SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI JUN 2019

DCC3103: GEOTECHNICAL ENGINEERING

TARIKH : 06 NOVEMBER 2019
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **DUA BELAS (12)** halaman bercetak.
Bahagian A: Struktur (2 soalan)
Bahagian B: Struktur (4 soalan)
Dokumen sokongan yang disertakan : Kertas Graf/Formula/Taylor Stability Chart

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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) Draw rock cycle.
Lukis kitaran batuan.

[5 marks]
[*5 markah*]

CLO1 C2

(b) Describe **FIVE (5)** processes involved in a rock cycle.
*Jelaskan **LIMA (5)** proses yang terlibat dalam kitaran batuan.*

[10 marks]
[*10 markah*]

CLO1 C3

(c) The following results in **Table A1(c)** were recorded during a triaxial test on a clay soil. Determine the shear strength parameters; c and φ.
*Berikut adalah data yang telah direkodkan dalam **Jadual A1(c)** semasa ujian tiga paksi bagi tanah liat. Tentukan parameter kekuatan ricih tanah; c dan φ.*

Table A1(c) / *Jadual A1(c)*

Cell pressure, σ_3 (kN/m^2) *Tekanan sel, σ_3 (kN/m^2)*	20	80	245
Deviator stress at failure, $\Delta\sigma$ (kN/m^2) *Tegasan Sisihan, $\Delta\sigma$ (kN/m^2)*	150	160	195

[10 marks]
[*10 markah*]

QUESTION 2
SOALAN 2

CLO1
C1

(a) List **FIVE (5)** equipment in Compaction Laboratory Test.
*Senaraikan **LIMA (5)** peralatan dalam Ujian Pemadatan di makmal.*

[5 marks]
[*5 markah*]

CLO1
C2

(b) A soil sample with a mass of 48 kg and the volume is 0.026 m^3. After it has dried in an oven for 24 hours, the mass reduced to 39 kg. Given the specific gravity as 2.65. Calculate:
Satu sampel tanah dengan berat 48 kg dan isipadu sebanyak 0.026 m^3. Selepas dikeringkan di dalam oven selama 24 jam, beratnya berkurang menjadi 39 kg. Diberi nilai G_S sebanyak 2.65. Kirakan

i. Moisture content, m
Kandungan lembapan, m

[3 marks]
[*3 markah*]

ii. Dry density, ρd
Ketumpatan kering, ρd

[2 marks]
[*2 markah*]

iii. Void ratio, e
Nisbah lompang, e

[5 marks]
[*5markah*]

CLO1
C3

(c) **Table A2 (c)** shows the laboratory Standard Compaction test results on a clayey soil. Determine the dry density and optimum moisture content based on the curve compaction graph.

Jadual A2(c) *menunjukkan keputusan ujian pemadatan piawai ke atas tanah liat. Tentukan ketumpatan kering maksimum dan kandungan lembapan optimum berdasarkan graf lengkung pemadatan.*

Table A2(c) / ***Jadual A2(c)***

Test number ***No Ujian***	**1**	**2**	**3**	**4**	**5**	**6**
Moisture content (%) *Kandungan lembapan*	8.4	10.6	12.9	14.4	16.6	18.6
Bulk density (Mg/m^3) *Ketumpatan pukal*	1.84	2.00	2.10	2.12	2.09	2.05

[10 marks]
[*10 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) **Figure B1(a)** shows the soil condition and the various unit weight for each soil type. Calculate the total stress, pore water pressure and effective stress at point A for the following condition:

Rajah B1(a) *menunjukkan tanah yang mempunyai pelbagai nilai berat unit untuk setiap lapisan tanah. Kira tegasan normal, tekanan air liang dan tekanan berkesan pada titik A mengikut keadaan berikut:*

