Mid Term

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Subject : Structure Analysis - II

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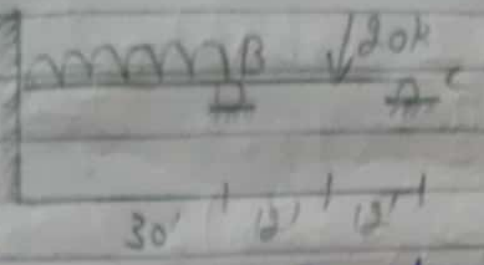
P#01

Q 1

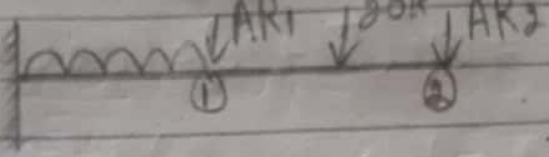
Solution:-



$EI = Constant$

$S.I = 2°$

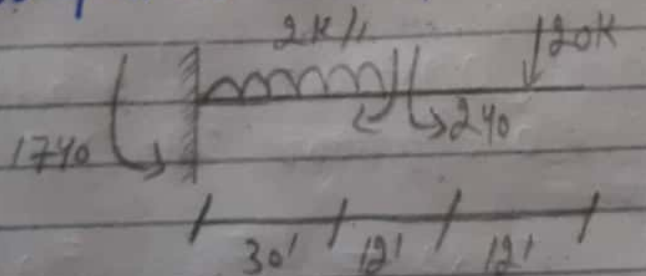
Step# 01: Select redundant actions

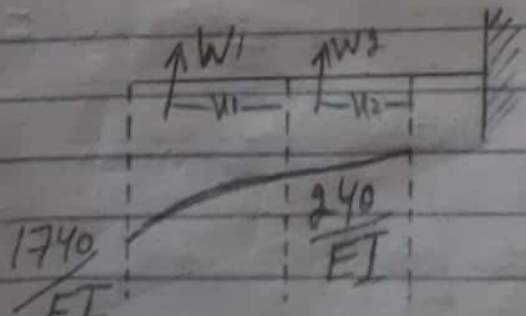


$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step# 02: Compute the Value of [DRL]





P#02

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

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

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

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

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

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

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

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

$$DRL_2 = 442860$$

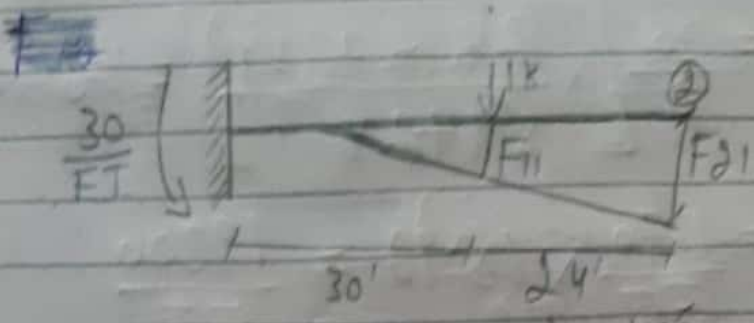
$$[DRL] = \frac{1}{EI}\begin{bmatrix} 48960 \\ 442860 \end{bmatrix}$$

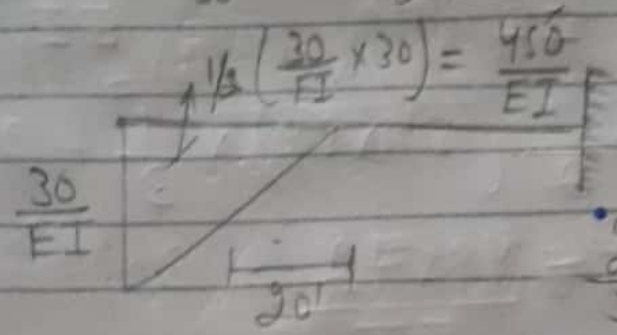
Step#03 Construct flexibility co-efficient matrix

