
UNIVERSITI SAINS MALAYSIA

First Semester Examination
2015/2016 Academic Session

December 2015/January 2016

EAG345 – Geotechnical Analysis **[Analisis Geoteknik]**

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **TWELVE (12)** pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUA BELAS (12)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: This paper contains **SIX (6)** questions. Answer **FIVE** questions.

[**Arahan** : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **LIMA** soalan.]

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].

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

1. At a particular site, a natural layer of soil is subjected to additional stresses. The element for the stressed soil is given in **Figure 1**.

*Di sebuah tapak, lapisan tanah asal telah diberikan tegasan tambahan. Elemen tanah yang tertegas diberikan seperti **Rajah 1**.*

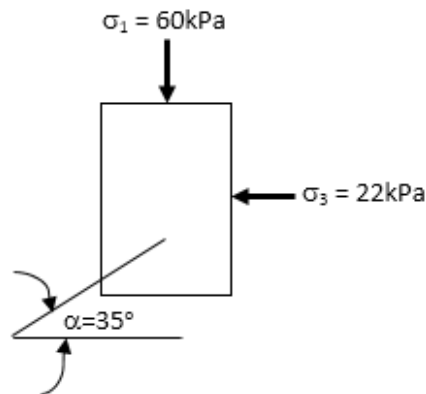


Figure 1 / Rajah 1

- [a] Draw the Mohr's circle and determine the normal stress σ_α and the shear stress τ on the plane inclined at $\alpha = 35^\circ$ from the horizontal reference plane.

Lukis bulatan Mohr dan tentukan tegasan normal dan tegasan ricih pada satah condong pada $\alpha = 35$ dari satah rujukan mendatar.

[7 marks/markah]

- [b] Determine the normal stress σ_α and the shear stress τ for the same element if it is rotated 20° from the horizontal plane as shown in **Figure 2**. Explain your results.

*Tentukan tegasan normal dan tegasan ricih bagi elemen yang sama jika ia diputar 20° dari satah mendatar seperti **Rajah 2**. Terangkan keputusan anda.*

[7 marks/markah]

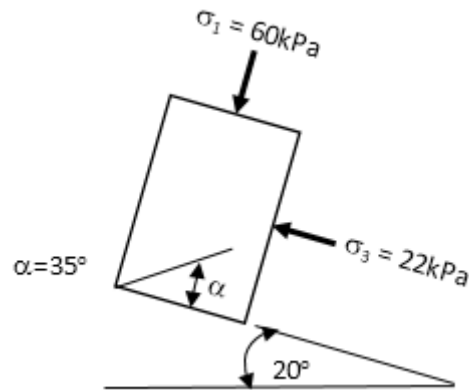


Figure 2 / Rajah 2

- [c] The soil sample is taken to the laboratory and prepared as a Triaxial test sample. Explain **THREE (3)** types of Triaxial tests and for each one of them, describe the drainage conditions before, during and after the test.

Sampel diambil dan dihantar ke makmal dan diuji sebagai sampel ujian tiga paksi. Terangkan TIGA (3) ujian tiga paksi dan bagi setiap satunya nyatakan keadaan saluran sebelum, semasa dan selepas ujikaji.

[6 marks/markah]

2. [a] Describe the meaning of earth pressure at rest, active and passive conditions.

Terangkan maksud tekanan tanah pada keadaan diam, aktif dan pasif.

[8 marks/markah]

- [b] A retaining wall is 7.25m high, where the soil supported consist of 5m of sand ($\gamma = 17.5 \text{ kN/m}^3$, $\phi = 35^\circ$) overlaying saturated sandy clay ($\gamma_{\text{sat}} = 19.5 \text{ kN/m}^3$, $\phi = 30^\circ$, $c = 16.6 \text{ kN/m}^2$). The ground water level is at the interface between sand and sandy clay.

