UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2006/2007

April 2007

EAG 245E/3 – Soil Mechanics
[Mekanik Tanah]

Duration: 3 hours
[Masa: 3 jam]

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

Instructions: Answer **FIVE (5)** questions only. All questions carry the same marks.
*[**Arahan**: Jawab **LIMA (5)** soalan sahaja. Semua soalan membawa jumlah markah yang sama.*

You may answer the question either in Bahasa Malaysia or in English or a combination of both languages.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris ataupun kombinasi kedua-dua bahasa.]

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] Briefly describe what are 3-phase and 2-phase relationships. Draw the phase diagram for each case involving the 3-phase and 2-phase reltionships.

(3 marks)

Terangkan secara ringkas apa itu hubungan 3-fasa dan 2-fasa. Lukiskan gambarajah fasa bagi kes 3-fasa dan kes 2-fasa.

[b] List the tests involved in determining index properties and in classifying soils.

(2 marks)

Senaraikan ujikaji-ujikaji yang terlibat dalam menentukan kandungan indeks dan pengelasan tanah.

[c] State the full name of the following acronym.

(5 marks)

Nyatakan nama penuh bagi akronim berikut.

(i) GW
(ii) GC
(iii) SP
(iv) SC
(v) Pt

[d] The following information is obtained from a sieve analysis to determine the range of particle sizes in a granular sample.

Maklumat daripada analisis ayakan diberi untuk mengenalpasti julat saiz zarah untuk sampel berbutir.

Sieve size (U.S Sieve No) *Saiz Ayak (No Sieve U.S)*	Sieve Opening (mm) *Saiz Bukaan Ayak (mm)*	Mass of Soil Retained on Each Sieve (g) *Berat Tertahan di Atas Setiap Bukaan Ayak (g)*
4	4.75	0
6	3.35	28
10	2	49.3
20	0.85	128.5
40	0.425	96.5
60	0.25	77.1
100	0.15	54.9
200	0.0075	43.1
Pan		22.6

i) Determine the percent finer than each sieve size and plot a particle-size distribution curve.

(4 marks)

Tentukan peratus telus bagi setiap ayak dan plot lengkung saiz zarah.

ii) Determine D_{10}, D_{30}, D_{60} from the particle-size distribution curve.

(2 marks)

Tentukan nilai D_{10}, D_{30}, D_{60} dari lengkung saiz zarah yang diperolehi.

iii) Calculate the Uniformity Coefficient, C_u.

(2 marks)

Kira Pekali Keseragaman, C_u.

iv) Calculate the Coefficient of Curvature, C_c.

(2 marks)

Kira Pekali Lengkung, C_c.

2. [a] Briefly describe the **THREE (3)** important groups of clay minerals and the main behaviour of each group.

(6 marks)

*Terangkan secara ringkas **TIGA (3)** kumpulan penting mineral tanah lempung dan sifat-sifat utama bagi setiap satunya.*

[b] Sketch clay minerals arrangement of each of the **THREE (3)** groups described above in (a).

(6 marks)

*Lukis **TIGA (3)** susunatur mineral lempung berdasarkan kumpulan yang diterangkan dalam (a).*

[c] Explain the terms Liquid Limit, Plastic Limit and Plasticity Index. Describe how they are measured.

(4 marks)

Terangkan istilah Had Cecair, Had Plastik dan Indeks Keplastikan. Terangkan bagaimana setiap satunya ditentukan.

2. [d] The Atterberg's limits of soil are LL = 75%, PL = 26% and the soil contains 44% clay by mass of solids. If the natural water content of the soil is 66%, determine its Plasticity Index, Activity and Liquidity Index. Describe the soil's general feature based on your answer.

(4 marks)

Had Atterberg's tanah adalah LL = 75%, PL = 26% dan kandungan tanah lempung adalah 44%. Sekiranya kandung air semulajadi adalah 66%, tentukan Indeks Keplastikan, Aktiviti dan Indeks Kecairan. Terangkan keadaan tanah berkenaan berdasarkan jawapan anda.

3. [a] Explain the meaning of total normal stress, pore water pressure and effective normal stress.

(6 marks)

Terangkan maksud tegasan normal jumlah, tekanan air liang dan tegasan normal berkesan.

[b] State the relationship which relates together the three stresses.

(2 marks)

Terbitkan persamaan yang menghubungkan ketiga-tiga tekanan tersebut.

