Day: M T W T F S

Date: ___/___/___

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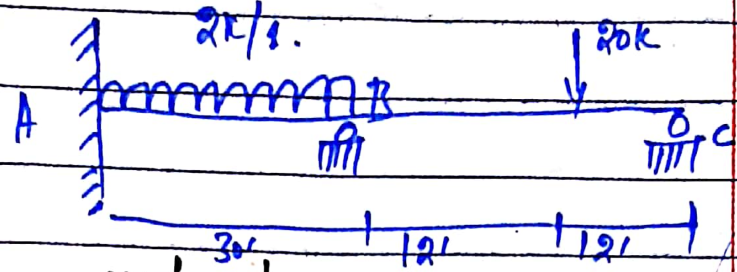
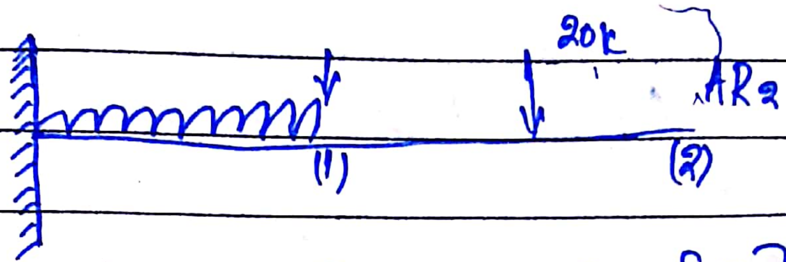
Section	NO # B
Department	BE (civil)
paper	Structure Analysis (II)
University	=> Iqra National University peshawar.
Date	21/08/2020.

Q NO (02)..



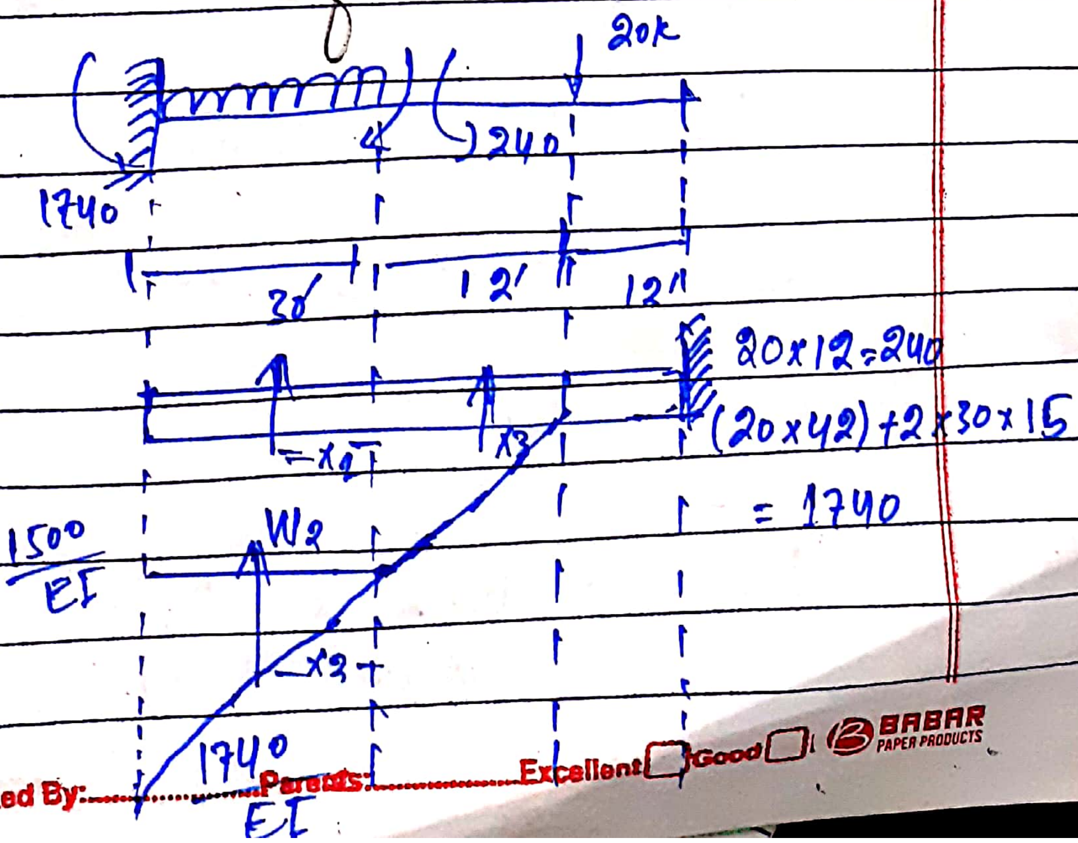
Sol:.. Select redundant actions.



