

## CC505 – STRUCTURAL ANALYSIS 1

## FORMULAE

## 1. Slope Deflection Method

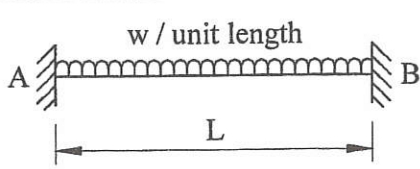
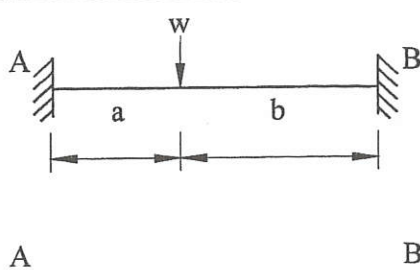
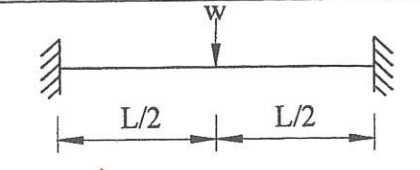
$$M_{AB} = [2EI/L][2\theta_A + \theta_B - (3\Delta/L)] + M_{AB}^F$$

$$M_{BA} = [2EI/L][2\theta_B + \theta_A - (3\Delta/L)] + M_{BA}^F$$

## 2. Moment Distribution Method

$$M_{BC}^S = M_{CB}^S = \frac{+6EI\Delta_B}{L_{BC}^2} @ \frac{3EI\Delta}{L^2}$$

Table 1 : Fixed End Moment

$M_{AB}^F = \frac{-wL^2}{12}$		$M_{BA}^F = \frac{wL^2}{12}$
$M_{AB}^F = \left(\frac{-wab^2}{L^2}\right)$		$M_{BA}^F = \left(\frac{wba^2}{L^2}\right)$
$M_{AB}^F = \frac{-wL}{8}$		$M_{BA}^F = \frac{wL}{8}$

SULIT



BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK  
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI JUN 2015

CC505: STRUCTURAL ANALYSIS 1

TARIKH : 20 OKTOBER 2015

TEMPOH : 8.30 AM – 10.30 AM (2 JAM)

Kertas ini mengandungi LIMA BELAS (15) halaman bercetak.

Bahagian A: Soalan Pendek (10 soalan)

Bahagian B: Soalan Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

**SECTION A : 40 MARKS**  
**BAHAGIAN A : 40 MARKAH**

**INSTRUCTION:**

This section consists of **TEN (10)** short questions. Answer **ALL** questions.

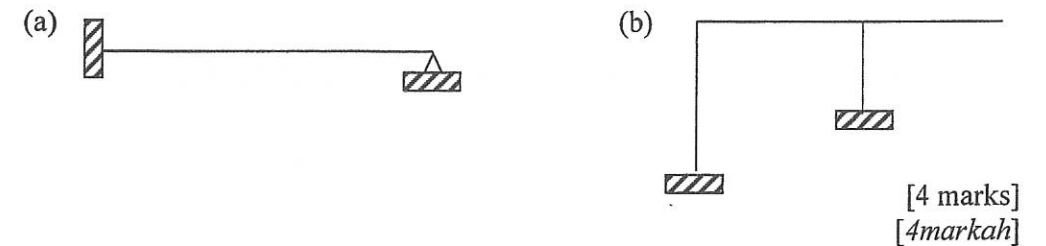
**ARAHAN:**

*Bahagian ini mengandungi SEPULUH (10) soalan pendek. Jawab semua soalan.*

CLO1  
C1 **QUESTION 1**  
**SOALAN 1**

Identify whether the structure is statically determinate or statically indeterminate. If the structure is statically indeterminate, calculate the degree of indeterminacy.

