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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	GEOTECHNICS II
COURSE CODE	:	BFC 34402
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE/JULY 2016
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

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Q1 (a) The fundamentals of flow net construction for seepage calculation is based on the assumption that the soil is isotropic. However in nature, most soils exhibit some degree of anisotropy. Describe briefly **TWO (2)** adjustments / modifications that need to be done in drawing flow net underneath a concrete dam for anisotropic soil. Also sketch the difference between the flow nets of isotropic and isotropic soil.

(6 marks)

(b) Define soil liquefaction and how this phenomena can cause the loss of strength in soils.

(4 marks)

(c) **Figure Q1(c)** 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 $k = 4 \times 10^{-4}$ cm/s.

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

(4 marks)

(ii) Calculate the resultant uplift force and the location from the upstream face of the dam.

(8 marks)

(iii) Determine how high (above the ground surface) the water will rise if piezometers are placed at point X.

(3 marks)

Q2 (a) Demonstrate your understanding of Rankine's active state for cohesionless soil backfill with appropriate illustrations.

(5 marks)

(b) Demonstrate your understanding of Rankine's passive state for cohesive soil backfill with appropriate illustrations.

(5 marks)

(c) A retaining wall 6 m high with a vertical back face retains a horizontal homogeneous cohesionless soil backfill. The water level is at 3 m below the top part of the wall. The saturated and dry unit weight of this sandy material are 18.5 kN/m^3 and 17.5 kN/m^3 respectively. Consider the internal friction angle for the saturated cohesionless soil as 34° and 38° for a dry cohesionless material.

(i) Analyse the magnitude and location of the resultant lateral force per unit length of the wall if the wall is restrained from yielding.

(7 marks)

(ii) Investigate the Rankine's passive earth pressure by assuming the wall is frictionless.

(5 marks)

(iii) Distinguish the difference of Rankine's passive earth pressure if the soil-wall friction is not zero.

(3 marks)

Q3 (a) Describe, wherever necessary with the aid of sketches, the methods to determine coefficient of consolidation using:

i) Casagrande Method (settlement versus log time method).

(4 marks)

ii) Taylor Method (settlement versus square root of time method).

(4 marks)

(b) A soil profile is as shown in **Figure Q3(b)**. Results of a laboratory consolidation test conducted on a specimen collected from the middle of the clay layer are as shown in the figure. Calculate the primary consolidation settlement of the clay layer if a uniformly distributed load, q, of 100 kPa is applied at the ground surface if :

i) The clay is normally consolidated.

(6 marks)

ii) The clay is overconsolidated with an over consolidation ratio of 1.4.

(6 marks)

(c) During the construction of the major roads at UTHM new campus in Parit Raja, surcharge loads and vertical drains were used. Discuss the advantage of using these techniques.

(5 marks)

Q4 (a) A slope can be natural or man made. Explain briefly with the aid of sketches the major categories of slope failures.

(5 marks)

(b) As an engineer, it is important to come up with solutions in preventing slope failure. One precautionary measure is to improve the shear strength of the slope in the failure zone. Propose a practical technique that can be used based on that precautionary measure that can improve the stability of the slope.

(4 marks)

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

(i) Determine the height of the slope. Given that $\beta = 45$, $\phi = 20^\circ$, $c = 20\ kN/m^2$, $\gamma = 16\ kN/m^3$. Use **Figure Q4(c)(ii)** assist in your calculation.

(3 marks)

(ii) Calculate the approximate mass of each equally divided slice based on the data given in **Figure Q4(c)(i)**, **Table 1** and the information given in **Q4(c)(i).**

(5 marks)

(iii) Using the ordinary method of slice, determine the factor of safety (FS) of the slope.

(8 marks)

