REPORT ON GEOTECHNICAL INVESTIGATION

-: Project :-

ON CONSTRUCTION OF PROPOSED MULTI STORIED BUILDING OF SRI SUKDEB BISWAS, S/O.- LATE AKUL CHANDRA BISWAS, R.S. DAG NO. 1221(P), R.S. KHATIAN NO. 901 (640), L.R. DAG NO. 1475(P), L.R. KHATIAN NO. 7804, IN MOUZA- BARABAHERA, J.L. NO. 5, UNDER KANAIPUR GRAM PANCHAYAT, P.S. UTTARPARA, DISTRICT- HOOGHLY.

- :Testing & Report PreparationBy : -

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EUREKA FOUNDATION

Kolkata

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1. INTRODUCTION:

A Project Build on Construction of Proposed Multi Storied Building of Sri Sukdeb Biswas, S/O.- Late Akul Chandra Biswas, R.S. Dag no. 1221(P), R.S. Khatian No. 901 (640), L.R. Dag no. 1475(P), L.R. Khatian no. 7804, in Mouza- Barabahera, J.L. no. 5, Under Kanaipur Gram Panchayat, P.S. Uttarpara, District- Hooghly.

The soil investigation was necessary for the purpose of the foundation design and construction of the said proposed building at Kanaipur.

Accordingly the subsoil exploration work with 08 boreholes (3 x 20.45m, 4 x 15.45m, 1 x 10.45m depth) was carried out as proposed by the project authority.

During borehole exploration, disturbed and undisturbed samples were collected.

The present report deals with the geotechnical investigation findings at the location and the recommendation of type of the most suitable foundation depending on the field and laboratory test results.

2. SOIL EXPLORATION

Eight boreholes were sunk within the premises of the proposed project, the depths of boreholes were measured from the existing ground level and hence the depth of borehole indicates depth below ground level (BGL). The execution of the subsoil exploration job at site was commenced on February 22nd, 2024 and completed on February 26th, 2024.

Our site in-charge has maintained the log sheets of the boreholes. Visually classified soils encountered according to the standard soil classification system. We have also obtained relatively undisturbed and bulk samples for the sub-surface materials from each borehole advanced at different locations. The soil exploration methodology followed at site, has been explained below.

3. FIELD INVESTIGATION

Geotechnical Investigation was conducted in an attempt for optimization in the design of foundation for the proposed structures to be constructed at this site. The entire Investigation program had been divided mainly into two parts, I) Field works & II) Laboratory tests.

I) Field works unfold the sub-surface deposit types and their characteristics

II) Laboratory tests part would help determining the relevant physical and geotechnical properties of the sub-surface deposits leading to analysis etc.

Schedule of boreholes in tabulated form is given below:

Bore Hole No.	Terminating Depth (m)	Standing Water Table below EGL (m)	Date of Commencement	Date of Completion
BH-1	20.45	0.20	22.02.2024	22.02.2024
BH-2	10.45	0.20	23.02.2024	23.02.2024
BH-3	20.45	0.20	23.02.2024	24.02.2024
BH-4	20.45	0.20	24.02.2024	24.02.2024
BH-5	15.45	0.20	24.02.2024	24.02.2024
BH-6	15.45	0.30	25.02.2024	25.02.2024
BH-7	15.45	0.30	25.02.2024	26.02.2024
BH-8	15.45	0.30	26.02.2024	26.02.2024

4. EXPLORATORY BORING

The provision laid down in BIS 1892: 1979 was followed in sinking the exploratory boreholes. Boreholes were advanced into the soil by Auger to sink 150 mm diameter bore holes by using manually operated equipment. The Auger boring continued upto maximum depth of 4.5m and thereafter wash boring technique was adopted. Stabilization of the boreholes was achieved by circulating Bentonite slurry. Suitable casings were used upto about 3.0 m below ground level (BGL) to prevent cave-in of soil inside the boreholes. Log sheet of each borehole has been presented in Annexure.

4.1 FIELD AND LABORATORY WORKS

Field and laboratory works associated with this investigation has been conducted as per the following specifications of the Bureau of Indian Standards (BIS):

	FIELD WORK	Relevant I.S. Codes
I	Collections of soil samples	IS: 1892-1979 IS: 2131-1981 IS: 2132-1986
II	Labeling and Packing	IS: 1892-1979 IS: 2131-1981 IS: 2132-1986
III	Standard Penetration Test (SPT)	IS: 9640-1980 IS: 2131-1981

Laboratory Tests	Relevant I.S. Codes
Water Content	IS: 2720(Part-2)-1973
Liquid Limit (LL) and Plastic Limit (PL)	IS: 2720(Part-5)-1985
Grain-Size Analysis	IS: 2720(Part-4)-1985
Specific Gravity	IS: 2720(Part-3)-1980
Consolidation Test	IS: 2720(Part-15)-1986
Unconfined Compressive Strength	IS: 2720(Part-10)-1991
Tri-axial Test	IS: 2720(Part-11)-1993
Direct Shear Test	IS: 2720(Part-13)-1986

5. SAMPLING:

Disturbed samples were collected from split spoon sampler of Standard Penetration Test (SPT) at different depths of each borehole; the disturbed samples were also collected near the ground level. The undisturbed samples were collected at average 3m interval, while the SPT field test was conducted at average 1.5m interval. Groundwater table was observed and recorded in the field bore log sheet.

Undisturbed sample were obtained as per the specification by forcing a thin wall sample of internal diameter 100 mm and 450 mm length open drive sampling assembly having area ratio of about 10% (as per IS: 2132-1986). Before insertion of sampling tube in the borehole the disturbed soils were removed properly form the same. The sampling assembly was driven to the required depth manually with the help of jarring link. The undisturbed samples retained in the lowest tube were brought to the surface and both the ends of the tube were sealed by a thin layer of molten wax. Further the end of the tube was closed by screwed caps or tight fittings lids. The depth of the samples and other particulars were marked on the tube along with the label.

Representative disturbed soil samples were collected from Auger, cutting shoe of the undisturbed sampling assembly and split spoon of standard penetrometer, as per the specification, at close intervals to maintain a continuous record of subsurface strata. The collected samples were kept in airtight polythene packets and labeled properly about project name, date of sampling, borehole number, and depth of sampling.

6. STANDARD PENETRATION TEST (SPT)

The standard penetration test is a well established and unsophisticated method, which was developed in the United States around 1925. It has since undergone refinements with respect to equipment and testing procedure. The testing procedure varies in different parts of the world. Therefore standardisation of SPT was essential in order to facilitate the comparison of results from different investigations. The equipment is simple, relatively inexpensive and rugged. Another advantage is that representative but disturbed soil samples are obtained. The reliability of the method and the accuracy of the result depend on the experience and care of the engineer / engineering supervisor on site.

A split barrel sampler is driven from the bottom of a pre-bored hole into the soil by means of a 63.5 kg hammer, dropped freely from a height of 0.76 m. The diameter of the prebored hole varies normally between 60 and 200 mm. If the hole does not stay open by itself, casing or drilling mud should be used. The sampler is first driven to a depth of 15 cm below the bottom of the pre-bored hole, then the number of blows required to drive the sampler another 30 cm into the soil, the so called N30 count, is recorded. The rods used for driving the sampler should have sufficient stiffness. The quality of test results depends on several factors, such as actual energy delivered to the head of the drill rod, the dynamic properties (impedance) of the drill rod, the method of drilling and bore hole stabilisation. The SPT is generally conducted in all types of deposit . But the SPT can be difficult to perform in loose sands and silts below the ground water level, as the bore hole can collapse and disturb the soil to be tested. The following factors can affect the test results : nature of the drilling fluid in the bore hole, diameter of the bore hole, the configuration of the sampling spoon and the frequency of delivery of the hammer blows. Therefore, it should be noted that drilling and stabilisation of the bore hole must be carried out with care. The measured **N-value** (**blows / 0.30 m**) is so-called standard penetration resistance of the soil. The penetration resistance is influenced by the stress conditions at the depth of test. Peck et al. (1974) proposed, based on settlement observations of footings, the following relationship for correction of confinement pressure.. The measured N value is to be multiplied by a correction factor C_N to obtain a reference value, N_1, corresponding to an effective overburden stress of **1 t/ft^2** (approximately **107 kpa**).

Thus $\mathbf{N_1 = N. C_N}$

Where, C_N is a stress correction factor.

Again $\mathbf{C_N = 0.77. \log_{10} (20/p')}$

Where p' is the effective overburden pressure.

The second correction over the corrected value of N_1 is due to fine or silty sand below water table.

The reason for this correction is that for a measured N greater than 15 cm, the sand is medium dense or denser. The means that when the hammer is dropped to drive the tube cause the sand to dilate. Where water is present, this dilation causes negative pore pressures to be developed.

For relatively clean sand, these pore water pressures are fully dissipated by the time the next blow is applied. For sand, which has its pore space partly blocked by silts or clays or is a very fine sand, the rate at which these negative pore water pressures dissipates may very much lower. Therefore they may not be fully dissipated by the time, the next blow is applied a second or so latter. This may mean that there is a built up negative pore water pressures as the blows are applied.

Since, there has been no change in total stress a reduction of pore water pressure (even though it is temporary) must lead to a temporary increase in effective stress. Since the greater the effective stress, the greater is the strength of the material being tested. Therefore as the strength increase has only been caused temporarily because of dilation effects. It must be accounted for by the measured 'N' value. Thus for this correction, the following facts have been kept in mind.

- **Sand layer must be always below the water table.**
- **'N' value must be greater than 15.**
- **Have reduced permeability.**

The resistance (N30) has been correlated with the consistency of clayey soil and also the relative density of non cohesive soils can be classified as shown below in table – 1, Brooms (1986).

FOR SAND AND GRAVEL

Relative density	Very loose	Loose	Medium	Dense	Very Dense.
N_{30} blows / 0.30 m	< 4	< 4 – 10	10 – 30	30 – 50	> 50

FOR CLAY AND SILT

Consistency	VerySoft	Soft	Medium	Stiff	VeryStiff.
N_{30} blows / 0.30 m	<2	2 – 4	4 – 8	8 – 16	16 – 32

The test is mainly used to estimate the relative stiffness and strength (bearing capacity) of soils. Deformation characteristics of granular soils can be estimated from empirical correlations, Peck et. Al (1974). It is also possible to get some indications from SPT of the shear strength in cohesive soils. The SPT used frequently for the evaluation of the liquefaction potential of water saturated, loose sands and silts in seismic areas, Seed and De Alba (1986). For this work, the method used for SPT is as per IS:2131 – 1981.

7. GROUND WATER TABLE (GWT)

Ground water observations were made during boring and the depth at which it was encountered and the standing water level was recorded in the respective bore log sheet.

8. LABORATORY TEST

The soil samples from the 100 mm diameter sampling tubes were extracted in the laboratory by pushing out the soil cone by employing and extractor frame. The cone was jacked out in the direction that corresponds with the soil movement within the tube during sampling. The extracted samples using 100 mm diameter were made to the actual size of the samples to be used for the testing.

Relevant laboratory tests were conducted on selected disturbed and undisturbed soil samples collected during the field investigation for proper identification, classification and for determining the various engineering properties including the shear strength parameters of these sub-soils deposits. Some of the routine tests were also carried out using the soil samples. In general, the following tests were carried out on representative soil samples collected from exploratory boreholes at different depth/ strata:

1. Natural Moisture content (NMC)
2. Atterberg limits
3. Bulk density/ Dry density
4. Triaxial test
5. Unconfined compressive strength test
6. Grain size analysis
7. Consolidation tests.

The above mentioned laboratory tests were conducted as per the relevant Indian Standard Codes of practice and the results of these tests are furnished in the Annexure of this report. Results have been presented in the form of tables and graphs.

8.1 Natural Moisture Content (NMC) and Atterberg Limits

Natural moisture content (NMC), Liquid limit (LL), Plastic limit (PL), and Shrinkage limit (SL) of silty clay/ clayey silt samples were determined to (a) classify the soil by the unified soil classification system, (b) qualitatively assess their consistency and compressibility, and (c) obtain swelling characteristics of the soil. Soil has been considered both from disturbed and undisturbed samples collected from the exploratory boreholes.

8.2 Bulk density and Dry density

These were determined by measuring the weight and dimension of triaxial/ unconfined compression test samples. The dry density has been calculated from the estimated bulk density and the NMC. The bulk density and dry density values have been given in the laboratory test results sheets.

8.3 Grain size analysis (Sieve and Hydrometer)

The grain size distribution of some representative samples were determined from sieve analysis and hydrometer analysis depending upon the average grain diameter of the soil samples. The higher grained samples like sand were analyzed through sieve and the lower grain samples like fine silt and clay were analyzed through hydrometer. The results have been presented in the tables and graphs.

8.4 Triaxial Test and Unconfined Compressive strength test

For Triaxial test, 38 mm diameter and 76 mm long specimens were obtained by jacking out the soil core into three thin-walled brass tubes, each having a wall thickness of 1/800 mm. The inside of the tubes was coated with a thin layer of silicon oil.

To obtain the specimens for consolidation test the Odometer ring was placed on the trimmed horizontal face of the soil within the 100 mm sampling tube and the soil around the cutting edge was gradually removed with a spatula as the ring was gently pushed into the soil. The ring with the soil was then removed by cutting across the soil core with the help of piano wire saw.

The Triaxial test was conducted on the clay / silty clay/ clayey silt samples to determine the shear strength parameters of the collected soil samples. The cell pressures employed for the test were 1.0 kg/ cm^2, 1.5 kg/ cm^2, and 2.0 kg/ cm^2. The strain rate for the triaxial test under quick condition has been taken 1.25 mm/min. The samples both for Triaxial test and unconfined compressive strength test were loaded maximum upto 20% of axial strain, if not failed the said strain.

