



**GEOTECHNICAL INVESTIGATION
REPORT FOR THE PROPOSED
COMMERCIAL BUILDING AT PLOT NO.
90A, SECTOR - 18, GURUGRAM**

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Client:

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Job No. : **G(D) 4566**

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GEOTECHNICAL INVESTIGATION REPORT for the Proposed Commercial Building at Plot No. 90A, Sector - 18, Gurugram

EXECUTIVE SUMMARY

M/s Semac Consultants Pvt. Ltd, Gurgaon, Haryana – 122016 are the consultants for the proposed project at Plot No. 90A, Sector - 18, Gurugram, Haryana.

The proposed structure consists of a basement, ground floor and thirteen upper floors.

The Geotechnical investigation programme has been undertaken at the site, as per the scope of investigations, stipulated by the client. The scope of work consisted of conducting boreholes in soil strata down to 25m depth at three locations.

The results of the field investigations indicate that the presence of filled-up strata down to maximum depth of about 2.7m below the existing ground level below which the subsoil strata generally consists of clayey sandy silt down to the depth investigated except between 10.5m and 22m depths wherein layers of sandy soils with occasional clay have also been encountered.

The N-values (N-values 15 -78) indicate that the subsoil is medium dense down to the depth investigated.

Ground water table had not been encountered in any of the boreholes down to the depth investigated i.e. 25m below the existing ground level.



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Considering the type of structure involved and the subsoil characteristics as determined from the geotechnical investigations, Raft Foundations have been recommended at a depth between 3.5m and 5m below the existing ground level. Net allowable bearing pressure of 40 t/m² has been recommended for an allowable settlement of 75mm.

Precaution : - Foundation surface must be compacted heavily. If any loose pockets are observed, the same shall be filled with brickbats/gravel and compacted. Foundations can subsequently be placed over such a prepared surface



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1.0 INTRODUCTION

- 1.1 M/s Semac Consultants Pvt. Ltd, 3rd Floor, Plot No. 05, Udyog Vihar, Phase - III, Gurgaon, Haryana – 122016 are the consultants for the proposed project at Plot No. 90A, Sector - 18, Gurugram, Haryana.
- 1.2 To design the substructure for the proposed structure, adequate information regarding the subsoil conditions is required. For this purpose, detailed geotechnical investigations have been undertaken at the site of the proposed structure.
- 1.3 This report contains the details of the geotechnical investigations conducted along with the results and analysis of the investigations and the recommendations thereof.
- 1.4 The geotechnical investigation has been carried out as per the authorization of the authorised signatory of Semac Consultants Pvt. Ltd vide their work order reference no. SCPL/GT/NCPL/038/2023-2024. This authorization has been given in response to our offer reference no.NCD/Q/SEMAC/053A/2023 dated 11th July 2023

2.0 PROJECT DETAILS

2.1 Site Location

- 2.1.1 The site for the proposed project is located at Plot No. 90A, Sector - 18, Gurugram, Haryana and is situated at a distance of about 1 km from IFFCO Chowk Metro Station, on Delhi - Jaipur Highway, Gurugram.

2.2 Site Layout and Topography

- 2.2.1 A schematic site plan showing the dimensions and other details of the site is enclosed in this report (fig. 1a).
- 2.2.2 The site had been observed to be almost levelled in its topography and the general level of the site had been observed to be about 2.5m below the adjacent road level.



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2.2.3 An existing building at the site had been observed to be demolished for the new construction due to which the existing ground level had been observed to be about 2.5m below the adjacent road level.

2.2.4 The colour of the surface earth had been observed to be Yellowish brown.

2.3 Seismic Zone

2.3.1 The present site is located in the Seismic Zone - IV which is an area of high seismic activity and earthquake intensity, as per the seismic zoning map of India given in BIS code IS:1893 (Part1) - 2016.

2.4 The Structure

2.4.1 The proposed structure is a Commercial Building consisting of a basement, ground floor and thirteen upper floors.

2.4.2 The structure is understood to be a framed one and the construction is proposed to be of Reinforced Cement Concrete.

3.0 OBJECT OF INVESTIGATIONS

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

- a) Type of foundation
- b) Depth below the ground level at which the foundation system is to be laid
- c) Allowable bearing pressure at the foundation level

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

- a) The subsoil profile indicating thickness of the various soil strata, to a depth within the influence zone below the foundations
- b) Engineering properties of the soil strata at various levels



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

4.0 SCOPE OF INVESTIGATIONS

4.1 The scope of investigations as stipulated by the client consists of :

- a) Conducting boreholes in soil strata down to 25m depth at three locations.
- b) Conducting relevant laboratory tests on soil samples recovered.
- c) Preparation and submission of a technical report in three copies containing the details of the tests carried out, their analysis and recommendations regarding the foundation system to be adopted.

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

- a) Conducting standard penetration tests at 1.5/3m intervals.
- b) Recovering undisturbed soil samples from various levels of the subsoil strata.
- c) Recording ground water table levels, if met with.

5.0 FIELD INVESTIGATIONS

5.1 Preliminary Details

5.1.1 Field investigations had been carried out between 14th July 2023 and 19th July 2023.

5.1.2 A schematic site plan showing the test locations is given in fig. 1a.

5.1.3 Photographs showing view of the site and work under progress are given in fig. 1b.



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5.2 Boreholes

- 5.2.1 All the boreholes were progressed by shell and auger method. Casing pipe were used to stabilize the sides of the boreholes.
- 5.2.2 All the boreholes, BH1 to BH3 had been progressed down to the stipulated depth of 25m below the existing ground level.
- 5.2.3 The diameter of the boreholes was 150/100mm.
- 5.2.4 Standard penetration tests were conducted at 1.5/3m intervals. Disturbed soil samples recovered from split spoon samplers were retained for identification purposes.
- 5.2.5 Undisturbed soil samples were recovered by thin walled tubes conforming to IS : 2132. These tubes had an area ratio of less than 10%.
- 5.2.6 The ends of sample tubes were sealed by wax to prevent loss/ ingress of moisture. Disturbed soil samples were enclosed in polythene bags.
- 5.2.7 The samples thus recovered were transported to the laboratory for testing purposes.
- 5.2.8 Ground water table had not been encountered in any of the boreholes, down to the depth investigated i.e. 25m below the existing ground level, during the period of field investigation i.e. July 2023.

