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PROJECT

GEOTECHNICAL INVESTIGATION FOR THE PROPOSED GROUP HOUSING (GROUND + 2 FOORS) DEVELOPMENT AT PADUR, CHENGALPATTU DISTRICT LOCATED IN SURVEY NOs 126/1A, 126/1B, 126/1C, 126/2, 126/3, 225/1, 226/2B, 226/2C, 226/2D, 226/3, 226/4A, 226/4B, 226/5, 228/1, 228/2, 228/3, 228/4, 228/5, 233/2, 233/3, 233/4, 233/5 PADUR 5.70 ACRES

CLIENT

V.G.N HOMES PRIVATE LIMITED,
NO. 333, POONAMALLEE HIGH ROAD,
AMAINDAKARAI, CHENNAI – 600 029.

TITLE

GEOTECHNICAL INVESTIGATION REPORT

REPORT NO.: GT- 2237

DATE	REVISON	DESCRIPTION		AUTHORISED SIGNATORY
03/07/2021	FIRST SUBMISSION	SUBMISSION OF FINAL GEOTECHNICAL REPORT	SIGN	
			DATE	03/07/2021
			DESIGNATION	**MANAGING DIRECTOR**
			NAME	**DR. C.V.PRASAD**

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GEOMARINE
THE SPIRIT OF ENGINEERING

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REPORT TEXT

CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project : **GROUP HOUSING DEVELOPMENT (GROUND + 2 FLOORS)**

Project Owner : **M/s V.G.N HOMES PRIVATE LIMITED**

Project Location : **PADUR, CHENGALPATTU DISTRICT**

Job Code : **GT-2237**

1.1 Scope Of Work

1.1.1 Field Work

- Conducting five soil investigation bore holes of 150 mm diameter in Soil & Overburden. In case of rock formation NX Diameter with Core barrel shall be adopted to progress the drilling up the termination depth.
- Conducting Standard Penetration Test (SPT) within the borehole at:
  - Every 1.0m depth interval up to 6.0m.
  - From 6.0m to 12.0m, SPT is conducted at every 1.5m depth interval
  - From 12.0m to 20.0m SPT is conducted at every 2.0m depth interval
  - Beyond 20.0m SPT is conducted at every 2.5m depth interval till the termination depth.
- In the project site, the depth of investigation is 4.0m below the existing ground level
- 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
- Sub-Surface Stratification
- Foundation System
- Recommendation
- Annexure

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

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

2.1 Methodology of Field Work:

2.1.1 Equipment Used and Method of Drilling:

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

2.1.2 Standard Penetration Tests:

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

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

2.1.3 Collection of Soil Samples:

2.1.3.1 Disturbed Samples:

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

2.1.4 Collection of Ground Water Samples:

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

Note on Groundwater Table Record:

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

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 Table – 2.1 to 2.5. The graphical representation of grainsize distribution curve for the representative samples in each bore is presented in Fig. 2.7 to 2.11

2.2.2 On Fine Grained Soil

On the SPT sample index property tests were conducted to estimate consistency. These test results are presented in Table- 2.1 to 2.5. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig. 2.12 to 2.16.

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

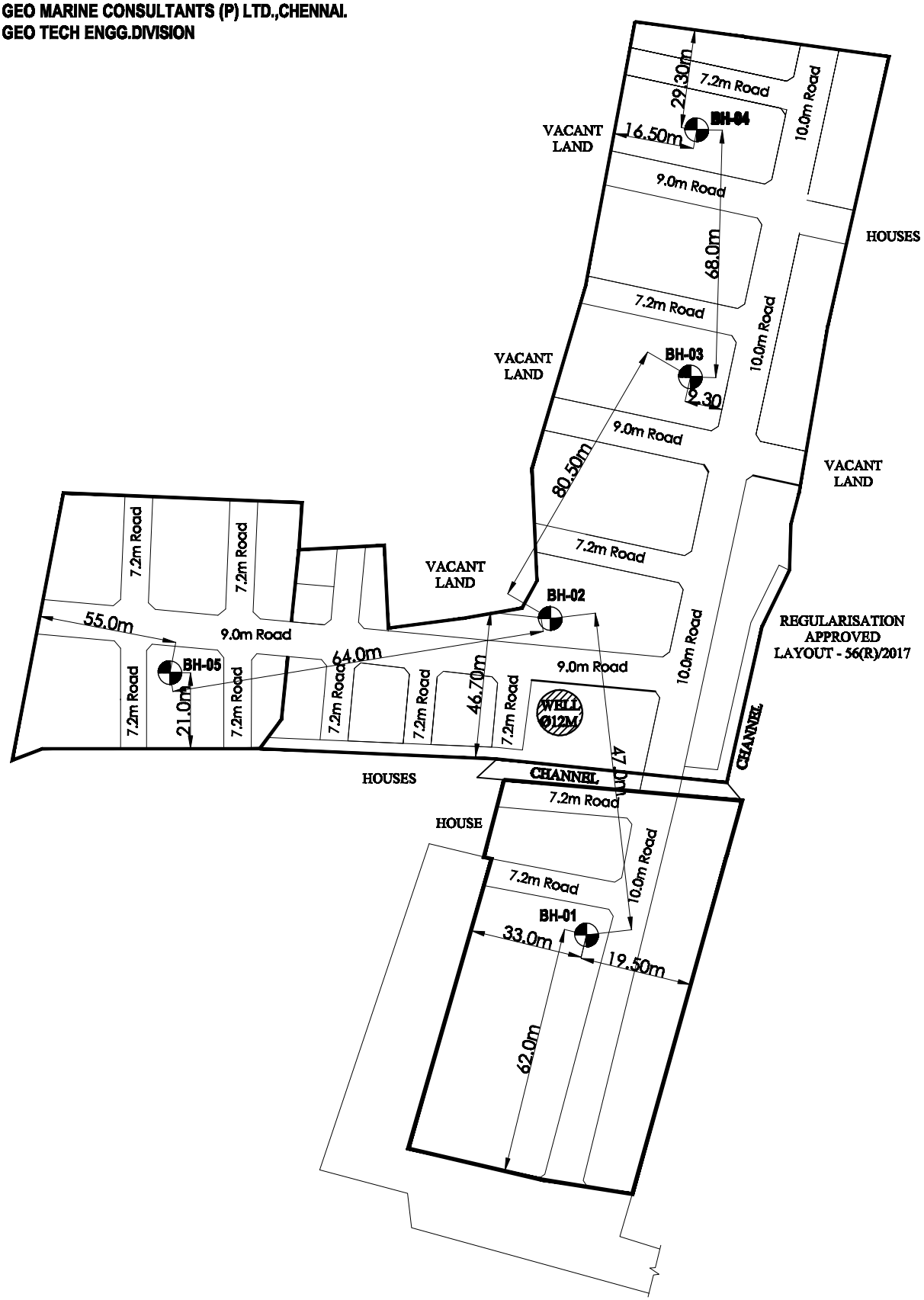
2.3 Summary:

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 Fig. 2.1 to 2.5.

The sub soil strata variation within the investigation location is presented in cross section profile Fig. 2.6.

SITE PLAN

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GEO TECH ENGG.DIVISION



2.0 SITE PLAN SHOWING THE LOCATION OF FIELD INVESTIGATION POINTS AT VGN PADUR.

SOIL PROFILES

GEOMARINE THE SPIRIT OF ENGINEERING	SITE INVESTIGATION RECORD	BORE HOLE No.	BH-01
		PAGE No.	1

PROJECT NAME	PROPOSED CONSTRUCTION OF GROUP HOUSING DEVELOPMENT	DIA OF BORE HOLE	150mm ✓ / NX

LOCATION	Padur, OMR	MACHINE No.	-	CHAINAGE (m)		-	BORE START DATE	24/06/2021
STRUCTURE	G+1 or 2 Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N	-	BORE END DATE	24/06/2021
JOB CODE	JC-GT-2237	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 %	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
	24/06/2021	14 To 14	33 To 37	SC	-	-												Brown,Yellow Brown,Moist,Poorly Graded,Fine & Medium Grains Sand Fraction,Medium Dense,**Clayey Silty SAND (SC)**
1							14	16	13	**29**	1.00 – 1.45	1	SS	-1.0				
		14 To 14	51 To 53	SC	-	-												
2							40	6cm Penet for 55Blows		**>100**	2.00 – 2.21	2	SS	-2.0		L1	2.0	
		15 To 15	05 To 07	SC	-	-												Brown,Greyish Brown,Moist,Fine to Coarse Sand & Gravels Mixture,Very Dense,**Completely Weathered Rock - Grade V Rock** / Descent from Hypersthene Granite
3							30	7cm Penet for 57Blows		**>100**	3.00 – 3.22	3	SS	-3.0				
		15 To 15	21 To 25	SC	-	-												
4							12cm Penet for 59Blows			**>100**	4.00 – 4.12	4	SS	-4.0		L2	4.2	
5																		
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	K. Loganathan	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	24/06/2021	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Karthik	WATER TABLE (m)	2.80	
WS - Wash Sample	DB - Diamond Bit	DATE	28/06/2021	CASING DEPTH (m)	0.0	

Borehole terminated at 4 m depth below E.G.L

FIG.2.1 Sub Soil Profile at BH-01 Location

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02
PAGE No.	1

PROJECT NAME	PROPOSED CONSTRUCTION OF GROUP HOUSING DEVELOPMENT					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Padur, OMR	MACHINE No.	-	CHAINAGE (m)	-	BORE START DATE	24/06/2021
STRUCTURE	G+1 or 2 Floors	DRILLING METHOD	Rotary	CO-ORDINATES N	-	BORE END DATE	24/06/2021
JOB CODE	JC-GT-2237	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	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	24/06/2021	11	17	SC	-	-												
		To																
		11	19				13	15	16	31	1.00	1	SS	-1.0				Greyish Brown,Moist,Poorly Graded, Fine to Coarse Sand,Dense,**Clayey Silty SAND (SC)**
		11	31								1.45							
		To		SC	-	-										L1	1.7	
2		11	33												+ + +			
							12cm Penet for 52Blows			>100	2.00	2	SS	-2.0	+ + +			
		11	47								2.12				+ + +			
		To		SC	-	-									+ + +			Brown,Greyish Brown,Moist,Fine to Coarse Sand With Gravels,Very Dense,**Residual Soil & Completely Weathered Rock - Grade V & VI Rock Formation**/ Descent from Hypersthene Granitic Rock
3		11	50												+ + +			
							37	7cm Penet for 55Blows		>100	3.00	3	SS	-3.0	+ + +			
		12	02								3.22				+ + +			
		To		SC	-	-									+ + +			
		12	13												+ + +			
4							4cm Penet for 60Blows			>100	4.00	4	SS/WS	-4.0	+ +	L2	4.1	
											4.04							
5																		
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	K. Loganathan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	24/06/2021	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Karthik	WATER TABLE (m) 2.80	
WS - Wash Sample	DB - Diamond Bit	DATE	28/06/2021	CASING DEPTH (m) 0.0	

