UNIVERSITI SAINS MALAYSIA

2nd. Semester Examination
2002/2003 Academic Session
Peperiksaan Semester Kedua
Sidang Akademik 2002/2003

February / March 2003

EAG 245E/3 – Soil Mechanics *(Mekanik Tanah)*

Time : 3 hours
Masa : 3 jam

Instructions to candidates:

1. Ensure that this paper contains <u>**TWELVE**</u> **(12)** printed pages including appendices.
1. *Sila pastikan kertas peperiksaan ini mengandungi <u>**DUA BELAS**</u> (12) muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.*

2. This paper contains <u>**SIX**</u> **(6)** questions. Answer <u>**FIVE**</u> **(5)** questions only. Marks will be given to the <u>**FIRST FIVE**</u> **(5)** questions put in order on the answer script and <u>**NOT**</u> the <u>**BEST FIVE**</u> **(5)**.
2. *Kertas ini mengandungi <u>**ENAM**</u> (6) soalan. Jawab <u>**LIMA**</u> (5) soalan sahaja. Markah hanya akan dikira bagi <u>**LIMA**</u> (5) jawapan <u>**PERTAMA**</u> yang dimasukkan di dalam buku mengikut susunan dan bukannya <u>**LIMA**</u> (5) jawapan terbaik.*

3. All questions carry the same mark.
3. *Semua soalan mempunyai markah yang sama.*

4. All questions can be answered either in English or Bahasa Malaysia or combination of both languages.
4. *Semua soalan boleh dijawab dalam Bahasa Inggeris atau Bahasa Malaysia ataupun kombinasi kedua-dua bahasa.*

5. Write answered question numbers on the cover sheet of the answer script.
5. *Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.*

1.   Figure 1 (Appendix) shows the cross-section of a concrete dam. The dam itself is completely impermeable. The drawing is according to scale, horizontally and vertically.

(a) Draw the flownet of water seepage through, underneath the dam.

(10 marks)

(b) Determine the rate of flow per m width of dam, q, in m^3/day, if k, is given as 3.5×10^{-4} cm/s.

(5 marks)

(c) Determine the head level in m above the bedrock and water pressure at A and at B.

(5 marks)

1.   *Rajah 1 (di lampiran) menunjukkan keratan rentas sebuah empangan konkrit. Anggap empangan tak telap air. Rajah telahpun dilukis menurut skel.*

(a) Lukiskan jaring aliran bagi aliran air melalui tanah di bawah empangan.

(10 markah)

(b) Tentukan kadar aliran air bagi setiap meter lebar empangan, dalam unit m^3/hari, jika nilai pekali kebolehtelapan tanah, k, bersamaan dengan 3.5 x 10^{-4} cm/s.

(5 markah)

(c) Tentukan kedudukan di atas paras batu hampar turus dan tekanan air di kedudukan A dan B.

(5 markah)

2.   Figure 2 (Appendix) shows the plot of effective stress versus void ratio of a consolidation test.

(a) If the sample was taken from a depth where the effective stress was 100 kPa, determine if the soil in the field was over consolidated, normally consolidated, or under consolidated.

(5 marks)

(b) If stress in the field were to be increased from 100 kPa, to 200 kPa, determine the total settlement that will occur. Assume that initial thickness was 5.0m.

(5 marks)

(c) If an additional uniform preconsolidation of 200 kPa were to be applied, determine the time required to have a settlement as much as that in question (b) above. Table 1 may be used. Assume $C_v = 1.0$ m^2/year and drainage was in one direction only.

(10 marks)

2. *Rajah 2 (di lampiran) menunjukkan plot tegasan berkesan lawan nisbah lompang bagi suatu ujian pengukuhan.*

   (a) *Jika sampel diambil dari suatu kedalaman yang mempunyai beban berkesan bernilai 100 kPa, tentukan samada tanah tersebut di lapangan terkukuh lebih, terkukuh normal, atau terkukuh kurang.*

   (5 markah)

   (b) *Jika beban seragam yang hendak dikenakan menyebabkan tegasan berkesan bertambah daripada 100 kPa kepada 200 kPa di tempat sampel diambil tentukan jumlah enapan yang akan berlaku bagi lapisan tanah tersebut. Anggap ketebalan asal 5.0 m.*

   (5 markah)

   (c) *Jika beban pra-pengukuhan seragam sebanyak 200 kPa lagi boleh dikenakan di tempat tersebut, tentukan masa yang diperlukan bagi mendapatkan jumlah enapan seperti yang telah ditentukan di soalan (b) di atas. Gunakan Jadual 1 sebagai bantuan. Anggap nilai C_v = 1.0 m²/tahun dan saliran hanya satu hala.*

   (10 markah)

3. Figure 3 (Appendix) shows the plot of time versus sample thickness of a consolidation test. For the test, the pressure was just being raised from 100 kPa to 200 kPa.

