

SULIT



**BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI**

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI JUN 2017

DCC3103 : GEOTECHNICAL ENGINEERING

TARIKH : 27 OKTOBER 2017

MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **TIGA BELAS (13)** halaman bercetak.

Bahagian A: Struktur (2 soalan)

Bahagian B: Struktur (4 soalan)

Dokumen sokongan yang disertakan : Kertas Graf, Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SECTION A : 50 MARKS**BAHAGIAN A : 50 MARKAH****INSTRUCTION:**

This section consists of **TWO (2)** structured questions. Answer **ALL** questions.

ARAHAN:

Bahagian ini mengandungi DUA (2) soalan berstruktur. Jawab SEMUA soalan.

QUESTION 1**SOALAN 1**

CLO1
C1

- (a) List **THREE (3)** types of main rock and **THREE (3)** types of main soil.

Senaraikan TIGA (3) jenis batuan utama dan TIGA (3) jenis tanah utama.

[6 marks]

[6 markah]

CLO1
C2

- (b) Explain the formation process for each rock (listed above).

Jelaskan proses pembentukan setiap batuan tersebut (yang telah dinamakan di atas).

[9 marks]

[9 markah]

CLO2
C3

- (c) A consolidated undrained triaxial test was done on a soil sample. Considering the pore water pressure of the soil, calculate and draw a graph to determine the cohesion of effective stress and friction angle from the data as shown in Table A1.

Satu ujian tiga paksi terkukuh tak tersalir telah dijalankan ke atas satu sampel tana. Dengan mengambilkira tekanan air liang tanah tersebut, kira dan lukis graf untuk menentukan kejelikitan tegasan efektif dan sudut geseran dari data seperti Jadual A1.

Table A1/Jadual A1

Cell Pressure (kN/m^2) / Tekanan Sel (kN/m^2)	150	300	450
Deviator (kN/m^2) / Tegasan Sisihan (kN/m^2)	192	341	504
Pore water Pressure (kN/m^2) / Tekanan air liang (kN/m^2)	80	154	222

[10 marks]

[10 markah]

QUESTION 2

SOALAN 2

CLO1
C2

- a) Describe the following requirement criteria for the design of foundation:

Jelaskan faktor-faktor kriteria keperluan berikut yang mempengaruhi rekabentuk asas:

- i. Bearing capacity of soil
Keupayaan galas tanah
- ii. The depth of foundation
Kedalaman asas
- iii. Settlement
Pemendapan
- iv. Factor of safety
Faktor keselamatan

[8 marks]

[8 markah]

CLO2
C3

- b) **Figure A2** shows a square footing of dimension 5m x 5m subjected to a vertical load of 2000kN at its center. The footing is constructed on the ground surface and its weight can be ignored. If the clay has a shear strength of $c = 50\text{kN/m}^2$ and $\phi = 0^\circ$, calculate the factor of safety against bearing capacity failure using Terzaghi formula.

Rajah A2 menunjukkan sebuah asas segiempat sama berdimensi 5m x 5m menanggung beban menegak 2000kN di tengahnya. Asas tersebut dibina di permukaan tanah dan beratnya boleh diabaikan. Jika tanah liat pada asas tersebut mempunyai nilai kekuatan ricih $c = 50\text{kN/m}^2$ dan $\phi = 0^\circ$, kirakan faktor keselamatan terhadap kegagalan keupayaan galas menggunakan formula Terzaghi.

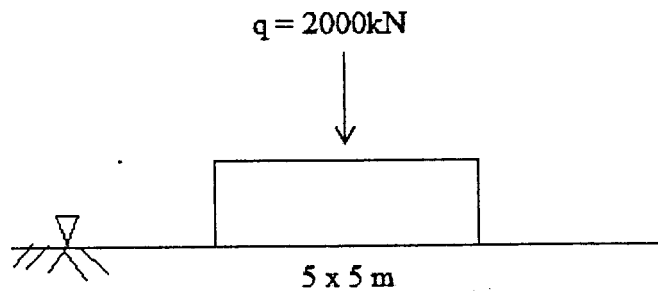


Figure A2/Rajah A2

[9 marks]

[9 markah]

- c) A square footing is 2m x 2m in plan. The soil supporting the foundation has a friction angle of $\phi' = 25^\circ$ and $c' = 20\text{kN/m}^2$. The unit weight of soil, γ is 16.5kN/m^3 . Calculate the allowable gross load on the foundation with a safety factor of 3. Assume the depth of the foundation (D_f) is 1.5m and general shear failure occurs in the soil.

