UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER 1
SESI 2016/2017

COURSE NAME	:	GEOTECHNICAL TECHNOLOGY
COURSE CODE	:	DAB 20402
PROGRAMME	:	DAB
EXAMINATION DATE	:	DECEMBER 2016 /JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ANY **FOUR (4)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHTEEN (18)** PAGES

ENGLISH

Q1. (a) Explain the standard dimensions of Thin Wall Sampler (Shelby)

(4 marks)

(b) Justify the disturbances of soil sample if the external diameter of the sampler is 50 mm and the thickness of the sampler is 2.5mm

(6 marks)

(c) The results of a refraction survey of distance from source versus time recorded of first arrival is as shown in **Figure Q1(c),** determine by using Method 1 :

(i) Approximate the value of X_c

(2 marks)

Calculate the following :

(ii) The slope of ab, bc and cd

(2 marks)

(iii) The thickness of layer 1 and 2

(2 marks)

(iv) The total thickness of soil

(2 marks)

(d) Explain **two (2)** human errors that occur during the process of driving *McIntosh* / JKR probe.

(2 marks)

(e) A vane shear test has been done on the sample of marine clay from the campus of UTHM. The dimensions of the equipments and properties of the clay are as follows :

D=100 mm, H=200 mm, $i_T=i_B=25^\circ$ and has LL=85%, PL=38% and torque of 120 N-m

Calculate the value of corrected undrained shear strength, $s_{uv(corr)}$ of the clay.

(5 marks)

Q2 (a) **Table 1** shows the result of dry sieve test, calculate the percent retained (column 3) and percent passing (column 4).

(9 marks)

(b) From the result in **Table 1**, produce the curve of particle size versus percent passing.

(3 marks)

(c) From the curve sketched, determine the following :

(i) D_{10} ; D_{30} ; D_{60}

(1.5 marks)

(ii) C_u

(1.5 marks)

(iii) C_c

(2 marks)

(d) **Table 2** shows the result of a proctor compaction test on a soil sample.

Analyse the following. Assumed the value of specific graviti is 2.72.

(i) Values of dry unit weight in kN/m^3

(1 mark)

(ii) The optimum moisture content

(1 mark)

(iii) Maximum unit weight.

(1 mark)

(iv) Percent air-void at maximum unit weight.

(2 marks)

(e) Sketch and label the location of limits for fine grain soil, phases and volume.

(3 marks)

Q3 (a) A liquid limit (LL) test for a fine grain soil sample using cone penetrometer produce the results as in **Table 3**. Solve the following :

(i) Sketch the plot of penetration versus moisture content.

(5 marks)

(ii) Determine the value of liquid limit of the soil.

(1 mark)

(b) Explain **two (2)** factors that affect permeability.

(4 marks)

(c) Calculate the value of flow rate for the earth dam **in Figure Q3(c)** if the permeability, k of the soil taken as 4.69×10^{-9} cm/s.

(2 marks)

(d) A pumping of confined aquifer is accomplished in estimating the value of permeability of porous layer in the aquifer. After reaching an equilibrium, the following data is obtained :

- Rate of discharge = 900 liter/min.
- Water level h_1 = 4.5 m and h_2 = 8 m at the distance of r_1 = 10 m and r_2 = 75 m.
- Thickness of aquifer = 10 m.

Water level before pumping was 2m.

Hint : $q = 750l/\min = 0.0125m^3/s$

(i) Sketch and label the above problem with unscaled figure.

(8 marks)

(ii) Calculate k

(2 marks)

(e) Explain **three (3)** factors that influence the selection of pile footing as the best solution to a construction.

(3 marks)

Q4 (a) A direct shear test was conducted on a coarse grain soil sample and the result was as shown in **Table 4**.

(i) Sketch the appropriate plot of normal stress versus shear stress

(4 marks)

Evaluate the following :

(ii) Value of cohesion, c

(1 mark)

(iii) Angle of internal friction,

(1 mark)

(b) Sketch and label the theoretical intersection of flow line and equipotential line.

(4 marks)

(c) Compare the concept of local and general shear. Sketching and labelling that explain your answer is encouraged.

(5 marks)

(d) An unconfined compression test is conducted on a cylinder of soil sample. It fails under axial stress of 2.0 kg/cm^2. The failure plane, Θ makes an angle of 55° with the horizontal. Analyze the case by the following:

(i) Produce the scaled figure of the problem

(6 marks)

From the figure estimate the following :

(ii) Cohesion, c

(2 marks)

(iii) Angle of internal friction, ϕ of the soil sample.

