

Appendix – 5.1.7 (2)

Geological Survey

Soil Investigation Report on Natural Conditions for preparatory survey on Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)

Project Location: Matarbari, Maheshkhali, Cox's Bazar

Client: SGS Bangladesh Ltd



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1.0 INTRODUCTION

The Government of the People's Republic of Bangladesh has taken up a project for the establishment of a coal-fired power plant at Matarbari in Maheshkhali Upazila of Cox's Bazar District. Coal Power Generation Company Bangladesh Limited (CPGCBL) is the implementation agency on behalf of the Government of Bangladesh. To conduct Natural and Social Environmental Survey, Topographic Survey and Soil Investigation, and Survey on Natural Conditions for Preparatory Survey on Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2), CPGCBL has engaged an international consulting firm Tokyo Electric Power Services Co., Ltd. (TEPSCO) who provides wide-ranging engineering services; planning, study, design, construction supervision and after care.

Ground Instrumentation & Engineering Pte. Ltd. (GIE) has been awarded Geotechnical Investigation work for this project from SGS Bangladesh Ltd.

For the geotechnical investigation, a total of 8 (eight) boreholes drilling was executed by GIE. A Satellite Map showing the project location in Figure 02 (Site Vicinity Map) and a satellite image of the borehole locations is provided in Figure 03 at the end of the report. A borehole layout map provided by the client is presented in Figure 04. The purpose of the soil investigation was to provide the subsoil information and the pertinent soil strength for the design of the proposed coal-fired power plant and other ancillary structures at the site.

The field investigation of the project was conducted from 03 February 2021 to 20 February 2021. Lab testing for samples was conducted thereafter in GIE Laboratory, Dhaka & SAC-SINGLAS accredited laboratory in GIE, Singapore, and Bangladesh University of Engineering and Technology (BUET).

This report presents the results of the field investigation and laboratory works including interpolated subsurface profiles between the boreholes investigated. The interpolated profiles are prepared based on the borehole information in Figure 05. Variation of subsurface conditions between the holes may exist as the boreholes are quite apart.

2.0 SCOPE OF WORK

The scope of works as stipulated in Contract Specification is summarized as follows.

- Mobilization and demobilization of 02 (two) hydraulic rotary drilling rig, necessary equipment, and personnel to the project site.
- Drilling and sampling of 8 (eight) boreholes as specified. The in-situ tests (SPTs) were conducted as specified and undisturbed samplings from every cohesive soil layer were taken.
- Full-time field supervision of drilling and sampling work during the fieldwork and prepare bore log.
- Conducting laboratory testing for all the samples to evaluate the pertinent physical, chemical and engineering characteristics of the soil underlying the site.
- Preparing a factual report following the requirement of contract specifications.

3.0 REFERENCES / CODE OF PRACTICES

Soil investigation was carried out in compliance with ASTM Standards. The soil description and geological classification are described with relevant ASTM D2488 and Unified Soil Classification Systems (USCS). Standard Penetration Tests were conducted at intervals specified in accordance with D1586. The laboratory testing and Classification of soils were made following the relevant ASTM standard.

4.0 EQUIPMENT

Two rotary drilling rigs were mobilized at this site to drill the boreholes of this project. The manual excavation was conducted for trial excavation for boreholes to avoid any utilities in borehole locations. Split spoon sampler was used for disturbed sampling, while Shelby tubes & Mazier samplers were used for undisturbed sampling. Laboratory testing was conducted using standard equipment for the respective laboratory testing.

5.0 METHODS OF FIELD INVESTIGATION

5.1 General

The fieldwork for this sub-soil investigation was conducted from 03 February 2021 to 20 February 2021 upon receipt of the instruction from the Client. Search for any existing service lines and utility facilities were carried out at the drilling locations.

5.2 Setting Out

All borehole locations were set out jointly by GIE and the client's representative. The reduced level (RL) of the boreholes is provided by the client. The RL and coordinates of borehole points are given in the following table.

Table 5.1: Borehole Coordinates and Reduced Levels

Location- Matarbari, Maheshkhali, Cox's Bazar			
BH Ref.	Northing (m)	Easting (m)	Elevation (m)
BH-01	2400600	385231	4.680
BH-02	2400781	384907	4.300
BH-03	2400612	384904	4.970
BH-04	2400455	384901	4.192
BH-05	2400617	384596	4.332
BH-06	2400493	384316	7.179
BH-07	2400624	384147	6.774
BH-08	2400763	383978	5.885

5.3 Field Work for Exploratory Boreholes

One skid-mounted rotary drilling rig & one tractor mounted rotary drilling utilizing wash techniques were used to drill the boreholes. Flush jointed casings with nominal diameters of 100 mm were used to stabilize and prevent the collapse of the borehole walls.

A tri-cone drag bit was used to advance the borehole and water was used as the flushing medium. Bentonite was added to the water when it was necessary to stabilize uncased sections of a borehole or where running sands are encountered.

Sampling and in situ testing (SPT) were performed at specified intervals over the depth drilled. The undisturbed soil sample is recovered using a thin-walled sampler. The disturbed sample is collected from the SPT split spoon sampler after each Standard Penetration Test (SPT). A standard split barrel sampler of 50 mm outer diameter was lowered to the bottom of the borehole on drill rods. The sampler was then be driven 450 mm into the soil by a 63.5 kg self-tripping hammer free falling from a height of 760 mm.

The blow counts required to advance the final 300 mm of a 450 mm sampler drive was recorded on the borehole logs as SPT 'N' values. In dense strata where it is difficult to drive the sampler the full 450 mm, the penetration achieved beyond the initial 150 mm seating drive, with 50 blows of the hammer was recorded instead.

All the SPT samples were extruded at the site for necessary inspection and identification of the soils encountered.

SPT continued until reaching the hard layer with N value of 50 or more for 5 consecutive times.

After inspection, the recovered SPT samples were placed in double polythene bags to prevent moisture loss. The undisturbed samples were preserved within Shelby tubes with proper waxing and were kept in a cool environment and were later transported to a Laboratory in Dhaka (GIE Lab) for extrusion.

Upon extrusion, the samples were cut into pieces and wrapped with several layers of polyethylene and finally with aluminium foil. All scheduled soil tests were conducted in GIE Laboratory, Bangladesh & Singapore and Bangladesh University of Engineering and Technology (BUET).

The logging of boreholes was carried out by a geologist/site engineer with wide experience on subsoil and geological conditions of the site and in accordance with relevant ASTM and USCS. The Borehole Logs are presented in Appendix A of this report.

6.0 LABORATORY TESTS

A program of laboratory testing was specified by the client to obtain the relevant material properties of the soil strata at the project site. Upon receipt of the Test Program from the Consultant, laboratory investigation of the selected samples was carried out. All samples were examined by a soil technician and checked against the laboratory test results before the final description. The Laboratory Test Result is presented in Appendix B.

In general, the testing is divided into the following areas:

- (I) Index Property Tests
 - Natural Moisture Content
 - Specific Gravity
 - Unit Weight (wet and dry density)
 - Atterberg Limits Test
 - Particle Size Distribution by Sieve and Hydrometer Analysis

- Laboratory Permeability Test (Falling Head)
- (II) Strength Tests
- Unconsolidated-Undrained Triaxial Compression Tests (UU)
 - Unconfined Compression Test (UCT)
 - Direct Shear Test
- (III) Deformation Tests
- Consolidation Test
 - Modified Proctor Compaction Test
- (IV) Chemical Tests
- Chemical Test of Soil (pH, Chloride, Sulfate)
 - Chemical Test of Water (pH, Chloride, Sulfate)

6.1 Index Property Tests

6.1.1 Moisture Content

The water content is determined by oven drying selected moist/wet soil material for at least 24 hours to a constant dry mass at a temperature of 105 °C. The loss in weight of the sample due to drying represents the weight of the moisture of the soil. The moisture content of the soil is presented as a percentage of the dry weight of the soil. This test is performed in accordance with ASTM D2216.

6.1.2 Specific Gravity

The specific gravity of the soil particles is determined using a stoppered bottle pycnometer with a volume of 50 ml. The bottle is filled with distilled water and weighed. The unit weight of the water can then be determined. Then the bottle is partly filled with distilled water in which 10 g of dry crumbled soil is mixed. Entrapped air is removed from this mixture by subjecting the contents of the bottle to a vacuum. The bottle is then filled up with distilled water and weighed. The unit weight of the particles of the soil can be computed with these data. The weights of the bottle and contents are determined at a temperature of 20°C. The test is performed in general accordance with ASTM D 854-02.

6.1.3 Unit Weight (wet and dry density)

Unit weights are computed from the wet and dry weights of a standard volume of soil. The dry weight is obtained after determining the moisture content of a wet sample of the standard volume of soil. The unit weight, γ (kN/m³), refers to the unit weight of the soil at the sampled water content. The dry unit weight γ_d , is determined from the mass of the oven-dried soil and the initial volume. This test is performed in accordance with ASTM 7263-09.

6.1.4 Atterberg Limits

The Atterberg limits refer to arbitrarily defined boundaries between the liquid and plastic states (i.e., liquid limit, W_L , and between the plastic and brittle states i.e., plastic limit, W_P), of fine-grained soils. They are expressed in the percentage of water content. The range of water contents over which soil behaves plastically is termed the Plastic Index and corresponds to the numerical difference between the liquid and plastic limit (i.e., $W_L - W_P$). Tests to determine the Atterberg limits were performed on soil samples of cohesive material.

The soil is dried and then ground into separate grains using a mortar. The soil grains larger than 425 μm size are removed by sieving. The soil is then thoroughly mixed with different quantities of distilled water. The liquid and plastic limits of the soil are then determined in accordance with ASTM D 4318.

6.1.5 Particle Size Analysis

Particle size distribution is determined utilizing sieving, hydrometer tests, or both. The percentage of the weight of the various particle sizes above 74 μm is determined by sieving through a set of standard sieves using an electric shaker capable of horizontal and vertical motions. Wire sieves of up to and including the opening size of 2 mm, are used. Plate sieves with an opening size of more than 2 mm are used when more than 5 % of the weight of the specimen is retained on the 2 mm sieve.

When there is a considerable amount of particles smaller than 74 μm , the sieving is complemented by a hydrometer test in which the sample is mixed with water and stirred for about 15 minutes. An additive was used to prevent the flocculation of the soil particles.

After mixing, the density of the water-soil slurry is measured at fixed time intervals, and the particle size distribution of the sediment particles was determined. This test is performed in accordance with ASTM D 422.

6.1.6 Laboratory Permeability Test (Falling Head)

The falling head permeability test involves flow of water through a relatively short soil sample connected to a standpipe which provides the water head and also allows measuring the volume of water passing through the sample. The diameter of the standpipe depends on the permeability of the tested soil. The test can be carried out in a Falling Head permeability cell or in an oedometer cell.

Before starting the flow measurements, the soil sample is saturated and the standpipes are filled with de-aired water to a given level. The test then starts by allowing water to flow through the sample until the water in the standpipe reaches a given lower limit. The time required for the water in the standpipe to drop from the upper to the lower level is recorded. This test is performed in accordance with ASTM D5084.

6.2 Soil Strength Tests

6.2.1 Unconsolidated-Undrained Triaxial Compression Tests (UU)

This test was performed on undisturbed samples of cohesive soils. Depending on the consistency of the cohesive material, the test specimen was prepared by trimming the sample or by pushing a mould into the sample. The height to diameter ratio of the sample was two. A rubber membrane was placed around the specimen and a confining pressure was applied to the sample. During the axial loading of the specimen, the confining pressure was kept constant and the drainage of pore water was not allowed. The test was strain-controlled at the rate of 2 percent per minute and the test was continued until the specimen shears and a peak value was obtained, or until 20 percent strain has occurred. A multi-stage test was performed for this investigation. The results of the test are presented as deviator stress versus axial strain. In accordance with the ASTM requirement, the results of Triaxial compression were expressed as ultimate deviator stress. The undrained shear strength, defined as half the ultimate deviator stress, can be derived from these presentations and is reported to the nearest whole kPa. This test is performed in general accordance with ASTM D 2850.

6.2.2 Unconfined Compressive Strength Test (UCT)

This test was performed on undisturbed samples of cohesive soils. Depending on the consistency of the cohesive material, the test specimen was prepared by trimming the sample or by pushing a mould into the sample. The height to diameter ratio of the sample was two. The test was strain-controlled at the rate of 1 percent of sample height per minute and the test was continued until the specimen shears and a peak value was obtained, or until 20 percent strain has occurred. A single-stage test was performed for this investigation.

The results of the test are presented as deviator stress versus axial strain. In accordance with the ASTM requirement, the results of Triaxial compression were expressed as ultimate deviator stress. The undrained shear strength, defined as half the ultimate deviator stress, can be derived from these presentations and is reported to the nearest whole kPa. The test is performed in general accordance with ASTM D 2166.

6.2.3 Direct Shear Test

Direct shear test, a simple and commonly used test, is performed in the shear box apparatus consists of two pieces shear box of a square cross-section. The test is conducted in accordance with ASTM D3080. The direct shear test is one of the oldest strength tests for soils. A direct shear device is used to determine the shear strength of cohesionless soils. The experiment is run three times at various normal confining stresses. For each of the tests, a plot of the maximum normal stresses vs maximum shear stresses is produced. From the plot, a straight-line approximation of the Mohr-coulomb failure envelope is produced and presented in Appendix B of this report.

6.3 Deformation Tests

6.3.1 Consolidation Tests

Consolidation is the process of time-dependent settlement of saturated clayey soil when subjected to increased loading. The consolidation test unit consists of a consolidometer and a loading device. The consolidometer can be either a floating ring consolidometer or a fixed ring consolidometer. The floating ring consolidometer usually consists of a brass ring in which the soil specimen is placed. One porous stone is placed at the top of the specimen and another porous stone at the bottom. A plastic ring surrounding the specimen fits into a groove on the base plate. The load is applied through a loading head that is placed on the top porous stone. In the floating ring consolidometer, compression of the soil specimen occurs from the top and bottom towards the center. The fixed ring consolidometer essentially consists of the same components i.e., a hollow base plate, two porous stones, a brass ring to hold the soil specimen, and a metal ring that can be fixed tightly to the top of the base plate. In the fixed ring consolidometer, the compression of the specimen occurs from the top towards the bottom. Consolidation of saturated clay soil occurs due to the expulsion of water under a static, sustained load. The consolidation characteristics of soils are required to predict the magnitude and the rate of settlement. The test is conducted in accordance with ASTM D 2435.

6.3.2 Modified Proctor Compaction Test

The degree of soil compaction required to achieve the desired engineering properties is often specified as a percentage of the modified maximum dry unit weight as determined using this test method. If the required degree of compaction is substantially less than the modified maximum dry unit weight using this test method, it may be practicable for testing to be performed using Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort and to specify the degree of compaction as a percentage of the standard maximum dry unit weight.

When a series of samples of soil is compacted at different water content the plot usually shows a distinct peak. Compaction is the process of densification of soil by reducing air voids. The degree of compaction of a given soil is measured in terms of its dry density. The dry density is maximum at the optimum water content. A curve is drawn between the water content and the dry density to obtain the maximum dry density and the optimum water content. The test methodology followed is ASTM D1557.

6.4 Chemical Tests

6.4.1 Chemical Tests of Soil

The samples were collected from boreholes and sent to Sac Singlas accredited laboratory (GIE Singapore Lab) in Singapore for conduction of chemical Tests. The test methodology followed is BS 1377: Part-3 (2018). The pH Value was performed using Electrometric Method (Clause 12), Sulfate Content was performed using Gravimetric Method (Clause 7) & Chloride test was performed using Volhard's Method (Clause 9). The summary of the test results is presented in the following table

Table-6.1: Summary of chemical test results (Soil Sample)

Borehole	Sample	pH Value (pH Unit)	Chloride Content (%)	Sulfate Content (%)
BH-01	UD-01	4.3	0.69	0.51
BH-02	UD-02	4.3	0.43	0.27
BH-03	UD-02	7.0	0.34	0.08
BH-04	UD-02	7.5	0.36	0.16
BH-05	UD -01	7.4	0.46	0.31
BH-06	UD-03	7.5	0.44	0.45
BH-07	UD-01	5.2	0.49	0.31

6.4.2 Chemical Tests of Water

After collecting water samples from the corresponding boreholes, they were sent to the Sac Singlas accredited laboratory (GIE Singapore Lab) in Singapore for conduction of chemical Tests. The test methodology followed is BS 1377: Part-3 (2018). The pH Value was performed using Electrometric Method (Clause 12), Sulfate Content was performed using Gravimetric Method (Clause 7) & Chloride test was performed using Volhard's Method (Clause 9). The summary of the test results is presented in the following table

Table-6.2: Summary of chemical test results (Water Sample)

Borehole	pH Value (pH Unit)	Sulphate as SO ₄ (mg/L)	Chloride Content (g/L)
BH-02	6.8	7.7	1424
BH-03	6.7	8.4	1218
BH-04	6.7	8.79	1597
BH-06	6.6	7.56	1959
BH-07	6.7	5.91	362

7.0 SOIL DESCRIPTION

7.1 General

All boreholes are properly logged and drawn showing the thickness of each layer, the color, the type and visual description of each layer, depth below the surface, depth of water level, etc.

Classification of soils is made in accordance with the Unified Classification System (USCS).

Consistency and Apparent Density for cohesive and granular soil as well as their classification system are presented below.

Consistency and Apparent Density of Soil (a 140-pound hammer dropped 30 inches) ASTM D 1586

Table 7.1: Apparent Density of cohesionless soil

SPT N-Value	Apparent Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
> 50	Very dense

Table: 7.2 Consistency of Cohesive Soil (Clay & Silt)

SPT N-Value	Consistency
<2	Very soft
3 - 4	Soft
5 - 8	Medium stiff
9 - 15	Stiff
16 - 30	Very stiff

7.2 Engineering Classification of Soils (As adopted in BNBC 2017)

Soils are divided into three major groups, coarse-grained, fine-grained, and organic. The classification is based on classification test results namely grain size analysis and consistency test. The coarse-grained soils shall be classified using Table 7.3. Outlines of organic and inorganic soil separations are also provided in Table 7.3. The fine-grained soils shall be classified using the plasticity chart shown in Figure 7.1. In this context, this Code adopts the provisions of ASTM D2487. In addition to these classifications, a soil shall be described by its color, particle angularity (for coarse-grained soils), and consistency. Further to the above classification soils exhibiting swelling or collapsing characteristics shall be recorded. For undisturbed soil information on stratification, compactness, cementation, moisture conditions and drainage characteristics shall be included.

Table 7.3: Engineering Classification of Soils (Criteria for Assigning Group Symbols and Names using Laboratory Tests)

Classification (For particles smaller than 75 mm and based on estimated weights)			Group Symbol	Group Name ^B	Laboratory Classification			
					Percent finer than 0.075mm	Other Criteria		
Coarse grained soils (More than 50% of the material retained on No. 200 sieve (0.075 mm))	Gravels (More than 50% of coarse fraction retained on No. 4 sieve (4.75 mm))	Clean gravels	GW	Well graded gravels, sandy gravels, sand gravel mixture, little or no fines. ^D	< 5 ^E	$C_u \geq 4$ and $1 \leq C_z \leq 3$ ^C		
			GP	Poorly graded gravels, sandy gravels, Sand gravel mixture, little or no fines. ^D		$C_u < 4$ and/or $1 > C_z > 3$ ^C		
		Gravel with fines	GM	Silty gravels, silty sandy gravels. ^{D, F, G}	> 12 ^E	$I_p < 4$ or the limit values below 'A' line of plasticity chart	For 4 > $I_p > 7$ and limit values above	
			GC	Clayey gravels, silty clayey gravels. ^{D, F, G}		$I_p > 7$ and the limit values above 'A' line of Plasticity Chart	'A' line, dual symbol required*	
	Sands (over 50% of coarse fraction smaller than 4.75 mm))	Clean Sands	SW	Well graded sand, gravelly sand, little or no fines. ^H	< 5 ^E	$C_u \geq 6$ and $1 \leq C_z \leq 3$ ^C		
			SP	Poorly graded sands, gravelly sand, little or no fines. ^H		$C_u < 6$ and/or $1 > C_z > 3$ ^C		
		Sands with fines	SM	Silty sand, poorly graded sand silt mixtures. ^{F, G, H}	> 12 ^E	$I_p < 4$ or the limit values below 'A' line of Plasticity chart	For 4 > $I_p > 7$ and limit values above A- line, dual symbols required.	
			SC	Clayey sand, sand clay mixtures. ^{F, G, H}		$I_p > 7$ and the limit values above 'A' line of plasticity chart		
	Fine grained soils (Over 50% of the material smaller than 0.075 mm))	Silts & Clays $w_L < 50$	Inorganic	ML	Silt of low to medium compressibility, very fine sands, rock flour, silt with sand. ^{K, L, M}	Limit values on or below 'A' line of plasticity chart & $I_p < 4$		
				CL	Clays of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay. ^{K, L, M}	Limit values above 'A' line of plasticity chart and/or $I_p > 4$		
Organic			OL	Organic clay ^{K, L, M, N} and Organic silt ^{K, L, M, O} of low to medium plasticity	$\frac{\text{Liquid limit (oven dried)}}{\text{Liquid limit (undried)}} < 0.75$			
Silts & Clays $w_L \geq 50$		Inorganic	MH	Silt of high plasticity, micaceous fine sandy or silty soil, elastic silt. ^{K, L, M}	Limit values on or below 'A' line of plasticity chart			
			CH	High plastic clay, fat clay. ^{K, L, M}	Limit values above 'A' line of plasticity chart			
		Organic	OH	Organic clay of high plasticity. ^{K, L, M, P}	$\frac{\text{Liquid limit (oven dried)}}{\text{Liquid limit (undried)}} < 0.75$			
			Soils of high organic origin		PT	Peat and highly organic soils. ^{K, L, M, Q}	Identified by colour, odour, fibrous texture and spongy characteristics.	

NOTES:

- A* Based on the material passing the 3-in. (75-mm) sieve
- B* If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
- C* $C_u = D_{60}/D_{10}$, $C_z = (D_{30})^2 / (D_{10} \times D_{60})$
- D* If soil contains $\geq 15\%$ sand, add "with sand" to group name.
- E* Gravels with 5 to 12 % fines require dual symbols:
 GW-GM well-graded gravel with silt
 GW-GC well-graded gravel with clay
 GP-GM poorly graded gravel with silt
 GP-GC poorly graded gravel with clay
- F* If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
- G* If fines are organic, add "with organic fines" to group name.
- H* If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
- I* Sands with 5 to 12 % fines require dual symbols:
 SW-SM well-graded sand with silt
 SW-SC well-graded sand with clay
 SP-SM poorly graded sand with silt
 SP-SC poorly graded sand with clay.
- J* If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- K* If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.
- L* If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sand" to group name.
- M* If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.
- N* $PI \geq 4$ and plots on or above "A" line.
- O* $PI < 4$ or plots below "A" line.
- P* PI plots on or above "A" line.
- Q* PI plots below "A" line.

If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:

Trace -	Particles are present but estimated to be less than 5 %
Few -	5 to 10 %
Little -	15 to 25 %
Some -	30 to 45 %
Mostly -	50 to 100 %

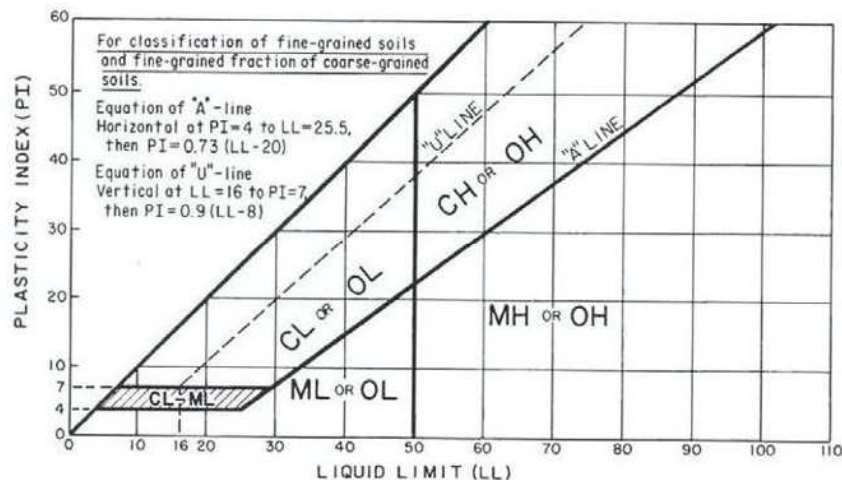


Fig-7.1: Plasticity Chart (Based on materials passing 425 μm)

8.0 SITE GEOLOGY

The surface geology of Bangladesh is dominated by young (Holocene) alluvial and deltaic sediments deposited within the last 6000 to 10000 years. Surface sediments in the north include coarse-grained mountain front alluvial fan deposits. Sediments in much of lowland central Bangladesh are alluvial sands and silts, while in the South closer to the coast, sediments are predominantly deltaic silts and clays where the present site of investigation is located.

An extract from 'Geological Map of Bangladesh' showing the geology of the project area is presented in Figure 01 (Ref. Geological Map of Bangladesh –by Geological Survey of Bangladesh). This geological map indicates that the soil type of the site is categorized as alluvial deposits (alluvial sand and alluvial silt & clay). This is a recent type of deposit and constitutes the major land surface of Bangladesh. Geologically there is no significant variation in the process of soil formation of our studied areas.

The original ground level was MSL+1.0 m before starting Matarbari Project. At this moment (Feb-2021), reclamation work is ongoing in the project site by phase-I of the Matarbari Project.

9.0 SUBSURFACE CONDITIONS

The subsurface soil stratification at this selected area may be broadly categorized into the following layers-

Layer 01- The topmost non-cohesive layer (Fill) consists of greyish to brownish, fine to medium-grained SAND/Silty SAND with traces of mica, seashell fragments, and partially mixed with clay and silt. The thickness of the layer is from 1.00m to 13.00m.

Layer 02- This underlying non-cohesive intermittent layer is about 01m to 03m thick and consists of fine-grained grey to dark grey SAND/Silty SAND. This layer extends up to 5.50m BGL at BH-01, 3.50m BGL at BH-02, 4.50m BGL at BH-03, and 3.50m BGL at BH-08. The SPT N Values range from 5 to 22 and the relative density of the layer is loose to medium dense.

Layer 03- This cohesive layer consists of grey to dark grey CLAY /CLAY with Sand/ Sandy CLAY/SILT/ Clayey SILT. The thickness of the layer is from 5.00m to 15.50m. The SPT N Values range from 0 to 8 and the consistency of the layer is very soft to medium stiff.

Layer 04- This underlying non-cohesive layer is about 3.00m to 28.00m thick and consists of grey to dark grey Silty SAND. The SPT N Values range from 12 to 50 and the relative density of the layer is medium dense to dense and dense to very dense. There are few intermittent cohesive layers consist of CLAY with Sand/ SILT with Sand are found at different depths into this layer. The thickness of these intermittent layers varies between 1m to 2m and SPT N Values range from 15 to 23. The Consistency of these layers shows that they are medium-stiff to stiff in nature.

Layer 05- The lowermost grey to dark grey cohesive intermittent layer consists of CLAY with Sand/ Sandy CLAY/ Clayey SILT/Sandy SILT. The thickness of the layer is from 5.00m to 20.00m. The SPT N Values range from 23 to 50 and the consistency of the layer is very stiff to hard. This layer extends up to 24m BGL at NBH-351, 23.30m BGL at BH-05, 35m BGL at NBH-201, 28.43m BGL at BH-01, 25.32M BGL at BH-04, and 28.37m BGL at BH-06.

The general variation in the subsurface conditions across the site is indicated on soil profiles presented in Figure 06. It should be noted that the profile is interpolated between the boreholes which

are quite a distance apart and therefore natural variations between the investigation points may exist. For detailed information on the subsurface condition, the individual bore logs are referred to in Appendix A.

10.0 GROUNDWATER CONDITIONS

Groundwater is measured in boreholes upon completion of boreholes and recorded in the Bore logs. The groundwater as measured during drilling is found at 1.3 m to 2.7 m depth below the ground surface. However, these water levels were measured inside the boreholes during drilling and do not represent the precise groundwater condition of the site. Moreover, the groundwater at the project site is subjected to fluctuations during the dry and rainy seasons as well as with the tidal flow. The water levels encountered in borehole are mentioned in the following table.

Table-10.1: Water Level (MSL)

Borehole Reference	Water Level (m_MSL)	Date
BH-01	1.98	04-Feb-21
BH-02	-0.20	16-Feb-21
BH-03	2.47	13-Feb-21
BH-04	1.79	07-Feb-21
BH-05	-0.67	17-Feb-21
BH-06	4.18	09-Feb-21
BH-07	0.77	20-Feb-21
BH-08	0.89	04-Feb-21

11.0 SITE CLASSIFICATION

11.1 General

The Site Class Definition quantifies the soil's propensity to amplify, or in some cases decrease, surface ground motion propagating from underlying rock. The Site Class Definition is also used by designers to determine the Seismic Performance Zone for a structure.

According to Bangladesh National Building Code (BNBC), site will be classified as type SA, SB, SC, SD, SE, S1 and S2 based on the provisions of this Section. Classification will be done in accordance with the following table based on the soil properties of upper 30 meters of the site profile.

Table-11.1: Site Classification Based on Soil Properties

Site Class	Description of soil profile up to 30 meters depth	Average Soil Properties in top 30 meters		
		Shear wave velocity, $\bar{V}_s$ (m/s)	SPT Value, $\bar{N}$ (blows/30cm)	Undrained shear strength, $\bar{S}_u$ (kPa)
SA	Rock or other rock-like geological formation, including at most 5 m of weaker material at the surface.	> 800	--	--

Site Class	Description of soil profile up to 30 meters depth	Average Soil Properties in top 30 meters		
		Shear wave velocity, $\bar{V}_s$ (m/s)	SPT Value, $\bar{N}$ (blows/30cm)	Undrained shear strength, $\bar{S}_u$ (kPa)
SB	Deposits of very dense sand, gravel, or very stiff clay, at least several tens of meters in thickness, characterized by a gradual increase of mechanical properties with depth.	360-800	> 50	> 250
SC	Deep deposits of dense or medium dense sand, gravel or stiff clay with thickness from several tens to many hundreds of metres.	180-360	15-50	70-250
SD	Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil.	< 180	< 15	< 70
SE	A soil profile consisting of a surface alluvium layer with V_s values of type SC or SD and thickness varying between about 5m and 20m, underlain by stiffer material with $V_s > 800$ m/s.	--	--	--
S ₁	Deposits consisting, or containing a layer at least 10 m thick, of soft clays/silts with a high plasticity index (PI>40) and high-water content.	< 100 (indicative)	--	10-20
S ₂	Deposits of liquefiable soils, of sensitive clays, or any other soil profile not included in types SA to SE or S1	--	--	--

Average soil properties will be determined as given in the following equations:

$$\bar{V}_s = \frac{\sum_{i=1}^n d_i}{\sum_{i=1}^n \frac{d_i}{V_{si}}} \text{-----(i)}$$

$$\bar{N} = \frac{\sum_{i=1}^n d_i}{\sum_{i=1}^n \frac{d_i}{N_i}} \text{-----(ii)}$$

$$\bar{S}_u = \frac{\sum_{i=1}^k d_{ci}}{\sum_{i=1}^k \frac{d_{ci}}{S_{ui}}} \text{-----(iii)}$$

Where,

n = Number of soil layers in upper 30 m

d_i = Thickness of layer *i*

V_{si} = Shear wave velocity of layer *i*

N_i = Field (uncorrected) Standard Penetration Value for layer *i*

k = Number of cohesive soil layers in upper 30 m

d_{ci} = Thickness of cohesive layer *i*

S_{ui} = Undrained shear strength of cohesive layer i

The site profile up to a depth of 30 m is divided into n number of distinct soil or rock layers. Where some of the layers are cohesive, k is the number of cohesive layers. Hence $\sum_{i=1}^n d_i = 30$ m, while $\sum_{i=1}^k d_{ci} < 30$ m if $k < n$. In other words, if there are both cohesionless and cohesive layers, the standard penetration value N as directly measured in the field without correction will be used.

11.2 Analysis of Site Classification Based on the SPT N Values (for Reference only)

$\bar{N}$ Method [Equation (ii)] is used to determine the site classification of this project. The summary of the site classification at this moment of Feb-2021 is given in the following table.

Table-11.2: Summary of the site classification

Borehole Ref.	BH 01	BH 02	BH 03	BH 04	BH 05	BH 06	BH 07	BH 08
Total Thickness (m)	30	30	30	30	30	30	30	30
Total (Thickness/ N Value)	2.50	2.56	2.09	1.89	3.16	4.47	1.75	3.12
Total $\bar{N}$ for Individual boreholes	12.02	11.72	14.33	15.91	9.51	6.71	17.15	9.60
Average $\bar{N}$ for boreholes	12.12							
Site Class	SD							
Description of soil profile up to 30 meters depth (BNBC)	Deep deposits of dense or medium dense sand, gravel or stiff clay with thickness from several tens to many hundreds of meters.							

The details calculation of the site classification is given in Appendix C of this report.

This site classification should be conducted again after the completion of the reclamation work and soil improvement work (if necessary) at the project site.

12.0 PRECAUTIONARY MEASURE

12.1 Soil Liquefaction (for Reference only)

Soil liquefaction occurs when a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress such as shaking during an earthquake or other sudden change in stress condition, in which material that is ordinarily a solid behaves like a liquid. To occur liquefaction in any soil layer following 3 prerequisites are to be fulfilled-

- Soil is to be granular
- State of soil is to be loose
- Water should be present

Liquefaction susceptibility at a site is commonly expressed in terms of a factor of safety versus the occurrence of liquefaction. This factor is defined as the ratio between available cyclic resistance ratio (CRR) and cyclic stresses ratio (CSR). The cyclic stresses generated by the anticipated earthquake.

So, $F_L = \frac{CRR}{CSR}$ [According to BNBC (Chapter-3, Part-6)]

If $F_L \leq 1$, liquefaction is said to take place. Otherwise, liquefaction does not occur.

Both parameters are commonly normalized with respect to the effective overburden stress at the depth in question. With the present state of knowledge, the prediction of liquefaction is an approximation.

However, Seed and Idriss (1971) formulated the following equation for the calculation of CSR;

$$CSR = 0.65 \times \frac{a_{max}}{g} \times \frac{\sigma_0}{\sigma'_0} \times r_d$$

Where,

a_{max} = Peak horizontal acceleration at ground surface due to earthquake in terms of “g”
[According to Bangladesh National Building Code (BNBC) 2007, Peak Ground Acceleration for the project area is 0.12g which falls in earthquake zone 1]

σ_0 & σ'_0 = total and effective vertical overburden stresses

r_d = Stress reduction coefficient

$$\begin{aligned} &= 1.0 - 0.00765 z && \text{for } z \leq 9.15 \text{ m} \\ &= 1.174 - 0.0267 z && \text{for } 9.15 \text{ m} \leq z \leq 23 \text{ m} \\ &= 0.744 - 0.008 z && \text{for } 23 \leq z \leq 30 \text{ m} \\ &= 0.50 && \text{for } z > 30 \text{ m} \end{aligned}$$

Thomas F. Blake (Fugro-West, Inc., Ventura, Calif., written Commun) approximated the simplified CRR by the following equation,

$$CRR = \frac{a + cx + ex^2 + gx^3}{1 + bx + dx^2 + fx^3 + hx^4}$$

Where,

$x = (N_1)_{60cs}$; $a = 0.048$; $b = -0.1248$; $c = -0.004721$; $d = 0.009578$; $e = 0.0006136$;
 $f = -0.0003285$; $g = -1.673 \times 10^{-5}$; and $h = 3.714 \times 10^{-6}$.

$(N_1)_{60}$ = Corrected SPT N Value for overburden pressure.

$(N_1)_{60cs}$ = Corrected SPT N Value for clean SAND (if fine content, FC < 5%)

The above formula for calculating CRR is not applicable for $(N_1)_{60cs} > 30$. According to BNBC, any SPT value higher than 30 will not liquify (Thumb Rule).

In order to consider the effect of fines content percentage (%FC) on CRR, various suggestions have been made to correct the normalized standard penetration resistance values. Idriss and Boulanger (2010) recommended the following formula:

$$(N_1)_{60cs} = (N_1)_{60} + \Delta(N_1)_{60}$$

$$\Delta(N_1)_{60} = e^{\left[1.63 + \frac{9.7}{FC + 0.01} - \left(\frac{15.7}{FC + 0.01}\right)^2\right]}$$

The following assumptions are considered during liquefaction analysis of the present site.

- Liquefaction is analysed based on the soil investigation of the site.
- 30.0m depth from the existing ground level is analysed for liquefaction. [Any depth more than 30.0m does not tend to liquify. (Seed, 1968; Seed & Idriss, 1971; Dobry, et al. 1982; Prakash, 1987)]
- If a bore hole got terminated before 30.0 m below ground level (BGL), then the last counted SPT and soil type is considered as same for the depth of 30.0 m BGL.
- The fine content for a sample is assumed if particle size analysis was not performed.
- The ground water level is assumed to be equal to the existing ground level.
- SPT value higher than 30 is considered 30 during the calculation.

After analysing the liquefaction probability of the sites, we can conclude the following probability for the stations area.

According to the analysis, the present site is susceptible to liquefaction is about 16 m below ground level. The details of the liquefaction analysis are presented in appendix D in this report.

This soil liquefaction study should be conducted again after the completion of the reclamation work and soil improvement work (if necessary) at the project site.

12.2 Pile Load Test

We recommend that an indicator pile program be implemented across the project site before the commencement of actual construction to ascertain pile driving criteria and pile length requirements. The indicator piles should be installed with the same equipment and techniques that will be used to install the production piles.

The calculated capacity of piles must be checked/ verified by testing adequate numbers of test piles (usually 1%-2% of total piles) Precautions should be taken for long term effects of compressibility of soft layers which may produce negative skin friction and other factors as well.

12.3 Instrumentation

In the case of deep excavation, Instrumentation plays an important role. It is suggested to monitor any soil movement or any change in the soil stress condition around the excavation zones. This is particularly important when the proposed construction is taking place within a heavily urbanized area. This is to avoid any possible damages or accident which may otherwise risk the lives of construction crews, workers and safety of the nearby structures. This instrumentation and monitoring will help the Engineer to take remedial measures for problems, which may be encountered during construction. It would also help to assess the performance of the proposed temporary/permanent structure during the construction as well as during the service period.

In addition to the above, the instrumentation monitoring records would be powerful tools in protecting the owner/contractor from the possible damage dispute.

Different types of instruments as recommended for this project are tabulated in the following Table.

Table 12.1: Recommended Instrumentation Programme

Types of Instruments	Location	Suggested Quantity	Purpose
Inclinometer in soils	Along the excavation boundaries	To be decided by PE	To monitor the lateral movement of the ground due to the effect of excavation
Inclinometer in retaining wall	Along the Diaphragm wall boundary	To be decided by PE	To monitor the lateral movement of the Diaphragm wall due to the effect of excavation

Types of Instruments	Location	Suggested Quantity	Purpose
Piezometers (Vibrating wire/ Pneumatic)	Along the excavation boundaries	To be decided by PE	To monitor change in piezometric pressure due to excavation
Water Stand Pipe	Along the excavation boundaries	To be decided by PE	To monitor the groundwater level
Road/Ground settlement point	Along the boundaries	@10m c/c	To monitor ground/road settlement during the construction period

Prepared By

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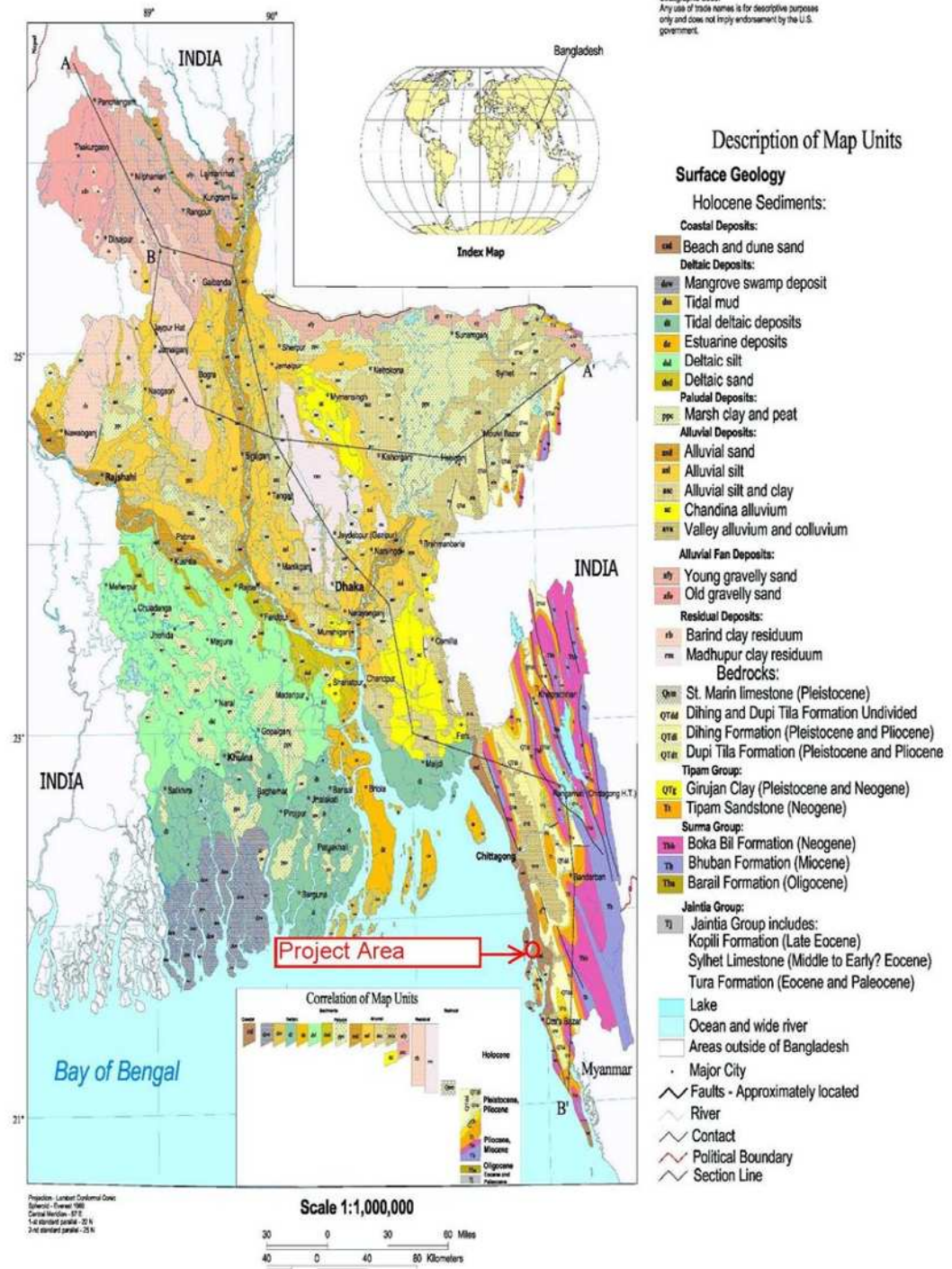
Checked By

Md. Touhidul Islam
Senior Geologist
M.Sc. in Geological Sciences, JU

Approved By

Md. Mafizur Rahman
Executive Director
B.Sc. in Civil Engineering, BUET
PGD (The Netherlands)

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the International Stratigraphic Code.
Any use of trade names is for descriptive purposes only and does not imply endorsement by the U.S. government.



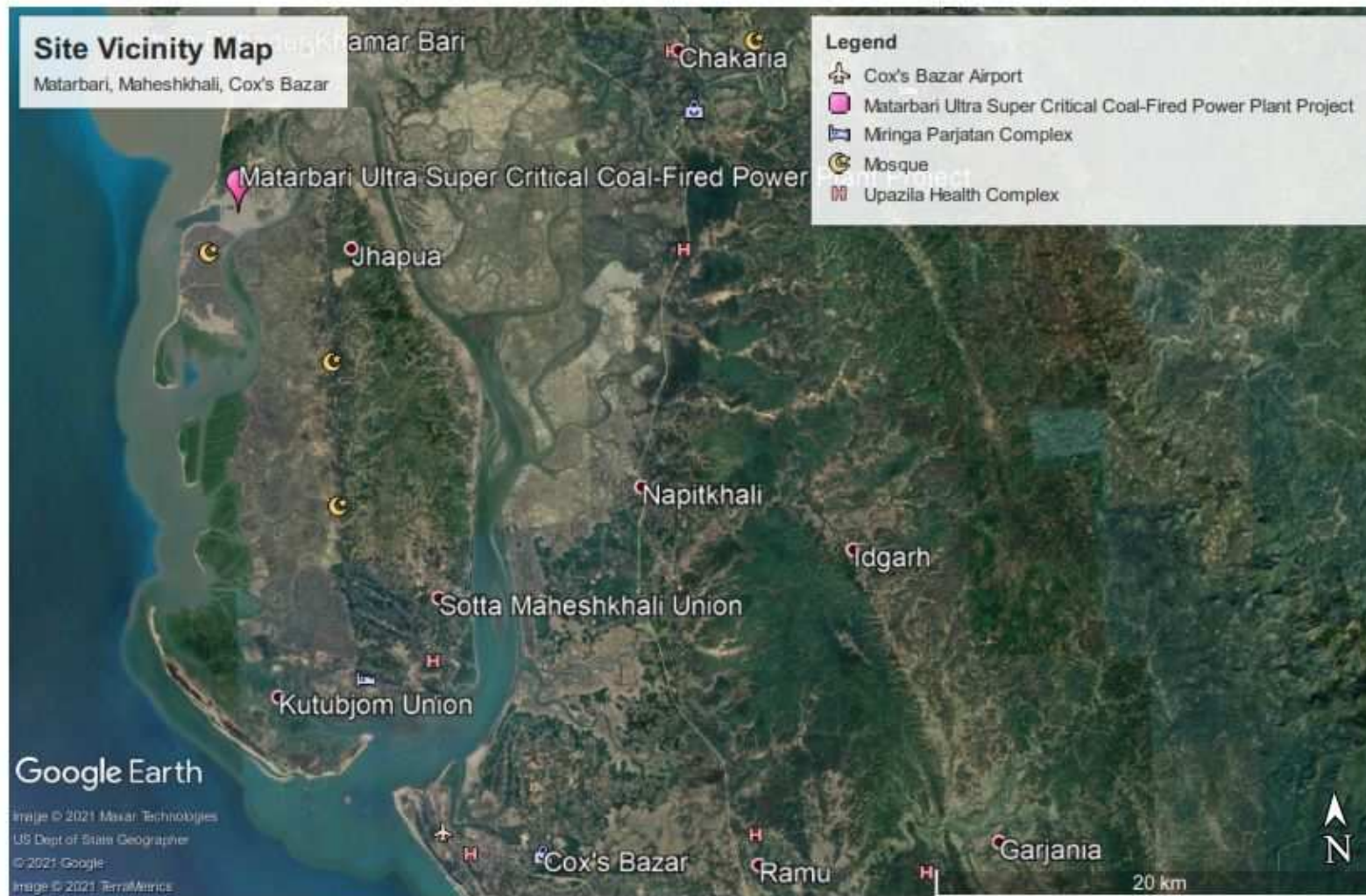


Figure-02: Site Vicinity Map (Satellite Image)

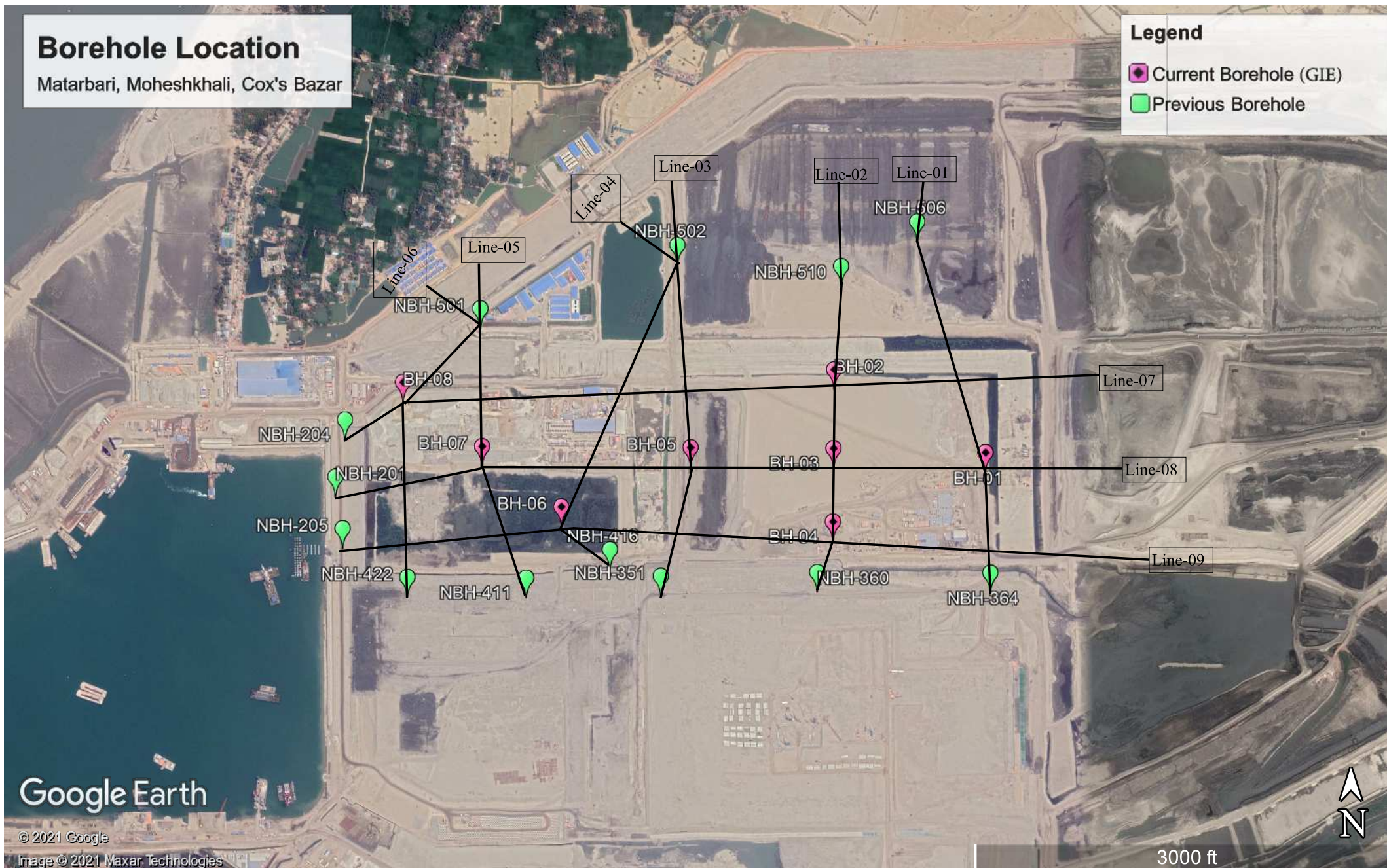


Figure-03: Borehole Location (Satellite Image)

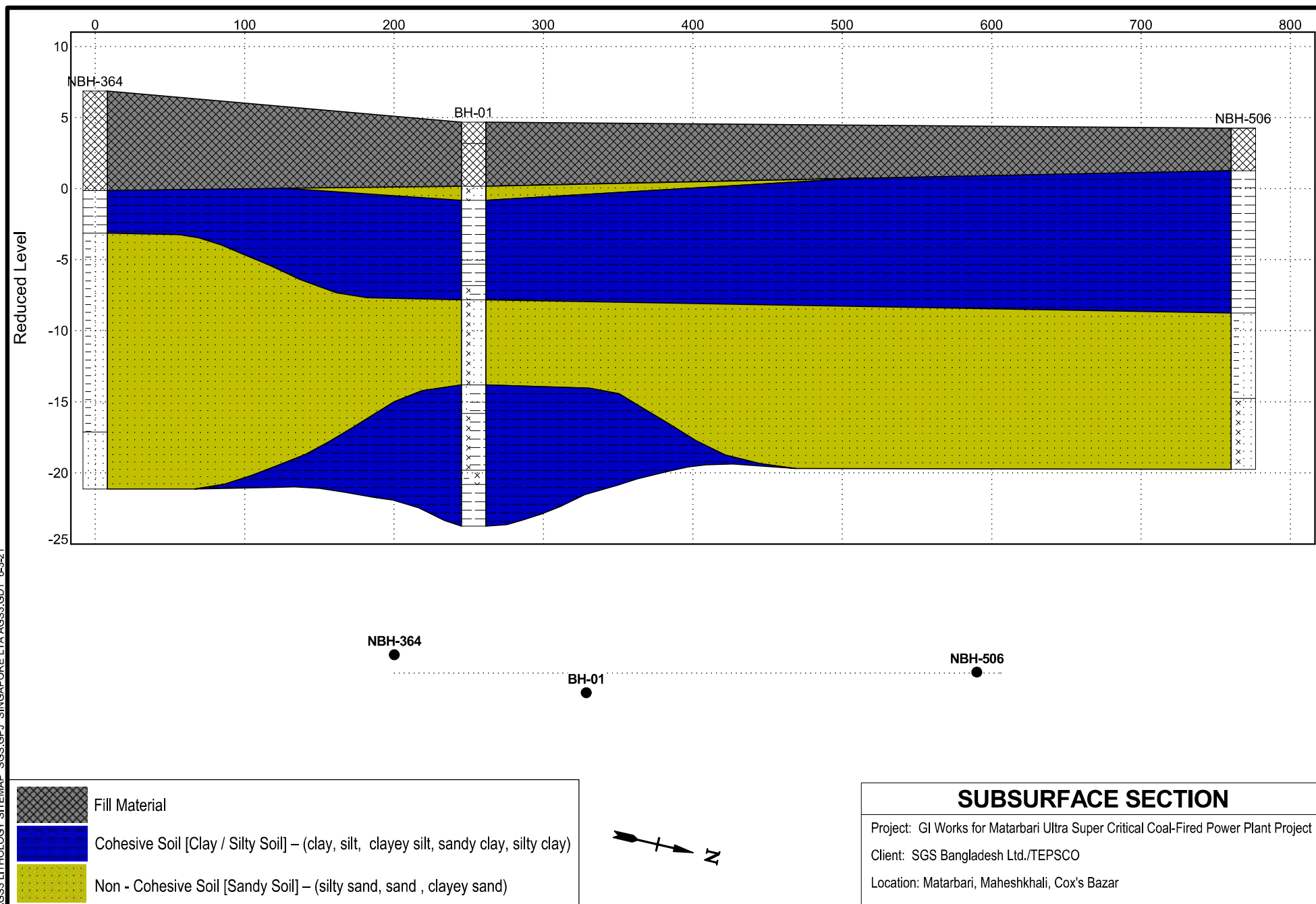


Figure-5.1: Soil Profile (Line-01)

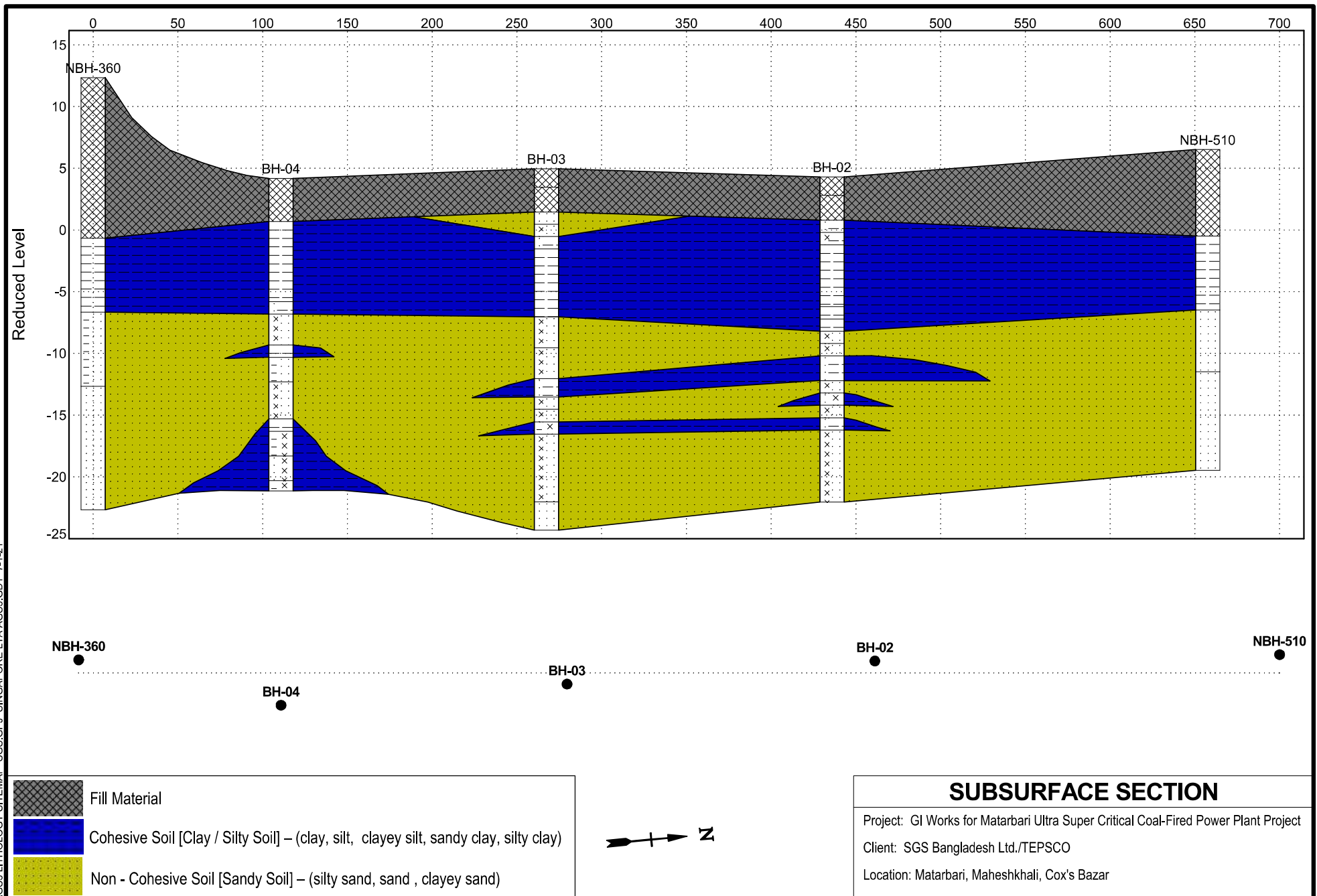


Figure-5.2: Soil Profile (Line-02)

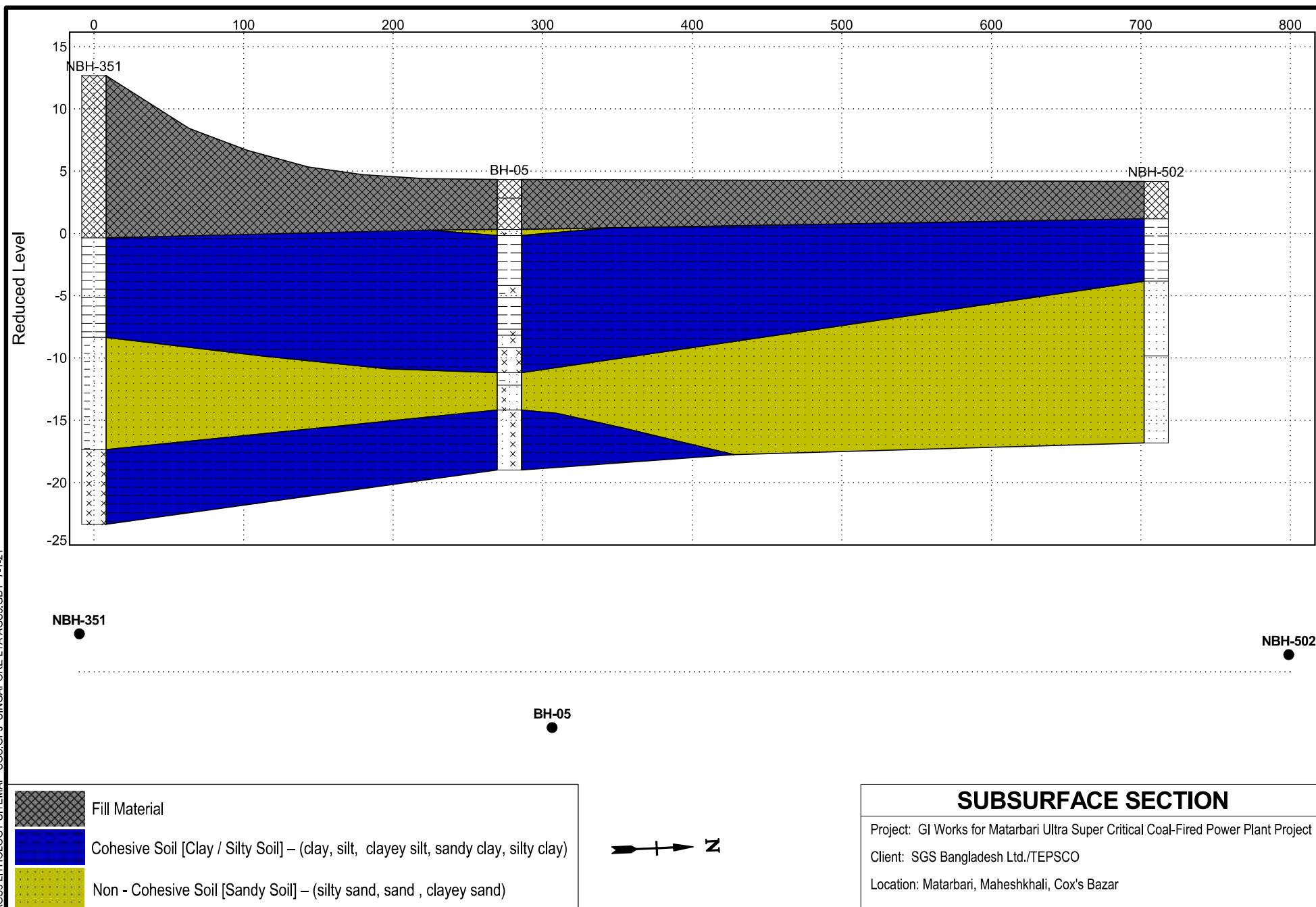
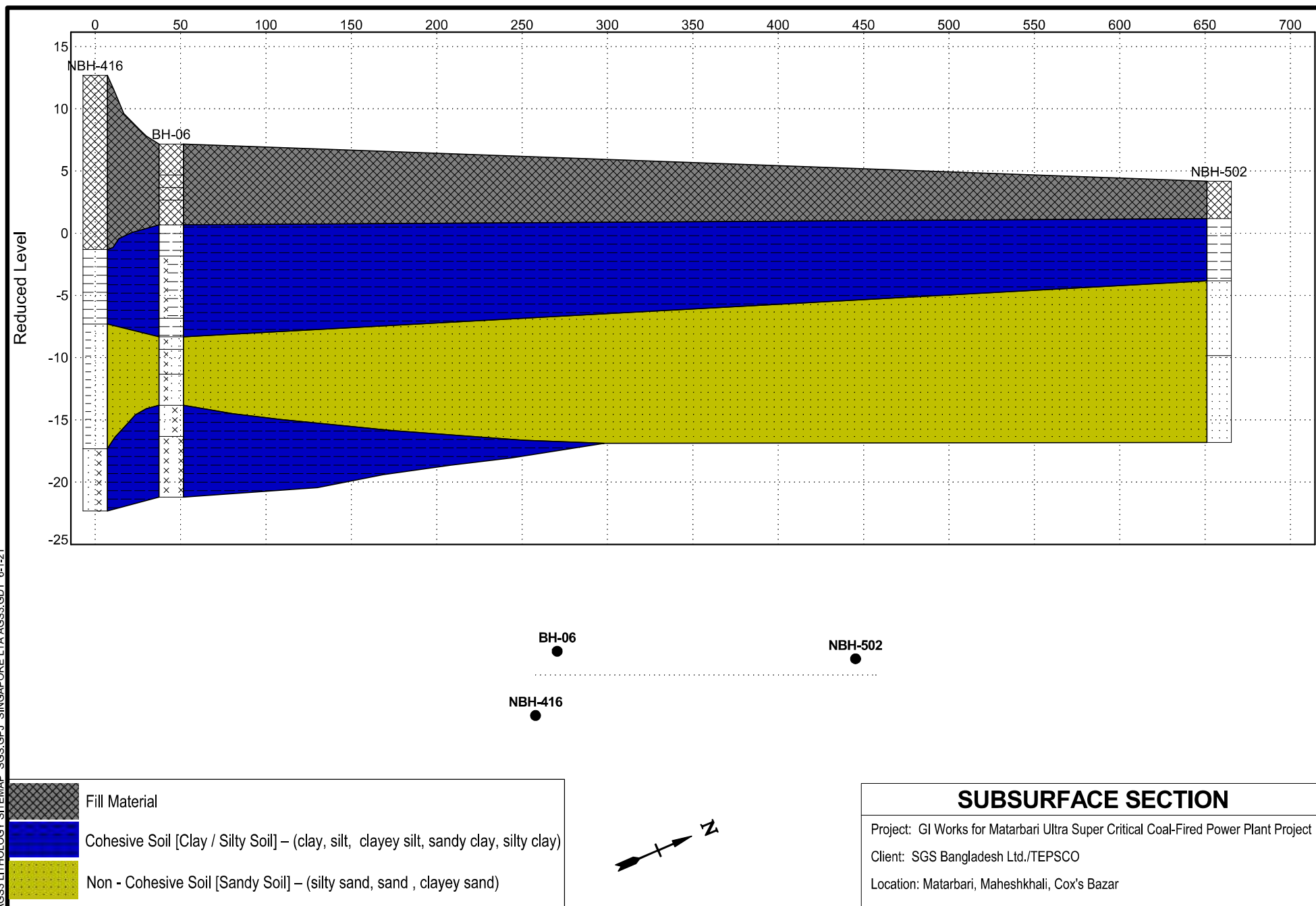