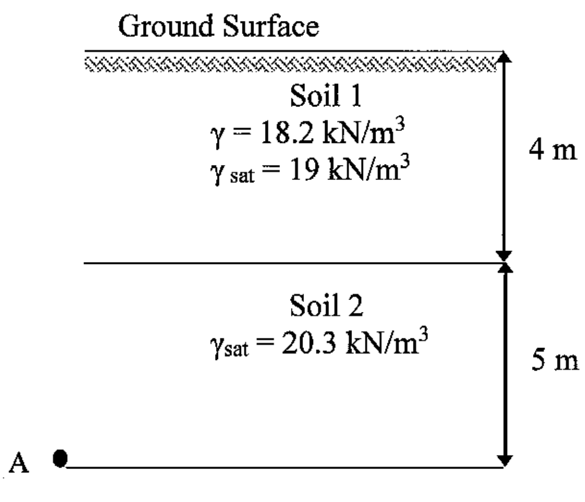


Figure B1(a) / *Rajah B1(a)*

i. The groundwater table is 2 m below ground surface
Aras air berada 2 m bawah permukaan bumi

[5 marks]
[*5 markah*]

ii. The groundwater table is at the top of Soil 2.
Aras air berada di lapisan atas Soil 2

[5 marks]
[*5 markah*]

CLO2
C4

(b) From the soil profile shown in **Figure B1(b)** below:
*Dari profil tanah yang ditunjukkan dalam **Rajah B1(b)** dibawah:*

i. Calculate the total stress, pore water pressure and effective stress at point A, B, C and D.
Kirakan tegasan normal, tekanan air liang dan tekanan berkesan pada titik A, B, C dan D.

[10 marks]
[*10 markah*]

ii. Draw the distribution diagram for the total stress, pore water pressure and effective stress of each layer.
Lukiskan gambarajah taburan untuk tegasan normal, tekanan air liang dan tegasan berkesan bagi setiap lapisan

[5 marks]
[*5 markah*]

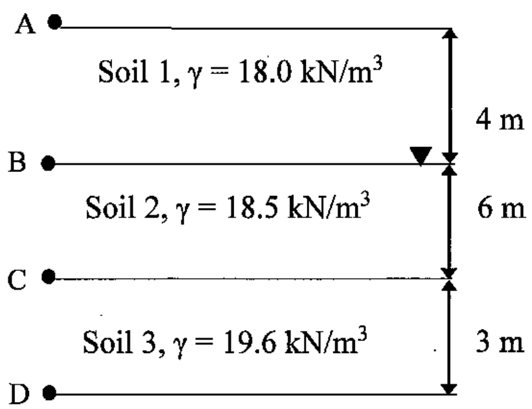


Figure B1(b) / *Rajah B1(b)*

QUESTION 2
SOALAN 2

CLO2
C3

(a) Based on **Figure B2(a)**, determine the total active thrust of gravity wall below.
Berdasarkan ***Rajah B2(a)***, *tentukan jumlah tujah aktif bagi tembok graviti di bawah.*

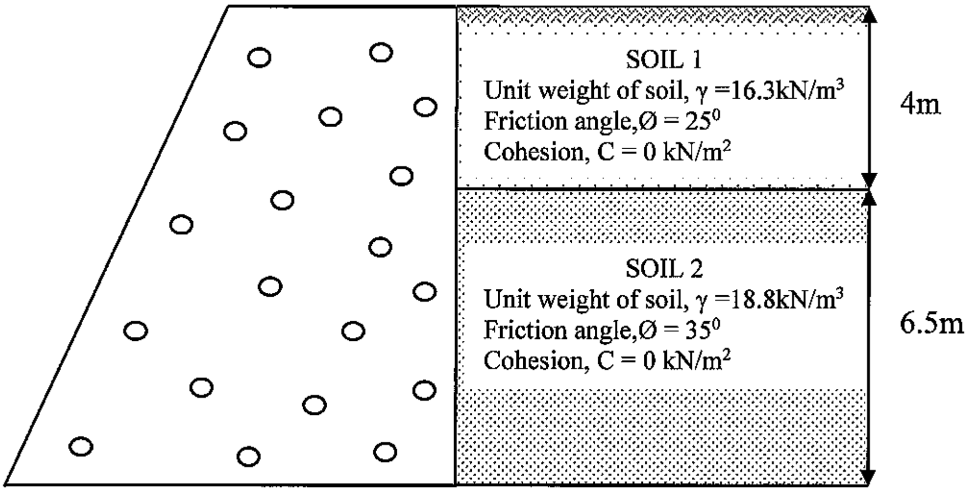


Figure B2(a) / ***Rajah B2(a)***

[10 marks]
[*10 markah*]

CLO2
C4

(b) **Figure B2(b)** shows a retaining wall. Calculate the factor of safety against sliding.

