Name # Habibullah

Section # "C"

ID # 7716

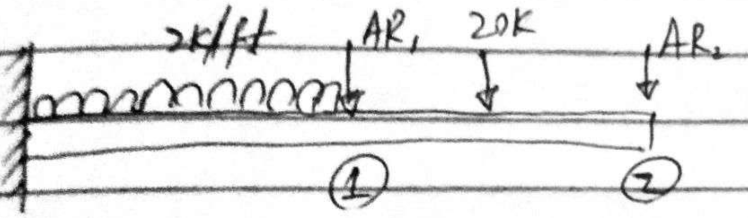
Pno 1:

Solution:

Structural Indeterminancy = 2°

Step 1 #

Select Redundant Actions

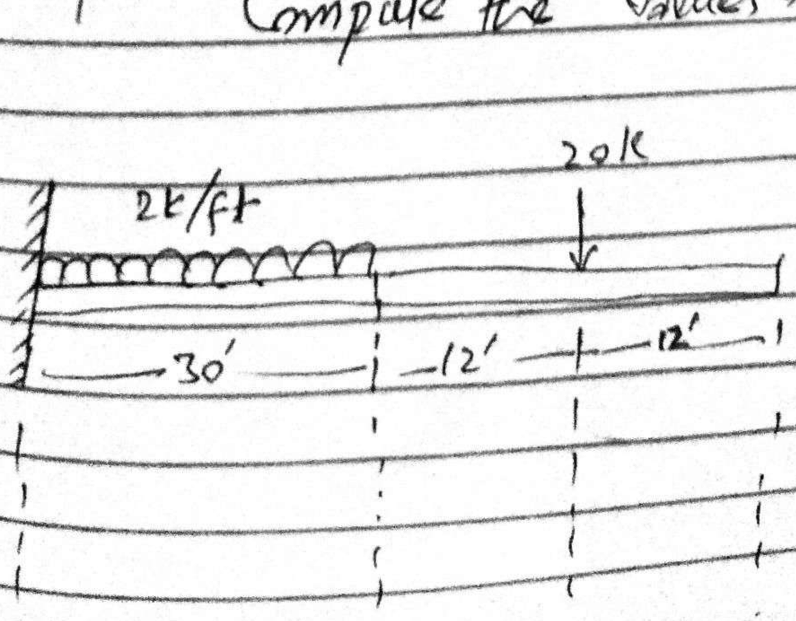


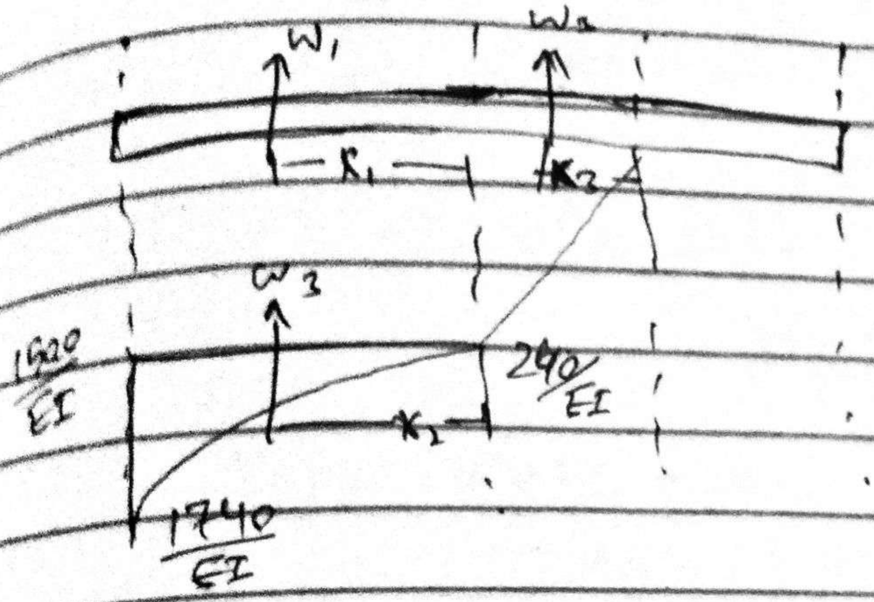
$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step 2 :

Compute the values of [DRL]





