SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI JUN 2016

DCC3103: GEOTECHNICAL ENGINEERING

TARIKH : 05 NOVEMBER 2016
MASA : 8.30 AM - 10.30 AM (2 JAM)

Kertas ini mengandungi **DUA BELAS (12)** halaman bercetak.
Bahagian A: Struktur (2 soalan)
Bahagian B: Struktur (4 soalan)
Dokumen sokongan yang disertakan : Formula, Carta Keplastikan, Taylor Stabilization Chart, Terzaghi's Bearing Capacity Factors & Kertas graf

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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 the process involved in a rock cycle.

Senaraikan proses yang terlibat dalam kitaran batu.

[6 marks]

[6 markah]

CLO1
C2

(b) Explain the terms below:

Terangkan istilah-istilah dibawah:

i. Disturbed Sample.

Sampel Terganggu.

[4.5 marks]

[4.5 markah]

ii. Undisturbed sample.

Sampel Tidak Terganggu.

[4.5 marks]

[4.5 markah]

CLO2
C3

(c) A Triaxial Test was conducted on three samples taken from the same soil. The test results are shown in **Table A1.** Calculate the values of cohesion and angle of friction of the soil.

Ujian tiga paksi telah dijalankan ke atas tiga sampel yang diambil dari tanah yang sama. Keputusan ujian ditunjukkan di dalam ***Jadual A1****. Kirakan nilai kejelekitan dan sudut geseran sampel tanah tersebut.*

Table A1
Jadual A1

Sample *Sampel*	Minor stress *Tegasan Minor,* *(kN/m^2)*	Deviator Stress *Tegasan Deviator* *(kN/m^2)*
A	25	155
B	85	165
C	230	200

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

CLO1
C2

(a) With the help of sketch, explain clearly the **THREE (3)** modes of shear failure in shallow foundations.

*Terangkan dengan jelas berserta lakaran **TIGA (3)** mod kegagalan ricih dalam asas cetek.*

[8 marks]

[*8 markah*]

CLO2
C3

(b) A square footing of 1.5m x 1.5m is located at 1.3m below the ground surface. The subsoil consists of a thick deposit of stiff cohesive soil with unconfined compressive strength of, q_u = 150 kN/m^2. The unit weight of the soil, $\gamma = 18.84\ kN/m^3$. Calculate the allowable bearing capacity with a factor of safety of 3.

Sebuah asas segiempat sama berukuran 1.5m x1.5m berkedalaman 1.3m di bawah permukaan tanah. Tanah bawah terdiri daripada tanah liat tegar dengan nilai kekuatan mampatan tak terkurung, q_u = 150 kN/m^2. Berat unit tanah, $\gamma = 18.84\ kN/m^3$. Kirakan keupayaan galas dibenarkan dengan faktor keselamatan sebanyak 3.

[9 marks]

[*9 markah*]

CLO2
C4

(c) The size of square footing is 2 m x 2 m. The soil which support the footing consist of an internal friction angle, $\emptyset = 25^{\circ}$ and cohesion, , $c' = 20\ kN/m^2$. The unit weight of the soil, $\gamma = 16.5\ kN/m^2$. Determine the allowable load, Q on the foundation with a factor of safety of 3. Assume that the depth of foundation (D_f) is 1.5 m.

Sebuah asas segiempat sama berukuran 2 m x 2 m di atas pelan. Tanah yang menanggung asas tersebut mempunyai sudut geseran, $\emptyset = 25^{\circ}$ *dan kejelekitan tanah,* $c' = 20\ kN/m^2$. *Berat unit tanah,* $\gamma = 16.5\ kN/m^2$. *Tentukan beban yang dibenarkan ke atas asas dengan faktor keselamatan sebanyak 3. Andaikan kedalaman asas (D_f) ialah 1.5 m.*

[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) The unit weight of a moist soil is γ_b is 18.2kN/m^3. Given the specific gravity, G_s = 2.68 and moisture content, m = 11.52%, calculate:

Berat unit basah tanah, γ_b adalah 18.2kN/m^3. Diberi graviti tentu, G_s = 2.68 dan kandungan lembapan, m = 11.52%, kirakan :

i. Dry unit weight, γ_d (kN/m^3)
Berat unit kering, γ_d (kN/m^3)

ii. Void ratio,e
Nisbah lompang, e

iii. Porosity, n
Keliangan, n

iv. Degree of saturation, S_r
Darjah ketepuan, S_r

[13 marks]
[13 markah]

CLO2
C4

(b) **Table B1** shows the data for a Standard Proctor test from a laboratory test.

i. Draw a graph of dry density versus moisture content.
ii. Determine the maximum dry density and optimum moisture content from the graph.

