

**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 II : 2023/2024**

**DCC 40163: THEORY OF STRUCTURE**

**TARIKH : 06 JUN 2024**

**MASA : 2.30 PETANG – 4.30 PETANG (2 JAM)**

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Kertas ini mengandungi **LIMA BELAS (15)** halaman bercetak.  
Bahagian A: Subjektif (2 soalan)  
Bahagian B: Subjektif (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 :**

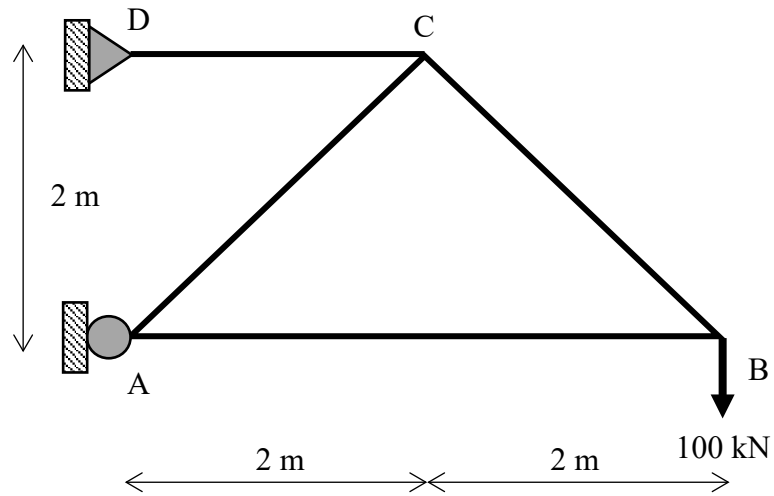
This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

**ARAHAN :**

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

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

- CLO2 (a) Discuss the difference between statically determinate trusses and statically indeterminate trusses with example.  
*Bincangkan perbezaan di antara kekuda boleh tentu statik dan kekuda tidak boleh tentu statik beserta contoh.*
- [8 marks]  
[8 markah]
- CLO2 (b) Figure A1(b) shows the statically determinate trusses with 100kN load at joint B. Given the cross-section area of each members is 400mm<sup>2</sup> and Elastic Modulus is 200GPa. Based on the information given on Table A1(b), determine the vertical displacement at joint C by using Virtual Work Method.  
*Rajah A1(b) menunjukkan kekuda boleh tentu statik dengan beban 100kN pada sambungan B. Diberi luas keratan rentas setiap anggota ialah 400mm<sup>2</sup> dan Modulus Keanjalan ialah 200GPa. Berdasarkan maklumat yang diberi pada Jadual A1(b), tentukan anjakan pugak pada sambungan C dengan menggunakan Kaedah Kerja Maya.*

Figure A1(b) / *Rajah A1(b)*Table A1(b) / *Jadual A1(b)*

Member <i>Anggota</i>	Internal Forces due to External Load, P (kN) <i>Daya dalaman disebabkan oleh Beban Luar, P (kN)</i>
AB	- 100
BC	+ 141.42
AC	- 141.42
CD	+ 200

[7 marks]

[7 markah]

- CLO2 (c) Figure A1(c) shows the statically indeterminate trusses has pinned supported at A and D. Given cross-sectional area, Elastic Modulus, internal force due to external load and internal forces due to vertical unit load of the member as shown in Table A1(c). Calculate the forces of each members using the Method of Virtual Work if the horizontal reaction at A is selected as the redundant.

