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GEOTECHNICAL REPORT FOR

RESIDENTIAL BUILDING AT NOOKAMPALAYAM ROAD, PERUMBAKKAM VILLAGE, CHENNAI

90 Dwelling units
S.No.241/2,242/1A,242/1C,243/2A,243/2B,

Client :

M/s. S R Developer.,
Chennai

Architect :

Consultant :

Structural Consultant :

Job No. : G(C)9691 Date : 14.07.2022

NAGADI CONSULTANTS PRIVATE LIMITED

Branch : Chennai

STILT + 5 FLOORS

Project : 90 Dwelling Units S.No.241/2, 242/1A,242/1C,243/2A,243/2B

RESIDENTIAL BUILDING AT NOOKAMPALAYAM ROAD, PERUMBAKKAM VILLAGE, CHENNAI

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G(C)9691 14.07.2022

Job No. : Date :

Stilt+5 Floors 90 dwelling untis S.No.241/2,242/1A,242/1C,243/2A,243/2B

GEOTECHNICAL INVESTIGATION REPORT

for Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai

EXECUTIVE SUMMARY

M/s. S R Developer., Chennai are associated in construction of Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

The site for the proposed Residential Building is situated at Survey Nos. 241/2, 242/1A, 242/1C, 243/2A on the eastern side of Nookampalayam Road, Perumbakkam Village, Chennai - 600119. The site measures approximately 35m x 50m. The site is having boundary wall on western side and open on the other three sides and is fairly level in topography.

The proposed Residential Building consists of an open stilt floor at ground level and five upper floors.

Geotechnical investigations have been undertaken at the site as per the scope of investigations, stipulated by the client, which consisted of 3 boreholes down to 10m depth or if refusal/rock strata (where N>100) is met earlier then further drilling in refusal strata by 3m was to be carried out.

The investigations reveal filled up soil down to 1m depth (only at the location of borehole BH1) below which virgin soil was encountered. The virgin soil is Brown clayey silty sand with gravel down to 5.5/6m depth at which refusal strata in the form of completely weathered rock was encountered and continued till maximum termination depth of 9m below existing ground level.

The soil strata encountered till refusal strata is in a medium dense state with observed N-values ranging between 8 and 43.

Ground water was encountered between 2.9 and 3.5m depth in the boreholes during the period of field investigations.

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In view of the observed subsoil conditions, the proposed structure can be supported on Isolated/Strip footings at 2m depth below the existing ground level. Net allowable bearing pressure for various widths of foundations are given below.

Depth of Foundation Below E G L (m)	Allowable Settlement (mm)	Net Allowable Bearing Pressure (t/m^2) for Widths of Foundations (m)		
		1.5	3	≥4.5
2	50	16	19	21

Alternatively, Pile foundations may be adopted. The piles capacities are given below for piles after embedding in completely weathered rock strata (where N>100) by 5 times the diameter of piles:

Diameter of Pile (mm)	Safe pile Capacity (t)	Uplift Capacity (t)
450	85	25
500	100	35
600	150	50

For Isolated/Strip Foundations

The excavated soil can be used for backfilling purposes.

The foundation surface should be watered for at least 24 hours. The top slush should then be removed and the surface compacted heavily. If any loose pockets are observed, the same shall be filled with brickbats/ gravel and compacted well. Foundations can subsequently be placed over such a prepared surface.

Stiff Tie-beams connecting the columns in both directions may be provided which will render additional rigidity to the structure.

For Pile Foundations

After reaching the required depth in the pile bore, 15cm thick layer of gravel should be placed and compacted at the bottom so that the slush formed at the bottom is diminished.

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REPORT ON GEOTECHNICAL INVESTIGATION FOR RESIDENTIAL BUILDING AT NOOKAMPALAYAM ROAD, PERUMBAKKAM VILLAGE, CHENNAI

1.0 INTRODUCTION

1.1 Overview

1.1.1 M/s. S R Developer., Chennai are associated in construction of Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

1.1.2 The geotechnical investigations have been carried to ascertain the soil conditions for the design of foundations of the proposed Residential Building.

1.2 Authority

A detailed geotechnical investigations programme has been conducted as per the authorisation by M/s. S R Developer., Chennai vide their Work Order dated 01.06.2022.

2.0 PROJECT DETAILS

2.1 Site Location

The site for the proposed Residential Building is situated at Survey Nos. 241/2, 242/1A, 242/1C, 243/2A on the eastern side of Nookampalayam Road, Perumbakkam Village, Chennai - 600119. The key map showing the location of the site is given in fig. 1.

2.2 Site Layout and Topography

2.2.1 The site measures approximately 35m x 50m. The site is having boundary wall on western side and open on the other three sides and is fairly level in topography.

2.2.2 The colour of the exposed soil surface is Brown.

2.3 The Structure

As per information provided by the client, proposed Residential Building consists of an open stilt floor at ground level and five upper floors.