Tembok penahan yang ketinggiannya adalah 7.25m, menahan tanah pasir 5m ($\gamma = 17.5 \text{ kN/m}^3$, $\phi = 35^\circ$) dan ditanggung oleh tanah lempung berpasir yang tepu ($\gamma_{\text{sat}} = 19.5 \text{ kN/m}^3$, $\phi = 30^\circ$, $c = 16.6 \text{ kN/m}^2$). Aras air bumi berada pada antaramuka tanah pasir dan tanah lempung berpasir.

- [i] Sketch the distribution of active pressure on the wall

Lakarkan agihan tekanan aktif pada tembok penahan

[5 marks/markah]

- [ii] State the principle applied to the problem.

Nyatakan prinsip yang digunakan dalam permasalahan ini.

[2 marks/markah]

- [iii] Calculate the thrust per linear meter of wall.

Kira tujah per linear meter tembok.

[5 marks/markah]

3. [a] Flexible retaining wall can fail in 5 different modes. Sketch them and explain the causes of failure.

Tembok penahan sokong bebas boleh gagal dalam 5 mod. Lakar dan terangkan sebab kegagalan.

[5 marks/markah]

- [b] An anchored sheetpile wall retains soil of 6.4m height, and the pile has a total length of 12m. The soil has unit weight of 19kN/m^3 and $\phi = 30^\circ$. The tie rod is at 1.2m below the ground surface and 3m apart space as shown in **Figure 3**.

Determine;

- [i] the proportion of possible passive resistance on the total embedded length if the piling is mobilized

kadar rintangan pasif yang mungkin terjadi daripada jumlah panjang tertanam bagi cerucuk yang terubah.

[10 marks/markah]

- [ii] the pull force in the anchor

daya tarik rod ikat

[5 marks/markah]

*Tembok cerucuk terikat menahan tanah pada ketinggian 6.4m, dan cerucuk mempunyai kedalaman 12m sepenuhnya. Tanah tersebut mempunyai berat unit sebanyak 19kN/m^3 dan $\phi = 30^\circ$. Rod ikat terletak 1.2m dibawah permukaan tanah dan berjarak 3m di antaranya seperti **Rajah 3**.*

Tentukan;

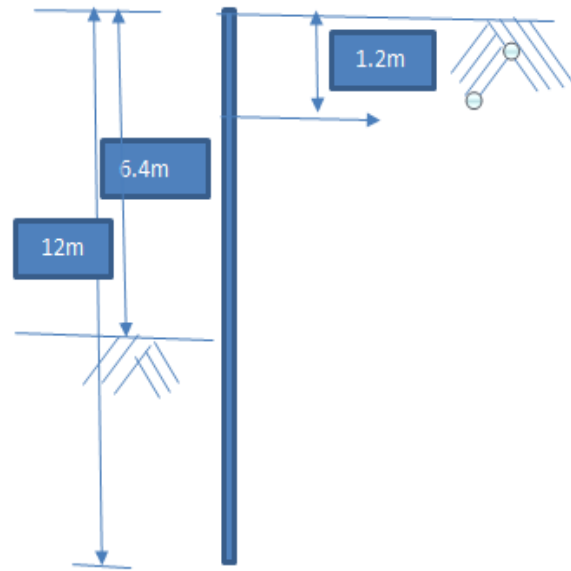


Figure 3 / Rajah 3

4. Site investigation is mandatory to be carried out prior to construction. A site investigation consists of several steps which every good civil engineer needs to understand.

Penyiasatan tapak adalah mandatori dijalankan sebelum pembinaan. Suatu penyiasatan tapak mengandungi beberapa langkah yang mana setiap jurutera awam yang baik perlu ketahui.

- [a] The first step is called preliminary investigation. It is a general inspection of a site, which is essential in site investigation process. Describe **FIVE (5)** items to be considered when conducting a preliminary site investigation.