(2 marks)

Q5 (a) Describe and sketch the changes in safety factor during and after construction of embankment according to Bishop and Bjerrum, (1960).

(4 marks)

(b) **Table 5** shows the result of a consolidation test on a soft marine clay soil. Each pressure increment having been maintained for 24 hours.

After it had consolidated for 24 hours the sample was removed from the apparatus and found to have a moisture content of 22 %. The particle specific gravity of the soil was 2.67.

(i) Produce the void-ratio to effective pressure curve

(4 marks)

(ii) Produce the thickness vs pressure curve

(4 marks)

(iii) Evaluate the value of the coefficient of volume change for a pressure range of 250 to 650 kPa.

(3 marks)

(iv) Evaluate the consolidation settlement, if a layer of this clay is 15 m in thick.

(3 marks)

(c) A soft, normally consolidated clay layer has the following criteria. A foundation will be constructed and the load will be subjected to vertical stress increase of 25 kPa. Assuming $C_c = 0.009(LL-10)$

Clay criteria :

Thickness	=	12 m
Natural moisture content	=	56%.
Saturated unit weight	=	19.6 kN/m^3
Specific gravity	=	2.73
Liquid limit	=	72 %

(i) Sketch and label the problem.

(4 marks)

(ii) Predict the settlement of the foundation if groundwater level is at the surface of the clay.

(3 marks)

END OF QUESTION

BAHASA MELAYU

S1. (a) Jelaskan dimensi piawai bagi Pensampel Dinding Nipis (*Shelby*)

(4 markah)

(b) Justifikasikan gangguan kepada sampel tanah jika pensampel mempunyai diameter luar 50 mm dan ketebalan pensampel ialah 2.5mm

(6 markah)

(c) Keputusan ukur biasan untuk jarak dari sumber melawan masa diambil untuk tiba mula ialah seperti yang ditunjukkan dalam **Rajah S1(c),** tentukan dengan menggunakan kaedah 1 :

(i) Anggarkan nilai X_c

(2 markah)

Kirakan yang berikut :

(ii) Kecerunan ab, bc dan cd

(2 markah)

(iii) Ketebalan lapisan 1 dan 2

(2 markah)

(iv) Jumlah ketebalan tanah

(2 markah)

(d) Jelaskan **dua (2)** kesalahan manusia yang biasanya berlaku semasa proses pemacuan proba McIntosh / JKR.

(2 markah)

(e) Satu ujian ricih vane telah dijalankan ke atas sampel tanah liat marin dari kampus UTHM. Dimensi peralatan dan sifat-sifat tanah liat itu adalah seperti berikut :

D=100mm, H=200mm, $i_T=i_B=25^\circ$ dan nilai LL=85%, PL=38% dan *torque* sebanyak 120 N-m

Kirakan nilai kekuatan ricih yang diperbetulkan, $s_{uv(corr)}$ untuk tanah liat itu.

(5 markah)

S2 (a) **Jadual 1** menunjukkan keputusan ujian ayakan kering, kirakan peratus tertahan (kolum 3) dan peratus melepasi (kolum 4).

(9 markah)

(b) Dari keputusan dalam **Jadual 1**, hasilkan lengkok saiz zarah melawan peratus melepasi.

(3 markah)

(c) Dari lengkuk yang dilakarkan, tentukan yang berikut :

(i) D_{10} ; D_{30} ; D_{60}

(1.5 markah)

(ii) C_u

(1.5 markah)

(iii) C_c

(2 marks)

(d) **Jadual 2** menunjukkan keputusan dari ujian pemadatan *proctor* ke atas satu sampel tanah.

Analsakan yang berikut. Andaikan nilai graviti tentunya sebagai 2.72.

(i) Nilai-nilai berat tentu kering dalam kN/m^3

(1 markah)

(ii) Kandungan kelembapan tanah optima.

(1 markah)

(iii) Nilai berat tentu kering maksima.

(1 markah)

(iv) Peratus lompang udara pada berat tentu kering maksima.

(2 markah)

(e) Lakar dan labelkan lokasi had-had untuk tanah berbutiran halus, fasa-fasa dan isipadu.

(3 markah)

S3 (a) Satu ujikaji had cecair (LL) untuk tanah berbutiran halus dengan menggunakan *cone penetrometer* menghasilkan keputusan seperti dalam **Jadual 3**. Selesaikan yang berikut:

(i) Lakarkan plotan penembusan melawan kandungan kelembapan.

