NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

FACULTY OF INDUSTRIAL TECHNOLOGY

BACHELOR OF ENGINEERING (HONOURS DEGREE)

PART III SECOND SEMESTER SUPPLEMENTARY EXAM – AUGUST 2014

GEOTECHNICAL ENGINEERING I TCW 3205

INSTRUCTIONS

Answer any four questions

Time : 3 hours

Total marks 100

QUESTION 1

(a) What are the elements that cause stresses within a horizontal soil mass ? **(2marks)**

(b) List two elements that make up the total stress (σ) in saturated soils . **(2marks)**

(c) For the subsoil condition shown in fig. 1c , draw the total , neutral and effective stress diagrams upto a depth of 9 m , neglecting capillary flow.

(21 marks)

(25 marks)

QUESTION 2

(a) Name two components that influence shear strength of a soil . **(2 marks)**

(b) How are the two elements in (a) above combined in Coulomb's shear strength equation ? Qualify all the symbols used . **(7 marks**)

QUESTION 2 CONTINUED

(c) Fig. 2c shows a prismatic mass of soil , on which normal stresses of 600 kN/m^2 and 300 kN/m^2 act on the horizontal and vertical planes , respectively . In addition to these normal stresses , shear stress of 280 kN/m^2 acts as shown. Draw the Mohr stress circle and determine the magnitudes of the principal stresses and the orientation of the principal planes. **(16 marks)**

(25 marks)

QUESTION 3

(a) Name two forces that affect the stability of sloping ground . **(2 marks)**

(b) List four ways in which slope movement and failure can occur were stability of slopes is concerned. **(4 marks)**

(c) Fig. 3c shows a temporary cutting. The material is homogeneous clay of density 1 800 kN/m^3, cohesion 50 kN/2 and angle of shearing resistance zero. Given that area ABCDE = 184 m^2 , calculate the factor of safety for the slip circle shown , allowing for a tension crack which may be filled with water CD. **(10 marks)**

(d) Briefly explain the difference between the short- term and long – term stability of earth structures and also include the types of shear strength parameters considered.

(6 marks)

(e) List three methods which are generally used for analyzing stability of slopes of embankments. **(3 marks)**

(25 marks)

QUESTION 4

A cohesionless soil with a void ratio 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 . Take the coefficient of earth pressure at rest K_o = 0,5 and γ_w = 9,81 kN/m^3. Assume the soil to be dry above the water table and saturated below the water table. Calculate the following quantities at a depth of 5 m below the ground surface : total stresses , σ_v and σ_H , effective stresses σ'_v and σ'_H and pore water pressure u. Also sketch the lateral earth pressure diagrams. **(25 marks)**

(25 marks)

QUESTION 5

(a) Explain and differentiate between compressibility and compaction in reference to soil strata. **(5 marks)**

(b) A saturated soil has a compression index C_c = 0,27 . Its void ratio at a stress of 125 kN/m^2 is 2,04 and its permeability is 3,5 x 10^{-8} cm/sec. Calculate :

(i) the change in the void ratio if the stress is increased to 187,5kN/m^2 **(5 marks)**

(ii) the settlement in (i) if the soil stratum is 5m thick **(5 marks)**

(iii) the time required for 50 % consolidation to occur if drainage is one way and time factor is 0,196 for 50 % consolidation. **(10 marks)**

(25 marks)

QUESTION 6

Fig. 6 shows the backfill behind a smooth vertical retaining wall.

(a) Determine the shear force in kN which must be mobilized beneath the base of the wall to prevent movement away from the backfill. **(8 marks)**

(b) At what height above the base does the total horizontal thrust act ? **(5 marks)**

(c) What would be the total pressure behind the wall if drainage is provided to lower the water table to the base of the wall ? **(4marks)**

(d) Sketch the pressure diagrams **(8 marks)**

(25 marks)

