Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2022/2023

| | | |
|---|---|---|
| COURSE NAME | : | GEOTECHNICS II |
| COURSE CODE | : | BFC 35403 |
| PROGRAMME CODE | : | BFF |
| EXAMINATION DATE | : | JULY/ AUGUST 2023 |
| DURATION | : | 3 HOURS |
| INSTRUCTIONS | 1. | ANSWER ALL QUESTIONS |
| | 2. | THIS FINAL EXAMINATION IS 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) Understanding the movement of fluids that contribute to flow in soils is important for a range of engineering applications to ensure the safety and stability of structures.

(i) Based on your understanding of flow in soils, discuss what is the phenomenon of capillary rise is soils.

(4 Marks)

(ii) Construct a detail diagram of a flow net that occurs on a temporary structure that resist lateral forces exerted by water against an excavation. Also, explain the constrains when construction a flow net.

(6 Marks)

(b) Seepage plays an important part in certain considerations of engineering design of structures. Explain in detail the various engineering applications that considers seepage analysis.

(15 Marks)

**Q2** (a) **Figure Q2(a)** shows the ring foundation to support a silo. Given $R_1 = 2.5$ m while $R_2 = 5$ m. The total vertical load is 5000 kN.

(i) Plot the vertical stress increase with depth up to 7 m (use 1 m interval) under the center of the ring (point O).

(12 Marks)

(ii) Determine the maximum vertical stress increase and its location.

(3 Marks)

(b) Referring to **Figure Q2(b)**, the vertical stress increase at point $A$ is 42 kN/m$^2$ due to application of line loads $q_1$ and $q_2$. Determine the magnitude of $q_2$.

(10 Marks)

**Q3** (a) The aim of compaction and consolidation is to reduce the volume of the soil. Distinguish between the consolidation and compaction processes.

(3 Marks)

(b) Consolidation is the process of dissipating excess pore water pressure in the soil. Compare the differences between the sand and saturated clay in terms of consolidation process and settlement behaviour.

(4 Marks)

(c) Briefly describe the differences between normally consolidated soil and oversonsolidated soil. Please give an example of how soil normally consolidates and overconsolidates in your explanation.

(5 Marks)

(d) As consultant for a road construction, you are requested to determine the total settlement for the stretch of road due to consolidation of underlain unconsolidated clay. The cross section for the road embankment and its underlain soil are shown in **Figure Q3(d)** and its details are listed in **Table Q3(d)**.

(13 Marks)

**Q4** (a) Explain briefly **THREE (3)** types of slope failure

(3 Marks)

(b) For the infinite slope shown in **Figure Q4(b)** (consider there is no seepage through the soil), determine:

(i) The factor of safety against sliding along the soil-rock interface.

(1.5 Marks)

(ii) The height, H, that will give a factor of safety (Fs) of 2 against sliding along the soil-rock interface.

(1.5 Marks)

(c) A cutting saturated clay in a saturated clay is inclined at a slope of 1 vertical: 1.5 horizontal and has a vertical height of 10.0 m. The bulk unit weight of the soil is 18.5 kN/m$^3$ and its undrained cohesion is 40 kN/m$^2$ ($\phi_u = 0$). Determine the factor of safety against immediate shear failure along the slip circle shown in **Figure Q4(c).**

(i) Ignoring the tension crack
Given:

| | |
|---|---|
| Sector angle, $\Theta$ | $= 84.06^0$ |
| Area of slip mass,A | $= 102.1$ m$^2$ |
| Centroid distance from O,d | $= 6.54$ m |

(1.5 Marks)

(ii) Allowing for tension crack empty of water
Given:

| | |
|---|---|
| Sector angle, $\Theta_c$ | $= 67.44^0$ |
| Area of slip mass,A | $= 71.64$ m$^2$ |
| Centroid distance from O,d | $= 5.86$ m |
| Pw = 0 | |

(1.5 Marks)

(d) Stability of slope for different type of slope need different analysis and concern. Cuttings are excavated, whereas embankments are built. The total stress and pore pressure changed was totally different.

(i) Differentiate the stability of slope in cuttings, in embankment and in natural slope in terms of total stress and pore pressure.

(10 Marks)

(ii) Many methods can be use in slope improvement. Discuss **TWO (2)** methods in slope improvement.

