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NAME OF PROJECT

**PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (TWO
BASEMENT + GROUND + 22 UPPER FLOORS) AT ARUMBAKKAM, CHENNAI**

CLIENT

**RDX ARCHITECTS,
#2,4TH STREET, KAMARAJ NAGAR,
SATHYA GARDEN, SALIGRAMAM,
CHENNAI – 600 093**

TITLE

GEOTECHNICAL INVESTIGATION REPORT

REPORT NO.: GT-2057

DATE	REVISION	DESCRIPTION		AUTHORISED SIGNATORY
03/03/2020	FIRST SUBMISSION	SUBMISSION OF GEOTECHNICAL REPORT	SIGN	
			DATE	03/03/2020
			DESIGNATION	MANAGING DIRECTOR
			NAME	DR. C.V.PRASAD

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INTRODUCTION

1.0 Project Information Matrix

Nature of project : Residential Building (2 Basement + G +22 Floors)
Project Client : **RDX Architects**
Project Owner : **TAMILNADU HOUSING BOARD**
Project Location : Arumbakkam, Chennai
Job Code : GT-2057

1.1 Scope Of Work**1.1.1 Field Work**

- ☞ Conducting five soil investigation bore holes of 150 mm diameter up to a maximum depth of 30m depth.
- ☞ Conducting Standard Penetration Test (SPT) within the borehole at every 1.0m depth interval up to 10.0m and thereafter at every 1.5m up to the borehole termination depth
- ☞ Collection of soil samples and undisturbed samples from the clayey strata with SPT-value greater than 2 to less than 15 if met within the investigation depth
- ☞ Collection of water samples if groundwater table met within the investigation depth

1.1.2 Laboratory Work

- ☞ Natural Moisture Content
- ☞ Atterberg limits
- ☞ Grain Size Analysis
- ☞ Chemical Analysis test on soil and water samples to give pH, Chlorides and Sulphates

1.2 Structure of the Report

- ☞ Contents
- ☞ Introduction
- ☞ Investigation Methodology & Test Results
- ☞ Sub-Surface Stratification
- ☞ Foundation System
- ☞ Recommendation
- ☞ Annexure

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

Five soil investigation boreholes were put as per the planning of the engineer in-charge and these locations are shown in Fig.2.0. The equipment used and the methodology adopted to carry out the fieldwork is described below.

2.1 Methodology of Field Work:

2.1.1 Equipment Used and Method of Drilling:

All the boreholes were sunk by conventional rotary drilling rigs. For borehole Methodology followed for boring conformed to IS: 1892 -2000. Boring was progressed by the cutting action of rotating bit with water circulation and stabilizing the side of the boreholes by using casing pipes/bentonite slurry up to required depth to prevent collapse of sidewall. Boring was continued by normal boring process using MS soil cutter in soil. However Tungsten Carbide (TC) bit drilling was resorted to drill in highly weathered rock stratum where the normal boring process became slow. Diamond Core (DC) bit drilling was adopted in moderately weathered rock formations where penetration using TC bit was became slow.

2.1.2 Standard Penetration Tests:

This is a field test to determine "Penetration Resistance of Stratum at the Test Depth". This has been conducted in the boreholes generally up to refusal depth using procedures described in IS: 2131- 2002. In this test, split spoon sampler (50.8 mm OD and 35 mm ID) has replaced driving bit. Sampler is then driven by dropping 63.5 kg hammer on top of driving collar with free fall of 75 cm. The length of sampler is 60 cm.

The tests were conducted at the depth intervals indicated in Chapter-1 (Sec.1.1.1).

2.1.3 Collection of Soil Samples:

2.1.3.1 Disturbed Samples:

The SPT-samples collected were used as disturbed soil samples. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

2.1.4 Collection of Ground Water Samples:

One representative water sample from each borehole was collected after 24 hours of completing the borehole if water table met within the investigated depth.

Note on Groundwater Table Record:

- ✧ Groundwater table observation in geotechnical report is predominantly to arrive at foundation design criteria and shall not be construed as design guidelines for the design of dewatering systems
- ✧ The groundwater level indicated in the bore logs is specific to the duration of investigation and intensity of the monsoon rains during the time of investigation. Hence, the level shall be taken as guidelines only to plan the investigation for the dewatering system

- ☞ No foundation excavation or basement excavations if anticipated within the groundwater table zone shall be carried out without implementing groundwater lowering schemes

2.2 Laboratory testing:

2.2.1 On Coarse Grained Soil

On the representative samples, sieve analysis tests were conducted to arrive at grain size distribution. These tests were conducted as per I.S.2720 (part 4)-1985 and the results are presented in Tables-2.1 to 2.5. The graphical representation of grain size distribution curve for the representative samples in each bore is presented in Fig. 2.7 to 2.11.

2.2.2 On Fine Grained Soil

On the SPT sample index property tests were conducted to estimate consistency. These test results are presented in Tables-2.1 to 2.5. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig. 2.12 to 2.21.

2.2.3 Chemical Analysis Tests

On representative soil and water samples chemical analysis tests were conducted to estimate pH, Chloride and Sulphates and these results are presented in Table - 2.6.

2.3 Summary:

The locations of the field investigation boreholes are shown in site plan given in Fig.2.0. The average sub soil profiles encountered at each location along with their classification and engineering properties are presented in Figs.2.1 to 2.5. Further, the cross sectional variation of the sub surface profile through different bore holes in different directions are presented in Fig.2.7.



FIGURE 2.1 SITE PLAN CONSISTING OF FIELD INVESTIGATION BOREHOLE LOCATIONS

SITE INVESTIGATION RECORD															BORE HOLE No. BH-01		
															PAGE No. 1		
PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															DIA OF BORE HOLE 150mm ☒		
PROJECT NAME															BORE START DATE 21/01/2020		
LOCATION Arumbakkam, Chennai															BORE END DATE 23/01/2020		
STRUCTURE 2 Basement + G + 22 Floors															TOTAL DRILL DAYS 3		
JOB CODE GT-2057																	
MACHINE No. -																	
DRILLING METHOD Rotary																	
FLUSHING MEDIUM Bentonite																	
CHAINAGE (m) -																	
CO-ORDINATES N -																	
CO-ORDINATES E -																	
Layer Data																	
Geotechnical Description																	
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details				Legend	No	Depth		
	Date	Time		Total Core Recovery %	R.Q.D. %	Blows/cm.			Depth	No.	Type	RL (m)					
	Hr.	Min.			0-15	15-30	30-45	SPT 'N' Value									
	21/01/2020	16:59 To 17:48															
	22/01/2020	11:09 To 11:50															
	23/01/2020	14:50 To 15:05	SC	-	9	20	23	43	7.00	1	SS	-7.0					
					18	28	34	62	8.00	2	SS	-8.0					
									8.45								
	Filled up Materials consisting of old building debris, Brick pats & soil mixture Brownish yellow, Moist, Poorly Graded, Fine to Medium Grains, Dense to very Dense, SILTY SAND (SM) with Clay Binder at times Borehole at this location is terminated at 8.0m due to uncontrollable water loss																

CS - Core Sample	DS - Disturbed Sample	LOGGED	Muralikrishnan K.	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	23/01/2020	E.G.L. WRT ROAD LEVEL (m)	0.00	Water table could not be established due to uncontrollable water loss
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	-	
WS - Wash Sample	DB - Diamond Bit	DATE	29/01/2020	CASING DEPTH (m)	0.0	

Borehole terminated at 8 m depth below E.G.L

FIG.2.1 Sub Soil Profile at BH-01 Location

SITE INVESTIGATION RECORD															BORE HOLE No. BH-02		
PROJECT NAME: PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															SHEET: 1 OF 3		
LOCATION: Arumbakkam, Chennai															DIA OF BORE HOLE: 150mm ✓		
MACHINE No. -															BORE START DATE: 10/01/2020		
STRUCTURE: 2 Basement + G + 22 Floors															BORE END DATE: 20/01/2020		
DRILLING METHOD: Rotary															TOTAL DRILL DAYS: 5		
JOB CODE: GT-2057																	
FLUSHING MEDIUM: Bentonite																	
CO-ORDINATES: N - E -																	
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details				Layer Data				
	Date	Time		Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description
						0-15	15-30	30-45									
1			SC	-	-	3	5	8	13	1.00	1	SS	-1.0				Filled up Materials consisting of old building debris, Brick pats & soil mixture
			SC	-	-					1.45							
2			SC	-	-	4	3	3	6	2.00	2	SS	-2.0				
			SC	-	-					2.45							
3			SC	-	-					3.00	-	-	-3.0				
4			SC	-	-	9	8	9	17	4.00	3	SS	-4.0				Brownish Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense, Clayey Silty SAND (SC)
			SC	-	-					4.45							
5			SC	-	-	8	11	13	24	5.00	4	SS	-5.0				
			SC	-	-					5.45							
6	09:31 To 09:33		SC	-	-	3	7	16	23	6.00	5	SS	-6.0				
7	09:58 To 10:00		SC	-	-	25	24	22	46	7.00	6	SS	-7.0				Greyish Brown, Grey, Moist, Poorly Graded, Fine to Medium Grains, Dense to Very Dense, SAND - Silty SAND (SP/SP-SM) to Silty SAND (SM)
			SC	-	-					7.45							
8	10:20 To 10:22		SC	-	-	15	24	29	53	8.00	7	SS	-8.0				
			SC	-	-					8.45							
9	10:41 To 10:43		SC	-	-	20	14	19	33	9.00	8	SS	-9.0				
10	11:06 To 11:08		SC	-	-					9.45							Grey, Moist, Stiff, Silty CLAY (CI) Lean Clay of Medium Plasticity
						7	5	5	10	10.00	9	SS	-10.0				
										10.45							

CS - Core Sample		DS - Disturbed Sample		LOGGED		Loganathan K.		PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample		SC - Soil Cutter		DATE		11/01/2020		E.G.L WRT ROAD LEVEL(m)		0.00	
UDS- Undisturbed Sample		TCB - Tungsten Carbide Bit		CHECKED		Anitha Kondusamy		WATER TABLE (m)		-	
WS - Wash Sample		DB - Diamond Bit		DATE		29/01/2020		CASING DEPTH (m)		0.00	

Water table could not be established due to uncontrollable water loss

SITE INVESTIGATION RECORD															BORE HOLE No.		BH-02	
															SHEET		2 OF 3	
PROJECT NAME															DIA OF BORE HOLE		150mm	
PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															NX			
LOCATION		Arumbakkam, Chennai		MACHINE No.		-		CHAINAGE (m)		-		BORE START DATE		10/01/2020				
STRUCTURE		2 Basement + G + 22 Floors		DRILLING METHOD		Rotary		CO-ORDINATES		N -		BORE END DATE		20/01/2020				
JOB CODE		GT-2057		FLUSHING MEDIUM		Bentonite		E -				TOTAL DRILL DAYS		5				
Depth below E.G.L. (m)	Drilling progress per metre			Core Details			SPT Details			Sample Details			Layer Data					
	Date	Time		Type of Drill Bit (SC / TCB / DB)	Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description
		Hr.	Min.				0-15	15-30	30-45									
11	11/01/2020	11	36	SC	-	-	1	2	3	5	11.50	10	SS	-11.5		L4	11.5	Grey, Moist, Stiff, Silty CLAY (CI) Lean Clay of Medium Plasticity
12		12	17	SC	-	-	7	10	17	27	11.95							Grey, Moist, Poorly Graded, Fine to Medium Grains, Loose, Clayey Silty SAND (SC)
13		12	19								13.00	11	SS	-13.0		L5	13.0	
14		13	45	SC	-	-	13	20	26	46	13.45							
15		13	47								14.50	12	SS	-14.5				Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense to Dense, Clayey Silty SAND (SC) to Silty SAND (SM)
16		14	30	SC	-	-	15	17	30	47	14.95							
17		14	32								16.00	13	SS	-16.0				
18		16	02	SC	-	-	15	36	37	73	16.45							
19		16	04								17.50	14	SS	-17.5		L6	17.5	Grey, Moist, Poorly Graded, Fine to Medium Grains, Very Dense, Silty SAND (SM)
20	12/01/2020			SC	-	-	13	31	37	68	17.95							
											19.00	15	SS	-19.0		L7	19.0	Brownish Grey, Moist, Hard, Compacted CLAY (CH) Clays of High Plasticity
											19.45							

CS - Core Sample		DS - Disturbed Sample		LOGGED		Loganathan K.		PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample		SC - Soil Cutter		DATE		12/01/2020		E.G.L. WRT ROAD LEVEL (m)		0.00	
UDS - Undisturbed Sample		TCB - Tungsten Carbide Bit		CHECKED		Anitha Kondusamy		WATER TABLE (m)		-	
WS - Wash Sample		DB - Diamond Bit		DATE		29/01/2020		CASING DEPTH (m)		0.00	

Water table could not be established due to uncontrollable water loss

SITE INVESTIGATION RECORD															BORE HOLE No. BH-02		
															SHEET 3 OF 3		
PROJECT NAME: PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															DIA OF BORE HOLE: 150mm		
LOCATION: Arumbakkam, Chennai															NX		
MACHINE No. -															BORE START DATE: 10/01/2020		
STRUCTURE: 2 Basement + G + 22 Floors															BORE END DATE: 20/01/2020		
DRILLING METHOD: Rotary															TOTAL DRILL DAYS: 5		
JOB CODE: GT-2057																	
FLUSHING MEDIUM: Bentonite																	
CO-ORDINATES: N - E -																	
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details				Layer Data				
	Date	Time		Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description
						0-15	15-30	30-45									
21	12/01/2020	Total Drilling Time 10 Mins	SC	-	-	15	23	34	57	21.00	17	SS	-21.0				Brownish Grey, Moist, Hard, Compacted CLAY (CH) Clays of High Plasticity
22		Total Drilling Time 6 Mins	SC	-	-					21.45							
23	13/01/2020					33		15Cm Penet for 60Blows	>100	23.00	18	SS	-23.0		L8	23.0	Brownish Grey, Moist, Poorly Graded, Fine Grains, Very Dense, Clayey Silty SAND (SC)
24		Total Drilling Time 3 Mins	SC	-	-					23.30							
25						23	57	11Cm Penet for 52Blows	>100	25.00	19	SS	-25.0		L9	25.0	Brownish Green, Moist, Hard, Compacted CLAY (CI to CL) Clays of Medium to Low Plasticity
26	20/01/2020	14 To 15 55 To 05	SC	-	-					25.41							
27						40	40	8Cm Penet for 45Blows	>100	27.00	20	SS	-27.0		L10	27.5	Borehole at this location is terminated at 27.0m due to uncontrollable water loss
28										27.38							
29																	
30																	

CS - Core Sample	DS - Disturbed Sample	LOGGED	Loganathan K.	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	20/01/2020	E.G.L WRT ROAD LEVEL(m)	0.00	Water table could not be established due to uncontrollable water loss
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	-	
WS - Wash Sample	DB - Diamond Bit	DATE	29/01/2020	CASING DEPTH (m)	0.00	

Borehole terminated at 27 m depth below E.G.L
FIG.2.2 Sub Soil Profile at BH-02 Location

SITE INVESTIGATION RECORD															BORE HOLE No. BH-03										
															SHEET 1 OF 3										
PROJECT NAME PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															DIA OF BORE HOLE 150mm ☒										
															NX ☒										
LOCATION		Arumbakkam, Chennai		MACHINE No.		-		CHAINAGE (m)		-		BORE START DATE		22/01/2020											
STRUCTURE		2 Basement + G + 22 Floors		DRILLING METHOD		Rotary		CO-ORDINATES		N -		BORE END DATE		28/01/2020											
JOB CODE		GT-2057		FLUSHING MEDIUM		Bentonite		E -		-		TOTAL DRILL DAYS		6											
Depth below E.G.L. (m)	Drilling progress per metre			Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details				Sample Details				Layer Data										
	Date	Time			Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description							
		Hr.	Min.				0-15	15-30	30-45																
1	22/01/2020	10	45	SC	-	-	2	5	2	7	3.00	1	SS	-5.5	L1	2.5	Filled up Materials consisting of old building debris, Brick pats & soil mixture								
2		11	15															3.45	2	SS	-6.5				
3		12	15															3	3	4	7	4.00	2	SS	-6.5
4		12	27															5	12	14	26	5.00	3	SS	-7.5
5		14	07															5	6	8	14	6.00	4	SS	-8.5
6	23/01/2020	14	30	SC	-	-	5	4	6	10	7.00	5	SS	-9.5	L2	5.2	Brownish Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense to Dense, Clayey Silty SAND (SC)								
7		14	57															7	12	8	20	8.00	-	*SS	-10.5
8		15	00															12	15	19	34	9.00	6	SS	-11.5
9		15	19															13	15	15	30	10.00	7	SS	-12.5
10		15	21															10	45	10	47	10.45			
11		16	14	SC	-	-											Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense to Dense, Silty SAND (SM)								
12	16	16	10															45	10	47					

CS - Core Sample		DS - Disturbed Sample		LOGGED		Muralikrishnan K.		PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample		SC - Soil Cutter		DATE		23/01/2020		E.G.L WRT ROAD LEVEL(m)		-2.50	
UDS- Undisturbed Sample		TCB - Tungsten Carbide Bit		CHECKED		Anitha Kondusamy		WATER TABLE (m)		4.50	
WS - Wash Sample		DB - Diamond Bit		DATE		29/01/2020		CASING DEPTH (m)		0.00	

SITE INVESTIGATION RECORD															BORE HOLE No. BH-03		
															SHEET 2 OF 3		
PROJECT NAME: PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															DIA OF BORE HOLE: 150mm NX		
LOCATION: Arumbakkam, Chennai		MACHINE No. -		CHAINAGE (m) -		BORE START DATE: 22/01/2020											
STRUCTURE: 2 Basement + G + 22 Floors		DRILLING METHOD: Rotary		CO-ORDINATES: N - E -		BORE END DATE: 28/01/2020											
JOB CODE: GT-2057		FLUSHING MEDIUM: Bentonite				TOTAL DRILL DAYS: 6											
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details				Layer Data				
	Date	Time		Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description
						0-15	15-30	30-45									
11	23/01/2020	11:40 To 11:50	SC	-	-	11	14	19	33	11.50	8	SS	-14.0				Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense to Dense, Silty SAND (SM) to Clayey Silty SAND (SC)
12		12:16 To 12:20	SC	-	-	15	17	17	34	11.95V	9	SS	-15.5				
13		10:16 To 10:31	SC	-	-	33	57	10Cm Penet for 50Blows	>100	13.00	10	SS	-17.0		L4	14.5	
14	24/01/2020	Total Drilling Time 42 Mins	SC	-	-	15	20	29	49	13.45V	11	SS	-18.5				
16		16:05 To 16:54	SC	-	-	14	44	46	90	14.50	12	SS	-20.0				
17		11:05 To 11:28	SC	-	-	37	55	10Cm Penet for 51Blows	>100	16.00	13	SS	-21.5		L5	19.0	
18	25/01/2020									16.45V							Greyish Brown, Moist, Poorly Graded, Fine to Medium Grains, Very Dense, Silty SAND (SM)
19										17.50							
20										17.95V							
CS - Core Sample		DS - Disturbed Sample		LOGGED		Muralikrishnan K.		PROJECT SITE DETAILS		REMARKS							
SS - Split Spoon Sample		SC - Soil Cutter		DATE		25/01/2020		E.G.L WRT ROAD LEVEL(m)		-2.50							
UDS- Undisturbed Sample		TCB - Tungsten Carbide Bit		CHECKED		Anitha Kondusamy		WATER TABLE (m)		4.50							
WS - Wash Sample		DB - Diamond Bit		DATE		29/01/2020		CASING DEPTH (m)		0.00							