Jadual B1 *menunjukkan data yang diperolehi dari ujikaji pemadatan proktor piawai.*

i. Lukiskan graf ketumpatan kering maksimum melawan kandungan air.
ii. Tentukan ketumpatan kering maksimum dan kandungan air optimum dari graf tersebut.

Table B1
Jadual B1

Volume of Proctor mould (cm^3) *Isipadu acuan proctor (cm^3)*	Mass of wet soil in the mould (kg) *Jisim tanah basah dalam acuan (kg)*	Moisture content (%) *Kandungan lembapan (%)*
943.3	1.67	11
943.3	1.76	12
943.3	1.93	15
943.3	1.85	16
943.3	1.76	19
943.3	1.70	20

[12 markah]
[*12 marks*]

QUESTION 2

SOALAN 2

CLO2 C3

(a) A surface layer of sand is 4m thick and this overlies a 6m layer of clay. The ground water level is 2m from the layer of clay. The saturated weight of sand is 18 kN /m^3 and saturated weight of clay is 20 kN /m^3, while the saturated weight of sand above the groundwater level is 16 kN /m^3. Calculate the effective stress 8m from the surface of earth.

Satu lapisan pasir berketebalan 4m berada di atas tanah liat yang berketebalan 6m. Paras air bumi berada pada kedalamanan 2m dari permukaan pasir. Berat unit tepu pasir adalah 18 kN /m^3 dan berat unit tepu tanah liat adalah 20 kN / m^3, berat unit pasir atas paras air bumi adalah 16 kN /m^3. Dapatkan tegasan berkesan pada kedalaman 8m dari permukaan bumi.

[12 marks]

[*12 markah*]

CLO2 C4

(b) A retaining wall built during the excavation carried out as shown in **Figure B2** to bear two soil layers behind it. Regardless of passive pressure in front of the retaining wall.

*Sebuah tembok penahan dibina semasa kerja pengorekan dijalankan seperti dalam **Rajah B2** untuk menanggung dua lapisan tanah di belakangnya. Abaikan tekanan pasif di hadapan tembok penahan tersebut.*

i. Draw the active side pressure acting on the rear wall.
Lukiskan tekanan sisi aktif yang bertindak di belakang tembok.

ii. Based on the Rankine Theory, analyze the magnitude and the position of the active thrust of soil behind the wall.
Analisa arah dan kedudukan tujah aktif tanah di belakang tembok tersebut berdasarkan teori Rankine.

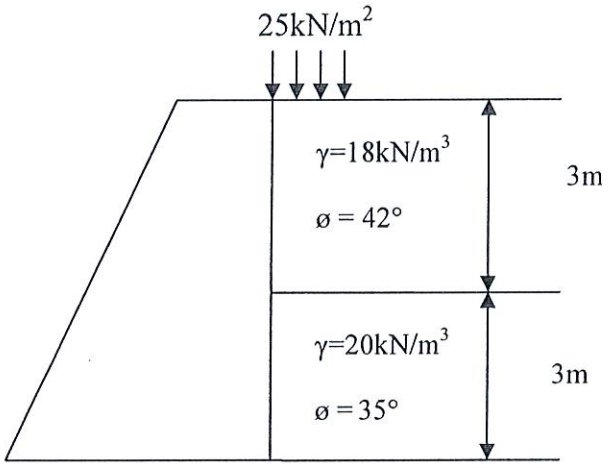


Figure B2
Rajah B2

[13 marks]
[*13 markah*]

QUESTION 3
SOALAN 3

CLO2 C3

(a) A slope has an inclination of 30^0 and is 8m high. The soil properties are Cu = 20 kN/m^3, $\varphi u = 0^0$, γ_{bulk} = 15kN/m^3. Calculate the factor of safety using Taylor's method if the clay deposit overlies rock which lies 2m below the base of the slope.

Satu cerun mempunyai kecerunan 30^o dan 8m tinggi. Diberi sifat-sifat tanah tersebut adalah Cu = 20 kN / m^3, $\varphi u = 0^o$, γ = 15kN / m^3. Kirakan faktor keselamatan menggunakan kaedah Taylor jika tanah keras dijumpai terletak 2m di bawah permukaan cerun tanah.

