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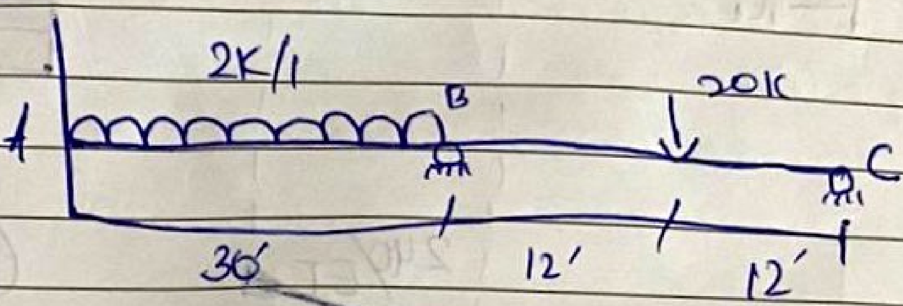
Section ⟹ B

Subject ⟹ Structural Analysis - II

Teacher ⟹ Engr. Adeed Khan

Q NO 1

1.

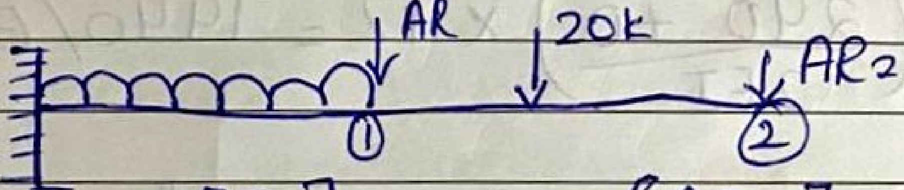


Sol:-

EI constant

S.I = 2

Step 01 : Select redundant actions

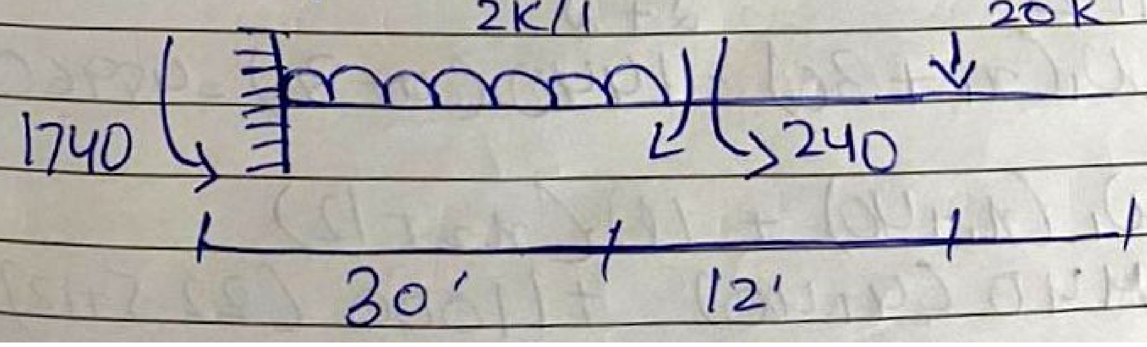


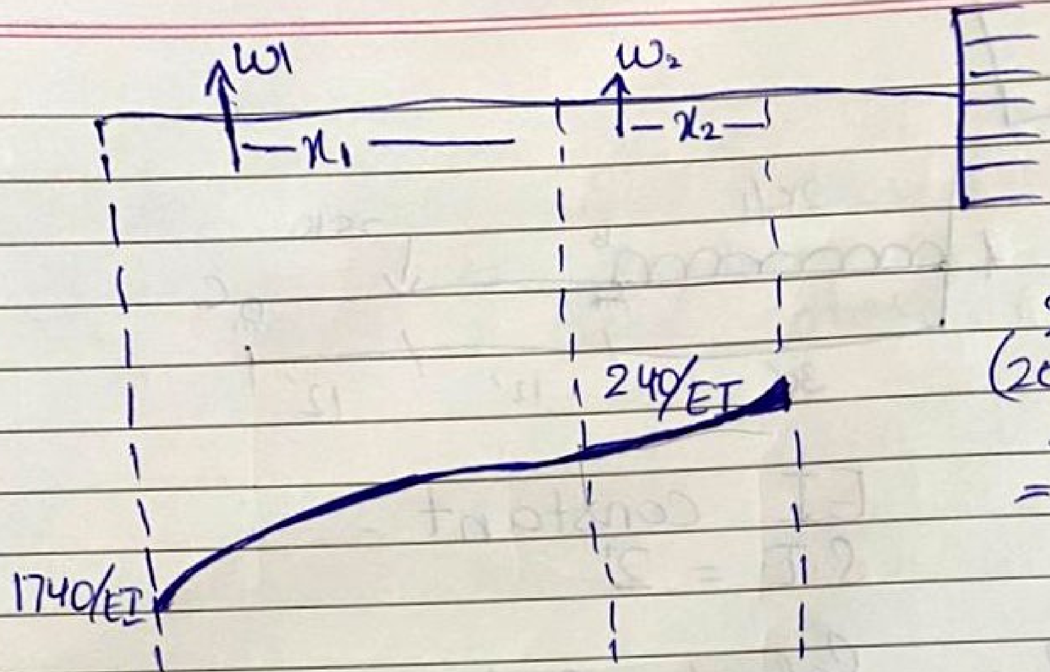
$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$, $\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$

