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Paper : Structure II.

Section : "B"

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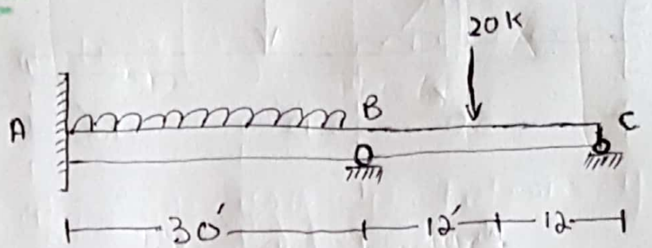
IINU. Official.

Q No# 1



$EI = \text{Constant};$

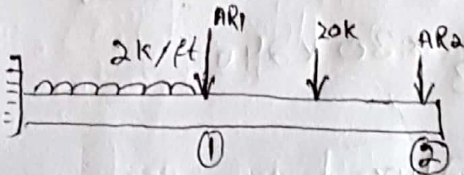
Solution :

First of all Find indeterminany :

$\Rightarrow \quad S.I = 2^\circ$

Step # 1

Select Redundant Actions:



$$\begin{bmatrix} DRS_1 \\ DR_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

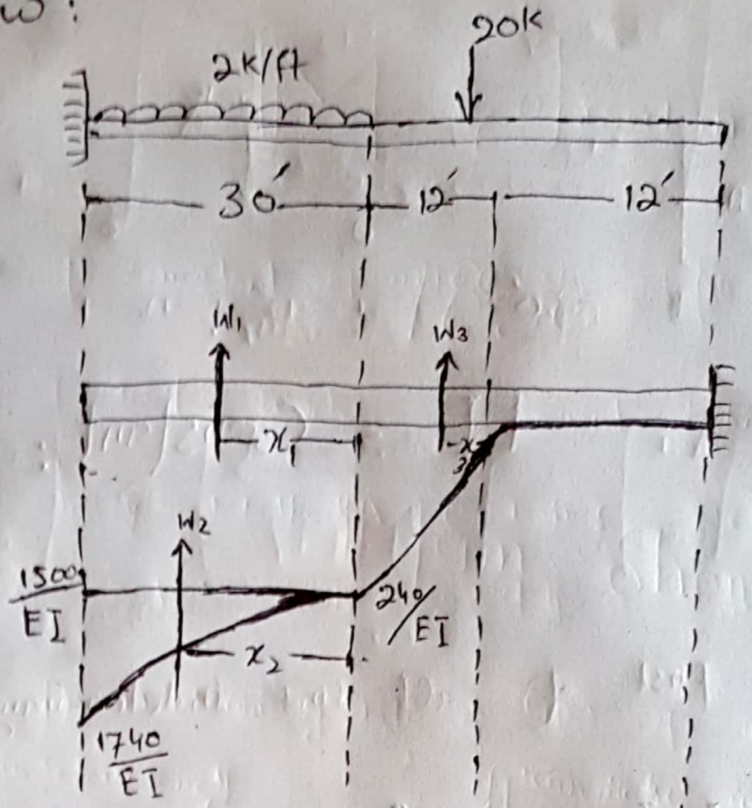
$$[DRS] = [DRL] + [F] \times [AR]$$

Step # 2

compute the value of [DRL]

P.T.O

NOW :



$\because 20 \times 12 = 240$

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

NOW;

$\Rightarrow W_1 = 1500 \times 30 = \boxed{45000}$

$\Rightarrow W_2 = \frac{1}{3} \times 30 \times 240$

$\Rightarrow \boxed{W_2 = 2400}$

$\Rightarrow W_3 = \frac{1}{2} \times 12 \times 240$

$\boxed{W_3 = 1440}$

$\Rightarrow x_1 = b/2$

$= 30/2$

$\boxed{x_1 = 15'}$

P.T.O

$\Rightarrow \quad x_2 = \frac{3}{n+2} \times L$

$\Rightarrow \quad \frac{3}{2+2} \times 30 =$

$\boxed{x_2 = 22.5'}$

$\Rightarrow \quad x_3 = \frac{2}{3} \times L$

$= \frac{2}{3} \times 12$

$\boxed{x_3 = 8'}$

$\Rightarrow$ Now Finding DRL:

$\Rightarrow DRL_2 = W_1 \times (x_1 + 24) + W_2 \times (x_2 + 24) + W_3 \times (x_3 + 12).$

Put value:

$\Rightarrow 45000(15 \times 24) + 2400(22.5 + 24) + 1440(8 + 12).$

$\Rightarrow$ using calculator.

