UNIVERSITI SAINS MALAYSIA

KSCP Examination
Academic Session 2008/2009

June 2009

EAS 254/3 – Structural Analysis

(Analisis Struktur)

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **ELEVEN (11)** printed pages including appendix before you begin the examination.
*[Sila pastikan kertas peperiksaan ini mengandungi **SEBELAS(11)** muka surat bercetak termasuk lampiran 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.]

...2/-

1. Figure 1 shows a frame with roller and pin supports at A and D, respectively. The frame is subjected to: uniformly distributed loads of 7.5kN/m, 5kN/m and 2.5kN/m along members AB, BC and BD, respectively; and a point load of 20kN at C. EI for members AB and BC are the same, while that of member BD is 0.5 times that of members AB and BC.

   (a) Compute the vertical displacement of joint C by using method of virtual work.
   (b) Determine the changes in magnitude of vertical displacement of joint C in comparison with value obtained in (a):

      (i) if EI of member BD is changed from 0.5EI to 1.5EI.
      (ii) if EI of member AB is changed from EI to 2EI.

   (20 marks)

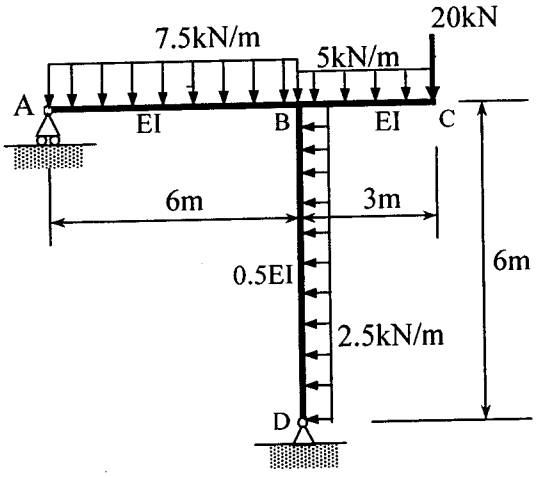


Figure 1

2. (a) Figure 2(a) shows a cantilever beam suspended using a cable. The beam is subjected to a uniformly distributed load of 2.5kN/m. Determine the expression for tension in cable. Use method of least work.

   (8 marks)

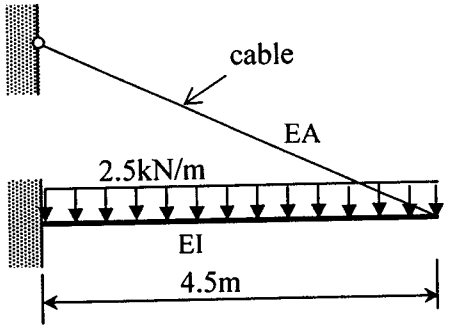


Figure 2(a)

(b) Figure 2(b) shows a simple two-member truss subjected to a vertical load of 75kN at D. All supports A, B and C are of pinned type. A third member BD is later added.
Compute:
(i) the force in the added member BD.
(ii) the changes in magnitude of forces in members AD and CD due to the addition of member BD.
Use method of least work.

(12 marks)

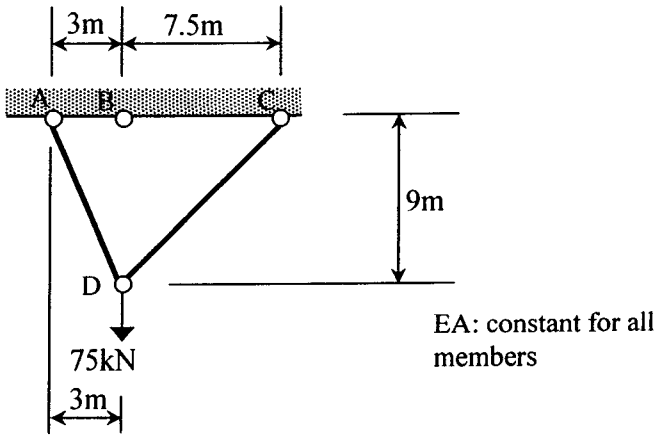


Figure 2 (b)

3. Figure 3 shows a typical frame of a part of a building. Support A and D are fixed. Span BC carries a uniformly distributed load of 20 kN/m. EI value for all members 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)

