

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 : 2025/2026

DCC40163 : THEORY OF STRUCTURE

TARIKH : 13 MEI 2026

MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **ENAM BELAS (16)** halaman bercetak.

Bahagian A: Subjektif (2 soalan)

Bahagian B: Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Formula

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**

The stability and determinacy of trusses are essential elements in structural analysis, ensuring that structures can safely support loads while allowing accurate calculations of internal forces.

Kestabilan dan ketentuan kekuda adalah elemen yang penting dalam analisis struktur untuk memastikan struktur dapat menyokong beban dengan selamat serta membolehkan pengiraan daya dalaman dilakukan dengan tepat.

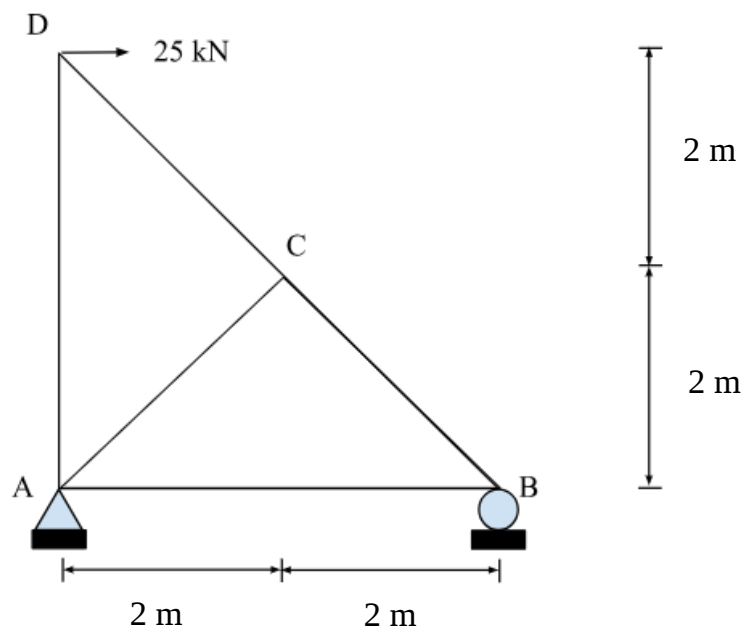


Figure A1(a)/ *Rajah A1(a)*

- CLO2 (a) Based on Figure A1(a), identify the internal forces for all members of the truss using the Method of Joint. Given the value of Reactions at joint A, B as follows and AC is a zero-force member.
- Berdasarkan Rajah A1(a), kenal pasti daya dalaman semua anggota kekuda tersebut menggunakan Kaedah Sambungan/Sendi. Diberi nilai daya tindak balas di sambungan/sendi A, B adalah seperti berikut dan AC adalah anggota daya sifar.*
- $$R_A = -25 \text{ kN}, H_A = -25 \text{ kN}, R_B = 25 \text{ kN}$$
- [8 marks]
[8 markah]
- CLO2 (b) Table A1(a) shows the internal forces for all members of the truss in Figure A1(a) subjected to 1-unit virtual load (horizontal to the right) at D. If the cross-sectional area, A and modulus of elasticity, E for all members are 0.0015m² and 200 GPa. Calculate the horizontal displacement at joint D by referring to the internal force values in each member obtained in the answer to question 1(a).
- Jadual A1(a) menunjukkan daya dalaman semua anggota bagi kekuda pada Rajah A1(a) disebabkan oleh 1-unit daya maya (mengufuk ke kanan) pada sambungan/sendi D. Jika nilai luas keratan rentas, A dan modulus keanjalan, E bagi semua anggota kekuda tersebut adalah 0.0015 m² dan 200 GPa. Kirakan anjakan ufuk pada sambungan/sendi D dengan merujuk nilai daya dalam setiap anggota yang diperolehi pada jawapan soalan 1(a).*

Table A1(a)/ *Jadual A1(a)*

Member/ <i>Anggota</i>	Internal Force Member subjected to 1-unit virtual load (horizontal to the left) at D/ <i>Nilai Daya Dalaman dikenakan beban maya 1-unit (mendatar ke kiri) di D</i>
AB	+1
AC	0
AD	+1
BC	-1.414
CD	-1.414

[7 marks]

[7 markah]

CLO2

- (c) By selecting member BD as redundant (R), the internal forces subjected to external loads and the internal forces subjected to 1-unit redundant load of the planar truss are shown in Figure A1(c)(ii) and Figure A1(c)(iii). The cross-sectional area, A , and the modulus of elasticity, E , of the truss members are constant. Analyze the internal forces of the members (F_i) of the truss if the obtained value of redundant (R) is +38.35 kN.