*Langkah pertama dipanggil penyiasatan awal. Ia adalah pemeriksaan am tapak yang penting. Terangkan **LIMA (5)** butiran yang perlu diambil kira semasa penyiasatan awal tapak.*

[5 marks/markah]

- [b] Trial pits are used in some projects. Explain the negative and positive aspects of a trial pit.

Dalam sesetengah projek, parit percubaan digunakan. Terangkan aspek positif dan negatif bagi parit percubaan.

[5 marks/markah]

- [c] A soil investigation is conducted for commercial building project and the borelog information from 12.50m depth until 20.00m is given in **Table 1**. The soil unit weight for hard clay is 20.8kN/m^3 and for very dense sand is 21.7kN/m^3 . Ground water level is at 3.00m below ground surface.

*Satu penyiasatan tapak telah dijalankan untuk projek bangunan perniagaan dan maklumat log lubang jara daripada 12.50m sehingga 20.00m diberikan dalam **Jadual 1**. Berat unit tanah bagi lempung keras ialah 20.8kN/m^3 dan pasir sangat padat ialah 21.7kN/m^3 . Aras air bumi terletak 3.00m di bawah permukaan tanah.*

Table 1 / Jadual 1

Depth (m) <i>Kedalaman (m)</i>	Description <i>Penerangan</i>	SPT Blow Count <i>Bilangan hentakan SPT</i>		
		1 st 0.15 m	2 nd 0.15 m	3 rd 0.15 m
12.50	Hard, grey sandy CLAY <i>Lempung pasir KELABU, keras</i>	13	14	17
14.00		14	16	15
15.50		11	17	18
17.00	Dense, grey clayed SAND <i>PASIR berlempung kelabu, padat</i>	12	18	21
18.50	Very dense, grey clayed SAND <i>Pasir berlempung kelabu, sangat padat</i>	11	22	28/80 mm
20.00		13	25	25/60 mm

Draw the soil profile including soil type, depth, unit weight and the SPT number for each layer.

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Lukis profil tanah termasuk jenis tanah, kedalaman, berat unit dan nombor SPT bagi setiap lapisan tanah.

[10 marks/markah]

5. A slope can either be natural or man-made. In any given situation when the slope is exposed or imposed with external loading, it may fail when the soil reach its maximum capacity to withhold the additional stresses imposed on the soil.

Cerun boleh berada dalam keadaan semulajadi atau buatan manusia. Dalam mana-mana situasi cerun terdedah ataupun dikenakan beban luaran, ia mungkin akan gagal jika cerun mencapai kapasiti maksimum bagi menahan lebihan bebanan ke atasnya.

- [a] Describe the main forces involved in the equilibrium of a soil element in a slope with the aid of a free body diagram.

Terangkan daya-daya penting yang terlibat dalam keseimbangan elemen tanah di dalam cerun dengan bantuan gambarajah jasad bebas.

[5 marks/markah]

- [b] At a particular site, a cut slope is to be made as shown in **Figure 4**. Using ordinary method of slices, determine the Factor of Safety for the slope. Use graph paper to redraw the slope according to scale. (Maximum 4 slices)

*Di suatu tapak binaan, potongan cerun akan dibuat seperti **Rajah 4**. Menggunakan kaedah hirisan biasa, tentukan Faktor Keselamatan bagi cerun tersebut. Gunakan kertas graf bagi melukis semula cerun tersebut menurut skala. (Maksimum 4 hirisan)*

[15 marks/markah]

