
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2009/2010

November 2009

EAA 455/2 – Reinforced Concrete Structural Design II
[Rekabentuk Struktur Konkrit Bertetulang II]

Duration : 2 hours
[Masa : 2 jam]

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

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

Instructions: This paper contains **FIVE(5)** questions. Answer any **FOUR (4)** questions.

*[Arahan: Kertas ini mengandungi **LIMA (5)** soalan. Jawab mana-mana **EMPAT (4)** soalan lain]*

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.]

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

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

1. a) Discuss the design concept that affect the structural capacity of bored pile and micro pile.

(5 marks)

- b) A pile cap with **FOUR (4)** pile group arrangement is shown in Figure 1. Design and provide relevant detailing based on the following requirements :-

- i) Dead Load (service) = 1200 kN
- ii) Live Load (service) = 500 kN
- iii) Column size = 400 mm x 400 mm
- vi) Allowable pile working load = 500 kN
- v) Pile diameter = 200 mm micro pile
- vi) Grout grade/density = C35/24 kN/m³
- vii) Pile cap thickness = 750 mm
- viii) Pile embedded length = 100 mm
- ix) Main reinforcement size = 16 mm ($f_y = 465 \text{ N/mm}^2$)
- x) Edge distance = 150 mm

(20 marks)

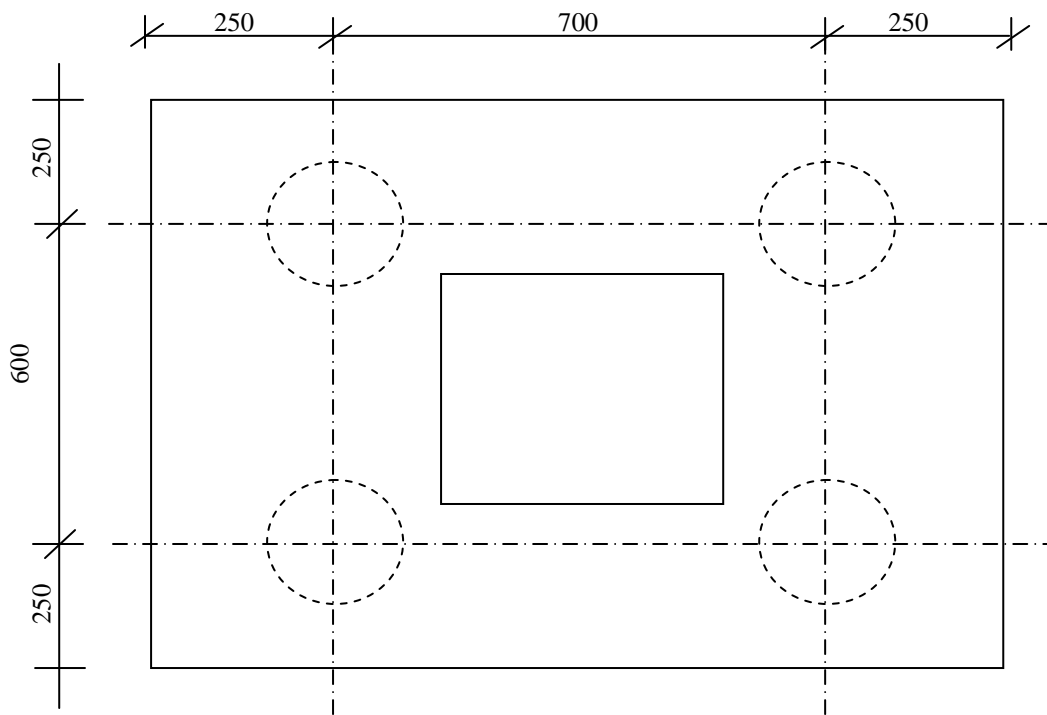


Figure 1 (All dimension in mm)

