

**C 3105**

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

Fourth Semester

(Regulation 2004)

Civil Engineering

CE 1251 — MECHANICS OF SOILS

(Common to B.E. (Part-Time) Third Semester Regulation – 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State whether the following statements are true or false. Justify.
  - (a) Silt particles are visible to the naked eye.
  - (b) "5 percent fines" in a soil means that the soil has 5% of clay size particles.
2. What is the difference between water content and Degree of saturation?
3. What are various forms of soil water?
4. In a saturated soil stratum, water table exists at the surface. The effective stress in the soil, at a depth of 2 m is 20 kN/m<sup>3</sup>. If the water table rises by 0.5 m, during floods what will be change in the effective stress?
5. What is the principle behind the construction of Newmark's influence chart?
6. Define the following :
  - (a) compression index
  - (b) coefficient of consolidation.
7. Enumerate the type of laboratory tri-axial test you would specify to be carried out in connection with field problem of initial stability of a footing on saturated clay.
8. On which type of soils unconfined compression test is conducted? Explain with the help of Mohr circles how shear strength parameters are determined in this type of test.

9. State the situations under which modified Bishop's method of slope stability analysis is more suitable?
10. What are different types of slopes? Give examples.

PART B — (5 × 16 = 80 marks)

11. (a) (i) An earth embankment is compacted at water content of 18% to a bulk unit weight of 19.2 kN/m<sup>3</sup>. If specific gravity of the solids is 2.7, find void ratio and degree of saturation of the compacted embankment. (8)
- (ii) Classify the soil on the basis of information given below : (8)

Liquid Limit, %	Plasticity Index, %	% Clay size	% Silt size	% Sand size
500	450	80	20	0

Or

- (b) (i) Discuss in detail various field compaction methods. (8)
- (ii) In a Standard Proctor test the mould of 1 litre capacity weighs 12.5N when empty. Successive trials gave the following results.

Weight of mould + wet soil (N)	29.6	30.1	31.5	31.2	30.8
Water content (%)	16.7	18.6	21.0	21.7	23.5

Determine maximum dry density and optimum water content. If  $G = 2.7$ . (8)

12. (a) (i) A sand stratum is 10 m thick. The water table is 2 m below ground level. The unit weights of sand layer above and below water table are 17 kN/m<sup>3</sup> and 21 kN/m<sup>3</sup> respectively. The capillary rise above water table is 1 m. Draw the total stress, pore water pressure and effective stress diagrams for the sand stratum. (12)
- (ii) In a saturated soil medium, flow is caused by a head of 5 m. A flow net shows 10 equipotential drops. The approximate size of each field is 0.50 m. Calculate the hydraulic gradient across each field. (4)

Or

- (b) Calculate the coefficient of permeability of a soil sample 6 cm in height and 50 cm<sup>2</sup> in cross sectional area, if a quantity of water equal to 430 cc passed down in 10 minutes under an effective constant head of 40cm. On oven drying, the test specimen weighed 4.98 N. Taking specific gravity of the solids as 2.65, calculate the seepage velocity of water during the test. (8 + 8)

13. (a) (i) An annular ring footing of external and internal radii of 8 m and 4 m respectively transmits a pressure of 100 kN/m<sup>2</sup>. Compute the vertical stress at a depth of 2 m below the center. (8)
- (ii) What are different components of settlement? Draw the consolidation curve for normally consolidated and over consolidated clay. (8)

Or

- (b) (i) A concentrated load of 800 kN acts at the ground surface. Compute the vertical stress at 8 m depth and 2 m away from the axis. Use Westergaard analysis. Take  $\mu = 0.25$ . (8)
- (ii) There is a bed of compressible clay of 4 m thickness with pervious sand on top and impervious rock at the bottom. In a consolidation test on an undisturbed specimen of clay from this deposit 90% settlement was reached in 4 hours. The specimen was 20 mm thick. Estimate the time in years for the building founded over this deposit to reach 90% of its final settlement. (8)
14. (a) (i) Calculate the potential shear strength on a horizontal plane at a depth of 3 m below the surface in a formation of cohesionless soil when the water table is at a depth of 3.5 m. The degree of saturation may be taken as 0.5 on the average. Void ratio is 0.5. Specific gravity of solids is 2.7. Angle of internal friction is 30°. What will be the modified value of shear strength if the water table reaches the ground surface? (10)
- (ii) A vane, 10.8 cm long, 7.2 cm in diameter, was pressed into a soft clay at the bottom of a bore hole. Torque was applied and the value at failure was 45 Nm. Find the shear strength of the clay on a horizontal plane. (6)

Or

- (b) (i) In an unconfined compression test, a sample of sandy clay 8 cm long and 4 cm in diameter fails under a load of 120 N at 10% strain. Compute the shearing resistance taking into account the effect of change in cross section of the sample. (6)
- (ii) Clean and dry sand samples were tested in a large shear box, 25 cm × 25 cm and the following results were obtained :
- |                         |     |     |     |
|-------------------------|-----|-----|-----|
| Normal load, kN         | 5   | 10  | 15  |
| Peak shear load, kN     | 5   | 10  | 15  |
| Ultimate shear load; kN | 2.9 | 5.8 | 8.7 |

Determine the angle of shearing resistance of the sand in the dense and loose states. (10)

15. (a) (i) An embankment is inclined at an angle of  $35^\circ$  and its height is 15 m. The angle of shearing resistance is  $15^\circ$  and cohesion intercept is  $200 \text{ kN/m}^2$ . The unit weight of soil is  $18 \text{ kN/m}^3$ . If Taylor's stability number is 0.06, find the factor of safety with respect to cohesion.
- (ii) Discuss the friction circle method for the stability analysis of slopes. Can this method be used for purely cohesive soil? (8)

Or

- (b) (i) A cutting is made 10 m deep with sides sloping at 8 : 5 in a clay soil having a mean undrained strength of  $50 \text{ kN/m}^2$  and a mean bulk density of  $19 \text{ kN/m}^3$ . Determine the factor of safety under immediate (undrained) conditions given the following details of the impending failure circular surface: The center of rotation lies vertically above the middle of the slope. Radius of failure arc is 16.5 m. The deepest portion of the failure surface is 2.5 m below the bottom surface of the cut (i.e., the center of rotation is 4 m above the top surface of the cut). Allowance is to be made for tension cracks developing to a depth of 3.5 m from surface. Assume that there is no external pressure on the face of the slope. (10)
- (ii) Discuss various slope protection measures. (6)