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

(a) Apply a unit value of AR_1 at reference point

(i) Compute the value of F_{11} & F_{21}



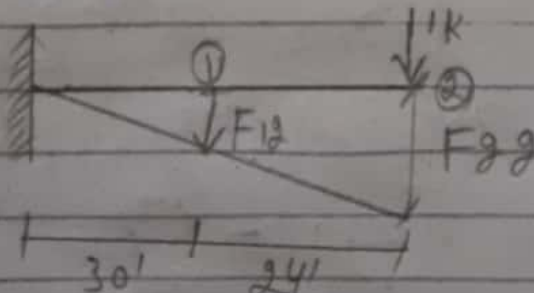


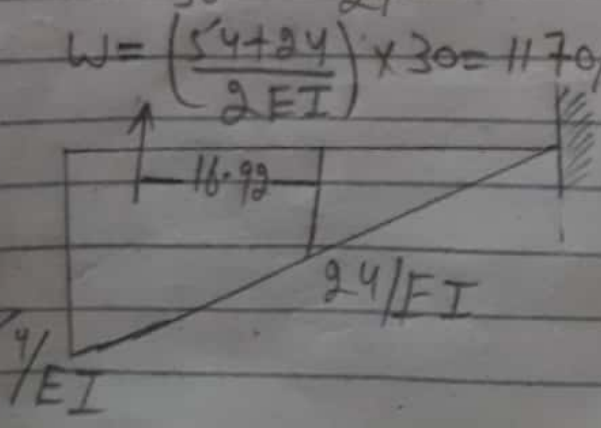
$$F_{11} = \frac{450}{EI}(20) = \frac{9000}{EI}$$

$$F_{21} = \frac{450}{EI}(20+24) = \frac{198000}{EI}$$

(b) Apply a unit of AR2 at reference point (2).

(ii) Compute the value of F_{12} & F_{22}





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

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

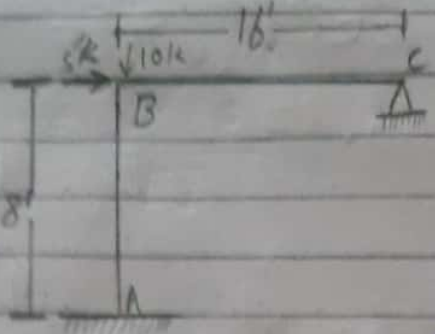
$$F_{22} = \frac{1}{2}(54 \times 54) \times \frac{1}{3} + 24$$

$$\boxed{F_{22} = \frac{49572}{EI}}$$

Answer

Q 3

Solution:-



E = Constant

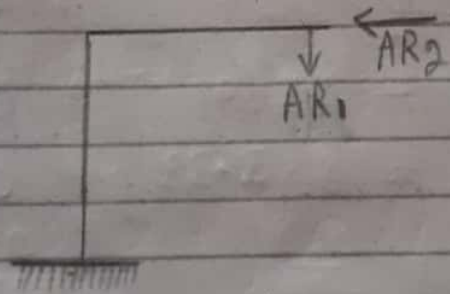
$I_c = I$

$I_B = 2I$

Total Statical indeterminacy

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

Step# 01 Identify redundant actions



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

Step# 02 Compute Value of [DRL]

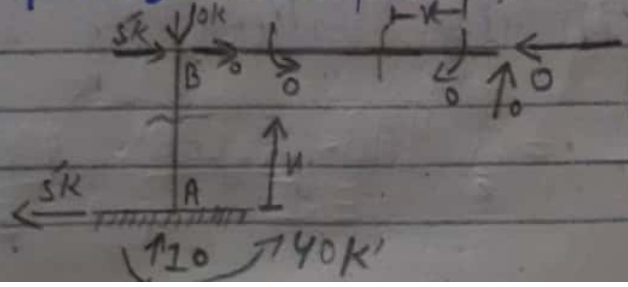


Fig: AML Value (M. Values)

Step# 03 :- (F) or (AMR)

(a)