2. a) Determine the structural capacity for a 200 mm diameter micro pile using the material strength and strain compatibility methods. The micro pile is using API pipe as reinforcement with cross sectional area of 3401 mm^2 . The characteristic strength of grout and API pipe are 25 N/mm^2 and 550 N/mm^2 , respectively. Assume the modular ratio as 8.0
- (5 marks)

- b) A typical cross section of an abutment wall having vertical and raked piles is shown in Figure 2. Determine the adequacy of the pile arrangement if the allowable pile working load is 400 kN. The ratio of the raked pile is taken as 1:4.
- (20 marks)

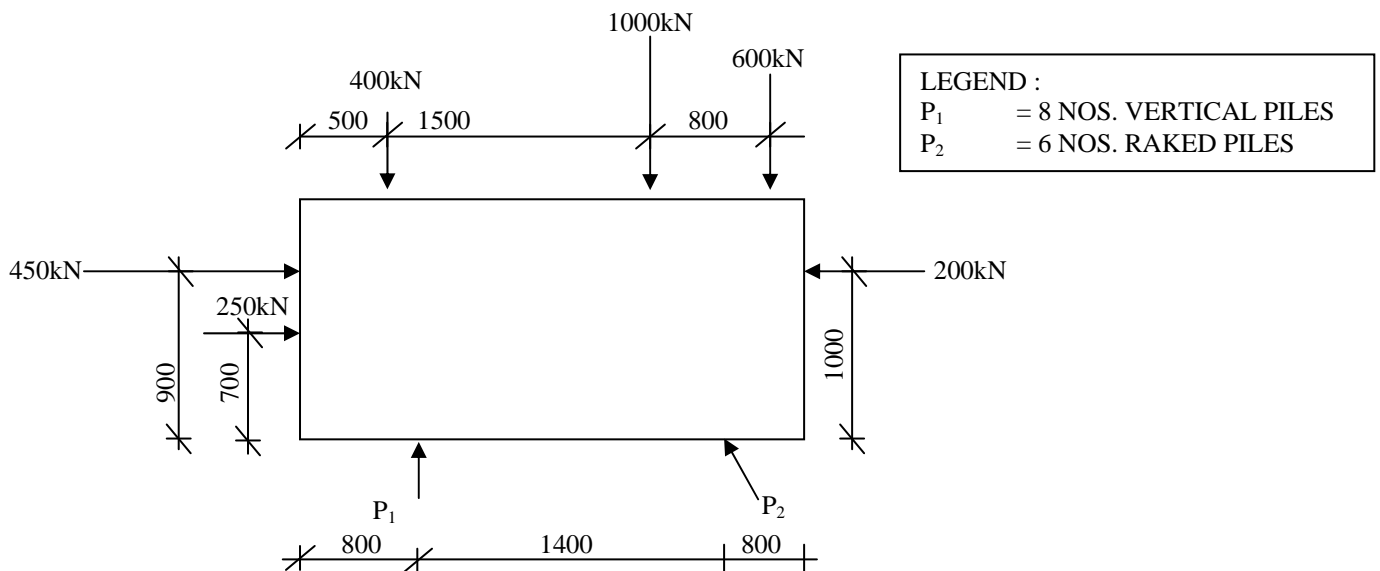


Figure 2 (All dimension in mm)

3. a) Discuss briefly why it is uneconomical to use very high strength steels in reinforced concrete beam design compare to prestress concrete beam.
- (5 marks)

- b) A simply supported 25 meter span Class 2 pre-tensioned beam with parabolic single tendon is subjected to selfweight, Dead Load = 3 kN/m and Imposed Load = 12 kN/m. Calculate the final **mid span stresses** both at **transfer and service** based on requirements given. Discuss the results obtained.