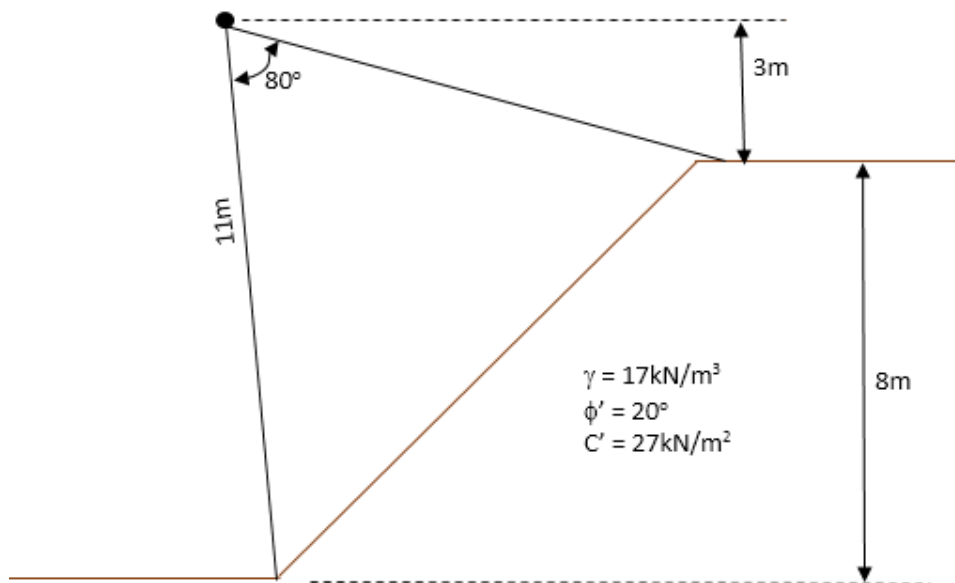


Figure 4 / Rajah 4

6. Determine the capacity of a 40cm by 40cm, single, concrete pile when driven to the depth of 28m, 33m, and 40m, through the profile shown in **Figure 5**. This can be achieved by filling the spaces of **Table 2** given by a, b, c, d, e, f, g, h, j and k after carrying out the necessary calculations. Finally, determine the penetration depth that gives the highest bearing capacity.

Equation and properties for:

Sand: $q_{tip} = p_v N_q^*$, Curve for friction angle versus N_q^* is given in **Figure 6**, coefficient of friction between sand and concrete pile = 0.45, K (coefficient of lateral earth pressure at rest) for dense sand = 1.1, Critical Depth = 20D (D=width), saturated unit weight of sand = 21 kN/ m³.

Clay: $q_{tip} = 9c$ (c=cohesion), adhesion factor = 0.8

*Tentukan kapasiti bagi suatu cerucuk konkrit, bersaiz 40cm x 40cm dan dipacu ke kedalaman 28m, 33m dan 40m melalui profil seperti **Rajah 6**. Ini boleh dicapai dengan memenuhi ruang a,b,c,d,e,f,g,h,j dan k di dalam Jadual 2, setelah pengiraan dijalankan. Akhirnya tentukan kedalaman tusukan yang memberi kapasiti terbesar.*

Persamaan dan sifat:

Pasir: $q_{tip} = p_v N_q^*$, Lengkung sudut geseran melawan N_q^* seperti diberi dalam Rajah 5, pekali geseran bagi pasir dan cerucuk = 0.45, K (pekali tekanan mendatar diam) bagi pasir padat = 1.1, Kedalaman kritikal = $20D$ (D =lebar), berat unit pasir tepu = 21 kN/m^3 .

Lempung: $q_{tip} = 9c$ (c =kejelekitan), faktor kelekatan = 0.8

[20 marks/markah]