Borehole terminated at 4 m depth below E.G.L

FIG.2.2 Sub Soil Profile at BH-02 Location

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-03
PAGE No.	1

PROJECT NAME	PROPOSED CONSTRUCTION OF GROUP HOUSING DEVELOPMENT					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Padur, OMR	MACHINE No.	-	CHAINAGE (m)	-	BORE START DATE	25/06/2021
STRUCTURE	G+1 or 2 Floors	DRILLING METHOD	Rotary	CO-ORDINATES N	-	BORE END DATE	26/06/2021
JOB CODE	JC-GT-2237	FLUSHING MEDIUM	Bentonite	CO-ORDINATES 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	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	25/06/2021	12	19	SC	-	-												
		To																
		12	20				11	14	9	23	1.00	1	SS	-1.0				Brown,Greyish Brown,Moist,Poorly Graded,Fine to Medium Grains,Medium Dense,**Silty SAND (SM)/ Partly Residual Soil**
		12	40								1.45							
		To		SC	-	-												
2		12	42				12	18	46	64	2.00	2	SS	-2.0		L1	2.0	
	26/06/2021	12	57								2.45				+ + + + + + + + + + + +			Brown,Greyish Brown,Moist,Fine to Coarse Sand With Gravels,Very Dense,**Residual Soil & Completely Weathered Rock - Grade V & VI Rock Formation**/ Descent from Hypersthene Granitic Rock
		To		SC	-	-												
3		13	00				23	17	68	85	3.00	3	SS	-3.0				
		13	16								3.45							
		To		SC	-	-												
		13	19															
4							45	7cm Penet for 55Blows		>100	4.00	4	SS	-4.0	+ +	L2	4.3	
											4.22							
5																		
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	K. Loganathan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	26/06/2021	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Karthik	WATER TABLE (m) 2.80	
WS - Wash Sample	DB - Diamond Bit	DATE	28/06/2021	CASING DEPTH (m) 0.0	

Borehole terminated at 4 m depth below E.G.L

FIG.2.3 Sub Soil Profile at BH-03 Location

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-04
PAGE No.	1

PROJECT NAME	PROPOSED CONSTRUCTION OF GROUP HOUSING DEVELOPMENT					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Padur, OMR	MACHINE No.	-	CHAINAGE (m)	-	BORE START DATE	26/06/2021
STRUCTURE	G+1 or 2 Floors	DRILLING METHOD	Rotary	CO-ORDINATES N	-	BORE END DATE	26/06/2021
JOB CODE	JC-GT-2237	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	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	26/06/2021	15	25	SC	-	-												
		To																
		15	27				13	23	28	**51**	1.00 / 1.45	1	SS	-1.0				Brown,Greyish Brown,Moist,Poorly Graded,Fine & Medium Grains Sand Fraction,Very Dense,**Clayey Silty SAND (SC)**
		15	46															
		To		SC	-	-												
2		15	47				9	10	14	**24**	2.00 / 2.45	2	SS	-2.0		L1	2.0	
		15	58												+ + + / + + / + + + / + + / + + +			Greyish Brown,Moist,Fine to Medium Grains Sand Fraction With Gravel Mix, Medium Dense,**Clayey Silty Sand With Lime (SC)/ Residual Soil - Grade VI Rock Formation**
		To		SC	-	-												
		16	00													L2	3.0	
3							25	15cm Penet for 62Blows		**>100**	3.00 / 3.30	3	SS	-3.0	+ + + / + + / + + + / + + / + + +			Brown,Greyish Brown,Moist,Fine to Coarse Sand & Gravels Mixture,Very Dense,**Completely Weathered Rock - Grade V Rock** / Descent from Hypersthene Granite
		16	13															
		To		SC	-	-												
		16	17													L3	4.1	
4							4cm Penet for 52Blows			**>100**	4.00 / 4.02	4	WS	-4.0				
5																		
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	K. Loganathan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	26/06/2021	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Karthik	WATER TABLE (m) 2.80	
WS - Wash Sample	DB - Diamond Bit	DATE	28/06/2021	CASING DEPTH (m) 0.0	

Borehole terminated at 4 m depth below E.G.L

FIG.2.4 Sub Soil Profile at BH-04 Location

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-05
PAGE No.	1

PROJECT NAME	PROPOSED CONSTRUCTION OF GROUP HOUSING DEVELOPMENT					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Padur, OMR	MACHINE No.	-	CHAINAGE (m)	-	BORE START DATE	24/06/2021
STRUCTURE	G+1 or 2 Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	24/06/2021
JOB CODE	JC-GT-2237	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

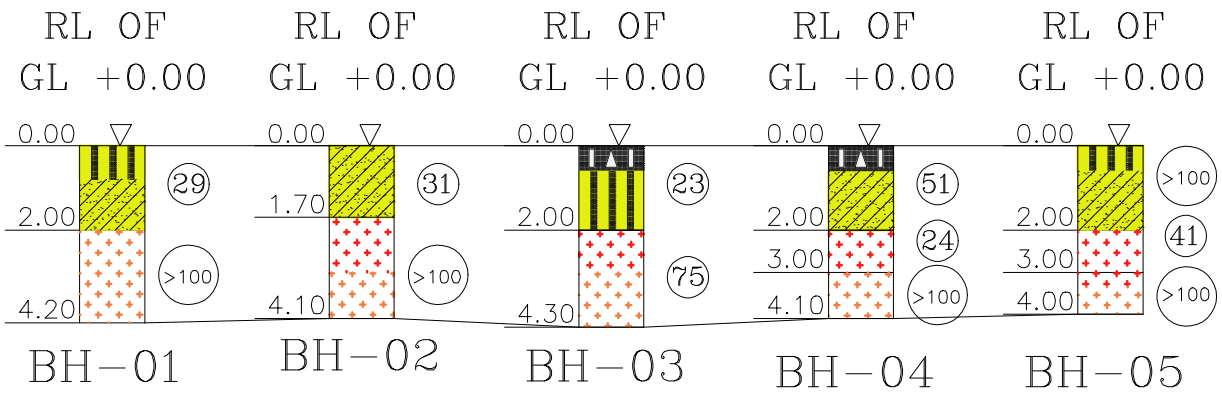
Depth below E.G.L. (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
1	24/06/2021	16	27	SC	-	-												
		To																
		16	29				10cm Penet for 55Blows			>100	1.00 / 1.10	1	SS	-1.0				Reddish Brown,Moist,Poorly Graded, Fine to Coarse Sand With Gravels,Very Dense,**Clayey Sandy Gravels (SC)**
		16	44															
		To		SC	-	-												
2		16	45				12	12	29	41	2.00 / 2.45	2	SS	-2.0		L1	2.0	
		17	09															Brown,Yellow Brown,Moist,Fine to Coarse Sand With Gravels,Dense, **Residual Soil - Grade VI Rock Formation** / Descent from Hypersthene Grantic Rock
		To		SC	-	-												
		17	11															
3		17	22				30	12cm Penet for 56Blows		>100	3.00 / 3.27	3	SS	-3.0		L2	3.0	
		To		SC	-	-												Brown,Greyish Brown,Moist,Fine to Coarse Sand With Gravels,Very Dense,**Residual Soil & Completely Weathered Rock - Grade V & VI Rock Formation**/ Descent from Hypersthene Granitic Rock
		17	26															
4							6cm Penet for 60Blows			>100	4.00 / 4.06	4	SS	-4.0		L3	4.0	
5																		
6																		
7																		
8																		
9																		
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	K. Loganathan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	24/06/2021	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Karthik	WATER TABLE (m) 2.80	
WS - Wash Sample	DB - Diamond Bit	DATE	28/06/2021	CASING DEPTH (m) 0.0	

Borehole terminated at 4 m depth below E.G.L

FIG.2.5 Sub Soil Profile at BH-05 Location

CROSS SECTION PROFILE



LEGEND

SILTY SAND (SM)

CLAYEY SILTY SAND (SC)

COMPLETELY WEATHERED ROCK(GRADE-05)

COMPLETELY WEATHERED ROCK(GRADE-06)

