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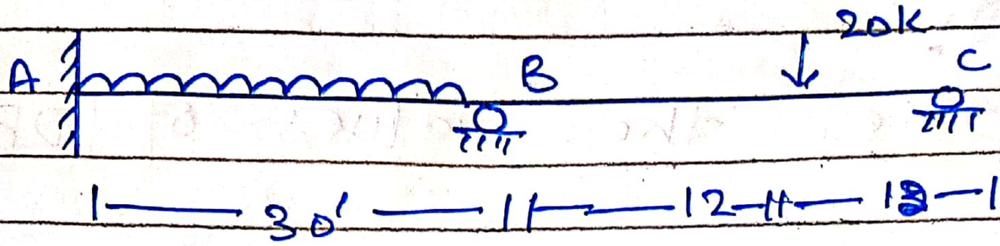
ID : 7753

SEC: A

QUESTION #1.



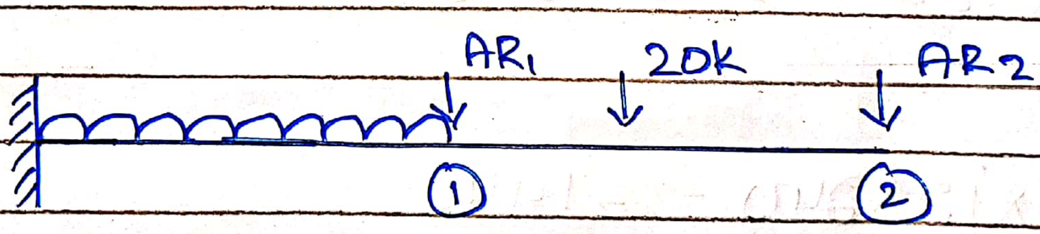
EI = constant

SOLUTION

structural indetermining = 2°

STEP # 01

Select Redundent Actions

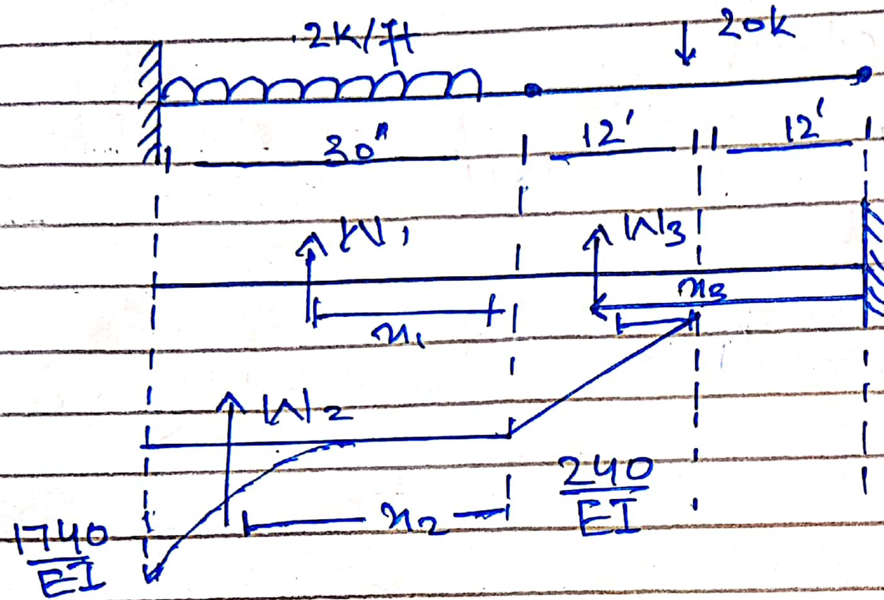


$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

$$[DRS_1] = [DRL] + [F] \times [AR]$$

STEP#2:

Compute the values of [DRL]



