Client: Power Cell, Power Division

Consultant: WinDForce Manatement Survices Pvt. Ltd.

GEOTECHNICAL INVESTIGATION REPORT

For the project

Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh at Sonagazi, Bangladesh.

20th June, 2017

Final report

NOOR-ZAMAN ENGINEERING FOUNDATION

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ABBREVIATION

C_U	Coefficient of uniformity
C_Z	Coefficient of curvature
q_U	Unconfined Compressive strength
D_f	Depth of foundation.
N'	Corrected SPT for overburden pressure
N''	Corrected SPT for dilatancy effect
Nf	Field SPT
P_0'	Effective overburden pressure
G.W.T.	Ground Water Table
E.G.L.	Existing Ground Level

CHAPTER-1: GENERAL

1.1. INTRODUCTION

This soil test report has been prepared on the basis of an agreement in between **WinDForce Management Services Private Limited, India** and **Noor-Zaman Engineering Foundation**, **Bangladesh** to conduct the assignment names **Geotechnical Survey work for the Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh** for **Power Cell, Power Division** of **Ministry of Power, Energy And Mineral Resources, Bangladesh.** Accordingly, a detailed subsoil investigation program has been undertaken and carried out by the **Noor-Zaman Engineering Foundation**, during the month of **M ay, 2017**. The geotechnical investigation work includes execution of **7 (Seven)** Borings extending to depth of 43.5 meters, performance of a variety of field and laboratory tests to determine the subsoil conditions. The information, so far has been obtained from carrying out the above subsurface investigation program, is provided in detail, in the following articles.

1.2. LOCATION

The Sub-Soil investigation Works has been undertaken for the Feasibility Study for Development Utility Scale Solar & Wind Projects at Sonagazi near Choto Feni River in Bangladesh.

FIG-1. Site for the Feasibility Study for Development Utility Scale Solar & Wind Projects at Sonagazi near Choto Feni River in Bangladesh.

1.3. PURPOSE OF STUDY

The purpose of this Sub-Soil Investigation was to determine the Geotechnical properties and distribution of sub-surface materials and ground water levels within the project area to facilitate the Feasibility Study for Development Utility Scale Solar & Wind Projects.

1.4. SCOPE OF THE WORK

The Sub-Soil Investigation consisted of field studies and laboratory tests. The field portion of the investigation consists of test borings and field testing. Laboratory studies included tests to determine soil properties including physical and mechanical properties.

The scope of Works for soil investigation of the site is as following:

a) Mobilization and Demobilization

b) Drilling boreholes and production of appropriate borehole logs

c) Standard Penetration Tests (SPT's)

d) Undisturbed and Disturbed sampling

e) Laboratory testing of samples & Reporting.

1.5. DETAILED WORK UNDERTAKEN

1.5.1. FIELD WORK

1.5.1.1. Boreholes

7 Nos. of soil boring of 150mm diameter have been conducted by manual boring method as approved by the CLIENT'S Geotechnical Engineer at the locations provided by the Client. The investigation has been carried out in accordance with ASTM D-420 & 1452. Field identification and logging of soil samples has been made in accordance with the Unified Soil Classification System (USCS).

Boreholes have been backfilled to their pre-existing condition as per approval of the CLIENT'S Geotechnical Engineer.

All the borings have been conducted in the presence of the experienced technical personnel of Noor-Zaman Engineering Foundation for drilling and logging. The borehole records have been taken that include soil type, nature of sample, soil moisture content and consistency, SPT blow counts, ground water observation and apparent origin (fill, alluvium, recent sediments, etc.) and daily field logs have been prepared by the Site Engineer of Noor-Zaman Engineering Foundation.

Bore logs have been prepared in the CLIENT'S format in accordance with USCS classification and draft logs have been submitted within one week of drilling.

The entire bore has been conducted in dry land so no temporary platform was required.

Boreholes have been surveyed for locations (coordinates) and elevations and have been shown on a plan with an appropriate number referencing system in accordance with the approval of the CLIENT'S Geotechnical Engineer.

FIG-2. Soil exploratory boring for the Feasibility Study for Development Utility Scale Solar & Wind Projects at Sonagazi near Choto Feni River in Bangladesh.

1.5.1.2. Soil sampling and in-situ testing

SPT tests have been carried out in accordance with the procedure in ASTM D-1586; from existing ground level and at 1.5 m interval. Before conducting the test, the bottom of the borehole has been cleaned properly and the spoon has been seated vertically in position in the borehole. Disturbed samples have been collected from the SPT tube.

Undisturbed sample (75mm diameter) has been collected at several depths where cohesive soil strata were encountered, in good quality thin walled seamless Shelby

Tubes conforming to the ASTM D-1587. No SPT have been conducted immediately before collection of an undisturbed sample.

Ground water table has been measured 24 hours after drilling and has been recorded in the bore log.

FIG-3. Standard Penetration Test for the Feasibility Study for Development Utility Scale Solar & Wind Projects at Sonagazi near Choto Feni River in Bangladesh.

1.5.1.3. Storage and transportation of samples

Noor-Zaman Engineering Foundation has stored samples in a place that avoids contact direct sun-light, secured and free from any disturbance and transported within a week of extraction to the laboratory of **Noor-Zaman Engineering Foundation** Dhaka office.

1.5.2. LABORATORY TESTING

The laboratory tests performed were as per requirement of the tests decided by CLIENT'S Geotechnical Engineer are listed below.

TABLE 1. List of laboratory tests Quantity information

Item description	Quantity
a) Specific gravity	18
b) Grain size analysis of soil by sieve and Hydrometer	60
c) Atterberg Limit Test	13
d) Unit weight of soil	00
e) Natural moisture content	60
f) Consolidation test for cohesive soil	00
g) Direct shear test	21
h) Unconfined compressive test for cohesive soil	00

All Tests have been carried out in the laboratory previously approved by CLIENT'S.

FIG-4. Moisture Content test in Progress

FIG-5. Atterberg Limits test in Progress

FIG-6. Grain size analysis (Hydrometer) test in Progress

FIG-7. Grain size analysis (Sieve) test in Progress

FIG-8. Specific Gravity test in Progress

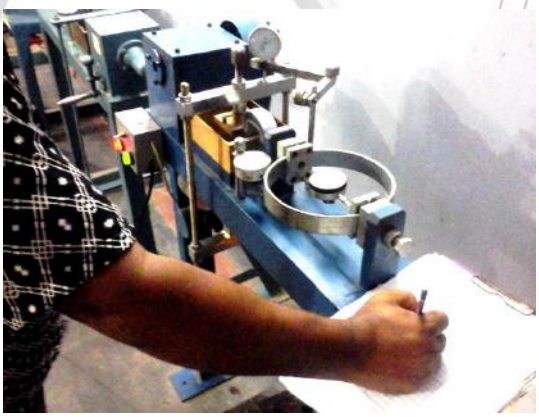


FIG-9. Direct Shear test in Progress

1.5.3. REPORTING

1.5.3.1. Logs

All bore logs have been written in English and presented in a form acceptable to CLIENT'S that contains a summary of all the information on the daily site records, a description of all strata and levels of changes of strata.

1.5.3.2. Laboratory Test Results

Noor-Zaman Engineering Foundation has submitted two copies of preliminary laboratory test results to the Client's Representative and after review of the Client's Representative the test results have been included in the Final Report.

1.5.3.3. Final Report

Following completion of the boreholes, and field and laboratory testing, a comprehensive Geotechnical Final Report has been prepared comprising:

a) Site description and geology, site plan

b) Investigation methodology

c) Detailed logs, and location plans

d) Laboratory methodology, laboratory test results (with summary of test results)

e) Ground water table within the boreholes 24 hours after completion

f) Mechanical properties of soil obtained from the field and laboratory tests

g) Soil strength parameters

h) Photographs

1.6. SEISMIC ZONE AND LIQUEFACTION POTENTIAL

Ali (1998) presented the earthquake base and seismic zoning map of Bangladesh. Tectonic frame work of Bangladesh and adjoining areas indicate that Bangladesh is situated adjacent to the plate margins of India and Eurasia where devastating earthquake has occurred in the past. Non-availability of earthquake, geologic and tectonic data posed great problem in earthquake hazard mapping of Bangladesh in the past. The first seismic map which was prepared in 1979 was developed considering only the epicentre location of past earthquake and isoseismic map of very few of them. During preparation of national building code of Bangladesh in 1993, substantial effort was given in revising the existing seismic zoning map using geophysical and tectonic data earthquake data, ground motion attenuation data and strong motion data available from within as well as outside of the country. During this study geophysical and tectonic data were available from geological survey of Bangladesh. Earthquake data were collected from NOAA data files and geodetic survey, U.S. Dept. of commerce.

Seismic zoning map for Bangladesh has been presented in Bangladesh National Building code (BNBC) published in 1993. The pattern of ground surface acceleration contours having 200 year return period is the basis of this seismic zoning map. There are three zones in the map— Zone I, Zone II and Zone III. The seismic coefficients of the zones are 0.08g, 0.05g and 0.04g for Zone I, Zone II and Zone III, respectively.

Bangladesh National Building Code (1993) placed the project area in seismic Zone II as shown in Figure. The seismic zones in the code are not based on the analytical assessment of seismic hazard are mainly based in the historical data. An updated seismic zoning map based on analytical studies was recently developed by sharfuddin (2001). This zoning was based on consistent ground motion criterion

such as equal peak ground acceleration levels. In this map also placed the project area in seismic Zone II. This map also has been three zones namely-Zone I, Zone II and Zone III. The seismic coefficients are also the same as in the map presented by BNBC (1993).

The proposed project location is in Zone II (BNBC, 2006, modified) with maximum ground acceleration of 0.2 g for 200 years return period. The historical seismic activities at the site are negligible. Hence, the probability of Liquefaction below the foundation is low for seismic activity. However, due to vibratory equipment located very adjacent to the foundation may have some affect so; precaution should be taken for such conditions.

FIG-11. Seismic Zoning Map of Bangladesh (BN`BC Part 6 Chapter 2 Article 2.5.4.2)

1.7. METHOD OF INVESTIGATION

This investigation consists of field & laboratory tests, which were carried out as following:

1.7.1. Exploratory boreholes

During the period on **23th May, 2017** to **31th May, 2017, seven** exploratory boreholes were drilled at locations, selected by the representative of the client. The boreholes were minimum 100 mm diameter and advanced using mechanically wash method. Casing was used in upper part of the hole and to remove cuttings/loose soil from the borehole and stabilize borehole walls against cave-in, drilling fluid (water mixed with Bentonite) was radically pumped into the borehole through nose of the chopping bit chisel attached at lower end of drill rod. The boreholes depths below the existing ground surface, date of drilling are summarized in the following table.

TABLE 2. Summary of Boreholes information

Sl No.	*Location*	*Bore Hole No.*	*CO-ORDINATE (UTM system)*			*R.L*	*Drilled Depth*	*Drilling completion Date*
			Zone	N	E			
1	Sonagazi, Bangladesh.	01	46Q	2520419	0332115	(-)4.40	43.5	23-May-17
2		02		2520676	0333015	(-)4.60	43.5	25-May-17
3		03		2520824	0334211	(-)5.00	43.5	26-May-17
4		04		2520822	0334810	(-)5.20	43.5	27-May-17
5		05		2520580	0335336	(-)5.00	43.5	28-May-17
6		06		2521564	0333348	(-)5.05	43.5	29-May-17
7		07		2521441	0334639	(-)5.15	43.5	30-May-17

1.7.2. Standard Penetration Test

SPT tests have been carried in accordance with the procedure in ASTM D-1586; from existing ground level and at 1.5 m interval. According to requirements of ASTM, using drill rod & Standard split spoon, standard penetration tests have been performed in all boreholes at specified levels and results of such tests are presented in bore logs.

The Standard Penetration Test (SPT) is a commonly used in situ test in order to determine the consistency / Relative density of the investigated site within the shortest possible period of time. The test includes dropping of a hammer weighing 140 lbs. (63.5 kg) and falling freely over a constant height of 30"(76 cm) along the drill pipe in order to drive the sampler attached at the end of the same. The number of the Blows, necessary to produce the penetration was recorded in three different stages each at six inches of interval. The number of the Blows required in the 2nd and 3rd six inches of the penetration of the sampler is called the SPT value (N) and is represented by "N". The above "N" values are shown in the Bore-log chart against the respective interval of the depth, in the case of each Boring.

The term consistency of the cohesive soil is generally used on the basis of the SPT values (N) in the following way.

N	...	...	0-2	...	...	Very Soft
N	...	...	2-4	...	...	Soft
N	...	...	4-8	...	...	Firm
N	...	...	8-15	...	...	Stiff
N	...	...	15-30	...	...	Very Stiff
N	...	...	30-50	...	...	Hard
N	...	...	>50	...	...	Very Hard

The term relative density for the non-cohesive soil is based on the SPT values (N) in the following way.

N	...	...	0-4	...	...	Very loose
N	...	...	4-10	...	...	Loose
N	...	...	10-30	...	...	Medium dense
N	...	...	30-50	...	...	Dense
N	...	...	>50	...	...	Very dense

1.7.3. Recording of soil stratification:

During boring, soil stratification in the borehole, with other information and field reports was prepared by an experienced Site Engineer of **Noor-Zaman Engineering Foundation**. Depth with thickness & description of strata encountered, soil sampling, results of in-situ tests etc. was presented in the bore logs.

1.7.4. Sampling

Disturbed and Undisturbed soil samples were collected as following

1.7.4.1. Collection of disturbed soil samples

In accordance with requirements of AASHTO T-206, after visual examination of soil retained within the spoon used for standard penetration tests, available disturbed soil samples was preserved within double layered polythene bags in water tight condition, with proper identification tag and subsequently all soil samples were safely transported to laboratory for necessary tests.

1.7.4.2. Collection of undisturbed soil samples

In accordance standard procedure ASTM 9/507: Thin walled tubes sampling of soil undisturbed soil samples from significant cohesive zone was collected and preserved within 75 mm dia. open end Shelby tube, in wax sealed condition and was transported to selected laboratory with proper identification tag and preserved there for specified tests.

1.7.5. Recording of Ground Water Table

Generally, the ground water table is measured and recorded in boreholes. But this general practice was not measured ground water table during the operation of boreholes. The ground water table at boreholes was measured 24 hours (when it became stable) after completion of borings. However, this is the level of the Apparent Ground water, formed by the entrapped surface water.

The depths of Ground water below the existing ground surface and date of Ground water measurement are summarized in the following table.

TABLE 3. Summary of ground water table

Sl No.	*Bore Hole No.*	*CO-ORDINATE (UTM system)*				*G.W.T.*	*Drilling completion Date*	*G.W.T. Recording Date*
		Zone	N	E	*R.L*			
1	01	46Q	2520328	0332115	(-)4.40	(-)3.50	23-May-17	24-May-17
2	02		2620605	0333028	(-)4.60	(-)3.50	25-May-17	26-May-17
3	03		2520535	0334228	(-)5.00	(-)3.00	26-May-17	27-May-17
4	04		2520729	0334807	(-)5.20	(-)3.00	27-May-17	28-May-17
5	05		2520487	0335333	(-)5.00	(-)2.50	28-May-17	29-May-17
6	06				(-)5.05	(-)3.05	29-May-17	30-May-17
7	07				(-)5.15	(-)5.15	30-May-17	31-May-17

1.8. LABORATORY TESTS

1.8.1. Natural Moisture Content Tests

Natural Moisture Content Tests were performed on selected samples according to ASTM D420-69.

1.8.2. Wet & Dry Unit Weight Tests

Wet & Dry Unit Weight Tests were performed on selected samples according to ASTM D420-69.

1.8.3. Atterberg Limits Tests

Atterberg Limits Tests were performed on selected samples, collected from cohesive zones only according to ASTM D423-66 & D424-59.

1.8.4. Specific Gravity Test

Specific Gravity Test were performed on selected soil Samples, according to ASTM D854-83.

1.8.5. Grain size Analysis Test

Grain size Analysis Test were performed on available representative disturbed & undisturbed soil samples, collected from different strata according to ASTM D421-38 & D422-63.

1.8.6. Direct Shear (Qc/D.S.) Tests

Direct Shear (Qc/D.S.) Tests were performed on 50mm x 50mm x 20mm specimens, prepared from selected available disturbed and undisturbed samples, collected from cohesive/non-cohesive strata, encountered in the boreholes to determine their cohesion and angle of internal friction, according to ASTM D-3080-72.

1.8.7. Unconfined Compression Test

Unconfined Compression Tests were performed on 35.6mm dia. specimens, prepared from selected available disturbed (Remolded)/ undisturbed samples, were performed according to ASTM D2166-85.

1.8.8. One Dimension Consolidation Tests

On 63.5mm dia. & 25mm thick specimens, 1-D consolidation tests with prepared from selected undisturbed samples, collected from significant cohesive zones, and with 1:1 increment ratio and 24-hours duration for each load were performed according to ASTM D-2435-70.

CHAPTER-2: EVALUATION OF BEARING CAPACITY

2.1. CORRECTION OF THE SPT VALUES

$$N' = \frac{4*N}{1+2*P_0'} \quad ; P_0' > 1.5 \text{ ksf}$$

$$N' = \frac{4*N}{3.25+0.5*P_0'} \quad ; P_0' < 1.5 \text{ ksf}$$

Field SPT values have been corrected for overburden pressure and dilatancy.

For coarse, cohesion-less soil according to Bazaraa(1967)-

In very fine, or Silty, saturated sand Terzaghi & Peck (First Edition, P-426) recommended that the penetration number be adjusted if N is greater than 15 as ***N″=15+0.5*(N′-15).***

2.2. EVALUATION OF BEARING CAPACITY

2.2.1. Shallow Foundation

For cohesive soil, the criteria for finding Bearing Capacity is based on the cohesion parameters obtained from unconfined compression strength tests or estimated from the corrected SPT values. For granular soil it is Bearing Capacities of the foundation can be evaluated according to Terzaghi, Meyerhof and Hansen.

2.2.2. Deep Foundation

Whenever necessary Deep Foundation preferably Pile may be used. To evaluate skin friction and end bearing capacity following formulae may be used-

According to Meyerhof for sandy soil

$$f_{su} = q_c/200 = 4*N/200 \text{ ton/ ft}^2$$

$$q_{pu} = q_c = 4*N \text{ ton/ ft}^2$$

However, when soil are not purely sand rather presence of some silt material are found, above relation may be modified as per observation of Schmertmann (1970)

$$q_{pu} = q_c = 3*N \ ton/ft^2$$

$$f_{su} = q_c/200 = 3*N/200 \ ton/ft^2$$

For cohesive soil α method proposed by Tomlinson (1971)

$$f_s = \alpha c + q^* k^* \tan\delta$$

Depending on the existing soil type, the values of both the skin friction as well as the end bearing of the pile have been evaluated for the different depths of investigation and are presented in Appendix –E & Appendix –F.

CHAPTER-2: GEOTECHNICAL PROPERTIES

3.1. INTRODUCTION

The Geo-technical properties i.e. the physical as well as the engineering properties of the investigated soil have been determined on the basis of executing Thirty three Boring each extending to a depth of 30.0 m to 49.5 m and subsequent performance of the laboratory tests. These are discussed in detail in the following articles.

3.2. PHYSICAL PROPERTIES

The physical properties i.e. the color, odor, texture and the general index properties such as the specific gravity and plasticity have been determined by visual inspection and from performing some specific laboratory tests. These may be summarized as follows:

a. Subsoil stratification

The top formation of soil, extending to the depth of investigation is predominated by nature consisting of Grey Stiff Clayey SILT, trace Sand (Ref: Bore-logs). It may be mentioned here, that a layer of Grey Stiff Clayey SILT, Little Sand that exists roughly up to the depth of the investigation (Ref: Bore-logs). Further below, the layers of Grey Stiff Clayey SILT, trace Sand extending to the depth of the investigation, (Ref: Bore-logs).

b. Consistency/Relative density

The top formation of soil, extending to the depth of the investigation, Grey Loose to Medium Dense Silty SAND (Ref: Bore-logs). Further below, the layers of the

Grey Loose Sandy SILT roughly up to the depth of the investigation in the case of each borehole (Ref: Bore-logs). The subsequent layers of soil, extending to the depth of the investigation, generally have been found in a Grey Medium Dense Sandy SILT occasionally in a dense state (Ref: Bore-logs).

c. Natural Moisture Content & Specific Gravity

The natural moisture content of the investigated soil usually varies from 18.64% to 30.92%. The Specific gravity of the investigated soil usually varies from 2.54 to 2.60.

3.3. ENGINEERING PROPERTIES

The engineering properties of the subsoil formation of the project area have been determined by the performance of the laboratory tests. The evaluated properties may be summarized as follows.

a. Angle of Internal Friction

The values of the angle of internal friction, as obtained from the performance of the direct shear tests, vary from 25^{o} to 34^{o}.

CHAPTER-3: DISCUSSION

4.1. DISCUSSION

Layer distribution and soil type that found in soil exploratory borings are given below:

01 BH# 01

Form 0 m to 3 m	LIGHT GREY FIRM CLAYEY SILT, TRACE SAND.
Form 3 m to 10.5 m	GREY LOOSE TO MEDIUM DENSE SILTY SAND.
Form 10.5 m to 15 m	GREY LOOSE SANDY SILT.
Form 15 m to 16.5 m	GREY MEDIUM DENSE SILTY SAND.
Form 16.5 m to 18 m	LIGHT GREY DENSE SILTY SAND.
Form 18 m to 25.5 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 25.5 m to 34.5 m	GREY MEDIUM DENSE SANDY SILT.
Form 34.5 m to 43.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.

02 BH# 02

Form 0 m to 3 m	GREY FIRM CLAYEY SILT, TRACE SAND.
Form 3 m to 7.5 m	GREY LOOSE SANDY SILT.
Form 7.5 m to 16.5 m	GREY LOOSE TO MEDIUM DENSE SILTY SAND.
Form 16.5 m to 18 m	LIGHT GREY VERY DENSE SILTY SAND.
Form 18 m to 19.5 m	GREY MEDIUM DENSE SANDY SILT.
Form 19.5 m to 22.5 m	LIGHT GREY STIFF TO VERY STIFF CLAYEY SILT, TRACE SAND.
Form 22.5 m to 25.5 m	GREY STIFF CLAYEY SILT, LITTLE SAND.
Form 25.5 m to 30 m	GREY MEDIUM DENSE TO DENSE SANDY SILT.
Form 30 m to 36 m	GREY MEDIUM DENSE SILTY SAND.
Form 36 m to 43.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.

03 BH# 03

Form 0 m to 6 m	GREY FIRM TO STIFF CLAYEY SILT, TRACE SAND.
Form 6 m to 9 m	GREY LOOSE TO MEDIUM DENSE SILTY SAND.
Form 9 m to 16.5 m	GREY LOOSE TO MEDIUM DENSE SANDY SILT.
Form 16.5 m to 19.5 m	LIGHT GREY MEDIUM DENSE SILTY SAND.
Form 19.5 m to 22.5 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 22.5 m to 25.5 m	GREY LOOSE SILTY SAND.
Form 25.5 m to 30 m	LIGHT GREY MEDIUM DENSE TO DENSE SANDY SILT.
Form 30 m to 37.5 m	GREY MEDIUM DENSE SILTY SAND.
Form 37.5 m to 43.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.

04 BH# 04

Form 0 m to 4.5 m	GREY SOFT TO FIRM CLAYEY SILT, TRACE SAND.
Form 4.5 m to 9 m	GREY LOOSE TO MEDIUM DENSE SANDY SILT.
Form 9 m to 13.5 m	GREY MEDIUM DENSE SILTY SAND.
Form 13.5 m to 16.5 m	GREY FIRM TO STIFF CLAYEY SILT, TRACE SAND.
Form 16.5 m to 19.5 m	GREY MEDIUM DENSE SILTY SAND.
Form 19.5 m to 22.5 m	GREY MEDIUM DENSE SANDY SILT.
Form 22.5 m to 25.5 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 25.5 m to 33 m	GREY MEDIUM DENSE TO DENSE SILTY SAND.
Form 33 m to 34.5 m	GREY LOOSE SANDY SILT.
Form 34.5 m to 43.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.

05 BH# 05

Form 0 m to 4.5 m	GREY SOFT TO FIRM CLAYEY SILT, TRACE SAND.
Form 4.5 m to 9 m	GREY MEDIUM DENSE SANDY SILT.
Form 9 m to 16.5 m	GREY LOOSE TO MEDIUM DENSE SILTY SAND.
Form 16.5 m to 19.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.

Form 19.5 m to 27 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 27 m to 39 m	GREY MEDIUM DENSE TO DESNE SILTY SAND.
Form 39 m to 43.5 m	LIGHT GREY DENSE SILTY SAND.

06 BH# 06

Form 0 m to 3 m	GREY SOFT TO FIRM CLAYEY SILT, TRACE SAND.
Form 3 m to 7.5 m	GREY LOOSE SANDY SILT.
Form 7.5 m to 12 m	LIGHT GREY MEDIUM DENSE SILTY SAND.
Form 12 m to 15 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 15 m to 22.5 m	GREY MEDIUM DENSE SILTY SAND.
Form 22.5 m to 25.5 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 25.5 m to 34.5 m	LIGHT GREY MEDIUM DENSE SILTY SAND.
Form 34.5 m to 43.5 m	GREY MEDIUM DENSE TO DENSE SILTY SAND.

07 BH# 07

Form 0 m to 4.5 m	GREY SOFT TO FIRM CLAYEY SILT, TRACE SAND.
Form 4.5 m to 10.5 m	GREY LOOSE TO MEDIUM DENSE SANDY SILT.
Form 10.5 m to 12 m	GREY MEDIUM DENSE SILTY SAND.
Form 12 m to 16.5 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 16.5 m to 19.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.
Form 19.5 m to 22.5 m	GREY STIFF CLAYEY SILT, TRACE SAND.
Form 22.5 m to 30 m	LIGHT GREY MEDIUM DENSE SILTY SAND.
Form 30 m to 37.5 m	GREY MEDIUM DENSE SILTY SAND.
Form 37.5 m to 43.5 m	LIGHT GREY MEDIUM DENSE TO DENSE SILTY SAND.

CHAPTER-4: RECOMMENDATION

5.1. RECOMMENDATION

For the **Geotechnical Survey work for the Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh** at **Sonagazi** near **Choto Feni River** in **Bangladesh** for **Power Cell, Power Division** of **Ministry of Power, Energy And Mineral Resources, Bangladesh** following recommendation is given considering all aspects:-

Experienced structural engineer and geo-technical engineer are required to work side by side to select the appropriate foundation types and soil improvement measure that might be needed to be taken at the site of proposed construction.

Since it is beyond the scope of our assigned job we can just reflect on different options briefly, to help the design team to appraise problem for an appropriate solution.

Deep foundation

Skin friction as well as point-bearing capacity for different layer shave been derived and are provided in Appendix – E of this report for design aid in case of bored piles.

Skin friction as well as point-bearing capacity for different layers have been derived and are provided in Appendix – F of this report for design aid in case of driven piles.

5.2. PRECAUTIONARYMEASURE

In case of any excavation it should be designed properly taking care of existing Structure, utility lines and available techniques.

Note:

a. However in spite of the above suggestion there is scope to choose foundation system for the structure in dependently for any experienced Geo-technical Engineer.

b. Whenever any soil improvement measures are taken or pile is driven, field tests must be carried out to ensure that the bearing capacity and settlement criterion commensurate to design values.

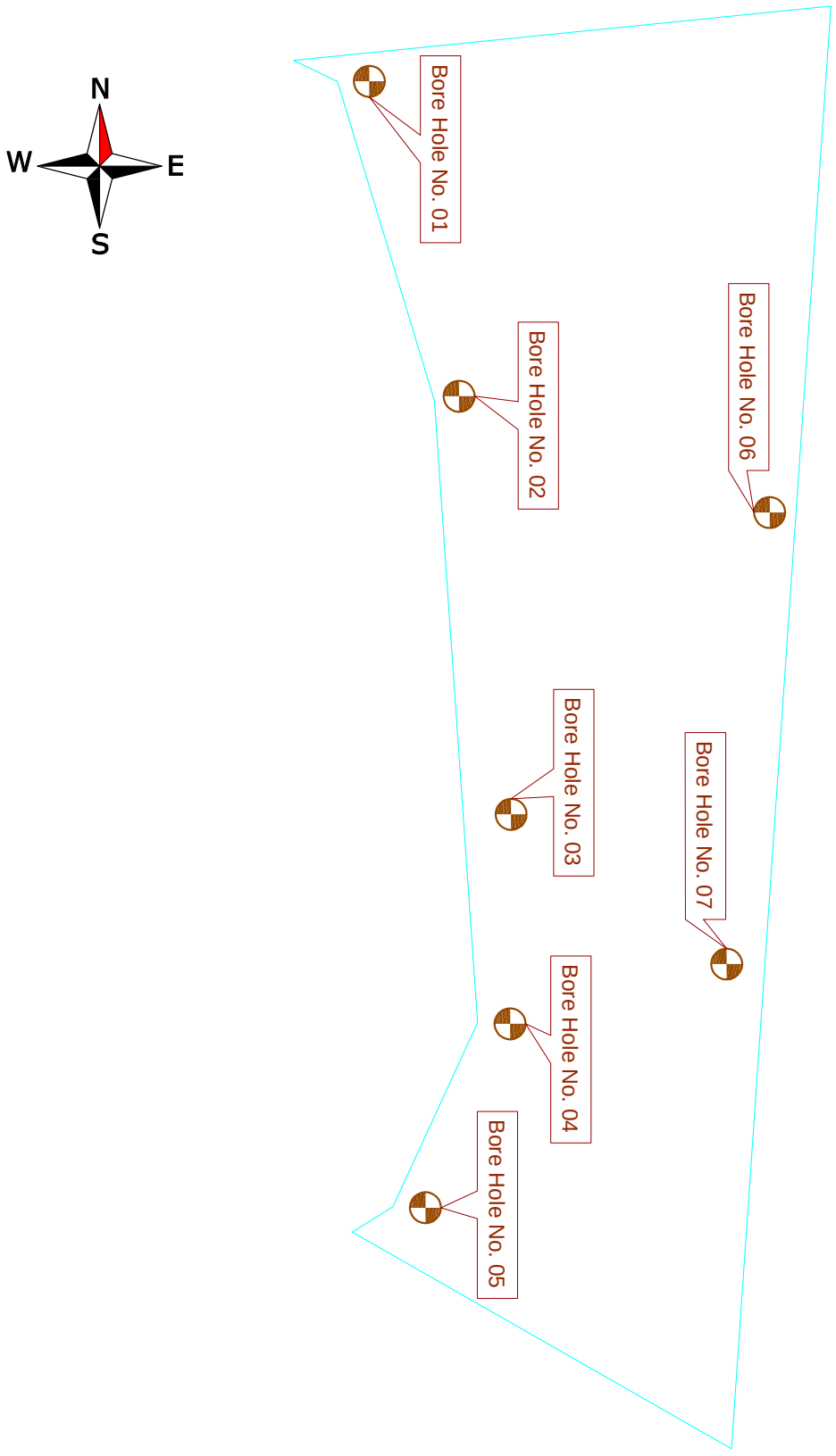
APPENDIX-A: Location Map

Client : Power Cell, Power Division.

Consultant : WinDForce Manatement Survices Pvt. Ltd.

Project :Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.

Location : Sonagazi, Bangladesh.



SKETCH SHOWING BOREHOLE LOCATIONS

(Not to Scale)

N00R-ZAMAN ENGINEERING FOUNDATION

Drawn by : Rakibul

Checked. by : F. JEWEL

APPENDIX-B: Bore Logs

BORE LOG

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***	**BORE HOLE NO.:**	***01***
CLIENT:	***Power Cell, Power Division.*** **CONSULTANT:** ***WinDForce Manatement Survices Pvt. Lt***	**RL (m) :**	***(-)4.40***
METHOD OF BORING :	**Manual** **DATE STARTED:** ***23 / 05 / 17***	***N:***	***2520419***
DIAMETER :	**100 mm** **DATE COMPLETED:** ***23 / 05 / 17***	***E:***	***0332115***
INCLINATION :	**Vertical** **G. W. T (m):** ***(-) 3.50*** **ON** ***24 / 05 / 17***	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	$N = N_2+N_3$	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
										10 20 30 40 50 60 70 80						
1.5	Light Grey Firm Clayey SILT, trace Sand.	ML			SP-1	1	2	3	5	0 5	6.00	94.00	31.00	12.00	2.57	26.46
3.0					SP-2	2	2	2	4	4						
4.5					SP-3	3	4	4	8	8						
6.0	Grey Loose to Medium Dense Silty SAND.	SM			SP-4	4	4	5	9	9						
7.5					SP-5	4	5	6	11	11						
9.0					SP-6	7	7	10	17	17	61.52	38.48				23.65
10.5					SP-7	7	8	11	19	19						
12.0	Grey Loose Sandy SILT.	SM			SP-8	3	4	5	9	9	27.14	72.86				27.32
13.5					SP-9	4	5	5	10	10						
15.0					SP-10	3	4	6	10	10						
16.5	Grey Medium Dense Silty SAND.	SM			SP-11	3	14	15	29	29	64.32	35.68				22.48
18.0	Light Grey Dense Silty SAND.	SM			SP-12	10	20	27	47	47	85.22	14.78				19.99
19.5					SP-13	3	4	5	9	9						
21.0					SP-14	4	5	8	13	13						
22.5	Grey Stiff Clayey SILT, trace Sand.	ML			SP-15	5	6	10	16	16						
24.0					SP-16	3	4	5	9	9	6.00	94.00	33.00	15.00	2.60	20.10
25.5					SP-17	3	4	7	11	11						
27.0					SP-18	10	10	11	21	21						
28.5	Grey Medium Dense Sandy SILT.	SM			SP-19	4	6	10	16	16						
30.0					SP-20	5	13	14	27	27						

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*01*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)4.40*
METHOD OF BORING :	Manual **DATE STARTED:** *23 / 05 / 17*	***N:***	*2520419*
DIAMETER :	100 mm **DATE COMPLETED:** *23 / 05 / 17*	***E:***	*0332115*
INCLINATION :	Vertical **G. W. T (m):** *(-) 3.50* **ON** *24 / 05 / 17*	***ZONE:***	*46Q*

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
31.5	Grey Medium Dense Sandy SILT.	SM			SP-21	9	10	12	22	27						
33.0					SP-22	8	10	10	20	22	41.92	58.08				22.75
34.5					SP-23	7	7	8	15	20						
36.0					SP-24	7	10	20	30	15						
37.5					SP-25	8	12	16	28	30						
39.0	Light Grey Medium Dense to Dense Silty SAND.	SM			SP-26	7	12	17	29	28	74.04	25.96				
40.5					SP-27	10	15	22	37	29						19.88
42.0					SP-28	10	20	20	40	37						
43.5					SP-29	20	18	28	46	40						
										46						

10 20 30 40 50 60 70 80

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***	**BORE HOLE NO.:**	***02***
CLIENT:	***Power Cell, Power Division.*** **CONSULTANT:** ***WinDForce Manatement Services Pvt. Lt***	**RL (m) :**	***(-)4.60***
METHOD OF BORING :	**Manual** **DATE STARTED:** ***24 / 05 / 17***	***N:***	***2520676***
DIAMETER :	**100 mm** **DATE COMPLETED:** ***25 / 05 / 17***	***E:***	***0333015***
INCLINATION :	**Vertical** **G. W. T (m):** ***(-) 3.00*** **ON** ***26 / 05 / 17***	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
										10 20 30 40 50 60 70 80						
										0						
1.5	Grey Firm Clayey SILT, trace Sand.	ML			SP-1	2	3	3	6	6						
3.0					SP-2	2	2	3	5	5	5.00	95.00	34.00	15.00	2.56	30.92
4.5					SP-3	4	4	4	8	8						
6.0	Grey Loose Sandy SILT.	SM			SP-4	4	4	6	10	10	41.81	58.19				24.77
7.5					SP-5	4	4	5	9	9						
9.0					SP-6	7	8	9	17	17						
10.5					SP-7	6	8	10	18	18						
12.0	Grey Loose to Medium Dense Silty SAND.	SM			SP-8	4	4	6	10	10						
13.5					SP-9	4	5	6	11	11	61.11	38.89				22.84
15.0					SP-10	4	5	5	10	10						
16.5					SP-11	3	3	4	7	7						
18.0	Light Grey Very Dense Silty SAND.	SM			SP-12	3	27	25	52	52	77.95	22.05				19.46
19.5	Grey Medium Dense Sandy SILT.	SM			SP-13	6	10	15	25	25						
21.0	Light Grey Stiff to Very Stiff Clayey SILT, trace Sand.	ML			SP-14	4	6	7	13	13						
22.5					SP-15	5	7	11	18	18	6.00	94.00	32.00	14.00	2.59	30.44
24.0	Grey Stiff Clayey SILT, Little Sand.	ML			SP-16	4	4	6	10	10						
25.5					SP-17	4	5	7	12	12	12.00	88.00			2.60	28.36
27.0	Grey Medium Dense to Dense Sandy SILT.	SM			SP-18	15	10	10	20	20						
28.5					SP-19	5	8	9	17	17						
30.0					SP-20	6	14	18	32	32	29.62	70.38				23.15

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*02*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)4.60*
METHOD OF BORING :	Manual **DATE STARTED:** *24 / 05 / 17*	***N:***	*2520676*
DIAMETER :	100 mm **DATE COMPLETED:** *25 / 05 / 17*	***E:***	*0333015*
INCLINATION :	Vertical **G. W. T (m):** *(-) 3.00* **ON** *26 / 05 / 17*	***ZONE:***	*46Q*

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
31.5					SP-21	10	10	17	27	32						
33.0	Grey Medium Dense Silty SAND.	SM			SP-22	8	10	10	20	27						
34.5					SP-23	6	8	9	17	20	59.78	40.22				20.38
36.0					SP-24	5	8	10	18	17						
37.5					SP-25	6	10	12	22	18						
39.0	Light Grey Medium Dense to Dense Silty SAND.	SM			SP-26	7	12	15	27	22						
40.5					SP-27	10	15	20	35	27						
42.0					SP-28	12	20	22	42	35	75.35	24.65				20.44
43.5					SP-29	12	24	25	49	42						
										49						

10 20 30 40 50 60 70 80

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***	**BORE HOLE NO.:**	***03***
CLIENT:	***Power Cell, Power Division.*** **CONSULTANT:** ***WinDForce Manatement Services Pvt. Lt***	**RL (m) :**	***(-)5.0***
METHOD OF BORING :	**Manual** **DATE STARTED:** ***25 / 05 / 17***	***N:***	***2520824***
DIAMETER :	**100 mm** **DATE COMPLETED:** ***26 / 05 / 17***	***E:***	***0334211***
INCLINATION :	**Vertical** **G. W. T (m):** ***(-) 3.00*** **ON** ***27 / 05 / 17***	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
1.5					SP-1	1	2	2	4	4						
3.0	Grey Firm to Stiff Clayey SILT, trace Sand.	ML			SP-2	2	3	4	7	7						
4.5					SP-3	4	4	6	10	10	6.00	94.00	33.00	14.00	2.60	29.34
6.0					SP-4	3	4	4	8	8						
7.5	Grey Loose to Medium Dense Silty SAND.	SM			SP-5	4	4	4	8	8						
9.0					SP-6	6	7	8	15	15	59.55	40.45				23.19
10.5					SP-7	4	6	10	16	16						
12.0	Grey Loose to Medium Dense Sandy SILT.	SM			SP-8	3	4	5	9	9						
13.5					SP-9	4	5	5	10	10	45.20	54.80				24.68
15.0					SP-10	3	3	3	6	6						
16.5					SP-11	2	3	6	9	9						
18.0	Light Grey Medium Dense Silty SAND.	SM			SP-12	10	10	17	27	27						
19.5					SP-13	5	6	7	13	13	67.75	32.25				22.14
21.0	Grey Stiff Clayey SILT, trace Sand.	ML			SP-14	4	6	8	14	14						
22.5					SP-15	4	6	8	14	14	6.00	94.00	32.00	14.00	2.59	27.36
24.0	Grey Loose Silty SAND.	SM			SP-16	3	4	5	9	9						
25.5					SP-17	4	5	5	10	10	65.46	34.54				21.36
27.0	Light Grey Medium Dense to Dense Sandy SILT.	SM			SP-18	10	10	10	20	20						
28.5					SP-19	4	5	10	15	15	80.78	19.22				19.36
30.0					SP-20	5	14	20	34	34						

