

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), Nov 2017

B. Tech in Civil Engineering, Semester V

Roll No.....

CE508: Geotechnical Engineering - I (Soil Mechanics)

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
 2. Assume suitable data wherever required and mention it clearly.
 3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
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Q.1A Objective type questions (10 questions @ 1 mark) 10

- i. The condition to achieve laminar flow of fluid through soils is $Re > 1$. (True/False)
- ii. Write the formula for liquidity index and consistency index
- iii. Write the formula for plasticity index and toughness index
- iv. Write the formula for shrinkage index and shrinkage ratio
- v. Is there any difference in water content of the soil, when it is placed in the cup in a loose state or dense state (Yes/No)
- vi. Define ZAVL.
- vii. Write the formula for flow index and activity
- viii. Void ratio and water content decreases during consolidation (True/False)
- ix. Ultimate/final/total consolidation settlement is dependent on number of drainage paths (T/F)
- x. What is a_v ?

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- i. A soil sample contains volume of air equal to $1/5^{\text{th}}$ of total volume and the volume of water is $1/4^{\text{th}}$ of total volume. Determine its void ratio and porosity.
- ii. A partially saturated sample of a soil has a density of 1950 kg/m^3 and a water content of 21%. If specific gravity is 2.65, calculate degree of saturation.
- iii. If the ratio of γ_{sat} to γ_d is 1.3, determine the void ratio. Take $G_s = 2.6$
- iv. During a permeability test on a soil sample with falling head permeameter, equal time intervals are noted for drop of head from h_1 to h_2 and again from h_2 to h_3 then relation between h_1 , h_2 and h_3 is _____

Q.3A The following data were recorded for a constant head permeability test. 05

- Internal diameter of permeameter = 100 mm

- Height of the soil sample = 150 mm
- Rate of upward flow = 540 ml/min
- Head loss over the length of the sample = 360 mm
- Porosity of the soil sample = 40 %
- Room temperature = 21°

Calculate the coefficient of permeability, Darcy velocity, and seepage velocity.

- Q.3B For a soil with $D_{60}=0.42$ mm, $D_{30}=0.21$ mm and $D_{10}=0.16$ mm, calculate the uniformity coefficient, coefficient of gradation and effective grain size. Also determine the Reynold's number for the flow through soil in Q.3A. Take the average grain size as D_{60} and dynamic viscosity of fluid as 9.81×10^{-3} g/cm-s. 05
- Q.4A Explain the classification of soil. What are the various methods? Briefly state them. 05
- Q.4B Define Capillarity. How capillary rise does occurs in soils. 05
- Q.5A One meter thick fill was compacted by vibrating roller, and there was 30 mm reduction in the fill thickness. The initial void ratio was 0.94. What would be the void ratio after the compaction? 05
- Q.5B Briefly explain diffuse double layer theory in compaction. 05
- Q.6A A soil profile is shown in the figure below. The capillary action within the soil strata partially saturates up to 4 m of the soil above water table. An average value of saturation level in the capillary zone of clay layer is $S = 80\%$ and the same of Silt layer is $S = 30\%$. Calculate the unit weight and pore water pressure at various demarcations across the profile. 05

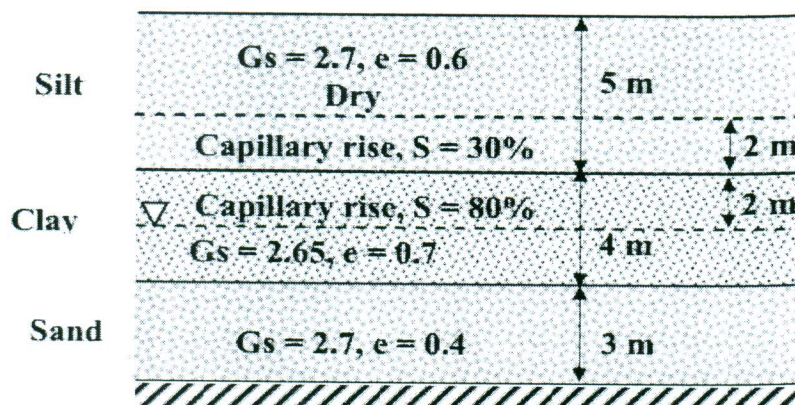


Fig. A

- Q.6B In the above problem, plot the variation of total stress, pore water pressure and effective stress with depth. 05