$20 \times 12 = 240$

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

$= 1740$

$W_1 = 1500 \times 30 = 45000$

$W_2 = \frac{1}{3} \times 30 \times 240 = 2400$

$W_3 = \frac{1}{2} \times 12 \times 240 = 1440$

$x_1 = \frac{b}{2} = \frac{30}{2} = 15'$

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

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

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

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

$= 675000 + 54000$

$DRL_1 = 729000 / EI$

$DRL_2 = W_1(x_1 + 24) + W_2(x_2 + 24)$

$+ W_3(x_3 + 12)$

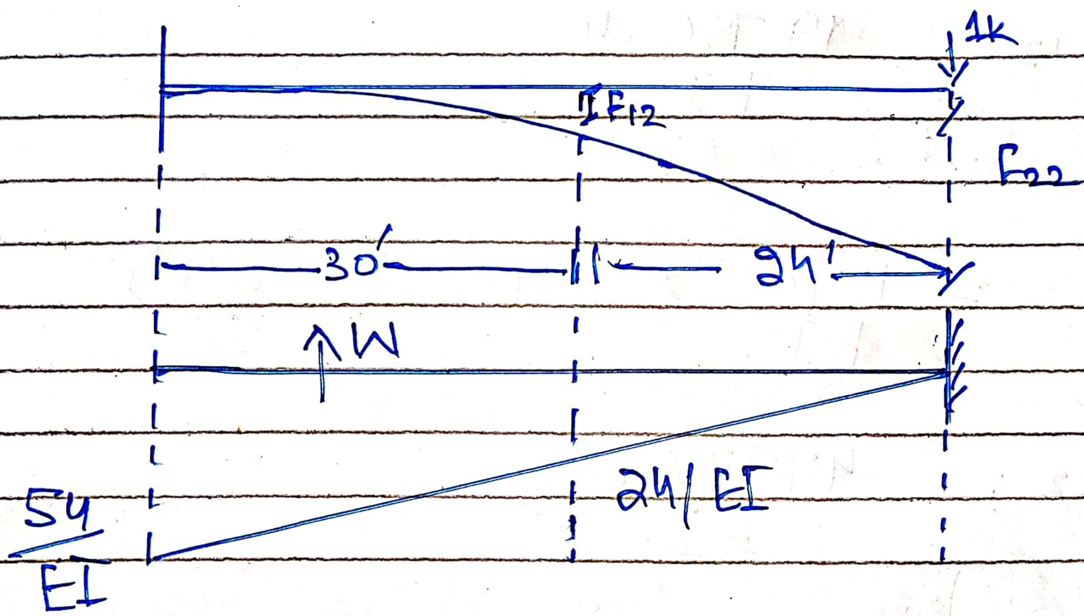
$= 45000(15+24) + 2400(22.5+24)$
$+ 1440(8+12)$

$= 1755000 + 111600 + 28800$

$DRL_2 = 1895400 / EI$

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

b) Now apply unit load on AR_2



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

$$= 1170/EI$$

Now the distance

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

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

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$= 16.92'$

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

$F_{12} = \frac{19796.4}{EI}$

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

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

Hence

$$F_{2\times2} = \begin{bmatrix} 9000 & 1979.6.4 \\ 19800 & 47876.4 \end{bmatrix} \frac{1}{EI}$$

Compute value of AR

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

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

$$[F]^{-1} = \frac{1}{[F]} \, Adj\, F$$

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

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

$$= (430887600 - 391968720)$$

$$[F] = 38918880$$

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} \frac{1}{EI} \times \frac{\begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}}{38918880}$$

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

ANSWER

QUESTION # 2:

FORCE METHOD	DISPLACEMENT METHOD
it is also known as flexibilty matrix method or compatibility method	it is also called as equilibrium method or stiffness method or matrix method
in force method the unkown are taken as force	in this the unkown are taken as joint displacement (θ, Δ)
number of redundant = Ds	number of redundant = Dk
The force method determined by compatibility equation of displaoement	In this method the displacment are determined by equilibrium equation of forces.
type of indetermancy is static	type of indetermancy is kinetic indetermancy

this method is suitable when $D_s < D_k$	this method is suitable when $D_s > D_k$

SUITABLE METHOD FOR STRUCTURAL ANALYSIS OF MATRIX APPROCH:

For anglysis of structure of matrix approch both the force method or displacment method can be used depends upon suitation.