i) f_{cu} (at 28 days)	= 50 N/mm ²
ii) f_{ci} (at transfer)	= 35 N/mm ²
iii) Jacking Force, P	= 3000 kN
iv) Efficiency, μ	= 0.75
v) Tendon eccentricity (at mid span)	= + 400 mm
vii) Z_1 (top)	= 150 x 10 ⁶ mm ³
viii) Z_2 (bottom)	= 100 x 10 ⁶ mm ³
ix) Beam cross sectional area	= 450 x 10 ³ mm ²
x) Concrete density	= 24 kN/m ³

(20 marks)

4. a) The analysis of a flat slab structure can be carried out by dividing the structure into a series of equivalent frames. List out the requirements to be followed in order determine the moments in these frames using the moment and shear coefficients in the simplified methods.

(5 marks)

- b) Sketch **THREE (3)** forms of drop panel and column head for flat slab floor.

(6 marks)

- c) An important consideration in the design of the flat slab is the calculation for punching shear at the head of the column and at the change in the depth of the slab. Check the punching shear of flat the slab. The following data are given :

...5/-

Diameter of column head, h_c	= 1400mm
Ultimate load on the floor, F	= 650kN per panel
Equivalent distributed load, n	= 15.5kN/m ²
Effective depth of slab, d	= 305mm
Middle strip positive moment, M	= 150kNm
Overall depth of slab	= 250mm

(14 marks)

5. The cantilever retaining wall shown in Figure 3, is used to support soil of the following properties;

Density of soil, ρ	= 2500 kg/m ³
Factor of safety γ_f	= 1.6
Coefficient of active pressure K_a	= 0.5
Coefficient of passive pressure K_p	= 3.0
Coefficient of friction μ	= 0.5

You are required to calculate the following :

- i) Amount of stability of the retaining wall
- ii) Amount of reinforcement required for the cantilever wall

The lever arm curve and the sectional area and spacing table is given in the Appendix A.

(25 marks)

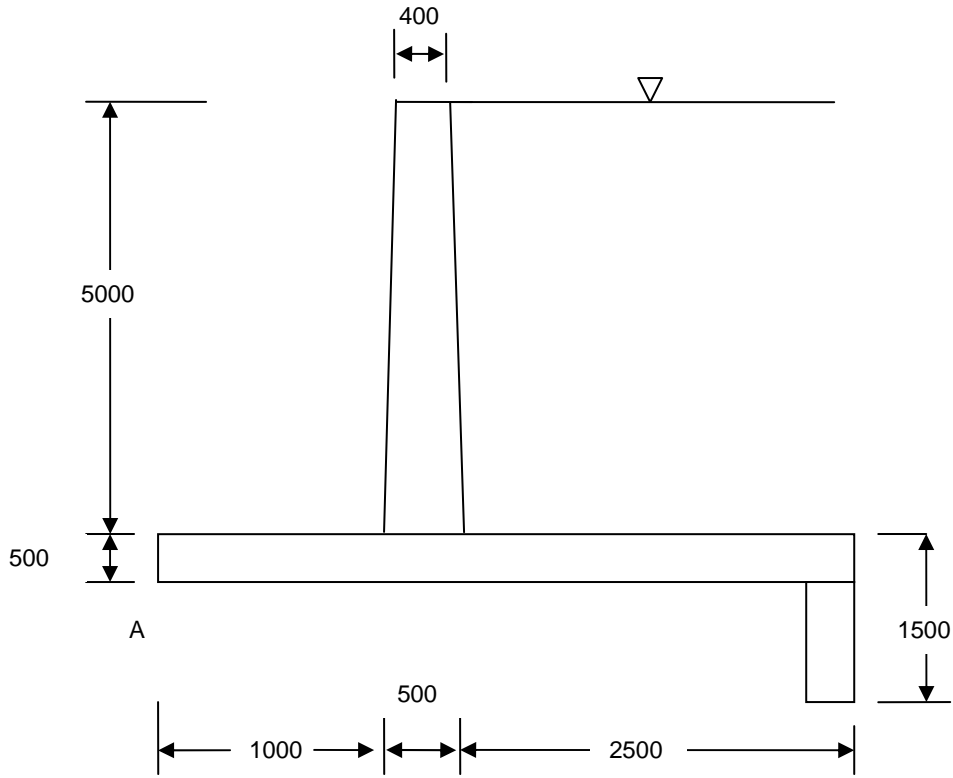


Figure 3 (All dimension in mm)