$\Rightarrow 1755000 + 111600 + 28800$

$\boxed{DRL_2 = \frac{1895400}{EI}}$

Now DRL$_1$:

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

$= 45000(15) + 2400(22.5).$

$\boxed{DRL_1 = 729000}$

So;

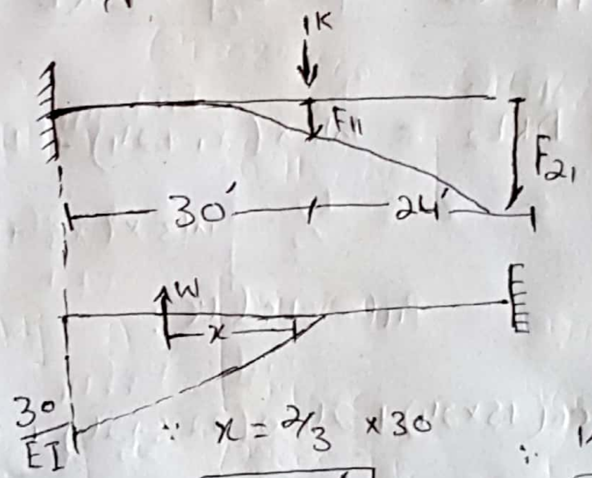
$$DRL = \frac{1}{EI}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}.$$

Step # 3

Flexibility Matrix:

$$\Rightarrow \quad [F]_{2\times 2} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}.$$

(a) Appling unit load on AR_1.



$\because x = \frac{2}{3} \times 30$ $\quad\boxed{x = 20'}$

$\therefore |W| = \frac{1}{2}\left(\frac{30}{EI} \times 30\right)$ $\quad\boxed{|W| = 450/EI}$

So;

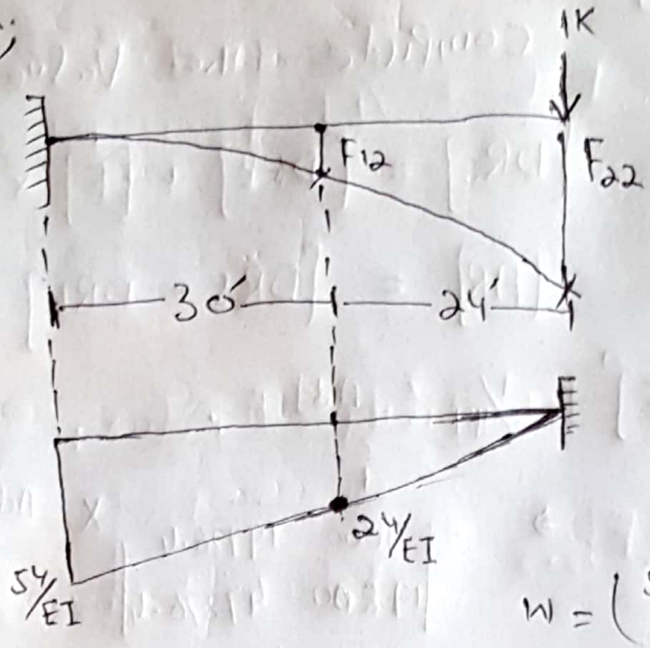
$$\Rightarrow \quad F_{11} = \frac{450}{EI}(20) = \boxed{\frac{9000}{EI}}$$

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

Now

Apply unit load on AR_2

Then;



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

$$\boxed{w = \frac{1170}{EI}}$$

Now the distance:

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

Put value:

$$\Rightarrow \frac{30}{3}\left[\frac{24+2(54)}{54+24}\right] \quad \because \; b = 24, \; a = 54$$

$$\boxed{x = 16.92'}$$

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

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

$$\boxed{F_{22} = \frac{47876.4}{EI}}$$

P.T.O.