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

Step #02

Complete the values of [DRL]





20 x 12 = 240
(20 x 42) + 2x
30 x 15
= 1740.

$$W_1 = \left(\frac{240 + 0}{2EI}\right) \times 12 = 1440/EI$$

$$W_2 = \frac{1}{n+1} \times (b \times h) = \frac{1}{2+1} \left(\frac{1100}{EI}\right) \times 30 = 1100/EI$$

$$x_1 = \frac{L}{3}\left(\frac{a+2b}{a+b}\right)$$

$$x_1 = \frac{12}{3}\left(\frac{240 + 2(0)}{240+0}\right) = 4'$$

$$x_2 = \frac{3}{n+2} \times b = \frac{3}{2+2}(30) = 22.5$$

$$DRL_1 = W_1(x_1 + 30) = 1440(4 + 30) = 48960$$

$$DRL_2 = W_1(x_1 + 40) + W_2(x_2 + 12)$$

$$= 1440(4 + 40) + 11000(22.5 + 12)$$

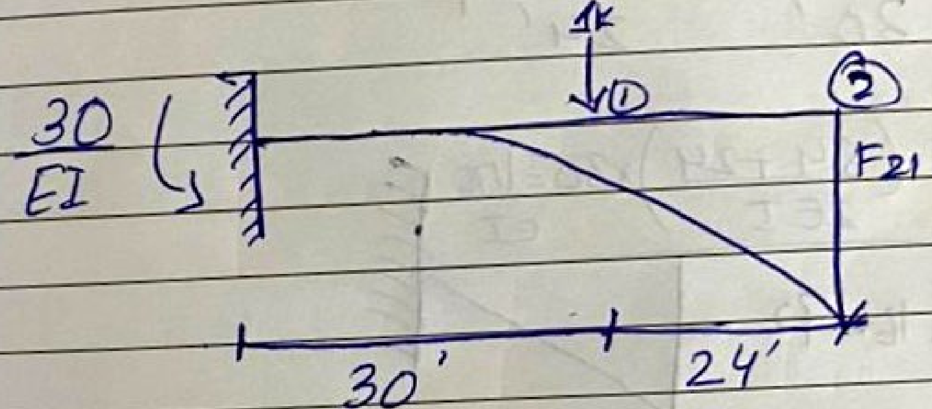
$$DRL_2 = 442860$$

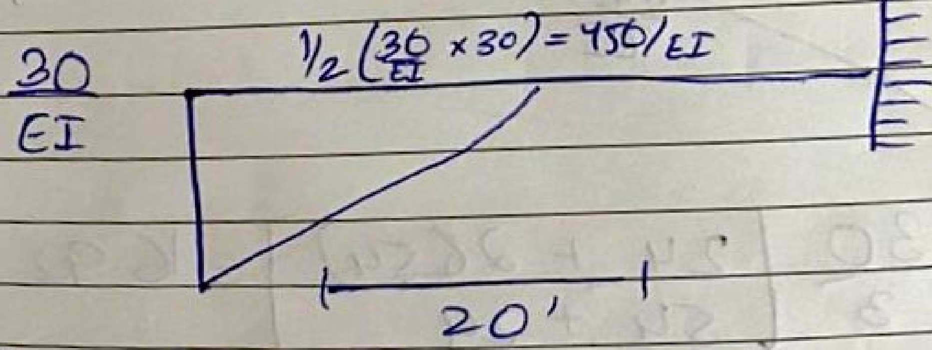
$$[DRL] = \frac{1}{EI}\begin{bmatrix} 48960 \\ 442860 \end{bmatrix}$$

Step 03 :
Construct flexibility co-efficient matrix

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

a) Apply a unit value of AR at reference p
i- Compute the value of F_{11} & F_{21}.





