

SITE : H. NO.- 1430, STATION ROAD, WARD NO.- 05, MIDNAPORE MUNICIPALITY

A REPORT ON

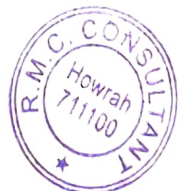
**SOIL INVESTIGATION FOR THE PROPOSED (B + G + V) STORIED
BUILDING AT MOUZA- SEKHPURA, J.L. NO.- 172, R.S. PLOT
NO.- 153/323(P), L.R. PLOT NO.- 648, HOLDING NO.- 1430, STATION
ROAD, WARD NO.- 05, P.S.- KOTWALI, UNDER MIDNAPORE
MUNICIPALITY**

OWNER : GANESH GHOSH

EXECUTED BY :

RMC CONSULTANT

**1ST FLOOR, FLAT NO.- 02 SHREE RAM APARTMENT,
NEAR HANSKHALI POOL, HOWRAH- 711109**



Sl. No.

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INTRODUCTION

It has been a proposal to construct a B+G+VI STD building at **Site: HOLDING NO. 1430, STATION ROAD, WARD NO.-5, WARD NO.-03, MIDNAPORE MUNICIPALITY**

. The job of subsoil exploration was entrusted to M/S. RMC CONSULTANT.

Soil exploration was carried out at this site to assess the subsoil deposition & condition and to ascertain the safe foundation types suitable for the proposed structure. Altogether three boreholes of 20.0M depth each respectively were sunk at different indicated locations (shown in Fig.1 in Annexure). The fieldwork for the soil exploration, including all field tests and undisturbed sampling, were done in the month of Feb, 2024 in presence of authorized representatives of client. The undisturbed samples and disturbed samples were tested in the Soil Mechanics laboratory following IS: 2720 and its parts. This report deals with the findings of field and laboratory test results, drawings, figures and makes recommendations for the safe foundations of the proposed structure.



2. FIELD EXPLORATION

2.1 BORING

The boring was done at the site using 200mm diameter auger and shell equipment by a manually operated winch. To prevent possible caving in of the sides of the boreholes, flush jointed casing pipes were used as boring progressed. Circulation of betonies slurry was resorted to whenever necessary to stabilize the sides of the boreholes.

2.2 SAMPLING

Undisturbed samples were collected at suitable intervals of depth from the bore holes by driving two - tier thin walled open drive samplers of 100mm diameter. The area ratio of the tubes was kept about 12%, after withdrawal, the lower tube was retained, covered with an impervious disc and sealed with wax at both ends before transportation to the laboratory. In addition, disturbed samples were taken at suitable intervals of depth and at changes of strata in order to physical examination of the nature of all the representative strata. These were collected from the auger and the barrel of the split spoon sampler after the standard penetration tests. The depth wise locations of the entire undisturbed, disturbed and standard penetration test samples have been given in the bore log data sheets, enclosed with this report.



2.3 IN-SITU TEST

a) Standard Penetration Test:

Standard penetration tests were conducted within the bore holes at suitable intervals of depth at levels as shown in the bore log data sheets. The tests were done with the standard split spoon sampler as per IS: 2131 latest edition. The N - values were obtained by counting the number of blows required to drive the split spoon sampler from 15 cm to 45 cm.

3. LABORATORY TESTS

The soil samples from the 10cm diameter sampling tubes were extracted in the laboratory by pushing out the soil core with the help of a jack and a frame. The core was jacked out in a direction that corresponded to the soil movement within the tube during sampling.

The following tests were done on representative samples of the cohesive strata.

- a) Natural Water Content
- b) Atterberg Limits
- c) Bulk Density
- d) Specific Gravity
- e) Grain Size Distribution
- f) Unconfined shear strength
- g) Undrained Triaxial Test



h) Consolidation Test

i) Direct shear test

For triaxial shear and unconfined compressive strength tests, three no. 38 mm diameter 76 mm long specimens were obtained by jacking out the soil core, each into a thin-walled brass tube, having the wall thickness of 1/32". The inside of the tubes was coated with a thin layer of silicon oil. To obtain specimens for consolidation test, the odometer ring was placed on the trimmed horizontal faces of the soil within the 10 cm diameter 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 a piano wire saw.

The laboratory tests were run to ascertain the average engineering properties of the sub-soil strata and to obtain the necessary data required for determination of particulars of the foundation. These are detailed below. A summary of all test results has been given in the enclosed laboratory sheet.

3.1 Natural moisture content & Atterberg limits

Natural moisture content of clayey silt / silty sand / sand samples have been determined by oven drying method and also liquid limit and plastic limit of clayey silt samples were determined (a) to classify the soil by the IS classification system and (b) to qualitatively assess their consistency and compressibility.



3.2 Bulk density & Dry density

These were determined by measuring the weights and dimensions of tri-axial shear and unconfined compressive strength test samples before testing and after oven drying. The bulk density & dry density values of the samples have been given in the enclosed laboratory sheet.

3.3 Grain size analysis

The grain size distributions of some representative samples were determined from hydrometer and /or sieve analysis. The results are Plotted and shown in this report.

3.4 Tri-axial shear test (UU)

These were run on the clayey silt samples to determine their shear strengths. The cell pressures employed were 0.5, 1.0 and 1.5 kg/sq.cm. The samples were tested under quick condition at a rate of 1.25 mm/min and were loaded up to maximum 20% axial strain.

3.5 Consolidation test

Consolidation tests were run in floating ring type odometers, in single & four unit consolidation frames under standard load increment ratio starting from 0.25 kg/sq.cm and going up to 8 kg/sq.cm in general. The pressure vs void ratio curves are given in this report.



3.6 Specific Gravity

The Specific Gravity of the soil samples was determined by adopting standard procedure. The soil sample was dried in oven dried for 24 hours and pulverized. The sample was then poured into a specific gravity bottle and topped up with distilled water. The specific gravity bottle was stirred and heated to eliminate air bubbles. The weight of the specific gravity bottle was recorded along with the temperature of the sample.



4. SOIL PROFILE

The soil profile as revealed by borings is shown in Fig 2 in Annexure. The depth wise variation of N values along the boreholes is shown alongside the soil profile.

