# B 2103

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fourth Semester

Civil Engineering

CE 240 — SOIL MECHANICS

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

Assume relevant data, if necessary

PART A — (10 × 2 = 20 marks)

1. Would soils transported by wind be deposited in a sorted state or would the deposit at a particular location contains particles of many sizes?

2. From among the ranges of numerical values, given, select the range valid for the following soil parameters.

   (a) Water content, w in %

   (i) $w \leq 0$

   (ii) $0 < w < 100$

   (iii) $0 \leq w \leq 100$

   (iv) $0 \leq w$.

   (b) Degree of saturation, S in %

   (i) $S \leq 0$

   (ii) $0 < S < 100$

   (iii) $0 \leq S \leq 100$

   (iv) $0 \leq S$.

3. List the name of rollers used to achieve the maximum density in sandy and clayey deposits.

4. State whether the following statements are true or false.

   (a) Effective stresses in soil increases during the monsoon when the water table rises

   (b) Permeability of a soil is the flow per unit area through the soil under a hydraulic gradient of 1.0.

5. List any two assumptions made in Boussinesq's stress distribution theory.

6. The compressibility of over consolidated clay is less than that of the same clay in a normally consolidated state? why?

7. What constitutes 'failure' for a soil sample being sheared.

8. The angle of shearing resistance interms of total stresses for a saturated clay as obtained from a UU test is zero. Does this mean that the strength of clay cannot be attributed to friction.

9. An infinite mass of sand has $\gamma_b$ of $20\ kN/m^3$ and is just stable at a slope of $30^\circ$. If the entire mass is inundated and ends up below the water table, will the slope remain stable. If not at what inclination will it be stable?

10. What is the difference between stability Number and Safety Factor?

PART B — (5 × 16 = 80 marks)

11. (a) (i) In order to find the relative density of a sand, a mould of volume 1000 ml was used. When the sand was dynamically compacted in the mould, its mass was 2.10 kg, whereas when the sand was poured in loosely, its mass was 1.635 kg. If the insitu density of the soil was 1.5 g/cm³, calculate the relative density. Assume Gs = 2.65. (8)

(ii) Brief the I.S. soil classification system. (8)

Or

(b) (i) Discuss the importance of Atterberg limits in soil engineering. (8)

(ii) A borrow area soil has a natural water content of 10% and a bulk density of 1.8 g/cm³. The soil is used for an embankment to be compacted at 18% moisture content to a dry density of 1.85 g/cm³. Determine the amount of water to be added to 1.0 m³ of borrow soil. How many cubic metres of excavation is required for 1 m³ of compacted embankment. (8)

12. (a) (i) In a falling-head permeameter if the time intervals for drop in levels from $h_1$ to $h_2$ and $h_2$ to $h_3$ are equal, prove that $h_2 = \sqrt{h_1 h_3}$. (8)

(ii) How would you determine the average permeability of a soil deposit consisting of a number of layers? What is its use in soil engineering? (8)

