CLIENT:

DHAKA WASA

REPORT ON:

SUB – SOIL INVESTIGATION WORK AT DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.





Submission Date : February – 2026

Number of Bore Hole : 04.

SUB – SOIL TESTED & REPORTED BY:

IDEAL TECHNOLOGY SOIL & ENGINEERS

SOIL TEST, DIGITAL SURVEY, LAYOUT SURVEY, SITU PILE, SAND PILE, PRE-CAST PILE & ETC.

SOIL LABORATORY OFFICE:

306 / 7, UTTAR BADDA, HOSSAIN MARKET, BADDA, DHAKA – 1212.

MOB:- 01910-507552, 01719-947959.

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1.0 INTRODUCTION:

A geotechnical investigation was performed for the Sub – Soil Investigation Work At Dasherkandi Sewerage Treatment Plant, Dhaka, Bangladesh.
This report consists of various relevant data, drawings, bore logs, graphs, etc. for the entire satisfaction of the Design Engineer. Subsequent sections of this report contain descriptions of the field exploration and laboratory testing results and general sub-surface conditions.

2.0 METHODOLOGY:

IDEAL TECHNOLOGY SOIL & ENGINEERS sent the SPT team for the field test at the site. The SPT team leader contracted with the client's representative to recognize the selected land and locations for field tests.

2.1 Scope of work:

The main scopes of this investigation work are:

a. Execution of exploratory borings, recording of sub-soil stratification, and position of groundwater table.
b. Execution of standard penetration test (SPT) at a 5ft depth interval with the collection of disturbed soil samples up to the final depth exploration of each boring.
c. Preparation of the final report with all works including detailed description of soil stratification sub-soil.
d. From the field tests and laboratory tests, scope of calculation for bearing capacity value for design shallow foundation.
e. For loose and soft strata, from the field and laboratory tests, scope calculation for the skin friction and rearing values for design deep foundation.

3.0 FIELD WORKS:

All the field works and field tests were conducted as per standard procedure as laid down in **ASTM specifications** as follows:

3.1 Exploratory Boring Drilling:

Drilling was executed by the wash boring method. 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 end of the drilling pipe. The upper end of the same was forced at high pressure through a pressure pipe. Forced slurry or water emerges at high velocity through the pores of the chopping bit, and returns to the surface through the annular space between the drilling pipe and the side of the casing or hole, carrying with it the broken-up soils. In this way, drilling is advanced up to a level of 6" above the depth, where SPT has to be executed.



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3.2 Standard Penetration Test:

Standard penetration Tests have been executed in all the bore holes at 5ft. interval of depth up to the final depth of boring. In this test, a split spoon sampler of 2" out diameter and 1-3/8" inner weighing 140 lbs. failing freely for a height of 30 inch length of the sampler is recorded. The number of blows for the last 12 inch penetration of the total 18 inch is known as the standard penetration value (N-Values) as **specified by ASTM** and is plotted SPT value of the particular depth.

3.3 Extraction of soil samples:

Distributed soil samples were collected at 5'-0" intervals and every change of soil strata by split spoon sampler. These soil samples were studied visually and the soil classification was done to prepare a strata chart of soils up to the explored depth. Before collection of samples, the hole is washed and cleaned the drill pipe with the help of an adapter and is lowered into the hole. The sampler is then pressed down into the ground in one rapid continuous movement until the tube, except 4 inches from the top is filled with a soil sample. Undisturbed soil samples are taken at a depth where a layer of soil is changed such as 8ft or 12ft. Undisturbed soil samples are collected by means of thin-walled sharp ended 3 inch dia. Shelby tube from the cohesive soil formation. The collected tubes were then labeled with detailed job designation, and date and shifted to the laboratory for testing.

4.0 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, which are as follows:

4.1 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 weighed both in its natural state and in oven oven-dry state and the moisture content is calculated by dividing the loss of weight of the sample by its dry weight.

4.2 Complete Grain Size Analysis:

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 particle sizes, 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, 40 gms of the oven-dry sample, is thoroughly mixed with the required quantity of water in a calibrated glass cylinder. To avoid flocculation, a little dispersing agent is added. 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 the largest particle remounting in suspension at the level of the hydrometer can be computed by means of Stocks Law, whereas

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the weight of the particles finer than size, can be computed from the density of the suspension at the same level.

The mixture is washed through U.S Standard sieve No. 200 and the fraction retained is dried. The fraction retained on each sieve is weighed for calculation of the percentage of different fraction. The results are represented by cumulative curves plotted on semi-logarithmic graph paper.

4.3 Atterberg limits:

The physical properties of clay are greatly influenced by moisture content. A given soil behave as fluid or soil or, as a plastic material, depending on how much water contents that correspond to the boundaries between the states of consistency are called as the Atterberg limit.
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 limit device which consists of brass cup and an arrangement to impart blows to cup at an uniform rate. The water content at which 25 blows are required is termed as the limit.
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 a glass plate with a hand.

4.4 Specific Gravity Test:

The specific gravity of a solid is defined as the ratio of the unit weight of the solid in air to the unit weight of water. To determine the specific gravity of soil samples, 25 grams of oven dried soil sample is thoroughly pulverized and is placed in a calibrate pycnometer. Water is purred incise the pycnometer until its top is lightly below the calibrated mark. The mixture is then boiled thoroughly to eliminate all the air bubbles. More water is then added to the mixture till it over night, the temperature is then recorded and the bottle is weighed.

The specific Gravity Gs is given by:

$$Gs = \frac{Gt \times Ws}{Ws - W1 + W2}$$

Where,

Gt = Specific Gravity of water at T°C.
Ws = The weight of over dry soil (25 gm).
W1 = Weight of flask + soil + water.
W2 = Weight of flask + water.

4.5 Direct Shear Test:

Direct shear tests 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, 5 cm by two pieces sample, square box, etc. The rate on the shearing displacement of approximately 10 mm per minute is often for a sample used for a sample thickness of about 1.2 cm.

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The results of a direct shear test on cohesion less & cohesive soil can be presented in a summary table & by stress-strain curve. A stress-strain curve normally consists of shear Stress, and 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. Another curve normal stress versus shearing stress will give an angle of internal friction and cohesion for cohesive soils.

4.6 Unconfined Compression Test:

The unconfined compression test is a simple method for determining of shearing strength of cohesive soil which is important to determine the bearing capacity of soil. As the name implies, the lateral confining pressure in an unconfined compression test is kept at zero, unsupported specimen, and at failure is measured. The specimen is prepared from the undisturbed soil sample by carefully trimming it to a cylindrical shape of 7 cm height and 3.5 cm diameter. The specimen is then placed on the level pedestal of the unconfined compression apparatus in a vertical position. The load is applied axially on the top of the specimen an is distributed uniformly over surface of the specimen with the help of double providing ring assembly fitted with a strain gauge, fitted with the apparatus. The load is applied at such a rate that the vertical deformation of the sample is nearly 2% (two percent) per minute in order to avoid and drainage during compression. The load is kept increasing until the specimen fails along the shearing plane. The maximum load at failure is known as the unconfined compressive strength of the sample the shearing strength of the sample is half of the unconfined compressive strength.

4.7 Consolidation Test:

The gradual process compression of soil under the action of static load and with decrease of void ratio due to expulsion of water from the soil pores is tar med consolidation phenomenon compressibility characteristics of a soil as the period and magnitude of settlement of a foundation depends on these characteristics. The test is performed on a specimen of circular shape of 6.35 cm dia and 2.54 cm thickness, the specimen is prepared from the undisturbed sample by carefully trimming it to the required dimension with the help of a cutting edge and wire saw the specimen is then placed in the consolidation ring and its top and bottom are trimmed of level with that of the ring. The specimen along with the ring on the top and the other at the bottom of the help of a level arrangement with the apparatus. Decreases in volume of specimen are read from a strain gauge attached to the consolidation unit at specified time intervals the consolidation unit is always kept full with water in order to avoid evaporation of the specimen.

The load increment is allowed after each twenty four hours, the observed readings are then plotted on semi-logarithmic graph paper to give the pressure-void ratio curve from which compression index, Cc. can be calculated. Cc. is important factor governing the settlement process of underlying soils.

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5.0 DESCRIPTION OF SOIL COMPOSITION:

The following terms are used in this report for description of soil composition:

Trace	:	1 to 10%
Little	:	11 to 20%
Some	:	20 to 35%
Sandy	:	35 to 50%
Clayey	:	35 to 50%
Silty	:	35 to 50%

6.0 PHYSICAL PROPERTIES:

The overall physical properties of the sub-soil formation of the project area have been evaluated based on 04 (Four) boring extending up to the depth of 60'-0" have been selected and pointed out by the owner. The physical properties of the investigation site may be discussed as follows:

6.1 Ground Water Table (GWT):

The groundwater table has been not identified in each borehole.

6.2 Correlation table of soils based on of SPT values:

Two tables for Nom-Cohesive and Cohesive Soils Based on N-Values as below:

6.3 Values of approximate unconfined compressive strength based on N-values for Cohesive soil (After K. Terzaghi and R.B. Peck):

Table No: - 1

N-Values	Condition	Unconfined compressive strength, Tsf	Remarks
Bellow 2	Very Soft	Bellow 0.25	To be used with extreme caution.
2-4	Soft	0.25-0.50	
4-8	Medium	0.50-1.00	
8-15	Stiff	1.00-2.00	
15-30	Very Stiff	2.00-4.00	
Over 30	Hard	Over 4.00	

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.

