GEOTECHNICAL INVESTIGATION REPORT FOR THE
PROPOSED HOUSING PROJECT AT SY. NO. 56, ADDIGANAHALLI,
BENGALURU

CLIENT
The Chief Engineer
RGRHCL, Cauvery Bhavan,
K G Road,
Bengaluru

CONSULTANTS
M/s. ACS Design Consulting Pvt. Ltd.,
# 1150, ‘ARNAV’, 4th Floor,
13th Cross, 1st Stage, 1st Phase,
Chandra Layout,
Bengaluru – 560 072

GEO-ENGINEERING COMPANY PVT. LTD.
#28, 5th Main, 3rd Phase, Peenya Industrial Area, Behind Bescom,
Bengaluru - 560 058
<table>
<thead>
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<th><strong>Report on</strong></th>
<th>Geotechnical investigation for the proposed Housing Project at Sy No. 56, Addiganahalli, Bengaluru</th>
</tr>
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<td><strong>Report No</strong></td>
<td>GECPL/140718 – 389/A</td>
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<td><strong>Report for</strong></td>
<td>The Chief Engineer, RGRHCL, Cauvery Bhavan, K G Road, Bengaluru</td>
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<td><strong>Reference</strong></td>
<td>Telephonic Confirmation dated July 13, 2018</td>
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<tr>
<td><strong>Field investigation carried out by</strong></td>
<td>Mr. Praveen &amp; Team, Site Engineer</td>
</tr>
<tr>
<td><strong>Managing Director</strong></td>
<td>Mr. Jayaprakash K N</td>
</tr>
<tr>
<td><strong>Technical Advisor</strong></td>
<td>Mr. Umesh Kumar N Technical Manager (Geo-Technical Engg)</td>
</tr>
<tr>
<td><strong>Report By</strong></td>
<td>Mr. Abhijith S Geo Technical Engineer</td>
</tr>
<tr>
<td><strong>Date of submission of report</strong></td>
<td>20.01.2018</td>
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INTRODUCTION
The Chief Engineer, RGRHCL, Bengaluru had entrusted us with the work of carrying out the geotechnical investigation for the proposed Housing Project at Sy. No. 56, Addiganahalli, Bengaluru. The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. This report consists of the details about the field and laboratory tests performed and the recommendations made based on the test results.

SCOPE
The scope of work includes both the field and laboratory tests. Four boreholes by manual auger method were drilled in the construction area to obtain the sub-surface stratification. Fig A: shows the location of the boreholes on the entire plan of the proposed construction site. Refer Annexure I

FIELD INVESTIGATION
Boring and Sampling
150 mm diameter boring at all places is carried out in accordance with IS: 1892 -1979 Code of Practice for sub-surface investigation of foundation (re – affirmed in 1992) by adopting auger boring. Representative / undisturbed samples are collected at different depths as the boring operation progressed. Various laboratory tests are conducted on the samples collected. Standard penetration tests are conducted at every 1.50m interval as per IS: 2131 – 1981.

Field testing
Standard penetration test
Standard Penetration Test (SPT) is carried out at different depths in all the boreholes & the ‘N’ values are recorded. The number of blows required to drive a 50mm diameter split spoon sampler for a depth of 30cm using a 65 kg hammer for a drop of 75cm is recorded as ‘N’ value.
The results of all the penetration tests are performed in each of the boreholes and they are shown in their respective Bore logs (Refer Annexure II). The test is halted if,

i) 50 blows are required for any 150mm penetration.
ii) 100 blows are required for 300mm penetration.
iii) 10 successive blows produce no advance and the N – value is recorded as “REFUSAL”.

4
LABORATORY TESTING
Samples procured were transported to laboratory for obtaining Index and Engineering properties. In the laboratory, samples were visually classified by Geotechnical Engineer. Laboratory tests are being carried out as per relevant IS: 2720 guidelines.

*Generally Soil Samples were tested for following parameters*

- Particle Size analysis
- Bulk Density
- Natural Moisture content
- Atterberg’s limits

The above said test results are tabulated. Refer Annexure III.

SUB SOIL PROFILE
The sub-soil formations comprise of from top nil to termination depth reddish to pinkish yellow/ yellowish to reddish pink/ grayish pink sandy Silt/ sandy Gravels was encountered. All the boreholes are terminated at the stage of “REFUSAL”. During the time of investigation water table was not encountered at any depth below natural ground level; however the same may be subjected to seasonal fluctuations.

CONCLUSIONS
The following conclusions are drawn based on field and laboratory investigations.

1. All the boreholes are terminated at the stage of “REFUSAL”.
2. During the time of investigation water table was not encountered at any depth below natural ground level; however the same may be subjected to seasonal fluctuations.
3. The sub soil varies from top nil to termination depth dense strata was noticed.
4. The atterberg’s limits indicate that the sub-soil is medium compressible in nature.
RECOMMENDATIONS

The following recommendations are made based on the detailed investigation conducted at the proposed construction site.

1. The foundation for structure shall be taken to a minimum depth of 1.5m below the existing ground level.

2. Isolated/combined footing up to minimum width of 2.0m may be designed with the following allowable bearing pressure of, which gives a factor of safety of 3.0 against shear failure and for an allowable settlement of 25mm;

<table>
<thead>
<tr>
<th>Depth below existing ground level, m</th>
<th>Net SBC, kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>250</td>
</tr>
</tbody>
</table>

Note 1: During excavations, in case any variation is noticed in the strata/seepage same shall be brought to the notice of geotechnical engineer for review of net SBC recommended.

3. The bottom of foundation shall be properly leveled and verified for loose pockets/weaker zones and if found, the same shall be replaced with lean concrete.

for GEOENGINEERING COMPANY PRIVATE LTD

(SYAPRAKASH K. N.)
ANNEXURE I

Fig A: Location of Bore holes
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NCL</th>
<th>Sample</th>
<th>SPT Test, number of blows recorded</th>
<th>N Value = N-100</th>
<th>Core Recovery, %</th>
<th>RQD, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinkish yellow sandy gravel</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td>25, 25, 25</td>
<td></td>
<td></td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

SPT: Standard Penetration test  
Refusal means SPT N>50  
B: No. of blows  
R: Rebound  
SR: Soh Rock  
HR: Hard Rock  
DS: Disturbed Sample  
CWR: completely weathered rock  
WWR: weakly weathered rock  
Bore hole was terminated at 1.5m depth below existing ground level
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NGL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>R Value, %</th>
<th>Core Recovery, %</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Grayish pink sandy Silt</td>
<td>0.0</td>
<td></td>
<td>000</td>
<td>DS</td>
<td>1st, 2nd, 3rd 15cm</td>
<td>N₁, N₂, N₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grayish pink sandy gravels</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td>16 20 30 50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SPT = Standard Penetration test  Refusal means SPT N>50  B = No. of blows  R = Rebound  St: Soft Rock  HR: Hard Rock  DS: Disturbed Sample  CWR: completely weathered rock  MWR: Moderately weathered rock

Bore hole was terminated at 1.5m depth blow existing ground level
**BOREHOLE - 03**

<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NCL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>S. Value = N_1 \times N_2</th>
<th>Core Recovery, %</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>Yellowish red sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellowish pink sandy gravels</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td></td>
<td>15</td>
<td>20</td>
<td>30</td>
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</table>

- **SPT** = Standard Penetration test
- Refusal means SPT N>50
- B = No. of blows
- R = Rebound
- **HR** = Hard Rock
- **DS** = Disturbed Sample
- **CWR** = Completely weathered rock
- **MWR** = Moderately weathered rock

Bole hole was terminated at 1.5m depth blow existing ground level
### BOREHOLE - 04

| Description of Sub-soil stratum | Depth (m) | Legend | N.C. | Sample | SPT TEST, number of blows recorded | N Value = N_1+N_2
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<tr>
<td>Pinkish yellow sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td>DS</td>
<td>1st 15cm</td>
<td>2nd 15cm</td>
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<tr>
<td>Pinkish yellow sandy gravel</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>DS</td>
<td>SPT</td>
<td>17</td>
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- **SPT** - Standard Penetration test
- **Refusal means SPT N=50**
- **B= No. of blows**
- **R=Rebound**
- **SR: Soft Rock**
- **HR: Hard Rock**
- **DS=Disturbed Sample**
- **CWR: completely weathered rock**
- **MWR: Moderately weathered rock**

**Remarks**

Bore hole was terminated at 1.5m depth blow existing ground level
# Laboratory Test Report on Soil Samples

**Client:** The Chief Engineer, RGRHCL  
**Project:** Housing Project  
**Job No.:** 389  
**Location:** Sy. No. 56, Addiganahalli  
**Date of Sample Received:** 14-07-2018  
**Date of Test:** 18-07-2018

<table>
<thead>
<tr>
<th>BH No.</th>
<th>Sample Type</th>
<th>Sample no.</th>
<th>Depth (m)</th>
<th>Grain Size Distribution (%)</th>
<th>Atterberg Limits (%)</th>
<th>Shear Parameters</th>
<th>Description of Soil Strata</th>
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<tr>
<td>1</td>
<td>SPT</td>
<td>0718/442</td>
<td>1.5</td>
<td>34.1</td>
<td>22.8</td>
<td>21.9</td>
<td>7.0</td>
</tr>
<tr>
<td>2</td>
<td>UDS</td>
<td>0718/443</td>
<td>1.0</td>
<td>4.3</td>
<td>6.4</td>
<td>11.2</td>
<td>14.4</td>
</tr>
<tr>
<td>3</td>
<td>SPT</td>
<td>0718/444</td>
<td>1.5</td>
<td>39.1</td>
<td>22.7</td>
<td>22.3</td>
<td>6.2</td>
</tr>
<tr>
<td>4</td>
<td>UDS</td>
<td>0718/445</td>
<td>1.0</td>
<td>0.0</td>
<td>1.1</td>
<td>4.6</td>
<td>8.7</td>
</tr>
</tbody>
</table>

This report relates only to the sample tested and shall not be reproduced except in full without written approval of laboratory management.

