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## GEOTECHNICAL REPORT FOR

Proposed Commercial Office Building  
at D.No.486, old S.No.184, R.S.No.3869/2 &  
3870, Division No.116, Mylapore Village,  
Mylapore Taluk, Chennai District,  
Chennai - 600 035.

**Client :**

M/s. Bhaggyam Builders  
T. Nagar  
Chennai.

**Architect :**

**Consultant :**

**Structural Consultant :**

**Job No. :**

G(C)5570

**Date :**

06.02.2006

**NAGADI CONSULTANTS  
PRIVATE LIMITED**

**Branch :**

Chennai

**GEO TECHNICAL INVESTIGATIONS FOR THE PROPOSED  
COMMERCIAL OFFICE COMPLEX AT D.NO.486, Old S.NO.184,  
R.S.NO.3869/2 & 3870, DIVISION NO.116, MYLAPORE VILLAGE,  
MYLAPORE TALUK, CHENNAI DISTRICT, CHENNAI - 600 035**

**SYNOPSIS**

M/s. Bhaggyam Builders, Chennai, proposes to construct a Commercial Office complex at D.No.486, old S.No.184, R.S.No.3869/2 & 3870, Division No.116, Mylapore Village, Mylapore Taluk, Chennai District, Chennai - 600 035.

To design the substructures for the proposed project adequate information regarding subsoil conditions is required. For this purpose, a soil investigation has been undertaken at the site of the proposed project with the scope of investigations as stipulated by the clients.

The details of the soil investigation conducted along with their results, analysis of the results and recommendations thereof have been presented in this report.

The geo technical investigations have indicated that the soil consists of sandy silty clay and clayey silty sand. Water table was encountered at 3.80m in the boreholes during the period of field investigation.

Considering the type of structures involved and the subsoil characteristics as determined from the geo technical investigations, Raft foundations have been recommended at a

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depth of 3.50 m from the existing ground level with an allowable bearing pressure on the foundations  $17t/m^2$  for an allowable settlement of 50 mm.

  
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**REPORT FOR THE PROPOSED CONSTRUCTION OF COMMERCIAL OFFICE  
COMPLEX AT D.NO.486, Old S.NO.184, R.S.NO.3869/2 & 3870, DIVISION NO.116,  
MYLAPORE VILLAGE, MYLAPORE TALUK, CHENNAI DISTRICT, CHENNAI -**

**600 035**

**1.0 AUTHORITY**

- 1.1 M/s. Bhaggyam Builders, Chennai proposes to construct a Commercial Office complex at D.No.486, old S.No.184, R.S.No.3869/2 & 3870, Division No.116, Mylapore Village, Mylapore Taluk, Chennai District, Chennai - 600 035.
- 1.2 This soil investigation work has been undertaken based on the authorisation issued by M/s. Bhaggyam Builders, T. Nagar, Chennai.

**2.0 PROJECT DETAILS**

**2.1 The Site**

- 2.1.1 The site for the proposed project is located at D.No.486, old S.No.184, R.S.No.3869/2 & 3870, Division No.116, Mylapore Village, Mylapore Taluk, Chennai District, Chennai - 600 035.
- 2.1.2 The site is almost rectangular in shape and appears to be in one level. The site enclosed by compound wall on three sides and open on one side.
- 2.1.3 The colour of soil is brown/Grey.
- 2.1.4 Ground water table was encountered at 3.80 m in the boreholes during the period of field investigation which was conducted during the first week of February 2006.
- 2.2 Structure**
- 2.2.1 The proposed structure is commercial office complex comprising of basement, ground floor, Mezzanine Floor and three upper floors.



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## 2.3 Weather Conditions

2.3.1 Weather was clear during field investigations which was carried out during the first week of February 2006.

## 2.4 Seismic Zone

2.4.1 Site for the proposed project is situated in Anna Salai, Chennai which falls under Seismic Zone III as per IS 1893 (Part 1) - 2002.

## 2.5 Geographical Information

2.5.1 The proposed site lies:

- a) Latitude : At 13°05'
- b) Longitude : At 80°18'

## 3.0 OBJECT OF INVESTIGATIONS

3.1 The object of investigation was to design the foundation system of the proposed structure. 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 at the foundation levels.

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

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

3.3 For evaluating the above parameters both field investigations and laboratory tests over the



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soil samples have been carried out.

- 3.4 The results from these investigations and tests have been analysed to provide the required recommendations for the design of foundations. These recommendations are restricted to the locations around investigation points only.

#### 4.0 SCOPE OF INVESTIGATIONS

- 4.1 In order to achieve the above objectives, the scope included the following:

- Sinking 2 boreholes down to 10m depth or upto refusal strata (where N value is 50) as required by the client.
- Conducting standard penetration tests at 1.50m intervals.
- Collecting Disturbed/Undisturbed soil samples.
- Conducting relevant laboratory tests on soil samples recovered
- Preparation and submission of a technical report in two 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

- Conducting standard penetration tests at 1.50 m intervals
- Recovering undisturbed soil samples from various levels of the sub soil strata
- Recording ground water table levels, if met with.

