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PROJECT NAME

PLAN SHOWING THE PROPOSED CONSTRUCTION OF RESIDENTIAL NON HIGH RISE BUILDING VILLA NO. 1 TO 116 CONSISTS OF GROUND FLOOR + FIRST FLOOR, TOTALLY 116 D/U, COMPRISED IN SURVEY NOS. 85/1B, 86/2A, 86/2B, 86/3, 87/2, 102/1B, 103/3A, 103/3B, 105/1, 105/2 AND 105/3A OF SONALLUR VILLAGE, VANDALUR TALUK, CHENGALPET DISTRICT.

CLIENT NAME

CASAGRAND PREMIER BUILDER LIMITED,
NPL DEVI, NO.111, 5TH FLOOR,
LB ROAD, THIRUVANMIYUR,
CHENNAI 600 041.

TITLE

GEOTECHNICAL INVESTIGATION REPORT

PROJECT NO: GEC-JC-GT-6052/2024-2025

DATE: 19/08/2024

GEO ENGINEERING CONSULTANT

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 Test	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 2.8	Soil Profile	5-12
	2.9 to 2.16	Graphical Representation of Grain Size Analyses Curve	13-20
	2.17 to 2.24	Graphical Representation of Hydrometer Analyses Curve	21-28
TABLES	2.1 to 2.8	Laboratory Test Results	29-36
	2.9	Chemical Test Results	37
CHAPTER-3		**GEOLOGY & SUB-SURFACE STRATIFICATION**	
	3.0	Preamble	38
	3.1	Geology of Study Area	38
	3.2	Design Sub Soil Profile	38-42
CHAPTER-4		**FOUNDATION SYSTEM**	
	4.0	Preamble	43
	4.1	Proposed Structures	43

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	4.2	Foundation System	43
TABLE	4.1	Recommended Allowable Safe Bearing Pressures	44
CHAPTER-5		**RECOMMENDATIONS**	45
	5.1	Recommendations of the Type of Cement used for the Construction of Substructure along with extract of permissible limits as per IS:456-2000	46
ANNEXURE		Typical Bearing Capacity Computations for Foundations	47
	A1	Relationship Between Angle of Internal Friction & N-Value	48
	A2	Relationship Between UCC & SPT -Value (N) of Saturated Clay	48

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REPORT TEXT

CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project : Proposed Villa Project (G+1 Upper Floor)

Project Owner : **M/s Casagrand Premier Builder Limited,**

Project Location : Sonallur, Chennai.

Job Code : GEC-JC-GT-6052

1.1 Scope of Work

1.1.1 Field Work

- Conducting eight soil investigation bore holes of 150 mm& NX diameter up to 6.0m depth or up to the refusal strata with SPT>100
- Conducting Standard Penetration Test (SPT) within the borehole at every 1.0m & 1.50m depth interval up to termination depth.
- Collection of Soil Samples and undisturbed samples from the clayey strata with SPT-value less than 15.
- Collection of water samples if groundwater table met within the investigation depth

.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

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CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

Eight 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.

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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-2.1to 2.8. The graphical representation of grain size distribution curve for the representative samples in each bore is presented in Fig. 2.9 to 2.16.

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 2.8. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig.2.17 to 2.24.

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 - 2.9.

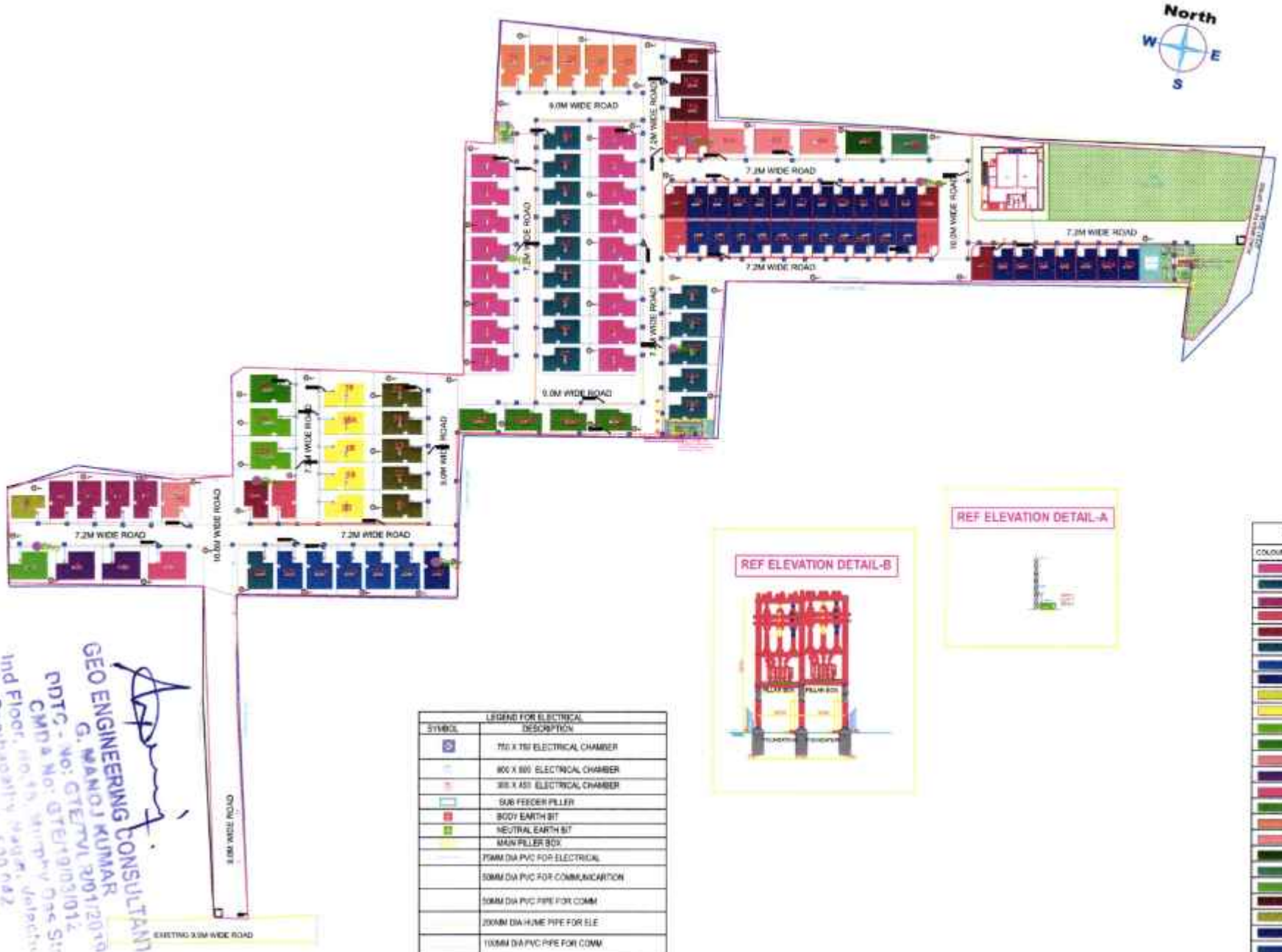
2.3 Summary:

The Eight 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 2.8.

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SITE PLAN

COLOUR CODE



REF ELEVATION DETAIL-B

REF ELEVATION DETAIL-A

LEGEND FOR ELECTRICAL	
SYMBOL	DESCRIPTION
	750 X 750 ELECTRICAL CHAMBER
	600 X 600 ELECTRICAL CHAMBER
	300 X 450 ELECTRICAL CHAMBER
	SUB FEEDER PILLER
	BODY EARTH BIT
	NEUTRAL EARTH BIT
	MAIN PILLER BOX
	75MM DIA PVC FOR ELECTRICAL
	50MM DIA PVC FOR COMMUNICARTION
	50MM DIA PVC PIPE FOR COMM
	200MM DIA HUME PIPE FOR ELE
	100MM DIA PVC PIPE FOR COMM
	150MM DIA HUME PIPE FOR ELE
	300MM DIA HUME PIPE FOR ELE

SONALUR 5.85 ACRES - VILLA PRODUCT MIX			
COLOUR CODE	VILLA TYPE	BHK	NO. OF VILLAS
	TYPE - A1	3BHK+3T	17
	TYPE - A2	3BHK+3T	14
	TYPE - A3	3BHK+3T	04
	TYPE - A4	3BHK+3T	01
	TYPE - A5	3BHK+3T	01
	TYPE - A6	3BHK+3T	01
	TYPE - A7	3BHK+3T	03
	TYPE - A8	3BHK+3T	01
	TYPE - A9	3BHK+3T	03
	TYPE - A10	3BHK+3T	03
	TYPE - A11	3BHK+3T	02
	TYPE - A12	3BHK+3T	01
	TYPE - A13	3BHK+3T	01
	TYPE - A14	3BHK+3T	03
	TYPE - A15	3BHK+3T	01
	TYPE - A16	3BHK+3T	04
	TYPE - A17	3BHK+3T	03
	TYPE - A18	3BHK+3T	03
	TYPE - A19	3BHK+3T	01
	TYPE - A20	3BHK+3T	01
	TYPE - A21	3BHK+3T	01
	TYPE - B1	3BHK+3T	03
	TYPE - B2	3BHK+3T	01
	TYPE - C1	3BHK+3T	16
	TYPE - C2	3BHK+3T	11
	TYPE - C3	3BHK+3T	04
	TYPE - C4	3BHK+3T	03
TOTAL NO OF VILLA			115

