



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 308: SOIL MECHANICS II

DATE: 30/7/2019

TIME: 2.00-4.00 PM

INSTRUCTIONS: Answer questions **ONE** and 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

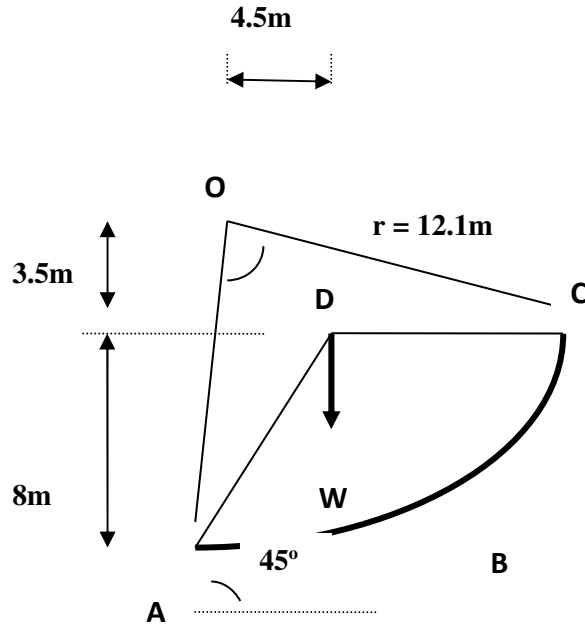
- i. With respect to total stress
- ii. With respect to effective stress

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 made of cohesive soil with $\phi = 0$ and $C = 20 \text{ kNm}^{-2}$ has a unit weight of 19 kNm^{-3} . If the weight of the sliding sector is 346 kN acting on an eccentricity of 5m from the centre of rotation, find the factor of safety against sliding of the trial circle. (12 marks)