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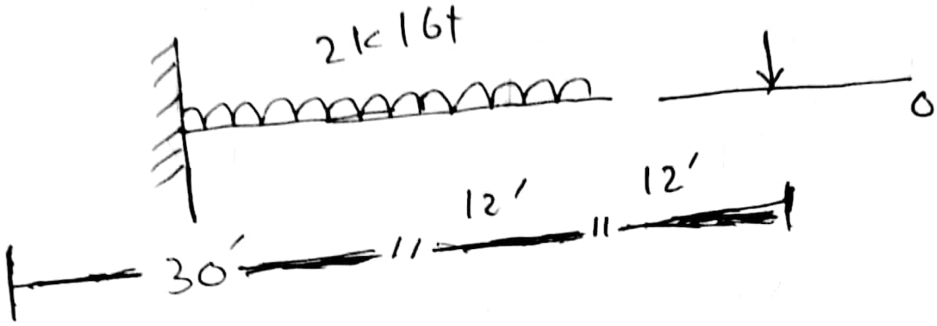
SECTION : A

Subject : Structure-II

Date : 21/8/2020

Question No # 1

~~Solution~~ :-



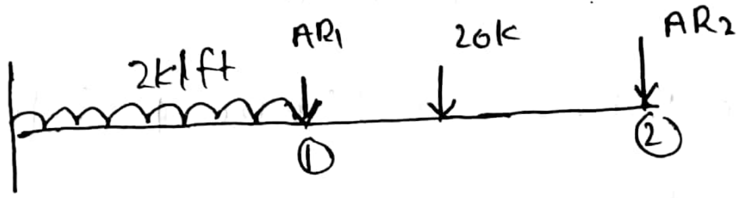
EI = constant

Solution:-

structure Indeterming = 2

Step # 1 :-

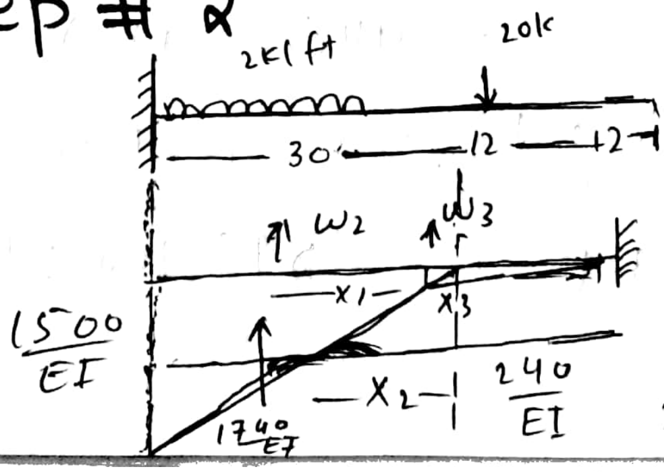
Select Redundant Actions



$$\begin{bmatrix} DRS_1 \\ DR_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step # 2



