Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## (ONLINE)
## SEMESTER II
## SESSION 2020/2021

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|---|---|---|
| COURSE NAME | : | ADVANCED GEOTECHNICAL ENGINEERING |
| COURSE CODE | : | MFG 10403 |
| PROGRAMME | : | MFA |
| EXAMINATION DATE | : | JULY 2021 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER ANY **FOUR (4)** QUESTIONS ONLY<br>**OPEN BOOK EXAMINATION** |

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

**Q1** (a) Construction projects may involve working with soil deposits that are under a body of water or below the groundwater that exists at a land area. As soil submerged below water, discuss by meant the term effective unit weight?

(4 marks)

(b) Compare the principal between saturated and unsaturated soils profiles in term of pore water pressure, total stress and effectives stress?

(9 marks)

(c) The expanding knowledge base on the fundamental principles of unsaturated soil mechanics is increasingly being incorporated into a diverse array of practical engineering problems. As an engineer, you need to summarize of the common types of engineering problems involving predominantly unsaturated soils as listed below;

(i) Flow-Related

(4 marks)

(ii) Stress- Related

(4 marks)

(iii) Deformation-Related

(4 marks)

**Q2** (a) Stress paths refer to the series of progressive changes in shear and normal stress that develop within a soil mass. Define in terms of principal stresses the parameters *q, p and p'* and the relation the quantities measured during a conventional undrained triaxial compression test.

(6 marks)

(b) A series of drained and undrained triaxial compression tests carried out on specimens of the same soil yielded the following results as shown in **Table 1** at points of failure. Plot the critical state line and obtain the critical state parameters M, Γ and λ.

(10 marks)

(c) The parameter of shear strength in clay is caused by the different drainage conditions to which a clays of some saturation is subjected to. Discussed in details the effect of different drainage for clay as below;

(i) Drained conditions

(3 marks)

(ii) Undrained conditions

(3 marks)

(iii) Partially conditions

(3 marks)

**Q3** (a) In the construction of UTHM Tanjung Laboh Aviation Centre, the contractor is decided to accelerate the construction of the main earth embankment fill near to the shoreline. Discuss **TWO (2)** suitable technique that are suitable to treat the Batu Pahat soft clay deposit in a faster rate of consolidation.

(6 marks)

(b) As a third year engineering student, you are given a task to share your understanding on explaining the concept of consolidation setelment by using a 1D Casagrande Method. Explain how you measure the preconsolidation pressure point from this laboratory setup with a suitable illustration.

(6 marks)

(c) In a laboratory work, you are deling with several different problems as stated below.

(i) A clay layer from which sample was obtained is 4 m thick. In a laboratory, a 24 mm thickness of the similar type of clay had been tested with double drainage and consolidated 50%. Find the time to consolidate 50% the actual 4 m layer with double drainage.

(4 marks)

(ii) Calculate the coefficient of Compressibility if the change in voids ratio is 0.18, initial void ratio is 0.68 with the increase of pressure as 200 kN/m2.

(4 marks)

(iii) Under a pressure of 200 kN/m2, a soil sample is having voids ratio of 0.72. If the void ratio is reduced to 0.5 under 450 kN/m2 load, calculate the change in effective pressure.

(5 marks)

**Q4** (a) Elaborate the basic principles are involved in soil improvement methods and remedies are available to soil stabilization methods.

(5 marks)

(b) In many construction site, there are soils that will give a challenges to foundation engineer to design foundation due the very weak and unstable soil properties Although it is not possible to solve all the problems caused by all soils, preventive measures can be taken to reduce the possibility of damage to structures when build on both soil. Discuss clearly the challenges construction on the collapsible soil and expansive soil and suggest the preventive measure that can be done.

(8 marks)

(c) The challenges faced by engineers on road construction over peats include limited accessibility, difficult traffic ability, expectations of very large settlements over an extended time period, and possibility of stability problems. The high compressibility, low shear strength and high ground water level causes specific problems for designing and constructing structures on such types of soil. You as geotechnical engineer responsible to construct road construction on the peat soil area. Suggest with sketches **TWO (2)** different methods will overcome these problems. Also compare the advantages and disadvantages for both method.

(12 marks)

**Q5** (a) Describe briefly the purpose of vertical deformation monitoring and a suitable instruments for this geotechnical assessment

(6 marks)

(b) As a site engineer, you are assigned to install a suitable instruments in monitoring a pore water pressure due to several different situations. Assess a logical reasons with a suitable illustrations on how are you going to arrange the instruments on site for:

(i) Retaining Wall

(4 marks)

(ii) Dewatering work of an excavation

(4 marks)

(iii) Landslide

(4 marks)

(c) Due to a very heavy downpour early last week, a seepage issues was recognised at an earth embankment dam. Understanding the risk of this geotechnical structure, you are decided to install a standpipe piezometer. Discuss in detail the procedures of installing this instrument.

(7 marks)

**-END OF THE QUESTIONS-**

**FINAL EXAMINATION**

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**Table 1:** Drained and undrained triaxial

| Test No (D = drained, U = undrained) | D1 | U1 | D2 | U2 | D3 | U3 |
|---|---|---|---|---|---|---|
| Cell pressure, $\sigma_r$ (kPa) | 120 | 120 | 200 | 200 | 400 | 400 |
| Total axial stress, $\sigma_a$ (kPa) | 284 | 194 | 493 | 320 | 979 | 645 |
| Pore pressure at failure, $u_f$ (kPa) | 0 | 69 | 0 | 117 | 0 | 230 |
| Specific volume, $\upsilon_f$ | 180 | 197 | 170 | 186 | 154 | 172 |