University of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

Branch : | **Class:** 4^{th} **year**

subject : Foundation Engineering | **Time : 3 Hours**

Examiner :Committee Foundation | **Date : 29/ 5/ 2011**

Note: Attempt 5 Questions only

Q1- A-Discuss five the following terms:

1- S.P.T N-value
2- Undisturbed Samples.
3- Area Ratio.
4- Negative Skin Friction.
5-Block Faiular.
6-Group action.
7-Fixed earth support. (10 marks)

B- Site investigation is to be carried out on an inner city gap site which is being redeveloped for a six stories building with a raft foundation of (20x30) m and 2m depth below N.G.L. The net applied pressure at the footing base is 100kPa. Geological map show that the soil is of loose deposit with a dry and submerged unit weight of 16 and 9 kN/m^3 respectively. The water table was found at a depth of 2m below N.G.L Outline a suitable site investigation project for this site, giving details of the boreholes (number, depth , locations) and laboratory test required. (10 marks)

Q2 : A- Distinguish between the immediate and consolidation settlement and explain which is likely to be more harmful to structures built over a clay layer. (5 marks)

B- The raft foundation shown in figure (1) of 30 x 20m dimension exerts foundation net pressure of 180 kN/m^2 . For the soil properties given in the fig (1), calculate:

1- Immediate settlement for the two layers.
2- Consolidation settlement for the clay layer. (15 marks)

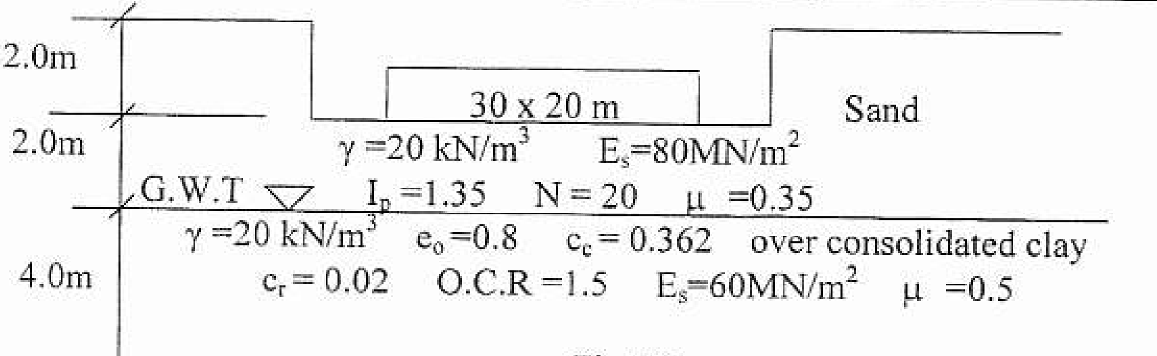

Fig (1)

Q3 : A group of 20m long and 1m diameter enlarge bored piles as shown in fig.(2), undrained cohesion strength (c_u = 80 kN/m^2) at the ground surface increasing uniformly to (200 kN/m^2) at the base. Suggest suitable F.S. and calculate the safe capacity of the group. (20 mark)

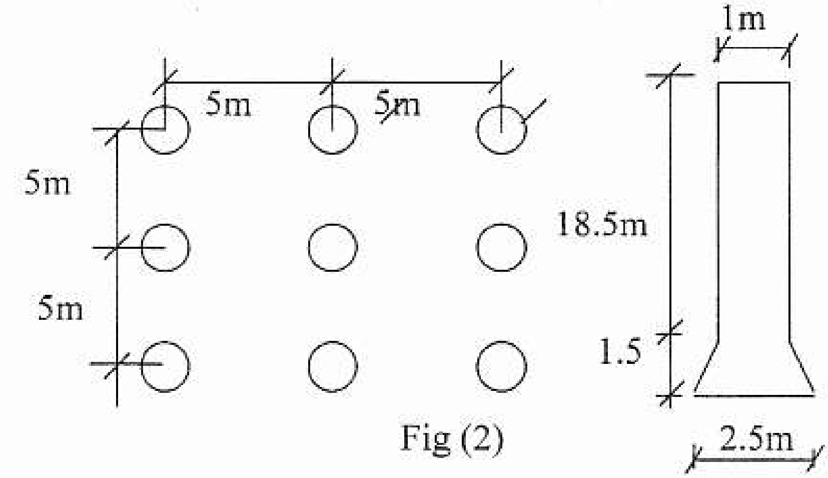

Fig (2)