* The parameter marked with "*" is not accredited by NABL

**Abbreviations used:**  
UDS: Undisturbed Sample,  
DS: Disturbed Sample,  
SPT: Standard Penetration Test,  
BH: Bore Hole,  
NP: Non Plastic

**Test Method Referred to:**  
Grain Size Distribution: IS 2720-4 1985 RA 2015  
Specific Gravity: IS 2720-3 SECTION 1 & 2 1980 RA 2011  
Direct Shear Test: IS 2720-13 1986 RA 2015  
Free Swell Index: IS 2720-40 1977 RA 2011  
Natural Moisture Content: IS 2720-2 1973 RA 2015

**Test Method Variation:** None

**END OF TEST RESULTS**
ANNEXURE IV

GRAIN SIZE ANALYSIS CURVES

Fig. No.1: Grain size analysis Curves around BH 1

Fig. No.2: Grain size analysis Curves around BH 2
Fig. No 3: Grain size analysis Curves around BH 3

Fig. No 4: Grain size analysis Curves around BH 4

***END OF REPORT***
GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED MULTI STORY RESIDENTIAL BUILDING AT SY. NO. 25, BYNAHALLI, BENGALURU

CLIENT
M/s. Rajiv Gandhi Rural Housing Corporation Ltd,
Cavery Bhavan, 9th Floor,
E & F Block, Kempegowda Road,
Bengaluru

CONSULTANTS
M/s. ACS Design Consulting Pvt. Ltd.,
# 1150, "ARNAV", 4th Floor,
13th Cross, 1st Stage, 1st Phase,
Behind Siddaganga Public School,
Chandra Layout,
Bangalore-72

GEO-ENGINEERING COMPANY PVT. LTD.
#28, 5th Main, 3rd Phase, Peenya Industrial Area, Behind Bescom,
Bengaluru - 560 058
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<th><strong>Report on</strong></th>
<th>Geotechnical investigation for the proposed Multi Storey Residential Building at Sy. No. 25, Bynahalli, Bengaluru</th>
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<td><strong>Report for</strong></td>
<td>M/s. Rajiv Gandhi Rural Housing Corporation Ltd., Cavery Bhavan, 9th Floor, E &amp; F Block, Kempegowda Road, Bengaluru</td>
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<td><strong>Reference</strong></td>
<td>Telephonic Confirmation dated Nov 22, 2018</td>
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<td><strong>Field investigation carried out by</strong></td>
<td>Mr. Praveen &amp; Team, Site Engineer</td>
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<tr>
<td><strong>Managing Director</strong></td>
<td>Mr. Jayaprakash K N</td>
</tr>
</tbody>
</table>
| **Technical Advisor** | Mr. Umesh Kumar N  
Technical Manager (Geo-Technical Engg) |
| **Report By** | Mr. Nagesh C  
Geo Technical Engineer |
| **Date of submission of report** | 29.11.2018 |
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7.0 Recommendations ................................................................................................................... 6

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<td>Annexure II- Field Records and Bore Logs</td>
<td>8-10</td>
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<tr>
<td>Annexure III- Laboratory Test Results</td>
<td>11</td>
</tr>
<tr>
<td>Annexure IV- Typical Sieve Curves</td>
<td>12-13</td>
</tr>
</tbody>
</table>
INTRODUCTION
M/s. Rajiv Gandhi Rural Housing Corporation Ltd., Bengaluru had entrusted us with the work of carrying out the geotechnical investigation for the proposed Multi Storey Residential Building (Stilt, G+9 floors) at Sy. No. 25, Bynahalli, Bengaluru. The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. This report consists of the details about the field and laboratory tests performed and the recommendations made based on the test results.

SCOPE
The scope of work includes both the field and laboratory tests. Three boreholes by manual auger method were drilled in the construction area to obtain the sub-surface stratification. Fig A: shows the location of the boreholes on the entire plan of the proposed construction site. Refer Annexure I

FIELD INVESTIGATION
Boring and Sampling
150 mm diameter boring at all places is carried out in accordance with IS: 1892 -1979 Code of Practice for sub-surface investigation of foundation (re – affirmed in 1992) by adopting auger boring. Representative / undisturbed samples are collected at different depths as the boring operation progressed. Various laboratory tests are conducted on the samples collected. Standard penetration tests are conducted at every 1.50m interval as per IS: 2131 – 1981.

Field testing
Standard penetration test
Standard Penetration Test (SPT) is carried out at different depths in all the boreholes & the ‘N’ values are recorded. The number of blows required to drive a 50mm diameter split spoon sampler for a depth of 30cm using a 65 kg hammer for a drop of 75cm is recorded as ‘N’ value.

The results of all the penetration tests are performed in each of the boreholes and they are shown in their respective Bore logs (Refer Annexure II). The test is halted if,

i) 50 blows are required for any 150mm penetration.

ii) 100 blows are required for 300mm penetration.

iii) 10 successive blows produce no advance and the N – value is recorded as “REFUSAL”.

LABORATORY TESTING
Samples procured were transported to laboratory for obtaining Index and Engineering properties. In the laboratory, samples were visually classified by Geotechnical Engineer. Laboratory tests are being carried out as per relevant IS: 2720 guidelines.

*Generally Soil Samples were tested for following parameters*
- Particle Size analysis
- Bulk Density
- Natural Moisture content
- Atterberg’s limits
- Direct Shear strength tests for UDS sample.

The above said test results are tabulated. *Refer Annexure III.*

SUB SOIL PROFILE
The sub-soil formations comprise of from top nil to termination depth yellowish brown to pinkish red/yellowish white sandy Silt/silty Sand was encountered. All the boreholes are terminated at stage of “REFUSAL” or at the depth of 6.0m below the existing ground level, whichever met earlier. During the time of investigation water table was not encountered at any depth below the existing ground level; however the same may be subjected to seasonal fluctuations.

CONCLUSIONS
The following conclusions are drawn based on field and laboratory investigations.

1. All the boreholes are terminated at stage of “REFUSAL” or at the depth of 6.0m below the existing ground level, whichever met earlier.
2. During the time of investigation water table was not encountered at any depth below existing ground level; however the same may be subjected to seasonal fluctuations.
3. The sub soil varies from top nil to termination depth medium dense to dense strata was noticed.
4. The atterberg’s limits indicate that the sub-soil is medium compressible in nature.
RECOMMENDATIONS
The following recommendations are made based on the detailed investigation conducted at the proposed construction site.

1. The foundation for structure shall be taken to a minimum depth of 1.5m below the existing ground level.
2. Isolated/combined footing up to minimum width of 2.0m may be designed with the following allowable bearing pressure of, which gives a factor of safety of 2.5 against shear failure and for an allowable settlement of 25mm;

<table>
<thead>
<tr>
<th>Depth below existing ground level, m</th>
<th>*Net SBC, kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>180</td>
</tr>
<tr>
<td>2.0</td>
<td>210</td>
</tr>
<tr>
<td>3.0</td>
<td>250</td>
</tr>
</tbody>
</table>

*Provide 100mm down size well graded aggregates well compacted to 9” depth followed by 4” sand cushion at founding level.

Note 1: During excavations, in case any variation is noticed in the strata/seepage same shall be brought to the notice of geotechnical engineer for review of net SBC recommended.

3. The bottom of foundation shall be properly leveled and verified for loose pockets/weaker zones and if found, the same shall be replaced with lean concrete.

for GEOENGINEERING COMPANY PRIVATE LTD

(JAYAPRAKASH K. N.)
ANNEXURE I

Fig A: Location of Bore holes
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = N₁ + N₂</th>
<th>Core Recovery, %</th>
<th>BORQ, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td>DS</td>
<td>SPT DS</td>
<td>10 15 20</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reddish silty Sand</td>
<td>1.5</td>
<td>SPT DS</td>
<td>10 15 20 35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>SPT DS</td>
<td>10 10 10 20</td>
<td></td>
<td></td>
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<td>10 15 10 25</td>
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<td></td>
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<tr>
<td>Pinkish red sandy Silt</td>
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<td>17 20 20 40</td>
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Bore hole was terminated at 6.0m depth blow existing ground level
Client: M/s. Rajiv Gandhi Rural Housing Corporation Ltd.