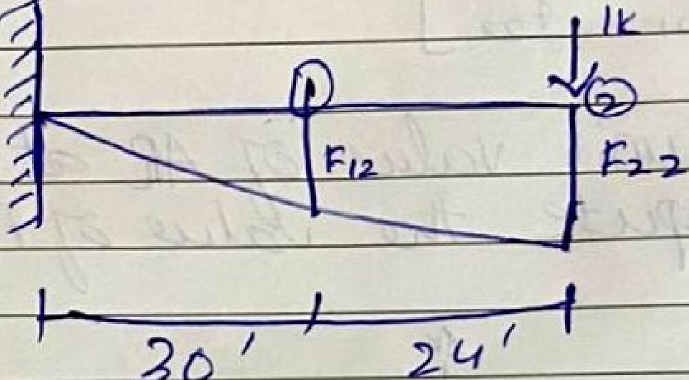
$\frac{2}{3}(30) = 20'$

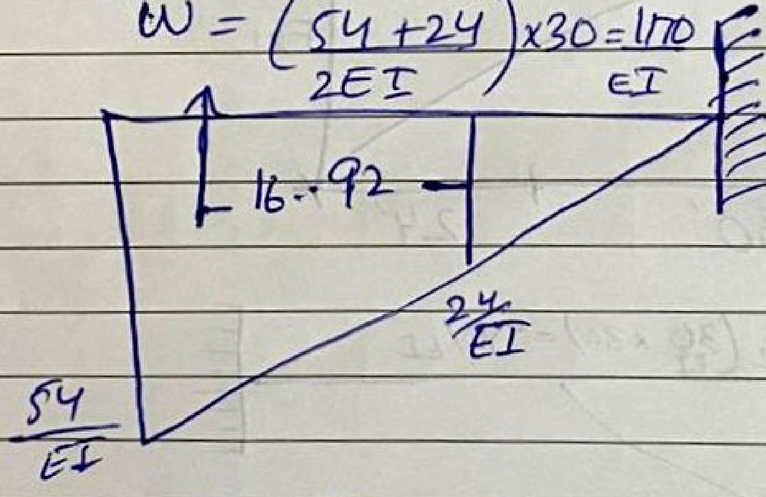
$$F_{11} = \frac{450}{EI}(20) = \frac{9000}{EI}$$

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

b. Apply a unit of AR_2 at reference point (2)

ii- Compute the value of F_{12} & F_{22}.





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

$$F_{12} = \frac{1170}{EI} \times 16.92 = \frac{19800}{EI}$$

$$F_{22} = \frac{1}{2}(54 \times 54) \times \frac{1}{3}(30) + 24$$

$$= \frac{49572}{EI}$$

QNO#2

In force method, we assume forces and moments as unknowns and solve for them. Then we calculate displacements and rotations from forces and moments.
This is better if static indeterminacy is less than kinematic indeterminacy.
Ex: three moment equation etc.

In displacement based method, we assume displacements and rotations as unknowns and solve them. Then we calculate forces and ~~solve them~~ moments from them.
This method is better if kinematic indeterminacy is less than static indeterminacy.
Ex: Slope deflection method, moment distribution method etc.

Force Method	Displacement Method
$D_s < D_k$	$D_s > D_k$
Forces are reductant or unknowns	Displacements are reductant or unknowns
Starts with equilibrium of forces.	Starts with compatible deformations
Forces found by Compability eqns of displacements	displacements found by equilibrium eqns for forces
no. of reductants = D_s not suitable for computer	no. of reductants = D_k not suitable for tresss.

Difference between force and displacement method are:-

Force Method :-

1. Assumed force as Unknown.
2. Preferable when structure has less static indeterminacy.
3. Known as Flexibility Method eg. Consistent Method of Deformations.

Displacement Method :-

1. Assumed Displacement as Unknown.
2. Preferable when structure has less Kinematic indeterminacy.
3. Known as stiffness Method. e.g. Slope Displacement Method and Moment Distribution Method.

