UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

EAG 345/3 – Geotechnical Analysis
[Analisis Geoteknik]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **ELEVEN (11)** pages of printed material before you begin the examination.
*[Sila pastikan kertas peperiksaan ini mengandungi **SEBELAS (11)** muka surat bercetak 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 English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

All questions **MUST BE** answered on a new sheet.
*[Semua jawapan **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. The result of a triaxial test is given as follows:-
Confining Stress at failure = 200kPa; Deviator Stress at failure = 100kPa

Keputusan suatu ujian 3-paksi diberi seperti berikut :-
Tegasan takungan sewaktu gagal = 200kPa; Tegasan sisih sewaktu gagal = 100kPa

(a) If the test is consolidated-undrained (CU), the material is granular, and the developed pore water pressure at failure is 50kPa, by means of a Mohr's circle construction, determine the total angle of friction of the material under CU condition and the effective angle of friction of the material.

[5 marks]

Jika ujian terkukuh-taktersalir (CU), bahan tanah berbutir, dan tekanan air liang sewaktu gagal 50kPa, dengan menggunakan kaedah binaan bulatan Mohr, tentukan sudut ricih kasar bahan di bawah keadaan CU dan sudut ricih berkesan bahan.

(b) If the test is consolidated-undrained (CU), the material is an over consolidated clay at given pressures, cohesion is known to be 30kPa, and the developed pore water pressure at failure is 50kPa, by means of a Mohr's circle construction, determine the total angle of friction of the material under CU condition and the effective angle of friction of the material.

[5 marks]

Jika ujian terkukuh-taktersalir (CU), bahan tanah lempung terkukuh lebih pada tekanan diberikan, kejelekitan 30kPa, dan tekanan air liang sewaktu gagal 50kPa, dengan menggunakan kaedah binaan bulatan Mohr, tentukan sudut ricih jumlah bahan dibawah keadaan CU dan sudut ricih berkesan bahan.

(c) If the test is unconsolidated-undrained (UU), the material is clay, and the developed pore water pressure at failure is 50kPa, by means of a Mohr's circle construction, determine the angle of friction of the material under UU condition.

[5 marks]

Jika ujian takterkukuh-taktersalir (UU), bahan tanah lempung, dan tekanan air liang sewaktu gagal 50kPa, dengan menggunakan kaedah binaan bulatan Mohr, tentukan sudut ricih bahan dibawah keadaan UU.

(d) If the test is consolidated-drained (CD), and the material is normally consolidated clay at given pressures, by means of a Mohr's circle construction, determine the effective angle of friction of the material.

[5 marks]

Jika ujian terkukuh-tersalir (CD), dan bahan tanah lempung terkukuh biasa, dengan menggunakan kaedah binaan bulatan Mohr, tentukan sudut ricih berkesan bahan.

2. (a) You were appointed as a design engineer for a road project. During the design stage, you encountered a location with high slopes nearby. You are required to design a retaining wall for that location.

(i) State the **TWO (2)** main factors that need to be considered during retaining wall design.

(ii) What are the standard check-ups that need to be done during the design?

(iii) Describe the general type of retaining wall that can be considered during the design.

[7 marks/*markah*]

Anda telah dilantik sebagai jurutera rekabentuk untuk suatu projek jalanraya. Semasa di peringkat rekabentuk, anda telah menemui suatu lokasi dengan cerun yang tinggi.

*(i) Nyatakan **DUA (2)** faktor yang perlu diambilkira dalam merekabentuk tembok penahan.*

(ii) Apakah pemeriksaan lazim yang perlu dibuat semasa rekabentuk?.

(iii) *Terangkan jenis am tembok penahan yang boleh digunakan semasa rekabentuk.*

(b) In a particular project, braced vertical sheeting is to be used for an open-trench excavation as applied for the construction of a section of subway tunnel that extends through medium stiff clay (c = 43kN/m^2, γ = 18kN/m^3). The excavation will be 12m deep and supported by three rows of struts. The top strut will be level with the ground surface, the second strut at 3m down and the third strut 7m down from the ground surface. The strut will be positioned at 3.5m center-to-center spacing (plan view spacing). Calculate the force in each strut.

