UNIVERSITI SAINS MALAYSIA

Second Semester Examination

Academic Session 2008/2009

April/May 2009

EAG 245/3 – Soil Mechanics
[Mekanik Tanah]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **FIFTEEN (15)** printed pages before you begin the examination.
*[Sila pastikan kertas peperiksaan ini mengandungi **LIMA BELAS (15)** muka surat bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This paper consists of **SIX (6)** questions. Answer **FIVE (5)** questions only. All questions carry the same marks.

*[**Arahan**: Kertas ini mengandungi **ENAM (6)** soalan. 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 page.
*[Semua soalan **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) In a particular project, you encountered **TWO (2)** different types of soil. As a civil engineer, you need to classify the soil. How would you determine if a soil was a silty sand or sandy silt if ;

   (i) Laboratory test equipment was available?

   (ii) Laboratory test equipment was not available?

   [5 Marks]

   b) An undisturbed specimen of clay was tested in the laboratory and the following results were obtained:

   Specific gravity of solids: 2.65

   Wet and oven-dried masses of the specimen 200g and 120g respectively.

   Assuming the wet specimen to be (a) 100% saturated and (b) 75% saturated.

   Determine,

   (i) the total volume

   (ii) the void ratio

   (iii) the porosity

   [15 Marks]

2. a) In clay mineralogy, there are **THREE (3)** important groups of clay minerals. Describe the group and its behaviour.

   [6 Marks]

   b) Explain the terms liquid limit, plastic limit and plasticity index. Describe how they are measured.

   [4 Marks]

   c) The following information and the grain size distribution data in Table 1, are to be used. All these soils are inorganic.

Determine:

(i) AASHTO group classification and group index for D through G.

(ii) USCS group symbol and group name for soil D through G.

[10 Marks]

Table 1

Soil Sample Identification	Liquid Limit	Plastic Limit
D	55	32
E	45	31
F	35	25
G	Non – plastic	

3. a) List the names of **TWO (2)** engineering projects where field compaction is necessary.

[6 Marks]

b) For an embankment project soil samples were collected from the borrow pit and tested in the laboratory using Standard Proctor method. Following results were obtained.

Table 2

Mass of wet soil in the mold, Kg	Moisture content
1.76	10
1.86	12
1.92	14
1.95	16
1.93	18
1.90	20

It was specified in the contract document that field density should be at least 95 % of $\gamma_{d(max)}$ at +/- 2% of w_{opt}.

(i) Calculate $\gamma_{d\,max}$ and w_{opt} for the borrow soil.

(ii) What is the range of water content that the contactor can compact the soil in the field?.

(iii) In order to verify the field compaction, sand cone tests was performed on the compacted soil. It was found that the field density (γ) was 18.7kN/m^3 with a moisture content of 16.3 %. Calculate the relative compaction R (%) and comment on the acceptability of the field compaction.

[14 Marks]

4. a) Define the following terms :

(i) Flow lines.

[2 Marks]

(ii) Equipotential lines.

[2 Marks]

(iii) Flow nets.

[2 Marks]

b) For the single row of sheet piles driven in to a permeable layer as shown in Figure 3.

(i) Draw flow nets, if H_1=6m, H_2=1 m D=4m, D_1=10 m.

(ii) Calculate the seepage loss per meter length of the sheet pile.

(iii) Determine the water level in a piezometer if it is placed at the tip of sheet pile in the permeable layer.

