UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	GEOTECHNICS II
COURSE CODE	:	BFC 34402
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015/JULY 2015
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1 (a) Define the term capillary rise in soils and briefly describe **TWO (2)** factors affecting the height of capillary rise in soils.

(5 marks)

(b) Flow net of a concrete dam can be used to determine among other things the rate of seepage underneath the dam, the hydraulic gradient and the uplift water pressure of the dam for both isotropic and anisotropic soil. Describe briefly **TWO (2)** adjustments / modifications that need to be done in drawing flow net underneath a concrete dam for anisotropic soil having permeability of the soil in the horizontal direction (k_x) four time bigger than the vertical direction (k_z).

(5 marks)

(c) **FIGURE Q1** shows a flow net for the flow of water in a soil underneath a concrete dam. If the soil is isotropic having a coefficient of permeability of 3.5 m/day and the difference in head is 6.5 m,

(i) Determine the quantity of seepage per m run of the dam.

(ii) Determine the maximum exit hydraulic gradient,

(iii) Determine the pore pressure at point A (toe of the dam), B (10 m from the toe) and C (heel of the dam) and estimate the uplift force of the dam.

(15 marks)

Q2 (a) **FIGURE Q2(a)** shows that there are two different values of line loads that are acting on the ground surface. Determine the increase of stress ($\Delta\sigma_z$) at point A.

(5 marks)

(b) In the design of a retaining wall, it is very important to determine the lateral earth pressure that is acting on the wall.

(i) The calculations to obtain the lateral earth pressure of a retaining wall can be determined by Rankine's and Coulomb's theory. Explain in detail the **TWO(2)** major assumptions that differentiates between Rankine's and Coulomb's method.

(4 marks)

(ii) For a rigid retaining wall, an engineer must design the wall according to stability checks. One of it, is to check for settlement under the retaining wall. Briefly describe with the aid of sketches the other **THREE (3)** stability checks on the retaining wall.

(3 marks)

(c) A 10 m high retainining wall has a horizontal backfill and the soil conditions adjacent to a retaining wall are shown in **FIGURE Q2(b)**. Assume that the wall is frictionless and a surcharge of 10 kN/m^2 is acting on the surface of the backfill. Determine Rankine's active force, Pa, per unit length of wall

(13 marks)

Q3 (a) With the aid of diagrams, briefly explain the initial compression, primary consolidation and secondary consolidation of saturated soft soil.

(4 marks)

(b) The preconsolidation pressure (σ'_c) is the important parameter in determination of OCR. With the aid of a sketch, describe the procedure in determination of preconsolidation pressure and then relate the σ'_c and OCR with normally consolidated and overconsolidated soils.

(5 marks)

(c) A 4.0 m thick fill is to be made of a soil with a Proctor maximum dry unit weight of 19.4 kN/m^3 and optimum moisture content of 13%. The underlying soils are shown in **FIGURE Q3**. One dimensional consolidation tests were performed at Points A and B. The results of consolidation test are shown in **TABLE Q3**. The silty sand is normally consolidated.

(i) Calculate the bulk unit weight (γ_b) of the proposed fill.

(2 marks)

(ii) Determine if the soft clay layer and medium clay layer are normally consolidated or overconsolidated.

(4 marks)

(iii) Determine the ultimate consolidation settlement due to the weight of the proposed fill.

(8 marks)

(iv) Calculate the consolidation settlement when the clay layer is 60% consolidated

(2 marks)

Q4 (a) For a finite slope with sliding circular failure surface, explain briefly with the aid of sketches the type of the modes of failure.

(3 marks)

(b) A slope beside the highway is seen to have failed and has caused significant damages. As an engineer, you are required to do detail observations on other slopes along the highway so that slope failure can be minimised.

(i) Suggest **THREE (3)** remedial or precautionary measure that needs to be considered in improving the stability of the slope.

(6 marks)

(ii) Propose **ONE (1)** practical tehcnique based on your suggestions to increase the stabiltiy of the slope.

(3 marks)

(c) **FIGURE Q4(a)** shows a slope that was constructed on a homogenous clayey soil.