Q4. A- 0.48m diameter .Vibro tube pile of 12 m length and 0.46m inner diameter driven through loose material and then into dense gravel to give ultimate driving resistance (R_u) of the pile 1500kN/m^2, using a 30kN single acting hammer with a stroke of 1.5m. Determine the set (S) of the pile if it is fitted with a helmet plastic dolly on top of the pile tube. The weight of the helmet and dolly is 5 kN, and the weight of the pile is 25 kN.
(k=0.9 , e = 0.4 for single-acting hammer) (10 mark)

B- Calculate load on piles 1&2 due to
($Q_{(group\ t)}$) = 6000kN Mx=1500kN.m
My=1000kN.m (and S =1.0 m.) (10 mark)

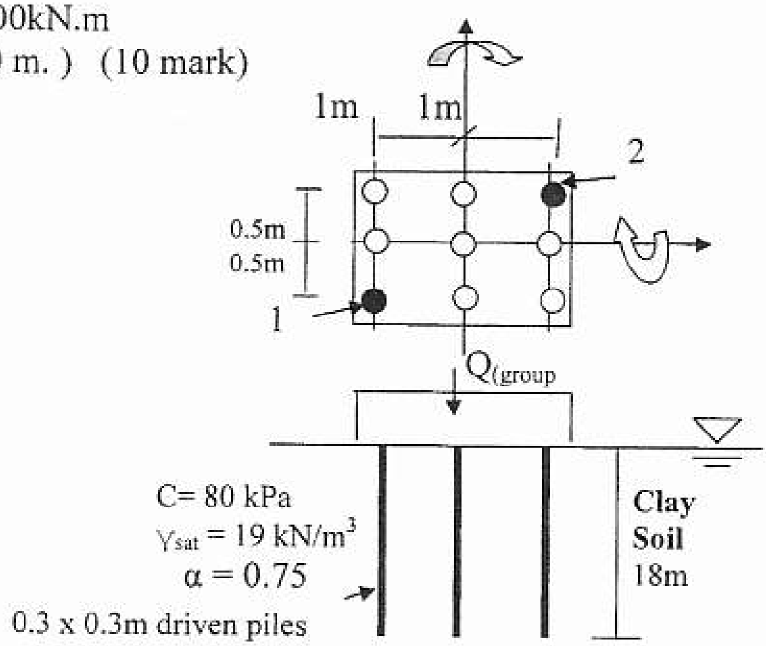

Fig (3)

Q5- Fig (4) shows an anchored sheet pile embedded in cohesive soil and support a cohesionless soil of 9.1m height. Find the embedded depth (d) and anchored force (T), Using F.S =1.5 on cohesive soil. (use free earth support method)

(20 mark)

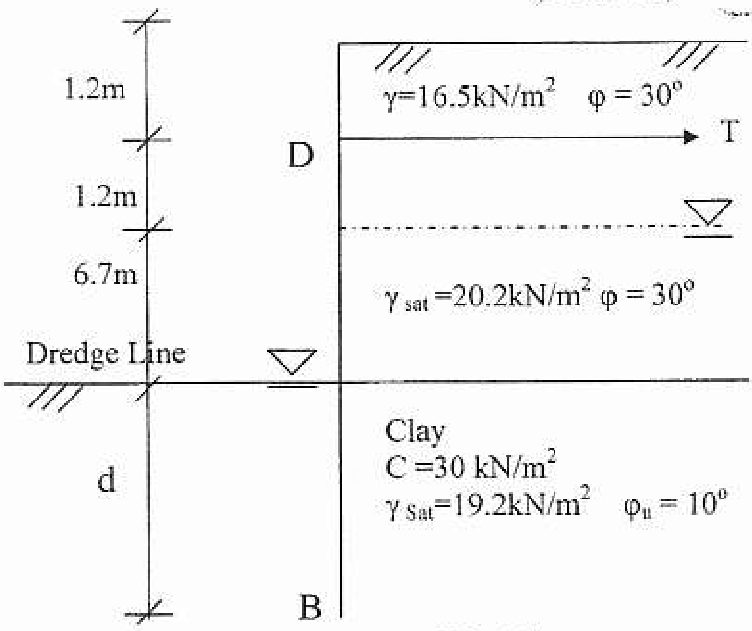

Fig (4)

Q6: A- Check bearing capacity of the 5m circular footing shown in fig.(5) for a F.S = 3.

(10 mark)

B- Design a trapezoidal combined footing for the two 50 x 50 cm. columns shown in fig .(6) (assume uniform pressure distribution if q_{all} = 120kPa).

