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Project :

**Buildings for Medical College for RIAHS, at Peelamedu,
Coimbatore, Tamil Nadu**

CONTENTS

	page no.
1. Executive Summary	1
2. Introduction	2
3. Authority	2
4. Object and Scope of Work	2 and 3
5. Project Details	
The Site	3
The Structure	3 and 4
Seismic Zone	4
6. Programme of Investigations	
Field Investigations	4 and 5
Lab Investigations	5 and 6
7. Results & Analysis of Investigations	6 to 10
8. Design Criteria & Recommendations	10 to 12
9. Limitations	13
10. List of IS Codes–Appendix-A	14 and 15
Tables	
Figures	

Job No. : G(B)9912

Date : 07.12.2012

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G(B)9912- GEOTECHNICAL INVESTIGATION REPORT for the proposed Multistoried Buildings for Medical College for RIAHS, at Peelamedu, Coimbatore, Tamil Nadu

EXECUTIVE SUMMARY

The authorities of Regional Institute of Allied Health Sciences, Ministry of Health and Family Welfare, Government of India, are constructing the proposed Multistoried Buildings for Medical College, at Peelamedu, Coimbatore, Tamil Nadu.

M/s Srikar And Associates (P) Ltd are the Architects for the project.

The proposed Buildings will be RCC Framed Structures, having ground floor, and four to eight upper floors.

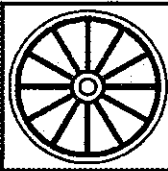
Geotechnical investigations have been undertaken at the site as per the scope of investigations, stipulated by the Client, which consisted of 14 boreholes down to 10m depth in soil strata.

The borehole investigations indicate the presence of a top surface layers of filled-up soil extending down to about depths varying from 0.4m to 0.7m below existing ground level. The fill is actually excavated earth (black cotton soil) from an adjacent site. The virgin subsoil encountered at the site, underlying the top filled-up soil, is sandy silty clay to silty clayey sand. This stratum is commonly know as black cotton soil, which is expansive in nature. Thereafter stratum of silty sand with clay and gravel is encountered. The colour of the subsoil varies from blackish grey, to dark brown in the top clayey strata, to greyish green and white with grey in the

lower depths. These lower strata extends down to refusal strata. Refusal strata was encountered at depths ranging from 1.4m to 2.3m below existing ground level, in the boreholes.

The observed N-values (N : 27-32) indicate that the top clay layer is very stiff to hard. Thereafter, the N-values ((N: 33-127) indicate that the subsoil is generally dense to very dense. Ground Water table was not encountered in any of the boreholes, at the time of investigations. The observations were carried out in the first week of November, 2012.

Based on the subsoil characteristics as determined from the geotechnical investigations, Shallow Foundations are recommended at a *minimum depth of 2.0m below existing ground level, or on refusal strata, whichever is encountered earlier*. Net Allowable Bearing Pressure values of 30t/m² and 80 t/m² have been recommended for design of foundations, resting on hard disintegrated rock and sound rock, respectively.



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Job No. **G(B) 9912**

Sheet No. : **1**

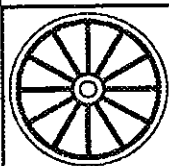
1.0 INTRODUCTION

- 1.1 With a view to determine adequate subsoil data required for the design of foundations of the proposed Multistoried Buildings, being constructed for the Medical College for Regional Institute of Allied Health Sciences, at Peelamedu, Coimbatore, Tamil Nadu, detailed geotechnical investigations were carried out. This report presents the results of the field investigations and laboratory tests, conducted as a part of the geotechnical investigations. Interpretation and analysis of subsoil data were carried out. Based on the analysis, recommendations for design of foundations of the proposed Multistoried Buildings are presented in the report.
- 1.2 The authorities of Regional Institute of Allied Health Sciences, Ministry of Health and Family Welfare, Government of India, are constructing the proposed Multistoried Buildings for Medical College, at Peelamedu, Coimbatore, Tamil Nadu.
- 1.3 M/s Srikar And Associates (P) Ltd, No.64, Sreeman Srinivasa Cross Street, Alwarpet, Chennai 600018, are the Architects for the project.
- 1.4 Authority**
- 1.4.1 The geotechnical investigations have been carried out as per the authorization of Letter dated 10th October, 2012, issued by Mr. Dhinesh.T, M/s Srikar And Associates (P) Ltd, No.64, Sreeman Srinivasa Cross Street, Alwarpet, Chennai 600018.

2.0 OBJECT AND SCOPE OF INVESTIGATIONS

2.1 Object of Investigations

- 2.1.1 For designing the foundation system of the proposed Multistoried Buildings, the following data are required:
- Type of foundation system
 - Depth below the ground level at which the foundation system is to be laid
 - Allowable bearing pressure at the foundation levels
- 2.1.2 To determine the above factors, the following information would be required:
- The subsoil profile indicating thickness of the various soil strata, to a depth within the influence zone below the foundations
 - Engineering properties of the soil strata at various levels



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Job No. **G(B) 9912**

Sheet No. : **2**

- c) Physical characteristics of the soil strata
- d) Variation of strength of soil strata with depth.

2.1.3 The object of conducting field and laboratory investigations and analysis is to obtain data for the parameters mentioned in 2.1.2 and providing recommendations.

2.2 Scope

2.2.1 The scope of investigation, as specified by Client, included the following :

- a) Progressing 14 boreholes to a minimum depth of 10m, or refusal strata, whichever is encountered earlier
- b) Conducting relevant laboratory tests, on soil samples collected from the boreholes
- c) Preparing a detailed report, giving recommendations regarding allowable bearing pressure on foundations of the Multistoried Buildings.

2.2.2 The following operations were to be undertaken while progressing the boreholes:

- a) Conducting penetration tests at regular intervals in soil strata to determine N-values.
- b) Recovering undisturbed soil samples from various levels of the subsoil strata.
- c) Recording ground water table levels, if met with.

3.0 PROJECT DETAILS

3.1 Site Location

3.1.1 The site for the proposed Multistoried Buildings is located at Peelamedu, Coimbatore, TamilNadu.

3.2 Site Layout and Topography

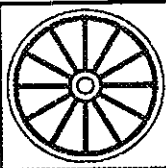
3.2.1 A schematic site plan showing the dimensions and other details of the site is enclosed in this report (fig. 1).

3.2.2 The site is having a gentle slope.

3.3 Structures

3.3.1 The proposed Buildings will be RCC Framed Structures and comprise of :

- a) Academic Block : having ground floor, and four upper floors.
- b) Admin & Library : having basement, ground floor, and four upper floors.



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Job No. : G(B) 9912

Sheet No. : 3

- c) Staff Quarters : having ground floor, and eight upper floors.
 - d) Boys Hostel : having ground floor, and seven upper floors.
 - e) Girls Hostel : having ground floor, and seven upper floors.
 - f) Dinning Hall & Kitchen : having ground floor only
 - g) Auditorium : having ground floor only
 - h) Canteen and Stores : having ground floor only
 - i) Guest House : having ground floor, and five upper floors
- (Type IV & Type V)

3.4 Seismic Zone

3.4.1 The site for the proposed Multistoried Buildings for Medical College is located at Peelamedu, Coimbatore, TamilNadu, which comes under Seismic Zone III, as per IS 1893 (Part1) - 2002.

4.0 FIELD INVESTIGATIONS

4.1 Preliminary Details

4.1.1 Field investigations had been carried out on 1st and 2nd November, 2012. The weather was cloudy with occasional clear skies at the time of investigations.

4.2 Boreholes

4.2.1 The boreholes were progressed using hand operated auger. The boreholes have been designated as BH1 to BH14.

4.2.2 The scope of work envisaged progressing 14 boreholes to 10.0m depth. However, refusal strata was encountered at depths less than 10.0m in all the boreholes, and the boring was terminated.

4.2.3 The location at which each borehole was carried out, and the termination depth of the each borehole, is given below :



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Sheet No. : 4

Location	Borehole No	Termination Depth (m) Below Existing Ground Level
Auditorium	BH 1	1.8
	BH 2	1.7
Common Dining & Kitchen	BH 3	1.4
	BH 4	1.8
Girls Hostel	BH 5	1.7
	BH 6	2.2
Boys Hostel	BH7	1.7
	BH8	2.3
Staff Quarters	BH9	1.7
Academic Block	BH10	1.8
	BH11	1.7
	BH12	1.8
Admin Block & Library	BH13	1.9
Guest House	BH 14	1.7

4.2.4 Penetration Tests were conducted at regular intervals in the boreholes, to determine N-values.

4.2.5 Undisturbed soil samples were recovered from various levels of the boreholes, using thin walled shelby tubes.

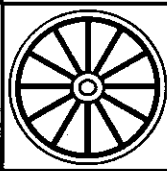
4.2.6 The disturbed soil samples were collected in polythene bags and labeled.

4.2.7 The samples thus recovered were transported to the laboratory for testing purposes.

5.0 LABORATORY INVESTIGATIONS

5.1 The soil samples brought to the laboratory were subjected to various tests to determine the following properties :

- Type of soil and its gradation
- Consistency limits
- Natural Bulk Density & Water Content



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Job No. G(B) 9912

Sheet No. : 5

- d) Strength parameters like cohesion, angle of shearing resistance
- e) Swelling Potential
- f) Deleterious Materials

5.1.2 In order to determine the above properties, the following tests have been conducted:

- a) Sieve analysis on coarse grained soil fraction
- b) Hydrometer analysis on fine grained soil fraction
- c) Atterberg Limits namely Liquid and Plastic Limits
- d) Natural Density and Water Content
- e) Triaxial compression tests
- f) Free Swell Expansion Tests
- g) Chemical Analysis of Soil.