8.5 Consolidation test

Consolidation test was conducted in floating ring type odometers in single and four units consolidation frame under standard load increment ratio starting from ¼ kg/cm^2 and upto 8 kg/cm^2 in general. The soil was kept saturated during the consolidation test, as specified the relevant IS code of practice. The void ratio (e) vs. Log (p) curves has been presented in the report as Annexure. The values of $c_c/(1+e_o)$, which represents the volume compressibility of soil at different depths are given in the report as results in the form of data sheet. During consolidation no swelling pressure was observed during the incremental loading in the tests.

9 SOIL PROFILE:

The average subsoil stratification has been considered for the design. The soil stratification may, in general, has been summarized as shown in Table 1.

Table 1: Average Subsoil Profile:

Stratum	Description	Thickness (m)
I	Filled up with soil,roots etc	0.70
II	Soft to medium stiff brownish grey clayey silt	4.80
III	Soft grey to dark grey silty clay with decomposed wood	4.50
IV	Medium stiff to stiff bluish grey silty clay with calcarious nodules	6.50
V	Very stiff yellowish grey clayey silt with kankars	3.50

10. SUB-SOIL STRATIFICATION

The generalized soil profile encountered at the site is shown in Sub-soil Profile and in the enclosed bore log data sheets in the Annexure. Variation of 'N' value with depth is shown in Depth vs. N-value Curve and in the bore log data sheets. Laboratory Test Results are presented in the Annexure. Other back-up sheets are also presented therein. Based on visual classification and results of field and laboratory tests major Strata including filling are identified.

Altogether 05(Five) different sub-soil layers were encountered within the bored depth of the boreholes. The different sub-soil layers are discussed below. The Designer gives a generalized soil profile along with design soil parameters at the end of this section for use.

Stratum – I
Filled up with soil,roots etc. (0.0m – 0.70m below G.L)

Stratum – II
Soft to medium stiff brownish grey clayey silt. (0.70m – 5.50m below G.L)

Natural moisture Content	29.67	%
Bulk density :	1.872	t/m^3
LL :	40.12	%
PL :	22.70	%
C_u :	0.258	(kg/cm^2)
mv :	0.0420	(pressure of 5 to 10 t/m2)

Stratum – III
Soft grey to dark grey silty clay with decomposed wood. (5.50m – 10.00m below G.L)

Bulk density :	1.872	t/m^3
Cu :	0.225	(kg/cm2)
mv :	0.0460	(pressure of 5 to 10 t/m2)

Stratum – IV
Medium stiff to stiff bluish grey silty clay with calcarious nodules. (10.00m – 16.50m below G.L)

Bulk density :	1.891	t/m^3
C_u :	0.280	(kg/cm^2)

Stratum – V
Very stiff yellowish grey clayey silt with kankars. (16.50m – 20.45m below G.L)

11. FOUNDATIONS

The selection of foundation type mainly depends on the engineering properties of subsoil, type of structure to be constructed and the loading pattern on the foundation, which will come through the super structure.

General considerations

The objective of this soil investigation work is to design and construct the foundation for proposed multi storied building at Kanaipur, District: Hooghly, West Bengal. The suitable loading pattern will be considered for determination of type of foundation and estimation of bearing capacity.

On the basis of the assumption of proposed structure, inference will be made for the type of foundation to be adopted and its bearing capacity. However, the foundation design should satisfy two basic requirements.

Foundation of a structure is to be designed from considerations of superstructure loading as well as subsoil condition at the site. Suitable foundations for a structure should satisfy the following basic design criteria:

a. There must be adequate factor of safety of the foundations against any possible bearing capacity failure and
b. The settlement of the foundations must be within permissible limits.

12. CAPACITY CALCULATION

Bearing Capacity

Sample Calculation of Bearing capacity against shear failure on the basis of laboratory test result:

The bearing capacity of different types of foundation placed at 2.00m Below EGL with **Well compacted and confined sand cushion of 0.40m** thick below assumed level of foundation, was obtained as follows

As per IS code (IS: 6403- 1981) the formula for bearing capacity is as follows: -

q net ultimate = CNcScdcic

The net safe bearing capacity is calculated as

q net safe = q net ultimate/F.O.S

Where, C = undrained cohesion of the soil
Nc = bearing capacity factors
Sc = shape factor
dc = depth factor
ic = inclination factor
FOS = factor of safety

Isolated Foundation, L & B i.e., 2.0m X 2.0m at a depth 2.0 m below the existing ground level:
Sc = 1.30, dc = 1.20, Nc =5.14, ic =1.00, D = 2.0m, C = 2.58T/m^2, B=2.0, F.O.S=2.5

Net safe bearing Capacity:

q net safe = 1/F x C x Nc x sc x dc x ic =8.27T/ m^2 .

13. Settlement calculation:

The foundation settlement occurs for cohesive layers of soil which are stressed due to the superstructure loads. The settlements may be computed using the following relations following IS: 8009(Part-I)-1976.

Immediate settlement (Si) = $q B (1-\mu^2) I/E$

Consolidation settlement $Sc = \sum m_v . \Delta p . H$

where,
- q = net pressure on soil
- B = least width of the foundation
- E = modulus of elasticity of soil
- ν = Poisson's ratio
- I = Influence factor
- m_v = co-efficient of volume compressibility
- H = Thickness of compressible layer
- Δp = effective overburden pressure at the center of the corresponding layer

Immediate settlement (Si) = $q B (1-\mu^2) I/E$

q	8.27 t/m^2
B	2.00 m
μ	0.50
I	1.12
E	1290T/m^2.
Si	10.78mm

Consolidation Settlement

i) 2nd stratum $Sc2 = m_v \times \Delta p \times H$
$= 0.00420 \times 2.069 \times 4.00$
$= 34.75mm$

Total settlement= 10.78 + 34.75 = 45.53mm
Total Settlement =**45.53mm** < 75 mm (which is safe).

The suggested net safe bearing capacity to be adopted for the 2m x 2m isolated footing at 2 m depth is **8.27 t/m²** with an estimated settlement of **45.53mm**.

14. DISCUSSIONS ON FOUNDATION:

The bearing capacities for different depth of shallow foundation are tabulated below.

Table -2

Type of Foundation	Depth of Foundation below EGL	Footing Size- (B x L)	Net Safe Bearing Capacity, T/m^2	Estimated Settlement (mm)
Square footing	1.50m	2.0m x 2.0m	7.93	43.64
		2.5m x 2.5m	7.72	53.12
Rectangular footing		2.0m x 3.0m	6.91	45.77
		2.5m x 4.0m	6.68	56.69
Strip footing		2.0m Wide (L/B=2.5)	6.10	62.94
		2.50m Wide (L/B=2.0)	5.89	75.00
Square footing	2.00m	2.0m x 2.0m	8.27	45.53
		2.5m x 2.5m	8.00	55.02
Rectangular footing		2.0m x 3.0m	7.21	47.77
		2.5m x 4.0m	6.92	58.72
Strip footing		2.0m Wide (L/B=2.5)	6.37	65.68
		2.50m Wide (L/B=2.0)	5.89	75.00

Note: Allowable Net Bearing Capacity satisfies both shear failure and permissible settlement (considered as 75 mm as per IS 1904) criteria.

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15. Sample Calculation of Pile vertical load capacity on the basis of laboratory test result:

Layers	Depth (m)	Φ	C (t/m^2)	Bulk density(γ) (t/m^3)
I	0.70	.....	.....	.....
II	4.80	.....	2.58	1.872
III	4.50	.....	2.25	1.805
IV	6.50	.....	2.80	1.891
V	1.50	.....	5.20	1.940

Pile diameter =0.45m

Length of pile = 18.00m from E.G.L

Cut off = 2.00m

Calculation of pile load capacity: (As per IS code-2911(Part-1/Sec-2))

Skin Friction, $Qs = a\,C\,As + K\,P_D \tan\delta\,Ast$

QsII= Π x 0.45 x 3.50 x 2.58 x 1.0 = 12.76t

QsIII= Π x 0.45 x 4.50 x 2.25 x 1.0 = 14.31t

QsIV= Π x 0.45 x 6.50 x 2.80 x 1.0 = 25.72t

QsV= Π x 0.45 x 1.50 x 5.20 x 0.835 = 9.21t

Total skin friction = 62.00t

End Bearing, $Qb = Ap\,N_C\,C_P$

= {0.7854 x (0.45)^2 x 9 x 5.20} = **7.44t**

Total load carrying capacity of pile = 62.00 + 7.44 = **69.44t**

Net downward load capacity of pile (F.O.S=2.5) = 69.44 /2.5 = **27.78t**

Say **28.00t**

Calculation of depth of fixity of pile:

The depth of fixity of piles has been calculated as per Amendment No. 3 to I.S: 2911 (Part I/Sec 2).Refer Appendix – C

Grade of concrete of piles = M 25 Diameter of piles = 450 mm

E = 5000√ (fck) = 25000.0 N/mm^2 = 250000 Kg/cm^2

Moment of inertia of pile = 201288.96 Cm^4

KB= 18.576 Kg/cm^2

R = (E I / KB) $^{1/4}$ = 228.14 Cm

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From fig - 4 of I.S: 2911 (Part I /Sec 2)

L1 =0.0 cm

L1 / T = 0.0, Lf / T = 2.12 (For fixed head Pile)

Therefore Lf = 483.70 Cm = **4.84m**

Under Lateral Load, considering the allowable horizontal deflection of pile at GL = 0.50cm

Lateral load for fixed head pile:

For fixed head (Q):

$Q = 12Ely / (L1+Lf)^3$

$Q = 12 \times 250000 \times 201288.96 \times 0.50 / (483.70)^3 =$ **2.70t.**

Table -4 (Load Carrying Capacities of R.C.C.Bored Piles of Straight Shaft

Assumed Cut – off level = 2.00 m below Ground level

Termination Depth of Pile below Ground Level (m)	Vertical Shaft Length (m)	Dia of Pile (mm)	Suggested Pile Vertical Load Capacity(t)	Suggested Pile Lateral Capacity(t)	Depth of Fixity (m)
18.00	16.00	450	28.00	2.70	4.84
		500	31.00	3.00	5.37
		600	38.00	3.60	6.45
20.00	18.00	450	33.00	2.70	4.84
		500	37.00	3.00	5.37
		600	45.00	3.60	6.45

N.B.: i) However the above load should confirmed by Load Test of pile as per IS: 2911(Part 4)

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15. RECOMMENDATIONS:

- The subsoil characteristic **of Proposed Multi Storied Building of Sri Sukdeb Biswas, S/O.- Late Akul Chandra Biswas, R.S. Dag no. 1221(P), R.S. Khatian No. 901 (640), L.R. Dag no. 1475(P), L.R. Khatian no. 7804, in Mouza- Barabahera, J.L. no. 5, Under Kanaipur Gram Panchayat, P.S. Uttarpara, District- Hooghly.** to be constructed was determined from soil exploration with Eight No. boreholes.
- On the basis of field and laboratory test result and rational judgments on the test results, the following features are summarized:

The subsoil properties are described with respect to the scope of Proposed Construction under conventional super structural loading pattern with different types of foundation. After careful study of the all tests which includes Field Tests and Laboratory Tests (by the laboratory personal of the concern agency) for eight numbers of boreholes dug in the site it has been found that the stratifications of the boreholes are in conformity with. All the boreholes are having five distinct layers from the level of bore hole Ground.

At this site, shallow foundations may be adopted in stratum – II, the subsoil of which consists of Soft to medium stiff brownish grey clayey silt and the values of net allowable bearing capacity for isolated square, rectangular and strip footings founded at 1.50m and 2.00m below E.G.L. assumed level of foundation are recommended as shown in **Table – 2, of section 14.**

- R.C.C. Cast -in-situ bored pile of length 16.00m and 18.00m below cutoff level (2.00m below bed level) is suggested.
- The capacity of such pile with 2.00m cut off length has been given **in Table-4, of section 15.** Installation of pile should be done following Direct Mud Circulation Technique with good quality of bentonite and there should be adequate provision for Load test of piles according to IS-2911-Part IV (latest edition). The minimum spacing of piles should be kept equal to 3 times the pile diameter.
- Precaution in all respect should be taken for nearby existing structures, if any.
- The final decision regarding the foundation will depend on the judgment of the engineer concerned.

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Project: Construction of Proposed Multi Storied Building at Barabahera, Kanaipur, District: Hooghly, West Bengal

BORE LOG

Bore Hole No. : 01

Standing Water Level : 0.20 m b.g.l.

Casing Lowered : **3.00m**

Method of Boring / Drilling : Wash

Dia.of Boring / Drilling : 150mm

Date : 22.02.24 To 22.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N' Value	Description
22.02.24	0.50	-	-	D					Filled up with soil,roots etc
	1.00	-	-	D					0.70m
	1.50	1.95	0.45	U					
	3.00	3.45	0.45	P	2	2	3	5	Soft to medium stiff brownish grey clayey silt
	4.50	4.95	0.45	U					
	6.00	6.45	0.45	P	1	1	1	2	5.50m
	7.50	7.95	0.45	P	1	1	1	2	Soft grey to dark grey silty clay with decomposed wood
	9.00	9.45	0.45	U					
	12.00	12.45	0.45	P	3	3	4	7	10.00m
	15.00	15.45	0.45	U					Medium stiff to stiff bluish grey silty clay with calcarious nodules
	18.00	18.45	0.45	P	5	8	10	18	16.00m
	20.00	20.45	0.45	P	7	10	14	24	Very stiff yellowish grey clayey silt with kankars
22.02.24	20.45	Termination Depth							

Abbreviations: U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

B.S. GEOTECH PVT. LTD. HOOGHLY

BORE LOG

Bore Hole No. : 02

Standing Water Level : 0.20 m b.g.l.