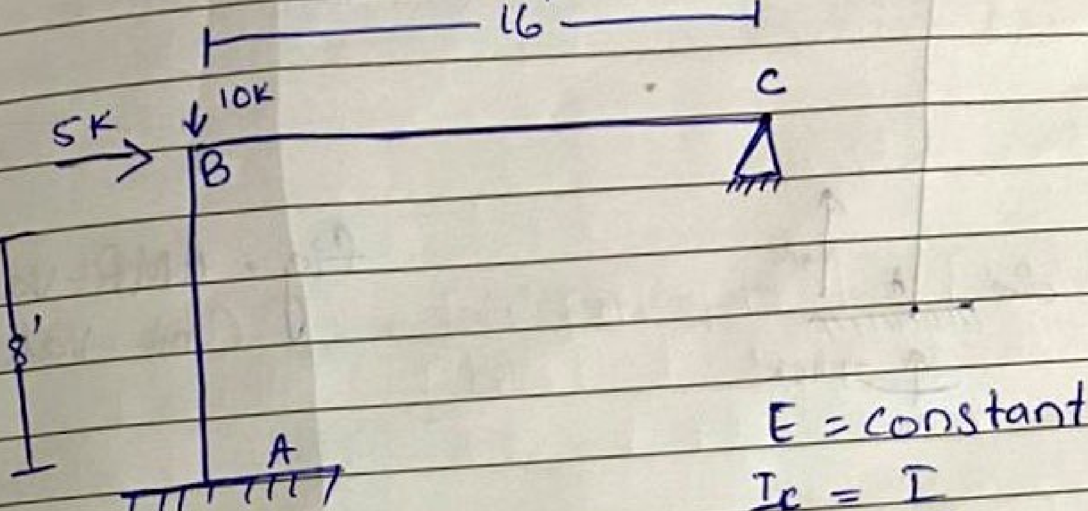
In Case of Both ended fixed support, static Indeterminacy = 6 - 3 = 3, while Kinematic Indeterminacy = 0. SO, better to Start the Calculation from moment Distribution Method.

(4)

Globally Displacement based analysis of Structure is easy and used more.

QNO#3

Pb # 01:

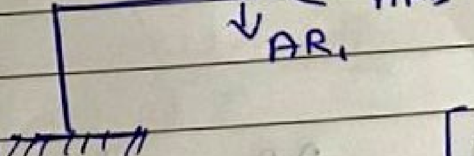


E = constant
$I_c = I$
$I_B = 2I$

Sol:-

Total statical indetermincy
$\Rightarrow R-3 = 5-3 = 2^{\circ}$

Step #01: Identify Redundant Actions



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

Step #02 : Compute value of

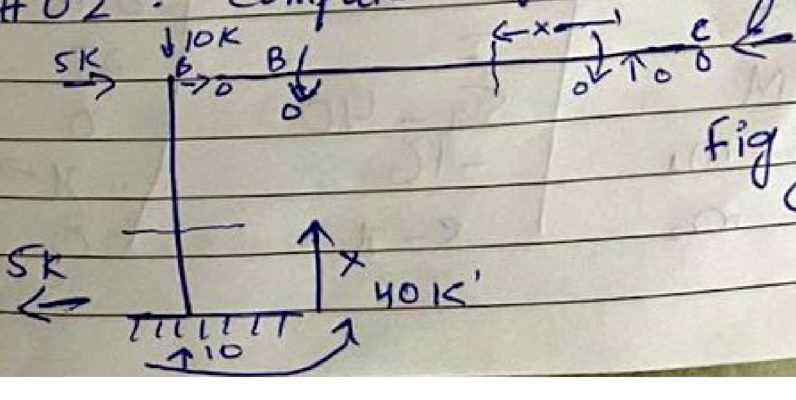


Fig : AML values (N-values).

