

**SULIT**



**KEMENTERIAN PENDIDIKAN TINGGI  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI**

**BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI  
KEMENTERIAN PENDIDIKAN TINGGI**

**JABATAN KEJURUTERAAN AWAM**

**PEPERIKSAAN AKHIR**

**SESI I : 2023/2024**

**DCC40163: THEORY OF STRUCTURES**

**TARIKH : 03 JANUARI 2023**

**MASA : 08.30 AM - 10.30 AM (2 JAM)**

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Kertas ini mengandungi **LIMA BELAS (15)** halaman bercetak.

Bahagian A: Struktur (2 soalan)

Bahagian B: Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**

**SECTION A : 50 MARKS****BAHAGIAN A : 50 MARKAH****INSTRUCTION:**

This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

**ARAHAN :**

*Bahagian ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.*

**QUESTION 1****SOALAN 1**

A truss is statically determinate when all its member forces can be determined using only equilibrium equations. Otherwise, it is statically indeterminate. According to statically determinate steel truss as shown in Figure A1(a) below that subjected to the vertical and horizontal external load of 400kN and 300kN at joints B and C, respectively.

*Semua daya anggota kekuda boleh tentu statik boleh ditentukan dengan menggunakan persamaan keseimbangan. Jika sebaliknya, ia dikatakan sebagai kekuda tidak boleh tentu statik. Berpandukan kekuda keluli boleh tentu statik seperti yang ditunjukkan dalam Rajah A1(a) di bawah, yang dikenakan beban luar pugak 400kN pada titik B dan beban luar mendatar 300kN pada titik C.*

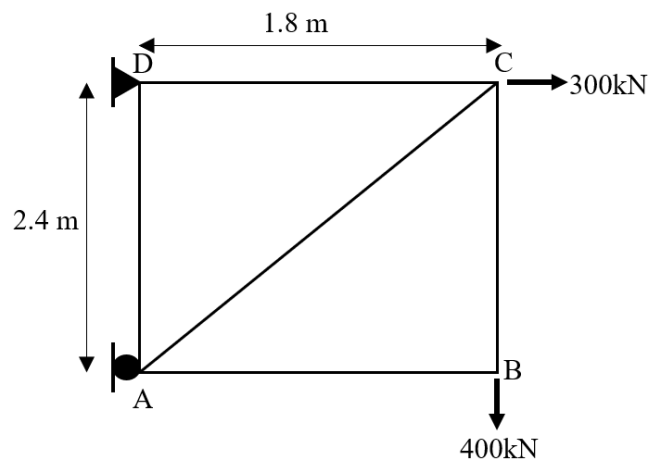


Figure A1(a)/ Rajah A1(a)

- CLO2 (a) Show the internal forces in each member for Figure A1(a) of the steel truss using the method of joints.  
*Tunjukkan daya dalaman pada setiap ahli kerangka keluli di dalam Rajah A1(a) dengan menggunakan kaedah sambungan.*
- [8 marks]  
[8 markah]
- CLO2 (b) Determine the vertical displacement of joint B of the steel truss for Figure A1(a). Given the cross-sectional area of each member is  $A = 1200\text{mm}^2$  and  $E = 200\text{ kN/mm}^2$ .  
*Tentukan pesongan pugak pada titik B bagi kekuda keluli di dalam Rajah A1(a). Diberi luas keratan rentas setiap anggota ialah  $A = 1200\text{mm}^2$  dan  $E = 200\text{ kN/mm}^2$ .*
- [7 marks]  
[7 markah]
- CLO2 (c) A statically indeterminate truss is subjected to an external load as shown in Figure A1(c). The internal forces (P) in each member are given as follows. Given the cross-sectional areas, A and the modulus of elasticity, E for each member of the truss are constant.  
*Sebuah kekuda tidak boleh tentu statik dikenakan beban luaran seperti ditunjukkan dalam Rajah A1(c). Daya dalaman anggota kerangka (P) diberi seperti berikut. Diberi luas keratan rentas, A dan modulus keanjalan, E bagi setiap anggota kekuda adalah malar.*