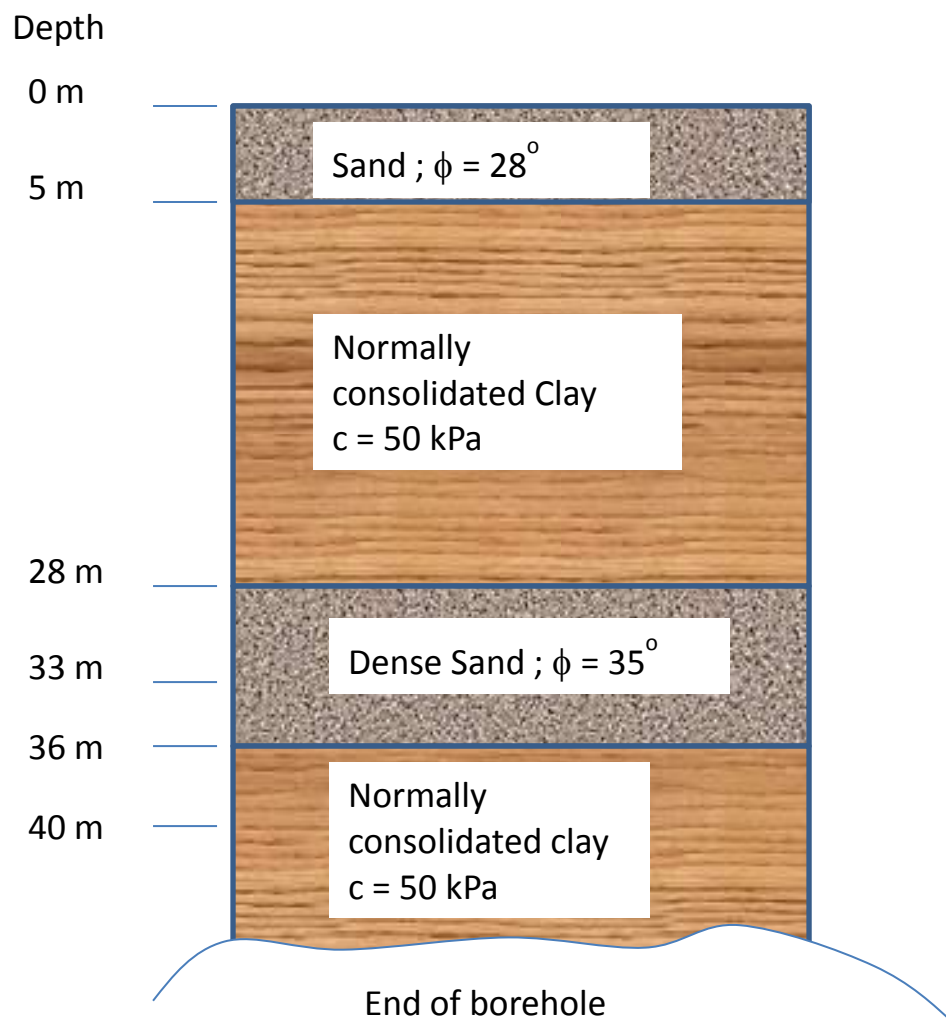


Figure 5 – The profile of a site where a pile needs to be driven into
Rajah 5 – Profil lokasi pemacuan cerucuk

Table 2 – Capacities of 40x40 cm square pile driven to various depths**Jadual 2 – Keupayaan cerucuk segi empat sama 40x40 cm dipacu pada pelbagai kedalaman**

Penetration Depth <i>Kedalaman Penusukan</i>	28m	33m	40m	Note
Friction for top 5m, kN <i>Geseran bagi 5m teratas, kN</i>	a	a	a	The penetration depth that gives the highest bearing capacity is: _____m <i>Kedalaman penusukan yang memberikan keupayaan galas tertinggi: _____m</i>
Friction from 5-28m, kN <i>Geseran bagi kedalaman 5-28m, kN</i>	b	b	b	
Friction from 28-33m, kN <i>Geseran bagi kedalaman 28-33m, kN</i>		c	c	
Friction from 33-40m, kN <i>Geseran bagi kedalaman 33-40m, kN</i>			d	
End bearing, kN <i>Galas hujung, kN</i>	e	f	g	
Total Capacity, kN <i>Keupayaan keseluruhan, kN</i>	h	j	k	

