

**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2012/2013**

**COURSE NAME** : GEOTECHNIC  
**COURSE CODE** : BFC 3033 / BFC 31703  
**PROGRAMME** : 3 BFF  
**EXAMINATION DATE** : DECEMBER 2012/JANUARY 2013  
**DURATION** : 3 HOURS  
**INSTRUCTION** : PART A: ANSWER ALL  
PART B : ANSWER **THREE (3)**  
QUESTIONS ONLY

**THIS PAPER CONSISTS OF THIRTEEN (13) PAGES**

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**PART A**

**Q1** (a) Explain with the aid of diagram One-Dimensional Consolidation Laboratory test

(6 marks)

(b)

The coordinates of two points on a virgin compression curve are shown in Table 1 below:

Table 1

Void ratio, $e$	Pressure, $\sigma'$ ( $\text{kN/m}^2$ )
$e_1 = 0.82$	125
$e_2 = 0.70$	200

Determine the void ratio that corresponds to a pressure of  $300 \text{ kN/m}^2$

(6 marks)

(c) A 3 m clay layer beneath a building is overlain by a stratum of permeable sand and gravel and is underlain by impermeable bedrock. The total expected primary consolidation settlement for the clay layer due to the footing load is 2 cm. Given the coefficient of consolidation ( $c_v$ ) is  $1.28 \times 10^{-3} \text{ cm}^2/\text{min}$ .

(i) Determine how many years will it take for 90 % of the total expected primary consolidation settlement to take place?

(4 marks)

(ii) Compute the amount of primary consolidation settlement after 1 year

(6 marks)

(iii) Calculate how many years will it take for primary consolidation settlement of 1 cm to take place?

(3 marks)

**PART B**

**Q2** (a) Explain how the particle size distribution curve is adopted in the BSCS, USCS and AASHTO soil classification systems.

(6 marks)

(b) The effective size, uniformity coefficient,  $D_{20}$ ,  $D_{30}$  and  $D_{90}$  of a soil are 0.0015 mm, 6000, 0.004 mm, 5.5 mm and 8 mm respectively. Plot the particle size distribution graph in order to:

(i) Determine the coefficient of gradation

(10 marks)

- (ii) Classify the soil based on the information from the particle size distribution curve  
(2 marks)

- (c) The wet unit weight of the same soil at two different degrees of saturation are observed to be as that given in the Table 2 below;

Table 2

Wet Unit Weight (kN/ m <sup>3</sup> )	Degree of saturation (%)
16.62	50
17.71	75

Indicating your assumptions, determine;

- (i) Void ratio and porosity  
(4 marks)
- (ii) Specific gravity of the soil particles  
(3 marks)

- Q3** (a) Briefly explain with labelled diagrams, the principal features and limitations of the constant head permeameter and the falling head permeameter tests. Give reasons why the above tests may not lead to a representative determination of the effective permeability of a large volume of soil in the field.  
(6 marks)

- (b) In a falling head permeability test,
- Length of soil specimen is 200 mm
  - Diameter of specimen is 100 mm
  - Diameter of standpipe is 8 mm
  - Head difference at the start of test is 500 mm
  - Head difference 3 minutes after the start is 300 mm

Determine:

- (i) The hydraulic conductivity of the soil in cm/sec  
(5 marks)
- (ii) Compute the head difference 90 sec after the test commenced?  
(3 marks)
- (c) A sheet pile wall retaining 8 m of water is as shown in Figure Q3.

- (i) Draw the flow net ( $N_f = 4$  and  $N_d = 6$ ) (6 marks)
- (ii) Determine the flow rate if  $k = 0.002$  cm/s (5 marks)

**Q4** (a) Discuss the differences among consolidated-drained (CD), consolidated-undrained (CU) and unconsolidated-undrained (UU) in term of sample preparation and testing. (6 marks)

(b) Give example and brief at least **ONE (1)** practical application of consolidated-drained (CD), consolidated-undrained (CU) and unconsolidated-undrained (UU) analysis for clays. (6 marks)

(c) A specimen of an over consolidated clay was consolidated under difference chamber of confining pressure. The following results were obtained from the undrained test as shown in Table 3

Table 3

Cell pressure (kPa)	100	200	350	500
Deviator stress at failure (kPa)	286	374	513	652
Deviator pore pressure (kPa)	-43	-12	39	87

Determine;

- (i) the consolidated-undrained angle of shearing resistance (6 marks)
- (ii) the peak strength parameters  $c'$  and  $\phi'$  for the soil (6 marks)
- (iii) shear stress equation on the failure plane (1 marks)