*Rajah A1(c) menunjukkan kekuda tidak boleh tentu statik mempunyai penyokong pin di A dan D. Diberi luas keratan rentas, Modulus Keanjalan, daya dalaman akibat beban luar dan daya dalaman akibat beban unit pugak anggota seperti ditunjukkan dalam Jadual A1(c). Kirakan daya setiap anggota dengan menggunakan Kaedah Kerja Maya jika tindak balas mendatar di A dipilih sebagai lelebih.*

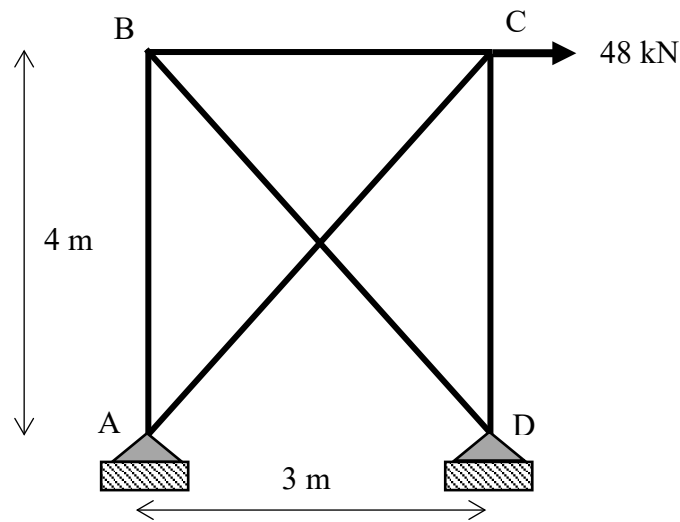


Figure A1(c) / Rajah A1(c)

Table A1(c) / *Jadual A1(c)*

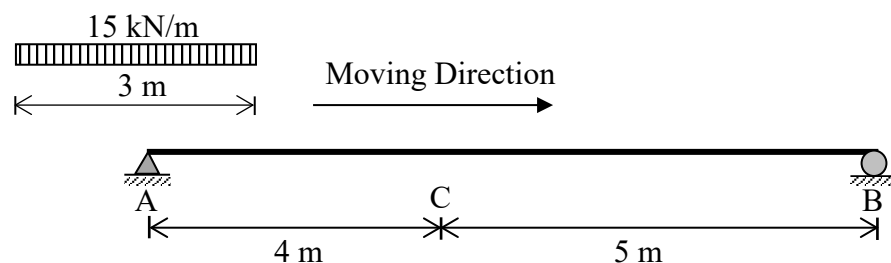
Member <i>Anggota</i>	Elastic Modulus, E (kN/mm <sup>2</sup> ) <i>Keanjalan Modulus, E (kN/mm<sup>2</sup>)</i>	Cross Sectional Area, A (mm <sup>2</sup> ) <i>Luas Keratan rentas, A (mm<sup>2</sup>)</i>	Internal Forces due to External Load, P (kN) <i>Daya dalaman disebabkan oleh Beban Luar, P (kN)</i>	Internal Forces due to Vertical Unit Load, $\mu$ (kN) <i>Daya dalaman disebabkan oleh Beban Unit, <math>\mu</math> (kN)</i>
AB	200	625	64	4/3
BC	200	500	- 48	1
CD	200	625	0	4/3
AC	30	400	0	- 5/3
BD	30	400	- 80	- 5/3

[10 marks]

[10 markah]

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

- CLO3 (a) A simply supported beam with a uniformly distribution load is shown in Figure A2(a) and moving from A to B. By using Influence Line Diagram Method:  
*Sebuah rasuk ditupang mudah dikenakan beban teragih seragam seperti ditunjukkan dalam Rajah A2(a) dan bergerak dari A ke B. Dengan menggunakan Kaedah Gambarajah Garis Imbas:*

Figure A2(a) / *Rajah A2(a)*

- (i) Calculate the maximum shear force at point C.

*Kirakan daya ricih maksimum di titik C.*

[6 marks]

[6 markah]

- (ii) Calculate the maximum bending moment at point C.

*Kirakan momen lentur maksimum di titik C.*

[5 marks]

[5 markah]

- CLO3 (b) A simply supported beam with 10 m length is subjected to a series of moving loads as shown in Figure A2(b). Evaluate the absolute maximum moment occurred in the beam.