(i) Determine the height of the slope. Where $\beta = 45$, $\phi = 20^\circ$, $c = 20$ kN/m^2, $\gamma = 16$ kN/m^3. Use **FIGURE Q4(b)** to aid in your calculation.

(3 Marks)

(ii) Using the ordinary method of slice, determined the factor of safety (FS) of the slope. Assuming that all the slices are divided equally.

(10 marks)

- END OF QUESTIONS -

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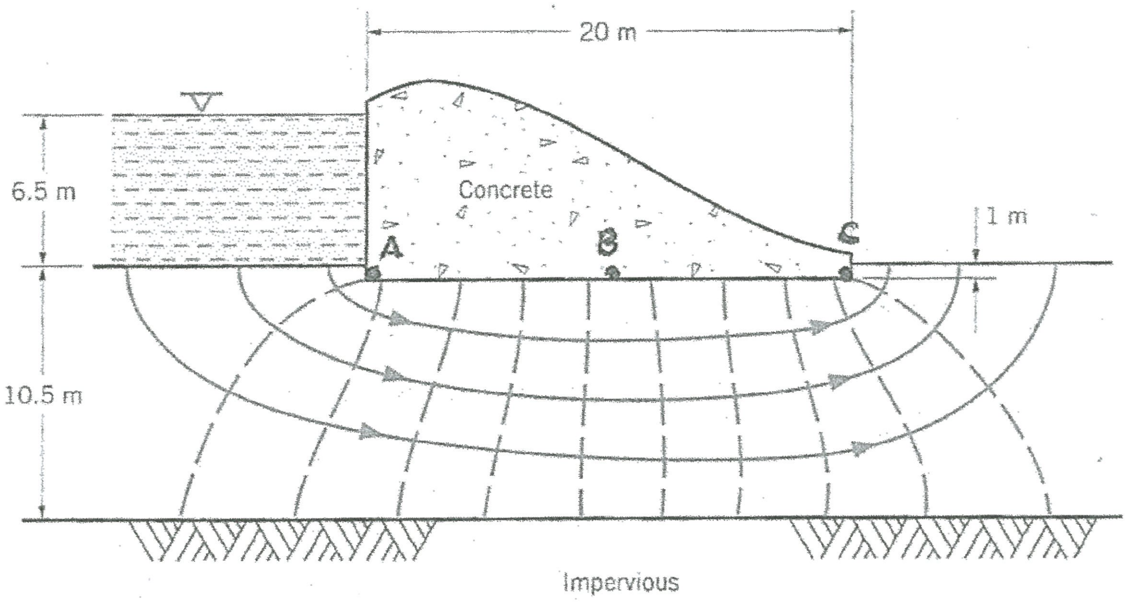

FIGURE Q1(a)

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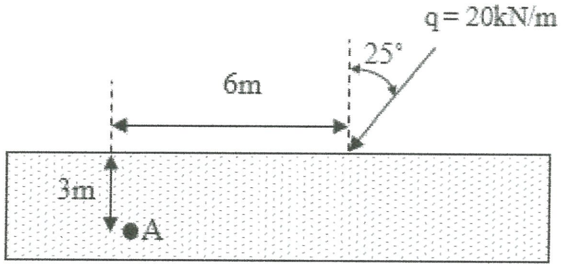

FIGURE Q2(a)

