2018 Soil Mechanics I and Exercises Midterm Exam

2018/11/20 (Tue) 13:00-14:00 W2 Lecture room

Attention:

- The exam consists of two questions for which you are provided with two answer sheets. Write down your name and student ID number on each answer sheet. Use one answer sheet per question and answer them in sequence, starting from [Question 1]. If the front page of an answer sheet is insufficient to complete your answer, use the back page of the same answer sheet after clearly indicating your intent.
- Scores for each question are equally weighted.
- In addition to personal writing instruments, non-programmable scientific calculators are permitted. However, programmable calculators and calculator functions of mobile phones are prohibited. Any attempts at cheating on the exam will result in failed credit of the course and serious penalties.
- Wherever necessary, specify the units in your answers.

[Question 1]

Answer the following questions:

1) A construction specification requires that a 100,000 m^3 embankment shall be constructed from soil compacted to a dry unit weight γ_d = 16.2 kN/m^3. The weight of a 0.3 m^3 soil sample used for the construction of the embankment, obtained before any work was done on the excavated material, was equal to 4.5 kN. Geotechnical laboratory tests revealed that the specific gravity of soil particle of this soil was G_s = 2.7 and its water content w = 15 %. Answer the following questions assuming that the unit weight of water γ_w = 9.8 kN/m^3.
   (1) Find the total unit weight γ_t and the dry unit weight γ_d of the soil sample taken from the excavation site.
   (2) Find the weights of the solid particles, W_s, and of water, W_w, in the embankment as specified by the construction specification.
   (3) Determine the volume of soil required from the excavation site for constructing the embankment of compacted soil, as indicated in the construction specification, without drying or adding any water.
   (4) Calculate the change in the degree of saturation of the soil from its initial condition at the excavation site to its final condition as part of the embankment.

2) Explain briefly the following terms
   (1) Relative density (D_r)
   (2) Optimum water content (w_{opt})

[Question 2]

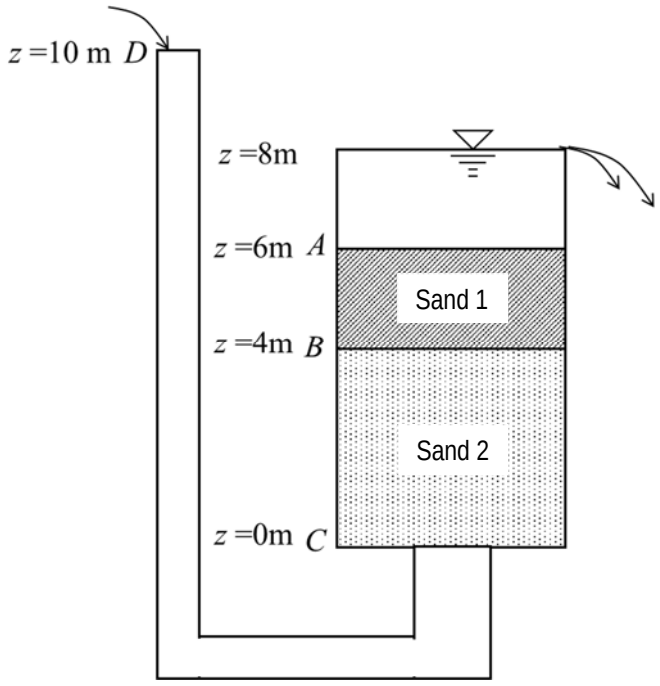
As shown in the following figure, a head difference is applied to a soil specimen consisting of two different soil layers, sand 1 and sand 2. The permeability coefficient of sand 1 is 2.0×10^{-4} m/s, and the permeability coefficient of sand 2 is 4.0×10^{-4} m/s.

Answer the following questions, assuming the unit weight of water as 9.8 kN/m^3:

(1) Find the total head difference in the sections AC, AB, and BC, respectively. Also, find the hydraulic gradient in the sections AB and BC.

(2) Plot the total head, the elevation head, and the pressure head distributions from $z = 0$ m to $z = 8$ m. Assume the datum to be located at $z = 0$ m.

(3) Find the effective stress at point C. Assume that sand 1 has a void ratio of 0.60, sand 2 has a void ratio of 0.75, and the soil particles of both soils have a specific gravity of 2.7.



(4) Assume a new, homogeneous specimen, in which sand 1, in the figure, is replaced by sand 2. How further will point D need to rise to cause seepage failure (quicksand) of the sample?