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SOIL EXPLORATION AND FOUNDATION REPORT

FOR THE PROPOSED BUILDING

AT

NO. 3/165

MOUNT POONAMALLEE ROAD

MANAPAKKAM

CHENNAI

PROJECT NO. TJE/001215/2019



T.J.ENGINEERS

SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION

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EXPLORATION REPORT

PROJECT NO. TJE/001215/2019

1.INTRODUCTION:

Mrs. MEERA DEVI CHAKRAVARTHY has proposed to construct a Stilt Floor + Five Floors Building at No. 3/165, Mount Poonamallee Road, Manapakkam, Chennai-600 102. The work was entrusted to T.J. Engineers by the promoter. The location is shown in Fig No.1. The object of the soil exploration work done is to determine the soil properties of the proposed area and to arrive at a most suitable type of foundation system for the proposed structure.

2.0 SCOPE OF WORK

The Scope of Work includes the following

Boreholes

- ❖ Drilling of borehole at the proposed borehole locations as per the direction of the client.
- ❖ Collection of disturbed and undisturbed soil samples and carrying out the relevant laboratory test on soils.
- ❖ Conducting of standard penetration test (SPT) within the borehole at every 1.50m depth interval or as required.
- ❖ Collection of soil sample from bore hole.
- ❖ Preparation of geotechnical investigation Report.

3.0. LOCATION & NUMBER OF BORE HOLES

For this purpose two bore holes were bored up to maximum depth of 8.50m below existing ground level. The bore hole location is shown in Fig No.1 and bore log details



are given in Fig No. 2&3. The bore holes were terminated in the Very Dense Sandy Gravel (Disintegrated Rock) layer.

4.0. GEOTECHNICAL INVESTIGATIONS

4.1. Filed Investigations of Boreholes

Rotary drilling boring technique was adopted for boring in this area. The Standard penetration tests were conducted at change of layers and at specified intervals, commencing the test at 1.50m below the existing ground level. The relative density of different soil layers obtained from the N-Values are given in the Fig No. 2&3. Disturbed and un disturbed samples were collected from all the layers for visual observation, classification tests and strength characteristics of the soil layers.

Standard Penetration Test (SPT)

Standard Penetration Tests were conducted using a split spoon sampler, as per relevant codal provision (IS: 2131 – 1981). The SPT is generally conducted in sandy and completely weathered rock strata till 45 cm penetration with number of blows recorded for every 15 cm penetration. The number of blows required for first 15 cm is neglected. The blows for last 30 cm penetration or refusal 'N' value of 100 whichever is earlier is taken as the 'N' value. In the clayey strata, when driving of sampling tube is not possible, SPT was conducted to know the consistency of the soil strata and to retrieve the disturbed soil sample. The soil samples obtained in the split spoon sampler are carefully packed in polythene bags for testing in the laboratory. The SPT values obtained at every 1.50m interval are given in the bore logs.



4.2. Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified.

4.3. Laboratory Tests for Borehole samples

The following laboratory tests were conducted on collected Soil Samples.

- I. Moisture Content as per IS: 2720 (Part 2)
- II. Specific Gravity as per IS: 2720 (Part 2)
- III. Sieve Analysis as per IS: 2720 (Part 4)
- IV. Hydrometer Analysis as per IS: 2720 (Part 4)
- V. Liquid Limit as per IS: 2720 (Part 5)
- VI. Plastic Limit as per IS: 2720 (Part 5)
- VII. Swelling Index as per IS: 2720 (Part 40)

5.0. BORE LOG DATA

The Summary of bore hole log data for BH-01 & BH-02 is given in Fig-2&3. Bore hole location is given in Fig.1.

6.0. LABORATORY TEST RESULTS

The laboratory test results of boreholes samples are presented in Table-1 and Table-2.

7.0. GROUND WATER TABLE

The ground water table was encountered at the **depth of 6.00m**, below the existing ground level at the time of soil exploration.

8.0. SUB SOIL PROFILE

From the visual identification from field test results, it is concluding that soil strata is not similar in BH-01 & BH-02 location.



In BH-01 Location the soil strata is made-up of four distinctive layers.