$20 \times 12 = 240$

$20 \times (12+30) + 2 \times 30 \times 15 = 174$

$W_1 = 1500 \times 30 = 45000$

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

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

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

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

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

Now Finding DRL :-

$DRL_1 = W_1(x_1) + W_2(x_2)$
$= 45000(15) + (2400)(22.5)$

$DRL_1 = 675000 + 54000$

$\boxed{DRL_1 = 729000}$

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

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

$= 1755000 + 111600 + 28800$

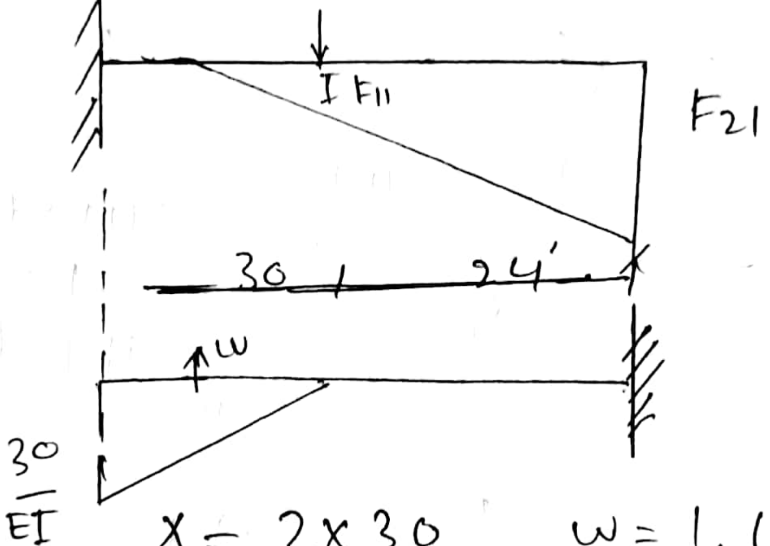
$DRL_2 = 1895400/EI$

Step # 3

Flexibidity matrix

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

(a) Applying unit load on AR_1



$X = \frac{2 \times 30}{3}$ $w = \frac{1}{2}\left(\frac{30 \times 30}{EI}\right)$

$X = 20'$ $w = \frac{450}{EI}$

So

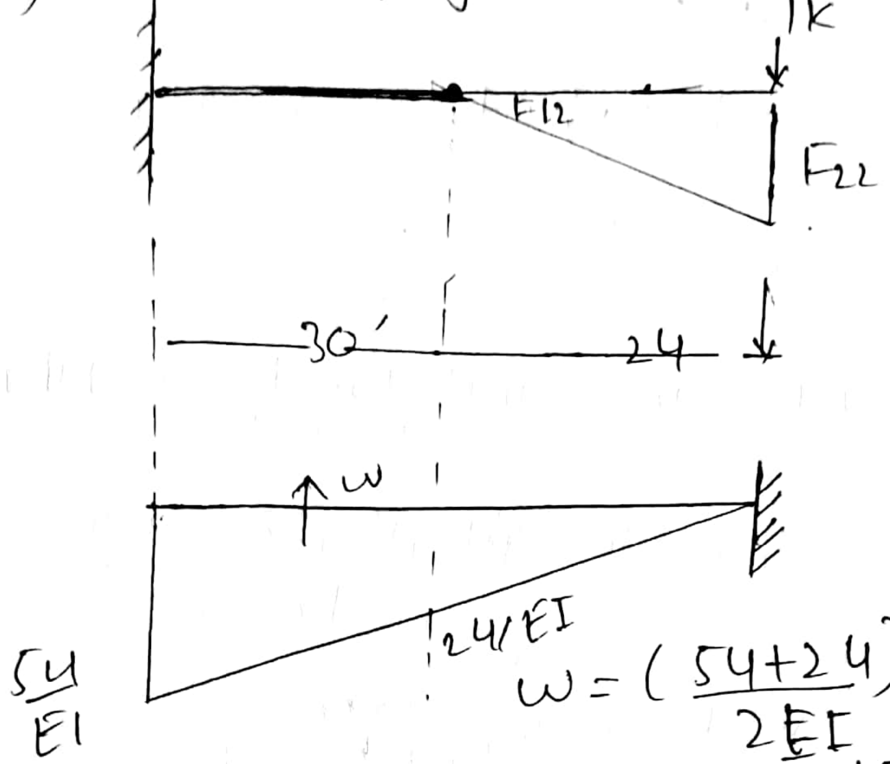
$$F_{11} = \frac{450}{EI}(20) = 9000/EI$$