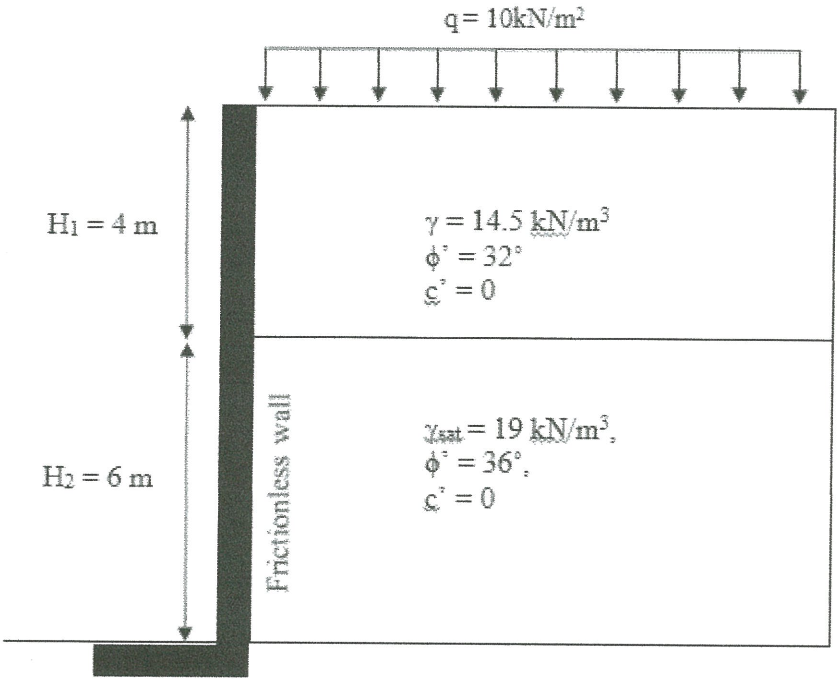

FIGURE Q2(b)

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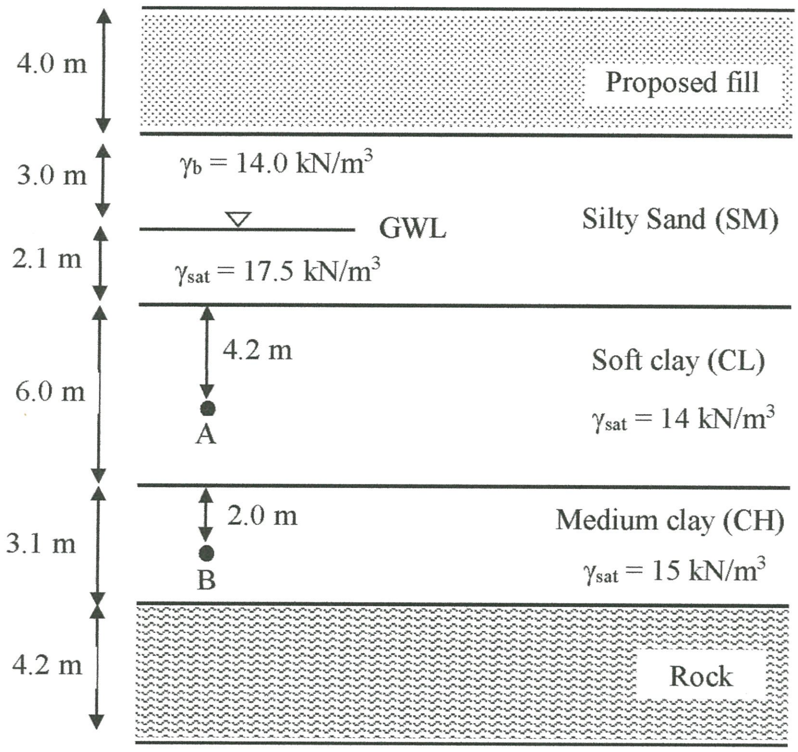

