SULIT

POLITEKNIK MALAYSIA

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)

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 $c = 50kN/m^2$ and $\emptyset = 0°$, 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 = 50kN/m^2 *dan* Ø = 0°, *kirakan faktor keselamatan terhadap kegagalan keupayaan galas menggunakan formula Terzaghi.*

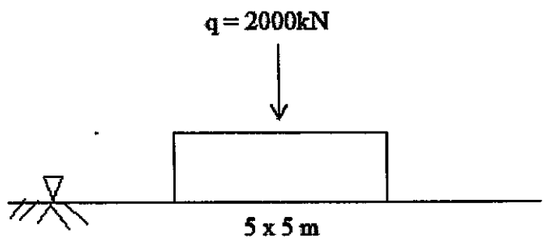


Figure A2/*Rajah A2*

[9 marks]
[9 markah]

c) A square footing is 2m x 2m in plan. The soil supporting the foundation has a friction angle of ϕ'=25° and c' = 20kN/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 ϕ'=25° dan c' = 20kN/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 *Nombor Ayak*	Sieve Size (mm) *Saiz Ayak (mm)*	Percentage Passing (%) *Peratus Telus (%)*
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. Interprete 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.

CLO2
C4

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

Table B1(b)/*Jadual B1(b)*

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

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, Ar = 0% on the same graph, if Gs=2.7.
Lukis garis ketepuan, Ar = 0% pada graf yang sama, jika Gs=2.7.

[12 marks]
[12 markah]

QUESTION 2

SOALAN 2

CLO2
C3

(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.

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

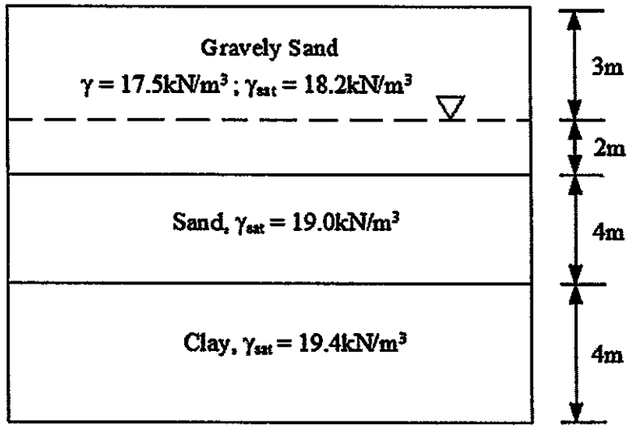


Figure B2/*Rajah B2*

[13 marks]

[13 markah]

CLO2
C3

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 : γ = 18 kN/m^3 and $\phi = 38^o$, 3m height

Lapisan 1 : γ = 18 kN/m^3 dan $\phi = 38^o$, 3m tinggi

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

Lapisan 2 : γ = 19 kN/m^3 dan $\phi = 38^o$, 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,

$A_1 = 18m^2$ $A_2 = 35m^2$ $A_3 = 58m^2$

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

$d_1 = 9.3m$ $d_2 = 8.2m$ $d_3 = 3.0m$

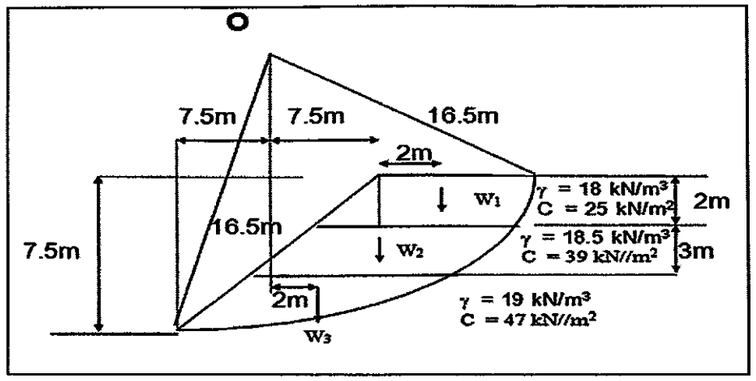


Figure B3/*Rajah B3*

[10 marks]

[10 markah]

CLO2
C4

(c) Analyze the factor of safety against slip failure for slope with the data as shown in **Table B3**. Given, $\gamma = 1850$ kg/m^3, c =6.8 KN/m^2 and Ø =18°.

*Analisis faktor keselamatan untuk cerun seperti data di dalam **Jadual B3**. Diberi, nilai untuk $\gamma = 1850$ kg/m^3, c =6.8 KN/m^2 dan Ø =18°.*

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=10 m, D3= 1.5m.*

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

(ii) If k = 6.5x10^{-3}, calculate the seepage loss, Q meter length per hour.