Given:

Unit weight of soil, γ_{soil} =18kN/m^3

Unit weight of concrete, $\gamma_{concrete}$ =24kN/m^3

Friction angle,Ø = 30^0

Cohesion, c = 0 kN/m^2

μ = 0.45

Rajah B2(b) *menunjukkan satu tembok penahan. Kira faktor keselamatan terhadap gelongsor.*

Diberi:

Berat Unit Tanah, $\gamma_{tanah} = 18 kN/m^3$

Berat Unit Konkrit, $\gamma_{konkrit} = 24 kN/m^3$

Sudut Geseran, $\varnothing = 30^0$

Kejelekitan, $c = 0\ kN/m^2$

$\mu = 0.45$

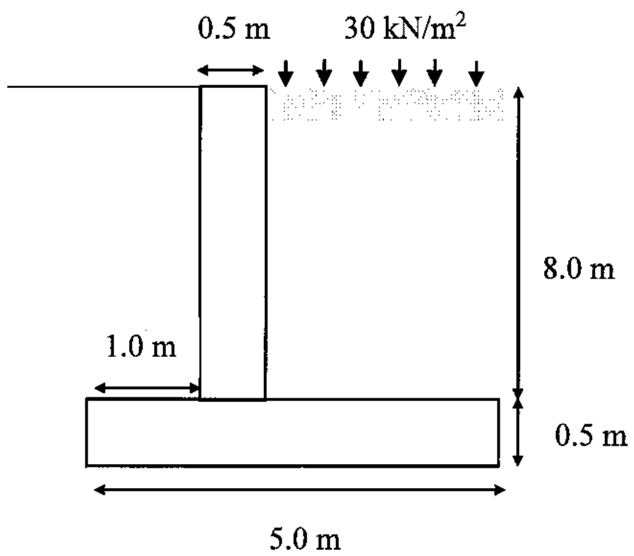


Figure B2(b) / *Rajah B2(b)*

[15 marks]
[*15 markah*]

QUESTION 3
SOALAN 3

CLO2
C3

(a) **Figure B3(a)** below shows one dig of sheet piling on sandy soil. If the coefficient of permeability (k) is 7.2×10^{-3} mm/sec, determine the quantity of seepage, Q in m^3/hour/m length.
Rajah B3(a) *menunjukkan satu korekan cerucuk keping pada lapisan tanah pasir. Jika diberi pekali kebolehtelapan (k) tanah adalah 7.2×10^{-3} mm/s, tentukan Kadaralir resipan, Q dalam unit m^3/jam/m panjang.*