(10 mark)

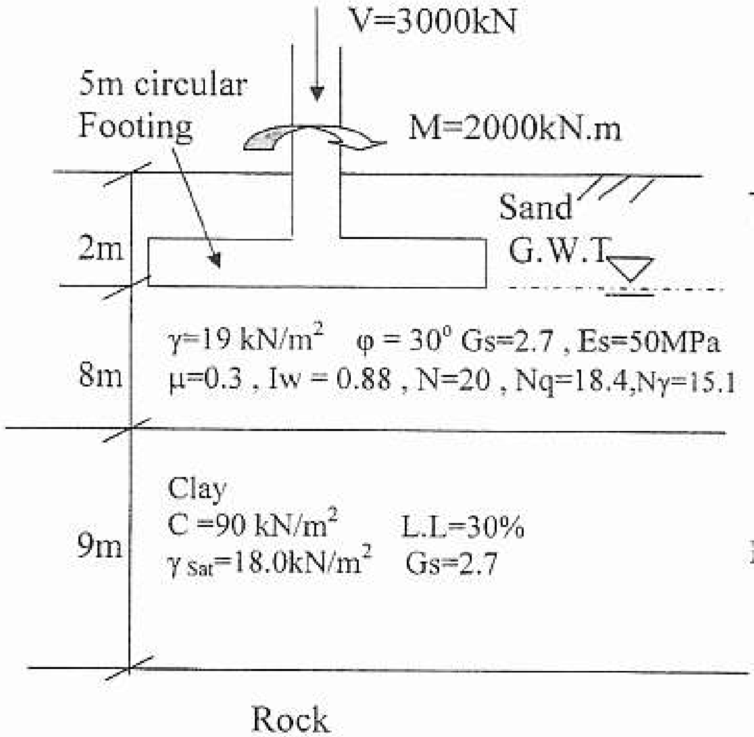

Fig (5)

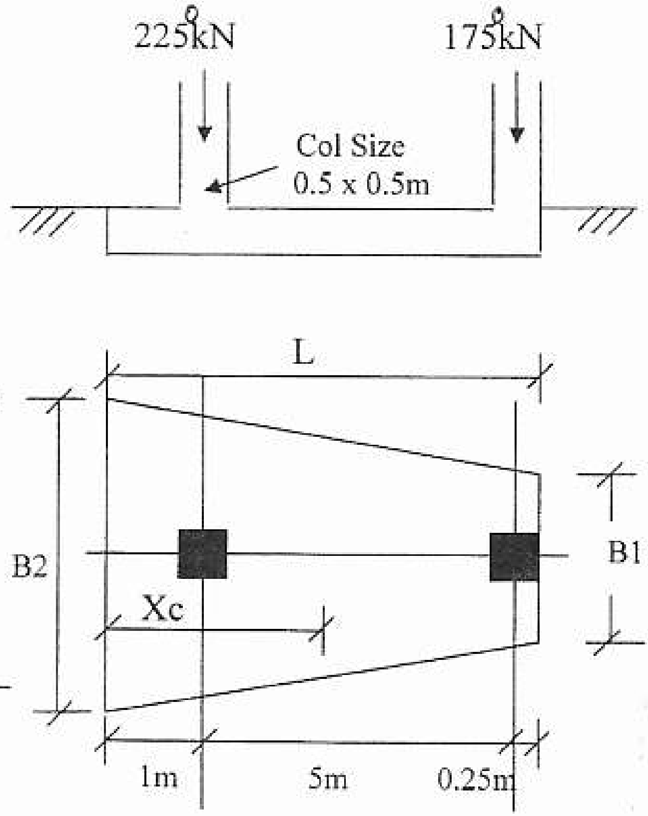

Fig (6)

Useful Equations

$$S_i = \frac{q B (1-\mu^2)}{E_s} I_w \quad O.C.R = \frac{P_c}{P'_o} \quad , P_a = k_a \gamma h - 2c\sqrt{k_a}$$

$$P_p = k_p \gamma h + 2c\sqrt{k_p}$$

$S_c = (C_c/1+e_o) H \log((p_o' + \Delta p)/p_o')$. For normally consolidation clay

$S_c = (C_r/1+e_o) H \log((p_o' + \Delta p)/p_o')$. For over consolidation clay If $P_c > P_o' + \Delta P$