Figure-5.3: Soil Profile (Line-03)



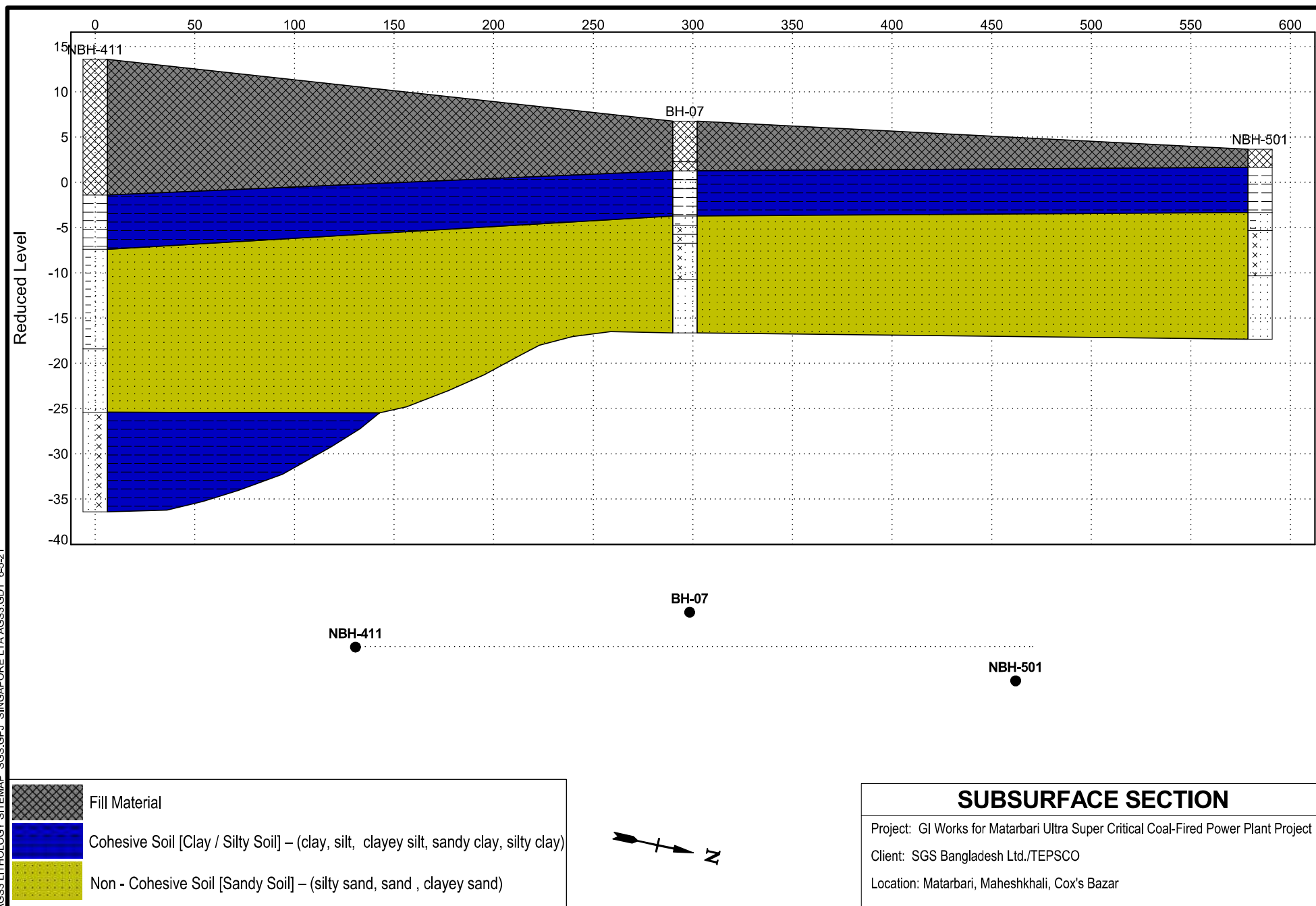


Figure-5.5: Soil Profile (Line-05)

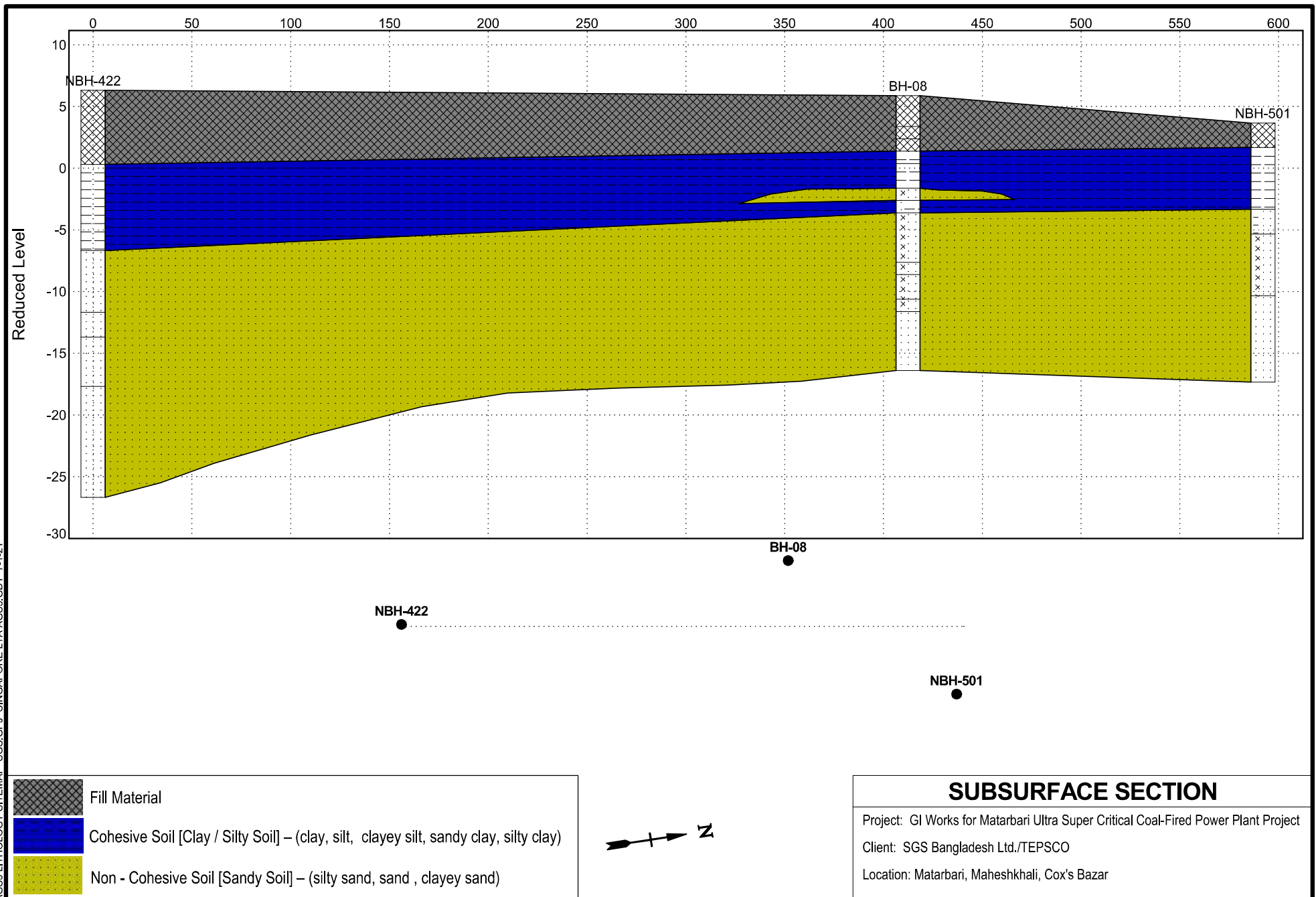


Figure-5.6: Soil Profile (Line-06)

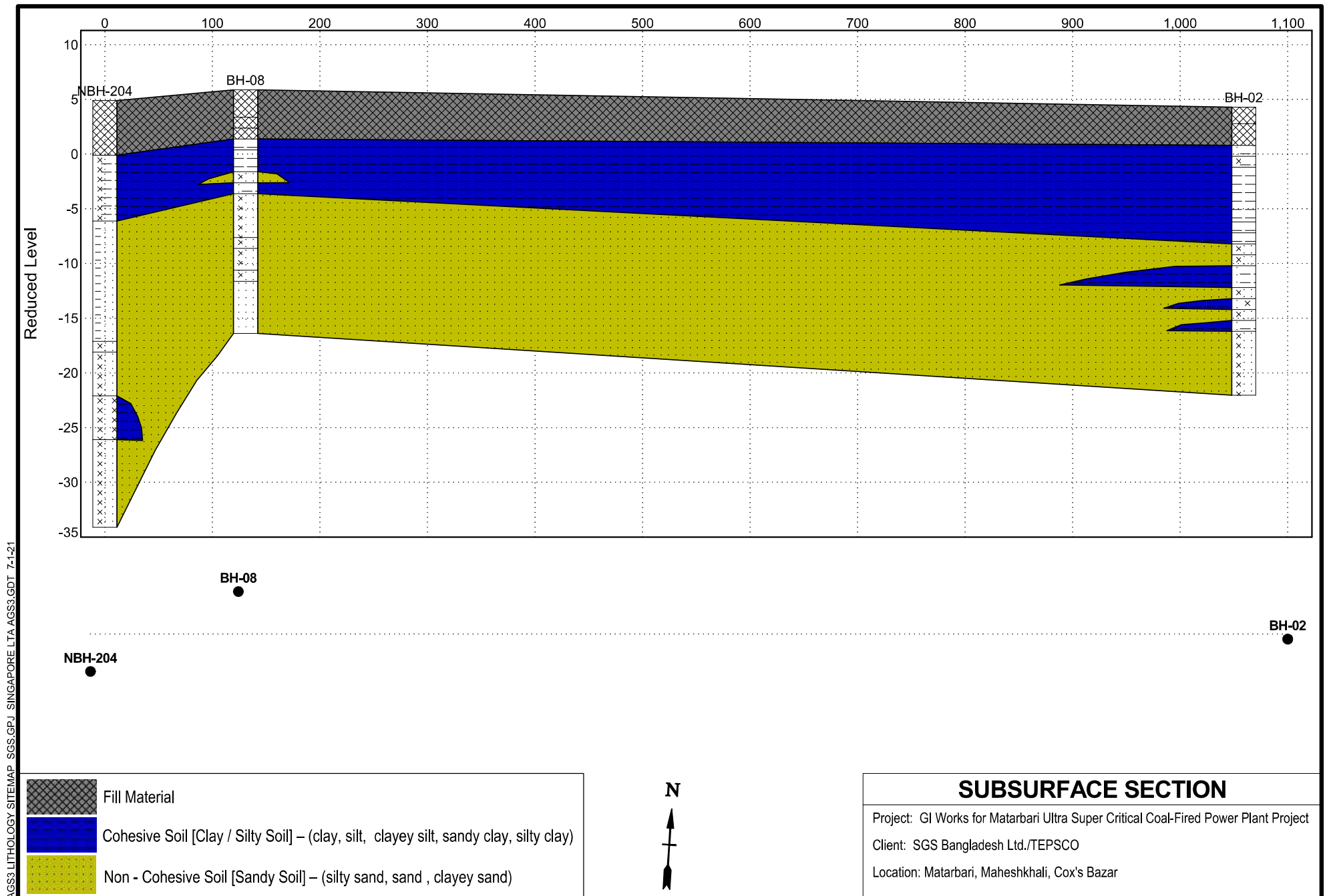


Figure-5.7: Soil Profile (Line-07)

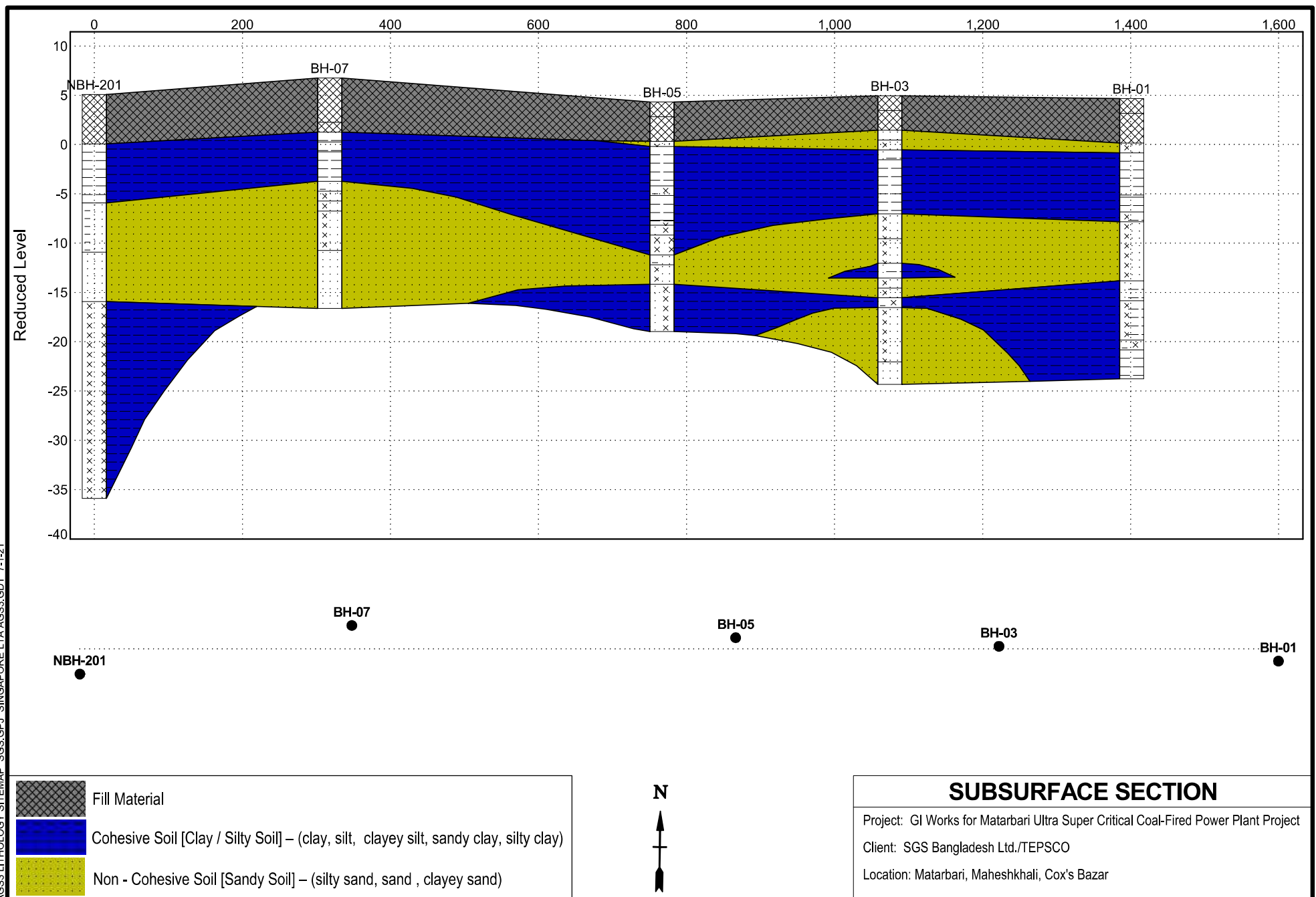


Figure-5.8: Soil Profile (Line-08)

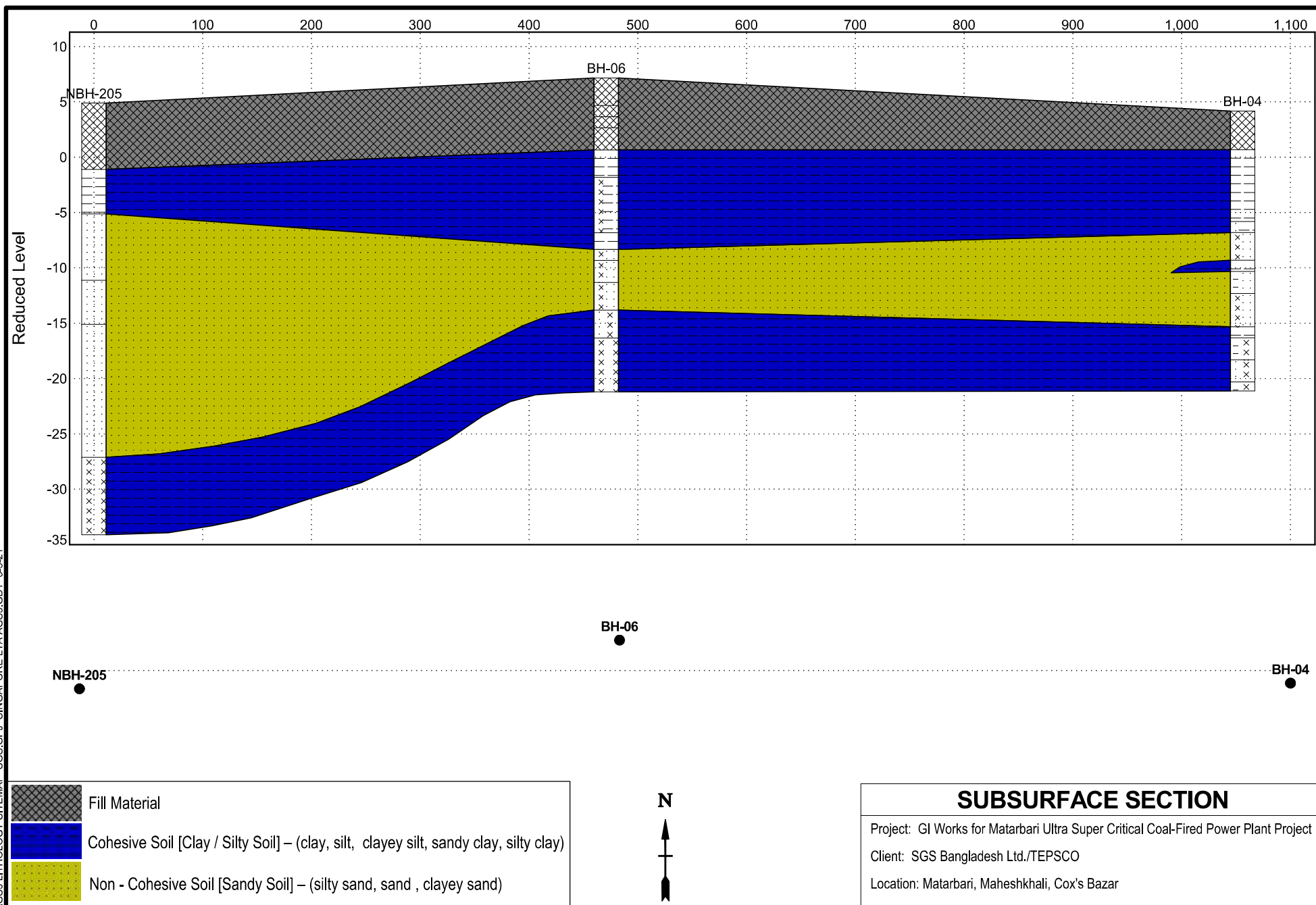


Figure-5.9: Soil Profile (Line-09)

APPENDIX A

BOREHOLE LOGS

APPENDIX A (i)

Final Field Bore Logs (Based on Lab Test Result)

REMARKS

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-01									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 03-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400600.000 m									
DRILLING DATE COMPLETED: 04-02-2021					FLUSHING MEDIUM: Water					EASTING: 385231.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 4.68 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Nakibul Alam Chowdhury					▽ PERCHED WL*: 2.7 m dated 04-02-2021									

Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	SPT N blows/30cm				SPT N blows/30cm	Rock		Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength		PL WC LL			
							X Undrained Shear Strength kN/m ²					TCR (%)	RQD (%)				C	φ	20	40	60	80
		(6.00)			15.00 SPT13 15.45	♦ Silty SAND (12.5-18.5m) Grey, fine grained silty SAND Medium dense to dense (Alluvial Sand) (continued)	20	40	60	80	21			SM	asd							
16				16.00 SPT14 16.45						15												
17				17.00 SPT15 17.45						23												
18	-13.82	18.50		18.00 SPT16 18.45						29												
19		(2.00)			19.00 SPT17 19.45	♦ Sandy lean CLAY (18.5-20.5m) Grey, sandy lean CLAY Stiff (Alluvial Silt & Clay)	20	40	60	80	13			CL	asc	0/38/62/0 0/40/44/16						
20	-15.82	20.50		20.00 SPT18 20.45						15												
21		(4.00)			21.00 SPT19 21.45	♦ Silty CLAY (20.5-24.5m) Grey, silty CLAY Hard (Alluvial Silt & Clay)					50/30cm			CL-ML	asc							
22				22.00 SPT20 22.42						50/27cm												
23				23.00 SPT21 23.45						45												
24	-19.82	24.50		24.00 SPT22 24.41						50/26cm												
25		(1.00)			25.00 SPT23 25.34	♦ Clayey SILT (24.5-25.5m) Grey clayey SILT Hard (Alluvial Silt & Clay)					50/19cm			CL-ML	asc							
26	-20.82	25.50		26.00 SPT24 26.41						50/26cm												
27		(2.93)			27.00 SPT25 27.42	♦ Lean CLAY (25.5-28.43m) Grey, lean CLAY Hard (Alluvial Silt & Clay)					50/27cm			CL	asc	0/3/97/0 0/4/75/21						
28	-23.75	28.43		28.00 SPT26 28.43						50/28cm												
29					Borehole terminated at 28.43m																	
30																						

RQD/TCR(%)



Ground Instrumentation & Engineering

LEGEND:

▼ — Pressuremeter Test (PMT)

⊕ — Vane Shear Test (V)

⊗ — Permeability Test (PBT)

□ — Packer Test (PKT)

⊠ — Standard Penetration Test (SPT)

▨ — Undisturbed Sample (UD)
Open Drive Thickwall Sample (OD)

▩ — Mazier Sample (MZ)
Denison Sample (DS)

□ — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ — Piston Sample (PS)

▬ — Core Run (CR)

▨ — TCR

▩ — RQD

BORING LOG SGS.GPJ SINGAPORE LTAAGS3.GDT 6-5-21

*WL - Ground Water Level observed from Borehole (BGL)

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PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-02				
CLIENT: TEPSCO														
GIE PROJECT NO: SIBD2104														
LOCATION: Matarbari, Maheshkhali, Cox's Bazar														
DRILLING DATE STARTED: 15-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400781.000 m				
DRILLING DATE COMPLETED: 16-02-2021					FLUSHING MEDIUM: Water					EASTING: 384907.000 m				
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 4.3 m				
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Raju Ahmed					PERCHED WL*:4.5 m dated 16-02-2021				
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	SPT N blows/30cm 20 40 60 80 X Undrained Shear Strength kN/m ² 20 40 60 80	SPT N blows/30cm	Rock TCR (%) RQD (%)	Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength C (kN/m ²) φ (°)	PL 20 WC 40 LL 60 80 Bulk Density Mg/m ³ 1.3 1.6 1.9 2.2
1	2.80	(1.50)			1.00 SPT1 1.45	♦ SAND (0-1.5m) Grey, fine grained SAND with traces of mica Medium dense (Fill)		13		FILL	Fill			
2		(2.00)			2.00 SPT2 2.45	♦ SAND (1.5-3.5m) Grey, fine grained SAND with traces of shell fragments Loose (Fill)		9		FILL	Fill	0/96/4/0 0/95/5/0	26.3	
3	0.80	3.50			3.00 SPT3 3.45			10						
4	-0.20	4.50			4.00 SPT4 4.45	♦ Sandy CLAY (3.5-4.5m) Grey, sandy CLAY Medium stiff (Alluvial Silt & Clay)		6		CL	asc			
5	-1.20	5.50			5.00 SPT5 5.45	♦ Silty CLAY (4.5-5.5m) Brownish grey, Silty CLAY Medium stiff (Alluvial Silt & Clay)		6		CL-ML	asc			
6					6.00 UD1 7.00							59 (UCT) 36 (UU)		
7					7.00 SPT6 7.45			3						
8		(5.00)			8.00 UD2 9.00	♦ Lean CLAY (5.5-10.5m) Grey, Lean CLAY Very soft to soft (Alluvial Silt & Clay)				CL	asc	48 (UCT) 46 (UU)		
9					9.00 SPT7 9.45			0						
10	-6.20	10.50			10.00 SPT8 10.45			3						
11	-7.20	11.50			11.00 SPT9 11.45	♦ Lean CLAY (10.5-11.5m) Grey, Lean CLAY Medium stiff (Alluvial Silt & Clay)		5		CL	asc	0/4/69/27		
12	-8.20	12.50			12.00 SPT10 12.45	♦ Lean CLAY (11.5-12.5m) Grey, Lean CLAY with sand Medium stiff (Alluvial Silt & Clay)		7		CL	asc	0/24/54/22		
13	-9.20	13.50			13.00 SPT11 13.45	♦ Silty SAND (12.5-13.5m) Grey, fine grained Silty SAND with slightly Clay Medium dense (Alluvial Sand)		22		SM	asd			
14	-10.20	14.50			14.00 SPT12 14.45	♦ Silty SAND (13.5-14.5m) Grey, fine grained Silty SAND with laminated Clay Medium dense (Alluvial Sand)		22		SM	asd			
15										CL	asc			

TO BE CONTINUED

LEGEND:

- Standard Penetration Test (SPT)
- Pressuremeter Test (PMT)
- Vane Shear Test (V)
- Permeability Test (PBT)
- Packer Test (PKT)
- Undisturbed Sample (UD)
- Open Drive Thickwall Sample (OD)
- Mazier Sample (MZ)
- Denison Sample (DS)
- Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- Piston Sample (PS)
- Core Run (CR)
- TCR
- RQD

Ground Instrumentation & Engineering

REMARKS:

*WL - Ground Water Level observed from Borehole (BGL)

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-02									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 15-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400781.000 m									
DRILLING DATE COMPLETED: 16-02-2021					FLUSHING MEDIUM: Water					EASTING: 384907.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 4.3 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Raju Ahmed					▽ PERCHED WL*: 4.5 m dated 16-02-2021									

Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	SPT N blows/30cm				SPT N blows/30cm	Rock		Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C 0/36/64/0 0/36/46/18	Shear Strength		PL WC LL			
							X Undrained Shear Strength kN/m ²					TCR (%)	RQD (%)				C (kN/m ²)	φ (°)	20	40	60	80
		(2.00)			15.00 SPT13 15.45	◆ Lean CLAY (14.5-16.5m) Grey, sandy lean CLAY Very stiff (Alluvial Silt & Clay) (continued)	20	40	60	80	20			CL	asc							
16	-12.20	16.50			16.00 SPT14 16.45					21												
17	-13.20	17.50			17.00 SPT15 17.45	◆ Silty SAND (16.5-17.5m) Grey, fine grained silty SAND with slightly Clay Medium dense (Alluvial Sand)				15			SM	asd								
18	-14.20	18.50			18.00 SPT16 18.45	◆ Sandy SILT (17.5-18.5m) Grey, sandy SILT with slightly Clay Very stiff (Alluvial Silt & Clay)				22			ML	asc								
19	-15.20	19.50			19.00 SPT17 19.45	◆ Silty SAND (18.5-19.5m) Grey, fine grained silty SAND with slightly Clay Medium dense (Alluvial Sand)				22			SM	asd								
20	-16.20	20.50			20.00 SPT18 20.45	◆ Sandy lean CLAY (19.5-20.5m) Grey, sandy lean CLAY Very stiff (Alluvial Silt & Clay)				23			CL	asc	0/33/53/14							
21					21.00 SPT19 21.45					38												
22					22.00 SPT20 22.44					50/29cm												
23		(5.84)			23.00 SPT21 23.39	◆ Silty SAND (20.5-26.34m) Brownish grey to grey, greyish brown, grey to light brown and light grey, fine grained silty SAND Dense to very dense (Alluvial Sand)				50/24cm			SM	asd	0/85/15/0 0/85/12/3	4 (DST)	34.8					
24					24.00 SPT22 24.27					50/12cm												
25					25.00 SPT23 25.33					50/18cm					0/86/14/0 0/86/12/2	(DST)	40					
26	-22.04	26.34			26.00 SPT24 26.34					50/19cm												
27						Borehole terminated at 26.34m																
28																						
29																						
30																						

RQD/TCR(%)



Ground Instrumentation & Engineering

LEGEND:

▼ — Pressuremeter Test (PMT)

⊕ — Vane Shear Test (V)

⊗ — Permeability Test (PBT)

□ — Packer Test (PKT)

⊠ — Standard Penetration Test (SPT)

▨ — Undisturbed Sample (UD)
Open Drive Thickwall Sample (OD)

▩ — Mazier Sample (MZ)
Denison Sample (DS)

□ — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ — Piston Sample (PS)

▬ — Core Run (CR)

▨ — TCR

▩ — RQD

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-03									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 11-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400612.000 m									
DRILLING DATE COMPLETED: 13-02-2021					FLUSHING MEDIUM: Water					EASTING: 384904.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 4.97 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Raju Ahmed					PERCHED WL*:2.5 m dated 13-02-2021									
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm 20 40 60 80 X Undrained Shear Strength kN/m ² 20 40 60 80	SPT N blows/30cm	Rock	Soil Type (USCS)	Geological Deposition	Grain Size Analysis	Shear Strength	PL	WC	LL			
1	3.47	1.50			1.00 SPT1 1.45	● Silty SAND (0.0-1.5m) Grey, fine grained silty SAND Loose (Fill)		7		FILL	Fill								
2		(2.00)			2.00 SPT2 2.45	● SAND (1.5-3.5m) Grey, fine-medium grained SAND with Silt Dense (Fill)		42		FILL	Fill	0/91/9/0 0/91/7/2							
3	1.47	3.50			3.00 SPT3 3.45			40											
4	0.47	4.50			4.00 SPT4 4.45	● SAND (3.5-4.5m) Grey, fine-medium grained SAND Loose (Alluvial Sand)		9		SP	asd	0/96/4/0	(DST)	39					
5	-0.53	5.50			5.00 SPT5 5.45	● Silty SAND (4.5-5.5m) Grey, fine grained silty SAND with traces of shell fragments Medium dense (Alluvial Sand)		22		SM	asd								
6	-1.53	6.50			6.00 SPT6 6.45	● Sandy CLAY (5.5-6.5m) Grey, sandy CLAY Medium stiff (Alluvial Silt & Clay)		5		CL	asc								
7					7.00 SPT7 7.45			5											
8					8.00 UD1 9.00								56 (UCT) 45 (UU)						
9		(5.50)			9.00 SPT8 9.45	● Lean CLAY (6.5-12.0m) Grey, lean CLAY Medium stiff (Alluvial Silt & Clay)		5		CL	asc								
10					10.00 SPT9 10.45			5											
11					11.00 SPT10 11.45			8											
12	-7.03	12.00			12.00 UD2 13.00							0/79/21/0 0/82/13/5							
13		(2.50)			13.00 SPT11 13.45	● Silty SAND (12.0-14.5m) Grey, fine grained silty SAND Medium dense (Alluvial Sand)		22		SM	asd								
14	-9.53	14.50			14.00 SPT12 14.45			25											
15										SM	asd								
RQD/TCR(%)																			

TO BE CONTINUED



Ground Instrumentation & Engineering

LEGEND:

- ▼ — Pressuremeter Test (PMT)
- ⊕ — Vane Shear Test (V)
- ⊗ — Permeability Test (PBT)
- — Packer Test (PKT)

- — Standard Penetration Test (SPT)
- ▨ — Undisturbed Sample (UD)
- ▨ — Open Drive Thickwall Sample (OD)
- ▨ — Mazier Sample (MZ)
- ▨ — Denison Sample (DS)

- — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- — Piston Sample (PS)
- — Core Run (CR)
- ▨ — TCR
- ▨ — RQD

*WL - Ground Water Level observed from Borehole (BGL)

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-03									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 11-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400612.000 m									
DRILLING DATE COMPLETED: 13-02-2021					FLUSHING MEDIUM: Water					EASTING: 384904.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 4.97 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Raju Ahmed					PERCHED WL*:2.5 m dated 13-02-2021									
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	SPT N blows/30cm	Rock	Soil Type (USCS)	Geological Deposition	Grain Size Analysis	Shear Strength	PL	WC	LL	Bulk Density Mg/m ³			
							20 40 60 80				G/SA/S/C	C				1.3	1.6	1.9	2.2
							20 40 60 80					(kN/m ²)	(°)						
16		(2.50)			15.00 SPT13 15.45	♦ Silty SAND (14.5-17.0m) Grey, fine grained silty SAND with slightly Clay Medium dense (Alluvial Sand) (continued)	26		SM	asd									
17	-12.03	17.00			16.00 SPT14 16.45		20												
18		(1.50)			17.00 MZ1 18.00	♦ Sandy lean CLAY (17.0-18.5m) Grey, sandy lean CLAY Very stiff (Alluvial Silt & Clay)	22		CL	asc	0/28/72/0 0/27/57/16	15 (DST)	21.9						
19		(1.00)			18.00 SPT15 18.45						0/32/54/14								
20	-14.53	19.50			19.00 SPT16 19.73	♦ Silty SAND (18.5-19.5m) Grey, fine grained silty SAND with laminated Clay Very dense (Alluvial Sand)	50/28cm		SM	asd									
21		(1.00)			20.00 SPT17 20.45	♦ Silty SAND (19.5-20.5m) Grey, fine grained silty SAND with slightly Clay Dense (Alluvial Silt & Clay)	37		SM	asd									
22	-15.53	20.50			21.00 SPT18 21.45	♦ Clayey SILT (20.5-21.5m) Grey, Clayey SILT Stiff (Alluvial Silt & Clay)	13		CL-ML	asc	0/5/70/25								
23					22.00 SPT19 22.34		50/19cm												
24		(5.50)			23.00 SPT20 23.45		38				0/83/17/0 0/84/12/4								
25					24.00 SPT21 24.34	♦ Silty SAND (21.5-27.0m) Grey and light grey, fine grained silty SAND Very dense (Alluvial Sand)	50/19cm		SM	asd									
26					25.00 SPT22 25.28		50/13cm												
27	-22.03	27.00			26.00 SPT23 26.27		50/12cm				0/93/6/1	1 (DST)	30.3						
28		(2.29)			27.00 MZ2 28.00	♦ SAND (27.0-29.29m) Grey, fine grained SAND with Silt Very dense (Alluvial Sand)	50/14cm		SP-SM	asd									
29					28.00 SPT24 28.29		50/14cm												
30	-24.32	29.29			29.00 SPT25 29.29	Borehole terminated at 29.29m													
										RQD/TCR(%)									
LEGEND: ▼ - Pressuremeter Test (PMT) ⊕ - Vane Shear Test (V) ⊗ - Permeability Test (PBT) □ - Packer Test (PKT) ⊠ - Standard Penetration Test (SPT) ▨ - Undisturbed Sample (UD) ▩ - Mazier Sample (MZ) ▭ - Denison Sample (DS) □ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*) ■ - Piston Sample (PS) ▬ - Core Run (CR) ▨ - TCR ▩ - RQD Ground Instrumentation & Engineering REMARKS:																			

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-04									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 06-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400455.000 m									
DRILLING DATE COMPLETED: 07-02-2021					FLUSHING MEDIUM: Water					EASTING: 384901.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 4.192 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Nakibul Ahmed Chowdhury					PERCHED WL*: 2.4 m dated 07-02-2021									
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm 20 40 60 80 × Undrained Shear Strength kN/m ² 20 40 60 80	SPT N blows/30cm	Rock	Soil Type (USCS)	Geological Deposition	Grain Size Analysis	Shear Strength	PL	WC	LL			
									TCR (%)	RQD (%)		G/SA/S/C	C (kN/m ²)	φ (°)	1.3	1.6	1.9	2.2	
1		(3.50)			1.00 SPT1 1.45	● Silty SAND (0.0-3.5m) Grey, fine grained silty SAND Medium dense to dense (Fill)		32		FILL	Fill	0/72/28/0 0/74/20/6	1 (DST)	33.7					
2					2.00 SPT2 2.45			27											
3	0.69	3.50			3.00 SPT3 3.45			13											
4					4.00 SPT4 4.45			0											
5					5.00 SPT5 5.45			0											
6					6.00 SPT6 6.45	● Lean CLAY (3.5-10.0m) Dark grey, lean CLAY Very soft (Alluvial Silt & Clay)		2		CL	asc								
7		(6.50)			7.00 UD1 8.00														
8					8.00 SPT7 8.45			0											
9					9.00 UD2 10.00							0/2/76/22	31 (UCT)						
10	-5.81	10.00			10.00 SPT8 10.45	● Sandy lean CLAY (10.0-11.0m) Dark grey, sandy lean CLAY Medium stiff (Alluvial Silt & Clay)		5		CL	asc	0/36/64/0 0/37/46/17							
11	-6.81	11.00			11.00 SPT9 11.45			27											
12		(2.50)			12.00 SPT10 12.45	● Silty SAND (11.0-13.5m) Grey, fine grained silty SAND Medium dense (Alluvial Sand)		17		SM	asd								
13	-9.31	13.50			13.00 SPT11 13.45			22											
14		(1.00)			14.00 SPT12 14.45	● Lean CLAY (13.5-14.5m) Grey, lean CLAY Medium stiff (Alluvial Silt & Clay)		6		CL	asc								
15	-10.31	14.50								SC	asd								
RQD/TCR(%)																			

TO BE CONTINUED

LEGEND:

▼ — Pressuremeter Test (PMT)

⊕ — Vane Shear Test (V)

⊗ — Permeability Test (PBT)

□ — Packer Test (PKT)

⊠ — Standard Penetration Test (SPT)

▨ — Undisturbed Sample (UD)

▩ — Mazier Sample (MZ)

▧ — Denison Sample (DS)

□ — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ — Piston Sample (PS)

▬ — Core Run (CR)

▨ — RQD

BORING LOG SGS.GPJ SINGAPORE LTAAGS3.GDT 6-5-21

Ground Instrumentation & Engineering

*WL - Ground Water Level observed from Borehole (BGL)

Page 40

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)												BORING LOG: BH-05											
CLIENT: TEPSCO																							
GIE PROJECT NO: SIBD2104																							
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																							
DRILLING DATE STARTED: 16-02-2021						BOREHOLE DIA: 150 mm						NORTHING: 2400617.000 m											
DRILLING DATE COMPLETED: 17-02-2021						FLUSHING MEDIUM: Water						EASTING: 384596.000 m											
PREPARED BY: Md. Shahjalal						DRILLING METHOD: Rotary open hole						REDUCED LEVEL: 4.332 m											
CHECKED BY: Aminul Islam						FIELD SUPERVISOR: Nakibul Ahmed Chowdhury						PERCHED WL*:5 m dated 17-02-2021											
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm 20 40 60 80 X Undrained Shear Strength kN/m ² 20 40 60 80				SPT N blows/30cm	Rock TCR (%) ROD (%)		Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength C (kN/m ²) φ (°)		PL WC LL 20 40 60 80 ■ Bulk Density Mg/m ³ 1.3 1.6 1.9 2.2				
1	2.83	(1.50)			1.00 SPT1 1.45	◆ Silty CLAY (0.0-1.5m) Grey, silty CLAY with lamination of sand Very soft (Fill)					0			FILL	Fill								
2		(2.50)			2.00 SPT2 2.45	◆ Lean CLAY (1.5-4.0m) Grey, lean CLAY Very soft (Fill)					2			FILL	Fill								
3					3.00 UD1 4.00																		
4	0.33	4.00			4.00 SPT3 4.45	◆ Silty SAND (4.0-4.5m) Grey, fine grained silty SAND Medium dense (Alluvial Sand)					16			SM	asd								
5	-0.17	4.50			5.00 SPT4 5.45						0												
6		(4.00)			6.00 SPT5 6.45	◆ Lean CLAY (4.5-8.5m) Grey, lean CLAY Very soft (Alluvial Silt & Clay)					0			CL	asc								
7					7.00 UD2 8.00																		
8	-4.17	8.50			8.00 SPT6 8.45						0												
9		(1.00)			9.00 SPT7 9.45	◆ Clayey SILT (8.5-9.5m) Grey, clayey SILT Very soft (Alluvial Silt & Clay)					0			CL-ML	asc								
10	-5.17	9.50			10.00 SPT8 10.45						2			CL	asc								
11		(2.50)			11.00 UD3 12.00	◆ Lean CLAY (9.5-12.0m) Grey, lean CLAY Very soft (Alluvial Silt & Clay)																	
12	-7.67	12.00			12.00 SPT9 12.45	◆ Clayey SILT (12.0-12.5m) Grey, clayey SILT with lamination of sand Soft (Alluvial Silt & Clay)					3			CL-ML	asc								
13	-8.17	12.50			13.00 SPT10 13.45	◆ Sandy SILT (12.5-13.5m) Grey, sandy SILT with lamination of clay Very soft (Alluvial Silt & Clay)					2			ML	asc								
14	-9.17	13.50			14.00 SPT11 14.45	◆ SILT (13.5-15.5m) Grey, SILT with sand Medium stiff (Alluvial Silt & Clay)					7			ML	asc	0/16/84/0 0/16/68/16							
15		(2.00)																					
TO BE CONTINUED												RQD/TCR(%)											
 Ground Instrumentation & Engineering												LEGEND: ◆ - Standard Penetration Test (SPT) ▼ - Pressuremeter Test (PMT) ⊕ - Vane Shear Test (V) ⊗ - Permeability Test (PBT) □ - Packer Test (PKT) ▨ - Undisturbed Sample (UD) ▩ - Open Drive Thickwall Sample (OD) ▤ - Mazier Sample (MZ) ▦ - Denison Sample (DS) ▢ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*) ■ - Piston Sample (PS) ▣ - Core Run (CR) ▧ - TCR ▨ - RQD											

BORING LOG SGS.GPJ SINGAPORE LTAAGS3.GDT 7-3-21

REMARKS:

*WL - Ground Water Level observed from Borehole (BGL)

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-05									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 16-02-2021 BOREHOLE DIA: 150 mm																			
DRILLING DATE COMPLETED: 17-02-2021 FLUSHING MEDIUM: Water										NORTHING: 2400617.000 m									
PREPARED BY: Md. Shahjalal DRILLING METHOD: Rotary open hole										EASTING: 384596.000 m									
CHECKED BY: Aminul Islam FIELD SUPERVISOR: Nakibul Ahmed Chowdhury										REDUCED LEVEL: 4.332 m									
										PERCHED WL*:5 m dated 17-02-2021									

Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	SPT N blows/30cm				SPT N blows/30cm	Rock		Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength		PL WC LL				
							X Undrained Shear Strength kN/m ²					TCR (%)	RQD (%)				C	φ	20	40	60	80	
	-11.17	15.50	xxxxx	X	15.00 SPT12 15.45		20	40	60	80	5			ML	asc								
16		(1.00)		X	16.00 SPT13 16.45	◆ Clayey SAND (15.5-16.5m) Grey, clayey SAND Loose (Alluvial Sand)					5			SC	asd								
17		(2.00)		X	17.00 SPT14 17.45	◆ Silty SAND (16.5-18.5m) Grey, fine grained silty SAND Medium dense (Alluvial Sand)					20			SM	asd	0/55/45/0 0/55/37/8	(DST)	37					
18				X	18.00 SPT15 18.45						32												
19	-14.17	18.50		X	19.00 SPT16 19.36						50/21cm												
20				X	20.00 SPT17 20.27						50/12cm												
21		(4.80)		X	21.00 SPT18 21.45	◆ Sandy SILT (18.5-23.3m) Grey, sandy SILT Hard (Alluvial Silt & Clay)					50			ML	asc	0/43/57/0 0/44/46/10	3 (DST)	35.1					
22				X	22.00 SPT19 22.43						50/28cm												
23	-18.97	23.30		X	23.00 SPT20 23.30						50/15cm												
Borehole terminated at 23.3m																							
24																							
25																							
26																							
27																							
28																							
29																							
30																							

RQD/TCR(%)

Ground Instrumentation & Engineering

LEGEND:

▼ — Pressuremeter Test (PMT)

⊕ — Vane Shear Test (V)

⊗ — Permeability Test (PBT)

▢ — Packer Test (PKT)

⊠ — Standard Penetration Test (SPT)

▨ — Undisturbed Sample (UD)
Open Drive Thickwall Sample (OD)

▩ — Mazier Sample (MZ)
Denison Sample (DS)

□ — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ — Piston Sample (PS)

▬ — Core Run (CR)

▤ — TCR

▦ — RQD

BORING LOG SGS.GPJ SINGAPORE LTAAGS3.GDT 7-3-21

*WL - Ground Water Level observed from Borehole (BGL)

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-06									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 08-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400493.000 m									
DRILLING DATE COMPLETED: 09-02-2021					FLUSHING MEDIUM: Water					EASTING: 384316.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 7.179 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Raju Ahmed					▽ PERCHED WL*:3 m dated 09-02-2021									
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm 20 40 60 80 × Undrained Shear Strength kN/m ² 20 40 60 80	SPT N blows/30cm	Rock	Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/SC	Shear Strength C (kN/m ²) φ (°)	PL 20 WC 40 LL 60 80 ■ Bulk Density Mg/m ³ 1.3 1.6 1.9 2.2					
1		(2.50)		1.00 SPT1 1.45	◆ Silty SAND (0.0-2.5m) Grey, fine grained silty SAND with traces of shell fragments Very loose to loose (Fill)		2			FILL	Fill								
2	4.68	2.50		2.00 SPT2 2.45			3												
3	3.68	(1.00)		3.00 SPT3 3.45	◆ Silty SAND (2.5-3.5m) Grey, fine grained silty SAND Loose (Fill)		5			FILL	Fill								
4	2.68	(1.00)		4.00 SPT4 4.45	◆ Silty SAND (3.5-4.5m) Grey, fine grained silty SAND with slightly Clay Very loose (Fill)		3			FILL	Fill								
5		(2.00)		5.00 SPT5 5.45	◆ SAND (4.5-6.5m) Light brown, fine-medium grained SAND with Silt Medium dense to dense (Fill)		12			FILL	Fill								
6	0.68	6.50		6.00 SPT6 6.45			32					0/91/9/0 0/93/5/2	1 (DST)	39.4					
7		(2.50)		7.00 SPT7 7.45	◆ Lean CLAY (6.5-9.0m) Brown, lean CLAY Medium stiff (Alluvial Silt & Clay)		6			CL	asc								
8				8.00 UD1 9.00															
9	-1.82	9.00		9.00 SPT8 9.45			0												
10				10.00 UD2 11.00															
11		(5.00)		11.00 SPT9 11.45	◆ Silty CLAY (9.0-14.0m) Dark grey and grey silty CLAY Very soft to soft (Alluvial Silt & Clay)		2			CL-ML	asc								
12				12.00 SPT10 12.45			2												
13				13.00 SPT11 13.45			3												
14	-6.82	14.00		14.00 UD3 15.00	◆ Lean CLAY (14.0-15.5m) Grey, lean CLAY Medium stiff (Alluvial Silt & Clay)					CL	asc	0/5/73/22	25 (UCT)						
15		(1.50)																	

TO BE CONTINUED



Ground Instrumentation & Engineering

LEGEND:

- ▼ — Pressuremeter Test (PMT)
- ⊕ — Vane Shear Test (V)
- ⊗ — Permeability Test (PBT)
- — Packer Test (PKT)

- ⊠ — Standard Penetration Test (SPT)
- ▨ — Undisturbed Sample (UD)
- ▩ — Mazier Sample (MZ)
- ▩ — Denison Sample (DS)
- ▩ — Open Drive Thickwall Sample (OD)

- — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- — Piston Sample (PS)
- ▩ — Core Run (CR)
- ▩ — RQD

*WL - Ground Water Level observed from Borehole (BGL)

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)										BORING LOG: BH-06									
CLIENT: TEPSCO																			
GIE PROJECT NO: SIBD2104																			
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																			
DRILLING DATE STARTED: 08-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400493.000 m									
DRILLING DATE COMPLETED: 09-02-2021					FLUSHING MEDIUM: Water					EASTING: 384316.000 m									
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 7.179 m									
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Raju Ahmed					▽ PERCHED WL*: 3 m dated 09-02-2021									

Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm				SPT N blows/30cm	Rock		Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength		PL WC LL			
							X Undrained Shear Strength kN/m ²					TCR (%)	RQD (%)				C	φ	20	40	60	80
	-8.32	15.50			15.00 SPT12 15.45		20	40	60	80	6			CL	asc							
16		(1.00)			16.00 SPT13 16.45	♦ Silty SAND (15.5-16.5m) Grey, fine grained silty SAND with slightly Clay Medium dense (Alluvial Sand)					13			SM	asd							
17	-9.32	16.50			17.00 SPT14 17.44	♦ Silty SAND (16.5-18.5m) Grey, fine grained silty SAND with traces of mica Very dense (Alluvial Sand)					50/29cm			SM	asd							
18		(2.00)			18.00 SPT15 18.44						50/29cm											
19	-11.32	18.50			19.00 SPT16 19.45	♦ Silty SAND (18.5-21.0m) Grey, fine grained silty SAND with slightly Clay Loose to medium dense (Alluvial Sand)					27			SM	asd							
20		(2.50)			20.00 SPT17 20.45						6											
21	-13.82	21.00			21.00 SPT18 21.45						22					0/39/61/0 0/37/50/13	3 (DST)	28				
22		(2.50)			22.00 SPT19 22.45	♦ Sandy SILT (21.0-23.5m) Grey, sandy SILT Stiff to very stiff (Alluvial Silt & Clay)					11			ML	asc							
23					23.00 SPT20 23.45						16											
24	-16.32	23.50			24.00 SPT21 24.42						50/27cm											
25					25.00 SPT22 25.37						50/22cm											
26		(4.87)			26.00 SPT23 26.41	♦ SILT (23.5-28.37m) Grey, SILT with traces of sand Hard (Alluvial Silt & Clay)					50/26cm			ML	asc	0/6/94/0 0/7/74/19	(DST)	33				
27					27.00 SPT24 27.43						50/28cm											
28	-21.19	28.37			28.00 SPT25 28.37						50/22cm											
29						Borehole terminated at 28.37m																
30																						

RQD/TCR(%)



Ground Instrumentation & Engineering

LEGEND:

▼ — Pressuremeter Test (PMT)

⊗ — Vane Shear Test (V)

⊗ — Permeability Test (PBT)

⊗ — Packer Test (PKT)

⊗ — Standard Penetration Test (SPT)

⊗ — Undisturbed Sample (UD)
Open Drive Thickwall Sample (OD)

⊗ — Mazier Sample (MZ)
Denison Sample (DS)

□ — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ — Piston Sample (PS)

▬ — Core Run (CR)

■ — TCR

■ — RQD

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)												BORING LOG: BH-07			
CLIENT: TEPSCO															
GIE PROJECT NO: SIBD2104															
LOCATION: Matarbari, Maheshkhali, Cox's Bazar															
DRILLING DATE STARTED: 18-02-2021				BOREHOLE DIA: 150 mm				NORTHING: 2400624.000 m							
DRILLING DATE COMPLETED: 20-02-2021				FLUSHING MEDIUM: Water				EASTING: 384147.000 m							
PREPARED BY: Md. Shahjalal				DRILLING METHOD: Rotary open hole				REDUCED LEVEL: 6.774 m							
CHECKED BY: Aminul Islam				FIELD SUPERVISOR: Raju Ahmed				▽ PERCHED WL*:6 m dated 20-02-2021							
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm 20 40 60 80 X Undrained Shear Strength kN/m² 20 40 60 80	SPT N blows/30cm	Rock TCR (%) RQD (%)	Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength C (kN/m²) φ (°)	PL WC LL 20 40 60 80 ■ Bulk Density Mg/m³ 1.3 1.6 1.9 2.2	
1					1.00 SPT1 1.45			17							
2		(4.50)			2.00 SPT2 2.45	♦ SAND (0.0-4.5m) Light brown, fine-medium grained SAND with Silt Loose to medium dense (Fill)		18		FILL	Fill				
3					3.00 SPT3 3.45			11				0/89/11/0 0/90/7/3	1 (DST)	33.4	
4	2.27	4.50			4.00 SPT4 4.45			10							
5	1.27	5.50			5.00 SPT5 5.45	♦ Silty SAND (4.5-5.5m) Brownish grey, fine grained silty SAND Dense (Fill)		34		FILL	Fill				
6	▽ 0.27	(1.00) 6.50			6.00 SPT6 6.45	♦ Sandy lean CLAY (5.5-6.5m) Grey, sandy lean CLAY Medium stiff (Alluvial Silt & Clay)		6		CL	asc	0/40/60/0 0/42/39/19			
7		(1.00) 7.50			7.00 SPT7 7.45	♦ Lean CLAY (6.5-7.5m) Yellowish brown to grey, lean CLAY Medium stiff (Alluvial Silt & Clay)		7		CL	asc				
8	-0.73				8.00 SPT8 8.45			2							
9		(3.00)			9.00 UD1 10.00	♦ Lean CLAY (7.5-10.5m) Grey, lean CLAY with Sand Very soft (Alluvial Silt & Clay)		0		CL	asc	0/23/63/14	26 (UCT)		
10	-3.73	10.50			10.00 SPT9 10.45			0							
11	-4.73	(1.00) 11.50			11.00 SPT10 11.45	♦ Clayey SAND (10.5-11.5m) Grey, clayey SAND Loose (Alluvial Sand)		8		SC	asd				
12	-5.73	(1.00) 12.50			12.00 SPT11 12.45	♦ Silty SAND (11.5-12.5m) Grey, fine grained silty SAND Dense (Alluvial Sand)		35		SM	asd				
13	-6.73	(1.00) 13.50			13.00 SPT12 13.45	♦ Silty SAND (12.5-13.5m) Grey, fine grained silty SAND with slightly Clay Medium dense (Alluvial Sand)		15		SM	asd				
14					14.00 SPT13 14.45	♦ Silty SAND (13.5-17.5m) Grey, fine-medium grained silty SAND Medium dense to dense (Alluvial Sand)		41		SM	asd	0/80/20/0 0/81/14/5			
15															
TO BE CONTINUED															
Ground Instrumentation & Engineering LEGEND: ▼ - Pressuremeter Test (PMT) ⊕ - Vane Shear Test (V) ⊗ - Permeability Test (PBT) ▤ - Packer Test (PKT) □ - Standard Penetration Test (SPT) ▨ - Undisturbed Sample (UD) ▩ - Open Drive Thickwall Sample (OD) ▧ - Mazier Sample (MZ) ▦ - Denison Sample (DS) □ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*) ■ - Piston Sample (PS) ▬ - Core Run (CR) ▨ - TCR ▩ - RQD															

BORING LOG SGS.GPJ SINGAPORE LTAAGS3.GDT 6-5-21

*WL - Ground Water Level observed from Borehole (BGL)

REMARKS

PROJECT: Geotechnical Investigation Works for Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)											BORING LOG: BH-08											
CLIENT: TEPSCO																						
GIE PROJECT NO: SIBD2104																						
LOCATION: Matarbari, Maheshkhali, Cox's Bazar																						
DRILLING DATE STARTED: 18-02-2021					BOREHOLE DIA: 150 mm					NORTHING: 2400763.000 m												
DRILLING DATE COMPLETED: 20-02-2021					FLUSHING MEDIUM: Water					EASTING: 383978.000 m												
PREPARED BY: Md. Shahjalal					DRILLING METHOD: Rotary open hole					REDUCED LEVEL: 5.885 m												
CHECKED BY: Aminul Islam					FIELD SUPERVISOR: Nakibul Alam Chowdhury					PERCHED WL*:5 m dated 20-02-2021												
Scale	Reduced Level (m)	Depth (m) (Thickness)	Graphic Log	Legend	Type & No.	Description	● SPT N blows/30cm 20 40 60 80 × Undrained Shear Strength kN/m² 20 40 60 80				SPT N blows/30cm	Rock TCR (%) RQD (%)		Soil Type (USCS)	Geological Deposition	Grain Size Analysis G/SA/S/C	Shear Strength C (kN/m²) φ (°)		PL WC LL 20 40 60 80 ■ Bulk Density Mg/m³ 1.3 1.6 1.9 2.2			
1		(2.50)			1.00 SPT1 1.45	♦ SAND(0.0-2.5m) Brownish grey, fine-medium grained SAND Loose to medium dense (Fill)					13			FILL	Fill							
2	3.39	2.50			2.00 SPT2 2.45						5					0/98/2/0	1 (DST)	31.5				
3		(1.00)			3.00 SPT3 3.45	♦ Silty SAND (2.5-3.5m) Brownish grey, fine-medium grained silty SAND with shell fragments Very loose (Fill)					1			FILL	Fill							
4		(1.00)			4.00 SPT4 4.45	♦ Silty SAND (3.5-4.5m) Grey, fine-medium grained SAND Medium dense (Fill)					19			FILL	Fill							
5		(1.00)			5.00 SPT5 5.45	♦ Lean CLAY (4.5-5.5m) Grey, lean CLAY Very soft (Alluvial Silt & Clay)					2			CL	asc							
6		(2.00)			6.00 SPT6 6.45	♦ Lean CLAY 5.5-7.5) Reddish brown and brownish grey, lean CLAY Soft to medium stiff (Alluvial Silt & Clay)					8			CL	asc							
7	-1.62	7.50			7.00 SPT7 7.45						4											
8		(1.00)			8.00 SPT8 8.45	♦ Silty SAND (7.5-8.5m) Grey, fine grained silty SAND Medium dense (Alluvial Sand)					25			SM	asd							
9		(1.00)			9.00 SPT9 9.45	♦ Sandy lean CLAY (8.5-9.5m) Grey, sandy lean CLAY Soft (Alluvial Silt & Clay)					3			CL	asc	0/38/44/18						
10					10.00 SPT10 10.45						29											
11		(4.00)			11.00 SPT11 11.45	♦ Silty SAND (9.5-13.5m) Grey, fine grained silty SAND Medium dense to dense (Alluvial Sand)					22			SM	asd							
12					12.00 SPT12 12.45						24					0/68/32/0 0/69/21/10						
13	-7.62	13.50			13.00 SPT13 13.45						31											
14		(1.00)			14.00 SPT14 14.45	♦ Silty SAND (13.5-14.5m) Grey, fine-medium grained silty SAND Medium dense (Alluvial Sand)					23			SM	asd							
15	-8.62	14.50												SM	asd							
TO BE CONTINUED																						
 Ground Instrumentation & Engineering LEGEND: ▼ — Pressuremeter Test (PMT) ⊗ — Vane Shear Test (V) ⊗ — Permeability Test (PBT) ▨ — Packer Test (PKT) ▨ — Standard Penetration Test (SPT) ▨ — Undisturbed Sample (UD) Open Drive Thickwall Sample (OD) ▨ — Mazier Sample (MZ) Denison Sample (DS) ▨ — Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*) ▨ — Piston Sample (PS) ▨ — Core Run (CR)																						

BORING LOG SGS.GPJ SINGAPORE LTAAGS3.GDT 7-3-21

TO BE CONTINUED



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Pressuremeter Test (PMT)
- ⊕ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊞ - Packer Test (PKT)

- ⊞ - Standard Penetration Test (SPT)
- ⊞ - Undisturbed Sample (UD)
- ⊞ - Mazier Sample (MZ)
- ⊞ - Denison Sample (DS)
- ⊞ - Open Drive Thickwall Sample (OD)

- ⊞ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- ⊞ - Piston Sample (PS)
- ⊞ - Core Run (CR)
- ⊞ - TCR
- ⊞ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

NEWARK, N.J.