$W_1 = 1500 \times 30 = 45000$

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

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

$x_1 = b/2 = \frac{30}{2} = 15'$

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

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

Now Finding DRL :

$DRL_2 = \omega_1 \times (x_1 + 24) + \omega_2 \times (x_2 + 24) +$
$\omega_3 \times (x_3 + 12)$

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

$= 1755000 + 111600 + 28800$

$\boxed{DRL_2 = 1895400 / EI}$

$DRL_1 = \omega_1 (x_1) + \omega_2 (x_2)$

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

$= 675000 + 54000$

$\boxed{DRL_1 = 729000}$

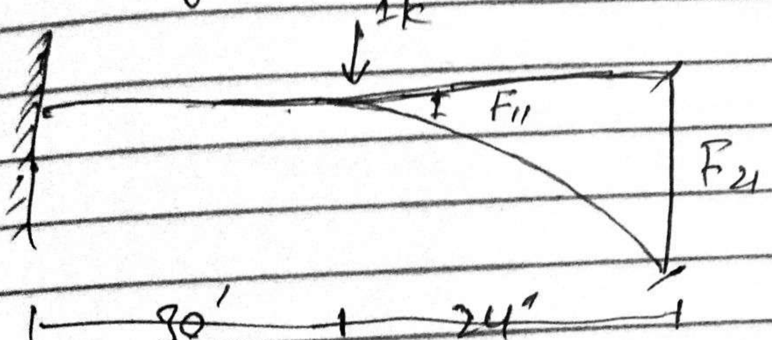
So

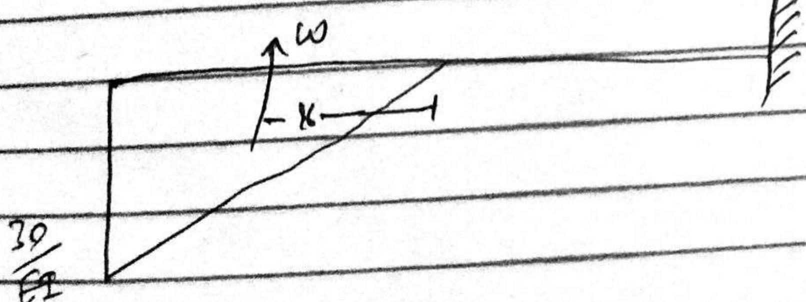
$$DRL = \frac{1}{EI} \left[\frac{729000}{1895400} \right]$$

Step 3: Flexibility Matrix

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

(a) Applying unit Load on R_1





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

$\boxed{x = 20'}$

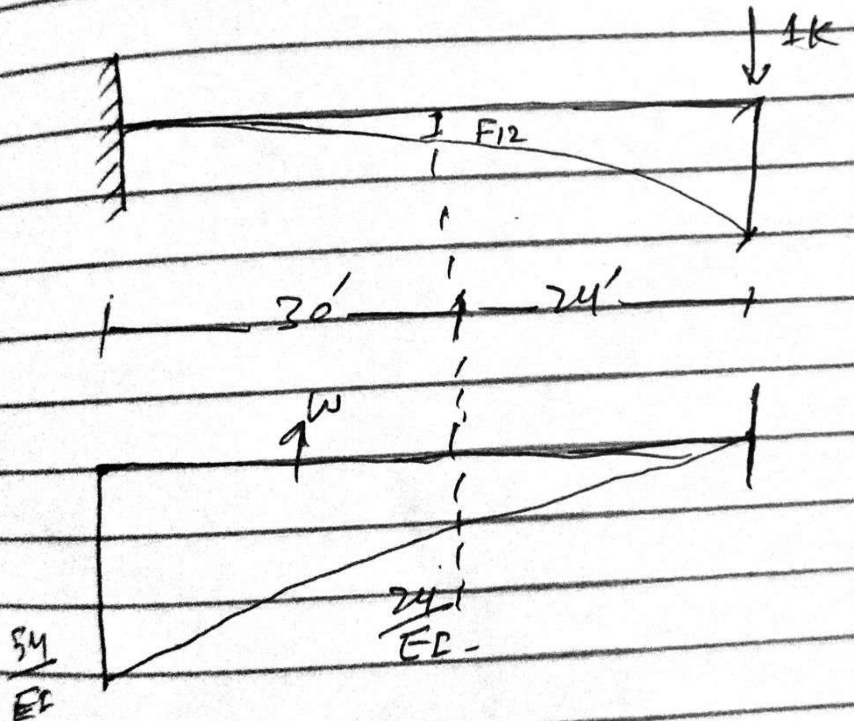
$w = \frac{1}{2}\left(\frac{30}{EI} \times 30\right)$

