Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	GEOTECHNICS II
COURSE CODE	:	BFC 34402
PROGRAMME	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS.
		2. THIS FINAL EXAMINATIONS IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK.**

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

Q1 (a) Many catastrophic failure occurred in geotechnical engineering due to instability of soil mass. Design a flow net in geotechnical system is need for solving groundwater flow problems. A flow net for flow around a single row of sheet piles in a permeable soil layer is shown in **Figure Q1(a)**.

(i) Discuss **SIX (6)** characteristics for sketching a flow net in seepage.

(6 marks)

(ii) Determine the height (above the ground surface) will the water rise if piezometers are placed at points a, b, c, d, e, f, g and h.

(10 marks)

(iii) Calculate the rate of flow net through flow channel II per unit length (perpendicular to the section shown) if given v = 30 mm/s and i = 7142.

(4 marks)

(b) A typical circular raft foundation is shown in **Figure Q1(b)**. The diameter of the tank is given as 10 m and the tank was loaded with uniform distributed load of 150 kN/m^2.

(i) Determine the vertical stress increment of soil at 5 m below the center of circular raft foundation.

(6 marks)

(ii) Calculate the differences of vertical stress increment at 5 m below the edge of circular raft foundation when compared to the point at 5 m below the center of raft foundation.

(8 marks)

(iii) Illustrate the stress distribution diagram underneath the circular raft foundation.

(6 marks)

Q2 (a) The readings in **Table Q2(a)** were taken for an increment of vertical stress of 20 kPa in an oedometer test on a saturated clay sample 75 mm in diameter and 20 mm thick. Drainage was permitted from the top and bottom boundaries. Determine the coefficient of consolidation using the Taylor (root time method).

(10 marks)

(b) One of the bungalow houses in Bukit Antarabangsa has some cracks due to settlement shown in **Figure Q2(b)**. The soil investigation and geophysical technique have been carried out and it was found that there are two types of soil under the subsurface. The different types of soil were found present different settlement. The silty soil has more settlement compared to sandy soil.

(i) Based on your literature and knowledge of geotechnical engineering, investigate the causes different types of soil present different settlement.

(10 marks)

(ii) Categorize the appropriate test in order to determine the consolidation settlement include data obtained from the test.

(6 marks)

(iii) The time required for 50% consolidation of a 25mm thick silty soil layer (drained at top and bottom) in the laboratory is 2 min 20 sec. Determine how long (in days) will it take for a 3m thick silty soil layer of the same silty in the field under the same pressure increment to reach 50% consolidation?

(4 marks)

Q3 (a) A slope as shown in **Figure Q3(a)** and data for each slice is tabulated in **Table Q3(a)**. Based on **Appendix A**, use slices method to prove that the factor of safety of the slope is greater than the design limit. Investigate what could be happen if the factor of safety is less than design limit. Your answer should be based on assumptions of Slope Stability Analysis.

(10 marks)

(b) A slope as shown in **Figure Q3(b)** is an arc of a circle representing the trial failure surface. With the true scale, illustrate the diagram and analyze using the ordinary method of slices to prove that the factor of safety against sliding for trial slip surface AC is a slope stable. Support your answer with relevant scale.

(20 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022
COURSE NAME : GEOTECHNICS II
PROGRAMME CODE : BFF
COURSE CODE : BFC 34402