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

GRAIN SIZE DISTRIBUTION CURVE

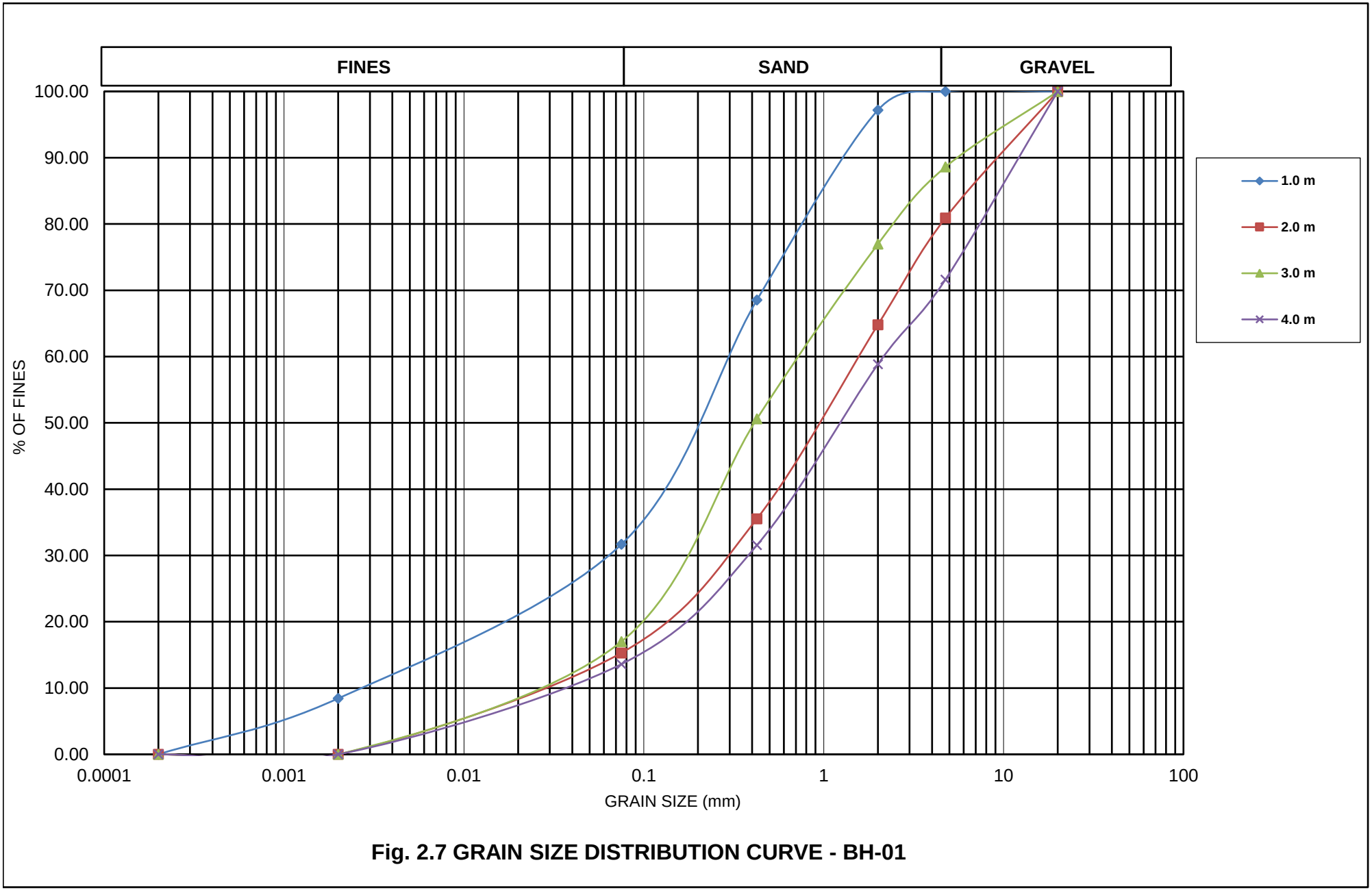


Fig. 2.7 GRAIN SIZE DISTRIBUTION CURVE - BH-01



Fig. 2.8 GRAIN SIZE DISTRIBUTION CURVE - BH-02

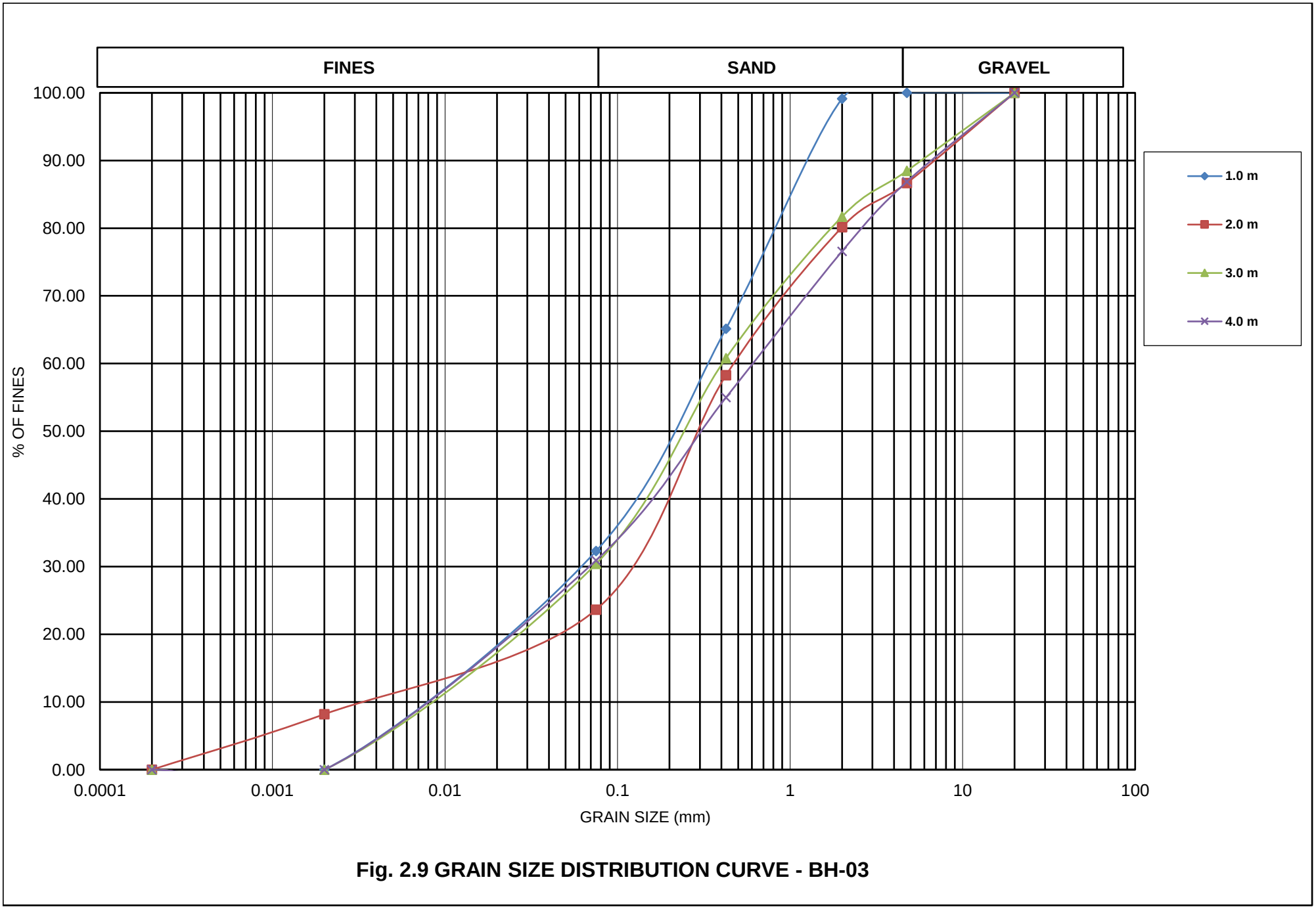


Fig. 2.9 GRAIN SIZE DISTRIBUTION CURVE - BH-03

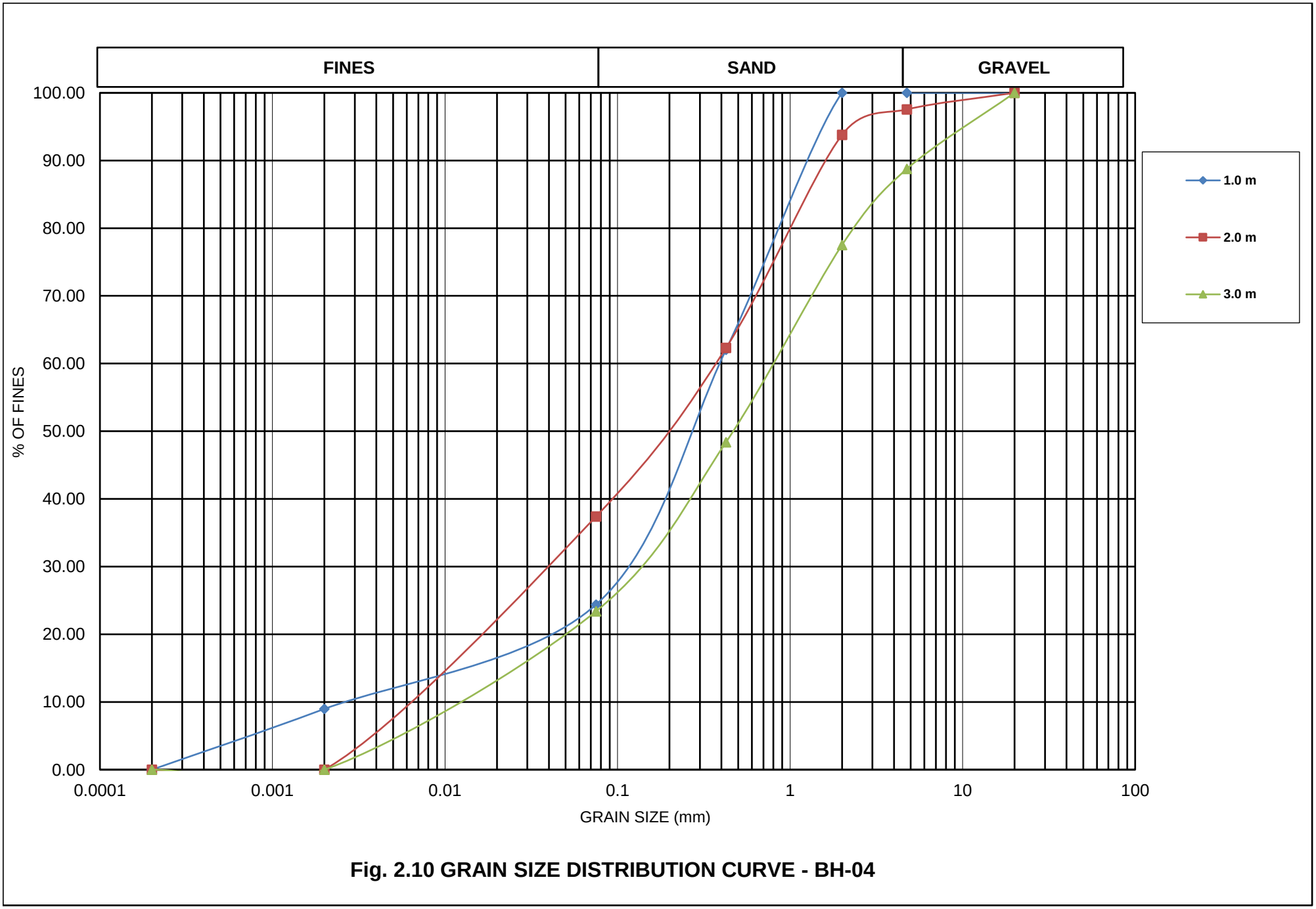


Fig. 2.10 GRAIN SIZE DISTRIBUTION CURVE - BH-04

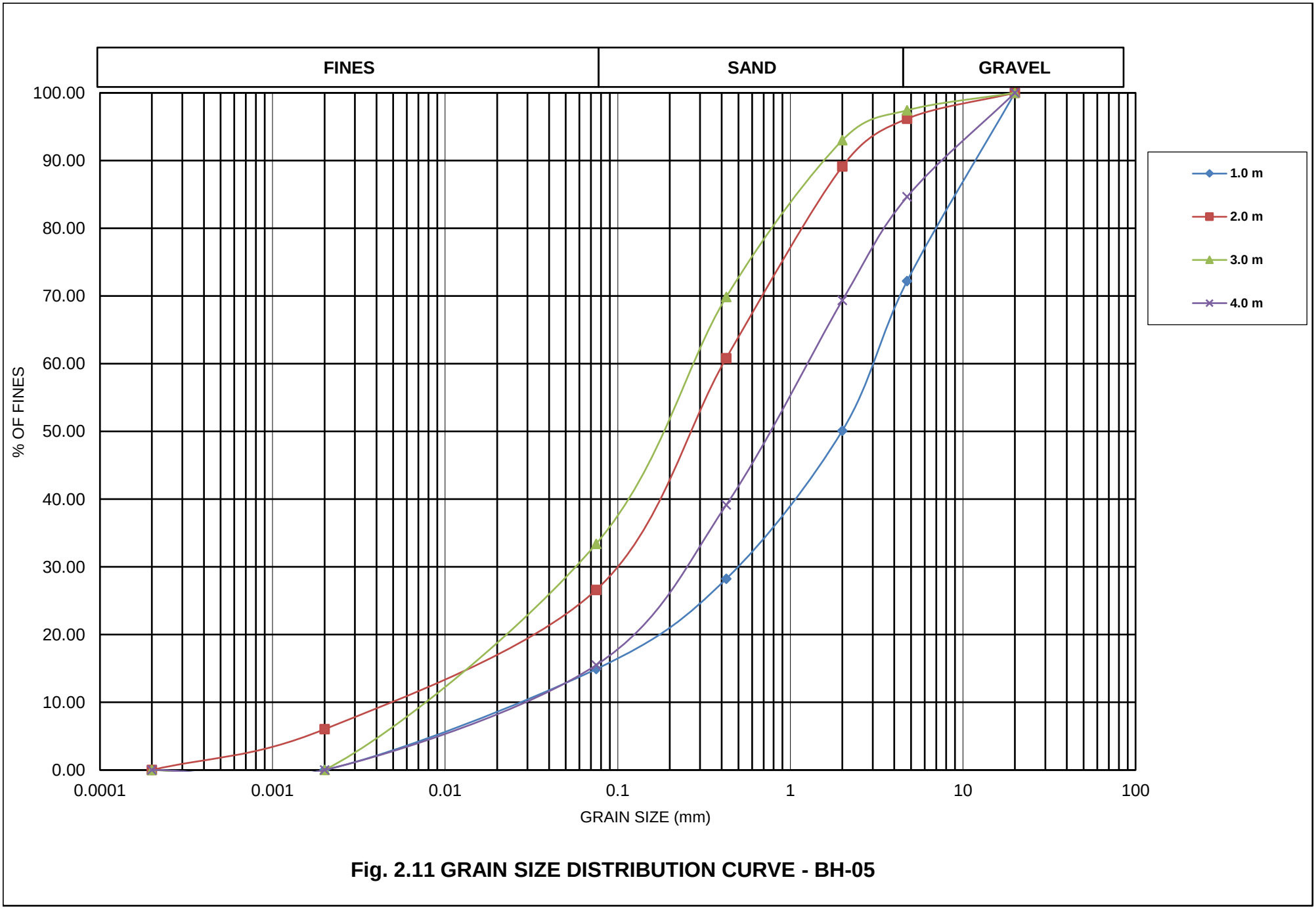


Fig. 2.11 GRAIN SIZE DISTRIBUTION CURVE - BH-05

HYDROMETER ANALYSIS CURVE

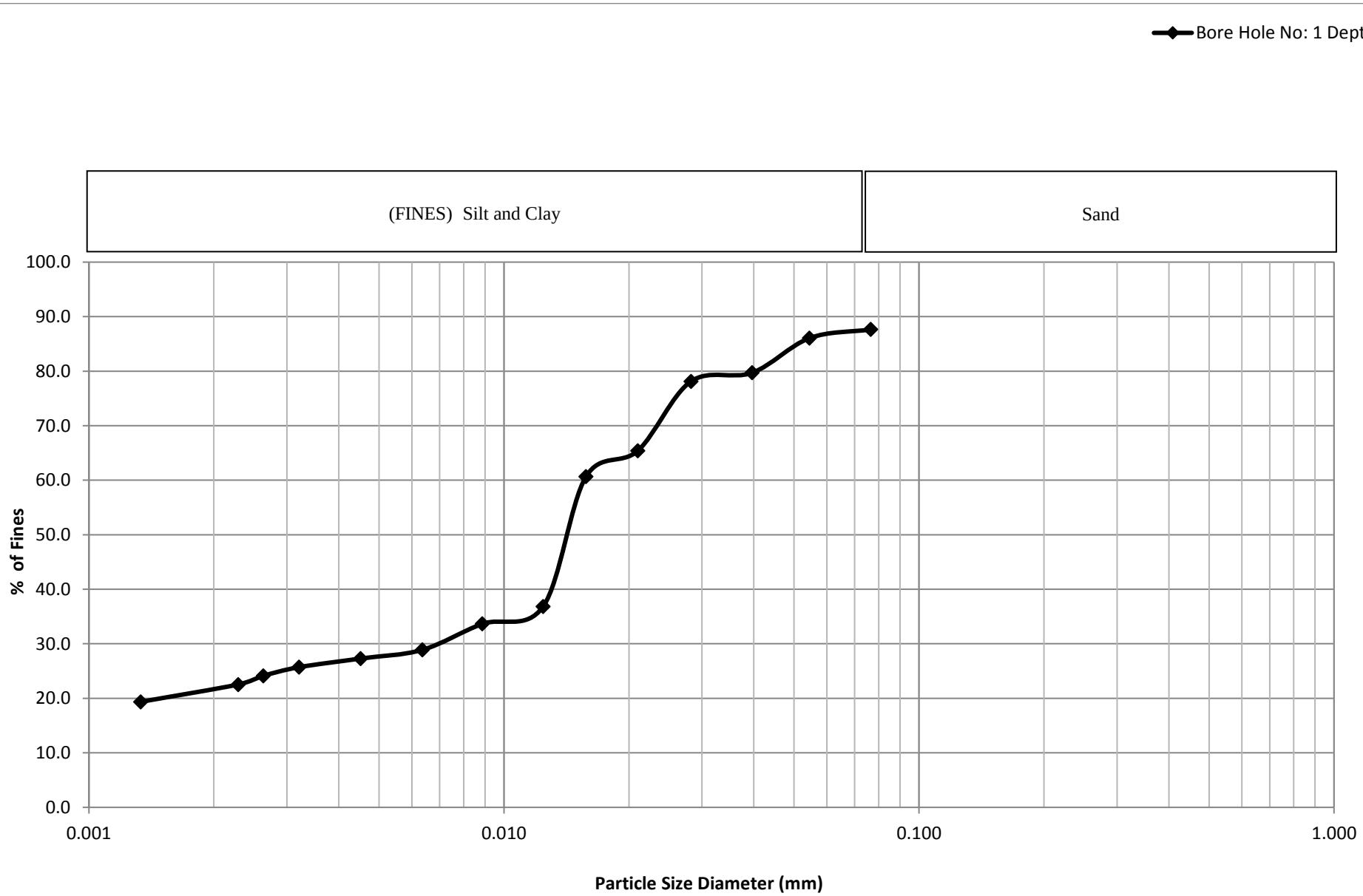


Fig 2.12 Hydrometer Analysis Master Curve

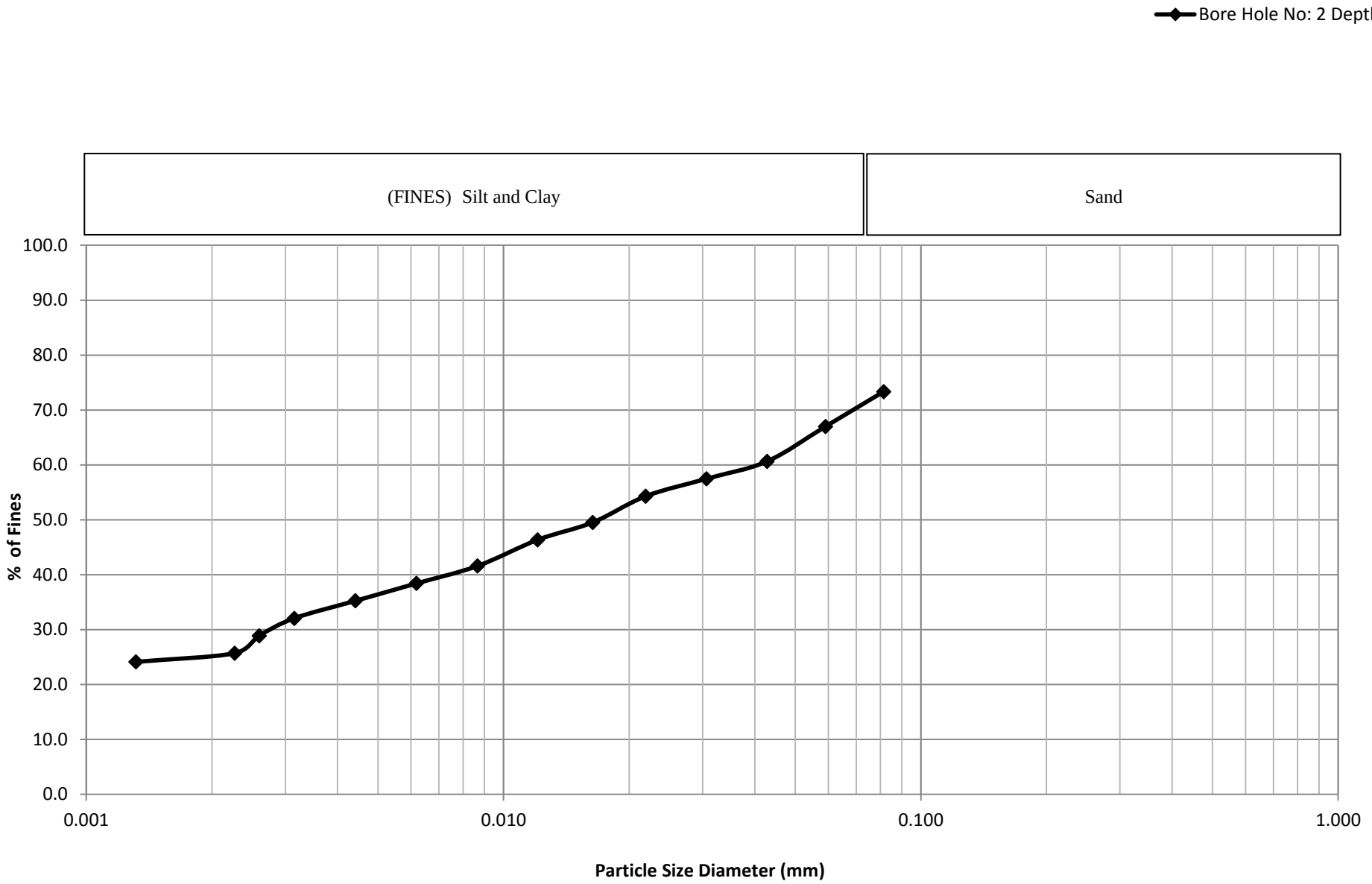


Fig 2.13 Hydrometer Analysis Master Curve

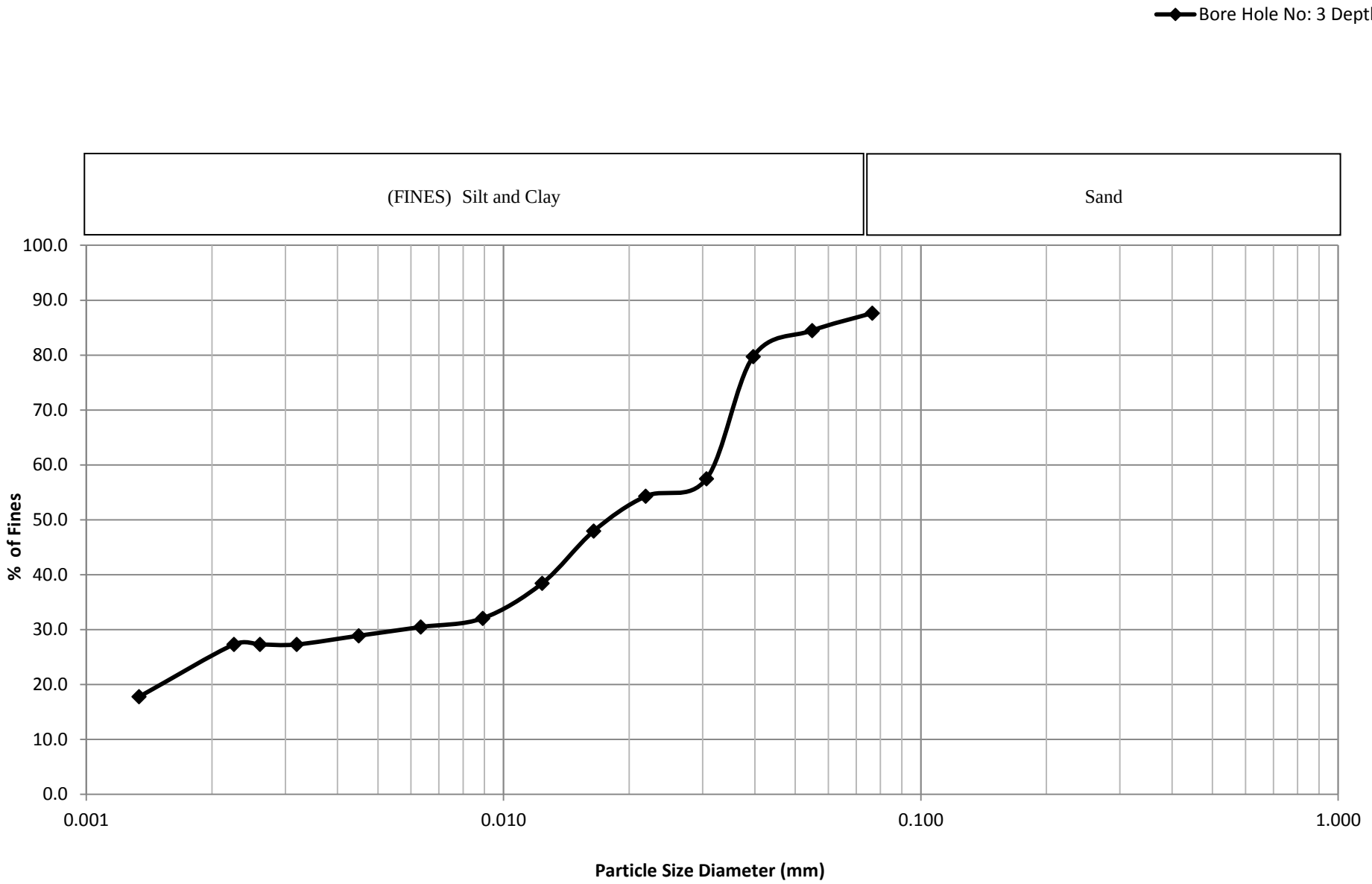


Fig 2.14 Hydrometer Analysis Master Curve

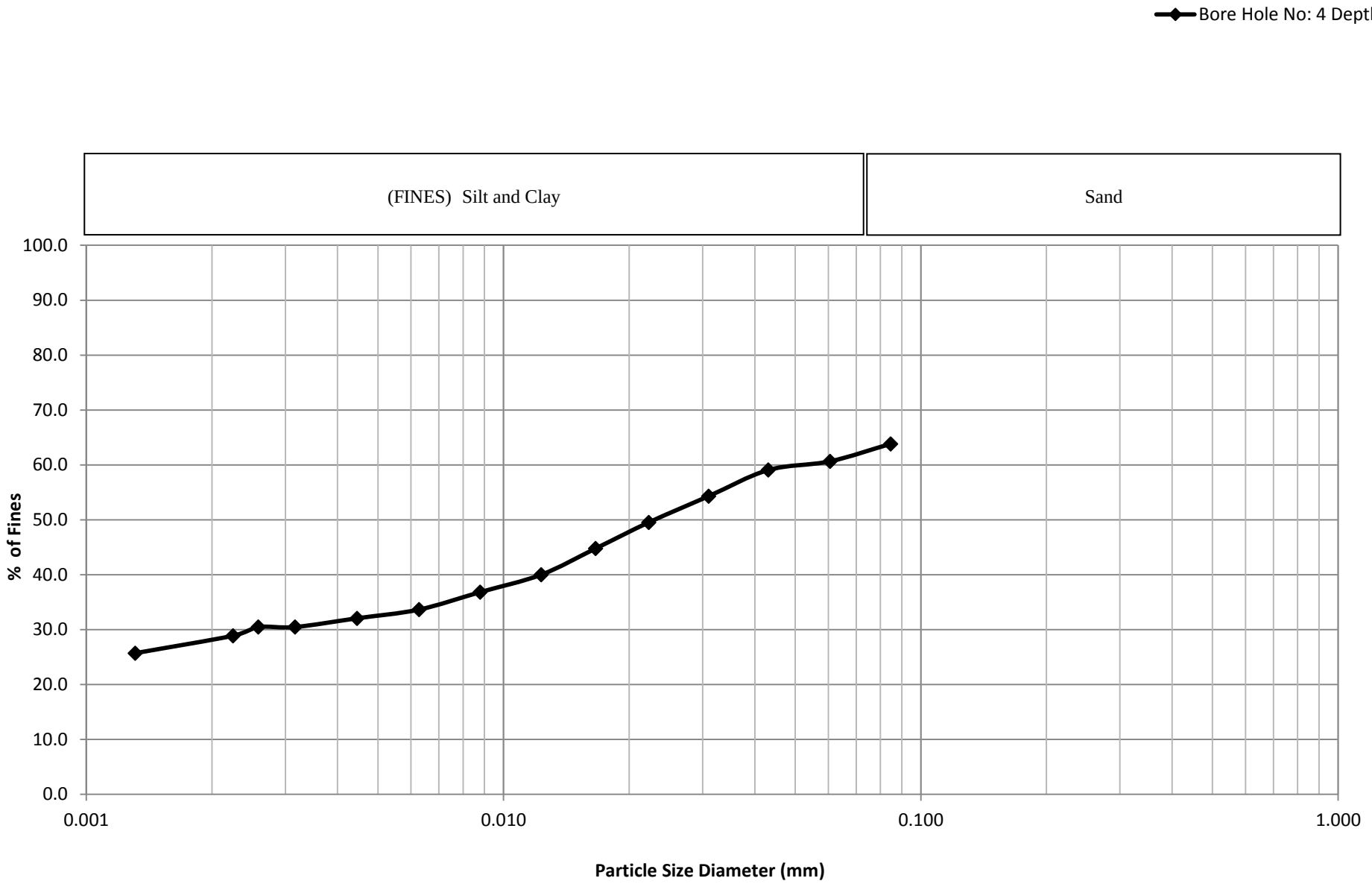


Fig 2.15 Hydrometer Analysis Master Curve

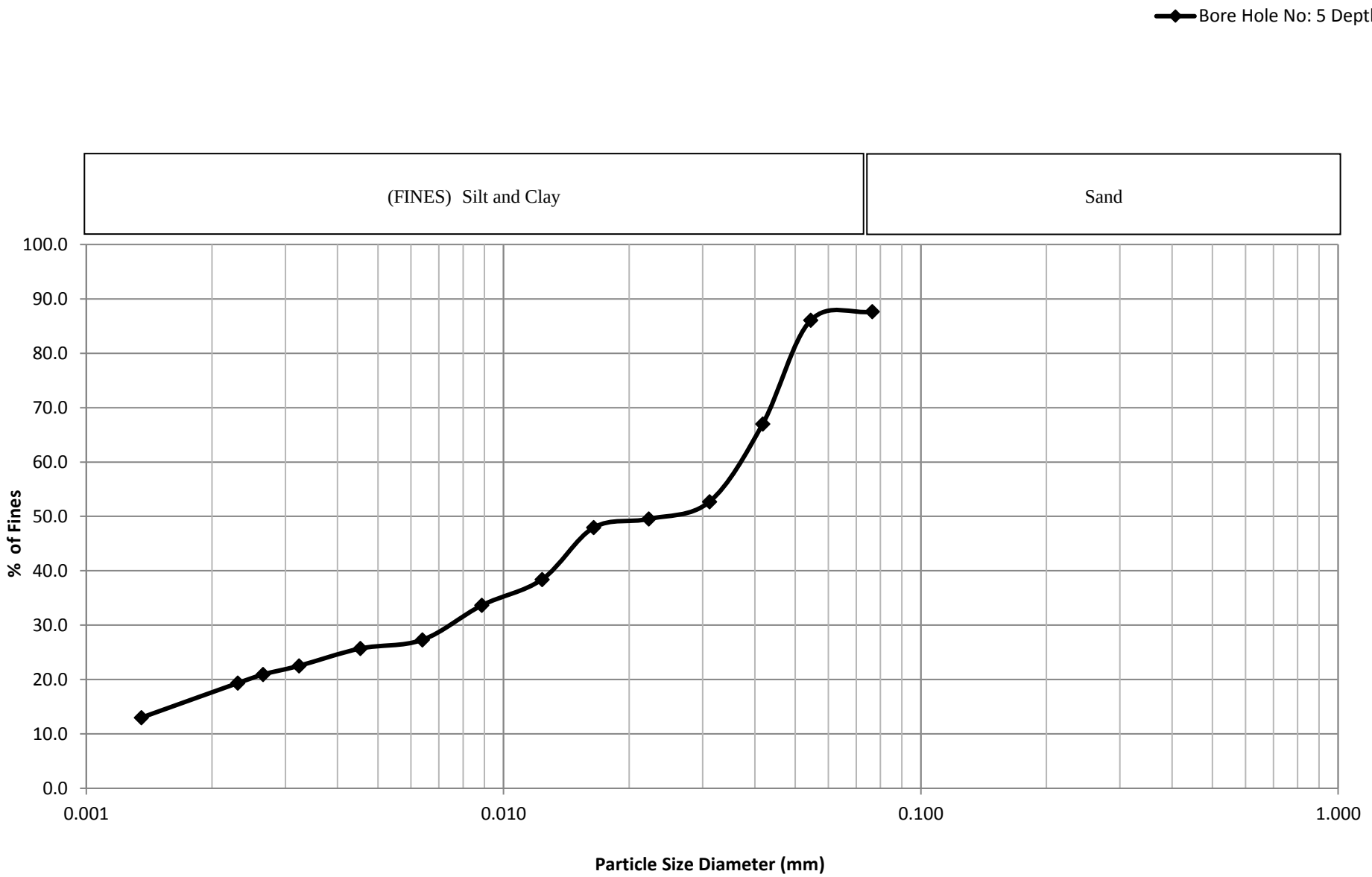


Fig 2.16 Hydrometer Analysis Master Curve

LABORATORY TEST RESULTS

GEOMARINE
THE SPIRIT OF ENGINEERING
