LOCAL GOVERNMENT ENGINEERING DEPARTMENT
Local Government Division
Ministry of Local Government, Rural Development & Cooperatives

UPAZILA ENGINEER, LGED, DELDUAR, TANGAIL, BANGLADESH.

PROJECT NAME:
PEDP-4

SCHOOL NAME:
PUTIYAJANI GOVT. PRIMARY SCHOOL
(EMIS CODE: -91306060706)

REPORT ON:
SUB-SOIL INVESTIGATION REPORT ON CONSTRUCTION OF PROPOSED 04 STORIED SCHOOL BUILDING

LOCATION:
DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

SUBMISSION TIME
DECEMBER 2023

SUB – SOIL TESTED & REPORTED BY:
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INDEX FOR APPENDICES

A B B R E V I A T I O N S

API	American Petroleum Institute
ASTM	American Society for Testing & Materials
BH	Bore Hole
C	Cohesion
Cc	Compression index
D	Disturb Sample
E.G.L	Existing Ground Level
e_o	Initial void ratio
FM	Fineness Modulus
FS	Factor of Safety
g	Gravitational acceleration
Gs	Specific gravity
H.F.L	High Flood Level
L.L	Liquid Limit
N.M.C	Normal Moisture Content
P.I	Plasticity Index
P.L	Plastic Limit
q_u	Unconfined Compressive Strength
R.L	Reduce Level
TBM	Temporary Bench Mark
UC	Unconfined Compression
UD	Undisturbed Sample
W.L	Water Level

1. INTRODUCTION:

A Geo-technical investigation was performed for the **construction of proposed 04 Storied Building on Putiyajani Govt. Primary School (EMIS Code: - 91306060706) at Dag No. - 4607, 4684, Khatian No. - 155, 257, Mouza - (Fazilhati), Upazila. - Delduar, Dist. - Tangail, Bangladesh.**

This report consists of various relevant data, drawings, bore logs, graphs etc. for entire satisfaction of the design Engineer. Discussion and recommendation of probable type of foundations have also been included; however, design engineer will select the suitable type of foundation. Subsequent sections of this report contain descriptions of the field exploration and laboratory testing results and general sub-surface conditions.

2. METHODOLOGY:

SONAR BANGLA SURVEY CONSULTANTS has sent experienced team to collect the field test at the site. Team leader of SPT team contracted with representative of client for recognizing the selected land and locations for field test.

2.1 Scope of work:

The main scopes of this investigation work are:

- Execution of exploratory borings, recording of sub-soil stratification and position of ground water table.
- Execution of standard penetration test (SPT) at an interval of 3 ft intervals from 0 ft to 15ft and 5 ft intervals from 15 ft to 50 ft depth of boring.
- Preparation of the final report with all works including detailed description of soil stratification sub-soil.
- From the field tests and laboratory tests, scope of calculation for bearing capacity value for design shallow foundation.
- From the field tests and laboratory tests, scope calculation for the skin friction and rearing values for design deep foundation.

2.2 Field works:

All the field works and field tests were conducted as per standard procedure as laid down in ASTM specification are as follows.

a) Exploratory Boring Drilling:

Drilling was executed by wash boring method (Figure 1). A hole was started by driving vertically a 4” diameter steel casing into the ground to some depth and then the formation ground casing was broken up by repeated drops of a chopping bit attached to the lower and of drilling pipe. The upper end of the same was forced at high pressure through pores of the chopping bit, and returns to the surface through the annular space between drilling pipe and the side of the casing or hole, carrying with it the broken-up soils. In this way drilling is advance up to a level of 6” above the depth, where SPT-N value has to be executed.

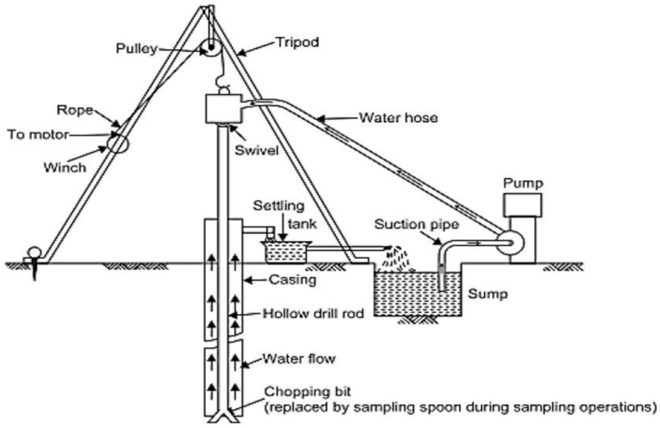


Figure 1: Wash Boring (Murthy, 2002pp.320)

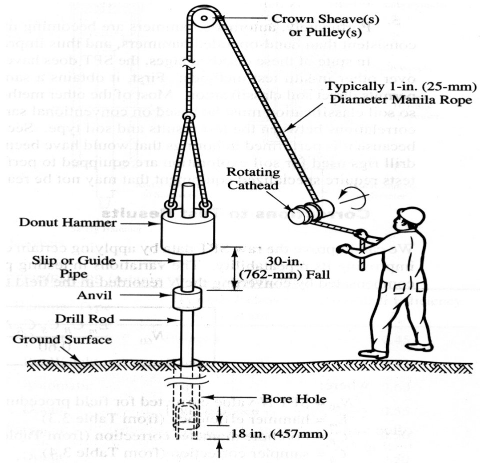


Figure 2: Operation of SPT with Donut Hammer (Coduto, 2001pp117)

b) *Standard Penetration Test (ASTM D 1586):*

Standard Penetration Tests (SPT) have been executed in all the bore holes at 1.5 m intervals up to 30 m depth of boring. In this test, a split spoon sampler of 2" out diameter and 1-3/8" inner diameter is made to penetrate 18 inches, into the soil by drops of a hammer weighting 140 lbs (63.5 kgs) falling freely for a height of 30 inches (Figure 2 & 3). Numbers of blows of hammer required for penetration of each 6" length of the sampler are recorded. The number of blows for the last 12 inches penetration of the total 18" is known as the Standard Penetration Value (N-values) as specified by ASTM and the SPT-N value is plotted with particular depth.

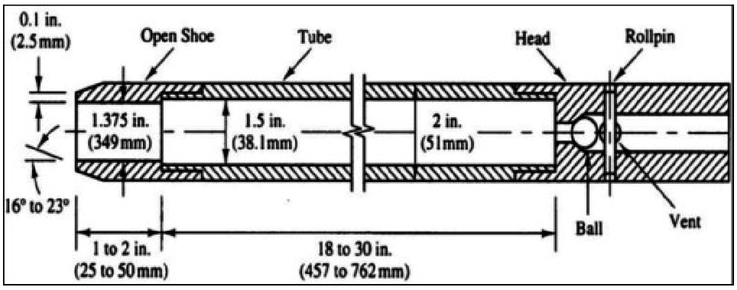


Figure 3: Split Sampler (Coduto, 2001 pp.117)

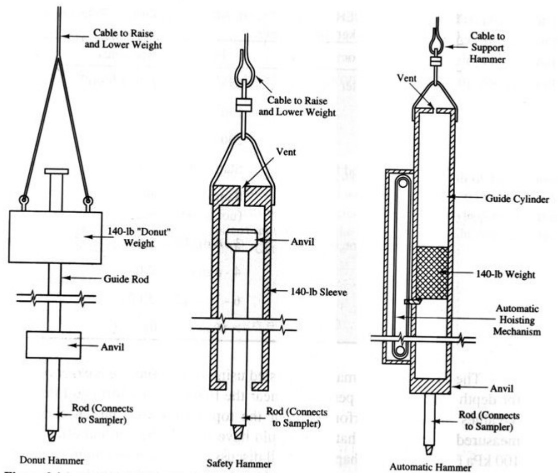


Figure 4: Different type of Hammer used in SPT (Coduto, 2001 pp.121)

It is important to point that several factors contribute to the variation of the Standard Penetration number N at a given depth for similar soil profile. These factors are the SPT hammer efficiency, borehole diameter, sampling method, rod length, water table and overburden pressure. The most two common types of SPT hammers used in the field are the safety hammer and donut hammer. They are usually dropped using a rope with two wraps around a pulley. The configurations of the hammers are shown in figure – 4.

c) *Extraction of disturbed soil sample:*

Disturbed soil samples were collected at different interval but most of them were 1.50 m. Cohesionless soils were sampled with the split spoon sampler in accordance with ASTM D1586 standard procedure. Each sample was removed from the sampler in the field, carefully examined and then classified by geotechnical technician. These soil samples were duly classified in situ in order to construct a depth wise stratification`s chart of borehole and to evaluate the overall sub-soil picture of the investigated site.