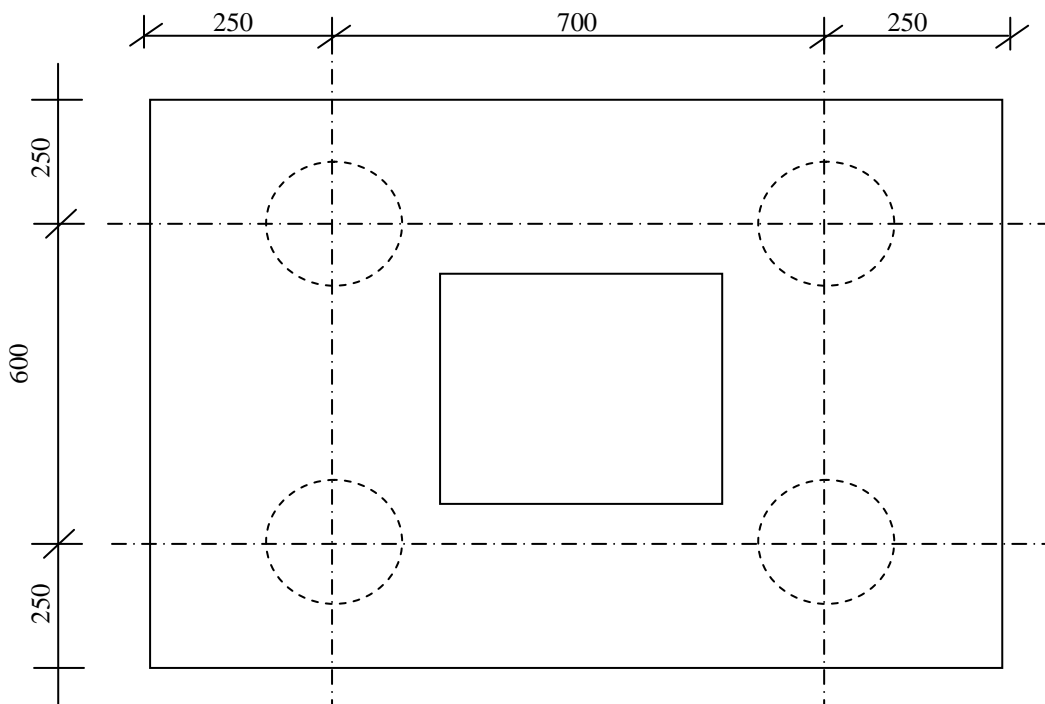
1. a) Bincangkan konsep rekabentuk yang mempengaruhi keupayaan struktur cerucuk tergerak dan cerucuk mikro.

(5 markah)

b) Satu tetopi cerucuk dengan susunan **EMPAT (4)** kumpulan cerucuk adalah seperti di Rajah 1. Rekabentuk dan sediakan perincian yang berkaitan berdasarkan keperluan-keperluan berikut :-

- i) *Beban Mati (kebolehhidmatan)* = 1200 kN
- ii) *Beban Hidup (kebolehhidmatan)* = 500 kN
- iii) *Saiz tiang* = 400 mm x 400 mm
- iv) *Beban kerja cerucuk dibenarkan* = 500 kN
- v) *Garispusat cerucuk* = 200 mm cerucuk mikro
- vi) *Gred simen turap/ketumpatan* = C35/24 kN/m³
- vii) *Ketebalan tetopi cerucuk* = 750 mm
- viii) *Kedalaman penusukan cerucuk* = 100 mm
- ix) *Saiz tetulang utama* = 16 mm ($f_y = 465 \text{ N/mm}^2$)
- x) *Jarak hujung* = 150 mm