10 20 30 40 50 60 70 80

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*03*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)5.0*
METHOD OF BORING :	Manual **DATE STARTED:** *25 / 05 / 17*	***N:***	*2520824*
DIAMETER :	100 mm **DATE COMPLETED:** *26 / 05 / 17*	***E:***	*0334211*
INCLINATION :	Vertical **G. W. T (m):** *(-) 3.00* **ON** *27 / 05 / 17*	***ZONE:***	*46Q*

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	$N = N_2+N_3$	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
31.5					SP-21	7	8	10	18	34						
33.0	Grey Medium Dense Silty SAND.	SM			SP-22	6	8	8	16	18						
34.5					SP-23	7	10	10	20	16						
36.0					SP-24	8	8	10	18	20	73.95	26.05				19.83
37.5					SP-25	7	7	10	17	18						
39.0					SP-26	8	10	12	22	17						
40.5	Light Grey Medium Dense to Dense Silty SAND.	SM			SP-27	10	17	20	37	22						
42.0					SP-28	12	20	21	41	37						
43.5					SP-29	13	21	23	44	41						
										44						

10 20 30 40 50 60 70 80

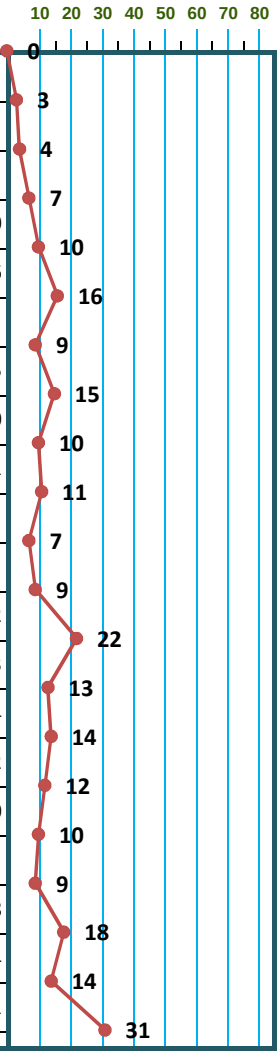
LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***	**BORE HOLE NO.:**	***04***
CLIENT:	***Power Cell, Power Division.*** **CONSULTANT:** ***WinDForce Manatement Services Pvt. Lt***	**RL (m) :**	***(-)5.20***
METHOD OF BORING :	**Manual** **DATE STARTED:** ***26 / 05 / 17***	***N:***	***2520822***
DIAMETER :	**100 mm** **DATE COMPLETED:** ***27 / 05 / 17***	***E:***	***0334810***
INCLINATION :	**Vertical** **G. W. T (m):** ***(-) 3.00*** **ON** ***28 / 05 / 17***	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
1.5	Grey Soft to Firm Clayey SILT, trace Sand.	ML			SP-1	1	1	2	3	3						
3.0					SP-2	1	2	2	4	4	4.00	96.00	34.00	16.00	2.55	28.31
4.5					SP-3	1	3	4	7	7						
6.0	Grey Loose to Medium Dense Sandy SILT.	SM			SP-4	2	4	6	10	10						
7.5					SP-5	4	6	10	16	16	43.56	56.44				24.61
9.0					SP-6	4	4	5	9	9						
10.5	Grey Medium Dense Silty SAND.	SM			SP-7	5	7	8	15	15						
12.0					SP-8	3	4	6	10	10	65.94	34.06				22.34
13.5					SP-9	4	5	6	11	11						
15.0	Grey Firm to Stiff Clayey SILT, trace Sand.	ML			SP-10	2	3	4	7	7						
16.5					SP-11	3	3	6	9	9	5.00	95.00	32.00	14.00	2.58	25.48
18.0	Grey Medium Dense Silty SAND.	SM			SP-12	10	10	12	22	22	67.93	32.07				21.85
19.5					SP-13	4	5	8	13	13						
21.0	Grey Medium Dense Sandy SILT.	SM			SP-14	4	7	7	14	14	42.42	57.58				24.19
22.5					SP-15	3	6	6	12	12						
24.0	Grey Stiff Clayey SILT, trace Sand.	ML			SP-16	3	5	5	10	10	9.00	94.00			2.58	26.74
25.5					SP-17	4	4	5	9	9						
27.0	Grey Medium Dense to Dense Silty SAND.	SM			SP-18	7	10	8	18	18						
28.5					SP-19	6	6	8	14	14						
30.0					SP-20	5	14	17	31	31	78.33	21.67				20.33



LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*04*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)5.20*
METHOD OF BORING :	Manual **DATE STARTED:** *26 / 05 / 17*	***N:***	*2520822*
DIAMETER :	100 mm **DATE COMPLETED:** *27 / 05 / 17*	***E:***	*0334810*
INCLINATION :	Vertical **G. W. T (m):** *(-) 3.00* **ON** *28 / 05 / 17*	***ZONE:***	*46Q*

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
31.5	Grey Medium Dense Silty SAND.	SM			SP-21	5	7	8	15	31						
					SP-22	3	6	6	12	15						
33.0	Grey Loose Sandy SILT.	SM			SP-23	2	3	4	7	12	44.52	55.48				24.89
34.5					SP-24	7	10	9	19	7						
36.0					SP-25	8	10	10	20	19						
37.5					SP-26	7	10	12	22	20						
39.0	Light Grey Medium Dense to Dense Silty SAND.	SM			SP-27	10	17	20	37	22	77.37	22.63				18.64
40.5					SP-28	12	20	21	41	37						
42.0					SP-29	13	22	25	47	41						
43.5										47						

10 20 30 40 50 60 70 80

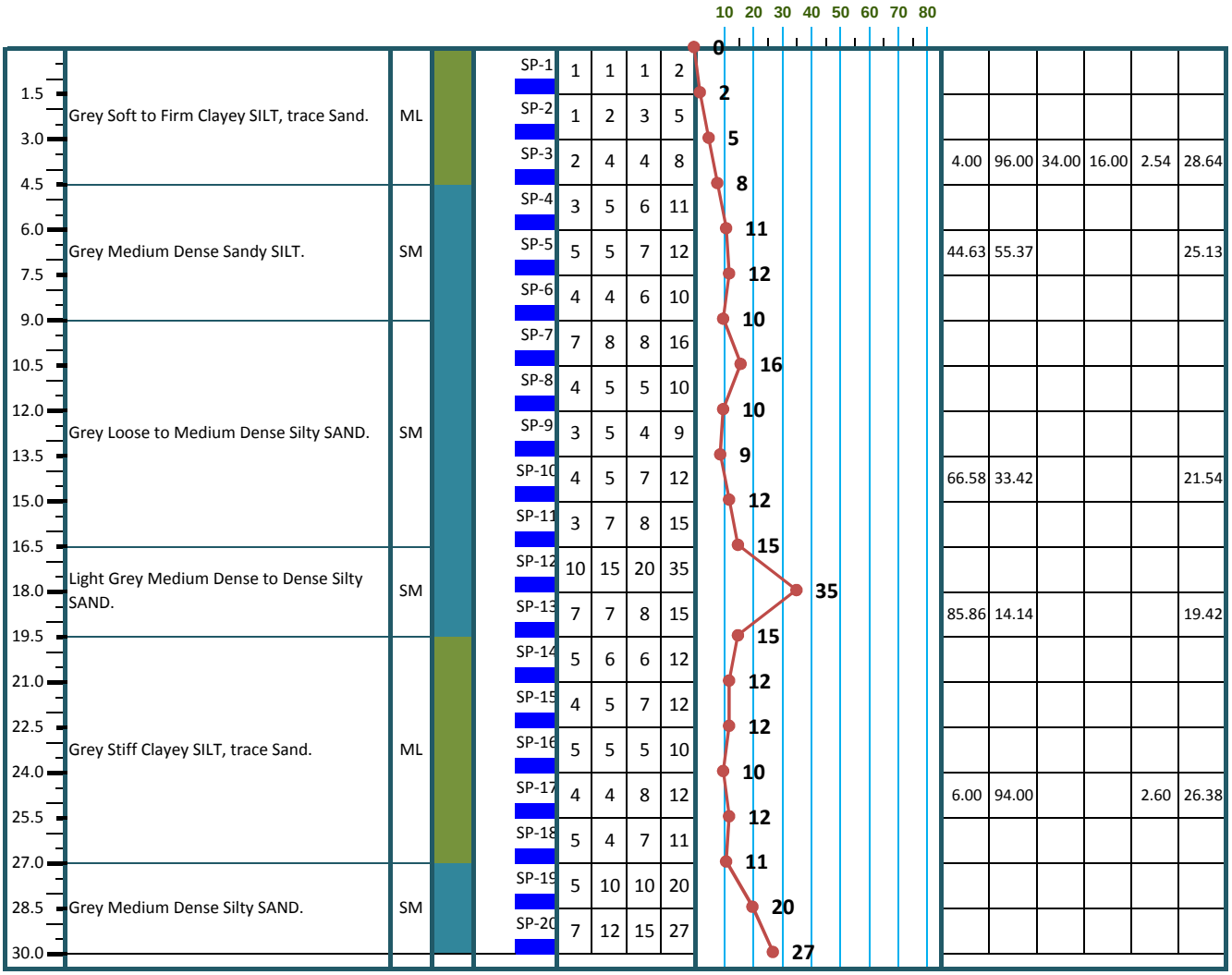
LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***	**BORE HOLE NO.:**	***05***
CLIENT:	***Power Cell, Power Division.*** **CONSULTANT:** ***WinDForce Manatement Services Pvt. Lt***	**RL (m) :**	***(-)5.0***
METHOD OF BORING :	**Manual** **DATE STARTED:** ***27 / 05 / 17***	***N:***	***2520580***
DIAMETER :	**100 mm** **DATE COMPLETED:** ***28 / 05 / 17***	***E:***	***0335336***
INCLINATION :	**Vertical** **G. W. T (m):** ***(-) 2.50*** **ON** ***29 / 05 / 17***	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
1.5	Grey Soft to Firm Clayey SILT, trace Sand.	ML			SP-1	1	1	1	2	2						
3.0					SP-2	1	2	3	5	5						
4.5					SP-3	2	4	4	8	8	4.00	96.00	34.00	16.00	2.54	28.64
6.0	Grey Medium Dense Sandy SILT.	SM			SP-4	3	5	6	11	11						
7.5					SP-5	5	5	7	12	12	44.63	55.37				25.13
9.0					SP-6	4	4	6	10	10						
10.5					SP-7	7	8	8	16	16						
12.0	Grey Loose to Medium Dense Silty SAND.	SM			SP-8	4	5	5	10	10						
13.5					SP-9	3	5	4	9	9						
15.0					SP-10	4	5	7	12	12	66.58	33.42				21.54
16.5					SP-11	3	7	8	15	15						
18.0	Light Grey Medium Dense to Dense Silty SAND.	SM			SP-12	10	15	20	35	35						
19.5					SP-13	7	7	8	15	15	85.86	14.14				19.42
21.0					SP-14	5	6	6	12	12						
22.5	Grey Stiff Clayey SILT, trace Sand.	ML			SP-15	4	5	7	12	12						
24.0					SP-16	5	5	5	10	10						
25.5					SP-17	4	4	8	12	12	6.00	94.00			2.60	26.38
27.0					SP-18	5	4	7	11	11						
28.5	Grey Medium Dense Silty SAND.	SM			SP-19	5	10	10	20	20						
30.0					SP-20	7	12	15	27	27						



LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*05*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)5.0*
METHOD OF BORING :	Manual **DATE STARTED:** *27 / 05 / 17*	***N:***	*2520580*
DIAMETER :	100 mm **DATE COMPLETED:** *28 / 05 / 17*	***E:***	*0335336*
INCLINATION :	Vertical **G. W. T (m):** *(-) 2.50* **ON** *29 / 05 / 17*	***ZONE:***	*46Q*

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
31.5					SP-21	11	12	20	32	27						
33.0					SP-22	8	10	12	22	32						
34.5	Grey Medium Dense to Desne Silty SAND.	SM			SP-23	6	7	10	17	22	71.85	28.15				20.33
36.0					SP-24	7	10	10	20	17						
37.5					SP-25	6	9	10	19	20						
39.0					SP-26	7	11	15	26	19						
40.5					SP-27	10	15	16	31	26						
42.0	Light Grey Dense Silty SAND.	SM			SP-28	11	20	20	40	31	78.65	21.35				18.96
43.5					SP-29	11	21	22	43	40						
										43						

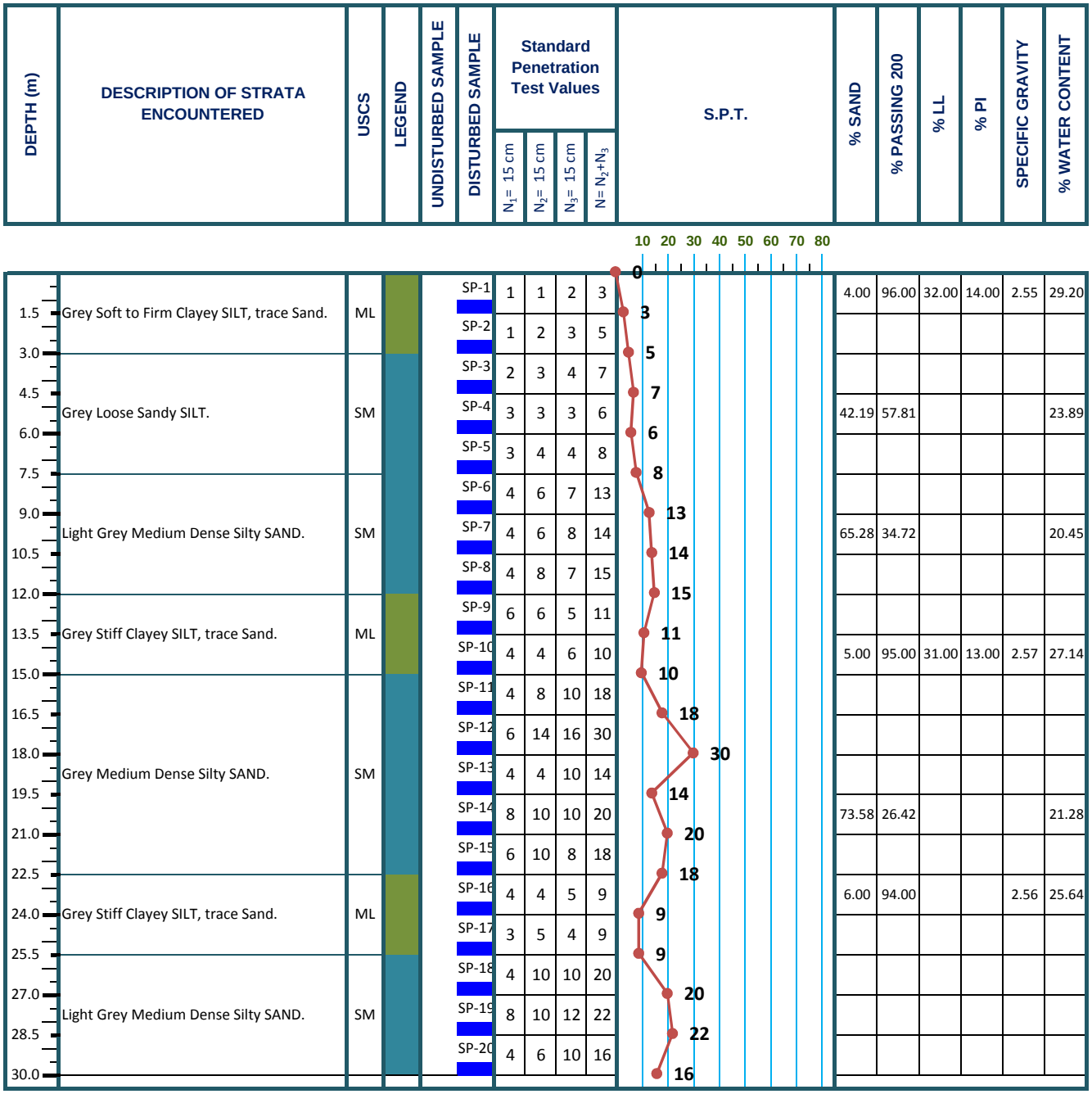
10 20 30 40 50 60 70 80

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***	**BORE HOLE NO.:**	***06***
CLIENT:	***Power Cell, Power Division.*** **CONSULTANT:** ***WinDForce Manatement Services Pvt. Lt***	**RL (m) :**	***(-)5.05***
METHOD OF BORING :	**Manual** **DATE STARTED:** ***28 / 05 / 17***	***N:***	***2521564***
DIAMETER :	**100 mm** **DATE COMPLETED:** ***29 / 05 / 17***	***E:***	***0333348***
INCLINATION :	**Vertical** **G. W. T (m):** ***(-) 3.05*** **ON** ***30 / 05 / 17***	***ZONE:***	***46Q***



LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*06*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)5.05*
METHOD OF BORING :	Manual **DATE STARTED:** *28 / 05 / 17*	***N:***	*2521564*
DIAMETER :	100 mm **DATE COMPLETED:** *29 / 05 / 17*	***E:***	*0333348*
INCLINATION :	Vertical **G. W. T (m):** *(-) 3.05* **ON** *30 / 05 / 17*	***ZONE:***	*46Q*

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	$N = N_2+N_3$	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
31.5					SP-21	4	6	10	16	16						
	Light Grey Medium Dense Silty SAND.	SM			SP-22	3	8	12	20	16	42.45	57.55				19.84
33.0					SP-23	6	10	10	20	20						
34.5					SP-24	4	6	6	12	20	80.55	19.45				20.44
36.0					SP-25	5	10	16	26	12						
37.5					SP-26	6	6	10	16	26						
39.0	Grey Medium Dense to Dense Silty SAND.	SM			SP-27	10	14	16	30	16						
40.5					SP-28	8	20	20	40	30						
42.0					SP-29	10	20	24	44	40						
43.5										44						

10 20 30 40 50 60 70 80

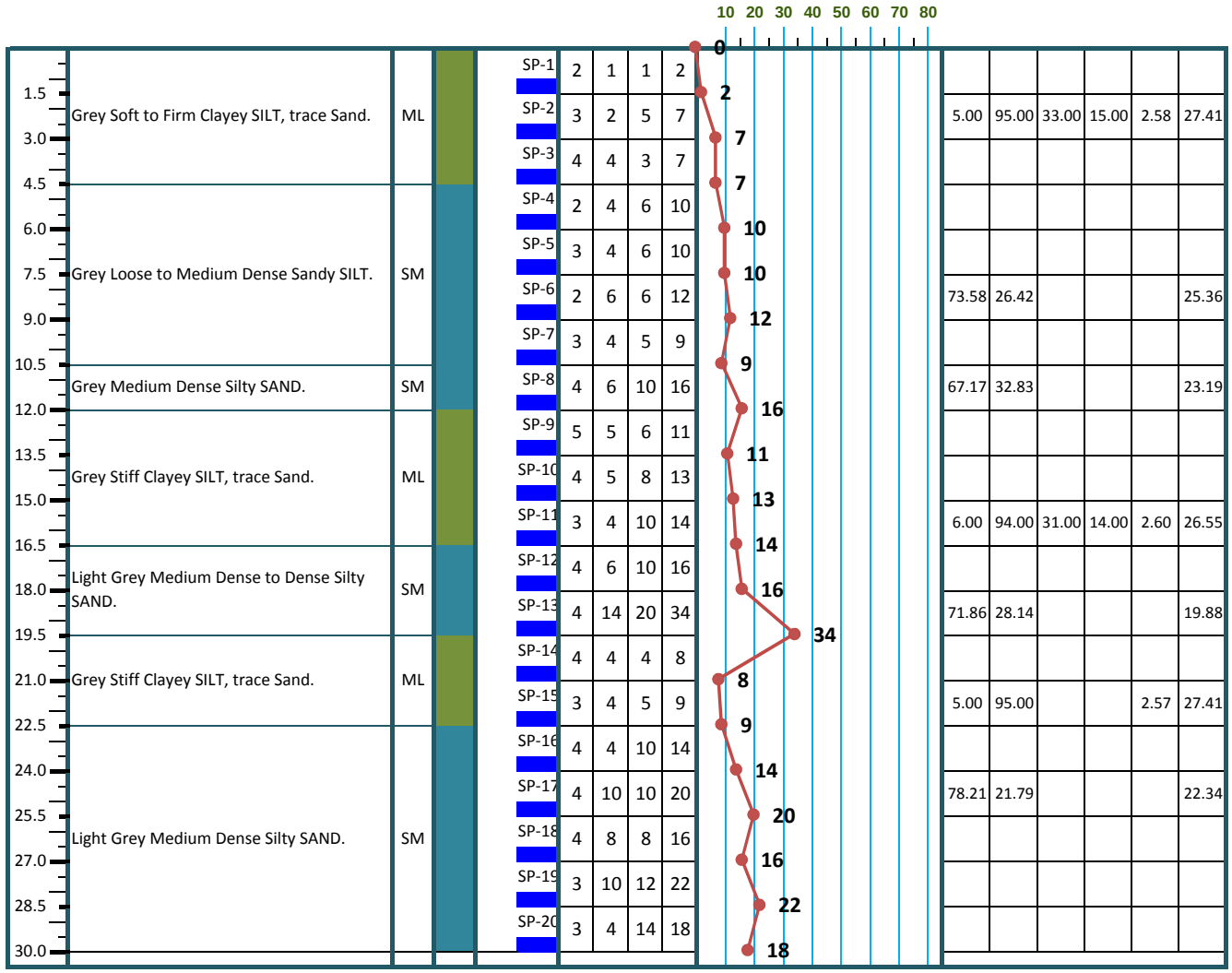
LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*07*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)5.15*
METHOD OF BORING :	Manual **DATE STARTED:** *29 / 05 / 17*	***N:***	***2521441***
DIAMETER :	100 mm **DATE COMPLETED:** *30 / 05 / 17*	***E:***	***0334639***
INCLINATION :	Vertical **G. W. T (m):** *(-) 5.15* **ON** *31 / 05 / 17*	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	N= N_2+N_3	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
0.0				SP-1	2	1	1	2	2						
1.5	Grey Soft to Firm Clayey SILT, trace Sand.	ML		SP-2	3	2	5	7	7	5.00	95.00	33.00	15.00	2.58	27.41
3.0				SP-3	4	4	3	7	7						
4.5				SP-4	2	4	6	10	10						
6.0				SP-5	3	4	6	10	10						
7.5	Grey Loose to Medium Dense Sandy SILT.	SM		SP-6	2	6	6	12	12	73.58	26.42				25.36
9.0				SP-7	3	4	5	9	9						
10.5	Grey Medium Dense Silty SAND.	SM		SP-8	4	6	10	16	16	67.17	32.83				23.19
12.0				SP-9	5	5	6	11	11						
13.5	Grey Stiff Clayey SILT, trace Sand.	ML		SP-10	4	5	8	13	13						
15.0				SP-11	3	4	10	14	14	6.00	94.00	31.00	14.00	2.60	26.55
16.5				SP-12	4	6	10	16	16						
18.0	Light Grey Medium Dense to Dense Silty SAND.	SM		SP-13	4	14	20	34	34	71.86	28.14				19.88
19.5				SP-14	4	4	4	8	8						
21.0	Grey Stiff Clayey SILT, trace Sand.	ML		SP-15	3	4	5	9	9	5.00	95.00			2.57	27.41
22.5				SP-16	4	4	10	14	14						
24.0				SP-17	4	10	10	20	20	78.21	21.79				22.34
25.5	Light Grey Medium Dense Silty SAND.	SM		SP-18	4	8	8	16	16						
27.0				SP-19	3	10	12	22	22						
28.5				SP-20	3	4	14	18	18						
30.0															



LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

BORE LOG

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	*Sonagazi, Bangladesh.*	**BORE HOLE NO.:**	*07*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Lt*	**RL (m) :**	*(-)5.15*
METHOD OF BORING :	Manual **DATE STARTED:** *29 / 05 / 17*	***N:***	***2521441***
DIAMETER :	100 mm **DATE COMPLETED:** *30 / 05 / 17*	***E:***	***0334639***
INCLINATION :	Vertical **G. W. T (m):** *(-) 5.15* **ON** *31 / 05 / 17*	***ZONE:***	***46Q***

DEPTH (m)	DESCRIPTION OF STRATA ENCOUNTERED	USCS	LEGEND	UNDISTURBED SAMPLE	DISTURBED SAMPLE	Standard Penetration Test Values N_1= 15 cm	N_2= 15 cm	N_3= 15 cm	$N = N_2+N_3$	S.P.T.	% SAND	% PASSING 200	% LL	% PI	SPECIFIC GRAVITY	% WATER CONTENT
										10 20 30 40 50 60 70 80						
					SP-21	4	4	6	10	18						
31.5					SP-22	4	10	14	24	10						
33.0	Grey Medium Dense Silty SAND.	SM			SP-23	4	6	10	16	24	66.94	33.06				20.36
34.5					SP-24	5	6	13	19	16						
36.0					SP-25	5	7	8	15	19						
37.5					SP-26	6	7	10	17	15						
39.0					SP-27	10	12	12	24	17						
40.5	Light Grey Medium Dense to Dense Silty SAND.	SM			SP-28	12	14	16	30	24	85.46	14.54				18.65
42.0					SP-29	12	20	19	39	30						
43.5										39						

LEGEND :

- SAND
- SILT
- CLAY
- SANDY SILT/SILTY SAND
- SILTY CLAY/CLAYEY SILT
- SANDY CLAY/CLAYEY SAND
- PEAT / ORGANIC SOIL

APPENDIX-C: Laboratory Test Results

APPENDIX-C1: Natural Moisture Content

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**29-May-17**
Bore Hole Number:	**01**

Moisture can and Lid Number	35	22	13	25	20
Specimen Number	**SP- 1**	**SP- 6**	**SP- 8**	**SP- 11**	**SP- 12**
M_{CMS} = Mass of can, lid & moist soil (grams)	194.83	162.54	175.14	164.77	135.14
M_{CDS} = Mass of can,lid & dry soil (grams)	158.84	135.85	142.25	139.89	116.35
M_w = Mass of pore water(grams)	35.99	26.69	32.89	24.88	18.79
M_C = Mass of empty, clean can + lid(grams)	22.84	22.98	21.87	29.2	22.34
M_S = Mass of soil solids (grams)	136	112.87	120.38	110.69	94.01
W = water content = M_w/M_s X 100%	**26.46%**	**23.65%**	**27.32%**	**22.48%**	**19.99%**

Date of Test:	**29-May-17**
Bore Hole Number:	**01**

Moisture can and Lid Number	1	C2	C5		
Specimen Number	**SP- 16**	**SP- 22**	**SP- 27**		
M_{CMS} = Mass of can, lid & moist soil (grams)	148.98	158.55	164.1		
M_{CDS} = Mass of can,lid & dry soil (grams)	128.3	131.1	138.59		
M_w = Mass of pore water(grams)	20.68	27.45	25.51		
M_C = Mass of empty, clean can + lid(grams)	25.43	10.45	10.29		
M_S = Mass of soil solids (grams)	102.87	120.65	128.3		
W = water content = M_w/M_s X 100%	**20.10%**	**22.75%**	**19.88%**		

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**29-May-17**
Bore Hole Number:	**02**

Moisture can and Lid Number	34	30	27	24	33
Specimen Number	**SP- 2**	**SP- 4**	**SP- 9**	**SP- 12**	**SP- 13**
M_{CMS} = Mass of can, lid & moist soil (grams)	235.66	163.12	164.5	132.51	131.34
M_{CDS} = Mass of can,lid & dry soil (grams)	186.08	135.45	138.32	113.94	105.45
M_w = Mass of pore water(grams)	49.58	27.67	26.18	18.57	25.89
M_C = Mass of empty, clean can + lid(grams)	25.72	23.75	23.71	18.52	20.41
M_S = Mass of soil solids (grams)	160.36	111.7	114.61	95.42	85.04
W = water content = M_w / M_s X 100%	**30.92%**	**24.77%**	**22.84%**	**19.46%**	**30.44%**

Date of Test:	**29-May-17**
Bore Hole Number:	**02**

Moisture can and Lid Number	29	17	10	C11	88
Specimen Number	**SP- 15**	**SP- 17**	**SP- 20**	**SP- 23**	**SP- 28**
M_{CMS} = Mass of can, lid & moist soil (grams)	166.59	177.24	150	156.99	171.43
M_{CDS} = Mass of can,lid & dry soil (grams)	133.57	142.98	125.43	132.2	145.4
M_w = Mass of pore water(grams)	33.02	34.26	24.57	24.79	26.03
M_C = Mass of empty, clean can + lid(grams)	22.48	22.17	19.31	10.55	18.05
M_S = Mass of soil solids (grams)	111.09	120.81	106.12	121.65	127.35
W = water content = M_w / M_s X 100%	**29.72%**	**28.36%**	**23.15%**	**20.38%**	**20.44%**

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**29-May-17**
Bore Hole Number:	**03**

Moisture can and Lid Number	99	95	88	97	89
Specimen Number	**SP- 3**	**SP- 6**	**SP- 9**	**SP- 13**	**SP- 15**
M_{CMS} = Mass of can, lid & moist soil (grams)	193.13	201.55	162.65	191.04	182.97
M_{CDS} = Mass of can,lid & dry soil (grams)	153.43	169.04	134.06	159.74	147.65
M_w = Mass of pore water(grams)	39.7	32.51	28.59	31.3	35.32
M_C = Mass of empty, clean can + lid(grams)	18.14	28.84	18.21	18.38	18.55
M_S = Mass of soil solids (grams)	135.29	140.2	115.85	141.36	129.1
W = water content = M_w / M_s X 100%	**29.34%**	**23.19%**	**24.68%**	**22.14%**	**27.36%**

Date of Test:	**29-May-17**
Bore Hole Number:	**03**

Moisture can and Lid Number	90	92	87		
Specimen Number	**SP- 17**	**SP- 19**	**SP- 24**		
M_{CMS} = Mass of can, lid & moist soil (grams)	160.73	165.05	156.97		
M_{CDS} = Mass of can,lid & dry soil (grams)	135.78	141.21	134.13		
M_w = Mass of pore water(grams)	24.95	23.84	22.84		
M_C = Mass of empty, clean can + lid(grams)	18.98	18.05	18.98		
M_S = Mass of soil solids (grams)	116.8	123.16	115.15		
W = water content = M_w / M_s X 100%	**21.36%**	**19.36%**	**19.83%**		

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**30-May-17**
Bore Hole Number:	**04**

Moisture can and Lid Number	9	10	99	95	88
Specimen Number	**SP- 2**	**SP- 5**	**SP- 8**	**SP- 11**	**SP- 12**
M_{CMS} = Mass of can, lid & moist soil (grams)	183.92	173.16	147.06	187.5	170.71
M_{CDS} = Mass of can,lid & dry soil (grams)	146.4	141.55	123.52	155.28	143.36
M_w = Mass of pore water(grams)	37.52	31.61	23.54	32.22	27.35
M_C = Mass of empty, clean can + lid(grams)	13.85	13.1	18.14	28.84	18.21
M_S = Mass of soil solids (grams)	132.55	128.45	105.38	126.44	125.15
W = water content = M_w / M_s X 100%	**28.31%**	**24.61%**	**22.34%**	**25.48%**	**21.85%**

Date of Test:	**30-May-17**
Bore Hole Number:	**04**

Moisture can and Lid Number	97	89	90	92	98
Specimen Number	**SP- 14**	**SP- 16**	**SP- 20**	**SP- 23**	**SP- 27**
M_{CMS} = Mass of can, lid & moist soil (grams)	155.34	169.62	157.54	167.98	169.13
M_{CDS} = Mass of can,lid & dry soil (grams)	128.66	137.75	134.13	138.1	145.43
M_w = Mass of pore water(grams)	26.68	31.87	23.41	29.88	23.7
M_C = Mass of empty, clean can + lid(grams)	18.38	18.55	18.98	18.05	18.27
M_S = Mass of soil solids (grams)	110.28	119.2	115.15	120.05	127.16
W = water content = M_w / M_s X 100%	**24.19%**	**26.74%**	**20.33%**	**24.89%**	**18.64%**

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**30-May-17**
Bore Hole Number:	**05**

Moisture can and Lid Number	2	3	6	5	8
Specimen Number	**SP- 3**	**SP- 5**	**SP- 10**	**SP- 13**	**SP- 17**
M_{CMS} = Mass of can, lid & moist soil (grams)	174.54	163.99	140.61	157.21	177.62
M_{CDS} = Mass of can,lid & dry soil (grams)	138.69	133.76	117.81	133.44	142.88
M_w = Mass of pore water(grams)	35.85	30.23	22.8	23.77	34.74
M_C = Mass of empty, clean can + lid(grams)	13.53	13.47	11.97	11.03	11.19
M_S = Mass of soil solids (grams)	125.16	120.29	105.84	122.41	131.69
W = water content = M_w / M_s X 100%	**28.64%**	**25.13%**	**21.54%**	**19.42%**	**26.38%**

Date of Test:	**30-May-17**
Bore Hole Number:	**05**

Moisture can and Lid Number	11	14			
Specimen Number	**SP- 21**	**SP- 28**			
M_{CMS} = Mass of can, lid & moist soil (grams)	164.1	154.42			
M_{CDS} = Mass of can,lid & dry soil (grams)	138.48	131.6			
M_w = Mass of pore water(grams)	25.62	22.82			
M_C = Mass of empty, clean can + lid(grams)	12.43	11.24			
M_S = Mass of soil solids (grams)	126.05	120.36			
W = water content = M_w / M_s X 100%	**20.33%**	**18.96%**			

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**31-May-17**
Bore Hole Number:	**06**

Moisture can and Lid Number	10	99	95	88	97
Specimen Number	**SP- 1**	**SP- 4**	**SP- 7**	**SP- 10**	**SP- 14**
M_{CMS} = Mass of can, lid & moist soil (grams)	177.43	170.3	185.62	158.25	170.67
M_{CDS} = Mass of can,lid & dry soil (grams)	140.29	140.96	159	128.36	143.95
M_w = Mass of pore water(grams)	37.14	29.34	26.62	29.89	26.72
M_C = Mass of empty, clean can + lid(grams)	13.1	18.14	28.84	18.21	18.38
M_S = Mass of soil solids (grams)	127.19	122.82	130.16	110.15	125.57
W = water content = M_w/M_s X 100%	**29.20%**	**23.89%**	**20.45%**	**27.14%**	**21.28%**

Date of Test:	**31-May-17**
Bore Hole Number:	**06**

Moisture can and Lid Number	89	90	92		
Specimen Number	**SP- 16**	**SP- 22**	**SP- 24**		
M_{CMS} = Mass of can, lid & moist soil (grams)	171.65	156.98	171.43		
M_{CDS} = Mass of can,lid & dry soil (grams)	140.41	134.13	145.4		
M_w = Mass of pore water(grams)	31.24	22.85	26.03		
M_C = Mass of empty, clean can + lid(grams)	18.55	18.98	18.05		
M_S = Mass of soil solids (grams)	121.86	115.15	127.35		
W = water content = M_w/M_s X 100%	**25.64%**	**19.84%**	**20.44%**		

NATURAL MOISTURE CONTENT

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**31-May-17**
Bore Hole Number:	**07**

Moisture can and Lid Number	90	92	98	87	96
Specimen Number	**SP- 2**	**SP- 6**	**SP- 8**	**SP- 11**	**SP- 13**
M_{CMS} = Mass of can, lid & moist soil (grams)	173.97	159.14	176.14	169.21	162.61
M_{CDS} = Mass of can,lid & dry soil (grams)	140.63	130.6	146.42	137.52	138.66
M_w = Mass of pore water(grams)	33.34	28.54	29.72	31.69	23.95
M_C = Mass of empty, clean can + lid(grams)	18.98	18.05	18.27	18.16	18.16
M_S = Mass of soil solids (grams)	121.65	112.55	128.15	119.36	120.5
W = water content = M_w/M_s X 100%	**27.41%**	**25.36%**	**23.19%**	**26.55%**	**19.88%**

Date of Test:	**31-May-17**
Bore Hole Number:	**07**

Moisture can and Lid Number	93	86	91	82	
Specimen Number	**SP- 15**	**SP- 17**	**SP- 23**	**SP- 28**	
M_{CMS} = Mass of can, lid & moist soil (grams)	187.7	187.46	150.88	146.55	
M_{CDS} = Mass of can,lid & dry soil (grams)	151.67	158.65	128.43	126.88	
M_w = Mass of pore water(grams)	36.03	28.81	22.45	19.67	
M_C = Mass of empty, clean can + lid(grams)	20.22	29.66	18.17	21.43	
M_S = Mass of soil solids (grams)	131.45	128.99	110.26	105.45	
W = water content = M_w/M_s X 100%	**27.41%**	**22.34%**	**20.36%**	**18.65%**	

APPENDIX-C2: Specific Gravity

SPECIFIC GRAVITY

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**30-May-17**
Bore Hole Number:	**01**

Sample Number:	**SP- 1**	**SP- 16**			
Pycnometer bottle number	1	2			
Constant temperature of test ^{o}C	32	32			
Wt. of pycnometer, W_1	14.75	13.79			
Wt. of pycnometer + dry soil, W_2	25.03	23.62			
Wt. of dry soil, $W_3 = W_2 - W_1$	10.28	9.83			
Wt. of pycnometer + soil+ water, W_4	76.68	75.42			
Wt. of pycnometer + water only, W_5	70.4	69.37			
Specific gravity (G_S) = $W_3 / (W_3 + (W_5 - W_4))$	**2.57**	**2.60**			

Date of Test:	**30-May-17**
Bore Hole Number:	**02**

Sample Number:	**SP- 2**	**SP- 15**	**SP- 17**		
Pycnometer bottle number	1	2	3		
Constant temperature of test ^{o}C	32	32	32		
Wt. of pycnometer, W_1	14.7	13.79	12.52		
Wt. of pycnometer + dry soil, W_2	24.18	22.71	23.37		
Wt. of dry soil, $W_3 = W_2 - W_1$	9.48	8.92	10.85		
Wt. of pycnometer + soil+ water, W_4	76.18	74.85	87.66		
Wt. of pycnometer + water only, W_5	70.4	69.37	80.98		
Specific gravity (G_S) = $W_3 / (W_3 + (W_5 - W_4))$	**2.56**	**2.59**	**2.60**		