Dengan memilih anggota BD sebagai kelebihan, nilai daya dalaman disebabkan oleh beban luar dan daya dalaman disebabkan 1-unit daya kelebihan sebuah kekuda berbentuk rata adalah seperti ditunjukkan dalam Rajah A1(c)(ii) dan Rajah A1(c)(iii). Diberi nilai luas keratan rentas, A dan Modulus Keanjalan, E setiap anggota kekuda tersebut adalah malar. Analisis daya dalaman (F_i) setiap anggota kekuda tersebut, jika nilai kelebihan (R) yang diperolehi adalah +38.35 kN.

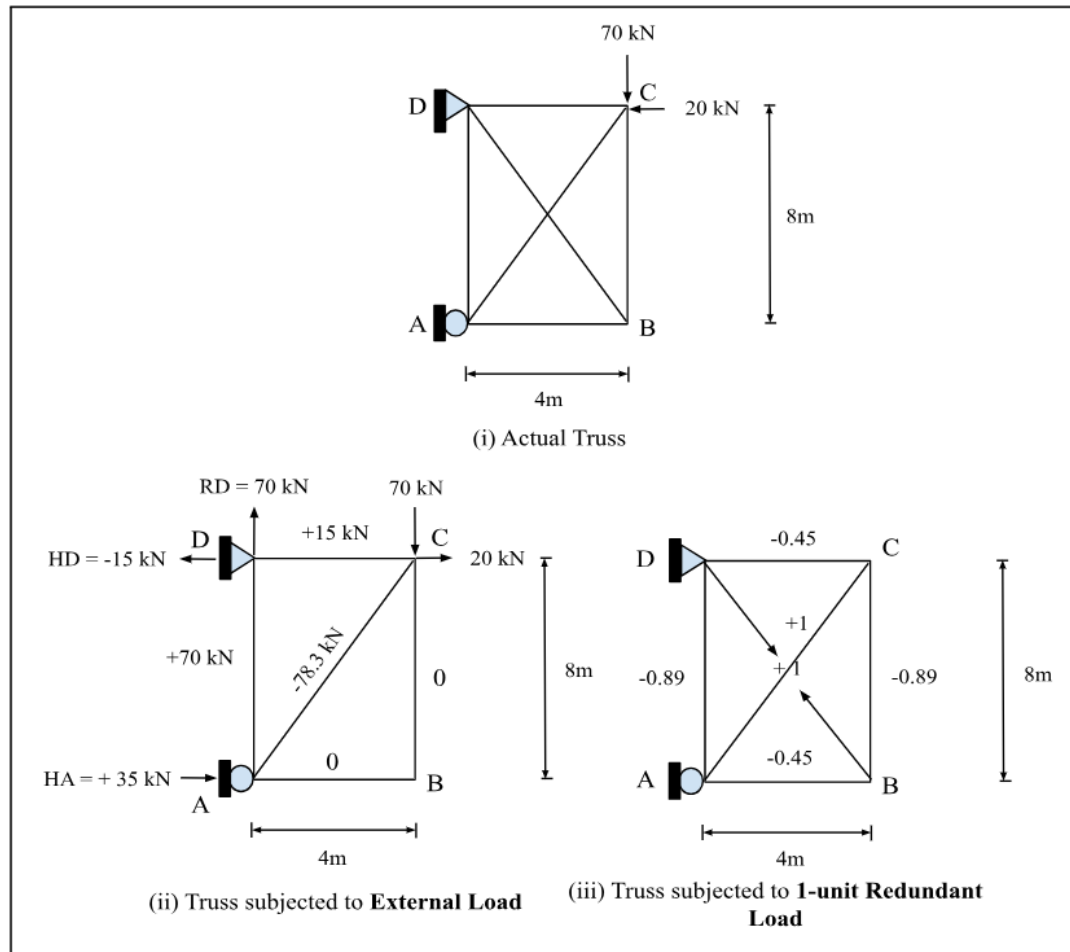


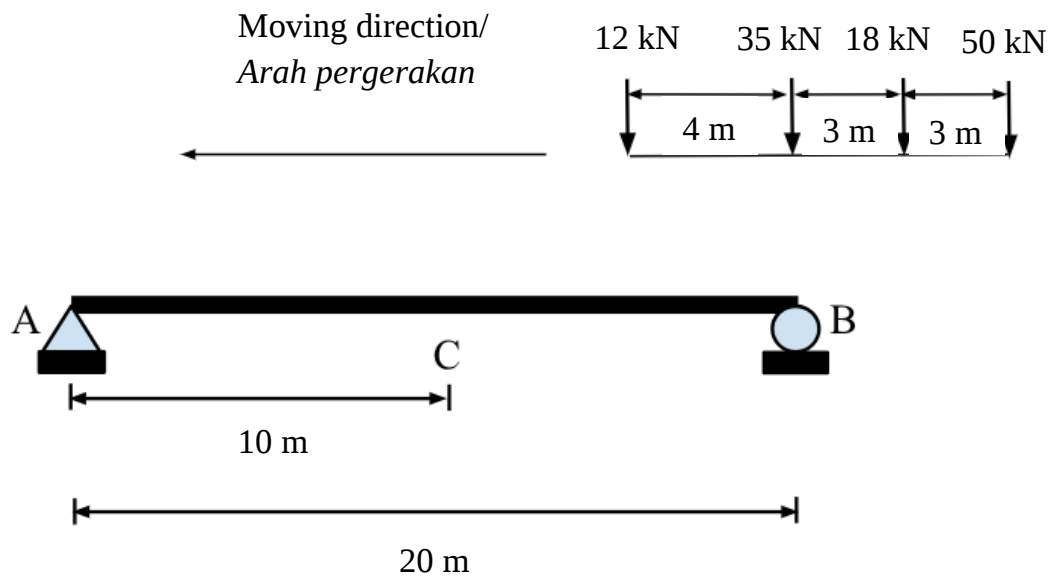
Figure A1(c) / Rajah A1(c)

[10 marks]

[10 markah]

QUESTION 2**SOALAN 2**

- CLO3 (a) A simply supported beam is subjected to a series of moving loads from right to left as shown in Figure A2. By using Influence Lines Method,
Sebuah rasuk disokong mudah dikenakan beban siri bergerak dari kanan ke kiri ditunjukkan dalam Rajah A2. Dengan menggunakan Kaedah Garis Imbas,
- i. Illustrate the reaction at support A and B as well as the shear force, bending moment at C.
Gambarkan rajah daya tindak balas pada penyokong A dan B serta daya ricih dan momen lentur di titik C.
- [6 marks]
[6 markah]
- ii. Analyze the maximum positive shear force at point C.
Analisis daya ricih positif maksimum pada titik C.
- [5 marks]
[5 markah]
- CLO3 b) Based on Figure A2, estimate the Absolute Maximum Moment of the beam due to a series of loads moving from right to left direction.
Berdasarkan Rajah A2, anggarkan Momen Maksimum Mutlak rasuk yang disebabkan oleh pergerakan satu siri beban dari kanan ke kiri.
- [14 marks]
[14 markah]

Figure A2/ *Rajah A2*

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 with two spans supported by pinned, roller, and fixed ends is shown in Figure B1. Span AB is subjected to a uniformly distributed load of 5 kN/m and a point load of 20 kN, while span BC is subjected to a point load of 25 kN. Based on Figure B1,

Sebuah rasuk selangar dengan dua rentang disokong oleh pin, rola dan hujung terikat ditunjukkan dalam Rajah B1. Rentang AB dikenakan beban teragih seragam 5 kN/m dan beban pugak 20 kN, manakala rentang BC dikenakan beban pugak 25 kN. Berdasarkan Rajah B1,