Job No: 970-1

Project: Multi Storey Residential Building

Location: Bynahalli

**BOREHOLE - 02**

<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>Core Recovery, %</th>
<th>RQD, %</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td></td>
<td>1st 15cm</td>
<td>N&lt;sub&gt;1&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>DS</td>
<td></td>
<td>2nd 15cm</td>
<td>N&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellowish white silty Sand</td>
<td>1.5</td>
<td>SPT</td>
<td>DS</td>
<td>3rd 15cm</td>
<td>N&lt;sub&gt;3&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Legend</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>SPT</td>
<td>DS</td>
</tr>
</tbody>
</table>

**Size of Borehole**: 150mm

**Ground water table**: Nil

**Commenced**: 23.11.18

**Completed**: 23.11.18

- **SPT**: Standard Penetration test
- **Refusal means SPT N>50**
- **B**: No. of blows
- **R**: Rebound
- **SR**: Soft Rock
- **HR**: Hard Rock
- **DS**: Disturbed Sample
- **CWR**: Completely weathered rock
- **MWR**: Moderately weathered rock

Bore hole was terminated at 1.5m depth blow existing ground level.
### Client
M/s. Rajiv Gandhi Rural Housing Corporation Ltd.,

### Job No
970-1

### Project
Multi Storey Residential Building

### Location
Bynahalli

### BOREHOLE - 03

<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = N₂ + N₃</th>
<th>Core Recovery, %</th>
<th>RQD, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td></td>
<td>SPT</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td>DS</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Reddish silty Sand</td>
<td>1.5</td>
<td></td>
<td></td>
<td>SPT</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
<td>SPT</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td></td>
<td></td>
<td>SPT</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>Yellowish brown sandy Silt</td>
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<td></td>
<td></td>
<td>SPT</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>23</td>
</tr>
</tbody>
</table>

- **SPT** = Standard Penetration test
- Refusal means SPT N>50
- B= No. of blows
- R=Rebound
- SR: Soft Rock

HR: Hard Rock
DS=Disturbed Sample
CWR: completely weathered rock
MWR: Moderately weathered rock

Bore hole was terminated at 6.0m depth blow existing ground level
### LABORATORY TEST REPORT ON SOIL SAMPLES

**Client:** M/s. Rajiv Gandhi Rural Housing Corporation Ltd  
**Project:** Multi Storey Residential Building  
**Job No.:** 970-1  
**Location:** Sy. No. 25, Bynahalli  
**Date of Sample Received:** 23-11-18  
**Date of Test:** 27-11-18

<table>
<thead>
<tr>
<th>BH No.</th>
<th>Sample Type</th>
<th>Sample no.</th>
<th>Depth (m)</th>
<th>Grain Size Distribution (%)</th>
<th>Atterberg Limits (%)</th>
<th>IS Classification (IS:1498-1970)</th>
<th>Natural Moisture Content (%)</th>
<th>Bulk Density (gm/cc)*</th>
<th>Specific Gravity</th>
<th>Shear Parameters</th>
<th>Description of Soil Strata</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UDS</td>
<td>1118/931</td>
<td>1.0</td>
<td>46.4</td>
<td>16.0</td>
<td>SM-MI</td>
<td>10.4</td>
<td>4.8</td>
<td>1.91</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>SPT</td>
<td>1118/932</td>
<td>3.0</td>
<td>0.0</td>
<td>10.1</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.4</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>SPT</td>
<td>1118/933</td>
<td>6.0</td>
<td>0.0</td>
<td>1.1</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>13.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>SPT</td>
<td>1118/934</td>
<td>1.5</td>
<td>0.0</td>
<td>12.2</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>7.2</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>SPT</td>
<td>1118/935</td>
<td>1.5</td>
<td>0.0</td>
<td>10.6</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>7.2</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>SPT</td>
<td>1118/936</td>
<td>3.0</td>
<td>0.4</td>
<td>1.2</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>10.8</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>SPT</td>
<td>1118/937</td>
<td>6.0</td>
<td>0.4</td>
<td>1.2</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>12.5</td>
<td>---</td>
<td>sandy Silt</td>
</tr>
</tbody>
</table>

This report relates only to the sample tested and shall not be reproduced except in full without written approval of laboratory management.

**Authorised Signatory:**

---

*The parameter marked with "$^*$" is not accredited by NABL.*

**Abbreviations used:**  

**Test Method Referred to:**  
Grain Size Distribution: IS 2720-4 1985 RA 2015  
Specific Gravity: IS 2720-3 SECTION 1 & 2 1980 RA 2011  
Direct Shear Test: IS 2720-13 1986 RA 2015  
Free Swell Index: IS 2720-40 1977 RA 2011  
Natural Moisture Content: IS 2720-2 1973 RA 2015

**Test Method Variation:** None

**END OF TEST RESULTS**
ANNEXURE IV

GRAIN SIZE ANALYSIS CURVES

Fig. No.1: Grain size analysis Curves around BH 1

Fig. No.2: Grain size analysis Curves around BH 2
Fig. No.3: Grain size analysis Curves around BH 3

***END OF REPORT***
GEOTECHNICAL INVESTIGATION REPORT FOR THE
PROPOSED HOUSING PROJECT AT SY. NO. 74, 75 & 76,
GANIGARAHALLI, BENGALURU

CLIENT
The Chief Engineer
RGRHCL, Cauvery Bhavan,
K G Road,
Bengaluru

CONSULTANTS
M/s. ACS Design Consulting Pvt. Ltd.,
# 1150, ‘ARNAV’, 4th Floor,
13th Cross, 1st Stage, 1st Phase,
Chandra Layout,
Bengaluru – 560 072

GEO-ENGINEERING COMPANY PVT. LTD.
#28, 5th Main, 3rd Phase, Peenya Industrial Area, Behind Bescom,
Bengaluru - 560 058
Report on: Geotechnical investigation for the proposed Housing Project at Sy No. 74, 75 & 76, Ganigarahalli, Bengaluru

Report No: GECPL/200718 – 404/A

Report for: The Chief Engineer,
RGRHCL, Cauvery Bhavan,
K G Road,
Bengaluru

Reference: Telephonic Confirmation dated July 20, 2018

Field investigation carried out by: Mr. Praveen & Team,
Site Engineer

Managing Director: Mr. Jayaprakash K N

Technical Advisor: Mr. Umesh Kumar N
Technical Manager (Geo-Technical Engg)

Report By: Mr. Abhijith S
Geo Technical Engineer

Date of submission of report: 26.01.2018
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1.0 Introduction .................................................................4
2.0 Objective of work..........................................................4
3.0 Field Investigations .........................................................4
4.0 Laboratory Tests ............................................................5
5.0 Sub Strata Profile ...........................................................5
6.0 Conclusions .................................................................5
7.0 Recommendations ..........................................................6

LIST OF ANNEXURES

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<thead>
<tr>
<th>Annexures</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
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<td>Annexure I- Bore Hole Location</td>
<td>7</td>
</tr>
<tr>
<td>Annexure II- Field Records and Bore Logs</td>
<td>8-11</td>
</tr>
<tr>
<td>Annexure III- Laboratory Test Results</td>
<td>12</td>
</tr>
<tr>
<td>Annexure IV- Typical Sieve Curves</td>
<td>13-14</td>
</tr>
</tbody>
</table>
INTRODUCTION
The Chief Engineer, RGRHCL, Bengaluru had entrusted us with the work of carrying out the geotechnical investigation for the proposed Housing Project at Sy.No. 74, 75 & 76, Ganigarahalli, Bengaluru. The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. This report consists of the details about the field and laboratory tests performed and the recommendations made based on the test results.

SCOPE
The scope of work includes both the field and laboratory tests. Four boreholes by manual auger method were drilled in the construction area to obtain the sub-surface stratification. Fig A shows the location of the boreholes on the entire plan of the proposed construction site. Refer Annexure I

FIELD INVESTIGATION
Boring and Sampling
150 mm diameter boring at all places is carried out in accordance with IS: 1892 -1979 Code of Practice for sub-surface investigation of foundation (re-affirmed in 1992) by adopting auger boring. Representative / undisturbed samples are collected at different depths as the boring operation progressed. Various laboratory tests are conducted on the samples collected. Standard penetration tests are conducted at every 1.50m interval as per IS: 2131 – 1981.

Field testing
Standard penetration test
Standard Penetration Test (SPT) is carried out at different depths in all the boreholes & the ‘N’ values are recorded. The number of blows required to drive a 50mm diameter split spoon sampler for a depth of 30cm using a 65 kg hammer for a drop of 75cm is recorded as ‘N’ value.
The results of all the penetration tests are performed in each of the boreholes and they are shown in their respective Bore logs (Refer Annexure II). The test is halted if,

i) 50 blows are required for any 150mm penetration.
ii) 100 blows are required for 300mm penetration.
iii) 10 successive blows produce no advance and the N – value is recorded as “REFUSAL”.

4
LABORATORY TESTING

Samples procured were transported to laboratory for obtaining Index and Engineering properties. In the laboratory, samples were visually classified by Geotechnical Engineer. Laboratory tests are being carried out as per relevant IS: 2720 guidelines.

*Generally Soil Samples were tested for following parameters*

- Particle Size analysis
- Bulk Density
- Natural Moisture content
- Atterberg’s limits

The above said test results are tabulated. *Refer Annexure III.*

SUB SOIL PROFILE

The sub-soil formations comprise of from top nil to termination depth yellowish to reddish pink/pinkish to brownish yellow sandy Silt/ silty Sand with presence of gravel was encountered. All the boreholes are terminated at the stage of “REFUSAL”. During the time of investigation water table was not encountered at any depth below the existing ground level; however the same may be subjected to seasonal fluctuations.

CONCLUSIONS

The following conclusions are drawn based on field and laboratory investigations.

1. All the boreholes are terminated at the stage of “REFUSAL”.
2. During the time of investigation water table was not encountered at any depth below existing ground level; however the same may be subjected to seasonal fluctuations.
3. The sub soil varies from top nil to termination depth medium dense to dense strata was noticed
4. The atterberg’s limits indicate that the sub-soil is medium compressible in nature.
RECOMMENDATIONS

The following recommendations are made based on the detailed investigation conducted at the proposed construction site.

