

SULIT



First Semester Examination
2019/2020 Academic Session

December 2019 / January 2020

**EAG345 – Geotechnical Analysis
(Analisis Geoteknik)**

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of **TEN (10)** pages of printed material including appendix before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat yang bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions : This paper consists of **SIX (6)** questions. Answer **FIVE (5)** questions.

Arahan : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **LIMA (5)** soalan.]

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

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

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- (1). The following are the results of a consolidated-undrained Triaxial test of a clay sample:

Berikut ini keputusan ujian tiga-paksi terkukuh-taktersalir bagi suatu sampel tanah lempung.

Table 1/ Jadual 1

Specimen No./ No. spesimen	σ_3 (kN/m ²)	σ_1 at failure / σ_1 sewaktu gagal (kN/m ²)	Pore pressure Tekanan lompong (kN/m ²)
1	191	376	100
2	383	636	100

- (a). Determine the friction angle and cohesion of the clay under the consolidated-undrained conditions.

Tentukan sudut ricih dan kejelekitan tanah lempung di bawah keadaan terkukuh-taktersalir.

[5 marks/markah]

- (b). Determine the friction angle and cohesion of the clay under the consolidated-drained conditions.

Tentukan sudut ricih dan kejelekitan tanah lempung di bawah keadaan terkukuh-tersalir.

[5 marks/markah]

- (c). A second sample of the same clay acquired from the same depth as the first was brought to the lab and tested under a consolidated-drained procedure. The confining stress applied this time ensured that the sample achieved normal consolidation before it was axially loaded. **Table 2** shows the results obtained. Determine the friction angle and cohesion of the clay under the given conditions.

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Sampel kedua daripada tanah lempung yang sama diambil dari kedalaman yang sama seperti yang pertama dibawa ke makmal dan diuji di bawah keadaan terkukuh-tersalir. Tekanan takungan kali ini dipastikan nilainya agar sampel mencapai pengukuhan normal sebelum ianya dikenakan tekanan paksi. **Jadual 2** menunjukkan keputusan yang didapati. Tentukan sudut ricih dan kejelekitan tanah dibawah keadaan yang diberi.

[5 marks/markah]

Table 2/Jadual 2

Specimen No./ No. spesimen	σ_3 (kN/m ²)	σ_1 at failure / σ_1 sewaktu gagal (kN/m ²)	Pore pressure / Tekanan lompong (kN/m ²)
3	500	1800	0

- (d). Determine the approximate depth in the field from where the samples might have been collected. Assume the saturated unit weight of soil from ground surface to the depth as 20 kN/m³, while the ground water level was at the ground surface.

Tentukan kedalaman dari mana sampel telah diambil. Anggap berat unit tanah dari paras bumi sehingga ke kedudukan sampel sebagai 20 kN/m³, sementara paras air bumi berkedudukan di permukaan tanah.

[5 marks/markah]

- (2). (a). Describe with sketches the meaning of earth pressure at rest, active and passive conditions.

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

[8 marks/markah]

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- (b). A retaining wall is 7 m high, where the soil supported consist of 5 m of sand ($\gamma = 17 \text{ kN/m}^3$, $\phi = 30^\circ$) overlaying saturated sandy clay ($\gamma_{\text{sat}} = 19 \text{ kN/m}^3$, $\phi = 25^\circ$, $c = 16 \text{ kN/m}^2$). The ground water level is at the upper level of sandy clay.

Sketch the distribution of active pressure on the wall and state the principal values. Calculate the thrust per linear meter of wall.

Satu tembok penahan bagi ketinggian 7 m, menahan 5 m tanah pasir ($\gamma = 17 \text{ kN/m}^3$, $\phi = 30^\circ$) dan dilapisi oleh tanah lempung berpasir yang tepu ($\gamma_{\text{sat}} = 19 \text{ kN/m}^3$, $\phi = 25^\circ$, $c = 16 \text{ kN/m}^2$). Air bumi adalah pada atas permukaan tanah lempung berpasir.

Lakarkan agihan tekanan aktif pada tembok penahan dan nyatakan apakah nilai prinsipal. Kira tujah per linear meter tembok.

[12 marks/markah]

- (3). (a). Retaining wall can fail in different modes. Sketch them and explain briefly why they failed.

Tembok penahan boleh gagal dalam pelbagai mod. Lakar dan terangkan dengan ringkas bagaimana ia gagal.