APPENDIX A (ii)

Field Bore Logs

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 1 of 3

PROJECT: <u>GIE Works for matarbari Power Plant</u>		CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>YWE</u> RID NO: <u>01</u>		BORING LOG: <u>BH-01</u>	
CONTRACTOR: <u>GIE</u>		BOREHOLE DIA: <u>150 mm</u>		DIA: <u>N/A</u>			
LOCATION: <u>Power Plant Area</u>		DRILLING DATE: <u>03.02.2021</u>		DRILLING METHOD: <u>Rotary</u>		NORTHING: <u>2400600.00</u>	
DRILLING ROD TYPE / SIZE: <u>8W/150 mm</u>		FLUSHING MEDIUM: <u>Water</u>		EASTING: <u>985231.00</u>		REDUCED LEVEL: <u>4.68</u>	
HAMMER TYPE / SNG: <u>Auto Trip</u>		CASING DIA / LENGTH: <u>150 mm / 6.0 m</u>		CLIENT'S REP: <u>[Signature]</u>		WL: <u>2.10 m</u>	
CAL. CERT. NO./DATE: <u>N/A</u>		DRILLER: <u>Jahangir</u>		SITE ENGR: <u>[Signature]</u>			

Depth (m) (Thickness)	Legend	Type of Soil	Description	Standard Penetration Test			SPT N Blows / 30 cm	TC (%)	SC (%)	RC (%)	Cone Resistance (MPa)	Remarks
				1st 10 cm	2nd 10 cm	3rd 10 cm						
0												
1	SPT 01		Grey loose silty fine SAND (fill)	4	4	5	9					Rec: 18 cm
2	SPT 02		Grey dense silty fine to medium SAND (fill)	12	21	27	48					Rec: 24 cm
3	SPT 03		Light brown medium dense silty fine SAND (fill)	10	12	15	27					Rec: 25 cm
4	SPT 04		Grey medium dense silty fine SAND (fill)	7	12	14	26					Rec: 29 cm
5	SPT 05		Grey very loose silty fine SAND with slightly clay	2	2	2	4					Rec: 30 cm
6	SPT 06		Grey medium stiff silty CLAY	1	2	3	5					Rec: 25 cm
7	UD 01		UD-01 sample taken from 7.0m to 8.0m depth									UD-01 Rec: 85 cm
8	SPT 07		Dark grey soft silty CLAY	0	1	2	3					Rec: 42 cm
9	SPT 08		Grey medium stiff silty CLAY	1	2	3	5					Rec: 34 cm
10												



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Piezometer Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PMT)
- ▨ - Packer Test (PKT)
- ⊗ - Standard Penetration Test (SPT)
- ▨ - Undisturbed Sample (UD)
- ▨ - Open Drive Thickwall Sample (OD)
- ▨ - Master Sample (MZ)
- ▨ - Densar Sample (DS)
- - Anemograph (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Pore Sample (PS)
- - Core Box (CB)
- - RQD
- - TCR

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 2 of 3

PROJECT: <u>GI Works for matabari Power Plant</u>		CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>YWE</u> RIG NO: <u>01</u>		BORING LOG: <u>BH-01</u>	
CONTRACTOR: <u>GJE</u>		BOREHOLE DIA: <u>150 mm</u>		DIA: <u>N/A</u>			
LOCATION: <u>Power Plant Area</u>		DRILLING METHOD: <u>Rotary</u>		NORTHING: <u>2400600.00</u>		EASTING: <u>385231.00</u>	
DRILLING DATE: <u>03.02.2021</u>		FLUSHING MEDIUM: <u>Water</u>		REDUCED LEVEL: <u>4.68</u>			
DRILLING ROD TYPE / SIZE: <u>BW / 50mm</u>		CASING DIA / LENGTH: <u>150 mm / 6.0 m</u>		WL: <u>2.10 m</u>			
HAMMER TYPE / SNG: <u>Autotap</u>		CAL. CERT. NO. / DATE: <u>N/A</u> DRILLER: <u>Jahansir</u> SITE ENGR: <u>[Signature]</u> CLIENT'S REP: <u>[Signature]</u>					

Depth (m)	Logical Type & No.	Description	Standard Penetration Test			SPT Blows / 30cm	F ₁₅ (%)	F ₃₀ (%)	F ₄₅ (%)	Geological Classification	Remarks
			1st 15cm	2nd 15cm	3rd 15cm						
10	UD 02	UD-02 Sample taken from 10.0m to 11.0m depth									UD-02 Rec: 82cm
11	SPT 09	Grey stiff clayey SILT with slightly sand	2	8	5	13					Rec: 29cm 03.02.21 04.02.21 ↓
12	SPT 10	Grey medium stiff silty CLAY	1	2	3	5					Rec: 36cm
13	SPT 11	Grey dense silty fine SAND	8	14	20	34					Rec: 25cm
14	SPT 12	Grey medium dense silty fine SAND with slightly clay	6	8	12	20					Rec: 34cm
15	SPT 13	Grey medium dense silty fine SAND with slightly clay	7	9	12	21					Rec: 30cm
16	SPT 14	Grey medium dense silty fine SAND with slightly clay	5	6	9	15					Rec: 33cm
17	SPT 15	Grey medium dense silty fine SAND with slightly clay	6	9	14	23					Rec: 28cm
18	SPT 16	Grey medium dense silty fine SAND with slightly clay	7	10	19	29					Rec: 29cm
19	SPT 17	Grey medium dense clayey SAND with slightly silt	5	6	7	13					Rec: 30cm
20											

LEGEND:

▼ - Piezometer Test (PMT)

⊕ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

⊞ - Packer Test (PKT)

⊠ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▩ - Open Drive Thickwall Sample (OD)

▪ - Mudier Sample (SG)

▬ - Distorted Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ - Filter Sample (FS)

▩ - Core Run (CR)

▨ - RQD

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*WL - Ground Water Level observed from Borehole (DGL)

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FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 3 of 3

PROJECT: <u>GIE Works for matabari Power Plant</u>		CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>YWE</u> RIG NO: <u>01</u>		BORING LOG: <u>BH-01</u>	
CONTRACTOR: <u>GJE</u>		BORERHOLE DIA: <u>150mm</u>		DIA: <u>N/A</u>			
LOCATION: <u>Power Plant Area</u>		DRILLING DATE: <u>04.02.2021</u>		DRILLING METHOD: <u>Rotary</u>		NORTHING: <u>2400600.00</u>	
DRILLING ROD TYPE / SIZE: <u>BW / 50 mm</u>		FLUSHING MEDIUM: <u>Water</u>		EASTING: <u>385231.00</u>		REDUCED LEVEL: <u>4.68</u>	
HAMMER TYPE / SNO: <u>Autotrip</u>		CASING DIA / LENGTH: <u>150 mm / 6.0 m</u>		CLIENT'S REP: <u>GJE</u>		WL: <u>2.70 m</u>	
CAL. CRT. NO / DATE: <u>N/A</u>		DRILLER: <u>Jahansir</u>		SITE ENGR: <u>[Signature]</u>			

Bore Depth (m)	Log Type & No	Description	Standard Penetration Test			SPT Blows / 30cm	Rock	Geological Classification	Remarks (e.g. Riser Water level during SPT, SPT Recovery, Strain gauge and also note SPT, LRI Recovery)
			1st 10cm	2nd 10cm	3rd 10cm				
20	X SPT 18	Grey medium dense clayey BAND with slightly silt	4	6	9	15			Rec: 32 cm
21	X SPT 19	Grey hard silty CLAY	11	18	22	50			Rec: 33 cm
22	X SPT 20	Grey hard silty CLAY	10	26	25	50			Rec: 30 cm
23	X SPT 21	Grey hard silty CLAY	11	18	27	45			Rec: 32 cm
24	X SPT 22	Grey hard silty CLAY	18	23	27	50			Rec: 36 cm
25	X SPT 23	Grey hard clayey SILT	23	30	20	50			Rec: 34 cm
26	X SPT 24	Grey hard silty CLAY	15	26	24	50			Rec: 35 cm
27	X SPT 25	Grey hard silty CLAY	17	26	24	50			Rec: 36 cm
28	X SPT 26	Grey hard silty CLAY	15	23	27	50			Rec: 45 cm
29									
30									

LEGEND:

▼ - Pressuremeter Test (PMT)

⊗ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

▨ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickwall Sample (OD)

▨ - Marier Sample (MZ)

▨ - Disturb Sample (DS)

□ - Attempted (UD*, OD*, PS*, MZ* & DS*)

■ - Piston Sample (PS)

▨ - Core Box (CR)

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

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FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: GI WORKS for Matachhari Power Plant		DRILL RIG MODEL: PRD RIG NO: 01		BORING LOG: 8H-02	
CLIENT: TEP820		BOREHOLE DIA: 150 mm			
CONTRACTOR: GIE		DIA: N/A			
LOCATION: Power Plant Area		DRILLING METHOD: Rotary		NORTHING: 2480781.00	
DRILLING DATE: 15.02.2021		FLUSHING MEDIUM: Water		EASTING: 384907.00	
DRILLING ROD TYPE / SIZE: BW / 50 mm		CASING DIA / LENGTH: 150 mm / 6.0 m		REDUCED LEVEL: 4.53	
HAMMER TYPE / SNO: Autotrip		SITE ENGINEER: Rock		CLIENT'S REP: [Signature]	
CAL. CERT NO / DATE: N/A		DRILLER:		WL: 1.15 m	

Depth (m)	Log No	Type & No	Description	Standard Penetration Test			SPT N	Rock			Geological Classification	Remarks
				1st 15cm	2nd 15cm	3rd 15cm		TS (%)	CS (%)	QP (%)		
0												
1	X	SPT 01	Grey medium dense fine SAND with traces of mica. (S11)	5	6	7	13					Ree = 17cm
2	X	SPT 02	Grey Loose fine SAND with traces of mica (S11)	3	3	6	9					Ree = 18cm
3	X	SPT 03	Grey Loose fine SAND with traces of shell fragments (S11)	4	4	6	10					Ree = 24cm
4	X	SPT 04	Grey medium stiff sandy CLAY.	2	3	3	6					Ree = 29cm
5	X	SPT 05	Brownish grey medium stiff silty CLAY.	2	2	4	6					Ree = 19cm
6		UD 01	UD-01 sample taken from 6.0 - 7.0 m depth									UD-01 Ree = 90cm
7	X	SPT 06	Grey soft silty CLAY.	1	1	2	3					Ree = 21cm 15.02.21 16.02.21 UD-02 Ree = 85cm
8		UD 02	UD-02 sample taken from 8.0 - 9.0 m depth.									
9	X	SPT 07	Grey very soft silty CLAY.	0	0	0	0					Ree = 37cm
10												



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Piezometer Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PMT)
- ▨ - Packer Test (PCT)
- ⊗ - Standard Penetration Test (SPT)
- ▨ - Undisturbed Sample (UD)
- ▨ - Open Drive Thickwall Sample (OD)
- ▨ - Marier Sample (MZ)
- ▨ - Denison Sample (DS)
- - Attempted (UD*, LOD*, PS*, MZ* & DS*)
- - Piston Sample (PS)
- ▨ - Core Run (CR)
- ▨ - RQD
- ▨ - TCR

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: <u>GIE Works for Matarchari Power Plant</u>		BORING LOG: <u>BH-02</u>	
CLIENT: <u>TEPSCO</u>	DRILL ROD MODEL: <u>PRD</u>	ROD NO: <u>01</u>	
CONTRACTOR: <u>GIE</u>	BORING HOLE DIA: <u>150 mm</u>		
LOCATION: <u>Power Plant Area</u>	DIA: <u>N/A</u>		
DRILLING DATE: <u>16.02.21</u>	DRILLING METHOD: <u>Rotary</u>	NORTHING: <u>2480781.00</u>	
DRILLING ROD TYPE / SIZE: <u>BW / 50 mm</u>	FLUSHING MEDIUM: <u>Water</u>	EASTING: <u>384907.00</u>	
HAMMER TYPE / SNO: <u>Auto trip</u>	CASING DIA / LENGTH: <u>150 mm / 6.9 m</u>	REDUCED LEVEL: <u>4.53</u>	
CAL. CERT. NO. / DATE: <u>N/A</u>	DRILLER: <u>Ravi</u>	CLIENT'S REP: <u>Shakti</u>	WL: <u>1.5 m</u>

Scale	Depth (m) (Thickness)	Legend Type #	Description	Standard Penetration Test			SPT N Blows / 30cm	Back			Geological Classification	Remarks (Always Record Water level during SPT. SPT Recovery, Strengths (if not also every 30 SPT, 10 Recovery)
				1st 15cm	2nd 15cm	3rd 15cm		TCR (k)	TCR (N)	MP (N)		
	10	☒ SPT 08	Grey soft silty clay.	1	1	2	3					Rec = 36cm
	11	☒ SPT 09	Grey medium stiff silty clay with laminated sand	1	2	3	5					Rec = 36cm
	12	☒ SPT 10	Grey medium stiff silty clay with slightly sand.	2	3	4	7					Rec = 35cm
	13	☒ SPT 11	Grey medium dense silty sand with slightly clay.	4	9	13	22					Rec = 29cm
	14	☒ SPT 12	Grey medium dense silty sand with laminated clay.	4	8	14	22					Rec = 25cm
	15	☒ SPT 13	Grey medium dense clayey sand.	4	8	12	20					Rec = 22cm
	16	☒ SPT 14	Grey medium dense clayey sand with laminated silt.	3	8	13	21					Rec = 27cm
	17	☒ SPT 15	Grey medium dense silty sand with slightly clay.	2	6	9	15					Rec = 30cm
	18	☒ SPT 16	Grey very stiff sandy silt with slightly clay.	4	9	13	22					Rec = 29cm
	19	☒ SPT 17	Grey medium dense silty sand with slightly clay	6	11	11	22					Rec = 29cm
	20											



Ground Instrumentation & Engineering

LEGEND:

☒ - Penetration Test (PMT)	☒ - Standard Penetration Test (SPT)	☐ - Attempted (UD*), (GD*), (PS*), (MZ*) & (DS*)
☒ - Vane Shear Test (V)	☒ - Undisturbed Sample (UD)	☒ - Photo Sample (PS)
☒ - Permeability Test (PBT)	☒ - Open Drive Thickwall Sample (OD)	☒ - TCR
☒ - Packer Test (PCT)	☒ - Marine Sample (MZ)	☒ - Core Box (CB)
	☒ - Denovo Sample (DS)	☒ - RQD

*WL - Ground Water Level observed from Borehole (BGL.)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: GI WORKS for mabarbari Power Plant				CLIENT: TEPSCO				DRILL ROD MODEL: PRD				RG NO: 01				BORING LOG: <u>BH-02</u>			
CONTRACTOR: GIE				BOREHOLE DIA: CORE				150 mm											
LOCATION: Power Plant Area				DIA: N/A															
DRILLING DATE: 16.02.21				DRILLING METHOD: Rotary												NORTHING: 2400781.00			
DRILLING ROD TYPE / SIZE: BW/50 mm				FLUSHING MEDIUM: Water												EASTING: 384907.00			
HAMMER TYPE / SNO: Auto trip				CASING DIA / LENGTH: 150 mm / 6.0 m												REDUCED LEVEL: 4.53			
CAL. CERT. NO. / DATE: N/A				DRILLER: masud				SITE ENGR: Ravi				CLIENT'S REP: Yash				WL: 4.5m			

Scale	Depth (m) (Thickness)	Lateral Type & No	Description	Standard Penetration Test			SPT N (blows / 30 cm)	Rock			Geotechnical Classification	Remarks (Notes about Water level during SPT, SPT Recovery, Intermittence of soil about every 20 SPT, 1st Recovery)
				q (kPa)	f (kPa)	N (blows)		TC (%)	SC (%)	RP (%)		
	20	X SPT 18	Grey very stiff sandy SILT.	3	6	17	23					Ree=36cm
	21	X SPT 19	Brownish grey to grey dense silty SAND.	9	17	21	38					Ree=20cm
	22	X SPT 20	Greyish brown very dense silty fine SAND	13	22	28	50					Ree=21cm
	23	X SPT 21	Grey to light brown very dense silty fine SAND.	10	26	24	50					Ree=22cm
	24	X SPT 22	Light Grey very dense silty fine SAND	32	50	0	50					Ree=17cm + 16.02.21 17.02.21 Ree=19cm
	25	X SPT 23	Light grey very dense fine SAND.	24	44	6	50					
	26	X SPT 24	Light grey very dense fine SAND	22	38	12	50					Ree=20cm
	27											
	28											
	29											
	30											



Ground Instrumentation & Engineering

LEGEND:

▼ - Penetration Test (PMT)

⊗ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

⊗ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickwall Sample (OD)

▨ - Maxier Sample (MZ)

▨ - Distress Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ - Piston Sample (PS)

▨ - Core Rot (CR)

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: GI WORKS for matarbarq power plant				DRILL RIG MODEL: PRD RIG NO: 01				BORING LOG: BH-03			
CLIENT: TEPSEO				BOREHOLE DIA: 150 mm							
CONTRACTOR: GIE				DIA: N/A				NORTHING: 2400612.00 EASTING: 384904.00 REDUCED LEVEL: 4.97			
LOCATION: Power Plant Area				DRILLING METHOD: Rotary							
DRILLING DATE: 11.02.2021				FLUSHING MEDIUM: Water				WL: 2.0 m			
DRILLING ROD TYPE / SIZE: BW / 50 mm				CASING DIA / LENGTH: 150 mm / 6.0 m							
HAMMER TYPE / SNO: Auto trip				CLIENT'S REP: [Signature]							
CAL. CHRT. NO. / DATE: N/A				DRILLER: MASUD SITE ENGINEER: Ravi							

Scale	Depth (m) (Thickness)	Legend	Description	Standard Penetration Test			SPT N (blows / 30cm)	SPT f ₆₀ (kN)	SPT f ₆₀ (kN)	SPT f ₆₀ (kN)	SPT f ₆₀ (kN)	SPT f ₆₀ (kN)	SPT f ₆₀ (kN)	Remarks
				1st 15cm	2nd 15cm	3rd 15cm								
	0													
	1	X SPT 01	Grey Loose silty fine SAND (fill)	1	1	6	7							Rec = 29cm
	2	X SPT 02	Grey Dense silty fine SAND with traces of shell fragments (fill)	7	20	22	42							Rec = 39cm
	3	X SPT 03	Grey Dense fine SAND with traces of shell fragments (fill)	8	17	23	40							Rec = 29cm
	4	X SPT 04	Grey Loose fine SAND with traces of shell fragments	3	4	5	9							Rec = 22cm
	5	X SPT 05	Grey medium dense silty fine SAND with traces of shell fragments	8	10	12	22							Rec = 40cm
	6	X SPT 06	Grey medium stiff sandy CLAY	2	2	3	5							Rec = 25cm
	7	X SPT 07	Grey medium stiff silty CLAY	0	2	3	5							Rec = 25cm
	8	UD 01	UD-01 sample taken from 8.0 - 9.0 m depth											UD-01 Rec = 82cm
	9	X SPT 08	Grey medium stiff silty CLAY	0	2	3	5							Rec = 31cm
	10													

Ground Instrumentation & Engineering

LEGEND:

▼ - Penetration Test (PMT)

⊗ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

⊞ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickwall Sample (OD)

▨ - Marier Sample (MZ)

▨ - Deason Sample (DS)

□ - Attempted (UD*), (GD*), (PS*), (MZ*) & (DS*)

■ - Plastic Sample (PS)

▨ - Core Run (CR)

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: <u>GIE WORKS for matarbari Power plant</u>						BORING LOG: <u>8H-03</u>					
CLIENT: <u>TEPSCO</u>			DRILL RIG MODEL: <u>PRD</u> RIG NO: <u>01</u>								
CONTRACTOR: <u>GIE</u>			BOREHOLE DIA: <u>150 mm</u>								
LOCATION: <u>Power Plant Area</u>			DIA: <u>N/A</u>								
DRILLING DATE: <u>11.02.2021</u>			DRILLING METHOD: <u>Rotary</u>			NORTHING: <u>2480612.00</u>					
DRILLING ROD TYPE / SIZE: <u>80/50 mm</u>			FLUSHING MEDIUM: <u>Water</u>			EASTING: <u>384904.00</u>					
HAMMER TYPE / SNO: <u>Auto trip</u>			CASING DIA / LENGTH: <u>150 mm / 6.9 m</u>			REDUCED LEVEL: <u>4.97</u>					
CAL CERT NO./DATE: <u>N/A</u>			DRILLER: <u>Masud</u> SITE ENGINEER: <u>Raza</u>			CLIENT'S REP: <u>[Signature]</u>			WL: <u>2.5 m</u>		

Scale	Depth (m) (Thickness)	Logical Type	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock			Core Log Classification	Remarks (Always Record Value from SPT) SPT: SPT Blows, Strength of soil also enter 20 SPT, 100 blow/s)
				1st 15cm	2nd 15cm	3rd 15cm		TCR (N)	UCS (N)	RQD (%)		
	10	X SPT 09	Grey medium stiff silty CLAY.	1	2	3	5					Rec = 36cm
	11	X SPT 10	Grey medium stiff silty CLAY.	2	3	5	8					Rec = 34cm
	12	UD 02	UD-02 sample taken from - 12.0 - 13.0 m depth									UD-02 Rec = 40cm
	13	X SPT 11	Grey medium dense silty SAND.	4	8	14	22					Rec = 32cm
	14	X SPT 12	Grey medium dense silty SAND.	10	12	13	25					Rec = 16cm <u>11.02.21</u> <u>13.02.21</u>
	15	X SPT 13	Grey medium dense silty SAND. with slightly clay	7	10	16	26					Rec = 19cm
	16	X SPT 14	Grey medium dense silty SAND with slightly clay.	6	8	12	20					Rec = 27cm
	17	MZ 01	MZ-01 sample taken from 17.0 + 18.0 m depth									MZ-01 Rec = 83cm
	18	X SPT 15	Grey very stiff clayey SPT with traces of sand	5	10	12	22					Rec = 22cm
	19	X SPT 16	Grey very dense silty SAND with laminated clay	8 15	17 15	33 13	50 28					Rec = 28cm
	20											



Geotechnical & Engineering

LEGEND:

▼ - Piezometer Test (PMT)

⊗ - Vane Shear Test (V)

⊙ - Permeability Test (PBT)

▨ - Packer Test (PCT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)
Open Drive Thruwall Sample (OD)

▨ - Mazier Sample (MZ)
Disturbance Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ - Plastic Sample (PS)

▨ - Core Run (CR)

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: GI WORKS for Matarbari Power Plant		DRILL RIG MODEL: PRD RIG NO: 01		BORING LOG: BH-03	
CLIENT: TEPSCO		BORING DIA: 150 mm			
CONTRACTOR: GIE		DIA: N/A			
LOCATION: Power Plant Area		DRILLING METHOD: Rotary		NORTHING: 2400612.00	
DRILLING DATE: 13.02.2021		FLUSHING MEDIUM: Water		EASTING: 384904.00	
DRILLING ROD TYPE / SIZE: BW / 50 mm		CASING DIA / LENGTH: 150 mm / 6.0 m		REDUCED LEVEL: 4.97	
HAMMER TYPE / SNO: Auto trip		CAL. CERT NO / DATE: N/A		DRILLER: Masud	
		SITE ENGR: RAB		CLIENT'S REP: [Signature]	
				WL: 2.5 m	

Scale	Depth (m) (Thickness)	Legend	Type & No	Description	Standard Penetration Test			SPT N Blows / 30 cm	Rock			Remarks (Always Record Water level during SPT. SPT blow counts, stringlines of and after every 30 SPT, 120 blow counts)
					1st 10 cm	2nd 10 cm	3rd 10 cm		TCR (%)	UCR (%)	SP (%)	
	20	X	SPT 17	Grey dense silty SAND with slightly CLAY.	13	23	14	37				Rec = 19cm
	21	X	SPT 18	Grey stiff clayey SILT with slightly sand.	4	5	8	13				Rec = 36cm
	22	X	SPT 19	Grey very dense silty SAND	15 15	34 15	16 4	50 19				Rec = 23cm
	23	X	SPT 20	Grey dense silty SAND	10	20	18	38				Rec = 21cm
	24	X	SPT 21	Grey very dense silty SAND.	16 15	42 15	8 4	50 19				Rec = 20cm
	25	X	SPT 22	Grey very dense silty SAND with traces of mica,	23 15	50 13	0 0	50 13				Rec = 17cm
	26	X	SPT 23	Light grey very dense silty SAND.	30 15	52 12	0 0	50 12				Rec = 15cm
	27	MZ	MZ 02	MZ-02 sample taken from 27.0-28.0m depth								MZ-02 Rec = 65cm
	28	X	SPT 24	Light Grey very dense silty SAND.	28 15	50 14	0 0	50 14				Rec = 18cm
	29	X	SPT 25	Light grey very dense silty SAND	32 15	50 14	0 0	50 14				13.02.21 14.02.21 Rec = 17cm



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Penetration Test (PMT)
- ⊕ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊞ - Packer Test (PKT)
- ⊠ - Standard Penetration Test (SPT)
- ▨ - Undisturbed Sample (UD)
- ▩ - Open Drive Thickwall Sample (OD)
- ▤ - Master Sample (MZ)
- ▥ - Decision Sample (DS)
- - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Pison Sample (PS)
- ▦ - TCR
- ▧ - Core Run (CR)
- ▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: <u>GIE Works for Malabar Power Plant</u>		DRILL ROD MODEL: <u>YWE</u> REG NO: <u>01</u>		BORING LOG:	
CLIENT: <u>TEPSCO</u>		BOREHOLE DIA: <u>150mm</u>		BH-04	
CONTRACTOR: <u>GIE</u>		DIA: <u>N/A</u>		NORTHING: <u>2400455.00</u>	
LOCATION: <u>Power Plant Area</u>		DRILLING METHOD: <u>Rotary</u>		EASTING: <u>984901.00</u>	
DRILLING DATE: <u>06-02-21</u>		FLUSHING MEDIUM: <u>Water</u>		REDUCED LEVEL: <u>4.192</u>	
DRILLING ROD TYPE / SIZE: <u>BW/50mm</u>		CASING DIA / LENGTH: <u>150 mm / 3.0 m</u>		WL: <u>2.0m</u>	
HAMMER TYPE / SNO: <u>Autotrip</u>		CAL CERT NO / DATE: <u>N/A</u>		DRILLER: <u>Jhargiri</u> SITE ENGR: <u>[Signature]</u> CLIENT'S REP: <u>[Signature]</u>	

Scale	Depth (m) (Thickness)	Log	Type & No	Description	Standard Penetration Test			SPT N Blows / 30cm	F ₁₅ (kN)	F ₃₀ (kN)	F ₄₅ (kN)	F ₆₀ (kN)	F ₇₅ (kN)	F ₉₀ (kN)	Remarks	
					1st 15cm	2nd 15cm	3rd 15cm									
	0															
	1	X	SPT 01	Grey dense silty fine SAND (fill)	5	13	19	32								Rec: 24cm
	2	X	SPT 02	Grey medium dense silty fine SAND (fill)	6	11	16	27								Rec: 24cm
	3	X	SPT 03	Grey medium dense silty fine SAND	5	6	7	13								Rec: 22cm
	4	X	SPT 04	Dark grey very soft silty CLAY	0	0	0	0								Rec: 33cm
	5	X	SPT 05	Dark grey very soft silty CLAY	0	0	0	0								Rec: 32cm
	6	X	SPT 06	Dark grey very soft silty CLAY	0	0	2	2								Rec: 35cm
	7		UD 01	UD-01 sample taken from 7.0m to 8.0m depth (Sample missed)												UD-01 Rec: 0.0cm
	8	X	SPT 07	Dark grey very soft silty CLAY	0	0	0									Rec: 33cm
	9		UD 02	UD-02 taken from 9.0m to 10.0m depth												UD-02 Rec: 80cm
	10															



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Penetration Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊞ - Packer Test (PKT)
- ⊗ - Standard Penetration Test (SPT)
- ⊞ - Undisturbed Sample (UD)
- ⊞ - Open Drive Thickwall Sample (OD)
- ⊞ - Master Sample (MZ)
- ⊞ - Division Sample (DS)
- - Anisotrop (UD*, OD*, PS*, MZ* & DS*)
- - Pore Sample (PS)
- - TCR
- - Core Box (CB)
- - BQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 12475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: <u>GIE works for Matarcbari Power Plant</u>										BORING LOG: <u>BH-04</u>	
CLIENT: <u>TEPSCO</u>					DRILL RIG MODEL: <u>YHE</u> RIG NO: <u>01</u>						
CONTRACTOR: <u>GIE</u>					BOREHOLE DIA: <u>150mm</u>					NORTHING: <u>2400455.00</u> EASTING: <u>384901.00</u> REDUCED LEVEL: <u>4.192</u> ▽ WL: <u>2.0m</u>	
LOCATION: <u>Power Plant Area</u>					DIA: <u>N/A</u>						
DRILLING DATE: <u>06.02.21</u>					DRILLING METHOD: <u>Rotary</u>					NORTHING: <u>2400455.00</u> EASTING: <u>384901.00</u> REDUCED LEVEL: <u>4.192</u> ▽ WL: <u>2.0m</u>	
DRILLING ROD TYPE / SIZE: <u>BW/50mm</u>					FLUSHING MEDIUM: <u>Water</u>						
HAMMER TYPE / SNG: <u>Auto trip</u>					CASING DIA / LENGTH: <u>150 mm / 3.0 m</u>					NORTHING: <u>2400455.00</u> EASTING: <u>384901.00</u> REDUCED LEVEL: <u>4.192</u> ▽ WL: <u>2.0m</u>	
CAL. CERT NO / DATE: <u>N/A</u>					DRILLER: <u>Jahangir</u> SITE ENGR: <u>ABD</u> CLIENT'S REP: <u>ABD</u>						

Depth (m) (Thickness)	Legend	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock			Geological Classification	Remarks (Notes about blow count, SPT, SPT blow count, blow count at 10m, etc.)
			1st 10cm	2nd 10cm	3rd 10cm		TCF (%)	SCF (%)	RQD (%)		
10	SPT 08	Dark grey clayey SAND with slightly silt	1	2	3	5					Rec: 27cm
11	SPT 09	Grey medium dense silty SAND	7	10	17	27					Rec: 31cm
12	SPT 10	Grey medium dense silty SAND	4	7	10	17					Rec: 30cm
13	SPT 11	Grey medium dense silty SAND	6	9	13	22					Rec: 25cm
14	SPT 12	Grey medium stiff clayey SILT with slightly sand	2	2	4	6					Rec: 28cm
15	SPT 13	Grey loose clayey SAND with slightly silt	2	3	7	10					Rec: 30cm
16	SPT 14	Grey medium dense clayey SAND with slightly silt	5	5	7	12					Rec: 24cm
17	SPT 15	Grey medium dense silty fine SAND	2	7	15	22					Rec: 30cm
18	SPT 16	Grey medium dense silty fine SAND	9	11	15	26					Rec: 30cm
19	SPT 17	Grey medium dense silty fine SAND	9	10	14	24					Rec: 27cm
20											



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Piezometer Test (PMT)
- ⊙ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊢ - Jack Test (PBT)
- ⊠ - Standard Penetration Test (SPT)
- ⊡ - Undisturbed Sample (UD)
- ⊢ - Open Drive Thickwall Sample (OD)
- ⊣ - Master Sample (MZ)
- ⊤ - Division Sample (DS)
- - Annotated (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Photo Sample (PS)
- ▨ - Core Run (CR)
- ▩ - RQD
- - TCR

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: GIE Works for Malabar Power Plant		CLIENT: TEPSCO		DRILL LOG MODEL: YWE		REG NO: 01	
CONTRACTOR: GIE		BOREHOLE DIA: 150mm		DIA: N/A		BORING LOG: BH-04	
LOCATION: Power Plant Area		DRILLING DATE: 07.02.21		DRILLING METHOD: Rotary		NORTHING: 2400455.00	
DRILLING ROD TYPE / SIZE: B2/50mm		FLUSHING MEDIUM: Water		EASTING: 384901.00		REDUCED LEVEL: 4.192	
HAMMER TYPE / SNO: Auto Strip		CASING DIA / LENGTH: 150 mm / 03		CLIENT'S REP: [Signature]		WL: 2.40m	
CAL. CRT. NO. / DATE: N/A		DRILLER: [Signature]		SITE ENG: [Signature]			

Depth (m) (Thickness)	Log	Type & No.	Description	Standard Penetration Test			SPT Blows / 30cm	Rock	Remarks
				1st 15cm	2nd 15cm	3rd 15cm			
20	SPT 18		Grey hard silty CLAY	9	15	27	42		Rec: 33cm
21	SPT 19		Grey hard clayey SILT	13/15	23/15	27/15	50/28		Rec: 22cm
22	SPT 20		Grey hard clayey SILT	11/15	21/15	29/15	50/27		Rec: 30cm
23	SPT 21		Grey hard sandy SILT	14/15	23/15	27/15	50/25		Rec: 29cm
24	SPT 22		Grey hard sandy SILT	16/15	29/15	22/15	50/21		↑ 06.02.21 07.02.21 ↓ Rec: 26cm
25	SPT 23		Grey hard clayey SILT	24/15	41/15	9/12	50/17		Rec: 36cm
26									
27									
28									
29									
30									



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Penetration Test (PMT)
- ⊙ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ▨ - Packer Test (PKT)
- ⊠ - Standard Penetration Test (SPT)
- ▨ - Undisturbed Sample (UD)
- ▨ - Open Drive Thickwall Sample (OD)
- ▨ - Mazur Sample (MZ)
- ▨ - Denison Sample (DS)
- - Attenuated (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Penon Sample (PS)
- ▨ - Core Box (CR)
- ▨ - TCR
- ▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: <u>GIE works for Maturbani Power Plant</u>		CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>YWE</u>	RIG NO: <u>02</u>	BORING LOG: <u>BH-05</u>	
CONTRACTOR: <u>GIE</u>		BORINGHOLE DIA: <u>100 mm</u>		DIA: <u>N/A</u>			
LOCATION: <u>Power Plant Area</u>		DRILLING DATE: <u>16.02.21</u>		DRILLING METHOD: <u>Rotary</u>		NORTHING: <u>2400617.08</u>	
DRILLING ROD TYPE / SIZE: <u>BW/50mm</u>		FLUSHING MEDIUM: <u>Water</u>		EASTING: <u>384596.00</u>		REDUCED LEVEL: <u>4.332</u>	
HAMMER TYPE / SNO: <u>Auto Grip</u>		CASING DIA / LENGTH: <u>100 mm / 6.0 m</u>		CLIENT'S REP: <u>[Signature]</u>		WL: <u>4.0m</u>	
CAL CURT NO/DATE: <u>N/A</u>		DRILLER: <u>Jahangir</u>		SITE ENGINEER: <u>[Signature]</u>			

Depth (m) (Thickness)	Legend	Type & No	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock				Geological Classification	Remarks (Give Shortest Water level during SPT, SPT blowcount, stratification of soil after every 30 SPT, 0/1 blowcount)
				1st 10cm	2nd 10cm	3rd 10cm		UC (N)	OC (N)	MP (N)	RP (N)		
0													
1	X	SPT 01	Grey very soft silty CLAY with lamination of sand (fs11)	0	0	0	0						Rec: 20cm
2	X	SPT 02	Grey very soft clayey SILT (fs11)	0	1	1	2						Rec: 16cm
3	UD	UD 01	UD-01 sample taken from 3.0m to 4.0m depth										UD-01 Rec: 70cm
4	X	SPT 03	Grey medium dense silty fine SAND	5	7	9	16						Rec: 28cm
5	X	SPT 04	Grey very soft silty CLAY with traces of organic compound.	0	0	0	0						Rec: 34cm
6	X	SPT 05	Grey very soft silty CLAY	0	0	0	0						Rec: 36cm
7	UD	UD 02	UD-02 sample taken from 7.0m to 8.0m depth										UD-02 Rec: 62cm
8	X	SPT 06	Grey very soft silty CLAY with traces of organic compound	0	0	0	0						Rec: 33cm
9	X	SPT 07	Grey very soft clayey SILT	0	0	0	0						Rec: 33cm
10													



LEGEND:

- ▼ - Penetration Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊗ - Packer Test (PKT)
- ⊗ - Standard Penetration Test (SPT)
- UD - Undisturbed Sample (UD)
- OD - Open Drive Thackwell Sample (OD)
- MZ - Moisture Sample (MZ)
- DS - Density Sample (DS)
- - Attempted (UD*, OD*, PS*, MG* & DS*)
- - Piston Sample (PS)
- - TCR
- - Core Box (CB)
- - RQD

Ground Instrumentation & Engineering

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: <u>G.I Works</u>				DRILL RIG MODEL: <u>YWE</u> RID NO: <u>02</u>				BORING LOG: <u>BH-05</u>			
CLIENT: <u>TEPSCO</u>				BORING DIA: <u>100mm</u>							
CONTRACTOR: <u>GIE</u>				DIA: <u>N/A</u>							
LOCATION: <u>Power Plant Area</u>				DRILLING METHOD: <u>Rotary</u>				NORTHING: <u>260067.00</u>			
DRILLING DATE: <u>16.02.21</u>				FLUSHING MEDIUM: <u>Water</u>				EASTING: <u>394596.00</u>			
DRILLING ROD TYPE / SIZE: <u>BW/50m</u>				CASING DIA / LENGTH: <u>100</u> mm / <u>6.0</u> m				REDUCED LEVEL: <u>4.392</u>			
HAMMER TYPE / SNO: <u>AutoStrip</u>				CLIENT'S REP: <u>[Signature]</u>				WL: <u>4.0m</u>			
CAL. CERT NO / DATE: <u>N/A</u>				DRILLER: <u>Johanna</u> SITE ENGINEER: <u>[Signature]</u>							

Depth (m)	Type & No	Description	Standard Penetration Test			SPT N	Blow / Min	Back	Remarks
			1st	2nd	3rd				
10	08	Grey very soft silty CLAY	0	0	2	2			Rec: 36cm
11	03	UD-03 taken from 11.0m to 12.0m depth							UD-03 Rec: 94cm
12	09	Grey soft clayey SILT with lamination of sand	1	1	2	3			Rec: 35cm
13	10	Grey very soft sandy SILT with lamination of clay	0	1	1	2			Rec: 41cm
14	11	Grey medium stiff sandy SILT with slightly clay	2	3	4	7			Rec: 42cm
15	12	Grey medium stiff sandy SILT with slightly clay	2	2	3	5			Rec: 30cm
16	13	Grey loose clayey SAND	1	1	4	5			Rec: 43cm
17	14	Grey medium dense silty fine SAND	5	8	12	20			Rec: 25cm
18	15	Grey medium dense silty fine SAND	12	14	18	32			Rec: 20cm
19	16	Grey very dense silty fine SAND	18	37	19	50			Rec: 22cm
20									

Ground Instrumentation & Engineering

LEGEND:

▼ - Penetration Test (PMT)

⊗ - Vane Shear Test (V)

⊙ - Penetration Test (PBT)

▨ - Packer Test (PKT)

⊠ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickwall Sample (OD)

▨ - Marier Sample (MS)

▨ - Distress Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MS*) & (DS*)

■ - Piston Sample (PS)

▨ - Core Run (CR)

▨ - RQD

▨ - TCR

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: <u>GIE works for Malabar Power Plant</u>		CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>YWE</u>	RIG NO: <u>02</u>	BORING LOG: <u>BH-05</u>	
CONTRACTOR: <u>GIE</u>		BOREHOLE DIA: <u>100mm</u>		DIA: <u>N/A</u>			
LOCATION: <u>Power Plant Area</u>		DRILLING DATE: <u>17.02.21</u>		DRILLING METHOD: <u>Rotary</u>		NORTHING: <u>2400617.00</u>	
DRILLING ROD TYPE / SIZE: <u>BW/50mm</u>		FLUSHING MEDIUM: <u>Water</u>		EASTING: <u>384596.00</u>		REDUCED LEVEL: <u>4.932</u>	
HAMMER TYPE / SNO: <u>Auto drop</u>		CASING DIA / LENGTH: <u>100 mm / 6.0 m</u>		CLIENT'S REP: <u>[Signature]</u>		WL: <u>5.0m</u>	
CAL. CERT NO / DATE: <u>N/A</u>		DRILLER: <u>Jahangir</u>		SITE ENGR: <u>[Signature]</u>			

Scale	Depth (m)	Legend	Type of No	Description	Standard Penetration Test			SPT N	17.02.21			Remarks
					1st 30cm	2nd 30cm	3rd 30cm		1st 30cm	2nd 30cm	3rd 30cm	
	20	X	SPT 17	Grey very dense silty fine SAND	90 15cm	50 15cm	0 0cm	50 120cm				Rec: 18cm
	21	X	SPT 18	Grey very dense silty fine SAND	14	22	28	50				Rec: 28cm ↑ 16.02.21 ↓ 17.02.21
	22	X	SPT 19	Grey very dense silty fine SAND	12	21	29	50 88cm				Rec: 32cm
	23	X	SPT 20	Grey very dense silty fine SAND with lamination of clay	17	50	0	50 15cm				Rec: 28cm
	24											
	25											
	26											
	27											
	28											
	29											
	30											



Ground Instrumentation & Engineering

LEGEND:

- ▼ - Penetration Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊞ - Packer Test (PKT)
- ⊞ - Standard Penetration Test (SPT)
- ▨ - Undisturbed Sample (UD)
- ▨ - Open Drive Thickwall Sample (OD)
- ▨ - Master Sample (MZ)
- ▨ - Disturbance Sample (DS)
- - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Piston Sample (PS)
- - Core Run (CR)
- - TCR
- - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: GIE WORKS for matarbari Power plant		CLIENT: TEPSCO		DRILL LOG MODEL: PRD	LOG NO: 01	BORING LOG: BH-06	
CONTRACTOR: GIE		BORING LOG DIA: 150 mm		DIA: N/A			
LOCATION: Power plant Area		DRILLING DATE: 08.02.2021		DRILLING METHOD: Rotary		NORTHING: 2400493.00	
DRILLING ROD TYPE / SIZE: BW / 50 mm		FLUSHING MEDIUM: Water		EASTING: 384316.00		REDUCED LEVEL: 7.179	
HAMMER TYPE / S/N: Autotap		CASING DIA / LENGTH: 150 mm / 6.0 m		SITE EPGR: (R)		CLIENT'S REP: (H)	
CAL. CERT. NO. / DATE: N/A		DRILLER: Masud		W.L. 2.20 m			

Depth (m) (ft)	Logical Type & dia	Description	Standard Penetration Test			SPT N Blows / 30cm	F ₁₅₀ (kN)	F ₁₅₀ (kN)	F ₁₅₀ (kN)	Geological Classification	Remarks (Always Record Water level during SPT. SPT blow count, Standard penetration test value more than 30 SPT, 100 Blows)
			1st 10cm	2nd 10cm	3rd 10cm						
0											
1	X SPT 01	Grey very loose silty fine SAND with traces of shell fragments. (fill)	1	1	1	2					Ree = 24cm
2	X SPT 02	Grey very loose silty fine SAND with traces of shell fragments (fill)	1	1	2	3					Ree = 29cm
3	X SPT 03	Grey Loose silty fine SAND (fill)	2	2	3	5					Ree = 18cm
4	X SPT 04	Grey very loose silty fine SAND with slightly clay. (fill)	0	1	2	3					Ree = 25cm
5	X SPT 05	Light brown medium dense silty fine SAND with traces of mica. (fill)	4	5	7	12					Ree = 29cm
6	X SPT 06	Light brown dense fine SAND with traces of mica. (fill)	7	16	16	32					Ree = 22cm
7	X SPT 07	Brown medium stiff silty CLAY.	2	2	4	6					Ree = 23cm
8	UD 01	UD-01 sample taken from 8.0-9.0 m depth									UD-01 Ree = 80cm
9	X SPT 08	Dark grey very soft silty CLAY	0	0	0	0					Ree = 30cm
10											



Ground Investigation & Engineering

LEGEND:

- ▼ - Penetration Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊗ - Packer Test (PCT)
- ⊗ - Standard Penetration Test (SPT)
- ⊗ - Unaltered Sample (UD)
- ⊗ - Open Drive Thickwall Sample (OD)
- ⊗ - Master Sample (MZ)
- ⊗ - Disturbance Sample (DS)
- ⊗ - Anemometer (UD*), (OD*), (PS*), (MZ*) & (DS*)
- ⊗ - Piers Sample (PS)
- ⊗ - Core Box (CB)
- ⊗ - RQD
- ⊗ - TCR

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: <u>GIE WORKS for mafarbari Power plant</u>		CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>REG NO: 01</u>	BORING LOG: <u>BH-06</u>
CONTRACTOR: <u>GIE</u>		BOREHOLE DIA: <u>150 mm</u>			
LOCATION: <u>Power plant Area</u>		DIA: <u>N/A</u>			
DRILLING DATE: <u>08.02.2021</u>		DRILLING METHOD: <u>Rotary</u>		NORTHING: <u>2400493.00</u>	
DRILLING ROD TYPE / SIZE: <u>BW / 50mm</u>		FLUSHING MEDIUM: <u>Water</u>		EASTING: <u>389916.00</u>	
HANDIER TYPE / SNG: <u>Auto trip</u>		CASING DIA / LENGTH: <u>150 mm / 6.9 m</u>		REDUCED LEVEL: <u>7.179</u>	
CAL. CHRT. NO / DATE: <u>N/A</u>		DRILLER: <u>masih</u>		SITE ENGR: <u>(Signature)</u> CLIENT'S REP: <u>(Signature)</u> WL: 9.0 m	

Bore No.	Depth (m)	Logical Type & No.	Description	Standard Penetration Test			SPT N (blows / 30cm)	Rock	Casing Depth (m)	Remarks
				1st	2nd	3rd				
10		UD 02	UD-02 sample taken from 10.0 - 11.0 m depth							UD-02 Rec = 90cm
11		SPT 09	Dark grey very soft silty CLAY.	1	1	1	2			Rec = 29cm ↑ 08.02.21 09.02.21
12		SPT 10	Grey very soft silty CLAY	1	1	1	2			Rec = 36cm
13		SPT 11	Grey soft silty CLAY	1	1	2	3			Rec = 29cm
14		UD 03	UD-03 sample taken from 14.0 to 15.0 m depth							UD-03 Rec = 85cm
15		SPT 12	Grey medium stiff silty CLAY.	2	3	3	6			Rec = 24cm
16		SPT 13	Grey medium dense silty SAND with slightly clay.	6	6	7	13			Rec = 19cm
17		SPT 14	Grey very dense silty SAND with traces of mica.	11 15	21 15	29 14	50 29			Rec = 25cm
18		SPT 15	Grey very dense silty SAND.	14 15	24 15	26 14	50 29			Rec = 23cm
19		SPT 16	Grey medium dense silty SAND with slightly clay.	6	16	11	27			Rec = 22cm
20										

Ground Instruments & Engineering

LEGEND:

▼ - Piezometer Test (PMT)

⊗ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

▨ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickwall Sample (OD)

▨ - Moisture Sample (MZ)

▨ - Disturbance Sample (DS)

□ - Annotated (UD*, OD*, PS*, MZ* & DS*)

▨ - Pison Sample (PS)

▨ - Core Run (CR)

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: <u>G.I. Works for Matarabari Power Plant</u>				BORING LOG: <u>BH-06</u>			
CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>PRD</u>		RIG NO: <u>01</u>			
CONTRACTOR: <u>GIE</u>		BOREHOLE DIA: <u>150 mm</u>					
LOCATION: <u>Power Plant Area</u>		DIA: <u>N/A</u>					
DRILLING DATE: <u>09.02.2021</u>		DRILLING METHOD: <u>Rotary</u>				NORTHING: <u>2450493.08</u>	
DRILLING ROD TYPE / SIZE: <u>BW 150 mm</u>		FLUSHING MEDIUM: <u>Water</u>				EASTING: <u>384316.08</u>	
HAMMER TYPE / SNO: <u>Autotrip</u>		CASING DIA / LENGTH: <u>150 mm / 6.0 m</u>				REDUCED LEVEL: <u>7.179</u>	
CAL. CHRT. NO / DATE: <u>N/A</u>		DRILLER: <u>Magud</u>		SITE ENGR: <u>Raja</u>		CLIENT'S REP: <u>GIE</u>	
						WL: <u>3.0 m</u>	

Bore	Depth (m)	Log	Type & No.	Description	Standard Penetration Test			SPT N (blows / 30cm)	Soil			Geological Classification	Remarks
					1st 15cm	2nd 15cm	3rd 15cm		Gr (%)	Si (%)	LP (%)		
20	17	X	SPT	Grey Loose Silty SAND with slightly clay	2	2	4	6					Rec = 30cm
21	18	X	SPT	Grey medium dense silty SAND.	5	7	15	22					Rec = 20cm
22	19	X	SPT	Grey medium dense silty SAND.	2	2	9	11					Rec = 44cm
23	20	X	SPT	Grey medium dense silty SAND.	2	8	8	16					Rec = 22cm
24	21	X	SPT	Grey hard sandy SILT.	11/15	23/15	27/12	50/27					Rec = 25cm
25	22	X	SPT	Grey hard sandy SILT.	16/15	33/15	17/7	50/22					Rec = 26cm
26	23	X	SPT	Grey hard sandy SILT.	12/16	24/15	26/11	50/26					Rec = 30cm ↑ 09.02.21 10.02.21 ↓
27	24	X	SPT	Grey hard sandy SILT	10/15	21/15	29/13	50/28					Rec = 31cm
28	25	X	SPT	Grey hard sandy SILT	17/15	34/15	16/7	50/22					Rec = 25cm
29													
30													

Ground Instrumentation & Engineering

LEGEND:

▼ - Penetration Test (PMT)

⊗ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

▨ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Throat Sample (OD)

▨ - Moisture Sample (MZ)

▨ - Disturbance Sample (DS)

□ - Attempted (UD*, IOD*, PS*, MZ* & DS*)

▨ - Pore Sample (PS)

▨ - Core Box (CR)

▨ - BQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: GI Works for mazarbati Power Plant				CLIENT: TERSCO				DRILL RIG MODEL: PRD RIG NO.: 01				BORING LOG:			
CONTRACTOR: GIE				BOREHOLE DIA: CORE: 150mm				DIA: N/A				BH-07			
LOCATION: Power Plant Area				DRILLING DATE: 18.02.2021				DRILLING METHOD: Rotary				NORTHING: 2400624.00			
DRILLING ROD TYPE / SIZE: BW / 50mm				FLUSHING MEDIUM: Water				EASTING: 384147.00				REDUCED LEVEL: 6.774			
HAMMER TYPE / SNO: Auto trip				CASING DIA / LENGTH: 150 mm / 6.0 m				WL: 4.5 m							
CAL CERT NO / DATE: N/A DRILLER: masud				SITE ENGR: Raza				CLIENT'S REP: [Signature]							

Scale	Depth (m) (Thickness)	Legend	Type & No	Description	Standard Penetration Test			SPT N Blows / 30cm	Thick			Geological Classification	Remarks (If water observed, state depth during SPT. SPT blow count, description of soil and other tests (SPT, LPT, Recovery))
					1st Bls	2nd Bls	3rd Bls		TS (s)	CS (s)	VS (s)		
	0												
	1		SPT 01	Light brown medium dense silty SAND. (fill)	5	8	9	17					Rec = 24cm
	2		SPT 02	Light brown medium dense silty SAND. (fill)	5	8	10	18					Rec = 21cm
	3		SPT 03	Light brown medium dense silty SAND with traces of shell fragments (fill)	3	5	6	11					Rec = 23cm
	4		SPT 04	Light brown loose silty SAND with traces of shell fragments (fill)	3	5	5	10					Rec = 27cm
	5		SPT 05	Brownish grey dense silty SAND. (fill)	9	17	17	34					Rec = 31cm
	6		SPT 06	Grey loose silty SAND with slightly clay.	1	2	4	6					Rec = 24cm
	7		SPT 07	Yellowish brown to grey medium stiff CLAY with slightly sand.	2	3	4	7					Rec = 22cm
	8		SPT 08	Grey very soft silty CLAY.	0	0	2	2					Rec = 36cm
	9		UD 01	UD-01 sample taken from 9.0 - 10.0 m depth.									UD-01 Rec = 80cm
	10												

Ground Instrumentation & Engineering

LEGEND:

- Penetration Test (PMT)

- Vane Shear Test (V)

- Permeability Test (PBT)

- Packer Test (PCT)

- Standard Penetration Test (SPT)

- Undisturbed Sample (UDS)
Open Drive Thawed Sample (ODS)

- Moisture Sample (MS)
Disturbance Sample (DS)

- Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

- Piston Sample (PS)

- Core Run (CR)

- RQD

*WL - Ground Water Level observed from Borehole (BCL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: GIE WORKS FOR MATARBARA POWER PLANT		CLIENT: TEPSCO		DRILL RIG MODEL: PRD RIG NO: 01		BORING LOG: BH-07	
CONTRACTOR: GIE		BOREHOLE DIA: CORE: 150 mm		DIA: N/A			
LOCATION: Power Plant Area		DRILLING DATE: 18.02.2021		DRILLING METHOD: Rotary		NORTHING: 2400624.00	
DRILLING ROD TYPE / SIZE: BW / 50 mm		FLUSHING MEDIUM: WATER		EASTING: 384147.00		REDUCED LEVEL: 6.774	
HAMMER TYPE / SNO: Auto Trip		CASING DIA / LENGTH: 150 mm / 6.0 m		CLIENT'S REP: 20.02.21		WL: 6.0 m	
CAL CERT NO / DATE: N/A		DRILLER: MABUD		SITE ENGR: (Rock)			

Depth (m)	Lithology	Description	Standard Penetration Test			SPT N	Rock			Remarks
			1st 15cm	2nd 15cm	3rd 15cm		TC (G)	IC (G)	UC (G)	
10	SPT 09	Grey very soft silty CLAY. with traces of sand.	0	0	0	0				Rec = 39 cm
11	SPT 10	Grey loose clayey SAND.	1	3	5	8				Rec = 23 cm
12	SPT 11	Grey dense silty SAND.	12	12	23	35				Rec = 25 cm
13	SPT 12	Grey medium dense silty SAND with slightly clay.	4	5	10	15				Rec = 23 cm
14	SPT 13	Grey dense silty SAND.	15	20	21	41				Rec = 20 cm
15	SPT 14	Grey dense silty SAND.	12	18	27	45				Rec = 25 cm
16	SPT 15	Grey Medium dense silty SAND.	10	12	12	24				Rec = 20 cm
17	SPT 16	Grey medium dense silty SAND.	7	13	14	27				Rec = 19 cm
18	SPT 17	Grey very dense silty fine SAND	21	40	10	50				Rec = 19 cm 18.02.21 20.02.21
19	SPT 18	Grey very dense silty fine SAND.	17	38	12	50				Rec = 17 cm
20										



LEGEND:

- ▼ - Piezometer Test (PMT)
- ⊗ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ⊗ - Packer Test (PKT)
- ⊗ - Standard Penetration Test (SPT)
- ⊗ - Undisturbed Sample (UD)
- ⊗ - Open Drive Thinwall Sample (OD)
- ⊗ - Matrix Sample (MZ)
- ⊗ - Disturb Sample (DS)
- - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Push Sample (PS)
- - Core Box (CB)
- - TCR
- - RQD

Ground Instrumentation & Engineering

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: <u>GIE Works for matarbarri Power Plant</u>				BORING LOG: <u>BH-07</u>			
CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>PRD</u> RIG NO: <u>01</u>					
CONTRACTOR: <u>GIE</u>		BOREHOLE DIA: CORE <u>150 mm</u>					
LOCATION: <u>Power plant Area</u>		DIA: <u>N/A</u>					
DRILLING DATE: <u>20/02/2021</u>		DRILLING METHOD: <u>Rotary</u>					
DRILLING ROD TYPE / SIZE: <u>BW/ 50 mm</u>		FLUSHING MEDIUM: <u>Water</u>		NORTHING: <u>2450624.62</u>			
HAMMER TYPE / SNO: <u>Auto-rip</u>		CASING DIA / LENGTH: <u>150 mm / 6.01 m</u>		EASTING: <u>384147.00</u>			
CAL. CERT NO. / DATE: <u>N/A</u>		DRILLER: <u>MASUD</u>		SITE UNGR: <u>Road</u>		CLIENT'S REF: <u>2450.02</u>	
REDUCED LEVEL: <u>6.774</u>		WL: <u>6.0 m</u>					

Depth (m)	Type of log	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock			Geological Classification	Remarks (Always Record Water level during SPT, NPT Recovery, Sample type and after every 10 SPT, 100 blow count)
			1st 15cm	2nd 15cm	3rd 15cm		20 (ft)	30 (ft)	40 (ft)		
20	SPT 19	Grey very dense silty fine SAND.	35 15	50 12	0 0	50 12					Rec=18cm
21	MZ 01	MZ-01 sample taken from 21.0 - 22.0 m depth									MZ-01 Rec=58cm
22	SPT 20	Grey very dense silty fine SAND.	20 15	31 15	19 8	50 23					Rec=23cm
23	SPT 21	Grey very dense silty fine SAND.	15 15	28 15	22 9	50 24					Rec=18cm
24											
25											
26											

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LEGEND:

▼ - Piezometer Test (PMT)

⊗ - Vane Shear Test (V)

⊙ - Permeability Test (PMT)

▨ - Packer Test (PKT)

⊠ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thick-wall Sample (OD)

▨ - Marker Sample (MZ)

▨ - Denom Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ - Photo Sample (PS)

▨ - Core Run (CR)

▨ - YCR

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 01 of 03

PROJECT: <u>GIE Works for Malabar Power Plant</u>				BORING LOG: <u>BH-08</u>			
CLIENT: <u>TEPSCO</u>		DRILL RIG MODEL: <u>YWE</u> RIG NO: <u>02</u>					
CONTRACTOR: <u>GIE</u>		BOREHOLE DIA: <u>100mm</u>					
LOCATION: <u>Power Plant Area</u>		DIA: <u>N/A</u>		NORTHING: <u>2400763.00</u>			
DRILLING DATE: <u>18.02.21</u>		DRILLING METHOD: <u>Rotary</u>		EASTING: <u>383978.00</u>			
DRILLING ROD TYPE / SIZE: <u>BW/50mm</u>		FLUSHING MEDIUM: <u>Water</u>		REDUCED LEVEL: <u>5.885</u>			
HAMMER TYPE / SNO: <u>Autostrp</u>		CASING DIA / LENGTH: <u>100 mm / 6.0 m</u>		WL: <u>4.0m</u>			
CAL CURT NO / DATE: <u>N/A</u> DRILLER: <u>Jahangir</u> SITE ENGR: <u>Abdullah</u> CLIENT'S REP: <u>Abdullah</u>							

Depth (m) (Chisano)	Legend	Type & No	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock			Geological Classification	Remarks (Always Record Penetration during SPT, NPT blow count, blow count or test also every 10 SPT, 10 blow count)
				1st 10cm	2nd 10cm	3rd 10cm		TCR (%)	QCR (%)	RQD (%)		
0												
1	X	SPT 01	Brownish grey medium dense SAND with rubbish (fill)	5	6	7	13					Rec: 83cm
2	X	SPT 02	Brownish grey loose SAND with rubbish (fill)	1	2	3	5					Rec: 35cm
3	X	SPT 03	Brownish grey very loose silty fine to medium SAND with shell fragments (fill)	0	0	1	1					Rec: 28cm
4	X	SPT 04	Grey medium dense silty fine to medium SAND (fill)	7	9	10	19					Rec: 18cm
5	X	SPT 05	Grey very soft silty CLAY	0	1	1	2					Rec: 34cm
6	X	SPT 06	Reddish brownish grey silty CLAY	2	3	5	8					Rec: 26cm
7	X	SPT 07	Brownish grey silty CLAY	1	2	2	4					Rec: 29cm
8	X	SPT 08	Grey medium dense silty SAND	8	14	11	25					Rec: 23cm
9	X	SPT 09	Grey soft sandy CLAY	1	1	2	3					Rec: 37cm
10												

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LEGEND:

▼ - Penetration Test (PMT)

⊕ - Vane Shear Test (V)

⊗ - Permeability Test (PMT)

▨ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickwall Sample (OD)

▨ - Marier Sample (MZ)

▨ - Denison Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ - Pluton Sample (PS)

▨ - Core Run (CR)

▨ - RQD

*WL - Ground Water Level observed from Borehole (BGL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 02 of 03

PROJECT: GI works for Matarbani Power Plant		CLIENT: TEPSCO		DRILL RIG MODEL: YWE		RIG NO: 02		BORING LOG: BH-08	
CONTRACTOR: GIE		BORTHOLI DIA: 100mm		DIA: N/A					
LOCATION: Power Plant Area		DRILLING DATE: 18.02.21		DRILLING METHOD: Rotary				NORTHING: 2400763.00	
DRILLING ROD TYPE / SIZE: B6/50mm		FLUSHING MEDIUM: Water						EASTING: 383978.00	
HAMMER TYPE / SNO: Autotrip		CASING DIA / LENGTH: 100 mm / 6.0 m						REDUCED LEVEL: 5.885	
CAL. CERT NO / DATE: N/A		DRILLER: Jahangir STEELER: 200		CLIENT'S REP: 18.02.21				WL: 4.0m	

Depth (m) (Thickness)	Legend	Type & No	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock			Geological Classification	Remarks (Always Record Water level during SPT. SPT Recovery, (Integrity of soil after every 30 SPT, (30 Blows))
				1st 15cm	2nd 15cm	3rd 15cm		TCR (%)	UCR (%)	RCR (%)		
10	X	SPT 10	Grey medium dense silty fine SAND	5	13	16	29					Rec: 28cm
11	X	SPT 11	Grey medium dense silty fine SAND	8	8	14	22					Rec: 25cm
12	X	SPT 12	Grey medium dense silty fine SAND	7	11	13	24					Rec: 24cm
13	X	SPT 13	Grey dense silty fine SAND	12	12	19	31					Rec: 28cm
14	X	SPT 14	Grey medium dense silty fine to medium SAND	5	6	17	23					Rec: 35cm
15	X	SPT 15	Grey dense silty fine SAND	12	17	20	37					Rec: 24cm ↑ 18.02.21 20.02.21 ↓
16	X	SPT 16	Grey dense silty fine SAND	12	14	18	32					Rec: 20cm
17	X	SPT 17	Grey dense silty SAND with clay lamination	6	10	23	33					Rec: 31cm
18	X	SPT 18	Grey very dense silty fine SAND	14 12	28 18	22 18	50 27cm					Rec: 21cm
19	X	SPT 19	Grey very dense silty fine SAND	11 12	41 18	9 5cm	50 20cm					Rec: 18cm
20												