→ When the degree of static indetermancy (D_s) is less than the degree of kinematic indeterminacy (D_k) i.e. $D_s < D_k$ then ~~th~~ it is suggested to use force method.

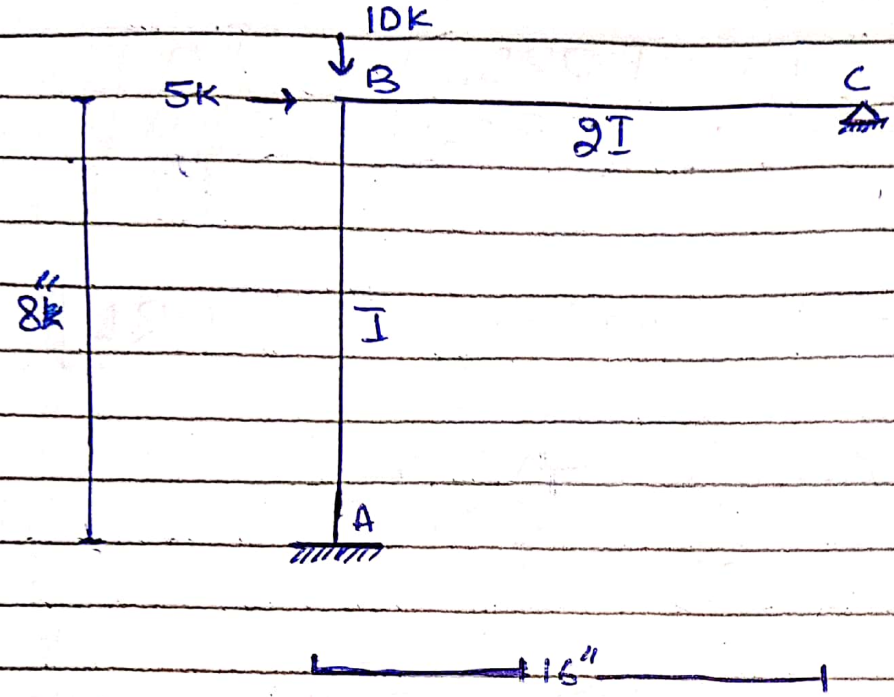
→ When the degree of static indeterminacy (D_s) is more than ~~ind~~ kinematic indeterminacy (D_k) i.e $D_k < D_s$ then it is suggested to use displacement method of anylysis.

→ The main advantage of displacement method is primary method used.

→ also displacement method is conductive to computer programing once the analytical model of the structure has been defined no furtaer engineering decision are required in stiffness method in order to carry out analysis.

Hence displacement method is most suitable for structural analysis of matrix approach.

QUESTION #3



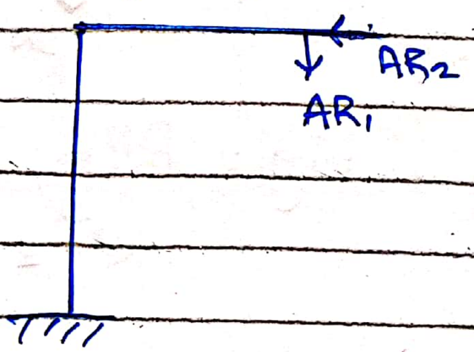
SOLUTION:

Total statical indeterminacy

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

STEP # 01

identifying Reductant actions



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

STEP # 02:

Compute value of [DRL]

