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# UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 2008/2009

November 2008

## **EBS 417/3 - Geomechanis [Geomekanik]**

Duration : 3 hours  
[Masa : 3 jam]

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Please ensure that this examination paper contains SEVEN printed pages and TWO pages APPENDIX before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat beserta DUA muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.]*

This paper contains SIX questions. TWO questions in PART A and FOUR questions in PART B.

*[Kertas soalan ini mengandungi ENAM soalan. DUA soalan di BAHAGIAN A dan EMPAT soalan di BAHAGIAN B.]*

**Instructions:** Answer FIVE questions : Answer ALL questions from PART A and THREE questions from PART B. If a candidate answers more than five questions only the first five questions in the answer sheet will be graded.

**[Arahan:** Jawab LIMA soalan. Jawab SEMUA soalan dari BAHAGIAN A dan TIGA soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]

Answer to any question must start on a new page.

*[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.]*

You may answer a question either in Bahasa Malaysia or in English.

*[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

**PART A****BAHAGIAN A**

1. [a] The results on sieve analysis on soil are:

*Keputusan analisa saringan ke atas suatu tanah ialah:*

<b>Sieve size (mm)</b> <i>Saiz saringan (mm)</i>	<b>Mass retained (g)</b> <i>Jisim yang tertinggal (g)</i>
50.00	0
37.50	15.5
20.00	17.0
14.00	10.0
10.00	11.0
6.30	33.0
3.35	114.5
1.18	63.3
0.60	18.2
0.15	17.0
0.063	10.5

The total mass of the sample was 311g, plot the particle size distribution curve and, from the inspection of this curve, determine the effective size and uniformity coefficient. Classify the soil based on the chart in Appendix 1.

*Jumlah jisim sampel ialah 311g, plotkan lengkungan taburan saiz zarah dan, daripada pemeriksaan lengkungan ini tentukan saiz keberkesanan dan pekali keseragaman. Kelaskan tanah ini berdasarkan carta di Lampiran 1.*

(15 marks/markah)

[b] Define the following:

- (i) Porosity
- (ii) Void Ratio
- (iii) Well graded soil
- (iv) Uniformly graded soil
- (v) Gap graded soil

*Berikan takrifan berikut:*

- (i) *keliangan*
- (ii) *nisbah ruang*
- (iii) *tanah bergred rapi*
- (iv) *tanah bergred seragam*
- (v) *tanah bergred sela*

(5 marks/markah)

2. [a] Outline the essential requirements considered necessary for a rock mass classification system for mine support design. Discuss the essential differences between the classification system proposed by Bieniawski and that proposed by Barton, Lien and Lunde.

*Nyatakan dengan ringkas mengenai keperluan-keperluan yang dianggap perlu untuk sistem pengelasan jisim batuan bagi rekabentuk sokongan lombong. Bincangkan perbezaan yang penting di antara sistem pengelasan yang dicadangkan oleh Bieniawski dan dicadangkan oleh Barton, Lien dan Lunde.*

(10 marks/markah)

- [b] Discuss the principle and merits of the application of shotcrete as a method of mine support. Include in the discussion the desirable properties of shotcrete, together with aspects of quality control, testing and safety.

*Bincangkan prinsip dan kebaikan penggunaan syotkret sebagai kaedah sokongan lombong. Masukkan dalam perbincangan mengenai sifat-sifat yang baik untuk syotkret bersama dengan aspek kawalan kualiti, ujian dan keselamatan.*

(10 marks/markah)