Jika k = 6.5x10^{-3}, *kirakan kehilangan resipan, Q meter panjang per jam.*

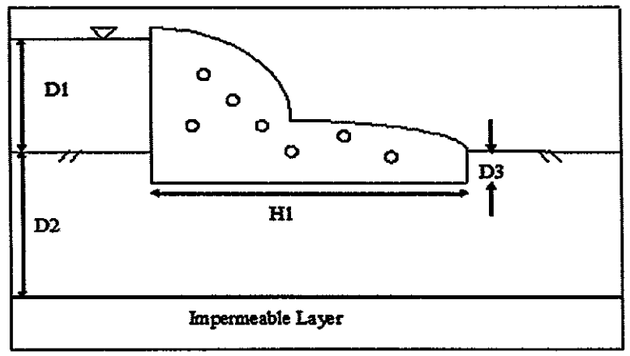


Figure B4(a) / *Rajah B4(a)*

[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 kadaralir resipan, Q.

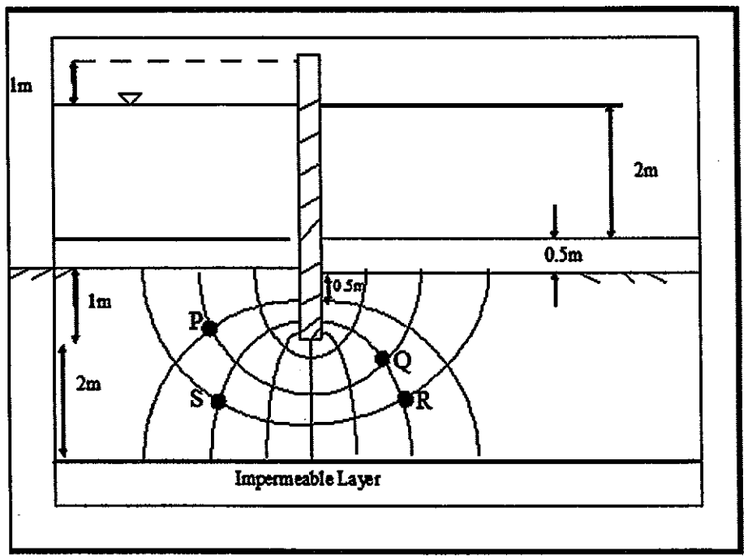


Figure B4(b) / ***Rajah B4(b)***

[8 marks]

[8 markah]

SOALAN TAMAT

BEARING CAPACITY FACTORS FOR GENERAL SHEAR

ANGLE OF FRICTION ϕ (DEGREES)	TERZAGHI N_c	TERZAGHI N_q	TERZAGHI N_γ	MEYERHOF N_c	MEYERHOF N_q	MEYERHOF N_γ	HANSEN N_c	HANSEN N_q	HANSEN N_γ	VESIC N_c	VESIC N_q	VESIC N_γ
0	5.70	1.00	0.00	5.10	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	5.63	1.20	0.01
4	6.97	1.49	0.38	6.19	1.43	0.04	6.19	1.43	0.04	6.19	1.43	0.05
5	7.34	1.64	0.50	6.49	1.57	0.07	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	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	7.53	2.06	0.22
10	9.60	2.69	1.21	8.34	2.47	0.37	8.34	2.47	0.38	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	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	10.37	3.59	0.97
15	12.86	4.46	2.50	10.98	3.94	1.13	10.98	3.94	1.18	10.98	3.94	1.18
16	13.68	4.92	2.84	11.63	4.34	1.37	11.63	4.34	1.43	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	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	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	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	19.32	9.60	5.76
25	25.13	12.72	9.70	20.72	10.66	6.77	20.72	10.66	6.76	20.72	10.66	6.76
26	27.09	14.21	11.35	22.25	11.85	8.00	22.25	11.85	7.94	22.25	11.85	7.94
28	31.61	17.81	15.15	25.80	14.72	11.19	25.80	14.72	10.94	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	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	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	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	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	50.59	37.75	40.05
38	77.50	61.55	73.47	61.35	48.93	64.07	61.35	48.93	56.17	61.35	48.93	56.17
40	95.66	81.27	100.39	75.31	64.20	93.69	75.31	64.20	79.54	75.31	64.20	79.54
42	119.67	108.75	165.68	93.71	85.37	139.32	93.71	85.37	113.96	93.71	85.37	113.96
44	151.95	147.74	248.29	118.37	115.31	211.41	118.37	115.31	165.58	118.37	115.31	165.58
45	172.29	173.29	294.50	133.87	134.87	282.74	133.87	134.87	200.81	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	152.10	158.50	244.65
48	258.29	297.85	742.61	199.26	222.30	528.45	199.26	222.30	366.67	199.26	222.30	366.67
50	347.51	415.15	1153.35	266.88	319.06	873.86	266.88	319.06	568.57	266.88	319.06	568.57

