UNIVERSITI SAINS MALAYSIA

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

February / March 2003

EAS 254E/3 – Structural Analysis
(Analisis Struktur)

Time : 3 hours
Masa : 3 jam

Instruction to candidates:
Arahan Kepada Calon :

1. Ensure that this paper contains **SEVEN (7)** printed pages include attachment.
1. *Sila pastikan kertas ini mengandungi **TUJUH (7)** muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.*

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

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

4. All questions **MUST BE** answered in Bahasa Malaysia or English or combination of both languages.
4. *Semua soalan boleh dijawab dalam Bahasa Malaysia atau Bahasa Inggeris 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.*

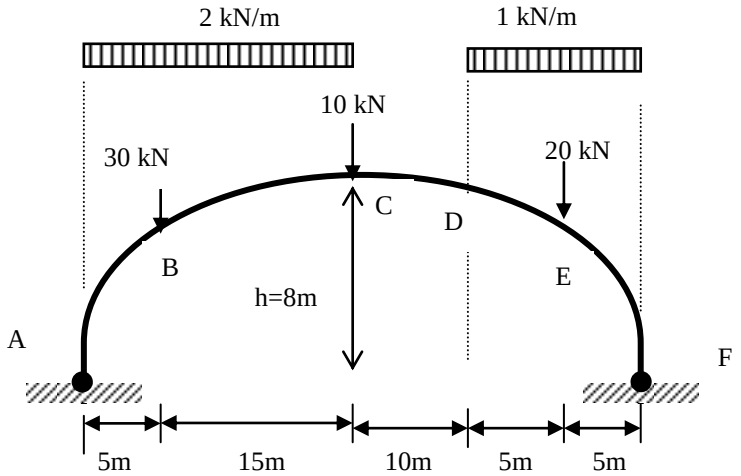
1. The two pinned parabolic arch shown in Figure 1 is designed to carry a uniformly distributed load of w = 2 kN/m and 1 kN/m along the span ABC and DEF. It is also designed to withstand point loads of 30kN, 10 kN and 20 kN at point B, C and E. Assume the shape of the arch is given by $y = \frac{4hx(L-x)}{L^2}$ and the horizontal thrust, $H = \frac{\sum \int_0^L M_s \; y \; dx}{\sum \int_0^L y^2 dx}$ Calculate:

i) Vertical reaction at both supports A and F;
ii) The denominator of equation for H.
iii) The numerator of equation for H.
iv) Value of H.
v) Bending Moment at points B, C, and D.

(20 marks)

Rajah 1.0 menunjukkan satu gerbang 2 engsel yang menampung beban teragih seragam, w = 2 kN/m dan 1 kN/m sepanjang rentang ABC dan DEF. Ia juga direkabentuk untuk menampung tiga beban tumpu 30kN, 10 kN dan 20 kN di titik B, C dan E. Anggap bentuk gerbang adalah parabola, $y = \frac{4hx(L-x)}{L^2}$ *dan daya mengufuk* $H = \frac{\sum \int_0^L M_s \; y \; dx}{\sum \int_0^L y^2 dx}$ *Kira nilai:*

i) Daya tindakbalas menegak di penyokong A dan F;
ii) Jumlah pembawah untuk persamaan H .
iii) Jumlah pengatas untuk persamaan H.
iv) Nilai H.
v) Momen lentur di titik B, C, dan D



Rajah 1.0

(20 markah)

2. (a) Give two reasons why the computation of deflections is essential in structural analysis.

(6 marks)

(a) Beri dua sebab mengapa pengiraan pesongan merupakan perkara yang penting dalam analisis struktur.

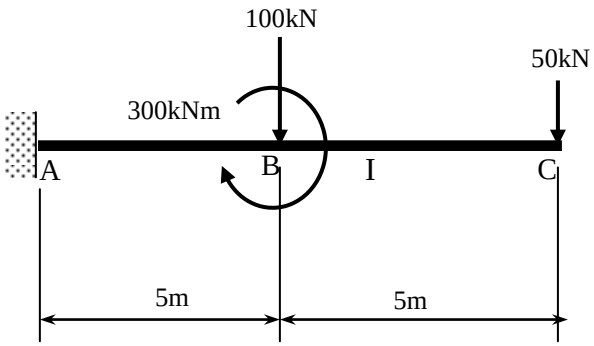
(6 markah)

(b) Using the method of virtual work, determine the smallest moment of inertia I required for the beam shown in Figure 2.0 to ensure that the maximum deflection does not exceed the limit of 1/360 of the span length. Use E=200GPa.