[10 marks]
[*10 markah*]

CLO2
C4

(b) Determine the safety factor for the dam shown in **Figure B3**. The embankment consists of a saturated soil for which the shearing resistance angle $\Theta_u = 0^0$ and the undrained cohesion is Cu = 70kN/m^3. The calculation is done for the reservoir with depth 18m assuming that the reservoir has been completely emptied.

*Tentukan faktor keselamatan empangan yang ditunjukkan dalam **Rajah B3**. Cerun ini terdiri daripada tanah yang tepu di mana sudut rintangan ricih $\varphi u = 0^0$ dan kejelekitan Cu = 70kN/m^3. Pengiraan akan dijalankan bagi kedalaman 18m dan takungan telah dikosongkan sepenuhnya.*

[15 marks]

[*15 markah*]

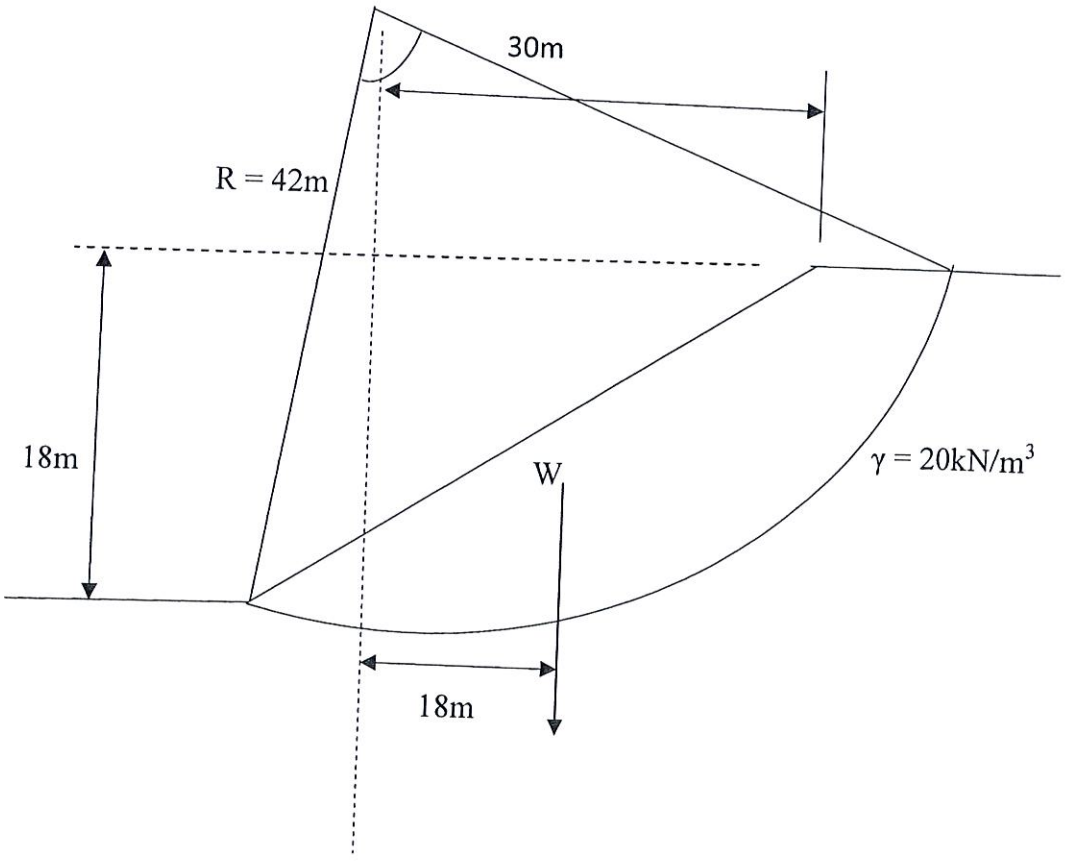


Figure B3
Rajah B3

QUESTION 4

SOALAN 4

Figure B4 shows a sheet piling in a clay sandy soil impounding upstream water. If the coefficient of permeability (k) is 7.2×10^{-3} mm/sec:

Rajah B4 *menunjukkan satu cerucuk keping di dalam tanah liat berpasir yang Ditakung di bahagian hulu. Jika pekali kebolehtelapan (k) adalah* 7.2×10^{-3} *mm/sec:*

CLO2 C3 (a) Draw the diagram using an appropriate scale and plot the flow net that contain equipotential lines, N_e and flow lines, N_f.

