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Section . . B .

Subject structure Analysis II

Submitted To;

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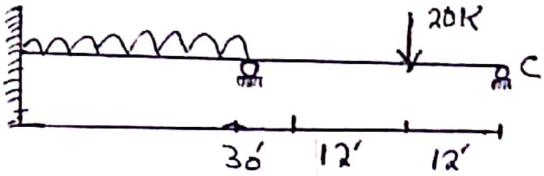
Question No1

Analyze the given beam shown in FIG-I by flexibility method. EI is constant.

1.

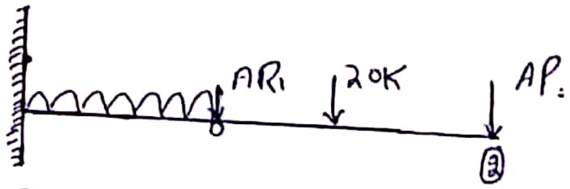


E.I constant

Sol:-

S.I = 2

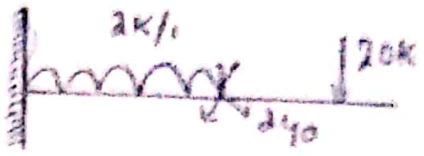
step 01:- Select redundant actions.

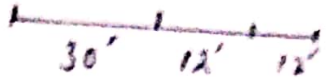


$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} \to \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step 2:- Complete the values of [DRL]

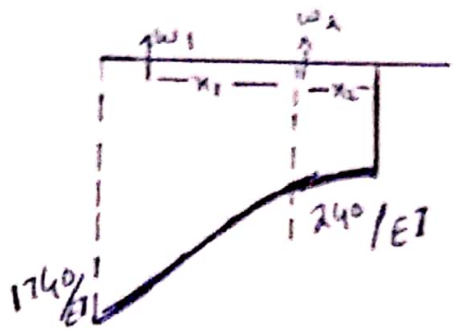




$20 \times 12 = 240$

$20 \times 40 + 2 \times 30 \times 15$

$= 1140$



$$w_1 = \left(\frac{240+0}{2EI}\right) \times 12 = 1440/EI$$

$$w_2 = \frac{1}{n+1} \times (b \times h) = \frac{1}{2+1}\left(\frac{1100}{EI}\right) \times 30 = 11000/EI$$

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

$$x_1 = 12/3\left(\frac{240+2(0)}{240+10}\right) = 4'$$

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

$$DRL_1 = w_1(x_1+30) = 1440(4+30) = 48960/EI$$

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

$$= 442860$$

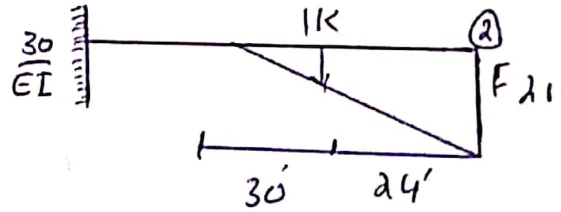
$$[DRL] = \frac{1}{EI}\begin{bmatrix} 48960 \\ 442860 \end{bmatrix}$$

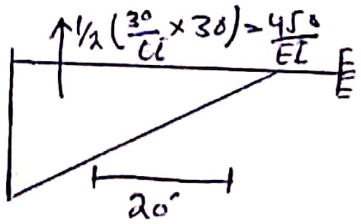
Step 3:- Construt flexibility Co-effient matrix.