Asas segiempat bersaiz 2m x 2m dalam pelan. Tanah yang menanggung asas tersebut mempunyai sudut geseran $\phi' = 25^\circ$ dan $c' = 20\text{kN/m}^2$. Berat unit tanah, γ ialah 16.5kN/m^3 . Kirakan berat kasar yang boleh ditanggung oleh asas tersebut dengan faktor keselamatan 3. Anggap tinggi asas (D_f) ialah 1.5m dan kegagalan ricih am berlaku dalam tanah.

[8 marks]

[8 markah]

SECTION B : 50 MARKS**BAHAGIAN B : 50 MARKAH****INSTRUCTION:**

This section consists of **FOUR (4)** structured questions. Answer **TWO (2)** questions only.

ARAHAN:

Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab DUA (2) soalan sahaja.

QUESTION 1**SOALAN 1**

CLO2
C3

- (a) A sample of soil was tested in the laboratory and the data is shown in **Table B1a:**

Sampel tanah telah diuji di makmal dan data yang diperolehi adalah seperti dalam Jadual B1a:

Sieve Number <i>Nombor Ayak</i>	Sieve Size (mm) <i>Saiz Ayak (mm)</i>	Percentage Passing (%) <i>Peratus Telus (%)</i>
1 in.	25	100
¾ in.	19	85
½ in.	12.5	70
3/8 in.	9.5	60
No. 4	4.75	48
No. 10	2.00	30
No. 40	0.425	16
No. 100	0.150	10
No. 200	0.075	2

Table B1a/Jadual B1a

- i. Based on **Table B1a**, calculate the value of coefficients of uniformity and curvature.

Berdasarkan kepada Jadual B1a, kirakan nilai pekali keseragaman dan pekali kelengkungan.

[6 marks]

[6 markah]

- ii. Interpret the soil according to the Unified Soil Classification System (USCS).

Kenalpasti tanah berdasarkan Sistem Pengelasan Tanah Bersekutu.

[7 marks]

[7 markah]

- (b) A set of laboratory compaction test data is tabulated as shown in **Table B1(b)**. The test was conducted in accordance to Standard Proctor Test procedure.

Satu set data ujian pepadatan makmal dan keputusan dijadualkan seperti Jadual B1(b). Ujian ini dijalankan mengikut prosedur Ujian Proctor Piawai.

Table B1(b)/Jadual B1(b)

Sample Number <i>Nombor Sampel</i>	1	2	3	4	5
Moisture content (%) <i>Kandungan Lembapan (%)</i>	13	14	16	18	20
Dry Density (kg/m^3) <i>Ketumpatan Kering (kg/m^3)</i>	1761	1832	1857	1809	1711

CLO2
C4

Based on **Table B1(b)**,

Berdasarkan kepada Jadual B1(b),

- i. Draw a compaction curve of dry density versus moisture content.

Lukis lengkuk pemadatan iaitu ketumpatan kering melawan kandungan lembapan.

- ii. Based on the graph, determine the value of maximum dry density and optimum moisture content.

Berdasarkan graf tersebut, tentukan ketumpatan kering maksimum dan kandungan lembapan optimum.

- iii. Draw the saturation line, $A_r = 0\%$ on the same graph, if $G_s = 2.7$.

Lukis garis ketepuan, $A_r = 0\%$ pada graf yang sama, jika $G_s = 2.7$.

[12 marks]

[12 markah]

QUESTION 2

SOALAN 2

- (a) Based on **Figure B2**, sketch a graph of total stress, effective total stress and pore water pressure versus depth for the given soil profile.