Casing Lowered : **3.00m**

Method of Boring / Drilling : Wash

Dia.of Boring / Drilling : 150mm

Date : 23.02.24 To 23.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N' Value	Description
23.02.24	0.50	-	-	D					Filled up with soil,roots etc
	1.00	-	-	D					0.50m
	1.50	1.95	0.45	P	2	2	3	5	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	U					
	4.50	4.95	0.45	P	2	2	3	5	
	6.00	6.45	0.45	P	1	1	1	2	5.50m
	8.00	8.45	0.45	P	1	1	1	2	Soft grey to dark grey silty clay with decomposed wood
	10.00	10.45	0.45	P	1	1	2	3	
23.02.24	10.45	Termination Depth							

Abbreviations U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

B.S. GEOTECH PVT. LTD.

BORE LOG

Bore Hole No. : 03

Method of Boring / Drilling : Wash

Standing Water Level : 0.20 m b.g.l.

Dia.of Boring / Drilling : 150mm

Casing Lowered : **3.00m**

Date : 23.02.24 To 24.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N' Value	Description
23.02.24	0.50	-	-	D					Filled up with soil,roots etc
									0.50m
	1.00	-	-	D					
	1.50	1.95	0.45	P	2	2	3	5	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	U					
	4.50	4.95	0.45	P	1	2	2	4	
									5.00m
	6.00	6.45	0.45	P	1	1	2	3	Soft grey to dark grey silty clay with decomposed wood
	7.50	7.95	0.45	P	1	1	2	3	
	9.00	9.45	0.45	U					
									10.00m
	12.00	12.45	0.45	P	4	4	6	10	Medium stiff to stiff bluish grey silty clay with calcarious nodules
	15.00	15.45	0.45	P	5	7	9	16	
									16.50m
	18.00	18.45	0.45	P	6	8	12	20	Very stiff yellowish grey clayey silt with kankars
	20.00	20.45	0.45	P	7	10	16	26	
24.02.24	20.45	Termination Depth							

Abbreviations U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

BORE LOG

Bore Hole No. : 04

Standing Water Level : 0.20 m b.g.l.

Casing Lowered : **3.00m**

Method of Boring / Drilling : Wash

Dia.of Boring / Drilling : 150mm

Date : 24.02.24 To 24.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N" Value	Description
24.02.24	0.50	-	-	D					Filled up with soil,roots etc
									0.50m
	1.00	-	-	D					
	1.50	1.95	0.45	P	2	2	3	5	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	P	2	2	4	6	
	4.50	4.95	0.45	U					
									5.50m
	6.00	6.45	0.45	P	1	1	2	3	Soft grey to dark grey silty clay with decomposed wood
	7.50	7.95	0.45	U					
	9.00	9.45	0.45	P	1	2	2	4	
									10.00m
	12.00	12.45	0.45	U					Medium stiff to stiff bluish grey silty clay with calcarious nodules
	15.00	15.45	0.45	P	6	8	10	18	
									16.00m
	18.00	18.45	0.45	P	8	10	12	22	
	20.00	20.45	0.45	P	9	12	15	27	Very stiff yellowish grey clayey silt with kankars
24.02.24	20.45	Termination Depth							

Abbreviations U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

BORE LOG

Bore Hole No. : 05

Method of Boring / Drilling : Wash

Standing Water Level : 0.20 m b.g.l.

Dia.of Boring / Drilling : 150mm

Casing Lowered : **3.00m**

Date : 24.02.24 To 24.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N° Value	Description
24.02.24	0.50	-	-	D					Filled up with soil,roots etc
									0.50m
	1.00	-	-	D					
	1.50	1.95	0.45	P	2	2	2	4	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	U					
	4.50	4.95	0.45	P	2	2	3	5	
									5.50m
	6.00	6.45	0.45	P	1	1	2	3	Soft grey to dark grey silty clay with decomposed wood
	7.50	7.95	0.45	P	1	1	1	2	
	9.00	9.45	0.45	P	1	1	1	2	
									10.00m
	12.00	12.45	0.45	P	4	3	6	9	Medium stiff to stiff bluish grey silty clay with calcarious nodules
	15.00	15.45	0.45	P	7	7	9	16	
24.02.24	15.45	Termination Depth							

Abbreviations: U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

BORE LOG

Bore Hole No. : 06

Method of Boring / Drilling : Wash

Standing Water Level : 0.30 m b.g.l.

Dia.of Boring / Drilling : 150mm

Casing Lowered : 3.00m

Date : 25.02.24 To 25.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N' Value	Description
25.02.24	0.50	-	-	D					Filled up with soil,roots etc
									0.50m
	1.00	-	-	D					
	1.50	1.95	0.45	P	1	2	2	4	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	U					
	4.50	4.95	0.45	P	2	3	3	6	
									5.50m
	6.00	6.45	0.45	P	1	1	1	2	
	7.50	7.95	0.45	P	1	1	1	2	Soft grey to dark grey silty clay with decomposed wood
	9.00	9.45	0.45	P	1	1	2	3	
									10.50m
	12.00	12.45	0.45	P	3	3	5	8	Medium stiff to stiff bluish grey silty clay with calcarious nodules
	15.00	15.45	0.45	P	7	8	9	17	
25.02.24	15.45	Termination Depth							

Abbreviations: U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

BORE LOG

Bore Hole No. : 07

Method of Boring / Drilling : Wash

Standing Water Level : 0.30 m b.g.l.

Dia of Boring / Drilling : 150mm

Casing Lowered : 3.00m

Date : 25.02.24 To 26.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N' Value	Description
25.02.24	0.50	-	-	D					Filled up with soil, roots etc
									0.50m
	1.00	-	-	D					
	1.50	1.95	0.45	P	2	2	3	5	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	U					
	4.50	4.95	0.45	P	2	3	4	7	
									5.50m
	6.00	6.45	0.45	P	1	1	2	3	Soft grey to dark grey silty clay with decomposed wood
	7.50	7.95	0.45	P	1	1	1	2	
	9.00	9.45	0.45	P	1	1	1	2	
									10.50m
	12.00	12.45	0.45	P	3	4	5	9	Medium stiff to stiff bluish grey silty clay with calcarious nodules
	15.00	15.45	0.45	P	8	7	8	15	
26.02.24	15.45	Termination Depth							

Abbreviations: U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

BORE LOG

Bore Hole No. : 08

Method of Boring / Drilling : Wash

Standing Water Level : 0.30 m b.g.l.

Dia.of Boring / Drilling : 150mm

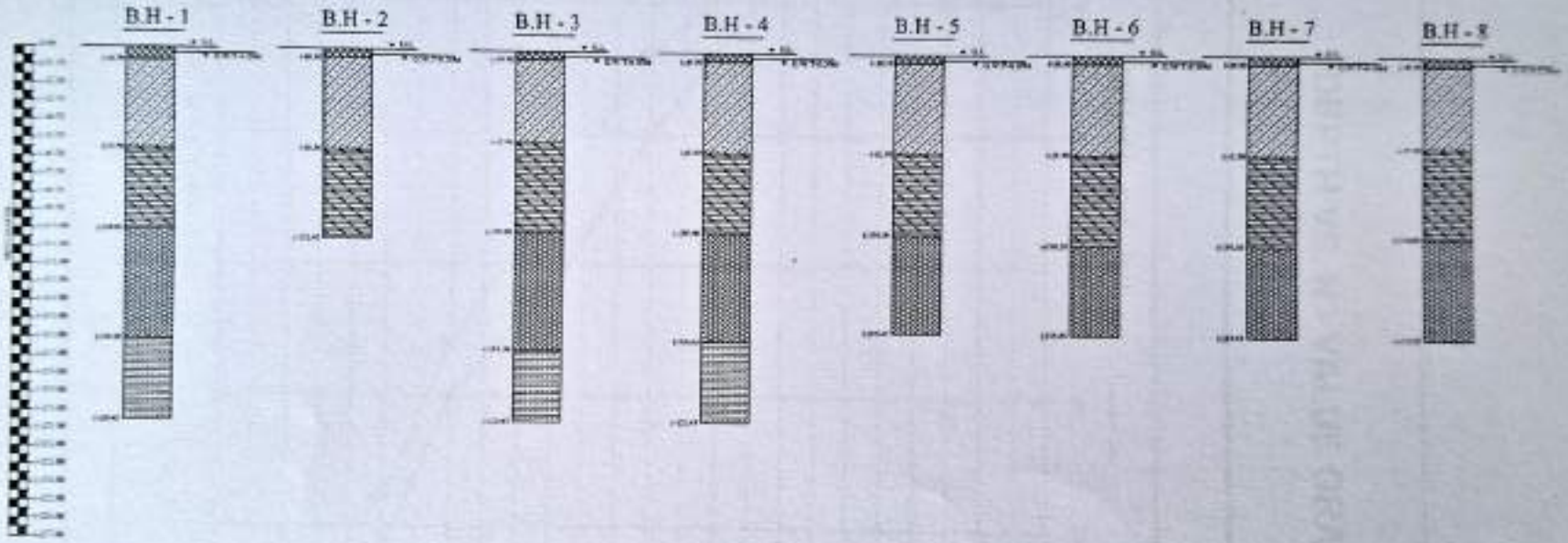
Casing Lowered : **3.00m**

Date : 26..02.24 To 26.02.24

Date	Depth (m) From	Depth (m) To	Length (m)	Nature of Sampling	SPT : No. of blows 00-15 cm	15-30 cm	30-45 cm	N' Value	Description
26..02.24	0.50	-	-	D					Filled up with soil,roots etc
									0.50m
	1.00	-	-	D					
	1.50	1.95	0.45	P	2	2	2	4	Soft to medium stiff brownish grey clayey silt
	3.00	3.45	0.45	U					
	4.50	4.95	0.45	P	2	3	3	6	
									5.00m
	6.00	6.45	0.45	P	1	1	1	2	Soft grey to dark grey silty clay with decomposed wood
	7.50	7.95	0.45	P	1	1	2	3	
	9.00	9.45	0.45	P	1	1	2	3	
									10.00m
	12.00	12.45	0.45	P	2	5	5	10	Medium stiff to stiff bluish grey silty clay with calcarious nodules
	15.00	15.45	0.45	P	7	7	9	16	
26.02.24	15.45	Termination Depth							

Abbreviations: U-Undisturbed Sample D-Disturbed Sample P-Standard Penetration Test

Sub-Soil Profile



Legend		Description
	I	Filled up with soil,waste etc
	II	Soft to medium stiff brownish grey clayey silt
	III	Soft grey to dark grey silty clay with decomposed wood
	IV	Medium stiff to stiff blueish grey silty clay with calcareous nodules
	V	Very stiff yellowish grey clayey silt with kankars

B. S. Geotech Pvt. Ltd.

Project: Construction of Proposed Multi Storied Building at Barabahera, Kanaipur, District: Hooghly, West Bengal

