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PROJECT

PROPOSED CONSTRUCTION OF RESIDENTIAL FLATS (DAC MARSHAL PROJECT) (STILT + 5 UPEER FLOORS) AT S.NO.25/1, 25/2, 25/3 & 25/4, I.A.F ROAD, SELAIYUR, CHENNAI.

CLIENT NAME

DAC DEVELOPERS PRIVATE LIMITED,
GROUND FLOOR DOOR NO.19, FLAT NO.A-1, K-BLOCK,
SHREYAS, 1ST MAIN ROAD, 1ST AVENUE,
ANNA NAGAR EAST,
CHENNAI – 600 102.

TITLE

GEOTECHNICAL INVESTIGATION REPORT

PROJECT NO: GEC-JC-GT-4010/2022-2023

REPORTING DATE: 17/05/2022

CONTENTS

	SEC. NO.	CONTENTS	PAGE NO.
			i-ii
CHAPTER-1		**INTRODUCTION**	
	1.0	Project Information Matrix	1
	1.1	Scope of Work	1
	1.1.1	Field Work	1
	1.1.2	Laboratory Work	1
	1.2	Structure of the Report	1
CHAPTER-2		**INVESTIGATION METHODOLOGY & TEST RESULTS**	
	2.0	Preamble	2
	2.1	Methodology of Field Work	2
	2.1.1	Equipment Used and Method of Drilling	2
	2.1.2	Standard Penetration Tests	2
	2.1.3	Collection of Soil Samples	2
	2.1.4	Collection of Ground Water Samples	2-3
	2.2	Laboratory Testing	3
	2.2.1	On Coarse Grained Soil	3
	2.2.2	On Fine Grained Soil	3
	2.2.3	Chemical Analysis Tests	3
	2.3	Summary	3
FIGURES	2.0	Site Plan showing the Location of Field Investigation Points	4
	2.1 to 2.5	Soil Profile	5-9
	2.6 to 2.10	Graphical Representation of grain size distribution curve	10-14
	2.11 to 2.15	Hydrometer Graph	15-19
TABLES	2.1 to 2.5	Laboratory Test Results	20-24
	2.6	Results of Chemical analysis	25
CHAPTER-3		**GEOLOGY & SUB-SURFACE STRATIFICATION**	
	3.0	Preamble	26
	3.1	Geology of region	26
	3.2	Design sub soil profile	26-28
CHAPTER-4		**FOUNDATION SYSTEM**	
	4.0	Preamble	29
	4.1	Proposed Structures	29
	4.2	Foundation System	29

FIGURE	4.1	Schematic diagrams for shallow foundation	30
CHAPTER-5		**RECOMMENDATION**	31
ANNEXURE		Typical bearing capacity computations for shallow foundations	32
	A1	Relationship Between Angle of Internal Friction & N-Value	33
	A2	Relationship Between UCC & SPT -Value (N) of Saturated Clay	33

REPORT TEXT

CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project	**:** Proposed Residential Flats (Stilt+5 Upper Floors)
Project Client	**: M/s DAC Developers Private Limited**
Project Location	**:** Selaiyur, Tambaram, Chennai .
Job Code	**:**JC-GT-4010

1.1 Scope Of Work

1.1.1 Field Work

- Conducting five soil investigation bore holes of 150 mm diameter or NX size diameter up to 5.0m depth or up to the refusal strata with SPT>100
- Conducting Standard Penetration Test (SPT) within the borehole at every 1.0m depth interval up to the 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's 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
- Geology &Sub-Surface Stratification
- Foundation System
- Recommendation
- Annexure

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

Five soil investigation borehole 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.2.6 to 2.10.

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 2.6. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig.2.11 to 2.15.

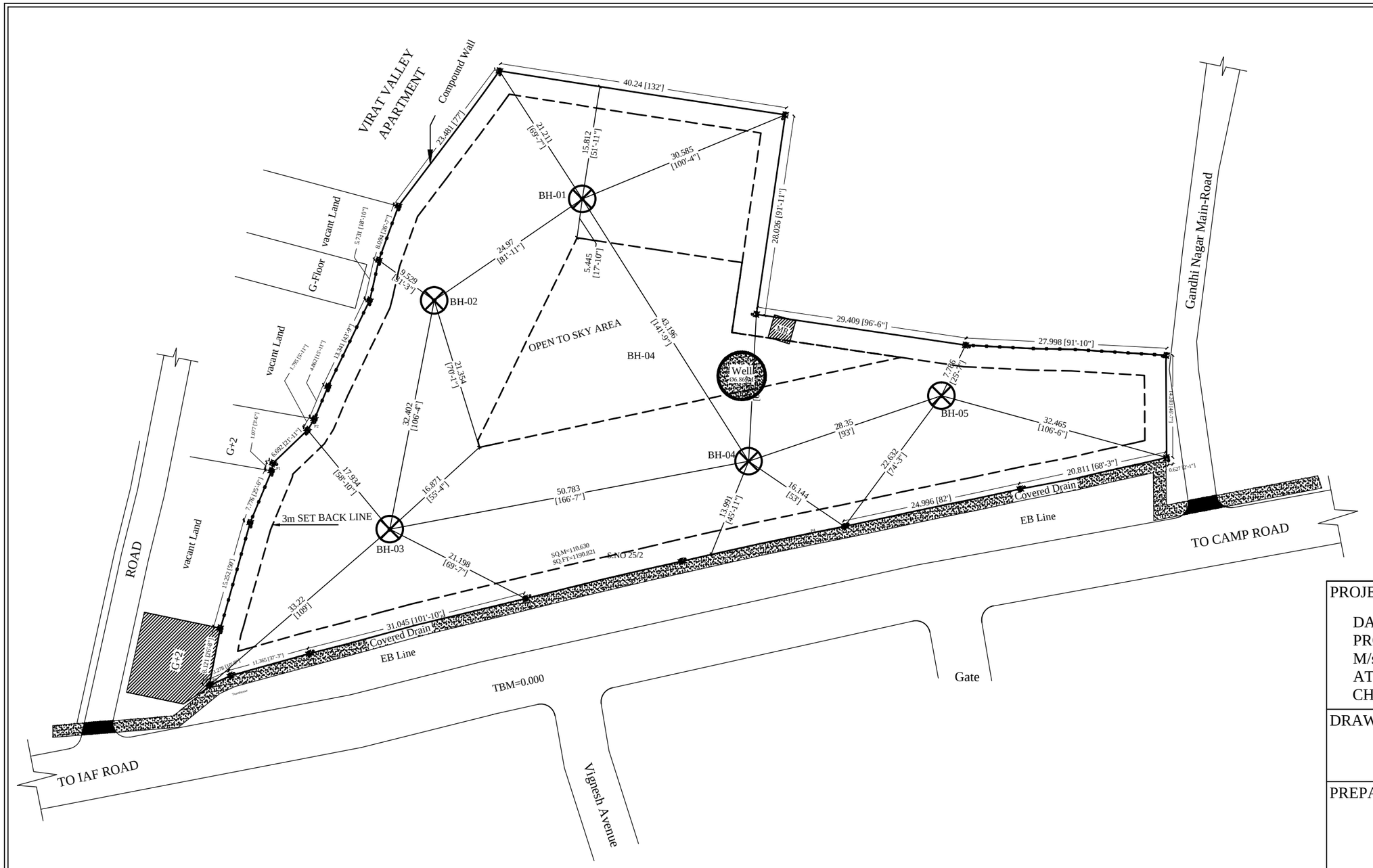
2.2.3 Chemical Analysis Tests

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.

SITE PLAN



NOTE:
TOTAL NO OF BORE HOLES: 5NO'S

PROJECT:

DAC MARSHAL
PROPOSED RESIDENTIAL FLATS FOR
M/s. DAC DEVELOPERS PVT LTD.
AT IAF - ROAD, EAST TAMBARAM
CHENNAI - 600073

DRAWING TITLE:

BORE HOLE LOCATION DRAWING

PREPARD BY:

G.GIRIJA
Structural Coordinator
(Emp Code:311)

SOIL PROFILE

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING			DIA OF BORE HOLE	150mm ✓		
					100mm ✓		
LOCATION	Selaiyur, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	07/05/2022
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	07/05/2022
JOB CODE	GEC-JC-GT- 4010	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
1	07/05/2022	10	50	SC	-	-												Brownish Grey, Moist,Loose, **Clayey Silty Sand(SC)** Sand-Clay mixtures
		To																
		10	53				4	3	3	**6**	1.00	1	SS	-1.0				
		11	03								1.45					L1	1.5	
		To		SC	-	-												
2		11	04				48	39	30	**69**	2.00	2	SS	-2.0				Brownish Grey, Moist, Very Dense **Completely Weathered Rock** (Descent from Charnockite)
		11	30								2.45							
		To		SC	-	-												
3		11	42				SPT Hammar Rebounded			**>100**	3.00	3	WS	-3.0		L2	3.0	
		11	52															
		To		DB	10	0												
4		12	20				-	-	-	**-**	4.00	4	CS	-4.0				Greyish Brown,**Moderately Weathered Rock** (Descent from Charnockite)
		12	30															
		To		DB	15	0												
		13	15															
5							-	-	-	**-**	5.00	5	CS	-5.0		L3	5.0	
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	Vinod Pradap	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	07/05/2022	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 2.70	
WS - Wash Sample	DB - Diamond Bit	DATE	17/05/2022	CASING DEPTH (m) 0.00	