$\boxed{w = \frac{450}{EI}}$

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

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

Now apply Unit Load on AR_2



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

$$W = \frac{1170}{EI}$$

Now the distance

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

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

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

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

Hence

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

Step #4: Compute the values of AR

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

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

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

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

$$|F| = (9000 \times 47876.4 - 19796.4 \times 19800)$$
$$(430887600 - 391968720)$$

$$|F| = 38918880$$

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{38918880}$$

$$\times \begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}$$

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

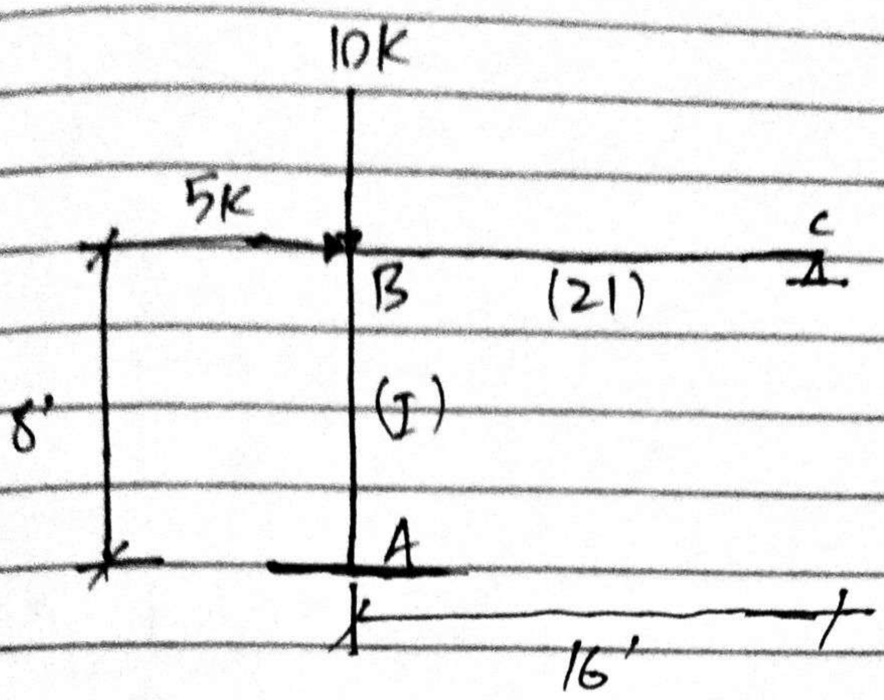
$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 66.193 \\ -67.505 \end{bmatrix}$$ Ans.

Qno.2:
Ans:

Force Method	Displacement Method
* $D_s < D_k$	* $D_s > D_k$
* Forces are reduntant or unknowns	* Displacement are reduntant or unknowns
* Starts with equilibrium of forces.	* Starts with compatible deformation.
* forces found by compatibility eqns of displacements.	* Displacements found by equilibrium eqns of forces.
* no of reduntants $= D_s$	* no. of reduntants $= D_k$
* not suitable for computer	* Not suitable for truses.

Displacement Method is more suitable for Structure analysis of Matrix approach. (By Stiffness Method)

Qno 3:



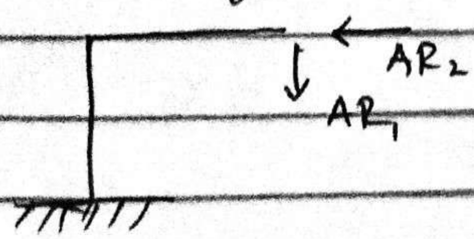
Solution:

Total Statical indeterminacy

$$R-3 = 5-3 = 2.$$

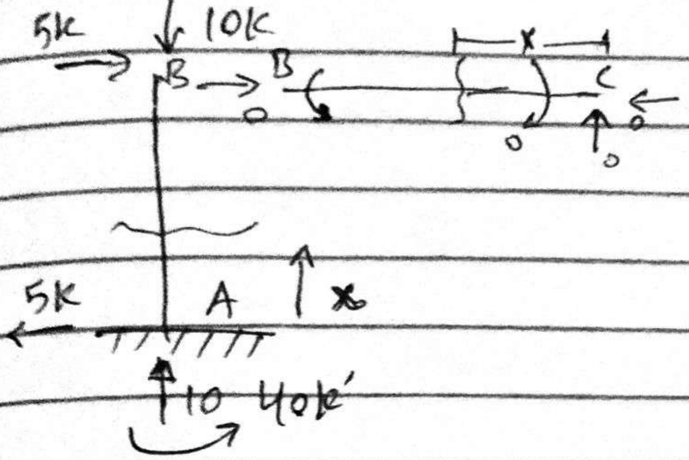
Step # 1

Identify Redundant Actions



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

Step 2: Compute value of [DRL]



Step 3: [F] or [AMR]

a)

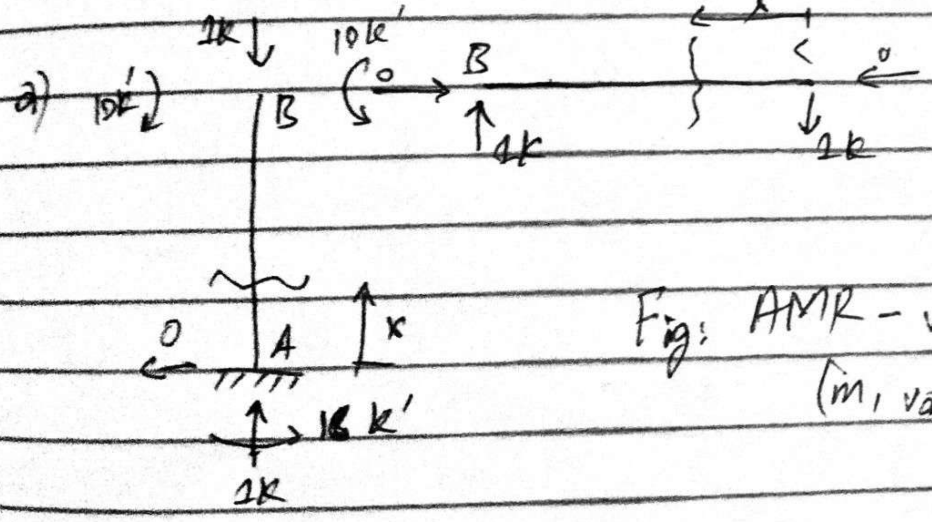


Fig: AMR - values (m_1 values)

b)

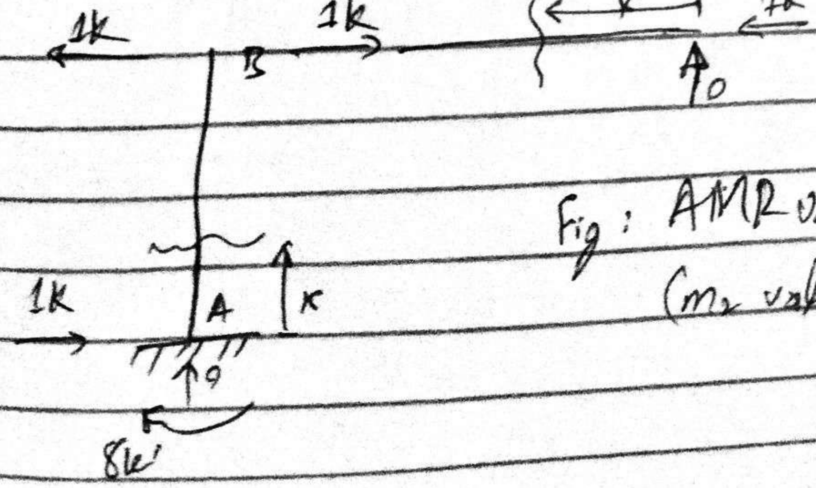


Fig: AMR values (m_2 values)

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

→ For Finding values of DRL :-

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

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

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

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

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

2) Compute Flexibility Matrix:-

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

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

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

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

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

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

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

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

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

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

As we know

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

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

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

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.00095 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$

Ans