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SOIL PROFILE

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF VILLA AT SONALLUR VILLAGE, CHENNAI					DIA OF BORE HOLE	150mm ✓ / NX ✓
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	14/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	14/08/2024
JOB CODE	JC-GT-6052	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	Layer Data: Geotechnical Description
0		18	24															
		To		SC	-	-												
		18	26															
1							7	8	9	17	1.00	1	SS	-1.0				Greyish, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
		18	38								1.45							
		To		SC	-	-												
		18	42															
2							13	19	27	46	2.00	2	SS	-2.0		L1	2.0	
		18	51								2.45					L2	2.5	Greyish Brown, Moist, Dense, **Residual Soil,** Descented from Charnockite
		To		SC	-	-												
		18	56															
3							4cm Penet.for 50 Blows			>100	3.00	3	SS	-3.0				
		19	05								3.04							Greyish Brown, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
		To		SC	-	-												
		19	09															
4							SPT Hammer Rebounded			>100	4.00	4	WS	-4.0		L3	4.0	
		19	20															
		To		DB	6	-												Greyish Brown,**Highly Weathered Rock** Descented from Charnockite
		19	41															
5							-	-	-	-	5.00	5	CS	-5.0		L4	5.0	
6																		
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	14/08/2024	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m)	1.00	
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	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 VILLA AT SONALLUR VILLAGE, CHENNAI	DIA OF BORE HOLE	150mm ✓ / NX ✓
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01
CHAINAGE (m)	-	BORE START DATE	14/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary
CO-ORDINATES	N -	BORE END DATE	14/08/2024
JOB CODE	JC-GT-6052	FLUSHING MEDIUM	Bentonite
CO-ORDINATES	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	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
0		15	36															
		To		SC	-	-												
		15	39															
1							5	7	8	15	1.00	1	SS	-1.0				Greyish, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
		15	47								1.45							
		To		SC	-	-												
		15	50															
2							9	14	21	35	2.00	2	SS	-2.0		L1	2.0	
		16	02								2.45							Greyish Brown, Moist, Dense, **Residual Soil,** Descented from Charnockite
		To		SC	-	-												
		16	05															
3							8cm Penet.for 50 Blows			>100	3.00	3	SS	-3.0		L2	3.0	
		16	14								3.08							Greyish Brown, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
		To		SC	-	-												
		16	17															
4							SPT Hammer Rebounded			>100	4.00	4	WS	-4.0		L3	4.0	
		16	21															Greyish Brown, **Highly Weathered Rock** Descented from Charnockite
		To		DB	8	-												
		16	38															
5							-	-	-	-	5.00	5	CS	-5.0		L4	5.0	
6																		
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	14/06/2024	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 1.00	
WS - Wash Sample	DB - Diamond Bit	DATE	17/06/2024	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 VILLA AT SONALLUR VILLAGE, CHENNAI	DIA OF BORE HOLE	150mm ✓ / NX ✓
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01
CHAINAGE (m)	-	BORE START DATE	14/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary
CO-ORDINATES	N -	BORE END DATE	14/08/2024
JOB CODE	JC-GT-6052	FLUSHING MEDIUM	Bentonite
CO-ORDINATES	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	Layer Data: Geotechnical Description
0		13	44	SC	-	-												
		To																
		13	45															
1							4	6	9	15	1.00	1	SS	-1.0				Greyish, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
		13	52								1.45							
		To		SC	-	-												
		13	56															
2							7	15	26	41	2.00	2	SS	-2.0		L1	2.0	
		14	02								2.45					L2	2.5	Greyish, Moist, Dense, **Residual Soil,** Descented from Charnockite
		To		SC	-	-												
		14	05															
3							6cm Penet.for 50 Blows			>100	3.00	3	SS	-3.0				
		14	16								3.06							Greyish Brown, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
		To		SC	-	-												
		14	19													L3	4.0	
4							SPT Hammer Rebounded			>100	4.00	4	WS	-4.0				
		14	28															Greyish Brown,**Highly Weathered Rock** Descented from Charnockite
		To		DB	5	-												
		14	49													L4	5.0	
5							-	-	-	-	5.00	5	CS	-5.0				
6																		
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	14/08/2024	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 1.00	
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	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 VILLA AT SONALLUR VILLAGE, CHENNAI			DIA OF BORE HOLE	150mm ✓ / NX ✓		
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	14/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	14/08/2024
JOB CODE	JC-GT-6052	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	22	SC	-	-	7	6	10	16	1.00	1	SS	-1.0				Brownish, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
		To									1.45					L1	1.5	
		10	23															
		10	37	SC	-	-												
		To																
2		10	40				33	6cm Penet.for 50 Blows		>100	2.00	2	SS	-2.0				Whitish Yellow, Moist, Dense, **Residual Soil,** Descented from Charnockite
		10	55								2.21					L2	2.3	
		To		SC	-	-												
		11	01															
3		11	13				5cm Penet.for 50 Blows			>100	3.00	3	SS	-3.0				Whitish Yellow, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
		To		SC	-	-					3.06							
		11	20													L3	4.0	
4		11	58				SPT Hammer Rebounded			>100	4.00	4	WS	-4.0				Greyish Brown,**Highly Weathered Rock** Descented from Charnockite
		To		DB	4	-												
		12	31													L4	5.0	
5							-	-	-	-	5.00	5	CS	-5.0				
6																		
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	14/08/2024	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m) 1.00	
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	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 VILLA AT SONALLUR VILLAGE, CHENNAI			DIA OF BORE HOLE	150mm ✓ / NX ✓		
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	14/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	14/08/2024
JOB CODE	JC-GT-6052	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	Blows/cm. 15-30	Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
1	14/08/2024	07	12 To 07	14 SC	-	-	5	7	9	16	1.00 to 1.45	1	SS	-1.0				Brownish, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
2		07	26 To 07	29 SC	-	-	8	17	23	40	2.00 to 2.45	2	SS	-2.0		L1	2.0	
		07	51 To 07	55 SC	-	-										L2	2.5	Brownish, Moist, Dense, **Residual Soil,** Descented from Charnockite
3							3cm Penet.for 50 Blows			>100	3.00 to 3.03	3	SS	-3.0				
4		08	10 To 08	16 SC	-	-										L3	4.5	Brownish, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
							SPT Hammer Rebounded			>100	4.50	4	WS	-4.5				
5		08	41 To 08	59 DB	10	-												Greyish Brown, **Highly Weathered Rock** Descented from Charnockite
6							-	-	-	-	6.00	5	CS	-6.0		L4	6.0	
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	14/08/2024	GROUND LEVEL (m)	0.00		
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m)	1.00		
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	CASING DEPTH (m)	0.00		

Borehole terminated at 6 m depth below E.G.L

FIG.2.5 Sub Soil Profile at BH-05 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-06						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF VILLA AT SONALLUR VILLAGE, CHENNAI			DIA OF BORE HOLE	150mm	✓	
					NX	✓	
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	13/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	13/08/2024
JOB CODE	JC-GT-6052	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	Layer Data: Geotechnical Description
0		18	10															
		To																
		18	12	SC	-	-												
1							7	11	13	24	1.00	1	SS	-1.0				Brownish, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
		18	24								1.45							
		To																
		18	26	SC	-	-												
2							14	39	8cm Penet.for 50 Blows	>100	2.00	2	SS	-2.0		L1	2.0	
		18	41								2.38							Brownish, Moist, Dense, **Residual Soil,** Descented from Charnockite
		To														L2	2.5	
	13/08/2024	18	45	SC	-	-												
3							4cm Penet.for 50 Blows			>100	3.00	3	SS	-3.0				Brownish, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
		18	56								3.04							
		To																
		18	59	SC	-	-										L3	4.0	
4							SPT Hammer Rebounded			>100	4.00	4	WS	-4.0				Greyish Brown,**Moderately Weathered Rock** Descented from Charnockite
		19	08															
		To																
5		19	24	DB	11	-										L4	5.5	
							-	-	-	-	5.50	5	CS	-5.5				
6																		
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	13/08/2024	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m)	1.00		
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	CASING DEPTH (m)	0.00		

Borehole terminated at 5.5 m depth below E.G.L

FIG.2.6 Sub Soil Profile at BH-06 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-07						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF VILLA AT SONALLUR VILLAGE, CHENNAI			DIA OF BORE HOLE	150mm ✓ / NX ✓		
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	13/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	13/08/2024
JOB CODE	JC-GT-6052	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	13/08/2024	15	28	SC	-	-	12	11	8	19	1.00	1	SS	-1.0				Reddish Brown, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
		To									1.45							
		15	31															
		15	43	SC	-	-												
		To																
2		15	47				32	5cm Penet.for 50 Blows		>100	2.00	2	SS	-2.0		L1	2.0	
		16	01								2.20				+ + +			Brownish, Moist, Dense, **Residual Soil,** Descented from Charnockite
		To		SC	-	-									+ + +	L2	2.3	
		16	05															
3							3cm Penet.for 50 Blows			>100	3.00	3	SS	-3.0				
		16	19								3.03							Brownish, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
		To		SC	-	-												
		16	31															
4							SPT Hammer Rebounded			>100	4.00	4	WS	-4.0				
		17	02													L3	4.5	
		To		DB	18	-												Greyish Brown, **Moderately Weathered Rock** Descented from Charnockite
5		17	29															
							-	-	-	-	5.50	5	CS	-5.5		L4	5.5	
6																		
7																		
8																		
9																		
10																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	13/08/2024	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m)	1.00		
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	CASING DEPTH (m)	0.00		

Borehole terminated at 5.5 m depth below E.G.L

FIG.2.7 Sub Soil Profile at BH-07 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-08						
SHEET	1	OF	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF VILLA AT SONALLUR VILLAGE, CHENNAI			DIA OF BORE HOLE	150mm	✓	
					NX	✓	
LOCATION	Sonallur Village, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	13/08/2024
STRUCTURE	G+1 Floor	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	13/08/2024
JOB CODE	JC-GT-6052	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	13/08/2024	11	42 To 11 44	SC	-	-	9	15	10	25	1.00 - 1.45	1	SS	-1.0				Reddish Brown, Moist, Medium Dense, Poorly Graded, **Clayey Silty SAND (SC)** Sand-Clay mixtures
2		11	56 To 12 00	SC	-	-	8	14	20	34	2.00 - 2.45	2	SS	-2.0		L1	2.0	
3		12	14 To 12 19	SC	-	-	31	10cm Penet.for 50 Blows		>100	3.00 - 3.25	3	SS	-3.0		L2	3.0	Yellowish, Moist, Dense, **Residual Soil,** Descented from Charnockite
4		12	30 To 12 35	SC	-	-										L3	4.5	Brownish, Moist, Very Dense, **Completely Weathered Rock** Descented from Charnockite
5		13	02 To 13 21	DB	8	-	SPT Hammer Rebounded			>100	4.50	4	WS	-4.5				Greyish Brown,**Highly Weathered Rock** Descented from Charnockite
6							-	-	-	-	6.00	5	CS	-6.0		L4	6.0	
7																		
8																		
9																		
10																		

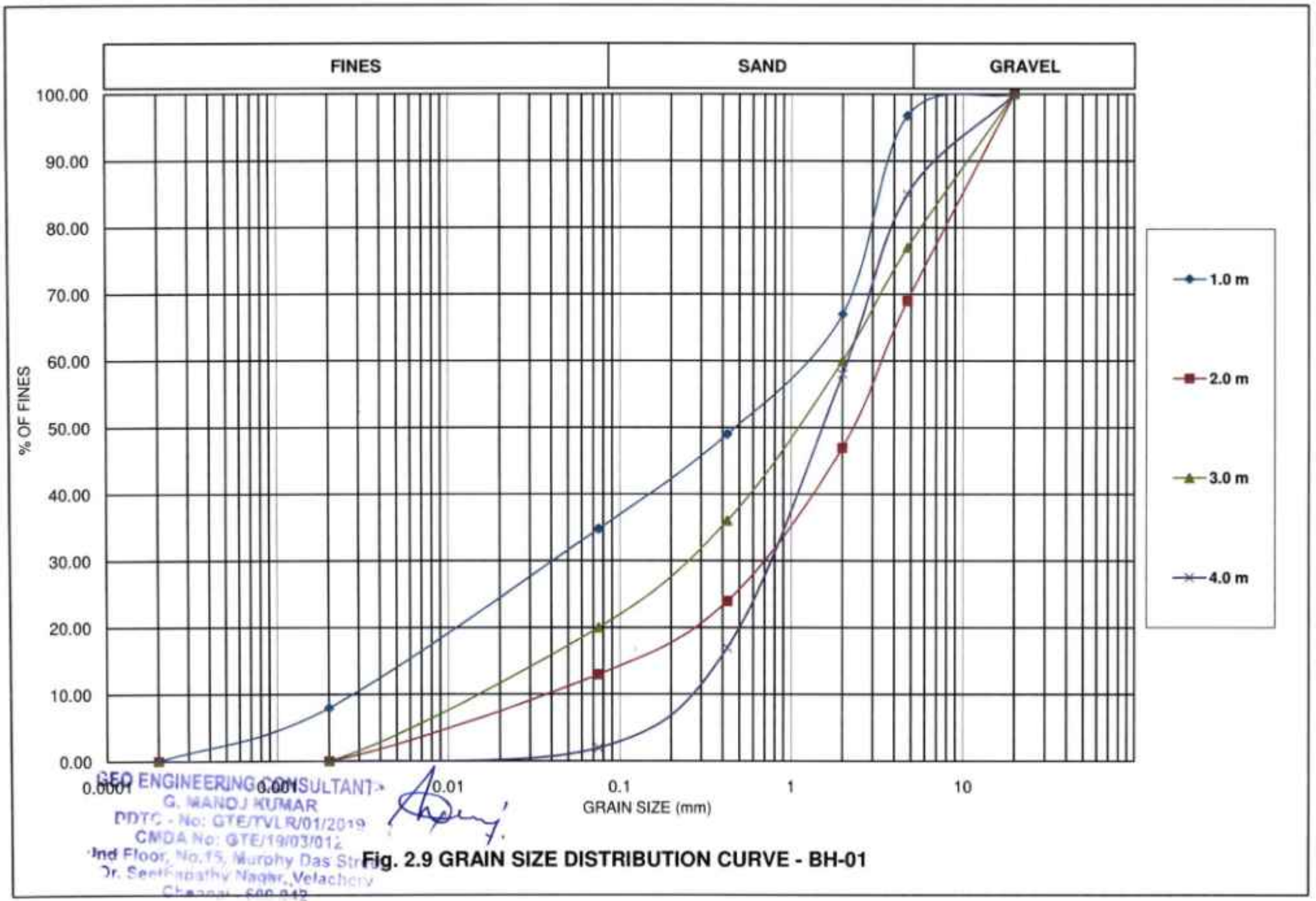
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CS - Core Sample	DS - Disturbed Sample	LOGGED	Dhivakar	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	13/08/2024	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Jaleel Yasin	WATER TABLE (m)	1.00		
WS - Wash Sample	DB - Diamond Bit	DATE	17/08/2024	CASING DEPTH (m)	0.00		

Borehole terminated at 6 m depth below E.G.L

FIG.2.8 Sub Soil Profile at BH-08 Location

Grain Size Distribution Curves



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Fig. 2.9 GRAIN SIZE DISTRIBUTION CURVE - BH-01

