LIST OF SITES

Administrative Building
Library Building
Girls Hostel
Central School
Academic Building No. 1
Academic Building No. 2
School of Management
PG Boys Hostel No. 1
PG Boys Hostel No. 2
PG Boys Hostel No. 3
Natural Resources Building





REPORT ON

A

GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>ADMINISTRATIVE</u> <u>BUILDING</u> IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

SUBMITTED TO:

O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



491-1

Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | ć |
| Sub-Soil profile and recommendation | 6 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>Administrative Building</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consultants

221040250A

1

CHAPTER - II

2.0 **PROJECT DETAILS:**

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|-----------------------|
| 1 | BH-01 | 2.00 | 18/02/2012 | 18/02/2012 |
| 2 | BH-02 | 2.00 | 18/02/2012 | 18/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2131 in bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.

CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.

221040250A

CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{\text{net safe}} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor



221040250A

F = Factor of safety

 N_{c} , N_{q} , N_{γ} = Bearing capacity factors

 $S_{c,} S_{q,} S_{\gamma}$ = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

 e_0 = initial void ratio

 p_0 = initial overburden pressure

 Δp = increase in overburden pressure

 λ_{oed} = Oedometer correction factor

 d_f = depth factor

d_r = Rigidity factor

CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for Open foundatio | | | | | | | | | |
|------------------------|-----------------------|--|--|--|--|--|--|--|--|
| Depth | (ton/m ²) | | | | | | | | |
| (m) from | | | | | | | | | |
| EGL | | | | | | | | | |
| 1.50 | 19.0 | | | | | | | | |
| 2.00 | 23.0 | | | | | | | | |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data and with any modified interpretation of geo-technical expert.

Hann

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)

221040250A

, °••,

CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS FROM SHEAR FAILURE CONSIDERATION

| | earing capacity of foundation of different sizes of foundation at different depth | | | | | | | | | | | | | | |
|---------------------|---|----------------------------------|-----------------------------------|----------------|----------------------------------|--------------------|---------------------------------|--|----------------|----------------------|-----------------|--------|--------|-----------|---------|
| Bear | Bearing capacity of foundation of different sizes of foundation at different depth As per IS:6403-1981 Cl. 5.1.2 | | | | | | | | | | | | | | |
| As p | ns per IS:6403-1981 Cl. 5.1.2 n case of General shear failure _{inet safe} =1/F[CN _c S _c d _c i _c + q(N _q -1)S _q d _q i _q + 0.5BγN _γ S _γ d _γ i _γ R _w '] | | | | | | | | | | | | | | |
| In ca | In case of General shear failure _{Anet safe} =1/F[CN _c S _c d _c i _c + q(N _q -1)S _q d _q i _q + 0.5BγN _γ S _γ d _γ i _γ R _w '] In case of Local shear failure | | | | | | | | | | | | | | |
| q _{net sa} | _{fe} =1/3 | F[CN _c S | $d_c i_c + q$ | (N_q-1) |)S _q d _q i | _q + 0.5 | BγN _γ S _γ | d _y i _y R _w |] | | | | | | |
| In ca | se of L | local she | ear failu | are | | | | | | | | | | | |
| g _{net sa} | _{fe} = 1/ | F[0.67{C | CN' _c S _c d | $i_{cl} + c$ | ı(N'₀-1 | l)S_d_i | a + 0.51 | BγN',S | ,d,i,R, | .'] | | | | | |
| Cons | iderin | g the w | orst cas | e as f | ullv su | ıbmer | sed i.e. | water | table | raises u | pto th | le gr | oun | d surface | |
| Whe | re a | mat mat = 9 | Safe bea | aring | capaci | itv | | | | | r | 0- | | | |
| | C = C | Cohecior | | 8 | P | | $\mathbf{R} = \mathbf{W}$ | idth of | the fo | undati | 171 | | | | - |
| | v = B | ulk unit | woight | ŀ | | | D - W | iuui oi | uie io | unuan | JII | | | | |
| | J D | M = R | aring | anacit | a facto | 270 | 444 | 1 – D | onth f | actors | | | | | |
| | | 9' ¹ y - D | earing t | apaci | y facto | 15 | | 4 - D | epui i | actors | | | | | |
| | S_{σ}, S_{q} | $S_{\gamma} = Sh$ | ape Fac | ctors | | ~ ~ | $1_{c}, 1_{q}, 1_{\gamma}$ | = Incl | inatio | n factor | s | | | | |
| | SHA | PE FAC | TORS | (IS:64 | 103-19 | 81), C | lause 5 | 1.2.1, | table-2 | | r | | | 1 | |
| | Snap | e of fou | Indatio | n | | Sc | | | s _q | | | Sγ | | | |
| | 1)Cc | ntinuou | is strip | | 1 | 1.00 | (1) | 1 | 1.00 | /1) | 10 | 1.00 | T \ | | |
| | (11) Ka | ctangle | | | | +0.2(B) | /L) | | +0.2(B) | /L) | 1-0. | 4(B/ | L) | | |
| | $\frac{111}{100}$ Science | juare | | | | 1.30 | | | 1.20 | | | 0.60 | | | |
| 1 | DEP | TH FAC | TORS | (15:64 | 103-19 | 81, C | lause 5 | .1.2.2 | 1.20 | | <u> </u> | | | | |
| | | 1 | | 11+0 | 2/17/1 | P)o art | (NL) | | | | | 1 | | | |
| | $\mathbf{d_c} = \frac{1+0.2(D/B)\operatorname{sqrt}(N_{\Phi})}{1+0.2(D/B)\operatorname{sqrt}(N_{\Phi})}$ | | | | | | | | | | | | | | |
| | L | dq | | for t | P < 10 | | tor $\Phi >$ | $10^{\circ} = 1$ | + 0.1(D | f/B)sqrt | ΊN _Φ | | | | |
| | L | d _γ | | for o | $P < 10^{\circ}$ | /=1 | for $\Phi >$ | $10^{\circ} = 1$ | + 0.1(D | _f /B)sqrt | N _o | | | | |
| Now | , | C = | | 0 | t/m² | γ= | 2.000 | t/m ³ | | SqN₀= | 1.963 | | | | |
| | | Φ = | | 3 | 36 | γ _{sub} ≕ | 1.000 | t/m³ | | C'= | 0 | | | | |
| Beari | ng Ca | pacity fa | actors a | s per | IS:640 | 3-1981 | l Table | 1 Clau | ıse 5.1. | .1 | | | | | |
| | | BCE | actors | Ger | ieral S | Shear | Lo | cal Sh | ear | | | | | | |
| | | | | | failue | r | jj | failue | | | | | | | |
| | | N | c= | | 49.316 | 6 | | 21.846 | | | | | | | |
| | | N | q= | | 36.28 | | | 11.475 | | | | | | | |
| | | N | | | 53.15 | 6 | | 11.930 | | 1 | | | | | |
| Using | the Fac | tor of Saf | fety = | 6 | | | | | | 1 | | | | | |
| of | 5 (j | of on | Ъ Ę | | | | | | | | | | | a | |
| ize . | | ati | th ati | | | | | | | | Incli | inati | ion | from | SBC |
| ŝ. | Dui | Sha | Del | R _w | Sha | ape fa | ctors | De | pth fa | ctors | fa | ctor | s | GSFailure | T/m^2 |
| | 101 | for | lof | | | | | | | | | | - | t/m^2 | 17 11 |
| R | r r | | | | S. | S. | S., | <u>d.</u> | d_ | | i. | i. | i. | 9111 | |
| 1.50 | 1.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | -q | -y | 19.02 | 19.02 |
| 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.29 | 1.15 | 1.15 | | | | 20.27 | 20.27 |
| 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.24 | 1.12 | 1.12 | | | 1 | 21.73 | 21.73 |
| 3.00 | 3.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.20 | 1.10 | 1.10 | | | | 23.30 | 23.30 |
| 1.50 | 1.50 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.52 | 1.26 | 1.26 | | | | 24.51 | 24.51 |
| 2.00 | 2.00 | Square | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 25.36 | 25.36 |
| 2.50 | 2.50 | oquare | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.31 | 1.16 | 1.16 | | | | 26.58 | 26.58 |
| 3.00 | 3.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.26 | 1.13 | 1.13 | | | | 27.98 | 27.98 |
| 1.50 | 1.50 | | 2,50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.65 | 1.33 | 1.33 | | | | 30.46 | 30.46 |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.49 | 1.20 | 1.20 | | | | 31.70 | 31.70 |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1 20 | 0.80 | 1.33 | 1.16 | 1.16 | | | | 32.89 | 32.89 |
| 3.00 | 0.00 | | | | 1.1.1.1.1 | | | | | | | | | | |

Jharkhand Foundation Consultants



| GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF G + 3 STORIED BUILDING IN PARMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE - CHERI/MANATU UNDER JHARKHAND | | | | | | | | | | | | | |
|---|----------------------------|--------------------------|---------------|--------------|-------------------|--------------|---------------|--------------------|----------------|--|--|--|--|
| FIELI Bore Hole No. BH-01 (Administra | <u>) BORE</u> ative Bui | <u>LOG DA'</u> lding) | <u>TA SHE</u> | ET | | | | | _ | | | | |
| Method of Boring Auger and Rotary Dia. of the Bore Hole 150 mm | | | | Water | : Table | 5 | 2.50m bgl | | | | | | |
| Date of Commencement 18/02/2012 | SYMBOL | DEP | тн | Date | of Con SPT | npletic | on N-Value | 18/02/2 Type of | 012 Remarks | | | | |
| Depth Depth | | From(m) | To (m) | 0-15 | 15-30 | 30-45 | <u> </u> | sample | | | | | |
| Reddish mooram 0.50m | | 0.50 | - | - | - | - | - | DS | | | | | |
| and pabbles | | 1.00 | 1.45 | 10 | 15 | 20 | 35 | SPT/DS | | | | | |
| Light greyish weathred rock mix with boulder and calcareous noodles | | 2.00 | 2.08 | 50 blo pe | ows fo netrati | r 8cm ion | >100 | SPT/DS | | | | | |
| | | | | | | | | | | | | | |
| | | (Termina | ation D | epth = | = 2.00 | m) | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | ; | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | - - - | | - | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | : | | | | | | |
| SPT - Standard Penetration Tests | | DS - Dist | urbed s | ample | s | UDS | - Undist | urbed sa | mples | | | | |

8

. . . .

221040250A

Ranch

| | | FIELI |) BORE | LOG DA | ГА SHE | ET | | | | | | |
|---|--|----------------------------|----------------|----------|--------------|----------------|------------------|-----------------|-----------|--------|-------|--|
| ore Ho | le No. | BH-02 (Administra | ative Bui | lding) | | | | | | | | |
| lethod | of Boring | Auger and Rotary | | | | Water | Table | 2 | 2.50m bgl | | | |
| ia. of tl | ne Bore Hole | 150 mm | | | | _ | | | | | | |
| Date of Commencement 18/02/2012 Date of Con | | | of Con | npletic | on | 18/02/20 |)12 | | | | | |
| Date and | DESC | CRIPTION | SYMBOL | DEP | IH Tr () | 0.15 | SPT | 20.45 | N-Value | sample | Kemai | |
| Deptit | | | THE STREET SET | From(m) | 10 (m) | 0-15 | 15-30 | 30-45 | | | | |
| | Dark brown weat | hered to soft rock | | 0.50 | - | - | - | - | - | DS | | |
| | 1. | .50m | | 1.00 | 1.45 | 6 | 13 | 28 | 41 | SPT/DS | | |
| | Yellowish grey de rock mix with gra | composed product o vels | f | 2.00 | 2.21 | 34, 5 6cm j | 0 blow penetr | vs for ation | >100 | SPT/DS | | |
| | | | | | | | | | | | | |
| | | | | (Termina | ation De | epth = | = 2.00 | m) | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | 1 | | | | | 1 | |

221040250A

1

Panch

REPORT ON GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED LIBRARY BUILDING IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

A

SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | 6 |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>Library Building</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth of foundation and the selection of type of foundation. As the ground, water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consultant

4oundation

Panch

CHAPTER - II

2.0 **PROJECT DETAILS:**

2.1. The fieldwork consisted of two nos. of bore hole at pre-determined location.The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.00 | 18/02/2012 | 18/02/2012 |
| 2 | BH-02 | 2.00 | 18/02/2012 | 18/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2131 in bore hole using a split epoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.



CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.



CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{net safe} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_\gamma N_\gamma S_\gamma D_\gamma R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor

Jharkhand Foundation Consultants

F = Factor of safety

 N_{c} , N_{q} , N_{γ} = Bearing capacity factors

 S_{c}, S_{q}, S_{γ} = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2.

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

- e_0 = initial void ratio
- p_0 = initial overburden pressure
- Δp = increase in overburden pressure
- λ_{oed} = Oedometer correction factor

 $d_f = depth factor$

dr = Rigidity factor

CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for O | pen foundation |
|-----------|-----------------------|
| Depth | (ton/m ²) |
| (m) from | |
| EGL | |
| 1.50 | 18.0 |
| 2.00 | 22.0 |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data and with any modified interpretation of geo- minical expert.

slanto

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)



CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS

.

| | | | I | FROM | <u>и SH</u> | EAR | FAILU | J <u>RE C</u> | <u>ONS</u> | DERA | TIO | N | | | |
|---|--|----------------|-------------|----------------|------------------|--------------------|----------------|------------------|------------|----------------------|--------|----------------|-----|------------------|---------|
| Beari | ng cap | pacity of | founda | ation | of diff | erent | sizes of | found | lation | at diffe | rent d | leptl | h | | |
| As pe | As per IS:6403-1981 Cl. 5.1.2 n case of General shear failure $a_{metsefe} = 1/F[CN_cS_cd_{cic} + q(N_0-1)S_0d_0i_0 + 0.5ByN_vS_vd_vi_vR_w']$ | | | | | | | | | | | | | | |
| In cas | n case of General shear failure net safe =1/F[CN _c S _c d _c i _c + q(N _q -1)S _q d _q i _q + 0.5BγN _y S _y d _y i _y R _w '] n case of Local shear failure | | | | | | | | | | | | | | |
| 9 _{net sa} | $\begin{aligned} & = 1/F[CN_cS_cd_ci_c + q(N_q-1)S_qd_qi_q + 0.5B\gamma N_\gamma S_\gamma d_\gamma i_\gamma R_w'] \\ & \alpha \text{ case of Local shear failure} \\ & \alpha_{\text{net safe}} = 1/F[0.67\{CN_c^{'}S_cd_ci_{cl} + q(N_q^{'}-1)S_qd_qi_q + 0.5B\gamma N_\gamma S_\gamma d_\gamma i_\gamma R_w'] \end{aligned}$ | | | | | | | | | | | | | | |
| In cas | The case of Local shear failure $net_{safe} = 1/F[0.67\{CN'_cS_cd_{ci_cl} + q(N'_q-1)S_qd_{qi_q} + 0.5B\gamma N'_\gamma S_\gamma d_\gamma i_\gamma R_w']$ Considering the worst case as fully submersed i.e. water table raises upto the ground surface | | | | | | | | | | | | | | |
| q _{net sat} | $\begin{array}{l} & \label{eq:netsafe} = 1/F[0.67\{CN'_cS_cd_ci_{c}] + q(N'_q-1)S_qd_qi_q + 0.5B\gamma N'_\gamma S_\gamma d_\gamma i_\gamma R_w'] \\ & \label{eq:netsafe} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$ | | | | | | | | | | | | | | |
| Cons | Considering the worst case as fully submersed i.e. water table raises up to the ground surface Where $q_{net safe} = Safe bearing capacity$ C = Cohesion B = Width of the foundation | | | | | | | | | | | | | | |
| Wher | Where $q_{\text{net safe}} = \text{Safe bearing capacity}$ C = Cohesion $B = Width of the foundationy = Bulk unit weight$ | | | | | | | | | | | | | | |
| | $C = Cohesion$ $\gamma = Bulk unit weight$ $N_{cr} N_{qr} N_{qr} = Bearing capacity factors$ $d_{cr} d_{qr} d_{r} = Depth factors$ | | | | | | | | | | | | | | |
| | $\gamma = Bulk unit weight$ $N_{c'} N_{q'} N_{\gamma} = Bearing capacity factors$ $d_{c'} d_{q'} d_{\gamma} = Depth factors$ | | | | | | | | | | | | | | |
| | $N_{cr} N_{qr} N_{q} = Bearing capacity factors$ $S_{cr} S_{rr} S_{rr} = Shape Factors$ $i_{rr} i_{rr} i_{rr} = Inclination factors$ | | | | | | | | | | | | | | |
| | $S_{cr} S_{qr} S_{\gamma} =$ Shape Factors $i_{cr} i_{qr} i_{\gamma} =$ Inclination factors | | | | | | | | | | | | | | |
| | SHAPE FACTORS (IS:6403-1981), Clause 5.1.2.1, table-2 | | | | | | | | | | | | | | |
| | Shape of foundation s_c s_q s_{γ} | | | | | | | | | | | | | | |
| i) Continuous strip 1.00 1.00 1 | | | | | | | | | | | | | | | |
| | ii) Ra | ctangle | ` | | 1. | +0.2(B, | /L) | 1 | +0.2(B/ | /L) | 1-0. | 4(B/ | Ľ) | 1 | |
| | iii) Sq | luare | | | | 1.30 | | | 1.20 | | 1 | 0.80 | | | |
| | iv) Ci | rcular | | | | 1.30 | | | 1.20 | | | 0.60 | | | |
| | DEPI | IH FAC | TORS | (15:64 | 103-19 | 81), C | lause 5. | .1.2.2 | | | | 1 | | | |
| | | d, | | 1+0. | 2(D/1 | 3)sqrt | (N_{Φ}) | | | | | | | | |
| | | dq | | for (| ¢ < 10° | =1 | for $\Phi >$ | $10^0 = 1$ | + 0.1(D | _f /B)sqrt | Nφ | | | | |
| | | d _y | | for ¢ | $P < 10^{0}$ | =1 | for Φ > | $10^0 = 1$ | + 0.1(D | ı/B)sqrt | Nφ | | | | |
| Now | , | C = | | 0 | t/m ² | γ= | 1.925 | t/m ³ | | SqN₀= | 1.963 | - | | | |
| | | Φ = | | 3 | 36 | γ _{sub} ≕ | 0.925 | t/m ³ | | C'= | 0 | | | | |
| Beari | ng Caj | pacity fa | actors a | s per | IS:640 | 3-1981 | l Table | 1 Clau | ise 5.1. | .1 | | | | | |
| | | DOP | | Gen | ieral S | hear | Loc | cal Sh | ear | | | | , | | |
| | | BCFa | actors | | failmo | - | f | failuer | : | | | | | | |
| | | N | ,= | | 49.316 | 5 | | 21.846 | | | | | | | |
| | | N | a= | | 36.28 | | | 11.475 | | | | | | | |
| | | N | <u></u> | | 53.15 | 5 | | 11.930 | | 1 | | | | | |
| Using | the Fac | tor of Saf | fety = | 6 | | | | | | 1 | | | | | |
| Ъ, | n) n | of on | o t | | | | | | | | | | | anat anta | |
| ize | () () | ape lati | pth lati | | | | | _ | | | Incl | inati | ion | from | SBC |
| ŝ | oun | Sha | Del | R _w | Sha | ipe fa | ctors | De | pth fac | ctors | fa | ctor | s | GSFailure | T/m^2 |
| | 2 | fo | foi | | | | | | | | | | | t/m ² | 1 |
| В | L | | | | S _c | Sq | S _y | dc | dq | dy | ic | i _q | i, | - | |
| 1.50 | 1.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 17.83 | 17.83 |
| 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.29 | 1.15 | 1.15 | | | | 19.06 | 19.06 |
| 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.24 | 1.12 | 1.12 | | | | 20.47 | 20.47 |
| 3.00 3.00 1.50 0.50 1.30 1.20 0.80 1.20 1.10 1.10 21.99 1.50 1.50 0.50 1.30 1.20 0.80 1.52 1.26 1.26 21.99 1.50 1.50 0.50 1.30 1.20 0.80 1.52 1.26 1.26 21.99 | | | | | | | | | | 21.99 | 21.99 | | | | |
| 2.00 | 2.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.32 | 1.20 | 1.20 | | | | 22.92 | 22.92 |
| 2.50 | 2.50 | Square | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.31 | 1.16 | 1.16 | | | | 24.97 | 24.97 |
| 3.00 3.00 2.00 | | | | 0.50 | 1.30 | 1.20 | 0.80 | 1.26 | 1.13 | 1.13 | | | | 26.33 | 26.33 |
| 1.50 | 1.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.65 | 1.33 | 1.33 | | | | 28.44 | 28.44 |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.49 | 1.25 | 1.25 | | | | 28.82 | 28.82 |
| 2.50 | 2.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 29.72 | 29.72 |
| 3.00 | 3.00 | i 1 | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.33 | 1.16 | 1.16 | | | | 30.89 | 30.89 |

221040260B

| GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF G + 3 STORIED BUILDING IN PARMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE - CHERI/MANATU UNDER KANKE BLOCK, DISTT RANCHI, JHARKHAND | | | | | | | | | | | | | |
|--|--|------------|-----------|----------|---------------|-----------------|------------------|---------|-----------|---------|--|--|--|
| | FIELD |) BORE | LOG DA' | ГА SHE | ET | | | | | | | | |
| Bore Hol | e No. BH-01 (Library Bui | ilding) | | | | | | | | | | | |
| Method | of Boring Auger and Rotary | | Water | Table | 2 | | 2.50m bgl | | | | | | |
| Dia. of th | ne Bore Hole 150 mm | | | | | | | | | | | | |
| Date of C | Commencement 18/02/2012 | | | | Date of | of Con | npletic | on | 18/02/2 | 012 | | | |
| Date and | DESCRIPTION | SYMBOL | DEP | rH | SPT | | | N-Value | sample | Kemarks | | | |
| Depui | | Alterative | From(m) | 10 (m) | 0-15 | 15-30 | 30-45 | | | | | | |
| | Reddish brown silty coarse sand | | 0.50 | - | - | - | - | - | DS | | | | |
| | 1.60m | | 1.00 | 1.45 | 2 | 8 | 17 | 19 | SPT/DS | | | | |
| | Darkbrown mooram mix with gravles and soft rock | | 2.00 | 2.25 | 33, 5 10cm | 0 blow penet | vs for ration | >100 | SPT/DS | | | | |
| | | | | | | | | | | | | | |
| | | | (Termina | ation D | epth = | = 2.00 | m) | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | - | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | - | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| SPT - Sta | andard Penetration Tests | | DS - Dist | turbed s | ample | S | UDS | - Undis | turbed sa | mples | | | |



| GEOTEC CENTRA | HNICAL INVESTIGATI L UNIVERSITY OF JHA | ON FOR THE PROPOSE RKHAND IN VILLAGE | D CONST - CHERI/I JHA | TRUCTION MANATU U ARKHAND | OF G + 3 NDER | STORIE | ED BUII | LDING KAN | IN PARN NKE BLOO | IANENT C. CK, DISTT. | AMPUS OF - RANCHI, | |
|-----------------------|---|---|-----------------------------|---------------------------------|------------------|--------------|------------------|------------------|---------------------|-------------------------|-----------------------|--|
| | | FIELD | BORE | LOG DA | ГА SHE | ET | | | | | | |
| Bore Ho Method | le No. of Boring | BH-02 (Library Bui Auger and Rotary | lding) | ling) | | | | 2 | | 2.50m bgl | | |
| Dia. of the Date of (| he Bore Hole Commencement | 150 mm 18/02/2012 | | | | Date | of Con | npletio | n | 18/02/2012 | | |
| Date and | DESCR | IPTION | SYMBOL | DEP | ГН | | SPT | | N-Value | Type of | Remarks | |
| Depth | | | NATURA DE LA COMPANSIÓN | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | | |
| | Dark greyish brown | n silty sand | | 0.50 | - | - | - | - | - | DS | | |
| | 1.7 | 0m | | 1.00 | 1.45 | 2 | 13 | 14 | 27 | SPT/DS | | |
| | Light grey gravele rock mix with calci | s to stiff product of tes | 33 | 2.00 | 2.21 | 19, 5 6cm | 0 blow penetr | rs for ration | >100 | SPT/DS | | |
| | | | | | | | | | | | | |
| | | | | (Termina | ation D | epth = | - 2.00 | m) | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | - | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| SPT - St | andard Penetration | Tests | | DS - Dist | urbed s | ample | s | UDS | - Undisi | turbed sa | mples | |



REPORT ON GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED GIRLS HOSTEL BUILDING IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

A

SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



491-3

Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | C |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



ſ

CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>Girls Hostel</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consult

CHAPTER - II

2.0 PROJECT DETAILS:

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.00 | 19/02/2012 | 19/02/2012 |
| 2 | BH-02 | 2.50 | 19/02/2012 | 19/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2131 in bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.



CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.



CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{net \ safe} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor

Jharkhand Foundation Consultants

F = Factor of safety

 $N_{c,} N_{q,} N_{\gamma}$ = Bearing capacity factors

 $S_{c,} S_{q,} S_{\gamma}$ = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2

 $S_c = \text{Ht}/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{\text{oed}} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

e₀ = initial void ratio

 p_0 = initial overburden pressure

 Δp = increase in overburden pressure

 λ_{oed} = Oedometer correction factor

 d_f = depth factor

 d_r = Rigidity factor



CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for Open foundation | | | | | | | |
|-------------------------|-----------------------|--|--|--|--|--|--|
| Depth | (ton/m ²) | | | | | | |
| (m) from | | | | | | | |
| EGL | | | | | | | |
| 1.50 | 19.5 | | | | | | |
| 2.00 | 23.0 | | | | | | |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data and with any modified intermetation of geo-technical expert.

Sentor

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)



CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS FROM SHEAR FAILURE CONSIDERATION

| | | | - | FRO. | <u>M SH</u> | EAR | FAIL | JKE C | ONS. | IDERA | 110 | N | | | |
|------------------------------|-----------------------------------|----------------------|------------------|---------------------|----------------------------------|---------------------------------|-------------------------------------|---|------------------|---------------------|----------------|------------------|-----|------------------------------|------------------|
| Bearin | g cap | pacity of | f found | ation | of dif | ferent | sizes o | f foun | dation | at diffe | erent c | lept | h | | |
| As per | IS:6 | 403 - 198 | 1 Cl. 5. | 1.2 | | | | | | | | | | | |
| In case | e of G | General : | shear fa | ailure | | | | | | | | | | | |
| q _{net safe} | =1/I | F[CN _c S | $d_{ci_{c}} + q$ | I(N ₉ -1 |)S _q d _q i | _q + 0.5 | 5BγN _y S | ,d _y i _y R _w | '] | | | | | | |
| In case | e of L | ocal she | ear failu | ıre . | • • | | | | | | | | | | |
| G net safe | = 1/ | F[0.67{C | CN',S,d | $i_{c1} + c$ | a(N'1 | l)S _a d _a | i _a + 0.5 | BγN',S | ,d,i,R, | .'I | | | | | |
| Consid | lerin | g the w | orst cas | e as f | ullv si | ibmer | sed i.e. | water | table | raises u | pto th | ne gr | oun | d surface | |
| Where | a. | $b = c_{at} = 0$ | Safe bea | aring | capac | itv | | | tubic . | | Pro u | 6. | | a barrace | |
| | C = C | Cohesior | ı | 0 | | , | B = W | idth of | f the fo | unđati | on ' | | | | |
| | y = Bulk unit weight | | | | | | | | | | | | | | |
| | N N | N = B | earing c | anaci | v facto | ors | đđ (| 1 = D | enth f | actors | | | | | |
| | | | To | | ., | | : : : : | - I- a | cptil I | . (| _ | | | | |
| | ס _{כי} , ס _{קי} | $S_{\gamma} = Sn$ | аре гас торе | ctors | 102 10 | 01) C | 1 _c , 1 _q , 1 | r = Incl | | n factor | S | | | | |
| | Shan | PE FAC | TOK5 | (15:04 n | £03-19 | <u>81), C</u> | lause o | .1. <i>2</i> .1, | table-2 | | | S | | T | |
| | | e of fou | a obvio | | ļ | C | | | <u>9</u> 1.00 | | | - ³ γ | | 4 | |
| | $\frac{1}{1}$ Ro | ctanglo | is strip | | 1 | 1.00 +0.2/B | (1) | 1 | 1.00 | /1) | 1.0 | 1.00 | (1) | - | |
| | $\frac{1}{10}$ Ka | liare | | | | 1 30 | / L) | | 1 20 | / L) | 1-0 | 0.80 | L) | - | |
| | v) Ci | rcular | | | | 1.30 | | <u> </u> | 1.20 | | | 0.60 | | - | |
| | DEPI | TH FAC | TORS | (15:64 | 1 103-19 | 181), C | lause 5 | 0.1.2.2 | | | | | |] | |
| Г | | d | | 1+0 | 2(D/ | B)sar | (N_{1}) | | | | | 1 | | | |
| - | | | | for a | $\frac{2(D)}{D < 10^6}$ | $\frac{D}{2} = 1$ | $\frac{1}{1}$ | 100 1 | + 0.1/17 | (P)cord | NI | - | | | |
| | | | | | - 10 | - 1 | | 10 - 1 | + 0.1(D | () D)SQI | | | | | |
| | | dγ | | for a | $\Phi < 10^{\circ}$ | = 1 | for $\Phi >$ | $10^{\circ} = 1$ | + 0.1(D | _f /B)sqr | Νφ |] | | | |
| Now, | | C = | | 0 | t/m* | γ= | 2.000 | t/m [°] | | SqN _Φ = | 1.963 | | | | |
| | | Φ = | | 3 | 36 | γ _{sub} ≝ | 1.000 | t/m° | | C'= | 0 | | | | |
| Bearing | g Caj | pacity fa | actors a | s per | IS:640 | 3-198 | 1 Table | 1 Claı | ıse 5.1 | .1 | | | | | |
| | | BCF | ectors | Ger | failuer f | | | cal Shear failuer | | | 1 m. | | | | |
| | | | | ļ | | | | | | | | | | | |
| | | N | c= | | 49.31 | 6 | | 21.846 | | | | | | | |
| | | N | = | | 3 6.2 8 | } | - | 11.475 | | | | | | | |
| | | N | γ= | | 53.15 | 156 11.930 | | | | | | | | | |
| Using th | e Fac | tor of Saf | ety = | 6 | | | | | | - | | | | | |
| of | (m | of ton | of ion | | | | | | | | | | | q _{net safe} | |
| lati | • | ape dati | pth dati | | 01 | 6 | | D. | - c1- C- | | Incl | inat | ion | from | SBC |
| o un | | Sh | De | Kw | Sn | аре га | ctors | De | ptn ra | ctors | fa | ctor | s | GSFailure | T/m ² |
| 9 9 | | fo | fo | | | | | | | | | | | t/m ² | |
| В | L | | | | S _c | Sq | Sy | d _c | dq | d _y | i _c | i _q | i, | | |
| 1.50 | 1.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 19.02 | 19.02 |
| 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.29 | 1.15 | 1.15 | | | | 20.27 | 20.27 |
| 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.24 | 1.12 | 1.12 | | | | 21.73 | 21.73 |
| 3.00 | 3.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.20 | 1.10 | 1.10 | | | | 23.30 | 23.30 |
| 2.00 | 2.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.52 | 1.20 | 1.20 | | | | 24.31 | 24.01 |
| 2.00 2 | 2.00 | Square | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 25.50 | 25.50 |
| 3.00 | 3.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.26 | 1.13 | 1.13 | | | | 27.98 | 27.98 |
| 1.50 | 1.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.65 | 1.33 | 1.33 | | | | 30.46 | 30.46 |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.49 | 1.25 | 1.25 | | | | 30.79 | 30.79 |
| 2.50 2 | 2.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 31.70 | 31.70 |
| 3.00 | 3.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.33 | 1.16 | 1.16 | | | | 32.89 | 32.89 |



. •

| GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF G + 3 STORIED BUILDING IN PARMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE - CHERI/MANATU UNDER JHARKHAND | | | | | | | | | | |
|---|---|----------|----------|---------|-------------------|-----------------------------|-----------|---------|----------|---------|
| | FIELD BORE LOG DATA SHEET | | | | | | | | | |
| Bore Hole No.BH-01 (Girls Hostel 3 Beded)Method of BoringAuger and RotaryWater TableDia of the Bore Hole150 mm | | | | | | | 2.50m bgl | | | |
| Date of C | Commencement 19/02/2012 | | | | Date o | of Con | npletio | on | 19/02/20 | 012 |
| Date and | DESCRIPTION | SYMBOL | DEP | ГН | | SPT | | N-Value | Type of | Remarks |
| Depth | | Same and | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sampie | |
| | Dark brown sand mix with mooram and pabbles | | 0.50 | - | - | - | - | | DS | |
| | 1.45m | | 1.00 | 1.45 | 5 | 17 | 20 | 37 | SPT/DS | |
| | Light yellow brown patches coarse sand mix with gravels and soft rock | | 2.00 | 2.37 | 18, 3 f pe: | 0,50 b or 7cn netrati | n ion | >100 | SPT/DS | |
| | | | (Termina | ation D | epth = | = 2.00 | m) | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| SPT - Sta | SPT - Standard Penetration Tests DS - Disturbed samples UDS - Undisturbed samples | | | | | | | | | |



| GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF G + 3 STORIED BUILDING IN PARMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE - CHERI/MANATU UNDER KANKE BLOCK, DISTT RANCHI, JHARKHAND | | | | | | | | | | |
|--|--|--------------|-------------|---------|----------------|------------------|--------------|------------------|---------|---------|
| | FIELD BORE LOG DATA SHEET | | | | | | | | | |
| Bore Hol Method | le No. BH-02 (Girls Host of Boring Auger and Rotary | d) | Water Table | | | 2.50m bgl | | | | |
| Dia. of th | Te Bore Hole 150 mm | | | | Date | of Con | nvletic | n | 19/02/2 | 012 |
| Date and | DESCRIPTION | SYMBOL DEPTH | | TH | SPT | | | N-Value | Type of | Remarks |
| Depth | | | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | |
| | | | 0.50 | - | - | - | - | - | DS | |
| | Reddish brown mooram | | 1.00 | 1.45 | 6 | 18 | 10 | 28 | SPT/DS | |
| | 2.10m | | 2.00 | 2.45 | 18 | 25 | 36 | 61 | SP17DS | |
| | White grey soft rock with pices o gravels and boulder | | 2.50 | 2.54 | 50 blo pe | ows fo netrat | r 4cm ion | >100 | SPT/DS | |
| | | | (Termina | ation D | epth = | = 2.50 | m) | - - - - | | |
| | | | | | | | | | | |
| | | | - | | | | | | | • |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| SPT - Standard Penetration Tests DS - Disturbed samples UDS - Undisturbed samples | | | | | | | | | | |

. 20



7

REPORT ON GEOTECHNICAL INVESTIGATION

A

FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>CENTRAL</u> <u>SCHOOL</u> IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

> SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033

221040260D

Yanc

Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | C. |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |


CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>Central School</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth or foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Fourdation Consultan

CHAPTER - II

2.0 **PROJECT DETAILS:**

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.50 | 19/02/2012 | 19/02/2012 |
| 2 | BH-02 | 2.00 | 19/02/2012 | 19/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2100 in bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.

CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.



CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{net \ safe} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation

 R_w = Water table correction factor



| GEOTEC | HNICAL INVESTIGAT L UNIVERSITY OF JHA | ION FOR THE ARKHAND IN | PROPOSI VILLAGE | ED CONST - CHERI/I JH/ | RUCTION MANATU U ARKHAND | OF G + 3 NDER | STORIE | ED BUII | LDING KAN | IN PARN NKE BLOO | IANENT C. CK, DISTT. | AMPUS OF - RANCHI, |
|------------|--|---------------------------|--------------------|------------------------------|--------------------------------|--------------------|--------------|-------------------|-------------------|---------------------|-------------------------|-----------------------|
| | | | FIELD | BORE | LOG DA | <u>ГА SHE</u> | ET | | | | | |
| Bore Hol | e No. | BH-01 (Ce | ntral Sch | nool) | | | | | | | | |
| Method | of Boring | Auger and | Rotary | | | | Water | Table | 2 | | 2.50m bg | 1 |
| Dia. of th | ne Bore Hole | 150 mm | | | | | | | | | | |
| Date of C | Commencement | 19/02/201 | 2 | | | Date of Completion | | | | 19/02/20 |)12 | |
| Date and | DESCI | RIPTION | | SYMBOL | DEP | TH | 0.45 | SPT | 00.45 | N-Value | sample | Kemarks |
| Depth | • | | | 14.11.24.24A | From(m) | To (m) | 0-15 | 15-30 | 30-45 | <u> </u> | Buttipic | |
| | Reddish brown mo 0.5 | ooram 50m | <u></u> | | 0.50 | - | - | - | - | - | DS | |
| | | | | | 1.00 | 1.45 | 14 | 17 | 19 | 36 | SPT/DS | |
| | Brownish grey s | oft rock m | ix with | | 2.00 | 2.45 | 23 | 30 | 36 | · 66 | SPT/DS | |
| | | | | | 2.50 | 2.53 | 50 blo pe | ows fo netrati | r 3cm ion 1 | >100 | SPT/DS | |
| | | | | | (Termina | ation D | epth = | - 2.50 | (m) | | | |
| | | | | | | | | | | | | |
| | | ••• | | | - | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | - | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| SPT - St | andard Penetration | Tests | | I | DS - Dist | urbed s | ample | s | UDS | - Undis | turbed sa | mples |



| GEOTEC CENTRA | HNICAL INVESTIGATION FOR THE PROPOSI LL UNIVERSITY OF JHARKHAND IN VILLAGE | ED CONS' - CHERI/ JH. | TRUCTION MANATU U ARKHAND | OF G + 3 JNDER | GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF G + 3 STORIED BUILDING IN PARMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE - CHERI/MANATU UNDER KANKE BLOCK, DISTT RANCHI, JHARKHAND | | | | | AMPUS OF - RANCHI, |
|-----------------------|---|-----------------------------|---------------------------------|-------------------|--|------------------------------|------------------|----------|-------------|-----------------------|
| | FIELT |) BORE | LOG DA | TA SHE | ET | | | | | |
| Bore Ho Method | le No. BH-02 (Central Sch of Boring Auger and Rotary | nool) | 200 212 | | Water | r Table | 2 | | 2.50m bg | çl |
| Dia. of the Date of C | he Bore Hole 150 mm Commencement 19/02/2012 | | | | Date | of Con | npletio | on | 19/02/2 | 012 |
| Date and | DESCRIPTION | SYMBOL | DEP | TH | | SPT | 1 | N-Value | lue Type of | Remarks |
| Depth | | | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | |
| | Yellowish brown coarse sand mix with mooram | | 0.50 | | æ | - | - | - | DS | |
| | | | 1.00 | 1.45 | 5 | 17 | 20 | 37 | SPT/DS | |
| | White grey brown patches soft rock | | 2.00 | 2.34 | 18, 3 f pe | 7, 50 b or 4cn netrati | lows n ion | >100 | SPT/DS | |
| | | | (Termin | ation D | epth = | = 2.00 | m) | | | |
| | | | | | | | | | | |
| | | - | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| SPT - Sta | andard Penetration Tests | L | DS - Dist | urbed s | amples | لا ع | UDS | - Undist | urbed say | mples |

9

Jharkhand Foundation Consultants

oundation

Panchi

6

E

REPORT ON GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>ACADEMIC</u> BUILDING-1 IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

A

SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD

RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



491-6

Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | C |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>Academic Building-1</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to **two** nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consultants

koundatio,

CHAPTER - II

2.0 PROJECT DETAILS:

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.00 | 20/02/2012 | 20/02/2012 |
| 2 | BH-02 | 2.50 | 20/02/2012 | 20/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2131 in bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.

CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.



CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing expacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{\text{net safe}} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor



F = Factor of safety

 N_{c} , N_{q} , N_{γ} = Bearing capacity factors

 $S_{c,} S_{q,} S_{\gamma}$ = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Second as a clause 9.2.2.2

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

 e_0 = initial void ratio

 p_0 = initial overburden pressure

 Δp = increase in overburden pressure

 λ_{oed} = Oedometer correction factor

 d_f = depth factor

d_r = Rigidity factor



CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for Open foundation | | | | | |
|-------------------------|-----------------------|--|--|--|--|
| Depth | (ton/m ²) | | | | |
| (m) from | | | | | |
| EGL | | | | | |
| 1.50 | 18.0 | | | | |
| 2.00 | 22.0 | | | | |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data and with any modified interpretation of geo-technical expert.

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)



CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS <u>FROM SHEAR FAILURE CONSIDERATION</u>

| Beari | ng cap | acity of | founda | ation | of diff | different sizes of foundation at different depth | | | | | | | | | |
|----------------------|-----------------------------------|--------------------------------|---|---------------------|---------------------------|--|--|----------------------------------|--|----------------------|----------------|----------------|----------------|------------------------------|-------------------|
| As pe | er 15:04 | 103-1981 | Door fo | iluro | | | | | | | | | | | |
| In cas | e oi G | eneral s | near ia | nure | | | DNC | 1 · D · | | | | | | | |
| q _{net sat} | e = 1/F | CN _c S _c | $d_c l_c + q$ | (N _q -1 | $S_q a_{q^1}$ | + 0.5 | ΒγΙΝγSγ | a _{yly} K _w | 1 | | | | | | |
| In cas | e of L | ocal she | ar failu | re | | | | | | | | | | | |
| q _{net sai} | $r_{e} = 1/1$ | F[0.67{C | N' _c S _c d _c | i _{c)} + q | (N' _q -1 |)S _q d _q i | _q + 0.5E | βγN' _γ S _γ | d _y i _y R _w ' |] | | | | | |
| Consi | iderin | g the wo | orst case | e as fi | illy su | bmer | sed i.e. | water | table r | aises u | pto th | e gr | oun | d surface | |
| Wher | e q _r | et safe = S | Safe bea | ring | capaci | ty | | | | | | | | | |
| | C = C | ohesion | l | | | | B = Wi | dth of | the fo | undatio | n | | | | |
| | γ = Bι | ılk unit | weight | | | | | | | | | | | | |
| | N_c , N_c | $_{\gamma} N_{\gamma} = Be$ | earing ca | apacit | y facto | rs | d _c ,d _q ,d | $l_{\gamma} = D d$ | epth fa | actors | | | | | |
| | S _c , S _q , | $S_{\gamma} = Sha$ | ape Fac | tors | | | i _c , i _q , i _y | = Incl | inatior | n factors | 5 | | | | |
| | SHA | PE FAC | TORS | (IS:64 | 03-19 | 81), Cl | lause 5. | 1.2.1, | able-2 | | | | | | |
| | Shap | e of fou | ndatio | n | | s _c | | | sq | | | sγ | | | |
| | i)Co | ntinuou | s strip | | | 1.00 | | | 1.00 | | 1 | 1.00 | | | |
| | ii) Ra | ctangle | | | 1. | +0.2(B) | /L) | 1 | +0.2(B/ | ′L) | 1-0. | 4 (B/ | L) | | |
| | iii) Sq | uare | | | | 1.30 | | | 1.20 | | (| 0.80 | | | |
| | iv) Ci | rcular | | | | 1.30 | | | 1.20 | | (|).60 | | | |
| | DEPI | H FAC | TOKS | (15:64 | 103-19 | o1), C | lause 5 | .1.2.2 | | | | | | | |
| | | ďc | | 1+0. | 2(D/I) | 3)sqrt | (N_{Φ}) | | | | | | | | |
| | | dq | | for 4 | ¢ < 10° | = 1 | for $\Phi >$ | $10^0 = 1$ | + 0.1(D | _f /B)sqrt | Nφ | | | | |
| | | d, | | for ¢ | $10^{\circ} < 10^{\circ}$ | =1 | for $\Phi >$ | $10^0 = 1$ | + 0.1(D | _f /B)sqrt | NΦ | | | | |
| Now | , | C = | | 0 | t/m ² | γ= | 1.925 | t/m ³ | | SqN₀≈ | 1.963 | | | | |
| | | Φ = | | 3 | 86 | $\gamma_{sub} =$ | 0.925 | t/m ³ | | C'= | 0 | | | | |
| Beari | ng Car | oacity fa | actors as | s per l | IS:640 | 3-1981 | Table | 1 Clau | se 5.1. | 1 | | | | | |
| | | | | Gen | eral S | hear | Lo | cal She | ear | ľ. | | | | | |
| | | BC Fa | leors | | failue | r | 1 | ailuer | | | | | , | | |
| | | N | = | | 49.316 | 5 | | 21.846 | | | | | | | |
| | | N | | | 36.28 | | | 11 475 | | | | | | | |
| | | N | 9 | | 52 154 | | | 11 020 | | | | | | | |
| | 1. F | | Υ¯ | | 55.150 | , | | 11.930 | | | | | | | |
| Using | the Fac | tor of Sat | ety = | 0 | | | | | | | | | | | |
| 2e 0 | | e o tio | th o tio: | | | | | | | | | | | q _{net safe} | |
| Siz | uaa | har nda | ep(nda | R _w | Sha | pe fa | ctors | De | pth fac | ctors | Incli | inat | ion | from | SBC |
| | no | S | Dino | | | | | | | | f fa | ctor | s | | 1/ m ⁻ |
| | | | Ŧ | | | | | | | | <u> </u> | | | t/m ⁻ | |
| B | L 150 | | 1 50 | 0.50 | 5 _c | 5 _q | - ⁵ y | a _c | $\frac{a_q}{1.20}$ | a _y | 1 _c | 1 _q | 1 _y | 17.83 | 17.83 |
| 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.29 | 1.15 | 1.15 | | | | 19.06 | 19.06 |
| 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.24 | 1.12 | 1.12 | | | | 20.47 | 20.47 |
| 3.00 | 3.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.20 | 1.10 | 1.10 | | | | 21.99 | 21.99 |
| 1.50 | 1.50 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.52 | 1.26 | 1.26 | | | | 22.92 | 22.92 |
| 2.00 | 2.00 | , | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 23.78 | 23.78 |
| 2.50 | 2.50 | Square | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.31 | 1.16 | 1.16 | | | | 24.97 | 24.97 |
| 3.00 | 3.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.26 | 1.13 | 1.13 | | | | 26.33 | 26.33 |
| 1.50 | 1.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.65 | 1.33 | 1.33 | | | | 28.44 | 28.44 |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.49 | 1.25 | 1.25 | | | | 28.82 | 28.82 |
| 2.50 | 2.50 | | 2,50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 29.72 | 29.72 |
| 3.00 | 3.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.60 | 1.33 | 1.10 | 1.10 | | | | 50.89 | 20.89 |