LEGEND:

- ▼ - Penetration Test (PAT)
- ⊕ - Vane Shear Test (V)
- ⊗ - Permeability Test (PBT)
- ▨ - Packer Test (PKT)
- ⊠ - Standard Penetration Test (SPT)
- ▨ - Undisturbed Sample (UD)
- ▨ - Open Drive Thickwall Sample (OD)
- ▨ - Marine Sample (MZ)
- ▨ - Disturb Sample (DS)
- - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)
- - Piston Sample (PS)
- ▨ - TCR
- ▨ - Core Run (CR)
- ▨ - RQD

Ground Instrumentation & Engineering

*WL - Ground Water Level observed from Borehole (BCL)

FIELD LOG (ISO 22475-1:2006)

GIE Project ID: SI

Sheet 03 of 03

PROJECT: <u>GIE Works for Malankara Power Plant</u>						BORING LOG: <u>BH-08</u>	
CLIENT: <u>TEPSCO</u>			DRILL RIG MODEL: <u>YWE</u> RIG NO: <u>02</u>				
CONTRACTOR: <u>GIE</u>			BOREHOLE DIA: <u>600</u> mm				
LOCATION: <u>Power Plant Area</u>			DIA: <u>N/A</u>				
DRILLING DATE: <u>20.02.21</u>			DRILLING METHOD: <u>Rotary</u>				
DRILLING ROD TYPE / SIZE: <u>DN/50mm</u>			FLUSHING MEDIUM: <u>Water</u>			NORTHING: <u>2400763.00</u>	
HAMMER TYPE / SNO: <u>Autotrip</u>			CASING DIA / LENGTH: <u>100</u> mm / <u>6.0</u> m			EASTING: <u>383978.00</u>	
CAL CERT NO / DATE: <u>N/A</u>			DRILLER: <u>Jahangir</u> SITE ENGR: <u>AB</u>			REDUCED LEVEL: <u>5.885</u>	
			CLIENT'S REP: <u>20.02.21</u>			WL: <u>5.0m</u>	

Depth (m) (Thickness)	Log Type & No	Description	Standard Penetration Test			SPT N Blows / 30cm	Rock			Remarks (Always Record Water level during SPT, SPT Blows, Penetration of rod after every 30 SPT, (OD) Blows)
			1st 15cm	2nd 15cm	3rd 15cm		TCR (%)	UCR (%)	RQD (%)	
20	☒ SPT 20	Grey very dense silty fine SAND	16 15cm	23 15cm	27 15cm	50 27cm				Rec: 24cm
21	☒ SPT 21	Grey very dense silty fine SAND	20 15cm	36 15cm	14 6cm	50 21cm				Rec: 21cm
22	☒ SPT 22	Grey very dense silty fine SAND	28 15cm	50 15cm	0 0cm	50 19cm				Rec: 19cm
23										
24										
25										
26										
27										
28										
29										
30										

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LEGEND:

▼ - Piezometer Test (PMT)

⊗ - Vane Shear Test (V)

⊗ - Permeability Test (PBT)

▨ - Packer Test (PKT)

⊗ - Standard Penetration Test (SPT)

▨ - Undisturbed Sample (UD)

▨ - Open Drive Thickness Sample (OD)

▨ - Marier Sample (MZ)

▨ - Denison Sample (DS)

□ - Attempted (UD*), (OD*), (PS*), (MZ*) & (DS*)

■ - Photo Sample (PS)

▨ - Core Rao (CR)

▨ - RQD

□ - TCR

*WL - Ground Water Level observed from Borehole (BGL)

APPENDIX B

TEST RESULT

APPENDIX B (i)

Summary of Laboratory Test Result

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project

SUMMARY OF TEST RESULTS

Client: TEPSCO										
BH No.: BH-01										
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)										
Sample No.				SPT-02	SPT-05	UD-01	UD-02	SPT-12	SPT-17	SPT-24
Depth (m)			from	2.00	5.00	7.00	10.00	14.00	19.00	26.00
			to	2.45	5.45	8.00	11.00	14.45	19.45	26.45
Classification Test										
Moisture Content:			%	12.58	14.29	35.79	26.73	21.62	24.66	22.40
Atterberg Limits	Liquid Limit	%			42.70	50.60		28.50		
	Plastic Limit	%			23.18	27.07		16.96		
	Plasticity Index	%			19.52	23.53		11.54		
Particle Size Distribution (Sieve)	Gravel	%	0.00	0.00			0.00	0.00	0.00	
	Sand	%	82.08	75.94			69.94	38.36	3.00	
	Silt/Clay	%	17.92	24.06			30.06	61.64	97.00	
Particle Size Distribution (Hydrometer)	Gravel	%	0.00	0.00			0.00	0.00	0.00	
	Sand	%	82.82	75.84			70.54	39.96	4.02	
	Silt	%	14.00	19.38			23.09	44.12	75.29	
	Clay	%	3.18	4.78			6.37	15.92	20.69	
Specific Gravity				2.66	2.67	2.73	2.68	2.72	2.69	2.73
Bulk Density			g/cm³			1.81	1.88			
Dry Density			g/cm³			1.33	1.48			
Soil Strength Test										
Unconfined Compression	Shear Strength	kPa			58.93	29.5				
	Phi angle	°								
Direct Shear	Cohesion	kPa	#							
	Phi angle	°	#				38			
Triaxial Compression (UU)	Shear Strength	kPa			60.10	97 to 116				
	Phi angle	°			0.00					
Soil Deformation Test										
Consolidation	Initial Void Ratio				1.21	0.903				
	Degree of Saturation	%			74.9	88				
	Preconsolidation pressure, PC	kPa			176	65				
	Compression Index, Cc				0.5298	0.2474				
Compaction	Maximum Dry Density	g/cm³								
	Optimum MC	%								
Chemical Analysis Test										
SOIL	pH				4.3					
	Chloride Content (acid-extract)	%			0.69					
	Sulfate Content (acid-extract)	%			0.51					
WATER	pH									
	Chloride content (in groundwater)	g/l								
	Sulfate content (as SO₄)	g/l								
Legend:	UC- Unconfined Compression				DST - Direct Shear OED - Oedometer			Remarks: *Sample is non plastic "##" Test on fill layer		
	UU- Unconsolidated Undrained									
	CIU-Consolidated Isotropic Undrained									
	CID-Consolidated Isotropic Drained									

N.B.: Test performed at GIE Laboratory (Denoted by black color)

Test performed at BUET (Denoted by red color)

BUET update their previous UU test result at UD-02

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project

SUMMARY OF TEST RESULTS

Client: TEPCO												
BH No.: BH-02												
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)												
Sample No.			SPT-01	SPT-02	UD-01	UD-02	SPT-09	SPT-10	SPT-13	SPT-18	SPT-21	SPT-23
Depth (m)	from		1.00	2.00	6.00	8.00	11.00	12.00	15.00	20.00	23.00	25.00
	to		1.45	2.45	7.00	9.00	11.45	12.45	15.45	20.45	23.45	25.45
Soil Classification Test												
Moisture Content:	%			20.71	50.08	37.30	37.55		26.92	25.04	16.93	15.67
Atterberg Limits	Liquid Limit	%			47.10	32.40	36.30		25.50			
	Plastic Limit	%			27.22	19.22	19.61		16.08			
	Plasticity Index	%			19.88	13.18	16.69		9.42			
Particle Size Distribution (Sieve)	Gravel	%		0.00					0.00		0.00	0.00
	Sand	%		95.90					35.86		85.44	86.00
	Silt/Clay	%		4.10					64.14		14.56	14.00
Particle Size Distribution (Hydrometer)	Gravel	%		0.00			0.00	0.00	0.00	0.00	0.00	0.00
	Sand	%		95.18			4.12	24.36	36.38	33.34	85.00	85.74
	Silt	%					68.82	53.36	46.11	52.33	12.45	12.03
	Clay	%		4.82			27.06	22.28	17.51	14.33	2.55	2.23
Specific Gravity				2.65	2.72	2.70	2.69		2.69		2.66	2.78
Bulk Density	g/cm ³				1.76	1.74						
Dry Density	g/cm ³				1.18	1.27						
Soil Strength Test												
Unconfined Compression	Shear Strength	kPa			59.16	48.28						
	Phi angle	°										
Direct Shear	Cohesion	kPa		0.00							3.65	
	Phi angle	°		26.30							34.8	40
Triaxial Compression (UU)	Shear Strength	kPa			32 to 39	46.4						
	Phi angle	°				0.00						
Soil Deformation Test												
Consolidation	Initial Void Ratio				1.234	1.038						
	Degree of Saturation	%			100	98.5						
	Preconsolidation pressure, PC	kPa			101	147						
	Compression Index, Cc				0.257	0.2503						
Compaction	Maximum Dry Density	g/cm ³	1.555									
	Optimum MC	%	15.6									
Chemical Analysis Test												
SOIL	pH				4.3							
	Chloride Content (acid-extract)	%			0.43							
	Sulfate Content (acid-extract)	%			0.27							
WATER	pH							6.8				
	Chloride	g/l						7.7				
	Sulphate	g/l						1.424				
Legend:	UC- Unconfined Compression					DST - Direct Shear			Remarks:			
	UU- Unconsolidated Undrained					OED - Oedometer			*Sample is non plastic			
	CIU-Consolidated Isotropic Undrained											
	CID-Consolidated Isotropic Drained											

N.B.: Test performed at GIE Laboratory (Denoted by black color)

Test performed at BUET (Denoted by red color)

BUET update their previous UU test result at UD-01

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project												
SUMMARY OF TEST RESULTS												
Client: TEPSCO												
BH No.: BH-03												
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)												
Sample No.			SPT-01	SPT-02	SPT-04	UD-01	UD-02	MZ-01	SPT-15	SPT-18	SPT-20	MZ-02
Depth (m)		from	1.00	2.00	4.00	8.00	12.00	17.00	18.00	21.00	23.00	27.00
		to	1.45	2.45	4.45	9.00	13.00	18.00	18.45	21.45	23.45	27.45
Classification Test												
Moisture Content:		%		20.14	17.70	34.31	25.97	32.69	30.32		24.50	18.73
Atterberg Limits	Liquid Limit	%				34.50	*		25.30			
	Plastic Limit	%				20.59	*		16.67			
	Plasticity Index	%				13.91	*		8.63			
Particle Size Distribution (Sieve)	Gravel	%		0.00	0.00		0.00	0.00			0.00	
	Sand	%		91.36	95.72		79.08	28.08			83.32	
	Silt/Clay	%		8.64	4.28		20.92	71.92			16.68	
Particle Size Distribution (Hydrometer)	Gravel	%		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Sand	%		91.24	95.50		81.72	27.22	31.88	4.94	83.76	92.78
	Silt	%		7.17	4.50		13.50	56.86	53.79	69.59	12.42	5.95
	Clay	%		1.59			4.78	15.92	14.33	25.47	3.82	1.27
Specific Gravity				2.65	2.67	2.77	2.67	2.70	2.69		2.66	2.65
Bulk Density		g/cm ³				1.82	1.91	1.92				1.84
Dry Density		g/cm ³				1.36	1.52	1.45				1.55
Soil Strength Test												
Unconfined Compression	Shear Strength	kPa				55.67	#					
	Phi angle	°										
Direct Shear	Cohesion	kPa						15.04				0.69
	Phi angle	°			39			21.90				30.30
Triaxial Compression (UU)	Shear Strength	kPa				47 to 51	#					
	Phi angle	°					#					
Soil Deformation Test												
Consolidation	Initial Void Ratio					1.03	0.75					
	Degree of Saturation	%				96.6	92.8					
	Preconsolidation pressure, PC	kPa				102	108					
	Compression Index, Cc					0.2657	0.0971					
Compaction	Maximum Dry Density	g/cm ³	1.552									
	Optimum MC	%	15.6									
Hydraulic Property Test												
Permeability Test		m/s						6.87E-09				
Chemical Analysis Test												
SOIL	pH						7.00					
	Chloride Content (acid-extract)	%					0.34					
	Sulfate Content (acid-extract)	%					0.08					
WATER	pH						6.7					
	Chloride	g/l					8.4					
	Sulphate	mg/l					1218					
Legend:	UC- Unconfined Compression				DST - Direct Shear			Remarks: *Sample is non plastic " #"= Test perform can not possible, because the sample is Sand in nature.				
	UU- Unconsolidated Undrained				OED - Oedometer							
	CIU-Consolidated Isotropic Undrained											
	CID-Consolidated Isotropic Drained											

N.B.: Test performed at GIE Laboratory (Denoted by black color)

Test performed at BUET (Denoted by red color)

BUET update their previous UU test result at UD-01

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project

SUMMARY OF TEST RESULTS

Client: TEPSCO											
BH No.: BH-04											
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)											
Sample No.			SPT-01	SPT-02	SPT-06	UD-02	SPT-08	SPT-12	SPT-15	SPT-18	SPT-22
Depth (m)		from	1.00	2.00	6.00	9.00	10.00	14.00	17.00	20.00	24.00
		to	1.45	2.45	6.45	10.00	10.45	14.45	17.45	20.45	24.45
Classification Test											
Moisture Content:		%		18.37	25.24	40.59	20.00	23.99	21.05	24.55	24.24
Atterberg Limits	Liquid Limit	%			28.80	32.50		26.80		42.80	*
	Plastic Limit	%			18.63	19.78		17.45		23.78	*
	Plasticity Index	%			10.17	12.72		9.35		19.02	*
Particle Size Distribution (Sieve)	Gravel	%		0.00			0.00		0.00		0.00
	Sand	%		71.74			36.36		82.88		41.02
	Silt/Clay	%		28.26			63.64		17.12		58.98
Particle Size Distribution (Hydrometer)	Gravel	%		0.00		0.00	0.00		0.00	0.00	0.00
	Sand	%		73.68		2.08	36.94		81.16	2.42	42.48
	Silt	%		19.95		75.64	45.55		13.43	81.66	47.97
	Clay	%		6.37		22.28	17.51		5.41	15.92	9.55
Specific Gravity				2.67	2.72	2.77	2.69	2.70	2.71	2.73	2.69
Bulk Density		g/cm ³				1.83					
Dry Density		g/cm ³				1.30					
Soil Strength Test											
Unconfined Compression	Shear Strength	kPa				31.33					
	Phi angle	°									
Direct Shear	Cohesion	kPa		1.15							
	Phi angle	°		33.7					37		
Triaxial Compression (UU)	Shear Strength	kPa				34 to 64					
	Phi angle	°									
Soil Deformation Test											
Consolidation	Initial Void Ratio					1.223					
	Degree of Saturation	%				100.0					
	Preconsolidation pressure, PC	kPa				134					
	Compression Index, Cc					0.4817					
Compaction	Maximum Dry Density	g/cm ³	1.598								
	Optimum MC	%	15.3								
Chemical Analysis Test											
SOIL	pH					7.5					
	Chloride Content (acid-extract)	%				0.36					
	Sulfate Content (acid-extract)	%				0.16					
WATER	pH					6.7					
	Chloride	g/l				8.79					
	Sulphate	g/l				1.60					
Legend:	UC- Unconfined Compression				DST - Direct Shear			Remarks: *Sample is non plastic "-": Test Progressing			
	UU- Unconsolidated Undrained				OED - Oedometer						
	CIU-Consolidated Isotropic Undrained										
	CID-Consolidated Isotropic Drained										

N.B.: Test performed at GIE Laboratory (Denoted by black color)
Test performed at BUET (Denoted by red color)

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project

SUMMARY OF TEST RESULTS												
Client: TEPSCO												
BH No.: BH-05												
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)												
Sample No.				SPT-01	UD-01	UD-02	UD-03	SPT-11	SPT-14	SPT-18		
Depth (m)			from	1.00	3.00	7.00	11.00	14.00	17.00	21.00		
			to	1.45	4.00	8.00	12.00	14.45	17.45	21.45		
Classification Test												
Moisture Content:			%		38.20	37.70	28.79	32.53	20.66	22.13		
Atterberg Limits	Liquid Limit	%		36.60	30.80	27.40		*				
	Plastic Limit	%		23.29	19.26	18.02		*				
	Plasticity Index	%		13.31	11.54	9.38		*				
Particle Size Distribution (Sieve)	Gravel	%					0.00	0.00	0.00			
	Sand	%					15.90	55.00	43.38			
	Silt/Clay	%					84.10	45.00	56.62			
Particle Size Distribution (Hydrometer)	Gravel	%					0.00	0.00	0.00			
	Sand	%					16.24	54.82	44.12			
	Silt	%					67.84	37.22	46.33			
	Clay	%					15.92	7.96	9.55			
Specific Gravity					2.73	2.72	2.77	2.71	2.69			
Bulk Density			g/cm ³		1.86	1.83	1.90					
Dry Density			g/cm ³		1.35	1.33	1.48					
Soil Strength Test												
Unconfined Compression	Shear Strength	kPa		24.02	29.12	26.83						
	Phi angle	°										
Direct Shear	Cohesion	kPa								3.28		
	Phi angle	°							37	35.1		
Triaxial Compression (UU)	Shear Strength	kPa		21.3	27.2	41 to 75						
	Phi angle	°		0	0							
Soil Deformation Test												
Consolidation	Initial Void Ratio			0.932	1.035	1.002						
	Degree of Saturation	%		100	100	99.9						
	Preconsolidation pressure, PC	kPa		77	100	133						
	Compression Index, Cc			0.22	0.2664	0.2885						
Compaction	Maximum Dry Density	g/cm ³	1.66									
	Optimum MC	%	17.9									
Chemical Analysis Test												
SOIL	pH			7.4								
	Chloride Content (acid-extract)	%		0.46								
	Sulfate Content (acid-extract)	%		0.31								
WATER	pH											
	Chloride											
	Sulphate											
Legend:	UC- Unconfined Compression				DST - Direct Shear				Remarks: *Sample is non plastic			
	UU- Unconsolidated Undrained				OED - Oedometer							
	CIU-Consolidated Isotropic Undrained											
	CID-Consolidated Isotropic Drained											

N.B.: Test performed at GIE Laboratory (Denoted by black color)
 Test performed at BUET (Denoted by red color)

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project SUMMARY OF TEST RESULTS

Client: TEPSCO											
BH No.: BH-06											
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)											
Sample No.				SPT-06	UD-01	UD-03	SPT-18	SPT-23			
Depth (m)			from	6.00	8.00	14.00	21.00	26.00			
			to	6.45	9.00	15.00	21.45	26.45			
Classification Test											
Moisture Content:			%	17.57	34.18	35.55	26.21	23.76			
Atterberg Limits	Liquid Limit	%		27.60	32.30						
	Plastic Limit	%		17.97	19.58						
	Plasticity Index	%		9.63	12.72						
Particle Size Distribution (Sieve)	Gravel	%		0.00			0.00	0.00			
	Sand	%		91.42			38.70	6.04			
	Silt/Clay	%		8.58			61.30	93.96			
Particle Size Distribution (Hydrometer)	Gravel	%		0.00		0.00	0.00	0.00			
	Sand	%		93.08		4.98	37.54	6.56			
	Silt	%		4.69		72.74	49.73	74.34			
	Clay	%		2.23		22.28	12.73	19.10			
Specific Gravity				2.65	2.71	2.79	2.69	2.80			
Bulk Density			g/cm ³		1.86	1.89					
Dry Density			g/cm ³		1.39	1.40					
Soil Strength Test											
Unconfined Compression	Shear Strength	kPa		30.42	25.33						
	Phi angle	°									
Direct Shear	Cohesion	kPa	0.72			3.24					
	Phi angle	°	39.4			28.00	33				
Triaxial Compression (UU)	Shear Strength	kPa		25.3	36 to 50						
	Phi angle	°		0							
Soil Deformation Test											
Consolidation	Initial Void Ratio			0.948	0.986						
	Degree of Saturation	%		100	89.3						
	Preconsolidation pressure, PC	kPa		100	111						
	Compression Index, Cc			0.2442	0.2056						
Compaction	Maximum Dry Density	g/cm ³									
	Optimum MC	%									
Chemical Analysis Test											
SOIL	pH				7.5						
	Chloride Content (acid-extract)	%			0.44						
	Sulfate Content (acid-extract)	%			0.45						
WATER	pH							6.6			
	Chloride	g/l						17.56			
	Sulphate	g/l						1.96			
Legend:	UC- Unconfined Compression				DST - Direct Shear			Remarks: *Sample is non plastic			
	UU- Unconsolidated Undrained				OED - Oedometer						
	CIU-Consolidated Isotropic Undrained										
	CID-Consolidated Isotropic Drained										

N.B.: Test performed at GIE Laboratory (Denoted by black color)
Test performed at BUET (Denoted by red color)

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project

SUMMARY OF TEST RESULTS											
Client: TEPSCO											
BH No.: BH-07											
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)											
Sample No.			SPT-01	SPT-03	SPT-06	SPT-07	UD-01	SPT-13	SPT-15	SPT-17	MZ-01
Depth (m)		from	1.00	3.00	6.00	7.00	9.00	14.00	16.00	18.00	21.00
		to	1.45	3.45	6.45	7.45	10.00	14.45	16.45	18.45	22.00
Classification Test											
Moisture Content:		%		16.66	22.48	28.13	30.53	18.23	24.45	21.21	19.28
Atterberg Limits	Liquid Limit	%				42.30	27.50				
	Plastic Limit	%				21.40	14.85				
	Plasticity Index	%				20.90	12.65				
Particle Size Distribution (Sieve)	Gravel	%		0.00	0.00			0.00	0.00		
	Sand	%		89.24	40.36			80.16	63.44		
	Silt/Clay	%		10.76	59.64			19.84	36.56		
Particle Size Distribution (Hydrometer)	Gravel	%		0.00	0.00		0.00	0.00	0.00	0.00	0.00
	Sand	%		90.12	41.50		22.54	81.24	63.04	85.68	92.74
	Silt	%		7.01	39.40		63.13	13.98	27.41	11.45	5.03
	Clay	%		2.87	19.10		14.33	4.78	9.55	2.87	2.23
Specific Gravity				2.65	2.69		2.77	2.66	2.67	2.67	2.65
Bulk Density		g/cm ³					1.90				1.96
Dry Density		g/cm ³					1.45				1.64
Soil Strength Test											
Unconfined Compression	Shear Strength	kPa					26.16				
	Phi angle	°									
Direct Shear	Cohesion	kPa		0.51							0.00
	Phi angle	°		33.4						39	35.1
Triaxial Compression (UU)	Shear Strength	kPa					40 to 59				
	Phi angle	°									
Soil Deformation Test											
Consolidation	Initial Void Ratio						0.821				
	Degree of Saturation	%					100				
	Preconsolidation pressure, PC	kPa					62				
	Compression Index, Cc						0.1377				
Compaction	Maximum Dry Density	g/cm ³	1.658								
	Optimum MC	%	15.5								
Hydraulic Property Test											
Permeability Test		m/s									1.58E-07
Chemical Analysis Test											
SOIL	pH						5.2				
	Chloride Content (acid-extract)	%					0.49				
	Sulfate Content (acid-extract)	%					0.31				
WATER	pH						6.7				
	Chloride	g/l					5.91				
	Sulphate	g/l					0.362				
Legend:	UC- Unconfined Compression			DST - Direct Shear				Remarks: *Sample is non plastic			
	UU- Unconsolidated Undrained			OED - Oedometer							
	CIU-Consolidated Isotropic Undrained										
	CID-Consolidated Isotropic Drained										

N.B.: Test performed at GIE Laboratory (Denoted by black color)
Test performed at BUET (Denoted by red color)

Ground Instrumentation & Engineering Pte.Ltd.



Geotechnical Investigation for Matarbari Project

SUMMARY OF TEST RESULTS												
Client: TEPSCO												
BH No.: BH-08												
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)												
Sample No.				SPT-02	SPT-05	SPT-07	SPT-09	SPT-12	SPT-16	SPT-21		
Depth (m)			from	2.00	5.00	7.00	9.00	12.00	16.00	21.00		
			to	2.45	5.45	7.45	9.45	12.45	16.45	21.45		
Classification Test												
Moisture Content:			%	16.70	27.61	35.52	21.10	25.29	23.84	19.42		
Atterberg Limits	Liquid Limit	%		31.20	41.50	26.50						
	Plastic Limit	%		18.00	23.45	15.64						
	Plasticity Index	%		13.20	18.05	10.86						
Particle Size Distribution (Sieve)	Gravel	%	0.00				0.00	0.00	0.00			
	Sand	%	97.50				68.48	53.32	90.14			
	Silt/Clay	%	2.50				31.52	46.68	9.86			
Particle Size Distribution (Hydrometer)	Gravel	%	0.00			0.00	0.00	0.00	0.00			
	Sand	%	97.90			38.18	68.98	52.48	90.70			
	Silt	%	2.10			44.31	21.47	33.19	7.71			
	Clay	%				17.51	9.55	14.33	1.59			
Specific Gravity				2.65	2.71	2.72	2.69	2.67	2.68	2.68		
Bulk Density			g/cm ³									
Dry Density			g/cm ³									
Soil Strength Test												
Unconfined Compression	Shear Strength	kPa										
	Phi angle	°										
Direct Shear	Cohesion	kPa	0.79					9.74				
	Phi angle	°	31.5					37.1	40			
Triaxial Compression (UU)	Shear Strength	kPa										
	Phi angle	°										
Soil Deformation Test												
Consolidation	Initial Void Ratio											
	Degree of Saturation	%										
	Preconsolidation pressure, PC	kPa										
	Compression Index, Cc											
Compaction	Maximum Dry Density	g/cm ³										
	Optimum MC	%										
Chemical Analysis Test												
SOIL	pH			6.8								
	Chloride Content (acid-extract)	%		0.43								
	Sulfate Content (acid-extract)	%		0.41								
WATER	pH											
	Chloride											
	Sulphate											
Legend:	UC- Unconfined Compression				DST - Direct Shear				Remarks: *Sample is non plastic			
	UU- Unconsolidated Undrained				OED - Oedometer							
	CIU-Consolidated Isotropic Undrained											
	CID-Consolidated Isotropic Drained											

N.B.: Test performed at GIE Laboratory (Denoted by black color)
 Test performed at BUET (Denoted by red color)

APPENDIX B (ii)

Details Laboratory Test Result

SGS



BH-01

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10	
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Sample No.:	SPT-02	Depth (m): 2.00-2.45
Can No.	180	
Weight of Wet Soil + Can (gm)	216.68	
Weight of Dry Soil + can (gm)	195.49	
Weight of Can (gm)	27.08	
Moisture Content (%)	12.58	
Description	Silty fine-medium SAND, SM	

Sample No.:	SPT-05	Depth (m): 5.00-5.45
Can No.	408	
Weight of Wet Soil + Can (gm)	255.16	
Weight of Dry Soil + can (gm)	226.38	
Weight of Can (gm)	24.91	
Moisture Content (%)	14.29	
Description	Silty fine-medium SAND, SM	

Sample No.:	UD-01	Depth (m): 7.00-8.00
Can No.	203	
Weight of Wet Soil + Can (gm)	273.60	
Weight of Dry Soil + can (gm)	208.36	
Weight of Can (gm)	26.08	
Moisture Content (%)	35.79	
Description	Lean CLAY, CL	

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 28-02-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10			
Sample No.:		UD-02		Depth (m): 10.00-11.00	
Can No.		107			
Weight of Wet Soil + Can (gm)		207.20			
Weight of Dry Soil + can (gm)		170.02			
Weight of Can (gm)		30.93			
Moisture Content (%)		26.73			
Description		Fat CLAY, CH			
Sample No.:		SPT-12		Depth (m): 14.00-14.45	
Can No.		365			
Weight of Wet Soil + Can (gm)		170.74			
Weight of Dry Soil + can (gm)		142.92			
Weight of Can (gm)		14.25			
Moisture Content (%)		21.62			
Description		Silty fine SAND, SM			
Sample No.:		SPT-17		Depth (m): 19.00-19.45	
Can No.		341			
Weight of Wet Soil + Can (gm)		178.37			
Weight of Dry Soil + can (gm)		145.93			
Weight of Can (gm)		14.39			
Moisture Content (%)		24.66			
Description		Sandy lean CLAY, CL			

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 28-02-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte Ltd	MOISTURE CONTENT ASTM D2216-10	
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Sample No.:	SPT-24	Depth (m): 26.00-26.45
Can No.	486	
Weight of Wet Soil + Can (gm)	201.58	
Weight of Dry Soil + can (gm)	167.44	
Weight of Can (gm)	15.04	
Moisture Content (%)	22.40	
Description	Lean CLAY, CL	

Sample No.:		Depth (m):
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Sample No.:		Depth (m):
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-01

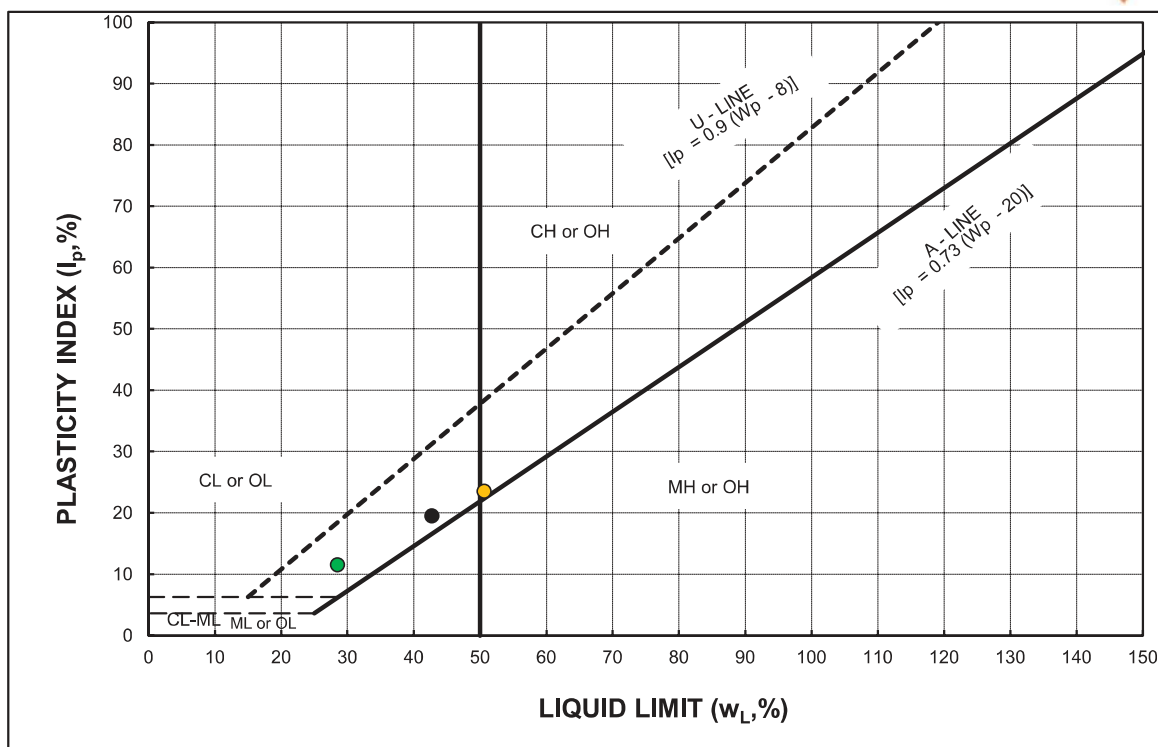
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 28-02-2021

Checked by: Suvashis Paul

Date: 05-03-2021



	Sample No.	Depth	W _L	W _P	I _p	Fines	Remarks
●	UD-01	7.00-8.00	42.70	23.18	19.52		Lean CLAY, CL
●	UD-02	10.00-11.00	50.60	27.07	23.53		Fat CLAY, CH
●	SPT-17	19.00-19.45	28.50	16.96	11.54		Lean CLAY, CL
●							
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05

*Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

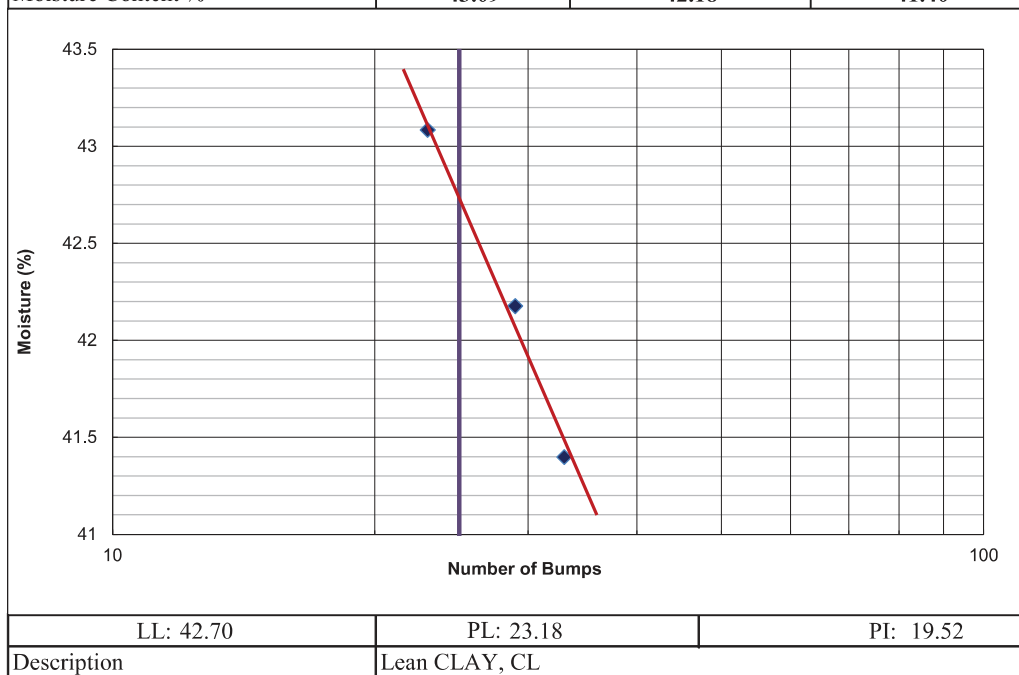
Sample No: UD-01

BH No.: BH-01

Sample Depth: 7.00-8.00

Plastic Limit Test		
Container No.	57	318
Weight of can (gm)	7.71	7.67
Wet weight of soil + can (gm)	32.87	32.89
Dry Weight of soil + can (gm)	28.15	28.13
Moisture Content %	23.09	23.26
Average	23.18	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	33
Container No.	432	436	477
Weight of can (gm)	3.63	3.83	3.77
Wet weight of soil + can (gm)	25.15	23.82	22.18
Dry Weight of soil + can (gm)	18.67	17.89	16.79
Moisture Content %	43.09	42.18	41.40



Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

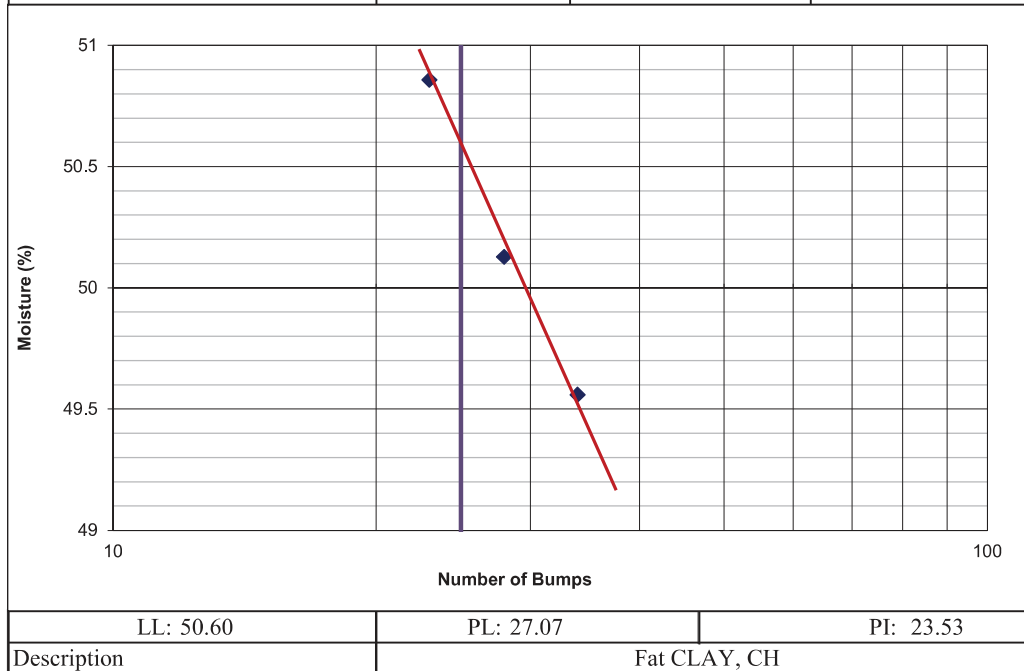
Sample No.: UD-02

BH No.: BH-01

Sample Depth: 10.00-11.00

Plastic Limit Test		
Container No.	415	336
Weight of can (gm)	9.42	9.33
Wet weight of soil + can (gm)	29.74	29.76
Dry Weight of soil + can (gm)	25.42	25.4
Moisture Content %	27.00	27.13
Average	27.07	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	34
Container No.	332	435	475
Weight of can (gm)	7.4	3.89	4.35
Wet weight of soil + can (gm)	28.49	27.52	24.72
Dry Weight of soil + can (gm)	21.38	19.63	17.97
Moisture Content %	50.86	50.13	49.56



Tested by: Rayhan
Date: 01-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

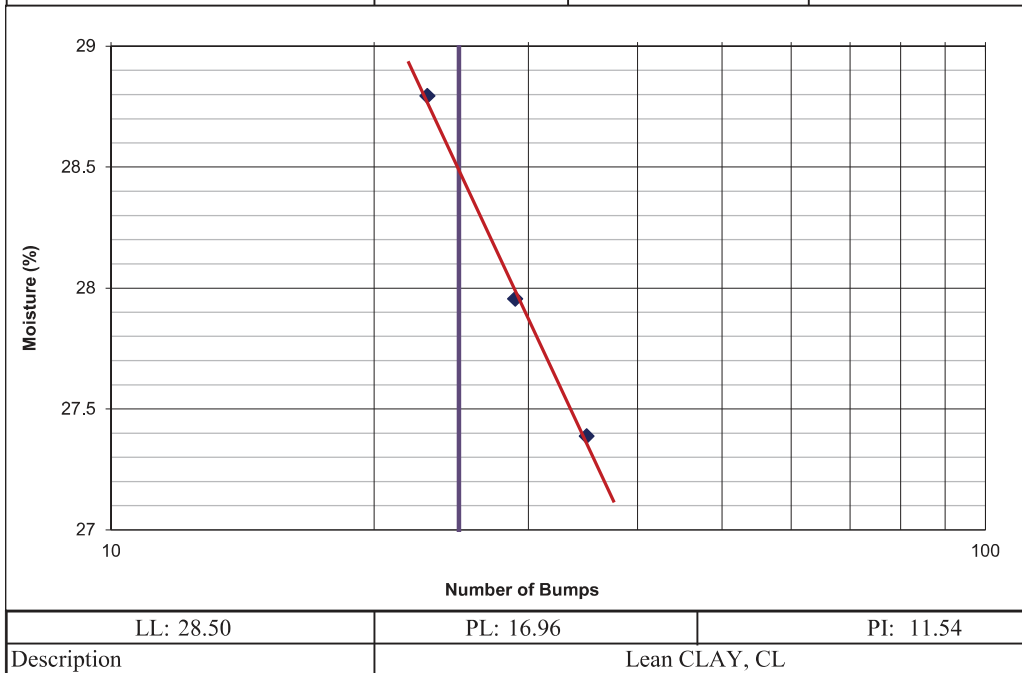
Sample No.: SPT-17

BH No.: BH-01

Sample Depth.: 19.00-19.45

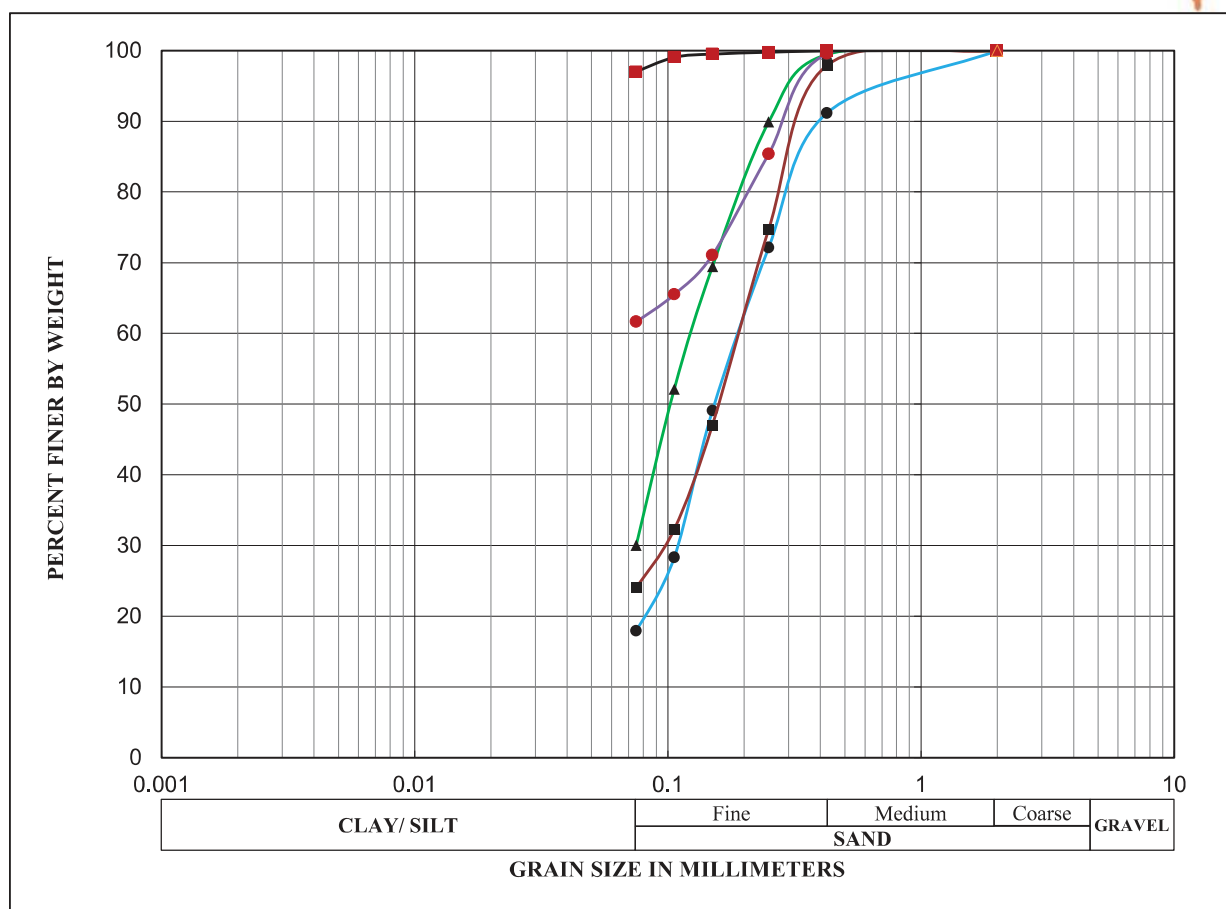
Plastic Limit Test		
Container No.	224	51
Weight of can (gm)	12.84	12.79
Wet weight of soil + can (gm)	36.46	36.48
Dry Weight of soil + can (gm)	33.05	33.03
Moisture Content %	16.87	17.05
Average	16.96	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	35
Container No.	325	441	479
Weight of can (gm)	7.2	3.76	9.22
Wet weight of soil + can (gm)	30.28	28.98	27.36
Dry Weight of soil + can (gm)	25.12	23.47	23.46
Moisture Content %	28.79	27.96	27.39



Tested by: Rayhan
Date: 01-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021



Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
● SPT-02	2.00-2.45	Silty fine-medium SAND, SM						
■ SPT-05	5.00-5.45	Silty fine-medium SAND, SM						
▲ SPT-12	14.00-14.45	Silty fine SAND, SM						
● SPT-17	19.00-19.45	Sandy lean CLAY, CL						
■ SPT-24	26.00-26.45	Lean CLAY, CL						
▲								

Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
							%Fine	%Medium	%Coarse	
● SPT-02	2.00-2.45	0.197	0.154	0.110	0.042	0.00	73.24	8.84	0.00	17.92
■ SPT-05	5.00-5.45	0.197	0.161	0.097	0.031	0.00	73.86	2.08	0.00	24.06
▲ SPT-12	14.00-14.45	0.126	0.103	0.075	0.025	0.00	69.38	0.56	0.00	30.06
● SPT-17	19.00-19.45	0.073	0.061	0.037	0.012	0.00	37.90	0.46	0.00	61.64
■ SPT-24	26.00-26.45	0.046	0.039	0.023	0.008	0.00	2.94	0.06	0.00	97.00
▲										

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

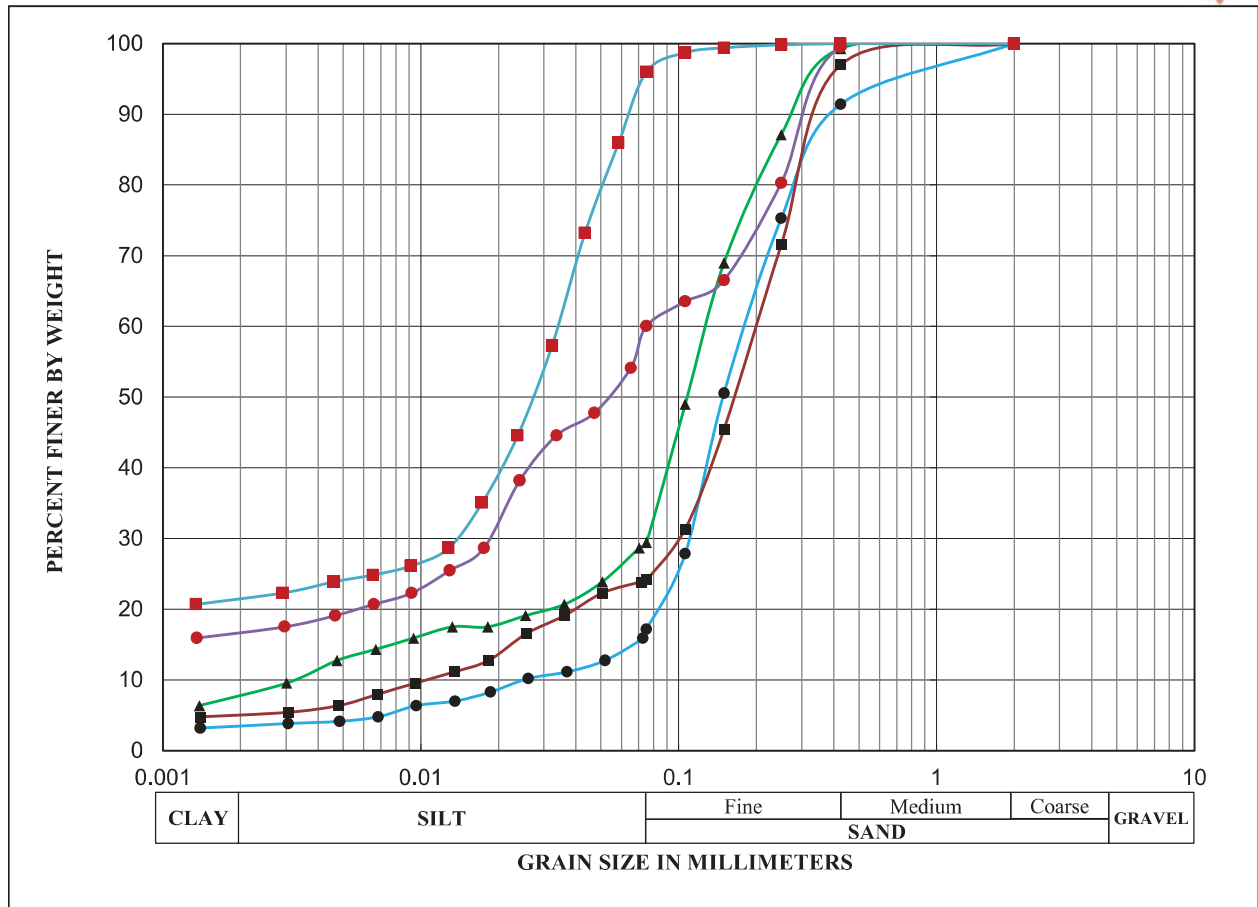
Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 01-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Silty fine-medium SAND, SM						
■	SPT-05	5.00-5.45	Silty fine-medium SAND, SM						
▲	SPT-12	14.00-14.45	Silty fine SAND, SM						
●	SPT-17	19.00-19.45	Sandy lean CLAY, CL						
■	SPT-24	26.00-26.45	Lean CLAY, CL						
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
								%Fine	%Medium	%Coarse		
●	SPT-02	2.00-2.45	0.188	0.149	0.110	0.025	0.00	74.24	8.58	0.00	14.00	3.18
■	SPT-05	5.00-5.45	0.206	0.167	0.100	0.011	0.00	72.84	3.00	0.00	19.38	4.78
▲	SPT-12	14.00-14.45	0.130	0.108	0.076	0.003	0.00	69.84	0.70	0.00	23.09	6.37
●	SPT-17	19.00-19.45	0.075	0.054	0.019	0.001	0.00	39.48	0.48	0.00	44.12	15.92
■	SPT-24	26.00-26.45	0.034	0.027	0.014	0.001	0.00	4.00	0.02	0.00	75.29	20.69
▲												

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-02	Depth(m)	2.00-2.45
Pyknometer No.		1
Mass of bottle + soil + water: M_3	gm	118.73
Mass of bottle + soil: M_2	gm	74.04
Mass of bottle + water: M_4	gm	99.99
Mass of bottle: M_1	gm	44.00
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	25.95
Mass of water used: $M_3 - M_2$	gm	44.69
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.30
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.66

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-05	Depth(m)	5.00-5.45
Pyknometer No.		2
Mass of bottle + soil + water: M_3	gm	117.15
Mass of bottle + soil: M_2	gm	74.10
Mass of bottle + water: M_4	gm	98.41
Mass of bottle: M_1	gm	44.13
Mass of soil: $M_2 - M_1$	gm	29.97
Mass of water in full bottle: $M_4 - M_2$	gm	24.31
Mass of water used: $M_3 - M_2$	gm	43.05
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.23
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.67

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



UD-01	Depth(m)	7.00-8.00
Pyknometer No.		3
Mass of bottle + soil + water: M_3	gm	117.97
Mass of bottle + soil: M_2	gm	74.54
Mass of bottle + water: M_4	gm	98.92
Mass of bottle: M_1	gm	44.52
Mass of soil: $M_2 - M_1$	gm	30.02
Mass of water in full bottle: $M_4 - M_2$	gm	24.38
Mass of water used: $M_3 - M_2$	gm	43.43
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	10.97
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.73

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 02-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.:	110-231613/20-21/CE Dated 11.3.21
Client :	Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka
Ref :	SGS/Phase-2/SI/090321 dated 9.3.21
Project :	Geotechnical Investigation at Matarbari
Location:	Matarbari
Test Method:	ASTM
Date of Test:	1-10.4.21 *

SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	1	2	3.0	4.0	5.0	6.0
Depth (m)	14-14.5	25-25.45	4-4.5	17-17.45	17-17.45	26-26.45
Sample No.	12.0	23.0	4.0	15.0	14.0	23.0
Soil Type	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand
Wt. of bottle+water+ soil, gm	371.6	375.3	373.4	371.6	380.1	396.4
Temperature (°C)	30.5	30.0	30.5	30.5	30.5	30.0
Wt. of bottle+water, gm	340.0	343.7	342.1	340.4	348.8	365.1
Wt. of soil, gm	49.8	49.2	49.9	49.3	49.7	48.6
Specific Gravity	2.72	2.78	2.67	2.71	2.69	2.80

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

Countersigned by :

f

Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



44A76bmM6

Test performed by :

25.5.21
Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-17	Depth(m)	19.00-19.45
Pyknometer No.		6
Mass of bottle + soil + water: M_3	gm	94.09
Mass of bottle + soil: M_2	gm	55.21
Mass of bottle + water: M_4	gm	75.23
Mass of bottle: M_1	gm	25.22
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	20.02
Mass of water used: $M_3 - M_2$	gm	38.88
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.13
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-24	Depth(m)	26.00-26.45
Pyknometer No.		7
Mass of bottle + soil + water: M_3	gm	90.91
Mass of bottle + soil: M_2	gm	51.10
Mass of bottle + water: M_4	gm	71.90
Mass of bottle: M_1	gm	21.11
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	20.80
Mass of water used: $M_3 - M_2$	gm	39.81
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	10.98
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.73

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-01	Depth (m):	7.00-8.00
Weight of soil	gm	155.90
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.81
Dry Density	(g/cm ³)	1.33
Void Ratio		1.05
Moisture Content	%	35.79
Specific Gravity	(g/cm ³)	2.73

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-02	Depth (m):	10.00-11.00
Weight of soil	gm	162.10
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.88
Dry Density	(g/cm ³)	1.48
Void Ratio		0.81
Moisture Content	%	26.73
Specific Gravity	(g/cm ³)	2.68

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-01

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 02-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

Total Stress Triaxial Compression

Unconfined Compression

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	7.00-8.00		
	Description	Lean CLAY, CL		
	Type	UD		
	Initial Sample Length	L_0	(mm)	76.0
	Initial Sample Diameter	D_0	(mm)	38.0
	Initial Sample Weight	W_0	(gr)	149.3
	Bulk Density	ρ_0	(Mg/m ³)	1.73
	Particle Density	ρ_s	(Mg/m ³)	2.73

Initial Conditions				
Strain Rate	m_s	(mm/min)	0.76000	
Membrane Thickness	m_b	(mm)	0.00	
Displacement Input	L_{IP}	(mm)	CH 7	
Load Input	N_{IP}	(N)	CH 2	
Initial Moisture	w_i	(%)	36	
Initial Dry Density	ρ_{d0}	(Mg/m ³)	1.27	
Initial Voids Ratio	e_0	.	1.15	
Initial Degree of Saturation	S_o	(%)	86	

Final Conditions			
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$ (kPa)		117.86
Strain At Max Stress	ϵ_f %	(%)	5.87
Final Moisture	ω_f %	(%)	36
Final Dry Density	ρ_{df}	(Mg/m ³)	1.27
Final Voids Ratio	e_f	.	1.15
Final Degree of Saturation	S_f	(%)	86.2
Notes			
			
		Failure Sketch (surface inclination)	

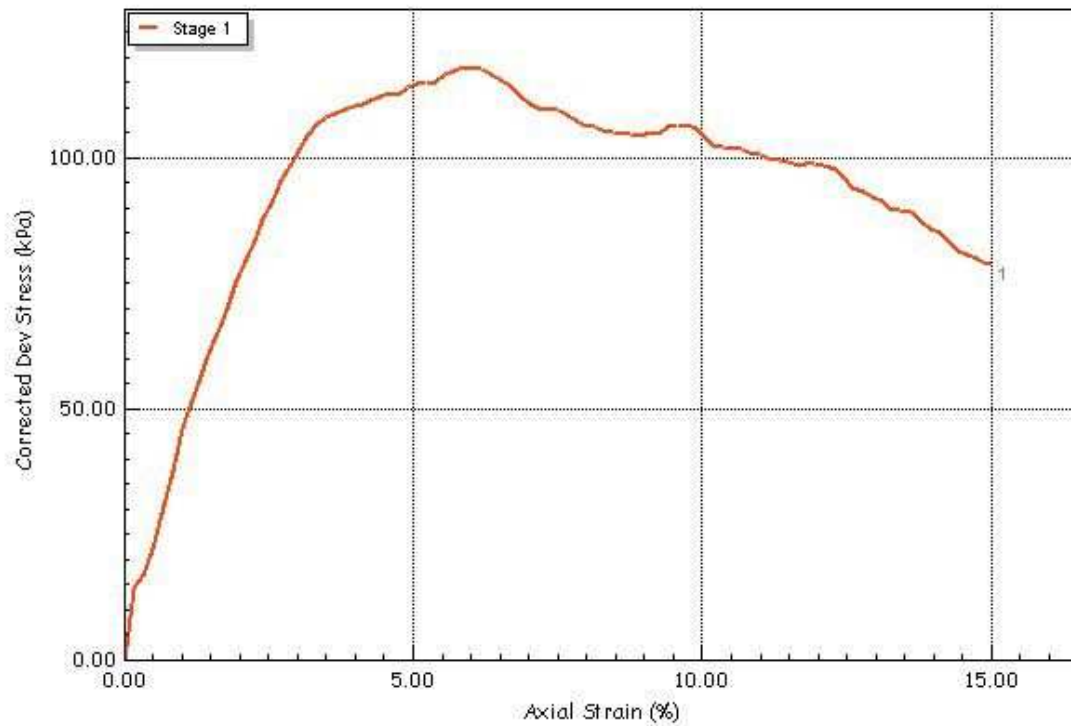
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	Site Reference		Borehole BH-01	
	Jobfile UCT		Sample UD-01	
	Client SGS		Depth 7.00-8.00	
	Operator R. Islam	Checked Aminul	Approved T. Islam	

GIE

Total Stress Triaxial Compression

Unconfined Compression

Test Results Plots



	Test Method D 2166/D2166M-13		Test Name UCT	
	Database: \SQLEXPRESS \ GIE-D		Test Date 3/16/2021	
	Site Reference		Borehole BH-01	
	Jobfile UCT		Sample UD-01	
	Client SGS		Depth 7.00-8.00	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



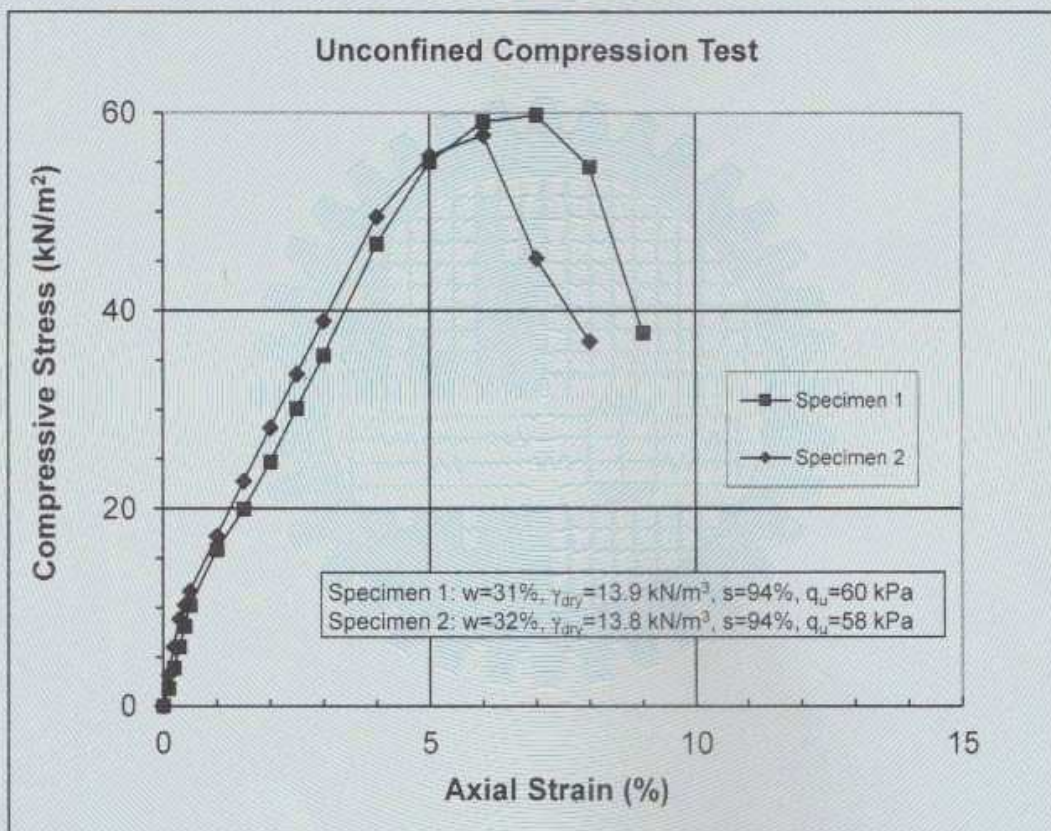
DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819-557964, PABX: 966-5650-80 Ext. 7226

GEOTECHNICAL ENGINEERING LABORATORY



BRTC No.: 110-231613/20-21/CE dated 11.3.21		
Client: Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project: Geotechnical Investigation at Matarbari		
Soil description: Grey silty clay, trace fine sand		
Test Method: ASTM		Date of Test: 29.3.21-1.4.21
BH No.: 1	Sample ID: UD-2	Depth: 10-11 m
		Location: Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Only two specimens could be prepared from the tube sample.
Sample was received in unsealed condition.

