Submitted By :- Nouman Ali

Submitted To :- Engr. Adeed Saib

ID :- 7462

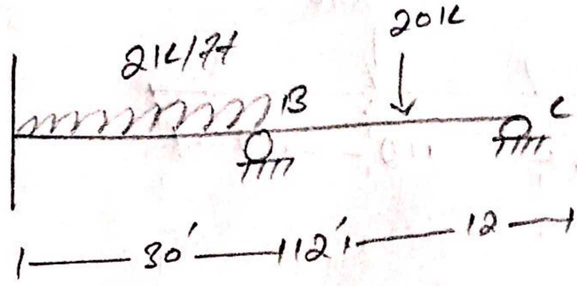
Subject :- Structure II

program :- BEC

Exam :- mid terms summer.

Date :- 21/8/2020.

Q#01

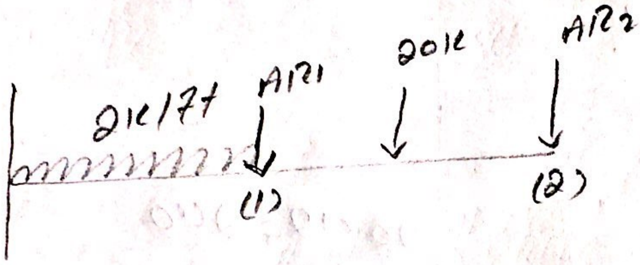


EI = constant.

Sol:

structural Indeterminancy = 2°

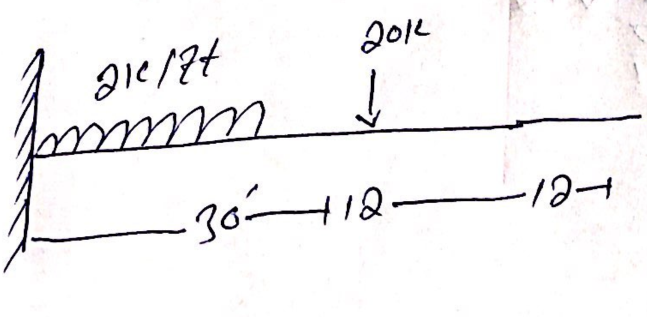
step#01 select Redundant Actions



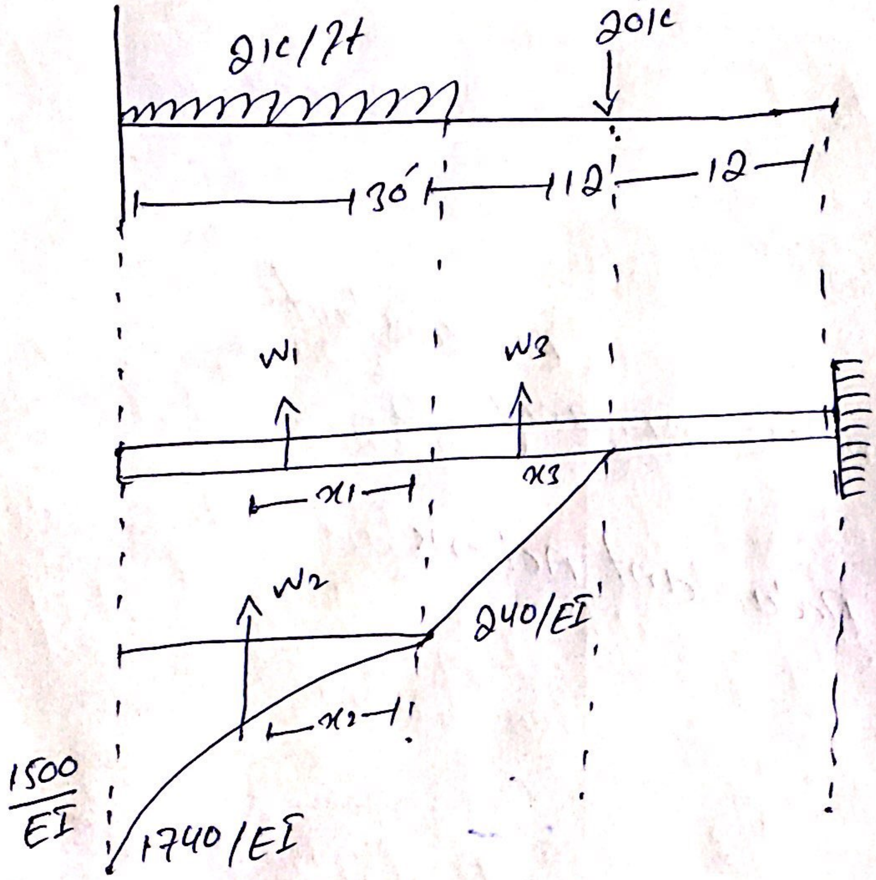
$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

step#02 Compute the value of [DRL]



P.T.O.



