UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

EAG 245/3 – Soil Mechanics
[Mekanik Tanah]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **ELEVEN** (11) printed pages including appendices before you begin the examination.
*[Sila pastikan kertas peperiksaan ini mengandungi **SEBELAS** (11) muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions: This paper contains **SIX** (6) questions. Answer **FIVE** (5) question. All questions carry the same marks.

*[**Arahan**:Kertas ini mengandungi **ENAM** (6) soalan. Jawab **LIMA** (5) soalan. Semua soalan membawa jumlah markah yang sama.]*

You may answer the question either in Bahasa Malaysia or English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

All questions **MUST BE** answered on a new page.
*[Semua soalan **MESTILAH** dijawab pada muka surat baru.]*

Write the answered question numbers on the cover sheet of the answer script.
[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]

1. (a) Explain what is meant by flow net and show an example how an approximate flow net can be drawn.

(8 marks)

Terangkan maksud jaringan aliran dan tunjukkan bagaimana anggaran jaringan aliran boleh di lakarkan

(8 markah)

(b) Construct a flow net for the sheet pile as in Figure 1 below, with D_1= 8m, D_2= 4m, H_1=14m and H_2 = 6 m. Estimate the seepage per m of width of sheet pile.

(12 marks)

Lakarkan jaringan aliran untuk cerucuk kepingan untuk Rajah 1 di bawah, dengan D_1= 8m, D_2= 4m, H_1=14m and H_2 = 6 m. Anggarkan resipan per m panjang cerecuk kepingan.

(12 markah)

D1

D2

H2

H1

PERMEABLE SOIL
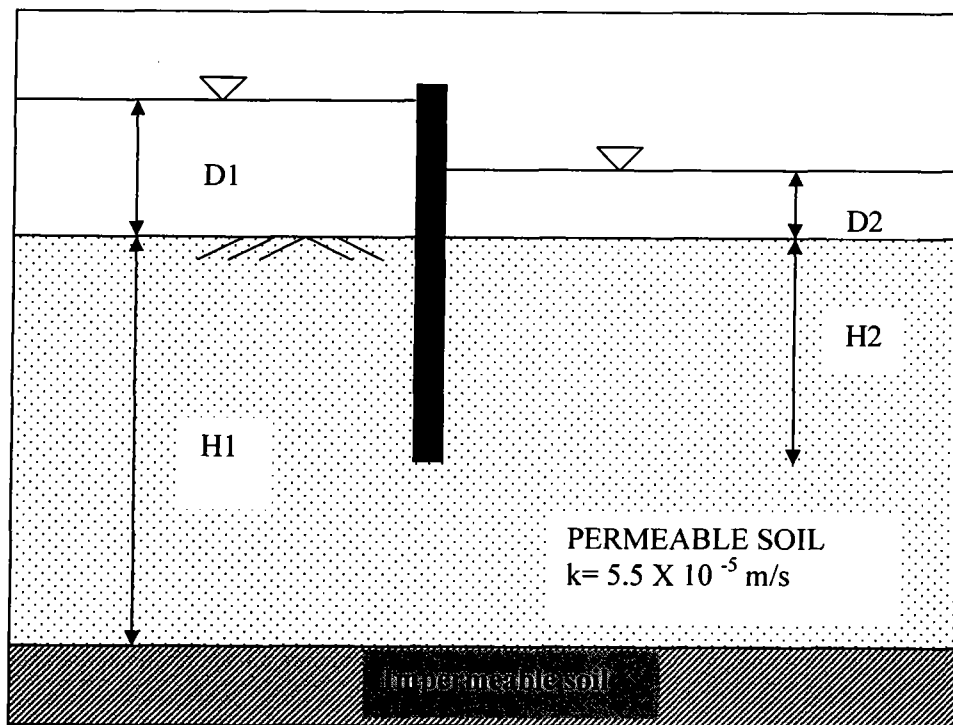k= 5.5 X 10^{-5} m/s

Impermeable soil

Figure 1 / Rajah 1

2. (a) Explain briefly with sketches differences between total and effective pressure

(6 marks)

Terangkan secara ringkas dengan lakaran perbezaan di antara tekanan jumlah dan tekanan efektif

(6 markah]

(b) The soil layer on a site consist of ;

0 - 5 m: BS gravel-sand with γ_{sat} = 19.5 kN/m^3 and γ = 18.0 kN/m^3

5 - 12 m: BS clay with γ = 17.0 kN/m^3

Draw an effective stress and total stress profile between 0 -12 m , when the water table is

i) 1m above the top of the clay.
ii) At clay layer

(14 marks)

Lapisan tanah di tapak mempunyai ciri berikut:

0 - 5 m: BS kerikil-pasir dengan γ_{sat} = 19.5 kN/m^3 and γ = 18.0 kN/m^3

5 - 12 m: BS lempung dengan γ = 17.0 kN/m^3

Lakar tegasan berkesan dan tegasan jumlah untuk profil di antara 0 -12 m, sekiranya paras air bumi pada

i)   1m di atas tanah lempung
ii)   Di atas lapisan lempung

(14 markah)

3.(a) Explain the purpose and importance of soil classification in engineering practices.

