UNIVERSITI SAINS MALAYSIA

First Semester Examination
2007/2008 Academic Session

October / November 2007

EAG 345/2 – Geotechnical Analysis
[Analisis Geoteknik]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of ELEVEN pages of printed material including appendices before you begin the examination.
[Sila pastikan 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 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. (a) There are different types of slope movement which triggered failure, identify **FIVE (5)** types of the movement and explain how these happen.

(8 marks)

*Terdapat beberapa jenis pergerakan cerun yang mengakibatkan kegagalan, nyatakan **LIMA (5)** jenis pergerakan tersebut dan jelaskan kejadian ini boleh berlaku.*

(b) As shown in Figure 1.0 below, the slope with its soil parameter of $\gamma = 17kN/m^3$, $c = 25kN/m^2$ and $\phi = 20°$. Analyse the slope without and with point load of W_b. Use ordinary method of slices for calculation factor of stability.

(12 marks)

Gambarajah 1.0 di bawah menunjukkan cerun yang mempunyai parameter tanah; $\gamma = 17kN/m^3$, $c = 55kN/m^2$ dan $\phi = 20°$. Buat analisis untuk cerun tersebut. Sekiranya tanpa beban dan dengan beban W_b. Gunakan kaedah hirisan untuk pengiraan faktor kestabilan.

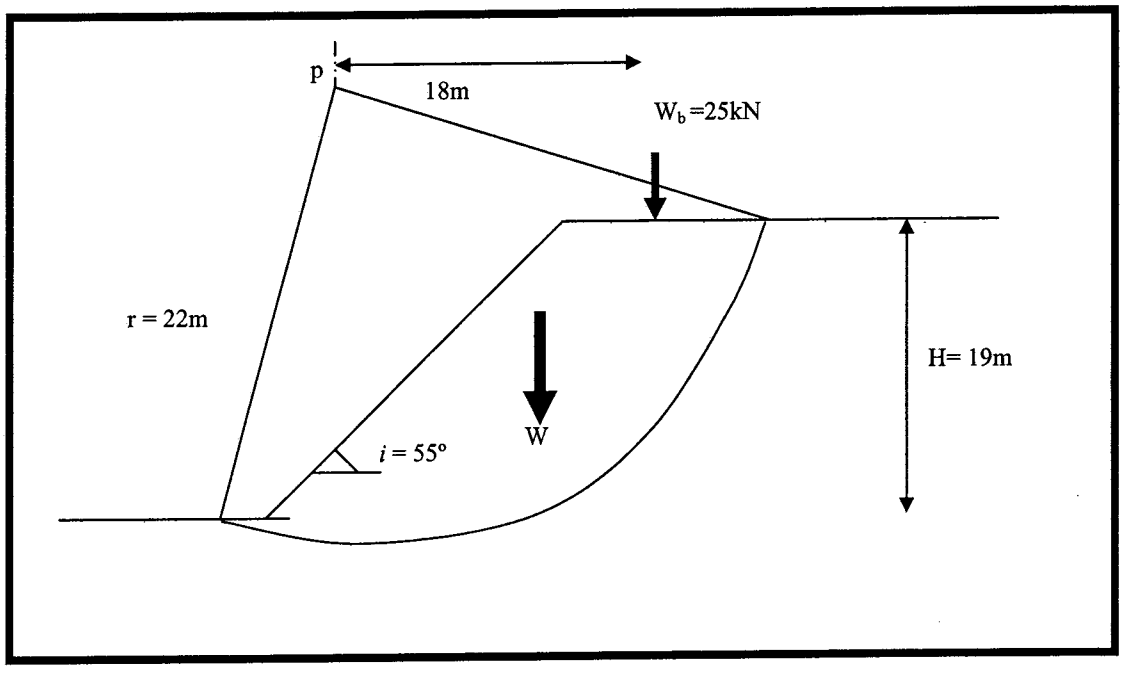


Figure 1.0 ***[Gambarajah 1.0]***

2. (a) What are the different in function between SPT and CPT test. Identify their advantages and limitation in these test.