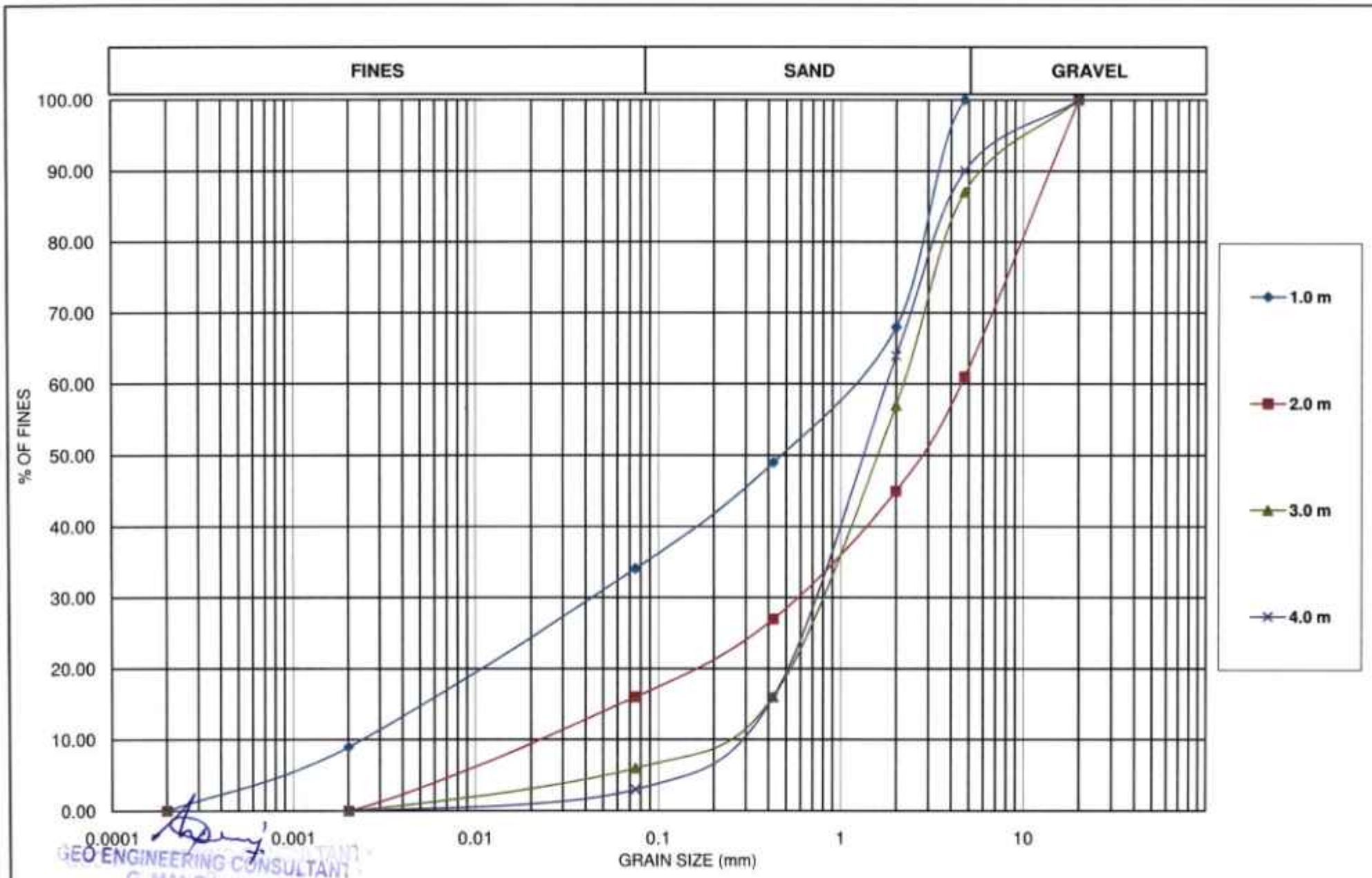
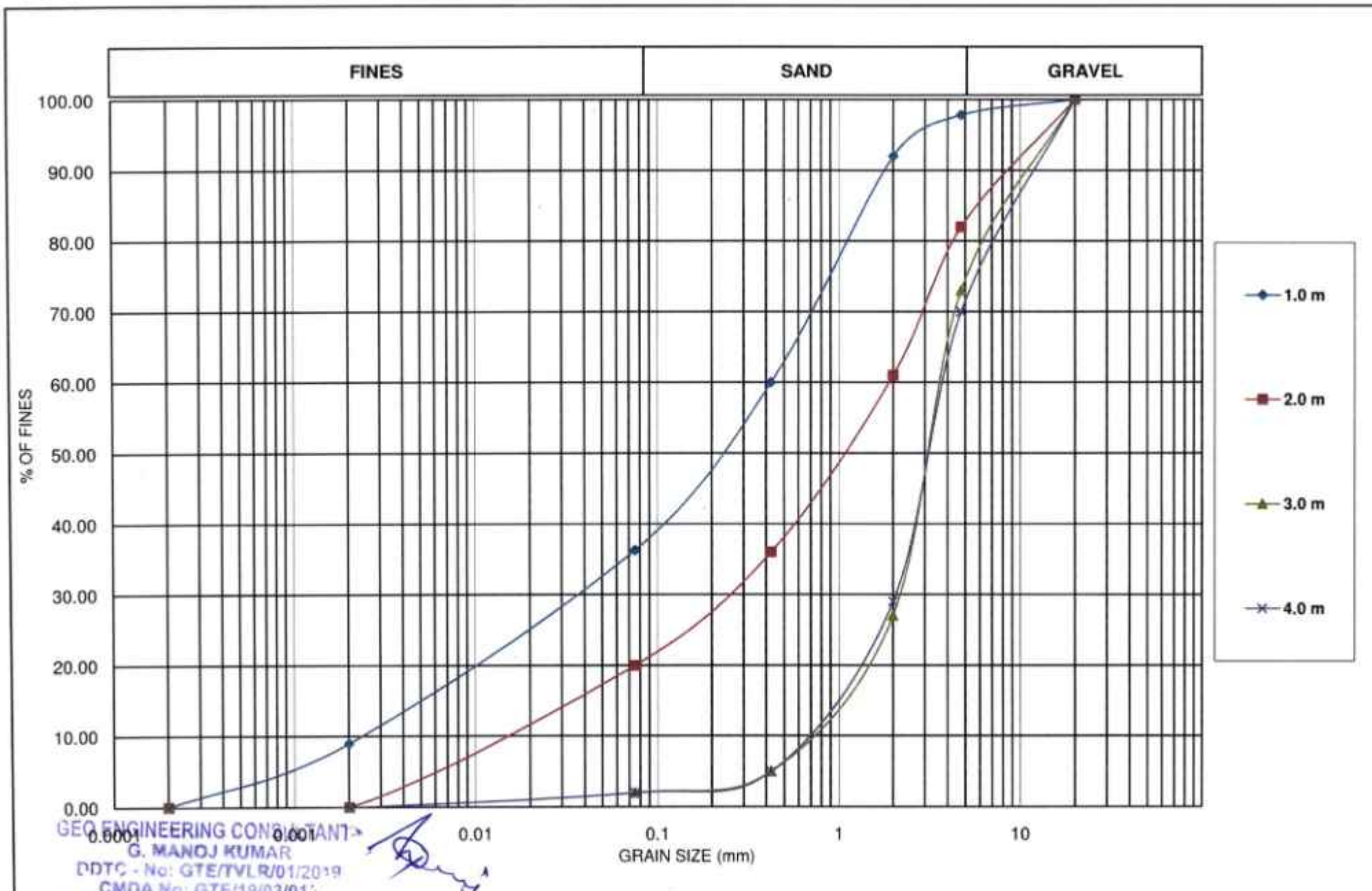


Fig. 2.10 GRAIN SIZE DISTRIBUTION CURVE - BH-02

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Fig. 2.11 GRAIN SIZE DISTRIBUTION CURVE - BH-03

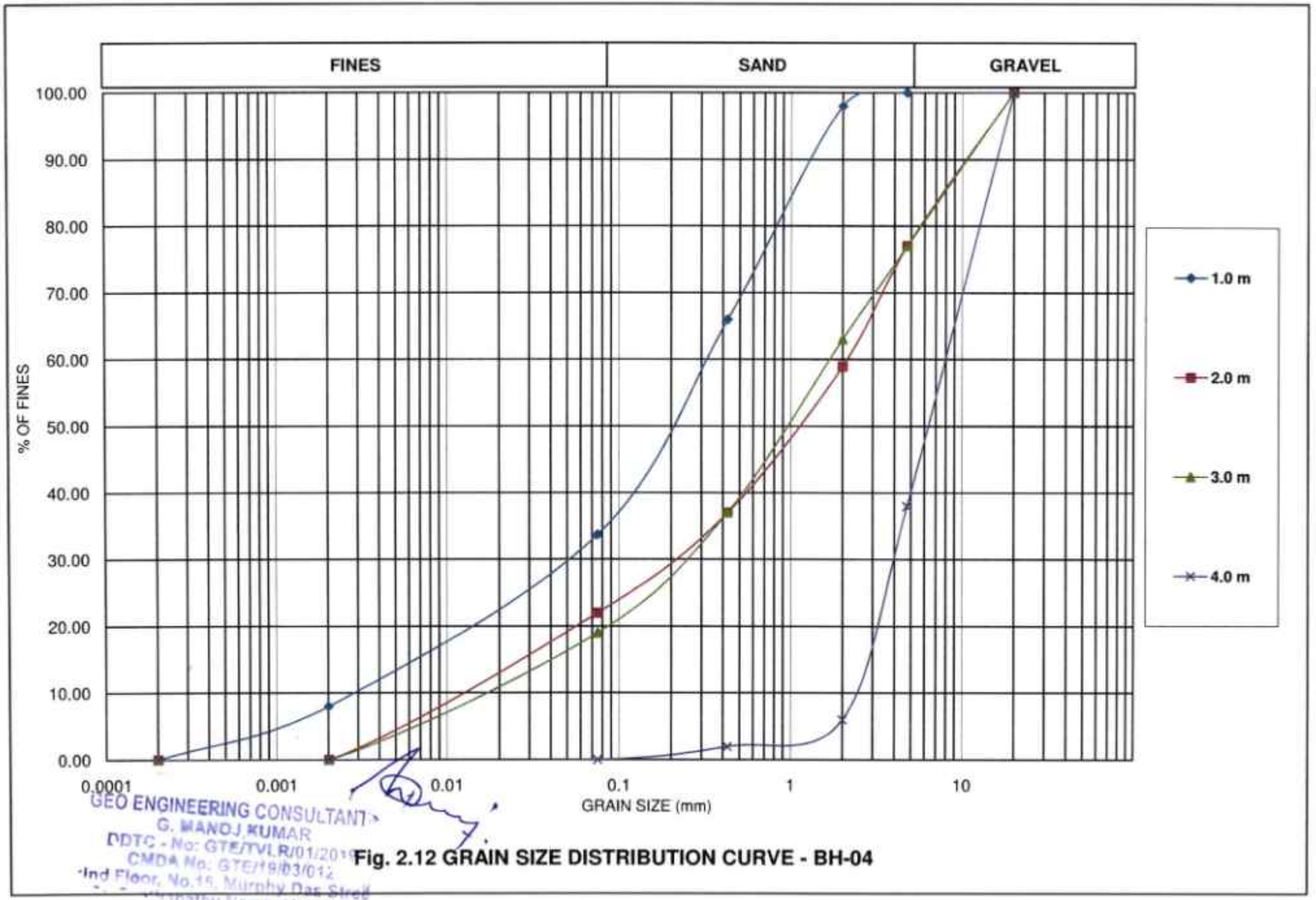
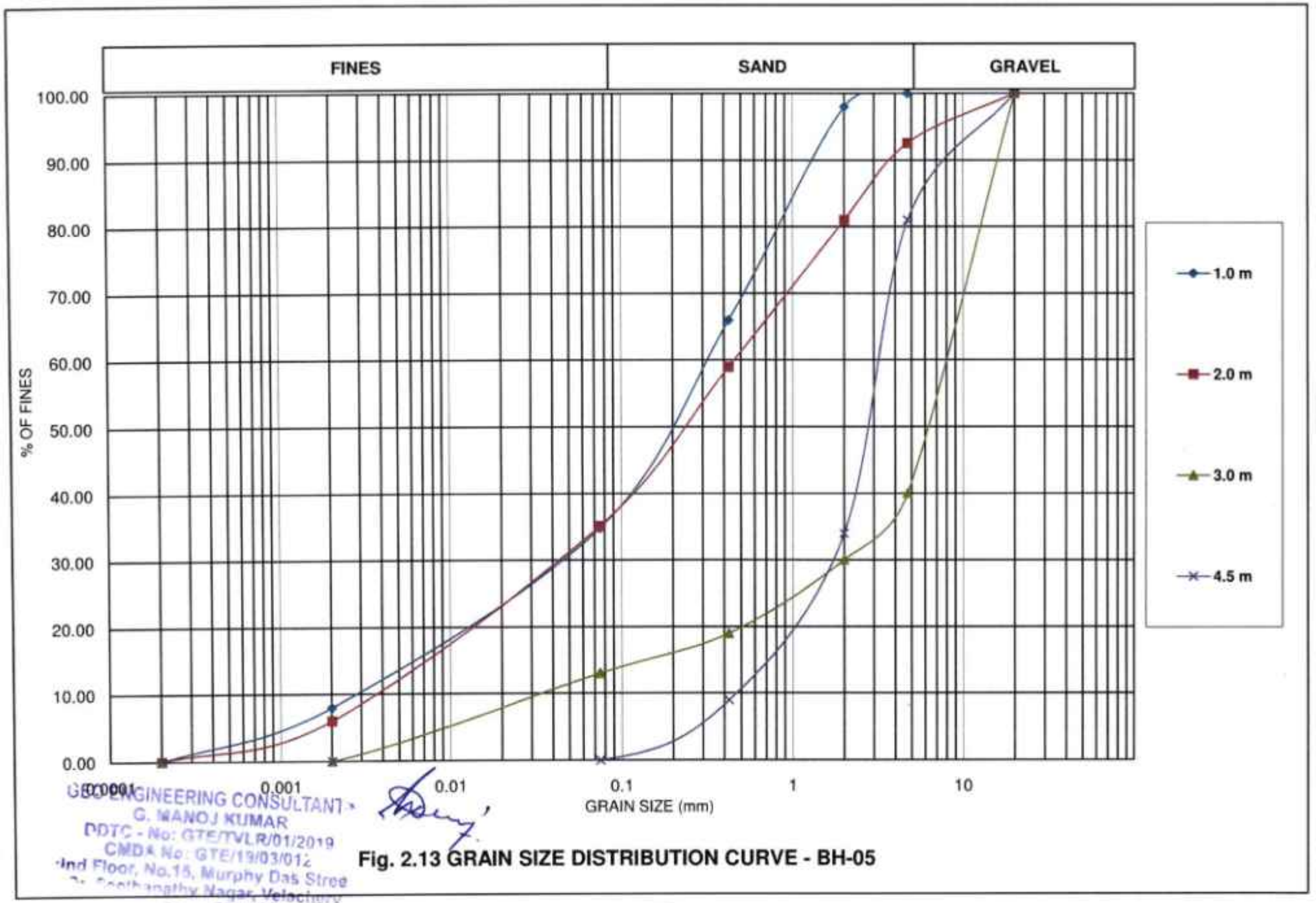