[c] On a certain site, the surface layer is silty sands and is 5.0 m thick. This silty sand layer overlies a 4.5 m thick peaty clay, which in turn overlies an impermeable bedrock. Draw the effective and total stress diagram for the given profile with the following conditions:

(i) Water table at the surface
(ii) Water table at a depth of 2.5m from the surface

Where, $\gamma_{silty\ sand\ (saturated)} = 20.0\ kN/m^3$, $\gamma_{silty\ sand(dry)} = 16.0\ kN/m^3$ and $\gamma_{clay(saturated)} = 19.0\ kN/m^3$.

(12 marks)

Dalam keadaan tertentu, tapak permukaan terdiri daripada lapisan 5.0 m pasir berkelodak. Di bawah lapisan ini terdapat gambut berlempung setebal 4.5 m sementara di bawahnya pula terdapat batuan dasar tak telap air. Lakar gambarajah tegasan berkesan dan tegasan jumlah bagi profil tersebut jika diberi keadaan berikut:

(i) Air bumi di permukaan
(ii) Air bumi pada kedalaman 2.5 m dari permukaan

Diberi, $\gamma_{pasir\ berkelodak(tepu)} = 20.0\ kN/m^3$, $\gamma_{pasir\ berkelodak(kering)} = 16.0\ kN/m^3$ *dan* $\gamma_{lempung(tepu)} = 19.0\ kN/m^3$

4. [a] What do you understand by the term 'flow net'?

(4 marks)

Apakah yang boleh anda fahami dengan istilah "Jaringan Aliran"?

[b] Make a sketch of a flow net of seepage under the sheet pile wall shown in Figure 1 and estimate the quantity of seepage in m^3/min/m run of piling if the permeability of the sand is 18 x 10^{-3} mm/s. If the unit weight of the sand is 18.5 kN/m^3 is there any likelihood of piping anywhere in front of the piles?

(12 marks)

Lakarkan jaringan aliran resipan di bawah dinding cerucuk keping yang di tunjukkan pada Rajah 1 dan anggarkan kuantiti resipan dalam unit m^3/min/m panjang untuk cerucuk sekiranya kebolehtelapan bagi pasir adalah 18 x 10^{-3}mm/s. Sekiranya berat unit pasir adalah 18.5 kN/m^3 mungkinkah terjadi keadaan perpaipan di hadapan cerucuk?

[c] Determine the value of pore water pressure at a point near the toe of the wall, which is indicated as X in Figure 1?

(4 marks)

Tentukan nilai tekanan air liang pada kaki tembok iaitu di kedudukan ditanda sebagai X di Rajah 1.

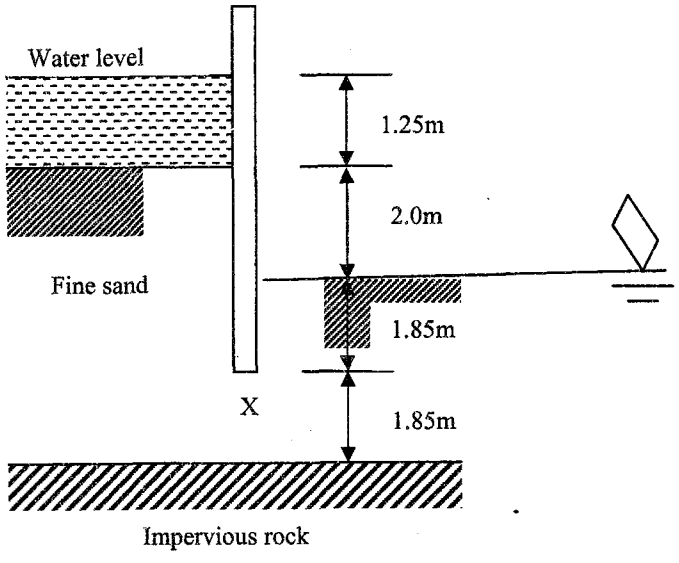

Figure 1

5. Table 1 shows the results of a lab test on a clay sample taken from site.

Jadual 1 menunjukkan keputusan ujian pengukuhan makmal suatu sampel lapisan lempung dari lapangan.

Table 1

e	Pressure, σ' (kPa)
2.100	25
2.085	50
2.055	100
2.010	200
1.740	400
1.390	800
1.030	1600
0.450	3200

[a] Determine the pre-consolidation stress using Casagrande's method. (4 marks)

Tentukan tegasan pra-pengukuhan menggunakan kaedah Casagrande.

[b] Determine compression index, C_C, and re-compression index, C_S. (4 marks)

Tentukan indeks mampatan, C_C, dan indeks mampatan semula, C_S.