1. The foundation for structure shall be taken to a minimum depth of 1.5m below the existing ground level.

2. Isolated/combined footing up to minimum width of 2.0m may be designed with the following allowable bearing pressure of, which gives a factor of safety of 3.0 against shear failure and for an allowable settlement of 25mm;

<table>
<thead>
<tr>
<th>Depth below existing ground level, m</th>
<th>Net SBC, kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>190</td>
</tr>
<tr>
<td>2.0</td>
<td>210</td>
</tr>
<tr>
<td>3.0</td>
<td>250</td>
</tr>
</tbody>
</table>

Note 1: During excavations, in case any variation is noticed in the strata/seepage same shall be brought to the notice of geotechnical engineer for review of net SBC recommended.

3. The bottom of foundation shall be properly leveled and verified for loose pockets/weaker zones and if found, the same shall be replaced with lean concrete.

for GEOENGINEERING COMPANY PRIVATE LTD

(JAYAPRAKASH K. N.)
NOTE: All dimensions are in feet only.
Drawing not to scale

Fig A: Location of Bore holes
<table>
<thead>
<tr>
<th>Client</th>
<th>The Chief Engineer, RGR1CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job No</td>
<td>404</td>
</tr>
<tr>
<td>Project</td>
<td>Housing Project</td>
</tr>
<tr>
<td>Location</td>
<td>Sy. No. 74, 75 &amp; 76, Ganigarahalli</td>
</tr>
</tbody>
</table>

**ANNEXURE II**

<table>
<thead>
<tr>
<th>BOREHOLE - 01</th>
<th>Size of Borehole</th>
<th>150mm</th>
</tr>
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<tbody>
<tr>
<td>Ground water table</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>Commenced</td>
<td>20.07.18</td>
<td></td>
</tr>
<tr>
<td>Completed</td>
<td>20.07.18</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NCL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value</th>
<th>Core Recovery</th>
<th>RQD, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td>SPT DS</td>
<td>10</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>DS</td>
<td>SPT DS</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td></td>
<td>-3.00</td>
<td>DS</td>
<td>SPT DS</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SPT = Standard Penetration test  
Refusal means SPT N>50  
B= No. of blows  
R=Rebound  
SR= Soft Rock  
HR= Hard Rock  
DS= Disturbed Sample  
CWR= Completely weathered rock  
MWR= Moderately weathered rock

Bore hole was terminated at 3.0m depth blow existing ground level.
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NGL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = N2/N1</th>
<th>Core Recovery, %</th>
<th>RQD, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td>DS</td>
<td>1st 15cm 2nd 15cm 3rd 15cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellowish red sandy Silt</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td>10 13 13</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellowish pink silty Sand with gravel</td>
<td>3.0</td>
<td></td>
<td>-3.00</td>
<td>SPT DS</td>
<td>19 25 30</td>
<td>55</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**SPT=Standard Penetration test**  
Refusal means SPT N>50  
B= No. of blows  
R=Rebound  
SR: Soft Rock  
HR: Hard Rock  
DS=Disturbed Sample  
CWR: completely weathered rock  
MWR: Moderately weathered rock

Bore hole was terminated at 3.8m depth blow existing ground level.
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NCL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = $N_1 + N_3$</th>
<th>Core Recovery</th>
<th>ROD, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reddish sandy Silt with gravel</td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinkish yellow silty Sand with gravel</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td>8 12 13 25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinkish yellow silty Sand with gravel</td>
<td>3.0</td>
<td></td>
<td>-3.00</td>
<td>SPT DS</td>
<td>20 25 30 55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- SPT: Standard Penetration Test
- DS: Disturbed Sample
- HR: Hard Rock
- CWR: Completely weathered rock
- MWR: Moderately weathered rock

**SR:** Soft Rock

**Bore hole was terminated at 3.0m depth blow existing ground level**
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>N.C.L.</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N value = N2/F2</th>
<th>Core Recovery</th>
<th>RQD.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td>DS</td>
<td>1st 15cm: 10, 2nd 15cm: 10, 3rd 15cm: 13</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>SPT</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT</td>
<td>DS</td>
<td>17, 27, 30</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brownish pink silty Sand</td>
<td>3.0</td>
<td></td>
<td>-3.00</td>
<td>SPT</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SPT=Standard Penetration test   Refusal means SPT N=50  B= No. of blows  R=Rebound  SR. Soft Rock
HR. Hard Rock  DS=Disturbed Sample  CWR. completely weathered rock  MWR. Moderately weathered rock

Bore hole was terminated at 3.0m depth blow existing ground level
# Geo Engineering Company Pvt. Ltd.

**Laboratory Test Report on Soil Samples**

**Client:** The Chief Engineer, RGRHCL  
**Project:** Housing Project  
**Job No.:** 404  
**Location:** Sy. No. 74, 75 & 76, Ganigarahalli

**Date of Sample Received:** 20-07-2018  
**Date of Test:** 24-07-2018

<table>
<thead>
<tr>
<th>BH No.</th>
<th>Sample Type</th>
<th>Sample no.</th>
<th>Depth (m)</th>
<th>Grain Size Distribution (%)</th>
<th>Atterberg Limits (%)</th>
<th>Shear Parameters</th>
<th>Description of Soil Strata</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPT</td>
<td>0718/606</td>
<td>1.5</td>
<td>Gravel 0.0, Coarse Sand 2.6, Medium Sand 9.1, Fine Sand 11.5, Silt &amp; Clay 76.8</td>
<td>Plastic Limit 38.9, Liquid Limit 21.8, Plastic Index 17.1</td>
<td></td>
<td>sandy Silt</td>
</tr>
<tr>
<td></td>
<td>SPT</td>
<td>0718/607</td>
<td>3.0</td>
<td>Gravel 7.0, Coarse Sand 8.0, Medium Sand 23.9, Fine Sand 19.5, Silt &amp; Clay 41.6</td>
<td>Plastic Limit 4.7, Liquid Limit 11.0</td>
<td></td>
<td>silty Sand with gravel</td>
</tr>
<tr>
<td></td>
<td>UDS</td>
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</tr>
<tr>
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</tr>
<tr>
<td></td>
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<td>Plastic Limit 11.8, Liquid Limit 3.1</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>SPT</td>
<td>0718/611</td>
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<td>Gravel 11.1, Coarse Sand 4.9, Medium Sand 10.1, Fine Sand 11.3, Silt &amp; Clay 62.6</td>
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<td></td>
<td>sandy Silt with gravel</td>
</tr>
<tr>
<td></td>
<td>SPT</td>
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<td>3.0</td>
<td>Gravel 10.7, Coarse Sand 2.7, Medium Sand 21.9, Fine Sand 15.0, Silt &amp; Clay 42.7</td>
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<td></td>
<td>sandy Silt with gravel</td>
</tr>
<tr>
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<td>SPT</td>
<td>0718/613</td>
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<td>Gravel 0.8, Coarse Sand 8.5, Medium Sand 11.2, Fine Sand 11.5, Silt &amp; Clay 68.0</td>
<td>Plastic Limit 4.9, Liquid Limit 11.6</td>
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<td>Plastic Limit 4.9, Liquid Limit 4.9</td>
<td></td>
<td>silty Sand</td>
</tr>
</tbody>
</table>

*The parameter marked with "*" is not accredited by NABL.*

**Abbreviations used:**  
UDS: Undisturbed Sample,  
DS: Disturbed Sample,  
SPT: Standard Penetration Test,  
BH: Bore Hole,  
NP: Non Plastic

**Test Method Referred to:**  
Grain Size Distribution: IS 2720-4 1985 RA 2015  
Specific Gravity: IS 2720-3 SECTION 1 & 2 1980 RA 2011  
Direct Shear Test: IS 2720-13 1986 RA 2015  
Free Swell Index: IS 2720-40 1977 RA 2011  
Natural Moisture Content: IS 2720-2 1973 RA 2015

**Test Method Variation:** None

**END OF TEST RESULTS**
ANNEXURE IV

GRAIN SIZE ANALYSIS CURVES

Fig. No.1: Grain size analysis Curves around BH 1

Fig. No.2: Grain size analysis Curves around BH 2
Fig. No.3: Grain size analysis Curves around BH 3

Fig. No.4: Grain size analysis Curves around BH 4

***END OF REPORT***
GEOTECHNICAL INVESTIGATION REPORT FOR THE
PROPOSED MULTI STOREY RESIDENTIAL BUILDING AT SY. NO. 78,
KUKKALAHALLI, BENGALURU

CLIENT
M/s. Rajiv Gandhi Rural Housing Corporation Ltd,
Cavery Bhavan, 9th Floor,
E & F Block, Kempegowda Road,
Bengaluru

CONSULTANTS
M/s. ACS Design Consulting Pvt. Ltd.,
# 1150, "ARNAV", 4th Floor,
13th Cross, 1st Stage, 1st Phase,
Behind Siddaganga Public School,
Chandra Layout,
Bangalore-72

GEO-ENGINEERING COMPANY PVT. LTD.
#28, 5th Main, 3rd Phase, Peenya Industrial Area, Behind Bescom,
Bengaluru - 560 058
<table>
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<tr>
<th><strong>Report on</strong></th>
<th>Geotechnical investigation for the proposed Multi Storey Residential Building at Sy. No. 78, Kukkalahalli, Bengaluru</th>
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<tbody>
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<td>GECPL/231118 – 970-1/A</td>
</tr>
<tr>
<td><strong>Report for</strong></td>
<td>M/s. Rajiv Gandhi Rural Housing Corporation Ltd., Cavery Bhavan, 9th Floor, E &amp; F Block, Kempegowda Road, Bengaluru</td>
</tr>
<tr>
<td><strong>Reference</strong></td>
<td>Telephonic Confirmation dated Nov 22, 2018</td>
</tr>
<tr>
<td><strong>Field investigation carried out by</strong></td>
<td>Mr. Praveen &amp; Team, Site Engineer</td>
</tr>
<tr>
<td><strong>Managing Director</strong></td>
<td>Mr. Jayaprakash K N</td>
</tr>
<tr>
<td><strong>Technical Advisor</strong></td>
<td>Mr. Umesh Kumar N Technical Manager (Geo-Technical Engg)</td>
</tr>
<tr>
<td><strong>Report By</strong></td>
<td>Mr. Nagesh C Geo Technical Engineer</td>
</tr>
<tr>
<td><strong>Date of submission of report</strong></td>
<td>29.11.2018</td>
</tr>
</tbody>
</table>
LIST OF CONTENTS