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



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Table No: - 2

N-Values	Condition	Relative density %	Angle of internal friction	Moist unit Wt. in gm/cc.
0-4	Very loose	0.0-0.20	25°-30°	1.12-1.60
4-10	Loose	0.20-0.40	30°-35°	1.44-1.84
10-30	Medium	0.40-0.60	35°-40°	1.76-2.08
30-50	Dense	0.60-0.85	40°-45°	1.76-2.24
Over 50	Very Dense	1.00	45°	2.08-2.40

The tabulated values apply for dry/moist cohesion's sand. For silts sands the bearing capacity values must be reduced by study of grain size classification and applying judgment. Collection for water table close to bottom of foundation the bearing values should be reduced to half. The bearing values are, however, not affected by the water table to a depth greater than 1.5 bearing capacity bellow foundation level, bearing capacity being least dimension of the table may be reduced by linear interpolation.

7.0 CORRECTION OF THE SPT VALUES

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

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

$N' = (4*N)/(1+2*P_o')$ when $P_o' < 1.5$ ksf

$N' = (4*N)/(3.25+0.5*P_o')$ when $P_o' > 1.5$ ksf

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



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8.0 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. According to this Zoning Map, the Project site falls in the Zone-2, (Zone 1 = low, Zone 2 = moderate, Zone 3 = Severe, Zone 4 = very Severe)

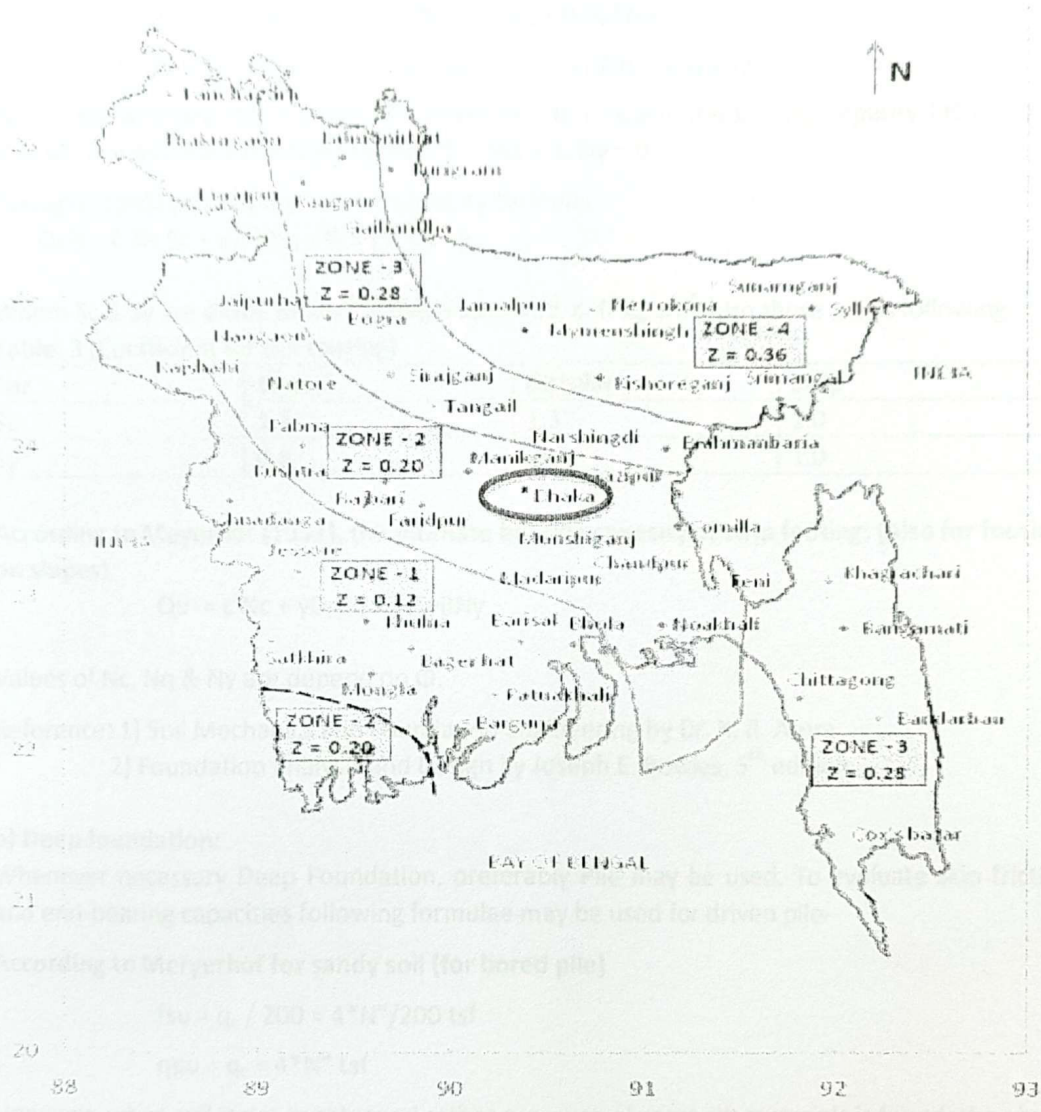


Fig: Seismic Zoning Map of Bangladesh (Source: BNBC 2020, Part-6, Ch-2, pg-80, Clause-2.5.6)

9.0 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 the above criteria,

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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), $Nc = 5.7$, $Nq = 1$, $N\gamma = 0$

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.

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, the above relations may be modified as per the observation of Schmertmann (1970): for Cast-in-Situ pile

$$fsu = 3*N''/200 \text{ tsf}$$

$$qpu = 3*N'' \text{ tsf}$$

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

$$fsu = 3*N''/100 \text{ tsf}$$

$$qpu = 3*N''/6 \text{ tsf}$$

Ultimate bearing capacity = Skin friction capacity (fs) + End bearing capacity (qp)
Allowable bearing capacity = Ultimate bearing capacity / F.S (F.S = 3).

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10.0 TABLE NO:-4

BEARING CAPACITIES OF THE SHALLOW FOUNDATION FROM THE FIELD AND LABORATORY TEST (F.S.=3.0)

Depth from EGL (ft)	Depth from EGL (m)	FIELD S.P.T.	Corrected S.P.T. Value = N-(N-15)/2	Soil Type	Bearing Capacity of Circular or Square footing (tsf)	Bearing Capacity of Continuous Footing (tsf)
Boring No.- 01						
5.00	1.52	5	5.00	C	0.84	0.67
10.00	3.05	4	4.00	C	0.79	0.66
15.00	4.57	7	7.00	C	1.34	1.10
20.00	6.10	13	13.00	C	2.33	1.88
Boring No.- 02						
5.00	1.52	3	3.00	C	0.54	0.44
10.00	3.05	4	4.00	C	0.79	0.66
15.00	4.57	8	8.00	C	1.49	1.21
20.00	6.10	14	14.00	C	2.47	2.00
Boring No.- 03						
5.00	1.52	6	6.00	C	0.99	0.78
10.00	3.05	4	4.00	C	0.79	0.66
15.00	4.57	7	7.00	C	1.34	1.10
20.00	6.10	12	12.00	C	2.18	1.77
Boring No.- 04						
5.00	1.52	4	4.00	C	0.69	0.56
10.00	3.05	5	5.00	C	0.94	0.77
15.00	4.57	9	9.00	C	1.63	1.33
20.00	6.10	13	13.00	C	2.33	1.88

NOTE:

1) The Bearing Capacity Factors have been taken from Terzaghi's Bearing Capacity Factor Table.
2) The derived values are approximate. 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.
3) Ground water level was considered at EGL.

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11.0 Bearing Capacities of Piles from the SPT and soil test parameters:

Table No. 5. The unit skin friction and the end bearing capacities for the bored piles in tsf (F.S = 3.00)

Depth (ft)	Depth from EGL (ft)	Depth from EGL (m)	S.P.T.	Corrected S.P.T. Value = N-(N-15)/2	Average S.P.T.	Soil Type	fsa (tsf)	qpa (tsf)
Boring No.- 01								
0	0.00	0.00	0	0.00	0.00	C	0.00	0.00
5	5.00	1.52	5	5.00	2.50	C	0.03	0.56
5	10.00	3.05	4	4.00	4.50	C	0.05	0.44
5	15.00	4.57	7	7.00	5.50	C	0.06	0.78
5	20.00	6.10	13	13.00	10.00	C	0.10	1.44
5	25.00	7.62	4	4.00	8.50	C	0.09	0.44
5	30.00	9.15	5	5.00	4.50	C	0.05	0.56
5	35.00	10.67	10	10.00	7.50	C	0.08	1.11
5	40.00	12.20	17	16.00	13.00	S	0.07	10.67
5	45.00	13.72	14	14.00	15.00	S	0.08	9.33
5	50.00	15.24	23	19.00	16.50	S	0.08	12.67
5	55.00	16.77	27	21.00	20.00	S	0.10	14.00
5	60.00	18.29	31	23.00	22.00	S	0.11	15.33
Boring No.02								
0	0.00	0.00	0	0.00	0.00	C	0.00	0.00
5	5.00	1.52	3	3.00	1.50	C	0.02	0.33
5	10.00	3.05	4	4.00	3.50	C	0.04	0.44
5	15.00	4.57	8	8.00	6.00	C	0.06	0.89
5	20.00	6.10	14	14.00	11.00	C	0.11	1.56
5	25.00	7.62	7	7.00	10.50	C	0.11	0.78
5	30.00	9.15	10	10.00	8.50	C	0.09	1.11
5	35.00	10.67	20	17.50	13.75	S	0.07	11.67
5	40.00	12.20	15	15.00	16.25	S	0.08	10.00
5	45.00	13.72	17	16.00	15.50	S	0.08	10.67
5	50.00	15.24	22	18.50	17.25	S	0.09	12.33
5	55.00	16.77	30	22.50	20.50	S	0.10	15.00
5	60.00	18.29	33	24.00	23.25	S	0.12	16.00
Boring No. 03								
0	0.00	0.00	0	0.00	0.00	C	0.00	0.00
5	5.00	1.52	6	6.00	3.00	C	0.03	0.67
5	10.00	3.05	4	4.00	5.00	C	0.05	0.44
5	15.00	4.57	7	7.00	5.50	C	0.06	0.78
5	20.00	6.10	12	12.00	9.50	C	0.10	1.33
5	25.00	7.62	6	6.00	9.00	C	0.09	0.67
5	30.00	9.15	8	8.00	7.00	C	0.07	0.89
5	35.00	10.67	17	16.00	12.00	S	0.06	10.67
5	40.00	12.20	19	17.00	16.50	S	0.08	11.33
5	45.00	13.72	26	20.50	18.75	S	0.09	13.67
5	50.00	15.24	30	22.50	21.50	S	0.11	15.00
5	55.00	16.77	34	24.50	23.50	S	0.12	16.33
5	60.00	18.29	38	26.50	25.50	S	0.13	17.67