- END OF QUESTIONS –

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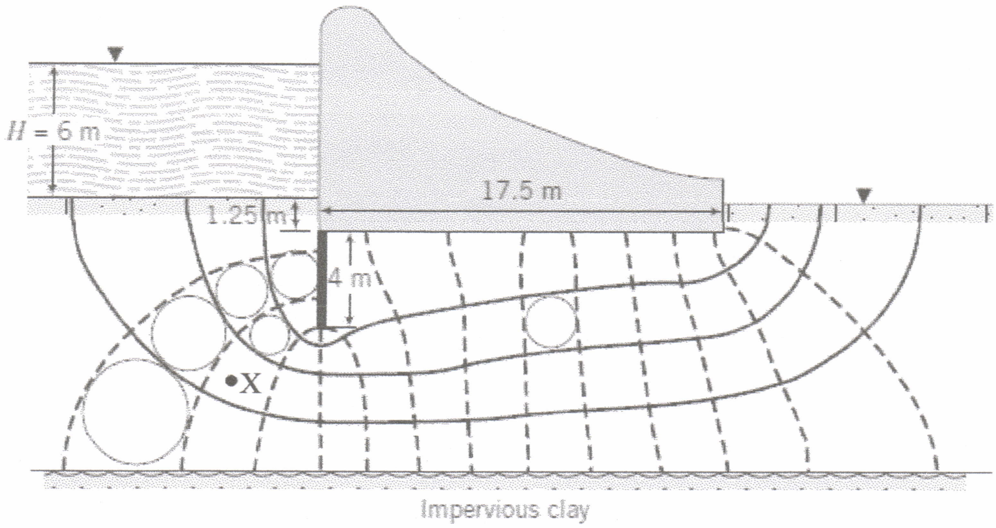

Figure Q1(c)

Surcharge load,q = 100 kN/m^2

0.5m Sand γ_{dry} = 18 kN/m^3

GWL ▽

1.0m Sand γ_{sat} = 18 kN/m^3

10.0m Clay

γ_{sat} = 19.8 kN/m^3
e_o = 0.8
C_c = 0.6
C_r = 0.06

Bedrock

Figure Q3(b)

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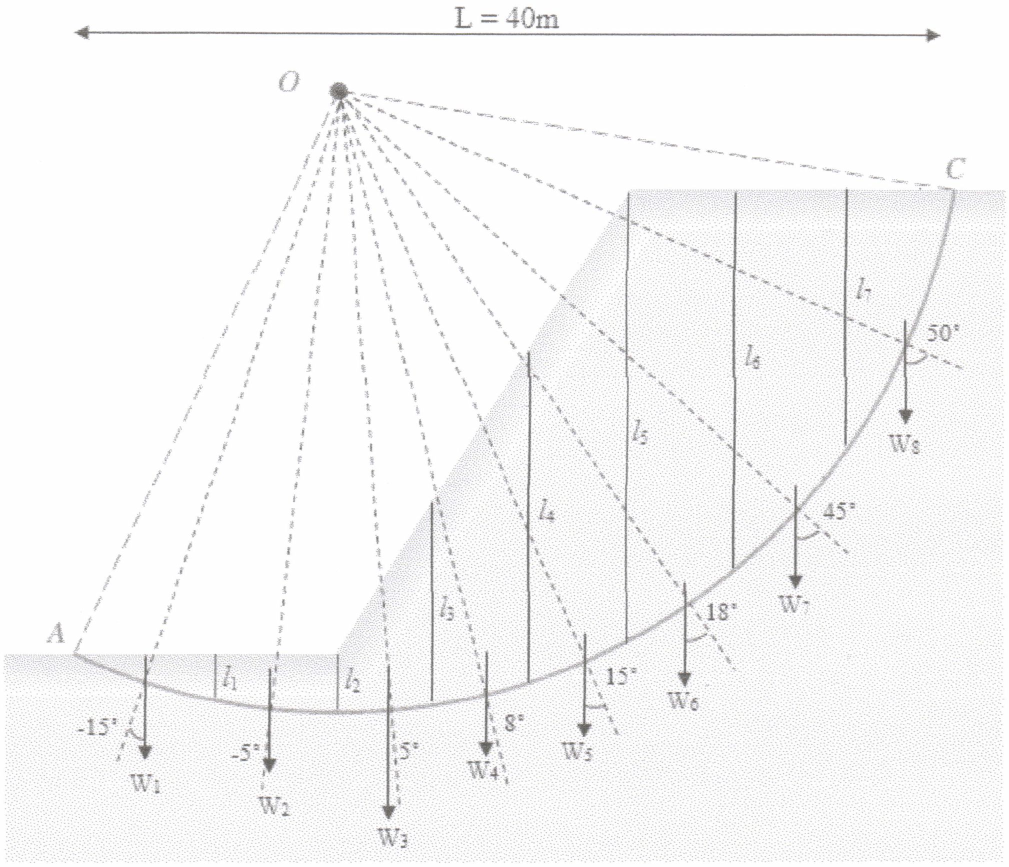

Figure Q4(a)(i)