DEPTH VS. N - VALUE GRAPH

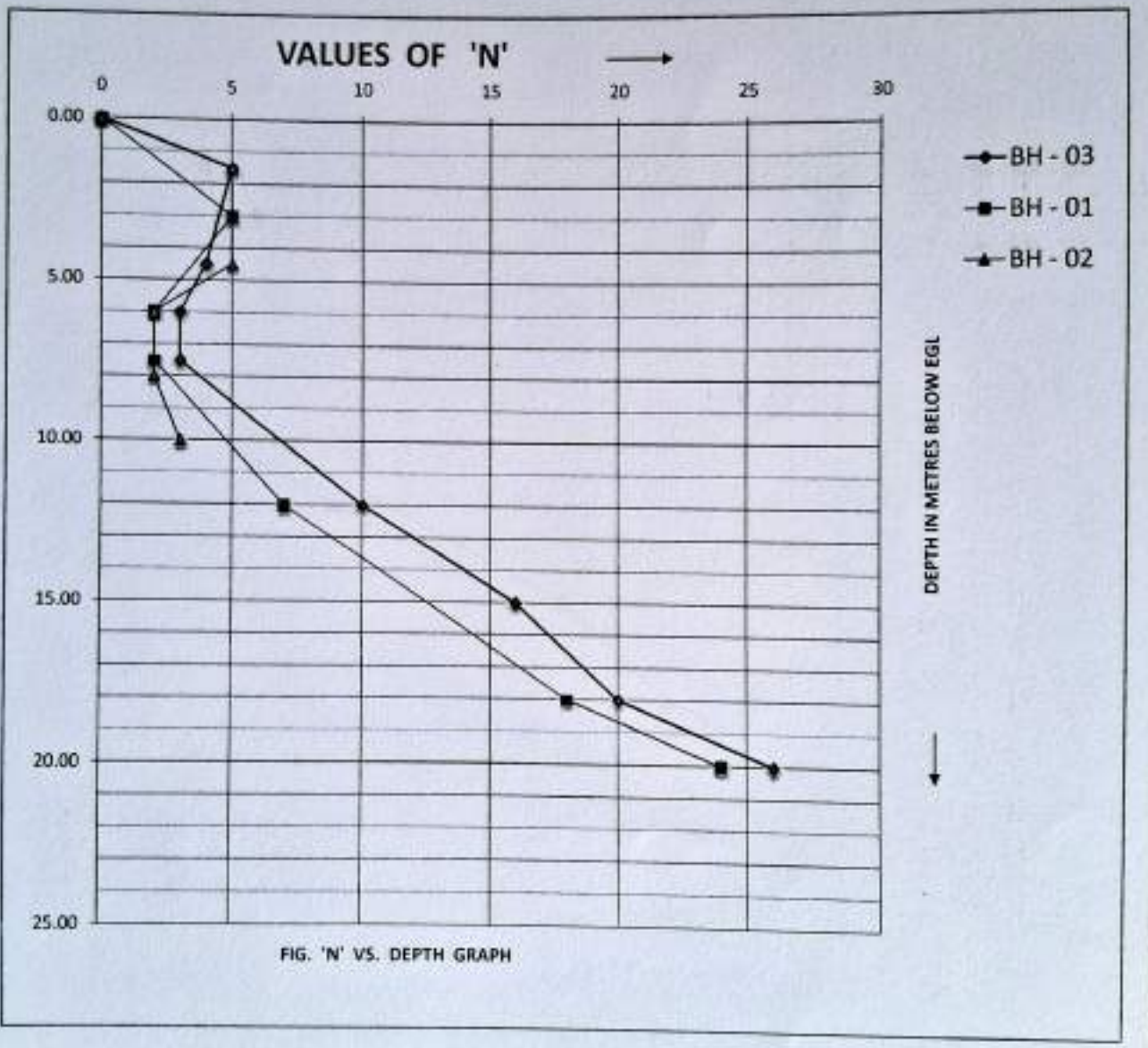


FIG. 'N' VS. DEPTH GRAPH

DEPTH VS. N - VALUE GRAPH

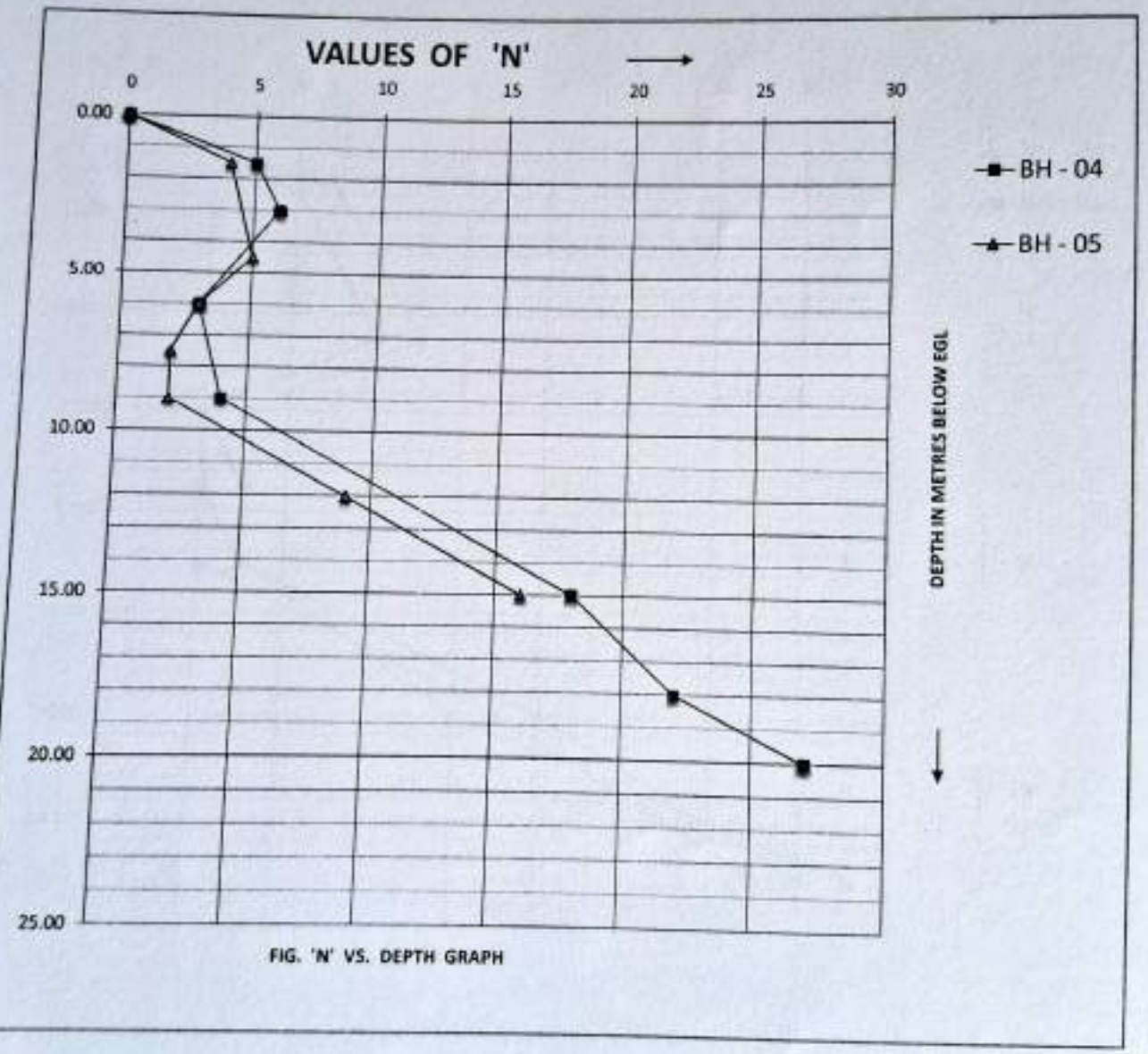


FIG. 'N' VS. DEPTH GRAPH

DEPTH VS. N - VALUE GRAPH

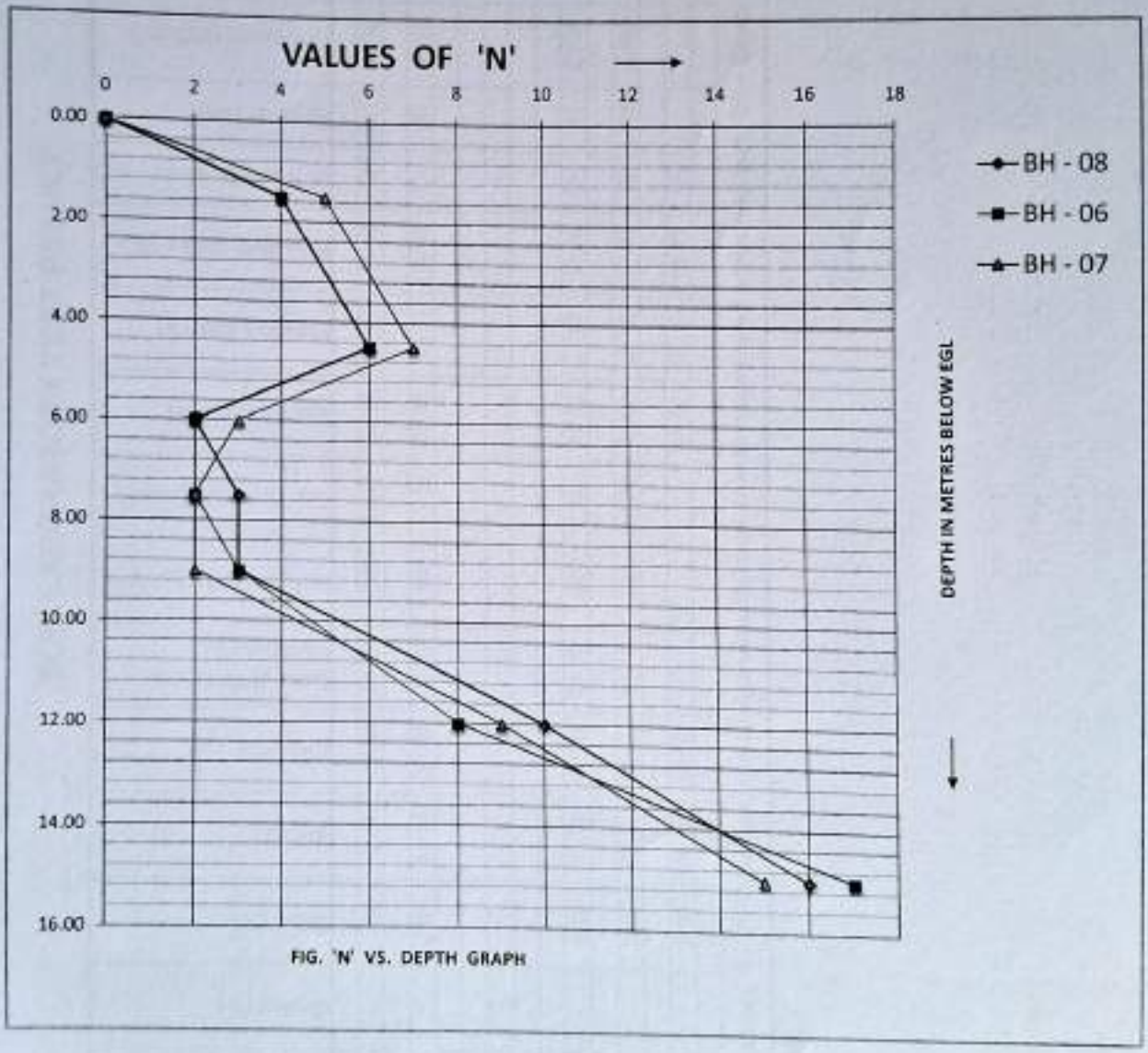


FIG. 'N' VS. DEPTH GRAPH

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm²)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm²)	m_v (cm²/kg)
BH. No. - 01	U	1.50	-	1.35	62.35	36.30	28.50	1.869	1.454	40.35	23.25	17.10	CI	UU	0.250	1.00	2.621		
	U	4.50	-	2.65	59.35	38.00	30.00	1.861	1.432	39.60	23.14	16.46	CI	UU	0.275	1.00	2.620	0.50 - 0.25	0.0482
																		1.00 - 0.50	0.0366
																		2.00 - 1.00	0.0305
																		4.00 - 2.00	0.0190
																		8.00 - 4.00	0.0223
	U	9.00	-	0.92	57.00	42.08	34.00	1.810	1.351	60.00	27.80	32.20	CH	UC	0.230	-			
	U	15.00	-	2.50	46.00	51.50	26.70	1.925	1.519	40.00	22.10	17.90	CI	UU	0.350	1.50	2.635		
	P	20.00	-	5.00	64.00	31.00				37.50	21.20	16.30	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Dersity (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm^2)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm^2)	m_v (cm^2/kg)
BH. No. - 02	U	3.00	-	2.65	57.00	40.35	30.00	1.872	1.440	39.70	22.30	17.40	CI	UU	0.265	1.00	2.628	0.50 - 0.25	0.0486
																		1.00 - 0.50	0.0399
																		2.00 - 1.00	0.0310
																		4.00 - 2.00	0.0230
																		8.00 - 4.00	0.0142
	P	6.00	-	1.10	51.70	47.20				56.35	27.65	28.70	CH						
	P	10.00	-	1.20	56.00	42.80				58.65	27.00	31.65	CH						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm^2)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm^2)	m_v (cm^2/kg)
BH. No. - 03	U	3.00	-	2.65	58.35	39.00	30.25	1.865	1.432	39.68	23.00	16.68	CI	UC	0.270		2.621		
	U	9.00	-	0.86	58.32	40.82	35.00	1.814	1.344	59.35	28.35	31.00	CH	UC	0.235	-		0.50 - 0.25	0.0511
																		1.00 - 0.50	0.0453
																		2.00 - 1.00	0.0364
																		4.00 - 2.00	0.0253
																		8.00 - 4.00	0.0125
	P	15.00	-	2.65	48.65	48.70				38.68	22.50	16.18	CI				2.632		
	P	20.00	-	4.98	63.58	31.44				38.00	22.00	16.00	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

B.S. GEOTECH PVT. LTD.

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm^2)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm^2)	m_v (cm^2/kg)
BH. No. - 04	P	1.50	-	1.35	55.00	43.65	28.50	1.869	1.454	37.50	22.00	15.50	CI						
	U	4.50	-	2.49	56.35	41.16	30.65	1.860	1.424	38.68	23.45	15.23	CI	UC	0.28		2.627		
	U	7.50	-	0.85	56.35	42.80	33.56	1.805	1.351	62.35	28.35	34.00	CH	UU	0.225	0.50			
	U	12.00	-	2.15	47.00	50.85	26.00	1.891	1.501	39.46	23.00	16.46	CI	UC	0.28		2.631		
	P	18.00	-	4.56	62.65	32.79				38.54	22.11	16.43	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm²)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm²)	m_v (cm²/kg)
BH. No. - 02	U	3.00	-	2.74	55.68	41.58	30.51	1.875	1.437	40.32	22.54	17.78	CI	UU	0.260	1.00	2.625		
	P	7.50	-	1.25	53.65	45.10				58.35	28.00	30.35	CH						
	P	15.00	-	2.51	45.65	51.84				39.65	21.68	17.97	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

B.S. GEOTECH P. LTD.

