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ID 7719

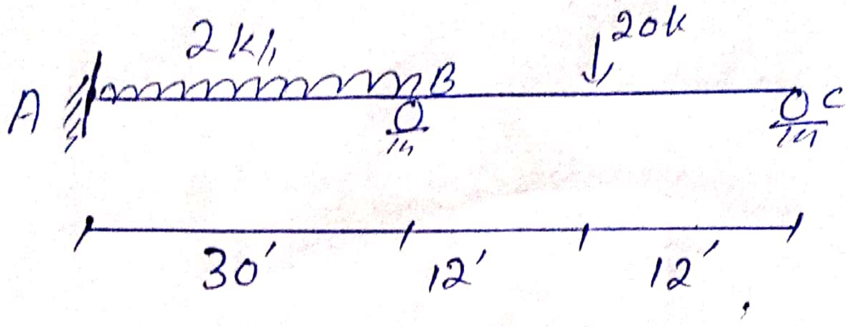
Sec "B"

Subject Structure Analysis II

Teacher Engr Adeed

QNO # 01

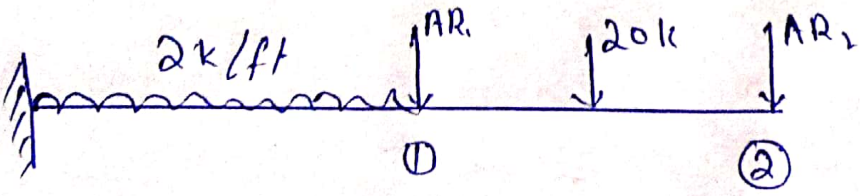
Ans:



E.I constant

S.I = 2°

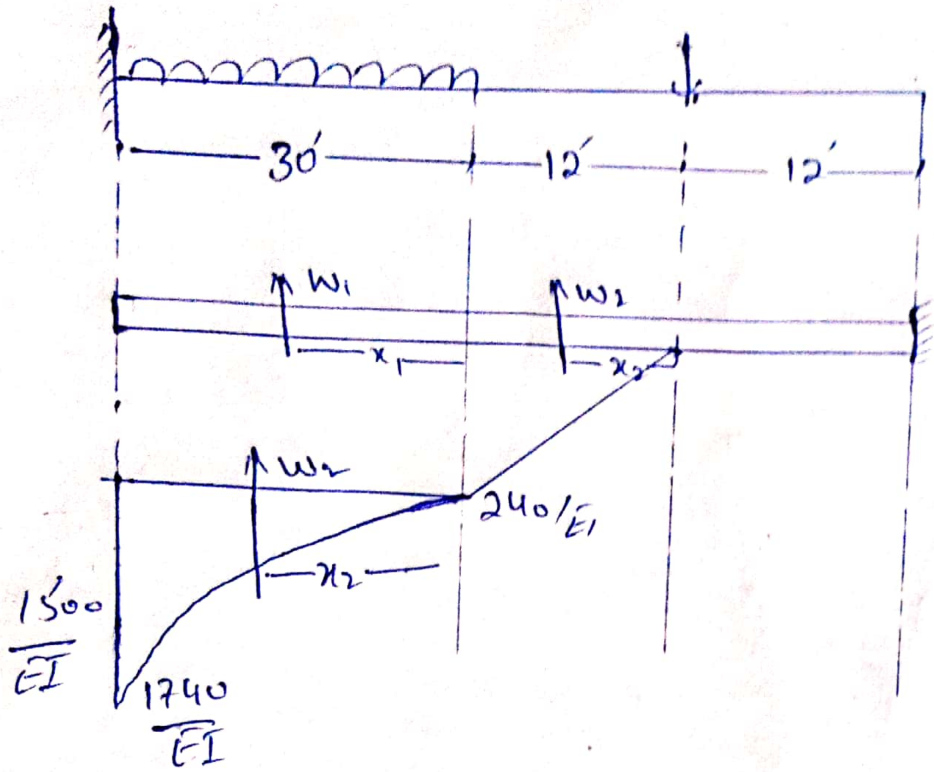
Step # 01 Slect Redundant Actions:



$$\begin{bmatrix} DRs_1 \\ DRs_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step#2 Compute the values of [DRL]