- | | | |
|------|---|-----------|
| i. | Filled Up Soil 0.00m to 0.50m | |
| ii. | Medium Dense Silty Sand, 0.50m to 6.00m SPT's | N = 17-25 |
| iii. | Stiff Sandy Silty Clay, 6.00m to 6.70m SPT's | N = 13 |
| iv. | Very Dense Sandy Gravel, 6.70m to 7.50m SPT's | N = >100 |

In BH-02 Location the soil strata is made-up of five distinctive layers.

- | | | |
|------|--|-----------|
| i. | Filled Up Soil 0.00m to 0.50m | |
| ii. | Stiff Silty Sandy Clay, 0.50m to 3.00m SPT's | N = 14 |
| iii. | Medium Dense to Dense Silty Sand, 3.00m to 5.00m SPT's | N = 28-31 |
| iv. | Stiff Sandy Silty Clay, 5.00m to 6.50m SPT's | N = 12 |
| v. | Very Dense Sandy Gravel, 6.70m to 7.50m SPT's | N = >100 |

The soil profile details are presented in the Bore logs, Presented in Fig. 2&3.

9.0. FOUNDATION ANALYSIS

From the bore log data at the top from 0.00m to 0.50m Filled Up Soil layer is present. From 0.50m to 5.00m/6.00m medium dense to dense Silty Sand layer is present. In BH-02 location, from 0.50m to 3.00m stiff Silty Sandy Clay layer is present, this layer has got swelling character, and this layer is not present in BH-01 location.

From 5.00m/6.00 to 6.50m/6.70m stiff Sandy Silty Clay layer is present, this layer has got swelling character. Below 6.70m very dense Sandy Gravel (Dis-integrated Rock) layer is seen, this layer is fair to rest pile foundation for heavy loaded structure.

The layer up to 6.70m is the critical zone for open foundation, with in the critical zone soil strata is medium dense to dense Silty Sand layer and stiff Sandy Silty Clay layer is present. For light loaded structure open foundation of **Isolated Footing (or) Continuous Strip Footing (or) Raft Foundation** can be adopted. The foundation can be



placed at the minimum depth of 3.00m below the existing ground level. The SBC at **3.00m depth** has been worked out and given below.

For heavy loaded structure, if the SBC is not sufficient for the expected loading intensity, structure with column positions are not symmetrical and long span, and sensitive for differential settlement, it is advisable to provide deep foundation of pile foundations. The pile foundation can be Bored Cast in situ pile. The pile foundation should be terminated at the minimum **depth of 9.00m** below existing ground level. The pile should be anchored into the very dense Sandy Gravel (Dis-integrated Rock) layer for minimum of 1.50m depth.

9.1. COMPUTATION OF THE SAFE BEARING CAPACITY AT 3.00m DEPTH

Based on the standard penetration test value the ultimate bearing capacity (q_u) could be calculated from the following formula.

$$q_u = \gamma D_f N_q + 0.4 \gamma' B N_\gamma$$

The observed N-Value is taken as 18 from Fig. 2&3.

The corresponding bearing capacity factors are,

$$N_q = 14.10$$

$$N_\gamma = 10.34$$

Where,

$$\gamma = \text{Bulk density} = 1.50 \text{ t/m}^3$$

$$\gamma' = \text{Submerged density} = 0.50 \text{ t/m}^3$$

$$D_f = \text{Depth of footing} = \text{Considered minimum of 2.50m.}$$

$$D_w = \text{Depth of water table} = 6.00\text{m}$$

$$B = \text{Breadth of the footing} = \text{Consider minimum of 1.00m.}$$



Substitute all the above values in the formula,

$$\begin{aligned} Q_u &= 1.50 \times 2.50 \times 14.10 + 0.4 \times 0.50 \times 1.00 \times 10.34 \\ &= 52.875 + 2.068 \\ &= 54.943 \text{ t/m}^2 \end{aligned}$$

Safe bearing capacity could be considered with a factor of safety of 2.5

$$\text{Hence, safe bearing capacity } q_s = 54.943 / 2.50 = 21.977 \text{ t/m}^2. \text{ Say } 22.00 \text{ t/m}^2$$