$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}.$$

$$[DRS] = [DRL] + F \times AR$$

Step No 2:- compute the values of [DRL].



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$W_1 = 1500 \times 30 = 45000$

$W_2 = \frac{1}{3} \times 30 \times 240 = 2400$

$W_3 = \frac{1}{2} \times 12 \times 240 = 1440$

$x_1 = b/2 = 30/12 = 15'$

$x_2 = \frac{3}{n+2} \times L = \frac{3}{2+2} \times 30 = 22.5'$

$x_3 = \frac{2}{3} \times L = \frac{2}{3} \times 12 = 8'$

Now Finding DRL.

$DRL_1 = W_1 (x_1) + W_2 (x_2)$

$45000(15) + 2400(22.5)$

$= 675000 + 54000$

$DRL_2 \{ = 729000$

$DRL_2 = W_1 \times (x_1 + 24) + W_2 \times (x_2 + 24)$
$+ W_3 \times (x_3 + 12).$

$= 45000\,(15+24) + 2400\,(22.5+24) + 1440\,(8+12).$

$= 1755000 + 111600 + 28800$

$$DRL_2 = 1895400/EI.$$

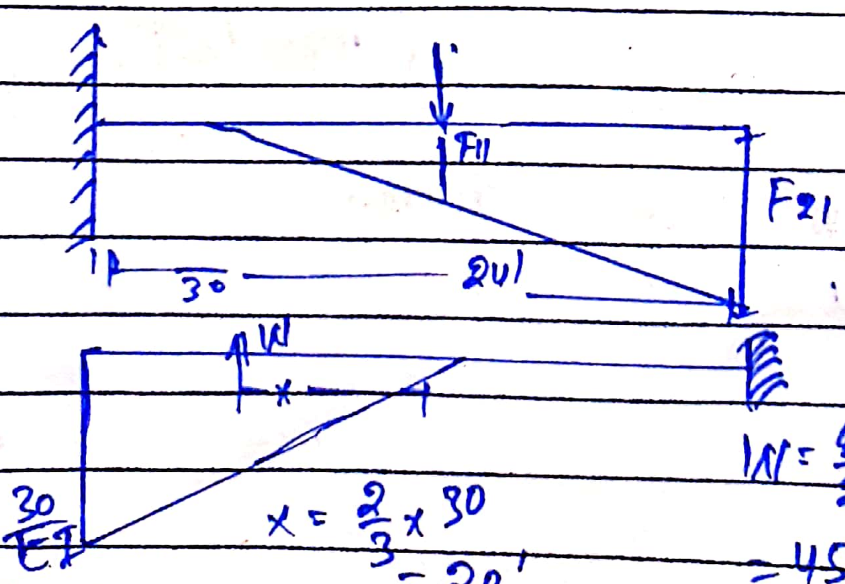
So,

$$DRL = \frac{1}{EI}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$$

Step No (3) Flexibility Matrix.

$$[F]_{2\times 2} \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}$$

(a) Applying unit load on AR_1.