The soil stratification may, in general, has been summarized as shown in Table 1

Table 1: Subsoil Profile:

Stratum	Description	Thickness (m)	N-Value
I	Reddish/Brownish grey silty clay with kankard	14.0	10-20
II	Yellowish grey silty sand	More than 6.0m up max. expl. Depth 20.0m	30-50

The ground water table was observed at a maximum depth of 5.0m below EGL. However, the water table may fluctuate due to seasonal variation and it has been considered to exist at EGL for design purpose.



5.0 SOIL PROPERTIES

5.1 FIELD TEST DATA

5.1.1 STANDARD PENETRATION RESISTANCE

A summary of the stratum wise variation of N-values throughout the site is given in Annexure.

5.2 Laboratory Test Data

A summary of all laboratory test results is given in Annexure. From a study of these test results, the engineering properties of different strata can be summarized as follows.

Stratum I

Brownish/ Reddish grey silty clay with kankars (0.0m – 14.0m below GL).

Bulk density : 1.86 t/m³

Natural moisture Content : 28 %

LL : 52 %

PL : 25 %

C_u : 5.0 t/m²

m_v : 0.0024 m²/ton

IS CLASSIFICATION : CH



Stratum II:

Yellowish grey silty sand (14.0m -20.0m below GL).

Bulk density : 1.92 t/m³

Φ =30-35

IS CLASSIFICATION : SM



FOUNDATION STUDY

6.1 General Considerations

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:

There must be adequate factor of safety of the foundations against any possible bearing capacity failure and

The settlement of the foundations must be within permissible limits.

Considering the intensity of loads at foundation and sub - soil conditions as obtained from the present investigation, shallow foundation in the form of raft for the proposed structure are investigated as follows:



RAFT FOUNDATION:

The proposed construction would be a Building

The size of the raft may be assumed 19.0 m x 10.5m

As such, assessment of safe bearing capacity of soil at shallow depth may be made as per IS: 6403 as given below:

a) Safe bearing capacity (q_s)

$$q_s = 1/F C N_c s_c d_c i_c$$

Where C = Cohesion

N_c = Bearing capacity factor = 5.14

s_c = Shape factor = $1 + 0.2 B/L = 1 + 0.2 \times 10.5 / 19.0 = 1.1$

d_c = depth factor = $1 + 0.2 D_f / B$

[D_f is depth of foundation]

[B is width of footing] = $1 + 0.2 \times 2.2 / 10.5 = 1.04$

i_c = Inclination factor = 1.0

F = Factor of safety = 2.5

Therefore $q_s = 1/2.5 \times 5.0 \times 5.14 \times 1.1 \times 1.04 \times 1 = 11.7 \text{ t/m}^2$



Estimation of settlement

i) Consolidation settlement (sc)

$$S_c = \sum m_v H \Delta \sigma$$

$$S_c = \{0.0024 \times 4.0 \times 11.7 \times 19.0 \times 10.5 / (19.0 + 2.0) (10.5 + 2.0)\} \times 0.8 \times 0.7 \times 0.94 \times 1000$$

$$= 44.9 \text{ MM}$$

Rigidity factor = 0.8

Porosity factor = 0.7

Depth factor = 0.94

Taking the allowable settlement 100 mm

Therefore, The net Allowable Bearing Capacity = 11.7 t/m²

Where

m_v = Coefficient of volume compressibility

H = Thickness of the stratum considered

$\Delta \sigma$ = Increase of effective pressure at the center of the stratum considered

(obtained by 2:1 dispersion).



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Raft Foundation.

Allowable net bearing pressures for raft foundation placed at 2.2m. on Below E.G.L. In stratum I are found out and shown in Table - 2A below.

Table - 2A: Bearing Capacity of raft Foundation

Size	Depth of foundation	Allowable bearing capacity	Settle-ment	Permissible allowable bearing capacity
(MXM)	(M)	(T/M ²)	(MM)	(T/M ²)
19.0 X 10.5	2.2	11.7	44.9	11.7

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Proprietor

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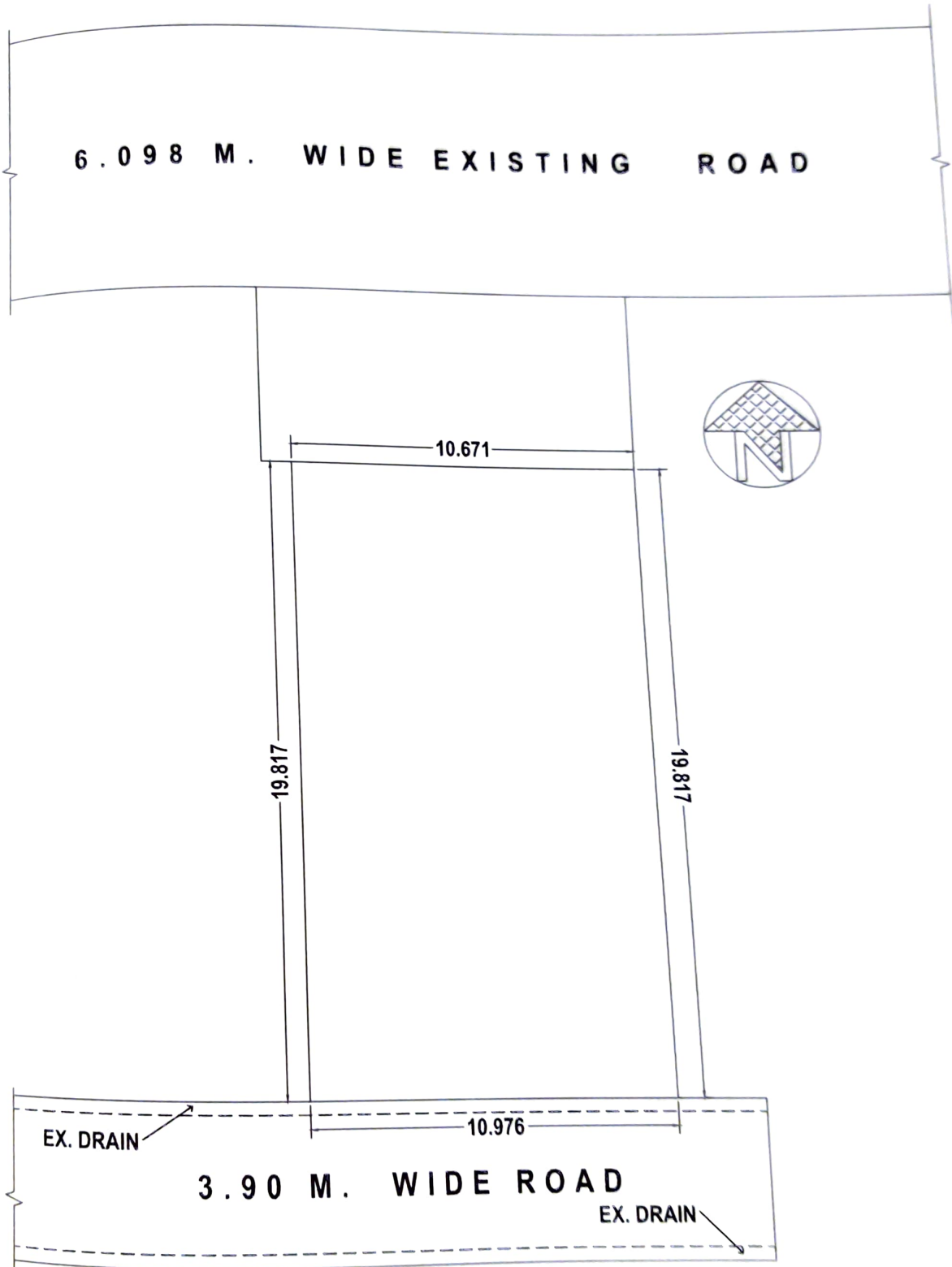


