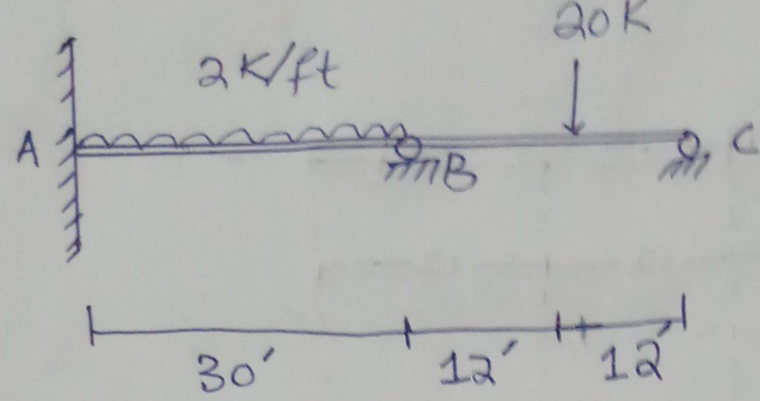
Name	Faraz Ahmed
I-D	7751
Section	"C"
Department	Bs-civil
Subject	Structure Analysis – II
Submitted TO	ENGR. Adeed Khan

QNO # 01.

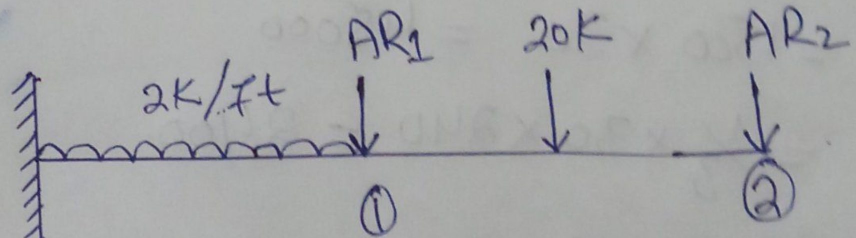


Solution:

Structural Indeterminancy = 2°

Step # 1

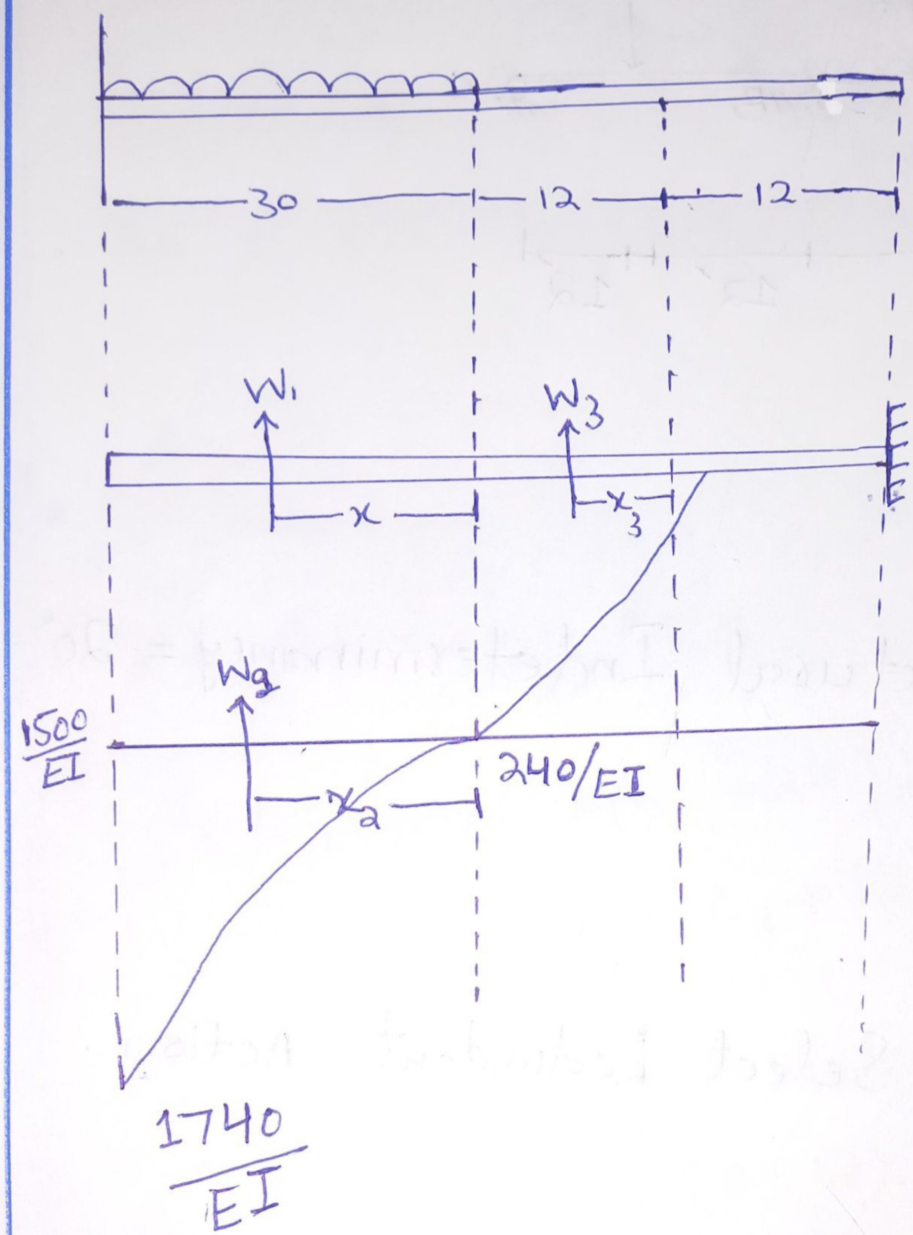
Select Redundant Action.