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2.4 Seismic Zone

Site for the proposed residential building is situated in Perumbakkam, Chennai which falls under Seismic Zone III as per IS 1893 (Part 1) - 2016.

2.5 Geographical Information

2.5.1 The site for the proposed residential building is located at:

a) Latitude : 12°53'

b) Longitude : 80°11'

3.0 OBJECT OF INVESTIGATIONS

3.1 For designing the foundation system of the proposed structures, the following data are required:

a) Type of foundation system.

b) Depth below the ground level at which the foundation system is to be laid.

c) Allowable bearing pressure on the foundations levels.

3.2 To determine above factors, the following information would be required:

a) The subsoil profile indicating thicknesses of the various soil strata, to a depth down to the influence zone below the foundations.

b) Engineering properties of the soil strata at various levels.

c) Physical characteristics of the soil strata.

d) Variation of the strength of the strata with depth.

3.3 For evaluating the above parameters, field investigations and laboratory investigations on the soil samples collected during the field investigations, have been carried out.

3.4 The results from these investigations have been analysed to provide the recommendations for the design of foundations.

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4.0 SCOPE OF INVESTIGATIONS

4.1 Scope of investigations as given in the work order:

a) Conducting 3 boreholes down to 10m depth or if refusal/rock strata (where N>100) is met earlier then further drilling in refusal strata by 3m, as required by the client.

b) Conducting standard penetration tests at 1.5m intervals.

c) Recovering undisturbed soil samples from various levels of the subsoil strata.

d) Recording ground water table levels, if met with.

e) Conducting relevant laboratory tests on soil and rock samples recovered.

f) Preparation and submission of a technical report containing the details of the tests carried out, their analysis and recommendations regarding the foundation system to be adopted. Two copies of the report are to be submitted.

5.0 FIELD INVESTIGATIONS

5.1 General Details

5.1.1 The locations of the boreholes were shown at site by the client's representative. A Schematic site plan showing the boreholes locations marked by the client is given in fig.1.

5.1.2 Weather was clear during the period of field investigations which were carried out in the second week of June 2022.

5.2 Boreholes

5.2.1 The boreholes were progressed by mechanically operated rotary core drill method.

5.2.2 Refusal strata (i.e. N-value > 100) was encountered between 5.5 and 6m depth below the existing ground level in the form of completely weathered rock (Charconites Based) strata. The drilling in refusal/rock strata was conducted using NX size core barrel fitted

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with diamond bits.

5.2.3 The boreholes were terminated after drilling minimum of 3m in refusal strata (where N>100) as per the scope of work.

5.2.4 The depth of water table encountered in the boreholes during the field investigations, depth at which refusal strata was encountered and termination depths of the boreholes are given in the following table.

Borehole No.	Depth of Water Table Below EGL (m)	Depth of Refusal/ Rock Strata Below EGL (m)	Termination Depth Below EGL (m)
1	2.9	6	9
2	3.5	5.8	9
3	3.3	5.5	9

5.2.5 Standard Penetration Tests were conducted in soil strata at 1.5m depth intervals. Additionally, Standard Penetration Tests had also been conducted in refusal strata for the confirmation of the refusal strata.

5.2.6 Disturbed soil samples recovered from split spoon samples were packed in polythene bags, labelled and retained for identification purposes.

5.2.7 Undisturbed soil samples were recovered only in some boreholes by thin walled tubes conforming to IS 2132. At other boreholes the samples could not be collected due to the nature of the sub soil strata. These tubes had an area ratio of less than 10%. The diameter of soil samples were 50 mm and its length was 45 cm.

5.2.8 Ground water was encountered between 2.9 and 3.5m depth in the boreholes during the period of field investigations.

6.0 LABORATORY INVESTIGATIONS

6.1 The undisturbed and disturbed soil samples brought to the laboratory were subjected to

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various tests to determine the following properties

a) Type of soil and its gradation

b) Consistency limits

c) Natural density

d) Natural water content

e) Shear strength properties

6.2 In order to determine the above properties listed in 6.1, the following tests were conducted.

a) Sieve analysis on the coarse grained soil fraction

b) Hydrometer analysis on the fine grained soil fraction

c) Liquid and plastic limits

d) Natural Density and Water Content tests

e) Triaxial compression tests

f) Free Swell Index tests

6.3 The rock core samples brought to the laboratory were subjected to various tests to determine the following properties

a) Unit Weight

b) Porosity

c) Water Absorption

d) Point load index

7.0 RESULTS AND ANALYSIS

7.1 Presentation of Results

7.1.1 The results of borehole investigations and of the laboratory investigations conducted on the soil and rock samples collected from the boreholes have been presented in the form

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of soil profile tables and rock profile tables. Table No.1 to 6 give the details of BH1 to BH3.