[14 Marks]

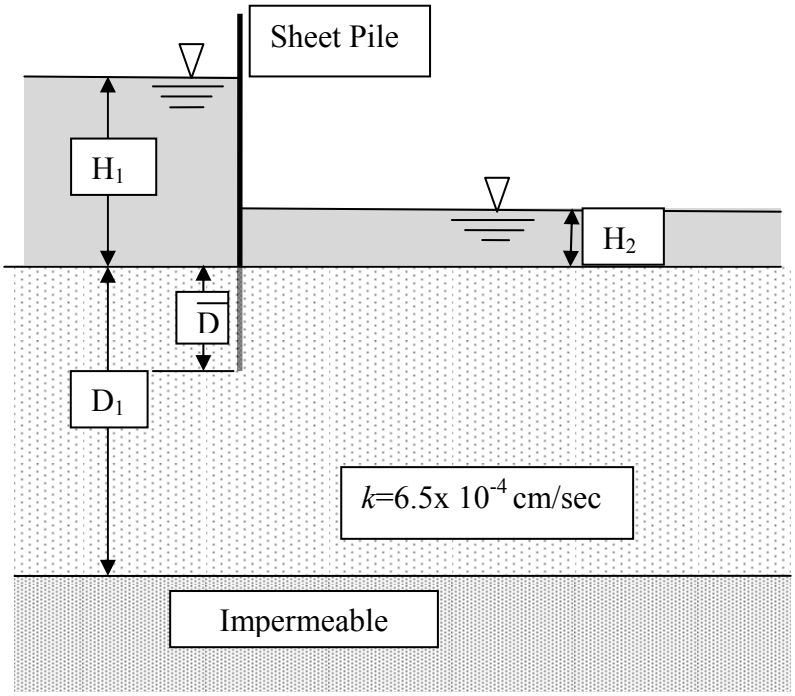


Figure 3

5. a) Briefly describe effective stress and its relation to neutral stress.

[3 Marks]

b) A 5 m deep river consists of saturated sand having unit weight 19.7 kN/m^3. Calculate the effective vertical stress at 10 m below the river bed.

[2 Marks]

c) A soil profile is shown in Figure 4.

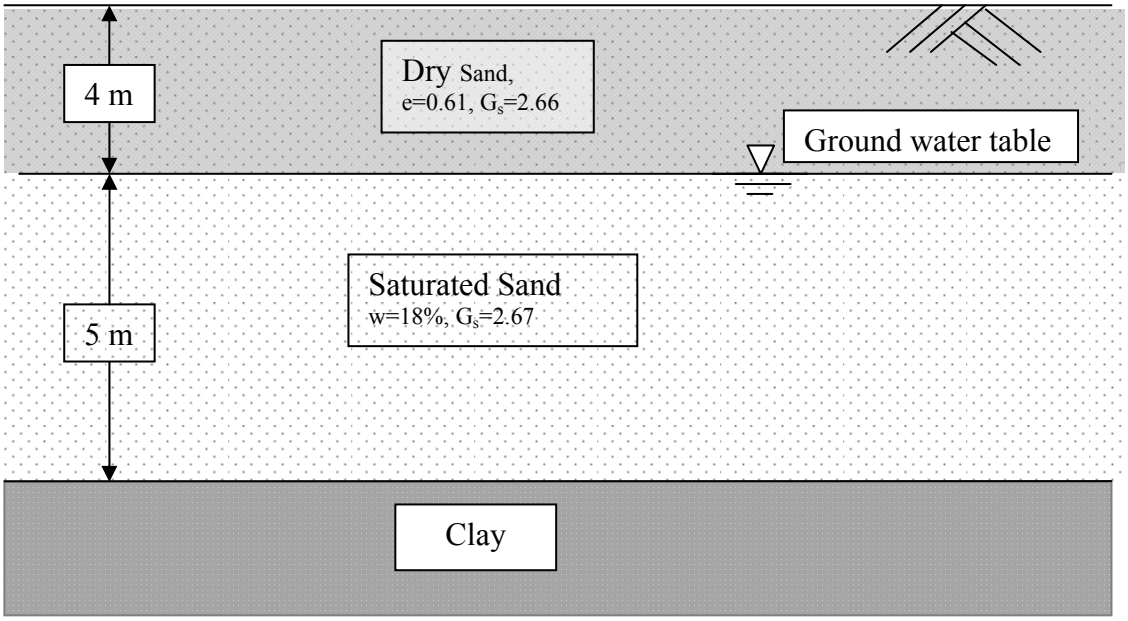


Figure 4

(i) Plot the variation of total stress, pore water pressure, and effective vertical stress with depth for the sand layer.

