SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENGAJIAN POLITEKNIK
KEMENTERIAN PENGAJIAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI 2 2021/2022

BCT40133 – GEOTECHNICAL ENGINEERING

TARIKH : 20 JUN 2022
MASA : 9.00 – 12.00 PM (3 JAM)

Kertas ini mengandungi **SEBELAS (11)** halaman bercetak.
Bahagian A: Struktur (4 soalan)
Dokumen sokongan yang disertakan : FORMULA

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN :

*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 C2 (a) Classify **FIVE (5)** processes involved in a rock cycle.

*Klasifikasi **LIMA (5)** proses dalam kitaran batuan.*

[5 marks]

[*5 markah*]

CLO1 C3 (b) From the particle size distribution curve given in Figure 1 (b), determine the uniformity coefficient (Cu) and coefficient of curvature (Cc) of the soil. Describe the gradation curve of the soil based on Cu and Cc obtained.

Dari lengkung agihan taburan zarah di Rajah 1(b), dapatkan koefisyen keseragaman (Cu) dan koefisyen kelengkungan (Cc) tanah tersebut. Jelaskan secara ringkas lengkung agihan tanah berpandukan Cu dan Cc yang di perolehi.

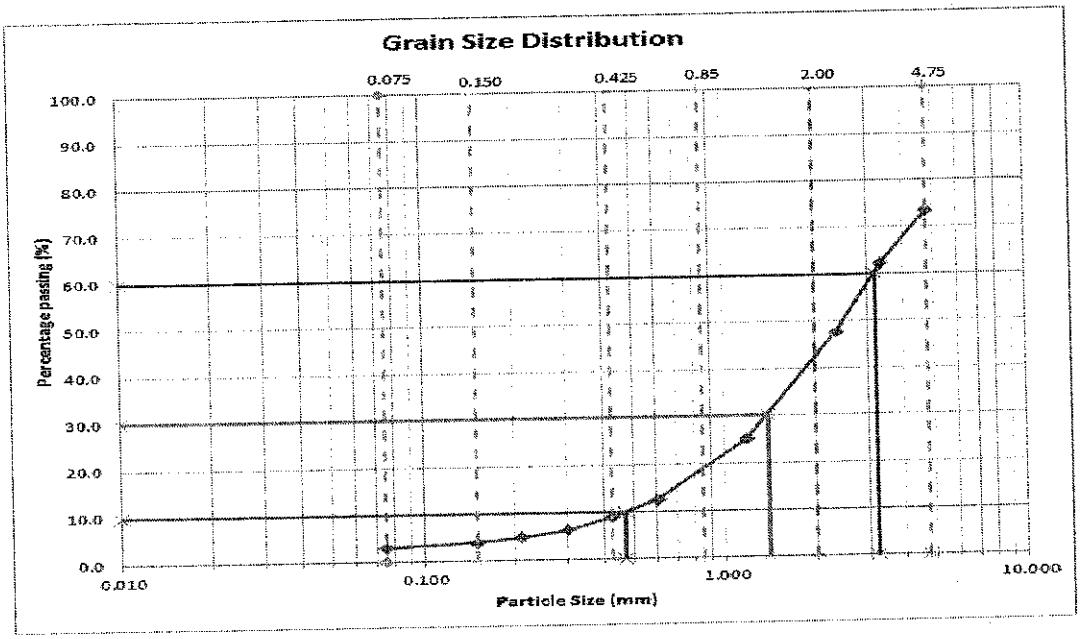


Figure 1 (b) / Rajah 1 (b)

D_{10} =

D_{30} =

D_{60} =

[10 marks]

[*10 markah*]

CLO1 C3 (c) A standard compaction test was performed on a sample of sandy clay. Table 1(c) shows the results obtained from this test.

Draw the graph of dry density against moisture content and determine the maximum dry density and optimum moisture content.

Suatu ujikaji pemadatan piawai telah dijalankan ke atas tanah liat berpasir. Jadual 1(c) menunjukkan keputusan ujian tersebut.

Lukiskan graf ketumpatan kering melawan kandungan lembapan dan tentukan ketumpatan kering maksimum dan kandungan lembapan optimum.