Page No.
1.0 Introduction ............................................................................................................................. 4
2.0 Objective of work .................................................................................................................... 4
3.0 Field Investigations ................................................................................................................. 4
4.0 Laboratory Tests ....................................................................................................................... 5
5.0 Sub Strata Profile ..................................................................................................................... 5
6.0 Conclusions ............................................................................................................................. 5
7.0 Recommendations ................................................................................................................... 6

LIST OF ANNEXURES

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</tr>
</thead>
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<td>Annexure I- Bore Hole Location</td>
<td>7-8</td>
</tr>
<tr>
<td>Annexure II- Field Records and Bore Logs</td>
<td>9-11</td>
</tr>
<tr>
<td>Annexure III- Laboratory Test Results</td>
<td>12</td>
</tr>
<tr>
<td>Annexure IV- Typical Sieve Curves</td>
<td>13-14</td>
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INTRODUCTION
M/s. Rajiv Gandhi Rural Housing Corporation Ltd., Bengaluru had entrusted us with the work of carrying out the geotechnical investigation for the proposed Multi Storey Residential Building (Stilt, G+9 floors) at Sy. No.78, Kukkalahalli, Bengaluru. The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. This report consists of the details about the field and laboratory tests performed and the recommendations made based on the test results.

SCOPE
The scope of work includes both the field and laboratory tests. Three boreholes by manual auger method were drilled in the construction area to obtain the sub-surface stratification. Fig A and Fig B: shows the location of the boreholes on the entire plan of the proposed construction site. Refer Annexure I

FIELD INVESTIGATION
Boring and Sampling
150 mm diameter boring at all places is carried out in accordance with IS: 1892 -1979 Code of Practice for sub-surface investigation of foundation (re – affirmed in 1992) by adopting auger boring. Representative / undisturbed samples are collected at different depths as the boring operation progressed. Various laboratory tests are conducted on the samples collected. Standard penetration tests are conducted at every 1.50m interval as per IS: 2131 – 1981.

Field testing
Standard penetration test
Standard Penetration Test (SPT) is carried out at different depths in all the boreholes & the ‘N’ values are recorded. The number of blows required to drive a 50mm diameter split spoon sampler for a depth of 30cm using a 65 kg hammer for a drop of 75cm is recorded as ‘N’ value.

The results of all the penetration tests are performed in each of the boreholes and they are shown in their respective Bore logs (Refer Annexure II). The test is halted if,

i) 50 blows are required for any 150mm penetration.

ii) 100 blows are required for 300mm penetration.

iii) 10 successive blows produce no advance and the N – value is recorded as “REFUSAL”.

4
LABORATORY TESTING

Samples procured were transported to laboratory for obtaining Index and Engineering properties. In the laboratory, samples were visually classified by Geotechnical Engineer. Laboratory tests are being carried out as per relevant IS: 2720 guidelines.

*Generally Soil Samples were tested for following parameters*

- Particle Size analysis
- Bulk Density
- Natural Moisture content
- Atterberg’s limits
- Direct Shear strength tests for UDS sample.

The above said test results are tabulated. *Refer Annexure III.*

SUB SOIL PROFILE

The sub-soil formations comprise of from top nil to termination depth yellowish brown to pinkish red/ yellowish white sandy Silt/ silty Sand with presence of gravel/ completely weathered rock was encountered. All the boreholes are terminated at the stage of “REFUSAL”. During the time of investigation water table was not encountered at any depth below the existing ground level; however the same may be subjected to seasonal fluctuations.

CONCLUSIONS

The following conclusions are drawn based on field and laboratory investigations.

1. All the boreholes are terminated at the stage of “REFUSAL”.
2. During the time of investigation water table was not encountered at any depth below existing ground level; however the same may be subjected to seasonal fluctuations.
3. The sub soil varies from top nil to termination depth dense strata was noticed.
4. The atterberg’s limits indicate that the sub-soil is medium compressible in nature.
RECOMMENDATIONS
The following recommendations are made based on the detailed investigation conducted at the proposed construction site.

1. The foundation for structure shall be taken to a minimum depth of 1.5m below the existing ground level.
2. Isolated/combined footing up to minimum width of 2.0m may be designed with the following allowable bearing pressure of, which gives a factor of safety of 2.5 against shear failure and for an allowable settlement of 25mm;

<table>
<thead>
<tr>
<th>Depth below existing ground level, m</th>
<th>Net SBC, kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>250</td>
</tr>
</tbody>
</table>

Note 1: During excavations, in case any variation is noticed in the strata/seepage same shall be brought to the notice of geotechnical engineer for review of net SBC recommended.

3. The bottom of foundation shall be properly leveled and verified for loose pockets/weaker zones and if found, the same shall be replaced with lean concrete.

for GEOENGINEERING COMPANY PRIVATE LTD

(JAYAPRAKASH K. N.)
ANNEXURE I

Fig A: Location of Bore holes
Fig B: Location of Bore holes
### ANNEXURE II

<table>
<thead>
<tr>
<th>Client</th>
<th>M/s. Rajiv Gandhi Rural Housing Corporation Ltd.,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job No</td>
<td>970-2</td>
</tr>
<tr>
<td>Project</td>
<td>Multi Storey Residential Building</td>
</tr>
<tr>
<td>Location</td>
<td>Kakkalahalli</td>
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</table>

#### BOREHOLE - 01

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NGL</th>
<th>SPT TEST, number of blows recorded</th>
<th>SPT N Value</th>
<th>Core Recovery, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.50</td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.50</td>
<td>-1.50</td>
<td>SPT</td>
<td>50B/6cm</td>
<td>R</td>
<td>&gt;50</td>
<td></td>
</tr>
</tbody>
</table>

- **NS** 15 cm
- **N2** 15 cm
- **N3** 15 cm

- **N** Value = **N2** + **N3**

**NGL**: Near Ground Level

**Legend**

- **NGL**: Near Ground Level
- **DS**: Disturbed Sample

**Description of Sub-soil stratum**

- **Yellowish red silty Sand**
- **Yellowish pink CWR**

**SPT** = Standard Penetration test

- Refusal means SPT N > 50
- B = No. of blows
- R = Rebound
- SR = Soft Rock
- HR = Hard Rock
- DS = Disturbed Sample
- CWR = Completely weathered rock
- MWR = Moderately weathered rock

Bore hole was terminated at 1.5m depth blow existing ground level
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NGL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>Q Value</th>
<th>% Core Recovery</th>
<th>RQD, %</th>
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</thead>
<tbody>
<tr>
<td>Brownish red sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td></td>
<td>1st 15cm N1 2nd 15cm N2 3rd 15cm N3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brownish red silty Sand</td>
<td>1.5</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td>20 50b/6cm &gt;50</td>
<td></td>
<td></td>
<td></td>
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</table>


Bore hole was terminated at 1.5m depth blow existing ground level
### BOREHOLE - 03

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Legend</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = N2 + N3</th>
<th>Core Recovery, RD%</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>0.0</td>
<td>NGL</td>
<td>0.00</td>
<td>1st 15cm</td>
<td>N1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>NGL</td>
<td>-0.50</td>
<td>2nd 15cm</td>
<td>N2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>NGL</td>
<td>-1.50</td>
<td>3rd 15cm</td>
<td>N3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description of Sub-soil stratum**

- **Reddish sandy Silt**
  - Depth: 0.0 m
  - Legend: NGL
  - Sample: 1st 15cm
  - SPT TEST, number of blows recorded: 0.00
  - N Value = N2 + N3
  - Core Recovery, RD%: 0.00

- **Yellowish white CWR**
  - Depth: 0.5 m
  - Legend: NGL
  - Sample: 2nd 15cm
  - SPT TEST, number of blows recorded: 0.50
  - N Value = N2 + N3
  - Core Recovery, RD%: 0.50

**Size of Borehole**: 150mm

**Ground water table**: Nil

**Commenced**: 23.11.18

**Completed**: 23.11.18

**Remarks**

- **SPT** = Standard Penetration test
- Refusal means SPT N > 50
- B = No. of blows
- R = Rebound
- SR: Soft Rock
- HR: Hard Rock
- DS = Disturbed Sample
- CWR: Completely weathered rock
- MWR: Moderately weathered rock

Bore hole was terminated at 1.5m depth blow existing ground level.
### LABORATORY TEST REPORT ON SOIL SAMPLES

**Client**: M/s. Rajiv Gandhi Rural Housing Corporation Ltd  
**Project**: Multi Storey Residential Building  
**Job No.**: 970-2