7.1.2 The soil profile tables indicate the following:

a) Standard Penetration Test Values (i.e. N- values observed) at various depths

b) Soil description identifying the type of soil

c) Grain size analysis indicating composition of sub soil

d) Consistency limits

e) In-situ bulk density and Water content

f) Triaxial compression test results

7.1.3 The rock profile tables indicate the following:

a) Description of rock

b) Number of core pieces in each drill run

c) Core Recovery in each drill run

d) RQD in each drill run

e) Unit Weight of rock samples

f) Porosity of rock samples

g) Water Absorption of rock samples

h) Uniaxial strength of rock derived from point load index

7.2 Analysis of Soil / Rock Profile

7.2.1 A perusal of the data presented in the soil/rock profile tables indicate the presence of the following substrata.

a) Stratum - I : Filled up strata

b) Stratum - II : Brown clayey silty sand with gravel

c) Stratum - III : Brownish grey with white completely weathered rock strata

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7.2.2 The thicknesses in each borehole of each strata described in 7.2.1 is given in the table below:

BH No.	Depth (m) : from - to		
	Stratum - I	Stratum - II	Stratum - III
1	0.0 - 1	1 - 6	6 - 9
2	-	0.0 - 5.8	5.8 - 9
3	-	0.0 - 5.5	5.5 - 9

7.2.3 The above results show that :

a) Stratum - II which comprises of Brown clayey silty sand with gravel has been encountered from Ground Level down to the depth 5.5-6m below existing ground level.

b) Stratum - III which comprises of Brownish grey with white completely weathered rock strata has been encountered at a depth of 5.5-6m down to maximum termination depth of 9m below existing ground level.

7.3 Soil Composition

7.3.1 The grain size distribution of the soil samples at various depths, as determined in the laboratory have been presented in the form of grain size analysis curves in figs. 3a & 3b.

7.3.2 The variations in the grain size distribution across the boreholes of Stratum - II (Brown clayey silty sand with gravel) are tabulated below:

BH No.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
1	3 - 21	56 - 66	13 - 18	9 - 15
2	2 - 16	51 - 63	17 - 22	10 - 18
3	1 - 7	57 - 64	17 - 23	14 - 19

7.3.3 The above results indicate that the soil in Stratum - II consists of about 51-57% of clay 13-23% of silt , 51-66% of sand and 1-21% of gravel.

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7.4 In-situ Bulk Density, Water Content and Dry density

7.4.1 The in-situ bulk densities, water contents and dry densities obtained from undisturbed soil samples are tabulated below.

BH No.	Depth (m)	In-situ Bulk Density (g/cm^3)	Water Content (%)	Dry Density (g/cm^3)
	2	1.86	13.2	1.64
1	3.5	1.91	13.5	1.68
	5	1.94	12.9	1.71
	2	1.84	13.6	1.61
2	3	1.93	14.3	1.68
	5	1.96	13.6	1.72
	2	1.86	13.3	1.64
3	3.5	1.92	15.1	1.66
	5	1.97	14.3	1.72

7.4.2 The dry densities indicate that the subsoil is in a medium dense state from existing ground level till refusal stratum.

7.5 Consistency Limits

7.5.1 The Consistency Limits of the soil in Stratum - II (Brown clayey silty sand with gravel) indicates that the liquid limit varies between 21% to 28%, plastic limit varies between 13% to 16% and plasticity index varies between 8% to 12%.

7.5.2 The Consistency Limits indicate that the soil in Stratum - II (Brown clayey silty sand with gravel) is low plastic in nature.

7.6 Standard Penetration Tests

7.6.1 Standard Penetration Test values (N-values observed) are presented in the soil profile table nos.1 to 6.

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7.6.2 Standard Penetration Test values (N-values observed) have also been presented in form of plots of N values vs depth in fig. 4.

7.6.3 The N-values indicate that the soil strata down to refusal/rock strata is in a medium dense state with observed N-values between 8 and 43.

7.7 Triaxial Test Results

The cohesion 'c' obtained from consolidated drained triaxial compression test on samples varies between 0.8 to 0.14kg/cm² and the angle of shearing resistance 'ϕ' of the soil varies between 25° & 28°.

7.8 Free Swell Index

7.8.1 The free swell index of the soil samples collected at various depths are given below:

BH No.	Free Swell Index (%) at depths (m)	
	1.5	3
1	11.2	8.6
2	14.8	8.9
3	14.1	9.2

7.8.2 The above results indicate that the soil strata is low swelling in nature. Hence, the excavated soil can be used for backfilling purposes.

7.9 Rock Conditions

7.9.1 An analysis of the data provided in the rock profile tables indicates the following :

a) The rock strata generally is brownish grey with white colored Charnockite based rock.

b) The core recovery is ranging between small pieces to 4% in rock strata.

c) RQD values is nil.

d) Unit weight of the rock generally varies between 2.58g/cm³ and 2.60g/cm³.

e) Porosity of the rock varies between 0.42% and 0.51%.

