15. (a) (i) A 45° slope has been excavated to a depth of 8 m in a saturated clay which has following properties; $C_u = 60\ kN/m^2$, $\phi_u = 0$; and unit weight = $20\,kN/m^3$. Determine the factor of safety for the trial failure surface whose radius is 12 m and arc length is 18.84 m. The area of the trial wedge is 70 m² and centre of gravity of the trial wedge is 4.5 m away from the centre of the failure surface. (6)

(ii) Discuss various methods for improving the stability of slopes. (7)

Or

(b) (i) An infinite slope made of soil with c' = 20 kPa, $\phi' = 20°$, $e = 0.65$ and G = 2.7, is 10 m high. The slope angle is 25°. Find the factor of safety with respect to height for the following conditions :

(1) When the soil is dry

(2) When the slope is submerged. (6)

(ii) Discuss the stability analysis of slopes by Fellenius method. (7)

PART C — (1 × 15 = 15 marks)

16. (a) An unconfined aquifer is known to be 32 m thick below the water table. A constant discharge of 2 cubic metres per minute is pumped out of the aquifer through a tube well till the water level in the tube well becomes steady. Two observation wells at distances of 15 m and 70 m from the tube well show falls of 3 m and 0.7 m respectively from their static water levels. Find the permeability of the aquifer.

Or

(b) Fig. 16 (b) shows the details of an embankment made of cohesive soil with $\phi = 0$ and $c = 30\ kN/m^2$. The unit weight of the soil is 18.9 kN/m^3. Determine the factor of safety against sliding along the trial circle shown. The weight of the sliding mass is 360 kN acting at an eccentricity of 5.0 m from the centre of rotation. Assume that no tension crack develops. The central angle is 70°.

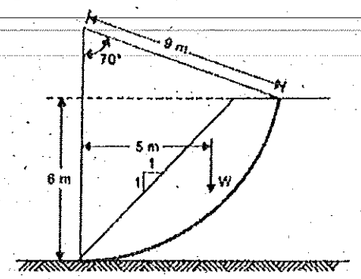

Fig.16(b)

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Question Paper Code : 52762

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulation 2013)

(Common to PTCE 6405 – Soil Mechanics for B.E. (Part-Time) Third Semester – Civil Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the phase diagram for completely dry and fully saturated soil mass.

2. List various factors affecting compaction.

3. Differentiate discharge velocity and seepage velocity.

4. State the Darcy's law of Permeability of soil.

5. Boussinesq's vertical stress due to a point load at a point which is at a depth of 'z' and at a radial distance of 'r' from the line of action of the load is 'σ_z', when the modulus of elasticity of the medium is 'E'. Find the vertical stress at the same point when the modulus of elasticity of the medium is doubled.

6. A consolidating stratum takes two years for 50 % consolidation. Find the time taken by the stratum for 90% consolidation for the same drainage condition.

7. Draw the strength envelope for fully saturated clay subjected to CD test.

8. Draw typical stress-strain curve for specimens failed by brittle failure and plastic failure.

9. State the influence of tension crack in factor of safety if the cracks are filled with water and without water.

10. How Taylor's stability Number is utilised for slope stability analysis?

PART B — (5 × 13 = 65 marks)

11. (a) (i) The liquid limit, plastic limit and shrinkage limit of a soil are 60%, 40% and 30% respectively A specimen of the soil has a volume of 100 cm^3 at liquid limit. Find its volume at shrinkage limit, if the specific gravity of solids is 2.0. When oven-dried sample of the soil is subjected to liquid limit test, the liquid limit reduced to 42%. Classify the soil as per IS, if the fraction of the soil passing 75 micron sieve is 70%. (10)

(ii) Discuss the influence of size of the particles of soil on optimum moisture content. (3)

Or

(b) (i) A loose, uncompacted sand fill 1.5 m deep has a relative density of 30%. Laboratory tests on the same sand indicate that the minimum and maximum void ratios are 0.45 and 0.82 respectively. The specific gravity of solids is 2.65. If the sand fill is compacted to a relative density of 70%, what is the decrease in its thickness? Also, find the dry unit weight of the compacted sand. (7)

(ii) The maximum dry density achieved in a laboratory compaction test on a soil which is being used for building a compacted fill is 1.98 g/cc. Two field density tests have been performed in the recently completed fill, but one of these tests has produced results that are definitely incorrect. Test A indicates a relative compaction of 97% at placement water content of 14.3% whereas Test B indicates a relative compaction of 98% at a placement water content of 14.7%. Which test results are definitely incorrect? Justify your answer. Take specific gravity of solids as 2.7. (6)

12. (a) (i) Name the various methods of laboratory determination of permeability with the soil type in which they are best suited and explain any one method in details. (7)

(ii) A field pumping test has been carried out in a well which was sunk through a horizontal stratum of sand 15 m thick and underlain by a clay stratum. Two observation wells were sunk at horizontal distances of 18 m and 35 m respectively from the pumping well. The initial position of the water table was 2.5 m below the ground level. At a steady state pumping rate of 925 litres/mm. the drawdown curves in the observation wells were found to be 2.5 m and 1.50 m respectively. Estimate the coefficient of permeability of the sand. (6)

Or

(b) (i) A drainage pipe beneath a dam has become clogged with sand; coefficient of permeability of the sand is 7.5 m/day. The average difference in head water and tail water elevation is 21 m and it has been observed that there is a flow of 160 litres per day through the pipe. The pipe is 97 m long and has a cross-sectional area of 0.02 m^2. Find out up to what length of the pipe is filled with sand? (6)

(ii) A flow net analysis was performed for estimating the seepage loss through the foundation of a cofferdam. Results of the flow net analysis gave a number of flow line 'N_f' = 6 and number of drops 'N_d' = 16. The head of water lost during seepage was 5 m. Assume the coefficient of permeability of the soil is 'k' = 4×10^{-5} m/min. Estimate the seepage loss per meter length of the cofferdam per day. Also estimate the exit gradient if the average length of the last flow field is 0.9 m. (7)

13. (a) (i) Describe the Newmarks chart and its application. (6)

(ii) A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 3 m, 6 m, 9 m, 12 m and 15 m directly below the point load; draw the vertical stress distribution diagram along vertical axis. (7)

Or

(b) (i) Describe Terzaghi's Theory of One Dimensional Consolidation along with the Spring Analogy. (7)

(ii) A clay layer of 8 m thick with Single Drainage settles by 120 mm in 2 years. The coefficient of consolidation for this clay was found to be $6 \times 10^{-3} cm^2/s$. Calculate the likely ultimate consolidation settlement and find out how long will it take to undergo 90% of this ultimate settlement. (6)

14. (a) The results of three consolidated undrained triaxial tests on identical specimens of a particular soil are as follows :

Test No.	1	2	3
Confining stress, kPa	200	300	400
Deviatoric stress at peak, kpa	244	314	384
Pore water pressure at peak, kPa	55	107	159

Determine the value of total and effective shear strength parameters. (13)

Or

(b) (i) The results of a direct shear test on a 60 mm × 60 mm specimen are given below. Determine shear strength parameters. (7)

Normal load, N	300	400	500	600
Shear force at failure, N	195	263	324	399

(ii) Sketch and discuss the stress-strain and volume change relationship for dense and loose sand. (6)