$x = \frac{2}{3} \times 30 = 20'$

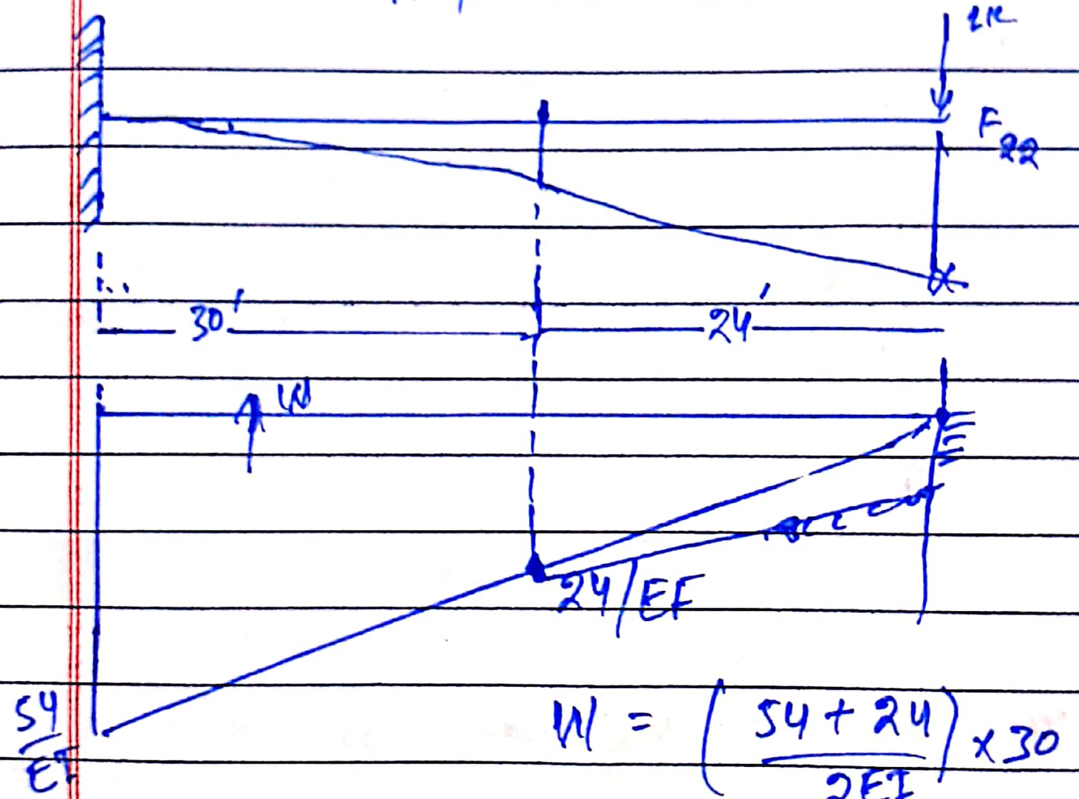
$W = \frac{1}{2}\left(\frac{30}{EI} \times 30\right) = 450/EI.$

So,

$$F_{11} = \frac{450(20)}{EI} = \frac{9000}{EI}$$

$$F_{21} = \frac{450(20+24)}{EI} = \frac{19800}{EI}.$$

Now apply unit load on R_2



$$W = \left(\frac{54+24}{2EI}\right) \times 30$$

$$= 1170/EI.$$

Now the distance.

$$x = \frac{L}{3}\left[\frac{b+2(a)}{a+b}\right]$$

$$= \frac{30}{3}\left[\frac{24+2(54)}{54+24}\right] = 16.92'$$

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$\Rightarrow F_{12} = \frac{1170}{EI} \times 16.92 = \frac{19796.4}{EI}$

$\Rightarrow F_{22} = \frac{1170}{EI} \times (16.92 + 24)$

$= \frac{47876.4}{EI}$

Hence

$$F_{2\times2} = \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix} \frac{1}{EI}.$$

Step # 4:- compute the values of AR.

$[DRS] = [DRL] + [F] \times [AR]$

$[AR] = [DRS - DRL] \times [F]^{-1}.$

$[F]^{-1} = \frac{1}{[F]} \times Adj\ F$

$$= \frac{1}{\begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix}} \times Adj \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix}$$

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$$[F] = (9000 \times 47876.4 - 19796.4 \times 19800)$$

$$(430887600 - 391968720)$$

$$|F| = 38918880.$$

$$\Rightarrow \text{Adj } A = \begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}$$

$$\begin{Bmatrix} AR_1 \\ AR_2 \end{Bmatrix} = \begin{bmatrix} 0 & -729000 \\ 0 & -1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{38918880} \begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}$$

$$= \begin{bmatrix} -729000 \\ -1895400 \end{bmatrix} \frac{1}{EI} \times \frac{\begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}}{38918880}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 66.193 \\ -67.505 \end{bmatrix}$$

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Q No (02) :- Difference b/w Force Method & Displacement Method.

