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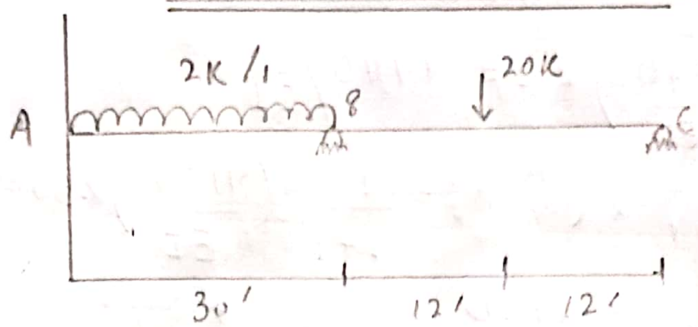
SEMESTER	SUMMER 2020 (MIDS)
SUBJECT:-	STRUCTURAL ANALYSIS - 2
INSTRUCTOR:	Engr. ADEED KHAN
SECTION:	"A"
DATE :-	21st, August, 2020

QUESTION: 01

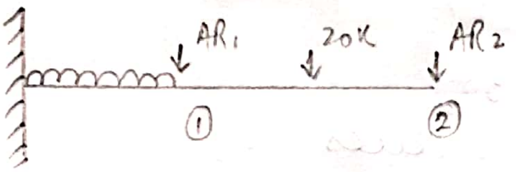


Solution:-

EI constant

S.I = 2"

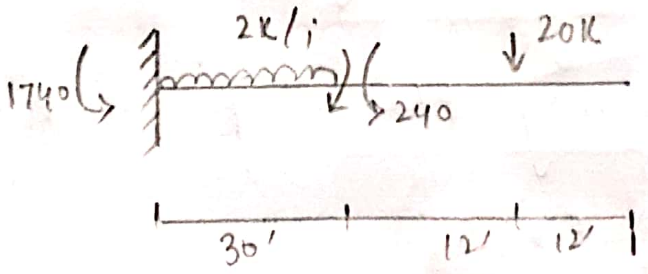
Step: 01 Select redundant action



$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} , \begin{bmatrix} AR_1 \\ A_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

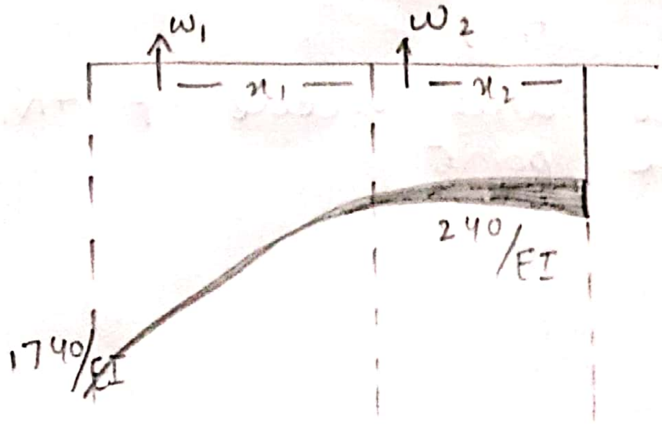
Step: 02 Now computing value of [DRL]



$20 \times 12 = 240$

$(20 \times 42) + 2 \times 30 \times 15$

$= 1.40$



Now

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

$$W_2 = 1/_{n+1} \times (b \times h) = \frac{1}{2+1}\left(\frac{1100}{EI}\right) \times 30 = 11000/EI$$

$$x_1 = L/_3 \left(\frac{a+2b}{a+b}\right)$$

$$\Rightarrow \quad x_1 = 12/_3 \left(\frac{240+2(0)}{240+0}\right) = 4'$$

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

Now,

$$DRL_1 = w_1 (x_1 + 30)$$

putting values

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

$$DRL_2 = w_1 (x_1 + 40) + w_2 (x_2 + 12)$$

putting values

$$DRL_2 = 1440 (4+40) + 11000 (22.5+12)$$

$$DRL_2 = 4,42,860$$

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

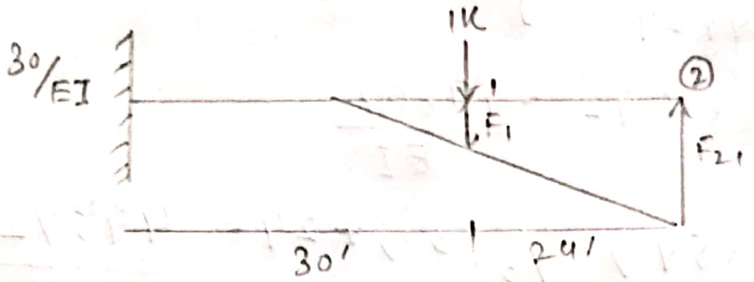
Step: 03

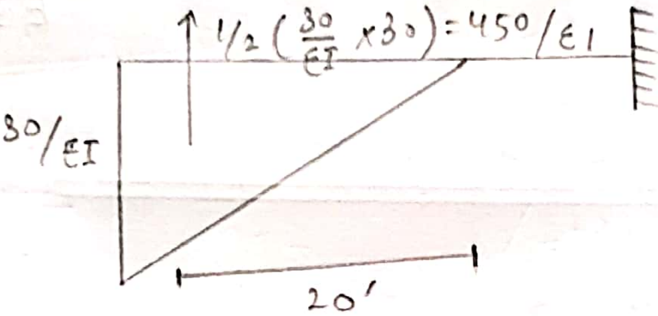
Now constructing flexibility co-efficient matrix