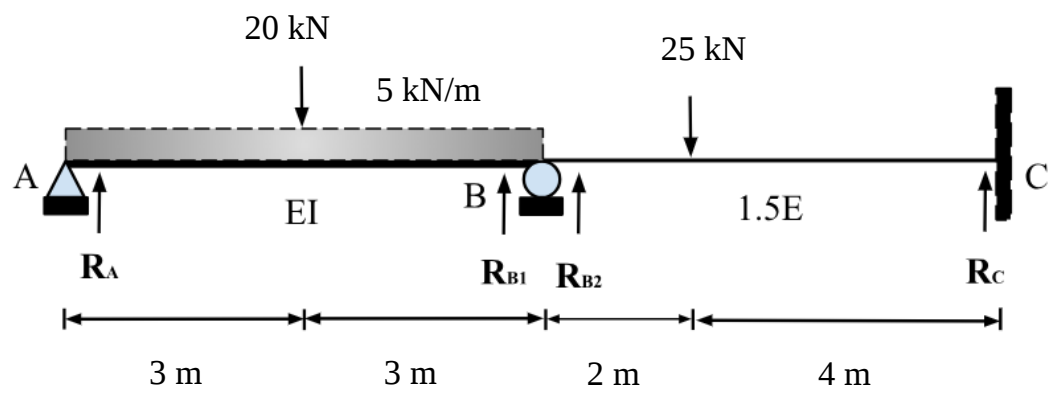
- CLO1 (a) Illustrate a free body diagram for a Moment at each support.

Ilustrasikan gambarajah daya bebas bagi Momen di setiap penyokong.

[4 marks]

[4 markah]

CLO1	(b) By using the Slope Deflection Method, state the Slope Deflection Equation for a moment at each span. Given the value of slope at C (θ_C) = 0, deflection (Δ) at each support = 0 and Fixed End Moment, FEM of each member as follows. <i>Dengan menggunakan Kaedah Cerun Pesongan, nyatakan persamaan cerun pesongan untuk momen pada setiap rentang. Diberi nilai cerun di C (θ_C) = 0, pesongan (Δ) pada setiap penyokong = 0 dan Momen Hujung Terikat, MHT bagi setiap anggota adalah seperti berikut.</i> FEM_{AB} = -30 kNm, FEM_{BA} = 30 kNm , FEM_{BC} = -22.22 kNm, FEM_{CB} = 44.44 kNm [6 marks] [6 markah]
CLO1	(c) i. Calculate the value of slope at support A and B, then the final moments at each support. <i>Kira nilai cerun pada penyokong A dan B, seterusnya, momen akhir pada setiap penyokong.</i> [7 marks] [7 markah]
CLO1	ii. Sketch a Shear Force Diagram (SFD) for the beam if the value of reactions at each support is as follows. <i>Lakarkan Gambarajah Daya Ricih (GDR) rasuk tersebut, jika nilai daya tindak balas pada setiap penyokong adalah seperti berikut.</i> R_A = 18.77 kN, R_{B1} = 31.23 kN , R_{B2} = 16.76 kN, R_C = 8.24 kN [8 marks] [8 markah]

Figure B1/ *Rajah B1*

QUESTION 2**SOALAN 2**

A portal frame supported by hinged and fixed ends is shown in Figure B2. Span AB is subjected to a uniformly distributed load of 8 kN/m and a point load of 25 kN. While span BC is subjected to a point load of 30 kN. By using Slope Deflection Method, *Sebuah kerangka portal disokong oleh engsel dan hujung terikat ditunjukkan dalam Rajah B2. Rentang AB dikenakan beban teragih seragam sebanyak 8 kN/m dan beban pugak sebanyak 25 kN. Manakala rentang BC dikenakan beban titik sebanyak 30 kN. Dengan menggunakan Kaedah Cerun Pesongan,*

- | | |
|------|--|
| CLO1 | <p>(a) State the basic Slope Deflection equation for a moment at each span.
 <i>Nyatakan persamaan asas Cerun Pesongan untuk momen di setiap rentang.</i></p> <p style="text-align: right;">[4 marks]
[4 markah]</p> |
| CLO1 | <p>(b) Identify the value of Fixed End Moment, FEM for each member of the portal frame.
 <i>Kenal pasti nilai Momen Hujung Terikat, MHT pada setiap anggota kerangka portal tersebut.</i></p> <p style="text-align: right;">[6 marks]
[6 markah]</p> |
| CLO1 | <p>(c) i. Calculate the value of slope at B and Final Moments at each span. Given the value of slope at A (θ_A) = 0, slope at C (θ_C) = 0 and deflection (Δ) at each support = 0.
 <i>Kirakan nilai cerun di B dan Momen Akhir di setiap rentang. Diberi nilai cerun di A (θ_A) = 0, cerun di C (θ_C) = 0 dan pesongan (Δ) pada setiap penyokong = 0.</i></p> <p style="text-align: right;">[7 marks]
[7 markah]</p> |

CLO1

- ii. Sketch the Bending Moment Diagram (BMD) of the portal frame if the reaction values at each support are as follows.