*Sebuah rasuk tupang mudah sepanjang 10m dikenakan satu siri beban bergerak seperti yang ditunjukkan dalam Rajah A2(b). Nilai Momen Maksima Mutlak yang berlaku dalam rasuk.*

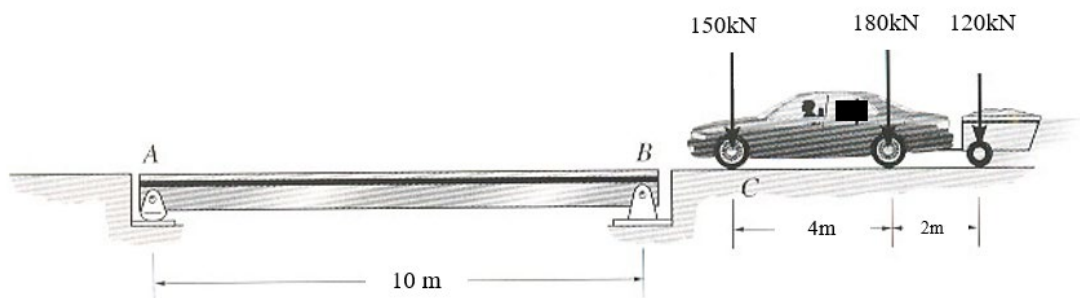


Figure A2(b) / Rajah A2(b)

[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**

- CLO1 (a) The statically indeterminate beam carries a point load and uniformly distributed load as shown in Figure B1(a). By using the Slope Deflection Method, identify the Fixed End Moment values.

*Satu rasuk tidak boleh tentu statik membawa beban tumpu dan beban teragih seragam seperti yang ditunjukkan dalam Rajah B1(a). Dengan menggunakan Kaedah Cerun Pesongan, kenal pasti nilai bagi Momen Hujung Terikat.*

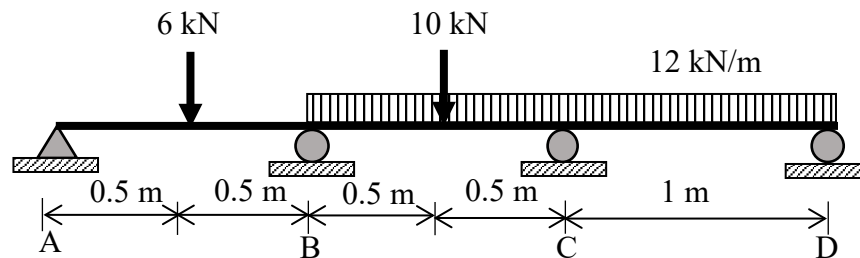


Figure B1(a) / Rajah B1(a)

[4 marks]

[4 markah]

- CLO1 (b) Show the Slope Deflection Equations for each member in Figure B1(a).  
*Tunjukkan Persamaan Cerun Pesongan bagi setiap anggota di dalam Rajah B1(a).*

[6 marks]

[6 markah]

CLO1 (c) A two-span continuous beam is subjected to a load as shown in Figure B1(c).

Given the value of Fixed End Moment as below:

*Satu rasuk selangar dua rentang dikenakan beban seperti dalam Rajah B1(c).*

*Diberi nilai Momen Hujung Terikat seperti di bawah:*

$$FEM_{AB} = -112.5 \text{ kNm}$$

$$FEM_{BC} = -19.2 \text{ kNm}$$

$$FEM_{BA} = +112.5 \text{ kNm}$$

$$FEM_{CB} = +28.8 \text{ kNm}$$

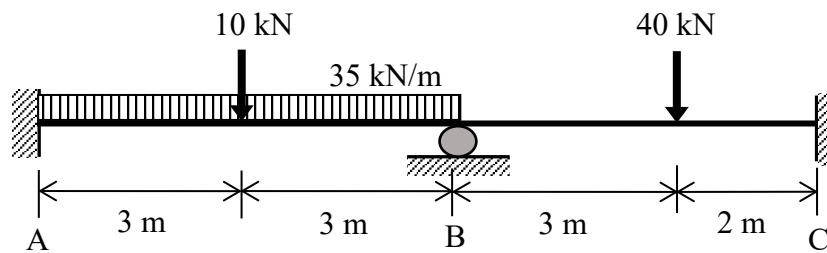


Figure B1(c) / Rajah B1(c)

(i) Calculate the values of slope at point B ( $\theta_B$ ).