Figure 5: Disturb sample extraction

Figure 6: Undisturb sample extraction

d) *Extraction of undisturbed soil sample:*

Undisturbed soil sampling is very important in soil investigation for determination of some important soil properties; Such as shear strength, unit weight, void ratio, compression index Cc, unconfined compression strength, angle of internal friction ϕ etc. Samples of cohesive soils were not obtained with a three-inch thin-walled (Shelby) tube sampler in general accordance with ASTM D 1587.

e) *Recording of ground water level:*

Ground water levels along the project alignment were measured during drilling operation and 24 hours afterward. Specific ground water readings are indicated on the boring logs. It is noted, however, that ground water levels may fluctuate seasonally, climatically and due to other factors not evident at the time of field exploration.

2.3 Laboratory tests:

All laboratory tests were conducted on soil samples collected either in the disturbed or in the undisturbed state. All tests were done as per ASTM procedures, are as follow:

a. *Natural Moisture Content:*

The Water content of a soil sample is the ratio of the weight of the water in the sample to its dry weight. It is usually expressed as a percentage. The soil sample is weighted both in natural state and in oven dry state and the moisture content is calculated by dividing the loss of weight of the sample by its dry weight.

Figure 7: Oven for moisture content finding

Figure 8: Sieve and hydrometer for particle size distribution

b. Particle Size Distribution:

The object of grain size analysis is to determine the size of the soil grains, and the percentage by weight of soil particles of different particles size, comprising a soil sample. The process consists of either sieve analysis or hydrometer analysis or both. The hydrometer analysis is adopted for sample passing sieve No. 200. For hydrometer analysis, 50 gm of the oven dry sample is thoroughly mixed with required quantity of water in a calibrated glass cylinder. In order to avoid flocculation, a little dispersing agent is adding. The density of the suspension is measured at specified time intervals, by means of a hydrometer or special design. At any particular time the size of largest particle remounting in suspension at the level of the hydrometer can be computed by means of Stocks law, whereas the weight of the particles finer then size, can be computed from the density of the suspension at the sample level. The mixture is washed through U.S standard sieve No. 200 and the fraction retained is dried. The friction retained of each sieve is weighted for calculation of the percentage of different friction. The results are represented by cumulative curves plotted on semi logarithmic graph paper.

c. Atterberg Limits:

Physical properties of clay are greatly influenced by water content. A given soil behaves as a fluid or a soil or, as plastic materials, depending on how much water it contains. The water contents that correspond to the boundaries between the states of consistency are called as the Atterberg limits. Liquid limit is the minimum water content at which a clay soil just starts behaving like a fluid. It is determined with the help of a standard liquid limit device. The plastic limit is the minimum water content at which a soil is just plastic and is determined by rolling out a soil sample at a slowly decreasing water content until, the desired water content is reached, at which a thread of 1/8 inch diameter just begging to crumble. The thread is rolled on glass plate with hand.

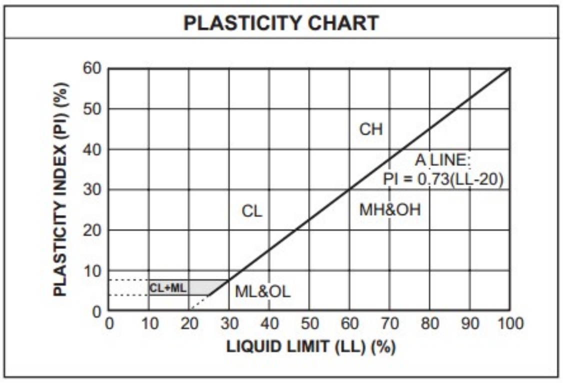


Figure 9: Casagrande apparatus and Atterberg limit cahrt

d. Specific Gravity Test:

The specific Gravity of a solid defined as the rate of the unit weight of the solid in air to the unit weight of water. To determine the specific gravity of soil sample, 25 grams of oven dried soil sample is thoroughly pulverized and is placed in a calibrated pycnometer. Water is poured inside the pycnometer until its top is slightly bellows the calibrated mark. The mixture is then belled thoroughly in order to eliminate the air baubles. More water is then added to mixture till overnight, the temperature is then recorded and the bottle is weighted. The specific gravity G_s is given by:

$$G_s = (G_t \text{ x } W_s) \div (Ws - W_1 + W_2)$$

Where,

G_t = Specific gravity of water at T°C.
W_s = The weight of oven dry soil (25 gms)
W_1 = Weight of flask + soil + water
W_2 = Weight of flask + water

e. Direct Shear Test:

Direct Shear test can be Performed for both cohesion less & cohesive soil to determine shear strength, angle of internal friction, cohesion c, volume change etc. The test is done in a direct shear machine which consists of a normal loading device, shearing device having diameter 6.35 cm and height 2.54 cm, circular box, etc. The rate on shearing displacement of sample approximately 10 mm per minute is determined. The results of a direct shear test on a cohesion less & cohesive soil can be presented in a summary table & by stress-strain curve. A stress- strain curve normally consists of shear stress; various shear displacement for both the undisturbed and the remolded tests under a specified normal load. The normal load usually varies from 1/3 kg/cm^2 to 1 kg/cm^2. Another curve of normal stress verses shearing stress will give angle of internal friction and cohesion for cohesive soil.

Figure 10: Direct Shear Test machine

Figure 11: Unconfined compression test and Consolidation test machine

f. Unconfined Compression Test (ASTM D 2166)

The primary purpose of this test is to determine the unconfined compressive strength, which is then used to calculate the unconsolidated undrained shear strength of the clay under unconfined conditions. According to the ASTM standard, the unconfined compressive strength (qu) is defined as the compressive stress at which an unconfined cylindrical specimen of soil will fail in a simple compression test. In addition, in this test method, the unconfined compressive strength is taken as the maximum load attained per unit area, or the load per unit area at 15% axial strain, whichever occurs first during the performance of a test.

g. Consolidation Test:

Consolidation Test is used to determine the rate and magnitude of settlement in soils. The settlement values obtained by this test are due to primary consolidation only which is 90% of the total consolidation. The results of consolidation test are very much helpful in the design of foundations

Selected soil samples were tested in the laboratory to determined applicable physical and engineering properties. The laboratory program included;

1) Grain size analysis (Sieve & Hydrometer) --4
2) Atterberg's Limit Test (Liquid & Plastic Limit) ------------------------------------2
3) Moisture content Test ---4
4) Direct Shear Test ---2
5) Specific Gravity Test ---4
6) Unconfined Compressive Strength Test --1

2.4 Physical properties:

The overall physical properties of the sub soil formation of the project area have been evaluated on the basis of 2 (Two) boring extending up to depth of 80 ft have been selected and pointed out by the representative of LGED. The physical properties of the investigation site may be discussed as follows:

a) Subsoil stratification :

The layers of the investigated site are extending roughly to the depth of 25 ft & 40 &35 ft. Soil layers are not homogenies.

***b) Ground Water Table (GWT)**:*

The ground water table has not been identified in each borehole which was present 5 ft & 5 ft below from EGL at BH-1 & BH-2, respectively.

Correlation table of soils based on of SPT values:

Two tables for Nom-Cohesive and Cohesive Soils Based on N-Values as below:
Values of approximate unconfined compressive strength based on N-values for Cohesive soil (After K. Terzaghi and R.B. Peck):

Table No:- 1

Consistency	**Very Soft**	**Soft**	**Medium Stiff**	**Stiff**	**Very Stiff**	**Hard**
Unconfined compressive strength, tsf	0-0.25	0.25-0.50	0.50-1.00	1.00-2.00	2.00-4.00	Over 4.00
N-Values	0 to 2	2 to 4	4 to 8	8 to 16	16 to 32	Over 32
Unit weight (Saturated) in pcf	100	100-120	110-130	120-140	130*	130*

In the above table the shear strength of cohesive soil is equal to ½ of unconfined compressive strength and the angle of shearing resistance of that soil is equal to zero. It should be remembered that the correlation for cohesive soil is always much reliable.

c) *Values of Unit Weight and Angle of Internal Friction of Non- Cohesive soil based on N-values (1948 K. Terzaghi and R.B. Peck):*

Table No:- 2

Compactness	**Very loose**	**Loose**	**Medium**	**Dense**	**Very Dense**
Relative Density, %	0% to 15%	15 to 35	35 to 65	65 to 85	85 to 100
N-Values	0 to 4	4 to 10	10 to 30	30 to 50	> 50
Angle of internal friction, ϕ	28	28 to 30	30 to 36	36 to 41	
Unit weight (moist), pcf	< 100+	95 to 125	110 to 130	110 to 140	>130
Submerged unit weight, pcf	< 60	55 to 65	60 to 70	65 to 85	>75

3. Correction of SPT Values

Field SPT values have been corrected for Dilatancy.

