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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	GEOTECHNICS II
COURSE CODE	:	BFC 34402
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	5 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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Q1 (a) Discuss on how to prevent the landslide on soil due to the rainfall effect.
(4 marks)

(b) There are several factors that causing slope failure including geological features, earthquake and rapid drawdown. Sketch and discuss detail these **THREE (3)** factors to the slope failure.
(6 marks)

(c) A potential slip circle of slope is shown in **Figure Q1(c)**. The slope is partially saturated. The weights of the slices have been determined and the average pore pressures acting on the bases of the slices have been determined from the flownet which are listed in Table 1. The properties of soil are as follows:

Bulk density = 1800 kg/m^3
Effective cohesion, c' = 28 kN/m^2
Effective friction angle, $\phi' = 30°$

Propose the best way to interpret the factor of safety for the slope undergoing seepage and for the failure surface shown.
(15 marks)

Q2 (a) Briefly explain **THREE (3)** constraints for sketching flow net.
(6 marks)

(b) **Figure Q2(b)** shows a dam that built together with a sheet pile wall on the upstream side in order to reduce seepage under the dam. A sheetpile penetrated into thick silty sand stratum which assumed as homogeneous and isotropic. By using the scale given;

(i) Determine the flow rate under the dam in m^3/s.
(3 marks)

(ii) Estimate the pore water pressure distribution at the base of the dam. Use an interval, $x = 1.5$ m.
(10 marks)

(iii) Examine the pore water pressure distribution on the front of the sheet pile. Use an interval, $x = 0.8$ m.
(6 marks)

Q3 (a) Discuss the difference between 'active Rankine state' and 'passive Rankine state'.
(4 marks)

(b) The 8 m high retaining wall is shown in **Figure Q3(b)**. Determine;

(i) Rankine active per unit length of the wall together with the location of the resultant.

(4 marks)

(ii) Rankine active force per unit length of the wall and the location of the resultant if the groundwater level was found at 3 m from the ground surface. Given saturated unit weight is 18.5 kN/m^3 with the friction angle 30°.

(17 marks)

Q4 (a) Briefly explain the differences in between primary consolidation settlement and secondary compression settlement by relating it to the changes in soil structure.

(8 marks)

(b) A soil profile is shown in **Figure Q4(b)**. It was found that the initial void ratio of clay is 0.9 with the liquid limit equal to 40. If uniform distributed load $\Delta\sigma$ = 120 kN/m^2 is applied at the ground surface;

(i) Estimate is the settlement of the clay layer caused by primary consolidation if the clay is normally consolidated?

(5 marks)

(ii) If the preconsolidation pressure is 200 kN/m^2, calculate the settlement of the clay layer caused by primary consolidation. Given $C_s = 1/6\ C_c$)

(4 marks)

(iii) Examine the hydraulic conductivity (in m/min) of the clay. (Given $e_f = 0.7$ and time for 50% consolidation = 45 days on double drainage)

(8 marks)

(Notes: You can use $T_v = \pi/4\ (U\% / 100)^2$ for $U < 60\%$ and $T_v = 1.781 - 0.933 \log(100 - U\%)$ for $U \geq 60\%$)

- END OF QUESTIONS-

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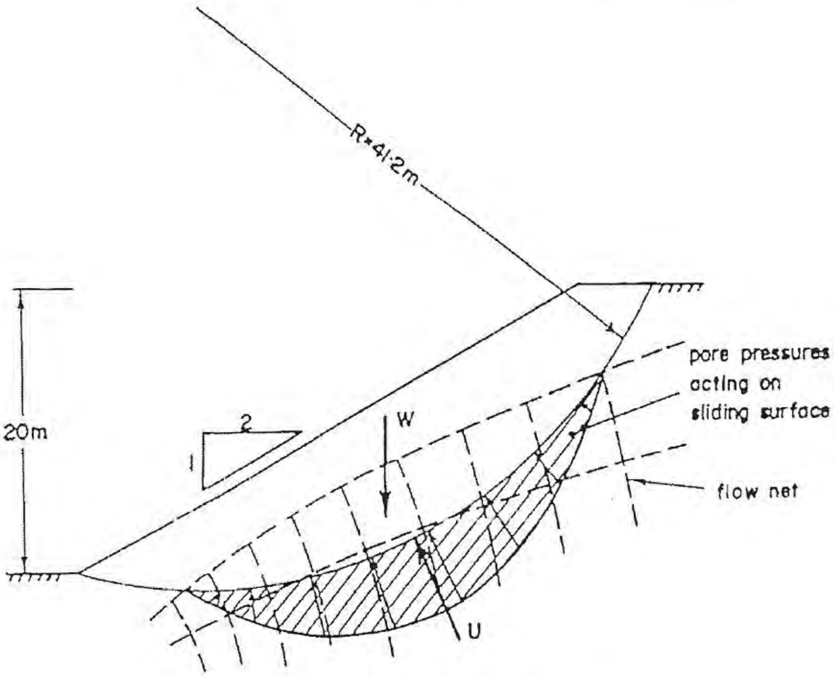
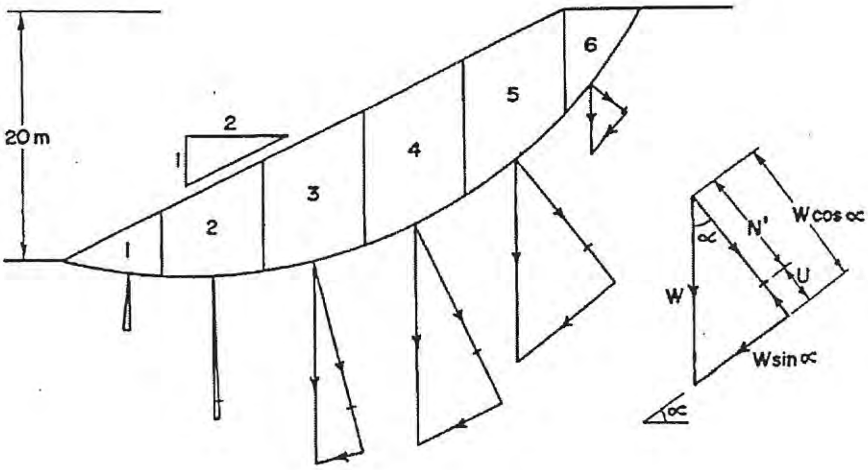