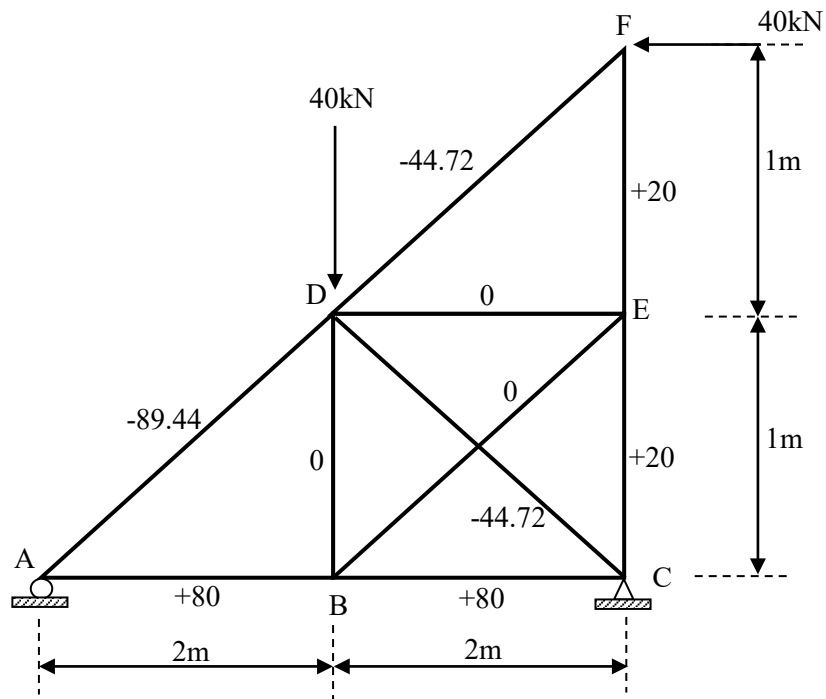


Figure A1(c)/ Rajah A1(c)

Calculate the internal force in all members of the truss due to the external load if member BE is a redundant.

*Kirakan daya dalaman bagi semua anggota disebabkan oleh beban luaran jika anggota BE adalah lelebi.*

[10 marks]

[10 markah]

## QUESTION 2

## SOALAN 2

- (a) Influence lines are essential in the design of a structure where the loads move along the span. Figure A2(a) shows a bridge that will be subjected to the wheel loads of a moving truck.

*Garis Imbas adalah penting dalam reka bentuk struktur di mana terdapat beban yang bergerak sepanjang rentang. Rajah A2(a) menunjukkan sebuah jambatan yang akan dikenakan beban roda trak yang bergerak.*

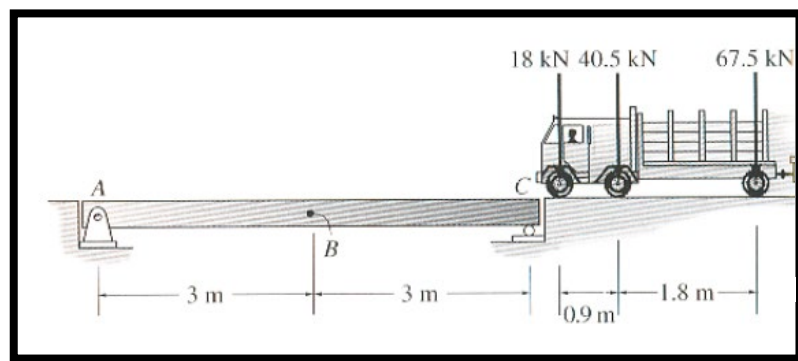


Figure A2(a)/ Rajah A2(a)

- CLO3 i) Illustrate the influence lines for reactions at A and C, shear force at point B and bending moment at point B of the bridge.  
*Lakarkan garis imbas bagi tindak balas pada A dan C serta daya ricih dan momen lentur pada titik B jambatan itu.*
- [6 marks]  
[6 markah]
- CLO3 ii) Calculate the maximum positive shear force created at point B in the beam due to the moving truck.  
*Kirakan daya ricih positif maksimum yang dihasilkan pada titik B dalam rasuk yang disebabkan oleh trak yang bergerak.*
- [5 marks]  
[5 markah]

- CLO3 (b) A 24m long simply supported beam carries a series of concentrated loads, as shown in Figure A2(b) below. Evaluate the absolute maximum moment in the beam produced by the wheel loads using Influence Line Diagram.