[13 marks/*markah*]

Dalam sebuah projek, kepingan tegak berembat akan digunakan untuk pengorekan jurang-terbuka seperti dikenakan pada pembinaan bahagian terowong jalan bawah yang menembusi tanah lempung sederhana kukuh (c = 43kN/m^2, γ = 18kN/m^3). Pengorekan akan dilakukan sehingga kedalaman 12m dengan diampu oleh 3 barisan topang. Topang paling atas akan berada searas dengan aras tanah, topang kedua berada 3m di bawah dan topang ketiga berada 7m dari aras tanah. Topang akan diletakkan 3.5m jarak tengah-ke-tengah (jarak pandangan pelan). Kira daya bagi setiap topang.

3. A soil investigation is conducted for 10-storey commercial building project which have a bored piling foundation estimated 40 meter depth. Table 1 is the borelog information until 9 meter depth. The soil unit weight for loose sand is 15kN/m^3 and saturated soil unit weight for firm clay is 20kN/m^3. Ground water level is at 3.00 meter below ground level.

Suatu penyiasatan tapak telah dijalankan untuk projek 10 tingkat bangunan perniagaan yang mempunyai asas cerucuk terjara dianggarkan sedalam 40 meter. Jadual 1 adalah maklumat log lubang jarak sehingga 9 meter. Berat unit tanah bagi pasir longgar ialah 15kN/m^3 dan berat unit tanah tepu bagi tanah liat kukuh ialah 20kN/m^3. Aras air bumi terletak 3.00 meter di bawah permukaan tanah.

Table / Jadual 1

Depth (m)	Description	SPT Blow Count			Standard Penetration Test, N_{60}
		1st 0.15 m	2nd 0.15 m	3rd 0.15 m	
1.50	Loose, dark grey clayey SAND				5
3.00					8
4.50	Firm, grey sandy CLAY				7
6.00	Medium dense, light grey clayed SAND	6	5	6	
7.50		7	8	8	
9.00	Stiff, grey sandy CLAY	8	8	7	

(a) Determine the Corrected Standard Penetration Test N Value for N value at depth 4.50 meter.

Given Liao and Whitman correction factor: $C_N = \left[\frac{1}{\left(\frac{\sigma_o'}{p_a}\right)}\right]^{0.5}$

[8 marks/*markah*]

Nyatakan Nilai Pembetulan N Ujian Penusukan Piawai bagi nilai N pada kedalaman 4.50 meter.

Diberikan faktor pembetulan Liao and Whitman: $C_N = \left[\frac{1}{\left(\frac{\sigma_o'}{p_a}\right)}\right]^{0.5}$

(b) Determine the Standard Penetration Test N Value at 7.50 meter and 9.00 meter depth.

[2 marks/*markah*]

Nyatakan nilai N Ujian Penusukan Piawai pada 7.50 meter dan 9.00 meter.

(c) During piling work, contractor encounter rock layer at 20 meter depth. However soil investigation report shows that granite layer is at 50 meter depth. Describe the condition encountered at that layer and what are the measures need to take for verify such condition.

[6 marks/*markah*]

Semasa kerja cerucuk dijalankan, kontraktor telah menemui lapisan batu pada kedalaman 20 meter. Walau bagaimanapun rujukan daripada laporan penyiasatan tapak menunjukkan lapisan granit terletak pada kedalaman 50 meter. Terangkan keadaan yang ditemui pada lapisan tersebut dan langkah yang perlu diambil untuk mengesahkan keadaan tersebut.

(d) Explain the need to seal undisturbed sample of cohesive soil immediately and name 2 methods of sealing sample.

[4 marks/*markah*]

Terangkan keperluan untuk mengedap sampel tak terganggu bagi tanah jelekit secepatnya dan namakan 2 kaedah pengedapan sampel.

4. (a) What are the ***THREE (3)*** reasons slope failure occurred and discuss individually how and why?

[8 marks/*markah*]

*Apakah **TIGA (3)** penyebab kegagalan cerun dan huraikan satu persatu sebab dan akibat kegagaln tersebut boleh terjadi?*

(b) As for the slope shown in Figure 1, find the factor of safety against sliding for the trial slip surface AC. Use the ordinary methods of slices.

[12 marks/*markah*]

Untuk cerun yang di tunjukkan dalam Gambarajah 1.0, kira faktor keselamatan terhadap geliciran pada satah permukaan AC. Gunakan kaedah biasa hirisan.