$w_1 = 1500 \times 30 = 45000$

$w_2 = \frac{1}{3} \times 30 = 240 = 2400$

$w_3 = \frac{1}{2} \times 12 \times 240 \quad = 1440$

$20 \times 12 = 240$

$20 \times (12+30) + 2x$

30×15

$= 1740$

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

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

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

Now Finding DRL:

$$DRL_1 = w_1(x_1) + w_2(x_2)$$

$$= 45000(15) + 2400(22.5)$$

$$= 675000 + 54000$$

$$= 729000$$

$$DRL_2 = w_1 \times (x_1 + 24) + w_2 \times (x_2 + 24) + w_3 \times (x_3 + 12)$$

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

$$= 1755000 + 111600 + 288000$$

$$DRL_2 = 1895400/EI$$

So,

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

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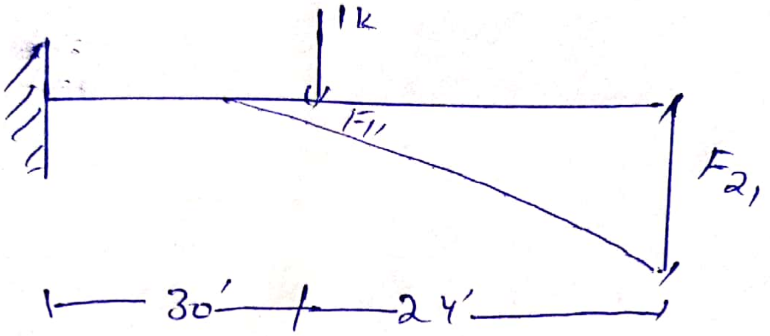
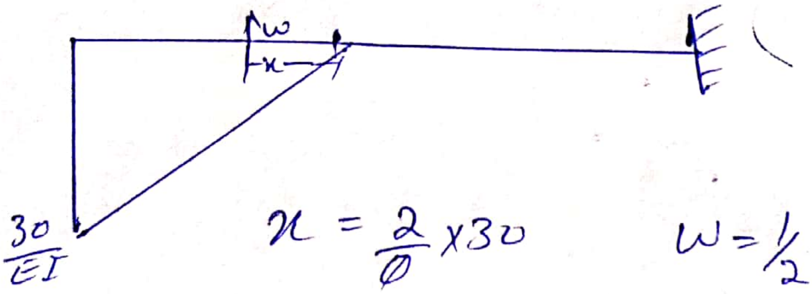
Step# 3 Flexibity Matrix

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

(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,

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

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

Now Apply unit Load on AR_2.

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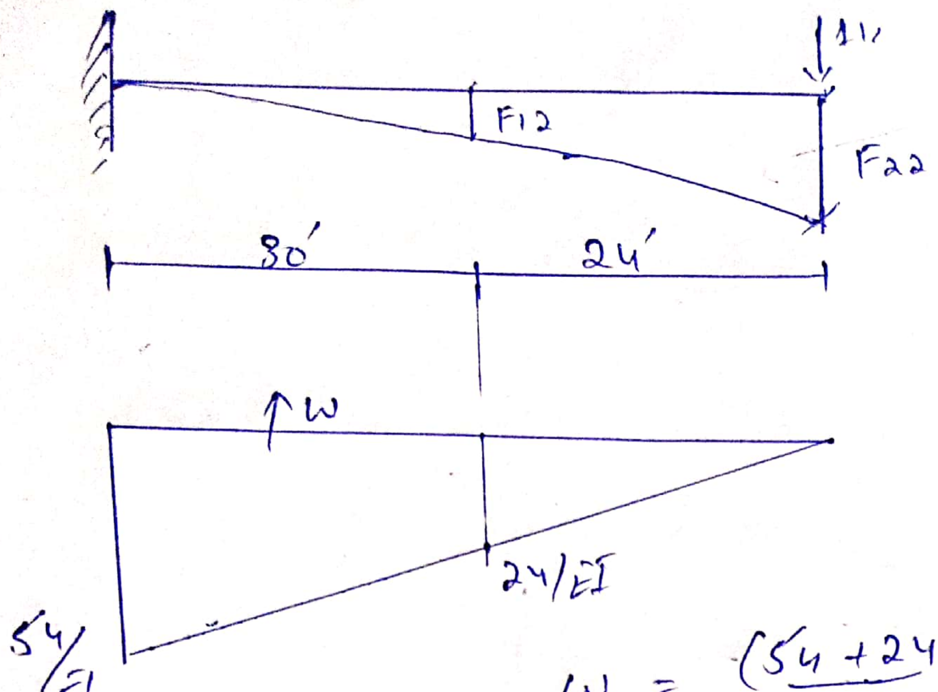