SITE INVESTIGATION RECORD															BORE HOLE No. BH-04			
															SHEET 1 OF 3			
PROJECT NAME: PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															DIA OF BORE HOLE: 150mm ✓ NX ✓			
LOCATION: Arumbakkam, Chennai		MACHINE No.:		-		CHAINAGE (m):		-		BORE START DATE: 28/01/2020								
STRUCTURE: 2 Basement + G + 22 Floors		DRILLING METHOD: Rotary		CO-ORDINATES: N -						BORE END DATE: 31/01/2020								
JOB CODE: GT-2057		FLUSHING MEDIUM: Bentonite								TOTAL DRILL DAYS: 4								
Depth below E.G.L. (m)	Drilling progress per metre			Core Details		SPT Details			Sample Details				Layer Data					
	Date	Time		Type of Drill Bit (SC / TCB / DB)	Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description
		Hr.	Min.				0-15	15-30	30-45									
1	28/01/2020	16	04	SC	-	-	-	-	-	-	1.00	-	-	-3.5				Filled up Materials consisting of old building debris, Brick pats & soil mixture
		16	15															
		16	24	SC	-	-	-	-	-	-	2.00	-	-	-4.5				
		16	33															
2		16	40	SC	-	-	-	-	-	-								Grey, Moist, Stiff to Very Stiff, Silty CLAY (CH to CL) Clays of High to Low Plasticity
		16	58															
		10	15	SC	-	-	-	-	-	-	3.00	1	SS	-5.5				
		10	25								3.45	✓						
3		10	56	SC	-	-	-	-	-	-	4.00	2	SS	-6.5		L1	4.0	Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense, Silty SAND (SM) to Clayey Silty SAND (SC)
		11	00								4.45	✓						
		11	27	SC	-	-	-	-	-	-	5.00	3	SS	-7.5		L2	5.5	
		11	30								5.45	✓						
4		11	52	SC	-	-	-	-	-	-	6.00	4	SS	-8.5				Grey, Moist, Poorly Graded, Fine to Medium Grains, Dense, Clayey Silty SAND (SC)
		11	55								6.45	✓						
		12	24	SC	-	-	-	-	-	-	7.00	5	SS	-9.5				
		12	27								7.45	✓						
5		12	46	SC	-	-	-	-	-	-	8.00	6	SS	-10.5				Grey, Moist, Poorly Graded, Fine to Medium Grains, Dense, Clayey Silty SAND (SC)
		12	48								8.45	✓						
		13	49	SC	-	-	-	-	-	-	9.00	7	SS	-11.5		L3	9.0	
		14	00								9.45	✓						
6		12	49	SC	-	-	-	-	-	-	10.00	8	SS	-12.5				Grey, Moist, Poorly Graded, Fine to Medium Grains, Dense, Clayey Silty SAND (SC)
		10									10.45	✓						

CS - Core Sample	DS - Disturbed Sample	LOGGED	Murali Krishnan K	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	29/01/2020	E.G.L. WRT ROAD LEVEL (m)	-2.50	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	4.50	
WS - Wash Sample	DB - Diamond Bit	DATE	06/02/2020	CASING DEPTH (m)	0.00	

GEO MARINE															SITE INVESTIGATION RECORD										BORE HOLE No. BH-04																		
PROJECT NAME															PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING										SHEET		2	OF	3														
LOCATION															Arumbakkam, Chennai					MACHINE No.					-					CHAINAGE (m)					-					DIA OF BORE HOLE		150mm	✓
STRUCTURE															2 Basement + G + 22 Floors					DRILLING METHOD					Rotary					CO-ORDINATES					N	-	BORE START DATE		28/01/2020				
JOB CODE															GT-2057					FLUSHING MEDIUM					Bentonite					E					-	BORE END DATE		31/01/2020					
TOTAL DRILL DAYS															4																												
Depth below E.G.L. (m)	Drilling progress per metre			Core Details			SPT Details				Sample Details				Layer Data																												
	Time		Type of Drill Bit (SC / TCB / DB)	Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description																										
	Hr.	Min.				0-15	15-30	30-45																																			
11	14	18	To	SC	-	-	19	24	25	49	11.50	9	SS	-14.0				Grey, Moist, Poorly Graded, Fine to Medium Grains, Dense, Clayey Silty SAND (SC) to Silty SAND (SM)																									
12	15	10	To	SC	-	-	34	40	12Cm Penet for 55Blows	>100	13.00	10	SS	-15.5		L4	13.0																										
13	15	30	To	SC	-	-	45	10Cm Penet for 50Blows	>100	14.50	11	SS	-17.0					Grey, Moist, Poorly Graded, Fine to Medium Grains, Very Dense, Silty SAND (SM)																									
14	16	25	To	SC	-	-	11	20	24	44	16.00	12	SS	-18.5		L5	16.0																										
15	16	40	To	SC	-	-	12	21	25	46	17.50	13	SS	-20.0				Brownish Grey, Moist, Hard, Compacted CLAY (CH to CI) Clays of High to Medium Plasticity																									
16	10	19	To	SC	-	-	21	28	39	67	19.00	14	SS	-21.5																													
17	11	55	To	SC	-	-																																					
18	Total Drilling Time 57Mints			SC	-	-																																					
19	Total Drilling Time 43Mints			SC	-	-																																					
20																																											

CS - Core Sample	DS - Disturbed Sample	LOGGED	Murali Krishnan K	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	30/01/2020	E.G.L WRT ROAD LEVEL(m)	-2.50	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	4.50	
WS - Wash Sample	DB - Diamond Bit	DATE	06/02/2020	CASING DEPTH (m)	0.00	

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SITE INVESTIGATION RECORD															BORE HOLE No. BH-05			
															SHEET 1 OF 3			
PROJECT NAME PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING															DIA OF BORE HOLE 150mm ☒			
															NX ☒			
LOCATION Arumbakkam, Chennai		MACHINE No. -		CHAINAGE (m) -		BORE START DATE 03/02/2020												
STRUCTURE 2 Basement + G + 22 Floors		DRILLING METHOD Rotary		CO-ORDINATES N -		BORE END DATE 06/02/2020												
JOB CODE GT-2057		FLUSHING MEDIUM Bentonite		CO-ORDINATES E -		TOTAL DRILL DAYS 4												
Depth below E.G.L. (m)	Drilling progress per metre			Core Details		SPT Details			Sample Details			Layer Data						
	Date	Time		Type of Drill Bit (SC / TCB / DB)	Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description
		Hr.	Min.				0-15	15-30	30-45									
1	03/02/2020	12	40	SC	-	-	7	10	11	21	3.00	1	SS	-5.5		L1	3.0	Filled up Materials consisting of old building debris, Brick pats & soil mixture
		To	57															
2		13	50															
		To	58															
3	03/02/2020	15	57	SC	-	-	4	8	9	17	3.45	2	SS	-6.5		L2	5.3	Brown, Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense, Silty SAND (SM)
		To	10															
4		16	35															
		To	38															
5	03/02/2020	16	55	SC	-	-	4	7	8	15	5.00	3	SS	-7.5		L2	5.3	Brown, Grey, Moist, Poorly Graded, Fine to Medium Grains, Medium Dense, Silty SAND (SM)
		To	58															
6		17	10															
		To	13															
7	04/02/2020	10	05	SC	-	-	5	8	9	17	6.00	4	SS	-8.5		L3	7.0	Grey, Moist, Poorly Graded, Fine to Medium Grains, Fine to Medium Grains, Loose, Silty SAND (SM) With Lenses of Clay
		To	10															
8		10	25															
		To	33															
9	04/02/2020	11	02	SC	-	-	6	11	11	22	7.00	5	SS	-9.5		L3	7.0	Grey, Moist, Poorly Graded, Fine to Medium Grains, Fine to Medium Grains, Medium Dense, Silty SAND (SM) to Clayey Silty SAND (SC)
		To	06															
10		11	06															
		To	06															
10	04/02/2020	11	06	SC	-	-	7	15	18	33	8.00	6	SS	-10.5		L3	7.0	Grey, Moist, Poorly Graded, Fine to Medium Grains, Fine to Medium Grains, Medium Dense, Silty SAND (SM) to Clayey Silty SAND (SC)
		To	06															
10		11	06															
		To	06															
10	04/02/2020	11	06	SC	-	-	7	15	18	33	9.00	7	SS	-11.5		L3	7.0	Grey, Moist, Poorly Graded, Fine to Medium Grains, Fine to Medium Grains, Medium Dense, Silty SAND (SM) to Clayey Silty SAND (SC)
		To	06															
10		11	06															
		To	06															
10	04/02/2020	11	06	SC	-	-	7	15	18	33	10.00	8	SS	-12.5		L3	7.0	Grey, Moist, Poorly Graded, Fine to Medium Grains, Fine to Medium Grains, Medium Dense, Silty SAND (SM) to Clayey Silty SAND (SC)
		To	06															
10		11	06															
		To	06															

CS - Core Sample	DS - Disturbed Sample	LOGGED	Muralikrishnan K.	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	04/02/2020	GROUND LEVEL (m)	-2.50	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	3.60	
WS - Wash Sample	DB - Diamond Bit	DATE	11/02/2020	CASING DEPTH (m)	0.00	

GEO MARINE															SITE INVESTIGATION RECORD										BORE HOLE No. BH-05					
PROJECT NAME															PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING										SHEET		2	OF	3	
LOCATION															Arumbakkam, Chennai										DIA OF BORE HOLE		150mm	☒	NX	☒
STRUCTURE															2 Basement + G + 22 Floors										BORE START DATE		03/02/2020			
JOB CODE															GT-2057										BORE END DATE		06/02/2020			
MACHINE No.															-										CHAINAGE (m)		-			
DRILLING METHOD															Rotary										CO-ORDINATES		N	-	E	-
FLUSHING MEDIUM															Bentonite										TOTAL DRILL DAYS		4			
Depth below E.G.L. (m)	Drilling progress per metre			Type of Drill Bit (SC / TCB / DB)	Core Details			SPT Details				Sample Details				Layer Data														
	Date	Time			Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	RL (m)	Legend	No	Depth	Geotechnical Description												
		Hr.	Min.				0-15	15-30	30-45																					
11	04/02/2020	11	32 To 37	SC	-	-	8	15	15	30	11.50	9	SS	-14.0				Grey, Moist, Poorly Graded, Fine to Medium Grains, Fine to Medium Grains, Medium Dense, Silty SAND (SM) to Clayey Silty SAND (SC)												
12	12	08 To 14	SC	-	-	7	12	13	25	13.00	10	SS	-15.5																	
13	13	48 To 05	SC	-	-	14	23	25	48	14.50	11	SS	-17.0			L4	14.5													
14	14	22 To 49	SC	-	-	14	21	27	48	16.00	12	SS	-18.5				Greenish Grey to Brown, Moist, Hard, Compacted CLAY (CH) Clay of High Plasticity													
15	15	09 To 44	SC	-	-	16	41	46	87	17.50	13	SS	-20.0																	
16	15	Total Drilling Time 38mins	SC	-	-	15	31	36	67	19.00	14	SS	-21.5			L5		19.0												
17	05/02/2020										19.45						L6	20.0	Brown, Moist, Poorly Graded, Fine to Medium Grains, Very Dense, Clayey Silty SAND (SC)											

CS - Core Sample	DS - Disturbed Sample	LOGGED	Muralikrishnan K.	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	05/02/2020	GROUND LEVEL (m)	-2.50	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	3.60	
WS - Wash Sample	DB - Diamond Bit	DATE	11/02/2020	CASING DEPTH (m)	0.00	

GEO MARINE										SITE INVESTIGATION RECORD										BORE HOLE No.		BH-05	
PROJECT NAME										PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING										SHEET		3 OF 3	
LOCATION										Arumbakkam, Chennai										DIA OF BORE HOLE		150mm	
STRUCTURE										2 Basement + G + 22 Floors										NX		✓	
MACHINE No.										-										BORE START DATE		03/02/2020	
DRILLING METHOD										Rotary										BORE END DATE		06/02/2020	
FLUSHING MEDIUM										Bentonite										TOTAL DRILL DAYS		4	
JOB CODE										GT-2057													
Depth below E.G.L. (m)		Drilling progress per metre		Core Details		SPT Details			Sample Details				Layer Data										
Date		Time		Type of Drill Bit (SC / TCB / DB)		Blows/cm.		SPT 'N' Value			Geotechnical Description												
Hr.		Min.		Total Core Recovery %		R.Q.D %		Depth			No. Type RL (m)												
						0-15 15-30 30-45					Legend No Depth												
05/02/2020		Total Drilling Time 82mins		SC		-		-		20 33			>100			21.00 15 SS -23.5			Greyish Brown, Moist, Hard, Compacted CLAY (CI to CH) Clay of Medium to High Plasticity				
14 To 15		52 To 28		SC		-		-		21 35			>100			21.41 16 SS -25.5							
15 To 16		50 To 27		SC		-		-		23			>100			23.38 17 SS -27.5							
06/02/2020		Total Drilling Time 59mins		TCB		0		0		8Cm Penet for 55Blows			>100			25.00 17 SS -29.5			Grey, Greenish Grey, Fissile, SHALE				
11 To 11		04 To 56		TCB		0		0		SPT Hammer Rebound			>100			27.00 17 SS -31.5							
11 To 11		56 To 59		TCB		-		-		SPT Hammer Rebound			>100			27.08 17 SS -32.5							
30		Total Drilling Time 59mins		TCB		-		-		SPT Hammer Rebound			>100			29.00 17 SS -32.5							
30		Total Drilling Time 59mins		TCB		-		-		SPT Hammer Rebound			>100			30.00 17 SS -32.5							

CS - Core Sample	DS - Disturbed Sample	LOGGED	Muralikrishnan K.	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	06/02/2020	GROUND LEVEL (m)	-2.50	*(F) - Sample Failed
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER TABLE (m)	3.60	
WS - Wash Sample	DB - Diamond Bit	DATE	11/02/2020	CASING DEPTH (m)	0.00	

Borehole terminated at 30 m depth below E.G.L.
FIG.2.5 Sub Soil Profile at BH-05 Location