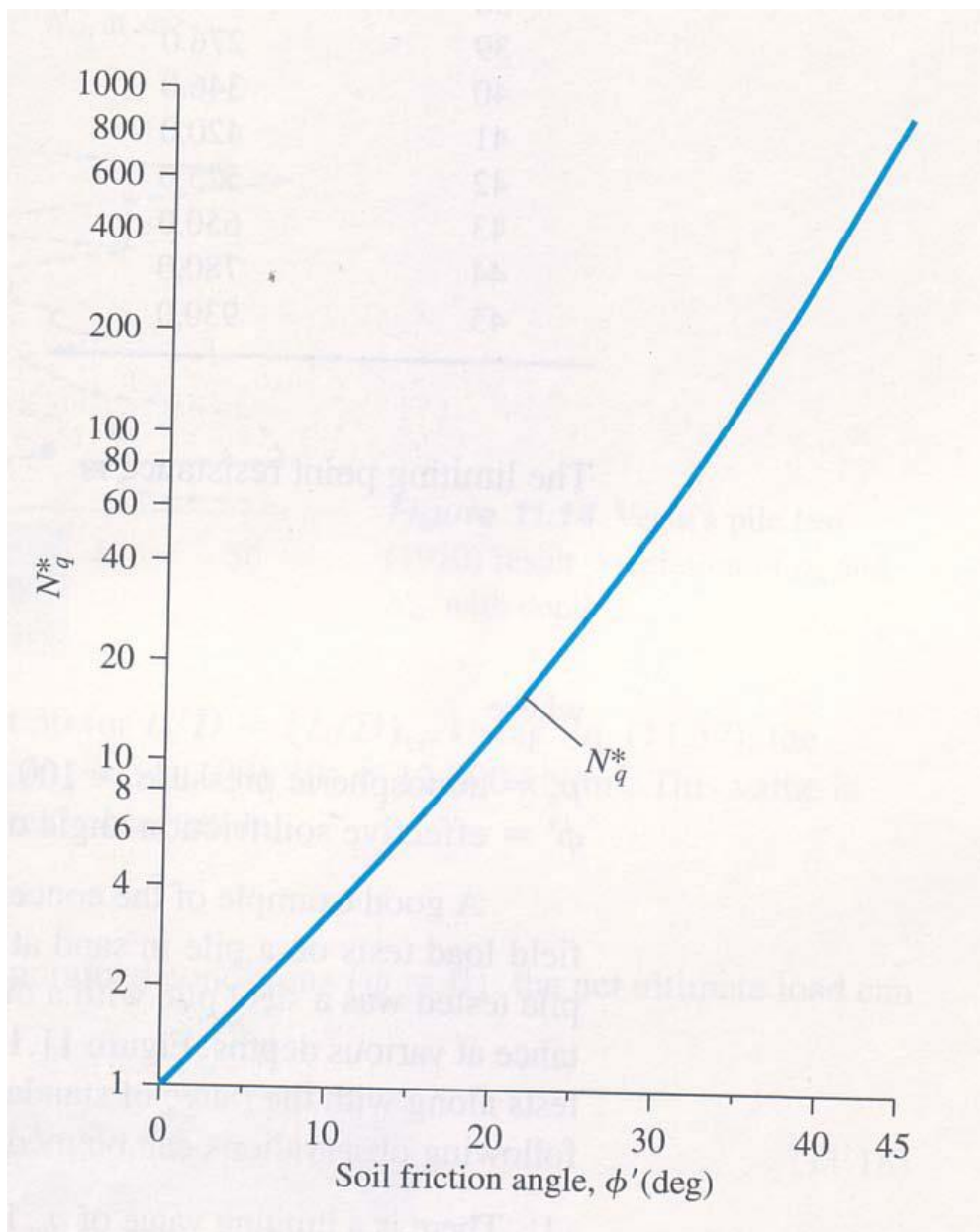


Figure 6 - N_q^* vs ϕ / *Rajah 6 - N_q^* vs ϕ*

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