(7 marks)

Apakah perbezaan fungsi di antara ujian SPT dan CPT. Nyatakan juga kelebihan dan kekurangan ujian tersebut.

(b) Soil sampling is important in Site Investigation techniques. What are the types of sampling commonly taken and give their categories of sampling accordingly to its nature.

(3 marks)

Pensampelan tanah adalah suatu yang penting dalam teknik penyiasatan di tapak. Apakah jenis-jenis sampel yang selalu diambil dan berikan kategori pensampelan yang dimaksudkan.

(c) Propose a site investigation project which need to be carried out. Give the details of the investigations needed and provide a borehole sample for the area by means of assumption their parameters according to your understanding.

(10 marks)

Cadangkan suatu projek penyiastan tapak yang akan dijalankan. Beri perincian penyiasatan yang perlu dijalankan dan sertakan suatu contoh lubang jara yang di perolehi di kawasan tersebut dengan mengandaikan parameter mengikut kefahaman anda.

3. This question is on capacity of a single pile embedded in clay. Pile is of spun-concrete type 0.200 m external diameter and 0.100 m internal diameter.

Soalan ini berkaitan keupayaan cerucuk tunggal yang dipacu ke dalam tanah lempung. Cerucuk jenis 'spun-concrete' bergarispusat luar 0.200 m dan dalam 0.100 m.

(a) Write down the equation relating ultimate vapacity, P_f; self weight of pile, W; ultimate skin friction force, R_{sf}; and ultimate end bearing force, Q_{bf}.

(4 marks)

Tuliskan persamaan yang mengaitkan antara keupayaan muktamad, P_f; berat cerucuk, W; daya geseran muktamad dinding, R_{sf}; dan daya galas muktamad hujung cerucuk, Q_{bf}.

3. (b) Given ultimate capacity, P_f, from load test of 1000 MN and ultimate skin friction force, R_{sf} from pull-up test of 600 MN; determine the ultimate end bearing force, Q_{bf}.

(4 marks)

Jika keupayaan muktamad, P_f, daripada ujian bebanan 1000 MN dan daya geseran muktamad dinding, R_{sf}; daripada ujian 'pull-up' 600 MN; tentukan daya galas muktamad hujung cerucuk, Q_{bf}.

(c) Suppose pile is to be driven into clay which average adhesion between pile's skin and clay of 20 MPa and pile need to have an ultimate capacity, P_f of 1000 MN, determine the required length of embedment if strength is to be derived totally from skin friction.

(4 marks)

Jika cerucuk dipacu ke dalam tanah lempung yang mempunyai rekatan purata antara dinding cerucuk dengan tanah 20 MPa dan cerucuk dikehendaki mempunyai keupayaan muktamad, P_f, 1000 MN, tentukan panjang cerucuk yang diperlukan jika keseluruhan keupayaannya datang daripada geseran dinding.

(d) For the situation described in Question 3(c) above, say the undrained cohesive strength of clay is 30 MPa, determine the adhesion factor used.

(4 marks)

Bagi keadaan yang diberi di soalan 3(c), jika kekuatan ricih tak tersalir tanah lempung 30 MPa, tentukan Faktor Rekatan yang digunakan.

(e) Suppose the depth limit at which pile can be driven is 50.0 m, determine the required ultimate end bearing force for pile to have ultimate capacity of 1000 MN.

(4 marks)

Jika had kedalaman pemacuan cerucuk 50.0 m, tentukan daya galas muktamad hujung cerucuk, Q_{bf}, agar keupayaan muktamad, P_f, 1000 MN.

4. This question is on capacity of square footing embedded in soil to support an ultimate load of 1000 MN. The bulk density of earth material is 1500 kg/m^3 and the water table is very deep. Terzaghi's expression for ultimate bearing capacity, q_{ult}, assuming general shear failure for square footing is given by: $q_{ult} = cN_c + 0.4B\gamma N_\gamma + qN_q$. Refer to Attachment 1 for help. Assume dense sand or stiff day.

