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Question Paper Code : X 20296

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Fourth Semester
Civil Engineering
CE 6405 – SOIL MECHANICS
(Common to PTCE 6405 – Soil Mechanics for B.E. (Part-Time) Third Semester – Civil Engineering – Regulations 2014)
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

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

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

3. What is the difference between discharge velocity and seepage velocity ?

4. List the various uses of flow net in engineering practice.

5. What is the principle behind Newmark's influence chart ?

6. Define coefficient of consolidation and compression index.

7. Draw the Mohr's Circle diagram for UCC test and mention the salient features.

8. The diameter of all the Mohr circles drawn at incipient failure condition for the results of a triaxial test performed on a soil is the same and equal to 150 kPa to a scale. Find the shear strength parameters of the soil.

9. Find the factor of safety of an infinite slope having a slope angle of 28°. The slope consists of cohesionless soil with angle of internal friction of 31°.

10. In the case of c – ϕ soil, the slope failure of an infinite slope never takes place, if the angle of slope is equal to angle of internal friction of the soil. Why ?

PART – B **(5×13=65 Marks)**

11. a) i) A partially saturated soil from an earth fill has a natural water content of 22% and a bulk unit weight of 19 kN/m^3. Assuming the specific gravity of soil solids as 2.65, compute the degree of saturation and void ratio. If subsequently he soil gets saturated, determine the dry density, buoyant unit weight and saturated unit weight. **(8)**

ii) Explain Indian Standard Soil classification system for classifying coarse grained soil. **(5)**

(OR)

b) i) Discuss the effect of compaction on various engineering properties of soils. **(5)**

ii) A soil sample is found to have the following properties. Classify the soil according to I.S. classification system. Passing 75 μ sieve = 10% ; Passing 4.75 mm sieve = 70% ; Uniformity coefficient = 8; coefficient of curvature = 2.8; Plasticity Index = 4%. **(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 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 1 m above the water table ? Take specific gravity of solids as 2.65. **(7)**

ii) In a falling head permeability test the length and area of cross section of soil specimen are 0.17 m 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 0.05 m thickness. Assume the flow is taking place perpendicular to the bedding plane. **(6)**

(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. **(9)**

ii) What is flow net ? List the properties of flow net. **(4)**

13. a) i) A Newmark's chart is drawn with an interval of 0.1 for σ_z/q. If there are 20 radial lines, find the influence factor. (σ_z and q are additional vertical pressure and applied loading intensity respectively). **(3)**

ii) A certain clay layer has a thickness of 2m. After one year when the clay layer was 50% consolidated a settlement of 20 mm occurred. For a similar clay layer, under similar loading and drainage conditions, how much settlement would occur at the end of one year and four years respectively, if the thickness of the new layer were 4 m ? **(10)**

(OR)

b) i) A point in a clayey layer is subjected to a stress of 80 kPa at present. The consolidation test results conducted on a sample of the clay show a preconsolidation pressure of 120 kPa. Say whether the clay is normally consolidated or overconsolidated. Justify your answer. **(3)**

ii) In a normally consolidated clay, the void ratio decreases from 1.02 to 0.92 when the effective pressure is increased from 80 kPa to 160 kPa. The coefficient of permeability of the clay for this pressure range is 1×10^{-10} m/s. How long will it take for a 2-m thick clay layer which is sandwiched between coarse sand and rock in the field to reach 60% consolidation ?
What is the settlement at that time ? **(10)**

14. a) i) Describe the Vane Shear Test in detail and explain the two methods adopted in this test – Fully submerged Vane and Partially Submerged Vane. **(6)**

ii) An unconfined Compression Test was conducted on an undisturbed clay sample. The sample had a diameter of 37.5 mm and length 80 mm. Load at failure measured by proving ring was 28 N and the axial deformation at failure point was 13 mm. Determine the unconfined compressive strength and the undrained shear strength of the clay. Plot all the results on a Mohr's Circle. **(7)**

(OR)

b) i) Direct Shear Test was conducted on Compacted Sand with Shear Box Dimensions 60 mm × 60 mm. The readings are listed below.

Normal Load	**Shear Load (N)**	
(N)	Peak	Ultimate
110	95	65
225	195	135
340	294	200

Determine the Angle of Shearing Resistance.
1) In the dense compacted state
2) In the loose state. **(10)**

ii) Define Deviator stress and its significance in Triaxial Shear Strength Test. **(3)**

15. a) i) Discuss in details of stability analysis of the slope using method of slices. **(6)**

ii) An infinite sandy soil slope has a saturated unit weight of γ_{sat} = 19.5 kN/m^3 and angle of internal friction ϕ = 35°. The minimum factor of safety needed for the slope against failure is 1.3, estimate the safe angle of the slope (1) when the slope is dry without seepage (2) if seepage occurs at and parallel to surface of the slope. **(7)**

(OR)

b) i) Explain in detail the concept of Friction circle method of analysis for design of the slopes. **(6)**

ii) Discuss in details the various slope protection measures are used to stabilize the slope against failure. **(7)**

PART – C **(1×15= 15Marks)**

16. a) The unit weight of a soil at 50% and 80% saturation is 17.60 kN/m^3 and 18.81 kN/m^3 respectively. Find.

i) Specific gravity of solids
ii) Void ratio
iii) Porosity
iv) Dry unit weight
v) Saturated unit weight
vi) Submerged unit weight
vii) Water content corresponding to 100% saturation when a disturbed sample of the same soil was subjected to classification tests, the following results were obtained :

Percentage finer than 4.75 mm	: 80
Percentage finer than 0.075 mm	: 9
Liquid limit	: 23%
Plastic limit	: 15%
Size corresponding to 10% finer	: 0.09 mm
Size corresponding to 30% finer	: 1.2 mm
Size corresponding to 60% finer	: 3.4 mm

Classify the soil as per IS 1498.

(OR)

b) A soil profile consists of 4-m thick and underlain by 3-m thick clay. The clay layer overlies hard rock. A square foundation of size 2 m carrying a load of 800 kN is founded at a depth of 1.5 m from the ground level. The ground water table is at the base of the foundation. The specific gravity of solids and void ratio of the sand are 2.7 and 0.7 respectively. The degree of saturation above the water table can be assumed as 30%. The liquid limit, water content and specific gravity of solids of the clay are 40%, 27% and 2.66 respectively. Estimate the probable consolidation settlement of the clay layer, assuming the clay to be normally consolidated. For calculation of additional vertical stress, equivalent point load approach shall be adopted (dividing the total area into four area units).

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