   (a) Determine the total settlement of the sample due to primary consolidation.

   (5 marks)

   (b) Determine t_{50} and t_{95}, which are the times needed for the sample to consolidate 50 percent and 95 percent respectively.

   (5 marks)

   (c) Determine C_v, the coefficient of consolidation, in m²/year. Assume this test used double drainage. The following equation may be applied: $T = \dfrac{C_v t}{H^2}$.

   (5 marks)

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(d) Given a clay layer in the field where the sample for the test was taken from had a thickness of 5.0 m and drained in a single direction, determine the time required for the layer to consolidate 95%. The following Table 1 may be applicable.

Table 1

U_{AVG}	T
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848
0.95	1.163
1.0	00

(5 marks)

3. *Rajah 3 (di lampiran) menunjukkan plot masa lawan ketebalan sampel daripada suatu ujian pengukuhan. Bagi ujian ini tekanan ditingkatkan dari 100 kPa kepada 200 kPa.*

   (a) Tentukan jumlah enapan sampel kerana pengukuhan utama.

   (5 markah)

   (b) Tentukan t_{50} dan t_{95} iaitu masa-masa yang diperlukan untuk sampel mengukuh 50 peratus dan 95 peratus.

   (5 markah)

   (c) Tentukan nilai pekali pengukuhan sampel tanah C_v, dalam unit m^2/tahun. Anggap ujian ini menggunakan saliran dua hala. Persamaan berikut mungkin berguna: $T = \dfrac{C_v t}{H^2}$.

   (5 markah)

(d) Jika lapisan lempung di lapangan yang diwakili oleh sampel dan ujian ini tebalnya 5.0m dan tersalir di satu arah sahaja, tentukan masa yang diperlukan oleh lapisan tersebut untuk mengukuh 95%. Jadual 1 di bawah ini boleh membantu.

Jadual 1

U_{AVG}	T
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848
0.95	1.163
1.0	00

(5 markah)

4. (a) Express the:
   i)   the bulk density
   ii) the saturated density
   iii) the dry density
   iv) the submerged density

   of a soil in terms of specific gravity of particles, the void ratio, the degree of saturation and the density of water.

   (10 marks)

(b) A soil sample has a water content of 30% and a bulk density of 1.96 Mg/m^3. Determine the dry density, the void ratio of the soil and the specific gravity of the particles.

   (10 marks)

4. (a) Terbitkan:
   i)   ketumpatan pukal
   ii) ketumpatan tepu
   iii) ketumpatan kering
   iv) ketumpatan tenggelam

   bagi tanah dalam sebutan graviti tentu zarah, nisbah lompang, darjah ketepuan dan ketumpatan air.

   (10 markah)

(b) Suatu sampel tanah mempunyai kandungan air sebanyak 30% dan ketumpatan pukal sebanyak 1.96 Mg/m³. Tentukan ketumpatan kering, nisbah lompang dan graviti tentu zarah.

(10 markah)

5. (a) Explain briefly the objective of classifying soil for engineering purposes. Name the Index tests required for the soil classification.

(6 marks)

(b) The result of a sieve analysis on a soil sample were:

Retained on 0.60mm	10g
Retained on 0.212mm	25g
Retained on 0.63mm	42g

And Sedimentation test indicated that the soil contained:

Diameter of particles 0.06 - 0.02mm	42g
Diameter of particles 0.02 - 0.006mm	15g
Diameter of particles 0.006 - 0.002mm	8g
Less than 0.002mm	5g

Plot the standard grading curve for the soil, determine the effective size, coefficient of uniformity and curvature for the soil. Describe the soil type.