(14 marks)

(b) Menggunakan kaedah kerja maya, kira momen sifat tekun terkecil I yang diperlukan untuk rasuk dalam Rajah 2.0 supaya pesongan maksimum tidak melebihi had 1/360 daripada jarak rentang. Guna E=200GPa.

(14 markah)



Rajah 2.0

3. (a) Explain the "Principle of Least Work".

(5 marks)

(a) Terangkan "Prinsip Kerja Terkurang".

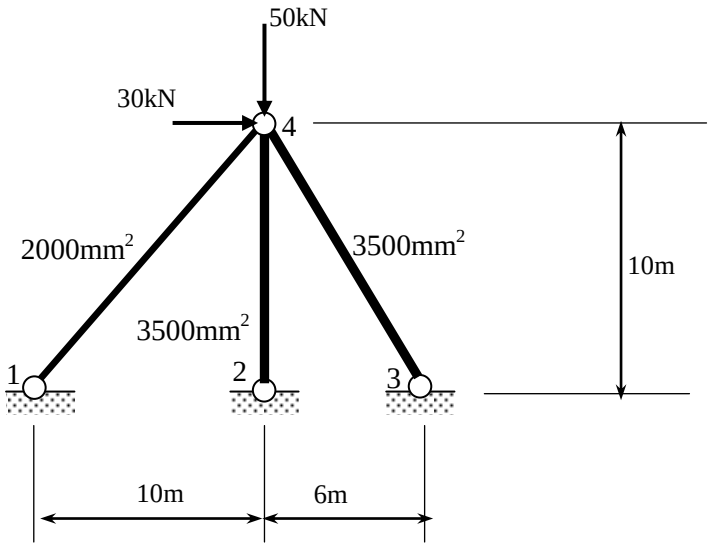
(5 markah)

(b) Figure 3.0 shows a three-member truss subjected to horizontal and vertical loads of 30kN and 50kN, respectively, at joint 4. Compute all member forces using the method of least work. The cross sectional area of each member is as indicated Figure 3.0 and the value of elastic modulus E for all members is 210GPa. Calculate the percent change in member forces if the cross sectional area of member 4-3 is increased from 3500mm^2 to 4000mm^2.

(15 marks)

(b) Rajah 3.0 menunjukkan satu kekuda tiga-anggota yang ditindak oleh beban ufuk 30 kN dan beban menegak 50kN pada sambungan 4. Kira daya dalam semua anggota dengan menggunakan kaedah kerja terkurang. Luas keratan anggota adalah seperti yang ditunjukkan dalam Rajah 3.0. Modulus keanjalan E untuk kesemua anggota adalah 210GPa. Kira peratus perubahan dalam daya anggota sekiranya luas keratan anggota 4-3 ditambah dari 3500mm^2 ke 4000mm^2.

(15 markah)



Rajah 3.0

4. (a) Explain the meaning of **redundancies** in statically indeterminate structures using a suitable example.

(5 marks)

*(a) Terangkan erti **keterlebihan** dalam struktur tidak bolehtentu statik dengan menggunakan satu contoh yang sesuai.*