6.0 LABORATORY INVESTIGATIONS

6.1 Tests on Soil Samples from Boreholes

- 6.2 The soil samples brought to the laboratory were subjected to various tests to determine the following properties :
- a) Type of soil and its gradation
 - b) Consistency limits
 - c) Natural Bulk Density & Water Content



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- d) Strength parameters like cohesion, angle of shearing resistance

6.3 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

7.0 RESULTS & ANALYSIS

7.1 Presentation of Results

7.1.1 The results of the boreholes investigations have been presented in the form of soil profile tables.

7.1.2 The soil profile tables indicate the following:

- a) Standard penetration test values at various depths
- b) Soil description identifying the type of soil
- c) Grain size analysis indicating composition of subsoil
- d) Atterberg limits
- e) Natural density and water content
- f) Triaxial test results

7.2 Soil Profile

7.2.1 A perusal of the data presented in the soil profile tables indicates that the subsoil mainly consists of the following three strata in the three boreholes:

- a) Stratum - I : Filled-up soil with debris
- b) Stratum - II : Clayey sandy silt with occasional gravel



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- c) Stratum - III : Silty sand with occasional clay and gravel/ gravelly silty sand

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

BH. No.	Strata (depth in m : from : to)		
	Stratum - I	Stratum - II	Stratum - III
1	0 - 2.7	2.7 - 6.7	6.7 - 7.5
		7.5 - 10.5	10.5 - 17.2
		17.2 - 25	
2	0 - 2.7	2.7 - 7.3	7.3 - 8.4
		8.4 - 11.8	11.8 - 15.9
		15.9 - 25	
3	0 - 2.6	2.6 - 6	6 - 7.5
		7.5 - 11.2	11.2 - 22
		22 - 25	

7.2.3 The above results show that :

- a) Stratum - I consisting of filled-up soils, has been encountered down to a maximum depth of about 2.7m below the existing ground level.
- b) Stratum - II consisting predominantly of silty soils with varying percentages of clay and sand, has been encountered down to a maximum depth of about 11.8m and also below a depth of about 16m, down to the depth investigated.
- c) Stratum - III consisting predominantly of sandy soils with significant percentages silt and occasional clay, has been encountered between 10.5m and 22m depths below the existing ground level. Additionally, occasional thin layers of this stratum have also been encountered between 6m and 8.4m depths below the existing ground level.



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7.3 Soil Composition

7.3.1 The grain size distributions of the soil samples in the three boreholes have been presented in the form of grain size analysis curves in figs. 5a to 5e.

7.3.2 The variations in the grain size distributions in each of the two strata (except Stratum - I i.e filled-up soil) in the three boreholes are as follows:

a) Stratum - II : Clayey sandy silt with occasional gravel

BH. No.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
1	0 - 23	20 - 41	49 - 65	2 - 13
2	2 - 10	20 - 46	46 - 60	5 - 14
3	2 - 27	29 - 43	37 - 57	5 - 12

b) Stratum - II : Silty sand with occasional clay and gravel/ gravelly silty sand

BH. No.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
1	0 - 8	48 - 57	36 - 57	2 - 7
2	0 - 2	50 - 55	37 - 42	4 - 10
3	0 - 48	27 - 76	22 - 37	0 - 10

7.3.3 The above results indicate that :

- a) Stratum - II consists of about 37% to 65% of silt, 20% to 46% of sand with rest of the soil matrix consisting of clay and gravel.
- b) Stratum - III consists of about 27% to 76% of sand, 22% to 57% of silt with occasional clay and gravel.

7.4 Natural Density and Water Content

7.4.1 The natural bulk densities, water contents and dry densities in the three boreholes vary as follows :



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BH. No.	Bulk Density (g/cm ³)	Water Content (%)	Dry Density (g/cm ³)
1	1.81 - 2.16	7.0 - 18.5	1.64 - 1.83
2	1.80 - 2.01	7.2 - 15.4	1.68 - 1.82
3	1.91 - 2.08	12.6 - 21.3	1.60 - 1.81

7.4.2 The dry densities of the soil have also been presented in the form of plots of dry density vs depth for the three boreholes conducted, in fig. 3.

7.4.3 The above results indicate that the subsoil is in a medium dense state down to the depth investigated.

7.5 Atterberg Limits

7.5.1 The Atterberg limits indicate that the subsoil is predominantly low plastic down to the depth investigated except for occasional thin layers of non-plastic soils between 13m and 22m depth below the existing ground level.

7.6 Standard Penetration Test Values (N-values)

7.6.1 The observed Standard Penetration Test values (N-values) vary between 15 and 78 as indicated in the soil profile tables and as also shown in the fig. 4 wherein the observed N-values have been plotted with respect to depths.

7.6.2 The above results indicate that the subsoil is in a medium dense state down to the depth investigated.

7.7 Triaxial Test Results

7.7.1 The results of triaxial tests are indicated in the respective soil profile tables. These results have been considered in providing the recommendations.



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7.8 Compiled Soil Profile

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

7.8.2 The above figure shows 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.

8.0 DESIGN CRITERIA

8.1 Design Parameters

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

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

8.1.2 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.

8.2 Type of Foundation

8.2.1 The type of foundation depends upon the following :

- a) Subsoil/rock conditions
- b) Type of structures
- c) Configuration of loading points
- d) Loading intensity on each column at the foundation level

8.2.2 The proposed structure is a Commercial Building consisting of a basement, ground floor and thirteen upper floors. Considering this, medium heavy loads can be anticipated on the foundations.



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8.2.3 The results of the investigations have indicated that the subsoil is in a medium dense state down to the depth investigated.

8.2.4 In view of the above, the proposed structure can be supported over ***Raft Foundations***.

8.3 Depth of Foundations

8.3.1 The minimum depth of foundation depends upon the following factors :

- a) Top filled-up strata / loose 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.

8.3.2 The above results indicate that the subsoil below the proposed founding level is in a medium dense state down to the depth investigated.

8.3.3 Filled-up strata has been encountered down to a depth of about 2.7m below the existing ground level.

8.3.4 Considering the above, and also that the proposed structure has a basement, the foundations for the proposed structures can be placed at a depth ***beyond 3.5m below the existing ground level***.

8.3.5 Excavations down to the above mentioned depth can be carried out by providing necessary side slopes.

8.3.6 The soil available at the founding level will be ***Yellowish brown clayey sandy silt***.

8.4 Allowable Bearing Pressures

8.4.1 Allowable bearing pressure depends upon the allowable settlement. An allowable settlement of ***75mm*** has been considered to evaluate the allowable bearing pressure for ***Raft Foundations***.



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8.4.2 Allowable bearing pressure has been evaluated by :

- a) Shear failure criterion using average soil data &
- b) Settlement criterion taking SPT values

8.4.3 On the basis of the above analysis, the following recommendations regarding the net allowable bearing pressure are being made :

For Raft foundations, net allowable bearing pressure of 40 t/m² can be adopted for an allowable settlement of 75mm, at a depth between 3.5m and 5m below the existing ground level.

9.0 RECOMMENDATIONS

9.1 Type of Foundation

Raft Foundations

9.2 Depth of Foundation

between 3.5m and 5m below the existing ground level

9.3 Allowable Bearing Pressure

For Raft foundations, net allowable bearing pressure of 40 t/m² can be adopted for an allowable settlement of 75mm, at a depth between 3.5m and 5m below the existing ground level.

9.4 Modulus of Subgrade Reaction (k-value)

9.4.1 Modulus of sub-grade reaction (k-value) for a 30 x 30cm plate size or 30cm wide beam, of 3 kg/cm³ can be adopted for design of Raft Foundations laid at a depth between 3.5m and 5m below the existing ground level.

9.4.2 The modulus of sub-grade reaction (k-value) given above is based on Standard Penetration Test values (N-values) as per the guidelines of article B-1.1, clause 3.1(F) of appendix B, IS: 2950(part I) -1981.



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9.5 ***SPECIAL NOTE***

Foundation surface must be compacted heavily. If any loose pockets are observed, the same shall be filled with brickbats/gravel and compacted. Foundations can subsequently be placed over such a prepared surface.

9.6 **Note**

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

9.7 **Appendices**

9.7.1 An appendix sheet showing the typical analysis of the allowable bearing pressure for Raft Foundations is enclosed in Appendix 'A' of this report.