*Rasuk tupang mudah sepanjang 24m dikenakan satu siri beban tertumpu seperti yang ditunjukkan dalam Rajah A2(b) di bawah. Nilaiakan momen maksimum mutlak dalam rasuk yang dihasilkan oleh beban roda dengan menggunakan garis imbas.*

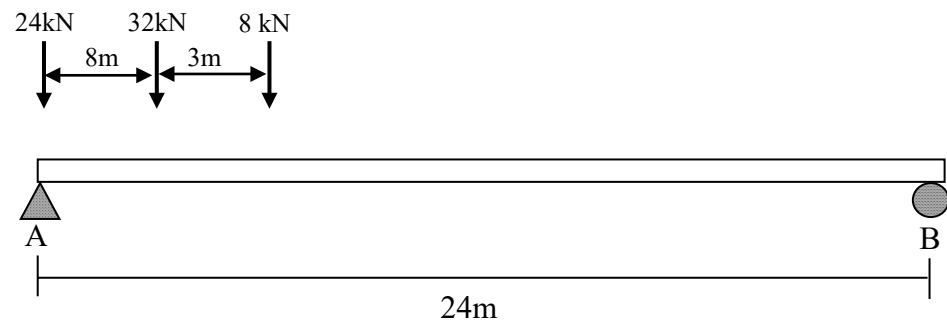


Figure A2(b)/ *Rajah A2(b)*

[14 marks]

[14 markah]

**SECTION B : 50 MARKS****BAHAGIAN B : 50 MARKAH****INSTRUCTION:**

This section consists of **FOUR (4)** subjective questions. Answer **TWO (2)** questions only.

**ARAHAN:**

*Bahagian ini mengandungi EMPAT (4) soalan subjektif. Jawab DUA (2) soalan sahaja.*

**QUESTION 1****SOALAN 1**

A continuous beam is built-in at A and C while B is supported by a roller as shown in Figure B1. It carries a uniformly distributed load of 3kN/m over AB and point loads of 5kN and 10kN over BC. EI is constant for all members. By using the Slope Deflection Method;

*Satu rasuk selangar yang diikat tegar pada titik A dan C manakala B ditupang secara rola seperti dalam Rajah B1. Rasuk dikenakan beban teragih seragam sebanyak 3kN/m di sepanjang rentang AB dan beban tumpu 5kN dan 10kN pada rentang BC. Nilai EI adalah malar untuk setiap anggota. Dengan menggunakan Kaedah Cerun Pesongan;*

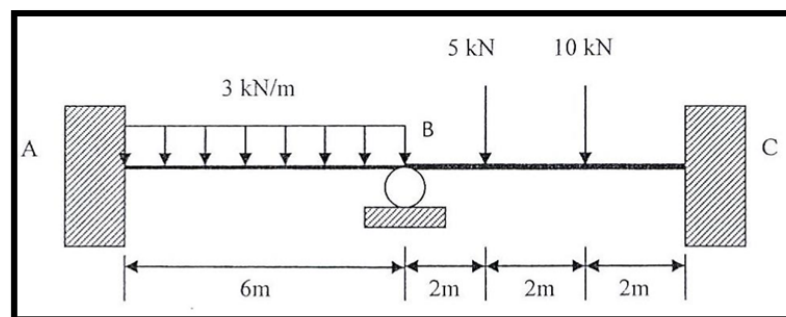


Figure B1/ *Rajah B1*

- |      |     |   |                         |
|------|-----|---|-------------------------|
| CLO1 | (a) | Identify the value of fixed end moment for each member.<br><i>Kenal pasti nilai momen hujung terikat pada setiap anggota.</i> | [4 marks]<br>[4 markah] |
| CLO1 | (b) | Identify the slope deflection equations for each member.<br><i>Kenal pasti persamaan cerun pesongan bagi setiap anggota.</i>  | [6 marks]<br>[6 markah] |
| CLO1 | (c) | i. Calculate the final moment for each support.<br><i>Kirakan momen akhir bagi setiap penyokong.</i>                          | [7 marks]<br>[7 markah] |
|      |     | ii. Sketch the shear force diagram.<br><i>Lakarkan gambarajah daya ricih.</i>   | [8 marks]<br>[8 markah] |



