UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/10

SUBJECT	:	GEOTECHNIC
SUBJECT CODE	:	BFC 3033
COURSE	:	3 BFF
DATE	:	MAY 2010
TIME	:	3 HOURS
INSTRUCTIONS	:	ANSWER FIVE QUESTIONS, Q1 AND ANY OTHER FOUR (4) QUESTIONS.

THIS PAPER CONSIST OF TWENTY ONE (21) PAGES

Q1 (a) Settlement generally occurs due to the compression of the material, reduction of void volume and rearrangement of soil grains due to the external static load. This shows that settlement characteristics will depend to the type of the soil and especially in fine-grained soil, is also time dependent. With the suitable diagram, draw the settlement characteristics and name all of the phases of settlement occur in the fine-grained soil. Give your explanation for each phase that has been listed.

(5 marks)

(b) The time for 50% consolidation of a 25 mm thick clay layer (drained at top and bottom) in the laboratory is 2 min. 20 sec. How long will it take for a 3-m thick layer of the same clay in the field under the same pressure increment to reach 50% consolidation? In the field, there is a rock layer at the bottom of the clay.

(5 marks)

(c) Calculate the primary consolidation settlement of the clay layer that has been subjected to surcharge load of 100 kN/m^2 as shown in Figure **Q1**. Given:
Sand: e = 0.6, Gs = 2.65; the sand above the ground water level is fully saturated.
Clay: e = 0.85, Gs = 2.75, C_c = 0.4, Cs = 0.04

(i) the clay is normally consolidated,

(2 marks)

(ii) the clay is over consolidated and the overconsolidation ratio is 1.5.

(2 marks)

(ii) Discuss the result in **Q1(c)(i)** and **Q1(c)(ii)**

(6 marks)

Q2 (a) Derive an expression for the bulk unit weight of a partially saturated soil in terms of the specific gravity of the particles G_s, the void ratio e, the degree of saturation S_r and the unit weight of water.

(5 marks)

(b) In a sample of clay the void ratio is 0.73 and the specific gravity of the soil particles is 2.70. If the voids are 92% saturated, find the bulk unit weight, the dry unit weight and the moisture content.

(5 marks)

(c) Explain briefly the major differences between the British Classification System and the Unified Soil Classification System (USCS).

(4 marks)

(d) The results of particle size analysis showed that particle passing sieve no. 4, 40, and 200 are 84%, 36.5% and 20.8% of the total weight respectively. The results of Atterberg limit tests done on soil fraction passing sieve no 40 gives liquid limit of 41.2% and plastic limit of 22.6%. Determine the classification of the soil according to the Unified Soil Classification System (USCS) based on Figure **Q2**.

(6 marks)

Q3 (a) A constant head permeameter has a diameter of 25 mm and the length of the soil sample is 250 mm. A constant head difference of 750 mm is maintained during the test, for which the discharge is 650 cm^3 in 3 minutes. Calculate the coefficient of permeability of the soil. Prove the formula used assuming Darcy's Law.

(4 marks)

(b) Describe briefly with the help of a neat sketch the method to determine the in-situ permeability of a sandy soil stratum using pumping from test well and measuring reduction in water levels from observation wells. The sandy soil stratum overlies a horizontal bed of impermeable material.

(4 marks)

(c) A flow net for flow in a permeable soil layer underneath a concrete dam is as shown in Figure **Q3.** Given the coefficient of permeability of the homogeneous and isotropic soil is 2.0×10^{-4} cm/sec.

(i) Determine the maximum exit hydraulic gradient and the factor of safety against boiling if the soil void ratio is 0.6 and the specific gravity is 2.7.

(4 marks)

(ii) Determine the porewater pressure at points A, B and C and based on these values estimate the uplift force under the dam.

(4 marks)

(iii) What modifications would you make if the permeability in the horizontal direction was found to be four times that in the vertical direction?

(4 marks)

Q4 (a) Describe the triaxial compression test for the determination of the shearing resistance of soils, explaining the principles of the following three types of test which are commonly conducted:

(i) The unconsolidated undrained (or quick, Q) test
(ii) The consolidated undrained (or intermediate, R) test
(iii) The consolidated drained (or slow, S) test.

(6 marks)

(b) Desribe briefly the determination of the undrained shear strength of plastic cohesive soils using the vane shear test.