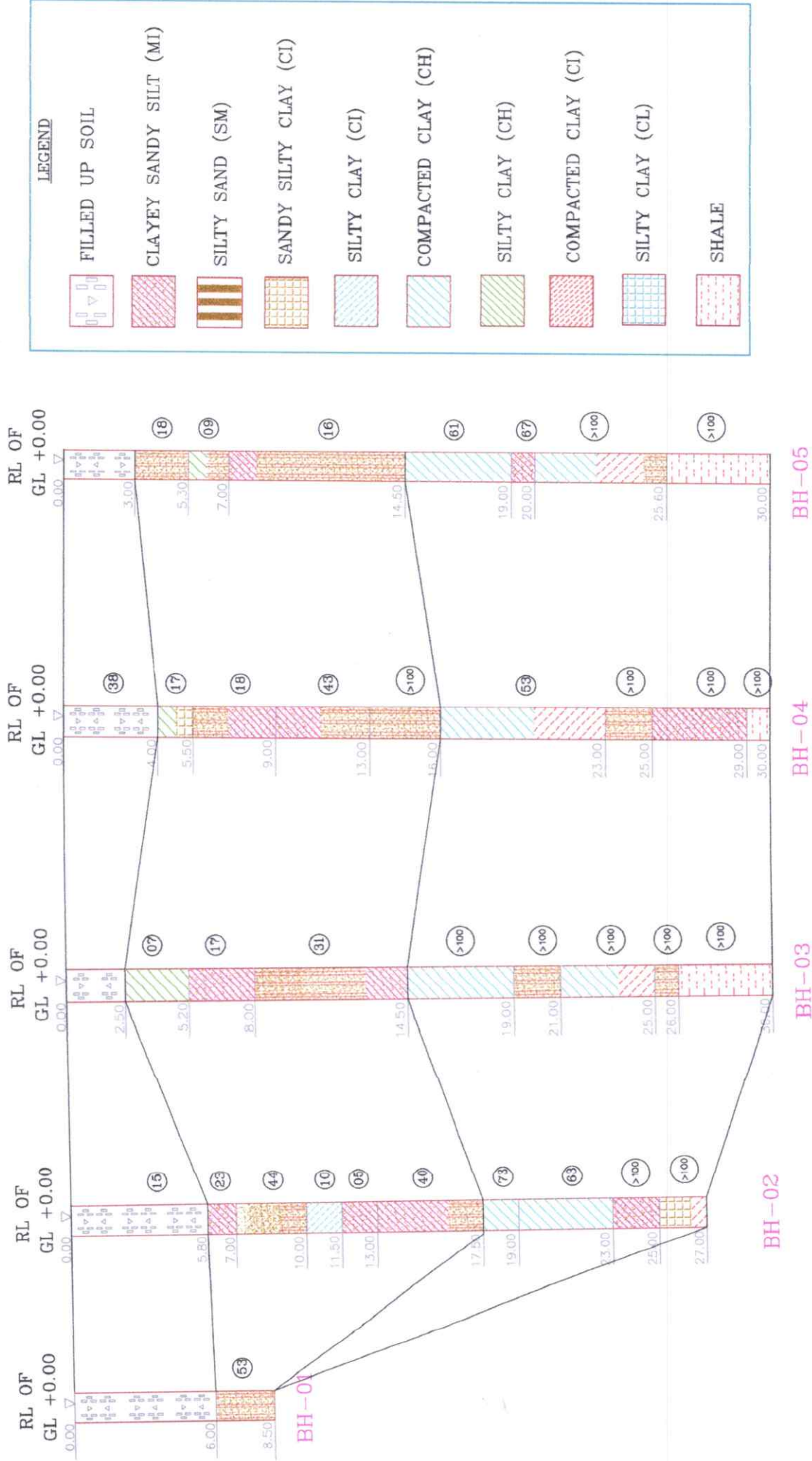


FIG.No.2.6 CROSS SECTIONAL VARIATION OF SUB SOIL PROFILE
THROUGH BH-01 TO 05

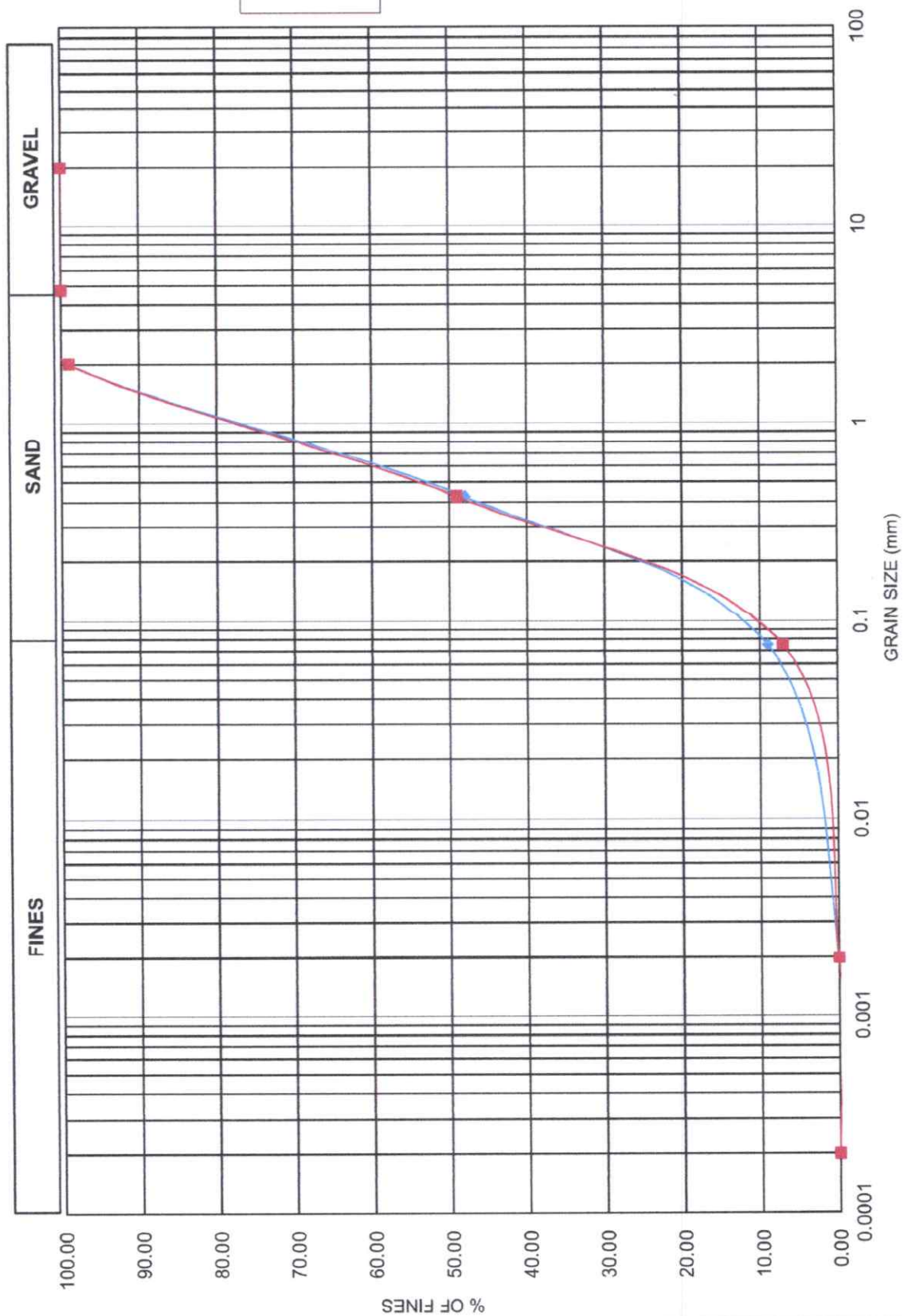


Fig. 2.7 GRAIN SIZE DISTRIBUTION CURVE - BH-01

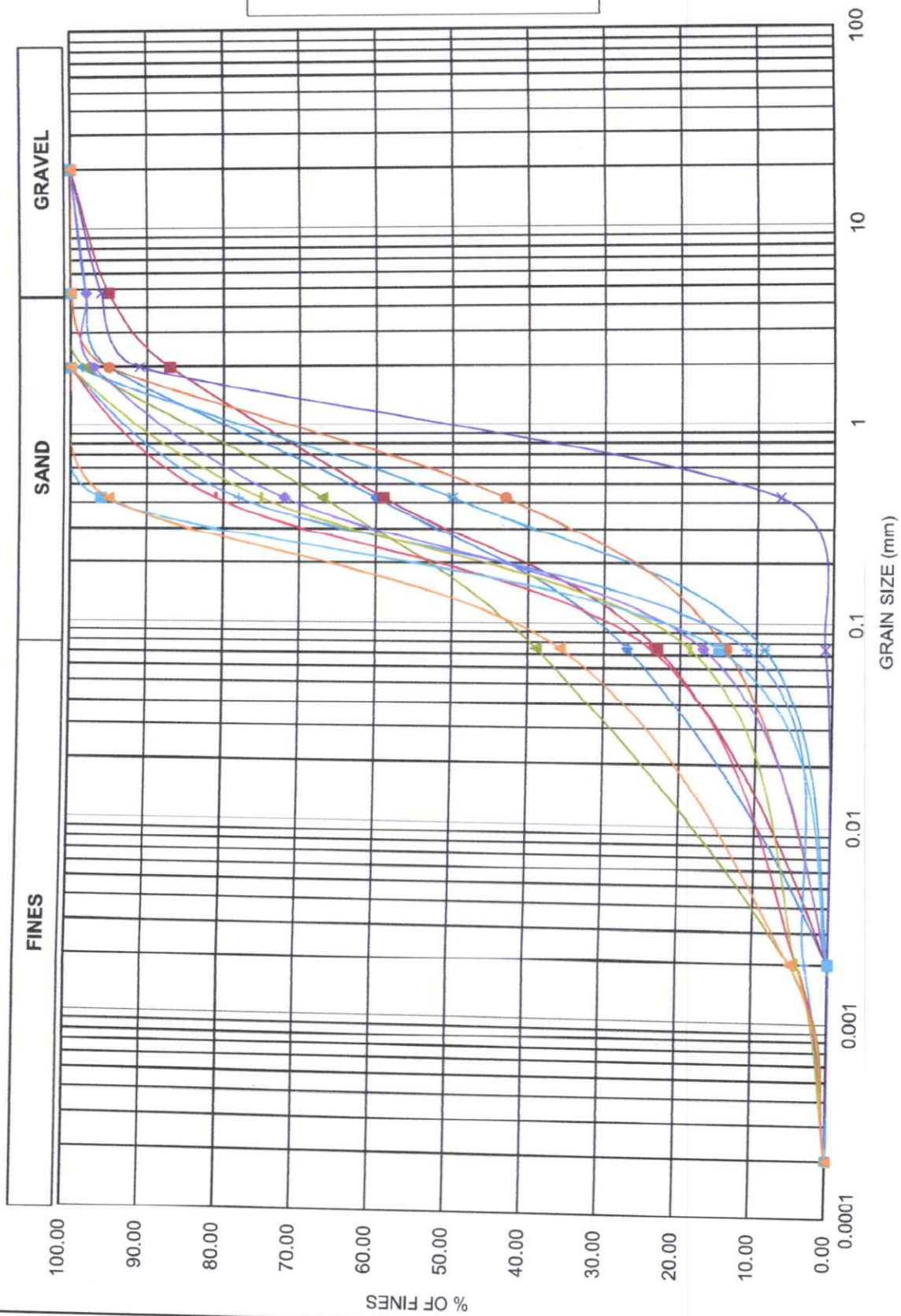


Fig. 2.8 GRAIN SIZE DISTRIBUTION CURVE - BH-02

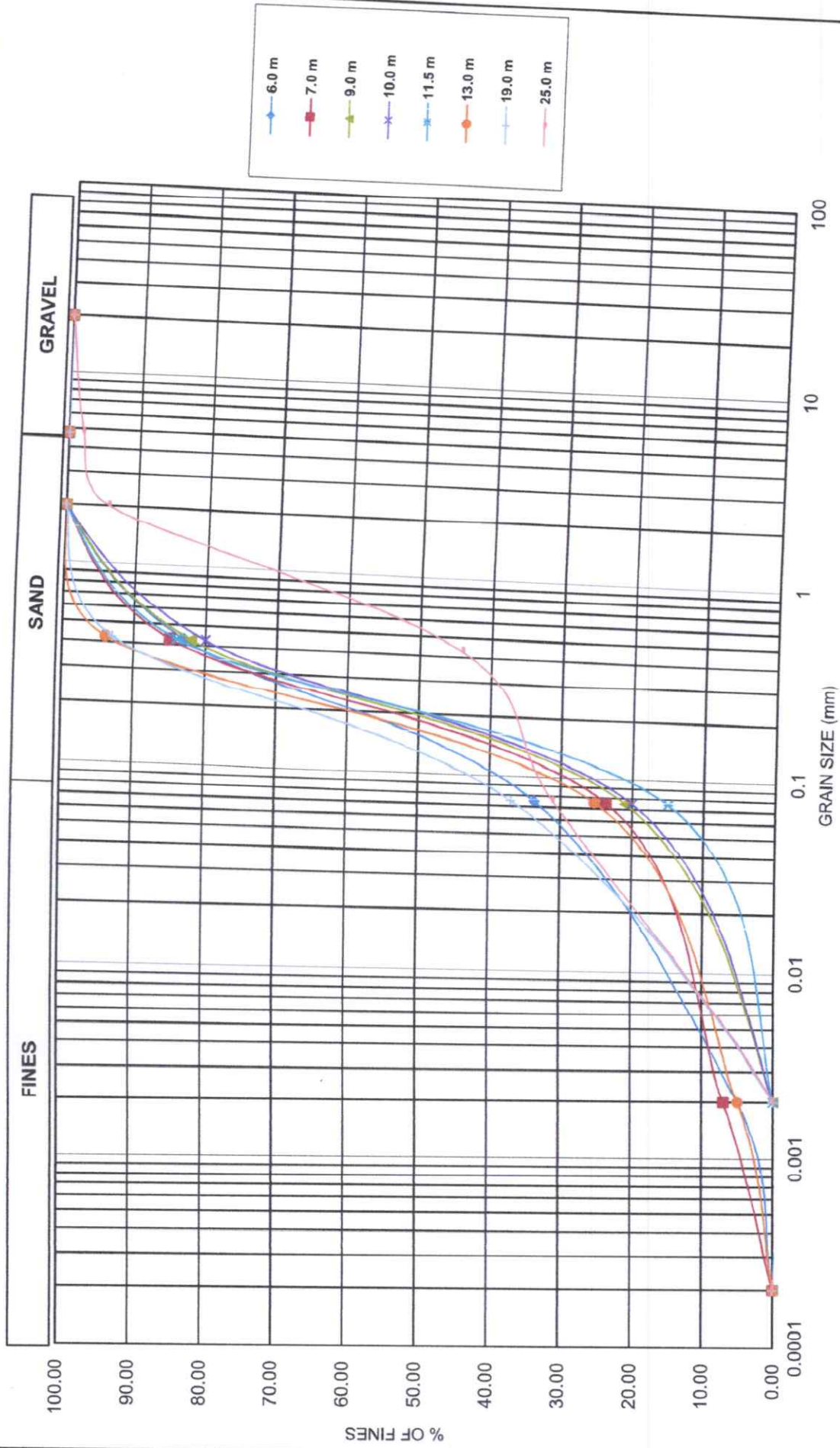


Fig. 2.9 GRAIN SIZE DISTRIBUTION CURVE - BH-03

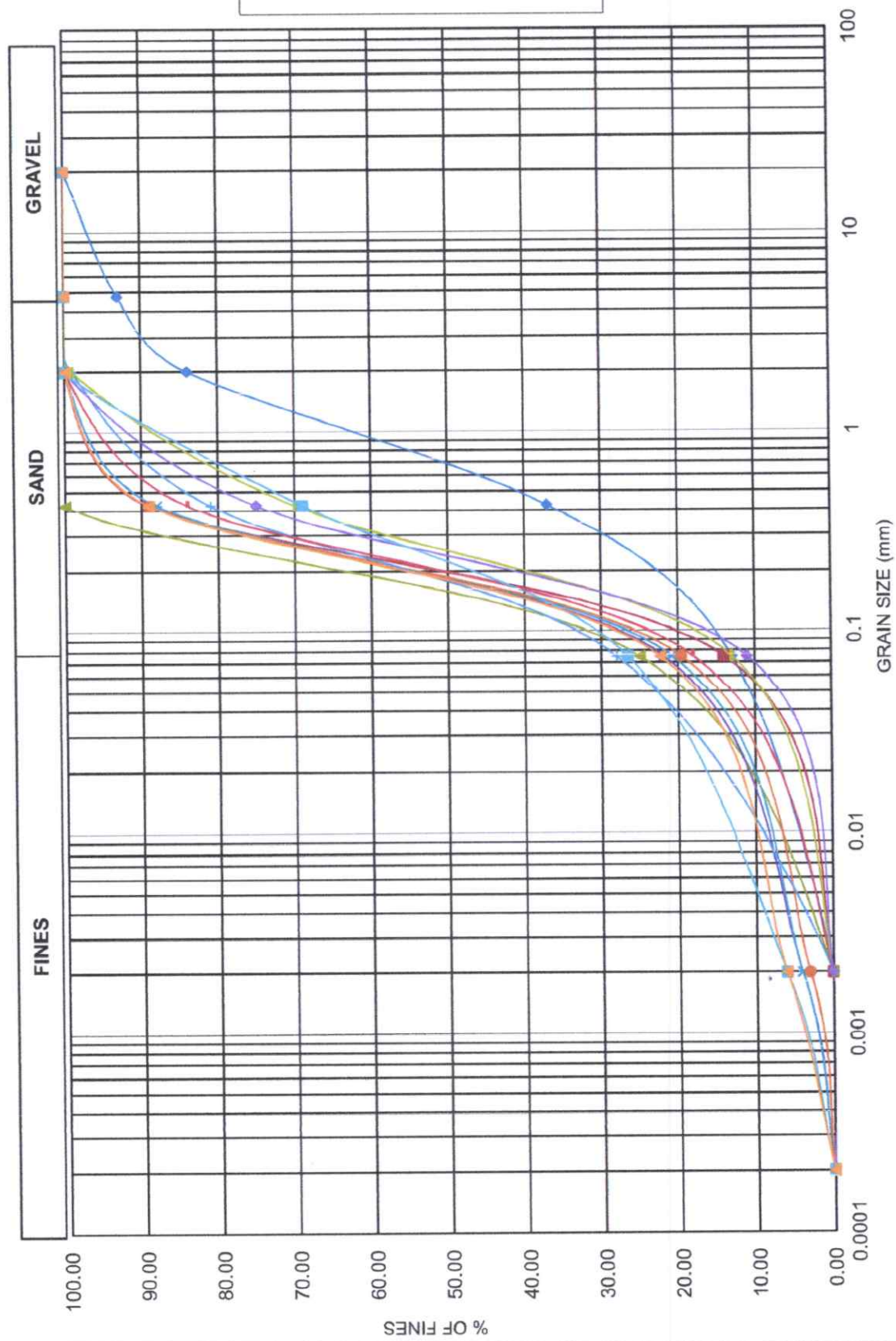


Fig. 2.10 GRAIN SIZE DISTRIBUTION CURVE - BH-04

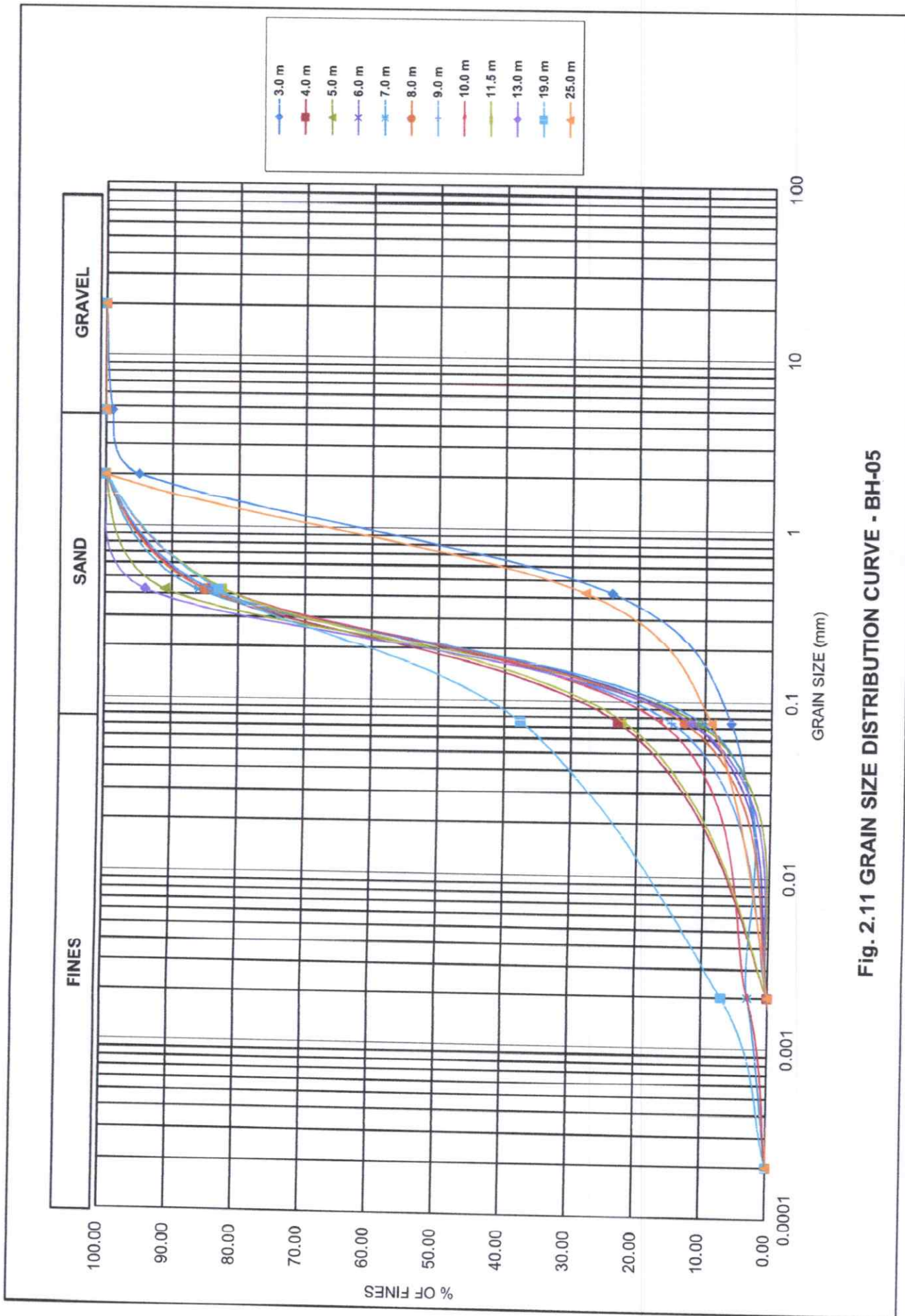


Fig. 2.11 GRAIN SIZE DISTRIBUTION CURVE - BH-05

—◆— Bore Hole No: 2 Depth: 10.0m

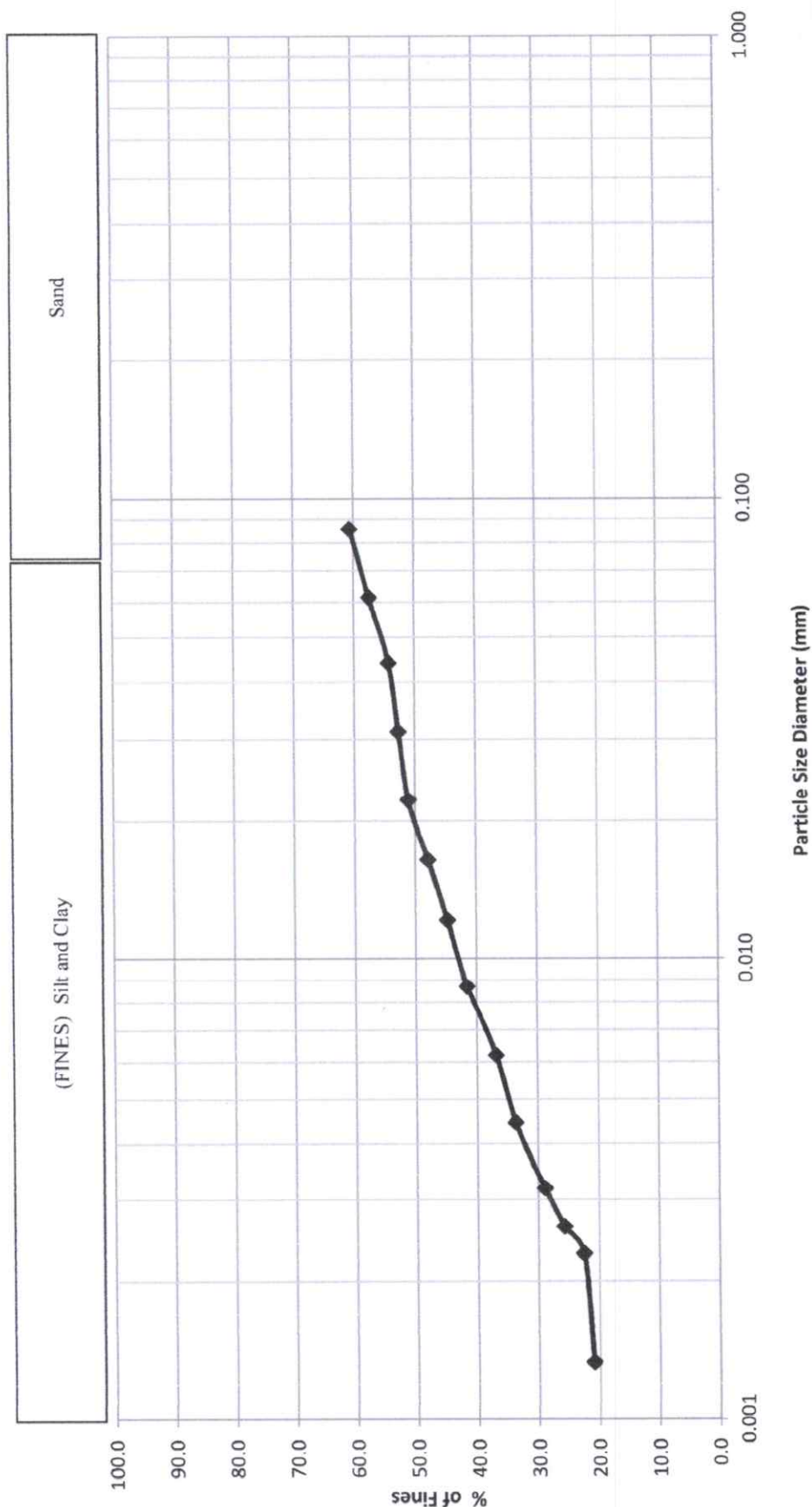


Fig 2.12 Hydrometer Analysis Master Curve

—●— Bore Hole No: 3 Depth: 7.0m

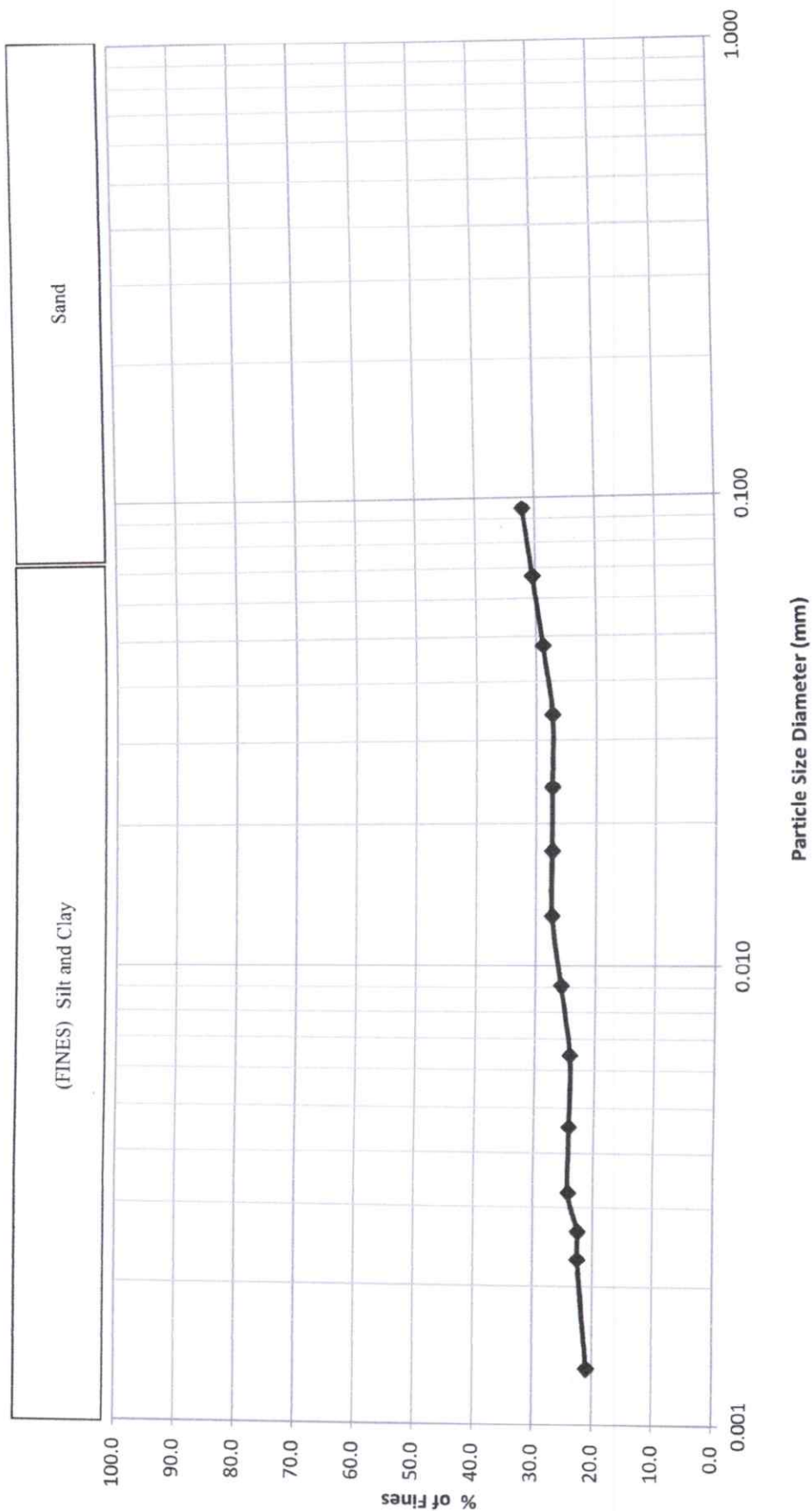


Fig 2.14 Hydrometer Analysis Master Curve

—◆— Bore Hole No: 3 Depth: 14.5m

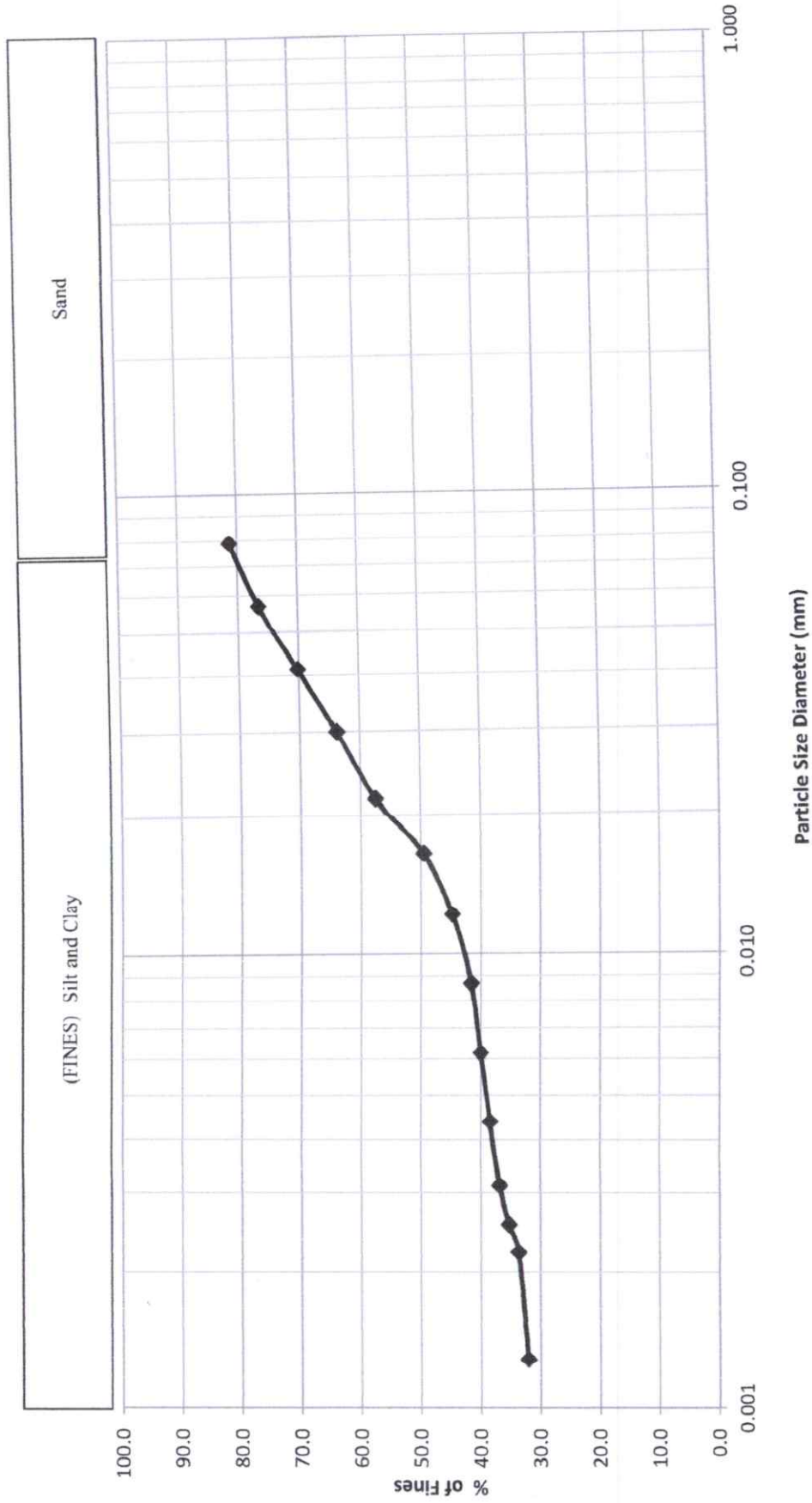


