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Submitted TO: Engr. Obeed Khan

Paper : Structure II.

Section: "B"

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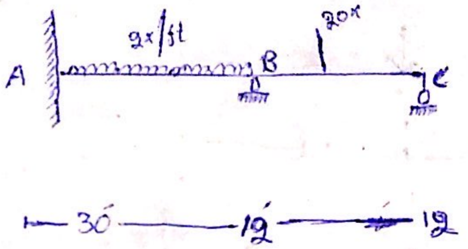
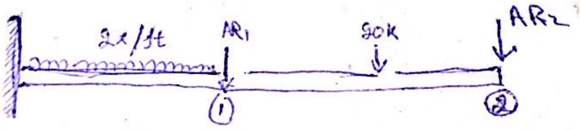
Q1



Soultion

Strouctoral Indeteerminancy = 2°

Step #01 Select Redund Actions

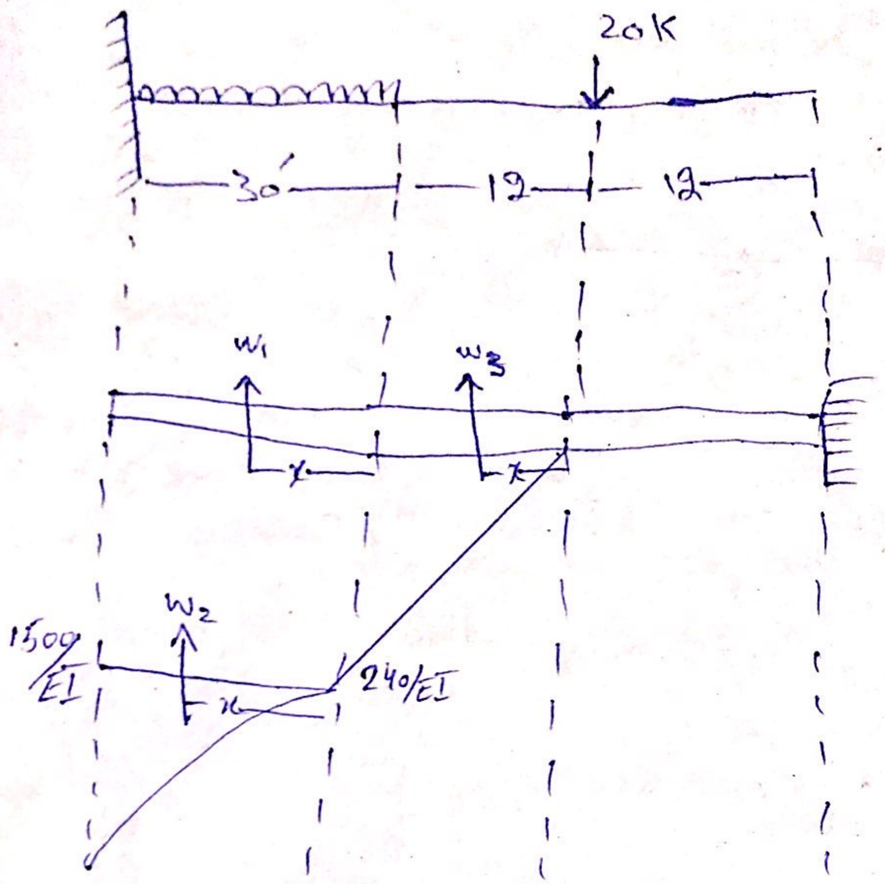


$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step #02: Compute the value of $[DRL]$