**QUESTION 2****SOALAN 2**

A portal frame is subjected to load, as shown in Figure B2(a). By using Slope Deflection Method,

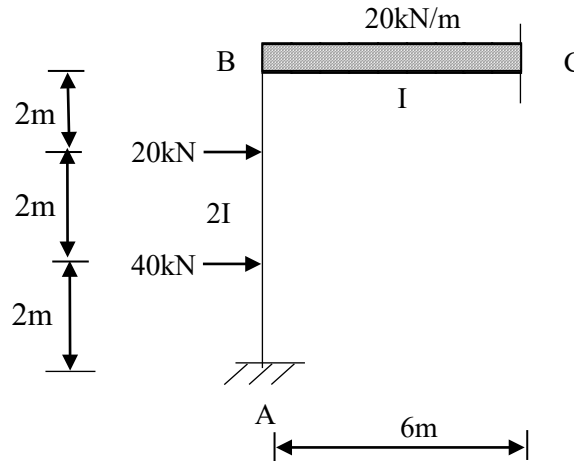
*Satu kerangka portal dikenakan beban seperti yang ditunjukkan dalam Rajah B2(a). Dengan menggunakan Kaedah Cerun Pesongan,*

- CLO1 (a) Identify the Fixed End Moment for each member.  
*Kenal pasti Momen Hujung Terikat untuk setiap anggota.*

[4 marks]

[4 markah]

- CLO1 (b) Identify the slope deflection equations for each member.  
*Kenal pasti persamaan cerun pesongan pada setiap anggota.*

Figure B2(a) / *Rajah B2(a)*

[6 marks]

[6 markah]

CLO1

- (c) Figure B2(c) shows a frame subjected to a uniformly distributed load. EI is constant for each member.

*Rajah B2(c) menunjukkan sebuah kerangka yang dikenakan beban teragih seragam. Nilai EI adalah malar untuk setiap rentang.*

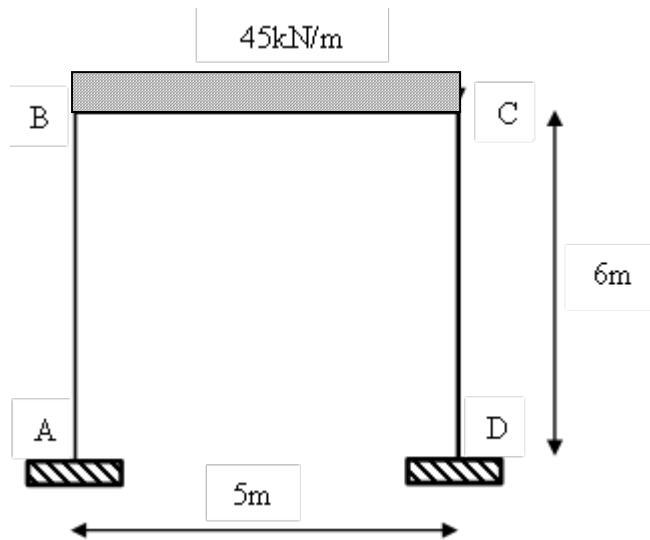


Figure B2(c) / Rajah B2(c)

- i. Calculate the final moment for each span in Figure B2(c) by using the Slope Deflection Method if Moment Equation is given as below.

*Kirakan momen akhir pada setiap rentang di dalam Rajah B2(c) dengan menggunakan Kaedah Cerun Pesongan jika Persamaan Momen diberi seperti di bawah.*

$$M_{AB} = \frac{2EI\theta_B}{6}, M_{BA} = \frac{4EI\theta_B}{6}$$

$$M_{BC} = \frac{4EI\theta_B}{5} + \frac{2EI\theta_C}{5} - 93.75$$

$$M_{CB} = \frac{4EI\theta_C}{5} + \frac{2EI\theta_B}{5} + 93.75$$

$$M_{CD} = \frac{4EI\theta_C}{6}, M_{DC} = \frac{2EI\theta_C}{6}$$

[7 marks]

[7 markah]

- ii. Sketch the Bending Moment Diagram (BMD) for Figure B2(b).  
Lakarkan Gambarajah Momen Lentur (GML) bagi Rajah B2(b).