5.2 Chemical Analysis

5.2.1 The soil samples collected from the boreholes had been tested to determine the pH-value and the presence of salts harmful to reinforced cement concrete construction namely Chloride and Sulphate contents.

6.0 RESULTS & ANALYSIS

6.1 Presentation of Results

6.1.1 The results of the borehole investigations have been presented in the form of soil profile tables 1 to 14. Based on these results a soil profile for each borehole has been compiled and presented in compiled soil profile fig. 2, and in individual soil profile figs. 3 to 7.

6.1.2 The soil profile tables include the following:

- a) Penetration test values (N-values) at various depths
- b) Soil description identifying the type of soil
- c) Grain size analysis indicating composition of subsoil
- d) Consistency limits
- e) Natural density and water content
- f) Triaxial compression tests.



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Job No. : G(B) 9912

Sheet No. : 6

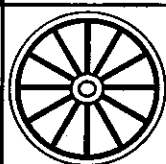
6.2 Analysis of Soil Profile

6.2.1 A perusal of the data presented in the soil profile tables 1 to 14, compiled soil profile fig.2, and in individual soil profile figs. 3 to 7, indicates that the subsoil mainly consists of the following three strata in the boreholes:

- a) Stratum - I : Filled up soil. The fill is actually excavated earth (black cotton soil) from an adjacent site.
- b) Stratum - II : **Sandy silty clay to silty clayey sand. The colour of the strata varies from blackish grey, to dark brown. This stratum is commonly know as black cotton soil, which is expansive in nature.**
- c) Stratum - III : Silty sand with clay and gravel. The colour of the strata varies from greyish green with yellow, to white with grey.

6.2.2 The thickness of the three strata in the boreholes are as follows :

BH. No.	Strata (depth in m : from : to)		
	Stratum - I	Stratum - II	Stratum - III
BH1	0.0 - 0.4	0.4 - 0.7	0.7 - 1.8
BH2	0.0 - 0.7	0.7 - 0.9	0.9 - 1.7
BH3	0.0 - 0.6	-	0.6 - 1.4
BH4	0.0 - 0.6	0.6 - 0.9	0.9 - 1.8
BH5	0.0 - 0.5	0.5 - 0.9	0.9 - 1.7
BH6	0.0 - 0.6	0.6 - 1.1	1.1 - 2.2
BH7	-	0.0 - 0.8	0.8 - 1.7
BH8	-	0.0 - 0.7	0.7 - 2.3
BH9	-	0.0 - 1.3	1.3 - 1.7
BH10	-	0.0 - 0.8	0.8 - 1.8
BH11	0.0 - 0.5	-	0.5 - 1.7
BH12	0.0 - 0.6	0.6 - 0.8	0.8 - 1.8
BH13	0.0 - 0.4	0.4 - 1.2	1.2 - 1.9
BH14	0.0 - 0.5	0.5 - 0.7	0.7 - 1.7



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Sheet No. : 7

6.2.3 Stratum III appears to be highly disintegrated rock which extends down to refusal strata. At refusal strata, hard disintegrated rock was encountered, and further boring by hand operated auger was not possible.

6.2.4 The depth of refusal strata encountered in each borehole is given below :

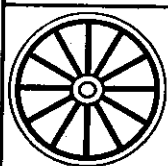
Borehole No	Depth (m) of Refusal Strata Below Existing Ground Level
BH1	1.8
BH2	1.7
BH3	1.4
BH4	1.8
BH5	1.7
BH6	2.2
BH7	1.7
BH8	2.3
BH9	1.7
BH10	1.8
BH11	1.7
BH12	1.8
BH13	1.9
BH14	1.7

6.3 Soil Composition

6.3.1 The results of field investigations and laboratory tests, and the details of each strata i.e. its thickness, classification, soil type, percentage of each fraction (namely – gravel, sand, silt and clay) present in the subsoil, can be had from compiled soil profile fig. 2, individual soil profile figs. 3 to 7, and tables 1 to 14. The Grain Size Analysis curves are given in fig. 8 to 14.

6.4 Consistency Limits (Refer Table no. 1 to 14)

6.4.1 The liquid limit of the subsoil ranges between 21 % and 66 %, and the plastic limit varies from 12 % to 31 %. Subsoil samples containing low percentage of fines, or mica, did not exhibit any plastic limit.



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Job No. G(B) 9912

Sheet No. : 8

6.5 Natural Bulk Density & Natural Water Content (Refer Table no. 1 to 14)

6.5.1 The Natural Bulk Density of the subsoil ranges between 1.88 g/cm³ and 2.05 g/cm³ and the Natural Water Content varies between 4.2 % and 37.5 %.

6.6 Tri-axial Shear Tests (Refer Table no. 1 to 14)

6.6.1 Tri-axial shear tests were conducted on the soil samples, collected from the boreholes. The angle of shearing resistance (ϕ), determined from tri-axial shear tests, ranges between 14 ° and 41 °. The Cohesion (c) values of the subsoil vary between 0.00 kg/cm² and 0.50 kg/cm².

6.7 Penetration Test Values (N-values)

6.7.1 Penetration Tests were conducted at various depths of each bore hole, to determine N-values. The N-values are also presented in tables.1 to 14, compiled soil profile fig.2, and in individual soil profile figs 3 to 7.

6.7.2 The observed N-values (N : 27-32) indicate that the top clay layer is very stiff to hard. Thereafter, the N-values ((N: 33-127) indicate that the subsoil is generally dense to very dense.

6.7.3 The N-values (observed) have been plotted with respect to depth in fig.15 and 16.

6.8 Free Swell Expansion Tests (Refer Table.15)

6.8.1 The Free Swell Expansion Tests were conducted on representative soil samples. The Free Swell Expansion Index of the top clay layers ranges from 30 % to 93%, indicating moderate to high swelling potential i.e the clay layer will undergo substantial volume changes with changes in moisture content.

6.8.2 The Free Swell Expansion Index of the lower gravelly silty sand strata varies from 0 % to 8 %, indicating that the lower strata is non swelling.

6.9 Chemical Analysis (Refer Table. 16)

6.9.1 The chemical analysis of representative soil samples were carried out. The results of the chemical analysis of the soil samples indicate that the pH of the subsoil ranges between 6.7 and 7.1 . The chloride content (cl) of the subsoil ranges from 19 ppm to 29 ppm, and the Sulphate (SO₃) content ranges from 40 ppm to 63 ppm.

6.9.2 The results of the Chemical Analysis of soil samples indicate that the pH, Chloride, and Sulphate content in the soil samples are within permissible limits.(Ref: I.S. 456 and Foundation Design and Construction by M.J Tomlinson, pg. 758).



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Job No. G(B) 9912

Sheet No. : 9

6.10 Compiled Soil Profile

6.10.1 An overview of the results and their analysis has been presented in the form of a compiled soil profile fig. 2. Individual soil profiles are also given in figs. 3 to 7.

6.10.2 The above figures show the various strata encountered and their thicknesses in each of the boreholes and also gives the soil composition and the observed N - values at various depths.

6.11 Ground Water Table

6.11.1 The ground water table was not encountered in any of the boreholes, at the time of investigations. The observations were made in the first week of November, 2012.

7.0 DESIGN CRITERIA AND RECOMMENDATIONS

7.1 Design Parameters

7.1.1 The parameters required for the design of the foundation system for the proposed buildings are:

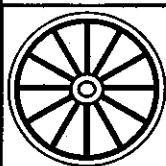
- a) Type of foundations to be adopted
- b) Depth at which the foundations have to be laid
- c) Allowable bearing pressure on the soil at the foundation level

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

7.2 Type of Foundations

7.2.1 The type of foundations for any structure, depends upon the subsoil conditions, type of structure as well as, the loading intensity on the foundations.

7.2.2 The top strata of virgin subsoil encountered at the site, underlying the top filled-up soil, is sandy silty clay, which is commonly known as black cotton soil, and are further underlain by strata of silty sand with clay and gravel, down to refusal strata. Also, the borehole investigations indicate that refusal strata is encountered at shallow depths in the site. Hence, Shallow Foundations can be adopted for the proposed buildings. The Shallow Foundations may be **Isolated/ Combined Footings**, depending upon the column loads, their spacing and configuration.



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Job No. **G(B) 9912**

Sheet No. : **10**

7.3 Depth of Foundations

7.3.1 The minimum depth of foundations of any structure, depends upon the following factors:

- a) Top loose strata/ swelling soil, if any
- b) Adequate depth of soil above founding level, to ensure mobilization of full safe bearing capacity
- c) Adequate depth of soil strata below founding level of requisite strength to mobilize the safe bearing capacity

7.3.2 Filled-up soil is encountered at the site, extending down to depths of about 0.4m to 0.7m below existing ground level. Also, the top strata of virgin subsoil encountered at the site is expansive sandy silty clay, underlain by silty sand with clay and gravel. The foundations of the proposed buildings must be taken below the top expansive layer, and rest for an adequate depth in the underlying non- swelling silty sand layer.

7.3.3 Hence, based on the discussions and criteria given above, the minimum depth of foundations recommended is 2.0m below existing ground level, or on refusal strata, whichever is encountered earlier.