Borehole terminated at 5 m depth below E.G.L

FIG.2.1 Sub Soil Profile at BH-01 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING			DIA OF BORE HOLE	150mm	✓	
					100mm		
LOCATION	Selaiyur, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	07/05/2022
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	08/05/2022
JOB CODE	GEC-JC-GT- 4010	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	2

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
1	07/05/2022	16	59	SC	-	-	5	6	6	12	1.00	1	SS	-1.0				Brownish Grey,Moist,Medium Dense, **Clayey Silty Sand(SC)** Sand-Clay mixtures
		To									1.45					L1	1.5	
		17	03															
		17	14	SC	-	-												
2		To					19	30	50	80	2.00	2	SS	-2.0				
		17	16								2.45							
		17	35	SC	-	-												Brown,Moist,Very Dense, **Completely Weathered Rock** (Descent from Charnockite)
		To																
3		17	37				13cm Pent.for 50 Blows			>100	3.00	3	SS	-3.0				
											3.13							
		09	05	SC	-	-												
	08/05/2022	To																
4		09	07				SPT Hammar Rebounded			>100	4.00	4	WS	-4.0		L2	4.0	
		09	27															Greyish Brown,**Moderately Weathered Rock** (Descent from Charnockite)
		To		DB	19	0												
		09	47															
5							-	-	-	-	5.00	5	CS	-5.0		L3	5.0	
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	Vinod Pradap	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	08/05/2022	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 2.70	
WS - Wash Sample	DB - Diamond Bit	DATE	17/05/2022	CASING DEPTH (m) 0.00	

Borehole terminated at 5 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	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING			DIA OF BORE HOLE	150mm	✓	
					100mm		
LOCATION	Selaiyur, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	09/05/2022
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	09/05/2022
JOB CODE	GEC-JC-GT- 4010	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
1	09/05/2022	14	08	SC	-	-												
		To																
		14	10															
		14	19								1.45							
		To		SC	-	-												
2		14	21				6	5	9	**14**	2.00	2	SS	-2.0				
		14	34								2.45					L1	2.5	
		35		SC	-	-												
3		14	37				13cm Pent.for 50 Blows			**>100**	3.00	3	SS	-3.0				
											3.13							
		14	49															Brown,Moist,Very Dense, **Completely Weathered Rock** (Descent from Charnockite)
		To		SC	-	-												
4		14	51				12cm Pent.for 50 Blows			**>100**	4.00	4	SS	-4.0				
		15	05								4.12							
		To		SC	-	-												
		15	06															
5							30	12 cm Pent.for 50 Blows		**>100**	5.00	5	SS	-5.0		L2	5.0	
											5.27							
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	Vinod Pradap	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	09/05/2022	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 2.70	
WS - Wash Sample	DB - Diamond Bit	DATE	17/05/2022	CASING DEPTH (m) 0.00	

Borehole terminated at 5 m depth below E.G.L

FIG.2.3 Sub Soil Profile at BH-03 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-04						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING			DIA OF BORE HOLE	150mm	✓	
					100mm		
LOCATION	Selaiyur, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	10/05/2022
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	10/05/2022
JOB CODE	GEC-JC-GT- 4010	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
1	10/05/2022	10	58	SC	-	-												
		To																
		11	00				3	3	4	7	1.00	1	SS	-1.0				Brownish Grey,Moist,Loose, **Clayey Silty Sand(SC)** Sand-Clay mixtures
		11	08								1.45					L1	1.5	
		To		SC	-	-												
2		11	10				5	7	19	26	2.00	2	SS	-2.0				Brownish Grey,Moist,Medium Dense, **Clayey Silty Sand/Residual Soil** (Descent from Charnockite)
		11	19								2.45					L2	2.5	
		To		SC	-	-												
3		11	20				32	32	9cm Pent.for 50 Blows	>100	3.00	3	SS	-3.0				Brownish Grey,Moist,Very Dense, **Completely Weathered Rock** (Descent from Charnockite)
		11	35								3.39							
		To		SC	-	-												
4		11	40				13cm Pent.for 50 Blows			>100	4.00	4	SS	-4.0		L3	4.1	
		11	55								4.13							Greyish Brown,**Moderately Weathered Rock** (Descent from Charnockite)
		To		DB	20	0												
5		12	22				-	-	-	-	5.00	5	CS	-5.0		L4	5.0	
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	Vinod Pradap	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	10/05/2022	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 2.70	
WS - Wash Sample	DB - Diamond Bit	DATE	17/05/2022	CASING DEPTH (m) 0.00	

Borehole terminated at 5 m depth below E.G.L

FIG.2.4 Sub Soil Profile at BH-04 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-05						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING			DIA OF BORE HOLE	150mm	✓	
					100mm		
LOCATION	Selaiyur, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	10/05/2022
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	10/05/2022
JOB CODE	GEC-JC-GT- 4010	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
1	10/05/2022	14	04	SC	-	-												
		To																
		14	05				3	5	7	12	1.00	1	SS	-1.0				Brownish Grey,Moist,Medium Dense, **Clayey Silty Sand(SC)** Sand-Clay mixtures
		14	19								1.45							
2		To		SC	-	-			11cm Pent.for 50 Blows									
		14	20				8	41		>100	2.00	2	SS	-2.0		L1	2.0	
		14	33								2.41							
		To		SC	-	-												
3		14	35				9cm Pent.for 50 Blows			>100	3.00	3	SS	-3.0				Greyish Brown,Moist,Very Dense, **Completely Weathered Rock** (Descent from Charnockite)
		14	49								3.09							
		To		SC	-	-												
4		14	56				SPT Hammar Rebounded			>100	4.00	4	WS	-4.0		L2	4.0	
		15	11															Greyish Black,**Moderately Weathered Rock** (Descent from Charnockite)
		To		DB	26	0												
5		15	47				-	-	-	-	5.00	5	CS	-5.0		L3	5.0	
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	Vinod Pradap	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	10/05/2022	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 2.70	
WS - Wash Sample	DB - Diamond Bit	DATE	17/05/2022	CASING DEPTH (m) 0.00	