CLO2
C3

Berdasarkan kepada **Rajah B2**, hasilkan graf jumlah tegasan, tegasan berkesan dan tekanan air liang melawan kedalaman bagi profil tanah tersebut.

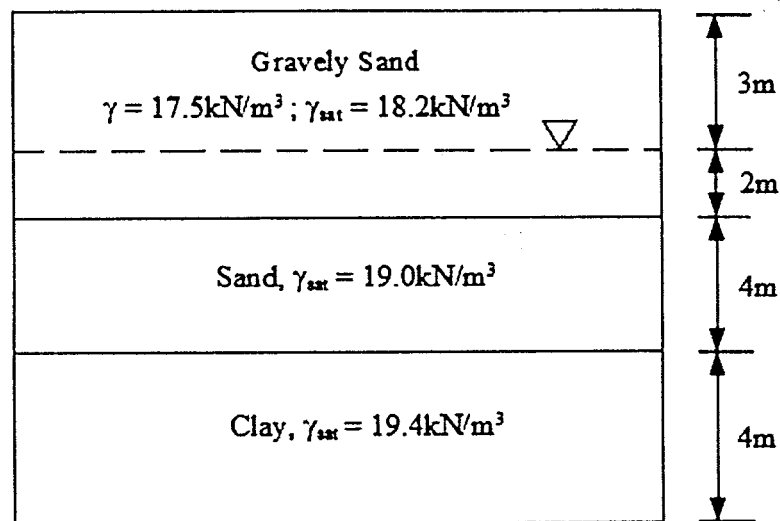


Figure B2/Rajah B2

[13 marks]

[13 markah]

CLO2
C4

- (b) Determine the active forces per unit length and the location of resultant for the following data. The water table is located at a depth of 3m below ground surface.

Tentukan tekanan aktif per unit panjang dan titik tindakannya bagi data berikut. Paras air terletak pada kedalaman 3m di bawah aras bumi.

1st layer : $\gamma = 18 \text{ kN/m}^3$ and $\phi = 38^\circ$, 3m height

Lapisan 1 : $\gamma = 18 \text{ kN/m}^3$ dan $\phi = 38^\circ$, 3m tinggi

2nd layer : $\gamma_{\text{sat}} = 19 \text{ kN/m}^3$ and $\phi = 38^\circ$, 3m height

Lapisan 2 : $\gamma = 19 \text{ kN/m}^3$ dan $\phi = 38^\circ$, 3m tinggi

[12 marks]

[12 markah]

QUESTION 3**SOALAN 3**CLO2
C3

- (a) **Figure B3** shows a slope with 3 layers of soil. Based on the data given, calculate the safety factor for the slope.

Rajah B3 menunjukkan satu cerun dengan 3 lapisan tanah. Berdasarkan kepada data yang telah diberi, kirakan faktor keselamatan untuk cerun tersebut.

Data given,

Data diberi,

$$A_1 = 18\text{m}^2 \quad A_2 = 35\text{m}^2 \quad A_3 = 58\text{m}^2$$

$$\theta_1 = 9^\circ \quad \theta_2 = 15^\circ \quad \theta_3 = 80^\circ$$

$$d_1 = 9.3\text{m} \quad d_2 = 8.2\text{m} \quad d_3 = 3.0\text{m}$$

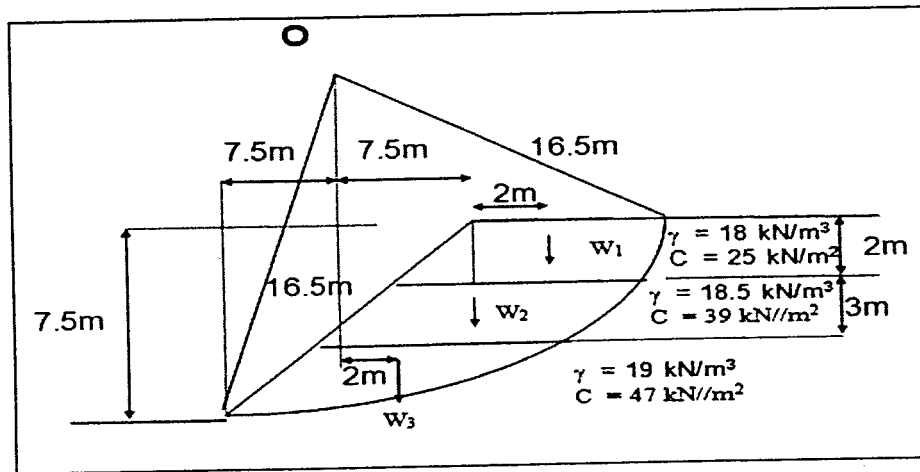


Figure B3/Rajah B3

[10 marks]