Fig 2.15 Hydrometer Analysis Master Curve

—◆— Bore Hole No: 4 Depth: 10.0m

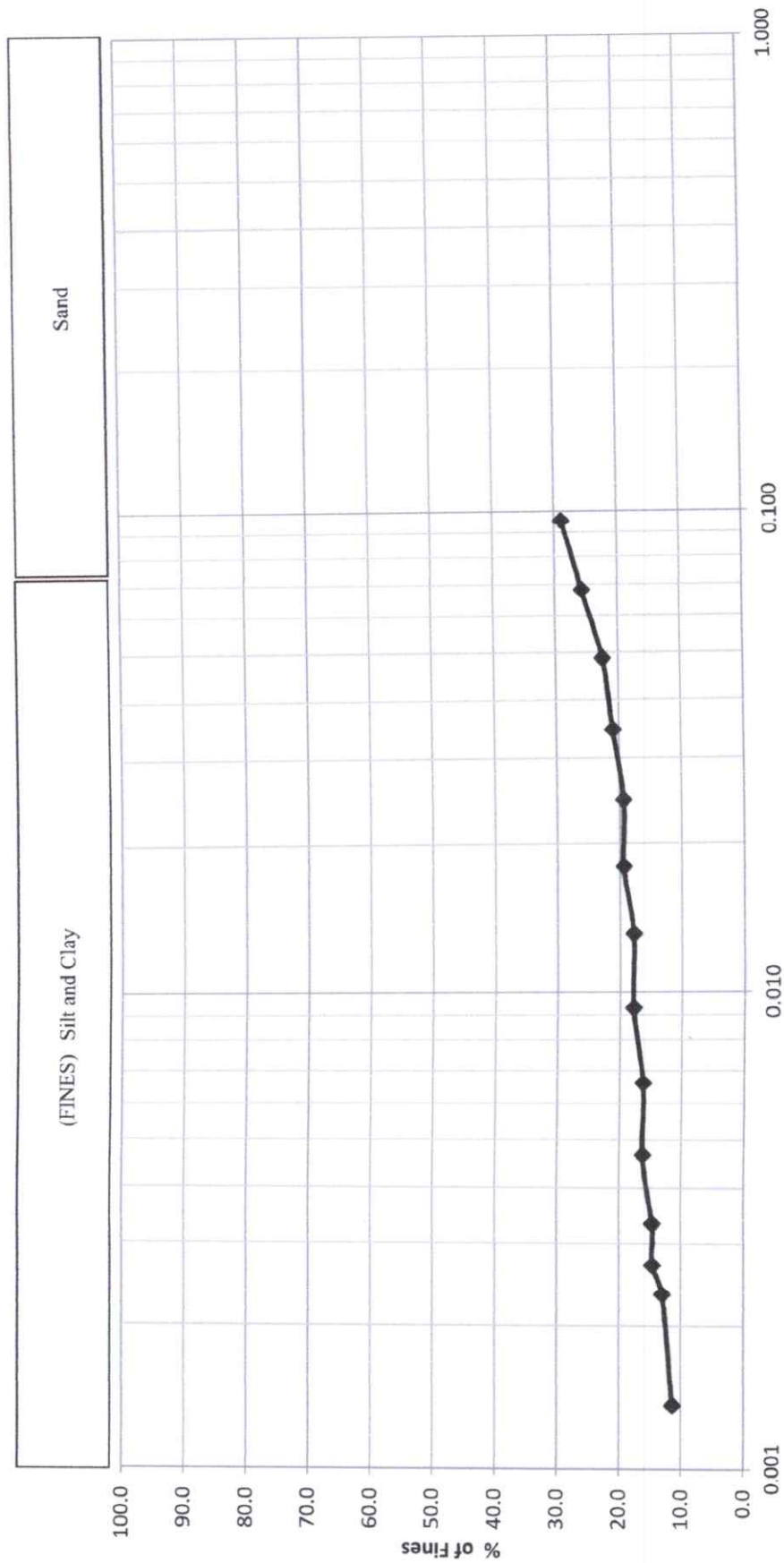


Fig 2.16 Hydrometer Analysis Master Curve

—●— Bore Hole No: 4 Depth: 16.0m

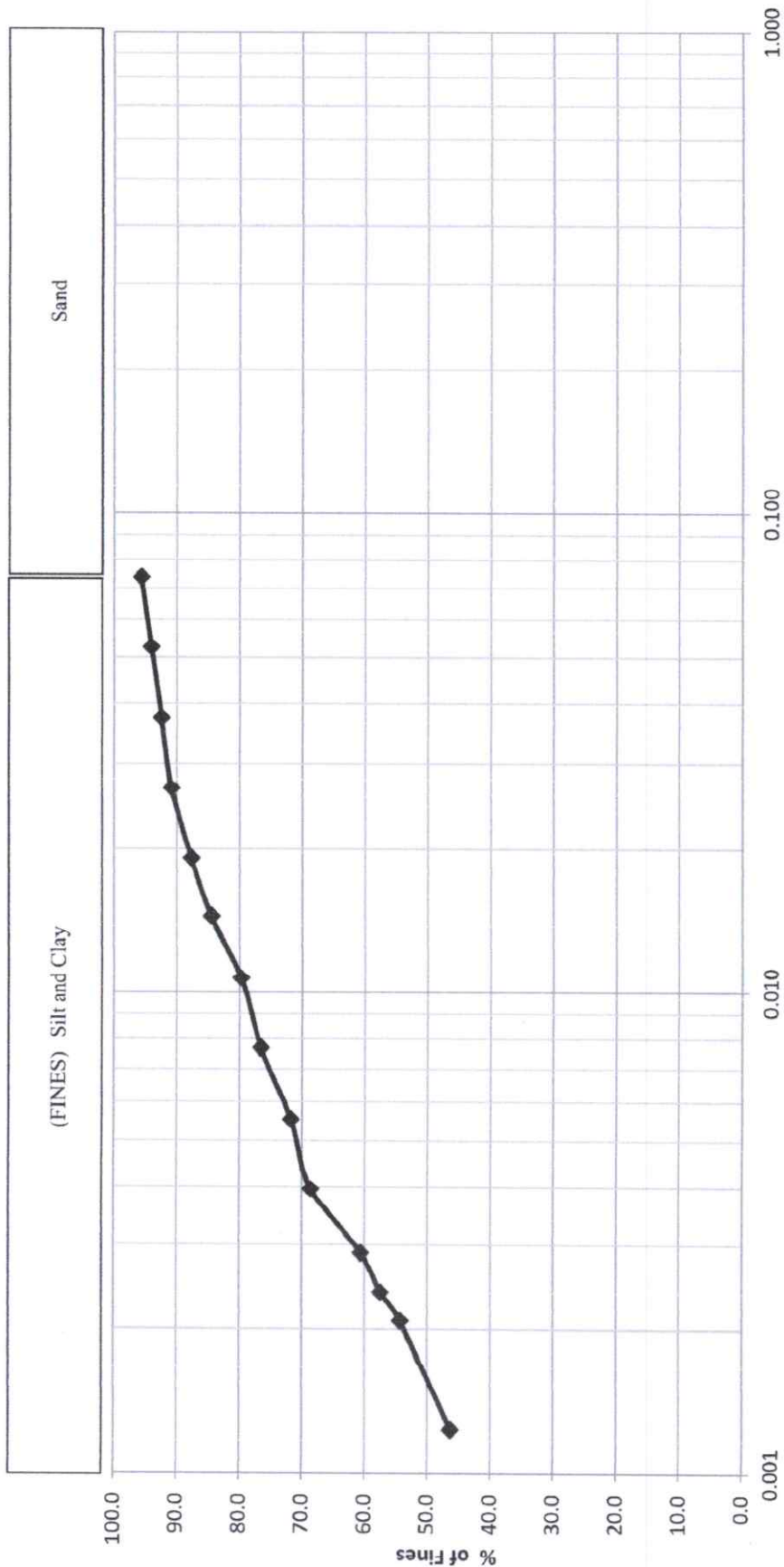


Fig 2.17 Hydrometer Analysis Master Curve

—◆— Bore Hole No: 4 Depth: 17.5m

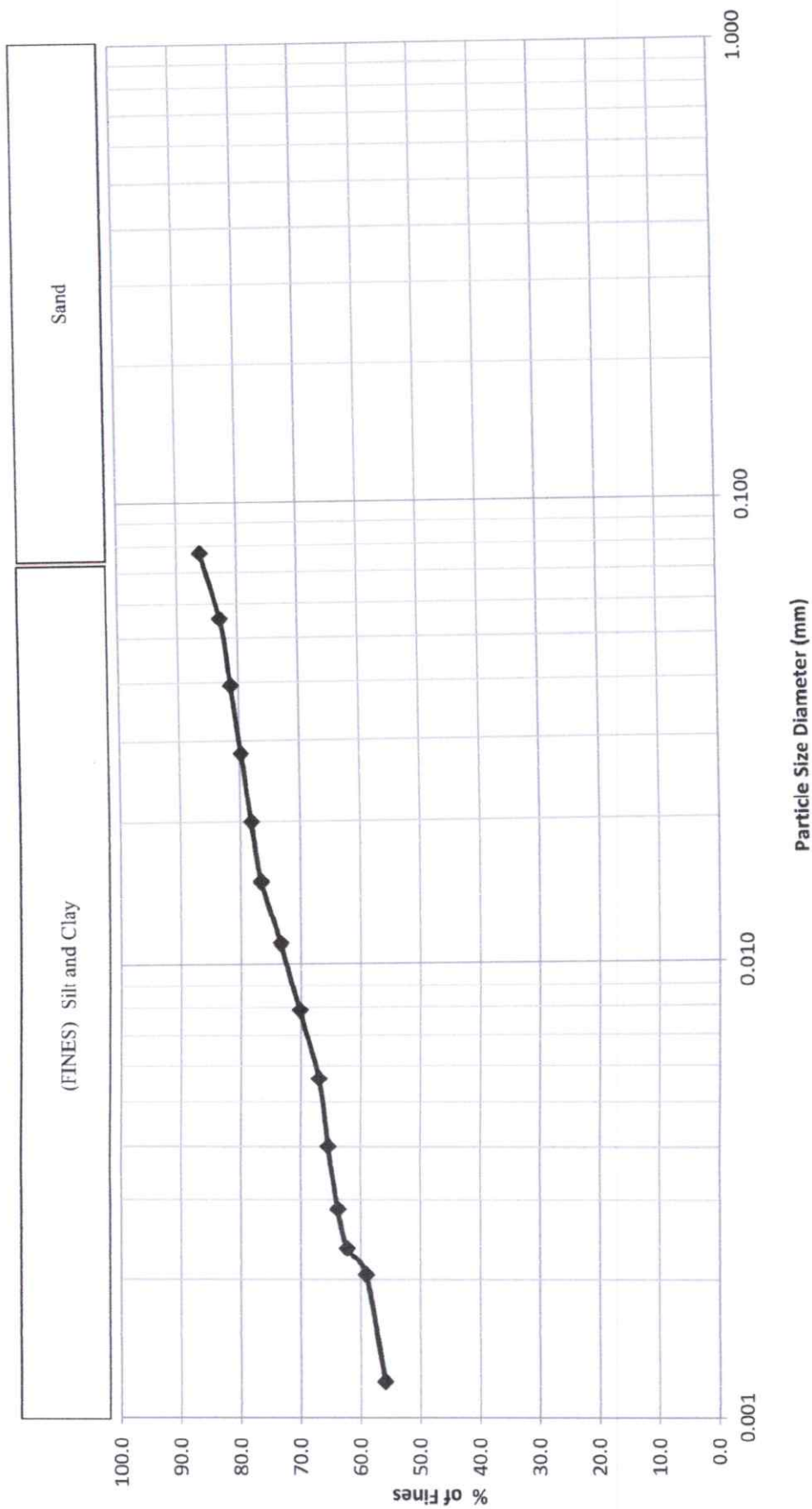


Fig 2.18 Hydrometer Analysis Master Curve

—◆— Bore Hole No: 5 Depth: 5.0m

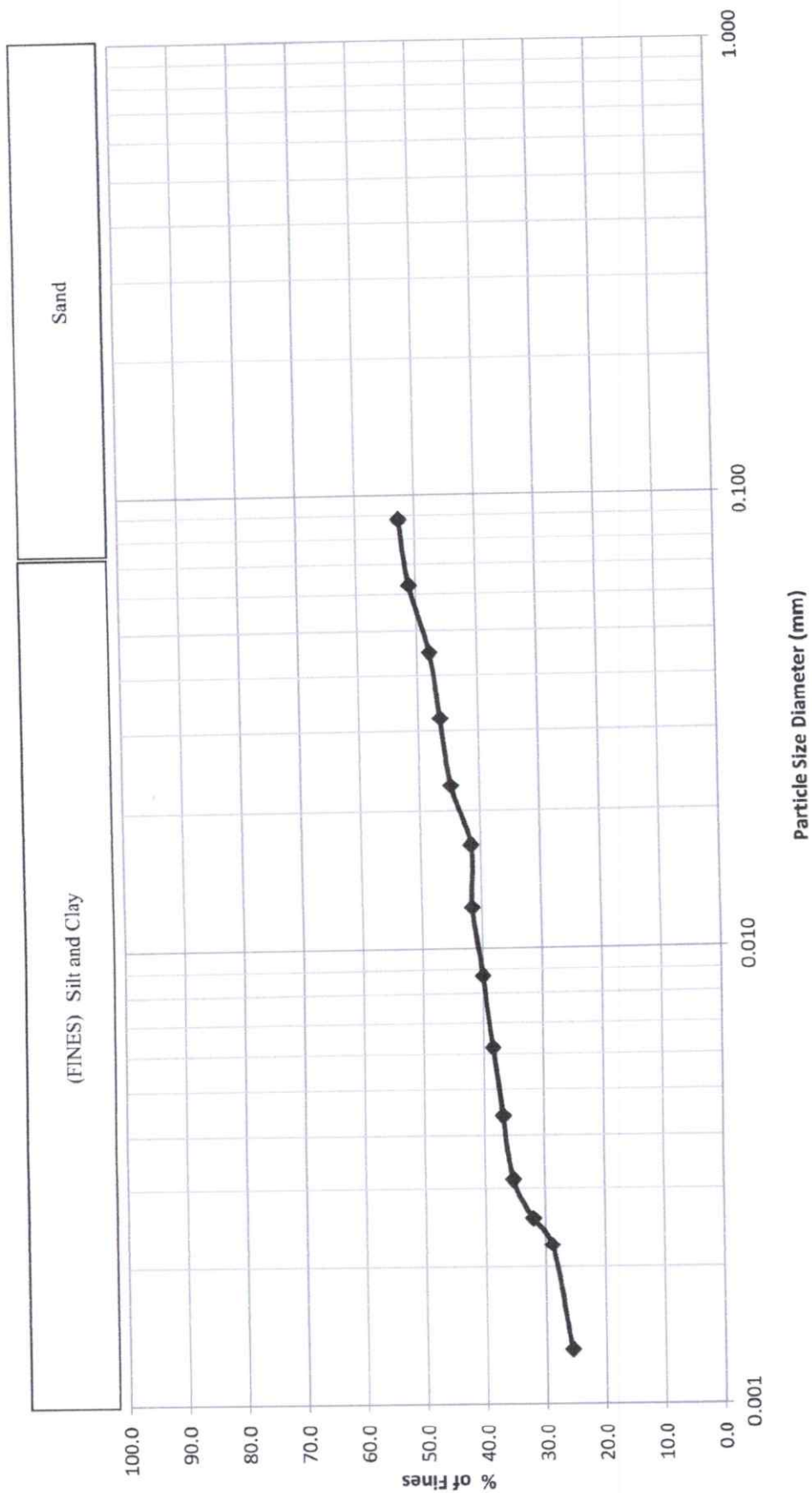


Fig 2.19 Hydrometer Analysis Master Curve

—◆— Bore Hole No: 5 Depth: 10.0m

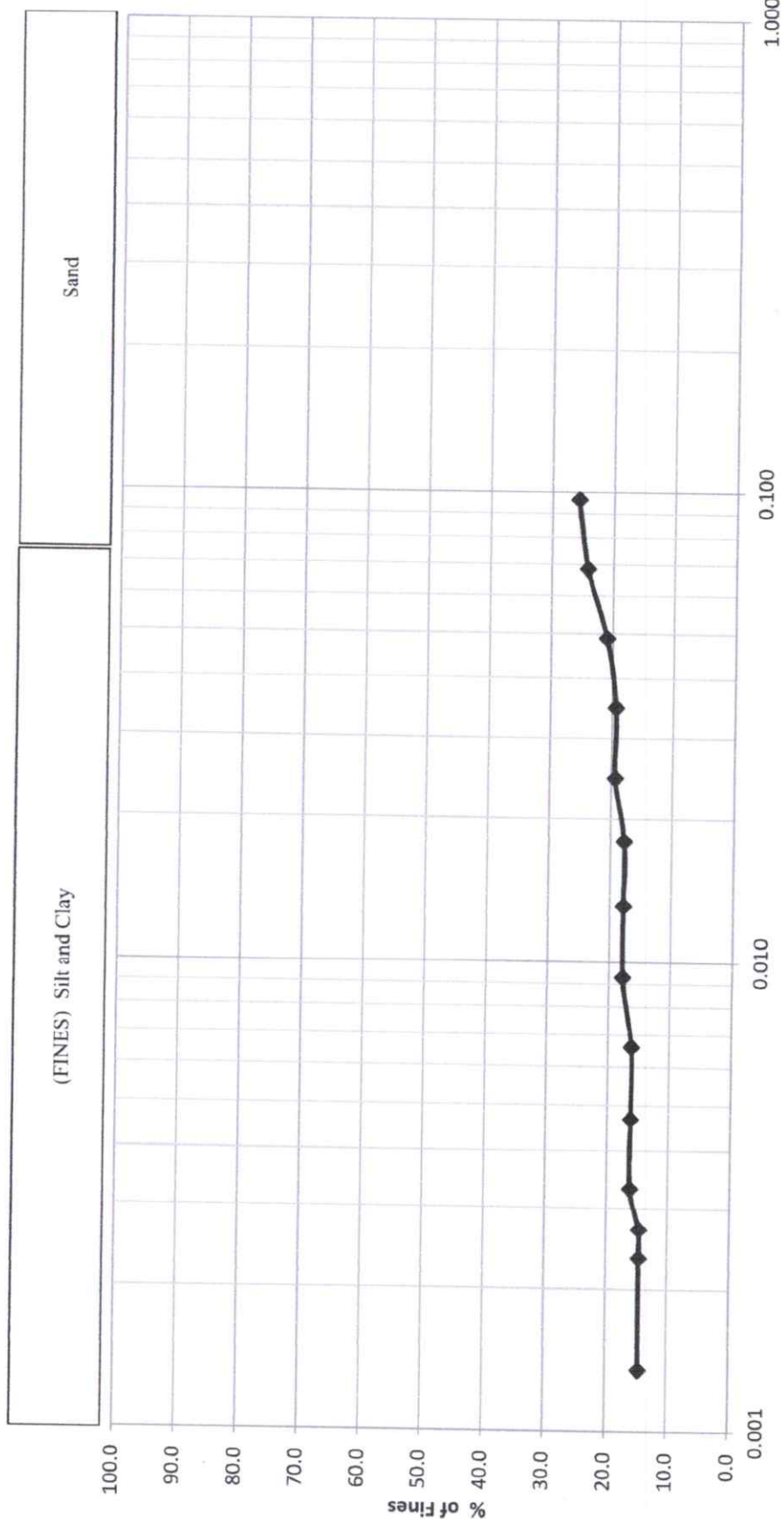


Fig 2.20 Hydrometer Analysis Master Curve

—◆— Bore Hole No: 5 Depth: 17.5m

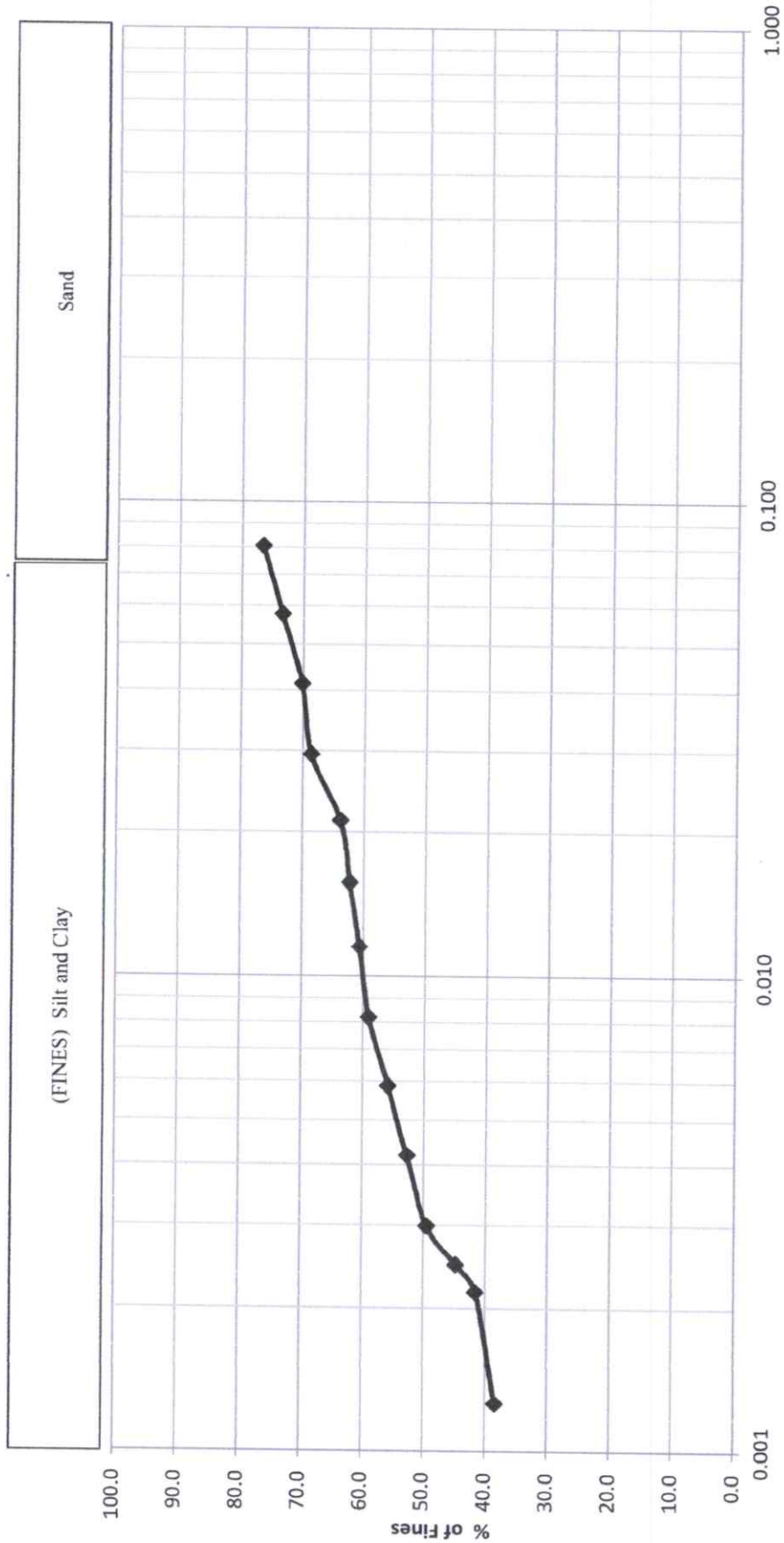


Fig 2.21 Hydrometer Analysis Master Curve

Table-2.1 Laboratory Classification of Soil Samples from BH-01

Sub Soil Classification																											
Fine Grained (FG)													Coarse Grained (CG)														
Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	N.M.C.(%)	L.L.(%)	P.L.(%)	I _p	I _c	Shrinkage (cm ³)	D.F.S (%)	Consistency	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D ₁₀ (mm)	D ₃₀ (mm)	D ₆₀ (mm)	C _u =D ₆₀ /D ₁₀	C _c =D ₃₀ ² /(D ₁₀ x D ₆₀)	Relative Density	IS-Notation		
7.0	43	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	51	39	9	0	-	-	-	-	-	-	Dense	Gravel	SP-SM
8.0	62	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	50	42	7	0	-	-	-	-	-	-	V.Dense	Gravel	SP-SM
FG = Fine Grained			PL = Plastic Limit			FS = Differential Free Swell Index			C _u = Uniformity Coefficient			NMC= Nature Moisture Content			I _c = (LL-NMC)/I _p			LL = Liquid Limit									
CG = Coarse Grained			I _p = Plasticity Index			C _c = Coefficient of Curvature			SL = Shrinkage Limit																		

