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

Fall 1997 Instructor: C.C. Swan

To get full credit, show all work.

Problem #1: (36 points)

A natural soil has a unit weight of 15 kN/m^3, a water content of 10%, and a specific gravity of solids of 2.7 when dumped loosely from a scraper. (Assume that γ_w=9.81kN/m^3.)

a. Find e, n, and S;

b. So that the soil can be most easily compacted, the water content needs to be raised to 15%. How much water (in kg) needs to be added to each cubic meter of soil to raise the water content to 15%? (**Hint: A block diagram for the soil might be useful here.**)

c. Assume that once the soil is compacted at w = 15%, the degree of saturation is 95%. Find new values of e, n, and γ for the soil in its compacted state.

Problem #2: (24 points)

a. Why is it that clay soils have permeabilities that are so much smaller than those of sands and gravels?

b. What type of standard tests would you perform on a soil to determine its susceptibility to expansiveness?

c. What results from these tests would be strong indicators of a highly expansive soil?

d. What is the liquidity index of a soil, and what does it measure?

Problem #3: (40 points)

To build an underwater foundation, a temporary sheetpile wall system has been constructed as shown in Figure 1, and the soil has been excavated to a depth of D=4m. The water level H on the back side of sheetpile is 3m. The corresponding flownet for this problem is also shown in Figure 1.

a. At what rate is water being pumped out of the excavation to maintain the water level shown?

b. What is the vertical effective stress at point A?

c. What is the factor of safety against heaving in the critical regions around the sheetpiles?

d. How high H would water have to be on the back side of the sheetpile wall to create an unstable situtation in the critical regions? (Assume that the water level in the excavation remains as shown in Figure 1.)

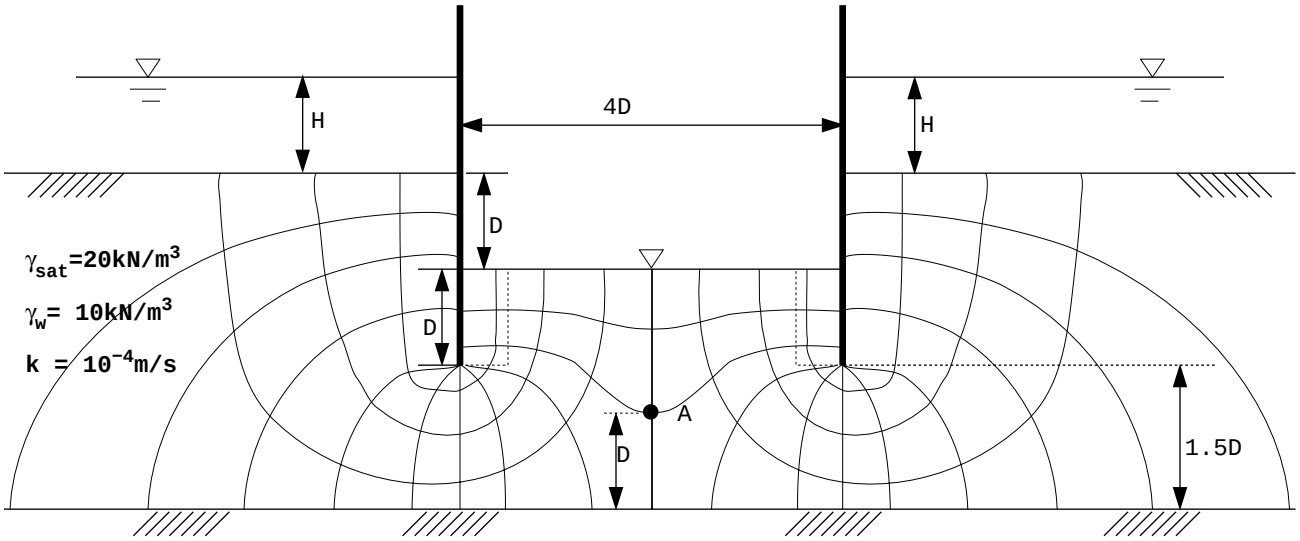

Figure 1. Seepage around sheetpile walls.

Bonus Question: (10 extra points!!) **Answer this question after questions 1–3.**

Consider the soil deposit shown in Figure 2. Write an expression for the effective or equivalent horizontal permeability of this soil deposit in terms of the dimensions and isotropic permeability symbols shown.

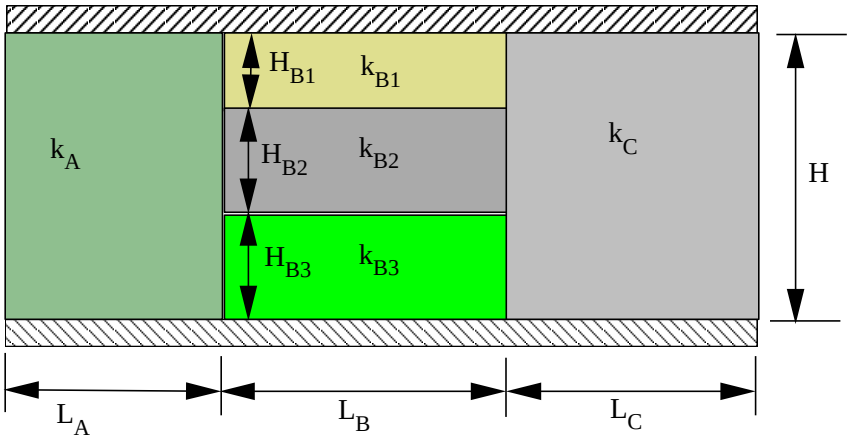

Figure 2. Soil Deposit with Multiple Layers.