[5 marks/markah]

- (b). An anchored sheetpile wall retain soil of height 7.5 m, the pile have total length of 12 m. The soil has unit weight of 18 kN/m^3 and $\phi = 27^\circ$. The tie rod is at 1.3 m below the ground surface and 3 m apart space as shown in **Figure 1**.

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Tembok cerucuk terikat menahan tanah pada ketinggian 7.5 m, cerucuk mempunyai kedalaman 12 m sepenuhnya. Tanah tersebut mempunyai berat unit sebanyak 18 kN/m^3 dan $\phi = 27^\circ$. Rod terikat ada pada 1.3 m di bawah permukaan bumi dan jarak 3 m antara rod seperti dalam **Rajah 1**.

Determine:

Tentukan:

- (i). Proportion of possible passive resistance on the total embedded length of the piling.

Komposisi kemungkinan rintangan pasif dalam jumlah kedalaman cerucuk terbenam.

- (ii). Pull force in the anchor

Daya tarikan sauh

[15 marks/markah]

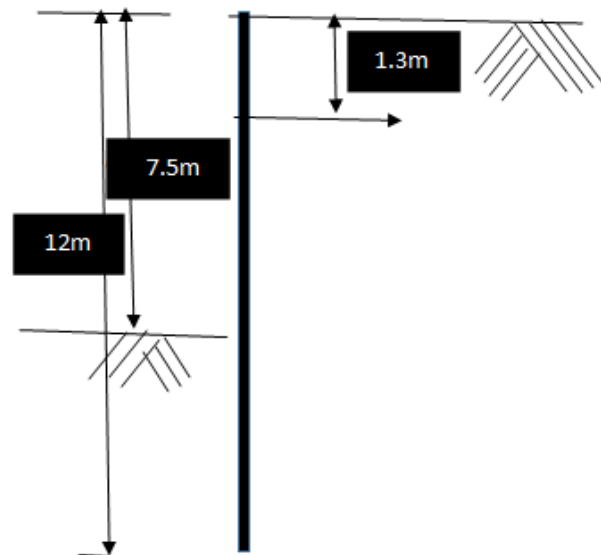


Figure 1/ Rajah 1

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- (4). (a). A new water tank with a capacity of 20,000 liter is to be built at Desasiswa Jaya, Universiti Sains Malaysia on soft ground consisting of CLAY and SAND materials with SPT-N values between 0 to 33.

Satu tangki air baru dengan kapasiti 20,000 liter akan dibina di Desasiswa Jaya, Universiti Sains Malaysia di atas tapak lembut mengandungi bahan LEMPUNG dan PASIR dengan nilai SPT-N di antara 0 ke 33.

- (a). Explain in detail **FIVE (5)** important aspects in preliminary site investigation for this project.

*Jelaskan dengan lengkap **LIMA (5)** aspek penting penyiasatan awal tapak bagi projek ini.*

[10 marks/markah]

- (b). Describe the **TWO (2)** field tests and **TWO (2)** laboratory tests suitable for this exploration.

*Terangkan **DUA (2)** ujikaji tapak dan **DUA (2)** ujikaji makmal yang sesuai bagi eksplorasi ini.*

[6 marks/markah]

- (c). Describe the types of soil sampling that can be taken from the site. Explain the usage for each type.

Terangkan jenis pensampelan tanah yang boleh diambil dari tapak. Jelaskan kegunaan setiap jenis tersebut.

[4 marks/markah]

- (5). Slope failure can be in various modes and one of the failures is an infinite slope failure as shown in **Figure 2**.

*Kegagalan cerun boleh terjadi dalam pelbagai mod dan salah satu dari kegagalan itu adalah kegagalan cerun infiniti seperti ditunjukkan dalam **Rajah 2**.*