Or

(b) (i) Prove that the discharge through an earth mass is given by

$$Q = k\frac{H}{N_d}N_f$$

$k$ = Co-efficient of permeability,

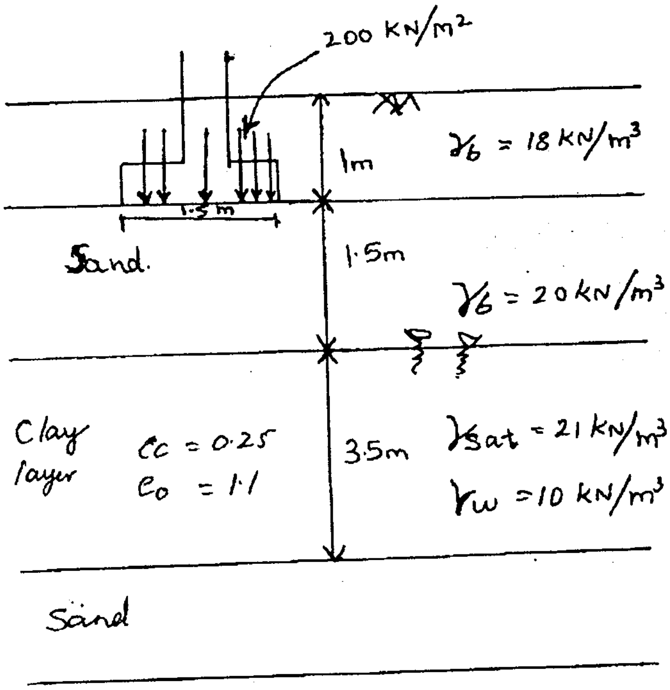
h = Head,

$N_f$ = Number of Flow channels

$N_d$ = Number of equipotential drops. (8)

(ii) Derive the equation to determine the Co-efficient of permeability from a pumping out test in an unconfined aquifer. (8)

13. (a) A footing has a size of $3\,m \times 1.5m$ and it causes a pressure increment of 200 kN/m² at its base. (Refer Fig 13 (a)). Determine the consolidation settlement at the middle of the clay layer. Assume 2 : 1 pressure distribution and consider the variation of pressure across the depth of the clay layer (16)




Or

(b) (i) The unit weight of the soil in a uniform deposit of loose sand $(K_0 = 0.5)$ is 16.5 kN/m³, Determine the geostatic stresses at a depth of 2 m.

Also Determine the vertical stress at a point P which is 3 m below ground level and at a radial distance of 3 m from the vertical load of 200 kN use Boussinesq's solution. (4 + 4)

(ii) There is a layer of soft clay 4 m thick under a newly constructed building. The over burden pressure over the centre of the clay layer is 300 kN/m². Compute the settlement if there is an increase in pressure of 100 kN/m² due to construction. Assume $Cc = 0.50$, $G_S = 2.70$. The water content of the deposit was found to be 50%. (8)

14. (a) (i) Define Slow, quick and consolidated quick triaxial shear test, illustrating their use by at least one field example. (6)

(ii) The following results were obtained from a series of consolidated undrained test on a soil, in which the pore water pressure was not determined. Determine the cohesion intercept and the angle of shearing resistance.

| Sample No. | 1 | 2 | 3 |
|---|---|---|---|
| Confining pressure (kN/m²) | 100 | 200 | 300 |
| Deviator stress at failure (kN/m²) | 600 | 750 | 870 |

(10)

Or

(b) (i) Derive a relationship between the principal stresses at failure using Mohr-Coulomb failure criterion. (10)

(ii) A direct shear test was performed on a 6 cm × 6 cm sample of dry sand. The normal load was 360 N. The failure occured at a shear load of 180 N. Plot the Mohr strength envelope, and determine $\phi$, Assume c = 0. Also determine the principal stresses at failure. (6)

15. (a) Using the Swedish method of slices, determine the safety factor of the slope given in Fig 15 (a) for the failure surface that has a radius R and its centre is located at 'O' as shown in the figure.

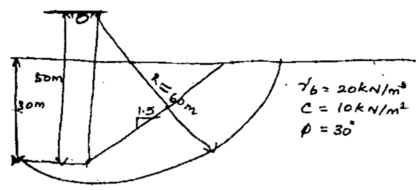



Fig. 15 (a) slope with a failure surface that has its centre at O and a radius of R. (16)

Or

(b) Fig. 15 (b) shows a slip surface with a radius of 22 m in a slope with a heiht of 14 m and an angle of inclination of 45°. If $\phi_m = 15°$, $\gamma = 18 kN/m^3$ and $c = 40\ kN/m^2$, determine the factor of safety with respect to cohesion using the friction circle method. The weight of the soil wedge is 1500 kN and it acts at a horizontal distance of 10.3 m from A. (16)

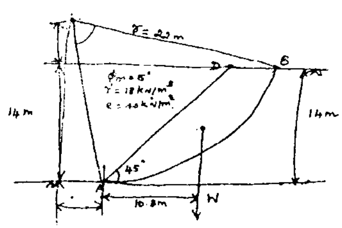



Fig. 15 (b)

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