Lakarkan gambarajah menggunakan skala yang sesuai dan plotkan aliran jaringan yang mengandungi garis jaringan persamaan N_e *and flow lines,* N_f.

[11 marks]

[*11 markah*]

CLO2 C4 (b)

i. Determine the quantity of seepage, Q in m^3/hour/m length.

Tentukan kuantiti resapan, Q in m^3*/hour/m panjang*

[7 marks]

[*7 markah*]

ii. Calculate the pore water pressure at point Z.

Kira tekanan air liang di titik Z.

[7 marks]

[*7 markah*]

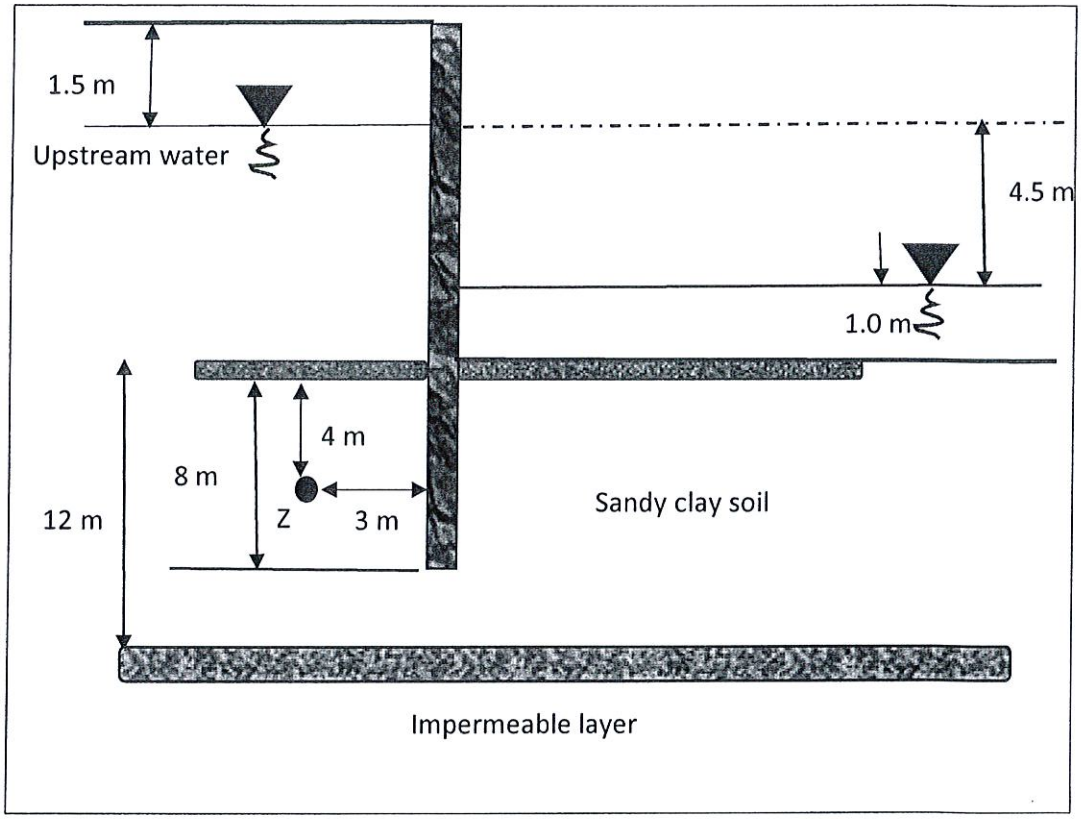
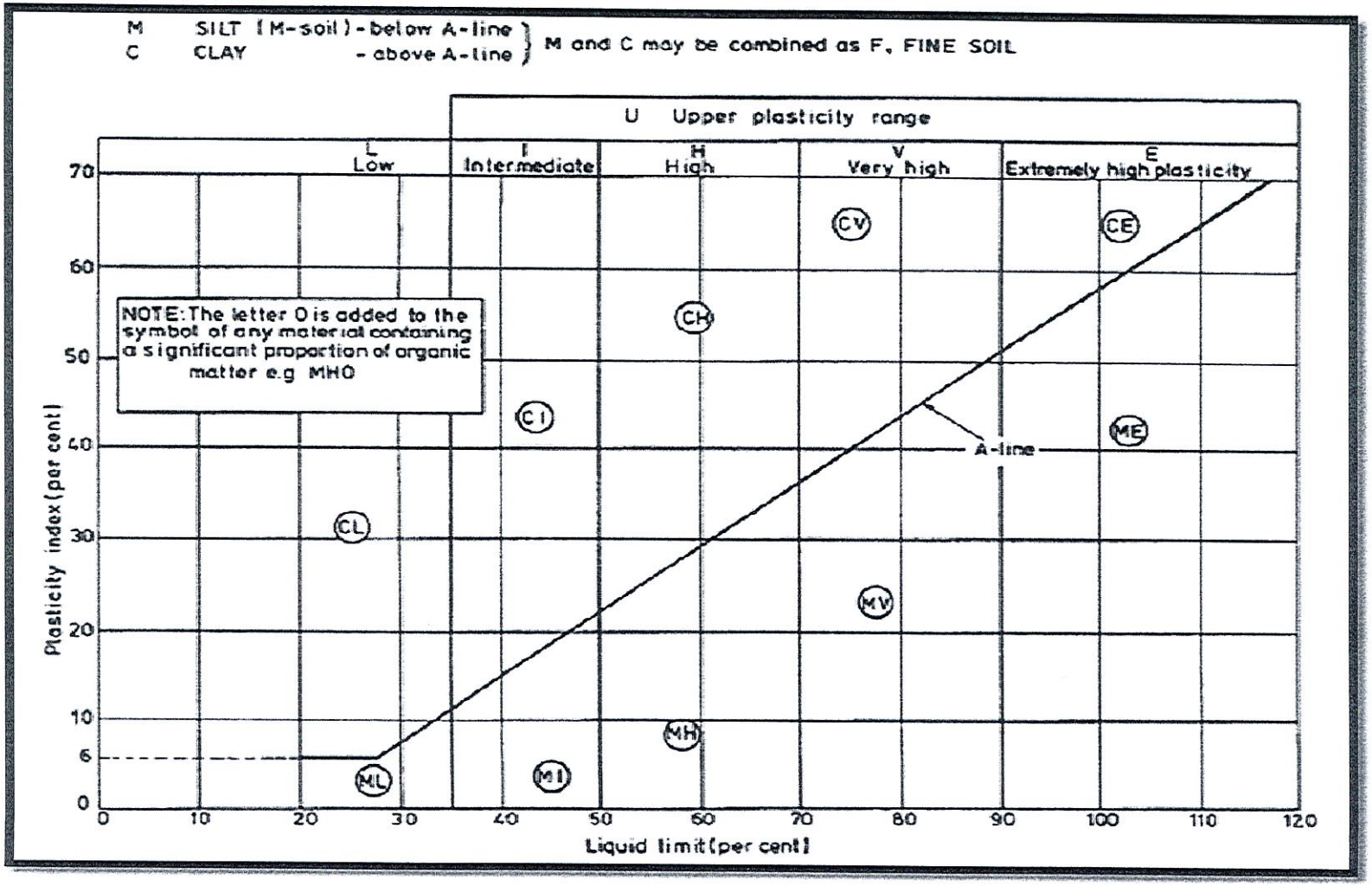