Table-2.2 Laboratory Classification of Soil Samples from BH-02

Sub Soil Classification																																
Fine Grained (FG)													Coarse Grained (CG)																			
Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	N.M.C(%)	LL (%)	PL (%)	Ip	Ic	Shrinkage (cm ³)	D.F.S (%)	Consistency	Position With Respect to A-Aline	IS-Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D ₁₀ (mm)	D ₃₀ (mm)	D ₆₀ (mm)	C _u =D ₆₀ /D ₁₀	C _c =D ₃₀ ² /(D ₁₀ x D ₆₀)	Relative Density	IS-Notation							
			N.M.C(%)	LL (%)	PL (%)	Ip	Ic	Shrinkage (cm ³)	D.F.S (%)	Consistency	Position With Respect to A-Aline	IS-Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D ₁₀ (mm)	D ₃₀ (mm)	D ₆₀ (mm)	C _u =D ₆₀ /D ₁₀	C _c =D ₃₀ ² /(D ₁₀ x D ₆₀)	Relative Density	Gravel	Sand						
Filling Soil (Mixture of clayey sand and brick pails)																																
Filling Soil																																
1.0	13	SS																														
2.0	6	SS																														
3.0	-	DS																														
4.0	17	SS																														
5.0	24	SS																														
6.0	23	SS	17	29	21	8	1.51	18	22	CG>50%	Above	-	0	2	31	25	37	5	-	-	-	-	-	-	M.Dense	<50%	SM					
7.0	46	SS	-	-	-	-	-	-	-	CG>50%	-	-	4	5	84	6	1	0	-	-	-	-	-	-	M.Dense	<50%	SM					
8.0	53	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	49	41	9	0	-	-	-	-	-	-	V.Dense	<50%	SP-SP					
9.0	33	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	5	52	29	14	0	-	-	-	-	-	-	Dense	<50%	SM					
10.0	10	SS	31	47	27	20	0.80	14	56	Stiff	Above	CI	-	-	-	-	78	22	-	-	-	-	-	FG>50%	FG>50%	FG>50%	FG>50%	FG>50%				
11.5	5	SS	22	26	20	5	0.67	19	39	CG>50%	Above	-	0	0	22	64	11	3	-	-	-	-	-	-	Loose	<50%	SC					
13.0	27	SS	14	27	20	8	1.76	20	20	CG>50%	Above	-	0	0	19	54	23	4	-	-	-	-	-	-	M.Dense	<50%	SC					
14.5	46	SS	13	29	19	10	1.54	18	44	CG>50%	Above	-	0	0	25	53	18	4	-	-	-	-	-	-	Dense	<50%	SC					
16.0	47	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	1	25	55	17	0	-	-	-	-	-	-	Dense	<50%	SM					
17.5	73	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	4	81	15	0	-	-	-	-	-	-	V.Dense	<50%	SM					
19.0	68	SS	33	94	40	54	1.13	9	110	Hard	Above	CH	-	-	-	-	46	54	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%	FG>50%	FG>50%			
21.0	57	SS	31	99	38	61	1.13	8	92	Hard	Above	CH	-	-	-	-	40	60	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%	FG>50%	FG>50%			
23.0	>100	SS	19	27	21	7	1.21	19	50	CG>50%	Above	-	0	0	5	56	34	5	-	-	-	-	-	-	V.Dense	<50%	SC					
25.0	>100	SS	20	30	21	9	1.13	18	50	Hard	Above	CL	0	1	14	20	55	10	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%	FG>50%	FG>50%			
27.0	>100	SS	14	42	18	24	1.20	15	43	Hard	Above	CI	0	0	4	30	54	12	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%	FG>50%	FG>50%			
FG = Fine Grained			Pl = Plastic Limit										NMC= Nature Moisture Content										Ic = (LL-NMC)/Ip				LL = Liquid Limit					
CG = Coarse Grained			Ip = Plasticity Index										FS = Differential Free Swell Index										C _u = Uniformity Coefficient				C _c = Coefficient of Curvature				SL = Shrinkage Limit	

Table-2.3 Laboratory Classification of Soil Samples from BH-03

Sub Soil Classification																										
Fine Grained (FG)													Coarse Grained (CG)													
Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	N.M.C(%)	L.L.(%)	P.L.(%)	Ip	Ic	Shrinkage (cm³)	D.F.S. (%)	Consistency	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D ₁₀ (mm)	D ₃₀ (mm)	D ₆₀ (mm)	C _u =D ₆₀ /D ₁₀	C _c =D ₃₀ ² /(D ₁₀ x D ₆₀)	Relative Density	IS-Notation	
																									Gravel	Sand
4.0	7	SS	43	71	30	40	0.69	10	43	M.Stiff	Above	CH	-	-	-	-	60	40	-	-	-	-	-	FG>50%	FG>50%	FG>50%
6.0	14	SS	16	26	13	13	0.77	18	11	CG>50%	Above	-	0	0	17	46	32	5	-	-	-	-	-	M.Dense	<50%	SC
7.0	10	SS	15	27	13	14	0.86	18	30	CG>50%	Above	-	0	0	15	56	22	7	-	-	-	-	-	Loose	<50%	SC
8.0	20	SS	Sample Failed																							
9.0	34	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	18	61	21	0	-	-	-	-	-	Dense	<50%	SM
10.0	30	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	20	60	20	0	-	-	-	-	-	M.Dense	<50%	SM
11.5	33	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	16	69	15	0	-	-	-	-	-	Dense	<50%	SM
13.0	34	SS	18	32	19	13	1.06	18	30	CG>50%	Above	-	0	0	6	65	24	5	-	-	-	-	-	Dense	<50%	SC
14.5	>100	SS	24	56	29	27	1.17	11	31	Hard	Above	CH	-	-	-	-	66	34	-	-	-	-	-	FG>50%	FG>50%	FG>50%
16.0	49	SS	33	101	40	62	1.12	7	53	Hard	Above	CH	-	-	-	-	40	60	-	-	-	-	-	FG>50%	FG>50%	FG>50%
17.5	90	SS	25	63	30	33	1.15	11	54	Hard	Above	CH	0	0	0	15	50	35	-	-	-	-	-	FG>50%	FG>50%	FG>50%
19.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	7	56	37	0	-	-	-	-	-	V.Dense	<50%	SM
21.0	>100	SS	21	72	27	45	1.14	10	67	Hard	Above	CH	-	-	-	-	68	32	-	-	-	-	-	FG>50%	FG>50%	FG>50%
23.0	>100	SS	14	46	20	26	1.22	13	19	Hard	Above	CI	0	0	0	28	55	17	-	-	-	-	-	FG>50%	FG>50%	FG>50%
25.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	4	50	13	31	0	-	-	-	-	-	V.Dense	<50%	SM
FG = Fire Grained			PL = Plastic Limit										FS = Differential Free Swell Index										Ic = (LL-NMC)/Ip		LL = Liquid Limit	
CG = Coarse Grained			Ip = Plasticity Index										C _u = Uniformity Coefficient										C _c = Coefficient of Curvature		SL = Shrinkage Limit	

Table-2.4 Laboratory Classification of Soil Samples from BH-04

Sub Soil Classification																										
Fine Grained (FG)												Coarse Grained (CG)														
Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	N.M.C(%)	L.L.(%)	P.L.(%)	Ip	Shrinkage (cm ³)	D.F.S.(%)	Consistency	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D ₁₀ (mm)	D ₃₀ (mm)	D ₆₀ (mm)	C _u =D ₆₀ /D ₁₀	C _c =D ₃₀ ² /(D ₁₀ x D ₆₀)	Relative Density	IS-Notation		
3.0	38	SS	-	-	-	-	-	-	-	-	-	7	9	47	24	13	0	-	-	-	-	-	-	Dense	Gravel	Sand
4.0	15	SS	31	57	24	32	3.81	15	Stiff	Above	CH	-	-	-	-	65	35	-	-	-	-	-	-	FG>50%	FG>50%	SM
5.0	18	SS	15	30	15	15	1.02	20	V.Stiff	Above	CL	-	-	-	-	85	15	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%
6.0	22	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	11	75	14	0	-	-	-	-	-	-	M.Dense	<50%	SM
7.0	18	SS	Plastic Clay No LL/PL carried out					25	CG>50%	Above	-	0	0	0	75	25	0	-	-	-	-	-	-	M.Dense	<50%	SC
8.0	15	SS	15	25	13	12	1.79	4	CG>50%	Above	-	0	0	12	63	21	4	-	-	-	-	-	-	Dense	<50%	SC
9.0	31	SS	15	27	16	11	1.05	-5	CG>50%	Above	-	0	0	12	64	20	4	-	-	-	-	-	-	Dense	<50%	SC
10.0	46	SS	14	27	15	12	1.06	-5	CG>50%	Above	-	0	0	11	67	19	3	-	-	-	-	-	-	Dense	<50%	SC
11.5	49	SS	-	-	-	-	-	-	CG>50%	-	-	0	1	18	53	28	0	-	-	-	-	-	-	Dense	<50%	SM
13.0	>100	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	16	66	18	0	-	-	-	-	-	-	V.Dense	<50%	SM
14.5	>100	SS	-	-	-	-	-	-	CG>50%	-	-	0	1	29	57	13	0	-	-	-	-	-	-	V.Dense	<50%	SM
16.0	44	SS	31	92	38	54	1.13	64	Hard	Above	CH	-	-	-	-	46	54	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%
17.5	46	SS	27	98	35	63	1.12	108	Hard	Above	CH	-	-	-	-	41	59	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%
21.0	55	SS	18	37	19	18	1.05	55	Hard	Above	CI	0	0	0	41	40	19	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%
23.0	>100	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	25	64	11	0	-	-	-	-	-	-	V.Dense	<50%	SP-SM
25.0	>100	SS	15	34	15	19	1.02	9	CG>50%	Above	-	0	0	31	38	25	6	-	-	-	-	-	-	V.Dense	<50%	SC
27.0	>100	SS	14	33	16	16	1.13	30	CG>50%	Above	-	0	0	11	62	21	6	-	-	-	-	-	-	V.Dense	<50%	SC
29.0	>100	SS	25	46	26	20	1.06	-13	Hard	Above	CI	-	-	-	-	80	20	-	-	-	-	-	-	FG>50%	FG>50%	FG>50%
FG = Fine Grained			Pl = Plastic Limit										FS = Differential Free Swell Index					NMC= Nature Moisture Content					Ic = (LL-NMC)/P		LL = Liquid Limit	
CG = Coarse Grained			Ip = Plasticity Index										C _u = Uniformity Coefficient					C _c = Coefficient of Curvature					SL = Shrinkage Limit			

Table-2.5 Laboratory Classification of Soil Samples from BH-05

Sub Soil Classification																										
Fine Grained (FG)													Coarse Grained (CG)													
Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	N.M.C(%)	L.L (%)	P.L (%)	Ip	Shrinkage (cm ³)	D.F.S (%)	Consistency	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D ₁₀ (mm)	D ₃₀ (mm)	D ₆₀ (mm)	C _u =D ₆₀ /D ₁₀	C _c =D ₃₀ ² /(D ₁₀ x D ₆₀)	Relative Density	IS-Notation		
																								Gravel	Sand	
3.0	21	SS	-	-	-	-	-	-	CG>50%	-	-	1	4	71	13	6	0	-	-	-	-	-	-	M.Dense	Gravel	SP-SM
4.0	17	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	15	62	23	0	-	-	-	-	-	-	M.Dense	Gravel	SM
5.0A	15	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	9	80	11	0	-	-	-	-	-	-	M.Dense	Gravel	SP-SM
5.0B			28	56	25	31	12	13	Stiff	Above	CH	-	-	-	-	71	29	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
6.0	9	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	16	72	12	0	-	-	-	-	-	-	Loose	Gravel	SP-SM
7.0	17	SS	11	23	12	11	18	10	CG>50%	Above	-	0	0	14	73	10	3	-	-	-	-	-	-	M.Dense	Gravel	SC
8.0	18	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	15	72	13	0	-	-	-	-	-	-	M.Dense	Gravel	SM
9.0	22	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	16	69	15	0	-	-	-	-	-	-	M.Dense	Gravel	SM
10.0	33	SS	12	25	13	12	18	11	CG>50%	Above	-	0	0	18	63	16	3	-	-	-	-	-	-	Dense	Gravel	SC
11.5	30	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	18	60	22	0	-	-	-	-	-	-	M.Dense	Gravel	SM
13.0	25	SS	-	-	-	-	-	-	CG>50%	-	-	0	0	6	82	12	0	-	-	-	-	-	-	M.Dense	Gravel	SP-SM
14.5	48	SS	32	89	37	53	10	75	Hard	Above	CH	-	-	-	-	52	48	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
16.0	48	SS	32	85	36	49	10	78	Hard	Above	CH	-	-	-	-	55	45	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
17.5	87	SS	33	83	37	46	12	69	Hard	Above	CH	-	-	-	-	58	42	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
19.0	67	SS	16	36	19	17	16	78	CG>50%	Above	-	0	0	17	41	35	7	-	-	-	-	-	-	V.Dense	Gravel	SC
21.0	>100	SS	28	62	31	31	11	58	Hard	Above	CH	-	-	-	-	65	35	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
23.0	>100	SS	16	36	17	19	15	0	Hard	Above	CI	-	-	-	-	74	26	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
25.0	>100	WS	-	-	-	-	-	-	CG>50%	-	-	0	0	72	19	9	0	-	-	-	-	-	-	V.Dense	Gravel	SP-SM
27.0	>100	SS	23	45	26	19	14	15	Hard	Above	CI	-	-	-	-	72	28	-	-	-	-	-	-	FG>50%	Gravel	FG>50%
FG = Fine Grained			PL = Plastic Limit										FS = Differential Free Swell Index										I _c = (LL-NMC)/Ip			
CG = Coarse Grained			Ip = Plasticity Index										C _u = Uniformity Coefficient										C _c = Coefficient of Curvature			
																							LL = Liquid Limit			
																							SL = Shrinkage Limit			

GEOLOGY & SUB-SURFACE STRATIFICATION

3.0 Preamble:

Geotechnical investigation carried out at a specific site provides location specific sub surface characteristics based on which the design of sub structures/foundations is generally carried out. However, the macro-level understanding of the sub surface is also needed for a comprehensive understanding of the sub structure/foundation response to naturally super imposed loads like earthquake forces etc., The macro level understanding of the sub surface is better provided through the knowledge of the Geology of the region. Since, it is beyond the scope of the present study to carry out geological investigation to establish the geology of the study region; published data are presented below along with the sub surface stratification observed through the direct borehole investigation carried out at the specified locations.

3.1 Geology of Study Area (based on the published data)

Geologically, the present site is located close vicinity to coastal region with sub surface consisting of sedimentary deposits. The top sedimentary deposit is under laid by upper gondwana shale formation, particularly lower stage of Sriperumpudur formation. The formation mechanism of the sediments is chiefly due to transportation of surface water deposition.

Though the gondwana shale formation is not encountered within the investigation depth, however the geological characteristics observed in the direct borehole investigation confirms that the present site does not depict any surprising geological features that are different from that of the region.

3.2 DESIGN SUB SOIL PROFILE: (WRT Foundation Engineering Application)

The sub soil characteristics obtained at the test location are further processed to arrive at the design soil parameters required for the design of sub structure using the following shear strength correlations with respect to the Standard Penetration Test Values of different layers.

- ☞ For Coarse Grained Material, Ref. IS: 6403 to estimate Angle of Shearing Resistance (Reproduced and shown in Fig.A1)
- ☞ For Fine Grained Material, Ref. Terzaghi & Peck, 1948, to estimate Unconfined Compressive Strength (Reproduced and shown in Fig.A2)

Based on the above, the average design soil characteristics are given below:

REFERENCE BORE HOLE-BH:				1	Ref R.L. of G.L. (m):			0.00			
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(g) kN/m ³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C _u) kPa	(I) Deg.
1	0.00	6.00	6.00	Filled up Soil	-	-	-	-	-	-	-
2	6.00	8.50	2.50	Silty Sand	Brownish Yellow	53	Very Dense	-	20.5	-	41.45

REFERENCE BORE HOLE-BH:				2	Ref R.L. of G.L. (m):			0.00			
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(g) kN/m ³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C _u) kPa	(I) Deg.
1	0.00	5.80	5.80	Filled up Soil	-	-	-	-	-	-	-
2	5.80	7.00	1.20	Clayey Silty Sand	Brownish Grey	23	Medium Dense	-	18.5	-	33.9
3	7.00	10.00	3.00	Silty Sand	Brownish Grey	44	Dense	-	20	-	39.65
4	10.00	11.50	1.50	Silty Clay	Grey	10	-	Stiff	17.5	67	-
5	11.50	13.00	1.50	Clayey Silty Sand	Grey	5	Loose	-	14	-	20.37
6	13.00	17.50	4.50	Clayey Silty Sand	Grey	40	Dense	-	20	-	38.75
7	17.50	19.00	1.50	Silty Sand	Grey	73	Very Dense	-	21	-	42.5
8	19.00	23.00	4.00	Compacted Clay	Brownish Grey	63	Very Dense	-	21	-	42.5
9	23.00	25.00	2.00	Clayey Silty Sand	Brownish Grey	>100	Very Dense	-	21	-	42.5
10	25.00	27.50	2.50	Compacted Clay	Brownish Green	>100	Very Dense	-	21	-	42.5

REFERENCE BORE HOLE-BH:				3	Ref R.L. of G.L. (m):			0.00			
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(g) kN/m ³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C _u) kPa	(I) Deg.
1	0.00	2.50	2.50	Filled up Soil	-	-	-	-	-	-	-
2	2.50	5.20	2.70	Silty Clay	Black	7	-	Medium Stiff	16	47	-
3	5.20	8.00	2.80	Clayey Silty Sand	Brownish Grey	17	Medium Dense	-	18	-	32.1
4	8.00	14.50	6.50	Silty Sand	Grey	30	Medium Dense	-	19	-	36
5	14.50	19.00	4.50	Compacted Clay	Greyish Brown	80	Very Dense	-	21	-	42.5
6	19.00	21.00	2.00	Silty Sand	Greyish Brown	>100	Very Dense	-	21	-	42.5
7	21.00	25.00	4.00	Compacted Clay	Brownish Grey	>100	Very Dense	-	21	-	42.5
8	25.00	26.00	1.00	Silty Sand	Brownish Grey	>100	Very Dense	-	21	-	42.5
9	26.00	31.50	5.50	Shale	Grey	>100	Very Dense	-	22	400	-
10	31.50	32.50	1.00	Completely Weathered Rock	Grey	CRR 30% RQD 0%					

REFERENCE BORE HOLE-BH:				4	Ref R.L. of G.L. (m):			0.00			
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(g) kN/m ³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C _u) kPa	(I) Deg.
1	0.00	4.00	4.00	Filled up Soil	-	-	-	-	-	-	-
2	4.00	5.50	1.50	Silty Clay	Grey	17	-	Very Stiff	20	113	-
3	5.50	9.00	3.50	Silty Sand	Grey	18	Medium Dense	-	18	-	32.4
4	9.00	13.00	4.00	Clayey Silty Sand	Grey	42	Dense	-	20	-	39.2
5	13.00	16.00	3.00	Silty Sand	Grey	>100	Very Dense	-	21	-	42.5
6	16.00	23.00	7.00	Compacted Clay	Brownish Grey	54	Very Dense	-	20.5	-	41.6
7	23.00	25.00	2.00	Silty Sand	Grey	>100	Very Dense	-	21	-	42.5
8	25.00	29.00	4.00	Clayey Silty Sand	Grey	>100	Very Dense	-	21	-	42.5
9	29.00	30.00	1.00	Shale	Grey	CRR 30% RQD 0%					

REFERENCE BORE HOLE-BH:					5	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(s) kN/m ³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C _u) kPa	(I) Deg.
1	0.00	3.00	3.00	Filled up Soil	-	-	-	-	-	-	-
2	3.00	5.30	2.30	Silty Sand	Brown	18	Medium Dense	-	18	-	32.4
3	5.30	7.00	1.70	Silty Sand	Grey	9	Loose	-	14.5	-	29.8
4	7.00	14.50	7.50	Silty Sand	Grey	26	Medium Dense	-	19	-	34.8
5	14.50	19.00	4.50	Compacted Clay	Greenish Grey	61	Very Dense	-	21	-	42.5
6	19.00	25.60	6.60	Compacted Clay	Greyish Brown	>100	Very Dense	-	21	-	42.5
7	25.60	30.00	4.40	Shale	Grey	>100	Very Dense	-	22	400	-

FOUNDATION SYSTEM

4.0 Preamble:

In the design of foundation system, the stress-strain compatibility of the super structure, sub structure and the bearing strata should be satisfied both individually and as a combined system. In view of this, the following data are needed for the design of foundation system, defined in terms of the type of sub structure and the bearing strata characteristics.