Borehole terminated at 5 m depth below E.G.L

FIG.2.5 Sub Soil Profile at BH-05 Location

Grain Size Distribution Curves

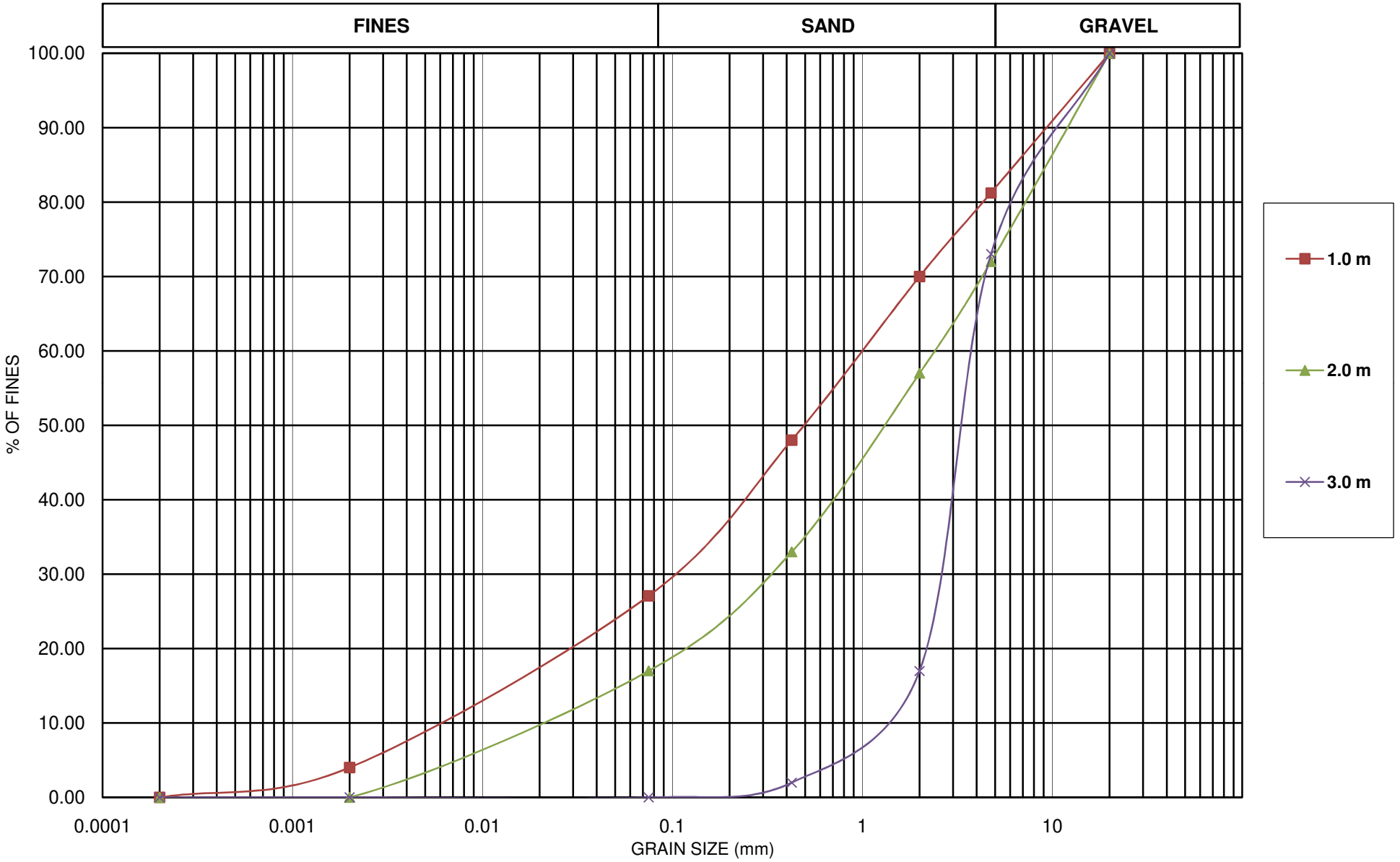


Fig. 2.6 GRAIN SIZE DISTRIBUTION CURVE - BH-01

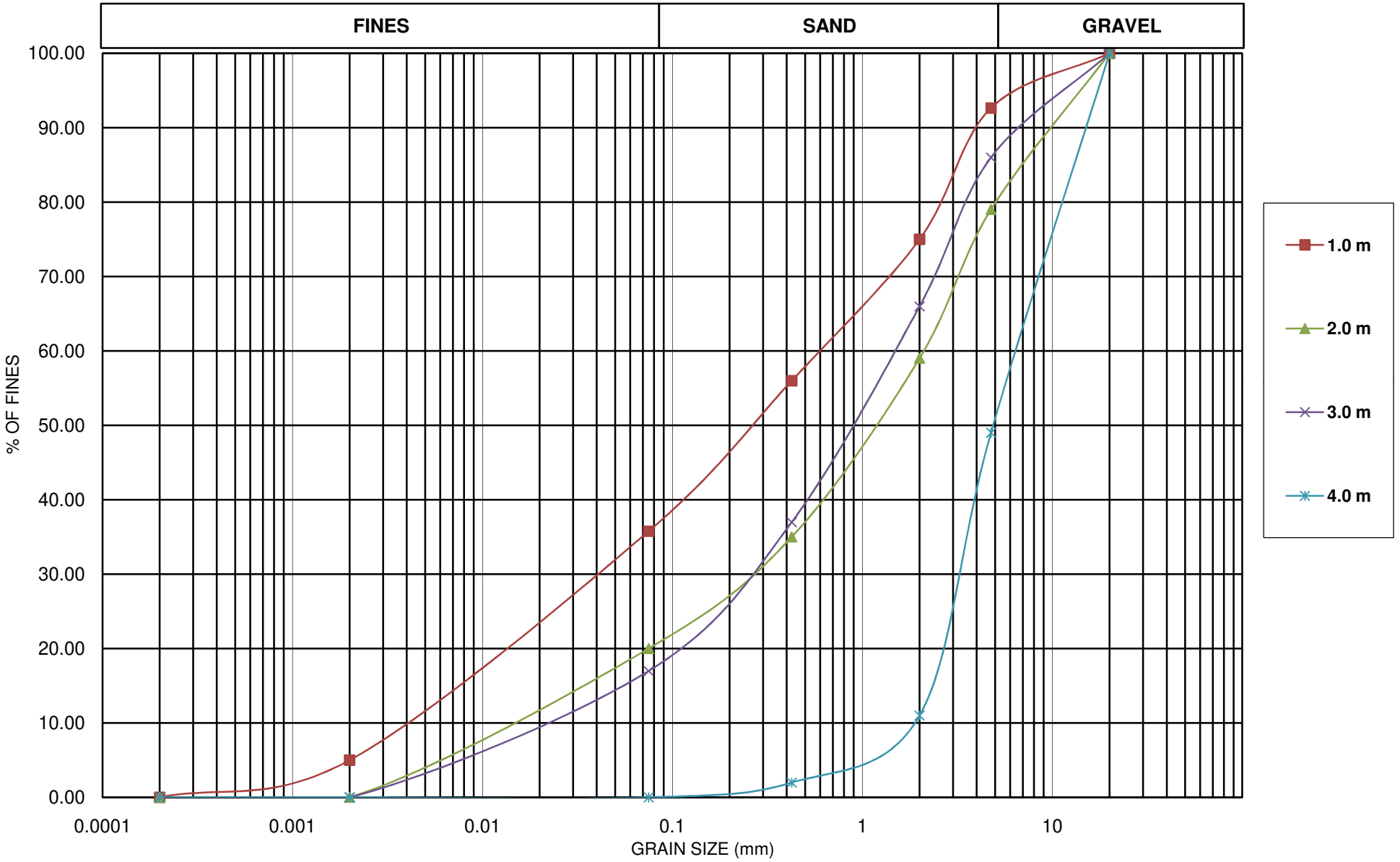


Fig. 2.7 GRAIN SIZE DISTRIBUTION CURVE - BH-02

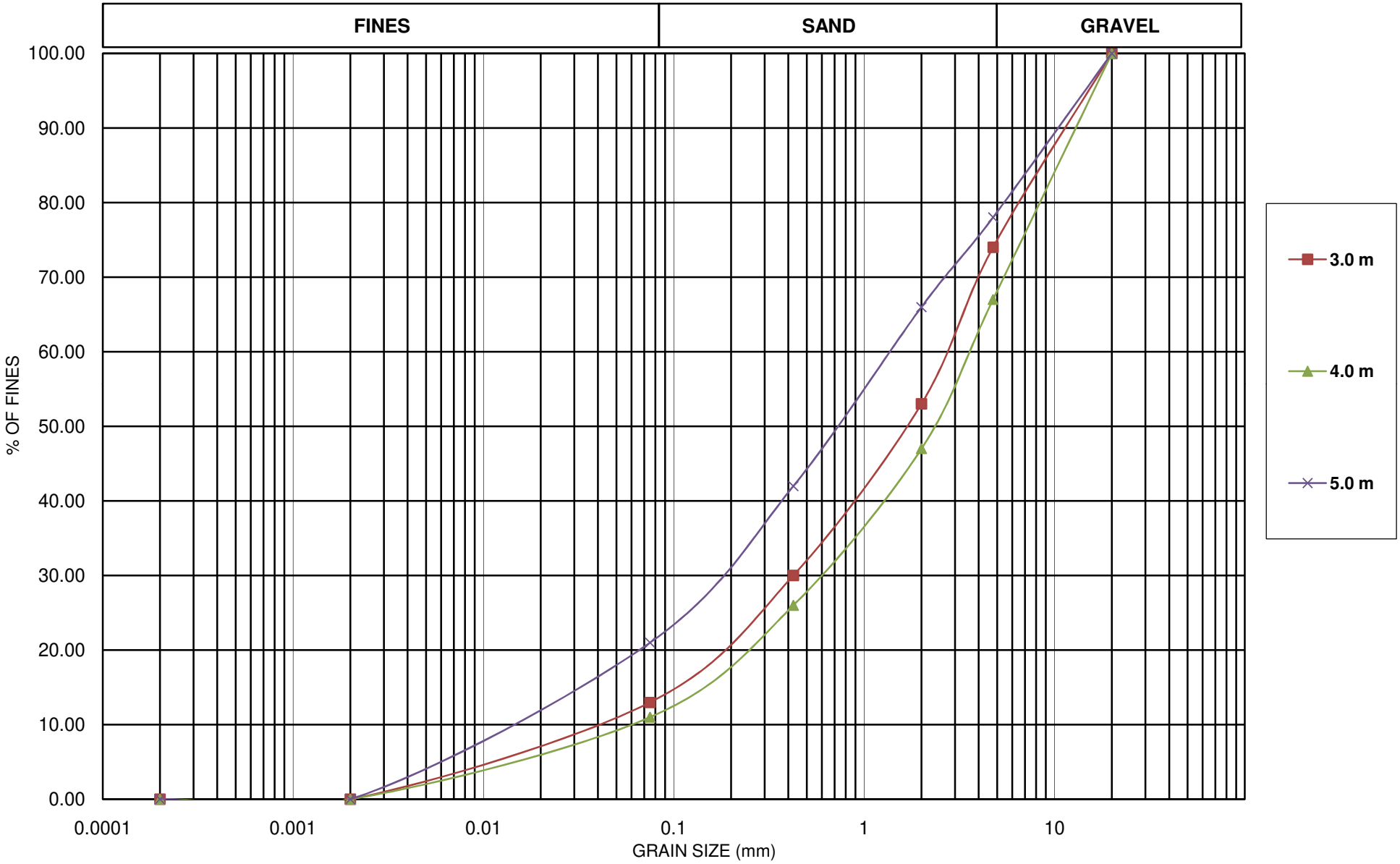


Fig. 2.8 GRAIN SIZE DISTRIBUTION CURVE - BH-03

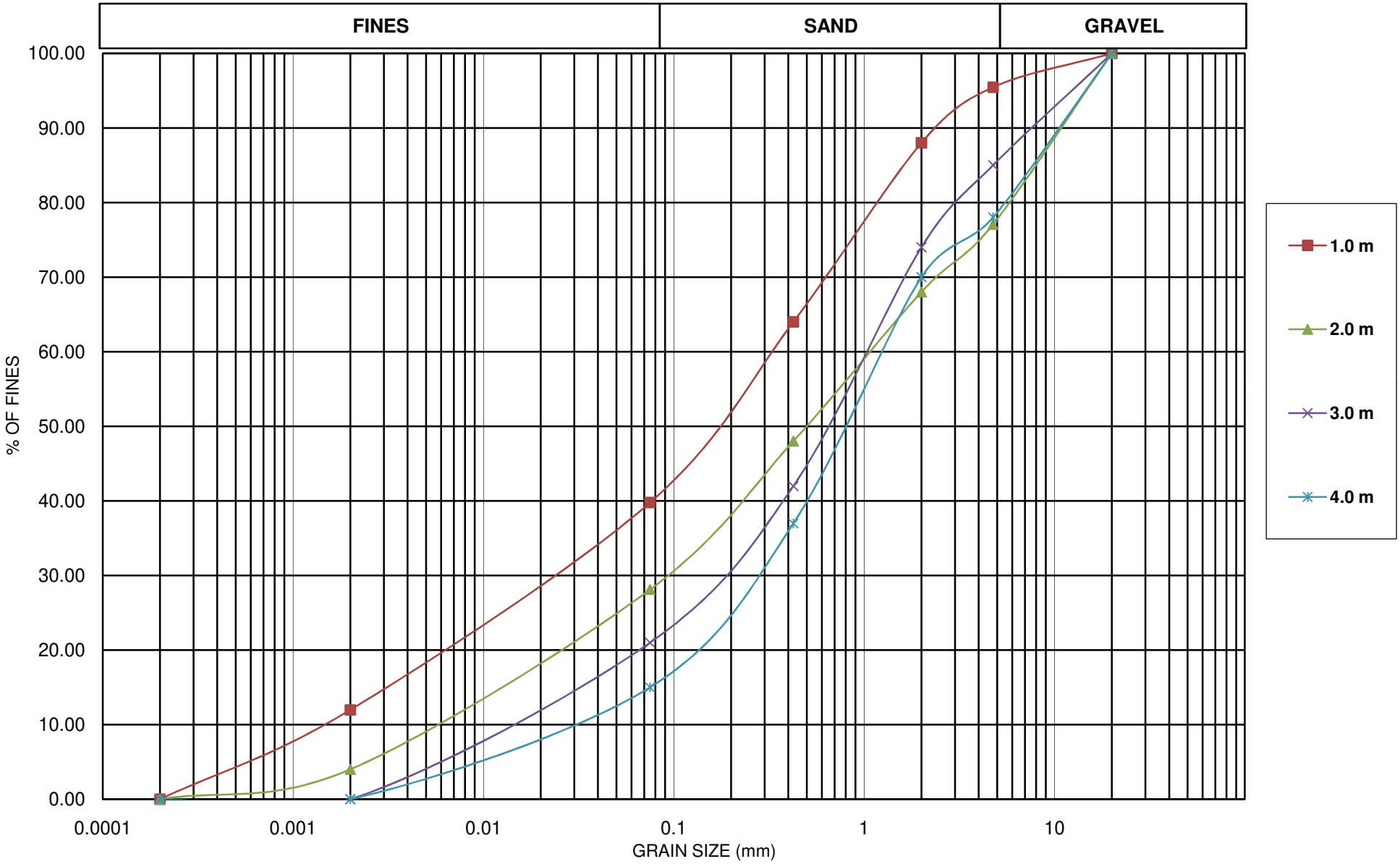


Fig. 2.9 GRAIN SIZE DISTRIBUTION CURVE - BH-04

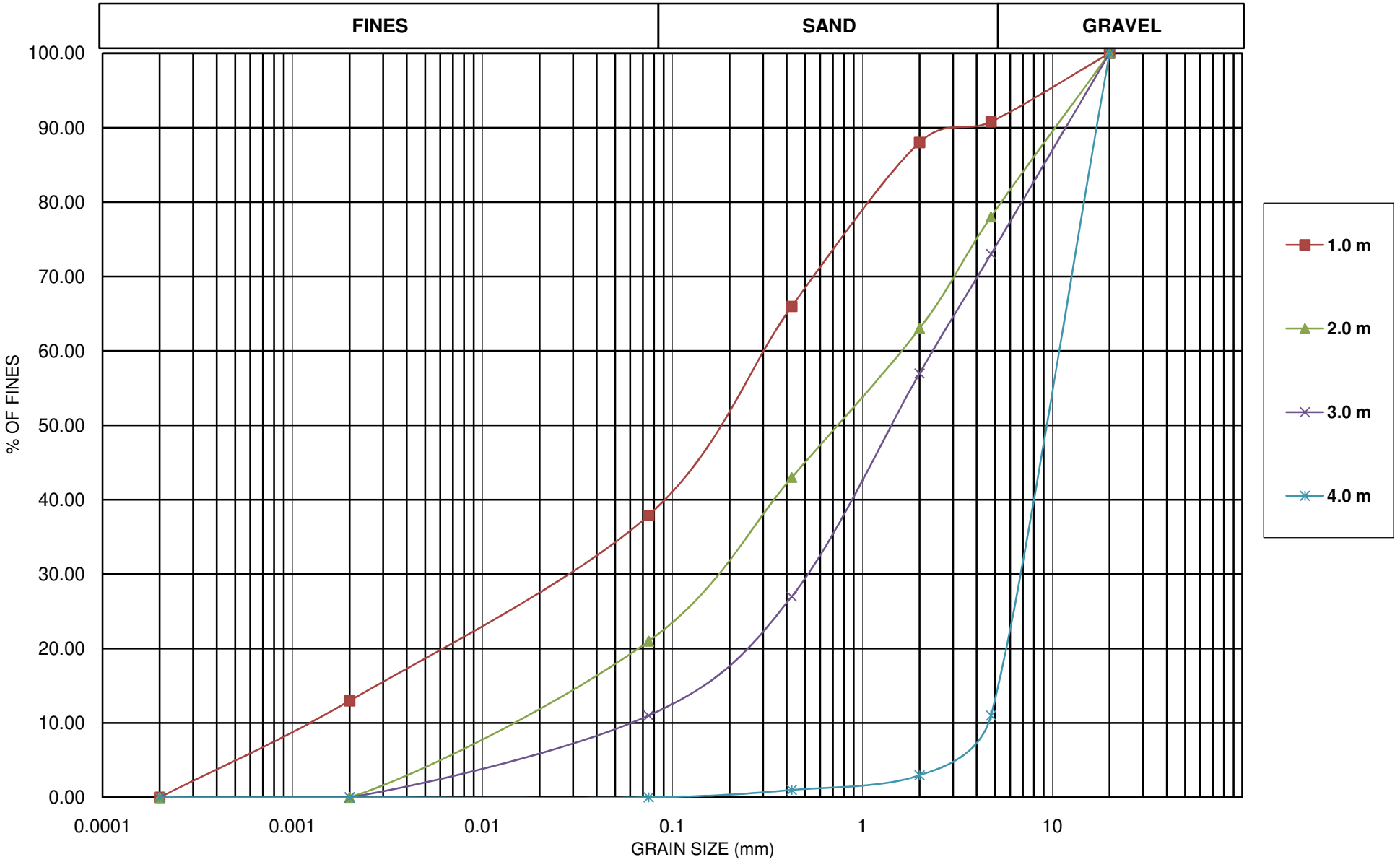


Fig. 2.10 GRAIN SIZE DISTRIBUTION CURVE - BH-05

HYDROMETER ANALYSIS CURVE

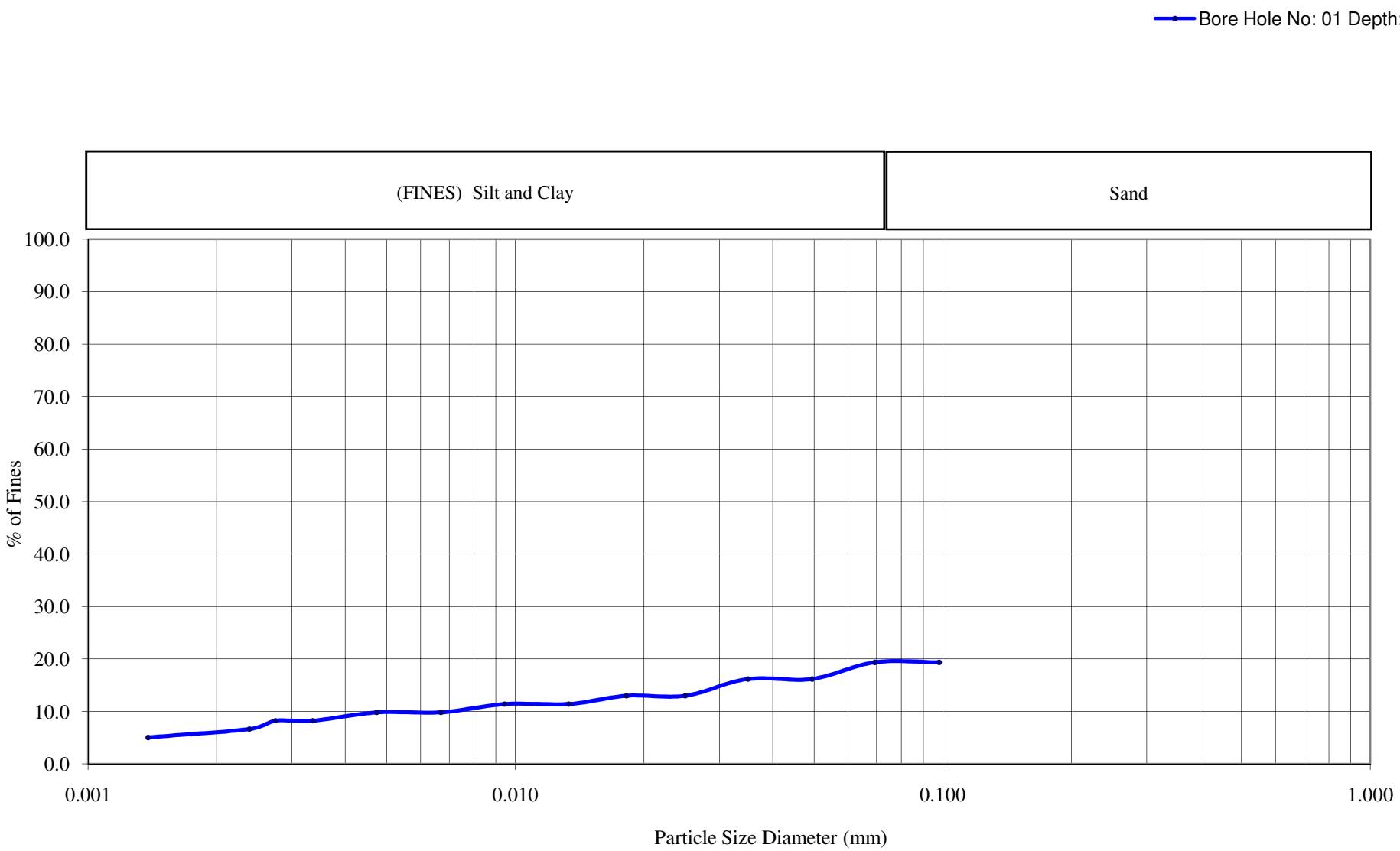