Step# 4

Compute the Value of AR.

$\Rightarrow [DRs] = [DRL] + [F] \times [AR]$.

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

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

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

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

$(430887600 - 391968720)$.

$\Rightarrow \boxed{|F| = 38918880}$

NOW;

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

$$\Rightarrow \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} / EI \times \frac{1}{38918880} \begin{bmatrix} 47876.4 & -1976.4 \\ -19800 & 9000 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} -729000 \\ -1895400 \end{bmatrix} / EI \times \begin{bmatrix} \frac{47876.4 \quad -19796.4 \\ -19800 \quad 9000}{38918880} \end{bmatrix}$$

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

Answer.

The End!

Q No 2 :

Different b/w force method & displacement method and suggest which method is more suitable .... ?

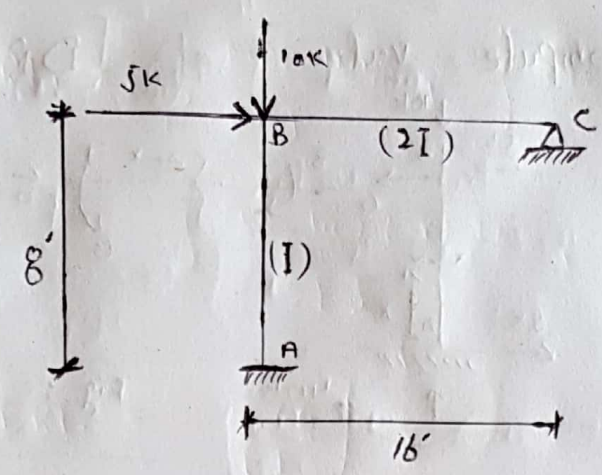
Ans :

In the force method of analysis primary unknow are force in this method compatibilaty equations written for displacement & rotations which are calculated by force displacement equations in the displacement method of analysis the primary unknows are the displacement.

P.T.O

Force Method	Displacement Method
(1) Method of consistant deformation	(1) slope deflection Method.
(2) Theorem of least work.	(2) moment distribution Method.
(3) Column analog Method	(3) Kain's Method.
(4) Flexibility matrix Method.	(4) Stiffness matrix method.
⇒ Types of indeterminacy static indeterminancy.	⇒ Types of indeterminancy kinematic indeterminacy.
(5) Govervesing Govering equation compatibality equation.	(5) Governing equation equilibrium equation.
(6) Force displacement relation Flexibilty matrix.	(6) Force displacement relation Stiffness . matrix.
(7) Assumed force as Unknow	(7) Assumed Displacement as Unknow.
(8) Preferable when structure has static indeterminancy.	(8) Preferable when structure has less kinematic indeterminancy.
(9) Know as Flexibility method e.g consistent method of deformations	(9) Know as stiffness method e.g slope Displacement method & moment Distribution method.

Q No # 3



E = constant

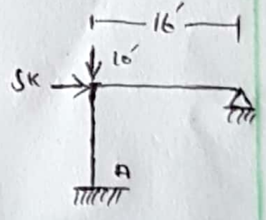
$I_c = I$

$I_B = 2I$

Solution :

Total statical indeterminacy .

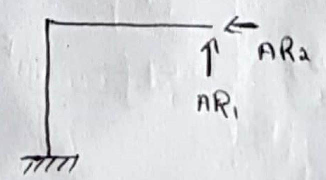
$\Rightarrow R-3 = 5-3$



$\boxed{R = 20}$

Step # 01

Identify Redundant Action .



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

Step # 2

Compute value of [DRL].