(14 marks)

5. (a) Terangkan secara ringkas objektif pengelasan tanah bagi tujuan kejuruteraan. Namakan ujian-ujian indeks yang diperlukan untuk tujuan pengelasan tanah.

(6 markah)

(b) Keputusan analisis ayakan untuk suatu sampel tanah adalah seperti berikut;

Tertahan pada 0.60mm	10g
Tertahan pada 0.212mm	25g
Tertahan pada 0.63mm	42g

Dan ujian mendapan menunjukkan tanah terdiri dari:

Diameter zarah pada 0.06 - 0.02mm	42g
Diameter zarah pada 0.02 - 0.006mm	15g
Diameter zarah pada 0.006 - 0.002mm	8g
Kurang dar 0.002mm	5g

Lakarkan lengkungan piawai untuk tanah dan tentukan saiz berkesan, pekali keserangan dan pekali kelengkungan. Terangkan jenis tanah tersebut.

(14 markah)

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

(5 marks)

(b) Following are the results from the liquid limit and plastic limit test for a soil:
Liquid limit test;

Number of blows, N	Moisture Content (%)
15	42
20	40.8
28	39.1

Plastic Limit = 27%
  (i) Draw the flow curves and obtain the liquid limit.
  (ii) What is the plasticity index of the soil.

(10 marks)

(c) Saturated soil is used to determine the shrinkage limit which had an initial volume, $V_i = 20.2 cm^3$, final volume, $V_f = 14.3 cm^3$, mass of wet soil, $M_1 = 34g$, and mass of dry soil, $M_2 = 24g$. Determine the shrinkage limit.

(5 marks)

6. (a) Terangkan terminologi Had Cecair, Had Plastik dan Indeks Keplastikan. Terangkan bagaimana ia diukur.

(5 markah)

(b) Berikut adalah keputusan had cecair dan had plastik;
Ujian Had Cecair;

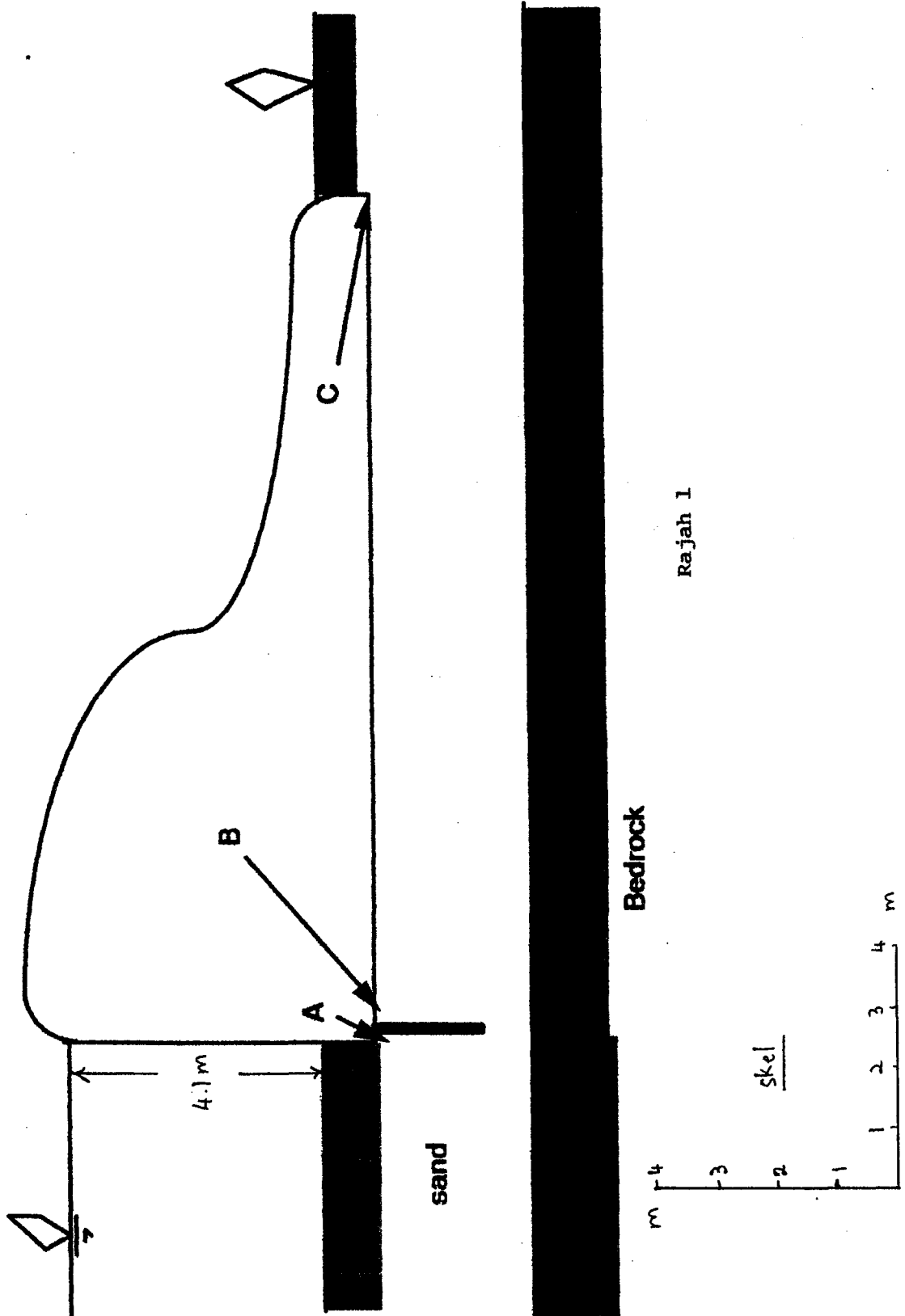| Bilangan Hentakan, N	Kandungan Air (%)
15	42
20	40.8
28	39.1