SPECIFIC GRAVITY

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**30-May-17**
Bore Hole Number:	**03**

Sample Number:	**SP- 3**	**SP- 15**			
Pycnometer bottle number	4	5			
Constant temperature of test ^{o}C	32	32			
Wt. of pycnometer, W_1	14.82	30.91			
Wt. of pycnometer + dry soil, W_2	25.16	40.9			
Wt. of dry soil, $W_3 = W_2 - W_1$	10.34	9.99			
Wt. of pycnometer + soil+ water, W_4	95.54	86.84			
Wt. of pycnometer + water only, W_5	89.18	80.71			
Specific gravity (G_S) = $W_3 / (W_3 + (W_5 - W_4))$	**2.60**	**2.59**			

Date of Test:	**31-May-17**
Bore Hole Number:	**04**

Sample Number:	**SP- 2**	**SP- 11**	**SP- 16**		
Pycnometer bottle number	1	2	3		
Constant temperature of test ^{o}C	32	32	32		
Wt. of pycnometer, W_1	14.75	13.79	12.52		
Wt. of pycnometer + dry soil, W_2	23.98	22.24	23.08		
Wt. of dry soil, $W_3 = W_2 - W_1$	9.23	8.45	10.56		
Wt. of pycnometer + soil+ water, W_4	76.01	74.54	87.45		
Wt. of pycnometer + water only, W_5	70.4	69.37	80.98		
Specific gravity (G_S) = $W_3 / (W_3 + (W_5 - W_4))$	**2.55**	**2.58**	**2.58**		

SPECIFIC GRAVITY

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**31-May-17**

Bore Hole Number:	**05**

Sample Number:	**SP- 3**	**SP- 17**			
Pycnometer bottle number	4	5			
Constant temperature of test ^{o}C	32	32			
Wt. of pycnometer, W_1	14.82	20.38			
Wt. of pycnometer + dry soil, W_2	25.03	29.75			
Wt. of dry soil, $W_3 = W_2 - W_1$	10.21	9.37			
Wt. of pycnometer + soil+ water, W_4	95.37	88.6			
Wt. of pycnometer + water only, W_5	89.18	82.83			
Specific gravity (G_S) = W_3 / (W_3 + (W_5-W_4))	**2.54**	**2.60**			

Date of Test:	**1-Jun-17**

Bore Hole Number:	**06**

Sample Number:	**SP- 1**	**SP- 10**	**SP- 16**		
Pycnometer bottle number	1	2	3		
Constant temperature of test ^{o}C	32	32	32		
Wt. of pycnometer, W_1	14.75	13.79	12.52		
Wt. of pycnometer + dry soil, W_2	23.3	24	23.87		
Wt. of dry soil, $W_3 = W_2 - W_1$	8.55	10.21	11.35		
Wt. of pycnometer + soil+ water, W_4	75.6	75.61	87.9		
Wt. of pycnometer + water only, W_5	70.4	69.37	80.98		
Specific gravity (G_S) = W_3 / (W_3 + (W_5-W_4))	**2.55**	**2.57**	**2.56**		

SPECIFIC GRAVITY

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

Date of Test:	**1-Jun-17**
Bore Hole Number:	**07**

Sample Number:	**SP- 2**	**SP- 11**	**SP- 15**		
Pycnometer bottle number	1	2	3		
Constant temperature of test ^{o}C	32	32	32		
Wt. of pycnometer, W_1	14.75	13.79	12.52		
Wt. of pycnometer + dry soil, W_2	24.2	25.06	22.57		
Wt. of dry soil, $W_3 = W_2 - W_1$	9.45	11.27	10.05		
Wt. of pycnometer + soil+ water, W_4	76.19	76.31	87.12		
Wt. of pycnometer + water only, W_5	70.4	69.37	80.98		
Specific gravity (G_S) = W_3 / (W_3 + (W_5-W_4))	**2.58**	**2.60**	**2.57**		

APPENDIX-C3: Particle size distribution with Hydrometer

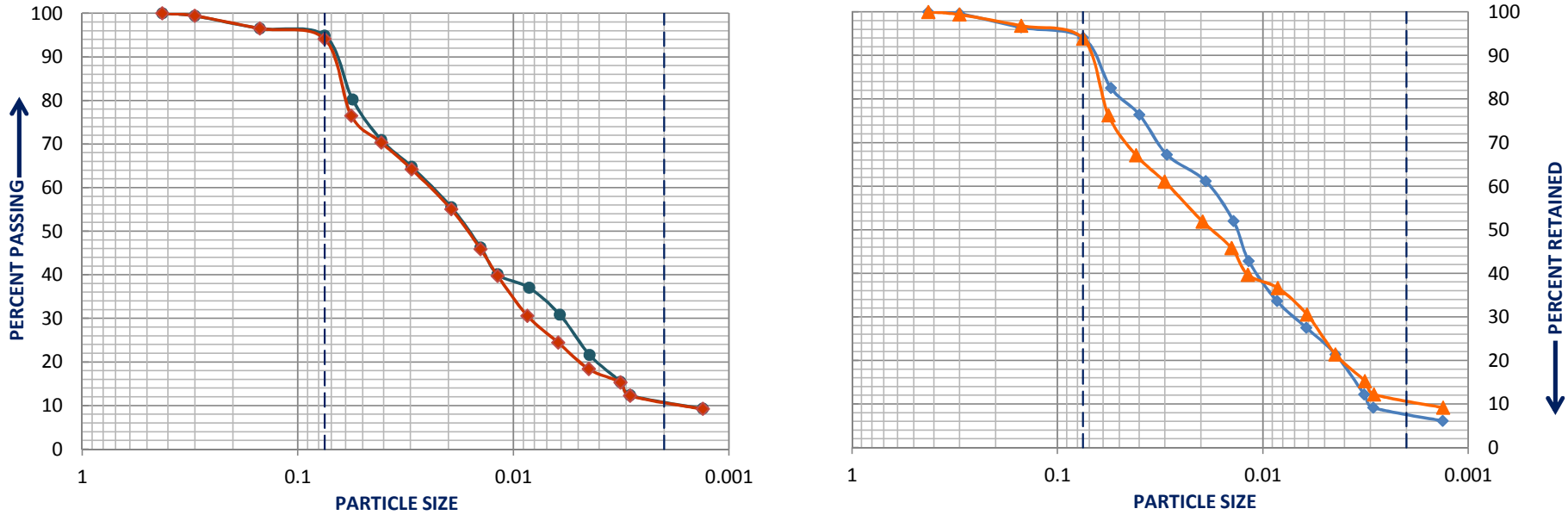
GRAIN SIZE ANALYSIS

PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

LEGEND: MEDIUM PEBBLES (4.75-20.0 mm), FINE PEBBLES (2.0-4.75 mm), SAND (0.075-2.0 mm), SILT (0.002-0.075 mm), CLAY (less than 0.002 mm).



SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	D_{60}	D_{30}	D_{10}	C_u	C_z	SOIL CLASSIFICATION	SAND %	SILT %	CLAY %
■	01	SP-1	1.5						SILT, TRACE CLAY, TRACE SAND	6	86	8
▲	01	SP-16	24.0						SILT, LITTLE CLAY, TRACE SAND	6	84	10
●	02	SP-2	3.0						SILT, LITTLE CLAY, TRACE SAND	5	84	11
◆	02	SP-15	22.5						SILT, LITTLE CLAY, TRACE SAND	6	83	11

NOOR-ZAMAN ENGINEERING FOUNDATION

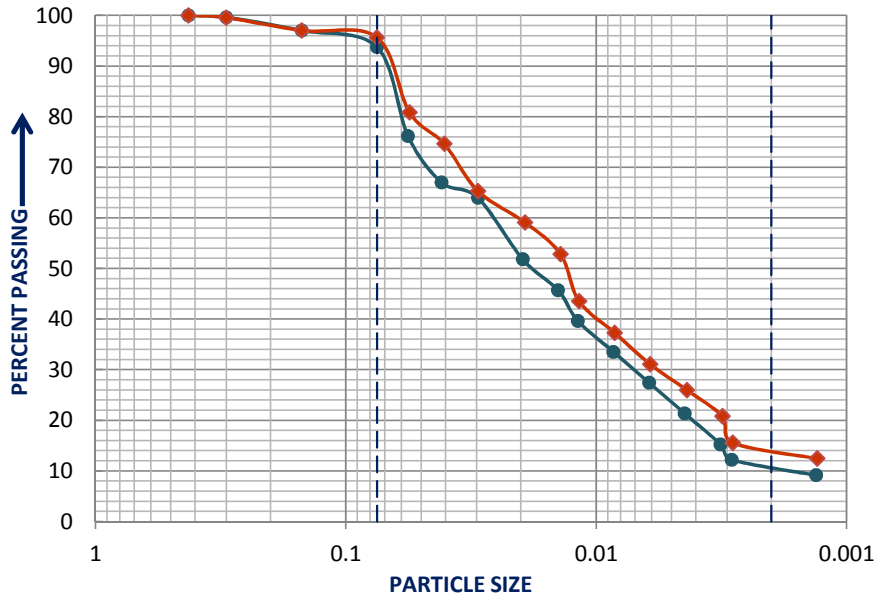
GRAIN SIZE ANALYSIS

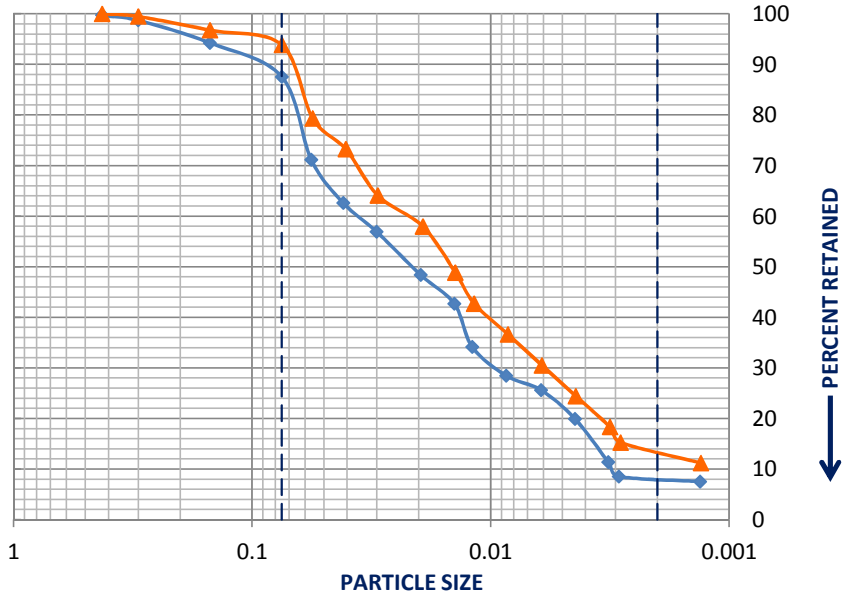
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

LEGEND: MEDIUM PEBBLES (4.75-20.0 mm), FINE PEBBLES (2.0-4.75 mm), SAND (0.075-2.0 mm), SILT (0.002-0.075 mm), CLAY (less than 0.002 mm).





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	D_{60}	D_{30}	D_{10}	C_u	C_z	SOIL CLASSIFICATION	SAND %	SILT %	CLAY %
■	02	SP-17	25.5						SILT, LITTLE SAND, TRACE CLAY	12	80	8
▲	03	SP-3	4.5						SILT, LITTLE CLAY, TRACE SAND	6	81	13
●	03	SP-15	22.5						SILT, LITTLE CLAY, TRACE SAND	6	80	14
◆	04	SP-2	3.0						SILT, LITTLE CLAY, TRACE SAND	4	85	11

NOOR-ZAMAN ENGINEERING FOUNDATION

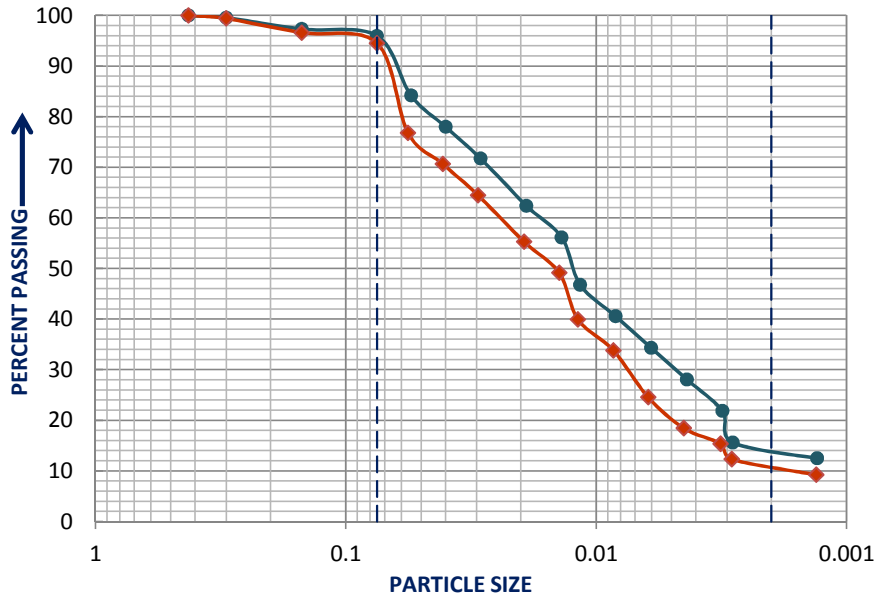
GRAIN SIZE ANALYSIS

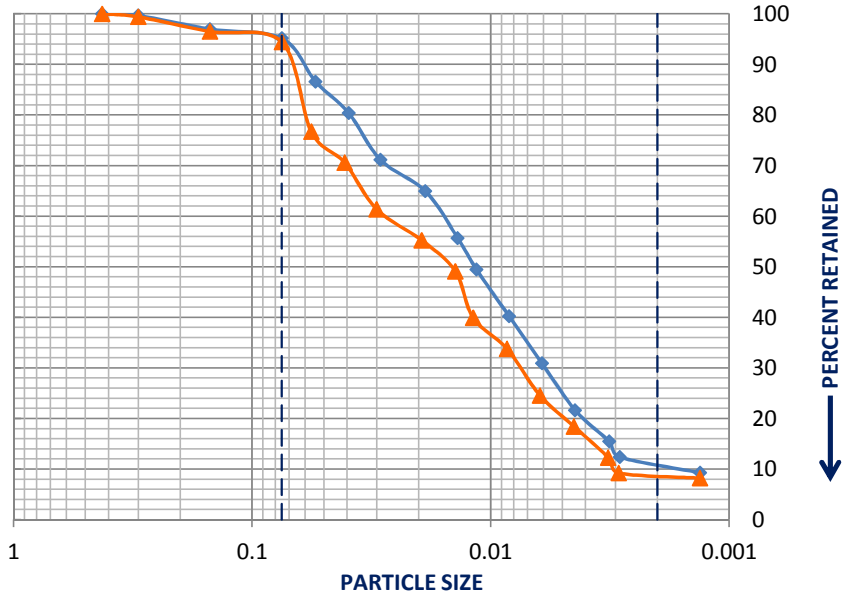
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

LEGEND: MEDIUM PEBBLES (4.75-20.0 mm), FINE PEBBLES (2.0-4.75 mm), SAND (0.075-2.0 mm), SILT (0.002-0.075 mm), CLAY (less than 0.002 mm).





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	D_{60}	D_{30}	D_{10}	C_u	C_z	SOIL CLASSIFICATION	SAND %	SILT %	CLAY %
■	04	SP-11	16.5						SILT, LITTLE CLAY, TRACE SAND	5	84	11
▲	04	SP-16	24.0						SILT, TRACE CLAY, TRACE SAND	6	85	9
●	05	SP-3	4.5						SILT, LITTLE CLAY, TRACE SAND	4	82	14
◆	05	SP-17	25.5						SILT, LITTLE CLAY, TRACE SAND	6	83	11

NOOR-ZAMAN ENGINEERING FOUNDATION

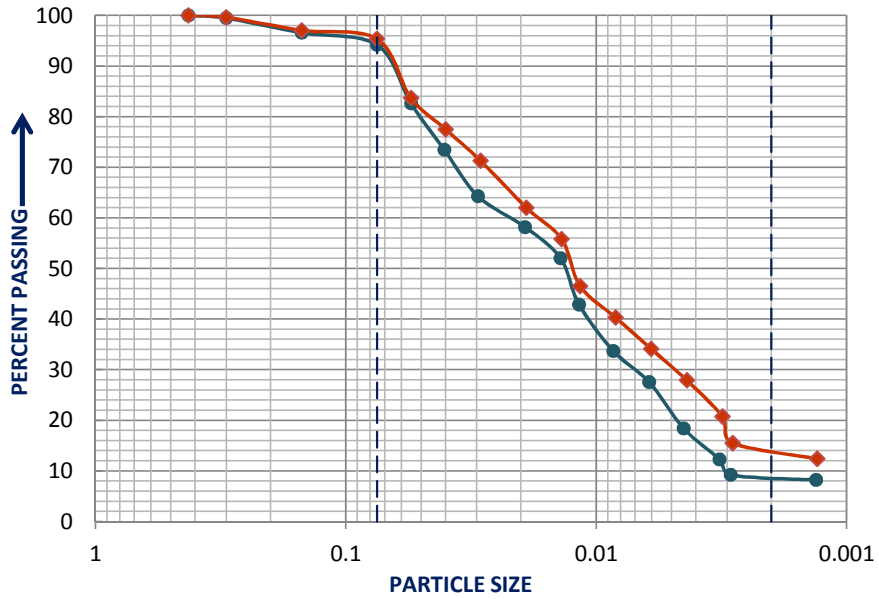
GRAIN SIZE ANALYSIS

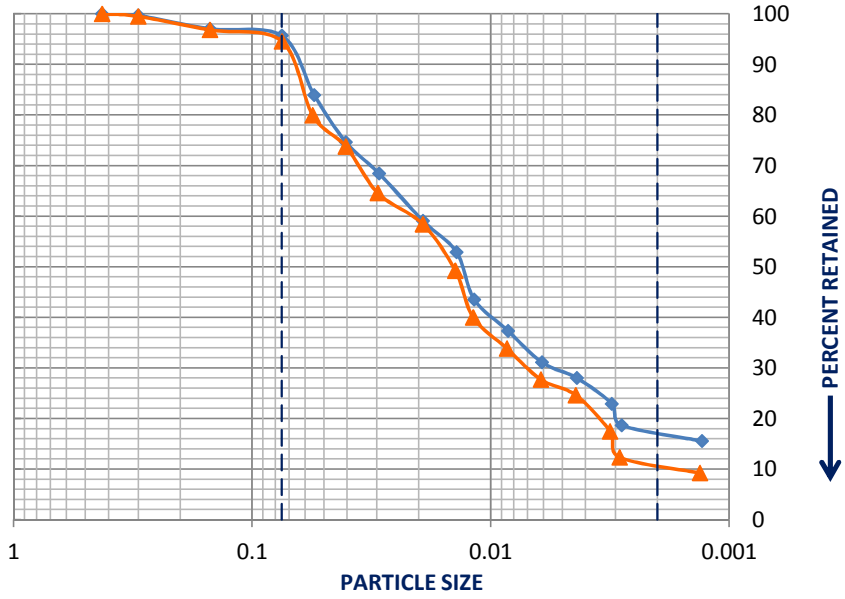
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

LEGEND: MEDIUM PEBBLES (4.75-20.0 mm), FINE PEBBLES (2.0-4.75 mm), SAND (0.075-2.0 mm), SILT (0.002-0.075 mm), CLAY (less than 0.002 mm).





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	D_{60}	D_{30}	D_{10}	C_u	C_z	SOIL CLASSIFICATION	SAND %	SILT %	CLAY %
■	06	SP-1	1.5						SILT, LITTLE CLAY, TRACE SAND	4	79	17
▲	06	SP-10	15.0						SILT, LITTLE CLAY, TRACE SAND	5	85	10
●	06	SP-16	24.0						SILT, TRACE CLAY, TRACE SAND	6	86	8
◆	07	SP-2	3.0						SILT, LITTLE CLAY, TRACE SAND	5	81	14

NOOR-ZAMAN ENGINEERING FOUNDATION

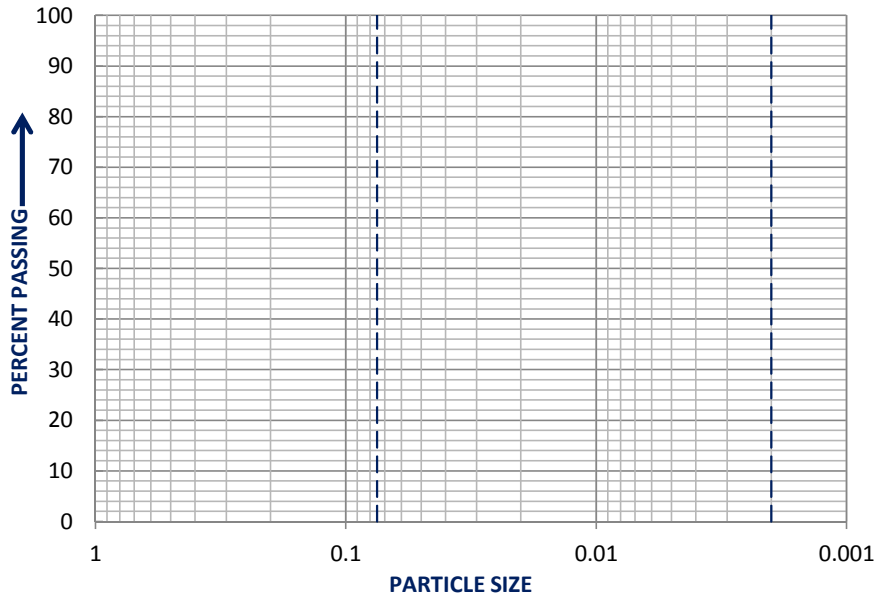
GRAIN SIZE ANALYSIS

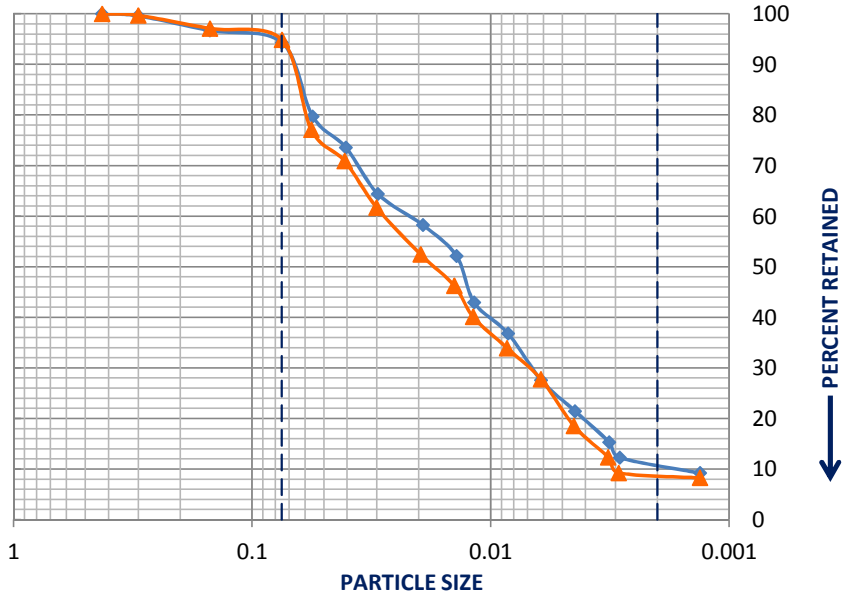
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

LEGEND: MEDIUM PEBBLES (4.75-20.0 mm), FINE PEBBLES (2.0-4.75 mm), SAND (0.075-2.0 mm), SILT (0.002-0.075 mm), CLAY (less than 0.002 mm).





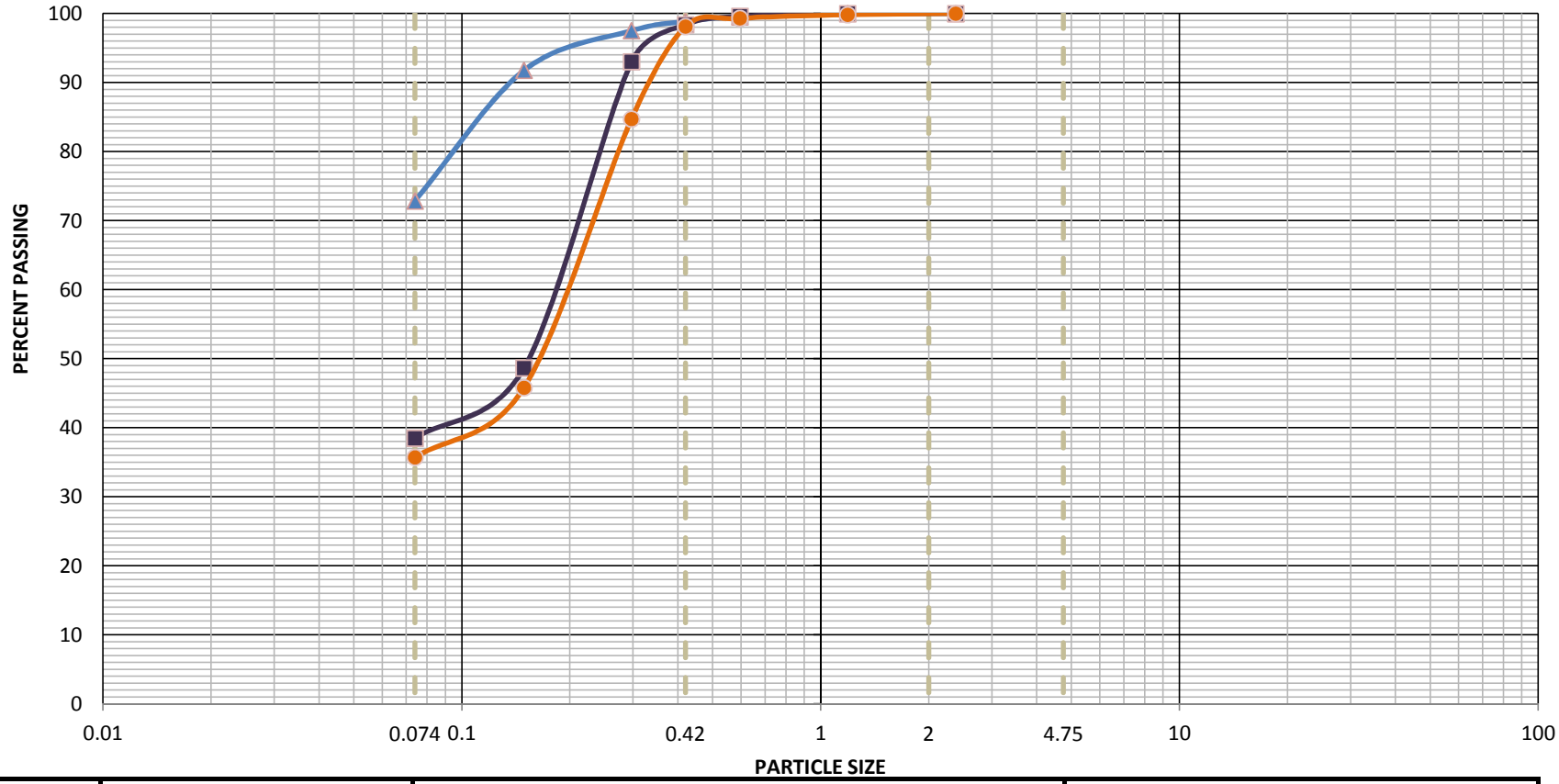
SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	D_{60}	D_{30}	D_{10}	C_u	C_z	SOIL CLASSIFICATION	SAND %	SILT %	CLAY %
■	07	SP-11	16.5						SILT, LITTLE CLAY, TRACE SAND	6	83	11
▲	07	SP-15	22.5						SILT, TRACE CLAY, TRACE SAND	5	86	9

NOOR-ZAMAN ENGINEERING FOUNDATION

APPENDIX-C4: Particle size distribution (Sieve only)

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

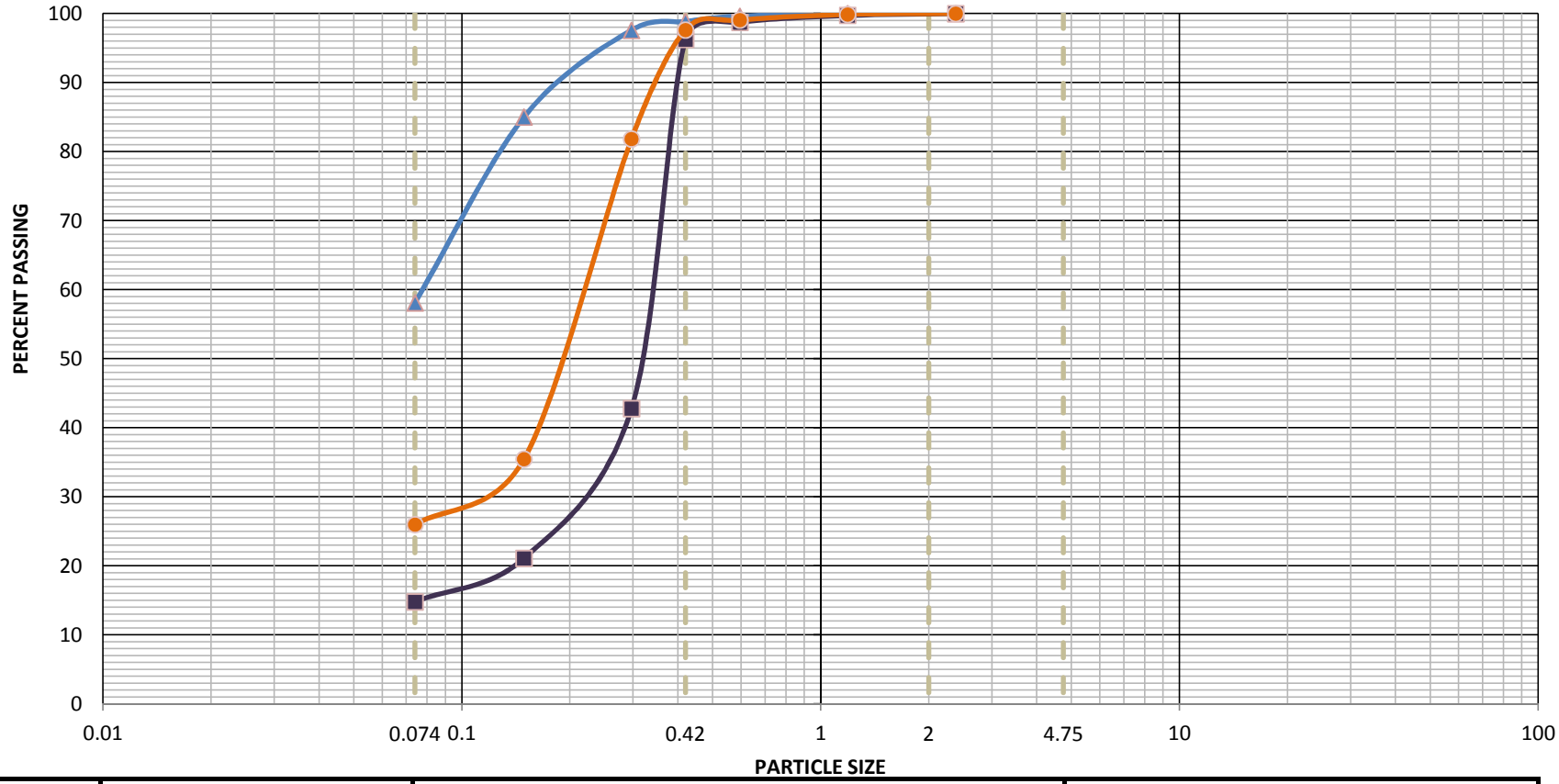


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	01	SP - 06	38.48	59.88	1.64	0.00	0.00
▲	01	SP - 08	72.86	25.99	1.15	0.00	0.00
●	01	SP - 11	35.68	62.42	1.90	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

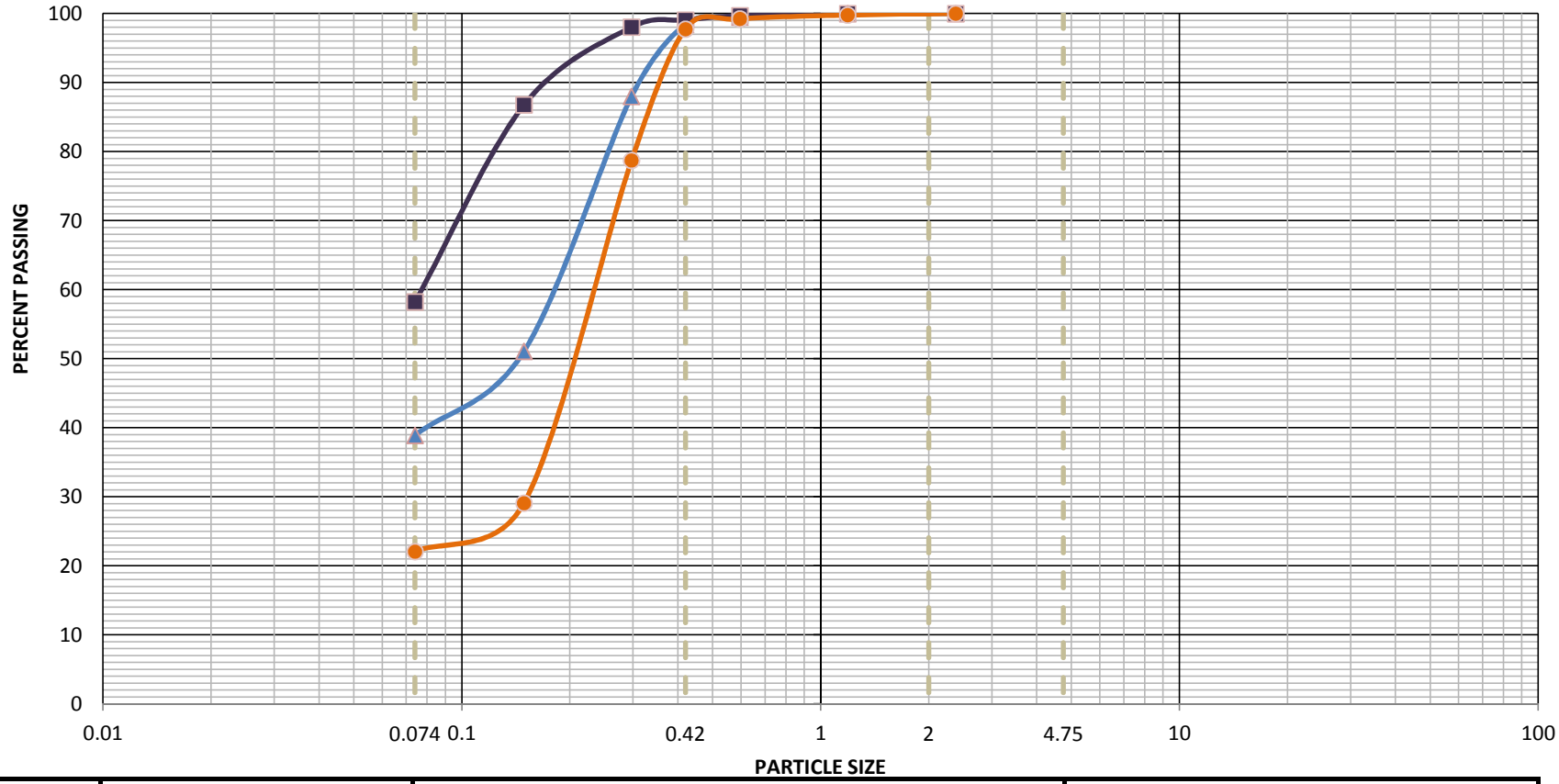


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	01	SP - 12	14.78	81.47	3.75	0.00	0.00
▲	01	SP - 22	58.08	40.77	1.15	0.00	0.00
●	01	SP - 27	25.96	71.64	2.40	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

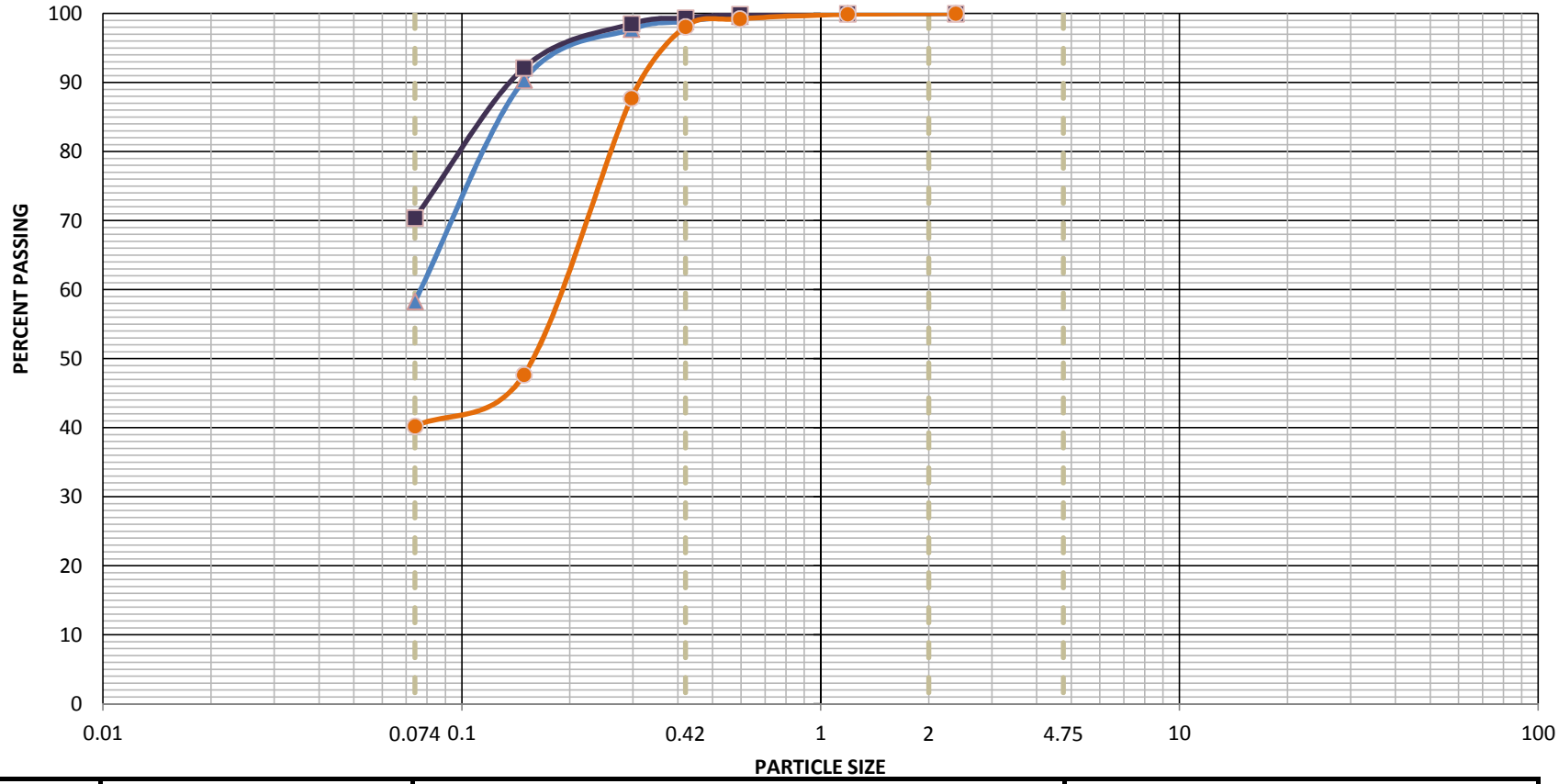


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	02	SP - 04	58.19	40.87	0.94	0.00	0.00
▲	02	SP - 09	38.89	59.53	1.58	0.00	0.00
●	02	SP - 12	22.05	75.70	2.25	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

