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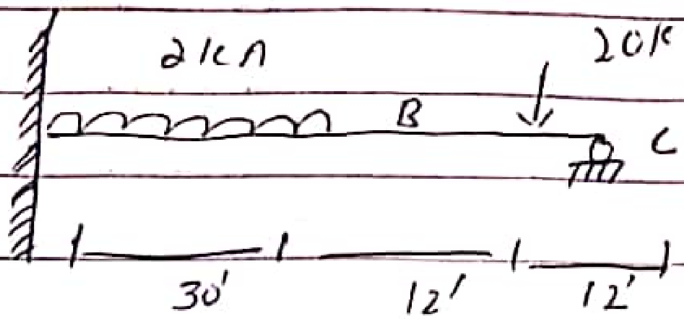
SECtion # B

Subject # Structure 2.

Instructor : Sir Adeeb Saib.

Question # 1.

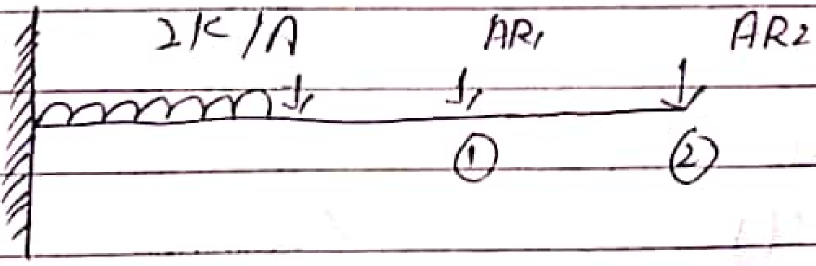


Solution:-

Structural Indeminancy. = 2°

Step 1:-

Select Redutant Actions.

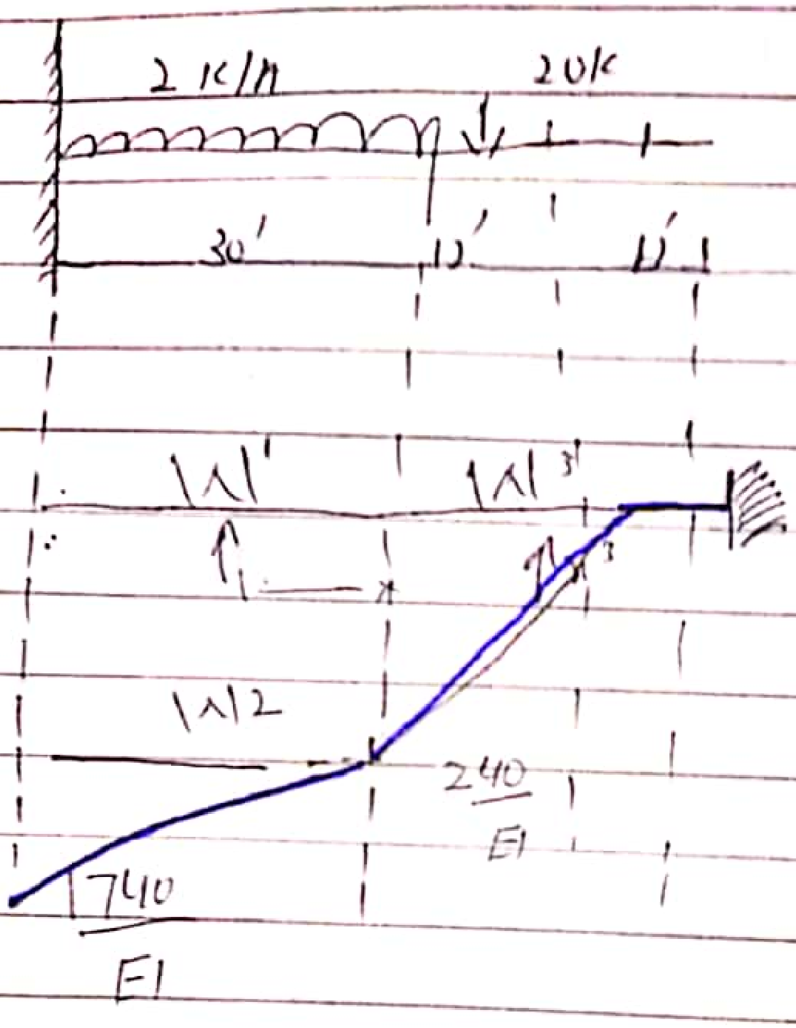


$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} , \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

$$[DRS] = [DRL] + [F] * [AR]$$

Step# 02:-

compute value of (DRL)