$$w = \frac{(54+24)}{2EI} \times 30$$

$$w = 1170/EI$$

Now the distance

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

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

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

$\Rightarrow F_{22} = \frac{1170}{EI} \times (16.92+24) = \frac{47876.4}{EI}$

Hence

$$F_{2\times2} \begin{bmatrix} 9000 & 19796.4 \\ 198000 & 47876.4 \end{bmatrix} \frac{1}{EI}$$

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Step#04 Compute the values of AR.

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

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

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

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

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

$$(430887600 - 391968720)$$

$$\Rightarrow |F| = 38918880$$

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

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

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

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

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Q No:2
Ans

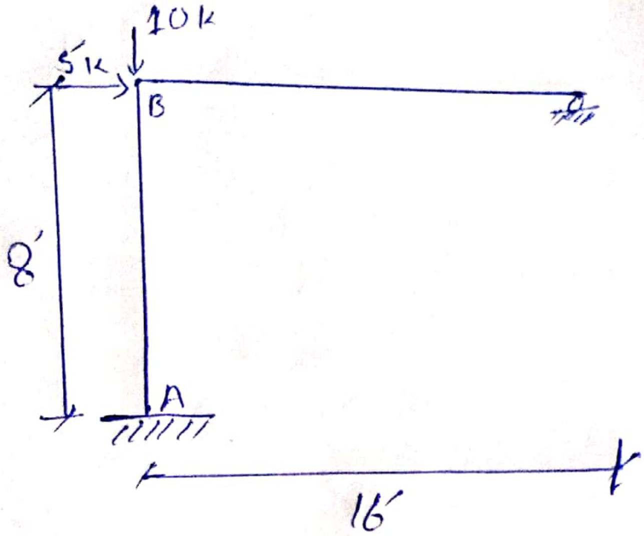
Force Method	Displacement Method
$D_s < D_k$	$D_s > D_k$
⇒ Assumed Force are unknown	⇒ Assumed Displacement as unknown.
⇒ Preferable when structure has less static indeterminate starts with equilibrium of forces.	⇒ Preferable when structure has less kinematic indeterminate starts with campatible deformation.
⇒ No of redundunts = Ds known as flexibility method eg: consistent method of deformation.	⇒ No of redundunts = Dk known as stiffness method eg slope Displacement method.
⇒ Forces found by compatibility eqs of Displacement.	⇒ Displacement found by equilibrium eqs of forces.

⇒ Displacement method is suitable for structure analysis of matrix approach.

Stiffere also called Displacement method is more suitable for structure analysis matrix approach, as it is a primary malhod used in matrix analysis. The main advantage of this method flexibabity method is that it is conductive to computer programing. once the analytical model of the structure has been defined, no further engineering decision are required in the stiffness method in order to carry out the analysis.

Q NO 3:.

Solution:.



Sol:

E = constant

$I_c = I$

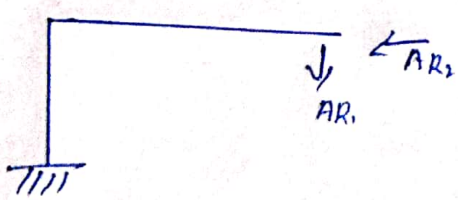
$I_B = 2I$

Total statical indetermincy

$\Rightarrow R-3 = 5-3 = 2$

Step # 01

Identify Redundant Actions.



$$\begin{bmatrix} A_{R_1} \\ A_{R_2} \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \qquad \begin{bmatrix} D_{RS_1} \\ D_{RS_2} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Step#02: Compute value of [DRL]