9.7.2 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 - B.

9.8 ***LIMITATIONS***

This Geotechnical investigation has been carried out at selected locations in the site chosen so as to represent the entire site. The recommendations provided in this report are hence valid only for these test locations. However, if there is any change in subsoil conditions and properties at places between or beyond chosen test locations, fresh investigations may have to be carried out at such locations.

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Technical Director

For Nagadi Consultants Pvt. Ltd.



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ANALYSIS FOR ALLOWABLE BEARING PRESSURE**A.1 METHODOLOGY**

A.1.1 The allowable bearing pressure is taken as the lower of the values obtained using two different criteria namely :

- a. Shear failure criterion
- b. Settlement criterion.

A.1.2 The shear failure criterion gives the safe bearing capacity which is based on the capacity of the soil to carry the load without undergoing shear failure.

A.1.3 The settlement criterion gives the safe bearing pressure which is the bearing pressure corresponding to an allowable settlement of the foundations.

A.2 DATA**A.2.1 Soil Properties**

The soil properties considered for the analysis for the allowable bearing pressure have been taken as the weighted average of the soil properties obtained from laboratory tests within the depth of influence of the foundations.

- a. Unit weight of the soil, γ = 1.75 g/cc
- b. Cohesion, c = 0.10 kg/cm²
- c. Angle of shearing resistance ϕ = 28°

A.2.2 Depth of Foundation

The depth of foundation has been taken as per section 8.2 as : $D = 5\text{m}$

A.2.3 Allowable Settlement

The allowable settlement adopted for the proposed structure is ' s ' = 75 mm



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A.3 SHEAR FAILURE CRITERION

The safe bearing capacity is determined as per IS 6403 - 1981.

A.3.1 Bearing Capacity Factors

For the above mentioned value of angle of shearing resistance ϕ , the bearing capacity factors are :

a. $N_c' = 20.09$

b. $N_q' = 10.41$

c. $N_\gamma' = 10.87$

A.3.2 Water Table Correction Factor

Water table correction factor has been adopted as $R_w' = 0.75$.

A.3.3 Safe bearing capacity

The safe bearing capacity is obtained using the equation given below wherein the factor of safety has been taken as equal to 3. Thereafter, the safe bearing capacity for different widths of foundation have been given.

$$q_b = \frac{1}{3} \cdot (c \cdot N_c' + \gamma \cdot D \cdot N_q' + 0.5 \cdot \gamma \cdot B \cdot N_\gamma' \cdot R_w') - \gamma \cdot D$$

Considering the widths of foundations greater than 5m, the safe bearing capacity works out to be **46.7 t/m²**.

A.4 SETTLEMENT CRITERION (Ref. IS : 8009)

The safe bearing pressure corresponding to an allowable settlement of the foundation is determined based on the N- values



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A.4.1 Based on N Values

Considering a **weighted average N-value of 21** determined based on the recorded N-values in the boreholes, the safe bearing pressure for widths of foundations greater than 10m determined as per IS 8009-1976 (Part 1) works out be **39.9 t/m²**.

A.5 RECOMMENDED ALLOWABLE BEARING PRESSURE

On the basis of the above, the recommended net allowable bearing pressure for Raft Foundations is **40 t/m²**.

Note : To obtain gross allowable bearing pressure, weight of soil overburden removed can be added to the above value.



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Appendix 'B'

(refer para no. 9.7.2)

LIST OF IS CODES

Field Investigation

1. IS : 1892 - 2021 : 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)



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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.

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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		B.H. Location :				Water Table : N.E.			Term. Depth : 25m			B.H. No.: 1		
		N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg Limits		In-situ properties		Triaxial Test	
Gravel (%)	Sand (%)				Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density (g/cm ³)	Water Cont (%)	Type	c (kg/cm ²)	φ (°)	
18	0.0	Filled-up soil with debris												
	2.7	Change of the strata												
22	3.0									1.98	17.8			
	3.9	Yellowish brown clayey sandy silt with gravel	3	20	65	12	29	20		1.95	18.5	CD	0.10	28
24	4.5									1.91	16.5			
	5.4	Yellowish brown clayey sandy silt with gravel	10	33	49	8	23	16		2.05	14.8			
24	6.0									2.16	17.8			
	6.7	Change of the strata								1.92	11.7	CD	0.11	29
35	6.9	Yellowish brown clayey silty sand with gravel	7	51	33	9	Low	Plastic						
	7.5	Change of the strata												
39	8.4	Yellowish brown clayey sandy silt	0	30	57	13	27	18						
	9.0													
	9.9	Yellowish brown clayey sandy silt with gravel	3	24	63	10	29	20						
	10.5	Change of the strata												
	11.4	Yellowish brown clayey silty sand	0	53	39	8	Low	Plastic						

SOIL PROFILE		Project : Proposed Project at Sector - 18, Gurugram											
		B.H. Location :		Water Table : N.E.		Term. Depth : 25m		B.H. No.: 1					
N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg		In-situ		Triaxial Test		
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density (g/cm ³)	Water Cont (%)	Type	c ^c (kg/cm ²)	φ ^o
46	12.0	Yellowish brown clayey silty sand	0	57	36	7	Low	Plastic	2.00	11.6	CD	0.09	30
	12.9								1.92	7.3			
58	13.5	Yellowish brown clayey silty sand	0	48	48	4	Low	Plastic	1.92	7.3			
	14.4								1.82	7.0			
54	15.0	Yellowish brown clayey silty sand with gravel	8	49	41	2	Low	Plastic	1.82	7.0			
	15.9								1.81	7.4			
40	16.5	Change of the strata	2	41	55	2	24	18	1.81	7.4			
	17.2								1.87	12.2			
	17.4								2.05	14.4			
46	18.0	Yellowish brown clayey sandy silt with gravel	2	31	60	7	25	18	2.05	14.4			
	20.4								1.98	17.4			
67	21.0	Yellowish brown clayey sandy silt with gravel	23	20	51	6	24	17	1.98	17.4			
	23.4								2	25			
56	24.0	Yellowish brown clayey sandy silt with gravel	2	25	61	12	27	19					
	25.0												
		Observed 'N' Values											



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		B.H. Location :			Water Table : N.E.			Term. Depth : 25m			B.H. No.: 2		
N - Value	Depth (m)	Soil Description	Grain Size Analysis				Atterberg		In-situ		Triaxial Test		
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Density (g/cm ³)	Water Cont (%)	Type	c (kg/cm ²)	φ (°)
35	11.8	Change of the strata											
	12.0	Yellowish brown clayey silty sand	0	55	37	8	Low	Plastic					
	12.9								1.86	7.1			
	46	Yellowish brown clayey silty sand	0	50	42	8	23	16					
	14.4								1.99	12.6			
	51	Yellowish brown clayey silty sand with gravel	2	51	43	4	Low	Plastic					
	15.9	Change of the strata							1.98	15.4	CD	0.10	31
	52	Yellowish brown clayey sandy silt with gravel	3	45	46	6	24	17					
	17.4								1.86	7.9			
	55	Yellowish brown clayey sandy silt with gravel	7	33	54	6	25	17					
	20.4								1.98	15.4			
	55	Yellowish brown clayey sandy silt with gravel	2	46	47	5	24	17					
23.4								2.00	10.9				
78	24.0	Yellowish brown clayey sandy silt with gravel	10	24	60	6	26	18					
	25.0								1.99	9.2			
		Observed 'N' Values											