*Kirakan nilai kecerunan di titik B ( $\theta_B$ ).*

[7 marks]

[7 markah]

(ii) Calculate the value of internal moment of the beam.

*Kirakan nilai momen dalaman bagi rasuk tersebut.*

[8 marks]

[8 markah]



## QUESTION 2

## SOALAN 2

- CLO1 (a) A statically indeterminate portal frame is loaded as shown in Figure B2(a). Identify the value of Fixed End Moment for each member.  
*Satu kerangka portal tidak boleh tentu statik dikenakan beban seperti dalam Rajah B2(a). Kenal pasti nilai Momen Hujung Terikat bagi setiap anggota.*

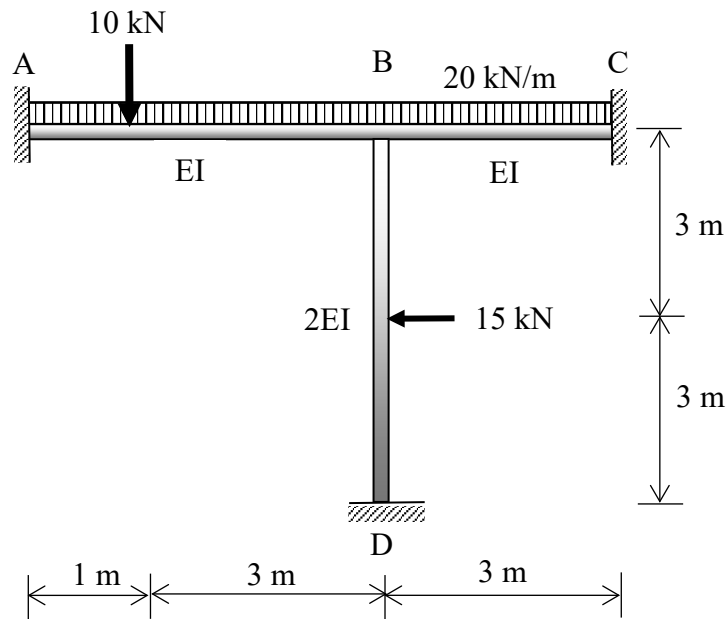


Figure B2(a) / Rajah B2(a)

[4 marks]

[4 markah]

- CLO1 (b) Indicate the slope deflection equation for each member that experiences the internal moments in Figure B2(a).  
*Tunjukkan persamaan cerun pesongan bagi setiap anggota yang mengalami momen dalaman di Rajah B2(a).*

[6 marks]

[6 markah]

- CLO1 (c) A non-sway portal frame is loaded as shown in Figure B2(c). The internal moment at support is given as follow:

*Sebuah kerangka portal tanpa huyung dikenakan beban seperti ditunjukkan dalam Rajah B2(c). Momen dalaman pada penyokong diberikan seperti berikut:*