	Force Method	Displacement Method
(1)	unknowns are taken redundant forces / reactions	uknowns are taken displacement
(2)	To find unknown forces or redundant compatibility equation are written	To find unknown displacement joint equilibrium conditions are written.
(3)	The number of compatibility equations needed is equal to the degree of static interdate Indeterminacy	The number of equilibrium condition needed is equal to the degree of kinematic indeterminacy.
(5)	calculate deflection	Reaction / movements calculated
	Remove redundancies	KI are suppressed
	Establish equilibrium	establish equilibrium.

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In the force Method of analysis, unknown are forces. In this method compatibility equations are written for displacement and rotations. solving these equations, redundant Force are calculated. once the redundent force are calculated, the remaining reactions are evaluted by equations of equilibrium.

In the displacement method of analysis, the primary unknowns are the displacements. In this method, first force - displacement unknowns relations are computed. and subsequently equation are written satisfying the equilibrium condition of the structure. After determining the unknown displacements. the other forces are calculated

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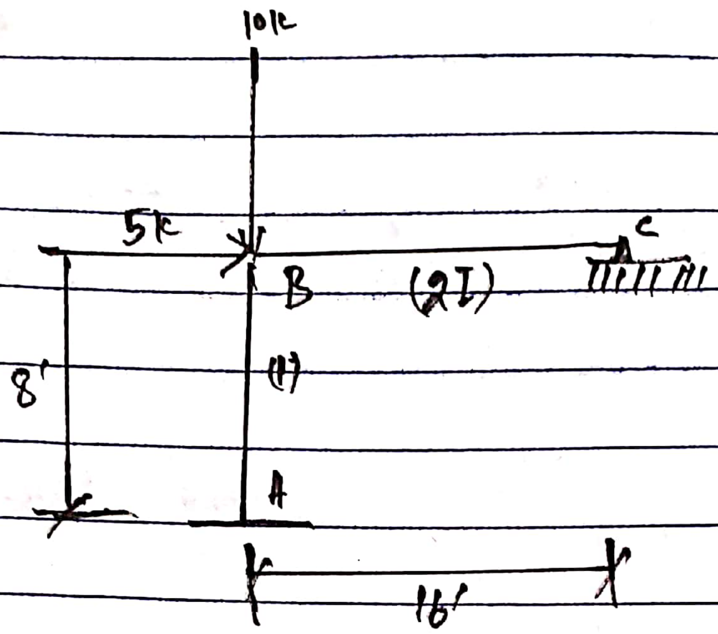
Satisfying the compatibility conditions and forces displacement relation.

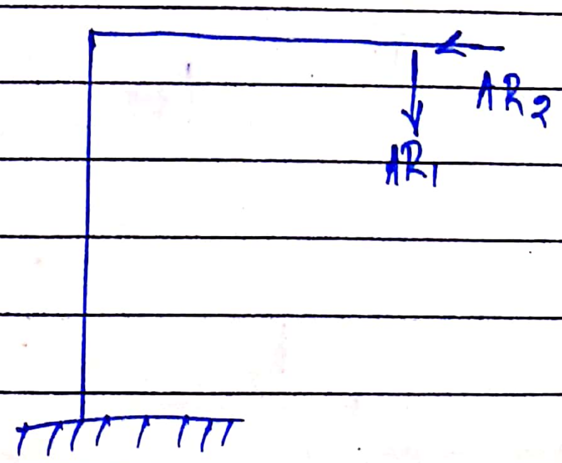
So this why displacement method of analysis is suitable for for matrix approch. And also the Displacement method is widly used in modern day for structural analysis b/c the displacement method is amanable to computer programing.

Q NO (03)



Sol:. Total statical indeterminacy
$\Rightarrow R-3 = 5-3 = 2^{\circ}$

Step #02: ① Identify Redundant Actions.