[9 Marks]

(ii) How high should the ground water table rise so that the effective vertical stress at the bottom of sand layer is 110 kN/m^2.

[6 Marks]

6. a) Describe the different between compaction and consolidation in term of all three aspects soil type, excess pore water pressure dissipation rate and process time are among the key aspect in consolidation process.

[6 Marks]

b) Figure 6 illustrates a 5 m earth embankment for 2 km stretch highway which was placed on the original deposit. The original ground level, O.G.L is at 39.0 m based on project reference level and ground water level is at 4 m below.

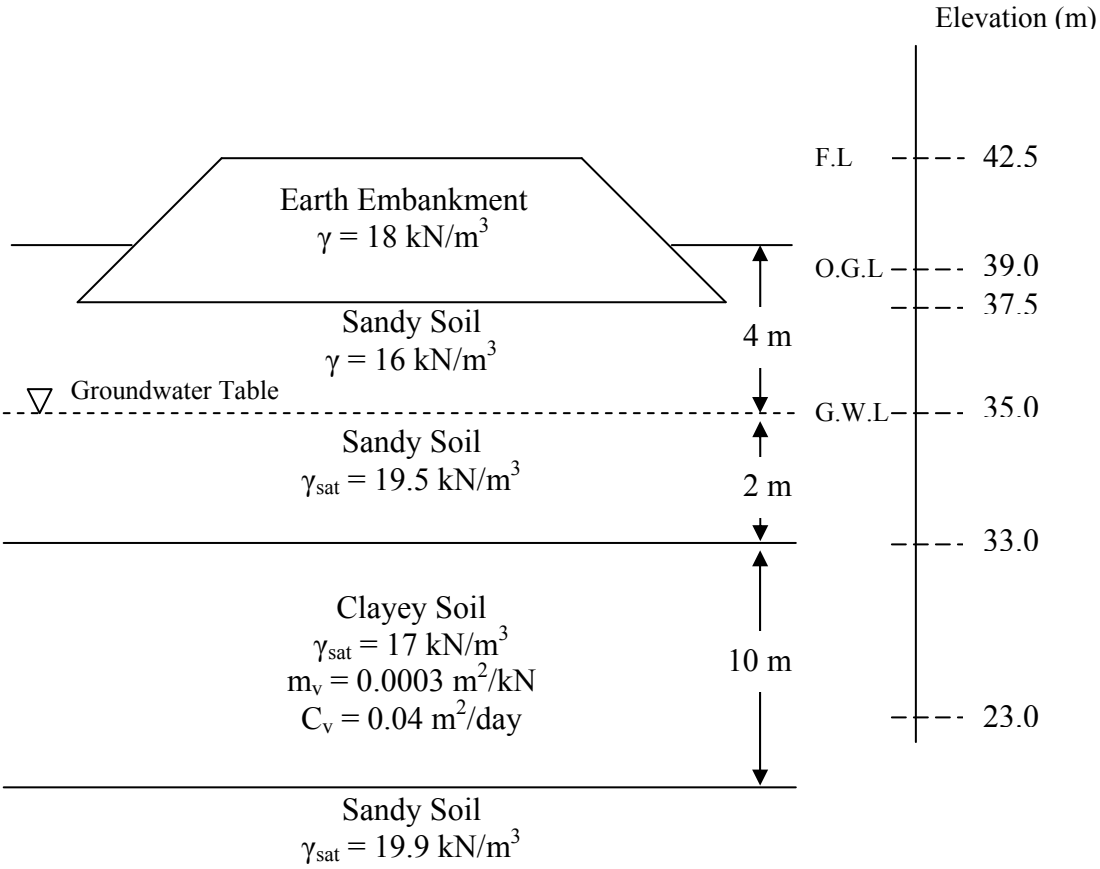


Figure 6

i) Determine time required for the clayey soil to reach 90% of consolidation and the time factor for 90% of consolidation is 0.848.

