## SOIL EXPLORATION AND FOUNDATION REPORT

## FOR THE PROPOSED BUILDING

AT

DOOR NO. 7 & 11

**JAYARAM STREET** 

THIRUVANMIYUR

**CHENNAI-600 041** 

PROJECT NO. TJE/002998/2023



# **T.J.ENGINEERS**

SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION T.J.HOUSE NO.4, ANNA NAGAR, 1<sup>ST</sup> STREET, VELACHERY, CHENNAI-42. tjengineers@yahoo.com tjengineers1998@gmail.com Ph : 42 33 41 94.

1

## **CONTENTS OF THE REPORT**

## **1.0 INTRODUCTION**

## 2.0 SCOPE OF WORK

## **3.0 LOCATION AND NUMBER OF BORE HOLES**

## 4.0 GEO TECHNICAL INVESTIGATION

- 4-1. Field Investigation of Bore Holes
- 4.2. Grain Size Analysis

**4-3.** Laboratory Test for Bore Hole Sample

## 5.0 BORE HOLE DATA

**6.0 LABORATORY TEST RESULTS** 

7.0 GROUND WATER TABLE

## **8.0 SUB SOIL PROFILE**

## 9.0 FOUNDATION ANALYSIS AND DESIGN

9.1. Computation of Safe Bearing Capacity of Soil at 2.00m depth

9.2. Settlement Analysis

### **10.0 CONCLUSIONS**

## **11.0 TABLES AND FIGURES**

#### **EXPLORATION REPORT**

#### PROJECT NO. TJE/002998/2023

#### **1.INTRODUCTION:**

**Mrs. SHARMILA BANTHIA** has proposed to construct a Ground Floor + Three Floors Building at Door No. 7 & 11, Jayaram Street, Thiruvanmiyur, Chennai-600 041. 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 10.50m 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 Silty Sand 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 in 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 4.80m**, below the existing ground level at the time of soil exploration. It was noticed from the existing well at the site.

#### **8.0. SUB SOIL PROFILE**

From the visual identification from field test results, it is concluding that the sub soil is basically made-up of two distinctive layers.

- i. Filled Up Soil 0.00m to 0.30m
- ii. Medium Dense to Very Dense Silty Sand, 0.30m to 10.50m SPT's N= 12-65

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

## **9.0 FOUNDATION ANALYSIS**

From the bore log data at the top from 0.00m to 0.30m Filled Up Soil layer is present. Below 0.30m medium dense to very dense Silty Sand layer is seen.

The layer up to 7.50m is the critical zone for open foundation system. Within the critical zone medium dense to dense Sandy layer is present. For the proposed Ground Floor + Three Floors 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 2.00m below the existing ground level, the existing ground level was same as the road level at the time of soil investigation. The SBC at 2.00m depth has been worked out and given below.

## 9.1. COMPUTATION OF THE SAFE BEARING CAPACITY AT 2.00m DEPTH

Based on the standard penetration test value the ultimate bearing capacity (qu) could be

calculated from the following formula.

qu =  $\gamma$  Df Nq + 0.4  $\gamma$ ' B N  $\gamma$ 

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

The corresponding bearing capacity factors are,

Nq = 18.61

 $N\gamma = 17.47$ 

Where,

$\gamma$ = Bulk density	= 1.50  t/m 3
$\gamma$ ' = Submerged density	= 0.50 t/m 3
Df = Depth of footing	= Considered minimum of 2.00m.
Dw = Depth of water table	= 4.80m

B = Breadth of the footing = Consider minimum of 1.00m.