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ULR: TC855921000000000128P

LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s VGN Homes Private Limited, Amaindakarai, Ch-29**	**Customer Reference**	:	Email Reference
Sample Description	:	Soil Sample	**Period of Testing**	:	28/06/2021 to 01/07/2021
Source of Sample	:	Customer Supplied- Borehole No. BH-01	**Sample Identification Number**	:	SS/GMC/062021/345/BH01
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2237/BH-01
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	03/07/2021
Sample Receipt Date	:	28/06/2021	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)													
			Moisture Content (%) AS PER IS 2720 (P-II) - 1973, RA-2015	LIQUID LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	PLASTIC LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	Plasticity Index (I_p= LL-PL)	Consistency Index (Ic=LL-NMC/I_p)	SHRINKAGE LIMIT (%) AS PER IS 2720 (P-VI) - 1972, RA-2011	FREE SWELL INDEX (%) AS PER IS 2720 (P-XL) - 1977, RA-2011	Consistancy	Position With Respect to A-Aline	IS:Notation	SPECIFIC GRAVITY AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010	GRAIN SIZE ANALYSIS AS PER IS 2720 (P-IV) - 1985, RA-2015						D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	Uniformity Co-Efficient $C_U=D_{60}/D_{10}$	Co-Efficient of Curvature $C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
													Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)							Gravel	Sand
1.0	29	SS	8.3	29.3	17.2	12.1	1.7	18.0	66.7	CG>50%	Above	-	-	0.0	2.8	28.7	31.1	29.0	8.4	-	-	-	-	-	M.Dense	<50%	SC
2.0	>100	SS	-	-	-	-	-	-	0.0	CG>50%	-	-	-	19.1	16.1	29.3	20.2	15.3		-	-	-	-	-	V.Dense	<50%	SM
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	11.4	11.6	26.4	33.6	17.0		-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	28.4	12.8	27.3	17.9	13.6		-	-	-	-	-	V.Dense	<50%	SM

**** END OF REPORT****

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(3) Any correction in this reports invalidates the reports

Authorised Signatory

(Technical Manager)