(4 marks)

Terangkan tujuan pengkelasan tanah dan kepentingannya dalam kerja-kerja kejuruteraan.

(4 markah)

(b) One of the most important elements in soil classification is the Atterberg Limit. With assistant of a sketch, define the terms Liquid Limit, Plastic Limit and Plasticity Index.

(6 marks)

Salah satu elemen penting dalam pengkelasan tanah adalah Had Atterberg. Berbantukan lakaran, beri definisi Had Cecair, Had Plastik dan Indeks Keplastikan.

(6 markah)

(c) A soil sample of 29kg mass consists of 16×10^3 cm^3 volume. When it is dried out in an oven, it weighs 22kg. The specific gravity of the solids is found to be 2.65.

a) Draw 3-phase diagram of the soil;
b) Calculate the void ratio, wet and dry unit weight of the soil.

(10 marks)

Satu sampel tanah seberat 29kg mempunyai isipadu 16×10^3 cm^3. Apabila telah dikeringkan dari oven, beratnya adalah 22kg. Ketumpatan tentu pepejal adalah 2.65

a) Lakarkan gambarajah 3 fasa tanah tersebut;
b) Kira nisbah lompang, berat unit basah dan kering tanah tersebut.

(10 markah)

4. (a) Explain with sketches **THREE** (3) types of clay fabric structure that are commonly found.

(6 marks)

*Terangkan dengan lakaran, **TIGA** (3) jenis struktur fabrik tanah lempung yang biasa ditemui.*

(6 markah)

(b) Soil A has been taken from a particular site and cone penetrometer test has been carried out to the sample. The results are presented below ;

Cone penetration (mm)	15.3	18.2	19.3	22.1	24.8
Water content (%)	39.1	40.9	42	44.5	45.5

Determine the Liquid Limit for the soil

(4 marks)

Sampel tanah A telah diambil dari tapak tertentu dan ujian penusukan kon telah dilakukan ke atas sampel. Keputusan adalah seperti berikut ;

Penusukan kon (mm)	*15.3*	*18.2*	*19.3*	*22.1*	*24.8*
Kandungan air (%)	*39.1*	*40.9*	*42*	*44.5*	*45.5*

Tentukan Had Cecair tanah tersebut

(4 markah)

(c) Table 1 shows the result obtained from a soil sample which was tested in the laboratory for a site nearby USM. If the Plasticity Index of the soil is nonplastic, classify the soil according to the AASHTO system and the Unified Soil Classification System. (Appendix 1 and 2)

U.S Sieve Size	Opening Size (mm)	Percentage Passing
No 4	4.75	98
No 10	2.00	92
No 40	0.425	43
No 100	0.150	7
No 200	0.075	3

Table 1 – Sieve Analysis

(10 marks)

Jadual 1 menunjukkan keputusan yang diperoleh dari satu sampel tanah yang telah diuji di makmal bagi suatu kawasan berdekatan USM. Jika Indeks Keplastikan tanah tersebut adalah tidak plastik, kelaskan tanah tersebut berdasarkan sistem AASHTO dan USCS. (Lampiran 1 dan 2)

Saiz Ayak	Saiz Bukaan (mm)	Peratus Halus
No 4	4.75	98
No 10	2.00	92
No 40	0.425	43
No 100	0.150	7
No 200	0.075	3

Jadual 1 – Analisis Ayak

(10 markah)

5. (a) Describe the difference between the Standard Compaction Test and Modified Compaction Test. Use sketch to show differences in their relationship.

(6 marks)

Huraikan perbezaan di antara Ujian Pemadatan Piawai dan Ujian Pemadatan Diubahsuai. Gunakan lakaran bagi menunjukkan perbezaan dalam hubungan di antara keduanya.

(6 markah)

(b) Describe **THREE** (3) factors affecting the compaction processes. Use diagrams and sketches to support your answer.

(6 marks)

*Jelaskan **TIGA** (3) faktor yang akan mempengaruhi proses pemadatan tanah. Gunakan rajah dan lakaran untuk menyokong jawapan anda.*

(6 markah)

(c) During a road construction, a sand replacement method was performed to evaluate the required in-situ density of soil.

    i. Explain what you understand by sand replacement method.

(4 marks)

    ii. The weight of sand used to fill test hole and funnel of sand-cone device is 853g and the weight of sand to fill funnel is 321g. The density of the sand is found to be $1.54g/cm^3$, the weight of the wet soil from the test hole is 739g and the moisture content is 15%. Calculate the dry unit weight of the compacted soil.

(4 marks)

Semasa pembinaan suatu jalan, suatu ujian di tapak menggunakan kaedah penggantian pasir telah dilakukan bagi menilai ketumpatan tanah yang diperlukan di tapak.

    i. Terangkan apa yang anda faham mengenai kaedah penggantian pasir.