$$M_{AB} = -66.065 \text{ kNm}$$

$$M_{BC} = -27.87 \text{ kNm}$$

$$M_{BA} = +27.87 \text{ kNm}$$

$$M_{CB} = -2.685 \text{ kNm}$$

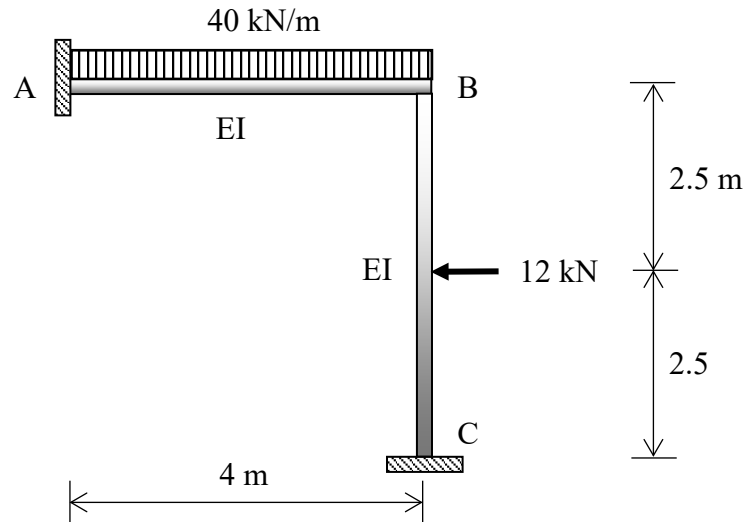


Figure B2(c) / Rajah B2(c)

- (i) Calculate reaction at the support of portal frame.  
*Kirakan nilai tindakbalas pada penyokong kerangka portal.*
- [7 marks]  
 [7 markah]
- (ii) Sketch the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD).  
*Lakarkan Gambarajah Daya Ricih (GDR) dan Gambarajah Momen Lentur (GML).*
- [8 marks]  
 [8 markah]

## QUESTION 3

## SOALAN 3

CLO1

- (a) A continuous beam is subjected to a point load and uniformly distribution load as shown in Figure B3(a). Identify Fixed End Moment value for each member of the beam.

*Satu rasuk selanjur dikenakan beban tumpu dan beban teragih seragam seperti yang ditunjukkan dalam Rajah B3(a). Kenal pasti nilai Momen Hujung Terikat pada setiap anggota bagi rasuk tersebut.*

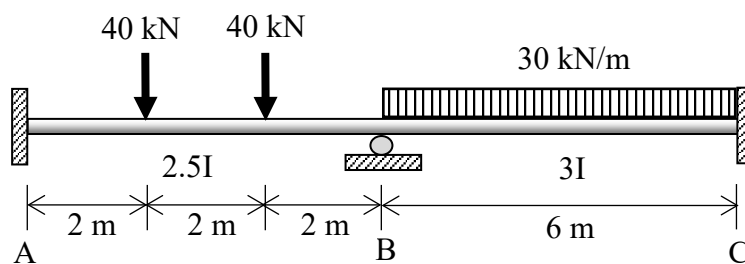


Figure B3(a) / Rajah B3(a)

[4 marks]

[4 markah]

CLO1

- (b) Identify the value of stiffness and distribution factor of the beam in Figure B3(a).  
*Kenal pasti nilai faktor kekukuhan dan faktor agihan bagi rasuk dalam Rajah B3(a).*

[6 marks]

[6 markah]

- CLO1 (c) Figure B3(c) shows a continuous beam is loaded to 25 kN/m uniformly distributed load and point load of 18kN. The Fixed End Moment is given as follows:

*Rajah B3(c) menunjukkan satu rasuk selanjur dikenakan beban teragih seragam 25 kN/m dan beban tumpu 18kN. Nilai Momen Hujung Terikat diberikan seperti berikut:*

$$FEM_{AB} = -8 \text{ kNm}$$

$$FEM_{BC} = -33.333 \text{ kNm}$$

$$FEM_{BA} = +4 \text{ kNm}$$

$$FEM_{CB} = +33.333 \text{ kNm}$$

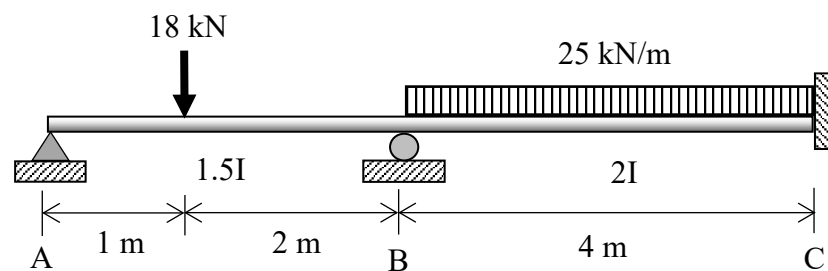


Figure B3(c) / *Rajah B3(c)*

- (i) Determine the value of the stiffness and distribution factor of the beam.  
*Tentukan nilai faktor kekukuhan dan faktor agihan bagi rasuk tersebut.*

[7 marks]

[7 markah]

- (ii) Calculate the final moment for each span of the beam by using Moment Distribution Method.