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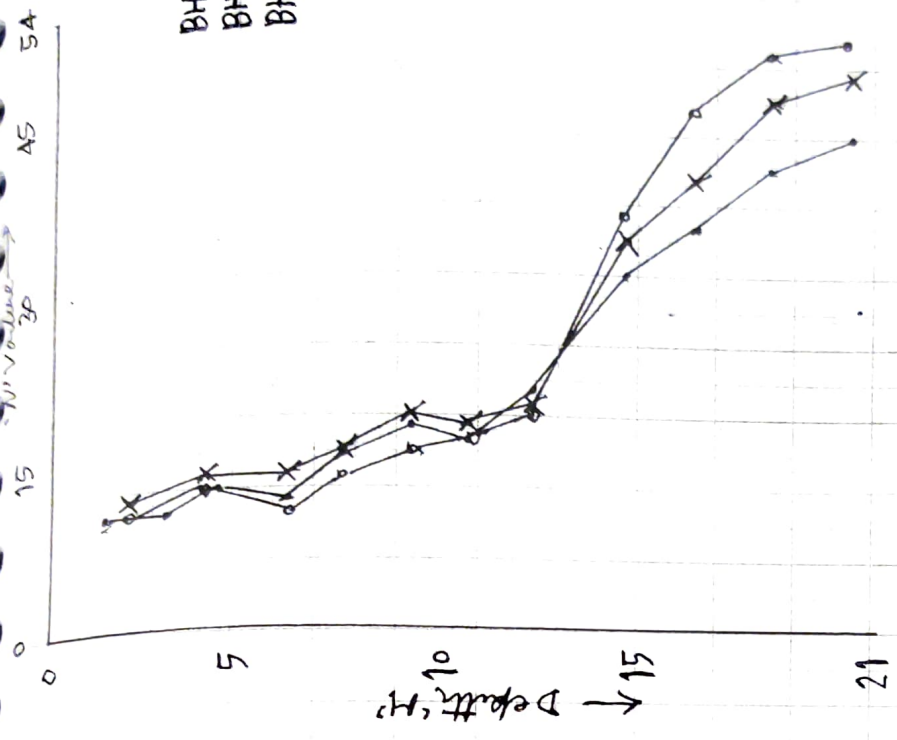
ANNEXURE



**BORE HOLE LOCATION MAP AT MOUZA- SEKHPURA ,
J.L. NO.- 172 , R.S. PLOT NO.- 153 / 323 (PART) , L.R.
PLOT NO.-648, WARD NO.- 5, HOLDING NO.- 1430 ,
STREET- STATION ROAD , P.S.- KOTWALI, UNDER
MIDNAPORE MUNICIPALITY.**