Fig.2.11 Hydrometer Analysis Master Curve

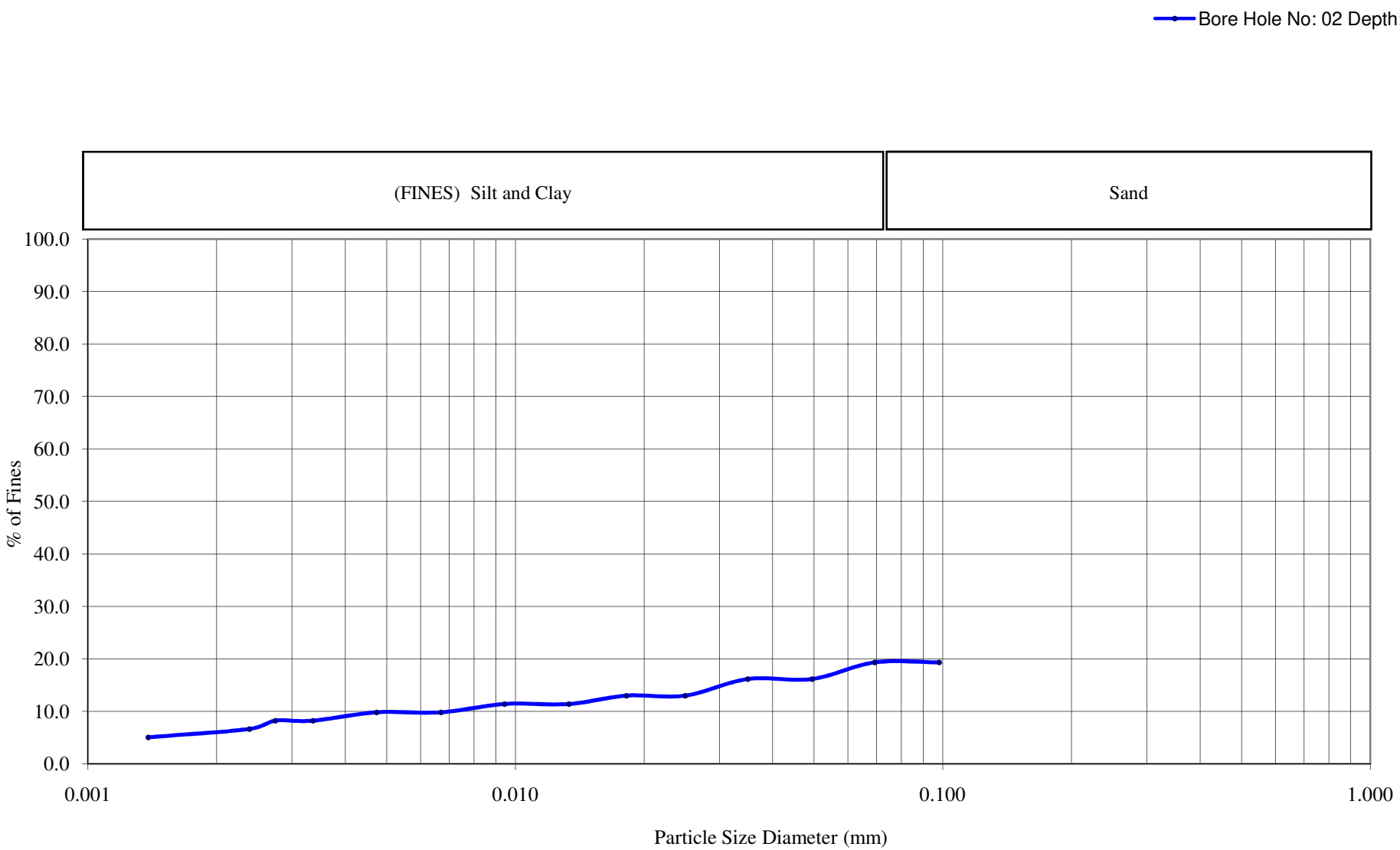


Fig.2.12 Hydrometer Analysis Master Curve

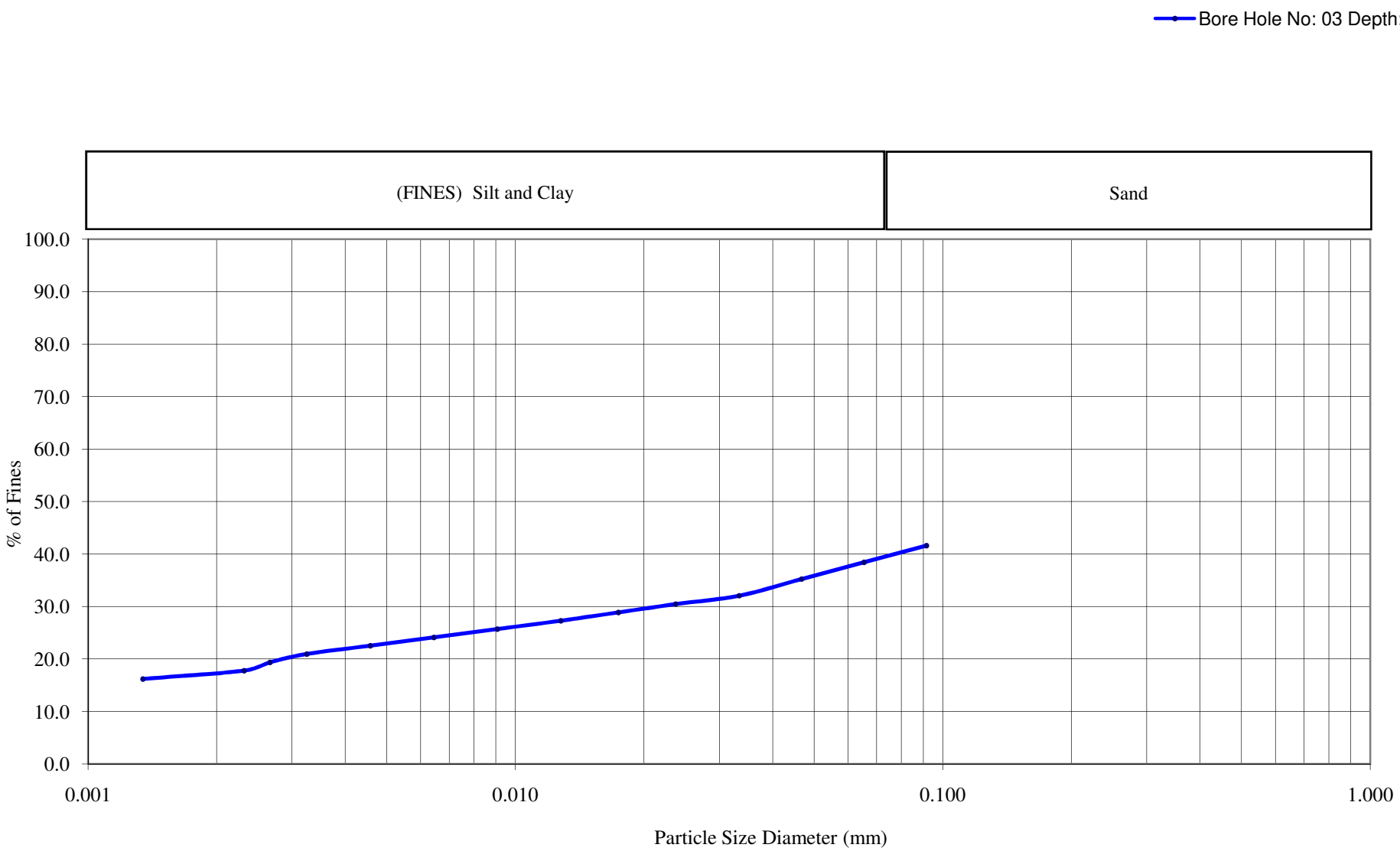


Fig.2.13 Hydrometer Analysis Master Curve

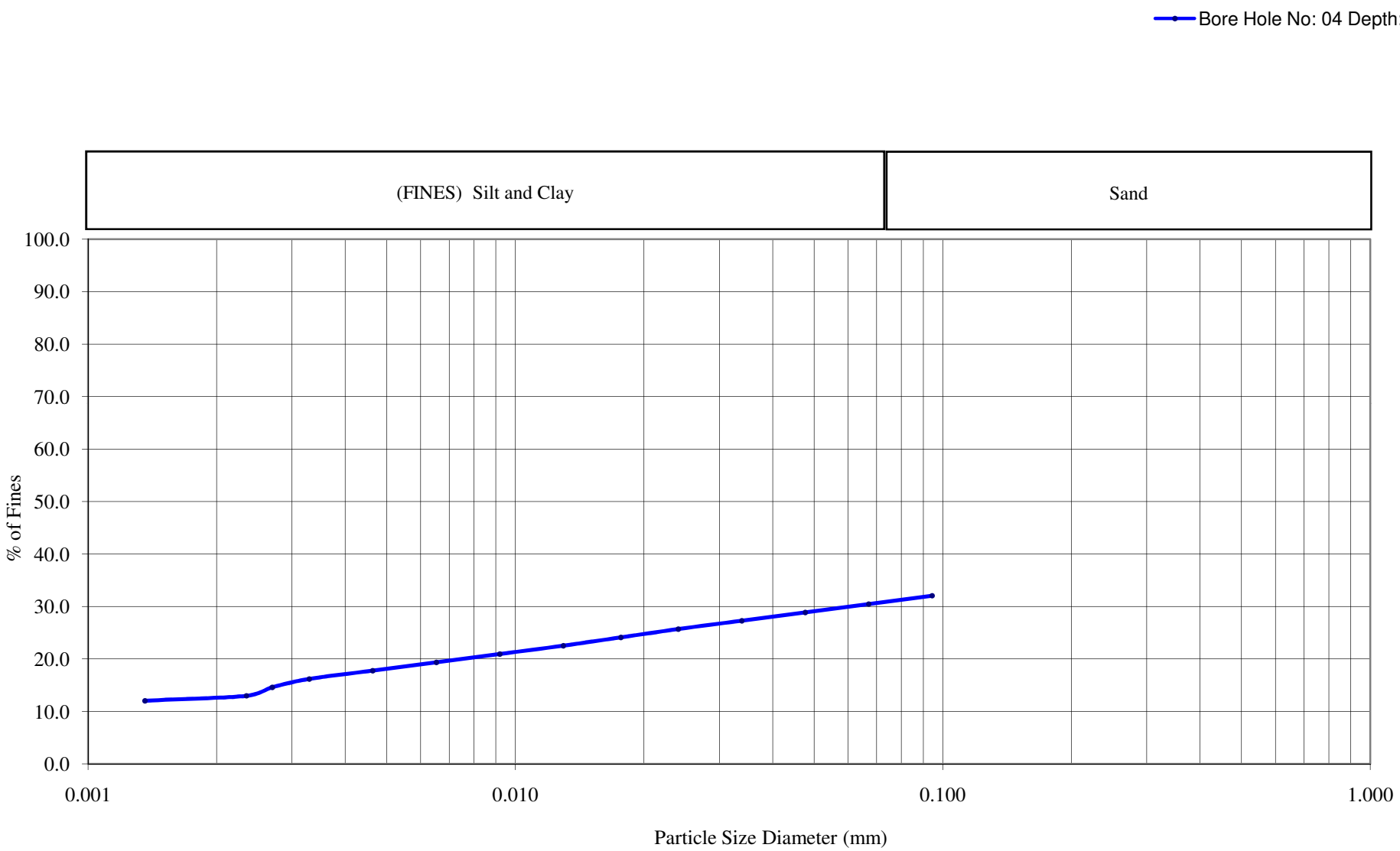


Fig.2.14 Hydrometer Analysis Master Curve

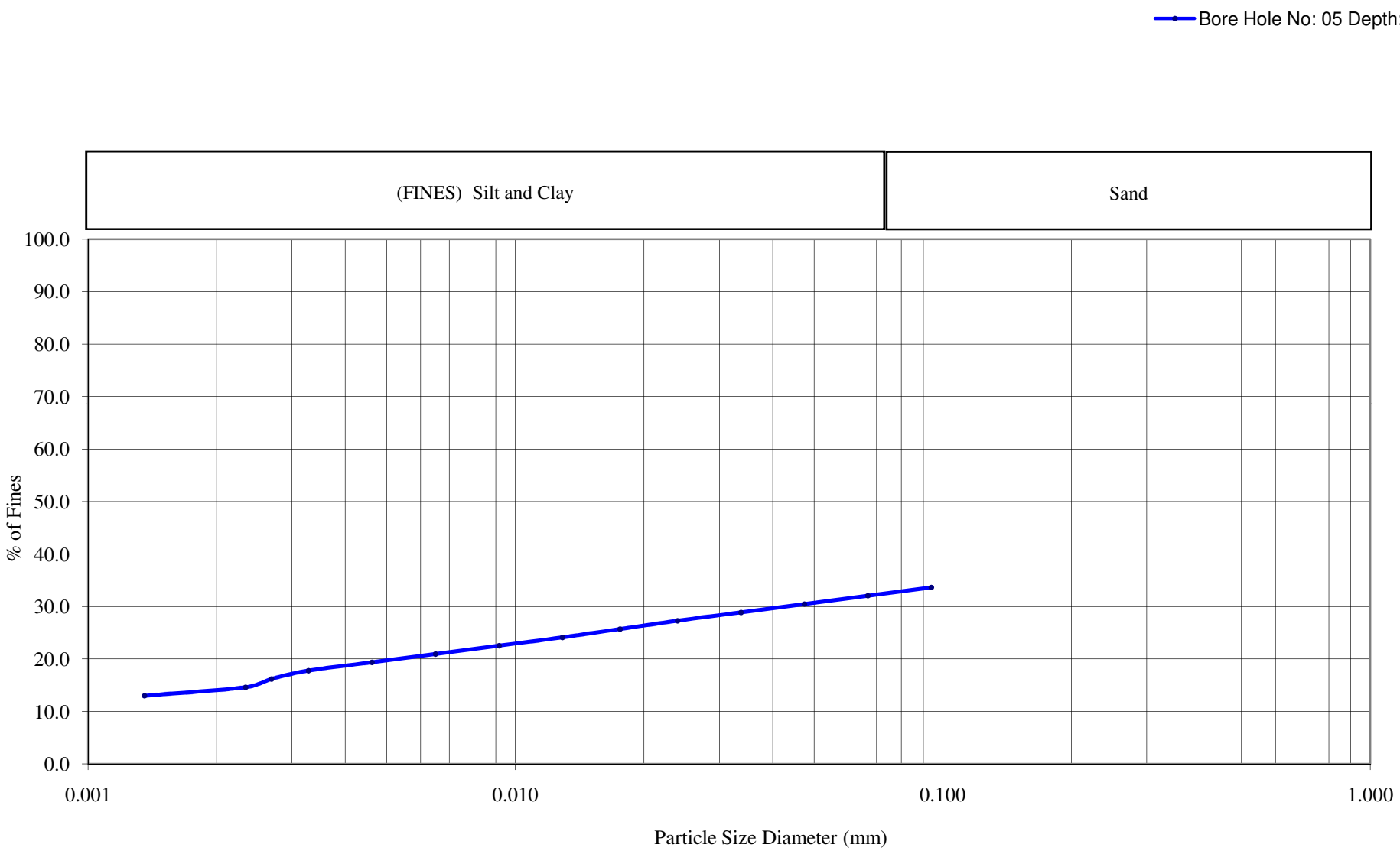


Fig.2.15 Hydrometer Analysis Master Curve

LABORATORY TEST RESULTS

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

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																							
			Fine Grained (FG)										Coarse Grained (CG)												IS-Notation	