[8 marks]

[8 markah]

**QUESTION 3****SOALAN 3**

A continuous beam is supported by a roller at A and B while fixed at support C as shown in Figure B3(a). The beam carries a uniformly distributed load of 100kN/m along span AB and a point load of 80kN at span BC.

*Satu rasuk selanjur ditupang secara rola pada titik A dan B manakala diikat tegar pada titik C seperti dalam Rajah B3(a). Rasuk dikenakan beban teragih seragam 100kN/m di sepanjang rentang AB dan beban tumpu 80kN pada rentang BC.*

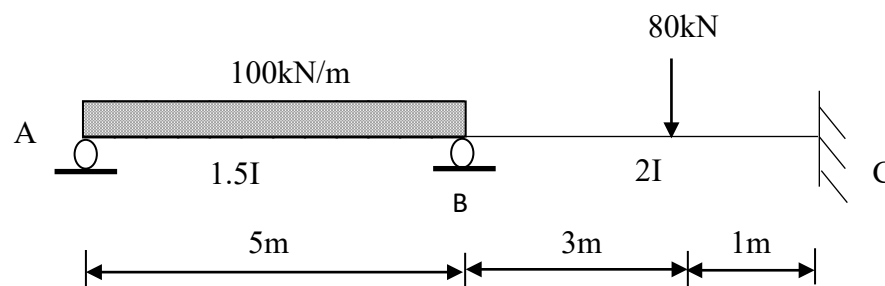


Figure B3(a) / Rajah B3(a)

- CLO1 (a) Identify the stiffness factor of the beam in Figure B3(a).  
*Kenal pasti faktor kekukuhan rasuk bagi Rajah B3(a).*

[4 marks]

[4 markah]

CLO1 (b) Identify the distribution factor of the beam in Figure B3(a).

*Kenal pasti faktor agihan rasuk bagi Rajah B3(a).*

[6 marks]

[6 markah]

(c) Figure B3(c) shows 40kN of point load acting at span AB and 60kN/m uniformly distributed load acting along span BC.

*Rajah B3(c) menunjukkan beban titik 40kN dikenakan pada rentang pada rentang AB dan 60kN/m beban teragih seragam dikenakan pada rentang BC.*

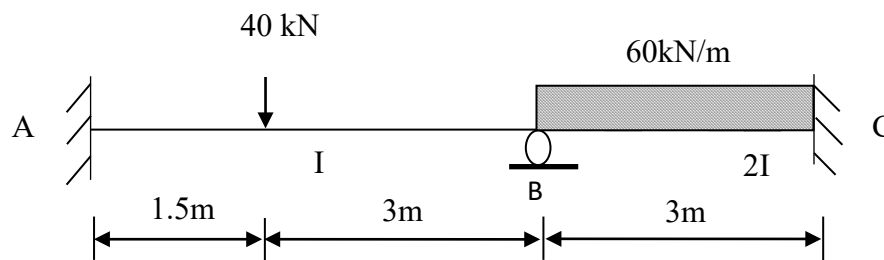


Figure B3(c) / *Rajah B3(c)*

CLO1

i. Table B3 shows the solution to calculate the final moment for each span. Complete the table below.

*Jadual B3 menunjukkan penyelesaian untuk menentukan momen akhir pada setiap rentang. Lengkapkan jadual di bawah.*

Table B3 / *Jadual B3*

<b>MEMBER END</b>	<b>AB</b>	<b>BA</b>	<b>BC</b>	<b>CB</b>
<b>DF</b>	0	0.25	0.75	0
<b>FEM</b>	- 26.67	10	- 45	45
<b>Moment distribution</b>				
<b>Carry Over</b>				
<b>Moment Distribution</b>				
<b>FINAL MOMENT</b>				

[7 marks]

[7 markah]

CLO1

- ii. Sketch the Shear Force Diagram (SFD).  
*Lakarkan Gambarajah Daya Ricih (GDR).*

[8 marks]

[8 markah]

**QUESTION 4****SOALAN 4**

A portal frame is subjected to load as shown in Figure B4(a). Given  $EI$  is constant for each span.

