Date

Name Zamarud Shah

ID 7463

Submitted To Engr. Adeed Khan

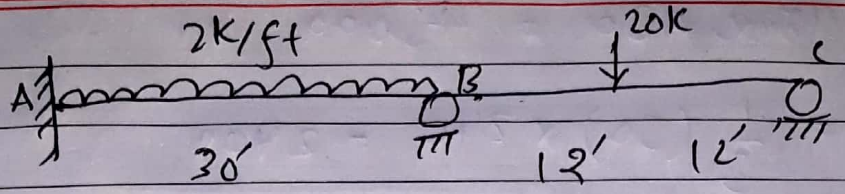
Subject Structure Analysis -II

Date 21/08/2020

Summer Semester 6th

Date ________

Q1:-

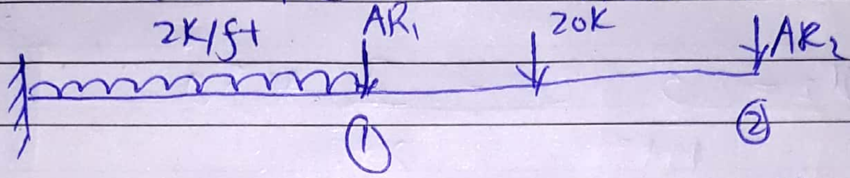


Sol:-

$S.I = 2^{\circ}$

Step 1:-

Select Redundat Actions.

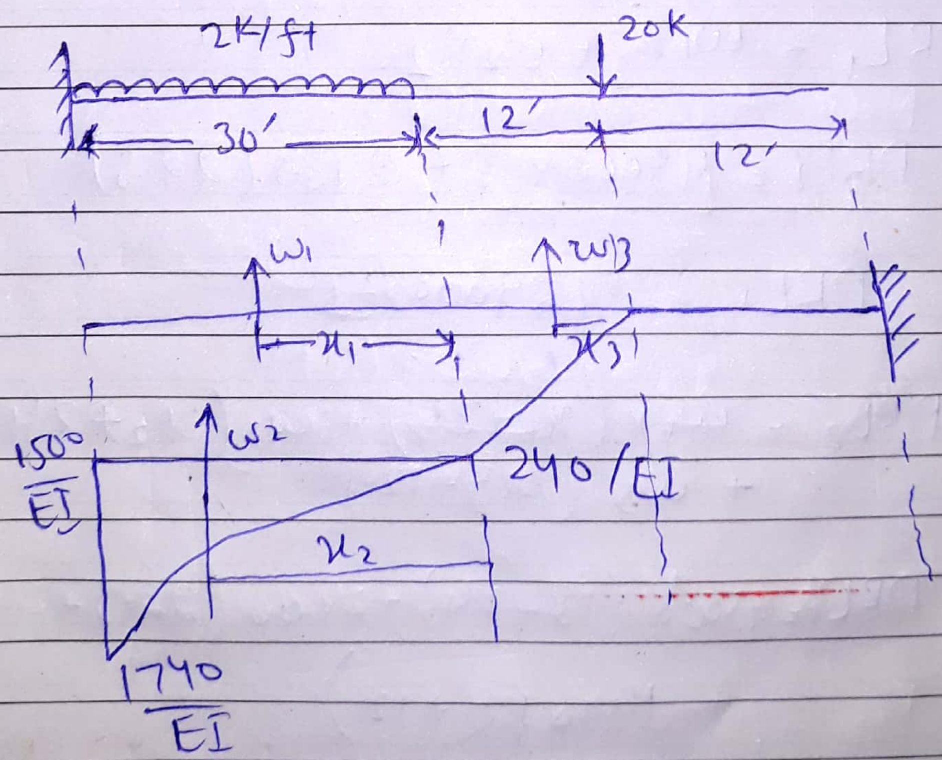


$$\begin{Bmatrix} DRS_1 \\ DRS_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix} , \begin{Bmatrix} AR_1 \\ AR_2 \end{Bmatrix} = \begin{Bmatrix} ? \\ ? \end{Bmatrix}$$