Specific Gravity= 2.68

Countersigned by :

[Signature]

Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

[Signature] 7.5.21

Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



BRTC BUET

BUETCE 0272380

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

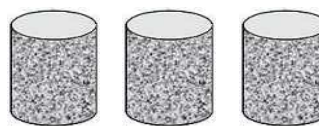
Summary Report

Sample Details		Depth	7.00-8.00		
 sketch showing specimen location in original sample	Description	Lean CLAY, CL			
	Type	UD			
			Spm. 1	2	3
	Initial Sample Length	L ₀ (mm)	76.0	76.0	76.0
	Initial Sample Diameter	D ₀ (mm)	38.0	38.0	38.0
	Initial Sample Weight	W ₀ (gr)	143.1	143.5	143.8
	Bulk Density	ρ ₀ (Mg/m ³)	1.66	1.66	1.67
	Particle Density	ρ _s (Mg/m ³)	2.73	2.73	2.73

Initial Conditions			Spm. 1	2	3
Specimen					
Initial Cell Pressure	σ ₃ (kPa)		65	130	260
Strain Rate	m _s (mm/min)		0.76000	0.76000	0.76000
Membrane Thickness	m _b (mm)		0.02	0.02	0.02
Displacement Input	L _{IP} (mm)		CH 7	CH 7	CH 7
Load Input	N _{IP} (N)		CH 2	CH 2	CH 2
Initial Moisture	ω _i (%)		36	36	36
Initial Dry Density	ρ _{d0} (Mg/m ³)		1.22	1.22	1.23
Initial Voids Ratio	e ₀		1.24	1.23	1.23
Initial Degree of Saturation	S _o (%)		80	80	80

Final Conditions			Spm. 1	2	3
Max Deviator Stress	(σ ₁ - σ ₃) _f (kPa)		118.94	123.52	126.52
Membrane Correction	m _c (kPa)		40.760	40.728	40.760
Strain At Max Stress	ε _f (%)		6.36	8.75	6.51
Shear Strength	c _U (kPa)		59.47	61.76	63.26
Final Moisture	ω _f (%)		35	35	35
Final Dry Density	ρ _{df} (Mg/m ³)		1.23	1.23	1.23
Final Voids Ratio	e _f		1.23	1.22	1.22
Final Degree of Saturation	S _f (%)		78.8	79.3	79.6

Notes



Failure Sketch
(surface inclination)

	Test Method		D 2850-03A (2007)		Test Name		UU	
	Database:		.\SQLEXPRESS \ GIE-D		Test Date		3/16/2021	
	Site Reference				Borehole		BH-01	
	Jobfile		UU		Sample		UD-01	
	Client		SGS		Depth		7.00-8.00	
	Operator		R. Islam		Checked		Aminul	
					Approved		T. Islam	

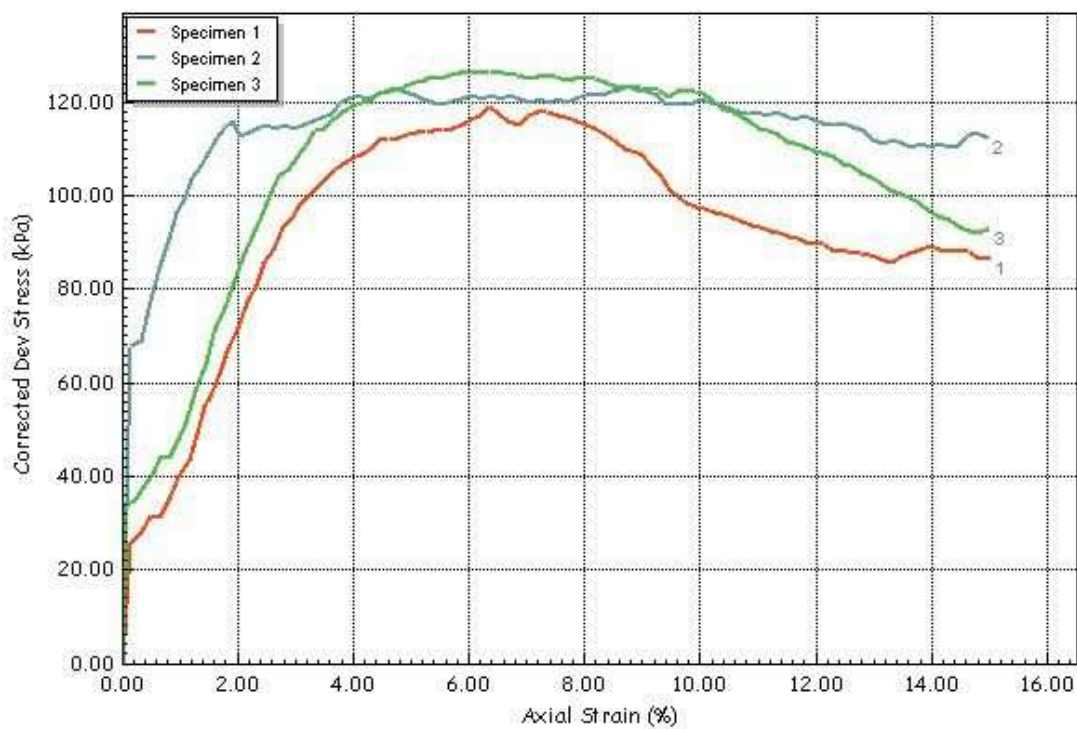
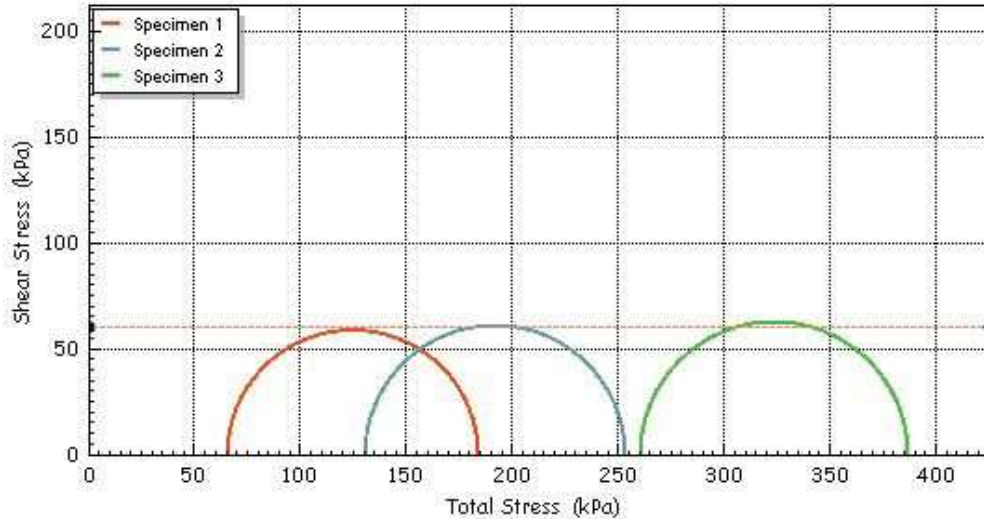
GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

Test Results Plots

Cohesion Level	c	(kPa)	60.1
Friction Angle	ϕ	(deg)	0.0



	Test Method D 2850-03A (2007)		Test Name UU	
	Database: \SQLEXPRESS \ GIE-D		Test Date 3/16/2021	
	Site Reference		Borehole BH-01	
	Jobfile UU		Sample UD-01	
	Client SGS		Depth 7.00-8.00	
	Operator R. Islam	Checked Aminul	Approved T. Islam	

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

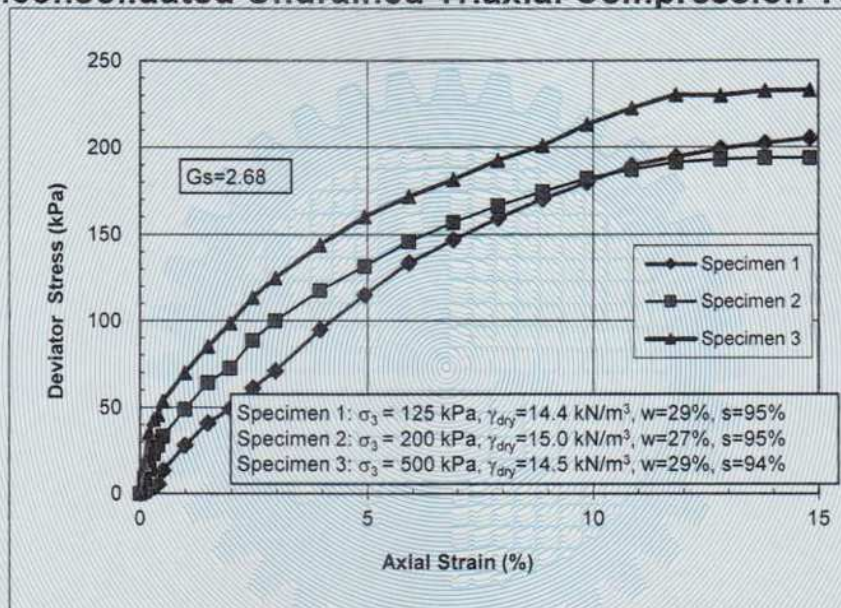
GEOTECHNICAL ENGINEERING LABORATORY



BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description :	Grey silty clay, trace fine sand	Test Method: ASTM
B.H. No.: 1	Sample: UD-2	Depth: 10-11 m
Location: Matarbari	Date of Test: 27.4.21-2.5.21	

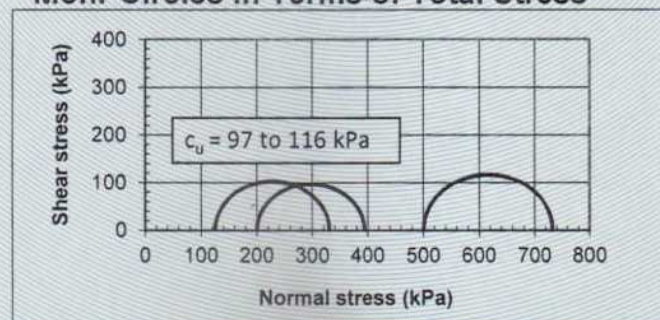
(Corrected Report)

Unconsolidated Undrained Triaxial Compression Test



E7d6DBGdA

Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading.

Countersigned by :

Dr. A.B.M. Badruzzaman
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

Dr. Tahmeed M. Al-Hussaini
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.





Project : Geotechnical Investigation for Matarbari Project
 Client - Location : TEPSCO
 Boring No : BH-01
 Sample No : UD-01
 Depth (m) : 7.00-8.00
 Soil Description : Lean CLAY, CL

Moisture Content Determination

		<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	=	134.10	131.37
Wt. of Ring + Dry Soil, gm	=	118.00	118.00
Weight of Water, gm	=	16.10	13.37
Weight of Container, gm	=	69.47	69.47
Weight of Dry Soil, gm	=	48.53	48.53
Water Content, %	=	33.2	27.5

Unit Weight Determination

		<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	=	134.10	131.37
Weight of Ring, gm	=	69.47	69.47
Weight of Wet Soil, gm	=	64.63	61.90
Height of Sample, cm	=	2	1.817
Diameter of Sample, cm	=	5	5
Volume of Sample, cm ³	=	39.27	35.68
Unit Wet Weight, kN/m ³	=	16.1	17.0
Unit Dry Weight, kN/m ³	=	12.1	13.3

Specific Gravity	=	2.73
Initial Void Ratio	=	1.209
Degree of Saturation, %	=	74.9
Room Temperature, °C	=	24.0
Temp. correction factor	=	0.91
Initial Transducer Reading	=	8.94
Effective Overburden Pressure	=	
Preconsolidation Pressure (kPa)	=	176
Compression Index (Cc)	=	0.5298

Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t ₉₀ (min)	c _v (cm ² /day.)	c _v (20°C) (cm ² /day.)	m _v (m ² /MN)	k x 10 ⁻⁹ (m/s)
1	12	8.899	0.001	0.042	1.204	7.809	156.518	142.431	0.175	7.752
2	25	8.805	0.001	0.136	1.194	35.226	34.534	31.426	0.362	3.541
3	50	8.737	0.002	0.203	1.187	22.350	53.990	49.131	0.135	2.062
4	100	8.559	0.007	0.376	1.168	4.886	243.988	222.029	0.175	12.068
5	200	8.130	0.012	0.800	1.121	10.932	105.771	96.252	0.216	6.468
6	400	6.743	0.021	2.178	0.969	39.292	26.760	24.351	0.359	2.718
7	200	6.798	0.016	2.128	0.974				0.014	
8	100	6.928	0.012	2.002	0.988				0.071	
9	50	7.078	0.009	1.855	1.004				0.163	
10	25	7.106	0.007	1.829	1.007				0.057	

Tested By: Rayhan

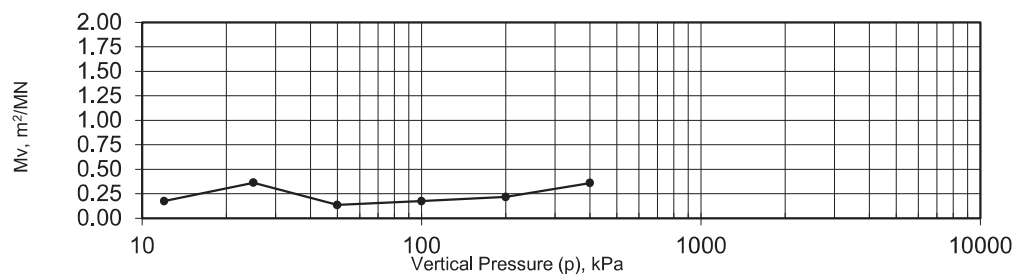
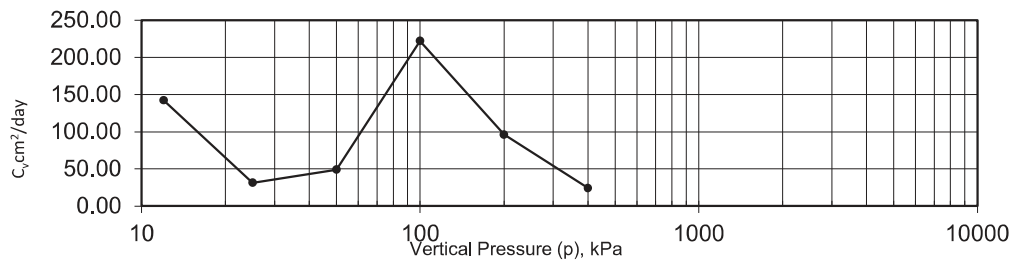
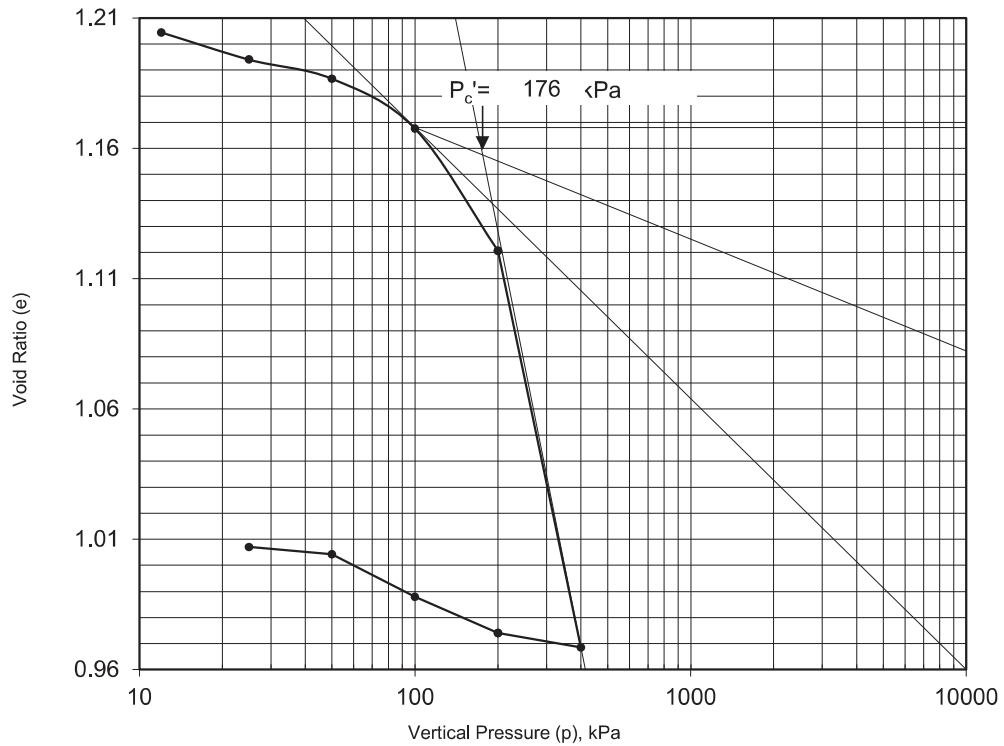
Checked & Approved By: T. Isla

Date: 19-03-2021

Date: 23-03-2021

ASTM D2435/D2435M - 11

$C_c = 0.529751$



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-01
 Sample : UD-01
 Depth (m) : 7.00-8.00



Ground Instrumentation & Engineering Pte Ltd	OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11																																																																																																																										
Project : SIBD2105 Client - Location : Geotechnical Investigation for Matarbari Project Boring No : BH-01 Sample No : UD-02 Depth (m) : 10.00-11.00 Soil Description : Fat CLAY, CH																																																																																																																											
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Tested By: Rayhan Date: 19-03-2021 Checked & Approved By: T. Islam Date: 23-03-2021																																																																																																																											



BH-02

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10	
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Sample No.:	SPT-02	Depth (m): 2.00-2.45
Can No.	103	
Weight of Wet Soil + Can (gm)	188.99	
Weight of Dry Soil + can (gm)	158.78	
Weight of Can (gm)	12.90	
Moisture Content (%)	20.71	
Description	Fine-medium SAND, SP	

Sample No.:	UD-01	Depth (m): 6.00-7.00
Can No.	94	
Weight of Wet Soil + Can (gm)	181.70	
Weight of Dry Soil + can (gm)	125.81	
Weight of Can (gm)	14.21	
Moisture Content (%)	50.08	
Description	Lean CLAY, CL	

Sample No.:	UD-02	Depth (m): 8.00-9.00
Can No.	109	
Weight of Wet Soil + Can (gm)	325.00	
Weight of Dry Soil + can (gm)	243.29	
Weight of Can (gm)	24.21	
Moisture Content (%)	37.30	
Description	Lean CLAY, CL	

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 28-02-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10			
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Sample No.:	SPT-09	Depth (m): 11.00-11.45			
Can No.	201				
Weight of Wet Soil + Can (gm)	218.89				
Weight of Dry Soil + can (gm)	165.87				
Weight of Can (gm)	24.68				
Moisture Content (%)	37.55				
Description	Lean CLAY, CL				

Sample No.:	SPT-13	Depth (m): 15.00-15.45			
Can No.	98				
Weight of Wet Soil + Can (gm)	177.30				
Weight of Dry Soil + can (gm)	143.09				
Weight of Can (gm)	15.99				
Moisture Content (%)	26.92				
Description	Sandy lean CLAY, CL				

Sample No.:	SPT-18	Depth (m): 20.00-20.45			
Can No.	406				
Weight of Wet Soil + Can (gm)	205.29				
Weight of Dry Soil + can (gm)	169.54				
Weight of Can (gm)	26.78				
Moisture Content (%)	25.04				
Description	Sandy lean CLAY, CL				

Geotechnical Investigation for Matarbari Project

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Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 28-02-2021

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Date: 05-03-2021

Ground Instrumentation & Engineering Pte Ltd	MOISTURE CONTENT ASTM D2216-10		
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Sample No.:	SPT-21	Depth (m): 23.00-23.45
Can No.	97	
Weight of Wet Soil + Can (gm)	178.27	
Weight of Dry Soil + can (gm)	154.58	
Weight of Can (gm)	14.61	
Moisture Content (%)	16.93	
Description	Silty fine SAND, SM	

Sample No.:	SPT-23	Depth (m): 25.00-25.45
Can No.	484	
Weight of Wet Soil + Can (gm)	214.64	
Weight of Dry Soil + can (gm)	188.78	
Weight of Can (gm)	23.78	
Moisture Content (%)	15.67	
Description	Silty fine SAND, SM	

Sample No.:		
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-02

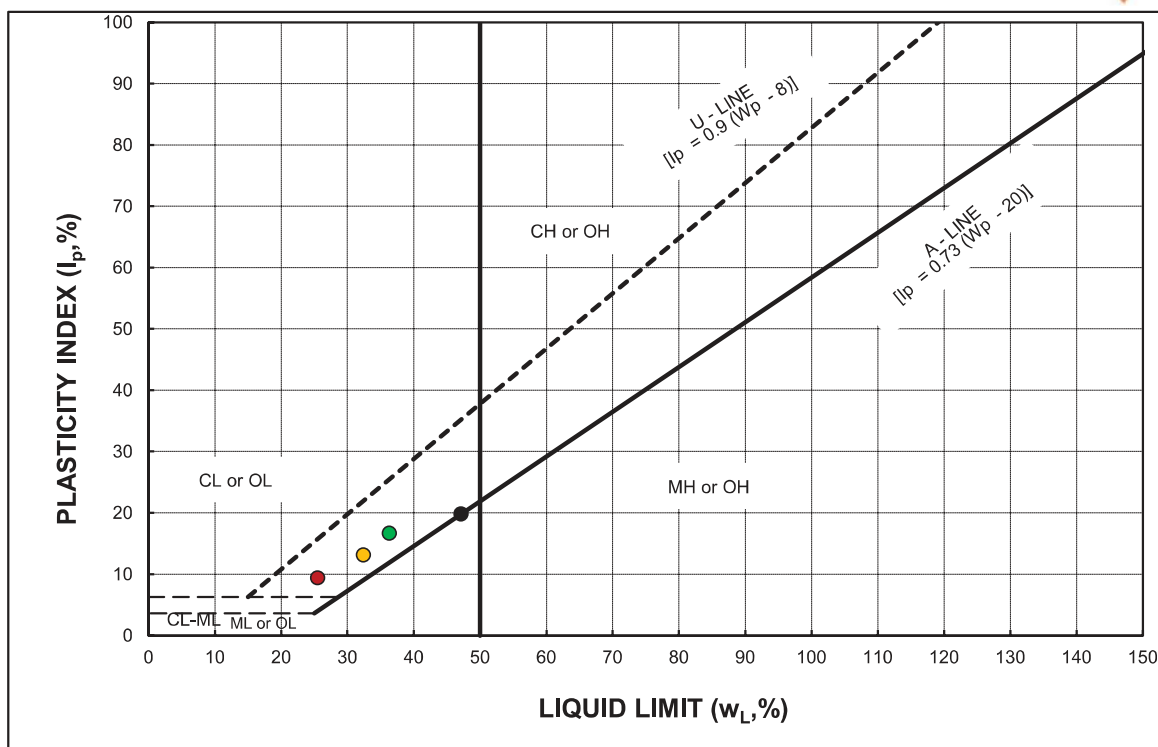
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 28-02-2021

Checked by: Suvashis Paul

Date: 05-03-2021



	Sample No.	Depth	W _L	W _P	I _p	Fines	Remarks
●	UD-01	6.00-7.00	47.10	27.22	19.88		Lean CLAY, CL
●	UD-02	8.00-9.00	32.40	19.22	13.18		Lean CLAY, CL
●	SPT-09	11.00-11.45	36.30	19.61	16.69		Lean CLAY, CL
●	SPT-13	15.00-15.45	25.50	16.08	9.42		Lean CLAY, CL
●							
●							
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○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05

*Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

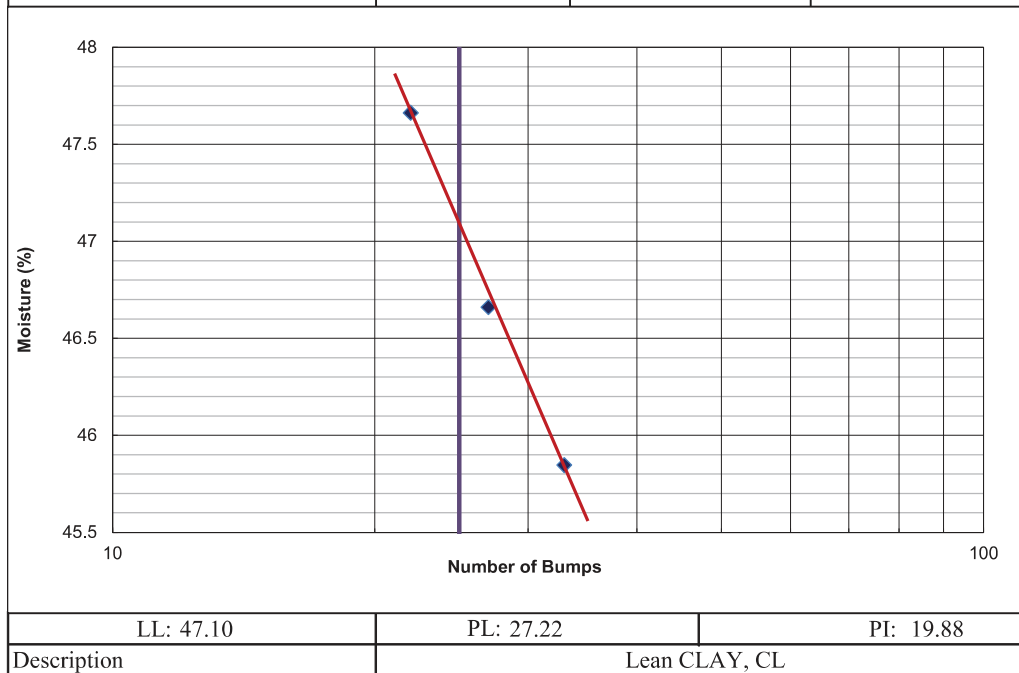
Sample No: UD-01

BH No.: BH-02

Sample Depth: 6.00-7.00

Plastic Limit Test		
Container No.	422	322
Weight of can (gm)	7.59	7.55
Wet weight of soil + can (gm)	36.63	36.65
Dry Weight of soil + can (gm)	30.43	30.41
Moisture Content %	27.15	27.30
Average	27.22	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	27	33
Container No.	328	320	327
Weight of can (gm)	8.24	7.67	8.08
Wet weight of soil + can (gm)	25.93	23.92	23
Dry Weight of soil + can (gm)	20.22	18.75	18.31
Moisture Content %	47.66	46.66	45.85



Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

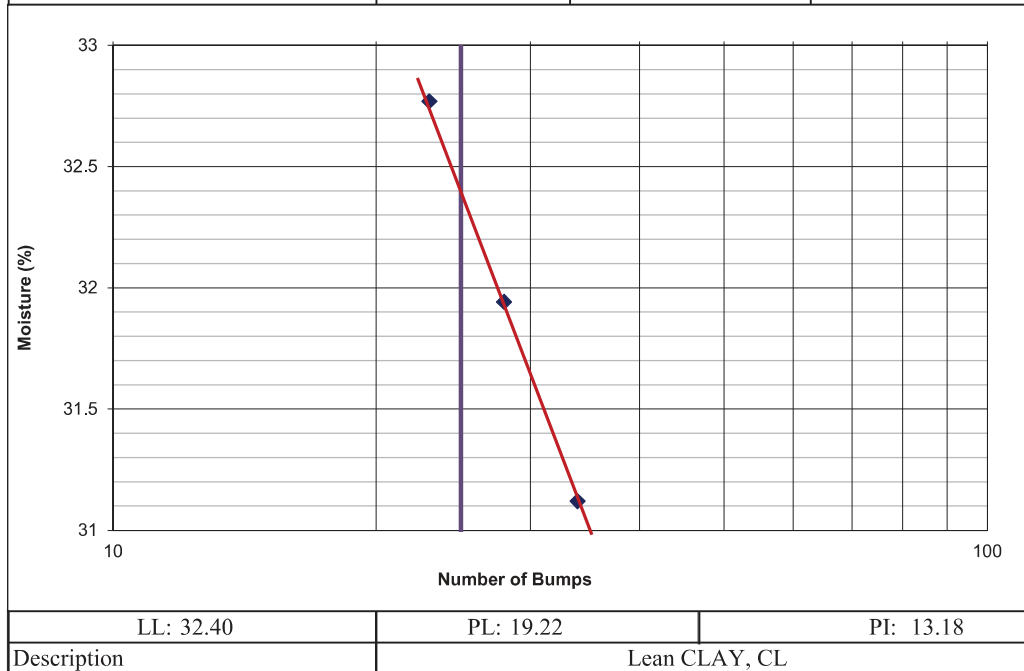
Sample No.: UD-02

BH No.: BH-02

Sample Depth: 8.00-9.00

Plastic Limit Test		
Container No.	228	34
Weight of can (gm)	12.19	12.15
Wet weight of soil + can (gm)	35.92	35.94
Dry Weight of soil + can (gm)	32.11	32.09
Moisture Content %	19.13	19.31
Average	19.22	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	34
Container No.	441	442	433
Weight of can (gm)	3.76	3.95	4.02
Wet weight of soil + can (gm)	26.53	25.14	23.57
Dry Weight of soil + can (gm)	20.91	20.01	18.93
Moisture Content %	32.77	31.94	31.12



Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

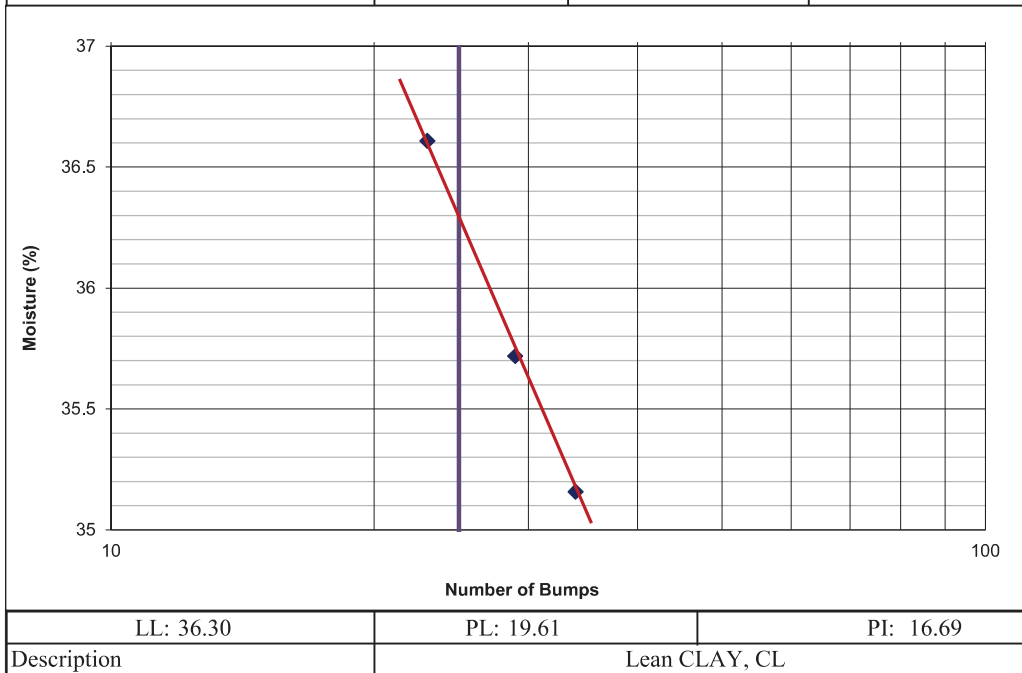
Sample No.: SPT-09

BH No.: BH-02

Sample Depth.: 11.00-11.45

Plastic Limit Test		
Container No.	350	347
Weight of can (gm)	8.61	8.54
Wet weight of soil + can (gm)	30.46	30.48
Dry Weight of soil + can (gm)	26.89	26.87
Moisture Content %	19.53	19.69
Average	19.61	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	34
Container No.	332	329	331
Weight of can (gm)	7.4	9.42	9.86
Wet weight of soil + can (gm)	29.23	28.76	27.89
Dry Weight of soil + can (gm)	23.38	23.67	23.2
Moisture Content %	36.61	35.72	35.16



Tested by: Rayhan
Date: 01-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

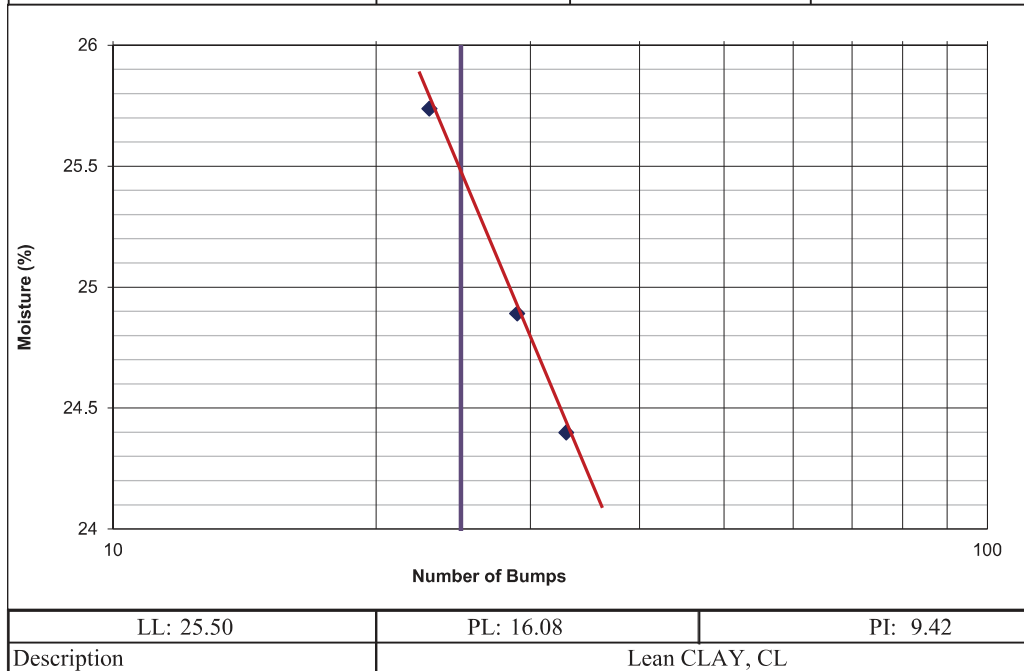
Sample No.: SPT-13

BH No.: BH-02

Sample Depth.: 15.00-15.45

Plastic Limit Test		
Container No.	43	30
Weight of can (gm)	11.67	11.51
Wet weight of soil + can (gm)	38.14	38.16
Dry Weight of soil + can (gm)	34.48	34.46
Moisture Content %	16.05	16.12
Average	16.08	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	33
Container No.	438	440	444
Weight of can (gm)	4.07	3.76	4.19
Wet weight of soil + can (gm)	25.37	23.93	20.76
Dry Weight of soil + can (gm)	21.01	19.91	17.51
Moisture Content %	25.74	24.89	24.40

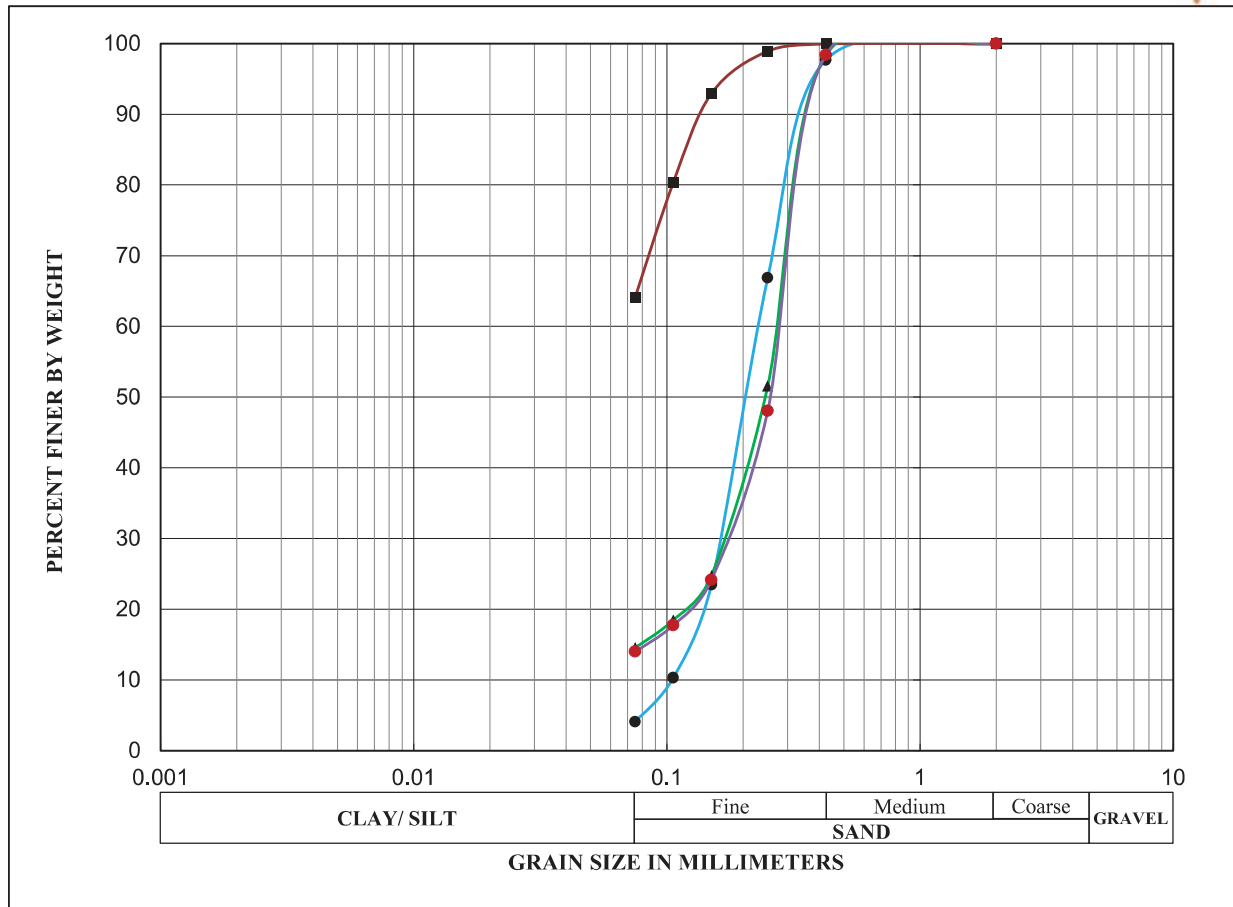


Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Fine-medium SAND, SP					2.24	1.11
■	SPT-13	15.00-15.45	Sandy lean CLAY, CL						
▲	SPT-21	23.00-23.45	Silty fine SAND, SM						
●	SPT-23	25.00-25.45	Silty fine SAND, SM						
■	SPT-00	#N/A						#N/A	#N/A
▲	SPT-00	#N/A						#N/A	#N/A

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
								%Fine	%Medium	%Coarse	
●	SPT-02	2.00-2.45	0.234	0.211	0.165	0.105	0.00	93.60	2.30	0.00	4.10
■	SPT-13	15.00-15.45	0.070	0.058	0.035	0.012	0.00	35.80	0.06	0.00	64.14
▲	SPT-21	23.00-23.45	0.282	0.244	0.170	0.052	0.00	83.78	1.66	0.00	14.56
●	SPT-23	25.00-25.45	0.292	0.257	0.174	0.054	0.00	84.40	1.60	0.00	14.00
■	SPT-00	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	#N/A
▲	SPT-00	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	#N/A

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

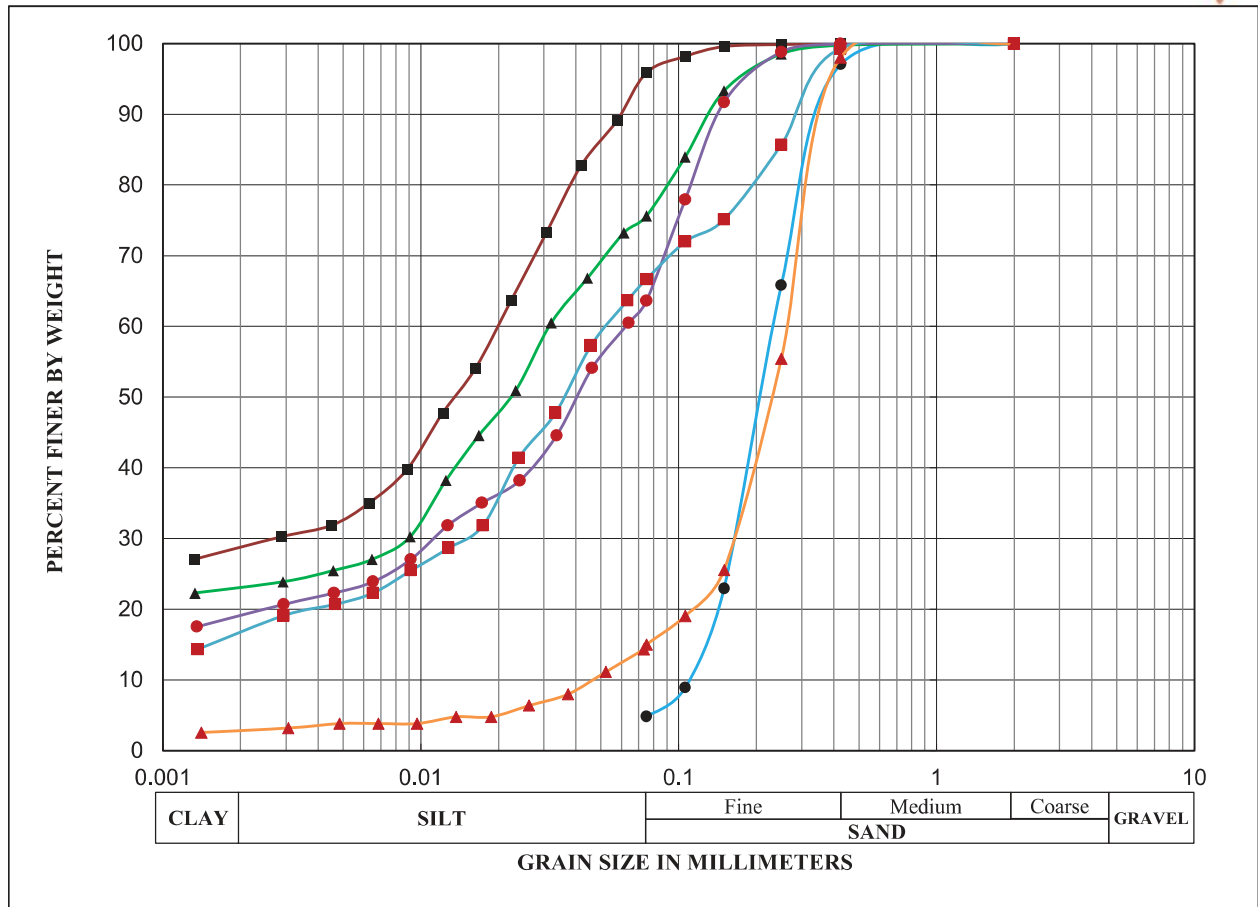
Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 01-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Fine-medium SAND, SP					2.16	1.07
■	SPT-09	11.00-11.45	Lean CLAY, CL						
▲	SPT-10	12.00-12.45	Lean CLAY with Sand, CL						
●	SPT-13	15.00-15.45	Sandy lean CLAY, CL						
■	SPT-18	20.00-20.45	Sandy lean CLAY, CL						
▲	SPT-21	23.00-23.45	Silty fine SAND, SM						

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
								%Fine	%Medium	%Coarse		
●	SPT-02	2.00-2.45	0.236	0.213	0.167	0.109	0.00	92.22	2.96	0.00	4.82	
■	SPT-09	11.00-11.45	0.020	0.014	0.003	0.000	0.00	4.08	0.04	0.00	68.82	27.06
▲	SPT-10	12.00-12.45	0.032	0.022	0.009	0.001	0.00	24.10	0.26	0.00	53.36	22.28
●	SPT-13	15.00-15.45	0.063	0.041	0.011	0.001	0.00	36.30	0.08	0.00	46.11	17.51
■	SPT-18	20.00-20.45	0.053	0.036	0.015	0.001	0.00	32.64	0.70	0.00	52.33	14.33
▲	SPT-21	23.00-23.45	0.269	0.232	0.165	0.047	0.00	83.04	1.96	0.00	12.45	2.55

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

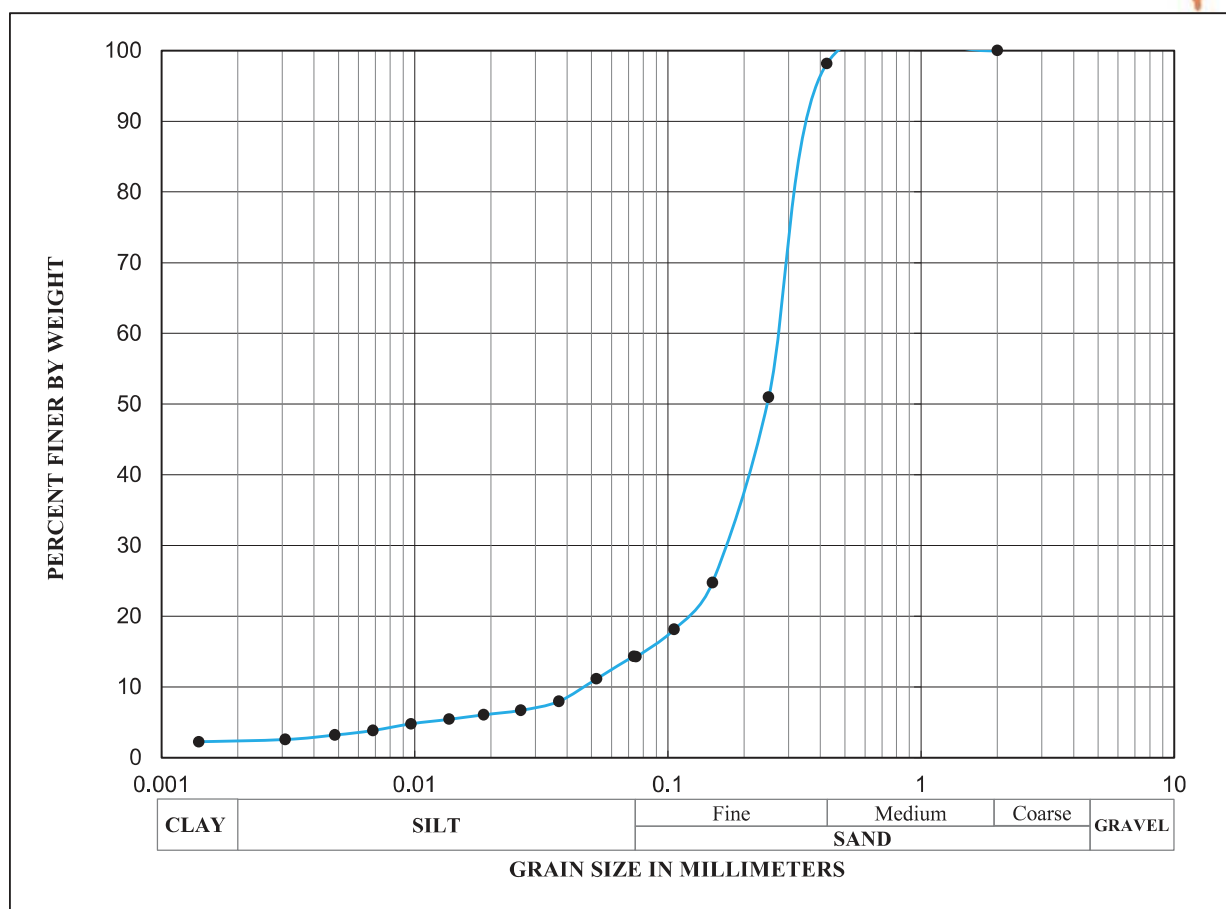
Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-23	25.00-25.45	Silty fine SAND, SM						
■									
▲									
●									
■									
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
								%Fine	%Medium	%Coarse		
●	SPT-23	25.00-25.45	0.284	0.246	0.170	0.047	0.00	83.90	1.84	0.00	12.03	2.23
■												
▲												
●												
■												
▲												

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-02	Depth(m)	2.00-2.45
Pyknometer No.		9
Mass of bottle + soil + water: M_3	gm	97.32
Mass of bottle + soil: M_2	gm	57.84
Mass of bottle + water: M_4	gm	78.61
Mass of bottle: M_1	gm	27.80
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	20.77
Mass of water used: $M_3 - M_2$	gm	39.48
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.33
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



UD-02	Depth(m)	8.00-9.00
Pyknometer No.		8
Mass of bottle + soil + water: M_3	gm	91.39
Mass of bottle + soil: M_2	gm	51.16
Mass of bottle + water: M_4	gm	72.48
Mass of bottle: M_1	gm	21.14
Mass of soil: $M_2 - M_1$	gm	30.02
Mass of water in full bottle: $M_4 - M_2$	gm	21.32
Mass of water used: $M_3 - M_2$	gm	40.23
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.11
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.70

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-09	Depth(m)	11.00-11.45
Pyknometer No.		17
Mass of bottle + soil + water: M_3	gm	124.09
Mass of bottle + soil: M_2	gm	71.87
Mass of bottle + water: M_4	gm	105.23
Mass of bottle: M_1	gm	41.89
Mass of soil: $M_2 - M_1$	gm	29.98
Mass of water in full bottle: $M_4 - M_2$	gm	33.37
Mass of water used: $M_3 - M_2$	gm	52.22
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.12
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-13	Depth(m)	15.00-15.45
Pyknometer No.		12
Mass of bottle + soil + water: M_3	gm	98.76
Mass of bottle + soil: M_2	gm	59.81
Mass of bottle + water: M_4	gm	79.85
Mass of bottle: M_1	gm	29.76
Mass of soil: $M_2 - M_1$	gm	30.05
Mass of water in full bottle: $M_4 - M_2$	gm	20.04
Mass of water used: $M_3 - M_2$	gm	38.95
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.14
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 02-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-21	Depth(m)	23.00-23.45
Pyknometer No.		16
Mass of bottle + soil + water: M_3	gm	119.06
Mass of bottle + soil: M_2	gm	73.91
Mass of bottle + water: M_4	gm	100.35
Mass of bottle: M_1	gm	43.92
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	26.45
Mass of water used: $M_3 - M_2$	gm	45.16
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.28
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.66

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE Dated 11.3.21	
Client : Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka	
Ref : SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Location: Matarbari	
Test Method: ASTM	Date of Test: 1-10.4.21 *

SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	1	2	3.0	4.0	5.0	6.0
Depth (m)	14-14.5	25-25.45	4-4.5	17-17.45	17-17.45	26-26.45
Sample No.	12.0	23.0	4.0	15.0	14.0	23.0
Soil Type	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand
Wt. of bottle+water+ soil, gm	371.6	375.3	373.4	371.6	380.1	396.4
Temperature (°C)	30.5	30.0	30.5	30.5	30.5	30.0
Wt. of bottle+water, gm	340.0	343.7	342.1	340.4	348.8	365.1
Wt. of soil, gm	49.8	49.2	49.9	49.3	49.7	48.6
Specific Gravity	2.72	2.78	2.67	2.71	2.69	2.80

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

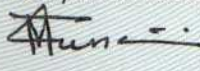
Countersigned by :

f 
Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



44A76bmM6

Test performed by :

 25.5.21
Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.





UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-01	Depth (m):	6.00-7.00
Weight of soil	gm	152.10
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.76
Dry Density	(g/cm ³)	1.18
Void Ratio		1.31
Moisture Content	%	50.08
Specific Gravity	(g/cm ³)	2.72

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 02-03-2021

Checked by: Suvashis Paul
Date: 05-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-02	Depth (m):	8.00-9.00
Weight of soil	gm	150.00
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.74
Dry Density	(g/cm ³)	1.27
Void Ratio		1.13
Moisture Content	%	37.30
Specific Gravity	(g/cm ³)	2.70

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-02

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 05-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



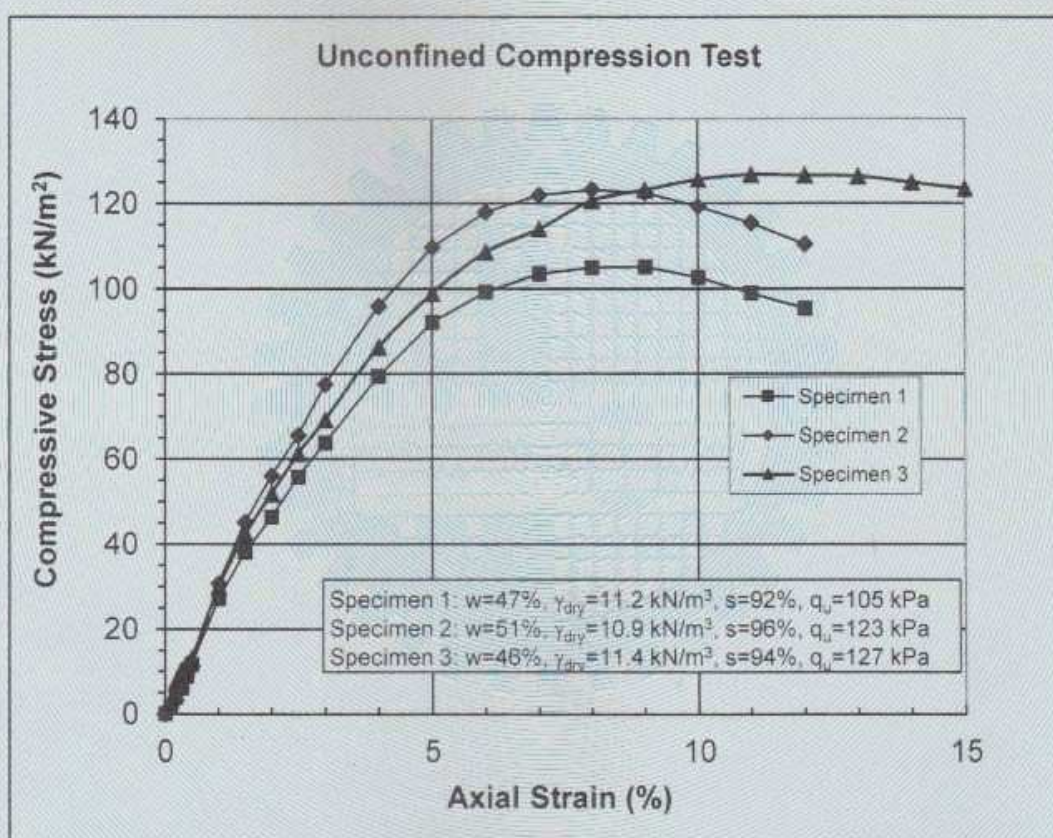
DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

GEOTECHNICAL ENGINEERING LABORATORY



BRTC No.: 110-231613/20-21/CE dated 11.3.21		
Client: Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project: Geotechnical Investigation at Matarbari		
Soil description: Grey to dary grey silty clay, trace roots		
Test Method:	ASTM	Date of Test: 29.3.21-1.4.21
BH No.: 2	Sample ID: UD-1	Depth: 6-7 m
		Location: Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Sample was received in unsealed condition.

Countersigned by:

[Signature]

Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.