- ξ The super structure characteristics along with the loading pattern on the sub structure
- ξ The sub soil characteristics that define the required substructure configuration for a safe transfer of super-structural loads to the bearing strata

Considering the above aspects of the foundation design, the suitable type of foundation system is presented below.

4.1 Proposed Structures

An understanding of the proposed construction and the order of loads on the foundations is needed for choosing the appropriate foundation system. In the present case, the proposed structure is configured with two basement floors and twenty two upper floors, and is meant for residential purpose. For this kind of structure, the column loads could vary between 6500 kN to 7500 kN.

The above mentioned loads have no bearing on the design of either sub or super structures and are mentioned just to provide an insight to choose an appropriate foundation system with respect to subsoil conditions.

4.2 Foundation System

The depth of two basement floor is informed to be about 7.0m with respect to the adjacent road level.

Hence, for the kind of proposed structure and the sub soil conditions, it is not possible to adopt any kind of open foundation system from both shear and settlement considerations. Hence, it is advisable to adopt deep pile foundation system.

The piles can be installed by drilling with direct mud circulation technique (**Bored Cast Insitu Piles**) and the recommended safe load carrying capacity of bored cast insitu piles in compression, tension and lateral for different diameters is worked out as per IS 2911-Part-I-Section-2 and are presented in Table 4.1.

Typical computations are presented in Annexure

**TABLE:- 4.1 RECOMMENDED SAFE LOAD CARRYING CAPACITIES OF BORED CAST-IN
SITU PILES**

Sl.No	Reference Bore hole No.	Length of Pile below Adjacent Road Level	Assumed Length of Cut-Off Below E.G.L	Length of Pile below Cut-off	Dia.of Pile in (mm)	SAFE LOAD CARRYING CAPACITY (kN)		
						Vertical Load Carrying Capacity	Pull Out Capacity	Lateral Load Carrying Capacity
1	BH-03	28.0	7.5	20.50	600	1800	900	60
2					650	2000	1000	70
3					750	2300	1200	90
4					800	2600	1300	95
5					900	3000	1500	120
6					1000	3500	1700	140

RECOMMENDATIONS

5.1 Recommendation for Deep pile foundation system

- ☞ For the kind of proposed structure and sub soil condition deep pile foundation is the suitable foundation to adopt. In the present case, **Bored Cast in situ piles** are recommended as the suitable foundation system.
- ☞ The allowable safe load carrying capacities of different diameters of piles as given in Table-4.1.can be adopted as provisional design loads, as the load carrying capacity of piles not only depends upon the sub soil properties, but also depends on the care and experience of installation of piles.
- ☞ The theoretical load carrying estimates of piles shall be confirmed by conducting pile loads tests as per the guide lines laid down in IS: 2911-Part-IV.
- ☞ The boring shall be carried out using direct mud circulation prepared out of sodium bentonite.
- ☞ After reaching the borehole termination depth, the borehole shall be cleaned using mud circulation for a minimum period of 30min or till the return mud is relatively clear of soil particles.
- ☞ After ensuring the borehole is clean, the tremie pipe shall be lowered and concreting can be done.

5.2 Construction method statement of pile foundation:

- ☞ The mud used shall be made out of sodium bentonite with minimum free swell index of more than 300% and liquid limit more than 100%. The silt content in bentonite shall not be more than 5%.
- ☞ The mud should be prepared using sodium bentonite with a density of 1.10 to 1.15 g/cc.

5.3 General Recommendation

- ☞ Since, chlorides and sulphates are well within the permissible limits, no special steel or cement is required for the construction.

AUTHORISED SIGNATORY



DR. C. V. PRASAD

GEO MARINE CONSULTANTS PRIVATE LIMITED



ESTIMATION OF SAFE LOAD CARRYING CAPACITY OF BORED CAST-IN-SITU PILES																	
Type of Pile			Bored		Diameter of Pile			Length of Pile below G.L. (m)			-28		As Per IS:2911-(P-I,S-2)-2010				
Reference Bore Hole			BH-03					600			Surcharge Pressure		0		kPa		
Layer No.	Layer Thk. (m)		Type of Strata	Ave. SPT	(γ) kN/m ³		Shear Parameters (C _u) kPa	Deg. of Layer	Effective Overburden Pressure (kPa)		Adhesion Factor (α)	Earth Pressure Coefficient (k)	Skin Friction (Q _s) kN				
	Top. R.L.	Bot. R.L.			Thickness	Ave. upto of Layer			Ave. upto of Layer	At top of Layer					At Bot. of Layer	At Mid. of Layer	
1	0.0	-7.5	7.5		17	18.0	18.0	-	32.1	0.0	24.0	12.0	-	1.1	qf	2	47.1
2	-7.5	-10.5	3.0														
3	-10.5	-17.0	6.5		31	19.5	18.8	-	36.3	24.0	85.8	54.9	-	1.3	qf	3	650.3
4	-17.0	-21.5	4.5		60	22.0	20.8	400	-	85.8	139.8	112.8	0.3	-	qf	4	882.2
5	-21.5	-23.5	2.0		60	20.5	21.3	-	42.5	139.8	160.8	150.3	-	1.5	qf	5	779.4
6	-23.5	-28.0	4.5		60	22.0	21.3	400	-	160.8	214.8	187.8	0.3	-	qf	6	882.2
Cut-Off Level																	
Summation of Positive Skin Resistance (kN) Q _s = 3241.05																	
Summation of Negative Skin Resistance (kN) -Q _s = 0.00																	
Computation of End Bearing Resistance																	
Bearing Stratum		Shale		SPT	φ	C _u	N _q	N _c	Eff.Ht.of Overburden		9	m					
				100	-	600	-	9	Effective Overburden Pressure		101.25	kN/m ²					
End Bearing Resistance (kN) Q _p = 1526.81																	
Ultimate Load Carrying Capacity (Q _{ult}) Q _u =Q _s +Q _p (kN) 4767.86																	
Safe Load Carrying Capacity (Q _{safe}) Q _s /2.5 (kN) 1907.15																	
Allowable Safe Load Carrying Capacity Q _{A-safe} (kN) 1907.15																	
Allowable Safe Pull out Capacity Q _{A-pull} : Qf/3 (kN) 1080.35																	
Skin Resistance in Clay Layer is π*d'*T ₁ *C _u *α																	
Skin Resistance in Sand Layer is π*d'*T ₁ *q _s *K*Tan(φ)																	
End Bearing Resistance in Clay Layer is π*d' ² /4*C _u *N _c																	
End Bearing Resistance in Sand Layer is π*d' ² /4*Q _s *N _q																	
Where																	
C _u =Undrained Shear Strength of Clay																	
φ=Angle of Shearing Resistance																	
N _c =Bearing Capacity Factor = 9																	
Q _s (kN) Effective Overburden Pressure at pile tip=Effective height of overburden X (γ*10)																	
K=Coef. Earth Pressure at Rest																	
q _s =Effective Overburden Pressure at middle of Layer																	
N _c =Bearing Capacity Factor, Ref. Fig.1 of IS: Code Referred above																	
Q _s (kN) Effective Overburden Pressure at pile tip=Effective height of overburden X (γ*10)																	
d=Dia. Of Pile																	
α=Adhesion Factor																	
T ₁ =Thickness of Layer																	

LATERAL LOAD CARRYING CAPACITY OF BORED CAST- SITU PILES

Reference Bore Hole : BH-03

1 Geometrical Data

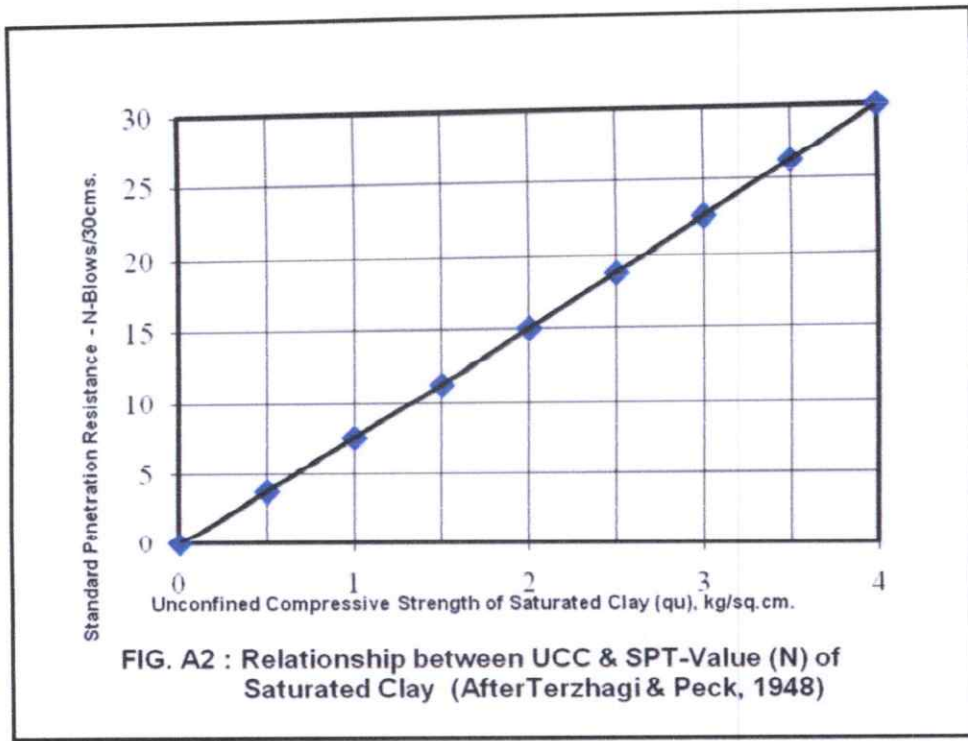
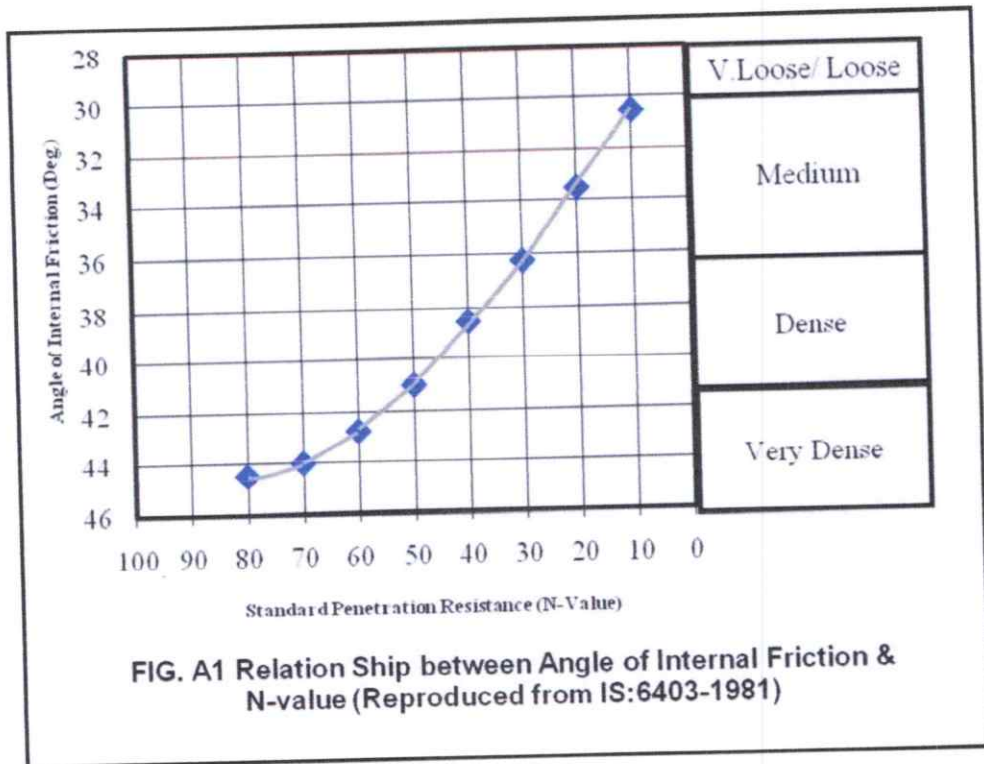
Type of Pile Head Considered	Fixed	
Diameter of Pile (d)	0.60	m
Free standing Length of Pile (e)	0	m
Length of Pile below Adjacent Road Level (Le)	28.0	m
Cut-Off Level From E.G.L	7.5	
Length of Pile below Cut-Off Level (Le)	20.5	m
Grade of Concrete (M)	25	MN/m ²
Young's Modulus of Concrete (E)	25000000	kN/m ²
Moment of Inertia (I)	0.006362	m ⁴

2 Determination of Depth of Fixity

Type of Soil Strata	Sand	
Ground Water Condition	Submerged	
Design SPT "N" Value	14	
$T = (EI/nh)^{1/5}$		
(n can be read as h in the above and below equation in case of Sand)		
nh=	1976	kN/m ³
In Case of Sand	-	kN/m ⁴
T=	2.41	m
L ₁ /T	0.00	
L _f /T	2.20	
Depth of Fixity below Cut off (z _f)	5.29	m

3 Determination of Lateral Load and Moment Carrying Capacity for 0.005 m Lateral Deflection:

Allowable Lateral Deflection (Y)	0.005	m
Lateral Load Carrying Capacity (H) = $Y \cdot 12EI / (e + z_f)^3$	64.41	kN
Recommended Design Lateral Load carrying Capacity	64	kN
Fixed End Moment, $M_F = H(e + z_f) / 2$	170	
Reduction Factor (L ₁ /T)	0.83	m
Actual Moment (Fixed End Moment/Reduction Factor), M_F	141	kN-m



Remedies! water leak due to building materials not properly maintaining & drilling.
Pitfall - no shoring. Smaller air conditioner unit fill - 1 inch water level 1.50 mto.

GEO MARINE THE SPIRIT OF ENGINEERING		SITE INVESTIGATION RECORD						BORE HOLE No. 02						
PROJECT NAME		LOCATION						PAGE No. 01						
STRUCTURE		MACHINE No.		CHAINAGE (m)		BORE START DATE		DIA OF BORE HOLE						
JOB CODE		DRILLING METHOD		CO-ORDINATES		BORE END DATE		150mm 100mm						
FLUSHING MEDIUM		Rotary		N		TOTAL DRILLING DAYS		5						
Bentonite		E												
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details			Layer Data		
	Date	Time		Total Core Recovery %	R.Q.D. %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	Depth (m)	Geotechnical Description
						0-15	15-30	30-45						
1	10-01-2020					3	5	8	13	1.00	01	DS		Filled up Soil Building materials & clayey soil
2						4	3	3	6	2.00	2	SS		
3										3.00	3	DS		
4						9	8	9	17	4.00	4	SS		
5						8	11	13	24	5.00	5	SS		
6	10-01-2020	9:31 9:33	Soil Cutter			3	7	16	23	6.00	6	SS		Brownish Grey M. Dense fine Sand with clay packets
7		9:58 10:00				25	24	22	46	7.00	7	DS		Greyish Brown Dense M. coarse to fine Sand
8		10:20 10:22				15	24	29	53	8.00	8	SS		- Do -
9		10:41 10:43				20	14	19	33	9.00	9	SS		Brownish Dense fine to M. coarse Sand
10		11:06 11:08				7	5	5	10	10.00	10	SS		Bluish Grey stiff silty clay with sand packets
CS - Core Sample		DS - Disturbed Sample		SUPERVISOR NAME		15' Loganathan		PROJECT SITE DETAILS						
SS - Split Spoon Sample		SC - Soil Cutter		SIGNATURE		15' Loganathan		GROUND LEVEL (m)						
UDS - Undisturbed Sample		TCB - Tungsten Carbide Bit		DATE		11/01/2020		WATER TABLE (m)						
WS - Wash Sample		DB - Diamond Bit		CLIENT IN-CHARGE				CASING DEPTH (m)						

SITE INVESTIGATION RECORD

BORE HOLE No. **02**
PAGE No. **02**
DIA OF BORE HOLE 150mm **✓**
100mm
BORE START DATE **10/01/2020**
BORE END DATE **20/01/2020**
TOTAL DRILLING DAYS **5**

PROJECT NAME **TNMB - Arumbakkam - Chennai**
LOCATION
MACHINE No.
CHAINAGE (m)
DRILLING METHOD Rotary
CO-ORDINATES N
E
FLUSHING MEDIUM Bentonite

Depth below E.G.L. (m)	Drilling progress per metre			Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details				Sample Details			Layer Data			
	Date	Time			Total Core Recovery %	R.C.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	Depth (m)	Geotechnical Description		
		Hr.	Min				0-15	15-30	30-45								
1		11 36 11 39															
2				SC													Greyish loose clayey Sand
3		12 17 12 19		SC													Greyish M. Dense Cemented Sand
4		1 45 1 47		SC													Greyish Dense Cemented Sand
5		2 30 2 32		SC													Greenish Grey Dense Cemented Sand.
6		4 02 4 04		SC													Greyish very Dense Silty fine sand (Sa
7				SC													Brownish Grey very Hard Compacted Clay
8																	
9																	
10																	

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	PROJECT SITE DETAILS
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE	GROUND LEVEL (m)
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	WATER TABLE (m)
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE	CASING DEPTH (m)