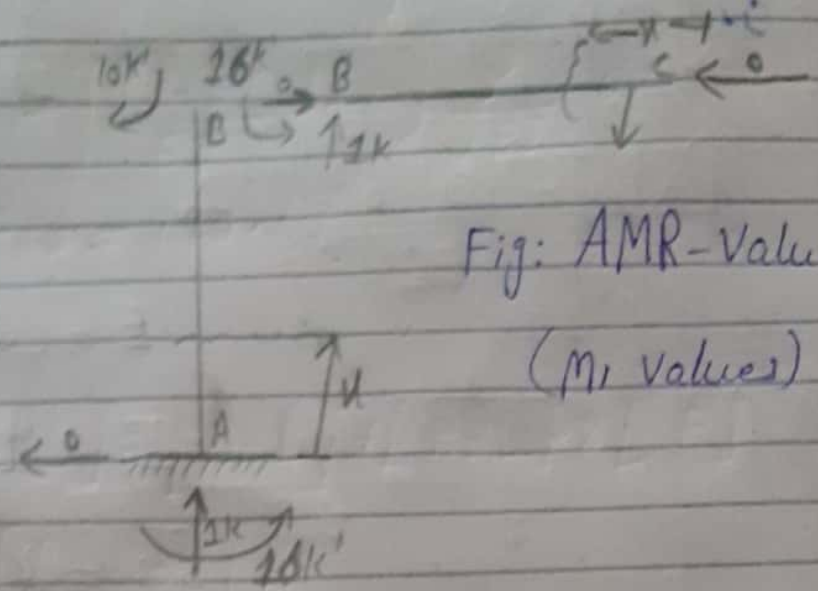


Fig: AMR-Values

(M_1 values)

(b)

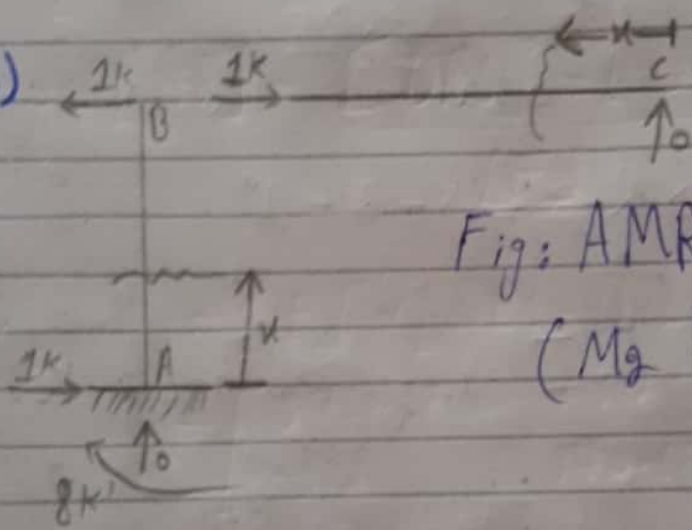


Fig: AMR-values

(M_2 values)

Member	AB	BC
Origin	A	C
Limits	0-8	0-16
I	I	2I
M	5x-40	0
M1	-16	x
M2	8-x	0

- For finding values of DRL:-

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

P# 07

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

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

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

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

⇒ Compute Flexibility matrix-

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

$$\Rightarrow F_{11} = \int_0^8 \frac{m_1^2 (AB)}{EI} + \int_0^{16} \frac{m_2^2 (BC)}{EI}$$

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

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

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

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

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

P#08

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

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

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

As we know

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

~~$\Rightarrow [RR] \rightarrow [A$~~

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

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

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

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

Answer

Q2

* Force Method:- → In force Method forces are redundant or unknows.

→ Force method starts with equilibrium of forces.

→ Forces found by compatibility equations of displacements.

→ No of redundants = DS

→ Not suitable for compute

→ It strain energy method

DS < DK

→ Known as flexibility method.

* Displacement Method:- → Also known as stiffness matrix Method

→ Slope deflection method

→ Moment distribution method

Ds > Dk

→ Displacements are redundants or unknowns.

P#10

→ Starts with Complete deformations

→ Displacement found by equilibrium equation of forces.

→ No of redundants = DK

→ Not Suitable for truss.

Suggestion:- Displacement method is below and suitible because It is used globally and is very easy too.