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

a) Apply a unit value of DLI at reference point

i. Complete the value of F_{11} and F_{21}





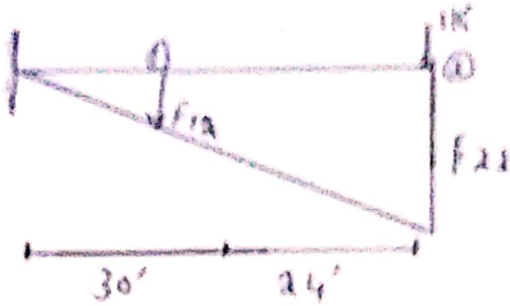
$$F_{11} = \frac{450}{EI}(20) = \frac{9000}{EI}$$

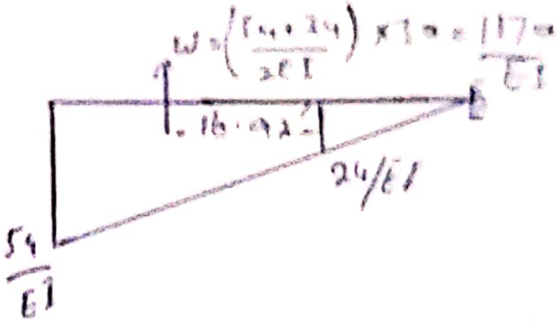
$$F_{21} = \frac{450}{EI}(20+24) = \frac{19800}{EI}$$

b: Apply a unit of AP2 at reprence point 2 in Compute the value of

FO & F_{22}.

4)





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

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

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

Question No2

Q→ Difference between force method and displacement method and suggest which method is more suitable for structure analysis of matrix apporach.

ANSWER:-

Force Method	Displacement Method.
$D_s < D_K$	$D_s > D_K$
Forces are redundent or unknowns	Displacement are redundent or unknown
starts with equilibrium of forces.	starts with compatible deformation
Forces found by Compatibility eqns of displacements.	displacement found by equilibrium equal of forces.
no of reduntunts = Ds	no of reduntants = DK.
not suitable for Comput	not of suitable for truss

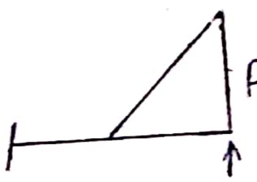
This. method is more suitable for structural analysis of matrix approach.
There are two main method of
u structural analysis of using matrix approach

(i) Force method
(ii) Displacement method.

Force Method..
This method is also Known as flexibility or Compatibility method. In this method the degree of static Indertermarty of the is determined and the vedindants are identified. A Co-ordinate is assigned to each vedudants at Co-ordinate

Thus $AR_1, AR_2 ---, AR_n$ are the vedudants at Co-ordinate 1, 2, — n.
if all the redundant are removed the resting structure Know as

as the released stre is statically determinat from the principle of superposition the net displacement at any point in a statically determinate stre is the sum of the displacement in the basic determinate stre due to applied loads and the redudants thus condition, know as compalibility condition may be exposed by the equation for "n" redudant actions.



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

$$DRS_1 = DRL_1 + F_{11} AR_1 + F_{12} AR_2 + \text{-----} F_{1n} AR_n$$

$$DRS_2 = DRL_2 + F_{21} AR_1 + F_{22} AR_2 + \text{-----} F_{2n} AR_n$$

$$DRS_n = DRL_n + F_{n1} AR_1 + F_{n2} AR_2 + \text{-----} F_{nn} AR_n$$

writing these equation in matrix form

$$\begin{bmatrix} DRS_1 \\ DRS_2 \\ DRS_n \end{bmatrix} = \begin{bmatrix} DRL_1 \\ DRL_2 \\ DRL_n \end{bmatrix} + \begin{bmatrix} F_{11} + F_{12} & \text{-----} & F_{1n} \\ F_{12} \quad F_{22} & \text{-----} & F_{2n} \\ F_{n1} \quad F_{n2} & \text{-----} & F_{nn} \end{bmatrix} \begin{bmatrix} AR_1 \\ AR_2 \\ AR_n \end{bmatrix}$$

$[DRS]_{n\times1} = (DRL)_{n\times1} + [F]_{n\times n}(AR)_{n\times1}$ 8) a)

$F(AR) = DRS - (DRL)$

$AR = (F)^{-1}(DRS - DRL)$

n = Degree of Indeforminary

where DRS = support settement Relation Corresponding to the redadant action

DRL · displacement (Rotation/translation) Corresponding to the redudent action in a released stre (Basic det str) due to applied loads.