Soalan ini berkaitan dengan keupayaan tapak segi empat segi bagi menyokong bebanan muktamad 1000 MN. Ketumpatan pukal tanah 1500 kg/m^3 dan paras airnya sangat dalam. Persamaan Terzaghi bagi Keupayaan Galas Muktamad, q_{ult}, diberi sebagai: $q_{ult} = 1.3cN_c + 0.4B\gamma N_\gamma + qN_q$. Rujuk Lampiran 1 sebagai bantuan. Anggap pasir padat atau tanah liat keras.

(a) Determine the required sizes of the footing for the given depths if the soil is cohesionless with angle of friction of 40 degrees.
[i] Depth = 0 m (at the surface of ground)
[ii] Depth = 1.5 m
[iii] Depth = 3.0 m

(10 marks)

Tentukan saiz tapak bagi setiap kedalaman yang diberi jika tanah tak jeleket dengan nilai sudut ricih 40 darjah.
[i] Kedalaman = 0 m (pada permukaan tanah)
[ii] Kedalaman = 1.5 m
[iii] Kedalaman = 3.0 m

(b) Determine the required sizes of footing for the given depths if the soil has zero angle of friction with cohesion of 30 MPa.

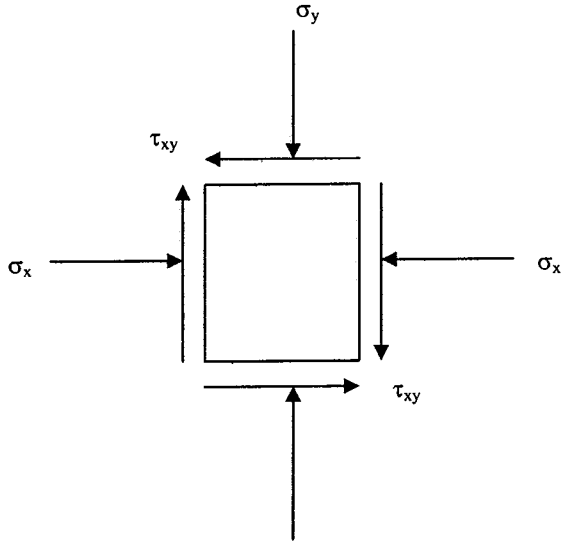
(10 marks)

Tentukan saiz tapak bagi setiap kedalaman yang diberi jika tanah mempunyai nilai sudut ricih kosong dan nilai kejeleketan 30 MPa.

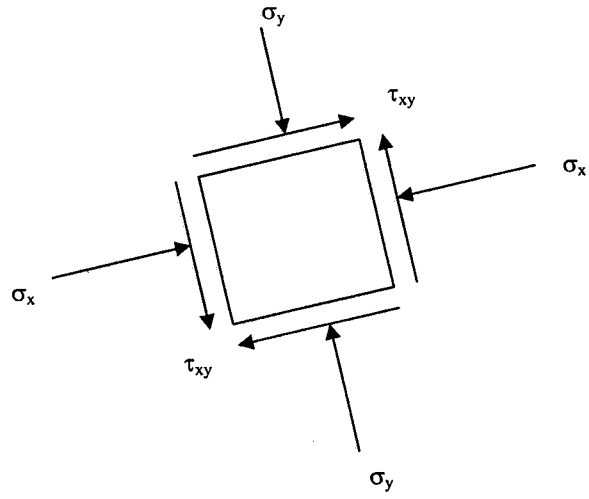
5. (a) For the stressed elements given in Figure 2(a) & 2(b), draw the respective Mohr Circles describing the stress arrangements. In each of the Mohr Circle, determine also the 'POLE'.

(3 marks)

Bagi elemen-elemen yang diberi di Rajah 2(a) dan 2(b), lukiskan bulatan Mohr bagi setiap satunya bagi menerangkan susunan tegasan-tegasannya. Bagi setiap Bulatan Mohr tersebut, tentukan juga kedudukan 'POLE'.



