Verified RealEstate™

Your trusted partner for buying, selling, and managing property, ensuring hassle-free service with 100% transparency.

3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996

Official Property Record

Digitally Verified Record - Powered by Verified RealEstate™



SOIL EXPLORATION AND FOUNDATION REPORT

FOR THE PROPOSED BUILDING

AT

SURVEY NO.116/2

PONNAMBALAM SALAI

MAXWORTH NAGAR

KOLAPAKKAM

CHENNAI

PROJECT NO. TJE/001958/2021

T.J.ENGINEERS

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

T. J. ENGINEERS CHENNAI-42.

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 the soil at 1.80m depth
- 9.2. Settlement Analysis
- 9.3. Load Carrying Capacity of the conventional pile

10.0 CONCLUSIONS

11.0 TABLES AND FIGURES

T. J. ENGINEERS CHENNAI-42

EXPLORATION REPORT

PROJECT NO. TJE/001958/2021

1.INTRODUCTION:

M/S ARA CONSTRUCTION has proposed to construct a Stilt Floor + Five Floors Building at Survey No.116/2, Ponnambalam Salai, Maxworth Nagar, Kolapakkam, Chennai-600 112. The soil investigation 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 four bore holes were bored up to maximum depth of 23.00m below existing ground level. The bore hole location is shown in Fig No.1 and bore log details

T. J. ENGINEERS CHENNAI-42.

are given in Fig No. 2,3,4&5. 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. 2,3,4&5. 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.

T. J. ENGINEERS ★ CHENNAI-42. ★

4.2. Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1a, 1b. 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, BH-03 & BH-04 is given in Fig No. 2,3,4&5. Borehole location is given in Fig-1.

6.0. LABORATORY TEST RESULTS

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

7.0. GROUND WATER TABLE

The ground water table was **encountered at the depth of 5.00m** below the existing ground level at the time of soil exploration.

T. J. ENGINEERS CHENNAI-42.

8.0. SUB SOIL PROFILE

From the visual identification from field test results, it is concluded that soil strata is not similar in both the locations.

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

i. Top Soil Sandy Silty Clay, 0.00m to 1.20m

ii. Medium Dense Silty Sand, 1.20m to 5.00m SPT's N = 12-19

iii. Medium Stiff Silty Clay, 5.00m to 7.00m SPT's N = 6

iv. Loose Silty Clayey Sand, 7.00m to 9.00m SPT's N = 9

v. Soft to Medium Stiff Sandy Silty Clay, 9.00m to 15.80m SPT's N = 4-6

vi. Medium Dense Silty Clayey Sand, 15.80m to 17.80m SPT's N = 20

vii. Very Dense Clayey Silty Sandy Gravel, 17.80m to 22.50m SPT's N = >100

viii. Very Dense Sandy Gravel, 22.50m to 23.00m SPT's N = >100

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

i. Top Soil Sandy Silty Clay, 0.00m to 1.20m

ii. Medium Dense Silty Sand, 1.20m to 5.00m SPT's N = 12-22

iii. Soft to Medium Stiff Sandy Silty Clay, 5.00m to 10.50m SPT's N = 4-5

In BH-03 Location soil strata is made-up of eight distinctive layers.

i. Top Soil Sandy Silty Clay, 0.00m to 1.20m

ii. Loose to Medium Dense Silty Sand, 1.20m to 5.20m SPT's N = 10-26

iii. Medium Stiff Silty Clay, 5.20m to 7.00m SPT's N = 8

T. J. ENGINEERS ★ CHENNAI-42. ★

iv. Very Loose to Loose Silty Clayey Sand, 7.00m to 9.50m SPT's N = 4-9

v. Soft to Medium Stiff Sandy Silty Clay, 9.50m to 16.00m

SPT's N = 4-6

vi. Medium Dense to Dense Silty Clayey Sand, 16.00m to 19.20m

SPT's N = 20-38

vii. Very Dense Clayey Silty Sandy Gravel, 19.20m to 22.50m

SPT's N = >100

viii. Very Dense Sandy Gravel, 22.50m to 23.00m SPT's N = >100

In BH-04 Location soil strata is made-up of three distinctive layers.

i. Top Soil Sandy Silty Clay, 0.00m to 1.20m

ii. Medium Dense Silty Sand, 1.20m to 5.20m SPT's N = 11-23

iii. Loose Silty Clayey Sand, 5.20m to 8.50m SPT's N = 5-7

iv. Soft to Medium Stiff Sandy Silty Clay, 8.50m to 10.50m SPT's N = 4-7

The soil profile details are presented in the Bore logs, Fig. 2,3,4&5.