- Q5** (a) Sketch and describe the term of active pressure, passive pressure and at-rest pressure of lateral earth pressure. (6 marks)
- (b) The frictionless sheet pile supports a soil as shown in Figure **Q5**. The backfill is subjected to a surcharge of  $15 \text{ kN/m}^2$ . The groundwater is located 3 m below the soil surface. Determine the following:
- (i) The active lateral earth pressure distribution with depth. (5 marks)
- (ii) The passive lateral earth pressure distribution with depth. (4 marks)
- (iii) The magnitude and locations of the active and passive forces. (5 marks)
- (iv) The resultant force and its location. (3 marks)
- (v) Based on your calculation, check and evaluate the stability of the pile. (2 marks)
- Q6** (a) Explain briefly **FOUR (4)** factors that might affect the stability of a slope. (8 marks)
- (b) Figure **Q6** shows a slope in material for which  $\phi' = 20^\circ$ ,  $c' = 19 \text{ kN/m}^2$ , and  $\gamma = 18.5 \text{ kN/m}^3$ . Estimate the factor of safety against slip on the trial circle using the Ordinary Method of Slice. (17 marks)

**BAHAGIAN A**

S1 (a) Jelaskan dengan bantuan gambarajah Ujikaji Pengukuhan Satu Dimensi (6 markah)

(b) Nilai koordinat dua titik pada lengkung mampatan dara sebagaimana Jadual 1 dibawah:

Jadual 1

<i>Nisbah lompong, e</i>	<i>Tekanan, <math>\sigma'</math> (kN/m<sup>2</sup>)</i>
$e_1 = 0.82$	125
$e_2 = 0.70$	200

Tentukan nilai nisbah lompong bagi tekanan 300 kN/m<sup>2</sup> (6 markah)

(c) Satu lapisan tanah liat 3 m tebal diapit oleh lapisan tanah pasir dibahagian atas dan lapisan batuan dasar yang tidak telap air dibahagian bawah. Jumlah enapan yang disebabkan oleh pengukuhan utama bagi tanah liat tersebut yang disebabkan oleh beban papak adalah sebanyak 2 cm. Diberi nilai pekali pengukuhan ( $c_v$ ) adalah  $1.28 \times 10^{-3}$  cm<sup>2</sup>/min.

(i) Tentukan berapa tahun diperlukan bagi mencapai 90 % jumlah enapan pengukuhan utama untuk berlaku? (4 markah)

(ii) Kirakan nilai enapan pengukuhan utama selepas 1 tahun. (6 markah)

(iii) Kirakan berapa tahun diperlukan bagi enapan pengukuhan utama mencapai nilai 1 cm? (3 markah)

**BAHAGIAN B**

Q2 (a) Jelaskan bagaimana taburan saiz zarah digunapakai didalam sistem pengelasan tanah BSCS, USCS and AASHTO (6 markah)

(b) Nilai saiz berkesan, pekali keseragaman,  $D_{20}$ ,  $D_{30}$  and  $D_{90}$  adalah 0.0015 mm, 6000 mm, 0.004 mm, 5.5 mm and 8 mm.. Plotkan graf taburan saiz zarah bagi:

- (i) Tentukan nilai pekali penggedran. (10 markah)
- (ii) Kelaskan tanah tersebut berdasarkan graf taburan saiz zarah (2 markah)
- (c) Berat unit basah bagi tanah yang sama tetapi mempunyai nilai darjah ketepuan yang berbeza adalah seperti di Jadual 2:

Jadual 2

Berat unit basah ( $\text{kN}/\text{m}^3$ )	Darjah ketepuan (%)
16.62	50
17.71	75

Dengan menyatakan andaian yang diambil, tentukan:

- (i) Nisbah lompong dan keliangan (4 markah)
- (ii) Graviti tentu bagi tanah (3 markah)
- Q3** (a) Terangkan secara ringkas dengan bantuan gambarajah, ciri-ciri utama dan had-had bagi ujikaji meter telap turus malar dan ujikaji meter telap turus menurun. Berikan sebab-sebab kenapa ujikaji-ujikaji diatas tidak boleh digunakan bagi menentukan nilai kebolehtelapan didalam isipadu tanah yang besar ditapak. (6 markah)
- (b) Data bagi ujikaji turus menurun,
- Panjang spesimen tanah adalah 200mm
  - Diameter spesimen adalah 100 mm
  - Diameter paip tegak adalah 8mm
  - Perbezaan turus pada awal ujikaji adalah 500mm
  - Perbezaan turus 3 minit selepas ujikaji adalah 300mm