*Kenalpasti sama ada struktur di bawah ini boleh tentu statik atau tak boleh tentu static. Jika struktur adalah tidak tentu statik, kirakan darjah ketakbolehtentuan.*



**Figure A1**

*Rajah A1*

[4 marks]  
[4markah]

CLO1  
C2 **QUESTION 2**  
**SOALAN 2**

The propped cantilever beam is subjected to two uniformly distributed loads (UDL) and a point load as shown in **Figure A2**, outline the deflection equation for Case 1: Support is removed

*Satu rasuk julur bersangga dikenakan dua beban teragih seragam dan satu beban tumpu seperti yang ditunjukkan dalam **Rajah A2**, berikan persamaan pesongan untuk Kes 1: Penyokong disingkirkan*

[4 marks]

[4 markah]

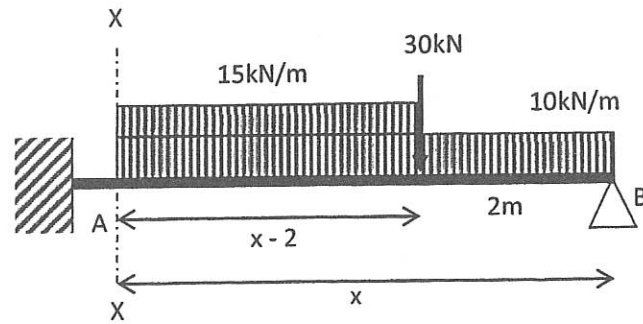


Figure A2

Rajah A2

CLO1  
C3 QUESTION 3  
SOALAN 3

Figure A3 shows a diagram for Superposition Method Case 2 without external loads.

If  $y_{B1} = \frac{-1000}{3EI}$ , calculate the value for reaction at B ( $R_B$ ).

Rajah A3 menunjukkan gambarajah pesongan bagi Kaedah Tindihan Kes 2 tanpa beban luaran.

Jika  $y_{B1} = \frac{-1000}{3EI}$ , kirakan nilai tindakbalas pada sokong B ( $R_B$ ).

[4 marks]  
[4 markah]

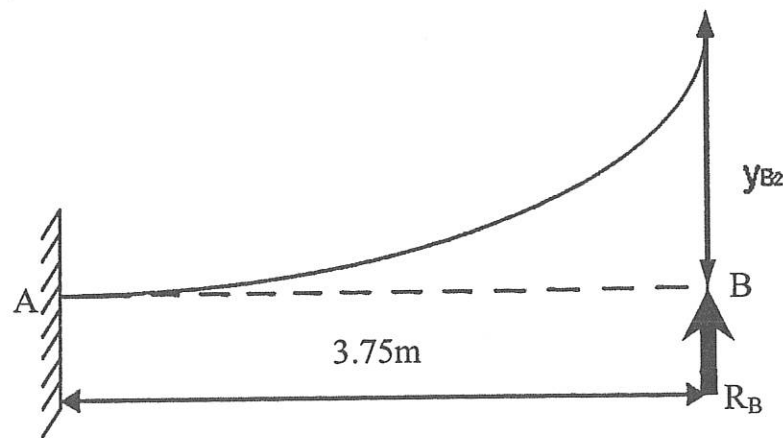


Figure A3

Rajah A3

CLO1  
C1 QUESTION 4  
SOALAN 4

State the Slope Deflection Equation for the indeterminate beam shown in Figure A4 by using the Slope Deflection Method and the value of Fixed End Moment given.

$FEM_{AB} = -12\text{kNm}$ ,  $FEM_{BA} = 12\text{kNm}$ ,  $FEM_{BC} = -2.22\text{kNm}$ ,  $FEM_{CB} = 1.11\text{kNm}$

Nyatakan persamaan cerun pesongan bagi rasuk tidak boleh tentu bagi Rajah A4 dengan menggunakan kaedah Cerun Pesongan dan nilai Momen Hujung Terikat yang diberi.