GEOMARINE
THE SPIRIT OF ENGINEERING
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ULR: TC855921000000000128P

LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s VGN Homes Private Limited, Amaindakarai, Ch-29**	**Customer Reference**	:	Email Reference
Sample Description	:	Soil Sample	**Period of Testing**	:	28/06/2021 to 01/07/2021
Source of Sample	:	Customer Supplied- Borehole No. BH-02	**Sample Identification Number**	:	SS/GMC/062021/345/BH02
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2237/BH-02
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	03/07/2021
Sample Receipt Date	:	28/06/2021	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)													
			Moisture Content (%) **AS PER IS 2720 (P-II) - 1973, RA-2015**	LIQUID LIMIT (%) **AS PER IS 2720 (P-V) - 1985, RA-2015**	PLASTIC LIMIT (%) **AS PER IS 2720 (P-V) - 1985, RA-2015**	**Plasticity Index (I_P= LL-PL)**	**Consistency Index (Ic=LL-NMC/I_p)**	SHRINKAGE LIMIT (%) **AS PER IS 2720 (P-VI) - 1972, RA-2011**	FREE SWELL INDEX (%) **AS PER IS 2720 (P-XL) - 1977, RA-2011**	**Consistancy**	**Position With Respect to A-Aline**	**IS:Notation**	SPECIFIC GRAVITY **AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010**	GRAIN SIZE ANALYSIS **AS PER IS 2720 (P-IV) - 1985, RA-2015**						**D_{10} (mm)**	**D_{30}(mm)**	**D_{60} (mm)**	Uniformity Co-Efficient **$C_U=D_{60}/D_{10}$**	Co-Efficient of Curvature **$C_c=D_{30}^2/(D_{10}xD_{60})$**	**Relative Density**	**IS-Notation**	
													Gravel (%)	**Coarse (%)**	**Medium (%)**	**Fine (%)**	**Silt (%)**	**Clay (%)**							**Gravel**	**Sand**
1.0	31	SS	10.2	33.2	17.3	15.9	1.4	17.5	33.3	CG>50%	Above	-	-	0.0	4.1	30.4	26.3	29.3	10.0	-	-	-	-	-	Dense	<50%	SC
2.0	>100	SS	16.0	26.6	15.0	11.6	0.9	-	14.3	CG>50%	Above	-	-	10.4	10.9	26.1	31.3	21.4		-	-	-	-	-	V.Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	25.1	12.2	23.7	17.1	21.9		-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	4.3	16.1	44.0	24.3	11.4		-	-	-	-	-	V.Dense	<50%	SP-SM

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ULR: TC855921000000000128P

LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s VGN Homes Private Limited, Amaindakarai, Ch-29**	**Customer Reference**	:	Email Reference
Sample Description	:	Soil Sample	**Period of Testing**	:	28/06/2021 to 01/07/2021
Source of Sample	:	Customer Supplied- Borehole No. BH-03	**Sample Identification Number**	:	SS/GMC/062021/345/BH03
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2237/BH-03
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	03/07/2021
Sample Receipt Date	:	28/06/2021	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)														
			Moisture Content (%) AS PER IS 2720 (P-II) - 1973, RA-2015	LIQUID LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	PLASTIC LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	Plasticity Index (I_P= LL-PL)	Consistency Index (Ic=LL-NMC/I_p)	SHRINKAGE LIMIT (%) AS PER IS 2720 (P-VI) - 1972, RA-2011	FREE SWELL INDEX (%) AS PER IS 2720 (P-XL) - 1977, RA-2011	Consistancy	Position With Respect to A-Aline	IS:Notation	SPECIFIC GRAVITY AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010	GRAIN SIZE ANALYSIS AS PER IS 2720 (P-IV) - 1985, RA-2015						D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	Uniformity Co-Efficient $C_U=D_{60}/D_{10}$	Co-Efficient of Curvature $C_C=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
													Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)							Gravel	Sand
1.0	23	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	0.0	0.9	34.0	32.9	32.3		-	-	-	-	-	M.Dense	<50%	SM
2.0	64	SS	10.7	28.6	17.3	11.2	1.6	19.0	33.3	CG>50%	Above	-	-	12.2	7.6	21.9	28.4	21.7	8.2	-	-	-	-	-	V.Dense	<50%	SC
3.0	85	SS	-	-	-	-	-	-	18.2	CG>50%	-	-	-	11.5	6.8	20.9	30.4	30.4		-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	13.1	10.3	21.6	24.1	30.9		-	-	-	-	-	V.Dense	<50%	SM

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ULR: TC855921000000000128P

LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s VGN Homes Private Limited, Amaindakarai, Ch-29**	**Customer Reference**	:	Email Reference
Sample Description	:	Soil Sample	**Period of Testing**	:	28/06/2021 to 01/07/2021
Source of Sample	:	Customer Supplied- Borehole No. BH-04	**Sample Identification Number**	:	SS/GMC/062021/345/BH04
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2237/BH-04
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	03/07/2021
Sample Receipt Date	:	28/06/2021	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)														
			Moisture Content (%) AS PER IS 2720 (P-II) - 1973, RA-2015	LIQUID LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	PLASTIC LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	Plasticity Index (I_p= LL-PL)	Consistency Index (Ic=LL-NMC/I_p)	SHRINKAGE LIMIT (%) AS PER IS 2720 (P-VI) - 1972, RA-2011	FREE SWELL INDEX (%) AS PER IS 2720 (P-XL) - 1977, RA-2011	Consistancy	Position With Respect to A-Aline	IS:Notation	SPECIFIC GRAVITY AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010	GRAIN SIZE ANALYSIS AS PER IS 2720 (P-IV) - 1985, RA-2015						D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	Uniformity Co-Efficient $C_U=D_{60}/D_{10}$	Co-Efficient of Curvature $C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
													Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)							Gravel	Sand
1.0	51	SS	10.8	25.5	13.4	12.1	1.2	19.0	20.0	CG>50%	Above	-	-	0.0	0.0	38.0	30.9	22.2	9.0	-	-	-	-	-	V.Dense	<50%	SC
2.0	24	SS	13.7	26.5	17.2	9.3	1.4	18.5	29.4	CG>50%	Above	-	-	2.5	3.8	31.5	24.9	37.4		-	-	-	-	-	M.Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	-	-	-	-	-	11.3	11.2	29.2	25.0	23.4		-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	WS	SS Sample Not Recovered & Wash Sample Collected										-	78.4	14.4	6.3	0.9	0.0		-	-	-	-	-	V.Dense	-	<50%

**** END OF REPORT****

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ULR: TC855921000000000128P

LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s VGN Homes Private Limited, Amaindakarai, Ch-29**	**Customer Reference**	:	Email Reference
Sample Description	:	Soil Sample	**Period of Testing**	:	28/06/2021 to 01/07/2021
Source of Sample	:	Customer Supplied- Borehole No. BH-05	**Sample Identification Number**	:	SS/GMC/062021/345/BH05
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2237/BH-05
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	03/07/2021
Sample Receipt Date	:	28/06/2021	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)													
			Moisture Content (%) AS PER IS 2720 (P-II) - 1973, RA-2015	LIQUID LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	PLASTIC LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	Plasticity Index (I_P= LL-PL)	Consistency Index (Ic=LL-NMC/I_p)	SHRINKAGE LIMIT (%) AS PER IS 2720 (P-VI) - 1972, RA-2011	FREE SWELL INDEX (%) AS PER IS 2720 (P-XL) - 1977, RA-2011	Consistancy	Position With Respect to A-Aline	IS:Notation	SPECIFIC GRAVITY AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010	GRAIN SIZE ANALYSIS AS PER IS 2720 (P-IV) - 1985, RA-2015						D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	Uniformity Co-Efficient $C_U=D_{60}/D_{10}$	Co-Efficient of Curvature $C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
													Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)							Gravel	Sand
1.0	>100	SS	10.5	25.6	14.0	11.6	1.3	-	6.3	CG>50%	Above	-	-	27.78	22.1	21.88	13.32	14.9		-	-	-	-	-	V.Dense	<50%	SC
2.0	41	SS	10.8	22.6	13.0	9.6	1.2	18.8	0.0	CG>50%	Above	-	-	3.6	7.28	28.3	29.8	25.0	6.0	-	-	-	-	-	Dense	<50%	SC
3.0	>100	SS	-	-	-	-	-	-	10.0	-	-	-	-	2.58	4.42	23.16	36.44	33.4		-	-	-	-	-	V.Dense	<50%	SM
4.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	15.35	15.3	30.22	23.63	15.5		-	-	-	-	-	V.Dense	<50%	SM

**** END OF REPORT****

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(Technical Manager)

Table-2.6 Results of Chemical Analysis									
		Water				Soil (2:1)			
SL No.	Bore HoleNo.	Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)	Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)
1.0	BH-01	2.80	7.58	377.0	173.6	2.0	7.33	88.8	39.5
2.0	BH-02	2.80	7.55	394.8	268.7	1.0	7.38	93.5	35.6
3.0	BH-03	2.80	7.60	355.0	288.2	2.0	7.35	85.8	37.3
4.0	BH-04	2.80	7.57	379.2	277.8	2.0	7.35	63.8	34.9
5.0	BH-05	2.80	7.48	385.7	301.0	2.0	7.39	103.2	29.6

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.

3.1 Climate and Rainfall of the Region:

The district generally experiences hot and humid climatic conditions. The district receives the rain under the influence of both southeast and northeast monsoons. Most of the precipitation occurs in the form of cyclonic storm caused due to the depressions in Bay of Bengal chiefly during northeast monsoon period. The southwest monsoon rainfall is highly erratic and summer rains are negligible. The normal annual rainfall over the district varies from 1105 mm to 1214mm. It is the minimum in the western and northwestern parts of the district around Uttiramerur (1105 mm) and it is the maximum around Kovalam (1214.2 mm).

The minimum and maximum temperature are 20°C & 37°C. The daytime heat is oppressive and the temperature is as high as 43°C.

3.2 Geomorphology and Soils:

The prominent geomorphic units identified in the district through interpretation of satellite imagery are

i) Chingleput-Tirukkalukkunram Surface (Erosional)

ii) Palar Surface (fluvial and

iii) Mamallapuram (Mahabalipuram) surface (Marina) etc.

The elevation of the area ranges from 100 m amsl in the west to a sea level in the east. The major part of the area is characterised by an undulating topography with innumerable depressions, which are used as irrigation tanks

Soils have been classified into

1) clayey soil,

2) red sandy or red loamy soil

3) Red sandy brown clayey soil and

4) Alluvial soil.

Of the above soils brown clayey soil is the most predominant, covering more than 71 percent of the areal extent of Kancheepuram district. Alluvial soils are found on the banks of Palar, Cheyyar and other rivers. The river alluvium is transported and is seen in coastal area of

this district. Sandy coastal alluvial (arenacious soil) occurs along the seacoast as a narrow belt.

3.3 Geological Order of the Study Area:

The stratigraphy of the study area can be classified as recent formation which is underlain by basement rock of meta-igneous origin (hypersthene granite/ Charnockite rock)

Deposits of Recent Age

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

Archaean Basement Rock (Charnockite Rock / Hypersthene Granite)

The sub soil in the project site consists of overburden soil predominantly of clayey sand up to a depth of 3.0m followed by rock formation of varying grade varies from Grade-VI to V (Residual Soil to Completely Weathered Rock) up to the investigation depth of maximum 7.0m below the existing ground level..