In very fine or silty, saturated sand Terzaghi & Peck (First Edition, P-426) recommended that the penetration number be adjusted in N is greater than 15 as

$$N'' = 15+0.5*(N_f-15)$$

4. Earthquake & Seismicity:

Bangladesh has been divided into four Seismic Zones namely Zone-1, Zone-2, Zone-3, and Zone-4 with values of Seismic Zoning coefficient, z of 0.12, 0.20, 0.28 and 0.36 respectively.

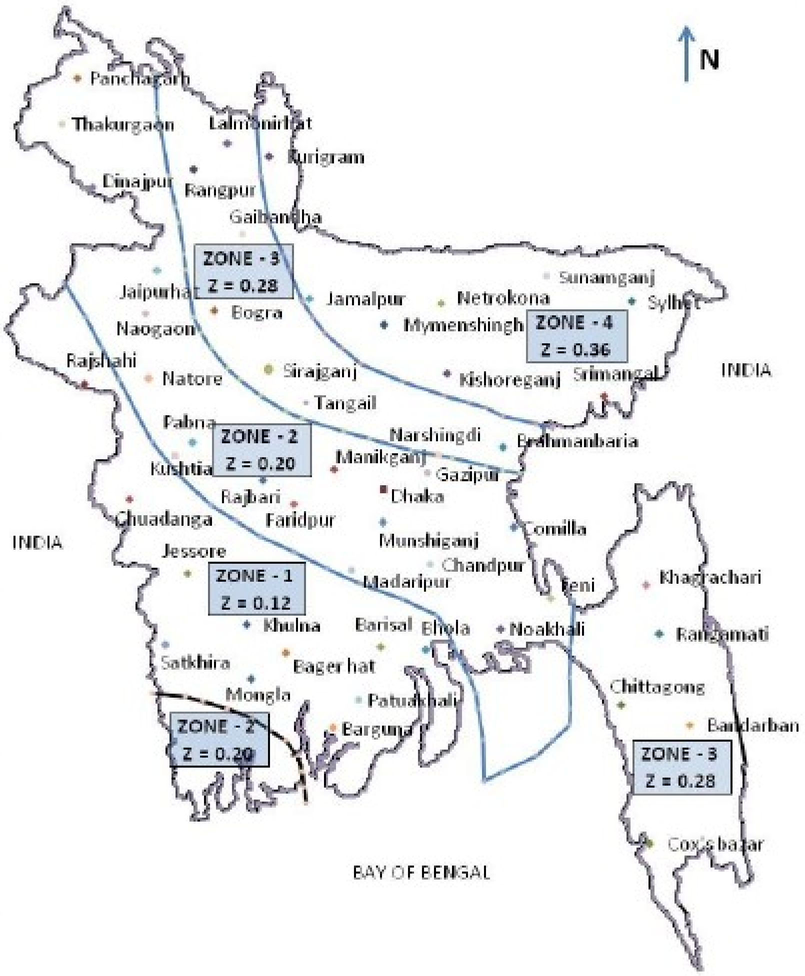


Fig: Seismic zoning map of Bangladesh. Source: BNBC-2020, Part IV, Ch. 02, Page - 3195

According to this Zoning Map, the Project site falls in the **Zone-3**, i.e. in the **Severe** seismic intensity zone.

5. Determination of Settlement of soil:

The magnitude and rate of settlement due to consolidation of normally consolidated soils can be calculated by the following equations (Terzaghi, 1943)

$$S = Cc\, H/(1+ e_0) \log10 (P_0 + \Delta P)/P_0$$

where,

S = Settlement due to consolidation.

Cc= Compression index to be determined from the results of consolidation tests.

H= Thickness of the layer. If the soil is drained on top and bottom as in the consolidation test, half- thickness should be used.

e_0= natural void ratio of the soil in place.

P_0= weight of soil above mid-height of the consolidating layer.

ΔP=consolidation pressure = net additional pressure

6. EVALUATION OF BEARING CAPACITY OF FOUNDATION

a) Shallow foundation

For cohesive soil, the criteria for finding Bearing Capacity is based on the undrained shear strength and there the soil is assumed as purely cohesive soil or may be estimated from the **corrected SPT values.** For granular soil it can be calculated from φ & c values obtained from direct shear tests or from based on **corrected SPT values.** On the basis of above criteria, the Bearing Capacities of the foundation have been evaluated according to Terzaghi, (Appendix A4: (TABLE-1)).

According to Tarzaghi's formula: (For cohesive soil)

1. Square footing: $Qu = 1.3c'Nc + \gamma DNq + 0.4\gamma BN\gamma$
2. Circular footing: $Qu = 1.3c'Nc + \gamma DNq + 0.3\gamma BN\gamma$
3. Strip or Continuous footing: $Qu = c'Nc + \gamma DNq + 0.5\gamma BN\gamma$

For purely cohesive soil, Tarzaghi assumed, $\Phi = 0$, c'=c and the bearing capacity factor are as follows: (for general shear failure), Nc = 5.7, Nq = 1, Nγ = 0

Tarzaghi (1943) proposed a bearing capacity formula:

$$Qult = C\, Nc\, Sc + \gamma\, Df\, Nq + 0.5\, \gamma\, B\, N\gamma\, S\gamma$$

Where Sc & Sγ are shape factor. Tarzaghi assumed, c=0 kg/cm$^{2.}$ Also these are as following:

Table: 3 (Coefficient for the footing)

For	Square	Circular	Strip
Sc	1.3	1.3	1.0
Sγ	0.8	0.6	1.0

According to Meyerhof (1951), the ultimate bearing capacity of strip footing: (Also for footing on slopes)

$$Qu = c'Nc + \gamma D_f Nq + 0.5\gamma BN\gamma$$

Values of Nc, Nq & Nγ are depend on Φ.

Reference: 1) Soil Mechanics and Foundation Engineering by Dr. K. R. Arora
2) Foundation analysis and Design by Joseph E. Bowles, 5th edition.

A4: (TABLE-4) BEARING CAPACITIES OF THE SHALLOW FOUNDATION FROM THE FIELD AND LABORATORY TEST (F.S=2.5)
NOTE:

Cum. Depth from EGL (ft)	Cum. Depth from EGL (m)	FIELD S.P.T.	Corrected S.P.T. Value = N-(N-15)/2	Soil Type	Square Or Circular footing (tsf)	Strip (Continuous) Footing (tsf)
Boring No.- 01						
3.00	1.00	2	2	C	0.41	0.33
6.00	2.00	4	4	C	0.82	0.66
9.00	3.00	4	4	C	0.88	0.73
12.00	4.00	7	7	C	1.47	1.19
15.00	5.00	5	5	C	1.19	0.99
20.00	6.00	8	8	C	1.81	1.49
Boring No.- 02						
3.00	1.00	3	3	C	0.58	0.46
6.00	2.00	5	5	C	0.99	0.79
9.00	3.00	4	4	C	0.88	0.73
12.00	4.00	6	6	C	1.29	1.06
15.00	5.00	9	9	C	1.87	1.52
20.00	6.00	7	7	C	1.64	1.36

1) Structural/ foundation engineer is free from any obligation to use these values. He/she can refine/calculate, taking the soil parameters obtained from field & lab tests.
2) Inclination factor, ground factor & base factors have been considered as 1 in calculation of bearing capacity equation.
3) Symbol: C = Clay
4) The above values are net ones.
5) Skempton's relation was used in case of cohesive soil and Design graphs were used for sandy soil
6) Depth has been measured from EGL of Boreholes.

b) Deep foundation:

Whenever necessary Deep Foundation, preferably Pile may be used. To evaluate skin friction and end bearing capacities following formulae may be used for driven pile-

According to Meryerhof for sandy soil (for bored pile)

$$fsu = q_c / 200 = 4*N''/200 \text{ tsf}$$

$$qpu = q_c = 4*N'' \text{ tsf}$$

However, when soil is not purely sand rather presence of some silt materials is found, above relations may be modified as per observation of Schmertmann (1970): for bored pile

fsu = 3*N”/200 tsf

qpu = 3*N” tsf

According to M. J. Tomlinson for cohesive soil (for bored pile)

fsu = 3*N”/100 tsf

qpu = 3*N”/6 tsf

Depending on the existing soil type, the values of both the skin friction as well as the end bearing capacities of piles have been derived and provided in this report (Appendix A-4 Table-5).