Substitute all the above values in the formula,

Qu = 
$$1.50x2.00x \ 18.61 + 0.4 \ x \ 0.50 \ x \ 1.00 \ x \ 17.47$$
  
=  $55.83 + 3.494$   
=  $59.324 \ t/m^2$ 

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

Hence, safe bearing capacity q s =  $59.324 / 2.50 = 23.72917.747 \text{ t/m}^2$ . Say 24.00 t/m<sup>2</sup>

### Therefore, Safe Bearing Capacity of the soil at the depth of 2.00m is 24.00 t/m<sup>2</sup>

## 9.2. SETTLEMENT ANALYSIS FOR THE LOADING INTENSITY OF 24.00 t/m<sup>2</sup> LAYER -1, SILTY SAND

The Settlement of the Sand layer can be calculated using the following formula.

S<sub>1</sub> = (H/C)Log<sub>e</sub> ( $\sigma'_0 + \Delta \sigma / \sigma'_0$ )

Where

Н	=The thickness of the compressible layer
	= 5.50m
С	$= 1.5 q_{\rm c} / \sigma'_0$
$q_c$	= Static cone resistance
	$= 400 \text{ t/m}^2$
С	$= 1.5 \times 400/7.125$
	= 84.21
$\sigma'_0$	=The original effective over burden pressure at the centre of the layer
	$= 7.125 \text{ t/m}^2$
Δσ	= The stress increases at the centre of the layer due to foundation loads
	(or) pressure
	$= 0.725 \text{ t/m}^2$
$\mathbf{S}_1$	= (5.50 /84.21) x Log <sub>e</sub> (7.125 +0.725/7.125)
	$= 0.0653 \times 10^{-3} \times 0.0962$
	$= 0.006283 \text{ x } 10^{-3} \text{m}$
	= 6.28mm

## TOTAL SETTLEMENT

= 6.28mm < 50mm

The maximum allowable settlement as per IS: 1904-1986 for R.C.C structure with Isolated footing foundation is 50mm. The settlement is within the permissible limit. Hence it is Safe.

### **10.0. CONCLUSIONS**

- 1. Soil in the shallow depth is fair to adopt open foundation system.
- 2. The foundation can be Isolated Footing or Continuous Strip Raft Footing (Inverted T Beam) or Raft Foundation.
- 3. The **open foundation** can be placed at the **minimum depth** of **2.00m** below existing ground level (existing ground level considered as the ground level at the time of soil investigation). The existing ground level was same as the road level at the time of soil investigation.
- 4. The Safe Bearing Capacity of the soil at the depth of 2.00m is 24.00  $t/m^2$ .
- 5. The **minimum width** of footing should be maintained as **1.00m** to avoid any punching shear failure and to achieve suggested SBC.
- 6. The shallow foundation should rest on natural un disturbed Silty Sand layer.
- 7. All the foundation should rest on 100 mm thick 1:4:8 concrete mat.
- 8. The foundation bed should be well compacted by ramming before laying PCC.
- 9. If isolated footing provided, it is advisable to provide **plinth beam** connecting all column on both direction, **continuous belt beam** at floor level, **continuous sill slab and continuous lintel beam**.
- 10. Since the soil strata is sandy precaution should be taken in deep excavation for underground sump, Swimming pool and septic tank etc. The soil under footing should not get disturbed, if get disturbed the foundation depth should be taken up to the deep excavation depth. The **foundation should rest on the natural undisturbed strata.**
- 11. All suggested foundation recommendations and precautions should be adopted while undertaking the design aspects and construction activities.

## For T.J. Engineers

03 - 11 - 2023



CI      :      Chennai-600 041.      DATE OF COMMENT        HOLE NO      :      B.H:01      DATE OF COMPLET        DF BORING      :      Rotary Drilling      G.W.L :											27 - <sup>-</sup> 27 - <sup>-</sup> 4.80n	10 - 2 10 - 2 n (Wel	023 023 II)
						Standard	penetratio	on testdata	Grap	nical r	eprese	entatio	n
Depth below G.L	Soil profile	Description of soil	Thickness of layer	Depth at witch samples are	collected	Depth at witch test is conducted	N-Value	Relative density/ Consistency	10	20	20	40	5
0.00			0.30	0.5	0.0.5				10	20	30	40	5
		Filled Up Soil		0.30									
1.00						1.50	12	Medium Dense		1			
2.00													
3.00						3.00	20	Medium Dense		ļ			
5.00						4.50	28	Medium Dense					
6.00		Silty Sand-SLS1 ( Whitish Yellowish Brown )				6.00	42	Dense					
7.00						7.50	53	Very Dense					
8.00													
9.00						9.00	61	Very Dense					
10.00													
10.50						10.50	56	Very Dense					
12.00													
13.00													
14.00													
15.00													