[10 markah]

- (c) Analyze the factor of safety against slip failure for slope with the data as shown in **Table B3**. Given, $\gamma = 1850 \text{ kg/m}^3$, $c = 6.8 \text{ kN/m}^2$ and $\phi = 18^\circ$.

CLO2
C4

Analisis faktor keselamatan untuk cerun seperti data di dalam Jadual B3.

Diberi, nilai untuk $\gamma = 1850 \text{ kg/m}^3$, $c = 6.8 \text{ kN/m}^2$ dan $\phi = 18^\circ$.

Table B3/Jadual B3

Slice/ Hirisan	α	Z(m)	b (m)
1	-25	1.8	3
2	8.5	3.7	3
3	11	4.6	3
4	30	5.2	3
5	52	2.5	3

[15 marks]

[15 markah]

QUESTION 4

SOALAN 4

CLO2
C3

- (a) For a concrete dam as shown in **Figure B4(a)**:

*Bagi sebuah empangan konkrit seperti **Rajah B4(a)**.*

- (i) Construct flow nets, if $H1=14m$, $D1=6m$, $D2=10m$, $D3=1.5m$.

Bina jaringan aliran jika $H1=14m$, $D1=6m$, $D2=10m$, $D3=1.5m$.

- (ii) If $k = 6.5 \times 10^{-3}$, calculate the seepage loss, Q meter length per hour.

Jika $k = 6.5 \times 10^{-3}$, kirakan kehilangan resipan, Q meter panjang per jam.

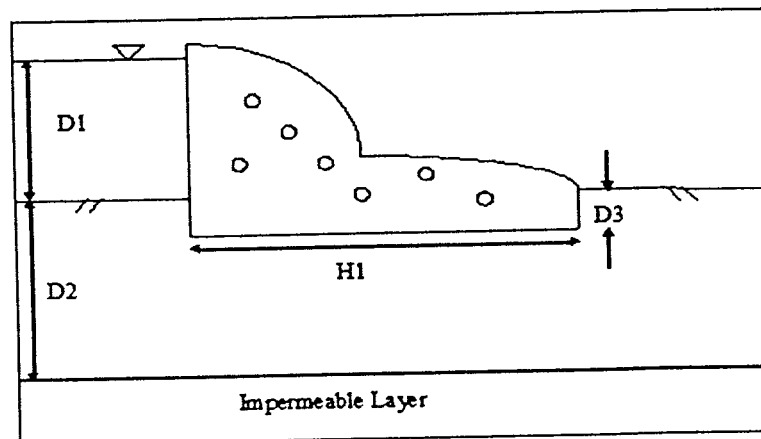


Figure B4(a) / Rajah B4(a)

[17 marks]

[17 markah]

CLO2
C4

- (b) Analyze flow net by referring to **Figure B4(b)**,

Dengan merujuk **Rajah B4(b)** analisis jaringan aliran,

- i. From point P, Q, R and S, identify which points have the same differential head.

Daripada titik P, Q, R dan S, kenalpasti titik-titik yang mempunyai ketinggian turus yang sama.

- ii. If the coefficient of permeability $k = 0.005$ m/hour, calculate the quantity of seepage, Q .

Jika pekali kebolehtelapan tanah $k = 0.005$ m/jam, kirakan kadar alir resipan, Q .