(4 marks)

(c) A consolidated drained triaxial test was conducted on a normally consolidated soils. The resulta are as follows:

Chamber confining pressure = 140 kN/m^2
Deviator stress at failure = 263.5 kN/m^2

Determine:

(i) Effective angle of friction

(2 marks)

(ii) Angle that the failure plane makes with the major principal plane

(2 marks)

(iii) The effective normal stress and the shear stress on the failure plane

(3 marks)

(iv) The effective normal stress and the shear stress on the failure of maximum shear stress

(3 marks)

Q5 (a) With the aid of sketches, explain the following terminologies related to stresses in soil:

(i) Total and effective stress
(ii) Effective overburden stress
(iii) Lateral earth pressure coefficient
(iv) Passive force

(4 marks)

(b) For the stressed element shown in Figure **Q5(a)**, determine the major and the minor principal stresses, and the orientation of the principal planes.

(4 marks)

(c) The retaining structure shown in the Figure **Q5(b)**

(ii) Calculate the active and passive forces, it's direction and centroid of force using Rankine method starting from level B.

(4 marks)

(iii) If those calculation is done by Coulomb method (you don't need to calculate by Coulomb method), what the result likely will be, give your comment and evaluation.

(3 marks)

$$Ka = \cos\alpha \frac{\cos\alpha - \sqrt{\cos^2\alpha - \cos^2\phi}}{\cos\alpha + \sqrt{\cos^2\alpha - \cos^2\phi}} \; ; \; Kp = \cos\alpha \frac{\cos\alpha + \sqrt{\cos^2\alpha - \cos^2\phi}}{\cos\alpha - \sqrt{\cos^2\alpha - \cos^2\phi}}$$

(d) A rectangular footing 2.4 m x 2.0 m carries a uniformly distributed load of 320 kN/m^2. Find the intensity of vertical pressure at a depth of 4.2 m below the center and corner of the footing. Use the Influence chart provided in Figure **Q5(c)**

(5 marks)

Q6 (a) With the aid of sketches, briefly describe **three (3)** slope stabilisation methods.

(3 marks)

(b) One of the assumptions made in the ordinary slice method is that the interslice forces are neglected, comment on whether this assumption is realistic or not.

(3 marks)

(c) In the stability analysis of an earth embankment, the slip circle is as shown in Figure **Q6**. By using **Table 1** and the Fellenius method, determine the factor of safety of the slope.

(14 marks)

S1 (a) Pengenapan biasanya adalah disebabkan oleh pemadatan bahan, pengurangan isipadu lompang dan penyusunan zarah-zarah tanah disebabkan daya static luar. Ini membuktikan yang ciri-ciri pengenapan akan bergantung pada jenis tanah dan terutamanya untuk tanah berzarah halus, bergantung pada masa. Dengan berbantukan rajah yang sesuai, lukis cirri-ciri pengenapan dan namakan kesemua fasa pengenapan yang berlaku dalam tanah berbijian halus. Terangkan setiap fasa yang telah dinyatakan.

(5 markah)

(b) Masa yang diambil untuk mencapai 50% pengukuhan untuk satu lapisan tanah liat satebal 25 mm (dialirkan dari atas dan bawah) dalam makmal ialah 2 min. 20 sec. Berapa lamakah yang akan diambil oleh tanah liat sama satebal 3m ditapak bina dibawah peningkatan tekanan yang sama untuk mencapai 50% pengukuhan? Ditapak bina dibawah lapisan tanah liat ini terdapat lapisan batu hampar.

(5 markah)

(c) Tentukan pengenapan pengukuhan primer untuk satu lapisan tanah liat yang dikenakan beban sucaj sebanyak 100 kN/m^2 seperti di Rajah **Q1.** Diberi:
Pasir: e = 0.6, Gs = 2.65; pasir diatas air bumi adalah tepu sepenuhnya
Tanah liat: e = 0.85, Gs = 2.75, C_c = 0.4, Cs = 0.04

(i) tanah liat adalah terkukuh biasa,

(2 markah)

(ii) tanah liat terkukuh lebih dan nisbah pengukuhan lebih ialah 1.5.

(2 markah)

(iii) bincangkan keputusan daripada S1(c)(i) dan S1(c)(ii)

(6 markah)

S2 (a) Terbitkan hubungan berat unit pukal untuk tanah separa tepu dengan graviti tentu zarah-zarah G_s, nisbah lompang e, darjah ketepuan S_r dan berat unit air.