$$\{DRS\} = \{DRL\} + \{F\} \times \{AR\}$$

Step 2:-

Compute the values of $\{DRL\}$



$20 \times 12 = 240$

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

$= 1740$

Date

$\omega_1 = 1500 \times 30 = 45000$

$\omega_2 = \frac{1}{3}(30) \times 240 = 2400$

$\omega_3 = \frac{1}{2} \times 12 \times 240 = 1440$

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

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

$x_2 = 22.5'$

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

$x_3 = 8'$

$DRL_1 = \omega_1 x_1 + \omega_2 x_2$

$DRL_1 = 45000 \times 15 + 2400(22.5)$

$DRL_1 = 729000/EI$

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

$DRL_2 = 45000(15+24) + 2400(22.5+24) + 1440(8+12)$

$= 1755000 + 111600 + 288000$

$DRL_2 = 1895400/EI$

Date

So

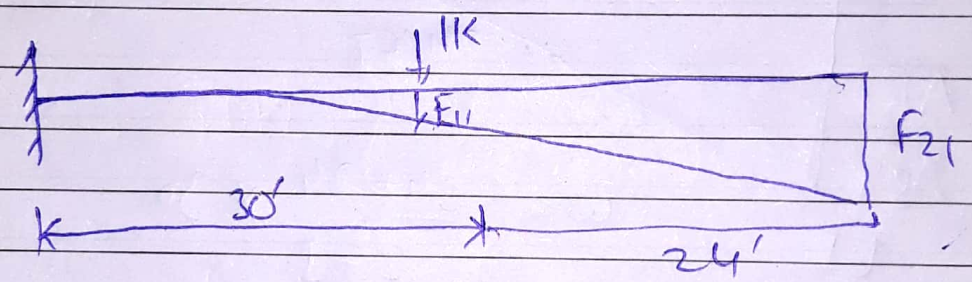
$$DRL = \frac{1}{EI}\begin{Bmatrix} 729000 \\ 1895400 \end{Bmatrix}$$

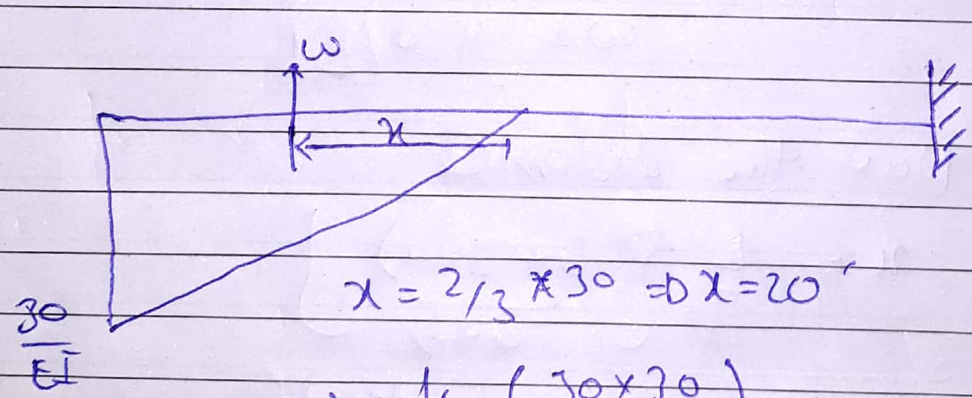
step 3 :-

Flexibility matrix.

$$[F_2]_{2\times2} = \begin{Bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{Bmatrix}$$