[3 Marks]

ii) Determine degree of consolidation at depth 5.5 m below clay layer after 1 year consolidation process start.

[6 Marks]

iii) Discuss briefly why normally degree of consolidation is designed to achieve at least 90% of consolidation.

[5 Marks]

(TERJEMAHAN)

1. a) *Dalam suatu projek, anda telah menemui **DUA (2)** jenis tanah yang berbeza. Sebagai seorang jurutera awam, anda dikehendaki mengklasifikasikan tanah tersebut. Bagaimana anda ingin menentukan jika tanah tersebut pasir berkelodak atau kelodak berpasir, jika;*

   (ii) Peralatan ujian makmal ada?
   (iii) Peralatan ujian makmal tidak ada?

   [5 Markah]

   b) *Suatu sampel tanah lempung yang tak terganggu telah diuji di makmal dan keputusan dari ujian tersebut adalah seperti berikut :*

   Graviti tentu pepejal : 2.65
   Jisim basah dan kering ketuhar spesimen 200g dan 120g turutan.
   Anggap spesimen basah adalah (a) 100% tepu dan (b) 75% tepu.

   Tentukan :
   (i) Jumlah isipadu
   (ii) Nisbah lompang
   (iii) Keliangan

   [15 Markah]

2. a) *Dalam menerangkan mineral tanah lempung, terdapat **TIGA (3)** kumpulan penting mineral tanah lempung. Terangkan kumpulan tersebut dan sifat- sifatnya.*

   [6 Markah]

   c) *Terangkan terminology Had Cecair, Had Plastik dan Indeks Keplastikan. Terangkan bagaimana ia diukur.*

   [4 Markah]

   c) *Informasi dan data saiz zarah di tunjukkan dalam Jadual 1. Kesemua tanah adalah tanah tak organik.*

Tentukan

(i) Kumpulan Pengelasan dan Indeks ASSHTO untuk tanah D ke G

(ii) Kumpulan simbol dan nama pengelasan USCS untuk tanah D ke G

[10 Markah]

***Jadual* 1**

Rujukan Sampel Tanah	***Had Cecair***	***Had Plastik***
D	55	32
E	45	31
F	35	25
G	*Tak Plastik*	

3. a) *Senaraikan nama* ***DUA (2)*** *projek-projek kejuruteraan di mana pemadatan tapak adalah diperlukan.*

[6 Markah]

b) *Bagi suatu projek tambakan, sempel tanah diambil dari lubang pinjam dan diuji di makmal menggunakan kaedah Proktor Piawai. Keputusan berikut diperolehi :*

Jadual 2

Berat tanah basah di dalam acuan, Kg	*Kandungan lembapan*
1.76	*10*
1.86	*12*
1.92	*14*
1.95	*16*
1.93	*18*
1.90	*20*

Tanah dinyatakan di dalam dokumen kontrak bahawa ketumpatan tapak sekurang-kurangnya 95 % dri $\gamma_{d(maks)}$ pada +/- 2% of w_{opt}.

(iv) Kira $\gamma_{d\,maks}$ dan w_{opt} bagi tanah pinjam tersebut.

(v) Apakah had bagi kandungan air yang mana kontraktor boleh memanpatkan tanah tersebut di tapak?

(vi) Dalam menentukan kepadatan di tapak, ujian kon pasir dilaksanakan pada tanah yang telah dimampatkan. Diperolehi kepadatan tapak (γ) adalah 18.7kN/m^3 dengan kandungan lembapan 16.3 %. Kirakan pemadatan relatif R(%) dan beri komen untuk pemakaian kemadatan tapak tersebut..