GEO MARINE THE SPIRIT OF ENGINEERING										SITE INVESTIGATION RECORD										BORE HOLE No. 02		PAGE No. 03	
PROJECT NAME: TNHB - Arumbakkam										LOCATION: Arumbakkam		MACHINE No. YELLOW HD		CHAINAGE (m)		DIA OF BORE HOLE: 150mm / 100mm		BORE START DATE: 10/01/2020		BORE END DATE: 20/01/2020		TOTAL DRILLING DAYS: 5	
STRUCTURE: TNHB COMMERCIAL										DRILLING METHOD: Rotary		CO-ORDINATES: N, E		FLUSHING MEDIUM: Bentonite									
JOB CODE										Core Details		SPT Details		Sample Details		Layer Data							
Drilling progress per metre										Type of Drill Bit (SC / TCB / DB)		Blows/cm.		SPT 'N' Value		Depth (m)		Geotechnical Description					
Date										Total Core Recovery %		0-15, 15-30, 30-45		Depth		No.		Type					
Hr. Min										R.C.D. %													
12/01/2020										SC		15 23 34 57		21.00		17		SS		Greyish Brown v. Hard Compacted clay			
0 06																							
13/01/2020										SC		15cm / 60 blows Hammer taken N x 100		23.00		18		SS		Greyish Brown Very Dense ss / ly fine sand			
0 8																							
14/01/2020										SC		23 57 58 110cm N x 100		25.00		19		SS		- Do -			
15 45																							
16/01/2020										SC		40 to 80cm 710cm 45 blows SPT taken N x 100		27.00		20		SS		Hard, Brownish Greenish, colour compacted clay Hard (SHALE YOUNGER STAGE)			
17 00																							
18 00																							
19 00																							
20 00																							
21 00																							
22 00																							
23 00																							
24 00																							
25 00																							
26 00																							
27 00																							
28 00																							
29 00																							
30 00																							

This bore hole for investigation soil investigation has been terminated at the depth of 27mbs due to water level continuously occurring

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	MURALI KRISHNAN	PROJECT SITE DETAILS
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE	K. Prasad	GROUND LEVEL (m)
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	20.01.2020	WATER TABLE (m)
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)

GEOMARINE THE SPIRIT OF ENGINEERING		SITE INVESTIGATION RECORD						BORE HOLE No.		BH-03					
								PAGE No.		01					
PROJECT NAME		TNHB - Arumbakkam, Chennai						DIA OF BORE HOLE		150mm ✓ 100mm					
LOCATION		Arumbakkam		MACHINE No.			CHAINAGE (m)			BORE START DATE		22-01-2020			
STRUCTURE				DRILLING METHOD		Rotary		N		BORE END DATE		28-01-2020			
JOB CODE				FLUSHING MEDIUM		Bentonite		CO-ORDINATES		E		TOTAL DRILLING DAYS		6	
Depth below E.G.L. (m)	Drilling progress per metre			Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details			Layer Data		
	Date	Time			Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	Depth (m)	Geotechnical Description
		Hr.	Min				0-15	15-30	30-45						
1		10	45	↓ SC										Filled up Rubrics concrete material (om Depth. to 2.50mts)	
2															
3		11	15				2	5	2	7	3.00	1	SS	Blackish loose, Sandy clay	
4		12	15				3	3	4	7	4.0	2	SS	Blackish m. stiff clay	
5	22/01/2020	12	27												
5		14	07				5	12	14	26	5.0	3	SS	Blackish to greyish color m. stiff clay to m. dense silty fine sand.	
5		14	30												
6		14	57												
6		15	00	↓			5	6	8	14	6.0	4	SS	BLACKISH GREY COLORED M. DENSE, FINE TO MEDIUM GRAINS SILTY SAND	
7		15	19	to SC											
7		15	21				5	4	6	10	7.0	5	SS	LOOSE, COMPACTED CLAYEY SILTY SAND.	
8		15	42	SC											
8		15	47				7	12	8	20	8	6	SS	(FINE TO MEDIUM GRAINS) SPT SAMPLE SLIPPED IN BORE HOLE.	
9		16	14	SC											
9		16	16				12	15	19	34	9	7	(SS)	GREENISH COLOURED MEDIUM TO FINE SILTY SAND	
10	23/01/2020	10	45	SC											
10		10	47				13	15	15	30	10	8	(SS)	GREENISH, M. DENSE, TO DENSE CEMENTED SAND FINE TO MEDIUM GRAINS	

M. Venugopal Sir
 R. Mohan Kumar
 22/01/2020

CS - Core Sample		DS - Disturbed Sample		SUPERVISOR NAME		PROJECT SITE DETAILS	
SS - Split Spoon Sample		SC - Soil Cutter		SIGNATURE		GROUND LEVEL (m)	
UDS - Undisturbed Sample		TCB - Tungsten Carbide Bit		DATE		WATER TABLE (m)	
WS - Wash Sample		DB - Diamond Bit		CLIENT IN-CHARGE		CASING DEPTH (m)	

GEOMARINE THE SPIRIT OF ENGINEERING										SITE INVESTIGATION RECORD										BORE HOLE No. BH-03	
PROJECT NAME TNHB - Arumbakkam										PAGE No. 02		DIA OF BORE HOLE 150mm ✓									
LOCATION ARUMBAKKAM		MACHINE No. HD-2		CHAINAGE (m)		BORE START DATE 22-01-2020		BORE END DATE 28-01-2020		TOTAL DRILLING DAYS 6											
STRUCTURE		DRILLING METHOD Rotary		CO-ORDINATES N		BORE END DATE 28-01-2020		TOTAL DRILLING DAYS 6													
JOB CODE		FLUSHING MEDIUM Bentonite		CO-ORDINATES E																	
Depth below E.G.L (m)	Drilling progress per metre			Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details			Layer Data								
	Date	Time			Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	Depth (m)	Geotechnical Description						
		Hr.	Min				0-15	15-30	30-45												
1	23-01-2020	11	40	SC			11	14	19	33	11.50	9	SS		DENSE, GREENISH GREY, SILTY SAND (COMPACTED) FINE TO MEDIUM GRAINS						
2		11	50	SC																	
3	23-01-2020	12	16				15	17	17	34	13.0	10	SS		DENSE, GREENISH & GREY (N. FINE GRAINS OF SILTY SOILS) & SILTY SAND						
4		12	20	SC																	
5	24/01/2020	10	16	SC																	
6		10	30	SC																	
7	24/01/2020	14	40				33	57	100	700	14.5	11	SS		LAYER CHANGE L/C HARD, GREENISH & BROWN COMPACTED CLAY. (SHALE) HARD CLAY						
8		14	47	SC																	
9	24/01/2020	14	55				15	20	29	49	16.0	12	SS		HARD, GREENISH BROWN (COMPACTED CLAY SHALE) HARD SHALE						
10		14	30	SC																	
11	25/01/2020	16	05	SC			14	44	46	9.0	17.5	13	SS		LAYER CHANGE - HARD BROWN, GREENISH COLOR COMPACTED HARD CLAY (SHALE) WITH VERY FINE SILTY SAND						
12		11	05	SC																	
13	25/01/2020	11	28				37	55	100	510	19.0	14	SS		HARD & V. DENSE. COMPACTED CLAY (SHALE) LOOK LIKE VERY VERY FINE SILTY SAND						
14		11	30	SC																	
15	11	50	SC																		

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	MURAL KRISHNAN	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE	R. Murali	GROUND LEVEL (m)	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	25/01/2020	WATER TABLE (m)	4.5
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	

GEOMARINE THE SPIRIT OF ENGINEERING		SITE INVESTIGATION RECORD				BORE HOLE No. BH-02					
PROJECT NAME		MACHINE No.		CHAINAGE (m)		PAGE No. 03					
LOCATION		DRILLING METHOD		CO-ORDINATES		DIA OF BORE HOLE					
STRUCTURE		FLUSHING MEDIUM		N		150mm					
JOB CODE		Bentonite		E		100mm					
						BORE START DATE 22-01-2020					
						BORE END DATE 28-01-2020					
						TOTAL DRILLING DAYS 6					
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details		Sample Details		Layer Data	
	Date	Time		Total Core Recovery %	R.Q.D. %	Blows/cm	SPT 'N' Value	Depth	No.	Type	Geotechnical Description
1	25/01/2020	Tattal Drilling Time Hammer 1 1/2 Hr	SC	21 35	100%	10cm 55 blows	21-0	15	(SS)	HARD, BROWNISH GREEN COMPACTED SILTY CLAY	
2			SC	23 40	100%	10cm 55 blows	23-0	16	(SS)	HARD, GREYISH GREEN COMPACTED SILTY CLAY	
3	09 55 to 10 30		SC	9cm 55 blows	70%	10cm 55 blows	25-0	17	(SS)	V-DENSE, BROWNISH & GREY, COARSE SAND. MEDIUM TO COARSE GRAINS L/C 26m	
4	11 18 to 12 40		SC	3cm 55 blows	70%	10cm 55 blows	27-0	18	(SS)	V-HARD, SHALE, DARK GRAY, (COMPACTED SILTY CLAY ROCK) SPT SAMPLE BLENDER (WS) only	
5	14 45 to 15 40		DB	SPT Hammer Rebound, 700	0%	10cm 55 blows	28-0	19	(SS)	do	
6	15 25 to 16 35		DB	SPT Hammer Rebound, 700	0%	10cm 55 blows	29-0	20	(SS)	V-HARD, SHALE ROCK Dark Grayish.	
7	10 20 to 12 10		TC	30% 0%	0%	10cm 55 blows	30-0	21	(SS)	V-HARD, SILTY COMPACTED CLAY SHALE ROCK, GRAY, SEDIMENTARY ROCK ORIGIN	

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	MURALI KRISHNAN-E	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE	R. Murugesan	GROUND LEVEL (m)	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	28/01/2020	WATER TABLE (m)	4.5
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	

GEO MARINE THE SPIRIT OF ENGINEERING						SITE INVESTIGATION RECORD								BORE HOLE No.		04.	
														PAGE No.		01	
PROJECT NAME						TNHB - ARUMBAKKAM,								DIA OF BORE HOLE		150mm	
LOCATION						MACHINE No.		HD-2		CHAINAGE (m)				BORE START DATE		28-01-2020	
STRUCTURE						DRILLING METHOD		Rotary		CO-ORDINATES		N		BORE END DATE		31-01-2020	
JOB CODE						FLUSHING MEDIUM		Bentonite		E		TOTAL DRILLING DAYS		4			
Depth below G.L. (m)		Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)		Core Details		SPT Details				Sample Details			Layer Data		
Date		Time		Total Core Recovery %		R.Q.D %		Blows/cm.				SPT 'N' Value			Geotechnical Description		
Hr.		Min						0-15 15-30 30-45				Depth No. Type			Depth (m)		
28-01-2020		16 04		Se				Concrete & Filled up Rubbles				1.0			NIL		
29-01-2020		16 15		Se				Concrete & Filled up Rubbles				2.0			NIL		
		16 24		Se													
		16 33		Se													
		16 40		Se													
		16 58		Se													
		10 15		Se				17 18 20 38				3.0 1 (SS)			GREYISH YELLOW, DENSE, SILTY SAND		
		10 25		Se				5 7 8 15				4.0 2 (SS)			MEDIUM TO COARSE GRANULAR GRAVEL WITH FILLED UP SOIL COVERED		
		10 56		Se											STIFF, SILTY CLAY, DARK BLACK COLOUR, WET.		
		11 00		Se				6 8 10 18				5.0 3 SS			STIFF, SILTY CLAY, DARK BLACK COLOUR, SILTY SANDY CLAY LAYER CHANGES		
		11 27		Se													
		11 30		Se													
		11 52		Se				8 11 11 22				6.0 4 SS			M-DENSE TO DENSE SILTY SAND		
		11 55		Se													
		12 04		Se				6 10 8 18				7.0 5 SS			M-DENSE, SILTY SAND		
		12 27		Se													
		12 46		Se				3 6 9 15				8.0 6 SS			M-DENSE, GREENISH GREY, CLAYEY SILTY SAND FINE TO MEDIUM GRAINS		
		12 48		Se													
		13 49		Se				10 14 17 31				9.0 7 SS			DENSE, GREYISH GREEN CLAYEY SILTY SAND		
		14 00		Se													
								12 21 25 46				10.0 8 SS			DENSE, GREYISH GREEN, CLAYEY SILTY SAND		

GEOMARINE THE SPIRIT OF ENGINEERING		SITE INVESTIGATION RECORD										BORE HOLE No. 04	
PROJECT NAME		TNH3- ARUMBAKKAM										PAGE No. 02	
LOCATION		MACHINE No.		CHAINAGE (m)		BORE START DATE		BORE END DATE		TOTAL DRILLING DAYS			
ARUMBAKKAM		HD-2				28-01-2020		31-01-2020		4			
STRUCTURE		DRILLING METHOD		CO-ORDINATES		BORE END DATE		BORE END DATE		TOTAL DRILLING DAYS			
		Rotary		N		31-01-2020		31-01-2020		4			
JOB CODE		FLUSHING MEDIUM		Bentonite		E		E		4			
Depth below E.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details			Layer Data	
	Date	Time		Total Core Recovery %	R.Q.D %	Blows/cm			Depth	No.	Type	Depth (m)	Geotechnical Description
						0-15	15-30	30-45					
1	29-01-2020	14 18											
2		16 25	Sc			19	24	25	49	11.50	9	SS	DARK DENSE, GREENISH COLOUR GREY, SILTY VERY FINE GRAINS SAND
3		15 10											
4		15 30	Sc										
5		16 25	Sc			34	40	12cm	10	130	12	SS	DENSE, DARK GREEN GREY SILTY VERY FINE TO MEDIUM SAND
6		16 40	Sc			45	50	10cm	7	14.50	18	SS	DENSE, DARK GREEN & GREY SILTY SAND FINE TO MEDIUM COARSE GRAINS
7		10 19	Sc			19	20	24	44	16.0	12	SS	V. HARD, GREY BROWNISH RED COMPACTED SILTY CLAY (SHALE)
8		10 55	Sc			12	21	25	46	17.5	13	SS	V. HARD, GREY, BROWNISH RED, COMPACTED SILTY CLAY (SHALE)
9		12 12	Sc			21	28	39	67	17.0	14	SS	V. HARD & V. DENSE, DARK BROWNISH GREY WITH SILTY CLAYEY SAND, (CEMENTED SAND)
10		12 50	Sc										
11		13 05	Sc										
12		13 24	Sc										
13		13 50	Sc										
14		14 18	Sc										
15		14 48	Sc										
16		15 14	Sc										
17		15 35	Sc										

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	MURALI KRISHNAN K	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE	K. Murugan	GROUND LEVEL (m)	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	30-01-2020	WATER TABLE (m)	4.5m
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	

[illegible]

GEO MARINE THE SPIRIT OF ENGINEERING		SITE INVESTIGATION RECORD						BORE HOLE No. BH-5							
PROJECT NAME TNHB - ARUMBAKKAM.		PAGE No. 2						DIA OF BORE HOLE 150mm ☒ 100mm ☐							
LOCATION ARUMBAKKAM BWS		MACHINE No. H.D-2		CHAINAGE (m)		BORE START DATE 03-02-2020		BORE END DATE 06/02-2020							
STRUCTURE		DRILLING METHOD Rotary		CO-ORDINATES N		TOTAL DRILLING DAYS 4									
JOB CODE		FLUSHING MEDIUM Bentonite		CO-ORDINATES E											
Depth below E.G.L. (m)	Drilling progress per metre			Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details			Layer Data		
	Date	Time			Total Core Recovery %	R.Q.D %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	Depth (m)	Geotechnical Description
		Hr.	Min				0-15	15-30	30-45						
1	04/02/2020	11	32												
2		11	37	8c											
3		12	08												
4		to		SC											
5		12	14												
6		13	48	SC											
7		14	05												
8		14	22	SC											
9		to													
10		14	49												
11		15	09	SC											
12		to													
13		15	44												
14		16	10	SC											
15		to													
16		16	25												
17		16	05												
18		11	28												
19		11	56												
20		to													
21		12	30												
22															
23															
24															
25															
26															
27															
28															
29															
30															

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME MURUGAN K. R.	PROJECT SITE DETAILS
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE R. Murugan	GROUND LEVEL (m)
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE 05/02/2020	WATER TABLE (m)
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE	CASING DEPTH (m)

GEOMARINE THE SPIRIT OF ENGINEERING		SITE INVESTIGATION RECORD				BORE HOLE No. BH-5							
PROJECT NAME		TNRB - Arumakkam.				PAGE No. 03							
LOCATION		MACHINE No. H-2		CHAINAGE (m)		DIA OF BORE HOLE							
STRUCTURE		DRILLING METHOD		CO-ORDINATES		BORE START DATE							
JOB CODE		FLUSHING MEDIUM		CO-ORDINATES		BORE END DATE							
		Bentonite		E		TOTAL DRILLING DAYS							
						4							
Depth below L.G.L. (m)	Drilling progress per metre		Type of Drill Bit (SC / TCB / DB)	Core Details		SPT Details			Sample Details			Layer Data	
	Date	Time		Total Core Recovery %	R.Q.D. %	Blows/cm.			SPT 'N' Value	Depth	No.	Type	Geotechnical Description
						0-15	15-30	30-45					
1	12/02/2020	12:47				20	33	11cm	710	21.0	15	SS	V. HARD SILTY CLAY (on HARD CLAY, (SHALE)
2		13:15											
		14:05											
		14:23											
		14:50											
		15:28	SC										
3		15:50				21	35	8cm	710	23.0	16	SS	CLAYEY SILTY SAND
4		16:27	SC										23.40 mts L/C
5		16:54				23	7cm		3100	24.80 m	17	LC	SILTY SAND
6		17:30											VERY FINE SAND
7		10:12	TC	0% 0%									BROWNISH GREY
8		10:35											TO DENSE SILTY SAND
9		11:04											SPT SAMPLE SLIPPED
10		11:56											INTHE BORE HOLE
11		12:16											Hard Strata Starting at the
12		12:48											2.650 mts depth
13		14:08											V. Hard SHALE
14		14:35											COMPACTED HARD CLAY
													[SHALE ROCK pieces]
													GREY & BLUEISH GREY
													wee, COMPLETELY TO
													Highly WEATHERED
													(COMPACTED CLAY) SHALE
													Rock
													DO
CS - Core Sample		DS - Disturbed Sample		SUPERVISOR NAME		MURALE KRISHNAN/K		PROJECT SITE DETAILS					
SS - Split Spoon Sample		SC - Soil Cutter		SIGNATURE		R. Murakrishnan		GROUND LEVEL (m)					
UDS - Undisturbed Sample		TCB - Tungsten Carbide Bit		DATE		06/02/2020		WATER TABLE (m)					
WS - Wash Sample		DB - Diamond Bit		CLIENT IN-CHARGE				CASING DEPTH (m)					