ⓐ Applying unit load on AR_1





$x = 2/3 * 30 \Rightarrow x = 20'$

$$\omega = 1/2\left(\frac{30\times30}{EI}\right)$$

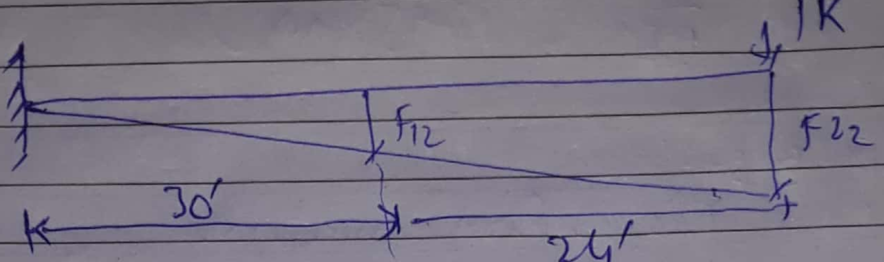
$\omega = 450/EI$

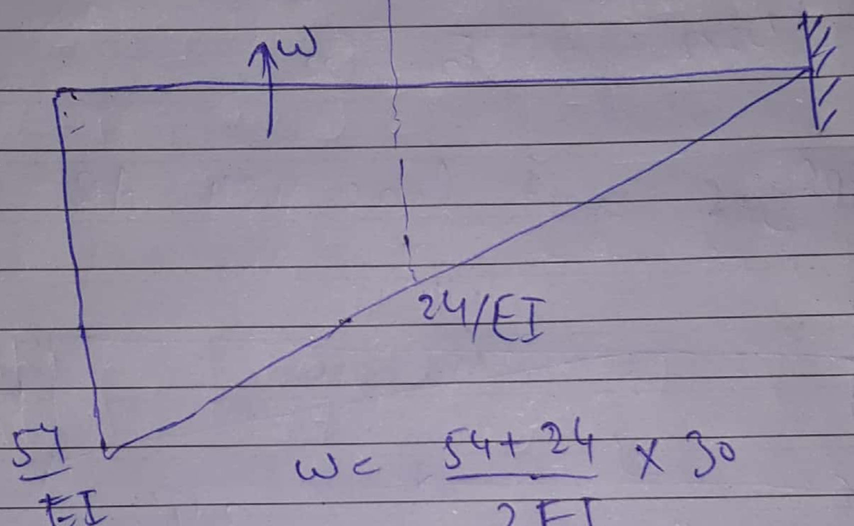
So $F_{11} = \frac{450(20)}{EI} = 9000/EI$

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

Date

Now apply unit load on AR_2





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

$$w = 1170/EI$$

Now the distance

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

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

$$x = 16.92'$$

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

$$F_{12} = 19796.4/EI$$

(5)

Date

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

$$F_{22} = \frac{47876.4}{EI}$$

Hence

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

Step 4:-

Compute the values of AR

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

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

$$F^{-1} = \frac{1}{|F|} \times adj\, F$$

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

$$|F^{-1}| = (9000 \times 47876.4 - 19796.4 \times 19800)$$

$$|F^{-1}| = 430887600 - 391968720$$

$$|F^{-1}| = 38918880$$

Scanned by CamScanner

6

Date

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

$$\begin{Bmatrix} AR_1 \\ AR_2 \end{Bmatrix} = \begin{Bmatrix} 0-729000 \\ 0-1895400 \end{Bmatrix} \frac{1}{EI} \times \frac{1}{38918880} \left[\text{Adj } A \right]$$

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

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

Date

Q2:- Differentiate b/w force and displacement Method and suggest which method is suitable for structure analysis of matrix approch.

Ans:-

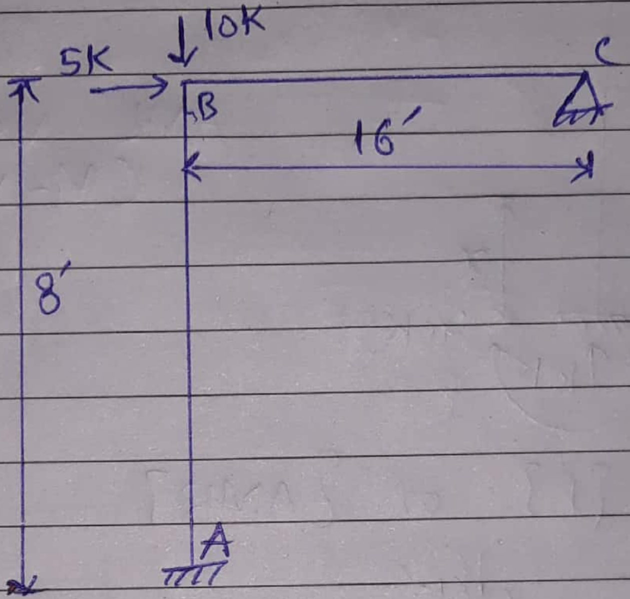
Force Method	Displacement Method.
• Unknown are taken redundants forces/ reactions	• Unknowns are taken displacement.
• To find unknow forces or redundant compatib-ility equations are written.	• To find unknow displacement joint Equillibrium conditions are written.
• The number of compatib-ility equations needed is equal to degree of static ~~ret~~ indeterminacy.	• The number of equillibrium conditions needed is equal to degree of kinematic indeterminacy.