Had Plastik = 27%
  (i) Lakar lengkungan pengaliran dan dapatkan Had Cecairnya.
  (ii) Tentukan Indeks Keplastikan tanah tersebut.

(10 markah)

(c) Suatu tanah tepu digunakan untuk menentukan Had Kecutan dengan isipadu awal, $V_i = 20.2 cm^3$, isipadu akhir, $V_f = 14.3 cm^3$, jisim bagi tanah basah, $M_1 = 34g$, dan jisim bagi tanah kering, $M_2 = 24g$. Tentukan Had Kecairan bagi tanah tersebut.
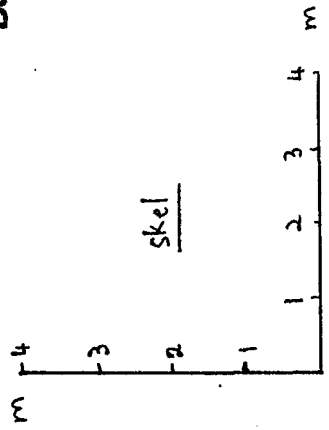
(5 markah)

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Rajah 1

4.) m

sand

Bedrock

A

B

C

skel

Rajah 2

Effective Consolidation Stress (kPa)

Void Ratio,e

Rajah 3

Sample Thickness (mm)

Time (min)

PERATUSAN KETELUSAN (%)

SAIZ AYAK (mm)