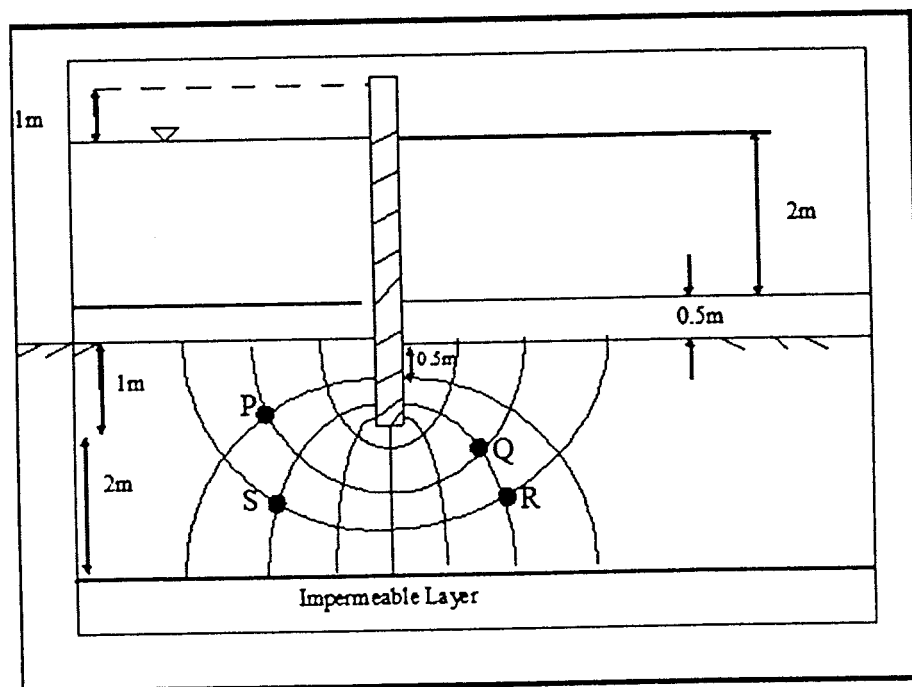


Figure B4(b) / Rajah B4(b)

[8 marks]

[8 markah]

SOALAN TAMAT

LOADING CAPACITY FACTORS FOR GENERAL SHEAR

ANGLE OF FRICTION ϕ (DEGREES)	TERZA AGHI			INTERLORE			HANSENG		
	N_c	N_q	N_γ	N_c	N_q	N_γ	N_c	N_q	N_γ
0	5.70	1.00	0.00	5.10	1.00	0.00	5.10	1.00	0.00
2	6.30	1.22	0.18	5.63	1.20	0.01	5.63	1.20	0.01
4	6.97	1.49	0.38	6.19	1.43	0.04	6.19	1.43	0.06
5	7.34	1.64	0.50	6.49	1.57	0.07	6.49	1.57	0.07
6	7.73	1.81	0.62	6.81	1.72	0.11	6.81	1.72	0.11
8	8.60	2.21	0.91	7.53	2.06	0.21	7.53	2.06	0.22
10	9.60	2.69	1.21	8.34	2.47	0.37	8.34	2.47	0.39
12	10.76	3.29	1.70	9.28	2.97	0.60	9.28	2.97	0.63
14	12.11	4.02	2.23	10.37	3.59	0.92	10.37	3.59	0.97
15	12.86	4.45	2.50	10.98	3.94	1.13	10.98	3.94	1.18
16	13.68	4.92	2.94	11.63	4.34	1.37	11.63	4.34	1.43
18	15.52	6.04	3.87	13.10	5.26	2.00	13.10	5.26	2.08
20	17.69	7.44	4.97	14.83	6.40	2.87	14.83	6.40	2.95
22	20.27	9.19	6.61	16.88	7.82	4.07	16.88	7.82	4.13
24	23.36	11.40	8.58	19.32	9.60	5.72	19.32	9.60	5.75
25	25.13	12.72	9.70	20.72	10.66	6.77	20.72	10.66	6.76
26	27.09	14.21	11.35	22.25	11.85	8.00	22.25	11.85	7.84
28	31.61	17.81	15.15	25.80	14.72	11.19	25.80	14.72	10.94
30	37.16	22.46	19.73	30.14	18.40	15.67	30.14	18.40	15.07
32	44.04	28.52	27.49	35.49	23.18	22.02	35.49	23.18	20.79
34	52.64	36.50	36.96	42.16	29.44	31.15	42.16	29.44	28.77
35	57.75	41.44	42.40	46.12	33.30	37.15	46.12	33.30	33.92
36	63.53	47.16	51.70	50.59	37.75	44.43	50.59	37.75	40.05
38	77.50	61.55	73.47	61.35	48.93	64.07	61.35	48.93	58.17
40	95.66	81.27	100.39	75.31	64.20	93.69	75.31	64.20	79.54
42	119.67	108.75	165.69	93.71	85.37	139.32	93.71	85.37	113.96
44	151.85	147.74	248.29	118.37	115.31	211.41	118.37	115.31	165.68
45	172.29	173.29	294.50	133.87	134.87	262.74	133.87	134.87	200.81
46	196.22	204.19	426.96	152.10	158.50	328.73	152.10	158.50	244.65
48	258.28	287.85	742.81	199.26	222.30	526.45	199.26	222.30	368.67
50	347.51	415.15	1153.15	266.88	319.06	873.86	266.88	319.06	568.57