(20 markah)



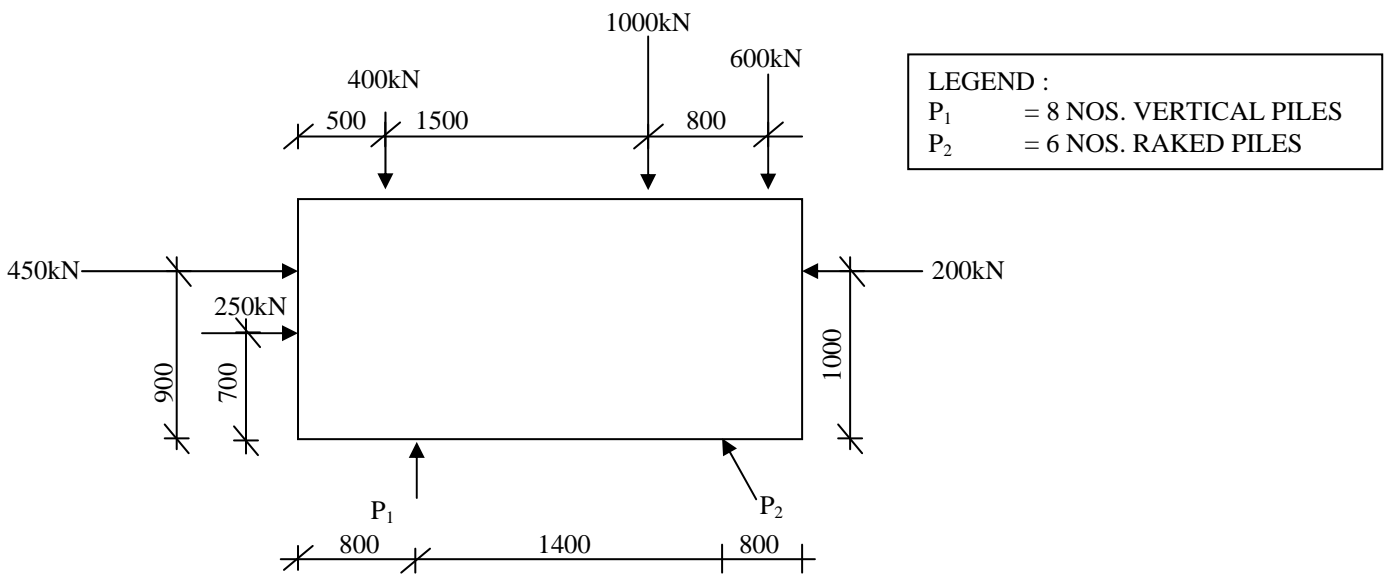
Rajah 1 (Semua dimensi dalam mm)

2. a) Tentukan keupayaan struktur satu cerucuk mikro bergarispusat 200 mm cerucuk mikro menggunakan kaedah kekuatan bahan dan keserasian terikan. Cerucuk mikro tersebut menggunakan paip API dengan keratan rentas 3401 mm^2 sebagai tetulang . Kekuatan ciri simen turap dan paip API masing-masing adalah 25 N/mm^2 dan 550 N/mm^2 . Anggap nisbah modular sebagai 8.0.

(5 markah)

- b) Satu keratan tipikal tembok landas yang mempunyai cerucuk pugak dan sadak adalah seperti di Rajah 2. Tentukan susunan cerucuk sekiranya keupayaan kerja dibenarkan cerucuk tersebut adalah 400 kN. Nisbah cerucuk sadak di ambil sebagai 1:4.