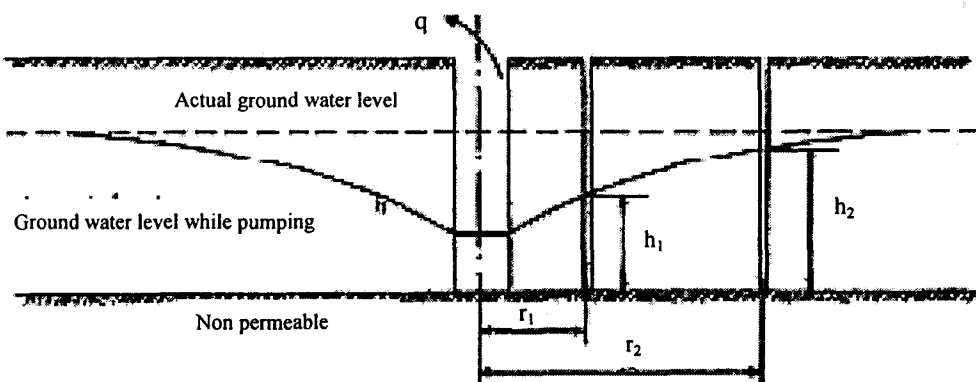
**PART B****BAHAGIAN B**

3. [a] In pumping out test as shown in Figure 1, water is pumped out from a well at the rate of  $q$  and the height of water level at the first observation well at distance  $r_1$  from the center of the pumping well is  $h_1$  and the water level at the second observation well at  $r_2$  from the pumping well is  $h_2$ . Derive the coefficient of permeability:

*Dalam ujian pegepaman keluar seperti yang ditunjukkan dalam Rajah 1, air dipam keluar daripada sebuah telaga pada kadar alir  $q$  dan ketinggian paras air di telaga pemerhatian pertama dengan jarak  $r_1$  daripada titik tengah telaga yang mengepam ialah  $h_1$  dan paras air di telaga pemerhatian kedua pada  $r_2$  dari telaga pengepaman ialah  $h_2$ . Terbitkan pekali kebolehtelapan.*

(5 marks/markah)

$$k = \frac{2.3q \log_{10} \left( \frac{r_2}{r_1} \right)}{\pi(h_2^2 - h_1^2)}$$

**Figure 1****Rajah 1**

- [b] State and describe the corrective measures for failing slopes.

*Nyatakan dan terangkan langkah pemulihan untuk cerun yang gagal.*

(15 marks/markah)

...5/-

4. [a] Define (i) total stress (ii) effective stress (iii) induced stress.

Takrifkan (i) tegasan jumlah (ii) tegasan berkesan (iii) tegasan aruhan.

(6 marks/markah)

- [b] A concrete dam as shown in Figure 2 is constructed over a soil with a sloping impervious bedrock, and a cut-off wall is positioned as shown to reduce seepage. Determine the seepage per day per meter length of dam if  $k$  for the underlying soil is  $3 \times 10^{-3}$  mm/s. Sketch the uplift pressure diagram and give the pressure at points A, B and C.

Sebuah empangan konkrit seperti ditunjukkan di dalam Rajah 2 dibina di atas tanah dengan batuan hampar yang mencerun, dan suatu dinding penghalang diletakkan di bawah empangan untuk mengurangkan resapan. Tentukan resapan per hari per meter panjang empangan sekiranya nilai  $k$  untuk tanah ialah  $3 \times 10^{-3}$  mm/s. Lakar rajah tekanan angkat atas, dan berikan tekanan di titik A, B dan C.

(14 marks/markah)