Rajah 2(a)



Rajah 2(b)

(b) What do you understand by the term 'tension crack' and when does this condition happened?

(2 marks)

Apakah yang anda fahami dengan terma retak tegangan dan bilakah keadaan ini terjadi?

5. (c) Details of a frictionless reinforced concrete cantilever retaining wall are shown in Figure 2(c), the unit weight being 23.5kN/m^3. Due to inadequate drainage, the water table has risen to the level indicated. Above the water table, the backfill soil is sand with the unit weight of 17kN/m^3 and the soil friction is 38^0. For the soil below the water table, the saturated unit weight is 20kN/m^3. The angle of friction between the base of the wall and foundation soil is 25^0. Point load acts in the middle of the top stem of the wall. (γ_w = 9.8kN/m^3).

i. Determine the active pressure behind the wall. (8 marks)

ii. Check for safety factors against overturning and sliding for the wall. (5 marks)

iii. Calculate the maximum and minimum pressure under the base of the retaining wall. (2 marks)

Perincian bagi satu tembok penahan konkrit yang tidak mempunyai geseran adalah seperti yang ditunjukkan dalam Rajah 2(c), di mana berat unit tanah adalah 23.5kN/m^3. Disebabkan pengaliran yang kurang memuaskan, aras air meningkat ke aras yang ditunjukkan dalam rajah. Bagi tanah yang berada di atas paras air, tanah tambak adalah pasir dengan berat unit 17kN/m^3 dan sudut geseran adalah 38^0. Bagi tanah di bawah aras air, berat unit tanah tepu adalah 20kN/m^3. Sudut geseran di antara bahagian bawah tembok dengan tanah yang menanggung beban adalah 25^0. Suatu beban titik bertindak di bahagian tengah dinding atas tembok penahan tersebut. (γ_w = 9.8kN/m^3).

i. Tentukan tekanan aktif yang bertindak di belakang tembok penahan.

ii. Semak faktor keselamatan terhadap keterbalikan dan gelinciran bagi tembok tersebut.

iii. Kira nilai-nilai maksimum dan minimum tekanan di bahagian bawah tembok penahan tersebut.

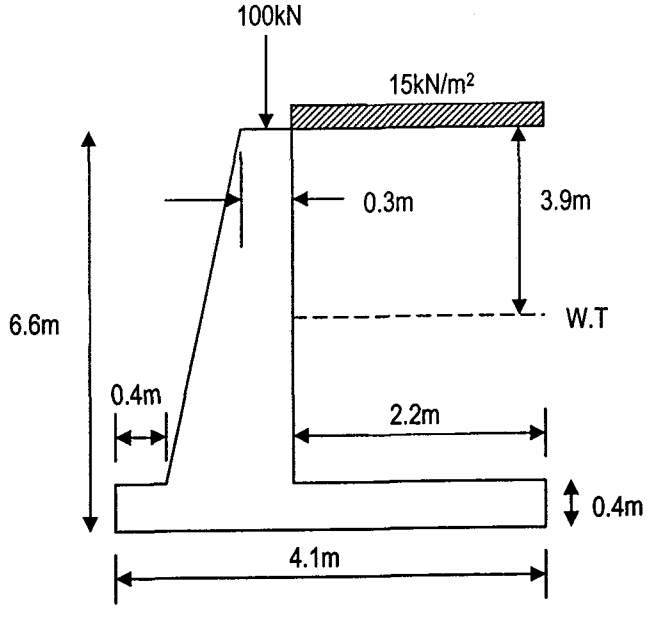


Figure 2(c)

6. (a) As a geotechnical engineer, you are needed to design a retaining wall for a proposed project. How many types of retaining walls that you know and how does it effected your decision on the type of retaining wall to be used in that project? (Include sketches).

(6 marks)

Sebagai seorang jurutera geoteknik, anda dikehendaki untuk merekabentuk tembok penahan untuk suatu projek. Berapakah jenis tembok penahan yang anda ketahui dan bagaimana ia mempengaruhi pemilihan tembok penahan bagi projek tersebut?(Sertakan gambarajah).