BH-1-
 BH-2-X
 BH-3-0



'N' vs Depth Plot

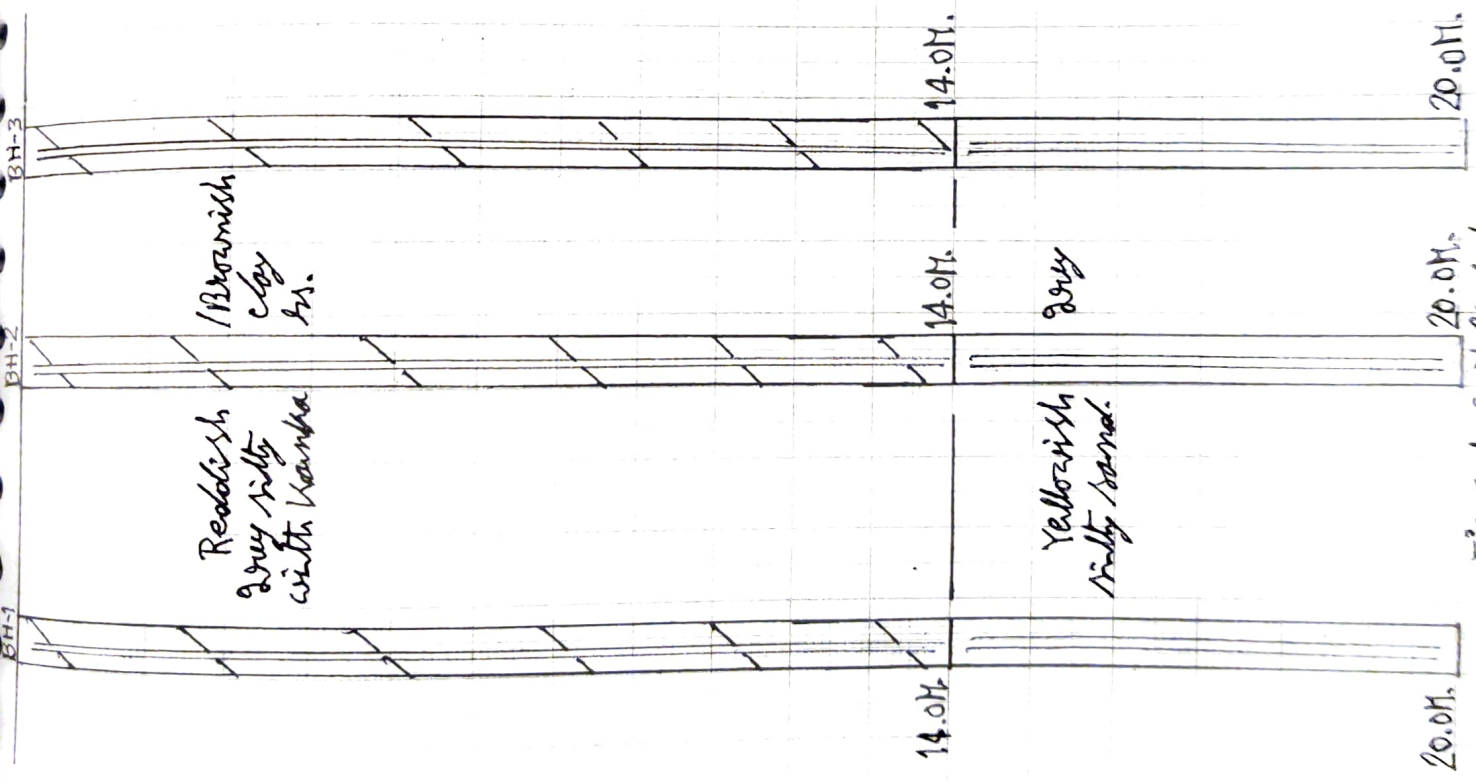


Fig. Sub-Soil Profile



TYPE OF BORING/DRILLING : Auger/wash
 DIA OF BORING : 150mm.
 GROUND WATER LEVEL : 5.0M.

BORE HOLE NO. : 1
 DATE STARTED : 19/2/2024
 DATE COMPLETED : 20/2/2024

DEPTH OF BORING/CORISG(M)		DESCRIPTION OF STRATA	STRATA THICKNESS (M)	SAMPLE		SP T (N)
FROM	TO			TYPE	DEPTH(M)	
0.0	14.0	Reddish/Brownish grey silty clay with kankars.	14.0	DS-1	0.50	
				SPT-1	1.50-2.10	10
				SPT-2	3.00-3.60	10
				UDS-1	4.00-4.45	
				SPT-3	4.50-5.10	12
				SPT-4	6.00-6.60	11
				SPT-5	7.50-8.10	15
				SPT-6	9.00-9.60	17
				SPT-7	10.50-11.10	16
				SPT-8	12.00-12.60	20
14.0	20.0	Yellowish grey silty sand.	6.0	SPT-9	14.50-15.10	30
				Spt-10	16.00-16.60	34
				Spt-11	18.00-18.60	39
				Spt-12	20.00-20.60	42



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TYPE OF BORING/DRILLING : Auger/wash
 DIA OF BORING : 150mm.
 GROUND WATER LEVEL : 5.0M.

BORE HOLE NO. : 2
 DATE STARTED : 20/2/2024
 DATE COMPLETED : 21/2/2024

DEPTH OF BORING/CORISG(M)		DESCRIPTION OF STRATA	STRATA THICKNESS (M)	SAMPLE		SP T (N)
FROM	TO			TYPE	DEPTH(M)	
0.0	14.0	Reddish/Brownish grey silty clay with kankars.	14.0	DS-1	0.50	11 13 13 15 18 17 19
				SPT-1	2.00-2.60	
				UDS-1	3.50-3.95	
				SPT-2	4.00-4.60	
				SPT-3	6.00-6.60	
				SPT-4	7.50-8.10	
				SPT-5	9.00-9.60	
				SPT-6	10.50-11.10	
14.0	20.0	Yellowish grey silty sand.	6.0	SPT-7	12.00-12.60	33 38 45 47
				SPT-8	14.50-15.10	
				SPT-9	16.00-16.60	
				Spt-10	18.00-18.60	
				Spt-11	20.00-20.60	



TYPE OF BORING/DRILLING : Auger/wash BORE HOLE NO. : 3
 DIA OF BORING : 150mm. DATE STARTED : 22/2/2024
 GROUND WATER LEVEL : 5.0M. DATE COMPLETED : 22/2/2024

DEPTH OF BORING/CORISG(M)		DESCRIPTION OF STRATA	STRATA THICKNESS (M)	SAMPLE		SP T (N)
FROM	TO			TYPE	DEPTH(M)	
0.0	14.0	Reddish/Brownish grey silty clay with kankars.	14.0	DS-1	0.50	
				SPT-1	2.00-2.60	10
				SPT-2	4.00-4.60	12
				UDS-1	5.00-5.45	
				SPT-3	6.00-6.60	10
				SPT-4	7.50-8.10	13
				SPT-5	9.00-9.60	15
				SPT-6	10.50-11.10	16
			SPT-7	12.00-12.60	18	
14.0	20.0	Yellowish grey silty sand.	6.0	SPT-8	14.50-15.10	35
				SPT-9	16.00-16.60	44
				Spt-10	18.00-18.60	49
				Spt-11	20.00-20.60	50

