2017 Soil Mechanics II and Exercises Midterm Exam

2017/6/7 (Wed.) 8:45-10:15 Kyotsu 4 Lecture room

Attention:

- The exam consists of three questions for which you are provided with three answer sheets. <u>Write down your name and ID number on every answer sheet. Use one answer sheet per question and answer them in sequence, starting from [Question 1].</u> 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 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] An elastic ground is subjected to an embankment load with the transversal cross section shown in Figure 1, having a top width 4 m, a base width 8 m, and a crest height 2 m. Under this condition, determine the vertical stress σ_z $(= I_\sigma \times q)$ due to the embankment load at points A–D (each of which is located at 2 m deep), as indicated in the figure, by using the Osterberg's chart shown in Figure 2. Herein, I_σ is the influence value and the distributed load q (corresponding to a height of the embankment, see Figure 2) acting on the ground due to the embankment is calculated from a total unit weight of embankment soil γ_t = 17.0 kN/m^3. Stresses induced by the embankment loading can be solved by applying the principle of superposition.

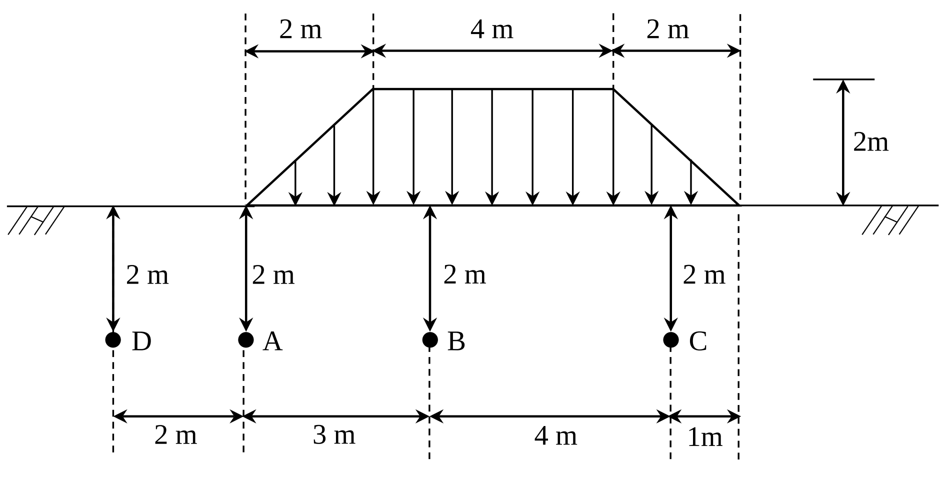

Figure 1

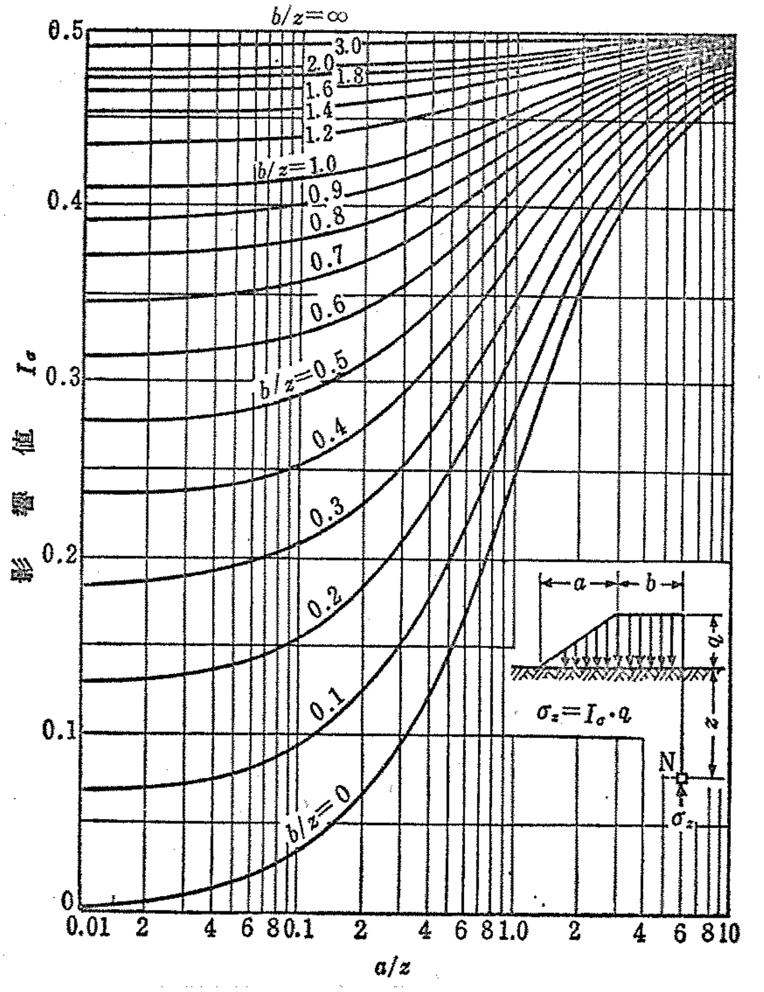

Figure 2 Influence factor for determination of vertical stress in soil mass due to embankment loading (Osterberg's chart)

[Question 2] Briefly answer the following questions

(1) Describe the characteristics of the Mohr-Coulomb failure criterion by comparing it with Coulomb's failure criterion and Mohr's failure criterion. Also, derive the Mohr-Coulomb's failure criterion in terms of the principal stresses by using the Mohr's stress circle.

(2) Drained triaxial tests under constant confining pressure were carried out for two samples of the same sand that were prepared at different densities. Plot the relationship between volume change and axial strain for the loose and dense samples, respectively. Briefly explain the dilatancy phenomenon.

(3) A sample of a saturated, normally consolidated clay was subject to an unconfined compression test, obtaining an unconfined compression strength value of q_u. Plot the Mohr's stress circle for this result and use it to estimate the undrained shear strength c_u of the sample. The tested sample was then remolded, and the newly prepared specimen was also subject to an unconfined compression test, from which a new value of unconfined compression strength, q_{ur}, was obtained. Find the degree of sensitivity of this soil.

[Question 3] The profile of a soil being retained behind a 9 m high vertical frictionless wall is given in Figure 3. Assuming that the groundwater table drops far below the wall, answer the following questions according to Rankine's active earth pressure theory.

(1) Draw the diagram of the lateral earth pressure distribution acting on the back of the wall in active condition.

(2) Determine the magnitude of the total active force per unit length of wall.

(3) Determine the point of application of the total active force.

(4) Discuss whether or not a retaining wall designed assuming a frictionless wall condition would stay on the safe side if friction worked between the soil and the back of the wall in an actual case.

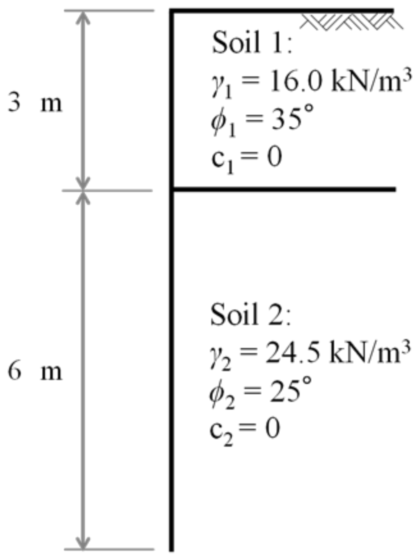

Figure 3 Profile of soil retained behind a retaining wall