53:030 SOIL MECHANICS

Department of Civil & Environmental Engineering
The University of Iowa
Fall Semester 2001

Midterm Exam #1, 1 hour
4 questions, 100 points

Question #1: (15 points)

A moist soil packed into a volume of $0.1m^3$ has a dry mass of 150 kg and a water content of 10%. The average specific gravity of the grains comprising the soil is 2.60. Compute:

a. The dry density of the soil;
b. The moist density of the soil;
c. The void ratio;
d. The porosity;
e. The degree of saturation; and
f. The volume occupied by the water in the soil.

Question #2: (15 points)

A loose (D_r = 15%) layer of sandy soil has a thickness of approximately 10m. After being subjected to dynamic in-situ compaction, the relative density D_r of the soil has been increased to 75%. Calculate the change in thickness of the soil layer. [For the soil, e_{min} = 0.50 and e_{max} = 1.0].

Question #3: (20 points)

a. In a few sentences, discuss the significance of the three Atterberg Limits of fine-grained soils;

b. In a few sentences, explain the basic principles underlying measurement of soil grain-size distributions using hydrometers.

Question #4: (50 points)

Consider seepage occurring around the flow-retaining structure shown below. For the soil: e = 0.8; G_s = 2.7; and k = 10^{-6} m/second. The retaining structure is embedded 2.5m into the soil. Given the flownet, and the dimensions provided, compute the following:

a) The volumetric flow rate beneath the structure per unit width in the out-of-plane direction;
b) The factor of safety against heaving in the critical region;
c) The fluid pressure at point M along the base of the structure;
d) The vertical effective stress at point C; and
e) The approximate magnitude and direction of the seepage forces per unit volume at the tip of the sheetpile.

<u>To receive full credit, remember to show all of your work.</u>