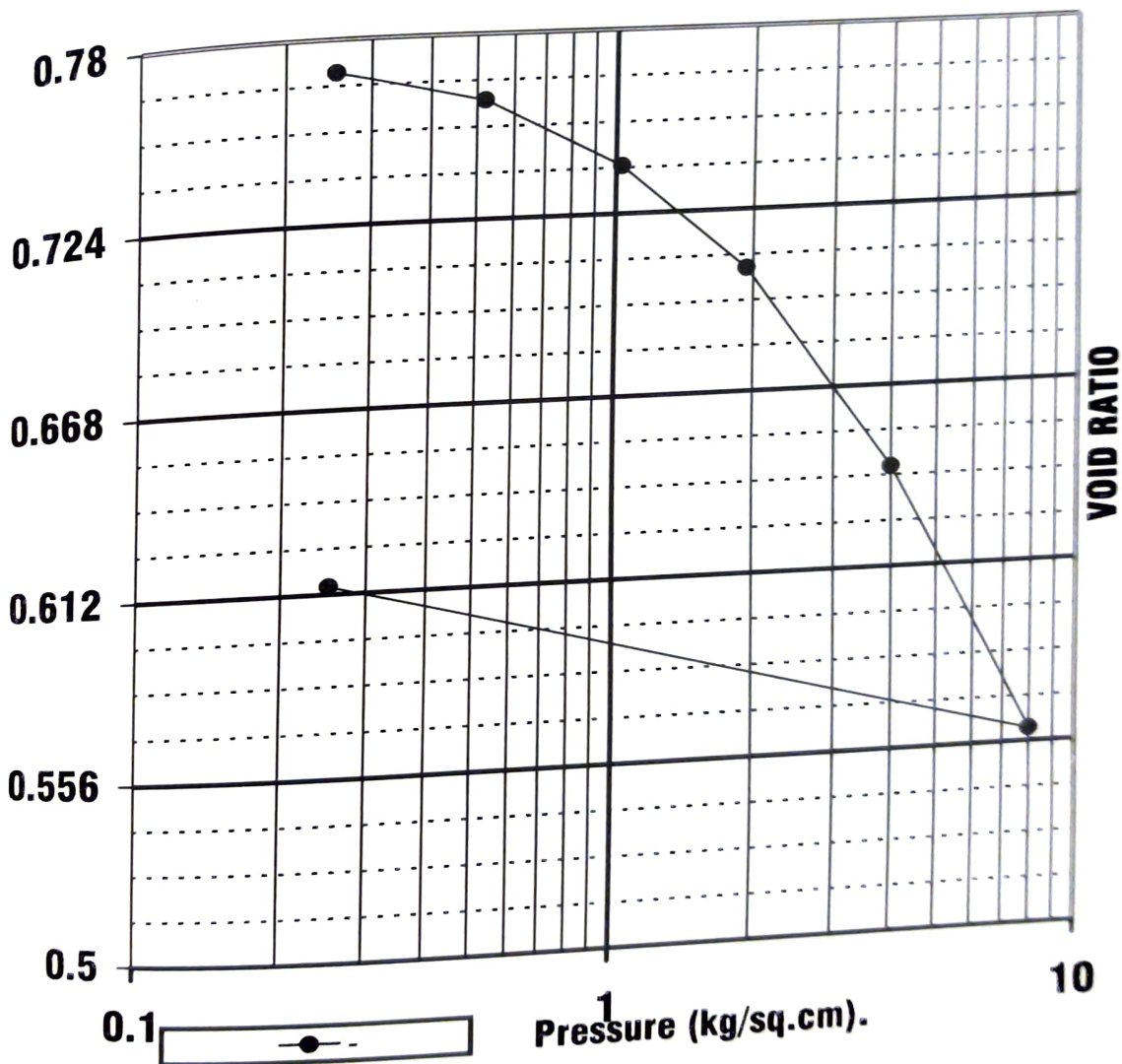


LABORATORY TEST RESULTS

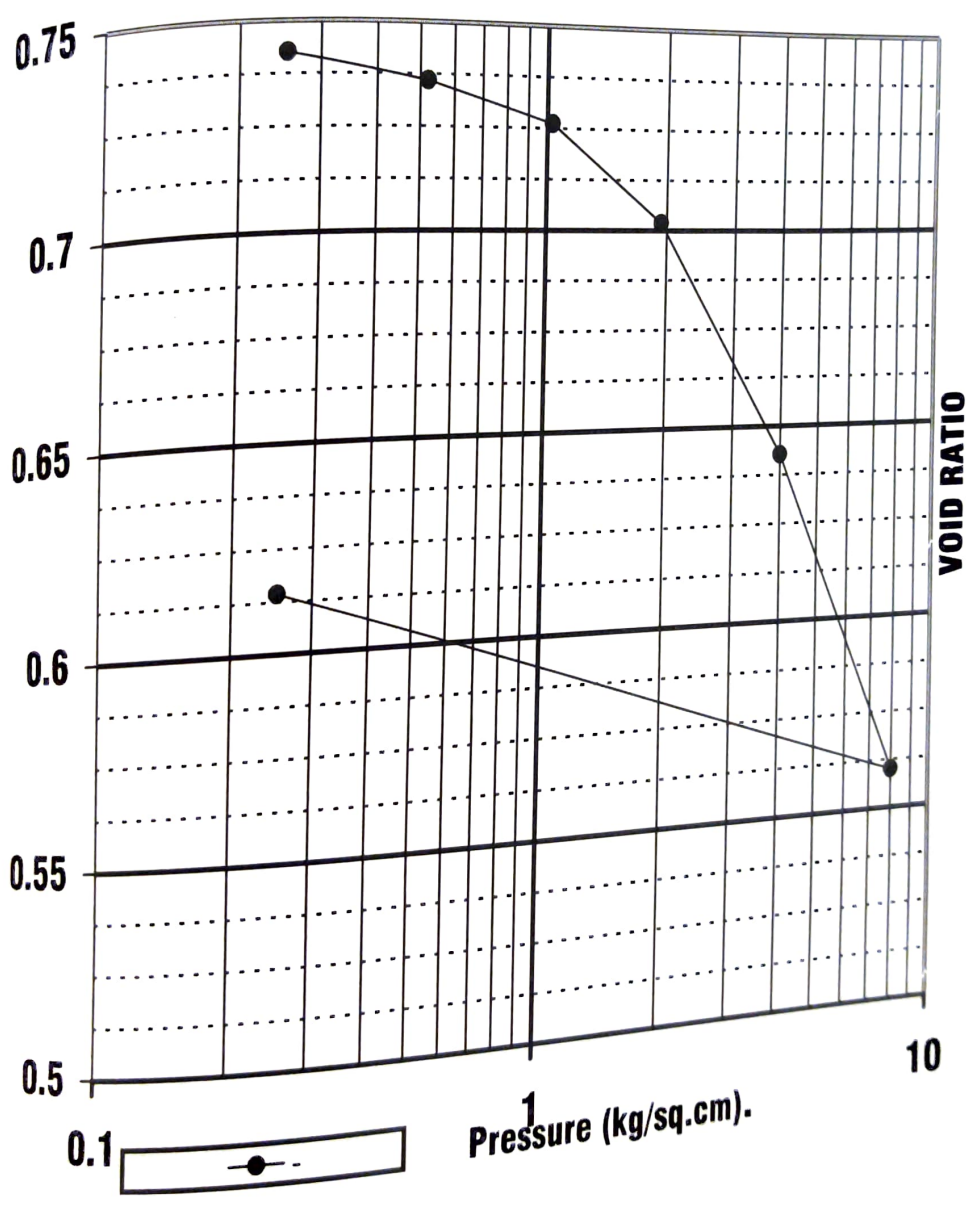
Depth (m)	Sample no.	Bulk density	NMC (%)	Sp. Gr.	Atterberg Limit		U.C.S(T/M ²)	Shear Strength		Initial void ratio	Consolidation	Grain Size			GRAVEL(%)	Bore
					LL (%)	PL (%)		C	(DEGREE)Ø			m _v (cm ² /kg)	Sand (%)	Silt (%)		
4.0	U D S	1.94 (kg/cm ²)	24.00	2.67	58	28	5.8	6.0	4	0.77	0.018 (0.25-0.5)	8	56	31	5	1
3.5	U D S	1.92 (kg/cm ²)	22.00	2.69	57	26	6.0	6.3 (T/M ²)	5	0.75	0.024 (0.5 - 1.0)	9	53	32	6	2
5.0	U D S	1.95	22.00	2.69	57	26	6.0	6.3	5	0.74	0.023 (0.5 - 1.0)	10	53	32	5	3



