Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-II Examination July 2010

Subject code: 722005

Subject Name: Advanced Foundation Engineering

Date:07 /07 /2010 **Time: 11.00am – 1.30pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** While computing settlement due to consolidation (Sc), the clay stratum should be divided in minimum three parts, why? A 2.00 m x 3.00 m size footing is placed at 2.00 m depth below the ground level (GL) within a 10.0 m thick clay stratum. Ground water table (GWT) lies at 2.00 m depth below the GL. The clayey soil has γ_t = 19.0 kN/m^3, γ_{sat} = 21.33 kN/m^3, LL = 80%, G = 2.7 & water content below 2.0m depth = 18.52 %. If the gross pressure intensity at the footing base = 240 kPa, divide the clay stratum in TWO PARTS and compute the settlement due to consolidation (Sc). **06**

(b) A 4 x 4 = 16 pile group is embedded in uniform cohesive bed (Cu = 50 kPa, Φu = 0.0˚, γ_t = 16 kN/m^3 , G = 2.70 , γ_d = 14 kN/m^3 , LL= 60 %). The piles diameter and length are 0.50 m and 12.0 m respectively. Calculate the settlement of the pile group under the applied load of 3000 kN. **06**

Q.2 **(a)** In case of the eccentric load, why shall the size of the footing be modified? For the data given below, compute the safe bearing capacity values for a 2.00 m x 2.50 m size rectangular footing with 0.15 m eccentricity along the width :- **06**

- D_f = 2.00 m
- GWT = 3.00 m below the GL
- Soil properties : γ_t = 18 kN/m^3 ; γ_{sat} = 20 kN/m^3 ; C = 33 kPa , Φ = 26˚

Φ˚	**Nc**	**Nq**	**Nr**
16	12.9	4.4	2.5
18	16.7	6.1	4.8
20	17.7	7.4	5.0
26	25.8	13.1	10.5

(b) 1) State the factors causing differential settlements and also the factors deciding/governing permissible settlements. **03**

2) Mention the important recommendations for the 'Depth of footing' & 'for a new footing adjacent to old/existing footing'. **03**

OR

(b) 1) Explain the procedure of proportioning of footing and mention its importance. **03**

2) For a footing placed at GL, show the effect of Rigidity/Flexibility of the footing and soil type on the contact pressure diagram. **03**

Q.3 **(a)** Data given: **06**

1. LHS column: 0.40m x 0.40m touching the property line on LHS,
   W1 = 1500 kN & M1 = 150 kN-m clockwise
2. RHS column: W2 = 1000 kN & M1 = 80 kN-m anticlockwise
3. c/c distance between column axes = 8.00 m
4. SBC = 240 kPa

Find size of the STRAP footing and draw S.F. & B.M. diagrams mentioning typical values.

(b) A caisson 4 m x 8 m in plan is sunk in a sand deposit (($\Phi = 31^\circ$, **06**
$\gamma_{sat} = 20$ kN/m^3, $\mu = 0.3$) is subjected to a vertical load of 18000 kN acting at top of the pier. The pier height from the maximum scour level is 10 m and the depth of caisson from the scour level is 15 m.
Consider $k_v = 200$ MN/ m^3 , $k_h = n_h y$ & $n_h = 1.50$ MN/ m^4 . Determine factor of safety if a horizontal force of 1200 kN is acting at top of the pier. Use Elastic analysis of the well foundation.

