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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESI 2012/2013**

COURSE NAME : GEOTECHNIC
COURSE CODE : BFC3033/BFC31703
PROGRAMME : 3 BFF
EXAMINATION DATE : JUNE 2013
DURATION : 3 HOURS
INSTRUCTION : PART A : ANSWER **ALL**
QUESTIONS
PART B: ANSWER **THREE (3)**
QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FOURTEEN (14)** PAGES

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PART A

- Q1** (a) Describe briefly the phenomenon of consolidation of clays by Terzaghi's spring analogy and discuss its limitation. (4 marks)
- (b) Explain with sketches the differences between initial compression, primary compression and secondary compression of soil. (6 marks)
- (c) An oedometer test on a specimen of fully saturated stiff clay gave the following results (as shown in **Table Q1**) for the pressure increment from 100 to 200 kN/m². The initial thickness of the specimen under no pressure was 19 mm. Determine m_v , c_v and k by using the log time curve fitting method. (15 marks)

Table Q1

Time from start of loading (minute)	Specimen compression (mm)
0	0.61
0.25	0.96
0.50	1.06
0.75	1.16
1.00	1.24
1.50	1.35
2.25	1.45
4.00	1.60
5.0	1.66
7.0	1.73
11.0	1.79
16.0	1.82
30.0	1.86
90.0	1.92

(15 marks)

PART B

- Q2** (a) Define the terms of voids ratio, porosity and degree of saturation. (3 marks)
- (b) A soil sample was tested in the laboratory and the following data were collected:
- | | |
|------------------------|-----------------------|
| Mass of wet specimen | $M_1 = 158.0\text{g}$ |
| Mass of dry specimen | $M_2 = 110.2\text{g}$ |
| Volume of wet specimen | $V = 90.2\text{g}$ |
| Specific gravity | $G_s = 2.60$ |
- Determine;
- (i) The water content (2 marks)
- (ii) The bulk and dry densities (2 marks)
- (iii) The void ratio (2 marks)
- (iv) The porosity (2 marks)
- (v) The degree of saturation (2 marks)
- (c) **Table Q2** shows the results of experiments of dry sieving test to classify a soil by the USCS classification system.

Table Q2

<i>Sieve Sizes</i>	<i>Mass retained (g)</i>
20 mm	0
14 mm	18.9
10 mm	67.4
6.3 mm	44.2
3.35 mm	75.8
2 mm	122.1
1.18 mm	193.7
600 μm	240.0
425 μm	282.2
300 μm	242.1
212 μm	233.7
150 μm	265.3
63 μm	240.0
tray	80.0

Determine the effective size, median size, uniformity and coefficient of curvature.

(12 marks)

- Q3** (a) Explain what quick sand phenomenon is and under what situations may this occur?

(4 marks)

- (b) For a falling head permeability test, the following data are given:

Length of the soil specimen = 508 mm
 Area of the soil specimen = 25.8 cm²
 Area of the standpipe = 1.29 cm²
 Head difference at time $t = 0$ is 762 mm
 Head difference at time $t = 10$ min is 305 mm

Determine;

- (i) The hydraulic conductivity of the soil (cm/min)

(3 marks)

- (ii) What was the head difference at time $t = 5$ min?

(3 marks)

- (c) A pumping test was carried out to determine the coefficient of permeability of soil at a site which was selected for the construction of earth dam. Observation wells were established at a distance of 3 m and 6 m from the test well. The following data were obtained :

Depth of water table = 16 m
 Discharge under steady condition = 2.3m³/min
 Drawdown at outer well = 0.50 m
 Drawdown at inner well = 1.5 m

Determine the coefficient of permeability of the soil.

(15 marks)

- Q4** (a) Explain briefly what is a Mohr's stress circle and strength envelope. Also state the importance in connection with the determination of shear strength parameters of a soil. (4 marks)
- (b) Discuss and compare the methods of determining the shear strength of soils by the shear box and unconfined compression apparatus. (8 marks)
- (c) The test result of consolidated undrained (CU) triaxial test with pore pressure measurements was performed on a soil sample. Results are shown in **Table Q3**.

Table Q3

	Test 1	Test 2	Test 3
Cell Pressure (kN/m ²)	350	400	500
Deviator Stress (kN/m ²)	143	208	312
Pore Pressure (kN/m ²)	326	354	418

Plot the effective stress failure envelope on a Mohr-Coulomb diagram and determine the shear strength parameters.