Therefore, Safe Bearing Capacity of the soil at the depth of 3.00m is 22.00 t/m²

9.2. LOAD CARRYING CAPACITY OF THE CONVENTIONAL PILE

Based on the standard penetration test value the ultimate load carrying capacity (q_u) could be calculated from the following formula.

$$Q_u = Q_b + Q_s$$

$$Q_s = \text{Ultimate unit skin friction on an individual layer}$$

$$= K_s \sigma'_{vo} \tan \delta \pi D L$$

Where

$$K_s = \text{Co-efficient of horizontal soil stress} = 0.471$$

$$\sigma'_{vo} = \text{average effective overburden pressure} = 4.00 \text{ t/m}^2$$

$$\delta = \text{angle of wall friction} = 32$$

$$D = \text{Dia meter of pile} = 0.40\text{m}$$

$$L = \text{Length of individual layer} = 1.00\text{m}$$

$$\begin{aligned} Q_s &= 0.471 \times 4.00 \times 0.624 \times 3.14 \times 0.40 \times 1.00 \\ &= 1.476 \text{ t} \end{aligned}$$



$$Q_b = N_q \sigma'_{vo} A_b$$

where

$$N_q = \text{Bearing Capacity Factor} = 135$$

$$\sigma'_{vo} = \text{effective overburden pressure at the toe} = 4.25 \text{ t/m}^2$$

$$A_b = \text{Cross sectional area at the base}$$

$$D = \text{Dia of Pile} = 0.40\text{m}$$

$$= 135 \times 4.25 \times 3.14 \times 0.40^2 / 4$$

$$Q_b = 72.063 \text{ t}$$

$$Q_u = Q_b + Q_s$$

$$= 72.063 + 1.476 = 73.539 \text{ t}$$

$$Q_{\text{safe}} = Q_u / F.S = 73.539 / 2.5 = 29.415 \text{ say } 29.50 \text{ t}$$

The safe load carrying capacity for five different diameter of piles for the **depth of 8.50m** are worked out and are given below.

Dia of Pile	Depth of Pile	Safe Load (Tones)
400mm	8.50m	29.50
450mm	8.50m	37.00
500mm	8.50m	46.00
600mm	8.50m	66.00
750mm	8.50m	102.50

The above safe loads are provisional and shall be confirmed by conducting pile load test as per the guide line laid down in IS: 2911 (Part: IV).



10.0. CONCLUSIONS

1. Soil in the shallow depth is fair to adopt open foundation system for light loaded structure.
2. For light loaded structure open foundation of **Isolated Footing (or) Continuous Strip Footing (or) Raft Foundation** can be adopted.
3. The open foundation can be placed at the minimum depth of 3.00m below the existing ground level. The existing ground level is same as the road level at the time of soil investigation.
4. The **Safe Bearing Capacity** of the soil at **3.00m depth** is **22.00 t/m²**.
5. The **minimum width** of footing should be maintained as **1.00m** to avoid any punching shear failure and to achieve suggested SBC.
6. All the foundation should rest on 100 mm thick 1:4:8 concrete mat over 100mm thick River Sand or M Sand.
7. The foundation bed should be well compacted by ramming before laying PCC.
8. **If isolated footing provided**, it is advisable to make the structure as rigid as possible by providing **plinth beam** connecting all column on both direction, **continuous sill slab and continuous lintel beam**.
9. The foundation should rest on the natural undisturbed strata.
10. **For heavy loaded structure**, if the SBC is not sufficient for the expected loading intensity, structure with column positions are not symmetrical and long span, structure sensitive for differential settlement, it is advisable to **provide deep foundation of pile foundations**. The pile foundation can be Bored Cast in situ pile. The pile foundation should be terminated at the **minimum depth of 8.50m** below



existing ground level. The load carrying capacity for five different diameter of pile for the minimum depth of 8.50m is worked out and given below.

