INDIAN INSTITUTE OF TECHNOLOGY

Date FN/AN **Time:** 2 Hrs **Full Marks:** 30 **No of Students:** 80

Autumn Semester 2012 **Department:** Civil Engineering **Sub No.:** CE31003

3rd year B Tech (H) **Sub Name:** Soil Mechanics

Instructions: Attempt **ALL** questions

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1. A 280 m^3 mass of saturated clay had a void ratio of 0.962 and a specific gravity of solids of 2.71. A fill was then placed over this clay, causing it to compress. During this process some of the water was squeezed out of the voids. However, the volume of the solids remained unchanged and soil mass remained saturated. After completion of possible compression under the fill load the void ratio had become 0.758. Compute
   (a) the initial and final moisture content of the clay
   (b) the new volume of the clay
   (c) the volume of water squeezed out
   (d) the initial and final unit weight of the saturated clay [4]

2. In a shrinkage limit test the following data were obtained: (i) mass of shrinkage dish filled with soil slurry = 94 g (ii) mass of shrinkage dish and oven dried soil = 80.1 g (iii) mass of shrinkage dish = 50 g (iv) vol of shrinkage dish = 24.6 cm^3 (v) vol of oven dried soil obtained by mercury displacement = 15.9 cm^3. Determine the shrinkage limit of the soil sample. Derive the expression used for the calculation of shrinkage limit. [4]

3. During compaction a 1-m thick stratum was consolidated a total of 30 mm via a vibrating roller. Initially the void ratio was determined to be 0.94, the water content 16%, and G = 2.67. Determine the (i) void ratio and (ii) unit weight of the soil mass in the compacted state. [3]

4. Explain the importance of plasticity chart in soil classification. [3]

5. A pit is to be excavated in a fine sand stratum completely saturated up to the ground surface. It was found that a cubical box of 0.3m side filled with dry sand collected from the site had a weight of 530.7 N and it would take about 90.7 N of additional water to completely fill the air voids in sand sample. The container's weight = 45.36 N. The pit was to be dug to a 6.3 m depth. To stabilize the bottom of the excavation (prevent boiling) it is decided to drive steel sheet piles to act as 'cut off' walls that encircle the excavation. Determine the minimum depth of sheet piling would have to be driven for an impending quick condition. [5]

6. A layer of sand 8.0 m thick lies above a layer of clay. The water table is at a depth of 1.0 m below the ground surface. Above the water table the sand is saturated with capillary moisture. The saturated unit weight of sand is 20 kN/m^3 and its dry unit weight is 17.0 kN/m^3. Plot the total stress, neutral stress and effective stress with depth up to a depth of 8.0 m. [5]

7. A foundation is to be constructed at a site where the soil profile is as shown in Fig. Q.7. The base of the foundation is 3m by 6m and, it exerts a total load of 5400 kN, which includes the weight of the structure, foundation and soil surcharge on the foundation. The initial void ratio and compression index of the compressible clay layer is respectively, 1.38 and 0.68. Determine the (i) average increase of pressure in the clay layer due to the foundation load (ii) average effective vertical pressure in the clay layer before applying the foundation load and (iii) total expected consolidation settlement of the clay layer because of the foundation load. [2+2+2]

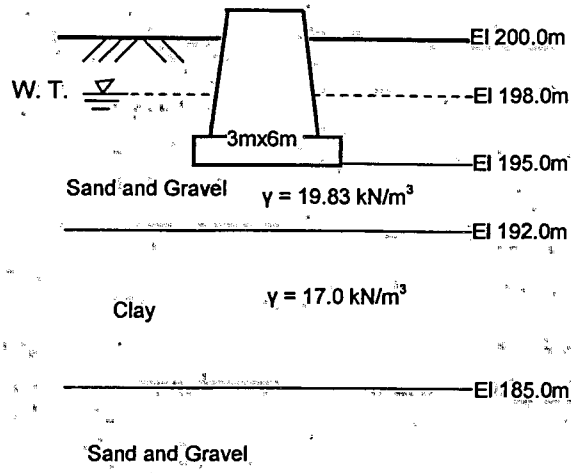

Fig. Q.7