(a): Potential failure surface



(b) Slices of slope

FIGURE Q1 (c)

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TABLE 1 : Details of slices of slope

Slice	Slice width (m)	Weight of slice, W (kN)	Pore pressure force, u (kN)	α (°)
1	8	450	0	-6.37
2	8	1118	150	2.81
3	8	1590	370	14
4	8	1742	450	25.85
5	8	1590	340	39.05
6	6	570	20	50.8

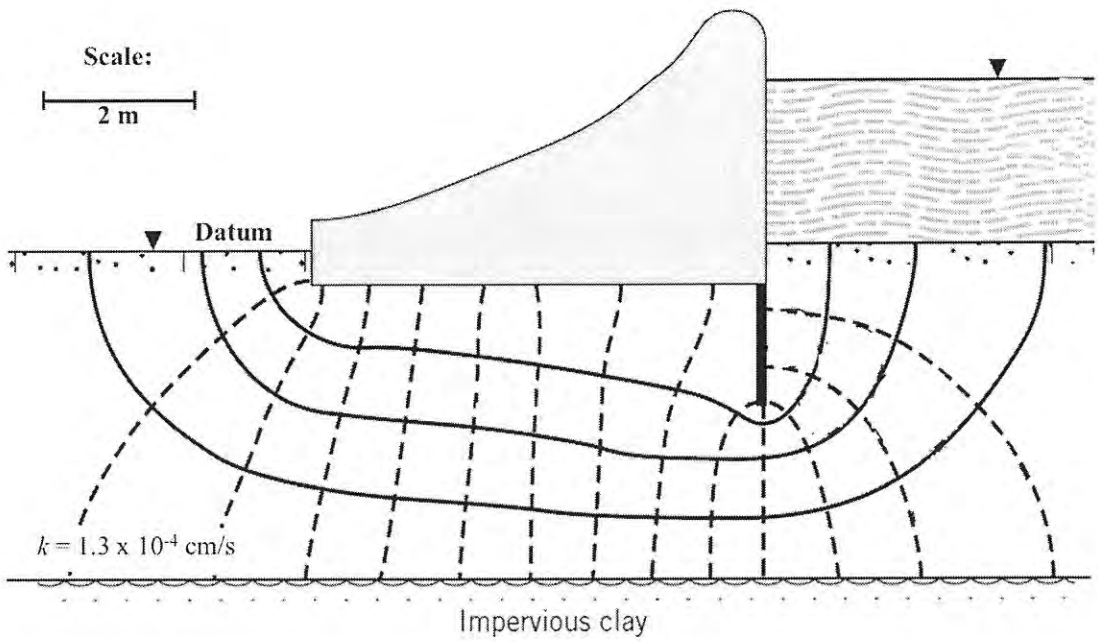

FIGURE Q2 (b): Flow net underneath earth dam

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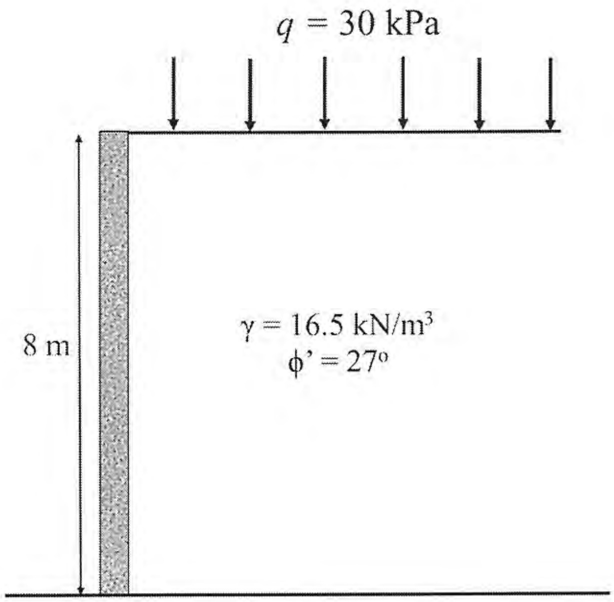