#### 5.0 PROGRAMME OF INVESTIGATIONS

##### 5.1 Field Investigations

- 5.1.1 Field investigations were carried out during the first week of February 2006.

- 5.1.2 The location of the boreholes were shown at site by the client.

- 5.1.3 A Schematic site plan showing the locations of the test points is given in Fig 1.

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## 5.2 Boreholes

- 5.2.1 Both the boreholes have been progressed down to 10m depth from the existing ground level.
- 5.2.2 The boreholes were progressed by shell and auger method.
- 5.2.3 Standard penetration tests were conducted at 1.50/3.00m intervals. Disturbed soil samples recovered from split spoon samplers were retained for identification purposes.
- 5.2.4 Undisturbed soil samples were recovered by thin walled shell-by tubes conforming to IS 2132. These tubes had an area ratio of less than 10%.
- 5.2.5 The diameter of soil samples were 50 mm and its length was 45 cm.
- 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 Water table was encountered at 3.80m depth from the existing ground level. The termination depth of the boreholes along with the depth of water table encountered is given in the table below:

| BH No. | Termination depth from existing G L (m) | Depth of water table from existing G L (m) |
|--------|-----------------------------------------|--------------------------------------------|
| 1      | 10.00                                   | 3.80                                       |
| 2      | 10.00                                   | 3.80                                       |

## 6.0 LABORATORY INVESTIGATIONS

- 6.1 The soil samples brought to the laboratory were tested to evaluate the following properties
- Type of soil and its gradation
  - Consistency limits
  - Natural density

  
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- d) Natural water content
- e) Shear tests

6.2 In order to determine the above properties the following tests have been 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) Shear tests
- f) Specific Gravity
- g) Free Swell Index tests.

## 7.0 RESULTS OF INVESTIGATIONS

### 7.1 Borehole

7.1.1 The results of the field investigations conducted in the borehole and the laboratory investigations conducted on the soil samples collected from the borehole has been presented in the form of soil profile table.

7.1.2 The soil profile tables indicate the following:

- a) Standard Penetration Test Values (i.e. N- values ) at various depths
- b) Soil description identifying the type of soil
- c) Grain size analysis indicating composition of sub soil
- d) Atterberg limits
- e) Natural density and Water content
- f) Shear test results

  
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## 8.0 ANALYSIS OF RESULTS

### 8.1 Subsoil Profile

8.1.1 An analysis of the data provided in this table indicates extensive stratification of the sub soil with the presence of the following strata in the sub soil:

- a) Stratum I : Brown clayey silty sand
- b) Stratum II : Grey sandy silty clay

8.1.2 The compiled subsoil profile as determined from the results of the field and laboratory investigations has been presented in Fig 2.

8.1.3 The thicknesses and the depths at which these strata occur varies in all the boreholes as given in the following table:

| BH NO. | Depth in m (from - to)  |           |
|--------|-------------------------|-----------|
|        | Strata I                | Strata II |
| 1      | 1.10-2.40<br>3.50-10.00 | 2.40-3.50 |
| 2      | 0.50-10.00              | —         |

8.1.4 The colour of the soil is predominantly brown/ grey.

8.1.5 Filled up soil was encountered from ground level to 1.10 m depth in Borehole No.1 and from ground level to 0.50m depth in Borehole No.2. The filled up soil consists of silty sand intermixed with brickbats.

### 8.2 Grain size Distribution

8.2.1 The grain size distributions of the soil at various depths have been presented in the form of grain size distribution curves in Figs 3 & 4.

8.2.2 The grain size distribution in the identified subsoil strata in the boreholes varies as given below:

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a) Stratum - I : Brown clayey silty sand

| BH NO. | Gravel % | Sand % | Silt % | Clay % |
|--------|----------|--------|--------|--------|
| 1      | 0        | 61-72  | 17-24  | 12-15  |
| 2      | 0        | 62-67  | 18-21  | 15-17  |

b) Stratum - II : Grey sandy silty clay

| BH NO. | Gravel % | Sand % | Silt % | Clay % |
|--------|----------|--------|--------|--------|
| 1      | 0        | 16-26  | 19-31  | 43-65  |

This stratum was encountered in Borehole No.1 only.

### 8.3 Natural Density and Water Content

8.3.1 The natural density of the sub soil strata varies from 1.82 to 1.85 g/cm<sup>3</sup> and water content varies from 8.62% to 9.28%.

### 8.4 Atterberg Limits:

8.4.1 The Atterberg Limits in Stratum I are given below:

Liquid Limit : 19-20%

Plastic Limit : 13%

8.4.2 The Atterberg Limits in Stratum II are given below:

Liquid Limit : 35%

Plastic Limit : 22%

### 8.5 Shear Test Results

8.5.1 The cohesion found from triaxial shear test results varies between 0.16 to 0.17 kg/cm<sup>2</sup> and the angle of internal friction of the soil ranges from 24 to 26°.

