53:030 Soil Mechanics

The University of Iowa
College of Engineering
Midterm Exam #1
19 October 2005

Question #1: (30 points)

A soil that is 66.7% saturated has a mass density of 1850 kg/m^3. The mass density of the same soil when fully saturated is 1950 kg/m^3. For this soil find:

a. the void ratio e;
b. the moisture content at S=66.7%;
c. the specific gravity of the soil solids G_s.

Question #2: (20 points)

a. what type of a soil would you expect to have a very large plasticity index PI?
b. in the AASHTO classification system, why should well-graded sandy and gravelly soils get higher classifications than more uniform sands and gravels?
c. the hydraulic conductivities of clay soils are typically many orders of magnitude smaller than those of sandy soils. In a few sentences explain why this is true.
d. in a few sentences, and perhaps with a diagram, please explain the physical meaning of effective stresses in soils.

Question #3: (25 points)

For the U-tube shown in Figure 1, compute the following:

a. the equivalent horizontal permeability or conductivity of the four-layer soil system;
b. the head loss in each of the four layers;
c. the fluid pressure at point X;
d. which layer experiences the maximum seepage force?
e. what is the magnitude of the seepage force on that layer?

Question #4: (25 points)

For the situation shown in Figure 2:

a. draw the best flow net you can within the limited time you have; **(15 points)**
b. compute the volumetric flow rate beneath the levee structure per unit length in the out-of-plane direction; **(5 points)**
c. compute the factor of safety against heaving in the critical region. **(5 points)**

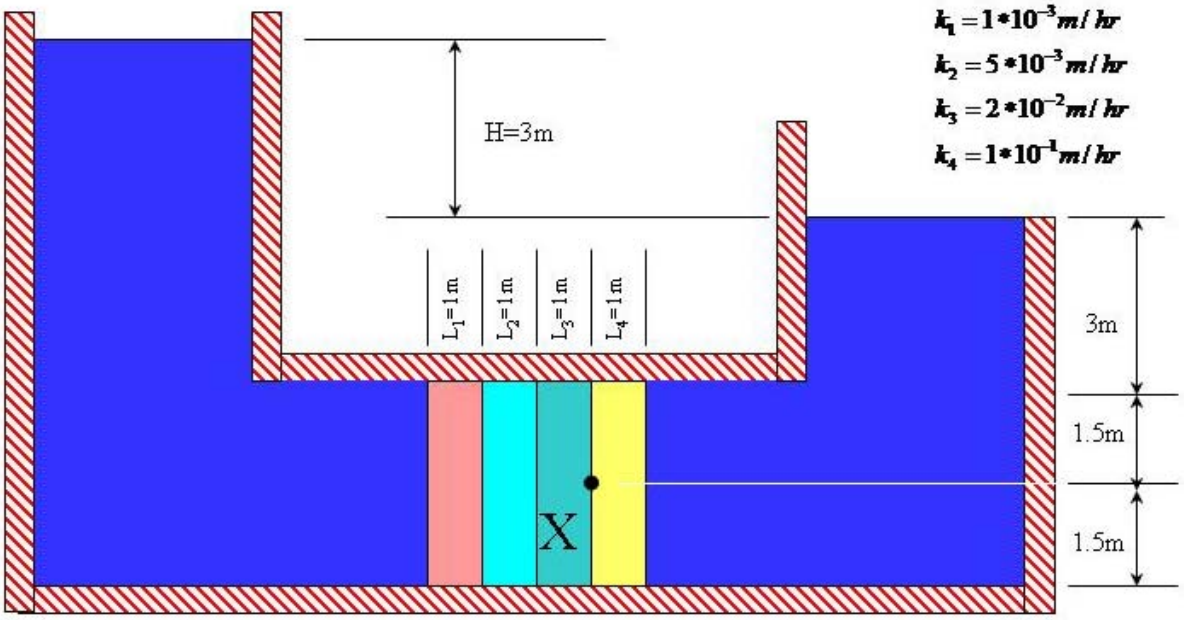

Figure 1.

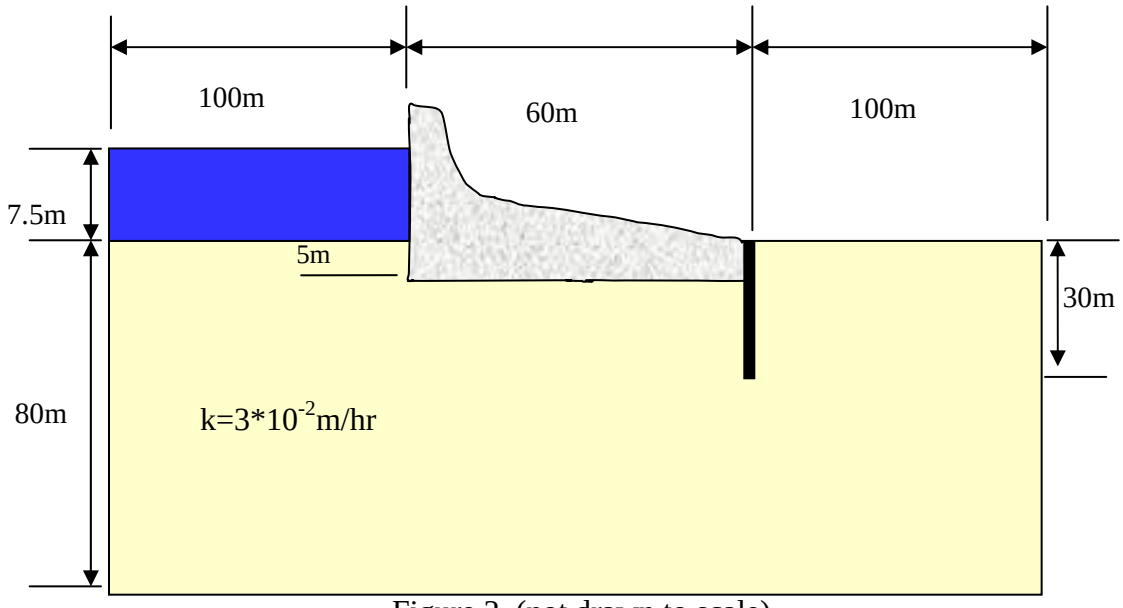

Figure 2. (not drawn to scale)