P-T-O



$20 \times 12 = 240$

$20(12+30) + 2 \times 30 \times 15$

$= 1740$

$w_1 = 1500 \times 30 = 45000$

$w_2 = \frac{1}{3} \times 30 \times 240 = 2400$

$w_3 = 1/2 \times 12 \times 240 = 1440$

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

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

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

Now Finding DRL :-

$DRL_2 = w_1 \times (x_1 + 24) + w_2 \times (x_2 + 24) + w_3(x_3 + 12)$

$= 45000(15+24) + 2400(22.5+24) + 1755000 + 111600 + 28800$

$\Rightarrow \boxed{DRL_2 = 1895400/EI}$

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

So,

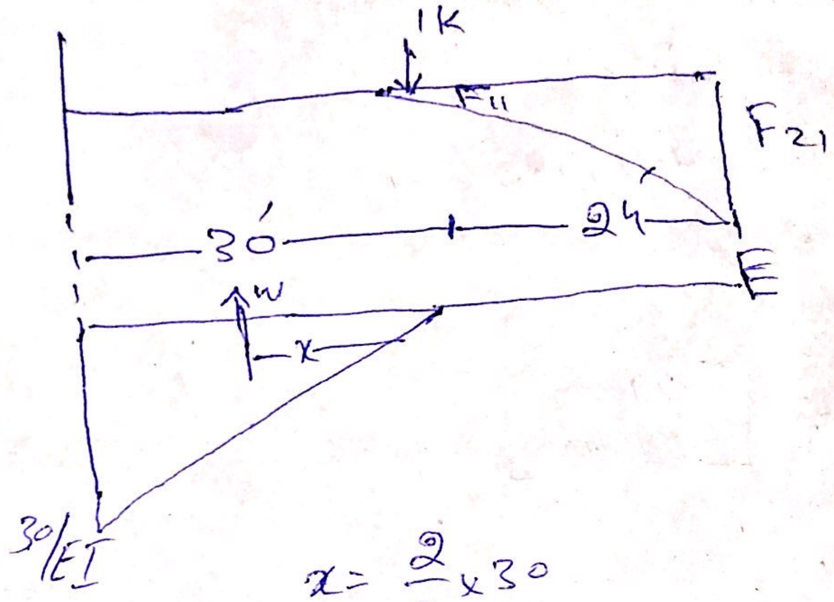
$$DRL = \frac{1}{EI}\begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$$

Step #03:

Flexibility Matrix.

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

$\Rightarrow$ Applying limit on AR_1



$x = \frac{2}{3} \times 30$

$= 20'$

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

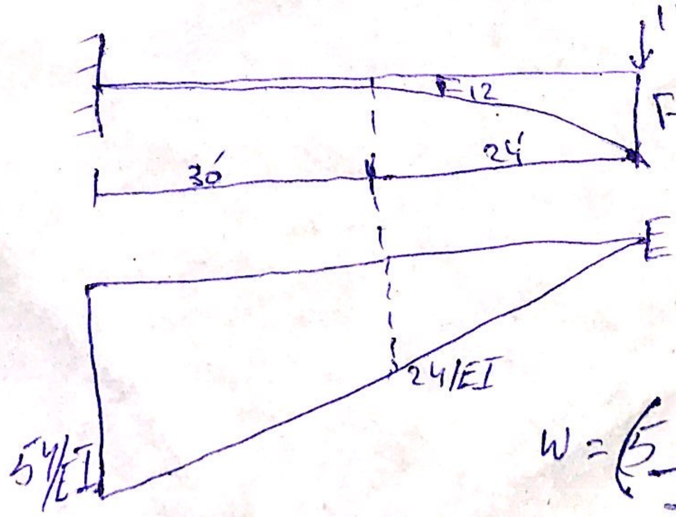
$= 450/EI$

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 :-



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

$= 1170/EI$

Now the distance

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

$$= \frac{30}{3}\left[\frac{24+2(54)}{54+21}\right] = 16.92$$

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

$$\Rightarrow F_{22} = \frac{1170}{EI} \times (16.92) = \frac{19796.4}{EI}$$

Hence

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

Step #04 Compute the values of AR

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

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

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

P.T.O.

$$= \frac{1}{\begin{vmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{vmatrix}} \times \mathrm{Adj}\left(\begin{bmatrix} 9000 & 19796.4 \\ 198000 & 47876.4 \end{bmatrix}\right)$$

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

$$= (430887600 - 391968720)$$

$$|F| = 38918880$$

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

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

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

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

Q2 Differention beteen force method and displement method and suggest which method is more Saitble for strucre analysis of matrial opProch.

Ans in the force method of analysis Primary unknown are force in this method compalibity equation written for displacement and rotation wich are calculated by force displement equation in the displacement method of analysis the Primary unknows are the displacement.

Force methods	Displancement methodes
① method of consistant deformation	① Slope deflection method.
② Theorem of least work	② moment destraibulion method.
③ Coulmn analogy method.	③ Kani,s method.
④ flexiblity matride method.	④ Stiffness matrix method.
→ Type of indeterminay static indeterminay.	→ Types of indeterminay Kinematic indetearminy.
→ Goververning govering eqation compatiblity.	→ Governing eqution equilibrian eqution.

→ force displacement relation flexibility method	→ force displacement relation Stiffness methrace.
→ Assumed force as unknown.	→ Assumed displacement as unknown.
→ Preferable when Structure has less Static indeterminancy.	→ Preferable when Structure indeterminacy.
→ Known as Flexibility method eg Consistant method of Deformations.	→ Known as Stiffness meth e.g slope displacement method and moment distribu method.

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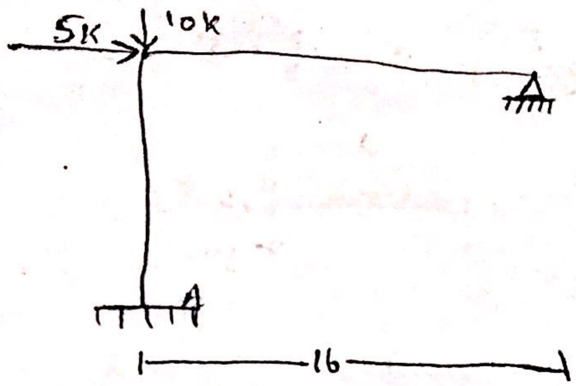