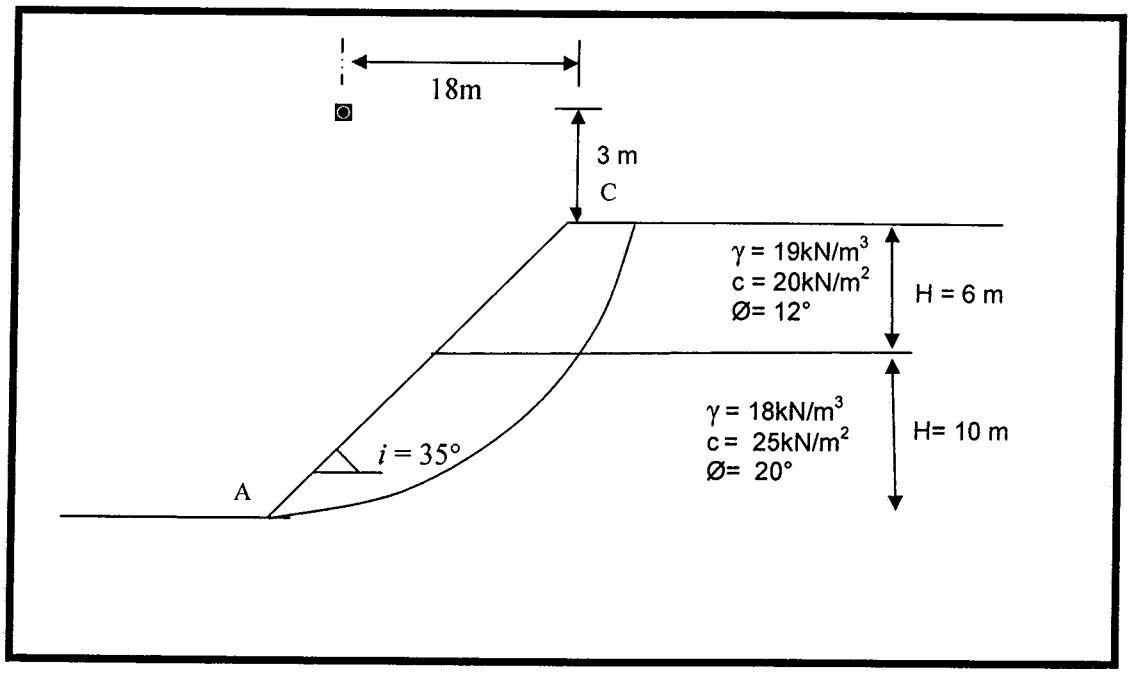

Figure 1

5. A footing is planned to support an ultimate load of 30MN (Allowable load is 10MN and Factor of Safety is 3.0). The footing will be embedded 2.0m below ground surface. The bulk density of earth material is 1600kg/m^3 and the water table is very deep. Terzaghi's equation for ultimate bearing capacity, q_{ult}, for circular foundation is given by: $q_{ult} = 1.3cN_c + 0.3B\gamma N_\gamma + qN_q$ while Terzaghi's equation for ultimate bearing capacity, q_{ult}, for square foundation is given by: $q_{ult} = 1.3cN_c + 0.4B\gamma N_\gamma + qN_q$. (Refer Figure 1 and 2).

Suatu tapak dirancang bagi menyokong bebanan muktamad 30MN (bebanan dibenar 10MN manakala Faktor Keselamatan 3.0). Tapak terletak di kedalaman 2.0m. Ketumpatan pukal tanah 1600kg/m^3 dan aras air bumi sangat dalam. Persamaan Terzaghi bagi Keupayaan Galas Muktamad, q_{ult}, bagi tapak bulat diberi sebagai: $q_{ult} = 1.3cN_c + 0.3B\gamma N_\gamma + qN_q$ manakala persamaan Terzaghi bagi Keupayaan Galas Muktamad, q_{ult}, bagi tapak segi empat sama diberi sebagai: $q_{ult} = 1.3cN_c + 0.4B\gamma N_\gamma + qN_q$. Rujuk (Rajah 1 dan 2).

(a) Determine the required size of a circular footing if the soil is cohesive (zero angle of friction) with cohesion value of 40kPa.

[5 marks/*markah*]

Tentukan saiz tapak bulat jika tanah lempung (sudut ricih sifar) dengan nilai kejelekitan 40kPa.