(5 markah)

(ii) Tentukan nilai had cecair tanah tersebut.

(1 markah)

(b) Jelaskan **dua (2)** faktor yang memberi kesan kepada kebolehtelapan.

(4 markah)

(c) Kirakan nilai bagi kadar alir untuk empangan tanah dalam **Rajah S3(c)** jika nilai kebolehtelapan, k diambil sebagai 4.69×10^{-9} cm/s.

(2 markah)

(d) Pengepaman satu *aquifer* terkurung telah dijalankan untuk menganggarkan nilai kebolehtelapan lapisan tanah porous dalam *aquifer*. Selepas mencapai tahap keseimbangan, data yang berikut telah di perolehi :

- Kadar alir = 900 liter/min.
- Aras air h_1 = 4.5 m dan h_2 = 8 m pada jarak r_1 = 10 m dan r_2 = 75 m.
- Ketebalan *aquifer* = 10 m.

Aras air sebelum pengepaman ialah 2 m.

Petua : $q = 750 l/\min = 0.0125 m^3/s$

(i) Lakar dan labelkan permasalahan di atas tanpa skala.

(8 markah)

(ii) Kirakan nilai k

(2 markah)

(e) Jelaskan **tiga (3)** faktor yang mempengaruhi pemilihan asas cerucuk sebagai penyelesaian kepada sesuatu pembinaan.

(3 markah)

S4 (a) Satu ujian ricih terus telah dijalankan ke atas sampel tanah berbutiran kasar dan keputusan nya seperti yang ditunjukkan dalam **Jadual 4**.

(i) Lakarkan plotan yang betul untuk tegasan normal melawan tegasan ricih.

(4 markah)

Nilaikan yang berikut :

(ii) Nilai kejelekitan, c

(1 markah)

(iii) Sudut geseran dalaman, ϕ

(1 markah)

(b) Lakar dan labelkan secara teorinya pertemuan antara garisan aliran dan garisan sama upaya.

(4 markah)

(c) Bandingkan konsep ricih tempatan dan ricih umum. Lakaran dan perlabelan untuk menjelaskan jawapan anda adalah digalakkan.

(5 markah)

(d) Satu ujikaji mampatan tidak terkurung dijalankan ke atas sampel silinder tanah. Ia gagal di bawah tegasan paksi sebanyak 2.0 kg/cm^2. Planar kegagalan, Θ bersudut sebanyak 55° dari ufuk. Analisiskan kes ini seperti berikut :

(i) Hasilkan rajah berskala untuk masalah itu.

(6 markah)

Dari rajah anggarkan yang berikut :

(ii) Kejelekitan, c

(2 markah)

(iii) Sudut geseran dalaman, ϕ tanah tersebut.

(2 markah)

S5 (a) Hurai dan lakarkan perubahan dalam faktor keselamatan semasa dan selepas pembinaan penambakan mengikut Bishop and Bjerrum, (1960).

(4 markah)

(b) **Jadual 5** menunjukkan keputusan ujian pengukuhan ke atas tanah liat lembut marin. Setiap kenaikan tekanan adalah dikekalkan untuk 24 jam.

Selepas 24 jam pengukuhan, sampel dialihkan dari radas dan di dapati berkandungan air sebanyak 22 peratus. Graviti tentu untuk tanah tersebut ialah 2.67.

(i) Hasilkan lengkok nisbah lompang melawan tekanan berkesan.

(4 markah)

(ii) Hasilkan ketebalan melawan lengkok tekanan.

(4 markah)

(iii) Kirakan nilai pekali perubahan isipadu untuk julat tekanan dari 250 to 650 kPa.

(3 markah)

(iv) Nilaikan enapan pengukuhan, jika lapisan tanah liat ini15 m tebal.

(3 markah)

(c) Selapis tanah liat terkukuh biasa mempunyai kriteria yang berikut. Sebuah asas akan dibina dan dikenakan penambahan tegasan sebanyak 25 kPa. Andaikan $C_c = 0.009(LL-10)$

Kriteria tanah liat :

Ketebalan	=	12 m
Kandungan air semulajadi	=	56%.
Berat tentu tepu	=	19.6 kN/m^3
Graviti tentu	=	2.73
Had cecair	=	72 %

(i) Lakar dan labelkan masalah ini.

(4 markah)

(ii) Ramalkan enapan asas jika aras air bumi berada di permukaan tanah liat itu.

