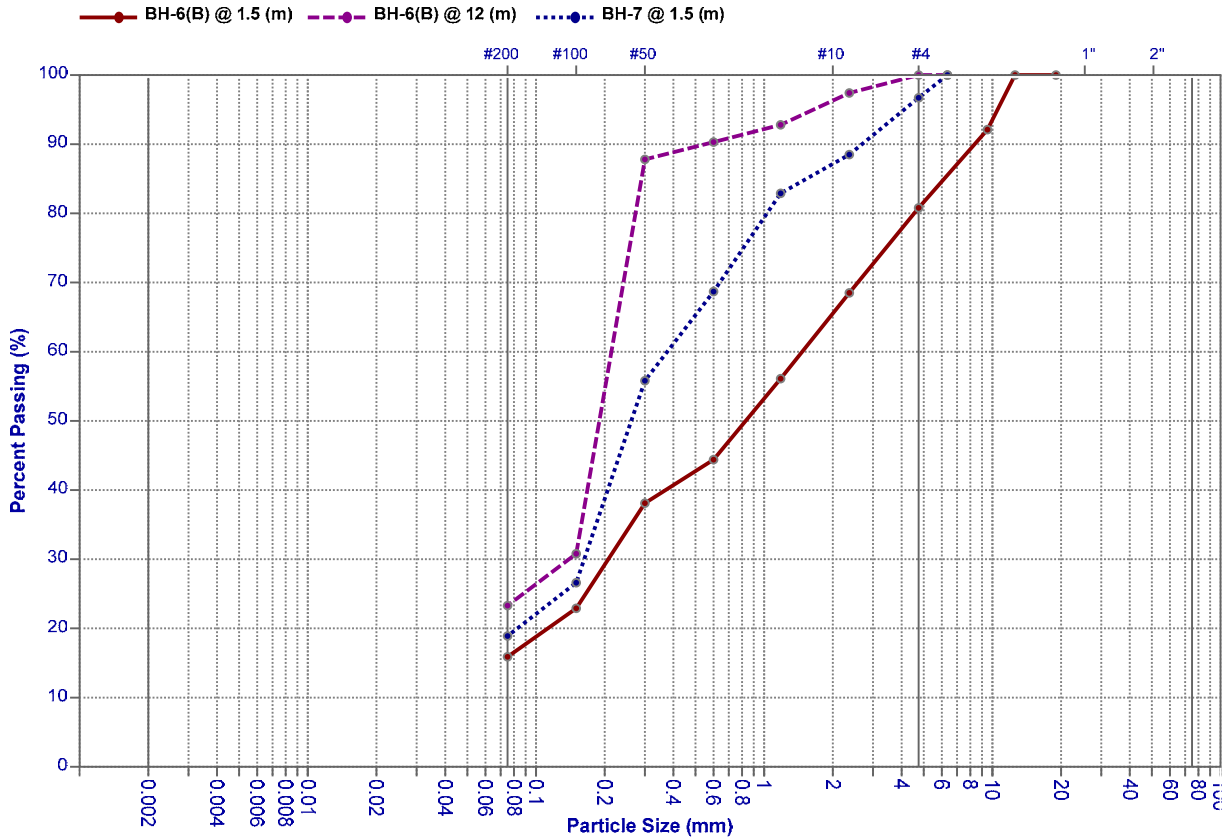
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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	15.9	64.9	19.2	-
-	23.3	76.7	-	-
-	18.9	77.8	3.3	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-6(B)	1.5	-	0.207	0.829	1.467	0.384	-	-	-	N/A	SM	A-2-4
BH-6(B)	12	-	0.139	0.189	0.214	1.204	-	-	-	N/A	SM	A-2-4
BH-7	1.5	-	0.163	0.261	0.376	0.942	-	-	-	N/A	SM	A-2-4

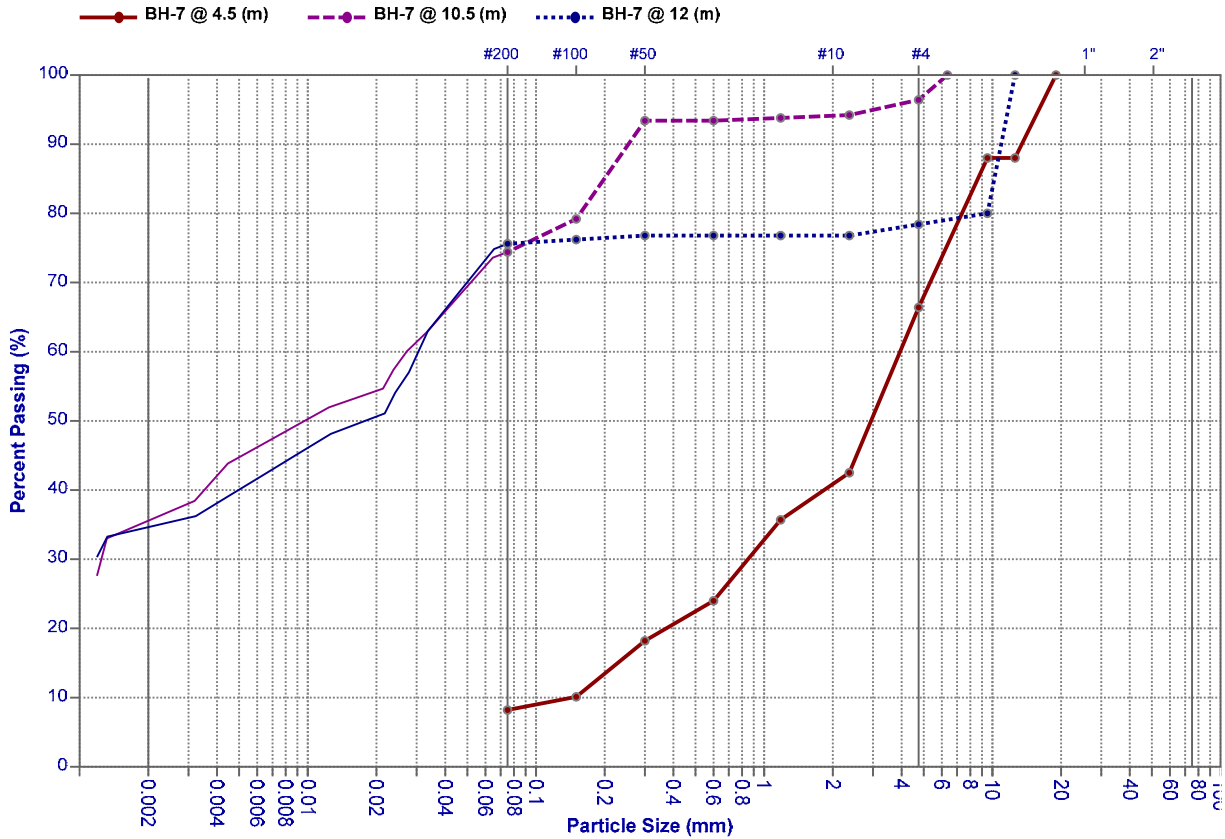
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Project : Coal Unloading Terminal
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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	8.2	58.2	33.6	.
35.6	38.8	22	3.6	.
34.6	41	2.8	21.6	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-7	4.5	0.145	0.849	2.939	3.939	1.262	27.166	-	-	N/A	SW-SM	A-2-4
BH-7	10.5	0.001	0.001	0.01	0.027	0.037	27	39.1	13.1	N/A	ML	A-6
BH-7	12	0.001	0.001	0.018	0.03	0.033	30	41.7	15.2	N/A	ML	A-7-6

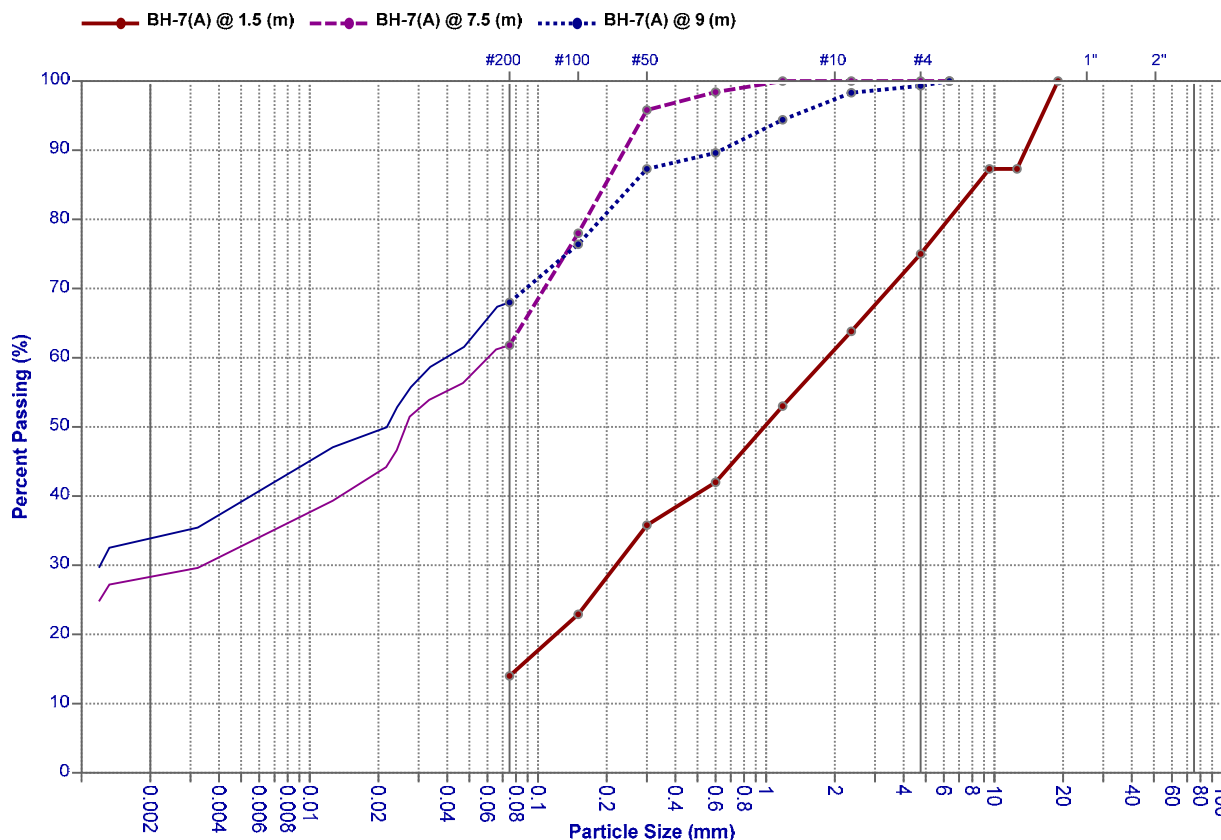
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 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	14	61	25	.
28.3	33.5	38.2	-	.
33.9	34.1	31.3	0.7	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-7(A)	1.5	-	0.22	0.981	1.849	0.344	-	-	-	N/A	SM	A-2-4
BH-7(A)	7.5	0.001	0.003	0.026	0.06	0.15	60	19.8	3.5	N/A	ML	A-4
BH-7(A)	9	0.001	0.001	0.022	0.039	0.026	39	19.7	3.4	N/A	ML	A-4

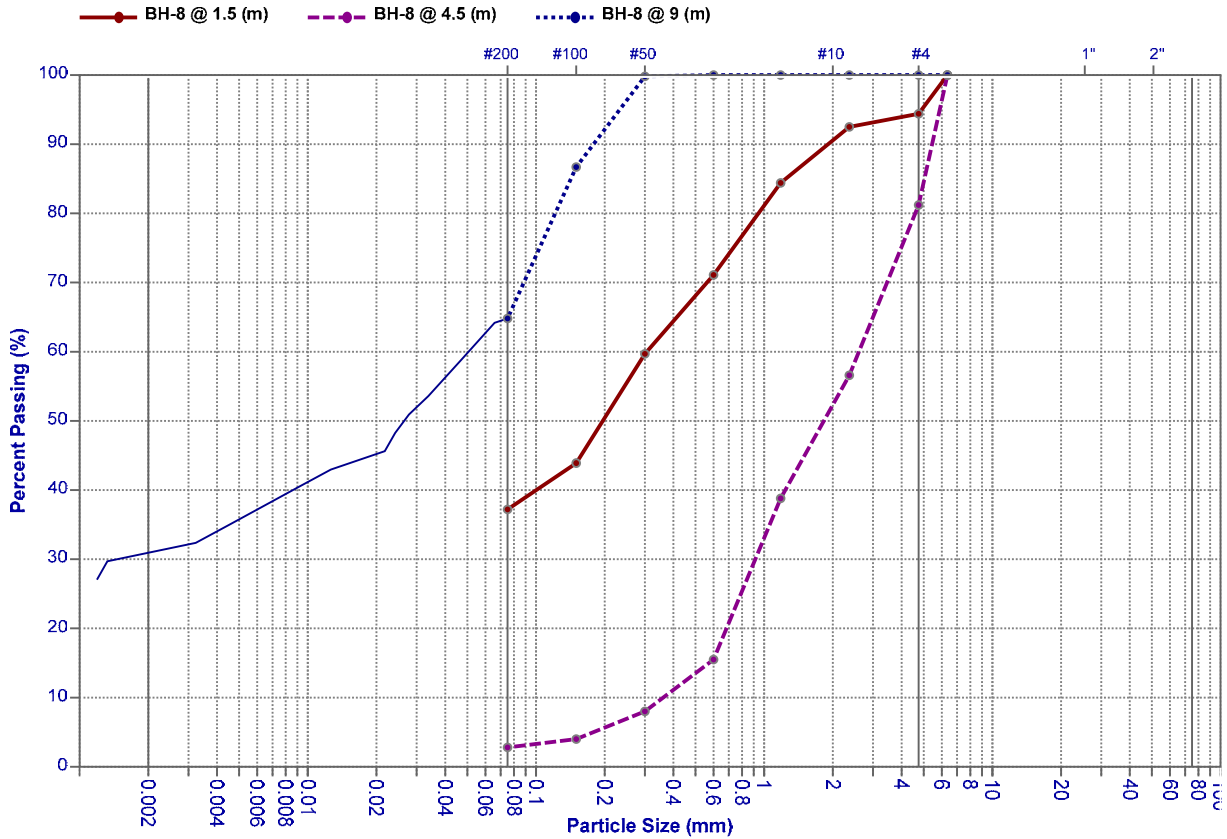
Sieve Analysis Test

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 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	37.2	57.2	5.6	-
-	2.8	78.4	18.8	-
30.9	33.9	35.2	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-8	1.5	-	-	0.196	0.306	-	-	-	-	N/A	SM	A-4
BH-8	4.5	0.361	0.914	1.825	2.6	0.89	7.202	-	-	N/A	SP	A-2-4
BH-8	9	0.001	0.001	0.026	0.051	0.02	51	-	-	N/A	ML	A-4

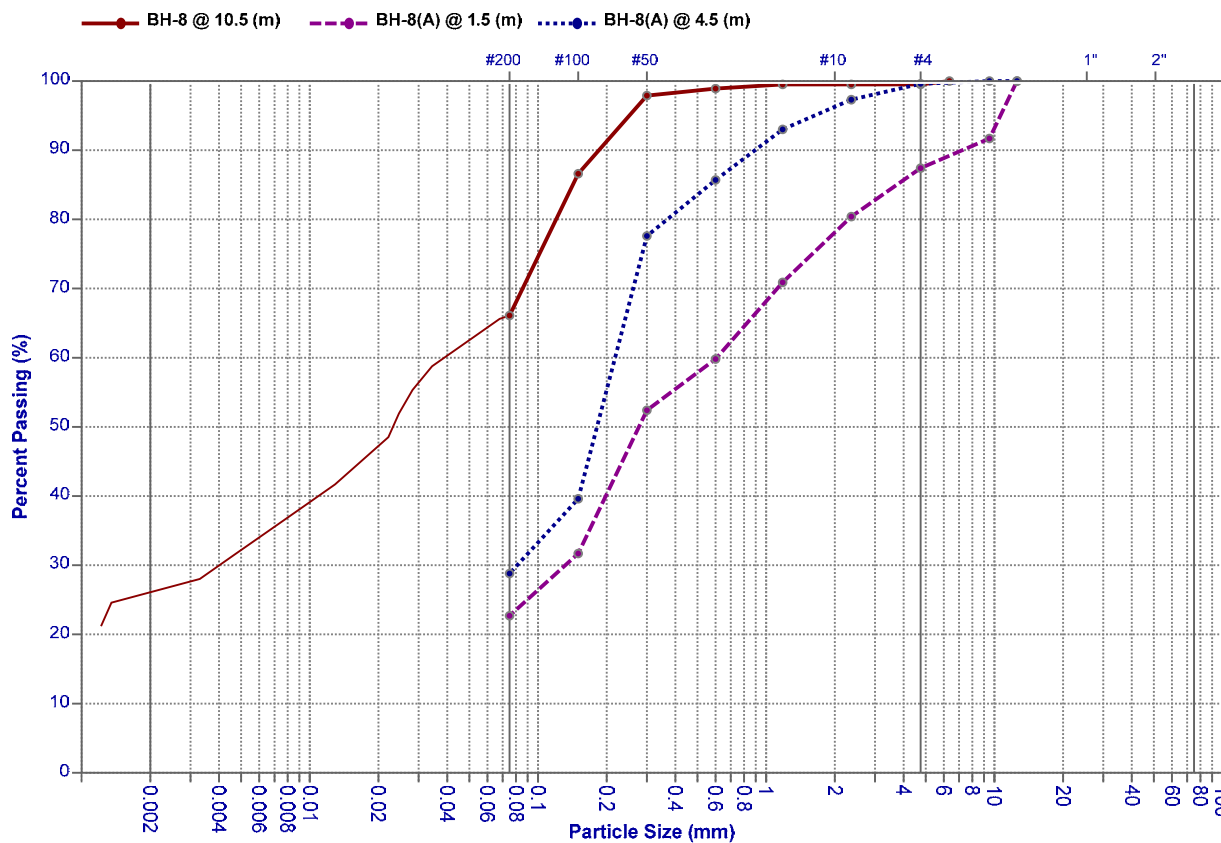
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Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
26.1	40	33.4	0.5	-
-	22.7	64.7	12.6	-
-	28.8	70.8	0.4	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-8	10.5	0.001	0.004	0.023	0.039	0.41	39	-	-	N/A	ML	A-4
BH-8(A)	1.5	-	0.132	0.277	0.607	0.383	-	-	-	N/A	SM	A-2-4
BH-8(A)	4.5	-	0.081	0.181	0.218	0.401	-	-	-	N/A	SM	A-2-4

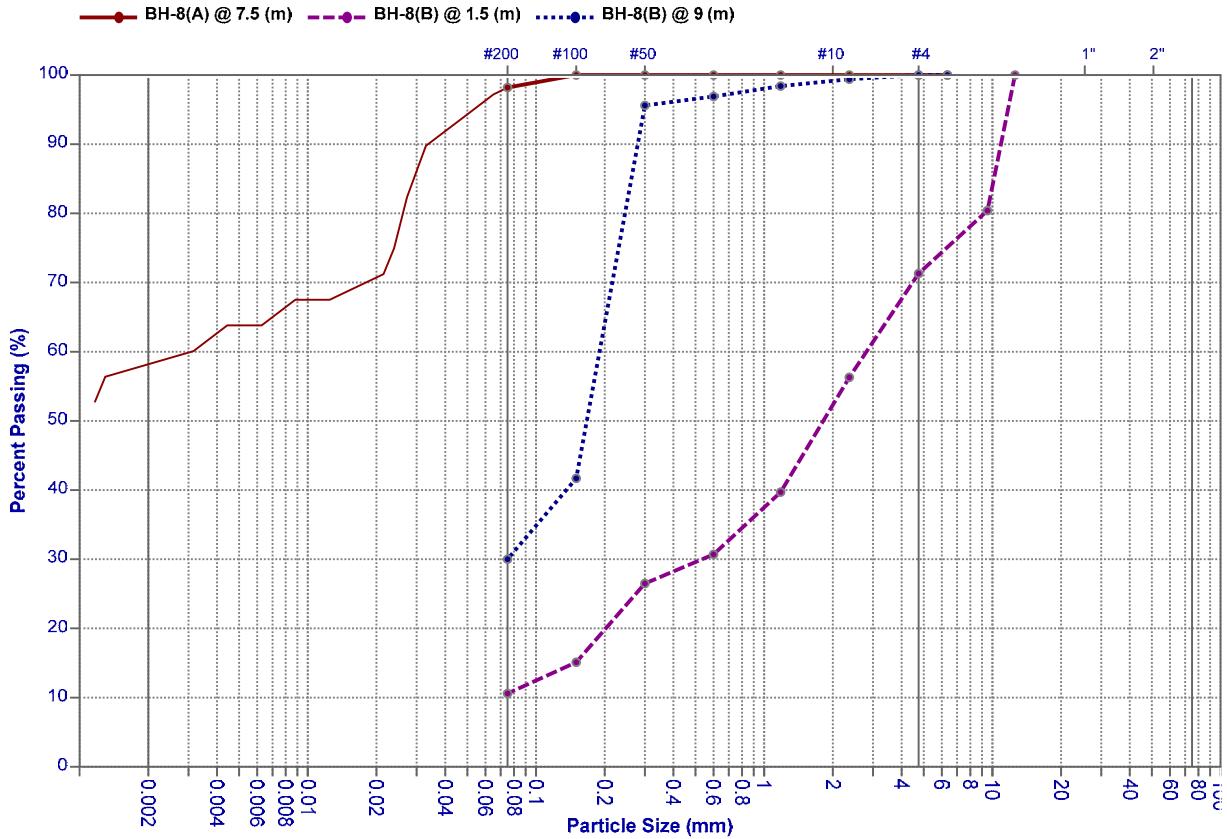
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 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
58.2	40	1.8	-	-
-	10.6	60.7	28.7	-
-	30	70	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-8(A)	7.5	0.001	0.001	0.001	0.003	0.333	3	40.8	15.1	N/A	ML	A-7-6
BH-8(B)	1.5	-	0.535	1.814	2.804	1.343	-	-	-	N/A	SW-SM	A-2-4
BH-8(B)	9	-	0.076	0.167	0.19	0.405	-	-	-	N/A	SM	A-2-4

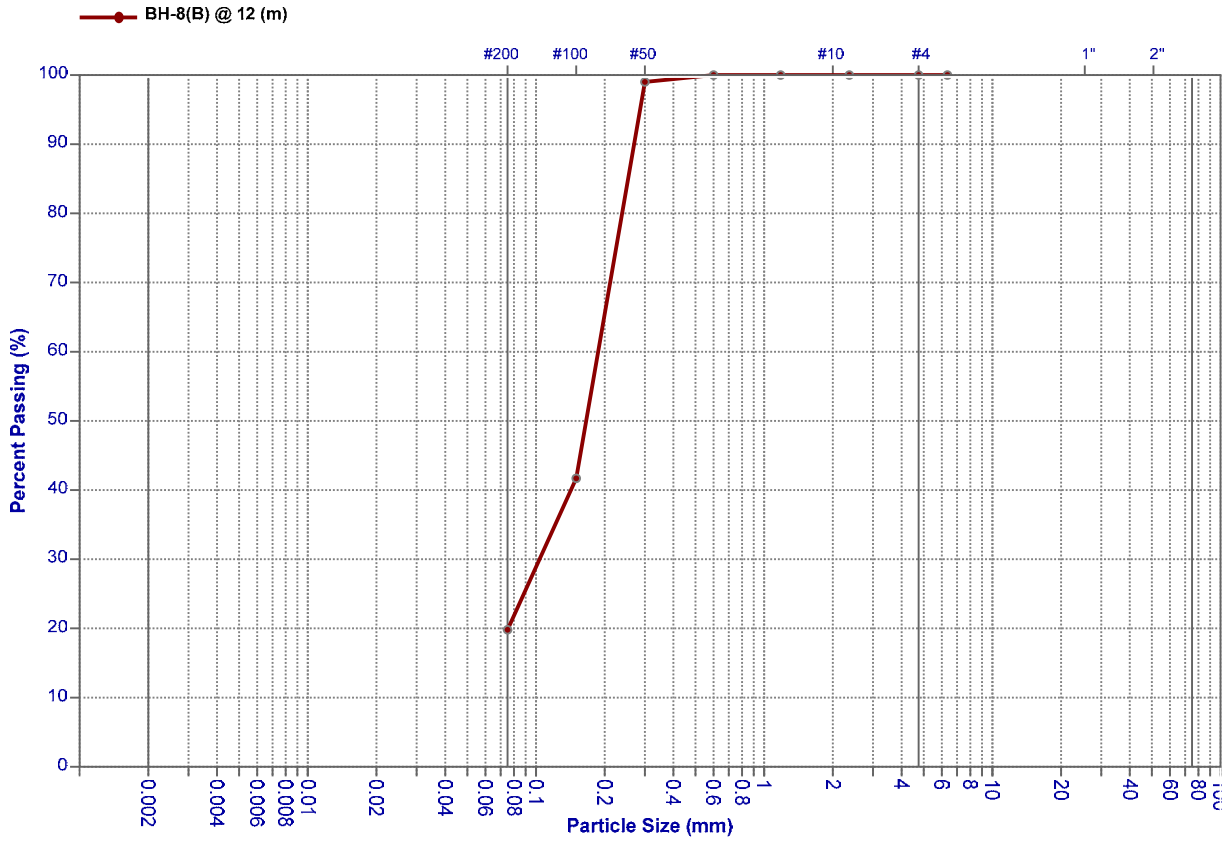
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Project : Coal Unloading Terminal
 Client : Techno Consultant International
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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	19.8	80.2	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-8(B)	12	-	0.104	0.166	0.187	0.771	-	-	-	N/A	SM	A-2-4

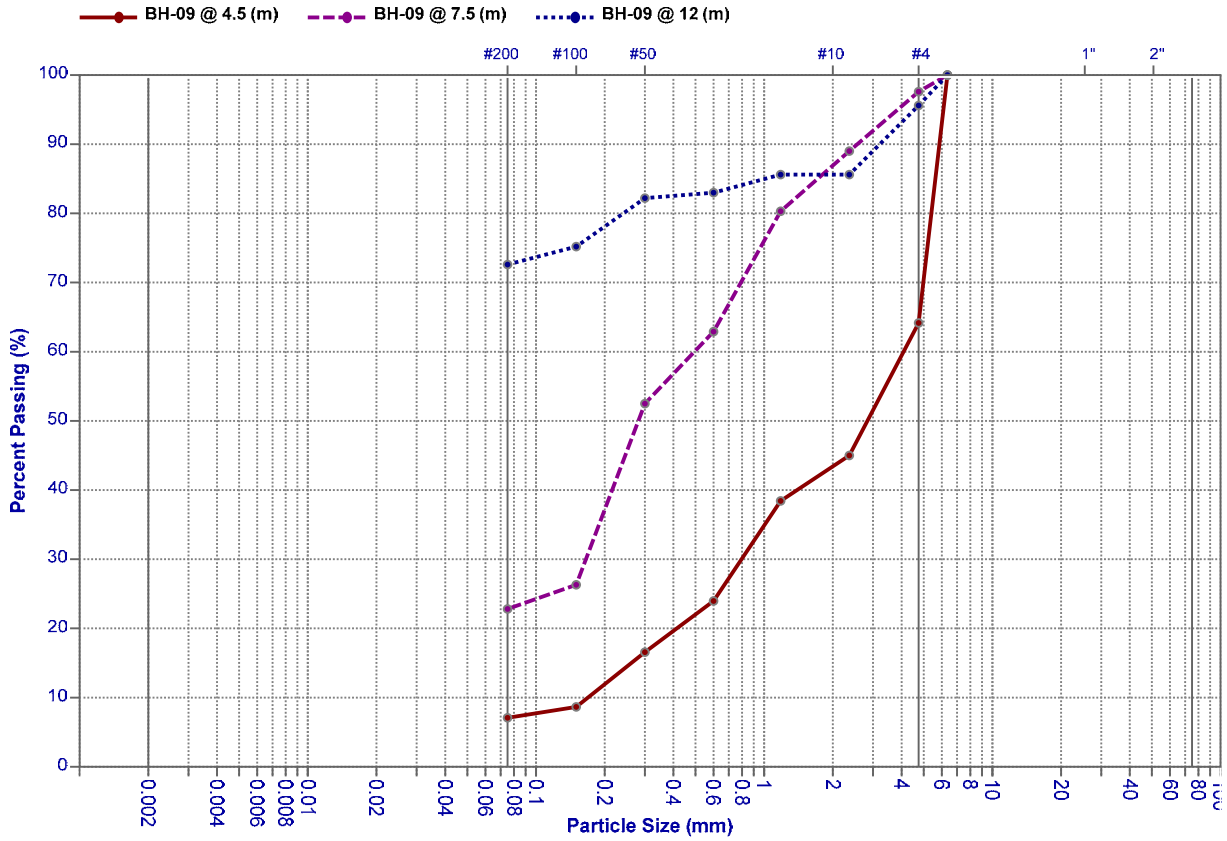
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	7.1	57.1	35.8	-
-	22.8	74.8	2.4	-
-	72.6	23	4.4	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-09	4.5	0.169	0.796	2.832	4.08	0.919	24.142	-	-	N/A	SP-SM	A-2-4
BH-09	7.5	-	0.165	0.281	0.495	0.733	-	-	-	N/A	SM	A-2-4
BH-09	12	-	-	-	-	-	-	35.8	10.7	N/A	ML	A-6

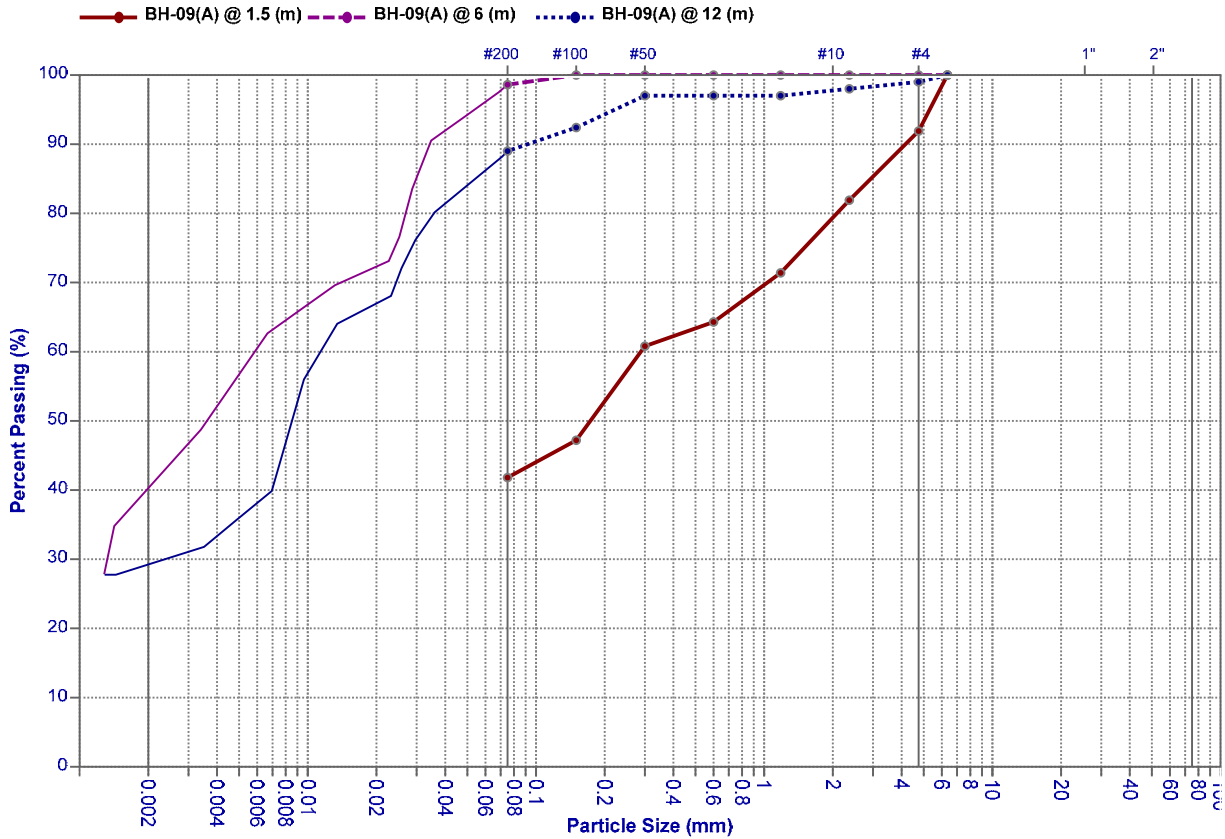
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 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	41.8	50.1	8.1	.
40.3	58.3	1.4	-	.
29.3	59.7	10	1	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-09(A)	1.5	-	-	0.173	0.288	-	-	-	-	N/A	SM	A-4
BH-09(A)	6	0.001	0.001	0.004	0.006	0.167	6	35.9	9.8	N/A	ML	A-4
BH-09(A)	12	0.001	0.002	0.009	0.011	0.364	11	-	-	N/A	ML	A-4

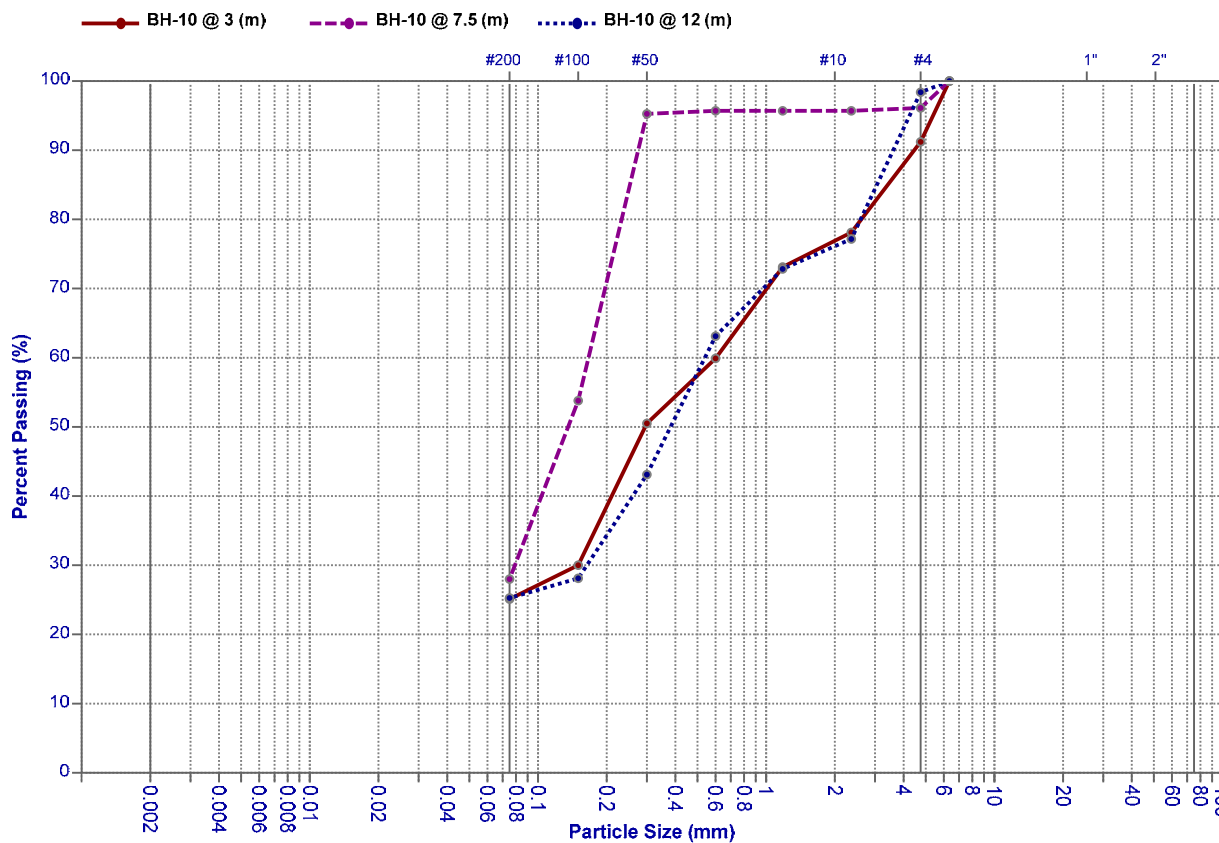
Sieve Analysis Test

Project : Coal Unloading Terminal
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 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	25.1	66.1	8.8	.
-	28	68.1	3.9	.
-	25.3	73.1	1.6	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-10	3	-	0.15	0.295	0.603	0.498	-	-	-	N/A	SM	A-2-4
BH-10	7.5	-	0.079	0.135	0.166	0.501	-	-	-	N/A	SM	A-2-4
BH-10	12	-	0.164	0.381	0.539	0.665	-	-	-	N/A	SM	A-2-4

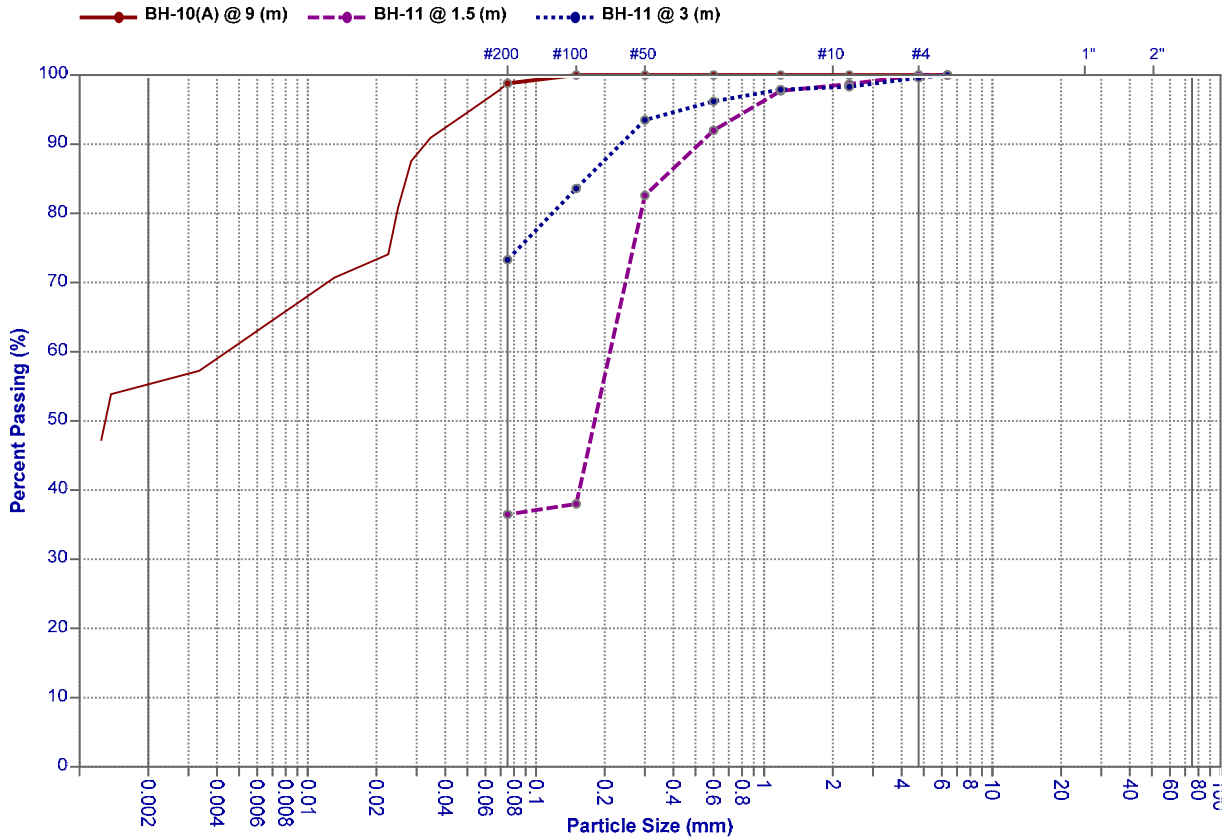
Sieve Analysis Test

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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
55.3	43.5	1.2	-	-
-	36.5	63.5	-	-
-	73.3	26.3	0.4	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-10(A)	9	0.001	0.001	0.001	0.004	0.25	4	31.3	9.4	N/A	CL	A-4
BH-11	1.5	-	-	0.181	0.211	-	-	-	-	N/A	SM	A-4
BH-11	3	-	-	-	-	-	-	-	-	N/A	ML	A-4

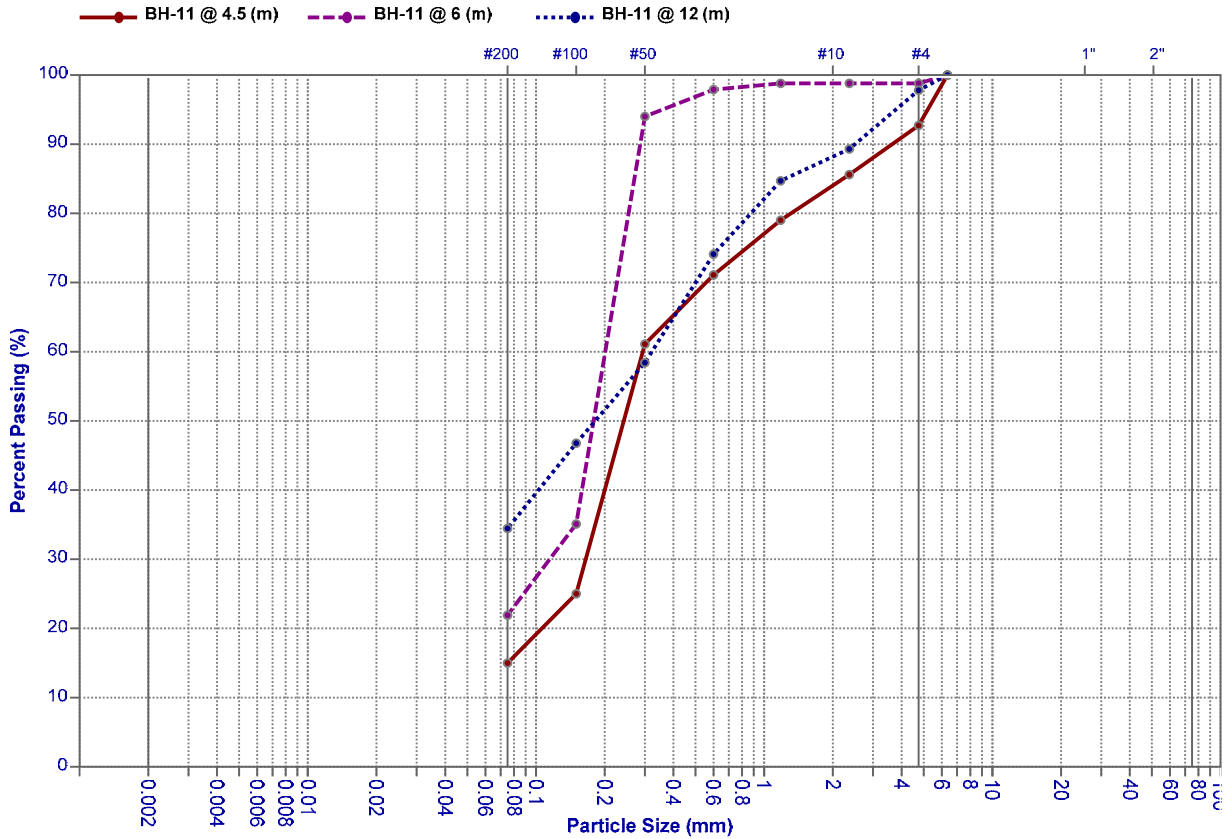
Sieve Analysis Test

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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	15	77.7	7.3	.
-	21.9	76.9	1.2	.
-	34.4	63.4	2.2	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-11	4.5	-	0.165	0.242	0.294	1.218	-	-	-	N/A	SM	A-2-4
BH-11	6	-	0.115	0.179	0.201	0.877	-	-	-	N/A	SM	A-2-4
BH-11	12	-	-	0.182	0.322	-	-	-	-	N/A	SM	A-2-4

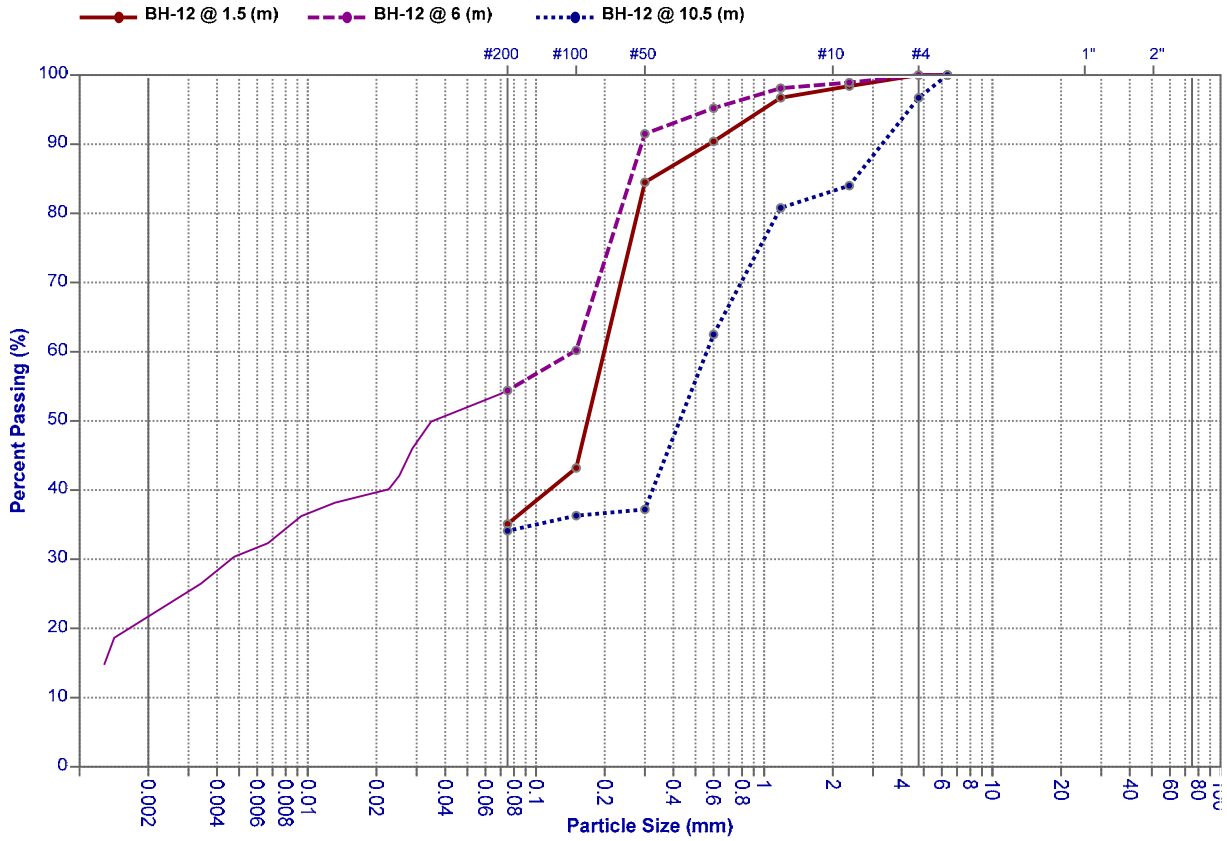
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Project : Coal Unloading Terminal
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 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	35.1	64.9	-	-
21.7	32.7	45.6	-	-
-	34.1	62.6	3.3	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-12	1.5	-	-	0.168	0.199	-	-	-	-	N/A	SM	A-4
BH-12	6	0.001	0.005	0.035	0.146	0.171	146	-	-	N/A	ML	A-4
BH-12	10.5	-	-	0.426	0.56	-	-	-	-	N/A	SM	A-2-4

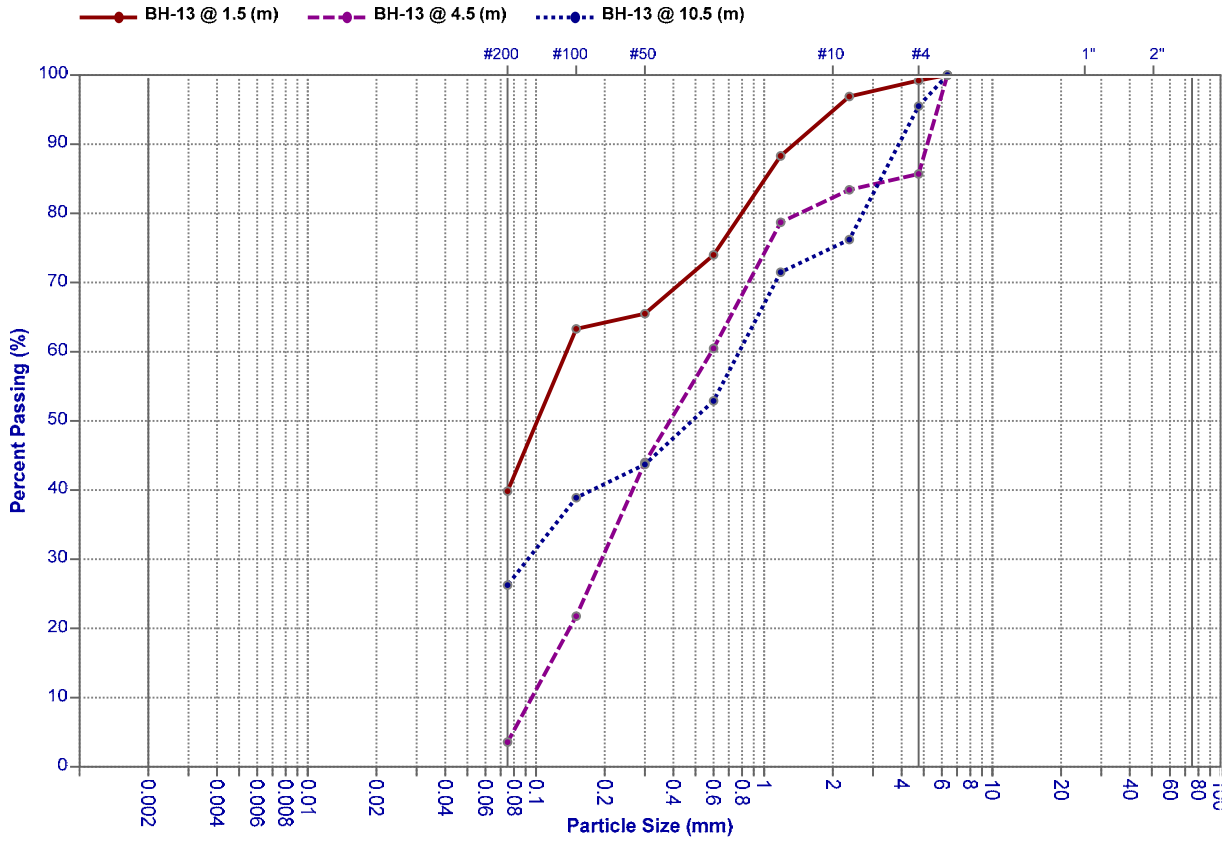
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 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	39.8	59.3	0.8	.
-	3.6	82.1	14.3	.
-	26.2	69.2	4.5	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-13	1.5	-	-	0.101	0.136	-	-	-	-	N/A	SM	A-4
BH-13	4.5	0.096	0.194	0.386	0.588	0.667	6.125	-	-	N/A	SP	A-2-4
BH-13	10.5	-	0.092	0.482	0.777	0.145	-	-	-	N/A	SM	A-2-4

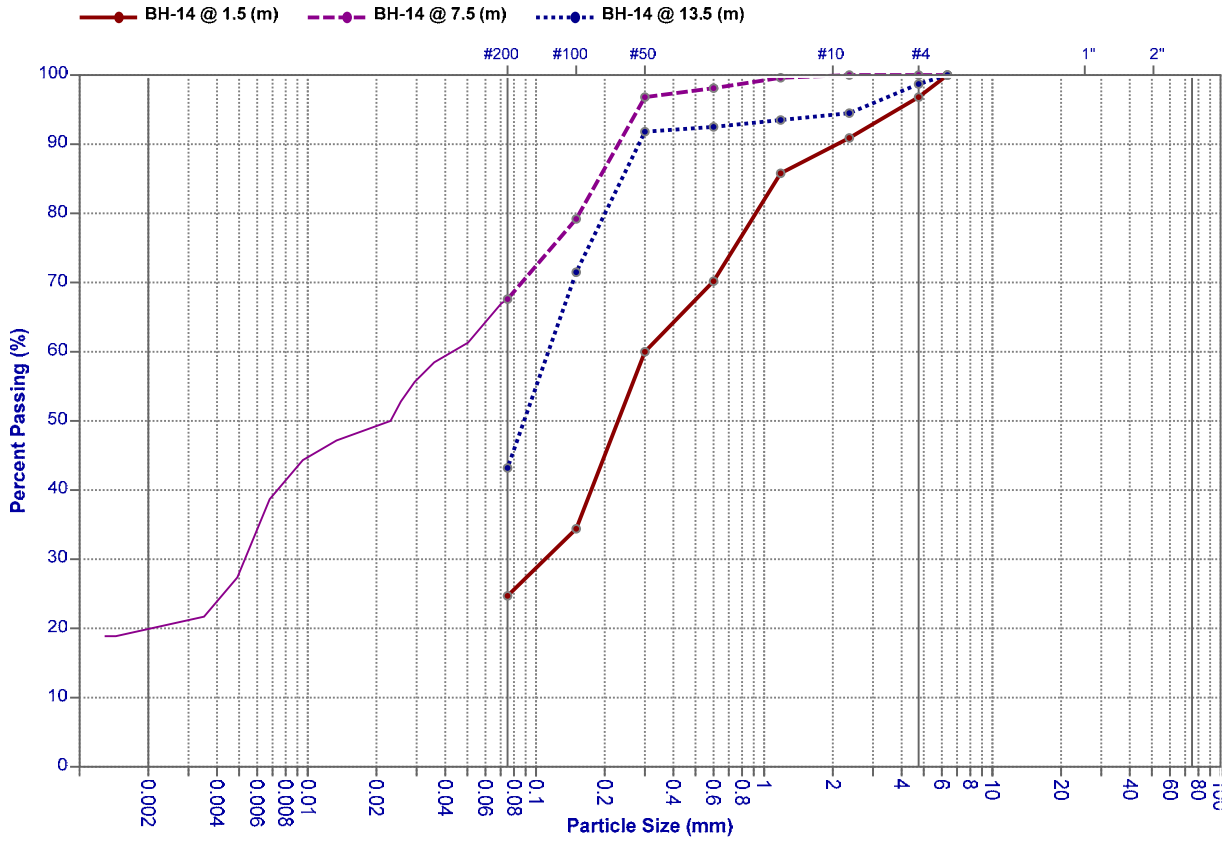
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 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



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Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	24.7	72.1	3.2	-
19.9	47.7	32.4	-	-
-	43.2	55.5	1.3	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-14	1.5	-	0.11	0.229	0.301	0.536	-	-	-	N/A	SM	A-2-4
BH-14	7.5	0.001	0.005	0.023	0.043	0.581	43	-	-	N/A	ML	A-4
BH-14	13.5	-	-	0.089	0.113	-	-	-	-	N/A	SM	A-4

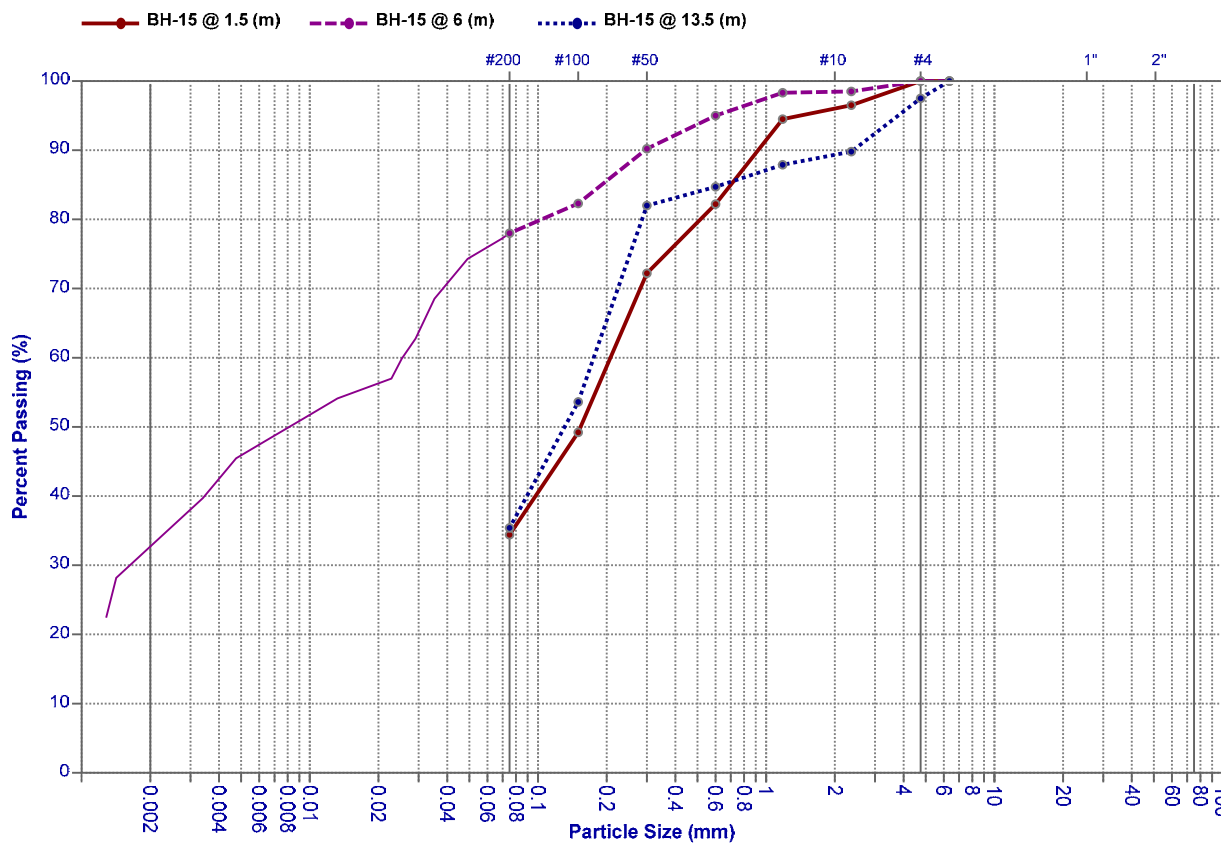
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	34.4	65.6	-	-
32.7	45.3	22	-	-
-	35.4	62.1	2.5	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-15	1.5	-	-	0.154	0.208	-	-	-	-	N/A	SM	A-2-4
BH-15	6	0.001	0.002	0.008	0.025	0.16	25	-	-	N/A	ML	A-4
BH-15	13.5	-	-	0.131	0.175	-	-	-	-	N/A	SM	A-4

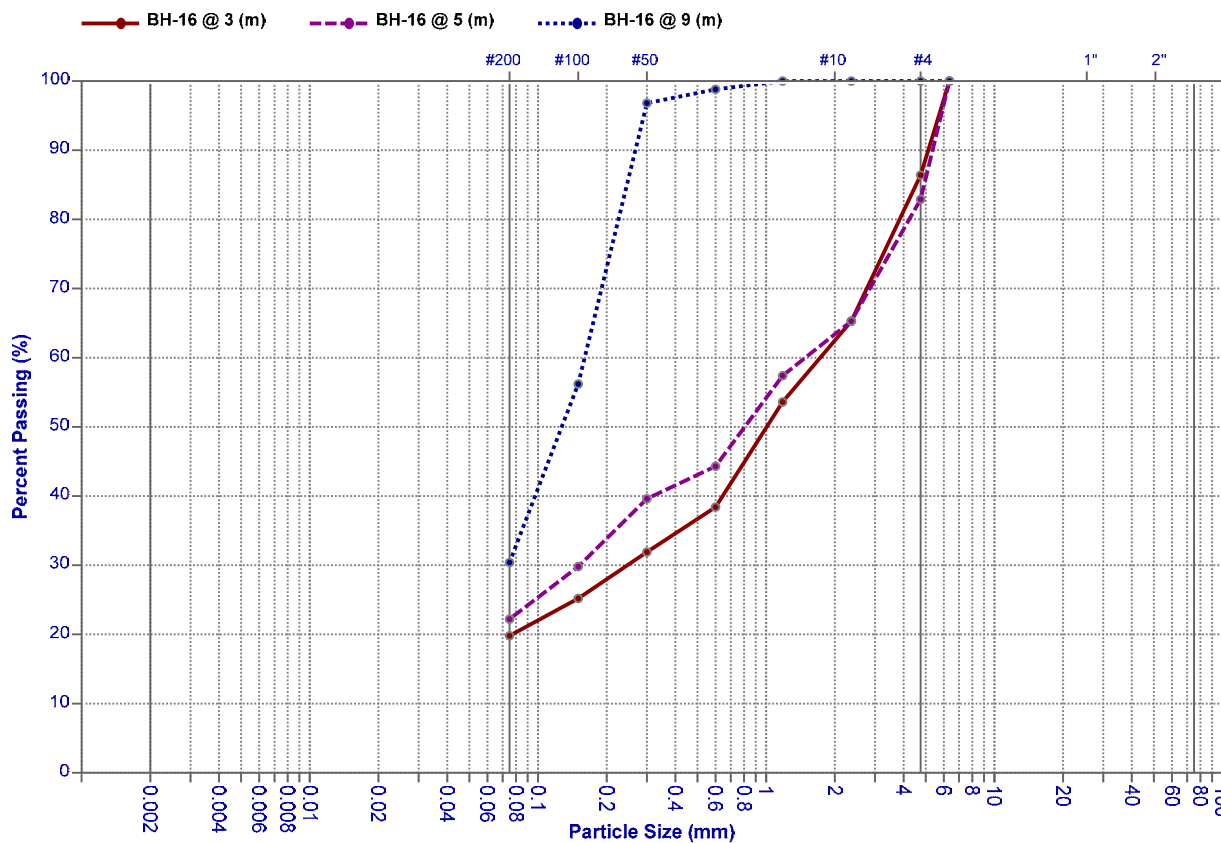
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	19.8	66.6	13.6	-
-	22.2	60.7	17.1	-
-	30.4	69.6	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-16	3	-	0.246	1.005	1.724	0.468	-	-	-	N/A	SM	A-2-4
BH-16	5	-	0.152	0.805	1.482	0.208	-	-	-	N/A	SM	A-2-4
BH-16	9	-	-	0.127	0.16	-	-	-	-	N/A	SM	A-2-4

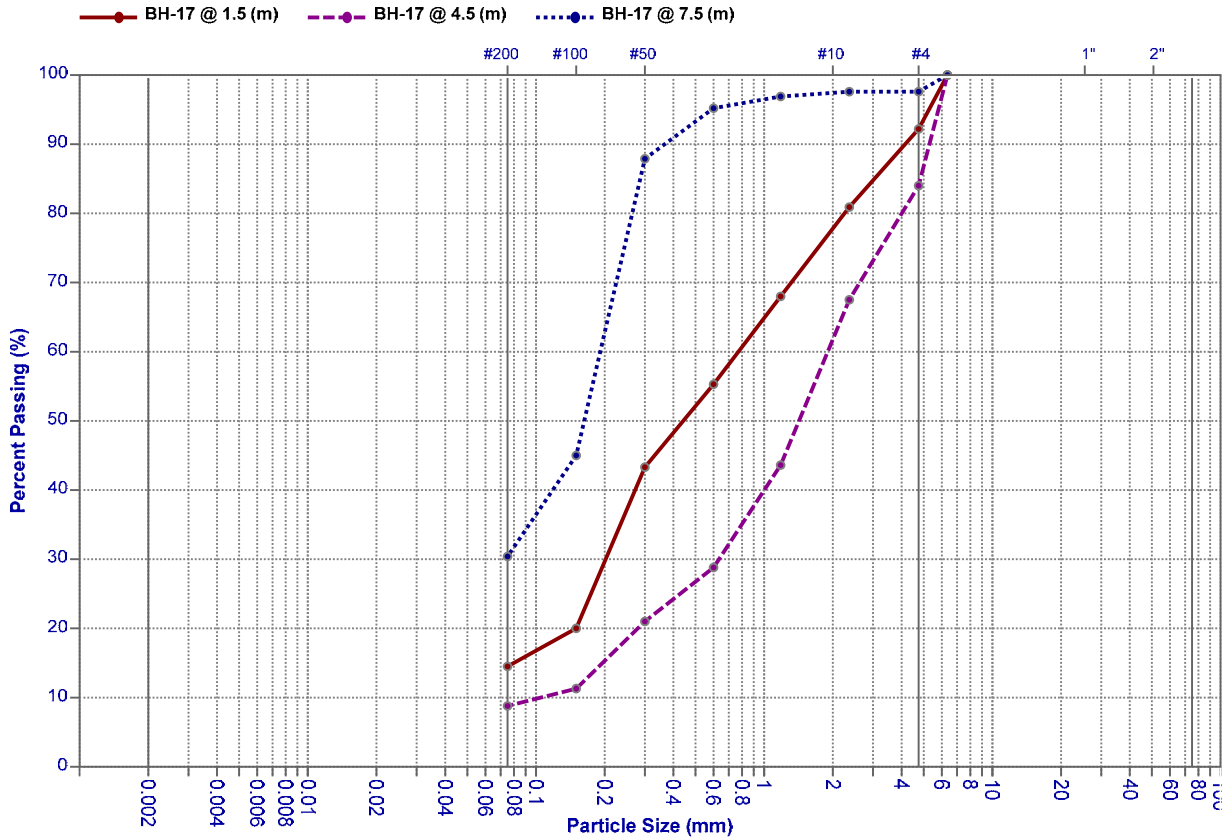
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	14.5	77.7	7.8	-
-	8.8	75.2	16	-
-	30.4	67.2	2.4	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-17	1.5	-	0.202	0.442	0.771	0.696	-	-	-	N/A	SM	A-2-4
BH-17	4.5	0.105	0.634	1.421	1.899	2.016	18.086	-	-	N/A	SW-SM	A-2-4
BH-17	7.5	-	-	0.163	0.191	-	-	-	-	N/A	SM	A-2-4

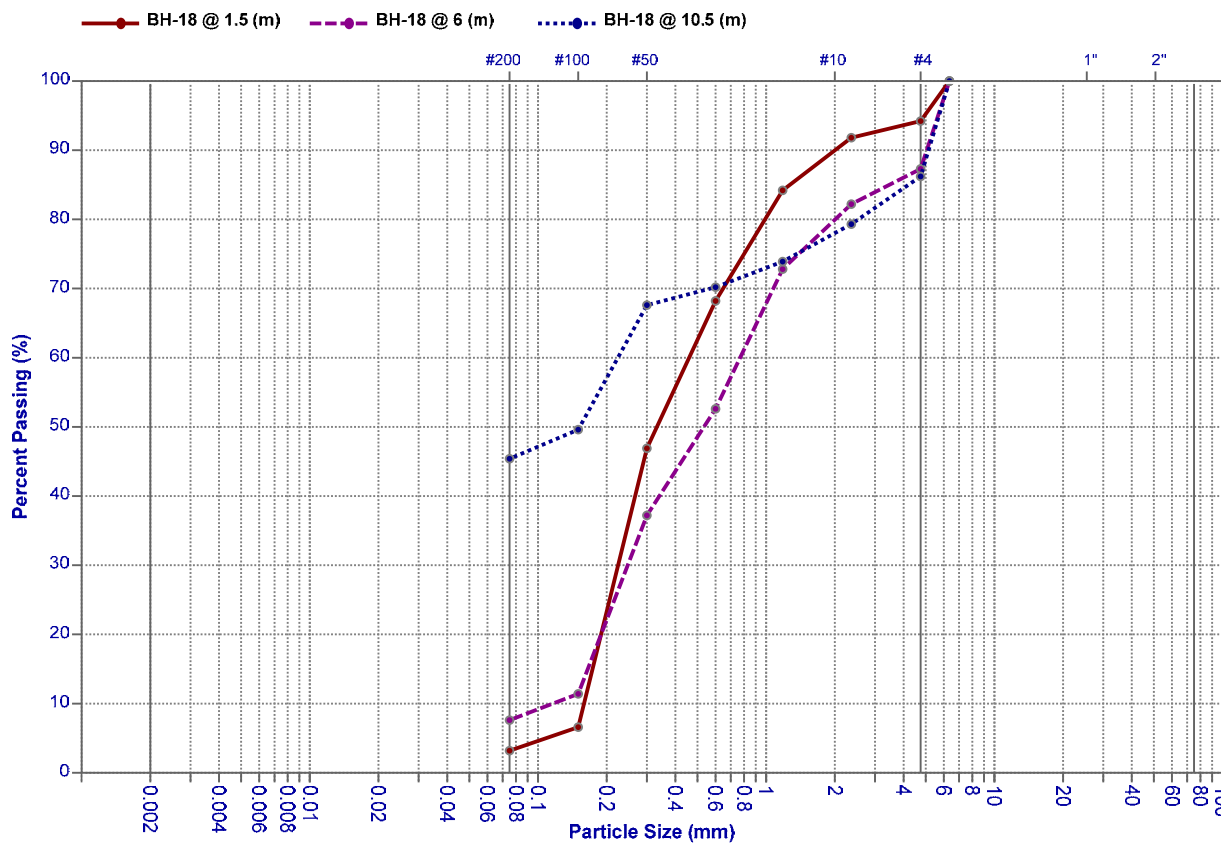
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	3.2	91	5.8	-
-	7.6	79.7	12.7	-
-	45.4	40.8	13.8	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-18	1.5	0.159	0.224	0.332	0.459	0.688	2.887	-	-	N/A	SP	A-2-4
BH-18	6	0.116	0.247	0.534	0.769	0.684	6.629	-	-	N/A	SP-SM	A-2-4
BH-18	10.5	-	-	0.152	0.224	-	-	-	-	N/A	SM	A-4

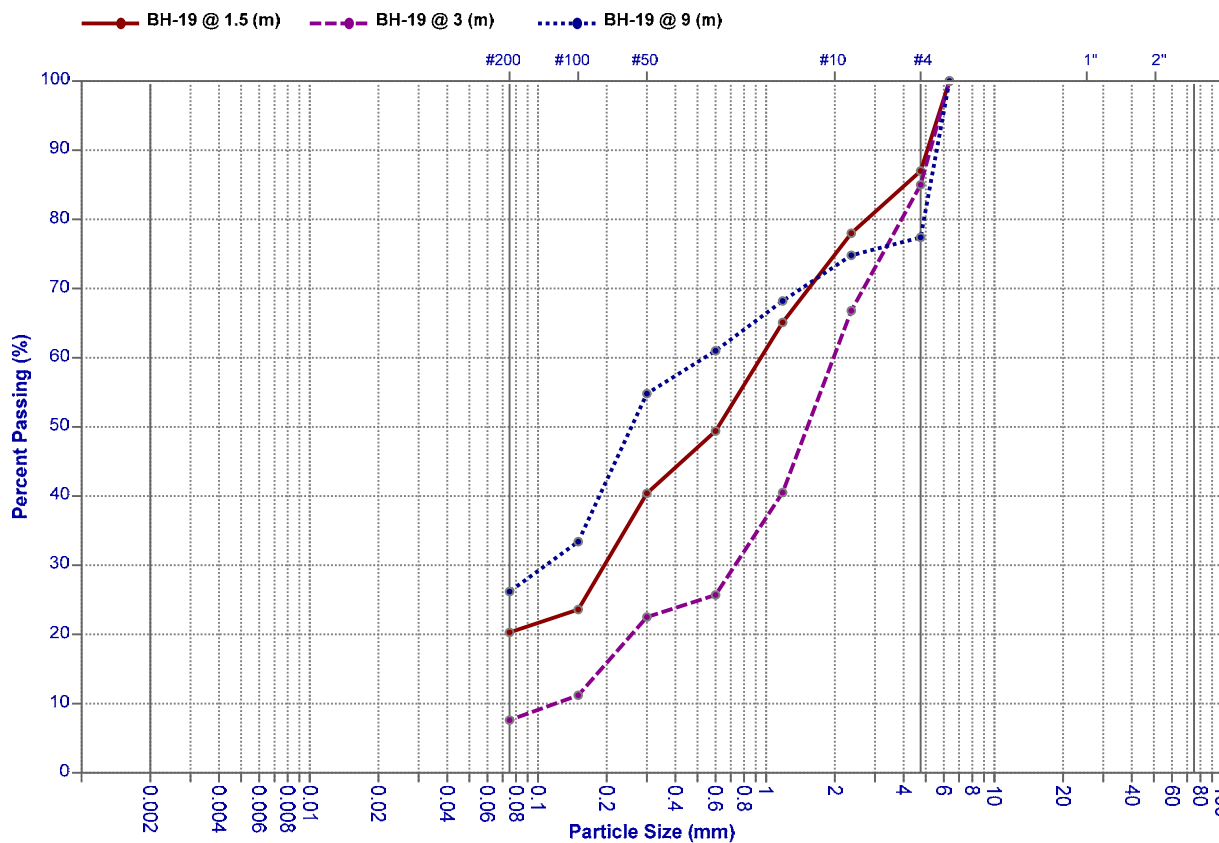
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	20.3	66.7	13	.
-	7.6	77.4	15	.
-	26.2	51.2	22.6	.