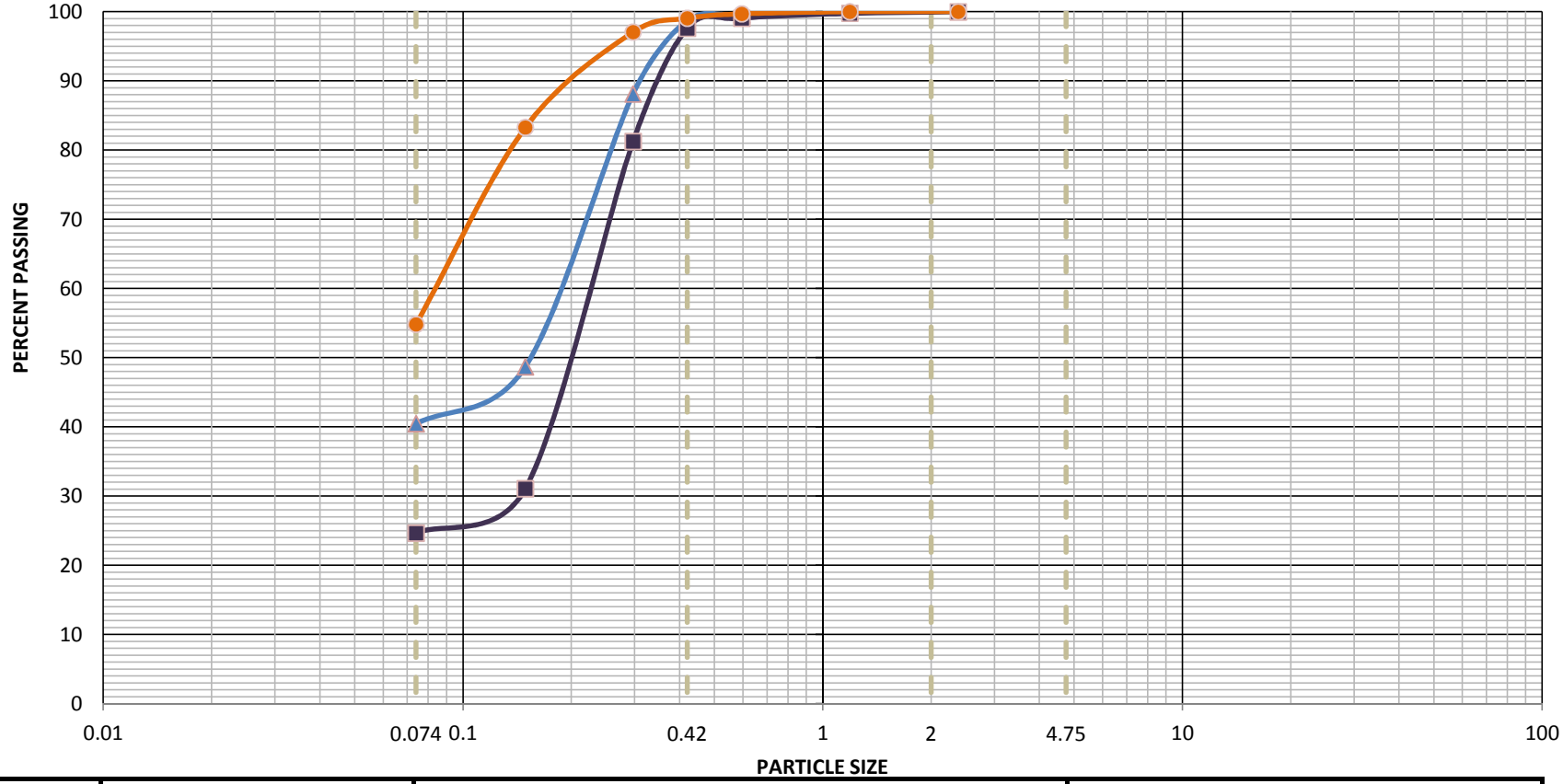
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*



SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	02	SP - 13	70.38	28.98	0.64	0.00	0.00
▲	02	SP - 20	58.29	40.55	1.16	0.00	0.00
●	02	SP - 23	40.22	57.87	1.91	0.00	0.00

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

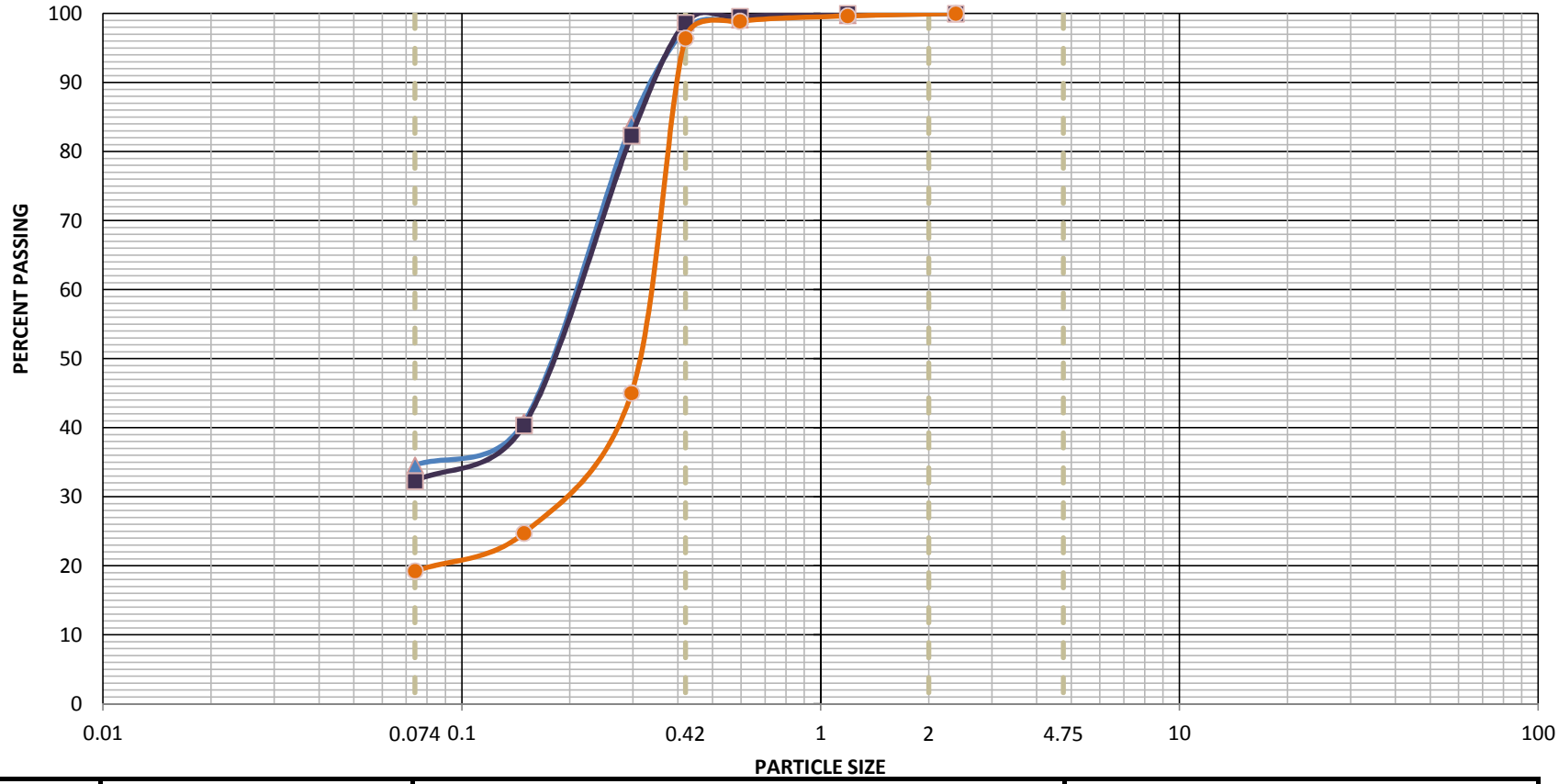


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	02	SP - 28	24.65	72.96	2.39	0.00	0.00
▲	03	SP - 06	40.45	58.24	1.31	0.00	0.00
●	03	SP - 09	54.80	44.24	0.96	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

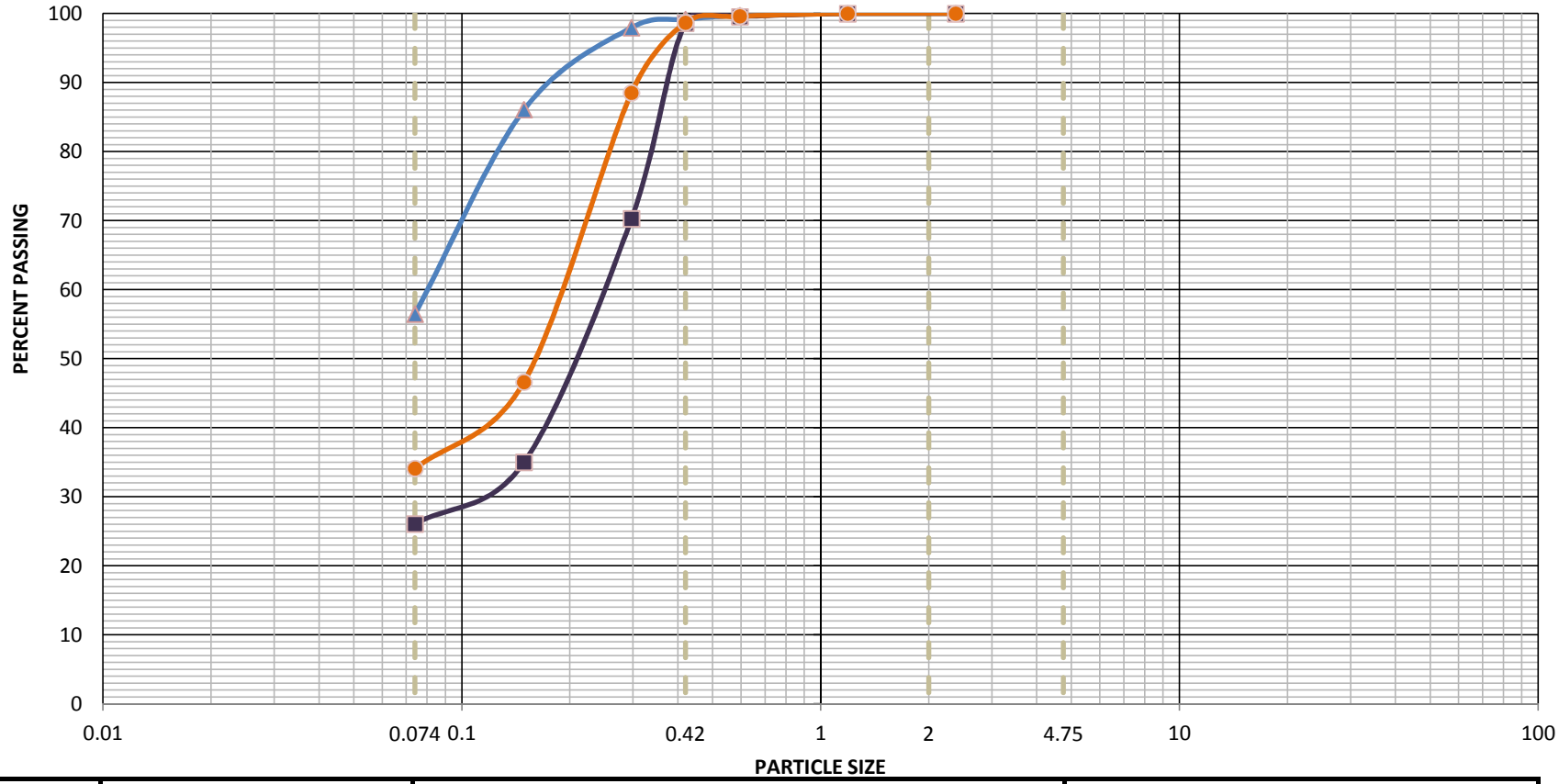


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	03	SP - 13	32.25	66.39	1.36	0.00	0.00
▲	03	SP - 17	34.54	63.09	2.37	0.00	0.00
●	03	SP - 19	19.22	77.19	3.59	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

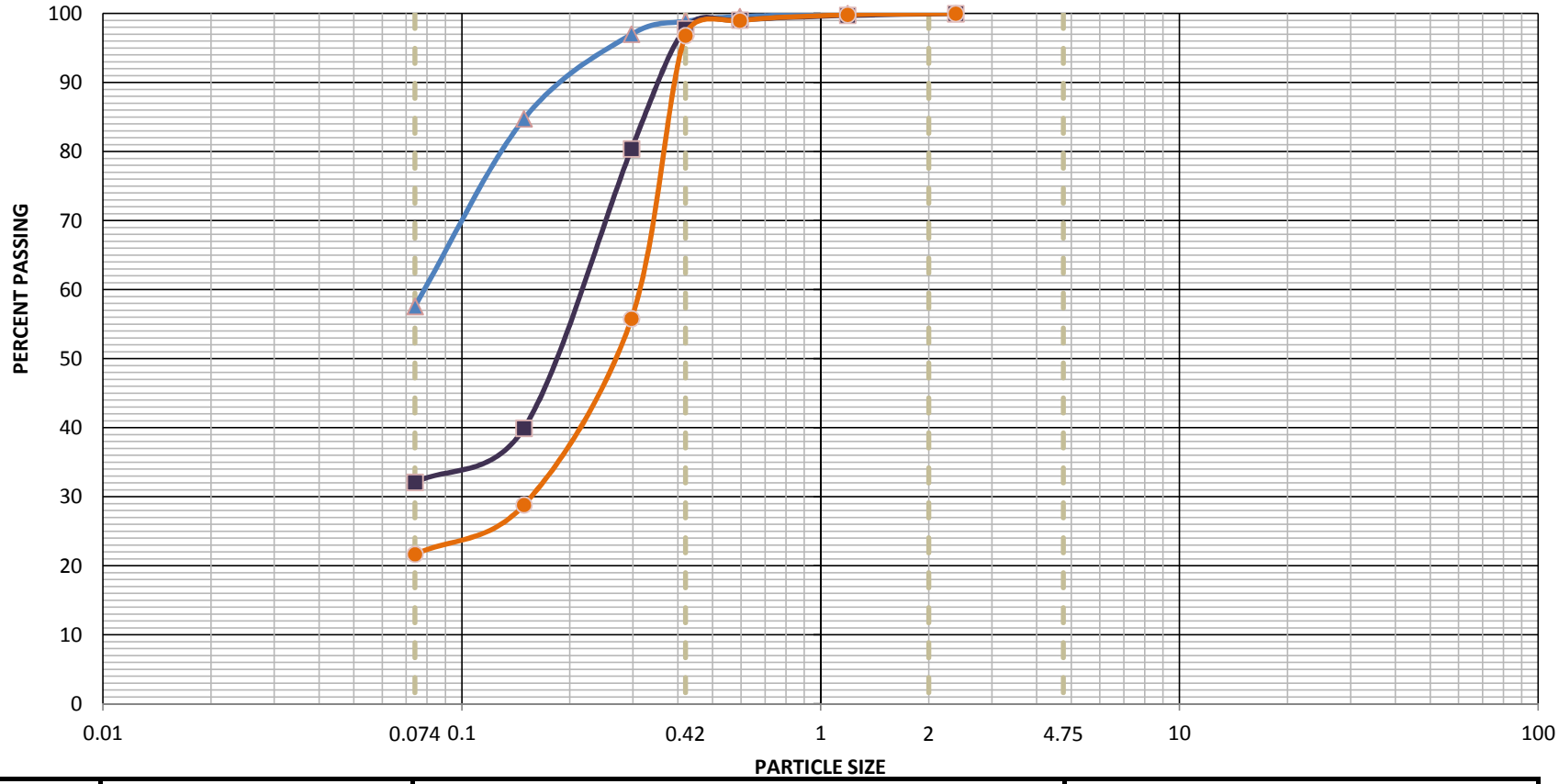
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*



SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	03	SP - 24	26.05	72.53	1.42	0.00	0.00
▲	04	SP - 05	56.44	42.71	0.85	0.00	0.00
●	04	SP - 08	34.06	64.61	1.33	0.00	0.00

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

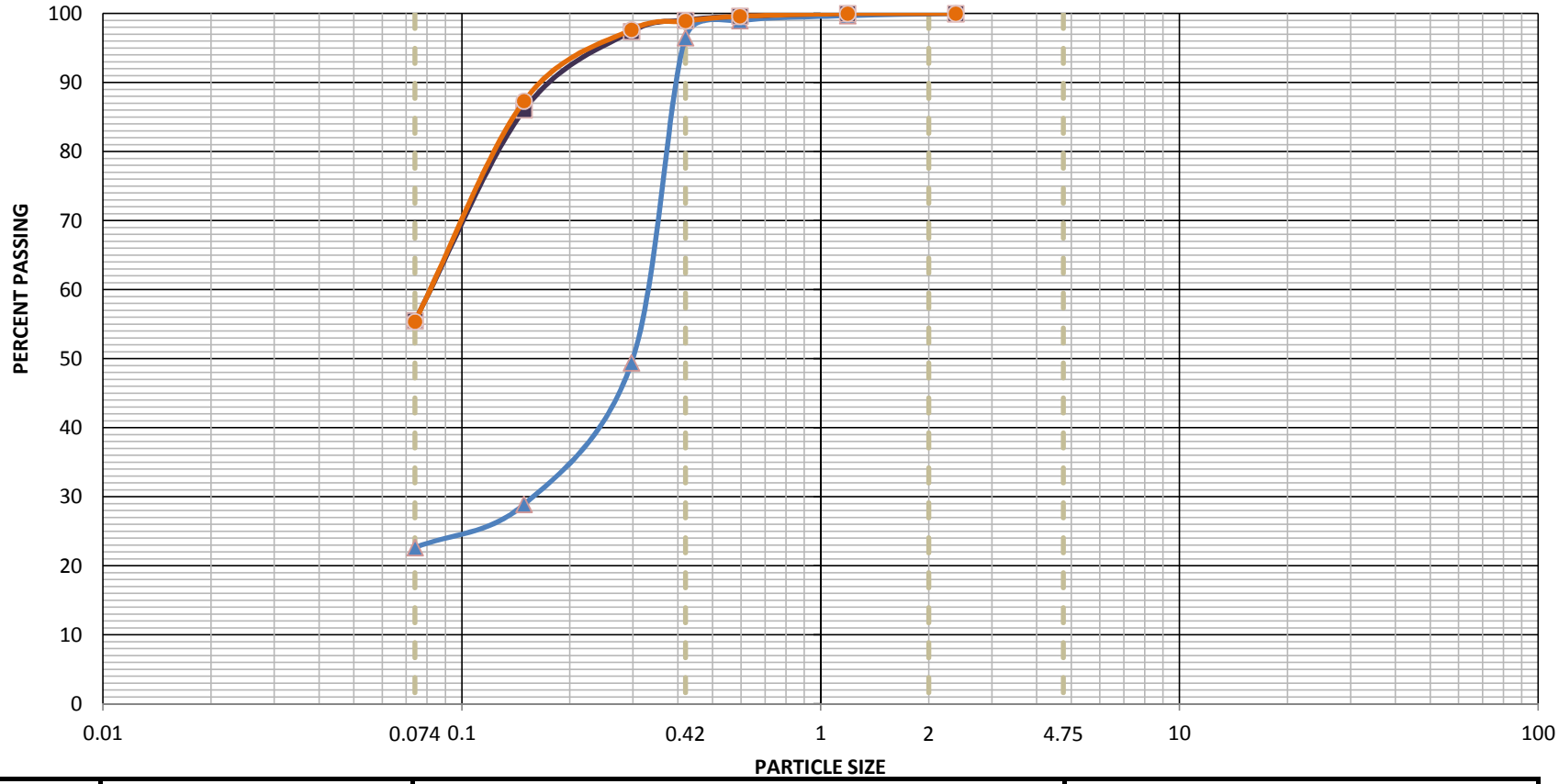


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	04	SP - 12	32.07	65.70	2.23	0.00	0.00
▲	04	SP - 14	57.58	41.29	1.13	0.00	0.00
●	04	SP - 20	21.67	75.14	3.19	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

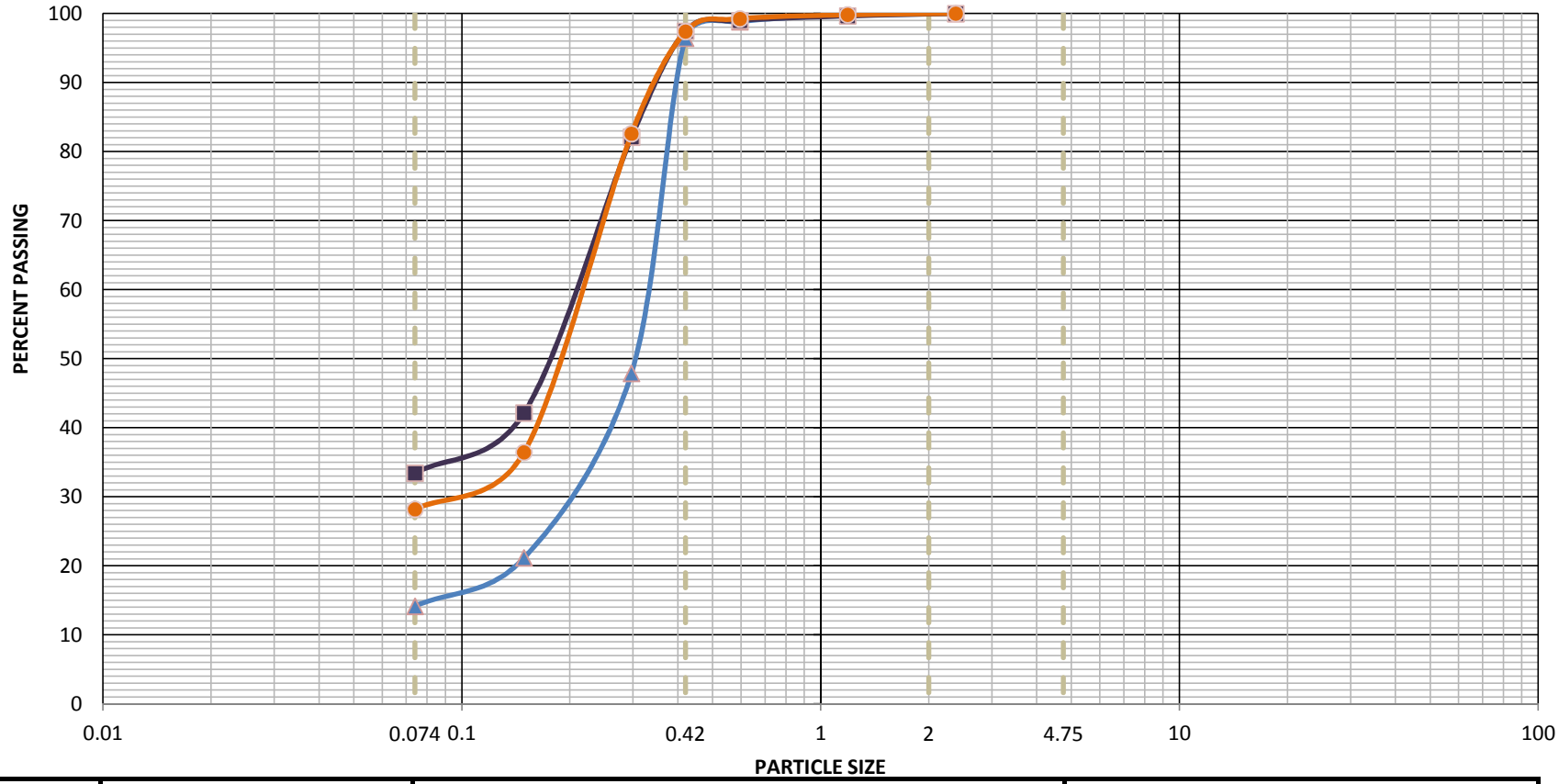


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	04	SP - 23	55.48	43.54	0.98	0.00	0.00
▲	04	SP - 27	22.63	73.88	3.49	0.00	0.00
●	05	SP - 05	55.37	43.54	1.09	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

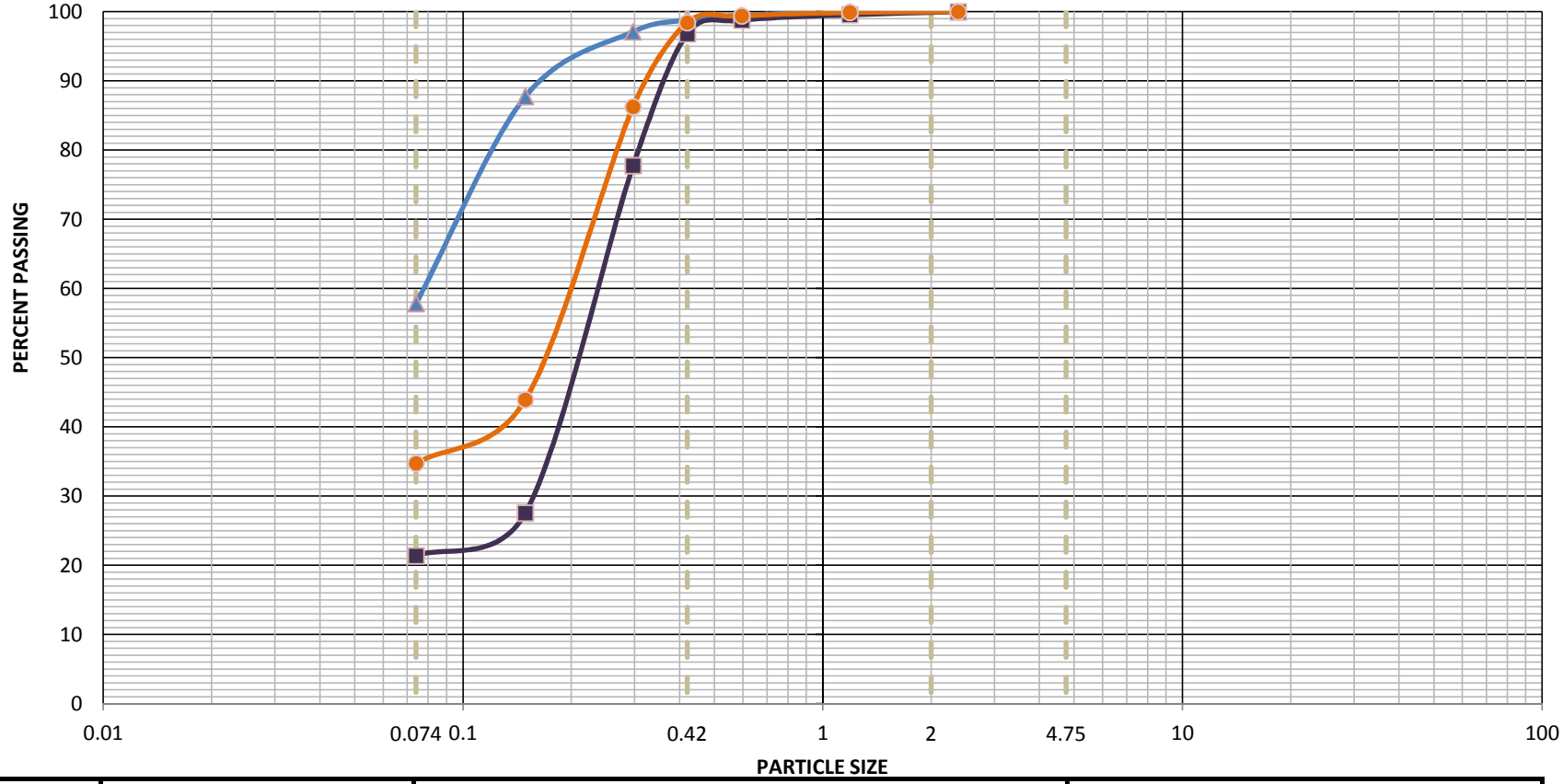


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	05	SP - 10	33.42	64.01	2.57	0.00	0.00
▲	05	SP - 13	14.14	82.27	3.59	0.00	0.00
●	05	SP - 21	28.15	69.22	2.63	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

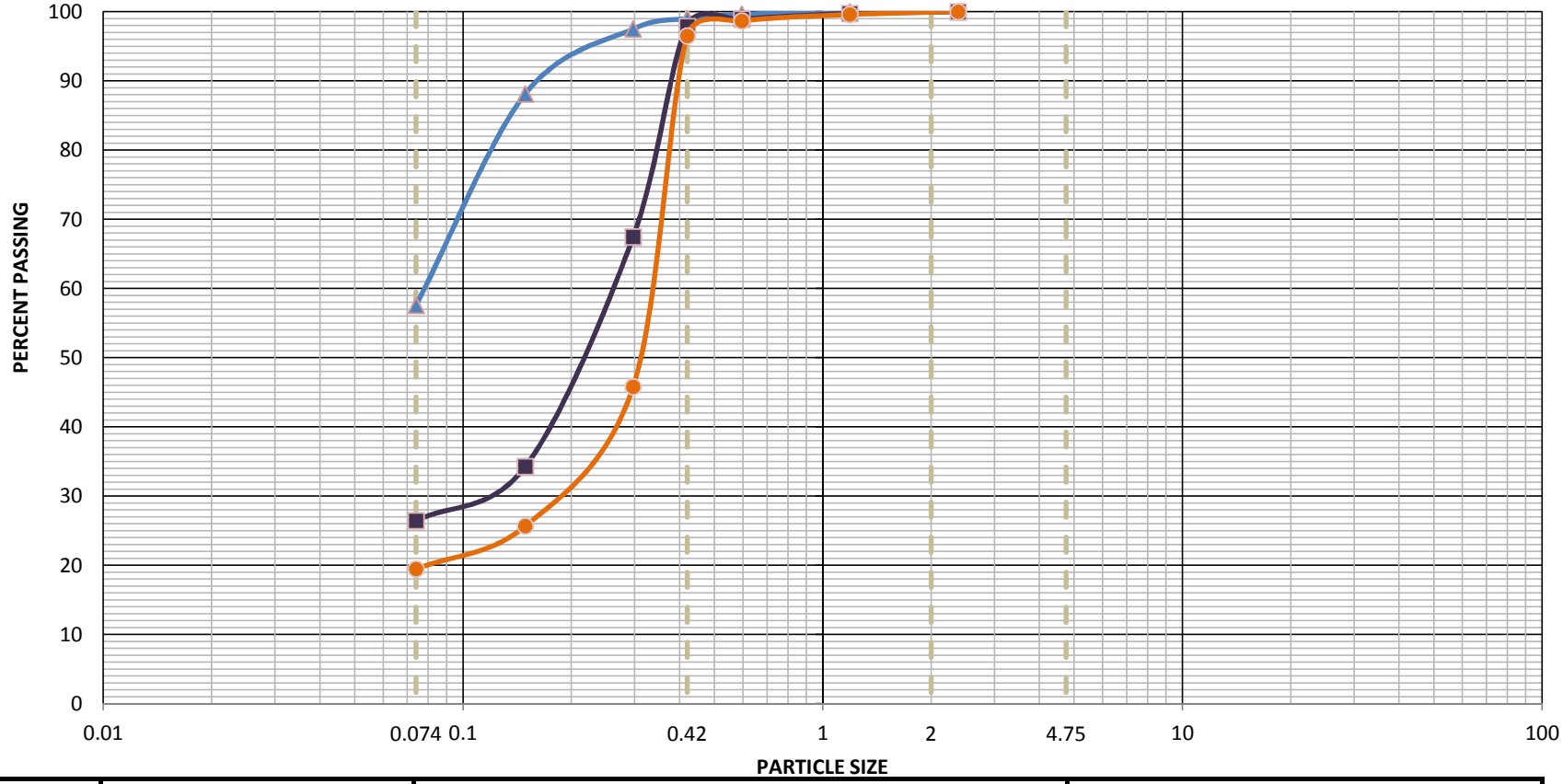


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	05	SP - 28	21.35	75.44	3.21	0.00	0.00
▲	06	SP - 04	57.81	40.98	1.21	0.00	0.00
●	06	SP - 07	34.72	63.69	1.59	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

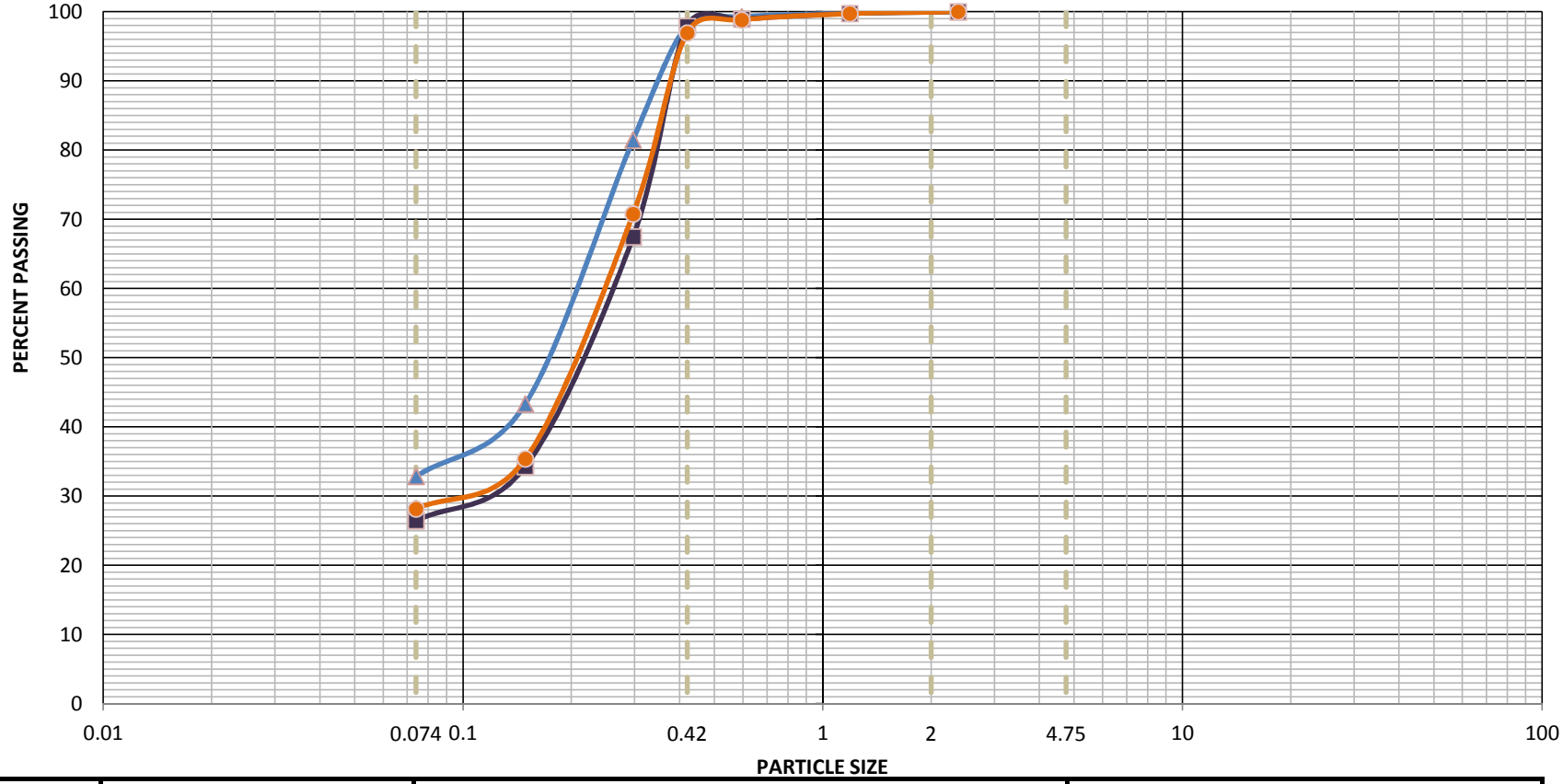


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	06	SP - 14	26.42	71.45	2.13	0.00	0.00
▲	06	SP - 22	57.55	41.45	1.00	0.00	0.00
●	06	SP - 27	19.45	77.04	3.51	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*

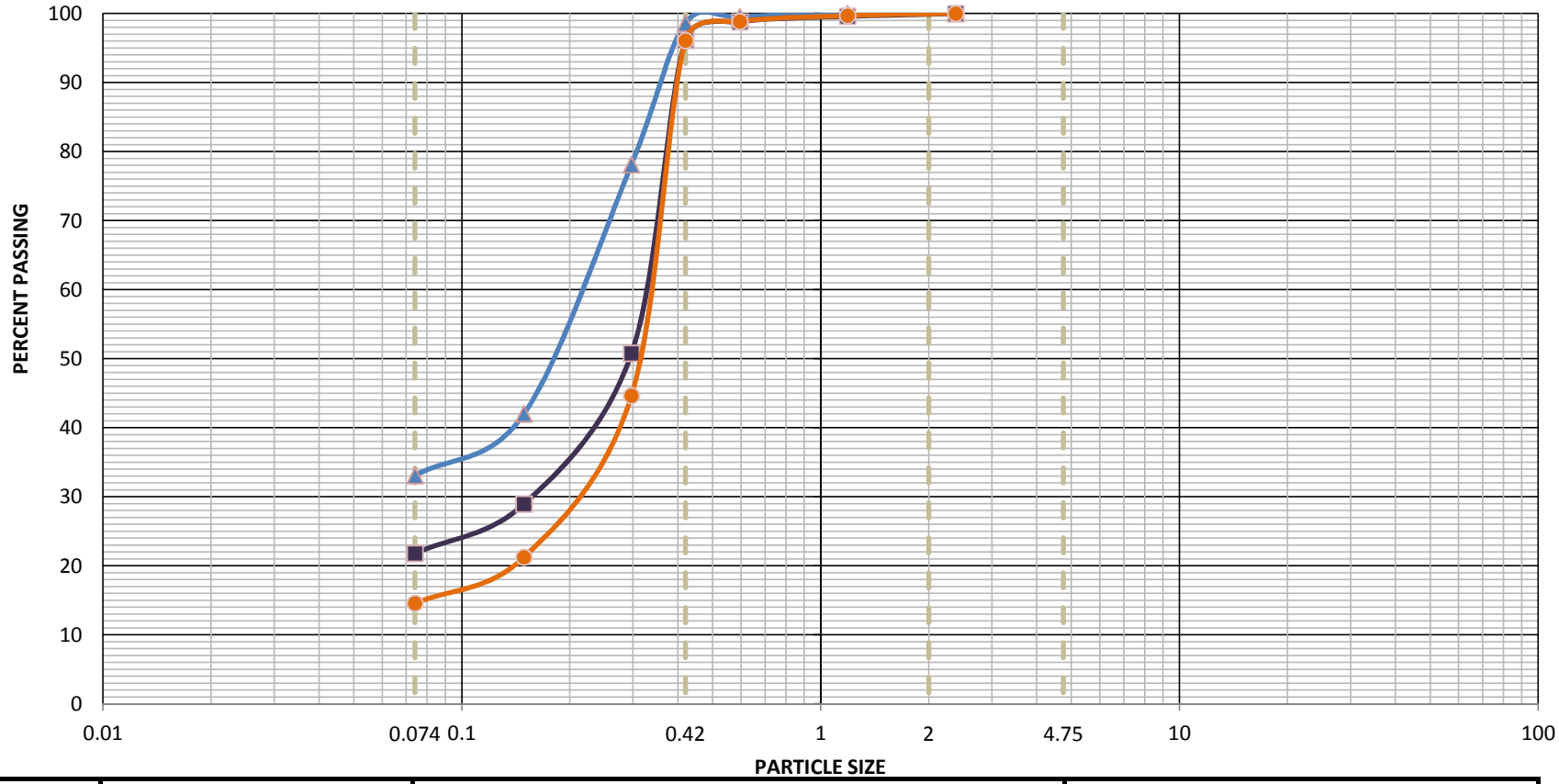


SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	07	SP - 06	26.42	71.45	2.13	0.00	0.00
▲	07	SP - 08	32.83	65.14	2.03	0.00	0.00
●	07	SP - 13	28.14	68.80	3.06	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