T. J. ENGINEERS CHENNAI-42.

9.0. FOUNDATION ANALYSISAND DESIGN

From the bore log data at the top from 0.00m to 1.20m Sandy Silty Clay Desiccated Crust layer is present. From 1.20m to 5.20m loose to medium dense Silty Sand layer is present. From 5.20m to 16.00m very loose to medium dense Silty Clayey Sand layer and soft to medium stiff Sandy Silty Clay layer is present and the Sandy Silty Clay layer has got swelling character. From 16.00m to 19.20m medium dense Silty Clayey Sand layer is present. From 19.20m to 22.50m very dense Clayey Silty Sand/ Clayey Silty Sand Gravel layer is present.

Below 22.50m very dense Sandy Gravel (Dis-integrated Rock) layer is seen, this layer is fair to rest the pile foundation for heavy loaded structure.

The layer up to 16.00m is the critical zone for open foundation system. Within the critical zone loose to medium dense Sandy layer and soft to medium stiff Clayey layer is present, and the Clayey layer has got swelling character. For light loaded structure open foundation of **Isolated Footing or Continues Strip Raft Footing or Raft Foundation** can be adopted. The open foundation can be placed at the minimum **depth of 1.80m** below the existing ground level.

For heavy loaded structure, if the SBC is not sufficient for the expected loading intensity, 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 23.00m** below existing ground level. The pile should be anchored into the very dense Sandy Gravel (Dis-integrated Rock) layer minimum of 0.50m depth.



9.1. COMPUTATION OF THE SAFE BEARING CAPACITY AT 1.80m 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 11 from Fig. 2,3,4&5.

The corresponding bearing capacity factors are,

$Nq = 10.33$

$N\gamma = 7.70$

Where,

γ = Bulk density = 1.50 t/m 3

γ' = Submerged density = 0.50 t/m 3

Df = Depth of footing = 1.80 m.

Dw = Depth of water table = 5.00m

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

Substitute all the above values in the formula,

$Qu = 1.50 \times 1.80 \times 10.33 + 0.4 \times 0.50 \times 1.00 \times 7.70$

$= 27.891 + 1.54$

$= 29.431\ t/m^2$

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

Hence, safe bearing capacity qs = $29.431 / 2.50 = 11.77\ t/m^2$. Say $12.00 t/m^2$

Therefore, Safe Bearing Capacity of the soil at the depth of 1.80m is 12.00 t/m^2

T. J. ENGINEERS CHENNAI-42.

9.2. SETTLEMENT ANALYSIS FOR THE INTENSITY OF 12.00 t/m^2

LAYER -1, SILTY SAND

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

$$S_I = (H/C)\ \mathrm{Log}_e\ (\sigma'_0 + \Delta\sigma / \sigma'_0)$$

Where

H = The thickness of the compressible clay layer

= 3.40m

σ'_0 = The effective over burden pressure at the centre of the layer

= 5.25 t/m^2

$\Delta\sigma$ = The stress increases at the centre of the clay layer due to foundation loads (or) pressure

= 0.592 t/m^2

C = $1.5q_c / \sigma'_0$

q_c = Static cone resistance

=220 t/m^2

C = 1.5x220/5.25

= 62.85

S_I = (3.40 /62.85) x Log_e (5.25 +0.592 /5.25)

= 0.054 x 0.0944

= 0.005097 x 10^{-3}

=5.09mm

T. J. ENGINEERS CHENNAI-42

LAYER -2, SANDY SILTY CLAY

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

$$S_2 = (C_c / 1 + e_0) H \quad Log (\sigma'_0 + \Delta\sigma / \sigma'_0)$$

Where

C_c = Coefficient of compression index

= 0.35

e_0 = The initial void ratio

= 1.80

H =The thickness of the compressible clay layer

= 10.80m

σ'_0 = The original effective over burden pressure at the centre of the clay layer

= 10.30t/m^2

$\Delta\sigma$ = The stress increases at the centre of the clay layer due to foundation loads (or) pressure

= 0.089 t/m^2

S_2 = (0.35 /1+1.80) 10.80 Log (10.30 + 0.089 /10.30)

= 0.125 x 10.80 x 0.00346

= 0.0047m

= 4.70mm

TOTAL SETTLEMENT

= $S_1 + S_2$

= 5.09 + 4.70

= 9.79mm < 50mm

The maximum allowable settlement as per IS: 1904-1986 for R.C.C structure with Isolated footing foundation is 50mm- 75mm.**The settlement is within the permissible limit. Hence it is Safe**