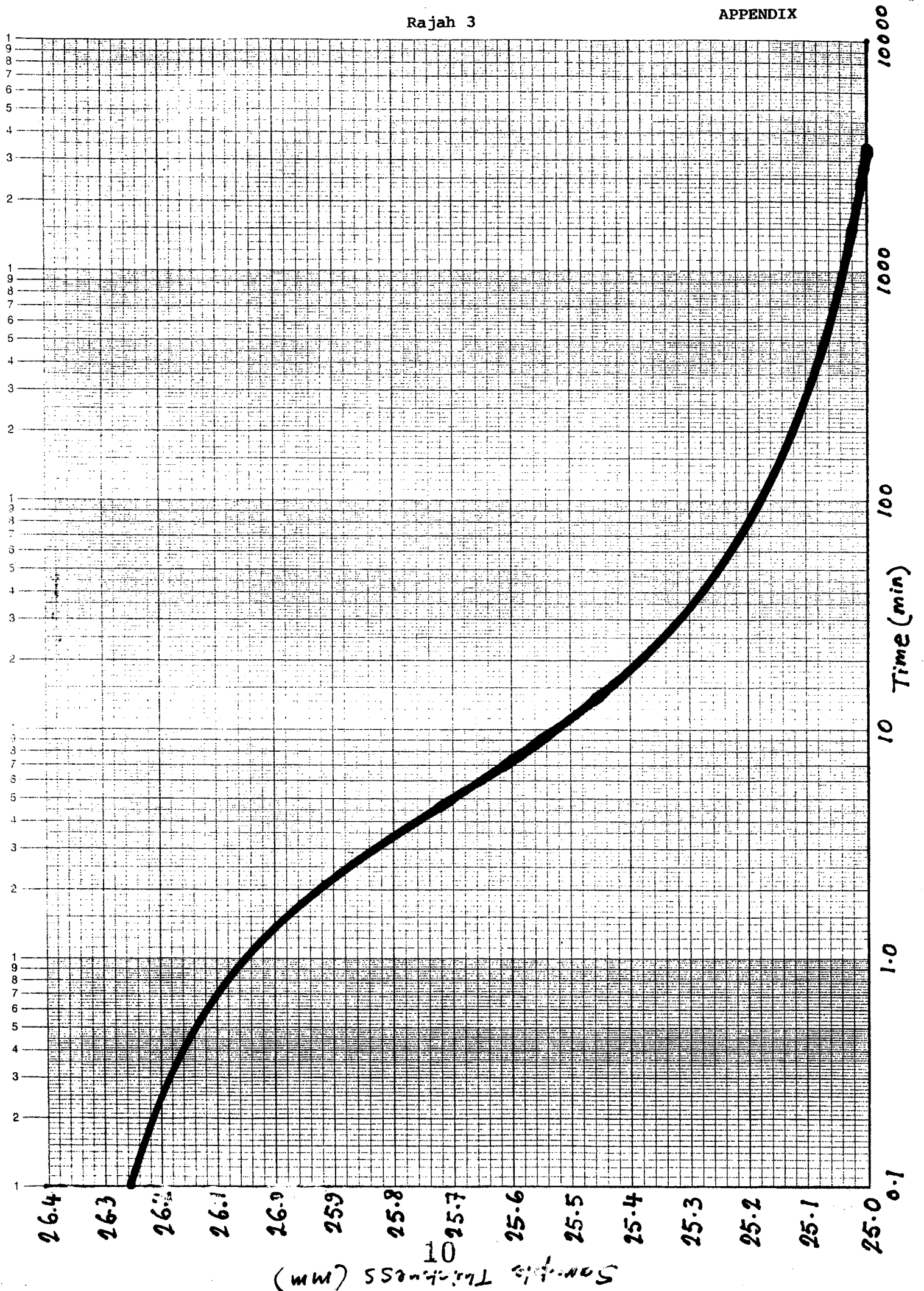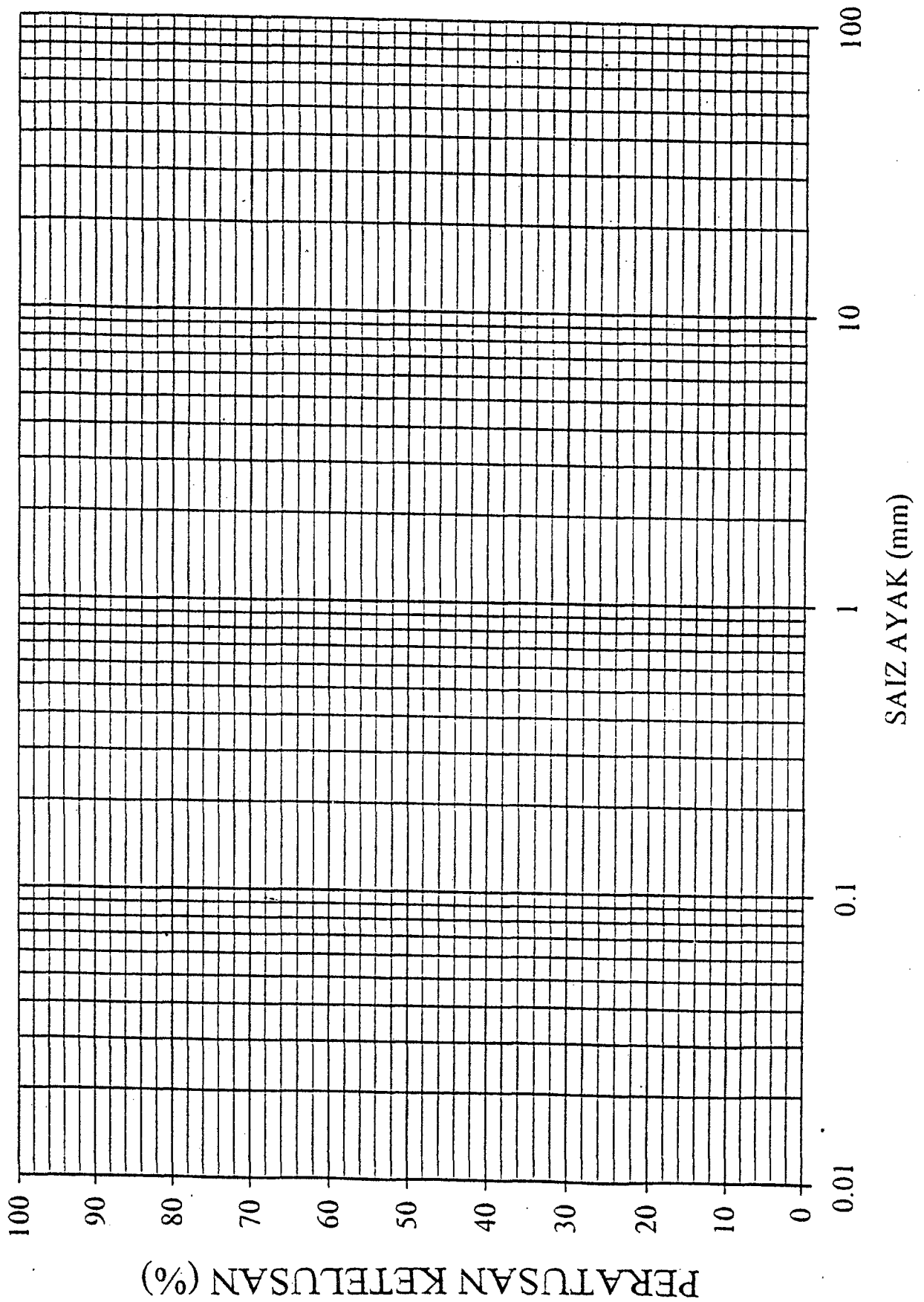100   90   80   70   60   50   40   30   20   10   0