Jharkhand Foundation Consultants

221040260F

| | | FIE | LD BORE | LOG DA | ГА SHE | ЕТ | | | | | |
|------------|--------------------|-----------------|--------------------|----------|---------|--------------|------------------|-----------------|---------|----------|-------|
| Bore Ho | e No. | BH-01 (Academi | c Building |) | | 2 | | | | | |
| Method | of Boring | Auger and Rotar | у | , , | | Water | Table | 2 | | 2.50m bg | 1 |
| Dia. of tl | ne Bore Hole | 150 mm | | | | | | | | | |
| Date of C | Commencement | 20/02/2012 | | | Date o | of Con | 20/02/20 | 20/02/2012 | | | |
| Date and | DESC | RIPTION | SYMBOL | DEP | TH | 0.15 | SPT | 20.45 | N-Value | ample | Kemar |
| Depth | | | a the state of the | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | | |
| | Reddish mooram | | | 0.50 | - | - | - | - | - | DS | |
| | 1. | 00m | | 1.00 | 1.45 | 4 | 10 | 20 | 30 | SPT/DS | |
| | White grey soft ro | ck | | 2.00 | 2.21 | 35, 5 6cm | 0 blow penetr | vs for ation | >100 | SPT/DS | |
| | | | | | | | | | | | |
| | | | | (Termina | ation D | epth = | = 2.00 | m) | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | 1 | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |



| | ····· | | | | | | | | | | |
|------------------|--|--|------------------------------|--------------------------------|------------------|------------|---------|--------------|--------------------|-------------------------|-----------------------|
| GEOTEC CENTRA | HNICAL INVESTIGAT AL UNIVERSITY OF JH | FION FOR THE PROPOSI ARKHAND IN VILLAGE | ED CONST - CHERI/I JH/ | RUCTION MANATU U ARKHAND | OF G + 3 NDER | STORII | ED BUI | LDING KAN | IN PARN NKE BLO | AANENT C. CK, DISTT. | AMPUS OF - RANCHI, |
| | | FIELI | BORE | LOG DA' | ГА SHE | ЕТ | | | | | |
| Bore Ho | le No. | BH-02 (Academic | Building |) | | | | | | | |
| Method | of Boring | Auger and Rotary | 0 | · | | Water | Table | 9 | | 2.50m bg | 1 |
| Dia. of th | he Bore Hole | 150 mm | | | | | | | | | |
| Date of O | Commencement | 20/02/2012 | | | | Date | of Con | npletio | on | 20/02/20 |)12 |
| Date and | DESC | RIPTION | SYMBOL | DEP | TH | | SPT | | N-Value | Type of | Remarks |
| Depth | | | | .From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | |
| | Reddish brown m | ooram with pebbles | | 0.50 | - | - | - | - | - | DS | |
| | | | | 1.00 | 1.45 | 10 | 12 | 15 | 27 | SPT/DS | |
| | 1. | 50m | 33 X | | | | | | ļ | | |
| | Light grey soft roc | k mix with graveles | | 2.00 | 2.45 | 18 | 27 | 36 | 63 | SPT/DS | |
| | | | | 2.50 | 2.55 | pe | netrati | r 5cm ion | >100 | SPT/DS | |
| | | | | | | | | | | | |
| | | | | (Termina | ation D | epth = | = 2.50 | m) | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SDT St | andard Penetration | Tests | | DS - Diet | urbed | ample | | | - Undist | urbed so | mples |
| Uld | made a source and the second | | | ~~ 10101 | | | - | 220 | ~ | | |



221040260F

.

REPORT ON GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>ACADEMIC</u> BUILDING-2 IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

A

SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | 6 |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>Academic Building-2</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the deput of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consultant

CHAPTER - II

2.0 PROJECT DETAILS:

.

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 3.00 | 21/02/2012 | 21/02/2012 |
| 2 | BH-02 | 2.50 | 21/02/2012 | 21/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per 15, 2131 in bore hole using a split spoce ampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.



CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.



CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{\text{net safe}} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor



F = Factor of safety

 $N_{c,} N_{q,} N_{\gamma}$ = Bearing capacity factors

 $S_{c,} S_{q,} S_{\gamma}$ = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

e₀ = initial void ratio

 p_0 = initial overburden pressure

 Δp = increase in overburden pressure

 λ_{oed} = Oedometer correction factor

- d_f = depth factor
- $d_r = Rigidity factor$



CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for Open foundation | | | | | |
|-------------------------|-----------------------|--|--|--|--|
| Depth | (ton/m ²) | | | | |
| (m) from | | | | | |
| EGL | | | | | |
| 1.50 | 18.0 | | | | |
| 2.00 | 22.0 | | | | |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data

and with any modified interpretation of geo-technical expert.

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)



<u>.</u>...

CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS FROM SHEAR FAILURE CONSIDERATION

| | | | | FRO | <u>M SH</u> | EAR | FAILL | <u>IRE C</u> | ONSI | DERA | <u>IOIT.</u> | N | | | |
|-------------------------------|--|----------------------------------|---|--------------------|---|----------------------------------|-----------------------------------|--|--|---------------------------------------|----------------|----------------|-----|-------------------|---------------|
| Beari | Bearing capacity of foundation of different sizes of foundation at different depth | | | | | | | | | | | | | | |
| As per I5:6403-1981 Cl. 5.1.2 | | | | | | | | | | | | | | | |
| In cas | In case of General shear failure | | | | | | | | | | | | | | |
| q _{net sat} | _{fe} =1/H | F[CN _c S _c | d _c i _c + q | (N _q -1 |)S _q d _q i | 4 + 0.5 | ΒγΝ _γ S _γ | d _r i _r R _w ' |] | | | | | | |
| In cas | se of L | ocal she | ear failu | ire | | | | | | | | | | | |
| q net sat | _{fe} = 1/ | F[0.67{C | CN' _c S _c d | $i_{c} + c_{c}$ | [(Ν' _q -1 |)S _q d _q i | _q + 0.5F | βγN',S | d _y i _y R _w | '] | | | | | |
| Cons | iderin | g the wo | orst cas | e as fi | ally su | bmer | sed i.e. | water | table 1 | aises u | pto th | e gr | oun | d surface | |
| Wher | e q | net safe = S | Safe bea | aring | capaci | ty | | | | | | • | | | |
| C = Cohesion | | | | • | - | - | B = W | idth of | the fo | undatio |)n | | | | |
| | $\gamma = B_1$ | ulk unit | weight | | | | | | | | | | | | |
| | N _c , N | $N_{\rm r} = B_{\rm r}$ | earing c | apacit | y facto | rs | d _c ,d _o ,d | $l_{y} = D$ | epth fa | actors | | | | | |
| | SS | S = Sh | - ane Fac | tors | - | | iii. | , = Incl | - inatior | 1 factors | \$ | | | | |
| | SHA | PE FAC | TORS | (15.64 | 03-19 | 81). C | lause 5 | 121. | table-2 | 1 140101 | 5 | | | | |
| | Shap | e of fou | indatio | n | | S _c | | | S _a | · | | S _v | |] | |
| | i)Co | ntinuou | is strip | | | 1.00 | | 1.00 | | | 1.00 | · · · · - | Ì | | |
| | ii) Ra | ctangle | | | 1. | +0.2(B) | /L) | 1+0.2(B/L) | | | 1-0. | 4(B/ | 'L) | | |
| | iii) Sc | uare | | | | 1.30 | | | 1.20 | · · · · · · · · · · · · · · · · · · · | (| 0.80 | | | |
| | iv) Ci | ircular | | | | 1.30 | | | 1.20 | | (| 0.60 | | | |
| | DELI | FH FAC | TORS | (15:64 | 103-19 | 81), C | lause 5 | 1.2.2 | | | | | | | |
| | | d _c | | 1+0. | 2(D/1 | 3)sqrt | (N_{Φ}) | | | | | | | | |
| | | d, | | for (| or $\Phi < 10^{\circ} = 1$ for $\Phi > 10^{\circ} = 1 + 0.1(D_f/B) \text{sqrtN}_{\Phi}$ | | | | | | | | | | |
| | | d. | | for 6 | ₽ < 10 ⁰ | = 1 | for $\Phi >$ | $10^0 = 1$ | + 0.1(D | (/B)sart | No | | | | |
| Now $C = 0$ | | | $0 \text{ t/m}^2 \gamma = 1.950 \text{ t/m}^3 \text{ SaN}_{\oplus} = 1.963$ | | | | | | | | | | | | |
| | , | Φ = | | | 36 | γμ= | 0.950 | , t/m ³ | | C'= | 0 | | | | |
| Beari | no Ca | nacity fa | actors a | s ner | | 3-1981 | l Table | í 1 Clar | ise 5.1 | 1 | U | | | | |
| Deur | | | | Ger | ieral S | hear | Lo | cal Sh | Par | 1 | | | | | |
| | | BC Fa | actors | | failue | r | | failuer | | | - | | | | |
| | | N | | | 49.316 | 5 | | 21.846 | | | | | | | |
| | | N | = | | 36.28 | | | 11.475 | | | | | | | |
| | | N | q | | 53 156 11 930 | | | | | | | | | | |
| ¥ laina | the Fee | | γ io.tau | 6 | 00.100 | , | | 11.900 | | | | | | | |
| Using H | | Lor or Sa | ery - | | | <u> </u> | | 1 | · · · · · | | | | | | |
| 2 e C | | pe o | th c | | | | | | | | | | | Q net safe | ana |
| ŝ | na | haj nda |)ep ndå | R _w | Sha | ipe fa | ctors | De | pth fa | ctors | Incl | inat | ion | rrom CSEailura | |
| | | S | D | | | | | | | | 14 | Ctor | 5 | | 1/ m- |
| | _ | | | | | - c | <u> </u> | | | | | | | ψm | |
| B | L 150 | | 1 50 | 0.50 | 130 | $\frac{S_q}{1.20}$ | 0.80 | 1 39 | $\frac{u_q}{1.20}$ | 1.20 | 1 _C | 1 _q | Iy | 18.23 | 18 23 |
| 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.29 | 1.15 | 1.15 | | | | 19.46 | 19.46 |
| 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.24 | 1.12 | 1.12 | | | | 20.89 | 20.89 |
| 3.00 | 3.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.20 | 1.10 | 1.10 | | | | 22.42 | 22.42 |
| 1.50 | 1.50 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.52 | 1.26 | 1.26 | | | | 23.45 | 23.45 |
| 2.00 | 2.00 | Sauaro | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 24.30 | 24.3 0 |
| 2.50 | 2.50 | oquare | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.31 | 1.16 | 1.16 | | | | 25.51 | 25.51 |
| 3.00 | 3.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.26 | 1.13 | 1.13 | | | | 26.88 | 26.88 |
| 1.50 | 1.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.65 | 1.33 | 1.33 | | | | 29.12 | 29.12 |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.49 | 1.25 | 1.25 | | | | 29.47 | 29.47 |
| 2.00 | 3.00 | ╞ | 2.50 | 0.50 | 1.30 | 1.20 | 0.00 | 1.37 | 1.20 | 1.20 | | | | 31 56 | 31 56 |
| 0.00 | 0.00 | | L.JU | 0.001 | 1.00 | 1 2.20 | 0.00 | 2.00 | | | | | | 01.00 | 01.00 |