(13 marks)

- Q5** (a) Describe the difference between the term of active pressure, passive pressure and at-rest pressure of lateral earth pressure. (4 marks)
- (b) A soil profile is shown in **Figure Q5(b)**. Calculate the total stress, pore water pressure, and effective stress at points A, B, C and D. (9 marks)
- (c) A 6 m high retaining wall retains a soil comprised of two (3m) thick layers as shown in **Figure Q5(c)** with the following properties:

Upper layer: $c' = 0$ kPa, $\phi' = 20^\circ$, $\gamma = 17$ kN/m³ ;

Lower layer: $c' = 0$, $\phi' = 35^\circ$, $\gamma = 18$ kN/m³ .

Determine the lateral earth force at rest per unit length of the wall and the location of the resultant force. Assume OCR = 1

(12 marks)

- Q6** (a) Sketch and briefly explains **FOUR (4)** types of slopes failure or mass movement.
- (8 marks)
- (b) A cut slope was excavated in a homogenous soil is shown in **Figure Q6**. By using the ordinary method of slices, find the factor of safety with respect to sliding for the following trial cases. The detail is given below:

$$\beta = 45^{\circ}, \phi' = 20^{\circ}, c' = 19.2 \text{ kN/m}^2, \gamma = 18.08 \text{ kN/m}^3$$
$$H = 12.2 \text{ m}, \alpha = 30^{\circ}, \theta = 70^{\circ}$$

(17 marks)

- END OF QUESTIONS -

BAHAGIAN A

- S1** (a) Huraikan dengan ringkas fenomena pengukuhan tanah liat mengikut analogi pegas Terzaghi's dan bincangkan tentang hadnya. (4 markah)
- (b) Terangkan dengan bantuan gambarajah perbezaan di antara mampatan awal, mampatan primer dan mampatan sekunder dalam tanah. (6 markah)
- (c) Satu ujian oedometer dijalankan ke atas sampel tanah liat keras tepu dengan mendapat keputusan (dalam **Jadual S1**) dengan tegasan meningkat daripada 100 kepada 200 kN/m². Ketebalan awal sampel tanah tanpa tekanan adalah 19 mm. Tentukan nilai m_v , c_v dan k dengan menggunakan kaedah lengkung log masa.

Jadual S1

Masa semasa bermula beban (minit)	Mampatan sampel (mm)
0	0.61
0.25	0.96
0.50	1.06
0.75	1.16
1.00	1.24
1.50	1.35
2.25	1.45
4.00	1.60
5.0	1.66
7.0	1.73
11.0	1.79
16.0	1.82
30.0	1.86
90.0	1.92

(15 markah)

BAHAGIAN B

S2 (a) Takrifkan terma nisbah lompong, keliangan dan darjah ketepuan.

(3 markah)

(b) Satu sampel tanah diuji di makmal dan keputusan yang didapati adalah :

Berat sampel basah	$M_1 = 158.0\text{g}$
Berat sampel kering	$M_2 = 110.2\text{g}$
Isipadu sampel basah	$V = 90.2\text{g}$
Graviti tentu	$G_s = 2.60$

Tentukan;

(i) Kandungan air

(2 markah)

(ii) Berat Unit Tepu dan Berat Unit Kering

(2 markah)

(iii) Nisbah lompong

(2 markah)

(iv) Keliangan

(2 markah)

(v) Darjah ketepuan

(2 markah)

(c) **Jadual S2** menunjukkan keputusan ujikaji ke atas ujian ayakan kering bagi mengklasifikasi tanah mengikut sistem pengelasan.

Jadual S2

<i>Saiz ayak</i>	<i>Berat Tertahan(g)</i>
20 mm	0
14 mm	18.9
10 mm	67.4
6.3 mm	44.2
3.35 mm	75.8
2 mm	122.1
1.18 mm	193.7
600 μm	240.0
425 μm	282.2
300 μm	242.1
212 μm	233.7
150 μm	265.3
63 μm	240.0
penahan	80.0

Tentukan saiz efektif, saiz pertengahan, keseragaman dan pekali lengkungan.

(12 markah)

- S3 (a) Terangkan fenomena pasir jelus dan dalam situasi apakah ianya akan berlaku.

(4 markah)

- (b) Bagi ujian kebolehtelapan turus menurun, data yang diperolehi adalah seperti berikut:

Panjang sampel tanah = 508 mm
 Luas kawasan sampel = 25.8 cm²
 Luas paip = 1.29 cm²
 Perbezaan turus pada masa $t = 0$ adalah 762 mm
 Perbesaan turus pada masa $t = 10$ adalah 305 mm

Tentukan;

- (i) Hidraulik konduktiviti tanah (cm/min)

(3 markah)

- (ii) Perbezaan turus pada masa $t = 5$ min?