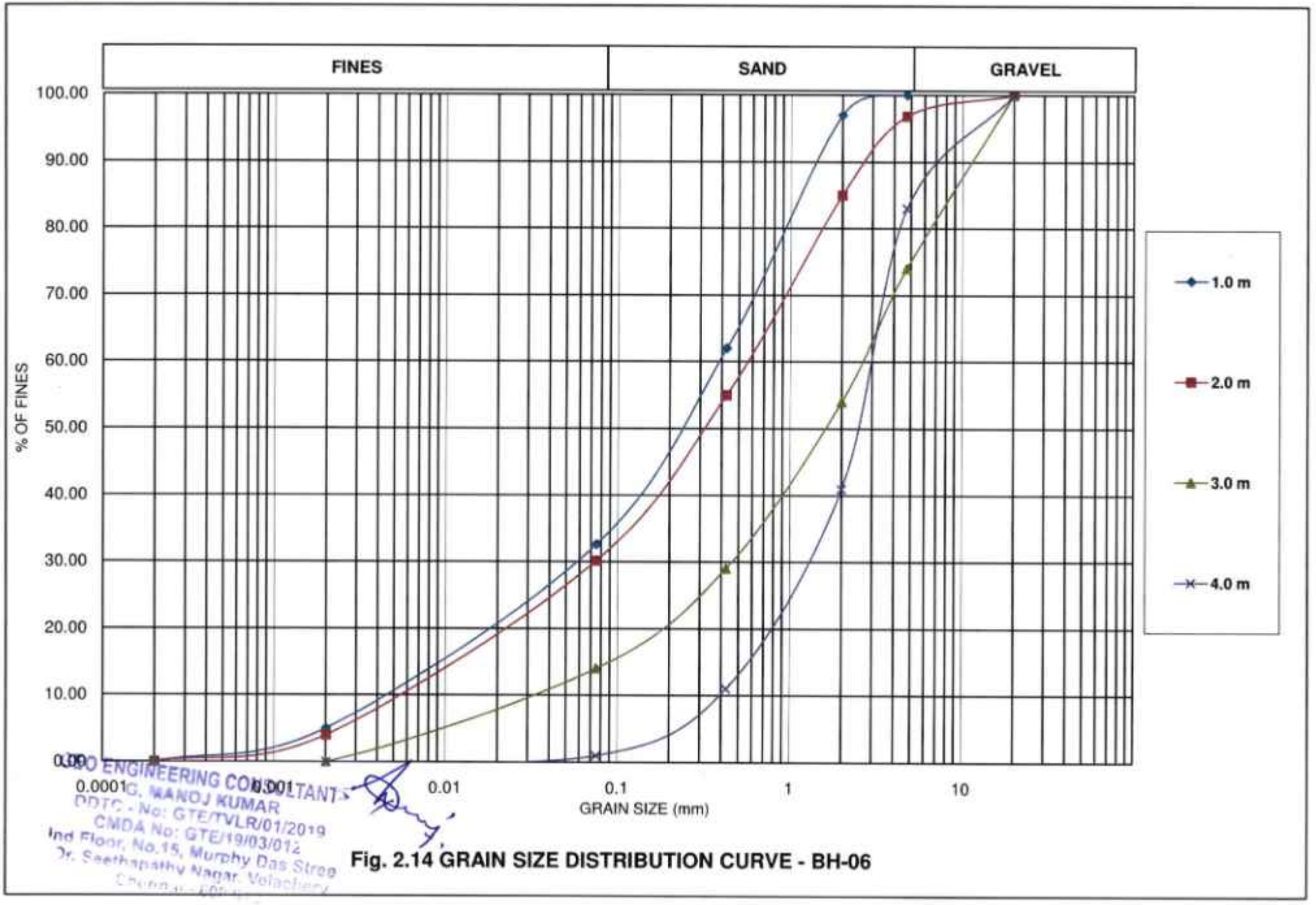
Fig. 2.12 GRAIN SIZE DISTRIBUTION CURVE - BH-04

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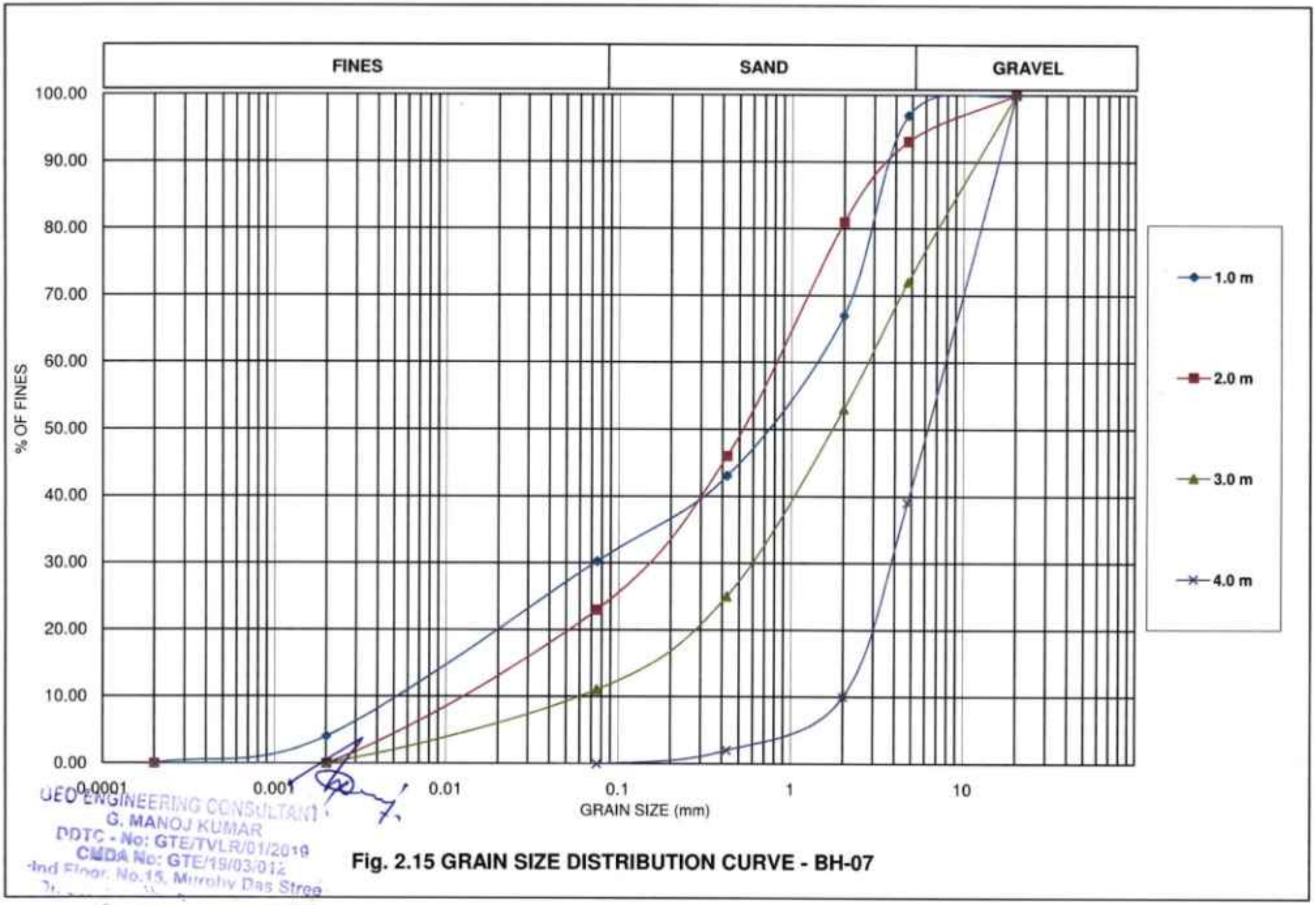
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Fig. 2.13 GRAIN SIZE DISTRIBUTION CURVE - BH-05



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Fig. 2.14 GRAIN SIZE DISTRIBUTION CURVE - BH-06



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Fig. 2.15 GRAIN SIZE DISTRIBUTION CURVE - BH-07