Dia of Pile	Depth of Pile	Safe Load (Tones)
400mm	8.50m	29.50
450mm	8.50m	37.00
500mm	8.50m	46.00
600mm	8.50m	66.00
750mm	8.50m	102.50

The above safe loads are provisional and shall be confirmed by conducting pile load test as per the guide line laid down in IS: 2911 (Part: IV)

11. The pile should be **anchored** into the very dense Sandy Gravel (Dis-integrated Rock) layer for minimum of **1.00m**. The depth of pile may vary slightly according to site condition.
12. Proper precaution should be taken while boring the pile against sliding of bore hole, by maintaining the proper dense bentonite slurry or providing temporary casing or permanent casing and pile concreting should be done as soon as boring is over.
13. The bore hole should be flushed properly before laying concrete.
14. All suggested foundation recommendations and precautions should be adopted while undertaking the design aspects and construction activities.

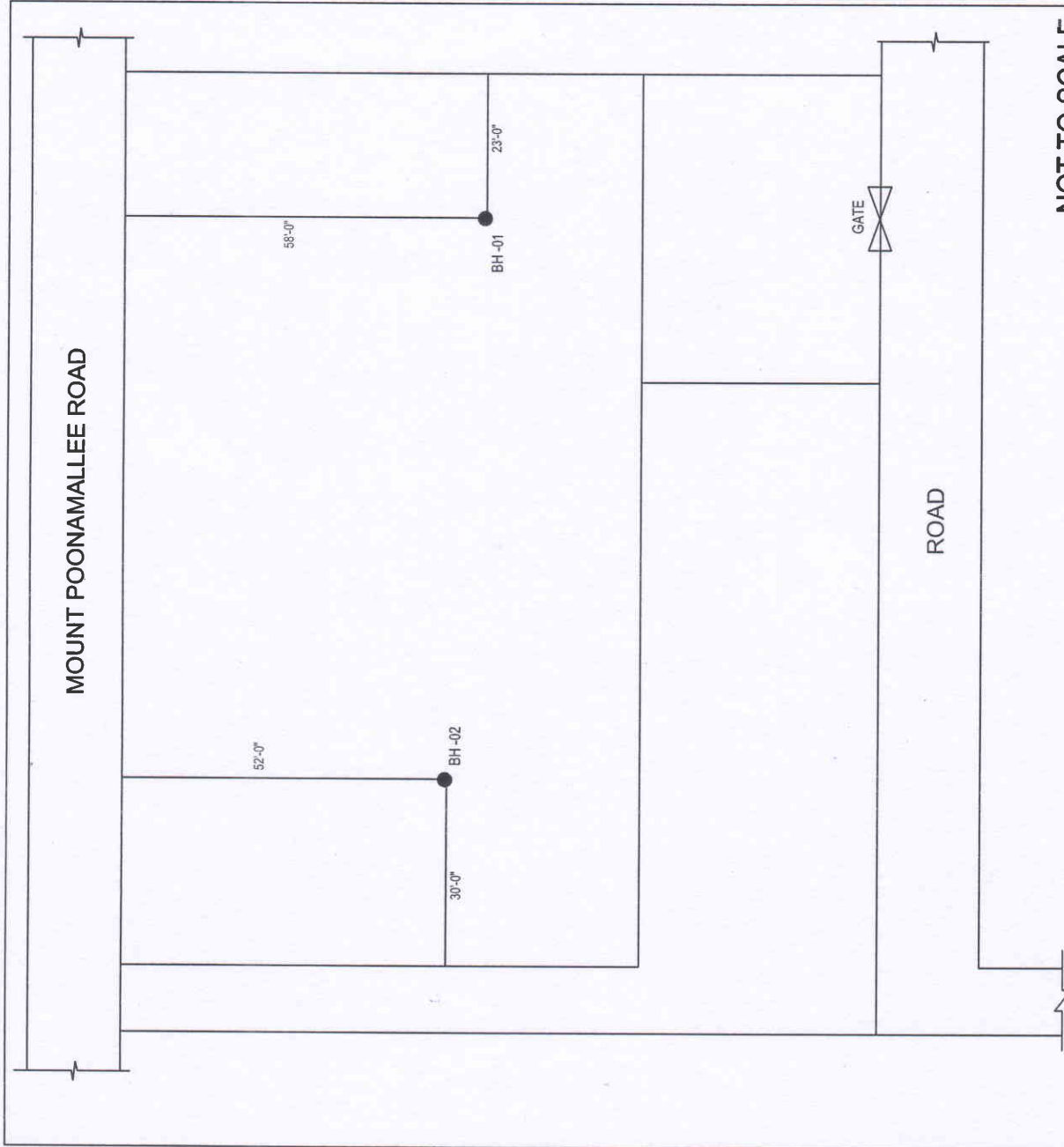


For T.J. Engineers

04 - 02 - 2019

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DTCP Reg. No: CGLRGN/RGTE/2019/07/010





CLIENT:- Mrs. MEERA DEVI CHAKRAVARTHY CHENNAI.	PROJECT:- PROPOSED BUILDING AT NO. 3/165, MOUNT POONAMALLEE ROAD, MANAPAKKAM, CHENNAI-102.	SITE PLAN FIG.1	NOT TO SCALE  T.J. ENGINEERS and Investigation and foundation design division T.J. HOUSE PLOT NO. 4, ANNA NAGAR, 1ST STREET, VELACHERY, CHENNAI-42, Tjengineers@yahoo.com Tjengineers@gmail.com OFF: 04-42334174
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BORE LOG

PROJECT : Proposed Building at No. 3/165, Mount Poonamallee Road, Manapakkam, Chennai-102. DATE OF COMMENCEMENT: 28 - 01 - 2019
 BORE HOLE NO : B.H:01 DATE OF COMPLETION : 28 - 01 - 2019
 TYPE OF BORING : Rotary Drilling G.W.L : 6.00m

Depth below G.L	Soil profile	Description of soil	Thickness of layer	Depth at which samples are collected		Standard penetration test data			Graphical representation of penetration resistance				