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-19	1.5	-	0.195	0.616	0.947	0.535	-	-	-	N/A	SM	A-2-4
BH-19	3	0.119	0.73	1.516	1.973	2.27	16.58	-	-	N/A	SW-SM	A-2-4
BH-19	9	-	0.108	0.257	0.537	0.29	-	-	-	N/A	SM	A-2-4

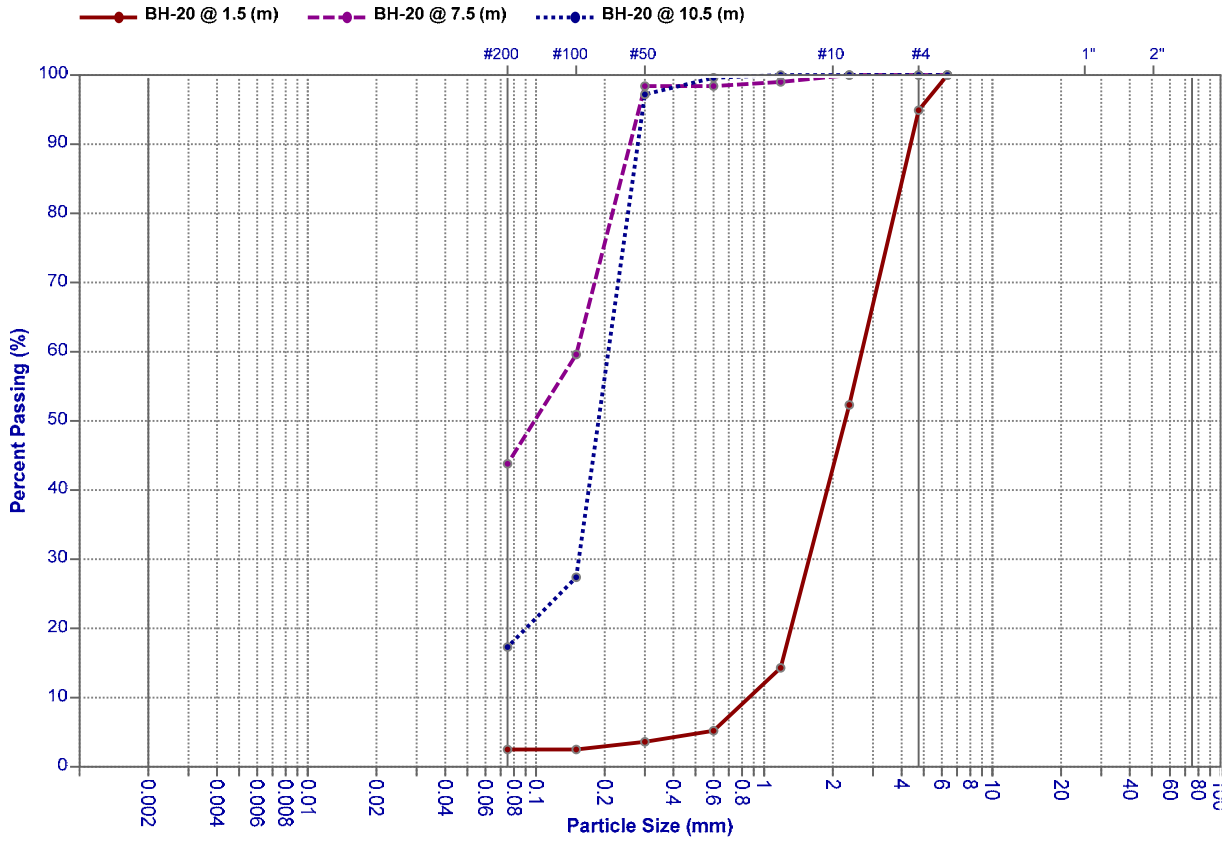
Sieve Analysis Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Soil Testing Services



ASTM C136



Particle Distribution

Clay	Silt	Sand	Gravel	Cobble
-	2.5	92.4	5.1	-
-	43.8	56.2	-	-
-	17.3	82.7	-	-

Classification

Borehole	Sample Depth (m)	D10 (mm)	D30 (mm)	D50 (mm)	D60 (mm)	Cc	Cu	LL (%)	PI (%)	Disp. (%)	USCS	AASHTO
BH-20	1.5	0.857	1.571	2.263	2.678	1.075	3.125	-	-	N/A	SP	A-2-4
BH-20	7.5	-	-	0.098	0.151	-	-	-	-	N/A	SM	A-4
BH-20	10.5	-	0.154	0.188	0.207	1.528	-	-	-	N/A	SM	A-2-4

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-2

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
10.02	21.71	18.49	17	38
8.87	18.29	15.84	22	35.2
11.99	27.44	23.56	34	33.5
				-

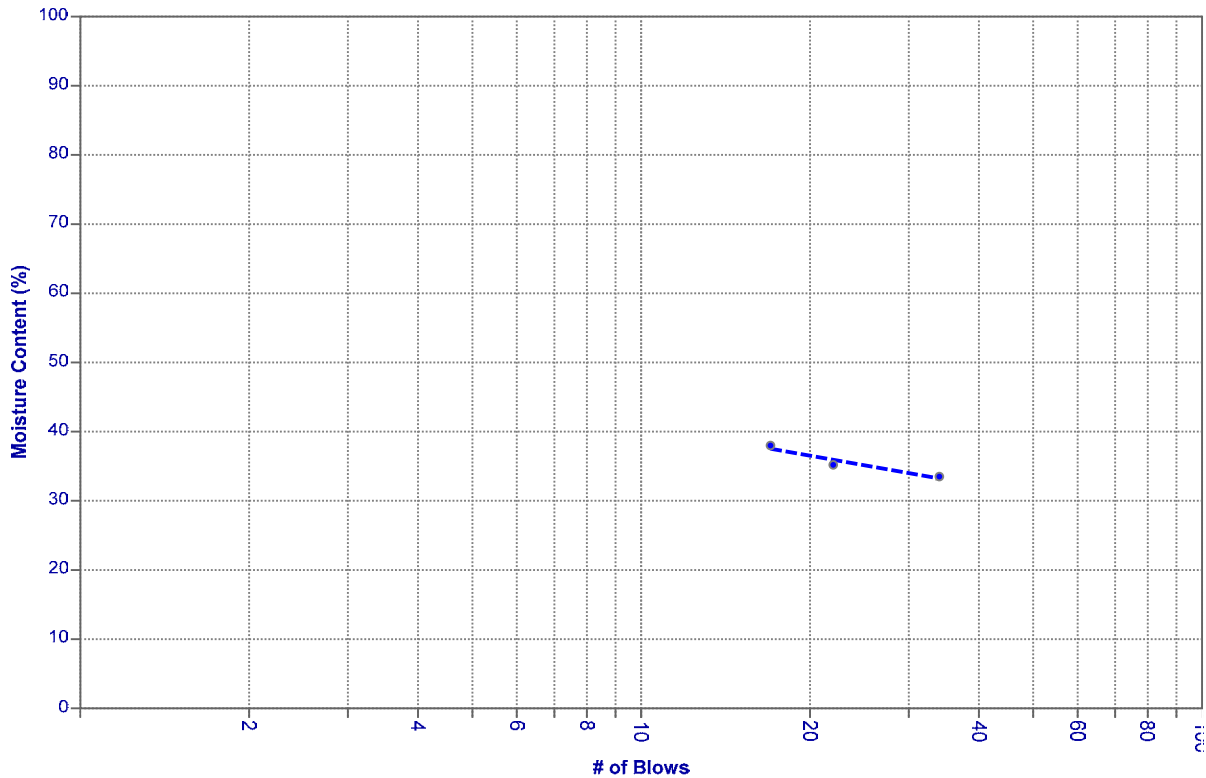
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
15.38	19.85	18.9	27

LL = 35.1 %

PL = 27 %

PI=8.1



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-2(B)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.5 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
13.86	23.22	20.83	17	34.3
20.01	28.8	26.63	25	32.8
14.01	25.33	22.62	30	31.5
				-

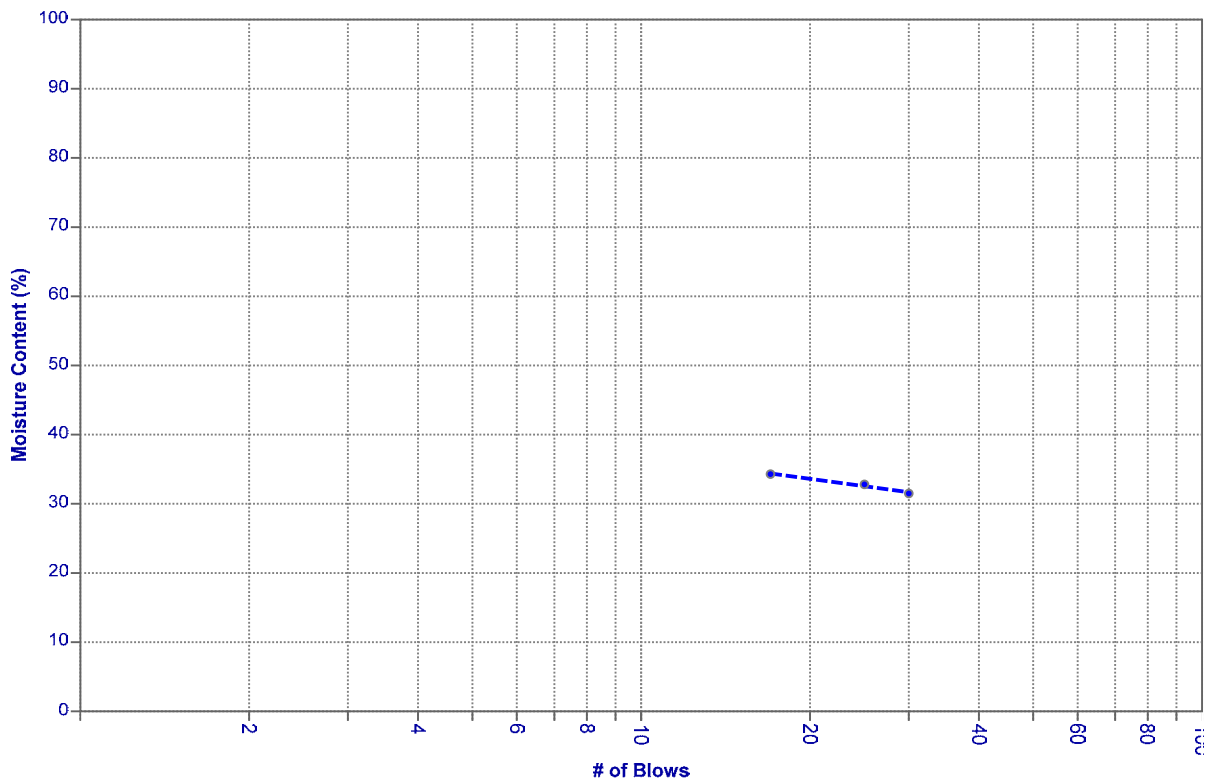
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
13.53	18.58	17.63	23.2

LL = 32.5 %

PL = 23.2 %

PI=9.3



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-3

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 15 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
13.85	24.45	21.48	17	38.9
11.31	21.73	18.94	26	36.6
10.64	20.51	18	42	34.1
				-

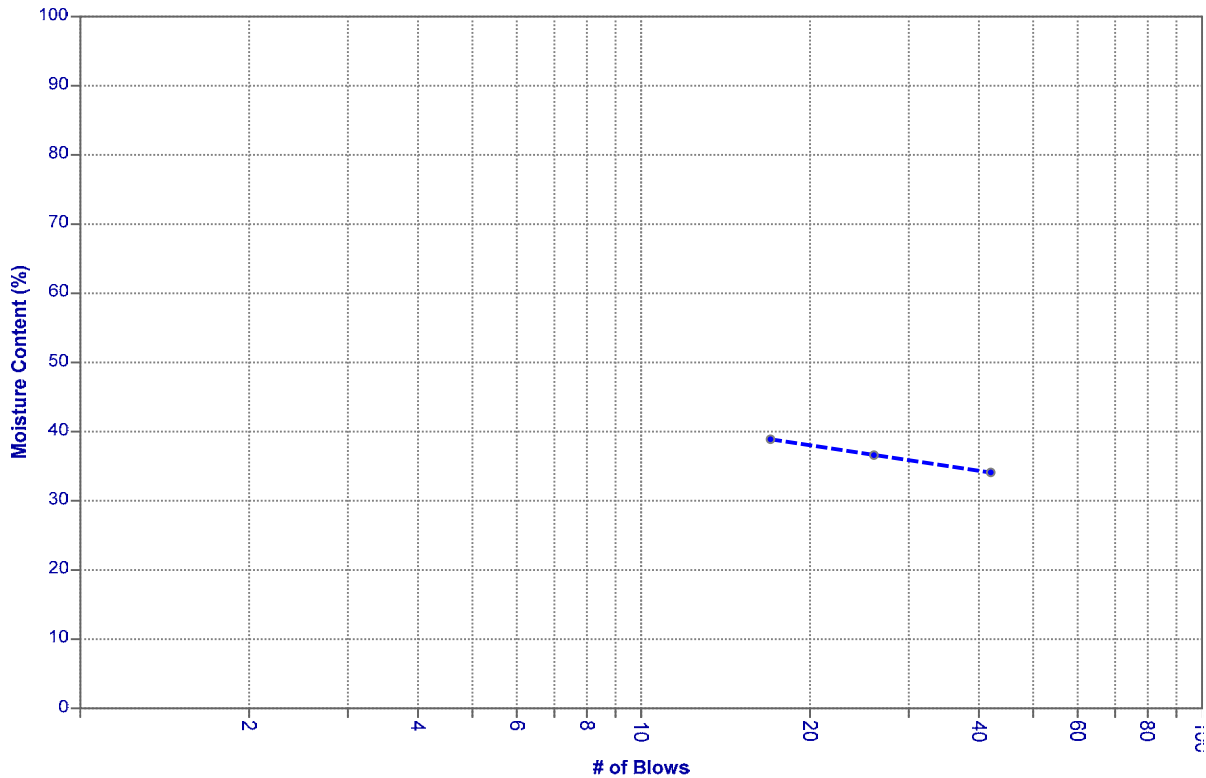
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
11.12	15.33	14.34	30.7

LL = 36.8 %

PL = 30.7 %

PI=6.1



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-4

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.5 (m)



Job No.: K15-1185-101

Classification : CL

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
8.73	30.53	24.07	11	42.1
11.97	28.66	23.99	28	38.9
15.45	26.97	23.94	44	35.7
				-

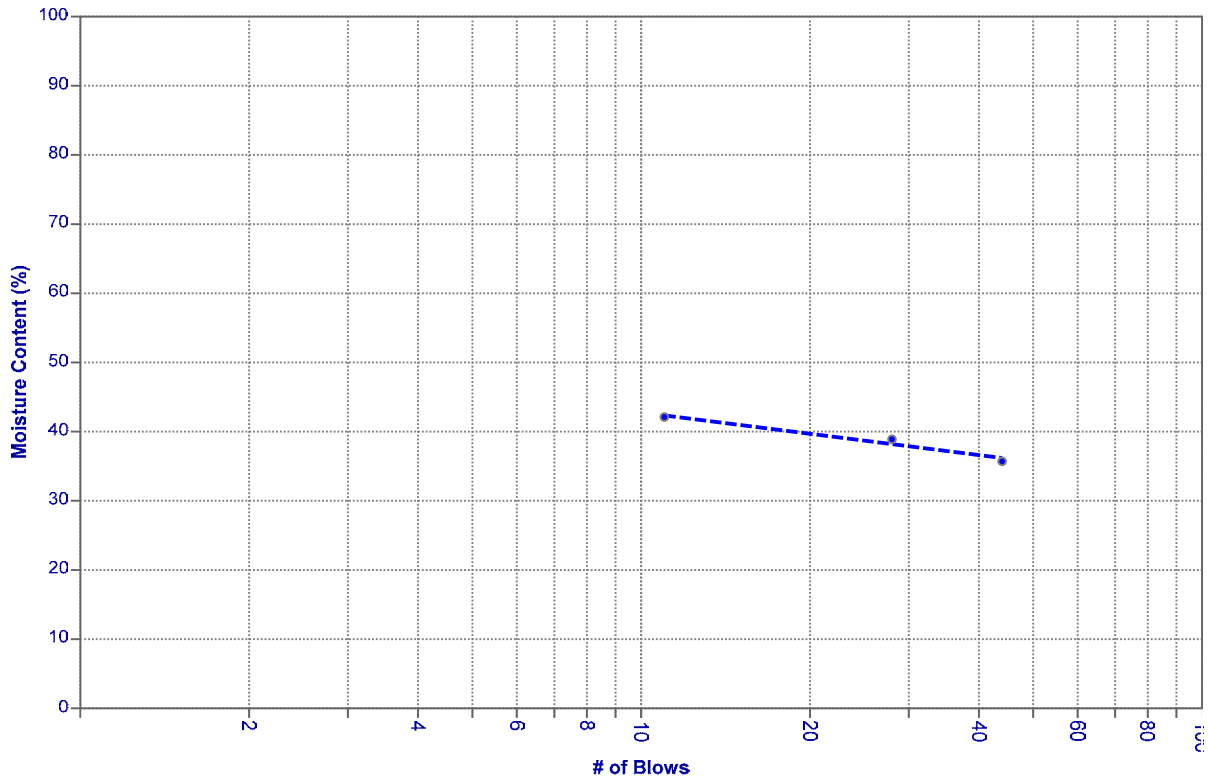
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
19.52	22.17	21.7	21.6

LL = 38.7 %

PL = 21.6 %

PI=17.1



Unified Description : Low Plasticity Clay With Sand
AASHTO Description : Clayey soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-4

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
10.87	25.05	20.74	18	43.7
13.23	29.09	24.25	26	43.9
11.11	29.56	24.26	35	40.3
				-

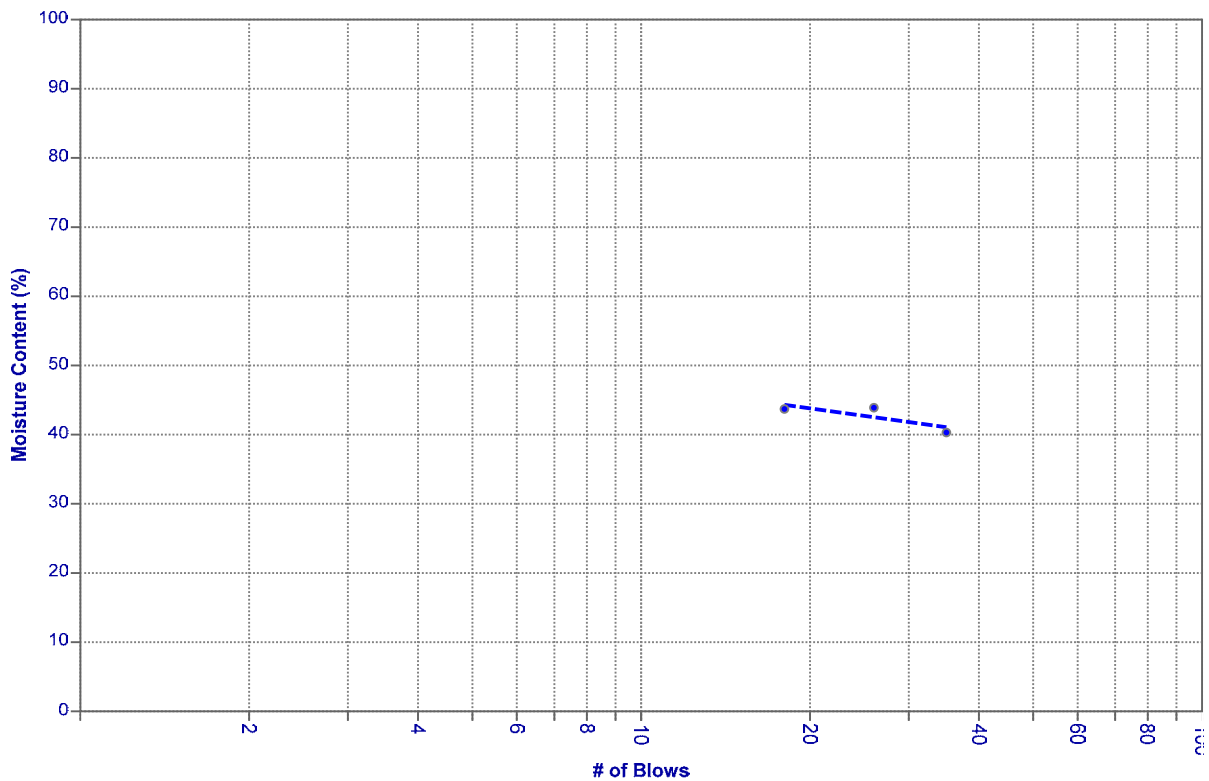
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
14.2	21.6	19.95	28.7

LL = 42.7 %

PL = 28.7 %

PI=14



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : Clayey soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-5

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.5 (m)

Job No.: K15-1185-101

Classification : CL

Location : Port Qasim

Sample Type : SPT Split Spoon



ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
14.26	24.65	22.25	20	30
21.6	31.48	29.59	34	23.7
				-

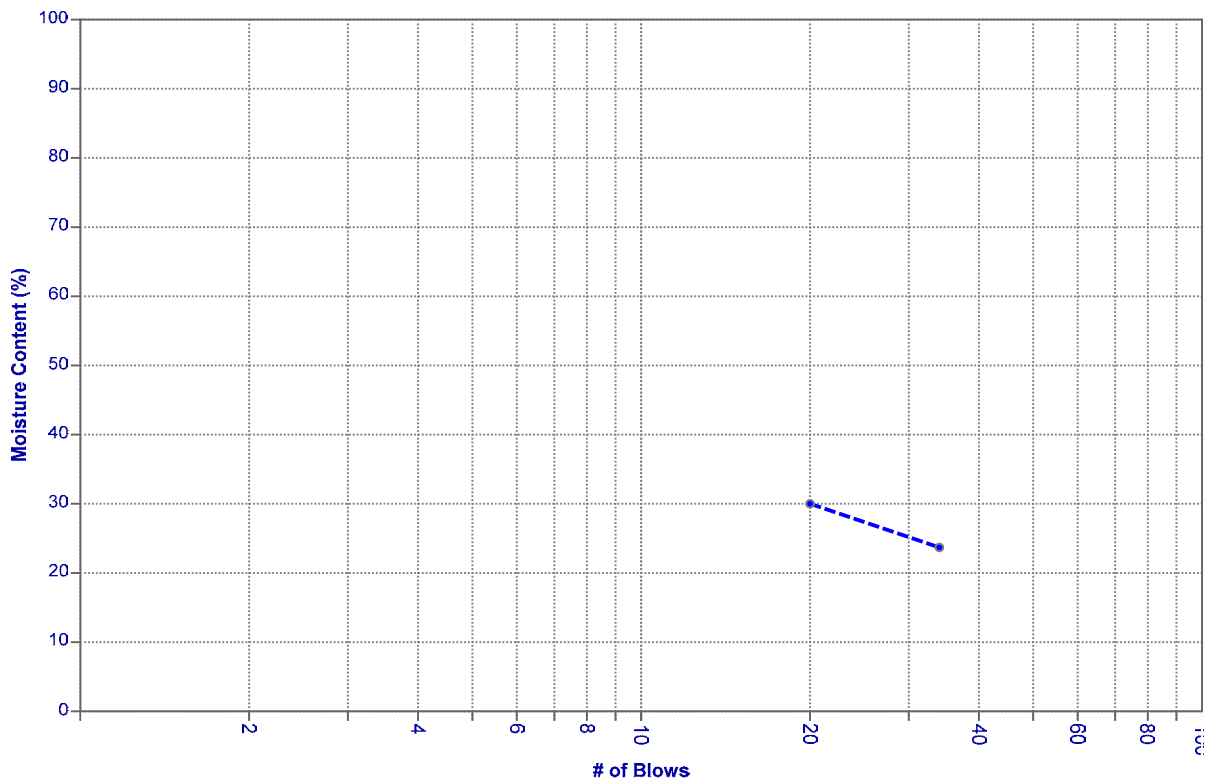
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
9.59	12.82	12.29	19.6

LL = 27.4 %

PL = 19.6 %

PI=7.8



Unified Description : Low Plasticity Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-5

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.5 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
12	26.97	22.51	19	42.4
8.23	19.74	16.54	28	38.5
11.83	22.42	19.77	48	33.4
				-

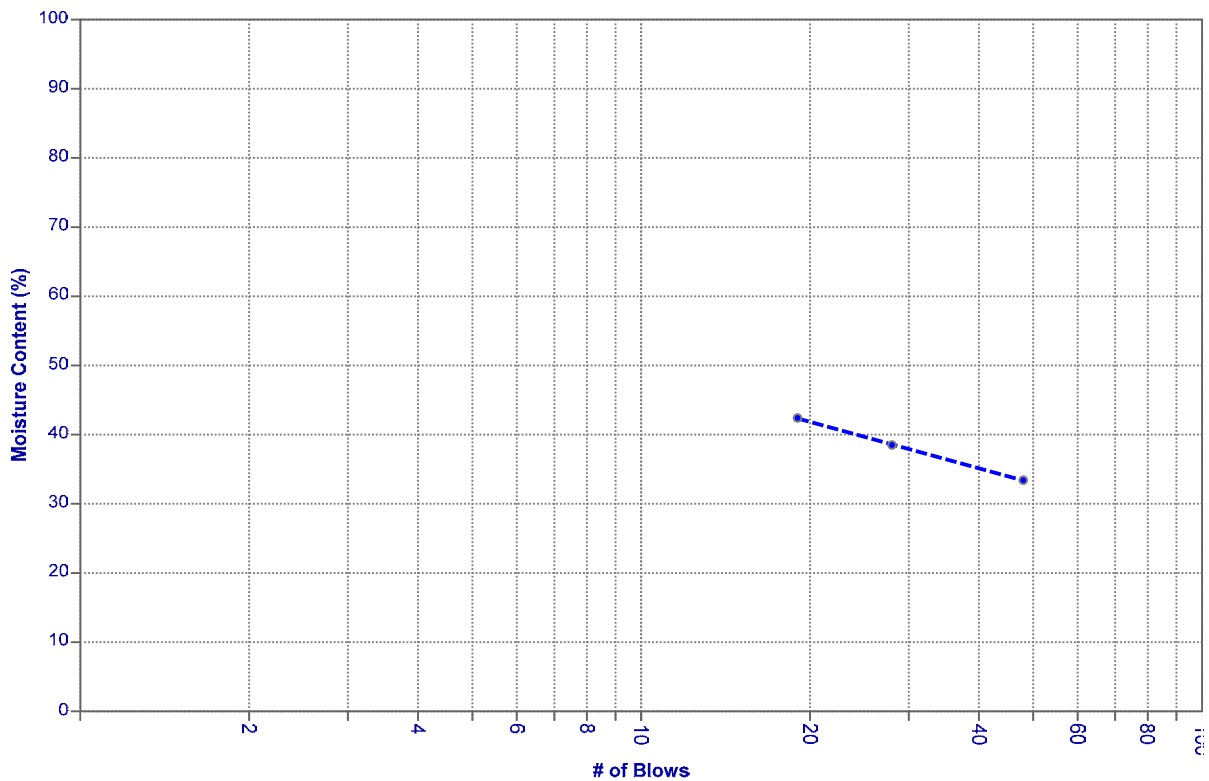
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
10.2	14.9	13.85	28.8

LL = 39.7 %

PL = 28.8 %

PI=10.9



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : Clayey soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-5(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 1.5 (m)



Job No.: K15-1185-101

Classification : CL-ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
19.54	34.74	32.05	20	21.5
11.15	23.1	21.1	29	20.1
13.21	21.35	20.17	40	17
				-

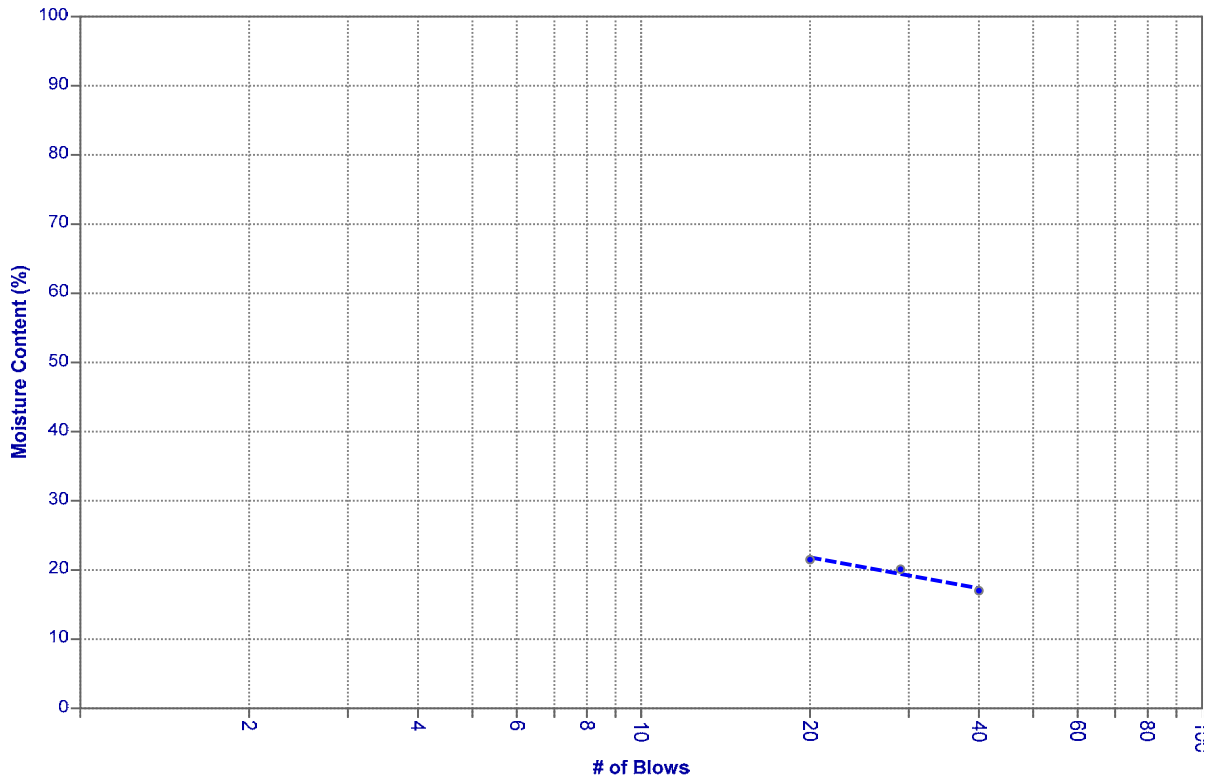
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
23.9	25.5	25.3	14.3

LL = 20.4 %

PL = 14.3 %

PI=6.1



Unified Description : Silty Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-5(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 6 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
10.3	17.88	16.3	16	26.3
119.89	133.72	131.8	30	16.1
8.8	16.45	15.1	42	21.4
				-

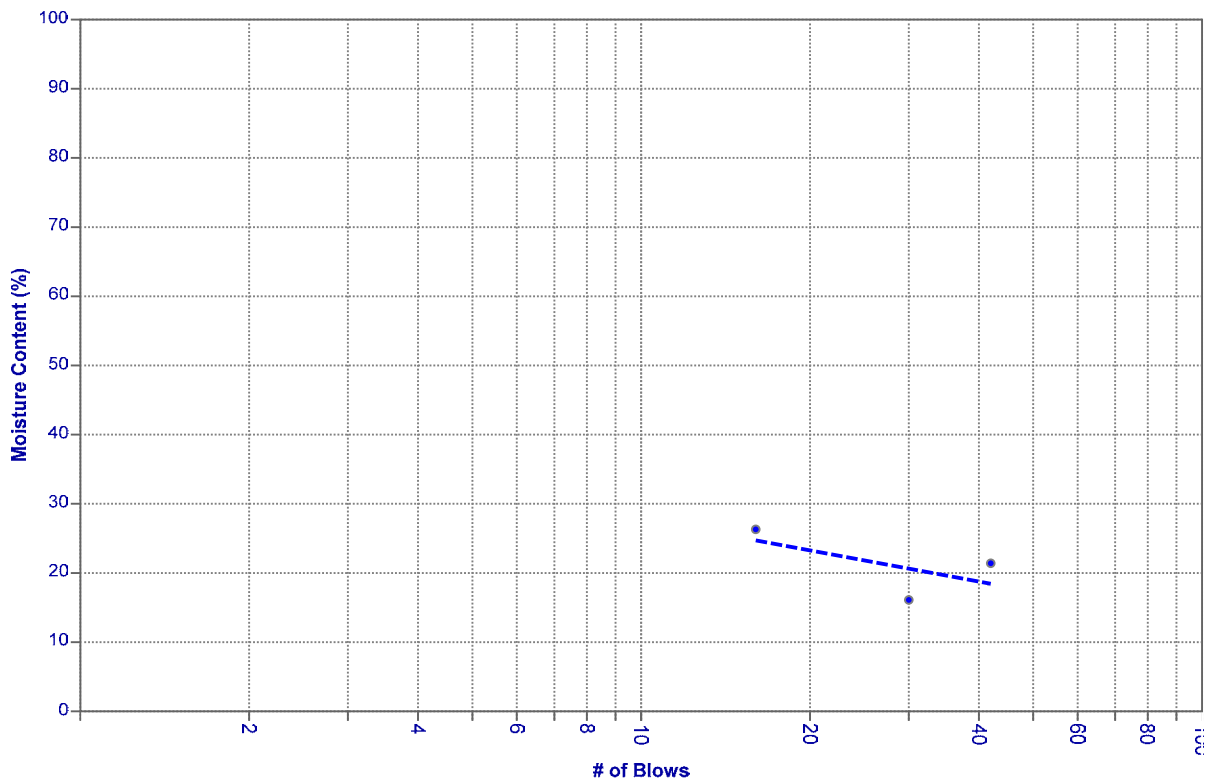
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
91.35	96.25	95.5	18.1

LL = 21.8 %

PL = 18.1 %

PI=3.7



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-5(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 19.5 (m)



Job No.: K15-1185-101

Classification : CL

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
21.69	36.96	33.93	15	24.8
13.89	26.83	24.46	25	22.4
19.56	31.39	29.25	32	22.1
				-

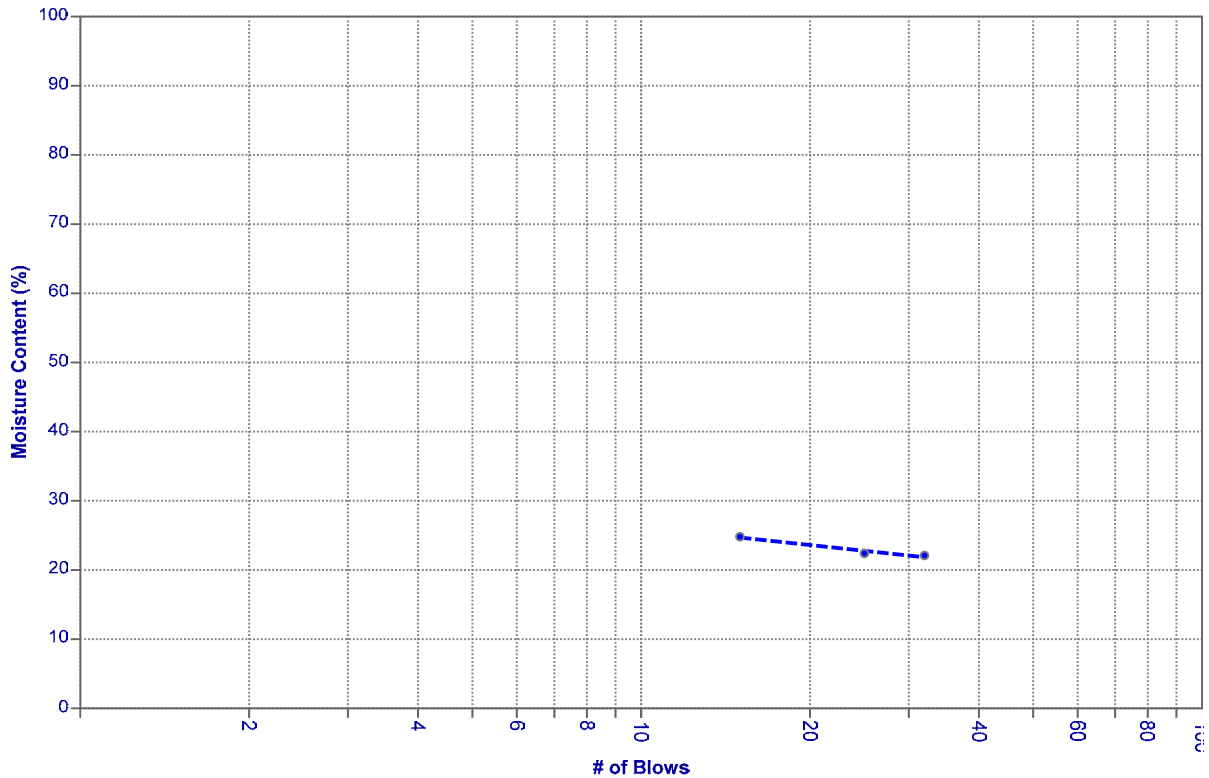
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
9.41	13.46	12.92	15.4

LL = 22.8 %

PL = 15.4 %

PI=7.4



Unified Description : Low Plasticity Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-6

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.5 (m)



Job No.: K15-1185-101

Classification : CL-ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
10.92	23.03	20.33	16	28.7
20.21	32.97	30.3	31	26.5
21.65	39.38	35.81	41	25.2
				-

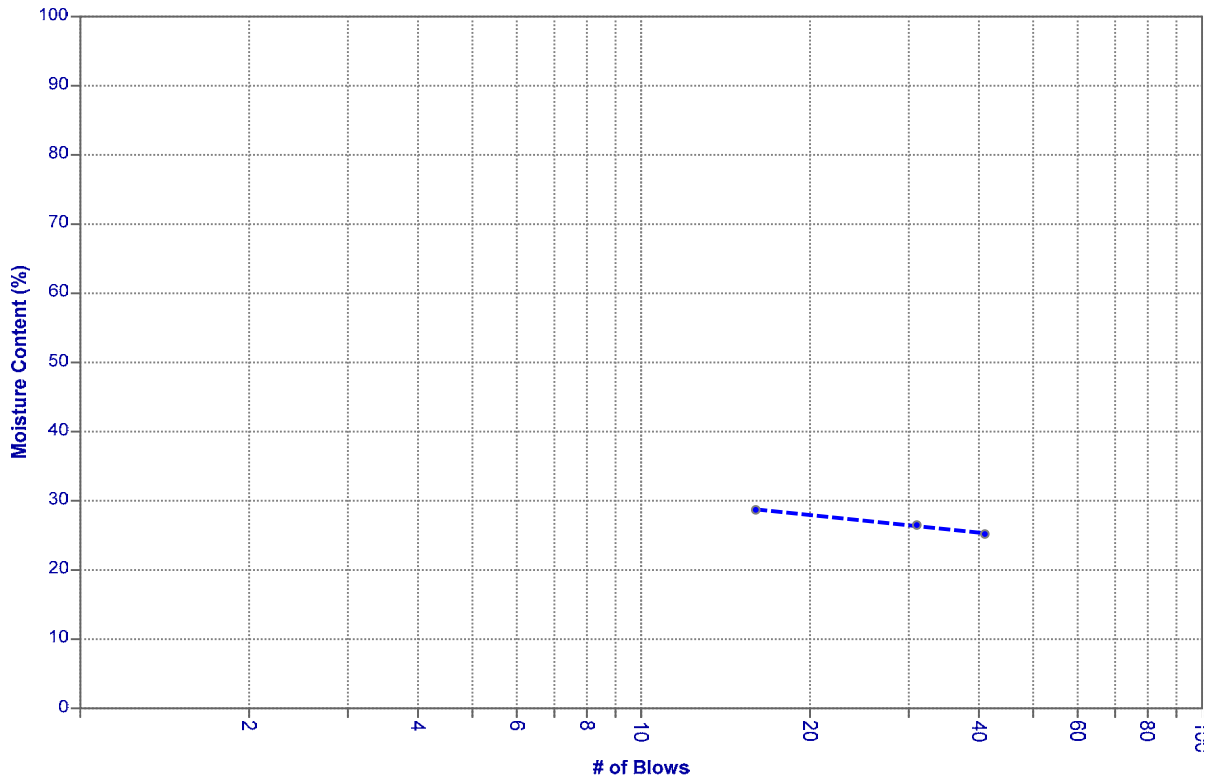
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
9.96	13.49	12.9	20.1

LL = 27.1 %

PL = 20.1 %

PI=7



Unified Description : Silty Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-7

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 10.5 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
15.5	32.63	27.63	18	41.2
12.24	21.94	19.3	31	37.4
15.61	27.21	24.1	40	36.6
				-

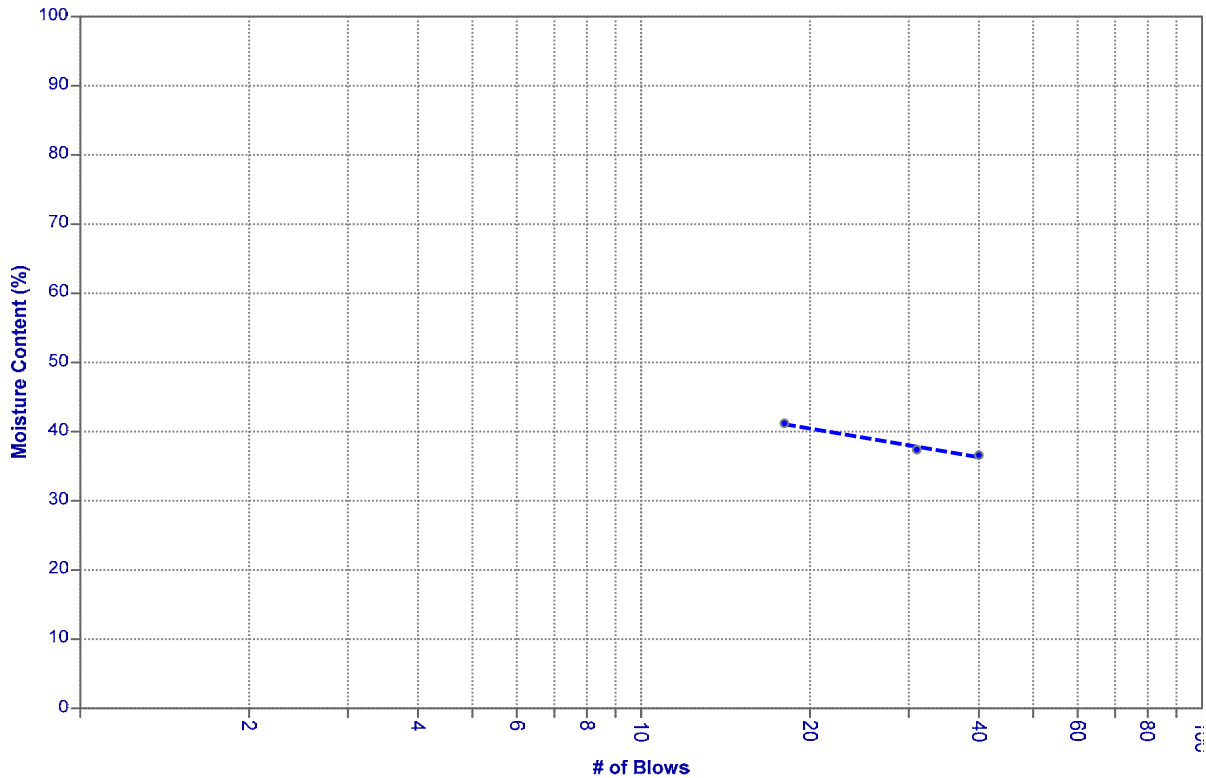
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
10.18	15.03	14.03	26

LL = 39.1 %

PL = 26 %

PI=13.1



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : Clayey soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-7

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
11.25	22.7	19.28	17	42.6
8.9	18.78	15.91	30	40.9
11.17	22.57	19.25	45	41.1
				-

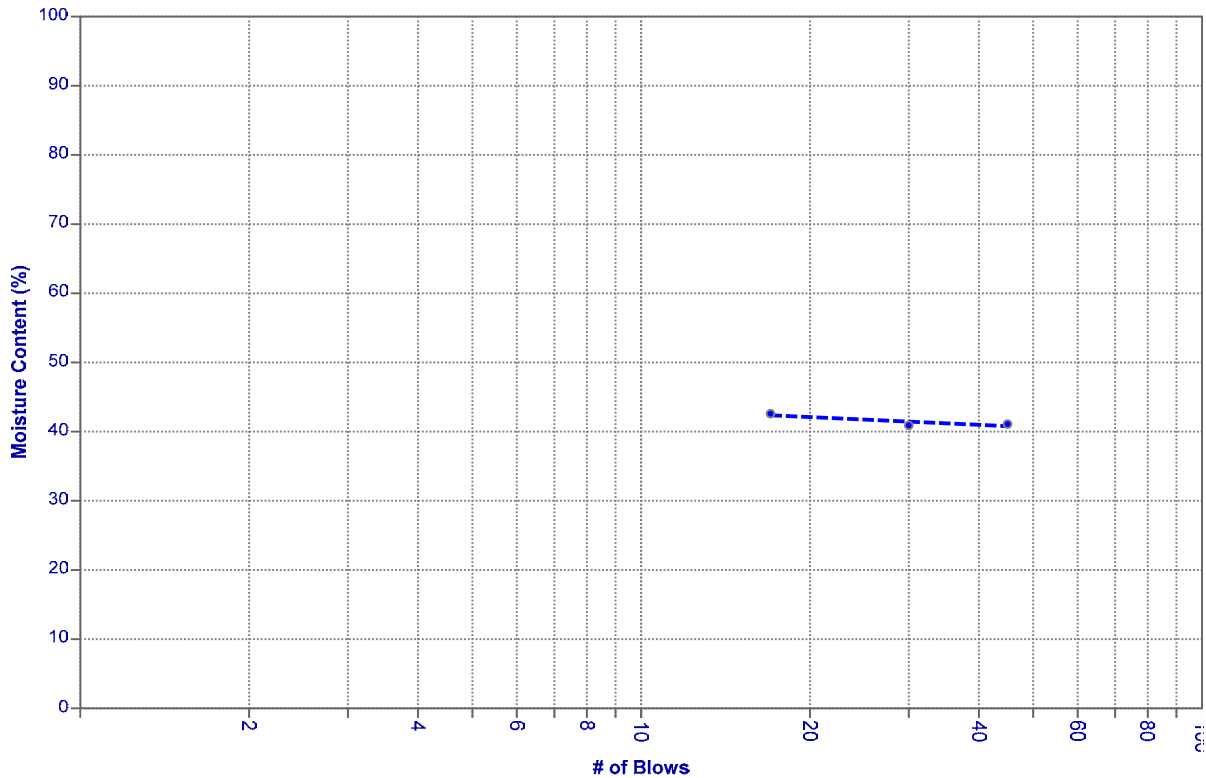
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
10.25	14.36	13.5	26.5

LL = 41.7 %

PL = 26.5 %

PI=15.2



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : Clayey soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-7(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.5 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
8.24	23.03	20.7	13	18.7
9.48	22.58	20.2	21	22.2
21.56	33.6	31.7	47	18.7
				-

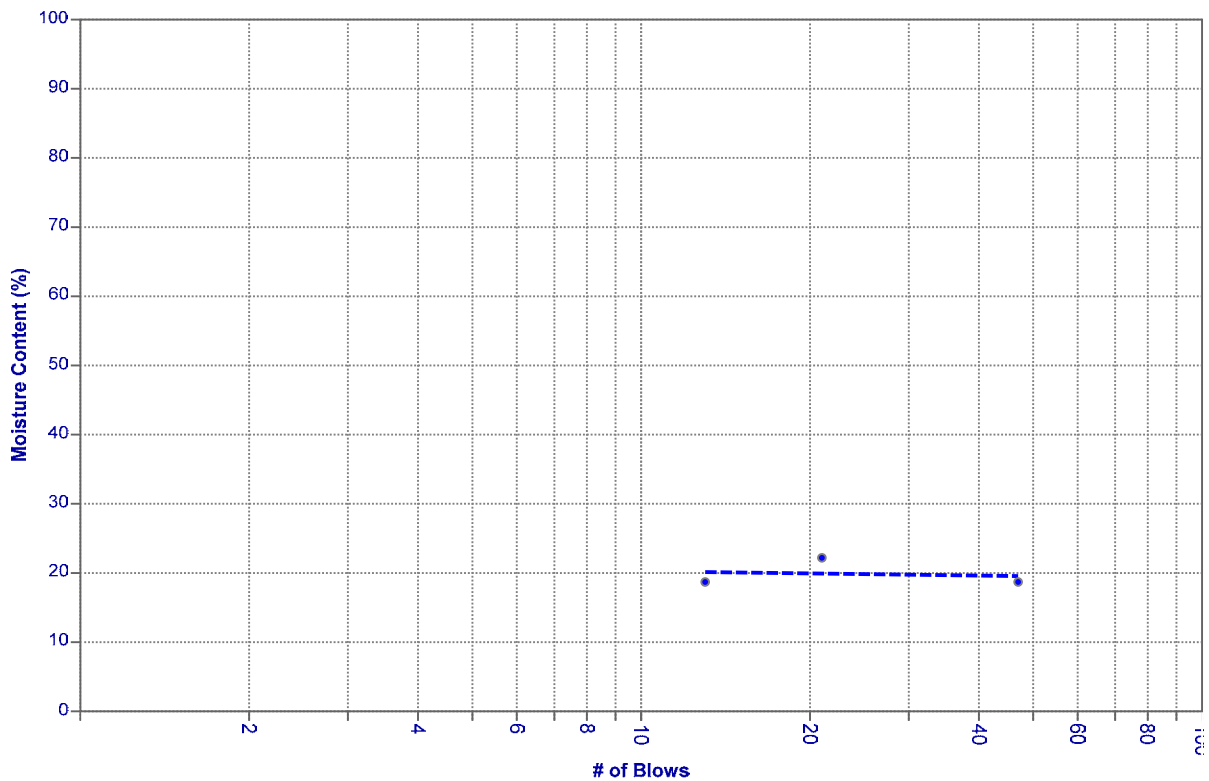
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
23.89	29.66	28.85	16.3

LL = 19.8 %

PL = 16.3 %

PI=3.5



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-7(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 9 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
20.13	34.08	31.59	15	21.7
10.61	23.12	21.04	22	19.9
11.33	24.88	22.8	39	18.1
				-

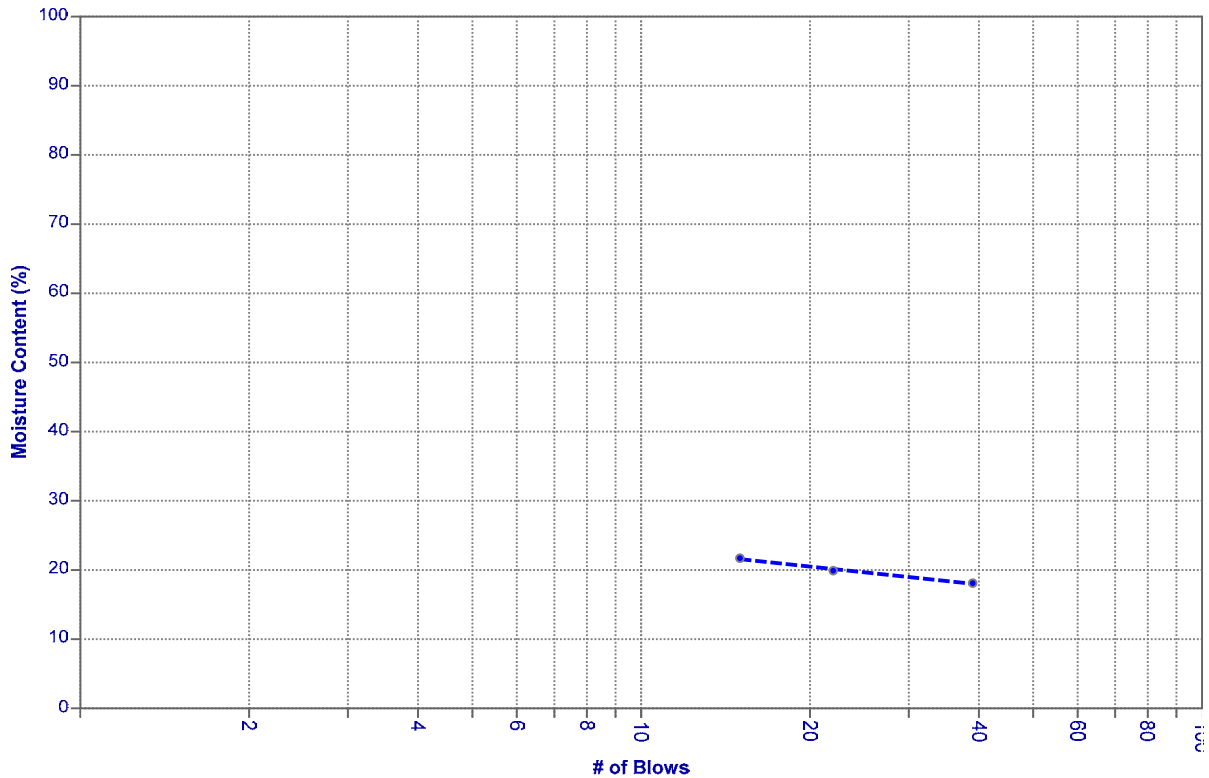
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
15.2	19.63	19.01	16.3

LL = 19.7 %

PL = 16.3 %

PI=3.4



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-7(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 10.5 (m)



Job No.: K15-1185-101

Classification :

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
10.01	24.09	20.33	13	36.4
11	23.73	20.55	23	33.3
21.26	31.54	29.04	40	32.1
				-

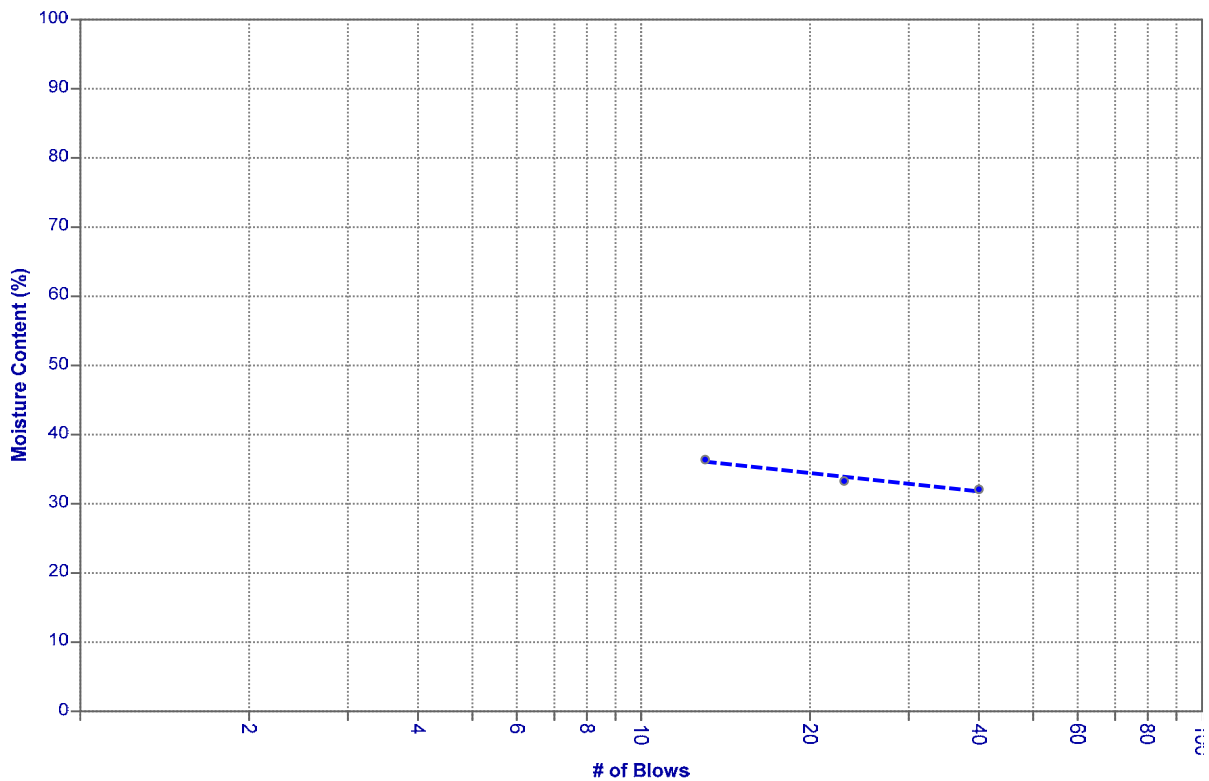
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
11.82	16.64	15.65	25.8

LL = 33.6 %

PL = 25.8 %

PI=7.8



Unified Description :
AASHTO Description :

Tested By :
SDN

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-8(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.5 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
11.3	18.36	16.25	15	42.6
8.23	19.74	16.43	28	40.4
				-

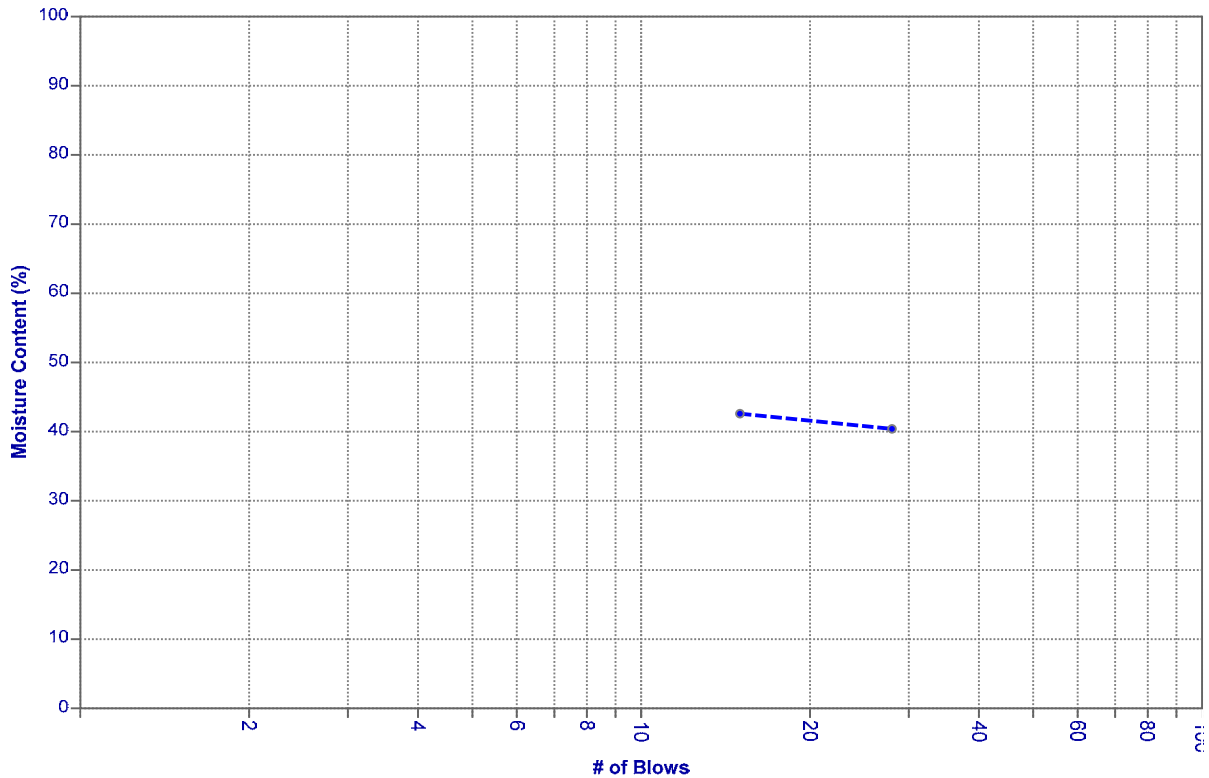
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
10.6	16.67	15.43	25.7

LL = 40.8 %

PL = 25.7 %

PI=15.1



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : Clayey soils

Tested By :

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-09

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
10.6	21.55	18.47	14	39.1
12.07	29.66	25.04	26	35.6
				-

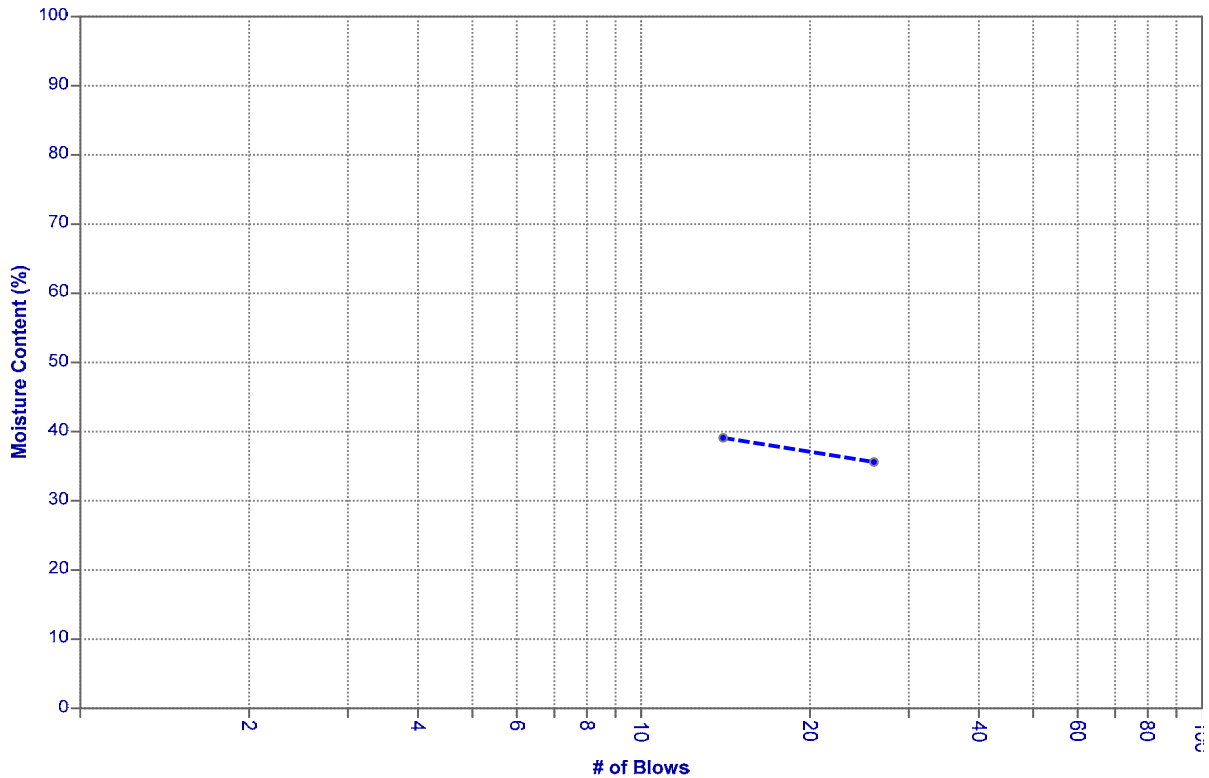
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
9.44	13.13	12.39	25.1

LL = 35.8 %

PL = 25.1 %

PI=10.7



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : Clayey soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-09(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 6 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
23.8	36.05	32.75	17	36.9
13.96	28.07	24.37	29	35.5
				-

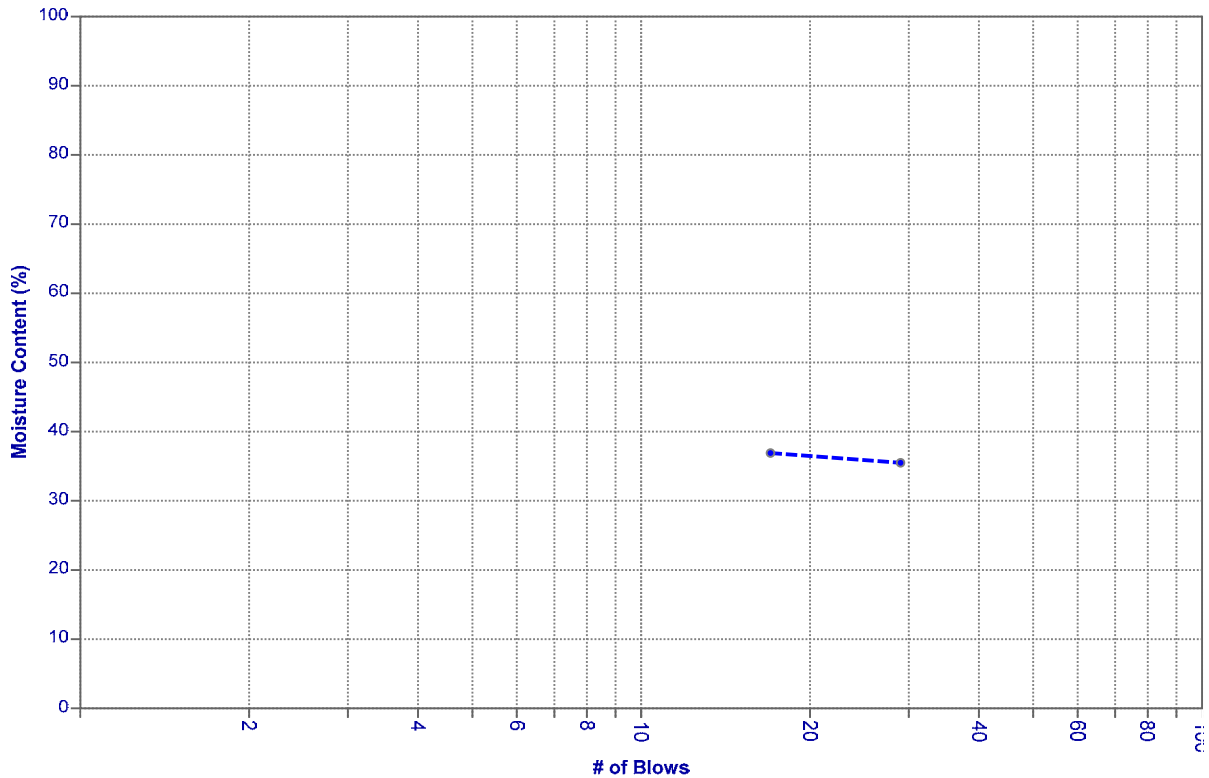
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
9.46	15.75	14.45	26.1

LL = 35.9 %

PL = 26.1 %

PI=9.8



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 6 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
14.15	26.5	23.21	15	36.3
20.2	36.72	32.58	24	33.4
12.19	26.36	23.12	36	29.6
				-

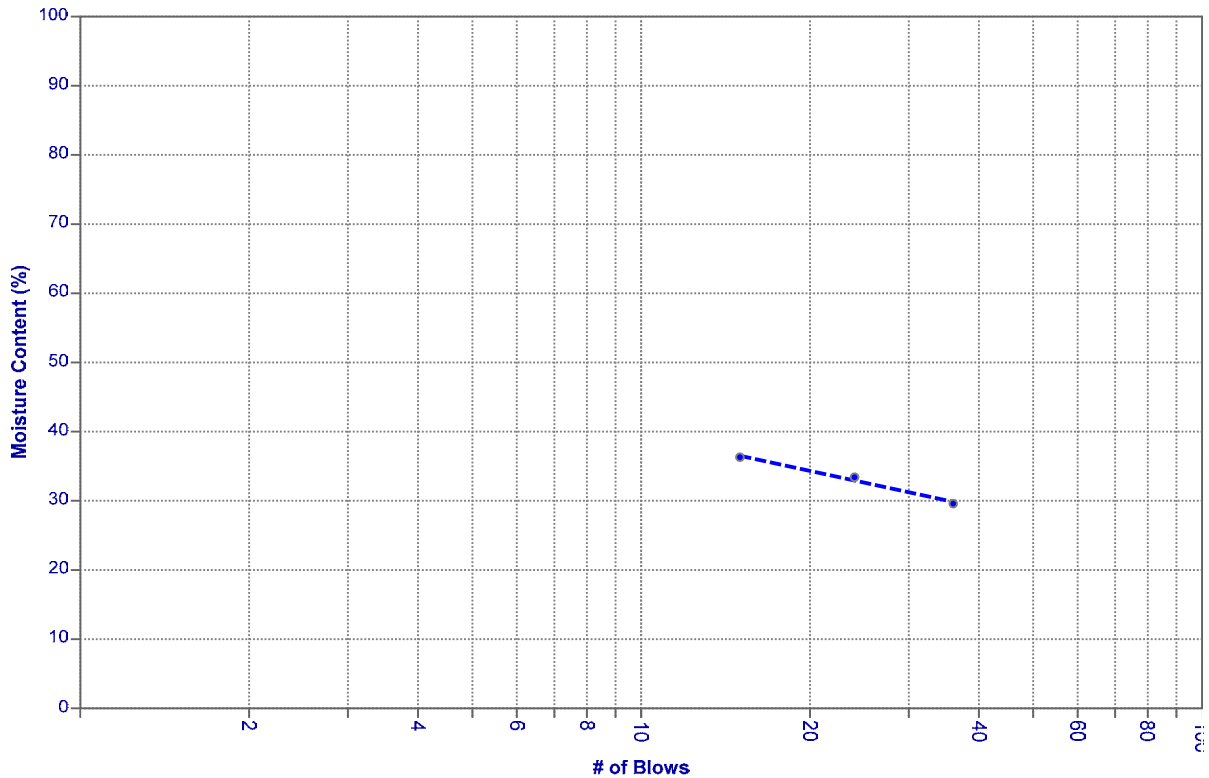
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
10.91	16.92	15.71	25.2

LL = 32.6 %

PL = 25.2 %

PI=7.4



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 8 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
13.26	21.01	18.65	10	43.8
19.89	33.23	29.56	27	38
				-

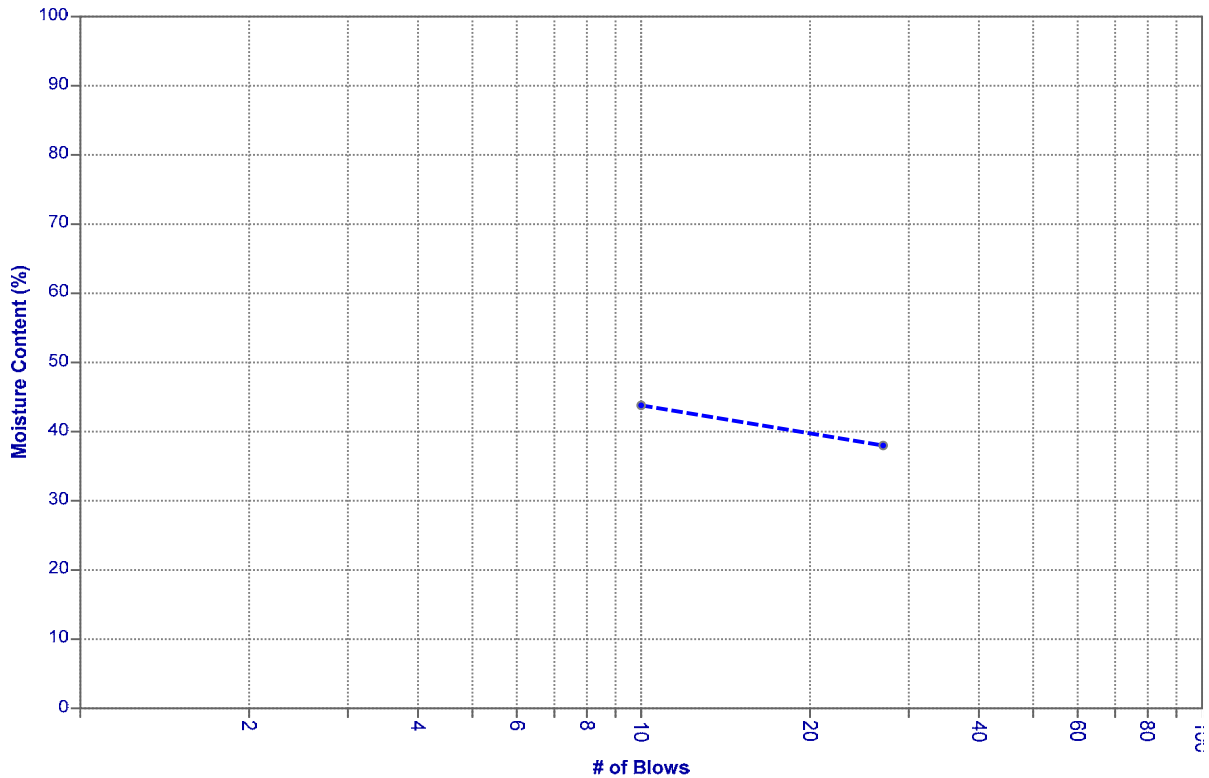
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
10.2	13.64	12.85	29.8

LL = 38.4 %

PL = 29.8 %

PI=8.6



Unified Description : Low Plasticity Silt With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 9 (m)



Job No.: K15-1185-101

Classification : CL

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
11.84	24.07	20.99	16	33.7
11.82	23.61	20.84	28	30.7
				-

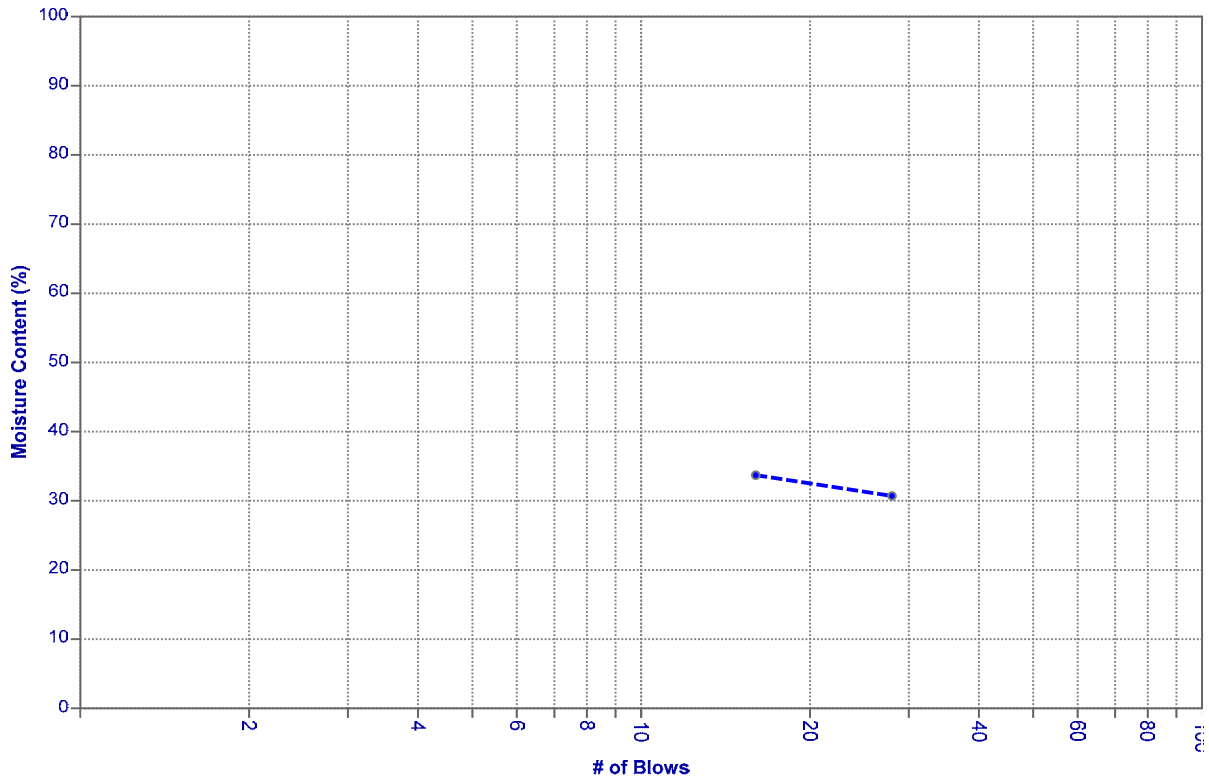
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
14.06	20.07	18.99	21.9

LL = 31.3 %

PL = 21.9 %

PI=9.4



Unified Description : Low Plasticity Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

ATTERBERG LIMITS TEST

Project : Coal Unloading Terminal

Borehole : BH-11

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 15 (m)



Job No.: K15-1185-101

Classification : CL-ML

Location : Port Qasim

Sample Type : SPT Split Spoon

ASTM D2216-90, D854

Liquid Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	# of Blows	Moisture Content (%)
14.35	26	23.5	13	27.3
10.7	21.04	18.98	25	24.9
8.92	16.75	15.2	38	24.7
				-

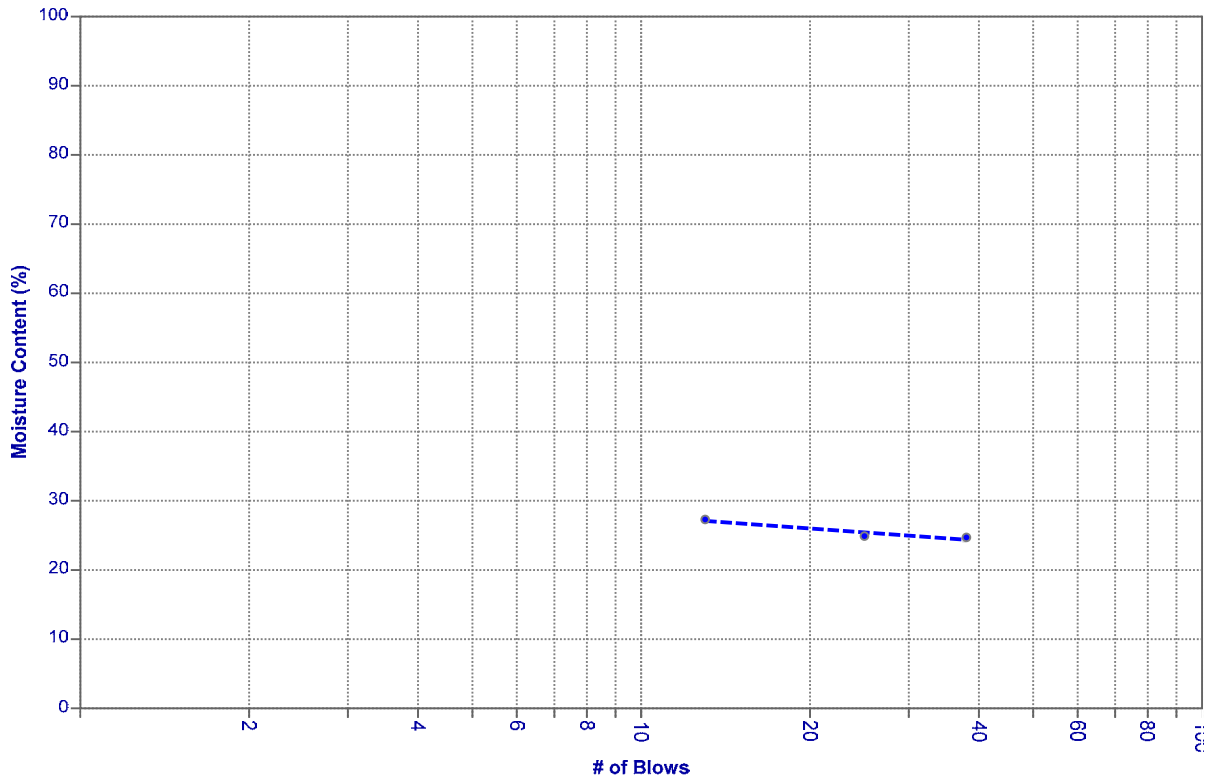
Plastic Limit

Cont. W (gr)	Cont. + Wet Soil W (gr)	Cont. + Dry Soil W (gr)	Moisture Content (%)
13.27	15.9	15.45	20.6

LL = 25.4 %

PL = 20.6 %

PI=4.8



Unified Description : Silty Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :
HG