Tentukan:

- (i) Keberaliran hidraulik bagi tanah tersebut dalam cm/sec (5 markah)
- (ii) Kirakan perbezaan turus dalam masa 90 saat selepas ujikaji dimulakan? (3 markah)

- (c) Satu tembok cerucuk keping menahan 8 m air seperti Rajah Q3.
- (i) Lukiskan jaringan aliran ( $N_f = 4$  and  $N_d = 6$ ) (6 markah)
- (ii) Tentukan kadar aliran jika  $k = 0.002$  cm/s (5 markah)
- Q4** (a) Bincangkan perbezaan diantara terkukuh salir (CD), terkukuh tidak tersalir (CU) dan tidak terkukuh tidak tersalir (UU) dari segi aspek penyediaan sampel dan pengujian (6 markah)
- (b) Berikan satu contoh dan nyatakan secara ringkas sekurang-kurangnya **SATU (1)** aplikasi praktikal analisis tanah liat dari setiap ujikaji pengukuhan-tersalir (CD), pengukuhan-tak tersalir (CU) dan tak terkukuh-tak tersalir (UU). (6 markah)
- (c) Satu spesimen tanah liat sangat-terkukuh telah dikukuhkan dibawah tekanan kebuk terkurung yang berbeza. Berikut adalah keputusan yang diperolehi daripada ujian tak tersalir tersebut seperti Jadual 3

Jadual 3

Tekanan Sel (kPa)	100	200	350	500
Tekanan <i>Deviator</i> ketika gagal (kPa)	286	374	513	652
Tekanan Liang <i>Deviator</i> (kPa)	-43	-12	39	87

Tentukan;

- (i) Sudut rintangan ricih bagi pengukuhan-tak tersalir (6 markah)
- (ii) Parameter kekuatan tertinggi  $c'$  dan  $\phi'$  tanah. (6 markah)
- (iii) Persamaan tegasan ricih pada satah kegagalan (1 markah)