T. J. ENGINEERS CHENNAI-42.

9.3. LOAD CARRYING CAPACITY OF THE CONVENTIONAL PILE FOR 23.00m DEPTH

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

$$Qu = Qb + Qs$$

Qs = Ultimate unit skin friction on an individual layer

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

Where

Ks = Co-efficient of horizontal soil stress = 0.471

σ'_{vo} = average effective overburden pressure = 10.75 t/m^2

δ = angle of wall friction = 32

D = Dia meter of pile = 0.40m

L = Length of individual layer = 3.00m

= 0.471 x 10.75 x 0.624 x 3.14 x 0.40 x 3.00

= 11.90 t

$q_b = Nq\ \sigma'_{vo}\ Ab$

where

Nq = Bearing Capacity Factor = 110

σ'_{vo} = effective overburden pressure at the toe = 11.50 t/m^2

Ab = Cross sectional area at the base

T. J. ENGINEERS CHENNAI-42.

D = Dia of Pile = 0.40m

= 110 x 11.50 x 3.14 x 0.40^2 /4

= 158.88 t

Qu = Qb + Qs

= 158.88 + 11.90 = 170.78 t

Q safe = Qu/F.S = 170.78/2.5 = 68.31 say 68.00 t

The safe load carrying capacity for five different diameter of piles for the **depth of 23.00m** are worked and are given below.

Dia of Pile	Depth of Pile	Safe Load (Tones)
400mm	23.00m	68
450mm	23.00m	86
500mm	23.00m	105
600mm	23.00m	150
750mm	23.00m	232

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).

T. J. ENGINEERS CHENNAI-42.

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 Continues Strip Raft Footing or Raft Foundation** can be adopted.
3. The open foundation can be placed at the minimum **depth of 1.80m** below the existing ground level.
4. The Safe Bearing Capacity of the soil at the **depth of 1.80m is 12.00 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 layer.
7. All the foundation should rest on 100 mm thick 1:4:8 concrete mat, over 100m thick river sand or M sand layer.
8. **If open foundation of Isolated Footing provided** it is advisable to make the structure as rigid as possible by providing plinth beam connecting column on both direction, **Continues Sill Slab** and **continues lintel beam connecting monolithically with column.**
9. **For heavy loaded structure**, if the SBC is not sufficient for the expected loading intensity, **deep foundation of pile** can be provided. The pile foundation can be Bored Cast in situ pile. The pile foundation should be terminated at the minimum **depth of 23.00m** below existing ground level. The pile should be anchored into the very dense Sandy Gravel (Dis-integrated Rock) layer for minimum of 0.50m depth.

T. J. ENGINEERS ★ CHENNAI-42. ★

10. The safe load carrying capacity for five different diameters of piles for the **depth of 23.00m** are worked and are given below.

Dia of Pile	Depth of Pile	Safe Load (Tones)
400mm	23.00m	68
450mm	23.00m	86
500mm	23.00m	105
600mm	23.00m	150
750mm	23.00m	232

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 boring should be done with **Percussion drilling** or **Hydraulic Rotary Drilling**, with DMC method.
12. The bore hole should be flushed properly before laying concrete.
13. The soil strata is soft and loose in consistency, proper precaution should be taken against sliding of bore hole by maintaining proper dense bentonite slurry or providing temporary casing or permanent casing.
14. For foundation design stress due to any eccentricity and horizontal force should be considered and stability should be checked.
15. It is advisable not to mix deep foundation and shallow foundation in same building individually. Combined Pile cum Raft Can be adopted.
16. All suggested foundation recommendations and precautions should be adopted while undertaking the design aspects and construction activities.

T. J. ENGINEERS ★ CHENNAI-42. ★

For T.J. Engineers

16 - 07 - 2021

Dr. S.CHOCKALINGAM, M.E. (Geo-Tech)., Ph.D.,
Geo - Technical Engineer
T.J. ENGINEERS
Plot No:4, Anna Nagar, 1st Street,
Velachery, Chennai-600 042.
Phone: 044-42334194 Mob: 9841255480
CMDA Registration No: GTE/19/03/006
DTCP Reg. No: CGLRGN/RGTE/2019/07/010

T. J. ENGINEERS ★ CHENNAI-42. ★



our services doesn't just end there

Buying & Selling Services

Property Buying Assistance, Property Selling Support, Market Price Analysis, Owner Outreach and Negotiation.

Legal & Documentation Services

Certified EC, Patta, legal opinions, property verification, due diligence, litigation solutions, and legal heir certificates.

Property Development & Approvals

Building plan approvals, construction, layout and sub-division approvals, zone conversion, and occupancy certification.

NRI & Investment Services

Escrow Services, Rentals, Litigation Solutions, Property Valuation and Property Management

Compliance & Special Services

Demolition, Vaasthu checks, regularization of unauthorized buildings, and office space solutions.



empowering your real estate decisions with smart tools

Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

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

Zoning & Land Use Analysis

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

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

Verified RealEstate™

We're honored to be part of your real estate journey

3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996
www.verified.realestate