$20 \times 12 = 240$

$20 \times (12+30) + 2 \times 30 \times 15 = 1740$

$w_1 = 1500 \times 30 = 45000$

$w_2 = 1/3 \times 30 \times 240 = 2400$

$w_3 = 1/2 \times 12 \times 240 = 1440$

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

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

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

Now finding DRL:-

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

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

$$\Rightarrow 1755000 + 111600 + 28800$$

$$DRL_2 = 1895400/EI$$

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

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

$$= 675000 + 54000$$

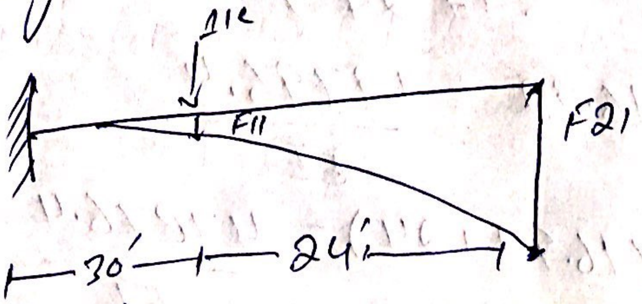
$$= 729000$$

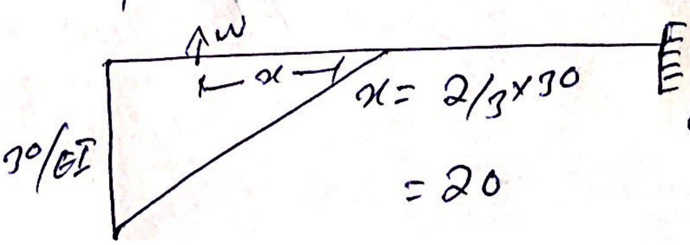
So $DRL = \frac{1}{EI}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$

Step #03 Flexibility matrix

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

(a) applying unit load on AR1





$x = 2/3 \times 30$

$= 20$

$w = 1/2 (\frac{30}{EI} \times 30$

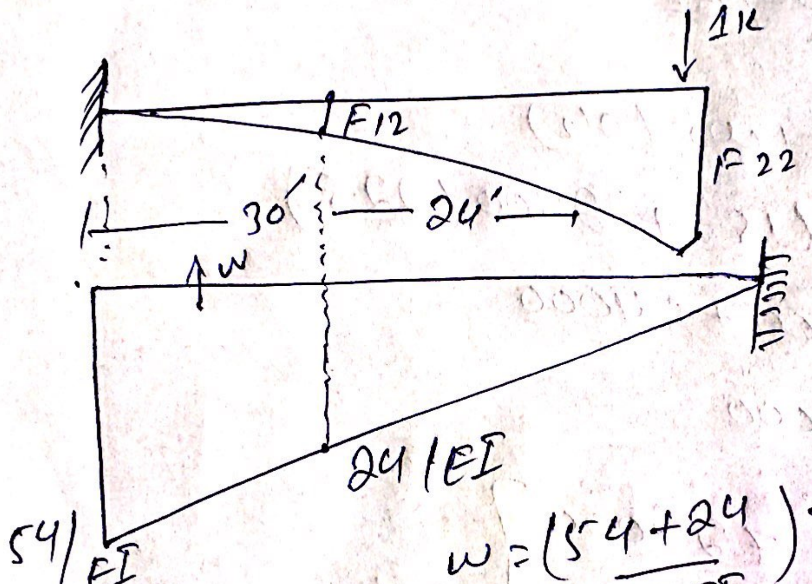
$= 450/EI$

So

$$F11 = \frac{450}{EI}(20) = 9000/EI$$

$$F21 = \frac{450}{EI}(20+24) = 19800/EI$$

No apply unit load on AR2



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

$$\Rightarrow 1170/EI$$

Now the distance

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

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

$$= F12 = \frac{1170}{EI} \times 16.92 = \frac{19796.4}{EI}$$

$$\Rightarrow F22 = \frac{1170}{EI} \times (16.92+24) = \frac{47876.4}{EI}$$

Hence

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

Step #04 Compute the value of AR

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

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

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

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

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

$$(430887600 - 391968720$$

$$\Rightarrow |F| = 38918880$$

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

$$\begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} 1/EI \times \frac{1}{38918880} \begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}$$