				D.S	U.D.S	Depth at which test is conducted	N-Value	Relative density/ Consistency	10	20	30	40	50
0.00		Filled Up Soil	0.50										
1.00		Silty Sand-SLS1 (Yellowish Brown)	1.40			1.50	17	Medium Dense					
2.00		Silty Sand-SLS2 (Whitish Yellowish Brown)	2.10			3.00	18	Medium Dense					
3.00													
4.00		Silty Sand-SLS3 (Yellowish Brown)	2.00			4.50	25	Medium Dense					
5.00													
6.00		Sandy Silty Clay-SSLC1 (Dark Gray)	0.70			6.00	13	Stiff					
7.00		Sandy Gravel-SG1 (Disintegrated Rock) (Whitish Gray Brown)				7.50	>100	Very Dense					
7.80													
8.00													
9.00													
10.00													

Remark: All Dimensions in meters
 → End of Boring

FIG: 2



BORE LOG

PROJECT : Proposed Building at No. 3/165, Mount Poonamallee Road, Manapakkam, Chennai-102. DATE OF COMMENCEMENT: 29 - 01 - 2019
 BORE HOLE NO : B.H:02 DATE OF COMPLETION : 29 - 01 - 2019
 TYPE OF BORING : Rotary Drilling G.W.L : 6.00m

Depth below G.L	Soil profile	Description of soil	Thickness of layer	Depth at which samples are collected		Standard penetration test data			Graphical representation of penetration resistance				
				D.S	U.D.S	Depth at which test is conducted	N-Value	Relative density/ Consistency					
0.00		Filled Up Soil	0.50										
1.00			0.50										
2.00		Silty Sandy Clay-SSLC1 (Grayish Yellowish Brown)	2.50			1.50	14	Stiff					
3.00						3.00	31	Dense					
4.00		Silty Sand-SLS1 (Yellowish Brown Whitish)	0.50										
			3.50										
5.00		Silty Sand-SLS2 (Yellowish Brown)	1.50			4.50	28	Medium Dense					
6.00		Sandy Silty Clay-SSLC1 (Dark Gray)	1.50			6.00	12	Stiff					
7.00													
8.00		Sandy Gravel-SG1 (Disintegrated Rock) (Whitish Gray Brown)				7.50	>100	Very Dense					
8.50						8.50	>100	Very Dense					
9.00													
10.00													

Remark: All Dimensions in meters
 → End of Boring

FIG: 3



Project: Proposed Building at No. 3/165, Mount Poonamallee Road, Manapakkam, Chennai-600 102.

