NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

BACHELOR OF ENGINEERING (HONOURS) DEGREE

PART III SECOND SEMESTER EXAMINATION. APRIL 2014

GEOTECHNICAL ENGINEERING I TCW 3205

INSTRUCTIONS

Answer any four questions

Time : 3hrs.

Total marks : 100

QUESTION 1

(a) List the components that make up shearing resistance of a soil . **(2 marks)**

(b) How are these components combined in Coulomb' shear strength equation? **(5 marks)**

© Represent Coulomb's equation graphically. **(5 marks)**

(d) What are the general elements that make up the frictional resistance of a soil. **(3 marks)**

(e) List three laboratory tests and two field tests used for determining the shear strength of soils. **(5 marks)**

QUESTION 2

(a) List four ways in which slope movement and failure can occur. **(4 marks)**

QUESTION 2 continued

(b) Fig. 2 shows the section through a cutting in clay . ABC is a trial slip surface and CD is a tension crack, 4,5m deep. The area ABCDE is $152m^2$ and its centroid is at G. The density of the soil is $1,92Mg/m^3$ and its cohesion is $43kN/m^2$. Taking $\Phi = 0^o$, find the factor of safety against slip along the surface ABC . Allow for the tension crack being filled with water after heavy rain. **(21 marks)**

(25 marks)

QUESTION 3

(a) A cohesionless soil with a void ratio of e = 0,6 and specific gravity of soil solids , G_s = 2,65 exists at a site where the water table is located at a depth of 2m below the ground surface . Taking the value of coefficient of earth pressure at rest K_o = 0,5 , calculate the following quantities at a depth of 5m below the ground surface :

(i) total stresses ($б_v$ and $б_H$) . **(10 marks)**

(ii) effective stresses ($б'_v$ and $б'_H$) . **(7 marks)**

(iii) pore water pressure. **(2 marks)**

Take the soil above the water table to be dry and $Y_w = 9,81\ kN/m^3$.

(b) Sketch the lateral earth pressure diagram. **(6 marks)**

(25 marks)

QUESTION 4

The following observation are recorded in a consolidation test on a fully saturated specimen

Initial height of specimen = 20mm

Diameter of specimen = 75mm

Specific gravity of soil grains = 2,77

Water content (final) = 39%

Applied pressure in kN/m^2	0	50	100	200	400	800	0
Final dial gauge reading mm x 10^{-2}	100	359	499	632	768	899	766

Calculate the void ratio corresponding to each pressure increament. **(25 marks)**

QUESTION 5

(a) What do you understand by the following : (i) bearing capacity and (ii) safe bearing capacity of a soil. **(2 marks)**

(b) Explain the following types of failure of a soil under a footing :

(i) general shear failure **(5 marks)**

(ii) local shear failure **(4 marks)**

(iii) punching shear failure **(3 marks)**

(c) A foundation in a loose sand is 4m wide , 6m long and is 1,5m deep . The soil weighs $16kN/m^3$ and has an angle of internal friction of 32^0. Calculate the safe bearing capacity adopting a factor of safety of 2. **(11 marks)**

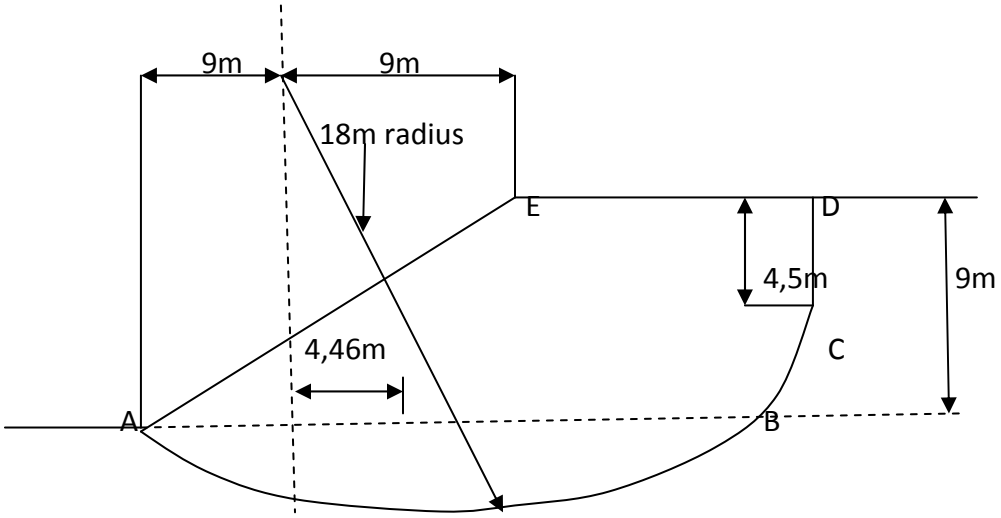
(25 marks)

QUESTION 6

At a construction site , a 3m thick clay layer is followed by a 4m thick gravel layer , which is resting on an impervious rock . A load of 25 kN/m2 is applied suddenly at the surface . The saturated unit weights of the soils are 19 kN/m^3 and 20 kN/m^3 for the clay and gravel layers, respectively . The water table is at the surface . Draw diagrams showing variation with , depth , of total , neutral and effective stresses in the layers . **(25 marks)**

Diagrams

Fig. 2



List of formulae

$\frac{\Delta H}{H_o} = \frac{\Delta e}{1 + e_o}$ $e_f = w_f.G_s$ $Y_{sub} = Y_{sat} - Y_w$ $Y_d = Y_w .G_s/ 1+e$

$Y_{sat} = Y_w.(G_s + e)/ 1+e$ $C_l = 2/3\ C$ $\phi_l = \tan^{-1} (2/3 \tan \Phi)$

$N_c = (N_q -1) \cot \Phi$ $N_Y = 1{,}8 (N_q -1) \tan \Phi$ $N_q = \tan^2 (45^0 + \Phi/2) e^{\pi \tan \Phi}$

$N_{c(r)} = (1 + 0{,}3\ B/l) Nc$ $N_{Y(r)} = (1 – 0{,}2B/L)N_Y$

$q_f = c.N_c+Y.D_f. N_{q(r)} +½YB.N_{Y(r)}$