A5: (Table No – 5) The unit allowable skin friction and the unit allowable tip resistance capacities for the bored cast-in-situ pile in ton per square feet (tsf) (F.S = 3.00)

SPT Interval (ft)	Cum. Depth from EGL (ft)	Cum. Depth from EGL (m)	S.P.T.	Corrected S.P.T. Value = N-(N-15)/2	Average S.P.T.	Soil Type	Allowable unit skin friction, fsa (tsf)	Allowable unit end bearing capacity, qpa (tsf)
Boring No.- 01								
0	0.00	0.00	0	0.00	0.00		0.00	0.00
3.00	3.00	1.00	2	2.00	1.00	C	0.01	0.22
3.00	6.00	2.00	4	4.00	3.00	C	0.03	0.44
3.00	9.00	3.00	4	4.00	4.00	C	0.04	0.44
3.00	12.00	4.00	7	7.00	5.50	C	0.06	0.78
3.00	15.00	5.00	5	5.00	6.00	C	0.06	0.56
5.00	20.00	6.00	8	8.00	6.50	C	0.07	0.89
5.00	25.00	7.50	7	7.00	7.50	C	0.08	0.78
5.00	30.00	9.00	22	18.50	12.75	S	0.06	12.33
5.00	35.00	10.50	25	20.00	19.25	S	0.10	13.33
5.00	40.00	12.00	29	22.00	21.00	S	0.11	14.67
5.00	45.00	13.50	30	22.50	22.25	S	0.11	15.00
5.00	50.00	15.00	35	25.00	23.75	S	0.12	16.67
5.00	55.00	16.50	37	26.00	25.50	S	0.13	17.33
5.00	60.00	18.00	41	28.00	27.00	S	0.14	18.67

SPT Interval (ft)	Cum. Depth from EGL (ft)	Cum. Depth from EGL (m)	S.P.T.	Corrected S.P.T. Value = N-(N-15)/2	Average S.P.T.	Soil Type	Allowable unit skin friction, fsa (tsf)	Allowable unit end bearing capacity, qpa (tsf)
Boring No.- 02								
0	0.00	0.00	0	0.00	0.00		0.00	0.00
3.00	3.00	1.00	3	3.00	1.50	C	0.02	0.33
3.00	6.00	2.00	5	5.00	4.00	C	0.04	0.56
3.00	9.00	3.00	4	4.00	4.50	C	0.05	0.44
3.00	12.00	4.00	6	6.00	5.00	C	0.05	0.67
3.00	15.00	5.00	9	9.00	7.50	C	0.08	1.00
5.00	20.00	6.00	7	7.00	8.00	C	0.08	0.78
5.00	25.00	7.50	8	8.00	7.50	C	0.08	0.89
5.00	30.00	9.00	20	17.50	12.75	S	0.06	11.67
5.00	35.00	10.50	24	19.50	18.50	S	0.09	13.00
5.00	40.00	12.00	26	20.50	20.00	S	0.10	13.67
5.00	45.00	13.50	28	21.50	21.00	S	0.11	14.33
5.00	50.00	15.00	32	23.50	22.50	S	0.11	15.67
5.00	55.00	16.50	34	24.50	24.00	S	0.12	16.33
5.00	60.00	18.00	39	27.00	25.75	S	0.13	18.00

Note:

a. SPT (N) values are corrected within calculation.
b. Self-weight of pile and negative skin frictions are not considered in this report.
c. Design engineer is free from any obligation to use these values. He/she can refine/calculate, taking the soil parameters obtained from field & lab tests.
d. Symbol: S = Sand, C = Clay

7. CONCLUSION & RECOMMENDATION:

This report is prepared on the basis of supplied SPT and samples from filed for **construction of proposed 04 Storied Building on Putiyajani Govt. Primary School (EMIS Code: - 91306060706) at Dag No. - 4607, 4684, Khatian No. - 155, 257, Mouza - (Fazilhati), Upazila. - Delduar, Dist. - Tangail, Bangladesh.**

The average bearing capacity of the shallow foundation including isolated column footing may be considered in the following way:

To be considered average 0.87 tsf (F.S =2.5) at the depth of 9’-0” measured from EGL at and around the test point for the site.

Alternatively,

Work type	**Foundation type**	**Compaction materials**	**Mixing ratio**	Length (From E.G.L.)	**Length of Filling**	**Depth of footing**	**Proposed Bearing capacity**
Bearing capacity improvement	Shallow with 98% proper compaction	Khoa & Coarse Sand	2:1	9’-0”	3’-0”	6’-0”	1.19 tsf

PRECAUTIONARY MEASURE

- In case of any excavation, it should be designed properly taking are of existing building, utility lines & available techniques.
- Seismic factors must be considered in design (Ref: Seismic Zoning map of Bangladesh, BNBC)

Note.

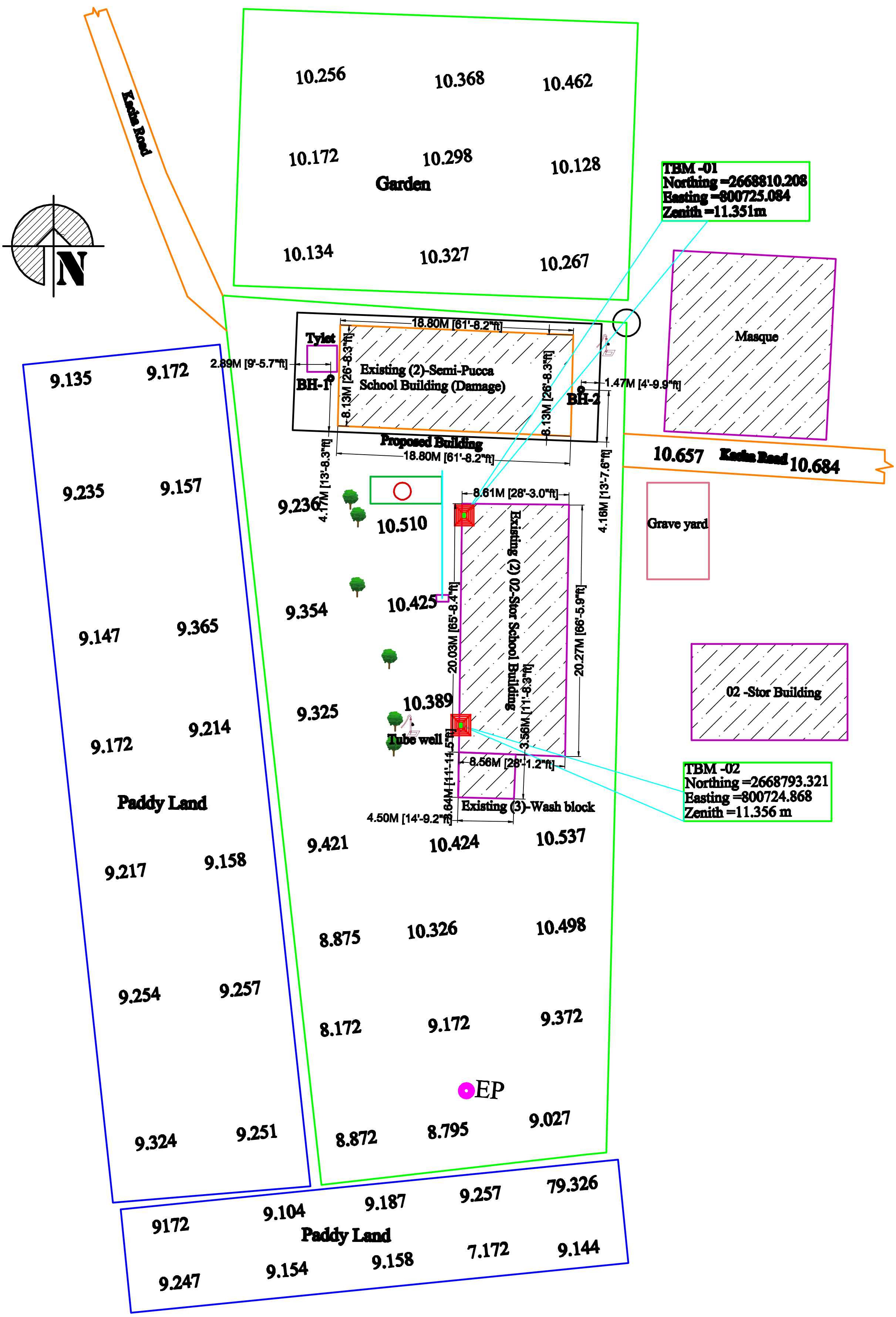
a) 1Tsf = 2ksf = 1.09 Kg/cm^2, 1Ton = 1000kg = 2000 lbs, E.G.L. = Existing Ground Level.
b) Foundation base should be kept dry during construction period.
c) In nature, soils are neither homogeneous nor isotropic.
d) Foundation design engineer may consider any other alternative type, depth as well as bearing capacity of soil according to requirement in the light of information provided in this report.
e) The initiated engineer is responsible only for making this report.
f) Experience and judgment are always necessary in adopting proper soil parameters to use the calculation of ultimate bearing capacity.

However, the design Engineer may select any other alternative type, depth as well as the bearing capacity of the foundation in the light of information provided in this report.

Recommended by

19 No:-Putiajani Dokkhin Govt Primary School

Upazila: Delduar, District: Tangail.



