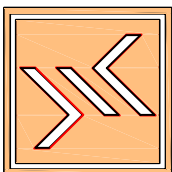


A REPORT ON SOIL INVESTIGATION FOR
CONSTRUCTION OF SOCIETY PLAZA COMPLEX
(NEAR CLOCK TOWER), LUDHIANA.

SOIL INVESTIGATION DONE ON: AUGUST 6, 2015.

SOIL INVESTIGATION REPORT PREPARED BY: ER. B S RUPRA

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REPORT ON SOIL INVESTIGATION FOR CONSTRUCTION OF SOCIETY PLAZA, NEAR CLOCK TOWER, LUDHIANA.

1. INTRODUCTION:

The soil investigation for this project was carried out on August 5, 2015 to find out bearing capacity of soil at proposed foundation level. The soil investigation comprised of performing Standard Penetration Test (S.P. Test), collecting soil samples, analyzing them for bearing capacity parameters and then calculating bearing capacity.

2. FIELD TESTING:

At the proposed site two (100-150mm) diameter bore holes were drilled for SP Tests using shell and auger method as per IS: 1892-1979. Casing was used to retain bore holes in sandy layers. During drilling operation S P test was performed at regular intervals as per (IS 2131 –1981) to record N values. Standard split spoon sampler attached to lower end of “A” drill rods was driven in bore holes by standard hammer of 63.5 Kg. falling from a height of 75.0cm. The sampler was driven 45.0cm and numbers of blows required for each 15.0cm penetration were recorded. The number of blows for first 15.0cm. penetration were not taken into account. This was considered as seating drive. The numbers of blows for last 30.0cm penetration were designated as “N” value. Also disturbed / undisturbed soil samples were collected for laboratory investigations. The bore hole logs showing N values at different depths are attached.

3. LABORATORY TESTING:

The samples collected were tested in laboratory for Soil Classification (Sieve Analysis), Atterberg's Limits (Liquid Limit and Plastic Limit), Shear Parameters, Natural moisture content, density of soil.

4. DEPTH OF FOUNDATION:

As per architectural drawings, proposed structure is having double basement with basement floor level (- 11.0m) below existing road level. As such bearing capacity is found at 11.0m depth from existing ground level for 5.0m wide foundation.

5. BEARING CAPACITY CALCULATIONS:

The bearing capacity is found both on the basis of shear as well as settlement criteria.

Bearing Capacity calculations on the basis of shear:

As per IS 6403 (1981) the net ultimate bearing capacity q_d is given by:

$$q_d = \frac{2}{3} c N_c' s_c d_c + \gamma D_f (N_q' - 1) s_q d_q + 0.5 \gamma B N_\gamma' s_\gamma d_\gamma . W \dots\dots\dots(1)$$

Where

c is cohesion,

γ is unit weight of soil,

N_c' , N_q' and N_γ' are Bearing capacity factors,

d_c , d_q and d_γ are depth factors

s_c , s_q and s_γ are shape factors,

B is width of the foundations,

D_f is the depth of the foundation,

and W is water table correction factor.

5.1 Bearing Capacity Calculation for 5.0m wide Foundation

(at 11.0m depth below existing ground level):

$$\gamma = 1.78 \text{ g/cc}$$

$$c = 0.00 \text{ kg/m}^2$$

$$\phi = 31^\circ$$

$$B = 5.0\text{m} \quad D_f = 1.50\text{m} \text{ (below basement floor level)}$$

$$\text{For } \phi = 31^\circ$$

N_c' , N_q' and N_γ' are:

$$N_c' = 17.2, N_q' = 8.02 \text{ and } N_\gamma' = 7.50$$

$$s_c = 1.0$$

$$s_q = 1.0 \text{ and } s_\gamma = 1.0$$

$$\begin{aligned} d_c &= \{1 + 0.2 (D_f/B) \tan (45^\circ + \phi')\} \\ &= \{1 + 0.2 (1.5/5.0) \tan (45^\circ + 10.95)\} \\ &= 1.08 \end{aligned}$$

$$\begin{aligned} d_q = d_\gamma &= \{1 + 0.1 (D_f/B) \tan (45^\circ + \phi')\} \\ &= \{1 + 0.1 (1.5/5.0) \tan (45^\circ + 10.95)\} \end{aligned}$$

$$d_q = d_\gamma = 1.04$$

$$W = 1$$

Substituting these values in equation (1)

$$\begin{aligned} q_d &= \frac{2}{3} \times 0.00 \times 17.2 \times 1.0 \times 1.08 + 1.78 \times 1.5 \times 7.02 \times 1.0 \times 1.04 \\ &\quad + 0.5 \times 1.78 \times 5.0 \times 7.50 \times 1.0 \times 1.04 \times 1 \\ &= 54.20 \text{ t / m}^2 \end{aligned}$$

Safe net allowable bearing capacity on basis of shear criteria = $54.20/2.5 = 21.68 \text{ t / m}^2$
.....1(a)

5.2 Bearing Capacity based on Settlement for 5.0m wide foundation:

Depth of foundation = 11.0m (from existing ground level)

Average of Corrected value of N in weakest bore hole (B.H.-2) at proposed

foundation level = 14.77

Safe net allowable Bearing capacity

[When B = 5.0m, N = 14.77, S = 40mm & W = 1] = 18.32 t / m²2(a)

Safe net allowable bearing capacity at 11.0m depth from existing ground level

is 18.32 t / m² taking least of 1(a) and 2(a).