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f) Water absorption of the rock varies between 0.16% and 0.17%.

g) Point load strength of the slightly and moderately weathered rock generally varies between 202kg/cm^2 and 282kg/cm^2.

7.9.2 The rock strata has been observed to have a completely weathered state (generally recognised by small pieces to low core recovery) at different depths in different boreholes.

7.10 Compiled Soil Rock Profile

7.10.1 An overview of the results and their analysis has been presented in the form of a compiled soil and rock profile (fig. 2).

7.10.2 The above figure shows the various strata encountered and their thicknesses in each of the boreholes and also gives the soil / rock composition and the observed N-values at various depths along with core recovery and RQD.

8.0 DESIGN CRITERIA

8.1 Primary Parameters

8.1.1 The parameters required for the design of foundation system for the proposed structure are:

a) Type of foundation to be adopted

b) Depth at which the foundations have to be laid

c) Allowable bearing pressure

8.1.2 On the basis of the analysis of the results of investigations, the required design parameters have been arrived at and are given in the following sections.

8.2 Type of Foundations

8.2.1 The type of foundation depends on the following:

a) Subsoil conditions

b) Type of structure

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c) Configuration at loading points

d) Loading intensity on each sub-structure/structural element.

8.2.2 As per information provided by the client, the proposed Residential Building consists of a open stilt floor at ground level and five upper floors.

8.2.3 The results of the investigations are shown that the soil encountered is in a medium dense state from existing ground level down to refusal/rock strata.

8.2.4 In view of the above, *Isolated/Strip Footings* can be adopted for the proposed residential building. **Alternatively,** Pile foundation may be adopted.

8.3 Depth of Isolated/Strip Foundations

8.3.1 The depth at which foundations should be laid will be governed by the following criteria.

a) Top filled up strata/loose soil, if any

b) There should be sufficient thickness of soil above the footing/foundations so that the bearing capacity of the soil can be fully mobilised.

c) Soil below the level of footings/foundations should have the requisite strength to support the anticipated bearing pressures on the foundations without allowing the settlement of footings/foundations to exceed the acceptable limits.

d) Requirements of the type of structure (Residential Building consists of a open stilt floor at ground level and five upper floors)

8.3.2 The results of the investigations are shown that the soil encountered is in a medium dense state down to refusal/rock strata.

8.3.3 In view of the above factors, foundations of the proposed structure can be made to rest at a minimum depth of *2m below the existing ground level.* The soil available at the founding level will be Brown clayey silty sand with gravel.

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8.4 Allowable Bearing Pressure

8.4.1 Allowable bearing pressure has been evaluated by:

a) Shear failure criteria based on the average soil data

b) Settlement criteria based on the SPT values (N-values)

c) Settlement criteria based on deformation modulus

8.4.2 An allowable settlement of 50mm has been considered to evaluate the allowable bearing pressure for Isolated footings.

8.4.3 A water table correction factor of 0.5 has been considered.

8.4.4 Net Allowable bearing pressure that can be adopted at for various widths of foundations at 2m depth below the existing ground level are given below:

Net Allowable Bearing Pressures (t/m^2) for Widths of Foundations (m)		
1.5	**3**	**≥4.5**
16	19	21

8.4.5 The calculations for the allowable bearing pressure have been provided in Appendix A of this report.

8.5 Pile Foundations

8.5.1 Termination Depth

8.5.1.1 The piles may be terminated after embedding in completely weathered rock strata (where N>100) by 5 times the diameter of piles.

8.5.2 Pile Capacities

8.5.2.1 The safe pile capacities and safe uplift capacities for different diameters of piles are given below:

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Diameter of Pile (mm)	Safe pile Capacity (t)	Uplift Capacity (t)
450	85	25
500	100	35
600	150	50

9.0 RECOMMENDATIONS

9.1 Type of Foundations

a) *Isolated/Strip Footings OR*

b) *Pile Foundations*

9.2 Depth of Foundations

a) *Minimum 2m below the existing ground level*

b) *After embedding in completely weathered rock strata (where N>100) by 5 times the diameter of piles*

9.3 Net Allowable Bearing Pressure

Depth of Foundations Below E G L (m)	*Allowable Settlement (mm)*	*Net Allowable Bearing Pressures (t/m²) for Widths of Foundations (m)*		
		1.5	*3*	*≥4.5*
2	*50*	*16*	*19*	*21*

9.4 Pile Capacities

Diameter of Pile (mm)	*Safe pile Capacity (t)*	*Uplift Capacity (t)*
450	*85*	*25*
500	*100*	*35*
600	*150*	*50*

9.5 Notes

9.5.1 The recommendations given in this report have been arrived at on the basis of design

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parameters which have been judiciously adopted by giving due consideration to the results of field and laboratory investigations as well as NAGADI's experience of over four decades in working in various types of soil and rock conditions all over India.