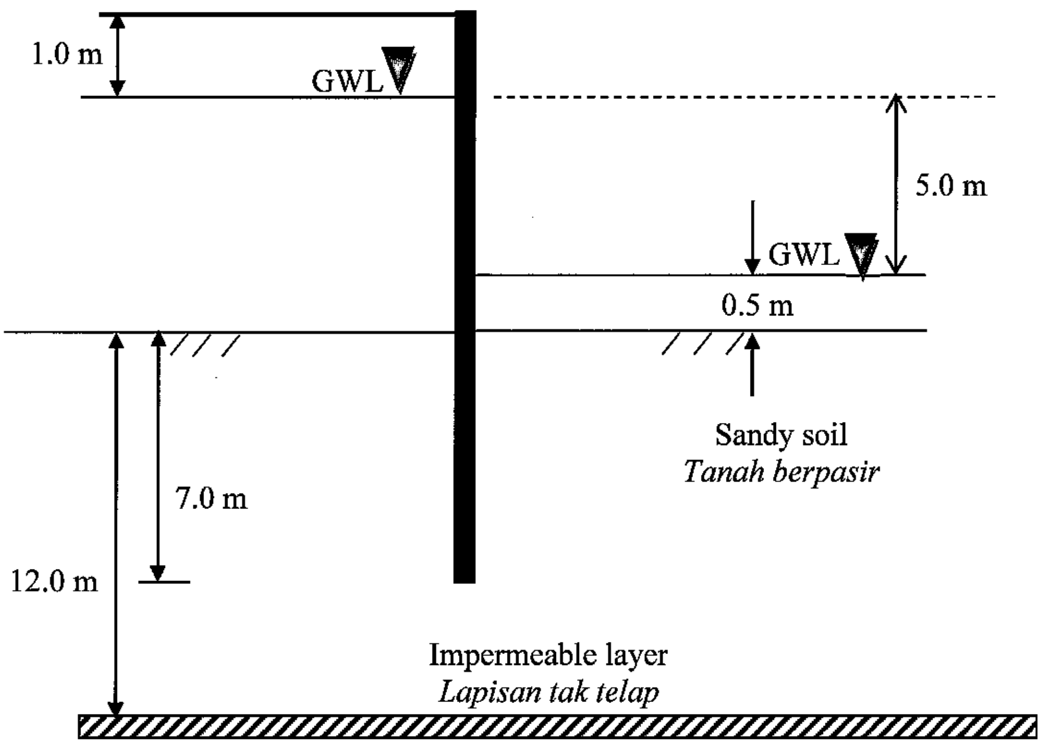


Figure B3(a) / ***Rajah B3(a)***

[10 marks]
[*10 markah*]

CLO2 C4

(b) **Figure B3(b)** below shows a draft of earth dam. The coefficient of permeability of the soil is 4.5×10^{-2} cm/s. Determine the pore water pressure at point A.

Rajah B3(b) *di bawah menunjukkan keratan bagi empangan tanah. Pekali kebolehtelapan tanah ialah 4.5×10^{-2} cm/s. Tentukan tekanan air liang di titik A.*

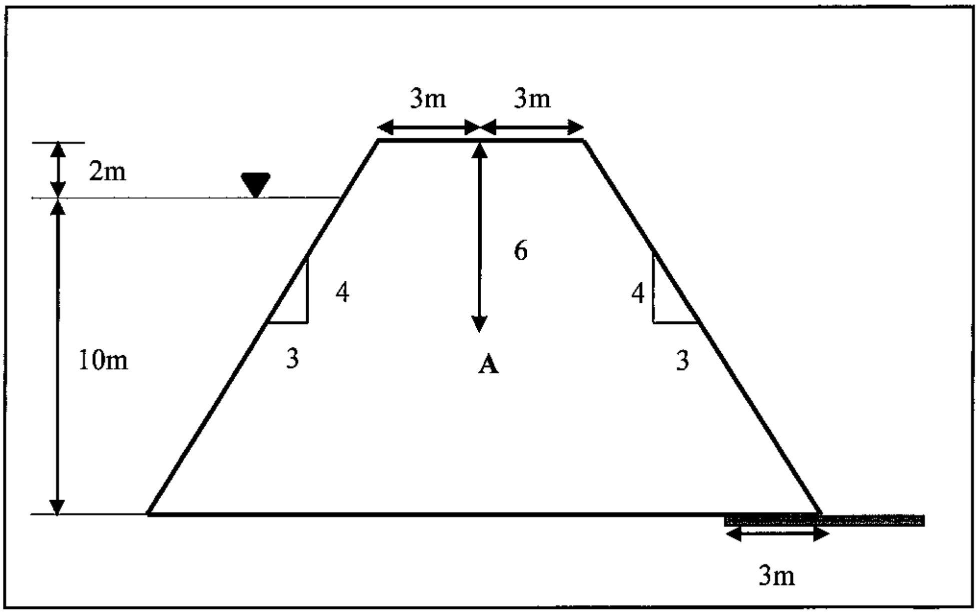


Figure B3(b) / *Rajah* B3(b)

[15 marks]
[*15 markah*]

CLO2
C3

QUESTION 4
SOALAN 4

(a) A cutting of slope in a cohesive soil form a slope angle 35^0 and height of 8m. Given undrained cohesion,c_u is $40kN/m^2$ and unit weight,$\gamma = 18kN/m^3$. With the use of Taylor Stability Charts, calculate the factor of safety for:
Satu keratan cerun bagi tanah liat tepu membentuk sudut 35^0 dan ketinggian 8m. Diberi kekuatan ricih tidak bersalir, c_u $40kN/m^2$ dan berat unit tanah $\gamma = 18kN/m^3$. Dengan menggunakan kaedah kestabilan Taylor, kira faktor keselamatan untuk:

i. A hard stratum exists well below the slope.
Lapisan keras berada jauh di bawah cerun