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Boring No. 04								
0	0.00	0.00	0	0.00	0.00	C	0.00	0.00
5	5.00	1.52	4	4.00	2.00	C	0.02	0.44
5	10.00	3.05	5	5.00	4.50	C	0.05	0.56
5	15.00	4.57	9	9.00	7.00	C	0.07	1.00
5	20.00	6.10	13	13.00	11.00	C	0.11	1.44
5	25.00	7.62	8	8.00	10.50	C	0.11	0.89
5	30.00	9.15	10	10.00	9.00	C	0.09	1.11
5	35.00	10.67	18	16.50	13.25	S	0.07	11.00
5	40.00	12.20	24	19.50	18.00	S	0.09	13.00
5	45.00	13.72	30	22.50	21.00	S	0.11	15.00
5	50.00	15.24	29	22.00	22.25	S	0.11	14.67
5	55.00	16.77	33	24.00	23.00	S	0.12	16.00
5	60.00	18.29	36	25.50	24.75	S	0.12	17.00

Note:

a. C = Cohesive soil, S = Non Cohesive soil.

b. f_{sa} = Allowable value of the skin friction.

c. q_{pa} = Allowable value of the pile end bearing capacity.

d. SPT (N) values are corrected within calculation.

e. The drive values are approximate. Structural/foundation engineer is free from any obligation to use these values. He/she can refine/ recalculate, taking the soil parameters obtained from field & lab tests.

f. The theories on the ultimate bearing capacity presented in this report are based on idealized conditions of soil profiles.

g. Hence, experience and judgment are always necessary in adopting proper soil parameters to use the calculation of ultimate bearing capacity.

1Tsf = 2ksf = 1.09 Kg/cm^2, 1Ton = 1000kg = 2000 Lbs,

E.G.L. = Existing Ground Level.

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12.0 *CONCLUSION & RECOMMENDATION:*

CONCLUTION:

The overall investigation results of the site defines that **Shallow Foundation & Pile Foundation** is suitable for the best economic and structurally safe of the project.

RECOMMENDATION:

On the basis aforesaid condition, the following recommendations are suggested for Sub – Soil Investigation Work at Dasherkandi Sewerage Treatment Plant, Dhaka, Bangladesh.

The bearing capacity of the soil strata has been given in the table - 04 & 05.

The foundation design engineer may select the type, depth as well as bearing capacity.

Note.

a) 1Tsf = 2ksf = 1.09 Kg/cm^2, 1Ton = 1000kg = 2000 Lbs = 9.87kn,
   E.G.L. = Existing Ground Level.
b) The theories on the ultimate bearing capacity presented in this report are based on idealized conditions of soil profiles. This is, in most field conditions, not true. Soil profiles are not always homogenous and isotropic.
c) Pile load test should be performed if pile load test is not performed then the value of pile should be Considered half
d) Hence, 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.

09.02.2026

ENGR. MOHAMMAD MOHSIN JAMAN
B.Sc Engineer Civil BUET
Fellow Member (IES)
F/09429 Soil & Foundation Engr.

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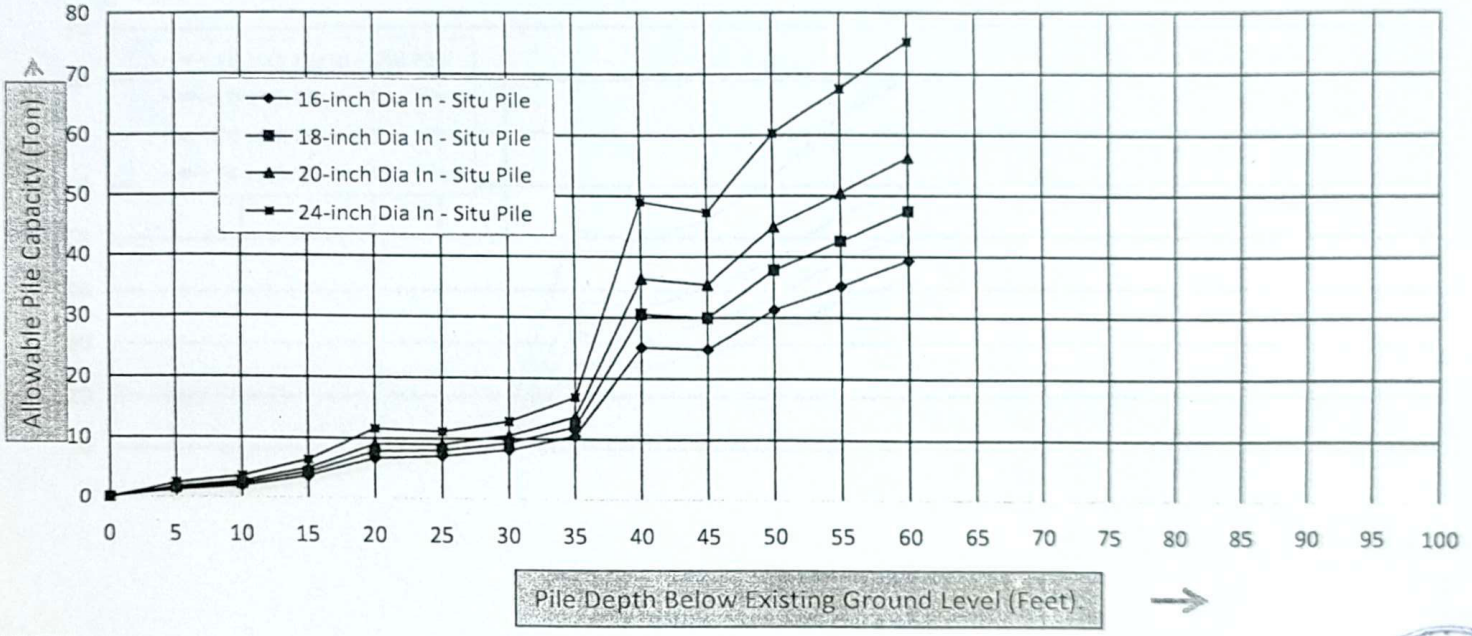
APPENDIX 1 : ALLOWABLE BEARING CAPACITY OF SINGLE PILE

Scanned with CamScanner

Bore Hole No. 01

Table No. 05

PILE DESIGN CHART, F.S. = 3.0.



NOTE:

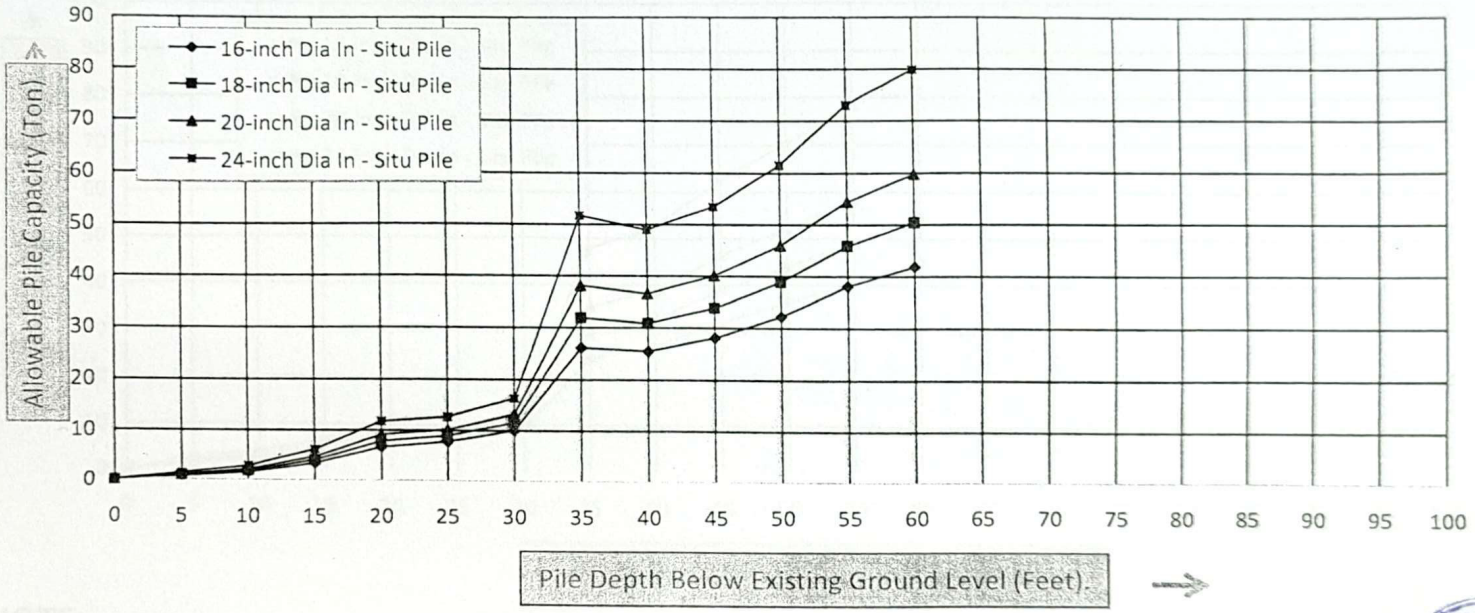
1. The Allowable axial compression loads shown in this figure include a minimum factor of safty (F.S.) of 3.00.
2. The center to center spacing / distances for the piles should be 2.5 to 3 times of diamter of pile.
3. The pile caps should be extended beyond the outside face of exterior piles at least 0.5 of diameter of pile

IDEAL TECHNOLOGY SOIL & ENGINEER

Bore Hole No. 02

Table No. 05

PILE DESIGN CHART, F.S. = 3.0.



