REPORT OF GEOTECHNICAL INVESTIGATIONS CONDUCTED AT LOCATION FOR CONSTRUCTION OF OVERHEAD WATER STORAGE TANK AT M/S ISGEC HEAVY ENGINEERING LTD RATTANGARH (NEAR DHAMLA)

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Department of Civil Engineering, National Institute of Technology, Kurukshtera, conducted Geotechnical investigations of soil formations at the site of the construction of OVERHEAD WATER STORAGE TANK AT M/S ISGEC HEAVY ENGINEERING LTD RATTANGARH (NEAR DHAMLA). The field investigations consisted of making bore holes at the site, taking out soil samples and conducting of standard penetration tests at various elevations inside the bore holes. The samples so collected were subjected to laboratory testing.

DEPARTMENT OF CIVIL ENGINEERING
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SITE: CONSTRUCTION OF OVERHEAD WATER STORAGE TANK AT M/S ISGEC HEAVY ENGINEERING LTD RATTANGARH (NEAR DHAMLA)

GROUND WATER TABLE

The GWT was not met in the depth of boring made at the site.

BORING OPERATIONS

Two bore holes (each 20′ deep) were made at the location.

Initially boreholes were advanced for short depth by using posthole auger. A casing pipe was pushed in and driven by slow frequent rotations to avoid excessive disturbance. As the casing advanced, the soil material within the casing was removed. The undisturbed soil samples were drawn by pushing thin walled steel tubes into the boreholes. The samples were taken below the bottom of the casing after cleaning the bore holes of any loose material at all elevations. Immediately, after collecting undisturbed samples these were marked and sealed.

FIELD TESTS

Standard Penetration Tests:

The standard penetration tests were conducted by driving split spoon sampler at various elevations into the soil through boreholes made at site. A hammer weighing 63.5 kg with av. free fall of 75 cm. was used to drive the sampler. The test was performed in three stages. The number of blows was counted for every 15-cm. penetration of the sampler. The blows required for Ist 15 cm. penetration was ignored as those required for seating drive. The number of blows required for next 30-cm. penetration were recorded as SPT values (N values). The test procedure adopted for conducting above test has been as per Indian Standard (IS: 2131: 1981).

LABORATORY TESTS

The following lab tests has been conducted in the Soil Mechanics Laboratory of National Institute of Technology, Kurukshetra, to determine index and engineering properties of the soil samples collected from the boreholes made at the site.

1. **Identification of Soil:** The soils were identified by simple visual examination as per "IS: 1498: 1970 Classification of Soil for General Engineering Purpose". Visual examination included the evaluation of color &

presence of any fibrous material. Shaking tests, strength tests, and dispersion tests were also conducted.

2. **Water Content:** The water content of soil samples has been determined by oven drying method as per recommendation of Indian Standard "IS: 2720 (Part II) 1973".

3. **Consistency Limits:** The liquid limit and plastic limits of the soil samples collected at various elevations of the bore holes has been evaluated as per procedure laid down in the Indian Standard "IS: 2720 (part V) 1970".

4. **Grain Size Distribution:** This classification test was conducted to determine the ranges of sizes of particles and percentage of particles in each of these size ranges of the soil met at various elevations of the bore holes. The test procedure standardized by Indian Standard "IS: 2720: (part IV) 1975" has been adopted to conduct the above test. The percentage of gravel coarse and medium sand, fine sand, silt and clay evaluated from this test has been presented in the enclosed bore hole sheets.

5. **Triaxial Compression Tests:** A series of triaxial compression. Tests were conducted on undisturbed samples collected from the boreholes to estimate shear strength parameters (c & ϕ). The height to diameter of the samples was kept 2. These samples were tested in triaxial cell under various confining pressures. The samples were tested under each cell pressure after consolidation. The cell pressure was applied by constant mercury application unit and the samples were sheared under constant strain. Mohr's failure envelopes were plotted from the result of a series of triaxial compression tests to determine shear strength parameters. These parameters have been presented in the enclosed borehole sheets.