Density & Moisture Test

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



ASTM D4643, D2216

Borehole	Sample Depth (m)	Moisture Content (%)	Dry Density (gr/cm3)	Wet Density (gr/cm3)
BH-1	1.5	6.44	1.6	1.7
BH-1	4.5	9.6	1.58	1.73
BH-1	9	14.67	1.54	1.77
BH-1	15	4.38	1.61	1.68
BH-2	1.5	7.41	1.48	1.59
BH-2	6	9.14	1.5	1.64
BH-2	12	13.07	1.4	1.58
BH-2(A)	3	7.45	1.45	1.56
BH-2(A)	4.5	13.54	1.45	1.65
BH-2(A)	9	9.69	1.54	1.69
BH-2(A)	10.5	12.48	1.51	1.7
BH-2(A)	12	16.23	1.54	1.79
BH-2(B)	1.5	7.87	1.52	1.64
BH-2(B)	6	8.95	1.42	1.55
BH-2(B)	13.5	20.1	1.42	1.71
BH-3	4.5	7.87	1.66	1.79
BH-3	9	10.92	1.66	1.84
BH-3	15	14.01	1.68	1.92
BH-3(A)	3	5.68	1.66	1.76
BH-3(A)	6	15.86	1.66	1.92
BH-3(A)	9	8.71	1.71	1.85
BH-3B	3	10.93	1.66	1.84
BH-3B	7.5	20.46	1.5	1.81
BH-3B	12	5.92	1.67	1.77
BH-3B	15	19.26	1.56	1.86
BH-4	3	5.25	1.56	1.64
BH-4	7.5	15.62	1.52	1.76
BH-4	12	10.21	1.61	1.77
BH-4(A)	1.5	6.63	1.86	1.98
BH-4(A)	6	11.86	1.59	1.78
BH-4(B)	1.5	7.75	1.6	1.72
BH-4(B)	9	10.84	1.7	1.88
BH-4(B)	10.5	6.12	1.66	1.76
BH-4(B)	13.5	10.89	1.69	1.87
BH-5	1.5	5.6	1.58	1.67
BH-5	7.5	10.85	1.55	1.72
BH-5	10.5	4.2	1.65	1.72
BH-5	13.5	14.17	1.49	1.7
BH-5(A)	1.5	16.83	1.57	1.83
BH-5(A)	4.5	21.26	1.49	1.8
BH-5(A)	6	10.91	1.65	1.83
BH-5(A)	19.5	17.59	1.74	2.05
BH-5(B)	3	10.52	1.66	1.83
BH-5(B)	7.5	13.02	1.57	1.77
BH-5(B)	10.5	11.79	1.66	1.86
BH-5(B)	12	9.99	1.71	1.88
BH-6	3	5.12	1.6	1.68
BH-6	7.5	16.84	1.65	1.93
BH-6	10.5	15.24	1.63	1.87

Density & Moisture Test

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



ASTM D4643, D2216

Borehole	Sample Depth (m)	Moisture Content (%)	Dry Density (gr/cm3)	Wet Density (gr/cm3)
BH-6(A)	1.5	4.67	1.54	1.61
BH-6(A)	7.5	5.7	1.54	1.63
BH-6(B)	1.5	2.63	1.6	1.64
BH-6(B)	12	16.8	1.54	1.8
BH-7	1.5	4.41	1.56	1.63
BH-7	4.5	9.18	1.85	2.01
BH-7	10.5	18.63	1.66	1.97
BH-7	12	20.79	1.63	1.97
BH-7(A)	1.5	3.88	1.75	1.81
BH-7(A)	7.5	12.24	1.66	1.86
BH-7(A)	9	10.25	1.55	1.71
BH-8	1.5	8.02	1.66	1.8
BH-8	4.5	18.44	1.55	1.83
BH-8	9	13.57	1.76	1.99
BH-8	10.5	13.96	1.74	1.99
BH-8(A)	1.5	14.39	1.54	1.76
BH-8(A)	4.5	15.58	1.52	1.76
BH-8(A)	7.5	27.88	1.45	1.85
BH-8(B)	1.5	4.99	1.45	1.52
BH-8(B)	9	21.23	1.56	1.89
BH-8(B)	12	21.47	1.42	1.72

Density & Moisture Test

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



ASTM D4643, D2216

Borehole	Sample Depth (m)	Moisture Content (%)	Dry Density (gr/cm3)	Wet Density (gr/cm3)
BH-09	4.5	10.02	1.89	2.08
BH-09	7.5	11.83	1.6	1.79
BH-09	12	17.49	1.57	1.84
BH-09(A)	1.5	10.45	1.57	1.73
BH-09(A)	6	20.94	1.6	1.93
BH-09(A)	12	24.54	1.7	2.11
BH-10	3	9.44	1.66	1.82
BH-10	7.5	12.98	1.66	1.87
BH-10	12	9.48	1.66	1.82
BH-10(A)	1.5	9.78	1.7	1.86
BH-10(A)	6	12.16	1.65	1.86
BH-10(A)	8	20.05	1.57	1.88
BH-10(A)	9	25.13	1.59	1.99
BH-11	1.5	4.32	1.75	1.83
BH-11	3	12.03	1.66	1.86
BH-11	4.5	12.76	1.72	1.94
BH-11	6	9.1	1.66	1.81
BH-11	12	18.54	1.67	1.97
BH-12	1.5	8.22	1.6	1.73
BH-12	6	14.51	1.67	1.91
BH-12	10.5	20.59	1.75	2.1
BH-13	1.5	12.65	1.66	1.87
BH-13	4.5	16.55	1.85	2.15
BH-13	10.5	14.65	1.66	1.9
BH-14	1.5	8.17	1.89	2.04
BH-14	7.5	15.16	1.66	1.91
BH-14	13.5	21.27	1.66	2.01
BH-15	1.5	6.1	1.85	1.97
BH-15	6	9.61	1.66	1.82
BH-15	13.5	16.37	1.87	2.18
BH-16	3	4.81	1.57	1.64
BH-16	5	12.35	1.85	2.08
BH-16	9	14.99	1.75	2.02
BH-17	1.5	4.35	1.89	1.97
BH-17	4.5	2.87	1.66	1.71
BH-17	7.5	6.99	1.6	1.71
BH-18	1.5	1.25	1.69	1.71
BH-18	6	13.91	1.86	2.12
BH-18	10.5	20.75	1.69	2.04
BH-19	1.5	6.45	1.66	1.77
BH-19	3	11.35	1.55	1.72
BH-19	9	13.18	1.57	1.77
BH-20	1.5	12.28	1.69	1.9
BH-20	7.5	10.98	1.46	1.62
BH-20	10.5	24.25	1.52	1.89

Soil Classification & Specific Gravity

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No .: K15-1185-101

Location : Port Qasim, Karachi

Soil Testing Services



Borehole	Sample Depth (m)	Soil Classification	Specific Gravity
BH-1	1.5	SM (A-2-4)	2.585
BH-1	4.5	ML (A-4)	2.652
BH-1	9	ML (A-4)	2.669
BH-1	15	SP-SM (A-2-4)	2.599
BH-2	1.5	SW-SM (A-2-4)	2.635
BH-2	6	SM (A-2-4)	2.644
BH-2	12	ML (A-4)	2.671
BH-2(A)	3	ML (A-4)	2.677
BH-2(A)	4.5	ML (A-4)	2.655
BH-2(A)	9	SM (A-2-4)	2.675
BH-2(A)	10.5	SM (A-2-4)	2.634
BH-2(A)	12	ML (A-4)	2.635
BH-2(B)	1.5	SM (A-2-4)	2.611
BH-2(B)	6	SM (A-2-4)	2.619
BH-2(B)	13.5	ML (A-4)	2.671
BH-3	4.5	SM (A-2-4)	2.606
BH-3	9	SM (A-2-4)	2.689
BH-3	15	ML (A-4)	2.647
BH-3(A)	3	ML (A-4)	2.669
BH-3(A)	6	SM (A-2-4)	2.599
BH-3(A)	9	SM (A-2-4)	2.610
BH-3(B)	3	SM (A-2-4)	2.614
BH-3(B)	7.5	ML (A-4)	2.685
BH-3(B)	12	SP (A-2-4)	2.586
BH-3(B)	15	ML (A-4)	2.687
BH-4	3	SM (A-2-4)	2.592
BH-4	7.5	CL (A-6)	2.666
BH-4	12	ML (A-7-6)	2.656
BH-4(A)	1.5	ML (A-4)	2.646
BH-4(A)	6	SM (A-2-4)	2.588
BH-4(B)	1.5	SM (A-2-4)	2.580
BH-4(B)	9	SM (A-2-4)	2.598
BH-4(B)	10.5	SP (A-2-4)	2.599
BH-4(B)	13.5	ML (A-4)	2.675
BH-5	1.5	SW-SM (A-2-4)	2.595
BH-5	7.5	CL (A-4)	2.671
BH-5	10.5	SW-SM (A-2-4)	2.612
BH-5	13.5	ML (A-6)	2.660
BH-5(A)	1.5	CL-ML (A-4)	2.668
BH-5(A)	4.5	SM (A-4)	2.620
BH-5(A)	6	ML (A-4)	2.656
BH-5(A)	19.5	CL (A-4)	2.688
BH-5(B)	3	SM (A-2-4)	2.625
BH-5(B)	7.5	ML (A-4)	2.675
BH-5(B)	10.5	SM (A-2-4)	2.610
BH-5(B)	12	SP (A-2-4)	2.588

Soil Classification & Specific Gravity

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No .: K15-1185-101

Location : Port Qasim, Karachi

Soil Testing Services



Borehole	Sample Depth (m)	Soil Classification	Specific Gravity
BH-6	3	SM (A-2-4)	2.621
BH-6	7.5	CL-ML (A-4)	2.634
BH-6	10.5	SM (A-4)	2.618
BH-6(A)	1.5	SM (A-2-4)	2.609
BH-6(A)	7.5	SM (A-2-4)	2.618
BH-6(B)	1.5	SM (A-2-4)	2.610
BH-6(B)	12	SM (A-2-4)	2.617
BH-7	1.5	SM (A-2-4)	2.630
BH-7	4.5	SW-SM (A-2-4)	2.625
BH-7	10.5	ML (A-6)	2.662
BH-7	12	ML (A-7-6)	2.653
BH-7(A)	1.5	SM (A-2-4)	2.624
BH-7(A)	7.5	ML (A-4)	2.669
BH-7(A)	9	ML (A-4)	2.654
BH-8	1.5	SM (A-4)	2.585
BH-8	4.5	SP (A-2-4)	2.595
BH-8	9	ML (A-4)	2.589
BH-8	10.5	ML (A-4)	2.651
BH-8(A)	1.5	SM (A-2-4)	2.594
BH-8(A)	4.5	SM (A-2-4)	2.595
BH-8(A)	7.5	ML (A-7-6)	2.645
BH-8(B)	1.5	SW-SM (A-2-4)	2.610
BH-8(B)	9	SM (A-2-4)	2.590
BH-8(B)	12	SM (A-2-4)	2.595

Soil Classification & Specific Gravity

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No .: K15-1185-101

Location : Port Qasim, Karachi

Soil Testing Services



Borehole	Sample Depth (m)	Soil Classification	Specific Gravity
BH-09	4.5	SP-SM (A-2-4)	2.675
BH-09	7.5	SM (A-2-4)	2.634
BH-09	12	ML (A-6)	2.635
BH-09(A)	1.5	SM (A-4)	2.611
BH-09(A)	6	ML (A-4)	2.592
BH-09(A)	12	ML (A-4)	2.666
BH-10	3	SM (A-2-4)	2.656
BH-10	7.5	SM (A-2-4)	2.646
BH-10	12	SM (A-2-4)	2.592
BH-10(A)	1.5	SP (A-2-4)	2.675
BH-10(A)	6	ML (A-4)	2.634
BH-10(A)	8	ML (A-4)	2.635
BH-10(A)	9	CL (A-4)	2.611
BH-11	1.5	SM (A-4)	2.599
BH-11	3	ML (A-4)	2.610
BH-11	4.5	SM (A-2-4)	2.614
BH-11	6	SM (A-2-4)	2.685
BH-11	12	SM (A-2-4)	2.647
BH-12	1.5	SM (A-4)	2.669
BH-12	6	ML (A-4)	2.599
BH-12	10.5	SM (A-2-4)	2.610
BH-13	1.5	SM (A-4)	2.614
BH-13	4.5	SP (A-2-4)	2.625
BH-13	10.5	SM (A-2-4)	2.634
BH-14	1.5	SM (A-2-4)	2.585
BH-14	7.5	ML (A-4)	2.675
BH-14	13.5	SM (A-4)	2.590
BH-15	1.5	SM (A-2-4)	2.612
BH-15	6	ML (A-4)	2.655
BH-15	13.5	SM (A-4)	2.654
BH-16	3	SM (A-2-4)	2.658
BH-16	5	SM (A-2-4)	2.618
BH-16	9	SM (A-2-4)	2.648
BH-17	1.5	SM (A-2-4)	2.645
BH-17	4.5	SW-SM(A-2-4)	2.622
BH-17	7.5	SM (A-2-4)	2.612
BH-18	1.5	SP (A-2-4)	2.589
BH-18	6	SP-SM (A-2-4)	2.675
BH-18	10.5	SM (A-4)	2.644
BH-19	1.5	SM (A-2-4)	2.599
BH-19	3	SW-SM(A-2-4)	2.584
BH-19	9	SM (A-2-4)	2.658
BH-20	1.5	SP (A-2-4)	2.648
BH-20	7.5	SM (A-4)	2.622
BH-20	10.5	SM (A-2-4)	2.612

Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-01
Sample Depth : 4.5-m
Classification : ML
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.09
0.28	0.17
0.42	0.29

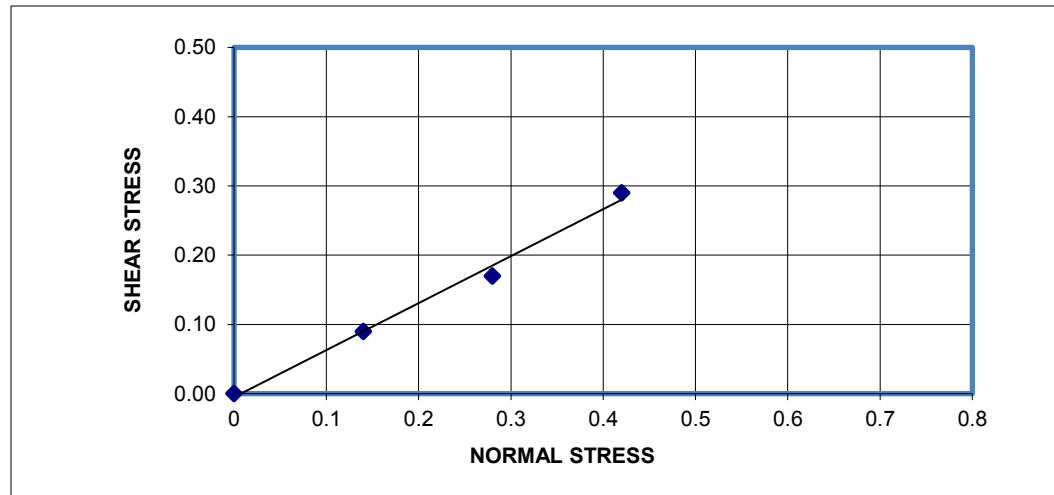
Cohesion (c)

0.00

Angle of friction (Φ)

34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-02
Sample Depth : 1.5-m
Classification : SW-SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.11
0.28	0.20
0.42	0.30

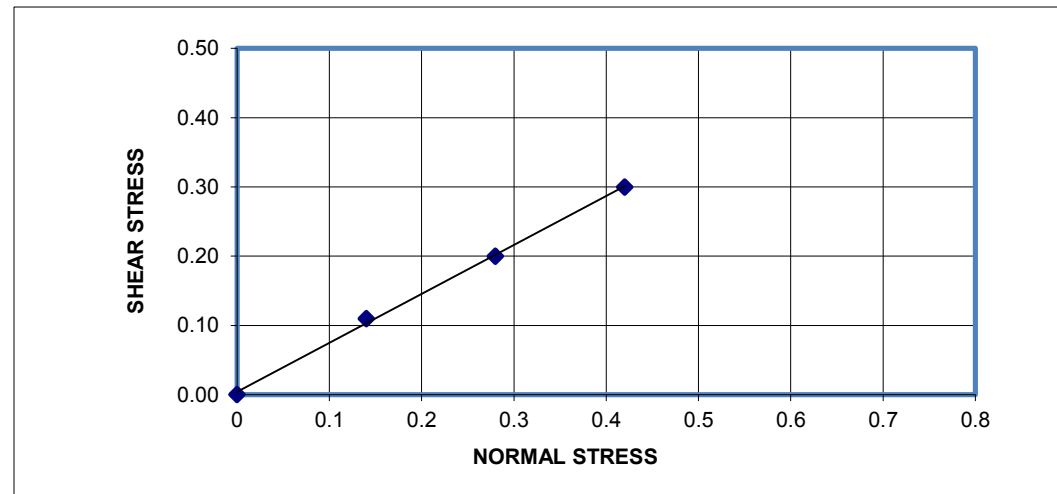
Cohesion (c)

0.00

Angle of friction (Φ)

35.54

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-02 (A)
Sample Depth : 3.0-m
Classification : ML
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.07
0.28	0.15
0.42	0.26

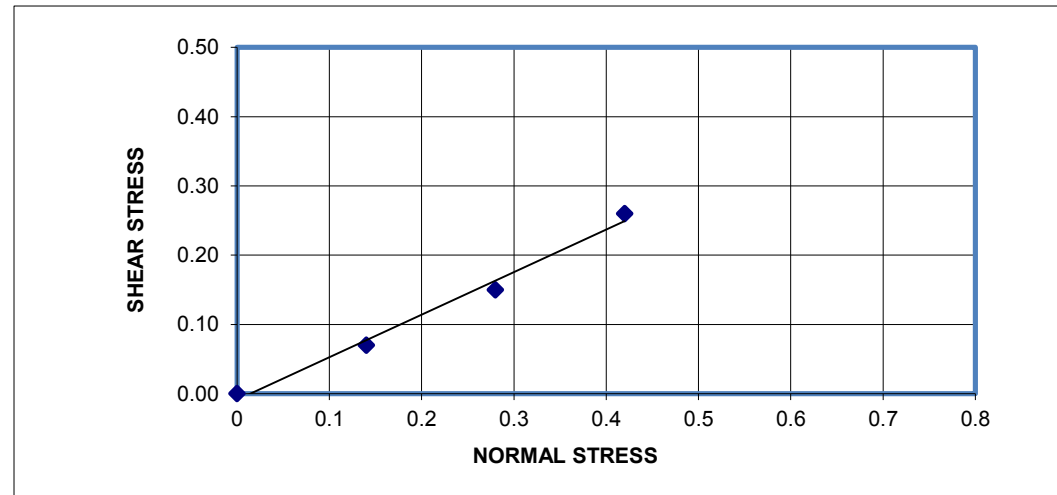
Cohesion (c)

0.00

Angle of friction (Φ)

31.76

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

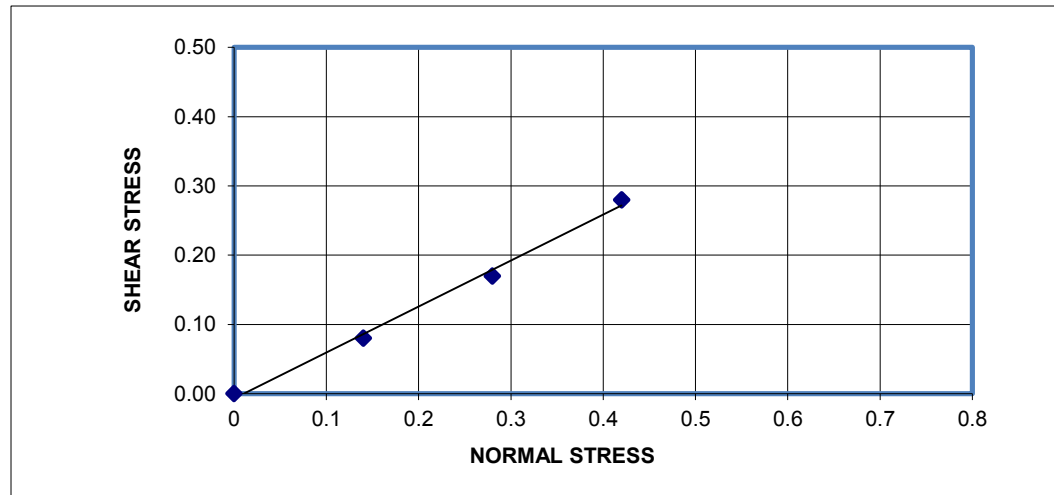
Borehole : BH-02 (A)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.17
0.42	0.28

Cohesion (c) 0.00

Angle of friction (Φ) 33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

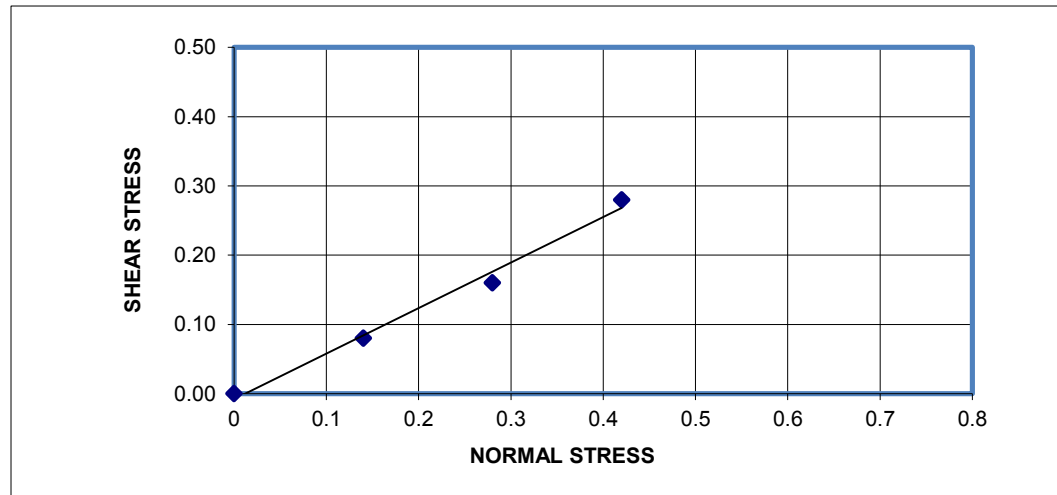
Borehole : BH-03
Sample Depth : 4.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.16
0.42	0.28

Cohesion (c) 0.00

Angle of friction (Φ) 33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-03(A)
Sample Depth : 3.00-m
Classification : ML
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.07
0.28	0.14
0.42	0.27

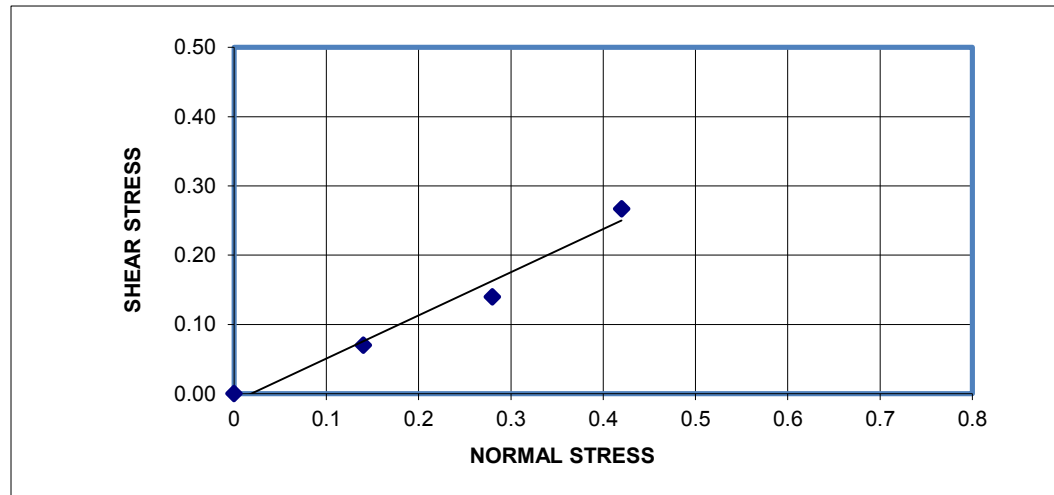
Cohesion (c)

0.00

Angle of friction (Φ)

32.45

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-03(B)
Sample Depth : 3.00-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.11
0.28	0.19
0.42	0.28

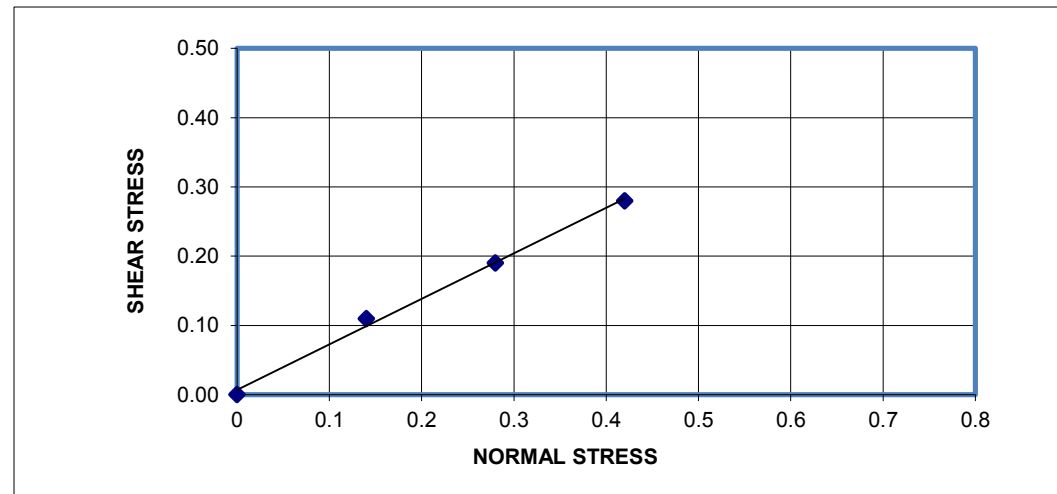
Cohesion (c)

0.00

Angle of friction (Φ)

33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-04
Sample Depth : 3.00-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.11
0.28	0.17
0.42	0.29

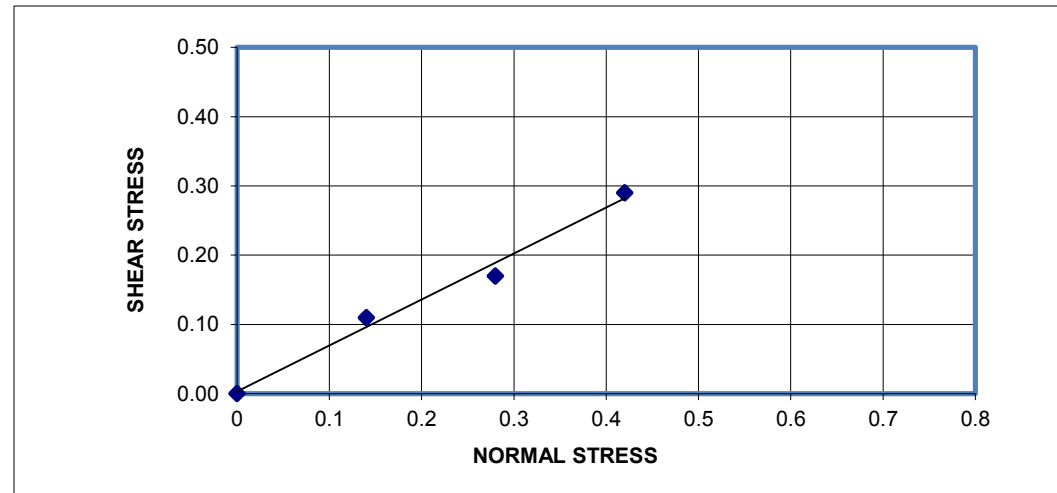
Cohesion (c)

0.00

Angle of friction (Φ)

34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

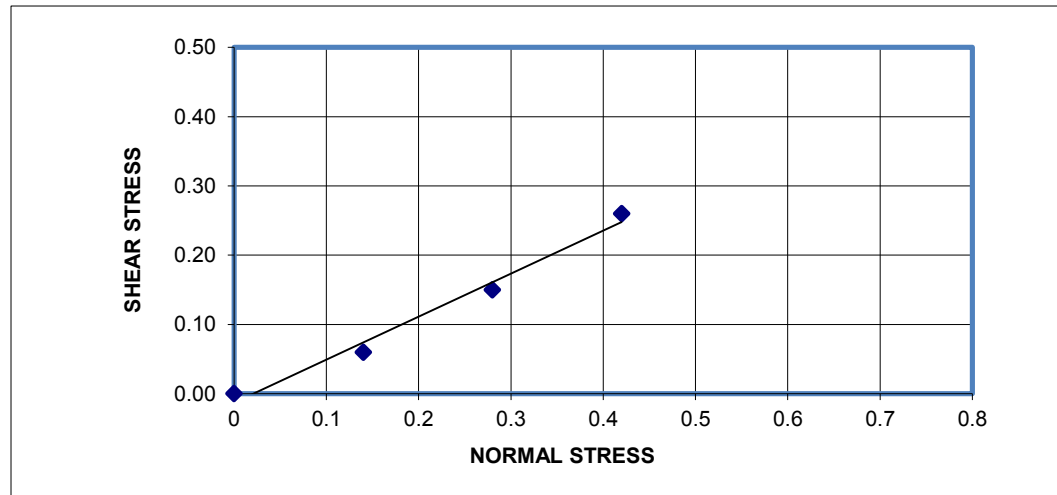
Borehole : BH-04(A)
Sample Depth : 1.50-m
Classification : ML
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.06
0.28	0.15
0.42	0.26

Cohesion (c) 0.00

Angle of friction (Φ) 31.76

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

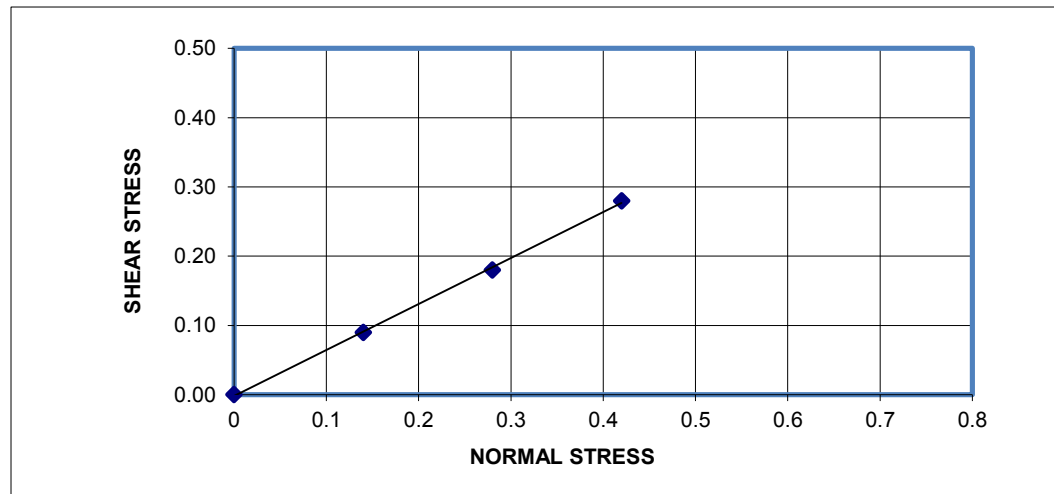
Borehole : BH-04(B)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.09
0.28	0.18
0.42	0.28

Cohesion (c) 0.00

Angle of friction (Φ) 33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

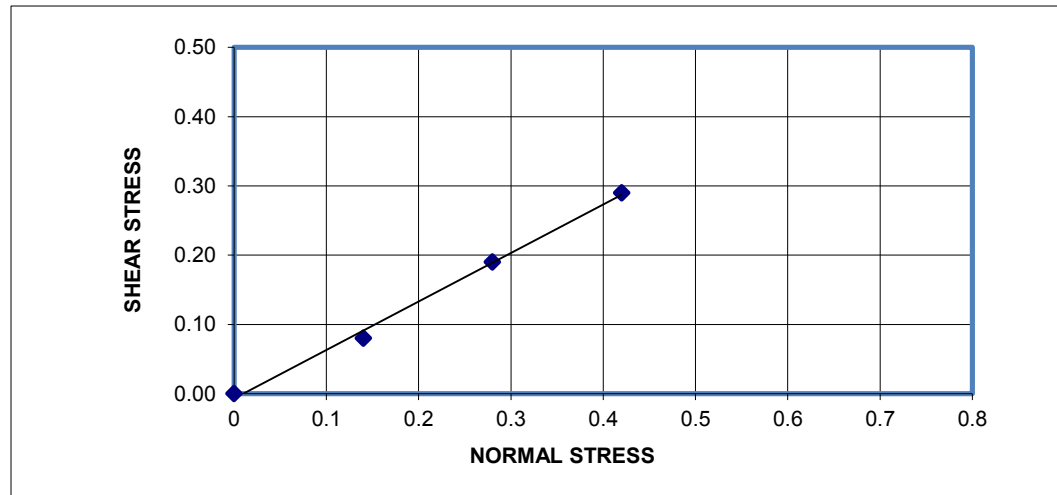
Borehole : BH-05
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.19
0.42	0.29

Cohesion (c) 0.00

Angle of friction (Φ) 34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

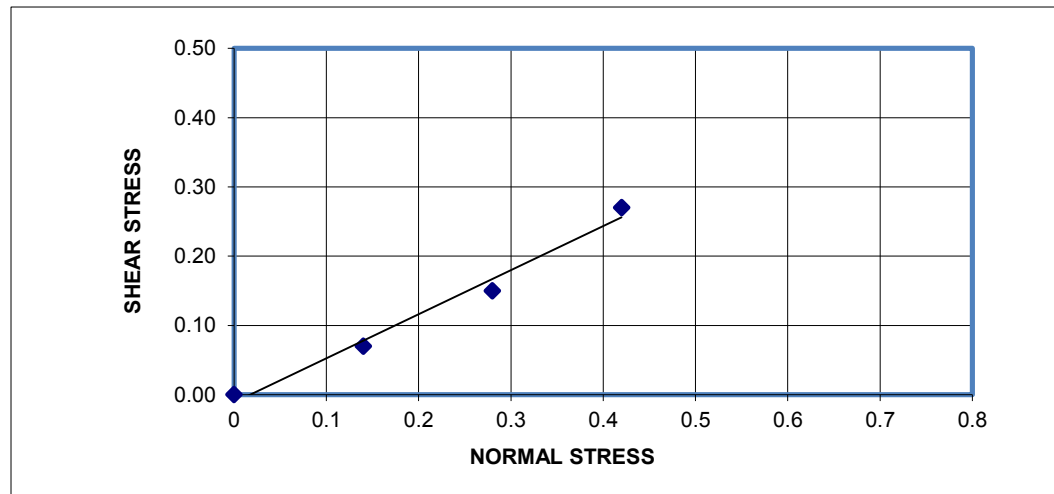
Borehole : BH-05(A)
Sample Depth : 4.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.07
0.28	0.15
0.42	0.27

Cohesion (c) 0.00

Angle of friction (Φ) 32.74

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-05(B)
Sample Depth : 3.00-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.09
0.28	0.17
0.42	0.28

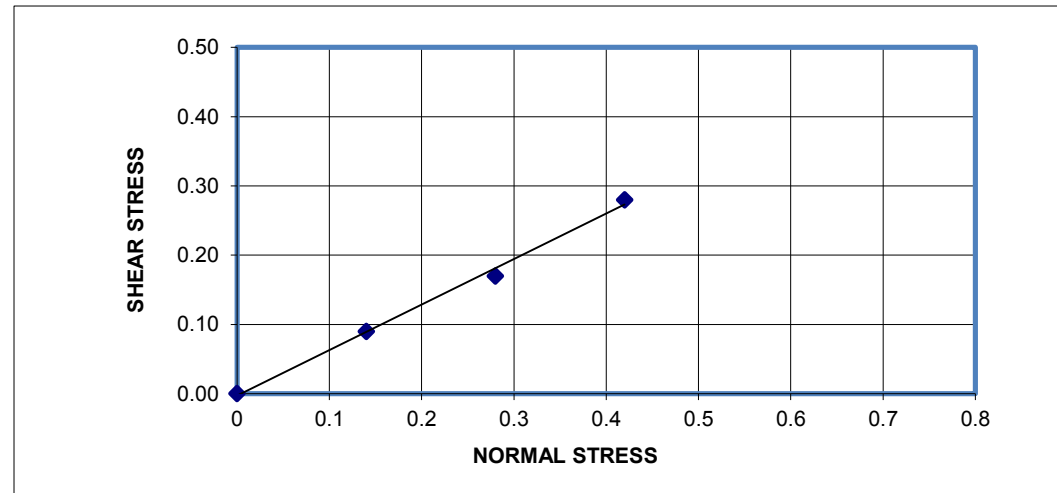
Cohesion (c)

0.00

Angle of friction (Φ)

33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-06
Sample Depth : 3.00-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.17
0.42	0.29

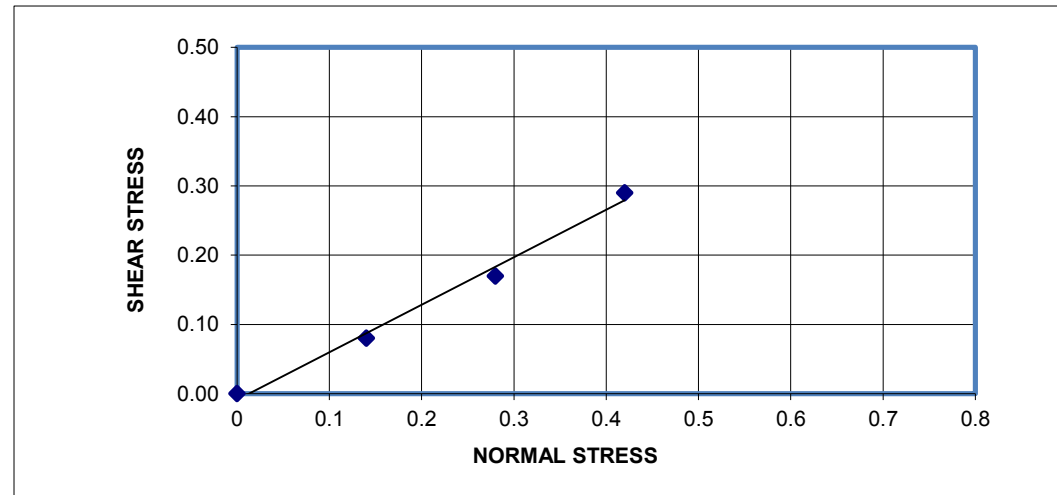
Cohesion (c)

0.00

Angle of friction (Φ)

34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-06(A)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.16
0.42	0.28

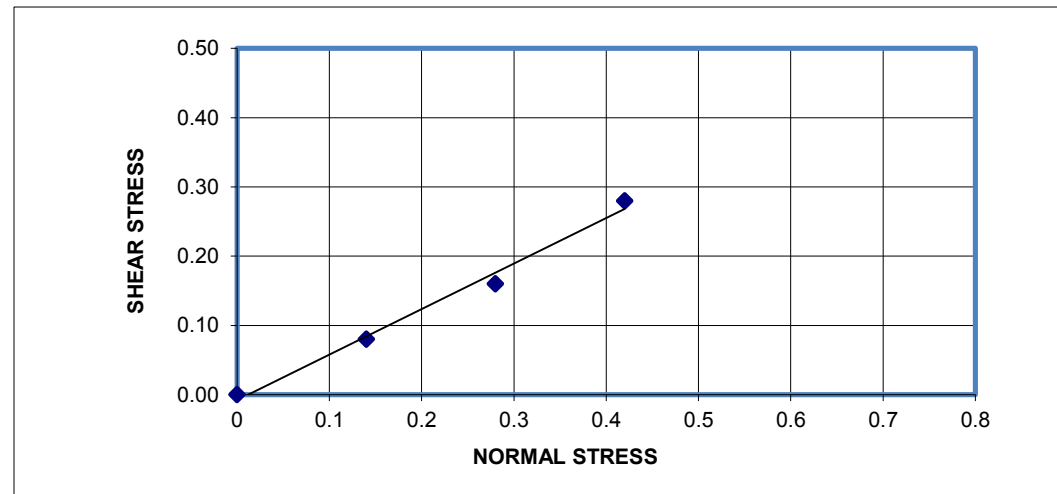
Cohesion (c)

0.00

Angle of friction (Φ)

33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

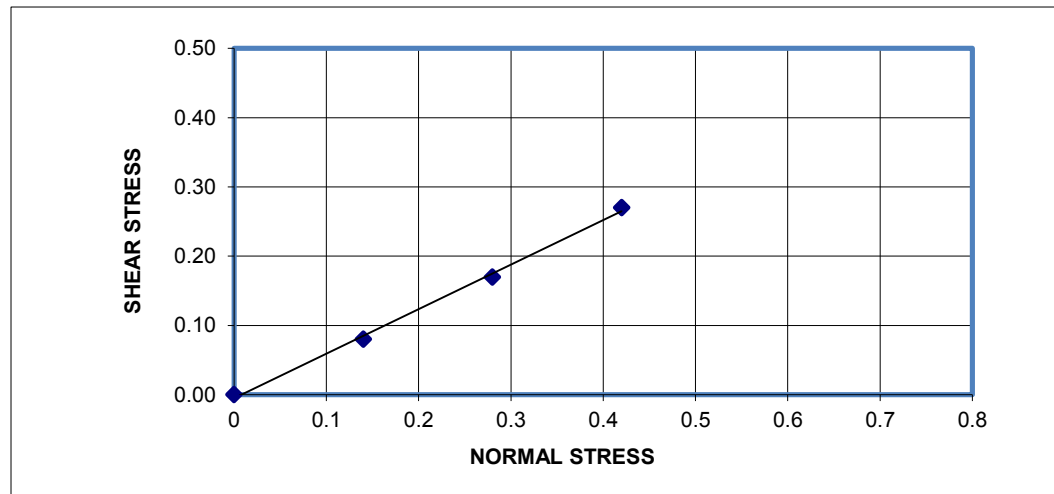
Borehole : BH-06(B)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.08
0.28	0.17
0.42	0.27

Cohesion (c) 0.00

Angle of friction (Φ) 32.74

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-07
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.09
0.28	0.19
0.42	0.29

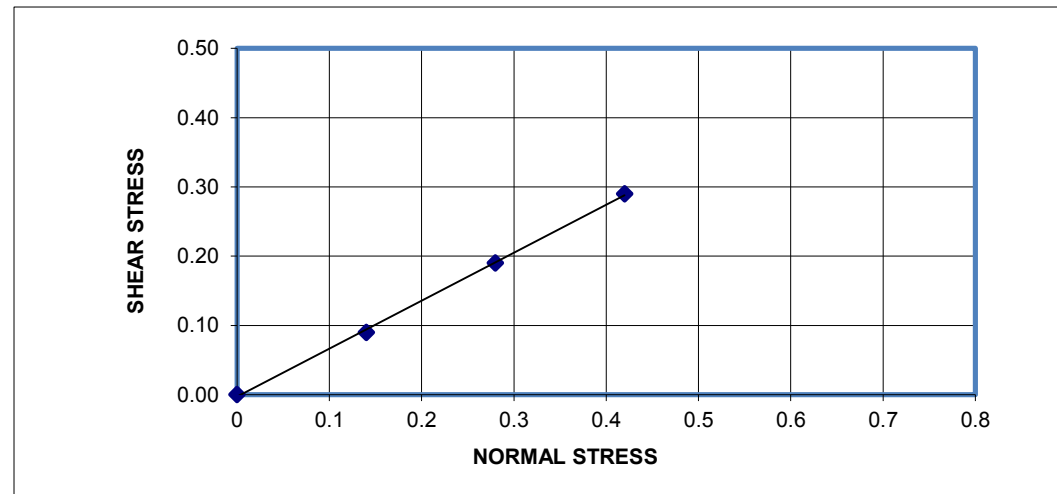
Cohesion (c)

0.00

Angle of friction (Φ)

34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-07(A)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.18
0.42	0.28

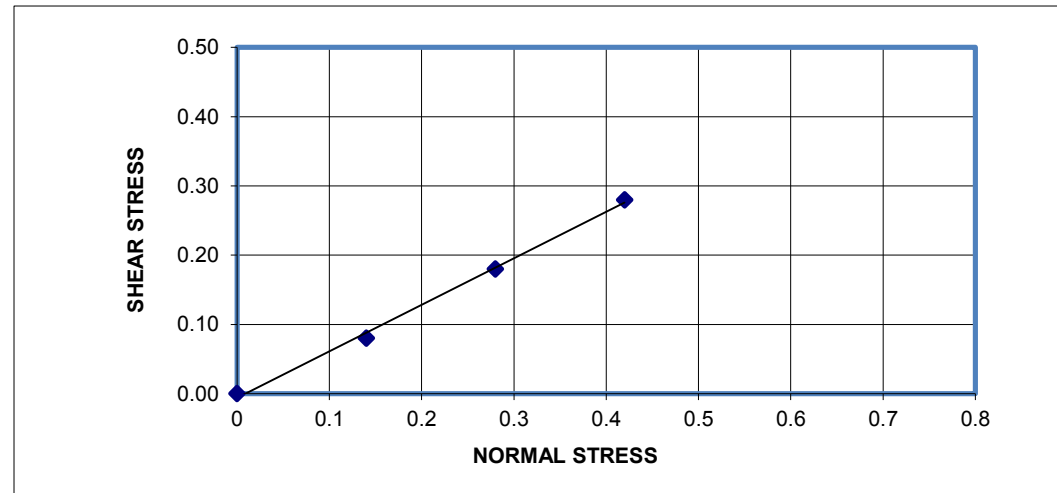
Cohesion (c)

0.00

Angle of friction (Φ)

33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-08
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.10
0.28	0.17
0.42	0.29

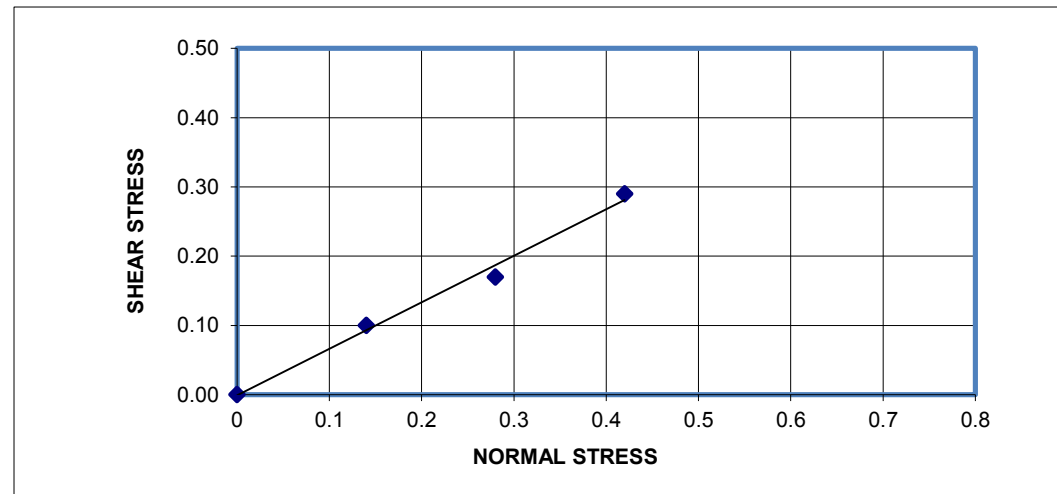
Cohesion (c)

0.00

Angle of friction (Φ)

34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

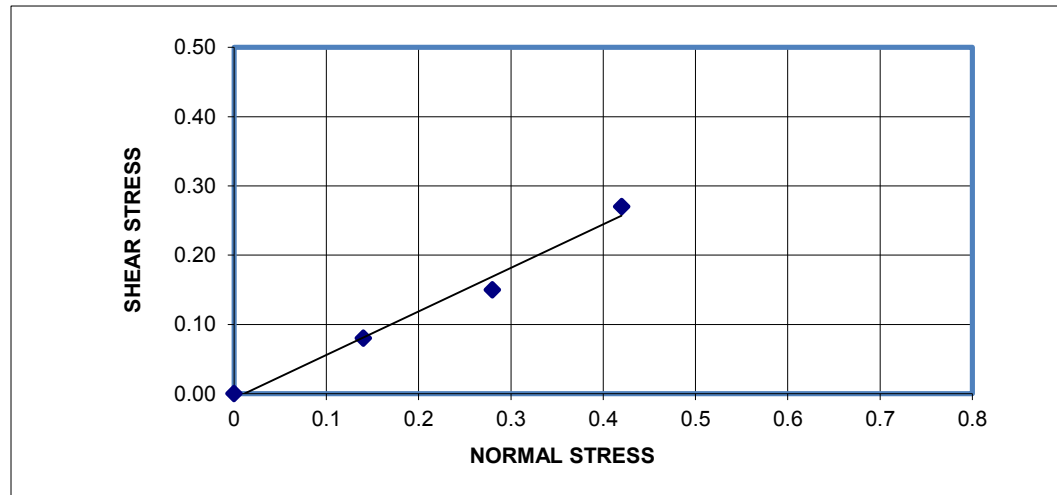
Borehole : BH-08(A)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.15
0.42	0.27

Cohesion (c) 0.00

Angle of friction (Φ) 32.74

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-08(B)
Sample Depth : 1.50-m
Classification : SW-SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.12
0.28	0.20
0.42	0.31

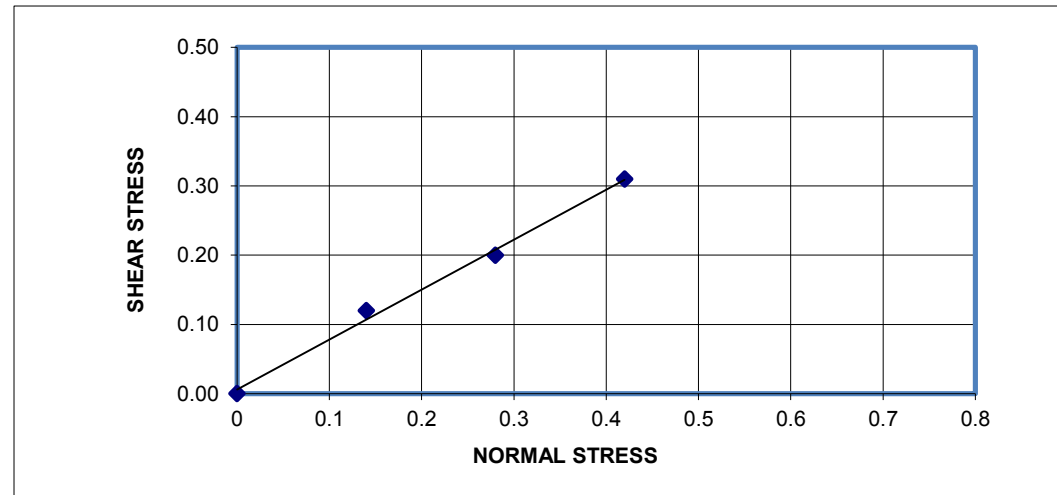
Cohesion (c)

0.00

Angle of friction (Φ)

36.43

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

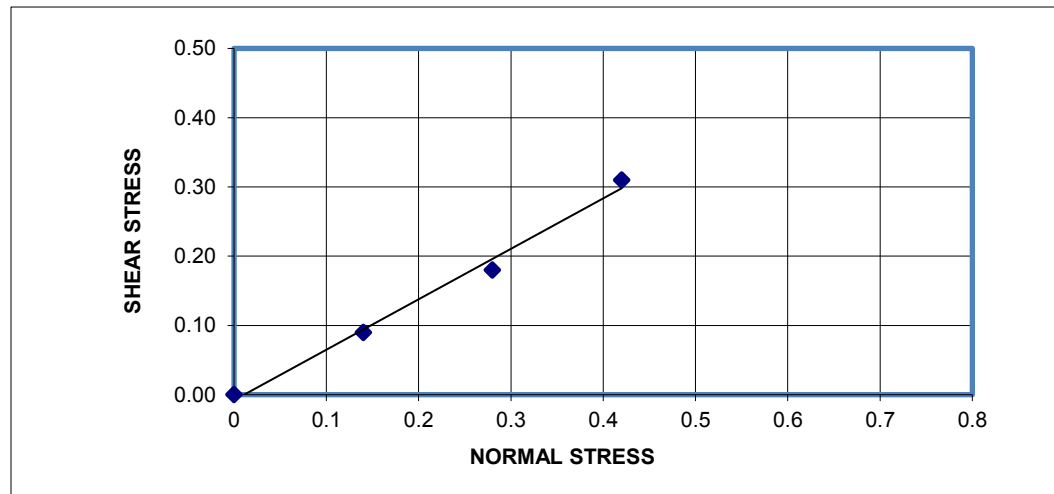
Borehole : BH-09
Sample Depth : 4.50-m
Classification : SP-SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.09
0.28	0.18
0.42	0.31

Cohesion (c) 0.00

Angle of friction (Φ) 36.43

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-09(A)
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.08
0.28	0.17
0.42	0.29

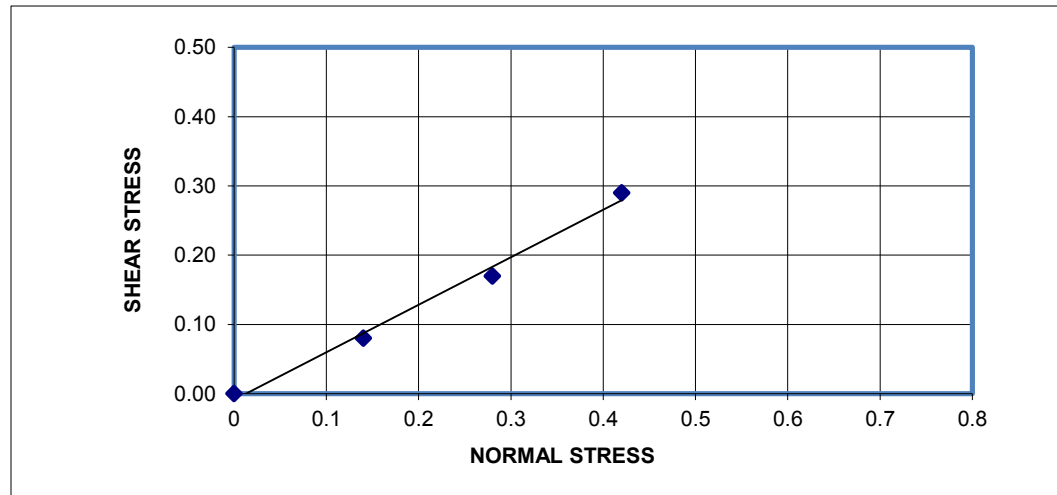
Cohesion (c)

0.00

Angle of friction (Φ)

34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-10
Sample Depth : 3.0-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.09
0.28	0.17
0.42	0.28

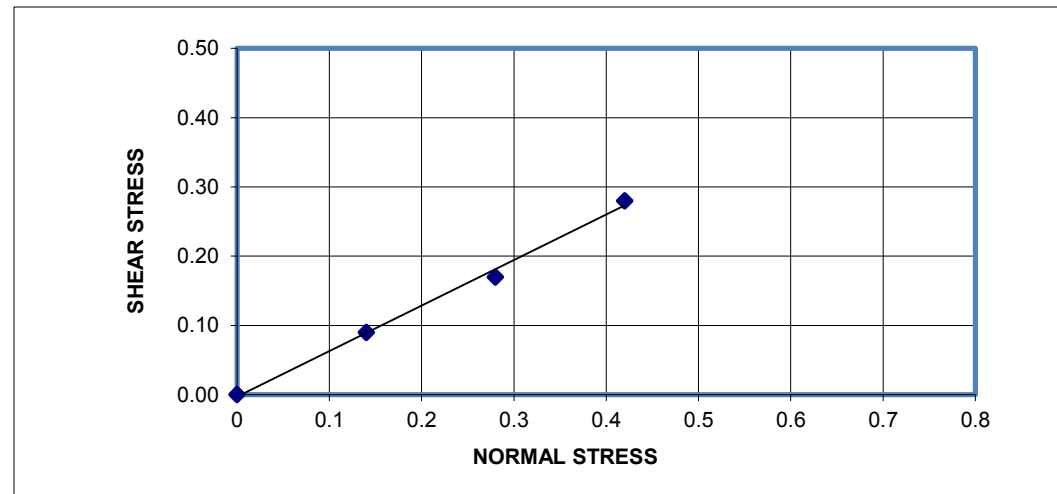
Cohesion (c)

0.00

Angle of friction (Φ)

33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

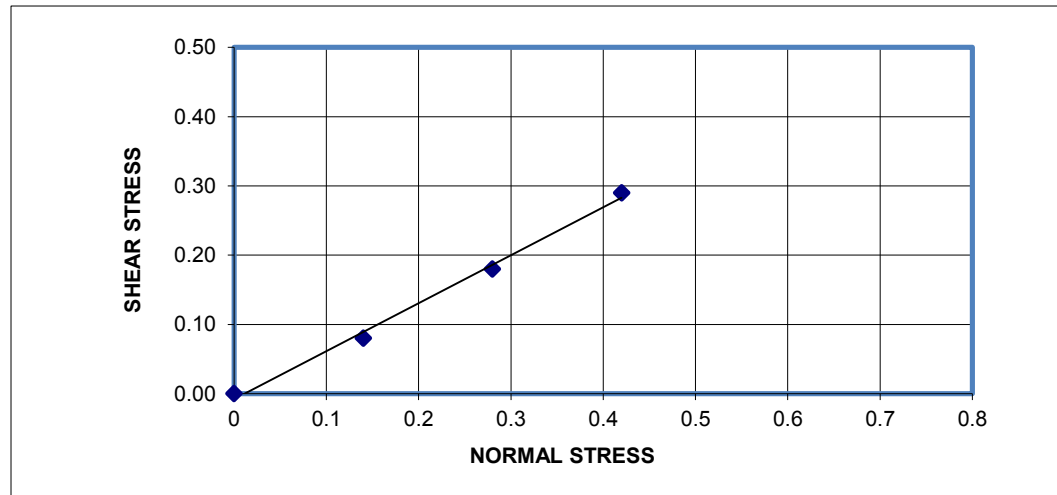
Borehole : BH-10(A)
Sample Depth : 1.5-m
Classification : SP
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.18
0.42	0.29

Cohesion (c) 0.00

Angle of friction (Φ) 34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

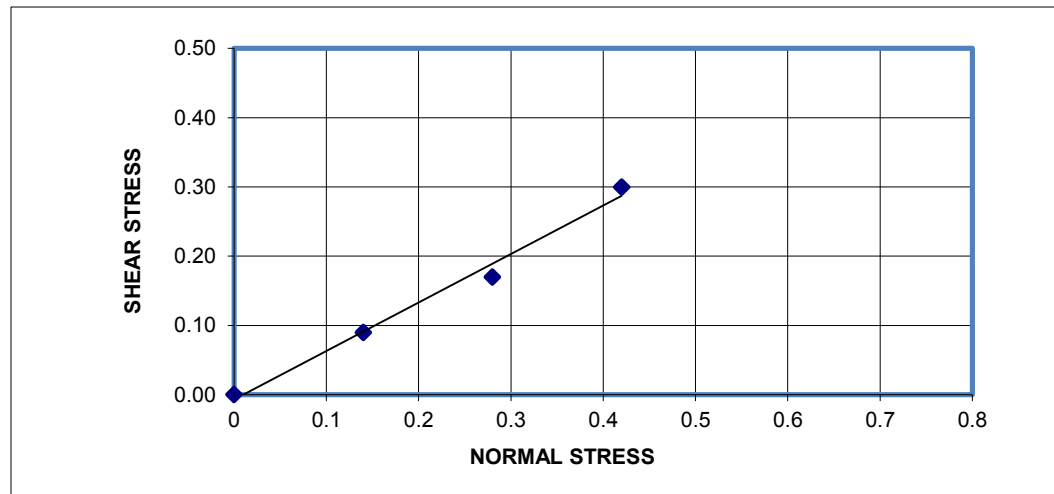
Borehole : BH-11
Sample Depth : 1.5-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.09
0.28	0.17
0.42	0.30

Cohesion (c) 0.00

Angle of friction (Φ) 35.54

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

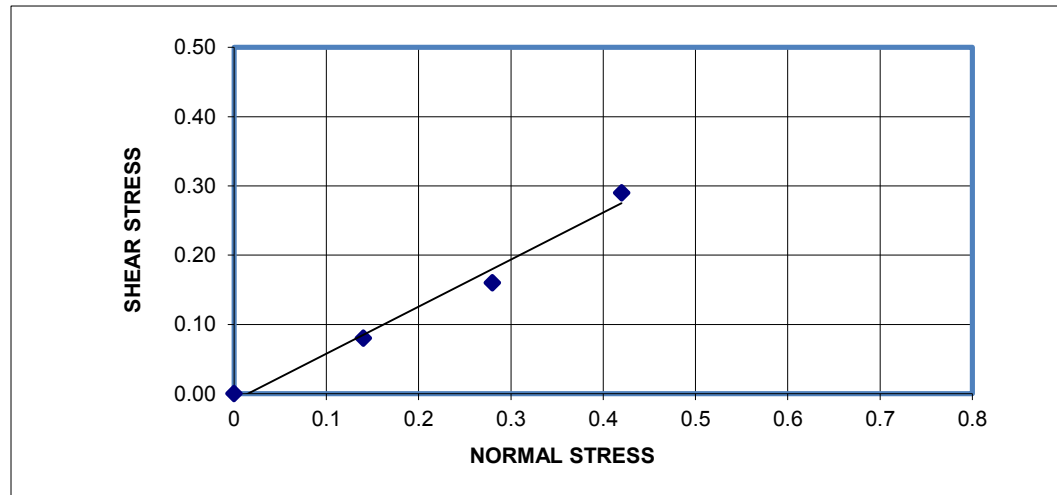
Borehole : BH-12
Sample Depth : 1.5-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.16
0.42	0.29

Cohesion (c) 0.00

Angle of friction (Φ) 34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

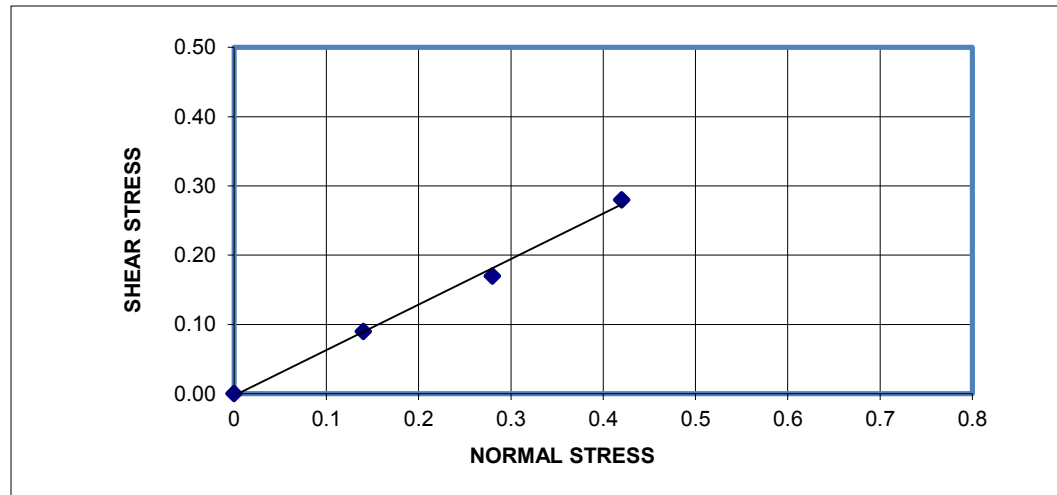
Borehole : BH-13
Sample Depth : 1.5-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.09
0.28	0.17
0.42	0.28

Cohesion (c) 0.00

Angle of friction (Φ) 33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

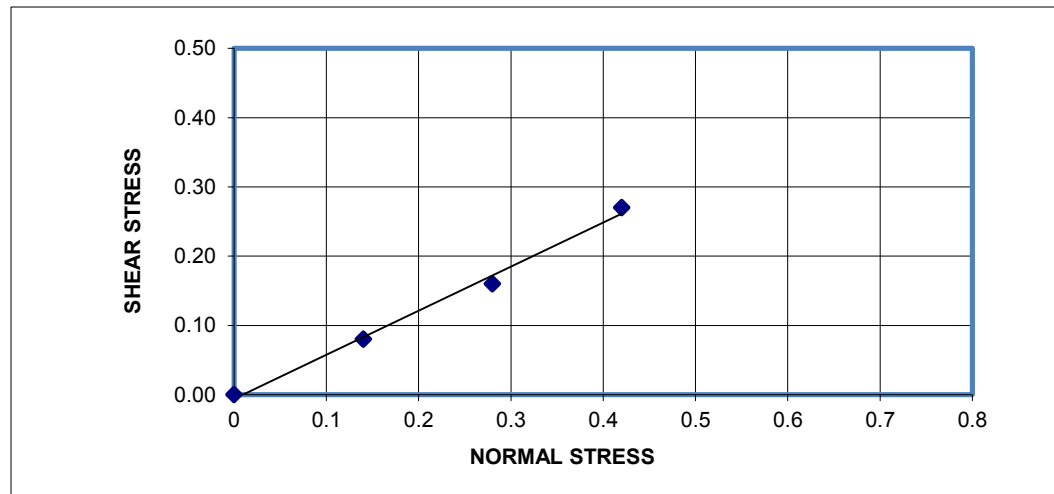
Borehole : BH-14
Sample Depth : 1.5-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.16
0.42	0.27

Cohesion (c) 0.00

Angle of friction (Φ) 32.74

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

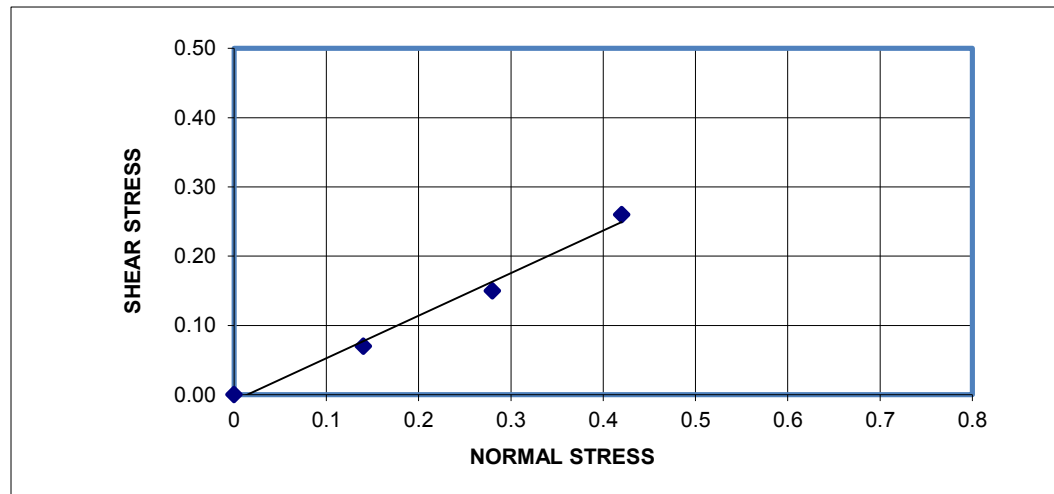
Borehole : BH-15
Sample Depth : 1.5-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.07
0.28	0.15
0.42	0.26

Cohesion (c) 0.00

Angle of friction (Φ) 31.76

DIRECT SHEAR TEST



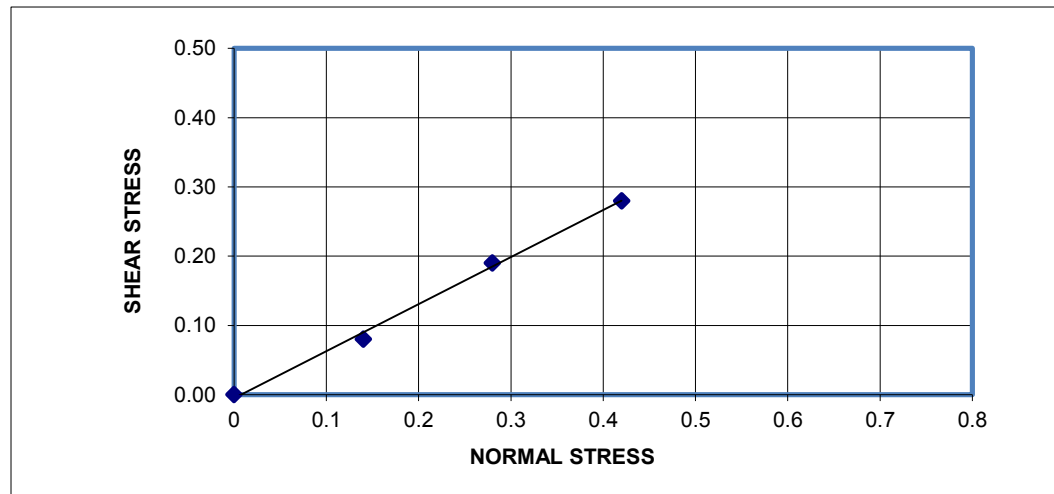
Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

Borehole : BH-16
Sample Depth : 3.0-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.19
0.42	0.28

Cohesion (c) : 0.00
Angle of friction (Φ) : 33.69

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

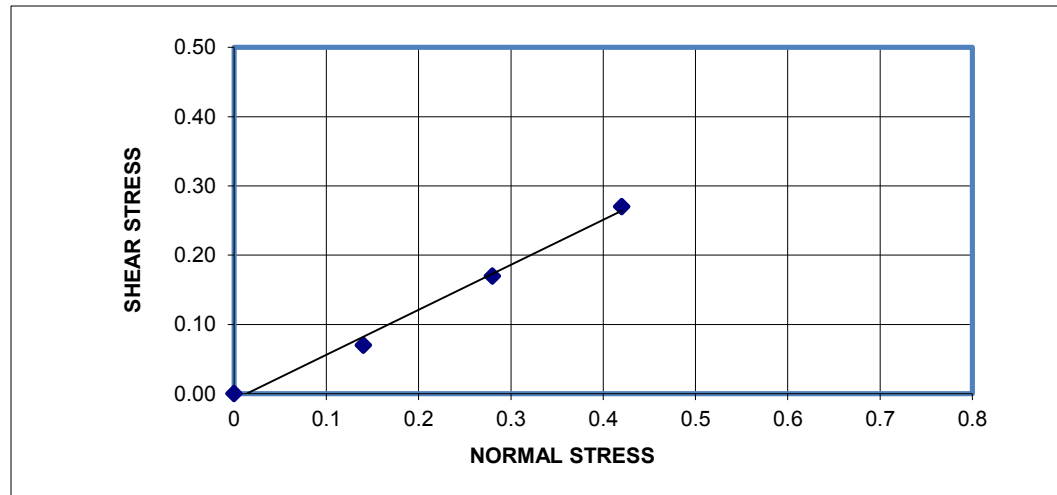
Borehole : BH-17
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.07
0.28	0.17
0.42	0.27

Cohesion (c) 0.00

Angle of friction (Φ) 32.74

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

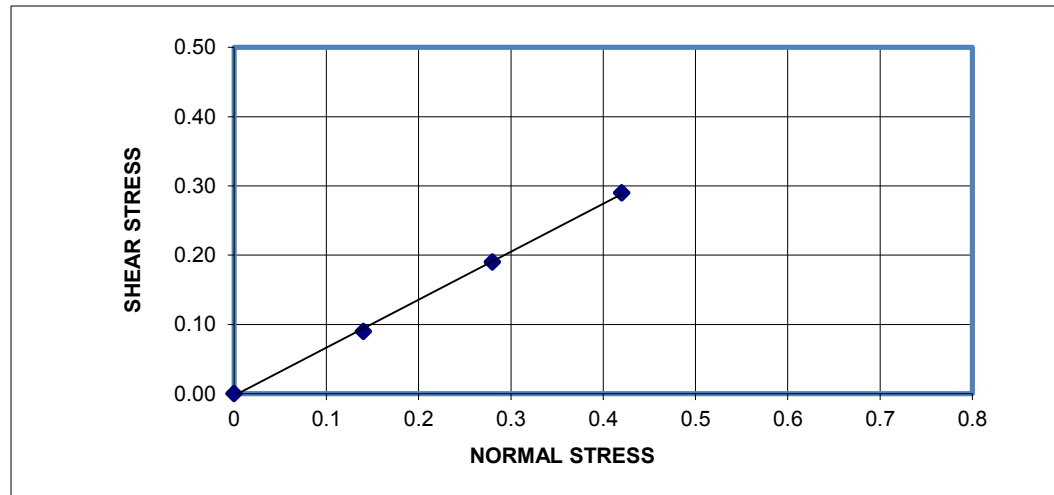
Borehole : BH-18
Sample Depth : 1.50-m
Classification : SP
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.09
0.28	0.19
0.42	0.29

Cohesion (c) 0.00

Angle of friction (Φ) 34.63

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

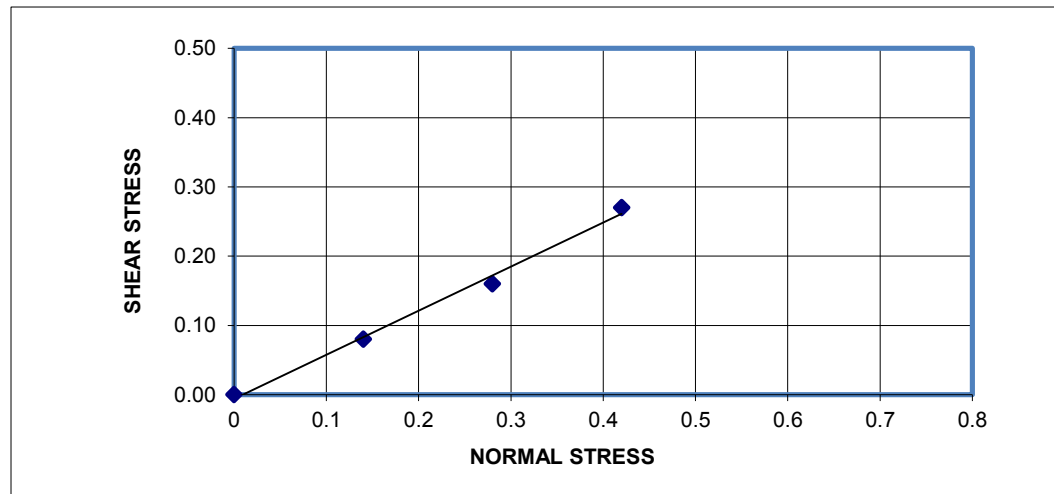
Borehole : BH-19
Sample Depth : 1.50-m
Classification : SM
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm ²)	SHEAR STRESS (kg/cm ²)
0.00	0.00
0.14	0.08
0.28	0.16
0.42	0.27

Cohesion (c) 0.00

Angle of friction (Φ) 32.74

DIRECT SHEAR TEST



Project : GI for Coal Unloading Terminal
Client : Techno Consultant International
Job No. : K15-1185-101
Location : Port Qasim, Karachi

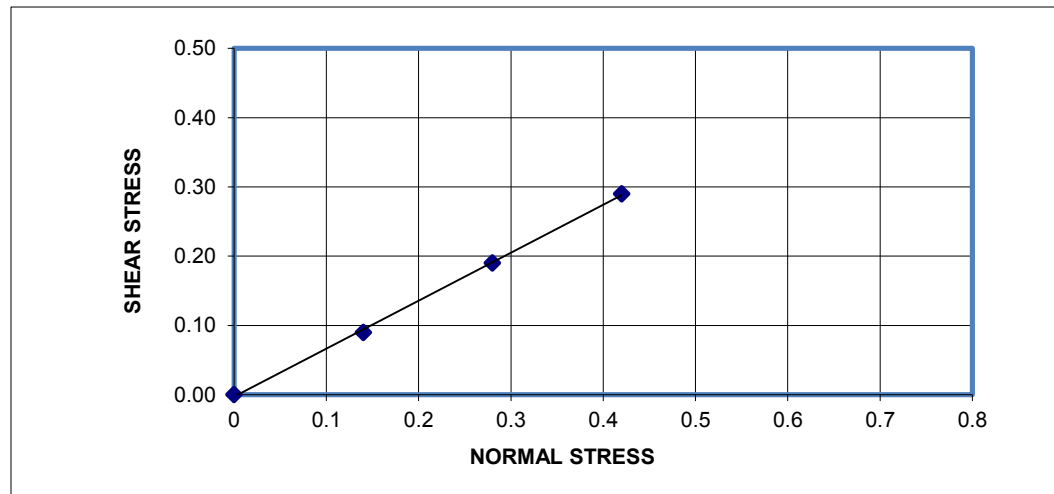
Borehole : BH-20
Sample Depth : 1.50-m
Classification : SP
Sample Type : SPT Split Spoon

NORMAL STRESS (kg/cm²)	SHEAR STRESS (kg/cm²)
0.00	0.00
0.14	0.09
0.28	0.19
0.42	0.29

Cohesion (c) 0.00

Angle of friction (Φ) 34.63

DIRECT SHEAR TEST



Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.5 (m)