$20 \times 12 = 240$

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

$1x1_1 = = 1500 \times 30 = 45000$

$1x1_2 = \frac{1}{3} \times 30 \times 240 = 2400$

$1x1_3 = \frac{1}{2} \times 12 \times 240 = 1440$

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

$x_2 = \frac{3}{n+2} \times 1 = \frac{3}{2+2} \times 30 = 22.5'$

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

Now Find DRL :-

$DRL_1 = W_1 (x_1) + W_2 (x_2)$

$= 45000 (15) + 24000 (22.5)$

$= 675000 + 54000$

$= \boxed{729000}$

DRL2 :-

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

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

$= 1755000 + 111600 + 28800$

$DRL_2 = \boxed{1895400}$ FI

④

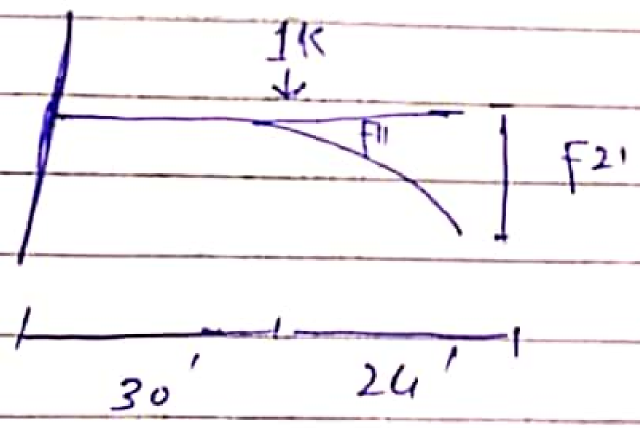
so DRL1 $\frac{1}{E_1}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$

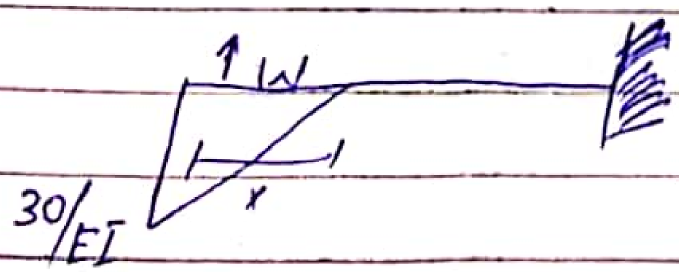
Step # 03:

Flexibility Matrix

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

(a) Apply Unit load on AR1





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

$= 20$

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

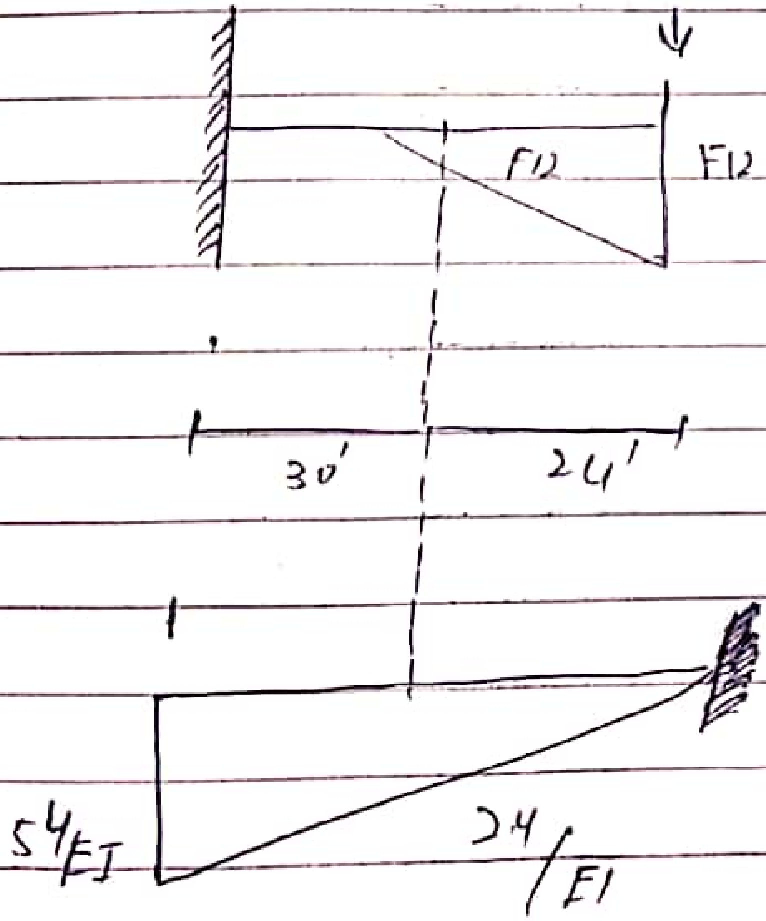
$= 450/EI$

So,

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

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

Now apply load on AR2



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

$$= 1170/EI$$

Now The distance

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

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

$$F12 = 1170/EI \times 16.92 = 19776.4/EI$$

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

Hence:-

$$F2\times2 \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix} 1/EI$$

Step 4 . Compute The value of AR.

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

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

$[F]^{-1} = 1/F$

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

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

$= (430887600 - 391968720)$

$|F| = 38918880$

$\Rightarrow Adj\,|A| = \begin{bmatrix} 47876.4 & -19796.4 \\ 79800 & 9000 \end{bmatrix}$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{38918880} \begin{bmatrix} 47876.4 & 19791 \\ 19800 & 9000 \end{bmatrix}$$

$$= \begin{bmatrix} -729000 \\ -1895400 \end{bmatrix} \frac{1}{EI} \frac{\begin{bmatrix} 47876.4 & -19796.4 \\ 79800 & 9000 \end{bmatrix}}{38918880}$$

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

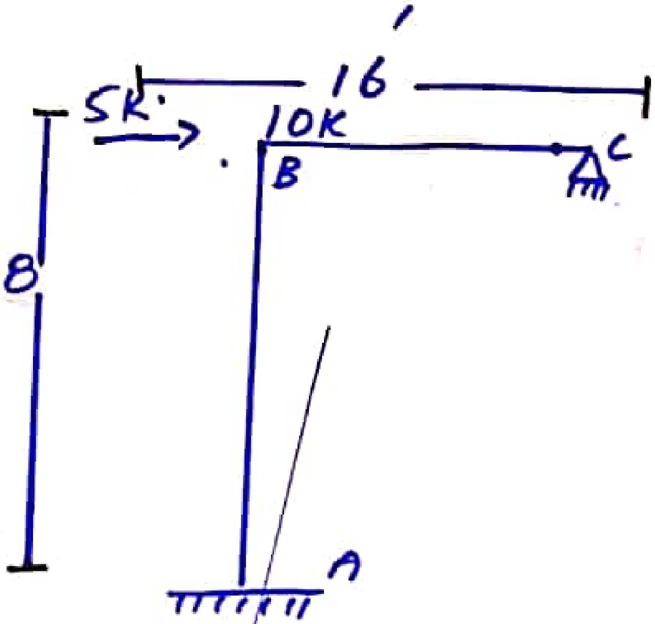
QNo 2. Difference b/w (8)

Force Method	Displacment Method
=> Ds < Dk	=> Ds > Dk
=> Forces are redundant or unknowns	=> Displacment are reduntant or unknowns.
=> Starts with equlibrium of forces.	=> Starts with compitable deformation
=> Forces found by compatibility of displacment	=> Displacment found by equilibrium equation. of forces
=> No of reduntants = Ds	=> No of reduntants = Dk
=> Not suitable for Compression.	=> Not suitable For truses.