BORE LOG

Remark: All Dimensions in meters

PROJECT BORE HOLE N TYPE OF BOR	: IO : ING :	Chennai-600 041. B.H:02 Rotary Drilling		, , , , , , , , , , , , , , , , , , ,	avanniy	,		DATE OF COMMENCEME DATE OF COMPLETION : G.W.L :	ENT:		27 - 1 27 - 1 4.80m	0 - 20 0 - 20 (Well	)23 )23  )
						Standard	penetratio	on testdata	Graph	hical re	eprese	ntation	n
Depth below G.L	Soil profile	Description of soil	Thickness of layer	Depth at witch samples are	s'd'n	Depth at witch test is conducted	N-Value	Relative density/ Consistency	of per	20	on resi	40	e 50
0.00		Filled Up Soil	0.30	0.30									
1.00						1.50	16	Medium Dense		1			
2.00													
3.00						3.00	24	Medium Dense					
5.00						4.50	31	Dense					
6.00		Silty Sand-SLS1 ( Whitish Yellowish Brown )				6.00	39	Dense					
7.00						7.50	57	Very Dense					
9.00						9.00	65	Very Dense					
10.00 10.50						10.50	53	Very Dense					
11.00													
12.00													
13.00													
14.00													
15.00													

BORE LOG

seed Building at Door No. 7 & 11 Ja

•

Remark: All Dimensions in meters

FIG. 4 GRAIN SIZE DISTRIBUTION CURVE-BH-01





Project: Proposed Building at Door No. 7 & 11, Jayaram Street, Thiruvanmiyur, Chennai-600 041.

T.J. ENGINEERS

FIG. 5 GRAIN SIZE DISTRIBUTION CURVE-BH-02





Project: Proposed Building at Door No. 7 & 11, Jayaram Street, Thiruvanmiyur, Chennai-600 041.



## LABORATARY TEST RESULTS

#### TABLE-1

B.H No	Layer thickness	Soil classification	Depth of sample collected SP. %of free gravity swell						Remarks		
	m		DS / SPT m	UDS m		%	Clay %	Silt %	Sand %	Gravel %	
4	0.00 - 0.30	Filled Up Soil	_	_	_	_	_	_	_	_	_
1	0.30 - 10.50	Silty Sand-SLS1	1.50	_	2.63	_	0	14	86	0	_
	0.00 - 0.30	Filled Up Soil	_	_	_	_	_	_	_	_	_
2	0.30 - 10.50	Silty Sand-SLS1	10.50	_	2.63	_	0	12	88	0	_

## LABORATARY TEST RESULTS

#### TABLE -2

B.H No	Layer thickness	Soil classification	Depth of sample collected		Depth of sample collected		Depth of sample collected		LL	PL	Bulk density	Consolidation Parameters		Shear Strength Parmeters		Remarks
	m		DS / SPT m	UDS m	%	%	t/m <sup>3</sup>	e <sub>o</sub>	Cc	Cu t/m²	ø degree					
1	0.00 - 0.30	Filled Up Soil	_	_	_	_	_	_	_	_	_	_				
	0.30 - 10.50	Silty Sand-SLS1	1.50	_	_	_	1.51	_	_	_	33	_				
2	0.00 - 0.30	Filled Up Soil	_	_	_	_	_	_	_	_	_	_				
2	0.30 - 10.50	Silty Sand-SLS1	10.50	_	_	_	1.56	_	_	_	38	_				