Job No.: K15-1185-101

Rock Name : Claystone

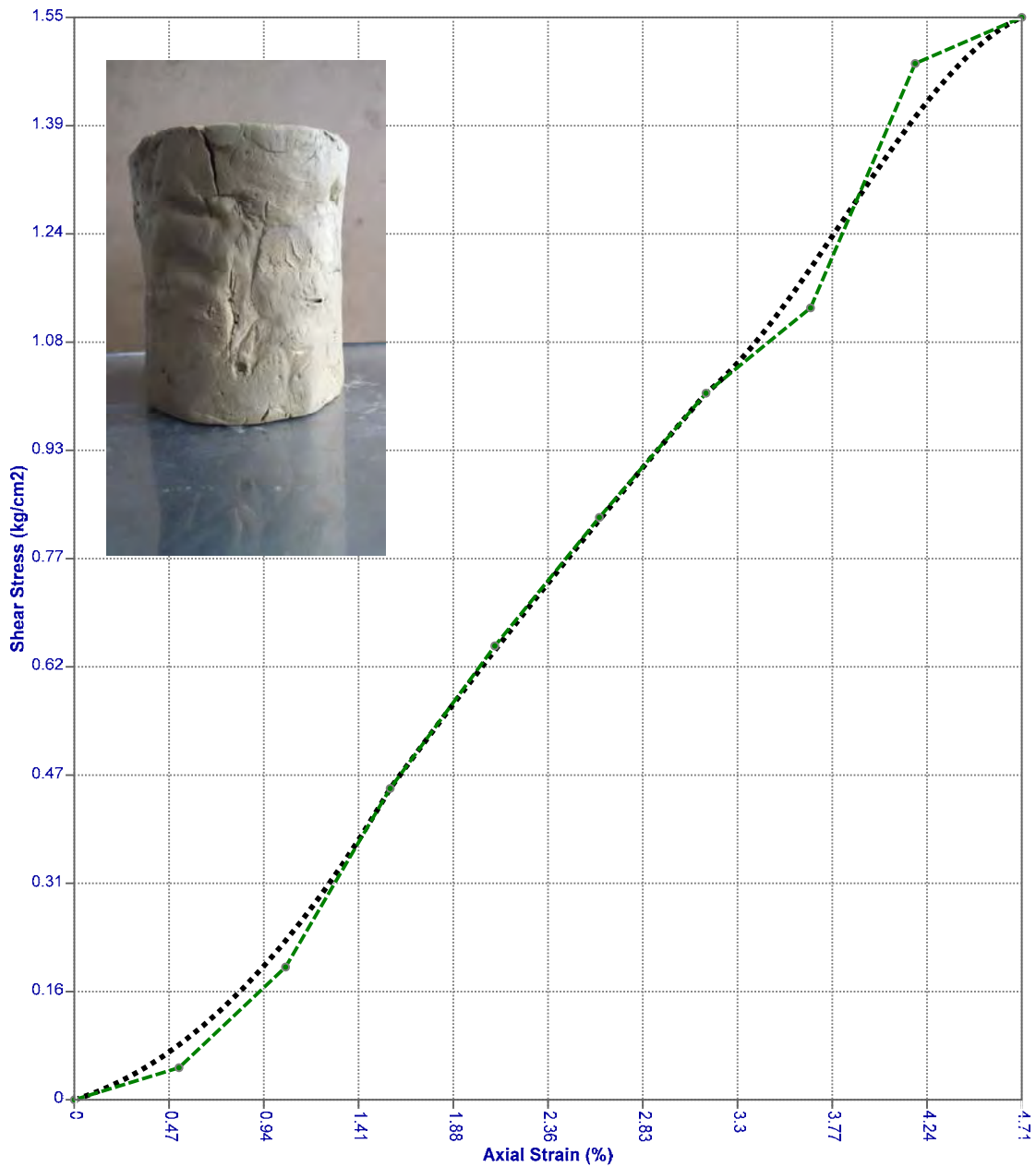
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (ka/cm ²)	Cu (kg/cm ²)
7.455	9.561	1	Moist	22.31	1.8	1.55	0.78



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.6 (m)



Job No.: K15-1185-101

Rock Name : Claystone

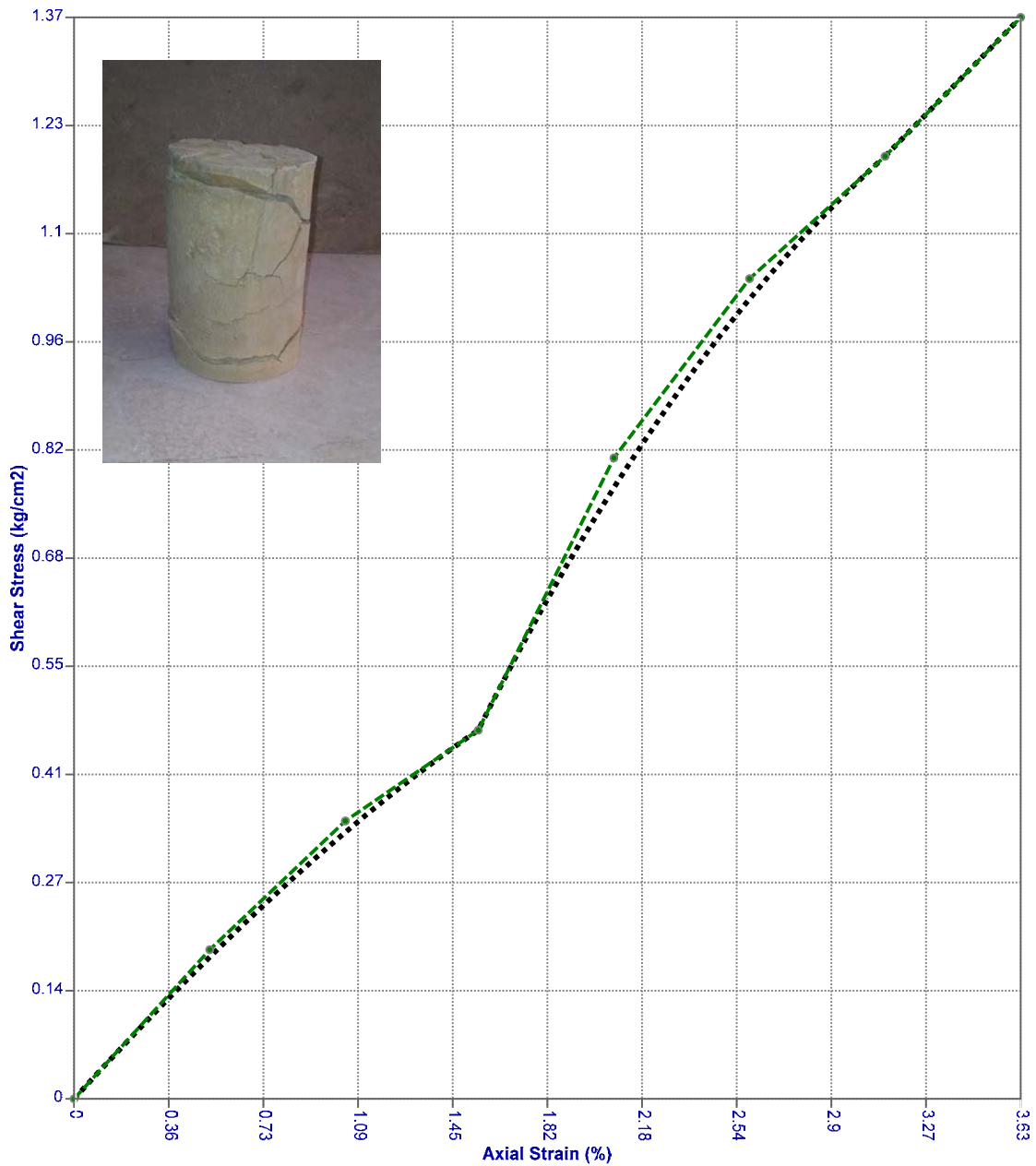
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	C_u (kg/cm ²)
7.33	9.654	1	Moist	21.87	1.84	1.37	0.68



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 17.6 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

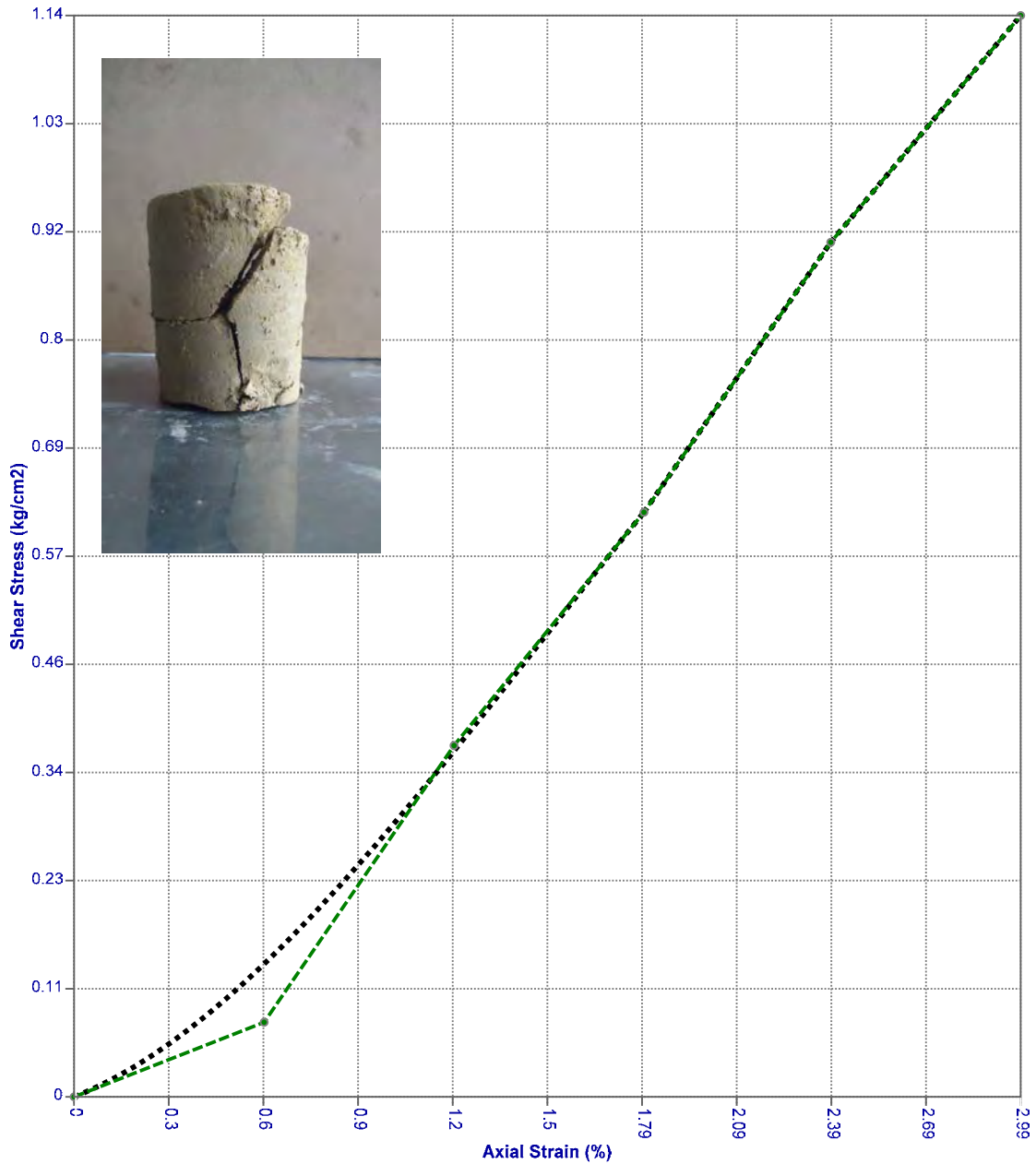
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.929	8.356	1	Moist	19.05	1.69	1.14	0.57



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 19.8 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

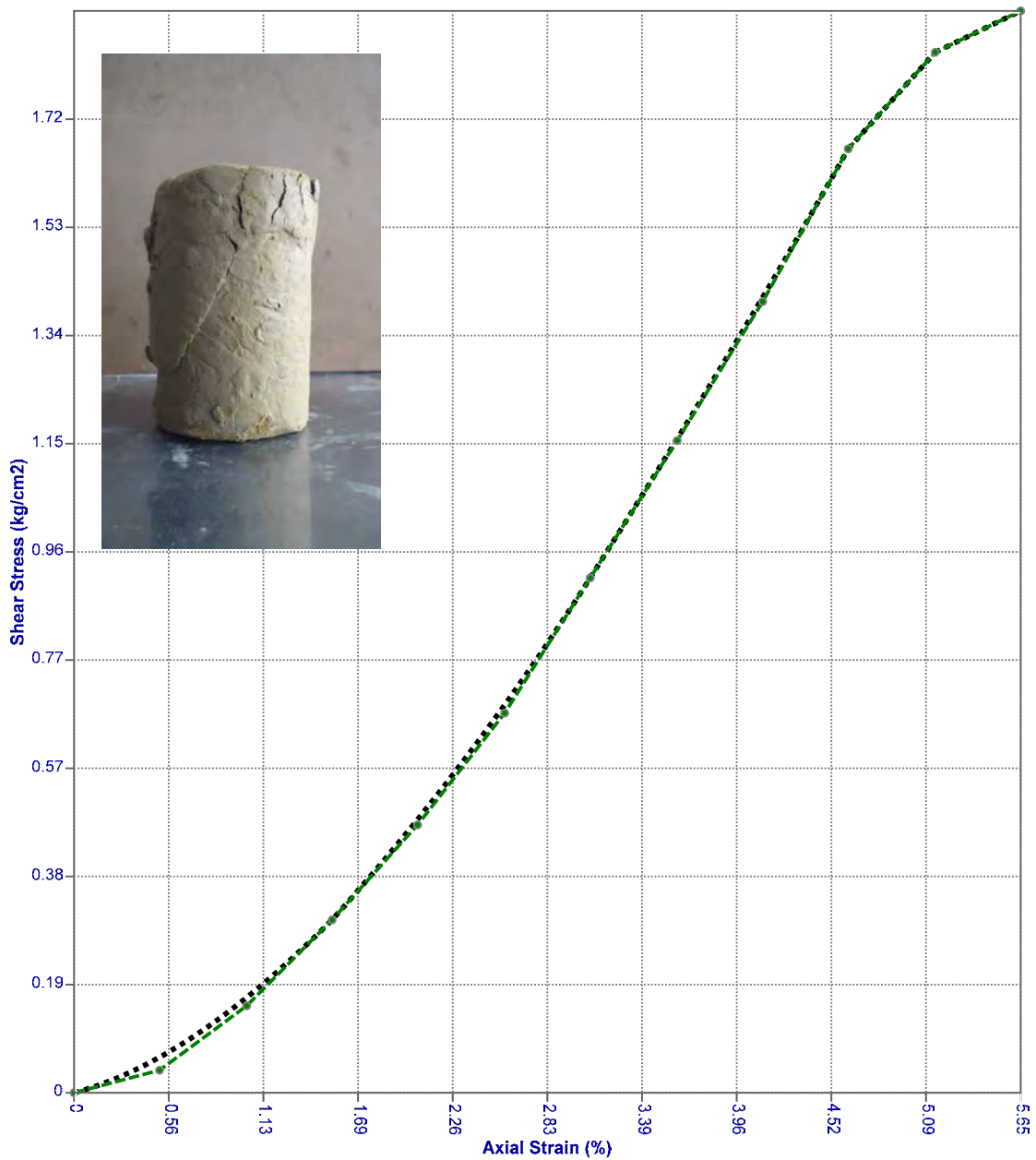
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (ka/cm ²)	Cu (kg/cm ²)
6.137	9.734	1	Moist	16.42	1.81	1.91	0.96



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 22.3 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

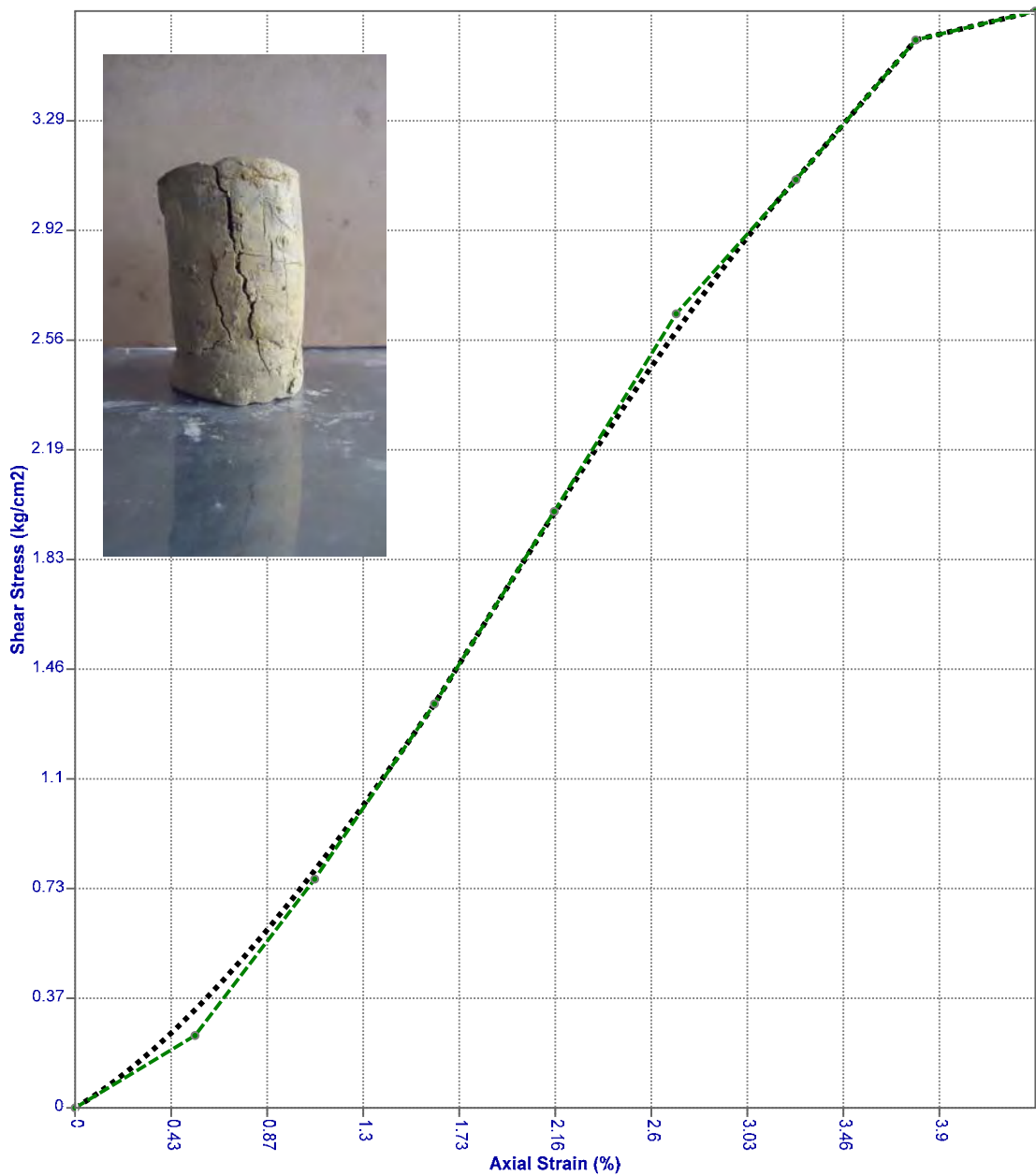
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.421	9.238	1	Moist	20.43	1.76	3.66	1.83



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 27.3 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

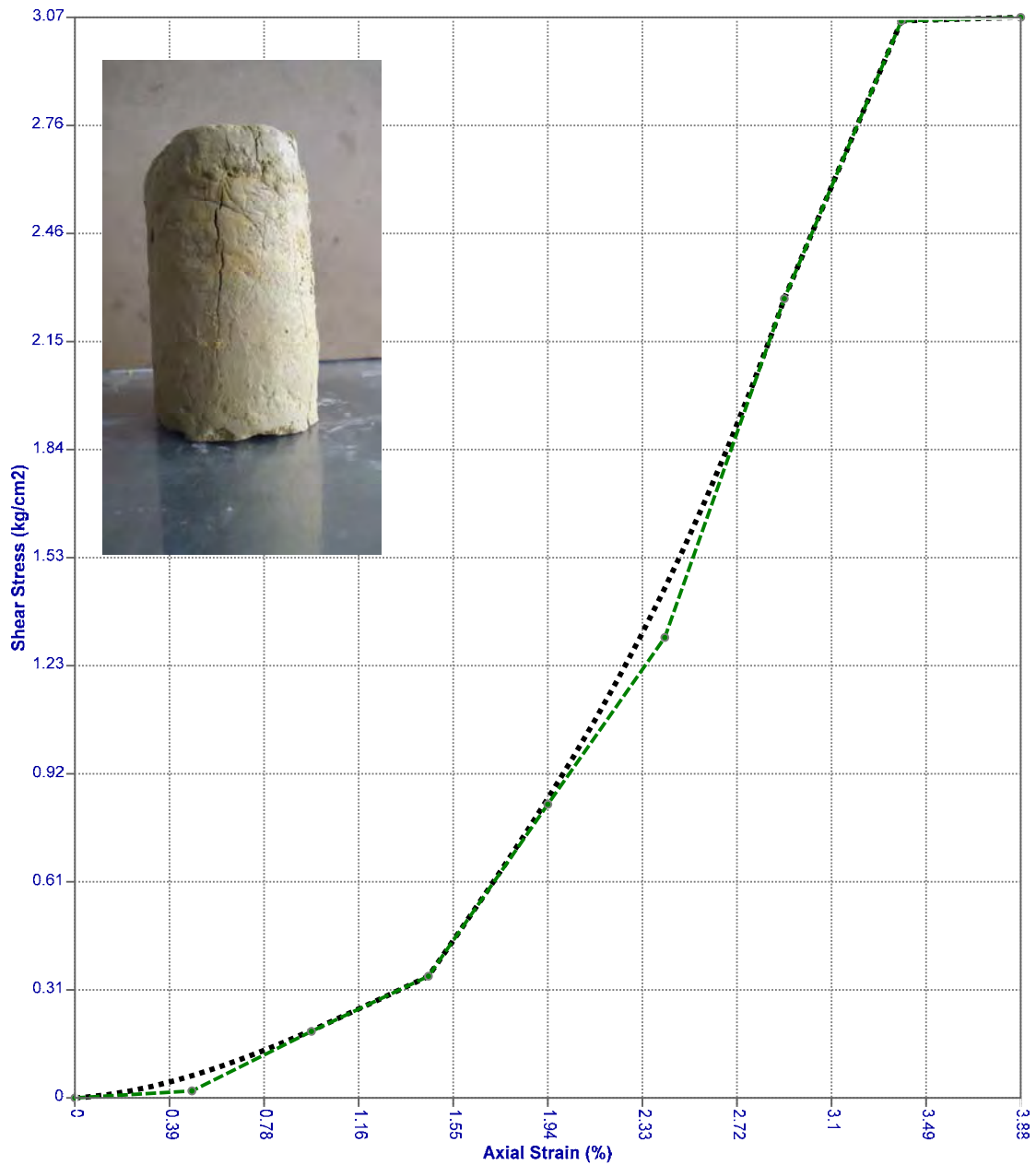
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.225	10.31	1	Moist	19.8	1.77	3.07	1.54



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-2(B)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.5 (m)



Job No.: K15-1185-101

Rock Name : Claystone

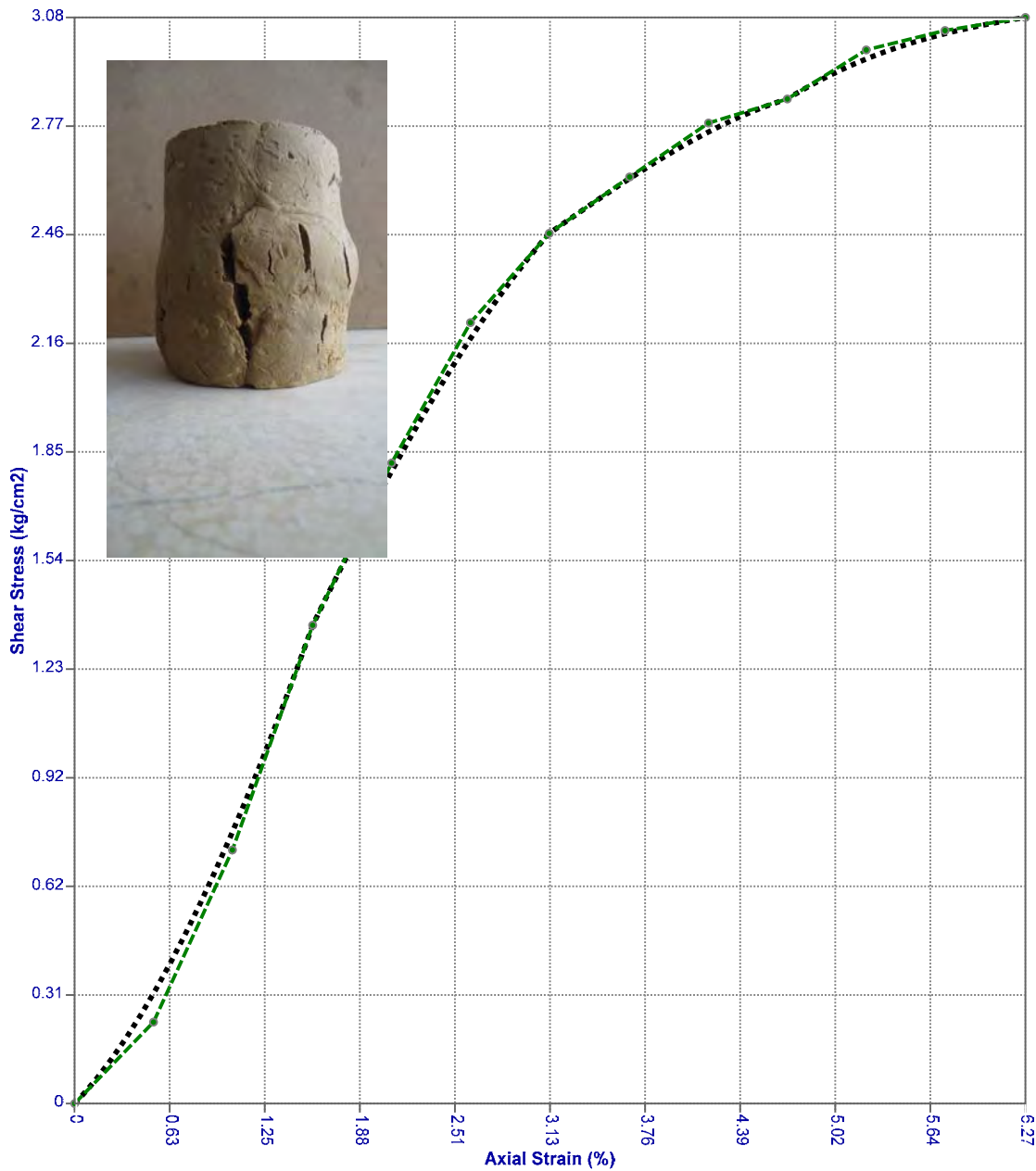
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.618	9.574	1	Moist	17.06	1.78	3.08	1.54



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-3(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.53 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

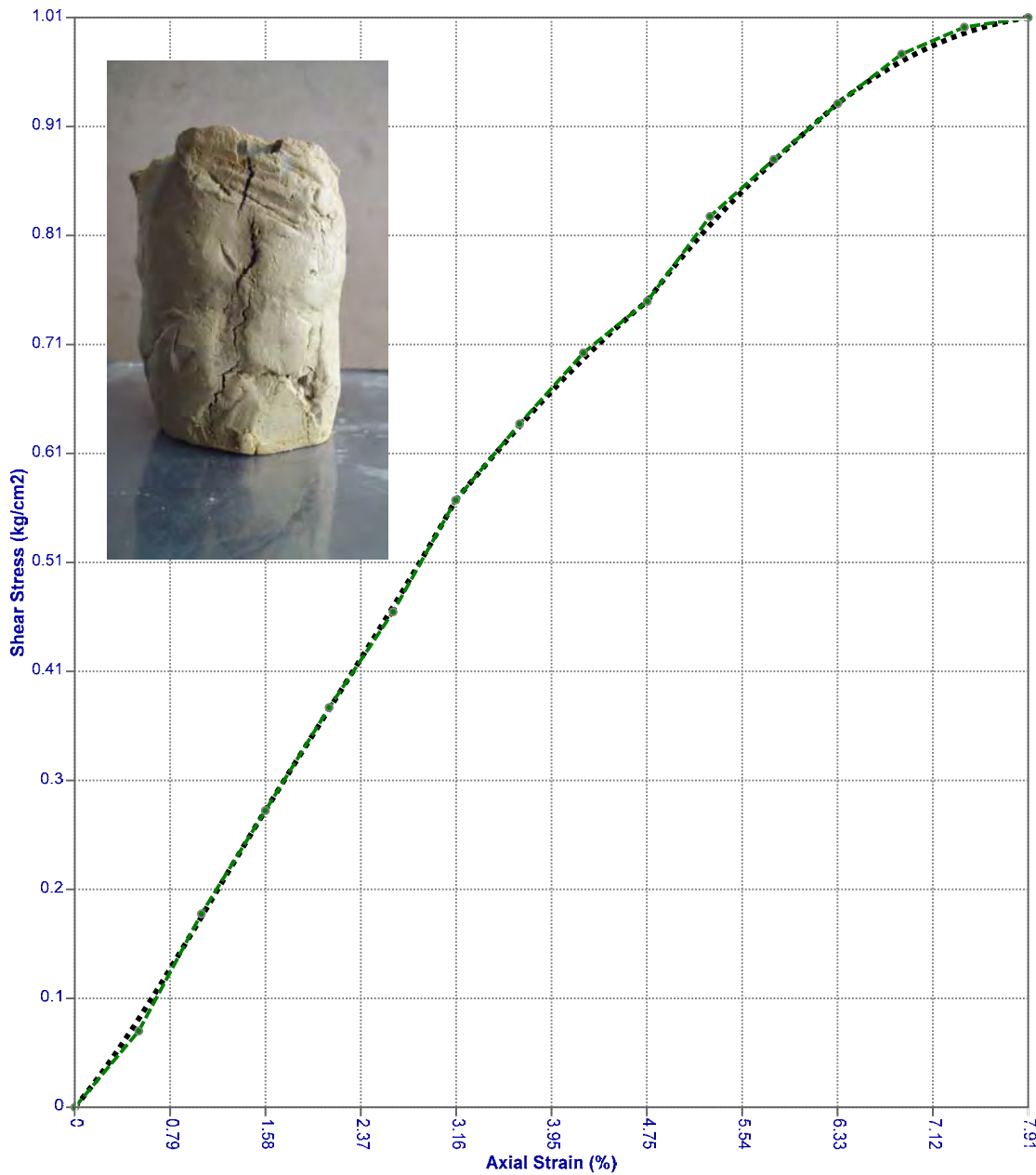
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (ka/cm ²)	Cu (kg/cm ²)
6.8	9.482	1	Moist	18.93	1.6	1.01	0.5



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-3(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 16.5 (m)



Job No.: K15-1185-101

Rock Name : Shale

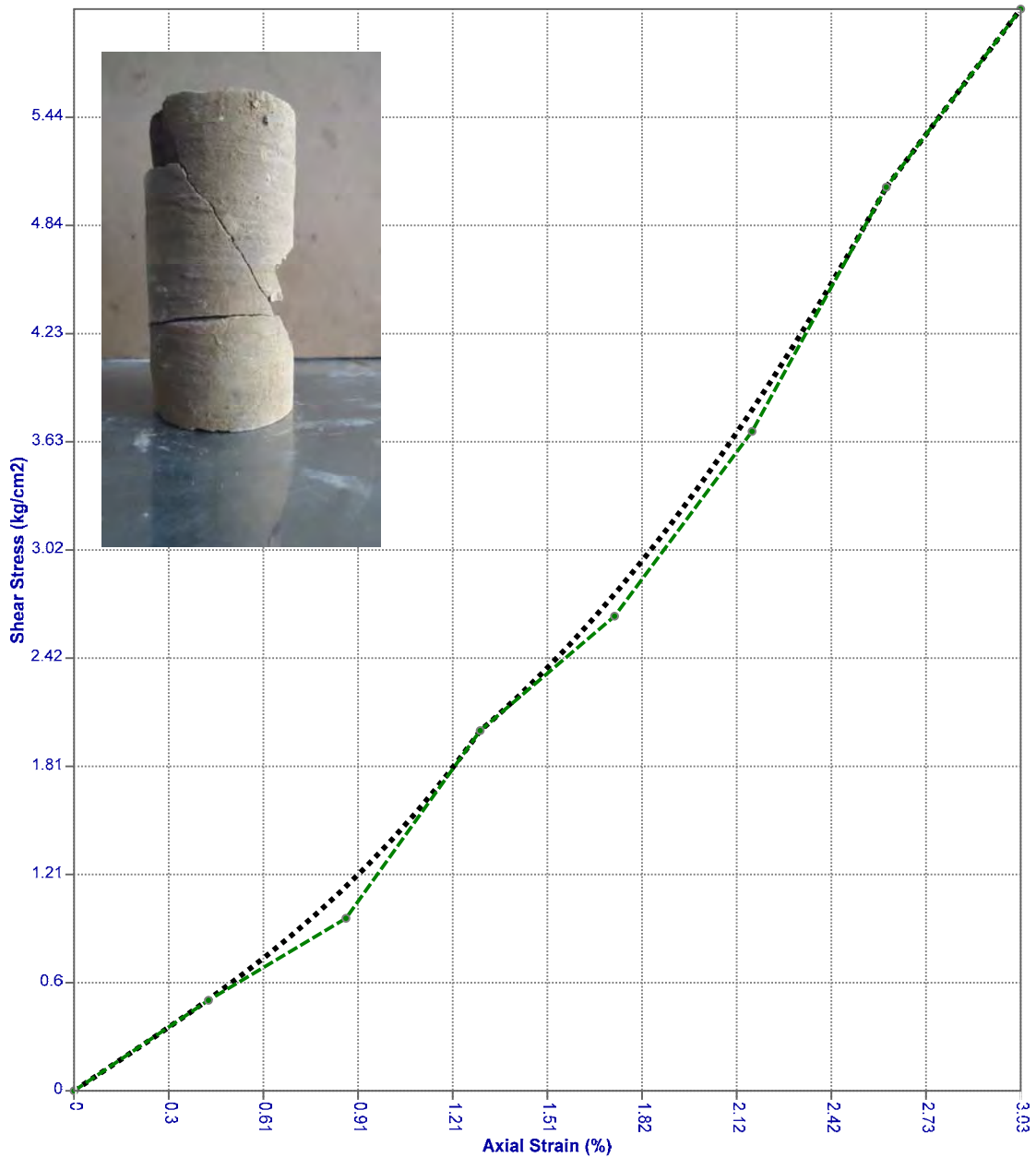
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.922	11.539	1	Moist	13.4	1.93	6.05	3.02



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-3(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 19.5 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

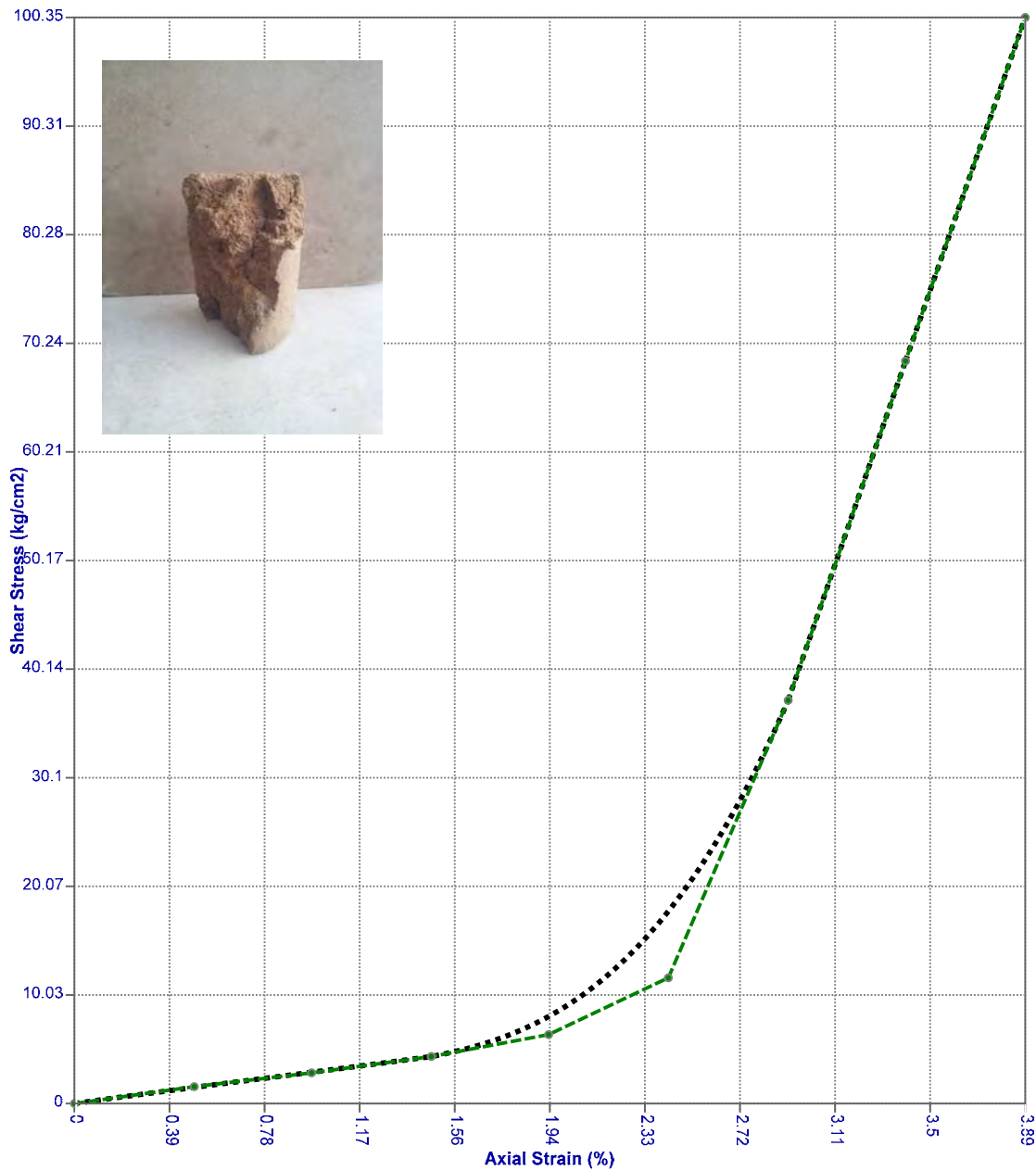
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
6.191	10.287	1	Moist	9.09	2.26	100.35	50.18



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-3(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 22.8 (m)



Job No.: K15-1185-101

Rock Name : Shale

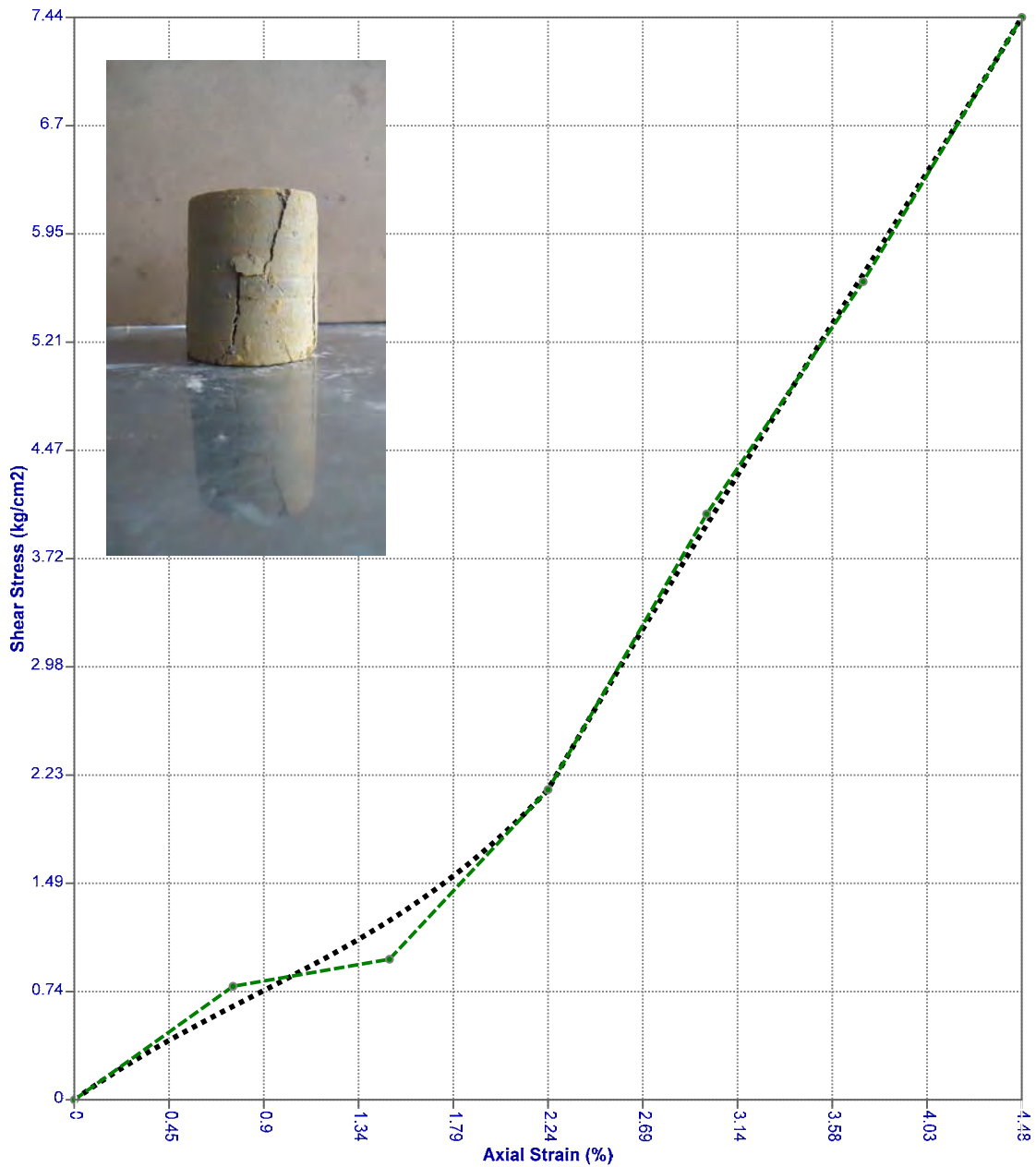
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.369	6.7	1	Moist	19.96	1.78	7.44	3.72



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-3(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 27.5 (m)



Job No.: K15-1185-101

Rock Name : Shale

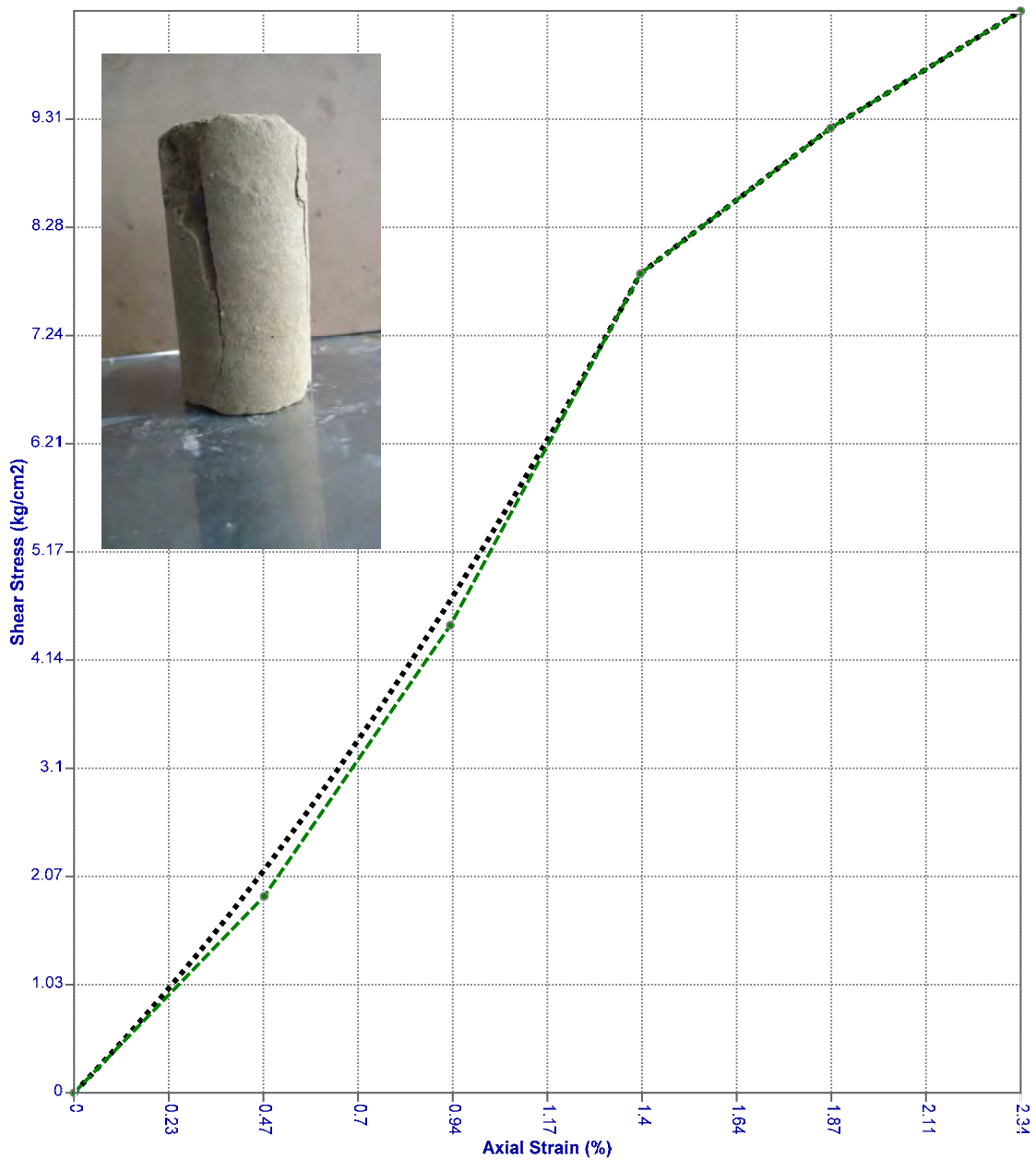
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
5.641	10.696	1	Moist	12.34	1.76	10.35	5.18



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-4(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.5 (m)



Job No.: K15-1185-101

Rock Name : Shale

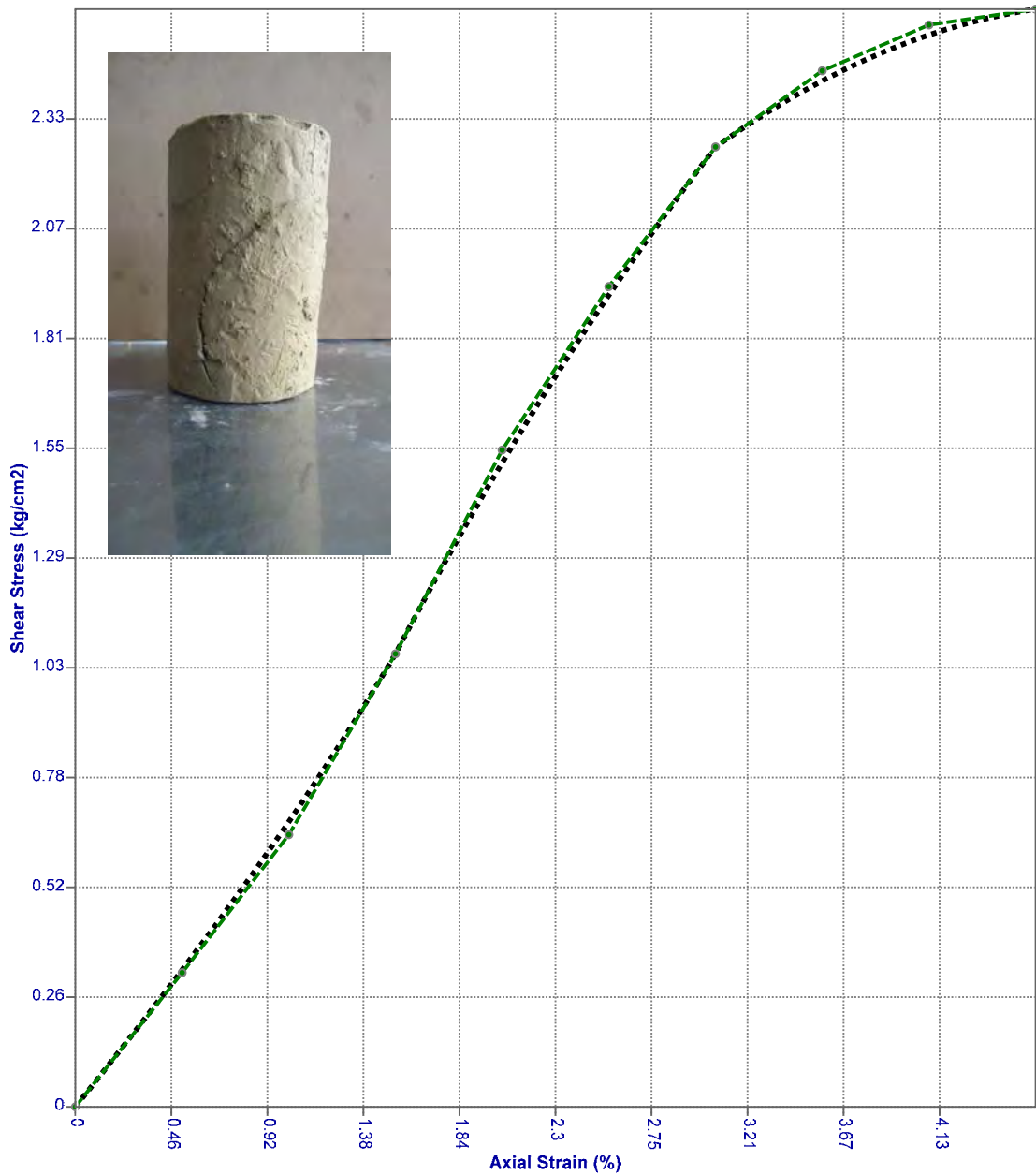
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.208	9.813	1	Moist	15.15	1.75	2.59	1.3



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-4(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 18.5 (m)



Job No.: K15-1185-101

Rock Name : Shale

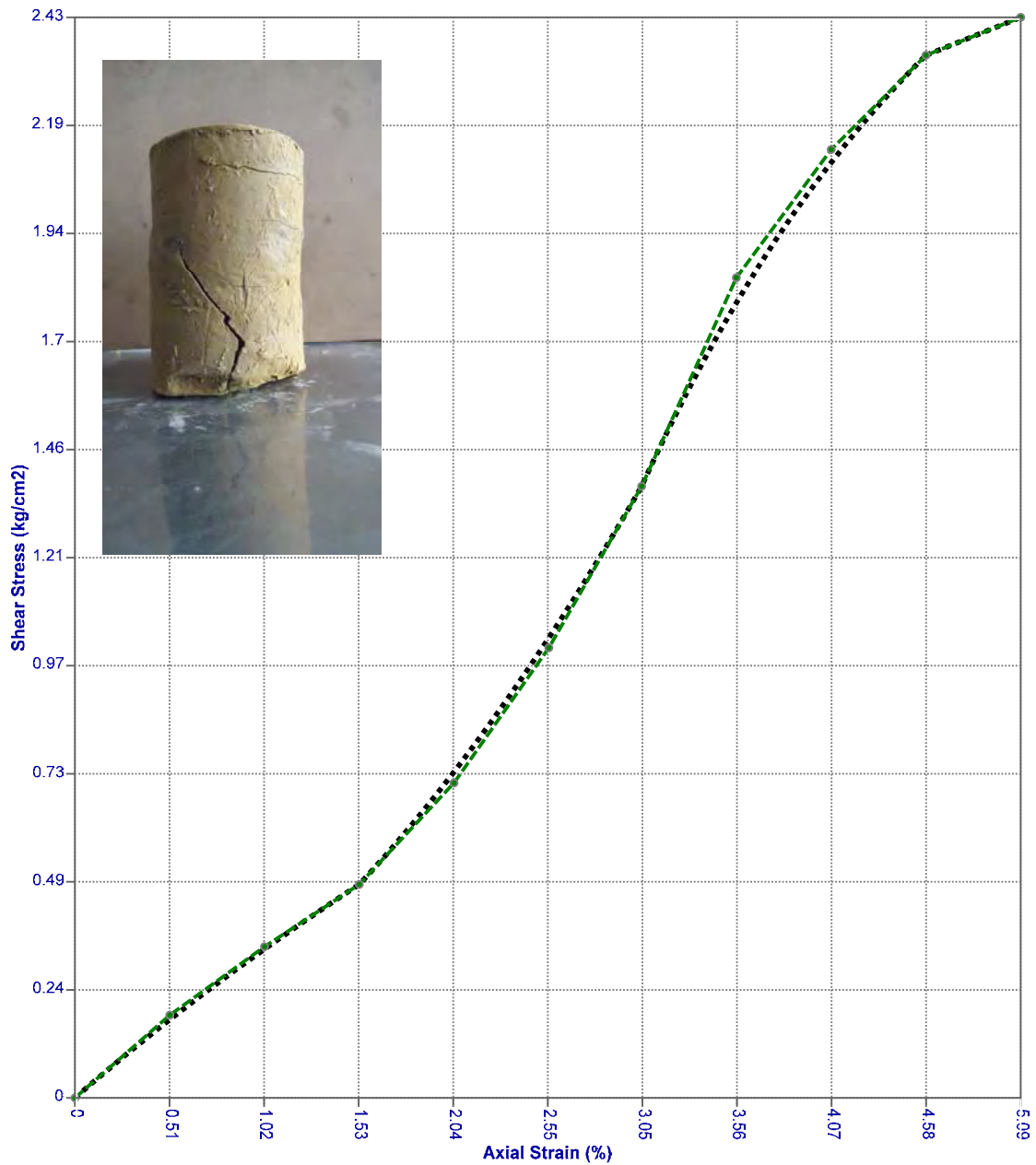
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.503	9.821	1	Moist	18.54	1.75	2.43	1.22



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-4(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 22.57 (m)



Job No.: K15-1185-101

Rock Name : Shale

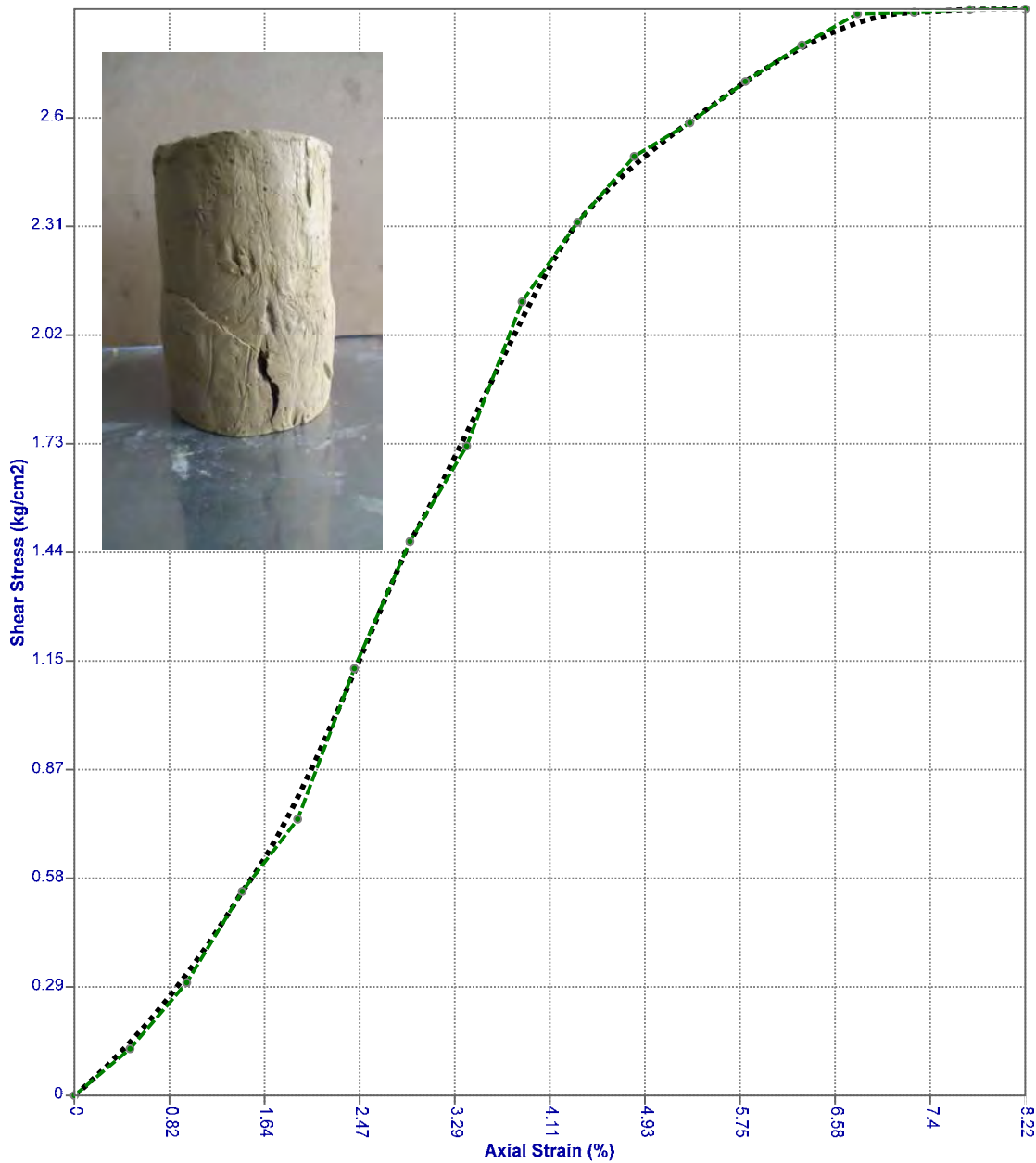
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (ka/cm ²)	Cu (kg/cm ²)
6.546	10.336	1	Moist	18.64	1.75	2.88	1.44



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-5

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.2 (m)



Job No.: K15-1185-101

Rock Name : Shale

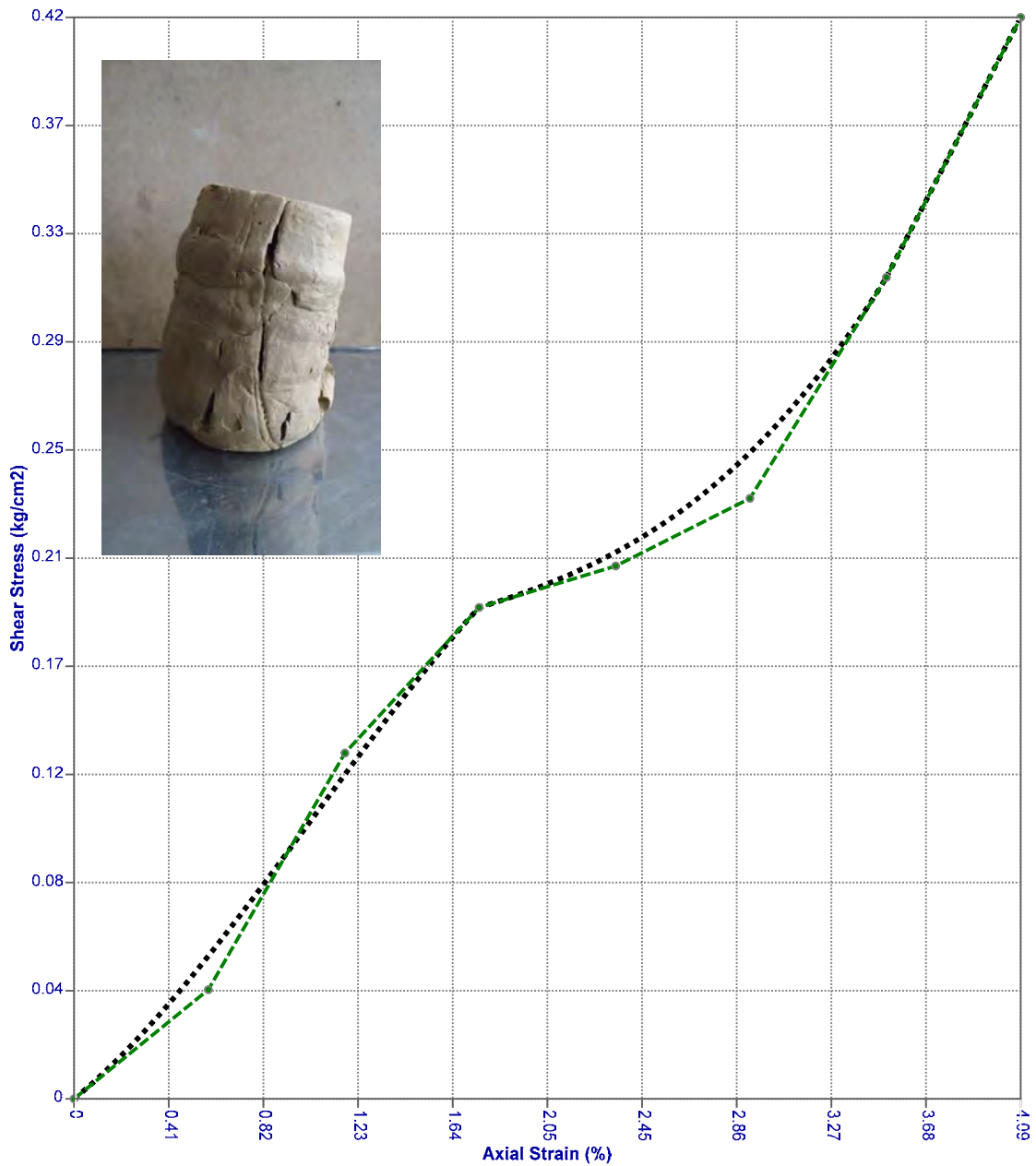
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.985	8.548	1	Moist	21.86	1.66	0.42	0.21



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-5(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 21.2 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

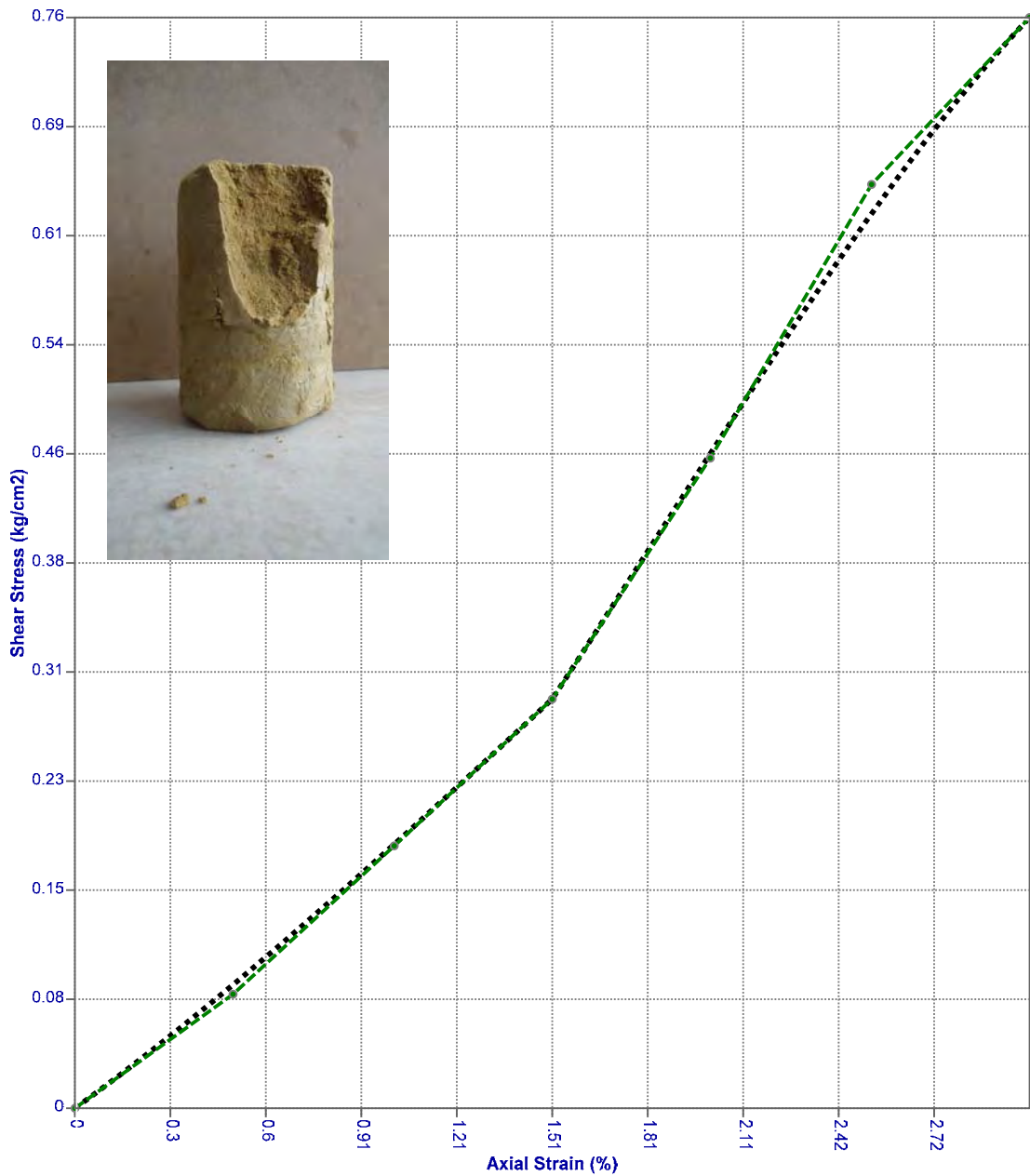
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.404	9.94	1	Moist	15.78	1.72	0.76	0.38



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-5(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 28.5 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

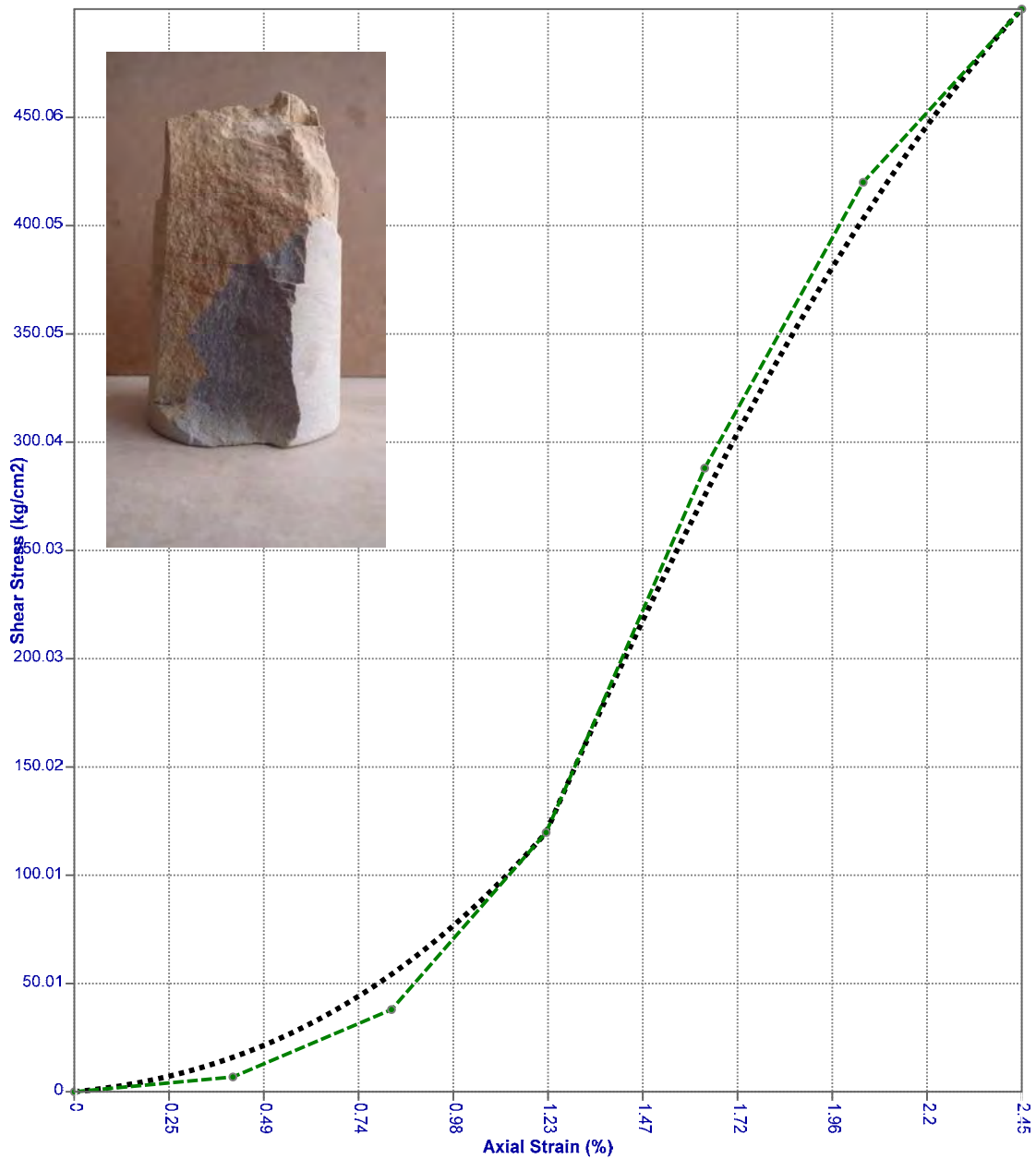
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.104	12.249	1	Moist	1.97	2.58	500.07	250.04



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-6

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 9.3 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

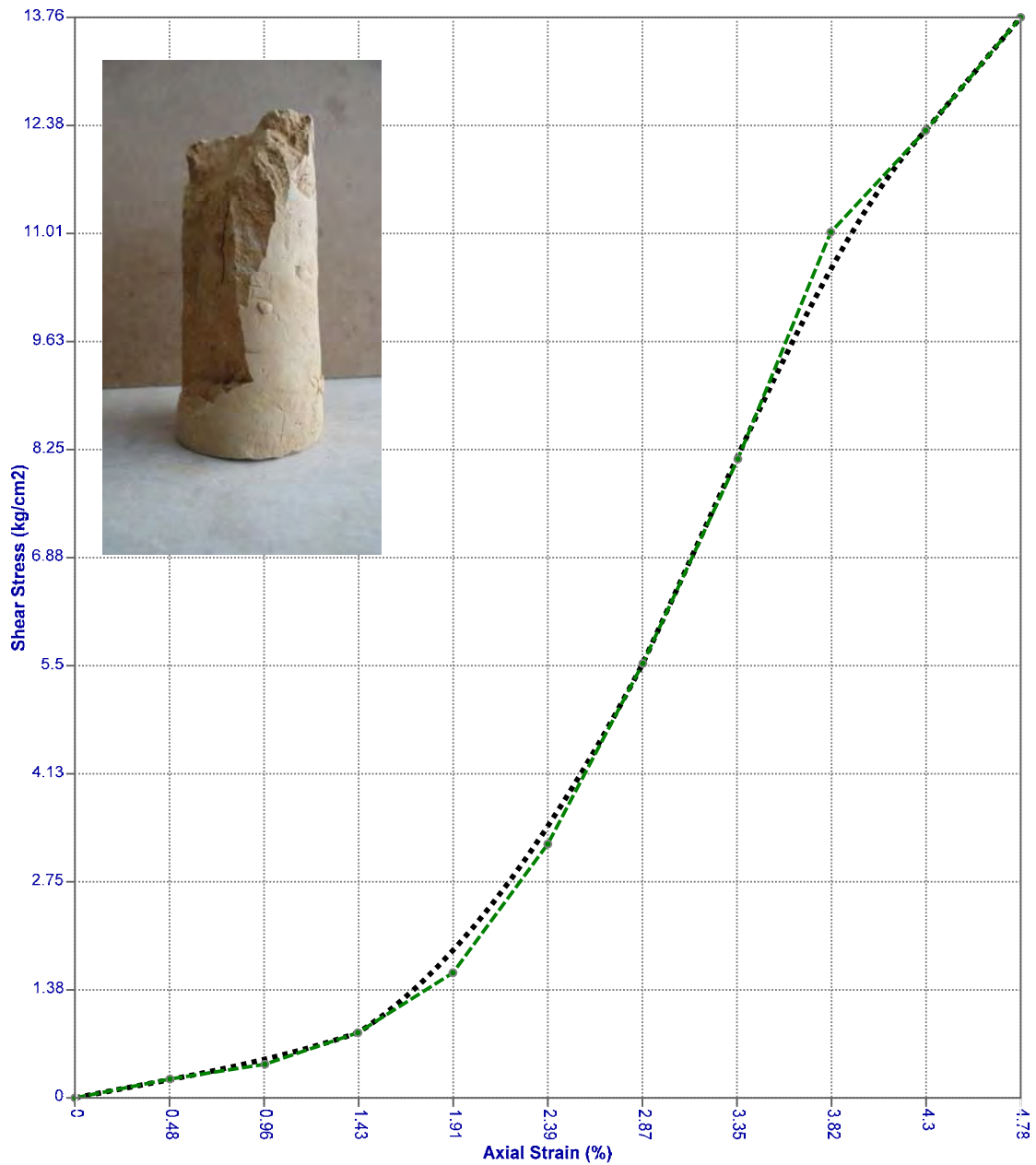
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
4.599	10.458	1	Moist	14.94	2.5	13.76	6.88



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-6

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.3 (m)



Job No.: K15-1185-101

Rock Name : Claystone

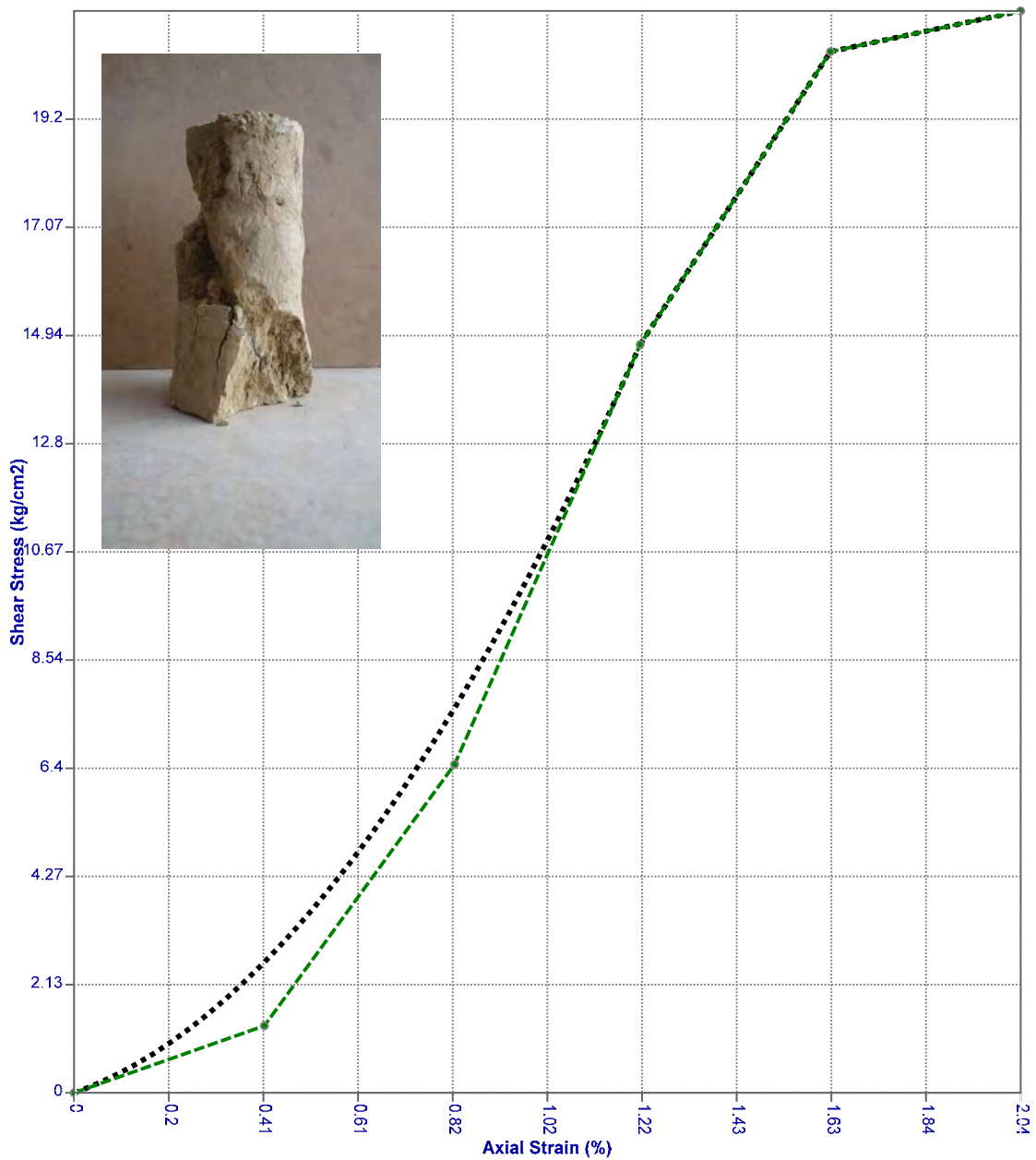
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.708	12.259	1	Moist	13.68	1.86	21.34	10.67



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-6(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.5 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

