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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2014

CIVIL ENGINEERING BRANCH

FOURTH SEMESTER

CE 8402 – Soil Mechanics

(Regulation 2012)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Find the relative density of sand whose maximum, minimum and natural dry unit weights are 18kN/m^3, 15kN/m^3 and 16.5kN/m^3 respectively.
2. List various field compaction methods along with their suitability.
3. What is quick sand condition? List the conditions for the development of quick sand condition.
4. Derive the expression for capillary rise in a tube inserted in water.
5. Define overconsolidated, normally consolidated and under 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 and fully saturated sand subjected to UU 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 x 16 = 80 marks)

11. i) A partially saturated sample of soil has a volume of 60cc and mass of 92g. The sample is dried in an oven and its dried mass is 73.8g. If the specific gravity of solids be 2.62, find the degree of saturation, water content, void ratio, porosity, bulk unit weight and dry unit weight. (6)

    ii) Explain IS soil classification system for classifying coarse grained soil. (5)

    iii) Discuss the effect of compaction on various engineering properties of soil. (5)

12. a(i) The water table in a certain area is at a depth of 4m below the ground surface. To a depth of 15m, 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 10m below the ground surface. What will be the change in the effective stress if the soil gets saturated by capillarity for a height of 1m above the water table? Take specific gravity of solids as 2.65. (8)

    a(ii) List various laboratory tests for determination of coefficient of permeability and explain any one method in detail. (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 12m and 24m respectively from the test well. Water was pumped out from the well at a rate of180 litres/minute until the water levels became steady. The height of water in the two boreholes was found to be 4.2m and 6.3m respectively above the impermeable bed. Find the coefficient of permeability of the sandy soil. Estimate the effective grain size using Hazen's equation. (8)

    b(ii) What is flow net? List the properties of flow net. Explain in detail various uses of flow net. (8)

13. a(i) Two footings 6m apart (c/c distance) at the same level carry concentrated loads of 1000kN and 1500kN respectively. Compute the vertical pressure at the following points:
(1) Midway between the footings at a depth of 3m below the footing level.
(2) Vertically below the centre of each footing at the same depth of 3m. (8)

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

OR

b(i) Subsurface exploration at the site of a proposed building reveals the existence of 2.4m thick layer of soft clay below a stratum of coarse sand which is 4m thick and extends from the ground surface upto the top of the clay layer. The ground water table is at 2.5m 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 17.8kN/m^3 and 21kN/m^3 respectively. Estimate the probable settlement of the building, if its construction will increase average vertical pressure on the clay layer by 71kPa. (10)

b(ii) Explain with neat 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 770kPa when the cell pressure was 200kPa, while the second specimen failed at a deviator stress of 1370kPa under a cell pressure of 400kPa. Determine the shear strength parameters. Also, find the deviator stress at failure when the cell pressure was 600kPa. 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 600kPa. (10)

a(ii) Explain vane shear test and also derive the expression to obtain undrained shear strength. (6)

OR

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

b(ii) Briefly state the strength envelope with the help of Mohr circle for saturated sand and clay during Consolidated Undrained and Consolidated Drained tests. (8)

15. a(i) A new canal is excavated to a depth of 5m with banks having 1:1 slope. The properties of the soil are: cohesion = 14kPa, angle of internal friction = 20°, void ratio = 0.65 and specific gravity of solids = 2.70. Calculate the factor of safety with respect to cohesion when the canal is running full. What will be the factor of safety if the slope is changed to be 30° to vertical? The Taylor's stability number is given in the table for different slope angles for angle of internal friction = 20°.

Slope angle	30°	45°	60°	75°	90°
Stability number	0.025	0.062	0.097	0.134	0.182

(10)

a(ii) Discuss various methods for improving the stability of slopes. (6)

OR

b(i) An infinite slope made of soil with c'=20kPa, ϕ'=20°, e=0.65 and G=2.7 is 10m 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)

b(ii) Discuss the stability analysis of slopes by Swedish method of slices for c-ϕ soil. (8)

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