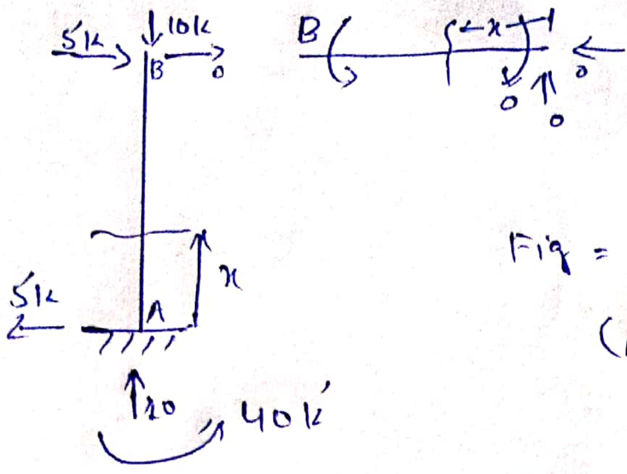


Fig = AML values

(M - values)

Step#03 [F] or [AMR]

(a)

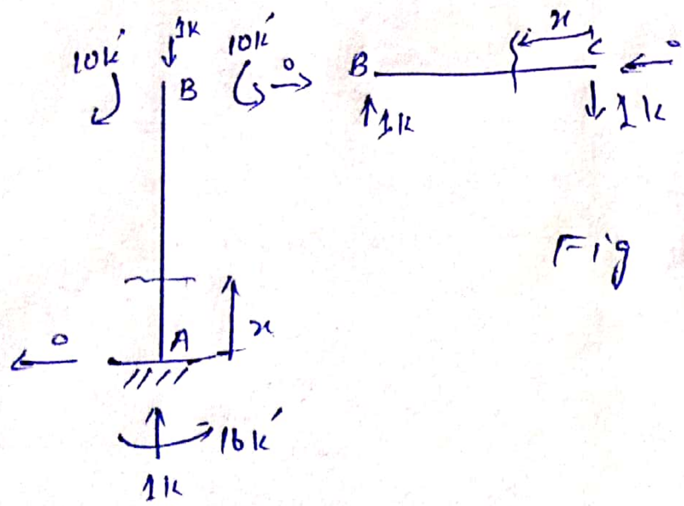


Fig AMR - values

(m_1 values)

(b)

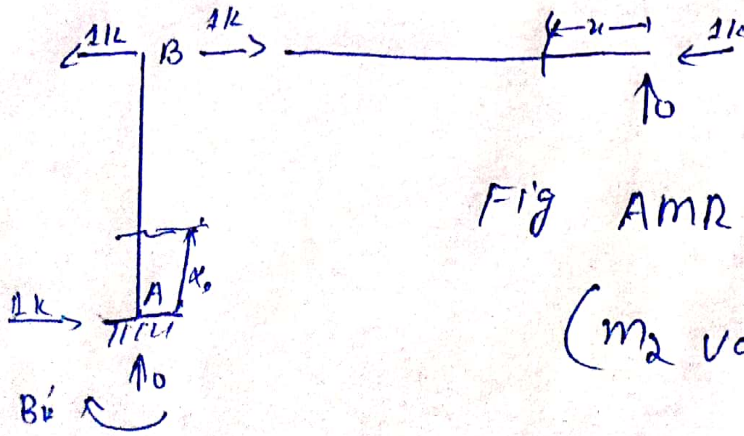


Fig AMR values

(m_2 values)

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

=> Finding values of DRL:

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

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

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

$$DRL_2 = \int_0^8 \frac{(5x-40)\cdot(8-x)\,dx}{EI} + \int_0^{16} \frac{0 \cdot 0 \, dx}{E(2I)}$$

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

⇒ Compute flexibility matrix:

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

⇒ $F_{11} = \int_0^8 \frac{m_1^2 (AB)}{EI} + \int_0^{16} \frac{m_1^2 {}_{BC}}{EI} = \int_0^8 \frac{(-16)^2 dx}{EI} + \int_0^{16} \frac{x^2 dx}{2EI}$

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

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

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

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

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

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

$$\boxed{F_{22} = 170.67}$$

As we know

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

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

~~⇒ AR = [DRS] − DRL~~

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

$$= \begin{bmatrix} 2730.67 & -512 \\ -512 & 170.67 \end{bmatrix} \times \begin{bmatrix} 0-25 \\ 0+85 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ RR_2 \end{bmatrix} = \begin{bmatrix} -0.00005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$