$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \quad \begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

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Step NO (2)
Compute the value of [DRL]

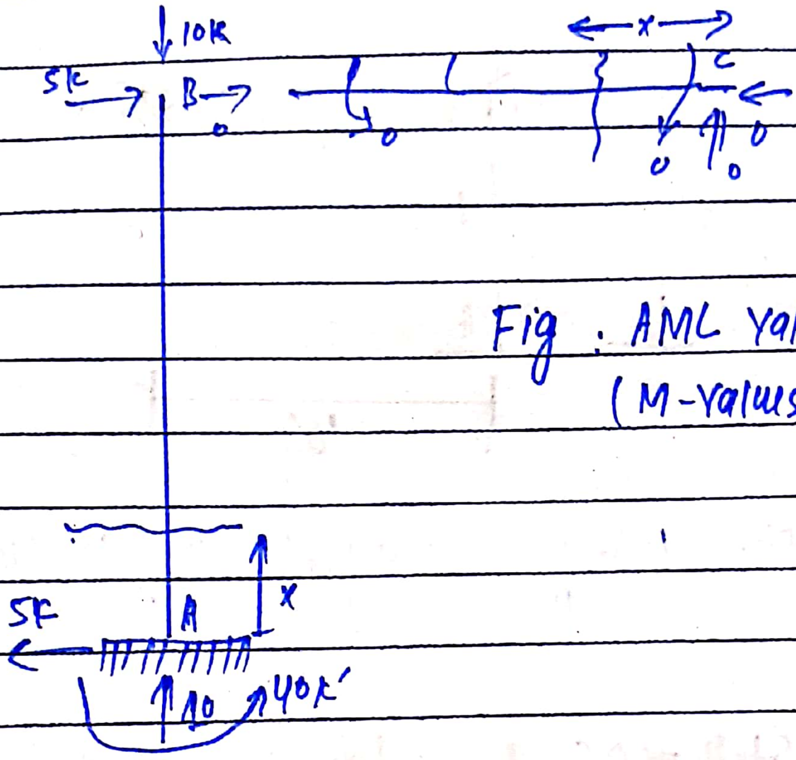

Fig: AML values
(M-values).

Step NO (03): [F] or [AMR]

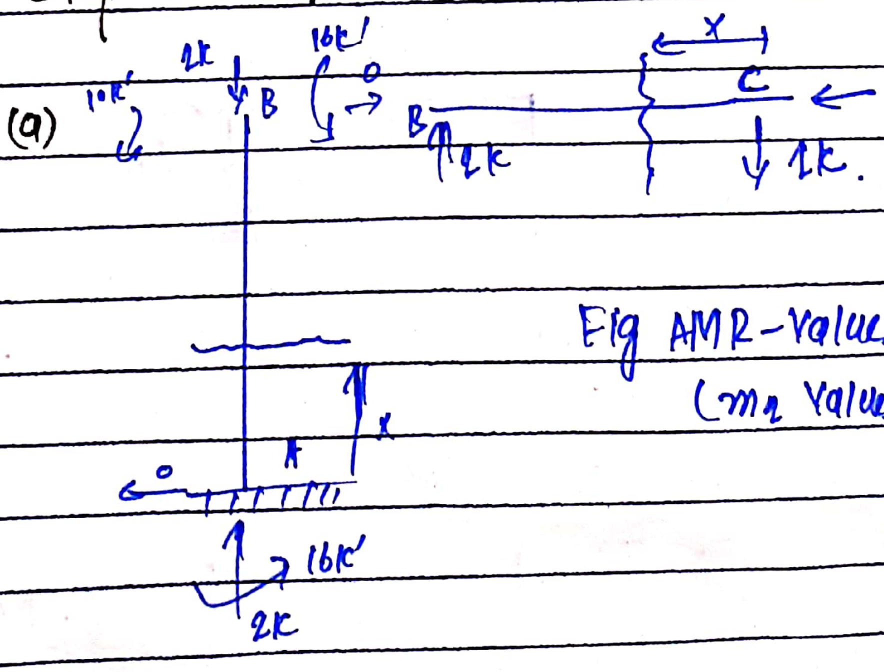

Fig AMR-Values
(m_2 Values)

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(b)