AR = The redudant actions.

F = flexibility co-efficient i-e. displacement Caused by unit action.

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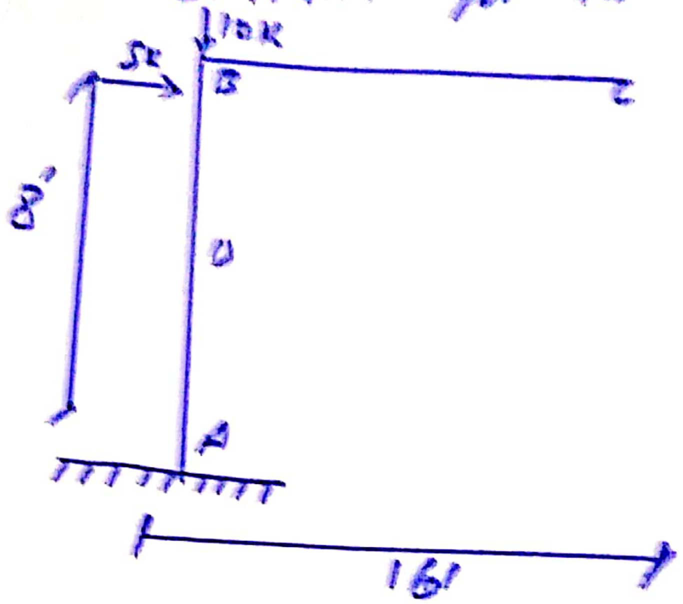
9)

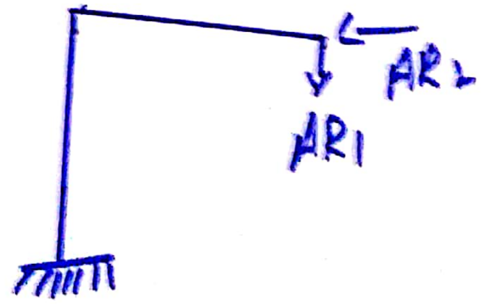
Q-No3 Analyze the rigid-joint frame Shown in Fig-2 by flexibility method. Assume EI is Constant for all members.



Solution:

$$S \cdot I = R - 3$$
$$= 5 - 3$$
$$= 2^{\circ}$$

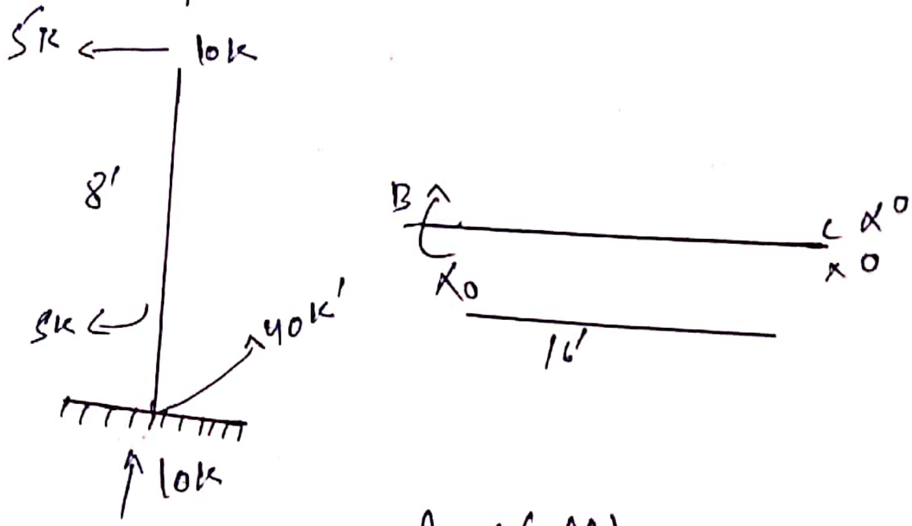
Step:01 Identify the redundant Action



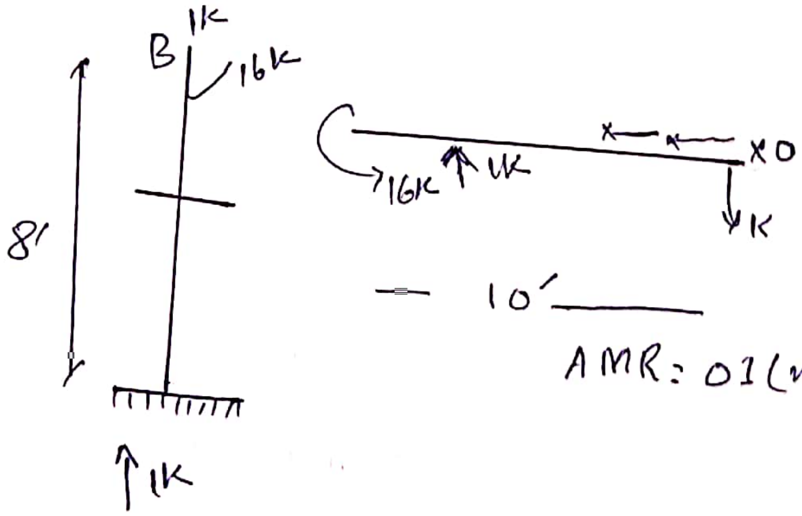
$$\begin{bmatrix} DRS1 \\ DRS2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \begin{bmatrix} AR1 \\ AR2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

Step:: 02

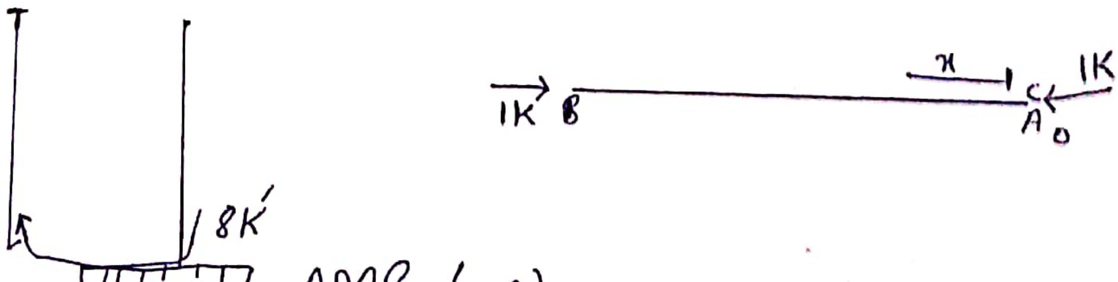
compute the value of DRL and F



∆ML- values (M)



AMR: 01 (m)



AMR_2 (02)

11)

Member	AB	BC	DPL₁
origin	A	C	
Limit	0-8	0-16	
I	I	2I	
M	$5x-40$	0	$\int \frac{5x-40+5}{-} x$
m_1	-16	x	
m_2	$8-x$	0	

$$DRL_1 = \int \frac{(5x-40)(-16)}{EI} dx \Rightarrow DRL_2 = \int_0^8 \frac{(5x-40)(8-x)}{EI} = \frac{-853.3}{EI}$$

$$F_{11} = \int_0^8 -\frac{(16)^2}{EI} dx + \int_0^{16} \frac{x^2}{2EI} dx = 2730.67/EI$$

$$F_{12} = \int_0^8 \frac{-(16)^2(8-x)}{EI} dx = -512/EI$$

$$F_{22} = -\int_0^8 \frac{(8-x)^2}{EI} dx = 170.07/EI$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}^{-1} \begin{bmatrix} DRS_1 = DRL_1 \\ DRS_2 = DRL_2 \end{bmatrix}$$

$$\begin{bmatrix} AR1 \\ AR2 \end{bmatrix} \begin{bmatrix} 2730.31 & -812 \\ -512 & 1700 \end{bmatrix} \begin{bmatrix} 0 & -2500 \\ 0 & -813.33 \end{bmatrix}$$

the End