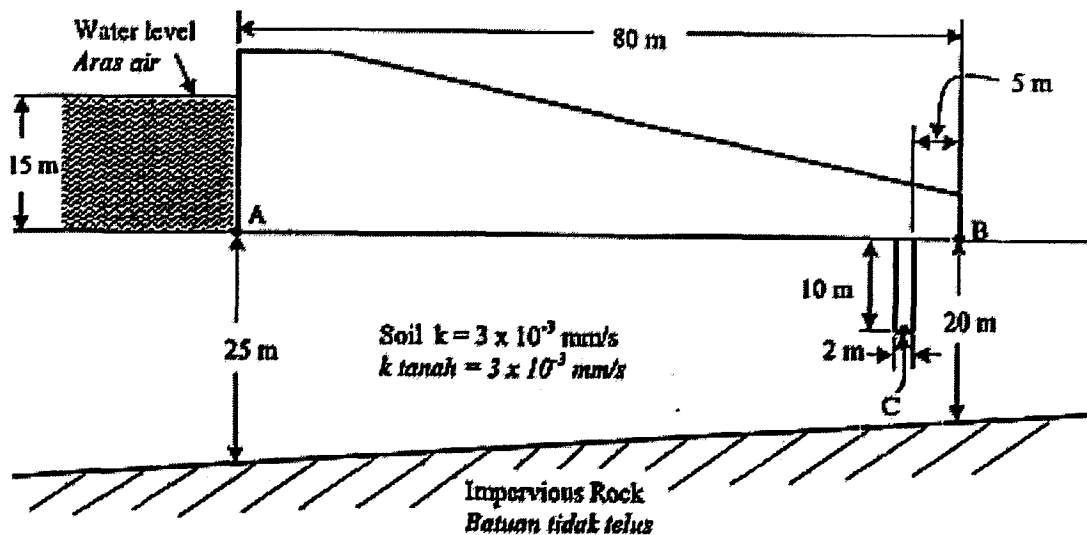


Figure 2

Rajah 2

5. [a] What are the types of stresses in rock and discuss briefly each one of them.

*Apakah jenis tegasan dalam batuan dan bincangkan dengan ringkas mengenai setiap satunya.*

(10 marks/markah)

- [b] Write short notes about the common rock slope failures illustrating with the help of sketches of the slope and the stereographic projection of each failure.

*Tuliskan nota ringkas mengenai kegagalan batuan yang biasa terjadi dan tunjukkan dengan lakaran dan unjuran stereografi bagi setiap kegagalan.*

(10 marks/markah)

6. [a] Describe briefly the failure criterion used in rocks.

*Terangkan dengan ringkas kriteria kegagalan dalam batuan.*

(4 marks/markah)

- [b] Plot the poles of the following discontinuities:

- (i) dip  $10^\circ$  towards  $030^\circ$
- (ii) dip  $20^\circ$  towards  $035^\circ$
- (iii) dip  $21^\circ$  towards  $032^\circ$
- (iv) dip  $15^\circ$  towards  $031^\circ$
- (v) dip  $14^\circ$  towards  $032^\circ$

Estimate the general dip and trend of these structures?

*Plot kutub-kutub ketakselajaran berikut:*

- (i) *miring  $10^\circ$  ke arah  $030^\circ$*
- (ii) *miring  $20^\circ$  ke arah  $035^\circ$*
- (iii) *miring  $21^\circ$  ke arah  $032^\circ$*
- (iv) *miring  $15^\circ$  ke arah  $031^\circ$*
- (v) *miring  $14^\circ$  ke arah  $032^\circ$*

*Anggarkan kemiringan am dan tren struktur-struktur ini?*

(6 marks/markah)

[c] A road cut is going to cut through a granite hill. The rock slope of the road is going to dip towards  $300^\circ$ . The rock has two sets of joint as follow:

Set 1 dips  $52^\circ$  towards  $258^\circ$

Set 2 dips  $60^\circ$  towards  $333^\circ$

The angles of the road cut are being considered at the following angles:

(i)  $60^\circ$

(ii)  $52^\circ$

(iii)  $40^\circ$

Give your comments on the type of failures (if any) that may occur on each proposed slope.

What is the most steepest slope that you would recommend and why? Attach all tracing papers used with your answers.

*Sebuah jalan raya akan dibina dan akan memotong sebahagian daripada sebuah bukit granit. Cerun di tepi jalan raya ini miring ke arah  $300^\circ$ . Batuan yang akan dipotong ini terdapat dua kekar iaitu:*

