UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	SOFT SOIL ENGINEERING
COURSE CODE	:	BFG 40603
PROGRAMME	:	BFF
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER **ALL** QUESTIONS.
	2.	THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSED BOOK.**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) The negative skin friction is a downward drag force exerted on a pile due to settlement of the clay layer.

(i) With the aid of the diagram, discuss **TWO (2)** situations that result in a negative skin friction force being generated.

(6 marks)

(ii) Propose strategies for mitigating the negative effects of skin friction.

(5 marks)

(b) An embankment will be constructed on very soft soil as shown in **Figure Q1(b)**. The details pertaining to a project is shown in **Table 1**. The selected PVDs have the cross sectional dimensions of 95 mm in length and 4 mm in thickness. The smear zone is assume to be 1.5 times the equivalent diameter of PVD. Assume that the PVD will be installed in triangular pattern.

(i) Determine the average consolidation ratio, U_{vr} after 9 months of preloading by considering the smear effect and well resistance effect.

(10 marks)

(ii) Predict the settlement after 9 months of preloading.

(4 marks)

Q2 (a) The 10 m double track railway will be constructed on soft marine clay deposits in Muar, Johor. The embankment height of 3 m will be constructed prior placing the ballast layer. As we know that, this type of soil have low shear strength, low bearing capacity and high compressibility. As a geotechnical engineer, you are required to:

(i) Proposed the best method of embankment construction to fullfill the stability criteria of the construction process.

(3 marks)

(ii) Justify the selection of the embankment construction method.

(7 marks)

(iii) Discuss with the aid of sketches the procedure of your proposed method.

(6 marks)

(iv) Summarize the methods to monitor and control the construction of embankment.

(9 marks)

Q3 (a) Determining the soil profile, particularly in areas with soft soils, is difficult. The usual technique is accomplished by the application of the boring method. When soil samples are collected every 1.5 m, this method has a limit in terms of determining an accurate subsurface soil profile. Kindly make a recommendation with an explanation

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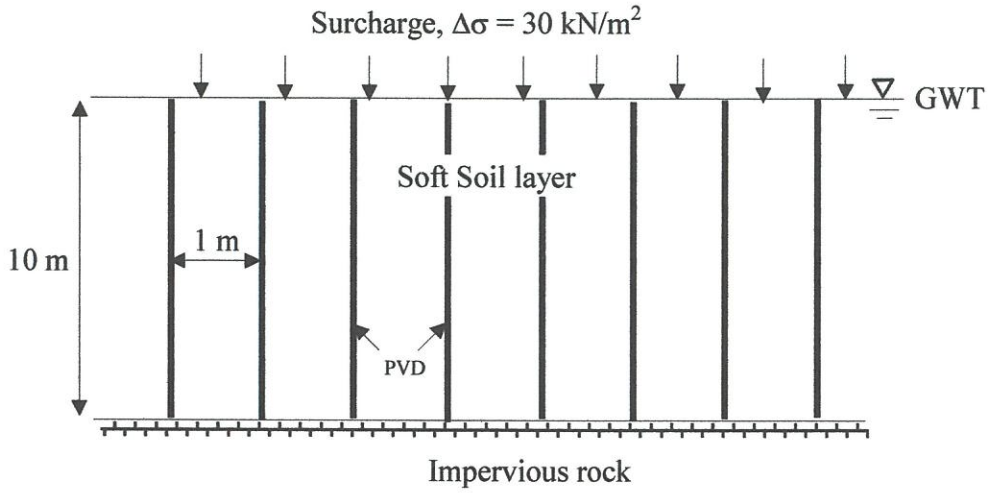

FIGURE Q1(b): Soil profile of soft soil improved PVD

TABLE 1: Data for PVD project

Item	*Parameters*	*Value*
Surcharge	$\Delta\sigma$	30 kN/m^2
Soft soil layer	Saturated unit weight, γ_{sat}	16 kN/m^3
	Compression index, C_c	0.7
	Coefficient of vertical consolidation, C_v	0.65 m^2/year
	Coefficient of horizontal consolidation, C_r	1.3 m^2/year
	Initial void ratio, e_o	1.5
	Vertical Permeability in undisturbed zone, k_v	5 x 10^{-8} m/s
	Horizontal Permeability in undisturbed zone, k_h	1 x 10^{-8} m/s
	Horizontal Permeability in smear zone, k_s	3.3x 10^{-9} m/s
PVD properties	Discharge capacity, Q_c	1 x 10^{-4} m^3/s