19



YWLg5BBrK

Specific Gravity= 2.72

Test performed by:

[Signature] 7.5.21

Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



BRTC-BUET

BUETCE 0272381

Total Stress Triaxial Compression

Unconfined Compression

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	8.00-9.00		
	Description	Lean CLAY, CL		
	Type	UD		
	Initial Sample Length	L ₀	(mm)	76.0
	Initial Sample Diameter	D ₀	(mm)	38.0
	Initial Sample Weight	W ₀	(gr)	160.5
	Bulk Density	ρ ₀	(Mg/m ³)	1.86
	Particle Density	ρ _s	(Mg/m ³)	2.70

Initial Conditions				
Strain Rate	m _s	(mm/min)	0.76000	
Membrane Thickness	m _b	(mm)	0.00	
Displacement Input	L _{IP}	(mm)	CH 7	
Load Input	N _{IP}	(N)	CH 2	
Initial Moisture	ω _i %	(%)	37	
Initial Dry Density	ρ _{d0}	(Mg/m ³)	1.36	
Initial Voids Ratio	e ₀	.	0.98	
Initial Degree of Saturation	S _o	(%)	100	

Final Conditions			
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$ (kPa)		96.57
Strain At Max Stress	$\epsilon_f\%$ (%)		7.18
Final Moisture	$\omega_f\%$ (%)		37
Final Dry Density	ρ_{df} (Mg/m ³)		1.36
Final Voids Ratio	e_f .		0.98
Final Degree of Saturation	S_f (%)		100.0
Notes			
			
		Failure Sketch (surface inclination)	

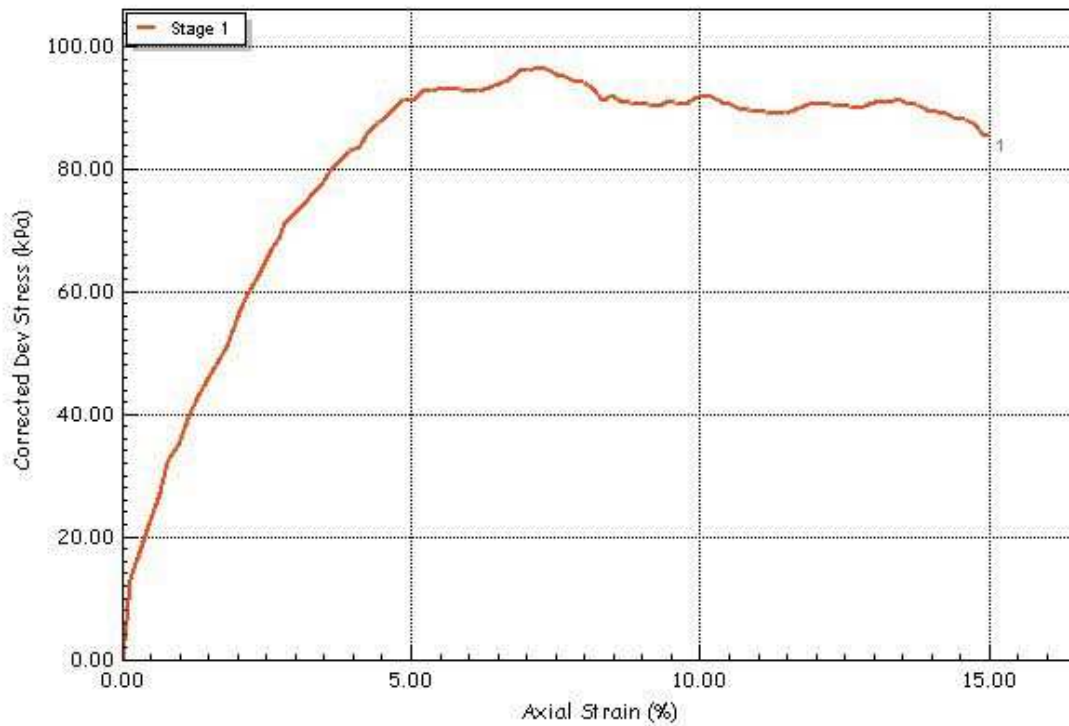
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	Database: .\SQLEXPRESS \ GIE-D		Test Date 3/16/2021	
	Site Reference		Borehole BH-02	
	Jobfile UCT		Sample UD-02	
	Client SGS		Depth 8.00-9.00	
Operator R. Islam		Checked Aminul	Approved T. Islam	

GIE

Total Stress Triaxial Compression

Unconfined Compression

Test Results Plots



	Test Method D 2166/D2166M-13		Test Name UCT	
	Database: \SQLEXPRESS \ GIE-D		Test Date 3/16/2021	
	Site Reference		Borehole BH-02	
	Jobfile UCT		Sample UD-02	
	Client SGS		Depth 8.00-9.00	
Operator R. Islam		Checked Aminul	Approved T. Islam	

GIE

Direct Shear Tests

Direct Shearbox Test

Summary

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	2.00-2.45				
	Description	Silty fine SAND, SP				
	Type	Disturbed Soil				
				Spm. 1	2	3
	Initial Height	H ₀	(mm)	20.0	20.0	20.0
	Initial Width	D ₀	(mm)	60.0	60.0	60.0
	Initial Weight	W ₀	(gr)	129.0	129.0	129.0
	Initial Bulk Density	ρ ₀	(Mg/m ³)	1.79	1.79	1.79
	Particle Density	ρ _s	(Mg/m ³)	2.65	2.65	2.65

Initial Condition				Spm. 1	2	3
Normal Stress Level		(kPa)		50	100	200
Is Specimen Submersed?				Yes	Yes	Yes
Reverse Method				Motor Drive		
Hoz. Control Machine				Not Used	Not Used	Not Used
Initial Moisture	ω _i	(%)		21	21	21
Initial Dry Density	ρ _{di}	(Mg/m ³)		1.48	1.48	1.48
Initial Voids Ratio	e _i	.		0.788	0.788	0.788
Initial Degree of Saturation	S _i	(%)		70.3	70.3	70.3
Notes						

Max Shear Stress Results				Spm. 1	2	3
Final Moisture	ω _f	(%)		23	22	22
Final Dry Density	ρ _{df}	(Mg/m ³)		1.49	1.51	1.60
Final Voids Ratio	e _f	.		0.814	0.790	0.689
Final Degree of Saturation	S _f	(%)		74.4	72.8	83.4
Peak Shear Stress		(kPa)		23.8	49.6	99.5
Hoz Displacement	L _H	(mm)		12.000	12.000	10.220
Vertical Displacement	L _V	(mm)		-0.300	-0.510	0.360

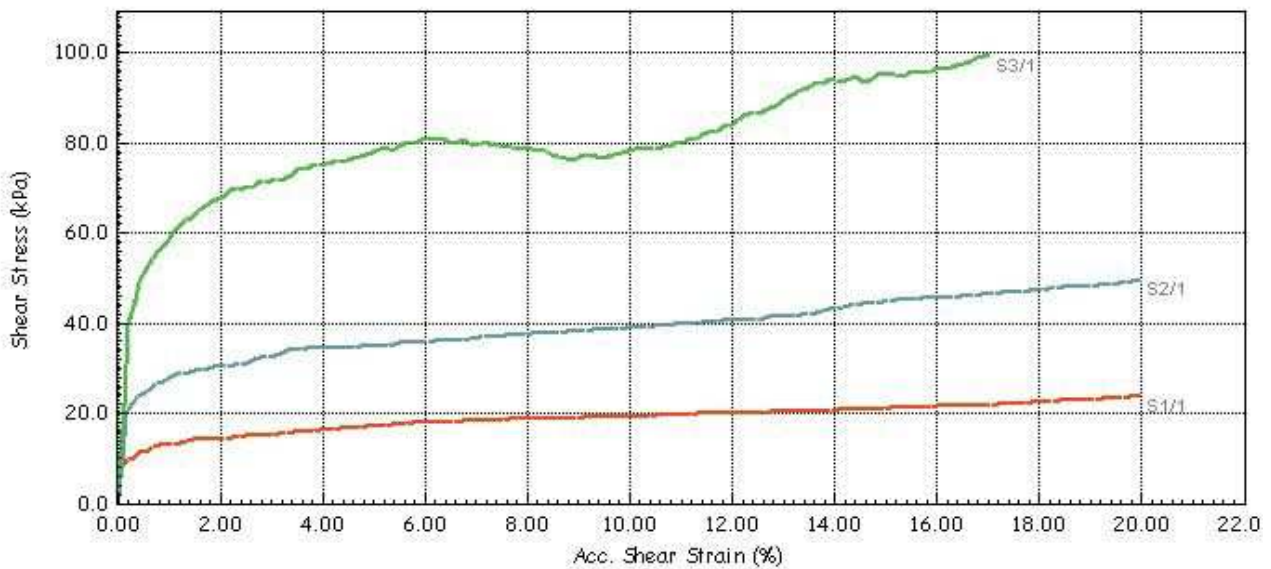
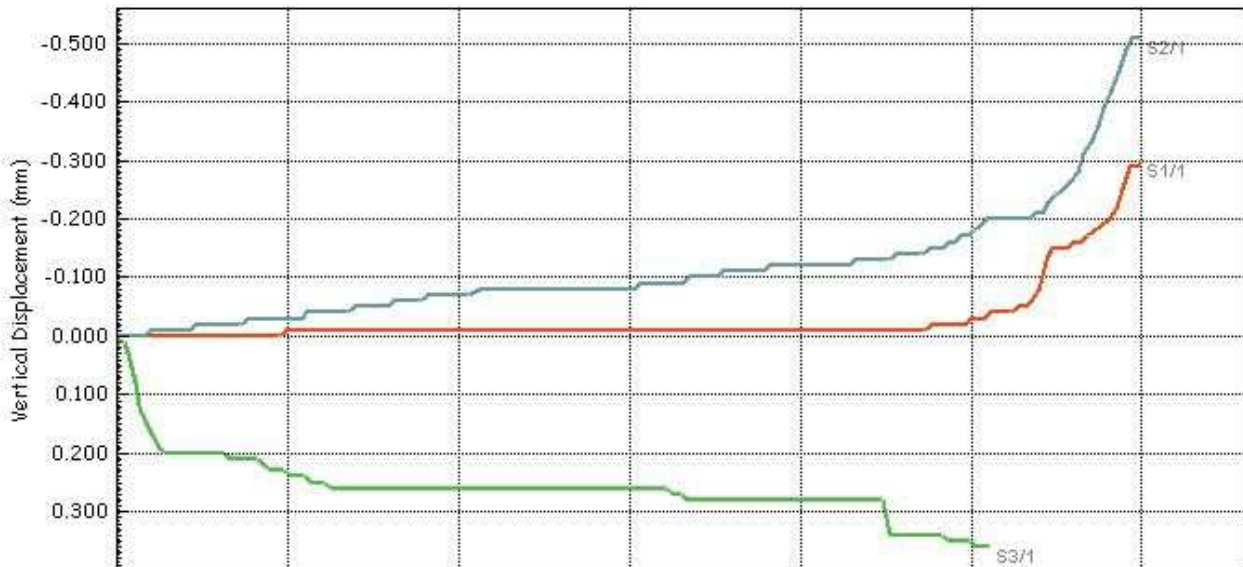
GIE

	Test Method		ASTM D 3080-04		Test Name		Direct Shear				
					Database:		.\SQLEXPRESS \ GIE-D				
	Site Reference				Test Date		3/11/2021				
	Jobfile		Direct Shear Test		Sample		SPT-02				
	Client		SGS		Borehole		BH-02				
Operator		R. Islam		Checked		Aminul		Approved		T. Islam	

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/11/2021	
	Jobfile Direct Shear Test		Sample SPT-02	
	Client SGS		Borehole BH-02	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

GIE

Direct Shear Tests

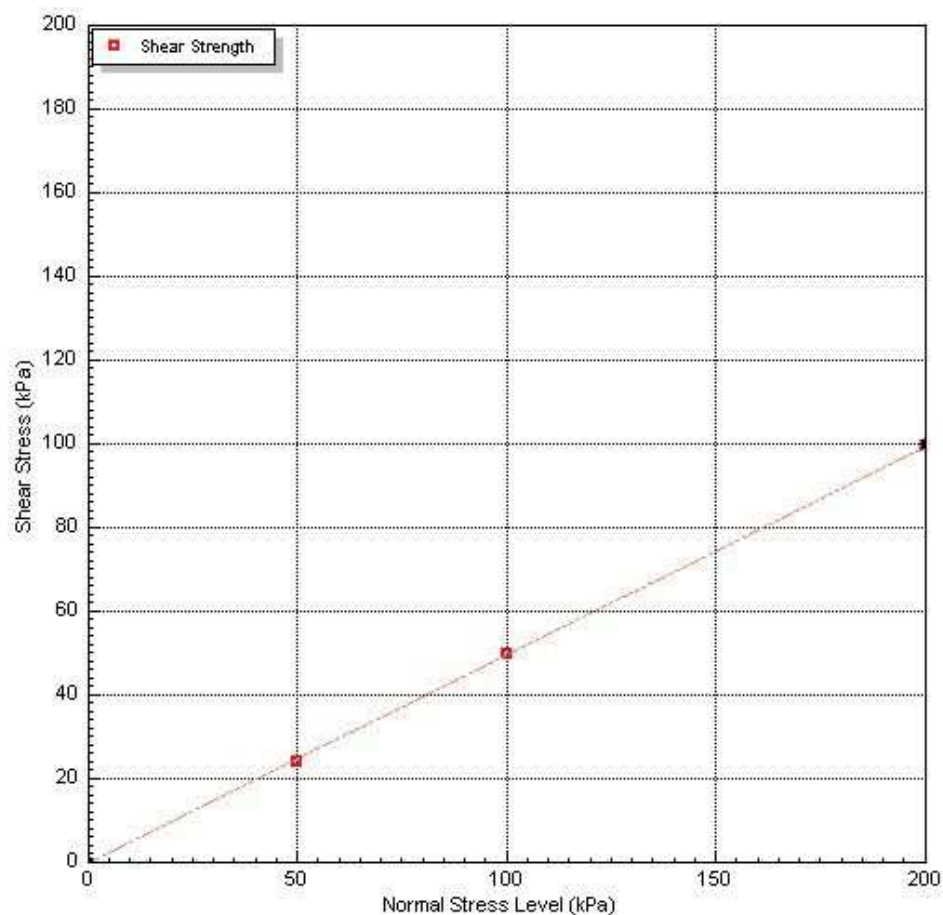
Direct Shearbox Test

Shear Stage

Envelope Failure Results

		Spm. 1	2	3
Final Moisture	ω_f (%)	23	22	22
Final Dry Density	ρ_{df} (Mg/m ³)	1.49	1.51	1.60
Final Voids Ratio	e_f	0.814	0.790	0.689
Final Degree of Saturation	S_f (%)	74.4	72.8	83.4
Apparent cohesion	c (kPa)	0.00		
Angle of Shearing Resistance	ϕ	26.3		

Notes



	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/11/2021
	Jobfile	Direct Shear Test	Sample	SPT-02
	Client	SGS	Borehole	BH-02
	Operator	R. Islam	Checked	Aminul
			Approved	T. Islam

GIE

Direct Shear Tests

Direct Shearbox Test

Summary

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	23.00-23.45				
	Type	Disturbed Soil				
				Spm. 1	2	3
	Initial Height	H ₀	(mm)	20.0	20.0	20.0
	Initial Width	D ₀	(mm)	60.0	60.0	60.0
	Initial Weight	W ₀	(gr)	152.7	152.7	152.7
	Initial Bulk Density	ρ ₀	(Mg/m ³)	2.12	2.12	2.12
	Particle Density	ρ _s	(Mg/m ³)	2.66	2.66	2.66

Initial Condition				Spm. 1	2	3
Normal Stress Level		(kPa)		250	500	1000
Is Specimen Submersed?				Yes	Yes	Yes
Reverse Method				Motor Drive		
Hoz. Control Machine				Not Used	Not Used	Not Used
Initial Moisture	ω _i %	(%)		17	17	17
Initial Dry Density	ρ _{di}	(Mg/m ³)		1.82	1.82	1.82
Initial Voids Ratio	e _i	.		0.463	0.463	0.463
Initial Degree of Saturation	S _i	(%)		95.7	95.7	95.7
Notes						

Max Shear Stress Results				Spm. 1	2	3
Final Moisture	ω _f %	(%)		20	18	17
Final Dry Density	ρ _{df}	(Mg/m ³)		1.82	1.87	1.90
Final Voids Ratio	e _f	.		0.440	0.368	0.351
Final Degree of Saturation	S _f	(%)		100.0	100.0	100.0
Peak Shear Stress		(kPa)		184.8	353.7	696.9
Hoz Displacement	L _H	(mm)		11.380	12.000	11.150
Vertical Displacement	L _V	(mm)		-0.240	-0.160	0.190

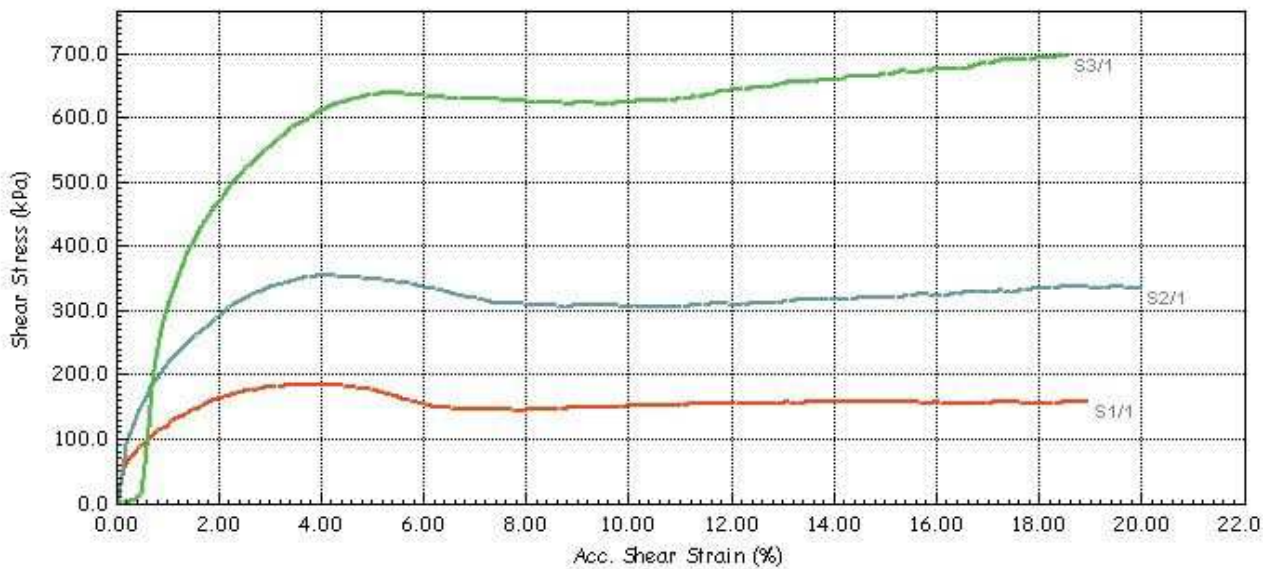
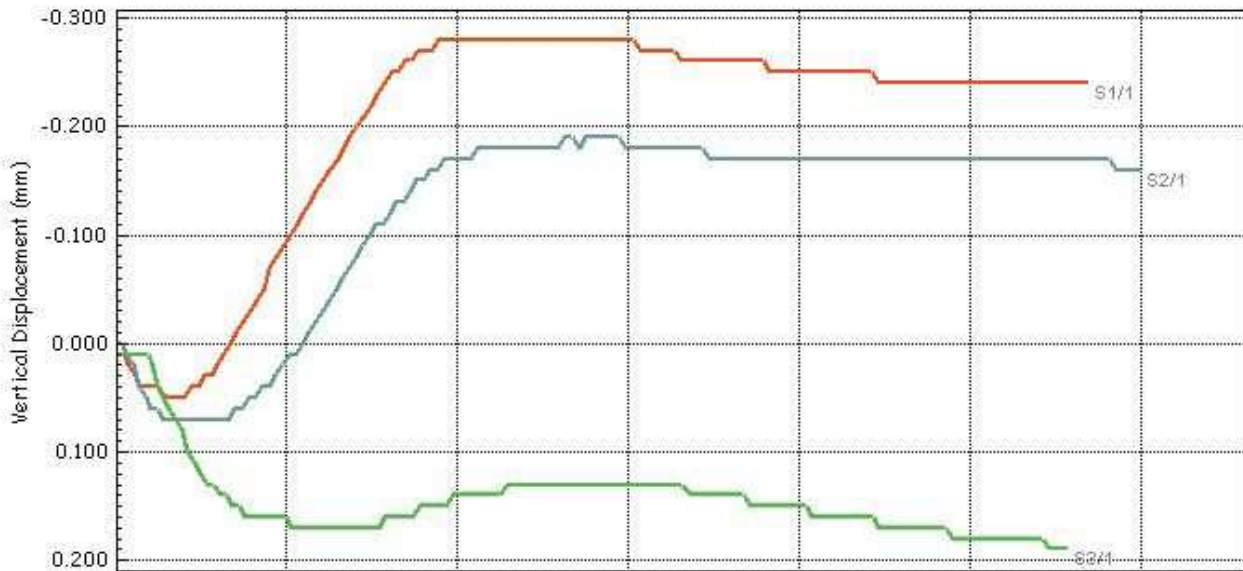
GIE

	Test Method	ASTM D 3080-04		Test Name	Direct Shear Test	
				Database:	.\SQLEXPRESS \ GIE-D	
	Site Reference			Test Date	3/14/2021	
	Jobfile	Direct Shear Test		Sample	SPT-21	
	Client	SGS		Borehole	BH-02	
Operator	R. Islam	Checked	Aminul	Approved	T. Islam	

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear Test	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/14/2021	
	Jobfile Direct Shear Test		Sample SPT-21	
	Client SGS		Borehole BH-02	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

GIE

Direct Shear Tests

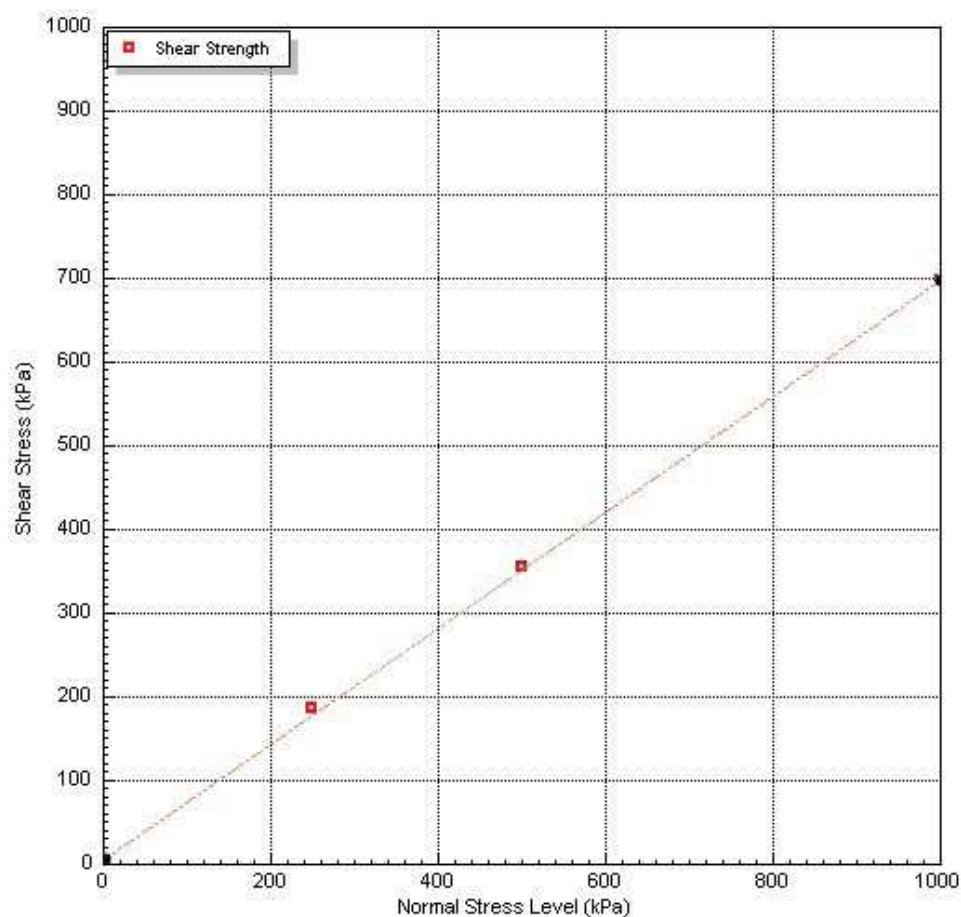
Direct Shearbox Test

Shear Stage

Envelope Failure Results

		Spm. 1	2	3
Final Moisture	ω_f (%)	20	18	17
Final Dry Density	ρ_{df} (Mg/m ³)	1.82	1.87	1.90
Final Voids Ratio	e_f	0.440	0.368	0.351
Final Degree of Saturation	S_f (%)	100.0	100.0	100.0
Apparent cohesion	c (kPa)	3.65		
Angle of Shearing Resistance	ϕ	34.8		

Notes



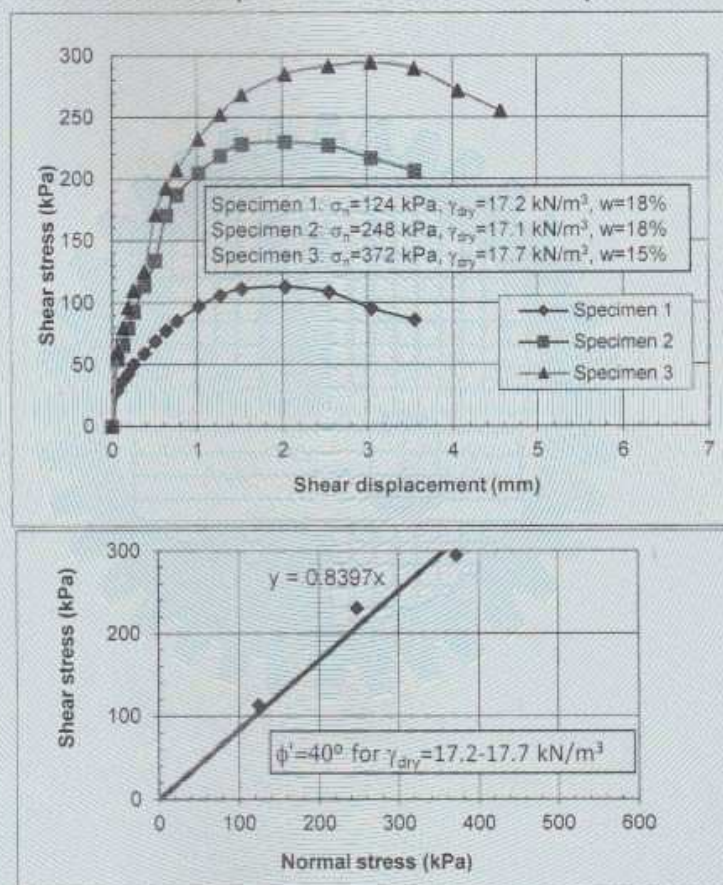
	Test Method		ASTM D 3080-04		Test Name		Direct Shear Test				
					Database: .\SQLEXPRESS \ GIE-D						
	Site Reference				Test Date				3/14/2021		
	Jobfile				Sample				SPT-21		
	Client				Borehole				BH-02		
Operator		R. Islam		Checked		Aminul		Approved		T. Islam	

GIE



BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand	Location: Matarbari	
Bore-Hole: 2	Sample: 23	Depth: 25-25.45 m
Date of Test: 7.4.21-12.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition.

Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.

Countersigned by :

[Signature]

Dr. A.B.M. Badruzzaman

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

[Signature] 8.5.21

Dr. Tahmeed M. Al-Hussaini

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.



BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

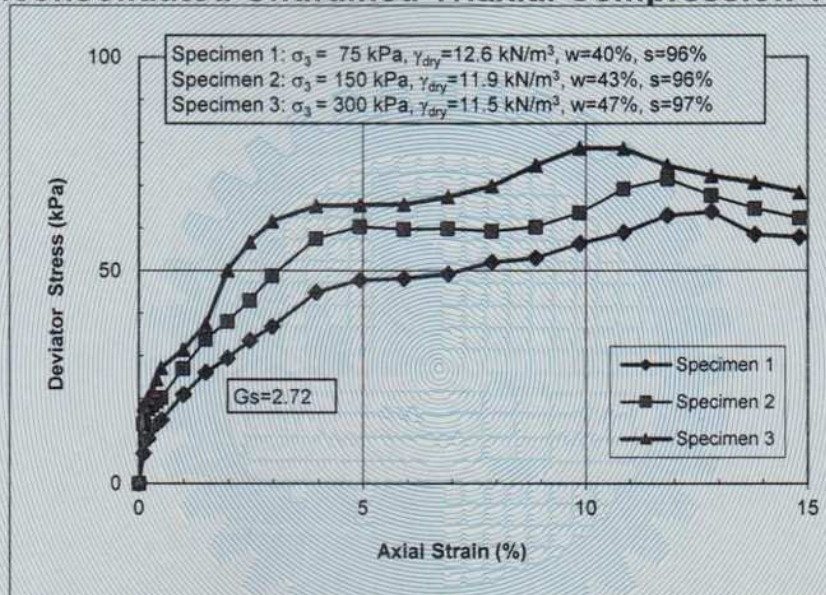


GEOTECHNICAL ENGINEERING LABORATORY

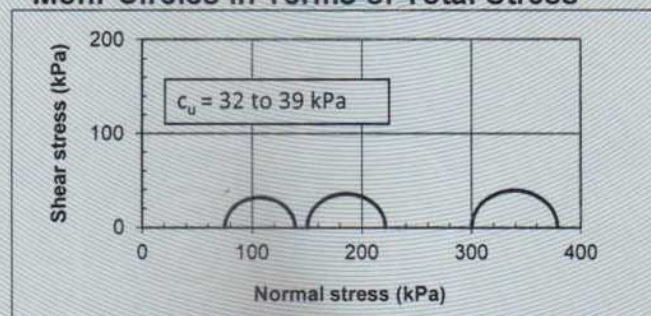
BRTC No.: 110-231613/20-21/CE dated 11.3.21		
Sent by: Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project: Geotechnical Investigation at Matarbari		
Soil description:	Grey soft silty clay, trace roots	Test Method: ASTM
B.H. No.: 2	Sample: UD-1	Depth: 6-7 m
Location: Matarbari	Date of Test: 2.5.21-5.5.21	

(Corrected Report)

Unconsolidated Undrained Triaxial Compression Test



Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading.

Countersigned by:

[Signature]

Dr. A.B.M. Badruzzaman
 Professor, Dept. of Civil Engineering
 BUET, Dhaka - 1000.

Test performed by:

[Signature] 3.6.21

Dr. Tahmeed M. Al-Hussaini
 Professor, Dept. of Civil Engineering
 BUET, Dhaka - 1000.



Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

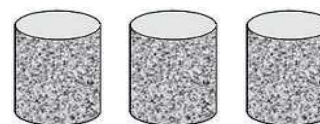
Summary Report

Sample Details		Depth	8.00-9.00			
 sketch showing specimen location in original sample		Type	UD	Spm. 1	2	3
		Initial Sample Length	L_0 (mm)	76.0	76.0	76.0
		Initial Sample Diameter	D_0 (mm)	38.0	38.0	38.0
		Initial Sample Weight	W_0 (gr)	158.4	158.9	158.0
		Bulk Density	ρ_0 (Mg/m ³)	1.84	1.84	1.83
		Particle Density	ρ_s (Mg/m ³)	2.70	2.70	2.70

Initial Conditions			Spm. 1	2	3
Specimen					
Initial Cell Pressure	σ_3 (kPa)		80	160	320
Strain Rate	$\dot{\epsilon}_s$ (mm/min)		0.76000	0.76000	0.76000
Membrane Thickness	m_b (mm)		0.02	0.02	0.02
Displacement Input	L_{IP} (mm)		CH 7	CH 7	CH 7
Load Input	N_{IP} (N)		CH 2	CH 2	CH 2
Initial Moisture	ω_i (%)		37	40	40
Initial Dry Density	ρ_{d0} (Mg/m ³)		1.34	1.32	1.31
Initial Voids Ratio	e_0		1.02	1.05	1.06
Initial Degree of Saturation	S_o (%)		99	100	100

Final Conditions			Spm. 1	2	3
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$ (kPa)		73.66	97.53	105.49
Membrane Correction	m_c (kPa)		40.760	40.727	40.760
Strain At Max Stress	ϵ_f (%)		6.54	6.34	5.37
Shear Strength	c_u (kPa)		36.83	48.76	52.74
Final Moisture	ω_f (%)		37	38	38
Final Dry Density	ρ_{df} (Mg/m ³)		1.34	1.34	1.33
Final Voids Ratio	e_f		1.02	1.02	1.03
Final Degree of Saturation	S_f (%)		99.0	100.0	99.3

Notes



Failure Sketch
(surface inclination)

	Test Method D 2850-03A (2007)		Test Name UU	
	Database: .\SQLEXPRESS \ GIE-D		Test Date 3/16/2021	
	Site Reference		Borehole BH-02	
	Jobfile UU		Sample UD-02	
	Client SGS		Depth 8.00-9.00	
	Operator R. Islam	Checked Aminul	Approved T. Islam	

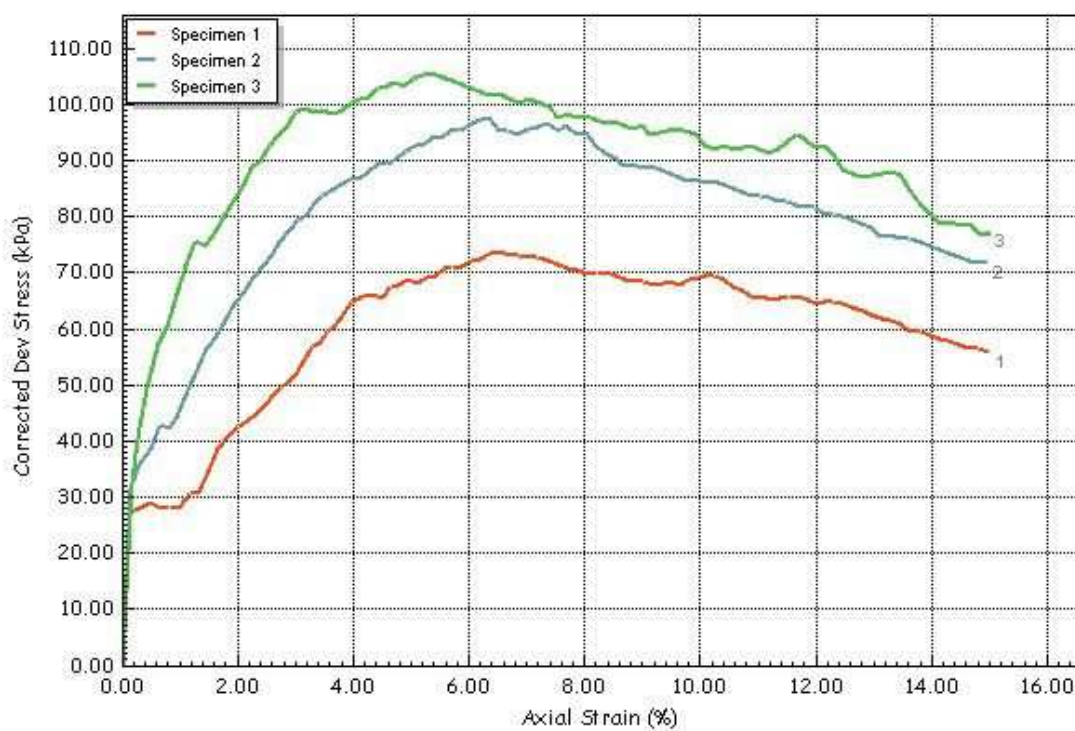
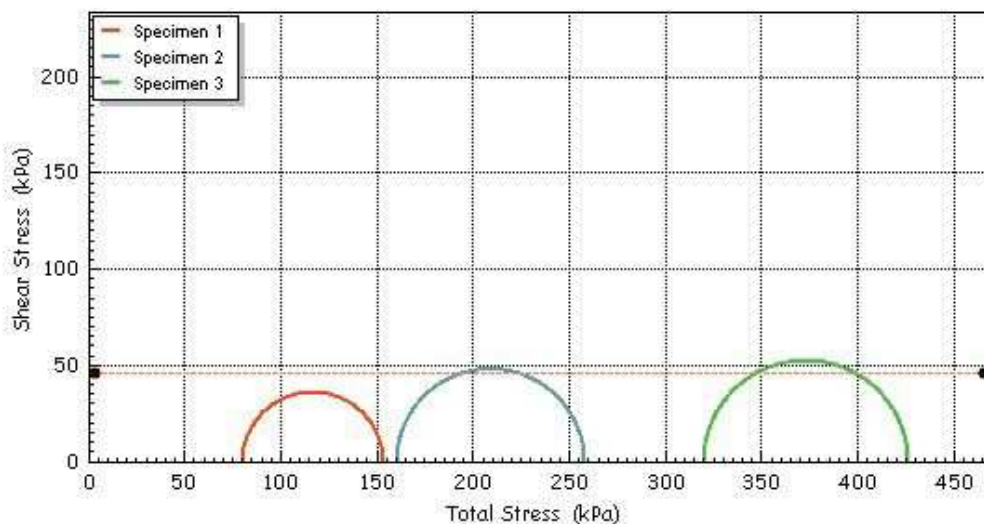
GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

Test Results Plots

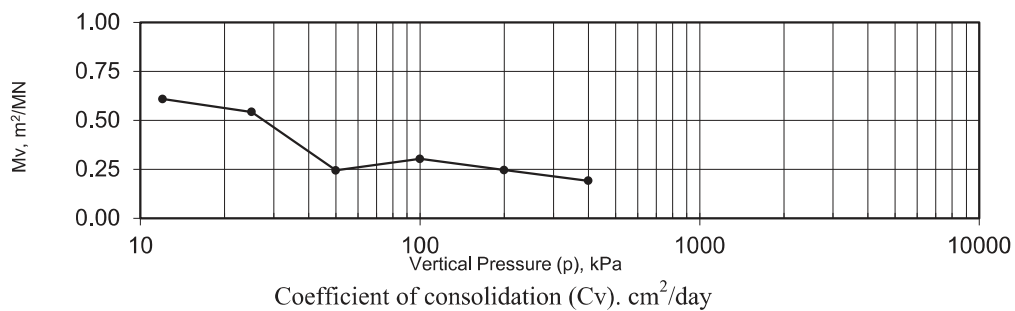
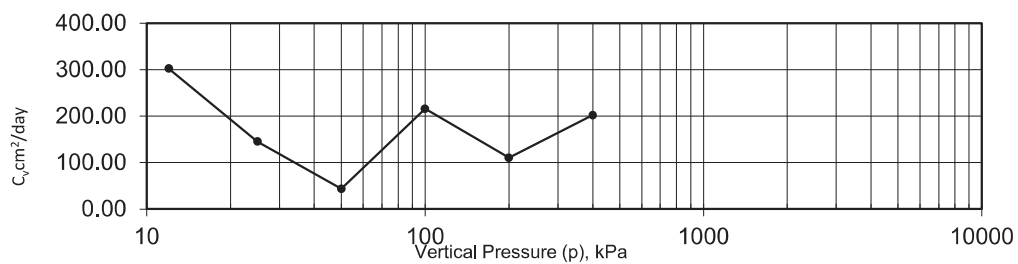
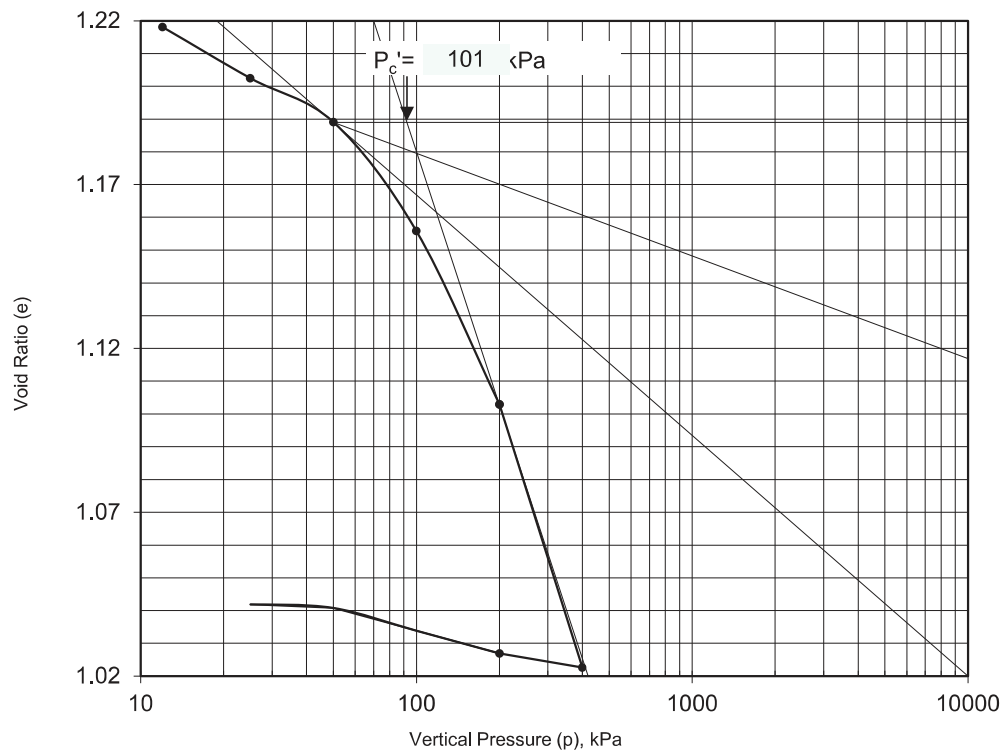
Cohesion Level	c	(kPa)	46.4
Friction Angle	ϕ	(deg)	0.0



	Test Method D 2850-03A (2007)		Test Name UU	
	Database: \SQLEXPRESS \ GIE-D		Test Date 3/16/2021	
	Site Reference		Borehole BH-02	
	Jobfile UU		Sample UD-02	
	Client SGS		Depth 8.00-9.00	
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GIE

Ground Instrumentation & Engineering Pte Ltd	OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11																																																																																																																										
Project : SIBD2105 Client - Location : Geotechnical Investigation for Matarbari Project Boring No : BH-02 Sample No : UD-01 Depth (m) : 6.00-7.00 Soil Description : Lean CLAY, CL <u>Moisture Content Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr><td>Wt. of Ring + Wet Soil, gm</td><td style="text-align: center;">= 142.00</td><td style="text-align: center;">139.66</td></tr> <tr><td>Wt. of Ring + Dry Soil, gm</td><td style="text-align: center;">= 117.50</td><td style="text-align: center;">117.50</td></tr> <tr><td>Weight of Water, gm</td><td style="text-align: center;">= 24.50</td><td style="text-align: center;">22.16</td></tr> <tr><td>Weight of Container, gm</td><td style="text-align: center;">= 69.52</td><td style="text-align: center;">69.52</td></tr> <tr><td>Weight of Dry Soil, gm</td><td style="text-align: center;">= 47.98</td><td style="text-align: center;">47.98</td></tr> <tr><td>Water Content, %</td><td style="text-align: center;">= 51.1</td><td style="text-align: center;">46.2</td></tr> </tbody> </table> <u>Unit Weight Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr><td>Wt. of Ring + Wet Soil, gm</td><td style="text-align: center;">= 142.00</td><td style="text-align: center;">139.66</td></tr> <tr><td>Weight of Ring, gm</td><td style="text-align: center;">= 69.52</td><td style="text-align: center;">69.52</td></tr> <tr><td>Weight of Wet Soil, gm</td><td style="text-align: center;">= 72.48</td><td style="text-align: center;">70.14</td></tr> <tr><td>Height of Sample, cm</td><td style="text-align: center;">= 2</td><td style="text-align: center;">1.828</td></tr> <tr><td>Diameter of Sample, cm</td><td style="text-align: center;">= 5</td><td style="text-align: center;">5</td></tr> <tr><td>Volume of Sample, cm³</td><td style="text-align: center;">= 39.27</td><td style="text-align: center;">35.89</td></tr> <tr><td>Unit Wet Weight, kN/m³</td><td style="text-align: center;">= 18.1</td><td style="text-align: center;">19.2</td></tr> <tr><td>Unit Dry Weight, kN/m³</td><td style="text-align: center;">= 12.0</td><td style="text-align: center;">13.1</td></tr> </tbody> </table> <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Specific Gravity</td><td style="text-align: center;">= 2.73</td></tr> <tr><td>Initial Void Ratio</td><td style="text-align: center;">= 1.234</td></tr> <tr><td>Degree of Saturation, %</td><td style="text-align: center;">= 100.0</td></tr> <tr><td>Room Temperature, °C</td><td style="text-align: center;">= 24.0</td></tr> <tr><td>Temp. correction factor</td><td style="text-align: center;">= 0.91</td></tr> <tr><td>Initial Transducer Reading</td><td style="text-align: center;">= 8.52</td></tr> <tr><td>Effective Overburden Pressure</td><td style="text-align: center;">=</td></tr> <tr><td>Preconsolidation Pressure</td><td style="text-align: center;">= 101</td></tr> <tr><td>Compression Index (Cc)</td><td style="text-align: center;">= 0.2570</td></tr> </tbody> </table>				<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	= 142.00	139.66	Wt. of Ring + Dry Soil, gm	= 117.50	117.50	Weight of Water, gm	= 24.50	22.16	Weight of Container, gm	= 69.52	69.52	Weight of Dry Soil, gm	= 47.98	47.98	Water Content, %	= 51.1	46.2		<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	= 142.00	139.66	Weight of Ring, gm	= 69.52	69.52	Weight of Wet Soil, gm	= 72.48	70.14	Height of Sample, cm	= 2	1.828	Diameter of Sample, cm	= 5	5	Volume of Sample, cm ³	= 39.27	35.89	Unit Wet Weight, kN/m ³	= 18.1	19.2	Unit Dry Weight, kN/m ³	= 12.0	13.1	Specific Gravity	= 2.73	Initial Void Ratio	= 1.234	Degree of Saturation, %	= 100.0	Room Temperature, °C	= 24.0	Temp. correction factor	= 0.91	Initial Transducer Reading	= 8.52	Effective Overburden Pressure	=	Preconsolidation Pressure	= 101	Compression Index (Cc)	= 0.2570																																																							
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Tested By: Rayhan Date: 19-03-2021 Checked & Approved By: T. Islam Date: 23-03-2021																																																																																																																											



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-02
 Sample : UD-01
 Depth (m) : 6.00-7.00

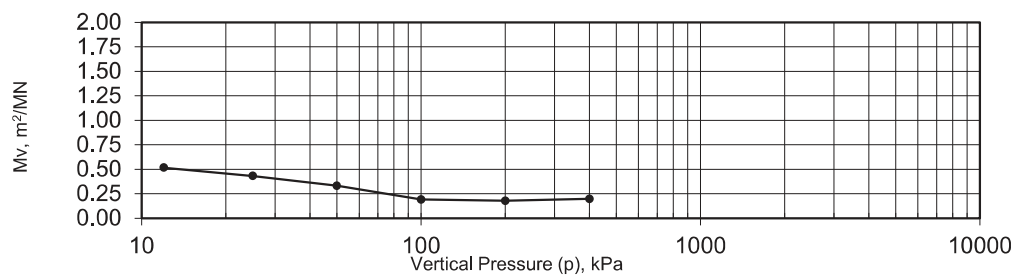
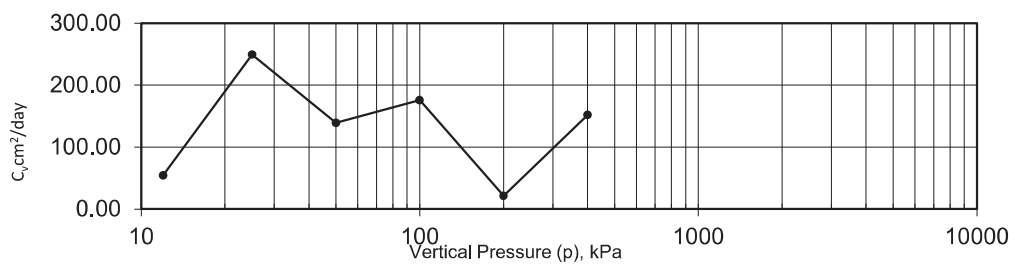
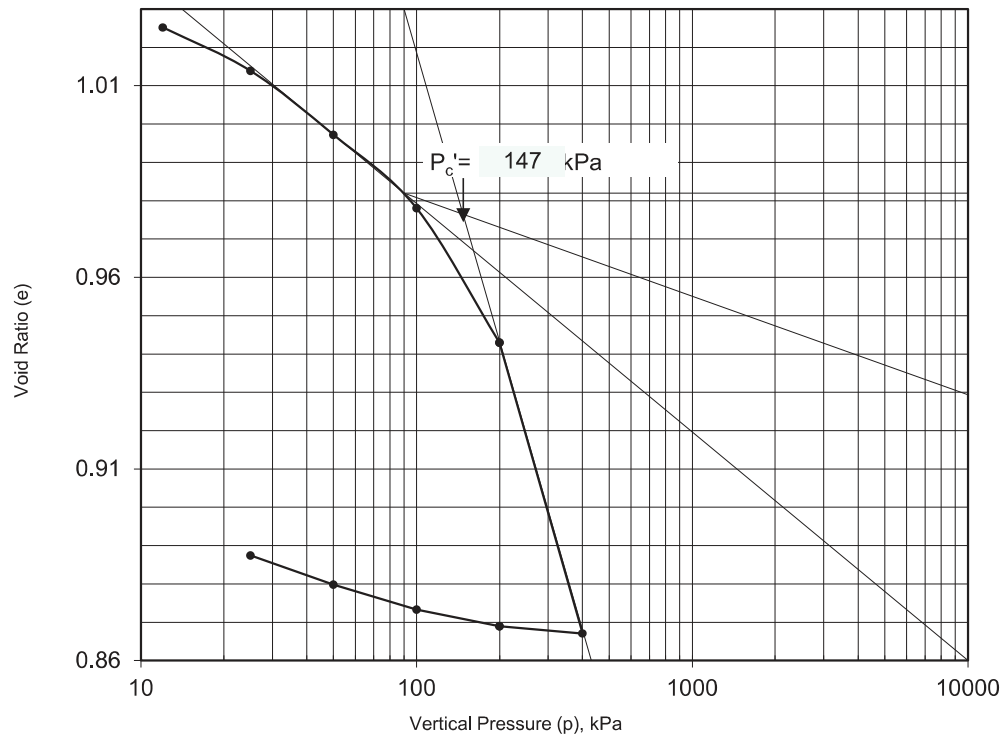


Ground Instrumentation &
Engineering Pte Ltd

Ground Instrumentation & Engineering Pte Ltd	OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11																																																																																																																										
Project : Geotechnical Investigation for Matarbari Project Client - Location : TEPSCO Boring No : BH-02 Sample No : UD-02 Depth (m) : 8.00-9.00 Soil Description : Lean CLAY, CL																																																																																																																											
<u>Moisture Content Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr> <td>Wt. of Ring + Wet Soil, gm</td> <td style="text-align: center;">141.20</td> <td style="text-align: center;">138.68</td> </tr> <tr> <td>Wt. of Ring + Dry Soil, gm</td> <td style="text-align: center;">121.50</td> <td style="text-align: center;">121.50</td> </tr> <tr> <td>Weight of Water, gm</td> <td style="text-align: center;">19.70</td> <td style="text-align: center;">17.18</td> </tr> <tr> <td>Weight of Container, gm</td> <td style="text-align: center;">69.47</td> <td style="text-align: center;">69.47</td> </tr> <tr> <td>Weight of Dry Soil, gm</td> <td style="text-align: center;">52.03</td> <td style="text-align: center;">52.03</td> </tr> <tr> <td>Water Content, %</td> <td style="text-align: center;">37.9</td> <td style="text-align: center;">33.0</td> </tr> </tbody> </table>				<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	141.20	138.68	Wt. of Ring + Dry Soil, gm	121.50	121.50	Weight of Water, gm	19.70	17.18	Weight of Container, gm	69.47	69.47	Weight of Dry Soil, gm	52.03	52.03	Water Content, %	37.9	33.0																																																																																																				
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Tested By: Rayhan Date: 19-03-2021 Checked & Approved By: T. Isla Date: 23-03-2021																																																																																																																											

ASTM D2435/D2435M - 11

$C_c = 0.250285$



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-02
 Sample : UD-02
 Depth (m) : 8.00-9.00



Ground Instrumentation &
 Engineering Pte Ltd

GEOTECHNICAL AND MATERIAL LABORATORY
Ground Instrumentation & Engineering Pte.Ltd.
House-7 Road-12, Dhaka 1230

LABORATORY COMPACTION TEST DATA
(Dry Density- Moisture Content Relationship)
ASTM D1557

Date: 25/03/2021

Project : Geotechnical Investigation for Matarbari, ID-SIBD-2105
Client : SGS
Test Pit No. : BH-02
Sample Depth : 1.00 m
Method: Standard Proctor (using 2.5 kg rammer)

Volume of Mould: 950 cm³

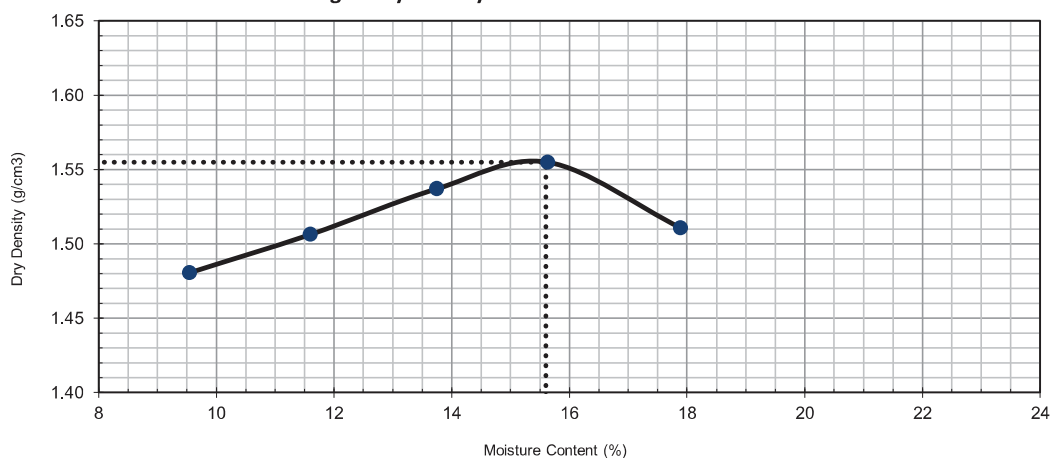
Test No.:		1	2	3	4	5	
Mass of Mould+ Base+Compacted Materials (m2)	g	5201	5257	5321	5368	5352	
Mass of Mould+ Base(m1)	g	3660	3660	3660	3660	3660	
mass of Compacted Materials(m2-m1)	g	1541	1597	1661	1708	1692	
Bulk Density, $\rho = \frac{m2 - m1}{vol. of mold}$	g/cm ³	1.622	1.681	1.748	1.798	1.781	
Moisture Content (w)	%	9.55	11.60	13.75	15.63	17.89	
Dry Density, $\rho_d = \frac{100\rho}{100 + w}$	g/cm ³	1.481	1.506	1.537	1.555	1.511	

MOISTURE CONTENT

Test No.:		1		2		3		4		5			
Container No.:		B-42	B-55	B-50	B-43	B-68	B-47	B-63	B-77	B-54	B-40		
Mass of container + wet soil	g	62.5	61.7	71.9	57.34	60.56	60.94	57.16	60.53	72.83	80.27		
mass of container + dry soil	g	59.3	58.8	67.91	53.49	56.1	57.3	53.17	55.6	66.9	73.8		
Mass of Water	g	3.16	2.81	3.96	3.85	4.46	3.69	3.99	4.93	5.91	6.49		
Mass of Container	g	26.42	29.24	33.67	20.39	23.91	30.21	27.37	24.4	33.8	37.6		
Mass of Dry Soil	g	32.9	29.6	34.24	33.1	32.19	27.04	25.8	31.2	33.12	36.18		
Moisture Content	%	9.60	9.49	11.57	11.63	13.86	13.65	15.47	15.80	17.84	17.94		
Average Moisture Content	%	9.5		11.6		13.8		15.6		17.9			

Maximum Dry Density	1.555	g/cm ³
Optimum Moisture Content	15.6	%

Fig. : Dry Density vs Moisture Content Curve





BH-03

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10	
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Sample No.:	SPT-02	Depth (m): 2.00-2.45
Can No.	405	
Weight of Wet Soil + Can (gm)	230.34	
Weight of Dry Soil + can (gm)	196.33	
Weight of Can (gm)	27.45	
Moisture Content (%)	20.14	
Description	Fine-medium SAND with Silt, SP-SM	

Sample No.:	SPT-04	Depth (m): 4.00-4.45
Can No.	402	
Weight of Wet Soil + Can (gm)	159.50	
Weight of Dry Soil + can (gm)	139.41	
Weight of Can (gm)	25.92	
Moisture Content (%)	17.70	
Description	Fine-medium SAND, SP	

Sample No.:	UD-01	Depth (m): 8.00-9.00
Can No.	105	
Weight of Wet Soil + Can (gm)	180.80	
Weight of Dry Soil + can (gm)	138.34	
Weight of Can (gm)	14.58	
Moisture Content (%)	34.31	
Description	Lean CLAY, CL	

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10			
Sample No.:		UD-02		Depth (m): 12.00-13.00	
Can No.		95			
Weight of Wet Soil + Can (gm)		208.00			
Weight of Dry Soil + can (gm)		167.94			
Weight of Can (gm)		13.70			
Moisture Content (%)		25.97			
Description		Silty fine SAND, SM			
Sample No.:		MZ-01		Depth (m): 17.00-18.00	
Can No.		410			
Weight of Wet Soil + Can (gm)		236.60			
Weight of Dry Soil + can (gm)		184.93			
Weight of Can (gm)		26.86			
Moisture Content (%)		32.69			
Description		Lean CLAY with Sand, CL			
Sample No.:		SPT-15		Depth (m): 18.00-18.45	
Can No.		102			
Weight of Wet Soil + Can (gm)		187.81			
Weight of Dry Soil + can (gm)		147.34			
Weight of Can (gm)		13.85			
Moisture Content (%)		30.32			
Description		Sandy lean CLAY, CL			

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

Ground Instrumentation & Engineering Pte Ltd	MOISTURE CONTENT ASTM D2216-10		
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Sample No.:	SPT-20	Depth (m): 23.00-23.45
Can No.	50	
Weight of Wet Soil + Can (gm)	173.03	
Weight of Dry Soil + can (gm)	141.50	
Weight of Can (gm)	12.78	
Moisture Content (%)	24.50	
Description	Silty fine SAND, SM	

Sample No.:	MZ-02	Depth (m): 27.00-27.45
Can No.	210	
Weight of Wet Soil + Can (gm)	176.12	
Weight of Dry Soil + can (gm)	152.45	
Weight of Can (gm)	26.05	
Moisture Content (%)	18.73	
Description	Fine SAND with Silt, SP-SM	

Sample No.:		
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-03

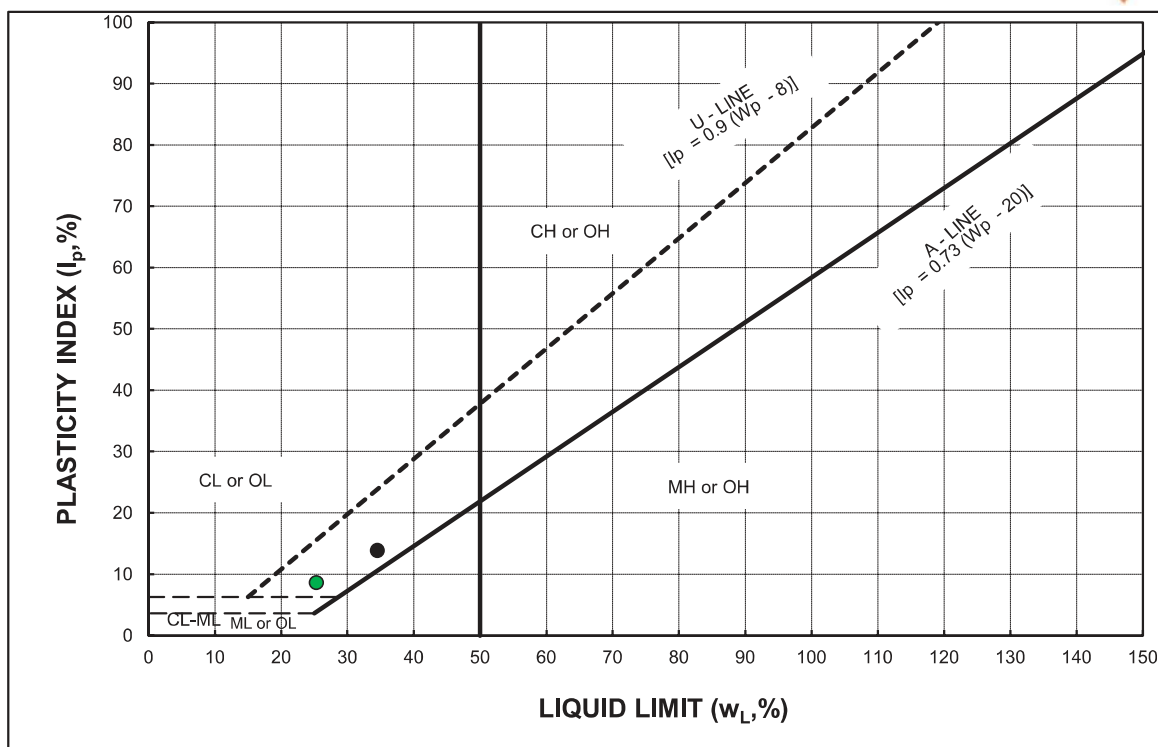
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 01-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021



	Sample No.	Depth	w_L	w_p	I_p	Fines	Remarks
●	UD-01	8.00-9.00	34.50	20.59	13.91		Lean CLAY, CL
●	UD-02	12.00-13.00	*	*	*		The sample is nonplastic
●	SPT-15	18.00-18.45	25.30	16.67	8.63		Lean CLAY, CL
●							
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05

*Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

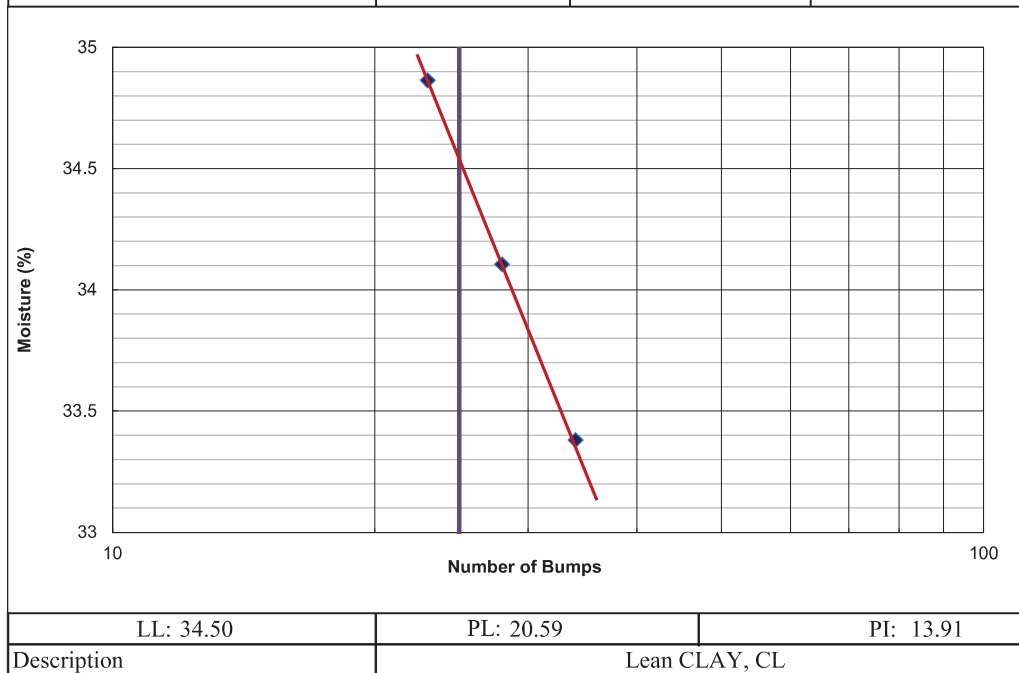
Sample No: UD-01

BH No.: BH-03

Sample Depth: 8.00-9.00

Plastic Limit Test		
Container No.	224	51
Weight of can (gm)	12.84	12.79
Wet weight of soil + can (gm)	35.35	35.37
Dry Weight of soil + can (gm)	31.52	31.5
Moisture Content %	20.50	20.68
Average	20.59	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	34
Container No.	319	478	476
Weight of can (gm)	9.25	4.08	4.16
Wet weight of soil + can (gm)	28.63	24.33	23.18
Dry Weight of soil + can (gm)	23.62	19.18	18.42
Moisture Content %	34.86	34.11	33.38



Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

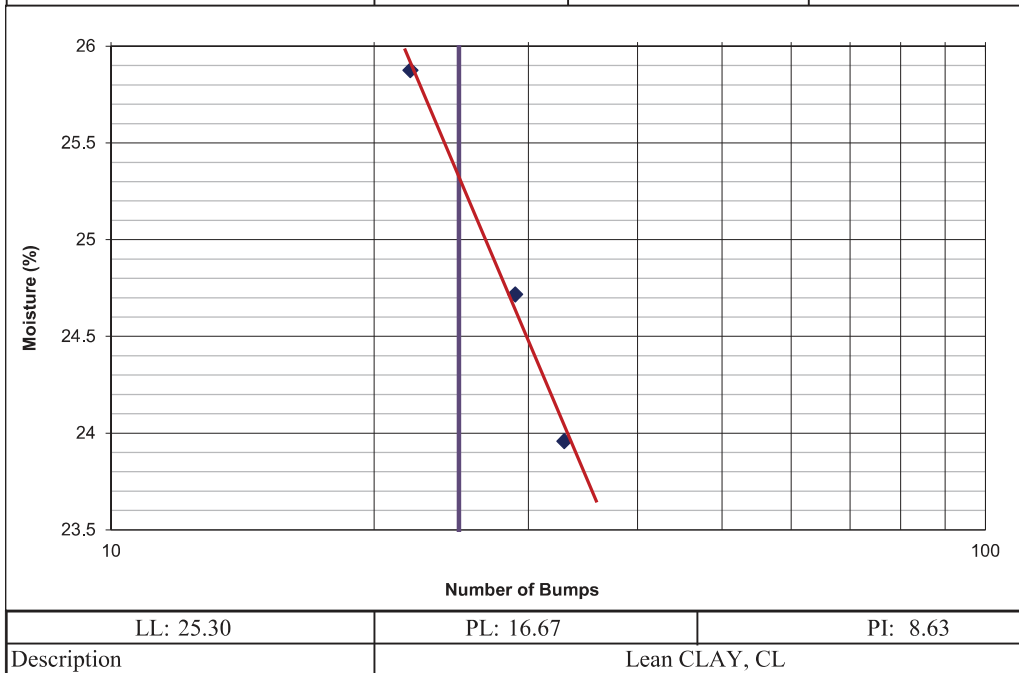
Sample No.: SPT-15

BH No.: BH-03

Sample Depth.: 18.00-18.45

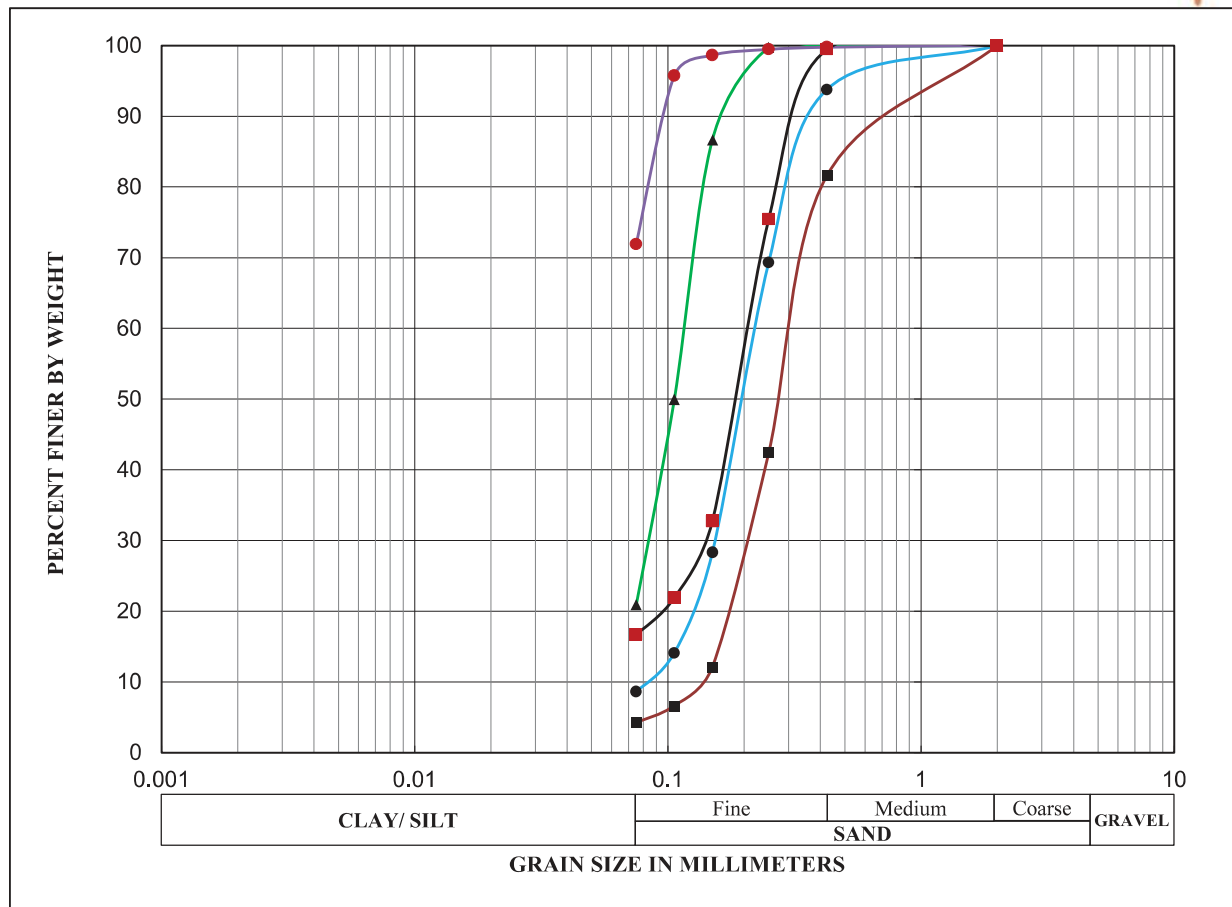
Plastic Limit Test		
Container No.	423	348
Weight of can (gm)	8.26	8.24
Wet weight of soil + can (gm)	33.72	33.74
Dry Weight of soil + can (gm)	30.1	30.08
Moisture Content %	16.58	16.76
Average	16.67	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	29	33
Container No.	334	327	328
Weight of can (gm)	9.9	8.08	8.24
Wet weight of soil + can (gm)	29.31	25.74	24.9
Dry Weight of soil + can (gm)	25.32	22.24	21.68
Moisture Content %	25.88	24.72	23.96