(3 markah)

- (c) Satu ujian pam di lapangan dijalankan bagi menentukan pekali kebolehtelapan tanah di tapak yang dipilih bagi pembinaan empangan tanah. Perigi pemerhatian dibina pada jarak 3 m dan 6 m daripada perigi ujian. Berikut adalah data yang diperolehi:

Kedalaman aras air bumi = 16 m
 Kadar aliran air dalam keadaan stabil = 2.3m³/min
 Penurunan aras air bagi perigi luar = 0.50 m
 Penurunan aras air bagi perigi dalam = 1.5 m

Tentukan pekali kebolehtelapan bagi tanah tersebut.

(15 markah)

- S4 (a) Terangkan dengan ringkas berkaitan dengan bulatan tegasan Mohr's and liputan kekuatan. Nyatakan juga kepentingan hubungan parameter kekuatan ricih tanah. (6 markah)
- (b) Bincang dan bandingkan kaedah penentuan kekuatan ricih tanah bagi ujian kotak ricih dan ujian mampatan tak terkurung. (8 markah)
- (c) Keputusan ujian tigapaksi terkukuh tak tersalir dengan pengukuran tekanan air liang dilakukan ke atas sampel tanah. Keputusan adalah seperti ditunjukkan dalam **Jadual S3**.

Jadual S3

	Ujian 1	Ujian 2	Ujian 3
Tekanan sel (kN/m^2)	350	400	500
Tegasan sisih (kN/m^2)	143	208	312
Tekanan air liang (kN/m^2)	326	354	418

Plotkan liputan kegagalan tegasan efektif berkesan menggunakan Mohr-Coulumb dan tentukan parameter kekuatan ricih.

(13 markah)

- S5 (a) Huraikan perbezaan antara terma tekanan aktif, tekanan pasif dan tekanan pada keadaan rehat ke atas tegasan tanah. (4 markah)
- (b) Profil tanah ditunjukkan dalam **Rajah Q5(b)**. Kirakan tegasan jumlah, tegasan air liang dan tegasan berkesan pada titik A, B, C and D. (9 markah)
- (c) Satu tembok penahan 6m dibina bagi menahan tanah yang mengandungi dua lapisan (3m) ketebalan seperti yang ditunjukkan dalam **Rajah Q5(c)** dengan nilai:

Lapisan atas : $c' = 0 \text{ kPa}$, $\phi' = 20^\circ$, $\gamma = 17 \text{ kN/m}^3$;

Lapisan bawah : $c' = 0$, $\phi' = 35^\circ$, $\gamma = 18 \text{ kN/m}^3$.

Tentukan daya tekanan sisi bumi di keadaan rehat bagi setiap per unit panjang dinding dan kedudukan daya tindak keseluruhan. Anggap $\text{OCR} = 1$.

(12 markah)

- S6** (a) Lakarkan dan terangkan dengan ringkas **EMPAT (4)** jenis kegagalan cerun atau pergerakan tanah.
- (8 markah)
- (b) Satu cerun potong dibina pada tanah yang seragam seperti yang ditunjukkan dalam Rajah **Q6**. Menggunakan kaedah hirisan biasa, tentukan faktor keselamatan bagi kes percubaan ini. Maklumat lanjut adalah seperti berikut:
- $\beta = 45^\circ$, $\phi' = 20^\circ$, $c' = 19.2 \text{ kN/m}^2$, $\gamma = 18.08 \text{ kN/m}^3$
 $H = 12.2 \text{ m}$, $\alpha = 30^\circ$, $\theta = 70^\circ$
- (17 markah)

- SOALAN TAMAT -

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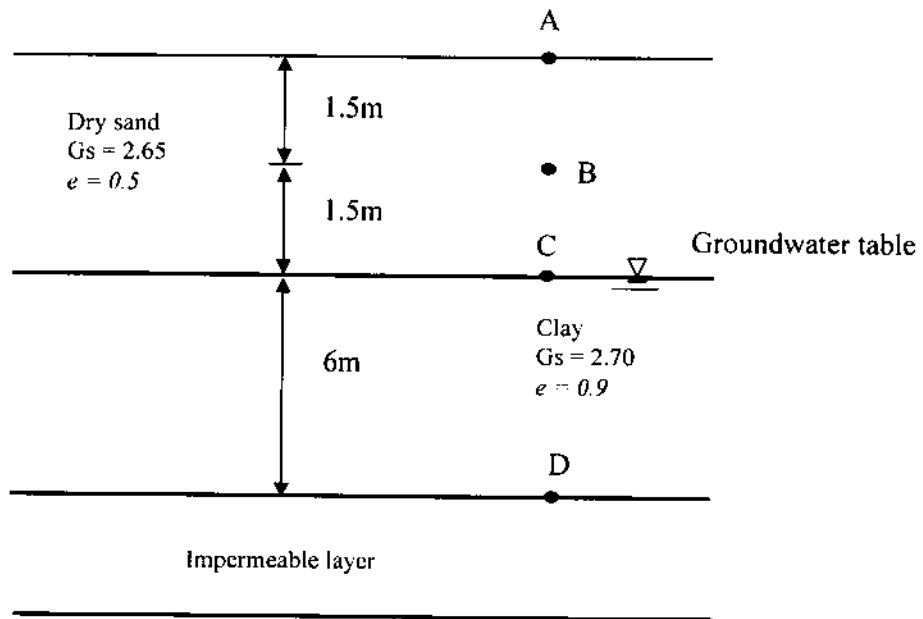