7.3.4 It is proposed to provide basement for Admin & Library Block. Hence, the minimum depth of foundations recommended is 1.5m below basement floor level, or on refusal strata, whichever is encountered earlier.

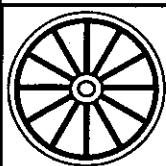
7.3.5 Note : Refusal strata can be defined as : when further excavation by ordinary manual means (using crowbar and pickaxe), or mechanical means, is not possible.

7.3.6 The soil available at founding levels will be generally greyish green with yellow, to brown with yellow and grey, silty sand with clay.

7.4 Allowable Bearing Pressure

7.4.1 The allowable bearing pressure on foundations of any structure, is evaluated based on the following criteria:

- a) Shear failure criterion using average soil data
- b) Settlement criterion
 - (i) From N-values
 - (ii) From elastic modulus determined from tri-axial shear tests.



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Sheet No. : 11

7.4.2 The borehole investigations indicate that refusal strata is encountered at shallow depths ranging from 1.4m to 2.3m below existing ground level. Therefore, all the foundations will be resting on refusal strata/ hard disintegrated rock, or close to it. Hence, the foundations will be safe against shear failure. Also, the settlements will be small and within permissible limits.

7.4.3 Under these substrata conditions, and considering local variations in the compactness of the disintegrated rock below foundations, an allowable bearing pressure of 30 t/m² can be adopted for design of foundations.

7.4.4 For design of foundations resting on hard rock, wherever encountered, an Allowable Bearing Pressure of 80 t/m² can be adopted.

7.4.5 *Note :While adopting the high values of allowable bearing pressure of 30t/m² and 80t/m², care must be taken to ensure that all foundations are resting on uniformly hard disintegrated rock, and hard rock strata, respectively.*

8.0 CONSTRUCTION ADVISORY

8.1 Loose pockets of disintegrated rock, wherever encountered, should be completely removed and backfilled with well compacted lean concrete. Thereafter, the leveling course of lean concrete can be laid, and construction of foundations can be taken up subsequently.

8.2 Refusal strata is encountered at shallow depths in the site. Hence, during excavation for foundations, hard disintegrated rock to hard rock will be encountered, and further excavation by ordinary manual means, using crowbar and pickaxe, or mechanical means, may not be possible. This should be taken into account while planning the work.

8.3 Wherever hard disintegrated rock / hard rock is encountered, and further excavation is not possible, the foundations may rest on the hard strata, after suitably dressing and benching the area.

8.4 The top expansive clay layers should not be used for backfill in foundations and under floors.

8.5 Flooring

8.5.1 It is recommended that the top expansive clay layer should be removed for a depth of not less than 0.50m. The backfilling should then be carried out with non- expansive, red earth / murrum type of soil. The backfill should be done in layers and well compacted. The construction of floors can be taken up subsequently.



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Sheet No. : 12

9.0 APPENDICES

- 9.1 A list of IS Codes referred for providing the recommendations and that which might be required to implement the same is also enclosed in this report in Appendix- A.

10.0 LIMITATIONS

- 10.1 The recommendations given in the report are based on the results of borehole investigations at 14 locations, as specified by the Architects. In case there is any substantial variation in the substrata conditions, from those encountered at the borehole locations, additional investigations may be carried out, if necessary.



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Sheet No. : 13

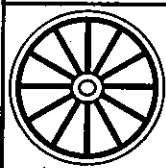
LIST OF IS CODES

Field Investigation

1. IS : 1892 - 1979 : Code of practice for sub surface investigations for foundations (First revision)
2. IS : 2131 - 1981 : Method of Standard Penetration Tests for soils (First revision)
3. 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 (Part 8) -1983 : Determination of water content - dry density relation using heavy compaction. (First revision)
7. IS : 2720 - 1985 (Part 5) : Method of test for soils : Determination of liquid and plastic limit (Second revision)
8. IS 2720-1981 Part 12: Method of tests for soils : Determination of shear strength parameters using triaxial apparatus.



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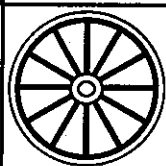
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Sheet No. : 14

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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TABLES



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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.											
		B.H. Location : Auditorium		Water Table : Nil		Term. Depth : 1.7m		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 $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)	ϕ (°)
27	0.0	Existing ground level											
	0.5	Filled - up - soil : 0.0m to 0.7m depth											
	0.8	Blackish brown sandy silty clay with traces of gravel	2	26	35	37	61	28					
	0.9	Greyish black with white silty gravelly sand with clay								Grave lly			
	1.5	Greyish black with white silty gravelly sand with clay	36	44	12	8	-	-		Grave lly			
	1.7	Refusal strata (27 blows for 2.5cm penetration)											
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density													



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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.											
B.H.Location : Dining & Kitchen		Water Table : Nil				Term. Depth : 1.4m		B.H. No.: 3					
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test		
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)	ϕ (°)
	0.0	Existing ground level											
	0.5	Filled - up - soil : 0.0m to 0.6m depth											
	0.7	Blackish grey silty sandy clay	0	35	26	39	56	28	-	-	-	-	-
96	0.9	White with grey sand with traces of silt, clay and gravel											
115	1.2	White with grey sand with traces of silt, clay and gravel							1.95	5.3	-	-	-
	1.4	Refusal strata (35 blows for 2.5cm penetration)	4	87	5	4	-	-	1.96	4.9	CD*	0.00	40
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * :Remoulded Sample													



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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.		Water Table : Nil		Term. Depth : 1.8m		B.H. No.: 4	
		B.H. Location : Dining & Kitchen		Grain Size Analysis		Atterberg Limits		In-situ properties	
Depth (m)	Soil Description	Clay (%)		Silt (%)		Sand (%)		Gravel (%)	
		Liquid (%)		Plastic (%)		Density $\gamma_b(g/cm^3)$		Water Cont (%)	
		Type		Type		Type		Type	
		Type		Type		Type		Type	
		Type		Type		Type		Type	
0.0	Existing ground level								
0.5	Filled - up - soil : 0.0m to 0.6m depth								
0.8	Blackish grey silty sandy clay								
0.9	White with blackish grey silty sand with clay and gravel								
1.5	White with greyish black sandy gravel with silt and clay								
1.8	Refusal strata (29 blows for 2.5cm penetration)								
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * : Remoulded Sample									



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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.										
		B.H. Location : Girls Hostel		Water Table : Nil		Term. Depth : 1.7m		B.H. No.: 5				
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test	
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)
	0.0	Existing ground level										
	0.5	Filled - up - soil : 0.0m to 0.5m depth										
	0.7	Blackish grey silty sandy clay	0	30	22	48	56	22	-			
36	0.9	Brownish green with yellow silty sand with clay and gravel							1.98	10.9	CD*	35
92	1.5	Brownish green with yellow silty sand with clay and gravel							1.99	7.1		
	1.7	Refusal strata (27 blows for 2.5cm penetration)										
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * :Remoulded Sample												



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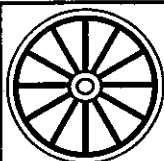
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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.											
		B.H. Location : Boys Hostel		Water Table : Nil		Term. Depth : 2.3m		B.H. No.: 8		Triaxial Test			
		Grain Size Analysis				Atterberg Limits		In-situ properties					
■ N - Value	Depth (m)	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)	ϕ (°)
	0.0	Existing ground level											
33	0.5	Blackish brown silty clayey gravelly sand	20	53	12	15	-	-	-	-	-	-	-
52	0.9	Greyish brown with light yellow silty sand with clay and gravel	8	58	27	7	-	-	1.89	6.3	-	-	-
	1.5	Greyish brown with light yellow silty sand with clay and gravel							1.93	5.7	CD*	0.00	37
115	2.0	Brown with yellow sandy silt with clay and traces of gravel	2	39	50	9	45	30	1.94	5.1	CD*	0.00	36
	2.3	Refusal strata (28 blows for 2.5cm penetration)											
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * :Remoulded Sample													

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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.										
		B.H. Location : Staff Quarters		Water Table : Nil		Term. Depth : 1.7m		B.H. No.: 9				
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test	
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)
	0.0	Existing ground level										
	0.5	Dark brown silty clayey sand with gravel		42	19	30	37	16	-	-		
27	0.9	Dark brown silty clayey sand with gravel					-	-	2.02	18.3		
92	1.5	Blackish brown with light yellow gravelly silty sand with clay	17	50	24	9	26	14	1.94	5.6		
	1.7	Refusal strata (27blows for 2.5cm penetration)										
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density												

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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.										
		B.H. Location : Academic Block		Water Table : Nil		Term. Depth : 1.8m		B.H. No.: 10				
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test	
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)
	0.0	Existing ground level										
	0.5	Dark brown silty sandy clay										
38	0.9	Blackish brown with light yellow silty sand with clay and gravel	10	54	28	8	30	16		2.00	12.3	
98	1.5	White with grey silty sand with clay and gravel	7	63	23	7	-	-		1.94	5.1	
	1.8	Refusal strata (21 blows for 2.5cm penetration)										
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * :Remoulded Sample												

SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.											
B.H. Location : Academic Block		Water Table : Nil		Term. Depth : 1.7m		B.H. No.: 11							
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test		
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)	ϕ (°)
	0.0	Existing ground level											
	0.5	Filled - up - soil : 0.0m to 0.5m depth											
72	0.9	Blackish brown silty gravelly sand with clay	28	47	19	6	22	13	1.88	6.2			
121	1.5	Brown with light yellow gravelly sand with silt and clay	22	64	9	5	-	-	Gravelly		Sample		
	1.7	Refusal strata (17 blows for 2.5cm penetration)											
		Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density											