*Set 1 miring  $52^\circ$  ke arah  $258^\circ$*

*Set 2 miring  $60^\circ$  ke arah  $333^\circ$*

*Sudut muka cerun potongan ini sedang dipertimbangkan seperti berikut:*

*(i)  $60^\circ$*

*(ii)  $52^\circ$*

*(iii)  $40^\circ$*

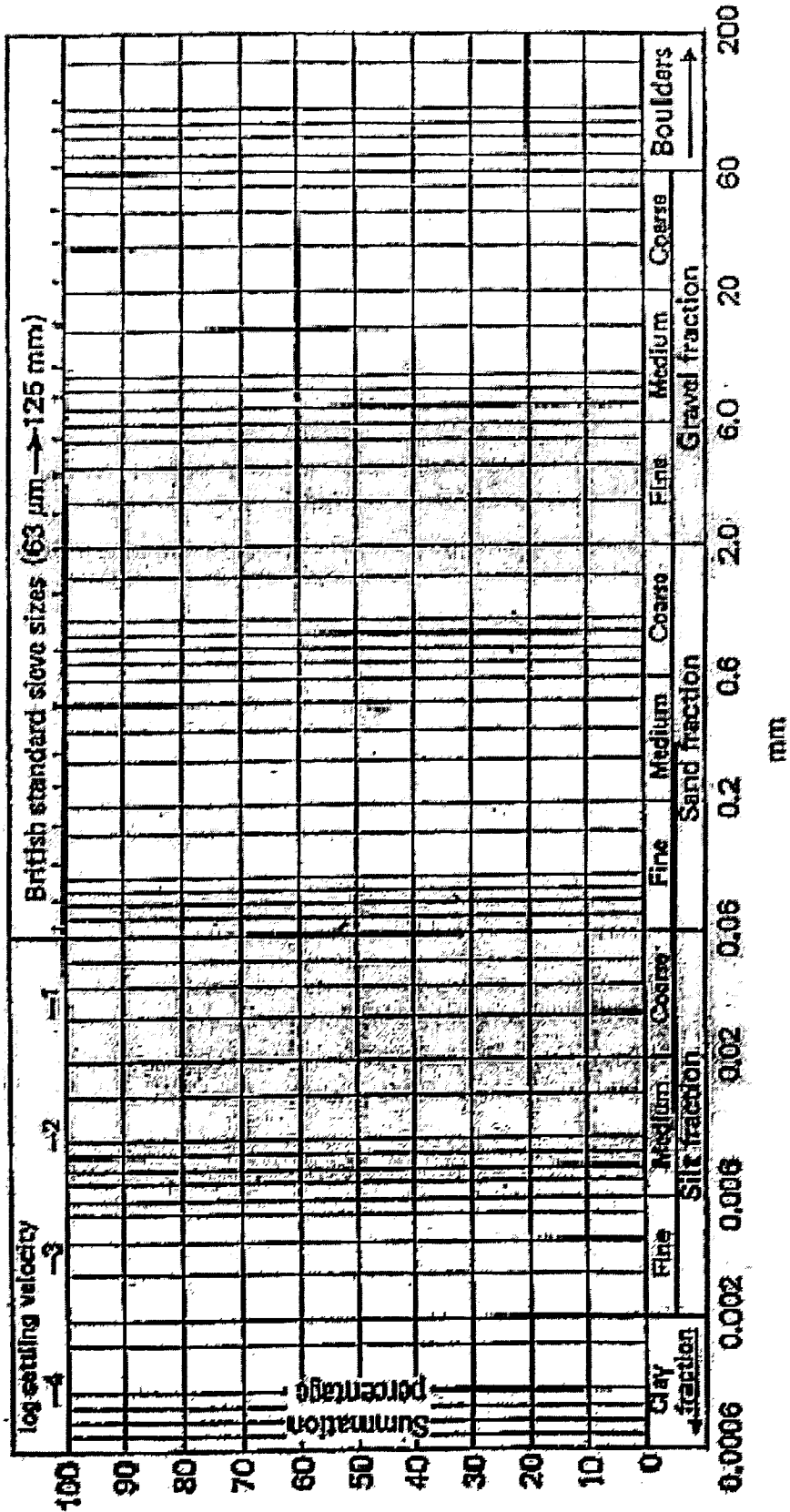
*Beri komen anda mengenai jenis kegagalan (jika ada) yang mungkin terjadi pada setiap sudut muka cerun yang dicadangkan.*

*Apakah sudut muka cerun yang paling curam yang anda syorkan dan nyatakan mengapa? Jawapan anda hendaklah disertakan dengan kertas surih yang anda gunakan.*

(10 marks/markah)