[5 marks]
[5 markah]

ii. A hard stratum exists at 4m below the toe of the slope.
Lapisan keras berada 4m dibawah kaki cerun

[5 marks]
[5 markah]

CLO2
C4

(b) Based on **Figure B4(b)** and **Table B4(b)** below, determine the factor of safety for the slope by using Fellenius slices method.
*Berdasarkan **Rajah B4(b)** dan **Jadual B4(b)** di bawah, tentukan faktor keselamatan cerun dengan menggunakan kaedah hirisan Fellenius.*

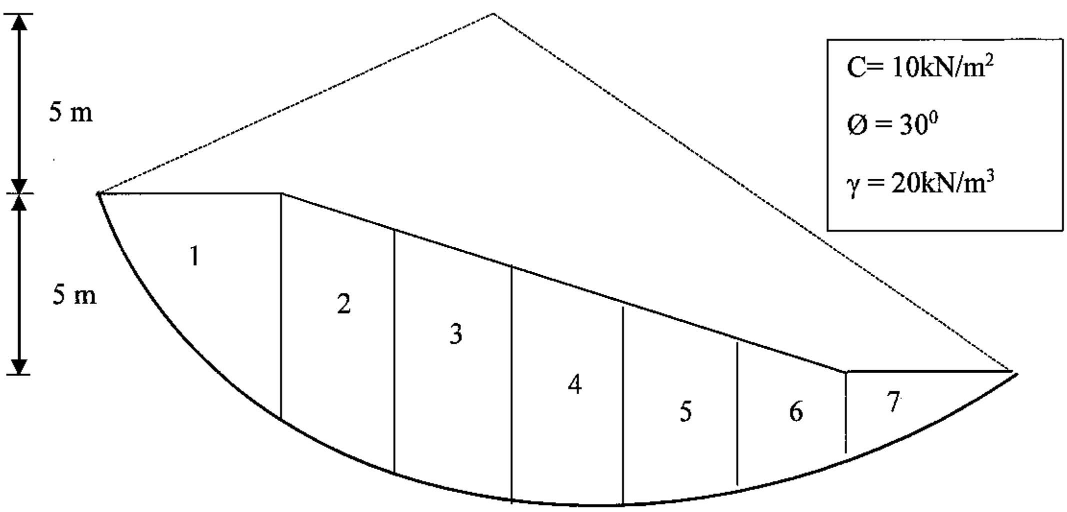


Figure B4(b) / *Rajah B4(b)*

Table B4(b) / *Jadual 4(b)*

Slices	b (m)	α^0	z (m)
1	2.0	51	1.65
2	2.0	36	3.65
3	1.3	28	4.15
4	0.7	24	3.90
5	2.0	15	3.50
6	2.0	2	2.50
7	2.0	-5	1.20

[15 marks]
[*15 markah*]

SOALAN TAMAT

LAMPIRAN FORMULA (DCC3103 – GEOTECHNICAL ENGINEERING)