-

Jharkhand Foundation Consultants

Foundation

Panch

| GEOTECHNICAL INVESTIGATION FOR THE PROPOSE CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE | D CONS - CHERI/I JHJ | TRUCTION MANATU U ARKHAND | OF G + 3 INDER | STORII | ED BUII | LDING KAN | IN PARN NKE BLO | IANENT C CK, DISTT. | AMPUS OF - RANCHI, |
|---|----------------------------|---------------------------------|-------------------|--------|------------------|--------------|--------------------|------------------------|-----------------------|
| FIELD | BORE | LOG DA | TA SHE | ET | | | | | |
| Bore Hole No. BH-01 (Academic Hole No. Method of Boring Auger and Rotary Diamondary 150 | Building | Part -2) | | Water | r Table | 2 | | 2.50m bg | ;1 |
| Date of Commencement 21/02/2012 | | | | Date | of Con | npletic | on | 21/02/2 | 012 |
| Date and DESCRIPTION | SYMBOL | DEP | TH | | SPT | | N-Value | Type of | Remarks |
| Depth | 595 (A) | · From(m) | To (m) | 0-15 | 15-30 | 30-45 | · · · | sample | |
| Yellowish grey sandy silt mix with | | 0.50 | - | - | - | - | - | DS | |
| 1.45m | <u> </u> | 1.00 | 1.45 | 7 | 10 | 19 | 29 | SPT/DS | |
| Light grey decomposed soft rock mix | | 2.00 | 2.45 | 10 | 18 | 23 | 41 | SPT/DS | |
| with graveles and pabbles | | 3.00 | 3.19 | 4cm | o blow penetr | ation | >100 | SPT/DS | |
| | | (Termina | ation D | epth = | = 3.00 | m) | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| · · · · · | - | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| SPT - Standard Penetration Tests | | DS - Dist | urbed s | amples | 5 | UDS - | - Undist | urbed sa | nples |



| GEOTECHNICAL INVESTIGATION FOR THE PROPOSE CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE | ED CONST - CHERI/I JH/ | TRUCTION MANATU U ARKHAND | OF G + 3 NDER | STORIE | ED BUII | LDING KAN | IN PARN JKE BLO | IANENT C CK, DISTT. | AMPUS OF - RANCHI, |
|--|------------------------------|---------------------------------|------------------|--------------|------------------|-----------------|--------------------|------------------------|-----------------------|
| FIELD | BORE | LOG DA | TA SHE | ET | | | | | |
| Bore Hole No.BH-02 (Academic IMethod of BoringAuger and Rotary | Building | Part -2) | | Water | Table | 2 | | 2.50m bg | ;1 |
| Dia. of the Bore Hole 150 mm Date of Commencement 21/02/2012 | | | | Date o | of Con | npletic | on | 21/02/20 | 012 |
| Date and DESCRIPTION | SYMBOL | DEP | TH | | SPT | | N-Value | Type of | Remarks |
| Depth | | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | |
| Reddish brown sandy silt mix with | | 0.50 | - | - | - | - | - | DS | |
| mooram | / | 1.00 | 1.45 | 5 | 16 | 19 | 35 | SPT/DS | |
| Light brown decomposed soft rock mix | | 2.00 | 2.45 | 10 | 17 | 29 | 46 | SPT/DS | |
| with graveles and pabbles | | 2.50 | 2.71 | 29, 5 6cm | 0 blow penetr | vs for ation | >100 | SPT/DS | |
| | | | | | | | | | |
| | | (Termina | ation D | i epth = | ı = 2.50 | m) | | | |
| | | | | | | | | | |
| | | | - | | | | | | |
| | | | | | | | | - | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| SPT - Standard Penetration Tests | | DS - Dist | urbed s | amples | s | UDS | - Undisi | urbed sa | mples |



٦

221040260H

9

•••

REPORT ON

A

GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>SCHOOL OF</u> <u>MANAGEMENT</u> IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | |
| Sub-Soil profile and recommendation | |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>School of Management</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with
- the decign parameters for designing founciations, the depth of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consultant

indation

Panch

CHAPTER - II

2.0 PROJECT DETAILS:

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.00 | 21/02/2012 | 21/02/2012 |
| 2 | BH-02 | 4.00 | 21/02/2012 | 21/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2131 in bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.



CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.



<u>CHAPTER – IV</u>

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{net \ safe} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor

Jharkhand Foundation Consultants

F = Factor of safety

 N_{c} , N_{q} , N_{γ} = Bearing capacity factors

 $S_{c_{\gamma}}S_{q_{\gamma}}S_{\gamma}$ = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

eo = initial void ratio

 p_0 = initial overburden pressure

 Δp = increase in overburden pressure

 λ_{oed} = Oedometer correction factor

 d_f = depth factor

 d_r = Rigidity factor

CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for Open foundation | | | | | |
|-------------------------|-----------------------|--|--|--|--|
| Depth | (ton/m ²) | | | | |
| (m) from | | | | | |
| EGL | | | | | |
| 1.50 | 18.0 | | | | |
| 2.00 | 22.0 | | | | |

* Detail calculations are shown in the subsequent pages.

However, any other alternative solutions may be suitably adopted based on these soil data and with any modified interpretation of geo-technical expert.

A Maiti)

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)



221040260G
CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS FROM SHEAR FAILURE CONSIDERATION

| | ł | | | 1 | ROL | <u>M 5H</u> | EAK | FAILU | <u>JRE C</u> | UNSI | DEKA | | N | | | |
|-------|---|--|----------------------------------|--|-----------------------|----------------------------------|----------------------------------|---------------------------------|--|--|----------------|-----------------|-----------------------|---------------|------------------------------|---------|
| | Bearing capacity of foundation of different sizes of foundation at different depth | | | | | | | | | | | | | | | |
| | As pe | er IS:64 | 103-1981 | l Cl. 5.1 | 1.2 | re | | | | | | | | | | |
| | In cas | se of G | eneral s | shear fa | lure | | | | | | | | | | | |
| | Q net saf | _{fe} =1/F | [CN _c S _c | d _c i _c + q | (N _q -1 |)S _q d _q i | + 0.5 | ΒγN _γ S _γ | d _y i _y R _w ' |] | | | | | | |
| | In cas | e of L | ocal she | ar failu | re | | | | | | | | | | | |
| | q _{net saf} | $t_{e} = 1/3$ | F[0.67{C | :N' _c S _c d _c | i _{c}} + q | (N' _q -1 |)S _q d _q i | _q + 0.51 | ΒγN' _γ S _γ | d _y i _y R _w | '] | | | | | |
| | Consi | idering | g the wo | orst case | e as fu | ally su | bmer | sed i.e. | water | table r | aises u | pto th | e gr | oun | d surface | |
| | Wher | e q | et safe = S | Safe bea | ring | capaci | ty | | | | | | | | | |
| | | Ċ = Ċ | ohësion | ı | | | | B = W | idth of | the fo | undatio |)1 1 | | | | |
| | | $\gamma = B\iota$ | ılk unit | weight | | | | | | | | | | | | |
| | $N_{cr} N_{qr} N_{r}$ = Bearing capacity factors $d_{cr} d_{qr} d_{r}$ = Depth factors | | | | | | | | | | | | | | | |
| | $S_{cr} S_{ar} S_{r} =$ Shape Factors $i_{cr} i_{ar} i_{r} =$ Inclination factors | | | | | | | | | | | | | | | |
| | SHAPE FACTORS (IS:6403-1981). Clause 5.1.2.1. table-2 | | | | | | | | | | | | | | | |
| | Shape of foundation s _c s _q | | | | | | | | Sγ | | | | | | | |
| | | i)Co | ntinuou | s strip | | | 1.00 | | | 1.00 | | | 1.00 | | | |
| | | ii) Ra | ctangle | | | 1. | +0.2(B | /L) | 1 | +0.2(B/ | ′L) | 1-0. | 4(B/ | 'L) |] | |
| | | iii) Sq | uare | | | | 1.30 | | | 1.20 | | (| 0.80 | | | |
| | | iv) Ci | rcular | | 110-267 | | 1.30 | lauge h | | 1.20 | | | 0.60 | | | |
| | | DEPI | H FAC | 1085 | (15:64 | 103-19 | 81), C | lause 5 | .1.2.2 | _ | | | 1 | | | |
| | | $\mathbf{d_c} = \frac{1+0.2(D/B)\operatorname{sqrt}(N_{\Phi})}{1+0.2(D/B)\operatorname{sqrt}(N_{\Phi})}$ | | | | | | | | | | | | | | |
| | | d_q for $\Phi < 10^0 = 1$ for $\Phi > 10^0 = 1 + 0.1(D_t/B)$ sqrtt | | | | | Nφ | | | | | | | | | |
| | d _{γ} for $\Phi < 10^0 = 1$ for $\Phi > 10^0 = 1 + 0.1(D_f/B)$ sqrt | | | | | N_{Φ} | | | | | | | | | | |
| | Now, C = $0 t/m^2 \gamma = 2.000 t/m^3$ SqN _{Φ} = 1 | | | | | | 1.942 | | | | | | | | | |
| | | | Φ = | | 3 | 36 | $\gamma_{sub} =$ | 1.000 | t/m ³ | | C'= | 0 | | | | |
| | Beari | ng Caj | pacity fa | actors a | s per | IS:640 | 3-1981 | l Table | 1 Clau | ise 5.1. | 1 | | | | | |
| | | | BCE | tore | Ger | ieral S | hear | Lo | cal Sh | ear | | | | | | |
| .,,,, |] | | | | | failue | r | 1 | failuer | | | | *, · | | | |
| | | | N | c [≡] | | 47.718 | 3 | | 21.360 | | | | | | | |
| | | | N | q = | | 34.79 | | | 11.123 | | | | | | | |
| | | | N |) ⁺⁼ | | 50.593 | 3 | | 11.477 | | | | | | | |
| | Using | the Fac | tor of Saf | ety = | 6 | | | | | | | | | | | |
| | foi | | e of ion | h of ion | | | | | | | | | | | q _{net safe} | |
| | Siz | ICCAL | uap. Idat | eptl | R., | Sha | ine fa | ctors | De | oth fa | ctors | Incli | inat | ion | from | SBC |
| | | mo | Sł | D III | | | -p - 1- | | | P | | fa | ctor | s | GSFailure | T/m^2 |
| | 4 | Ĥ | Ţ | Ψ. | | | | | | | | | | | t/m² | |
| | B | L | | 1 50 | 0.50 | S_c | S_q | Sy | d _c | d_q | d _y | i _c | iq | iy | 1015 | 1015 |
| | 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.19 | 1.19 | | | | 19.34 | 19.34 |
| | 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.23 | 1.12 | 1.12 | | | | 20.73 | 20.73 |
| | 3.00 | 3.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.19 | 1.10 | 1.10 | | | | 22.22 | 22.22 |
| | 1.50 | 1.50 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.52 | 1.26 | 1.26 | | | | 23.38 | 23.38 |
| | 2.00 | 2.00 | Square | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.19 | 1.19 | | | | 24.20 | 24.20 |
| | 2.50 | 2.50 | oquare | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.31 | 1.16 | 1.16 | | | | 25.36 | 25.36 |
| | 3.00 | 3.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.20 | 1.13 | 1.13 | | | | 20.09 | 20.69 |
| | 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.05 | 1.32 | 1.52 | | | | 29.38 | 29.38 |
| | 2,50 | 2.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.19 | 1.19 | | | | 30.24 | 30.24 |
| | 3.00 | 3.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.32 | 1.16 | 1.16 | | | | 31.38 | 31.38 |
| | | _ | | | and the second second | | | | | | | | and the second second | 14 3 00 10 10 | | |

Jharkhand Foundation Consultants

٠

221040260G

1

| GEOTEC CENTRA | GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF G + 3 STORIED BUILDING IN PARMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND IN VILLAGE - CHERI/MANATU UNDER J:HARKHAND | | | | | | | | | | |
|-----------------------|--|--|--------|-----------------------|------------------------|--------------------|------------------|-----------------|----------|-------------------|---------|
| Bore Hol Method | le No. B of Boring A | <u>FIELD</u> H-01 (School of Ma Luger and Rotary | BORE : | LOG DA' aent Parik | <u>FA SHE</u> h Ji) | <u>ET</u> Water | Table | : | | 2.50m bg | 1 |
| Dia. of the Date of C | Commencement 2 | 1/02/2012 | | | <u> </u> | Date of | of Con | pletic | n | 21/02/20 | 012 |
| Date and Depth | DESCRIPT | ION | SYMBOL | DEP From(m) | TH To (m) | 0-15 | SPT 15-30 | 30-45 | N-Value | Type of sample | Remarks |
| | Reddish mooram | | | 0.50 | - | ~ | - | - | - | DS | |
| | 1.00m | | | 1.00 | 1.45 | 10 | 15 | 20 | 35 | SPT/DS | |
| | White grey soft rock | | | 2.00 | 2.20 | 32, 50 5cm j | 0 blow penetr | rs for ation | >100 | SPT/DS | |
| | | | | (Termina | ation De | epth = | 2.00 | m) | | | |
| | • | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SPT - Sta | andard Penetration Tes | its | | DS - Dist | urbed sa | amples | ! ; | UDS - | - Undist | urbed sa | nples |



221040260G

. . .