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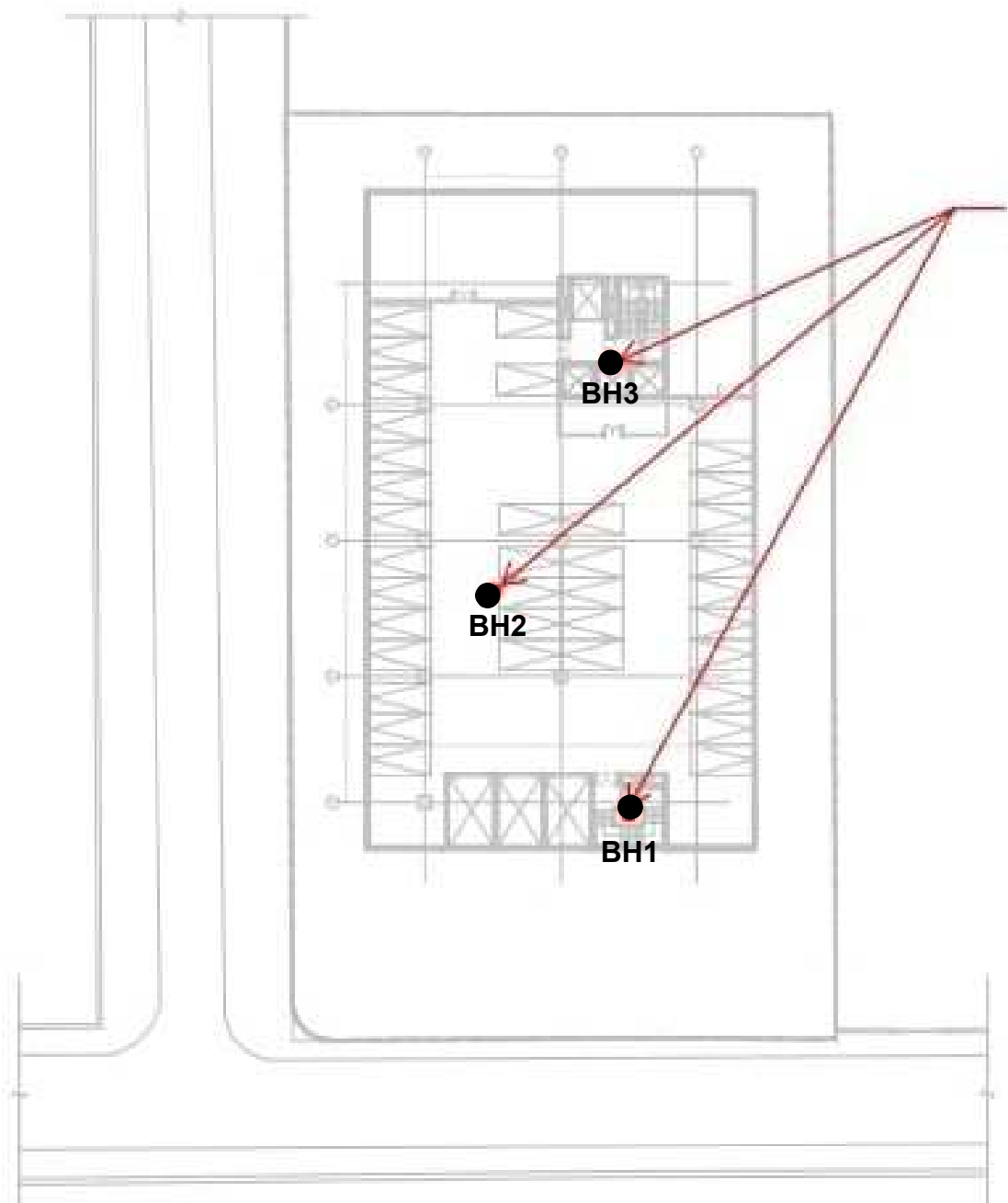
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SCHEMATIC SITE PLAN



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**PHOTOGRAPHS SHOWING
VIEW OF THE SITE AND BOREHOLE UNDER PROGRESS**

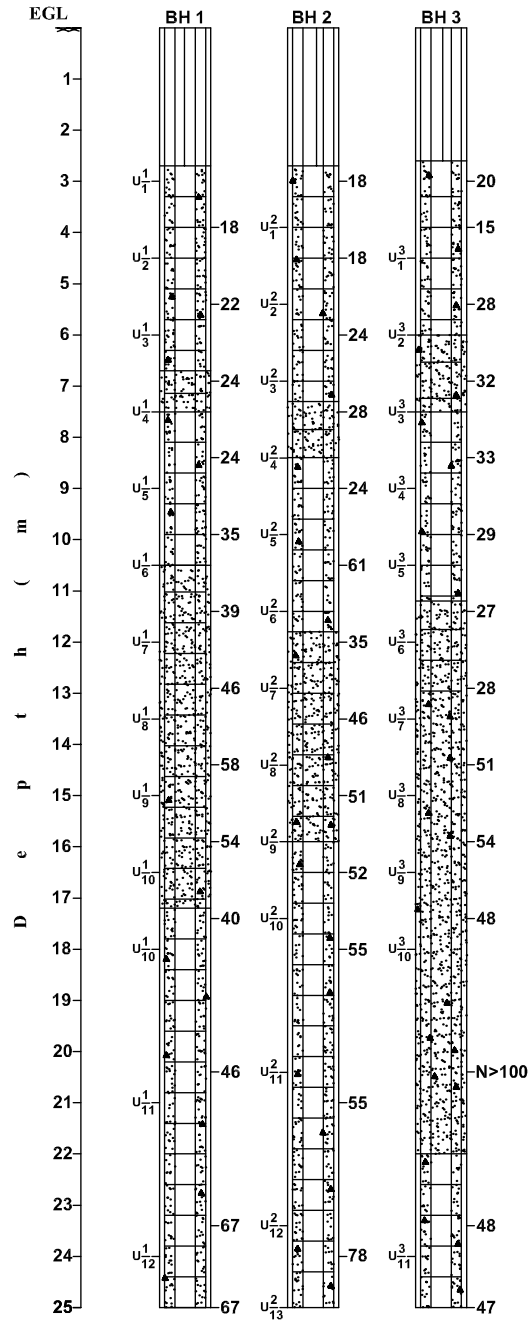


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Sheet No. : 1b



LEGEND



Filled-up soil with debris



Yellowish brown clayey sandy silt with
(2-13)% (20-46)% (3765)%
occasional gravel
(0-27)%



Yellowish brown silty sand with
(22-57)% (27-76)%
occasional clay and gravel
(0-10)% (0-48)%



48 Observed 'N' Values

u₂¹ 2nd undisturbed soil sample of BH 1

Ground Water table has not been encountere.