PRACTICAL SIZE DISTRIBUTION

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Survices Pvt. Ltd.*



SYMBOL	BORE No.	SAMPLE No.	SILT & CLAY %	SAND %			GRAVEL %
				Fine	Medium	Coarse	
■	07	SP - 17	21.79	74.32	3.89	0.00	0.00
▲	07	SP - 23	33.06	65.52	1.42	0.00	0.00
●	07	SP - 28	14.54	81.54	3.92	0.00	0.00

NOOR-ZAMAN ENGINEERING FOUNDATION

Appendix-C5: Atterberg Limit

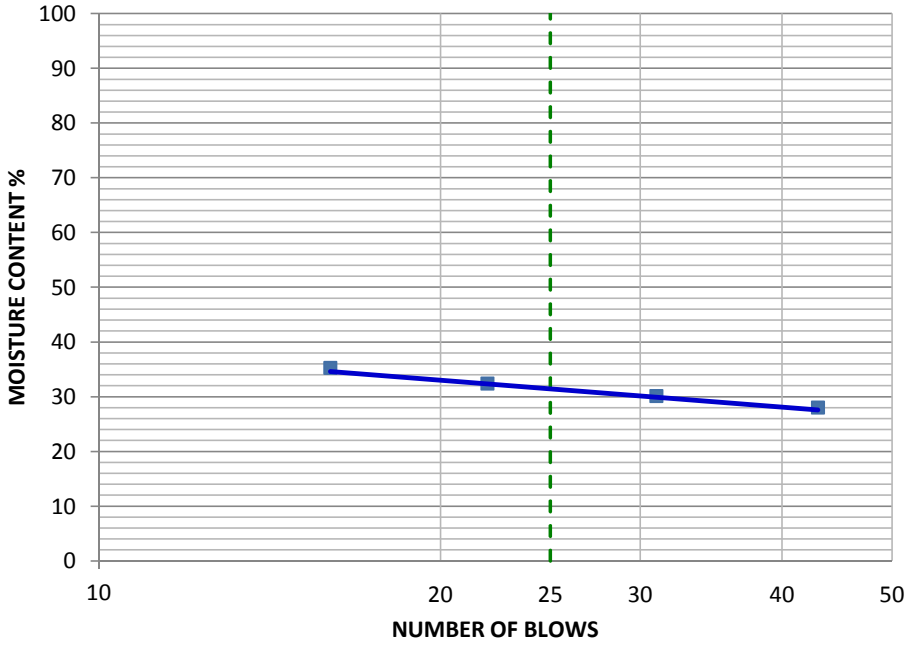
PLASTICITY INDEX TEST

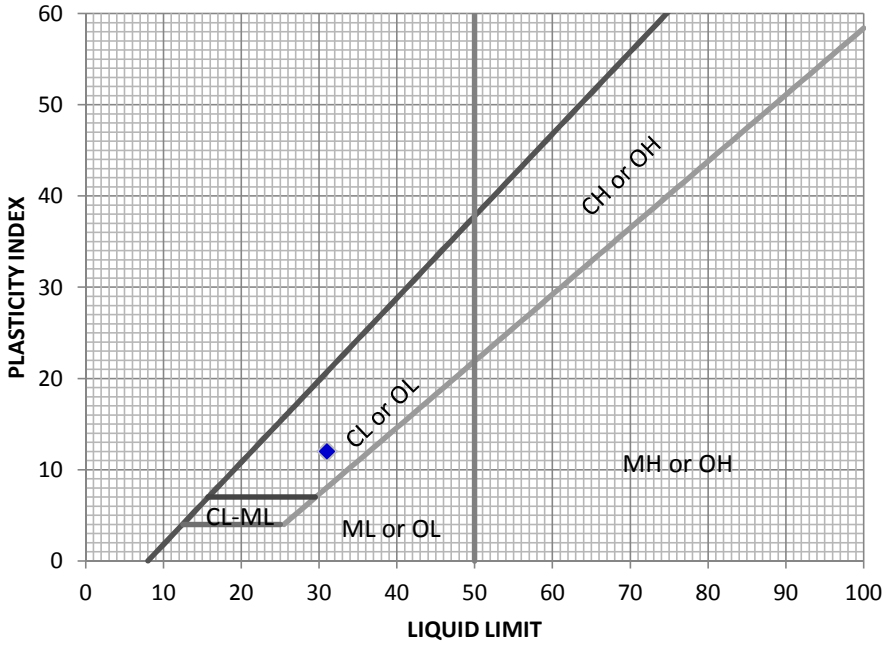
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	01	SP- 1	1.5	Light Grey Clayey SILT, trace Sand.	ML	26.46	31	19	12

NOOR-ZAMAN ENGINEERING FOUNDATION

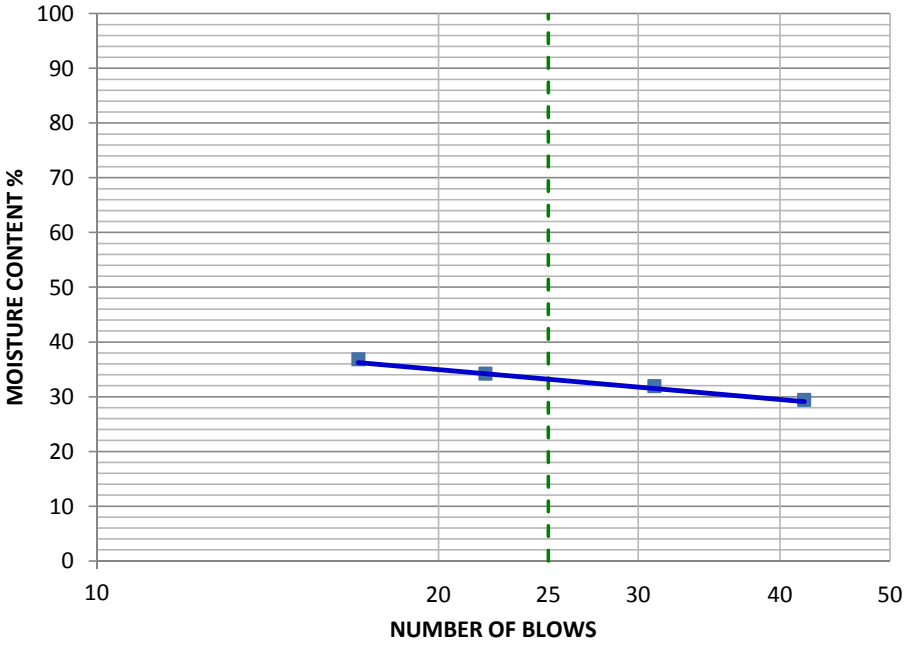
PLASTICITY INDEX TEST

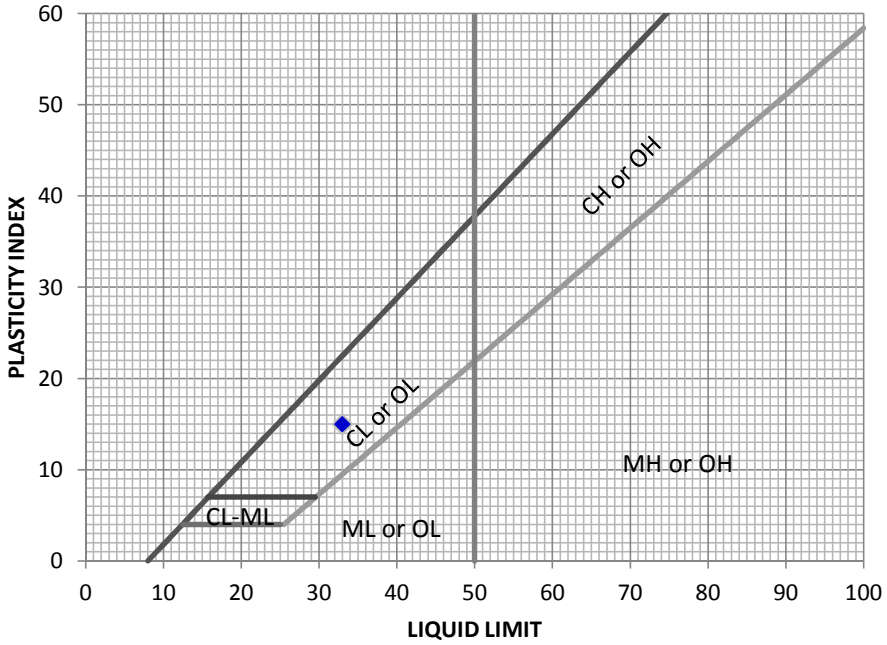
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	01	SP- 16	24.0	Grey Clayey SILT, trace Sand.	ML	20.10	33	18	15

NOOR-ZAMAN ENGINEERING FOUNDATION

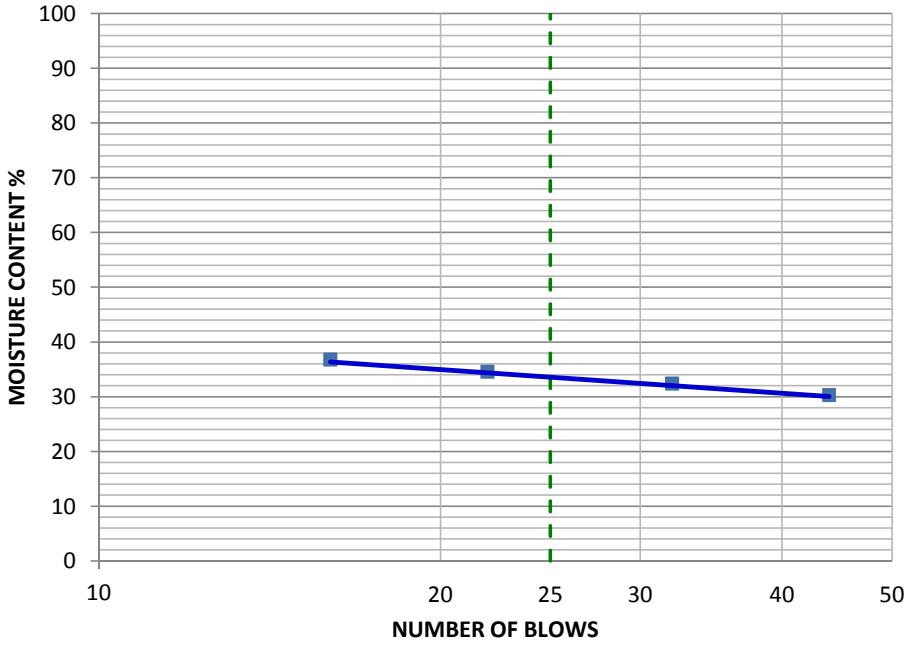
PLASTICITY INDEX TEST

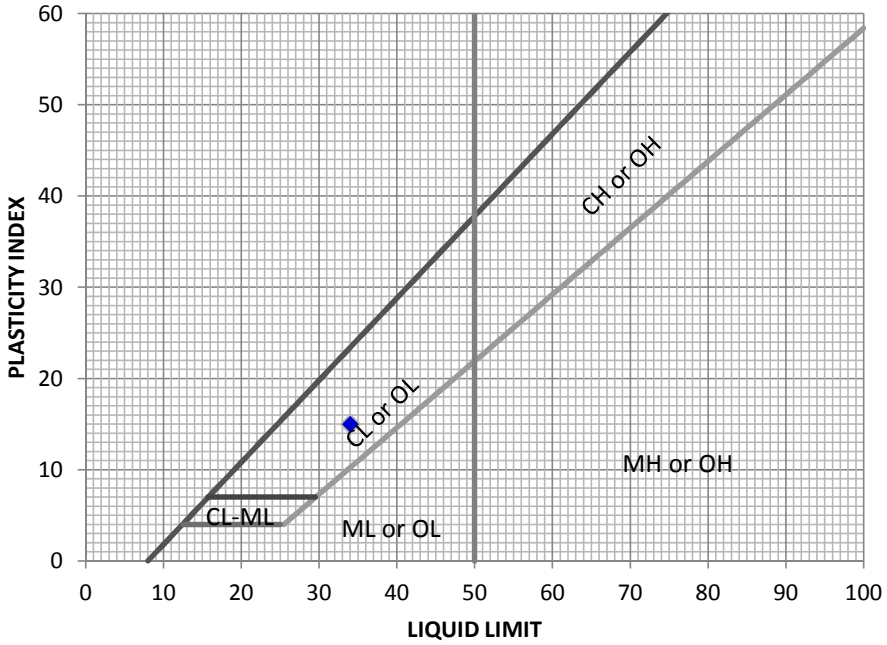
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	02	SP- 2	3.0	Grey Clayey SILT, trace Sand.	ML	30.92	34	19	15

NOOR-ZAMAN ENGINEERING FOUNDATION

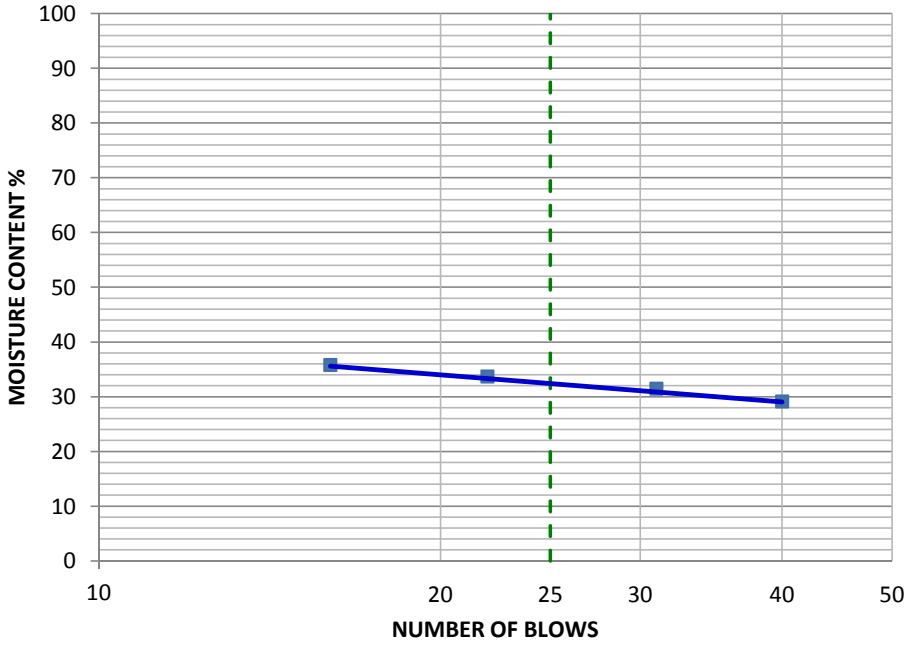
PLASTICITY INDEX TEST

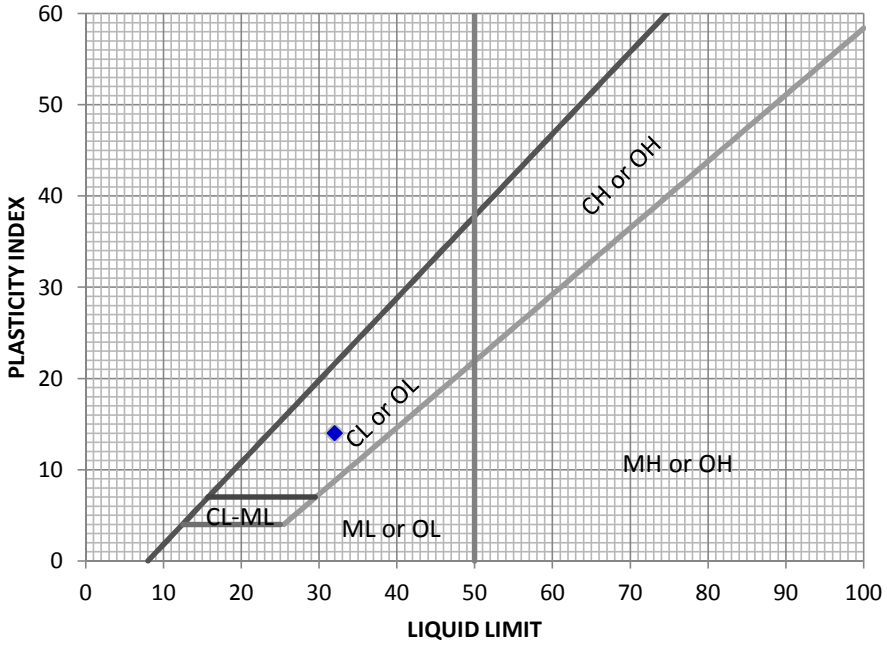
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	02	SP- 15	22.5	Light Grey Clayey SILT, trace Sand.	ML	29.72	32	18	14

NOOR-ZAMAN ENGINEERING FOUNDATION

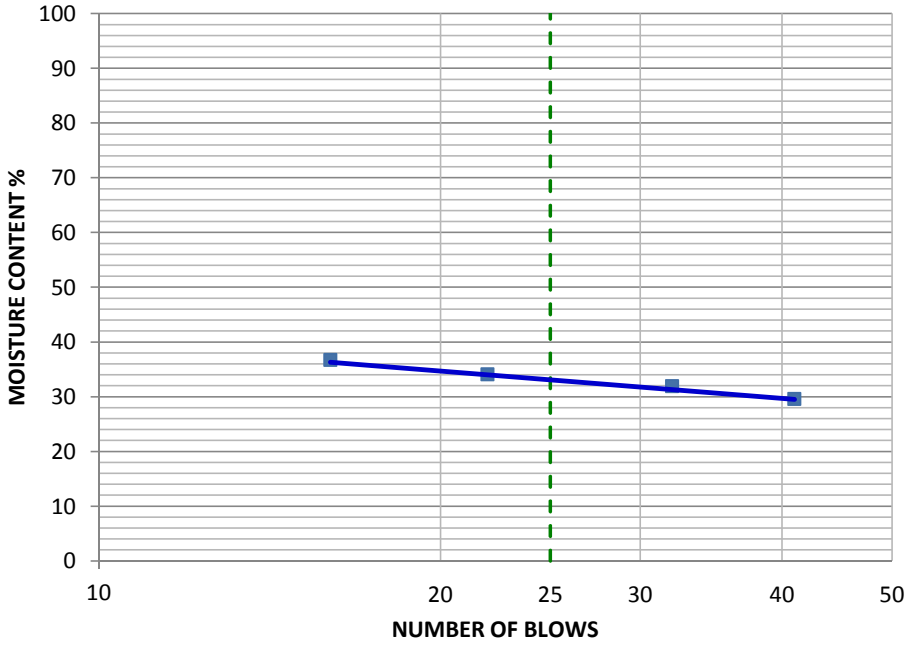
PLASTICITY INDEX TEST

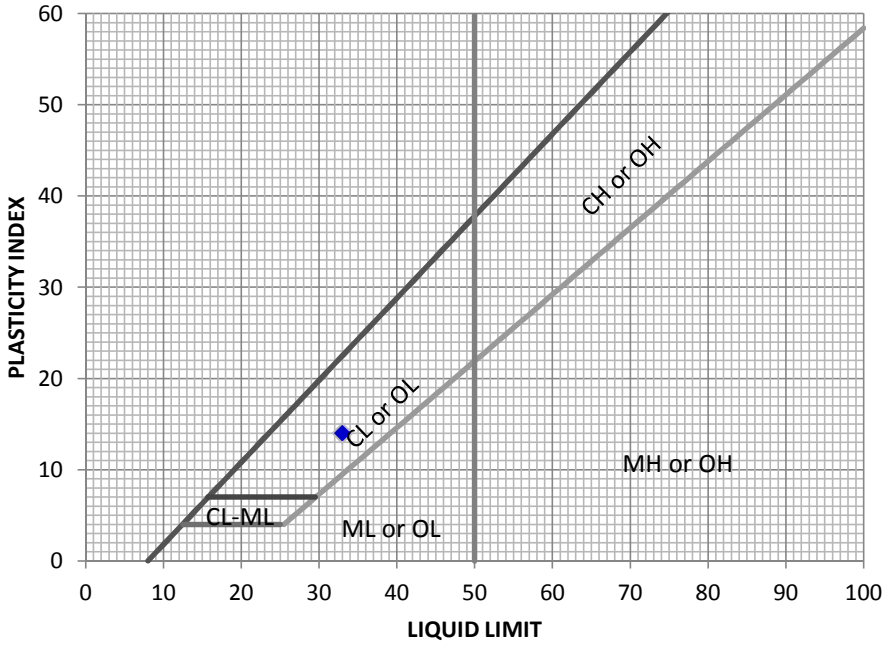
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	03	SP- 3	4.5	Grey Clayey SILT, trace Sand.	ML	29.34	33	19	14

NOOR-ZAMAN ENGINEERING FOUNDATION

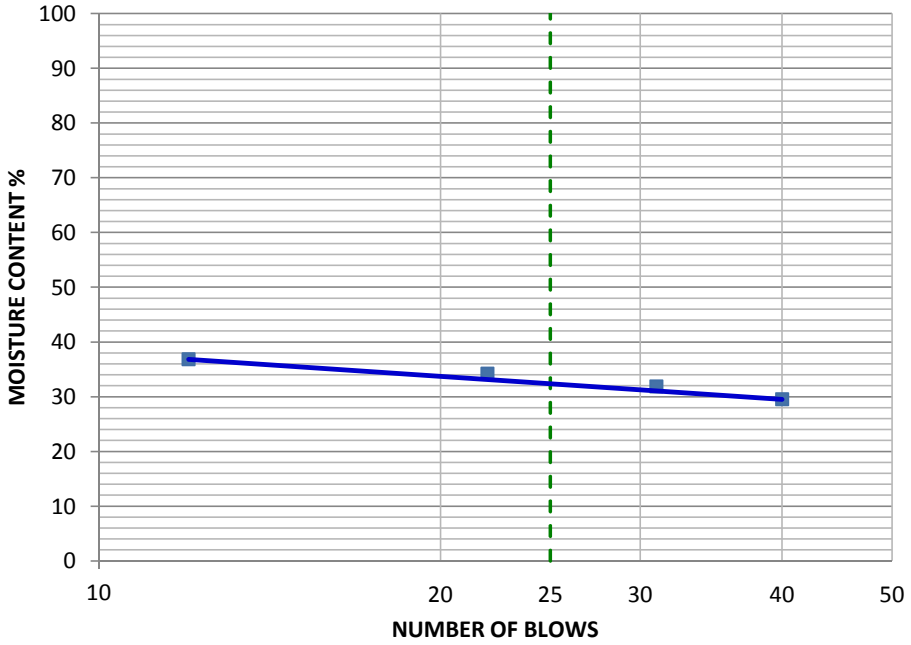
PLASTICITY INDEX TEST

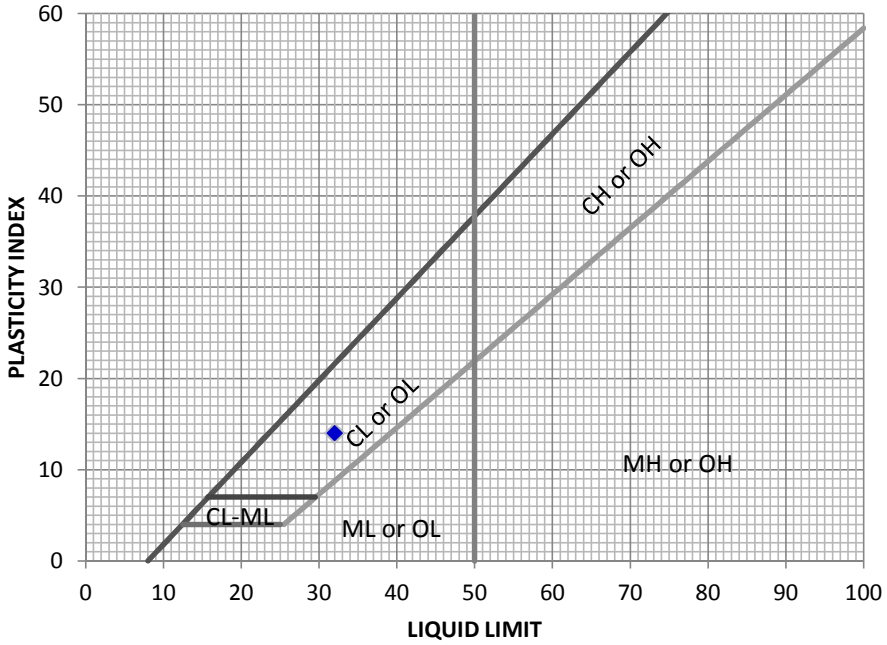
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	03	SP- 15	22.5	Grey Clayey SILT, trace Sand.	ML	27.36	32	18	14

NOOR-ZAMAN ENGINEERING FOUNDATION

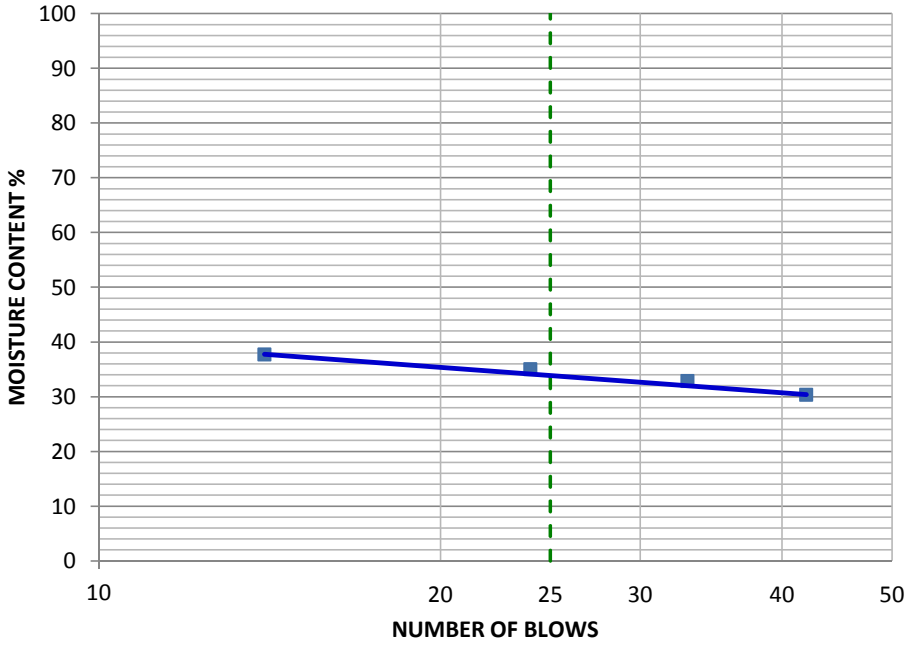
PLASTICITY INDEX TEST

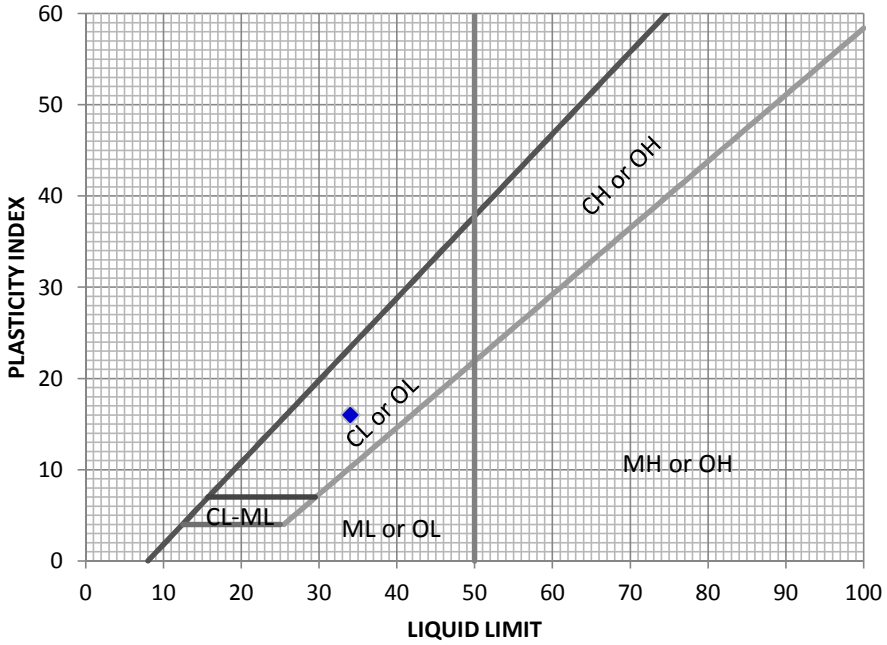
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	04	SP- 2	3.0	Grey Clayey SILT, trace Sand.	ML	28.31	34	18	16

NOOR-ZAMAN ENGINEERING FOUNDATION

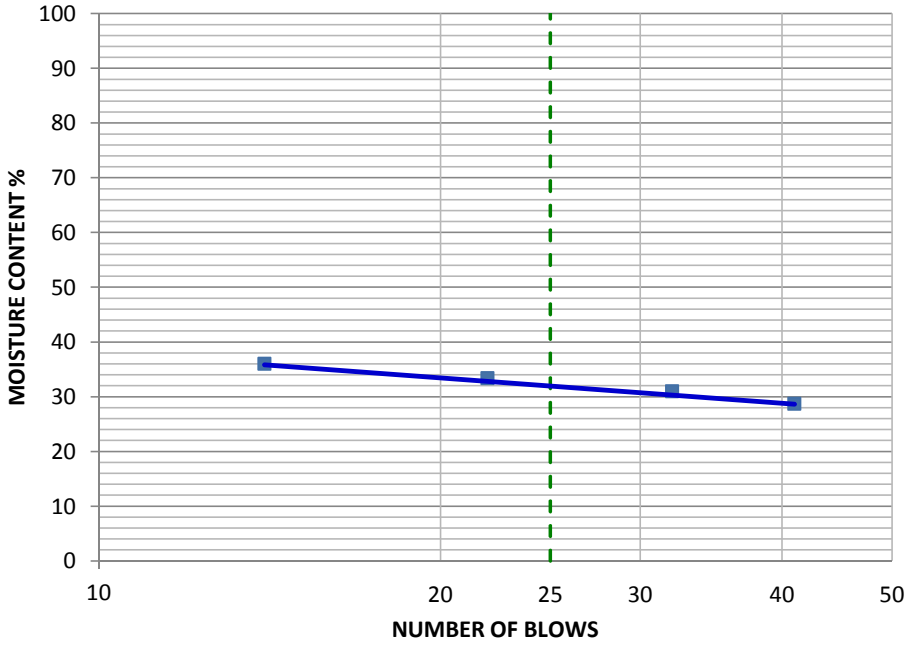
PLASTICITY INDEX TEST

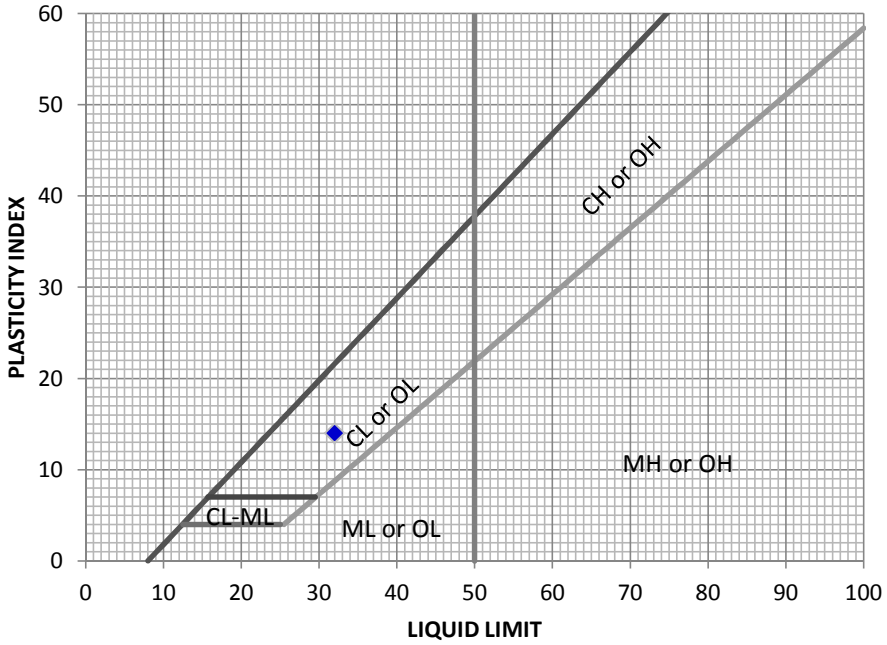
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	04	SP- 11	16.5	Grey Clayey SILT, trace Sand.	ML	25.48	32	18	14

NOOR-ZAMAN ENGINEERING FOUNDATION

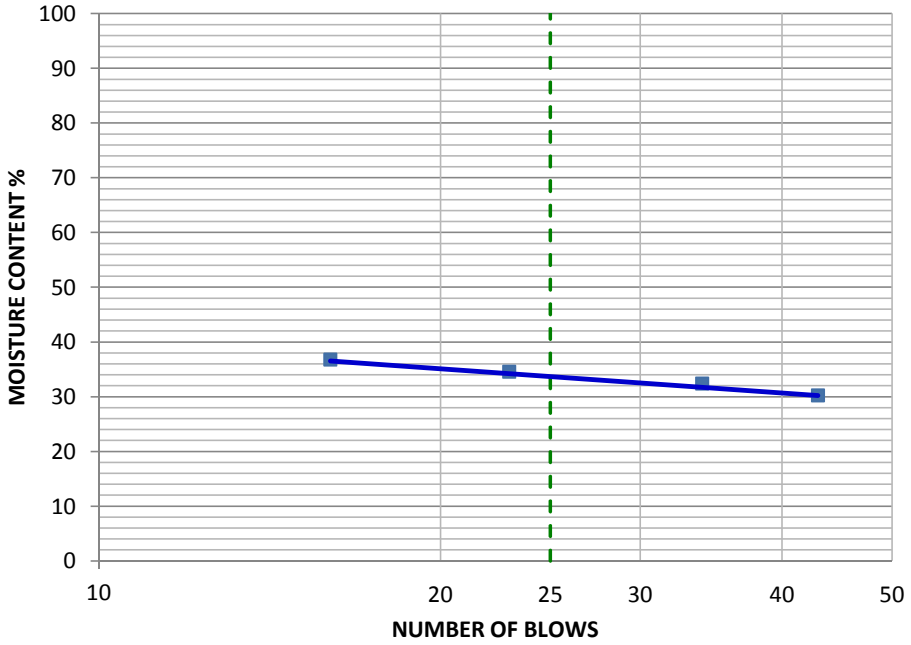
PLASTICITY INDEX TEST

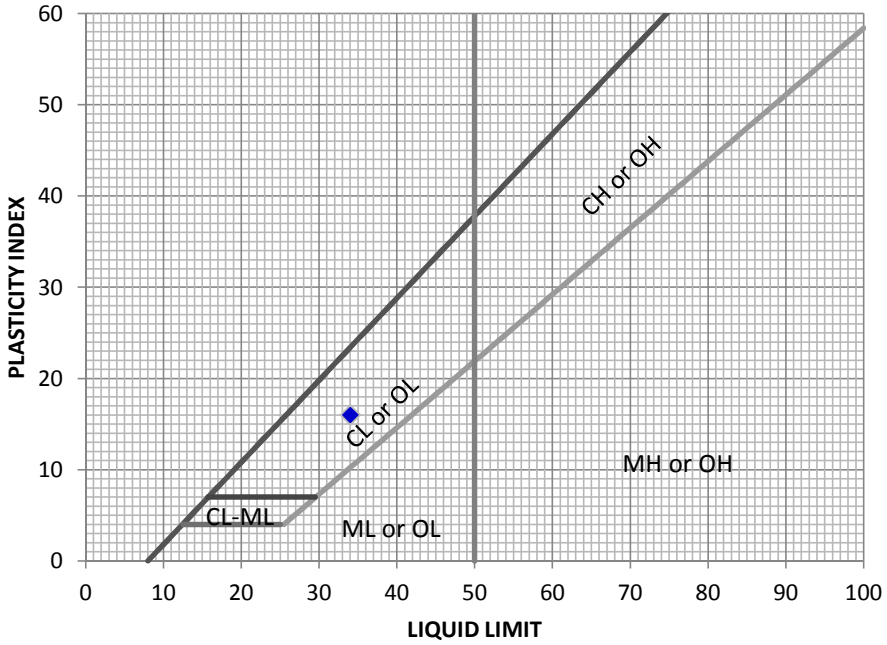
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	05	SP- 3	4.5	Grey Clayey SILT, trace Sand.	ML	28.64	34	18	16