Table 1: Data on the height of the slices

	l_1	l_2	l_3	l_4	l_5	l_6	l_7
Length (m)	2.0	2.5	6.3	8.5	10.2	9.0	7.6

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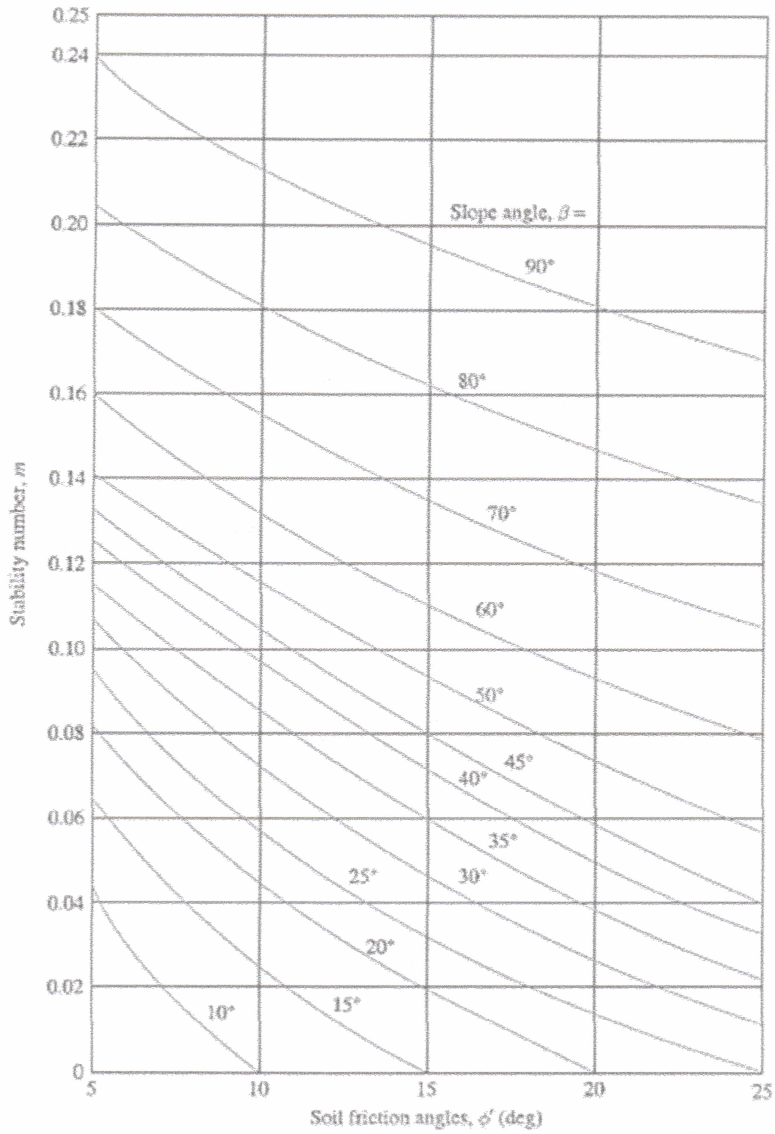

Figure Q4(b)(ii)

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Given that:

Flow in Soil

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

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

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

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

Stress in Soil

Conventional retaining walls

Rankine active and passive pressure

$P_a = \frac{1}{2} K_a \gamma_1 H^2$ $P_a = \frac{1}{2} K_a \gamma_1 H^2 + qK_a H$

$P_v = P_a \sin \alpha°$ $P_h = P_a \cos \alpha°$

$P_p = \frac{1}{2} K_p \gamma_2 D^2 + 2c'_2 \sqrt{K_p} D$

$K_a = \tan^2 \left(45° - \frac{1}{2}\phi'_1\right)$ $K_p = \tan^2 \left(45° + \frac{1}{2}\phi'_2\right)$

Factor of safety against overturning

$$FS = \frac{\Sigma W_i X_i}{\Sigma P_{a_i} z_{a_i}} = \frac{\Sigma (A_i \times \gamma_i) X_i}{\Sigma P_{a_i} z_{a_i}}$$

$$FS = \frac{\gamma_{n+i} A_{n+i} x_{n+i} + \text{K} + \gamma_n A_n x_n}{P_a \cos \alpha (H'/3)}$$

Factor of safety against sliding

$$FS = \frac{\Sigma V \tan\left(\frac{2}{3}\phi'_2\right) + \frac{2}{3} B c'_2 + P_p}{P_a \cos \alpha}$$

$z_o = \frac{2c_u}{\gamma}$

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Consolidation and Settlement

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

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

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

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

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

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

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

Slope Stability

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

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

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