COMPILED SOIL PROFILE



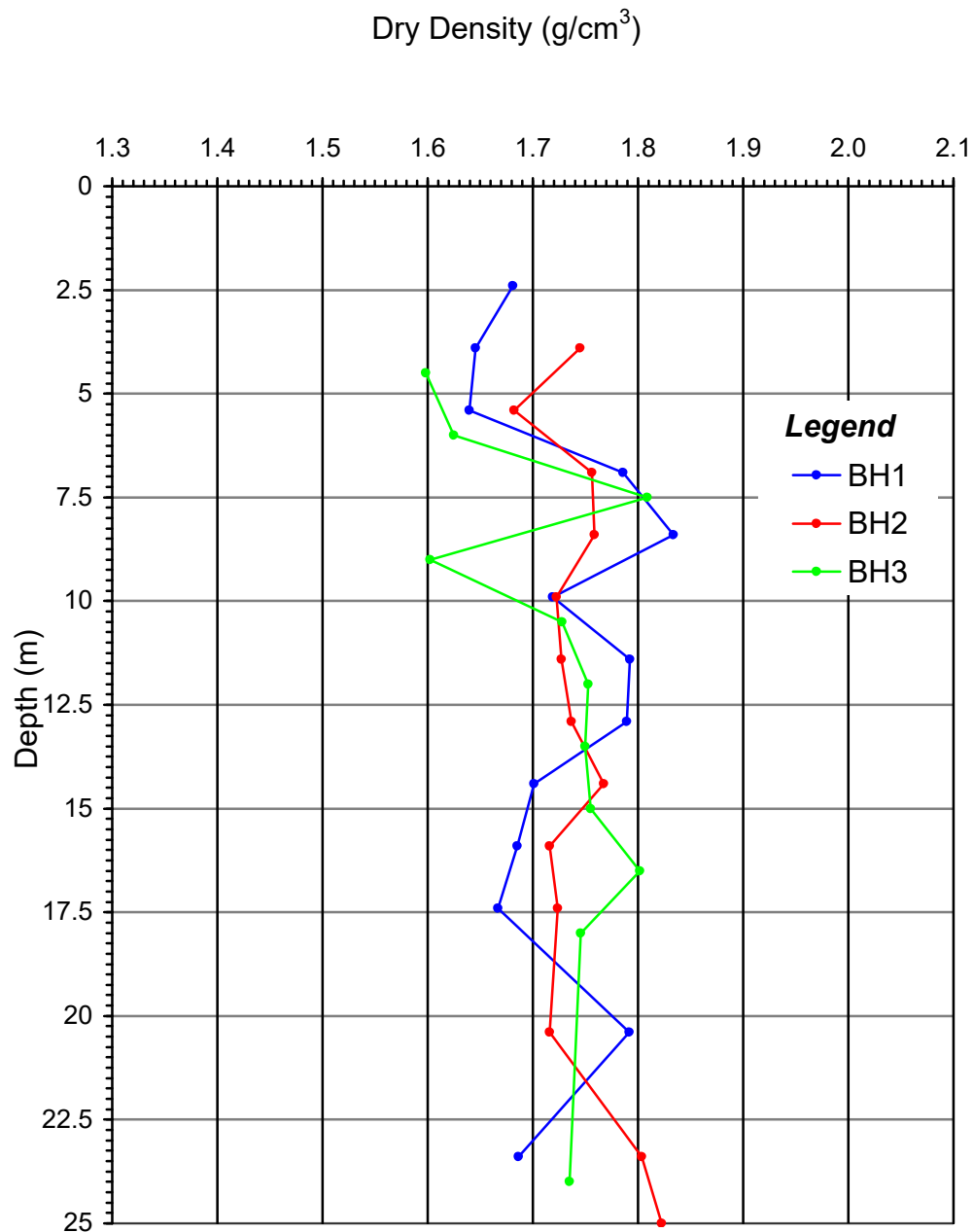
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Dry Density vs Depth Curves

(Refer paragraph no. 7.4.2)



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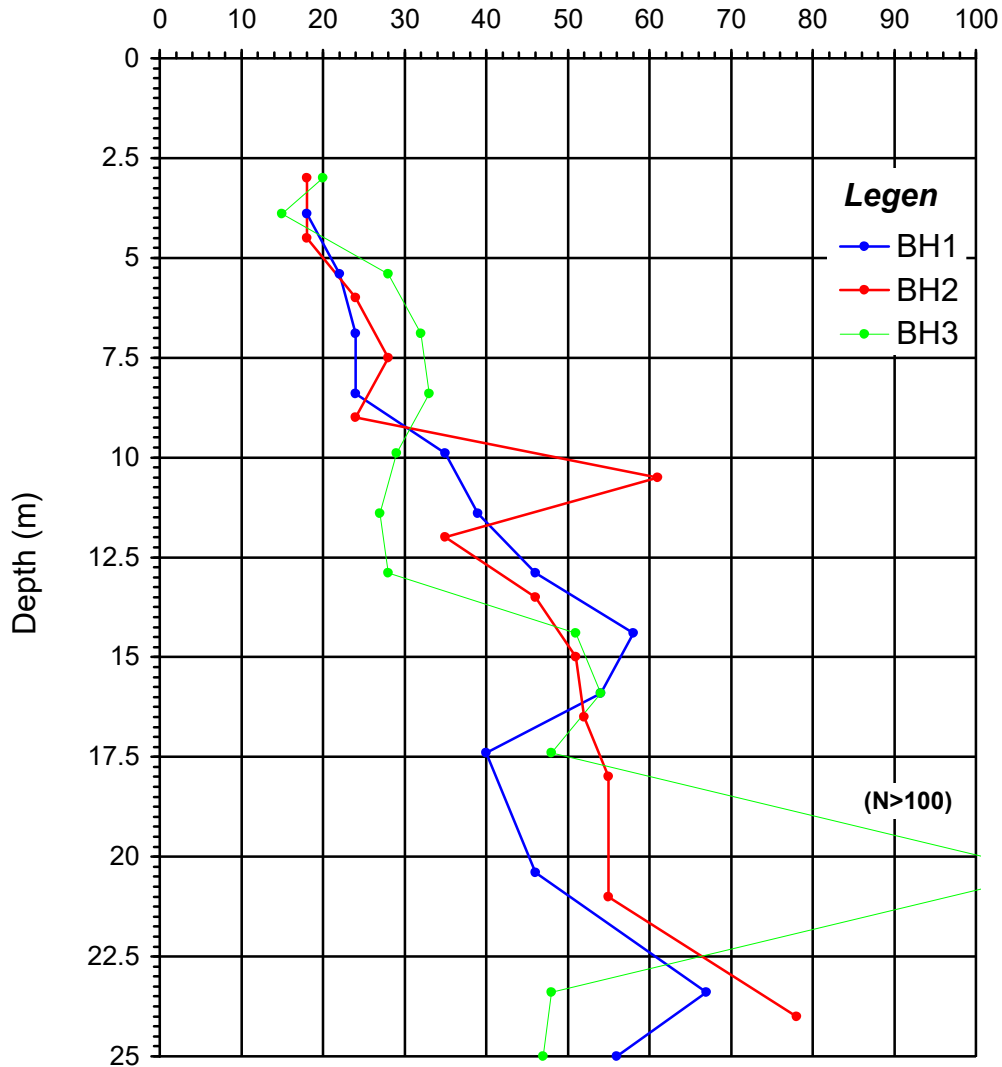
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N - Values (Observed)



N - Values vs Depth Curves

(Refer paragraph no. 7.6.1)