FIGURE Q5(b)

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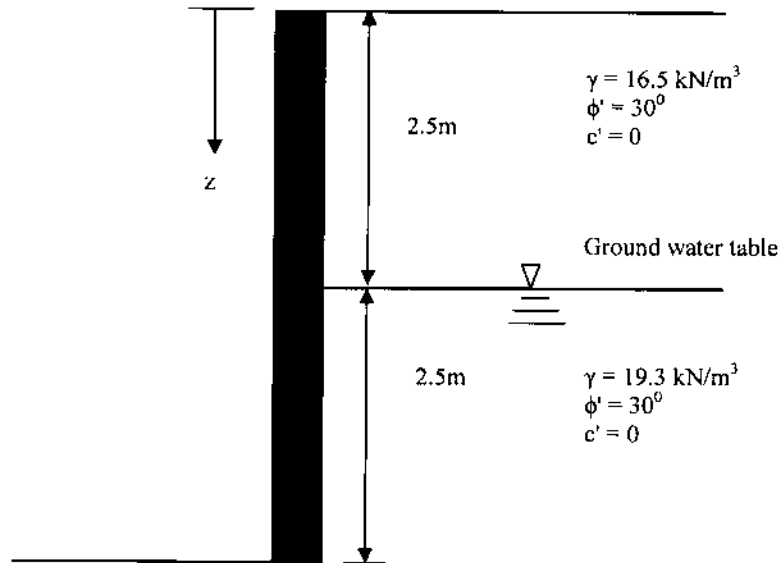


FIGURE Q5 (c)

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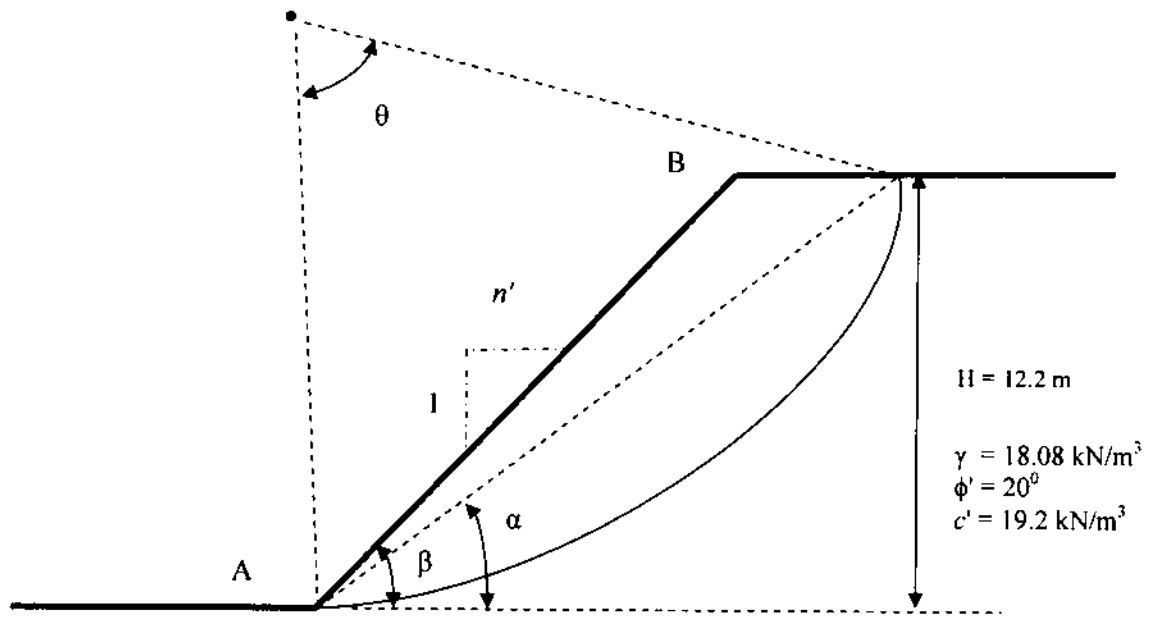


FIGURE Q6.