Step # 03: [F]. or [AMR]

a)

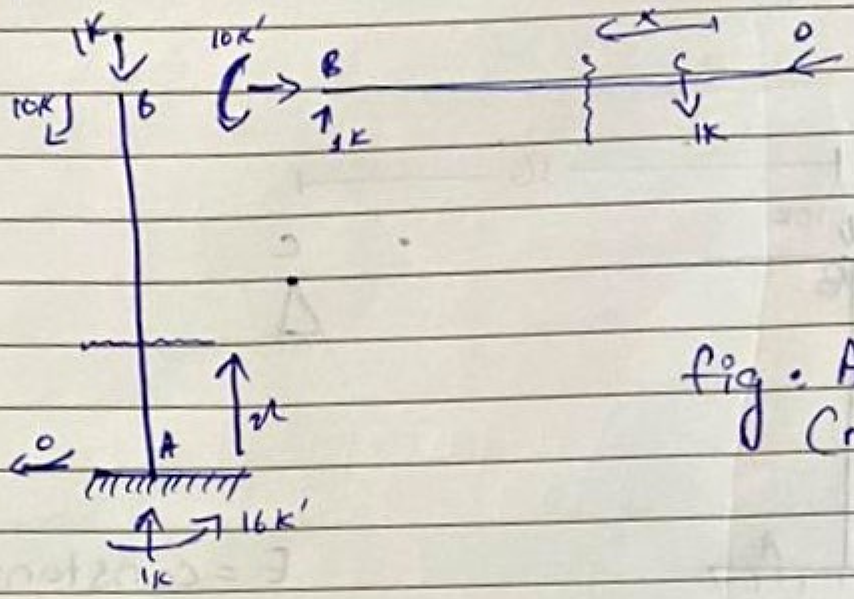


fig: AMR-values (m1 values)

b)

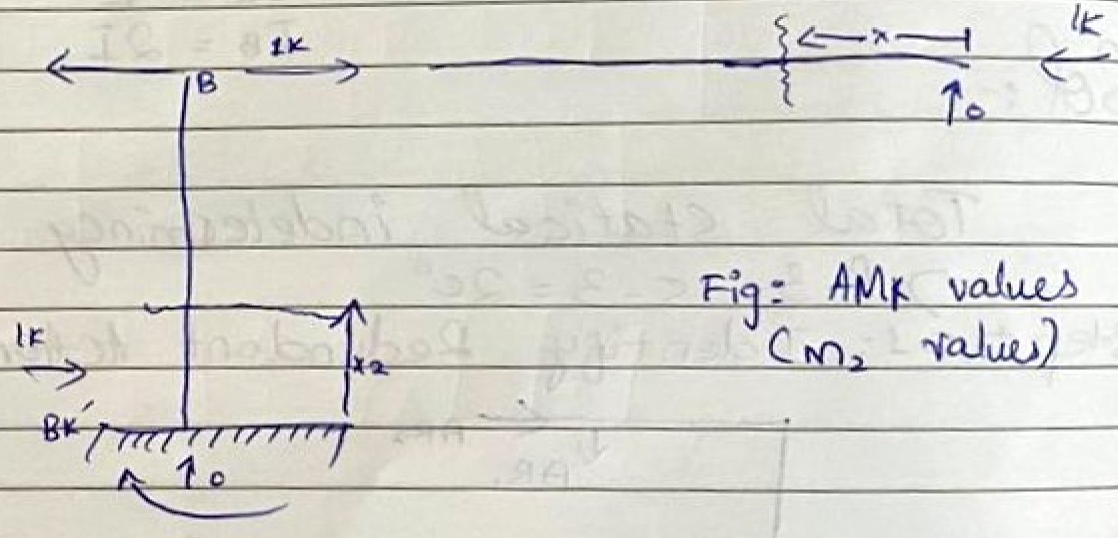


Fig: AMR values (m2 values)

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

select origin should be select the support

Take x-section on AML fig and find moment from origin

Take x-section on m_2 fig from the origin.

⇒ for Finding values of DRL's :-

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

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

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

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

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

⇒ compute Flexibility Matrix :-

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

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

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

$$F_{12} = F_{21} = \int_0^8 M_{1(AB)} \cdot M_2(AB) + \int_0^{16} m_{1(BC)} \cdot m_2(BC)$$

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

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

(4)

$F_{22} = \int_0^8 (m_2)^2_{AB}\, dx + \int_0^{4} (m_2)^2_{BC}\, dx$

$= \int_0^8 \frac{(8-x)^2}{EI} dx + \int_0^{4} \frac{0^2}{2EI} dx$

$F_{22} = 170.67$

As we know

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

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

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

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

$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.00005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$

1) click mode → click matrix
2) Mat A (1)
3) select order
4) Put values & click =
5) Press [on]
6) Shift + 4
7) Press 1
8) Now Press 2 (Mat B)
9) Select order & Put values
10) Press on
11) Shift + 45
12) Mat A × Mat B = Result

Scanned with CamScanner