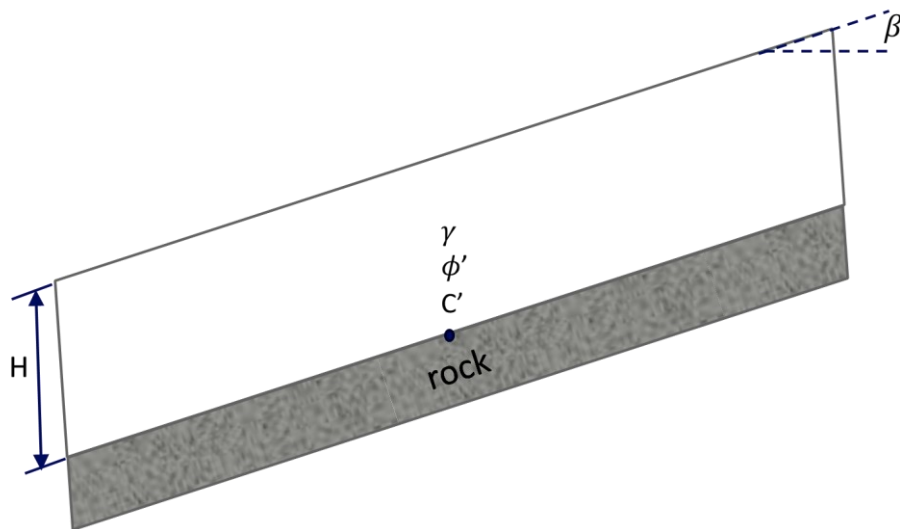


Figure 2/Rajah 2

- (a). Illustrate a free body diagram including all forces acting on a single slice of infinite slope.

Lakar gambarajah jasad bebas termasuk semua daya bertindak ke atas satu hirisan cerun infiniti.

[4 marks/markah]

- (b). Establish the factor of safety equation using the limit equilibrium method for an infinite slope without seepage.

Terbitkan persamaan faktor keselamatan menggunakan kaedah keseimbangan terhad bagi cerun infiniti tanpa resapan.

[6 marks/markah]

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- (c). **Figure 3** shows a cross-section of slope. Calculate the factor of safety using mass procedure method. (Use the information given in the **Appendix**). If FOS = 1.5, determine the new depth for the slope.

Rajah 3 menunjukkan keratan rentas cerun. Kira faktor keselamatan menggunakan kaedah prosedur jisim. (Guna maklumat diberikan dalam **Lampiran**). Jika F.K = 1.5, tentukan kedalaman baharu bagi cerun tersebut.

[10 marks/markah]

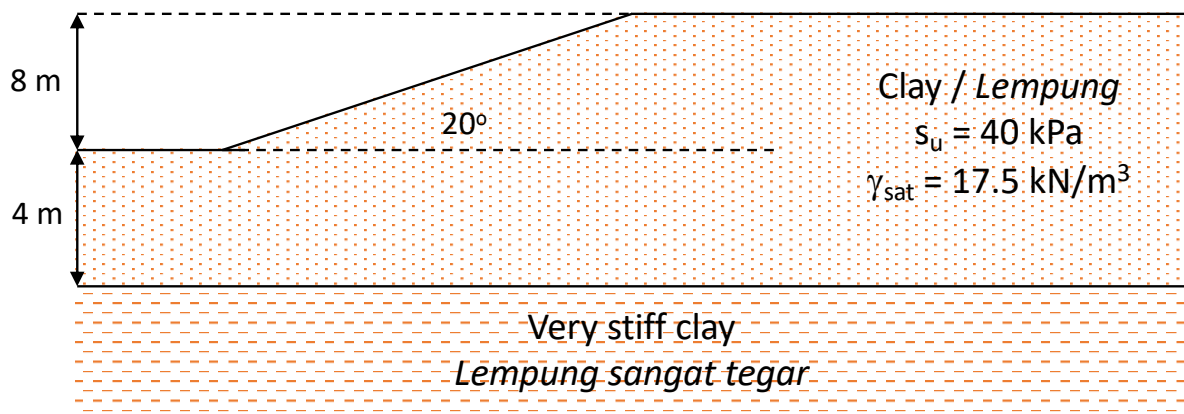


Figure 3/Rajah 3

- (6). (a). Define bearing capacity of soil.
Takrifkan keupayaan galas tanah.

[4 marks/markah]

- (b). Terzaghi's equation for ultimate bearing capacity, q_f , for strip foundation with width, B and depth, z is:

Persamaan Terzaghi bagi keupayaan galas muktamad q_f , untuk tapak jalur dengan lebar, B dan kedalaman, z adalah:

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$$q_f = CN_c + \gamma ZN_q + 0.5\gamma BN_\gamma$$

With cohesion, c and unit weight, γ .

Dengan jelekitan, c dan berat unit tanah, γ .

Describe the **THREE (3)** components in the equation above.