NOOR-ZAMAN ENGINEERING FOUNDATION

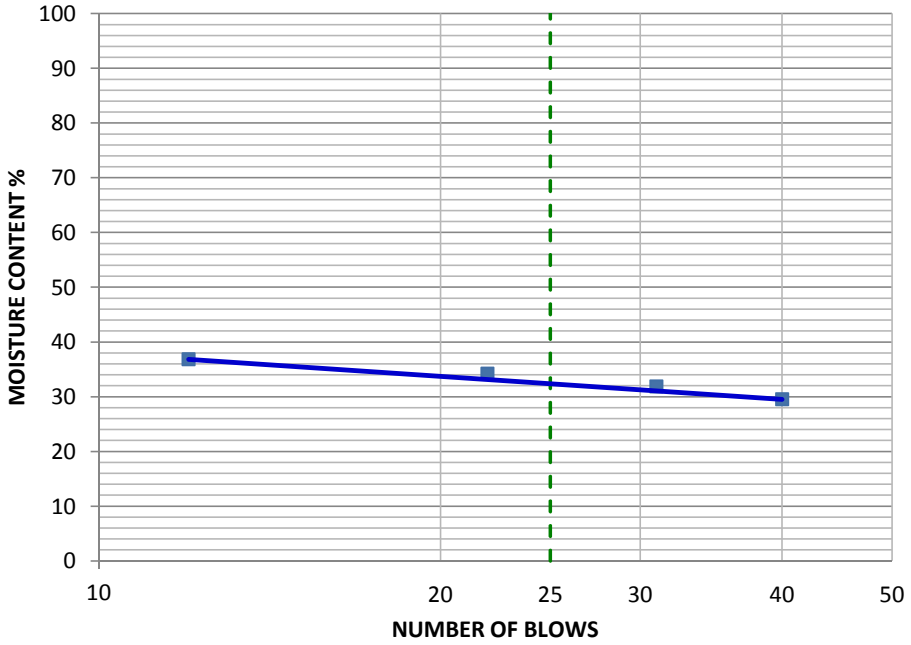
PLASTICITY INDEX TEST

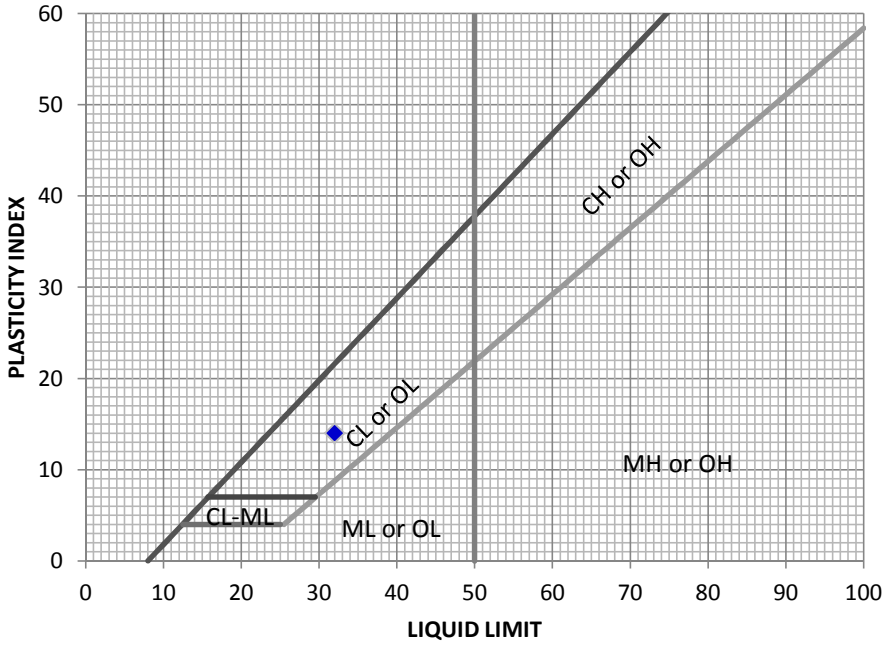
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	06	SP- 1	1.5	Grey Clayey SILT, trace Sand.	ML	29.20	32	18	14

NOOR-ZAMAN ENGINEERING FOUNDATION

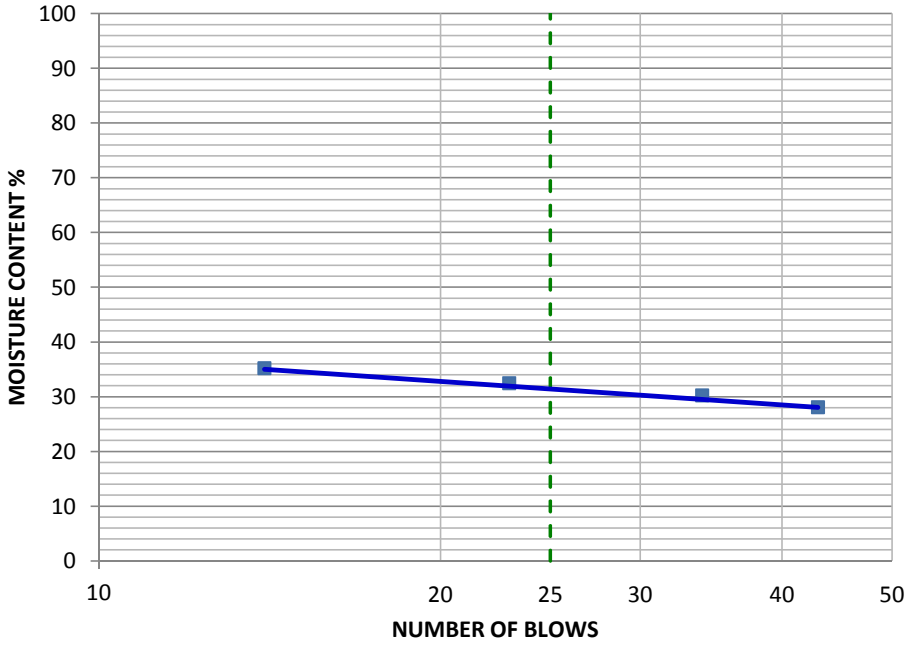
PLASTICITY INDEX TEST

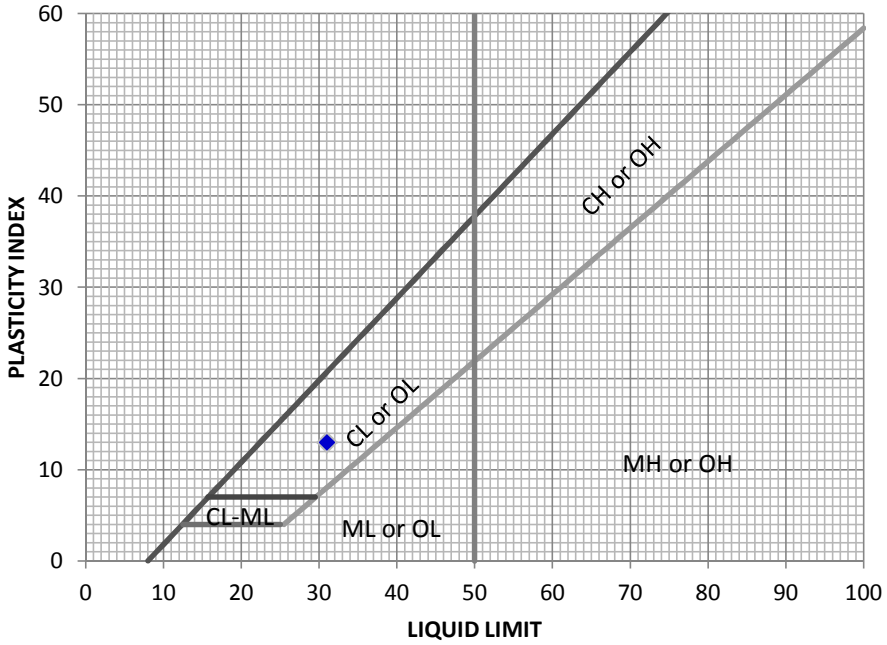
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	06	SP- 10	15.0	Grey Clayey SILT, trace Sand.	ML	27.14	31	18	13

NOOR-ZAMAN ENGINEERING FOUNDATION

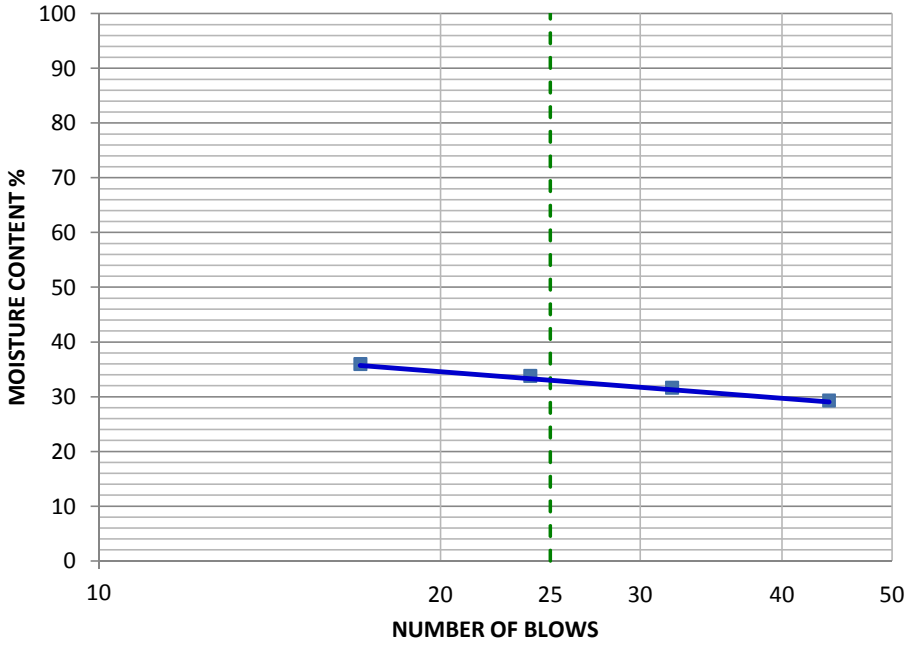
PLASTICITY INDEX TEST

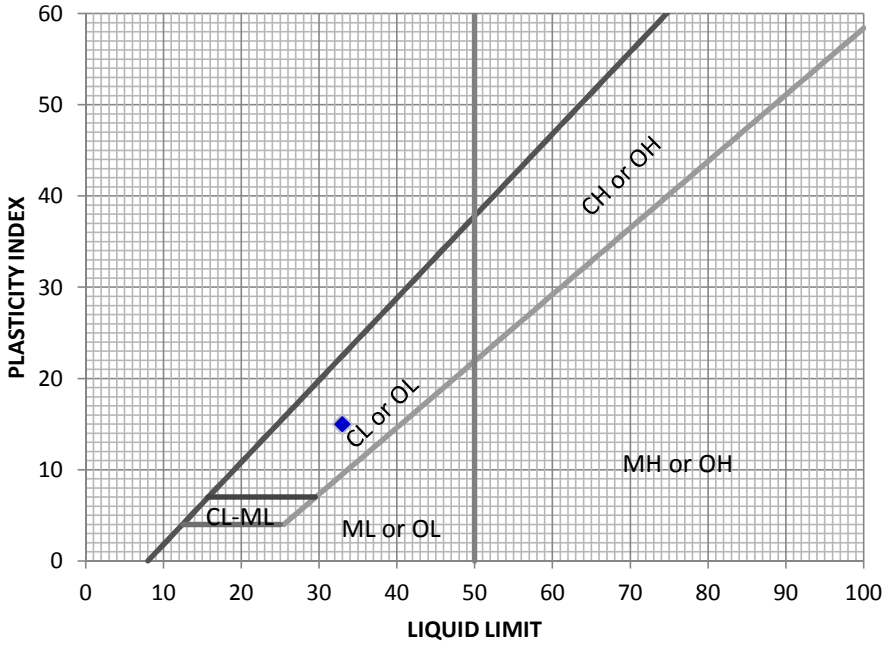
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	07	SP- 2	3.0	Grey Clayey SILT, trace Sand.	ML	27.41	33	18	15

NOOR-ZAMAN ENGINEERING FOUNDATION

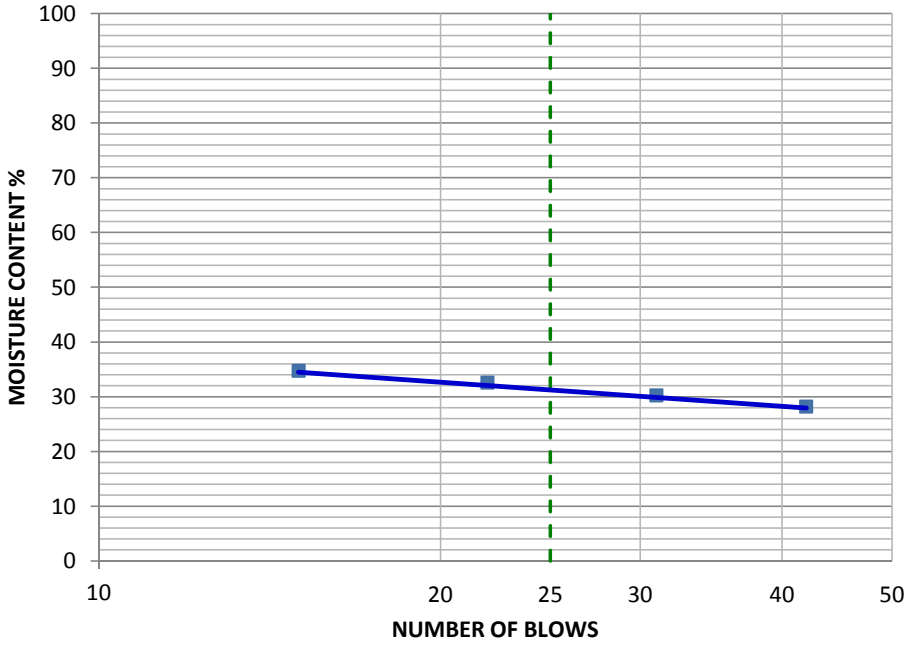
PLASTICITY INDEX TEST

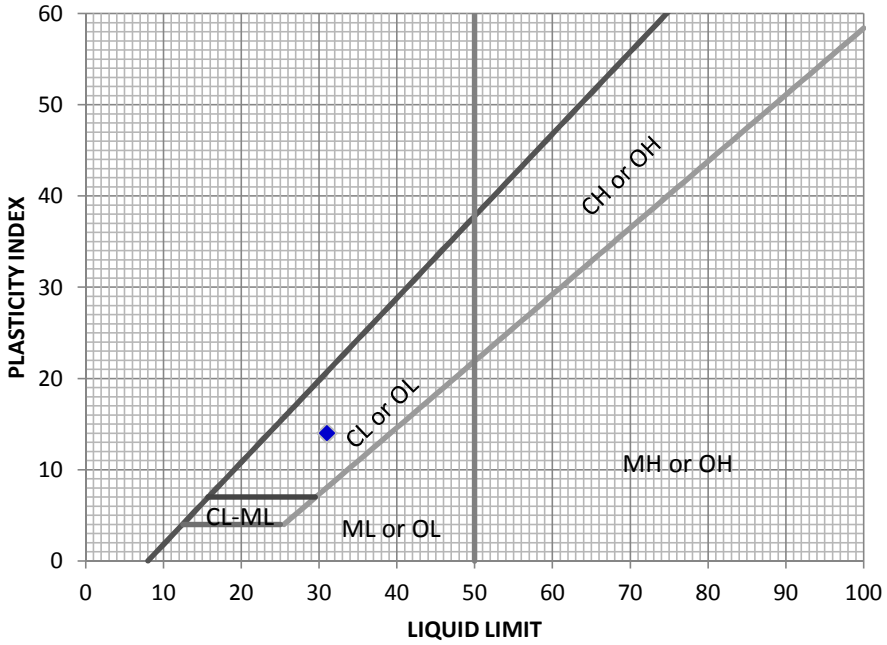
PROJECT: *Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*

LOCATION: *Sonagazi, Bangladesh.*

CLIENT: *Power Cell, Power Division.*

CONSULTANT: *WinDForce Manatement Survices Pvt. Ltd.*





SYMBOL	BORE HOLE NO.	SAMPLE NO.	DEPTH (m)	MATERIAL DESCRIPTION	USCS	NMC %	LL	PL	PI
■	07	SP- 11	16.5	Grey Clayey SILT, trace Sand.	ML	26.55	31	17	14

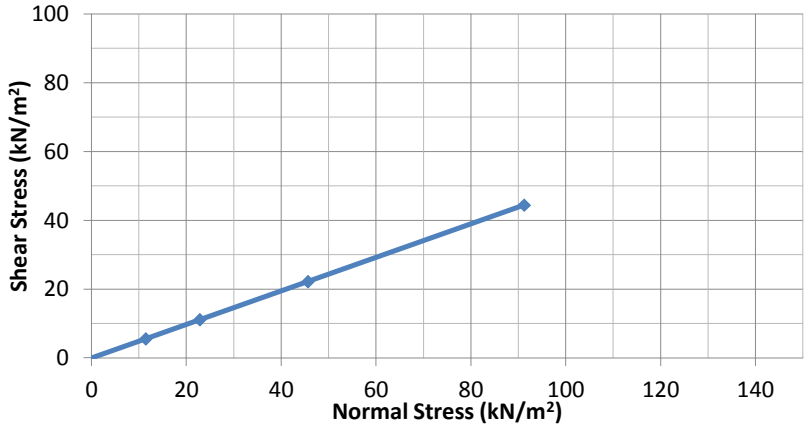
NOOR-ZAMAN ENGINEERING FOUNDATION

Appendix-C6: Direct shear

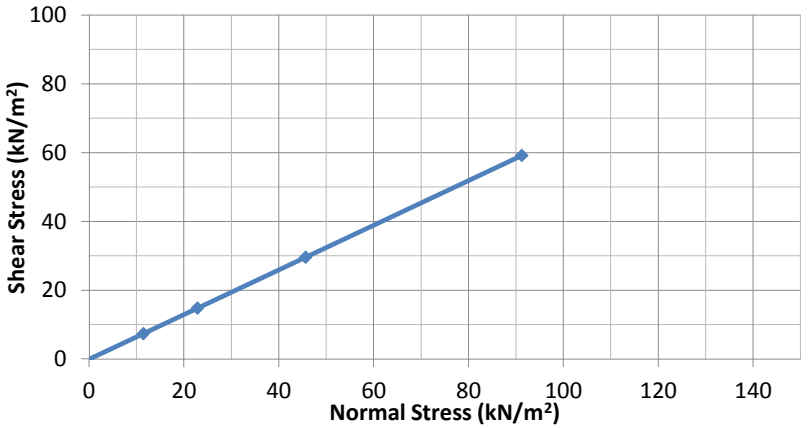
DIRECT SHEAR TEST

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

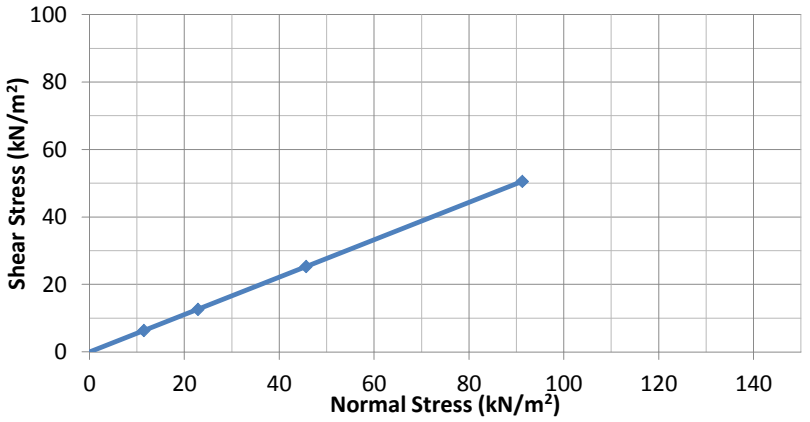
BH - 1	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-08	0.0	26



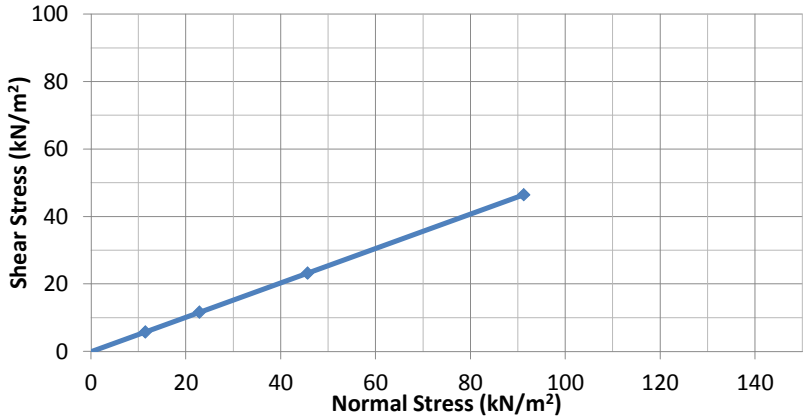
BH - 1	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-11	0.0	33



BH - 1	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-22	0.0	29



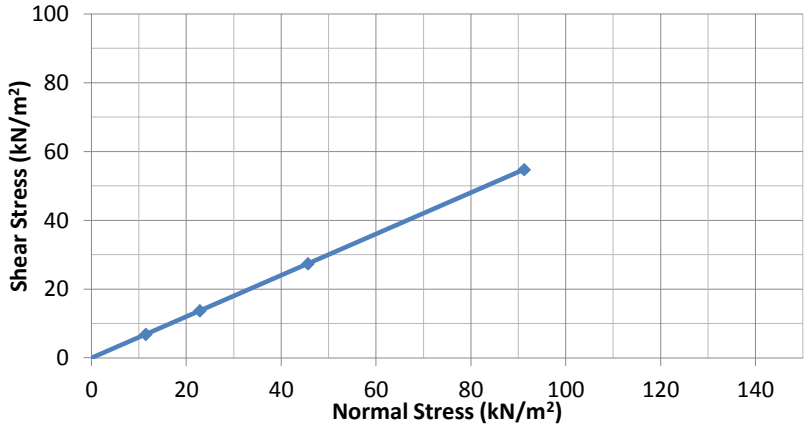
BH - 2	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-09	0.0	27



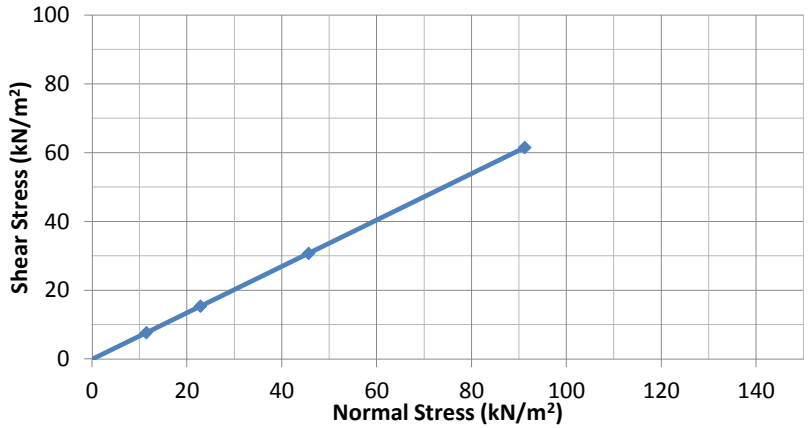
DIRECT SHEAR TEST

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

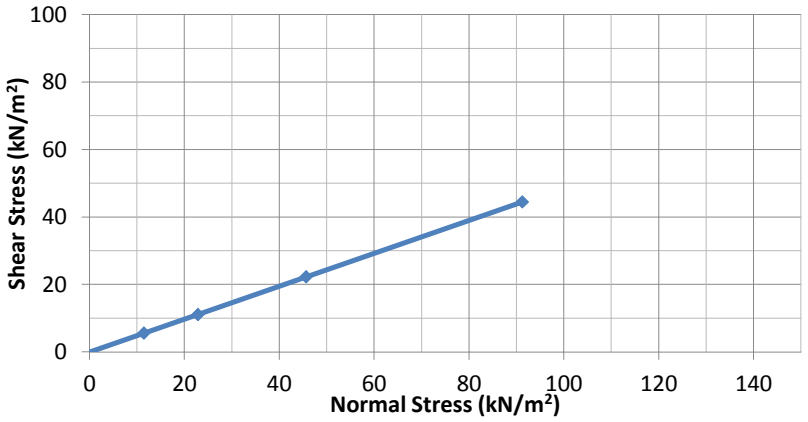
BH - 2	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-13	0.0	31



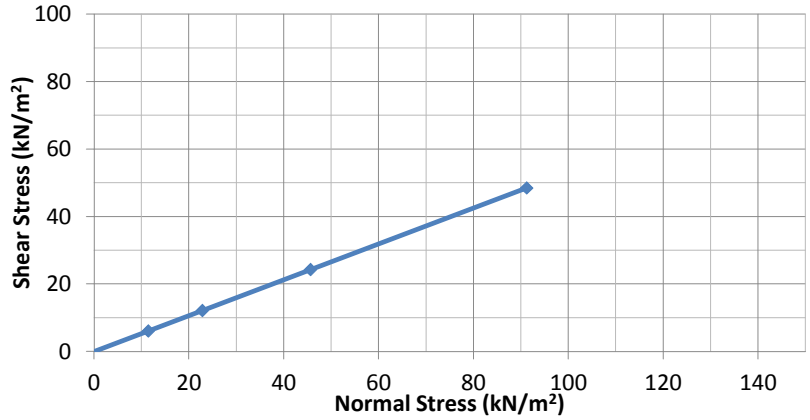
BH - 2	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-20	0.0	34



BH - 3	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-09	0.0	26



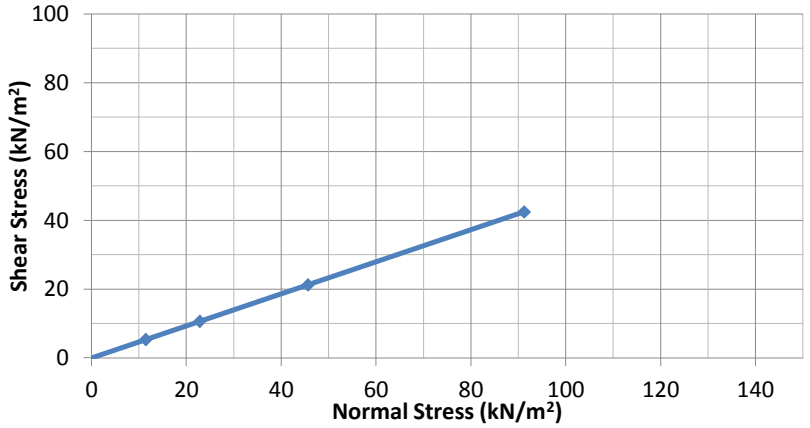
BH - 3	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-13	0.0	28



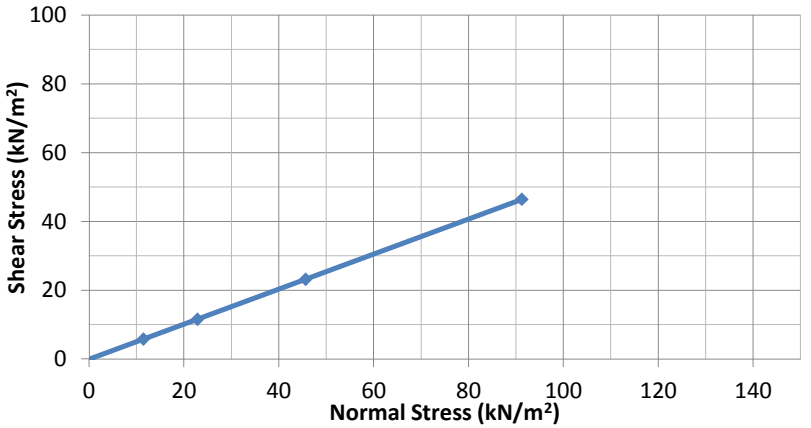
DIRECT SHEAR TEST

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

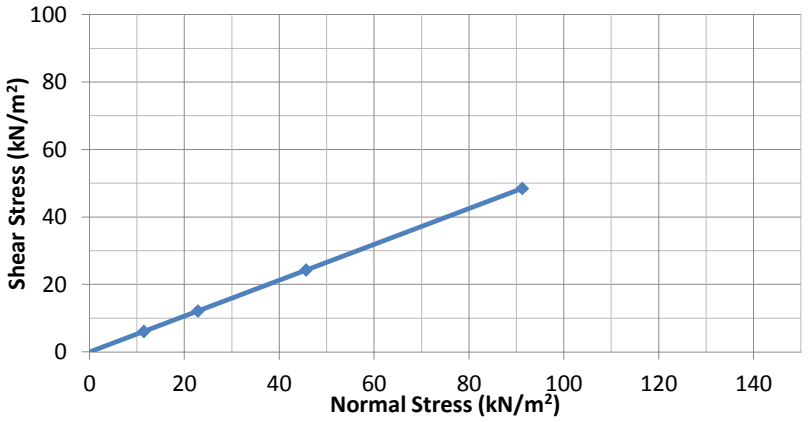
BH - 3	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-17	0.0	25



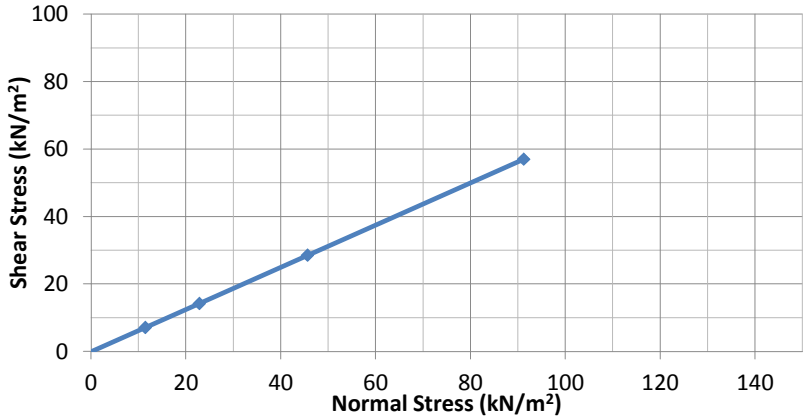
BH - 4	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-08	0.0	27



BH - 4	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-14	0.0	28



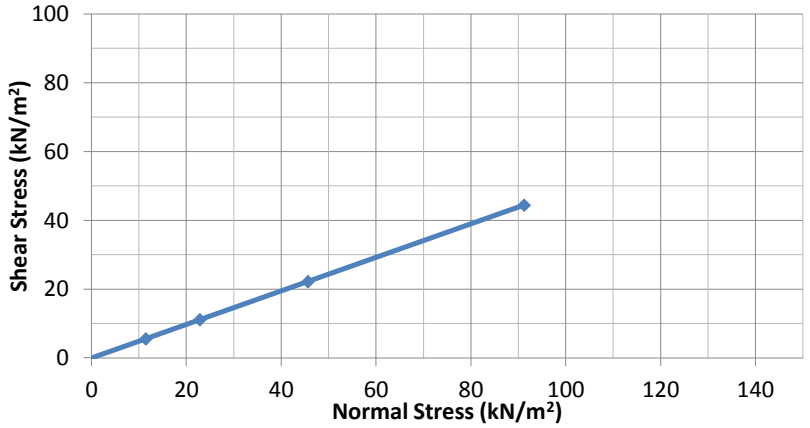
BH - 4	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-20	0.0	32



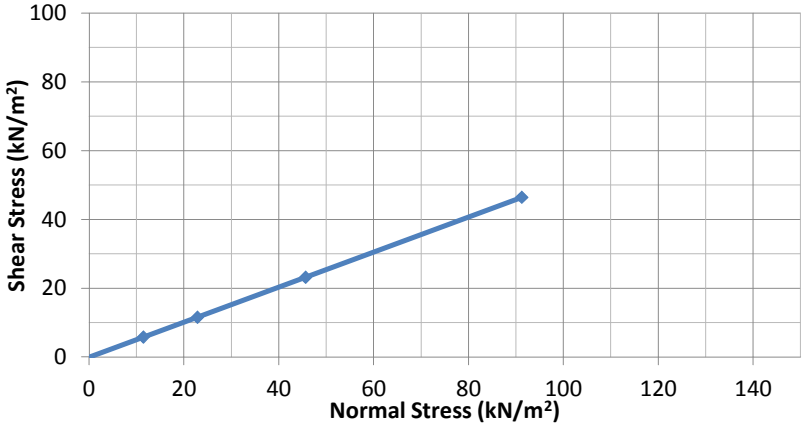
DIRECT SHEAR TEST

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

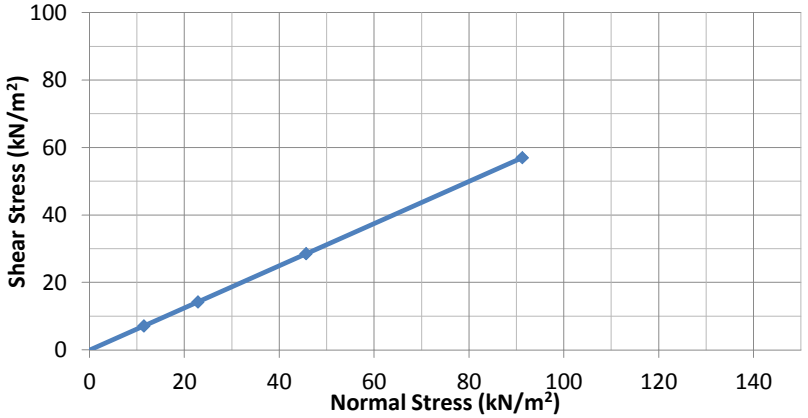
BH - 5	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-10	0.0	26



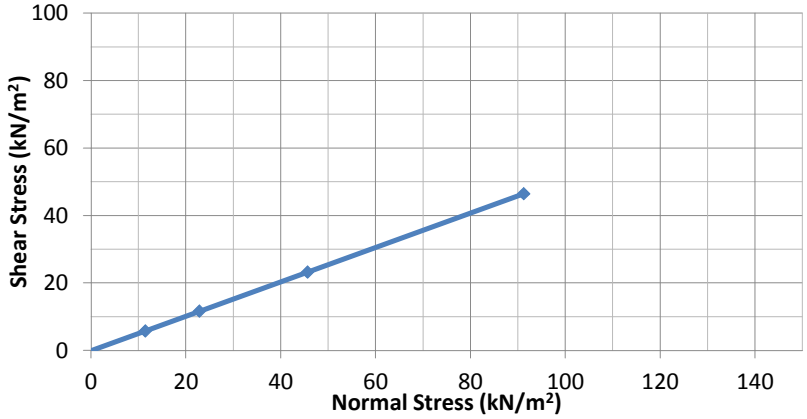
BH - 5	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-13	0.0	27



BH - 5	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-21	0.0	32



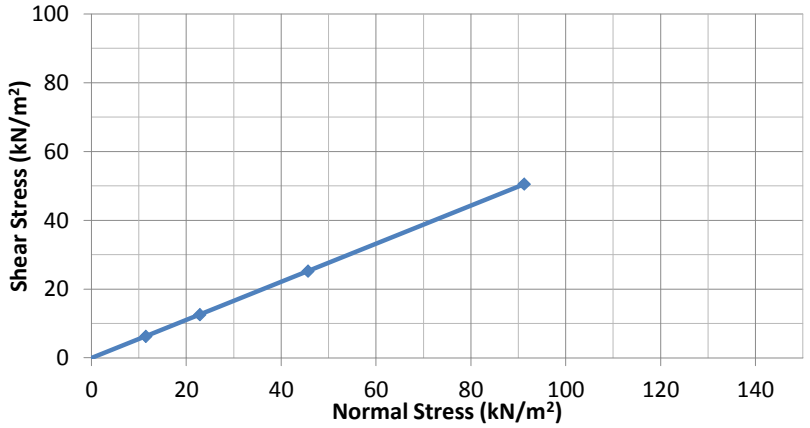
BH - 6	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-07	0.0	27



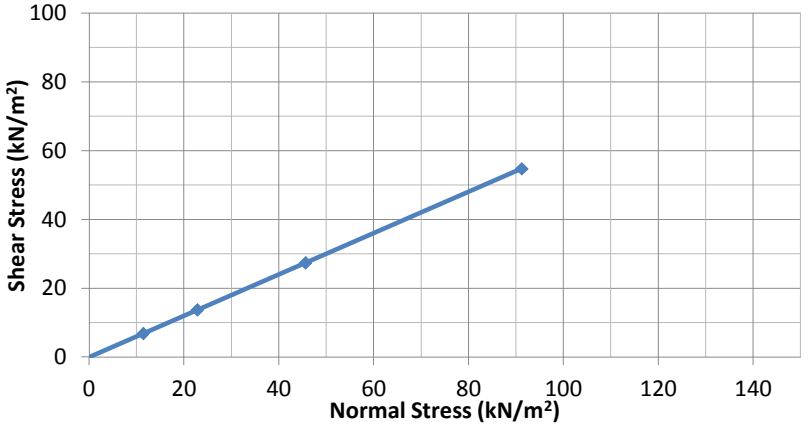
DIRECT SHEAR TEST

PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***
LOCATION:	***Sonagazi, Bangladesh.***
CLIENT:	***Power Cell, Power Division.***
CONSULTANT:	***WinDForce Manatement Survices Pvt. Ltd.***

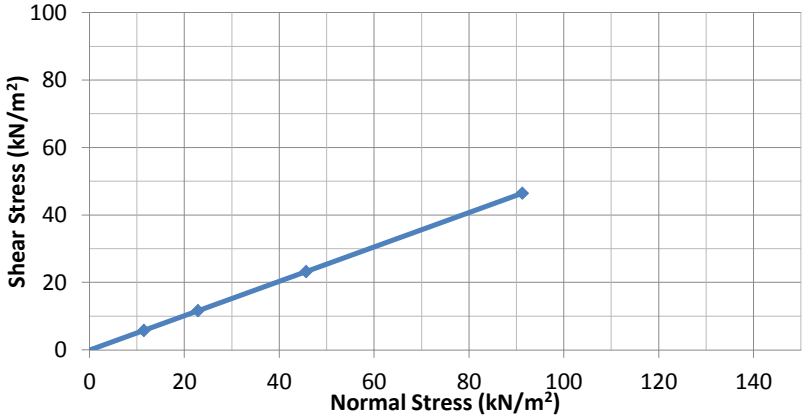
BH - 6	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-14	0.0	29



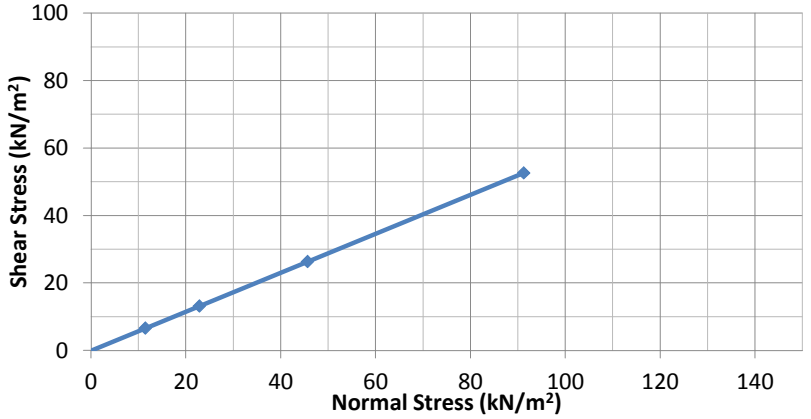
BH - 6	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-22	0.0	31



BH - 7	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-08	0.0	27



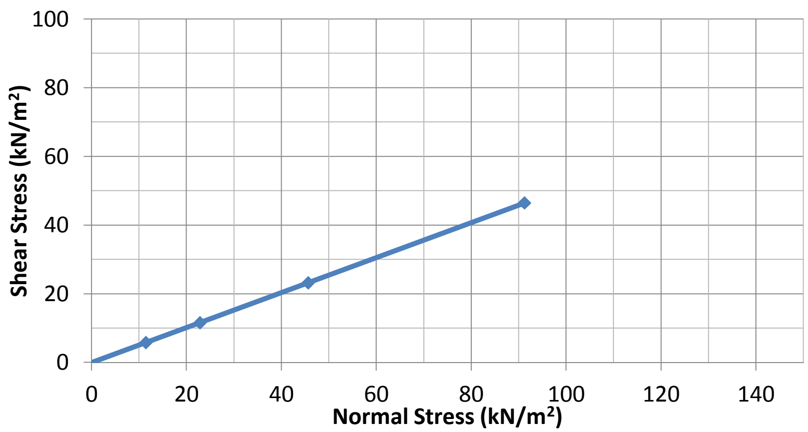
BH - 7	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-17	0.0	30