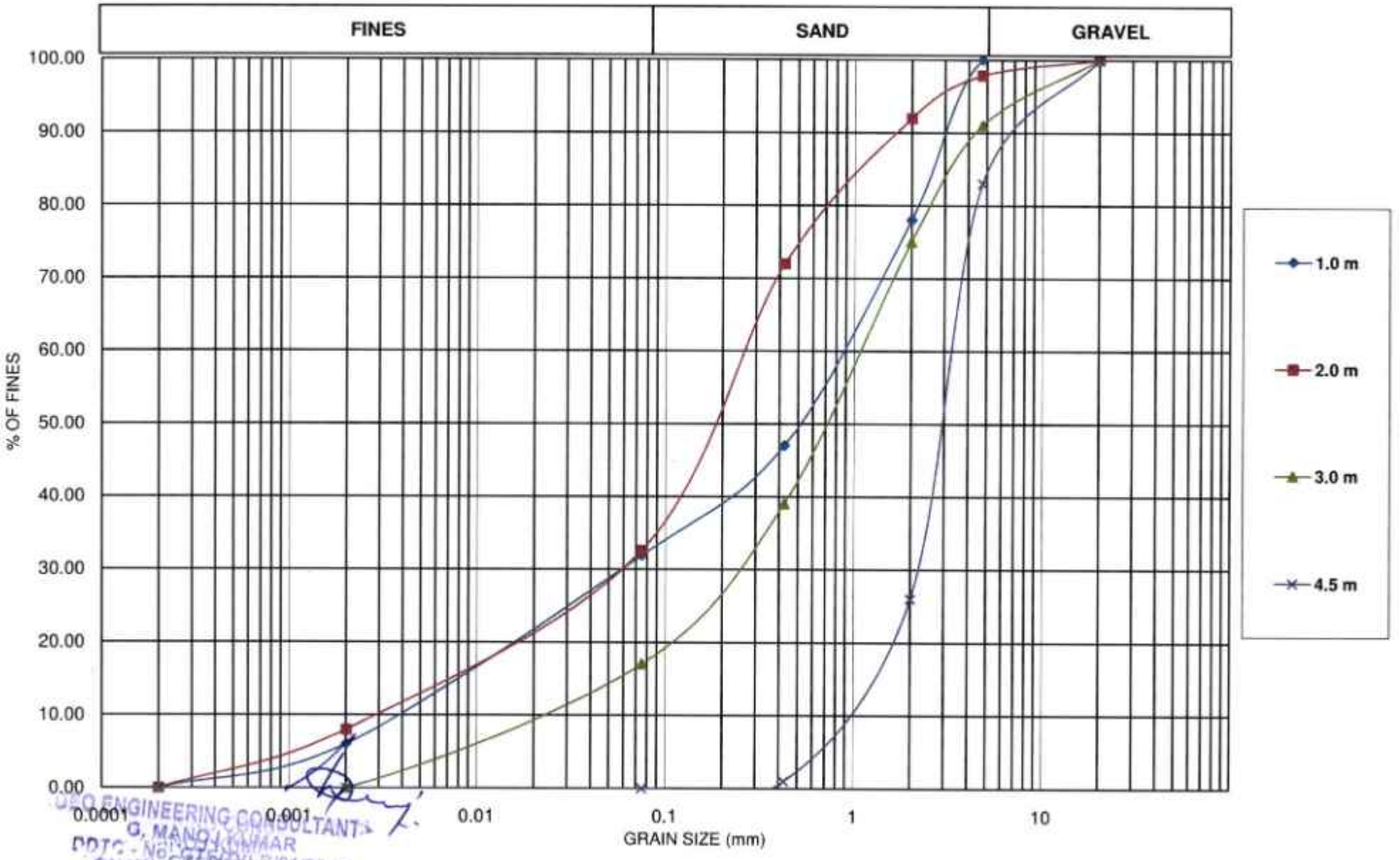


Fig. 2.16 GRAIN SIZE DISTRIBUTION CURVE - BH-08

HYDROMETER ANALYSIS CURVE

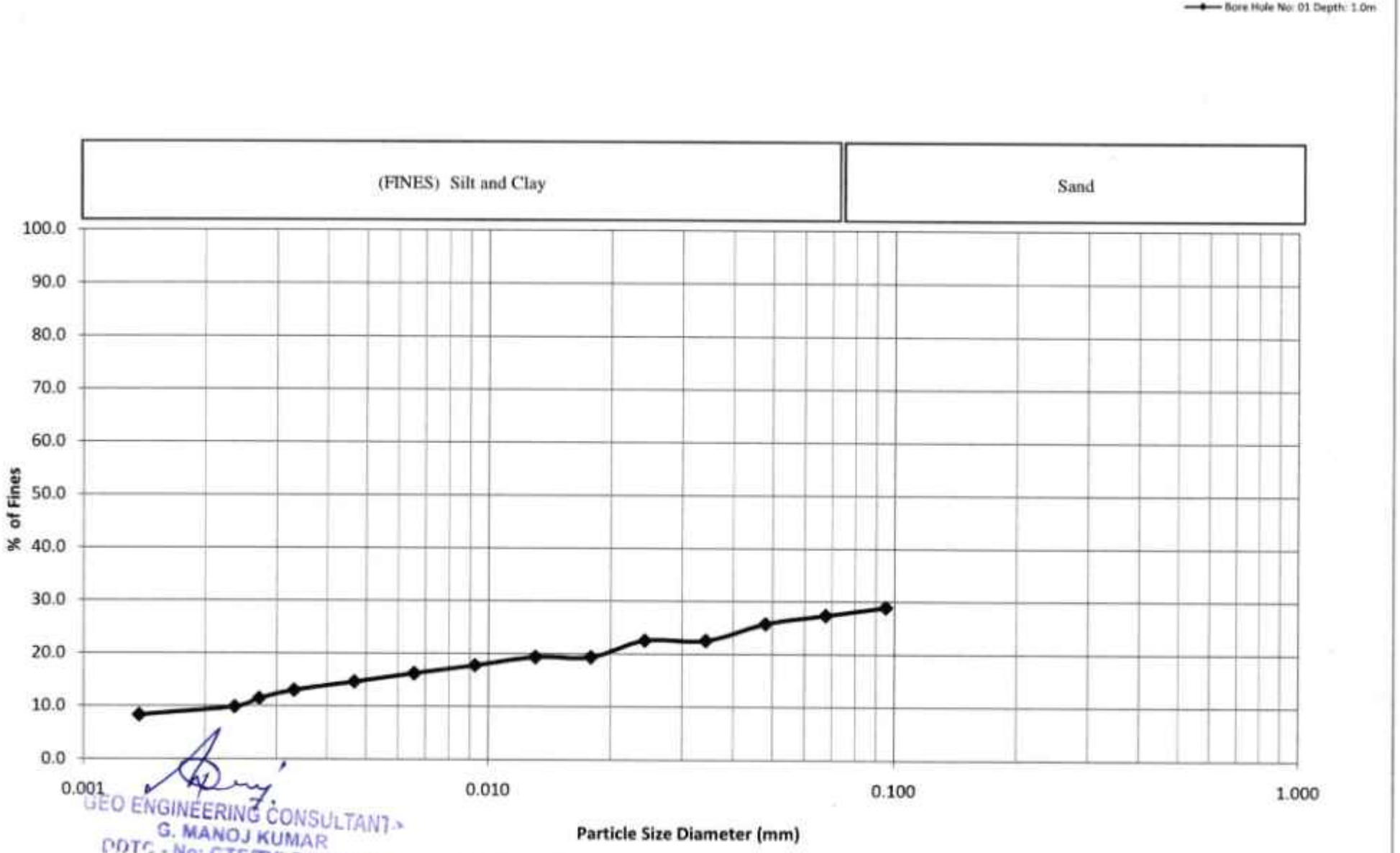


Fig 2.17 Hydrometer Analysis Master Curve

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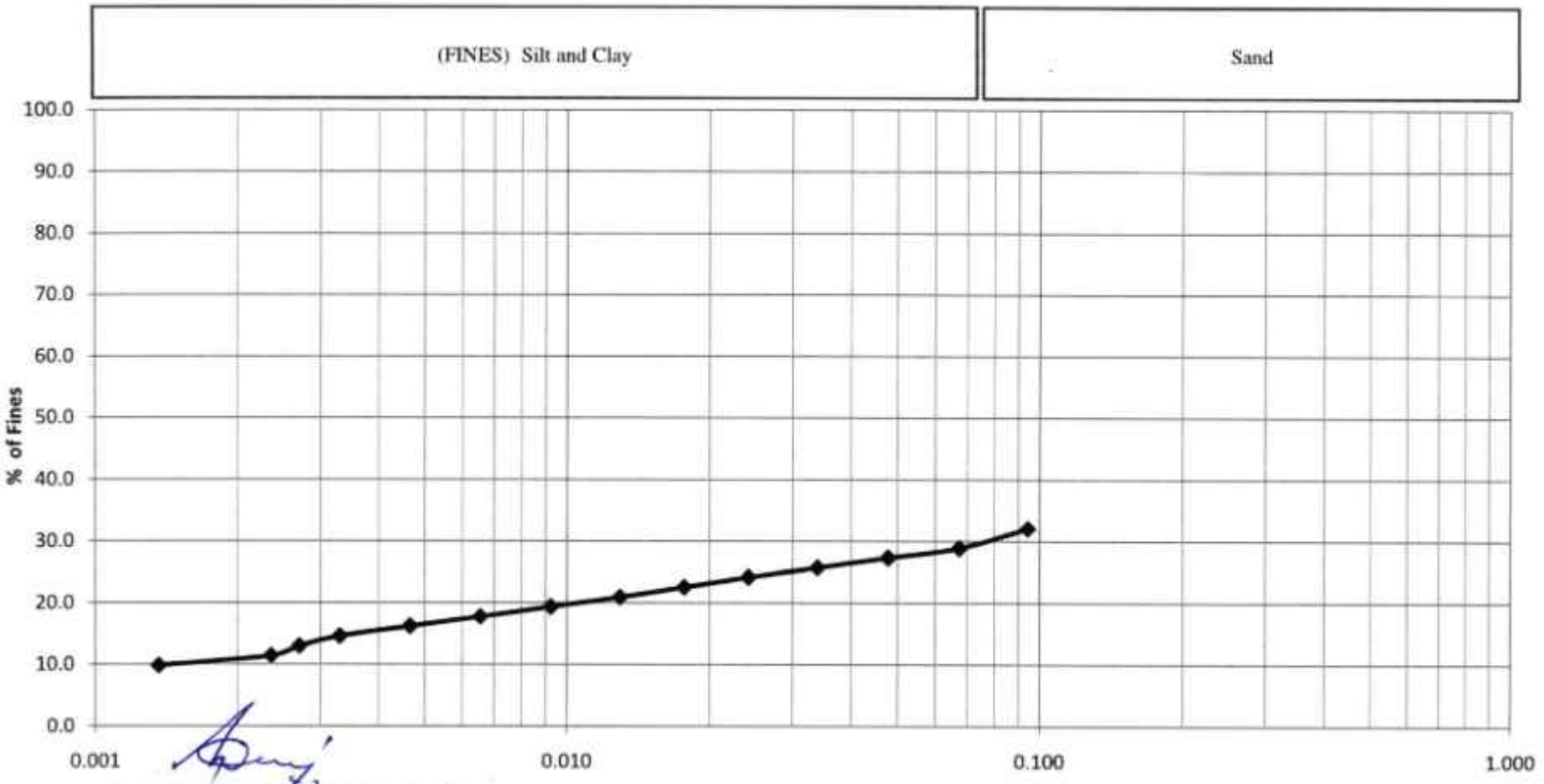
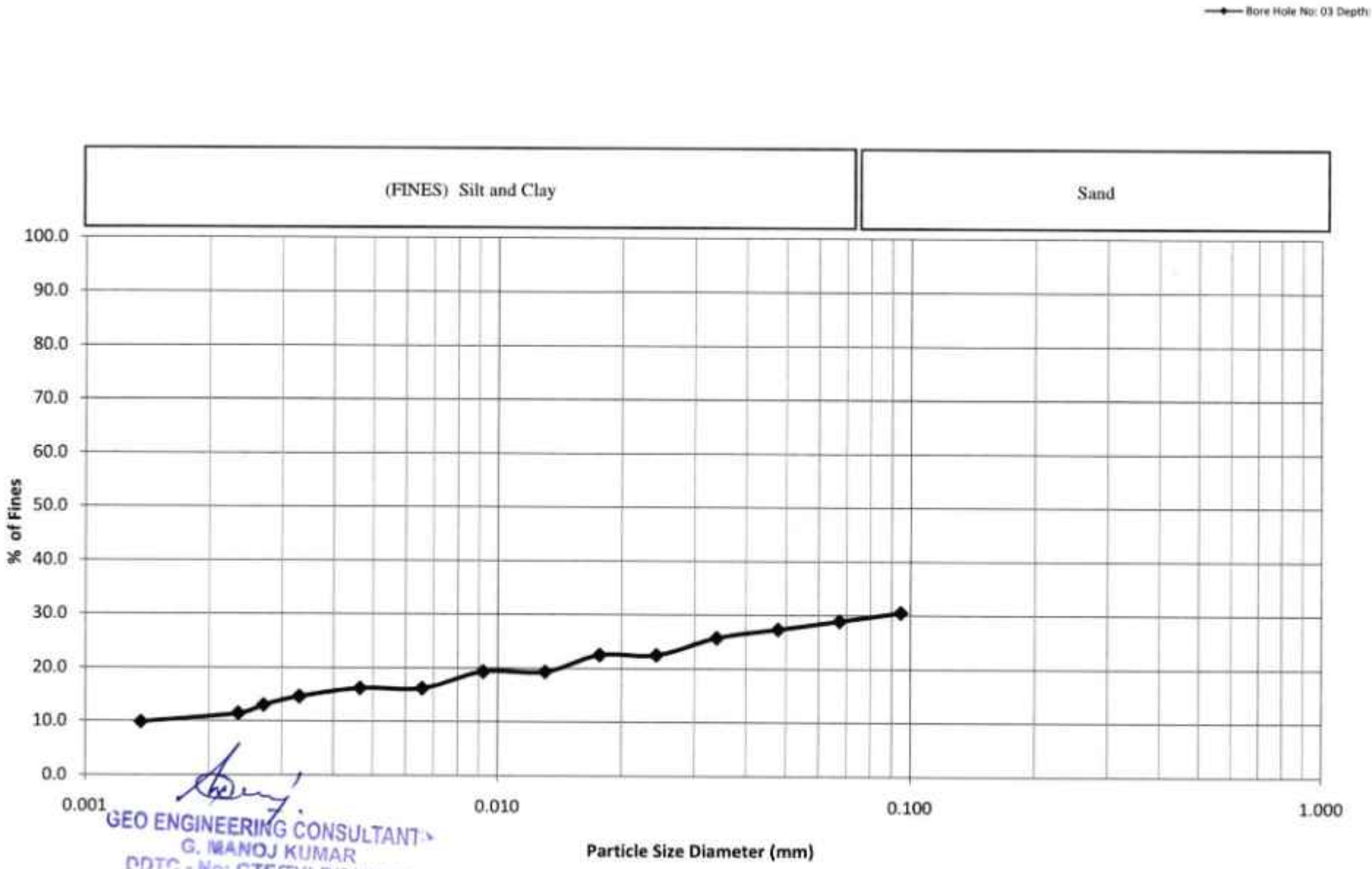