(6 Marks)

**- END OF QUESTIONS -**

**FINAL EXAMINATION**

SEMESTER/SESSION : II / 2022/2023
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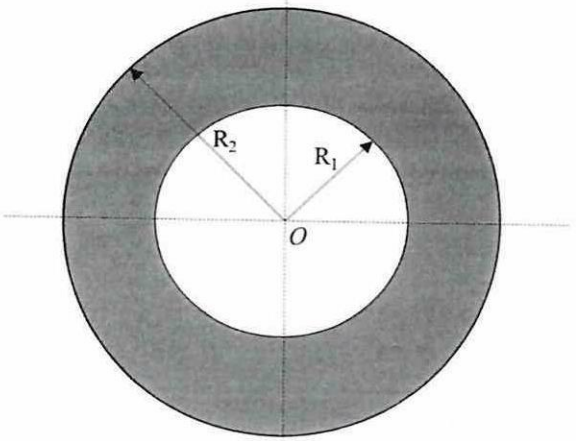


**FIGURE Q2(a)** : Ring foundation

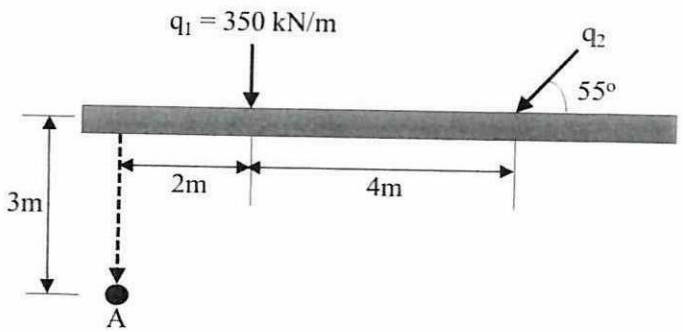


**FIGURE Q2(b)** : Ring foundation

**FINAL EXAMINATION**

SEMESTER/SESSION : II / 2022/2023 PROGRAMME CODE : BFF
COURSE NAME : GEOTECHNICS II COURSE CODE : BFC 35403

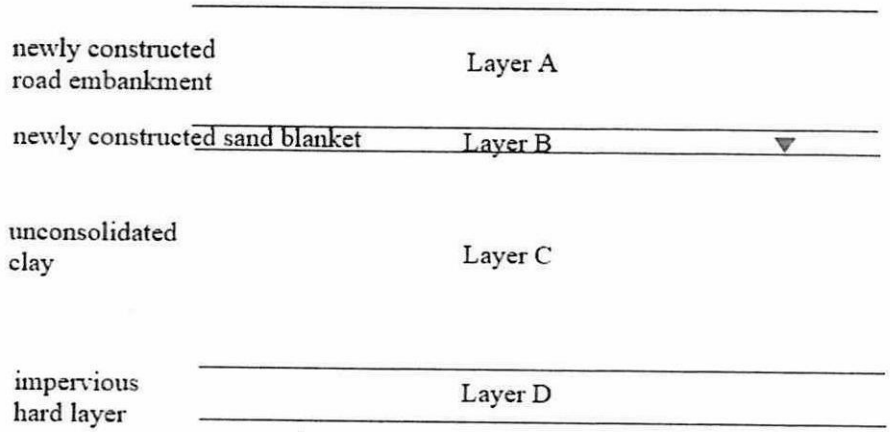


**FIGURE Q3(d)** : Cross section of road embankment

**TABLE Q3(d)**: Details of soil profile

| Layer | Thickness (m) | Soil Properties |
|---|---|---|
| A | 3 | $\gamma_{dry} = 18$ kN/m$^3$ |
| B | 0.5 | $\gamma_{dry} = 17$ kN/m$^3$ |
| C | 10 | $\gamma_{sat} = 19$ kN/m$^3$; $e_o = 0.9$; $C_c = 0.36$ |
| D | 5 | $\gamma_{sat} = 21$ kN/m$^3$ |