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

b) Now apply unit load on AR_2

P.T.O

(4) b) Now Apply unit load on AR_2



$$w = \left(\frac{54+24}{2EI}\right) \times 30$$
$$= 1170/EI$$

Now the distance

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

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

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

$$\boxed{F_{12} = \frac{19796.4}{EI}}$$

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

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

Hence

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

Step # 4

Compute the value of AR

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

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

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

$$= \frac{1}{\begin{vmatrix} 19000 & 1976.4 \\ 19800 & 47876.4 \end{vmatrix}} \times \text{Adj} \begin{vmatrix} 9000 & 197964 \\ 19800 & 478764 \end{vmatrix}$$

$$|F| = (9000 \times 4787.64 - 19796.4 \times 19800$$
$$= 430887600 - 391968720)$$

$$|F| = 38918880$$

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0-72000 \\ 0-1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{38918880} \begin{bmatrix} \cancel{47876.4} \end{bmatrix}$$

$$\begin{bmatrix} 4787604 & -19796.4 \\ -198000 & 9000 \end{bmatrix}$$

$$= \begin{bmatrix} -729000 \\ -1895400 \end{bmatrix} \frac{1}{EI} \times \frac{\begin{vmatrix} 47876.4 & -19796 \\ -19800 & 9000 \end{vmatrix}}{38918880}$$

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

Ans

—— x —— x

Question # 2

	Force Method	Displacement Method
(1)	it is also known as Flaxibiditity matrix method or lampatability method	it is also called as equilibrium method or stiffness matrix method
2)	In Force method the unknown are taken as Force or reaction	In displacement method the unknown are take as Joint displacement (θ, Δ)
(3)	In the Force method number of reduntant = DS	In displacement method number of redundants = DK
4)	The Force are determined by compatibility equation of displacemnt	In this method the displacement are determined by equilibrium equation of Force
5)	In this method Type of Indeterminacy is static	In this method Type of Indeterminacy is kinematic Indetermin g
	This method is suitable when DS < DK	This method is suitable when DS > DK

Suitable method for structure Analysis of matrix approach

For analysis of structure of matrix approach both the Force method or displacement method can be used depend upon situation.

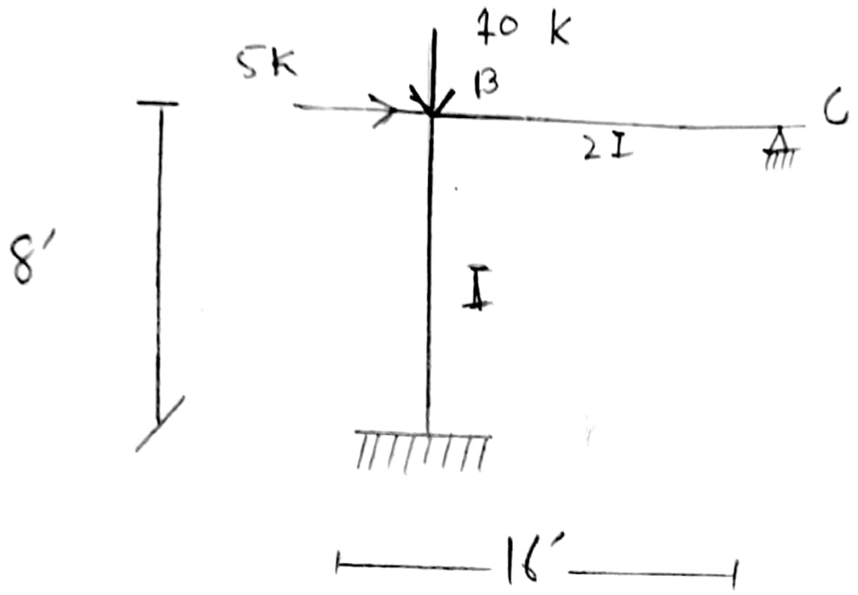
→ when the degree of static indeterminacy (Ds) is less than the degree of kinematic Indeterminacy (DK) i-e $D_s < D_K$ then it is suggested to use Force method.

→ when the degree of static Indeterminacy (Ds) is more than kinematic Indeterminacy (DK) i-e $D_K < D_s$ then it is suggested to use displacment method of analysis

→ The main advantage of displacment method is it is primary method used in matrix analysis.