E = constant

$I_c = I$

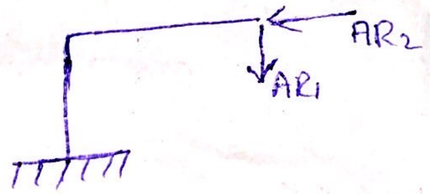
$I_B = 2I$

Sol:-

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 # 2 : Compute value of [DRL]

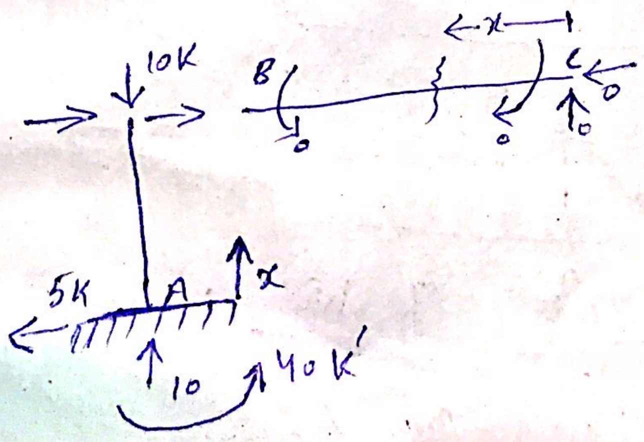


Fig: AML values (M-value)

Step # 03 : [F] or [AMR]

a)

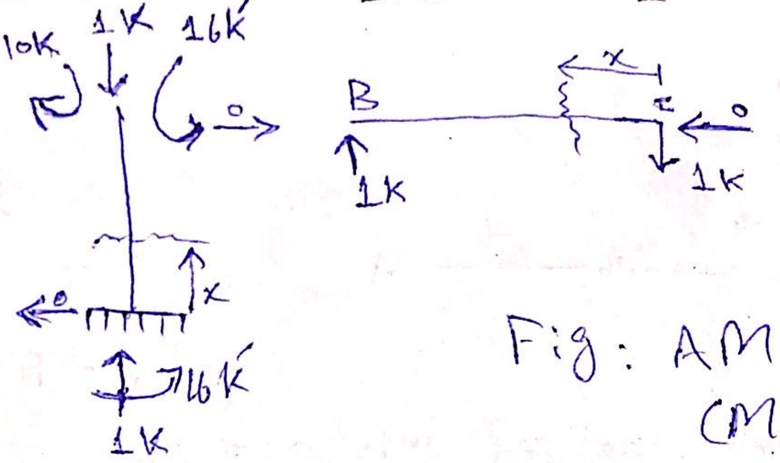


Fig: AMR-values
(M₁ values)

b)

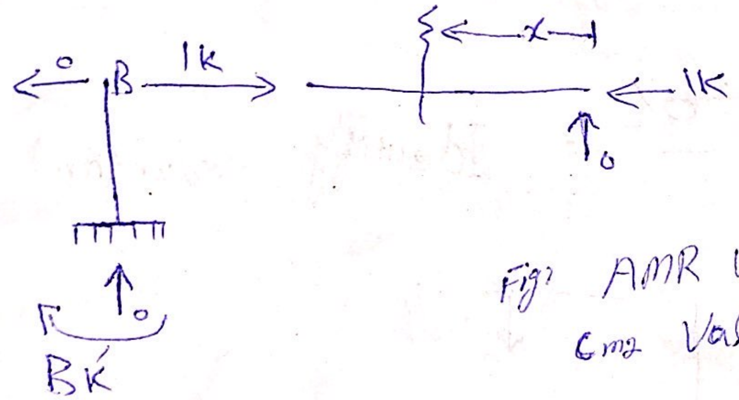


Fig: AMR Values
(m₂ Values.

member	AB	BC
select origin	A	C
origin should be Limits	0-8	0-16
Select the Support I	I	I
Take x-Section on AML and Fig & Find Moment M	$5x-40$	0
M_1	-16	x
M_2	$8-x$	0

⇒ For Finding value of DRL :-

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

Scanned with CamScanner

$$= \int_0^8 \frac{(5x-40)(-18)}{EI}dx + \int_0^{16} \frac{0.x\ dx}{E(2I)}$$

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

$$DRL_2 = \int_0^8 \frac{(5x-40)(8-x)}{EI}dx + \int_0^{16} \frac{0.0}{E(2I)}dx$$

$$DRL_2 = \frac{-853.93}{EI}$$

⇒ Compute Flexibility Matrix :-

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

$$\Rightarrow F_{11} = \int_0^8 \frac{m_1^2(AB)}{EI} + \int_0^{16} \frac{m_1^2(BC)}{EI} = \int_0^8 \frac{(-16)^2}{EI}dx + \int_0^{16} \frac{x^2}{E(2I)}$$

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

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

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

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

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

$$F_{22} \Rightarrow \int_0^8 \frac{(8-x)^2}{EI}\, dx + \int_0^{16} \frac{0^2}{2EI}\, dx$$

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

As we know that

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

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

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

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.0005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$

THE END