UNIVERSITY OF AGDER

FACULTY OF SCIENCE AND TECHNOLGY

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Course code:	**BYG-504**
Course name:	**Soil mechanics and foundation**
Date:	December 20, 2016
Duration:	9:00-13:00
Number of pages incl. front page:	Three pages
Resources allowed:	Soil mechanics and foundations by Muni Budhu Lecture Presentations One sheet (A4: both sides) of backups (formulae etc.)
Notes:	Office kits: compass, calculator etc.

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BYG504 -- Autumn 2016

1. A soil sample has a moist /bulk unit weight γ= 20 kN/m^3 at a water content w = 10%. Assume the specific gravity of soil solids G_s = 2.7, try to:
   a.) determine the void ratio e;
   b.) show its degree of saturation S = wG_s /e, and calculate it.

10 points

2. For the seepage situations as shown in Figure 1, given the saturated specific weight of the soil is 20 kN/m^3; g =10 m/s^2, try:
   a.) to calculate the total stress, pore pressure and effective stress at levels of soil on planes as shown X-X in each case (1) and (2).
   b.) to change the levels of water tank until the effective stress at level X-X is approaching to 0, and specify the total and pore pressure (you can just do one case from either).

15 points

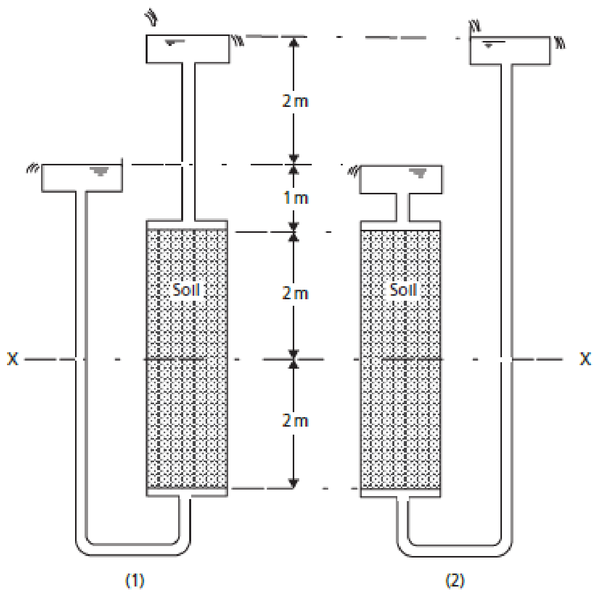

Figure 1

3. An oedometer test on a saturated clay soil gave the following results: C_c = 0.2, C_r = 0.04, OCR = 4; its unit weigh γ= 20 kN/m^3. The existing vertical effective stress in the field is 100 kPa. A building foundation will increase the vertical stress at the centre of the clay by 300 kPa. Assume thickness of the clay layer is 2 m.
   a) Calculate the primary consolidation settlement.
   b) What would be the difference in settlement if OCR was 1.5 instead of 4.

15 points

4. The initial effective stresses on a saturated soil element at a certain depth in a soil mass are σ'_1 = 40 kPa, σ'_2 = 20 kPa, and σ'_3 = 20 kPa. The groundwater level is well below the soil element. The changes in stresses on the soil element are shown in Fig. 1.

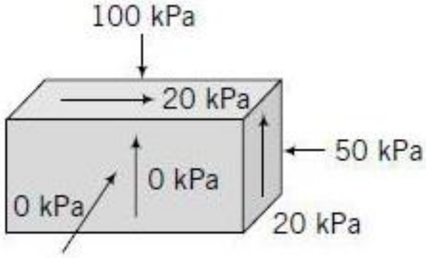

Fig.1

(a) Calculate the change in principal stresses.
(b) Plot the total stress path in (p, q) space, and the effective stress path (assuming that the soil is a linearly elastic material).
(c) The soil is measured with a strength of 30° in shear, if only the vertical load is increasing, try to predict the maximum of the vertical loading before its failure (with an aid of Mohr-Circle), and to identify the failure direction.

30 points

5. The water content of a sample of saturated soil at a mean effective stress of 20 kPa is 85%. Under a standard CD test, the sample was iso-tropically consolidated with a mean effective stress of 200 kPa. At the end of the consolidation the water content was 65%. The sample was then iso-tropically unloaded to a mean effective stress of 120 kPa; its water content increased by 1%. Calculate λ and κ and to show: $M_c = 6 \sin\phi'_{cs} / (3 - \sin\phi'_{cs})$, *where* ϕ'_{cs} is the critical internal friction angle. Assumed as ϕ'_{cs} = 30 °, then:
   a. To Draw the initial yield surface and the critical state line in (p', q), (p', e) spaces;
   b. if a standard CD test is continued by keeping the cell pressure constant while increasing the axial stress. Predict stresses p_y and q_y, at its initial yielding, and its stresses p_f and q_f at its critical state;
   c. If a CU test is carried out instead, predicting stresses p_y , q_y and the excessive water pore-pressure at this initial yielding; the stresses p_f , q_f and excessive pore pressure at its critical state.

30 points