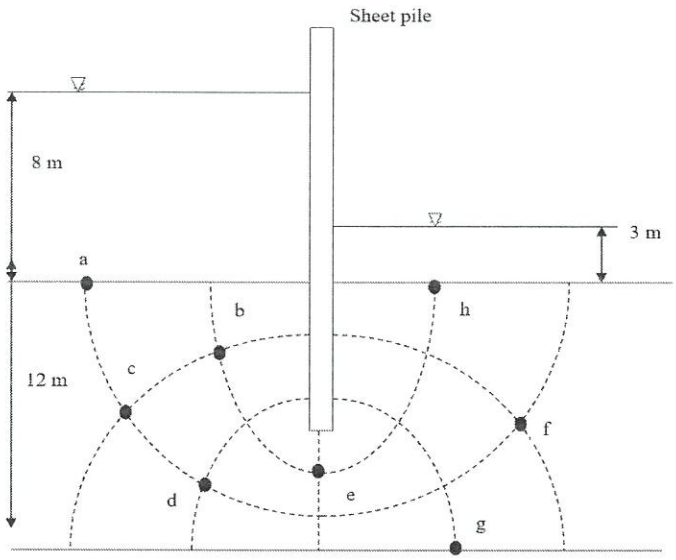

Figure Q1(a): A flow net of sheet pile

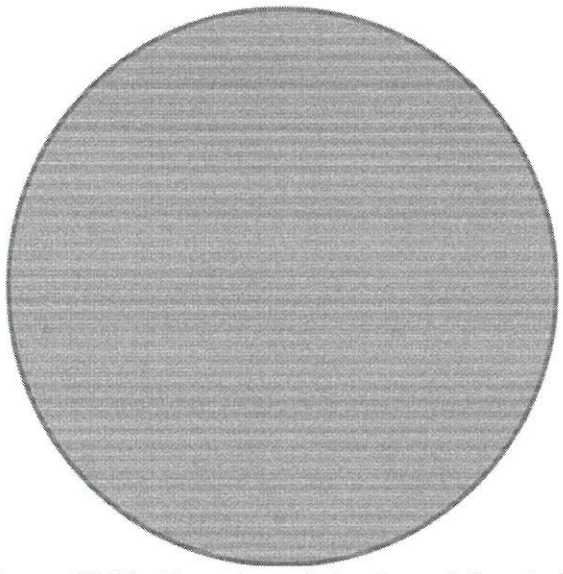

Figure Q1(b): Plan view of circular raft foundation

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022
COURSE NAME : GEOTECHNICS II
PROGRAMME CODE : BFF
COURSE CODE : BFC 34402

Table Q2(a): Oedometer test result

Time (min)	0.25	1	2.25	4	9	16	25	36	24 hours
ΔH (mm)	0.12	0.23	0.33	0.43	0.59	0.68	0.74	0.76	0.89

Figure Q2(b): Crack settlement with different soil types

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022
COURSE NAME : GEOTECHNICS II
PROGRAMME CODE : BFF
COURSE CODE : BFC 34402

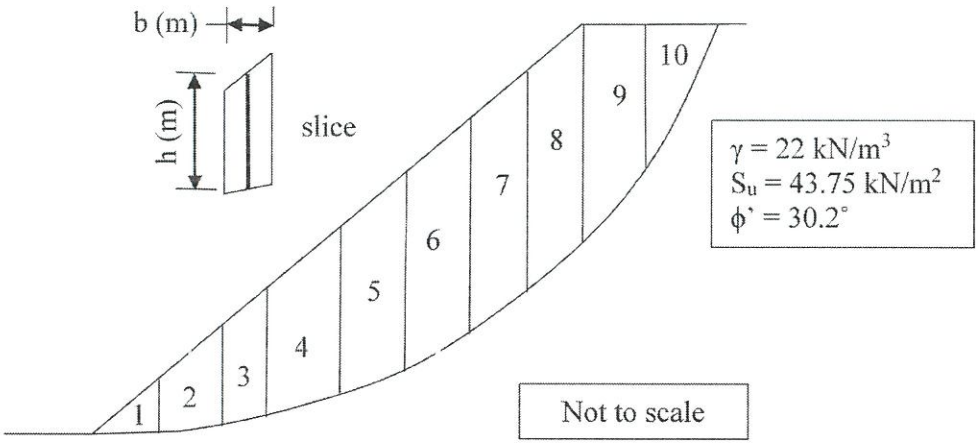

Figure 3(a): Slope

Table Q3(a): Data each slice

Slice	b (m)	h (m)	α	u
1	2	1.3	-14.7	8.0
2	2	3.7	-7.3	21.8
3	2	5.8	0	33.1
4	2	7.7	7.3	41.8
5	2	9.3	14.7	48.0
6	2	9.6	22.3	46.3
7	2	8.6	30.4	36.4
8	2	7.2	39.2	22.5
9	2	5.3	49.4	3.0
10	2	2.3	62.3	0.0