			NMC(%)	LL (%)	PL (%)	I_P	Ic	SL (%)	FS (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
1.0	6	SS	21	31	16	15	0.67	15	25	CG>50%	Above	-	18	12	22	18	26	4	-	-	-	-	-	Loose	<50%	SC
2.0	69	SS	-	-	-	-	-	-	-	CG>50%	-	-	28	15	24	16	17	0	-	-	-	-	-	V.Dense	<50%	SM
3.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	27	56	15	2	0	0	-	-	-	-	-	V.Dense	<50%	SP

FG = Fine Grained
CG = Coarse Grained
NMC= Nature Moisture Content
LL = Liquid Limit
PL = Plastic Limit
Ip = Plasticity Index
Ic = (LL-NMC)/Ip
SL = Shrinkage Limit
FS = Differential Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature

LAB IN-CHARGE	PRAVEEN
REVIEWED BY	JALEEL YASIN

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

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																								
			Fine Grained (FG)										Coarse Grained (CG)													IS-Notation	
			NMC(%)	LL (%)	PL (%)	I_P	Ic	SL (%)	FS (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
1.0	12	SS	20	37	19	18	0.94	16	10	CG>50%	Above	-	7	18	19	17	34	5	-	-	-	-	-	M.Dense	<50%	SC
2.0	80	SS	-	-	-	-	-	-	-	CG>50%	-	-	21	20	24	15	20	0	-	-	-	-	-	V.Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	14	20	29	20	17	0	-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	51	38	9	2	0	0	-	-	-	-	-	V.Dense	GP	<50%