(3 markah)

SOALAN TAMAT

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017 PROGRAM : 2 DAB
COURSE : GEOTECHNICAL TECHNOLOGY COURSE CODE : DAB 20402

LIST OF FORMULAE :

Q1 : $D_{ext} = D_{int} + 2(t)$; $A_r = \left(\frac{D_{ext}^{\ 2} - D_{int}^{\ 2}}{D_{int}^{\ 2}}\right) \times 100\%$;

$Slope\ ab : \frac{1}{v_{ab}} = \frac{time\ ab}{dis\tan ce\ ab}$; $Slope\ bc : \frac{1}{v_{ab}} = \frac{time\ bc}{dis\tan ce\ bc}$; $Slope\ cd : \frac{1}{v_{ab}} = \frac{time\ cd}{dis\tan ce\ cd}$

Method 1 :

$$Z_1 = \frac{1}{2}\sqrt{\frac{v_2 - v_1}{v_2 + v_1}}x_c \ ; \quad Z_2 = \frac{1}{2}\left[T_{i2} - 2Z_1\frac{\sqrt{v_3^2 - v_1^2}}{v_3 v_1}\right]\frac{v_3 v_2}{\sqrt{v_3^2 - v_2^2}} ;$$

$$s_{uv} = \frac{12T}{\pi D^2\left[\left(\frac{D}{\cos i_T}\right) + \left(\frac{D}{\cos i_B}\right) + 6H\right]} ;$$

Q2 : $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})}$; $\rho_d = \frac{\rho}{1+w}$; $\rho_d = \frac{G_s \rho_w}{1 + wG_s}(1 - A_v)$;

Q3 : $q = \frac{khN_f}{N_d}$; $k = \frac{q\ln\left(\frac{r_2}{r_1}\right)}{2\pi H(h_2 - h_1)}$

Q5: $m_v = \frac{dH}{H_0} \times \frac{1}{d\sigma_v} = \frac{1}{H_0} \times \frac{dH}{d\sigma_v}$; $S_c = m_v \times d\sigma_v \times H$

$\sigma_{v0} = \gamma' \times \frac{z}{2}(for\ pressure\ to\ middle\ of\ layer)$

$e_1 = w \times G_s$; $C_c = 0.009(LL - 10)$; $S_c = dH = \frac{C_c}{1 + e_1}\log\frac{\sigma_{v2}}{\sigma_{v1}}H_1$

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017
COURSE : GEOTECHNICAL TECHNOLOGY