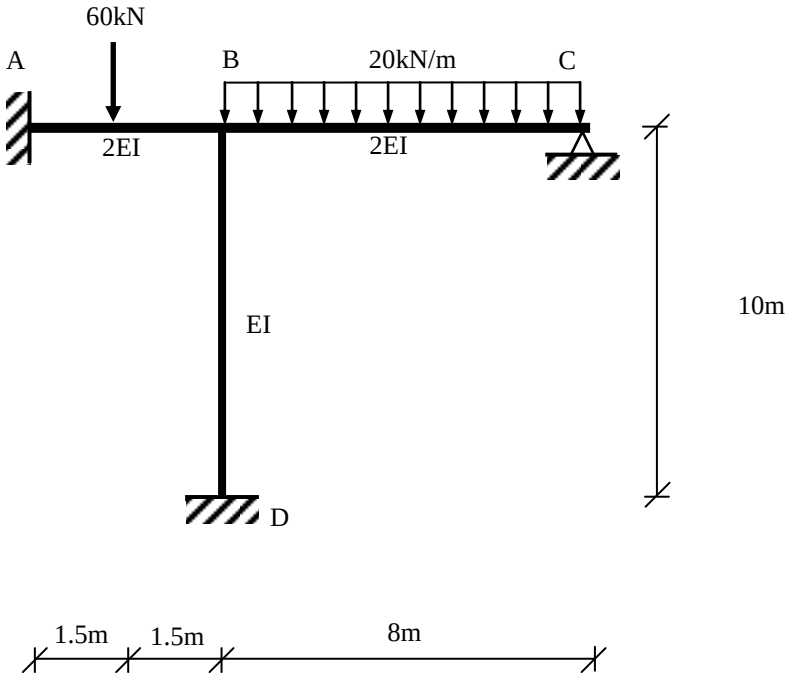
(5 markah)

(b) Figure 4.0 shows a rigid frame with roller-type supports at A and C and pin-type support at D. A vertical uniformly distributed load of 20kN/m acts along beams AB, BC and a horizontal load of 60kN acts at support A. Calculate all reactions by using the method of consistent deformation. Use reaction at support C as redundant.

(15 marks)

(b) Rajah 4.0 menunjukkan satu kerangka tegar dengan penyokong jenis rola pada A dan C dan penyokong jenis pin pada D. Satu beban teragih seragam dalam arah menegak 20kN/m bertindak di sepanjang rasuk AB, BC dan satu beban ufuk 60kN bertindak pada penyokong A. Kira semua daya tindakbalas dengan menggunakan kaedah pesongan konsisten. Guna daya tindakbalas pada C sebagai keterlebihan.

(15 markah)



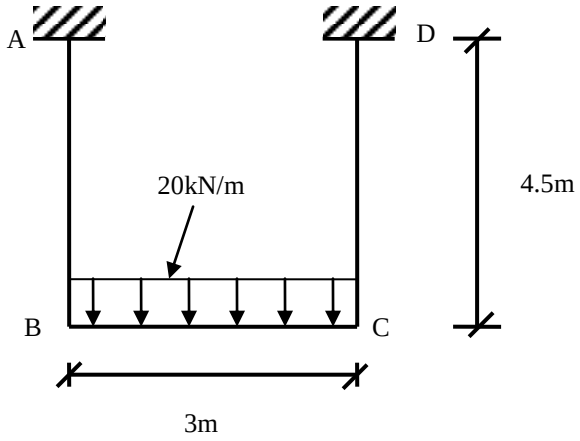
Rajah 4.0

5. Figure 5.0 shows a typical frame of a part of a building. Support A and D are fixed. Span BC carrying a uniformly distributed load of 20 kN/m. EI value for all member is equal. Using the Slope Deflection Method, calculate the bending moment at joint A, B, C and D and then sketch the distribution of the bending moment throughout the frame.

(20 marks)

Rajah 5.0 menunjukkan satu kerangka tipikal yang merupakan sebahagian daripada satu bangunan. Penyokong A dan D adalah jenis tegar. Satu beban teragih seragam 20kN/m bertindak di sepanjang rentang BC. Nilai EI adalah sama untuk semua anggota. Dengan menggunakan Kaedah Cerun Pesongan, kira momen lentur pada sambungan A, B, C dan D. Seterusnya, lakar gambarajah momen lentur untuk kerangka tersebut.