5. [c] The thickness of clay layer in the field after consolidation is 3 m, as shown in Figure 2. The vertical effective stress before consolidation was 200 kPa. Consolidation happened due to a uniform load with an average stress of 200 kPa resulting in the overall stress of 400 kPa. Determine total settlement that has occurred.

Table 2 shows the results when stress was increased in lab from 200 kPa to 400 kPa. Initial thickness of sample taken from field was 20 mm.

(4 marks)

Tebal lapisan lempung di lapangan selepas pengukuhan tamat adalah 3 m, sebagaimana ditunjukkan di Rajah 2. Sebelum pengukuhan, tekanan tegak berkesan kerana beban purata atas 200 kPa. Pengukuhan berlaku kerana beban seragam tambahan sebanyak 200 kPa menjadikan beban purata keseluruhan 400 kPa. Anggarkan jumlah enapan yang telah berlaku.

Jadual 2 menunjukkan hasil ujian apabila tekanan ditambah dari 200 kPa ke 400 kPa. Tebal asal sampel makmal yang diambil dari lapangan ialah 20 mm.

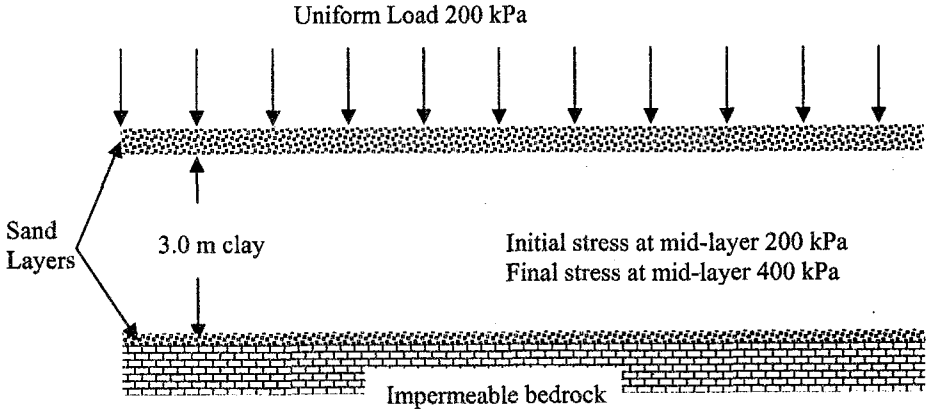

Figure 2

Table 2

t, minute	e
0.1	2.98
1	2.97
5	2.90
15	2.86
30	2.82
60	2.79
180	2.77
480	2.75
1440	2.74

5. [d] If lab sample was doubly drained, determine coefficient of consolidation, C_v. (Refer to Table 3 and equation $T = \frac{C_v}{H^2} t$).

(4 marks)

Jika lapisan lempung ujian di makmal tersalir dua arah, iaitu ke atas dan ke bawah, tentukan nilai Pekali Pengukuhan, C_v. (Rujuk Jadual 3 dan persamaan $T = \frac{C_v}{H^2} t$).

Table 3

Uaverage	**T**
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	1.163
1.0	α

[e] Estimate the time required for the clay layer to achieve 90% consolidation in the field.

(4 marks)

Anggarkan berapa lama masa yang diperlukan bagi lapisan lempung mengalami 90% pengukuhan.

6. Table 4 shows changes in vertical stress with depth due to embankment construction as shown in Figure 3. Embankment width is 10.0 m, thickness 2.0 m, and density of 2000 kg/m^3. Density of field saturated soil is also 2000 kg/m^3.

Jadual 4 menunjukkan perubahan tegasan tegak menurut kedalaman disebabkan pembinaan tambak seperti ditunjukkan dalam Rajah 2. Lebar tambak 10.0 m, tebal 2.0 m, dan mempunyai ketumpatan 2000 kg/m^3. Ketumpatan tanah tepu di tapak 2000 kg/m^3.