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

→ Now apply a unit value of AR_1 at reference point

1. Compute value of F_{11} and F_{12}





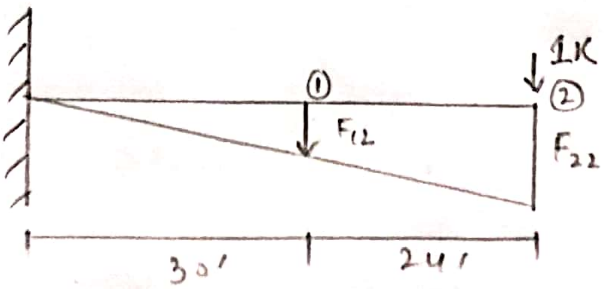
$2/3\,(30) = 20'$

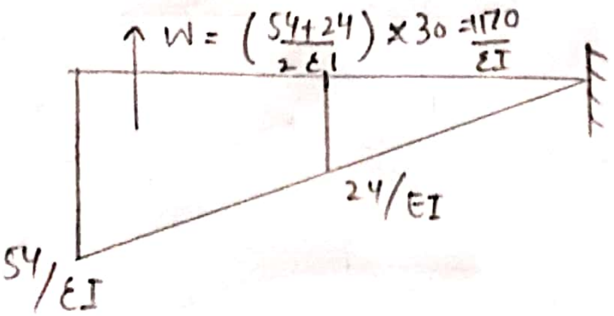
$$F_{11} = \frac{450}{EI}(20) = \frac{9000}{EI}$$

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

b. Apply a unit value of AR_2 at reference point ②

Compute value of F_{12} and F_{22}





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

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

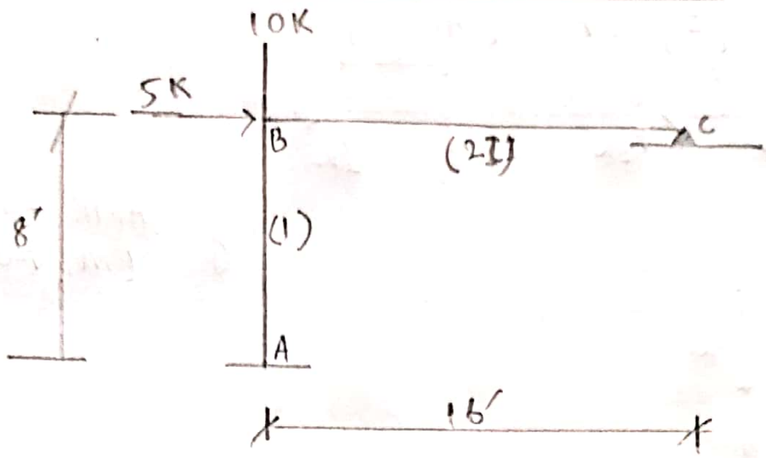
$$F_{22} = \frac{1}{2}(54\times54)\times \frac{1}{3}(30)+24 = \frac{49572}{EI}$$

QUESTION: 02

FORCE METHOD	DISPLACEMENT METHOD
1. We assume force and moment as unknown and solve for them	1. We assume displacement and rotation as unknown and solve for them.
2. Displacement and rotation calculated from forces and ~~movement~~ moment	2. Force and moment calculated from displacement and rotation
3. Better if static indeterminancy is less than kinetic indeterminancy.	3. Better if kinetic indeterminancy is less than static indeterminancy.
4. Starts with equilibrium of forces	4. Starts with compatible deformations
5. Forces found by compatibility equation of displacement	5. Displacement found by equilibrium equation
6. no. of reduntants = D_s	6. no. of reduntants = D_k
7. $D_s < D_k$	7. $D_s > D_k$
8. Not suitable for compatibility	8. Not suitable for trusses
9. It's column analogy method	9. It's Kani's method
10. Method of consistent deformation	10. Slope deflection method

→ Double Ingegration Method is more suitable structure analysis of matrix appraach because it's more accurate method and this method involve step by step integration so this is preferred for structure analysis of matrix approach.