Lakarkan Gambarajah Momen Lentur (GML) bagi Kerangka Portal tersebut, jika diberi nilai daya tindak balas pada setiap penyokong adalah seperti berikut.

$$R_A = 38.51 \text{ kN}, R_{B1} = 34.49 \text{ kN}, R_{B2} = 24.23 \text{ kN}, R_C = 5.77 \text{ kN}$$

[8 marks]

[8 markah]

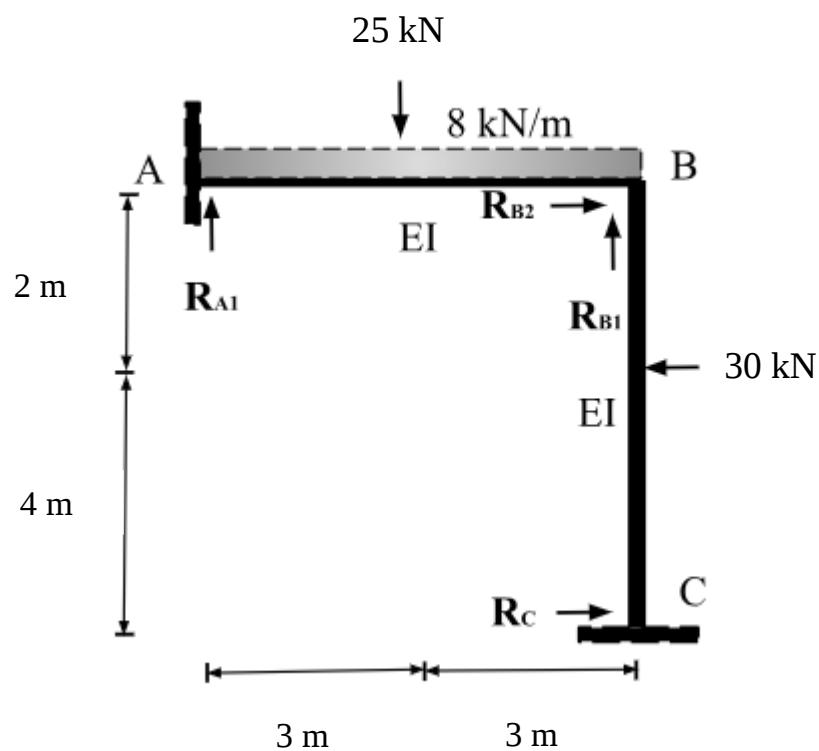


Figure B2/ Rajah B2

QUESTION 3**SOALAN 3**

A continuous beam with two spans supported by a roller and fixed end is shown in Figure B3. Span AB is subjected to a uniformly distributed load of 7 kN/m and a point load of 22 kN, while span BC is subjected to a point load of 40 kN. By using Moment Distribution Method,

Sebuah rasuk selangar dengan dua rentang disokong oleh rola dan hujung terikat ditunjukkan dalam Rajah B3. Rentang AB dikenakan beban teragih seragam 7 kN/m dan beban tumpu 22 kN, manakala rentang BC dikenakan beban tumpu 40 kN. Dengan menggunakan Kaedah Agihan Momen,

- | | |
|------|--|
| CLO1 | <p>(a) Identify the value of Stiffness Factor (K) for each span.
 <i>Kenal pasti nilai Faktor Kekukuhan (K) pada setiap rentang.</i></p> <p style="text-align: right;">[4 marks]
[4 markah]</p> |
| CLO1 | <p>(b) Calculate the Distribution Factor (DF) for each span.
 <i>Kira Faktor Agihan (FA) pada setiap rentang.</i></p> <p style="text-align: right;">[6 marks]
[6 markah]</p> |
| CLO1 | <p>(c) i. Calculate the final moment at each support with TWO (2) times of distribution. Given the value of Fixed End Moment (FEM) for each member as follows.
 <i>Kira momen akhir di setiap penyokong dengan DUA (2) kali agihan. Diberi nilai Momen Hujung Terikat (MHT) bagi setiap anggota adalah seperti berikut.</i></p> <p style="text-align: center;"> $FEM_{AB} = -59.33 \text{ kNm}$, $FEM_{BA} = 59.33 \text{ kNm}$, $FEM_{BC} = -40.83 \text{ kNm}$,
 $FEM_{CB} = 16.33 \text{ kNm}$ </p> <p style="text-align: right;">[7 marks]
[7 markah]</p> |

CLO1

- ii. Sketch the Bending Moment Diagram (BMD) of the beam, if the reaction values at each support are as follows.