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		B.H. Location : Academic Block	Water Table : Nil	Term. Depth : 1.8m	B.H. No.: 12		
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Triaxial Test
			Clay (%)	Silt (%)	Sand (%)	Gravel (%)	
	0.0	Existing ground level					
	0.5	Filled - up - soil : 0.0m to 0.6m depth					
	0.8	Blackish brown silty sandy clay					
64	0.9	Greenish brown with yellow gravelly silty sand with clay					
115	1.5	Greenish brown with yellow gravelly silty sand with clay					
	1.8	Refusal strata (25blows for 2.5cm penetration)					
		Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * : Remoulded Sample					
			Atterberg Limits				In-situ properties
			Liquid (%)	Plastic (%)	Density γ_b (g/cm ³)	Water Cont (%)	
							Type
							c (kg/cm ²)
							ϕ (°)



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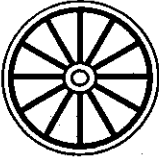
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SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.						
B.H. Location : Admin Block & Library		Water Table : Nil		Term. Depth : 1.9m		B.H. No.: 13		
Soil Description		Grain Size Analysis		Atterberg Limits		In-situ properties		
Depth (m)		Clay (%)	Silt (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	
■ N - Value		Gravel (%)	Sand (%)				Type	
							c (kg/cm ²)	
							ϕ (°)	
0.0	Existing ground level							
0.5	Filled - up - soil : 0.0m to 0.4m depth							
0.9	Dark brown silty sandy clay	0	23	66	31	2.05	37.5	14
1.5	Dark brown with light yellow silty sand with clay and gravel	9	71	-	-	1.96	5.9	39
1.9	Refusal strata (19blows for 2.5cm penetration)							
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density 3) * : Remoulded Sample								



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Job No. : G(B)9912
 Sheet No. : 13

SOIL PROFILE		Project : Multistoried Buildings at Peelamedu, Coimbatore, Tamil Nadu.										
		B.H. Location : Guest House		Water Table : Nil		Term. Depth : 1.7m		B.H. No.: 14				
■ N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test	
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density $\gamma_b(g/cm^3)$	Water Cont (%)	Type	c (kg/cm ²)
	0.0	Existing ground level										
	0.5	Filled - up - soil : 0.0m to 0.5m depth										
	0.8	Blackish brown silty sandy clay										
34	0.9	Brown with light yellow sandy gravel with silt and clay	52	31	8	9	-	Grave	Ily	Sam	ple	
127	1.5	Brown with light yellow clayey silty gravelly sand	33	39	14	14	23	Grave	Ily	Sam	ple	
	1.7	Refusal strata (30 blows for 2.5cm penetration)										
Note : 1) ■ N-Value (Observed) 2) γ_b : Bulk Density												



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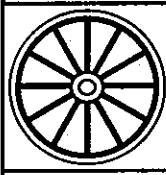
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Table No.15**RESULTS OF FREE SWELL EXPANSION TESTS**

Bore Hole No	Depth (m)	Free Swell Expansion Index (%)
BH1	0.5	46
BH2	0.8	70
	1.5	0
BH3	0.7	58
	1.2	2
BH4	0.8	67
BH5	0.7	87
BH6	0.9	55
	2.0	0
BH7	0.5	39
	1.5	0
BH8	0.5	31
BH9	0.5	30
BH10	0.5	41
	1.5	6
BH11	0.9	0
BH12	0.8	81
	1.5	2
4BH13	0.9	93
	1.5	0
BH14	1.5	8

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TABLE NO :16
RESULTS OF CHEMICAL ANALYSIS OF SOIL SAMPLES

Bore Hole No	Depth (m)	pH	Chloride cl (ppm)	Sulphate SO ₃ (ppm)
BH2	0.9	7.1	29	63
BH7	1.5	6.7	19	40



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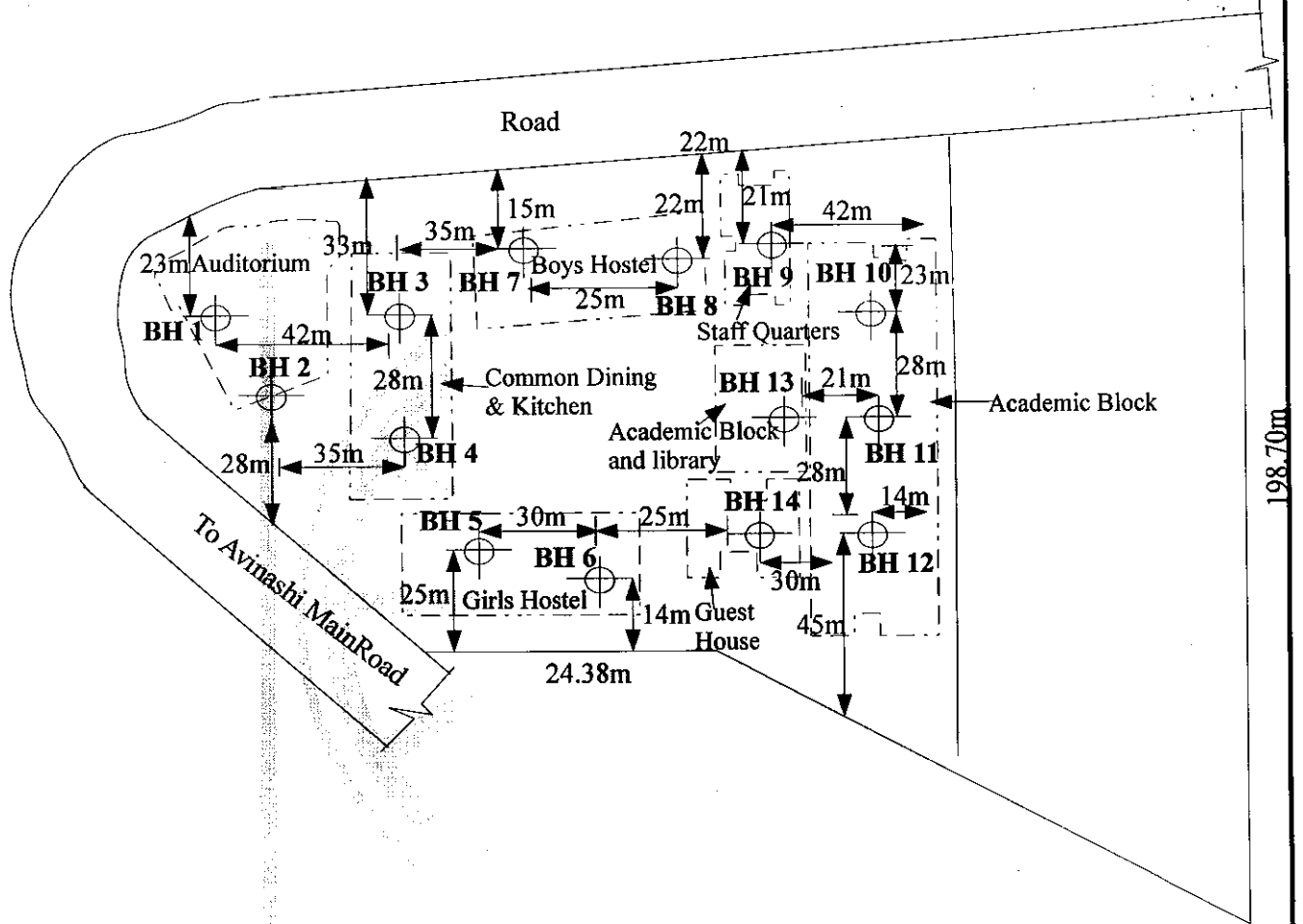
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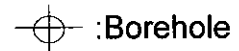
FIGURES





Schematic Site Plan

Legend:



: Borehole

NOTE: Sketch Not To Scale

Project:
Multistoried Bldgs for RIAHS,
At Peelamedu, Coimbatore



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Sheet No. : 1



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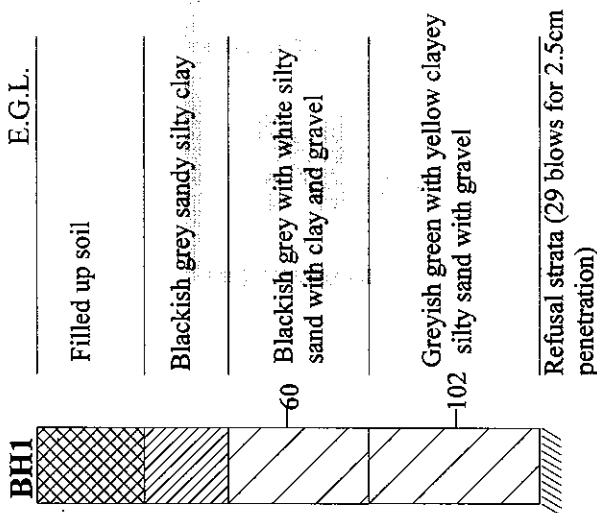
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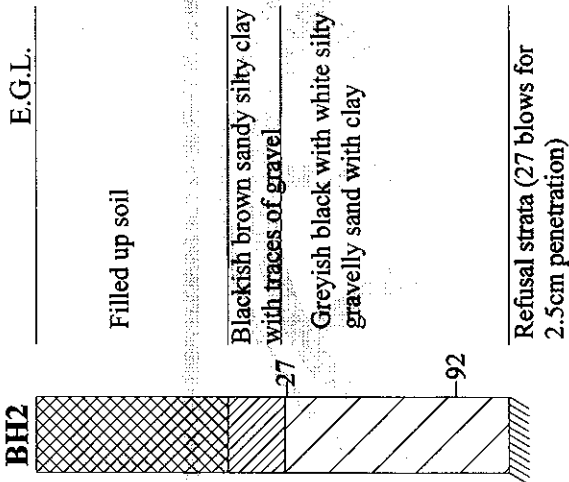
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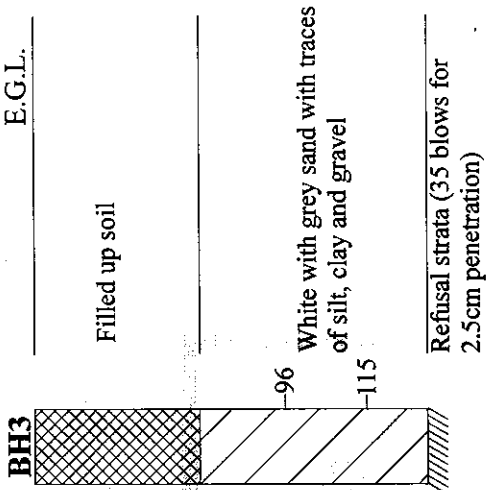
E.G.L.
 0.5
 1.0
 1.5
 2.0
 2.5
 3.0
 Depth (m)



