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Subject	Structure II
Section	A
Submitted to	Sir Adeel
Exam	Mid Term

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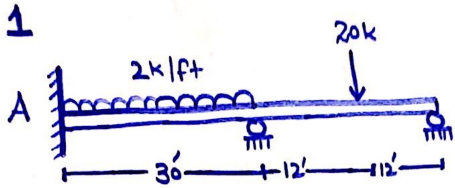
Q No 1

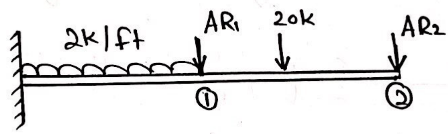


Solution:-

Structural Indeterminancy = 2°

Step:-1

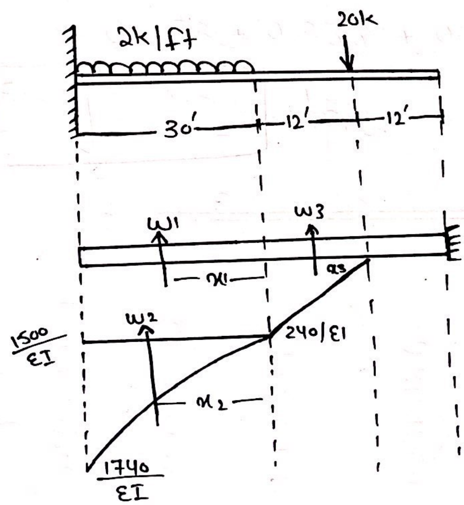
Select Redundant Actions



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

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

Step# 2 Compute the values of [DRL]



$w_1 = 1500 \times 30 = 45000$ $20 \times 12 = 240$

$w_2 = \frac{1}{3} \times 30 \times 240 = 2400$ $20 \times (12 + 30) + 2 \times 30 \times 15 = 1740$

$w_3 = \frac{1}{2} \times 12 \times 240 = 1440$

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

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

$x_3 = \frac{2}{3} \times L = \frac{2}{3} \times 12^{4} = 8'$

Now Finding DRL:-

$$DRL_2 = w_1 \times (x_1 + 24) + w_2 \times (x_2 + 24)\ w_3 \times (x_3 + 12)$$
$$= 45000(15+24) + 2400(22.5+24) + 1440(8+12)$$
$$= 1755000 + 111600 + 28800$$

$$DRL_2 = 1895400/EI$$

$$DRL_1 = w_1(x_1) + w_2(x_2)$$
$$= 45000(15) + 2400(22.5)$$
$$= 675000 + 54000$$
$$= 729000$$

So:-

$$DRL = \frac{1}{EI}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$$

Step #3

Flexibility Matrix

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

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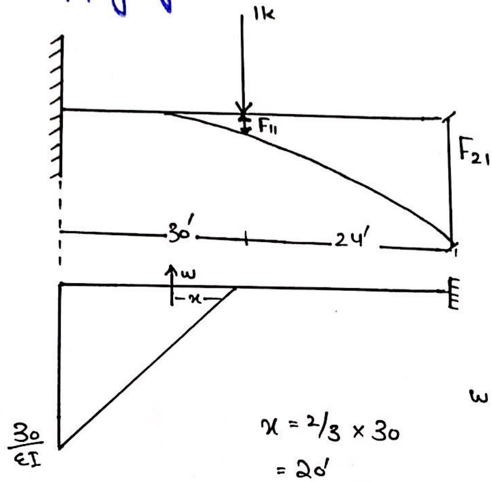
a) Applying Unit load on AR_1



$x = 2/3 \times 30$
$= 20'$

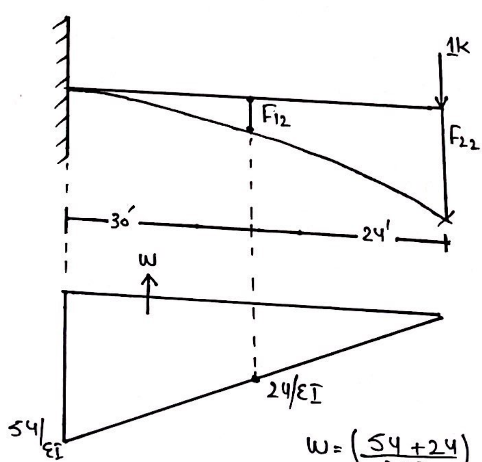
$w = 1/2\left(\frac{30}{EI} \times 30\right)$
$= 450/EI$