(b) State the **THREE (3)** types of Triaxial tests done in laboratory and explain the water flow before, during and after the tests.

(6 marks)

*Nyatakan **TIGA (3)** ujian 3 Paksi yang dilakukan di makmal dan terangkan aliran air sebelum, semasa dan selepas ujikaji.*

(c) At a point, the major principal stress is 80kPa compression and the minor principal stress is 20kPa compression.

i) Draw the Mohr's circle for this stress combination. (2 marks)

ii) What is the maximum shear stress acting at the point, and what is the value of normal stress acts on this same plane?

(1 mark)

iii) Determine the value of the normal and shear stress acting on a plane that is 60^0 from the minor principal plane.

(1 mark)

If the major principal stress is 80kPa compression and the minor principal stress is 20kPa tension.

iv) Draw the Mohr's circle for this stress combination. (2 marks)

v) What is the maximum shear stress acting at the point, and what is the value of normal stress acts on this same plane?

(1 mark)

vi) Determine the value of the shear and normal stress acting on a plane that is 30^0 from the major principal plane.

(1 mark)

Pada satu titik, tegasan prinsipal major adalah 80kPa mampatan dan tegasan prinsipal minor adalah 20kPa mampatan.

i) Lukis bulatan Mohr bagi kombinasi tegasan ini.
ii) Apakah nilai tegasan ricih maksimum yang bertindak pada titik ini, dan apakah nilai tegasan berkesan yang bertindak pada satah yang sama?
iii) Tentukan nilai tegasan normal dan tegasan ricih yang bertindak pada arah 60^0 dari satah prinsipal minor.

Sekiranya pada titik tersebut, tegasan prinsipal major adalah 80kPa mampatan dan tegasan prinsipal minor adalah 20kPa tegangan.

iv) Lukis bulatan Mohr bagi kombinasi tegasan ini.
v) Apakah nilai tegasan ricih maksimum yang bertindak pada titik ini, dan apakah nilai tegasan berkesan yang bertindak pada satah yang sama?
vi) Tentukan nilai tegasan normal dan tegasan ricih yang bertindak pada arah 30^0 dari satah prinsipal major.

LAMPIRAN 1

Bearing capacity factors [Eqs. (12.4), (12.5), and (12.6)]

ϕ'	N_c	N_q	N_γ	ϕ'	N_c	N_q	N_γ
0	5.14	1.00	0.00	23	18.05	8.66	8.20
1	5.38	1.09	0.07	24	19.32	9.60	9.44
2	5.63	1.20	0.15	25	20.72	10.66	10.88
3	5.90	1.31	0.24	26	22.25	11.85	12.54
4	6.19	1.43	0.34	27	23.94	13.20	14.47
5	6.49	1.57	0.45	28	25.80	14.72	16.72
6	6.81	1.72	0.57	29	27.86	16.44	19.34
7	7.16	1.88	0.71	30	30.14	18.40	22.40
8	7.53	2.06	0.86	31	32.67	20.63	25.99
9	7.92	2.25	1.03	32	35.49	23.18	30.22
10	8.35	2.47	1.22	33	38.64	26.09	35.19
11	8.80	2.71	1.44	34	42.16	29.44	41.06
12	9.28	2.97	1.69	35	46.12	33.30	48.03
13	9.81	3.26	1.97	36	50.59	37.75	56.31
14	10.37	3.59	2.29	37	55.63	42.92	66.19
15	10.98	3.94	2.65	38	61.35	48.93	78.03
16	11.63	4.34	3.06	39	67.87	55.96	92.25
17	12.34	4.77	3.53	40	75.31	64.20	109.41
18	13.10	5.26	4.07	41	83.86	73.90	130.22
19	13.93	5.80	4.68	42	93.71	85.38	155.55
20	14.83	6.40	5.39	43	105.11	99.02	186.54
21	15.82	7.07	6.20	44	118.37	115.31	224.64
22	16.88	7.82	7.13	45	133.88	134.88	271.76

...11/-