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

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

Step # 2 :: Compute the value of [DRL]



$W_1 = 1500 \times 30 = 45000$

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

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

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

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

$x_3 = 2/3 \times L = \frac{2}{\cancel{3}} \times \cancel{12}^{4} = 8'$

Now waiting DRL :-

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

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

$= 1755000 + 111600 + 28800$

$DRL_1 = W_1 (x_1) + W_2 (x_2).$
$= 45000 (15) + 2400 (22.5).$
$= 675000 + 54000$
$= 729000$

So,

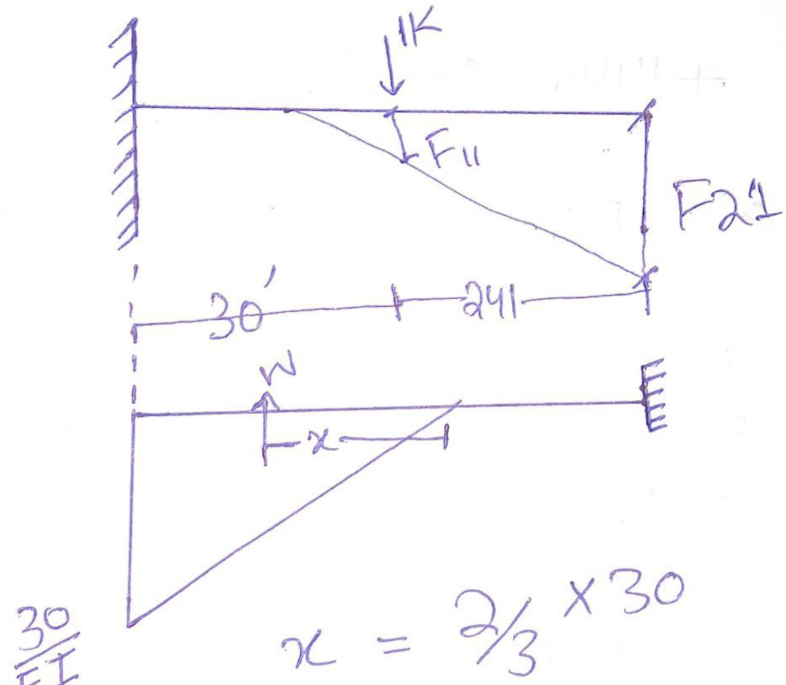
$$DRL = \frac{1}{EI}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$$