Table 4

Depth	Δ Pressure
0B	1.00q
1B	0.55q
2B	0.31q
3B	0.20q
6B	0.10q

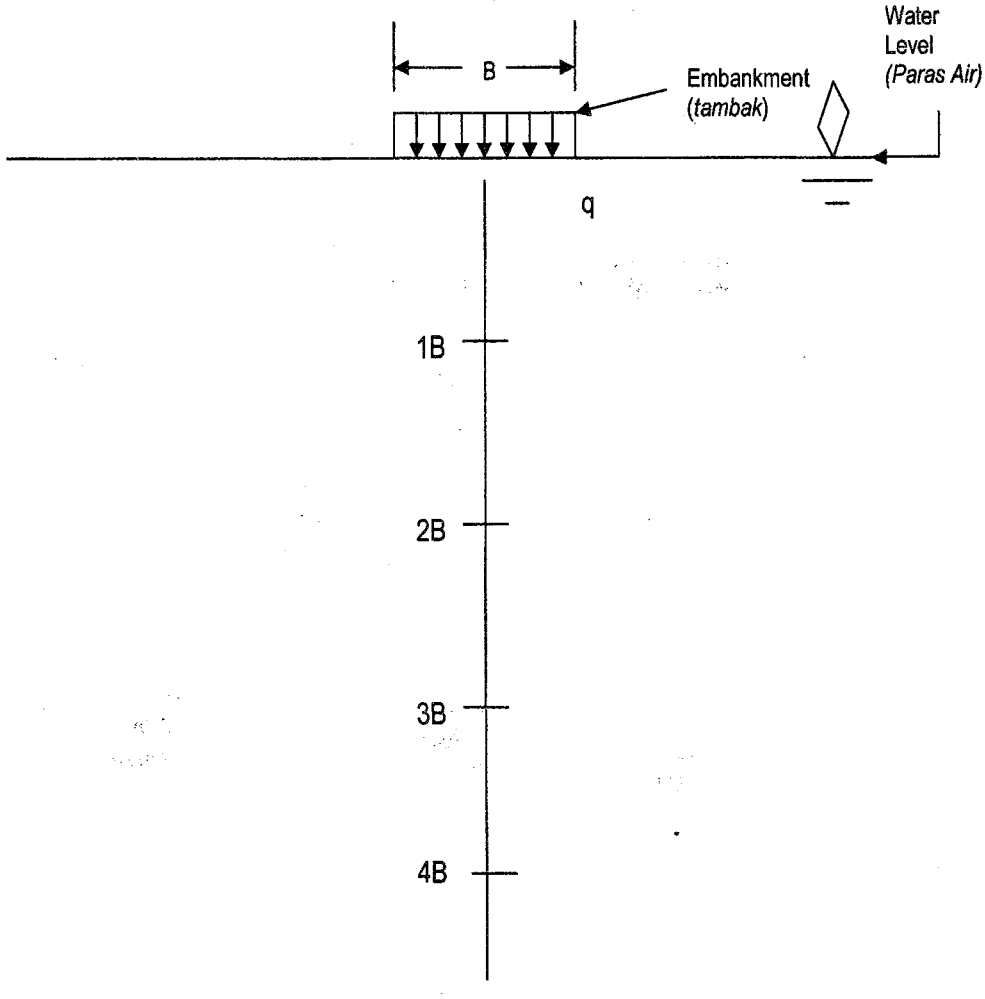

Figure 3

[a] Determine vertical total stresses at 0 m, 10 m, 30 m, and 50 m **before** embankment construction.

(4 marks)

Tentukan jumlah tegasan tegak pada had kedalaman 0 m, 10 m, 30 m, dan 50 m ***sebelum*** *terbinanya tambak.*

[b] Determine vertical effective stresses at 0 m, 10 m, 30 m, and 50 m **before** embankment construction.

(4 marks)

Tentukan tegasan berkesan tegak pada had kedalaman 0 m, 10 m, 30 m, dan 50 m ***sebelum*** *terbinanya tambak.*

[c] Determine total stresses at 0 m, 10 m, 30 m, and 50 m **after** embankment construction.

(4 marks)

Tentukan tegasan jumlah pada had kedalaman 0 m, 10 m, 30 m, dan 50 m ***selepas*** *terbinanya tambak.*

[d] Determine vertical effective stresses at 0 m, 10 m, 30 m, and 50 m **after** embankment construction.

(4 marks)

Tentukan tegasan berkesan tegak pada had kedalaman 0 m, 10 m, 30 m, dan 50 m ***selepas*** *terbinanya tambak.*

[e] If water level was brought down to the depth of 3B and the field soil is still saturated, determine effective stresses at 0 m, 10 m, 30 m, and 50 m **after** embankment construction.

(4 marks)

Sekiranya paras air diturunkan ke kedalaman 3B dan tanah di tapak masih lagi tepu, tentukan tegasan berkesan tegak pada had kedalaman 0 m, 10 m, 30 m, dan 50 m ***selepas*** *terbinanya tambak.*

LAMPIRAN