Lakar Gambarajah Momen Lentur (GML) bagi rasuk tersebut, berpandukan analisis nilai daya tindak balas pada setiap penyokong adalah seperti berikut.

$$R_A = 40.87 \text{ kN}, R_{B1} = 37.13 \text{ kN}, R_{B2} = 33.90 \text{ kN}, R_C = 6.10 \text{ kN}$$

[8 marks]

[8 markah]

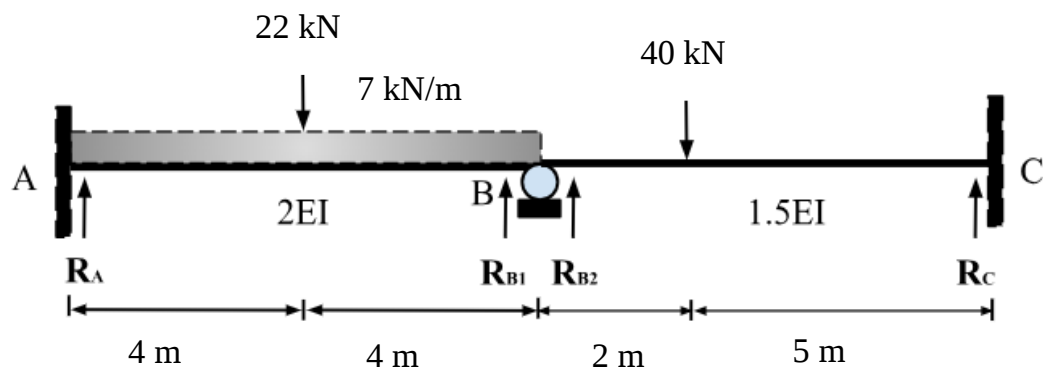


Figure B3/ Rajah B3

QUESTION 4**SOALAN 4**

A portal frame, supported by hinged, pinned and fixed ends is shown in Figure B4. Span AB is subjected to a point load of 25 kN and, while span BC is subjected to a uniformly distributed load of 8 kN/m. By using Moment Distribution Method,

Sebuah kerangka portal disokong oleh engsel, pin dan hujung terikat ditunjukkan dalam Rajah B4. Rentang AB dikenakan beban tumpu sebanyak 25 kN, manakala rentang BC dikenakan beban teragih seragam sebanyak 8 kN/m. Dengan menggunakan Kaedah Agihan Momen,

- CLO1 (a) Identify the value of Stiffness Factor, K for each span.
Kenalpasti nilai Faktor Kekukuhan, K pada setiap rentang.
- [4 marks]
[4 markah]

- CLO1 (b) Indicate the Distribution Factor, DF at each support.
Tunjukkan Faktor Agihan, DF pada setiap penyokong.
- [6 marks]
[6 markah]

- CLO1 (c) i. Calculate the final moment at each support with **TWO (2)** times of distribution. Given the value of Fixed End Moment for each member of the portal frame as follows.
Kira momen akhir di setiap penyokong dengan DUA (2) kali agihan. Diberi nilai Momen Hujung Terikat bagi setiap anggota kerangka portal adalah seperti berikut.

$$\mathbf{FEM_{AB} = -12.5 \text{ kNm}, FEM_{BA} = 12.5 \text{ kNm}, FEM_{BC} = 36 \text{ kNm},}$$

$$\mathbf{FEM_{BD} = 0 \text{ kNm}, FEM_{DB} = 0 \text{ kNm}}$$

[7 marks]
[7 markah]

- ii. Sketch the Shear Force Diagram (SFD) of the portal frame. The reaction values is given as follows.