→ Also displacment method is conductive to computer is programming, once the analytical model of the structure has been defined no Further engineering decision are required in stiffness method in order to carry out the analysis Hence displacement method is suitable for structure analysis of matrix approach.

Question # 03



E = Constant

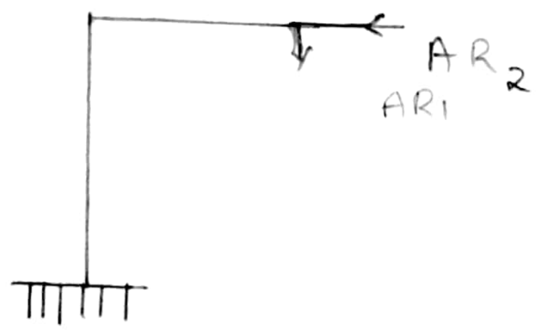
Solution :-

Total statical Indeterminicy

$R - 3 = 5 - 3 = 2$

Step 1 :-

Identifying Redundant action



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

Step # 2

compute value of [DRL]

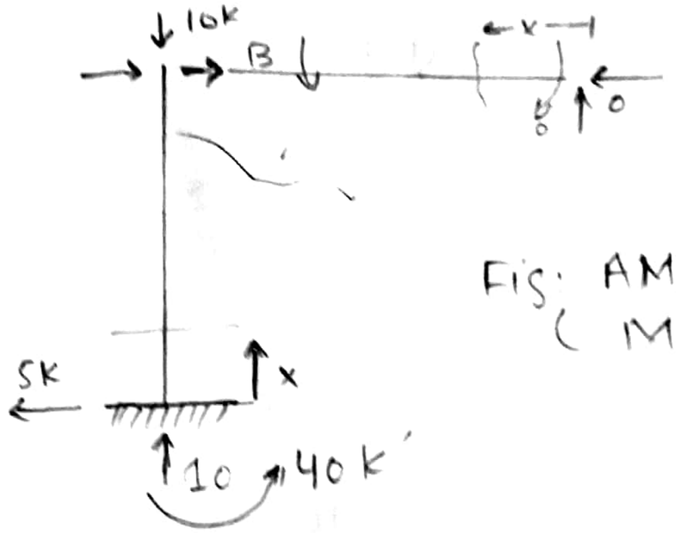


Fig: AML values
(M-values)

Step # 3

[F] or [AMR]

a)

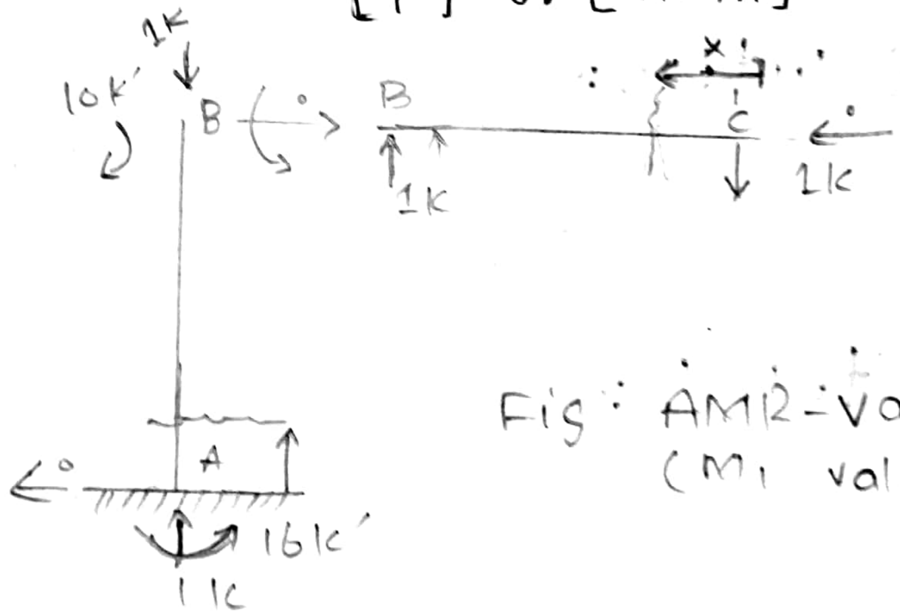


Fig: AMR-values
(M₁ values

b)