[14 Markah]

5. *a) Terjemahkan terma-terma berikut :*

(iv) Garisan Aliran [2 Markah]

(v) Garisan Sama Upaya [2 Markah]

(vi) Jaringan Aliran [2 Markah]

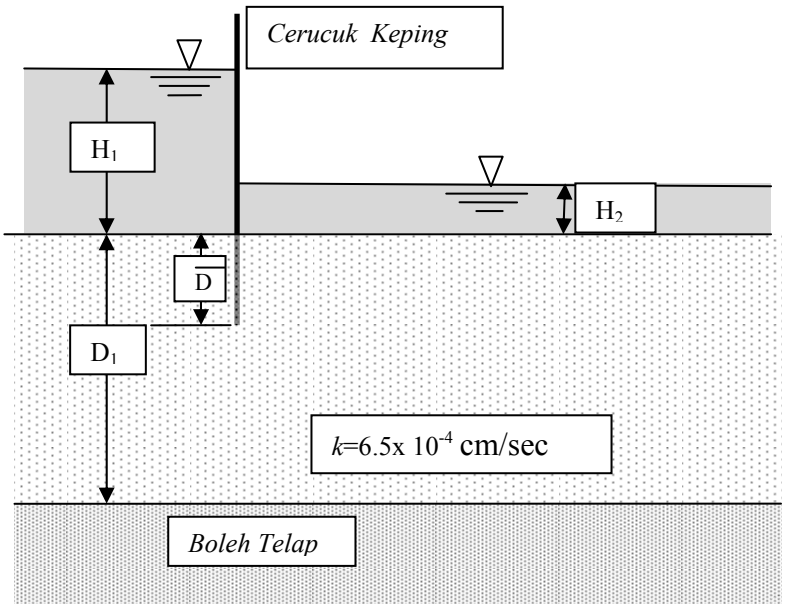
d) Bagi sebaris cerucuk keping yang dimasukkan ke dalam lapisan boleh telap seperti Rajah 3.

(iv) Lukisan jaringan aliran jika H_1=6m, H_2=1 m D=4m, D_1=10 m.

(v) Kirakan kehilangan resipan per meter panjang cerucuk kering.

(vi) Tentukan aras air dalam piezometer jika ia diletakkan pada hujung cerucuk kering dalam lapisan boleh telap.

[14 Markah]



Rajah 3

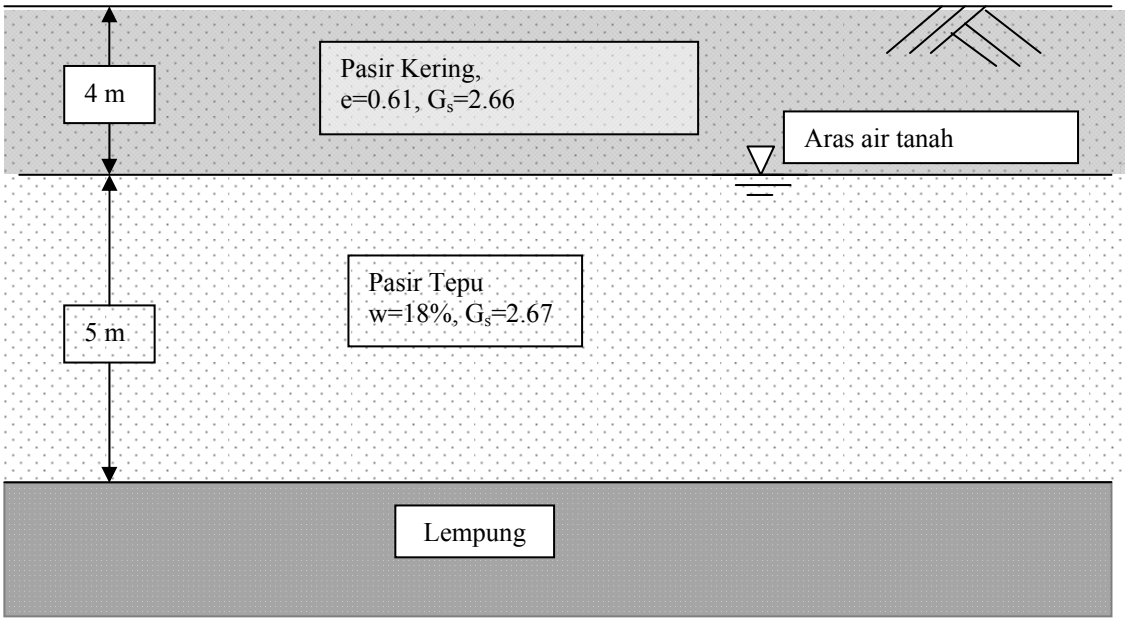
5. a) *Terangkan secara ringkas tegasan efektif dan hubungannya terhadap tegasan neutral.*