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

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

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

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

REFERENCE BORE HOLE-BH:					**1**	**Ref R.L. of G.L. (m):**			**0.00**		
Layer No.	**Layer Thk. (m)**			**Type of Strata**	**Colour**	**Ave. Design SPT**	**Relative Density**	**Consistency**	**(γ) kN/m^3**	**Shear Parameters**	
	Top BGL	**Bottom BGL**	**Thickness**							**(C_u) kPa**	**(ϕ) Deg.**
1.0	0.00	2.00	2.00	Clayey Silty Sand	Brown	29	Medium Dense	-	19	-	35.7
2.0	2.00	4.20	2.20	Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5

REFERENCE BORE HOLE-BH:					2	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m³	Shear Parameters	
	Top BGL	Bottom BGL	Thickness							(C_u) kPa	(ϕ) Deg.
1.0	0.00	1.70	1.70	Clayey Silty Sand	Greyish Brown	31	Dense	-	19.5	-	36.28
2.0	1.70	4.10	2.40	Residual Soil & Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5

REFERENCE BORE HOLE-BH:					3	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m³	Shear Parameters	
	Top BGL	Bottom BGL	Thickness							(C_u) kPa	(ϕ) Deg.
1.0	0.00	2.00	2.00	Silty Sand	Brown	23	Medium Dense	-	18.5	-	33.9
2.0	2.00	4.30	2.30	Residual Soil & Completely Weathered Rock	Greyish Brown	80	Very Dense	-	21	-	42.5

REFERENCE BORE HOLE-BH:					4	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m³	Shear Parameters	
	Top BGL	Bottom BGL	Thickness							(C_u) kPa	(ϕ) Deg.
1.0	0.00	2.00	2.00	Clayey Silty Sand	Brown	51	Very Dense	-	20.5	-	41.15
2.0	2.00	3.00	1.00	Residual Soil	Greyish Brown	24	Medium Dense	-	18.5	-	34.2
3.0	3.00	4.10	1.10	Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5

REFERENCE BORE HOLE-BH:					5	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m³	Shear Parameters	
	Top BGL	Bottom BGL	Thickness							(C_u) kPa	(ϕ) Deg.
1.0	0.00	2.00	2.00	Clayey Silty Sand	Reddish Brown	>100	Very Dense	-	21	-	42.5
2.0	2.00	3.00	1.00	Residual Soil	Yellow Brown	41	Dense	-	20	-	38.98
3.0	3.00	4.00	1.00	Residual Soil & Completely Weathered Rock	Greyish Brown	>100	Very Dense	-	21	-	42.5

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 geotechnical investigation is carried out for residential development and the proposed structure can be Ground + 1 to 2 Floors. For this kind of structure, the column loads could vary between 250kN to 1000 kN depending upon the spacing of columns and spans.

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 Sub Soil Profile:

The encountered geological sub soil stratification in the project site is classified into two layers:

Layer-I	0.0m to 2.0m	Clayey Sand/Silty Sand with Clay binder & Partly Residual Soil
Layer-II	2.0m to 4.0m	Grade-VI & V Rock formation, Residual Soil to Completely Weathered Rock

4.3 Foundation System:

4.3.1 Characteristics of Bearing Stratum:

From foundation depth consideration, the sub soil in the shallow depth shall be considered as bearing strata. However, the differential free swell property in the top 2.0m to 3.0m depth varying in the range of low to high, hence to contain the volume change property of the bearing strata below the foundation it is recommended to adopt soil replacement as discussed below.

In the present case, soil replacement with a non-swelling-non-shrinking type of soil or Quarry Dust or Sand-Gravel (1:1) mix is an ideal ground improvement technique to adopt below the footing.

4.3.2 Foundation System:

The sub soil right from ground level is good from shear strength consideration, from soil volume consideration, no shallow foundation shall be adopted without any ground improvement technique.

For the kind of proposed construction, isolated column footings can be adopted and the footings can be placed over a well compacted sand-gravel mix or quarry dust of 300mm thickness laid in non-compacted layers of 150mm and compacted at optimum moisture content using a plate compactor or hand rammer.

For different depth of foundation, the allowable net safe bearing pressure is worked out as per IS 6403 and presented in Table 4.1.

Typical schematic arrangement of foundation is given in Fig. 4.1. Typical computations are presented in Annexure-I.

TABLE-4.1 RECOMMENDED ALLOWABLE SAFE BEARING PRESSURE

S.No.	Type/Shape of Foundation	Overall Depth of Foundation Excavation (D_{fe}) (m)	Soil Replacement within the foundation trench (S_r) (m)	Depth of Foundation from E.G.L (D_f) (m)	Safe Bearing Capacity (kPa)	Elastic Settlement (mm)
1.0	Isolated Footing / Square	1.25	0.30	0.95	200	2.44
2.0		1.50	0.30	1.20	225	2.75
3.0		1.80	0.30	1.50	250	3.05

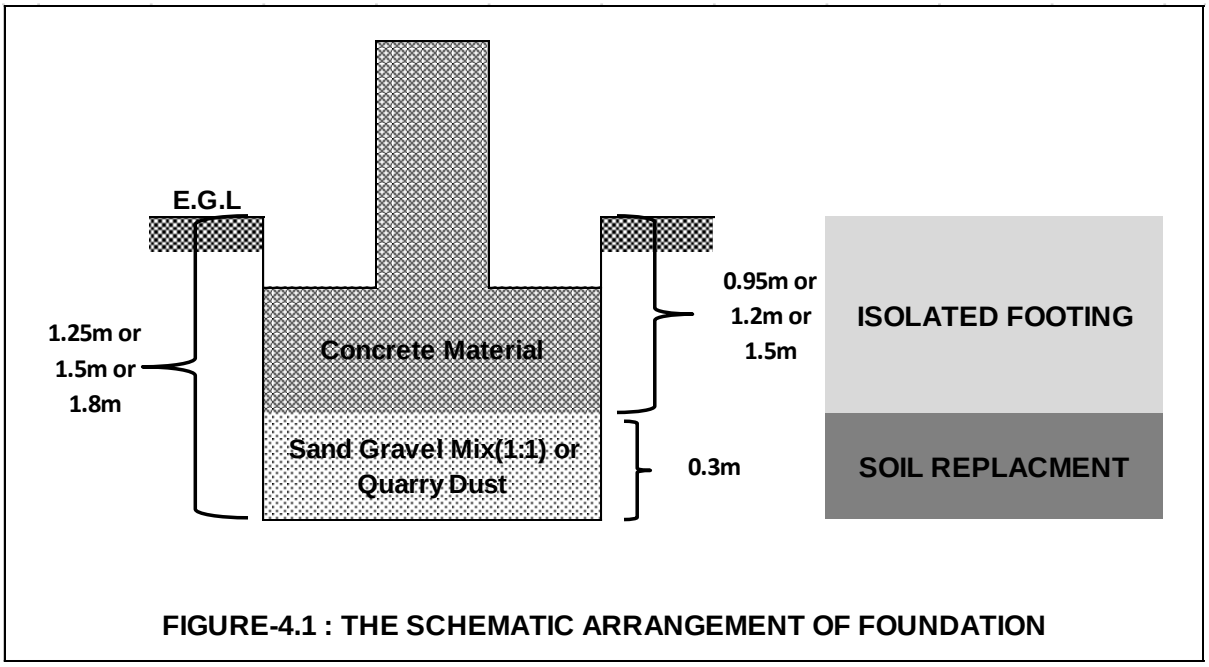


FIGURE-4.1 : THE SCHEMATIC ARRANGEMENT OF FOUNDATION

RECOMMENDATIONS

CHAPTER-5

RECOMMENDATIONS

- For the kind of proposed structure, shallow foundation can be adopted.
- The allowable net safe bearing pressure for different depth of footings are presented in Table 4.1.
- It is ideal to place all the foundation over a compacted sand-gravel mix or quarry dust of 300mm thickness.
- All columns shall be connected with grade beams in both the directions irrespective of column layout.
- Excavated earth is suitable for backfilling purpose.
- The present project site fall in seismic zone-III as per IS 1893-P-I and based on the liquefaction analysis the sub soil formation exists at site is non-liquefiable considering the zone-III seismic intensity.
- The chlorides content in ground water & soil-water extract is less than the permissible limit of 500 mg/l as per IS 456 Table 1.0. Hence no special steel is required for the construction.
- Corresponding to the sulphate content in 2:1 Water-Soil extract and ground water use Table 4.0 of IS 456 Clause 2.0 for minimum cement content and maximum water cement ratio. Hence ordinary Portland cement is suitable for the construction.

AUTHORISED SIGNATORY

GEO MARINE CONSULTANTS PVT. LTD. CHENNAI-41

DR. C. V. PRASAD
GEOMARINE CONSULTANTS PRIVATE LIMITED

ANNEXURE-I

GEOMARINE

TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

Ref Borehole: BH-03

1.1 Geometrical Data :

Shape of the Foundation	Square
Depth of footing below E.G.L"Df" (m)	0.95
Soil Replacement either with Quarry Dust or Sand-Gravel Mix below the footing (m)	0.30
Depth of Foundation Excavation (m)	1.25
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
Thickness of Fill (m)	0.00

1.2 Soil Data :

Type of Effective Bearing Strata :	Clayey Sand
Design SPT-value of the Bearing Strata :	23.0
Type of Shear Failure:	General
Angle of Shearing Resistance	33.9

1.3 Design Parameters:

Bulk Density of Soil (γ_{bulk})	18.0
Water Table Correction Factor (w')	0.50
Effective Overburden pressure at foundation level including the thickness of fill (q)	10.00
Bearing Capacity Factors:	
N_c =	N/A
N_q =	30.02
N_g =	42.39
Shape Factors:	
S_c =	-
S_q =	1.20
S_g =	0.80
Depth Factors :	
D_c =	-
D_q =	1.02
D_g =	1.02
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'	510.21	kPa
(g should be read as gama)		

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50	
Qsafe :	**204.1**	**kPa**
Say Q_{safe}	**200.0**	**kPa**

2 Computation of Settlement as per IS:8009-Part I

2.0 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_e)=	$qB(1-m^2)*I/E_s$	
q= bearing pressure	200.00	
Poission's Ratio (μ)	0.20	
Modulus of Elasticity (E_s)(Ref. Joseph E Bowels,1996,page316,Table5.6, Japanese design standards)		
Modulus of Elasticity (E_s)	59800	
Size of footing considered for maximum settlement(m)	1.00	
Influence factor	0.95	
Rigidity Factor	0.80	
Elastic Settlement (S_e)	2.44	mm
	<50	mm

GEOMARINE

TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

Ref Borehole: BH-03

1.1 Geometrical Data :

Shape of the Foundation	Square	
Depth of footing below E.G.L"Df" (m)	1.20	
Soil Replacement either with Quarry Dust or Sand-Gravel Mix below the footing (m)	0.30	
Depth of Foundation Excavation (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	
Thickness of Fill (m)	0.00	

1.2 Soil Data :

Type of Effective Bearing Strata :	Clayey Sand	
Design SPT-value of the Bearing Strata :	23.0	
Type of Shear Failure:	General	
Angle of Shearing Resistance	33.9	

1.3 Design Parameters:

Bulk Density of Soil (γ_{bulk})	18.0	
Water Table Correction Factor (w')	0.50	
Effective Overburden pressure at foundation level including the thickness of fill (q)	12.00	
Bearing Capacity Factors:		
N_c =	N/A	
N_q =	30.02	
N_g =	42.39	
Shape Factors:		
S_c =	-	
S_q =	1.20	
S_g =	0.80	
Depth Factors :		
D_c =	-	
D_q =	1.02	
D_g =	1.02	
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'	583.96	kPa
(g should be read as gama)		

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50	
Qsafe :	233.6	kPa
Say Q_{safe}	**225.0**	**kPa**

2 Computation of Settlement as per IS:8009-Part I

2.0 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_e)=	$qB(1-m^2)*I/E_s$	
q= bearing pressure	225.00	
Poission's Ratio (μ)	0.20	
Modulus of Elasticity (E_s)(Ref. Joseph E Bowels,1996,page316,Table5.6, Japanese design standards)		
Modulus of Elasticity (E_s)	59800	
Size of footing considered for maximum settlement(m)	1.00	
Influence factor	0.95	
Rigidity Factor	0.80	
Elastic Settlement (S_e)	2.75	mm
	<50	mm

GEOMARINE

TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

Ref Borehole: BH-03

1.1 Geometrical Data :

Shape of the Foundation	Square
Depth of footing below E.G.L"Df" (m)	1.50
Soil Replacement either with Quarry Dust or Sand-Gravel Mix below the footing (m)	0.30
Depth of Foundation Excavation (m)	1.80
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
Thickness of Fill (m)	0.00