Displacement Method is more suitable for structure analysis matrix approach as it is a primary method is ~~that~~ used in matrix analysis. The main advantage of this method over flexibility method is that is conductive to computer programing one of the analytical model of the structure has been defined. No further engineering decisions are required in the stiffness method in order to carry out the analysis.

Date

Q 3:- Analyze the rigid-joint frame shown in figure by flexibility Method. Assume EI is constant for all members.

Sol:-



Sol:- E = constant

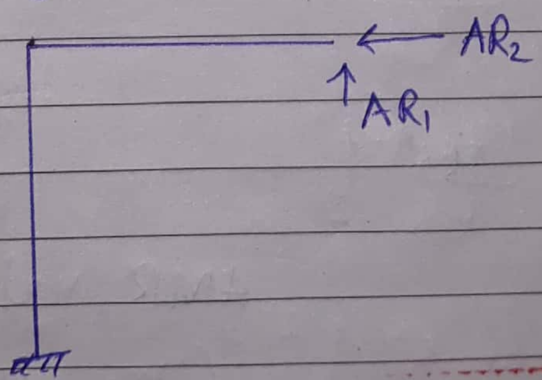
$I_C = I$

$I_B = 2I$

Total statical indeterminacy

$R - 3 = 5 - 3 = 2^\circ$

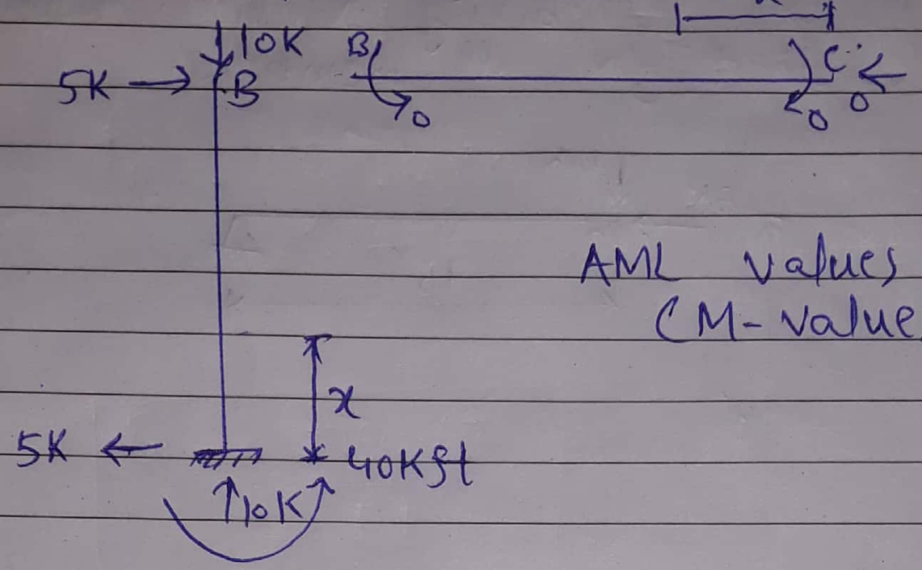
Step 01:- Identify Redundant Actions



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

9

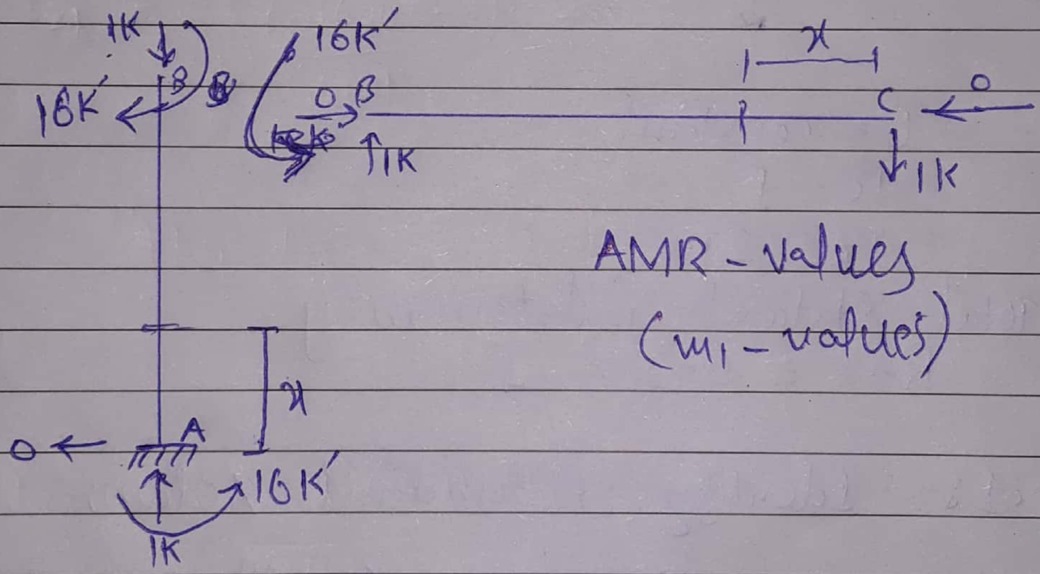
Step 2:- Compute value of {DRL}



AML values
(M- values)

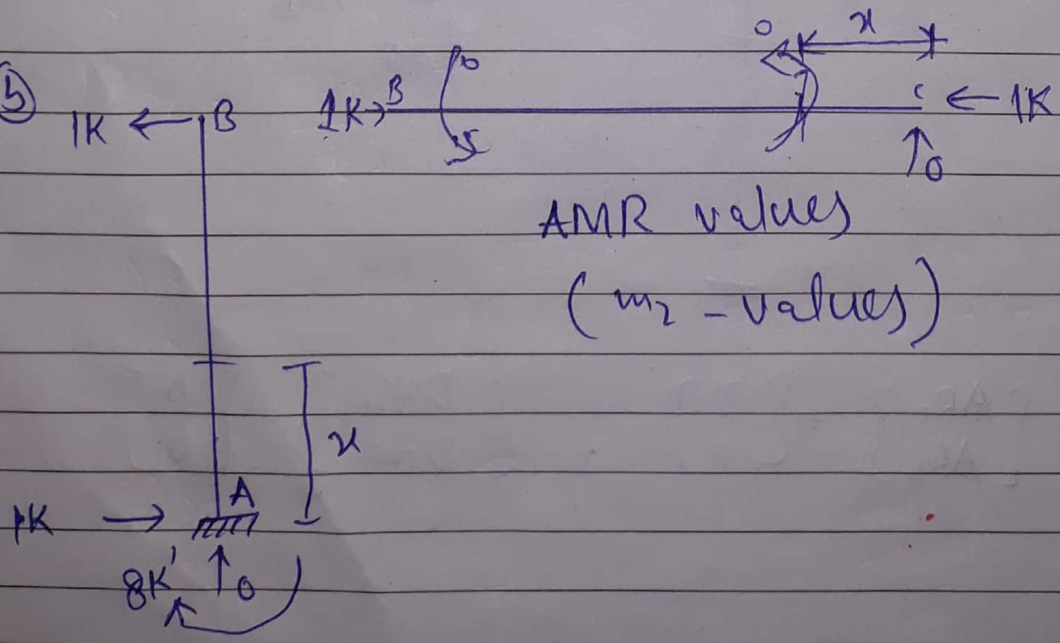
Step 3:- {F} or {AMR}

(a)



AMR - values
(m_1 - values)

(b)



AMR values
(m_2 - values)

Date

Members	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

$$DRL_1 = \int_0^8 \frac{(5x-40)(16)}{EI}\,dx + \int_0^{16} \frac{(0)(-x)}{2EI}\,dx$$

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

$$DRL_2 = \int_0^l \frac{M_{AB} \times m_1(AB)}{EI} + \int_0^l \frac{M_{BC} \times m_2(BC)}{EI}$$

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

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

Compute flexibility matrix.

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

(11)

Date

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

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

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

$$F_{12} = F_{21} = \int_0^8 \frac{(-16)(8-x)}{EI} + 0$$

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

$$F_{22} = \int_0^8 \frac{(8-x)(8-x)}{EI} dx + 0$$

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

$$\begin{Bmatrix} AR_1 \\ AR_2 \end{Bmatrix} = EI \begin{bmatrix} 2730.67 & -512 \\ -512 & 170.67 \end{bmatrix}^{-1} \begin{bmatrix} 0-2560 \\ 0-(-853.33) \end{bmatrix} \times \frac{1}{EI}$$

$$\begin{Bmatrix} AR_1 \\ AR_2 \end{Bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$

End