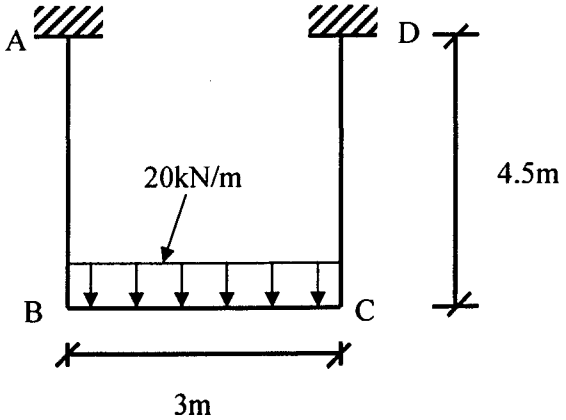


Figure 3

4. Using the Moment Distribution Method, calculate the bending moment at critical sections of the continuous beam shown in Figure 4. Then ;

   (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)

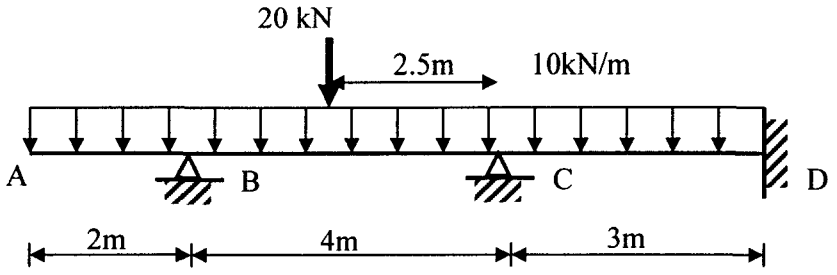


Figure 4

5. (a) State **TWO (2)** differences between elastic and plastic analysis

(4 marks)

   (b) Draw **THREE (3)** collapse mechanisms of the frame as shown in Figure 5. If the column and the beam of the frame were constructed using the section as given in Table 1, determine the collapse load, P, of the frame for each mechanism.

(16 marks)

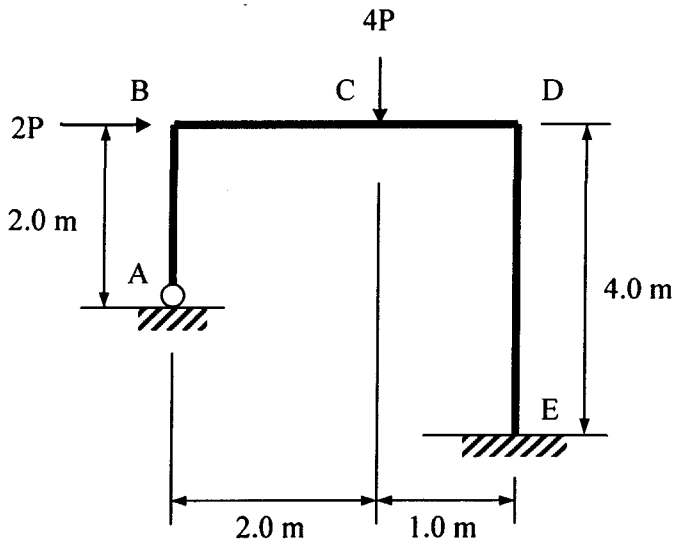
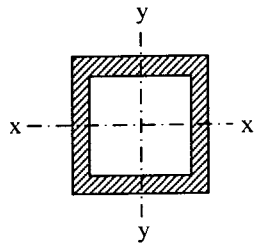
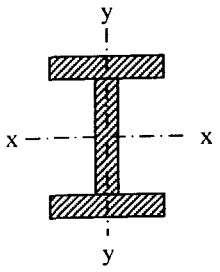


Figure 5

Table 1

Member	Column	Beam
Cross-section		
Cross-sectional area	11514 mm^2	31400 mm^2
Modulus of elasticity	200 GPa	200 GPa
Yield stress of the section	275 N/mm^2	275 N/mm^2
Elastic section modulus	1.085×10^6 mm^3	4.113×10^5 mm^3
Plastic section modulus	1.262×10^6 mm^3	5.605×10^6 mm^3

6. Figure 6 shows a beam supported at A and C. The support at A is fixed and C is a roller. Assume the flexural rigidity of the beam is constant.

   (a) Without any calculation, state the analysis procedures to draw qualitative influence lines for the reaction at support of the indeterminate beam.

   (4 marks)

   (b) Draw the influence line for the shear at B. Plot numerical values every 1.0 m.