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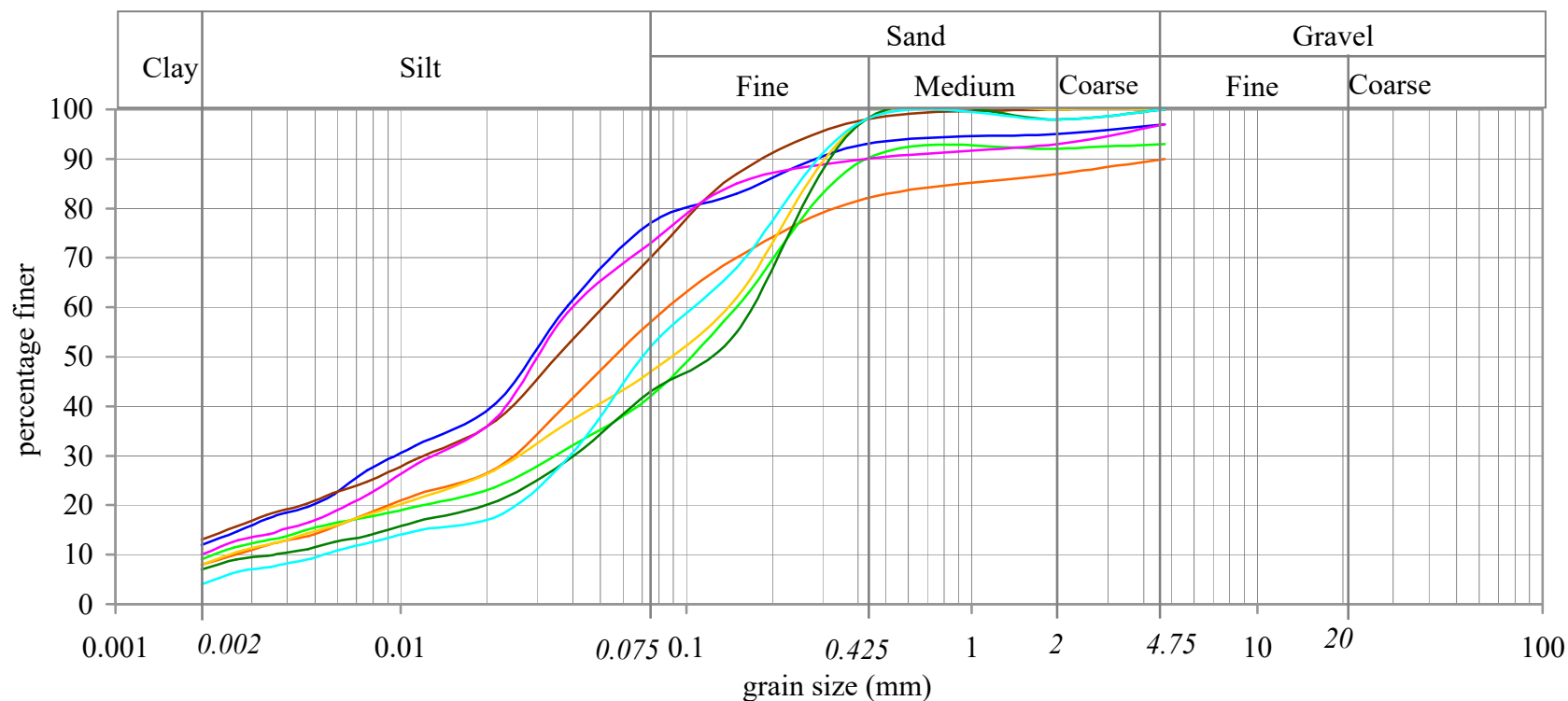
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Grain Size Analysis Curves (refer paragraph no. 7.3.1)



Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	C _u
	1	3.9	Clayey sandy silt with gravel	3	20	65	12	0.029	-	-
	1	5.4	Clayey sandy silt with gravel	10	33	49	8	0.089	0.0025	35.6
	1	6.9	Clayey silty sand with gravel	7	51	33	9	0.15	0.0022	68.2
	1	8.4	Clayey sandy silt	0	30	57	13	0.051	-	-
	1	9.9	Clayey sandy silt with gravel	3	24	63	10	0.039	0.002	19.5
	1	11.4	Clayey silty sand	0	53	39	8	0.14	0.0026	53.8
	1	12.9	Clayey silty sand	0	57	36	7	0.16	0.0031	51.6
	1	14.4	Clayey silty sand	0	48	48	4	0.11	0.0052	21.2



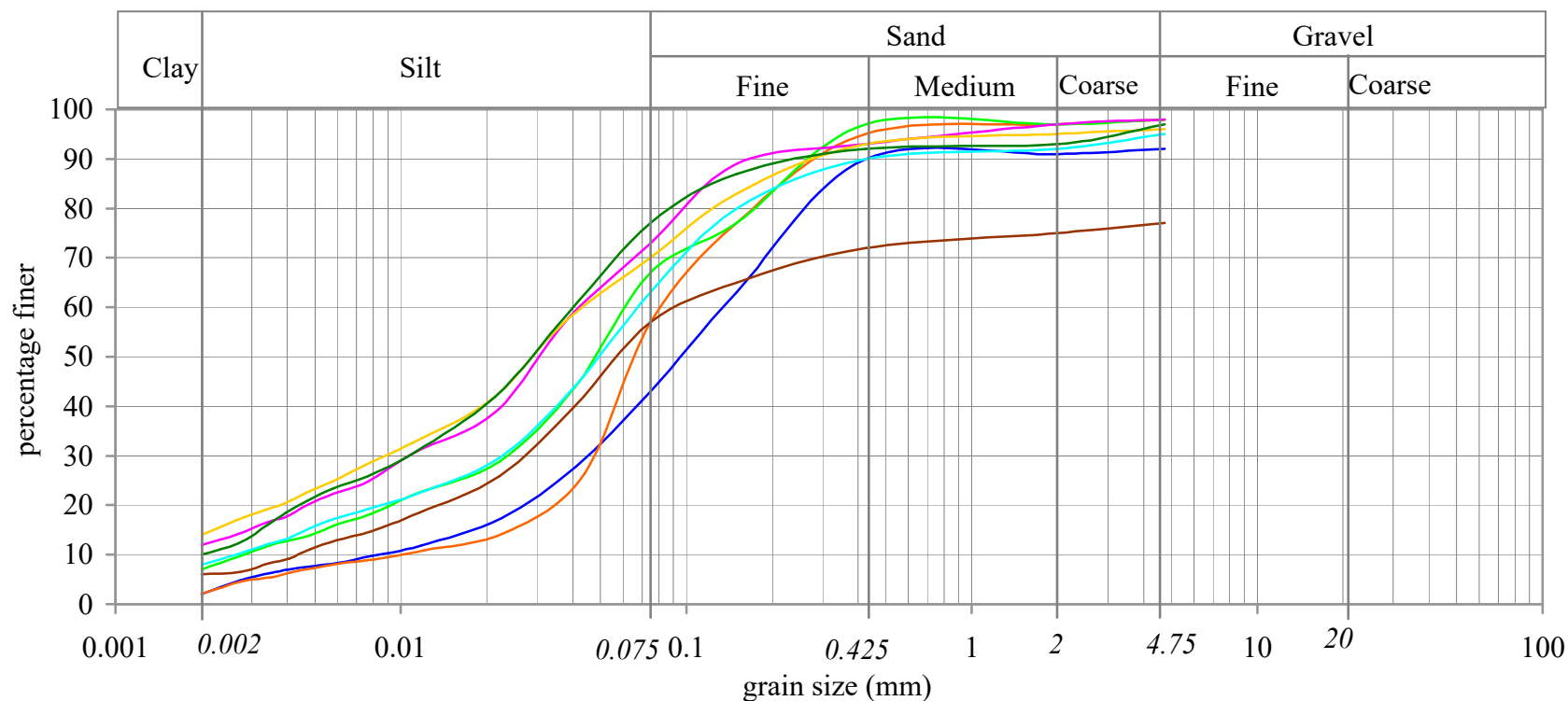
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Grain Size Analysis Curves (refer paragraph no. 7.3.1)



Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	C _u
—	1	15.9	Clayey silty sand with gravel	8	49	41	2	0.14	0.0089	15.7
—	1	17.4	Clayey sandy silt with gravel	2	41	55	2	0.071	0.0091	7.8
—	1	20.4	Clayey sandy silt with gravel	2	31	60	7	0.06	0.0026	23.1
—	1	23.4	Clayey sandy silt with gravel	23	20	51	6	0.089	0.0042	21.2
—	1	25	Clayey sandy silt with gravel	2	25	61	12	0.041	-	-
—	2	3	Clayey sandy silt with gravel	4	26	56	14	0.04	-	-
—	2	4.5	Clayey sandy silt with gravel	3	20	67	10	0.04	0.002	20.0
—	2	6	Clayey sandy silt with gravel	5	32	55	8	0.069	0.0023	30.0



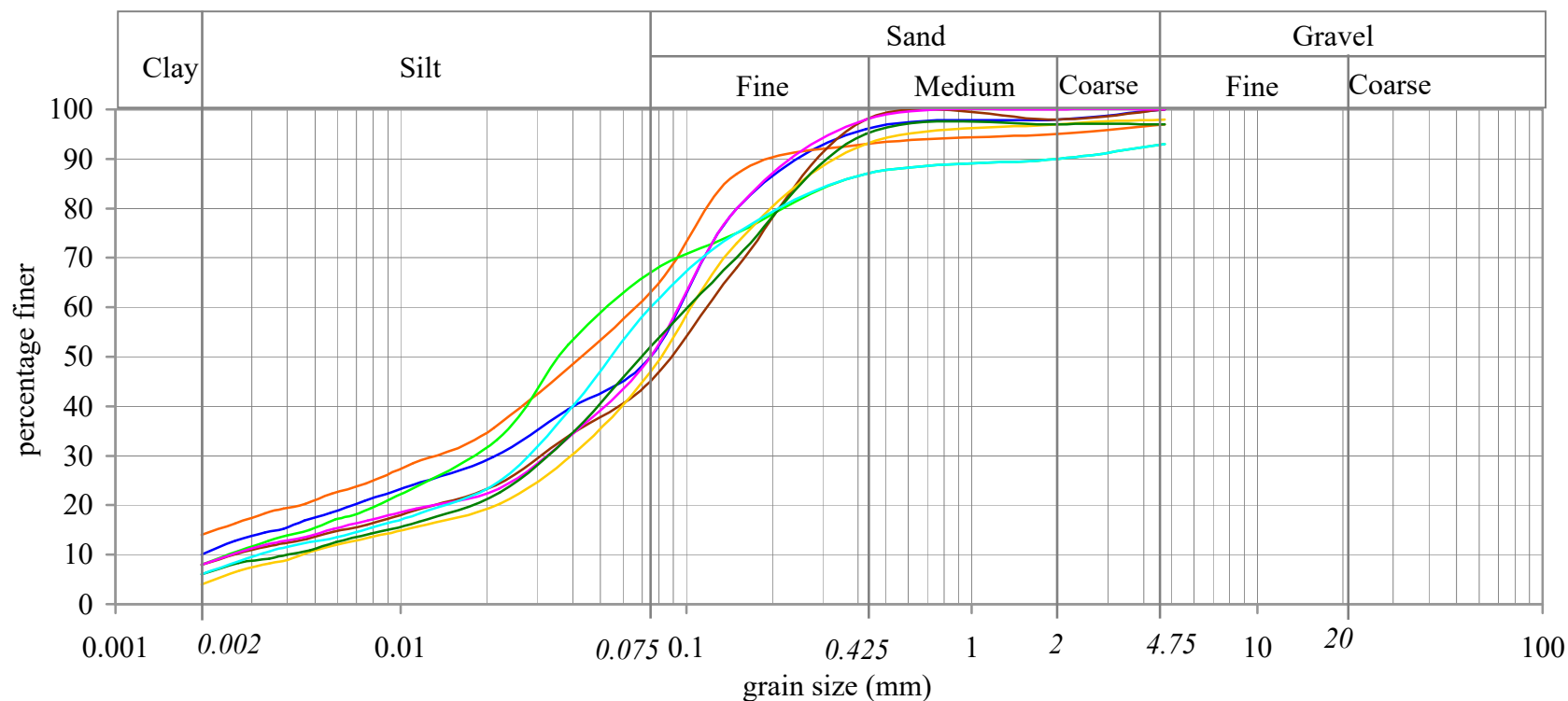
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Grain Size Analysis Curves (refer paragraph no. 7.3.1)



Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	C _u
	2	7.5	Clayey silty sand	0	50	40	10	0.11	0.002	55.0
	2	9	Clayey sandy silt with gravel	3	34	49	14	0.07	-	-
	2	10.5	Clayey sandy silt with gravel	7	26	59	8	0.051	0.0029	17.6
	2	12	Clayey silty sand	0	55	37	8	0.13	0.0026	50.0
	2	13.5	Clayey silty sand	0	50	42	8	0.091	0.0025	36.4
	2	15	Clayey silty sand with gravel	2	51	43	4	0.11	0.0042	26.2
	2	16.5	Clayey sandy silt with gravel	3	45	46	6	0.11	0.0038	28.9
	2	18	Clayey sandy silt with gravel	7	33	54	6	0.075	0.0031	24.2