LAMPIRAN FORMULA (CC502 – GEOTECHNICS 2)

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

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

$u_w = u_w\left(\frac{N_w}{N_e}.\Delta H - (-Z_w)\right)$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$q_u = c_u N_c + \gamma\,DNq + 0.5\,\gamma\,BN_\gamma$

CIRCLE FOUNDATION

$q_u = 1.3c_u N_c + \gamma\,DNq + 0.3\,\gamma\,BN_\gamma$

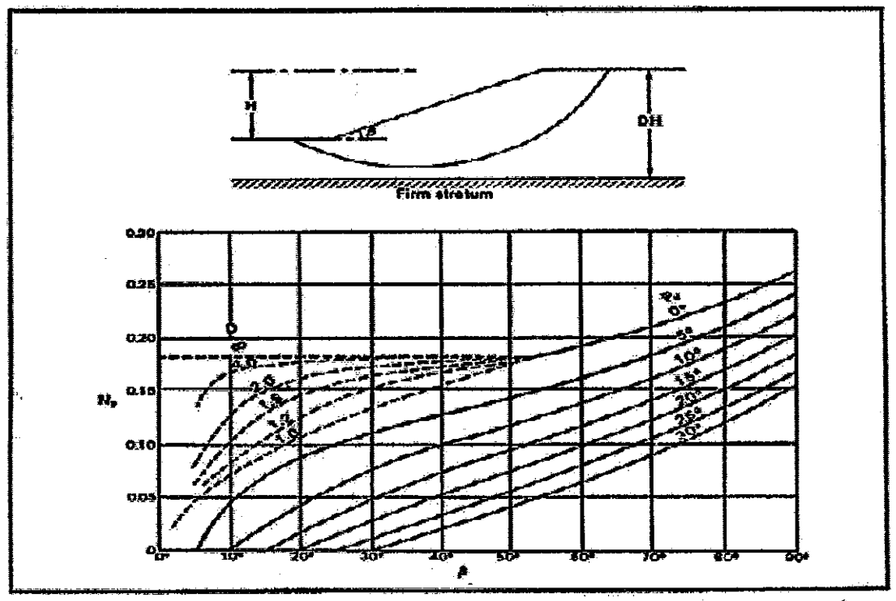
SQUARE SPREAD FOUNDATION

$q_u = 1.3c_u N_c + \gamma\,DNq + 0.4\,\gamma\,BN_\gamma$

RECTANGLE SPERAD FOUNDATION

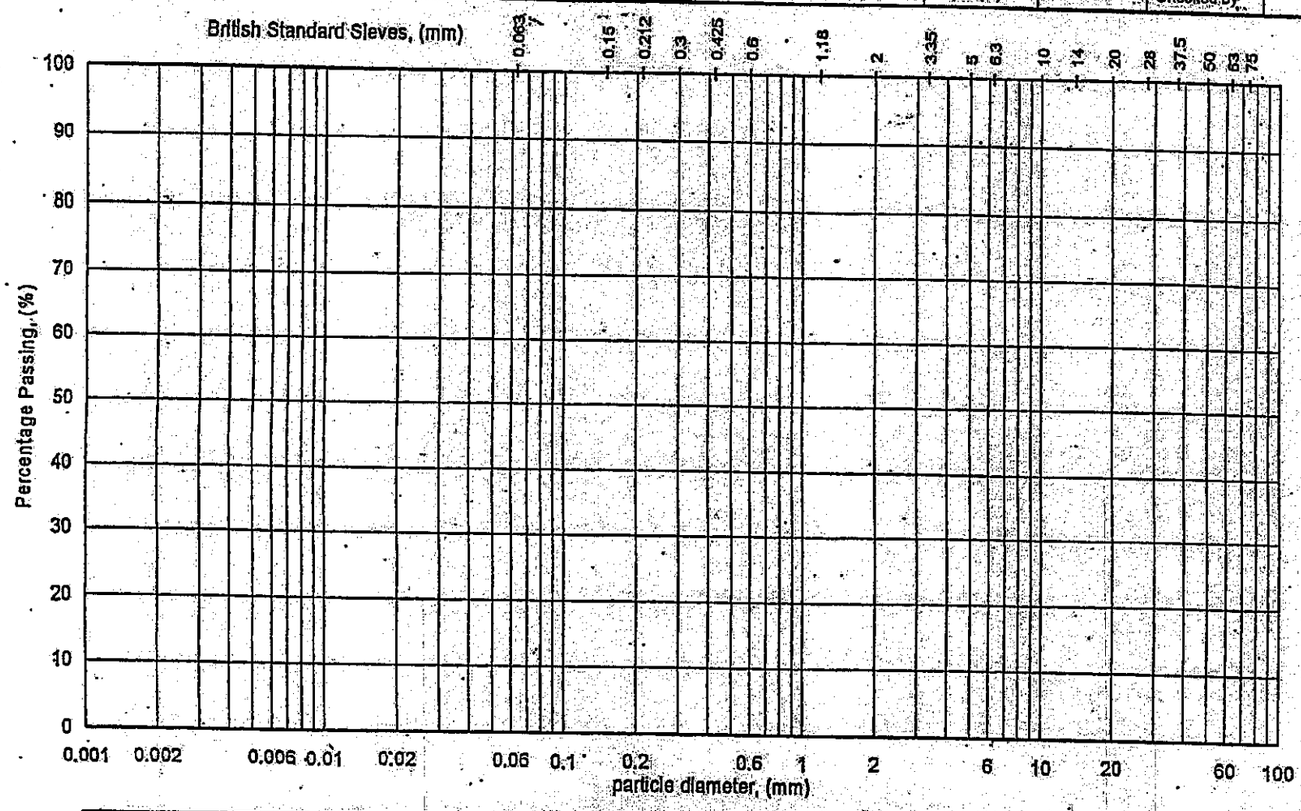
$q_u = c_u N_c\,[1+0.3\,(B/L) + \gamma\,DNq + 0.5\,\gamma\,BN_\gamma[1-0.2\,(B/L)]$