Lakarkan Gambarajah Daya Ricih (GDR) bagi kerangka portal tersebut. Diberi nilai daya tindak balas pada setiap rentang adalah seperti berikut.

$$R_A = 13.30 \text{ kN}, R_{B1} = 11.70 \text{ kN}, R_{B2} = 24 \text{ kN}, R_{B3} = -2.53 \text{ kN}, R_D = 2.53 \text{ kN}$$

[8 marks]

[8 markah]

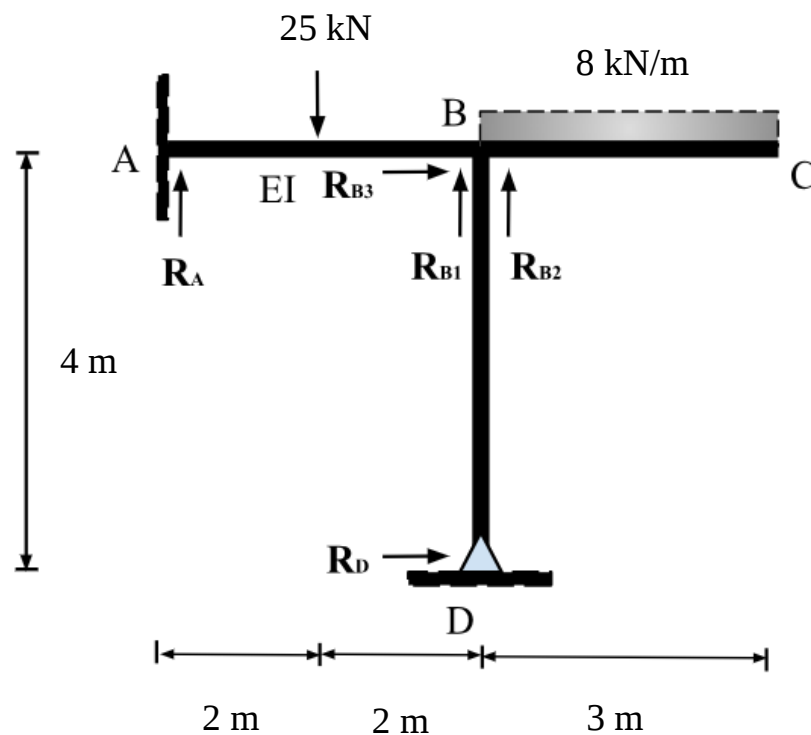


Figure B4/ Rajah B4

SOALAN TAMAT

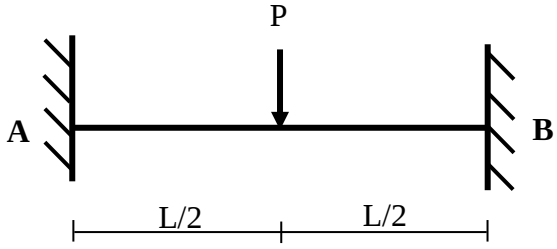
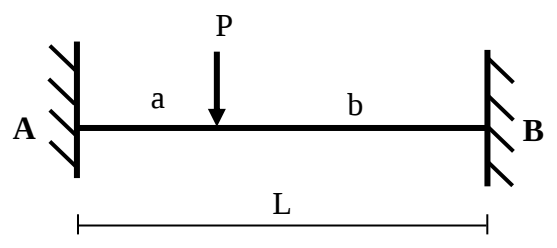
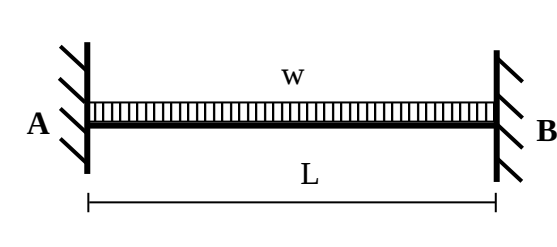
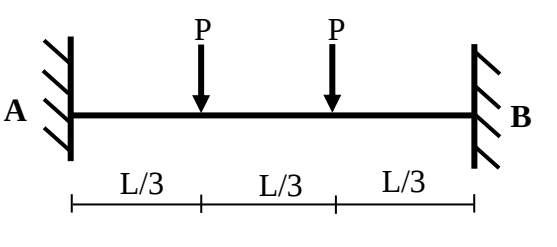
DCC40163 – THEORY OF STRUCTURE

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

$$DF = K / \sum K$$

$$DF = 0 \text{ (for Fixed)}$$

$$DF = 1 \text{ (for Pinned or Roller)}$$

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. Displacement caused by the external load

$$\delta = \sum \left[\frac{P\mu L}{AE} \right]$$

5. Influence Lines

i. $R_A = 1 - x/L, \quad R_B = x/L$

ii. $V_C = -x/L, \quad V_C = 1 - x/L$

iii. $M_C = bx/L, \quad M_C = a(1 - x/L)$