

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

Fall 2000

Instructor: C.C. Swan

**To get full credit, please show all of your work.**

Problem #1: (20 points)

500 cm<sup>3</sup> of soil in its natural state has a weight (mass) of 8.34N (850 g). After being dried, the soil sample has a weight (mass) of 6.63N (675 g). The average specific gravity of the minerals comprising the soil is 2.70. Determine the water content  $w$ , the degree of saturation  $S$ , the void ratio  $e$ , and the porosity  $n$  for the soil in its natural state.

Problem #2: (25 points)

- a. A soil has a plastic limit (PL) of 30, and a liquid limit (LL) of 60. What moisture content corresponds to a liquidity index of 0.50?
- b. How does specific surface area affect soil hydraulic conductivities?
- c. Briefly explain the physical meaning of total stresses, effective stresses, neutral stresses or pore pressures in soils?
- d. In the AASHTO soil classification system, what types of soils generally receive the highest A-1 and A-2 ratings?

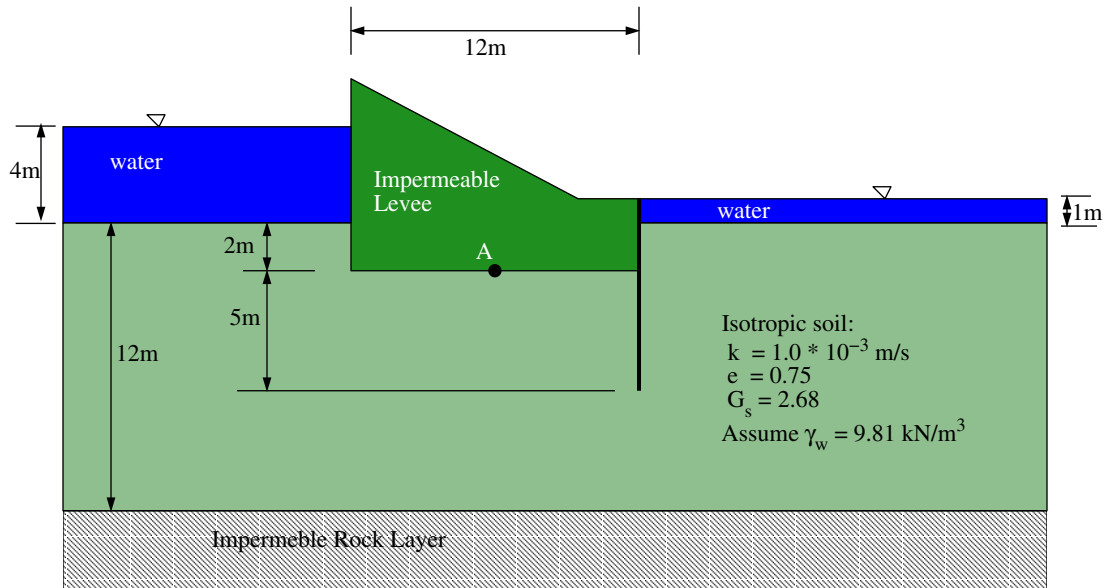
Problem #3: (55 points)

A levee structure is shown in Figure 1 below.

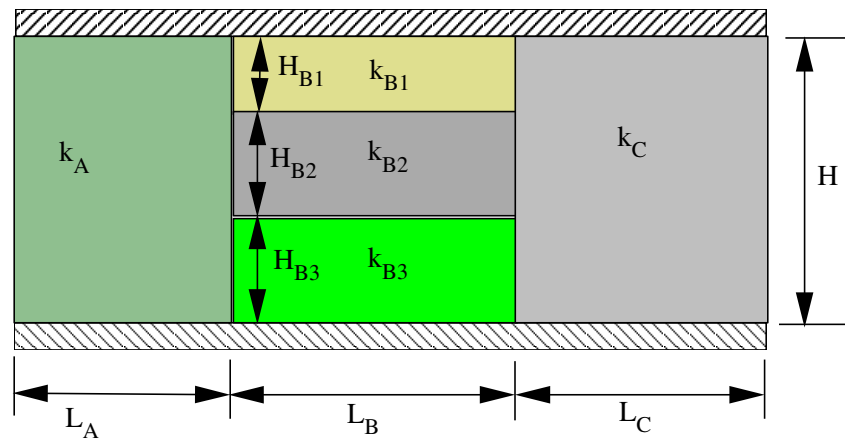
- a. In your exam booklet, please draw the problem to scale and draw a proper flownet.
- b. Based on your flow net, what is the rate of seepage beneath the levee per unit length of levee?
- c. Using your flownet, compute the fluid pressure at point A midway along the base of the levee.
- d. Compute the factor of safety against heaving in the critical region of this problem.

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 1.** Levee problem.



**Figure 2.** Soil deposit with multiple layers.