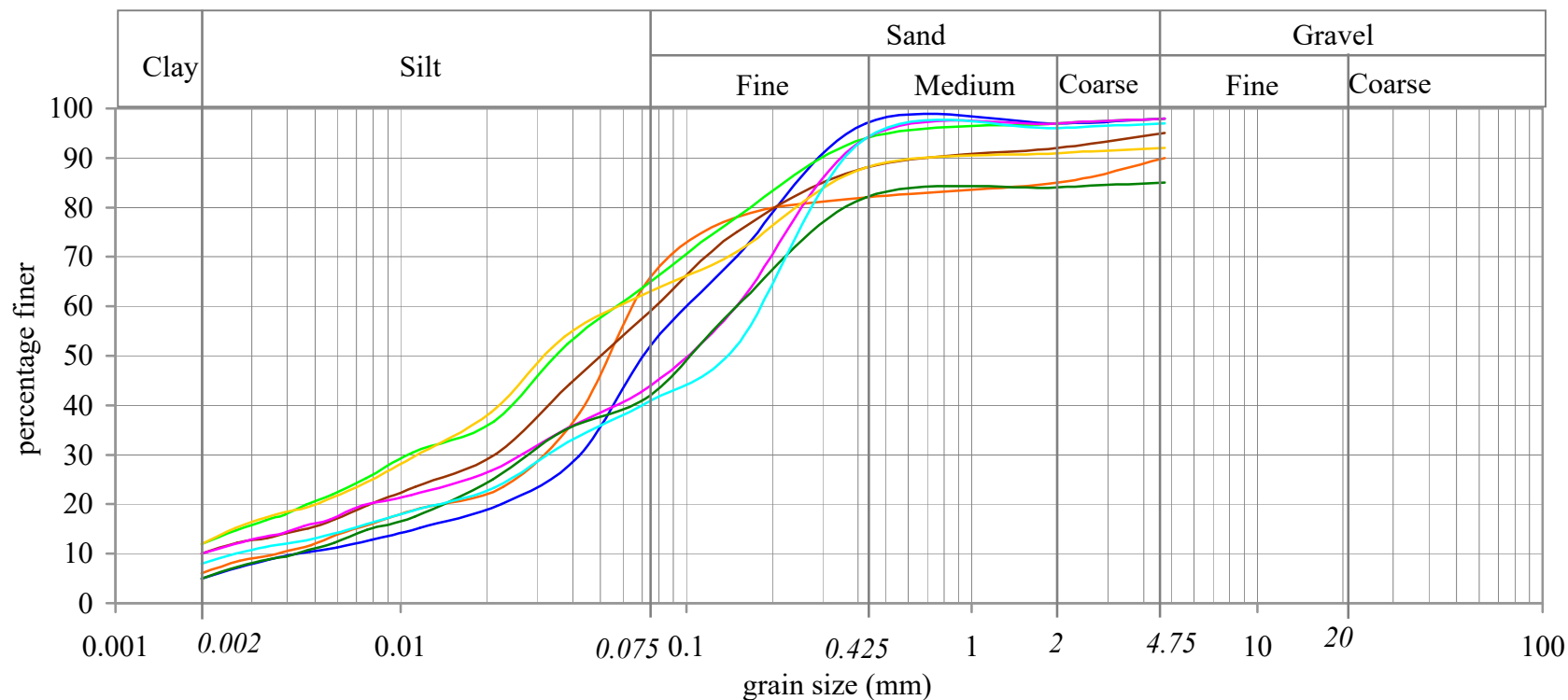
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Grain Size Analysis Curves (refer paragraph no. 7.3.1)



Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	C _u
Blue	2	21	Clayey sandy silt with gravel	2	46	47	5	0.11	0.0045	24.4
Orange	2	24	Clayey sandy silt with gravel	10	24	60	6	0.065	0.0039	16.7
Green	3	3.9	Clayey sandy silt with gravel	2	33	53	12	0.055	-	-
Brown	3	5.4	Clayey sandy silt with gravel	5	36	49	10	0.16	0.002	80.0
Magenta	3	6.9	Clayey silty sand with gravel	2	54	34	10	0.16	0.002	80.0
Yellow	3	8.4	Clayey sandy silt with gravel	8	29	51	12	0.055	-	-
Dark Green	3	9.9	Clayey silty sand with gravel	15	43	37	5	0.16	0.0045	35.6
Cyan	3	11.4	Clayey silty sand with gravel	3	56	33	8	0.19	0.0026	73.1

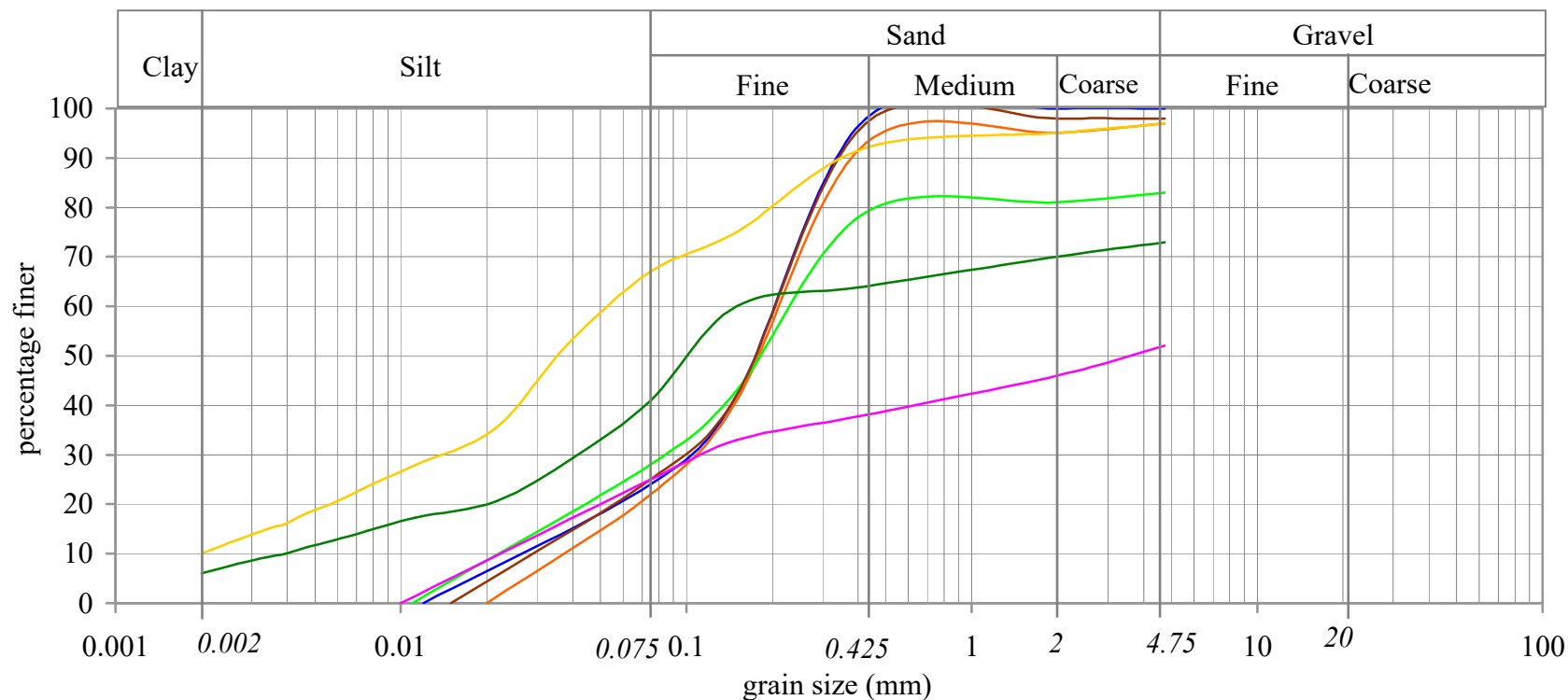


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Grain Size Analysis Curves (refer paragraph no. 7.3.1)



Line Style	Bore hole	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	d ₆₀	d ₁₀	C _u
	3	12.9	Silty sand	0	76	24	0	0.21	0.026	8.1
	3	14.4	Silty sand with gravel	3	75	22	0	0.21	0.038	5.5
	3	15.9	Silty sand with gravel	17	55	28	0	0.23	0.021	11.0
	3	17.5	Silty sand with gravel	2	73	25	0	0.21	0.028	7.5
	3	20.4	Gravelly silty sand	48	27	25	0	-	0.022	-
	3	23.4	Clayey sandy silt with gravel	3	30	57	10	0.051	0.002	25.5
	3	25	Clayey sandy silt with gravel	27	32	35	6	0.16	0.0038	42.1

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