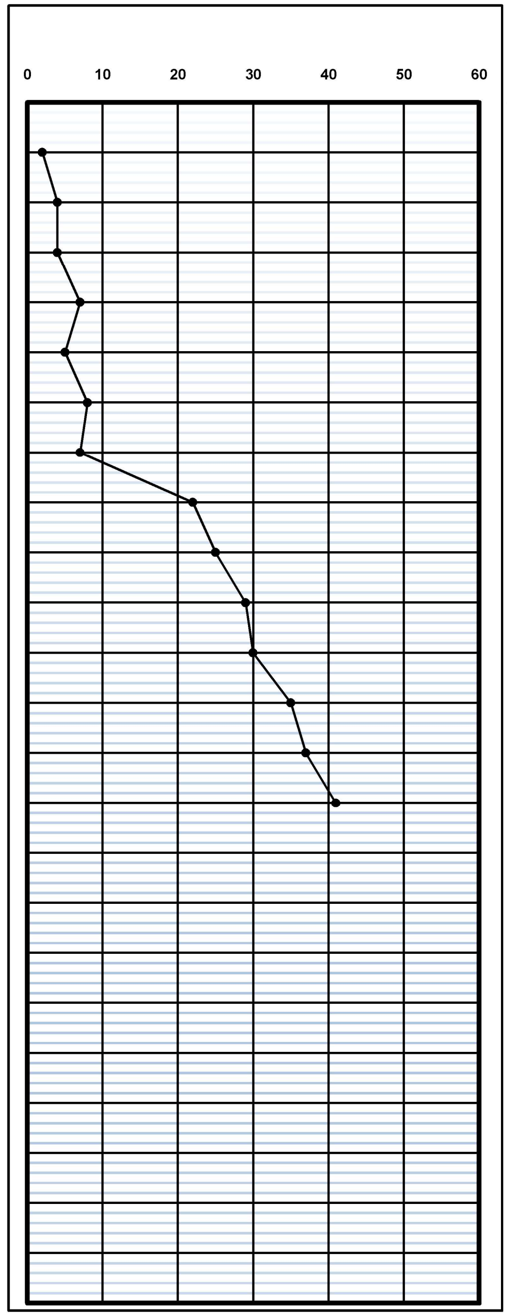
SONAR BANGLA SURVEY CONSULTANTS

CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: -91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Start date:- 09/12/2023	Type of Drilling : Manual drive (Hand Wash)		
Completion date :- 09/12/2023	TBM-01 Kept on the 02 -Stor School Building's Barnda North side		
Weather :- Sunny	ELEVATION RL(m)= 9.263	GWL (m) = -	2.134146341
Bore Hole No. : 01	Total Depth = 18.0 m		

Cum. Depth in ft	Cum. Depth in meter	RL (BH), m	Layer changes, m	Discription of Classification (Visual)	Graphics	Boring Dia	SPT Interval(m)	6"	6"	6"	6"+6"=12"	Sample type	Sample ID
3	1	8.26		Blackish soft to medium stiff, medium plastic clay with trace fine sand and some silt		10cm Percussion Method	1	1	1	1	2		D-1
6	2	7.26					1	1	2	2	4		D-2
9	3	6.26					1	1	2	2	4		D-3
12	4	5.26	3.0	Dark Grey medium stiff, medium plastic clay with trace fine sand and some silt			1	2	3	4	7		D-4
15	5	4.26					1	1	2	3	5		D-5
20	6	3.26					1	2	3	5	8		D-6
25	7.5	1.76					1.5	2	3	4	7		D-7
30	9	0.26	7.5	Dark Grey medium dense fine sand with some silt			1.5	3	12	10	22		D-8
35	10.5	-1.24					1.5	3	10	15	25		D-9
40	12	-2.74					1.5	4	12	17	29		D-10
45	13.5	-4.24	12.00	Light Grey dense fine sand with some silt			1.5	4	14	16	30		D-11
50	15	-5.74					1.5	5	17	18	35		D-12
55	16.5	-7.24					1.5	7	19	18	37		D-13
60	18	-8.74					1.5	8	20	21	41		D-14
			18	Tip of BH RL = 8.74 m									

S.P.T Graph



SAND .... SILTY SAND .... AY .... Y CLAY .... R SH

SPLIT SPOON SAMPLE .... SHELBY TUBE SAMPLE ....

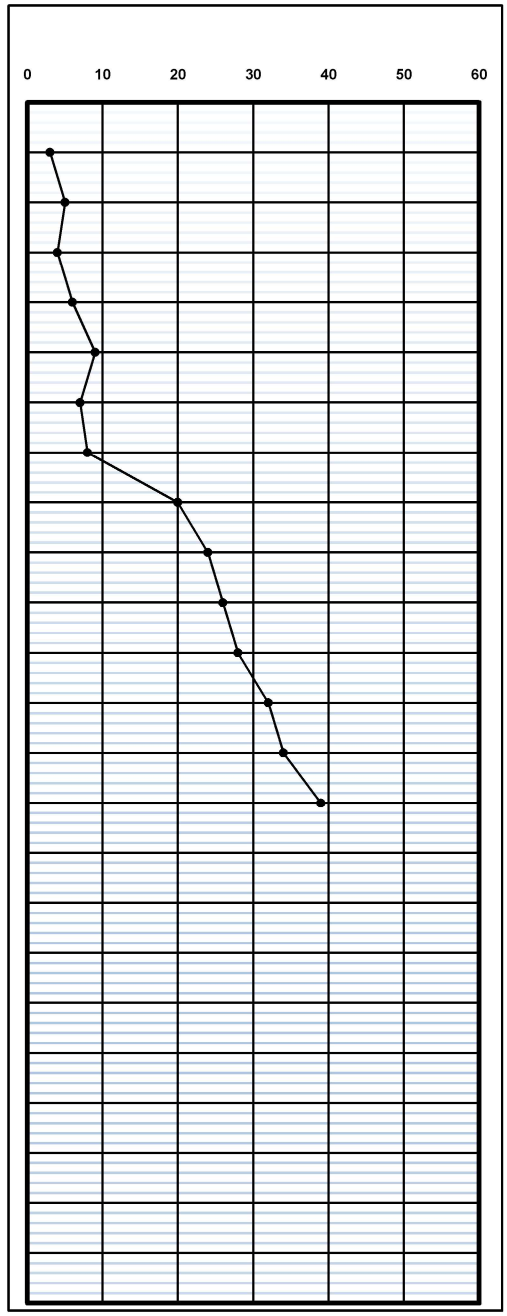
SONAR BANGLA SURVEY CONSULTANTS

CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Start date:- 09/12/2023	Type of Drilling : Manual drive (Hand Wash)
Completion date :- 09/12/2023	TBM-01 Kept on the 02 -Stor School Building's Barnda North side
Weather :- Sunny	ELEVATION RL(m)= 10.602 GWL (m) = - 2.43902439
Bore Hole No. : 02	Total Depth = 18.0 m

Cum. Depth in ft	Cum. Depth in meter	RL (BH), m	Layer changes, m	Discription of Classification (Visual)	Graphics	Boring Dia	SPT Interval(m)	6"	6"	6"	6"+6"=12"	Sample type	Sample ID
3	1	9.60		Blackish soft to medium stiff, medium plastic clay with trace fine sand and some silt		10cm Percussion Method	1	1	1	2	3		D-1
6	2	8.60					1	1	2	3	5		D-2
9	3	7.60					1	1	2	2	4		D-3
12	4	6.60	3.0	Dark Grey medium stiff to stiff, medium plastic clay with trace fine sand and some silt			1	2	2	4	6		D-4
15	5	5.60					1	2	4	5	9		D-5
20	6	4.60					1	2	3	4	7		D-6
25	7.5	3.10					1.5	2	3	5	8		D-7
30	9	1.60	7.5	Dark Grey medium dense fine sand with some silt			1.5	3	9	11	20		D-8
35	10.5	0.10					1.5	3	11	13	24		D-9
40	12	-1.40					1.5	4	12	14	26		D-10
45	13.5	-2.90					1.5	4	13	15	28		D-11
50	15	-4.40	13.5	Light Grey dense fine sand with some silt			1.5	5	15	17	32		D-12
55	16.5	-5.90					1.5	6	16	18	34		D-13
60	18	-7.40					1.5	8	19	20	39		D-14
			18	Tip of BH RL = 7.40 m									