(5 markah)

(b) Dalam satu sampel tanah liat nisbah lompang ialah 0.73 dan graviti tentu zarah-zarah ialah 2.70. Sekiranya lompang ini ialah 92% tepu, tentukan berat unit pukal, berat unit kering dan kandungan lembapan.

(5 markah)

(c) Terangkan secara rengkas perbezaan-perbezaan utama diantara Sistem Pengkelasan British dan Sistem Pengkelasan Tanah Bersekutu (USCS).

(4 markah)

(d) Keputusan analisis saiz zarah menunjukkan yang zarah melepasi ayak no. 4, 40, dan 200 adalah masing-masing 84%, 36.5% and 20.8%. Keputusan ujikaji had Atterberg keatas tanah yang lulus ayak no 40 menunjukkan had cecair 41.2% dan had plastik ialah 22.6%. Tentukan kelas tanah ini mengikut Sistem Pengkelasn Bersekutu (USCS) berdasarkan Rajah **Q2**.

(6 markah)

S3 (a) Satu meter telap turus tetap bergarispusat 25 mm dan panjang sampel tanah didalamnya ialah 250 mm. Perbezaan turus malar 750 mm dikenakan sepanjang ujikaji ini, dimana isipadu discaj diukur ialah 650 cm^3 dalam tempoh 3 minit. Tentukan pekali ketelapan tanah berkenaan. Buktikan rumusan yang digunakan dengan menganggap Hukum Darcy.

(4 markah)

(b) Terangkan secara rengkas dengan mengunakan lakaran kaedah untuk menentukan pekali ketelapan ditapak bina untuk lapisan tanah berpasir menggunakan pemepaman dari telaga ujian dan mengukur pengurangan aras air ditelaga-telaga cerapan. Lapisan tanah berpasir terletak diatas satu hamparan tanh tak telap air.

(4 markah)

(c) Satu lukisan jaringan aliran dalam lapisan tanah telap air dibawah empangan konkrit adalah seperti yang ditunjukkan dalam Rajah **Q3**. Diberi pekali ketelapan tanah homogen dan isotropik ini ialah 2.0×10^{-4} cm/sec.,

(i) Tentukan kecerunan hidraul keluar maksimum dan factor keselamatan terhadap pengelegakan sekiranya nisbah lompang ialah 0.6 dan graviti tentu tanah ialah 2.7.

(4 markah)

(ii) Tentukan tekanan air liang pada titik A, B dan C dan berdasarkan nilai-nilai ini anggarkan daya tujahan dibawah empangan ini.

(4 markah)

(iii) Apakah perubahan-perubahan yang harus anda lakukan sekiranya pekali ketelapan arah mengufuk ialah empat kali ganda dari arah memugak?

(4 markah)

S4 (a) Terangkan ujikaji mampatan tiga-paksi bagi menentukan rentangan ricih tanah-tanah, menerangkan prinsip-prinsip tiga jenis ujikaji berikut yang mana biasa digunakan:

(i) Ujikaji Terkukuh Tersalir (atau cepat, Q)
(ii) Ujikaji terkukuh tak tersalir (atau pertengahan, R)
(iii) Ujikaji Terkukuh Tersalir (atau lambat, S)

(6 markah)

(b) Terangkan secara rengkas ujikaji untuk menentukan kekuatan ricih tak tersalir tanah-tanah menjelekit plastik menggunakan ujikaji bilah ricih.

(4 markah)

(c) Satu ujikaji tiga-paksi terkukuh tersalir telah dilakukan keatas tanah terkukuh biasa. Keputusan ujikaji adalah seperti berikut:

Tekanan kurungan balang = 140 kN/m^2
Tegasan ricih ketika gagal = 263.5 kN/m^2

Tentukan:

(i) Sudut rintangan dalam kesan,

(2 markah)

(ii) Sudut antara satah gagal dengan satah utama major.

(2 markah)

(iii) Tegasan normal kesan dan tegasan ricih atas satah kegagalan.

(3 markah)

(iv) Tegasan normal kesan dan tegasan ricih atas satah tegasan ricih maksimum.

