**The University of Iowa**
**Department of Civil & Environmental Engineering**
**SOIL MECHANICS 53:030**
**Midterm Exam**
**(1 Hour)**

**Fall 1995** **Instructor: C.C. Swan**

Problem #1: (25 points)

A sand with a minimum void ratio of 0.50 and a maximum void ratio of 1.00 has a relative density of 10 percent. The average specific gravity of the minerals in the soil is 2.68, and $\gamma_w = 10kN \cdot m^{-3}$.

a. Compute $\gamma_{dry}$ and $\gamma_{sat}$ for the sand in its present state with $D_r = 10\%$.

b. How much will a 3m thick stratum of this sand setttle if the sand is densified to $D_r = 60\%$?

Recall that

$$D_r = \frac{e_{max} - e}{e_{max} - e_{min}} \cdot 100\%$$

Problem #2: (15 points)

a. In general, fine-grained soils (especially clays) have **significantly** lower permeabilities than do coarse-grained soils. Why is this so?

b. What is the liquidity index $I_L$ (or LI using the text's notation) of a fine-grained soil?

c. If as a geotechnical engineer you were asked to consider a major construction project on a sensitive clay soil deposit with a liquidity index $I_L = 110\%$, how might you respond and why ?

Problem #3: (30 points)

Steady state seepage is occuring in the U-tube shown in Figure 1. The cross-section of the U-tube has dimensions 1 meter by 1 meter. Note the standpipes inserted at points A, B, and C.

a. How high ($h_B$) is the water standing in the standpipe located at B?

b. How high is the exit water level $h_C$?.

c. What is the total flow rate through the three-layered soil system?

d. What is the total seepage force magnitude and direction acting on the three-layered soil sytem?

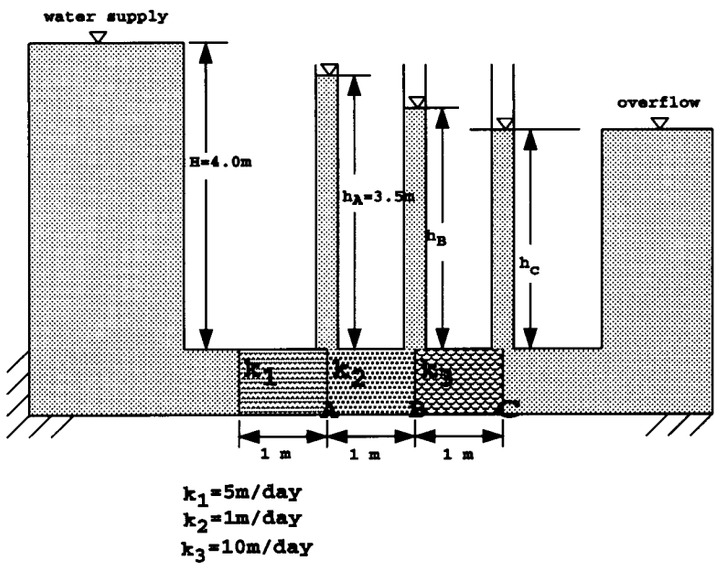


**Figure 1.** Steady seepage occuring in a three-layered soil system.

Problem #4: (30 points)

Figure 2 shows a reservoir with a sheet pile cut-off while Figure 3 shows the corresponding flownet (through the soil) for this problem. Utilizing the information given in these figures, compute the following:

a. the rate of seepage loss from the reservoir per unit width of sheetpile.

b. the pore fluid pressure at point A.

c. the factor of safety against boiling in the heave zone immediately to the right of the sheetpile.

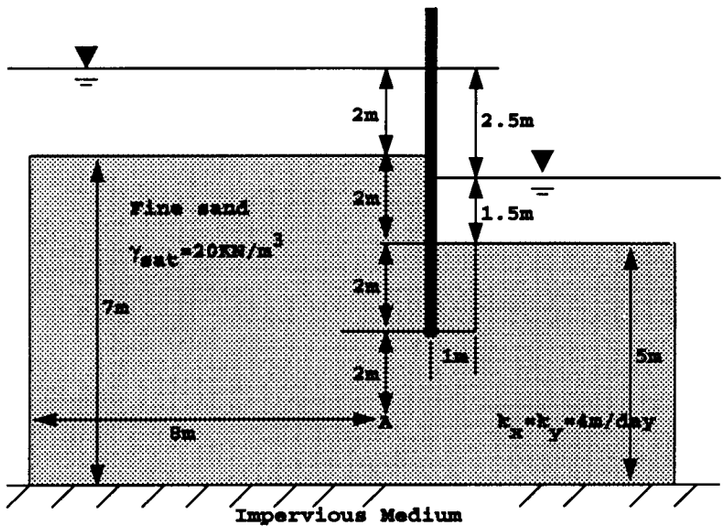


**Figure 2.** Steady seepage under a sheet-pile cutoff wall.

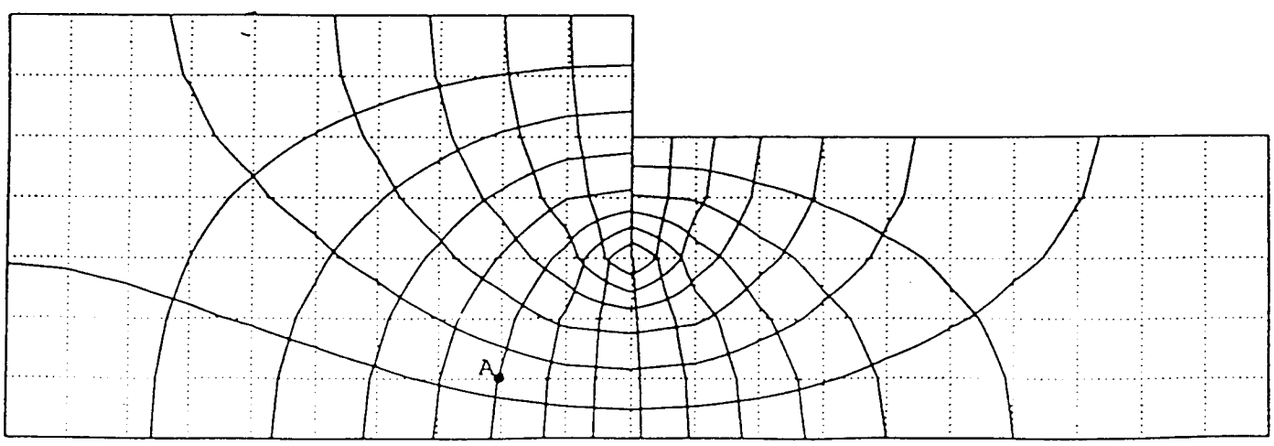


**Figure 3.** Flow net for seepage under the sheet-pile cutoff wall.