Step # 3 :-

Flexibility Matrix

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

(a) Apply Unit load on AR_1



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

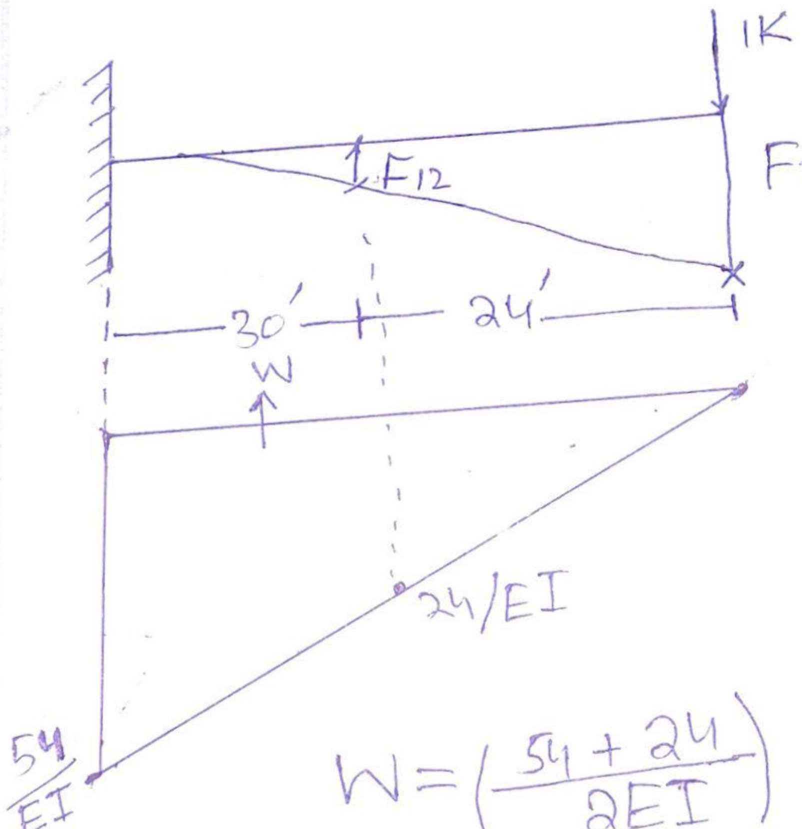
$$W_1 = \frac{1}{2}\left(\frac{30}{EI} \times 30\right) = 450/EI$$

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.



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

$$= 1170/EI$$

Now the distance

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

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

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

$$\Rightarrow F_{22} = \frac{1170}{EI} \times (16.92 + 24) = \frac{47787.4}{EI}$$

Hance

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

Step # 4:-

Compute the value of AR.

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

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

$$[F]^{-1} = \frac{1}{|F|} \times \text{adj } F.$$

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

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

$$|F| = 38918880.$$

$$\Rightarrow \text{adj } F = \begin{vmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{vmatrix}$$

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

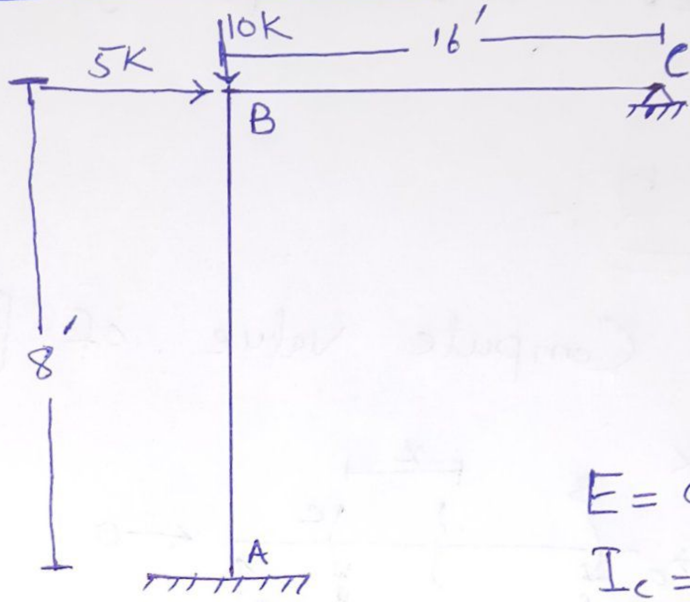
$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 66.193 \\ -67.505 \end{bmatrix}$$