(20 markah)



Rajah 2 (Semua dimensi dalam mm)

3. a) Bincangkan dengan ringkas mengapa tidak ekonomi untuk menggunakan tetulang berkekuatan tinggi dalam rekabentuk rasuk konkrit bertetulang berbanding rasuk konkrit pretegasan.

(5 markah)

b) Satu rasuk pra-tegangan tersangga mudah Kelas 1 dengan rentangan 25 meter beserta tendon tunggal parabolik dikenakan beban swa-berat, Beban Mati = 3 kN/m dan Beban Hidup = 12 kN/m. Kira tegasan akhir di sangga dan tengah rentang pada masa pindah dan kebolehhidmatan berdasarkan kehendak-kehendak yang diberikan. Bincang keputusan yang diperolehi.-

- i) f_{cu} (pada 28 hari) = 50 N/mm²
- ii) f_{ci} (masa pindah) = 35 N/mm²
- iii) Daya Tujahan, P = 3000 kN
- iv) Kecekapan, μ = 0.75
- v) Kesipian tendon (di tengah rentang) = + 400 mm
- vi) Z_1 (atas) = 150 x 10⁶ mm³
- vii) Z_2 (bawah) = 100 x 10⁶ mm³
- viii) Keratan rentas rasuk = 450 x 10³ mm²
- ix) Ketumpatan konkrit = 24 kN/m³

(20 markah)

4. a) Analisis struktur papak rata boleh dilakukandengan membahagikan struktur kepada kerangka setara secara bersiri. Senaraikan keperluan yang perlu diikuti untuk menentukan momen-momen pada kerangka menggunakan pekali momen dan pekali ricih dalam kaedah dipermudahkan.

(5 markah)

b) Lakarkan **TIGA (3)** bentuk jatuhan pada panel dan kepala tiang untuk lantai papak rata.

(6 markah)

c) Pertimbangan penting dalam merekabentuk papak rata ialah penggiraan ricih tebukan pada kepala tiang dan perubahan kedalaman papak. Semak ricih tebukan papak rata. Data berikut diberikan :-

<i>Garis pusat kepala tiang, h_c</i>	<i>= 1400mm</i>
<i>Beban muktamad ke atas lantai, F</i>	<i>= 650kN pc panel</i>
<i>Beban agihan setara, n</i>	<i>= 15.5 kN/m²</i>
<i>Kedalaman efektif papak pada kepala tiang, d</i>	<i>= 305mm</i>
<i>Momen positif pertengahan rentang, M</i>	<i>= 150 kNm</i>
<i>Kedalaman keseluruhan papak lantai</i>	<i>= 250mm</i>

(14 markah)

5. *Dinding penahan julur di Rajah 3, digunakan untuk menahan tanah yang mempunyai ciri-ciri berikut:*