NOTE:

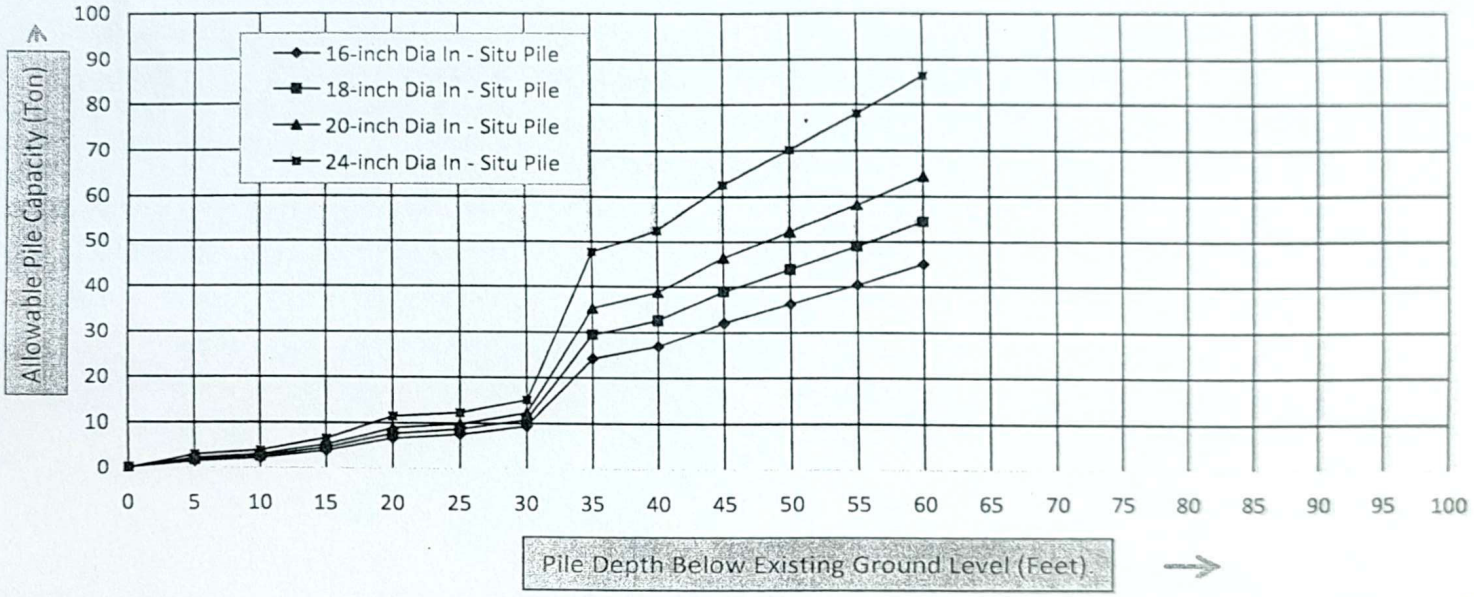
1. The Allowable axial compression loads shown in this figure include a minimum factor of safty (F.S.) of 3.00.
2. The center to center spacing / distances for the piles should be 2.5 to 3 times of diamter of pile.
3. The pile caps should be extended beyond the outside face of exterior piles at least 0.5 of diameter of pile

IDEAL TECHNOLOGY SOIL & ENGINEER

Bore Hole No. 03

Table No. 05

PILE DESIGN CHART, F.S. = 3.0.



NOTE:

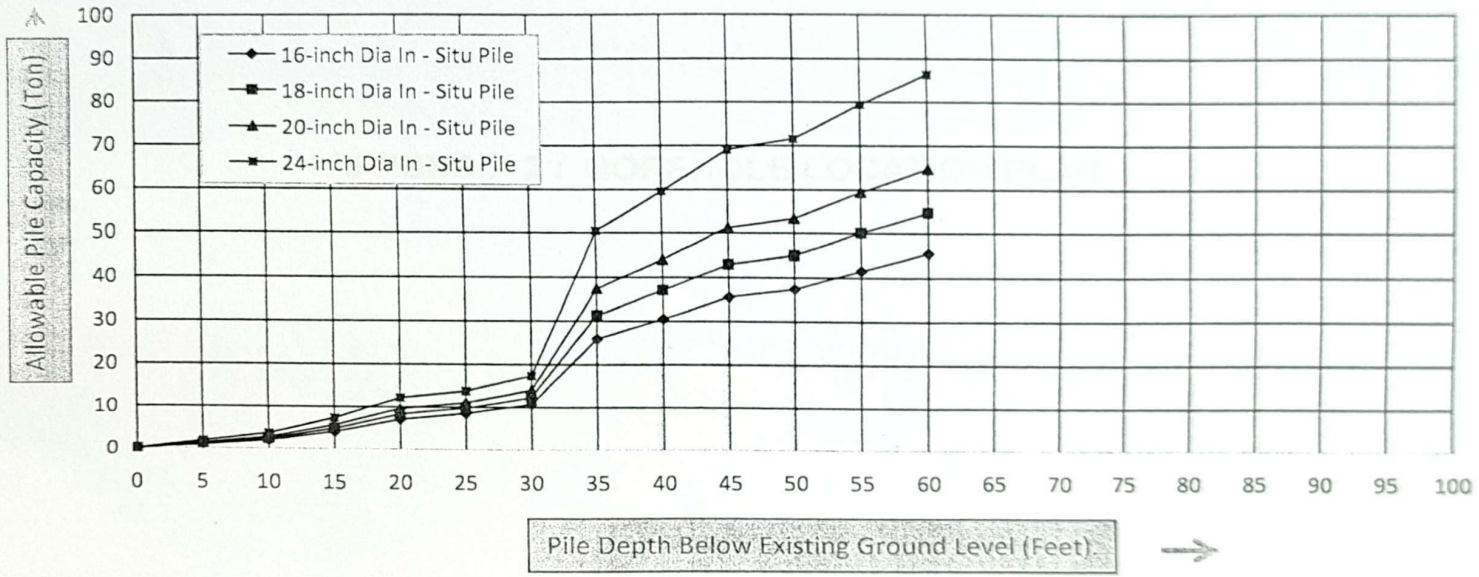
1. The Allowable axial compression loads shown in this figure include a minimum factor of safty (F.S.) of 3.00.
2. The center to center spacing / distances for the piles should be 2.5 to 3 times of diamter of pile.
3. The pile caps should be extended beyond the outside face of exterior piles at least 0.5 of diameter of pile

IDEAL TECHNO SOIL & ENGINEER

Bore Hole No. 04

Table No. 05

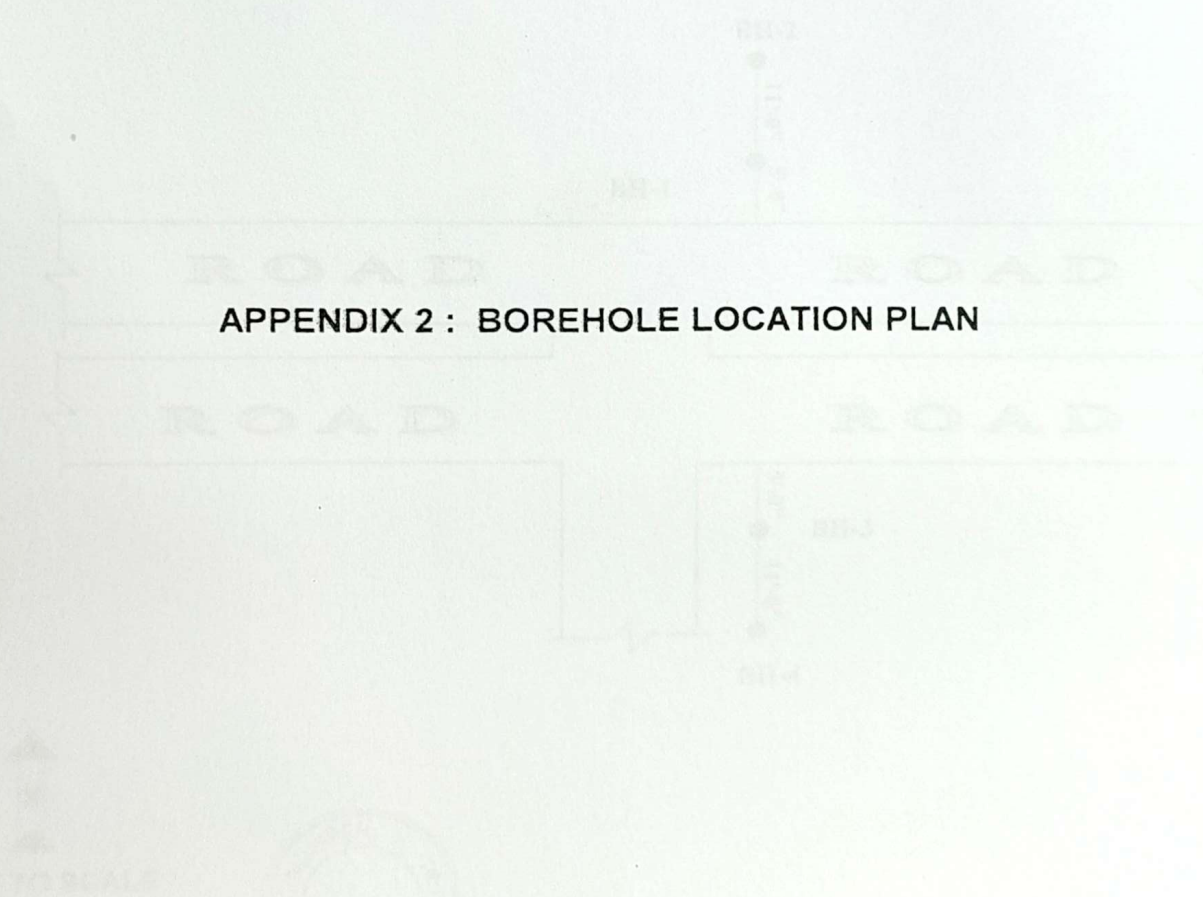
PILE DESIGN CHART, F.S. = 3.0.



