JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS-2022

B.Tech.- IV Semester (Civil)

COURSE CODE (CREDITS): 18B11CE411(3) MAX. MARKS: 35

COURSE NAME: Geotechnical Engineering

COURSE INSTRUCTORS: Saurabh Rawat MAX. TIME: 2 Hours

*Note: All questions are compulsory. Marks are indicated against each question in square brackets.*

[1] Explain the compaction of fine-grained and coarse-grained soils clearly bringing out the difference between the governing mechanisms. Also, explain the variation of soil permeability of fine-grained soil on dry and wet side of optimum showing its significance to field construction of highways and earthen dams. **[3+3 = 6 marks]**

[2] Two rows of sheet piles are driven to a depth of 4.4 m below the bed of a river to form a coffer dam. Excavation is then carried out within the coffer dam up to a depth of 3.3 m below water level by keeping the area free from water by pumping. The riverbed is sand with $k = 3 \times 10^{-3}$ cm/s and is underlain by an impermeable stratum at a depth of 6.0 m below the riverbed as shown in **Fig. 1**.

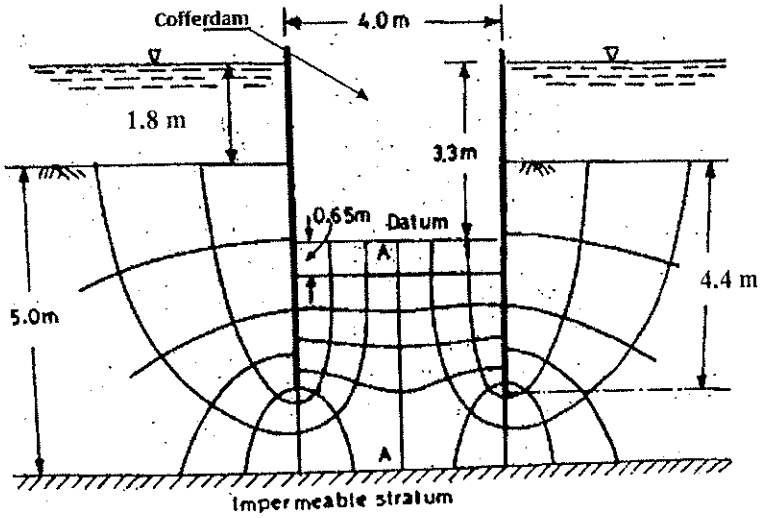


*Fig. 1*

**(a)** What is the quantity of flow into the coffer dam per hour per meter length of the sheet pile walls?
**(b)** Is there any danger of quicksand condition developing at the bottom of the excavation? Comment on the factor of safety. **[3+3 = 6 marks]**

[3] The plastic limit of a soil is 25% and its plasticity index is 8%. When the soil is dried from its state of plastic limit, the volume change is 25% of its volume at plastic limit. Similarly, the corresponding volume change from liquid limit to dry state is 34% of its volume at liquid limit. Determine the shrinkage limit. **[5 marks]**

[4] In the test set – up shown in **Fig. 2**, two different granular soils are placed in permeameter, and flow is allowed to take place under a constant total head of 30 cm.

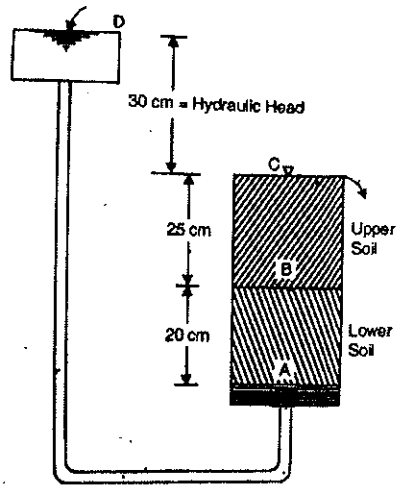


*Fig. 2*

Determine: **(a)** The total head and pressure head at point A. **(b)** If 30% of the total head is lost as water flows upwards through the lower layer, what is the total head and pressure head at B? **(c)** If the permeability of layer is $3 \times 10^{-3}$ cm/sec, calculate the discharge through the soil. **(d)** For upper soil [$e = 0.68$ and $G_s = 2.70$] and lower soil [$e = 0.52$ and $G_s = 2.66$], determine the discharge and seepage velocity through each soil. **(e)** If the total head is increased, determine at what value of head will either soil experience the 'quick condition'?

**[1+2+1+2+2 = 8 marks]**

**[5]** A consulting geotechnical Engineer submitted the following report to his claim. The client has engaged you to evaluate the report. Indicate which statement or parts thereof are incorrect or which do not appear to logically follow from the information given in earlier statements. Each statement is numbered to facilitate identification. Your answers should be in the following form:

| Statement (A) | Evaluation remark |
|---|---|

**A.** The soil profile at the site consists of 10 m of medium plasticity fine sand (layer A) underlain by a layer B of 5 m of clay which in turn is underlain by 10 m of uniform coarse sand (Layer C) with angular particles having diameter range of 2 to 6 mm which rests on rock.

**B.** The water table was 5 m below the ground surface but water in a standpipe inserted in layer C rose to the ground surface indicating artesian condition in Layer A.

**C.** Water in a standpipe inserted in the middle of the clay layer B rose to middle of the fine sand layer A.

**D.** The properties of the clay layer determined in the laboratory. Its permeability as determined from a constant head permeameter was found to be $3.9873 \times 10^{-8}$ m/sec. Its total unit weight was 27 kN/m$^3$. The sand in layer C has a permeability of $10^{-4}$ m/sec.

**E.** The flow occurring through the clay layer B was occurring in the upward direction under a gradient of 1, thus creating quick condition in Layer B.

**F.** The total unit weight of sand in layer A was 20 kN/m$^3$ with a total flow of water into layer A was $4.8 \times 10^{-6}$ m$^3$/min per m$^2$.

**G.** The effective stress was measured at the interface of Layers A and B was found to be 150 kN/m$^2$.

**[1+1+1+2+1+2+2 = 10 marks]**