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm^2)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm^2)	m_v (cm^2/kg)
BH. No. - 06	U	3.00	-	2.71	54.68	42.61	30.50	1.672	1.434	39.68	23.10	16.58	CI	UU	0.270	1.00	2.621	0.25-0.5	0.0482
																		0.5-1.0	0.0413
																		1.0-2.0	0.0307
																		2.0-4.0	0.0231
																		4.0-8.0	0.0141
	P	7.50	-	1.02	52.65	46.33				60.35	28.50	31.85	CH						
	P	15.00	-	2.48	46.35	51.17				38.69	22.60	16.09	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm^2)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm^2)	m$_v$ (cm^2/kg)
BH. No. - 07	U	3.00	-	2.54	56.35	41.11	31.50	1.879	1.429	40.88	23.15	17.53	CI	UC	0.280		2.628		
	P	7.50	-	0.90	53.68	45.42				59.68	27.68	32.00	CH						
	P	15.00	-	2.38	50.35	47.27				39.84	23.15	16.69	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

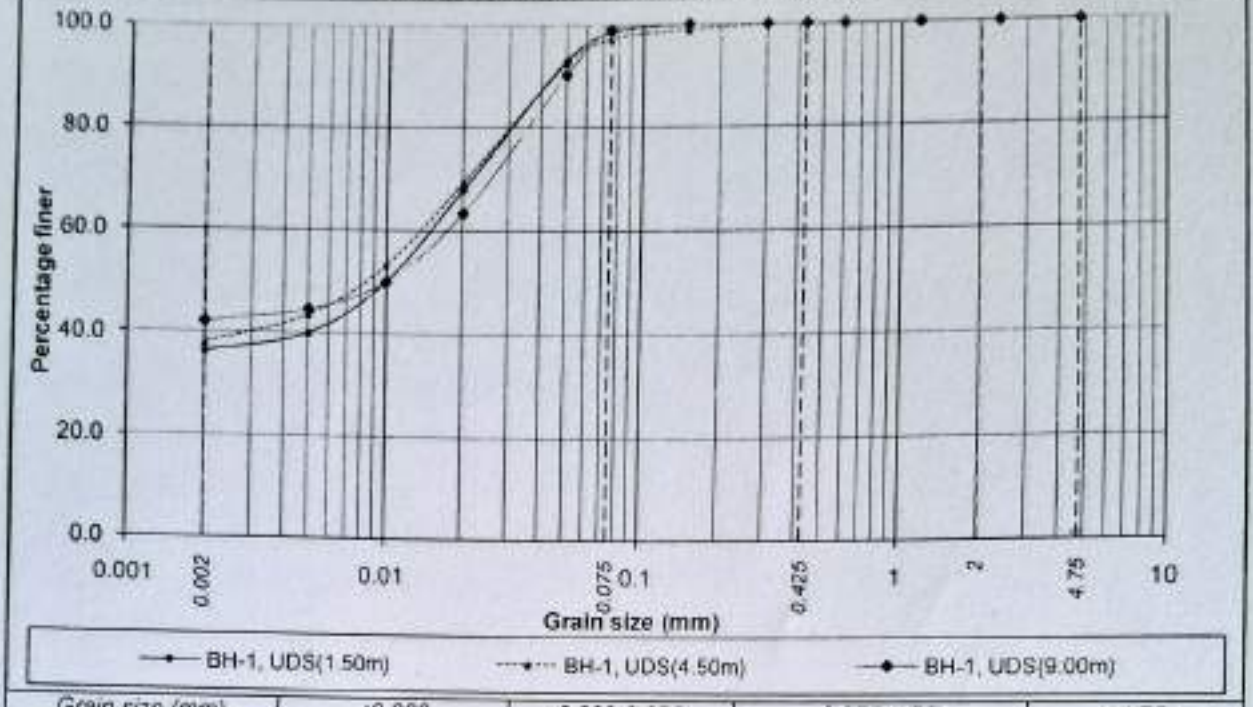
SOIL LABORATORY TEST RESULT

Description	Type	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	IS Classification	Type of Test	Cohesion (kg/cm^2)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm^2)	m$_v$ (cm^2/kg)
BH. No. - 08	U	3.00	-	2.10	58.69	39.21	30.50	1.871	1.434	41.68	23.50	18.18	CI	UC	0.289		2.624		
	P	7.50	-	1.10	54.68	44.22				60.26	28.65	31.61	CH						
	P	15.00	-	2.15	53.65	44.20				38.12	22.00	16.12	CI						

D = Distrubed soil sample, P = SPT Sample, U = Undistrubed Sample, UU= Uncosolidated undrained test, DS= Direct shear test

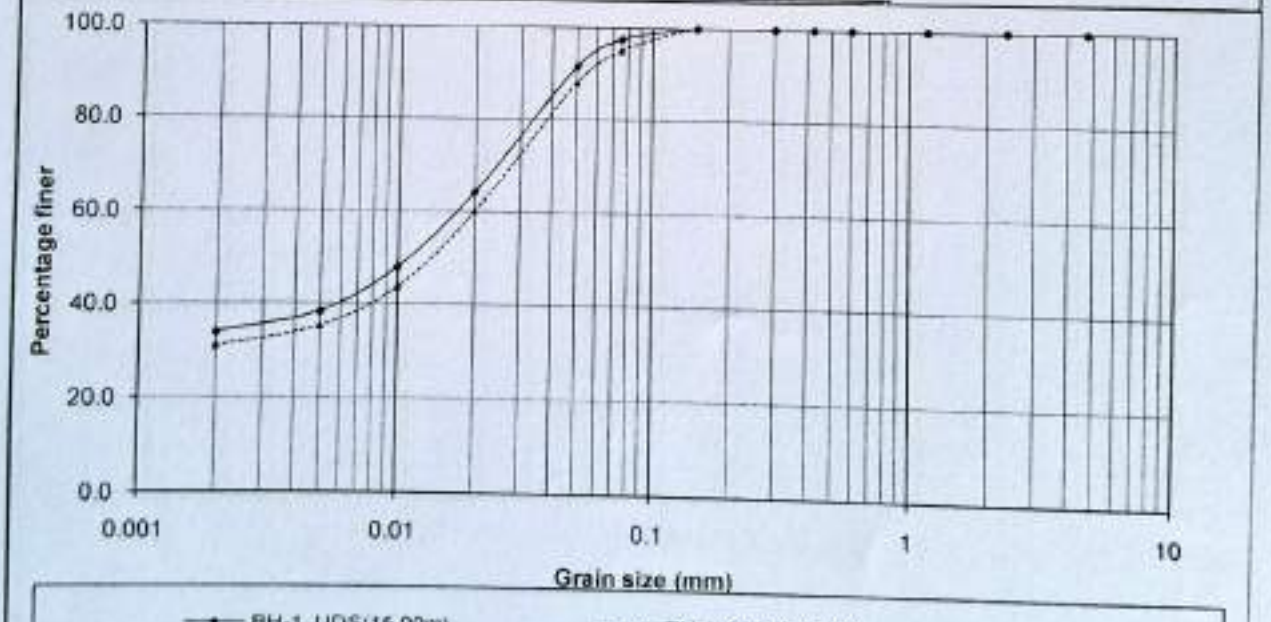
UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-1, UDS(1.50m)	36.30	62.35	1.35	0.00
BH-1, UDS(4.50m)	38.00	59.35	2.65	0.00
BH-1, UDS(9.00m)	42.08	57.00	0.92	0.00

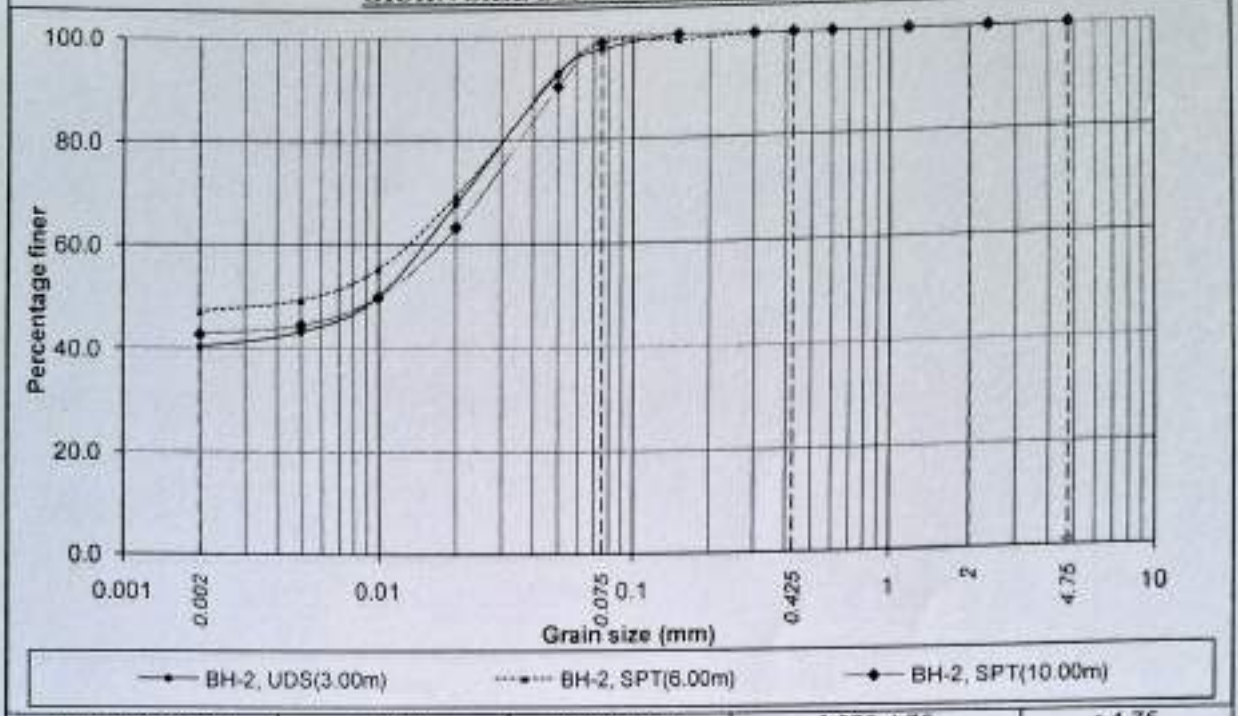
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-1, UDS(15.00m)	33.85	63.65	2.50	0.00
BH-1, SPT(20.00m)	31.00	64.00	5.00	0.00

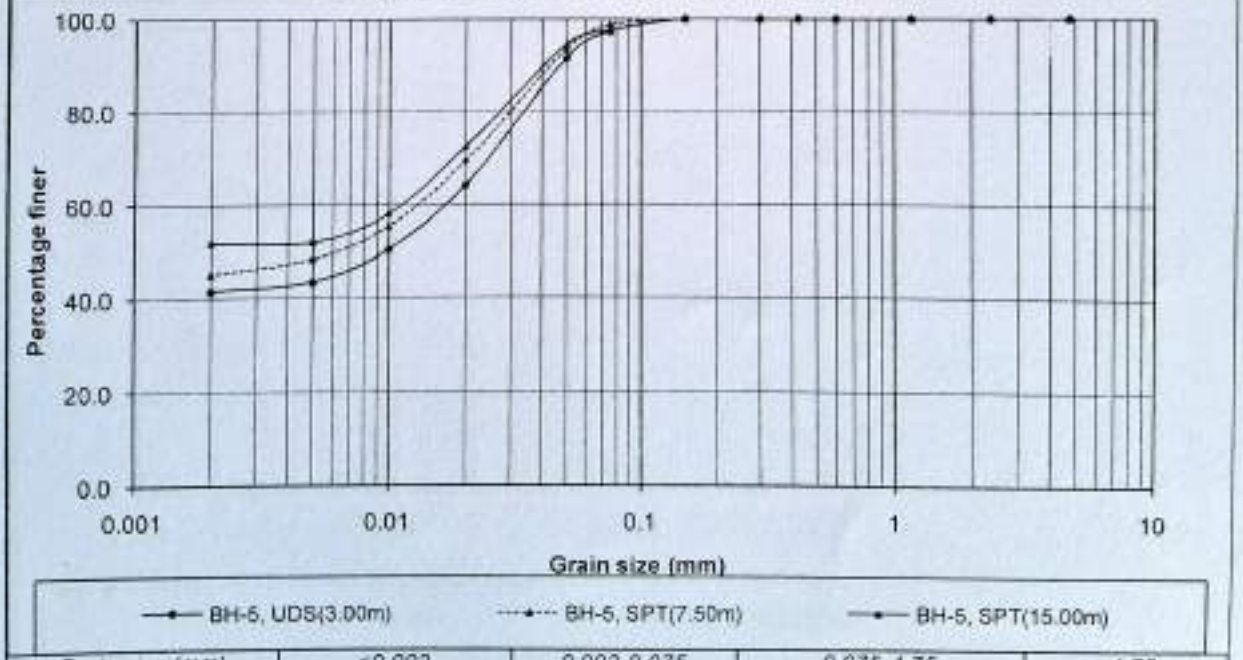
*Silt & Clay

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-2, UDS(3.00m)	40.35	57.00	2.65	0.00
BH-2, SPT(6.00m)	47.20	51.70	1.10	0.00
BH-2, SPT(10.00m)	42.80	56.00	1.20	0.00

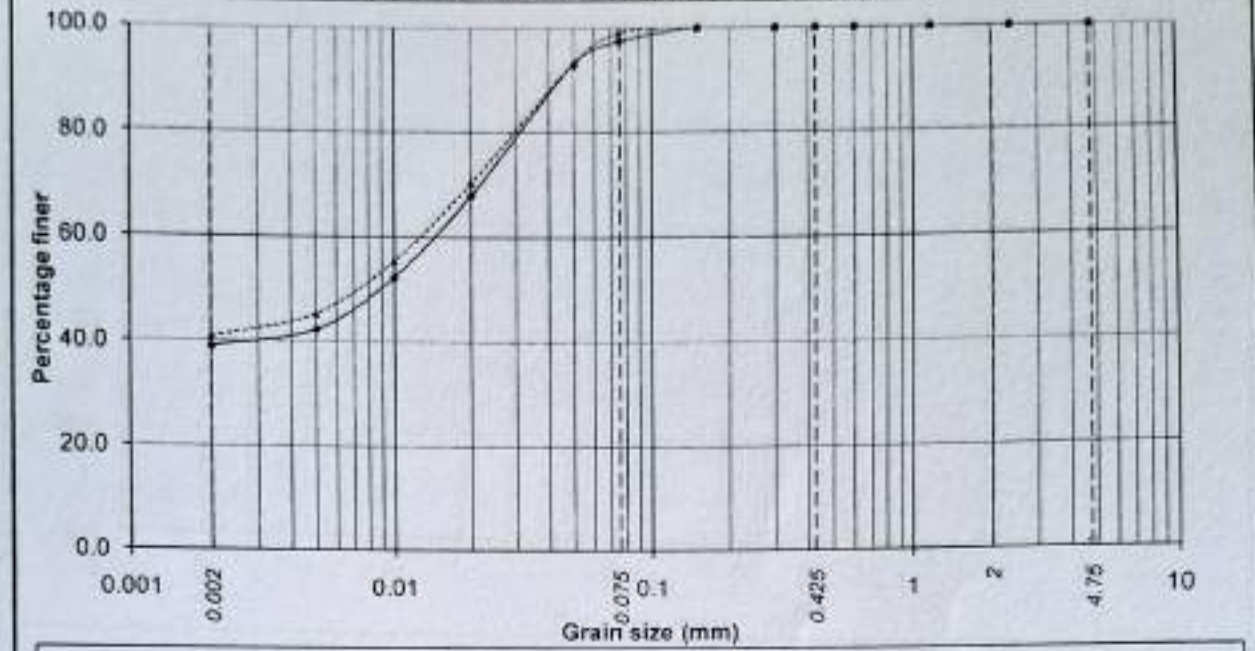
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-5, UDS(3.00m)	41.56	55.68	2.74	0.00
BH-5, SPT(7.50m)	45.10	53.65	1.25	0.00
BH-5, SPT(15.00m)	51.84	45.65	2.5	0.00

