



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : ADVANCED GEOTECHNIC
COURSE CODE : BFG 40203
PROGRAMME CODE : BFF
EXAMINATION DATE : JANUARY / FEBRUARY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.

TERBUKA

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

- Q1** (a) There are some parameters that can be obtained from the stress-strain curve. Construct and differentiate the method of obtaining these parameters. (5 marks)
- (b) The soil profile consists of sand, clay, sandy clay, peat and stiff sand. The water table is located 1.0 m below the ground surface. Some specific soil properties are given in **Table 1**. The surcharge load of 120 kN/m^2 is applied on the ground surface.
- (i) Determine the settlement of the soil using linear and natural strain concepts. (15 marks)
- (ii) Recommend the best method of settlement determination. (5 marks)
- Q2** (a) There are some methods to determine the soil suction in the laboratory such as filter paper, Tempe cell and pressure plate test. Ahmad have an undisturbed soil sample obtained from the block sampler and he have no idea on the suitable method to determine the soil suction for his sample. You are required to recommend and explain briefly the best method in determination of soil suction for his unsaturated soil sample. (8 marks)
- (b) The soil-water characteristic curve (SWCC) is costly and time-consuming to measure directly. As a result, mathematical models such as the Brooks and Corey model, the Van Genuchten model, and the Fredlund and Xing model have been developed. Evaluate performance of the Fredlund and Xing model for determining the SWCC. (7 marks)
- (c) Many nations, including Japan, Malaysia, and Hong Kong, have suffered significant damage as a result of rainfall-induced landslides. Slope instability is caused by rainwater penetration into unsaturated soil slopes. To assess the stability of the unsaturated slope, important metrics such as the soil-water characteristic curve (SWCC) are necessary. Share your expertise about the SWCC in the design of unsaturated soil slopes with your friend. In your explanation, you must include an SWCC determination, SWCC behavior, and the relationship between SWCC and other unsaturated properties. (10 marks)
- Q3** (a) A new highway will be constructed from Kuantan to Kuala Terengganu by Malaysian-Thai Development Berhad, and it will pass through the clay soil area. Over the soft soil region, they propose to use a geosynthetic-reinforced road. As a consulting engineer, you must report in detail on the construction process, including site preparation, geosynthetics installation, fill placement, and compaction, and construction monitoring for them. (10 marks)

(b) The proposed building was constructed on soft soil in Batu Pahat, Johor. The prefabricated vertical drain (PVD) was installed together with the embankment fill to improve the problematic soil by accelerating the consolidation. The problem arose when the ground surface was getting wet. The settlement was slow compared to the predicted settlement as in the design, and there were no significant changes in the excess pore water pressure. Evaluate the problem and suggest some precautions to avoid having the same problem arise again.

(9 marks)

(c) The construction of geosynthetic-reinforced embankment on very soft soil is very crucial. Therefore, the sequence and rate of fill placement have to be planned properly. With the aid of sketches, plan the sequence of staged construction of the embankment on an extremely weak foundation.

(6 marks)

Q4

(a) The selection of a constitutive model in numerical modelling is crucial to obtain accurate results. Discuss the advantages and disadvantages of the Mohr-Coulomb model, the soft soil model, and the hardening soil model in geotechnical modeling.

(6 marks)

(b) KTMB will investigate the effect of train movement on settlement behaviour of the rail track located on soft soil using PLAXIS 2D software for their new proposed project in Johor. You are required to propose and explain in detail the suitable geometry of model boundaries, aided by related sketches, to justify the answer. The width of the railway track is 3m and the distributed load of the train is 50 kN/m².

(7 marks)

(c) Differential settlements along roads and highways, particularly approaches to structure such as bridge and culverts on soft soil, are common problems. The most common practice of the bridge or culvert is generally supported by piles usually driven to a firmer layer. The embankment adjacent to the abutment or culvert would settle due to the consolidation settlement under the embankment load. You must recommend innovative solutions to solve the differential settlement problem with the simulation procedure aided with an appropriate figure. Your answer should include selecting suitable soil parameters, structures, boundary conditions, initial condition, mesh, stage construction, and expected results of your proposed model.

(12 marks)

-END OF QUESTIONS-



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Table 1: Properties of soil

Layer	Soil Type	Thickness (m)	Porosity, n	Unit weight (kN/m ³)	Compression index, C_c
1	Sand	1	0.45	20	0.006
2	Clay	2	0.42	18	0.760
3	Sandy clay	6	0.41	19	0.120
4	Peat	4	0.52	12	1.500
5	Stiff sand	5	0.40	21	0.003

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LIST OF FORMULA

STRESS STRAIN PARAMETERS

$$q' = \sigma'_1 - \sigma'_3$$

$$p' = \frac{1}{3}(\sigma'_1 - \sigma'_3)$$

$$\varepsilon_s = \frac{2}{3}(\varepsilon_1 - \varepsilon_3)$$

$$\varepsilon_v = \varepsilon_1 + 2\varepsilon_3$$

$$K' = \frac{\delta p'}{\delta \varepsilon_v}$$

$$3G' = \frac{\delta q'}{\delta \varepsilon_s}$$

$$E' = \frac{\delta' \sigma'_1}{\delta \varepsilon_1}$$

$$\nu' = -\frac{\delta' \varepsilon_3}{\delta \varepsilon_1}$$

$$\nu' = \frac{3K' - 2G}{2G + 6K'}$$

$$G' = \frac{E'}{2(1 + \nu')}$$

$$K' = \frac{E'}{3(1 - 2\nu')}$$