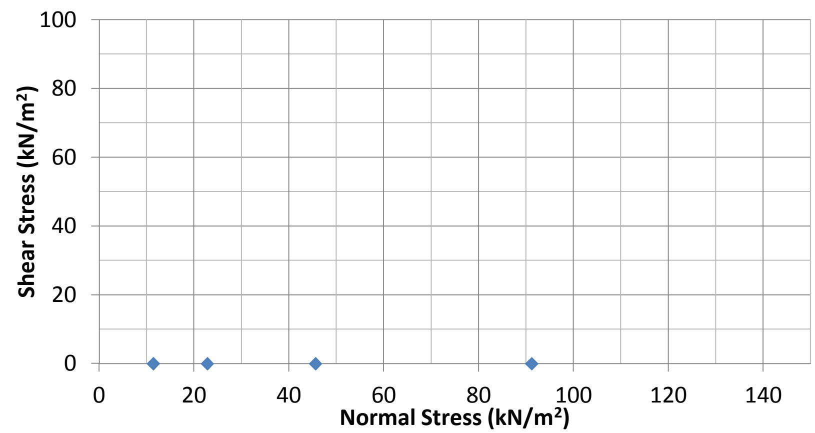


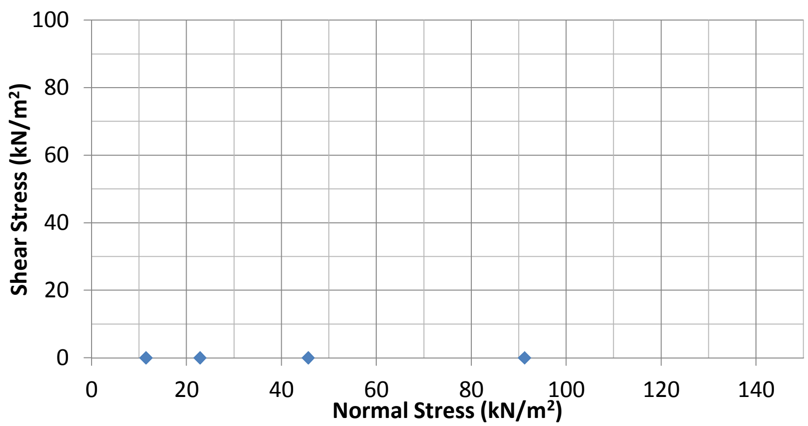
DIRECT SHEAR TEST

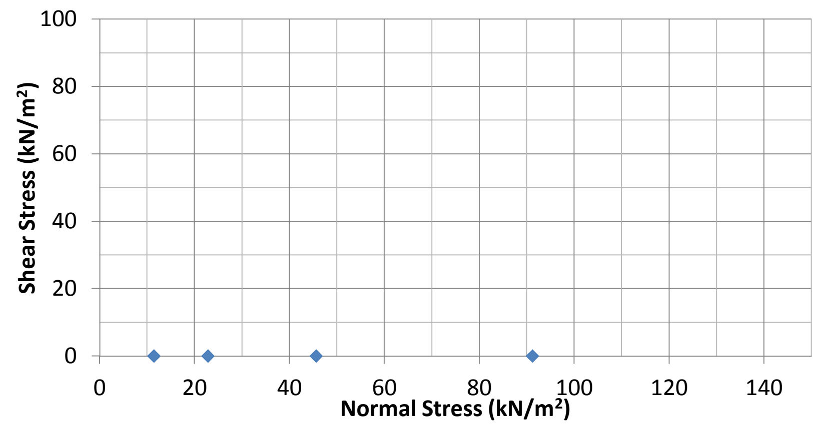
PROJECT:	***Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.***		
LOCATION:	***Sonagazi, Bangladesh.***		
CLIENT:	***Power Cell, Power Division.***	**CONSULTANT:**	***WinDForce Manatement Survices Pvt. Ltd.***

BH - 7	COHESION (kN/m^2)	FRICTION ANGLE (deg)
SP-23	0.0	27









APPENDIX-D: Summary Sheet for test results

SUMMERY SHEET OF TEST RESULTS

CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Ltd.*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
LOCATION:	*Sonagazi, Bangladesh.*

B.H. NO.	Sample	Depth (m)	Atterberg Limit			Particle Size Distribution with Hydrometer			SPECIFIC GRAVITY	Natural Moisture Content (%)	Practical Size Distribution				Unit Weight		Unconfined Compression		Direct Shear		Consolidation Test		
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sand (%)	Silt (%)	Clay (%)			Fine (%)	Medium (%)	Coarse (%)	Silt & Clay (%)	Wet (KN / m3)	Dry (KN / m3)	Compressive Strength (kPa)	Strain Failure (%)	Cohesion C (kPa)	Angle of Friction (j)	e_o	C_c	$P_{c\ (Kpa)}$
01	SP- 01	1.5	31.0	19.0	12.0	6.0	86.0	8.0	2.57	26.46													
	SP- 06	9.0								23.65	59.88	1.64	0.00	38.48									
	SP- 08	12.0								27.32	25.99	1.15	0.00	72.86					0.0	26.0			
	SP- 11	16.5								22.48	62.42	1.90	0.00	35.68					0.0	33.0			
	SP- 12	18.0								19.99	81.47	3.75	0.00	14.78									
	SP- 16	24.0	33.0	18.0	15.0	6.0	84.0	10.0	2.60	20.10													
	SP- 22	33.0								22.75	40.77	1.15	0.00	58.08					0.0	29.0			
	SP- 27	40.5								19.88	71.64	2.40	0.00	25.96									
02	SP- 02	3.0	34.0	19.0	15.0	5.0	84.0	11.0	2.56	30.92													
	SP- 04	6.0								24.77	40.87	0.94	0.00	58.19									
	SP- 09	13.5								22.84	59.53	1.58	0.00	38.89					0.0	27.0			
	SP- 12	18.0								19.46	75.70	2.25	0.00	22.05									
	SP- 13	19.5								30.44	28.98	0.64	0.00	70.38					0.0	31.0			
	SP- 15	22.5	32.0	18.0	14.0	6.0	83.0	11.0	2.59	29.72													
	SP- 17	25.5				12.0	80.0	8.0	2.60	28.36													
	SP- 20	30.0								23.15	40.55	1.16	0.00	58.29					0.0	34.0			
	SP- 23	34.5								20.38	57.87	1.91	0.00	40.22									
	SP- 28	42.0								20.44	72.96	2.39	0.00	24.65									

SUMMERY SHEET OF TEST RESULTS

CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Ltd.*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
LOCATION:	*Sonagazi, Bangladesh.*

B.H. NO.	Sample	Depth (m)	Atterberg Limit			Particle Size Distribution with Hydrometer			SPECIFIC GRAVITY	Natural Moisture Content (%)	Practical Size Distribution				Unit Weight		Unconfined Compression		Direct Shear		Consolidation Test		
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sand (%)	Silt (%)	Clay (%)			Fine (%)	Medium (%)	Coarse (%)	Silt & Clay (%)	Wet (KN / m3)	Dry (KN / m3)	Compressive Strength (kPa)	Strain Failure (%)	Cohesion C (kPa)	Angle of Friction (j)	e_o	C_c	$P_{c\ (kpa)}$
03	SP- 03	4.5	33.0	19.0	14.0	6.0	81.0	13.0	2.60	29.34													
	SP- 06	9.0								23.19	58.24	1.31	0.00	40.45									
	SP- 09	13.5								24.68	44.24	0.96	0.00	54.80					0.0	26.0			
	SP- 13	19.5								22.14	66.39	1.36	0.00	32.25					0.0	28.0			
	SP- 15	22.5	32.0	18.0	14.0	6.0	80.0	14.0	2.59	27.36													
	SP- 17	25.5								21.36	63.09	2.37	0.00	34.54					0.0	25.0			
	SP- 19	28.5								19.36	77.19	3.59	0.00	19.22									
	SP- 24	36.0								19.83	72.53	1.42	0.00	26.05									
04	SP- 02	3.0	34.0	18.0	16.0	4.0	85.0	11.0	2.55	28.31													
	SP- 05	7.5								24.61	42.71	0.85	0.00	56.44									
	SP- 08	12.0								22.34	64.61	1.33	0.00	34.06					0.0	27.0			
	SP- 11	16.5	32.0	18.0	14.0	5.0	84.0	11.0	2.58	25.48													
	SP- 12	18.0								21.85	65.70	2.23	0.00	32.07									
	SP- 14	21.0								24.19	41.29	1.13	0.00	57.58					0.0	28.0			
	SP- 16	24.0				6.0	85.0	9.0	2.58	26.74													
	SP- 20	30.0								20.33	75.14	3.19	0.00	21.67					0.0	32.0			
	SP- 23	34.5								24.89	43.54	0.98	0.00	55.48									
	SP- 27	40.5								18.64	73.88	3.49	0.00	22.63									

SUMMERY SHEET OF TEST RESULTS

CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Ltd.*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
LOCATION:	*Sonagazi, Bangladesh.*

B.H. NO.	Sample	Depth (m)	Atterberg Limit			Particle Size Distribution with Hydrometer			SPECIFIC GRAVITY	Natural Moisture Content (%)	Practical Size Distribution				Unit Weight		Unconfined Compression		Direct Shear		Consolidation Test		
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sand (%)	Silt (%)	Clay (%)			Fine (%)	Medium (%)	Coarse (%)	Silt & Clay (%)	Wet (KN / m3)	Dry (KN / m3)	Compressive Strength (kPa)	Strain Failure (%)	Cohesion C (kPa)	Angle of Friction (j)	e_o	C_c	$P_{c\ (Kpa)}$
05	SP- 03	4.5	34.0	18.0	16.0	4.0	82.0	14.0	2.54	28.64													
	SP- 05	7.5								25.13	43.54	1.09	0.00	55.37									
	SP- 10	15.0								21.54	64.01	2.57	0.00	33.42					0.0	26.0			
	SP- 13	19.5								19.42	82.27	3.59	0.00	14.14					0.0	27.0			
	SP- 17	25.5				6.0	83.0	11.0	2.60	26.38													
	SP- 21	31.5								20.33	69.22	2.63	0.00	28.15					0.0	32.0			
	SP- 28	42.0								18.96	75.44	3.21	0.00	21.35									
06	SP- 01	1.5	32.0	18.0	14.0	4.0	79.0	17.0	2.55	29.20													
	SP- 04	6.0								23.89	40.98	1.21	0.00	57.81									
	SP- 07	10.5								20.45	63.69	1.59	0.00	34.72					0.0	27.0			
	SP- 10	15.0	31.0	18.0	13.0	5.0	85.0	10.0	2.57	27.14													
	SP- 14	21.0								21.28	71.45	2.13	0.00	26.42					0.0	29.0			
	SP- 16	24.0				6.0	86.0	8.0	2.56	25.64													
	SP- 22	33.0								19.84	41.45	1.00	0.00	57.55					0.0	31.0			
	SP- 24	36.0								20.44	77.04	3.51	0.00	19.45									

SUMMERY SHEET OF TEST RESULTS

CLIENT:	*Power Cell, Power Division.* **CONSULTANT:** *WinDForce Manatement Services Pvt. Ltd.*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*
LOCATION:	*Sonagazi, Bangladesh.*

B.H. NO.	Sample	Depth (m)	Atterberg Limit			Particle Size Distribution with Hydrometer			SPECIFIC GRAVITY	Natural Moisture Content (%)	Practical Size Distribution				Unit Weight		Unconfined Compression		Direct Shear		Consolidation Test		
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sand (%)	Silt (%)	Clay (%)			Fine (%)	Medium (%)	Coarse (%)	Silt & Clay (%)	Wet (KN / m3)	Dry (KN / m3)	Compressive Strength (kPa)	Strain Failure (%)	Cohesion C (kPa)	Angle of Friction (j)	e_o	C_c	P_c (Kpa)
07	SP- 02	3.0	33.0	18.0	15.0	5.0	81.0	14.0	2.58	27.41													
	SP- 06	9.0								25.36	71.45	2.13	0.00	26.42									
	SP- 08	12.0								23.19	65.14	2.03	0.00	32.83					0.0	27.0			
	SP- 11	16.5	31.0	17.0	14.0	6.0	83.0	11.0	2.60	26.55													
	SP- 13	19.5								19.88	68.80	3.06	0.00	28.14									
	SP- 15	22.5				5.0	86.0	9.0	2.57	27.41													
	SP- 17	25.5								22.34	74.32	3.89	0.00	21.79					0.0	30.0			
	SP- 23	34.5								20.36	65.52	1.42	0.00	33.06					0.0	27.0			
	SP- 28	42.0								18.65	81.54	3.92	0.00	14.54									

APPENDIX-E: Pile Capacity (Bored Pile)

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*01*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	1.00 m
alpha	=	0.45
Ab	=	8.45 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	5.0	30.0	5	5	C	0.31	-	-	-	-	50.72	2.38	7.92	10.29
3.0	4.0	30.0	4	4	C	0.25	-	-	-	-	50.72	1.90	6.33	10.61
4.5	8.0	30.0	8	8	S	-	26.4	0.36	0.2927	6.25	50.72	1.25	5.15	10.68
6.0	9.0	30.0	9	9	S	-	26.7	0.36	0.4098	6.25	50.72	1.77	7.21	14.50
7.5	11.0	30.0	11	11	S	-	27.3	0.37	0.5269	9	50.72	2.33	13.35	22.97
9.0	17.0	30.0	17	16	S	-	28.8	0.40	0.6440	9	50.72	3.02	16.32	28.95
10.5	19.0	30.0	19	17	S	-	29.1	0.40	0.7611	12.5	50.72	3.61	26.78	43.02
12.0	9.0	30.0	9	9	S	-	26.7	0.36	0.8782	6.25	50.72	3.79	15.45	35.48
13.5	10.0	30.0	10	10	S	-	27	0.37	0.9953	9	50.72	4.34	25.22	49.59
15.0	10.0	30.0	10	10	S	-	27	0.37	1.1124	9	50.72	4.85	28.18	57.41
16.5	29.0	30.0	29	22	S	-	30.6	0.42	1.2295	14	50.72	6.16	48.46	83.84
18.0	47.0	30.0	47	31	S	-	33.3	0.47	1.3466	18.75	50.72	7.42	71.08	113.88
19.5	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	61.33
21.0	13.0	30.0	13	13	C	0.81	-	-	-	-	50.72	6.18	20.59	73.85
22.5	16.0	30.0	16	15	C	0.94	-	-	-	-	50.72	7.13	23.75	84.15
24.0	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	78.92
25.5	11.0	30.0	11	11	C	0.69	-	-	-	-	50.72	5.23	17.42	87.32
27.0	21.0	30.0	21	18	S	-	29.4	0.40	2.0492	12.5	50.72	9.82	72.11	151.83
28.5	16.0	30.0	16	15	S	-	28.5	0.39	2.1663	9	50.72	10.03	54.88	144.63
30.0	27.0	30.0	27	21	S	-	30.3	0.42	2.2834	14	50.72	11.31	89.99	191.05
31.5	22.0	30.0	22	18	S	-	29.4	0.40	2.4005	12.5	50.72	11.50	84.47	197.03
33.0	20.0	30.0	20	17	S	-	29.1	0.40	2.5176	12.5	50.72	11.92	88.59	213.07
34.5	15.0	30.0	15	15	S	-	28.5	0.39	2.6347	9	50.72	12.20	66.75	203.43
36.0	30.0	30.0	30	22	S	-	30.6	0.42	2.7518	14	50.72	13.78	108.45	258.91
37.5	28.0	30.0	28	21	S	-	30.3	0.42	2.8689	14	50.72	14.21	113.07	277.74
39.0	29.0	30.0	29	22	S	-	30.6	0.42	2.9859	14	50.72	14.95	117.68	297.31
40.5	37.0	30.0	37	26	S	-	31.8	0.44	3.1030	18.75	50.72	16.23	163.79	359.64
42.0	40.0	30.0	40	27	S	-	32.1	0.45	3.2201	18.75	50.72	17.02	169.97	382.84
43.5	46.0	30.0	46	30	S	-	33	0.46	3.3372	18.75	50.72	18.20	176.15	407.22

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*02*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia = 1.00 m
alpha = 0.45
Ab = 8.45 Sft
Ks = 0.7
Nc = 9
FoS = 3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	6.0	30.0	6	6	C	0.38	-	-	-	-	50.72	2.85	9.50	12.35
3.0	5.0	30.0	5	5	C	0.31	-	-	-	-	50.72	2.38	7.92	13.15
4.5	8.0	30.0	8	8	S	-	26.4	0.36	0.2927	6.25	50.72	1.25	5.15	11.63
6.0	10.0	30.0	10	10	S	-	27	0.37	0.4098	9	50.72	1.79	10.38	18.65
7.5	9.0	30.0	9	9	S	-	26.7	0.36	0.5269	6.25	50.72	2.27	9.27	19.81
9.0	17.0	30.0	17	16	S	-	28.8	0.40	0.6440	9	50.72	3.02	16.32	29.87
10.5	18.0	30.0	18	16	S	-	28.8	0.40	0.7611	9	50.72	3.56	19.28	36.40
12.0	10.0	30.0	10	10	S	-	27	0.37	0.8782	9	50.72	3.83	22.25	43.20
13.5	11.0	30.0	11	11	S	-	27.3	0.37	0.9953	9	50.72	4.40	25.22	50.56
15.0	10.0	30.0	10	10	S	-	27	0.37	1.1124	9	50.72	4.85	28.18	58.38
16.5	7.0	30.0	7	7	S	-	26.1	0.36	1.2295	6.25	50.72	5.17	21.63	57.00
18.0	52.0	30.0	52	33	S	-	33.9	0.48	1.3466	18.75	50.72	7.57	71.08	114.02
19.5	25.0	30.0	25	20	C	1.25	-	-	-	-	50.72	9.51	31.67	84.12
21.0	13.0	30.0	13	13	C	0.81	-	-	-	-	50.72	6.18	20.59	79.22
22.5	18.0	30.0	18	16	C	1.00	-	-	-	-	50.72	7.61	25.34	91.58
24.0	10.0	30.0	10	10	C	0.63	-	-	-	-	50.72	4.75	15.84	86.83
25.5	12.0	30.0	12	12	C	0.75	-	-	-	-	50.72	5.71	19.00	95.70
27.0	20.0	30.0	20	17	S	-	29.1	0.40	2.0492	12.5	50.72	9.71	72.11	158.51
28.5	17.0	30.0	17	16	S	-	28.8	0.40	2.1663	9	50.72	10.14	54.88	151.44
30.0	32.0	30.0	32	23	S	-	30.9	0.43	2.2834	14	50.72	11.56	89.99	198.10
31.5	27.0	30.0	27	21	S	-	30.3	0.42	2.4005	14	50.72	11.89	94.61	214.61
33.0	20.0	30.0	20	17	S	-	29.1	0.40	2.5176	12.5	50.72	11.92	88.59	220.52
34.5	17.0	30.0	17	16	S	-	28.8	0.40	2.6347	9	50.72	12.34	66.75	211.02
36.0	18.0	30.0	18	16	S	-	28.8	0.40	2.7518	9	50.72	12.89	69.72	226.87
37.5	22.0	30.0	22	18	S	-	29.4	0.40	2.8689	12.5	50.72	13.74	100.95	271.85
39.0	27.0	30.0	27	21	S	-	30.3	0.42	2.9859	14	50.72	14.79	117.68	303.37
40.5	35.0	30.0	35	25	S	-	31.5	0.44	3.1030	18.75	50.72	16.05	163.79	365.53
42.0	42.0	30.0	42	28	S	-	32.4	0.45	3.2201	18.75	50.72	17.20	169.97	388.91
43.5	49.0	30.0	49	32	S	-	33.6	0.47	3.3372	18.75	50.72	18.57	176.15	413.66

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*03*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	1.00 m
alpha	=	0.45
Ab	=	8.45 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	4.0	30.0	4	4	C	0.25	-	-	-	-	50.72	1.90	6.33	8.24
3.0	7.0	30.0	7	7	C	0.44	-	-	-	-	50.72	3.33	11.08	16.31
4.5	10.0	30.0	10	10	C	0.63	-	-	-	-	50.72	4.75	15.84	25.82
6.0	8.0	30.0	8	8	C	0.50	-	-	-	-	50.72	3.80	12.67	26.46
7.5	8.0	30.0	8	8	S	-	26.4	0.36	0.5269	6.25	50.72	2.24	9.27	25.30
9.0	15.0	30.0	15	15	S	-	28.5	0.39	0.6440	9	50.72	2.98	16.32	35.33
10.5	16.0	30.0	16	15	S	-	28.5	0.39	0.7611	9	50.72	3.52	19.28	41.82
12.0	9.0	30.0	9	9	S	-	26.7	0.36	0.8782	6.25	50.72	3.79	15.45	41.78
13.5	10.0	30.0	10	10	S	-	27	0.37	0.9953	9	50.72	4.34	25.22	55.88
15.0	6.0	30.0	6	6	S	-	25.8	0.35	1.1124	6.25	50.72	4.62	19.57	54.86
16.5	9.0	30.0	9	9	S	-	26.7	0.36	1.2295	6.25	50.72	5.30	21.63	62.22
18.0	27.0	30.0	27	21	S	-	30.3	0.42	1.3466	14	50.72	6.67	53.07	100.33
19.5	13.0	30.0	13	13	S	-	27.9	0.38	1.4637	9	50.72	6.62	37.08	90.96
21.0	14.0	30.0	14	14	C	0.88	-	-	-	-	50.72	6.66	22.17	82.70
22.5	14.0	30.0	14	14	C	0.88	-	-	-	-	50.72	6.66	22.17	89.36
24.0	9.0	30.0	9	9	S	-	26.7	0.36	1.8150	6.25	50.72	7.82	31.93	106.95
25.5	10.0	30.0	10	10	S	-	27	0.37	1.9321	9	50.72	8.43	48.95	132.40
27.0	20.0	30.0	20	17	S	-	29.1	0.40	2.0492	12.5	50.72	9.71	72.11	165.26
28.5	15.0	30.0	15	15	S	-	28.5	0.39	2.1663	9	50.72	10.03	54.88	158.06
30.0	34.0	30.0	34	24	S	-	31.2	0.43	2.2834	18.75	50.72	11.69	120.52	235.39
31.5	18.0	30.0	18	16	S	-	28.8	0.40	2.4005	9	50.72	11.24	60.82	186.93
33.0	16.0	30.0	16	15	S	-	28.5	0.39	2.5176	9	50.72	11.65	63.79	201.55
34.5	20.0	30.0	20	17	S	-	29.1	0.40	2.6347	12.5	50.72	12.48	92.71	242.95
36.0	18.0	30.0	18	16	S	-	28.8	0.40	2.7518	9	50.72	12.89	69.72	232.85
37.5	17.0	30.0	17	16	S	-	28.8	0.40	2.8689	9	50.72	13.43	72.69	249.25
39.0	22.0	30.0	22	18	S	-	29.4	0.40	2.9859	12.5	50.72	14.30	105.07	295.94
40.5	37.0	30.0	37	26	S	-	31.8	0.44	3.1030	18.75	50.72	16.23	163.79	370.88
42.0	41.0	30.0	41	28	S	-	32.4	0.45	3.2201	18.75	50.72	17.20	169.97	394.26
43.5	44.0	30.0	44	29	S	-	32.7	0.46	3.3372	18.75	50.72	18.01	176.15	418.45

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*04*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	**1.00 m**
alpha	=	**0.45**
Ab	=	**8.45 Sft**
Ks	=	**0.7**
Nc	=	**9**
FoS	=	**3**

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	3.0	30.0	3	3	C	0.19	-	-	-	-	50.72	1.43	4.75	6.18
3.0	4.0	30.0	4	4	C	0.25	-	-	-	-	50.72	1.90	6.33	9.66
4.5	7.0	30.0	7	7	C	0.44	-	-	-	-	50.72	3.33	11.08	17.74
6.0	10.0	30.0	10	10	S	-	27	0.37	0.4098	9	50.72	1.79	10.38	18.83
7.5	16.0	30.0	16	15	S	-	28.5	0.39	0.5269	9	50.72	2.44	13.35	24.23
9.0	9.0	30.0	9	9	S	-	26.7	0.36	0.6440	6.25	50.72	2.78	11.33	24.99
10.5	15.0	30.0	15	15	S	-	28.5	0.39	0.7611	9	50.72	3.52	19.28	36.47
12.0	10.0	30.0	10	10	S	-	27	0.37	0.8782	9	50.72	3.83	22.25	43.27
13.5	11.0	30.0	11	11	S	-	27.3	0.37	0.9953	9	50.72	4.40	25.22	50.63
15.0	7.0	30.0	7	7	C	0.44	-	-	-	-	50.72	3.33	11.08	39.82
16.5	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	47.27
18.0	22.0	30.0	22	18	S	-	29.4	0.40	1.3466	12.5	50.72	6.45	47.39	86.86
19.5	13.0	30.0	13	13	S	-	27.9	0.38	1.4637	9	50.72	6.62	37.08	83.17
21.0	14.0	30.0	14	14	S	-	28.2	0.39	1.5808	9	50.72	7.23	40.05	93.37
22.5	12.0	30.0	12	12	S	-	27.6	0.38	1.6979	9	50.72	7.59	43.02	103.93
24.0	10.0	30.0	10	10	C	0.63	-	-	-	-	50.72	4.75	15.84	81.50
25.5	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	84.20
27.0	18.0	30.0	18	16	S	-	28.8	0.40	2.0492	9	50.72	9.60	51.92	131.46
28.5	14.0	30.0	14	14	S	-	28.2	0.39	2.1663	9	50.72	9.91	54.88	144.34
30.0	31.0	30.0	31	23	S	-	30.9	0.43	2.2834	14	50.72	11.56	89.99	191.01
31.5	15.0	30.0	15	15	S	-	28.5	0.39	2.4005	9	50.72	11.11	60.82	172.95
33.0	12.0	30.0	12	12	S	-	27.6	0.38	2.5176	9	50.72	11.25	63.79	187.16
34.5	7.0	30.0	7	7	S	-	26.1	0.36	2.6347	6.25	50.72	11.08	46.36	180.82
36.0	19.0	30.0	19	17	S	-	29.1	0.40	2.7518	12.5	50.72	13.03	96.83	244.33
37.5	20.0	30.0	20	17	S	-	29.1	0.40	2.8689	12.5	50.72	13.59	100.95	262.04
39.0	22.0	30.0	22	18	S	-	29.4	0.40	2.9859	12.5	50.72	14.30	105.07	280.46
40.5	37.0	30.0	37	26	S	-	31.8	0.44	3.1030	18.75	50.72	16.23	163.79	355.40
42.0	41.0	30.0	41	28	S	-	32.4	0.45	3.2201	18.75	50.72	17.20	169.97	378.78
43.5	47.0	30.0	47	31	S	-	33.3	0.47	3.3372	18.75	50.72	18.38	176.15	403.35

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*05*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	**1.00 m**
alpha	=	**0.45**
Ab	=	**8.45 Sft**
Ks	=	**0.7**
Nc	=	**9**
FoS	=	**3**

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	2.0	30.0	2	2	C	0.13	-	-	-	-	50.72	0.95	3.17	4.12
3.0	5.0	30.0	5	5	C	0.31	-	-	-	-	50.72	2.38	7.92	11.25
4.5	8.0	30.0	8	8	C	0.50	-	-	-	-	50.72	3.80	12.67	19.80
6.0	11.0	30.0	11	11	S	-	27.3	0.37	0.4098	9	50.72	1.81	10.38	19.33
7.5	12.0	30.0	12	12	S	-	27.6	0.38	0.5269	9	50.72	2.36	13.35	24.65
9.0	10.0	30.0	10	10	S	-	27	0.37	0.6440	9	50.72	2.81	16.32	30.42
10.5	16.0	30.0	16	15	S	-	28.5	0.39	0.7611	9	50.72	3.52	19.28	36.91
12.0	10.0	30.0	10	10	S	-	27	0.37	0.8782	9	50.72	3.83	22.25	43.71
13.5	9.0	30.0	9	9	S	-	26.7	0.36	0.9953	6.25	50.72	4.29	17.51	43.27
15.0	12.0	30.0	12	12	S	-	27.6	0.38	1.1124	9	50.72	4.97	28.18	58.91
16.5	15.0	30.0	15	15	S	-	28.5	0.39	1.2295	9	50.72	5.69	31.15	67.57
18.0	35.0	30.0	35	25	S	-	31.5	0.44	1.3466	18.75	50.72	6.97	71.08	114.46
19.5	15.0	30.0	15	15	S	-	28.5	0.39	1.4637	9	50.72	6.78	37.08	87.24
21.0	12.0	30.0	12	12	C	0.75	-	-	-	-	50.72	5.71	19.00	74.87
22.5	12.0	30.0	12	12	C	0.75	-	-	-	-	50.72	5.71	19.00	80.57
24.0	10.0	30.0	10	10	C	0.63	-	-	-	-	50.72	4.75	15.84	82.16
25.5	12.0	30.0	12	12	C	0.75	-	-	-	-	50.72	5.71	19.00	91.03
27.0	11.0	30.0	11	11	C	0.69	-	-	-	-	50.72	5.23	17.42	94.68
28.5	20.0	30.0	20	17	S	-	29.1	0.40	2.1663	12.5	50.72	10.26	76.23	163.75
30.0	27.0	30.0	27	21	S	-	30.3	0.42	2.2834	14	50.72	11.31	89.99	188.83
31.5	32.0	30.0	32	23	S	-	30.9	0.43	2.4005	14	50.72	12.15	94.61	205.59
33.0	22.0	30.0	22	18	S	-	29.4	0.40	2.5176	12.5	50.72	12.06	88.59	211.64
34.5	17.0	30.0	17	16	S	-	28.8	0.40	2.6347	9	50.72	12.34	66.75	202.14
36.0	20.0	30.0	20	17	S	-	29.1	0.40	2.7518	12.5	50.72	13.03	96.83	245.25
37.5	19.0	30.0	19	17	S	-	29.1	0.40	2.8689	12.5	50.72	13.59	100.95	262.96
39.0	26.0	30.0	26	20	S	-	30	0.41	2.9859	14	50.72	14.63	117.68	294.32
40.5	31.0	30.0	31	23	S	-	30.9	0.43	3.1030	14	50.72	15.71	122.30	314.65
42.0	40.0	30.0	40	27	S	-	32.1	0.45	3.2201	18.75	50.72	17.02	169.97	379.34
43.5	43.0	30.0	43	29	S	-	32.7	0.46	3.3372	18.75	50.72	18.01	176.15	403.53

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*06*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	1.00 m
alpha	=	0.45
Ab	=	8.45 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	3.0	30.0	3	3	C	0.19	-	-	-	-	50.72	1.43	4.75	6.18
3.0	5.0	30.0	5	5	C	0.31	-	-	-	-	50.72	2.38	7.92	11.72
4.5	7.0	30.0	7	7	S	-	26.1	0.36	0.2927	6.25	50.72	1.23	5.15	10.19
6.0	6.0	30.0	6	6	S	-	25.8	0.35	0.4098	6.25	50.72	1.70	7.21	13.95
7.5	8.0	30.0	8	8	S	-	26.4	0.36	0.5269	6.25	50.72	2.24	9.27	18.25
9.0	13.0	30.0	13	13	S	-	27.9	0.38	0.6440	9	50.72	2.91	16.32	28.21
10.5	14.0	30.0	14	14	S	-	28.2	0.39	0.7611	9	50.72	3.48	19.28	34.66
12.0	15.0	30.0	15	15	S	-	28.5	0.39	0.8782	9	50.72	4.07	22.25	41.69
13.5	11.0	30.0	11	11	C	0.69	-	-	-	-	50.72	5.23	17.42	42.09
15.0	10.0	30.0	10	10	C	0.63	-	-	-	-	50.72	4.75	15.84	45.26
16.5	18.0	30.0	18	16	S	-	28.8	0.40	1.2295	9	50.72	5.76	31.15	66.34
18.0	30.0	30.0	30	22	S	-	30.6	0.42	1.3466	14	50.72	6.74	53.07	95.00
19.5	14.0	30.0	14	14	S	-	28.2	0.39	1.4637	9	50.72	6.70	37.08	85.71
21.0	20.0	30.0	20	17	S	-	29.1	0.40	1.5808	12.5	50.72	7.49	55.63	111.74
22.5	18.0	30.0	18	16	S	-	28.8	0.40	1.6979	9	50.72	7.95	43.02	107.08
24.0	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	82.60
25.5	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	86.88
27.0	20.0	30.0	20	17	S	-	29.1	0.40	2.0492	12.5	50.72	9.71	72.11	154.44
28.5	22.0	30.0	22	18	S	-	29.4	0.40	2.1663	12.5	50.72	10.38	76.23	168.94
30.0	16.0	30.0	16	15	S	-	28.5	0.39	2.2834	9	50.72	10.57	57.85	161.13
31.5	16.0	30.0	16	15	S	-	28.5	0.39	2.4005	9	50.72	11.11	60.82	175.21
33.0	20.0	30.0	20	17	S	-	29.1	0.40	2.5176	12.5	50.72	11.92	88.59	214.91
34.5	20.0	30.0	20	17	S	-	29.1	0.40	2.6347	12.5	50.72	12.48	92.71	231.51
36.0	12.0	30.0	12	12	S	-	27.6	0.38	2.7518	9	50.72	12.30	69.72	220.81
37.5	26.0	30.0	26	20	S	-	30	0.41	2.8689	14	50.72	14.05	113.07	278.21
39.0	16.0	30.0	16	15	S	-	28.5	0.39	2.9859	9	50.72	13.82	75.65	254.62
40.5	30.0	30.0	30	22	S	-	30.6	0.42	3.1030	14	50.72	15.54	122.30	316.81
42.0	40.0	30.0	40	27	S	-	32.1	0.45	3.2201	18.75	50.72	17.02	169.97	381.50
43.5	44.0	30.0	44	29	S	-	32.7	0.46	3.3372	18.75	50.72	18.01	176.15	405.69

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*07*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	**1.00 m**
alpha	=	**0.45**
Ab	=	**8.45 Sft**
Ks	=	**0.7**
Nc	=	**9**
FoS	=	**3**

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	2.0	30.0	2	2	C	0.13	-	-	-	-	50.72	0.95	3.17	4.12
3.0	7.0	30.0	7	7	C	0.44	-	-	-	-	50.72	3.33	11.08	15.36
4.5	7.0	30.0	7	7	C	0.44	-	-	-	-	50.72	3.33	11.08	18.69
6.0	10.0	30.0	10	10	S	-	27	0.37	0.4098	9	50.72	1.79	10.38	19.78
7.5	10.0	30.0	10	10	S	-	27	0.37	0.5269	9	50.72	2.30	13.35	25.05
9.0	12.0	30.0	12	12	S	-	27.6	0.38	0.6440	9	50.72	2.88	16.32	30.89
10.5	9.0	30.0	9	9	S	-	26.7	0.36	0.7611	6.25	50.72	3.28	13.39	31.25
12.0	16.0	30.0	16	15	S	-	28.5	0.39	0.8782	9	50.72	4.07	22.25	44.17
13.5	11.0	30.0	11	11	C	0.69	-	-	-	-	50.72	5.23	17.42	44.57
15.0	13.0	30.0	13	13	C	0.81	-	-	-	-	50.72	6.18	20.59	53.92
16.5	14.0	30.0	14	14	C	0.88	-	-	-	-	50.72	6.66	22.17	62.16
18.0	16.0	30.0	16	15	S	-	28.5	0.39	1.3466	9	50.72	6.23	34.12	80.34
19.5	34.0	30.0	34	24	S	-	31.2	0.43	1.4637	18.75	50.72	7.49	77.26	130.97
21.0	8.0	30.0	8	8	C	0.50	-	-	-	-	50.72	3.80	12.67	70.19
22.5	9.0	30.0	9	9	C	0.56	-	-	-	-	50.72	4.28	14.25	76.05
24.0	14.0	30.0	14	14	S	-	28.2	0.39	1.8150	9	50.72	8.30	45.98	116.09
25.5	20.0	30.0	20	17	S	-	29.1	0.40	1.9321	12.5	50.72	9.15	67.99	147.24
27.0	16.0	30.0	16	15	S	-	28.5	0.39	2.0492	9	50.72	9.49	51.92	140.66
28.5	22.0	30.0	22	18	S	-	29.4	0.40	2.1663	12.5	50.72	10.38	76.23	175.35
30.0	18.0	30.0	18	16	S	-	28.8	0.40	2.2834	9	50.72	10.69	57.85	167.66
31.5	10.0	30.0	10	10	S	-	27	0.37	2.4005	9	50.72	10.47	60.82	181.10
33.0	24.0	30.0	24	19	S	-	29.7	0.41	2.5176	12.5	50.72	12.20	88.59	221.07
34.5	16.0	30.0	16	15	S	-	28.5	0.39	2.6347	9	50.72	12.20	66.75	211.43
36.0	19.0	30.0	19	17	S	-	29.1	0.40	2.7518	12.5	50.72	13.03	96.83	254.54
37.5	15.0	30.0	15	15	S	-	28.5	0.39	2.8689	9	50.72	13.28	72.69	243.68
39.0	17.0	30.0	17	16	S	-	28.8	0.40	2.9859	9	50.72	13.98	75.65	260.63
40.5	24.0	30.0	24	19	S	-	29.7	0.41	3.1030	12.5	50.72	15.03	109.19	309.20
42.0	30.0	30.0	30	22	S	-	30.6	0.42	3.2201	14	50.72	16.13	126.91	343.05
43.5	39.0	30.0	39	27	S	-	32.1	0.45	3.3372	18.75	50.72	17.64	176.15	409.92

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*01*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	0.50 m
alpha	=	0.45
Ab	=	2.11 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	5.0	30.0	5	5	C	0.31	-	-	-	-	25.36	1.19	1.98	3.17
3.0	4.0	30.0	4	4	C	0.25	-	-	-	-	25.36	0.95	1.58	3.72
4.5	8.0	30.0	8	8	S	-	26.4	0.36	0.2927	6.25	25.36	0.62	1.29	4.05
6.0	9.0	30.0	9	9	S	-	26.7	0.36	0.4098	6.25	25.36	0.88	1.80	5.45
7.5	11.0	30.0	11	11	S	-	27.3	0.37	0.5269	9	25.36	1.16	3.34	8.15
9.0	17.0	30.0	17	16	S	-	28.8	0.40	0.6440	9	25.36	1.51	4.08	10.40
10.5	19.0	30.0	19	17	S	-	29.1	0.40	0.7611	12.5	25.36	1.80	6.70	14.82
12.0	9.0	30.0	9	9	S	-	26.7	0.36	0.8782	6.25	25.36	1.89	3.86	13.88
13.5	10.0	30.0	10	10	S	-	27	0.37	0.9953	9	25.36	2.17	6.30	18.49
15.0	10.0	30.0	10	10	S	-	27	0.37	1.1124	9	25.36	2.43	7.05	21.66
16.5	29.0	30.0	29	22	S	-	30.6	0.42	1.2295	14	25.36	3.08	12.11	29.80
18.0	47.0	30.0	47	31	S	-	33.3	0.47	1.3466	18.75	25.36	3.71	17.77	39.17
19.5	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	27.10
21.0	13.0	30.0	13	13	C	0.81	-	-	-	-	25.36	3.09	5.15	31.78
22.5	16.0	30.0	16	15	C	0.94	-	-	-	-	25.36	3.57	5.94	36.13
24.0	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	35.90
25.5	11.0	30.0	11	11	C	0.69	-	-	-	-	25.36	2.62	4.35	39.31
27.0	21.0	30.0	21	18	S	-	29.4	0.40	2.0492	12.5	25.36	4.91	18.03	57.89
28.5	16.0	30.0	16	15	S	-	28.5	0.39	2.1663	9	25.36	5.01	13.72	58.59
30.0	27.0	30.0	27	21	S	-	30.3	0.42	2.2834	14	25.36	5.66	22.50	73.03
31.5	22.0	30.0	22	18	S	-	29.4	0.40	2.4005	12.5	25.36	5.75	21.12	77.40
33.0	20.0	30.0	20	17	S	-	29.1	0.40	2.5176	12.5	25.36	5.96	22.15	84.39
34.5	15.0	30.0	15	15	S	-	28.5	0.39	2.6347	9	25.36	6.10	16.69	85.03
36.0	30.0	30.0	30	22	S	-	30.6	0.42	2.7518	14	25.36	6.89	27.11	102.34
37.5	28.0	30.0	28	21	S	-	30.3	0.42	2.8689	14	25.36	7.11	28.27	110.60
39.0	29.0	30.0	29	22	S	-	30.6	0.42	2.9859	14	25.36	7.48	29.42	119.23
40.5	37.0	30.0	37	26	S	-	31.8	0.44	3.1030	18.75	25.36	8.11	40.95	138.87
42.0	40.0	30.0	40	27	S	-	32.1	0.45	3.2201	18.75	25.36	8.51	42.49	148.93
43.5	46.0	30.0	46	30	S	-	33	0.46	3.3372	18.75	25.36	9.10	44.04	159.57