(3 markah)

S5 (a) Dengan menggunakan lakaran-lakaran, terangkan perkara berikut yang berkait dengan tegasan dalam tanah:

(i) Tegasan-tegasan jumlah dan kesan
(ii) Tegasan tanggungan kesan
(iii) Pekali tekanan sisi tanah
(iv) Daya pasif

(4 markah)

(b) Untuk satu unsur bertegasan seperti yang ditunjukkan di Rajah **Q5(a),** tentukan tegasan-tegasan utama major dan minor, dan arah satah-satah utama.

(4 markah)

(c) Sebuah struktur penahan seperti yang ditunjukkan dalam Rajah **Q5(b)**

(ii) Kira daya-daya aktif dan pasif, arah dan titik tindak daya menggunakan kaedah Rankine bermula dari aras B

(4 markah)

(iii) Sekiranya pengiraan ini dibuat mengunakan kaedah Coulomb (anda tidak perlu mengira dengan kaedah ini secara terperinci), apakah kemungkinan keputusan yang akan diperolehi, beri komen dan penilaian anda.

(3 markah)

$$Ka = \cos\alpha \frac{\cos\alpha - \sqrt{\cos^2\alpha - \cos^2\phi}}{\cos\alpha + \sqrt{\cos^2\alpha - \cos^2\phi}} \; ; Kp = \cos\alpha \frac{\cos\alpha + \sqrt{\cos^2\alpha - \cos^2\phi}}{\cos\alpha - \sqrt{\cos^2\alpha - \cos^2\phi}}$$

(d) Satu tapak segiempat bujur berukuran 2.4 m x 2.0 m membawa beban teragih bernilai 320 kN/m^2. Kira perubahan tekanan pugak pada kedalaman 4.2m dibawah tengah-tengah dan bucu tapak berkenaan. Guna carta imbas yang diberikan seperti Rajah **Q5(c).**

(5 markah)

S6 (a) Dengan bantuan lakaran, terangkan dengan ringkas **tiga (3)** kaedah penstabilan cerun.

(3 markah)

(b) Salah satu anggapan yang digunapakai dalam kaedah hirisan biasa ialah bahawa daya antara tepi hirisan diabaikan. Beri komen samada anggapan ini realistik atau tidak.

(3 markah)

(c) Dalam analisa kestabilan tambakan tanah, lingkaran kegagalan dilukiskan seperti dalam Rajah **Q6**. Dengan menggunakan **Jadual 1** dan Kaedah Fellenius, tentukan nilai faktor keselamatan cerun ini.

(14 markah)

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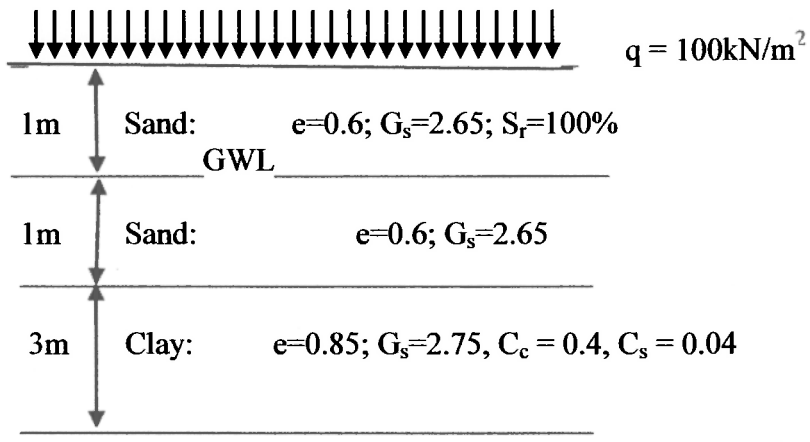

Figure Q1

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Table 3.2 Unified Soil Classification System (Based on Material Passing 76.2-mm Sieve)

Criteria for assigning group symbols				Group symbol
Coarse-grained soils More than 50% of retained on No. 4 sieve	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3^c$	GW
			$C_u < 4$ and/or $1 > C_c > 3^c$	GP
		Gravels with Fines More than 12% fines[a,d]	$PI < 4$ or plots below "A" line (Figure 3.2)	GM
			$PI > 7$ and plots on or above "A" line (Figure 3.2)	GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3^c$	SW
			$C_u < 6$ and/or $1 > C_c > 3^c$	SP
		Sands with Fines More than 12% fines[b,d]	$PI < 4$ or plots below "A" line (Figure 3.2)	SM
			$PI > 7$ and plots on or above "A" line (Figure 3.2)	SC
Fine-grained soils 50% or more passes No. 200 sieve	**Silts and clays** Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 3.2)[e]	CL
			$PI < 4$ or plots below "A" line (Figure 3.2)[e]	ML
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$; see Figure 3.2; OL zone	OL
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line (Figure 3.2)	CH
			PI plots below "A" line (Figure 3.2)	MH
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$; see Figure 3.2; OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a] Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.