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

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

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

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

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

$$\rho_b = \frac{M_T}{V_T}$$

$$PI = LL - PL$$

$$LI = \frac{w - PL}{PI}$$

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

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

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

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

Slope,	30	60	90	120	150	180

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

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

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

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

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

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

$$Q = kH\frac{N_f}{N_e}$$

$$u_x = \gamma_w\,[h_x - (-Z_x)]$$

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

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

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

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

$$G_s = \frac{M_s}{V_s\rho_w}$$

$$\rho_d = \frac{\rho_b}{1+w}$$

$$e = \frac{n}{1-n}$$

α						
$\dfrac{\Delta a}{a+\Delta a}$	0.37	0.32	0.25	0.18	0.10	0

STRIP FOUNDATION

$$q_u = c_u N_c + \gamma D N_q + 0.5 \gamma B N_\gamma$$

CIRCLE FOUNDATION

$$q_u = 1.3 c_u N_c + \gamma D N_q + 0.3 \gamma B N_\gamma$$

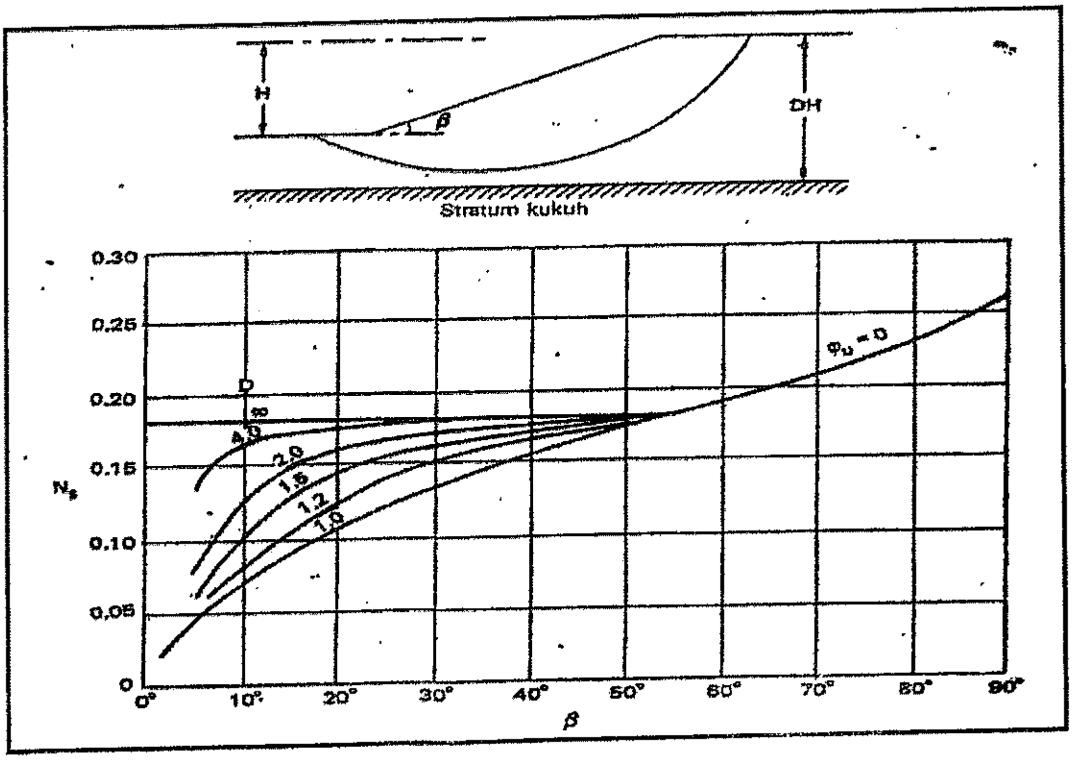
SQUARE SPREAD FOUNDATION

$$q_u = 1.3 c_u N_c + \gamma D N_q + 0.4 \gamma B N_\gamma$$

RECTANGLE SPERAD FOUNDATION

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

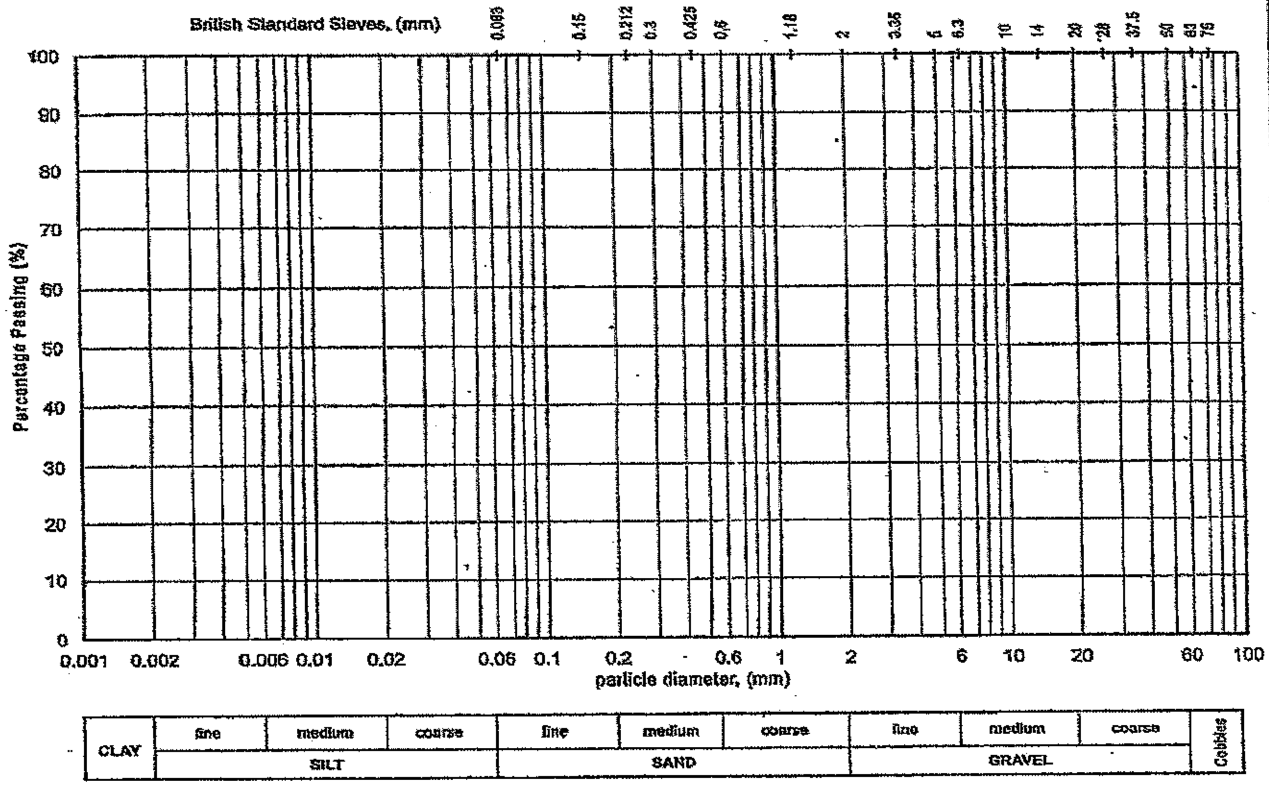
Taylor Stabilization Chart



GERAF SEMI LOG (JKA)

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 Classsification	

Remarks :

UNIFIED SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

Major divisions		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 materials is larger than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to the naked eye) — GRAVELS More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the 1/4" size may be used as equivalent for the 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.	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between one and 3