### ANNEXURE III

<table>
<thead>
<tr>
<th>BH No.</th>
<th>Sample Type</th>
<th>Sample no.</th>
<th>Depth (m)</th>
<th>Grain Size Distribution (%)</th>
<th>Atterberg Limits (%)</th>
<th>IS Classification</th>
<th>Natural Moisture Content (%)</th>
<th>Free Swell Index (%)</th>
<th>Bulk Density (gm/cc)*</th>
<th>Specific Gravity</th>
<th>Cohesion (kN/m²)</th>
<th>Angle of Internal Friction (deg.)</th>
<th>Description of Soil Strata</th>
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<tr>
<td>1</td>
<td>SPT</td>
<td>1118/938</td>
<td>1.0</td>
<td>0.1</td>
<td>2.7</td>
<td>31.5</td>
<td>34.0</td>
<td>31.7</td>
<td>35.8</td>
<td>---</td>
<td>NP</td>
<td>---</td>
<td>SM-MI</td>
</tr>
<tr>
<td>2</td>
<td>UDS</td>
<td>1118/939</td>
<td>1.0</td>
<td>6.5</td>
<td>8.7</td>
<td>6.4</td>
<td>11.5</td>
<td>66.9</td>
<td>41.7</td>
<td>25.7</td>
<td>16.1</td>
<td>---</td>
<td>MI</td>
</tr>
<tr>
<td>2</td>
<td>SPT</td>
<td>1118/940</td>
<td>1.5</td>
<td>1.1</td>
<td>3.1</td>
<td>30.2</td>
<td>32.2</td>
<td>33.4</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>SPT</td>
<td>1118/941</td>
<td>1.5</td>
<td>0.0</td>
<td>1.9</td>
<td>31.3</td>
<td>35.3</td>
<td>31.5</td>
<td>36.2</td>
<td>---</td>
<td>NP</td>
<td>---</td>
<td>SM-MI</td>
</tr>
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</table>

* The parameter marked with "**" is not accredited by NABL

**Test Method Variation**: None

---

This report relates only to the sample tested and shall not be reproduced except in full without written approval of laboratory management.

**Authorised Signatory**

---

**Test Method Referred to**:  
- Grain Size Distribution: IS 2720-4 1985 RA 2015  
- Free Swell Index: IS 2720-40 1977 RA 2011  
- Natural Moisture Content: IS 2720-2 1973 RA 2015  
- Specific Gravity: IS 2720-3 SECTION 1 & 2 1980 RA 2011
ANNEXURE IV

GRAIN SIZE ANALYSIS CURVES

Fig. No.1: Grain size analysis Curves around BH 1

Fig. No.2: Grain size analysis Curves around BH 2
Fig. No.3: Grain size analysis Curves around BH 3

***END OF REPORT***
GEOTECHNICAL REPORT

<table>
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<th>PROPOSED MULTI STORIED BUILDING FOR RAJIV GANDHI RURAL HOUSING CORPORATION LTD</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>CLIENT</td>
<td>M/S PITHAVADIAN AND PARTNERS</td>
</tr>
</tbody>
</table>
REPORT ON GEOTECHNICAL INVESTIGATION FOR PROPOSED MULTI STORIED BUILDING

1.0 INTRODUCTION

M/s Rajiv Gandhi Rural Housing Corporation Ltd proposes to build a Multi Storied building at Mandur. The consultants for the project are M/s Pithavadian and Partners. Geotechnical investigation was entrusted to M/s Aptech foundations.

2.0 OBJECT AND SCOPE OF WORK

The object of geotechnical investigation, in brief was to ascertain the type of substrata, their characteristics and their suitability for the proposed structure and to decide on the type and depth of foundation and also to assess the bearing capacity. The scope of work included field and laboratory investigations as detailed below.

2.1 Field Investigations

Field investigation was carried out on 19/12/2018. It consisted of the following:

2.1.1 Drilling

Three boreholes of 150mm diameter was required to be drilled by rotary method, in all types of soil and soft rock. Fig 1 shows the borehole locations.

2.1.2 Sampling

Disturbed soil samples:

SPT samples and wash samples were collected at various depths and at every change of strata. These were sealed in watertight containers and labeled before being sent to the laboratory for testing.
Disturbed soil samples:

SPT samples and wash samples were collected at various depths and at every change of strata. These were sealed in watertight containers and labeled before being sent to the laboratory for testing.

2.1.3 Standard Penetration Test

Standard penetration tests were conducted in accordance with IS 2131: 1981 in test boreholes. The blow counts of last 30 cms of penetration of the split spoon sampler with 63.5 kg drop weight tripping automatically with a free fall of 75 cms. The details of N values are given in the borelog.

2.2 Laboratory Testing

The scope of laboratory testing in soil is as follows:

i) Grain size analysis as per IS 2720 part 4 – 1985
iii) Natural Moisture Content as per IS 2720 – part 2 - 1973

2.2.1 Natural Moisture Content (NMC)

Test procedure conforms to IS:2720 (Part 2 ) – 1973

A moisture cup is loosely filled with soil and weighted with lid. It is then kept in oven with lid removed and maintained at temparture of the oven at 110°C for 24 hours. The lid of the container is replaced and the dry weight found out. The percentage of water content has been calculated using the formula.

\[ w = \left( \frac{W2 - W3}{W3 - W1} \right) \times 100 \]

Where
W2 = weight of container with wet soil, in g
W3 = weight of container with dry soil, in g
W1 = weight of container with lid in g
w = moisture content (%)

2.2.2 Particle size analysis


i) Sieve Analysis

Sieve analysis has been done by wet sieving method. Sieving has been done using a sieve shaker by passing through the following IS sieves: 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.70 mm, 1.40 mm, 1.00 mm, 600 microns, 425 microns, 100 microns, and 75 microns.

2.2.3 Atterberg Limits

Liquid limit and plastic limit tests on Cohesive and Semi-cohesive samples has been done as per procedure in IS 2720 (Part 5) – 1985.

Liquid limit and plastic limit tests on Cohesive and Semi-cohesive samples has been done as per procedure in IS 2720 (Part 5) – 1985. Testing is done as per IS 2720 (Part 5) 1985 using the “cone penetrometer” method where errors of groove cutting involved in Casagrande’s device are minimized. In cone penetrometer tests about 200 gm of soil passing 425 micron sieve is taken, mixed with requisite water, placed in cup and compacted lightly in 3 layers. The tip of penetrometer is adjusted such that it just touches soil surface. The needle is allowed to plunge slowly under its own weight for 5 seconds and penetration in mm is recorded. The water content is adjusted such that penetration is between 20-30mm. The following relationship is used to evaluate liquid limit.

\[ WL = Wx + 0.01 \times [25 - X] \times [Wx + 15] \]

Where \( Wx \) = water content at recorded penetration (%)
WL = Liquid Limit (%)  
X = Recorded penetration in mm
A portion of the sample is then taken out for water content determination and the water content is determined.

3.0 DESCRIPTION OF SUBSTRATA

The field borehole logs of BH1 to BH3 are presented in Tables 1 to 3. The subsoil at the BH1 to BH3 is more or less similar and consists of reddish brown clayey sand upto 1m below EGL underlain by soft disintegrated weathered rock up to the termination depth of 3m below EGL. Water table was not encountered in the boreholes at the time of investigation. N values are seen to be more than 100 at 1m depth below EGL.

4.0 RESULTS AND DISCUSSION

4.1 SPT Values

N values from SPT are also shown in the borelogs (Tables 1 to 3).

4.2 Soil Properties

Table 4 gives the various soil properties obtained from the samples collected from BH1 to BH3. The particle size distribution curves are shown in Fig. 2. The liquid and plastic limit values indicate soil of low to medium compressibility.

5.0 BEARING CAPACITY

5.1 Shallow Foundations

Based on SPT

The safe bearing pressure for foundation of 1.5m width placed at 1.5m depth below EGL, maybe determined using the N values from SPT given in Tables 1 to 3. Thus, for a total settlement of 25mm, the safe bearing pressure at the three
Safe bearing pressure calculations based on IS 8009 (Part 1) – 1976, are given in Appendix 1.

<table>
<thead>
<tr>
<th>BH No</th>
<th>Depth of foundation, m</th>
<th>Nature of substrata</th>
<th>Safe Bearing Pressure, Tons/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH1</td>
<td>1.5</td>
<td>Soft disintegrated weathered rock</td>
<td>31.0</td>
</tr>
<tr>
<td>BH2</td>
<td>1.5</td>
<td>Soft disintegrated weathered rock</td>
<td>31.0</td>
</tr>
<tr>
<td>BH3</td>
<td>1.5</td>
<td>Soft disintegrated weathered rock</td>
<td>31.0</td>
</tr>
</tbody>
</table>

6.0 RECOMMENDATIONS

Based on the geotechnical investigations carried out for the proposed multi storied building at Mandur, following recommendations are made:

1. Subsoil consists of clayey sand underlain by soft disintegrated weathered rock.
2. Shallow foundations maybe adopted. The allowable bearing pressure for foundations placed at 1.5m depth below EGL maybe taken as 31 tons/m².
<table>
<thead>
<tr>
<th>SAMPLE TYPE / SPT</th>
<th>N VALUE</th>
<th>DESCRIPTION OF STRATA</th>
<th>DEPTH below ground level m</th>
<th>CORES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS/0.5m</td>
<td>25 50 75 100</td>
<td>Reddish brown clayey sand</td>
<td>0.0</td>
<td></td>
<td>150mm Ø</td>
</tr>
<tr>
<td>SPT/1m</td>
<td>N &gt; 100</td>
<td>Soft disintegrated weathered rock (Laterite)</td>
<td>1.5 to 3.0</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>SPT/1.5m</td>
<td>N &gt; 100</td>
<td></td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Borehole terminated at 3m depth</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2  BOREHOLE LOG