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*02*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	0.50 m
alpha	=	0.45
Ab	=	2.11 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	6.0	30.0	6	6	C	0.38	-	-	-	-	25.36	1.43	2.38	3.80
3.0	5.0	30.0	5	5	C	0.31	-	-	-	-	25.36	1.19	1.98	4.59
4.5	8.0	30.0	8	8	S	-	26.4	0.36	0.2927	6.25	25.36	0.62	1.29	4.53
6.0	10.0	30.0	10	10	S	-	27	0.37	0.4098	9	25.36	0.89	2.60	6.73
7.5	9.0	30.0	9	9	S	-	26.7	0.36	0.5269	6.25	25.36	1.14	2.32	7.59
9.0	17.0	30.0	17	16	S	-	28.8	0.40	0.6440	9	25.36	1.51	4.08	10.86
10.5	18.0	30.0	18	16	S	-	28.8	0.40	0.7611	9	25.36	1.78	4.82	13.38
12.0	10.0	30.0	10	10	S	-	27	0.37	0.8782	9	25.36	1.92	5.56	16.04
13.5	11.0	30.0	11	11	S	-	27.3	0.37	0.9953	9	25.36	2.20	6.30	18.98
15.0	10.0	30.0	10	10	S	-	27	0.37	1.1124	9	25.36	2.43	7.05	22.15
16.5	7.0	30.0	7	7	S	-	26.1	0.36	1.2295	6.25	25.36	2.59	5.41	23.09
18.0	52.0	30.0	52	33	S	-	33.9	0.48	1.3466	18.75	25.36	3.79	17.77	39.24
19.5	25.0	30.0	25	20	C	1.25	-	-	-	-	25.36	4.75	7.92	34.14
21.0	13.0	30.0	13	13	C	0.81	-	-	-	-	25.36	3.09	5.15	34.46
22.5	18.0	30.0	18	16	C	1.00	-	-	-	-	25.36	3.80	6.33	39.45
24.0	10.0	30.0	10	10	C	0.63	-	-	-	-	25.36	2.38	3.96	39.46
25.5	12.0	30.0	12	12	C	0.75	-	-	-	-	25.36	2.85	4.75	43.10
27.0	20.0	30.0	20	17	S	-	29.1	0.40	2.0492	12.5	25.36	4.85	18.03	61.23
28.5	17.0	30.0	17	16	S	-	28.8	0.40	2.1663	9	25.36	5.07	13.72	62.00
30.0	32.0	30.0	32	23	S	-	30.9	0.43	2.2834	14	25.36	5.78	22.50	76.55
31.5	27.0	30.0	27	21	S	-	30.3	0.42	2.4005	14	25.36	5.95	23.65	83.65
33.0	20.0	30.0	20	17	S	-	29.1	0.40	2.5176	12.5	25.36	5.96	22.15	88.11
34.5	17.0	30.0	17	16	S	-	28.8	0.40	2.6347	9	25.36	6.17	16.69	88.82
36.0	18.0	30.0	18	16	S	-	28.8	0.40	2.7518	9	25.36	6.44	17.43	96.01
37.5	22.0	30.0	22	18	S	-	29.4	0.40	2.8689	12.5	25.36	6.87	25.24	110.69
39.0	27.0	30.0	27	21	S	-	30.3	0.42	2.9859	14	25.36	7.40	29.42	122.26
40.5	35.0	30.0	35	25	S	-	31.5	0.44	3.1030	18.75	25.36	8.03	40.95	141.82
42.0	42.0	30.0	42	28	S	-	32.4	0.45	3.2201	18.75	25.36	8.60	42.49	151.96
43.5	49.0	30.0	49	32	S	-	33.6	0.47	3.3372	18.75	25.36	9.29	44.04	162.79

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*03*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	**0.50**	**m**
alpha	=	**0.45**	
Ab	=	**2.11**	**Sft**
Ks	=	**0.7**	
Nc	=	**9**	
FoS	=	**3**	

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	4.0	30.0	4	4	C	0.25	-	-	-	-	25.36	0.95	1.58	2.53
3.0	7.0	30.0	7	7	C	0.44	-	-	-	-	25.36	1.66	2.77	5.39
4.5	10.0	30.0	10	10	C	0.63	-	-	-	-	25.36	2.38	3.96	8.95
6.0	8.0	30.0	8	8	C	0.50	-	-	-	-	25.36	1.90	3.17	10.06
7.5	8.0	30.0	8	8	S	-	26.4	0.36	0.5269	6.25	25.36	1.12	2.32	10.33
9.0	15.0	30.0	15	15	S	-	28.5	0.39	0.6440	9	25.36	1.49	4.08	13.59
10.5	16.0	30.0	16	15	S	-	28.5	0.39	0.7611	9	25.36	1.76	4.82	16.09
12.0	9.0	30.0	9	9	S	-	26.7	0.36	0.8782	6.25	25.36	1.89	3.86	17.02
13.5	10.0	30.0	10	10	S	-	27	0.37	0.9953	9	25.36	2.17	6.30	21.64
15.0	6.0	30.0	6	6	S	-	25.8	0.35	1.1124	6.25	25.36	2.31	4.89	22.54
16.5	9.0	30.0	9	9	S	-	26.7	0.36	1.2295	6.25	25.36	2.65	5.41	25.70
18.0	27.0	30.0	27	21	S	-	30.3	0.42	1.3466	14	25.36	3.34	13.27	36.90
19.5	13.0	30.0	13	13	S	-	27.9	0.38	1.4637	9	25.36	3.31	9.27	36.21
21.0	14.0	30.0	14	14	C	0.88	-	-	-	-	25.36	3.33	5.54	35.81
22.5	14.0	30.0	14	14	C	0.88	-	-	-	-	25.36	3.33	5.54	39.14
24.0	9.0	30.0	9	9	S	-	26.7	0.36	1.8150	6.25	25.36	3.91	7.98	45.49
25.5	10.0	30.0	10	10	S	-	27	0.37	1.9321	9	25.36	4.22	12.24	53.96
27.0	20.0	30.0	20	17	S	-	29.1	0.40	2.0492	12.5	25.36	4.85	18.03	64.60
28.5	15.0	30.0	15	15	S	-	28.5	0.39	2.1663	9	25.36	5.01	13.72	65.31
30.0	34.0	30.0	34	24	S	-	31.2	0.43	2.2834	18.75	25.36	5.84	30.13	87.56
31.5	18.0	30.0	18	16	S	-	28.8	0.40	2.4005	9	25.36	5.62	15.20	78.26
33.0	16.0	30.0	16	15	S	-	28.5	0.39	2.5176	9	25.36	5.83	15.95	84.83
34.5	20.0	30.0	20	17	S	-	29.1	0.40	2.6347	12.5	25.36	6.24	23.18	98.30
36.0	18.0	30.0	18	16	S	-	28.8	0.40	2.7518	9	25.36	6.44	17.43	98.99
37.5	17.0	30.0	17	16	S	-	28.8	0.40	2.8689	9	25.36	6.72	18.17	106.45
39.0	22.0	30.0	22	18	S	-	29.4	0.40	2.9859	12.5	25.36	7.15	26.27	121.70
40.5	37.0	30.0	37	26	S	-	31.8	0.44	3.1030	18.75	25.36	8.11	40.95	144.49
42.0	41.0	30.0	41	28	S	-	32.4	0.45	3.2201	18.75	25.36	8.60	42.49	154.64
43.5	44.0	30.0	44	29	S	-	32.7	0.46	3.3372	18.75	25.36	9.00	44.04	165.19

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*04*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	0.50 m
alpha	=	0.45
Ab	=	2.11 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	3.0	30.0	3	3	C	0.19	-	-	-	-	25.36	0.71	1.19	1.90
3.0	4.0	30.0	4	4	C	0.25	-	-	-	-	25.36	0.95	1.58	3.25
4.5	7.0	30.0	7	7	C	0.44	-	-	-	-	25.36	1.66	2.77	6.10
6.0	10.0	30.0	10	10	S	-	27	0.37	0.4098	9	25.36	0.89	2.60	6.82
7.5	16.0	30.0	16	15	S	-	28.5	0.39	0.5269	9	25.36	1.22	3.34	8.78
9.0	9.0	30.0	9	9	S	-	26.7	0.36	0.6440	6.25	25.36	1.39	2.83	9.66
10.5	15.0	30.0	15	15	S	-	28.5	0.39	0.7611	9	25.36	1.76	4.82	13.41
12.0	10.0	30.0	10	10	S	-	27	0.37	0.8782	9	25.36	1.92	5.56	16.07
13.5	11.0	30.0	11	11	S	-	27.3	0.37	0.9953	9	25.36	2.20	6.30	19.01
15.0	7.0	30.0	7	7	C	0.44	-	-	-	-	25.36	1.66	2.77	17.14
16.5	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	20.07
18.0	22.0	30.0	22	18	S	-	29.4	0.40	1.3466	12.5	25.36	3.23	11.85	31.58
19.5	13.0	30.0	13	13	S	-	27.9	0.38	1.4637	9	25.36	3.31	9.27	32.32
21.0	14.0	30.0	14	14	S	-	28.2	0.39	1.5808	9	25.36	3.62	10.01	36.67
22.5	12.0	30.0	12	12	S	-	27.6	0.38	1.6979	9	25.36	3.79	10.75	41.21
24.0	10.0	30.0	10	10	C	0.63	-	-	-	-	25.36	2.38	3.96	36.79
25.5	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	38.54
27.0	18.0	30.0	18	16	S	-	28.8	0.40	2.0492	9	25.36	4.80	12.98	52.75
28.5	14.0	30.0	14	14	S	-	28.2	0.39	2.1663	9	25.36	4.96	13.72	58.45
30.0	31.0	30.0	31	23	S	-	30.9	0.43	2.2834	14	25.36	5.78	22.50	73.01
31.5	15.0	30.0	15	15	S	-	28.5	0.39	2.4005	9	25.36	5.56	15.20	71.27
33.0	12.0	30.0	12	12	S	-	27.6	0.38	2.5176	9	25.36	5.63	15.95	77.64
34.5	7.0	30.0	7	7	S	-	26.1	0.36	2.6347	6.25	25.36	5.54	11.59	78.82
36.0	19.0	30.0	19	17	S	-	29.1	0.40	2.7518	12.5	25.36	6.52	24.21	97.96
37.5	20.0	30.0	20	17	S	-	29.1	0.40	2.8689	12.5	25.36	6.79	25.24	105.78
39.0	22.0	30.0	22	18	S	-	29.4	0.40	2.9859	12.5	25.36	7.15	26.27	113.96
40.5	37.0	30.0	37	26	S	-	31.8	0.44	3.1030	18.75	25.36	8.11	40.95	136.75
42.0	41.0	30.0	41	28	S	-	32.4	0.45	3.2201	18.75	25.36	8.60	42.49	146.90
43.5	47.0	30.0	47	31	S	-	33.3	0.47	3.3372	18.75	25.36	9.19	44.04	157.64

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*05*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	0.50 m
alpha	=	0.45
Ab	=	2.11 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	2.0	30.0	2	2	C	0.13	-	-	-	-	25.36	0.48	0.79	1.27
3.0	5.0	30.0	5	5	C	0.31	-	-	-	-	25.36	1.19	1.98	3.64
4.5	8.0	30.0	8	8	C	0.50	-	-	-	-	25.36	1.90	3.17	6.73
6.0	11.0	30.0	11	11	S	-	27.3	0.37	0.4098	9	25.36	0.90	2.60	7.07
7.5	12.0	30.0	12	12	S	-	27.6	0.38	0.5269	9	25.36	1.18	3.34	8.99
9.0	10.0	30.0	10	10	S	-	27	0.37	0.6440	9	25.36	1.41	4.08	11.13
10.5	16.0	30.0	16	15	S	-	28.5	0.39	0.7611	9	25.36	1.76	4.82	13.64
12.0	10.0	30.0	10	10	S	-	27	0.37	0.8782	9	25.36	1.92	5.56	16.29
13.5	9.0	30.0	9	9	S	-	26.7	0.36	0.9953	6.25	25.36	2.15	4.38	17.25
15.0	12.0	30.0	12	12	S	-	27.6	0.38	1.1124	9	25.36	2.49	7.05	22.41
16.5	15.0	30.0	15	15	S	-	28.5	0.39	1.2295	9	25.36	2.85	7.79	26.00
18.0	35.0	30.0	35	25	S	-	31.5	0.44	1.3466	18.75	25.36	3.48	17.77	39.46
19.5	15.0	30.0	15	15	S	-	28.5	0.39	1.4637	9	25.36	3.39	9.27	34.35
21.0	12.0	30.0	12	12	C	0.75	-	-	-	-	25.36	2.85	4.75	32.68
22.5	12.0	30.0	12	12	C	0.75	-	-	-	-	25.36	2.85	4.75	35.54
24.0	10.0	30.0	10	10	C	0.63	-	-	-	-	25.36	2.38	3.96	37.12
25.5	12.0	30.0	12	12	C	0.75	-	-	-	-	25.36	2.85	4.75	40.77
27.0	11.0	30.0	11	11	C	0.69	-	-	-	-	25.36	2.62	4.35	42.99
28.5	20.0	30.0	20	17	S	-	29.1	0.40	2.1663	12.5	25.36	5.13	19.06	62.82
30.0	27.0	30.0	27	21	S	-	30.3	0.42	2.2834	14	25.36	5.66	22.50	71.91
31.5	32.0	30.0	32	23	S	-	30.9	0.43	2.4005	14	25.36	6.08	23.65	79.15
33.0	22.0	30.0	22	18	S	-	29.4	0.40	2.5176	12.5	25.36	6.03	22.15	83.67
34.5	17.0	30.0	17	16	S	-	28.8	0.40	2.6347	9	25.36	6.17	16.69	84.38
36.0	20.0	30.0	20	17	S	-	29.1	0.40	2.7518	12.5	25.36	6.52	24.21	98.42
37.5	19.0	30.0	19	17	S	-	29.1	0.40	2.8689	12.5	25.36	6.79	25.24	106.24
39.0	26.0	30.0	26	20	S	-	30	0.41	2.9859	14	25.36	7.31	29.42	117.74
40.5	31.0	30.0	31	23	S	-	30.9	0.43	3.1030	14	25.36	7.86	30.57	126.75
42.0	40.0	30.0	40	27	S	-	32.1	0.45	3.2201	18.75	25.36	8.51	42.49	147.18
43.5	43.0	30.0	43	29	S	-	32.7	0.46	3.3372	18.75	25.36	9.00	44.04	157.73

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*06*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	**0.50**	**m**
alpha	=	**0.45**	
Ab	=	**2.11**	**Sft**
Ks	=	**0.7**	
Nc	=	**9**	
FoS	=	**3**	

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	3.0	30.0	3	3	C	0.19	-	-	-	-	25.36	0.71	1.19	1.90
3.0	5.0	30.0	5	5	C	0.31	-	-	-	-	25.36	1.19	1.98	3.88
4.5	7.0	30.0	7	7	S	-	26.1	0.36	0.2927	6.25	25.36	0.62	1.29	3.81
6.0	6.0	30.0	6	6	S	-	25.8	0.35	0.4098	6.25	25.36	0.85	1.80	5.17
7.5	8.0	30.0	8	8	S	-	26.4	0.36	0.5269	6.25	25.36	1.12	2.32	6.81
9.0	13.0	30.0	13	13	S	-	27.9	0.38	0.6440	9	25.36	1.46	4.08	10.03
10.5	14.0	30.0	14	14	S	-	28.2	0.39	0.7611	9	25.36	1.74	4.82	12.51
12.0	15.0	30.0	15	15	S	-	28.5	0.39	0.8782	9	25.36	2.03	5.56	15.28
13.5	11.0	30.0	11	11	C	0.69	-	-	-	-	25.36	2.62	4.35	16.69
15.0	10.0	30.0	10	10	C	0.63	-	-	-	-	25.36	2.38	3.96	18.67
16.5	18.0	30.0	18	16	S	-	28.8	0.40	1.2295	9	25.36	2.88	7.79	25.38
18.0	30.0	30.0	30	22	S	-	30.6	0.42	1.3466	14	25.36	3.37	13.27	34.23
19.5	14.0	30.0	14	14	S	-	28.2	0.39	1.4637	9	25.36	3.35	9.27	33.58
21.0	20.0	30.0	20	17	S	-	29.1	0.40	1.5808	12.5	25.36	3.74	13.91	41.96
22.5	18.0	30.0	18	16	S	-	28.8	0.40	1.6979	9	25.36	3.98	10.75	42.79
24.0	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	37.74
25.5	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	39.87
27.0	20.0	30.0	20	17	S	-	29.1	0.40	2.0492	12.5	25.36	4.85	18.03	59.19
28.5	22.0	30.0	22	18	S	-	29.4	0.40	2.1663	12.5	25.36	5.19	19.06	65.41
30.0	16.0	30.0	16	15	S	-	28.5	0.39	2.2834	9	25.36	5.29	14.46	66.10
31.5	16.0	30.0	16	15	S	-	28.5	0.39	2.4005	9	25.36	5.56	15.20	72.40
33.0	20.0	30.0	20	17	S	-	29.1	0.40	2.5176	12.5	25.36	5.96	22.15	85.31
34.5	20.0	30.0	20	17	S	-	29.1	0.40	2.6347	12.5	25.36	6.24	23.18	92.58
36.0	12.0	30.0	12	12	S	-	27.6	0.38	2.7518	9	25.36	6.15	17.43	92.98
37.5	26.0	30.0	26	20	S	-	30	0.41	2.8689	14	25.36	7.03	28.27	110.84
39.0	16.0	30.0	16	15	S	-	28.5	0.39	2.9859	9	25.36	6.91	18.91	108.40
40.5	30.0	30.0	30	22	S	-	30.6	0.42	3.1030	14	25.36	7.77	30.57	127.83
42.0	40.0	30.0	40	27	S	-	32.1	0.45	3.2201	18.75	25.36	8.51	42.49	148.26
43.5	44.0	30.0	44	29	S	-	32.7	0.46	3.3372	18.75	25.36	9.00	44.04	158.81

SKIN FRICTION & END-BEARING (BORED PILE)

PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*	**BORE HOLE NO.:**	*07*
LOCATION:	*Sonagazi, Bangladesh.*		
CLIENT:	*Power Cell, Power Division.*	**CONSULTANT:**	*WinDForce Manatement Survices Pvt. Ltd.*

Pile Dia	=	0.50 m
alpha	=	0.45
Ab	=	2.11 Sft
Ks	=	0.7
Nc	=	9
FoS	=	3

Depth m	Field N	Penetration, cm	N	N'	Soil Type	Cu (Ton/ft^2)	Fi'	tan(del)	Overburden pressure (Ton/sft)	Nq	As (sft)	Qs (Tons)	Qb (Tons)	Pile Resistance (Tons)
1.5	2.0	30.0	2	2	C	0.13	-	-	-	-	25.36	0.48	0.79	1.27
3.0	7.0	30.0	7	7	C	0.44	-	-	-	-	25.36	1.66	2.77	4.91
4.5	7.0	30.0	7	7	C	0.44	-	-	-	-	25.36	1.66	2.77	6.57
6.0	10.0	30.0	10	10	S	-	27	0.37	0.4098	9	25.36	0.89	2.60	7.29
7.5	10.0	30.0	10	10	S	-	27	0.37	0.5269	9	25.36	1.15	3.34	9.19
9.0	12.0	30.0	12	12	S	-	27.6	0.38	0.6440	9	25.36	1.44	4.08	11.37
10.5	9.0	30.0	9	9	S	-	26.7	0.36	0.7611	6.25	25.36	1.64	3.35	12.28
12.0	16.0	30.0	16	15	S	-	28.5	0.39	0.8782	9	25.36	2.03	5.56	16.52
13.5	11.0	30.0	11	11	C	0.69	-	-	-	-	25.36	2.62	4.35	17.93
15.0	13.0	30.0	13	13	C	0.81	-	-	-	-	25.36	3.09	5.15	21.81
16.5	14.0	30.0	14	14	C	0.88	-	-	-	-	25.36	3.33	5.54	25.54
18.0	16.0	30.0	16	15	S	-	28.5	0.39	1.3466	9	25.36	3.12	8.53	31.64
19.5	34.0	30.0	34	24	S	-	31.2	0.43	1.4637	18.75	25.36	3.75	19.31	46.17
21.0	8.0	30.0	8	8	C	0.50	-	-	-	-	25.36	1.90	3.17	31.93
22.5	9.0	30.0	9	9	C	0.56	-	-	-	-	25.36	2.14	3.56	34.46
24.0	14.0	30.0	14	14	S	-	28.2	0.39	1.8150	9	25.36	4.15	11.50	46.55
25.5	20.0	30.0	20	17	S	-	29.1	0.40	1.9321	12.5	25.36	4.58	17.00	56.62
27.0	16.0	30.0	16	15	S	-	28.5	0.39	2.0492	9	25.36	4.74	12.98	57.35
28.5	22.0	30.0	22	18	S	-	29.4	0.40	2.1663	12.5	25.36	5.19	19.06	68.62
30.0	18.0	30.0	18	16	S	-	28.8	0.40	2.2834	9	25.36	5.35	14.46	69.37
31.5	10.0	30.0	10	10	S	-	27	0.37	2.4005	9	25.36	5.24	15.20	75.35
33.0	24.0	30.0	24	19	S	-	29.7	0.41	2.5176	12.5	25.36	6.10	22.15	88.39
34.5	16.0	30.0	16	15	S	-	28.5	0.39	2.6347	9	25.36	6.10	16.69	89.03
36.0	19.0	30.0	19	17	S	-	29.1	0.40	2.7518	12.5	25.36	6.52	24.21	103.06
37.5	15.0	30.0	15	15	S	-	28.5	0.39	2.8689	9	25.36	6.64	18.17	103.67
39.0	17.0	30.0	17	16	S	-	28.8	0.40	2.9859	9	25.36	6.99	18.91	111.40
40.5	24.0	30.0	24	19	S	-	29.7	0.41	3.1030	12.5	25.36	7.52	27.30	127.30
42.0	30.0	30.0	30	22	S	-	30.6	0.42	3.2201	14	25.36	8.06	31.73	139.80
43.5	39.0	30.0	39	27	S	-	32.1	0.45	3.3372	18.75	25.36	8.82	44.04	160.92

APPENDIX-F: Pile Capacity (Driven Pile)

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*01*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	5	30	5	5.0	5.0	1.03	5.24	6.27
3.00	4	30	4	4.0	4.5	1.96	4.19	6.15
4.50	8	30	8	8.0	6.0	3.20	8.38	11.57
6.00	9	30	9	9.0	8.5	4.95	9.42	14.37
7.50	11	30	11	11.0	10.0	7.01	11.52	18.53
9.00	17	30	17	16.0	13.5	9.80	16.76	26.55
10.50	19	30	19	17.0	16.5	13.20	17.80	31.00
12.00	9	30	9	9.0	13.0	15.88	9.42	25.30
13.50	10	30	10	10.0	9.5	17.84	10.47	28.31
15.00	10	30	10	10.0	10.0	19.90	10.47	30.37
16.50	29	30	29	22.0	16.0	23.20	23.04	46.24
18.00	47	30	47	31.0	26.5	28.67	32.46	61.13
19.50	9	30	9	9.0	20.0	32.79	9.42	42.21
21.00	13	30	13	13.0	11.0	35.06	13.61	48.67
22.50	16	30	16	15.5	14.3	38.00	16.23	54.23
24.00	9	30	9	9.0	12.3	40.52	9.42	49.95
25.50	11	30	11	11.0	10.0	42.59	11.52	54.10
27.00	21	30	21	18.0	14.5	45.58	18.85	64.43
28.50	16	30	16	15.5	16.8	49.03	16.23	65.26
30.00	27	30	27	21.0	18.3	52.79	21.99	74.78
31.50	22	30	22	18.5	19.8	56.87	19.37	76.24
33.00	20	30	20	17.5	18.0	60.58	18.33	78.90
34.50	15	30	15	15.0	16.3	63.93	15.71	79.64
36.00	30	30	30	22.5	18.8	67.80	23.56	91.36
37.50	28	30	28	21.5	22.0	72.33	22.51	94.85
39.00	29	30	29	22.0	21.8	76.82	23.04	99.86
40.50	37	30	37	26.0	24.0	81.77	27.23	109.00
42.00	40	30	40	27.5	26.8	87.28	28.80	116.08
43.50	46	30	46	30.5	29.0	93.26	31.94	125.20

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*02*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	6	30	6	6.0	6.0	1.24	6.28	7.52
3.00	5	30	5	5.0	5.5	2.37	5.24	7.61
4.50	8	30	8	8.0	6.5	3.71	8.38	12.09
6.00	10	30	10	10.0	9.0	5.57	10.47	16.04
7.50	9	30	9	9.0	9.5	7.53	9.42	16.95
9.00	17	30	17	16.0	12.5	10.10	16.76	26.86
10.50	18	30	18	16.5	16.3	13.46	17.28	30.73
12.00	10	30	10	10.0	13.3	16.19	10.47	26.66
13.50	11	30	11	11.0	10.5	18.35	11.52	29.87
15.00	10	30	10	10.0	10.5	20.52	10.47	30.99
16.50	7	30	7	7.0	8.5	22.27	7.33	29.60
18.00	52	30	52	33.5	20.3	26.45	35.08	61.53
19.50	25	30	25	20.0	26.8	31.96	20.94	52.91
21.00	13	30	13	13.0	16.5	35.37	13.61	48.98
22.50	18	30	18	16.5	14.8	38.41	17.28	55.69
24.00	10	30	10	10.0	13.3	41.14	10.47	51.61
25.50	12	30	12	12.0	11.0	43.41	12.57	55.98
27.00	20	30	20	17.5	14.8	46.45	18.33	64.78
28.50	17	30	17	16.0	16.8	49.91	16.76	66.66
30.00	32	30	32	23.5	19.8	53.98	24.61	78.59
31.50	27	30	27	21.0	22.3	58.57	21.99	80.56
33.00	20	30	20	17.5	19.3	62.54	18.33	80.86
34.50	17	30	17	16.0	16.8	65.99	16.76	82.75
36.00	18	30	18	16.5	16.3	69.34	17.28	86.62
37.50	22	30	22	18.5	17.5	72.95	19.37	92.32
39.00	27	30	27	21.0	19.8	77.02	21.99	99.02
40.50	35	30	35	25.0	23.0	81.77	26.18	107.95
42.00	42	30	42	28.5	26.8	87.28	29.85	117.13
43.50	49	30	49	32.0	30.3	93.52	33.51	127.03

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*03*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	4	30	4	4.0	4.0	0.82	4.19	5.01
3.00	7	30	7	7.0	5.5	1.96	7.33	9.29
4.50	10	30	10	10.0	8.5	3.71	10.47	14.18
6.00	8	30	8	8.0	9.0	5.57	8.38	13.95
7.50	8	30	8	8.0	8.0	7.22	8.38	15.60
9.00	15	30	15	15.0	11.5	9.59	15.71	25.30
10.50	16	30	16	15.5	15.3	12.73	16.23	28.97
12.00	9	30	9	9.0	12.3	15.26	9.42	24.69
13.50	10	30	10	10.0	9.5	17.22	10.47	27.69
15.00	6	30	6	6.0	8.0	18.87	6.28	25.15
16.50	9	30	9	9.0	7.5	20.42	9.42	29.84
18.00	27	30	27	21.0	15.0	23.51	21.99	45.50
19.50	13	30	13	13.0	17.0	27.02	13.61	40.63
21.00	14	30	14	14.0	13.5	29.80	14.66	44.46
22.50	14	30	14	14.0	14.0	32.69	14.66	47.35
24.00	9	30	9	9.0	11.5	35.06	9.42	44.48
25.50	10	30	10	10.0	9.5	37.02	10.47	47.49
27.00	20	30	20	17.5	13.8	39.85	18.33	58.18
28.50	15	30	15	15.0	16.3	43.20	15.71	58.91
30.00	34	30	34	24.5	19.8	47.28	25.66	72.93
31.50	18	30	18	16.5	20.5	51.50	17.28	68.78
33.00	16	30	16	15.5	16.0	54.80	16.23	71.04
34.50	20	30	20	17.5	16.5	58.21	18.33	76.53
36.00	18	30	18	16.5	17.0	61.71	17.28	78.99
37.50	17	30	17	16.0	16.3	65.06	16.76	81.82
39.00	22	30	22	18.5	17.3	68.62	19.37	87.99
40.50	37	30	37	26.0	22.3	73.21	27.23	100.44
42.00	41	30	41	28.0	27.0	78.78	29.32	108.10
43.50	44	30	44	29.5	28.8	84.71	30.89	115.60

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*04*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	3	30	3	3.0	3.0	0.62	3.14	3.76
3.00	4	30	4	4.0	3.5	1.34	4.19	5.53
4.50	7	30	7	7.0	5.5	2.47	7.33	9.81
6.00	10	30	10	10.0	8.5	4.23	10.47	14.70
7.50	16	30	16	15.5	12.8	6.86	16.23	23.09
9.00	9	30	9	9.0	12.3	9.38	9.42	18.81
10.50	15	30	15	15.0	12.0	11.86	15.71	27.57
12.00	10	30	10	10.0	12.5	14.44	10.47	24.91
13.50	11	30	11	11.0	10.5	16.60	11.52	28.12
15.00	7	30	7	7.0	9.0	18.46	7.33	25.79
16.50	9	30	9	9.0	8.0	20.11	9.42	29.53
18.00	22	30	22	18.5	13.8	22.94	19.37	42.32
19.50	13	30	13	13.0	15.8	26.19	13.61	39.80
21.00	14	30	14	14.0	13.5	28.97	14.66	43.64
22.50	12	30	12	12.0	13.0	31.66	12.57	44.22
24.00	10	30	10	10.0	11.0	33.92	10.47	44.40
25.50	9	30	9	9.0	9.5	35.88	9.42	45.31
27.00	18	30	18	16.5	12.8	38.51	17.28	55.79
28.50	14	30	14	14.0	15.3	41.66	14.66	56.32
30.00	31	30	31	23.0	18.5	45.47	24.09	69.56
31.50	15	30	15	15.0	19.0	49.39	15.71	65.10
33.00	12	30	12	12.0	13.5	52.17	12.57	64.74
34.50	7	30	7	7.0	9.5	54.13	7.33	61.46
36.00	19	30	19	17.0	12.0	56.61	17.80	74.41
37.50	20	30	20	17.5	17.3	60.17	18.33	78.49
39.00	22	30	22	18.5	18.0	63.88	19.37	83.25
40.50	37	30	37	26.0	22.3	68.47	27.23	95.69
42.00	41	30	41	28.0	27.0	74.03	29.32	103.36
43.50	47	30	47	31.0	29.5	80.12	32.46	112.58

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*05*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	2	30	2	2.0	2.0	0.41	2.09	**2.51**
3.00	5	30	5	5.0	3.5	1.13	5.24	**6.37**
4.50	8	30	8	8.0	6.5	2.47	8.38	**10.85**
6.00	11	30	11	11.0	9.5	4.43	11.52	**15.95**
7.50	12	30	12	12.0	11.5	6.81	12.57	**19.37**
9.00	10	30	10	10.0	11.0	9.07	10.47	**19.55**
10.50	16	30	16	15.5	12.8	11.70	16.23	**27.93**
12.00	10	30	10	10.0	12.8	14.33	10.47	**24.80**
13.50	9	30	9	9.0	9.5	16.29	9.42	**25.72**
15.00	12	30	12	12.0	10.5	18.46	12.57	**31.02**
16.50	15	30	15	15.0	13.5	21.24	15.71	**36.95**
18.00	35	30	35	25.0	20.0	25.37	26.18	**51.55**
19.50	15	30	15	15.0	20.0	29.49	15.71	**45.20**
21.00	12	30	12	12.0	13.5	32.27	12.57	**44.84**
22.50	12	30	12	12.0	12.0	34.75	12.57	**47.32**
24.00	10	30	10	10.0	11.0	37.02	10.47	**47.49**
25.50	12	30	12	12.0	11.0	39.29	12.57	**51.85**
27.00	11	30	11	11.0	11.5	41.66	11.52	**53.18**
28.50	20	30	20	17.5	14.3	44.60	18.33	**62.92**
30.00	27	30	27	21.0	19.3	48.57	21.99	**70.56**
31.50	32	30	32	23.5	22.3	53.15	24.61	**77.76**
33.00	22	30	22	18.5	21.0	57.49	19.37	**76.86**
34.50	17	30	17	16.0	17.3	61.04	16.76	**77.80**
36.00	20	30	20	17.5	16.8	64.50	18.33	**82.82**
37.50	19	30	19	17.0	17.3	68.05	17.80	**85.86**
39.00	26	30	26	20.5	18.8	71.92	21.47	**93.39**
40.50	31	30	31	23.0	21.8	76.41	24.09	**100.49**
42.00	40	30	40	27.5	25.3	81.61	28.80	**110.41**
43.50	43	30	43	29.0	28.3	87.44	30.37	**117.81**

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*06*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	3	30	3	3.0	3.0	0.62	3.14	3.76
3.00	5	30	5	5.0	4.0	1.44	5.24	6.68
4.50	7	30	7	7.0	6.0	2.68	7.33	10.01
6.00	6	30	6	6.0	6.5	4.02	6.28	10.30
7.50	8	30	8	8.0	7.0	5.46	8.38	13.84
9.00	13	30	13	13.0	10.5	7.63	13.61	21.24
10.50	14	30	14	14.0	13.5	10.41	14.66	25.08
12.00	15	30	15	15.0	14.5	13.40	15.71	29.11
13.50	11	30	11	11.0	13.0	16.09	11.52	27.60
15.00	10	30	10	10.0	10.5	18.25	10.47	28.72
16.50	18	30	18	16.5	13.3	20.98	17.28	38.26
18.00	30	30	30	22.5	19.5	25.00	23.56	48.57
19.50	14	30	14	14.0	18.3	28.77	14.66	43.43
21.00	20	30	20	17.5	15.8	32.02	18.33	50.34
22.50	18	30	18	16.5	17.0	35.52	17.28	52.80
24.00	9	30	9	9.0	12.8	38.15	9.42	47.58
25.50	9	30	9	9.0	9.0	40.01	9.42	49.43
27.00	20	30	20	17.5	13.3	42.74	18.33	61.07
28.50	22	30	22	18.5	18.0	46.45	19.37	65.83
30.00	16	30	16	15.5	17.0	49.96	16.23	66.19
31.50	16	30	16	15.5	15.5	53.15	16.23	69.39
33.00	20	30	20	17.5	16.5	56.56	18.33	74.88
34.50	20	30	20	17.5	17.5	60.17	18.33	78.49
36.00	12	30	12	12.0	14.8	63.21	12.57	75.77
37.50	26	30	26	20.5	16.3	66.56	21.47	88.03
39.00	16	30	16	15.5	18.0	70.27	16.23	86.50
40.50	30	30	30	22.5	19.0	74.19	23.56	97.75
42.00	40	30	40	27.5	25.0	79.34	28.80	108.14
43.50	44	30	44	29.5	28.5	85.22	30.89	116.11

SKIN FRICTION & END-BEARING (DRIVEN PILE)

CLIENT:	Power Cell, Power Division.	**BORE HOLE NO.:**	*07*
PROJECT:	*Feasibility Study for Development Utility Scale Solar & Wind Projects in Bangladesh.*		
LOCATION:	Sonagazi, Bangladesh.		

Pile diameter 12.00'' 1.0 FT **FoS.** 3 3

Cross sectional area (sft) 0.79 upto 10.0' below 10.0'

Depth, m	Field N	Penetration, cm	N	N'	Average S.P.T.	Cum Allowable Skin Friction, Qa=.02N/F.S., Tons	Allowable End Bearing Capacity, Qa=4N/F.S., Tons	Allowable working load, Tons
1.50	2	30	2	2.0	2.0	0.41	2.09	2.51
3.00	7	30	7	7.0	4.5	1.34	7.33	8.67
4.50	7	30	7	7.0	7.0	2.78	7.33	10.11
6.00	10	30	10	10.0	8.5	4.54	10.47	15.01
7.50	10	30	10	10.0	10.0	6.60	10.47	17.07
9.00	12	30	12	12.0	11.0	8.87	12.57	21.43
10.50	9	30	9	9.0	10.5	11.03	9.42	20.46
12.00	16	30	16	15.5	12.3	13.56	16.23	29.79
13.50	11	30	11	11.0	13.3	16.29	11.52	27.81
15.00	13	30	13	13.0	12.0	18.77	13.61	32.38
16.50	14	30	14	14.0	13.5	21.55	14.66	36.21
18.00	16	30	16	15.5	14.8	24.59	16.23	40.82
19.50	34	30	34	24.5	20.0	28.72	25.66	54.37
21.00	8	30	8	8.0	16.3	32.07	8.38	40.45
22.50	9	30	9	9.0	8.5	33.82	9.42	43.25
24.00	14	30	14	14.0	11.5	36.19	14.66	50.85
25.50	20	30	20	17.5	15.8	39.44	18.33	57.77
27.00	16	30	16	15.5	16.5	42.84	16.23	59.07
28.50	22	30	22	18.5	17.0	46.35	19.37	65.72
30.00	18	30	18	16.5	17.5	49.96	17.28	67.24
31.50	10	30	10	10.0	13.3	52.69	10.47	63.16
33.00	24	30	24	19.5	14.8	55.73	20.42	76.15
34.50	16	30	16	15.5	17.5	59.34	16.23	75.57
36.00	19	30	19	17.0	16.3	62.69	17.80	80.49
37.50	15	30	15	15.0	16.0	65.99	15.71	81.70
39.00	17	30	17	16.0	15.5	69.19	16.76	85.94
40.50	24	30	24	19.5	17.8	72.85	20.42	93.27
42.00	30	30	30	22.5	21.0	77.18	23.56	100.74
43.50	39	30	39	27.0	24.8	82.28	28.27	110.56