[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

[c] $C_u = \frac{D_{60}}{D_{10}}, \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$

[d] If $4 < PI \leq 7$ and plots in the hatched area in Figure 3.2, use dual symbol GC-GM or SC-SM.

[e] If $4 < PI \leq 7$ and plots in the hatched area in Figure 3.2, use dual symbol CL-ML.

Figure Q2: USCS

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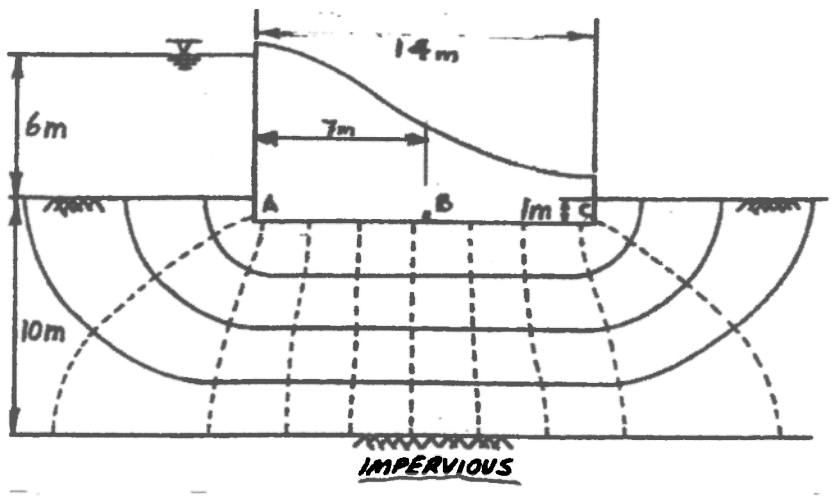

Fig. Q3 : Flow net underneath a concrete dam

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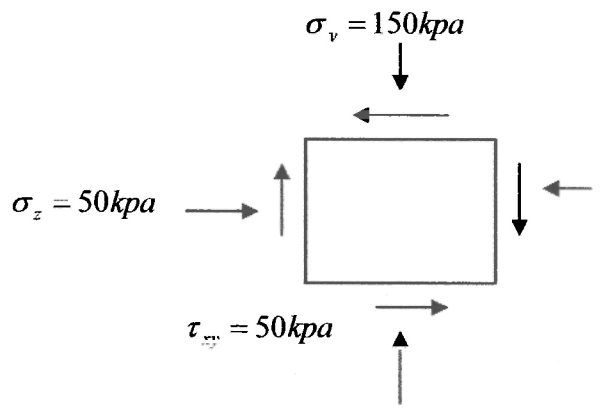