$S_c = (C_r/1+e_o) H \log(p_c / p_o') + (C_c/1+e_o) H \log(p_o' + \Delta p)/p_c$ For over consolidation clay If $P_o' < P_c < P_o' + \Delta P$

$$S_i = \frac{H}{C_s} \text{Log} \frac{P_o' + \Delta P}{P_o'} \qquad C_s = \frac{1.5\,C_r}{P_o'}$$

$$q_{ult} = C N_c S_c d_c + q N_q S_q d_q + 0.5 \gamma B' N_\gamma S_\gamma d_\gamma$$

$$S_c = 1 + (N_q/N_c)(B'/L') , \; S_q = 1 + (B'/L')\sin\varphi , \; S_\gamma = 1 + 0.4 B'/L'$$

$$d_c = 1 + 0.4D/B , \quad d_q = 1 + 2\tan\varphi (1 - \sin\varphi)^2 D/B , \; d_\gamma = 1$$

$$B' = B - 2e_y \qquad L' = L - 2e_x$$

$$K_p = \tan^2(45 + \varphi/2)$$

$$X_c = \frac{L}{3} \frac{(2B1 + B2)}{(B1 + B2)} \qquad V_c = 0.17 \varphi \sqrt{f_c'} \text{ , One way shear}$$

$$V_c = 0.34 \varphi \sqrt{f_c'} \text{ , Two way shear}$$

$$R_u = \frac{W \times h \times \acute{\eta}}{S + C/2} \qquad \varepsilon = 1 - \frac{\theta}{90} \left[\frac{(n-1)m + (m-1)n}{mn}\right]$$

$Q_{ult} = C_u . N_c A_b + C_a . A_s$ For Cohesive Soils

$Q_{ult} = s'_b N_q A_b + k_d s'_v \tan d \, A_s$ For Cohesionless soils

$$Q_{ult\,(group)} = Q_{ult(single)} \times n \times \varepsilon$$

$$Q_{max.} = \frac{\Sigma V}{n} + \frac{M_x . Y}{\Sigma Y^2} + \frac{M_y . X}{\Sigma X^2}$$

$$q_{max} = \frac{\Sigma V}{A}\left(1 + \frac{6e}{L}\right) , \quad C_c = 0.009(L.L - 10) , \quad \gamma = \frac{G_s + S_e}{1 + e} \times \gamma_w$$

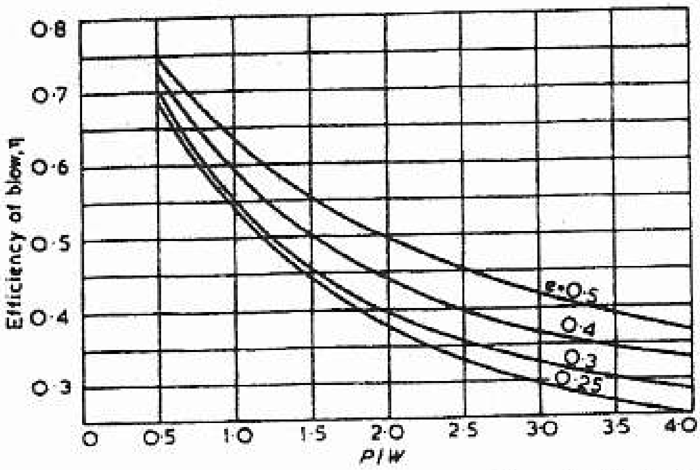

Fig. 1 Determination of efficiency factor, η, for use in the Hiley pile driving formula, after BSP Pocket Book (1969)

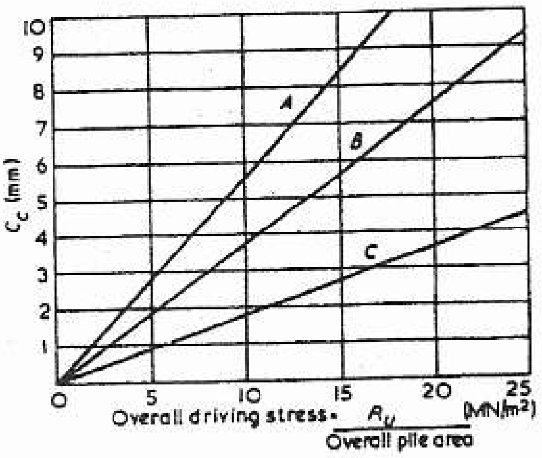

Fig. 2 Determination of temporary elastic compression C_c, after BSP Pocket Book (1969)
Key: A = concrete pile, 75 mm packing under helmet; B = concrete or steel pile, helmet with dolly or head of timber pile. C = 25 mm pad only on head of RC pile