(20 markah)



Rajah 5.0

6. Using the Moment Distribution Method, calculate the bending moment at critical sections of the continuous beam shown in Figure 6.0. Hence ;

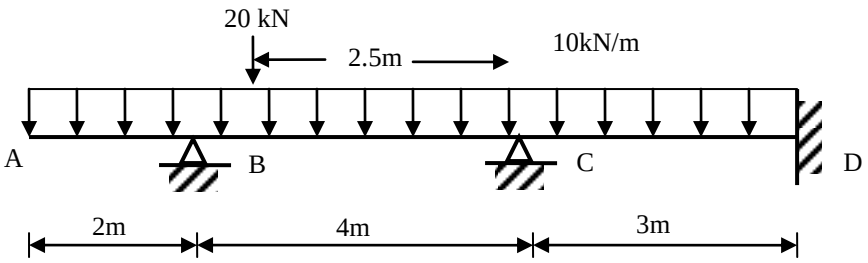
(a) Calculate the shear force
(b) Sketch the bending moment diagram
(c) Sketch the shear force diagram
(d) Sketch the deflected shape of the loaded beam

(20 marks)

Dengan menggunakan Kaedah Momen Agihan, kira momen lentur pada keratan kritikal rasuk selanjar yang ditunjukkan dalam Rajah 6.0. Seterusnya,

(a) Kira daya ricih
(b) Lakar gambarajah momen lentur
(c) Lakar gambarajah daya ricih
(d) Lakar bentuk pesongan rasuk selanjar tersebut.

(20 markah)



Rajah 6.0

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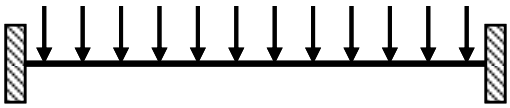
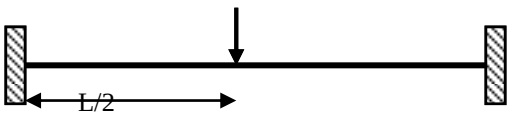
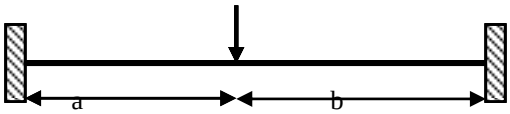
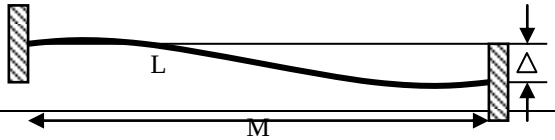
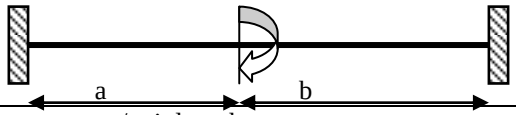
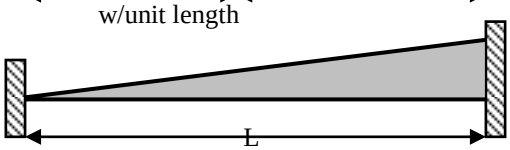
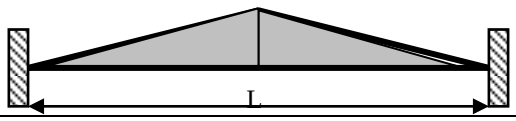
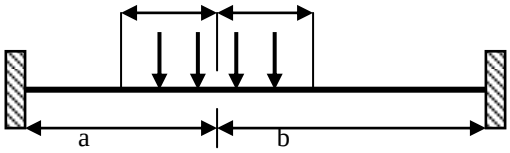
Attachment :

Fixed End Moment

$\frac{wL^2}{12}$	w / unit length 	$\frac{wL^2}{12}$
$\frac{WL}{8}$	W 	$\frac{WL}{8}$
$\frac{Wab^2}{L^2}$	W 	$\frac{Wba^2}{L^2}$
$\frac{6EI\Delta}{L^2}$		$\frac{6EI\Delta}{L^2}$
$\frac{Mb(2a-b)}{L^2}$	M 	$\frac{Mb(2b-a)}{L^2}$
$\frac{wL^2}{30}$	w/unit length 	$\frac{wL^2}{20}$
$\frac{5wL^2}{96}$	w/unit length 	$\frac{5wL^2}{96}$
$\frac{wd}{L^2}\left(ab^2+\frac{(a-2b)d^2}{12}\right)$	w/unit length d/2 d/2 	$\frac{wd}{L^2}\left(a^2b+\frac{(b-2a)d^2}{12}\right)$