[3 Markah]

b) *Sungai berkedalaman 5m mengandungi pasir tepu dengan berat unit 19.7 kN/m^3. Kira tegasan tegak efektif pada 10 m dibawah lapisan sungai.*

[2 Markah]

e) *Suatu profil tanah ditunjukkan dalam Rajah 4.*



Rajah 4

(iii) Plot variasi tegasan jumlah, tekanan air liang dan tegasan menegak efektif dengan ke dalaman lapisan pasir.

[9 Markah]

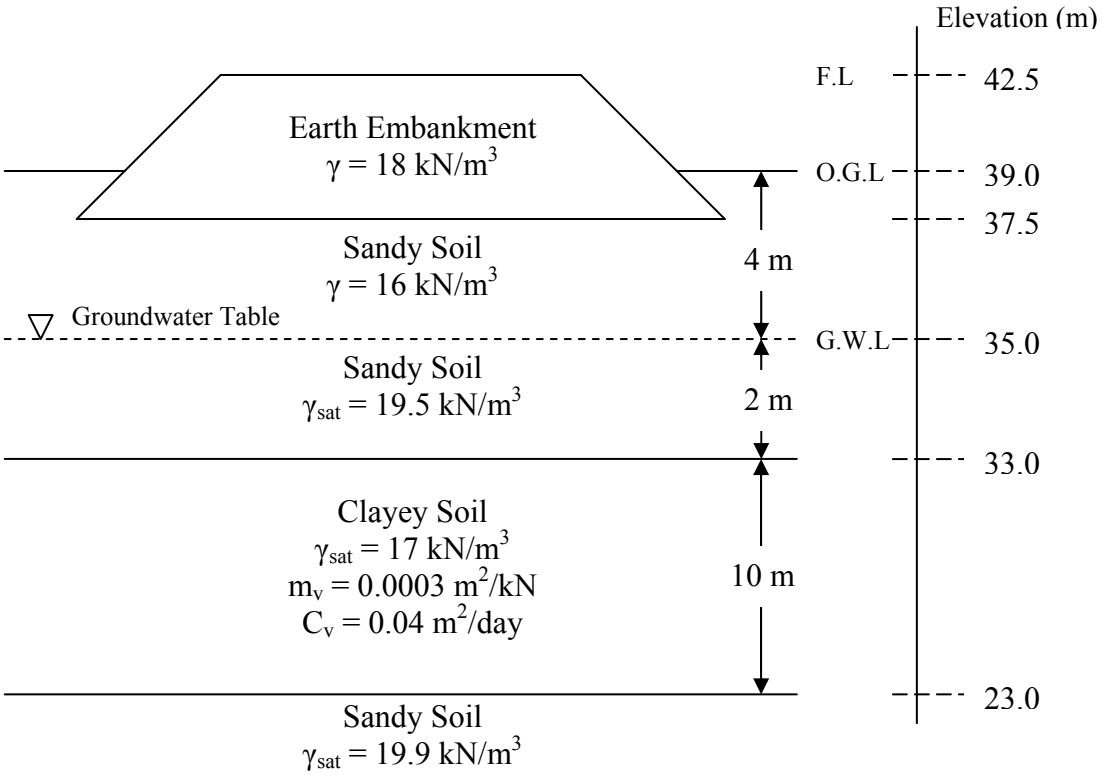
(iv) Berapakah tinggi sepatutnya kenaikan lapisan air tanah supaya tegasan tegak efektif bahagian bawah lapisan pasir ialah 110 kN/m^2 .