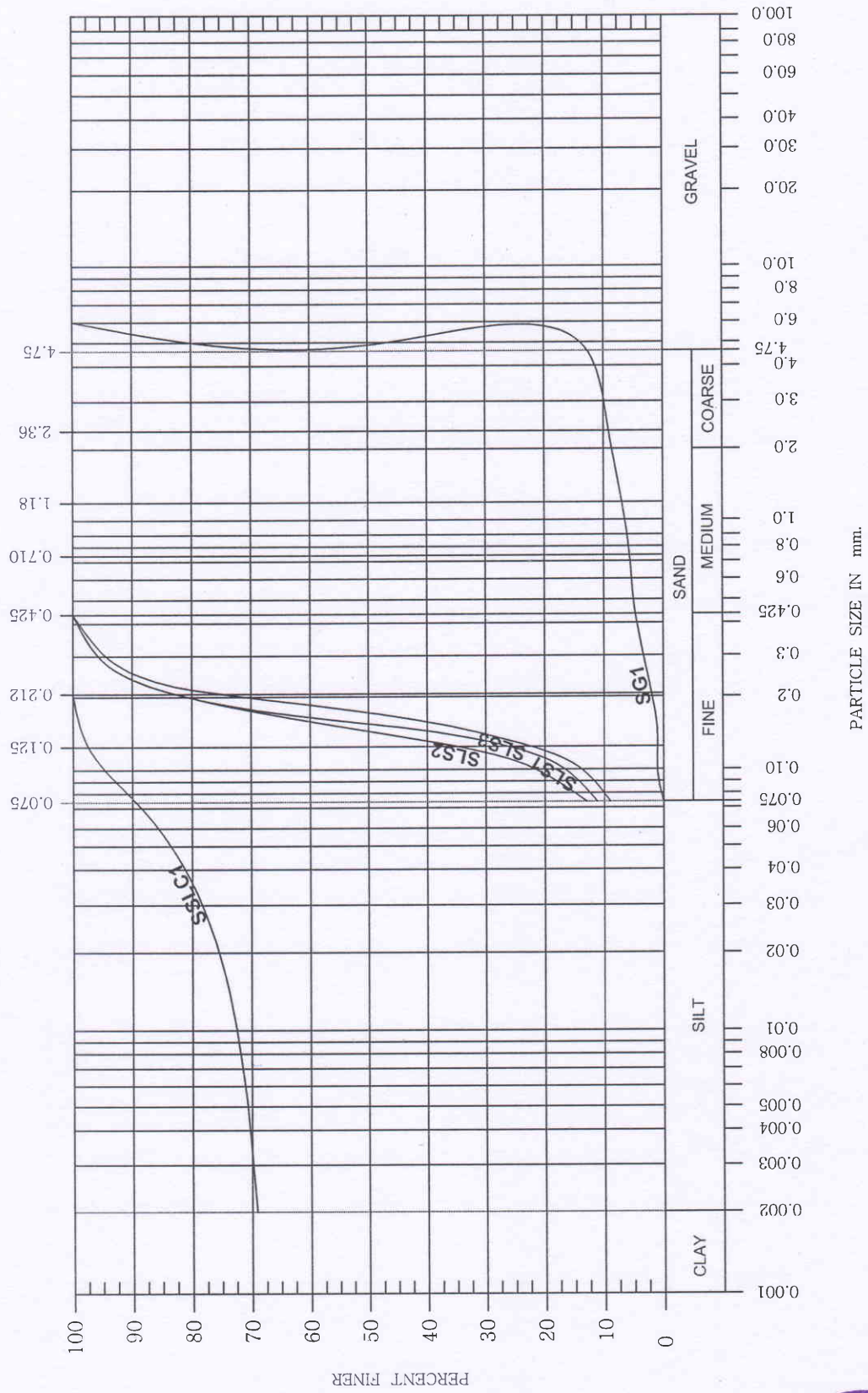


FIG. 4 GRAIN SIZE DISTRIBUTION CURVE-BH-01

Project: Proposed Building at No. 3/165, Mount Poonamallee Road, Manapakkam, Chennai-600 102.