PROGRAM : 2 DAB
COURSE CODE : DAB 20402

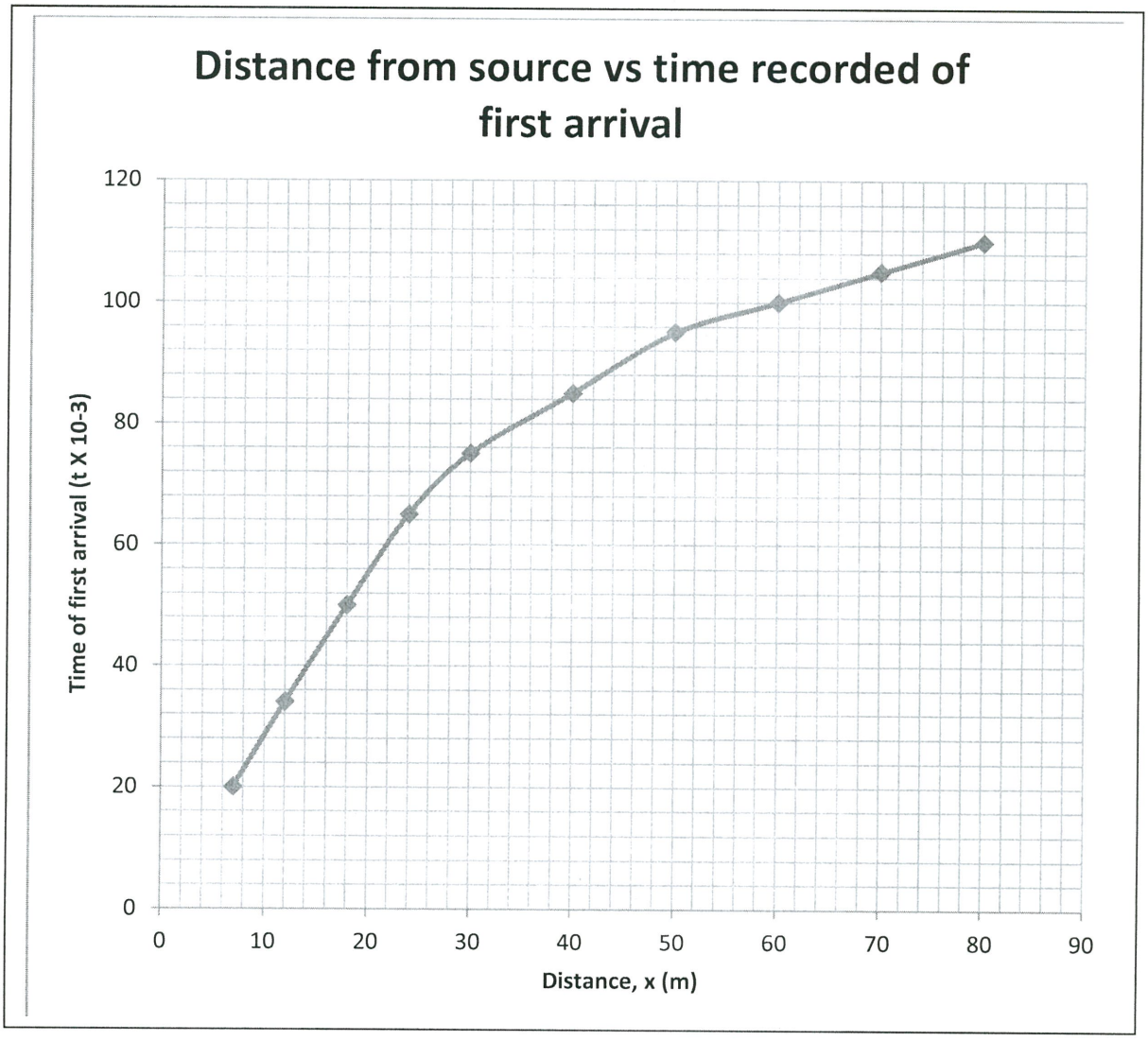

Figure Q1(c) : Results of a refraction survey test
Rajah S1(c) : Keputusan ujian ukur biasan

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017
COURSE : GEOTECHNICAL TECHNOLOGY

PROGRAM : 2 DAB
COURSE CODE : DAB 20402

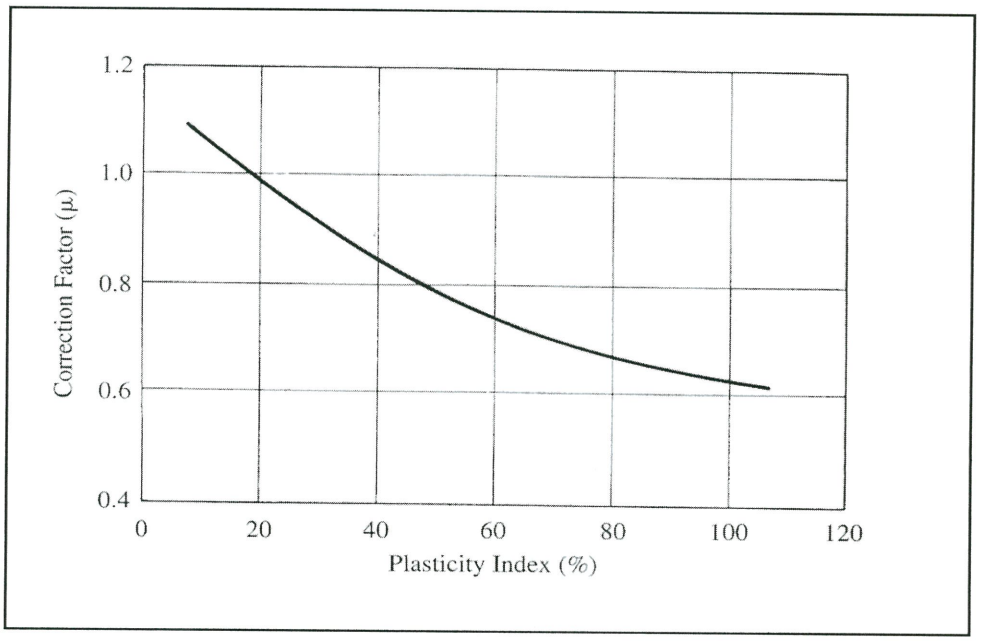

Figure Q1(e): Correction factor μ vs PI
Figure S1(e) : Faktor pembetulan μ melawan PI

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017
COURSE : GEOTECHNICAL TECHNOLOGY