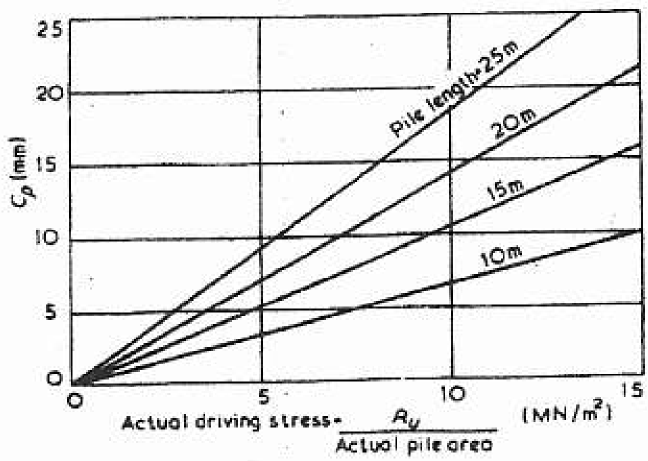

Fig. 3 Determination of temporary elastic compression C_p, for concrete piles, after BSP Pocket Book (1969)

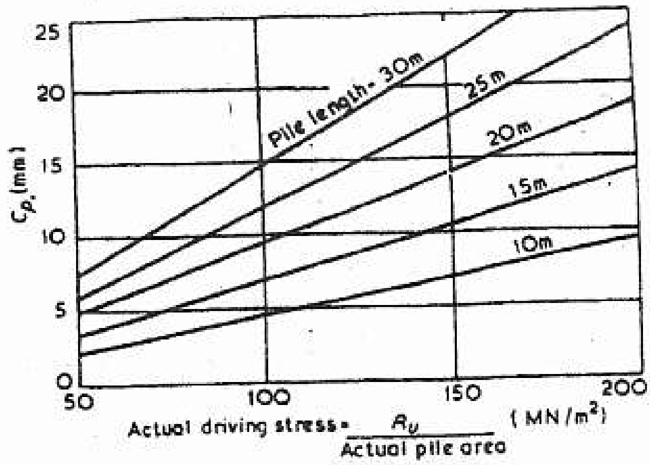

Fig. 4. Determination of temporary elastic compression C_p, for steel piles, after BSP Pocket Book (1969)

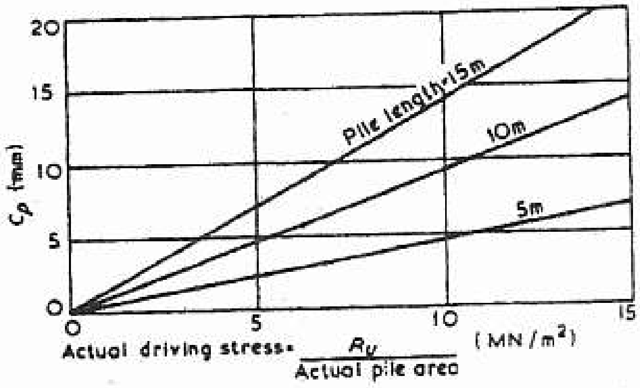

Fig. 5. Determination of temporary elastic compression C_p, for timber piles, after BSP Pocket Book (1969)

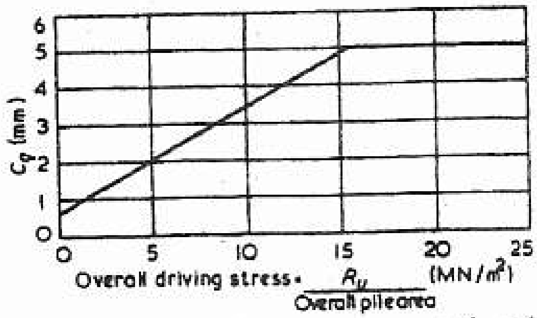

Fig. 6 Determination of temporary elastic Cq.

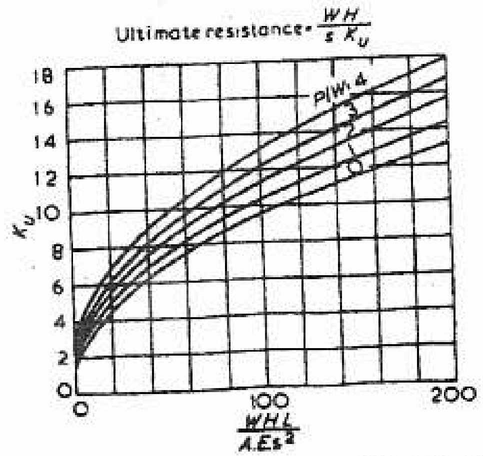

Fig. 7 Design chart for the Janbu pile driving formula