FG = Fine Grained
CG = Coarse Grained
NMC= Nature Moisture Content
LL = Liquid Limit
PL = Plastic Limit
Ip = Plasticity Index
Ic = (LL-NMC)/Ip
SL = Shrinkage Limit
FS = Differential Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature

LAB IN-CHARGE	PRAVEEN
REVIEWED BY	JALEEL YASIN

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

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																								
			Fine Grained (FG)										Coarse Grained (CG)													IS-Notation	
			NMC(%)	LL (%)	PL (%)	I_P	Ic	SL (%)	FS (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
1.0	11	SS	21	48	19	29	0.93	13	65	Stiff	Above	CI	0	4	25	20	33	18	-	-	-	-	-	FG>50%	FG>50%	FG>50%
2.0	14	SS	24	42	22	20	0.90	15	30	Stiff	Above	CI	6	4	15	23	36	16	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	26	21	23	17	13	0	-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	33	20	21	15	11	0	-	-	-	-	-	V.Dense	<50%	SP-SM
5.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	22	12	24	21	21	0	-	-	-	-	-	V.Dense	<50%	SM

FG = Fine Grained
CG = Coarse Grained
NMC= Nature Moisture Content
LL = Liquid Limit
PL = Plastic Limit
Ip = Plasticity Index
Ic = (LL-NMC)/Ip
SL = Shrinkage Limit
FS = Differential Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature

LAB IN-CHARGE	PRAVEEN
REVIEWED BY	JALEEL YASIN

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

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																								
			Fine Grained (FG)										Coarse Grained (CG)													IS-Notation	
			NMC(%)	LL (%)	PL (%)	I_P	Ic	SL (%)	FS (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
1.0	7	SS	28	45	22	23	0.74	15	42	CG>50%	Above	-	4	8	24	17	35	12	-	-	-	-	-	Loose	<50%	SC
2.0	26	SS	18	33	21	12	1.25	16	28	CG>50%	Above	-	22	10	20	17	27	4	-	-	-	-	-	M.Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	15	11	32	21	21	0	-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	22	8	33	22	15	0	-	-	-	-	-	V.Dense	<50%	SM

FG = Fine Grained
CG = Coarse Grained
NMC= Nature Moisture Content
LL = Liquid Limit
PL = Plastic Limit
Ip = Plasticity Index
Ic = (LL-NMC)/Ip
SL = Shrinkage Limit
FS = Differential Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature

LAB IN-CHARGE	PRAVEEN
REVIEWED BY	JALEEL YASIN

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

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																								
			Fine Grained (FG)										Coarse Grained (CG)													IS-Notation	
			NMC(%)	LL (%)	PL (%)	I_P	Ic	SL (%)	FS (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
1.0	12	SS	15	45	20	25	1.20	15	47	CG>50%	Above	-	8	4	22	20	33	13	-	-	-	-	-	M.Dense	<50%	SC
2.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	22	15	20	22	21	0	-	-	-	-	-	V.Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	27	16	30	16	11	0	-	-	-	-	-	V.Dense	<50%	SP-SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	89	8	2	1	0	0	-	-	-	-	-	V.Dense	GP	<50%

FG = Fine Grained
CG = Coarse Grained
NMC= Nature Moisture Content
LL = Liquid Limit
PL = Plastic Limit
Ip = Plasticity Index
Ic = (LL-NMC)/Ip
SL = Shrinkage Limit
FS = Differential Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature

LAB IN-CHARGE	PRAVEEN
REVIEWED BY	JALEEL YASIN

Table-2.6 Results of Chemical Analysis									
SL No.	Bore HoleNo.	Water				Soil(2:1)			
		Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)	Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)
1	BH-01	2.7	7.35	223	324	2.0	7.34	201	298
2	BH-03	2.7	7.35	229	321	3.0	7.34	208	291
3	BH-05	2.7	7.35	232	328	2.0	7.34	205	295

CHAPTER-3

GEOLOGY & SUB-SURFACE STRATIFICATION

3.0 Preamble:

Geotechnical investigation carried out at a specific site provides location specific sub surface engineering characteristics. However, in major project sites, where the construction activities spread over a very large area, location specific sub surface strata characteristics are studied together with the geological mapping data. This is required to incorporate the impact of any documented macro-level geological characteristics of the region on the foundation design, irrespective of the location specific sub surface strata characteristics.

In view on the above, though it is beyond the scope of the present study to carry out macro-level geological investigation, the regional geology based on the published data is presented and discussed with respect to the foundation design.

3.1 Geology of the Region (based on the published data)

Formation Characteristics:

The present location falls under Selaiyur, Tambaram, Chennai, geologically it is classified as recent alluvium deposits consisting of silty sand/clayey silty sand which is underlain with basement rock.

Recent Clays/Sand (Alluvium Deposits)

---------- Eparchean Unconformity ----------

Archaean Basement Rock (Charnockite Rock / Hypersthene Granite)

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:					01	Ref R.L. of G.L. (m):			0.00	
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.50	1.50	Clayey Silty Sand	Brownish Grey	6	Loose	-	14.5	-	29.2
2	1.50	3.00	1.50	Completed Weathered Rock	Brownish Grey	60	Very Dense	-	20.5	-	42.5
3	3.00	5.00	2.00	Moderately Weathered Rock	Greyish Brown	CRR-10% & 15%, RQD-0%					

REFERENCE BORE HOLE-BH:					02	Ref R.L. of G.L. (m):			0.00	
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.50	1.50	Clayey Silty Sand	Brownish Grey	12	Medium Dense	-	16	-	30.6
2	1.50	4.00	2.50	Completed Weathered Rock	Brownish Grey	80	Very Dense	-	21	-	42.5
3	4.00	5.00	1.00	Moderately Weathered Rock	Greyish Brown	CRR-19%, RQD-0%					

REFERENCE BORE HOLE-BH:					03	Ref R.L. of G.L. (m):			0.00	
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	2.00	2.00	Sandy Silty Clay	Brownish Grey	12	-	Stiff	18.5	80	-
2	2.00	5.00	3.00	Completed Weathered Rock	Brown	>100	Very Dense	-	21	-	42.5

REFERENCE BORE HOLE-BH:					04	Ref R.L. of G.L. (m):			0.00	
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.50	1.50	Clayey Silty Sand	Brownish Grey	7	Loose	-	14.5	-	29.4
2	1.50	2.50	1.00	Clayey Silty Sand/ Residual Soil	Brownish Grey	26	Medium Dense	-	19	-	34.8
3	2.50	4.00	1.50	Completed Weathered Rock	Brownish Grey	>100	Very Dense	-	21	-	42.5
4	4.00	5.00	1.00	Moderately Weathered Rock	Greyish Brown	CRR-20%, RQD-0%					

REFERENCE BORE HOLE-BH:					05	Ref R.L. of G.L. (m):			0.00	
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.50	1.50	Clayey Silty Sand	Brownish Grey	12	Medium Dense	-	16	-	30.6
2	1.50	3.00	1.50	Completed Weathered Rock	Brownish Grey	>100	Very Dense	-	21	-	42.5
3	3.00	5.00	2.00	Moderately Weathered Rock	Greyish Black	CRR-26%, RQD-0%					

FOUNDATION SYSTEM

CHAPTER-4

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.

- The super structure characteristics along with the loading pattern on the sub structure
- 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 stilt plus five upper floors, and is meant for residential use. For this kind of structure, the column loads could vary between 1500 kN to 2500 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

4.2 Foundation System

For the kind of proposed structure and sub soil conditions, shallow foundation system coupled with soil replacement within the foundation trench can be adopted. The Isolated column footings can be located at a depth of 1.7m over a well compacted sand-gravel (1:1) mix or quarry dust of 300mm thickness is recommended. Thus the overall depth of foundation excavation will be 2.00m below the existing ground level. The schematic arrangement of foundation system is presented in Fig.4.1. The footings can be designed for an allowable safe bearing pressure of 250kPa.