QNO # 02

Force Method	Displacement Method.
→ $D_s < D_K$	$D_s > D_K$
→ Force are Redundent or unknown	Displacement are redundent or unknown
→ Start with equilibrium of Force.	Start with — compatible deformation
→ Force Found by — Compatibility equation of displacement.	Displacement Found by equilibrium eqns of Force.
→ No's of reduntants $= D_s$	no's of reduntants $= D_k$.
→ Not suitable for Computer.	→ Not suitable for trusses.

⇒ Stiffness Method also called Displacement is more suitable for Structure analysis approach, As it is primary method used in matrix analysis. The main Advantages of this method - over flexibility Method is that it is conductive to computer Programming. once the analytical Model of the Structure has been define. No Further engineering decision are Required in Stiffness Method in order to Carry out analysis.

QNO # 03



E = constant

$I_c = I$

$I_B = 2I$

Solution:-

Total statical indeterminacy

$\Rightarrow R - 3 = 5 - 3 = 2^{\circ}$

Step # 1 :

Identify Redundant Action.

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

Step # 2 :-

Compute value of [DRL]

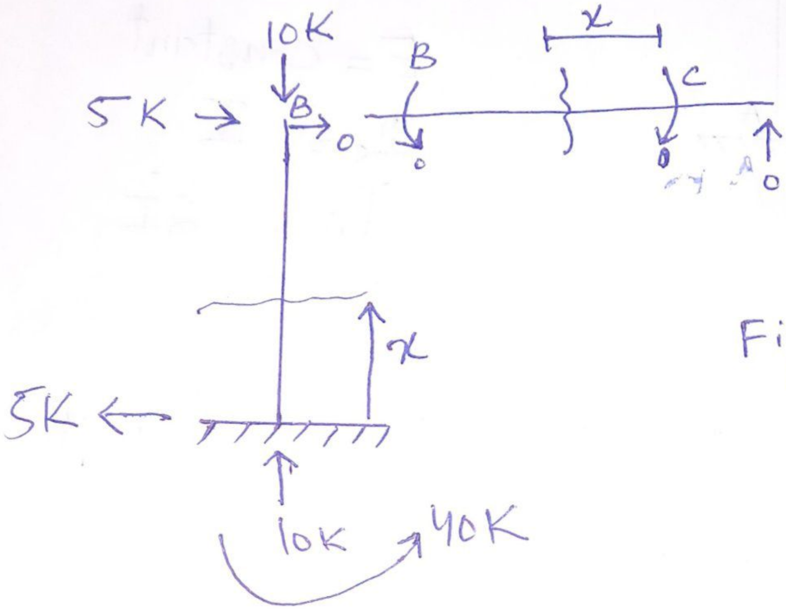


Fig: AML values (M-values).