DIAGRAMS

Fig. 1c

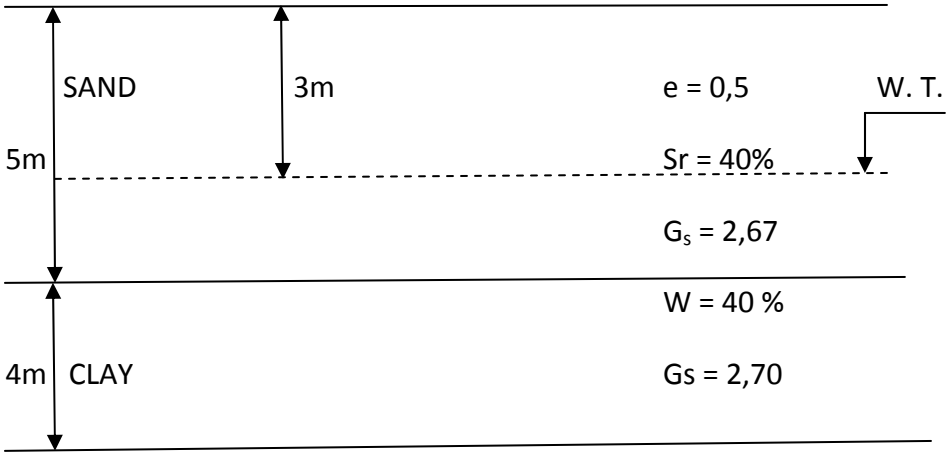


Fig. 2c

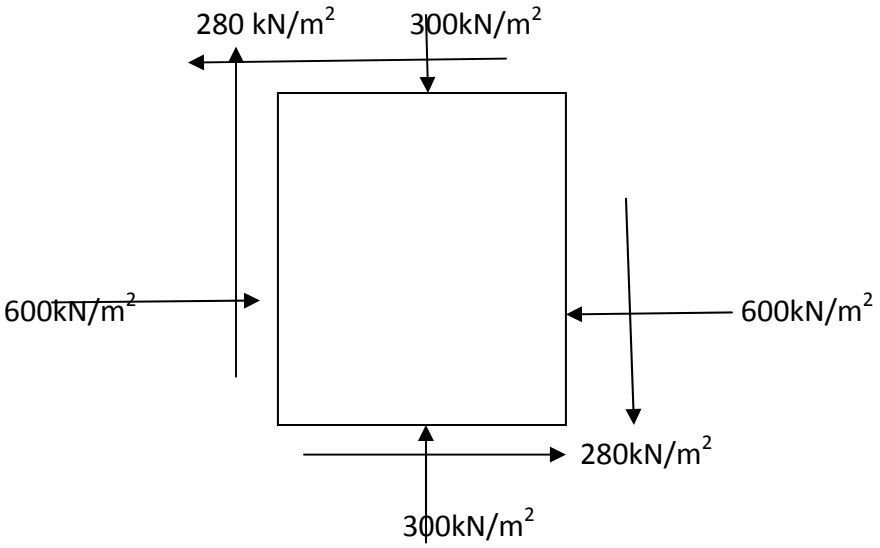

280 kN/m2
300kN/m2
600kN/m2
600kN/m2
280kN/m2
300kN/m2

Fig. 3c

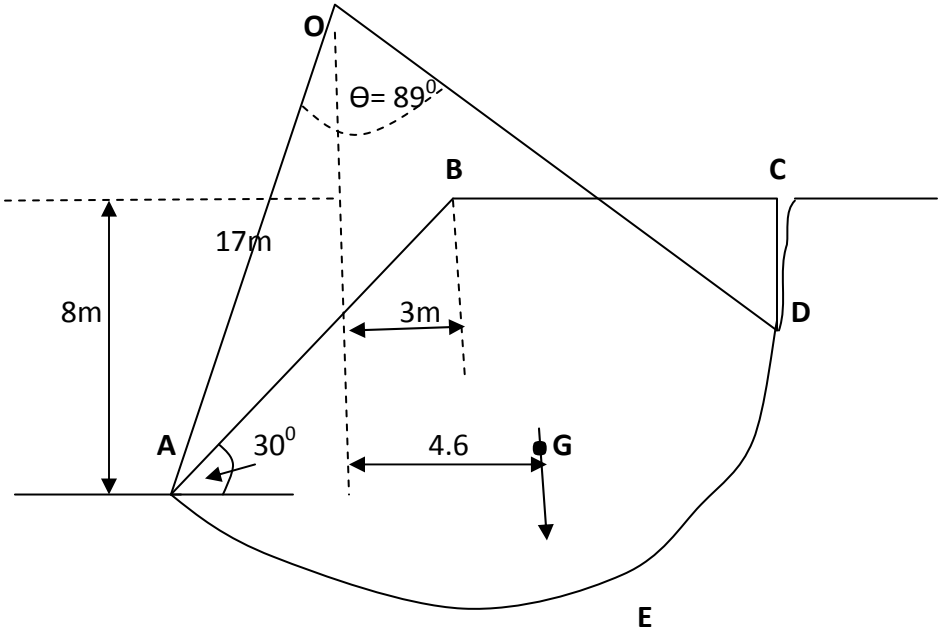
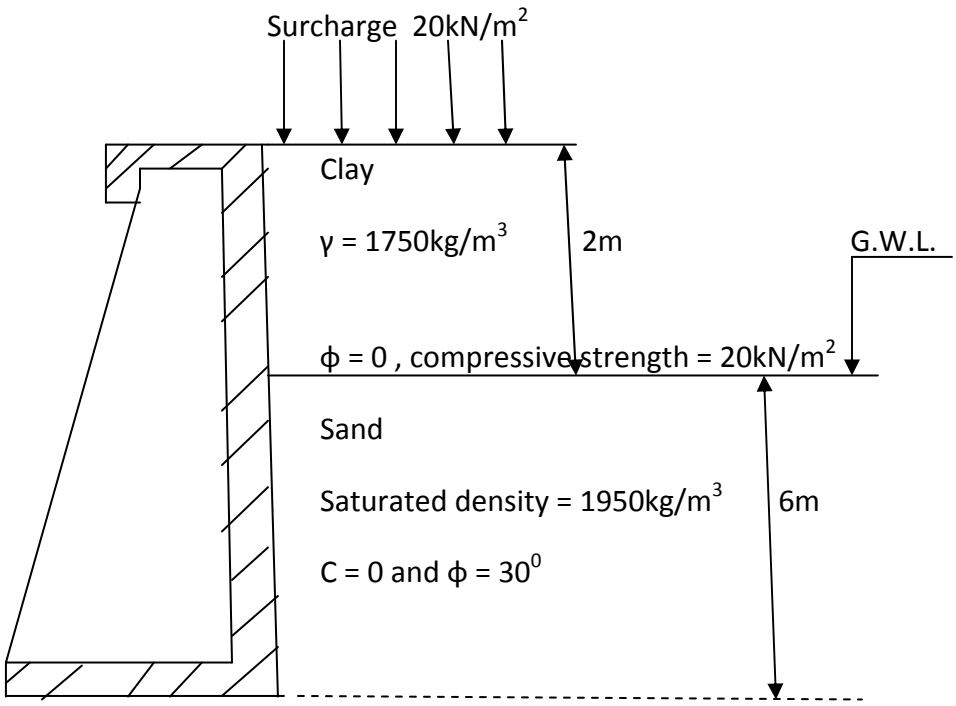

O
Θ= 89°
B
C
17m
8m
3m
D
A
30°
4.6
G
E

Fig. 6



List of formulae

$e = e_0 - C_c \log_{10} \frac{p_o + \Delta p}{p_0}$ $\quad T_v = \frac{C_v}{d^2} \times t$ $\quad \Delta H = m_v \times \Delta p \times H_0$

$K = C_v \times m_v \times \gamma_w$ $\quad \gamma_d = \gamma_w . G_s / 1 + e$ $\quad \gamma = \gamma_d (1 + w)$ $\quad e = w . G_s / S_r$

$\gamma_{sat} = \gamma_w . G_s / 1 + e (1 + w_{sat})$ $\quad \gamma_d = \gamma_w . G_s / 1 + e$ $\quad \gamma_{sat.} = \gamma_w . (G_s + e) / 1+e$

$\sigma_H = K_o . \gamma \times h + K_o \times \gamma \times h$