0.01   0.1   1   10   100
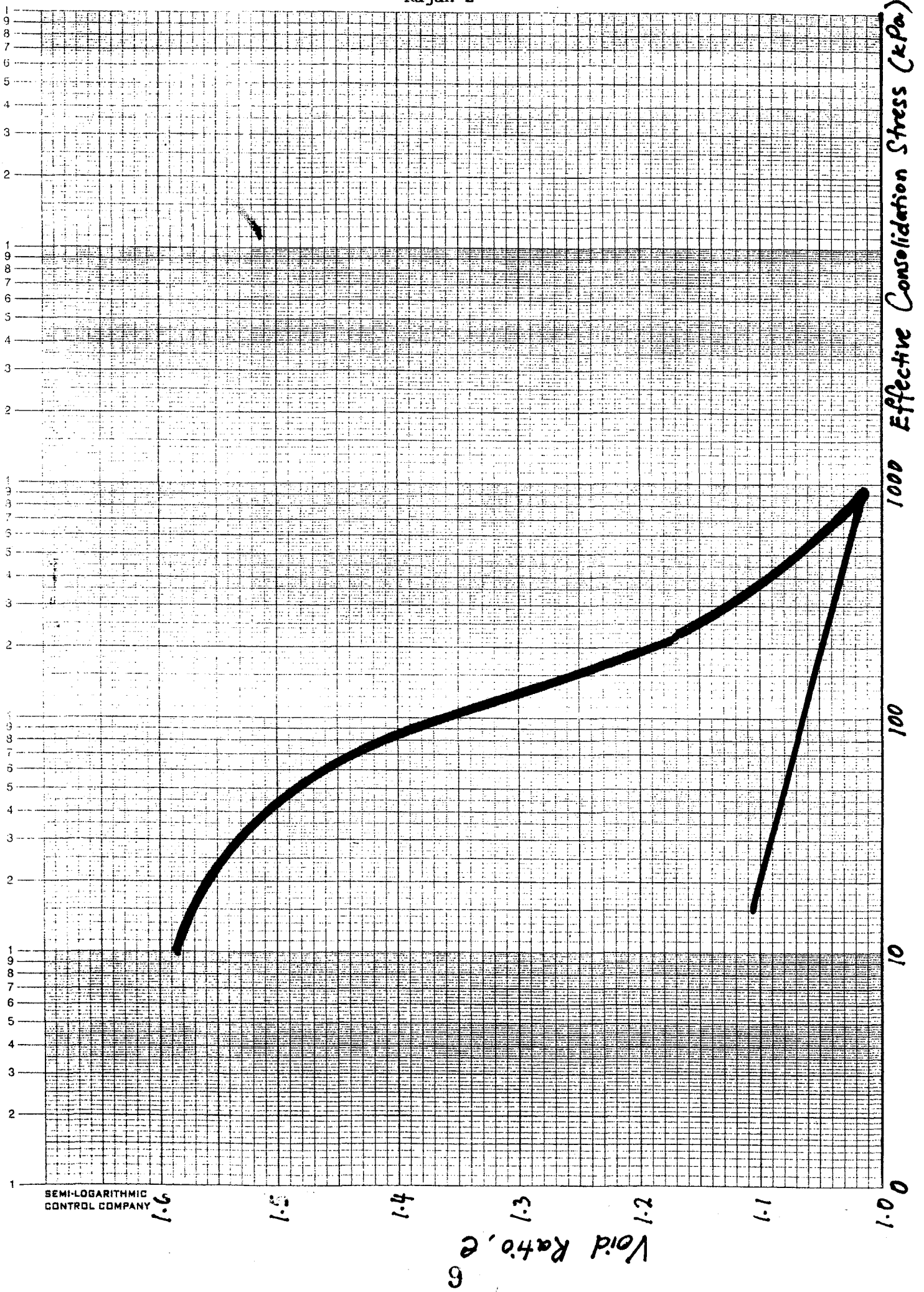
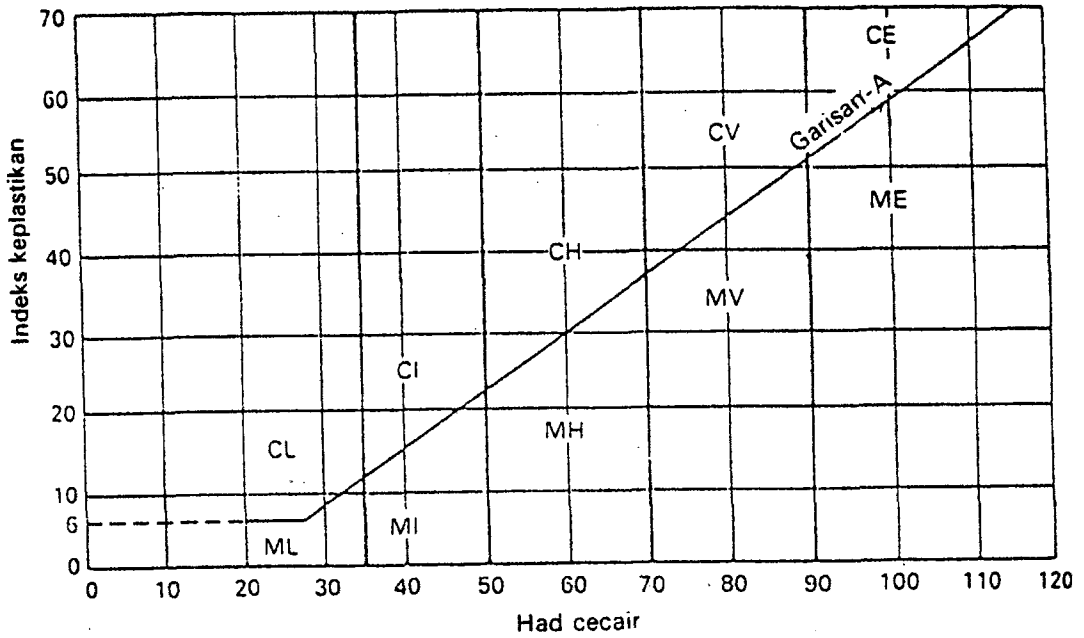*Mekanik Tanah*

Carta keplastikan: Sistem British (BS 5930: 1981). Disalin dengan izin BSI.
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