   (16 marks)

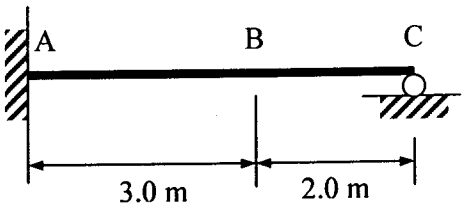


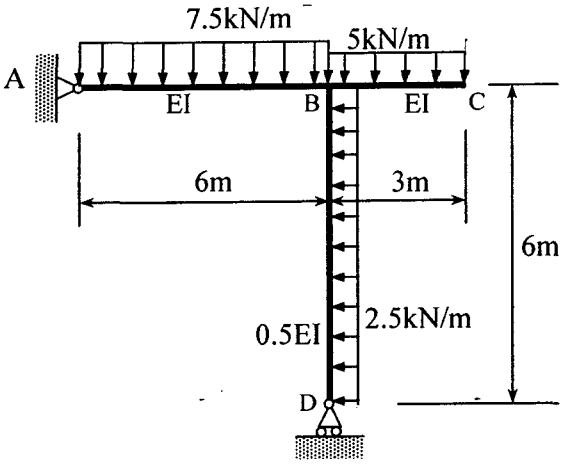
Figure 6

1. *Rajah 1 menunjukkan satu kerangka dengan penyokong jenis rola pada A dan jenis pin pada D. Kerangka berkenaan dikenakan: beban teragih seragam 10kN/m di sepanjang anggota AB, 5kN/m di sepanjang anggota BC dan 2.5kN/m di sepanjang anggota BD; dan satu beban tertumpu 20kN pada C. EI untuk anggota AB dan BC adalah sama; manakala EI untuk anggota BD adalah 0.5 kali nilai untuk anggota AB dan BC.*
Kirakan :

(a) Anjakan pugak titik C dengan menggunakan kaedah kerja maya.
(b) Perubahan dalam magnitud anjakan pugak titik C dengan membandingkan nilai yang diperoleh dalam (a):

(i) Jjika EI anggota BD ditukar dari 0.5EI kepada 1.5EI.
(ii) Jika EI anggota AB ditukar dari EI kepada 2EI.

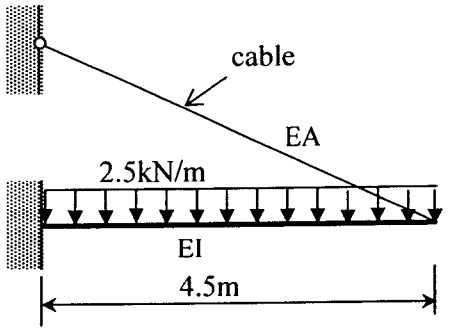
(20 markah)



Rajah 1

2. (a) *Rajah 2(a) menunjukkan satu rasuk julur yang digantung dengan menggunakan kabel. Rasuk berkenaan dikenakan satu beban teragih seragam 2.5kN/m. Tentukan ungkapan untuk daya tegangan kabel. Guna kaedah kerja terkurang.*

(8 markah)

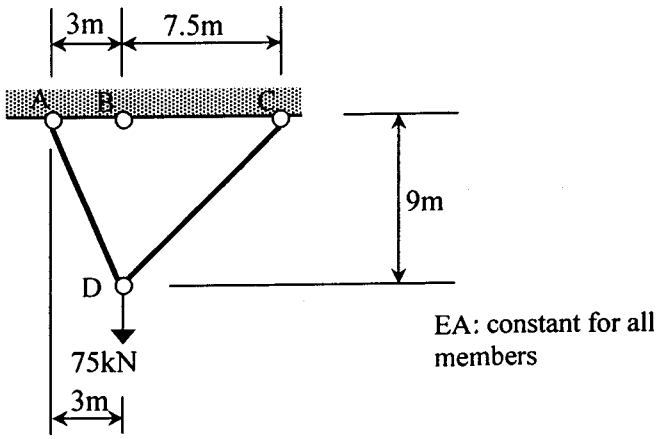


Rajah 2(a)

(b) *Rajah 2(b) menunjukkan satu struktur kekuda dua-anggota yang dikenakan satu beban pugak 75kN di D. Kesemua penyokong A, B dan C adalah jenis pin. Satu anggota ketiga, iaitu anggota BD, telah ditambahkan kemudian.*
Kirakan:
(i) daya anggota BD yang ditambahkan
(ii) perubahan dalam magnitud daya anggota AD dan CD akibat tambahan anggota BD.

Guna kaedah kerja terkurang.