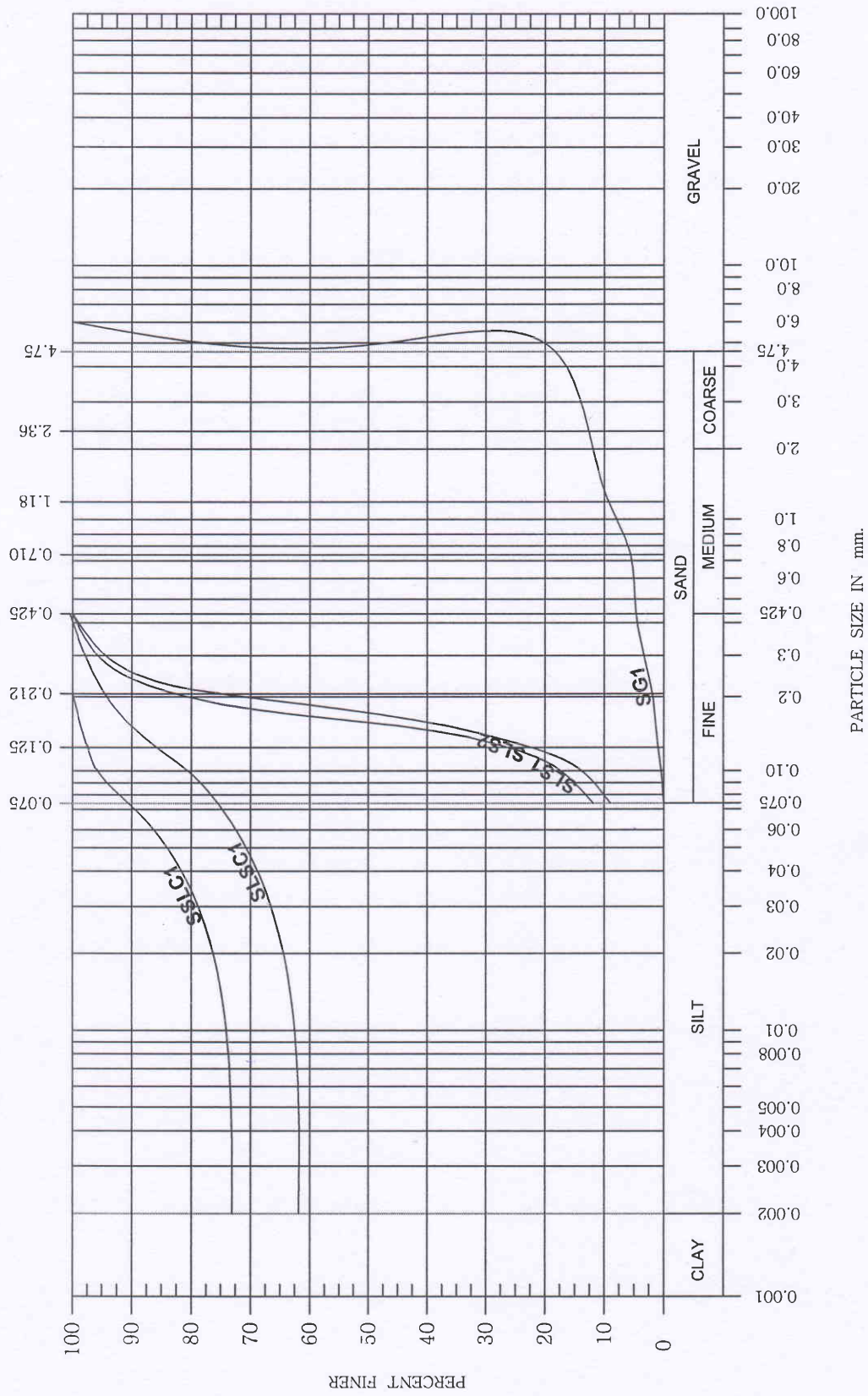


FIG. 5 GRAIN SIZE DISTRIBUTION CURVE-BH-02

LABORATORY TEST RESULTS

TABLE - 2

B.H No	Layer thickness m	Soil classification	Depth of sample collected		LL %	PL %	Bulk density t/m ³	Consolidation Parameters		Shear Strength Parameters		Remarks
			DS / SPT m	UDS m				e _o	Cc	Cu t/m ²	φ degree	
1	0.00 - 0.50	Filled Up Soil	-	-	-	-	-	-	-	-	-	-
	0.50 - 1.90	Silty Sand-SLS1	1.50	-	-	-	1.50	-	-	-	31	-
	1.90 - 4.00	Silty Sand-SLS2	3.00	-	-	-	1.50	-	-	-	32	-
	4.00 - 6.00	Silty Sand-SLS3	4.50	-	-	-	1.53	-	-	-	34	-
	6.00 - 6.70	Sandy Silty Clay-SSLC1	6.00	-	63	27	1.50	-	-	8.71	-	-
	6.70 - 7.80	Sandy Gravel-SG1	7.50	-	-	-	1.62	-	-	-	40	-
2	0.00 - 0.50	Filled Up Soil	-	-	-	-	-	-	-	-	-	-
	0.50 - 3.00	Silty Sandy Clay-SSLC1	1.50	-	48	21	1.50	-	-	9.38	-	-
	3.00 - 3.50	Silty Sand-SLS1	3.00	-	-	-	1.50	-	-	-	33	-
	3.50 - 5.00	Silty Sand-SLS2	4.50	-	-	-	1.52	-	-	-	32	-
	5.00 - 6.50	Sandy Silty Clay-SSLC1	6.00	-	65	28	1.50	-	-	8.10	-	-
	6.50 - 8.50	Sandy Gravel-SG1	8.50	-	-	-	1.63	-	-	-	40	-

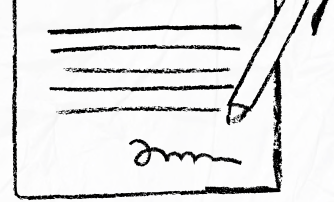