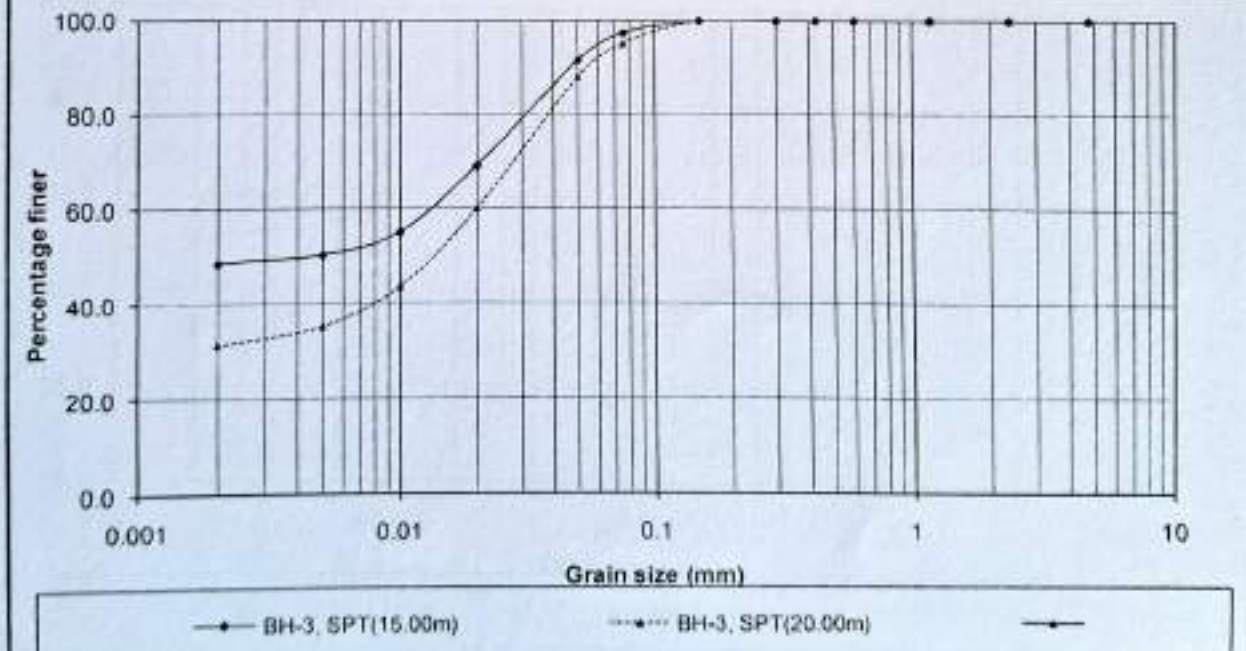
*Silt & Clay

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-3, UDS(3.00m)	39.00	58.35	2.65	0.00
BH-3, UDS(9.00m)	40.82	58.32	0.86	0.00

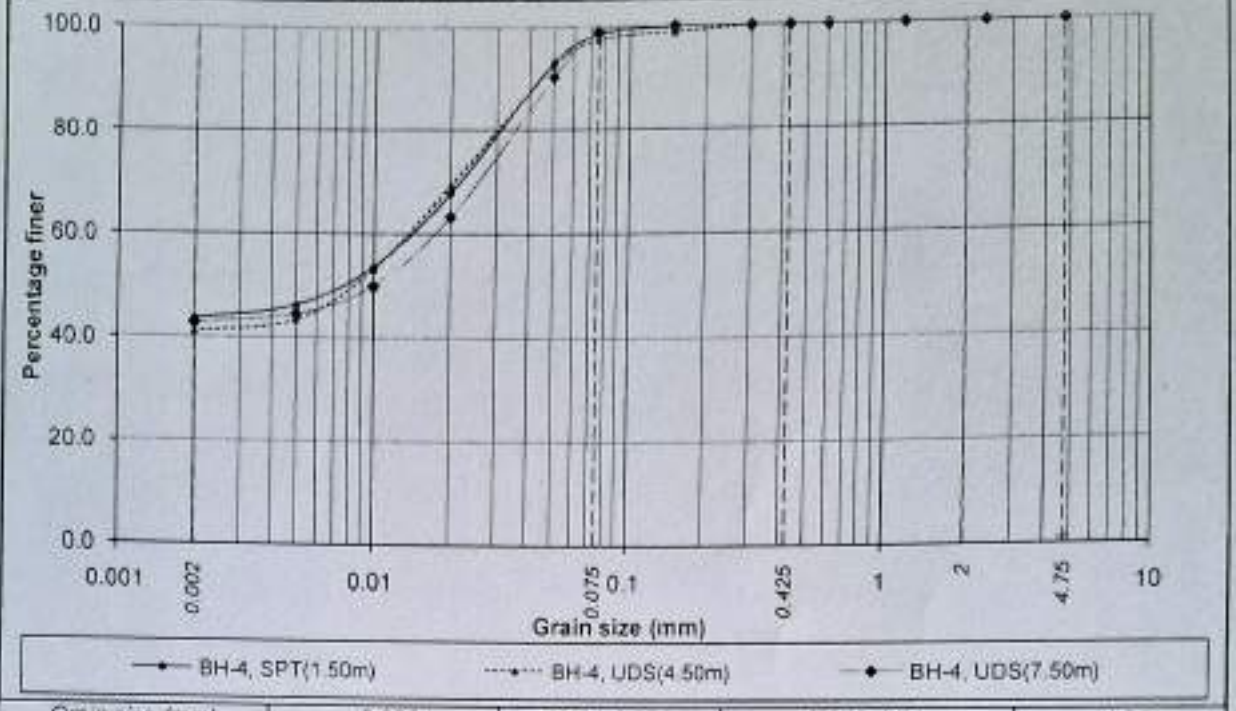
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-3, SPT(15.00m)	48.70	48.65	2.65	0.00
BH-3, SPT(20.00m)	31.44	63.58	4.98	0.00

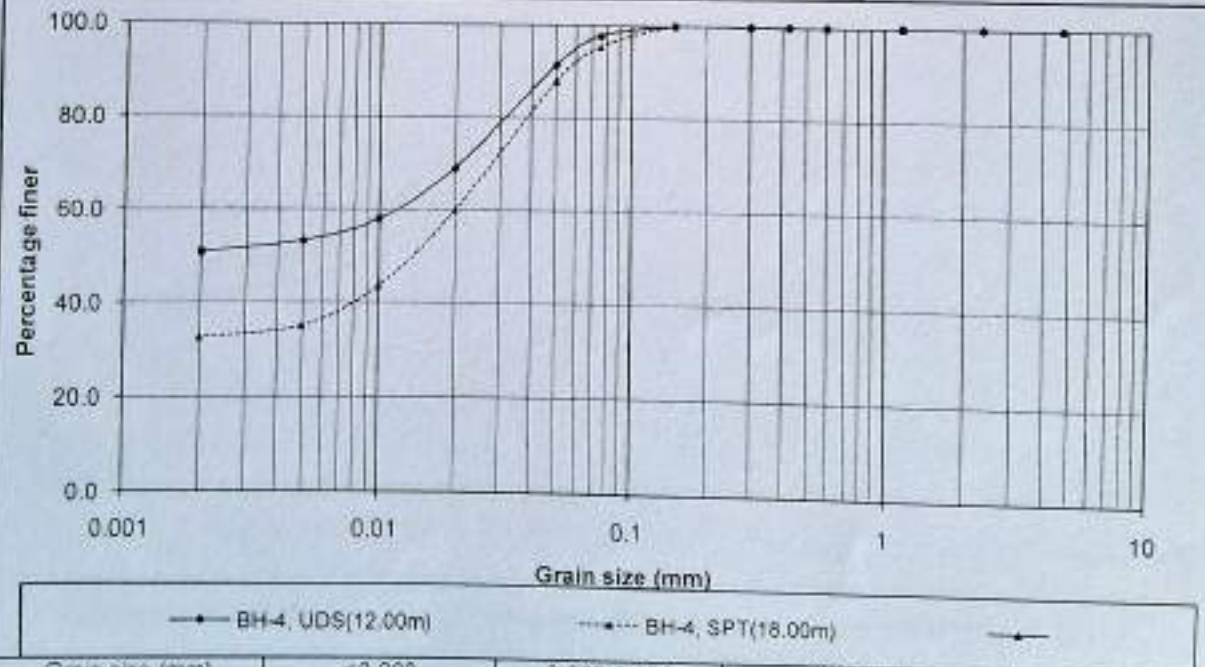
*Silt & Clay

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-4, SPT(1.50m)	43.65	55.00	1.35	0.00
BH-4, UDS(4.50m)	41.16	56.35	2.49	0.00
BH-4, UDS(7.50m)	42.80	56.35	0.85	0.00

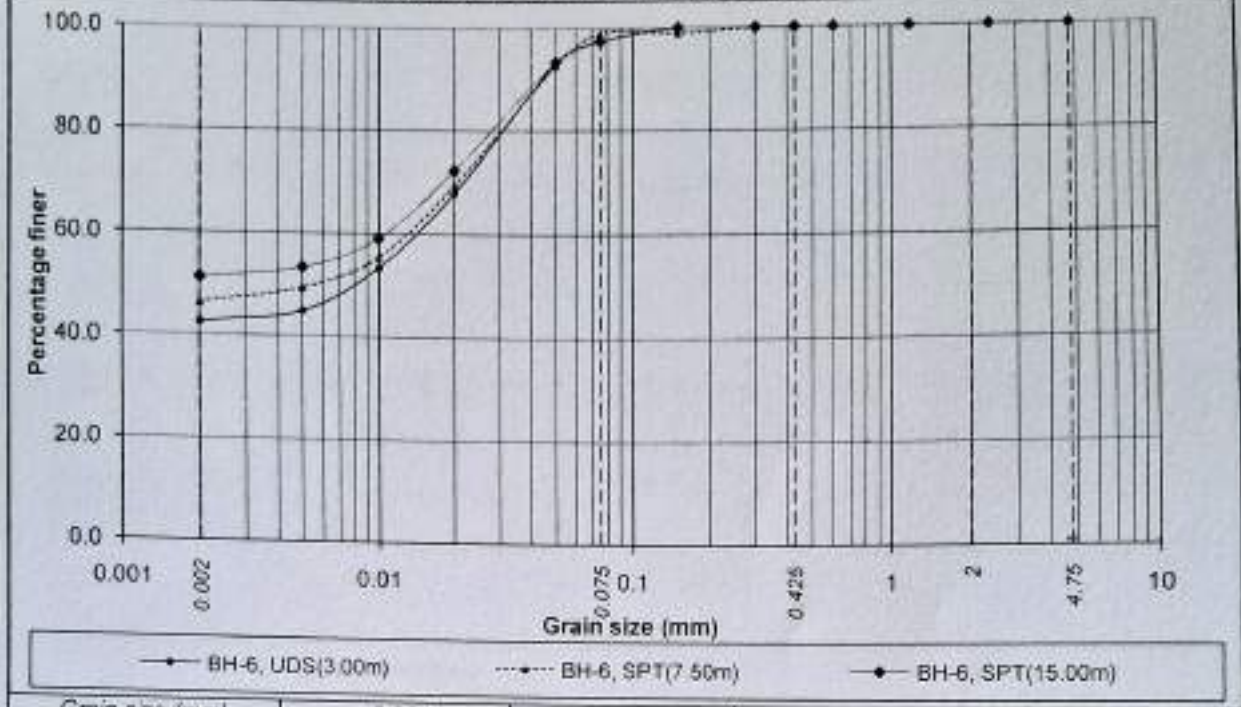
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-4, UDS(12.00m)	50.85	47.00	2.15	0.00
BH-4, SPT(18.00m)	32.79	62.65	4.56	0.00

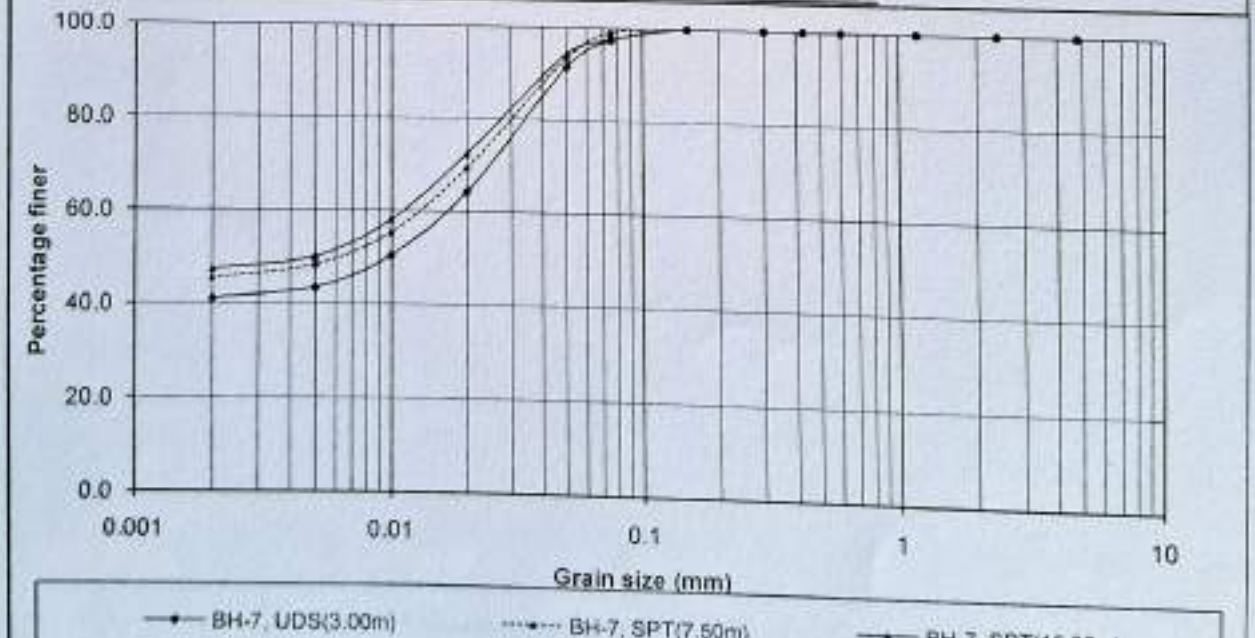
*Silt & Clay

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-6, UDS(3.00m)	42.61	54.68	2.71	0.00
BH-6, SPT(7.50m)	46.33	52.65	1.02	0.00
BH-6, SPT(15.00m)	51.17	46.35	2.48	0.00

