

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

Fall 1998

Instructor: C.C. Swan

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

Problem #1: (25 points)

The saturated unit weight of a soil is 126 lb/ft^3 . The water content of the saturated soil is 18.2%. Assuming that $\gamma_w = 62.4 \text{ lb/ft}^3$ compute the following:

- a. The dry unit weight of the soil (assuming no shrinkage upon drying);
- b. The void ratio of the soil; and
- c. The specific gravity G_s of the soil solids.

Hint: Usage of a block diagram for the soil may prove very helpful for this problem.

Problem #2: (25 points)

- a. How does specific surface area vary with soil grain sizes?
- b. How does specific surface area affect soil permeabilities or conductivities?
- c. Write down the expression for relative density D_r of a soil.
- d. Clearly explain the meaning of the different parameters in this expression.
- e. What types of soils generally get the highest ratings in the AASHTO classification system for usage as subgrade soils beneath pavements?

Problem #3: (50 points)

A levee structure is shown in Figure 1 below.

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

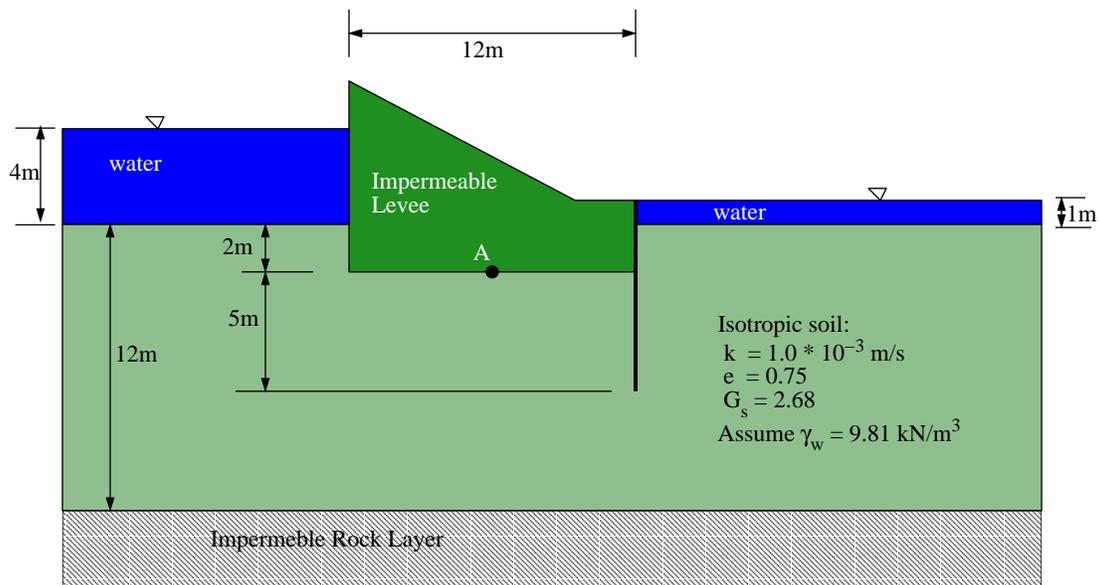


Figure 1. Levee problem.

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

Assume that for problem #3 above, the horizontal permeability of the soil $k_x = 16 \cdot 10^{-3} \text{ m/s}$ while the vertical permeability $k_z = 1.0 \cdot 10^{-3} \text{ m/s}$. What would be the flow rate beneath the dam in this case? (To get credit, show all supporting work.)