Tested by: Rayhan
Date: 02-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Fine-medium SAND with Silt, SP-SM					2.75	1.26
■	SPT-04	4.00-4.45	Fine-medium SAND, SP					2.47	1.00
▲	UD-02	12.00-13.00	Silty fine SAND, SM						
●	MZ-01	17.00-18.00	Lean CLAY with Sand, CL						
■	SPT-20	23.00-23.45	Silty fine SAND, SM						
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
								%Fine	%Medium	%Coarse	
●	SPT-02	2.00-2.45	0.227	0.203	0.154	0.083	0.00	85.14	6.22	0.00	8.64
■	SPT-04	4.00-4.45	0.329	0.284	0.209	0.133	0.00	77.32	18.40	0.00	4.28
▲	UD-02	12.00-13.00	0.118	0.106	0.085	0.036	0.00	78.96	0.12	0.00	20.92
●	MZ-01	17.00-18.00	0.063	0.052	0.031	0.010	0.00	27.84	0.24	0.00	71.92
■											
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

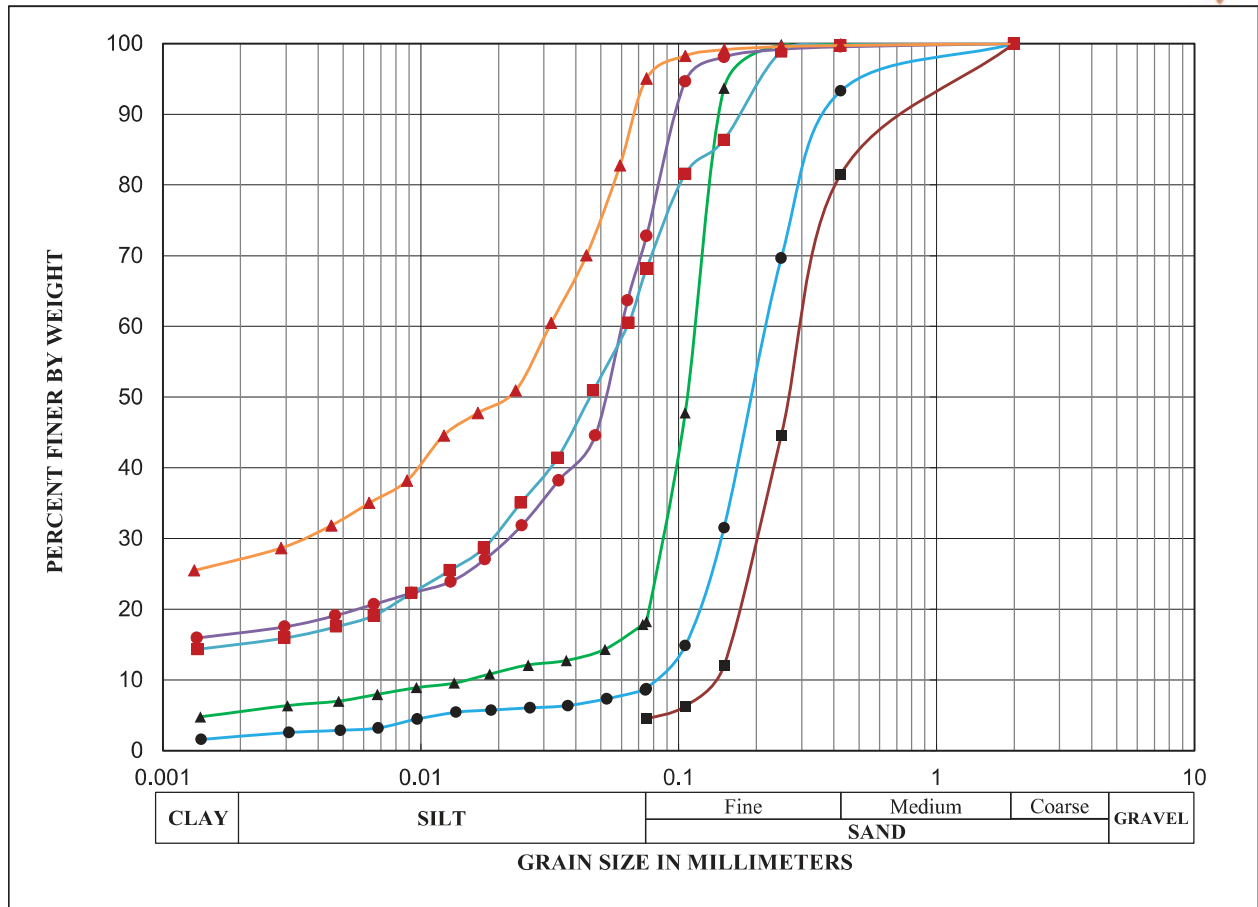
Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 02-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021



Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
● SPT-02	2.00-2.45	Fine-medium SAND with Silt, SP-SM					2.76	1.17
■ SPT-04	4.00-4.45	Fine-medium SAND, SP					2.40	0.97
▲ UD-02	12.00-13.00	Silty fine SAND, SM						
● MZ-01	17.00-18.00	Lean CLAY with Sand, CL						
■ SPT-15	18.00-18.45	Sandy lean CLAY, CL						
▲ SPT-18	21.00-21.45	Clayey SILT, CL-ML						

Sample	Depth	D ₆₀	D ₅₀	D ₃₀	D ₁₀	%Gravel	%Sand			%SILT	%CLAY
							%Fine	%Medium	%Coarse		
● SPT-02	2.00-2.45	0.225	0.198	0.146	0.081	0.00	84.54	6.70	0.00	7.17	1.59
■ SPT-04	4.00-4.45	0.323	0.276	0.205	0.134	0.00	77.00	18.50	0.00	4.50	
▲ UD-02	12.00-13.00	0.118	0.108	0.087	0.015	0.00	81.72	0.00	0.00	13.50	4.78
● MZ-01	17.00-18.00	0.060	0.052	0.022	0.001	0.00	26.76	0.46	0.00	56.86	15.92
■ SPT-15	18.00-18.45	0.063	0.045	0.019	0.001	0.00	31.62	0.26	0.00	53.79	14.33
▲ SPT-18	21.00-21.45	0.032	0.021	0.004	0.001	0.00	4.66	0.28	0.00	69.59	25.47

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

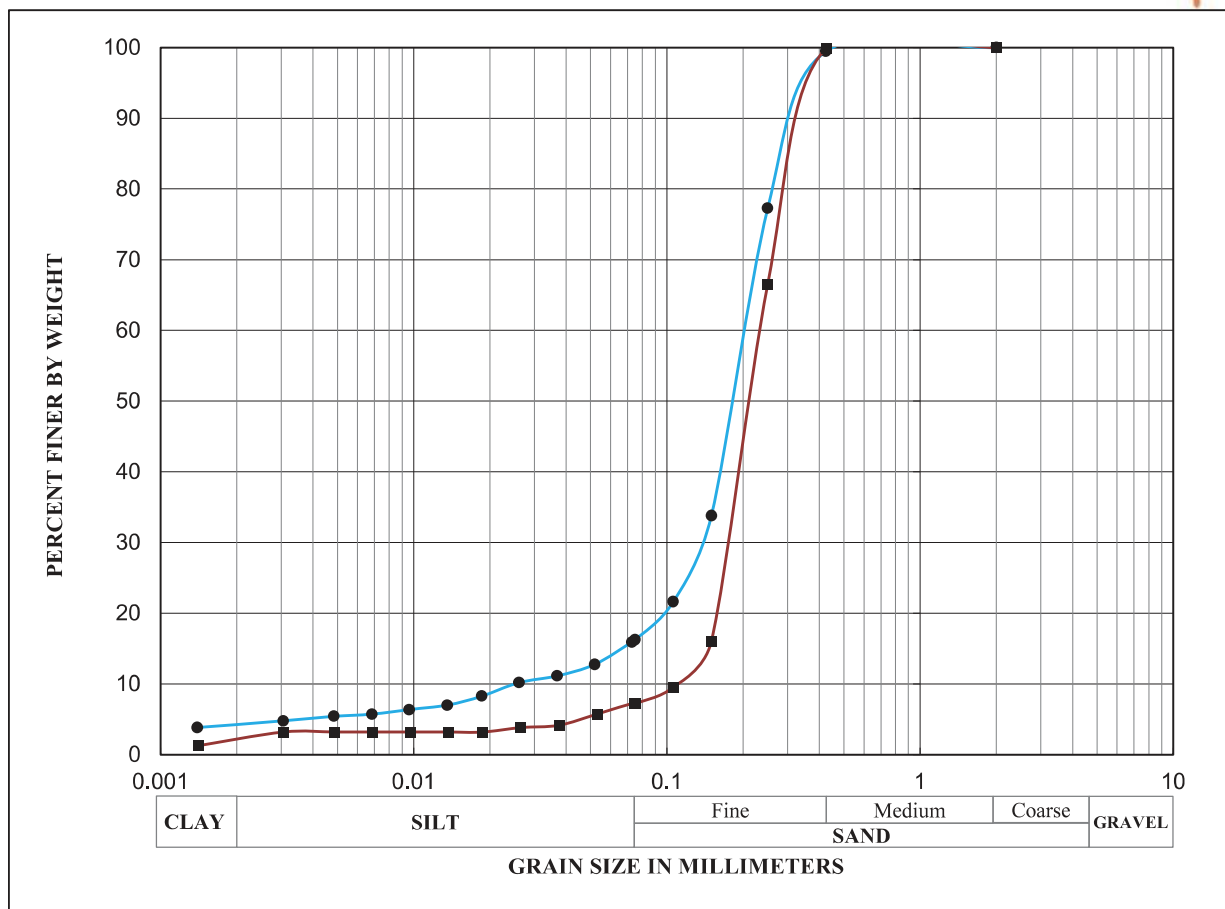
Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-20	23.00-23.45	Silty fine SAND, SM						
■	MZ-02	27.00-27.45	Fine SAND with Silt, SP-SM					2.17	1.22
▲									
●									
■									
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
								%Fine	%Medium	%Coarse		
●	SPT-20	23.00-23.45	0.210	0.187	0.136	0.025	0.00	83.22	0.54	0.00	12.42	3.82
■												
▲												
●												
■												
▲												

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-02	Depth(m)	2.00-2.45
Pyknometer No.		14
Mass of bottle + soil + water: M_3	gm	99.02
Mass of bottle + soil: M_2	gm	60.32
Mass of bottle + water: M_4	gm	80.30
Mass of bottle: M_1	gm	30.28
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	19.99
Mass of water used: $M_3 - M_2$	gm	38.70
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.32
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.:	110-231613/20-21/CE Dated 11.3.21
Client :	Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka
Ref :	SGS/Phase-2/SI/090321 dated 9.3.21
Project :	Geotechnical Investigation at Matarbari
Location:	Matarbari
Test Method:	ASTM
Date of Test:	1-10.4.21 *

SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	1	2	3.0	4.0	5.0	6.0
Depth (m)	14-14.5	25-25.45	4-4.5	17-17.45	17-17.45	26-26.45
Sample No.	12.0	23.0	4.0	15.0	14.0	23.0
Soil Type	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand
Wt. of bottle+water+ soil, gm	371.6	375.3	373.4	371.6	380.1	396.4
Temperature (°C)	30.5	30.0	30.5	30.5	30.5	30.0
Wt. of bottle+water, gm	340.0	343.7	342.1	340.4	348.8	365.1
Wt. of soil, gm	49.8	49.2	49.9	49.3	49.7	48.6
Specific Gravity	2.72	2.78	2.67	2.71	2.69	2.80

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

Countersigned by :

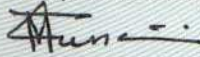
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Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



44A76bmM6

Test performed by :


25.5.21
Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



UD-02	Depth(m)	12.00-13.00
Pyknometer No.		19
Mass of bottle + soil + water: M_3	gm	123.82
Mass of bottle + soil: M_2	gm	72.39
Mass of bottle + water: M_4	gm	105.04
Mass of bottle: M_1	gm	42.41
Mass of soil: $M_2 - M_1$	gm	29.98
Mass of water in full bottle: $M_4 - M_2$	gm	32.65
Mass of water used: $M_3 - M_2$	gm	51.43
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.20
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.67

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



MZ-01	Depth(m)	17.00-18.00
Pyknometer No.		18
Mass of bottle + soil + water: M_3	gm	118.74
Mass of bottle + soil: M_2	gm	73.90
Mass of bottle + water: M_4	gm	99.79
Mass of bottle: M_1	gm	43.85
Mass of soil: $M_2 - M_1$	gm	30.05
Mass of water in full bottle: $M_4 - M_2$	gm	25.89
Mass of water used: $M_3 - M_2$	gm	44.84
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.10
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.70

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-15	Depth(m)	18.00-18.45
Pyknometer No.		10
Mass of bottle + soil + water: M_3	gm	99.24
Mass of bottle + soil: M_2	gm	59.82
Mass of bottle + water: M_4	gm	80.37
Mass of bottle: M_1	gm	29.83
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	20.55
Mass of water used: $M_3 - M_2$	gm	39.42
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.12
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-20	Depth(m)	23.00-23.45
Pyknometer No.		9
Mass of bottle + soil + water: M_3	gm	97.33
Mass of bottle + soil: M_2	gm	57.79
Mass of bottle + water: M_4	gm	78.61
Mass of bottle: M_1	gm	27.80
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	20.82
Mass of water used: $M_3 - M_2$	gm	39.54
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.27
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.66

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



MZ-02	Depth(m)	27.00-27.45
Pyknometer No.		4
Mass of bottle + soil + water: M_3	gm	118.60
Mass of bottle + soil: M_2	gm	73.87
Mass of bottle + water: M_4	gm	99.90
Mass of bottle: M_1	gm	43.88
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	26.03
Mass of water used: $M_3 - M_2$	gm	44.73
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.29
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-01	Depth (m):	8.00-9.00
Weight of soil	gm	157.20
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.82
Dry Density	(g/cm ³)	1.36
Void Ratio		1.04
Moisture Content	%	34.31
Specific Gravity	(g/cm ³)	2.77

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-02	Depth (m):	12.00-13.00
Weight of soil	gm	164.70
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.91
Dry Density	(g/cm ³)	1.52
Void Ratio		0.76
Moisture Content	%	25.97
Specific Gravity	(g/cm ³)	2.67

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

MZ-01	Depth (m):	17.00-18.00
Weight of soil	gm	165.30
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.92
Dry Density	(g/cm ³)	1.45
Void Ratio		0.87
Moisture Content	%	32.69
Specific Gravity	(g/cm ³)	2.70

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

MZ-02	Depth (m):	27.00-27.45
Weight of soil	gm	158.90
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.84
Dry Density	(g/cm ³)	1.55
Void Ratio		0.71
Moisture Content	%	18.73
Specific Gravity	(g/cm ³)	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-03

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



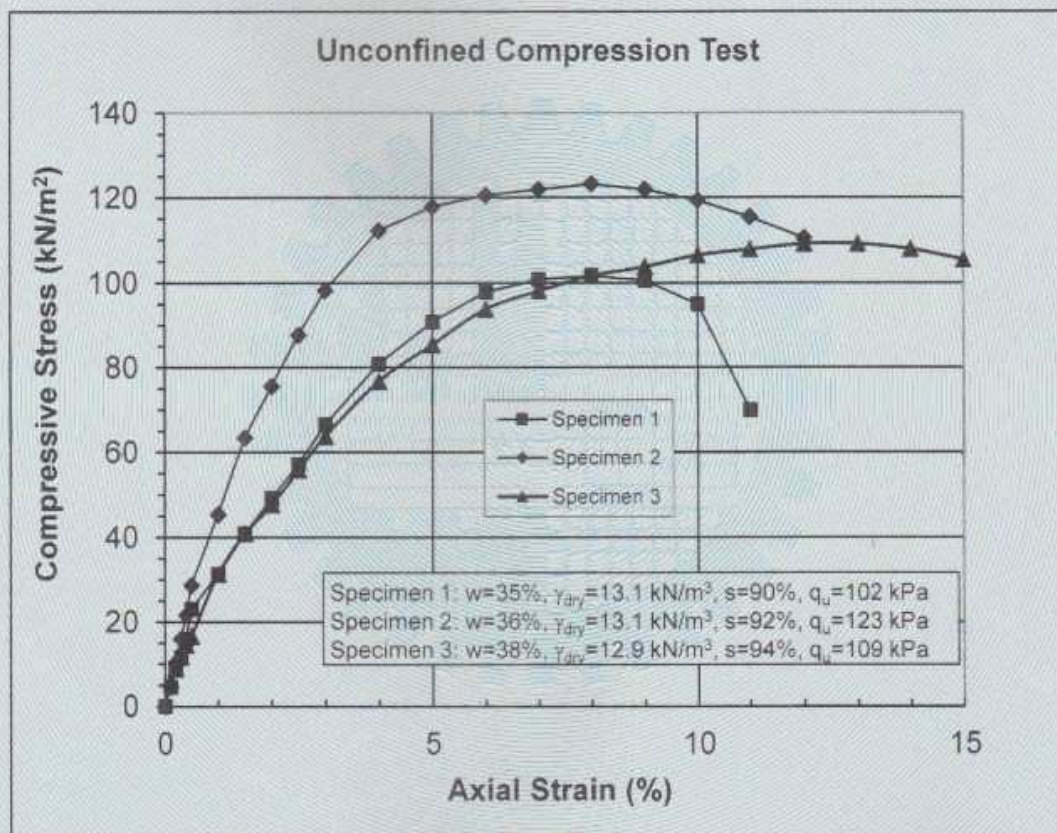
DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE dated 11.3.21			
Client : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka			
Ref : SGS/Phase-2/SI/090321 dated 9.3.21			
Project : Geotechnical Investigation at Matarbari			
Soil description : Grey silty clay			
Test Method: ASTM		Date of Test: 29.3.21-1.4.21	
BH No. : 3		Sample ID : UD-1	Depth: 8-9 m
			Location: Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Sample was received in unsealed condition.

Countersigned by :

Dr. A.B.M. Badruzzaman
Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



82TZbrZRb

Specific Gravity= 2.77

Test performed by :

Dr. Tahmeed M. Al-Hussaini
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



BRTC BUET

BUETCE 0272382

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

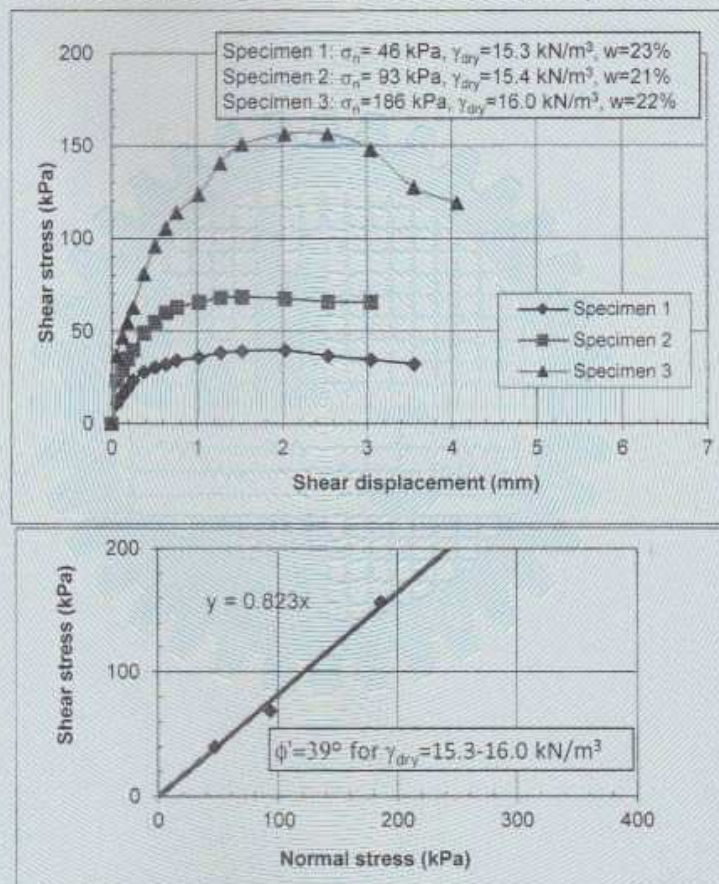
Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand	Location: Matarbari	
Bore-Hole: 3	Sample: 4	Depth: 4-4.45 m
Date of Test: 31.3.21-6.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition.

Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.



Countersigned by :

[Signature]

Dr. A.B.M. Badruzzaman

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

[Signature] 8.5.21

Dr. Tahmeed M. Al-Hussaini

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.

BRTC BUET

BUETCE 0272388

Direct Shear Tests

Direct Shearbox Test

Summary

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	17.00-18.00					
	Description	Lean CLAY with sand, CL					
	Type	Mazier					
				Spm. 1	2	3	
	Initial Height	H ₀	(mm)	20.0	20.0	20.0	
	Initial Width	D ₀	(mm)	60.0	60.0	60.0	
	Initial Weight	W ₀	(gr)	136.0	136.0	136.0	
	Initial Bulk Density	ρ ₀	(Mg/m ³)	1.89	1.89	1.89	
	Particle Density	ρ _s	(Mg/m ³)	2.70	2.70	2.70	

Initial Condition				Spm. 1	2	3
Normal Stress Level		(kPa)		150	300	600
Is Specimen Submersed?				Yes	Yes	Yes
Reverse Method				Motor Drive		
Hoz. Control Machine				Not Used	Not Used	Not Used
Initial Moisture	ω _i %	(%)		33	33	33
Initial Dry Density	ρ _{di}	(Mg/m ³)		1.42	1.42	1.42
Initial Voids Ratio	e _i	.		0.902	0.902	0.902
Initial Degree of Saturation	S _i	(%)		98.9	98.9	98.9
Notes						

Max Shear Stress Results				Spm. 1	2	3
Final Moisture	ω _f %	(%)		33	34	34
Final Dry Density	ρ _{df}	(Mg/m ³)		1.48	1.43	1.55
Final Voids Ratio	e _f	.		0.439	0.760	0.372
Final Degree of Saturation	S _f	(%)		100.0	100.0	100.0
Peak Shear Stress		(kPa)		78.2	127.1	253.4
Hoz Displacement	L _H	(mm)		11.250	12.000	12.000
Vertical Displacement	L _v	(mm)		0.290	0.350	0.420

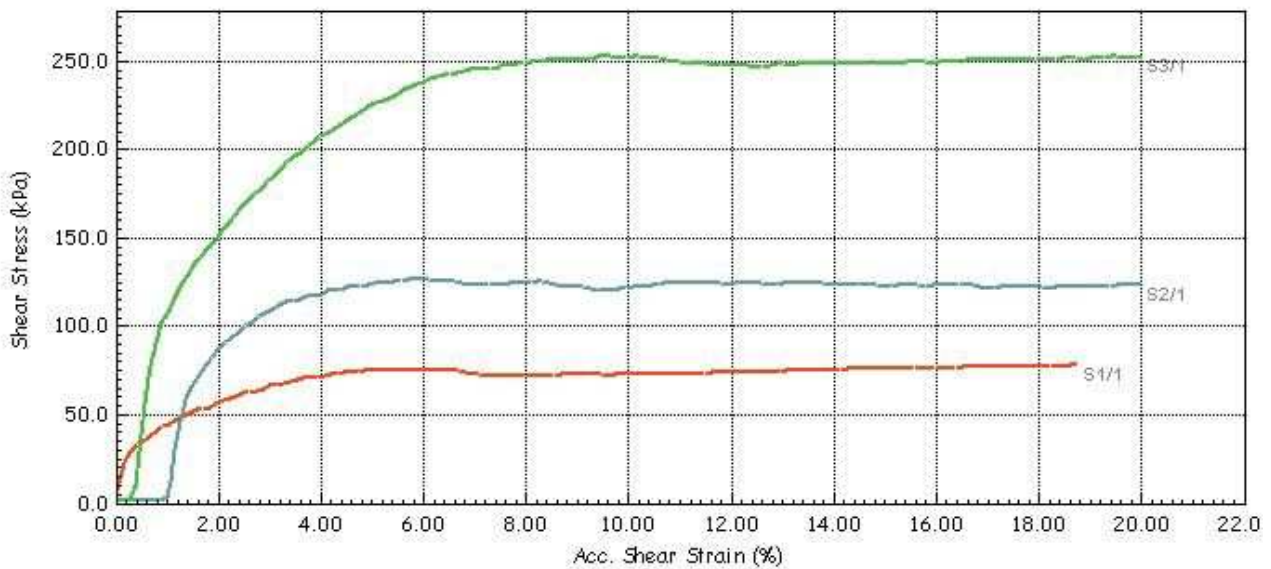
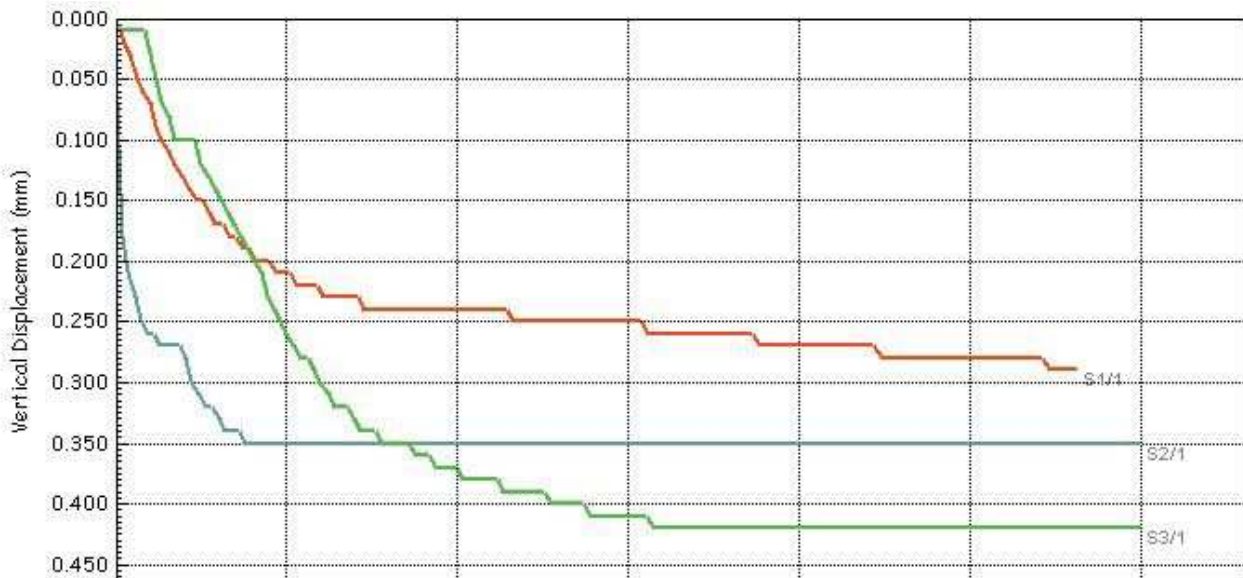
GIE

	Test Method		ASTM D 3080-04		Test Name		Direct Shear				
					Database:		.\SQLEXPRESS \ GIE-D				
	Site Reference				Test Date		3/15/2021				
	Jobfile		Direct Shear Test		Sample		Mazier-01				
	Client		SGS		Borehole		BH-03				
Operator		R. Islam		Checked		Aminul		Approved		T. Islam	

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/15/2021	
	Jobfile Direct Shear Test		Sample Mazier-01	
	Client SGS		Borehole BH-03	
Operator R. Islam		Checked Aminul	Approved T. Islam	

GIE

Direct Shear Tests

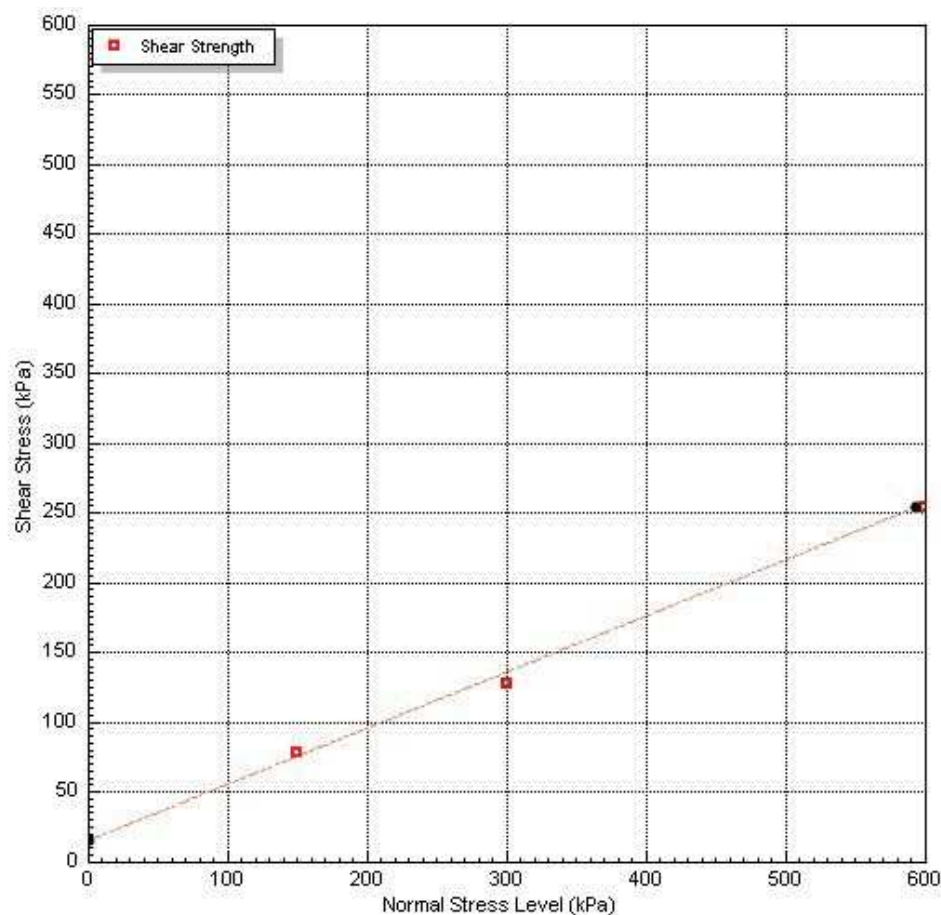
Direct Shearbox Test

Shear Stage

Envelope Failure Results

Final Moisture	$\omega_f\%$ (%)	Spm. 1	2	3
Final Dry Density	ρ_{df} (Mg/m ³)	33	34	34
Final Voids Ratio	e_f .	1.48	1.43	1.55
Final Degree of Saturation	S_f (%)	0.439	0.760	0.372
		100.0	100.0	100.0
Apparent cohesion	c (kPa)	15.04		
Angle of Shearing Resistance	ϕ .	21.9		

Notes



	Test Method	ASTM D 3080-04	Test Name	Direct Shear
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D
	Jobfile	Direct Shear Test	Test Date	3/15/2021
	Client	SGS	Sample	Mazier-01
	Operator	R. Islam	Borehole	BH-03
	Checked	Aminul	Approved	T. Islam

GIE

Direct Shear Tests

Direct Shearbox Test

Summary

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	27.00-28.00				
	Description					
	Type	Disturbed Soil				
				Spm. 1	2	3
	Initial Height	H ₀	(mm)	20.0	20.0	20.0
	Initial Width	D ₀	(mm)	60.0	60.0	60.0
	Initial Weight	W ₀	(gr)	149.5	149.5	149.5
	Initial Bulk Density	ρ ₀	(Mg/m ³)	2.08	2.08	2.08
	Particle Density	ρ _s	(Mg/m ³)	2.65	2.65	2.65

Initial Condition				Spm. 1	2	3
Normal Stress Level		(kPa)		250	500	1000
Is Specimen Submersed?				Yes	Yes	Yes
Reverse Method				Motor Drive		
Hoz. Control Machine				Not Used	Not Used	Not Used
Initial Moisture	ω _i	(%)		19	19	19
Initial Dry Density	ρ _{di}	(Mg/m ³)		1.75	1.75	1.75
Initial Voids Ratio	e _i	.		0.513	0.513	0.513
Initial Degree of Saturation	S _i	(%)		95.9	95.9	95.9
Notes						

Max Shear Stress Results				Spm. 1	2	3
Final Moisture	ω _f	(%)		19	20	19
Final Dry Density	ρ _{df}	(Mg/m ³)		1.78	1.87	1.88
Final Voids Ratio	e _f	.		0.513	0.370	0.360
Final Degree of Saturation	S _f	(%)		97.8	100.0	100.0
Peak Shear Stress		(kPa)		153.4	291.6	583.0
Hoz Displacement	L _H	(mm)		12.000	12.000	12.000
Vertical Displacement	L _V	(mm)		-0.010	0.300	0.310

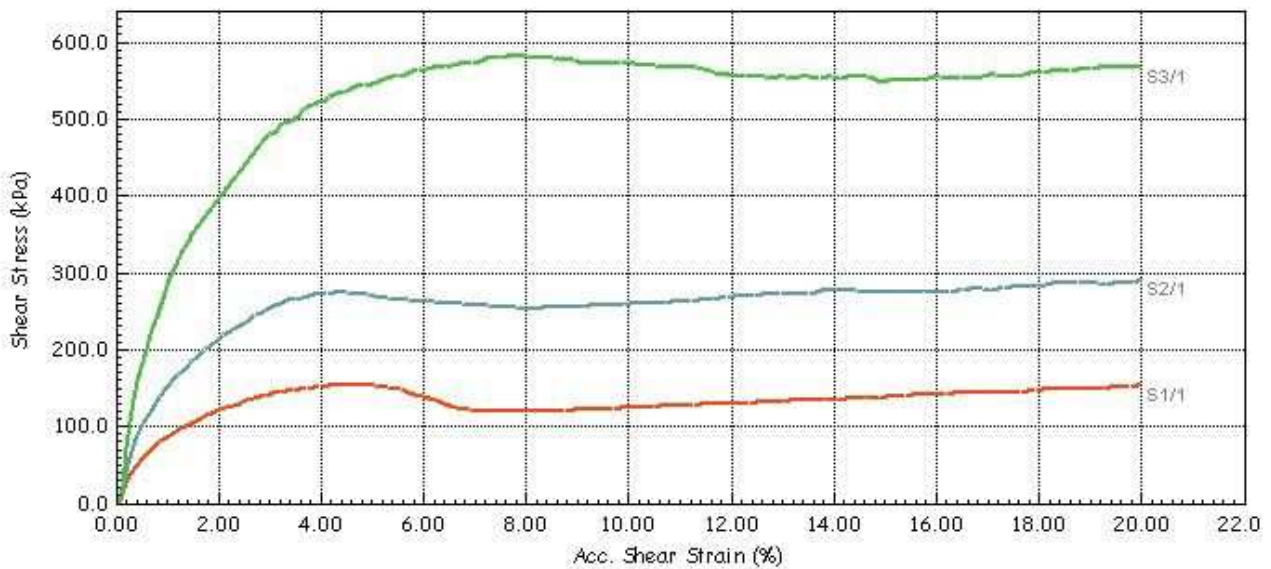
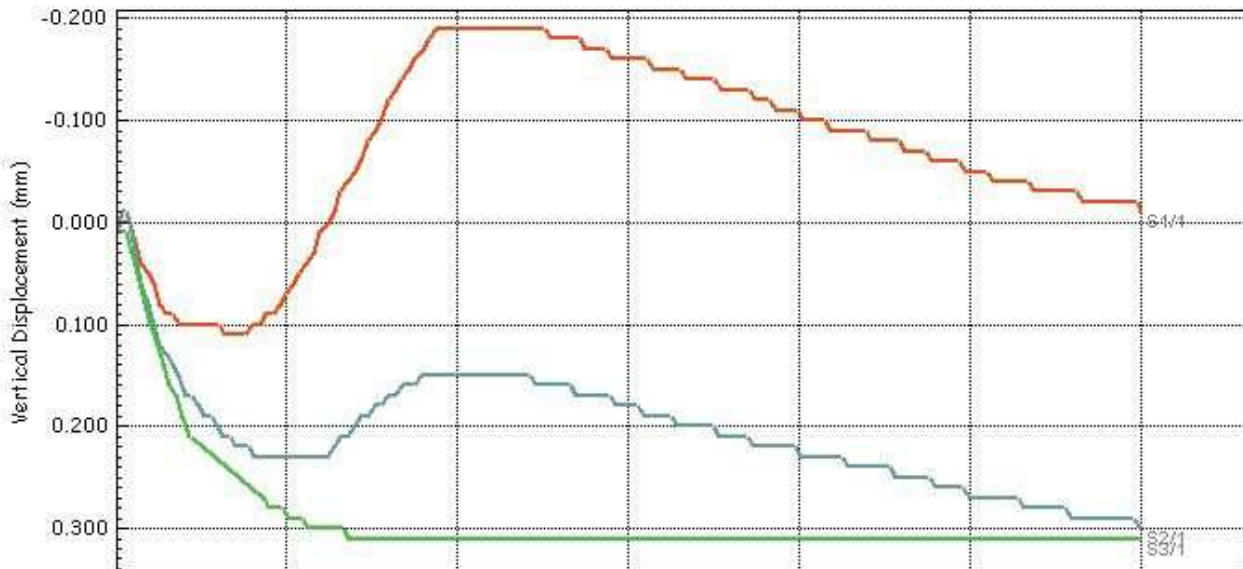
GIE

	Test Method ASTM D 3080-04		Test Name Direct Shear		
			Database: .\SQLEXPRESS \ GIE-D		
	Site Reference		Test Date 3/16/2021		
	Jobfile Direct Shear Test		Sample Mazier-02		
	Client SGS		Borehole BH-03		
Operator R. Islam		Checked Aminul		Approved T. Islam	

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/16/2021	
	Jobfile Direct Shear Test		Sample Mazier-02	
	Client SGS		Borehole BH-03	
Operator R. Islam	Checked Aminul	Approved T. Islam		

GIE

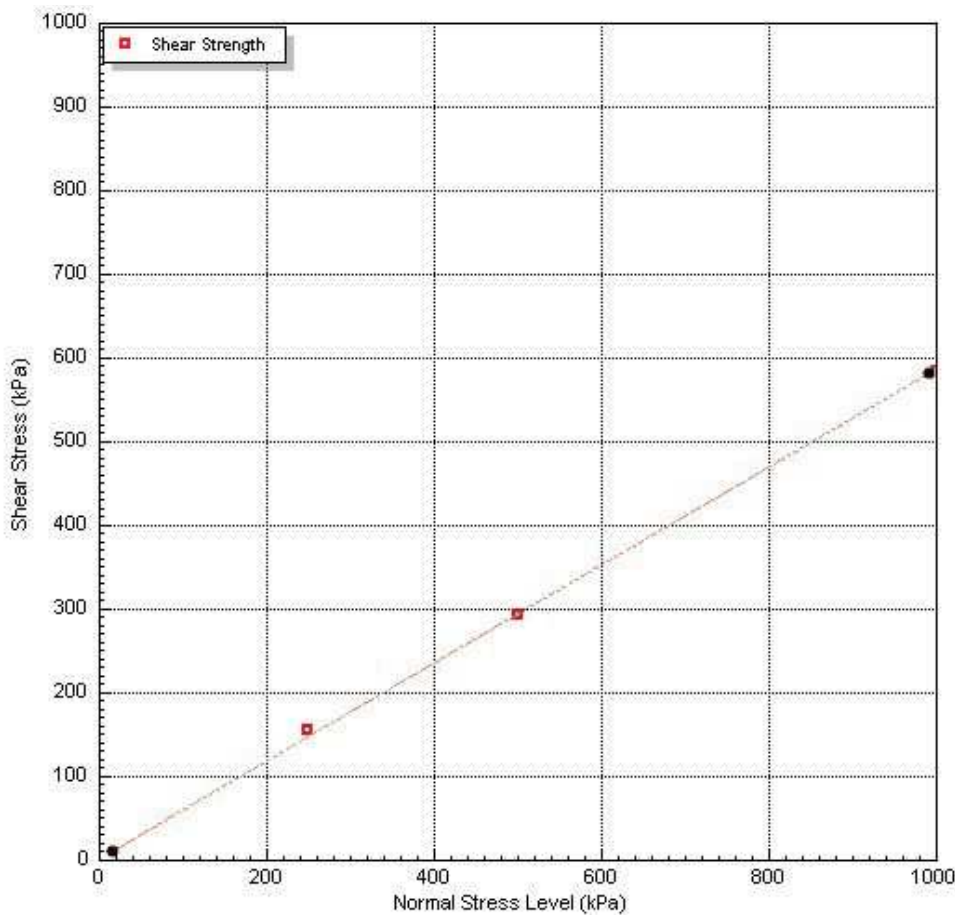
Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	19	20	19
Final Dry Density	ρ_{df} (Mg/m ³)	1.78	1.87	1.88
Final Voids Ratio	e_f	0.513	0.370	0.360
Final Degree of Saturation	S_f (%)	97.8	100.0	100.0
Apparent cohesion	c (kPa)	0.69		
Angle of Shearing Resistance	ϕ	30.3		

Notes



	Test Method		ASTM D 3080-04		Test Name		Direct Shear						
					Database: .\SQLEXPRESS \ GIE-D								
	Site Reference				Test Date				3/16/2021				
	Jobfile				Sample				Mazier-02				
	Client				Borehole				BH-03				
	Operator				R. Islam		Checked		Aminul		Approved		T. Islam

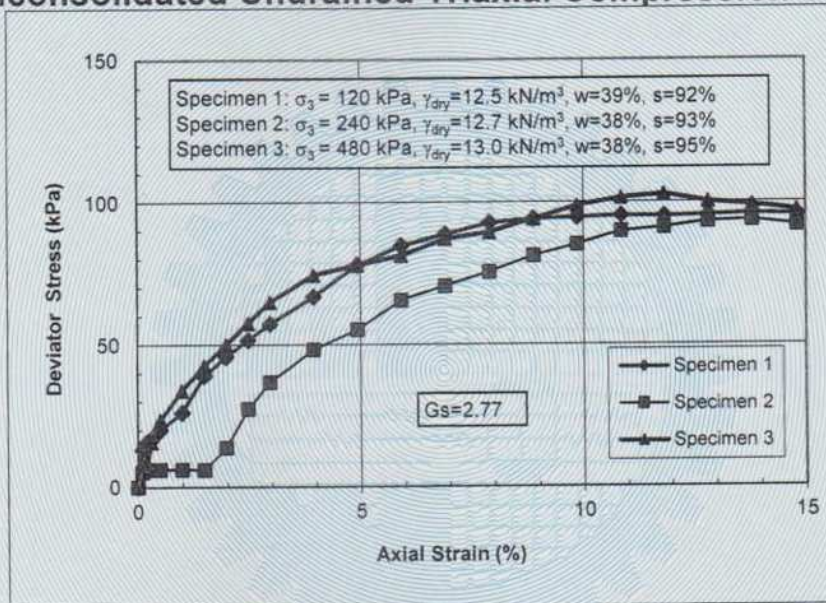
GIE



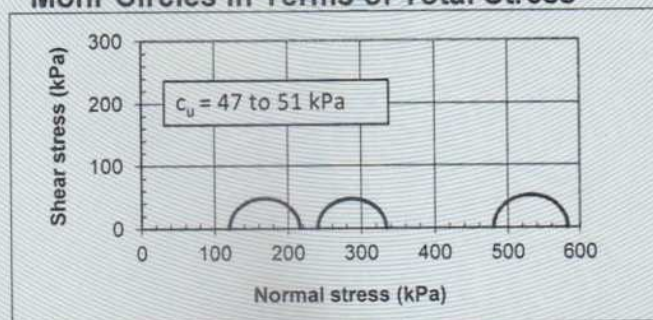
BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey silty clay	Test Method: ASTM	
B.H. No.: 3	Sample: UD-1	Depth: 8-9 m
Location: Matarbari	Date of Test: 5.5.21-9.5.21	

(Corrected Report)

Unconsolidated Undrained Triaxial Compression Test



Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading.

Countersigned by :

(Signature)

Dr. A.B.M. Badruzzaman
 Professor, Dept. of Civil Engineering
 BUET, Dhaka - 1000.

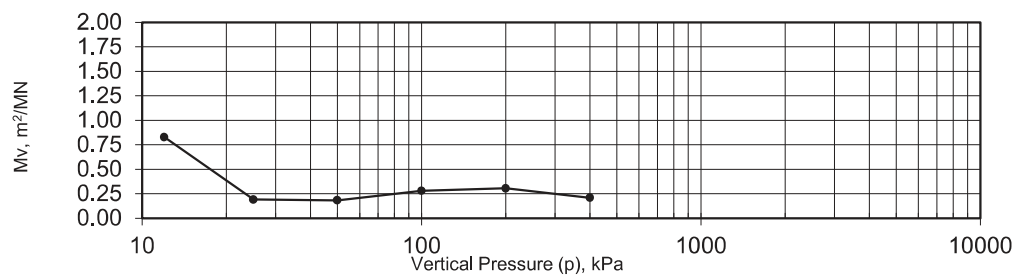
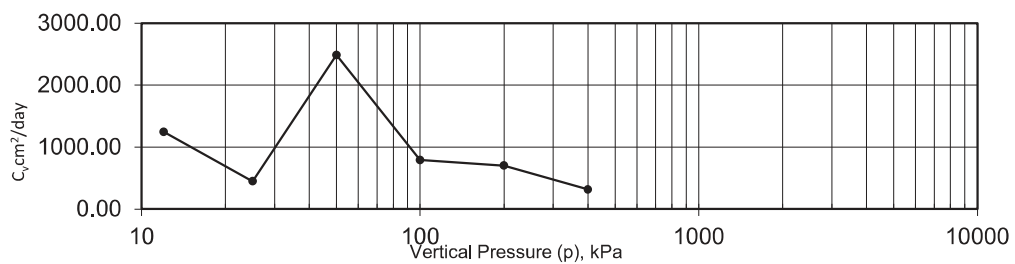
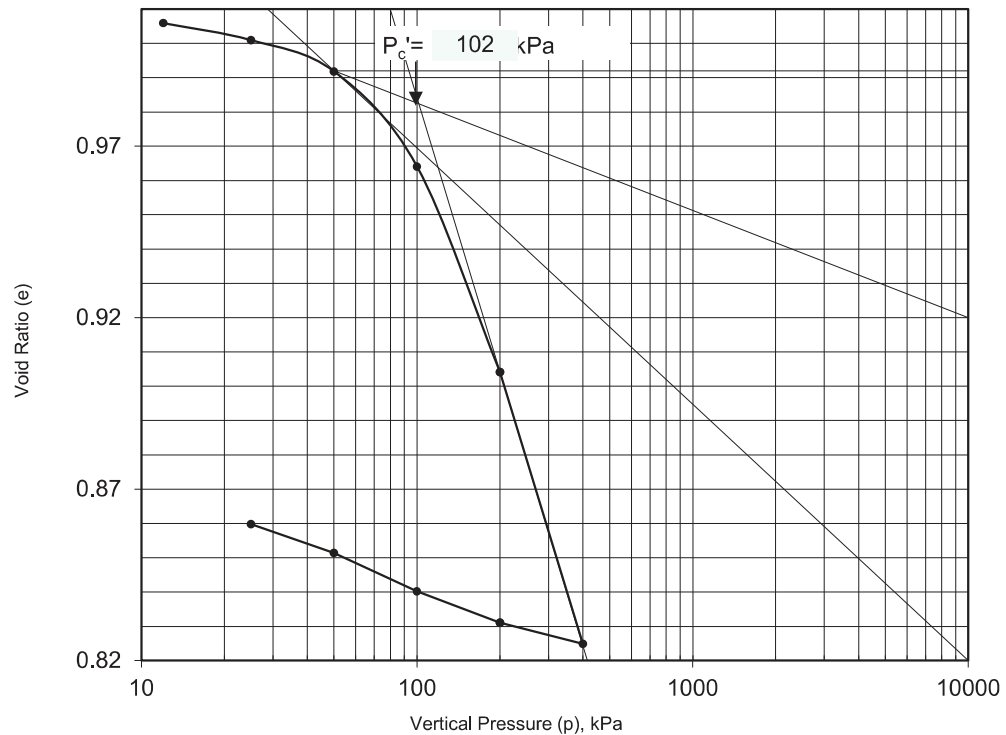
Test performed by :

(Signature) 3.6.21

Dr. Tahmeed M. Al-Hussaini
 Professor, Dept. of Civil Engineering
 BUET, Dhaka - 1000.



Ground Instrumentation & Engineering Pte Ltd	OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11																																																																																																																										
Project : Geotechnical Investigation for Matarbari Project Client - Location : TEPSCO Boring No : BH-03 Sample No : UD-01 Depth (m) : 8.00-9.00 Soil Description : Lean CLAY, CL <u>Moisture Content Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr><td>Wt. of Ring + Wet Soil, gm</td><td style="text-align: center;">141.40</td><td style="text-align: center;">139.04</td></tr> <tr><td>Wt. of Ring + Dry Soil, gm</td><td style="text-align: center;">122.19</td><td style="text-align: center;">122.19</td></tr> <tr><td>Weight of Water, gm</td><td style="text-align: center;">19.21</td><td style="text-align: center;">16.85</td></tr> <tr><td>Weight of Container, gm</td><td style="text-align: center;">69.47</td><td style="text-align: center;">69.47</td></tr> <tr><td>Weight of Dry Soil, gm</td><td style="text-align: center;">52.72</td><td style="text-align: center;">52.72</td></tr> <tr><td>Water Content, %</td><td style="text-align: center;">36.4</td><td style="text-align: center;">32.0</td></tr> </tbody> </table> <u>Unit Weight Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr><td>Wt. of Ring + Wet Soil, gm</td><td style="text-align: center;">141.40</td><td style="text-align: center;">139.04</td></tr> <tr><td>Weight of Ring, gm</td><td style="text-align: center;">69.47</td><td style="text-align: center;">69.47</td></tr> <tr><td>Weight of Wet Soil, gm</td><td style="text-align: center;">71.93</td><td style="text-align: center;">69.57</td></tr> <tr><td>Height of Sample, cm</td><td style="text-align: center;">2</td><td style="text-align: center;">1.836</td></tr> <tr><td>Diameter of Sample, cm</td><td style="text-align: center;">5</td><td style="text-align: center;">5</td></tr> <tr><td>Volume of Sample, cm³</td><td style="text-align: center;">39.27</td><td style="text-align: center;">36.05</td></tr> <tr><td>Unit Wet Weight, kN/m³</td><td style="text-align: center;">18.0</td><td style="text-align: center;">18.9</td></tr> <tr><td>Unit Dry Weight, kN/m³</td><td style="text-align: center;">13.2</td><td style="text-align: center;">14.3</td></tr> </tbody> </table> <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Specific Gravity</td><td style="text-align: center;">= 2.72</td></tr> <tr><td>Initial Void Ratio</td><td style="text-align: center;">= 1.026</td></tr> <tr><td>Degree of Saturation, %</td><td style="text-align: center;">= 96.6</td></tr> <tr><td>Room Temperature, °C</td><td style="text-align: center;">= 24.0</td></tr> <tr><td>Temp. correction factor</td><td style="text-align: center;">= 0.91</td></tr> <tr><td>Initial Transducer Reading</td><td style="text-align: center;">= 8.70</td></tr> <tr><td>Effective Overburden Pressure</td><td style="text-align: center;">=</td></tr> <tr><td>Preconsolidation Pressure (kPa)</td><td style="text-align: center;">= 102</td></tr> <tr><td>Compression Index (Cc)</td><td style="text-align: center;">= 0.2657</td></tr> </tbody> </table>				<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	141.40	139.04	Wt. of Ring + Dry Soil, gm	122.19	122.19	Weight of Water, gm	19.21	16.85	Weight of Container, gm	69.47	69.47	Weight of Dry Soil, gm	52.72	52.72	Water Content, %	36.4	32.0		<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	141.40	139.04	Weight of Ring, gm	69.47	69.47	Weight of Wet Soil, gm	71.93	69.57	Height of Sample, cm	2	1.836	Diameter of Sample, cm	5	5	Volume of Sample, cm ³	39.27	36.05	Unit Wet Weight, kN/m ³	18.0	18.9	Unit Dry Weight, kN/m ³	13.2	14.3	Specific Gravity	= 2.72	Initial Void Ratio	= 1.026	Degree of Saturation, %	= 96.6	Room Temperature, °C	= 24.0	Temp. correction factor	= 0.91	Initial Transducer Reading	= 8.70	Effective Overburden Pressure	=	Preconsolidation Pressure (kPa)	= 102	Compression Index (Cc)	= 0.2657																																																							
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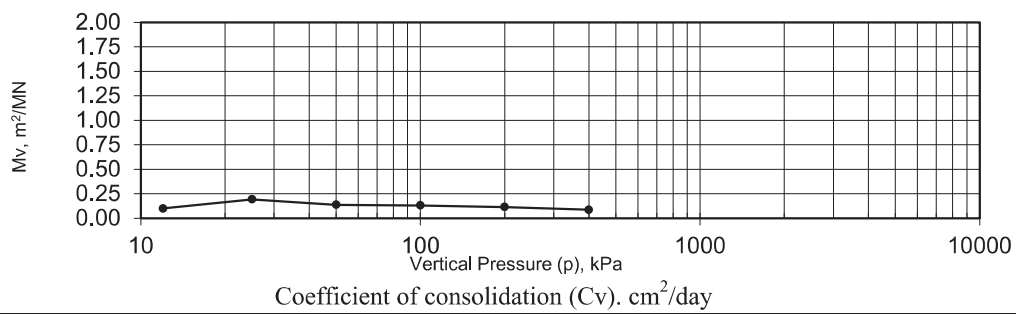
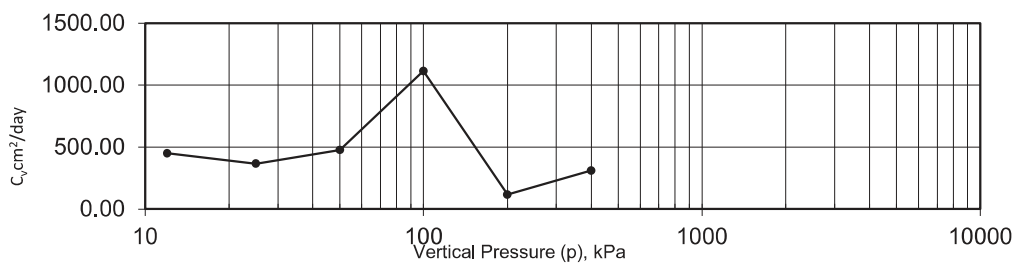
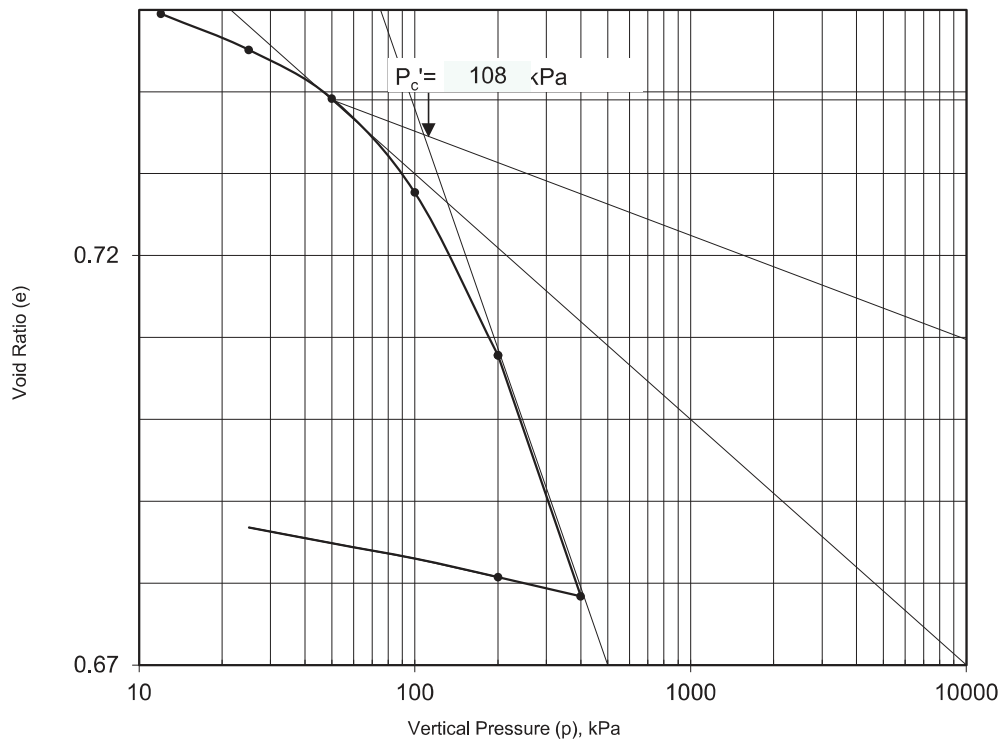


Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-03
 Sample : UD-01
 Depth (m) : 8.00-9.00

Ground Instrumentation & Engineering Pte Ltd	OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11																																																																																																																										
Project : SIBD2105 Client - Location : Geotechnical Investigation for Matarbari Project Boring No : BH-03 Sample No : UD-02 Depth (m) : 12.00-13.00 Soil Description : Silty SAND																																																																																																																											
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ASTM D2435/D2435M - 11

$C_c = 0.097098$



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-03
 Sample : UD-02
 Depth (m) : 12.00-13.00



Ground Instrumentation &
 Engineering Pte Ltd

GEOTECHNICAL AND MATERIAL LABORATORY
Ground Instrumentation & Engineering
Pte.Ltd. House-7 Road-12, Dhaka 1230

LABORATORY COMPACTION TEST DATA
(Dry Density- Moisture Content Relationship)
ASTM D1557

Date: 25/03/2021

Project : Geotechnical Investigation for Matarbari, ID-SIBD-2105

Client : SGS

Test Pit No. : BH-03

Sample Depth : 1.00 m

Method: Standard Proctor (using 2.5 kg rammer)

Volume of Mould: 950 cm³

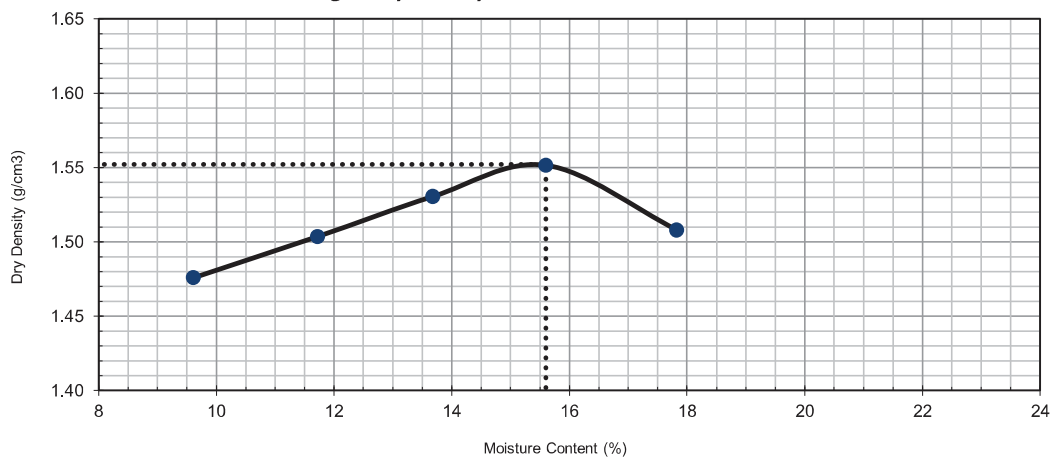
Test No.:		1	2	3	4	5	
Mass of Mould+ Base+Compacted Materials (m2)	g	5197	5256	5313	5364	5348	
Mass of Mould+ Base(m1)	g	3660	3660	3660	3660	3660	
mass of Compacted Materials(m2-m1)	g	1537	1596	1653	1704	1688	
Bulk Density, $\rho = \frac{m2 - m1}{vol. of mold}$	g/cm ³	1.618	1.680	1.740	1.794	1.777	
Moisture Content (w)	%	9.62	11.73	13.68	15.61	17.83	
Dry Density, $\rho_d = \frac{100\rho}{100 + w}$	g/cm ³	1.476	1.504	1.531	1.552	1.508	

MOISTURE CONTENT

Test No.:		1		2		3		4		5			
Container No.:		B-31	B-16	B-20	B-24	B-138	B-10	B-112	B-90	B-124	B-118		
Mass of container + wet soil	g	54.8	46.9	74.6	60.85	67.02	71.13	55.64	63.84	65.07	72.99		
mass of container + dry soil	g	52.2	44.4	71.12	57.57	62.26	66.5	51.12	58.94	58.9	67.2		
Mass of Water	g	2.61	2.43	3.52	3.28	4.76	4.6	4.52	4.90	6.13	5.81		
Mass of Container	g	24.91	19.31	40.83	29.85	26.92	33.43	22.05	27.66	24.68	34.48		
Mass of Dry Soil	g	27.3	25.12	30.29	27.72	35.34	33.1	29.07	31.28	34.26	32.7		
Moisture Content	%	9.56	9.67	11.62	11.83	13.47	13.90	15.55	15.66	17.89	17.77		
Average Moisture Content	%	9.6		11.7		13.7		15.6		17.8			

Maximum Dry Density	1.552	g/cm ³
Optimum Moisture Content	15.6	%

Fig. : Dry Density vs Moisture Content Curve





Ground Instrumentation &

Falling Head Permeability Test

K.H. Head Vol.2



Project ID: : SI BD2105 Project/Location: Geotechnical Investigation for Matarbari Project

Borehole No. : BH-03 Sample: MZ-01 Depth: 17.00 - 18.00 (m)

Soil Description : Lean CLAY with sand, CL

Method of Preparation: Undisturbed or Compacted
✓

Diameter, D , mm	73.00	Moisture Content, %	32
Area, A , mm ²	4185.40	Bulk Density, ρ , Mg/m ³	1.86
Length, L , mm	72.15	Dry Density, ρ_D , Mg/m ³	1.41
Volume, V , mm ³	301976.36	Particle Density, ρ_s	2.70 measured / assumed
Voids ratio, e	0.912	Temperature, °C	25
Standpipe diameter, mm	4.70	Standpipe area, (a) mm ²	17.3

Correction Factor for test temperature corresponding to 20°C 0.890

HEIGHT ABOVE OUTLET h (mm)	TIME TAKEN t (min)	HEIGHT RATIO	COEFFICIENT OF PERMEABILITY K_v (m/s)	AVERAGE K_v AT TEST TEMPERATURE K_v (m/s)
1070	0	-	-	-
465	520.00	2.30	7.97E-09	7.72E-09
202	555.00	2.30	7.47E-09	

CORRECTED AVERAGE K_v @ 20 °C

6.87E-09

The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council.
The report shall not be reproduced except in full, unless the management representative of GIE has given approval in writing.