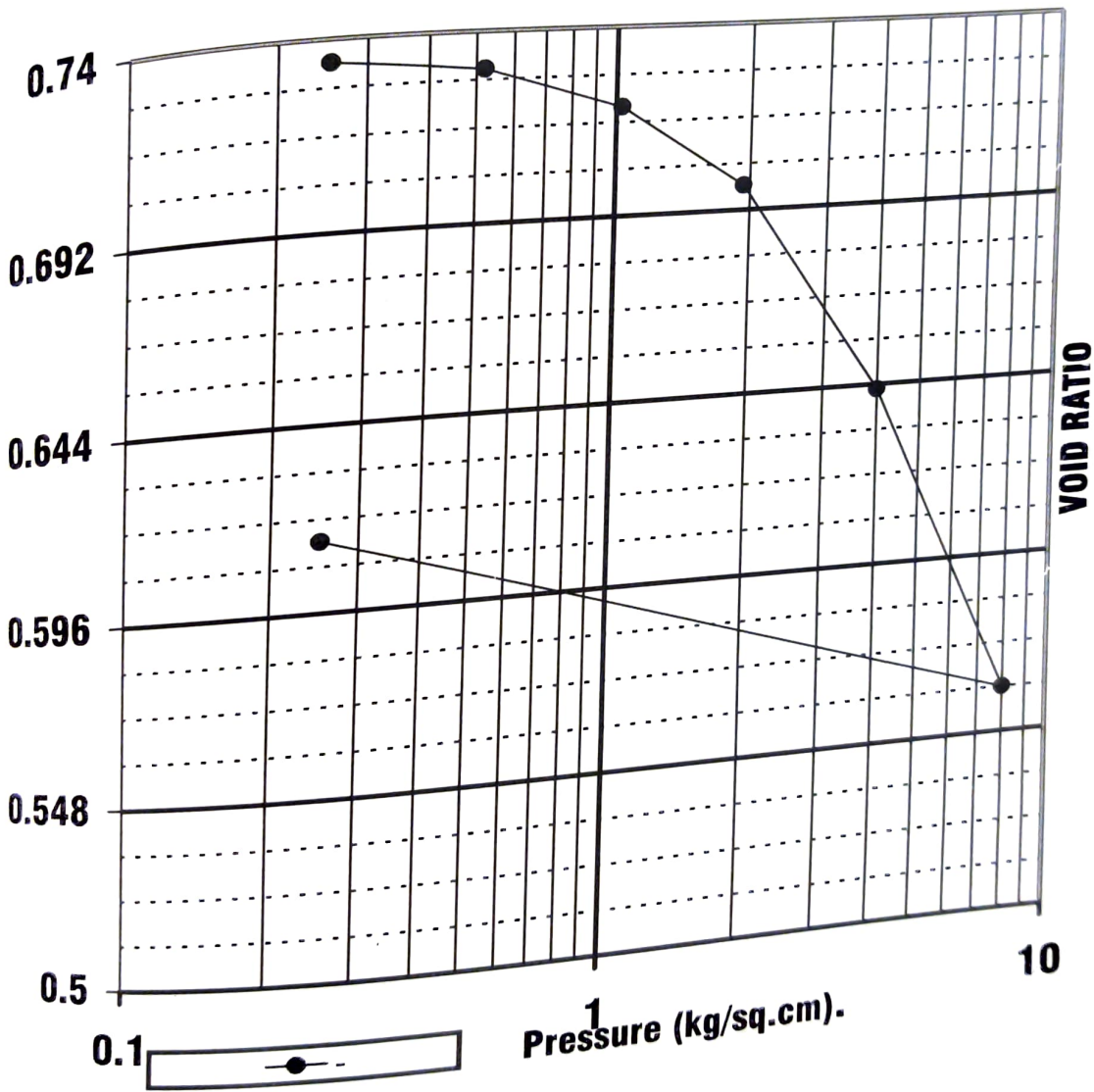
**B.H.No. 1 , Depth 4.0M $e_0 = 0.77$
e vs log p curve**



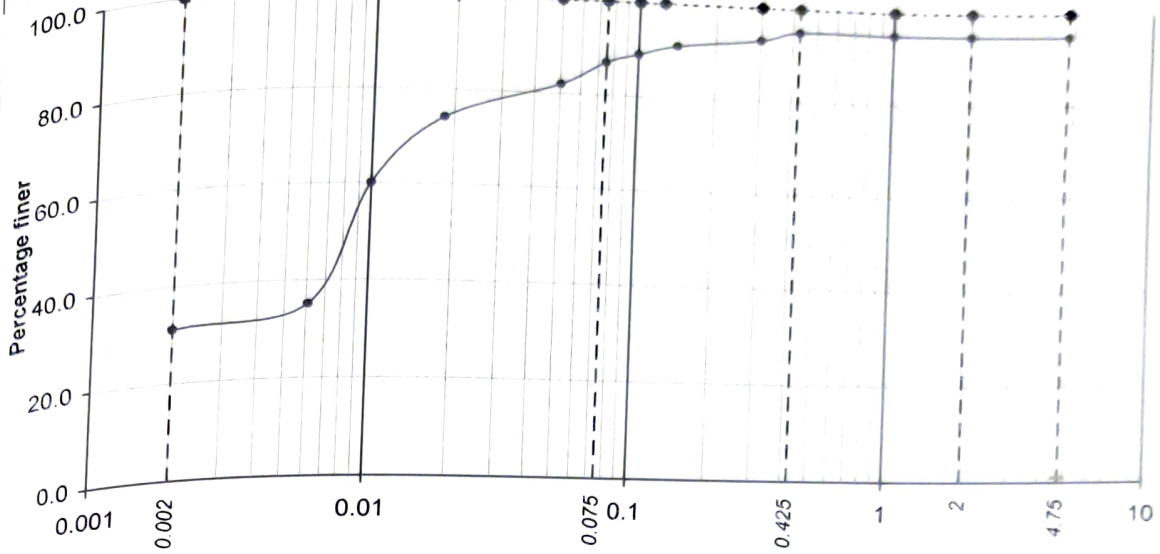
**B.H.No. 2 , Depth 3.5M $e_0 = 0.75$
e vs log p curve**