(4 markah)

    ii. Berat pasir yang digunakan untuk memenuhi lubang ujian dan alat kon-pasir adalah 853g dan berat pasir yang memenuhi corong adalah 321g. Ketumpatan pasir adalah $1.54g/cm^3$ dan berat tanah lembap dari lubang ujian adalah 739g dan kandungan lembapan tanah adalah 15%. Kira berat unit kering tanah yang telah dimampatkan.
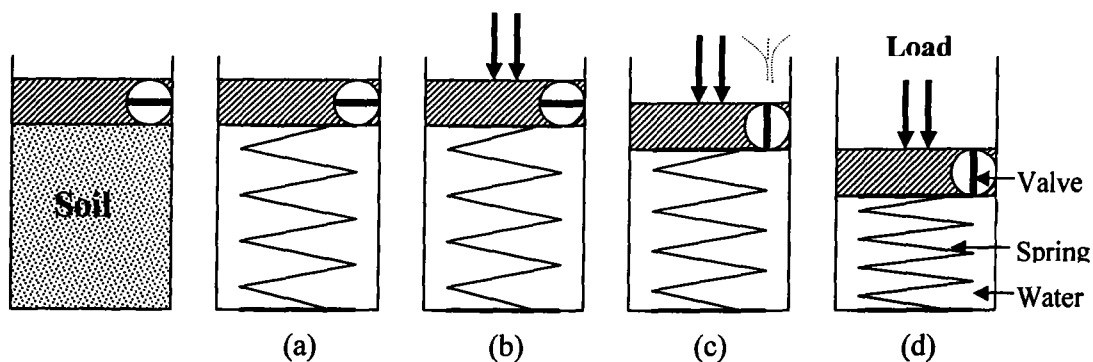
(4 markah)

6. (a) Describe briefly one dimensional consolidation process of each process for the analogy as rheology model shown in Figure 6.1. (a, b, c and d)

(4 marks)

Terangkan secara ringkas analogi setiap proses pengukuhan satu hala seperti digambarkan di dalam model rheology di dalam Rajah 6.1.(a, b, c dan d)

(4 markah)

Figure 2

(a)   (b)   (c)   (d)

(b)   A consolidation test was conducted on a soil sample which has a void ratio of 1.642 and resulted data shown in Table 6.1.

Ujian pengukuhan keatas suatu sampel tanah yang mempunyai nisbah lompang 1.642 dan menghasilkan data di Jadual 6.1.

Table 2

e	Pressure, σ' (kPa)
1.614	12.5
1.588	25
1.538	50
1.468	100
1.358	200
1.225	400
1.063	800

i.   Draw the e – log σ' curve.

(4 marks)

Lukiskan lengkung e – log σ'.

(4 markah)

ii. Determine the pre-consolidation pressure.

(4 marks)

Tentukan tegasan pra-pengukuhan.

(4 markah)

iii. Determine Compression Index, C_c.

(3 marks)

Tentukan Indeks Pengukuhan, C_c.

(3 markah)

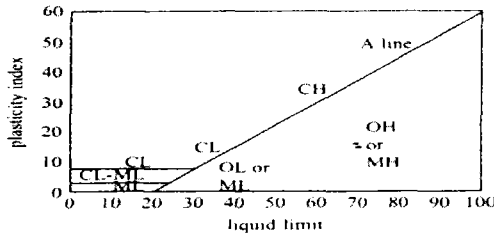iv. Determine the in-situ virgin compression line (Schmertmann Method).

(5 marks)

Tentukan lengkung mampatan dara di tapak (Kaedah Schmertmann).

(5 markah)

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APPENDIX/LAMPIRAN

COARSE More than 50% retained sieve #200	Gravel: more than 50% coarse fraction retained on sieve #4	Less than 5% fines	$C_u > 4, 1 \leq C_c \leq 3$	—	GW
			Not satisfying GW	—	GP
		More than 12% fines	Below 'A' line	—	GM
			Above 'A' line	—	GC
	Sand: less than 50% coarse fraction retained on sieve #4	Less than 5% fines	$C_u > 6, 1 \leq C_c \leq 3$	—	SW
			Not satisfying SW	—	SP
		More than 12% fines	Below 'A' line	—	SM
			Above 'A' line	—	SC
FINE Less than 50% retained sieve #200	$LL < 50$				ML
					CL
					OL
	$LL > 50$				MH
					CH
					OH

ORGANIC SOILS — Pt

Classification of Soils and Soil-Aggregate Mixtures by AASHTO Classification System (AASHTO M-145)

General Classification	Granular Materials (35% or less passing 0.075 mm)							Silt–Clay Materials (more than 35% passing 0.075 mm)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group Classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6
Sieve analysis: Percent passing:											
2.00 mm (No. 10)	50 max.	—	—	—	—	—	—	—	—	—	—
0.425 mm (No. 40)	30 max.	50 max.	51 min.	—	—	—	—	—	—	—	—
0.075 mm (No. 200)	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing 0.425 mm (No. 40):											
Liquid limit	—	—	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	
Plasticity index	6 max.		NP	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.[1]
Usual types of significant constituent materials	Stone fragments, gravel, and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to good						Fair to poor				

[1]Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

Source: Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Part I, Specifications, 13th ed., AASHTO, 1982.