	CLEAN GRAVELS (Little or no fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW
	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	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	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
	GRAVELS WITH FINES (Appreciable amount of fines)	Plastic fines (for identification procedures see CL below)	GC	Clayey gravels, poorly graded gravel-sand clay mixtures		Atterberg limits below "A" line or PI greater than 7
SANDS More than half of coarse fraction is smaller than 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
	CLEAN SANDS (Little or no fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sand, gravelly sands, little or no fines	EXAMPLE	Not meeting all gradation requirements for SW
	SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see CL below)	SM	Silty sand, poorly graded sand-silt mixtures	Silty sand gravelly; about 20% hard, angular gravel particle ½ - in 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)	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
	SANDS WITH FINES (Appreciable amount of fines)	Plastic fines (for identification procedures see CL below)	SC	Clayey sand, poorly graded sand-clay mixtures		Atterberg limits above "A" line with PI greater than 7

Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follow:
Less than 5% GW, GP, SW, SP
More than 12% GM, GC, SM, SC
5% to 12% Borderline cases requiring use of dual symbols

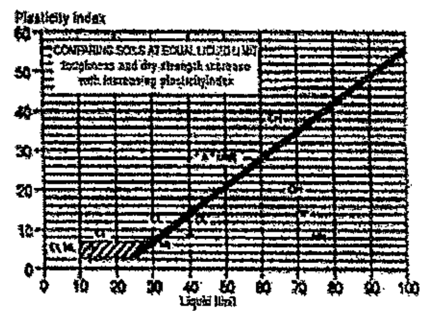
Use grain size curve in indentifying the fractions as given under field identification

FINE GRAINED SOILS More than half materials 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

Division	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand 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
	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	MN	Organic silts and organic silt-clays of low plasticity	
SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	OL	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silts	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions
	High to very high	None	High	CH	Inorganic clays of high organic plasticity	EXAMPLE:
	Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity	Clayey silt, brown, slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess, (ML)
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture			Pt	Peat and other organic soils	