LAMPIRAN FORMULA (CC502 – GEOTECHNICS 2)

$$Q = k H \frac{Nf}{Ne}$$

$$I = \frac{\Delta h}{\Delta s}$$

$$u_x = u_w \left(\frac{N_x}{N_s} \cdot \Delta H - (-Z_x) \right)$$

$$K_a = \frac{1 - \sin \phi}{1 + \sin \phi}$$

$$K_p = \frac{1 + \sin \phi}{1 - \sin \phi}$$

$$K_a = \cos \beta \cdot \frac{\cos \beta - \sqrt{(\cos^2 \beta - \cos^2 \phi)}}{\cos \beta + \sqrt{(\cos^2 \beta - \cos^2 \phi)}}$$

$$K_a = \frac{\sin^2(\alpha + \phi) \cos \delta}{\sin \alpha \sin(\alpha - \delta) \left[1 + \sqrt{\frac{\sin(\phi + \delta) \sin(\phi - \beta)}{\sin(\alpha - \delta) \sin \alpha + \beta}} \right]^2}$$

$$K_a = \left[\frac{\sin \phi}{1 + \sqrt{\frac{\sin(\phi + \delta) \sin \phi}{\cos \delta}}} \right]^2$$

$$Z_c = \frac{2C}{\gamma} \sqrt{\frac{1}{Ka}}$$

$$\sigma_a = ka [\gamma Z + q] - 2C\sqrt{Ka}$$

$$Z_c = \frac{2C}{\gamma} \sqrt{\frac{1}{Ka}}$$

$$FOS = \frac{CR^2 \theta}{Wd}$$

$$FOS = \frac{C_A R^2 \theta_A + C_B R^2 \theta_B}{Wd}$$

$$P = \frac{Rv}{B} \left(1 \pm \frac{6e}{B} \right)$$

$$FOS = \frac{Rv \tan \delta}{RH}$$

$$e = B/2 - \bar{X}$$

$$FOS = \frac{\mu R}{\mu T}$$

$$FOS = \frac{N_c C_u}{\gamma Z}$$

$$FOS = \frac{Cu}{N\gamma Z}$$

$$FOS = \frac{\sum CL' + w \cos \alpha \tan \phi}{\sum w \sin \alpha}$$

$$FOS = \frac{\sum CL' (W \cos \alpha - \mu L')}{\sum W \sin \alpha}$$

$$FOS = \frac{CR^2 \theta'}{Wd + PwYc}$$

Correction Table $\frac{\Delta a}{a + \Delta a}$ Earth Dam (Non Filter)

Slope, α	30	6	90	120	150	180
$\frac{\Delta a}{a + \Delta a}$	0.37	0.32	0.25	0.18	0.10	0