Fig 2.18 Hydrometer Analysis Master Curve

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Fig 2.19 Hydrometer Analysis Master Curve

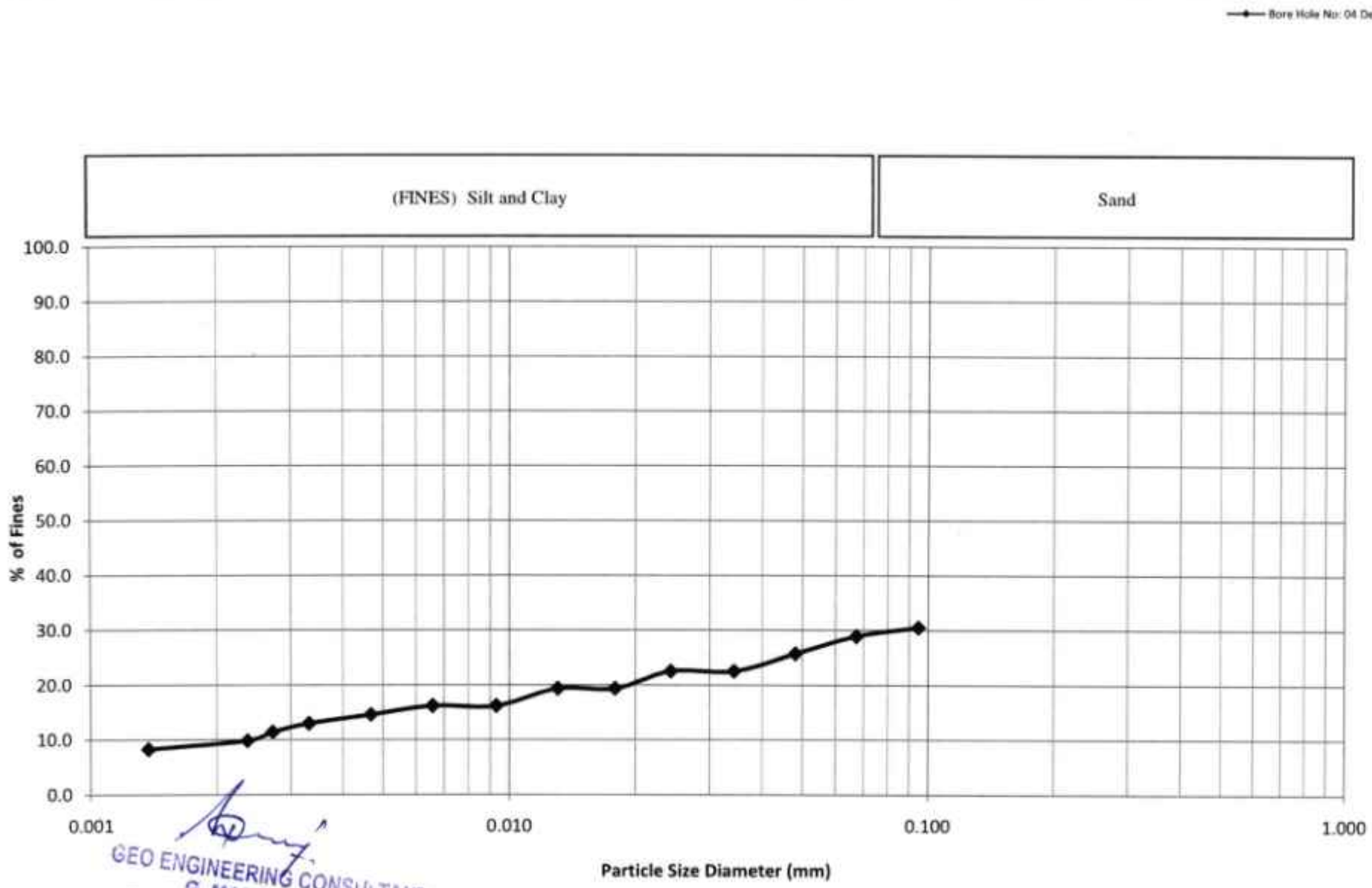
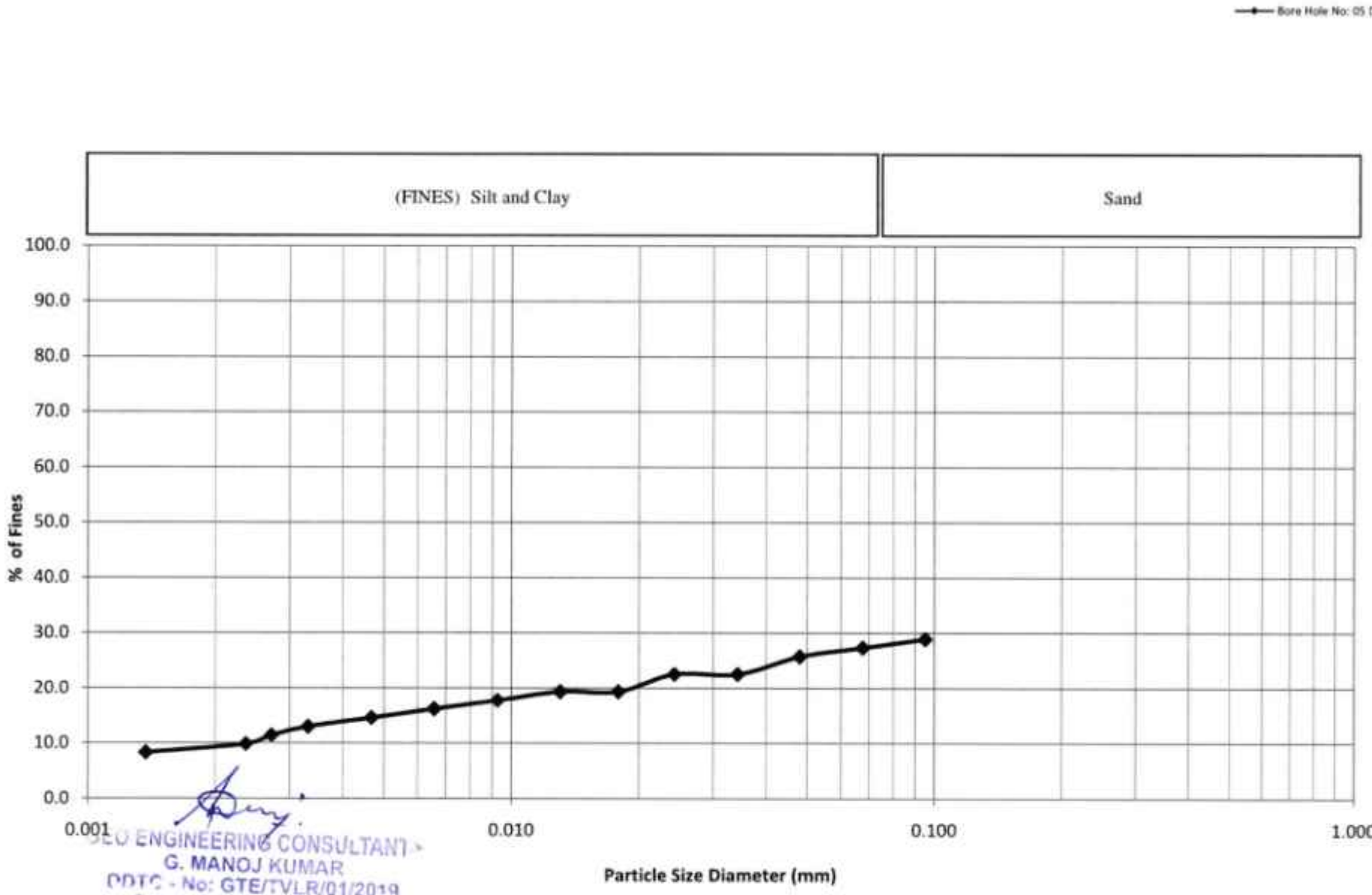


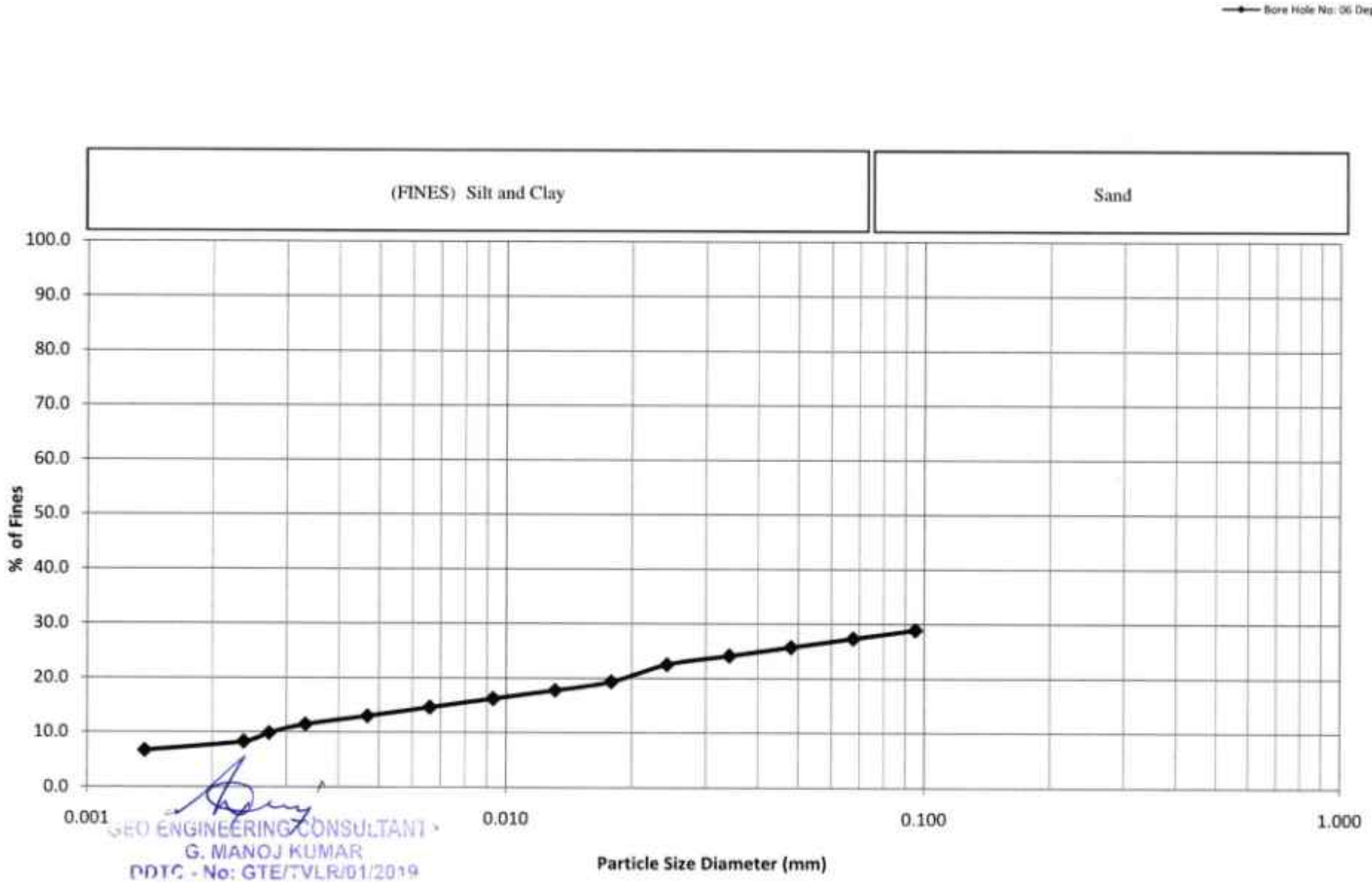
Fig 2.20 Hydrometer Analysis Master Curve