FIGURE Q3

TABLE Q3: Results from one dimensional consolidation test

Sample	C_c	C_r	e_o	σ_c' (kN/m^2)
A	0.59	0.19	1.90	76
B	0.37	0.14	1.21	120

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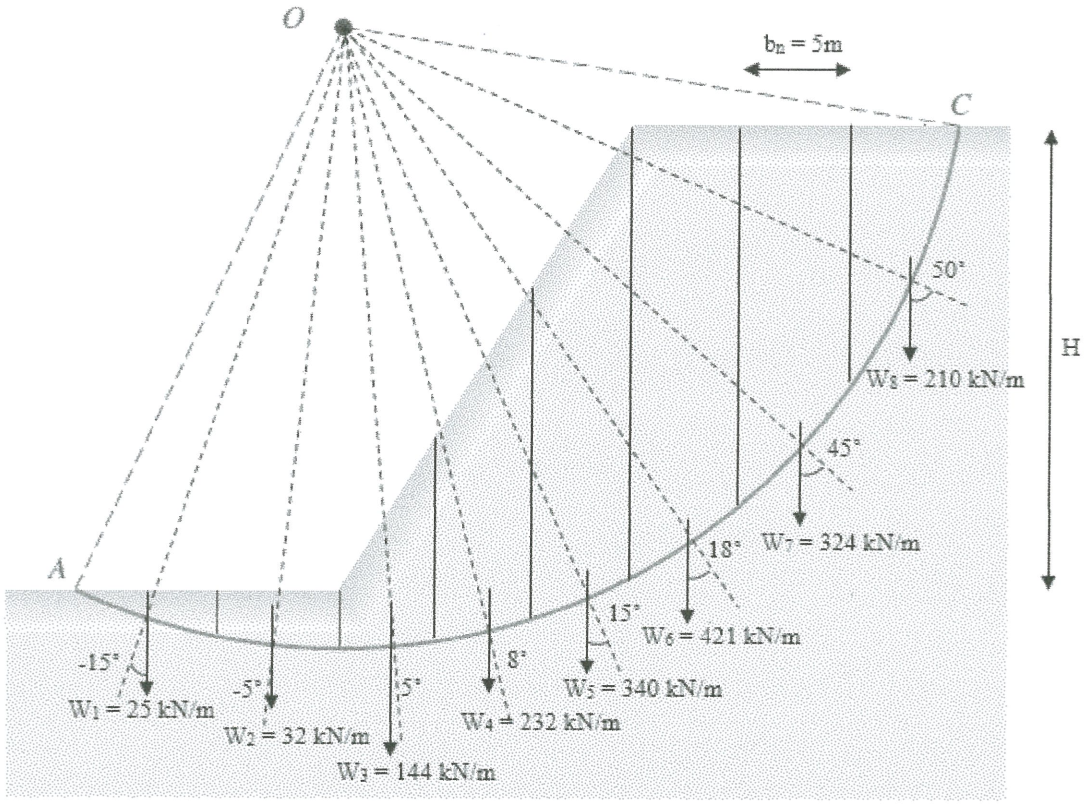

FIGURE Q4(a)

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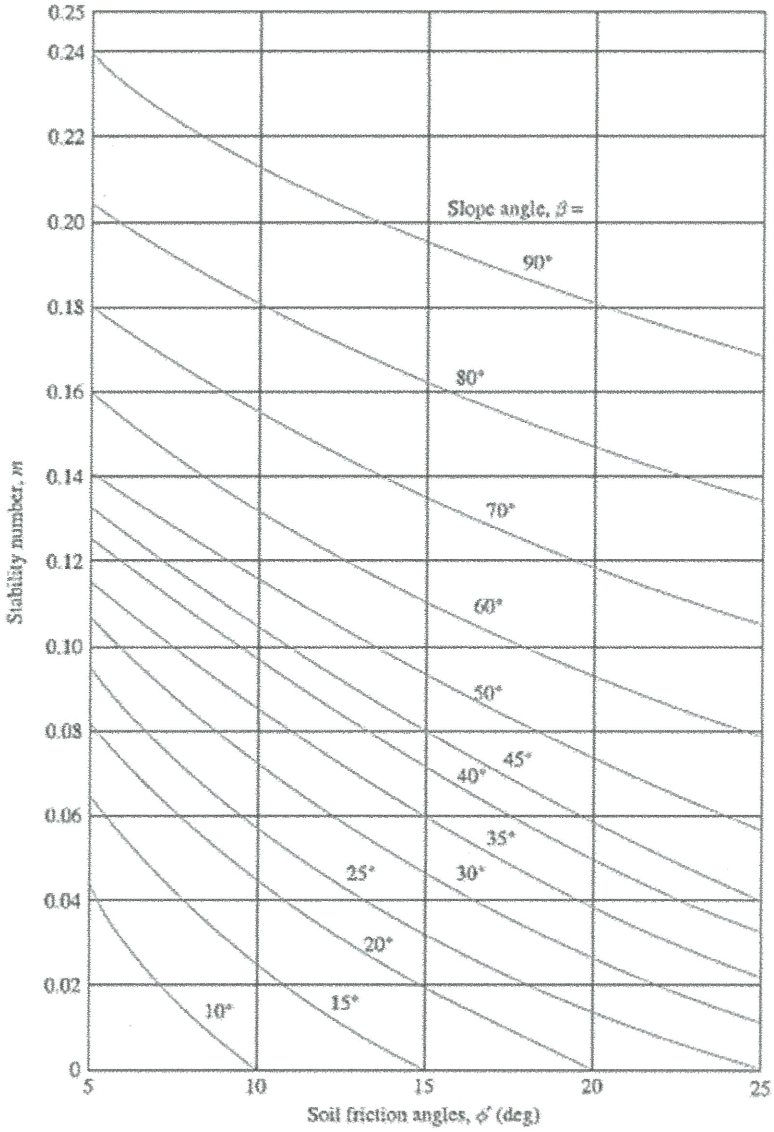