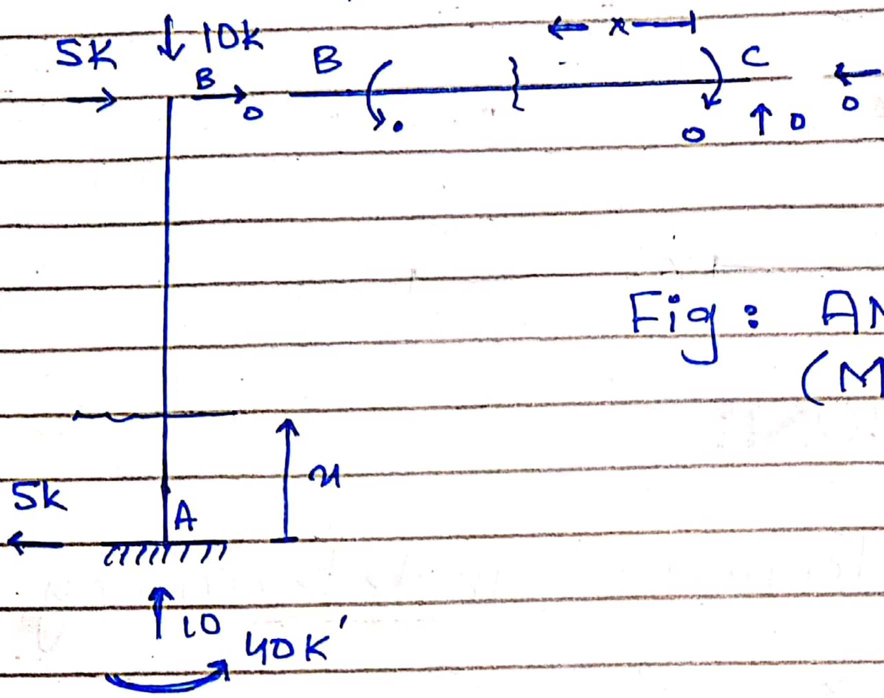


Fig: AML values
(M - values)

STEP # 03: [F] or [AMR]

a)

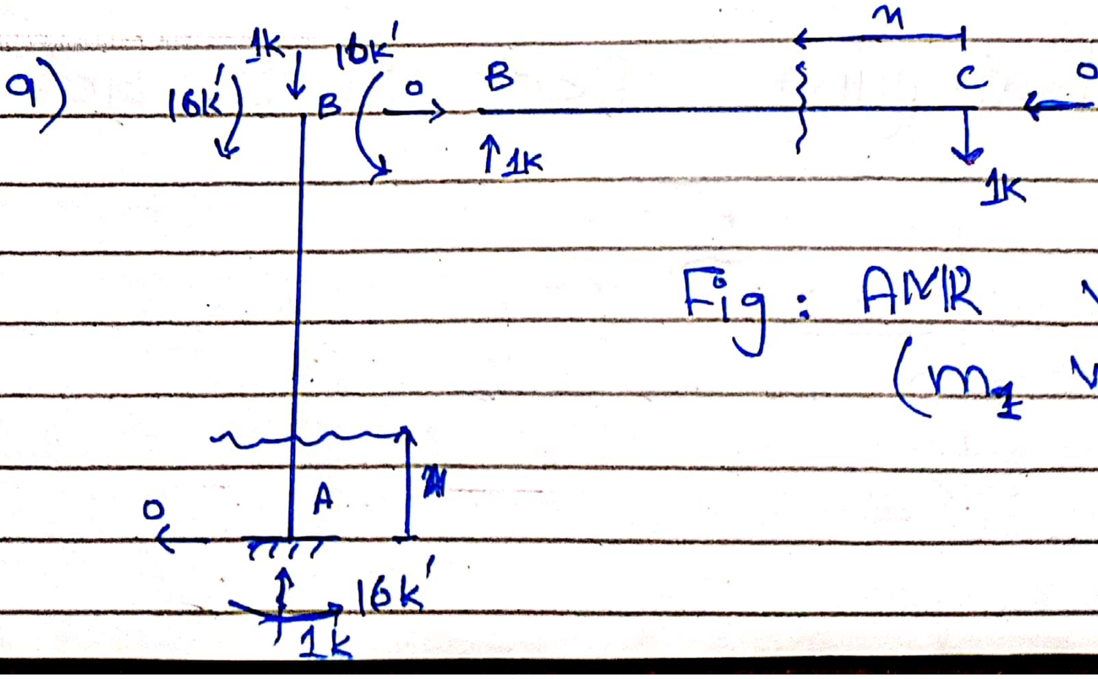


Fig: AMR values
(m_1 values)

b)