NOTE:

1. The Allowable axial compression loads shown in this figure include a minimum factor of safty (F.S.) of 3.00.
2. The center to center spacing / distances for the piles should be 2.5 to 3 times of diamter of pile.
3. The pile caps should be extended beyond the outside face of exterior piles at least 0.5 of diameter of pile

APPENDIX 2 : BOREHOLE LOCATION PLAN



LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.	**SITE PLAN**	IDEAL TECHNOLOGY SOIL & ENGINEERS

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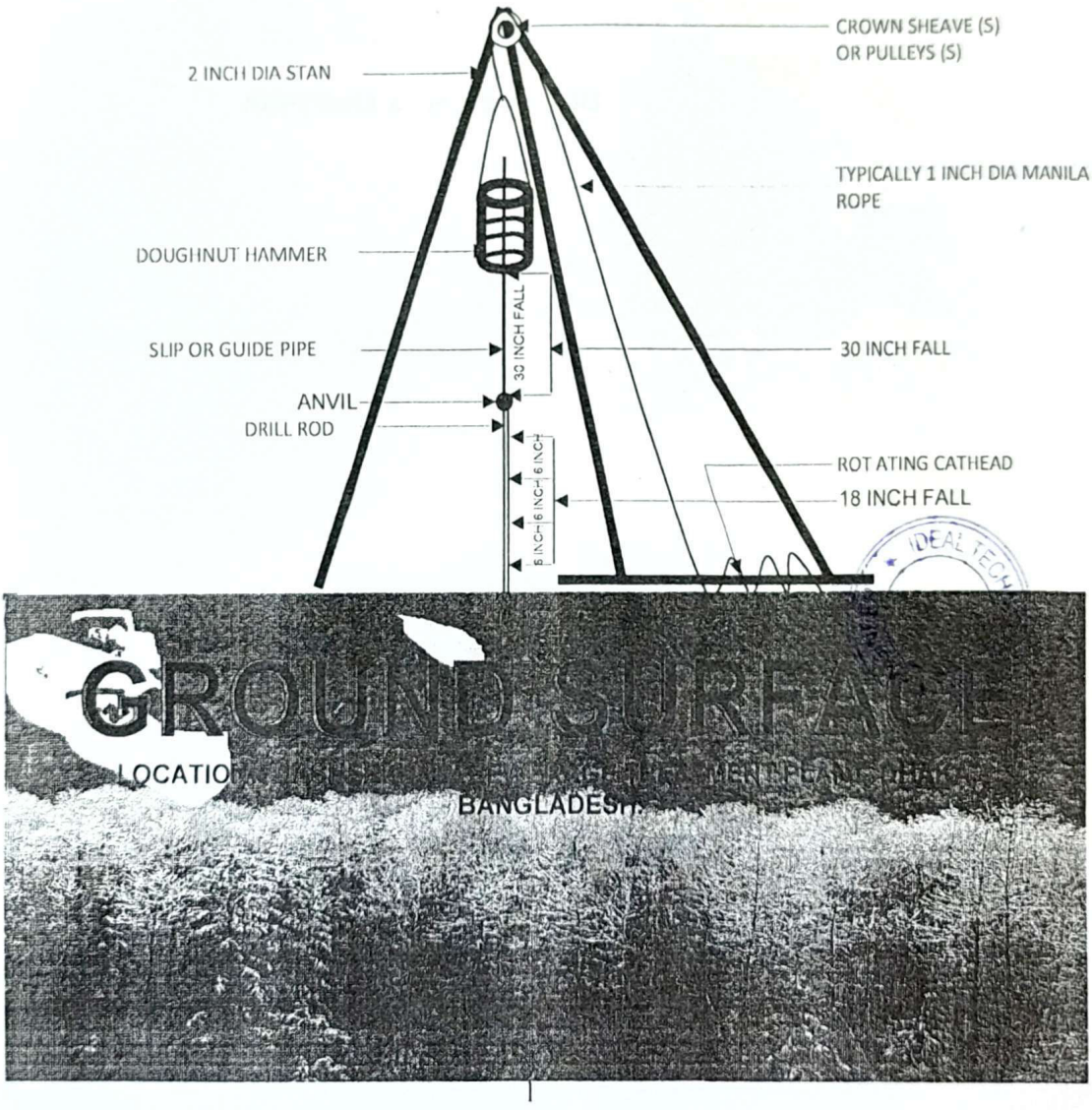
APPENDIX 3 : MANUAL DRIVE (HAND WASH)

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TYPE OF DRILLING : MANUAL DRIVE (HAND WASH)

STANDARD PENETRATION TEST:

STANDARD PENETRATION TESTS HAVE BEEN EXECUTED IN ALL THE BORE HOLES AT 5FT. INTERVAL OF DEPTH UP TO THE FINAL DEPTH OF BORING, IN THIS TEST, A SPLIT SPOON SAMPLER OF 2" OUT DIAMETER AND 1-3/8" INNER WEIGHING 140LBS/63.5KG. FAILING FREELY FOR A HEIGHT OF 30" LENGTH OF THE SAMPLER IS RECORDED. THE NUMBER OF BLOWS FOR THE LAST 12" PENETRATION OF THE TOTAL 18" IS KNOWN AS THE STANDARD PENETRATION VALUE (N - VALUES) AS **SPECIFIED BY ASTM** AND IS PLOTTED **SPT** VALUE OF THE PARTICULAR DEPTH.



APPENDIX 4 : BORING LOG

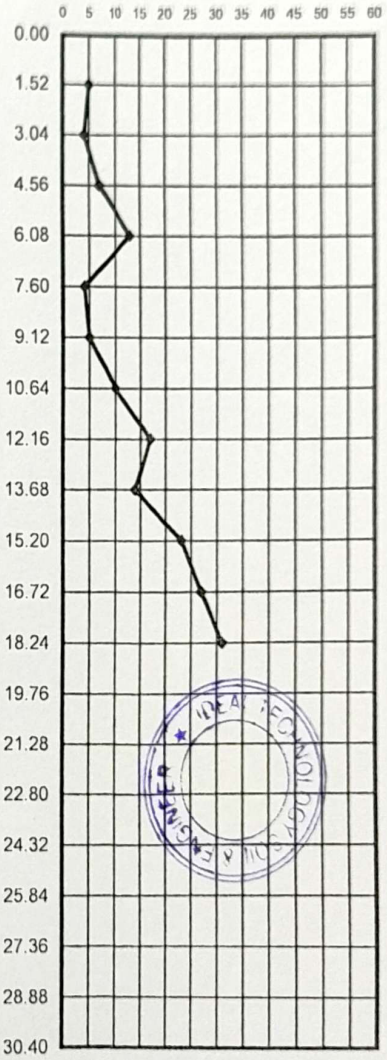
Scanned with CamScanner

IDEAL TECHNOLOGY SOIL & ENGINEERS

Bore Hole No.01	LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.		
Date of Start	26.01.26	Type of drilling:Manual drive (Hand Wash)	
Date of Completion	26.01.26	TBM taken on top of Carpeting road, TBM = 100.00	
Weather	SUNNY	RL= (-) 0'-0"	GWL = (-) 0'-0"
Total Depth = 60'-0"			

Depth in meter	Depth in feet	Thickness in feet	Graphics	Discription of Classification (Visual)	N- Values	Water Content %	Sample Type
1.52	5	6'-0"		Brick chips and Etc. Filling	5		D-1
3.04	10			Grey soft Clayey SILT with trace fine sand	4		D-2
4.56	15	13'-0"			7		D-3
6.08	20			Brown medium stiff to stiff Plastic CLAY with trace fine sand and some silt	13		D-4
7.60	25	22'-0"			4		D-5
9.12	30	27'-0"		Grey soft Clayey SILT with trace fine sand	5		D-6
10.64	35			Brown medium stiff to stiff SILT with trace fine sand and some clay	10		D-7
12.16	40	38'-0"			17		D-8
13.68	45			Brown medium dense to dense fine SAND with some to little silt	14		D-9
15.20	50				23		D-10
16.72	55				27		D-11
18.24	60	60'-0"			31		D-12

SPT Graph



SAND SAMPLES ..... CLAY SAMPLES ..... UNDISTURBED SAMPLES .....