9.5.2 The entire report should be studied before adopting the recommendations given in the report.

9.6 Construction Advisories

9.6.1 The soil of each strata has been described with name, colour etc. During excavation, any variations observed in the nature and condition of the soil from those given in this Report should be noted and appropriate action should be taken.

9.6.2 *Isolated/Strip Footings*

a) The excavated soil can be used for backfilling purposes.

b) The foundation surface should be watered for atleast 24 hours. The top slush should then be removed and the surface compacted heavily. If any loose pockets are observed, the same shall be filled with brickbats/ gravel and compacted well. Foundations can subsequently be placed over such a prepared surface.

c) Stiff Tie-beams connecting the columns in both directions may be provided which will render additional rigidity to the structure

9.6.3 *For Pile Foundations*

a) After reaching the required depth in the pile bore, 15cm thick layer of gravel should be placed and compacted at the bottom so that the slush formed at the bottom is diminished.

b) The bentonite being used during piling should be as per IS 2911.

9.7 References

A list of IS codes referred for providing the recommendations and that which might be required to implement the same has been given in Appendix B.

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10.0 LIMITATIONS

This Geotechnical investigation has been carried out at locations in the site chosen by the client as representing the entire site. The recommendations provided in this Report are hence valid only for those test locations. However, if there is any change in the subsoil conditions and properties at places between or beyond the chosen test locations, Nagadi may be contacted for further actions. Fresh investigations will have to be carried out at such locations.

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ANALYSIS FOR ALLOWABLE BEARING PRESSURE

Data

(i) Soil Properties :

c (kg/cm^2) = 0.13 ϕ = 25 ° γ (g/cm^3) = 1.86

(ii) Depth of Foundation, D (m) = 2

(iii) Allowable Settlement, s (mm) = 50

Shear Failure Criterion (Ref. IS : 6403)

N_c = 20.72 N_q = 10.66 N_γ = 10.87 R_w = 0.50 R_w' = 0.50

$$q_s = \frac{1}{3}\left(c \cdot N_c + \gamma D \cdot N_q \cdot R_w + 0.5 \cdot \gamma \cdot B \cdot N_\gamma \cdot R'_w\right) - \gamma D.R_w$$

B (m)	1.5	3.0	≥4.5
q_s (t/m^2)	16.3	18.8	21.3

Settlement Criterion (Ref. IS : 8009)

(i) From N Values

B (m)	1.5	3.0	≥4.5
H (m)	3	4	4
N_{av}	17	28	37
q_a (t/m^2)	17.5	26.2	33.5

(ii) From Triaxial Compression Tests : $q_a = \dfrac{s \cdot E}{0.7 \cdot H}$

B (m)	1.5	3.0	≥4.5
H (m)	3	4	4
E (kg/cm^2)	100	135	145
q_a (t/m^2)	23.8	24.1	25.8

ADOPT	**B (m)**	**1.5**	**3**	**≥4.5**
	q (t/m^2)	**16**	**19**	**21**

Note : q_s and q_a are NET VALUES, Weight of backfill etc. need not be added to the loading except in case of filling above original G.L.

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LIST OF IS CODES

Field Investigation

1. IS : 1498 - 1970 : Classification and identification of soils for general engineering purposes (First Revision) (Amendment 2)
2. IS : 1892 - 1979 : Code of practice for sub surface investigations for foundations (First revision)
3. IS : 2131 - 1981 : Method of Standard Penetration Tests for soils (First revision)
4. IS : 2132 - 1986 : Code of practice for thin walled tube sampling of soils (Second revision)

Laboratory Tests

1. IS : 2720 - 1983 (Part 1) : Methods of test for soils: Preparation of dry soil samples for various tests (Second revision)
2. IS : 2720 - 1980 (Part 2) : Method of test for soils: Determination of water content (Second revision) Amendment 1
3. IS : 2720 - 1980 (Part 3/Sec 1) : Method of test for soils : Determination of Specific Gravity : Fine grained soils. (First revision)
4. IS : 2720 - 1980 (Part 3/Sec 2) : Method of test for soils : Determination of Specific Gravity : Fine, Medium & Coarse grained soils. (First revision).
5. IS : 2720 - 1985 (Part 4) : Method of test for soils : Grain size analysis (Second revision)
6. IS : 2720 - 1985 (Part 5) : Method of test for soils : Determination of liquid and plastic limit (Second revision)
7. IS : 2720 - 1977 (Part 40) : Methods of tests for soils: Determination of free swell index of soils.

