



# TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

**BSC IN CIVIL ENGINEERING**

**ECE 2311: SOIL MECHANICS II**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 09 May 2016**

## Instructions to Candidates

You should have the following for this examination

*-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID*

This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions.

### **Question One (Compulsory)**

**(30 marks)**

- A concentrated load of 200kN acts at foundation level at a depth of 2m below ground surface. Compute the vertical stress along the axis of the load at a depth of 10m and at a radial distance of 5m at the same depth by (i) Boussinesq and (ii) Westergaard formulae for  $\mu = 0$ . Neglect the depth of the foundation. **(8 marks)**
- Outline the shearing characteristics of a soil. **(4 marks)**
- ABCD is a raft foundation of a multi-storey building, wherein AB = 30m and BC = 12m. The uniformly distributed load  $q$  over the entire raft is 750kN/m<sup>2</sup>. Determine  $\sigma_z$  at a depth of 20m below point O at the center of the raft. (Use chart II). **(5 marks)**

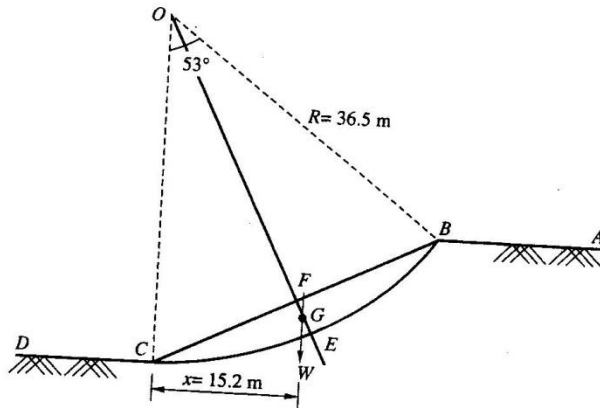
- d) i) Define a Rotational slide.( Illustrate) **(4marks)**  
 ii) Using illustrations outline the different types of circular surfaces failure. **(9marks)**

**Question Two (20marks)**

- a) Three parallel strip footings 3m wide each and 5m apart centre to centre transmit pressures of 250, 200 and 150kN/m<sup>2</sup> respectively. Calculate the vertical stress due to the combined loads beneath the centers of each footing at a depth of 4m below the base. Assume the footings are placed at a depth of 2m below the ground surface. **(10 marks)**
- b.) With the aid of sketches, discuss the various causes of failure of slopes. **(10 marks)**

**Question Three (20marks)**

- a) Briefly describe the Triaxial compression test for determining shear strength parameters of a soil. **(13 marks)**
- b) In Coulomb's equation,  $c$  and  $\sigma$  depend upon many factors. State the FOUR most important factors. **(2marks)**
- c) Calculate the factor of safety against shear failure along the slip circle shown in the fig. 16.6. Assume cohesion = 40kN/m<sup>2</sup>, angle of internal friction = zero and total unit weight of the soil = 20kN/m<sup>3</sup>. **(5marks)**



**Fig. Ex. 16.6**

**Question Four (20marks)**

- a) i) What is soil stabilization? **(2marks)**

- ii) Briefly highlight the various types of admixtures used in soil stabilization. **(8 marks)**
- b) The footings of sizes 4m x 4m and 3m x 3m are placed 9m centre to centre apart at the same level and carry loads of 200k and 180k respectively. Compare the vertical pressure at a depth of 4m at point C midway between the centers of the footings. **(8marks)**
- c) Define shear strength of soil. **(2 marks)**

**Question Five**

**(20marks)**

- a) An unconfined cylindrical specimen of clay fails under an axial stress of  $240\text{kN/m}^2$ . The failure plane was inclined at an angle of  $55^\circ$  to the horizontal. Determine the shear strength parameters of the soil. **(5 marks)**
- b) Determine by Culmann's method the critical height of an embankment having a slope angle of  $40^\circ$  and the constructed soil having  $C' = 650\text{kN/m}^2$ ,  $\phi = 20^\circ$  and effective unit weight =  $120\text{kN/m}^3$ . Find the allowable height of the embankment if  $F_c = F_\phi = 1.25$  **(5 marks)**
- c) What are the factors of safety with respect to average shearing strength, cohesion and internal friction of a soil, for which the shear strength parameters obtained from the laboratory tests are  $C' = 32\text{kN/m}^2$  and  $\phi' = 18^\circ$ . The expected parameters of mobilized shearing resistance are  $c' = 21\text{kN/m}^2$  and  $\phi'_u$  and the average effective pressure on the failure plane is  $110\text{kN/m}^2$ . For the same value of mobilized shearing resistance, determine:
- (i) Factor of safety with respect to height
  - (ii) Factor of safety with respect to friction when that with respect to cohesion is unity.
  - (iii) Factor of safety with respect to strength.

**(10 marks)**

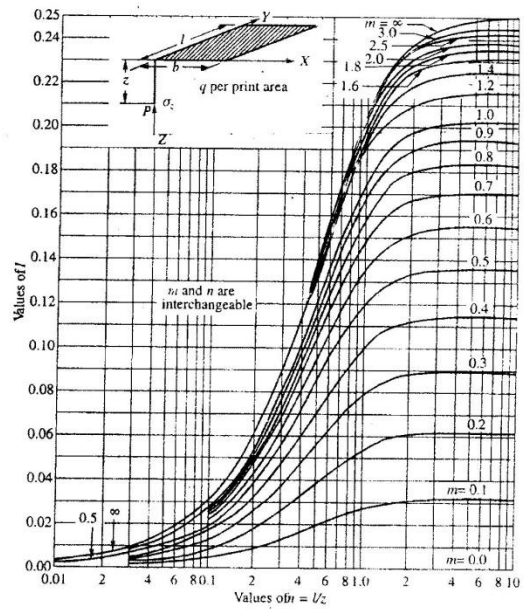


Chart II

Fig. 10.9 Graph for determining influence value for vertical normal stress  $\sigma_z$  at point  $P$  located beneath one corner of a uniformly loaded rectangular area. (After Fadum)