

Bachelor of Civil Engg. (Evening) 5th Year Exam.- 2018

Subject: Advanced Soil Mechanics

Time : Three hours

Answer any FOUR

Full Marks : 100

1. (a) State and explain Skempton's pore pressure parameters. Deduce the expression for excess pore pressure in terms of those parameters.
 (b) The results obtained from a series of CU tests with pore pressure measurements on a soil gave the following results: $c_{cu} = c'_{cu} = 0$, $\phi_{cu} = 15^\circ$, $\psi'_{cu} = 30^\circ$
 A sample of this soil was tested under a cell pressure of 150 kN/m^2 .
 Determine: (a) deviator stress at failure
 (b) pore water pressure at failure
 (c) minor principal effective stress at failure
 (d) major principal effective stress at failure
 (e) the magnitude of A_r . 10 + 15
2. (a) Write down Terzaghi's three dimensional consolidation equation clearly explaining the meaning of the various terms. Deduce the equation in polar coordinates. What do you mean by smear?
 (b) A 6m thick clay layer drained at top only has some sand drains. A uniform surcharge is applied at the top of the clay layer. Calculate the average degree of consolidation for combined vertical and radial drainage after 100 days of load application. Given $C_v = C_r = 4 \text{ mm}^2/\text{min}$, $d_e = 2\text{m}$, and $r_w = 0.2\text{m}$. Assume no smear. Compare this settlement using sand drains and that without using it during the same period. 10+15
3. (a) Explain with a neat sketch showing the various forces acting on a cantilever sheet pile wall. What do you mean by free earth and fixed earth support anchored sheet pile walls?
 (b) An anchored sheet pile wall of total height 15 m is penetrated 4.5m into a sandy stratum. It retains a similar sandy soil on its back upto its top with a horizontal ground surface. The tie bars are horizontal and are provided at a depth of 2m below the top. The free water level stands at a height of 8m above the dredge line in front of the wall and that of 9m in the backfill. The bulk density of sand above the free water level is 1.68 t/m^3 and the submerged density below the water level is 0.99t/m^3 . The angle of internal friction of sand is 35° . Determine the factor of safety with respect to passive resistance of soil for the given depth of penetration. What is the anchor pull per metre length of the wall? 10+15
4. (a) State and explain stress path giving a neat sketch.
 (b) Deduce the expression for K and draw the various K-lines. Explain K_0 and K_r lines giving neat sketches wherever necessary.

(c) CU triaxial tests conducted on specimens of a saturated clay soil gave the following results:

Cell Pressure σ_3 (kN/m ²)	Additional axial stress ($\sigma_1 - \sigma_3$) at deviator stress at failure (kN/m ²)	Pore water pressure u at failure (kN/m ²)
150	102	80
300	200	164
450	304	264
600	405	325

Determine the effective stress strength parameters c' and ϕ' by the Mohr circle method and the stress point method. 5 + 10 + 10

5. (a) Derive the equations of static equilibrium for stresses acting on an elemental soil mass in terms of effective stresses giving a neat sketch.

(b) Deduce the expressions of shear strain. What do you mean by plain strain problems? Explain the mathematical interpretations. 10 + 10 + 5