Fig. Q5(a) : Stressed soil element

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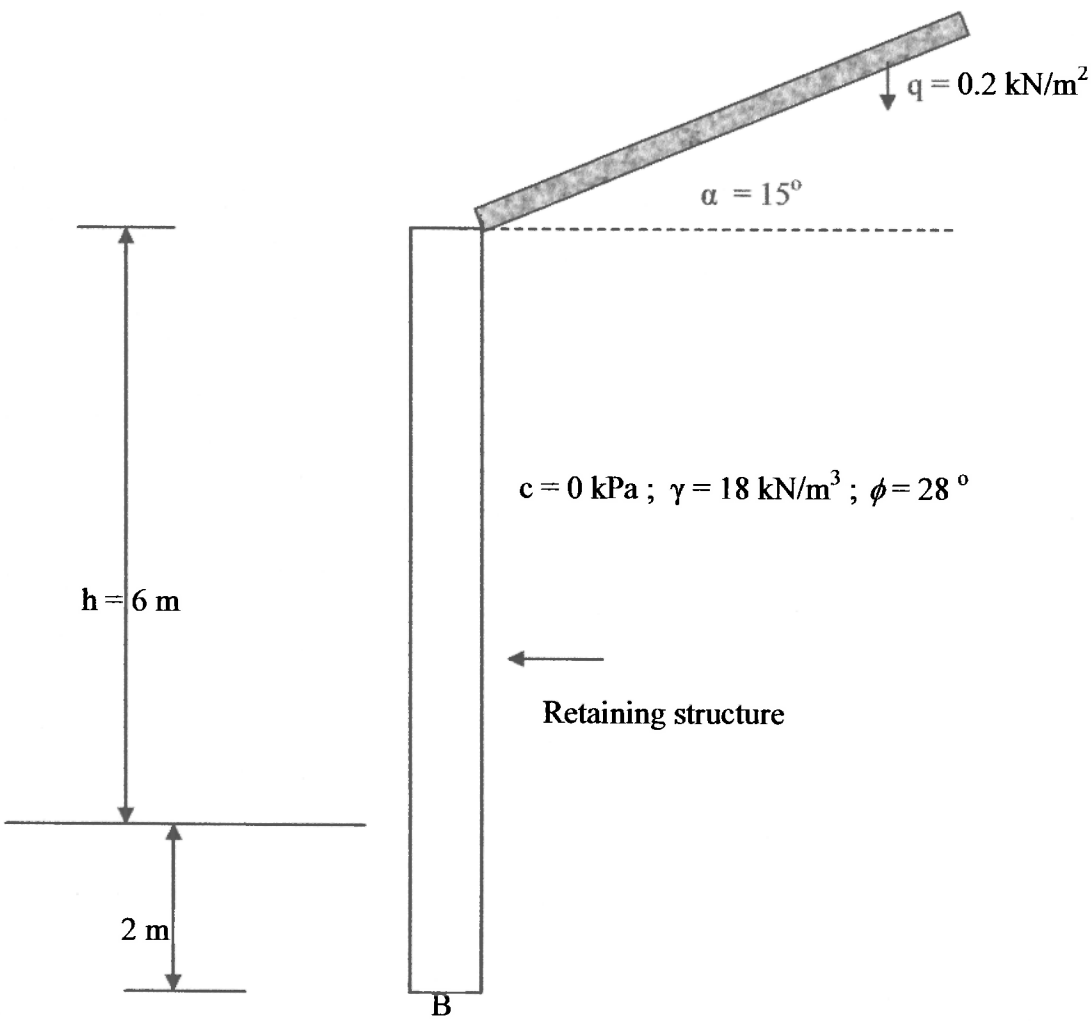

Figure Q5(b) : Retaining structure with inclined backfill

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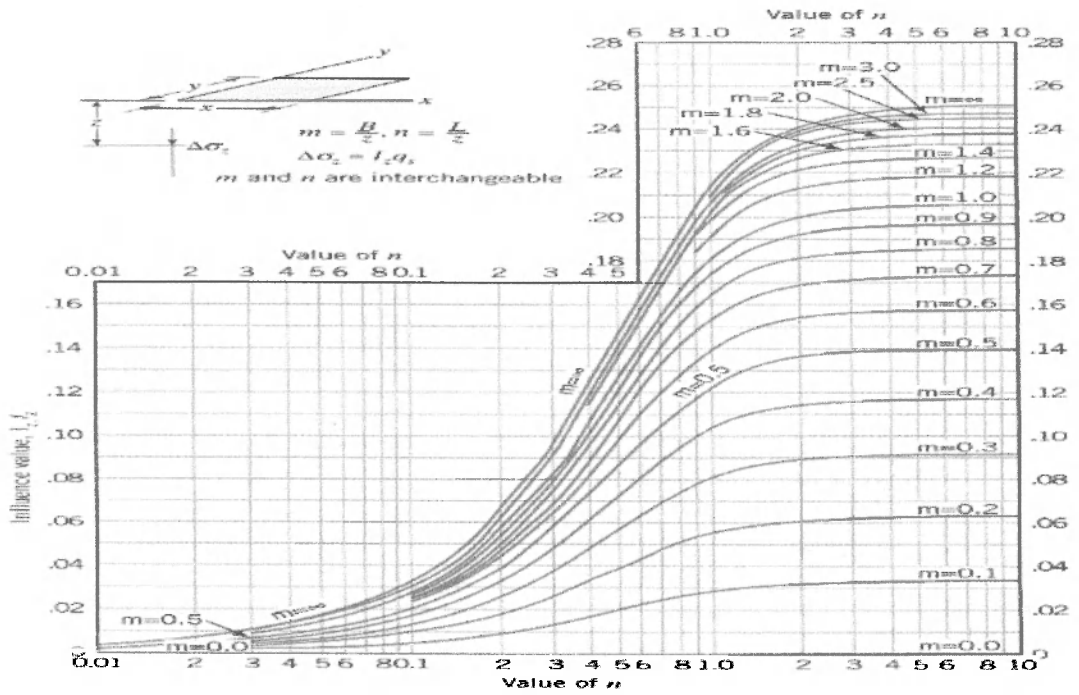