*Satu kerangka portal dikenakan beban seperti yang ditunjukkan dalam Rajah B4(a).*

*Diberi nilai  $EI$  adalah malar bagi setiap rentang.*

CLO1

- (a) Identify the Fixed End Moment for each member.

*Kenal pasti Momen Hujung Terikat untuk setiap anggota.*

[4 marks]

[4 markah]

CLO1

- (b) Identify the stiffness factor of the beam.

*Kenal pasti faktor kekakuan rasuk.*

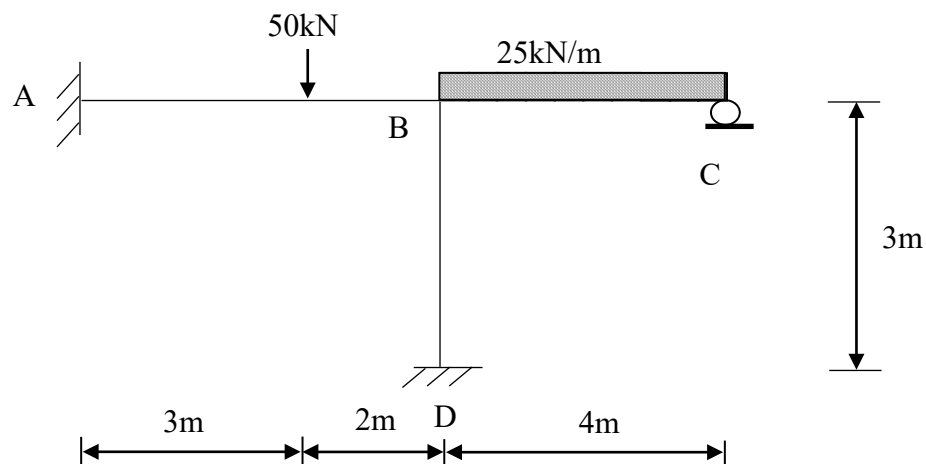


Figure B4(a) / *Rajah B4(a)*

[6 marks]

[6 markah]

CLO1

- (c) A portal frame is subjected to point load and uniformly distributed load, as shown in Figure B4(c). Given value of  $M_{AB}^F = -40\text{kNm}$ ,  $M_{BA}^F = 40\text{kNm}$ ,  $M_{BC}^F = -7.35\text{kNm}$  and  $M_{CB}^F = 9.80\text{kNm}$ .

*Satu kerangka portal dikenakan beban tumpu dan beban teagih seragam seperti dalam Rajah B4(c). Diberi nilai  $M_{AB}^F = -40\text{kNm}$ ,  $M_{BA}^F = 40\text{kNm}$ ,  $M_{BC}^F = -7.35\text{kNm}$  and  $M_{CB}^F = 9.80\text{kNm}$*

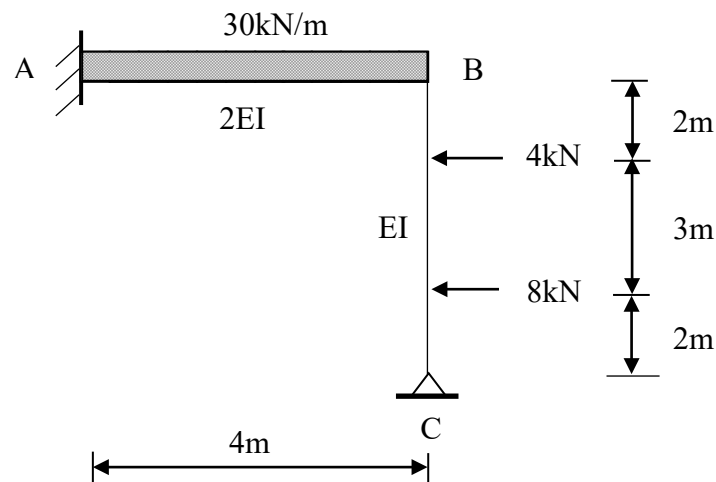


Figure B4(c) / Rajah B4(c)