Location : Auditorium



Location : Auditorium



Location : Common Dining & Kitchen

Soil Profile

Legend

E.G.L. : Existing Ground Level

- 60 : N - value (Observed)

Note : Water table not encountered

Project:
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 At Peelamedu, Coimbatore



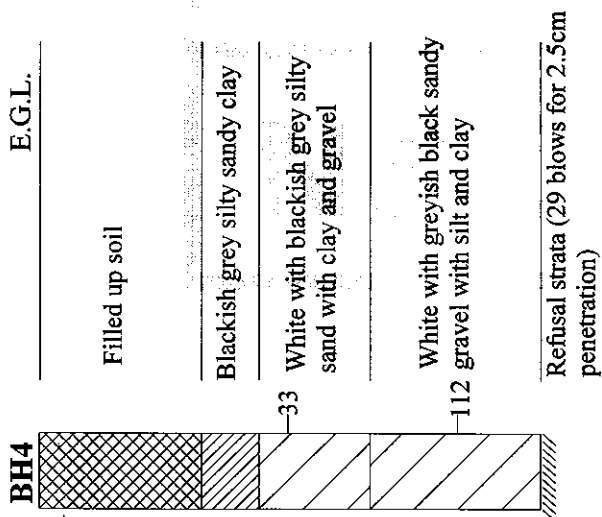
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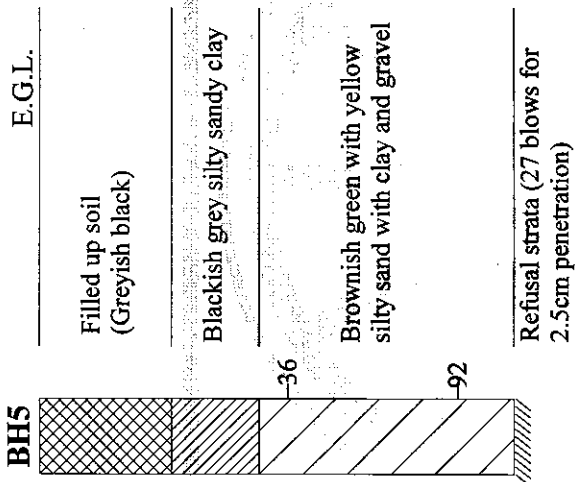
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E.G.L. 0.5 1.0 1.5 2.0 2.5 3.0
 Depth (m)

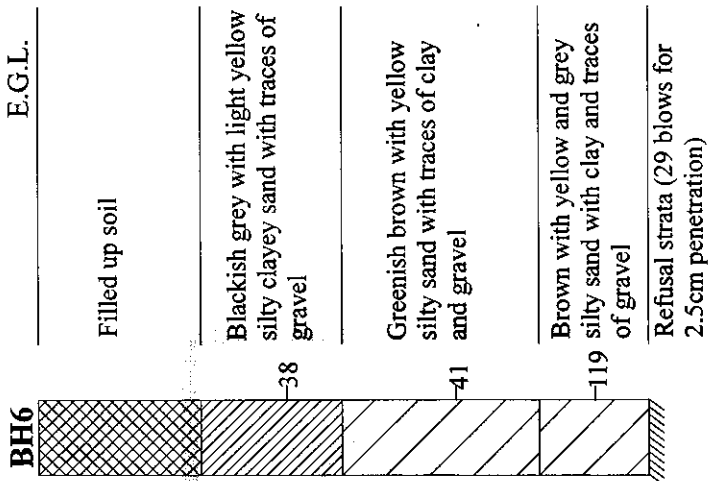


Location : Common Dining & Kitchen

Project:
 Multistoried Bldgs for RIAHS,
 At Peelamedu, Coimbatore



Location : Girls Hostel



Location : Girls Hostel

Soil Profile

Legend

E.G.L. : Existing Ground Level

-33 : N - value (Observed)

Note : Water table not encountered



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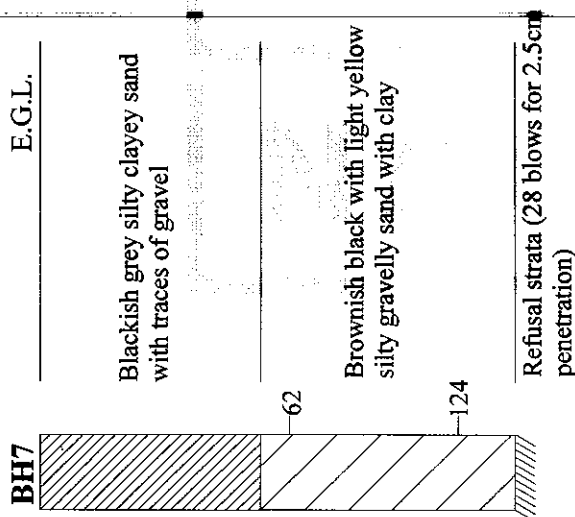
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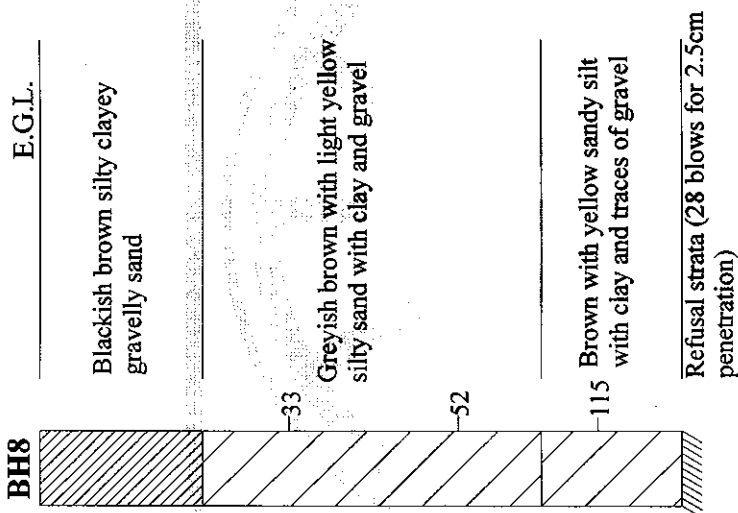
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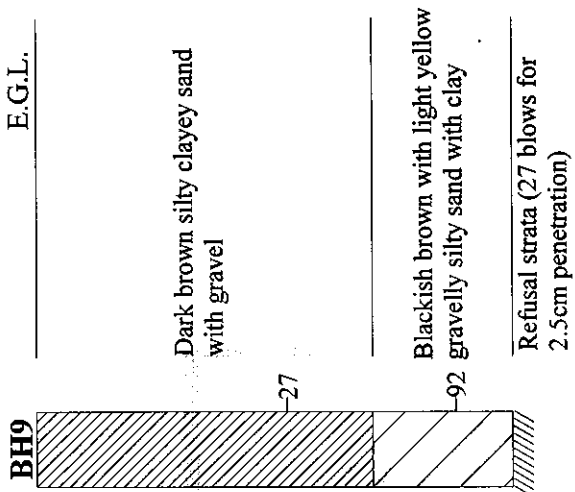
E.G.L. 0.5 1.0 1.5 2.0 2.5 3.0
Depth (m)



Location : Boys Hostel



Location : Boys Hostel



Location : Staff Quarters

Soil Profile

Legend

E.G.L. : Existing Ground Level

62 : N - value (Observed)