=> Stifness Method is also called Displacment Method. it is more suitable then Force.
it is suitable for structure

analysis Matrix approaches, 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 defined, no further engineering are required in the stiffness method in order to carry out the analysis.

Q3



E = Constant

$I_c = I$

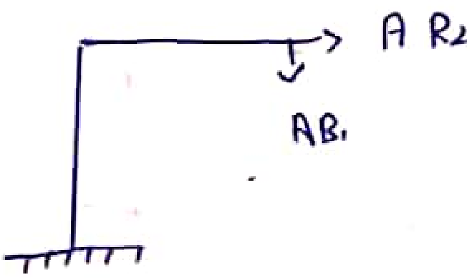
$I_B = 2I$

solution :-

Total statical Indeminy

=> R-3 = 5-3 = 2°

sTep 1 :- Identify Redoudant Actions.



$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$;

$DRS_1 = 0$

$DRS_2 = 0$.

STEP#2.

compute value OF (DRL)

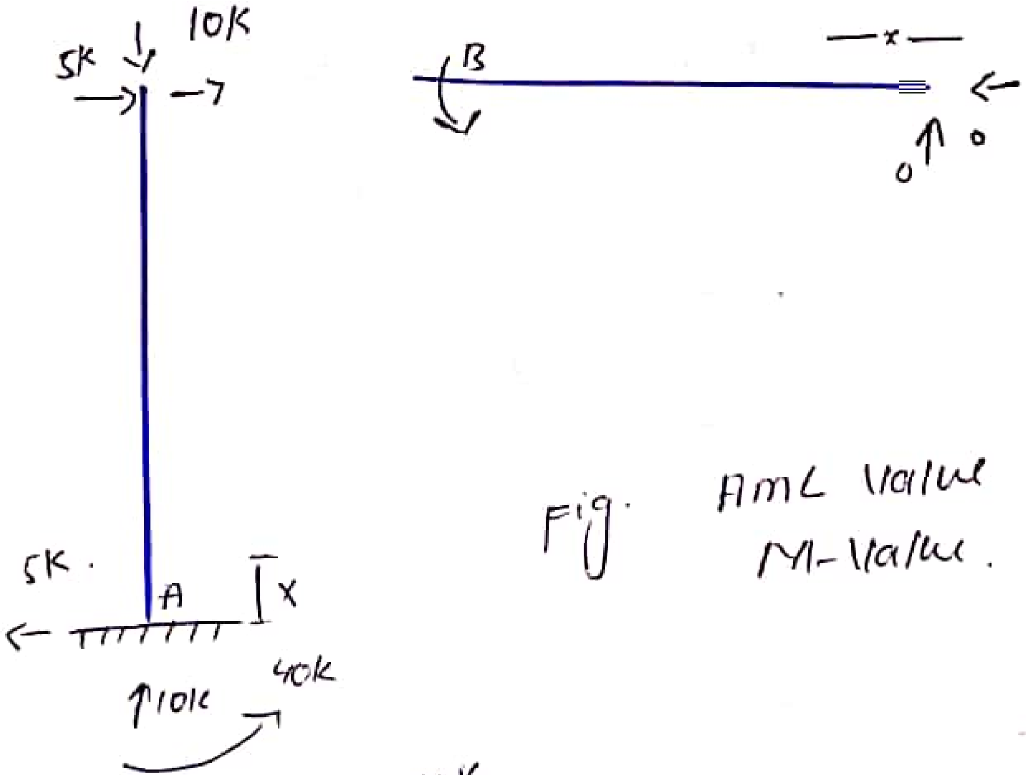


Fig. AML value
M-value.