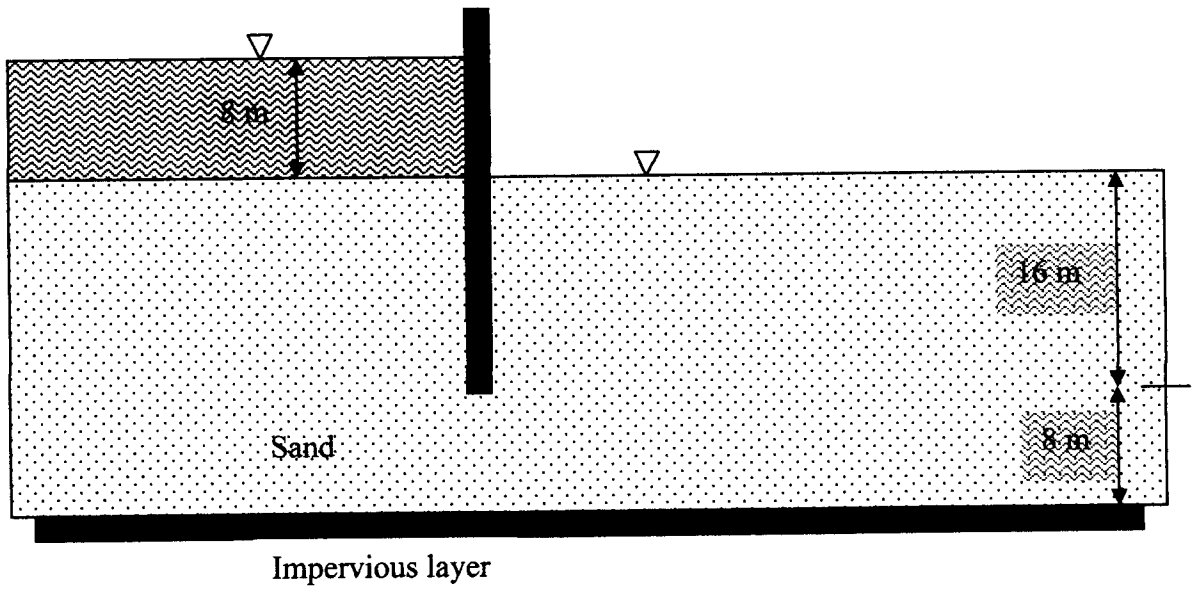


- Q5** (a) Lakar dan terangkan maksud tekanan aktif, tekanan pasif dan tekanan rehat bagi tekanan sisi tanah. (6 markah)
- (b) Cerucuk keping tiada geseran menyokong tanah seperti yang ditunjukkan dalam Rajah **Q5**. Tanah kambus balik dikenakan tekanan tambahan sebanyak  $15 \text{ kN/m}^2$ . Paras air bumi berada pada 3 m di bawah permukaan tanah. Tentukan yang berikut:
- (i) Taburan tekanan sisi aktif tanah dengan kedalaman. (5 markah)
- (ii) Taburan tekanan pasif tanah dengan kedalaman. (4 markah)
- (iii) Nilai dan lokasi tekanan aktif dan tekanan pasif. (5 markah)
- (iv) Daya keseluruhan dan lokasinya. (3 markah)
- (vi) Berdasarkan pengiraan anda, semak dan nilaikan kestabilan cerucuk tersebut. (2 markah)
- Q6** (a) Jelaskan dengan ringkas **EMPAT (4)** faktor yang boleh memberi kesan kepada kestabilan sesuatu cerun. (8 markah)
- (b) Rajah **Q6** menunjukkan satu cerun yang terdiri daripada tanah yang mempunyai parameter  $\phi' = 20^\circ$ ,  $c' = 19 \text{ kN/m}^2$ , dan  $\gamma = 18.5 \text{ kN/m}^2$ . Tentukan faktor keselamatan terhadap gelinciran pada bulatan cubaan dengan menggunakan Kaedah Hirisan (17 markah)

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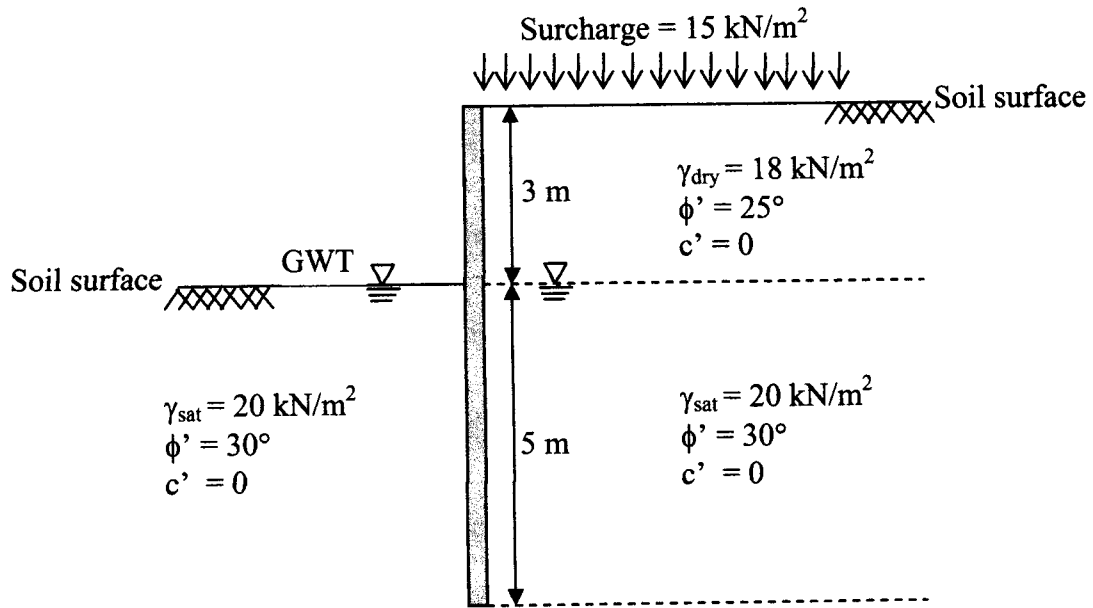