⇒

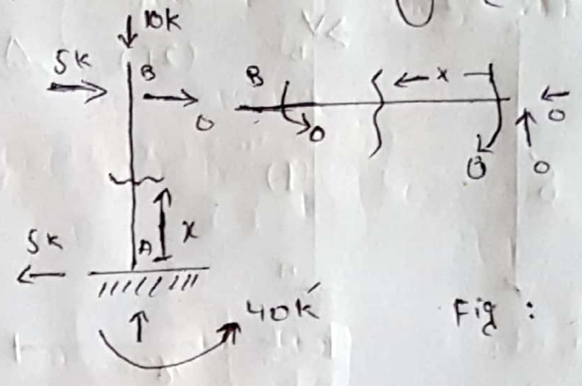


Fig : AML values (M-values).

Step # 3

[F]. or [AMR].

(a) ⇒

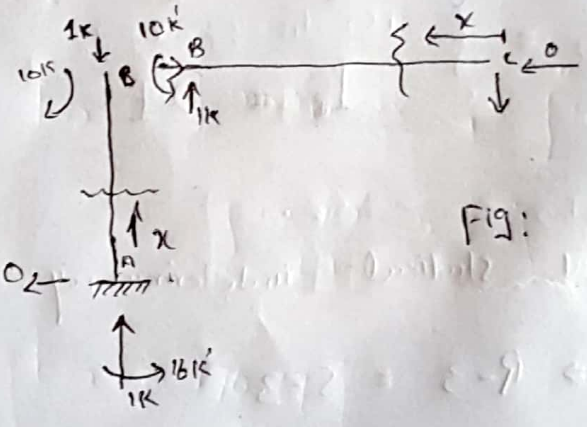


Fig: AMR - values. (m_1 values)

(b) ⇒

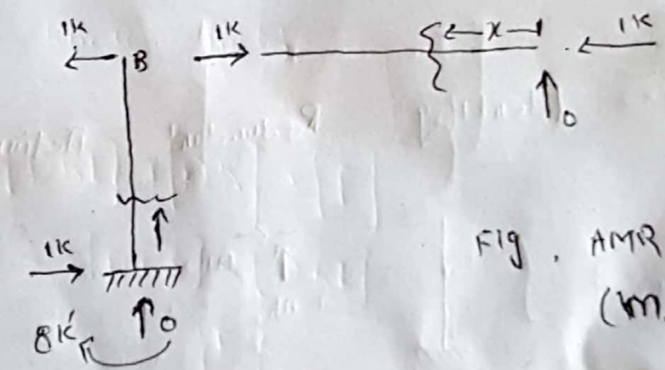


Fig. AMR values (m_2 values).

⇒

Member	AB	BC
origin	A	C
Limit	0-8	0-16
I	I	2I
M	$5x-40$	0
m_1	-16	x
m_2	$8-x$	0

P.T.O

⇒ For finding values of DRL :

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

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

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

⇒ DRL_2 :

$$DRL_2 = \int_0^8 \frac{(15x-40)(8-x)\,dx}{EI} + \int_0^{16} \frac{(0 \cdot 0)\,dx}{EI}$$

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

Now :

<u>Compute Flexibiltiy Matrix</u> :

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

$$\Rightarrow F_{11} = \int_0^8 \frac{m_{1(AB)}^2}{EI} + \int_0^{16} \frac{m_{1(BC)}^2}{EI} \Rightarrow \int_0^8 \frac{(-16)^2_{(AB)}}{EI}\,dx + \int_0^{16} \frac{x^2}{EI}$$

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

P.T.O

$\Rightarrow F_{12} = F_{21} \Rightarrow$

$$\Rightarrow \int_0^8 \frac{m_{1(AB)}}{\cancel{EI}} \cdot m_{2(AB)} + \int_0^{16} m_{1(BC)} \cdot m_{2(BC)}$$

Put value.

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

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

Now:

$\Rightarrow F_{22}$:

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

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

$$\Rightarrow \boxed{F_{22} = \frac{170.67}{EI}}$$

As we know that;

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

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

Put value.

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

Put the above value.

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

By calculator:

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

Answer:

X. XXX XXX

P(7)