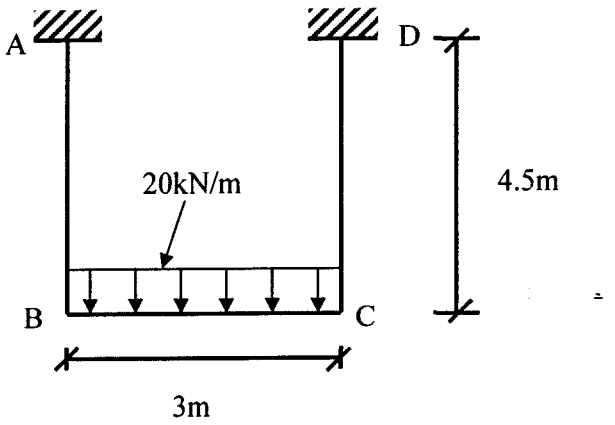
(12 markah)



Rajah 2 (b)

3. *Rajah 3 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,Y dan seterusnya, lakar gambarajah momen lentur untuk kerangka tersebut.*

(20 markah)

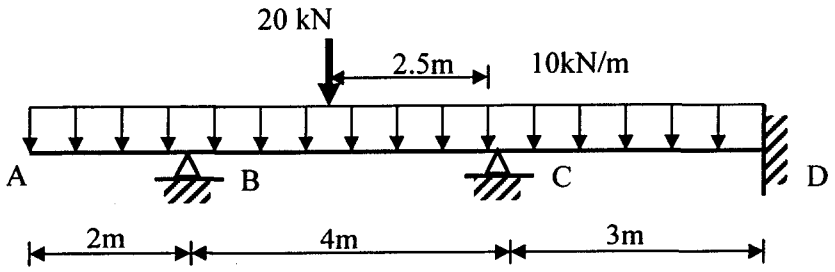


Rajah 3

4. *Dengan menggunakan Kaedah Momen Agihan, kira momen lentur pada keratan kritikal rasuk selanjar yang ditunjukkan dalam Rajah 4. Seterusnya,*

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

(20 markah)



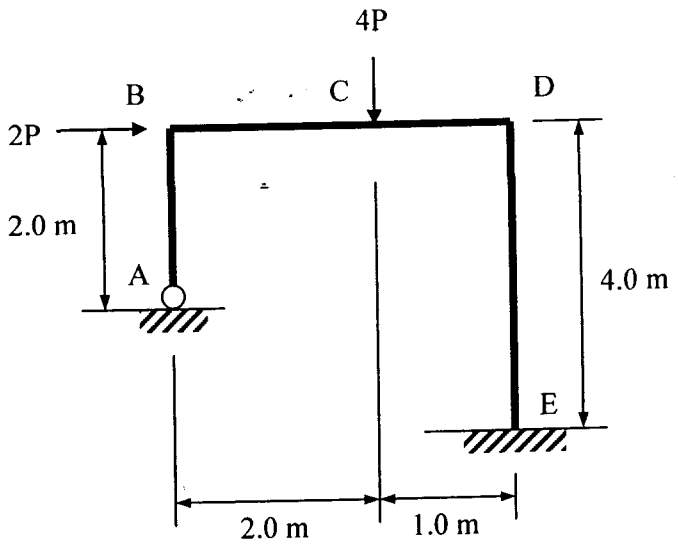
Rajah 4

5. *(a) Nyatakan **DUA (2)** perbezaan antara analisis elastik dan plastik.*

(4 markah)

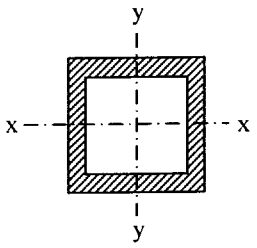
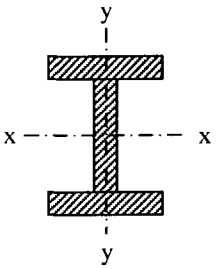
*(b) Lukiskan **TIGA (3)** mekanisma runtuh bagi struktur kerangka dalam Rajah 5. Sekiranya tiang dan rasuk kerangka tersebut dibina menggunakan keratan seperti dalam Jadual 1, tentukan beban runtuh bagi setiap mekanisma struktur kerangka tersebut.*

(16 markah)



Rajah 5

Jadual 1

Anggota	*Tiang*	*Rasuk*
Keratan rentas		
Luas keratan rentas	11514 mm^2	31400 mm^2
Modulus keanjalan	200 GPa	200 GPa
Tegasan alah keratan	275 N/mm^2	275 N/mm^2
Modulus keratan anjal	1.085×10^6 mm^3	4.113×10^5 mm^3
Modulus keratan plastik	1.262×10^6 mm^3	5.605×10^6 mm^3

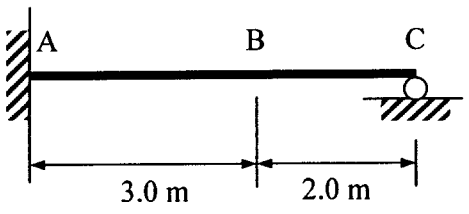
6. *Rajah 6 menunjukkan satu rasuk diikat tegar di A dan disokong rola di C. Andaikan ketegaran lenturan rasuk tersebut adalah malar.*

   (a) Tanpa sebarang pengiraan, nyatakan tatacara analisis untuk melukis garis imbas kualitatif bagi tindak balas di sokong untuk rasuk tidakboleh tentu statik.