Typical computation is presented in the annexure

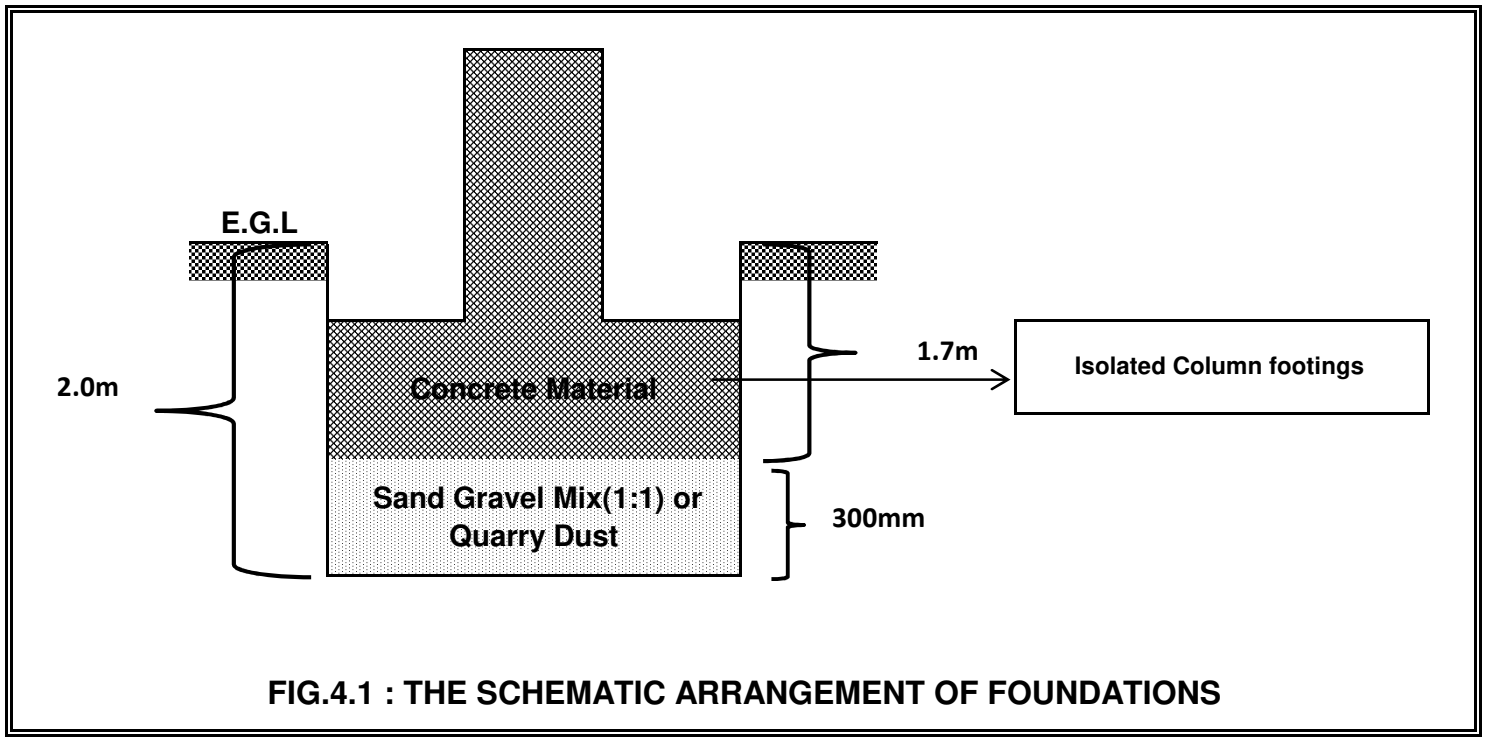


FIG.4.1 : THE SCHEMATIC ARRANGEMENT OF FOUNDATIONS

RECOMMENDATIONS

CHAPTER-5

RECOMMENDATIONS

5.0 Recommendation for Isolated Column footings:

- For the kind of sub soil conditions open foundation system coupled with soil replacement type of ground improvement technique can be adopted.
- The depth of foundation excavation shall be 2.0m below the ground level and shall be back filled with either sand-gravel mix (1:1) or quarry dust of 300mm thickness laid in non-compacted layers of thickness not more than 150mm and compacted at optimum moisture content using a plate vibrator.
- The footings can be located at 1.7m over the prepared bed and shall be designed for an allowable bearing pressure of 250 kPa.
- The back filling of foundation trenches shall be carried out using either sand/gravel or quarry dust.
- All columns shall be connected with grade beams in both the directions irrespective of wall layout
- The ground floor shall be minimum 1.0m above the natural ground and the plingth shall be filled with sand/gravel/quarry dust. This height is recommended to contain the influence of soil volume change on the flooring. In case, floor is not raised, the ground floor shall be constructed as a suspended R.C.C. slab.

5.1 General Recommendation:

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

FOR GEO ENGINEERING CONSULTANTS, CHENNAI

AUTHORIZED SIGNATORY

ANNEXURE

TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

Ref. BH-03

1.1 Geometrical Data :

Shape of the Foundation	square
Depth of Foundation Below E.G.L"Df" (m)	1.70
Soil Replacement Thickness of CNS Layer (m)	0.30
Total Depth of Foundation (m)	2.00
Breadth of Footing "B" (m)	1.00
Length of Footing "L" (m)	1.00
B/L	1.00
Inclination of Vertical Load with the Vertical (a)	0.00

1.2 Soil Data :

Type of Effective Bearing Strata :	Clay
Design SPT-value of the Bearing Strata	14.00
Type of Shear Failure:	General
Undrained Shear Strength (Cu)	93.33

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (g_{bulk})	20.00
Water Table Correction Factor (w')	0.50
Effective Overburden pressure at foundation level (q)	17.00
Bearing Capacity Factors:	
N_c =	5.14
N_q =	-
N_g =	-
Shape Factors:	
S_c =	1.30
S_q =	-
S_g =	-
Depth Factors :	
D_c =	1.34
D_q =	-
D_g =	-
Inclination Factor:	
I_c =	1.00
I_q =	-
I_g =	-

1.4 Ultimate Bearing Capacity (Qu) :

Qu=Cu*Nc*Sc*Dc*Ic	835.70	kPa

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50	
Qsafe :	334.28	kPa
Say Q_{safe}	**250**	**kPa**

2 Computation of Settlement for Maximum Pressure and Size of Footing: (as per IS:8009-Part-I-Ref. Eq.11) (Elastic Analysis)

The immediate elastic settlement (S_i)=	$qB(1-m^2)*I/E_s$	
q= bearing pressure	250.00	
Poission's Ratio (m_1)	0.20	
Modulus of Elasticity (E_s)(Ref. Joseph E Bowels,1996,page316,Table5.6, Japanese design standards)		
Modulus of Elasticity ($E_{s)}$	46666.67	
Size of footing considered for maximum settlement(m)	1.00	
Influence factor	1.00	
Rigidity Factor	1.00	
Elastic Settlement (DH_i)	5.14	mm
	<50	mm

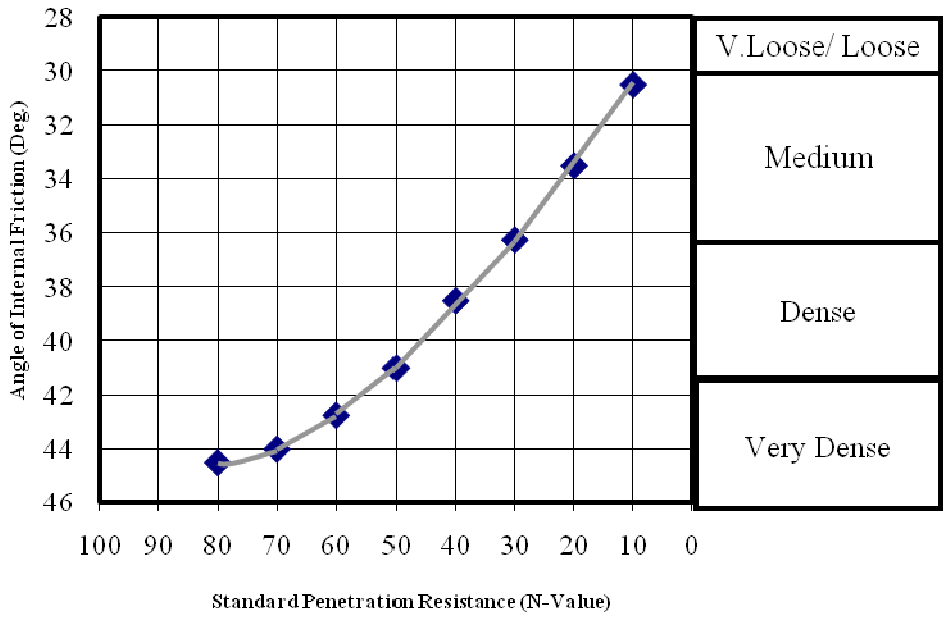


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

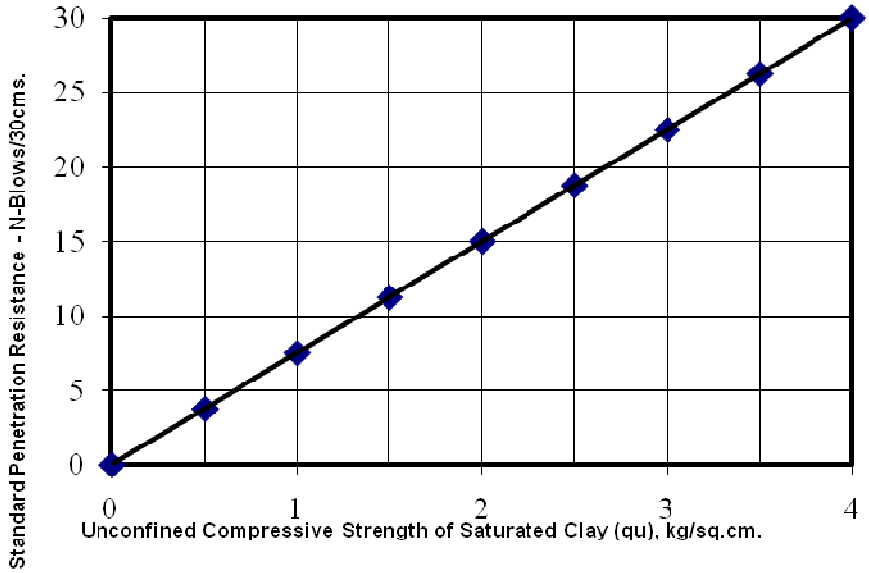


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)



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Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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