Table 1 (c) /*Jadual 1 (c)*

Trial No. *No. Ujian*	1	2	3	4	5	6
Dry density, ρ_d (kg/m^3) *Ketumpatan kering, ρ_d (kg/m^3)*	1670.3	1793.7	1874.5	1792.2	1732.7	1676.3
Moisture content, w (%) *Kandungan lembapan, w (%)*	7.7	11.5	14.6	17.5	19.7	21.2

[10 marks]
[*10 markah*]

QUESTION 2
SOALAN 2

CLO2
C2

(a) (i) Identify **FIVE (5)** factors affecting the permeability of the soil foundation.

*Kenalpasti **LIMA (5)** faktor yang mempengaruhi kebolehtelapan* asas tanah.

[5 marks]
[*5 markah*]

CLO2
C5

(ii) Figure 2(a) below shows a draft of earth dam. Construct a flow net for the earth dam with proper flow lines and equipotentials.

Rajah 2(a) di bawah menunjukkan keratan bagi empangan tanah. Lukis jaringan aliran bagi empangan tanah tersebut.

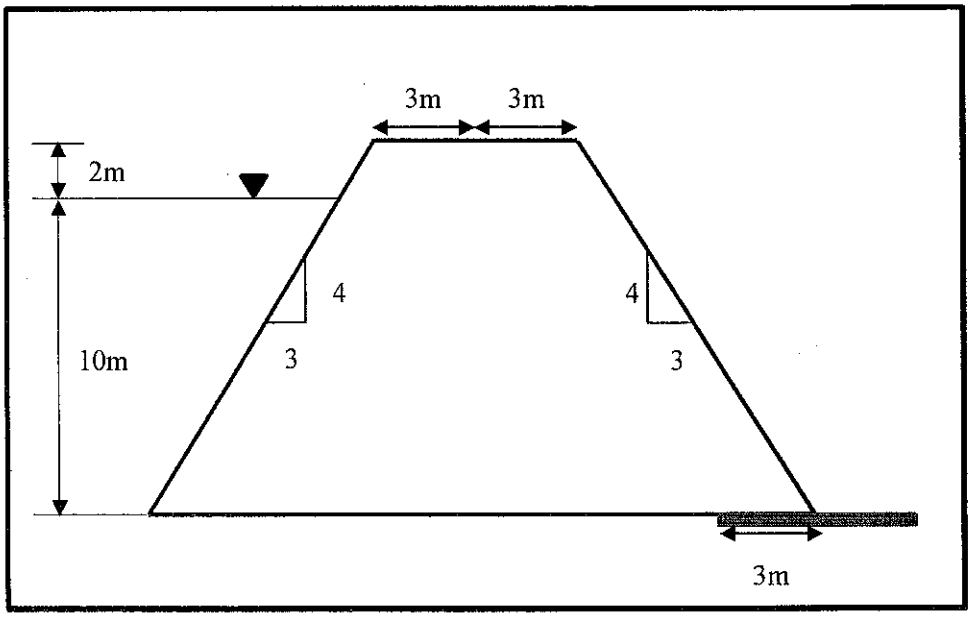


Figure 2(a) / *Rajah 2(a)*

[5 marks]

[*5 markah*]

CLO2
C3

(b) The following data were obtained from three (3) consolidated undrained triaxial test on a soil samples obtained from the construction site.

Data berikut di perolehi dari tiga (3) ujian Paksitiga Tak tersalir keatas sample tanah yang di ambil dari tapak pembinaan.

i) Draw the Mohr's circle of effective stresses from the results given in table 2b.
Lukis graf bulatan Mohr berpandukan keputusan yang diberikan dalam jadual 2b.

Cell Pressure *Tekanan Sel* (kN/m^2)	Deviator Stress *Tegasan Sisih* (kN/m^2)	Pore Water Pressure *Tekanan Air Liang* (kN/m^2)
150	193	50
250	242	120
350	382	150

Table 2b / *Jadual 2b*

[5 marks]

[5 markah]

CLO2 C4

ii) Determine the cohesion and friction angle of the soil samples.

Dapatkan nilai kejelekitan dan sudut rintangan dalam sampel tanah tersebut.

[10 marks]

[*10 markah*]

QUESTION 3

SOALAN 3

CLO2 C2

(a) (i) The profile shown in figure 3(a)(i) below is based on a soil investigation. Calculate the total effective stress of the soil at the depth of 1.5m, 4.0m and 9.0 m.