### 8.6 Standard Penetration Tests

8.6.1 Standard Penetration Test values (N-values) presented in the soil profile tables. The N



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values indicate the soil to be in medium dense state The curve showing relation between N - values and depth is shown in Fig 5.

## 8.7 Free Swell Index

8.7.1 The results of free swell index are given in the following table.

| BH No. | Free swell Index (%) at Depth(m) |       |
|--------|----------------------------------|-------|
|        | 1.50                             | 3.00  |
| 1      | 11.70                            | 32.60 |
| 2      | 11.80                            | 9.60  |

8.7.2 The excavated soil can be used for backfilling purposes. However the clayey soil encountered in BH 1 from 2.4 to 3.5m depth cannot be used for backfilling purposes.

## 8.8 Specific Gravity

8.8.1 The results of Specific Gravity are given in the following table:

| BH No. | Specific Gravity (%) at Depth(m) |      |
|--------|----------------------------------|------|
|        | 1.50                             | 3.00 |
| 1      | 2.47                             | 2.42 |
| 2      | 2.47                             | 2.49 |

## 9.0 DESIGN CRITERIA

### 9.1 Type of Foundations

9.1.1 The type of foundation depends upon the loading intensity at the foundation level and configuration at loading points.

9.1.2 The structure in the present case is a commercial office complex comprising of basement, ground floor, Mezzanine and three upper floors.

9.1.3 In view of the above, Raft foundations can be adopted for the proposed project.

  
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## 9.2 Depth of Foundation

9.2.1 The following criteria has been taken into consideration to arrive at the minimum depth of foundation.

- Top loose zone
- Adequate depth of soil above founding level, to ensure mobilization of full safe bearing capacity
- Adequate depth of soil strata below founding level of requisite strength to mobilize the safe bearing capacity and at the same time restrict the total and differential settlements within the allowable limits.
- Basement level

9.2.2 In view of the the above factors, foundations of the proposed structure shall be made to rest at a depth of 3.50m below the existing ground level.

9.2.3 The soil available at the founding level will be clayey silty sand.

## 9.3 Allowable Bearing Pressure

9.3.1 The allowable bearing pressure depends upon the allowable settlement. An allowable settlement of 50 mm has been considered to evaluate the allowable bearing pressure for Raft foundations.

9.3.2 Allowable bearing pressure has been evaluated by:

- Shear failure criteria taking the average soil data
- Settlement criteria taking SPT values (N-values)
- Settlement criteria based on deformation modulus

9.3.3 We had applied a correction factor of 0.5 for water table.

9.3.4 The recommended allowable bearing pressure at the foundation level i.e 3.50m depth is 17 t/m<sup>2</sup>.

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## 10.0 RECOMMENDATIONS

- a) Type of Foundations : Raft foundations
- b) Depth of Foundations : 3.50m from existing ground level
- c) Allowable bearing pressure : 17t/m<sup>2</sup>
- d) Settlement considered for calculations: 50mm

## 11.0 NOTE

- 11.1 The excavated soil can be used for backfilling purposes. However the clayey soil encountered in BH 1 from 2.4 to 3.5m depth cannot be used for backfilling purposes.
- 11.2 After the excavation, the foundation trenches should be flooded and compacted properly before laying the foundation. The top slush should be removed and the surface compacted properly. As a precautionary measure, spread brick-bats/gravels and compact the bottom of the pit. The foundations can be subsequently be placed over this prepared surface.



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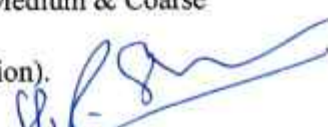
## LIST OF IS CODES

### Field Investigation

1. IS : 1498 - 1970 : Classification and identification of soils for general engineering purposes (First Revision) (Amendment 2)
2. IS : 1888 - 1982 : Method of load test on soil (Second revision)
3. IS : 1892 - 1979 : Code of practice for sub surface investigations for foundations (First revision)
4. IS : 2131 - 1981 : Method of Standard Penetration Tests for soils (First revision)
5. IS : 2132 - 1986 : Code of practice for thin walled tube sampling of soils (Second revision)
6. IS : 3043 - 1966 : Code of practice for earthing (Third reprint) January 1979.

### 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 - 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.
8. IS : 2720 - 1977 (Part 41) : Methods of tests for soils : Determination of swelling pressure 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)
5. IS 1893 - 1984 : Criteria for Earthquake resistant design of structures (Fourth revision).

  
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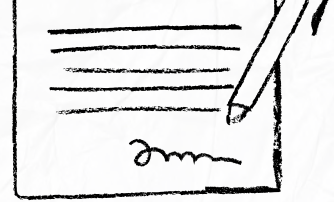
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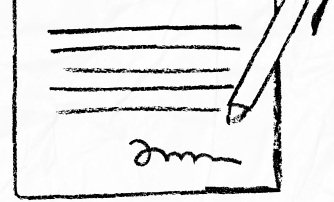
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