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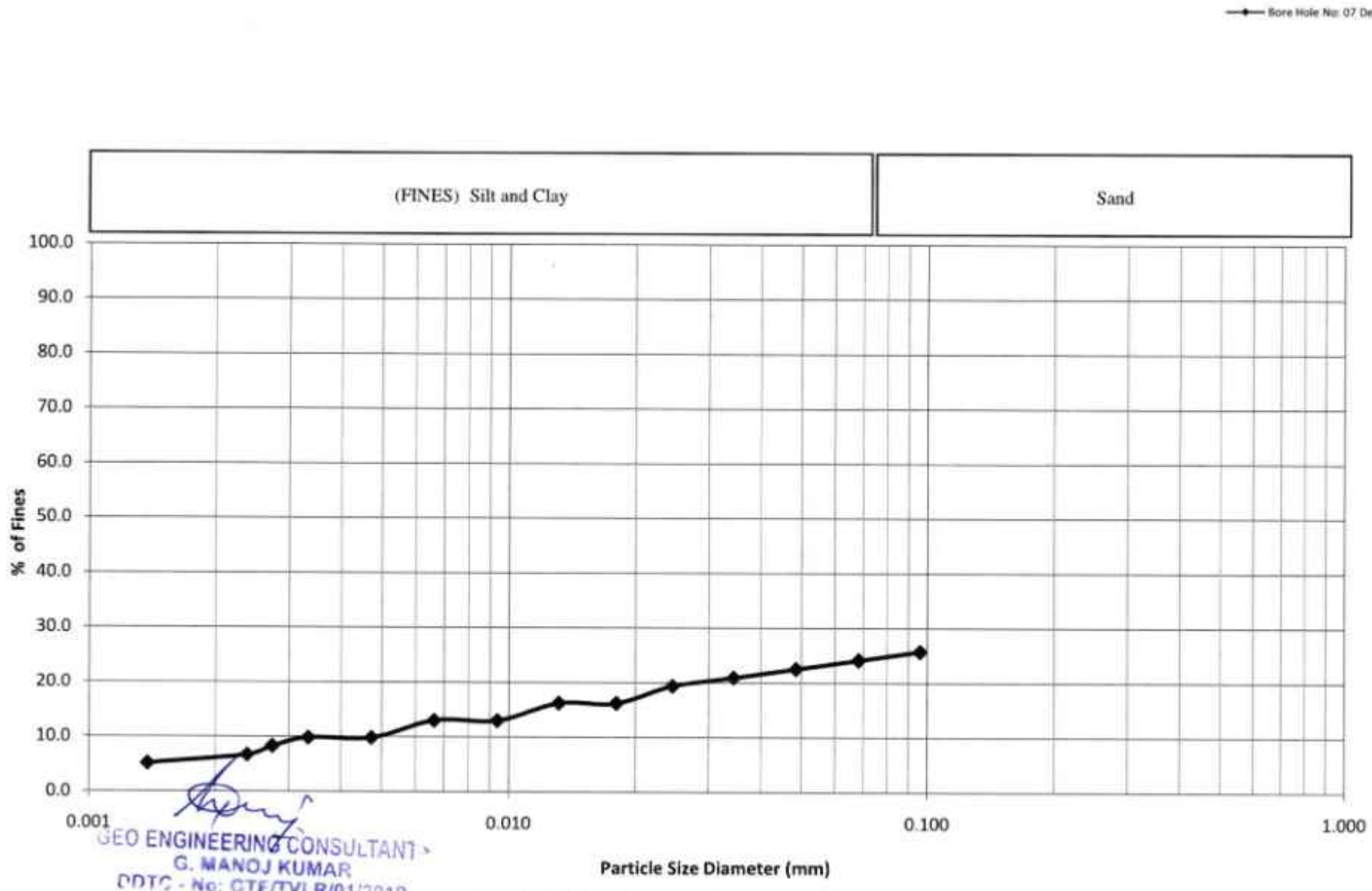
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Fig 2.21 Hydrometer Analysis Master Curve



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Fig 2.22 Hydrometer Analysis Master Curve



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Fig 2.23 Hydrometer Analysis Master Curve

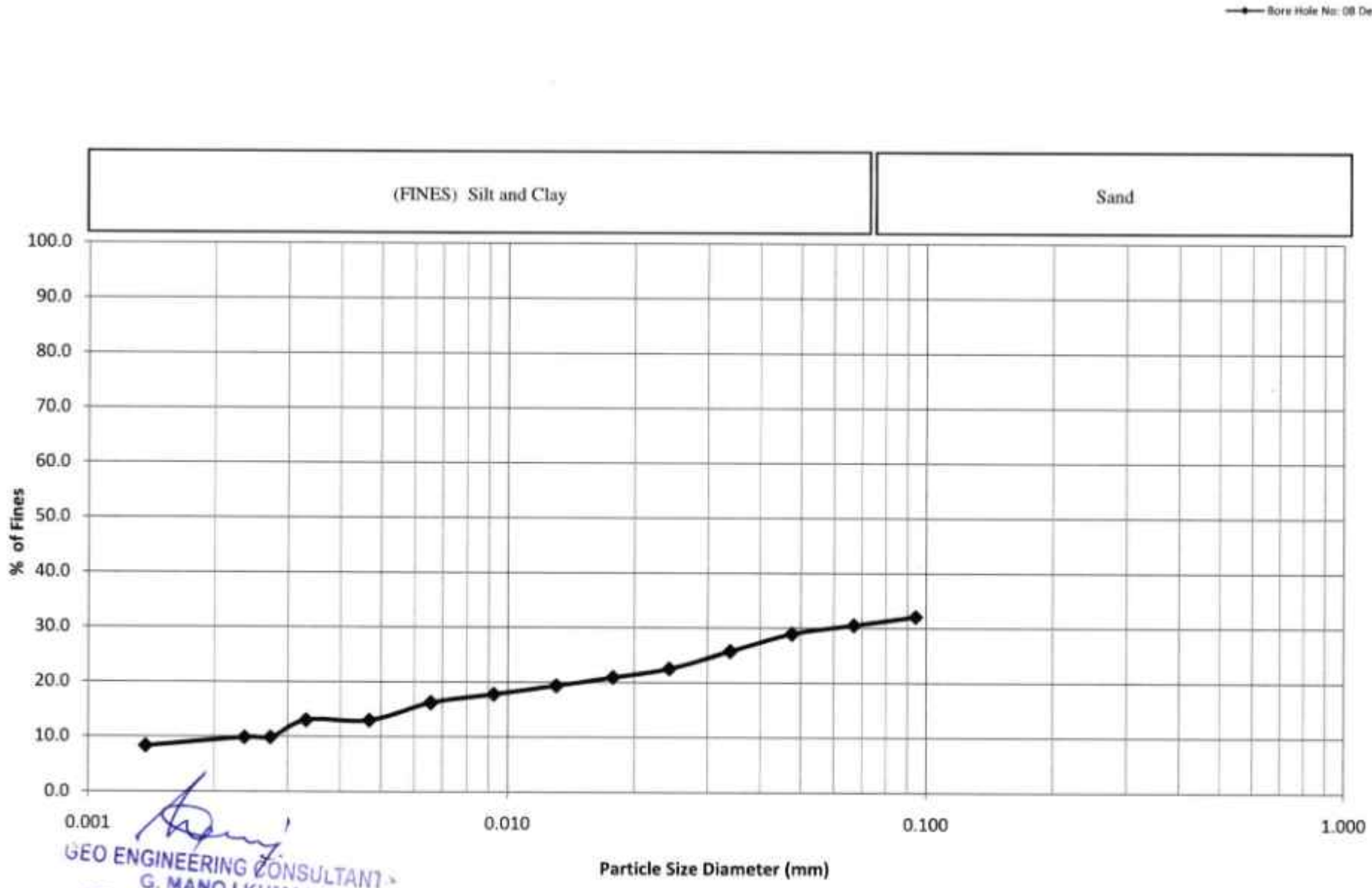


Fig 2.24 Hydrometer Analysis Master Curve

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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	17	SS	18	39	20	19	1.11	15	30	CG>50%	Above	-	3	30	18	9	32	8	-	-	-	-	-	M.Dense	<50%	SC
2.0	46	SS	-	-	-	-	-	-	-	CG>50%	-	-	31	22	23	11	13	0	-	-	-	-	-	Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	23	17	24	16	20	0	-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	15	27	41	15	2	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
IP=LL-PL

LAB IN-CHARGE	M.PRAVEEN
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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	15	SS	21	42	20	22	0.95	16	40	CG>50%	Above	-	0	32	19	9	31	9	-	-	-	-	-	M.Dense	<50%	SC
2.0	35	SS	-	-	-	-	-	-	-	CG>50%	-	-	39	16	18	11	16	0	-	-	-	-	-	Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	13	30	41	10	6	0	-	-	-	-	-	V.Dense	<50%	SP-SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	10	26	48	13	3	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
IP=LL-PL

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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	15	SS	22	41	20	21	0.90	14	61	CG>50%	Above	-	2	6	32	18	33	9	-	-	-	-	-	M.Dense	<50%	SC
2.0	41	SS	-	-	-	-	-	-	-	CG>50%	-	-	18	21	25	16	20	0	-	-	-	-	-	Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	27	46	22	3	2	0	-	-	-	-	-	V.Dense	<50%	SP
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	30	41	24	3	2	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
IP=LL-PL

LAB IN-CHARGE	M.PRAVEEN
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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	16	SS	14	36	16	20	1.10	16	53	CG>50%	Above	-	0	2	32	27	31	8	-	-	-	-	-	M.Dense	<50%	SC
2.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	23	18	22	15	22	0	-	-	-	-	-	V.Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	23	14	26	18	19	0	-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	62	32	4	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
IP=LL-PL

LAB IN-CHARGE	M.PRAVEEN
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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	16	SS	14	41	20	21	1.29	15	58	CG>50%	Above	-	0	2	32	26	32	8	-	-	-	-	-	M.Dense	<50%	SC
2.0	40	SS	13	38	18	20	1.25	19	10	CG>50%	Above	-	7	12	22	20	33	6	-	-	-	-	-	Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	60	10	11	6	13	0	-	-	-	-	-	V.Dense	GM	<50%
4.5	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	19	47	25	9	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
IP=LL-PL

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Table-2.6 Laboratory Classification of Soil Samples from BH-06

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	24	SS	12	44	20	24	1.33	18	10	CG>50%	Above	-	0	3	35	26	31	5	-	-	-	-	-	M.Dense	<50%	SC
2.0	>100	SS	11	33	19	14	1.57	19	11	CG>50%	Above	-	3	12	30	22	29	4	-	-	-	-	-	V.Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	26	20	25	15	14	0	-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	17	42	30	10	1	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
IP=LL-PL

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Table-2.7 Laboratory Classification of Soil Samples from BH-07

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	19	SS	13	39	16	23	1.13	15	42	CG>50%	Above	-	3	30	24	10	29	4	-	-	-	-	-	M.Dense	<50%	SC
2.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	7	12	35	23	23	0	-	-	-	-	-	V.Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	28	19	28	14	11	0	-	-	-	-	-	V.Dense	<50%	SP-SM
4.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	61	29	8	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
IP=LL-PL

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Table-2.8 Laboratory Classification of Soil Samples from BH-08

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification										Coarse Grained (CG)														
			Fine Grained (FG)																						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	25	SS	13	40	19	21	1.29	16	32	CG>50%	Above	-	0	22	31	11	30	6	-	-	-	-	-	M.Dense	<50%	SC
2.0	34	SS	17	32	18	14	1.07	16	41	CG>50%	Above	-	2	6	20	34	30	8	-	-	-	-	-	Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	9	16	36	22	17	0	-	-	-	-	-	V.Dense	<50%	SM
4.5	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	17	57	25	1	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
IP=LL-PL

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Table-2.9 Results of Chemical Analysis									
		Water				Soil (2:1)			
SL No.	Bore HoleNo.	Depth of Sample (m)	pH	Chlorides (mg/l)	Sulphates (mg/l)	Depth of Sample (m)	pH	Chlorides (mg/l)	Sulphates (mg/l)
1	BH-01	1.00	7.32	285	363	2.0	7.33	247	339
2	BH-03	1.00	7.32	275	354	2.0	7.34	241	320
3	BH-05	1.00	7.32	291	385	2.0	7.33	255	335
4	BH-07	1.00	7.33	284	381	2.0	7.34	236	315

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CHAPTER-3

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 the Region (based on the published data)

3.1.1 Formation Characteristics:

The present location falls under chengalpet district, which can be geologically classified as hard rock formation (Charnockite of Meta igneous origin) of Archaean Rock Group, overlain by recent alluvium deposits.The entire area is mostly covered by recent alluvium on the site. The rocks present in this site are of Archaean age undergone weathering to variable extent. The thickness of alluvium deposit is around 2 to 3 meter underlain by varying degree of weathering.

