

53:030 SOIL MECHANICS
Civil & Environmental Engineering
The University of Iowa
FALL SEMESTER, 2001

Homework Assignment # 4, Due Wednesday, 3 October 2001.

- 1) Consider the uniform layer of soil shown below in Figure 1. Calculate and plot the variation of σ_v , σ_v' , and u with depth. For the soil, $e = 0.50$ and $G_s = 2.65$.

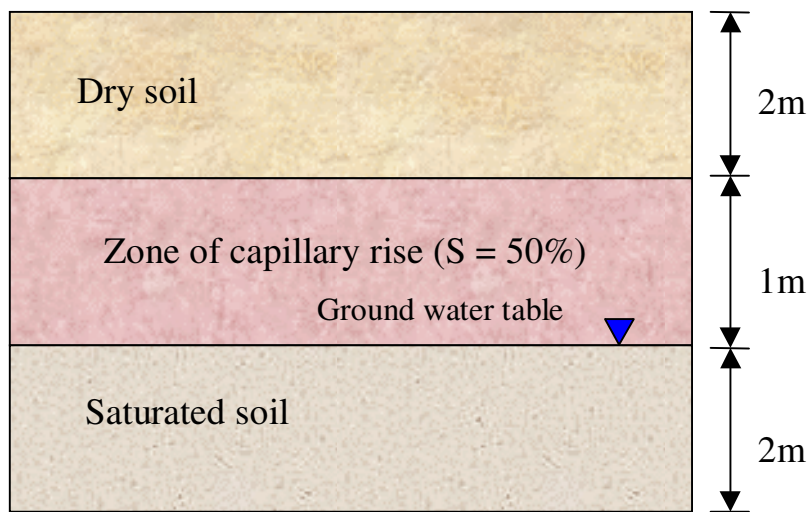


Figure 1. Soil deposit with dry, capillary, and saturated zones (not to scale).

- 2) For a saturated soil with $w = 40\%$ and $G_s = 2.71$, determine the saturated unit weight in English and metric units.
- 3) For a sand, the maximum and minimum possible void ratios were determined in the laboratory to be 0.94 and 0.33, respectively. Find the moist unit weight of the sand when it has a relative density D_r of 60%, a water content w of 10%. $G_s = 2.65$. Also, calculate the maximum and minimum possible dry unit weights that the sand can have.
- 4) A saturated clayey-silt soil has a mass of 54 grams and a volume of 29.5cm^3 . When this same soil is completely dried out, it has a mass of 37.5 grams and a volume of only 20.25cm^3 . For this soil, determine the following:
- The water content of the soil in its saturated state;
 - The void ratio of the soil in its saturated state;
 - The void ratio of the soil in its completely dry state; and
 - The shrinkage limit of this soil.

- 5) A loose, dry sandy soil deposit has a thickness of 3m and a relative density D_r of 10%. This soil has the same properties as those in Problem 3 above. Under the vibrational loading of an earthquake, the sand densified to D_r of 65%. How much would the thickness of the soil deposit change?
- 6) Develop a general expression for the change in thickness of a soil layer due to a change in the soil's void ratio.
- 7) State the conditions under which Darcy's law governing the seepage of fluid in porous media is valid.
- 8) Consider Figure 2 below. Compute the rate of seepage in the permeable soil layer per unit width in the out of plane direction. Assume that $H = 2\text{m}$, $\alpha = 10^\circ$, and $k = .0017\text{m/s}$.

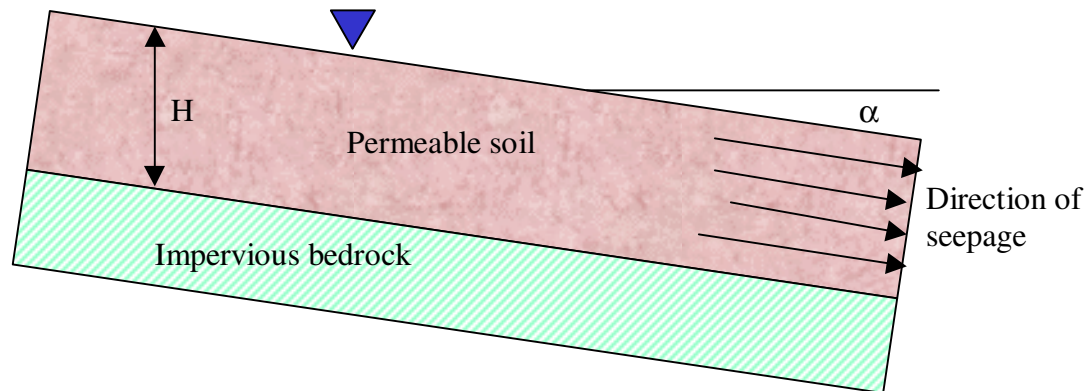


Figure 2. Seepage in a permeable layer of soil (not to scale).