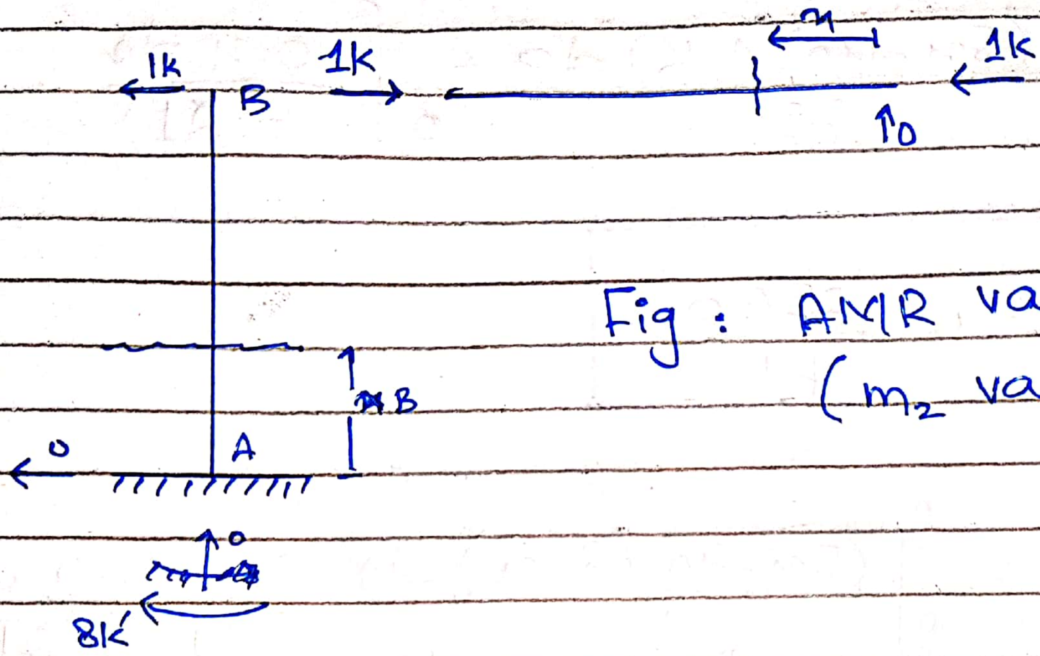


Fig : AMR values
(m_2 values)

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

Finding value of DRL:

$$DRL = \int_0^8 \frac{M_{AB} \cdot M_1(AB)}{EI} + \int_0^{16} \frac{M_{BC} \cdot m_2(BC)}{EI}$$

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

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

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

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

⇒ Compute Flexibility Matrix:

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

$$\rightarrow F_{11} = \int_0^8 \frac{m_i^2(AB)}{EI} + \int_0^{16} \frac{m_i^2(BC)}{EI}$$

$$= \int_0^8 \frac{m_i^2(AB)}{EI} + \int_0^{16} \frac{m_i^2(BC)}{E2I}$$

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

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

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

$$F_{22} = \int_0^8 (m_1)^2 AB\,dx + \int_0^{16} (m_2)^2 BC\,dx$$

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

$$F_{22} = 170.67$$

As we know that

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

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

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

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

$$\cancel{\begin{matrix} AR_1 \\ AR_2 \end{matrix}} = \cancel{\begin{bmatrix} 0.0005 \end{bmatrix}}$$

$$\begin{matrix} AR_1 \\ AR_2 \end{matrix} = \begin{bmatrix} -0.0005 \\ 4.97 \end{bmatrix}$$

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

ANSWER.