PROGRAM : 2 DAB
COURSE CODE : DAB 20402

Table 1 : Result from dry sieve test
Jadual 1 : Keputusan dari ujian ayakan kering

Particle size (mm)	Mass retained (g)	Percent retained (%)	Percent Passing (%)
6.3	5.5		
2	15.4		
0.6	86.7		
0.212	220.4		
0.063	436.8		
0.020	118.3		
0.006	80.3		
0.002	76.7		
pan	24.2		

Table 2 : Dry unit weight versus moisture content
Jadual 2 : Berat tentu kering melawan kandungan kelembapan

Water content (%)	Bulk unit weight (kN/m^3)	Dry unit weight (kN/m^3)
12.8	19.0	
14.2	19.7	
15.6	20.3	
16.8	20.5	
17.8	20.4	
19.2	20.1	

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017
COURSE : GEOTECHNICAL TECHNOLOGY

PROGRAM : 2 DAB
COURSE CODE : DAB 20402

Table 3 : Result from Liquid Limit test
Jadual 3 : Keputusan ujian had cecair

Cone penetration (mm)	10.1	13.8	18.7	23.1	32.8
Water content (%)	22.4	32.7	47.8	60.6	87.9

Table 4 : The values of normal and shear stress on soil sample
Jadual 4 : Nilai-nilai bagi tegasan normal dan ricih ke atas sampel tanah

Sample Number	Normal stress (kN/m2)	Shear stress (kN/m2)
1	16.8	51.7
2	38.3	61.8
3	57.5	64.2
4	76.6	71.8
5	100.6	88.1

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017
COURSE : GEOTECHNICAL TECHNOLOGY

PROGRAM : 2 DAB
COURSE CODE : DAB 20402

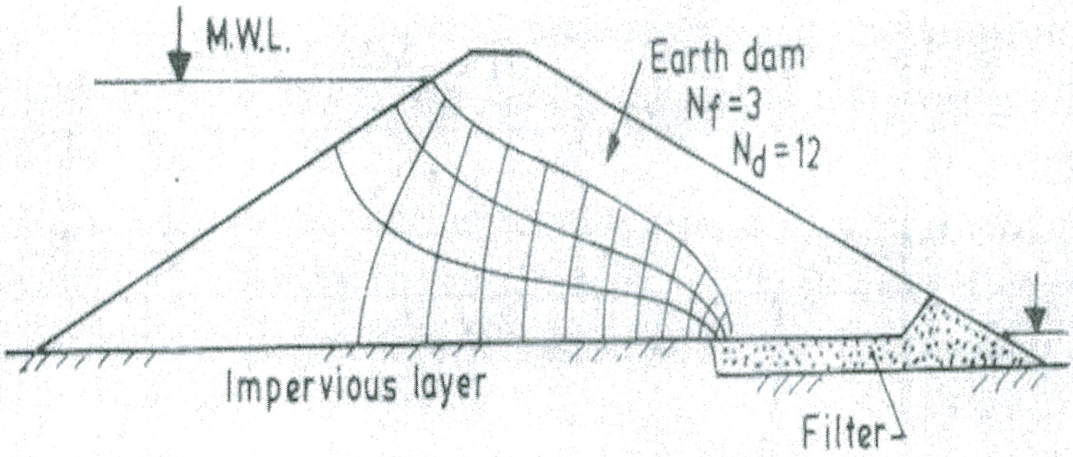

Fig. 7.11. Flow net for steady seepage through an earth dam founded on impervious stratum, and having a D/S toe filter.

Figure Q3(c): Flow net for steady seepage through an earth dam.
Rajah S3(c) : Jaringan aliran untuk resipan melalui empangan tanah.

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2016/2017
COURSE : GEOTECHNICAL TECHNOLOGY

PROGRAM : 2 DAB
COURSE CODE : DAB 20402

Table 4: Value of normal stress vs shear stress
Jadual 4: Nilai tegasan normal melawan tegasan ricih

Sample Number	Normal stress (kN/m2)	Shear stress (kN/m2)
1	60	108
2	128	122
3	208	144
4	280	158
5	340	168

Table 5 : Value of thickness and void ratio with pressure
Jadual 5 : Nilai ketebalan dan nisbah lompang dengan tekanan

Pressure (kPa)	Thickness of sample after consolidation (mm)	Void ratio, e
0	20	0.73
50	19.8	0.71
100	19.6	0.69
200	19.4	0.65
400	19.2	0.63
800	19.1	0.62