Figure B3
Rajah B3

SOALAN TAMAT

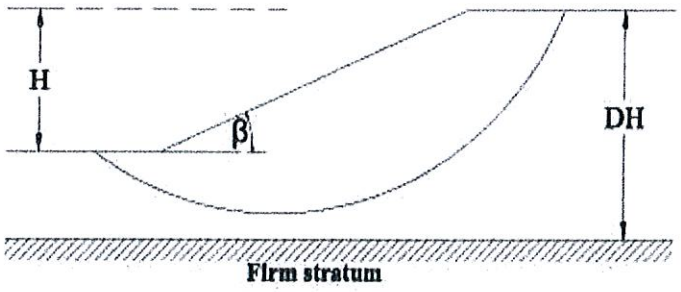
PIASTICITY CHART

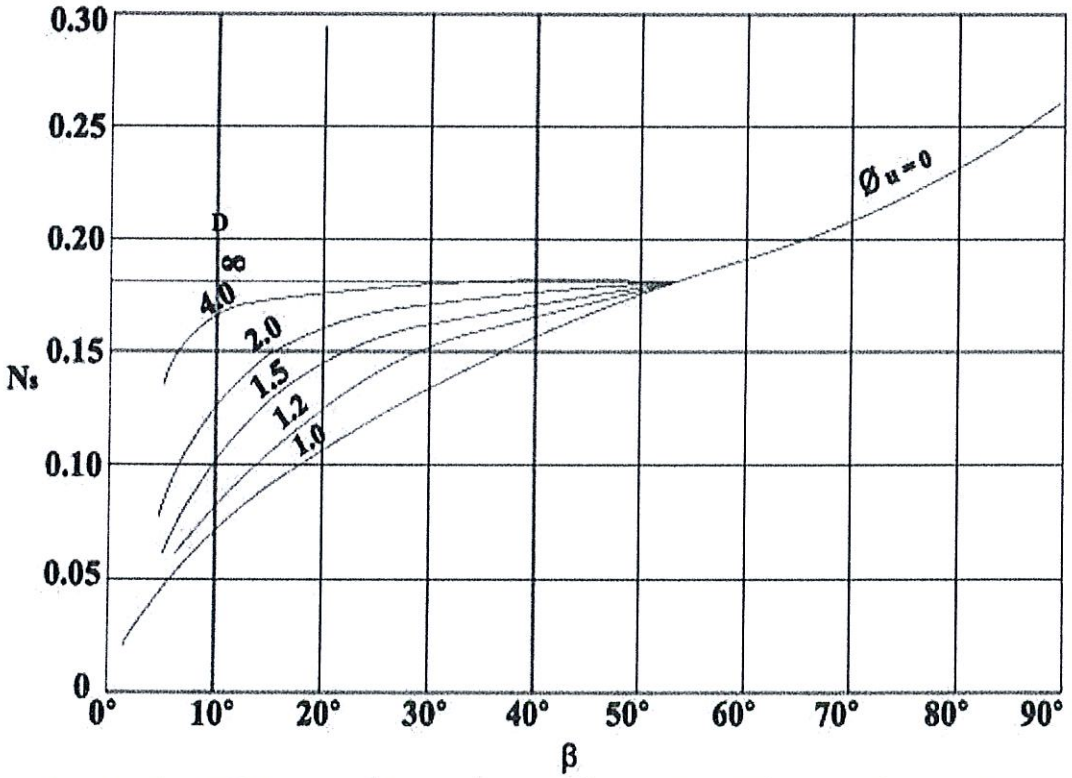


BEARING CAPACITY FACTORS FOR GENERAL SHEAR

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 Stabilization Chart





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

Fig. (3)

FORMULA APPENDIX / *LAMPIRAN FORMULA*

1. $V_t = V_s + V_v = V_s + V_w + V_a$

2. $G_s = \frac{m_s}{V_s \rho_w}$

3. $\rho_d = \frac{\rho b}{1+w}$

4. $\rho_b = \frac{Ms(1+w)}{v}$

5. $\rho_b = \frac{Gs\rho w(1+w)}{1+e}$

6. $\rho_d = \frac{Gs\rho w}{1+e}$

7. $S = \frac{wGs}{e}$

8. $\rho_{sat} = \frac{\rho w(Gs+e)}{1+e}$

9. $\rho_d = \frac{G_s \rho_w (1-A_r)}{(1+\omega G_s)}$

10. $n = \frac{e}{1+e}$

11. $\sigma = \rho gh = \gamma h$

12. $\sigma = \sigma' + u$

13. $u = \gamma_w h$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Slope, α	30	60	90	120	150	180
$\frac{\Delta a}{a+\Delta a}$	0.37	0.32	0.25	0.18	0.10	0