STRIP FOUNDATION

$$q_u = c_u N_c + \gamma DN_q + 0.5 \gamma BN_\gamma$$

CIRCLE FOUNDATION

$$q_u = 1.3c_u N_c + \gamma DN_q + 0.3 \gamma BN_\gamma$$

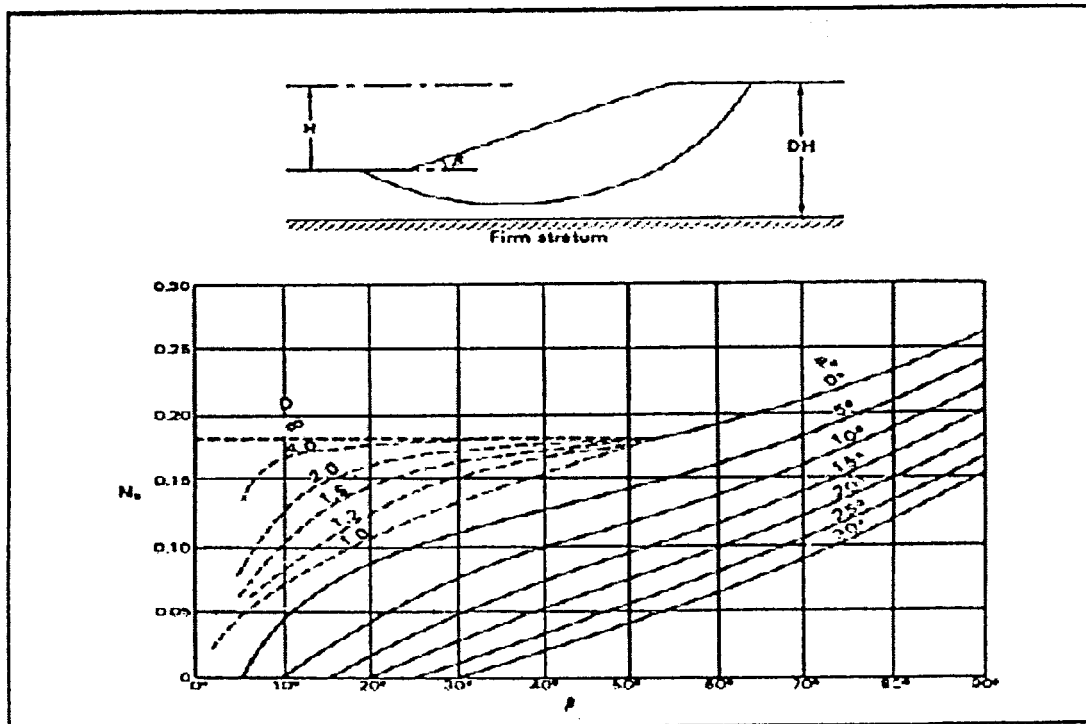
SQUARE SPREAD FOUNDATION

$$q_u = 1.3c_u N_c + \gamma DN_q + 0.4 \gamma BN_\gamma$$

RECTANGLE SPERAD FOUNDATION

$$q_u = c_u N_c [1 + 0.3 (B/L)] + \gamma DN_q + 0.5 \gamma BN_\gamma [1 - 0.2 (B/L)]$$

Taylor Stabilization Chart



PARTICLE SIZE DISTRIBUTION						
Job No.	Project	BH/Pit no.	Date			
Site	Client	Sample no.	Tested by			
Test method	Soil Descrip.	Depth (m)	Checked by			
British Standard Sieves, (mm) 100 90 80 70 60 50 40 30 20 10 0 0.075 0.15 0.25 0.3 0.425 0.6 1 2 3 4.75 6 7.5 10 15 20 25 30 37.5 47.5 60 75 Percentage Passing, (%)				GRADING CHARACTERISTICS % Gravel % Sand % Silt % Clay D₉₀ (mm) D₈₅ (mm) D₈₀ (mm) D₇₀ (mm) D₆₀ (mm) D₅₀ (mm) D₄₀ (mm) D₃₀ (mm) D₂₅ (mm) D₂₀ (mm) C_u C_g Soil Classification		
particle diameter, (mm) 0.001 0.002 0.006 0.01 0.02 0.06 0.1 0.2 0.3 0.425 0.6 1 2 3 4.75 6 7.5 10 15 20 25 30 37.5 47.5 60 75				Remarks:		
CLAY fine medium coarse SILT fine medium coarse SAND fine medium coarse GRAVEL fine medium coarse Cobbles				© BBB2000		

