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Question Paper Code : 77068

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. The natural dry density of a soil deposit was found to be 17.5kN/m^3. A sample of the soils was brought to the laboratory and the minimum and maximum dry densities were found as 16.0kN/m^3 and 19.0kN/m^3 respectively. Calculate the density index for the soil deposit.

2. What are different equipments available for compacting soil in the field?

3. How do you know that the flow through a soil obeys Darcy's law?

4. The internal diameter of a tube is 0.1 mm. What will be the maximum capillary rise when it is held vertical with bottom end dipped in pure water taken in a trough? Take for water at 20°, $T_s = 72.8 \times 10^{-6}$kN/m.

5. Define overconsolidated and normally consolidated soils.

6. Compare Boussinesq's and Westergaard's Analysis of stress distribution.

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

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

9. Differentiate the modes of failure of finite and infinite slopes.

10. What is the effect of depth of failure surface on the stability of infinite slope in cohesionless soil?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A soil sample has a diameter of 38.1 mm and a length of 76.2 mm. Its wet weight is 1.843 N and its dry weight is 1.647 N. If specific gravity of the solids is 2.7, find dry unit weight, bulk unit weight, void ratio, water content and degree of saturation. Suppose the diameter was incorrectly measured to be 37.6 mm and the length incorrectly measured to be 75.6 mm, what would be the resulting error in the computed values of degree of saturation and water content. (8)

(ii) Explain IS soil classification system for classifying coarse grained soil. (8)

Or

(b) (i) Discuss various factors influencing compaction behaviour of soils. (8)

(ii) The sieve analysis of a soil gave the following results: % passing 75 μ sieve = 8; % retained on 4.75 mm sieve = 35. Coefficient of curvature = 2.5; Uniformity coefficient = 7. The fine fraction gave the following results: Plasticity index = 3%; Liquid limit = 15%. Classify the soil as per IS soil classification system. (8)

12. (a) (i) The water table in a certain area is at a depth of 4 m below the ground surface. To a depth of 15 m, the soil consists of very fine sand having an average void ratio of 0.7. Above the water table, the sand has an average degree of saturation of 50%. Calculate the effective stress on a horizontal plane at a depth of 10 m below the ground surface. What will be the change in the effective stress if the soil gets saturated by capillarity for a height of 1 m above the water table? Take specific gravity of solids as 2.65. (8)

(ii) In a falling head permeability test the length and area of cross section of soil specimen are 0.17m and 21.8×10^{-4} m^2 respectively. Calculate the time required for the head to drop from 0.25 m to 0.10 m. The area of cross section of stand pipe is 2.0×10^{-4} m^2. The sample has three layers with permeabilities 3×10^{-5} m/sec for first 0.06 m, 4×10^{-5} m/sec for second 0.06 m and 6×10^{-5} m/sec for the third 0.05m thickness. Assume the flow is taking place perpendicular to the bedding plane. (8)

Or

(b) (i) A stratum of sandy soil overlies a horizontal bed of impermeable material, the surface of which is also horizontal. In order to determine the in-situ permeability of the soil, a test well was made upto the bottom of the stratum. Two observation boreholes were made at distances of 12 m and 24 m respectively from the test well. Water was pumped out from the well at a rate of 180 litres/minute until the water levels became steady. The height of water in the two boreholes was found to be 4.2 m and 6.3 m respectively above the impermeable bed. Find the coefficient of permeability of the sandy soil. (10)

(ii) What is flow net? List the properties of flow net. (6)

13. (a) (i) A rectangular foundation 1.5 m × 3.5 m transmits a uniform pressure of 350 kN/m² to the underlying soil. Determine the vertical stress at a depth of 1.5m below a point within the loaded area 1.0 m away from short edge and 0.5 m away from long edge. (8)

(ii) Derive Terzaghi's equation for one-dimensional consolidation stating clearly the assumptions made. (8)

Or

(b) (i) Subsurface exploration at the site of a proposed building reveals the existence of 2.4 m thick layer of soft clay below a stratum of coarse sand which is 4 m thick and extends from the ground surface upto the top of the clay layer. The ground water table is at 2.5 m below the ground surface. Laboratory tests indicate the natural water content of the clay as 40%, average liquid limit as 45% and specific gravity of solids as 2.75. The unit weight of the sand above and below water table is 17.8 kN/m³ and 21 kN/m³ respectively. Estimate the probable settlement of the building, if its construction increases average vertical pressure on the clay layer by 71 kPa. (10)

(ii) Explain with sketch Taylor's $\sqrt{t}$ method for the determination of coefficient of consolidation. (6)

14. (a) (i) Two identical specimens of a soil were tested in a triaxial apparatus. The first specimen failed at a deviator stress of 770 kPa when the cell pressure was 200 kPa, while the second specimen failed at a deviator stress of 1370 kPa under a cell pressure of 400kPa. Determine the shear strength parameters. Also, find the deviator stress at failure when the cell pressure was 600 kPa. If the same soil is tested in a direct shear apparatus, estimate the shear stress at which the sample will fail under a normal stress of 600 kPa. (10)

(ii) Explain vane shear test. (6)

Or

(b) (i) In a triaxial test, a soil specimen was consolidated under a cell pressure of 200 kPa and simultaneously a back pressure of 100 kPa is applied to saturate the specimen. Thereafter, with drainage prevented, the cell pressure was raised to 250 kPa resulting in an increased pore pressure of 149 kPa. Maintaining the same cell pressure of 250 kPa, now the deviator stress was increased to 170 kPa and a pore pressure of 220 kPa was observed. Calculated the pore pressure parameters A and B. (8)

(ii) Explain direct shear test stating clearly its advantages and disadvantages. (8)

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 m^2 and centre of gravity of the trial wedge is 4.5 m away from the centre of the failure surface. (8)

(ii) Discuss various methods for improving the stability of slopes. (8)

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. (8)

(ii) Discuss the stability analysis of slopes by Fellenius method. (8)