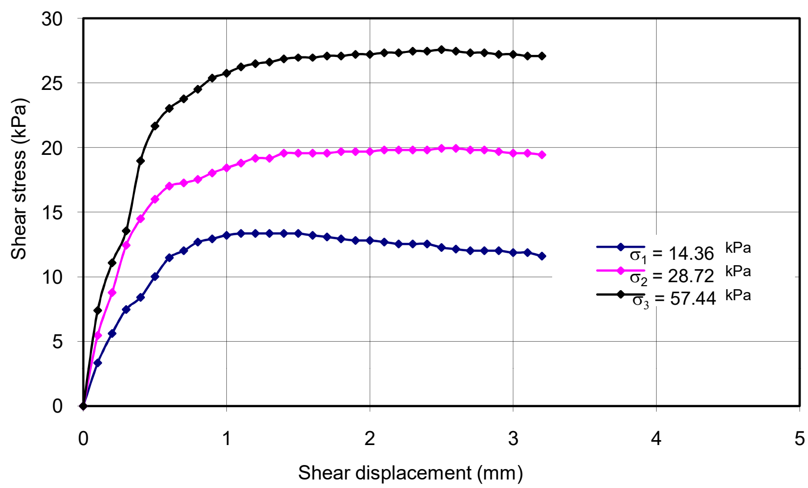
S.P.T Graph

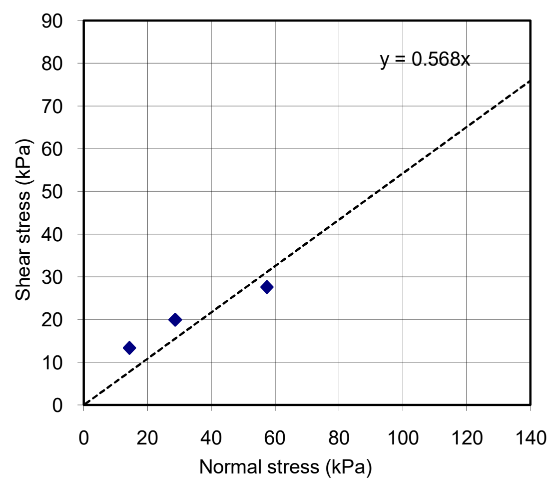


SAND .... SILTY SAND .... CLAY .... SILTY CLAY .... RUBBISH

SPLIT SPOON SAMPLE .... SHELBY TUBE SAMPLE ....

SONAR BANGLA SURVEY CONSULTANTS		
DIRECT SHEAR TEST (QUICK TYPE)		
Test Specification: ASTM D 2166 - 00		
PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.		
BH No. : 1	Sample ID : D-11	Depth: 45





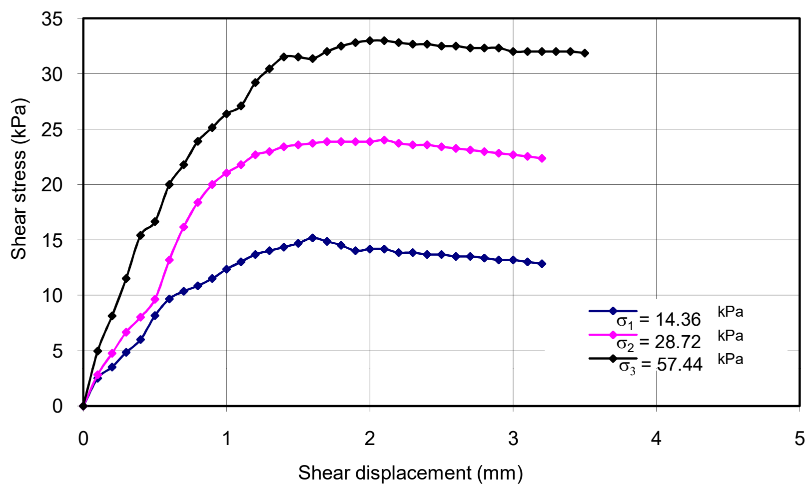
Result : ϕ = 25.92 C (kPa)= 0

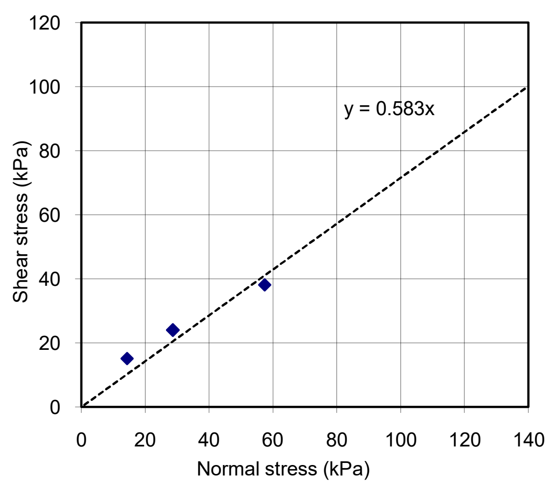
Countersigned By : Test Performed By:

Engr. Mohsin Jaman Engr. Rubel Islam

SONAR BANGLA SURVEY CONSULTANTS
DIRECT SHEAR TEST (QUICK TYPE)
Test Specification: ASTM D 2166 - 00
PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

BH No. :	2	Sample ID : D-11	Depth:	45





Result : ϕ = 27.61 C (kPa)= 0

Countersigned By : Test Performed By:

Engr. Mohsin Jaman Engr. Rubel Islam

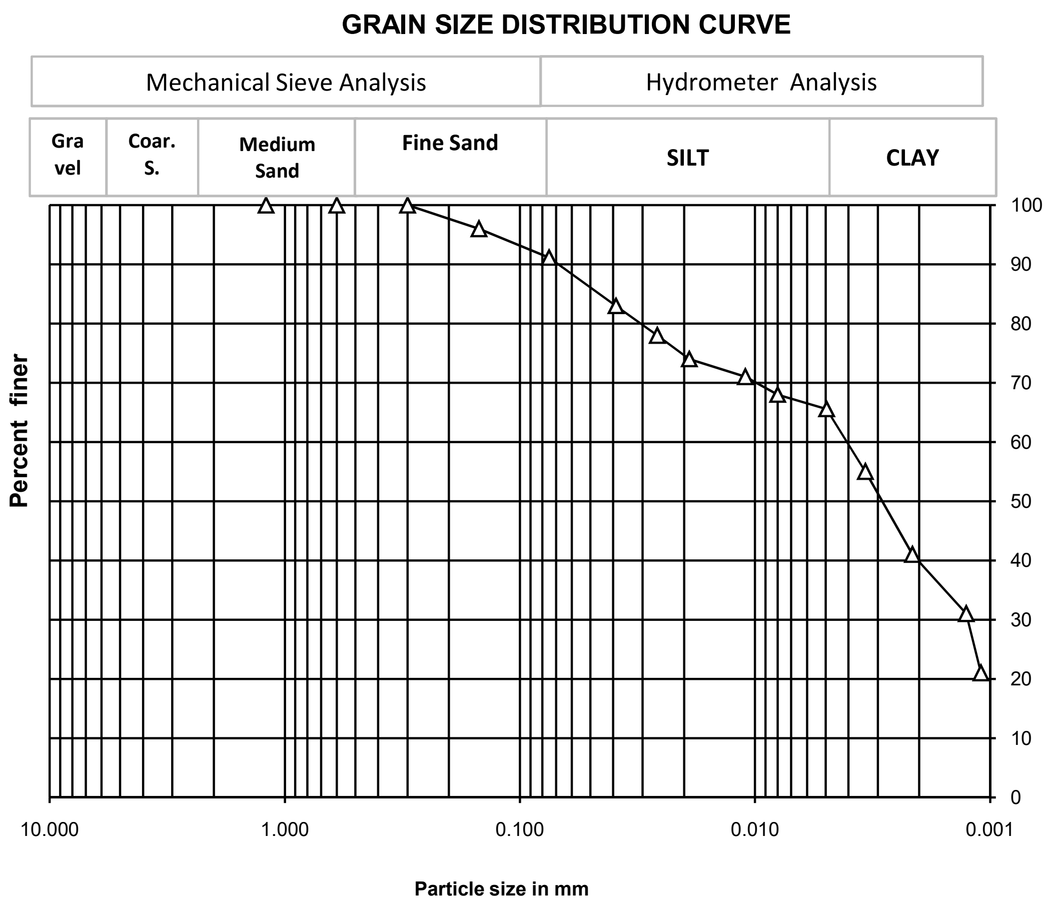
SONAR BANGLA SURVEY CONSULTANTS

Particle Size Analyis Report

Soil specification: As per USCS / ASTM D 2487

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Bore Hole No	Sample ID	Depth (ft)	Dry Sample (gm)	Moisture Content (%)	Sand	Silt	Clay	Sp. Gravity
1	D-7	25	87.45	23.43	**8.85**	**25.58**	**65.57**	2.6735