$FEM_{AB} = -12\text{kNm}$ ,  $FEM_{BA} = 12\text{kNm}$ ,  $FEM_{BC} = -2.22\text{kNm}$ ,  $FEM_{CB} = 1.11\text{kNm}$

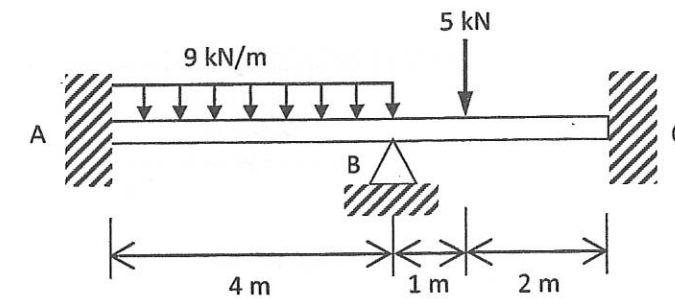


Figure A4

Rajah A4

[4 marks]  
[4 markah]

CLO1  
C3

## QUESTION 5

## SOALAN 5

Based on the Figure A5 and Moment Equation below. Calculate the value of  $\Theta_B$ .

Berdasarkan Rajah A5 dan Persamaan Momen di bawah. Kirakan nilai  $\Theta_B$ .

$$M_{AB} = \frac{3EI \Theta_B}{5} - 50$$

$$M_{BA} = \frac{6EI \Theta_B}{5} + 50$$

$$M_{BC} = EI \Theta_B - 20$$

$$M_{CB} = \frac{EI \Theta_B}{2} + 20$$

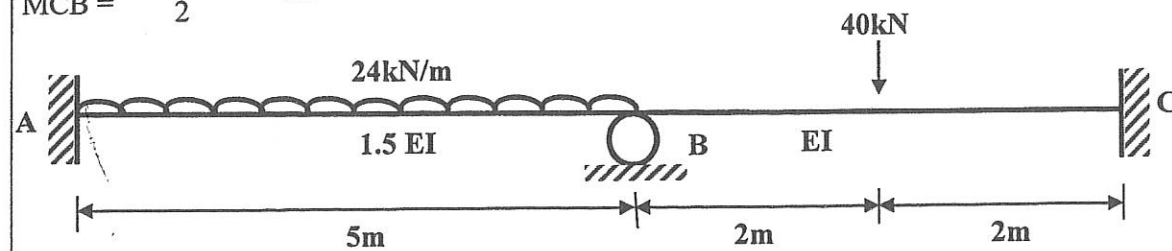


Figure A5

Rajah A5

[4 marks]

[4 markah]

CLO1  
C2

## QUESTION 6

## SOALAN 6

Identify the boundary condition and equilibrium equation for the indeterminate portal frame as shown in Figure A6.

Kenalpasti keadaan sempadan dan persamaan keseimbangan bagi kerangka portal tidak boleh tentu seperti yang ditunjukkan dalam Rajah A6.

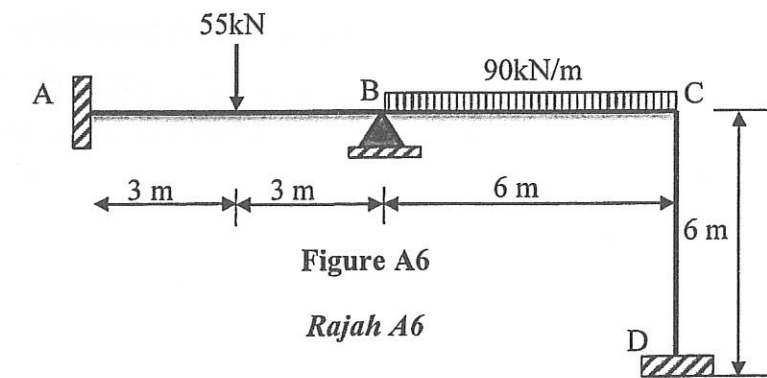


Figure A6

Rajah A6

[4 marks]  
[4 markah]

CLO1  
C3

**QUESTION 7**  
**SOALAN 7**

A portal frame is subjected to uniformly distributed load (UDL) of 9kN/m and point load of 8kN as shown in Figure A7. Calculate the value of internal moments for point C ( $M_{CB}$  &  $M_{CE}$ ) based on the information given below.