QUESTION: 03



Solution:-

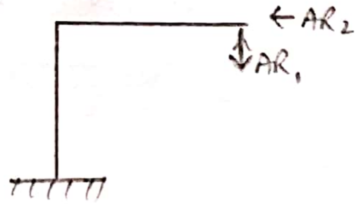
E = constant

$I_c = I$

$I_B = 2I$

Step: 01

→ Identify Redundant Action



$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \qquad \begin{bmatrix} DRS_1 \\ DRs \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Step: 02

Now computing value of DRL

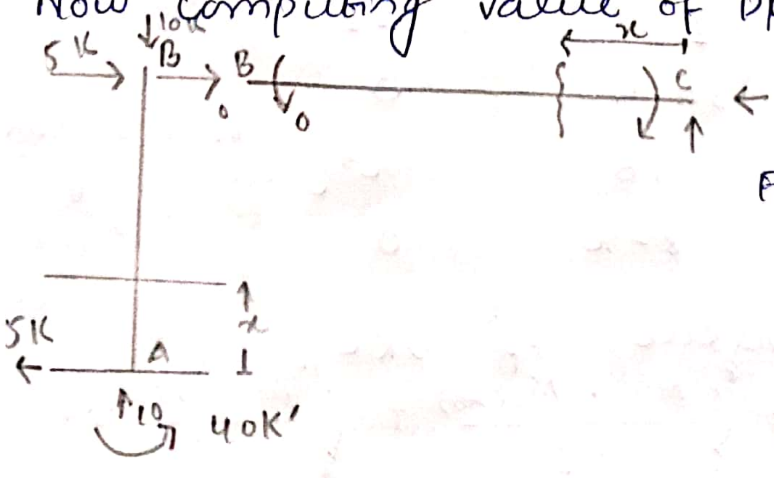


Fig: AML values (M.values)

Step: 03

Finding [F] or [AMR]

a)

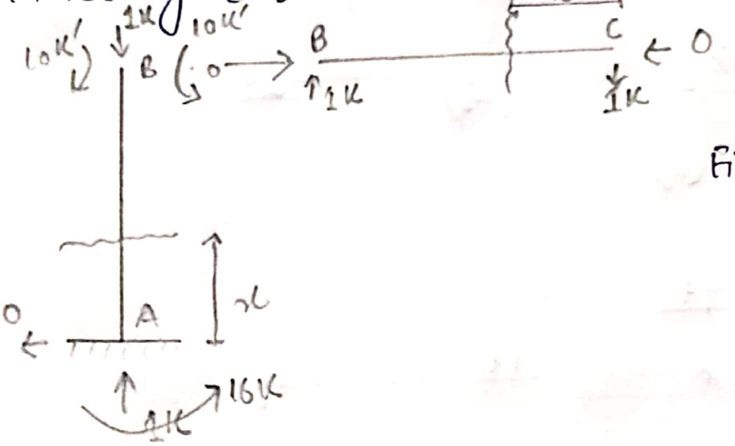


Fig AMR - values (M_1 values)

b)

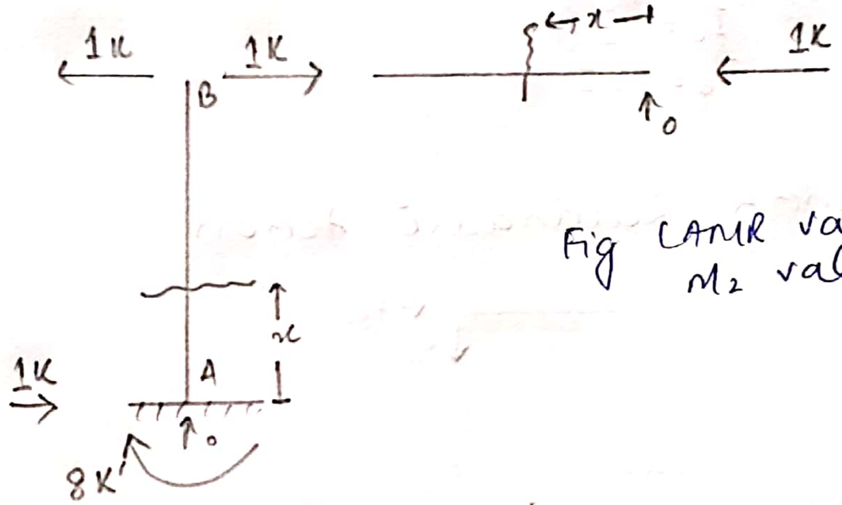


Fig (AMR values) M_2 value

Member	AB	BC
[should be selected, the support] Origin	A	C
Limits	0–8	0 – 16
I	I	2 I
[Take x-section on AML Fig and find moment] ← M	$5x-40$	0
m_1	-16	x → [Take x . section on m_1 Fig from origin]
m_2	$8-x$	0

For Finding value of DRL

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

putting values

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

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

Now

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

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

⇒ Now computing flexibility Matrix

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

$$\Rightarrow F_{11} = \int_0^8 \frac{m_1^2 CAB}{EI} + \int_0^{16} \frac{m_1^2 (BC)}{EI} =$$

putting values

$$= \int^8 \frac{(-16)^2\,dx}{EI} + \int^{16} \frac{x^2\,dx}{E(2I}$$

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

$$F_{12} = F_{21} = \int_0^8 m_1 CAB).\ m_2 (AB) + \int_0^{16} m_1 (BC) + m_2 (BC))$$

putting values

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

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

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

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

$F_{22} = 170.67$

Now As we already know

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

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

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

$$= \begin{bmatrix} 2730.67 & -512 \\ -1512 & 170.67 \end{bmatrix}^{-1} \times \begin{bmatrix} 0 - 2560 \\ 0 - 853.33 \end{bmatrix}$$

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