Foundation Construction

1. IS : 1080 - 1986 : Code of practice for design and construction of shallow foundations on soils (other than raft, ring and shell) (Second revision)
2. IS : 1904 - 1986 : Code of practice for design and construction of foundation in soils: General requirements (Third revision)
3. IS 6403 - 1981 : Code of practice for determination of bearing capacity of shallow foundations : First revision (Amendment 1)
4. IS 8009 - 1976 (Part 1) : Code of practice for calculation of settlements of foundations : Shallow foundations subject to symmetrical static vertical loads (Amendment 2)

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SOIL PROFILE

Project: Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

B. H. Location: IT Block | Water Table: 2.9m | Term. Depth : 9m | B.H. No. : 1

N - Value#	Depth (m)	Soil Description	Grain Size Analysis: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Atterberg Limits: Liquid (%)	Plastic (%)	In-situ properties: Density* (g/cm³)	Water Cont (%)	Triaxial Test: Type	c (kg/cm²)	Φ (°)
	0.0	Ground level											
	1.0	Filled up (Building materials)											
	1.5	Change of strata											
10	2.0	Brown clayey silty sand with gravels	3	64	18	15	22	15	1.86	13.2	CD	0.12	26
	3.0	Brown clayey silty sand with gravels											
18	3.5	Brown clayey silty sand with gravels	11	66	13	10	21	13	1.91	13.5	CD	0.10	27
	4.5	Brown clayey silty sand with gravels											
37	5.0	Brown clayey silty sand with gravels	21	56	14	9	-	NP	1.94	12.9	CD	0.08	28
	6.0	Change of strata											
>100 (136/40cm)		Brownish grey with white Completely Weathered Rock (Charnockites based)											

*-Natural Bulk Density # -N Values (Observed)

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ROCK PROFILE

Project : Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

Location :

B.H. Size : IT Block | Water Table (m) : 2.9m | Term. Depth (m) : 9.0m | BH No.: 1

Depth (m)	Strata Description	No. of Core Pieces of >75	No. of Core Pieces of 25-75	No. of Core Pieces of 10-25	No. of Core Pieces of <10	Core Recovery (%)	RQD (%)	Run Time (min)	Unit Weight (g/cm³)	Porosity (%)	Water Absorption (%)	Unconfined Compressive Strength (kg/cm²)	Point Load Strength (kg/cm²)	Remarks
6.0	Brownish grey with white Completely Weathered rock (Charnockites based)					S.P	Nil							S.P - Small Pieces
7.5	Brownish grey with white Completely Weathered rock (Charnockites based)					3	Nil		2.58	0.49	0.17		202	
9.0	Brownish grey with white Completely Weathered rock (Charnockites based)				1									

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SOIL PROFILE

Project: Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

B. H. Location: IT Block | Water Table: 3.5m | Term. Depth : 9.0m | B.H. No. : 2

N - Value#	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test		
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density* (g/cm³)	Water Cont (%)	Type	c (kg/cm²)	ϕ (°)
	0.0	Ground level											
8	1.5	Brown clayey silty sand with gravels	2	59	22	17	28	15					
	2.0	Brown clayey silty sand with gravels							1.84	13.6	CD	0.13	25
20	3.0	Brown clayey silty sand with gravels	16	51	19	14	24	14					
	3.5	Brown clayey silty sand with gravels							1.93	14.3	CD	0.13	26
43	4.5	Brown clayey silty sand with gravels	10	63	17	10	-	NP					
	5.0	Brown clayey silty sand with gravels							1.96	13.6	CD	0.09	28
	5.8	Change of strata											
>100 (92/25cm)	6.0	Brownish grey with white Completely Weathered Rock (Charnockites based)											
		*-Natural Bulk Density # -N Values (Observed)											

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ROCK PROFILE

Project : Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

Location :

B.H. Size : IT Block | Water Table (m) : 3.5m | Term. Depth (m) : 9.0m | BH No.: 2

Depth (m)	Strata Description	No. of Core Pieces of >75	No. of Core Pieces of 25-75	No. of Core Pieces of 10-25	No. of Core Pieces of <10	Core Recovery (%)	RQD (%)	Run Time (min)	Unit Weight (g/cm³)	Porosity (%)	Water Absorption (%)	Unconfined Compressive Strength (kg/cm²)	Point Load Strength (kg/cm²)	Remarks
6.0	Brownish grey with white Completely Weathered rock (Charnockites based)					S.P	Nil							S.P - Small Pieces
7.5	Brownish grey with white Completely Weathered rock (Charnockites based)					4	Nil		2.6	0.51	0.16		242	
9.0	Brownish grey with white Completely Weathered rock (Charnockites based)				2									

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SOIL PROFILE

Project: Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

B.H.Location: Main Entrance Arch | Water Table: 3.3m | Term. Depth : 9.0m | B.H. No. : 3