5.3 **Bearing Capacity Calculation for 5.0m wide Foundation (at 15.0m depth below existing ground level):**

$$\gamma = 1.80 \text{ g /cc}$$

$$c = 0.00 \text{ kg/m}^2$$

$$\phi = 31^\circ$$

B = 5.0m D_f = 1.50m (below basement floor level)

For $\phi = 31^\circ$

N_c' , N_q' and N_γ' are:

N_c' = 17.2, N_q' = 8.02 and N_γ' = 7.50

s_c = 1.0

s_q = 1.0 and s_γ = 1.0

$$\begin{aligned} d_c &= \{ 1 + 0.2 (D_f/B) \tan (45^\circ + \phi') \} \\ &= \{ 1 + 0.2 (1.5/5.0) \tan (45^\circ + 10.95) \} \\ &= 1.08 \end{aligned}$$

$$\begin{aligned} d_q = d_\gamma &= \{ 1 + 0.1 (D_f/B) \tan (45^\circ + \phi') \} \\ &= \{ 1 + 0.1 (1.5/5.0) \tan (45^\circ + 10.95) \} \end{aligned}$$

d_q = d_γ = 1.04 and W = 1

Substituting these values in equation (1)

$$\begin{aligned}q_d &= 2/3 \times 0.00 \times 17.2 \times 1.0 \times 1.08 + 1.8 \times 1.5 \times 7.02 \times 1.0 \times 1.04 \\ &\quad + 0.5 \times 1.8 \times 5.0 \times 7.50 \times 1.0 \times 1.04 \times 1 \\ &= 54.81 \text{ t / m}^2\end{aligned}$$

Safe net allowable bearing capacity on basis of shear criteria = $54.81/2.5 = 21.92 \text{ t / m}^2$
.....1(b)

5.4 **Bearing Capacity based on Settlement for 5.0m wide foundation:**

Depth of foundation = 15.0m (from existing ground level)

Average of Corrected value of N in weakest bore hole (B.H.-2) at proposed
foundation level = 18.68

Safe net allowable Bearing capacity

[When B = 5.0m, N = 18.68, S = 40mm & W = 1] = 24.40 t / m^2 2(b)

Safe net allowable bearing capacity at 11.0m depth from existing ground level
is 21.92 t / m^2 taking least of 1(b) and 2(b).

6. **RECOMMENDATIONS:**

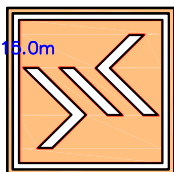
- (i) **The safe Net Allowable Bearing Capacity at 11.0m depth below existing ground level for 5.0m wide footing is 18.32 t / m^2 .**
- (ii) **The safe Net Allowable Bearing Capacity at 15.0m depth below existing ground level for 5.0m wide footing is 21.92 t / m^2 .**
- (iii) **Water table was not encountered up to depth investigated.**
- (iv) **In case depth of foundation is changed or bearing capacity is required at any other depth, the query should be referred to the consultants.**

(ER. B. S. RUPRA)

BORE LOG

1. NAME OF PROJECT: PROPOSED "SOCIETY PLAZA" COMPLEX NEAR CLOCK TOWER, LUDHIANA.
- 2 No. OF BORE HOLE: BH-I
3. DEPTH OF BORE HOLE: 22.5m
4. DEPTH OF WATER TABLE: NOT ENCOUNTERED UP TO DEPTH INVESTIGATED.
4. TOP LEVEL OF BORE HOLE: 0.60m BELOW EXISTING ROAD LEVEL.

DEPTH FROM N.S.L	DESCRIPTION OF STRATA	BORE LOG	N VALUES	S P T RESISTANCE CURVE			
				10	20	30	40
	BACKFILLING						
1.95m 2.30m	SANDY SILT		11				
3.00m	SILTY SAND		9				
3.90m 4.40m 4.80m	SANDY SILT SILTY SAND		10				
6.00m	SAND		9				
7.50m			11				
8.50m 9.0m	SAND		13				
10.50m			15				
12.0m			18				
13.50m	SAND WITH SANDSTONES		26				
15.00m			28				
15.80m 16.50m	SAND		31				
18.00m			36				
19.00m 19.50m	SILT		39				
20.50m 21.00m	SAND		40				
22.50m			40				



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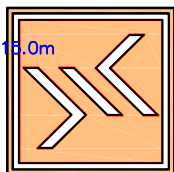
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BORE LOG

1. NAME OF PROJECT: PROPOSED "SOCIETY PLAZA" COMPLEX NEAR CLOCK TOWER, LUDHIANA.
- 2 No. OF BORE HOLE: BH-II
3. DEPTH OF BORE HOLE: 22.5m
4. DEPTH OF WATER TABLE: NOT ENCOUNTERED UP TO DEPTH INVESTIGATED.
4. TOP LEVEL OF BORE HOLE: 1.65m BELOW EXISTING ROAD LEVEL.

DEPTH FROM N.S.L	DESCRIPTION OF STRATA	BORE LOG	N VALUES	S P T RESISTANCE CURVE			
				10	20	30	40
1.50m	BACKFILLING						
	SANDY SILT		8				
3.00m	SILTY SAND		9				
4.50m			10				
6.00m	SAND		13				
7.50m			14				
9.0m			14				
10.50m	SAND		13				
12.0m			17				
13.50m			26				
15.00m	SAND WITH SANDSTONES		28				
16.50m	SAND		28				
18.00m			34				
19.50m	SILT		39				
21.00m	SAND		40				
22.50m			39				



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