- i. Identify distribution factor for each span.  
*Kenalpasti faktor agihan pada setiap rentang.*  
[7 marks]  
[7 markah]
  
- ii. Determine the final moment for each span by using the Moment Distribution Method (3 times of distribution).  
*Tentukan momen akhir pada setiap rentang dengan menggunakan Kaedah Agihan Momen (3 kali agihan).*  
[8 marks]  
[8 markah]

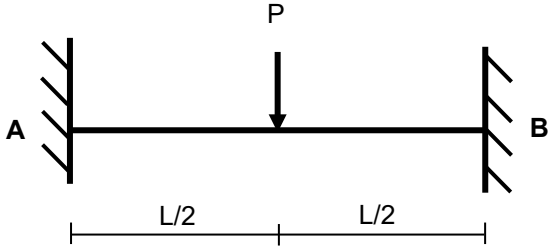
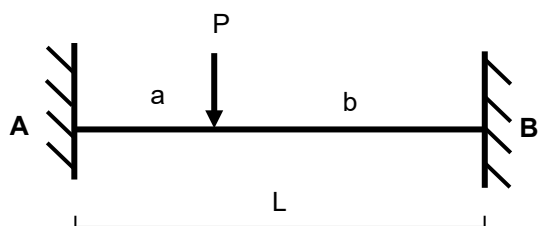
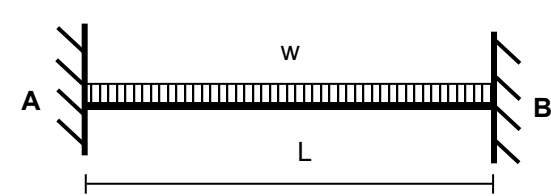
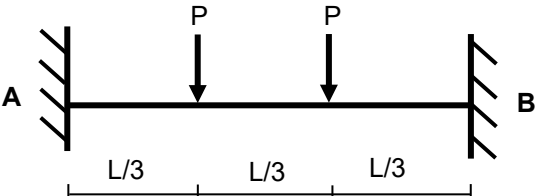
**SOALAN TAMAT**

**DCC40163 – THEORY OF STRUCTURES  
FORMULAE**

**1. Slope Deflection Method**

$$M_{AB} = \frac{2EI}{L} \left( 2\theta_A + \theta_B - \frac{3\Delta}{L} \right) + FEM_{AB}$$

$$M_{BA} = \frac{2EI}{L} \left( 2\theta_B + \theta_A - \frac{3\Delta}{L} \right) + FEM_{BA}$$

$FEM_{AB} = -\frac{PL}{8}$		$FEM_{BA} = +\frac{PL}{8}$
$FEM_{AB} = -\frac{Pab^2}{L^2}$		$FEM_{BA} = +\frac{Pa^2b}{L^2}$
$FEM_{AB} = -\frac{wL^2}{12}$		$FEM_{BA} = +\frac{wL^2}{12}$
$FEM_{AB} = -\frac{2PL}{9}$		$FEM_{BA} = +\frac{2PL}{9}$

**2. Moment Distribution Method**

i. Stiffness Factor

$$K = 4EI / L \text{ (for Fixed or Continuous)}$$

$$K = 3EI / L \text{ (for Pinned or Roller)}$$

ii. Distribution Factor

$$DF = K / \sum K$$



### 3. Statically Indeterminate Truss

- i. Redundant Force

$$R = - \frac{\sum P\mu L}{\sum \mu^2 L / AE}$$

- ii. Internal Force

$$F = P + \mu R$$

### 4. Displacement

- i. external load

$$\Delta = \sum P\mu L / AE$$

- ii. temperature changers

$$\Delta = \sum \mu c L t$$

- iii. fabrication error

$$\Delta = \sum \mu \lambda$$

### 5. Influence Lines

- i.  $R_A = 1 - x/L$ ,  $R_B = x/L$
- ii.  $V_C = -x/L$ ,  $R_A = 1 - x/L$
- iii.  $M_C = bx/L$ ,  $V_C = a(1 - x/L)$