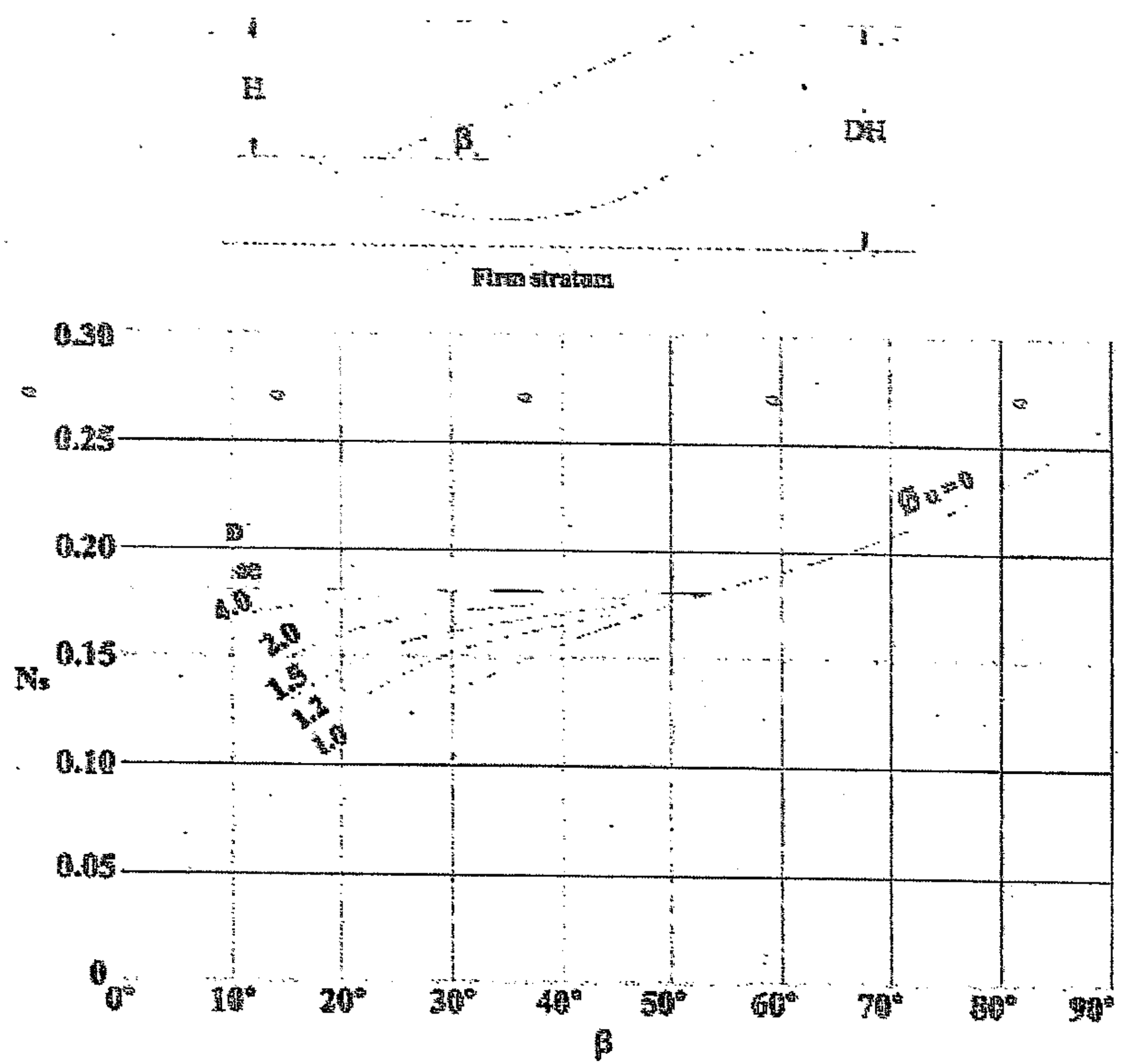
PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS



BEARING CAPACITY FACTORS FOR GENERAL SHEAR - DCC3103

BEARING CAPACITY FACTORS FOR GENERAL SHEAR

ANGLE OF FRICTION ϕ (DEGREES)	TERZAGHI			MEYERHOF			HANSEN		
	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	0.05
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	7.94
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	56.17
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	151.95	147.74	248.29	118.37	115.31	211.41	118.37	115.31	165.58
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	258.29	287.85	742.61	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



Taylor's stability coefficients $\phi_{u=0}$. (Reproduced by permission of the Boston of Civil Engineers)