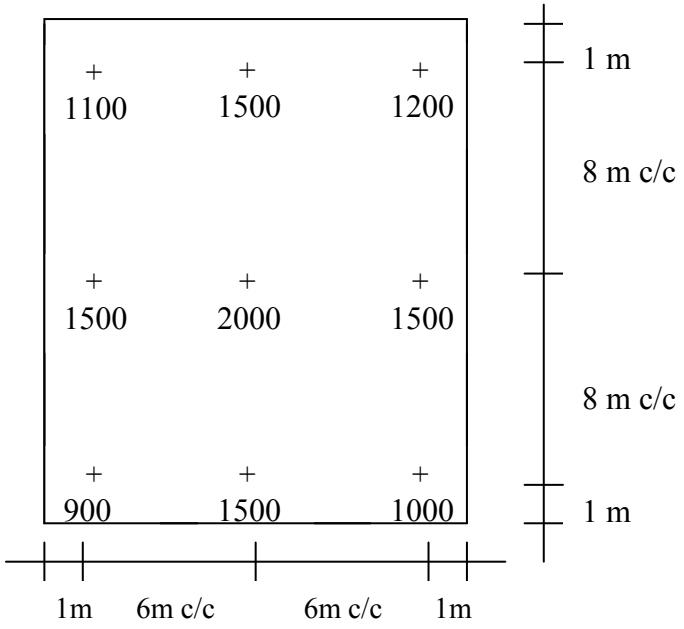
OR

Q.3 **(a)** Data given: **06**

1. LHS column: axis 0.80m away from the property line on LHS,
   W1 = 1800 kN & M1 = 100 kN-m clockwise
2. RHS column: W2 = 1500 kN
3. c/c distance between column axes = 6.00 m
4. SBC = 120 kPa

Find size of the TRAPEZOIDAL combined footing and draw only S.F. diagram mentioning typical values.

(b) Under which circumstances, the RAFT will be useful? For a raft shown below, compute the contact pressures under the corner points. If SBC = 100 kPa, give comments on the results. Loads are in kN. (Fig. is not to the scale). **06**



Q.4 **(a)** List out the various dynamic soil properties required for the design of machine foundation. Briefly describe the methods of finding these parameters including Block Vibration Test conducted as per IS code. **06**

(b) A Block Vibration Test was performed on a concrete block (M20) of 1mx1mx1m using vertical excitation. If unit weight of concrete is 24 kN/m^3 , determine C_u & D for the given information:- **06**

f (rpm)	500	600	700	750	850	950	1000	1200
A_z (mm)	0.2	0.6	1.5	2.5	3.2	2.5	1.5	0.6

OR

Q.4 **(a)** A machine foundation block of M20 concrete of size 2 m x 2 m x 2m is embedded in the weak sandy bed ground at a depth of 1.0 m. A reciprocating machine of weight equals to one fifth the weight of the block is attached over it. The operating frequency of the machine is 2000 rpm and induces uncoupled vertical and horizontal mode of oscillations. If the damping coefficient in the system is one forth of critical damping, check the adequacy of the foundation. The constant exciting force is 100 sin ωt kN. Also calculate the resonant frequency and maximum magnification factor. **06**

(b) Explain the usefulness of Lysmer lumped parameter method of finding various dynamic parameters related to machine foundation under vertical oscillations. **06**

Q.5 **(a)** A concrete pile (M20) 0.4 m square in section and 7.0 m long embedded in sandy bed is subjected to a horizontal load of 6 kN and moment of 5 kN-m at GL. Taking horizontal subgrade reaction η_h = 20,000 kN/m^3, find deflection if (a) pile is free headed and (b) the head is fixed with no external moment. **06**

Z	Ay	By	Am	Bm	As	Bs
0	2.435	1.623	0.000	1.000	-1.623	-1.750
0.5	1.644	0.873	0.459	0.976	--	--
0.6	1.496	0.752	0.532	0.960	--	--
0.7	1.353	0.642	0.597	0.939	--	--
0.8	1.216	0.540	0.649	0.914	--	--
0.9	1.086	0.448	0.693	0.885	--	--
1.0	0.962	0.364	0.727	0.852	--	--
1.2	0.738	0.223	0.767	0.775	--	--

(b) (1) Briefly describe the various tests to evaluate the swell potential of the given soil mass. How do you find the swelling pressure by performing various tests in the laboratory? **04**

(2) Write a short note on under-reamed piles. Under which situations you would prefer to use these piles. **02**

OR

Q.5 **(a)** A concrete pile 0.4 m square in section is driven 16.0 m into a dense sand (Φ = 30˚, γ_t = 19 kN/m^3). The pile's head is 1.0 m above the GL. Determine its lateral load carrying capacity from bending criteria only. Use Brom's method (use of Brom's chart is permitted). Take η_h = 12,450 kN/m^3, Ec = 2.2 x 10^7 kN/m^2. **06**

(b) A cantilever retaining wall is to be constructed to retain a sandy backfill. The following are the data:- **06**

Height of backfill above grade = 5.00 m

Inclination of the backfill with horizontal = 10˚, Φ = 30˚ ,

γ_t = 16 kN/m^3 . Determine the tentative dimension and various forces acting on the wall. Also check the stability of the wall against overturning and sliding.

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