Tested by : Faysal

Checked/Approved by : Mario

Date:

16/1/21

SGS



BH-04

Ground Instrumentation & Engineering Pte Ltd	MOISTURE CONTENT ASTM D2216-10	
Sample No.:	SPT-02	Depth (m): 2.00-2.45
Can No.	206	
Weight of Wet Soil + Can (gm)	260.18	
Weight of Dry Soil + can (gm)	223.45	
Weight of Can (gm)	23.52	
Moisture Content (%)	18.37	
Description	Silty fine SAND, SM	
Sample No.:	SPT-06	Depth (m): 6.00-6.45
Can No.	413	
Weight of Wet Soil + Can (gm)	229.91	
Weight of Dry Soil + can (gm)	188.66	
Weight of Can (gm)	25.26	
Moisture Content (%)	25.24	
Description	Lean CLAY, CL	
Sample No.:	UD-02	Depth (m): 9.00-9.45
Can No.	413	
Weight of Wet Soil + Can (gm)	183.00	
Weight of Dry Soil + can (gm)	137.46	
Weight of Can (gm)	25.26	
Moisture Content (%)	40.59	
Description	Lean CLAY, CL	

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

Ground Instrumentation & Engineering Pte Ltd		MOISTURE CONTENT ASTM D2216-10	
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Sample No.:	SPT-08	Depth (m): 10.00-10.45
Can No.	209	
Weight of Wet Soil + Can (gm)	221.89	
Weight of Dry Soil + can (gm)	189.67	
Weight of Can (gm)	28.55	
Moisture Content (%)	20.00	
Description	Sandy Lean CLAY, CL	

Sample No.:	SPT-12	Depth (m): 14.00-14.45
Can No.	207	
Weight of Wet Soil + Can (gm)	179.86	
Weight of Dry Soil + can (gm)	149.88	
Weight of Can (gm)	24.92	
Moisture Content (%)	23.99	
Description	Lean CLAY, CL	

Sample No.:	SPT-15	Depth (m): 17.00-17.45
Can No.	47	
Weight of Wet Soil + Can (gm)	182.06	
Weight of Dry Soil + can (gm)	152.70	
Weight of Can (gm)	13.24	
Moisture Content (%)	21.05	
Description	Silty fine-medium SAND, SM	

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

MOISTURE CONTENT ASTM D2216-10



Sample No.:	SPT-18	Depth (m): 20.00-20.45
Can No.		447
Weight of Wet Soil + Can (gm)		201.83
Weight of Dry Soil + can (gm)		164.65
Weight of Can (gm)		13.22
Moisture Content (%)		24.55
Description		Lean CLAY, CL

Sample No.:	SPT-22	Depth (m): 24.00-24.45
Can No.		100
Weight of Wet Soil + Can (gm)		186.69
Weight of Dry Soil + can (gm)		152.81
Weight of Can (gm)		13.03
Moisture Content (%)		24.24
Description		Sandy SILT, ML

Sample No.:		
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-04

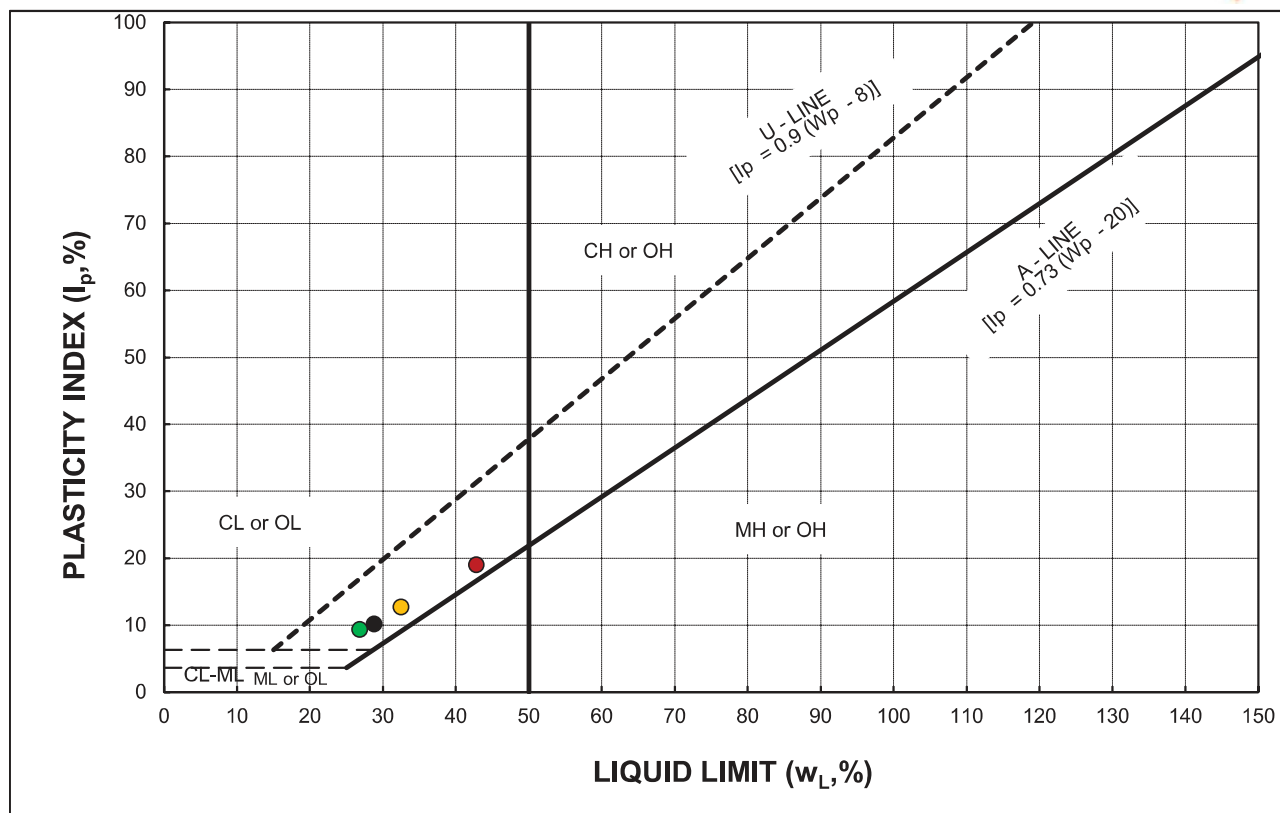
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021



	Sample No.	Depth	W_L	W_P	I_p	Fines	Remarks
●	SPT-06	6.00-6.45	28.80	18.63	10.17		Lean CLAY, CL
●	UD-02	9.00-9.45	32.50	19.78	12.72		Lean CLAY, CL
●	SPT-12	14.00-14.45	26.80	17.45	9.35		Lean CLAY, CL
●	SPT-18	20.00-20.45	42.80	23.78	19.02		Lean CLAY, CL
●	SPT-22	24.00-24.45	*	*	*		The sample is nonplastic
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05

*Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 07-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

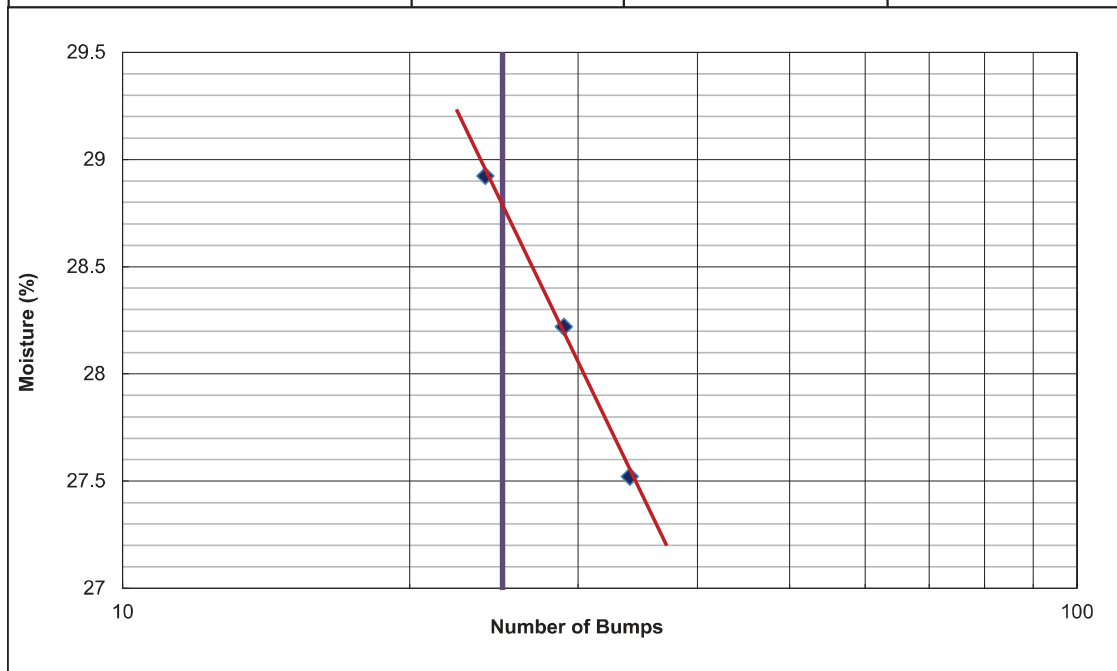
BH No.: BH-04

Sample No: SPT-06

Sample Depth: 6.00-6.45

Plastic Limit Test		
Container No.	426	59
Weight of can (gm)	7.64	7.61
Wet weight of soil + can (gm)	31.43	31.45
Dry Weight of soil + can (gm)	27.71	27.69
Moisture Content %	18.54	18.73
Average	18.63	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	24	29	34
Container No.	478	475	435
Weight of can (gm)	4.08	4.35	3.89
Wet weight of soil + can (gm)	25.03	24.16	23.86
Dry Weight of soil + can (gm)	20.33	19.8	19.55
Moisture Content %	28.92	28.22	27.52



LL: 28.80	PL: 18.63	PI: 10.17
Description	Lean CLAY, CL	

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

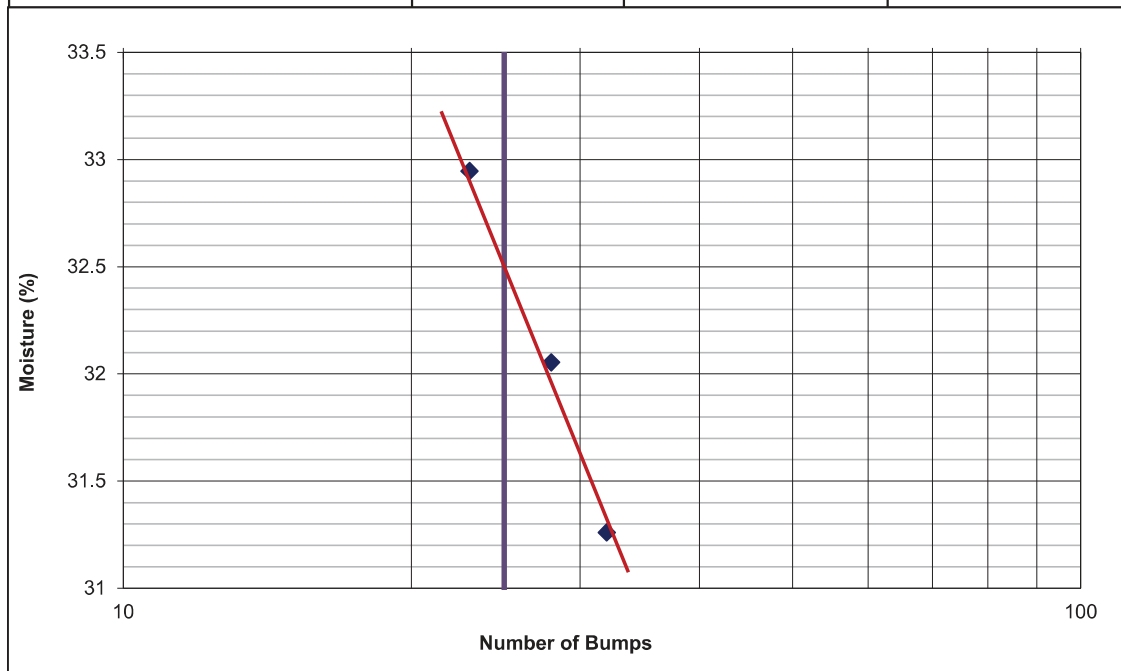
Sample No.: UD-02

BH No.: BH-04

Sample Depth: 9.00-9.45

Plastic Limit Test		
Container No.	353	345
Weight of can (gm)	9.01	8.99
Wet weight of soil + can (gm)	30.43	30.45
Dry Weight of soil + can (gm)	26.91	26.89
Moisture Content %	19.66	19.89
Average	19.78	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	32
Container No.	443	474	322
Weight of can (gm)	3.96	4.23	7.55
Wet weight of soil + can (gm)	26.92	23.51	22.33
Dry Weight of soil + can (gm)	21.23	18.83	18.81
Moisture Content %	32.95	32.05	31.26



LL: 32.50	PL: 19.78	PI: 12.72
Description	Lean CLAY, CL	

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

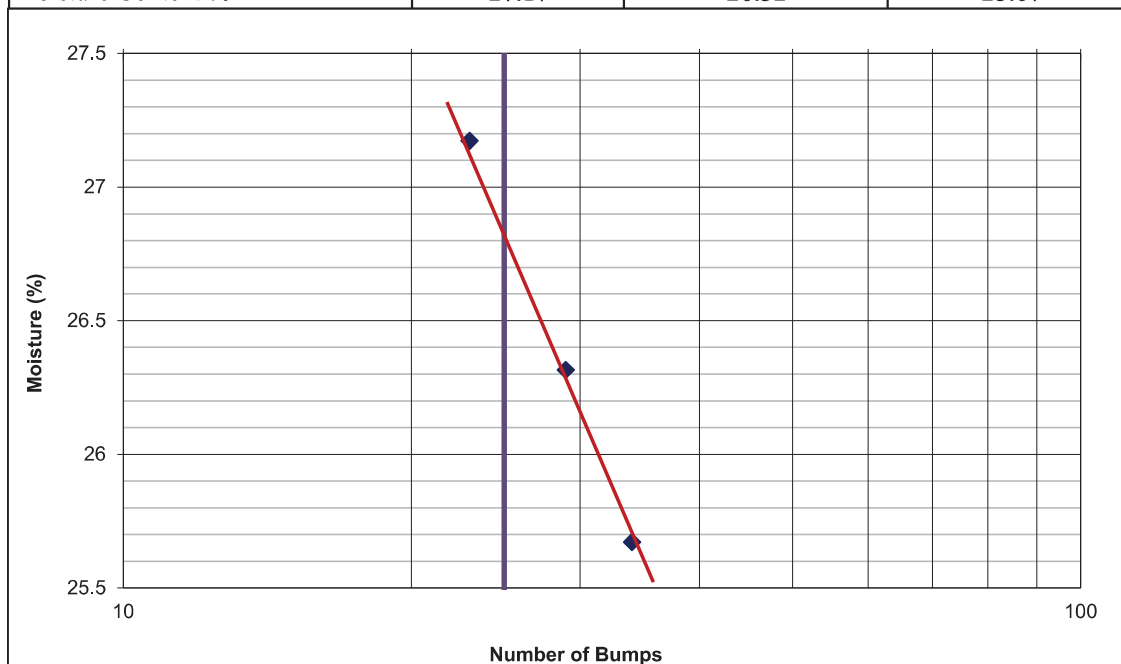
Sample No.: SPT-12

BH No.: BH-04

Sample Depth.: 14.00-14.45

Plastic Limit Test		
Container No.	227	9
Weight of can (gm)	14.07	14.06
Wet weight of soil + can (gm)	36.81	36.83
Dry Weight of soil + can (gm)	33.45	33.43
Moisture Content %	17.34	17.55
Average	17.45	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	34
Container No.	321	330	433
Weight of can (gm)	9.13	9.1	4.02
Wet weight of soil + can (gm)	28.74	27.82	24.14
Dry Weight of soil + can (gm)	24.55	23.92	20.03
Moisture Content %	27.17	26.32	25.67



LL: 26.80	PL: 17.45	PI: 9.35
Description	Lean CLAY, CL	

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

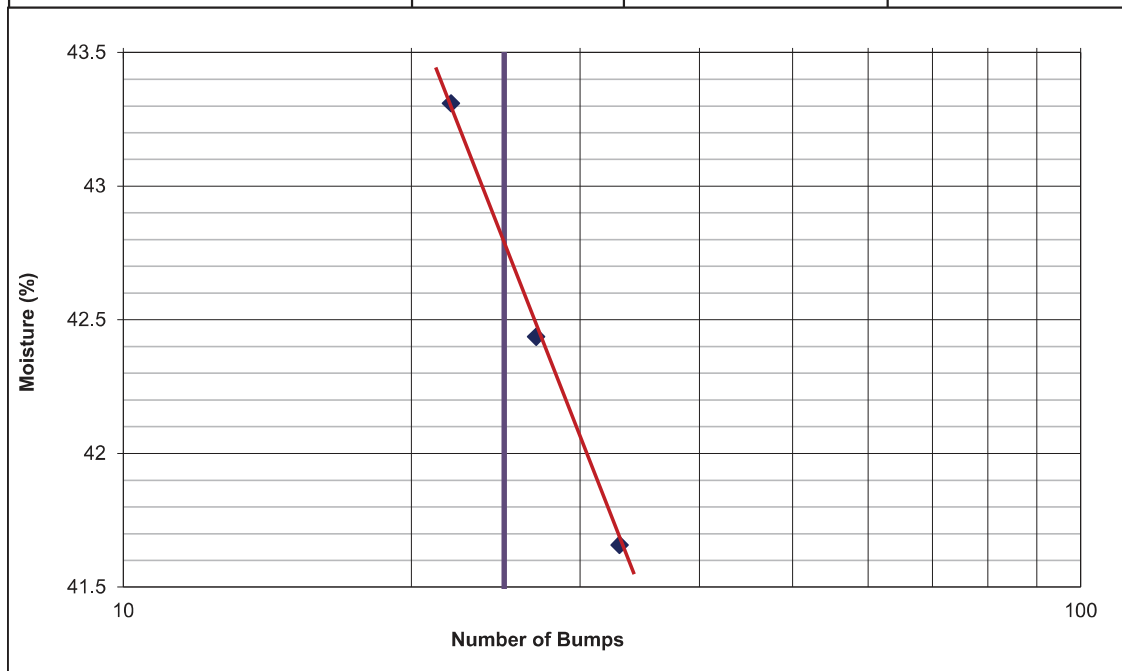
Sample No.: SPT-18

BH No.: BH-04

Sample Depth.: 20.00-20.45

Plastic Limit Test		
Container No.	421	333
Weight of can (gm)	7.18	6.93
Wet weight of soil + can (gm)	26.93	26.95
Dry Weight of soil + can (gm)	23.13	23.11
Moisture Content %	23.82	23.73
Average	23.78	

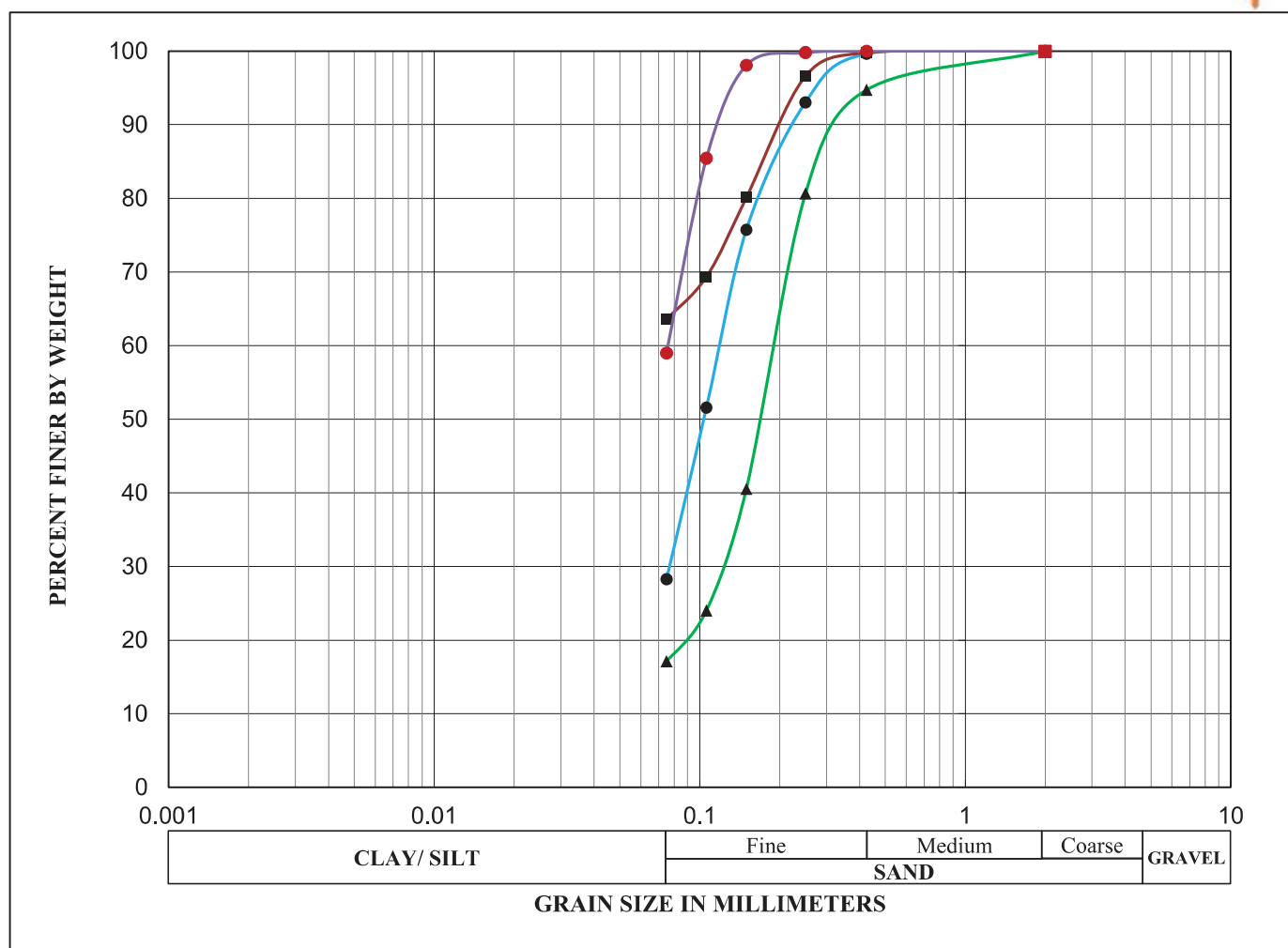
Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	27	33
Container No.	436	433	435
Weight of can (gm)	3.83	4.02	3.89
Wet weight of soil + can (gm)	25.04	21.44	18.41
Dry Weight of soil + can (gm)	18.63	16.25	14.14
Moisture Content %	43.31	42.44	41.66



LL: 42.80	PL: 23.78	PI: 19.02
Description	Lean CLAY, CL	

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Silty fine SAND, SM						
■	SPT-08	10.00-10.45	Sandy Lean CLAY, CL						
▲	SPT-15	17.00-17.45	Silty fine-medium SAND, SM						
●	SPT-22	24.00-24.45	Sandy SILT, ML						
■									
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
								%Fine	%Medium	%Coarse	
●	SPT-02	2.00-2.45	0.121	0.104	0.077	0.027	0.00	71.36	0.38	0.00	28.26
■	SPT-08	10.00-10.45	0.071	0.059	0.035	0.012	0.00	36.16	0.20	0.00	63.64
▲	SPT-15	17.00-17.45	0.198	0.174	0.122	0.044	0.00	77.62	5.26	0.00	17.12
●	SPT-22	24.00-24.45	0.076	0.064	0.038	0.013	0.00	41.02	0.00	0.00	58.98
■											
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

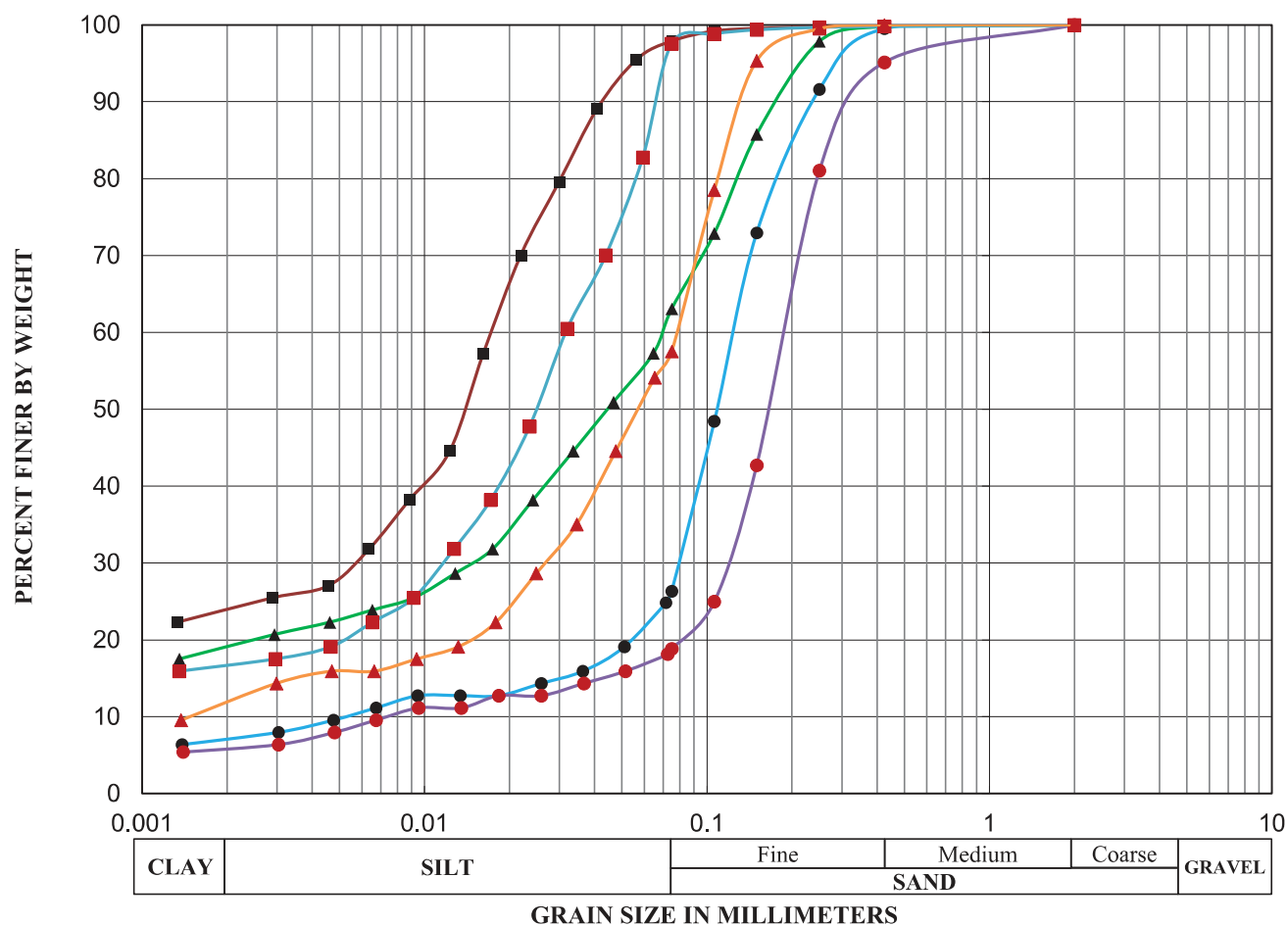
Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Silty fine SAND, SM						
■	UD-02	9.00-9.45	Lean CLAY, CL						
▲	SPT-08	10.00-10.45	Sandy Lean CLAY, CL						
●	SPT-15	17.00-17.45	Silty fine-medium SAND, SM						
■	SPT-18	20.00-20.45	Lean CLAY, CL						
▲	SPT-22	24.00-24.45	Sandy SILT, ML						

	Sample	Depth	D ₆₀	D ₅₀	D ₃₀	D ₁₀	%Gravel	%Sand			%SILT	%CLAY
								%Fine	%Medium	%Coarse		
●	SPT-02	2.00-2.45	0.127	0.109	0.080	0.005	0.00	73.20	0.48	0.00	19.95	6.37
■	UD-02	9.00-9.45	0.017	0.014	0.006	0.001	0.00	1.94	0.14	0.00	75.64	22.28
▲	SPT-08	10.00-10.45	0.070	0.045	0.015	0.001	0.00	36.72	0.22	0.00	45.55	17.51
●	SPT-15	17.00-17.45	0.195	0.169	0.119	0.008	0.00	76.28	4.88	0.00	13.43	5.41
■	SPT-18	20.00-20.45	0.032	0.025	0.012	0.001	0.00	2.20	0.22	0.00	81.66	15.92
▲	SPT-22	24.00-24.45	0.079	0.058	0.027	0.002	0.00	42.46	0.02	0.00	47.97	9.55

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-02	Depth(m)	2.00-2.45
Pyknometer No.		1
Mass of bottle + soil + water: M_3	gm	118.80
Mass of bottle + soil: M_2	gm	74.04
Mass of bottle + water: M_4	gm	99.99
Mass of bottle: M_1	gm	44.00
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	25.95
Mass of water used: $M_3 - M_2$	gm	44.76
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.23
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.67

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-06	Depth(m)	6.00-6.45
Pyknometer No.		3
Mass of bottle + soil + water: M_3	gm	117.88
Mass of bottle + soil: M_2	gm	74.49
Mass of bottle + water: M_4	gm	98.92
Mass of bottle: M_1	gm	44.52
Mass of soil: $M_2 - M_1$	gm	29.97
Mass of water in full bottle: $M_4 - M_2$	gm	24.43
Mass of water used: $M_3 - M_2$	gm	43.39
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.01
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.72

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-08	Depth(m)	10.00-10.45
Pyknometer No.		2
Mass of bottle + soil + water: M_3	gm	117.26
Mass of bottle + soil: M_2	gm	74.11
Mass of bottle + water: M_4	gm	98.41
Mass of bottle: M_1	gm	44.13
Mass of soil: $M_2 - M_1$	gm	29.98
Mass of water in full bottle: $M_4 - M_2$	gm	24.30
Mass of water used: $M_3 - M_2$	gm	43.15
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.13
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-12	Depth(m)	14.00-14.45
Pyknometer No.		9
Mass of bottle + soil + water: M_3	gm	97.54
Mass of bottle + soil: M_2	gm	57.85
Mass of bottle + water: M_4	gm	78.61
Mass of bottle: M_1	gm	27.80
Mass of soil: $M_2 - M_1$	gm	30.05
Mass of water in full bottle: $M_4 - M_2$	gm	20.76
Mass of water used: $M_3 - M_2$	gm	39.69
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.12
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.70

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE Dated 11.3.21	
Client : Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka	
Ref : SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Location: Matarbari	
Test Method: ASTM	Date of Test: 1-10.4.21 *

SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	1	2	3.0	4.0	5.0	6.0
Depth (m)	14-14.5	25-25.45	4-4.5	17-17.45	17-17.45	26-26.45
Sample No.	12.0	23.0	4.0	15.0	14.0	23.0
Soil Type	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand
Wt. of bottle+water+ soil, gm	371.6	375.3	373.4	371.6	380.1	396.4
Temperature (°C)	30.5	30.0	30.5	30.5	30.5	30.0
Wt. of bottle+water, gm	340.0	343.7	342.1	340.4	348.8	365.1
Wt. of soil, gm	49.8	49.2	49.9	49.3	49.7	48.6
Specific Gravity	2.72	2.78	2.67	2.71	2.69	2.80

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

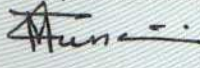
Countersigned by :

f 
Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



44A76bmM6

Test performed by :

 25.5.21
Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-18	Depth(m)	20.00-20.45
Pyknometer No.		13
Mass of bottle + soil + water: M_3	gm	98.84
Mass of bottle + soil: M_2	gm	59.28
Mass of bottle + water: M_4	gm	79.84
Mass of bottle: M_1	gm	29.29
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	20.56
Mass of water used: $M_3 - M_2$	gm	39.56
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	10.99
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.73

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-22	Depth(m)	24.00-24.45
Pyknometer No.		8
Mass of bottle + soil + water: M_3	gm	91.33
Mass of bottle + soil: M_2	gm	51.13
Mass of bottle + water: M_4	gm	72.48
Mass of bottle: M_1	gm	21.14
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	21.35
Mass of water used: $M_3 - M_2$	gm	40.20
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.14
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPSO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)



UNIT WEIGHT / BULK DENSITY VOID RATIO



Ground Instrumentation
& Engineering Pte Ltd

UD-02	Depth (m):	9.00-9.45
Weight of soil	gm	158.10
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.83
Dry Density	(g/cm ³)	1.30
Void Ratio		1.12
Moisture Content	%	40.59
Specific Gravity	(g/cm ³)	2.77

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-04

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 04-03-2021

Checked by: Suvashis Paul
Date: 07-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



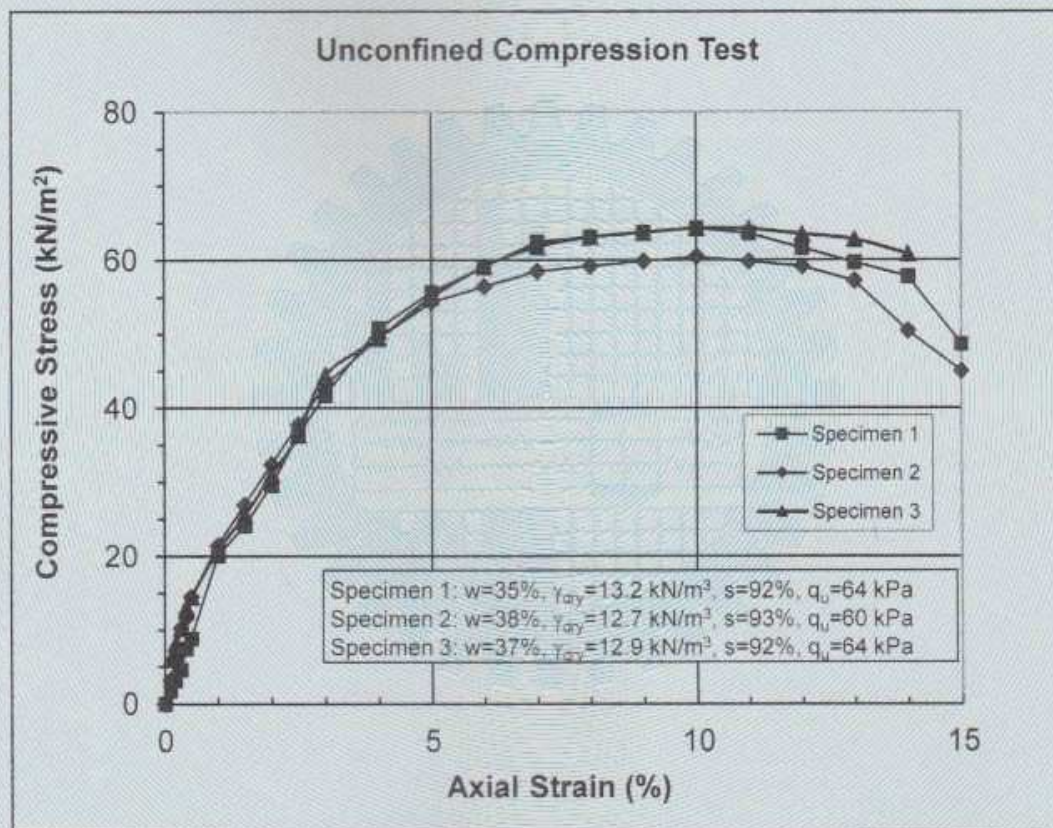
DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

GEOTECHNICAL ENGINEERING LABORATORY



BRTC No.: 110-231613/20-21/CE dated 11.3.21		
Client : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref : SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey silty clay		
Test Method:	ASTM	Date of Test: 29.3.21-1.4.21
BH No. : 4	Sample ID : UD-2	Depth: 9-10 m
		Location: Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Sample was received in unsealed condition.

Countersigned by :

[Signature]

Dr. A.B.M. Badruzzaman

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.



Specific Gravity= 2.77

Test performed by :

[Signature] 7.5.21

Dr. Tahmeed M. Al-Hussaini

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.



BRTC BUET

BUETCE 0272383

Direct Shear Tests

Direct Shearbox Test

Summary

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	2.00-2.45				
	Description	Silty SAND, SM				
	Type	Disturbed Soil				
				Spm. 1	2	3
	Initial Height	H ₀	(mm)	20.0	20.0	20.0
	Initial Width	D ₀	(mm)	60.0	60.0	60.0
	Initial Weight	W ₀	(gr)	139.4	139.4	139.4
	Initial Bulk Density	ρ ₀	(Mg/m ³)	1.94	1.94	1.94
	Particle Density	ρ _s	(Mg/m ³)	2.65	2.65	2.65

Initial Condition				Spm. 1	2	3
Normal Stress Level		(kPa)		50	100	200
Is Specimen Submersed?				Yes	Yes	Yes
Reverse Method				Motor Drive		
Hoz. Control Machine				Not Used	Not Used	Not Used
Initial Moisture	ω _i %	(%)		18	18	18
Initial Dry Density	ρ _{di}	(Mg/m ³)		1.64	1.64	1.64
Initial Voids Ratio	e _i	.		0.620	0.620	0.620
Initial Degree of Saturation	S _i	(%)		78.4	78.4	78.4
Notes						

Max Shear Stress Results				Spm. 1	2	3
Final Moisture	ω _f %	(%)		19	19	19
Final Dry Density	ρ _{df}	(Mg/m ³)		1.64	1.68	1.68
Final Voids Ratio	e _f	.		0.613	0.569	0.566
Final Degree of Saturation	S _f	(%)		80.3	86.6	86.9
Peak Shear Stress		(kPa)		36.6	65.6	134.7
Hoz Displacement	L _H	(mm)		12.000	12.000	12.000
Vertical Displacement	L _v	(mm)		0.050	0.030	0.050

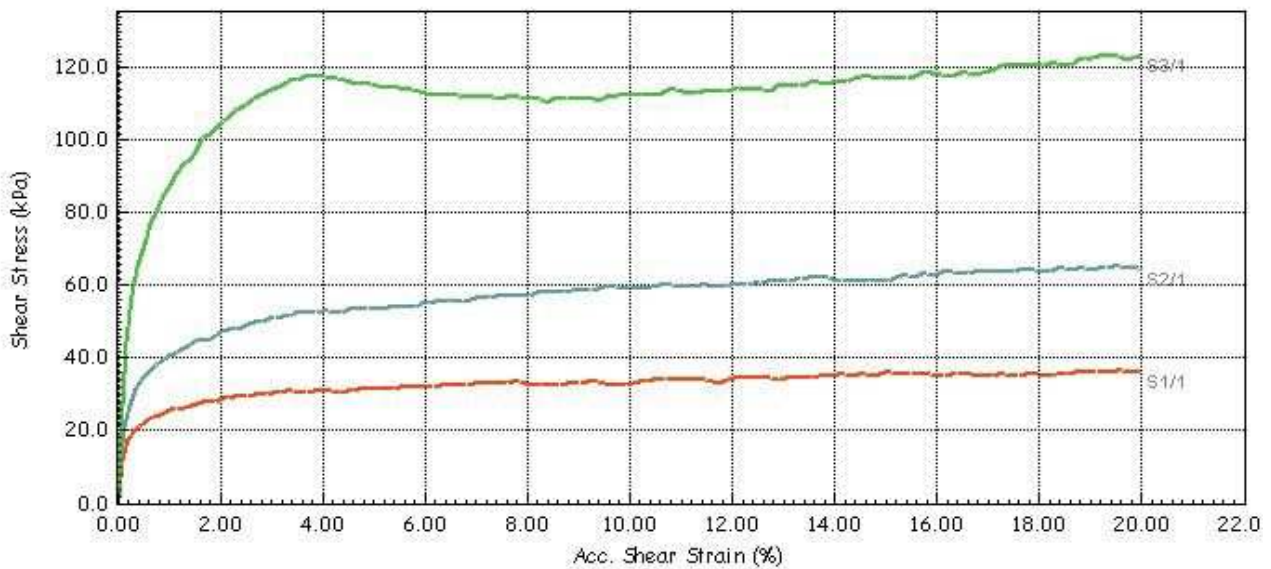
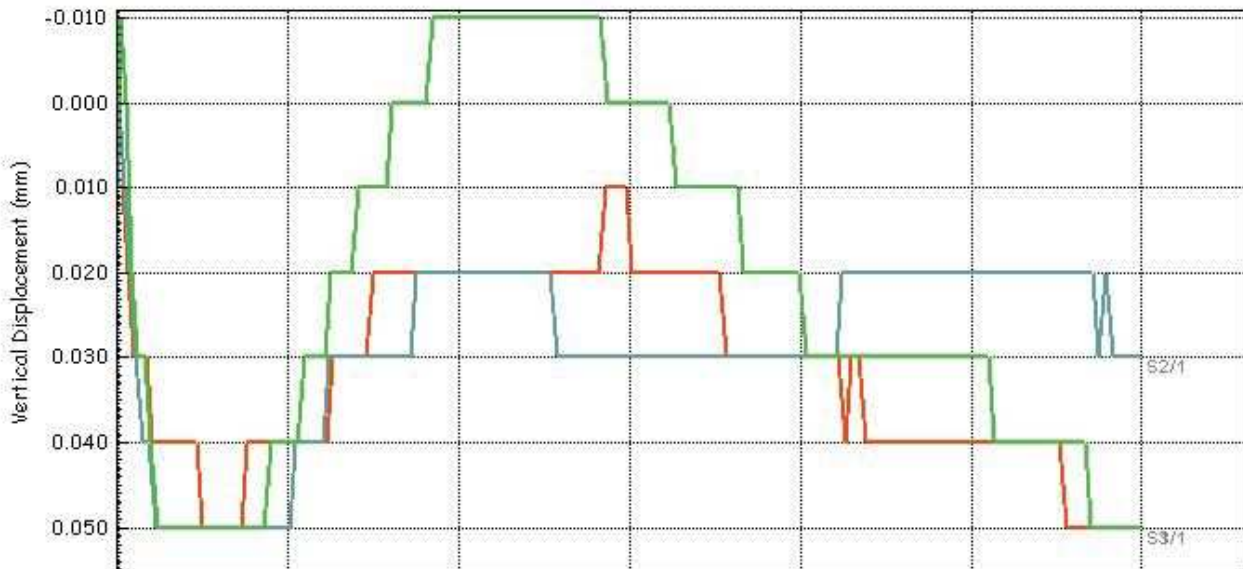
GIE

	Test Method		ASTM D 3080-04		Test Name		Direct Shear				
					Database:		.\SQLEXPRESS \ GIE-D				
	Site Reference				Test Date		3/20/2021				
	Jobfile		Direct Shear Test		Sample		SPT-02				
	Client		SGS		Borehole		BH-04				
Operator		R. Islam		Checked		Aminul		Approved		T. Islam	

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/20/2021	
	Jobfile Direct Shear Test		Sample SPT-02	
	Client SGS		Borehole BH-04	
Operator R. Islam		Checked Aminul	Approved T. Islam	

GIE

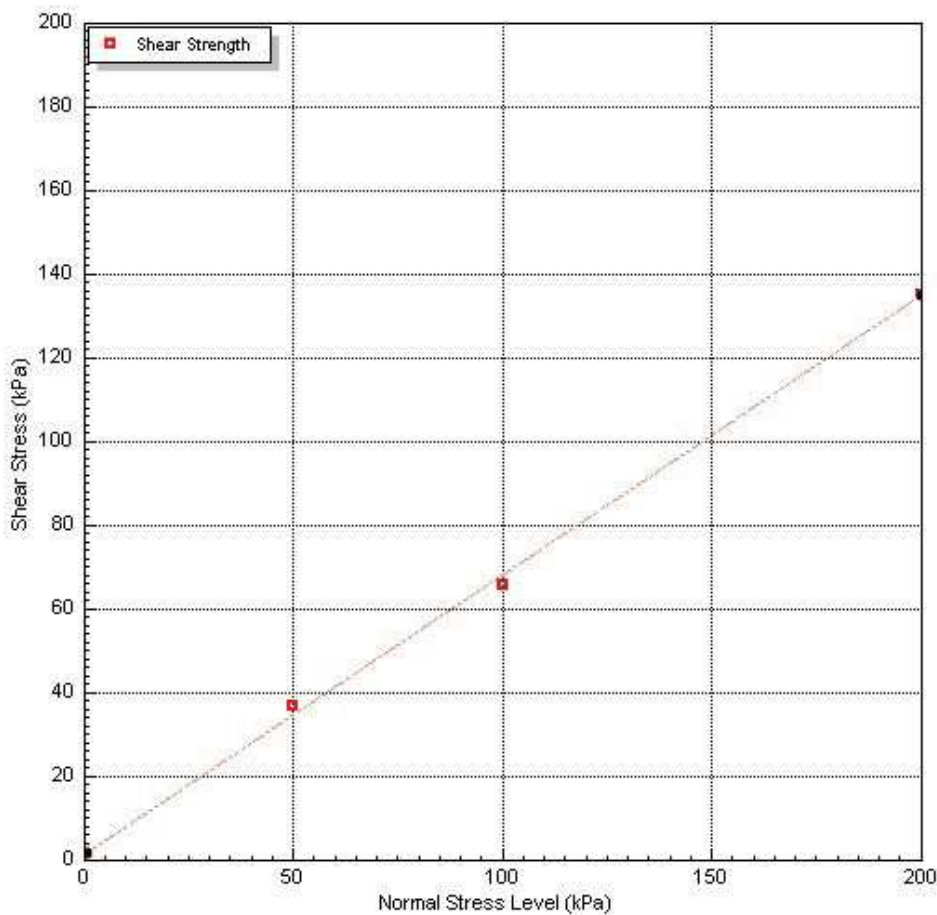
Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	19	19	19
Final Dry Density	ρ_{df} (Mg/m ³)	1.64	1.68	1.68
Final Voids Ratio	e_f	0.613	0.569	0.566
Final Degree of Saturation	S_f (%)	80.3	86.6	86.9
Apparent cohesion	c (kPa)	1.15		
Angle of Shearing Resistance	ϕ	33.7		

Notes



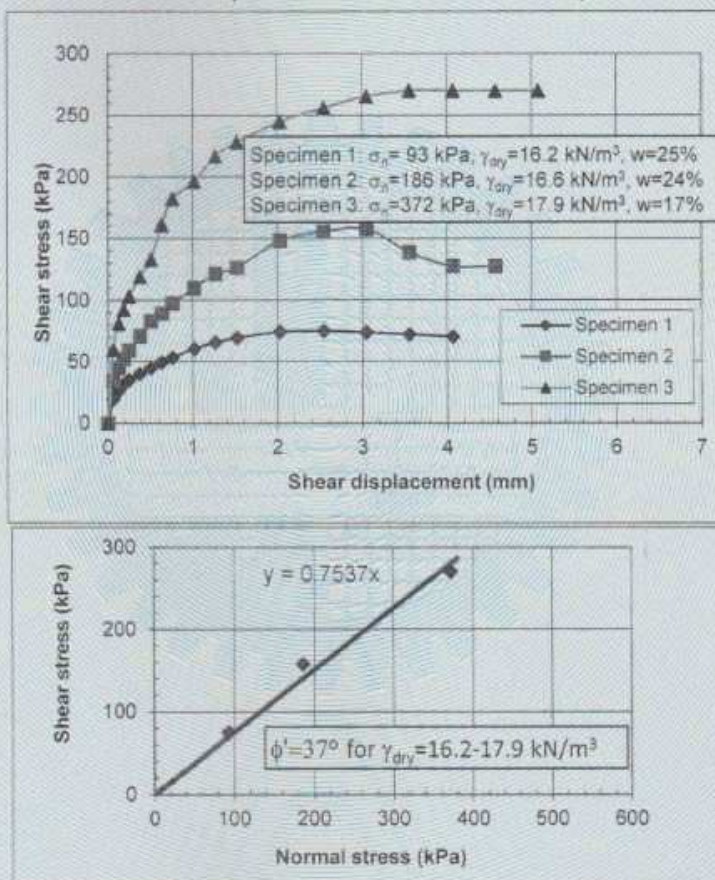
	Test Method		ASTM D 3080-04		Test Name		Direct Shear				
					Database: .\SQLEXPRESS \ GIE-D						
	Site Reference				Test Date				3/20/2021		
	Jobfile				Sample				SPT-02		
	Client				Borehole				BH-04		
Operator		R. Islam		Checked		Aminul		Approved		T. Islam	

GIE



BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand, trace clay	Location: Matarbari	
Bore-Hole: 4	Sample: 15	Depth: 17-17.45 m
Date of Test: 28.3.21-5.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition.

Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.

Countersigned by :

f. majid

Dr. A.B.M. Badruzzaman

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

Tahmeed M. Al-Hussaini
8.5.21

Dr. Tahmeed M. Al-Hussaini

Professor

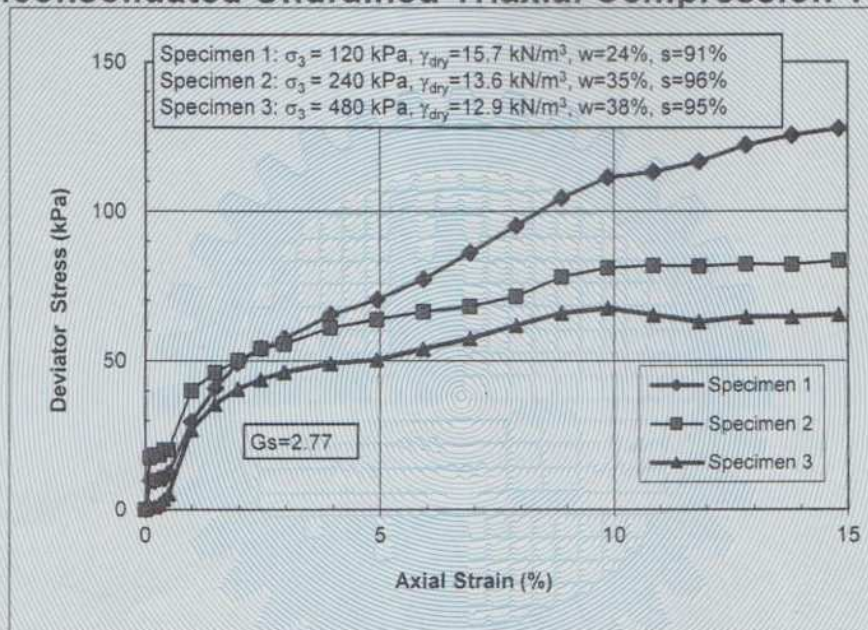
Department of Civil Engineering
BUET, Dhaka - 1000.



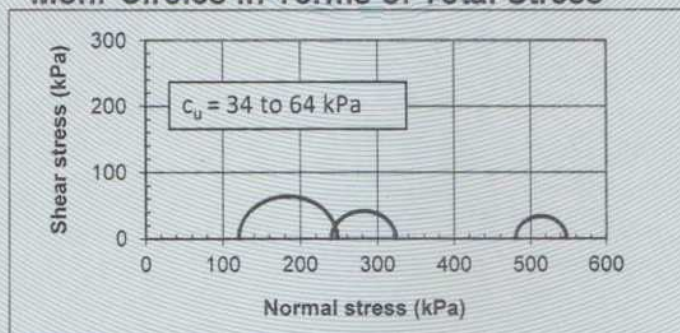


BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey silty clay	Test Method: ASTM	
B.H. No.: 4	Sample: UD-2	Depth: 9-10 m
Location: Matarbari	Date of Test: 17.5.21-23.5.21	

Unconsolidated Undrained Triaxial Compression Test



Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading. Differences in soil density may be noted resulting in different undrained shear strength.

Countersigned by :

Dr. A.B.M. Badruzzaman
 Professor, Dept. of Civil Engineering
 BUET, Dhaka - 1000.

Test performed by :

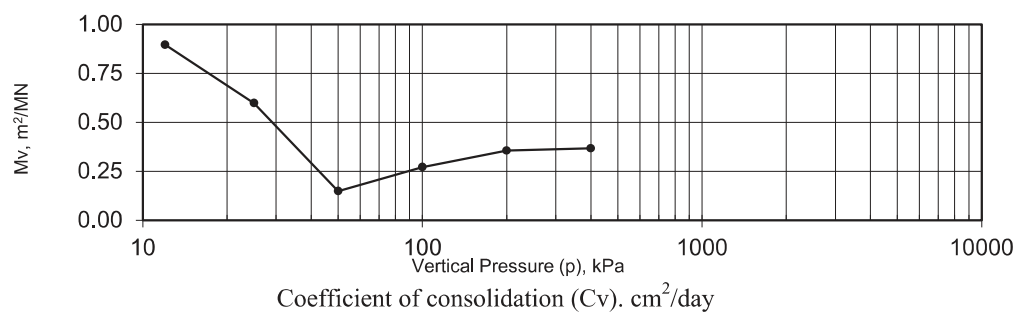
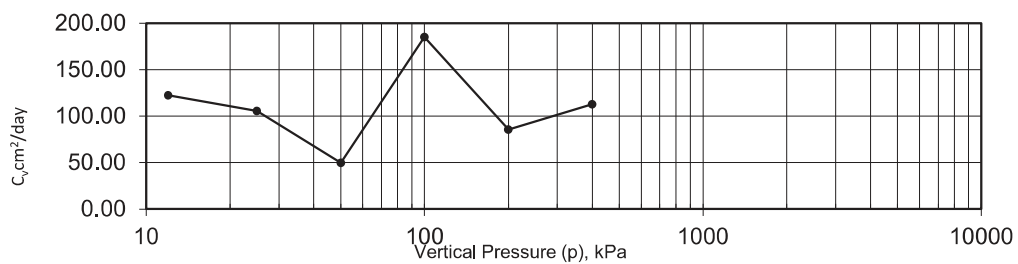
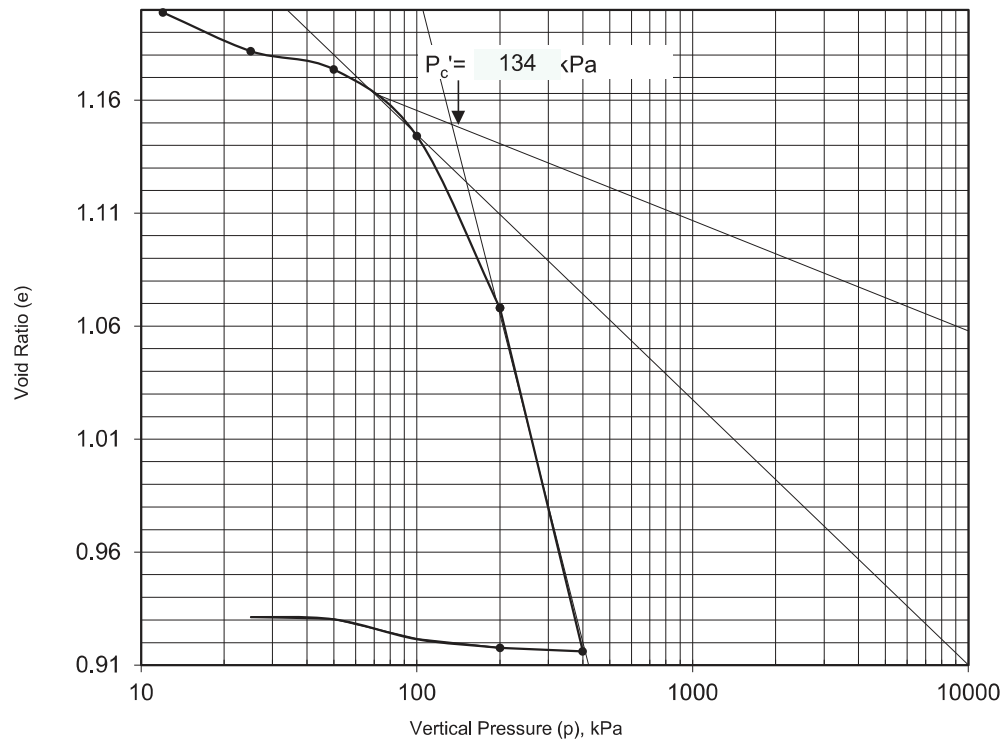
Dr. Tahmeed M. Al-Hussaini
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Ground Instrumentation & Engineering Pte Ltd	OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11																																																																																																																										
Project : SIBD2105 Client - Location : Geotechnical Investigation for Matarbari Project Boring No : BH-04 Sample No : UD-02 Depth (m) : 9.00-10.00 Soil Description : Lean CLAY, CL <u>Moisture Content Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr><td>Wt. of Ring + Wet Soil, gm</td><td style="text-align: center;">= 140.50</td><td style="text-align: center;">135.71</td></tr> <tr><td>Wt. of Ring + Dry Soil, gm</td><td style="text-align: center;">= 117.97</td><td style="text-align: center;">117.97</td></tr> <tr><td>Weight of Water, gm</td><td style="text-align: center;">= 22.53</td><td style="text-align: center;">17.74</td></tr> <tr><td>Weight of Container, gm</td><td style="text-align: center;">= 69.56</td><td style="text-align: center;">69.56</td></tr> <tr><td>Weight of Dry Soil, gm</td><td style="text-align: center;">= 48.41</td><td style="text-align: center;">48.41</td></tr> <tr><td>Water Content, %</td><td style="text-align: center;">= 46.5</td><td style="text-align: center;">36.6</td></tr> </tbody> </table> <u>Unit Weight Determination</u> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>Initial</u></th> <th style="text-align: center;"><u>Final</u></th> </tr> </thead> <tbody> <tr><td>Wt. of Ring + Wet Soil, gm</td><td style="text-align: center;">= 140.50</td><td style="text-align: center;">135.71</td></tr> <tr><td>Weight of Ring, gm</td><td style="text-align: center;">= 69.56</td><td style="text-align: center;">69.56</td></tr> <tr><td>Weight of Wet Soil, gm</td><td style="text-align: center;">= 70.94</td><td style="text-align: center;">66.15</td></tr> <tr><td>Height of Sample, cm</td><td style="text-align: center;">= 2</td><td style="text-align: center;">1.738</td></tr> <tr><td>Diameter of Sample, cm</td><td style="text-align: center;">= 5</td><td style="text-align: center;">5</td></tr> <tr><td>Volume of Sample, cm³</td><td style="text-align: center;">= 39.27</td><td style="text-align: center;">34.12</td></tr> <tr><td>Unit Wet Weight, kN/m³</td><td style="text-align: center;">= 17.7</td><td style="text-align: center;">19.0</td></tr> <tr><td>Unit Dry Weight, kN/m³</td><td style="text-align: center;">= 12.1</td><td style="text-align: center;">13.9</td></tr> </tbody> </table> Specific Gravity = 2.74 Initial Void Ratio = 1.223 Degree of Saturation, % = 100.0 Room Temperature, °C = 24.0 Temp. correction factor = 0.91 Initial Transducer Reading = 8.50 Effective Overburden Pressure = Preconsolidation Pressure = 134 Compression Index (Cc) = 0.4817				<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	= 140.50	135.71	Wt. of Ring + Dry Soil, gm	= 117.97	117.97	Weight of Water, gm	= 22.53	17.74	Weight of Container, gm	= 69.56	69.56	Weight of Dry Soil, gm	= 48.41	48.41	Water Content, %	= 46.5	36.6		<u>Initial</u>	<u>Final</u>	Wt. of Ring + Wet Soil, gm	= 140.50	135.71	Weight of Ring, gm	= 69.56	69.56	Weight of Wet Soil, gm	= 70.94	66.15	Height of Sample, cm	= 2	1.738	Diameter of Sample, cm	= 5	5	Volume of Sample, cm ³	= 39.27	34.12	Unit Wet Weight, kN/m ³	= 17.7	19.0	Unit Dry Weight, kN/m ³	= 12.1	13.9																																																																									
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Tested By: Rayhan Date: 24-03-2021 Checked & Approved By: T. Islam Date: 28-03-2021																																																																																																																											

ASTM D2435/D2435M - 11

$C_c = 0.48168$



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-04
 Sample : UD-02
 Depth (m) : 9.00-10.00



Ground Instrumentation &
 Engineering Pte Ltd

GEOTECHNICAL AND MATERIAL LABORATORY
Ground Instrumentation & Engineering
Pte.Ltd. House-7 Road-12, Dhaka 1230

LABORATORY COMPACTION TEST DATA
(Dry Density- Moisture Content Relationship)
ASTM D1557

Date: 29/03/2021

Project : Geotechnical Investigation for Matarbari, ID-SIBD-2105
Client : SGS
Test Pit No. : BH-04
Sample Depth : 1.00 m
Method: Standard Proctor (using 2.5 kg rammer)

Volume of Mould: 950 cm³

Test No.:		1	2	3	4	5	
Mass of Mould+ Base+Compacted Materials (m2)	g	5211	5288	5360	5410	5395	
Mass of Mould+ Base(m1)	g	3660	3660	3660	3660	3660	
mass of Compacted Materials(m2-m1)	g	1551	1628	1700	1750	1735	
Bulk Density, $\rho = \frac{m_2 - m_1}{vol. of mold}$	g/cm ³	1.633	1.714	1.789	1.842	1.826	
Moisture Content (w)	%	9.42	11.58	13.62	15.27	17.83	
Dry Density, $\rho_d = \frac{100\rho}{100 + w}$	g/cm ³	1.492	1.536	1.575	1.598	1.550	

MOISTURE CONTENT

Test No.:		1		2		3		4		5			
Container No.:		B-10	B-118	B-16	B-90	B-16	B-42	B-113	B-31	B-55	B-43		
Mass of container + wet soil	g	65.5	67.4	57.9	55.71	67.3	66.3	95.71	91.57	65.94	65.44		
mass of container + dry soil	g	62.6	64.6	53.91	52.76	61.52	61.5	86.42	82.53	60.4	58.6		
Mass of Water	g	2.81	2.78	3.95	2.95	5.78	4.76	9.29	9.04	5.5	6.88		
Mass of Container	g	33.43	34.48	19.31	27.66	19.31	26.42	23.84	24.93	29.24	20.39		
Mass of Dry Soil	g	29.2	30.12	34.6	25.1	42.21	35.12	62.58	57.6	31.2	38.17		
Moisture Content	%	9.62	9.23	11.42	11.75	13.69	13.55	14.84	15.69	17.63	18.02		
Average Moisture Content	%	9.4		11.6		13.6		15.3		17.8			

Maximum Dry Density	1.598	g/cm ³
Optimum Moisture Content	15.3	%

Fig. : Dry Density vs Moisture Content Curve