N - Value#	Depth (m)	Soil Description	Grain Size Analysis: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Atterberg Limits: Liquid (%)	Plastic (%)	In-situ properties: Density* (g/cm³)	Water Cont (%)	Triaxial Test: Type	c (kg/cm²)	Φ (°)
	0.0	Ground level											
10	1.5	Brown clayey silty sand with gravels	1	57	23	19	27	16					
	2.0	Brown clayey silty sand with gravels							1.86	13.3	CD	0.14	25
20	3.0	Brown clayey silty sand with gravels	7	59	20	14	23	45					
	3.5	Brown clayey silty sand with gravels							1.92	15.1	CD	0.12	26
26	4.5	Brown clayey silty sand with gravels	5	64	17	14	22	14					
	5.0	Brown clayey silty sand with gravels							1.97	14.3	CD	0.11	27
	5.5	Change of strata											
>100 (137/38cm)		Brownish grey with white Completely Weathered Rock (Charnockites based)											
		*-Natural Bulk Density # -N Values (Observed)											

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ROCK PROFILE

Project : Residential Building at Nookampalayam Road, Perumbakkam Village, Chennai - 600119.

Location :

B.H. Size : Main Entrance Arch

Water Table (m) : 3.3m

Term. Depth (m) : 9.0m

BH No.: 3

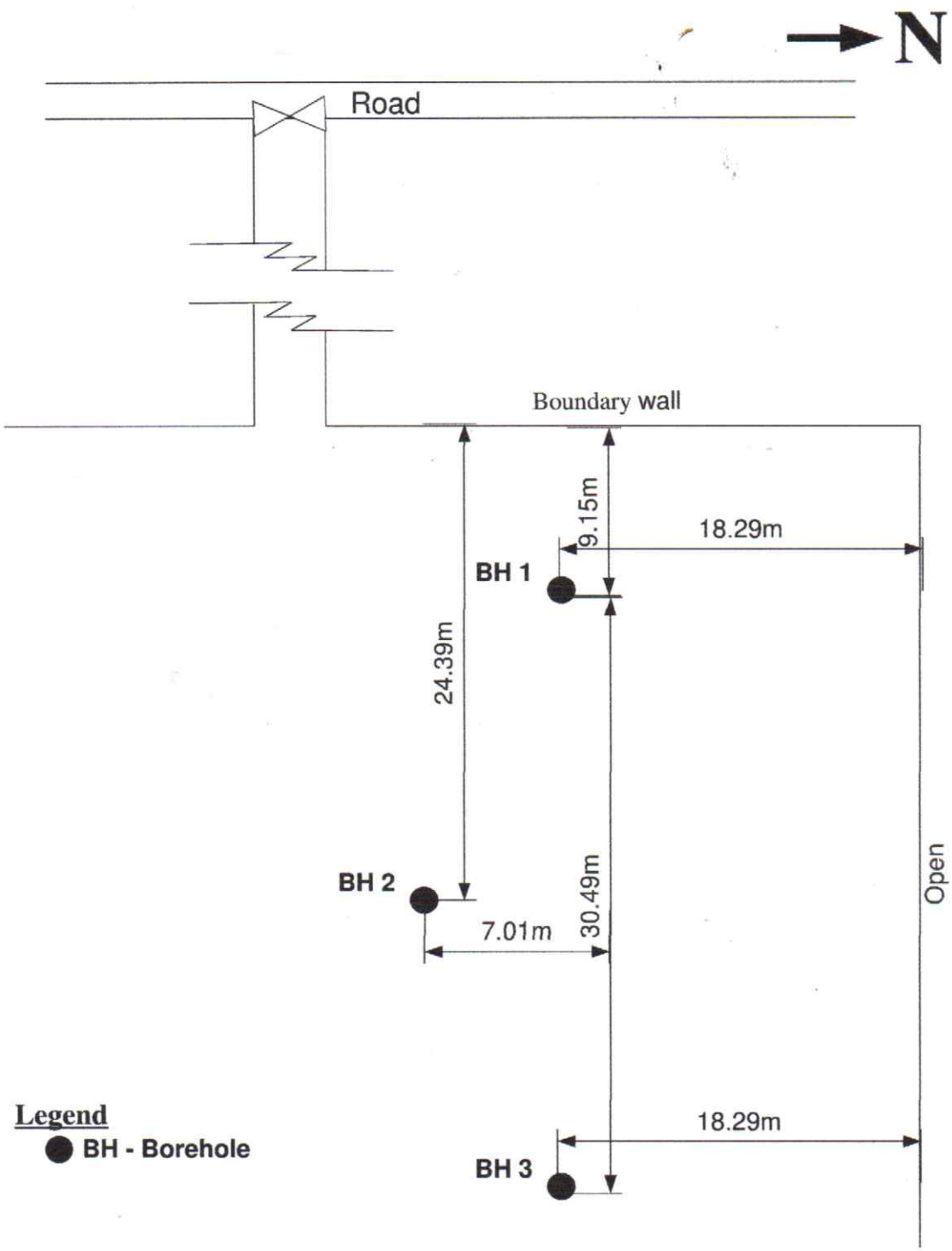
Depth (m)	Strata Description	No. of Core Pieces of	Core Recovery (%)	RQD (%)	Run Time (min)	Unit Weight (g/cm³)	Porosity (%)	Water Absorption (%)	Unconfined Compressive Strength (kg/cm²)	Point Load Strength (kg/cm²)	Remarks
		>75 / 25-75 / 10-25 / <10	100 / 80 / 60 / 40 / 20								
5.5	Brownish grey with white Completely Weathered rock (Charnockites based)		S.P	Nil							S.P - Small Pieces
7.0	Brownish grey with white Completely Weathered rock (Charnockites based)		2	Nil		2.6	0.42	0.16		282	
9.0	Brownish grey with white Completely Weathered rock (Charnockites based)	1									