**PROJECT**  
Proposed Multi Storied Building for M/s Rajiv Gandhi Rural Housing Corporation Ltd

**GROUND EL**

**CLIENT**  
Pithavadian and Partners

**METHOD**  
Rotary

**BH NO**  
BH2

**LOCATION**  
Mandur

**STARTED ON**  
20-12-2018

**COMPLETED ON**  
20-12-2018

**WATER TABLE**  
not encountered

<table>
<thead>
<tr>
<th>SAMPLE TYPE</th>
<th>N VALUE</th>
<th>DESCRIPTION OF STRATA</th>
<th>DEPTH below ground level m</th>
<th>CORES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPT/0.5m</td>
<td>25</td>
<td>Reddish brown clayey sand</td>
<td>0.0</td>
<td></td>
<td>150mm Ø</td>
</tr>
<tr>
<td>SPT/1m</td>
<td>50</td>
<td>Soft disintegrated weathered rock (Laterite)</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>75</td>
<td></td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT/2m</td>
<td>25</td>
<td></td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
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<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>75</td>
<td></td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>7.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT/3m</td>
<td>25</td>
<td></td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>9.0</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>75</td>
<td></td>
<td>10.0</td>
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<td></td>
</tr>
</tbody>
</table>

Borehole terminated at 3m depth
**TABLE 3  BOREHOLE LOG**

<table>
<thead>
<tr>
<th>SAMPLE TYPE / SPT</th>
<th>N VALUE</th>
<th>DESCRIPTION OF STRATA</th>
<th>DEPTH below ground level m</th>
<th>CORES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT/0.5m</td>
<td></td>
<td></td>
<td>0.0</td>
<td></td>
<td>150mm Ø</td>
</tr>
<tr>
<td>SPT/1m</td>
<td></td>
<td>Reddish brown clayey sand</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N &gt; 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT/2m</td>
<td></td>
<td>Soft disintegrated weathered rock (Laterite)</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N &gt; 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT/3m</td>
<td></td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N &gt; 100</td>
<td></td>
<td>Borehole terminated at 3m depth</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PROJECT** Proposed Multi Storied Building for M/s Rajiv Gandhi

**CLIENT** Pithavadian and Partners

**BH NO** BH3

**LOCATION** Mandur

**GROUND EL**

**METHOD** Rotary

**STARTED ON** 20-12-2018

**COMPLETED ON** 20-12-2018

**WATER TABLE** not encountered

---

**TABLE 3  BOREHOLE LOG**

<table>
<thead>
<tr>
<th>SAMPLE TYPE / SPT</th>
<th>N VALUE</th>
<th>DESCRIPTION OF STRATA</th>
<th>DEPTH below ground level m</th>
<th>CORES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>50</td>
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<td>75</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT/0.5m</td>
<td></td>
<td></td>
<td>0.0</td>
<td></td>
<td>150mm Ø</td>
</tr>
<tr>
<td>SPT/1m</td>
<td></td>
<td>Reddish brown clayey sand</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N &gt; 100</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>SPT/2m</td>
<td></td>
<td>Soft disintegrated weathered rock (Laterite)</td>
<td>2.0</td>
<td></td>
<td></td>
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<tr>
<td>N &gt; 100</td>
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<tr>
<td>SPT/3m</td>
<td></td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N &gt; 100</td>
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<td>Borehole terminated at 3m depth</td>
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<td></td>
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**TABLE No. 4**
**SOIL PROPERTIES**

<table>
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<tr>
<th>Soil Properties</th>
<th>Borehole No.</th>
<th>BH1</th>
<th>BH2</th>
<th>BH3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td></td>
<td>0.5m</td>
<td>0.5m</td>
<td>0.5m</td>
</tr>
<tr>
<td>Sample Type</td>
<td></td>
<td>DS</td>
<td>DS</td>
<td>DS</td>
</tr>
<tr>
<td>Grain size distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gravel %</td>
<td></td>
<td>6.0</td>
<td>8.0</td>
<td>10.0</td>
</tr>
<tr>
<td>sand %</td>
<td></td>
<td>58.0</td>
<td>55.0</td>
<td>57.0</td>
</tr>
<tr>
<td>silt %</td>
<td></td>
<td>36.0</td>
<td>37.0</td>
<td>33.0</td>
</tr>
<tr>
<td>clay %</td>
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<td>Soil Classification</td>
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<td>SC</td>
</tr>
<tr>
<td>Sp. Gravity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>water content %</td>
<td></td>
<td>9.3</td>
<td>9.8</td>
<td>8.7</td>
</tr>
<tr>
<td>unit weight, t/m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>voids ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>plastic limit</td>
<td></td>
<td>12.4</td>
<td>12.9</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Page 9
Fig. 2  Particle size distribution curves - BH1 - BH3
Appendix 2

Calculation of Safe Bearing Pressure as per IS 8009 (Part 1) - 1976 based on SPT values

BH2

Footing depth below EGL= 1.5 m
Footing width = 1.5 m
permissible settlement = 25mm

Influence zone (depth below EGL) from 0.50 m to 4.5 m

<table>
<thead>
<tr>
<th>Depth, m</th>
<th>SPT 'N'</th>
<th>Effective unit weight, ton/m²</th>
<th>Overburden Pr., Kg/cm²</th>
<th>OB Correction Factor</th>
<th>Corrected N values for OB</th>
<th>for diltancy</th>
<th>Layer depth, m</th>
<th>Layer thickness, m</th>
<th>Weighted N value (within influence zone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>2.00</td>
<td>0.2</td>
<td>1.54</td>
<td>154.0</td>
<td>84.5</td>
<td>0.5 - 1.0</td>
<td>0.50</td>
<td>42.3</td>
</tr>
<tr>
<td>2.0</td>
<td>100</td>
<td>2.00</td>
<td>0.4</td>
<td>1.31</td>
<td>131.0</td>
<td>73.0</td>
<td>1.5 - 4.0</td>
<td>2.50</td>
<td>182.5</td>
</tr>
</tbody>
</table>

Average N value = 56.2

Settlement per unit pressure in m per kg/sq.cm = 0.004

For 25mm settlement, safe bearing pressure = 6.25 kg/cm²
Correcting for submergence, safe bearing pressure = 3.13 kg/cm²

i.e. 31.0 tons/m²
GEOTECHNICAL INVESTIGATION REPORT FOR THE
PROPOSED HOUSING PROJECT AT SY. NO. 30, SADENHALLI,
BENGALURU

CLIENT
The Chief Engineer
RGRHCL, Cauvery Bhavan,
K G Road,
Bengaluru

CONSULTANTS
M/s. ACS Design Consulting Pvt. Ltd.,
# 1150, ‘ARNAV’, 4th Floor,
13th Cross, 1st Stage, 1st Phase,
Chandra Layout,
Bengaluru – 560 072

GEO-ENGINEERING COMPANY PVT. LTD.
#28, 5th Main, 3rd Phase, Peenya Industrial Area, Behind Bescom,
Bengaluru - 560 058
Report on : Geotechnical investigation for the proposed Housing Project at Sy No. 30, Sadennalli, Bengaluru

Report No : GECPL/140718 – 388/A

Report for : The Chief Engineer, RGRHCL, Cauvery Bhavan, K G Road, Bengaluru

Reference : Telephonic Confirmation dated July 13, 2018

Field investigation carried out by : Mr. Praveen & Team, Site Engineer

Managing Director : Mr. Jayaprakash K N

Technical Advisor : Mr. Umesh Kumar N Technical Manager (Geo-Technical Engg)

Report By : Mr. Abhijith S Geo Technical Engineer

Date of submission of report : 20.01.2018
LIST OF CONTENTS

1.0 Introduction ................................................................. 4
2.0 Objective of work ........................................................... 4
3.0 Field Investigations .......................................................... 4
4.0 Laboratory Tests ............................................................. 5
5.0 Sub Strata Profile ............................................................. 5
6.0 Conclusions .................................................................. 5
7.0 Recommendations ........................................................... 6

LIST OF ANNEXURES

<table>
<thead>
<tr>
<th>Annexures</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annexure I- Bore Hole Location</td>
<td>7</td>
</tr>
<tr>
<td>Annexure II- Field Records and Bore Logs</td>
<td>8-10</td>
</tr>
<tr>
<td>Annexure III- Laboratory Test Results</td>
<td>11</td>
</tr>
<tr>
<td>Annexure IV- Typical Sieve Curves</td>
<td>12-13</td>
</tr>
</tbody>
</table>
INTRODUCTION
The Chief Engineer, RGRHCL, Bengaluru had entrusted us with the work of carrying out the geotechnical investigation for the proposed Housing Project at Sy.No. 30, Sadenahalli, Bengaluru. The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. This report consists of the details about the field and laboratory tests performed and the recommendations made based on the test results.

SCOPE
The scope of work includes both the field and laboratory tests. Three boreholes by manual auger method were drilled in the construction area to obtain the sub-surface stratification. Fig A: shows the location of the boreholes on the entire plan of the proposed construction site. Refer Annexure I

FIELD INVESTIGATION
Boring and Sampling
150 mm diameter boring at all places is carried out in accordance with IS: 1892 -1979 Code of Practice for sub-surface investigation of foundation (re – affirmed in 1992) by adopting auger boring. Representative / undisturbed samples are collected at different depths as the boring operation progressed. Various laboratory tests are conducted on the samples collected. Standard penetration tests are conducted at every 1.50m interval as per IS: 2131 – 1981.