**FIGURE Q3**

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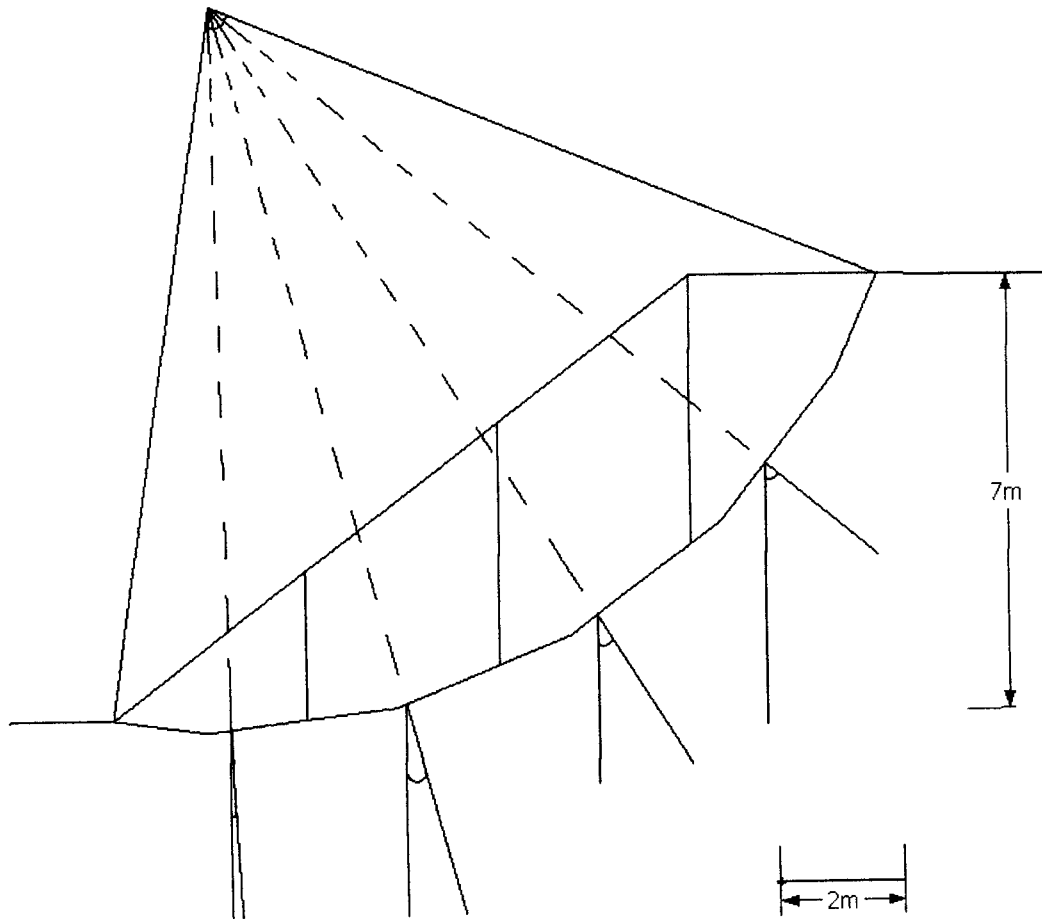


**FIGURE Q: SHEET PILE**

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Slice	Area of slices (m <sup>2</sup> )	$\alpha_n$ (deg)
1	$\frac{(3)(4.3)}{2} = 6.45$	50
2	$\frac{(3)(4.3 + 3.85)}{2} = 12.225$	32
3	$\frac{(3)(3.85 + 2.35)}{2} = 9.3$	16
4	$\frac{(3)(2.35)}{2} = 3.525$	2

**FIGURE Q6: CROSS SECTION OF SLOPE**

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**LIST OF FORMULA**

$$e = V_v/V_s$$

$$n = V_v/VT$$

$$Sr = V_w/V_v \times 100 \%$$

$$n = e/(1+e)$$

$$\gamma_d = \frac{W_s}{V}$$

$$\gamma_d = \frac{\gamma}{1+w}$$

$$V_w = \frac{W_s}{\gamma_w} = \frac{wG_s \gamma_w}{\gamma_w} = wG_s, \quad S = \frac{V_w}{V_s} = \frac{wG_s}{e}, \quad \gamma_d = \frac{W_s}{V} = \frac{G_s \gamma_w}{1+e}$$

$$k = \frac{QL}{Aht}$$

$$k = 2.303 \frac{aL}{At} \log_{10} \frac{h_1}{h_2}$$

$$\Delta q = k \frac{H}{N_d}$$

$$\Delta q = kH \left( \frac{N_f}{N_d} \right) n$$

$$\sigma'_1 = \sigma'_3 \tan^2 \left( 45 + \frac{\phi'}{2} \right) + 2c' \tan \left( 45 + \frac{\phi'}{2} \right)$$

$$t = \frac{T_v}{c_v} H^2$$

$$S_c = C_c \left( \frac{H}{1+e_0} \right) \log \frac{p}{p_0}$$

$$F_s = \frac{R\theta c + (\sum W_n \cos \alpha_n) \tan \phi'}{\sum W_n \sin \alpha_n}$$