Note : Water table not encountered

Project:
Multistoried Bldgs for RIAHS,
At Peelamedu, Coimbatore



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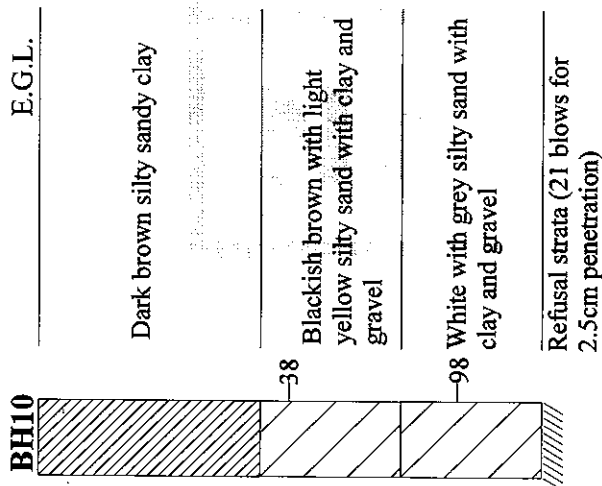
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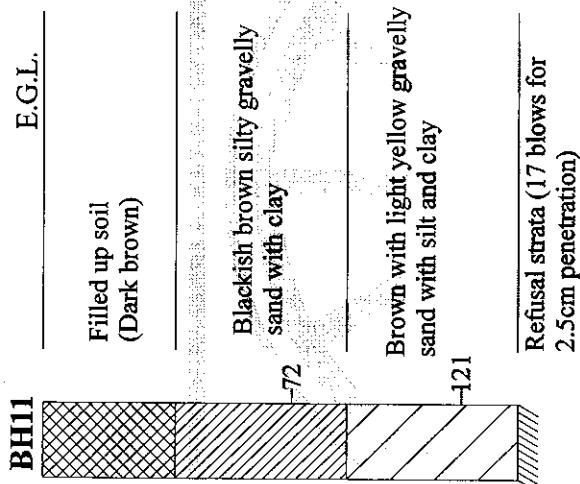
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E.G.L.
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 2.0
 2.5
 3.0
 Depth (m)

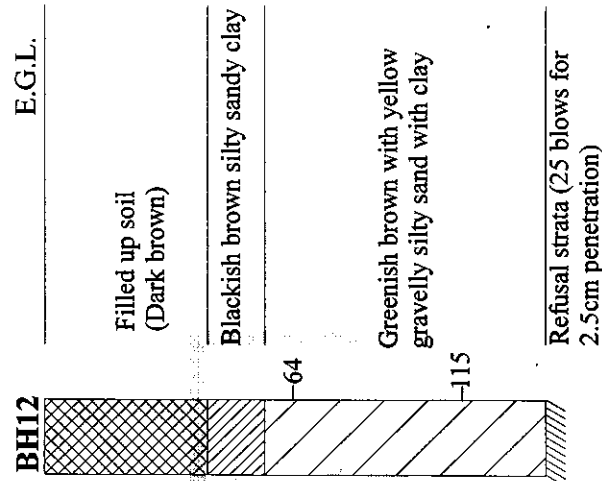


Location : Academic Block

Project:
 Multistoried Bldgs for RIAHS,
 At Peelamedu, Coimbatore



Location : Academic Block



Location : Academic Block

Soil Profile

Legend

E.G.L. : Existing Ground Level

38 : N - value (Observed)

Note : Water table not encountered



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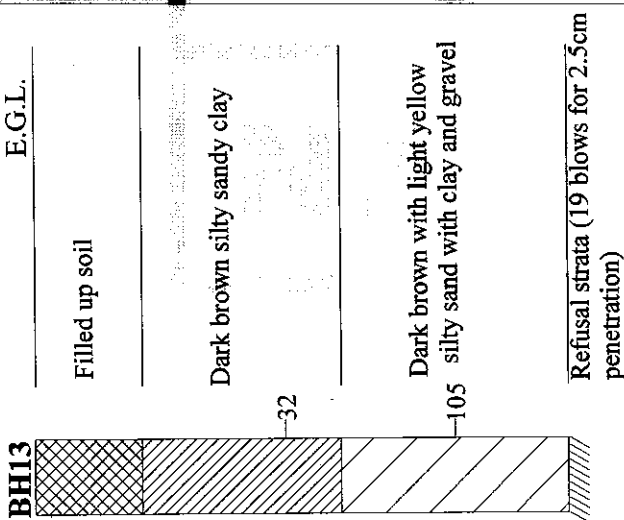
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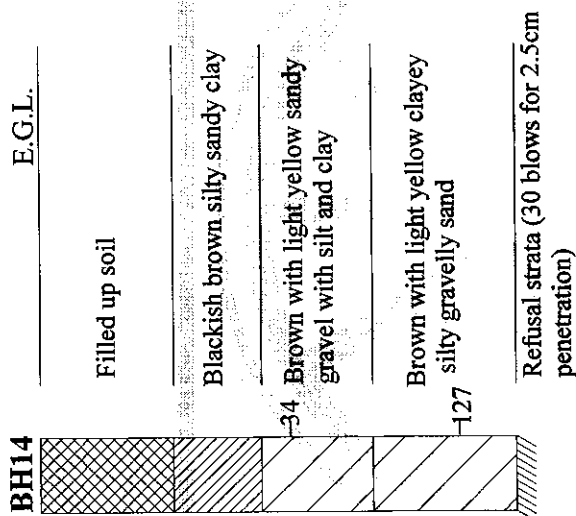
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E.G.L. 0.5 1.0 1.5 2.0 2.5 3.0
Depth (m)



Location : Admin Block & Library

Project:
Multistoried Bldgs for RIAHS,
At Peclamedu, Coimbatore



Location : Guest House

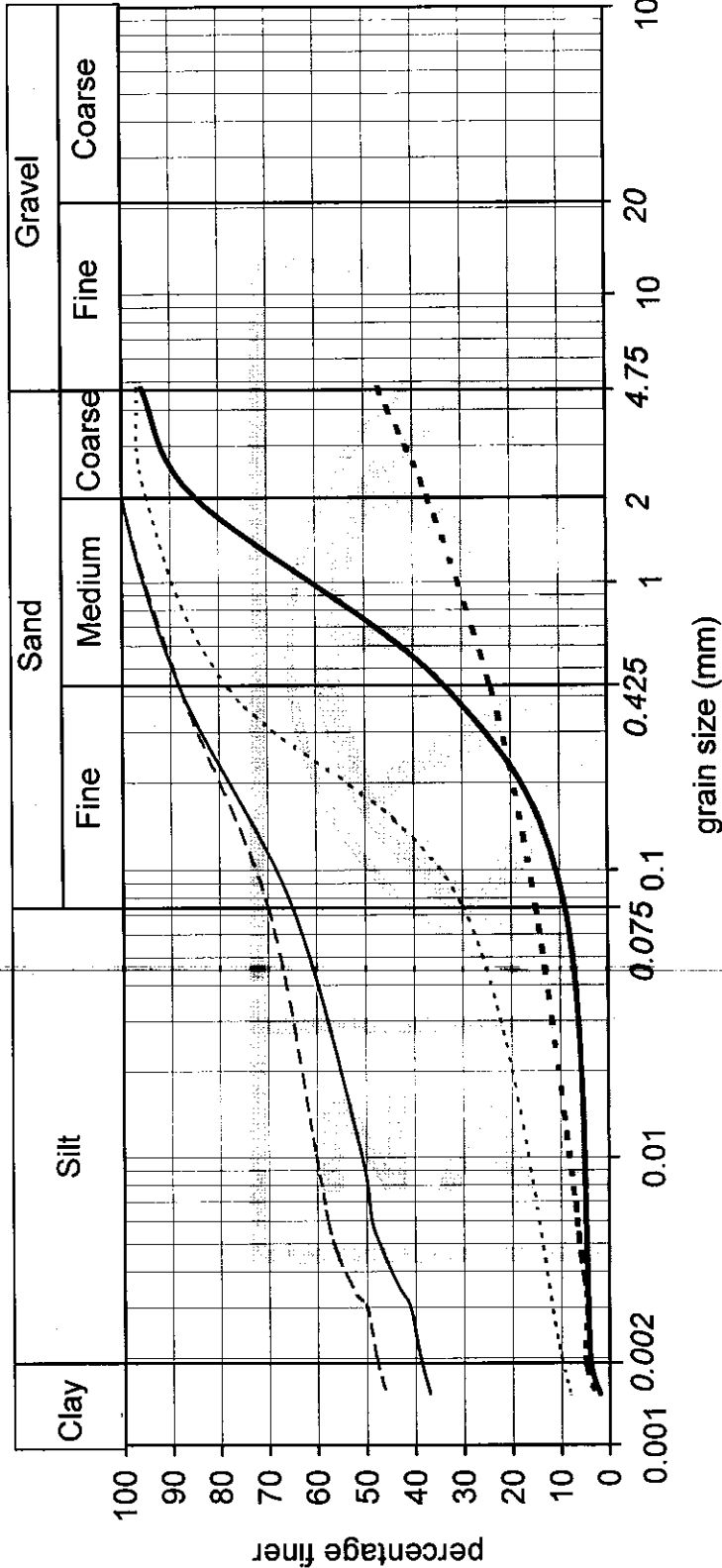
Soil Profile

Legend

E.G.L. : Existing Ground Level

+ 32 : N - value (Observed)

Note : Water table not encountered



Symbol	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	U
—	3	0.7	Blackish grey silty sandy clay	0	35	26	39	0.04	-	-
- - -	3	1.2	White with grey sand with traces of silt, clay and gravel	4	87	5	4	1	0.09	11.1
- - - - -	4	0.9	White with blackish grey silty sand with clay and gravel	3	67	20	10	0.1	-	-
- - - - -	4	1.5	White with greyish black sandy gravel with silt and clay	53	32	10	5	-	0.02	-
- - - - -	5	0.7	Blackish grey silty sandy clay	0	30	22	48	0.009	-	-