FIGURE Q3 (b): Earth retaining structure

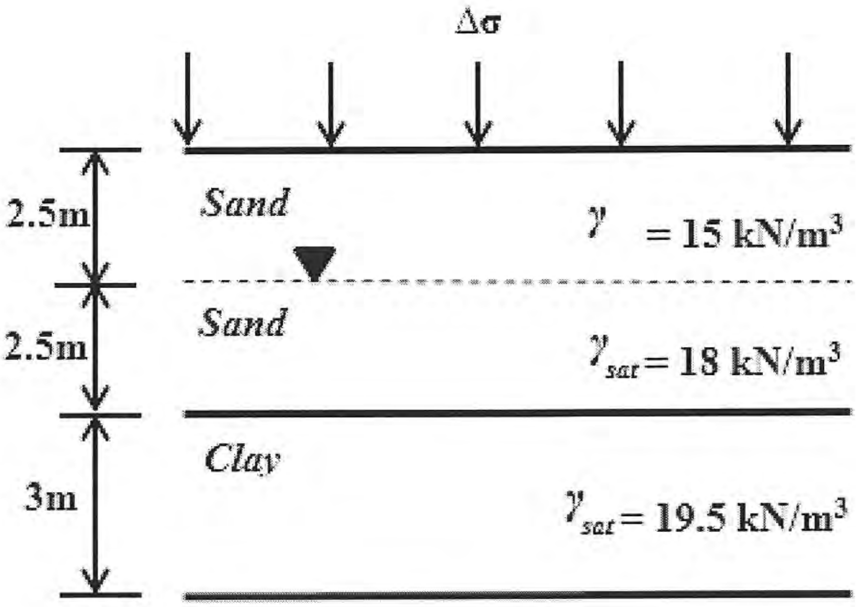

FIGURE Q4 (b): Earth retaining structure

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Flow in Soil

$$q = k\Delta H \frac{N_f}{N_d} \text{ isotropic soil}$$

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

$$i_{max} = \frac{\Delta h}{L_{min}}$$

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

$$U = \left[H - (N_d \Delta h) - h_z\right]\gamma_w$$

$$p_w = \frac{\square x}{3}\left[u_1 + u_n + 2u_{i(odd)} + 4u_{i(even)}\right]$$

$$i_{cr} = \frac{G_s - 1}{1 + e_o}$$

Stress in Soil

Conventional retaining walls

Rankine active and passive pressure

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

$$P_v = P_a \sin\alpha^\circ \qquad P_h = P_a \cos\alpha^\circ$$

$$\sigma'_a = k_a \gamma z \qquad \sigma'_p = k_p \gamma z$$

$$\sigma'_a = k_a (q + \gamma z) - 2c'\sqrt{k_a} \qquad \sigma'_p = k_p (q + \gamma z) + 2c'\sqrt{k_p}$$

$$K_a = \tan^2(45^\circ - \tfrac{1}{2}\phi'_1) \qquad K_p = \tan^2(45^\circ + \tfrac{1}{2}\phi'_2)$$

Factor of safety against overturning

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

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

Factor of safety against sliding

$$FS = \frac{\Sigma V \tan(\tfrac{2}{3}\phi'_2) + \tfrac{2}{3} B c'_2 + P_p}{P_a \cos\alpha} \qquad z_o = \frac{2c_u}{\gamma}$$

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Consolidation and Settlement

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

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

$$S_p = \frac{C_c H}{1+e_o}\log\left(\frac{\sigma'_o + \Delta\sigma'}{\sigma'_o}\right) \qquad C_c = 0.009(L_L - 10)$$

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

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

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

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

$$k = c_v m_v \gamma_w$$

$$T_v = \frac{\pi}{4}U^2_{avg} \qquad T_v = \frac{c_v t}{d^2} \qquad T_v = -0.933\log(1 - U_{avg}) - 0.085$$

$$U_z = 1 - \frac{u_e}{u_i} \qquad U_z = \frac{\Delta\sigma - u_e}{\Delta\sigma}$$

Slope Stability

$$FS = \frac{\sum_{n=1}^{n=p}(c_n \Delta x_n sec\alpha_n) + \sum_{n=1}^{n=p}(W_n cos\alpha_n - U)tan\phi_n'}{\sum_{n=1}^{n=p} W_n sin\alpha_n}$$

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

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

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