Berdasarkan kepada penyiasatan tanah, satu profail tanah telah diperolehi seperti rajah 3 (a)(i) di bawah. Kirakan jumlah tegasan berkesan bagi tanah tersebut pada kedalaman 1.5m, 4.0m dan 9.0m.

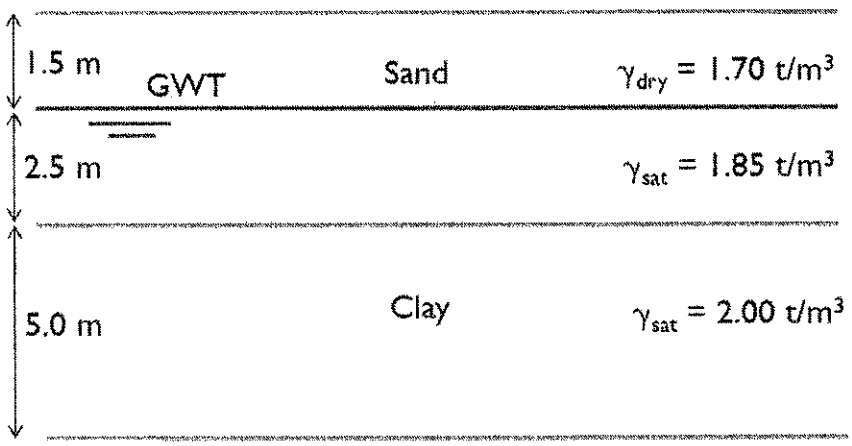


Figure 3 (a) (i) / *Rajah 3 (a) (i)*

[5 marks]

[*5 markah*]

CLO2
C3

(ii) The figure 3(a)(ii) 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 if the groundwater table is at the top of Soil 2.

Rajah 3(a)(ii) menunjukkan tanah yang mempunyai pelbagai nilai berat unit untuk setiap lapisan tanah. Kira tegasan normal, tekanan air liang dan tekanan berkesan pada titik A apabila aras air berada di lapisan atas Tanah 2.

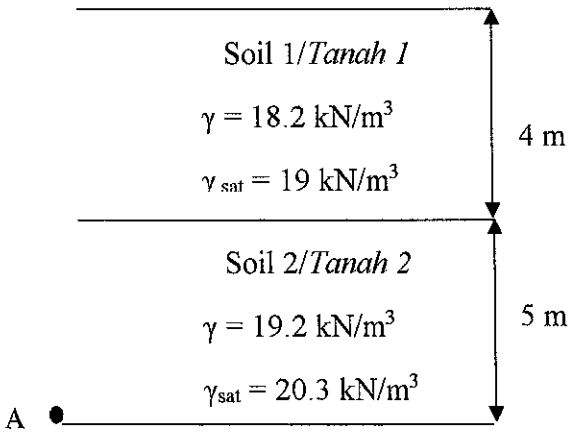


Figure 3 (a) (ii) / *Rajah 3 (b) (ii)*

(10 marks)

(*10 markah*)

(b) Table 3b results were obtained from a consolidation test on a sample of saturated clay, where each pressure increment had been maintained for 24 hours.

Jadual 3b adalah keputusan telah diperolehi daripada ujian pengukuhan ke atas sampel tanah liat tepu, setiap kenaikan tekanan telah dikekalkan selama 24 jam.

Table 3b/*Jadual 3b*

Pressure (kPa) *Tekanan (kPa)*	Thickness of sample after consolidation (mm) *Ketebalan sampel selepas pengukuhan (mm)*
0	30.0
5	29.7
10	29.5
20	29.1
50	28.7
100	28.5
200	28.2
400	27.7
800	27.4
1000	26.9
0	28.3

After it had expanded for 24 hours the sample was removed from the apparatus and found to have a water content of 30%. The particle specific gravity of the soil was 2.70.

Selepas ia telah berkembang untuk 24 jam sampel diambil dari radas dan didapati mempunyai kandungan air sebanyak 30%. Graviti tentu zarah tanah adalah 2.70.

CLO2
C4

(i) Analyze the void ratio of each of the pressure points.
Analisis nisbah lompang setiap tekanan yang dikenakan.

[5 marks]
[*5 markah*]

CLO2
C5

(ii) Determine the value of the coefficient volume change for a pressure range of 400kPa to 600kPa.
Tentukan pekali perubahan jumlah untuk pelbagai tekanan 400kPa ke 600kPa.