*Kirakan momen akhir pada setiap rentang bagi rasuk tersebut menggunakan Kaedah Agihan Momen.*

[8 marks]

[8 markah]

## QUESTION 4

## SOALAN 4

CLO1

- (a) A portal frame subjected with a point load and uniform distribution loads as shown in Figure B4(a). Identify the value of Fixed End Moment for each member of the portal frame.

*Sebuah kerangka portal dikenakan beban tumpu dan beban teragih seragam seperti ditunjukkan dalam Rajah B4(a). Kenal pasti nilai Momen Hujung Terikat bagi setiap anggota kerangka portal.*

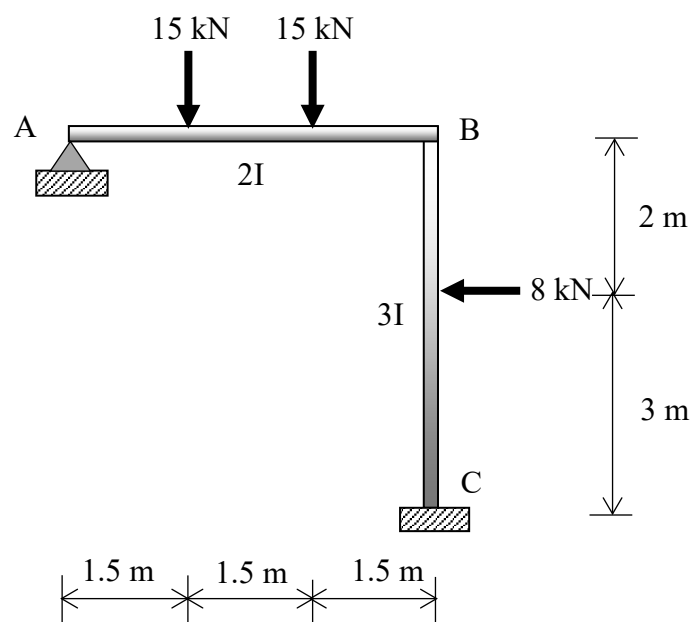


Figure B4(a) / Rajah B4(a)

[4 marks]

[4 markah]

CLO1

- (b) Refer to Figure B4(a), indicate the value of stiffness factor and distribution factors carried by each member.

*Merujuk kepada Rajah B4(a), tunjukkan nilai faktor kekukuhan dan faktor agihan yang dibawa oleh setiap anggota.*

[6 marks]

[6 markah]

- CLO1 (c) A non-sway portal frame has a uniform EI value is loaded as shown in Figure B4(c). Given the value of Fixed End Moment and distribution factor is as follows:

*Sebuah kerangka portal tanpa huyung mempunyai nilai EI yang seragam dibebankan seperti yang ditunjukkan dalam Rajah B4(c). Diberi nilai Momen Hujung Terikat dan faktor agihan adalah seperti berikut:*