FIGURE Q4(b)

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Given that:

Flow in Soil

$$q = k\,\frac{HN_f}{N_d}\ \textit{isotropic soil}$$

$$q = \sqrt{k_x k_z}\frac{H\,N_f}{N_d}\ \textit{Anisotropic soil}$$

$$i_{max} = \frac{\Delta h}{L}\ ,$$

Head loss of each potential drop, $\Delta h = \frac{\Delta H}{N_d}$

Stress in Soil

$$\Delta\sigma_z = \frac{2qz^3}{\pi(x^2+z^2)^2}\ \text{(Vertical stress caused by a vertical line load)}$$

$$\Delta\sigma_z = \frac{2qxz^2}{\pi(x^2+z^2)^2}\ \text{(Horizontal stress caused by a vertical line load)}$$

$$\sigma_o = (1-\sin\phi')OCR^{\sin\phi'}$$

$$\sigma'_a = K_a\sigma'_o - 2\sqrt{K_a}c'\quad \textit{Active pressure}$$

$$K_a = tan^2\left(45 - \frac{\phi'}{2}\right)$$

$$\sigma'_p = K_p\sigma'_o + 2\sqrt{K_p}c'\quad \textit{Active pressure}$$

$$K_p = tan^2\left(45 + \frac{\phi'}{2}\right)$$

$$P_a = \frac{1}{2}K_a\gamma H^2\quad \textit{Active force per unit length}$$

$$P_p = \frac{1}{2}K_p\gamma H^2\quad \textit{Passive force per unit length}$$

Consolidation and Settlement

$$\text{OCR} = \frac{\sigma'_c}{\sigma'_o}$$

$$S_p = H\frac{\Delta e}{1+e_o}$$

$$S_p = \frac{C_cH}{1+e_o}\log\left(\frac{\sigma'_o+\Delta\sigma'}{\sigma'_o}\right)$$

$$S_p = \frac{C_rH}{1+e_o}\log\left(\frac{\sigma'_o+\Delta\sigma'}{\sigma'_o}\right)$$

$$S_p = \frac{C_rH}{1+e_o}\log\left(\frac{\sigma'_c}{\sigma'_o}\right) + \frac{C_cH}{1+e_o}\log\left(\frac{\sigma'_o+\Delta\sigma'}{\sigma'_c}\right)$$

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$$T_v = \frac{c_v t}{H_{dr}^2}$$

$$m_v = \frac{a_v}{1+e_{av}} = \frac{(\Delta e / \Delta \sigma')}{1+e_{av}}$$

Slope Stability

$$FS = \frac{\sum_{n=1}^{n=p}(c'\Delta L_n + W_n cos\alpha_n tan\phi')}{\sum_{n=1}^{n=p} W_n sin\alpha_n}$$

$$FS = \frac{\sum C_u R^2 \theta}{\sum W_d}, \ \theta \text{ in radian}$$

$$H = \frac{c'}{\gamma m}$$