[5 marks]
[*5 markah*]

QUESTION 4

SOALAN 4

CLO2
C2

(a) Using the Taylor's Stability chart, determine the safety of the slope as shown in Figure 4(a) below.

Menggunakan Carta Kestabilan Taylor's, tentukan faktor keselamatan cerun dalam Rajah 4(a) di bawah.

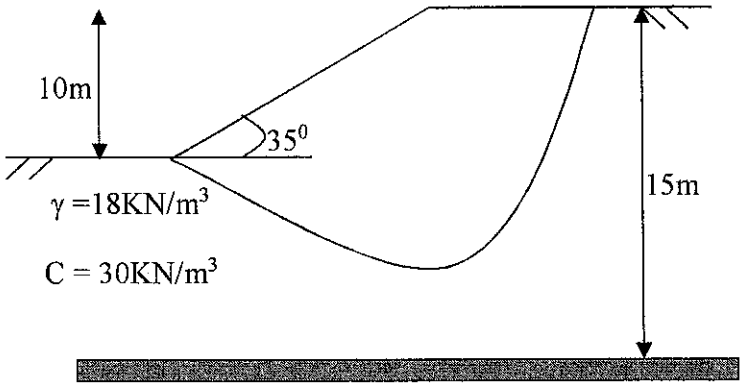


Figure 4(a)/ *Rajah 4(a)*

[5 marks]

[*5 markah*]

CLO2
C4

(b) Calculate the factor of safety (FS) against sliding shown in Figure 4(b) using the Total Stress Analysis Method.

Given :

Soil unit weight, γ	= 18.5 kN/m³	Angle of failure surface, θ	= 80°
Cohesion, C	= 5 kN/m²	Distance O to W, d	= 2 m
Area, A	= 250 m²	Radius, R	= 15 m

Kirakan faktor keselamatan terhadap gelangsar seperti yang ditunjukkan adalah Rajah 4(b) dengan menggunakan Kaedah Analisis Tegasan Jumlah.

Diberi:

Berat unit tanah, γ	*= 18.5 kN/m^3*	*Sudut kegagalan, θ*	*= 80°*
Kejelekitan, C	*= 5 kN/m^2*	*Jarak 0 ke W, d*	*= 2 m*
Luas, A	*= 250m^2*	*Jejari, R*	*= 15 m*

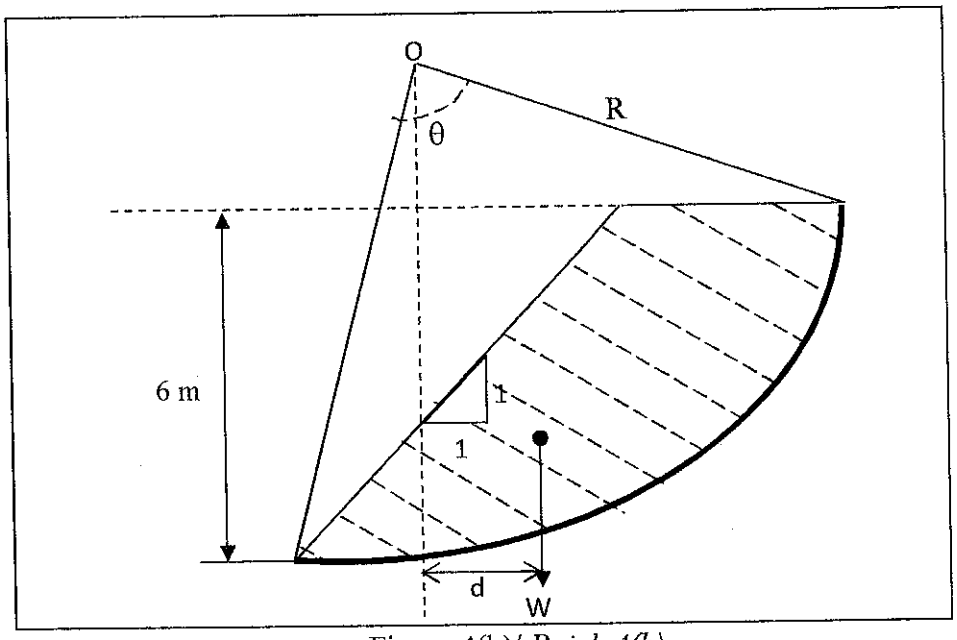


Figure 4(b)/ *Rajah 4(b)*

[10 marks]

[*10 markah*]

CLO2
C5

(c) A cut slope with 35m in height is shown in Figure 4 (c). Given:

Porosity, n = 46.2%

Specific Gravity = 2.7

Moisture content = 23%

Cohesion, C = 10 kN/m^2

Friction angle, $\phi = 15^0$

Estimate the safety factor of the slope using the Fellenius Methods of Slices. (Divide the slope into 7 slices).