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

$$\begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} 66.193 \\ -67.505 \end{bmatrix}$$

Q #02

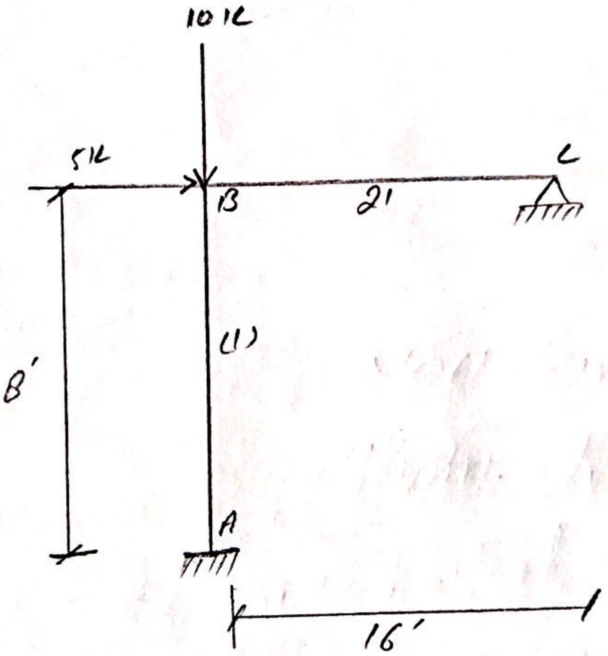
Ans

Force method	Displacement method
(1) DS < DK	DS > DK
(2) Force are redundant or unknown's	Displacement are redundant
(3) start with equilibrium of forces	start with compatible deformation
(4) Force found by compatibility of displacements	displacements found by equilibrium equation of forces.
(5) No. of redundants = DS	No. of redundants = DK
(6) Not suitable for computers	Not suitable for trusses.

⇒ Stiffness method is more suitable:

Stiffness method is also called Displacement method is more suitable for structure analysis matrix approach, as it's primary method are 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 defined as. No further engineering decisions are required in the stiffness method in order to carry-out the analysis.

Q#03



Sol:-

E = constant

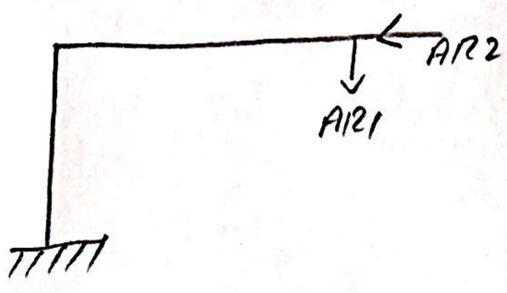
$I_C = I$

$I_B = 2I$

Total statical indeterminacy

$= 12 - 3 = 5 - 3 = 2$

Step#01: Identify Redundant Actions



$$\begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \cdot \begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Scanned with CamScanner

Step#02

Compute the value of [DRL]

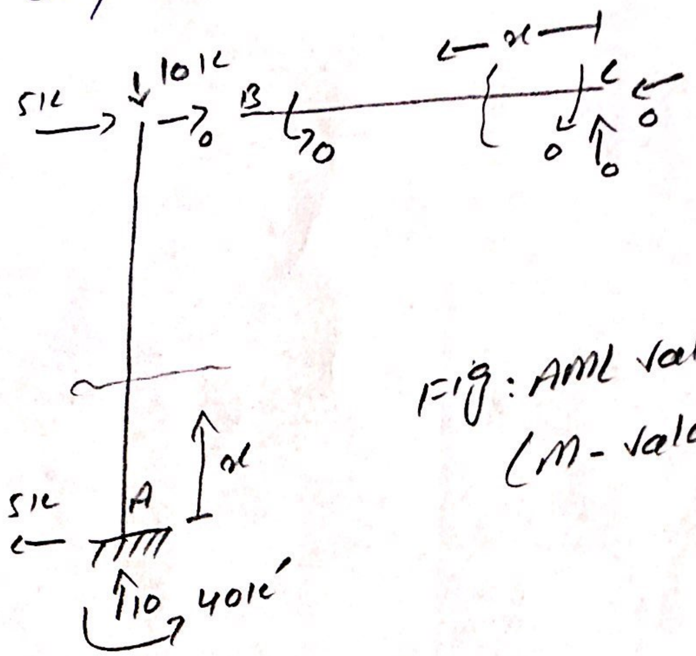


Fig: AML value
(M- values)