LABORATORY TEST RESULTS

TABLE - 1

B.H No	Layer thickness m	Soil classification	Depth of sample collected		SP. gravity	% of free swell	Grain size distribution				Remarks
			DS / SPT m	UDS m			Clay %	Silt %	Sand %	Gravel %	
1	0.00 - 0.50	Filled Up Soil	-	-	-	-	-	-	-	-	-
	0.50 - 1.90	Silty Sand-SLS1	1.50	-	2.63	-	0	12	88	0	-
	1.90 - 4.00	Silty Sand-SLS2	3.00	-	2.63	-	0	14	86	0	-
	4.00 - 6.00	Silty Sand-SLS3	4.50	-	2.63	-	0	9	91	0	-
	6.00 - 6.70	Sandy Silty Clay-SSLC1	6.00	-	2.65	62	69	20	11	0	-
	6.70 - 7.80	Sandy Gravel-SG1	7.50	-	2.63	-	0	0	14	86	-
2	0.00 - 0.50	Filled Up Soil	-	-	-	-	-	-	-	-	-
	0.50 - 3.00	Silty Sandy Clay-SSLC1	1.50	-	2.65	33	63	13	24	0	-
	3.00 - 3.50	Silty Sand-SLS1	3.00	-	2.63	-	0	13	87	0	-
	3.50 - 5.00	Silty Sand-SLS2	4.50	-	2.63	-	0	8	92	0	-
	5.00 - 6.50	Sandy Silty Clay-SSLC1	6.00	-	2.65	63	74	17	9	0	-
	6.50 - 8.50	Sandy Gravel-SG1	8.50	-	2.63	-	0	0	17	83	-





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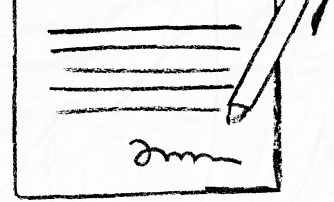
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