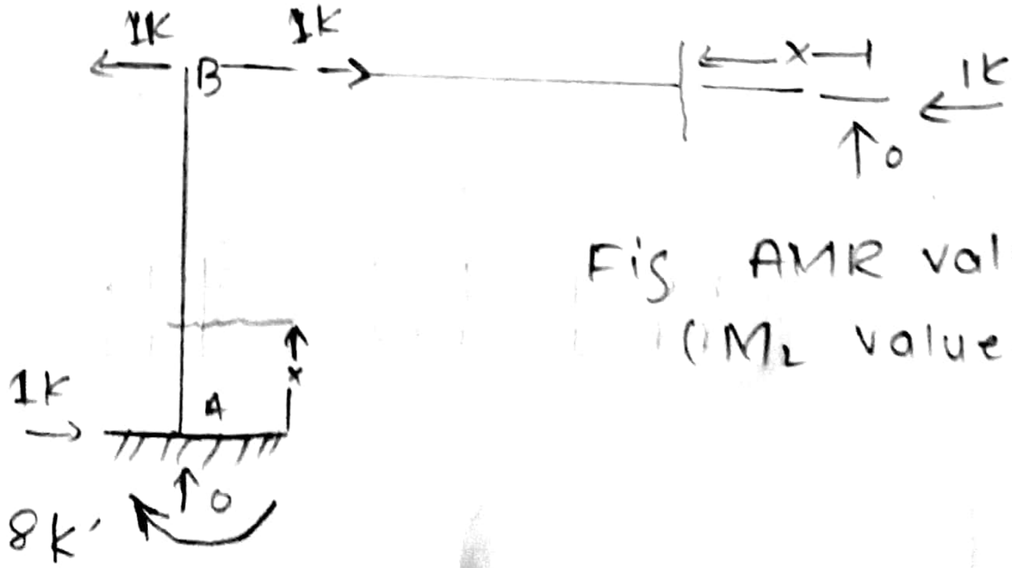


Fig AMR values
(M₂ values)

Member	AB	BC
origin	A	C
Limit	0-8	0-16
I	I	2I
M	5x-40	0
M_1	-16	-x
M_2	8-x	0

→ Finding values of DRL

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

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

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

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

$$\boxed{DRL_2 = \frac{-853.33}{E.I}}$$

→ Compute Flexibility Matrix

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

$$\Rightarrow F_{11} = \int_0^8 \frac{M_1^2 (AB)}{E.I} + \int_0^{16} \frac{m^2 (BC)}{E.I} = \int_0^8 \frac{(-16)^2 dx}{E.I} + \int_0^{16} \frac{x^2 dx}{E.I(2I)}$$

(12)

$$\boxed{F_{11} = \frac{2730.67}{E.I}}$$

$$F_{12} = F_{21} = \int_0^8 m(AB) \cdot M_2(AB) + \int_0^{16} m(BC) \cdot M_2(BC)$$

$$= \int_0^8 \frac{(-16)(8-x)dx}{E.I} + \int_0^{16} \frac{(x)(0)}{E(I_2)} dx$$

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

$$F_{22} = \int_0^8 (m_1)^2 AB\, dx + \int_0^{16} (m_2)^2 BC\, dx$$

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

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

As we know

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

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

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

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

$$\boxed{\begin{bmatrix} AR1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0.0005 \\ 4.97 \end{bmatrix}, \quad \begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}}$$