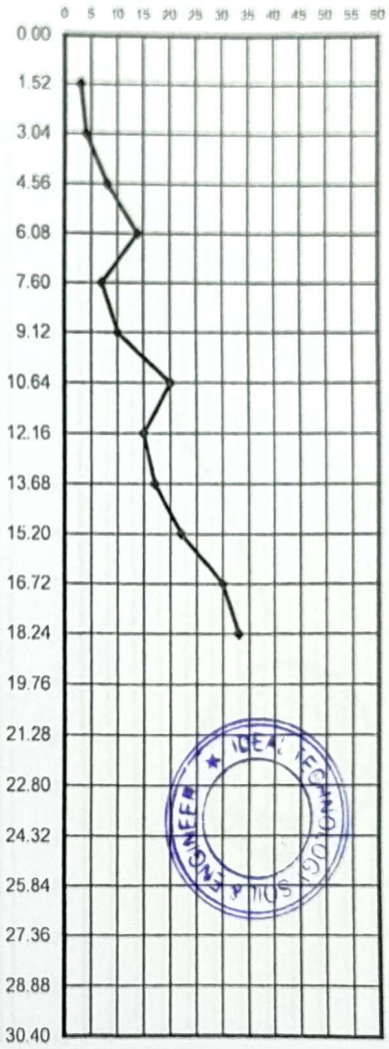
Scanned with CamScanner

IDEAL TECHNOLOGY SOIL & ENGINEERS

Bore Hole No.02	LOCATION : DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.	
Date of Start	25.01.25	Type of drilling:Manual drive (Hand Wash)
Date of Completion	25.01.25	TBM taken on top of Carpeting road, TBM = 100.00
Weather	SUNNY	RL= (-) 0'-0" / GWL = (-) 0'-0"
Total Depth = 60'-0"		

Depth in meter	Depth in feet	Thickness in feet	Graphics	Discription of Classification (Visual)	N- Values	Water Content %	Sample Type
1.52	5	6'-0"		Brick chips and Etc. Filling	3		D-1
3.04	10			Grey soft Clayey SILT with trace fine sand	4		D-2
4.56	15	13'-0"			8		D-3
6.08	20			Brown medium stiff to stiff Plastic CLAY with trace fine sand and some silt	14		D-4
7.60	25	22'-0"			7		D-5
9.12	30			Brown medium stiff to stiff SILT with trace fine sand and some clay	10		D-6
10.64	35	33'-0"			20		D-7
12.16	40			Brown medium dense to dense fine SAND with some to little silt	15		D-8
13.68	45				17		D-9
15.20	50				22		D-10
16.72	55				30		D-11
18.24	60	60'-0"			33		D-12

SPT Graph



SAND SAMPLES ..... CLAY SAMPLES ..... UNDISTURBED SAMPLES .....

Scanned with CamScanner

IDEAL TECHNOLOGY SOIL & ENGINEERS

Bore Hole No.03	LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.
Date of Start	26.01.26
Date of Completion	26.01.26
Weather	SUNNY
Total Depth = 60'-0"	

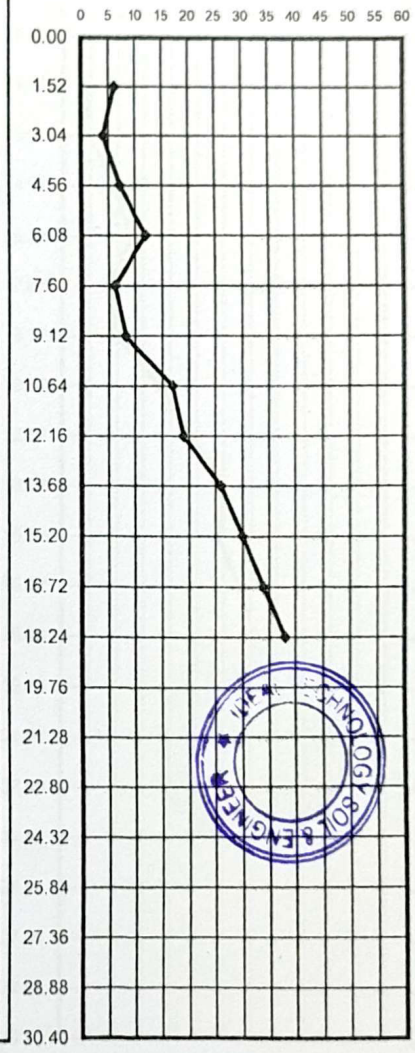
Type of drilling:Manual drive (Hand Wash)

TBM taken on top of Carpeting road, TBM = 100.00

RL= (-) 0'-0" | GWL = (-) 0'-0"

Depth in meter	Depth in feet	Thickness in feet	Graphics	Discription of Classification (Visual)	N- Values	Water Content %	Sample Type
1.52	5	6'-0"		Brick chips and Etc. Filling	6		D-1
3.04	10	13'-0"		Grey soft Clayey SILT with trace fine sand	4		D-2
4.56	15				7		D-3
6.08	20	22'-0"		Brown medium stiff to stiff Plastic CLAY with trace fine sand and some silt	12		D-4
7.60	25				6		D-5
9.12	30	33'-0"		Brown medium stiff SILT with trace fine sand and some clay	8		D-6
10.64	35				17		D-7
12.16	40				19		D-8
13.68	45			Brown medium dense to dense fine SAND with some to little silt	26		D-9
15.20	50				30		D-10
16.72	55				34		D-11
18.24	60	60'-0"			38		D-12

SPT Graph



SAND SAMPLES ..... CLAY SAMPLES ..... UNDISTURBED SAMPLES .....

Scanned with CamScanner

IDEAL TECHNOLOGY SOIL & ENGINEERS

Bore Hole No.04	LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.
Date of Start	27.01.26
Date of Completion	27.01.26
Weather	SUNNY
Total Depth = 60'-0"	

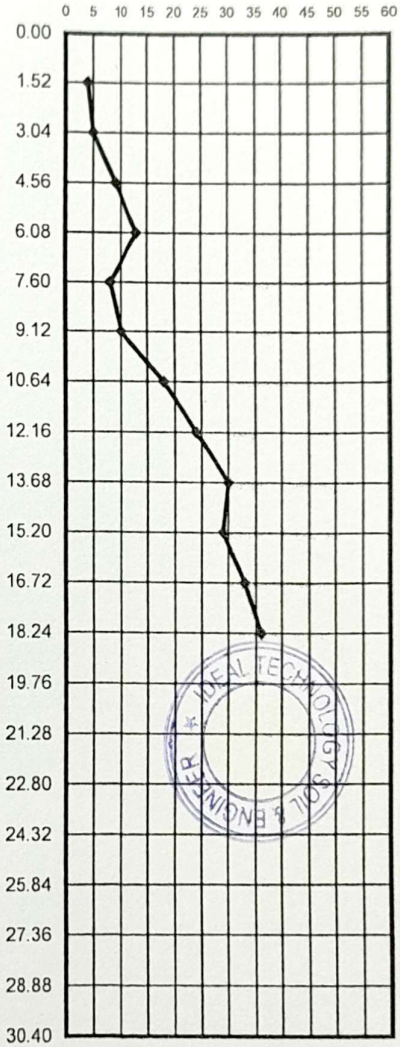
Type of drilling:Manual drive (Hand Wash)

TBM taken on top of Carpeting road, TBM = 100.00

RL= (-) 0'-0" | GWL = (-) 0'-0"

Depth in meter	Depth in feet	Thickness in feet	Graphics	Discription of Classification (Visual)	N- Values	Water Content %	Sample Type
1.52	5	6'-0"		Brick chips and Etc. Filling	4		D-1
3.04	10			Grey soft Clayey SILT with trace fine sand	5		D-2
4.56	15	13'-0"			9		D-3
6.08	20			Brown medium stiff to stiff Plastic CLAY with trace fine sand and some silt	13		D-4
7.60	25	22'-0"			8		D-5
9.12	30			Brown medium stiff SILT with trace fine sand and some clay	10		D-6
10.64	35	33'-0"			18		D-7
12.16	40				24		D-8
13.68	45				30		D-9
15.20	50			Brown medium dense to dense fine SAND with some to little silt	29		D-10
16.72	55				33		D-11
18.24	60	60'-0"			36		D-12

SPT Graph



SAND SAMPLES ..... CLAY SAMPLES ..... UNDISTURBED SAMPLES .....