The present site is Sonallur, Chengalpattu District, geologically it is classified as recent alluvium deposits consisting of Clayey Silty Sand/Residual Soil, which is underlying by varying degree of weathering and basement rock.

Recent alluvium deposit

Archaean Basement Crystalline Rock

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3.2 DESIGN SUB SOIL PROFILE: (from 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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	2.00	2.00	Clayey Silty Sand	Greyish	17	Medium Dense	-	18	-	32.1
2	2.00	2.50	0.50	Residual Soil	Greyish Brown	46	Dense	-	20	-	40.1
3	2.50	4.00	1.50	Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5
4	4.00	5.00	1.00	Highly Weathered Rock	Greyish Brown	CRR= 6% , 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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	2.00	2.00	Clayey Silty Sand	Greyish	15	Medium Dense	-	17.5	-	31.5
2	2.00	3.00	1.00	Residual Soil	Greyish Brown	35	Dense	-	19.5	-	37.38
3	3.00	4.00	1.00	Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5
4	4.00	5.00	1.00	Highly Weathered Rock	Greyish Brown	CRR= 8% , RQD= 0%					

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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	Clayey Silty Sand	Greyish	15	Medium Dense	-	17.5	-	31.5
2	2.00	2.50	0.50	Residual Soil	Greyish	41	Dense	-	20	-	38.98
3	2.50	4.00	1.50	Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5
4	4.00	5.00	1.00	Highly Weathered Rock	Greyish Brown	CRR= 8% , RQD= 0%					

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	16	Medium Dense	-	18	-	31.8
2	1.50	2.30	0.80	Residual Soil	Whitish Yelow	>100	Very Dense	-	21	-	42.5
3	2.30	4.00	1.70	Completely Weathered Rock	Whitish Yelow	>100	Very Dense	-	21	-	42.5
4	4.00	5.00	1.00	Highly Weathered Rock	Greyish Brown	CRR= 4% , RQD= 0%					

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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	2.00	2.00	Clayey Silty Sand	Brownish	16	Medium Dense	-	18	-	31.8
2	2.00	2.50	0.50	Residual Soil	Brownish	40	Dense	-	20	-	38.75
3	2.50	4.50	2.00	Completely Weathered Rock	Brownish	>100	Very Dense	-	21	-	42.5
4	4.50	6.00	1.50	Highly Weathered Rock	Greyish Brown	CRR= 10% , RQD= 0%					

REFERENCE BORE HOLE-BH:					06	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	Clayey Silty Sand	Brownish	24	Medium Dense	-	18.5	-	34.2
2	2.00	2.50	0.50	Residual Soil	Brownish	>100	Very Dense	-	21	-	42.5
3	2.50	4.00	1.50	Completely Weathered Rock	Brownish	>100	Very Dense	-	21	-	42.5
4	4.00	5.50	1.50	Moderately Weathered Rock	Greyish Brown	CRR= 11% , RQD= 0%					

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REFERENCE BORE HOLE-BH:					07	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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(Cu) kPa	(ϕ) Deg.
1	0.00	2.00	2.00	Clayey Silty Sand	Reddish Brown	19	Medium Dense	-	18	-	32.7
2	2.00	2.30	0.30	Residual Soil	Brownish	>100	Very Dense	-	21	-	42.5
3	2.30	4.50	2.20	Completely Weathered Rock	Brownish	>100	Very Dense	-	21	-	42.5
4	4.50	5.50	1.00	Moderately Weathered Rock	Greyish Brown	CRR= 18% , RQD= 0%					

REFERENCE BORE HOLE-BH:					08	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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(Cu) kPa	(ϕ) Deg.
1	0.00	2.00	2.00	Clayey Silty Sand	Reddish Brown	25	Medium Dense	-	18.5	-	34.5
2	2.00	3.00	1.00	Residual Soil	Brownish	34	Dense	-	19.5	-	37.1
3	3.00	4.50	1.50	Completely Weathered Rock	Brownish	>100	Very Dense	-	21	-	42.5
4	4.50	6.00	1.50	Highly Weathered Rock	Greyish Brown	CRR= 8% , RQD= 0%					

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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 ground floor plus one upper floors, and is meant for residential building occupancy. For this kind of structure, the column loads could vary between 500 kN to 900 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

For the kind of sub soil characteristics and the proposed structure shallow foundation system shall be adopted. The Isolated footings can be located at varying depths ranging from 1.0m to 2.0m below the existing ground level and the recommended allowable safe bearing pressures for different depth are worked out as per IS: 6403 and are presented in Table-4.1. All the footing shall rest 100mm thick M10 grade levelling coarse bed.

Typical computations are presented in Annexure.

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Table-4.1 Recommended Allowable Safe Bearing Pressures			
Sl.No.	Depth of Foundation below E.G.L. (m)	Allowable Safe Bearing Pressure (kPa)	Elastic Settlement (mm)
		Size of Foundation (m)	Size of Foundation (m)
		1.0	1.0
1	1.0	100	2.46
2	1.5	200	3.69
3	2.0	250	3.69

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RECOMMENDATIONS

CHAPTER-5

RECOMMENDATIONS

5.0 Recommendation for Shallow Foundation

- For the kind of sub soil characteristics and the proposed structures shallow foundation system shall be adopted
- The isolated footings can be located at varying depths ranging from 1.0m to 2.0m below the existing ground level
- The recommended allowable safe bearing pressures for different depths are worked out as per IS: 6403 and are presented in Table-4.1.
- All footings shall rest on 100mm thick M10 Grade levelling coarse bed.
- The excavated soil shall be used for foundation trenches.

5.1 General Recommendations

- Since, chlorides are well within the permissible limits, no special steel or cement is required for the construction of footings
- Recommendations of the type of cement used for the construction of substructure with chloride and sulphate concentration in soil & water as per IS: 456-2000 is presented in Table 5.1.

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ANNEXURE

Table-5.1: Recommendations of the Type of Cement used for the Construction of Substructure along with extract of permissible limits as per IS:456-2000

Concentration of Sulphates expressed as SO_3				Type of Cement	Cement Content (kg/m^3)	Max. Water-Cement Raio	Recommended Cement
In 2:1 water Soil		In Ground Water					
g/l	ppm	g/l	ppm				
<1	<1000	<0.3	<300	OPC/PPC/PSC	280	0.55	
1 to 1.9	1000-1900	0.3-1.2	300-1200	OPC/PPC/PSC	330	0.5	Recommended
				SSC/SRPC	310	0.5	
1.9 to 3.1	1900-3100	1.2-2.5	1200-2500	SSC/SRPC	330	0.5	
				PPC/PSC	350	0.45	
3.1-5	3100-5000	2.5-5	2500-5000	SSC/SRPC	370	0.45	
>5	>5000	>5	>5000	SSC/SRPC	400	0.4	
Where chloride is encountered along with sulphates in soil or ground water, ordinary portland cement with C_3A content form 5 to 8 percent shall be desirable to be used in concrete, instead of sulphate resisting cement. Alternatively, Portland slag cement conformng to IS 455 having more than 50 percent slag or a blend of ordinary portland cement and slag may be used provided sufficent information is available on performance of such blended cements in these conditions.							Recommended

OPC	Oridnary Port Land Cement	SSC	Supersulphated Cement
PPC	Portland Pozzolana Cement	SRPC	Sulpahte Resistant Port Land Cement
PSC	Portland Slag Cement		

NOTES:

However, the structural consultant shall refer the notes below Table-4, page-19 of IS:456-2000 for any required additional information on the use of cement for the construction of substrucutre.

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TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

Ref. BH-02

1.1 Geometrical Data :

Shape of the Foundation	square
Depth of Foundation Below E.G.L"Df" (m)	1.50
Soil Replacement Thickness of CNS Layer (m)	0.00
Total Depth of Foundation (m)	1.50
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 :	Sand
Average Design SPT-value of the Bearing Strata	20.00
Type of Shear Failure:	General
Angle of Shearing Resistance	33.00

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (g_{bulk})	18.00
Water Table Correction Factor (w')	0.50
Effective Overburden pressure at foundation level (q)	12.00

Bearing Capacity Factors:

N_c = N/A

N_q = 27.34

N_g = 37.78

Shape Factors:

S_c = -

S_q = 1.20

S_g = 0.80

Depth Factors :

D_c = -

D_q = 1.03

D_g = 1.03

Inclination Factor:

I_c = 1.00

I_q = 1.00

I_g = 1.00

1.4 Ultimate Bearing Capacity (Qu) :

Qu=q'(Nq-1)'Sq'Dq'Iq + 0.5'B'g'Ng'Sg'Dg'Ig'w' 531.73 kPa

(g should be read as gama)

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) : 2.50

Qsafe : 212.69 kPa

Say Q_{safe} 200 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 200.00

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_{si})	52000.00
Size of footing considered for maximum settlement(m)	1.00
Influence factor	1.00
Rigidity Factor	1.00
Elastic Settlement (DH_i)	3.69 mm
	<50 mm

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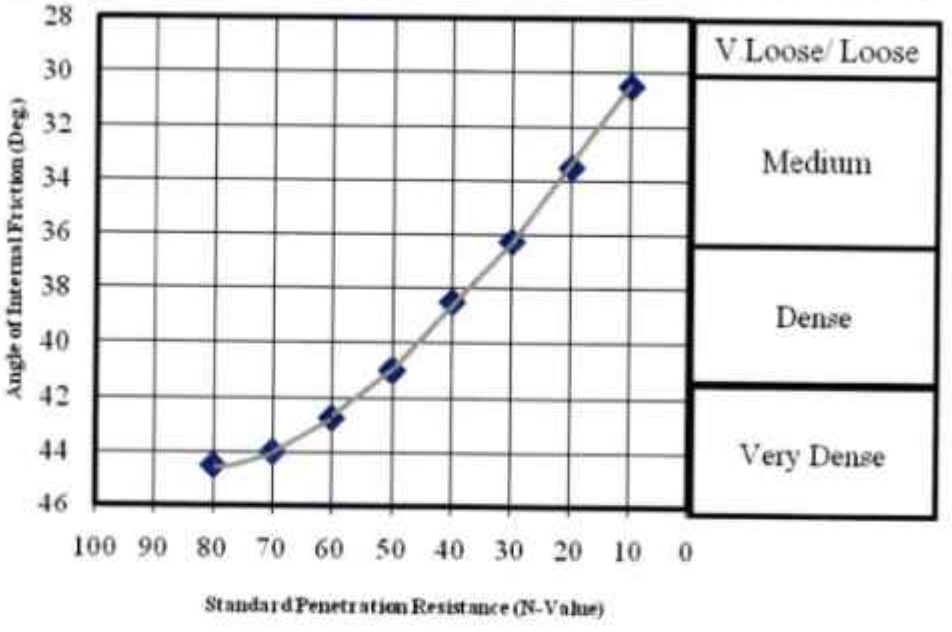


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

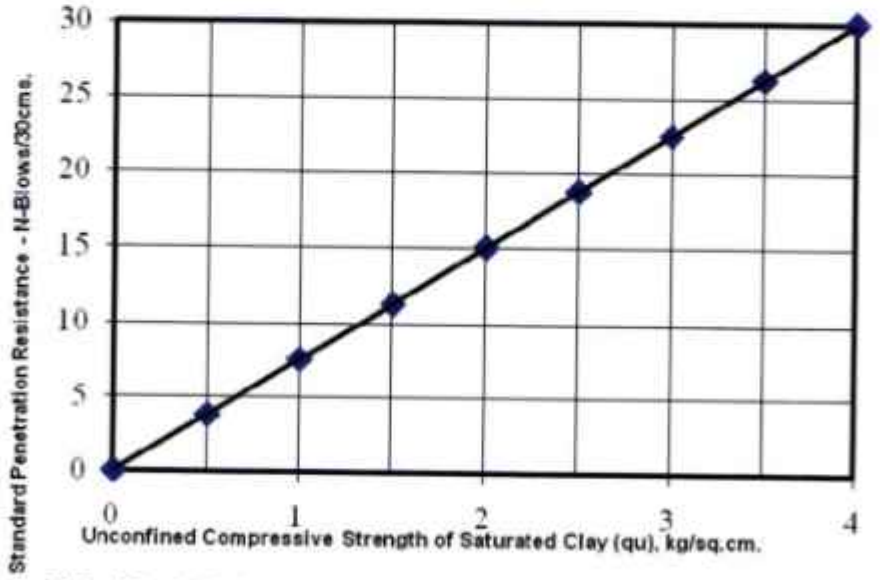


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)

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