Satu kerangka portal dikenakan beban teragih seragam 9kN/m dan beban tumpu 8kN seperti yang ditunjukkan di dalam Rajah A7. Kirakan nilai momen dalaman pada titik C ( $M_{CB}$  &  $M_{CE}$ ) berdasarkan kepada maklumat yang diberikan di bawah.

The value of fixed end moments

$$M_{CB}^F = 6.75 \text{ kNm}$$

$$M_{CE}^F = -2.041 \text{ kNm}$$

The value of slope deflection angle

$$\theta_B = 0.585 / EI$$

$$\theta_C = -1.441 / EI$$

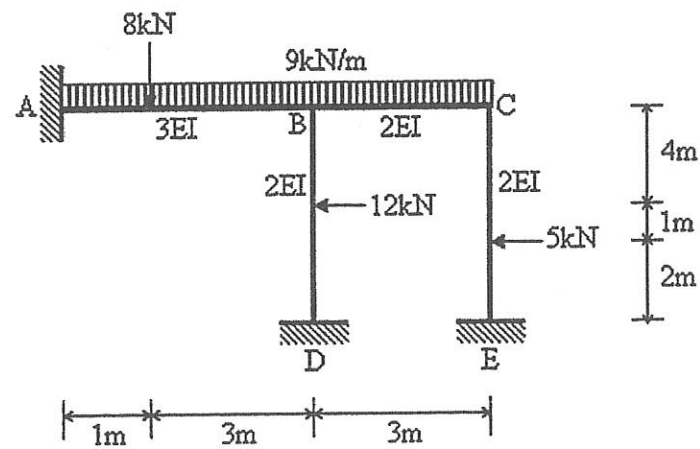


Figure A7  
Rajah A7

[4 marks]

[4 markah]

CLO 1  
C1

**QUESTION 8**  
**SOALAN 8**

Identify the stiffness factors, K for each span of the indeterminate beam.

Kenalpasti faktor kekukuhan, K bagi setiap rentang rasuk tidak boleh tentu tersebut. [4 marks]

[4 markah]

CLO 1  
C2

**QUESTION 9**  
**SOALAN 9**

Determine the fixed end moments for each members.

Tentukan nilai momen hujung terikat bagi setiap anggota.

[4 marks]

[4 markah]

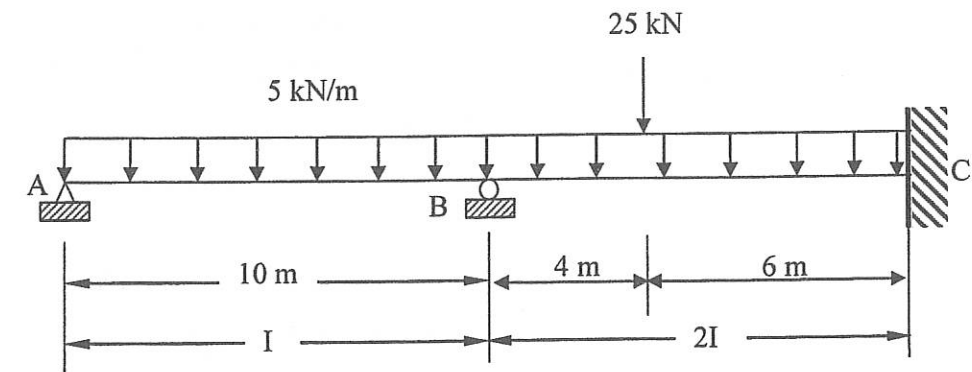


Figure A8  
Rajah A8

CLO1  
C2  
QUESTION 10  
SOALAN 10

Table A10 shows two end moments value for a sidesway frame;  $M_{load}$  is the end moments calculated with loads and  $M_{sway}$  is the end moments calculated with sidesway. If the restraining force for loads,  $R = 4.98\text{kN}$  and restraining force for sidesway,  $R_1 = 3.42\text{kN}$ , compute the value for:

- scale factor  $f$
- final moments for all members

Jadual A10 menunjukkan dua nilai momen yang dikira daripada kerangka hujung;  $M_{load}$  ialah nilai momen yang dikira dengan beban dan  $M_{sway}$  ialah nilai momen yang dikira dengan hujung. Jika daya penahan akibat beban,  $R = 4.98\text{kN}$  dan daya penahan akibat hujung,  $R_1 = 3.42\text{kN}$ , kirakan nilai bagi:

- faktor skala  $f$
- momen akhir untuk semua anggota

[4 marks]

[4 markah]

Table A10  
Jadual A10

Joint	A	B		C		D
Member	AB	BA	BC	CB	CD	DC
$M_{load}$	0	+16.14	-16.14	-4.61	+4.61	+2.32
$M_{sway}$	0	-32.7	+32.70	+30.81	-30.81	-40.36

SECTION B : 60 MARKS  
BAHAGIAN B : 60 MARKAH

## INSTRUCTION:

This section consists of FOUR (4) structured questions. Answer THREE (3) questions only.

## ARAHAN:

Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab TIGA (3) soalan sahaja.

CLO1  
C3  
QUESTION 1  
SOALAN 1

A continuous beam is fixed at A and C while supported by roller at B as shown in Figure B1. It carries a uniformly distributed load (UDL) of  $3\text{ kN/m}$  over AB and point loads of  $5\text{ kN}$  and  $10\text{ kN}$  over BC. If  $EI$  is constant for all members, use the Slope-Deflection Method to:

- calculate the final moments [14 marks]
- draw the shear force diagram and the bending moment diagram. [6 marks]

Satu rasuk selanjur diikat tegar pada titik A dan C manakala ditupang rola pada titik B seperti Rajah B1. Rasuk tersebut dikenakan beban teragih seragam  $3\text{ kN/m}$  pada rentang AB dan beban tumpu  $5\text{ kN}$  dan  $10\text{ kN}$  pada rentang BC. Sekiranya nilai  $EI$  adalah malar untuk setiap rentang, gunakan Kaedah Cerun Pesongan untuk:

- kirakan nilai momen lentur akhir [14 markah]
- lakarkan Gambarajah Daya Ricih dan Gambarajah Momen Lentur. [6 markah]