*Terangkan **TIGA (3)** komponen di dalam persamaan di atas.*

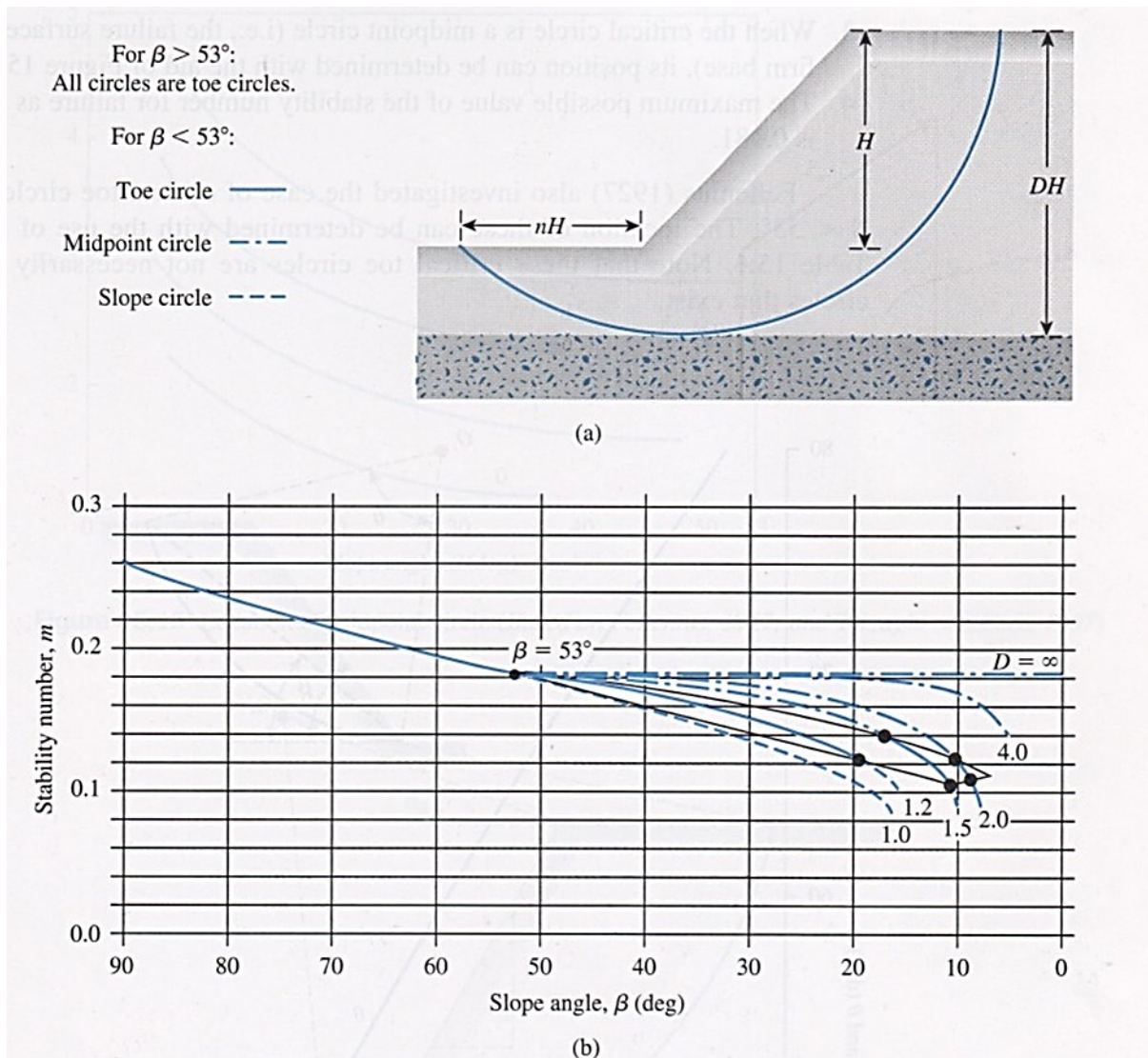
[6 marks/markah]

- (c). A strip foundation with 2.5 m width will be built at 3 m depth from ground surface. Determine the safe bearing capacity for the foundation using factor of safety 3.0. The cohesion value is 65 kN/m² and bulk density of 1.83 Mg/m³. Given $N_c = 10$, $N_q = 4$ and $N_\gamma = 2$.

Satu tapak jalur dengan lebar 2.5 m akan dibina pada kedalaman 3 m dari permukaan bumi. Tentukan keupayaan gelas selamat bagi tapak ini menggunakan faktor keselamatan 3.0. Nilai kejelekitan adalah 65 kN/m² dan ketumpatan tanah pukal 1.83 Mg/m³. Diberikan $N_c = 10$, $N_q = 4$ dan $N_\gamma = 2$.

[10 marks/markah]

APPENDIX/LAMPIRAN



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