STEP# 03:

a

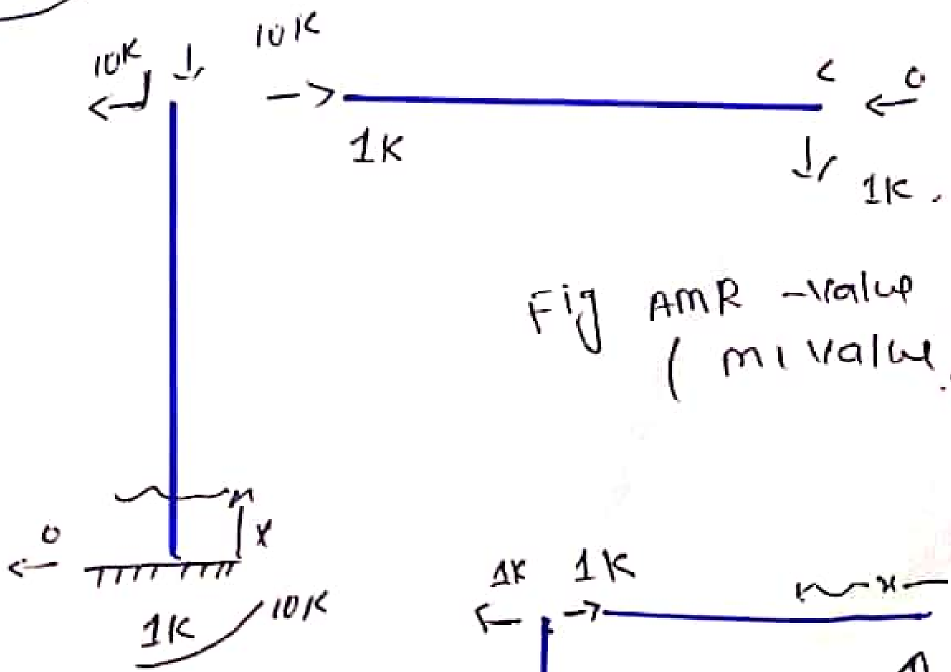
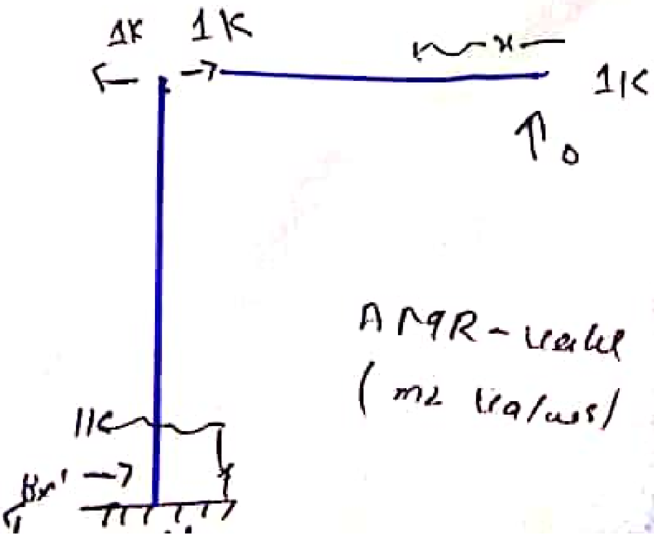


Fig AMR -value
(m1 value)



AMR-value
(m2 values)

Member	AB	BC
(scale origin should be select origin) Origin	A	C
Limits	0-8	0-6
I	I	2I
(Take x section from M figure) M	5x-40	0
m_1	-16	x
m_2	8-x	0

→ (take x section on m_1 figure from origin.)

For Finding value of DRL.

$$DRL_1 = \int_0^8 \frac{M_{AB} - m_1}{EI} + \int_0^{16} \frac{M_{BC} - M_2}{EI}$$

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

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

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

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

2) Compute Flexibility Matrix :-

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

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

$$+ \int_0^{16} \frac{x^2}{E(2)I}$$

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

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

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

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

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

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

$$F_{22} = 170.67$$

As we know that

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

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

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

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.0005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$