Perihalhan		Simbol Kump.	Nama Tipikal	Kritirila Pengelasan Tanah Berbutiran Kasar		
Tanah berbutiran kasar (Ayak No. 200 > 50 % tertahan)	Kerikil (Ayak No. 4 > 50% tertahan)	Kerikil bersih	GW	Kerikil gred baik, campuran kerikil-pasir, sedikit atau tiada yang halus.	$C_u = D_{60} / D_{10} > 4$ $1 < C_c = D^2_{30} / (D_{10}D_{60}) < 3$	
			GP	Kerikil gred tak baik, campuran kerikil-pasir, sedikit atau tiada yang halus.	Tidak memenuhi keperluan GW	
			GM	Kerikil bertanah kolodak, campuran kelodak kerikil-pasir.	Had Atterberg di bawah garisan A atau $PI < 4$	Di atas garisan A dengan $4 < PI < 7$ adalah kes sempadan, perlu menggunakan kedua-dua simbol.
			GC	Kerikil bertanah liat, campuran tanah liat kerikil-pasir.	Had Atterberg di atas garisan A atau $PI > 7$	
	Pasir (Ayak No. 4 > 50% telus)	Pasir bersih	SW	Pasir gred baik, pasir berkerikil, sedikit atau tiada yang halus.	$C_u = D_{60} / D_{10} > 6$ $1 < C_c = D^2_{30} / (D_{10}D_{60}) < 3$	
			SP	Pasir gred tak baik, pasir berkerikil, sedikit atau tiada yang halus.	Tidak memenuhi keperluan SW	
			SM	Pasir bertanah kolodak, campuran pasir-kelodak.	Had Atterberg di bawah garisan A atau $PI < 4$	Had plotan dalam zon rapat dengan $4 < PI < 7$ adalah kes sempadan, perlu menggunakan kedua-dua simbol.
			SC	Pasir bertanah liat, campuran pasir- tanah liat.	Had Atterberg di atas garisan A atau $PI > 7$	
Tanah berbutiran halus (Ayak No. 200 > 50% telus)	Kelodak dan tanah liat ($LL < 50\%$)	ML	Kelodak tanpa organik dan pasir yang amat halus, habuk batuan, pasir halus bertanah kelodak atau bertanah liat atau kelodak bertanah liat dengan sedikit keplastikan.	1. Tentukan peratus pasir dan kerikil dari graf lengkung saiz butiran. 2. Bergantung kepada peratus butiran halus (lebih kecil dari ayak No. 200), tanah berbutiran kasar dikelaskan seperti berikut:- $< 5\%$: GW, GP, SW, SP $> 12\%$: GM, GC, SM, SC $5 - 12\%$: kes sempadan, perlu menggunakan kedua-dua simbol.		
		CL	Tanah liat tanpa organik mempunyai keplastikan rendah atau sederhana, tanah liat berkerikil, tanah liat berpasir, tanah liat sahaja			
		OL	Kelodak organik dan tanah liat organik bertanah kelodak mempunyai keplastikan rendah.			
	Kelodak dan tanah liat ($LL > 50\%$)	MH	Kelodak tanpa organik, micaceous atau diatomaceous halus berpasir atau tanah berkelodak, kelodak elastik.	<u>Nota</u> GW - Well grade gravel GP - Poorly graded gravel GM - Silty gravel GC - Clayey gravel SW - Well grade sand SP - Poorly graded sand SM - Silty sand SC - Clayey sand ML - Silt with low plasticity CL - Clay with low plasticity OL - Organic with low plasticity MH - Silt with high plasticity CH - Clay with high plasticity OH - Organic with high plasticity Pt - Peat		
		CH	Tanah liat tanpa organik mempunyai keplastikan tinggi, tanah liat subur.			
		OH	Tanah liat organik mempunyai keplastikan sederhana hingga tinggi, kelodak organik.			
	Tanah organik tinggi	Pt	Tanah gambut dan lain-lain tanah dengan organik tinggi.			