OR

- Q.6B At a construction site, a 3 m thick clay layer is followed by a 4 m thick gravel layer which is resting on impervious rock. A load of 25 kN/m^2 is applied suddenly at the surface. The saturated unit weights of the soils are 19 kN/m^3 and 20 kN/m^3 for the clay and gravel layers respectively. The water table is at the surface. Draw the diagrams of total, effective stress and pore water pressure. 05

- Q.7A A 75 mm diameter clay specimen was consolidated in an oedometer under 200 kPa. At the end of consolidation, the void ratio is 0.863 and the specimen thickness is 18.51 mm. When a stress increment of 200 kPa was added to the current vertical stress of 200 kPa, the specimen consolidated to a thickness of 17.56 mm. Find the coefficient of volume compressibility and compression index of the clay. 05
- Q.7B In the above problem, If the vertical stress is increased from 400 kPa to 800 kPa, what would be the thickness of the specimen at the end of consolidation? Determine this separately using both m_v and C_c . Why are they different? 05
- OR
- Q.7B Determine total stress, effective stress and pore water pressure for the soil profile shown in Fig. B and draw the qualitative variation across the depth. 05
- Q.8A Define pre-consolidation pressure. What are the types of soil based on degree of consolidation? Explain the graphical procedure of determining the pre-historic pressure developed by Mr. Casagrande. 10
- Q.9A What is Casagrande's time fitting method? Explain in detail. (05) 10
- What is Taylor's time fitting method? Explain in detail. (05)
- Q.9B The soil profile at a site consists of a 3 m thick sand layer ($\gamma_m = 16.5 \text{ kN/m}^3$, $\gamma_{\text{sat}} = 18.5 \text{ kN/m}^3$) underlain by a 6 m thick clay layer ($w=27\%$, $G_s = 2.70$, $m_v = 0.31 \text{ MPa}^{-1}$, $C_v=2.6 \text{ m}^2/\text{year}$), which is underlain by a gravel layer as shown in the following figure. A 3 m compacted fill with a unit weight of 20 kN/m^3 is required to be placed at the ground level. 10
- (a) What would be the final consolidation settlement?
- (b) How long will it take for 50 mm of consolidation settlement?

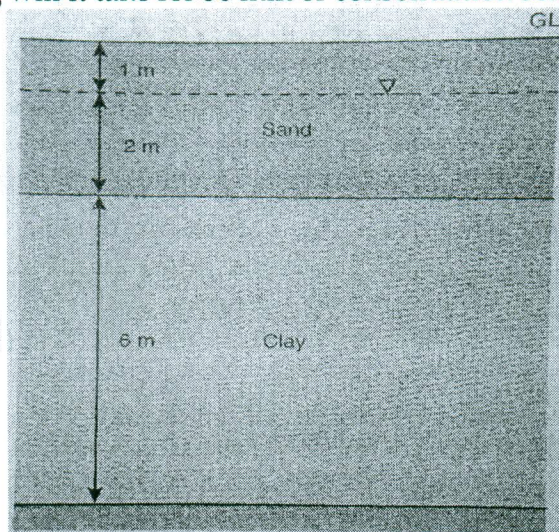


Fig. B

OR

- Q.9B Define shear strength parameters of the soil with a diagrammatic explanation. Draw the Mohr's failure envelope for (i) typical soil, (ii) Pure clay, (iii) Cohesionless soil. 10