Rajah 4(c) menunjukkan potongan cerun setinggi 35m. Diberi:

Keliangan, n = 46.2%

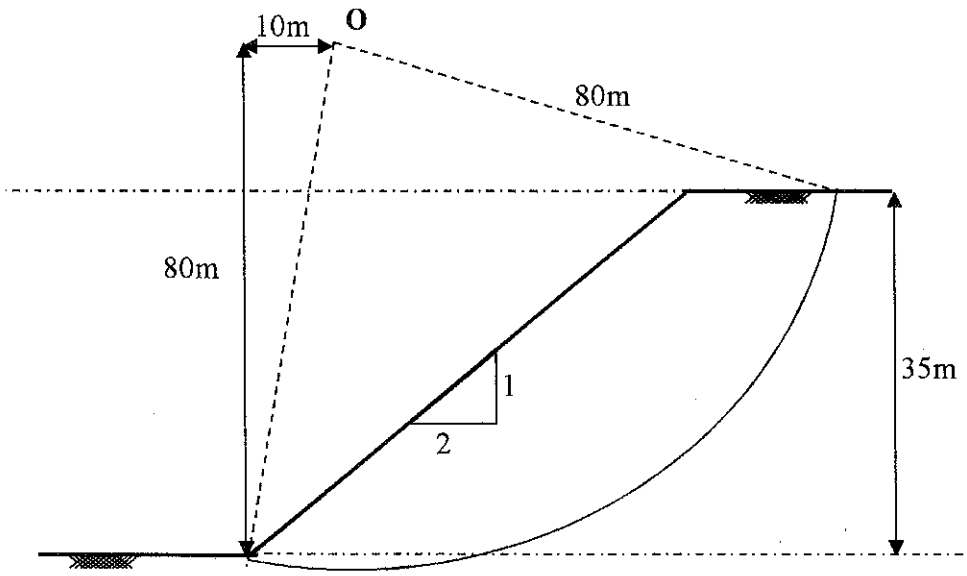
Graviti Tentu = 2.7

Kandungan Lembapan = 23%

Kejelekitan, C = 10 kN/m^2

Sudut geseran, $\phi = 15^0$

Tentukan faktor keselamatan bagi cerun di atas dengan menggunakan Kaedah Hirisan Fellenius. (Bahagikan kepada 7 hirisan).



[10 marks]

[*10 markah*]