[6 Markah]

6. *a) Jenis tanah, kadar resipan tekanan air lompang berlebihan dan jangka masa proses adalah antara aspek penting dalam proses pengukuhan. Terangkan perbezaan antara pemadatan dan pengukuhan berpandukan tiga aspek tersebut.*

[6 Markah]

b) Rajah 6 menunjukkan tambakkan tanah setinggi 5 m yang telah dibina di atas tanah asal bagi satu projek lebuhraya sepanjang 2 km. Aras asal tanah adalah pada 39.0 m pada paras ketinggian rujukan projek dan aras air bumi berada pada 4 m dibawahnya.



Rajah 6

i) *Tentukan masa yang diambil tanah lempung mencapai 90% pengukuhan dan faktor masa bagi 90% pengukuhan adalah 0.848.*

[3 Markah]

ii) *Tentukan darjah pengukuhan pada kedalaman 5.5 m di bawah lapisan lempung selepas setahun proses pengukuhan bermula.*

[6 Markah]

iii) *Bincangkan secara ringkas mengapa kebiasaannya darjah pengukuhan direkabentuk supaya mencapai sekurang-kurangnya 90% darjah pengukuhan.*

[5 Markah]

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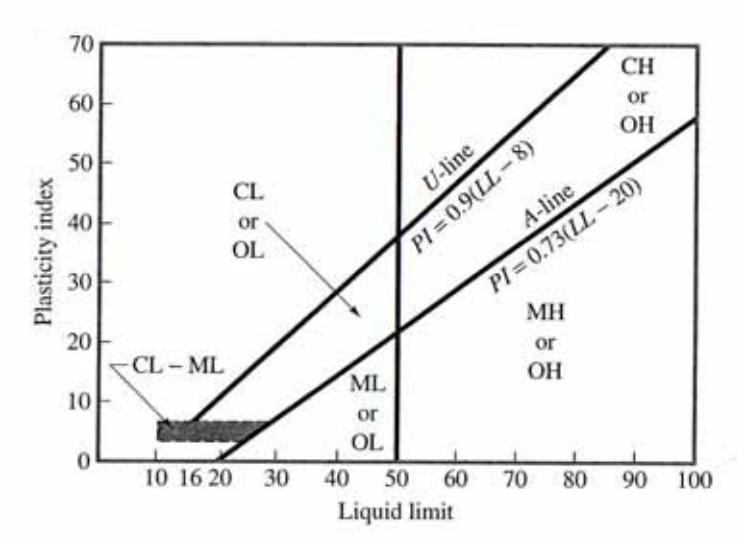
APPENDIX / LAMPIRAN



Criteria for Assigning Group Symbols				Group Symbol
Coarse-Grained Soils More than 50% of retained on No. 4 sieve	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3$[e]	GW
			$C_u < 4$ and/or $1 > C_c > 3$[e]	GP
		Gravels with Fines More than 12% fines[a,d]	$PI < 4$ or plots below "A" line (Figure 3.16)	GM
			$PI > 7$ and plots on or above "A" line (Figure 3.16)	GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3$[e]	SW
			$C_u < 6$ and/or $1 > C_c > 3$[e]	SP
		Sands with Fines More than 12% fines[b,d]	$PI < 4$ or plots below "A" line (Figure 3.16)	SM
			$PI > 7$ and plots on or above "A" line (Figure 3.16)	SC
Fine-Grained Soils 50% or more passes No. 200 sieve	**Silts and Clays** Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 3.16)[f]	CL
			$PI < 4$ or plots below "A" line (Figure 3.16)[f]	ML
		Organic	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit–not dried}} < 0.75$; see Figure 3.16; OL zone	OL
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line (Figure 3.16)	CH
			PI plots below "A" line (Figure 3.16)	MH
		Organic	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit–not dried}} < 0.75$; see Figure 3.16; OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a] Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.
[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.
[c] $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$
[d] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 3.16, use dual symbol GC-GM or SC-SM.
[e] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 3.16, use dual symbol CL-ML.

APPENDIX / LAMPIRAN