   (4 markah)

   (b) Lukiskan gambarajah garis imbas bagi ricih di B. Plotkan nilai numerik untuk setiap selaan 1.0 m.

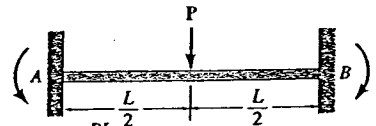
   (16 markah)



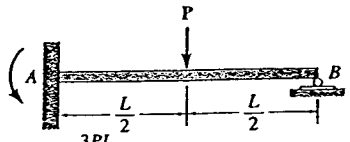
Rajah 6

-ooOOOoo-

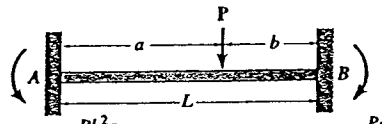
Fixed End Moments



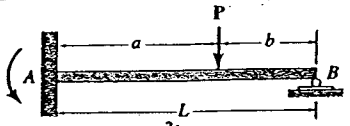
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



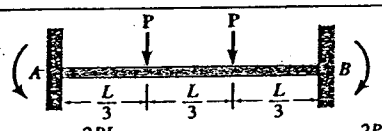
$(FEM)'_{AB} = \frac{3PL}{16}$



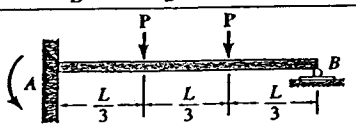
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



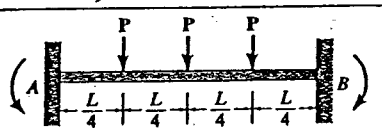
$(FEM)'_{AB} = (\frac{P}{L^2})(b^2a + \frac{a^2b}{2})$



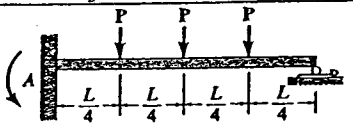
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



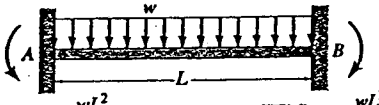
$(FEM)'_{AB} = \frac{PL}{3}$



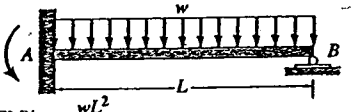
$(FEM)_{AB} = \frac{15PL}{48}$ $(FEM)_{BA} = \frac{15PL}{48}$



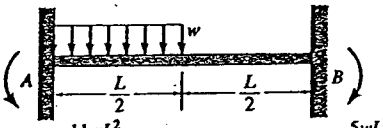
$(FEM)'_{AB} = \frac{45PL}{96}$



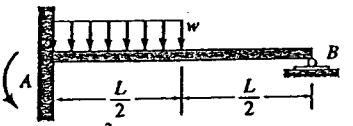
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



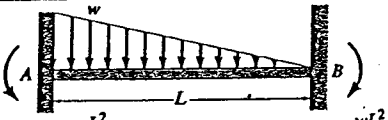
$(FEM)'_{AB} = \frac{wL^2}{8}$



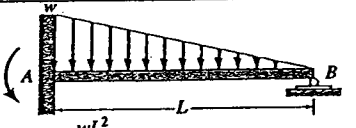
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



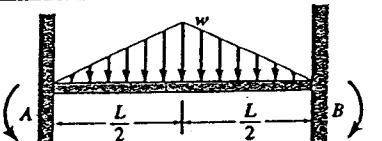
$(FEM)'_{AB} = \frac{9wL^2}{128}$



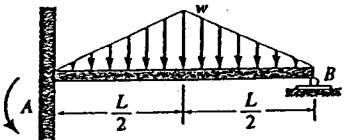
$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



$(FEM)'_{AB} = \frac{wL^2}{15}$

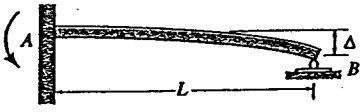


$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



$(FEM)'_{AB} = \frac{5wL^2}{64}$

$(FEM)_{AB} = \frac{6EI\Delta}{L^2}$ $(FEM)_{BA} = \frac{6EI\Delta}{L^2}$



$(FEM)'_{AB} = \frac{3EI\Delta}{L^2}$