SOALAN TAMAT

LAMPIRAN FORMULA BCT40133– GEOTECHNICAL ENGINEERING

1. $V_t = V_s + V_v = V_s + V_w + V_a$
2. $G_s = \frac{m_s}{V_s \rho_w}$
3. $\rho_d = \frac{\rho b}{1+w}$
5. $S_r = \frac{wGS}{e}$
6. $\rho_d = \frac{G_s \rho_w (1-A_r)}{(1+\omega G_s)}$
7. $k = \frac{VL}{Aht}$
8. $k = \frac{2.3039\ q\ log_{10}(\frac{r_2}{r_1})}{\pi(h_2^2 - h_1^2)}$ or $k = \frac{q\ ln(\frac{r_2}{r_1})}{\pi(h_2^2 - h_1^2)}$
9. $K_H = \frac{1}{H}(K_1H_1 + K_2H_2 + \ldots + K_nH_n)$
10. $\sigma = \rho gh = \gamma h$
11. $u = \gamma_w h$
12. $C_v = \frac{0.848H^2}{t_{90}}$
13. $\mathbf{Q} = k\ H\ \frac{Nf}{Ne}$
14. $i = \frac{\Delta h}{\Delta s}$
15. $u = \gamma_w [\ h - (-z)\ ]$
16. $K_a = \frac{1-\sin\phi}{1+\sin\phi}$
17. $\rho_b = \frac{Ms(1+w)}{v}$
18. $\gamma_b = \frac{Gs\rho w(1+w)}{1+e}$
19. $\rho_d = \frac{Gs\rho w}{1+e}$
20. $\rho_{sat} = \frac{\rho w(Gs+e)}{1+e}$
21. $n = \frac{e}{1+e}$
22. $k = 2.303\frac{aL}{At}\log_{10}(\frac{h_1}{h_2})$ or $k = \frac{aL}{At}\ln(\frac{h_1}{h_2})$
23. $k = \frac{q\ log_{10}(\frac{r_2}{r_1})}{2.727\ H\ (h_2 - h_1)}$ or $k = \frac{q\ ln(\frac{r_2}{r_1})}{2\pi\ H\ (h_2 - h_1)}$
24. $K_v = \frac{H}{\frac{H_1}{K_1} + \frac{H_2}{K_2} + \cdots\ldots + \frac{H_n}{K_n}}$
25. $\sigma = \sigma' + u$
26. $T_v = \frac{C_v\ t}{H^2}$
27. $C_v = \frac{k}{\gamma_w M_v}$
28. $FOS = \frac{CR^2\theta}{Wd}$
29. $FOS = \frac{C_A R^2\theta_A + C_B R^2\theta_B}{Wd}$
30. $\mathbf{P} = \frac{Rv}{B}\left(1 \pm \frac{6e}{B}\right)$
31. $FOS = \frac{Rv\ \tan\delta}{RH}$
32. $K_p = \frac{1+\sin\phi}{1-\sin\phi}$
44. $e = B/2 - \bar{X}$