Figure Q5(c) : Variation of Influence Value with m and n

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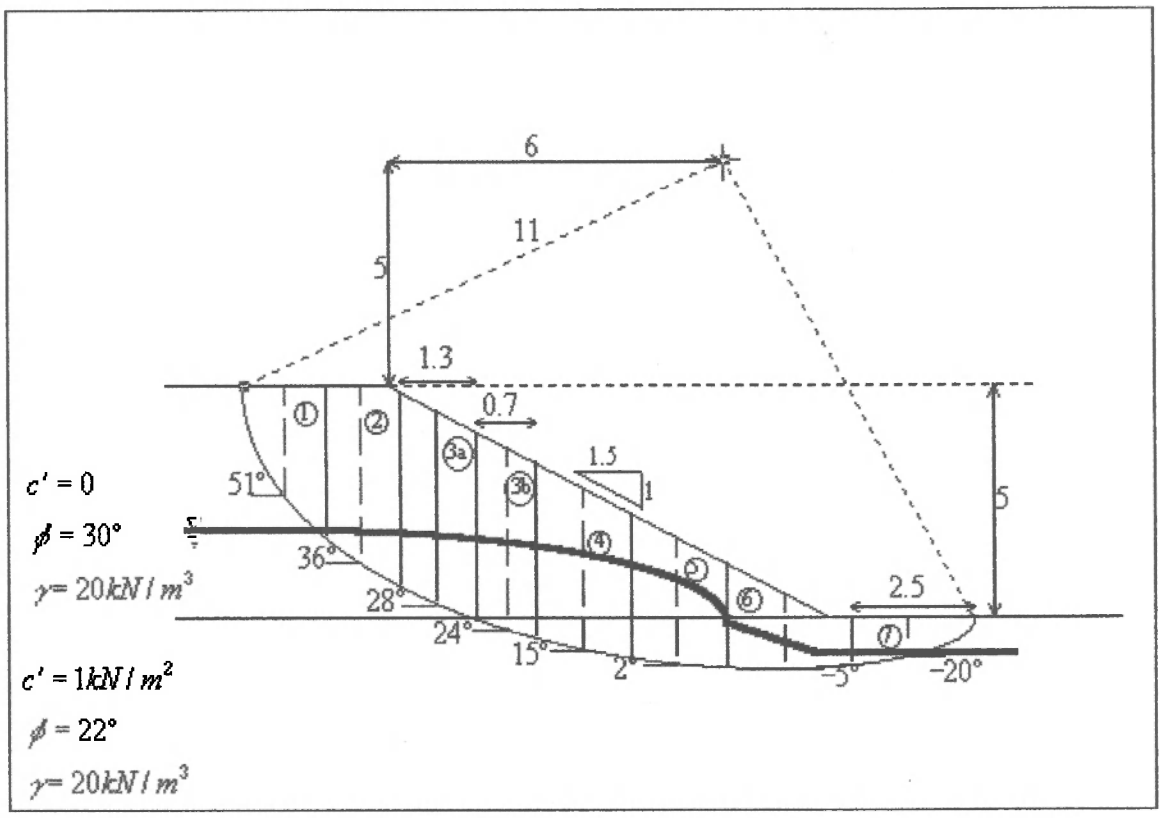

Figure Q6

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Table 1

No slice	α	b	h
1	51	2.0	1.65
2	36	2.0	3.65
3a	28	1.3	4.15
3b	24	0.7	3.90
4	15	2.0	3.50
5	2	2.0	2.50
6	-5	2.0	1.20
7	-20	2.5	0.5