



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 308 SOIL MECHANICS II

DATE: 16/5/2019

TIME: 11.00-1.00 PM

Instructions to Candidates

Answer question ONE Any Other TWO questions

QUESTION ONE (30 MARKS)

- a) Define the following terminologies as applied to shear strength of soils (5 marks)
- Complex stresses
 - Principal plane
 - Principal stress
 - Major principal stress
 - Minor principal stress
- b) From first principles derive the following equations: (10 marks)
- Shear (or tangential) stress, $\tau = \frac{\sigma_1 - \sigma_3}{2} \sin 2\theta$
 - Normal stress, $\sigma_n = \sigma_3 + (\sigma_1 - \sigma_3) \cos^2 \theta$
- c) A series of undisturbed samples from normally consolidated clay was subjected to consolidated undrained tests. The results were: (15 marks)

Cell pressure (kNm^{-2})	Deviator stress at failure (kNm^{-2})	Pore water pressure (kNm^{-2})
200	118	110
400	240	220
600	353	320

Plot in the same graph the strength envelop of the soil

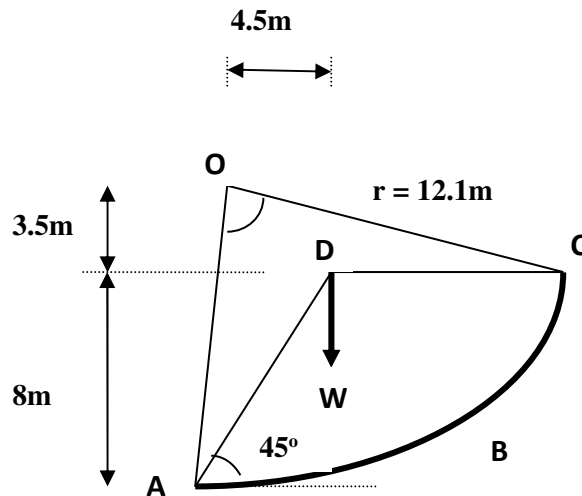
- i. With respect to total stress
- ii. With respect to effective stress

QUESTION TWO (20 MARKS)

- a) With the aid of sketches describe types of soil in terms of shear strength giving an example of each. (3 marks)
- b) State the factors which affect shearing resistance of a soil (6 marks)
- c) A cylindrical specimen of a saturated soil fails under an axial stress of 150kNm^{-2} in an unconfined compression test. The failure plane makes an angle of 52° with the horizontal. Calculate the cohesion and angle of shearing resistance of the soil. (11 marks)

QUESTION THREE (20 MARKS)

- a) Define the following terms as applied to stability of slopes (4 marks)
 - i. Infinite slopes
 - ii. Finite slopes
- b) The figure below shows a 45° slope ABCD of cross sectional area of 70m^2 excavated to a depth of 8m in a deep layer of saturated clay of unit weight 19kNm^{-3} . If the shear strength parameters, cohesion (C) and angle of internal friction (ϕ) are 65kNm^{-2} and 0° respectively if the angle AOC is 89.5° ,
 - i. Determine the factor of safety for the trial failure surface
 - ii. Determine the minimum factor of safety if $N_s = 0.18$
 - iii. Check that no loss of overall stability will occur according to the limit state approach (16 marks)



QUESTION FOUR (20 MARKS)

- What is soil stabilization? (2 marks)
- Describe types of soil stabilization (4 marks)
- What are the effects of lime and cement on soil properties? (4 marks)
- If a cohesive soil and a non-cohesive soil are blended,
 - What type of stabilization is that?
 - With the help of a shear strength envelope describe resulting soil. (10 marks)

QUESTION FIVE (20 MARKS)

- With the aid of sketches, describe different types of slope failures. (8 marks)
- An embankment 10m high is inclined at an angle of 36° to the horizon. A stability analysis by the method of slices gives the sum of shearing forces, normal forces and neutral forces as 450kN , 900kN , and 216kN respectively. The length of the failure arc is 27m . If laboratory tests on the soil indicate the effective stress values C' and ϕ' as 20kNm^{-2} and 18° respectively, determine the factor of safety with respect to shearing strength and cohesion. (12 marks)