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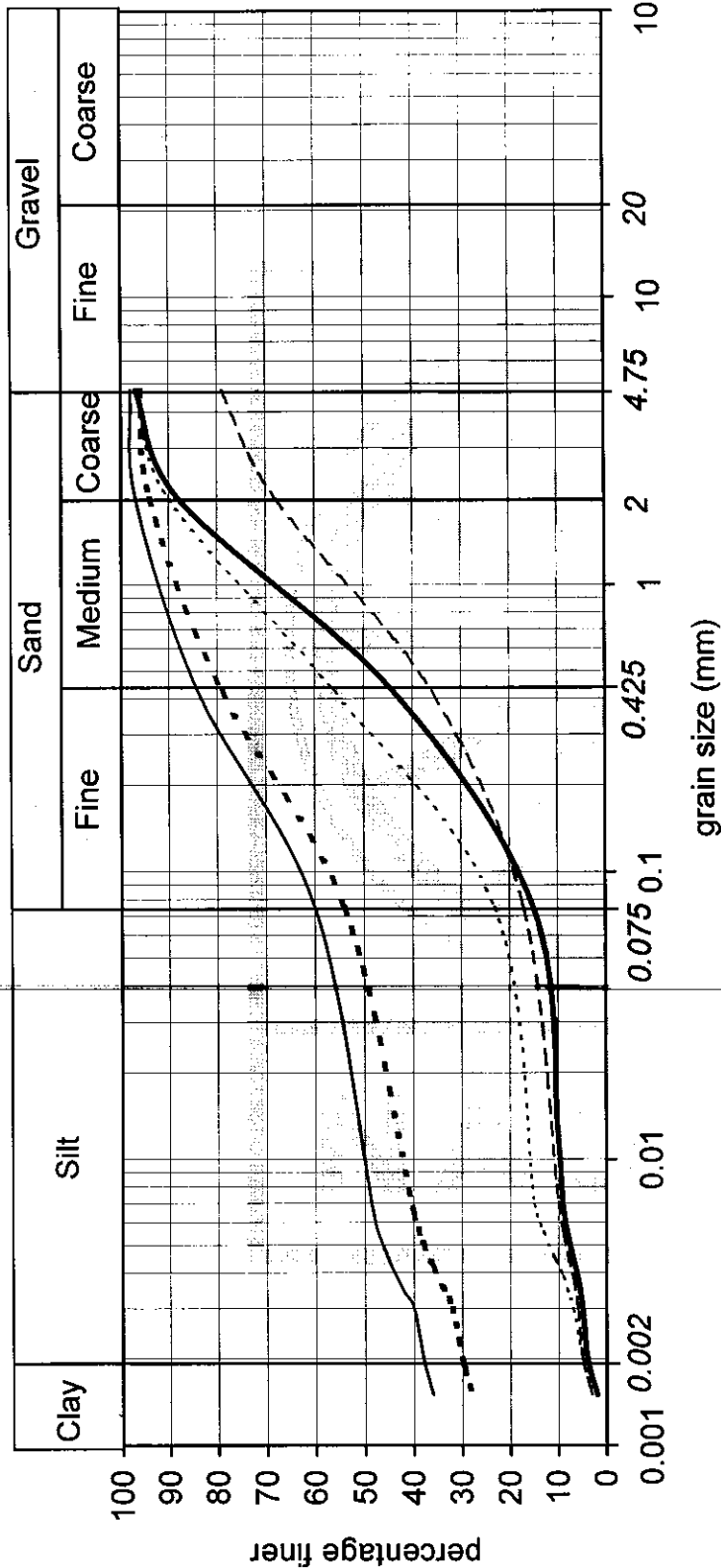
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Symbol	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	U
—	6	0.9	Blackish grey with light yellow silty clayey sand with traces of gravel	2	38	22	38	0.075	-	-
—	6	1.5	Greenish brown with yellow silty sand with traces of clay and gravel	3	82	11	4	0.8	0.02	40.0
- - - -	6	2.0	Brown with yellow and grey silty sand with clay and traces of gravel	3	74	18	5	0.5	0.004	125.0
- - - - -	7	0.5	Blackish grey silty clayey sand with traces of gravel	4	42	24	30	0.11	-	-
- - - - -	7	1.5	Brownish black with light yellow silty gravelly sand with clay	21	62	12	5	1.3	0.009	144.4



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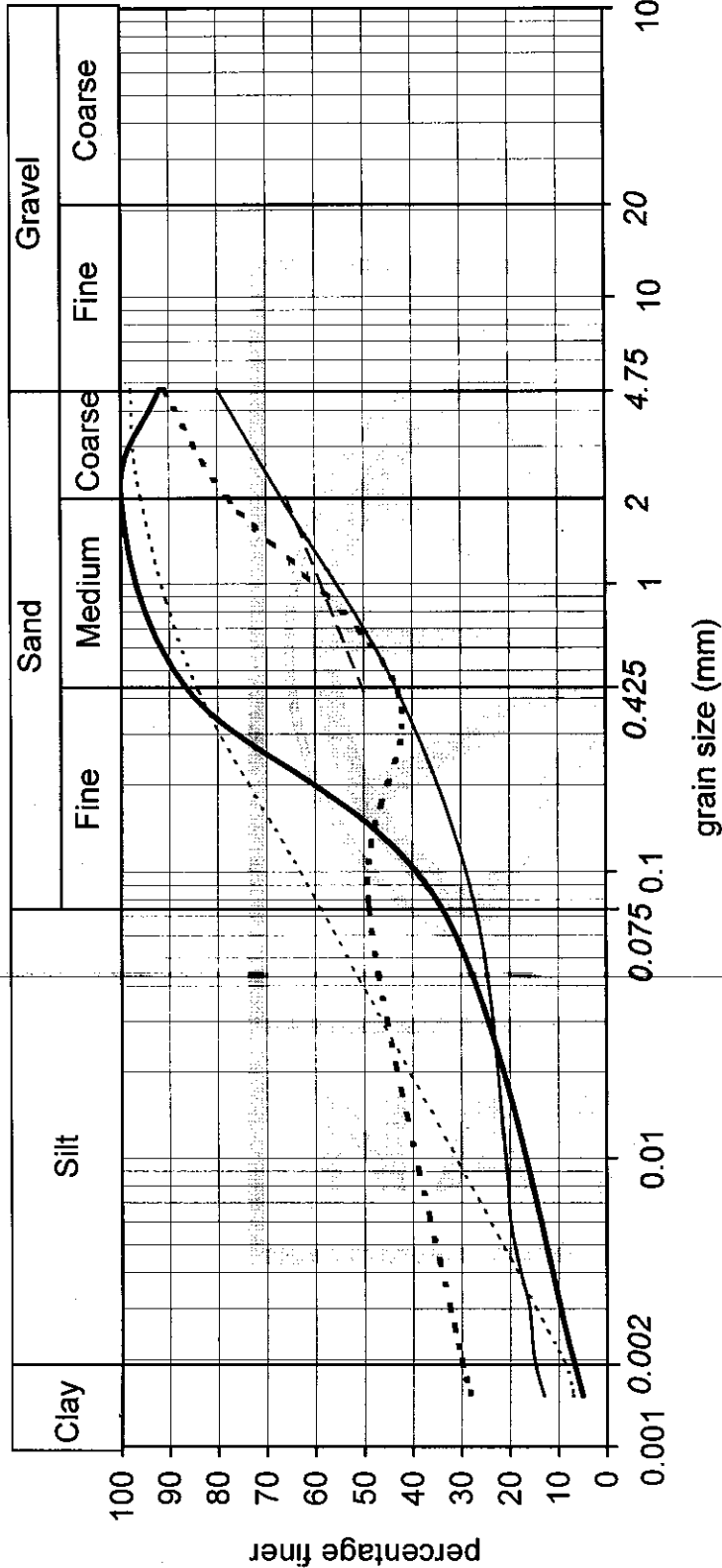
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Symbol	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	U
—	8	0.5	Blackish brown silty clayey gravelly sand	20	53	12	15	1.2	-	-
—	8	0.9	Greyish brown with light yellow silty sand with clay and gravel	8	58	27	7	0.053	-	-
----	8	2.0	Brown with yellow sandy silt with clay and traces of gravel	2	39	50	9	0.08	0.002	40.0
-----	9	0.5	Dark brown silty clayey sand with gravel	9	42	19	30	0.9	-	-