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

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

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

36. $Z_c = \dfrac{2C}{\gamma}\sqrt{\dfrac{1}{Ka}}$

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

38. $Z_c = \dfrac{2C}{\gamma}\sqrt{\dfrac{1}{Ka}}$

39. $Z_C = \dfrac{2C_U}{\gamma}$

40. $\Delta e = \dfrac{\Delta H}{H_f}(1+e_f)$

41. $M_v = \dfrac{\Delta e}{\Delta P} \times \dfrac{1}{(1+e_1)}$

42. $a = \dfrac{e_1 - e_2}{dp}$

43. $FOS = \dfrac{cR^2\theta}{(wd)-(w'd')}$

45. $FOS = \dfrac{\mu R}{\mu T}$

46. $FOS = \dfrac{N_c C_u}{\gamma Z}$

47. $FOS = \dfrac{Cu}{N_S \gamma Z}$

48. $FOS = \dfrac{\sum CL' + wkos\,\alpha\tan\phi}{\sum w\sin\alpha}$

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

50. $FOS = \dfrac{CR^2\theta'}{Wd + PwYc}$

51. $e_f = w.G_s$

52. $e_1 = e_2 + \Delta e$

53. $M_v = \dfrac{a}{1+e_1}$

54. $p = \dfrac{3P}{2\pi z^2\left[1+\left(\frac{r}{z}\right)^2\right]^{5/2}}$

55. $\Delta H = H \times \dfrac{e_1 - e_2}{\Delta P}$

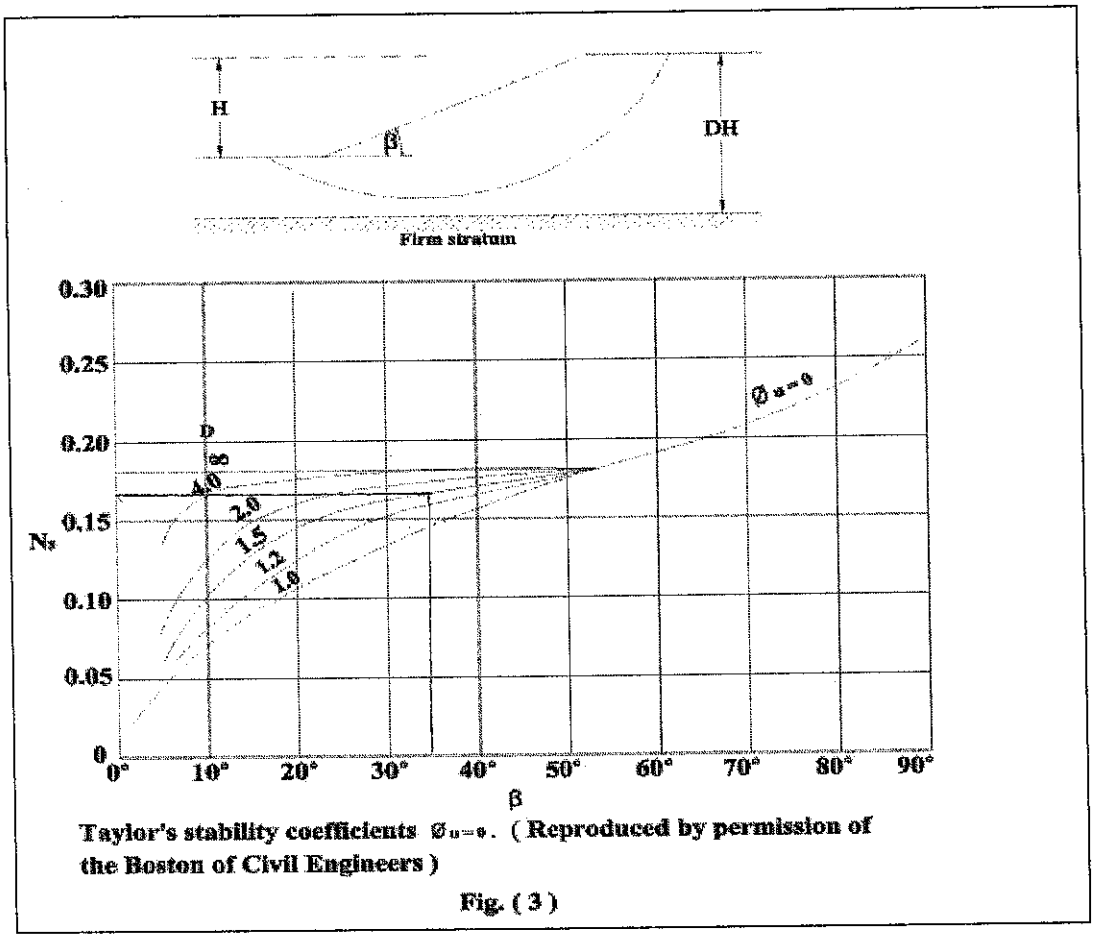
Correction Table $\dfrac{\Delta a}{a+\Delta a}$ Earth Dam (Non Filter)

56.

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

Taylor Stabilization Chart

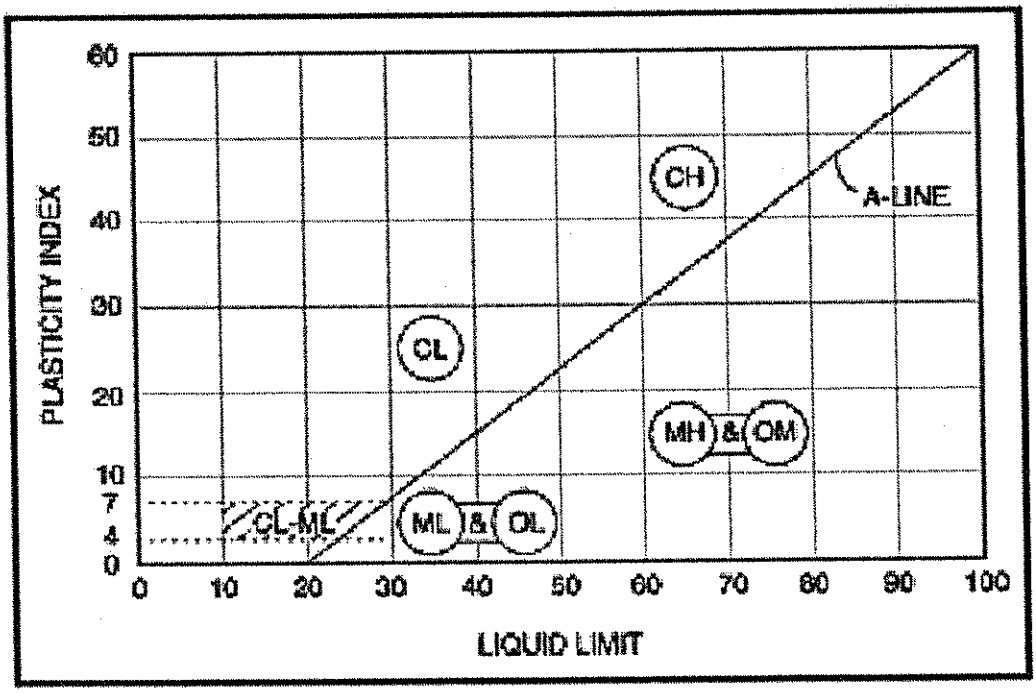
57.