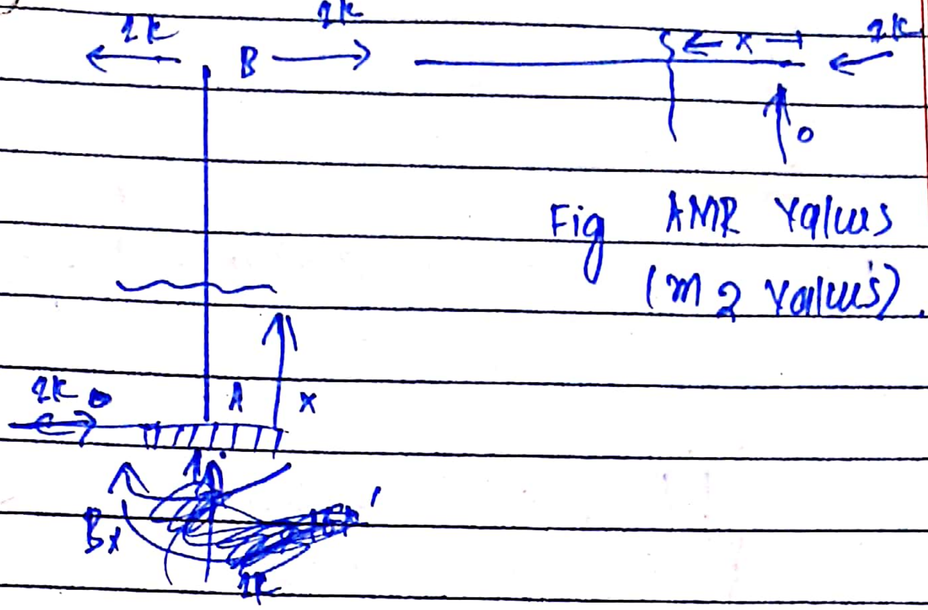

Fig AMR values (m2 values).

select origin should be select the support

Member	AB	BC
origin	A	C
Limit	0–8	0–16
I	I	2I
M	5x−40	0
m_1	-16	x
m_2	8−x	0

⇒ For finding values of DRL.

$$DRL_1 = \int_0^8 \frac{M_{AB} \cdot m_{1(AB)}}{EI} + \int_0^{16} \frac{M_{BC} \cdot m_{2(BC)}}{EI}$$

$$= \int_0^8 \frac{(5x-40)(-16)\,dx}{EI} + \int_0^{16} \frac{0 \cdot x\,dx}{E(2I)}$$

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$$DRL_1 = \frac{2560}{EI}$$

$$DRL_2 = \int_0^8 \frac{(5x-40)(8-x)\,dx}{EI} + \int_0^{16} \frac{0.0}{E(2I)}\,dx$$

$$DRL_2 = \frac{-853.33}{EI}$$

⇒ compute Flexibility Matrix.

$$F_{2\times2} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}$$

$$\Rightarrow F_{11} = \int_0^8 \frac{m_1^2(AB)}{EI} + \int_0^{16} \frac{m_2^2(BC)}{EI}$$

$$= \int_0^8 \frac{(-16)^2}{EI}\,dx + \int_0^{16} \frac{x^2}{E(2I)}\,dx.$$

$$F_{11} = \frac{2730.67}{EI}$$

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$$F_{12} = F_{21} = \int_0^8 m_1(AB) \cdot \frac{m_2(AB)}{} + \int_0^{16} m_1(BC) \cdot m_2(BC)$$

$$= \int_0^8 \frac{(-16)(8-x)\,dx}{EI} + \int_0^{16} \frac{(x)(0)\,dx}{2EI}.$$

$$F_{12} + F_{21} = \frac{-512}{EI}.$$

$$F_{22} = \int_0^8 (m_2)^2_{AB}\,dx + \int_0^{16} (m_2)^2_{BC}\,dx$$

$$= \int_0^8 \frac{(8-x)^2\,dx}{EI} + \int_0^{16} \frac{0^2\,dx}{2EI}$$

$$F_{22} = 170.67$$

As we know that

$$[DRS] = [DRL] + [AR] \times [F]$$

~~$\Rightarrow [AR] = [DRS] + [AR] \times [F]$~~

$$\Rightarrow [AR] = \frac{[DRS] - [DRL]}{[F]}.$$

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$$\Rightarrow [AR] = [P]^{-1} \times [DRS - DRL].$$

$$= \begin{bmatrix} 2730.67 & -512 \\ -512 & 170.67 \end{bmatrix} \times \begin{bmatrix} 0 & -2560 \\ 0 & +853.33 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.00005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}.$$