Appendix 1

Lampiran 1



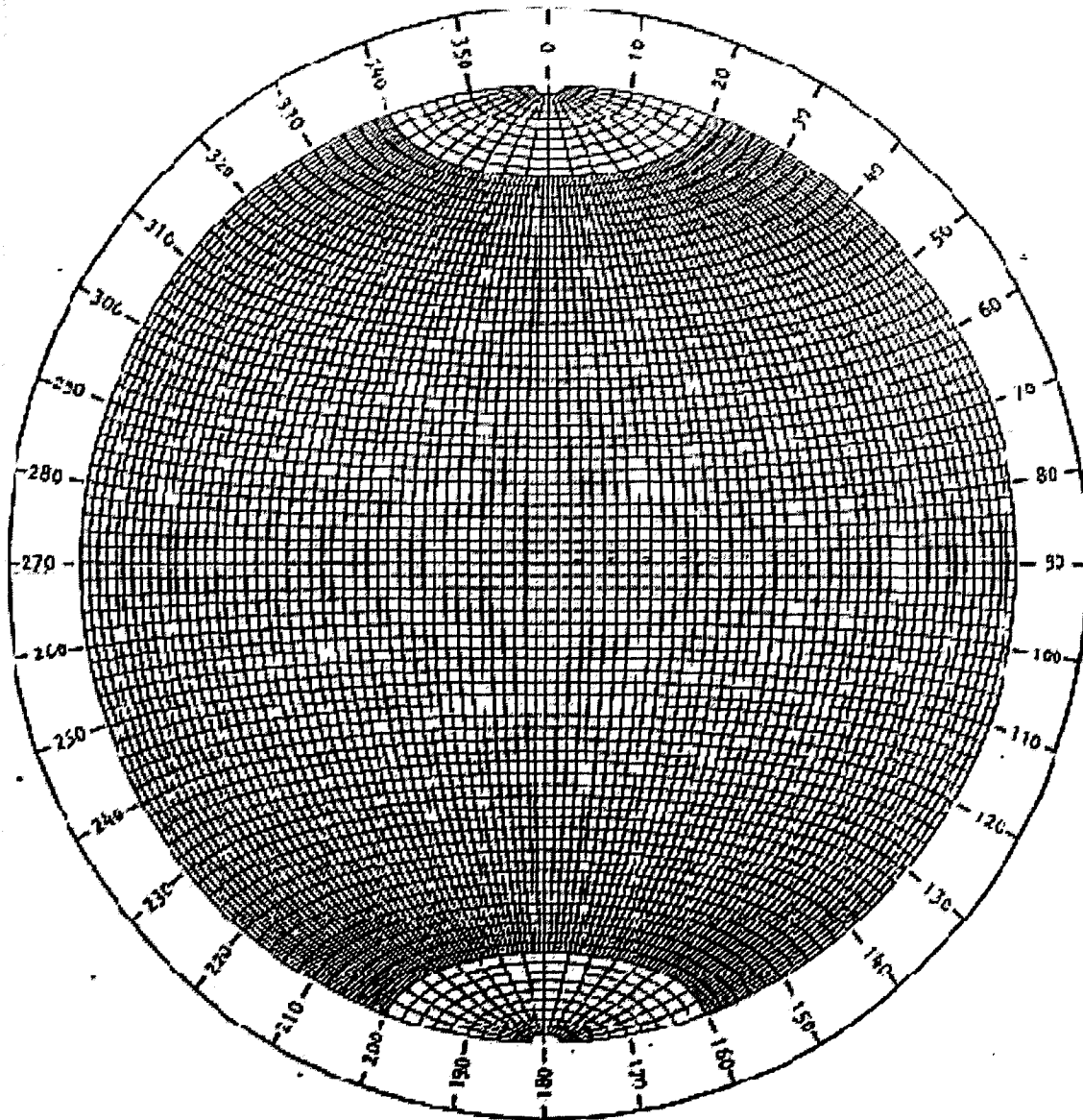
Particle Size Distribution Chart



**Appendix 2**

***Lampiran 2***

Stereonet



Equatorial equal-area stereonet marked in 2° intervals

Computer drawn by Dr. C.M. St John of the Royal School of Mines, Imperial College, London.