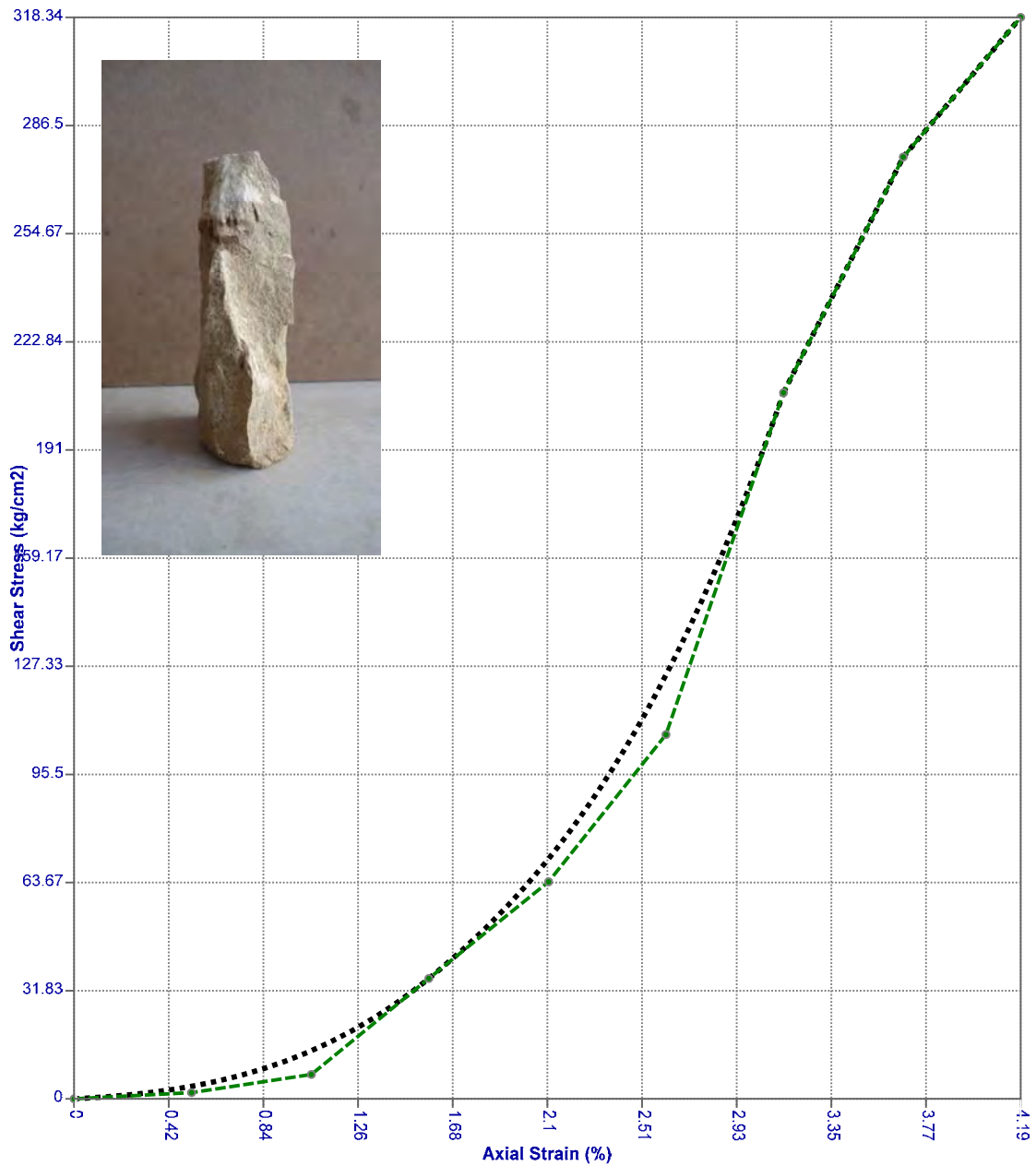
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.902	9.543	1	Moist	3.5	2.53	318.34	159.17



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-6(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 18.5 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

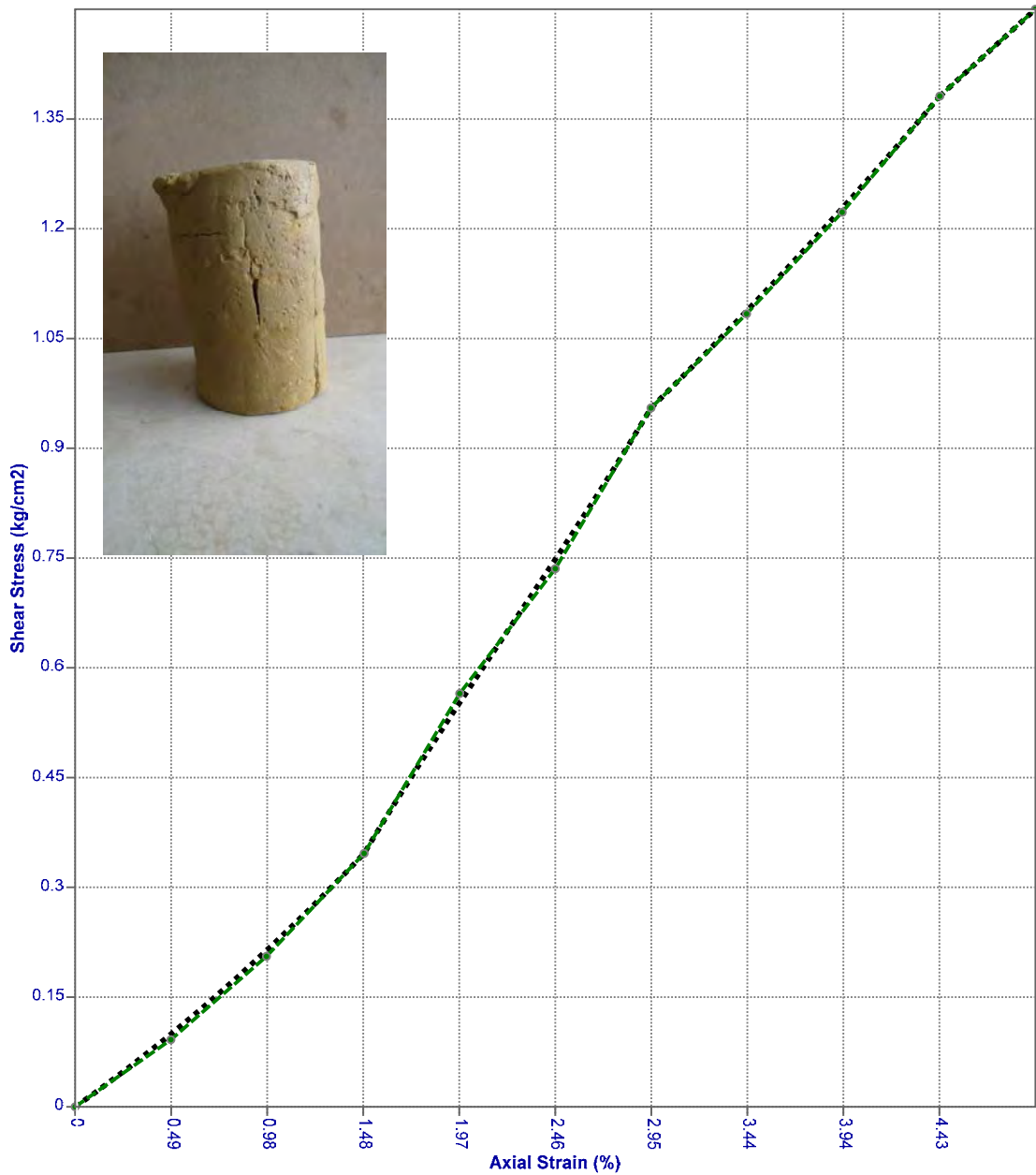
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.644	10.169	1	Moist	19.82	1.6	1.5	0.75



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Borehole : BH-6(B)
 Sample Depth : 13.8 (m)
 Rock Name : Sandstone
 Sample Type : Undisturbed

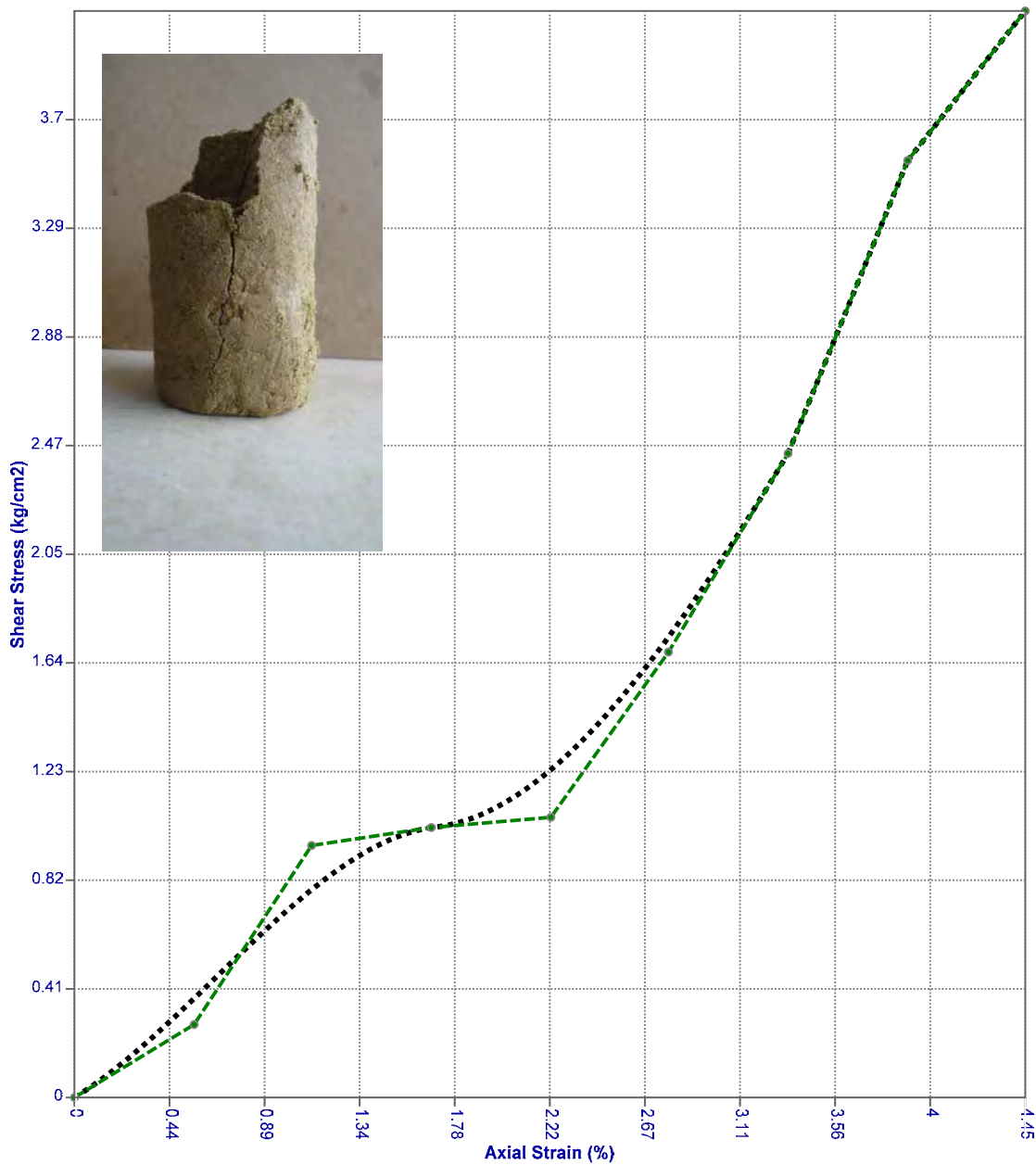
Soil Testing Services



ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.242	8.982	1	Moist	16.71	1.88	4.11	2.06



Unified Description :
 AASHTO Description :

Tested By :
 HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-7

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.56 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

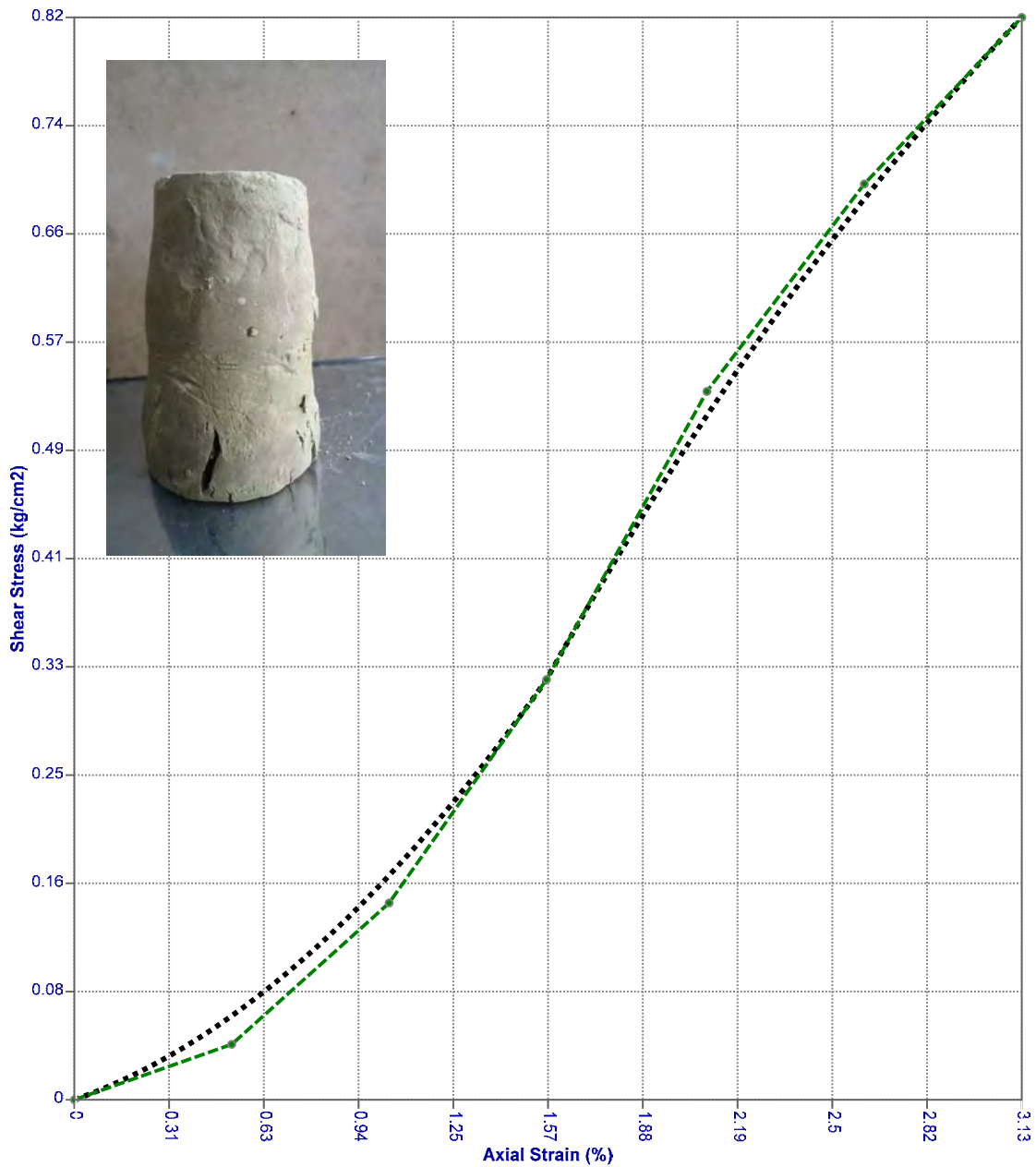
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.025	9.586	1	Moist	19.64	2.01	0.82	0.41



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-7(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.10 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

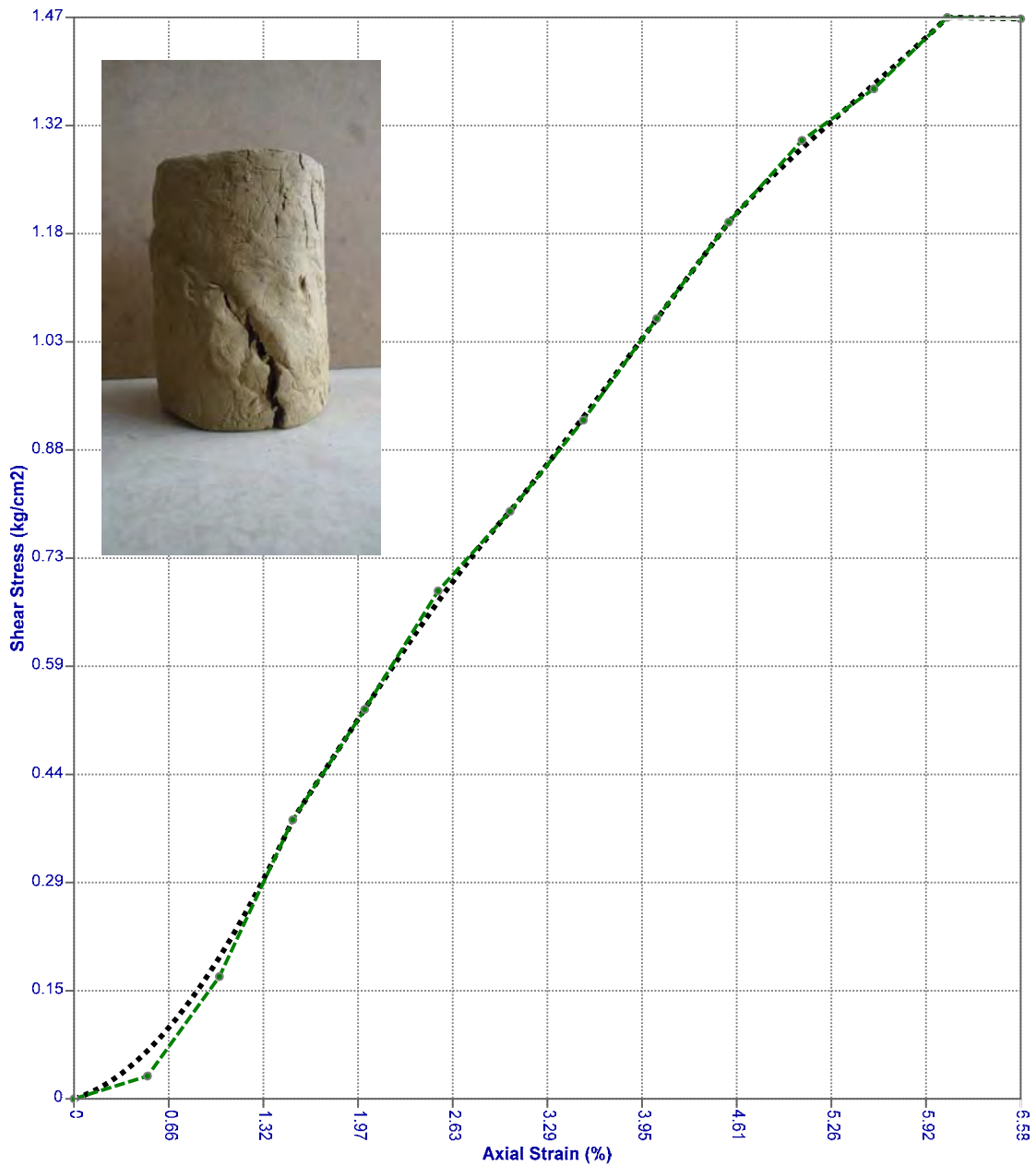
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.405	9.885	1	Moist	17.91	1.77	1.47	0.74



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-7(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 17.0 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

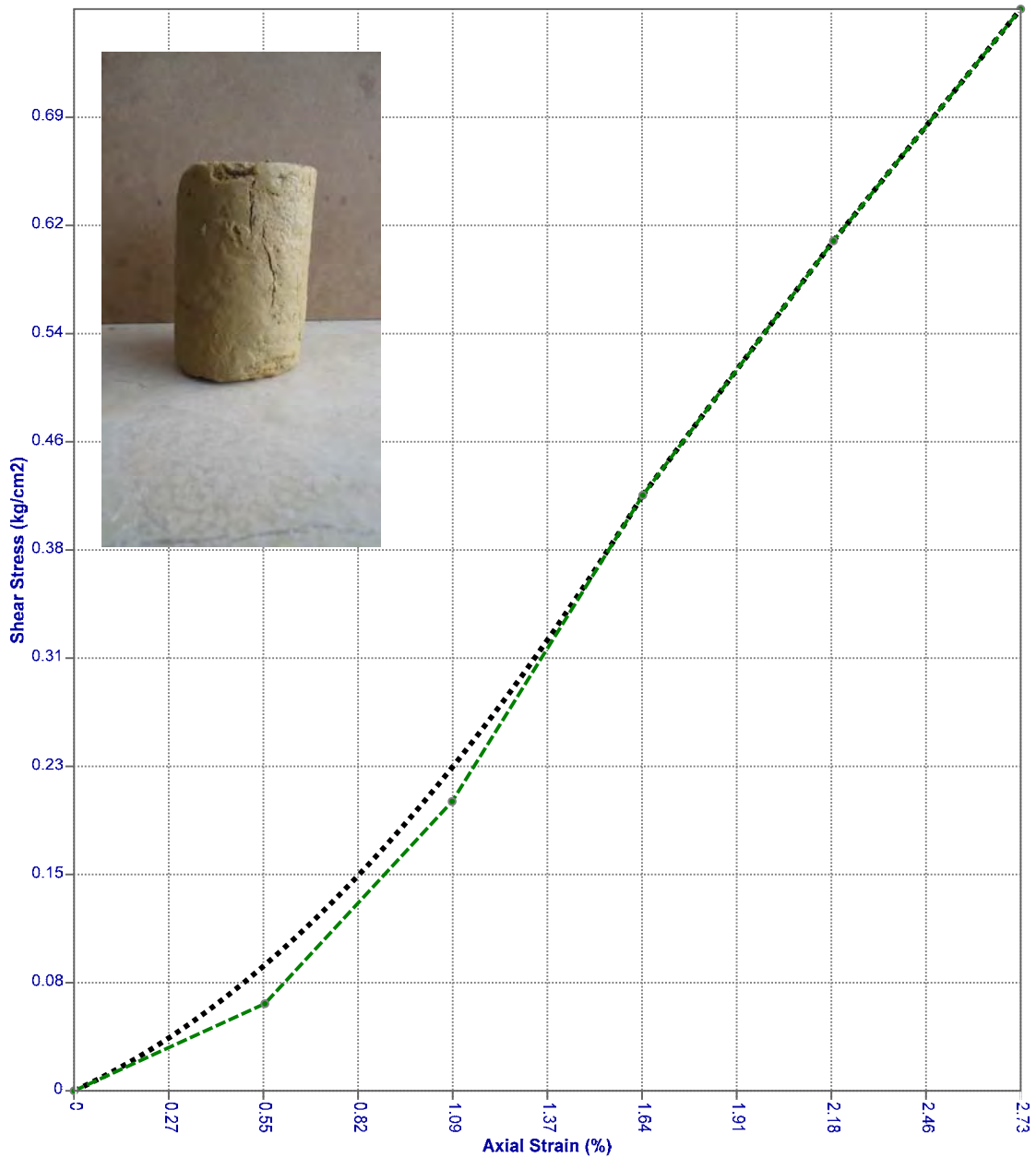
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.054	9.149	1	Moist	19.05	1.67	0.77	0.38



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-7(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 27.10 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

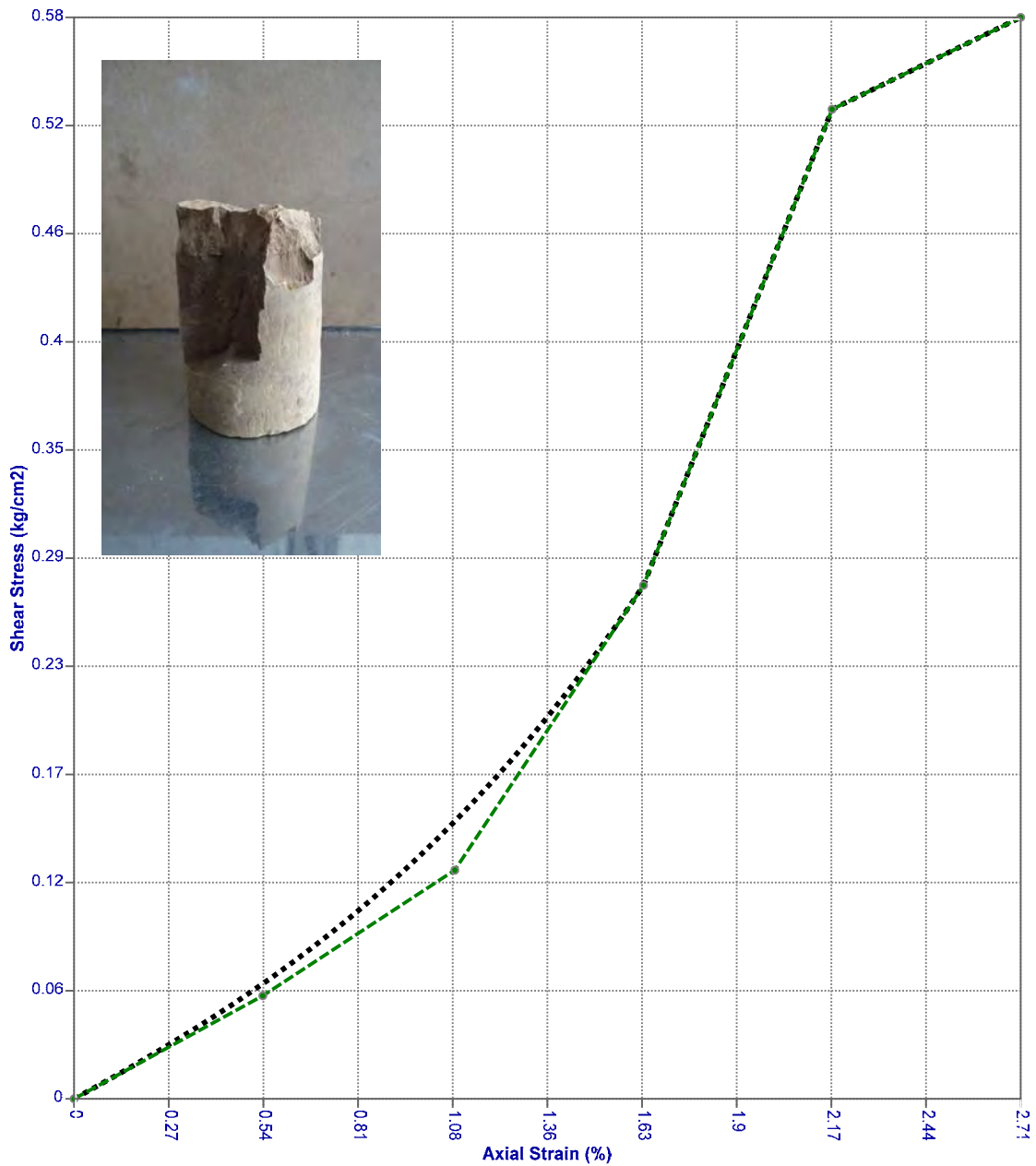
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.588	9.215	1	Moist	9.28	1.54	0.58	0.29



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Borehole : BH-8
 Sample Depth : 11 (m)
 Rock Name : Sandstone
 Sample Type : Undisturbed

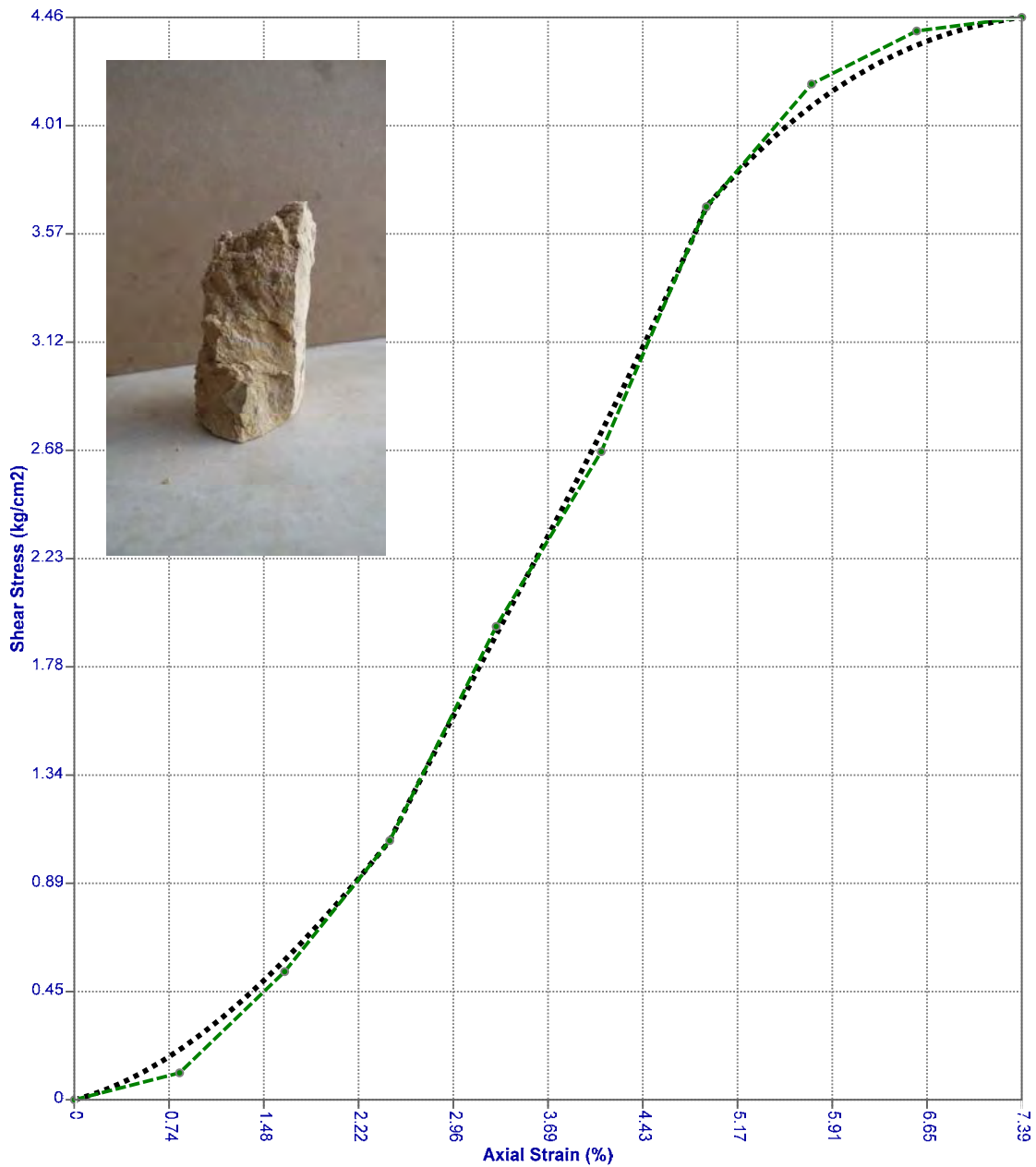
Soil Testing Services



ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
8.654	6.087	1	Moist	10.68	1.15	4.46	2.23



Unified Description :
 AASHTO Description :

Tested By :
 AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-8

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.9 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

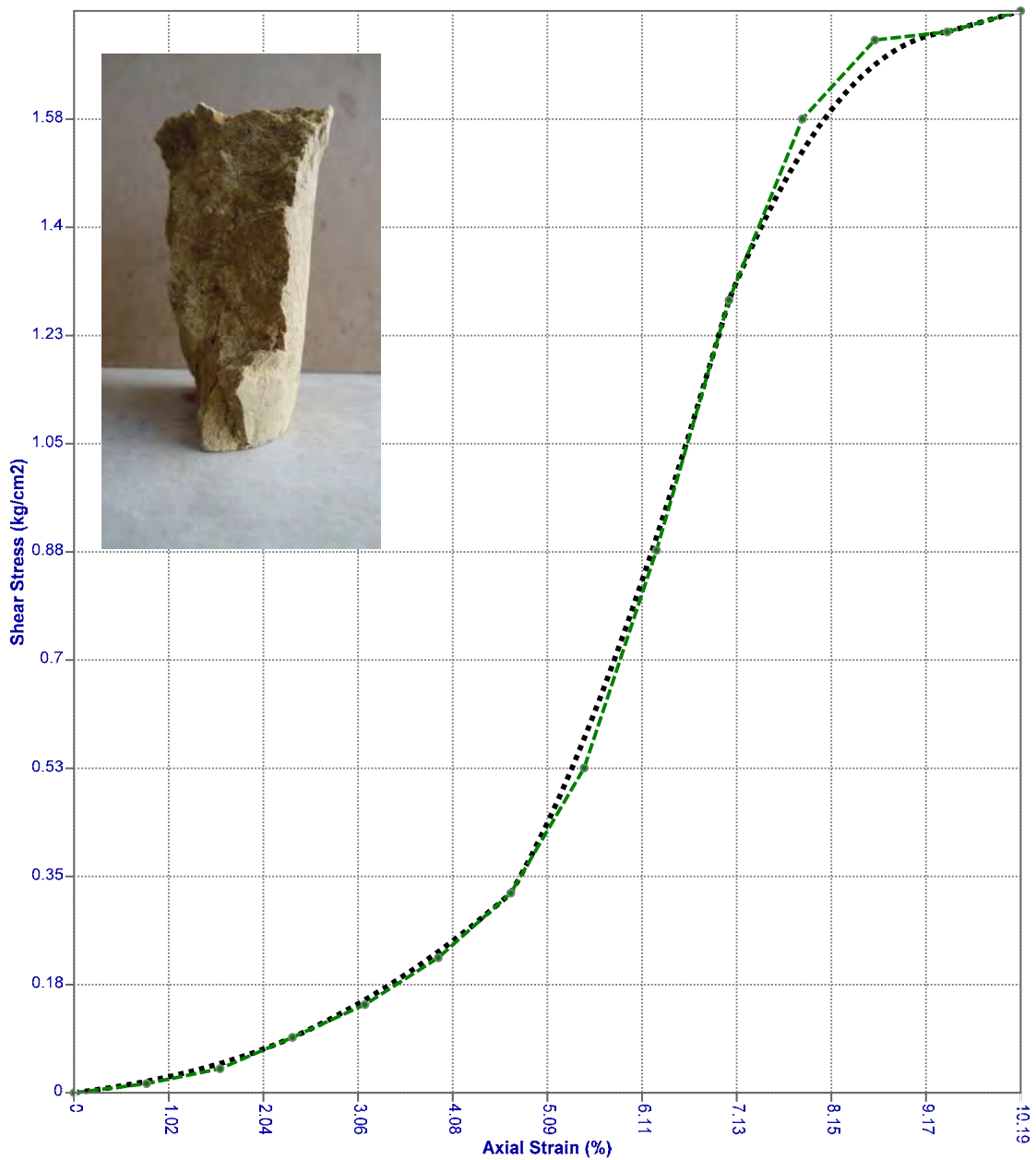
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
10.088	6.381	1	Moist	7.23	1.17	1.75	0.88



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-8(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.8 (m)



Job No.: K15-1185-101

Classification : ML

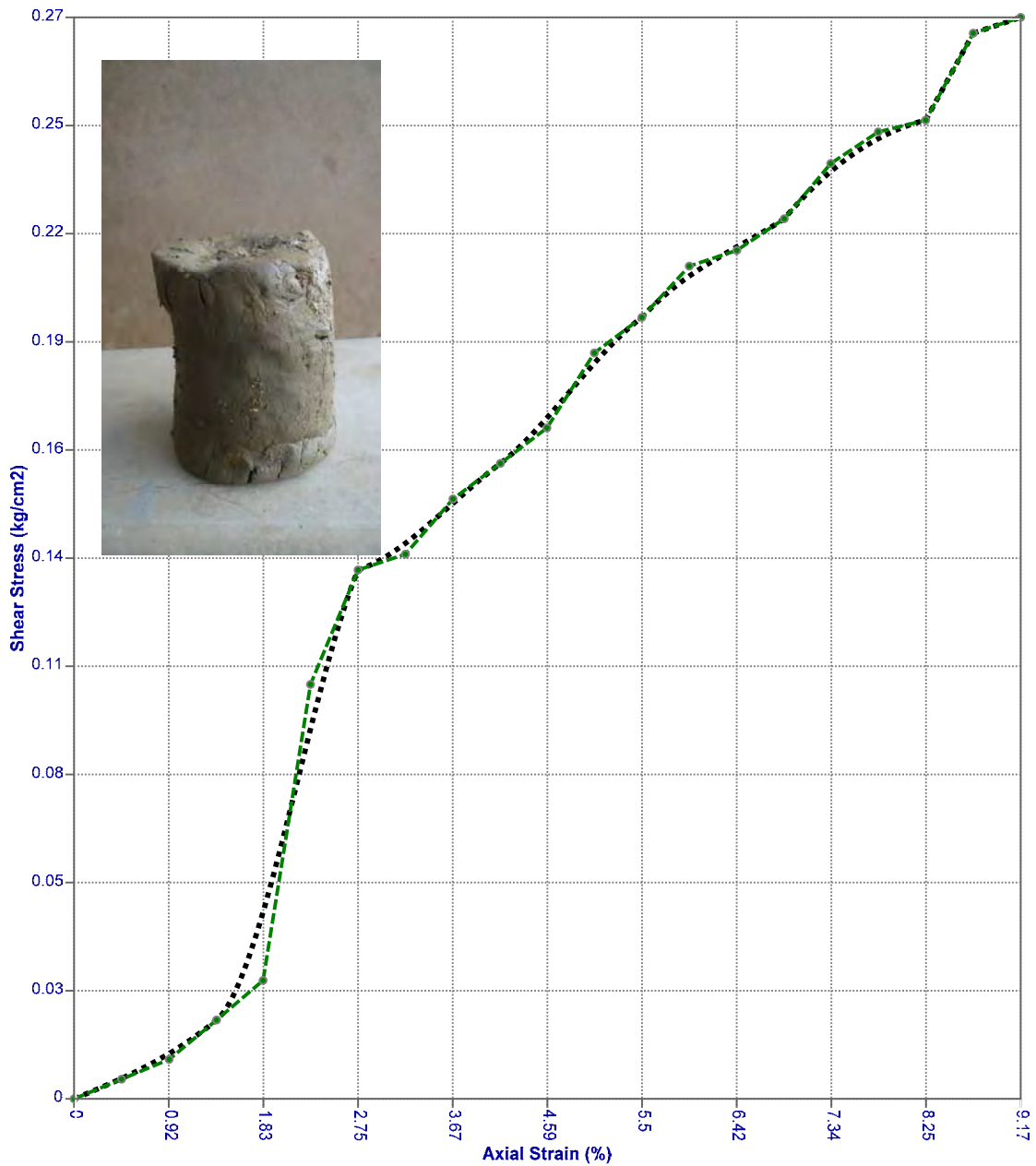
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
7.063	10.907	1	Moist	22.04	1.64	0.27	0.14



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-8(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.5 (m)



Job No.: K15-1185-101

Rock Name : Claystone

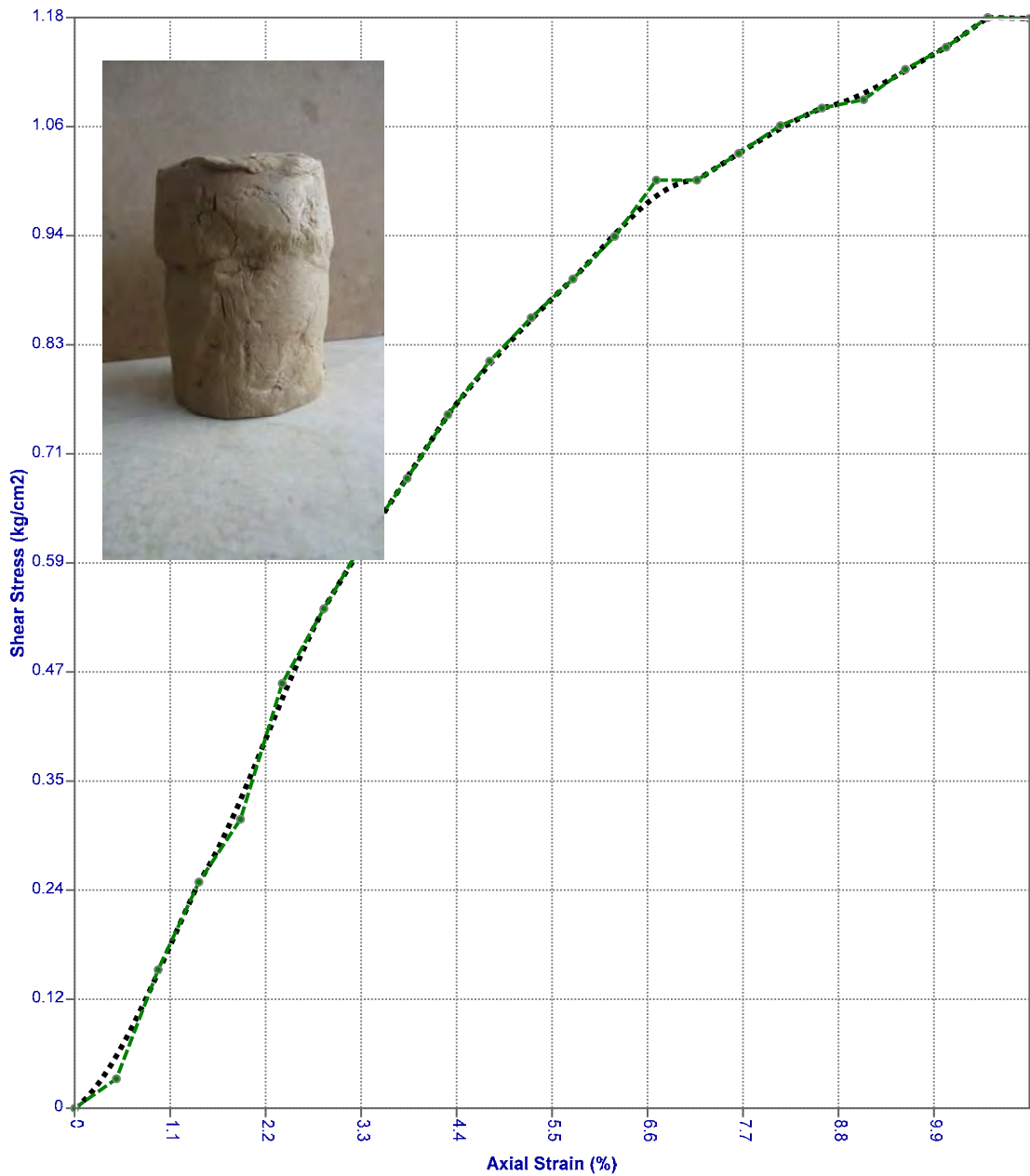
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.86	10.454	1	Moist	13.01	1.77	1.18	0.59



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-8(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 21.0 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

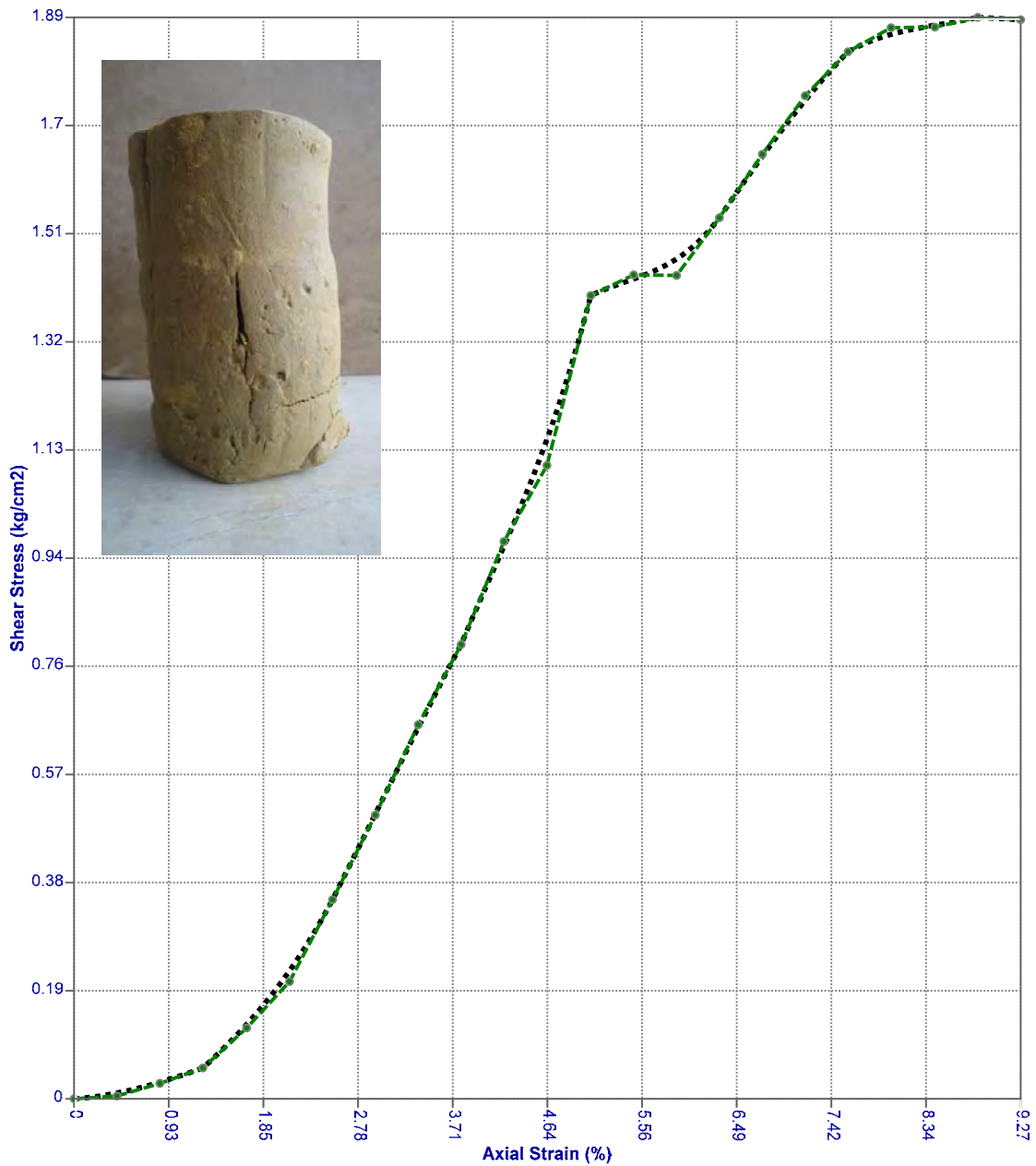
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.805	11.868	1	Moist	17.03	1.74	1.89	0.94



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-8(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 26.5 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

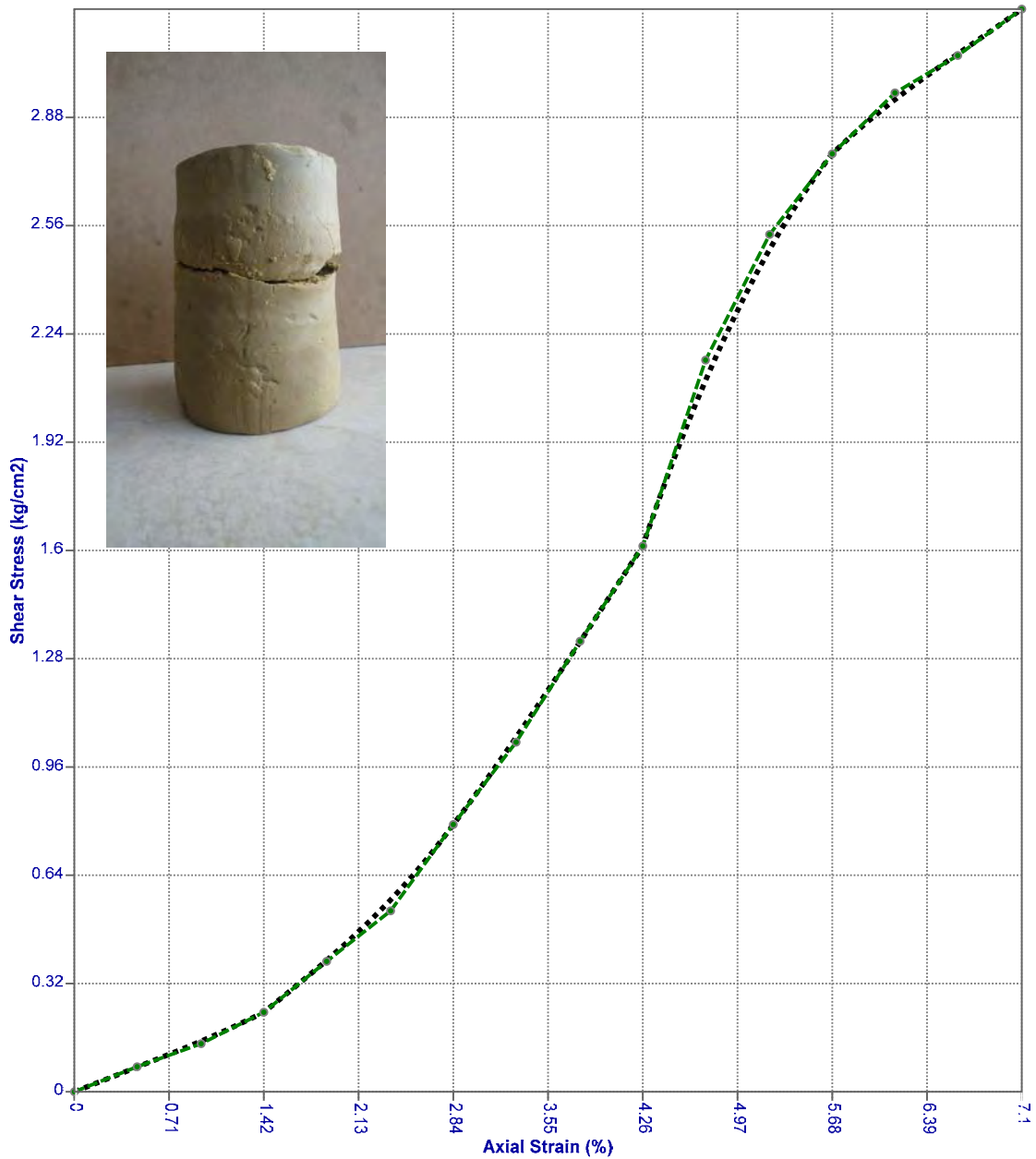
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
6.926	10.5663	1	Moist	14.94	1.73	3.2	1.6



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-8(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 28.8 (m)



Job No.: K15-1185-101

Rock Name : 29.5m

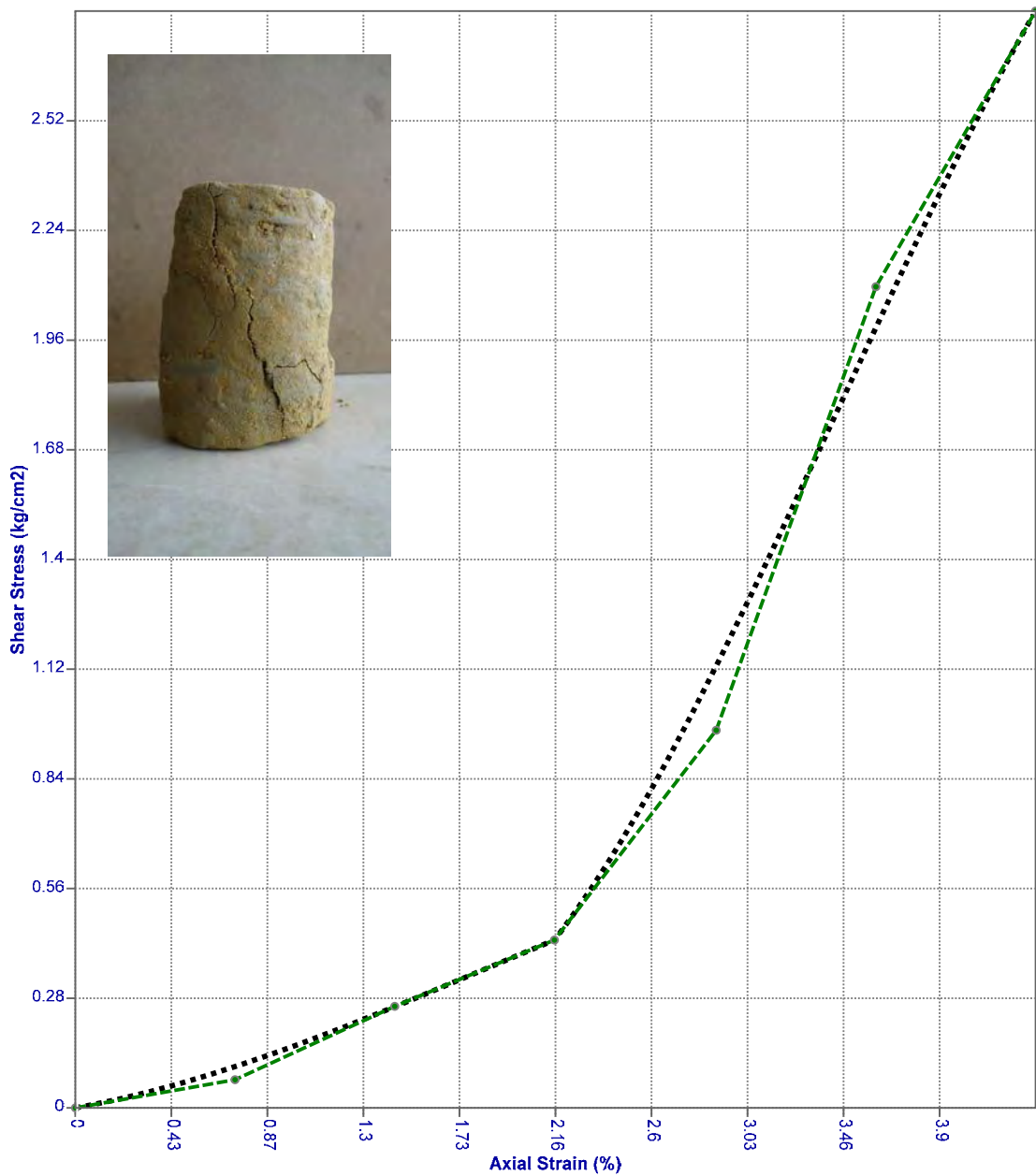
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
5.91	6.931	1	Moist	13.19	1.76	2.8	1.4



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-09(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.5 (m)



Job No.: K15-1185-101

Classification : CL

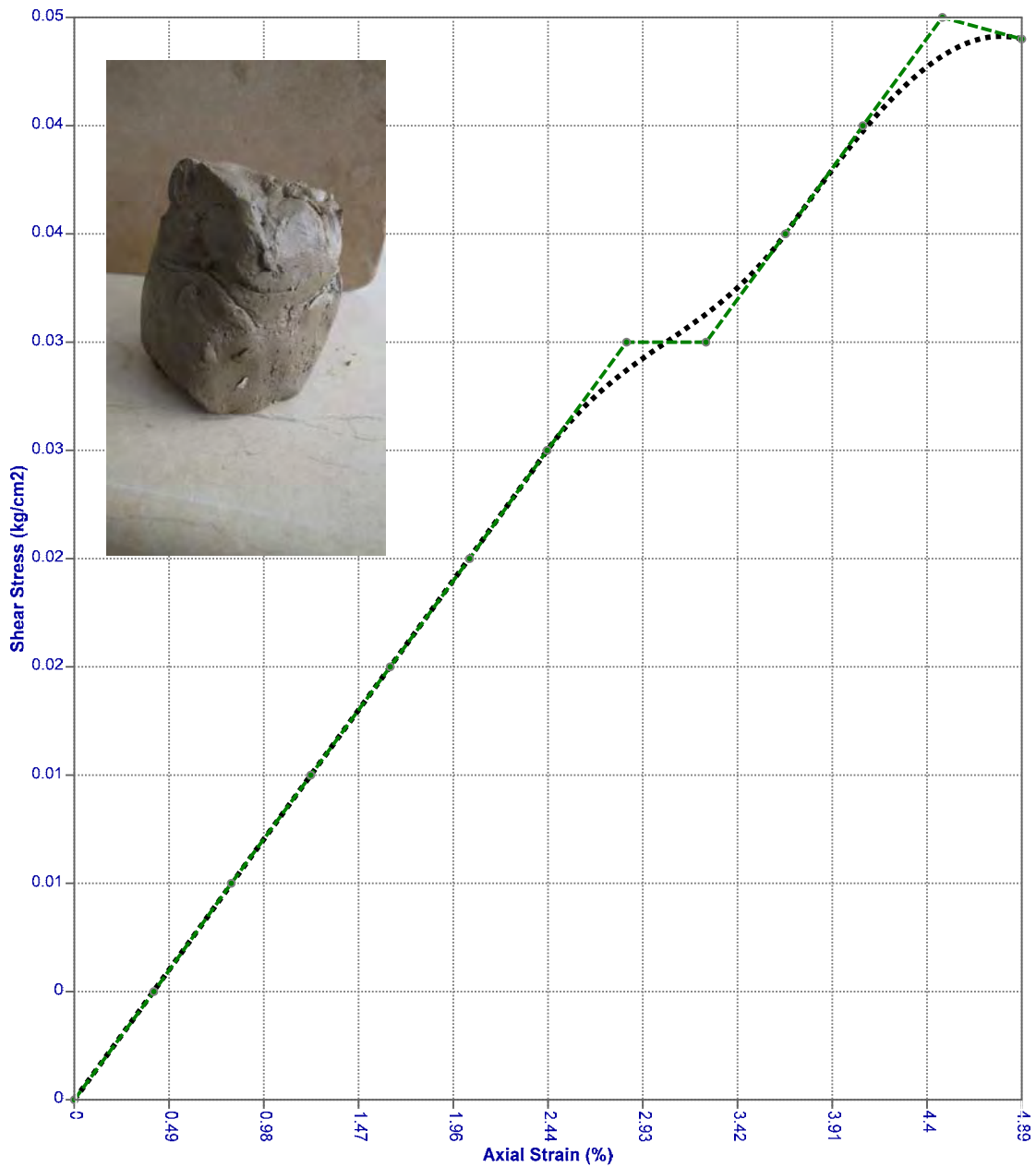
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	C_u (kg/cm ²)
6.996	12.274	1	Moist	20.27	1.56	0.05	0.02



Unified Description :
AASHTO Description :

Tested By :
SDN

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-09(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 15.65 (m)



Job No.: K15-1185-101

Rock Name : Claystone

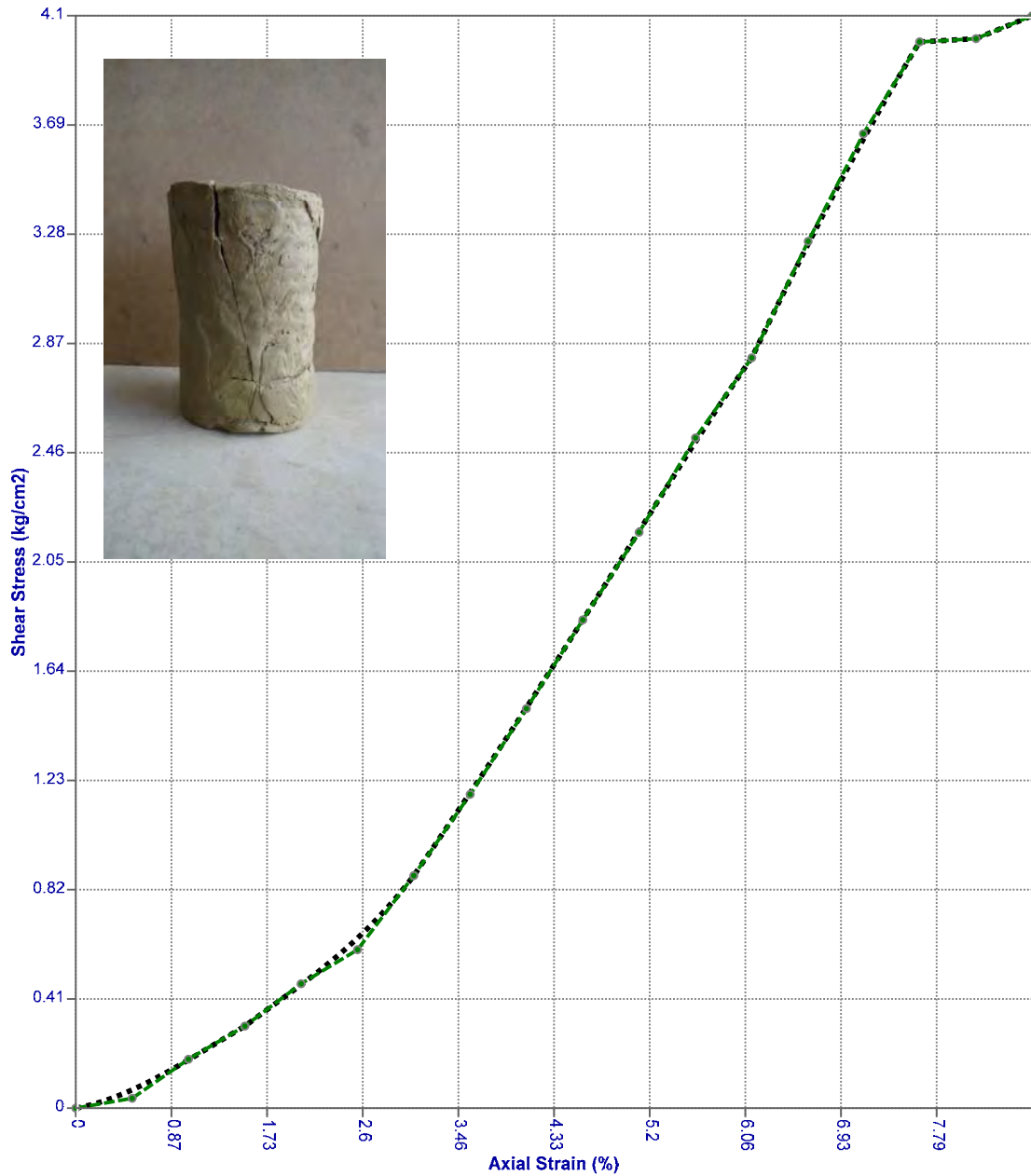
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.848	9.811	1	Moist	13.76	1.88	4.1	2.05



Unified Description :
AASHTO Description :

Tested By :
SDN

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-09(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 22.9 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

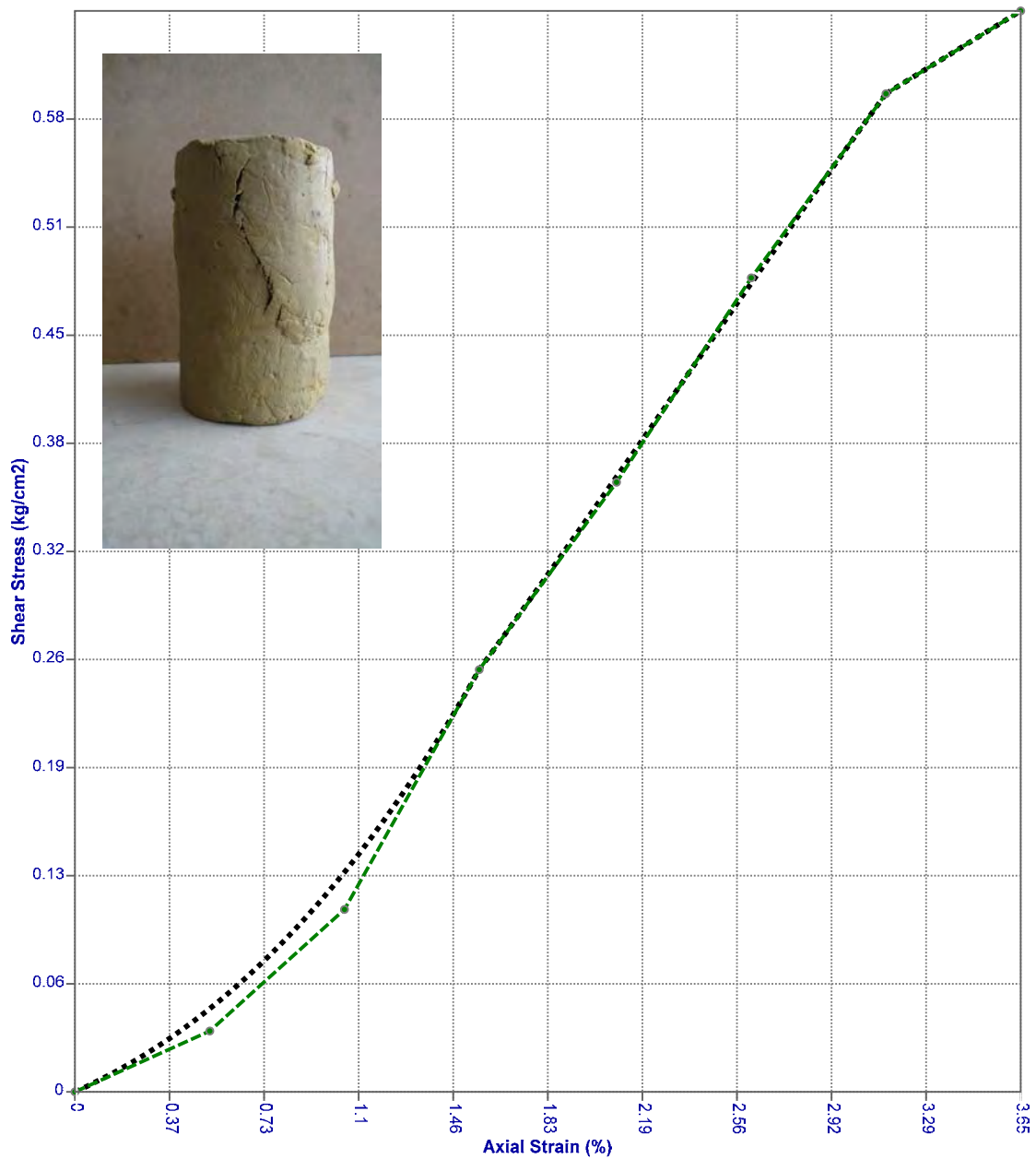
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.493	9.588	1	Moist	17.35	1.73	0.64	0.32



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Borehole : BH-09(A)
 Sample Depth : 25.65 (m)
 Rock Name : Sandstone
 Sample Type : Undisturbed

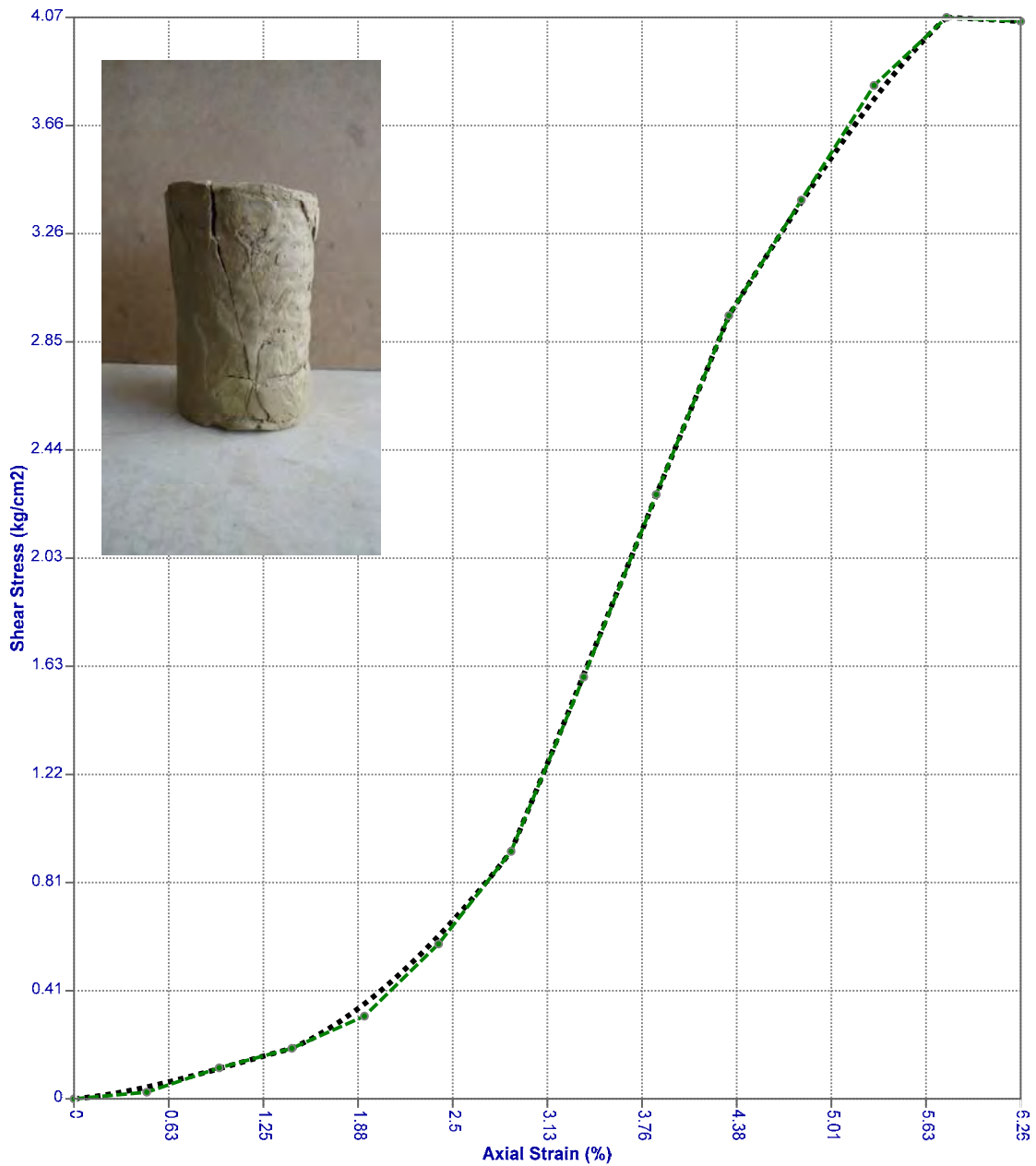
Soil Testing Services



ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.397	10.39	1	Moist	13.18	1.87	4.07	2.04



Unified Description :
 AASHTO Description :

Tested By :
 SDN

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-09(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 29.6 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

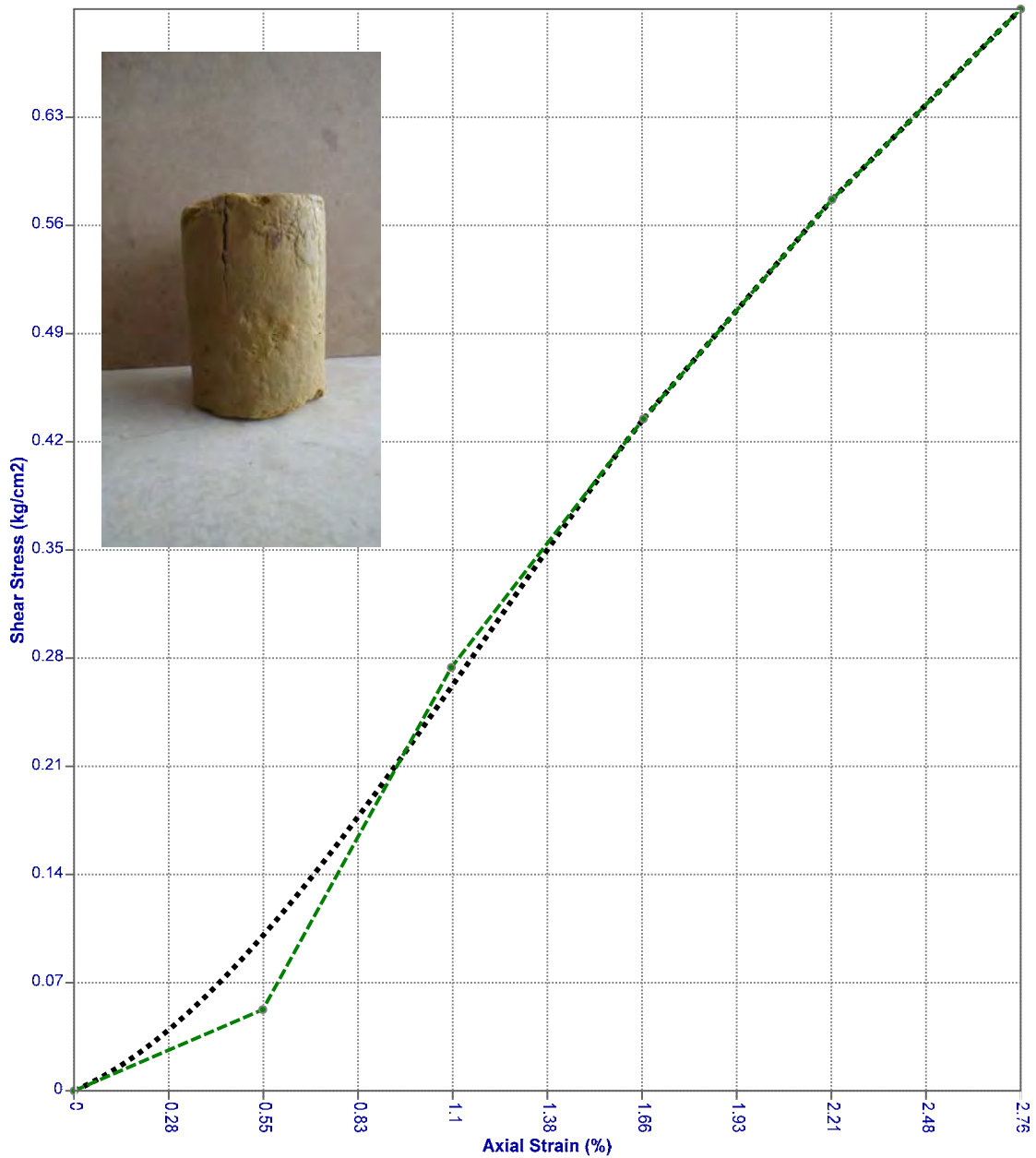
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.545	9.051	1	Moist	13.51	1.72	0.7	0.35



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-10

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 9.59 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

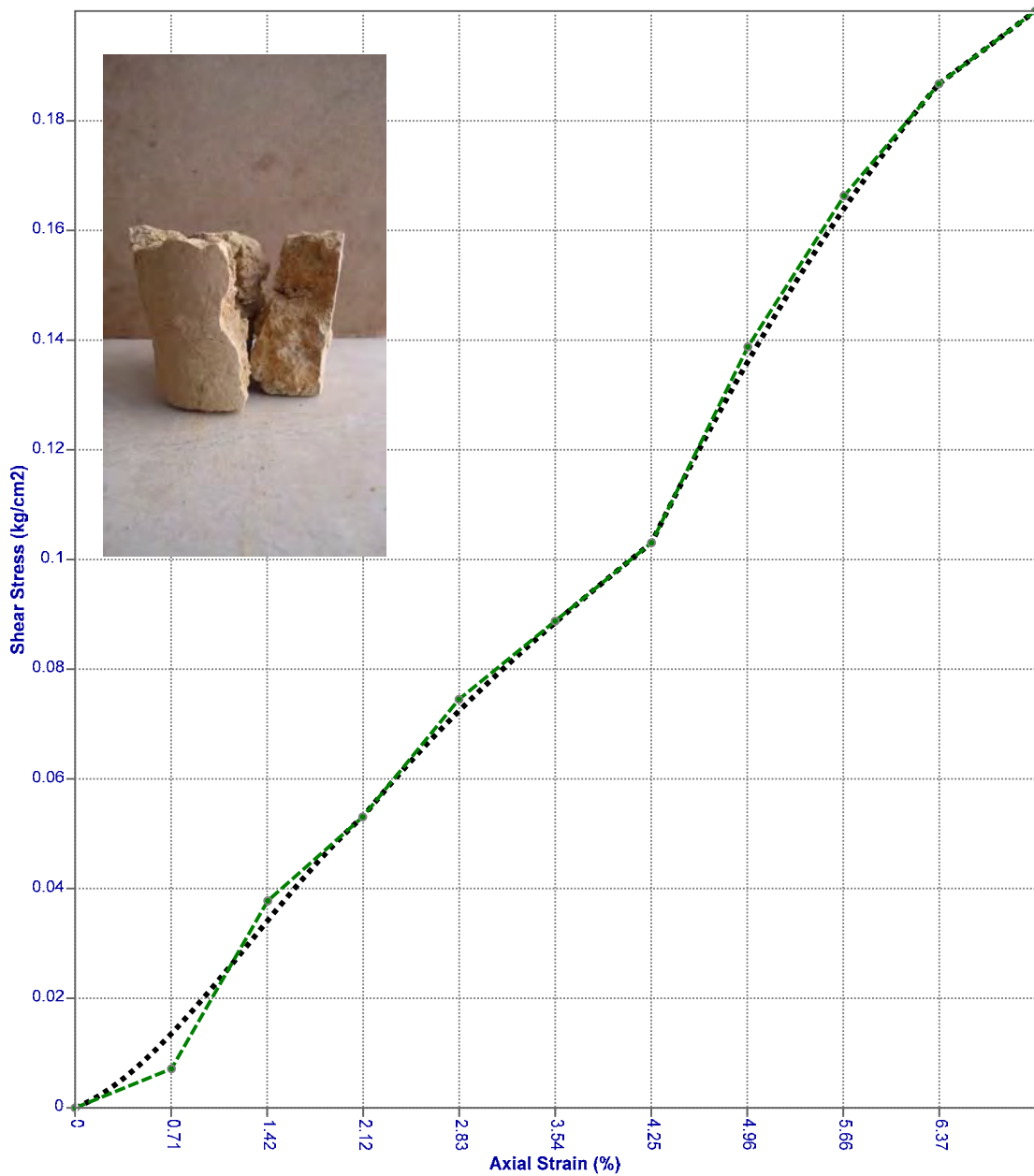
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.818	7.06	1	Moist	11.41	1.97	0.2	0.1