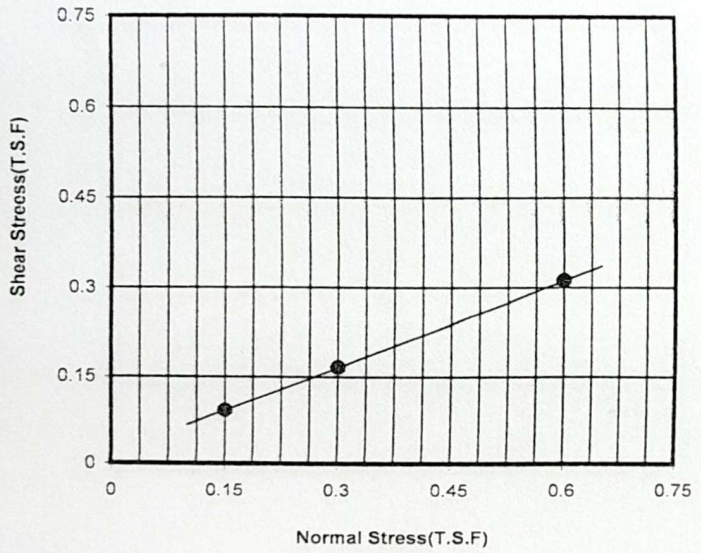
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APPENDIX 5 : DIRECT SHEAR TEST

DIRECT SHEAR TEST

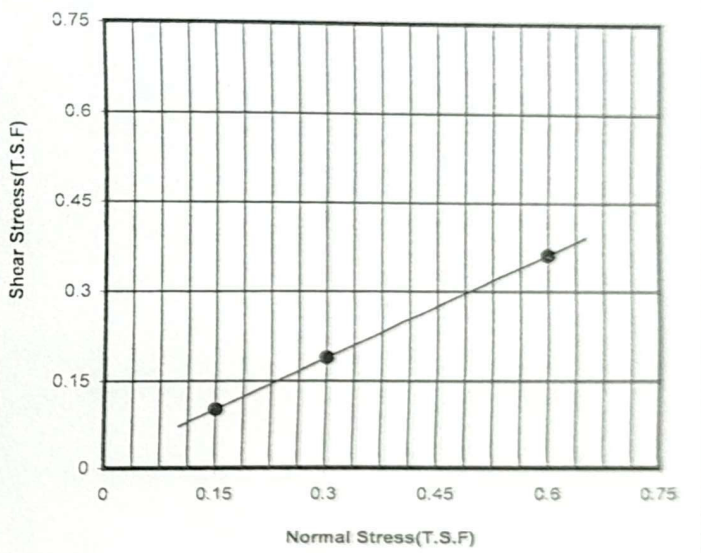
IDEAL TECHNOLOGY SOIL & ENGINEERS	LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

Bore hole no :	1	Sample no :	D-10	Depth= 50 ft



SHEARING ANGLE (DEGREE)	26
COHESION (t.s.f)	0.019

Bore hole no :	2	Sample no :	D-12	Depth= 60 ft



SHEARING ANGLE (DEGREE)	30
COHESION (t.s.f)	0.015

Tested By:
Engr. Md. Lakmia

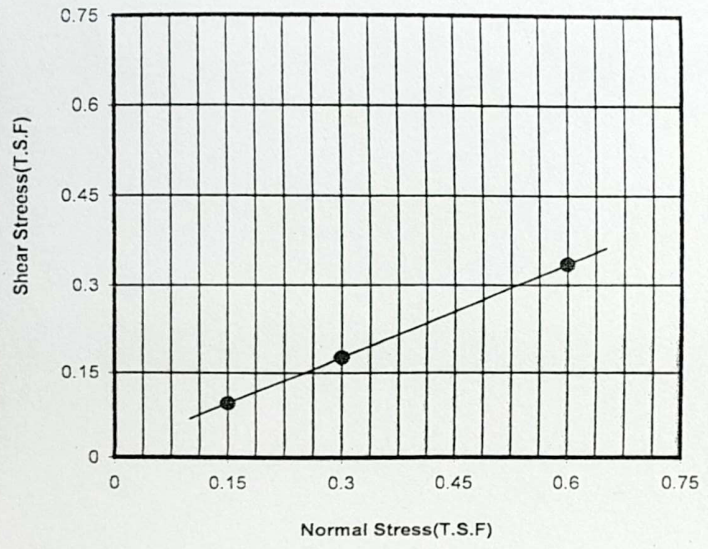
Checked By:
Engr. Md. Mohsin Jaman (BUET)

IDEAL SOIL & ENGINEER TECHNOLOGY

DIRECT SHEAR TEST

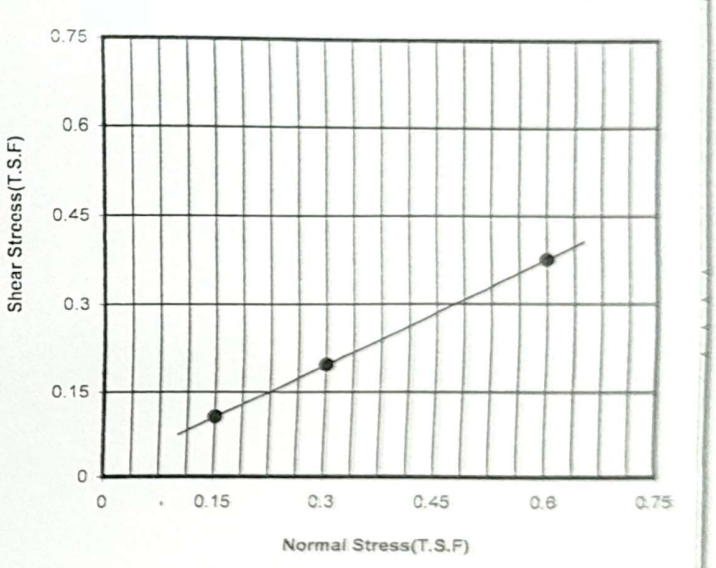
IDEAL TECHNOLOGY SOIL & ENGINEERS	LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

Bore hole no :	3	Sample no :	D-9	Depth= 45 ft



SHEARING ANGLE (DEGREE)	28
COHESION (t.s.f)	0.016

Bore hole no :	4	Sample no :	D-11	Depth= 55 ft



SHEARING ANGLE (DEGREE)	31
COHESION (t.s.f)	0.015

Tested By:
Engr. Md. Lakmia

Checked By:
Engr. Md. Mohsin Jaman (BUET)

IDEAL TECHNOLOGY SOIL & ENGINEER

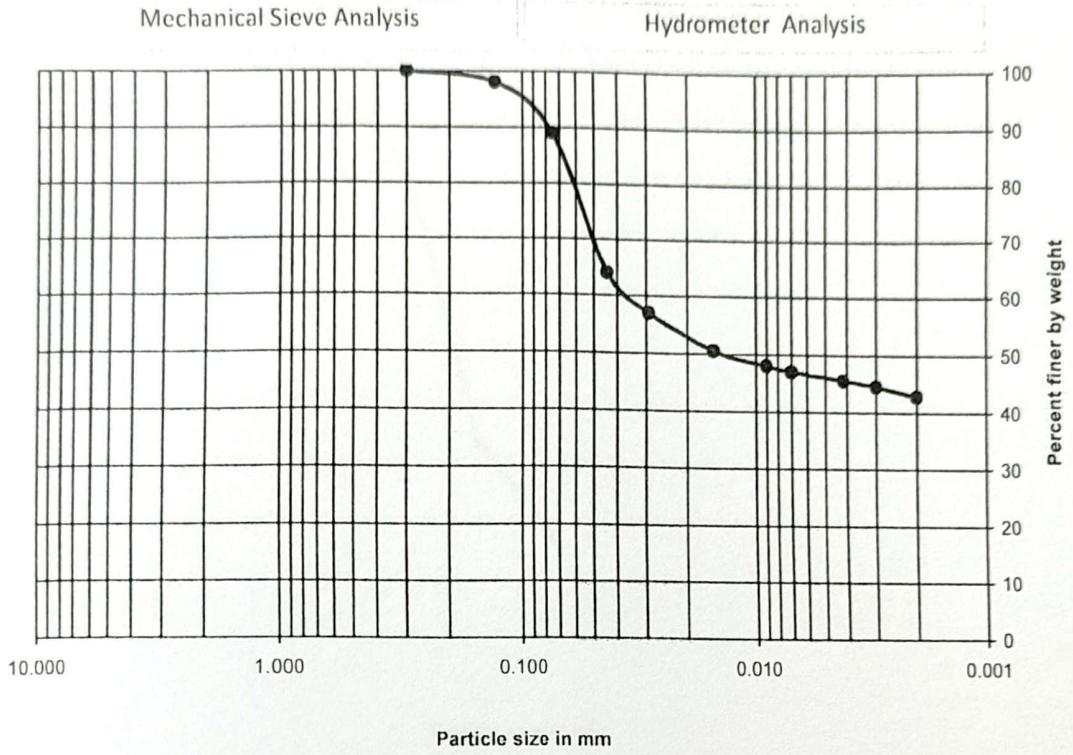
APPENDIX 6 : GRAIN SIZE ANALYSIS (HYDROMETER), GRAIN SIZE ANALYSIS (MECHANICAL)

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IDEAL TECHNOLOGY SOIL & ENGINEERS

LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

GRAIN SIZE DISTRIBUTION & ATTERBERG LIMIT



Bore hole	Series	Sample	Depth	Sand	Silt	Clay	Sp. Gr.	LL	PL	PI
BH-1		D-2	10	9.44	47.75	42.81	2.672			

IDEAL TECHNOLOGY SOIL & ENGINEER

Tested By:
Engr. Md. Lakmia

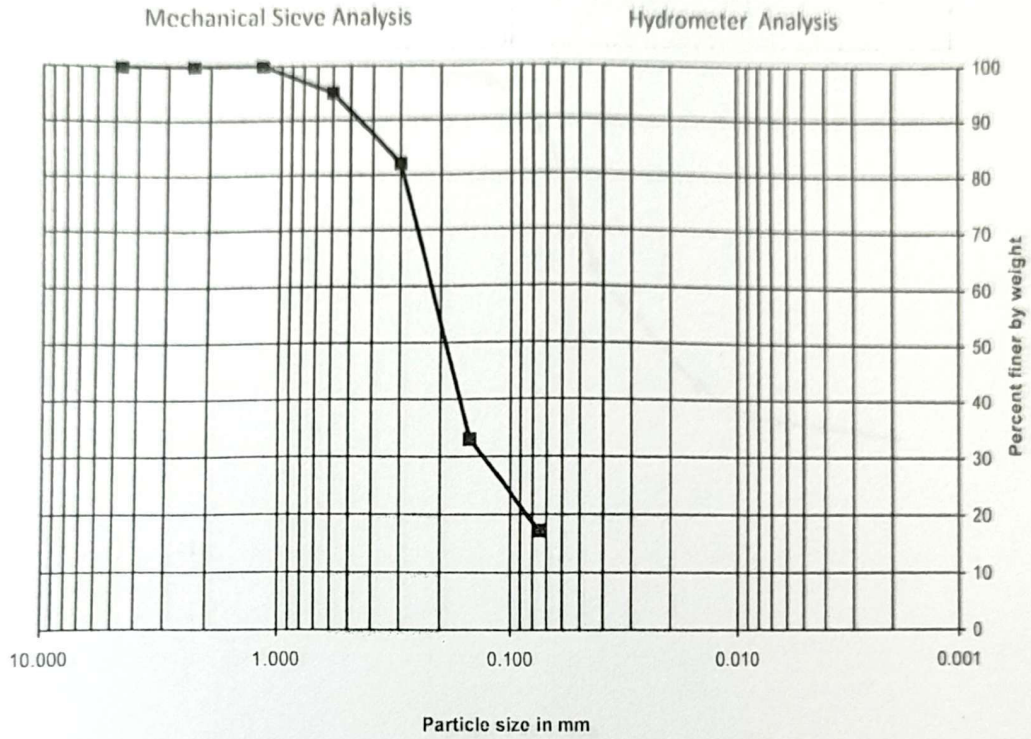
Checked By:
Engr. Md. Mohsin Jaman (BUET)