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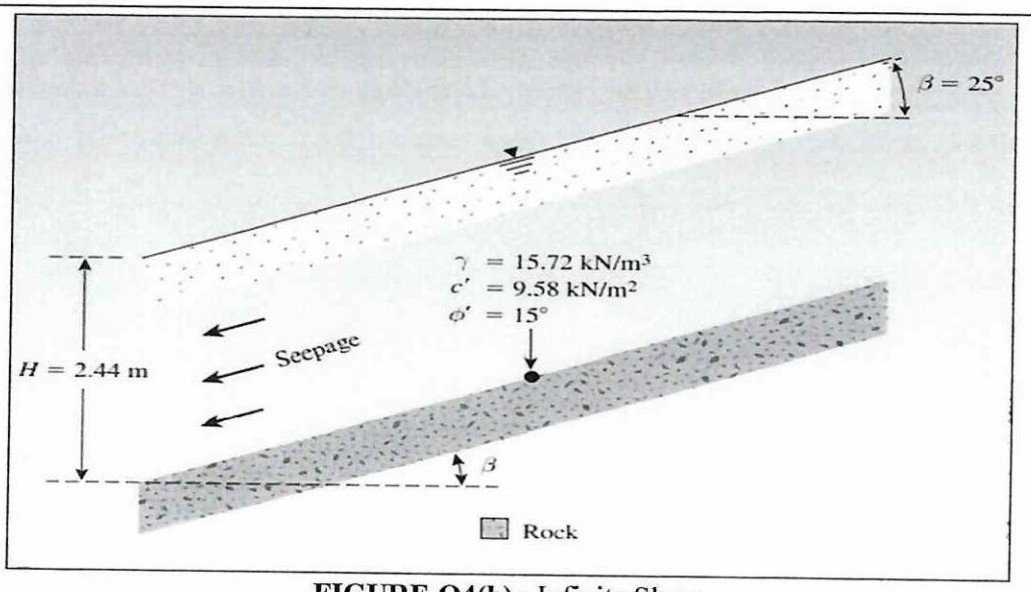


**FIGURE Q4(b)** : Infinite Slope

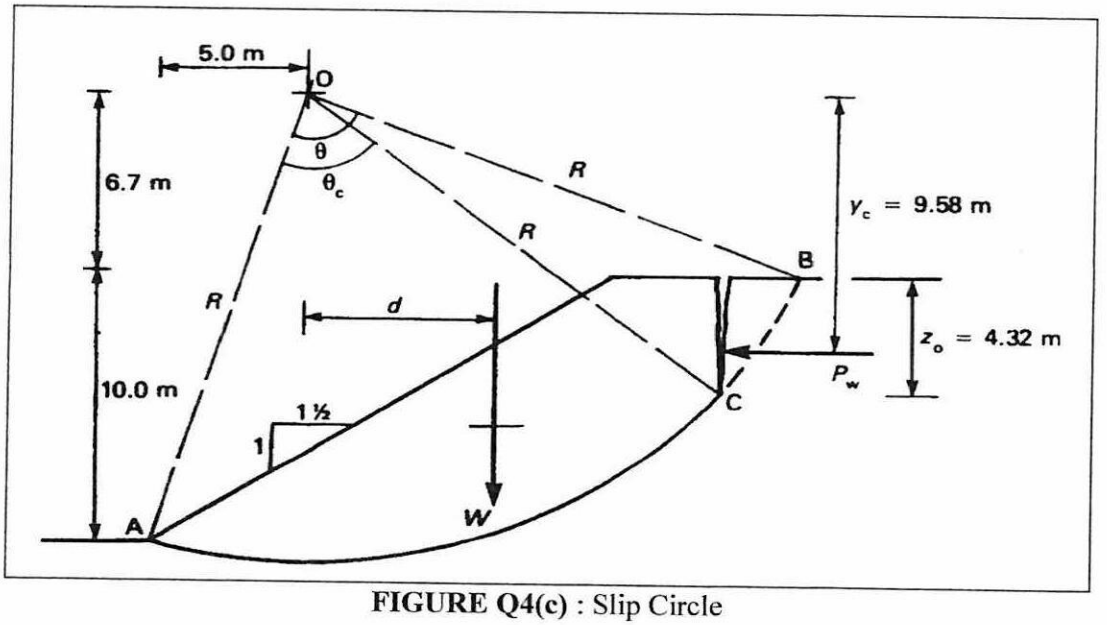


**FIGURE Q4(c)** : Slip Circle