Tested by
Engr. Rubel Islam

Counter Checked by
Engr. Mohsin Jaman

SONAR BANGLA SURVEY CONSULTANTS

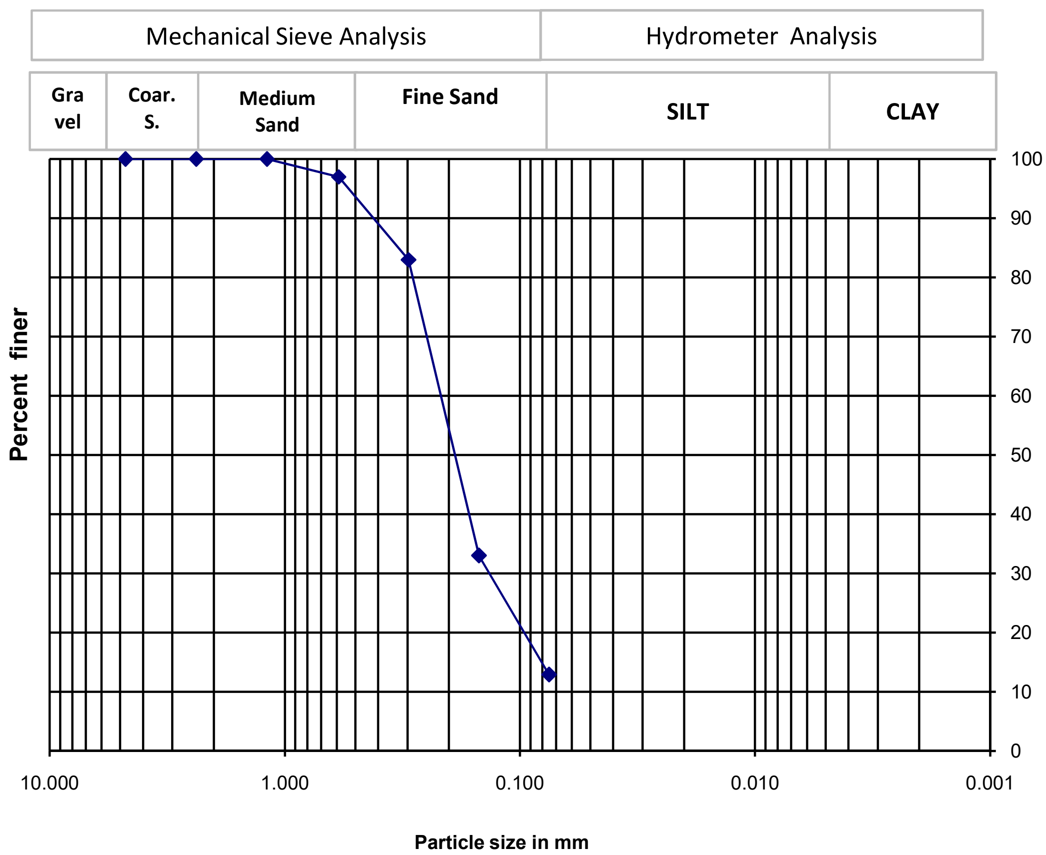
Particle Size Analyis Report

Soil specification: As per USCS / ASTM D 2487

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Bore Hole No	Sample ID	Depth (ft)	Dry Sample (gm)	Moisture Content (%)	Sand	Silt	Clay	Sp. Gravity
1	D-14	60	95.65	25.54	87.11	12.89		2.6846

GRAIN SIZE DISTRIBUTION CURVE



Tested by	Counter Checked by
Engr. Rubel Islam	Engr. Mohsin Jaman

SONAR BANGLA SURVEY CONSULTANTS

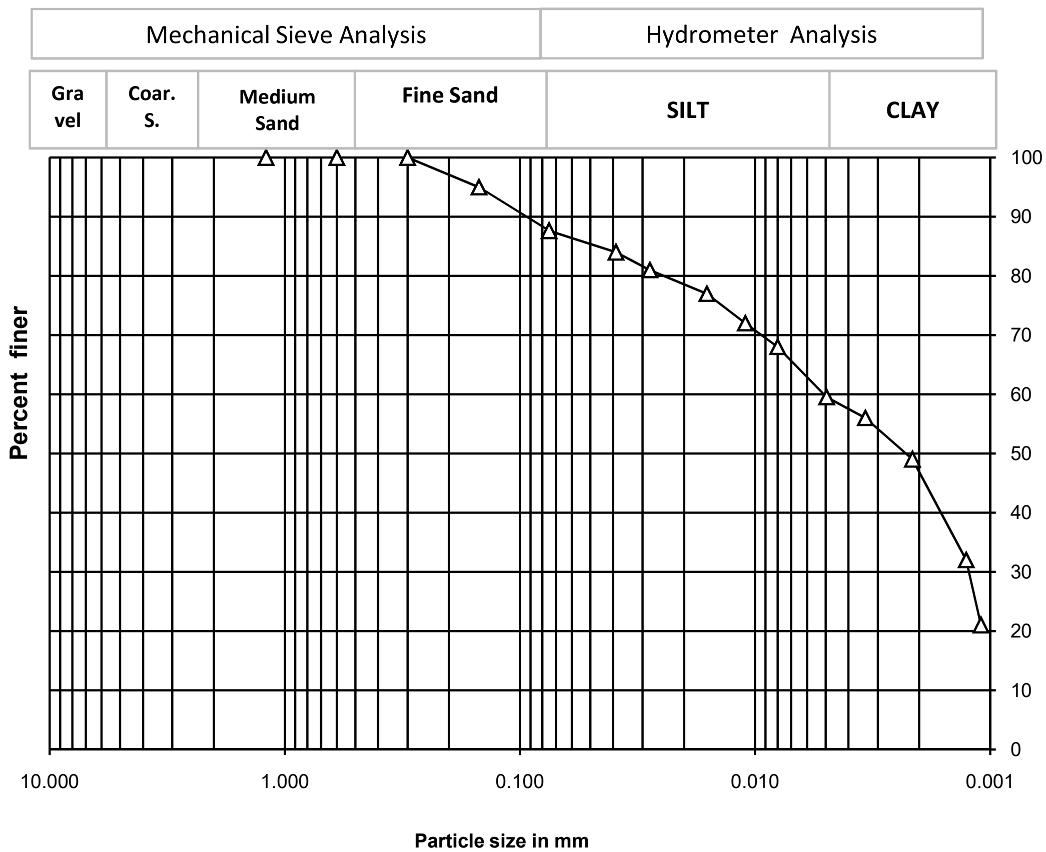
Particle Size Analyis Report

Soil specification: As per USCS / ASTM D 2487

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Bore Hole No	Sample ID	Depth (ft)	Dry Sample (gm)	Moisture Content (%)	Sand	Silt	Clay	Sp. Gravity
2	D-7	35	82.42	24.17	**7.98**	**21.65**	**70.37**	2.6734

GRAIN SIZE DISTRIBUTION CURVE



Tested by
Engr. Rubel Islam

Counter Checked by
Engr. Mohsin Jaman

SONAR BANGLA SURVEY CONSULTANTS

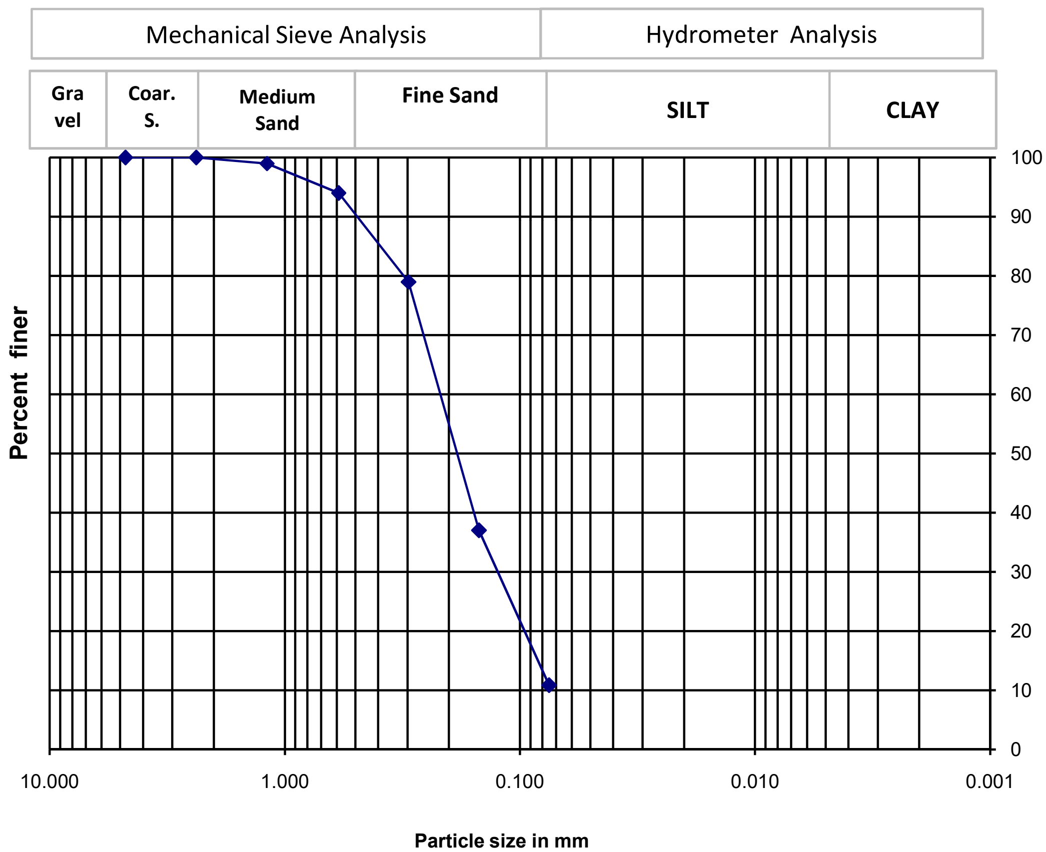
Particle Size Analyis Report

Soil specification: As per USCS / ASTM D 2487

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Bore Hole No	Sample ID	Depth (ft)	Dry Sample (gm)	Moisture Content (%)	Sand	Silt	Clay	Sp. Gravity
2	D-14	60	96.59	24.54	**89.16**	**10.84**		2.6847