Scanned with CamScanner

IDEAL TECHNOLOGY SOIL & ENGINEERS

LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

GRAIN SIZE DISTRIBUTION & ATTERBERG LIMIT



Bore hole	Series	Sample	Depth	Sand	Silt or clay	Sp. Gr.	LL	PL	PI
BH-2		D-9	45	82.78	17.22	2.682			

IDEAL TECHNOLOGY SOIL & ENGINEER

Tested By:
Engr. Md. Lakmia

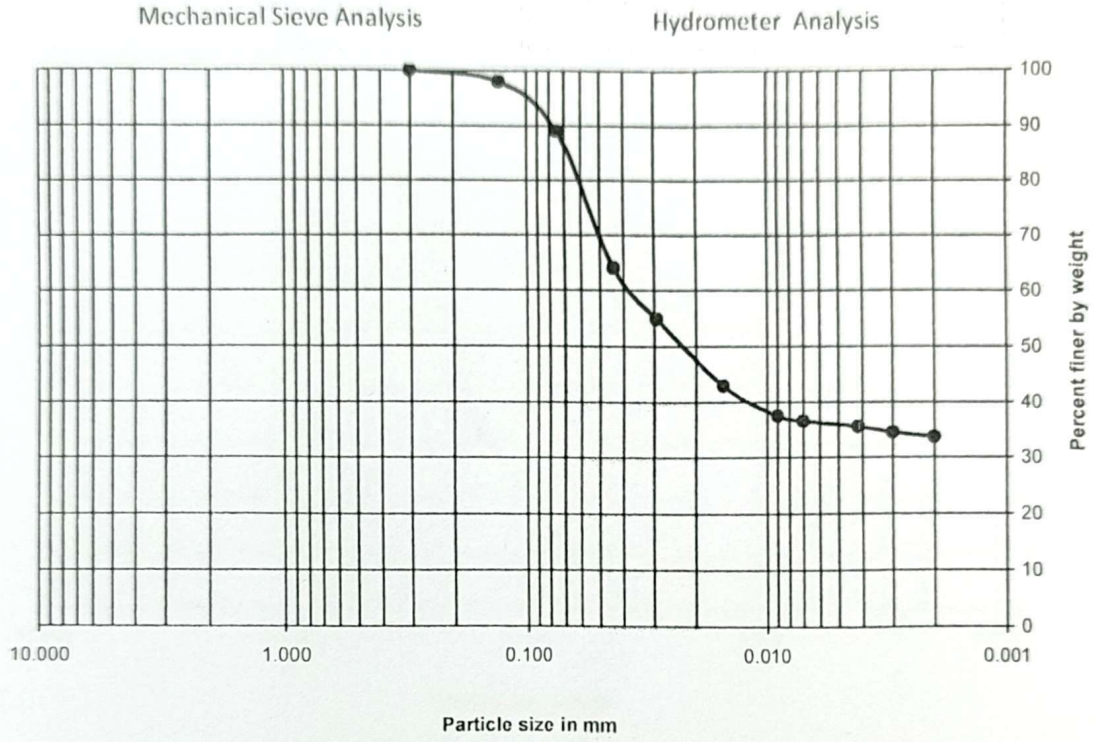
Checked By:
Engr. Md. Mohsin Jaman (BUET)

Scanned with CamScanner

IDEAL TECHNOLOGY SOIL & ENGINEERS

LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

GRAIN SIZE DISTRIBUTION & ATTERBERG LIMIT



Bore hole	Series	Sample	Depth	Sand	Silt	Clay	Sp. Gr.	LL	PL	PI
BH-3		D-6	30	10.25	56.14	33.61	2.675			

Tested By:
Engr. Md. Lakmia

IDEAL TECHNOLOGY SOIL & ENGINEER

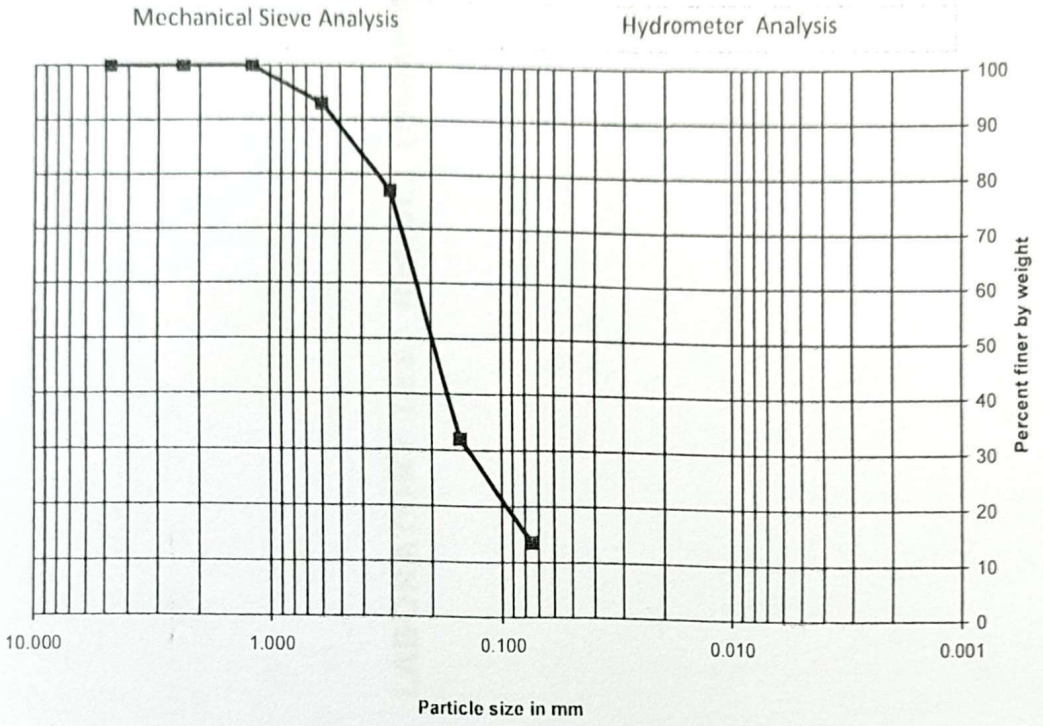
Checked By:
Engr. Md. Mohsin Jaman (BUET)

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IDEAL TECHNOLOGY SOIL & ENGINEERS

LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

GRAIN SIZE DISTRIBUTION & ATTERBERG LIMIT



Bore hole	Series	Sample	Depth	Sand	Silt or clay	Sp. Gr.	LL	PL	PI
BH-4		D-12	60	86.48	13.52	2.687			

IDEAL TECHNOLOGY SOIL & ENGINEER

Tested By:
Engr. Md. Lakmia

Checked By:
Engr. Md. Mohsin Jaman (BUET)

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APPENDIX 7 : LABORATORY TEST RESULT (SUMMARY)

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IDEAL TECHNOLOGY SOIL & ENGINEERS

LOCATION:- DASHERKANDI SEWERAGE TREATMENT PLANT, DHAKA, BANGLADESH.

Summary of Laboratory Test Results

Bore Hole No.		1	2	3	4	1	2	3	4
Sample ID No.		D-2	D-9	D-6	D-12	D-10	D-12	D-9	D-11
Depth in (ft)		10	45	30	60	50	60	45	55
Natural moisture content (%)		29.45	15.58	26.14	12.44				
Specific Gravity		2.674	2.682	2.675	2.687				
Atterberg limits	Liquid Limit, LL								
	Plastic Limit, PL								
	Plastic Index, PI								
Density	Wet (gm/cc)								
	Dry (gm/cc)								
Grain size analysis (Mechanical)	Sand (%)		82.78		86.48				
	Fines (%)		17.22		13.12				
Grain size analysis (Hydrometer)	Sand (%)	9.44		10.25					
	Silt (%)	47.75		56.14					
	Clay (%)	42.81		33.61					
Consolidation testes	Natural void ratio, Co								
	Compression Index, Cc								
Unconfined compression tests	Unconfined compression Strength, qu (kg/cm^2)								
	Strain of failure (%)								
Direct shear tests	ϕ (degree)					26	30	28	31
	Cohesion (t.s.f)					0.019	0.015	0.016	0.015

Tested By:
Engr. Md. Lakmia

IDEAL TECHNOLOGY SOIL & ENGINEER

Checked By:
Engr. Md. Mohsin Jaman (BUET)