Unified Description :
AASHTO Description :

Tested By :
SDN

Unconfined Compression Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Borehole : BH-10(A)
 Sample Depth : 7.5 (m)
 Classification : CL
 Sample Type : Undisturbed

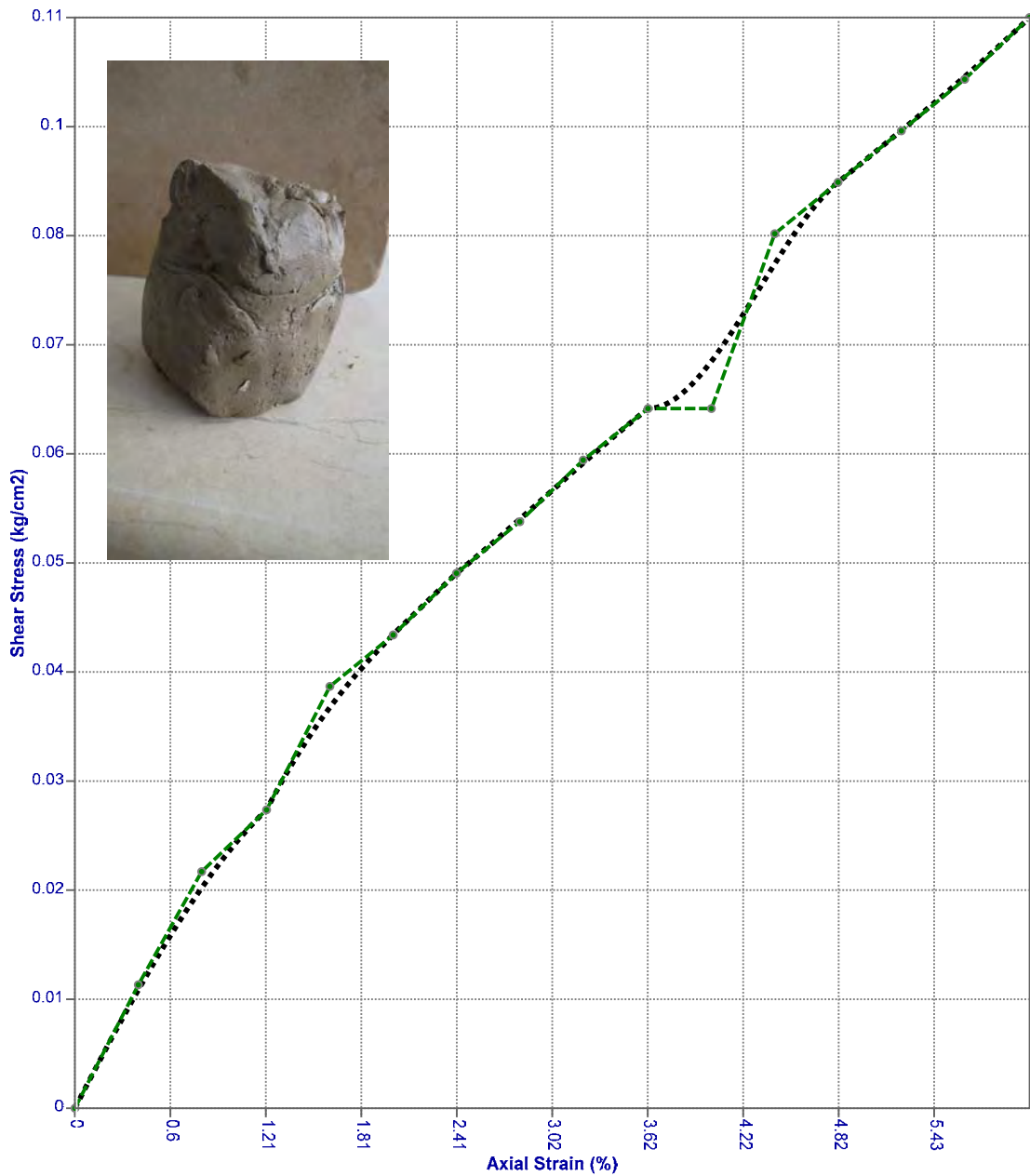
Soil Testing Services



ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
6.561	12.448	1	Moist	18.24	1.95	0.11	0.06



Unified Description :
 AASHTO Description :

Tested By :
 HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.3 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

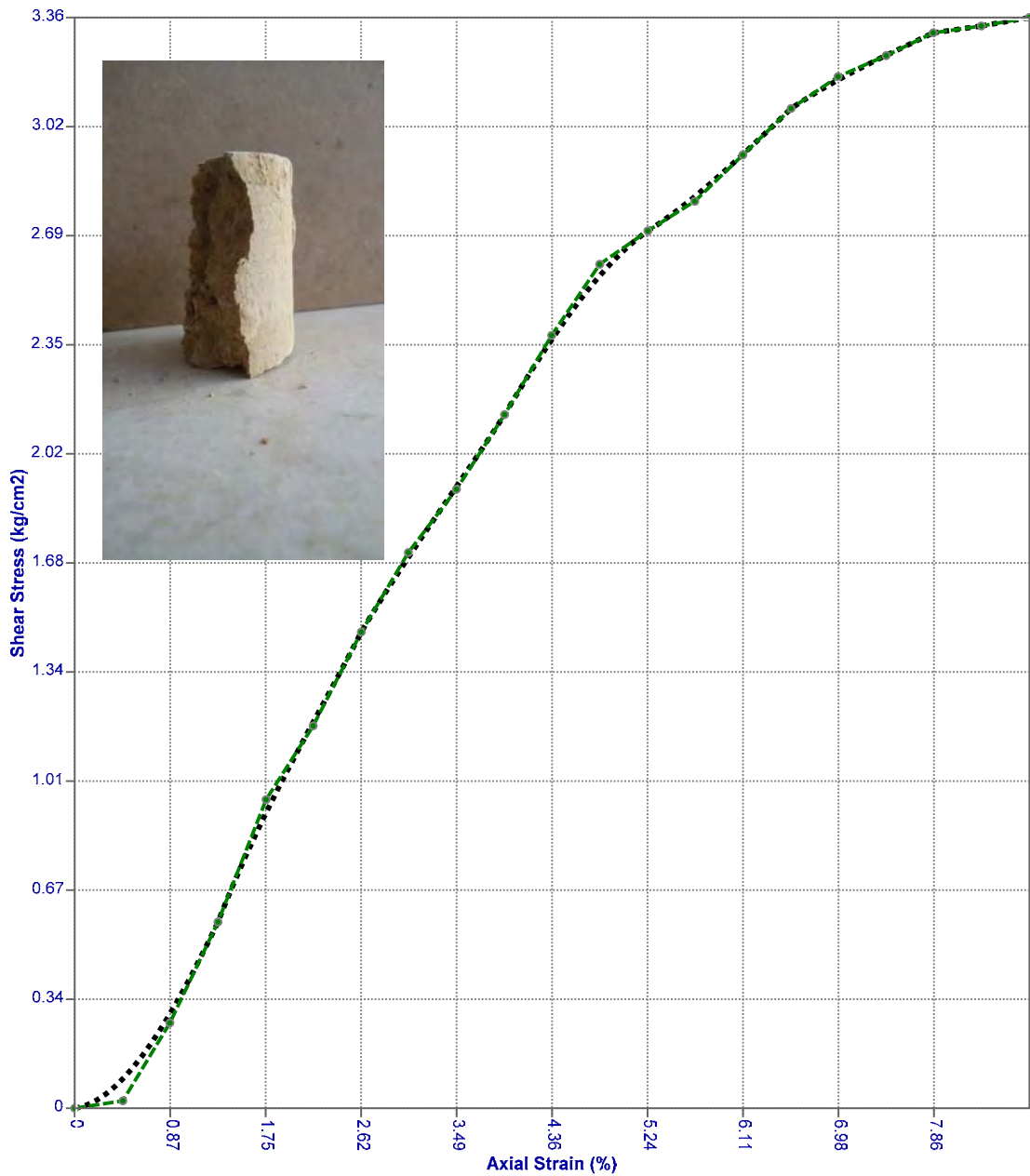
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.648	11.459	1	Moist	15.64	1.81	3.36	1.68



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 15.3 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

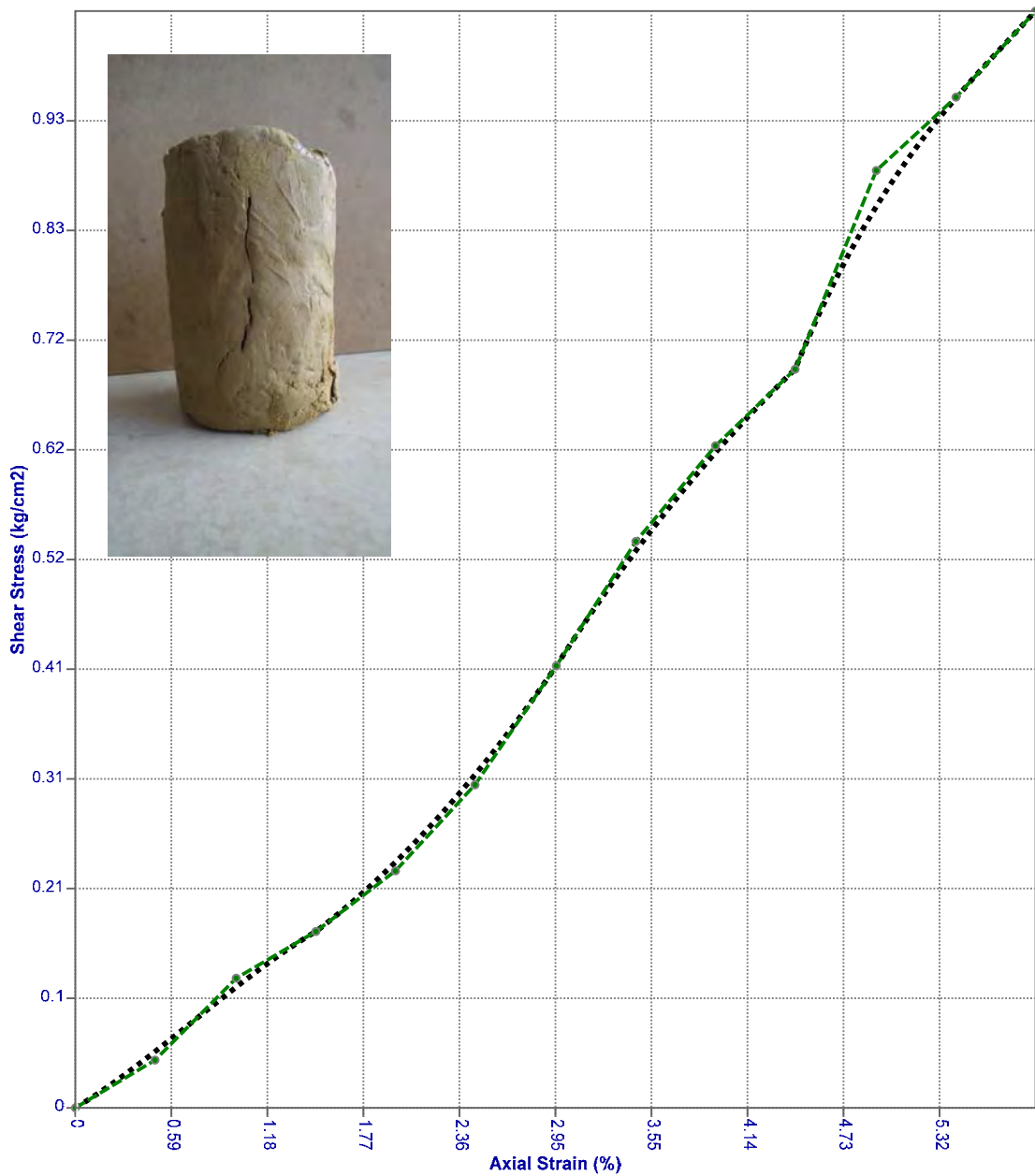
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.264	10.147	1	Moist	13.76	1.84	1.03	0.52



Unified Description :
AASHTO Description :

Tested By :
SDN

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 21.2 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

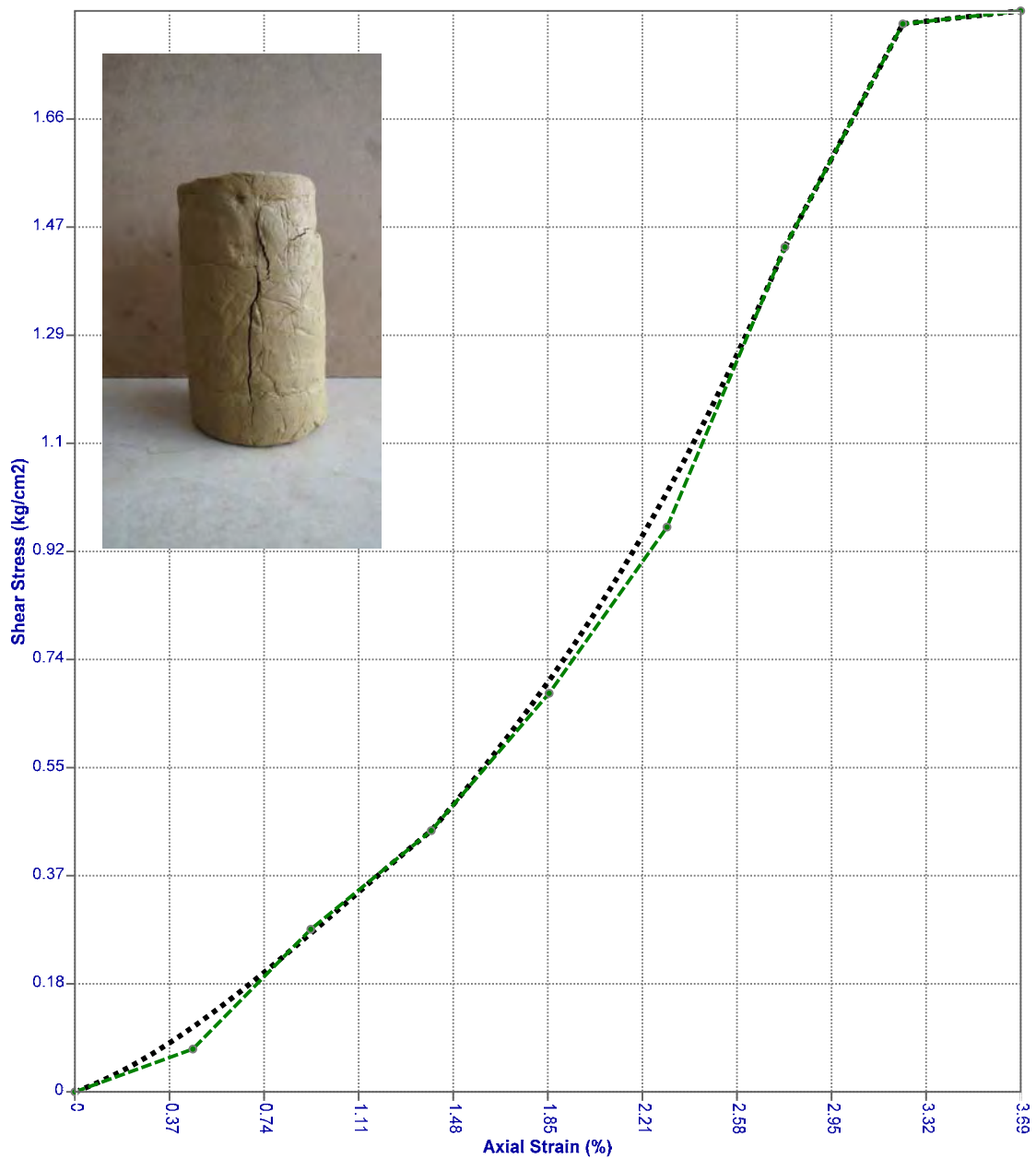
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.332	10.827	1	Moist	18.38	1.72	1.84	0.92



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-10(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 24.15 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

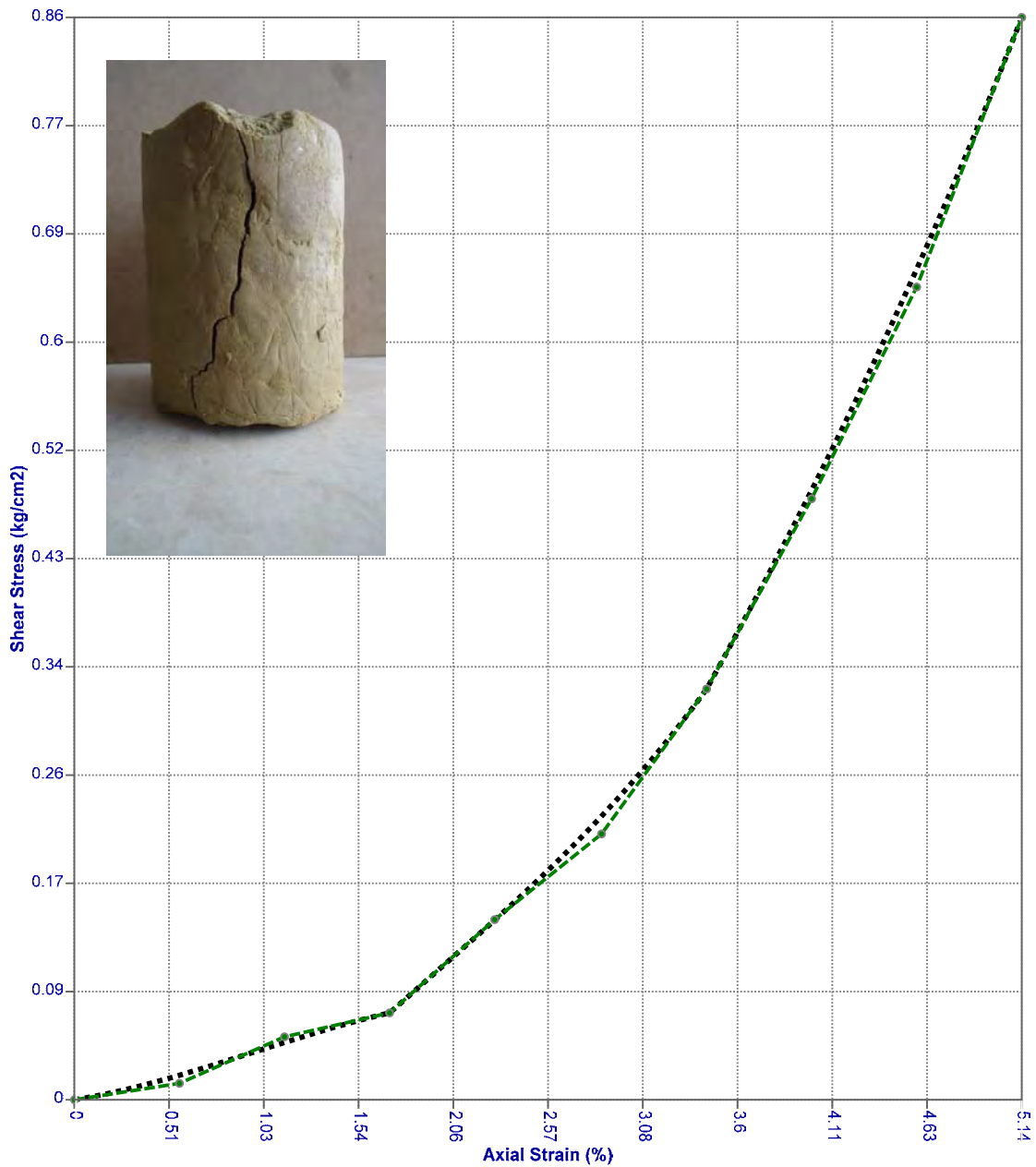
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.32	8.753	1	Moist	15.3	1.82	0.86	0.43



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal
 Client : Techno Consultant International
 Job No.: K15-1185-101
 Location : Port Qasim

Borehole : BH-10(A)
 Sample Depth : 29.1 (m)
 Rock Name : Sandstone
 Sample Type : Undisturbed

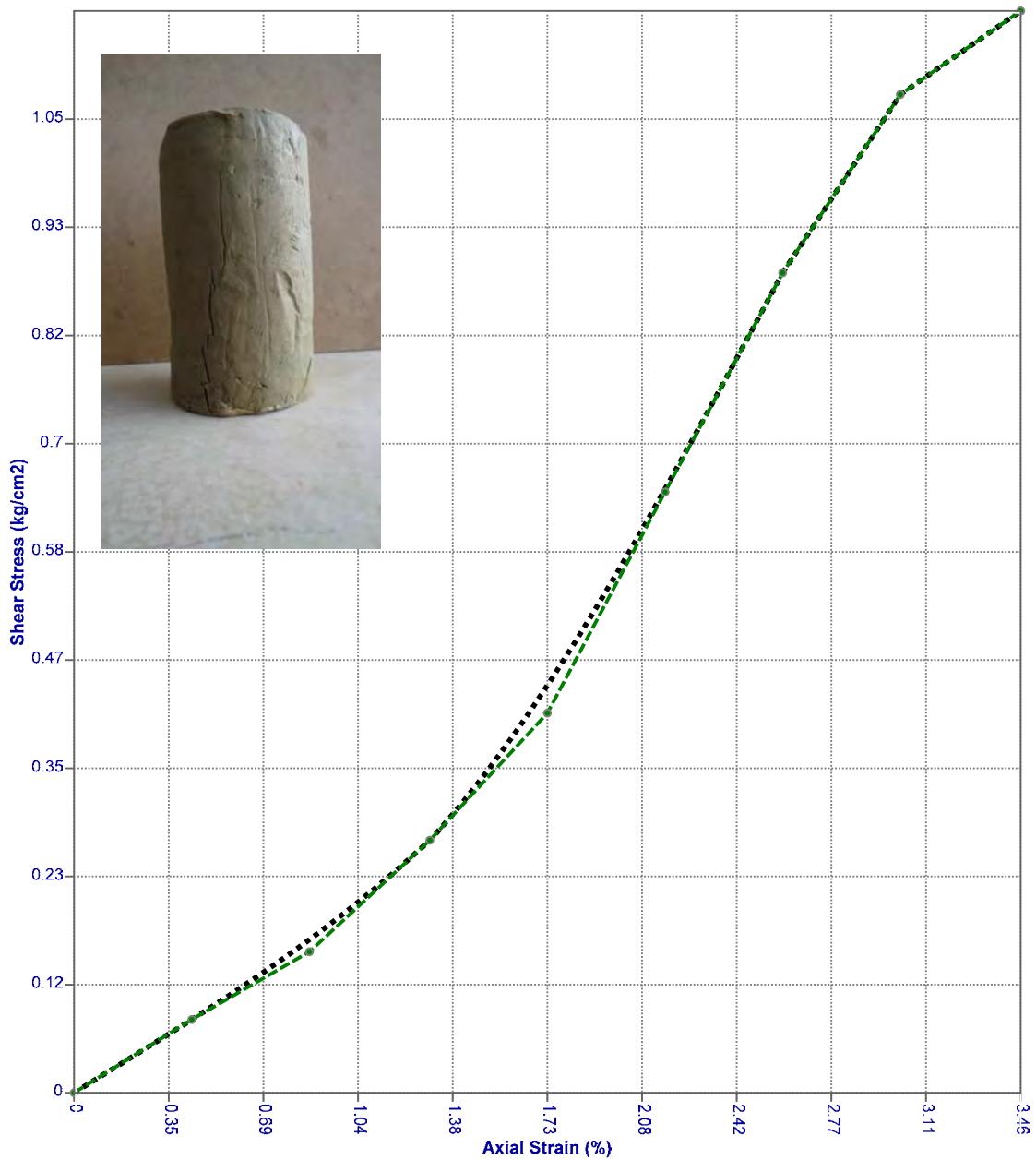
Soil Testing Services



ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.448	11.571	1	Moist	15.14	1.79	1.16	0.58



Unified Description :
 AASHTO Description :

Tested By :
 HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-11

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 8.15 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

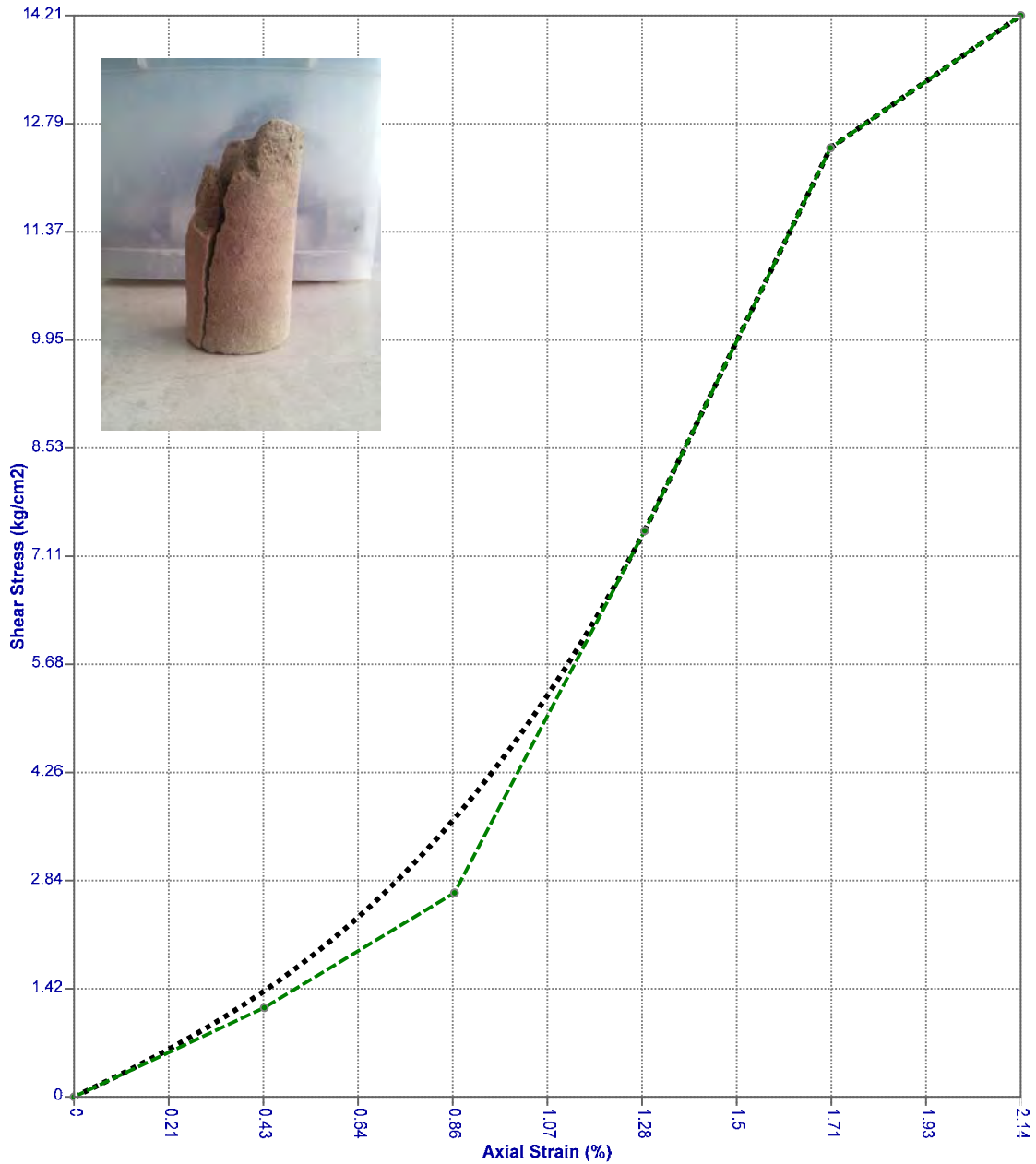
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.903	11.67	1	Moist	6.06	1.91	14.21	7.1



Unified Description :
AASHTO Description :

Tested By :
WA

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-11

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 9.6 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

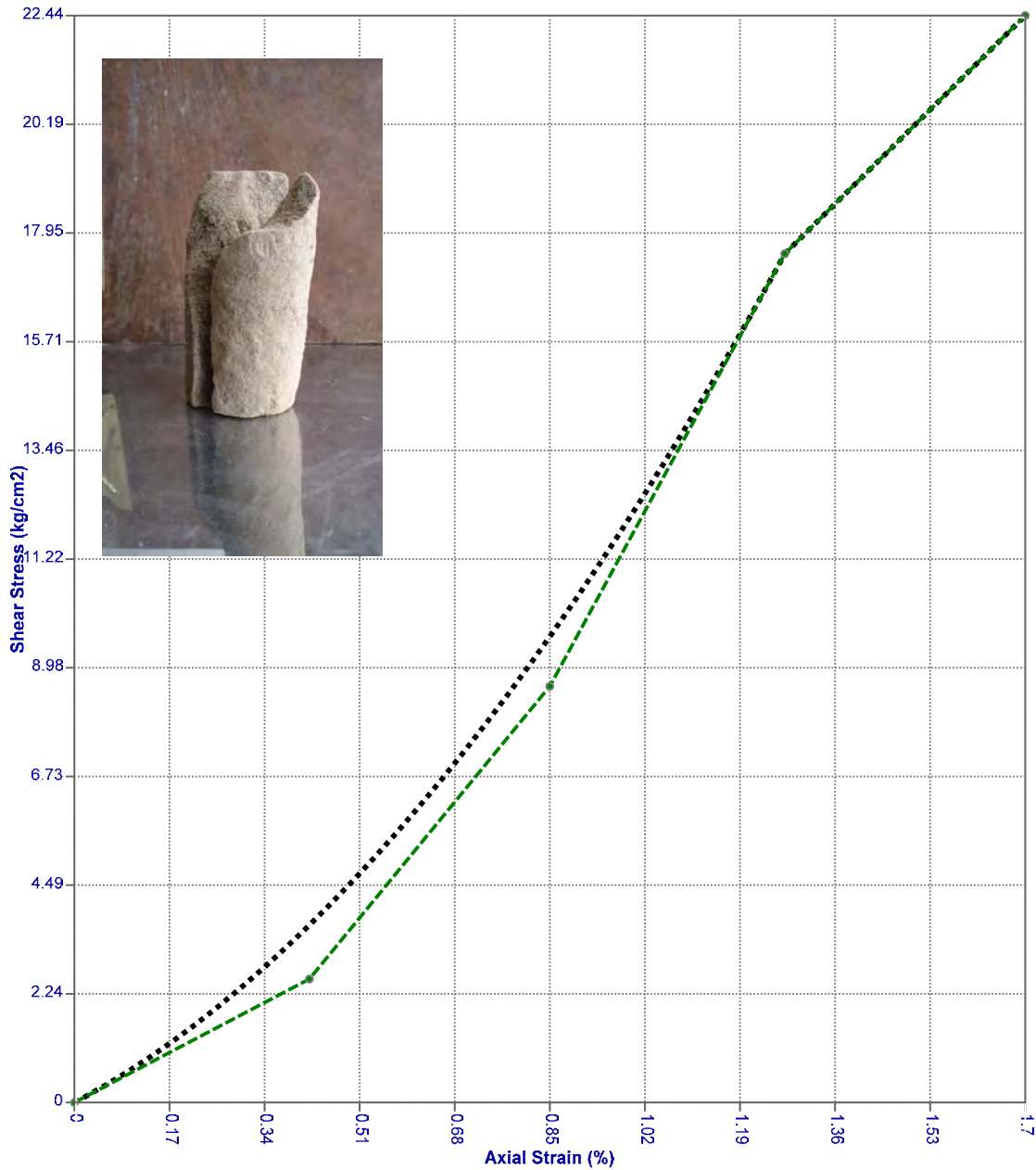
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.554	11.78	1	Moist	9.81	1.89	22.44	11.22



Unified Description :
AASHTO Description :

Tested By :
SDN

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-11

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 11.02 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

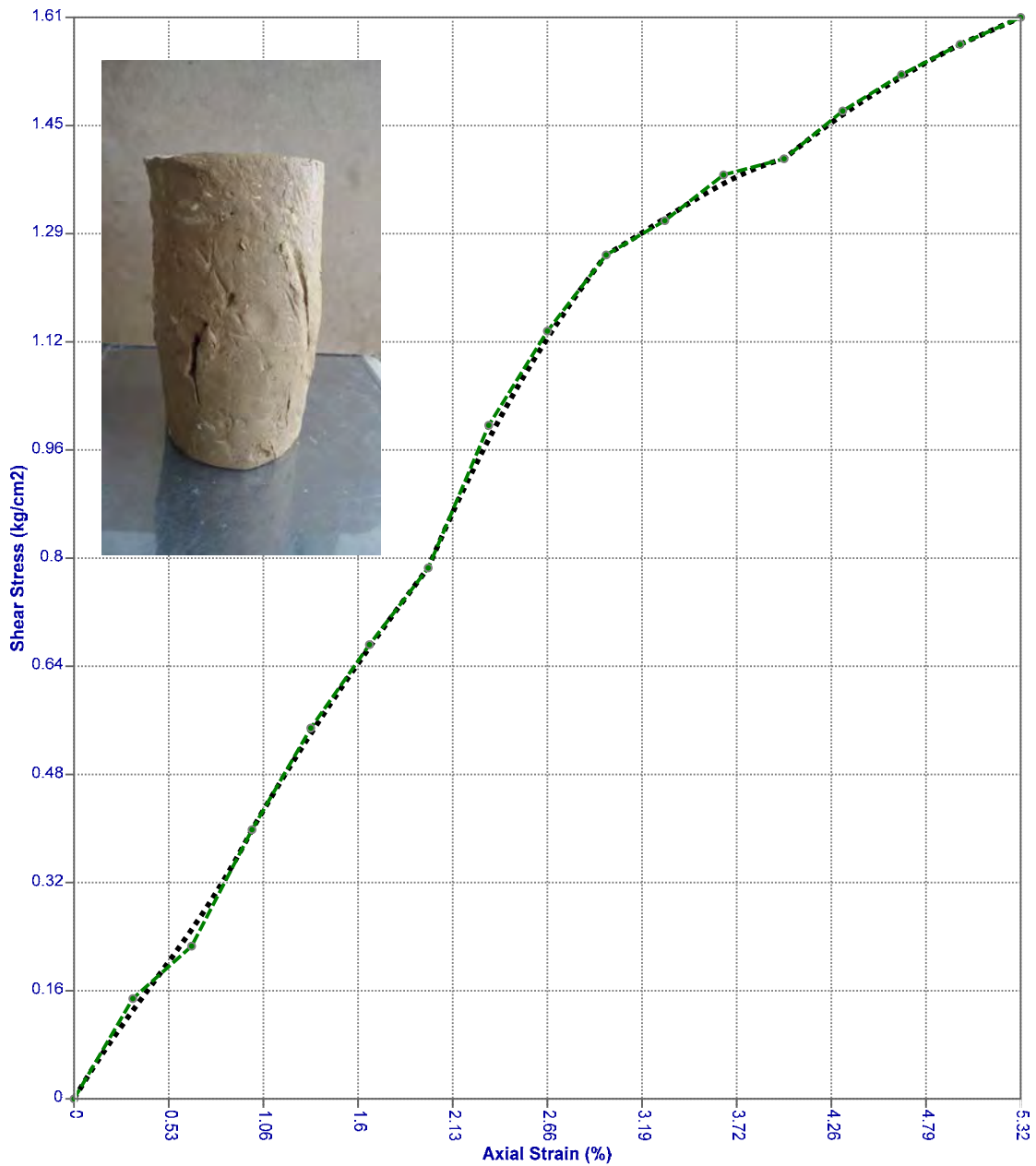
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
7.61	15.049	1	Moist	16.89	1.95	1.61	0.8



Unified Description :
AASHTO Description :

Tested By :
AK

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-12

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 11.5 (m)



Job No.: K15-1185-101

Rock Name : Claystone

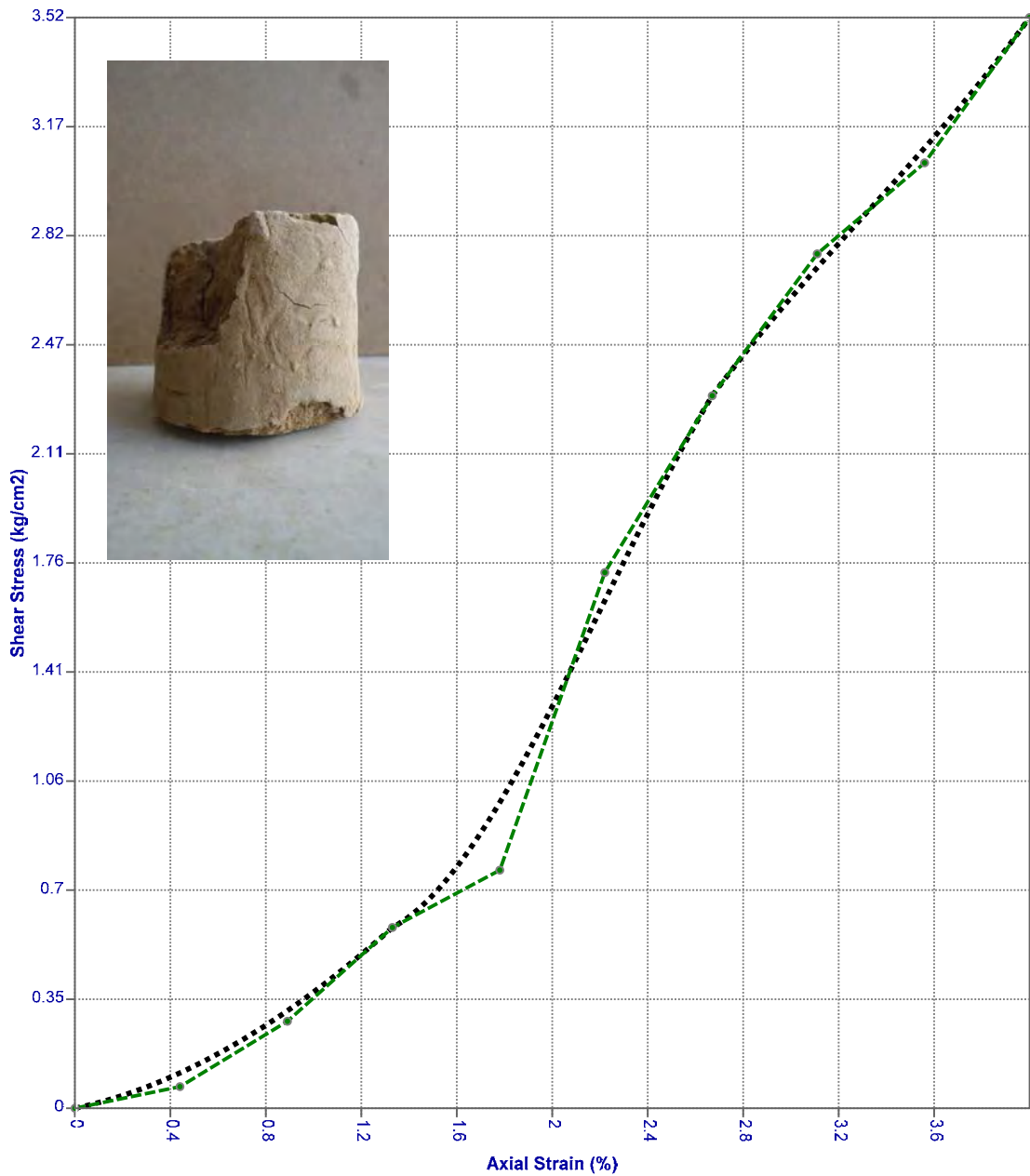
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
6.326	11.236	1	Moist	13.33	1.7	3.52	1.76



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-12

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.75 (m)



Job No.: K15-1185-101

Rock Name : Claystone

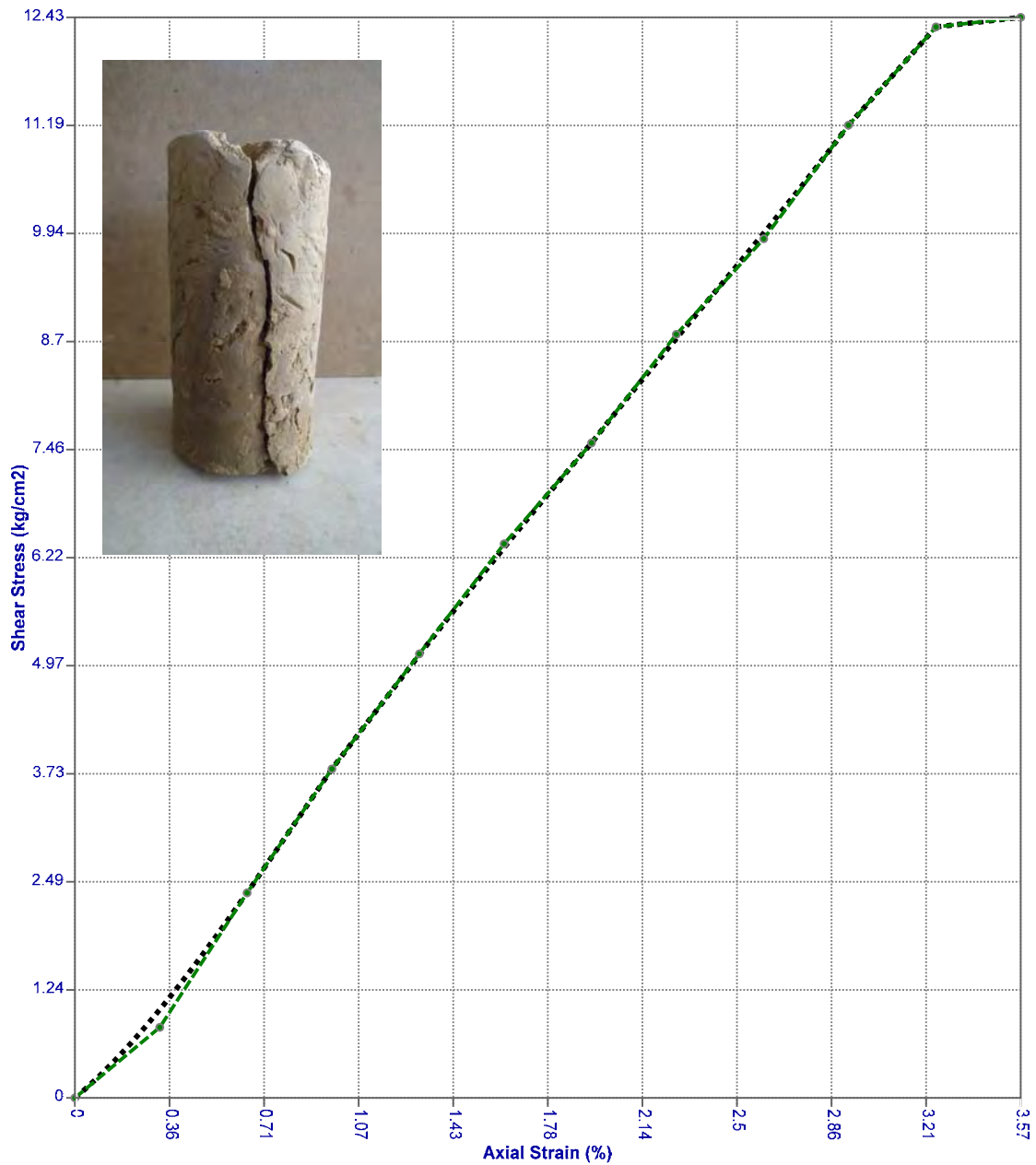
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
7.77	15.4	1	Moist	19.22	1.78	12.43	6.22



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-13

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 8.1 (m)

Job No.: K15-1185-101

Rock Name : Sandstone

Location : Port Qasim

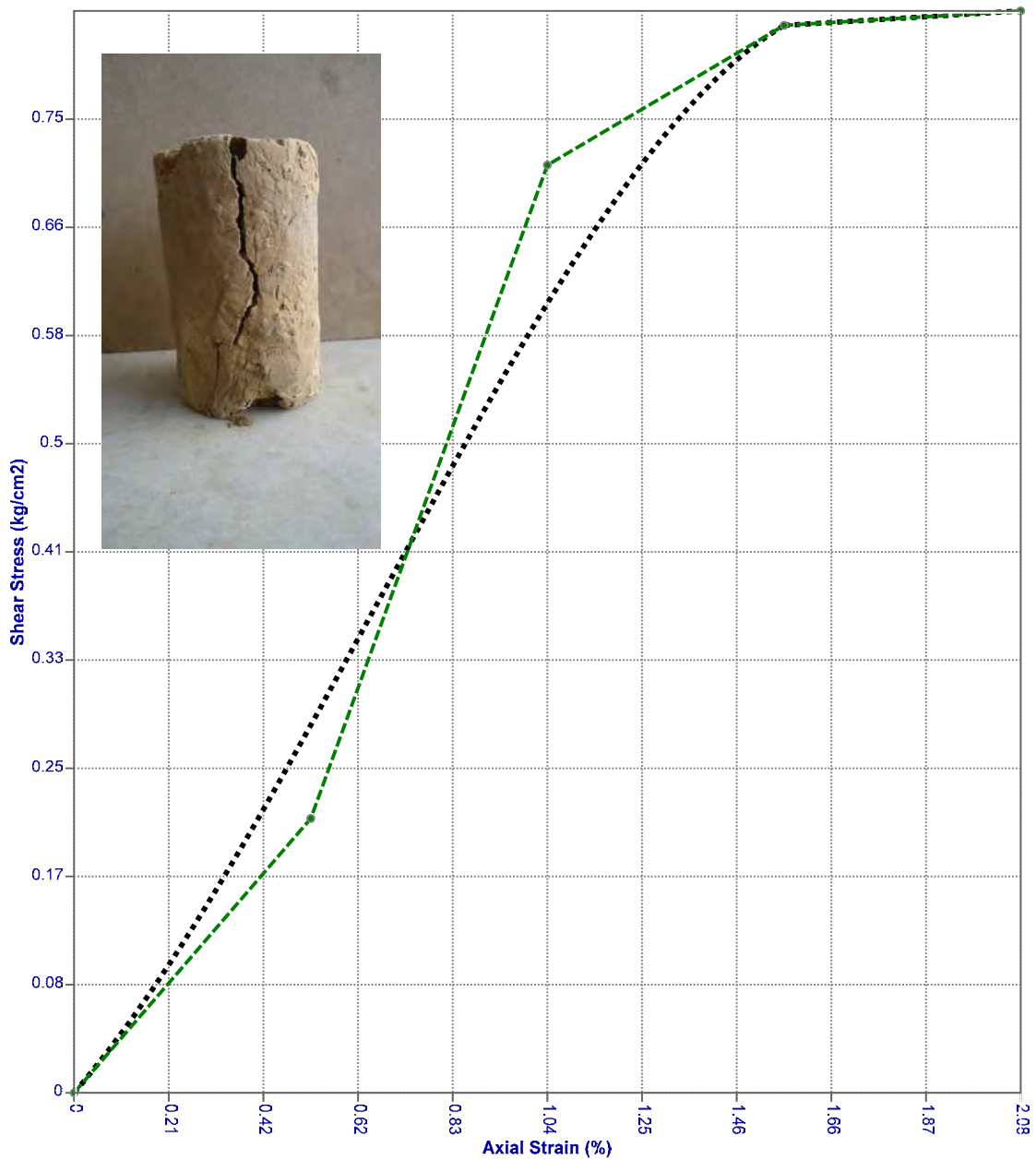
Sample Type : Undisturbed



ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
5.808	9.599	1	Moist	12.31	1.91	0.83	0.42



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-13

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.35 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

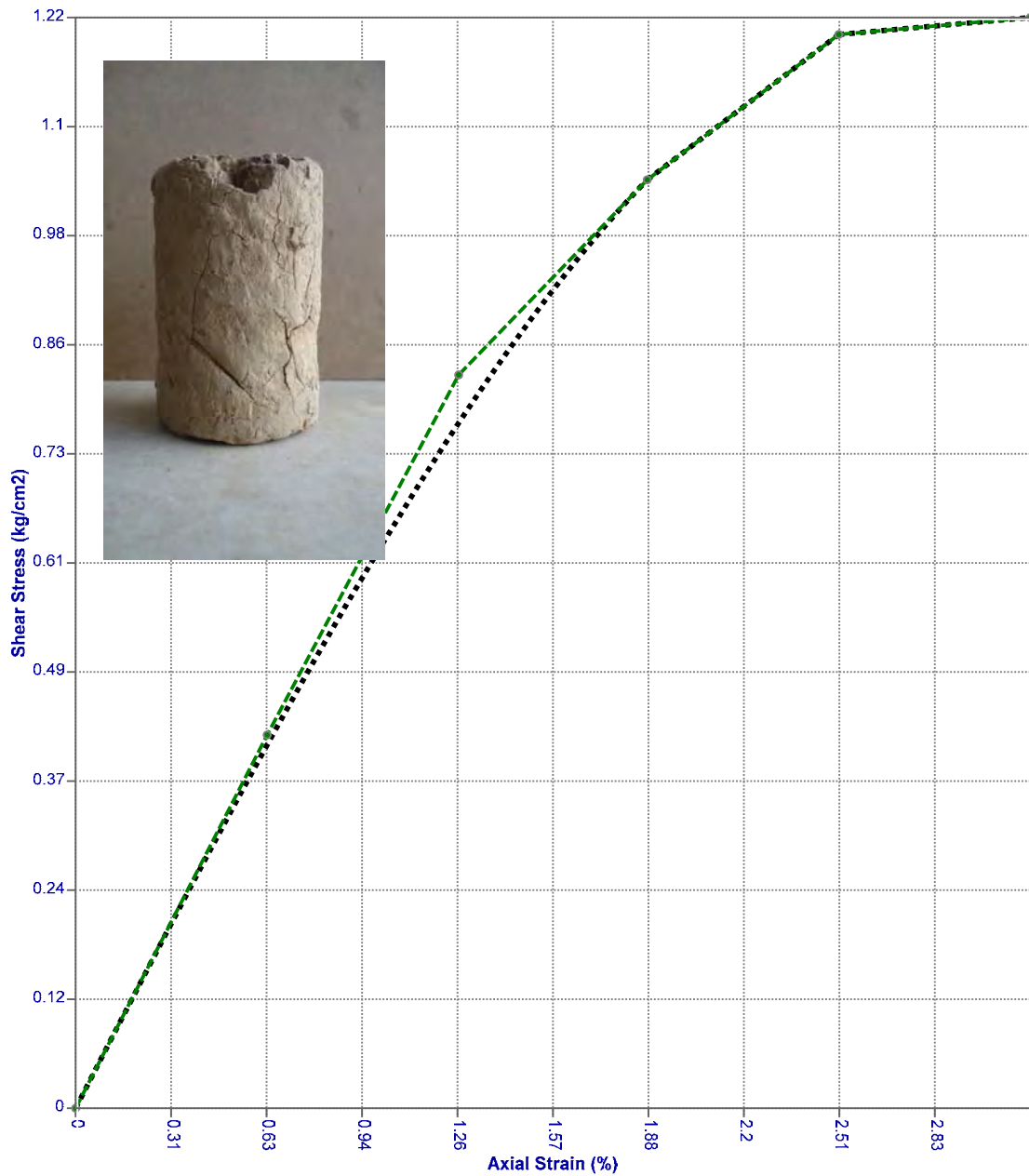
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.273	7.966	1	Moist	11.45	1.58	1.22	0.61



Unified Description :
AASHTO Description :

Tested By :
SDN

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-13

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.29 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

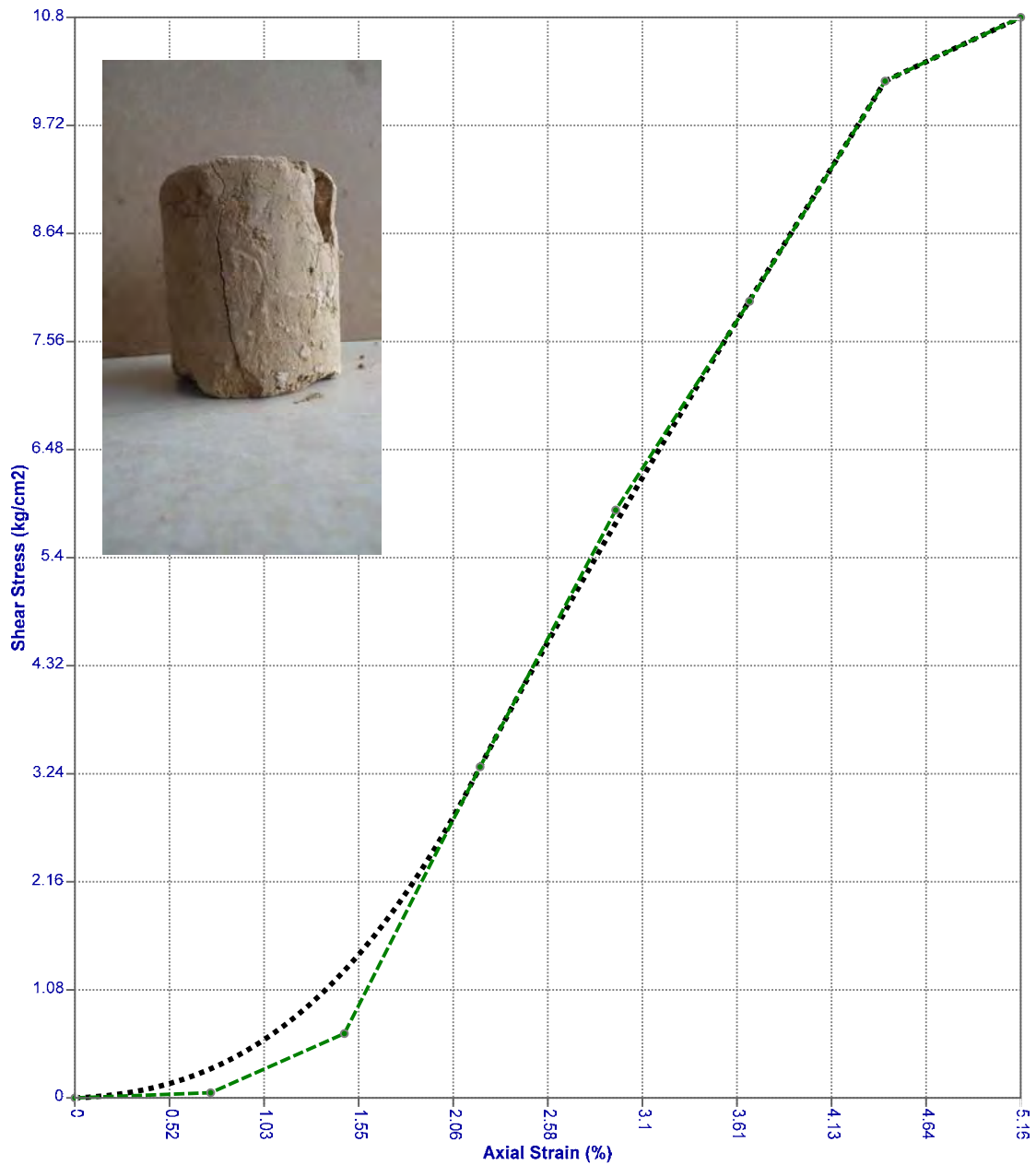
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
5.825	6.786	1	Moist	14.57	1.8	10.81	5.4



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-17

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.2 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

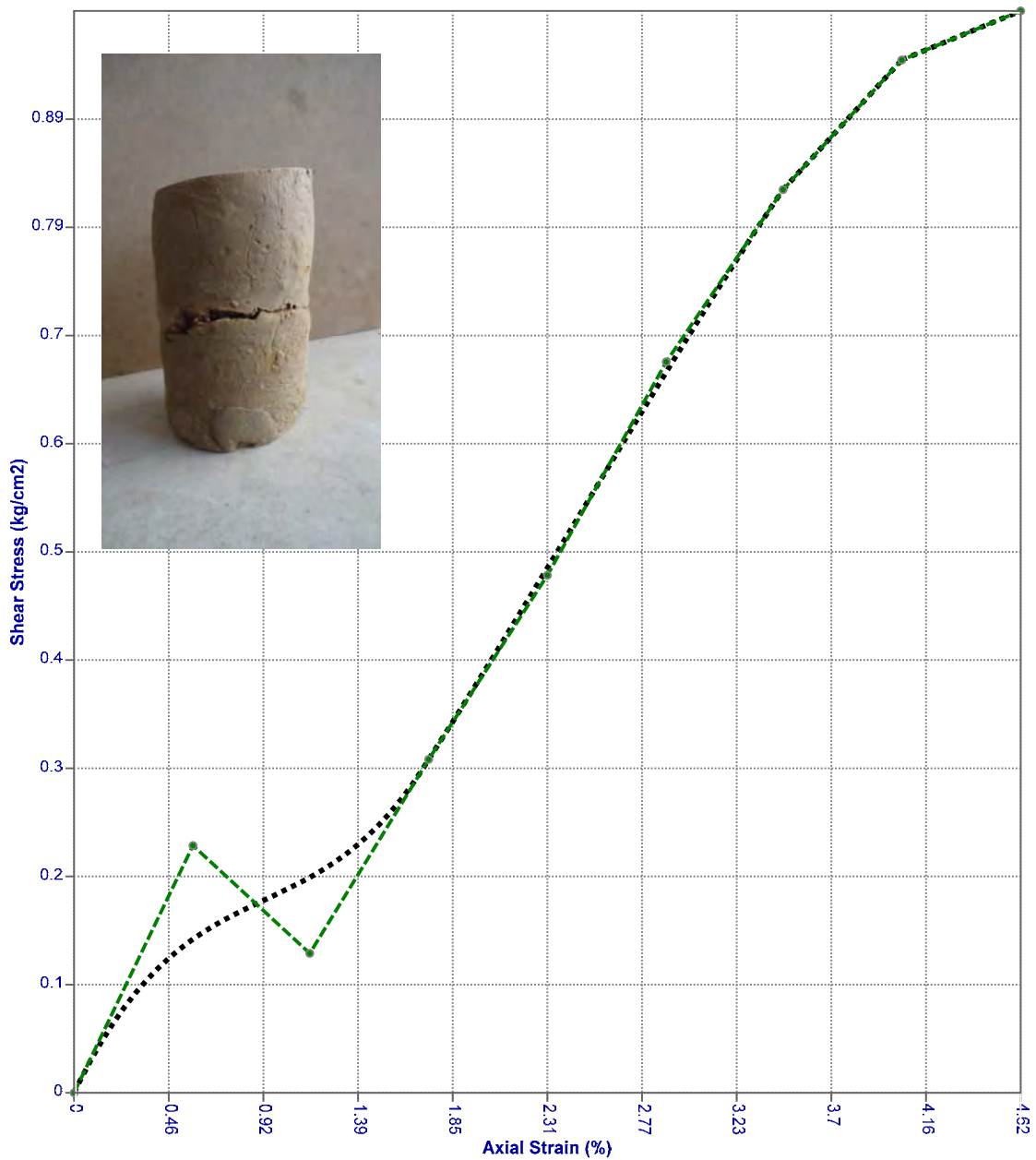
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression q_u (kg/cm ²)	Cu (kg/cm ²)
5.789	8.66	1	Moist	19.15	1.75	0.99	0.5



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-18

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 12.6 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

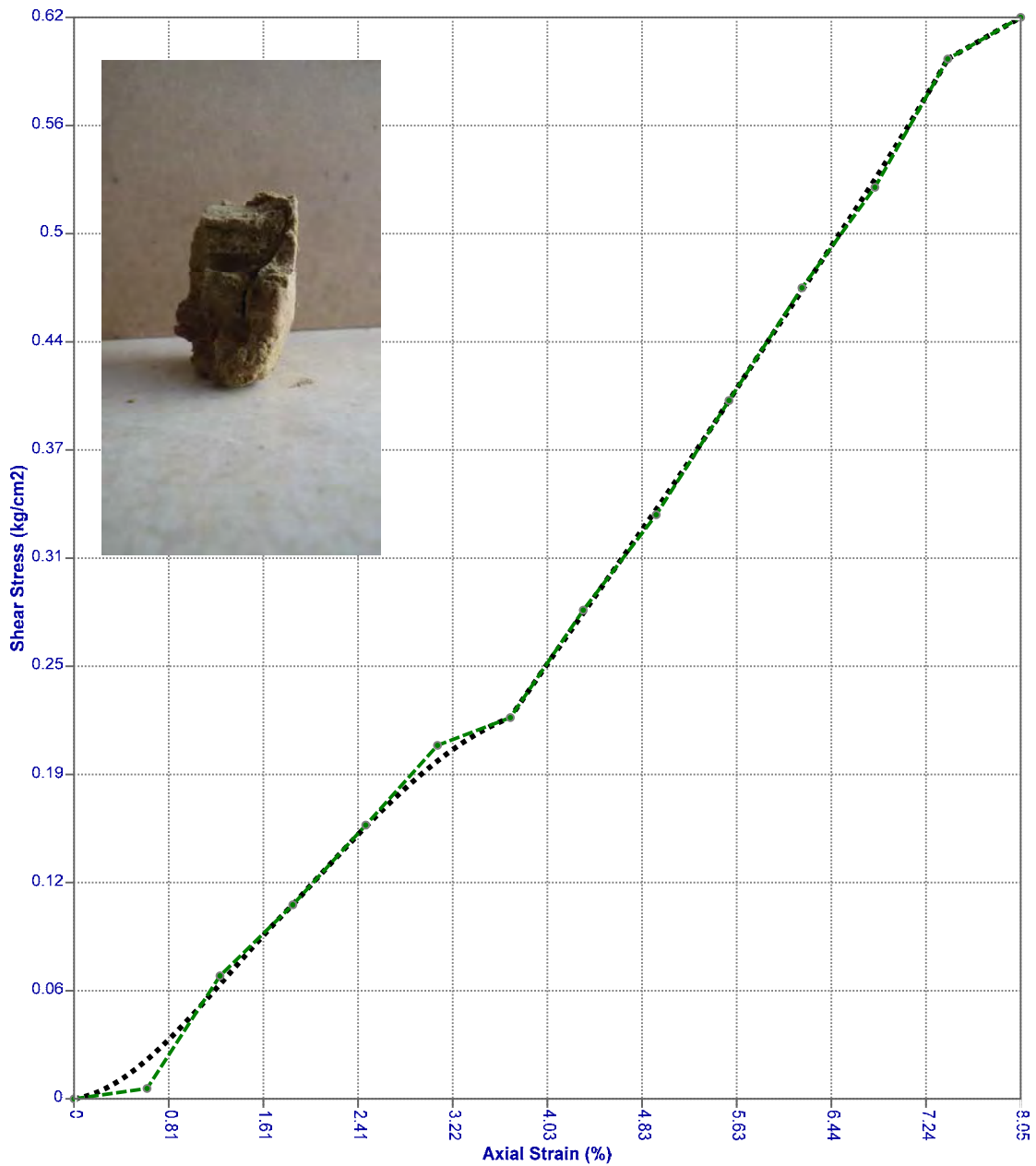
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.512	8.078	1	Moist	24.6	1.49	0.62	0.31



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-18

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

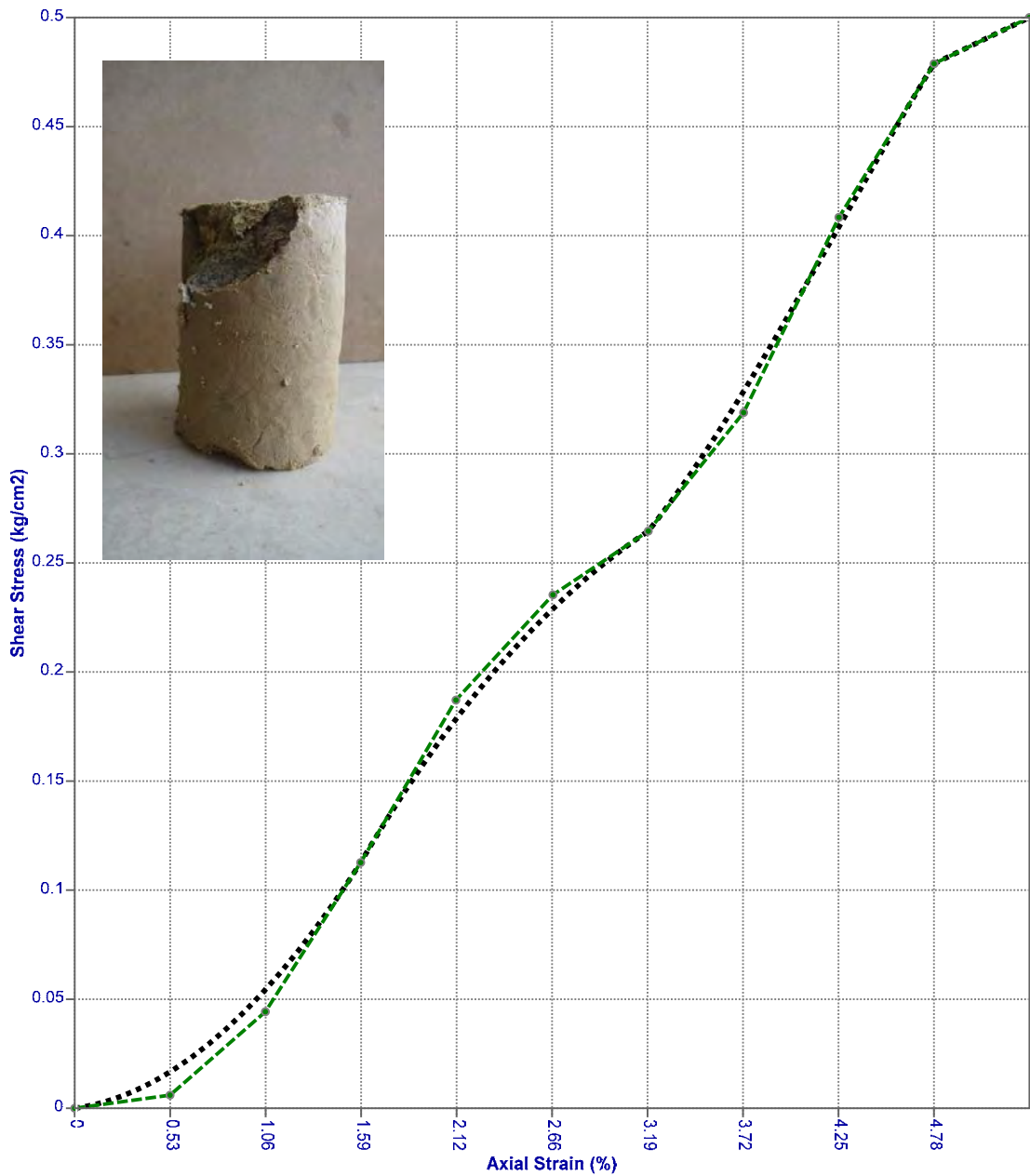
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression σ_u (kg/cm ²)	Cu (kg/cm ²)
6.343	9.415	1	Moist	24.17	2.02	0.5	0.25



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-19

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 10.95 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

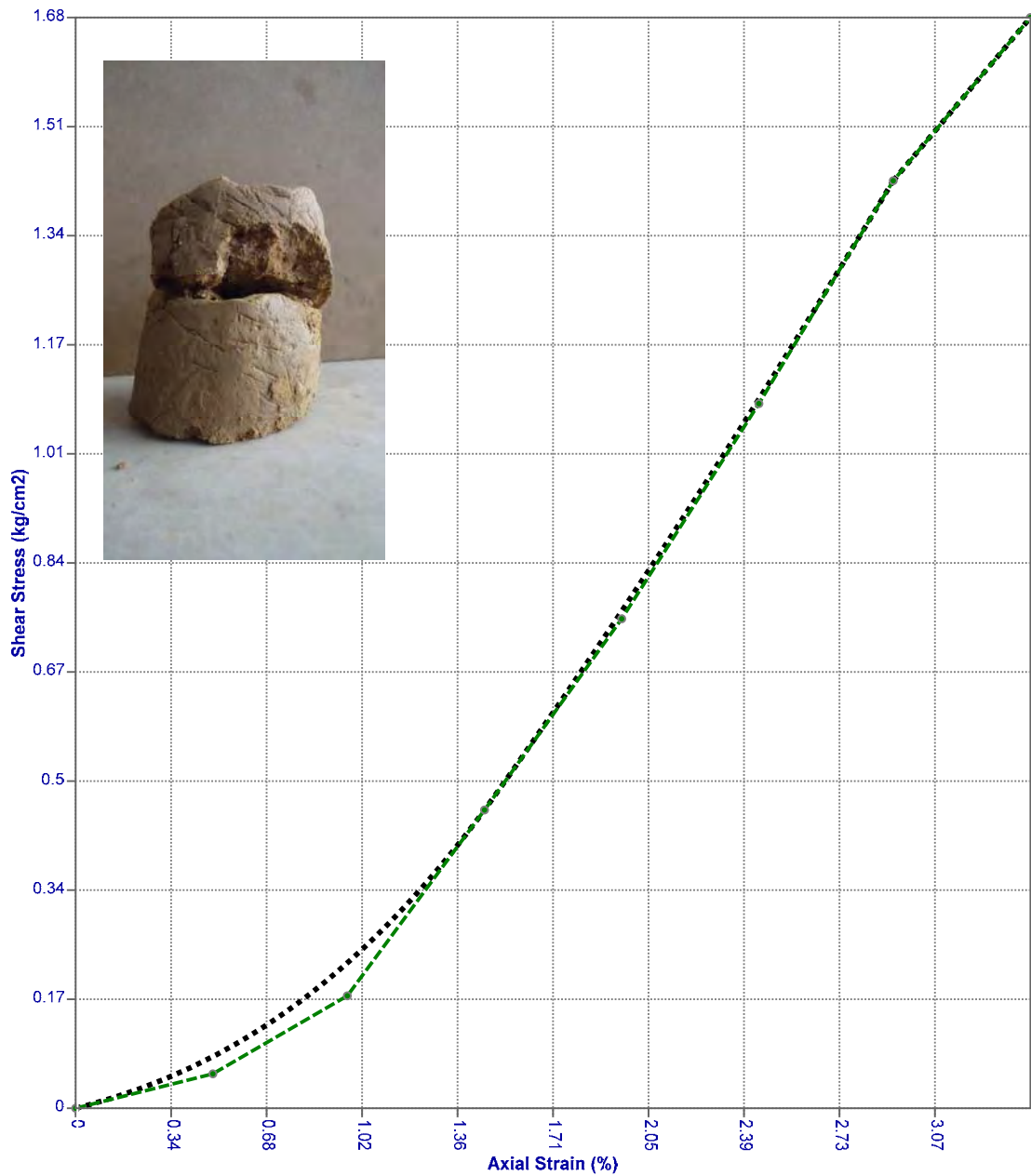
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
6.554	10.266	1	Moist	14.17	1.73	1.68	0.84



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-19

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 13.28 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

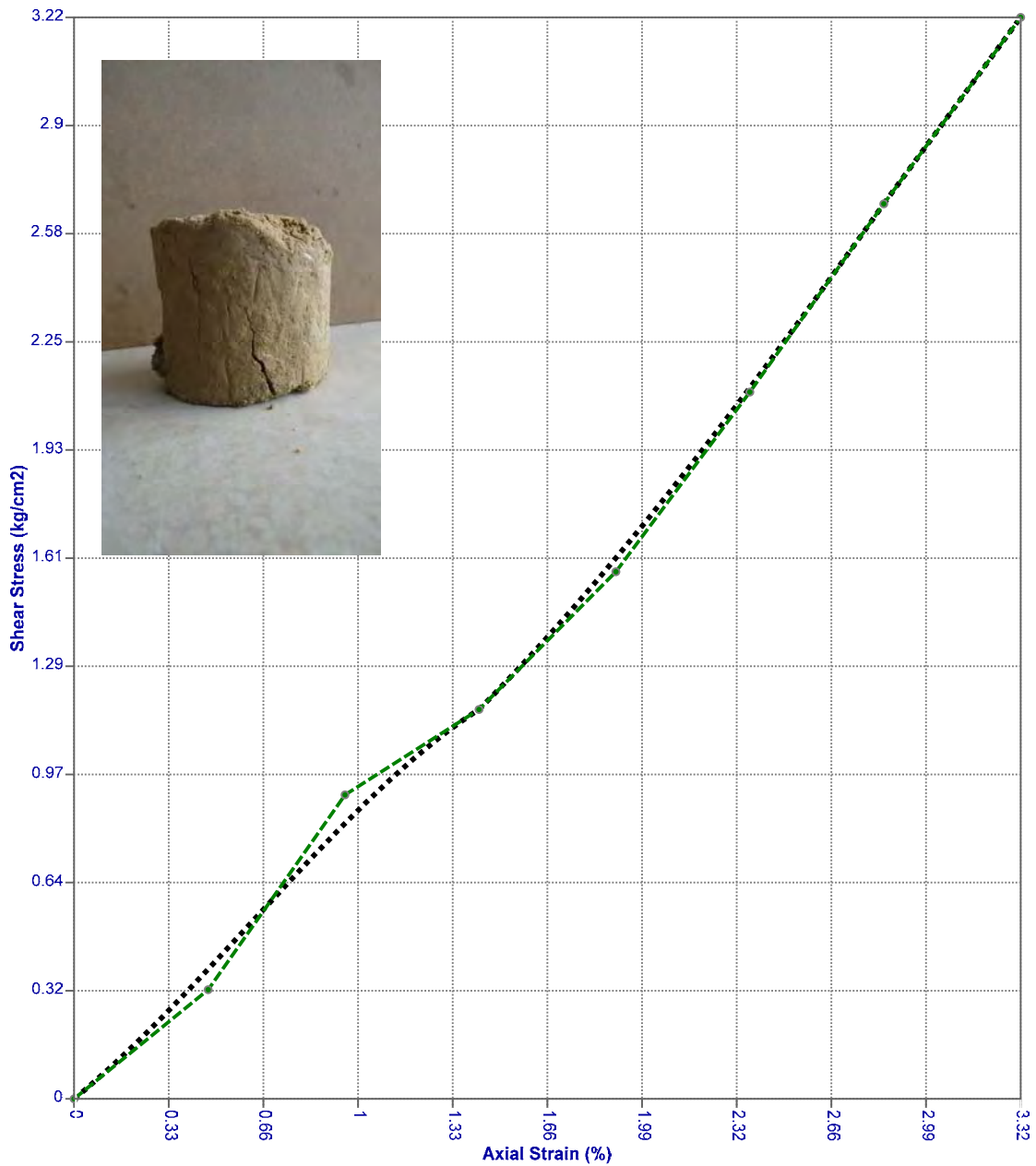
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (ka/cm ²)	Cu (kg/cm ²)
6.245	10.547	1	Moist	13.64	1.7	3.22	1.61



Unified Description :
AASHTO Description :

Tested By :
HG

Unconfined Compression Test

Project : Coal Unloading Terminal

Borehole : BH-19

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 14.1 (m)



Job No.: K15-1185-101

Rock Name : Sandstone

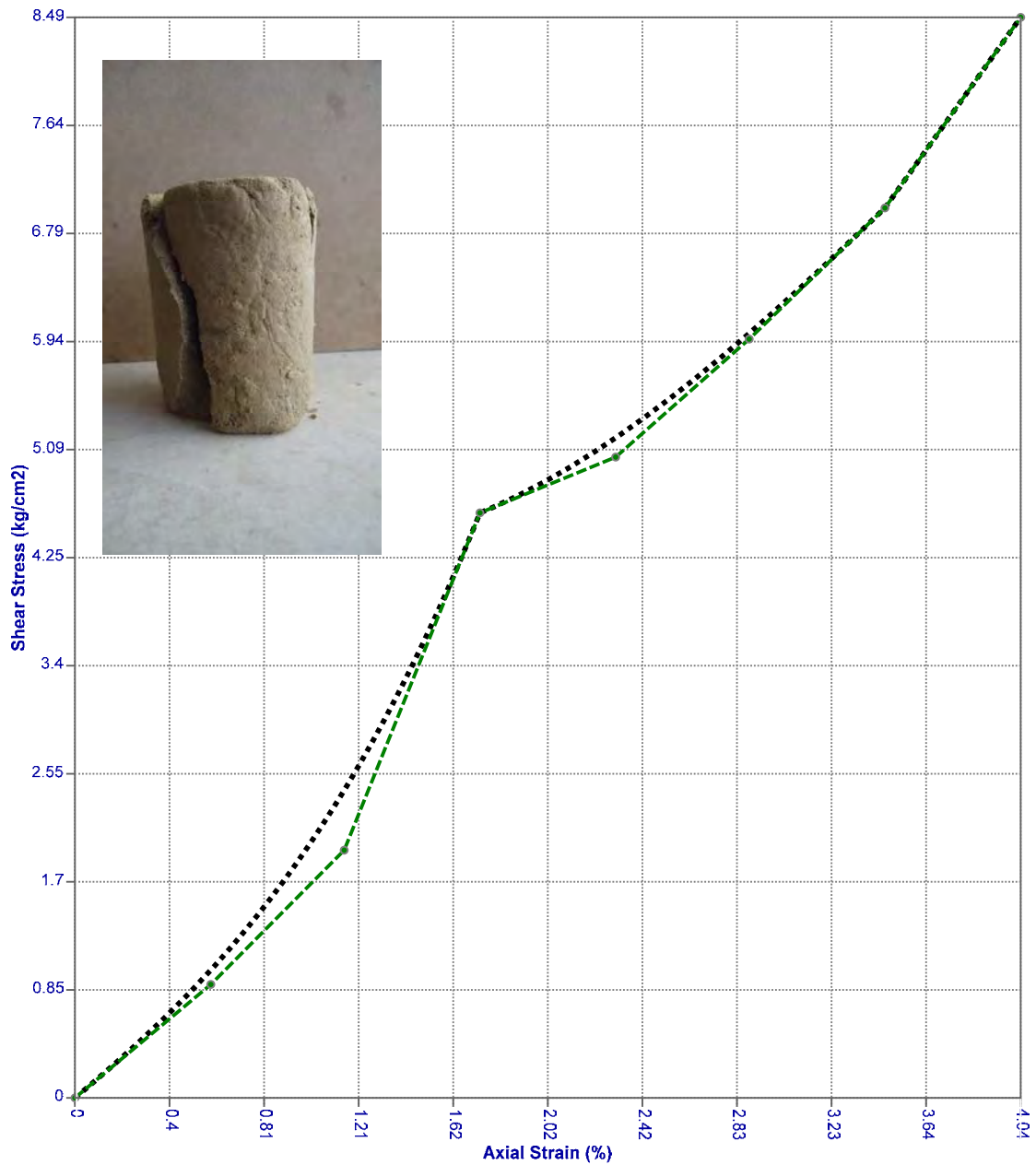
Location : Port Qasim

Sample Type : Undisturbed

ASTM D2166

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm ³)	Unconfined Compression au (kg/cm ²)	Cu (kg/cm ²)
5.662	8.67	1	Moist	19.97	1.72	8.49	4.24



Unified Description :
AASHTO Description :

Tested By :
HG

Chemical Test Results

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



ASTM D516, D512, D1293

Borehole	Sample Depth (m)	Description	Value
BH-1	1.5	pH	7.45
BH-2	1.5		7.65
BH-2(A)	3		7.56
BH-2(B)	1.5		7.55
BH-3	4.5		7.71
BH-3(A)	3		7.4
BH-3B	3		7.54
BH-4	3		7.45
BH-4(A)	1.5		7.58
BH-4(B)	1.5		7.44
BH-5	3		7.65
BH-5(A)	1.5		7.95
BH-5(B)	3		7.59
BH-6	3		7.88
BH-6(A)	1.5		7.62
BH-6(B)	1.5		7.52
BH-7	1.5		7.8
BH-7(A)	1.5		7.89
BH-8	1.5		7.56
BH-8(A)	1.5		7.58
BH-8(B)	1.5	7.85	
BH-1	1.5	Sulphate Content	0.03
BH-2	1.5		0.05
BH-2(A)	3		0.02
BH-2(B)	1.5		0.02
BH-3	4.5		0.06
BH-3(A)	3		0.03
BH-3B	3		0.09
BH-4	3		0.05
BH-4(A)	1.5		0.09
BH-4(B)	1.5		0.04
BH-5	3		0.07
BH-5(A)	1.5		0.07
BH-5(B)	3		0.05
BH-6	3		0.08
BH-6(A)	1.5		0.06
BH-6(B)	1.5		0.09
BH-7	1.5		0.02
BH-7(A)	1.5		0.07
BH-8	1.5		0.05
BH-8(A)	1.5		0.03
BH-8(B)	1.5	0.06	
BH-1	1.5	Chloride Content	0.26
BH-2	1.5		0.31
BH-2(A)	3		0.25
BH-2(B)	1.5		0.29
BH-3	4.5		0.33
BH-3(A)	3		0.21
BH-3B	3	0.36	

Chemical Test Results

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



ASTM D516, D512, D1298

Borehole	Sample Depth (m)	Description	Value
BH-4	3	Chloride Content	0.54
BH-4(A)	1.5		0.45
BH-4(B)	1.5		0.41
BH-5	3		0.32
BH-5(A)	1.5		0.29
BH-5(B)	3		0.46
BH-6	3		0.32
BH-6(A)	1.5		0.41
BH-6(B)	1.5		0.52
BH-7	1.5		0.23
BH-7(A)	1.5		0.52
BH-8	1.5		0.35
BH-8(A)	1.5		0.25
BH-8(B)	1.5		0.34

Chemical Test Results

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim

Soil Testing Services



ASTM D516, D512, D1293

Borehole	Sample Depth (m)	Description	Value
BH-09	4.5	pH	7.3
BH-09(A)	1.5		7.82
BH-10	3		7.3
BH-10(A)	1.5		7.3
BH-11	1.5		7.4
BH-12	1.5		7.3
BH-13	1.5		7.6
BH-14	1.5		7.6
BH-15	1.5		7.6
BH-16	3		7.66
BH-17	1.5		7.46
BH-18	1.5		7.9
BH-19	1.5		7.6
BH-20	1.5		7.81
BH-09	4.5	Sulphate Content	0.05
BH-09(A)	1.5		0.15
BH-10	3		0.07
BH-10(A)	1.5		0.17
BH-11	1.5		0.09
BH-12	1.5		0.07
BH-13	1.5		0.07
BH-14	1.5		0.12
BH-15	1.5		0.06
BH-16	3		0.05
BH-17	1.5		0.05
BH-18	1.5		0.06
BH-19	1.5		0.15
BH-20	1.5		0.02
BH-09	4.5	Chloride Content	0.29
BH-09(A)	1.5		0.79
BH-10	3		0.65
BH-10(A)	1.5		0.88
BH-11	1.5		0.27
BH-12	1.5		0.37
BH-13	1.5		0.55
BH-14	1.5		0.66
BH-15	1.5		0.55
BH-16	3		0.24
BH-17	1.5		0.67
BH-18	1.5		0.49
BH-19	1.5		0.66
BH-20	1.5		0.16

Water Chemical Test Results

Project : Coal Unloading Terminal

Client : Techno Consultant International

Job No.: K15-1185-101

Location : Port Qasim, Karachi

Soil Testing Services



ASTM D516, 512,

Borehole	Sample	Sample Depth (m)	Total Salt Content (ppm)	Chloride Content (ppm)	Sulphate Content (ppm)	pH Values
BH-2(A)	WS-1	12.15	1430	985	226	7.3
BH-5(A)	WS-4	11.0	2156	1648	356	7.4
BH-6(A)	WS-5	6.70	4350	3547	452	7.6
BH-8(A)	WS-7	4.40	9330	7458	569	7.4
BH-9(A)	WS-8	3.15	11236	8564	665	7.6

Consolidation Test

Project : Coal Unloading Terminal

Borehole : BH-08(A)

Soil Testing Services

Client : Techno Consultant International

Sample Depth : 7.8 (m)



Job No.: K15-1185-101

Classification : ML

Location : Port Qasim

Sample Type : Undisturbed

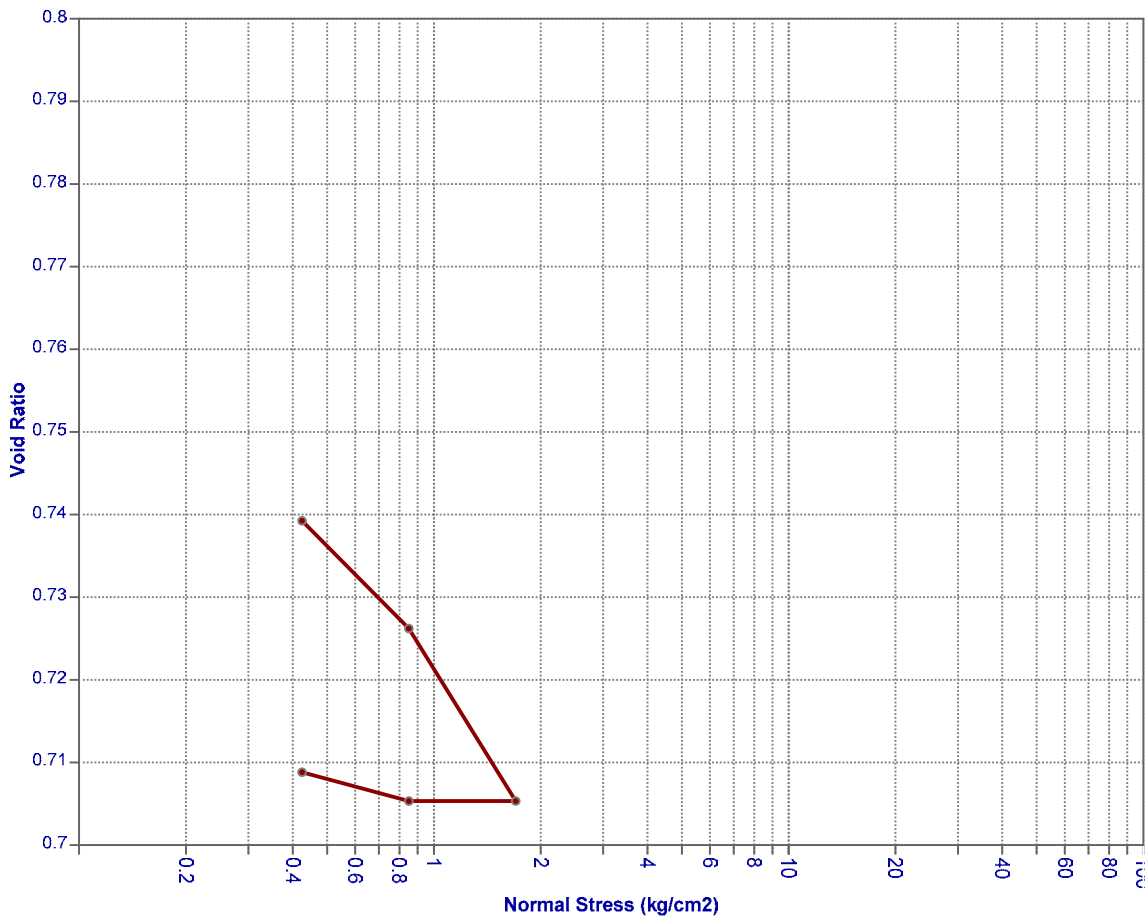
ASTM D2435

Sample Info

Diameter (cm)	Height (cm)	Dry Weight (gr)	Wet Weight Before (gr)	Wet Weight After (gr)	Void Ratio	Gs
6.2	2	92	111.5	185	0.74	2.65

Compression Parameters

Cc	Cs	Pre-Consolidation Pressure (kg/cm ²)
0.08	0.01	0.94



Mv Values

P1 (kg/cm ²)	P2 (kg/cm ²)	e1	e2	Mv 1/ (kg/cm ²)
0.425	0.85	0.739	0.726	1.76E-002
0.85	1.7	0.726	0.705	1.42E-002

Unified Description : Low Plasticity Clay With Sand
AASHTO Description : A-4, Silty soils

Tested By :
AK

General Information on Testing Procedures

A. DRILLING METHOD, FIELD TESTING & SAMPLING

The field testing program consisted of drilling works, and in-situ testing including Standard Penetration Tests (SPT), collection of soil samples, collection of water samples and rock coring. The following sections describe these activities in further detail.