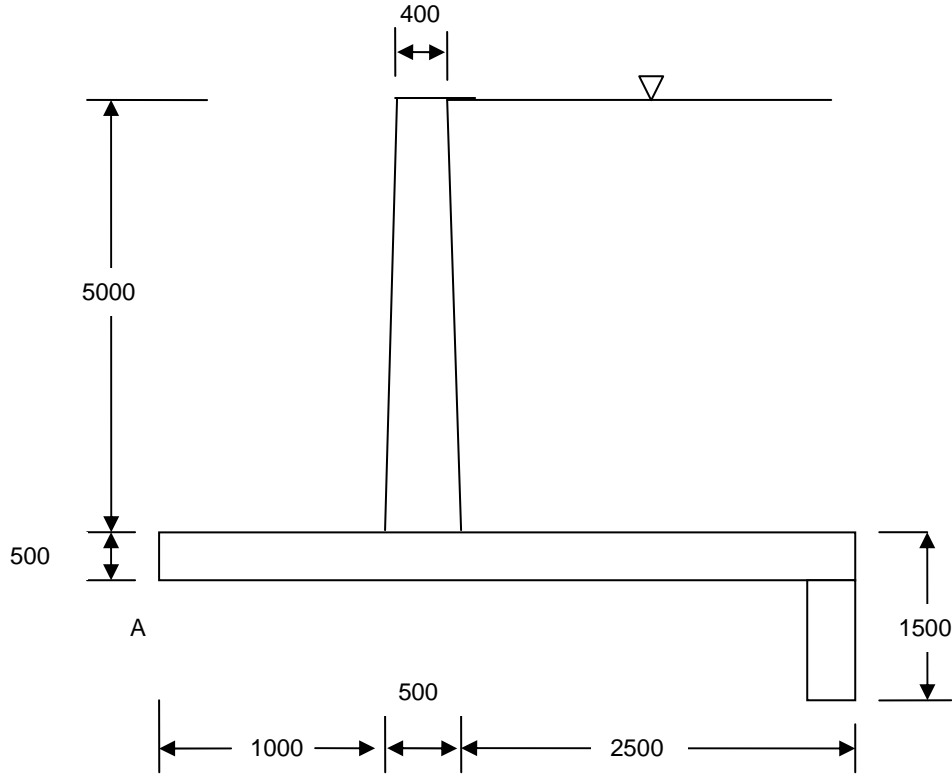
<i>Ketumpatan tanah, ρ</i>	<i>= 2500 kg/m³</i>
<i>Faktor keselamatan γ_f</i>	<i>= 1.6</i>
<i>Pekali tekanan aktif K_a</i>	<i>= 0.5</i>
<i>Pekali tekanan pasif K_p</i>	<i>= 3.0</i>
<i>Pekali geseran μ</i>	<i>= 0.5</i>

Anda diminta mengira

- i) kestabilan dinding penahan*
- ii) tetulang yang diperlukan untuk dinding julur tersebut.*

Rajah lengkung lever arm dan jadual sectional area and spacing dilampirkan di Lampiran A.

(25 markah)



Rajah 3

Appendix A / Lampiran A

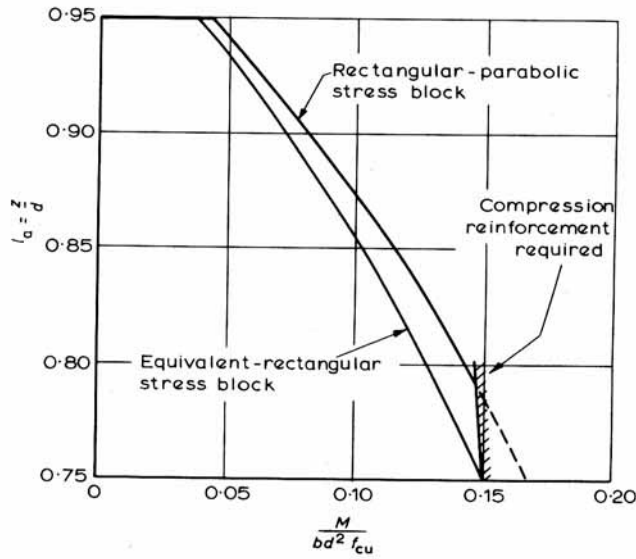


Figure 7.5 Lever-arm curve

APPENDIX

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Sectional Areas per Metre Width for Various Bar Spacings (mm²)

Bar size (mm)	Spacing of bars								
	50	75	100	125	150	175	200	250	300
6	566	377	283	226	189	162	142	113	94.3
8	1010	671	503	402	335	287	252	201	168
10	1570	1050	785	628	523	449	393	314	262
12	2260	1510	1130	905	754	646	566	452	377
16	4020	2680	2010	1610	1340	1150	1010	804	670
20	6280	4190	3140	2510	2090	1800	1570	1260	1050
25	9820	6550	4910	3930	3270	2810	2450	1960	1640
32	16100	10700	8040	6430	5360	4600	4020	3220	2680
40	25100	16800	12600	10100	8380	7180	6280	5030	4190