ESTIMATION OF ALLOWABLE BEARING PRESSURE

The stability of a foundation depends upon the safety of a soil against 1, its failure in shear (associated with plastic flow of soil material underneath the foundation and lateral expulsion of soil underneath the foundation and 2) excessive vertical displacement of settlement caused by process of consolidation of the soil under the foundation (elastic and plastic deformation). Therefore, in order not to endanger the structure there are two independent foundation stability criteria, which must be met simultaneously:

1. There should be adequate safety against a shear failure within the soil mass.
2. The possible differential and maximum settlement of the soil viz. foundation must be limited to safe tolerable acceptable magnitude.

In the present report the estimation of allowable bearing pressure has been made on the basis of above two criteria with following assumptions:

Type of Foundation	=	**Open Foundation**
Depth of Foundation	=	**200 cm**
Diameter of Foundation	=	**600 cm**

OVERHEAD WATER STORAGE TANK AT M/S ISGEC HEAVY ENGINEERING LTD RATTANGARH (NEAR DHAMLA)

SHEAR FAILURE CRITERION

Soil Properties $\varnothing$ = 29^0, c = 0

For $\phi = 29^0$, $N_c' = 15.2$, $N_q' = 6.6$ and $N_r' = 5.7$

As per IS 6403:1981, net ultimate bearing capacity of Strip footings,

$$Q_{mu} = \frac{2}{3} cN_c' + q(N_q' - 1) + \frac{1}{2}\gamma B N_r' W'$$

$$= 0 + 200\left(\frac{1.78}{1000}\right) \times (6.6 - 1) + \frac{1}{2} \times \left(\frac{1.78}{1000}\right) \times 600 \times 5.7 \times 0.5$$

= 1.99 + 1.52

= 3.51 kg/cm^2

$$Q_{NS} = \frac{3.51}{2.5} = 1.40 Kg/cm^2$$

SETTLEMENT FAILURE CRITERION

Corrected 'N' = 14

Q_{na} = 0.197 (N-3)W'

= $0.197(14-3) \times 0.5$

= 1.08 kg/cm^2

RECOMMENDATIONS

The net safe allowable bearing pressure is recommended as under:

S. No.	Location	Diameter of foundation	Depth of foundation from NGS	Allowable bearing pressure
1.	OVERHEAD WATER STORAGE TANK AT M/S ISGEC HEAVY ENGINEERING LTD RATTANGARH (NEAR DHAMLA)	6.0 m	2.0 m	1.08 kg/cm^2

The above values would need modification if depth and diameter/width of the foundation adopted in the field were different than the assumed one.

The recommendations are based on the properties observed in the two boreholes made at the site. Further it is observed that the proposed site has a filling of 3m. Therefore, total depth of foundation from the existing ground surface is 5.0m where as depth of foundation from natural ground surface is 2.0m.

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BORE HOLE NO. 1

Depth Below G.L. (Feet)	Soil Type	Description	SPT 'N' Value	Triaxial Test Result ∅ Deg.	Triaxial Test Result 'c' Kg/cm²	Depth of Water Table	LL & PL	Wet & Dry Bulk Densities (g/cc)	Sieve Analysis Percent Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt & Clay
			8						-	-	-	70	30
5				29	0		NP	1.78	-	-	-	80	20
	SM	SILTY	10					1.61	-	-	-	75	25
10		SAND		29	0		NP		-	-	-	90	10
			12						-	-	-	85	15
15				30	0		NP		-	-	-	92	8
			15						-	-	-	87	13
20				30	0		NP		-	-	-	86	14

BORE HOLE NO. 2

Depth Below G.L. (Feet)	Soil Type	Description	SPT 'N' Value	Triaxial Test Result ∅ Deg.	Triaxial Test Result 'c' Kg/cm²	Depth of Water Table	LL & PL	Wet & Dry Bulk Densities (g/cc)	Sieve Analysis Percent Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt & Clay
				29	0		NP		-	-	-	65	35
5			9					1.82	-	-	-	85	15
	SM	SILTY		29	0		NP	1.60	-	-	-	70	30
10		SAND	12						-	-	-	75	25
				30	0		NP		-	-	-	78	22
15			15						-	-	-	74	26
				31	0		NP		-	-	-	83	17
20			17						-	-	-	86	14

BORE HOLE DATA AND SOIL PROPERTIES
AT THE SITE FOR THE CONSTRUCTION OF
OHSR AT ISGEC HEAVY ENGG LTD RATTAN GARH (NEAR DHAMLA)