A.1. DRILLING METHOD

All the boreholes were drilled by using rotary/wash boring method; in this method soil is cut by the constant rotation of various types of bits. Drilling fluid, which is either water or bentonite slurry, is circulated through drilling rods. The returning fluid lifts loosened material. Tricone bit was used for cohesive and granular soils.

The drilling in rock was carried out by double tube core barrels in conjunction with carbide or diamond bit. In a double tube core barrel the outer barrel is rotated by the drill rods, while, the inner barrel, which is mounted on a swivel, does not rotate during the drilling process. The core cut by the coring bit passes into the inner barrel. Core was prevented from dropping out by a steel core catcher it was then extruded and wrapped with waxed bandage tape, to preserve the natural moisture of the recovered core. The cores were stored in a core box and transported to the laboratory for testing. Figure A-1 shows the drilling works in progress.

Details of the boreholes are given in Table A.1.

Table A.1 Details of Boreholes

Marking	Coordinates (UTM zone 42R)	Borehole Depth (meters)	Water table Depth (meters)
BH-01	326814.68m E, 2746979.34m N	15.0	Not encountered
BH-02	327013.03m E, 2746979.21m N	15.0	Not encountered

Table A.1 Details of Boreholes (continued)

Marking	Coordinates (UTM zone 42R)	Borehole Depth (meters)	Water table Depth (meters)
BH-02 A	326832.00m E, 2746776.46m N	30.0	12.15
BH-02 B	326728.33m E, 2747177.11m N	15.0	Not encountered
BH-03	327212.08m E, 2746978.75m N	15.0	Not encountered
BH-03 A	326832.00m E, 2746579.18m N	30.0	14.0
BH-03 B	326704.70m E, 2747374.28m N	15.0	Not encountered
BH-04	327442.84m E, 2746977.99m N	15.0	Not encountered
BH-04 A	326859.47m E, 2746380.86m N	30.0	12.5
BH-04 B	326677.03m E, 2747575.06m N	15.0	Not encountered
BH-05	327636.78m E, 2746977.12m N	15.0	Not encountered
BH-05 A	326885.61m E, 2746182.65m N	30.0	11.0
BH-05 B	326651.19m E, 2747770.16m N	15.0	Not encountered
BH-06	327834.17m E, 2746976.79m N	15.0	Not encountered
BH-06 A	326915.55m E, 2745980.81m N	30.0	6.7
BH-06 B	326584.79m E, 2748350.28m N	15.0	Not encountered
BH-07	328026.33m E, 2746975.97m N	15.0	Not encountered

Table A.1 Details of Boreholes (continued)

Marking	Coordinates (UTM zone 42R)	Borehole Depth (meters)	Water table Depth (meters)
BH-07 A	326944.23m E, 2745782.68m N	30.0	4.5
BH-08	328235.71m E, 2746974.62m N	15.0	Not encountered
BH-08 A	326963.16m E, 2745612.19m N	30.0	4.4
BH-08 B	326559.52m E, 2748350.59m N	15.0	2.5
BH-09	328636.94m E, 2746974.35m N	15.0	Not encountered
BH-09 A	326980.32m E, 2745380.05m N	30.0	3.3
BH-10	327013.03m E, 2746973.41m N	15.0	Not encountered
BH-10 A	326977.31m E, 2745501.38m N	30.0	3.8
BH-11	328839.56m E, 2746971.73m N	15.0	Not encountered
BH-12	329032.98m E, 2746971.73m N	15.0	Not encountered
BH-13	329232.28m E, 2746971.02m N	15.0	Not encountered
BH-14	329416.34m E, 2746970.73m N	15.0	Not encountered
BH-15	329614.94m E, 2746970.06m N	15.0	Not encountered
BH-16	329821.75m E, 2746967.41m N	15.0	Not encountered
BH-17	329814.66m E, 2746733.43m N	15.0	Not encountered

Table A.1 Details of Boreholes (continued)

Marking	Coordinates (UTM zone 42R)	Borehole Depth (meters)	Water table Depth (meters)
BH-18	329827.70m E, 2746476.57m N	15.0	Not encountered
BH-19	329807.83m E, 2747218.03m N	15.0	Not encountered
BH-20	329791.70m E, 2747455.70m N	15.0	Not encountered



Figure A-1 Drilling works in progress

A.2. FIELD TESTING

Field testing forms a crucial part of the soil investigation process and its results are used in the geotechnical design. As part of the field testing programme, Standard Penetration Tests (SPT) were executed at site:

Following sections indicate the processes carried out in SPTs:

A.2.1. STANDARD PENETRATION TESTS

The standard penetration tests (SPT) were carried out at interval of 1 meter to 1.5 meters in the overburden above the bedrock. The standard penetration test was carried out by "Safety" type sliding hammer. Split-spoon sampler was used in cohesive and fine granular soils to conduct SPT.

The standard penetration test was carried out by an assembly of the following parts:

- Drive-weight assembly, consisting of a drive head and a 63.5kg impact hammer, a hammer fall guide and the drop system. The drop mechanism will ensure a constant free fall of 760mm.
- Drive rods connect the drive-weight assembly to the sampler.
- The split spoon sampler was used to carry out the test, along with retrieving disturbed samples.

The base of the borehole was made clean and reasonably undisturbed at the test elevation. Following precautions were taken during the testing sequence:

- The level of water or bentonite slurry was maintained at a sufficient level above the groundwater level, to ensure any entry of water through the bottom of the borehole.
- The casing was not driven below the level at which the test will start.

The test was executed in the following steps:

- The sampler and the drive rods were lowered in the borehole and the hammer assembly added to it.
- The sampler is penetrated over seating drive of 150mm and the numbers of blows are recorded.
- In the same way the sampler is driven over a test drive of 300mm in two increments of 150mm.
- The numbers of blows are recorded during each of the last two increments.

- The test was deemed finished when total number of blows equal to 50 was reached.

The standard penetration test was carried out in accordance with the procedure given in BS 1377-9:1990.



Figure A-2 Standard Penetration Test in Progress

A.3. SAMPLING

Sampling forms an essential part of the geotechnical investigation process and good sampling is essential for proper laboratory testing of samples for determining strength and compressibility characteristics of soil.

Soil samples were extracted from all the boreholes with the help of following tools:

- Disturbed samples through SPT
- Undisturbed samples through Thin Walled Shelby Tube
- Rock core samples through Double Tube Core Barrel
- Water sample through Water Sampler

Following section indicates the processes carried out in each of the field tests and sampling.

A.3.1. SPT SAMPLES

Samples were recovered from standard penetration testing. The samples were recovered in split-spoon sampler and then stored in plastic bags. The storage of split-spoon samples in bags ensured retention of natural moisture of the samples which were later tested for gradation, consistency and chemical characteristics.



Figure A-3 Disturbed Soil Sample in Split Spoon Sampler

A.3.2. THIN-WALLED SHELBY TUBE SAMPLING

Undisturbed samples from soft to medium stiff clay were taken by Shelby tubes. The Shelby tube consists of an open tube with one sharp end connecting to a head which acts as an attachment to the drilling rods. The Shelby tube sampling is done by pushing the rods by exerting hydraulic pressure. The tube is lifted from the borehole after sampling and is preserved by waxing the open ends of the tube.

A.3.3. ROCK CORE SAMPLES

Rock core samples were collected from the deposits through coring. Unconfined compressive strength of these samples was determined in the laboratory. Figure A-4 shows the rock samples stored in core box.



Figure A-4 Rock core samples in core box

A.3.4. WATER SAMPLES

In order to determine the chemical characteristic of groundwater, water samples were collected from the boreholes. The samples were preserved in airtight bottle & later transported to the testing laboratory. Chemical characteristics of water samples have also been assessed through determination of sulphate content, chloride content, TDS and pH.

B. LABORATORY TESTING

Laboratory testing was carried out on retrieved disturbed soil samples. The following section enlists and gives details of relevant tests carried out on selected samples as required for determining the subsurface conditions and correlating with the information obtained from field testing and sampling.

B.1. GRAIN SIZE ANALYSIS

The purpose of grain size analysis is to determine the sizes of the assemblage of particles that make up the soil. The grain size analysis is conducted in two parts: for particles above the “# 200 US sieve”, sieve analysis is carried out by passing the selected soil sample from various sieves. For particles finer than the “# 200 US sieve”, hydrometer analysis is carried out. The combined process of determination of the size of particles is termed as the grain size analysis.

The results are appended with the report in Appendix C. Grain size analysis of one hundred and seventeen (117) soil samples were carried out as per ASTM D 422.

B.2. LIQUID AND PLASTIC LIMITS

The liquid and plastic limits of soil are parameters that define the state of the soil at different water content levels. The liquid limit is the water content above which the soil goes from solid phase to liquid phase and the plastic limit indicates the water content below which the soil mass makes the transition from a plastic, remouldable solid to a brittle mass which cannot be remoulded any more. The difference in the water contents at Liquid and Plastic limits is termed as the plasticity index and it is a measure of the plasticity of the soil under consideration. The samples used for determining the limits are finer than the “#40 US sieve”. The limits were determined in accordance with the ASTM D-4318.

Liquid and plastic limits of twenty three (23) samples extracted from boreholes were carried out in accordance with the given procedure.

B.3. NATURAL MOISTURE CONTENT

Natural moisture content is the quantity of water contained in a soil or rock sample. It is the ratio of the weight of water to the weight of solids in a given volume of soil or rock sample. Natural moisture content of one hundred and fifteen (115) samples was determined in accordance with ASTM 2216-05.

B.4. DENSITY

The weight per unit volume of the solid portion of soil is called particle (dry) density. Whereas, the oven dry weight of a unit volume of soil inclusive of pore spaces is called bulk (wet) density. The bulk density of a soil is always smaller than its particle density. Density of one hundred and fifteen (115) samples was determined in accordance with the procedure described in ASTM D 7263-09.

B.5. SPECIFIC GRAVITY

Specific gravity (G_s) is defined as mass of material in air divided by mass of water displaced by material. This quantity is used for calculation of void ratio, in hydrometer test, etc. Specific gravity of one hundred and fifteen (115) samples was determined in accordance with the procedure described in ASTM D 854-05.

B.6. DIRECT SHEAR TEST

The direct shear test involves, placing a test sample in a rectangular box having two portions, the top portion can move while the lower portion is fixed. The sample is consolidated under a normal load. Also, double drainage is ensured by placing porous stones on the top and bottom of the sample. Hence, the test may be carried out under drained conditions. The shear strength of a remoulded sample is measured by applying a horizontal force which pushes the top part of rectangular box, the sample is sheared to failure and the normal and shear stresses at the point of failure are noted down. The shear box test (or the direct shear test) suffers from various limitations the most prominent of which is the forced failure plane formed due the configuration of the apparatus; this might result in concealing the actual plane of failure. As, the tests are carried out on disturbed samples and since only the stresses at the point of failure are

determined the test results cannot be reliably used in describing the strength characteristics of the ground. The ASTM D 3080-04 was followed for the performance of static direct simple shear tests. The angle of internal friction of soil came out to be 31.76° to 36.43°.

B.7. UNCONFINED COMPRESSION TEST

Unconfined compressive strength test involves axially loading a cylindrical rock core or undisturbed clay sample to failure. The term unconfined is used because the lateral force on the sample is zero. The unconfined compressive strength test was carried out in accordance with ASTM D 7012. The strength of the retrieved samples tested came out to be ranging from 0.05 Kg/cm² to 500.07 Kg/cm². The results of the unconfined compression test are summarized in Appendices.

B.8. CHEMICAL TESTS

Sulphate in groundwater or soil can attack concrete placed in the ground or on surface. A reaction takes place between the sulphate and the aluminate compounds present in the cement, causing crystallisation of complex compounds. The expansion, which accompanies crystallisation, induces stresses in the concrete, which results in mechanical disintegration.

In moist conditions, such as exposure to seawater, the presence of chloride ion, Cl⁻, presents a serious possibility of the corrosion of the reinforcement. The presence of Ca(OH)₂ provides a strong alkaline environment in which a thin film of iron oxide is formed on the metal surface which protects it against corrosion. However, if the concrete is permeable to the extent that the soluble chlorides can reach up to the reinforcing steel, then in the presence of water and oxygen, the corrosion of the reinforcement will take place. Rust occupies more volume than the original steel, and hence the ensuing expansion of concrete, results in cracking and spalling.

Due to adverse effect of sulphates and chlorides on the quality of concrete it is essential to conduct chemical tests on soil and groundwater. This helps in quantifying the expected exposure of concrete to these chemicals and in devising precautionary measures to ensure integrity of concrete.

The following chemical tests were carried out on soil and water samples:

- Total dissolved solids
- Chloride content
- Sulphate content
- pH

Chemical tests were carried out in accordance with ASTM D 512, D 516, and D 1293. The selection of cement for underground concreting and is discussed in Chapter 4.

Table B.1 ACI standards for concrete for sulphate exposure

Sulphate Exposure	Water Soluble Sulphates in Soil (%)	Sulphate in Water (mg/L)	Cement Type
Negligible	0.00-0.10	0- 150	OPC
Moderate	0.10-0.20	150- 1500	Type II
Severe	0.20-2.00	1500-10000	Type V
Very Severe	Over 2.00	Over 10000	Type V plus pozzolan

Calculations

PILE CAPACITIES FOR BH-1

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17.5	8.8	29	-	-	-	-	-	29	0.51	0.515	3.0	2	2
1-2	cohesionless	0.76	1	17.5	26.3	29	-	-	-	-	-	29	0.51	0.515	3.0	5	7
2-3	cohesionless	0.76	1	17.5	43.8	29	-	-	-	-	-	29	0.51	0.515	3.0	9	16
3-4	cohesionless	0.76	1	17.5	61.3	29	-	-	-	-	-	29	0.51	0.515	3.0	13	29
4-5	cohesionless	0.76	1	17.5	78.8	29	-	-	-	-	-	29	0.51	0.515	3.0	16	45
5-6	cohesive	0.76	1	18	96.5	-	150	-	0.75	-	-	-	-	-	2.0	134	180
6-7	cohesionless	0.76	1	18.5	114.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	203
7-8	cohesionless	0.76	1	18.5	133.3	36	-	-	-	-	-	36	0.63	0.412	3.0	27	231
8-9	cohesionless	0.76	1	18.5	151.8	36	-	-	-	-	-	36	0.63	0.412	3.0	31	262
9-10	cohesionless	0.76	1	18.5	170.3	36	-	-	-	-	-	36	0.63	0.412	3.0	35	297
10-11	cohesionless	0.76	1	18.5	188.8	36	-	-	-	-	-	36	0.63	0.412	3.0	39	336
11-12	cohesionless	0.76	1	18.5	207.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	379
12-13	cohesionless	0.76	1	18.5	225.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	425
13-14	cohesionless	0.76	1	18.5	244.3	36	-	-	-	-	-	36	0.63	0.412	3.0	50	476
14-15	cohesionless	0.76	1	18.5	262.8	36	-	-	-	-	-	36	0.63	0.412	3.0	54	530

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17.5	8.8	29	-	-	-	-	-	29	0.51	0.515	3.0	2	2
1-2	cohesionless	1.00	1	17.5	26.3	29	-	-	-	-	-	29	0.51	0.515	3.0	7	10
2-3	cohesionless	1.00	1	17.5	43.8	29	-	-	-	-	-	29	0.51	0.515	3.0	12	22
3-4	cohesionless	1.00	1	17.5	61.3	29	-	-	-	-	-	29	0.51	0.515	3.0	17	38
4-5	cohesionless	1.00	1	17.5	78.8	29	-	-	-	-	-	29	0.51	0.515	3.0	22	60
5-6	cohesive	1.00	1	18	96.5	-	150	-	0.75	-	-	-	-	-	2.0	177	236
6-7	cohesionless	1.00	1	18.5	114.8	36	-	-	-	-	-	36	0.63	0.412	3.0	31	267
7-8	cohesionless	1.00	1	18.5	133.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	304
8-9	cohesionless	1.00	1	18.5	151.8	36	-	-	-	-	-	36	0.63	0.412	3.0	41	345
9-10	cohesionless	1.00	1	18.5	170.3	36	-	-	-	-	-	36	0.63	0.412	3.0	46	391
10-11	cohesionless	1.00	1	18.5	188.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	442
11-12	cohesionless	1.00	1	18.5	207.3	36	-	-	-	-	-	36	0.63	0.412	3.0	56	498
12-13	cohesionless	1.00	1	18.5	225.8	36	-	-	-	-	-	36	0.63	0.412	3.0	61	560
13-14	cohesionless	1.00	1	18.5	244.3	36	-	-	-	-	-	36	0.63	0.412	3.0	66	626
14-15	cohesionless	1.00	1	18.5	262.8	36	-	-	-	-	-	36	0.63	0.412	3.0	71	697

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	207.3	4.0	1057
Sand	760	15.0	36.0	45.0	262.8	4.0	1340
Sand	1000	12.0	36.0	45.0	207.3	4.0	1830
Sand	1000	15.0	36.0	45.0	262.8	4.0	2320

PILE CAPACITIES FOR BH-2

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	2.0	31	79
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	104
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	133
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	165
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	201
10-11	cohesive	0.76	1	18	194.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	335
11-12	cohesive	0.76	1	18	212.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	89	425
12-13	cohesive	0.76	1	18	230.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	89	514
13-14	Rock	0.76	1	21	249.5	45	-	130	-	0.5	0.7	45	0.79	0.293	5.0	22	536
14-15	Rock	0.76	1	21	270.5	45	-	130	-	0.5	0.7	45	0.79	0.293	5.0	22	558

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	2.0	41	104
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	33	137
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	38	174
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	217
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	265
10-11	cohesive	1.00	1	18	194.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	441
11-12	cohesive	1.00	1	18	212.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	118	559
12-13	cohesive	1.00	1	18	230.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	118	677
13-14	Rock	1.00	1	21	249.5	45	-	130	-	0.5	0.7	45	0.79	0.293	5.0	29	705
14-15	Rock	1.00	1	21	270.5	45	-	130	-	0.5	0.7	45	0.79	0.293	5.0	29	734

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	15.0	4.5	130.0	5.0	106
Rock	1000	15.0	4.5	130.0	5.0	184

PILE CAPACITIES FOR BH-2 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	cohesionless	0.76	1	8.5	226.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	321
13-14	cohesionless	0.76	1	8.5	234.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	370
14-15	cohesionless	0.76	1	8.5	243.3	36	-	-	-	-	-	36	0.63	0.412	3.0	50	420
15-16	Rock	0.76	1	21	258.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	443
16-17	Rock	0.76	1	21	279.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	467
17-18	Rock	0.76	1	21	300.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	490
18-19	Rock	0.76	1	21	321.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	513
19-20	Rock	0.76	1	21	342.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	537
20-21	Rock	0.76	1	21	363.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	560
21-22	Rock	0.76	1	21	384.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	584
22-23	Rock	0.76	1	21	405.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	607
24-24	Rock	0.76	1	21	426.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	630

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	447.0	45		140		0.5	0.7	45	0.79	0.293	5.0	23	654
25-26	Rock	0.76	1	21	468.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	23	677
26-27	Rock	0.76	1	21	489.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	23	701
27-28	Rock	0.76	1	21	510.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	23	724
28-29	Rock	0.76	1	21	531.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	23	747
29-30	Rock	0.76	1	21	552.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	23	771

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	203
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	251
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	53	304
11-12	cohesionless	1.00	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	58	361
12-13	cohesionless	1.00	1	8.5	226.3	36	-	-	-	-	-	36	0.63	0.412	3.0	61	423
13-14	cohesionless	1.00	1	8.5	234.8	36	-	-	-	-	-	36	0.63	0.412	3.0	64	486
14-15	cohesionless	1.00	1	8.5	243.3	36	-	-	-	-	-	36	0.63	0.412	3.0	66	552
15-16	Rock	1.00	1	21	258.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	583
16-17	Rock	1.00	1	21	279.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	614
17-18	Rock	1.00	1	21	300.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	645
18-19	Rock	1.00	1	21	321.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	676
19-20	Rock	1.00	1	21	342.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	706
20-21	Rock	1.00	1	21	363.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	737
21-22	Rock	1.00	1	21	384.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	768
22-23	Rock	1.00	1	21	405.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	799
24-24	Rock	1.00	1	21	426.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	830

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	1.00	1	21	447.0	45		140		0.5	0.7	45	0.79	0.293	5.0	31	860
25-26	Rock	1.00	1	21	468.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	31	891
26-27	Rock	1.00	1	21	489.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	31	922
27-28	Rock	1.00	1	21	510.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	31	953
28-29	Rock	1.00	1	21	531.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	31	984
29-30	Rock	1.00	1	21	552.0	45	-	140	-	0.5	0.7	45	0.79	0.293	5.0	31	1014

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	140.0	5.0	114
Rock	760	25.0	4.5	140.0	5.0	114
Rock	760	30.0	4.5	140.0	5.0	114
Rock	1000	20.0	4.5	140.0	5.0	198
Rock	1000	25.0	4.5	140.0	5.0	198
Rock	1000	30.0	4.5	140.0	5.0	198

PILE CAPACITIES FOR BH-2 B

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17	8.5	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	0.76	1	17	25.5	28	-	-	-	-	-	28	0.49	0.530	3.0	5	7
2-3	cohesionless	0.76	1	17	42.5	28	-	-	-	-	-	28	0.49	0.530	3.0	9	16
3-4	cohesionless	0.76	1	18.5	60.3	36	-	-	-	-	-	36	0.63	0.412	3.0	12	28
4-5	cohesionless	0.76	1	18.5	78.8	36	-	-	-	-	-	36	0.63	0.412	3.0	16	44
5-6	cohesionless	0.76	1	18.5	97.3	36	-	-	-	-	-	36	0.63	0.412	2.0	30	75
6-7	cohesionless	0.76	1	18.5	115.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	98
7-8	cohesionless	0.76	1	18.5	134.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	126
8-9	cohesionless	0.76	1	18.5	152.8	36	-	-	-	-	-	36	0.63	0.412	3.0	31	158
9-10	cohesionless	0.76	1	18.5	171.3	36	-	-	-	-	-	36	0.63	0.412	3.0	35	193
10-11	cohesionless	0.76	1	18.5	189.8	36	-	-	-	-	-	36	0.63	0.412	3.0	39	232
11-12	cohesionless	0.76	1	18.5	208.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	275
12-13	cohesionless	0.76	1	18.5	226.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	322
13-14	cohesive	0.76	1	18	245.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	456
14-15	Rock	0.76	1	21	264.5	45	-	300	-	0.5	0.7	45	0.79	0.293	5.0	50	506

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17	8.5	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	1.00	1	17	25.5	28	-	-	-	-	-	28	0.49	0.530	3.0	7	9
2-3	cohesionless	1.00	1	17	42.5	28	-	-	-	-	-	28	0.49	0.530	3.0	12	21
3-4	cohesionless	1.00	1	18.5	60.3	36	-	-	-	-	-	36	0.63	0.412	3.0	16	37
4-5	cohesionless	1.00	1	18.5	78.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	58
5-6	cohesionless	1.00	1	18.5	97.3	36	-	-	-	-	-	36	0.63	0.412	2.0	40	98
6-7	cohesionless	1.00	1	18.5	115.8	36	-	-	-	-	-	36	0.63	0.412	3.0	31	129
7-8	cohesionless	1.00	1	18.5	134.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	166
8-9	cohesionless	1.00	1	18.5	152.8	36	-	-	-	-	-	36	0.63	0.412	3.0	41	207
9-10	cohesionless	1.00	1	18.5	171.3	36	-	-	-	-	-	36	0.63	0.412	3.0	46	254
10-11	cohesionless	1.00	1	18.5	189.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	305
11-12	cohesionless	1.00	1	18.5	208.3	36	-	-	-	-	-	36	0.63	0.412	3.0	56	362
12-13	cohesionless	1.00	1	18.5	226.8	36	-	-	-	-	-	36	0.63	0.412	3.0	62	423
13-14	cohesive	1.00	1	18	245.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	600
14-15	Rock	1.00	1	21	264.5	45	-	300	-	0.5	0.7	45	0.79	0.293	5.0	66	666

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	15.0	4.5	300.0	5.0	245
Rock	1000	15.0	4.5	300.0	5.0	424

PILE CAPACITIES FOR BH-3

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	9	17
3-4	cohesionless	0.76	1	18	63.0	34	-	-	-	-	-	34	0.59	0.441	3.0	13	30
4-5	cohesionless	0.76	1	18	81.0	34	-	-	-	-	-	34	0.59	0.441	3.0	17	47
5-6	cohesionless	0.76	1	18.5	99.3	36	-	-	-	-	-	36	0.63	0.412	3.0	20	67
6-7	cohesionless	0.76	1	17.5	117.3	31	-	-	-	-	-	31	0.54	0.485	3.0	24	92
7-8	cohesionless	0.76	1	17.5	134.8	31	-	-	-	-	-	31	0.54	0.485	3.0	28	120
8-9	cohesionless	0.76	1	18	152.5	35	-	-	-	-	-	35	0.61	0.426	3.0	32	152
9-10	cohesionless	0.76	1	18.5	170.8	36	-	-	-	-	-	36	0.63	0.412	3.0	35	187
10-11	cohesionless	0.76	1	18.5	189.3	36	-	-	-	-	-	36	0.63	0.412	3.0	39	226
11-12	Rock	0.76	1	20	208.5	40	-	200	-	0.5	0.7	40	0.70	0.357	5.0	33	259
12-13	cohesionless	0.76	1	18.5	227.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	306
13-14	cohesionless	0.76	1	18.5	246.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	357
14-15	cohesionless	0.76	1	18.5	264.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	411

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	9	17
3-4	cohesionless	0.76	1	18	63.0	34	-	-	-	-	-	34	0.59	0.441	3.0	13	30
4-5	cohesionless	0.76	1	18	81.0	34	-	-	-	-	-	34	0.59	0.441	3.0	17	47
5-6	cohesionless	0.76	1	18.5	99.3	36	-	-	-	-	-	36	0.63	0.412	3.0	20	67
6-7	cohesionless	0.76	1	17.5	117.3	31	-	-	-	-	-	31	0.54	0.485	3.0	24	92
7-8	cohesionless	0.76	1	17.5	134.8	31	-	-	-	-	-	31	0.54	0.485	3.0	28	120
8-9	cohesionless	0.76	1	18	152.5	35	-	-	-	-	-	35	0.61	0.426	3.0	32	152
9-10	cohesionless	0.76	1	18.5	170.8	36	-	-	-	-	-	36	0.63	0.412	3.0	35	187
10-11	cohesionless	0.76	1	18.5	189.3	36	-	-	-	-	-	36	0.63	0.412	3.0	39	226
11-12	Rock	0.76	1	20	208.5	40	-	200	-	0.5	0.7	40	0.70	0.357	5.0	33	259
12-13	cohesionless	0.76	1	18.5	227.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	306
13-14	cohesionless	0.76	1	18.5	246.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	357
14-15	cohesionless	0.76	1	18.5	264.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	411

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	13.0	36.0	45.0	227.8	4.0	1162
Sand	760	15.0	36.0	45.0	264.8	4.0	1350
Sand	1000	13.0	36.0	45.0	227.8	4.0	2011
Sand	1000	15.0	36.0	45.0	264.8	4.0	2338

PILE CAPACITIES FOR BH-3 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	Rock	0.76	1	21	232.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	291
13-14	Rock	0.76	1	21	253.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	308
14-15	Rock	0.76	1	21	274.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	325
15-16	Rock	0.76	1	21	295.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	341
16-17	Rock	0.76	1	21	316.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	358
17-18	Rock	0.76	1	21	337.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	375
18-19	Rock	0.76	1	21	358.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	392
19-20	Rock	0.76	1	21	379.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	408
20-21	Rock	0.76	1	21	400.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	425
21-22	Rock	0.76	1	21	421.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	442
22-23	Rock	0.76	1	21	442.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	458
24-24	Rock	0.76	1	21	463.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	475

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	484.5	45		100		0.5	0.7	45	0.79	0.293	5.0	17	492
25-26	Rock	0.76	1	21	505.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	509
26-27	Rock	0.76	1	21	526.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	525
27-28	Rock	0.76	1	21	547.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	542
28-29	Rock	0.76	1	21	568.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	559
29-30	Rock	0.76	1	21	589.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	17	576

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	203
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	251
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	53	304
11-12	cohesionless	1.00	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	58	361
12-13	Rock	1.00	1	21	232.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	383
13-14	Rock	1.00	1	21	253.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	405
14-15	Rock	1.00	1	21	274.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	427
15-16	Rock	1.00	1	21	295.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	449
16-17	Rock	1.00	1	21	316.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	471
17-18	Rock	1.00	1	21	337.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	493
18-19	Rock	1.00	1	21	358.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	515
19-20	Rock	1.00	1	21	379.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	537
20-21	Rock	1.00	1	21	400.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	559
21-22	Rock	1.00	1	21	421.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	581
22-23	Rock	1.00	1	21	442.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	603
24-24	Rock	1.00	1	21	463.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	625

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	1.00	1	21	484.5	45		100		0.5	0.7	45	0.79	0.293	5.0	22	647
25-26	Rock	1.00	1	21	505.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	669
26-27	Rock	1.00	1	21	526.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	691
27-28	Rock	1.00	1	21	547.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	713
28-29	Rock	1.00	1	21	568.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	735
29-30	Rock	1.00	1	21	589.5	45	-	100	-	0.5	0.7	45	0.79	0.293	5.0	22	757

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	100.0	5.0	82
Rock	760	25.0	4.5	100.0	5.0	82
Rock	760	30.0	4.5	100.0	5.0	82
Rock	1000	20.0	4.5	100.0	5.0	141
Rock	1000	25.0	4.5	100.0	5.0	141
Rock	1000	30.0	4.5	100.0	5.0	141

PILE CAPACITIES FOR BH-3 B

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesive	0.76	1	18	120.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	203
7-8	cohesive	0.76	1	18	138.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	337
8-9	cohesive	0.76	1	18	156.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	472
9-10	cohesionless	0.76	1	18.5	174.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	508
10-11	cohesionless	0.76	1	18.5	192.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	547
11-12	cohesionless	0.76	1	20	212.0	36	-	-	-	-	-	36	0.63	0.412	3.0	44	591
12-13	cohesionless	0.76	1	18.5	231.3	36	-	-	-	-	-	36	0.63	0.412	3.0	48	639
13-14	cohesionless	0.76	1	18.5	249.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	690
14-15	cohesive	0.76	1	18.5	268.3	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	825

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesive	1.00	1	18	120.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	267
7-8	cohesive	1.00	1	18	138.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	444
8-9	cohesive	1.00	1	18	156.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	621
9-10	cohesionless	1.00	1	18.5	174.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	668
10-11	cohesionless	1.00	1	18.5	192.8	36	-	-	-	-	-	36	0.63	0.412	3.0	52	720
11-12	cohesionless	1.00	1	20	212.0	36	-	-	-	-	-	36	0.63	0.412	3.0	58	778
12-13	cohesionless	1.00	1	18.5	231.3	36	-	-	-	-	-	36	0.63	0.412	3.0	63	840
13-14	cohesionless	1.00	1	18.5	249.8	36	-	-	-	-	-	36	0.63	0.412	3.0	68	908
14-15	cohesive	1.00	1	18.5	268.3	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1085

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	C	Nc	FOS	Q _{END} (kN)
Clay	760	15.0	150.0	9.0	3.0	204
Clay	1000	15.0	150.0	9.0	3.0	353

PILE CAPACITIES FOR BH-4

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesive	0.76	1	18	120.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	203
7-8	cohesive	0.76	1	18	138.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	337
8-9	cohesionless	0.76	1	18.5	156.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	370
9-10	cohesionless	0.76	1	18.5	174.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	406
10-11	cohesionless	0.76	1	18.5	193.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	445
11-12	cohesive	0.76	1	18	211.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	580
12-13	cohesionless	0.76	1	18.5	229.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	627
13-14	cohesionless	0.76	1	18.5	248.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	678
14-15	cohesionless	0.76	1	18.5	266.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	733

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesive	1.00	1	18	120.0	0	-	-	-	0	0.00	1.000	2.0	177	267
7-8	cohesive	1.00	1	18	138.0	0	-	-	-	0	0.00	1.000	2.0	177	444
8-9	cohesionless	1.00	1	18.5	156.3	36	-	-	-	36	0.63	0.412	3.0	42	486
9-10	cohesionless	1.00	1	18.5	174.8	36	-	-	-	36	0.63	0.412	3.0	47	534
10-11	cohesionless	1.00	1	18.5	193.3	36	-	-	-	36	0.63	0.412	3.0	52	586
11-12	cohesive	1.00	1	18	211.5	0	-	-	-	0	0.00	1.000	2.0	177	763
12-13	cohesionless	1.00	1	18.5	229.8	36	-	-	-	36	0.63	0.412	3.0	62	825
13-14	cohesionless	1.00	1	18.5	248.3	36	-	-	-	36	0.63	0.412	3.0	67	893
14-15	cohesionless	1.00	1	18.5	266.8	36	-	-	-	36	0.63	0.412	3.0	72	965

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	C	Nc	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	13.0	36.0	-	-	45.0	229.8	4.0	1172
Sand	760	15.0	36.0			45.0	266.8	4.0	1361
Sand	1000	13.0	36.0			45.0	229.8	4.0	2029
Sand	1000	15.0	36.0	-	-	45.0	266.8	4.0	2356

PILE CAPACITIES FOR BH-4 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	cohesionless	0.76	1	8.5	226.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	321
13-14	cohesionless	0.76	1	8.5	234.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	370
14-15	Rock	0.76	1	21	249.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	411
15-16	Rock	0.76	1	21	270.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	453
16-17	Rock	0.76	1	21	291.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	495
17-18	Rock	0.76	1	21	312.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	537
18-19	Rock	0.76	1	21	333.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	579
19-20	Rock	0.76	1	21	354.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	620
20-21	Rock	0.76	1	21	375.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	662
21-22	Rock	0.76	1	21	396.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	704
22-23	Rock	0.76	1	21	417.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	746
24-24	Rock	0.76	1	21	438.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	788

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	459.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	829
25-26	Rock	0.76	1	21	480.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	871
26-27	Rock	0.76	1	21	501.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	913
27-28	Rock	0.76	1	21	522.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	955
28-29	Rock	0.76	1	21	543.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	997
29-30	Rock	0.76	1	21	564.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	1038

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	cohesionless	0.76	1	8.5	226.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	321
13-14	cohesionless	0.76	1	8.5	234.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	370
14-15	Rock	0.76	1	21	249.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	411
15-16	Rock	0.76	1	21	270.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	453
16-17	Rock	0.76	1	21	291.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	495
17-18	Rock	0.76	1	21	312.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	537
18-19	Rock	0.76	1	21	333.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	579
19-20	Rock	0.76	1	21	354.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	620
20-21	Rock	0.76	1	21	375.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	662
21-22	Rock	0.76	1	21	396.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	704
22-23	Rock	0.76	1	21	417.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	746
24-24	Rock	0.76	1	21	438.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	788

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	459.5	45		250		0.5	0.7	45	0.79	0.293	5.0	42	829
25-26	Rock	0.76	1	21	480.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	871
26-27	Rock	0.76	1	21	501.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	913
27-28	Rock	0.76	1	21	522.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	955
28-29	Rock	0.76	1	21	543.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	997
29-30	Rock	0.76	1	21	564.5	45	-	250	-	0.5	0.7	45	0.79	0.293	5.0	42	1038

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	250.0	5.0	204
Rock	760	25.0	4.5	250.0	5.0	204
Rock	760	30.0	4.5	250.0	5.0	204
Rock	1000	20.0	4.5	250.0	5.0	353
Rock	1000	25.0	4.5	250.0	5.0	353
Rock	1000	30.0	4.5	250.0	5.0	353

PILE CAPACITIES FOR BH-4 B

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17.5	8.8	29	-	-	-	-	-	29	0.51	0.515	3.0	2	2
1-2	cohesionless	0.76	1	17.5	26.3	29	-	-	-	-	-	29	0.51	0.515	3.0	5	7
2-3	cohesionless	0.76	1	17.5	43.8	29	-	-	-	-	-	29	0.51	0.515	3.0	9	16
3-4	cohesionless	0.76	1	18.5	61.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	29
4-5	cohesionless	0.76	1	18.5	80.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	46
5-6	cohesionless	0.76	1	18	98.5	32	-	-	-	-	-	32	0.56	0.470	3.0	21	66
6-7	cohesionless	0.76	1	18.5	116.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	90
7-8	cohesionless	0.76	1	18.5	135.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	118
8-9	cohesionless	0.76	1	18.5	153.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	150
9-10	cohesionless	0.76	1	18.5	172.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	185
10-11	cohesionless	0.76	1	18.5	190.8	36	-	-	-	-	-	36	0.63	0.412	3.0	39	225
11-12	cohesionless	0.76	1	18.5	209.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	268
12-13	cohesionless	0.76	1	18.5	227.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	315
13-14	cohesionless	0.76	1	18.5	246.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	366
14-15	cohesionless	0.76	1	18.5	264.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	420

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17.5	8.8	29	-	-	-	29	0.51	0.515	3.0	2	2
1-2	cohesionless	1.00	1	17.5	26.3	29	-	-	-	29	0.51	0.515	3.0	7	10
2-3	cohesionless	1.00	1	17.5	43.8	29	-	-	-	29	0.51	0.515	3.0	12	22
3-4	cohesionless	1.00	1	18.5	61.8	36	-	-	-	36	0.63	0.412	3.0	17	38
4-5	cohesionless	1.00	1	18.5	80.3	36	-	-	-	36	0.63	0.412	3.0	22	60
5-6	cohesionless	1.00	1	18	98.5	32	-	-	-	32	0.56	0.470	3.0	27	87
6-7	cohesionless	1.00	1	18.5	116.8	36	-	-	-	36	0.63	0.412	3.0	32	119
7-8	cohesionless	1.00	1	18.5	135.3	36	-	-	-	36	0.63	0.412	3.0	37	155
8-9	cohesionless	1.00	1	18.5	153.8	36	-	-	-	36	0.63	0.412	3.0	42	197
9-10	cohesionless	1.00	1	18.5	172.3	36	-	-	-	36	0.63	0.412	3.0	47	244
10-11	cohesionless	1.00	1	18.5	190.8	36	-	-	-	36	0.63	0.412	3.0	52	296
11-12	cohesionless	1.00	1	18.5	209.3	36	-	-	-	36	0.63	0.412	3.0	57	352
12-13	cohesionless	1.00	1	18.5	227.8	36	-	-	-	36	0.63	0.412	3.0	62	414
13-14	cohesionless	1.00	1	18.5	246.3	36	-	-	-	36	0.63	0.412	3.0	67	481
14-15	cohesionless	1.00	1	18.5	264.8	36	-	-	-	36	0.63	0.412	3.0	72	553

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	C	Nc	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	-	-	45.0	209.3	4.0	1067
Sand	760	15.0	36.0			45.0	264.8	4.0	1350
Sand	1000	12.0	36.0			45.0	209.3	4.0	1848
Sand	1000	15.0	36.0	-	-	45.0	264.8	4.0	2338

PILE CAPACITIES FOR BH-5

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesive	0.76	1	18	120.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	203
7-8	cohesive	0.76	1	18	138.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	337
8-9	cohesionless	0.76	1	18.5	156.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	369
9-10	cohesionless	0.76	1	18.5	174.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	405
10-11	cohesionless	0.76	1	18.5	193.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	445
11-12	cohesionless	0.76	1	18.5	211.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	489
12-13	cohesionless	0.76	1	18.5	230.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	536
13-14	cohesionless	0.76	1	18.5	248.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	588
14-15	cohesionless	0.76	1	18.5	267.3	36	-	-	-	-	-	36	0.63	0.412	3.0	55	643

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesive	1.00	1	18	120.0	0	-	-	-	0	0.00	1.000	2.0	177	267
7-8	cohesive	1.00	1	18	138.0	0	-	-	-	0	0.00	1.000	2.0	177	444
8-9	cohesionless	1.00	1	18.5	156.3	36	-	-	-	36	0.63	0.412	3.0	42	486
9-10	cohesionless	1.00	1	18.5	174.8	36	-	-	-	36	0.63	0.412	3.0	47	533
10-11	cohesionless	1.00	1	18.5	193.3	36	-	-	-	36	0.63	0.412	3.0	52	586
11-12	cohesionless	1.00	1	18.5	211.8	36	-	-	-	36	0.63	0.412	3.0	57	643
12-13	cohesionless	1.00	1	18.5	230.3	36	-	-	-	36	0.63	0.412	3.0	62	706
13-14	cohesionless	1.00	1	18.5	248.8	36	-	-	-	36	0.63	0.412	3.0	67	773
14-15	cohesionless	1.00	1	18.5	267.3	36	-	-	-	36	0.63	0.412	3.0	72	846

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	C	Nc	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	-	-	45.0	211.8	4.0	1080
Sand	760	15.0	36.0			45.0	267.3	4.0	1363
Sand	1000	12.0	36.0			45.0	211.8	4.0	1870
Sand	1000	15.0	36.0	-	-	45.0	267.3	4.0	2360

PILE CAPACITIES FOR BH-5 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17.5	8.8	30	-	-	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	0.76	1	17.5	26.3	30	-	-	-	-	-	30	0.52	0.500	3.0	5	7
2-3	cohesive	0.76	1	18	44.0	0	100	-	0.75	-	-	0	0.00	1.000	2.0	90	97
3-4	cohesive	0.76	1	18	62.0	0	100	-	0.75	-	-	0	0.00	1.000	2.0	90	186
4-5	cohesive	0.76	1	18	80.0	0	100	-	0.75	-	-	0	0.00	1.000	2.0	90	276
5-6	cohesionless	0.76	1	18	98.0	33	-	-	-	-	-	33	0.58	0.455	3.0	20	296
6-7	cohesive	0.76	1	18	116.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	431
7-8	cohesive	0.76	1	18	134.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	565
8-9	cohesive	0.76	1	18	152.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	700
9-10	cohesive	0.76	1	18	170.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	834
10-11	cohesive	0.76	1	18	188.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	968
11-12	cohesive	0.76	1	8	201.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1103
12-13	cohesive	0.76	1	8	209.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1237
13-14	cohesive	0.76	1	8	217.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1371
14-15	cohesive	0.76	1	8	225.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1506
15-16	cohesive	0.76	1	8	233.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1640
16-17	cohesive	0.76	1	8	241.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1774
17-18	cohesive	0.76	1	8	249.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	1909
18-19	cohesive	0.76	1	8	257.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	2043
19-20	cohesive	0.76	1	8	265.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	2177
20-21	cohesive	0.76	1	8	273.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	2312
21-22	Rock	0.76	1	21	287.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	12	2324
22-23	Rock	0.76	1	21	308.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	12	2335
24-24	Rock	0.76	1	21	329.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	12	2347

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	350.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	12	2359
25-26	Rock	0.76	1	21	371.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	12	2370
26-27	Rock	0.76	1	21	392.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	12	2382
27-28	Rock	0.76	1	21	413.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	12	2394
28-29	Rock	0.76	1	21	434.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	12	2405
29-30	Rock	0.76	1	21	455.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	12	2417

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17.5	8.8	30	-	-	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	1.00	1	17.5	26.3	30	-	-	-	-	-	30	0.52	0.500	3.0	7	10
2-3	cohesive	1.00	1	18	44.0	0	100	-	0.75	-	-	0	0.00	1.000	2.0	118	127
3-4	cohesive	1.00	1	18	62.0	0	100	-	0.75	-	-	0	0.00	1.000	2.0	118	245
4-5	cohesive	1.00	1	18	80.0	0	100	-	0.75	-	-	0	0.00	1.000	2.0	118	363
5-6	cohesionless	1.00	1	18	98.0	33	-	-	-	-	-	33	0.58	0.455	3.0	27	390
6-7	cohesive	1.00	1	18	116.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	567
7-8	cohesive	1.00	1	18	134.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	744
8-9	cohesive	1.00	1	18	152.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	920
9-10	cohesive	1.00	1	18	170.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1097
10-11	cohesive	1.00	1	18	188.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1274
11-12	cohesive	1.00	1	8	201.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1451
12-13	cohesive	1.00	1	8	209.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1628
13-14	cohesive	1.00	1	8	217.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1804
14-15	cohesive	1.00	1	8	225.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	1981
15-16	cohesive	1.00	1	8	233.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	2158
16-17	cohesive	1.00	1	8	241.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	2335
17-18	cohesive	1.00	1	8	249.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	2512
18-19	cohesive	1.00	1	8	257.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	2688
19-20	cohesive	1.00	1	8	265.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	2865
20-21	cohesive	1.00	1	8	273.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	3042
21-22	Rock	1.00	1	21	287.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	15	3057
22-23	Rock	1.00	1	21	308.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	15	3073
24-24	Rock	1.00	1	21	329.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	15	3088

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	1.00	1	21	350.5	45		70	-	0.5	0.7	45	0.79	0.293	5.0	15	3103
25-26	Rock	1.00	1	21	371.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	15	3119
26-27	Rock	1.00	1	21	392.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	15	3134
27-28	Rock	1.00	1	21	413.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	15	3150
28-29	Rock	1.00	1	21	434.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	15	3165
29-30	Rock	1.00	1	21	455.5	45	-	70	-	0.5	0.7	45	0.79	0.293	5.0	15	3180

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	25.0	4.5	70.0	5.0	57
Rock	760	30.0	4.5	70.0	5.0	57
Rock	1000	25.0	4.5	70.0	5.0	99
Rock	1000	30.0	4.5	70.0	5.0	99

PILE CAPACITIES FOR BH-5 B

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	cohesionless	0.76	1	18.5	231.3	36	-	-	-	-	-	36	0.63	0.412	3.0	48	322
13-14	cohesionless	0.76	1	18.5	249.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	374
14-15	Rock	0.76	1	21	269.5	45	-	200	-	0.5	0.7	45	0.79	0.293	5.0	33	407

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :



Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	36	0.63	0.412	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	36	0.63	0.412	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	36	0.63	0.412	3.0	43	203
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	36	0.63	0.412	3.0	48	251
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	36	0.63	0.412	3.0	53	304
11-12	cohesionless	1.00	1	18.5	212.8	36	-	-	-	36	0.63	0.412	3.0	58	361
12-13	cohesionless	1.00	1	18.5	231.3	36	-	-	-	36	0.63	0.412	3.0	63	424
13-14	cohesionless	1.00	1	18.5	249.8	36	-	-	-	36	0.63	0.412	3.0	68	492
14-15	Rock	1.00	1	21	269.5	45	200	0.5	0.7	45	0.79	0.293	5.0	44	536

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	15.0	4.5	200.0	5.0	163
Rock	1000	15.0	4.5	200.0	5.0	283

PILE CAPACITIES FOR BH-6

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	35	-	-	-	-	-	35	0.61	0.426	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	35	-	-	-	-	-	35	0.61	0.426	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	35	-	-	-	-	-	35	0.61	0.426	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	35	-	-	-	-	-	35	0.61	0.426	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	35	-	-	-	-	-	35	0.61	0.426	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	2.0	31	79
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	104
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	133
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	165
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	201
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	241
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	285
12-13	cohesive	0.76	1	18	231.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	420
13-14	cohesive	0.76	1	18	249.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	554
14-15	Rock	0.76	1	21	268.5	45	-	300	-	0.5	0.7	45	0.79	0.293	5.0	50	604

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	35	-	-	-	-	-	35	0.61	0.426	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	35	-	-	-	-	-	35	0.61	0.426	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	35	-	-	-	-	-	35	0.61	0.426	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	35	-	-	-	-	-	35	0.61	0.426	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	35	-	-	-	-	-	35	0.61	0.426	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	2.0	41	104
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	33	137
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	38	175
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	217
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	265
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	53	318
11-12	cohesionless	1.00	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	58	375
12-13	cohesive	1.00	1	18	231.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	552
13-14	cohesive	1.00	1	18	249.0	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	729
14-15	Rock	1.00	1	21	268.5	45	-	300	-	0.5	0.7	45	0.79	0.293	5.0	66	795

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	15.0	4.5	200.0	5.0	163
Rock	1000	15.0	4.5	200.0	5.0	283

PILE CAPACITIES FOR BH-6 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	9	17
3-4	cohesionless	0.76	1	18	63.0	34	-	-	-	-	-	34	0.59	0.441	3.0	13	30
4-5	cohesionless	0.76	1	18	81.0	34	-	-	-	-	-	34	0.59	0.441	3.0	17	47
5-6	cohesionless	0.76	1	18	99.0	34	-	-	-	-	-	34	0.59	0.441	3.0	21	67
6-7	cohesionless	0.76	1	8.5	112.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	91
7-8	cohesionless	0.76	1	8.5	120.8	36	-	-	-	-	-	36	0.63	0.412	3.0	25	115
8-9	cohesionless	0.76	1	8.5	129.3	36	-	-	-	-	-	36	0.63	0.412	3.0	27	142
9-10	Rock	0.76	1	21	144.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	167
10-11	Rock	0.76	1	21	165.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	192
11-12	Rock	0.76	1	21	186.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	217
12-13	Rock	0.76	1	21	207.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	242
13-14	Rock	0.76	1	21	228.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	268
14-15	Rock	0.76	1	21	249.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	293
15-16	Rock	0.76	1	21	270.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	318
16-17	Rock	0.76	1	21	291.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	343
17-18	Rock	0.76	1	21	312.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	368
18-19	Rock	0.76	1	21	333.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	393
19-20	Rock	0.76	1	21	354.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	418
20-21	Rock	0.76	1	21	375.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	443
21-22	Rock	0.76	1	21	396.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	468
22-23	Rock	0.76	1	21	417.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	493
24-24	Rock	0.76	1	21	438.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	518

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	459.0	45		150		0.5	0.7	45	0.79	0.293	5.0	25	543
25-26	Rock	0.76	1	21	480.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	568
26-27	Rock	0.76	1	21	501.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	594
27-28	Rock	0.76	1	21	522.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	619
28-29	Rock	0.76	1	21	543.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	644
29-30	Rock	0.76	1	21	564.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	25	669

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	12	22
3-4	cohesionless	1.00	1	18	63.0	34	-	-	-	-	-	34	0.59	0.441	3.0	17	39
4-5	cohesionless	1.00	1	18	81.0	34	-	-	-	-	-	34	0.59	0.441	3.0	22	62
5-6	cohesionless	1.00	1	18	99.0	34	-	-	-	-	-	34	0.59	0.441	3.0	27	89
6-7	cohesionless	1.00	1	8.5	112.3	36	-	-	-	-	-	36	0.63	0.412	3.0	30	119
7-8	cohesionless	1.00	1	8.5	120.8	36	-	-	-	-	-	36	0.63	0.412	3.0	33	152
8-9	cohesionless	1.00	1	8.5	129.3	36	-	-	-	-	-	36	0.63	0.412	3.0	35	187
9-10	Rock	1.00	1	21	144.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	220
10-11	Rock	1.00	1	21	165.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	253
11-12	Rock	1.00	1	21	186.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	286
12-13	Rock	1.00	1	21	207.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	319
13-14	Rock	1.00	1	21	228.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	352
14-15	Rock	1.00	1	21	249.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	385
15-16	Rock	1.00	1	21	270.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	418
16-17	Rock	1.00	1	21	291.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	451
17-18	Rock	1.00	1	21	312.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	484
18-19	Rock	1.00	1	21	333.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	517
19-20	Rock	1.00	1	21	354.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	550
20-21	Rock	1.00	1	21	375.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	583
21-22	Rock	1.00	1	21	396.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	616
22-23	Rock	1.00	1	21	417.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	649
24-24	Rock	1.00	1	21	438.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	682

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	1.00	1	21	459.0	45		150		0.5	0.7	45	0.79	0.293	5.0	33	715
25-26	Rock	1.00	1	21	480.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	748
26-27	Rock	1.00	1	21	501.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	781
27-28	Rock	1.00	1	21	522.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	814
28-29	Rock	1.00	1	21	543.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	847
29-30	Rock	1.00	1	21	564.0	45	-	150	-	0.5	0.7	45	0.79	0.293	5.0	33	880

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	150.0	5.0	123
Rock	760	25.0	4.5	150.0	5.0	123
Rock	760	30.0	4.5	150.0	5.0	123
Rock	1000	20.0	4.5	150.0	5.0	212
Rock	1000	25.0	4.5	150.0	5.0	212
Rock	1000	30.0	4.5	150.0	5.0	212

PILE CAPACITIES FOR BH-6 B

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	cohesionless	0.76	1	18.5	231.3	36	-	-	-	-	-	36	0.63	0.412	3.0	48	322
13-14	cohesionless	0.76	1	18.5	249.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	374
14-15	Rock	0.76	1	21	269.5	45	-	400	-	0.5	0.7	45	0.79	0.293	5.0	67	441

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	203
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	251
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	53	304
11-12	cohesionless	1.00	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	58	361
12-13	cohesionless	1.00	1	18.5	231.3	36	-	-	-	-	-	36	0.63	0.412	3.0	63	424
13-14	cohesionless	1.00	1	18.5	249.8	36	-	-	-	-	-	36	0.63	0.412	3.0	68	492
14-15	Rock	1.00	1	21	269.5	45	-	400	-	0.5	0.7	45	0.79	0.293	5.0	88	580

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	15.0	4.5	400.0	5.0	327
Rock	1000	15.0	4.5	400.0	5.0	566

PILE CAPACITIES FOR BH-7

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17.5	8.8	29	-	-	-	-	-	29	0.51	0.515	3.0	2	2
1-2	cohesionless	0.76	1	17.5	26.3	29	-	-	-	-	-	29	0.51	0.515	3.0	5	7
2-3	cohesionless	0.76	1	17.5	43.8	29	-	-	-	-	-	29	0.51	0.515	3.0	9	16
3-4	cohesionless	0.76	1	17.5	61.3	29	-	-	-	-	-	29	0.51	0.515	3.0	13	29
4-5	cohesionless	0.76	1	17.5	78.8	29	-	-	-	-	-	29	0.51	0.515	3.0	16	45
5-6	cohesionless	0.76	1	18.5	96.8	36	-	-	-	-	-	36	0.63	0.412	3.0	20	65
6-7	cohesionless	0.76	1	18.5	115.3	36	-	-	-	-	-	36	0.63	0.412	3.0	24	89
7-8	cohesionless	0.76	1	18.5	133.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	117
8-9	cohesionless	0.76	1	18.5	152.3	36	-	-	-	-	-	36	0.63	0.412	3.0	31	148
9-10	cohesionless	0.76	1	18	170.5	33	-	-	-	-	-	33	0.58	0.455	3.0	36	184
10-11	cohesionless	0.76	1	18	188.5	33	-	-	-	-	-	33	0.58	0.455	3.0	39	223
11-12	cohesionless	0.76	1	18	206.5	33	-	-	-	-	-	33	0.58	0.455	3.0	43	266
12-13	cohesive	0.76	1	18	224.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	400
13-14	cohesive	0.76	1	18	242.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	535
14-15	cohesive	0.76	1	18	260.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	669

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17.5	8.8	29	-	-	-	-	-	29	0.51	0.515	3.0	2	2
1-2	cohesionless	1.00	1	17.5	26.3	29	-	-	-	-	-	29	0.51	0.515	3.0	7	10
2-3	cohesionless	1.00	1	17.5	43.8	29	-	-	-	-	-	29	0.51	0.515	3.0	12	22
3-4	cohesionless	1.00	1	17.5	61.3	29	-	-	-	-	-	29	0.51	0.515	3.0	17	38
4-5	cohesionless	1.00	1	17.5	78.8	29	-	-	-	-	-	29	0.51	0.515	3.0	22	60
5-6	cohesionless	1.00	1	18.5	96.8	36	-	-	-	-	-	36	0.63	0.412	3.0	26	86
6-7	cohesionless	1.00	1	18.5	115.3	36	-	-	-	-	-	36	0.63	0.412	3.0	31	117
7-8	cohesionless	1.00	1	18.5	133.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	154
8-9	cohesionless	1.00	1	18.5	152.3	36	-	-	-	-	-	36	0.63	0.412	3.0	41	195
9-10	cohesionless	1.00	1	18	170.5	33	-	-	-	-	-	33	0.58	0.455	3.0	47	242
10-11	cohesionless	1.00	1	18	188.5	33	-	-	-	-	-	33	0.58	0.455	3.0	52	293
11-12	cohesionless	1.00	1	18	206.5	33	-	-	-	-	-	33	0.58	0.455	3.0	57	350
12-13	cohesive	1.00	1	18	224.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	527
13-14	cohesive	1.00	1	18	242.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	704
14-15	cohesive	1.00	1	18	260.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	881

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	C	Nc	FOS	Q _{END} (kN)
Clay	760	15.0	150.0	9.0	3.0	204
Clay	1000	15.0	150.0	9.0	3.0	353

PILE CAPACITIES FOR BH-7 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17.5	8.8	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	0.76	1	17.5	26.3	28	-	-	-	-	-	28	0.49	0.530	3.0	5	7
2-3	cohesionless	0.76	1	17.5	43.8	28	-	-	-	-	-	28	0.49	0.530	3.0	9	16
3-4	cohesionless	0.76	1	18	61.5	32	-	-	-	-	-	32	0.56	0.470	3.0	13	29
4-5	cohesionless	0.76	1	8	74.5	32	-	-	-	-	-	32	0.56	0.470	3.0	16	45
5-6	cohesionless	0.76	1	8	82.5	32	-	-	-	-	-	32	0.56	0.470	3.0	17	62
6-7	cohesionless	0.76	1	8	90.5	32	-	-	-	-	-	32	0.56	0.470	3.0	19	81
7-8	cohesionless	0.76	1	8	98.5	32	-	-	-	-	-	32	0.56	0.470	3.0	21	101
8-9	cohesive	0.76	1	7.5	106.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	72	173
9-10	cohesive	0.76	1	7.5	113.8	0	80	-	0.75	-	-	0	0.00	1.000	2.0	72	245
10-11	cohesive	0.76	1	7.5	121.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	72	316
11-12	Rock	0.76	1	21	135.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	326
12-13	Rock	0.76	1	21	156.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	336
13-14	Rock	0.76	1	21	177.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	346
14-15	Rock	0.76	1	21	198.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	357
15-16	Rock	0.76	1	21	219.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	367
16-17	Rock	0.76	1	21	240.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	377
17-18	Rock	0.76	1	21	261.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	387
18-19	Rock	0.76	1	21	282.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	397
19-20	Rock	0.76	1	21	303.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	407
20-21	Rock	0.76	1	21	324.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	417
21-22	Rock	0.76	1	21	345.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	427
22-23	Rock	0.76	1	21	366.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	437
24-24	Rock	0.76	1	21	387.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	447

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	408.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	457
25-26	Rock	0.76	1	21	429.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	467
26-27	Rock	0.76	1	21	450.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	477
27-28	Rock	0.76	1	21	471.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	487
28-29	Rock	0.76	1	21	492.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	497
29-30	Rock	0.76	1	21	513.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	507

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17.5	8.8	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	1.00	1	17.5	26.3	28	-	-	-	-	-	28	0.49	0.530	3.0	7	10
2-3	cohesionless	1.00	1	17.5	43.8	28	-	-	-	-	-	28	0.49	0.530	3.0	12	21
3-4	cohesionless	1.00	1	18	61.5	32	-	-	-	-	-	32	0.56	0.470	3.0	17	38
4-5	cohesionless	1.00	1	8	74.5	32	-	-	-	-	-	32	0.56	0.470	3.0	20	59
5-6	cohesionless	1.00	1	8	82.5	32	-	-	-	-	-	32	0.56	0.470	3.0	23	81
6-7	cohesionless	1.00	1	8	90.5	32	-	-	-	-	-	32	0.56	0.470	3.0	25	106
7-8	cohesionless	1.00	1	8	98.5	32	-	-	-	-	-	32	0.56	0.470	3.0	27	133
8-9	cohesive	1.00	1	7.5	106.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	94	228
9-10	cohesive	1.00	1	7.5	113.8	0	80	-	0.75	-	-	0	0.00	1.000	2.0	94	322
10-11	cohesive	1.00	1	7.5	121.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	94	416
11-12	Rock	1.00	1	21	135.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	429
12-13	Rock	1.00	1	21	156.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	443
13-14	Rock	1.00	1	21	177.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	456
14-15	Rock	1.00	1	21	198.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	469
15-16	Rock	1.00	1	21	219.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	482
16-17	Rock	1.00	1	21	240.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	495
17-18	Rock	1.00	1	21	261.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	509
18-19	Rock	1.00	1	21	282.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	522
19-20	Rock	1.00	1	21	303.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	535
20-21	Rock	1.00	1	21	324.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	548
21-22	Rock	1.00	1	21	345.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	561
22-23	Rock	1.00	1	21	366.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	575
24-24	Rock	1.00	1	21	387.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	588

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	1.00	1	21	408.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	601
25-26	Rock	1.00	1	21	429.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	614
26-27	Rock	1.00	1	21	450.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	627
27-28	Rock	1.00	1	21	471.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	641
28-29	Rock	1.00	1	21	492.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	654
29-30	Rock	1.00	1	21	513.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	667

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	60.0	5.0	49
Rock	760	25.0	4.5	60.0	5.0	49
Rock	760	30.0	4.5	60.0	5.0	49
Rock	1000	20.0	4.5	60.0	5.0	85
Rock	1000	25.0	4.5	60.0	5.0	85
Rock	1000	30.0	4.5	60.0	5.0	85

PILE CAPACITIES FOR BH-8

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	Q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	36	0.63	0.412	3.0	40	231
11-12	Rock	0.76	1	21	214.0	42	175	0.5	0.7	42	0.73	0.331	5.0	29	260
12-13	Rock	0.76	1	21	235.0	42	175	0.5	0.7	42	0.73	0.331	5.0	29	289
13-14	Rock	0.76	1	21	256.0	42	175	0.5	0.7	42	0.73	0.331	5.0	29	319
14-15	Rock	0.76	1	21	277.0	42	175	0.5	0.7	42	0.73	0.331	5.0	29	348

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	36	0.63	0.412	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	36	0.63	0.412	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	36	0.63	0.412	3.0	43	203
9 -10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	36	0.63	0.412	3.0	48	251
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	36	0.63	0.412	3.0	53	304
11-12	Rock	1.00	1	21	214.0	42	175	0.5	0.7	42	0.73	0.331	5.0	39	342
12-13	Rock	1.00	1	21	235.0	42	175	0.5	0.7	42	0.73	0.331	5.0	39	381
13-14	Rock	1.00	1	21	256.0	42	175	0.5	0.7	42	0.73	0.331	5.0	39	419
14-15	Rock	1.00	1	21	277.0	42	175	0.5	0.7	42	0.73	0.331	5.0	39	458

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	15.0	4.5	175.0	5.0	143
Rock	1000	15.0	4.5	175.0	5.0	247

PILE CAPACITIES FOR BH-8 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	28	-	-	-	-	-	28	0.49	0.530	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	28	-	-	-	-	-	28	0.49	0.530	3.0	9	17
3-4	cohesionless	0.76	1	18	63.0	28	-	-	-	-	-	28	0.49	0.530	3.0	13	30
4-5	cohesionless	0.76	1	8	76.0	28	-	-	-	-	-	28	0.49	0.530	3.0	16	45
5-6	cohesionless	0.76	1	8	84.0	28	-	-	-	-	-	28	0.49	0.530	3.0	17	63
6-7	cohesionless	0.76	1	8	92.0	28	-	-	-	-	-	28	0.49	0.530	3.0	19	82
7-8	cohesionless	0.76	1	8	100.0	28	-	-	-	-	-	28	0.49	0.530	3.0	21	102
8-9	cohesive	0.76	1	6.5	107.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	72	174
9-10	cohesive	0.76	1	6.5	113.8	0	80	-	0.75	-	-	0	0.00	1.000	2.0	72	246
10-11	cohesive	0.76	1	6.5	120.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	72	317
11-12	cohesionless	0.76	1	8	127.5	32		-	-	-	-	32	0.56	0.470	3.0	27	344
12-13	Rock	0.76	1	21	142.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	362
13-14	Rock	0.76	1	21	163.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	381
14-15	Rock	0.76	1	21	184.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	399
15-16	Rock	0.76	1	21	205.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	418
16-17	Rock	0.76	1	21	226.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	436
17-18	Rock	0.76	1	21	247.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	454
18-19	Rock	0.76	1	21	268.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	473
19-20	Rock	0.76	1	21	289.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	491

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
20-21	Rock	0.76	1	21	310.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	18	510
21-22	Rock	0.76	1	21	331.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	18	528
22-23	Rock	0.76	1	21	352.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	18	546
24-24	Rock	0.76	1	21	373.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	18	565
25-25	Rock	0.76	1	21	394.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	18	583
25-26	Rock	0.76	1	21	415.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	18	601
26-27	Rock	0.76	1	21	436.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	18	620
27-28	Rock	0.76	1	21	457.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	18	638
28-29	Rock	0.76	1	21	478.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	18	657
29-30	Rock	0.76	1	21	499.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	18	675

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	28	-	-	-	-	-	28	0.49	0.530	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	28	-	-	-	-	-	28	0.49	0.530	3.0	12	22
3-4	cohesionless	1.00	1	18	63.0	28	-	-	-	-	-	28	0.49	0.530	3.0	17	39
4-5	cohesionless	1.00	1	8	76.0	28	-	-	-	-	-	28	0.49	0.530	3.0	21	60
5-6	cohesionless	1.00	1	8	84.0	28	-	-	-	-	-	28	0.49	0.530	3.0	23	83
6-7	cohesionless	1.00	1	8	92.0	28	-	-	-	-	-	28	0.49	0.530	3.0	25	108
7-8	cohesionless	1.00	1	8	100.0	28	-	-	-	-	-	28	0.49	0.530	3.0	27	135
8-9	cohesive	1.00	1	6.5	107.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	94	229
9-10	cohesive	1.00	1	6.5	113.8	0	80	-	0.75	-	-	0	0.00	1.000	2.0	94	323
10-11	cohesive	1.00	1	6.5	120.3	0	80	-	0.75	-	-	0	0.00	1.000	2.0	94	418
11-12	cohesionless	1.00	1	8	127.5	32		-	-	-	-	32	0.56	0.470	3.0	35	453
12-13	Rock	1.00	1	21	142.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	477
13-14	Rock	1.00	1	21	163.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	501
14-15	Rock	1.00	1	21	184.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	525
15-16	Rock	1.00	1	21	205.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	549
16-17	Rock	1.00	1	21	226.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	574
17-18	Rock	1.00	1	21	247.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	598
18-19	Rock	1.00	1	21	268.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	622
19-20	Rock	1.00	1	21	289.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	646