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SCHEMATIC SITE PLAN

(NOT TO SCALE)

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Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d_{60}	d_{10}	U
	1	1.5	Clayey silty sand with gravel	3	64	18	15	0.425	-	-
	1	3.0	Clayey silty sand with gravel	11	66	13	10	0.925	0.002	462.5
	1	4.5	Clayey silty sand with gravel	21	56	14	9	2.000	0.003	666.7
	2	1.5	Clayey silty sand with gravel	2	59	22	17	0.320	-	
	2	3.0	Clayey silty sand with gravel	16	51	19	14	1.400	-	
	2	4.5	Clayey silty sand with gravel	10	63	17	10	1.600	0.002	800.0

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Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d_{60}	d_{10}	U
	3	1.5	Clayey silty sand with gravel	1	57	23	19	0.260	-	-
	3	3.0	Clayey silty sand with gravel	7	59	20	14	0.650	-	
	3	4.5	Clayey silty sand with gravel	5	64	17	14	0.810	-	
									-	
									-	
									-	
									-	
									-	

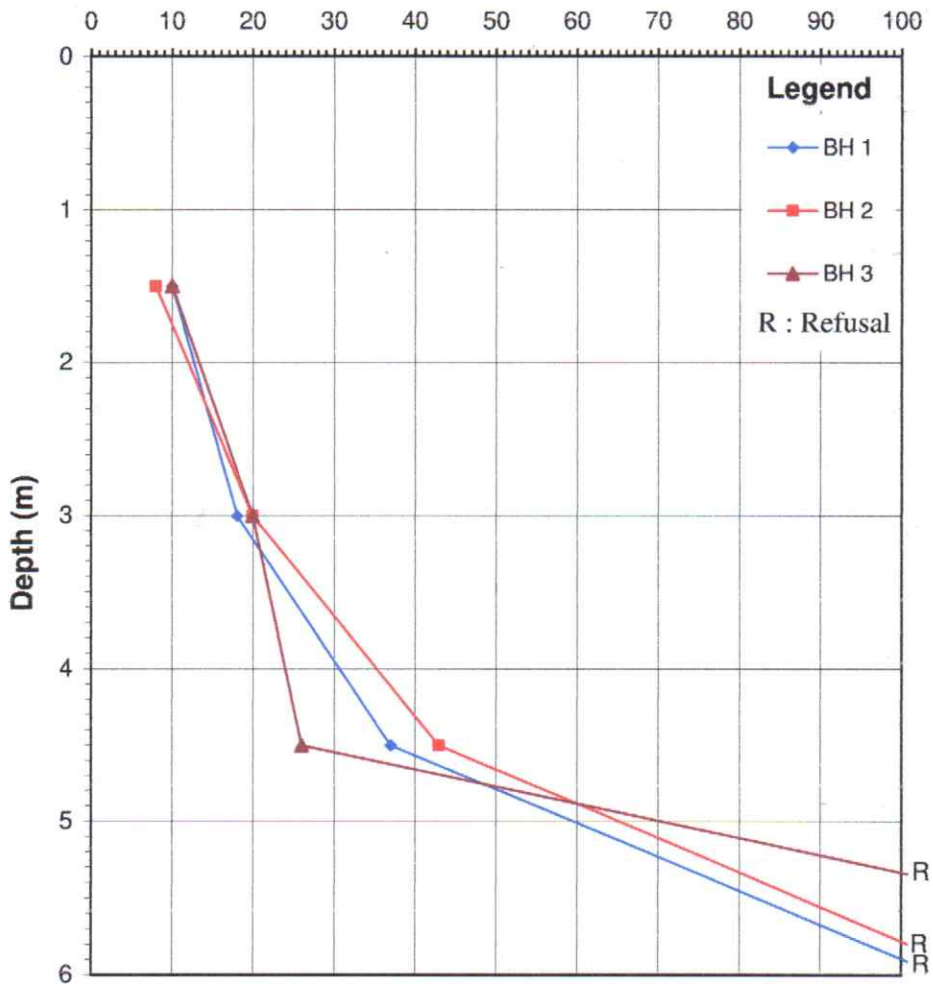
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SPT Values (Observed)



SPT Values (Observed) Vs Depth Curves

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