Step#03 : [F] or [AMR]

(a)

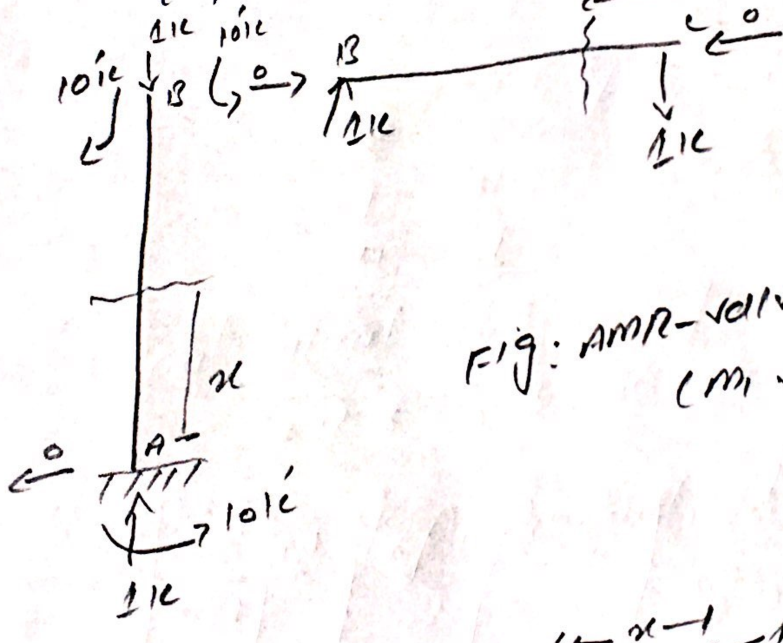


Fig: AMR-values
(M_1 values)

(b)

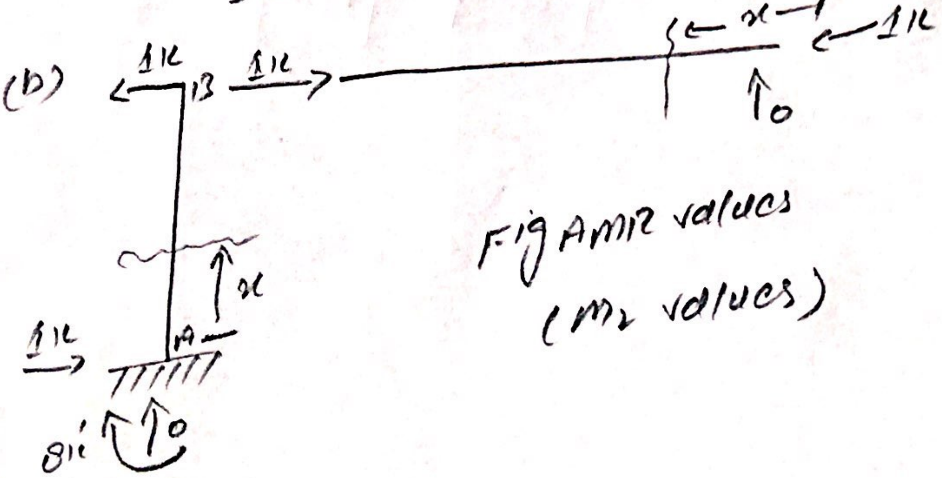


Fig AMR values
(M_2 values)

member	AB	BC
origin	A[redacted]	C
Limits	0-8	0-16
I	I	2I
m	$5x-40$	0
m_1	-16	
m_2	$8-x$	0

$x \to$ Take x section on m_1 Fig from the origin.

=> For finding the value of DRL:

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

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

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

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

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

⇒ Compute Flexibility ~~method~~ matrix :-

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

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

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

$$F_{12} = F_{21} = \int_0^8 M_{1(AB)} \cdot M_{2(AB)} + \int_0^{16} M_{1(BC)} \cdot M_{2}(BC)$$

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

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

$$F_{22} = \int_0^8 (M_2)^2_{AB}\,dx + \int_0^{16} (M_2)^2_{BC}\,dx$$

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

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

As we know that

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

$$\Rightarrow [AR] = \frac{[DRS] - [DRI]}{(F)}$$

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

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

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