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
20-21	Rock	1.00	1	21	310.0	42		110	-	0.5	0.7	42	0.73	0.331	5.0	24	670
21-22	Rock	1.00	1	21	331.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	24	695
22-23	Rock	1.00	1	21	352.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	24	719
24-24	Rock	1.00	1	21	373.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	24	743
25-25	Rock	1.00	1	21	394.0	45		110	-	0.5	0.7	45	0.79	0.293	5.0	24	767
25-26	Rock	1.00	1	21	415.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	24	791
26-27	Rock	1.00	1	21	436.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	24	816
27-28	Rock	1.00	1	21	457.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	24	840
28-29	Rock	1.00	1	21	478.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	24	864
29-30	Rock	1.00	1	21	499.0	45	-	110	-	0.5	0.7	45	0.79	0.293	5.0	24	888

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Nϕ	Q_{UC} (kN/m²)	FOS	Q_{END} (kN)
Rock	760	20.0	4.5	110.0	5.0	90
Rock	760	25.0	4.5	110.0	5.0	90
Rock	760	30.0	4.5	110.0	5.0	90
Rock	1000	20.0	4.5	110.0	5.0	156
Rock	1000	25.0	4.5	110.0	5.0	156
Rock	1000	30.0	4.5	110.0	5.0	156

PILE CAPACITIES FOR BH-8 B

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18	155.5	33	-	-	-	-	-	33	0.58	0.455	3.0	32	153
9-10	cohesionless	0.76	1	18	173.5	33	-	-	-	-	-	33	0.58	0.455	3.0	36	189
10-11	cohesionless	0.76	1	18	191.5	33	-	-	-	-	-	33	0.58	0.455	3.0	40	229
11-12	cohesionless	0.76	1	18.5	209.8	36	-	-	-	-	-	36	0.63	0.412	3.0	43	272
12-13	cohesionless	0.76	1	18.5	228.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	319
13-14	cohesionless	0.76	1	18.5	246.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	370
14-15	cohesionless	0.76	1	18.5	265.3	36	-	-	-	-	-	36	0.63	0.412	3.0	55	425

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	34	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	34	-	-	-	34	0.59	0.441	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	34	-	-	-	34	0.59	0.441	3.0	12	22
3-4	cohesionless	1.00	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	17	39
4-5	cohesionless	1.00	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	22	62
5-6	cohesionless	1.00	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	cohesionless	1.00	1	18	155.5	33	-	-	-	33	0.58	0.455	3.0	43	201
9-10	cohesionless	1.00	1	18	173.5	33	-	-	-	33	0.58	0.455	3.0	48	249
10-11	cohesionless	1.00	1	18	191.5	33	-	-	-	33	0.58	0.455	3.0	53	301
11-12	cohesionless	1.00	1	18.5	209.8	36	-	-	-	36	0.63	0.412	3.0	57	358
12-13	cohesionless	1.00	1	18.5	228.3	36	-	-	-	36	0.63	0.412	3.0	62	420
13-14	cohesionless	1.00	1	18.5	246.8	36	-	-	-	36	0.63	0.412	3.0	67	487
14-15	cohesionless	1.00	1	18.5	265.3	36	-	-	-	36	0.63	0.412	3.0	72	559

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	209.8	4.0	1070
Sand	760	15.0	36.0	45.0	265.3	4.0	1353
Sand	1000	12.0	36.0	45.0	209.8	4.0	1852
Sand	1000	15.0	36.0	45.0	265.3	4.0	2342

PILE CAPACITIES FOR BH-9

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	25	93
7-8	cohesionless	0.76	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	32	154
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesive	0.76	1	18	212.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	365
12-13	cohesive	0.76	1	18	230.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	499
13-14	cohesive	0.76	1	18	248.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	134	633
14-15	cohesionless	0.76	1	18.5	266.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	688

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	36	-	-	-	-	-	36	0.63	0.412	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	36	-	-	-	-	-	36	0.63	0.412	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	203
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	251
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	53	304
11-12	cohesive	1.00	1	18	212.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	480
12-13	cohesive	1.00	1	18	230.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	657
13-14	cohesive	1.00	1	18	248.5	0	150	-	0.75	-	-	0	0.00	1.000	2.0	177	833
14-15	cohesionless	1.00	1	18.5	266.8	36	-	-	-	-	-	36	0.63	0.412	3.0	72	906

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	15.0	36.0	45.0	266.8	4.0	1361
Sand	1000	15.0	36.0	45.0	266.8	4.0	2356

PILE CAPACITIES FOR BH-9 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
1-2	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
2-3	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
3-4	cohesionless	0.76	1	7.5	3.8	28	-	-	-	-	-	28	0.49	0.530	3.0	1	1
4-5	cohesionless	0.76	1	7.5	11.3	28	-	-	-	-	-	28	0.49	0.530	3.0	2	3
5-6	cohesionless	0.76	1	7.5	18.8	28	-	-	-	-	-	28	0.49	0.530	3.0	4	7
6-7	cohesive	0.76	1	8	26.5	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	20
7-8	cohesive	0.76	1	8	34.5	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	34
8-9	cohesive	0.76	1	6.5	41.8	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	47
9-10	cohesionless	0.76	1	6.5	48.3	30		-	-	-	-	30	0.52	0.500	3.0	10	57
10-11	cohesionless	0.76	1	6.5	54.8	30		-	-	-	-	30	0.52	0.500	3.0	11	69
11-12	cohesionless	0.76	1	8	62.0	30		-	-	-	-	30	0.52	0.500	3.0	13	82
12-13	cohesionless	0.76	1	8	70.0	29		-	-	-	-	29	0.51	0.515	3.0	15	96
13-14	cohesionless	0.76	1	8	78.0	29		-	-	-	-	29	0.51	0.515	3.0	16	112
14-15	cohesionless	0.76	1	8	86.0	29		-	-	-	-	29	0.51	0.515	3.0	18	130
15-16	Rock	0.76	1	21	100.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	140
16-17	Rock	0.76	1	21	121.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	150
17-18	Rock	0.76	1	21	142.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	160
18-19	Rock	0.76	1	21	163.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	170
19-20	Rock	0.76	1	21	184.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	180

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
20-21	Rock	0.76	1	21	205.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	10	190
21-22	Rock	0.76	1	21	226.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	200
22-23	Rock	0.76	1	21	247.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	210
24-24	Rock	0.76	1	21	268.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	221
25-25	Rock	0.76	1	21	289.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	10	231
25-26	Rock	0.76	1	21	310.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	241
26-27	Rock	0.76	1	21	331.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	251
27-28	Rock	0.76	1	21	352.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	261
28-29	Rock	0.76	1	21	373.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	271
29-30	Rock	0.76	1	21	394.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	10	281

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	Fill	1.00	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
1-2	Fill	1.00	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
2-3	Fill	1.00	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
3-4	cohesionless	1.00	1	7.5	3.8	28	-	-	-	-	-	28	0.49	0.530	3.0	1	1
4-5	cohesionless	1.00	1	7.5	11.3	28	-	-	-	-	-	28	0.49	0.530	3.0	3	4
5-6	cohesionless	1.00	1	7.5	18.8	28	-	-	-	-	-	28	0.49	0.530	3.0	5	9
6-7	cohesive	1.00	1	8	26.5	0	15	-	0.75	-	-	0	0.00	1.000	2.0	18	27
7-8	cohesive	1.00	1	8	34.5	0	15	-	0.75	-	-	0	0.00	1.000	2.0	18	45
8-9	cohesive	1.00	1	6.5	41.8	0	15	-	0.75	-	-	0	0.00	1.000	2.0	18	62
9-10	cohesionless	1.00	1	6.5	48.3	30		-	-	-	-	30	0.52	0.500	3.0	13	75
10-11	cohesionless	1.00	1	6.5	54.8	30		-	-	-	-	30	0.52	0.500	3.0	15	90
11-12	cohesionless	1.00	1	8	62.0	30		-	-	-	-	30	0.52	0.500	3.0	17	107
12-13	cohesionless	1.00	1	8	70.0	29		-	-	-	-	29	0.51	0.515	3.0	19	127
13-14	cohesionless	1.00	1	8	78.0	29		-	-	-	-	29	0.51	0.515	3.0	21	148
14-15	cohesionless	1.00	1	8	86.0	29		-	-	-	-	29	0.51	0.515	3.0	23	171
15-16	Rock	1.00	1	21	100.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	185
16-17	Rock	1.00	1	21	121.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	198
17-18	Rock	1.00	1	21	142.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	211
18-19	Rock	1.00	1	21	163.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	224
19-20	Rock	1.00	1	21	184.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	237

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
20-21	Rock	1.00	1	21	205.5	42		60	-	0.5	0.7	42	0.73	0.331	5.0	13	251
21-22	Rock	1.00	1	21	226.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	264
22-23	Rock	1.00	1	21	247.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	277
24-24	Rock	1.00	1	21	268.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	290
25-25	Rock	1.00	1	21	289.5	45		60	-	0.5	0.7	45	0.79	0.293	5.0	13	303
25-26	Rock	1.00	1	21	310.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	317
26-27	Rock	1.00	1	21	331.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	330
27-28	Rock	1.00	1	21	352.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	343
28-29	Rock	1.00	1	21	373.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	356
29-30	Rock	1.00	1	21	394.5	45	-	60	-	0.5	0.7	45	0.79	0.293	5.0	13	369

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{UC} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	60.0	5.0	49
Rock	760	25.0	4.5	60.0	5.0	49
Rock	760	30.0	4.5	60.0	5.0	49
Rock	1000	20.0	4.5	60.0	5.0	85
Rock	1000	25.0	4.5	60.0	5.0	85
Rock	1000	30.0	4.5	60.0	5.0	85

PILE CAPACITIES FOR BH-10

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17	8.5	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	17	25.5	36	-	-	-	-	-	36	0.63	0.412	3.0	5	7
2-3	cohesionless	0.76	1	17	42.5	36	-	-	-	-	-	36	0.63	0.412	3.0	9	16
3-4	cohesionless	0.76	1	18.5	60.3	36	-	-	-	-	-	36	0.63	0.412	3.0	12	28
4-5	cohesionless	0.76	1	18.5	78.8	36	-	-	-	-	-	36	0.63	0.412	3.0	16	44
5-6	cohesionless	0.76	1	18.5	97.3	36	-	-	-	-	-	36	0.63	0.412	3.0	20	64
6-7	cohesionless	0.76	1	18.5	115.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	88
7-8	cohesionless	0.76	1	18.5	134.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	116
8-9	cohesionless	0.76	1	18.5	152.8	36	-	-	-	-	-	36	0.63	0.412	3.0	31	147
9-10	Rock	0.76	1	21	172.5	42	-	20	-	0.5	0.7	42	0.73	0.331	5.0	3	151
10-11	Rock	0.76	1	21	193.5	42	-	20	-	0.5	0.7	42	0.73	0.331	5.0	3	154
11-12	cohesionless	0.76	1	18.5	213.3	36	-	-	-	-	-	36	0.63	0.412	3.0	44	198
12-13	cohesionless	0.76	1	18.5	231.8	36	-	-	-	-	-	36	0.63	0.412	3.0	48	246
13-14	cohesionless	0.76	1	18.5	250.3	36	-	-	-	-	-	36	0.63	0.412	3.0	52	297
14-15	cohesionless	0.76	1	18.5	268.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	353

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17	8.5	36	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	1.00	1	17	25.5	36	-	-	-	36	0.63	0.412	3.0	7	9
2-3	cohesionless	1.00	1	17	42.5	36	-	-	-	36	0.63	0.412	3.0	12	21
3-4	cohesionless	1.00	1	18.5	60.3	36	-	-	-	36	0.63	0.412	3.0	16	37
4-5	cohesionless	1.00	1	18.5	78.8	36	-	-	-	36	0.63	0.412	3.0	21	58
5-6	cohesionless	1.00	1	18.5	97.3	36	-	-	-	36	0.63	0.412	3.0	26	85
6-7	cohesionless	1.00	1	18.5	115.8	36	-	-	-	36	0.63	0.412	3.0	31	116
7-8	cohesionless	1.00	1	18.5	134.3	36	-	-	-	36	0.63	0.412	3.0	36	153
8-9	cohesionless	1.00	1	18.5	152.8	36	-	-	-	36	0.63	0.412	3.0	41	194
9-10	Rock	1.00	1	21	172.5	42	20	0.5	0.7	42	0.73	0.331	5.0	4	198
10-11	Rock	1.00	1	21	193.5	42	20	0.5	0.7	42	0.73	0.331	5.0	4	203
11-12	cohesionless	1.00	1	18.5	213.3	36	-	-	-	36	0.63	0.412	3.0	58	261
12-13	cohesionless	1.00	1	18.5	231.8	36	-	-	-	36	0.63	0.412	3.0	63	324
13-14	cohesionless	1.00	1	18.5	250.3	36	-	-	-	36	0.63	0.412	3.0	68	391
14-15	cohesionless	1.00	1	18.5	268.8	36	-	-	-	36	0.63	0.412	3.0	73	464

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	213.3	4.0	1088
Sand	760	15.0	36.0	45.0	268.8	4.0	1371
Sand	1000	12.0	36.0	45.0	213.3	4.0	1883
Sand	1000	15.0	36.0	45.0	268.8	4.0	2373

PILE CAPACITIES FOR BH-10 A

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
1-2	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
2-3	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
3-4	cohesionless	0.76	1	7	3.5	26	80	-	-	-	-	26	0.45	0.561	3.0	1	1
4-5	cohesionless	0.76	1	7	10.5	26	-	-	-	-	-	26	0.45	0.561	3.0	2	3
5-6	cohesionless	0.76	1	7	17.5	26	-	-	-	-	-	26	0.45	0.561	3.0	4	6
6-7	cohesive	0.76	1	6.5	24.3	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	20
7-8	cohesive	0.76	1	6.5	30.8	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	33
8-9	cohesive	0.76	1	6.5	37.3	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	47
9-10	cohesive	0.76	1	6.5	43.8	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	60
10-11	cohesive	0.76	1	6.5	50.3	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	74
11-12	cohesionless	0.76	1	7.5	57.3	29		-	-	-	-	29	0.51	0.515	3.0	12	85
12-13	Rock	0.76	1	21	71.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	99
13-14	Rock	0.76	1	21	92.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	112
14-15	Rock	0.76	1	21	113.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	126
15-16	Rock	0.76	1	21	134.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	139
16-17	Rock	0.76	1	21	155.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	152
17-18	Rock	0.76	1	21	176.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	166
18-19	Rock	0.76	1	21	197.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	179
19-20	Rock	0.76	1	21	218.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	192
20-21	Rock	0.76	1	21	239.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	206
21-22	Rock	0.76	1	21	260.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	219
22-23	Rock	0.76	1	21	281.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	233
24-24	Rock	0.76	1	21	302.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	246

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	$\bar{\delta}$	tan $\bar{\delta}$	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	323.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	259
25-26	Rock	0.76	1	21	344.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	273
26-27	Rock	0.76	1	21	365.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	286
27-28	Rock	0.76	1	21	386.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	299
28-29	Rock	0.76	1	21	407.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	313
29-30	Rock	0.76	1	21	428.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	326

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
1-2	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
2-3	Fill	0.76	1	0	0.0	28	-	-	-	-	-	28	0.49	0.530	3.0	0	0
3-4	cohesionless	0.76	1	7	3.5	26	80	-	-	-	-	26	0.45	0.561	3.0	1	1
4-5	cohesionless	0.76	1	7	10.5	26	-	-	-	-	-	26	0.45	0.561	3.0	2	3
5-6	cohesionless	0.76	1	7	17.5	26	-	-	-	-	-	26	0.45	0.561	3.0	4	6
6-7	cohesive	0.76	1	6.5	24.3	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	20
7-8	cohesive	0.76	1	6.5	30.8	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	33
8-9	cohesive	0.76	1	6.5	37.3	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	47
9-10	cohesive	0.76	1	6.5	43.8	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	60
10-11	cohesive	0.76	1	6.5	50.3	0	15	-	0.75	-	-	0	0.00	1.000	2.0	13	74
11-12	cohesionless	0.76	1	7.5	57.3	29		-	-	-	-	29	0.51	0.515	3.0	12	85
12-13	Rock	0.76	1	21	71.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	99
13-14	Rock	0.76	1	21	92.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	112
14-15	Rock	0.76	1	21	113.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	126
15-16	Rock	0.76	1	21	134.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	139
16-17	Rock	0.76	1	21	155.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	152
17-18	Rock	0.76	1	21	176.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	166
18-19	Rock	0.76	1	21	197.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	179
19-20	Rock	0.76	1	21	218.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	192
20-21	Rock	0.76	1	21	239.5	42		80	-	0.5	0.7	42	0.73	0.331	5.0	13	206
21-22	Rock	0.76	1	21	260.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	219
22-23	Rock	0.76	1	21	281.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	233
24-24	Rock	0.76	1	21	302.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	246

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	$\bar{\delta}$	tan $\bar{\delta}$	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
25-25	Rock	0.76	1	21	323.5	45		80	-	0.5	0.7	45	0.79	0.293	5.0	13	259
25-26	Rock	0.76	1	21	344.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	273
26-27	Rock	0.76	1	21	365.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	286
27-28	Rock	0.76	1	21	386.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	299
28-29	Rock	0.76	1	21	407.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	313
29-30	Rock	0.76	1	21	428.5	45	-	80	-	0.5	0.7	45	0.79	0.293	5.0	13	326

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{UC} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	20.0	4.5	80.0	5.0	65
Rock	760	25.0	4.5	80.0	5.0	65
Rock	760	30.0	4.5	80.0	5.0	65
Rock	1000	20.0	4.5	80.0	5.0	113
Rock	1000	25.0	4.5	80.0	5.0	113
Rock	1000	30.0	4.5	80.0	5.0	113

PILE CAPACITIES FOR BH-11

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	30	-	-	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	30	-	-	-	-	-	30	0.52	0.500	3.0	6	8
2-3	cohesionless	0.76	1	18	45.0	30	-	-	-	-	-	30	0.52	0.500	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	Rock	0.76	1	21	157.0	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	145
9-10	Rock	0.76	1	21	178.0	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	170
10-11	Rock	0.76	1	21	199.0	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	195
11-12	cohesionless	0.76	1	18.5	218.8	36	-	-	-	-	-	36	0.63	0.412	3.0	45	241
12-13	cohesionless	0.76	1	18.5	237.3	36	-	-	-	-	-	36	0.63	0.412	3.0	49	289
13-14	cohesionless	0.76	1	18.5	255.8	36	-	-	-	-	-	36	0.63	0.412	3.0	53	342
14-15	cohesionless	0.76	1	18.5	274.3	36	-	-	-	-	-	36	0.63	0.412	3.0	57	399

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	30	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	30	-	-	-	30	0.52	0.500	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	30	-	-	-	30	0.52	0.500	3.0	12	22
3-4	cohesionless	1.00	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	17	39
4-5	cohesionless	1.00	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	22	62
5-6	cohesionless	1.00	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	Rock	1.00	1	21	157.0	42	150	0.5	0.7	42	0.73	0.331	5.0	33	191
9-10	Rock	1.00	1	21	178.0	42	150	0.5	0.7	42	0.73	0.331	5.0	33	224
10-11	Rock	1.00	1	21	199.0	42	150	0.5	0.7	42	0.73	0.331	5.0	33	257
11-12	cohesionless	1.00	1	18.5	218.8	36	-	-	-	36	0.63	0.412	3.0	59	317
12-13	cohesionless	1.00	1	18.5	237.3	36	-	-	-	36	0.63	0.412	3.0	64	381
13-14	cohesionless	1.00	1	18.5	255.8	36	-	-	-	36	0.63	0.412	3.0	69	450
14-15	cohesionless	1.00	1	18.5	274.3	36	-	-	-	36	0.63	0.412	3.0	74	525

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	218.8	4.0	1116
Sand	760	15.0	36.0	45.0	274.3	4.0	1399
Sand	1000	12.0	36.0	45.0	218.8	4.0	1932
Sand	1000	15.0	36.0	45.0	274.3	4.0	2422

PILE CAPACITIES FOR BH-12

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	31	-	-	-	-	-	31	0.54	0.485	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	31	-	-	-	-	-	31	0.54	0.485	3.0	6	8
2-3	cohesionless	0.76	1	18	45.0	31	-	-	-	-	-	31	0.54	0.485	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	155.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	152
9-10	cohesionless	0.76	1	18.5	174.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	188
10-11	cohesionless	0.76	1	18.5	192.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	228
11-12	Rock	0.76	1	21	212.5	42	-	350	-	0.5	0.7	42	0.73	0.331	5.0	59	287
12-13	Rock	0.76	1	21	233.5	42	-	350	-	0.5	0.7	42	0.73	0.331	5.0	59	345
13-14	Rock	0.76	1	21	254.5	42	-	350	-	0.5	0.7	42	0.73	0.331	5.0	59	404
14-15	Rock	0.76	1	21	275.5	42	-	350	-	0.5	0.7	42	0.73	0.331	5.0	59	462

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	31	-	-	-	31	0.54	0.485	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	31	-	-	-	31	0.54	0.485	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	31	-	-	-	31	0.54	0.485	3.0	12	22
3-4	cohesionless	1.00	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	17	39
4-5	cohesionless	1.00	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	22	62
5-6	cohesionless	1.00	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	cohesionless	1.00	1	18.5	155.8	36	-	-	-	36	0.63	0.412	3.0	42	200
9-10	cohesionless	1.00	1	18.5	174.3	36	-	-	-	36	0.63	0.412	3.0	47	248
10-11	cohesionless	1.00	1	18.5	192.8	36	-	-	-	36	0.63	0.412	3.0	52	300
11-12	Rock	1.00	1	21	212.5	42	350	0.5	0.7	42	0.73	0.331	5.0	77	377
12-13	Rock	1.00	1	21	233.5	42	350	0.5	0.7	42	0.73	0.331	5.0	77	454
13-14	Rock	1.00	1	21	254.5	42	350	0.5	0.7	42	0.73	0.331	5.0	77	531
14-15	Rock	1.00	1	21	275.5	42	350	0.5	0.7	42	0.73	0.331	5.0	77	608

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{uc} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	12.0	4.5	350.0	5.0	286
Rock	760	15.0	4.5	350.0	5.0	286
Rock	1000	12.0	4.5	350.0	5.0	495
Rock	1000	15.0	4.5	350.0	5.0	495

PILE CAPACITIES FOR BH-13

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	30	-	-	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	30	-	-	-	-	-	30	0.52	0.500	3.0	6	8
2-3	cohesionless	0.76	1	18	45.0	30	-	-	-	-	-	30	0.52	0.500	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	155.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	152
9-10	cohesionless	0.76	1	18.5	174.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	188
10-11	cohesionless	0.76	1	18.5	192.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	228
11-12	cohesionless	0.76	1	18.5	211.3	36	-	-	-	-	-	36	0.63	0.412	3.0	44	272
12-13	Rock	0.76	1	21	231.0	42	-	80	-	0.5	0.7	42	0.73	0.331	5.0	13	285
13-14	Rock	0.76	1	21	252.0	42	-	80	-	0.5	0.7	42	0.73	0.331	5.0	13	298
14-15	Rock	0.76	1	21	273.0	42	-	80	-	0.5	0.7	42	0.73	0.331	5.0	13	312

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	30	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	30	-	-	-	30	0.52	0.500	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	30	-	-	-	30	0.52	0.500	3.0	12	22
3-4	cohesionless	1.00	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	17	39
4-5	cohesionless	1.00	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	22	62
5-6	cohesionless	1.00	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	cohesionless	1.00	1	18.5	155.8	36	-	-	-	36	0.63	0.412	3.0	42	200
9-10	cohesionless	1.00	1	18.5	174.3	36	-	-	-	36	0.63	0.412	3.0	47	248
10-11	cohesionless	1.00	1	18.5	192.8	36	-	-	-	36	0.63	0.412	3.0	52	300
11-12	cohesionless	1.00	1	18.5	211.3	36	-	-	-	36	0.63	0.412	3.0	57	357
12-13	Rock	1.00	1	21	231.0	42	80	0.5	0.7	42	0.73	0.331	5.0	18	375
13-14	Rock	1.00	1	21	252.0	42	80	0.5	0.7	42	0.73	0.331	5.0	18	392
14-15	Rock	1.00	1	21	273.0	42	80	0.5	0.7	42	0.73	0.331	5.0	18	410

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{UC} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	13.0	4.5	80.0	5.0	65
Rock	760	15.0	4.5	80.0	5.0	65
Rock	1000	13.0	4.5	80.0	5.0	113
Rock	1000	15.0	4.5	80.0	5.0	113

PILE CAPACITIES FOR BH-14

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	30	-	-	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	30	-	-	-	-	-	30	0.52	0.500	3.0	6	8
2-3	cohesionless	0.76	1	18	45.0	30	-	-	-	-	-	30	0.52	0.500	3.0	9	17
3-4	cohesionless	0.76	1	18	63.0	30	-	-	-	-	-	30	0.52	0.500	3.0	13	30
4-5	cohesionless	0.76	1	18	81.0	30	-	-	-	-	-	30	0.52	0.500	3.0	17	47
5-6	cohesionless	0.76	1	18.5	99.3	36	-	-	-	-	-	36	0.63	0.412	3.0	20	67
6-7	cohesionless	0.76	1	18.5	117.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	136.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	154.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	152
9-10	cohesionless	0.76	1	18.5	173.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	187
10-11	cohesionless	0.76	1	18.5	191.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	227
11-12	cohesionless	0.76	1	18.5	210.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	270
12-13	cohesionless	0.76	1	18.5	228.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	317
13-14	cohesionless	0.76	1	18.5	247.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	368
14-15	cohesionless	0.76	1	18.5	265.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	423

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	Q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	30	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	30	-	-	-	30	0.52	0.500	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	30	-	-	-	30	0.52	0.500	3.0	12	22
3-4	cohesionless	1.00	1	18	63.0	30	-	-	-	30	0.52	0.500	3.0	17	39
4-5	cohesionless	1.00	1	18	81.0	30	-	-	-	30	0.52	0.500	3.0	22	62
5-6	cohesionless	1.00	1	18.5	99.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	117.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	136.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	cohesionless	1.00	1	18.5	154.8	36	-	-	-	36	0.63	0.412	3.0	42	199
9-10	cohesionless	1.00	1	18.5	173.3	36	-	-	-	36	0.63	0.412	3.0	47	246
10-11	cohesionless	1.00	1	18.5	191.8	36	-	-	-	36	0.63	0.412	3.0	52	298
11-12	cohesionless	1.00	1	18.5	210.3	36	-	-	-	36	0.63	0.412	3.0	57	356
12-13	cohesionless	1.00	1	18.5	228.8	36	-	-	-	36	0.63	0.412	3.0	62	418
13-14	cohesionless	1.00	1	18.5	247.3	36	-	-	-	36	0.63	0.412	3.0	67	485
14-15	cohesionless	1.00	1	18.5	265.8	36	-	-	-	36	0.63	0.412	3.0	72	557

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	210.3	4.0	1072
Sand	760	15.0	36.0	45.0	265.8	4.0	1356
Sand	1000	12.0	36.0	45.0	210.3	4.0	1857
Sand	1000	15.0	36.0	45.0	265.8	4.0	2347

PILE CAPACITIES FOR BH-15

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	35	-	-	-	-	-	35	0.61	0.426	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	35	-	-	-	-	-	35	0.61	0.426	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	35	-	-	-	-	-	35	0.61	0.426	3.0	9	17
3-4	cohesionless	0.76	1	18	63.0	35	-	-	-	-	-	35	0.61	0.426	3.0	13	30
4-5	cohesionless	0.76	1	18	81.0	35	-	-	-	-	-	35	0.61	0.426	3.0	17	47
5-6	cohesionless	0.76	1	18.5	99.3	36	-	-	-	-	-	36	0.63	0.412	3.0	20	67
6-7	cohesionless	0.76	1	18.5	117.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	91
7-8	cohesionless	0.76	1	18.5	136.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	119
8-9	cohesionless	0.76	1	18.5	154.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	151
9-10	cohesionless	0.76	1	18.5	173.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	187
10-11	cohesionless	0.76	1	18.5	191.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	227
11-12	cohesionless	0.76	1	18.5	210.3	36	-	-	-	-	-	36	0.63	0.412	3.0	43	270
12-13	cohesionless	0.76	1	18.5	228.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	317
13-14	cohesionless	0.76	1	18.5	247.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	368
14-15	cohesionless	0.76	1	18.5	265.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	423

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	35	-	-	-	35	0.61	0.426	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	35	-	-	-	35	0.61	0.426	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	35	-	-	-	35	0.61	0.426	3.0	12	22
3-4	cohesionless	1.00	1	18	63.0	35	-	-	-	35	0.61	0.426	3.0	17	39
4-5	cohesionless	1.00	1	18	81.0	35	-	-	-	35	0.61	0.426	3.0	22	61
5-6	cohesionless	1.00	1	18.5	99.3	36	-	-	-	36	0.63	0.412	3.0	27	88
6-7	cohesionless	1.00	1	18.5	117.8	36	-	-	-	36	0.63	0.412	3.0	32	120
7-8	cohesionless	1.00	1	18.5	136.3	36	-	-	-	36	0.63	0.412	3.0	37	157
8-9	cohesionless	1.00	1	18.5	154.8	36	-	-	-	36	0.63	0.412	3.0	42	199
9-10	cohesionless	1.00	1	18.5	173.3	36	-	-	-	36	0.63	0.412	3.0	47	246
10-11	cohesionless	1.00	1	18.5	191.8	36	-	-	-	36	0.63	0.412	3.0	52	298
11-12	cohesionless	1.00	1	18.5	210.3	36	-	-	-	36	0.63	0.412	3.0	57	355
12-13	cohesionless	1.00	1	18.5	228.8	36	-	-	-	36	0.63	0.412	3.0	62	417
13-14	cohesionless	1.00	1	18.5	247.3	36	-	-	-	36	0.63	0.412	3.0	67	484
14-15	cohesionless	1.00	1	18.5	265.8	36	-	-	-	36	0.63	0.412	3.0	72	556

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	210.3	4.0	1072
Sand	760	15.0	36.0	45.0	265.8	4.0	1356
Sand	1000	12.0	36.0	45.0	210.3	4.0	1857
Sand	1000	15.0	36.0	45.0	265.8	4.0	2347

PILE CAPACITIES FOR BH-16

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	17.5	8.8	28	-	-	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	0.76	1	17.5	26.3	28	-	-	-	-	-	28	0.49	0.530	3.0	5	7
2-3	cohesionless	0.76	1	17.5	43.8	28	-	-	-	-	-	28	0.49	0.530	3.0	9	16
3-4	cohesionless	0.76	1	17.5	61.3	28	-	-	-	-	-	28	0.49	0.530	3.0	13	29
4-5	cohesionless	0.76	1	17.5	78.8	28	-	-	-	-	-	28	0.49	0.530	3.0	16	45
5-6	cohesionless	0.76	1	18.5	96.8	36	-	-	-	-	-	36	0.63	0.412	3.0	20	65
6-7	cohesionless	0.76	1	18.5	115.3	36	-	-	-	-	-	36	0.63	0.412	3.0	24	89
7-8	cohesionless	0.76	1	18.5	133.8	36	-	-	-	-	-	36	0.63	0.412	3.0	28	116
8-9	cohesionless	0.76	1	18.5	152.3	36	-	-	-	-	-	36	0.63	0.412	3.0	31	148
9-10	cohesionless	0.76	1	18.5	170.8	36	-	-	-	-	-	36	0.63	0.412	3.0	35	183
10-11	cohesionless	0.76	1	18.5	189.3	36	-	-	-	-	-	36	0.63	0.412	3.0	39	222
11-12	cohesionless	0.76	1	18.5	207.8	36	-	-	-	-	-	36	0.63	0.412	3.0	43	265
12-13	cohesionless	0.76	1	18.5	226.3	36	-	-	-	-	-	36	0.63	0.412	3.0	47	311
13-14	cohesionless	0.76	1	18.5	244.8	36	-	-	-	-	-	36	0.63	0.412	3.0	50	362
14-15	cohesionless	0.76	1	18.5	263.3	36	-	-	-	-	-	36	0.63	0.412	3.0	54	416

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	Q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	17.5	8.8	28	-	-	-	28	0.49	0.530	3.0	2	2
1-2	cohesionless	1.00	1	17.5	26.3	28	-	-	-	28	0.49	0.530	3.0	7	10
2-3	cohesionless	1.00	1	17.5	43.8	28	-	-	-	28	0.49	0.530	3.0	12	21
3-4	cohesionless	1.00	1	17.5	61.3	28	-	-	-	28	0.49	0.530	3.0	17	38
4-5	cohesionless	1.00	1	17.5	78.8	28	-	-	-	28	0.49	0.530	3.0	21	59
5-6	cohesionless	1.00	1	18.5	96.8	36	-	-	-	36	0.63	0.412	3.0	26	86
6-7	cohesionless	1.00	1	18.5	115.3	36	-	-	-	36	0.63	0.412	3.0	31	117
7-8	cohesionless	1.00	1	18.5	133.8	36	-	-	-	36	0.63	0.412	3.0	36	153
8-9	cohesionless	1.00	1	18.5	152.3	36	-	-	-	36	0.63	0.412	3.0	41	194
9-10	cohesionless	1.00	1	18.5	170.8	36	-	-	-	36	0.63	0.412	3.0	46	241
10-11	cohesionless	1.00	1	18.5	189.3	36	-	-	-	36	0.63	0.412	3.0	51	292
11-12	cohesionless	1.00	1	18.5	207.8	36	-	-	-	36	0.63	0.412	3.0	56	348
12-13	cohesionless	1.00	1	18.5	226.3	36	-	-	-	36	0.63	0.412	3.0	61	410
13-14	cohesionless	1.00	1	18.5	244.8	36	-	-	-	36	0.63	0.412	3.0	66	476
14-15	cohesionless	1.00	1	18.5	263.3	36	-	-	-	36	0.63	0.412	3.0	71	548

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	207.8	4.0	1060
Sand	760	15.0	36.0	45.0	263.3	4.0	1343
Sand	1000	12.0	36.0	45.0	207.8	4.0	1835
Sand	1000	15.0	36.0	45.0	263.3	4.0	2325

PILE CAPACITIES FOR BH-17

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18.5	9.3	36	-	-	-	-	-	36	0.63	0.412	3.0	2	2
1-2	cohesionless	0.76	1	18.5	27.8	36	-	-	-	-	-	36	0.63	0.412	3.0	6	8
2-3	cohesionless	0.76	1	18.5	46.3	36	-	-	-	-	-	36	0.63	0.412	3.0	10	17
3-4	cohesionless	0.76	1	18.5	64.8	36	-	-	-	-	-	36	0.63	0.412	3.0	13	31
4-5	cohesionless	0.76	1	18.5	83.3	36	-	-	-	-	-	36	0.63	0.412	3.0	17	48
5-6	cohesionless	0.76	1	18.5	101.8	35	-	-	-	-	-	35	0.61	0.426	3.0	21	69
6-7	cohesionless	0.76	1	18.5	120.3	35	-	-	-	-	-	35	0.61	0.426	3.0	25	94
7-8	cohesionless	0.76	1	18.5	138.8	35	-	-	-	-	-	35	0.61	0.426	3.0	29	122
8-9	cohesionless	0.76	1	18.5	157.3	35	-	-	-	-	-	35	0.61	0.426	3.0	33	155
9-10	cohesionless	0.76	1	18.5	175.8	36	-	-	-	-	-	36	0.63	0.412	3.0	36	191
10-11	cohesionless	0.76	1	18.5	194.3	36	-	-	-	-	-	36	0.63	0.412	3.0	40	231
11-12	cohesionless	0.76	1	18.5	212.8	36	-	-	-	-	-	36	0.63	0.412	3.0	44	275
12-13	cohesionless	0.76	1	18.5	231.3	36	-	-	-	-	-	36	0.63	0.412	3.0	48	323
13-14	cohesionless	0.76	1	18.5	249.8	36	-	-	-	-	-	36	0.63	0.412	3.0	51	374
14-15	cohesionless	0.76	1	18.5	268.3	36	-	-	-	-	-	36	0.63	0.412	3.0	55	430

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18.5	9.3	36	-	-	-	36	0.63	0.412	3.0	3	3
1-2	cohesionless	1.00	1	18.5	27.8	36	-	-	-	36	0.63	0.412	3.0	8	10
2-3	cohesionless	1.00	1	18.5	46.3	36	-	-	-	36	0.63	0.412	3.0	13	23
3-4	cohesionless	1.00	1	18.5	64.8	36	-	-	-	36	0.63	0.412	3.0	18	40
4-5	cohesionless	1.00	1	18.5	83.3	36	-	-	-	36	0.63	0.412	3.0	23	63
5-6	cohesionless	1.00	1	18.5	101.8	35	-	-	-	35	0.61	0.426	3.0	28	90
6-7	cohesionless	1.00	1	18.5	120.3	35	-	-	-	35	0.61	0.426	3.0	33	123
7-8	cohesionless	1.00	1	18.5	138.8	35	-	-	-	35	0.61	0.426	3.0	38	161
8-9	cohesionless	1.00	1	18.5	157.3	35	-	-	-	35	0.61	0.426	3.0	43	204
9-10	cohesionless	1.00	1	18.5	175.8	36	-	-	-	36	0.63	0.412	3.0	48	252
10-11	cohesionless	1.00	1	18.5	194.3	36	-	-	-	36	0.63	0.412	3.0	53	304
11-12	cohesionless	1.00	1	18.5	212.8	36	-	-	-	36	0.63	0.412	3.0	58	362
12-13	cohesionless	1.00	1	18.5	231.3	36	-	-	-	36	0.63	0.412	3.0	63	425
13-14	cohesionless	1.00	1	18.5	249.8	36	-	-	-	36	0.63	0.412	3.0	68	493
14-15	cohesionless	1.00	1	18.5	268.3	36	-	-	-	36	0.63	0.412	3.0	73	565

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	212.8	4.0	1085
Sand	760	15.0	36.0	45.0	268.3	4.0	1368
Sand	1000	12.0	36.0	45.0	212.8	4.0	1879
Sand	1000	15.0	36.0	45.0	268.3	4.0	2369

PILE CAPACITIES FOR BH-18

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	155.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	152
9-10	cohesionless	0.76	1	18.5	174.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	188
10-11	cohesionless	0.76	1	18.5	192.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	228
11-12	Rock	0.76	1	21	212.5	42	-	50	-	0.5	0.7	42	0.73	0.331	5.0	8	236
12-13	Rock	0.76	1	21	233.5	42	-	50	-	0.5	0.7	42	0.73	0.331	5.0	8	245
13-14	Rock	0.76	1	21	254.5	42	-	50	-	0.5	0.7	42	0.73	0.331	5.0	8	253
14-15	Rock	0.76	1	21	275.5	42	-	50	-	0.5	0.7	42	0.73	0.331	5.0	8	261

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	Q _{uc} (kN/m ²)	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	34	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	34	-	-	-	34	0.59	0.441	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	34	-	-	-	34	0.59	0.441	3.0	12	22
3-4	cohesionless	1.00	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	17	39
4-5	cohesionless	1.00	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	22	62
5-6	cohesionless	1.00	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	cohesionless	1.00	1	18.5	155.8	36	-	-	-	36	0.63	0.412	3.0	42	200
9-10	cohesionless	1.00	1	18.5	174.3	36	-	-	-	36	0.63	0.412	3.0	47	248
10-11	cohesionless	1.00	1	18.5	192.8	36	-	-	-	36	0.63	0.412	3.0	52	300
11-12	Rock	1.00	1	21	212.5	42	50	0.5	0.7	42	0.73	0.331	5.0	11	311
12-13	Rock	1.00	1	21	233.5	42	50	0.5	0.7	42	0.73	0.331	5.0	11	322
13-14	Rock	1.00	1	21	254.5	42	50	0.5	0.7	42	0.73	0.331	5.0	11	333
14-15	Rock	1.00	1	21	275.5	42	50	0.5	0.7	42	0.73	0.331	5.0	11	344

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{UC} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	12.0	4.5	50.0	5.0	41
Rock	760	15.0	4.5	50.0	5.0	41
Rock	1000	12.0	4.5	50.0	5.0	71
Rock	1000	15.0	4.5	50.0	5.0	71

PILE CAPACITIES FOR BH-19

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	34	-	-	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	34	-	-	-	-	-	34	0.59	0.441	3.0	6	7
2-3	cohesionless	0.76	1	18	45.0	34	-	-	-	-	-	34	0.59	0.441	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	155.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	152
9-10	Rock	0.76	1	21	175.5	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	177
10-11	Rock	0.76	1	21	196.5	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	202
11-12	Rock	0.76	1	21	217.5	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	228
12-13	Rock	0.76	1	21	238.5	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	253
13-14	Rock	0.76	1	21	259.5	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	278
14-15	Rock	0.76	1	21	280.5	42	-	150	-	0.5	0.7	42	0.73	0.331	5.0	25	303

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	1.00	1	18	9.0	34	-	-	-	34	0.59	0.441	3.0	2	2
1-2	cohesionless	1.00	1	18	27.0	34	-	-	-	34	0.59	0.441	3.0	7	10
2-3	cohesionless	1.00	1	18	45.0	34	-	-	-	34	0.59	0.441	3.0	12	22
3-4	cohesionless	1.00	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	17	39
4-5	cohesionless	1.00	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	22	62
5-6	cohesionless	1.00	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	27	89
6-7	cohesionless	1.00	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	32	121
7-8	cohesionless	1.00	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	37	158
8-9	cohesionless	1.00	1	18.5	155.8	36	-	-	-	36	0.63	0.412	3.0	42	200
9-10	Rock	1.00	1	21	175.5	42	150	0.5	0.7	42	0.73	0.331	5.0	33	233
10-11	Rock	1.00	1	21	196.5	42	150	0.5	0.7	42	0.73	0.331	5.0	33	266
11-12	Rock	1.00	1	21	217.5	42	150	0.5	0.7	42	0.73	0.331	5.0	33	299
12-13	Rock	1.00	1	21	238.5	42	150	0.5	0.7	42	0.73	0.331	5.0	33	332
13-14	Rock	1.00	1	21	259.5	42	150	0.5	0.7	42	0.73	0.331	5.0	33	365
14-15	Rock	1.00	1	21	280.5	42	150	0.5	0.7	42	0.73	0.331	5.0	33	398

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	N ϕ	Q _{UC} (kN/m ²)	FOS	Q _{END} (kN)
Rock	760	12.0	4.5	150.0	5.0	123
Rock	760	15.0	4.5	150.0	5.0	123
Rock	1000	12.0	4.5	150.0	5.0	212
Rock	1000	15.0	4.5	150.0	5.0	212

PILE CAPACITIES FOR BH-20

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m ²)	phi	c (kN/m ²)	q _{uc} (kN/m ²)	α adhesion	α reduction-rock	β correction	δ	tan δ	k _s	FOS	Q _{skin} (kN)	Q _{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	30	-	-	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	30	-	-	-	-	-	30	0.52	0.500	3.0	6	8
2-3	cohesionless	0.76	1	18	45.0	30	-	-	-	-	-	30	0.52	0.500	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	155.8	36	-	-	-	-	-	36	0.63	0.412	3.0	32	152
9-10	cohesionless	0.76	1	18.5	174.3	36	-	-	-	-	-	36	0.63	0.412	3.0	36	188
10-11	cohesionless	0.76	1	18.5	192.8	36	-	-	-	-	-	36	0.63	0.412	3.0	40	228
11-12	cohesionless	0.76	1	18.5	211.3	36	-	-	-	-	-	36	0.63	0.412	3.0	44	272
12-13	cohesionless	0.76	1	18.5	229.8	36	-	-	-	-	-	36	0.63	0.412	3.0	47	319
13-14	cohesionless	0.76	1	18.5	248.3	36	-	-	-	-	-	36	0.63	0.412	3.0	51	370
14-15	cohesionless	0.76	1	18.5	266.8	36	-	-	-	-	-	36	0.63	0.412	3.0	55	425

(A) - CALCULATION OF ALLOWABLE SKIN FRICTION :

Depth	Strata Encountered	Diameter of Pile (m)	Length of Layer (m)	Effective σ for this layer	Effective overburden (kN/m^2)	phi	Q_{uc} (kN/m^2)	α reduction-rock	β correction	δ	$\tan \delta$	k_s	FOS	Q_{skin} (kN)	Q_{skin} (Cum) (kN)
0-1	cohesionless	0.76	1	18	9.0	30	-	-	-	30	0.52	0.500	3.0	2	2
1-2	cohesionless	0.76	1	18	27.0	30	-	-	-	30	0.52	0.500	3.0	6	8
2-3	cohesionless	0.76	1	18	45.0	30	-	-	-	30	0.52	0.500	3.0	9	17
3-4	cohesionless	0.76	1	18.5	63.3	36	-	-	-	36	0.63	0.412	3.0	13	30
4-5	cohesionless	0.76	1	18.5	81.8	36	-	-	-	36	0.63	0.412	3.0	17	47
5-6	cohesionless	0.76	1	18.5	100.3	36	-	-	-	36	0.63	0.412	3.0	21	67
6-7	cohesionless	0.76	1	18.5	118.8	36	-	-	-	36	0.63	0.412	3.0	24	92
7-8	cohesionless	0.76	1	18.5	137.3	36	-	-	-	36	0.63	0.412	3.0	28	120
8-9	cohesionless	0.76	1	18.5	155.8	36	-	-	-	36	0.63	0.412	3.0	32	152
9-10	cohesionless	0.76	1	18.5	174.3	36	-	-	-	36	0.63	0.412	3.0	36	188
10-11	cohesionless	0.76	1	18.5	192.8	36	-	-	-	36	0.63	0.412	3.0	40	228
11-12	cohesionless	0.76	1	18.5	211.3	36	-	-	-	36	0.63	0.412	3.0	44	272
12-13	cohesionless	0.76	1	18.5	229.8	36	-	-	-	36	0.63	0.412	3.0	47	319
13-14	cohesionless	0.76	1	18.5	248.3	36	-	-	-	36	0.63	0.412	3.0	51	370
14-15	cohesionless	0.76	1	18.5	266.8	36	-	-	-	36	0.63	0.412	3.0	55	425

ALLOWABLE END BEARING RESISTANCE :

Socket Strata	Diameter of Pile (mm)	Length of Pile (m)	Φ	N_q	Effective overburden (kN/m ²)	FOS	Q_{END} (kN)
Sand	760	12.0	36.0	45.0	211.3	4.0	1078
Sand	760	15.0	36.0	45.0	266.8	4.0	1361
Sand	1000	12.0	36.0	45.0	211.3	4.0	1866
Sand	1000	15.0	36.0	45.0	266.8	4.0	2356

LIQUEFACTION ASSESSMENT FOR BH-6 A

Project Title: BH-6A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

PGA max : 0.2
 M=6.6
 Water Level : 0.05 m
 Analysis Method : NCEER Workshop (1996)
 MSF Method : Seed & Idriss (1982)
 MSF = 1.17
 Minimum Required Factor of Safety : 1

Depth (m)	SPT
0	15
1.5	35
3	46
4.5	27
6	50
7.5	50
9	50

Thickness (m)	Density (kN/m ³)	Bottom (m)	D50 (mm)	Fines Content (%)
6	18	6	0.311	13.2
3	18.5	9	0.592	29.2
0	0	9	0	0
0	0	9	0	0
0	0	9	0	0
0	0	9	0	0
0	0	9	0	0
0	0	9	0	0
0	0	9	0	0
0	0	9	0	0
		9		

Project Title: BH-6A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

∴ Notes:

Sv : Total overburden stress S'v : Effective overburden stress
 Cn : SPT correction factor Ks : K(sigma) due to the effect of overburden stress
 CRR : Cyclic Resistance Ratio CSR : Cyclic Stress Ratio
 LDI : Lateral Displacement Index St : Post-liquefaction settlement of the site
 Sr : Post-liquefaction residual strength

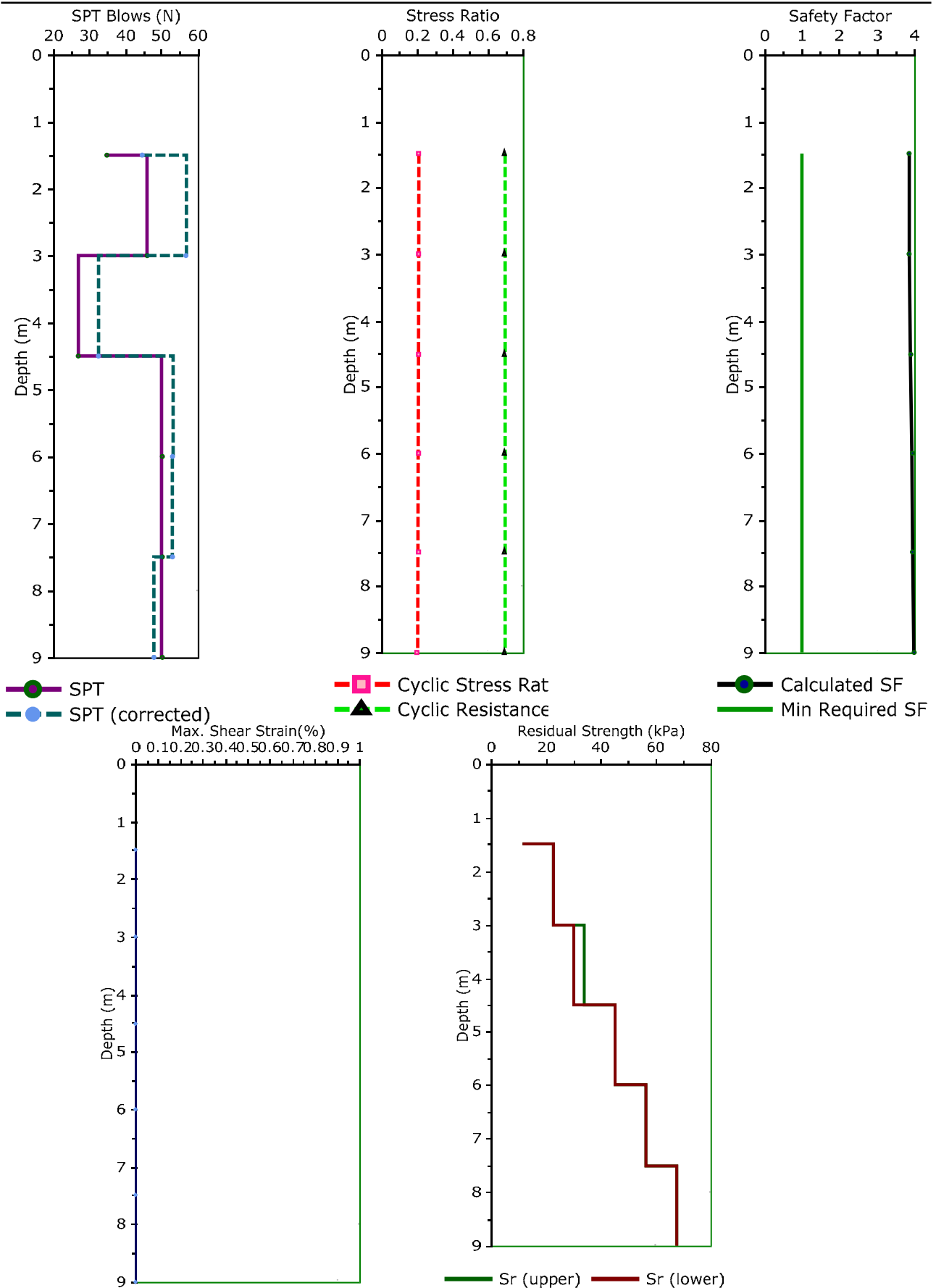
∴ Total estimated post-liquefaction movements:

Lateral Displacement =0 m
 Site Settlement =0 m

Depth (m)	Sv (kPa)	S'v (kPa)	D50 (mm)	SPT	Cn	Corr. SPT	Ks	CRR	CSR	Factor of Safety	Max. Shear Strain (%)	LDI (m)	St (m)	Min. Sr (kPa)	Max. Sr (kPa)
1.5	26.99	16.42	0.311	35	1.28	44.6	1	>0.7	0.211	3.87	0	0	0	0.12	0.12
3	53.98	32.48	0.311	46	1.24	56.9	1	>0.7	0.211	3.87	0	0	0	0.23	0.23
4.5	80.98	48.53	0.311	27	1.21	32.6	1	>0.7	0.209	3.9	0	0	0	0.31	0.35
6	107.97	64.59	0.311	50	1.06	53.2	1	>0.7	0.207	3.94	0	0	0	0.46	0.46
7.5	135.71	80.65	0.592	50	1.06	53	1	>0.7	0.206	3.96	0	0	0	0.58	0.58
9	163.45	96.7	0.592	50	0.96	47.9	1	>0.7	0.205	3.99	0	0	0	0.69	0.69

Project Title: BH-6A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES



LIQUEFACTION ASSESSMENT FOR BH-7 A

Project Title: BH-7A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

PGA max : 0.2
 M=6.6
 Water Level : 0.05 m
 Analysis Method : Seed et al. (1983)
 MSF Method : Seed & Idriss (1982)
 MSF = 1.17
 Minimum Required Factor of Safety : 1

Depth (m)	SPT
0	15
1.5	13
3	22
4.5	38
6	21
7.5	11
9	9
10.5	38

Thickness (m)	Density (kN/m ³)	Bottom (m)	D50 (mm)	Fines Content (%)
7.5	18	7.5	0.981	14
1	18.5	8.5	0.026	61.8
1	18.5	9.5	0.026	61.8
1	18.5	10.5	0.026	61.8
0	0	10.5	0	0
0	0	10.5	0	0
0	0	10.5	0	0
0	0	10.5	0	0
0	0	10.5	0	0
0	0	10.5	0	0
		10.5		

Project Title: BH-7A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

∴ Notes:

Sv : Total overburden stress S'v : Effective overburden stress
 Cn : SPT correction factor Ks : K(sigma) due to the effect of overburden stress
 CRR : Cyclic Resistance Ratio CSR : Cyclic Stress Ratio
 LDI : Lateral Displacement Index St : Post-liquefaction settlement of the site
 Sr : Post-liquefaction residual strength

∴ Total estimated post-liquefaction movements:

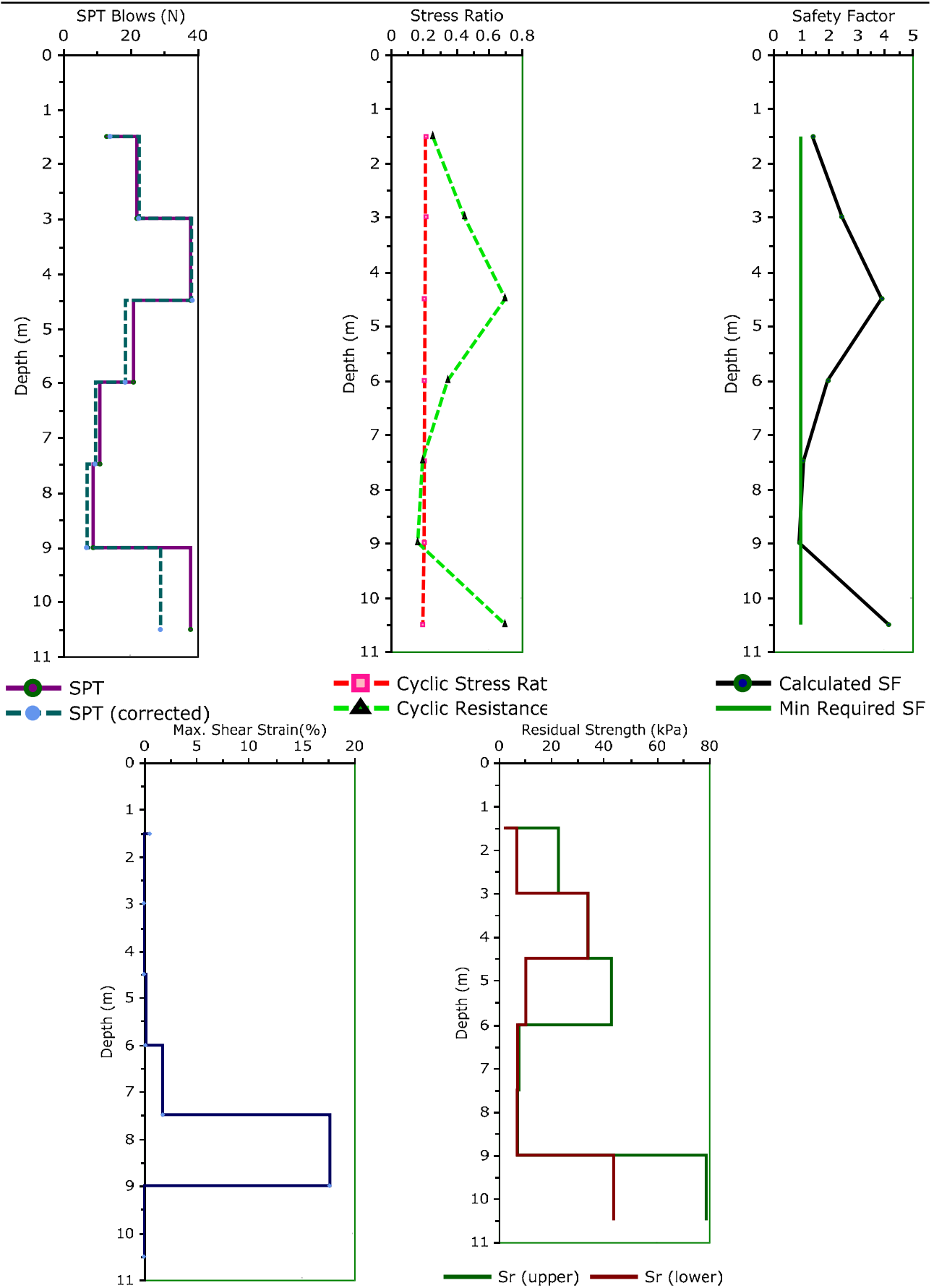
Lateral Displacement =0.24 m

Site Settlement =0 m

Depth (m)	Sv (kPa)	S'v (kPa)	D50 (mm)	SPT	Cn	Corr. SPT	Ks	CRR	CSR	Factor of Safety	Max. Shear Strain (%)	LDI (m)	St (m)	Min. Sr (kPa)	Max. Sr (kPa)
1.5	26.99	16.42	0.981	13	1.28	13.8	1	0.26	0.211	1.42	0.52	0.77	0	0.02	0.03
3	53.98	32.48	0.981	22	1.24	22.7	1	0.45	0.211	2.48	0	0.77	0	0.07	0.23
4.5	80.98	48.53	0.981	38	1.21	38.3	1	>0.7	0.209	3.9	0	0.77	0	0.35	0.35
6	107.97	64.59	0.981	21	1.06	18.6	1	0.35	0.207	1.96	0.2	1.07	0	0.11	0.44
7.5	134.96	80.65	0.981	11	1.06	9.7	1	0.19	0.205	1.1	1.78	3.74	0	0.07	0.08
9	162.7	96.7	0.026	9	0.96	7.2	1	0.16	0.204	0.94	17.69	30.27	0	0.07	0.07
10.5	190.45	112.76	0.026	38	0.92	29.1	1	>0.7	0.196	4.16	0	30.27	0	0.45	0.81

Project Title: BH-7A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES



LIQUEFACTION ASSESSMENT FOR BH-9 A

Project Title: BH-9A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

PGA max : 0.2
 M=6.6
 Water Level : 0.05 m
 Analysis Method : Seed et al. (1983)
 MSF Method : Seed & Idriss (1982)
 MSF = 1.17
 Minimum Required Factor of Safety : 1

Depth (m)	SPT
0	15
1.5	12
3	12
4.5	17
6	2
7.5	3
9	26
10.5	18
12	30
13.5	45
15	50

Thickness (m)	Density (kN/m ³)	Bottom (m)	D50 (mm)	Fines Content (%)
7.5	18	7.5	0.981	14
6	18	13.5	0.173	41.8
3	16.5	16.5	0.004	98.6
3	18	19.5	0.173	40
3	18	22.5	0.009	89
0	0	22.5	0	0
0	0	22.5	0	0
0	0	22.5	0	0
0	0	22.5	0	0
		22.5		

Project Title: BH-9A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

∴ Notes:

Sv : Total overburden stress S'v : Effective overburden stress
 Cn : SPT correction factor Ks : K(sigma) due to the effect of overburden stress
 CRR : Cyclic Resistance Ratio CSR : Cyclic Stress Ratio
 LDI : Lateral Displacement Index St : Post-liquefaction settlement of the site
 Sr : Post-liquefaction residual strength

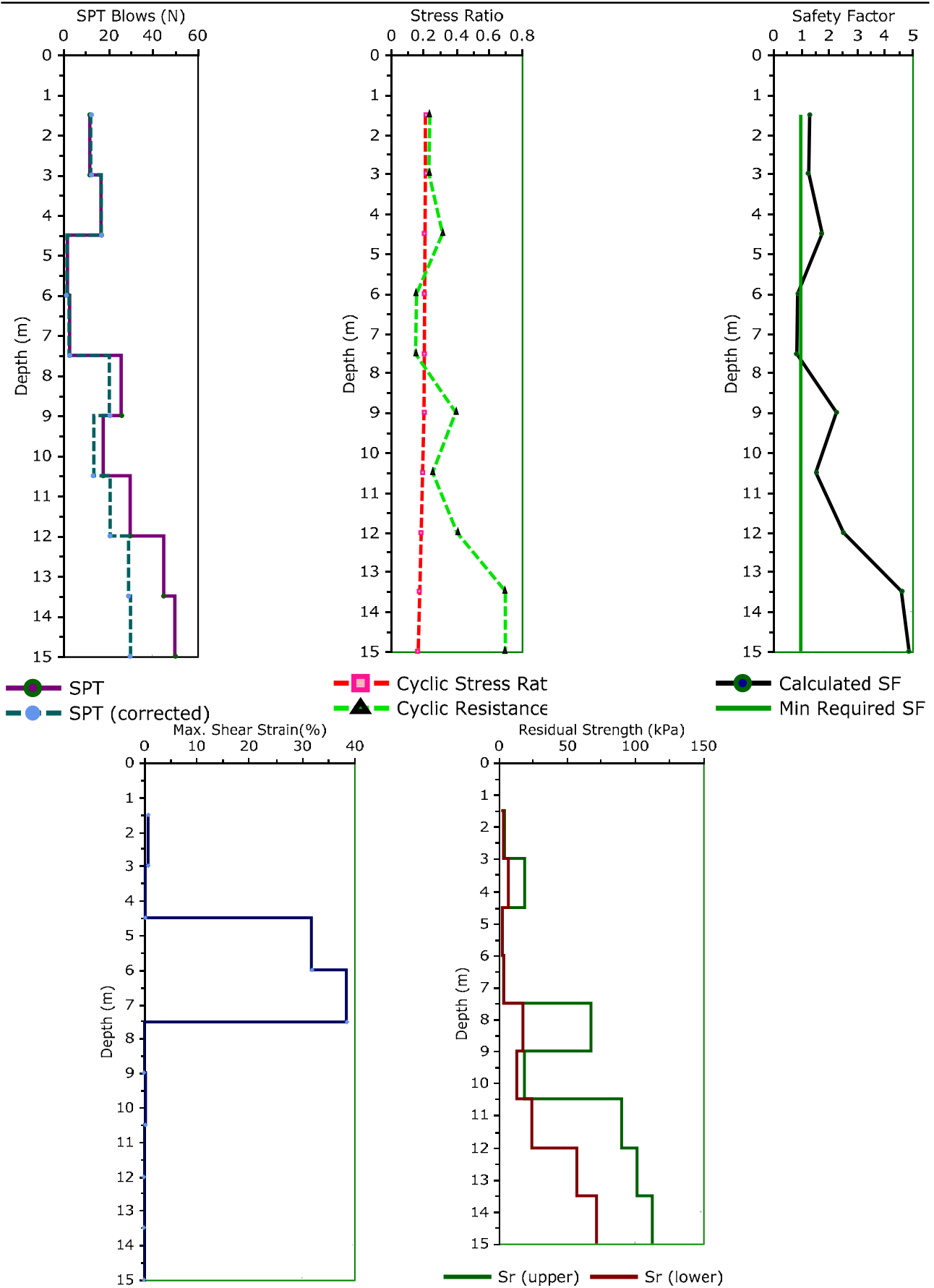
∴ Total estimated post-liquefaction movements:

Lateral Displacement =0.87 m
 Site Settlement =0.13 m

Depth (m)	Sv (kPa)	S'v (kPa)	D50 (mm)	SPT	Cn	Corr. SPT	Ks	CRR	CSR	Factor of Safety	Max. Shear Strain (%)	LDI (m)	St (m)	Min. Sr (kPa)	Max. Sr (kPa)
1.5	26.99	16.42	0.981	12	1.28	12.7	1	0.24	0.211	1.32	0.71	1.07	0	0.02	0.02
3	53.98	32.48	0.981	12	1.24	12.4	1	0.23	0.211	1.29	0.81	2.28	0	0.04	0.04
4.5	80.98	48.53	0.981	17	1.21	17.1	1	0.32	0.209	1.77	0.25	2.66	0	0.07	0.19
6	107.97	64.59	0.981	2	1.06	1.8	1	0.16	0.207	0.89	31.87	50.46	0.07	0.03	0.03
7.5	134.96	80.65	0.981	3	1.06	2.7	1	0.15	0.205	0.86	38.51	108.23	0.13	0.04	0.04
9	161.95	96.7	0.173	26	0.96	20.7	1	0.4	0.203	2.28	0	108.23	0.13	0.18	0.69
10.5	188.95	112.76	0.173	18	0.92	13.8	1	0.26	0.195	1.54	0.32	108.71	0.13	0.14	0.19
12	215.94	128.82	0.173	30	0.84	21.1	1	0.41	0.186	2.54	0	108.71	0.13	0.25	0.92
13.5	242.93	144.87	0.173	45	0.78	29.3	1	>0.7	0.177	4.61	0	108.71	0.13	0.59	1.03
15	267.68	160.93	0.004	50	0.73	30.2	1	>0.7	0.167	4.89	0	108.71	0.13	0.73	1.15

Project Title: BH-9A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES



LIQUEFACTION ASSESSMENT FOR BH-10 A

Project Title: BH-10A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

PGA max : 0.2
 M=6.6
 Water Level : 0.05 m
 Analysis Method : Japan' Bridge Code
 MSF Method : Seed & Idriss (1982)
 MSF = 1.17
 Minimum Required Factor of Safety : 1

Depth (m)	SPT
0	15
1.5	5
3	2
4.5	4
6	5
7.5	4
9	6
10.5	16
12	50

Thickness (m)	Density (kN/m ³)	Bottom (m)	D50 (mm)	Fines Content (%)
6	18	6	3.613	0.3
4.5	16	10.5	0.001	98.8
1.5	16.5	12	0.173	41.8
0	0	12	0	0
0	0	12	0	0
0	0	12	0	0
0	0	12	0	0
0	0	12	0	0
0	0	12	0	0

Project Title: BH-10A
Client: JICA/TCI
Address: PQ, KHI
Job Code: K15-1185-101

SOIL TESTING SERVICES

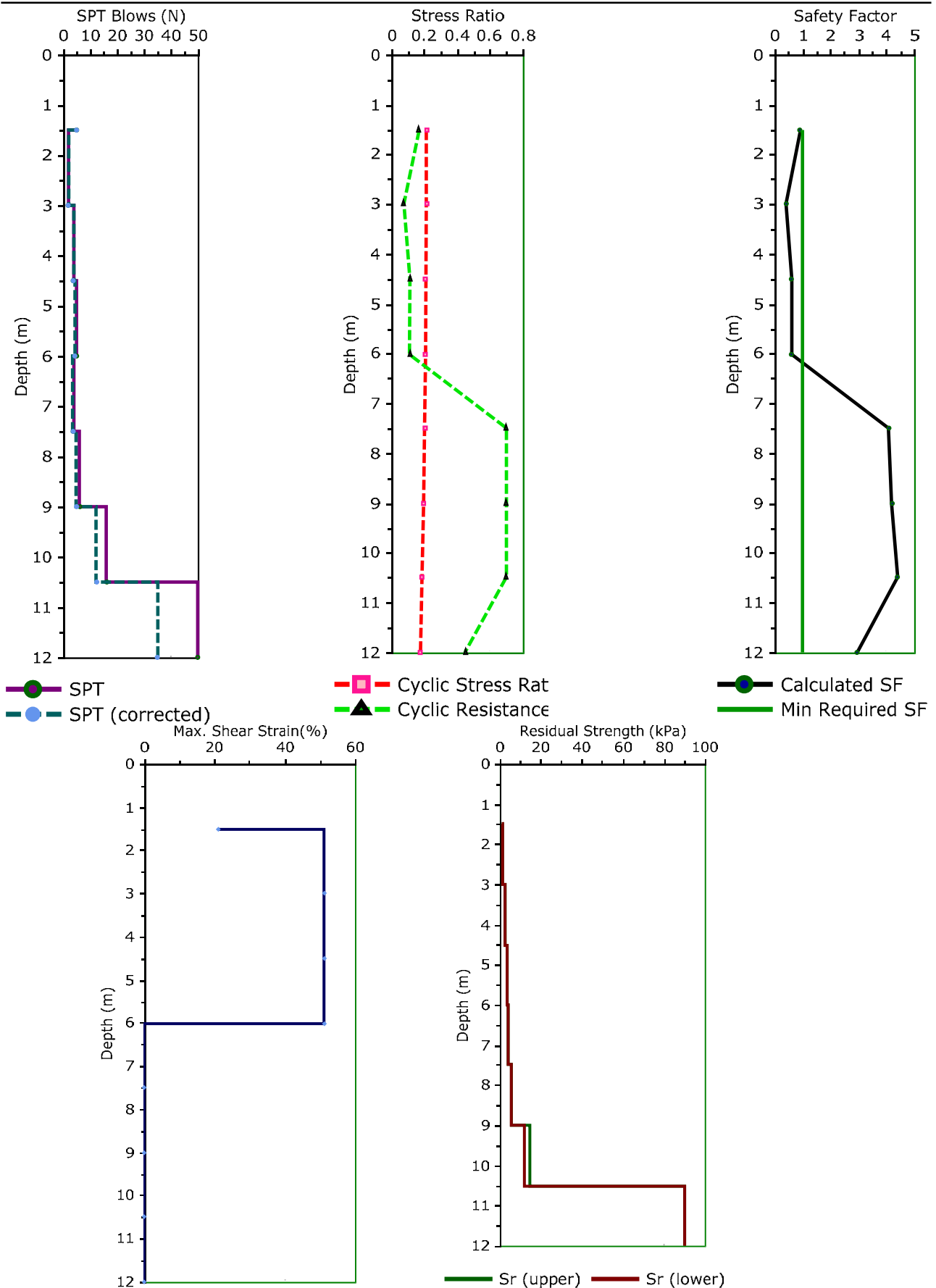
∴ Notes:

Sv : Total overburden stress S'v : Effective overburden stress
 Cn : SPT correction factor Ks : K(sigma) due to the effect of overburden stress
 CRR : Cyclic Resistance Ratio CSR : Cyclic Stress Ratio
 LDI : Lateral Displacement Index St : Post-liquefaction settlement of the site
 Sr : Post-liquefaction residual strength

∴ Total estimated post-liquefaction movements:

Lateral Displacement =2.1 m
 Site Settlement =0.26 m

Depth (m)	Sv (kPa)	S'v (kPa)	D50 (mm)	SPT	Cn	Corr. SPT	Ks	CRR	CSR	Factor of Safety	Max. Shear Strain (%)	LDI (m)	St (m)	Min. Sr (kPa)	Max. Sr (kPa)
1.5	26.99	16.42	3.613	5	1.28	5.3	1	0.17	0.211	0.93	21.08	31.62	0.07	0.01	0.01
3	53.98	32.48	3.613	2	1.24	2.1	1	0.07	0.211	0.41	51.2	108.42	0.13	0.01	0.01
4.5	80.98	48.53	3.613	4	1.21	4	1	0.11	0.209	0.62	51.2	185.22	0.2	0.03	0.03
6	107.97	64.59	3.613	5	1.06	4.4	1	0.11	0.207	0.62	51.2	262.02	0.26	0.04	0.04
7.5	131.96	80.65	0.001	4	1.06	3.5	1	>0.7	0.201	4.08	0	262.02	0.26	0.04	0.04
9	155.96	96.7	0.001	6	0.96	4.8	1	>0.7	0.195	4.19	0	262.02	0.26	0.06	0.06
10.5	179.95	112.76	0.001	16	0.92	12.2	1	>0.7	0.185	4.41	0	262.02	0.26	0.12	0.15
12	204.69	128.82	0.173	50	0.84	35.2	1	0.45	0.176	2.96	0	262.02	0.26	0.92	0.92



Appendix G

Photographs

FEASIBILITY STUDY ON COAL TRANSPORTATION BETWEEN PORT QASIM

SITE PHOTOGRAPHS



BORE HOLE NO. 07 (SPT # 02)



BORE HOLE NO. 07 (SPT # 03)



BORE HOLE NO. 07 (SPT # 03)



BORE HOLE NO. 07 (SPT # 05)



BORE HOLE NO. 07 (SPT # 09)



BORE HOLE NO. 07 (SPT # 01)



BORE HOLE NO. 07 (SPT # 09)



BORE HOLE NO. 07 (SPT # 06)



BORE HOLE NO. 07 (SPT # 04)



BORE HOLE NO. 07 (SPT # 08)



BORE HOLE NO. 07 (SPT # 01)

FEASIBILITY STUDY ON COAL TRANSPORTATION BETWEEN PORT QASIM

SITE PHOTOGRAPHS



BORE HOLE NO. 10



BORE HOLE NO. 10



BORE HOLE NO. 10



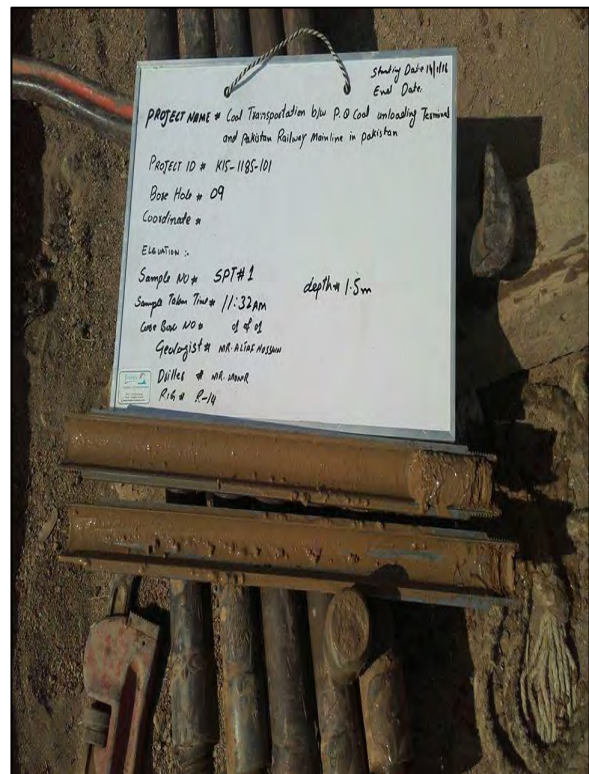
30 CM SCALE SECTION



DISTANCE MEASUREMENT



SPT -2 (BH-12)



SPT-1 (BH-09)



SPT-1 (BH-12)



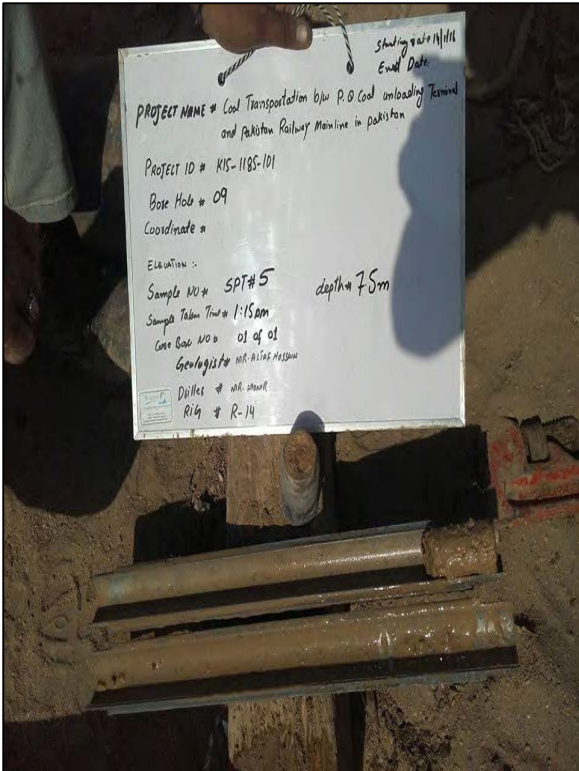
SPT-2 (BH-9)



SPT-3 (BH-09)



SPT-3 (BH-12)



SPT-5 (BH-9)



SPT-5 (BH-12)



SPT-6 (BH-09)



SPT-7 (BH-12)



SPT-7 (BH-9)



SPT-8 (BH-9)



SPT-8 (BH-12)



SPT-9 (BH-9)