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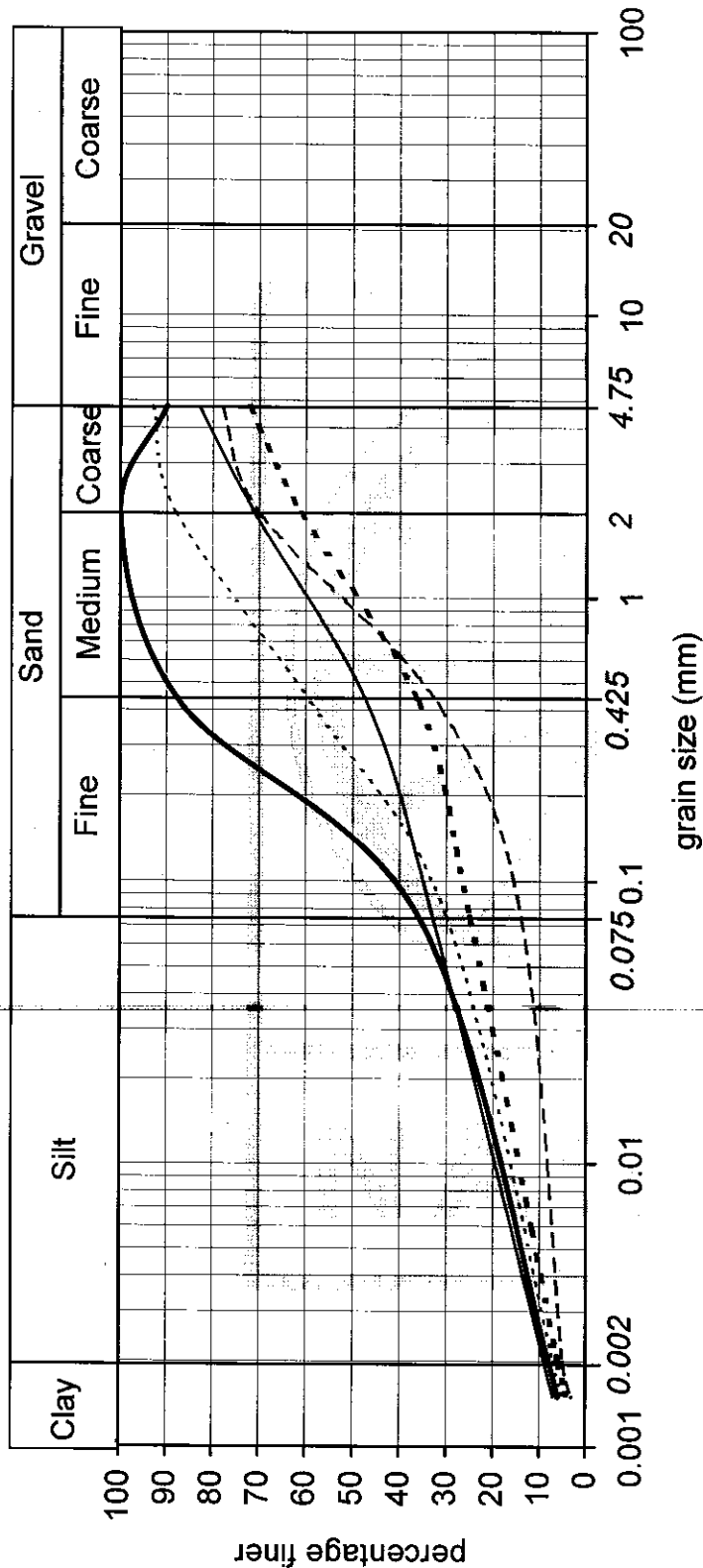
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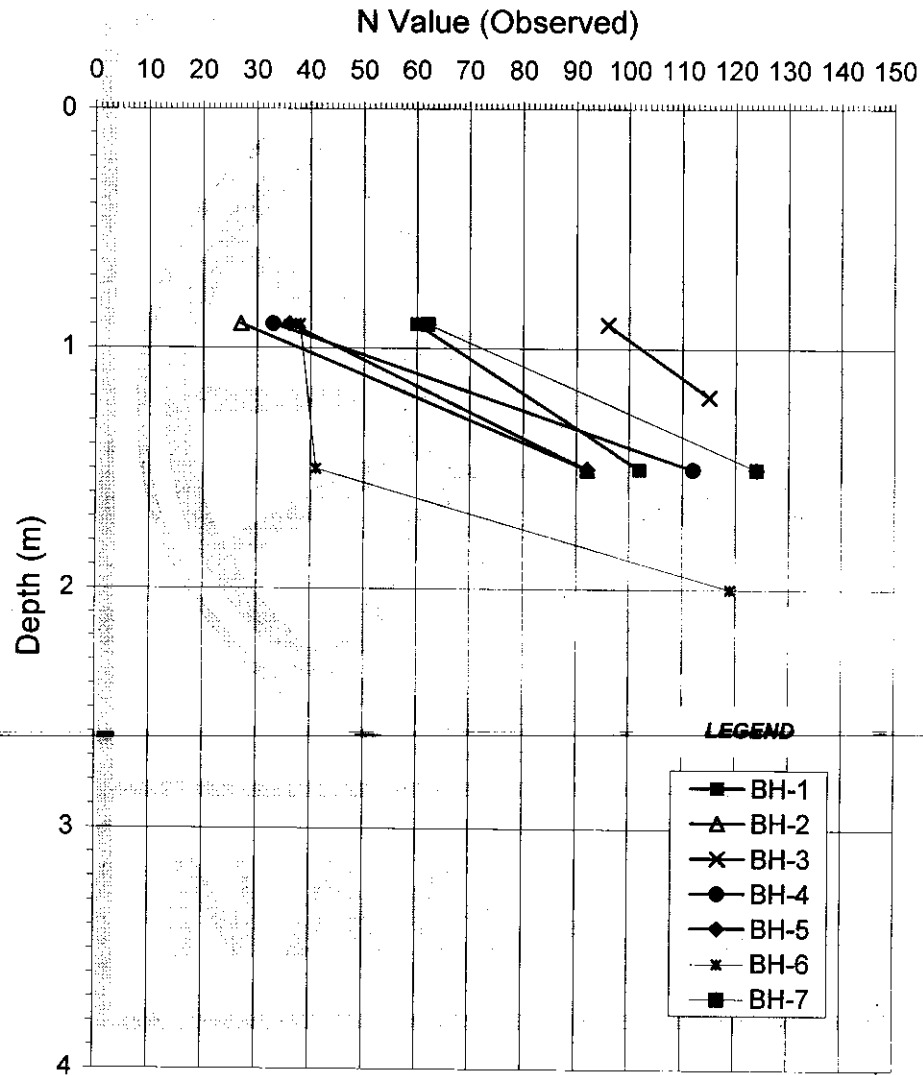
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Symbol	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	U
—	9	1.5	Blackish brown with light yellow gravelly silty sand with clay	17	50	24	9	1	0.0022	454.5
—	10	0.9	Blackish brown with light yellow silty sand with clay and gravel	10	54	28	8	0.03	-	-
---	10	1.5	White with grey silty sand with clay and gravel	7	63	23	7	0.425	0.003	141.7
---	11	0.9	Blackish brown silty gravelly sand with clay	28	47	19	6	2	0.0033	606.1
---	11	1.5	Brown with light yellow gravelly sand with silt and clay	22	64	9	5	1.3	0.02	65.0



N Values vs Depth Curves



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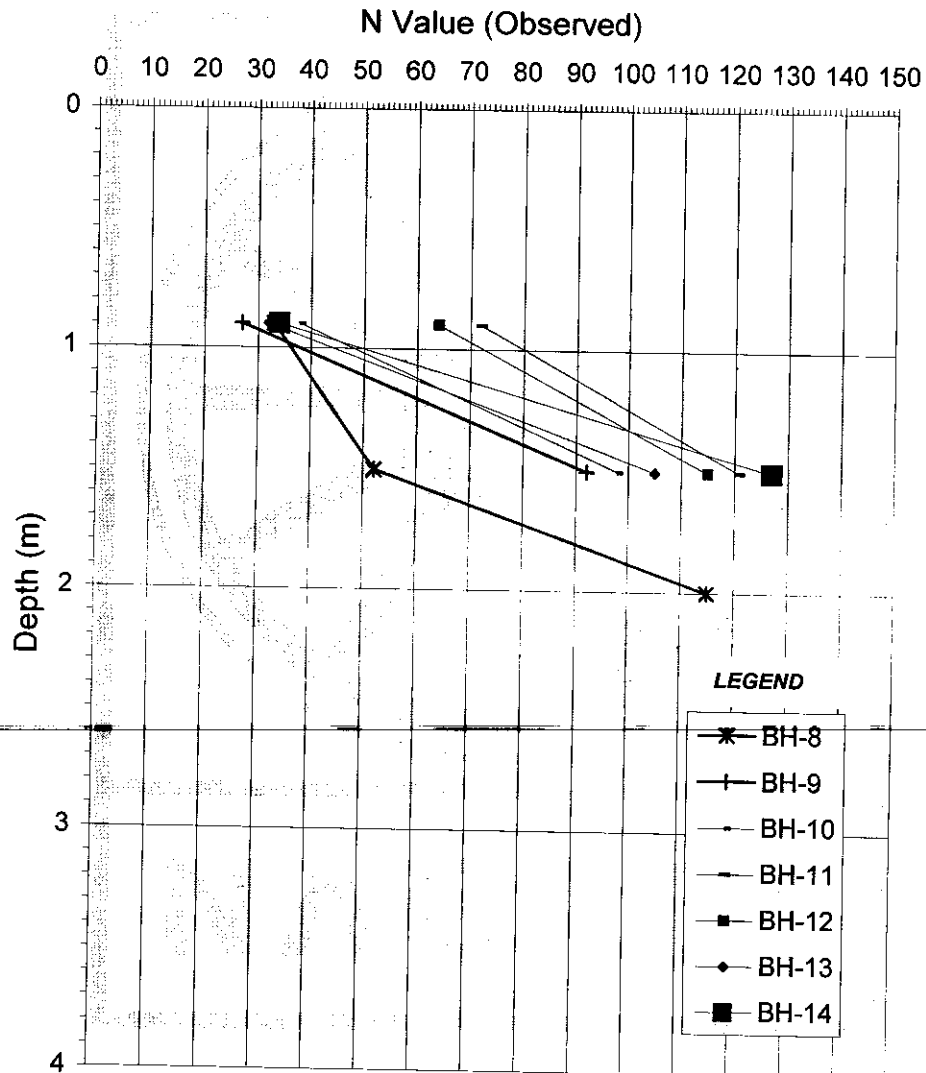
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N Values vs Depth Curves



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