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

$FOS = \frac{C_AR^2\theta_A + C_BR^2\theta_B}{Wd}$

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

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

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

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

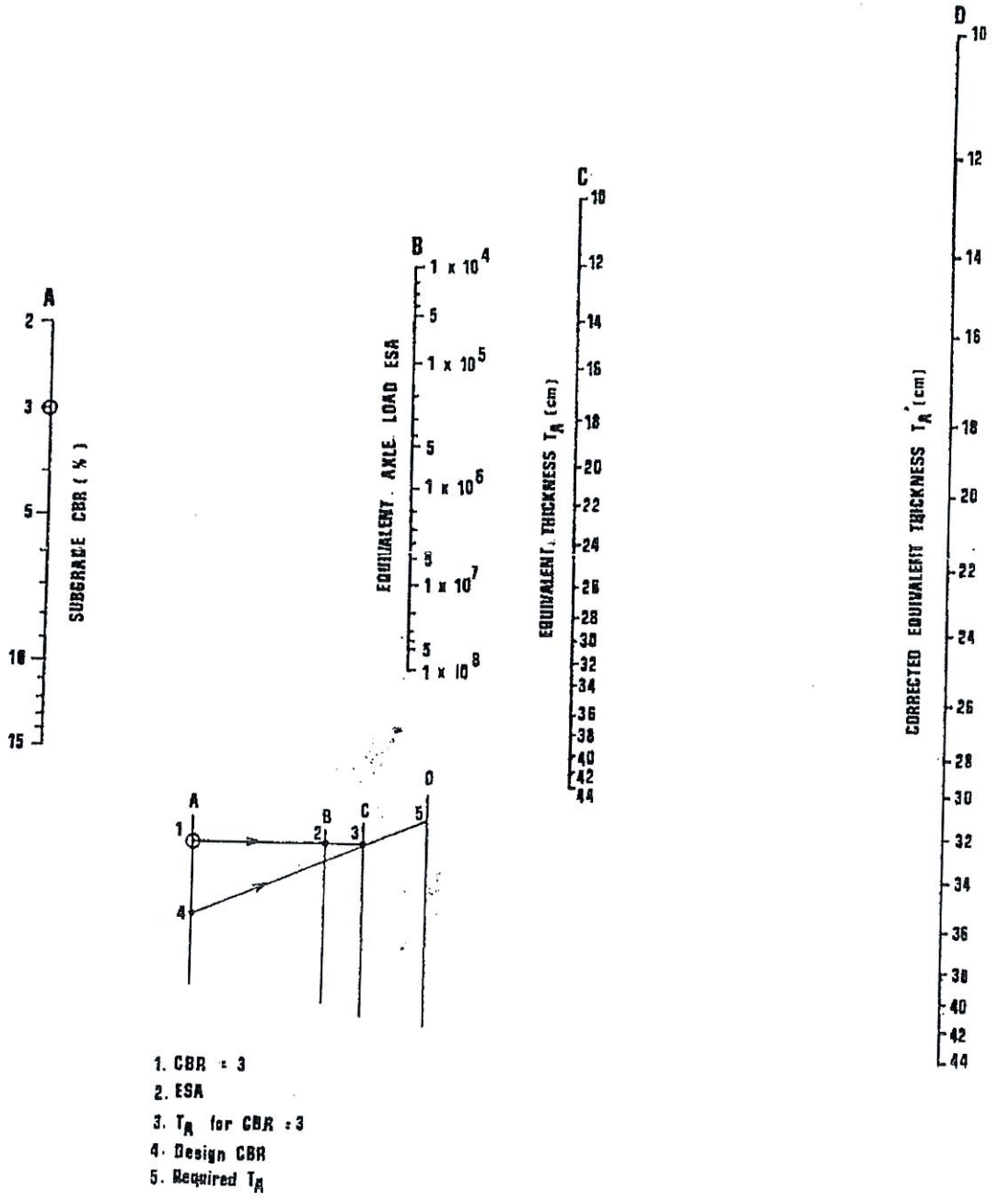
$FOS = \frac{N_cC_u}{\gamma Z}$

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

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

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

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



1. CBR = 3
2. ESA
3. T_A for CBR = 3
4. Design CBR
5. Required T_A

THICKNESS DESIGN NOMOGRAPH

Table 4.1: Conversion Factors to P.C.U's
(Source Arahan Teknik (Jalan) 8/86)

Type of Vehicle	Equivalent Value in P.C.U's			
	Urban Standards	Rural Standards	Round About	Traffic Signal
Passenger Car	1.00	1.00	1.00	1.00
Heavy vehicles	2.00	3.00	2.80	1.75
Buses	3.00	3.00	2.80	2.25
Motorcycle	0.75	1.00	0.75	0.33
Bicycle	0.33	0.50	0.50	0.20

Table 4.2 : Saturated flow Determination

Broad access road (m)	3.00	3.50	4.00	4.50	5.00	5.50
Saturated flow (u.k.p/hour)	1850	1875	1975	2175	2550	2900