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-7, UDS(3.00m)	41.11	56.35	2.54	0.00
BH-7, SPT(7.50m)	45.42	53.68	0.90	0.00
BH-7, SPT(15.00m)	47.27	50.35	2.4	0.0

*Silt & Clay

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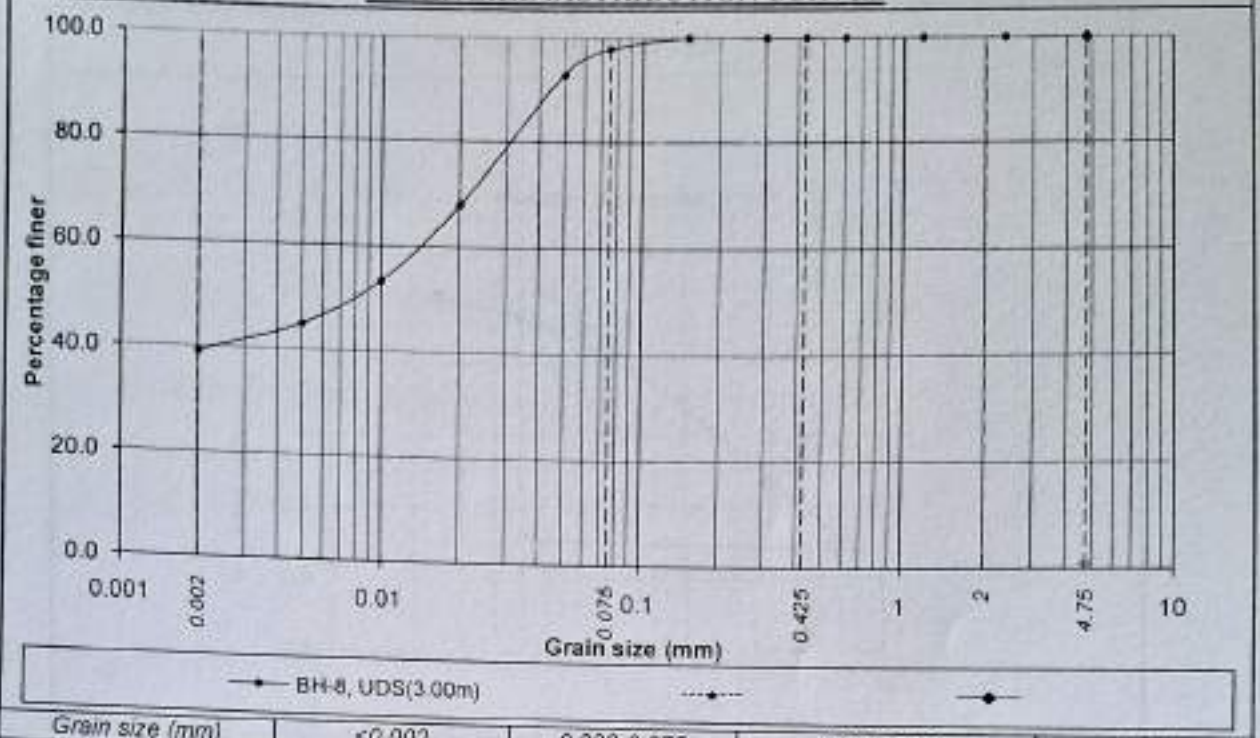
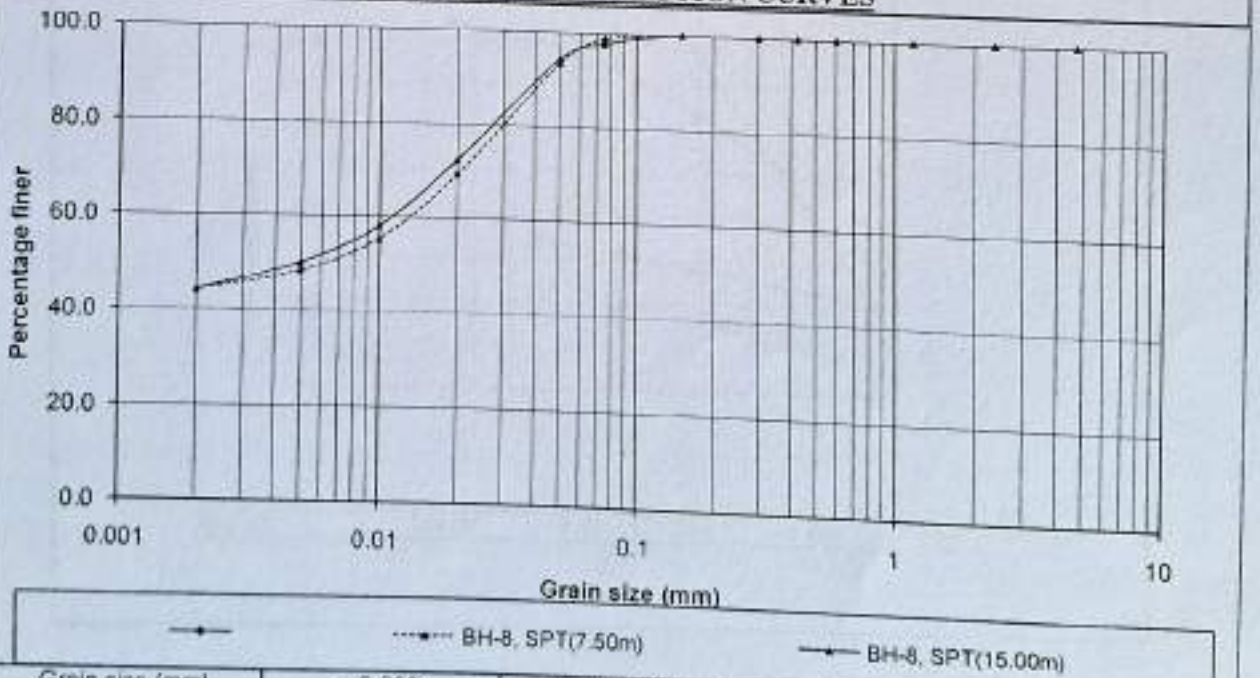
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-8, UDS(3.00m)	39.21	58.69	2.10	0.00

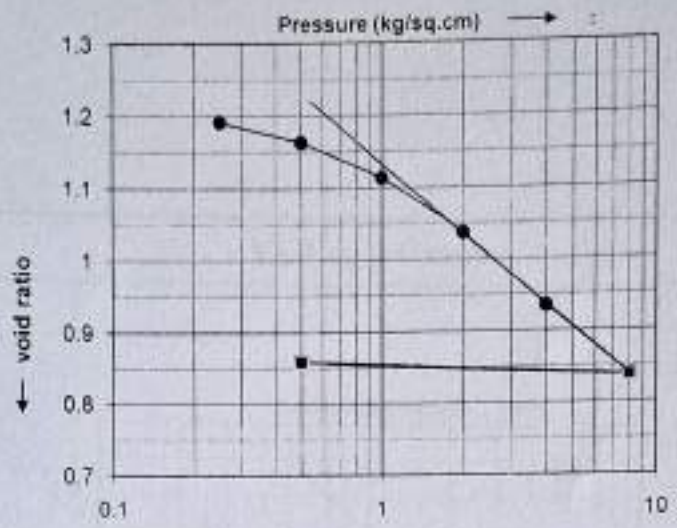
GRAIN SIZE DISTRIBUTION CURVES



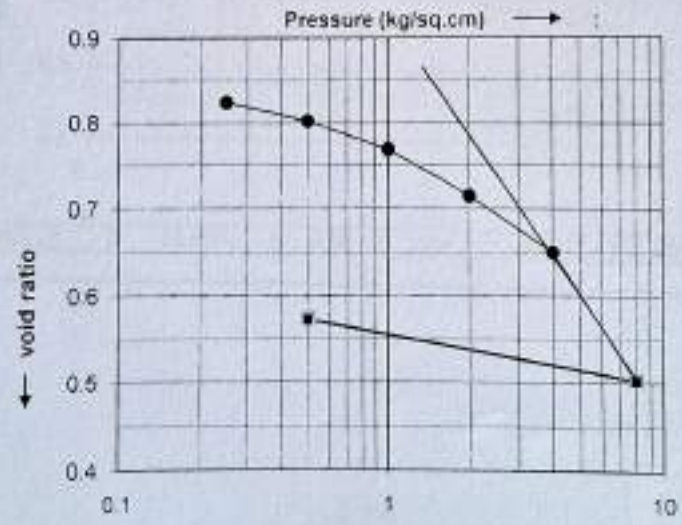
Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-8, SPT(7.50m)	44.22	54.68	1.10	0.00
BH-8, SPT(15.00m)	41.20	53.65	2.2	0.00

*Silt & Clay

e Vs. Log p Graph

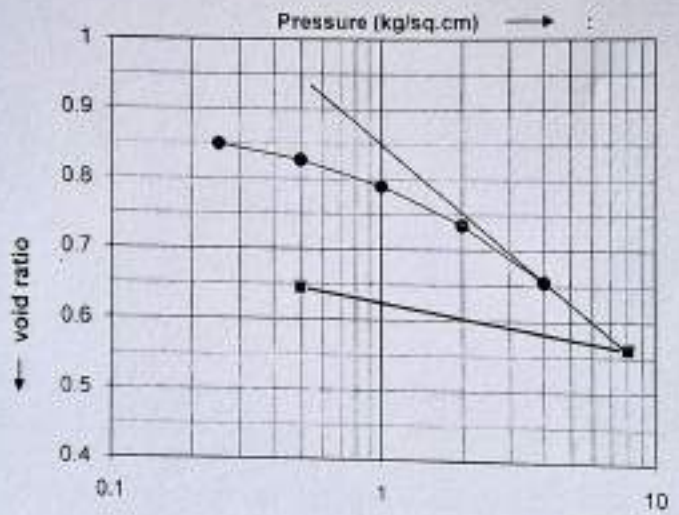


BH. NO.:	3	Depth:	9.00	Cc=	0.322	e0=	1.221



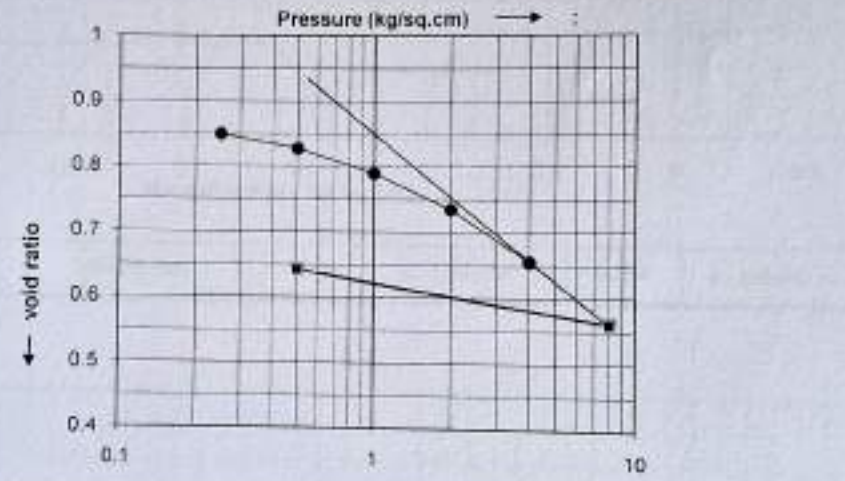
BH. NO.:	1	Depth:	4.50	Cc=	0.488	e0=	0.886