GRAIN SIZE DISTRIBUTION CURVE



Tested by

Engr. Rubel Islam

Counter Checked by

Engr. Mohsin Jaman

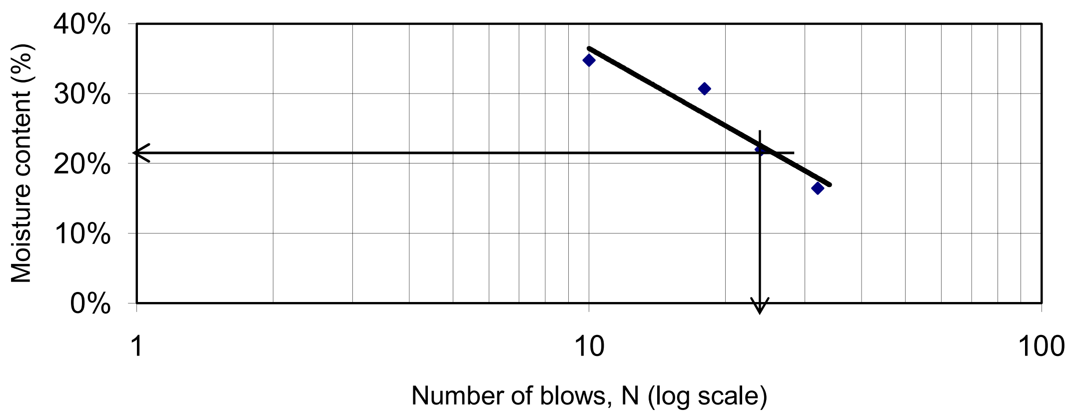
SONAR BANGLA SURVEY CONSULTANTS

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

ATTERBERG LIMIT TEST AS ASTM D 4318

BH NO.	Sample No.	Depth (ft)	Test Date
1	D-2	6	27.12.2023

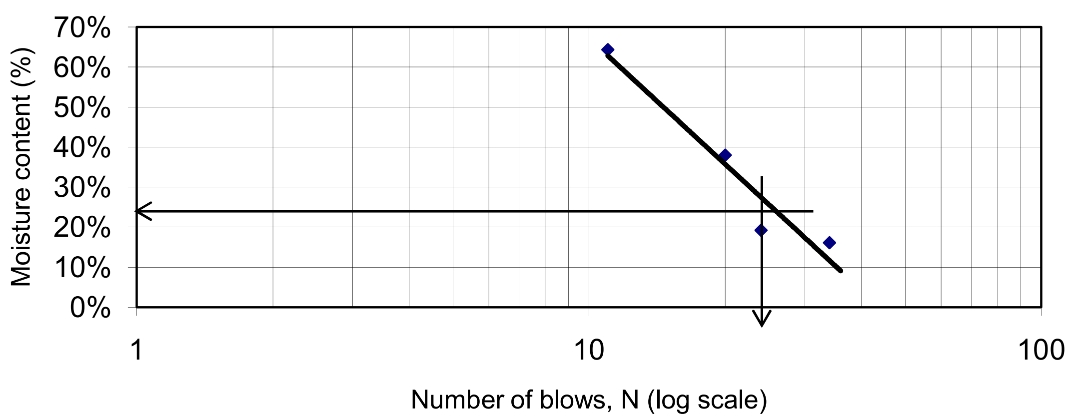
Liquid Limits Test Results



Sample Type	Clay	LL=	26.2	PL =	18.4	PI =	7.8

BH NO.	Sample No.	Depth (ft)	Test Date
2	D-2	6	27.12.2023

Liquid Limits Test Results



Sample Type	Clay	LL=	28.3	PL =	20.5	PI =	7.8

Tested By: Engr. Mohsin Jaman

Checked by:
Engr. Rubel Islam

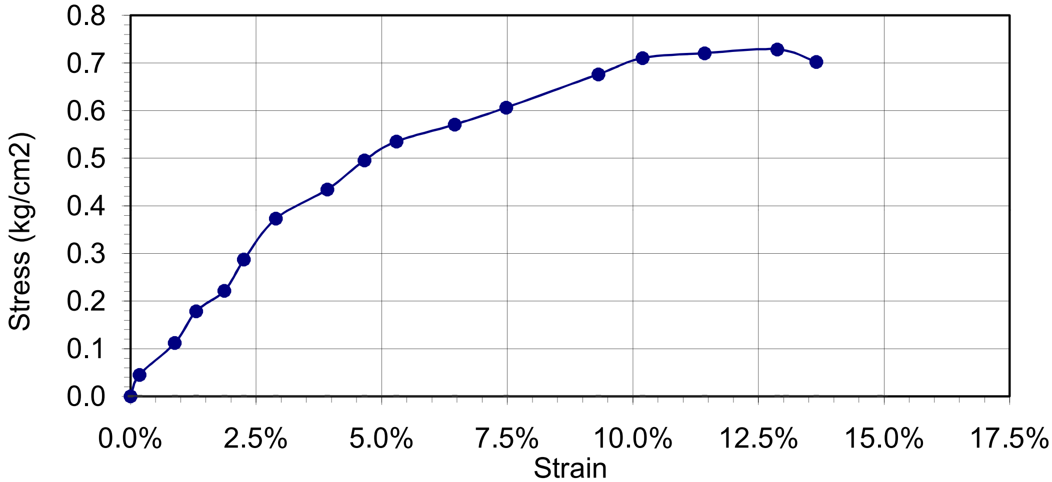
SONAR BANGLA SURVEY CONSULTANTS

Test Specification: ASTM D 2166 - 00

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Type of specimen	Clay (CL)	Sample ID: UD-1	
Date of testing	27/12/2023	Moisture Content:	27.01%
Bore hole number	BH-1	Wet Density, ρw (g/cc):	1.570944
Depth of sample (ft)	7 to 8.5	Dry Density, ρd (g/cc):	1.236858

Unconfined Compressive Strength Results



Result :

Unconfined compressive strength, kg/cm2:	0.7024
Strain Failure:	13.7%

Countersigned By :

Test Performed By:

Engr. Mohsin Jaman

Engr. Rubel Islam

SOIL TESTING LAB

SONAR BANGLA SURVEY CONSULTANTS

(SUMMARY OF LABORATORY TEST RESULTS)

PROJECT: CONSTRUCTION OF PROPOSED 04 STORIED BUILDING ON PUTIYAJANI GOVT. PRIMARY SCHOOL (EMIS CODE: - 91306060706) AT DAG NO. - 4607, 4684, KHATIAN NO. - 155, 257, MOUZA - (FAZILHATI), UPAZILA. - DELDUAR, DIST. - TANGAIL, BANGLADESH.

Bore Hole No		1					2									
Sample No		D-11	D-2	D-7	D-14	UD-1	D-11	D-2	D-7	D-14						
Depth (ft)		45	6	25	60	7 to 8.5	45	6	35	60						
Moisture Content (Natural) (%)				23.43	25.54	27.01			24.17	24.54						
Specific Gravity				2.6735	2.6846				2.6734	2.6847						
Atterberg Limit	Liquid Limit (LL)		26.2					28.3								
	Plastic Limit (PL)		18.4					20.5								
	Plastacity Index(PI)		7.8					7.8								
Density	Wet Density (gm/cc)					1.57										
	Dry Density (gm/cc)					1.23686										
Grain Size Analysis (Mechanical)	Sand (%)				87.11					89.16						
	Fines (%)				12.89					10.84						
Grain Size Analysis (Hydrometer)	Sand (%)			8.85					7.98							
	Silt (%)			25.58					21.65							
	Clay (%)			65.57					70.37							
Unconfined Compression Test	Unconfined Compression Strength, qu (kg/cm^2)					0.7024										
	Strain At Failure (%)					13.6525										
Direct Shear Test	Φ (Degree)	25.92					27.61									
	Cohesion, kPa	0					0									
Result checked by Engr. Mohsin Jaman																