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022
COURSE NAME : GEOTECHNICS II
PROGRAMME CODE : BFF
COURSE CODE : BFC 34402

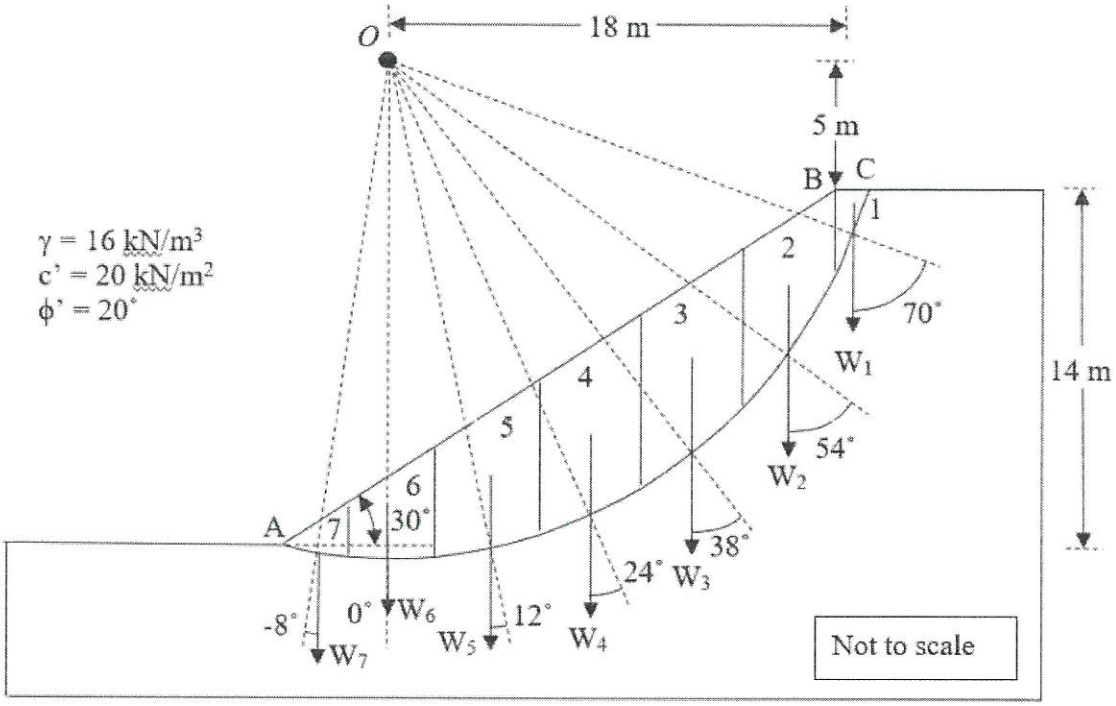

Figure Q3(b): Arc of a circle

Appendix A: Design Tables and Chart

Table 1: Design Approaches

Set of partial factors			
	Actions	Resistance	Material Properties
Design Approach 1, Combination 1	A1	R1	M1
Design Approach 1, Combination 2	A2	R1	M2
UK National Annex (for piles)	A2	R4	M1
Design Approach 2	A1	R2	M1
Design Approach 3	A2	R3	M2

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022 PROGRAMME CODE : BFF
COURSE NAME : GEOTECHNICS II COURSE CODE : BFC 34402

Table 2: Actions

Actions

Partial factors on actions		
Action (Q)	A1	A2
Permanent unfavorable action	1.35	1.00
Variable unfavorable action	1.50	1.30
Permanent favorable action	1.00	1.00
Variable favorable action	0	0

Table 3: Materials Properties

Materials

Partial factors on materials properties		
Material property (X)	M1	M2
tan φ'	1.00	1.25
Cohesion c'	1.00	1.25
Undrained shear strength S_u	1.00	1.40
Unit weight γ	1.00	1.00

Table 4: Resistances

Resistances

Partial factors on resistances			
Resistance	R1	R2	R3
Bearing resistance	1.00	1.40	1.00
Sliding resistance	1.00	1.10	1.00
Earth resistance	1.00	1.40	1.00