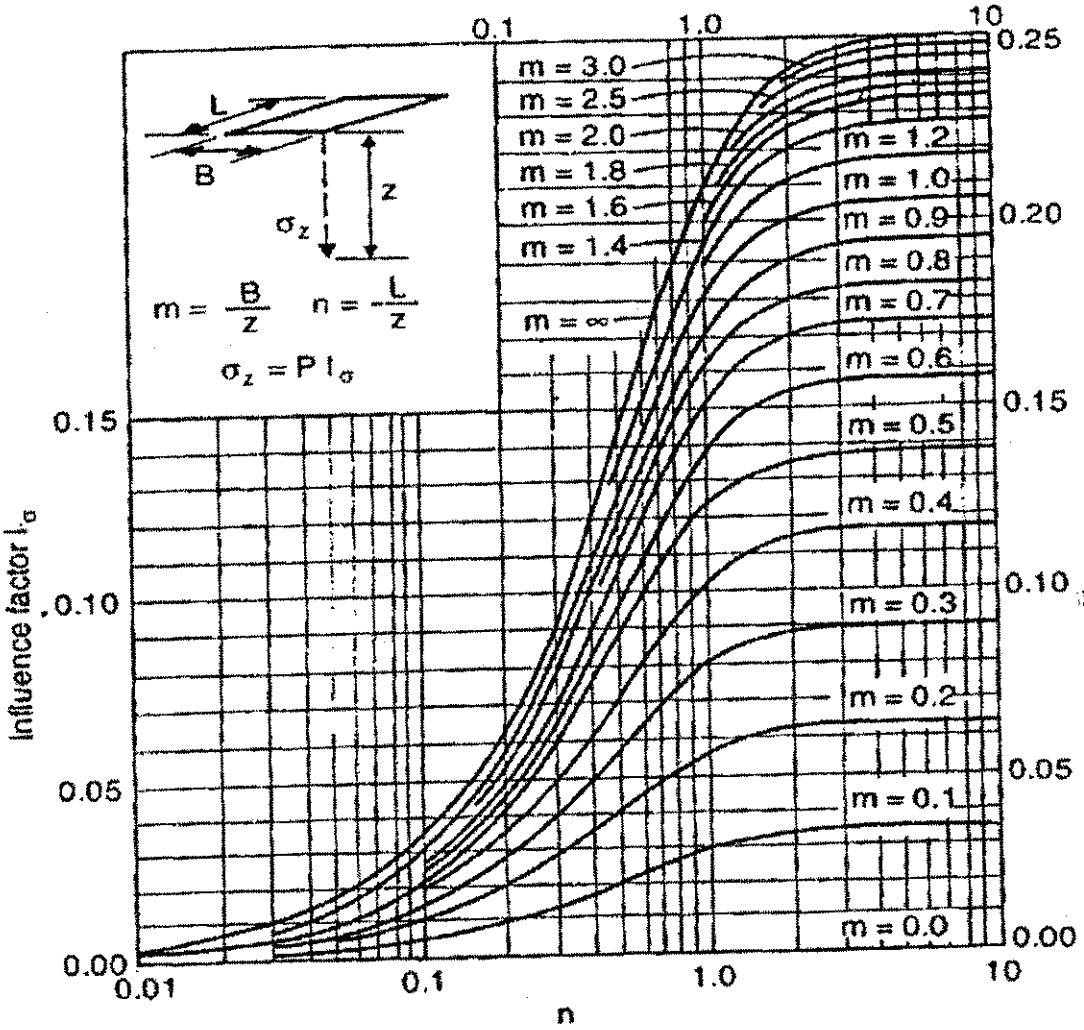
Taylor's stability coefficients $\varnothing_{u=0}$. (Reproduced by permission of the Boston of Civil Engineers)

Fig. (3)

58.



59.



Fadum Chart

60.

Darjah Pengukuhan (U_v)	Faktor Masa T_v
0.0	0.0
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848
0.95	1.129
1.00	∞

Jadual 19.1