(b) Determine the required size of a circular footing if the soil is granular (cohesion less) with angle of friction of 40 degrees.

[5 marks/*markah*]

Tentukan saiz tapak bulat jika tanah berbutir (kejelekitan sifar) dengan sudut ricihnya 40 darjah.

(c) Determine the required size of a square footing if the soil is cohesive (zero angle of friction) with cohesion value of 40kPa.

[5 marks/*markah*]

Tentukan saiz tapak segiempat sama jika tanah lempung (sudut ricih sifar) dengan nilai kejelekitan 40kPa.

(d) Determine the required size of a square footing if the soil is granular (cohesion less) with angle of friction of 40 degrees.

[5 marks/*markah*]

Tentukan saiz tapak segiempat sama jika tanah berbutir (kejelekitan sifar) dengan sudut ricihnya 40 darjah.

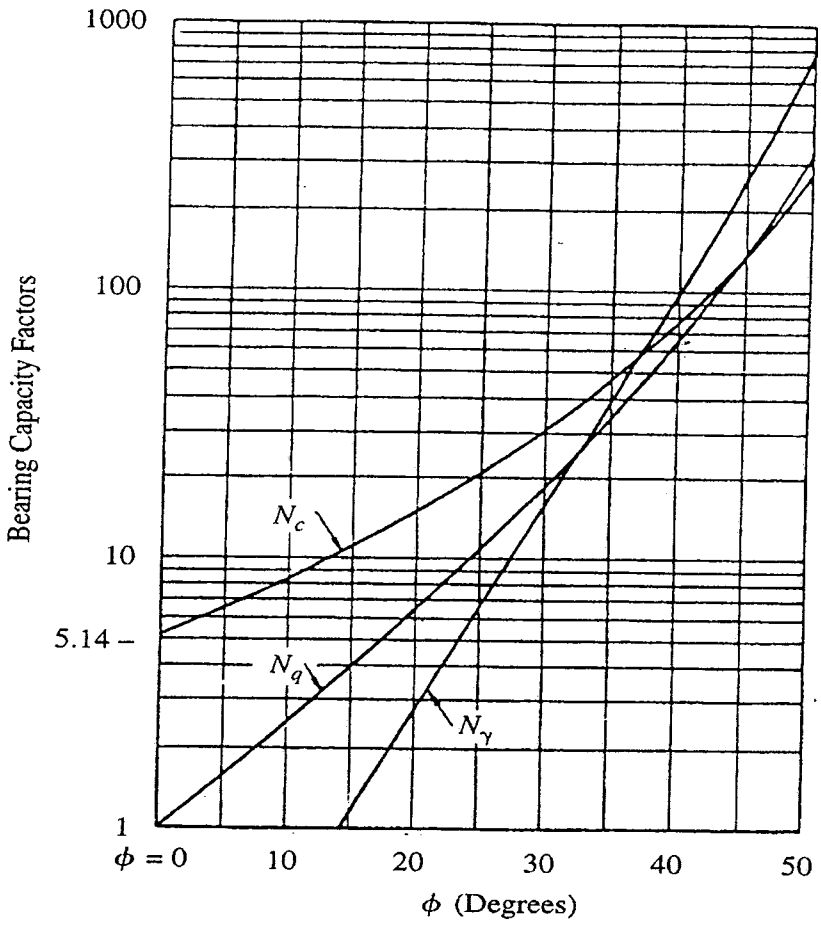

Figure 1

6. A pile foundation is planned to hold an ultimate load of 30MN (Allowable load is 10MN and Factor of Safety is 3.0). Each pile is 0.6m in diameter and fixed at 40m in length. The pile is made of concrete and the soil is generally dense sand with saturated unit weight of 20kN/m^3. Assume the following:

(i) Ground water is at the surface of the ground.

(ii) Horizontal stress is related to vertical stress according to $\sigma_h = \sigma_v$.

(iii) $\tan\delta$ for concrete against dense sand is 0.45

(iv) Critical depth is 20 times pile diameter.

(v) Effective angle of internal friction is 38 degrees.

(vi) N_q^* values are as given in attachment.

(vii) Total foundation capacity is sum of capacities of all individual piles.