$$FEM_{AB} = FEM_{BA} = FEM_{CD} = FEM_{DC} = 0 \text{ kNm}$$

$$FEM_{BC} = -90 \text{ kNm} \quad FEM_{CB} = +90 \text{ kNm}$$

$$DF_{AB} = 0 \quad DF_{BA} = \frac{3}{7} \quad DF_{BC} = \frac{4}{7}$$

$$DF_{CB} = \frac{4}{7} \quad DF_{CD} = \frac{3}{7} \quad DF_{DC} = 0$$

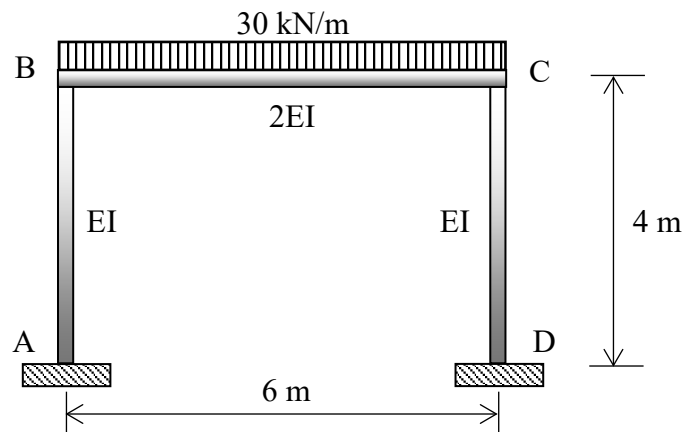


Figure B4(c)/ Rajah B4(c)

- (i) Calculate the final moment for each span by using Moment Distribution Method up to **THREE (3)** times distribution.

*Kirakan nilai momen akhir pada setiap rentang dengan menggunakan Kaedah Agihan Momen sehingga **TIGA (3)** kali agihan.*

[7 marks]

[7 markah]

- (ii) Sketch the Bending Moment Diagram (BMD) by indicating the important values.

*Lakarkan Gambarajah Momen Lentur (GML) dengan menunjukkan nilai-nilai yang penting.*

[8 marks]

[8 markah]

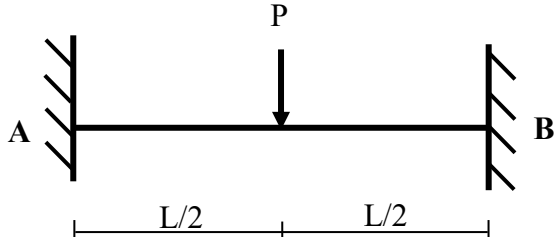
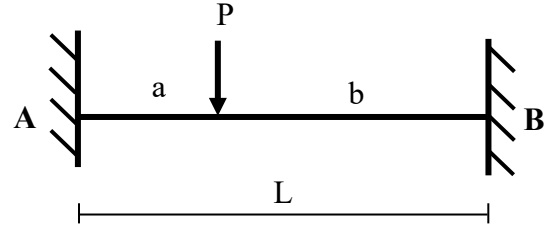
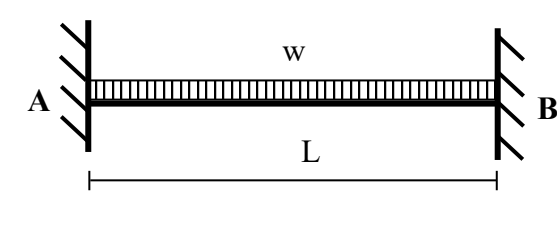
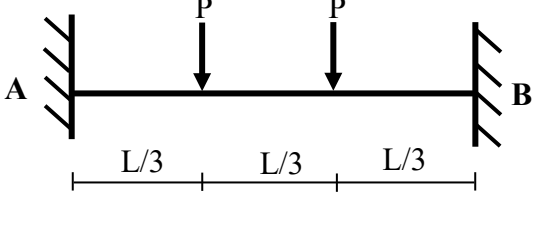
### SOALAN TAMAT

**DCC40163 – THEORY OF STRUCTURE**  
**FORMULA**

**1. Slope Deflection Method**

$$M_{AB} = \frac{2EI}{L} \left[ 2\theta_A + \theta_B - \frac{3\Delta}{L} \right] \pm M^F$$

$$M_{BA} = \frac{2EI}{L} \left[ 2\theta_B + \theta_A - \frac{3\Delta}{L} \right] \pm M^F$$

$M_{AB}^F = - PL/8$		$M_{BA}^F = PL/8$
$M_{AB}^F = - Pab^2/L^2$		$M_{BA}^F = Pba^2/L^2$
$M_{AB}^F = - wL^2/12$		$M_{BA}^F = wL^2/12$
$M_{AB}^F = - 2PL/9$		$M_{BA}^F = 2PL/9$



## 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.  $M_C = bx/L$ ,  $V_C = a(1 - x/L)$