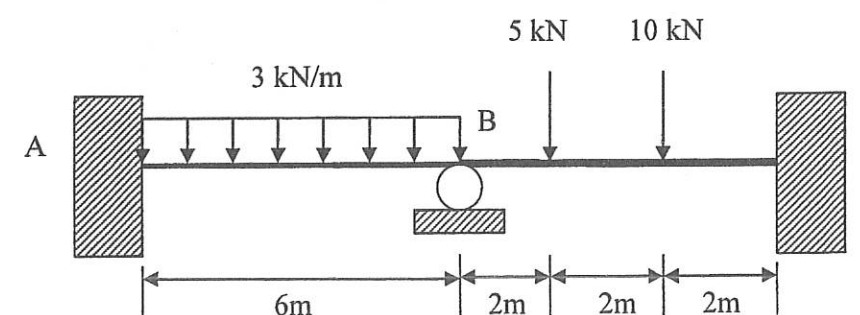


Figure B1

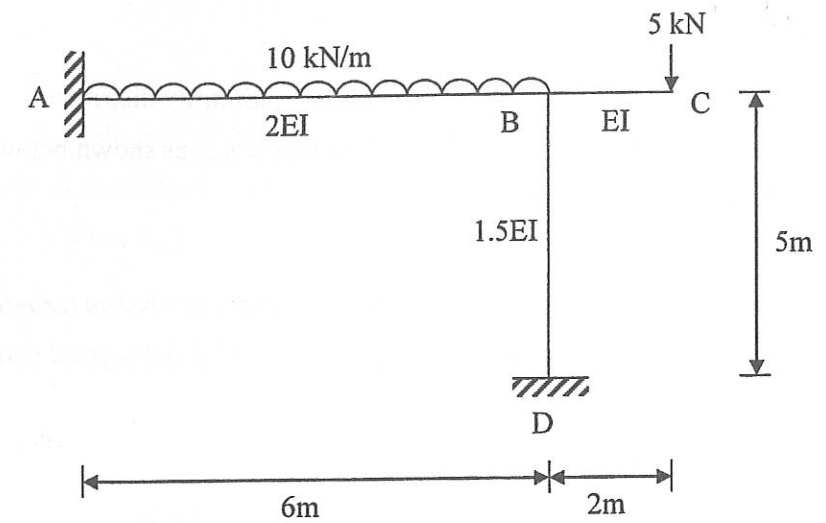
Rajah B1

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

The **Figure B2** is portal frame with 10 kN/m uniform load (UDL) and 5kN of point load. By using the **Slope Deflection Method**;

*Rajah B2 ialah kerangka portal dengan beban teragih seragam 10kN/m dan 5kN beban tumpu. Menggunakan Kaedah Cerun Pesongan;*

- CLO1  
C2
- (a) determine the value of the Fixed-end moments for each span.  
*tentukan nilai Momen Hujung Terikat setiap rentang.*
- [4 marks]  
[4 markah]
- CLO1  
C3
- (b) interpret the Moment Equations.  
*Nyatakan Persamaan Momen.*
- [6marks]  
[6 markah]
- CLO1  
C3
- (c) calculate the value of the slope ( $\Theta$ ) on its support.  
*kirakan nilai kecerunan ( $\Theta$ ) pada penyokong.*
- [5 marks]  
[5 markah]
- CLO1  
C2
- (d) determine the internal moment at point A, B and D.  
*tentukan nilai momen dalaman di titik A, B dan D.*
- [5 marks]  
[5 markah]



**Figure B2**  
**Rajah B2**

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

Figure B3 shows a continuous beam subjected to uniformly distributed loads and a point loads, and given the value of Fixed End Moment is as shown below. Apply the Moment Distribution Method to:

Rajah B3 menunjukkan satu rasuk selanjur yang dikenakan beban teragih seragam dan beban tumpu, diberi nilai Momen Hujung Terikat adalah seperti yang berikut. Gunakan Kaedah Agihan Momen untuk:

- |            |  |                                |
|------------|--|--------------------------------|
| CLO1<br>C2 | a) Determine the Stiffness values and Distribution Factors<br><i>Tentukan nilai Faktor kekukuhan dan Faktor Agihan</i> | (6 marks)<br><i>(6 markah)</i> |
| CLO1<br>C3 | b) Calculate the value of End Moment (3 times of distribution)<br><i>Kirakan nilai moment Akhir (3 kali agihan)</i>    | (8 marks)<br><i>(8 markah)</i> |
| CLO1<br>C3 | c) Calculate the reaction forces at the supports<br><i>Kirakan daya tindakbalas pada setiap tupang</i>                 | (6 marks)<br><i>(6 markah)</i> |

Given:

Diberi:

$$M_{AB}^F = M_{BA}^F = +75\text{kNm}, M_{BC}^F = M_{CB}^F = -135\text{kNm},$$

$$M_{CD}^F = -108\text{kNm}, M_{DC}^F = 72\text{kNm}$$

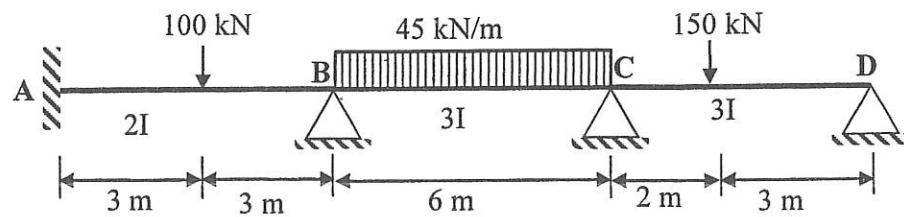


Figure B3  
Rajah B3

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

Figure B4 shows a non-sway portal frame ABCD subjected with loads. By using Moment Distribution Method, determine:

Rajah B4 menunjukkan kerangka portal tanpa huyung ABCD yang menanggung beban. Dengan menggunakan Kaedah Agihan Momen, tentukan :

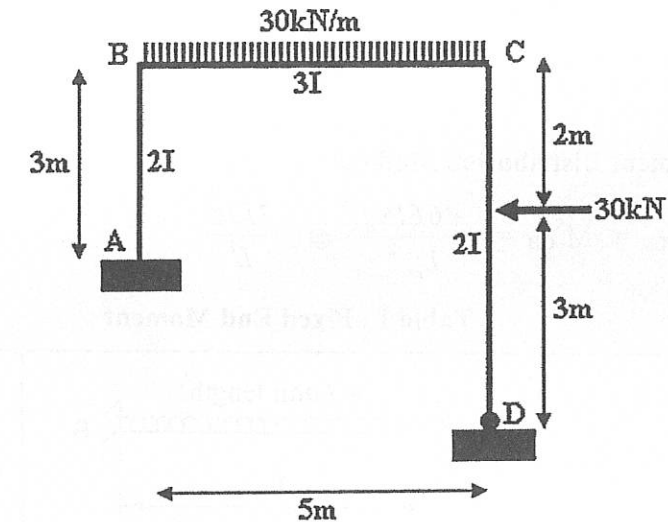


Figure B4  
Rajah B4

- |            |   |                        |
|------------|---|------------------------|
| CLO1<br>C3 | (a) fixed end moment.<br><i>momen hujung terikat.</i>   | [5 marks]<br>[5 marks] |
| CLO1<br>C3 | (b) stiffness Factor (K) and Distribution Factor (DF).<br><i>faktor kekukuhan (K) dan Faktor Agihan (DF).</i> | [7 marks]<br>[7 marks] |
| CLO1<br>C3 | (c) internal moment.<br><i>momen dalaman.</i>   | [8 marks]<br>[8 marks] |

SOALAN TAMAT



## CC505 – STRUCTURAL ANALYSIS 1

## FORMULAE

## 1. Slope Deflection Method

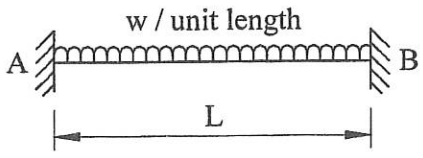
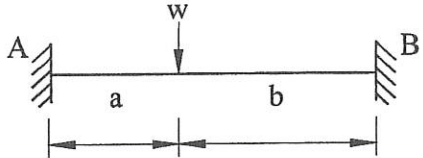
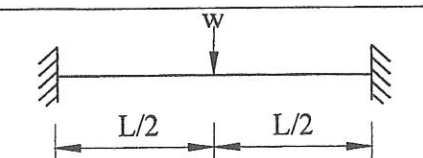
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$$M_{BA} = [2EI/L][2\theta_B + \theta_A - (3\Delta/L)] + M_{BA}^F$$

## 2. Moment Distribution Method

$$M_{BC}^S = M_{CB}^S = \frac{+6EI\Delta_B}{L_{BC}^2} @ \frac{3EI\Delta}{L^2}$$

Table 1 : Fixed End Moment

$M_{AB}^F = \frac{-wL^2}{12}$		$M_{BA}^F = \frac{wL^2}{12}$
$M_{AB}^F = \left(\frac{-wab^2}{L^2}\right)$		$M_{BA}^F = \left(\frac{wba^2}{L^2}\right)$
$M_{AB}^F = \frac{-wL}{8}$		$M_{BA}^F = \frac{wL}{8}$