e Vs. Log p Graph



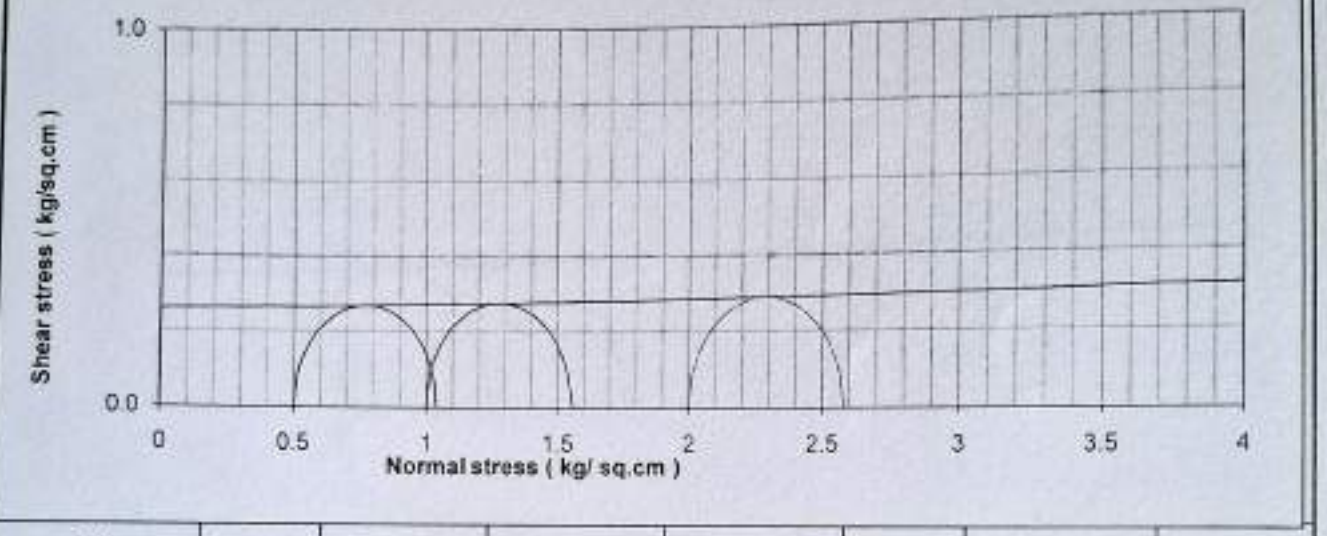
BH. NO.:	2	Depth:	3.00	Cc=	0.312	e0=	0.862

e Vs. Log p Graph

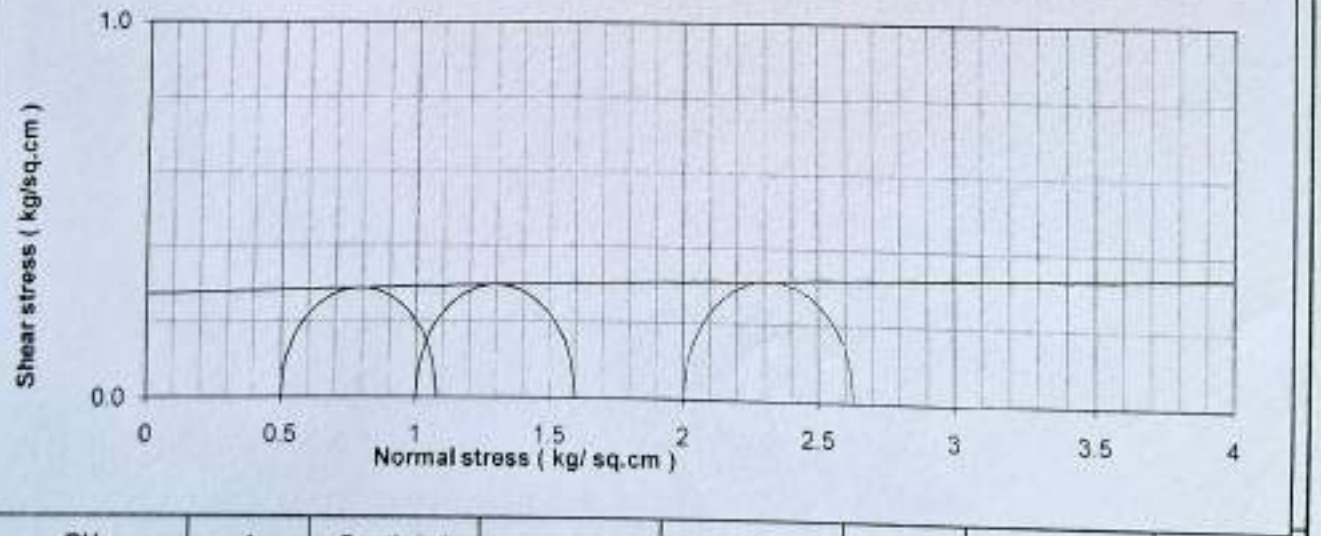


BH. NO.:	6	Depth:	3.00	Cc=	0.311	e0=	0.657

Mohr's Circle Diagram

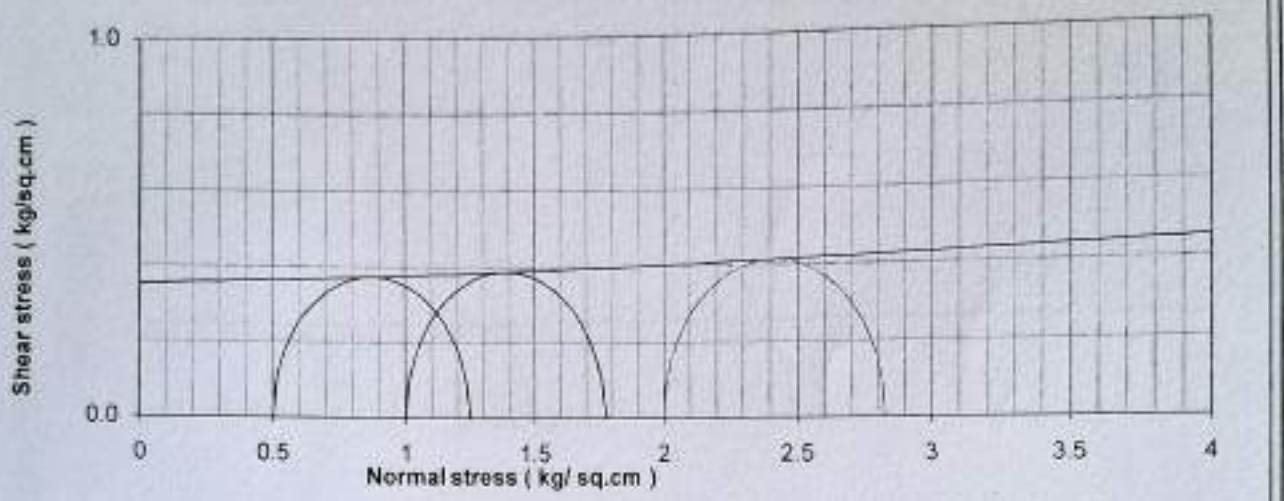


BH-	1	Depth (m)	1.50	C (kg/cm²)=	0.259	ϕ (degree) =	0.76

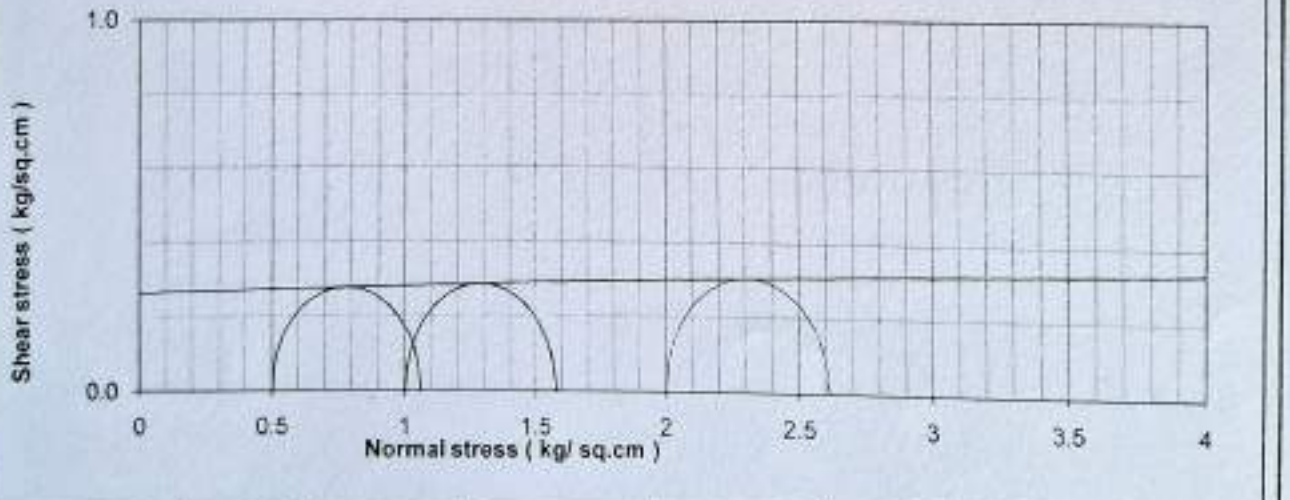


BH-	1	Depth (m)	4.50	C (kg/cm²)=	0.275	ϕ (degree) =	1.00

Mohr's Circle Diagram

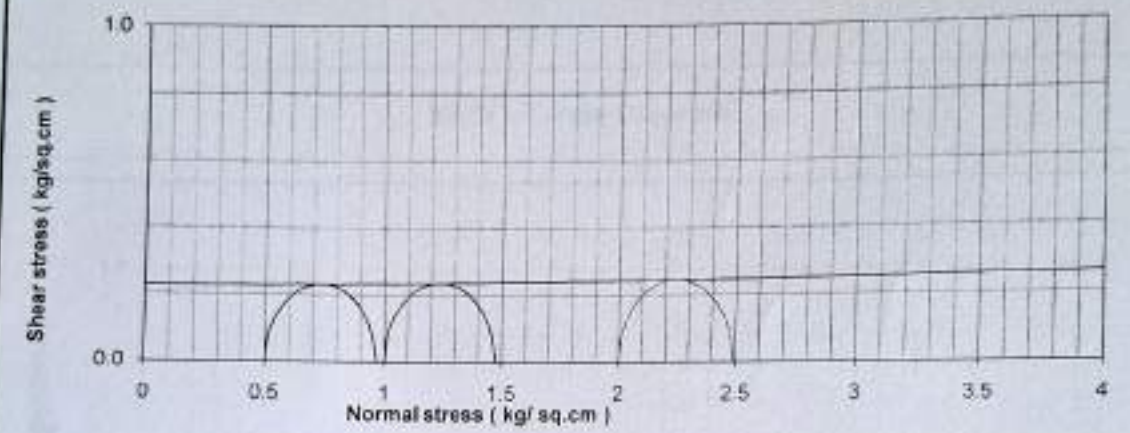


BH-	1	Depth (m)	15.00	C (kg/cm²)=	0.350	ϕ (degree) =	1.50

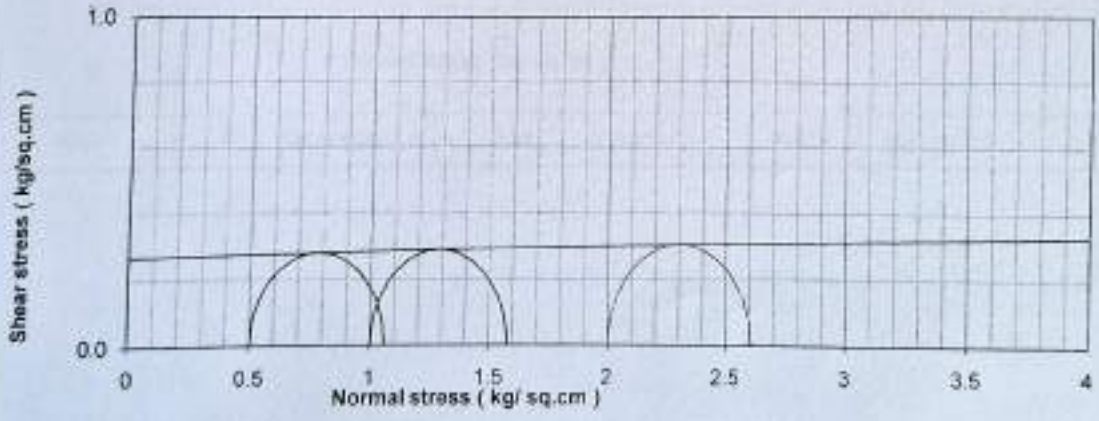


BH-	2	Depth (m)	3.00	C (kg/cm²)=	0.265	ϕ (degree) =	1.00

Mohr's Circle Diagram

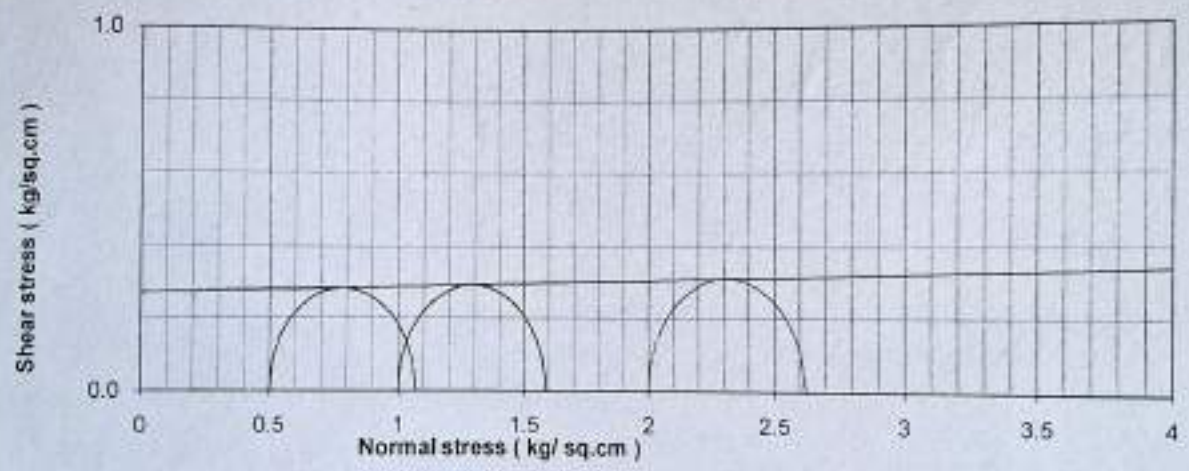


BH-	4	Depth (m)	7.50	C (kg/cm²)=	0.225	ϕ (degree) =	0.50



BH-	5	Depth (m)	3.00	C (kg/cm²)=	0.267	ϕ (degree) =	0.90

Mohr's Circle Diagram



BH-	6	Depth (m)	3.00	C (kg/cm^2)=	0.270	ϕ (degree) =	1.00