Step # 3 ::

[F] or [Amr]

(a)

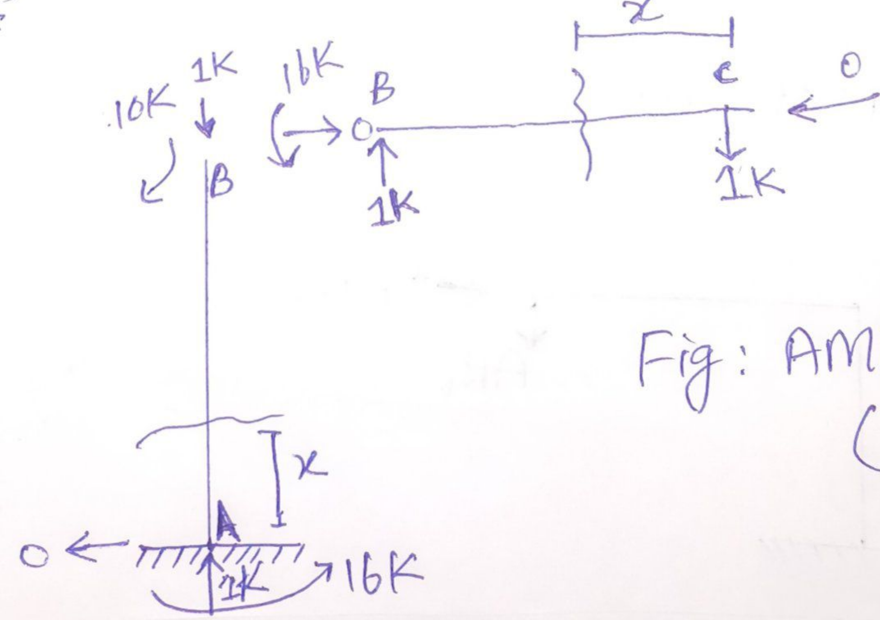


Fig: AMR-values (m, value).

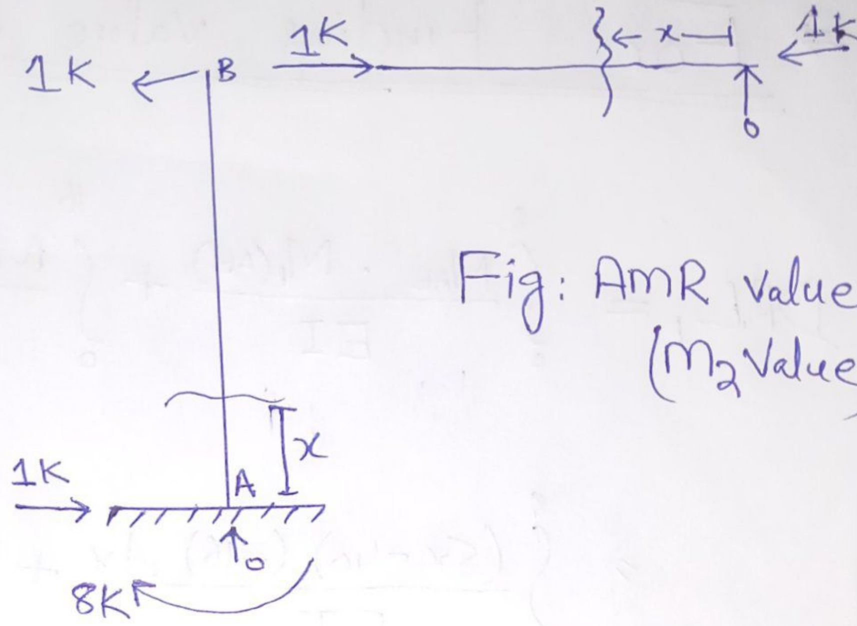


Fig: AMR value (M_2 Value)

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

⇒ For Finding value of DRL :-

$$DRL_1 = \int_0^8 \frac{M_{AB} \cdot M_1(AB)}{EI} + \int_0^{16} \frac{M_{BC} \cdot M_2(BC)}{EI}$$

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

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

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

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

$\Rightarrow$ Compute Flexibility Matrix :-

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

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

$$F_{11} = \frac{2730.63}{EI}$$

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

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

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

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

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

$$F_{22} = 170.67$$

As we Know

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

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

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

$$= \begin{bmatrix} 2730.67 & -512 \\ -512 & 170.67 \end{bmatrix}^{-1} \times \begin{bmatrix} 0 - 2560 \\ 0 + 853.33 \end{bmatrix}$$

$$\begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} -0.00005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$