So,

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

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

Now Apply Unit load on AR_2 :-



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

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Now the distance

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

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

$$\Rightarrow F_{12} = \frac{1170}{EI} \times 16.92 = \frac{19796.4}{EI}$$

$$\Rightarrow F_{22} = \frac{1170}{EI} \times (16.92+24) = \frac{47876.4}{EI}$$

Hence:-

$$F_{2\times2} = \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix} 1/EI$$

Step: 4 Compute the values of AR

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

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

$$[F]^{-1} = 1/|F| \times Adj\ F$$

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

$$|F| = (9000 \times 47876.4 - 19796.4 \times 1980)$$

$$(430887600 - 391968720)$$

$$|F| = 38918880$$

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} 1/EI \times \frac{1}{38918880}$$

$$= \begin{bmatrix} -729000 \\ -1895400 \end{bmatrix} 1/EI \times \frac{\begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}}{38918880}$$

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

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Question: No 2

Answer:-

Force Method	Displacement Method
Ds < DK	Ds > DK
Forces are redundent or unknowns.	Displacement are redundent or unknowns.
Starts with equilibrium of forces.	Starts with compatible deformations.
Forces found by Compatibility equations of displacements.	Displacement found by equilibrium equations of forces.
No of redundents = Ds	No of redundents = DK
Not suitable for computer	Not suitable for turns.
Method of Consistent deformation	Slope deflection method.
Theorem of least work.	moment distribution method.
Column analogy method.	Kani's method.
Flexibility matrix method	Stiffness matrix method.
Type of indeterminacy static indeteminacy.	Types of indeterminacy kinematic indeterminacy.

- In the Force method of analysis primary unknown are force in this method compatibility equations written for displacement and rotations which are calculated by force displacement equations in the displacement method of analysis the primar unknowns are the displacement.

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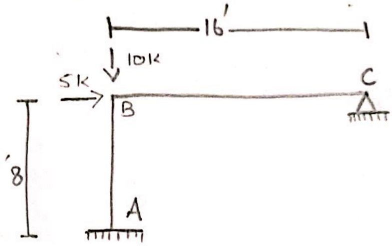
Q3)

Solution:-



E = constant

I = I

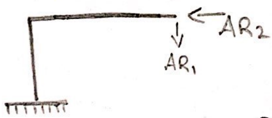
I_B = $2I$

Total Statical indeterminacy

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

Step # 01

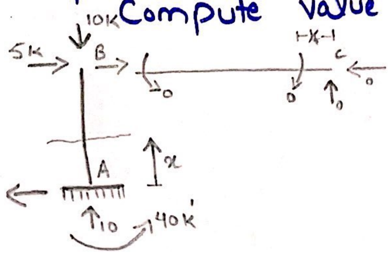
Identify Redundant Actions



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

Step # 2

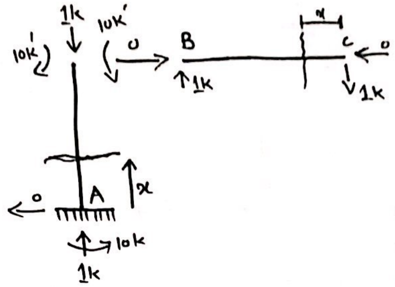
Compute value of [DRL]



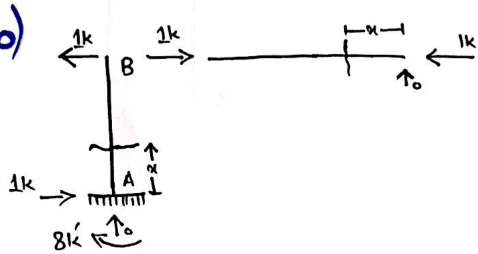
Step # 3

[F] or [AMR]

a)



(b)



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

⇒ **For Finding values of DRL's:-**

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

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

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

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

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

⇒ **Compute Flexibility Matrix :-**

$$F_{2\times2}^{-1} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}$$

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

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

$$F_{12} = F_{21} = \int_0^8 M_1(AB) \cdot M_2(AB) + \int_0^{16} m_1(BC) \cdot M_2(BC)$$

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

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

$$F_{22} = \int_0^8 (M_2)^2_{AB} \, dx + \int_0^{16} (M_2)^2_{BC} \, dx$$

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

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

As we know that

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

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

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

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

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

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