1.2 Soil Data :

Type of Effective Bearing Strata :	Clayey Sand
Design SPT-value of the Bearing Strata :	23.0
Type of Shear Failure:	General
Angle of Shearing Resistance	33.9

1.3 Design Parameters:

Bulk Density of Soil (γ_{bulk})	18.0
Water Table Correction Factor (w')	0.50
Effective Overburden pressure at foundation level including the thickness of fill (q)	14.40
Bearing Capacity Factors:	
N_c =	N/A
N_q =	30.02
N_g =	42.39
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'	673.36	kPa
(g should be read as gama)		

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50	
Qsafe :	269.3	kPa
Say Q_{safe}	**250.0**	**kPa**

2 Computation of Settlement as per IS:8009-Part I

2.0 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_e)=	$qB(1-m^2)*I/E_s$	
q= bearing pressure	250.00	
Poission's Ratio (μ)	0.20	
Modulus of Elasticity (E_s)(Ref. Joseph E Bowels,1996,page316,Table5.6, Japanese design standards)		
Modulus of Elasticity (E_s)	59800	
Size of footing considered for maximum settlement(m)	1.00	
Influence factor	0.95	
Rigidity Factor	0.80	
Elastic Settlement (S_e)	3.05	mm
	<50	mm

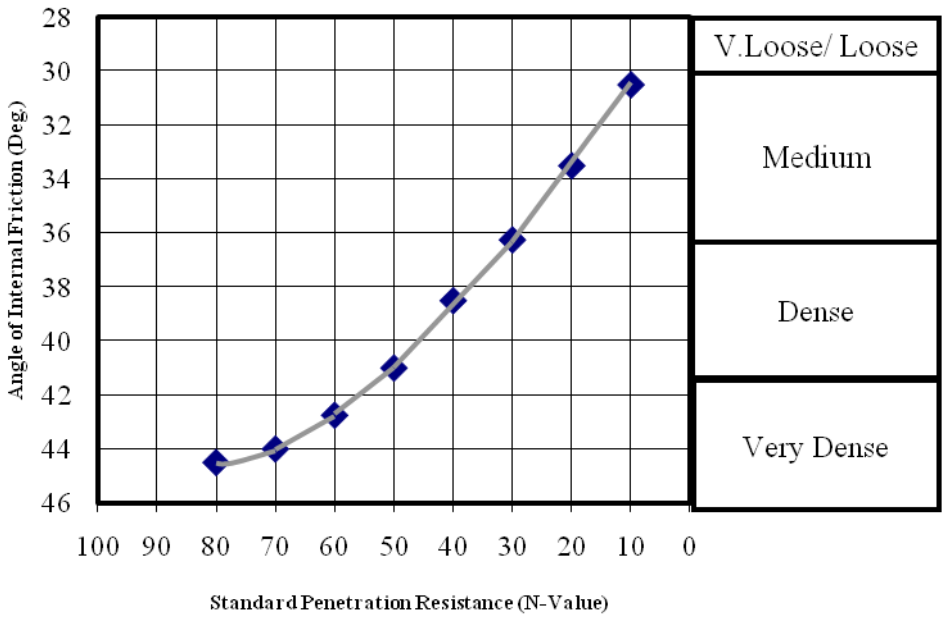


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

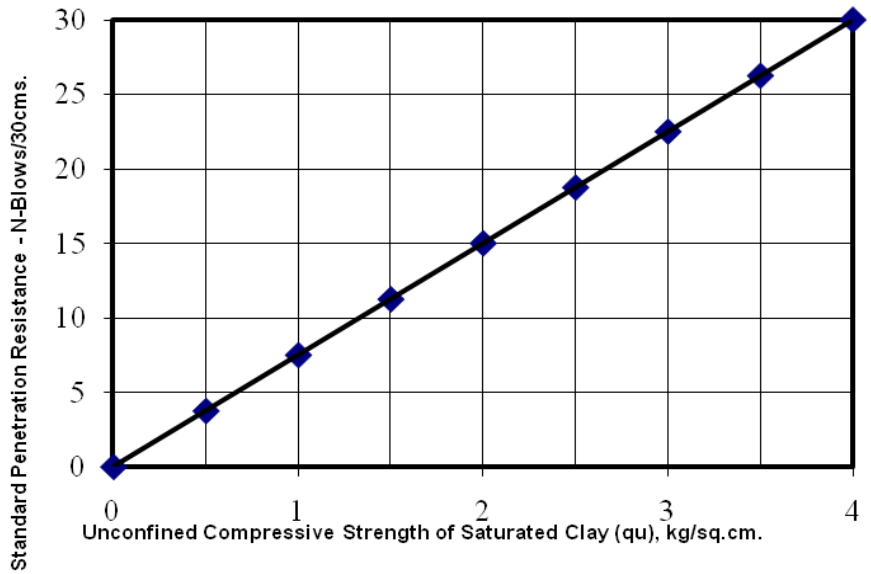


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)

ANNEXURE-II

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	01
PAGE No.	01
DIA OF BORE HOLE	150mm ✓ / 100mm
BORE START DATE	24/06/2024
BORE END DATE	24/06/2024
TOTAL DRILLING DAYS	1

PROJECT NAME	VGN - Padur						
LOCATION		MACHINE No.	CR-04	CHAINAGE (m)			
STRUCTURE		DRILLING METHOD	Rotary	CO-ORDINATES	N		
JOB CODE		FLUSHING MEDIUM	Bentonite		E		

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	Layer Data: Depth (m)	Geotechnical Description
1	24	2	33	SC			14	16	13	29	1.00	1	SS	1.15	Top Soil - Brownish clayey silty Sand.
		2	37												Brownish yellow m Quartz clayey Residual soil
		2	57												
2		2	53	SC			40	6cm/55b HR N>100			2.00	2	SS		Brownish very weak completely weathered Rock
	06	3	05												
		3	07												
3		3	21	SC			30	7cm/57b HR N>100			3.00	3	SS		Greyish Brown very weak completely Weathered Rock
		3	25												
	25														
4				SC			12cm/59blow HR N>100				4.00	4	SS		Brownish very weak completely weathered Rock
5	Borehole terminated at 4.00m depth below EGL														
6															
7															
8															
9															
0															

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	K. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	24/06/2024	WATER TABLE (m)	
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	—

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	02
PAGE No.	01
DIA OF BORE HOLE	150mm: ✓ / 100mm:
BORE START DATE	24/06/2021
BORE END DATE	24/06/2021
TOTAL DRILLING DAYS	1

PROJECT NAME	VGN - PADUR						
LOCATION		MACHINE No.	CR-04	CHAINAGE (m)			
STRUCTURE		DRILLING METHOD	Rotary	CO-ORDINATES	N		
JOB CODE		FLUSHING MEDIUM	Bentonite		E		

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	Layer Data: Depth (m)	Geotechnical Description
1	24	11	17												
		11	19	SC			13	15	16	31	1.00	1	SS	1.70	Greyish Brown Dense Clayey Silty Sand with Pebbles
		11	31												
2		11	33	SC			12cm/52blows HR N>100				2.00	2	SS		Greyish Brown very Dense Residual Soil (completely weathered)
	06	11	47												
3		11	50	SC			37	7cm/55b HR N>100			3.00	3	SS		Greyish Brown very Weak completely Weathered Rock
		12	02												
4	2021	12	13	SC			4cm/60blows HR N>100				4.00	4	SS WS		Brownish Very Weak completely Weathered Rock
5	Borehole Terminated at 4.00m Depth below mGL														
6															
7															
8															
9															
0															

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	B. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	24/06/2021	WATER TABLE (m)	
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	—

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	03
PAGE No.	01
DIA OF BORE HOLE	150mm 4 / 100mm
BORE START DATE	25/06/2021
BORE END DATE	26/06/2021
TOTAL DRILLING DAYS	1

PROJECT NAME	VGN - PADUR						
LOCATION		MACHINE No.	CR-04	CHAINAGE (m)			
STRUCTURE		DRILLING METHOD	Rotary	CO-ORDINATES	N		
JOB CODE		FLUSHING MEDIUM	Bentonite		E		

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	Layer Data: Depth (m)	Geotechnical Description
0	25/06	12	19											2.50	Top Soil - Filled up Soil
1	2021	12	20	SC			11	14	9	23	1.00	1	SS		Brownish medium Dense Silty Sand
		12	40												
2	26	12	42	SC			12	18	46	64	2.00	2	SS		Greyish yellow very Dense Residual Soil
		12	57												
3		1	00	SC			23	17	68	85	3.00	3	SS	3.20	yellowish Grey very Dense Residual Soil (C-weathered)
	06	1	16												
4		1	19	SC			45	700/55 HR		N>100	4.00	4	SS		yellowish Grey very weak Completely Weathered Rock
	2021														
5		Borehole Terminated at 4.00m Depth below in GL.													
6															
7															
8															
9															
0															

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	B. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	26/06/2021	WATER TABLE (m)	
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	04
PAGE No.	01
DIA OF BORE HOLE	150mm: 4 / 100mm:
BORE START DATE	26/06/2021
BORE END DATE	26/06/2021
TOTAL DRILLING DAYS	1

PROJECT NAME	VGN - PADUR						
LOCATION		MACHINE No.	CR-04	CHAINAGE (m)			
STRUCTURE		DRILLING METHOD	Rotary	CO-ORDINATES	N		
JOB CODE		FLUSHING MEDIUM	Bentonite		E		

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	Layer Data: Depth (m)	Geotechnical Description
0		3	25											0.50	Filled up Soil
1	26	3	27	SC			13	23	28	51	1.00	1	SS		Brownish Grey Dense clayey silty Sand
	/	3	46												
2		3	47	SC			9	10	14	24	2.00	2	SS		Greyish Brown Medium Dense clayey Sand with Lime (Sandy Clay)
	06														
		3	58												
3	/	4	00	SC			25	15cm/52 blow HR N>100			3.00	3	SS		Brownish Grey Very Weak Completely Weathered Rock
	2021														
		4	13												
4		4	17				4cm/52 blow HR N>100				4.00	4			Greyish Brown Very Weak Completely Weathered Rock
5	Borehole Terminated at 4.00m Duplis below in GL														
6															
7															
8															
9															
0															

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	K. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	26/06/2021	WATER TABLE (m)	
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	

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SITE INVESTIGATION RECORD

BORE HOLE No.	05
PAGE No.	01
DIA OF BORE HOLE	150mm 4 / 100mm
BORE START DATE	24/06/2021
BORE END DATE	24/06/2021
TOTAL DRILLING DAYS	1

PROJECT NAME	VGN - PADUR						
LOCATION		MACHINE No.	CR-06	CHAINAGE (m)			
STRUCTURE		DRILLING METHOD	Rotary	CO-ORDINATES	N		
JOB CODE		FLUSHING MEDIUM	Bentonite		E		

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	Layer Data: Depth (m)	Geotechnical Description
1	24/	4	27												
		4	29	SC			10cm/55b				1.00	1	SS		Reddish Brown very Dense Gravel
		4	44				HR N>100								
2		4	48	SC			12	12	29	41	2.00	2	SS		Brownish yellow Dense Residual Soil
	06	5	04												
3	/	5	11	SC			30	12cm/56b			3.00	3	SS		Greyish yellow Very Weak completely Weathered Rock
								HR N>100							
		5	22												
4	24/	5	26	SC			6cm/60blows				4.00	4	SS		Brownish Very Weak completely Weathered Rock
							HR N>100								
5	Borehole Terminated at 4.00m Depth below GL														
6															
7															
8															
9															
0															

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	S. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	24/06/2021	WATER TABLE (m)	
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	—

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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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