**B.H.No. 3 , Depth 5.0M $e_0 = 0.74$
e vs log p curve**



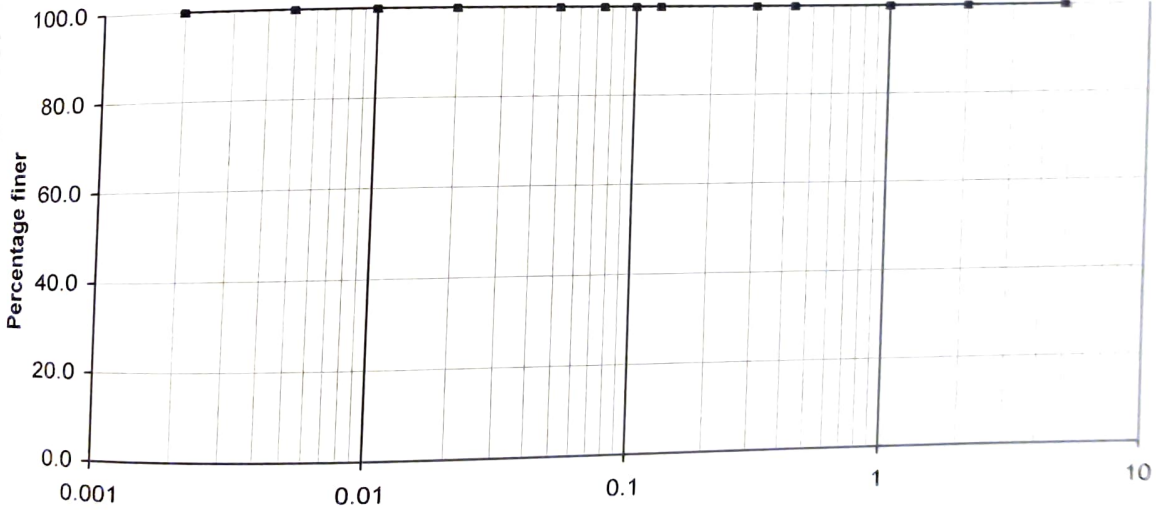
GRAIN SIZE DISTRIBUTION CURVES



—●— BH-1 U(4.00-4.45)
- - ▲ - - 0
—◆— 0

Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	clay	Silt (%)	Sand (%)	Gravel (%)
BH-1 U(4.00-4.45)	31.0	56.0	8.0	5.0
0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0

GRAIN SIZE DISTRIBUTION CURVES



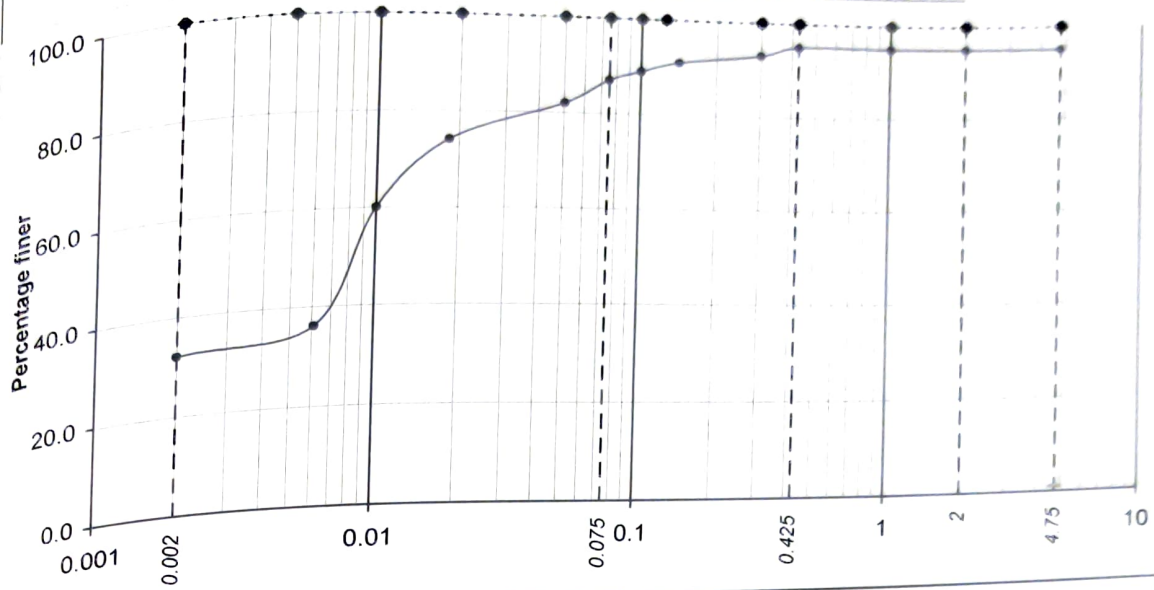
—●— 0
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—◆— 0

Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.9
0	0.0	0.0	0.0	0.0

*Silt & Clay



GRAIN SIZE DISTRIBUTION CURVES



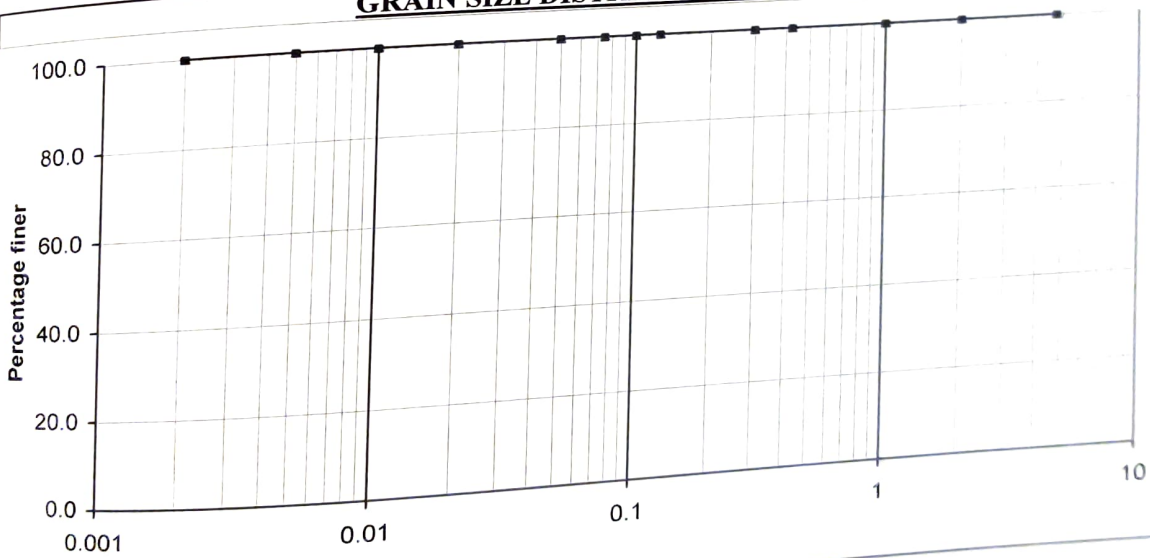
—●— BH-2 U(3.50-3.95)

---▲--- 0

—◆— 0

Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
	clay	Silt (%)	Sand (%)	Gravel (%)
Sample No.				
BH-2 U(3.50-3.95)	32.0	53.0	9.0	6.0
0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0

GRAIN SIZE DISTRIBUTION CURVES



—●— 0

---▲--- 0

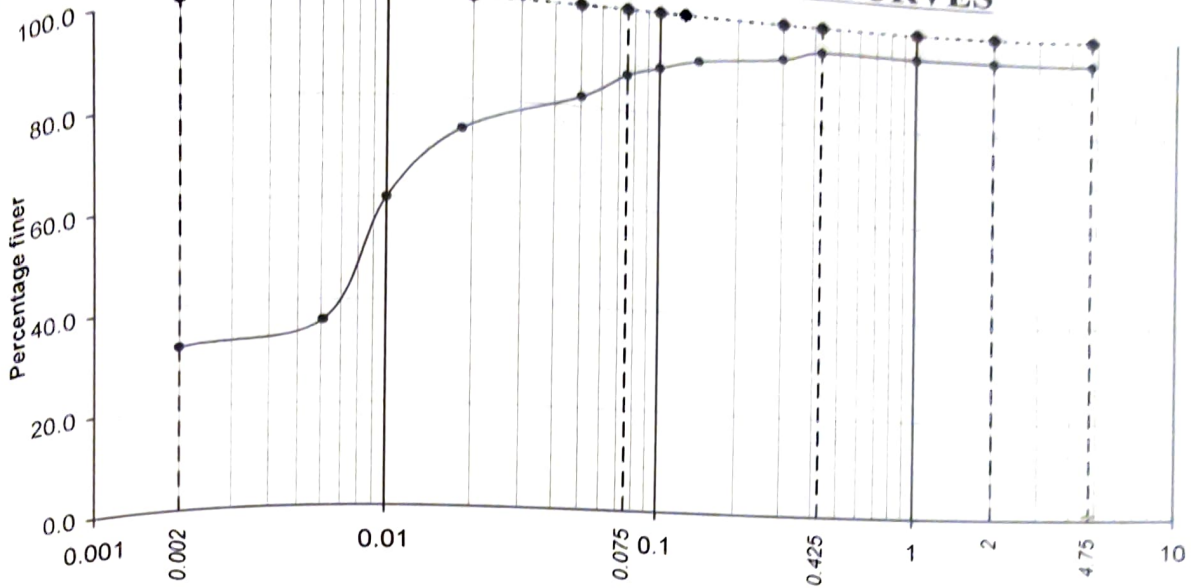
—◆— 0

Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
Sample No.				
0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.9
0	0.0	0.0	0.0	0.0

*Silt & Clay



GRAIN SIZE DISTRIBUTION CURVES



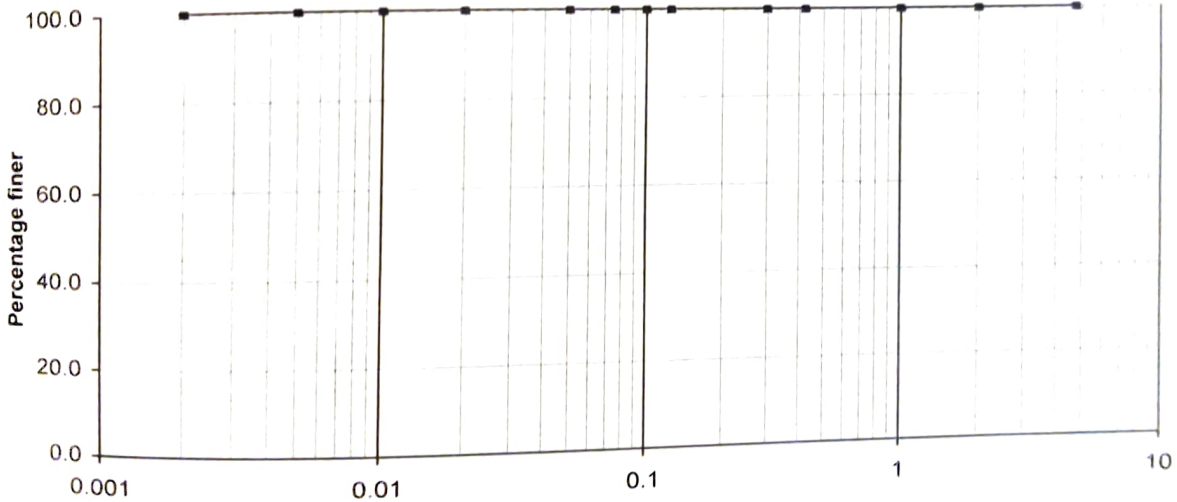
—●— BH-3 U(5.00-5.45)

---▲--- 0

◆ 0

Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	clay	Silt (%)	Sand (%)	Gravel (%)
BH-3 U(5.00-5.45)	32.0	53.0	10.0	5.0
0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0

GRAIN SIZE DISTRIBUTION CURVES



—●— 0

---▲--- 0

◆ 0

Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.9
0	0.0	0.0	0.0	0.0

*Silt & Clay

