Major Test
(I Semester 2013 – 2014)
CEL 610 – Foundation Engineering
Department of Civil Engineering
Indian Institute of Technology Delhi

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Time: 02 Hours **Date: 23.11.2013**

Total marks: 40

(Answer all the Questions)

1. A square footing of size 8 m × 8 m is founded at a depth of 2 m below the ground surface in loose to medium dense sand with net foundation base pressure of 120 kN/m^2. Standard penetration tests conducted at the site and the layer details are given in Table 1. The ground water table is found at the base of foundation. Above the water table, γ = 16.5 kN/m^3 and below the water table, γ_{sub} = 8.5 kN/m^3. Estimate the elastic settlement at the end of period of 3 years by Schmertmann's Method by making the use of the relationship $q_c = 4\ N_{corr}$ kg/cm^2, where q_c = Static cone penetration value in kg/cm^2. Use the equation $E_s = 4\ q_c$ for computing the modulus of elasticity of the sand, where E_s and q_c are expressed in MPa. [8]

2. Determine the (*i*) Safe vertical capacity, (*ii*) Lateral capacity and (*iii*) Safe uplift capacity of the single pile as per IS 2911 (Part 1/Section 2) - 2010 for the layered soil stratum as given in Table 2. Contribution of 5 m top portion measured from existing natural ground level of the pile can be ignored in the theoretical capacity calculation. The ground water table is found at the ground level (GL). The following data are given: Pile length = 36.5 m, Pile diameter = 1200 mm, Cut off level = 0 m below GL, Earth pressure coefficient (K_s) = 1.0, Unit weight of pile material = 2.5 Ton/m^3. Consider the fixed head pile and the first two layer as NC Clay for lateral pile capacity calculation. [10 + 5 + 2]

3. The allowable working load on a concrete pile of 16.5 m long that has been driven into sand is 1600 kN. The diameter of pile is 0.75 m. Skin resistance carries 700 kN of the allowable load, and the point bearing carries the rest. Use the modulus of elasticity of the pile material (E_p) = 29.6 × 10^6 kN/m^2, the modulus of elasticity of soil at or below the pile point (E_s) = 50 × 10^3 kN/m^2, Poisson's ratio of soil (μ_s) = 0.35. Consider the triangular distribution of unit skin resistance. Determine the total elastic settlement of the single pile. [5]

4. The section of a 3 × 4 group pile in a layered saturated clay is shown in Figure 1. The piles are square in cross section (356 mm × 356 mm). The center-to-center spacing of the piles is 889 mm. Determine the allowable load-bearing capacity of the pile group. Use FS = 4. Note that the groundwater table coincides with the ground surface. [5]

5. (a) Write the procedure for the determination of safe load from the initial pile load test data as per IS 2911, Part 4 (1985).

(b) Describe the methodology by Van Weele (1957) for the estimation of the load taken by the point bearing and skin friction from the pile load test data. [2.5 + 2.5]

Table 1

Layer No.	Depth (m)		Thickness (m)	N_{corr}
	From	To		
I	2	5	3	9
II	5	11	6	12
III	11	18	7	17

Table 2

Stratum No.	Depth below GL in meter (RL)		Average Field SPT-N value	Bulk density (t/m^3)	Liquid limit (%)	Plasticity index (%)	Shear strength parameters
	From	To					
I	4.100	2.600	5	1.60	53	25	$c = 2.5\ t/m^2$, $\phi = 0°$
II	2.600	-6.000	9	1.67	53	25	$c = 2.5\ t/m^2$, $\phi = 0°$
III	-6.000	-25.100	22	1.89	Non-Plastic		$c = 0\ t/m^2$, $\phi = 29°$
IV	-25.100	-33.800	30	1.92	44	19	$c = 11\ t/m^2$, $\phi = 0°$
V	-33.800	-46.500	60	1.94	Non-Plastic		$c = 0$, $\phi = 33°$

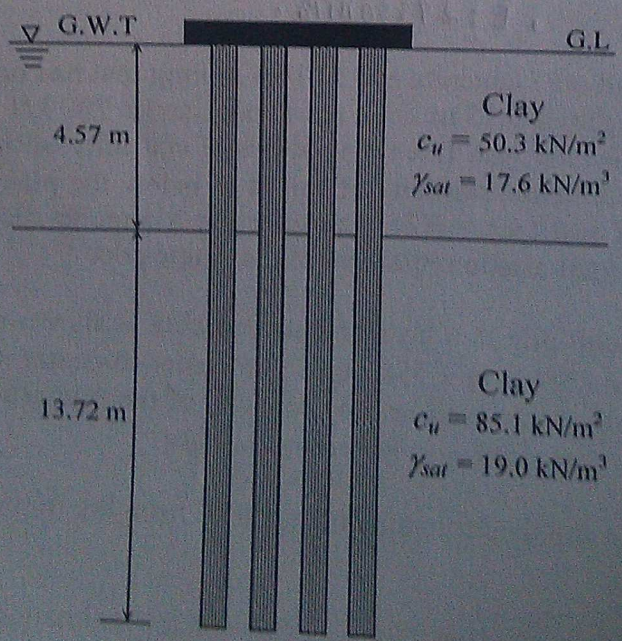

Figure 1