Field testing
Standard penetration test
Standard Penetration Test (SPT) is carried out at different depths in all the boreholes & the ‘N’ values are recorded. The number of blows required to drive a 50mm diameter split spoon sampler for a depth of 30cm using a 65 kg hammer for a drop of 75cm is recorded as ‘N’ value.
The results of all the penetration tests are performed in each of the boreholes and they are shown in their respective Bore logs (Refer Annexure II). The test is halted if,

i) 50 blows are required for any 150mm penetration.
ii) 100 blows are required for 300mm penetration.
iii) 10 successive blows produce no advance and the N – value is recorded as “REFUSAL”.

4
LABORATORY TESTING
Samples procured were transported to laboratory for obtaining Index and Engineering properties. In the laboratory, samples were visually classified by Geotechnical Engineer. Laboratory tests are being carried out as per relevant IS: 2720 guidelines.

*Generally Soil Samples were tested for following parameters*
- Particle Size analysis
- Bulk Density
- Natural Moisture content

The above said test results are tabulated. *Refer Annexure III.*

SUB SOIL PROFILE
The sub-soil formations comprise of from top nil to termination depth reddish gray/yellowish to reddish pink sandy Silt/ sily Sand was encountered. All the boreholes are terminated at the depth of 6.0m below existing ground level (or) at the stage of “REFUSAL” whichever is met earlier. During the time of investigation water table was not encountered at any depth below the existing ground level; however the same may be subjected to seasonal fluctuations.

CONCLUSIONS
The following conclusions are drawn based on field and laboratory investigations.

1. All the boreholes are terminated at the depth of 6.0m below existing ground level (or) at the stage of “REFUSAL” whichever is met earlier.
2. During the time of investigation water table was not encountered at any depth below existing ground level; however the same may be subjected to seasonal fluctuations.
3. The sub soil varies from top nil to termination depth medium dense to dense strata was noticed
4. The atterberg’s limits indicate that the sub-soil is medium compressible in nature.
RECOMMENDATIONS
The following recommendations are made based on the detailed investigation conducted at the proposed construction site.

1. The foundation for structure shall be taken to a minimum depth of 1.5m below the existing ground level.

2. Isolated/combined footing up to minimum width of 2.0m may be designed with the following allowable bearing pressure of, which gives a factor of safety of 3.0 against shear failure and for an allowable settlement of 25mm;

<table>
<thead>
<tr>
<th>Depth below existing ground level, m</th>
<th>Net SBC, kN/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>180</td>
</tr>
<tr>
<td>2.0</td>
<td>200</td>
</tr>
<tr>
<td>3.0</td>
<td>250</td>
</tr>
</tbody>
</table>

Note 1: During excavations, in case any variation is noticed in the strata/seepage same shall be brought to the notice of geotechnical engineer for review of net SBC recommended.

3. The bottom of foundation shall be properly leveled and verified for loose pockets/weaker zones and if found, the same shall be replaced with lean concrete.

for GEOENGINEERING COMPANY PRIVATE LTD

(JAYAPRAKASH K. N.)
NOTE: All dimensions are in feet only.
Drawing not to scale

Fig A: Location of Bore holes
### ANNEXURE II

<table>
<thead>
<tr>
<th>Client</th>
<th>The Chief Engineer, RGRHCL</th>
<th>Size of Borehole</th>
<th>150mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job No</td>
<td>288</td>
<td>Ground water table</td>
<td>Nil</td>
</tr>
<tr>
<td>Project</td>
<td>Housing Project</td>
<td>Commenced</td>
<td>14.07.18</td>
</tr>
<tr>
<td>Location</td>
<td>Sy. No. 30, Sadanahalli</td>
<td>Completed</td>
<td>14.07.18</td>
</tr>
</tbody>
</table>

#### BOREHOLE - 01

<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NGL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = N1*N2 N3</th>
<th>Core Recovery, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reddish sandy Silt</td>
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<td>-1.50</td>
<td>SPT DS</td>
<td>10 10 10 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>-3.00</td>
<td>SPT DS</td>
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</tr>
<tr>
<td></td>
<td>4.5</td>
<td>-4.50</td>
<td>SPT DS</td>
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<td>Reddish gray sandy Silt</td>
<td>6.0</td>
<td>-6.00</td>
<td>SPT DS</td>
<td>10   15   15   30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SPT** - Standard Penetration test  
**Refusal mean SPT N-50**  
**BR - No. of blows**  
**R - Rebound**  
**SR - Soft Rock**

HR = Hard Rock  
DS = Disturbed Sample  
CWR: completely weathered rock  
MWR: Moderately weathered rock

Bore hole was terminated at 6.0m depth blow existing ground level
### BOREHOLE - 02

<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NCL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
<th>N Value = N_1/N_3</th>
<th>Core Recovery, %</th>
<th>RQD, %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddish sandy Silt</td>
<td>0.0</td>
<td></td>
<td>0.00</td>
<td>DS</td>
<td>1st 15cm 2nd 15cm 3rd 15cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>-0.50</td>
<td>DS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellowish pink silty Sand</td>
<td>1.4</td>
<td></td>
<td>-1.50</td>
<td>SPT DS</td>
<td>17 75 10 55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **SPT**=Standard Penetration test  
- **Refusal means SPT N>50**  
- **N= No. of blows**  
- **R=Rebound**  
- **SR: Soft Rock**  
- **HR: Hard Rock**  
- **DS=Disturbed Sample**  
- **CWR: completely weathered rock**  
- **MWR: Moderately weathered rock**

Bore hole was terminated at 1.5m depth below existing ground level.
<table>
<thead>
<tr>
<th>Description of Sub-soil stratum</th>
<th>Depth (m)</th>
<th>Legend</th>
<th>NCL</th>
<th>Sample</th>
<th>SPT TEST, number of blows recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellowish red sandy Silt</td>
<td>0.0</td>
<td>0.00</td>
<td>DS</td>
<td>N1, N2, N3</td>
<td></td>
</tr>
<tr>
<td>Yellowish pink silty Sand</td>
<td>0.5</td>
<td>-0.50</td>
<td>SPT DS</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remarks</th>
<th></th>
</tr>
</thead>
</table>

- **SPT**: Standard Penetration Test
- **Refusal means SPT N>50**: Refusal means Standard Penetration Test N-value > 50
- **B**: No. of blows
- **R**: Rebound
- **SR**: Soft Rock
- **HR**: Hard Rock
- **DS**: Disturbed Sample
- **CWR**: Completely weathered rock
- **MWR**: Moderately weathered rock

Borehole was terminated at 1.5m depth below existing ground level
# Laboratory Test Report on Soil Samples

**GEO ENGINEERING COMPANY PVT. LTD.**

**Laboratory Test Report on Soil Samples**

**Client:** The Chief Engineer, RGRHCL  
**Project:** Housing Project  
**Job No.:** 388  
**Location:** Sy. No. 30, Sadanahalli  
**Date of Sample Received:** 14-07-2018  
**Date of Test:** 18-07-2018

## Texture Analysis

<table>
<thead>
<tr>
<th>BH No.</th>
<th>Sample Type</th>
<th>Sample No</th>
<th>Depth (m)</th>
<th>Grain Size Distribution (%)</th>
<th>Atterberg Limits (%)</th>
<th>IS Classification (IS-146-1970)</th>
<th>Natural Moisture Content (%)</th>
<th>Bulk Density (g/m³)*</th>
<th>Specific Gravity*</th>
<th>Cohesion (kN/m²)</th>
<th>Angle of Internal Friction (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPT</td>
<td>0718/449</td>
<td>1.5</td>
<td>gravel: 0.5, coarse sand: 1.5, medium sand: 17.8, fine sand: 22.2, silt &amp; clay: 58.0</td>
<td>liquid limit: 38.5, plas. limit: 21.9, plasticity index: 16.6</td>
<td>5M - 14.6</td>
<td>18.3</td>
<td>7.0</td>
<td>14.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SPT</td>
<td>0718/451</td>
<td>1.0</td>
<td>gravel: 0.0, coarse sand: 0.0, medium sand: 4.8, fine sand: 10.7, silt &amp; clay: 82.5</td>
<td>liquid limit: ---, plas. limit: ---, plasticity index: ---</td>
<td>5M-MII - 18.3</td>
<td>7.0</td>
<td>7.0</td>
<td>14.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SPT</td>
<td>0718/452</td>
<td>1.0</td>
<td>gravel: 0.0, coarse sand: 8.7, medium sand: 24.9, fine sand: 19.7, silt &amp; clay: 13.1</td>
<td>liquid limit: 33.6, plas. limit: 22.8, plasticity index: 14.4</td>
<td>5M-MII - 18.3</td>
<td>7.0</td>
<td>7.0</td>
<td>14.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description of Soil Strata:**
- Sandy Silt
- Sandy Silt
- Sandy Silt
- Silty Sand with gravel
- Silty Sand
- Silty Sand

---

*The parameter marked with ** is not accredited by NABL.*

**Test Method Referred to:**
- Grain Size Distribution: IS 2720-4:1985 RA 2015
- Specific Gravity: IS 2720-3: SECTION 1 & 2 1980 RA 2011
- Specific Gravity: IS 2720-3: SECTION 1 & 2 1980 RA 2011

**Test Method Variation:** None

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**END OF TEST RESULTS**

**Authorised Signatory:**

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**Notes:** This report relates only to the sample tested and shall not be reproduced except in full without written approval of laboratory management.
ANNEXURE IV

GRAIN SIZE ANALYSIS CURVES

Fig. No.1: Grain size analysis Curves around BH 1

Fig. No.2: Grain size analysis Curves around BH 2
Fig. No.3: Grain size analysis Curves around BH 3

***END OF REPORT***