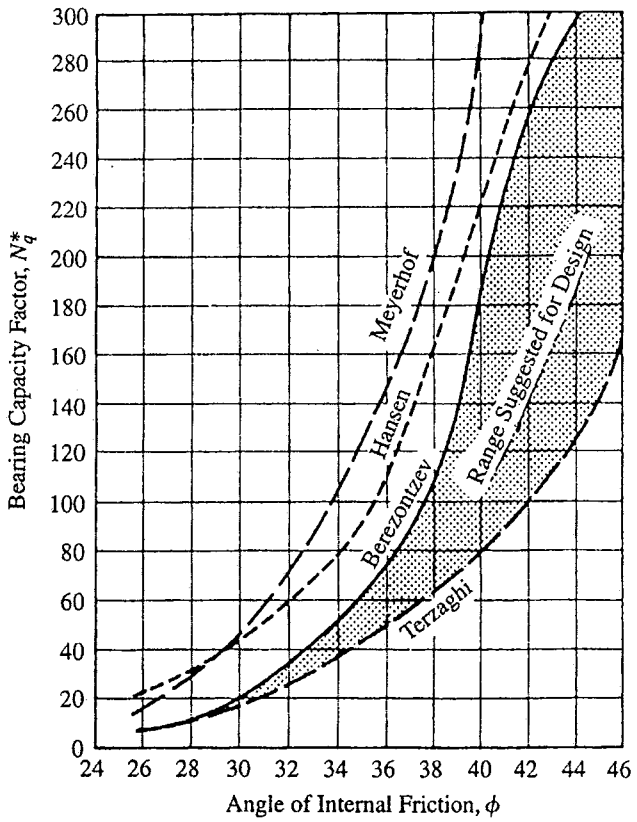

Figure 2

(viii) Shaft friction is given by $f.A_{surface} = \sum_{d=0}^{depth} (\tan \delta . \sigma_h) dA$

(ix) End Bearing is given by $Q_{ult} = A_p q_{ult} = A_p p_v N_q^*$

Suatu tapak cerucuk dirancang untuk menampung beban muktamad 30MN (Bebanan dibenarkan 10MN manakala Faktor Keselamatan 3.0). Setiap cerucuk bergaris pusat 0.6m dan panjangnya ditetapkan 40m. Cerucuk diperbuat daripada konkrit manakala tanah pasir padat dengan berat unitnya 20kN/m^3. Andaikan perkara berikut?

(i) *Paras airbumi terletak di permukaan tanah.*

(ii) *Tekanan sisi dan tekanan tegak menurut* $\sigma_h = \sigma_v$

(iii) $\tan \delta$ *konkrit melawan pasir padat = 0.45*

(iv) *Kedalaman kritikal 20 kali garispusat cerucuk.*

(v) *Sudut ricih dalam berkesan 38 darjah.*

(vi) *Nilai* N_q^* *diberikan di dalam lampiran.*

(vii) *Jumlah keupayaan tapak sama dengan jumlah keupayaan semua cerucuk.*

(viii) *Keupayaan geseran dinding diberi* $f.A_{surface} = \sum_{d=0}^{depth} (\tan \delta . \sigma_h) dA$

(ix) *Keupayaan galas hujung cerucuk diberi* $Q_{ult} = A_p q_{ult} = A_p p_v N_q^*$

(a) Draw the profiles for total horizontal ground stress versus depth, water pressure versus depth, and effective horizontal ground stress versus depth for the entire length of pile. Give consideration to critical depth.

[4 marks/*markah*]

Lukiskan taburan jumlah tekanan mendatar lawan kedalaman, tekanan air lawan kedalaman, dan tekanan mendatar berkesan lawan kedalaman bagi sepanjang cerucuk. Ambil kira kedalaman kritikal.

(b) Draw the profile for unit shaft friction, in kPa, versus depth for the entire pile length.

[4 marks/*markah*]

Lukiskan taburan geseran unit dinding cerucuk, dalam kPa, lawan kedalaman bagi sepanjang cerucuk.

(c) Determine the theoretical total skin friction capacity for each pile, in MN.

[4 marks/*markah*]

Tentukan jumlah geseran dinding bagi setiap cerucuk teori, dalam MN.

(d) Determine the theoretical end bearing capacity for each pile, in MN.

[4 marks/*markah*]

Tentukan kekuatan galas hujung cerucuk teori, dalam MN

(e) Determine the required number of piles for the foundation

[4 marks/*markah*]

Tentukan jumlah cerucuk yang diperlukan bagi tapak tersebut.

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