·*2 *

| GEOTECI CENTRA | HNICAL INVESTIGATION L UNIVERSITY OF JHARK | FOR THE PROPOSE CHAND IN VILLAGE | D CONST - CHERI/N JHA | RUCTION MANATU U ARKHAND | OF G + 3 NDER | STORIE | ED BUII | LDING KAN | IN PARN NKE BLO | IANENT C CK, DISTT. | AMPUS OF - RANCHI, |
|-------------------|---|-------------------------------------|-----------------------------|--------------------------------|------------------|--------------|------------------|-----------------|--------------------|------------------------|-----------------------|
| D TT | | FIELD | BORE | LOG DA | TA SHE | ET | | | | | |
| Method | of Boring A | Auger and Rotary | lanagem | ent Fariki | 1 31) | Water | Table | 9 | | 2.50m bg | ;I |
| Date of C | Commencement 2 | 1/02/2012 | | | | Date of | of Con | npletio | on | 21/02/2 | 012 |
| Date and | DESCRIPT | TION | SYMBOL | DEP | ГН | | SPT | | N-Value | Type of | Remarks |
| Depth | | | | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | |
| | | | | 0.50 | - | - | - | - | - | DS | |
| | Light yellowish grey s coarse sand and grave | ooft rock mix with eles | | · 1.00 | 1.45 | 6 | 8 | 10 | 18 | SPT/DS | |
| | | | | 2.00 3.00 | 2.45 3.45 | 6 | 18 14 | 19 30 | 37 | SPT/DS | |
| | | | | 4.00 | 4.19 | 31, 5 4cm | 0 blow penetr | vs for ation | >100 | SPT/DS | |
| | | | | | | | | | | | |
| | | | | (Termina | ation D | epth = I | = 4.00 |) m) | | | |
| | | | | | | | | | | | |
| | | ~ | | | - | | | | | ·, | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | 2 | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SPT - St | l andard Penetration Te | sts | | DS - Dist | urbed s | ample | s | UDS | - Undist | turbed sa | mples |



٦

221040260G

· .

REPORT ON GEOTECHNICAL INVESTIGATION

A

FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>PG BOYS</u> <u>HOSTEL-1</u> IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

> SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033



491-5



Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | 6 |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



.

CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>PG Boys Hostel-1</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to **two** nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

Jharkhand Foundation Consultant

indatio

ispare?

.

CHAPTER - II

2.0 PROJECT DETAILS:

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.50 | 20/02/2012 | 20/02/2012 |
| 2 | BH-02 | 3.00 | 20/02/2012 | 20/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2 addition bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.

CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant IS Specifications.

Jharkhand Foundation Consultants

CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations has been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{\text{net safe}} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor

oundatio,

Jharkhand Foundation Consultants

F = Factor of safety

 N_{c} , N_{q} , N_{γ} = Bearing capacity factors

 S_{c}, S_{q}, S_{γ} = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where $S_c = Co$ solidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

 e_0 = initial void ratio

 p_0 = initial overburden pressure

 Δp = increase in overburden pressure

 λ_{oed} = Oedometer correction factor

 d_f = depth factor

 d_r = Rigidity factor

Jharkhand Foundation Consultants

1.

CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for O | SBC for Open foundation | | | | | | | |
|-----------|-------------------------|--|--|--|--|--|--|--|
| Depth | (ton/m ²) | | | | | | | |
| (m) from | | | | | | | | |
| EGL | | | | | | | | |
| 1.50 | 18.0 | | | | | | | |
| 2.00 | 22.0 | | | | | | | |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data and with any modified interpretation of geo-technical expansion

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)

Iharkhand Foundation

ndatio

Panch

CALCULATION OF BEARING CAPACITY FOR SHALLOW FOUNDATIONS FROM SHEAR FAILURE CONSIDERATION

| | | | | ROP | <u>A SH</u> | EAR . | FAILU | JRE C | ONS. | DEKA | | <u>N</u> | | | | 1 |
|-------------------------------|---|-----------------------------------|-----------------------------------|--------------------|----------------------------------|-----------------------------------|---------------------------------|--|----------------|-----------|-----------------|--------------|-------------|------------------|---------|---|
| Beari | ng cap | pacity of | founda | ation | of diff | erent | sizes of | found | lation | at diffe | rent d | eptł | n | | | |
| As per IS:6403-1981 Cl. 5.1.2 | | | | | | | | | | | | | | | | |
| In ca | se of G | eneral s | shear fa | ilure | | | | | | | | | | | | |
| q _{net sa} | _{fe} =1/F | F[CN _c S _c | d _c i _c + q | (N _q -1 |)S _q d _q i | ₉ + 0.5 | ΒγΝ _γ S _γ | d _y i _y R _w ' |] | | | | | | | |
| In cas | se of L | ocal she | ar failu | ire | | - | | | | | | | | | | |
| g _{net sa} | $f_{e} = 1/2$ | F[0.67{C | N'S.d. | $i_{cl} + q$ | (N'1 | .)S _a d _a i | a + 0.51 | BγN',S, | d,i,R, | '] | | | | | | |
| Cons | Considering the worst case as fully submersed i.e. water table raises upto the ground surface | | | | | | | | | | | | | | | |
| Whe | re a. | $a_{ab} = 9$ | Safe bea | ring | apaci | itv | | | | | 1 | 0 | | | | |
| | C = C | ohesior | | 0 | 1 | | $\mathbf{R} = \mathbf{W}$ | iđth of | the fo | undatio | | • • | | | | |
| | $v = B_1$ | ilk iinit | ı weight | | | | 0 11 | iadii 01 | uic io | unaum | | | | | | |
| | NN | N = B | earing c | anacit | v facto | 175 | 4.4.6 | = D | enth fa | actors | | | | | | |
| | | | | | <i>y</i> 10200 | | | - I I | | . (| - | | | | | |
| | S_c, S_q | $S_{\gamma} = Sn$ | аре гас | tors | 02 10 | | $1_{c}, 1_{q}, 1_{\gamma}$ | = Incl | manor | 1 factor | 5 | | | | | |
| | SHA | PE FAC | ndatio | (15:64 | 03-19 | 81), C | lause 5 | 1.2.1,1 | table-2 | | r | \$ | | 1 | | |
| | Shap | e 01 10u | nuario | | | 1.00 | | | 1.00 | | <u> </u> | -γ 1.00 | | - | | 1 |
| | $\frac{1}{10}$ Co | otangla | is strip | | 1 | 1.00 | /1) | 1 | 1.00 +0.2/B | /1) | 1_0 | 1.00 4/B/ | <u>'T \</u> | 1 | | |
| Í | iii) Sa | langle | | | 1 | 1 30 | | | 1 20 | L) | | 1.80 | 5) | | | |
| | iv) Ci | rcular | | | | 1.30 | | | 1.20 | | | 0.60 | | - | | |
| | DEPI | THFAC | TORS | (15:64 | 03-19 | 81), C | lause 5 | .1.2.2 | | | | | | J | | |
| | Г | | | 1+0 | 2(D/) | R)cart | (NL) | | | | | 1 | | | | |
| | | | | 1.0. | $\frac{2(D)}{D < 10^{\circ}}$ | - 1 | $(1 \lor \phi)$ | $10^{0} - 1$ | L 0 1/D | (P) cont | NI | | | | | |
| | | a _q | | | 10 | -1 | 101 0 2 | 10 ~ 1 | + 0.1(D | () Djsqrt | <u></u> | | | | | 1 |
| | L | dγ | | for q | $p < 10^{-2}$ | = 1 | for $\Phi >$ | $10^{\circ} = 1$ | + 0.1(D | (/ B)sqrt | ίN _Φ |] | | | | |
| Now | , | C = | | 0 | t/m ⁻ | γ= | 1.925 | t/m° | | SqN₀= | 1.963 | | | | | |
| | | Φ ≕ | | 3 | 36 | $\gamma_{sub} =$ | 0.925 | t/m ^o | | C'= | 0 | | | | | 1 |
| Beari | ng Caj | pacity fa | actors a | s per | IS:640 | 3-1981 | I Table | 1 Clau | ıse 5.1 | .1 | | | | | | |
| | | BCE | actors | Gen | eral S | Shear | Lo | cal Sh | ear | | | | | | | |
| | | | | | failue | r | i | uliuei | | | | | | | | |
| | | N | c= | | 49.31 | 6 | | 21.846 | | | | | | | | |
| | | N | a= | | 36.28 | ; | | 11.475 | | | | | | | | |
| | | N | | | 53.15 | 6 | | 11.930 | | | | | | | | |
| Using | the Fac | tor of Saf | fetv = | 6 | | | L | | | 1 | | | | | | |
| ار | 5 F | Jo u | भु ह | | | | | | | | | | | a | | |
| Ze | | pe | atic | | | | | | | | Incl | inat | ion | Inet safe | SBC | |
| is. | pu | Sha | Dep | R _w | Sha | ape fa | ctors | De | pth fa | ctors | fa | ctor | s | GSFailure | T/m^2 | |
| | tou | fou | fou | | | | | | | | | | 0 | 1/m ² | 1/ III | |
| | | | : | | G | 5 | 5 | d | <u> </u> | <u> </u> | | | L i | <u>ч</u> | | 1 |
| в 1,50 | L 1.50 | | 1 50 | 0,50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | -4 | | 17.83 | 17.83 | |
| 2.00 | 2.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.29 | 1.15 | 1.15 | | | | 19.06 | 19.06 | 1 |
| 2.50 | 2.50 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.24 | 1.12 | 1.12 | | | | 20.47 | 20.47 | 1 |
| 3.00 | 3.00 | | 1.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.20 | 1.10 | 1.10 | | | | 21.99 | 21.99 | 1 |
| 1.50 | 1.50 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.52 | 1.26 | 1.26 | | | | 22.92 | 22.92 | |
| 2.00 | 2.00 | Sauare | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.39 | 1.20 | 1.20 | | | | 23.78 | 23.78 | |
| 2.50 | 2.50 | oquine | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.31 | 1.16 | 1.16 | | | | 24.97 | 24.97 | |
| 3.00 | 3.00 | | 2.00 | 0.50 | 1.30 | 1.20 | 0.80 | 1.26 | 1.13 | 1.13 | | | | 26.33 | 26.33 | |
| 1.50 | 1.50 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.65 | 1.33 | 1.33 | | | | 28.44 | 28.44 | |
| 2.00 | 2.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.47 | 1.25 | 1.25 | | | | 20.02 | 20.02 | |
| 2.00 | 3.00 | | 2.50 | 0.50 | 1.30 | 1.20 | 0.80 | 1.33 | 1.16 | 1.16 | | | | 30.89 | 30.89 | |
| 0.00 | 0.00 | | 2.00 | 0.00 | 1.00 | 1.20 | 0.00 | 1.00 | 1.10 | 1.10 | | | | 00.05 | 00.00 | I |