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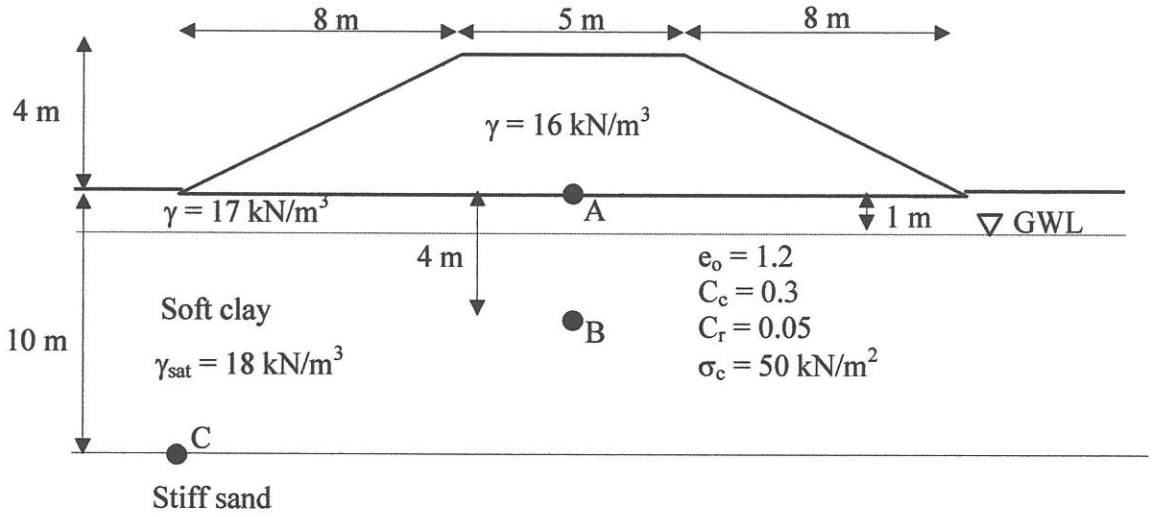
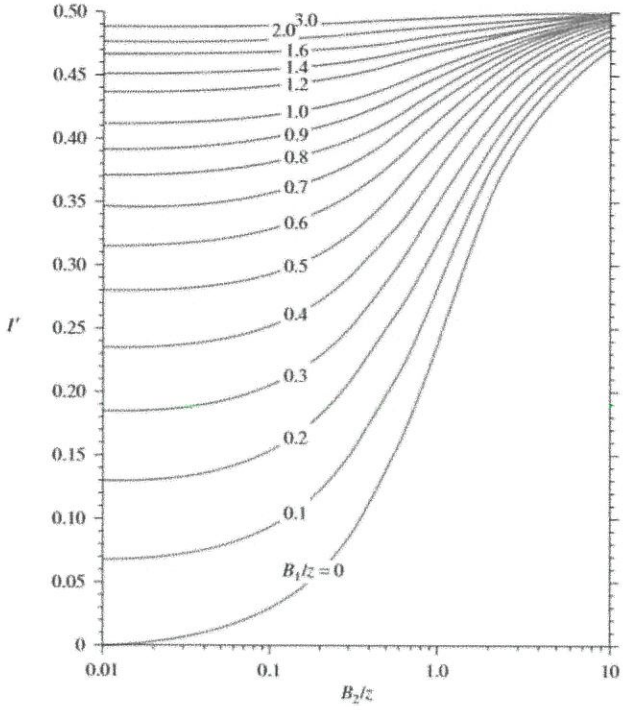


FIGURE Q4(c) : Geometry of embankment on soft soil



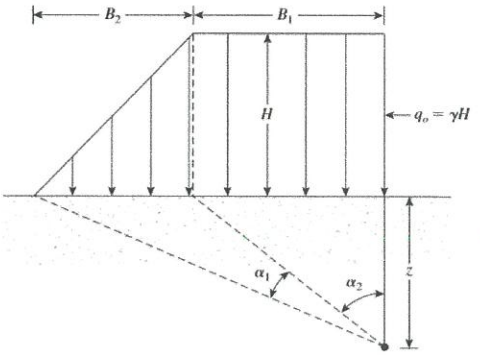


FIGURE Q4(c)(i): Influence value, I for embankment loading

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The following information may be useful. The symbols have their usual meaning.

Consolidation

$$OCR = \frac{\sigma_c'}{\sigma_o'}$$

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

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

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

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

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

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

$$F_s = \frac{N_c c_u}{\Delta\sigma}, \text{where } N_c = 5.14$$

$$T_v = \frac{C_v t}{h_{dr}^2}$$

$$U_v = \sqrt{\frac{4T_v}{\pi}}$$

$$U_{vr} = 1-(1-U_v)(1-U_r)$$

$$U_r = 1-\frac{(1-U_v)}{(1-U_{vr})}$$

$$d_c = \frac{b+t_g}{2}$$

$$d_e = 1.13S, \text{ for square pattern}$$

$$d_e = 1.05S, \text{ for triangular pattern}$$

$$N_D = \frac{d_e}{d_c}$$

$$T_r = \frac{C_r t}{d_e^2}$$

$$F_m(N_D) = \ln\frac{N_D}{N_s} + \frac{k_r}{k_s}\ln(N_s) - \frac{3}{4} + \pi z(2h_{dr} - z)\frac{k_r}{Q_c}$$

$$U_r = 1-\exp\left(\frac{-8T_r}{F_m(N_D)}\right)$$

PVD design