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	

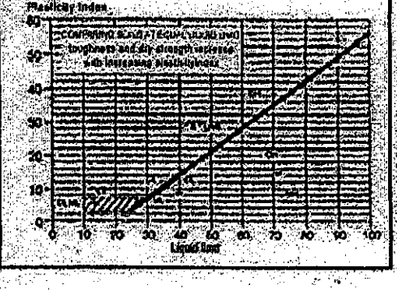


GRADING CHARACTERISTICS	
% Gravel	
% Sand	
% Silt	
% Clay	
D_{90} (mm)	
D_{85} (mm)	
D_{60} (mm)	
D_{50} (mm)	
D_{30} (mm)	
D_{15} (mm)	
D_{10} (mm)	
C_u	
C_g	
Soil Classification	
Remarks :	

CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	Cobbles
	SILT			SAND			GRAVEL			

UNIFIED SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (excluding particles larger than 3 inches and basing fractions on estimated weights)			GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentage of sand and gravel, max. size, angularity, surface condition, and hardness of the coarse grains; local or geological name and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics EXAMPLE Silty sand, gravelly; about 20% hard, angular gravel particles ½" maximum size, rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM)	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between one and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	GM	Silty gravel, poorly graded gravel-sand, silt mixtures	Not meeting all gradation requirements for GW Atterberg limits above "A" line with PI greater than 7 / Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols Atterberg limits below "A" line or PI greater than 7
			Plastic fines (for identification procedures see CL below)	GC	Clayey gravels, poorly graded gravel-sand clay mixtures	
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size (For visual classification, the ¼" size may be used as equivalent to the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amount of all intermediate particle sizes	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between one and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sand, gravelly sands, little or no fines	Not meeting all gradation requirements for SW Atterberg limits below "A" line or PI less than 4 / Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols Atterberg limits above "A" line with PI greater than 7
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see CL below)	SM	Silty sand, poorly graded sand-silt mixtures	
			Plastic fines (for identification procedures see CL below)	SC	Clayey sand, poorly graded sand-clay mixtures	
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to the naked eye)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE					
		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)		
	SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; color in wet condition, odor, if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions EXAMPLE: Clayey silt, brown, slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)	
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	OL	Organic silts and organic silty clays of low plasticity	
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	CH	Inorganic clays of high organic plasticity	
		Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity	
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture			Pt	Peat and other organic soils	



Attachment 1
USCS

Perihalan			Simbol Kump.	Nama Tipikal	Kriteria 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.	$Cu = D_{60}/D_{10} > 4$ $1 < Cc = D^2_{30}/(D_{10}D_{60}) < 3$	
			GP	Kerikil gred tak baik, campuran kerikil-pasir, sedikit atau tiada yang halus.	Tidak memenuhi keperluan GW	
		Kerikil dengan material halus.	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.	$Cu = D_{60}/D_{10} > 6$ $1 < Cc = D^2_{30}/(D_{10}D_{60}) < 3$	
			SP	Pasir gred tak baik, pasir berkerikil, sedikit atau tiada yang halus.	Tidak memenuhi keperluan SW	
		Pasir dengan material halus.	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 randah.		
	Kelodak dan tanah liat (LL > 50%)		MH	Kelodak tanpa organik, miseous atau diatomaseous halus berpasir atau tanah berkelodak, kelodak elastik.		
			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.		

Nota
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