| GEOTECI CENTRA | HNICAL INVESTIGATION FOR THE PROPO L UNIVERSITY OF JHARKHAND IN VILLAG | SED CONST E - CHERI/I JHA | IRUCTION MANATU U ARKHAND | OF G + 3 INDER | STORII | ED BUII | LDING KAN | IN PARN NKE BLO | IANENT C CK, DISTT. | AMPUS OF - RANCHI, |
|-------------------|---|---------------------------------|---------------------------------|-------------------|-------------|------------------|---------------|--------------------|------------------------|-----------------------|
| | FIEL | D BORE | LOG DA | TA SHE | ET | | | | | |
| Bore Hol | e No. BH-01 (P.G. Boys | Hostel) | | | | | | | | |
| Method o | of Boring Auger and Rotary | 7 | | | Wate | r Table | 9 | | 2.50m bg | ;1 |
| Dia. of th | ne Bore Hole 150 mm | | | | | | | | | |
| Date of C | of Commencement 20/02/2012 Date of Complet | | | | | | | | 20/02/2 | J12 Remarka |
| Date and | DESCRIPTION | SYMBOL | DEP | TH | 0.15 | SPT | 20.45 | N-Value | sample | Remarks |
| Deput | · · · · · · · · · · · · · · · · · · · | 15 and as the | From(m) | 10 (m) | 0-15 | 13-30 | 50-45 | [| | |
| | Reddish brown mooram with pebbles 0.50m | | 0.50 | | - | - | - | - | DS | |
| | | | 1.00 | 1.45 | 6 | 8 | 10 | 18 | SPT/DS | |
| | Light brownish yellow soft rock m | ix | 2.00 | 2.45 | 21 | 29 | 34 | 63 | SPT/DS | |
| | | | 2.50 | 2.54 | 50 bl pe | ows fo netrat | or 4cm ion | >100 | SPT/DS | |
| | | | | | | | | | | |
| | | | (Termin | I ation D | i epth = | = 2.50 | () m) | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | - | | | | | | | |
| | | | | | | | | | - | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | ÷ | | |
| | | | | | | | | | | |
| | | | | | | | | | | |



221040260E

| GEOTEC CENTRA | HNICAL INVESTIGATI | ION FOR THE PROPOSE ARKHAND IN VILLAGE | ED CONST - CHERI/I JH/ | TRUCTION MANATU U ARKHAND | OF G + 3 NDER | STORIE | ED BUII | LDING KAN | IN PARN NKE PLO | IANENT C CK, DISTT | AMPUS OF - RANCHI, |
|--------------------|---|---|------------------------------|---------------------------------|------------------|------------------|-------------------------------|-------------------|--------------------|-----------------------|-----------------------|
| | | FIELT | BORE | LOG DA' | LA SHE | ET | | | | | |
| Bore Hol Method | le No. of Boring | BH-02 (P.G. Boys H Auger and Rotary | Hostel) | <u>200211</u> | | Water | r Table | 9 | | 2.50m bg | çI |
| Dia. of th | ne Bore Hole Commencement | 150 mm 20/02/2012 | | | | Date | of Con | npletio | on | 20/02/2 | 012 |
| Date and | DESCR | RIPTION | SYMBOL | DEP | гн | | SPT | | N-Value | Type of | Remarks |
| Depth | | | | From(m) | To (m) | 0-15 | 15-30 | 30-45 | | sample | |
| | | | | 0.50 | - | - | - | - | - | DS | |
| | Reddish mooram | | | 1.00 | 1.45 | 4 | 5 | 6 | 11 | SPT/DS | |
| | | | 235 | 2.00 | 2.45 | 6 | 8 | 12 | 20 | SPT/DS | |
| | 2.5 Light grey soft roc and pabbles | 0m k mix with graveles | | 3.00 | 3.34 | 17, 3 f pe | 2, 50 b for 4cn netrati | olows n ion | >100 | SPT/DS | |
| | | | | (Termina | ation D | epth = | = 3.00 |) m) | | | |
| | | | | - | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SPT - Sta | andard Penetration | Tests | | DS - Dist | urbed s | amples | s | UDS | - Undisi | turbed sa | mples |

• #*



221040260E

,

A

REPORT ON GEOTECHNICAL INVESTIGATION FOR THE CONSTRUCTION OF THE PROPOSED G+3 STORIED <u>PG BOYS</u> <u>HOSTEL-2</u> IN PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JHARKHAND AT VILLAGE CHERI / MANATU, IN BLOCK - KANKE RANCHI

SUBMITTED TO: O.S.D. PROJECT CENTRAL UNIVERSITY OF JHARKHAND CITY CENTRE OPP. CMPDI, KANKE ROAD RANCHI, JHARKHAND

EXECUTED BY:

JHARKHAND FOUNDATION CONSULTANTS Regd. Office: FLAT NO. 4-D (4TH FLOOR) LAXMI APPARTMENT OLD ARGORA ROAD, ARGORA RANCHI – 834002 Ph. – 9431389413 / 09931095033

221040260J





Table of Contents

| > CHAPTER I | |
|-------------------------------------|-----|
| Introduction | 1 |
| CHAPTER II | |
| Project Details | 2 |
| CHAPTER III | |
| Laboratory Testings | 3 |
| CHAPTER IV | |
| Foundation Design & aspects | 4-5 |
| CHAPTER V | C |
| Sub-Soil profile and recommendation | 0 |
| Calculation of bearing capacity | 7 |
| Field Bore Log data sheet | 8-9 |



CHAPTER - I

1.0 INTRODUCTION:

- 1.1. In an attempt to facilitate the design of foundation structures for the construction of the proposed <u>PG Boys Hostel-2</u> in permanent campus of Central University of Jharkhand at village Cheri / Manatu, Block-Kanke, Ranchi, Jharkhand a subsoil investigation work was programmed and for this, the services of M/s. Jharkhand Foundation Consultants, Flat No. 4D (Forth Floor), Laxmi Apartment, Old Argora Road, Argora, Ranchi-834002.
- 1.2. The scope of the soil investigation consisted of making two nos. of bore holes for this proposed building.
- 1.3. The formation at the site is to be reported for various layers presented at their respective depth along with their thickness. This would also include the subsoil properties for each stratum so as to come up with the design parameters for designing foundations, the depth of foundation and the selection of type of foundation. As the ground water table location influences the bearing capacity of a foundation and the method of construction of a foundation at the site, its location has also to be found.
- 1.4. Soil samples both in disturbed and undisturbed condition wherever possible are to be collected. These samples would be different laboratory tests to obtain various properties of sub-soil formation.
- 1.5. The exploration of the sub-soil formation being limited to two nos. bore holes it is suggested that due weighted is given to the unexplored part of the area at the time of selecting design parameters.

221040260J

Jharkhand Foundation Consultants

oundation

CHAPTER - II

2.0 **PROJECT DETAILS:**

2.1. The fieldwork consisted of **two** nos. of bore hole at pre-determined location. The detail of fieldwork like depth of bore hole, date of the field work of site are presented below in tabular form:

| Sl. No. | Bore Hole No. | Terminating Depth (M) | Date of commencement | Date of completion |
|---------|---------------------|--------------------------|-------------------------|--------------------|
| 1 | BH-01 | 2.00 | 22/02/2012 | 22/02/2012 |
| 2 | BH-02 | 2.50 | 22/02/2012 | 22/02/2012 |

The fieldwork also included collection of undisturbed samples, disturbed samples and conducting standard penetration tests at regular intervals. The bore holes of 150mm diameter (SX size) are sunk by hand auger boring. The field work was carried out as per IS: 1892.

2.2. Standard penetration tests were conducted in the bore hole at regular intervals as per IS: 2131 in bore hole using a split spoon sampler. The split spoon sampler used for this test advanced by driving with a monkey weighing 63.5kg, falling freely through 750mm. The soil specimens were preserved in polythene bags for logging purpose.


CHAPTER - III

3. LABORATORY TESTING:

No laboratory tests were conducted on the collected samples due to the presence of moorum, kankars and highly weathered decomposed product of rock.

Grain size analysis. Liquid Limit, Plastic Limit Tests. Bulk Density, Dry Density. Natural Moisture Content. Specific Gravity. Unconsolidated Undrained (UU) test. One dimensional consolidation test.

The tests were conducted as per relevant **IS** Specifications.



.

CHAPTER - IV

4.0 FOUNDATION DESIGN ASPECTS:

A suitable foundation for any structure should have an adequate factor of safety exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soil should be within tolerable limit for the structure. The foundations in accordance with the recommendations herein will satisfy these criteria.

FOUNDATION DESIGN CRITERIA

The maximum permissible total settlement and differential for the foundation settlement is governed by the technical requirements of the structure.

BEARING CAPACITY OF OPEN FOUNDATION

Bearing capacity analysis for shallow foundations had been done in accordance with IS: 6403-1981. The following equation has been used for the analysis.

 $q_{\text{net safe}} = 1/F(CN_cS_cD_c + p(N_q-1)S_qD_q + 0.5B_{\gamma}N_{\gamma}S_{\gamma}D_{\gamma}R_w)$

Where q_{net safe} = Safe net bearing capacity of soil based on the shear failure criteria

- C = Cohesion of clay
- γ = Unit weight of soil
- p = Overburden pressure
- B = width of foundation
- R_w = Water table correction factor



F = Factor of safety

 N_{c} , N_{q} , N_{γ} = Bearing capacity factors

 $S_{c,} S_{q,} S_{\gamma}$ = Shape factors

 D_c , D_q , D_γ = Depth factors

All the Bearing capacity factors, Shape factors and depth factors has been considered as IS:6403-1981, Table -1 clause - 5.1.1, 5.1.2.1 and 5.1.2.2 respectively.

SETTLEMENT ANALYSIS FOR SHALLOW FOUNDATION

Settlement calculation has been done as per IS: 8009 (Part-1)-1976.

Immediate settlement considered as per clause 9.2.3.2

 $S_i = (pB(1-\mu^2)I)/E$

Where μ = Piosson's ratio = 0.5 for clay

I = Influence factor

Consolidation settlement considered as per clause 9.2.2.2

 $S_c = Ht/(1+e_0) \ge C_c \log_{10} ((p_0 + \Delta p)/p_0) \ge \lambda_{oed} \ge d_f \ge d_r$

Where S_c = Consolidation settlement

 H_t = Thickness of the compressible layer

 C_c = Co-efficient of consolidation

- e_0 = initial void ratio
- p_0 = initial overburden pressure
- Δp = increase in overburden pressure
- λ_{oed} = Oedometer correction factor
- d_f = depth factor
- dr = Rigidity factor



CHAPTER - V

5.0 SOIL PROFILE AND & RECOMMENDATION

From the exploratory bore holes at the site it is observed that sub soil formation at this site consists of cohesionless formation at ground surface and highly weathered decomposed product of rock below. Details of the formations along with the "N" values are shown in the field bore log data sheets.

Based on calculation the following bearing capacities are recommended:

| SBC for Open foundation | |
|-------------------------|-----------------------|
| Depth | (ton/m ²) |
| (m) from | |
| EGL | |
| 1.50 | 18.0 |
| 2.00 | 23.0 |

* Detail calculations are shown in the subsequent pages. However, any other alternative solutions may be suitably adopted based on these soil data and with any modified interpretation of grad-technical expert.

Alanto.

(A Maiti) (M.E. Soil Mech. and Fdn. Engg.) (Chartered Engineer)

