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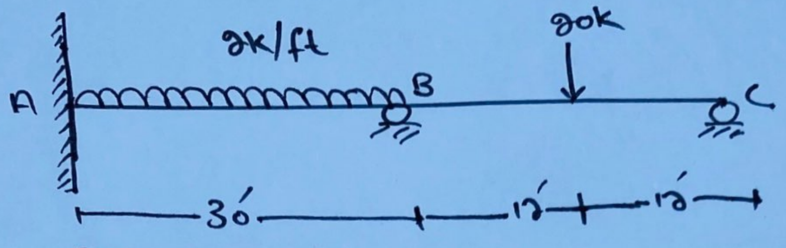
Subject : Structure Analysis II

Submitted to : Engr. Adeed

Semester. : 10th.

# Q 01:-

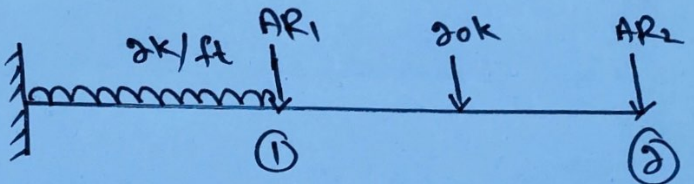



EI = constant

**Solution:-**

Structural Indeterminancy = 2°

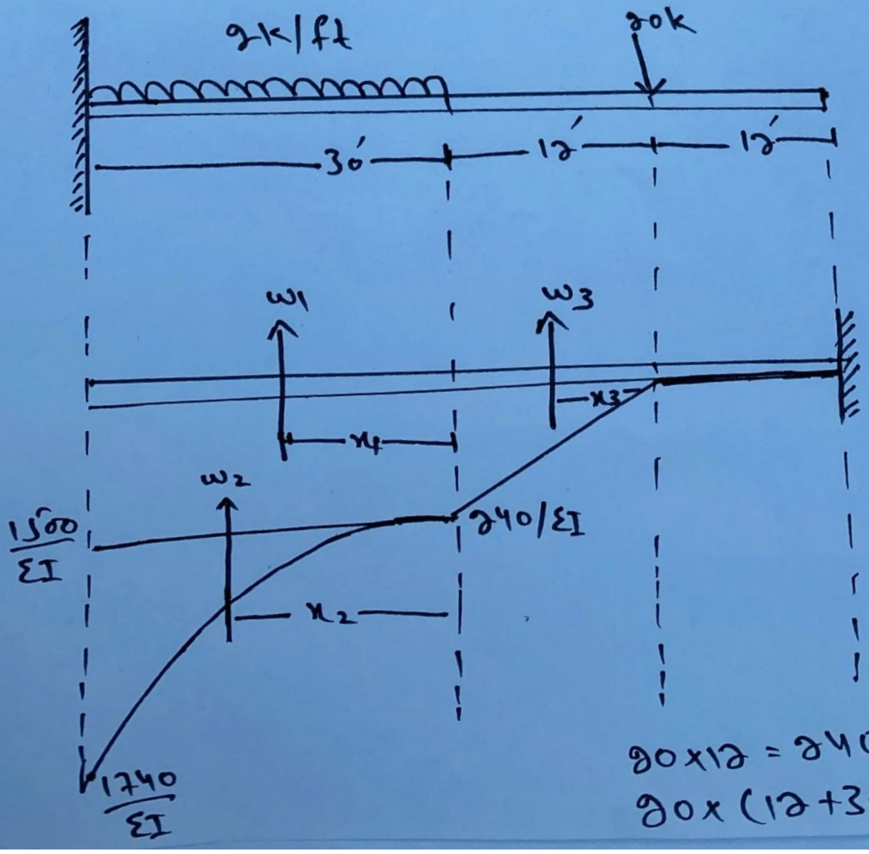
**Step 1** Select Redundant ~~A~~ Action




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

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

**Step 2** Compute the value of $[DRL]$




$20 \times 12 = 240$

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

$w_1 = 1500 \times 30 = 45000$

$w_2 = \frac{1}{2} \times 30 \times 240 = 2400$

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

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

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

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

<u>Now finding</u> <u>DRL.</u>

$DRL_1 = w_1(x_1) + w_2(x_2)$

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

$= 675000 + 54000$

$= 729000$

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

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

$= 1755000 + 111600 + 28800$

$DRL_2 = 1895400/EI$

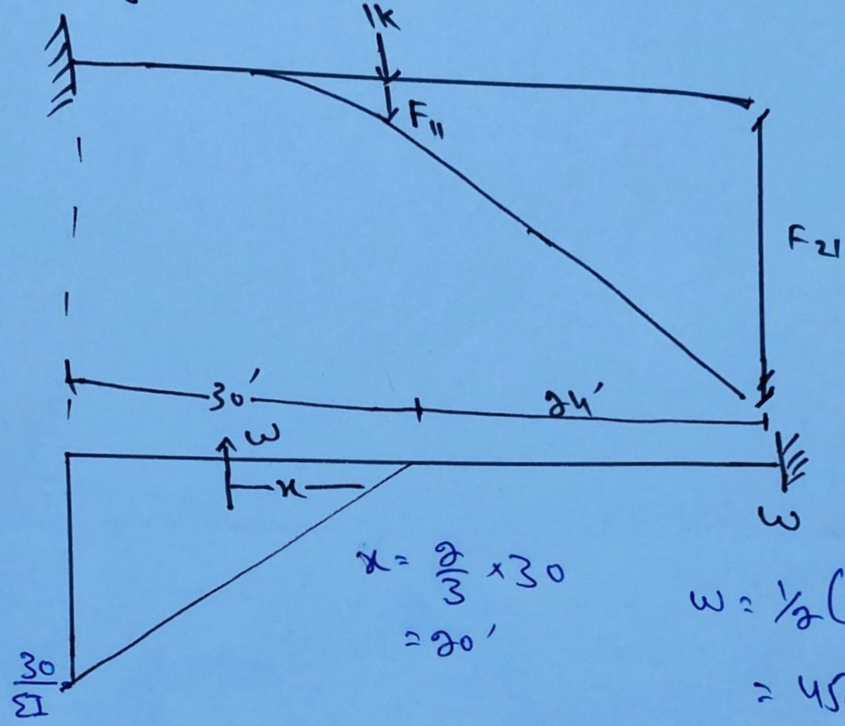
So,

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

**Step 3:** Flexibility Matrix

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

(a) Applying unit load on $AR_1$




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

$= 20'$

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

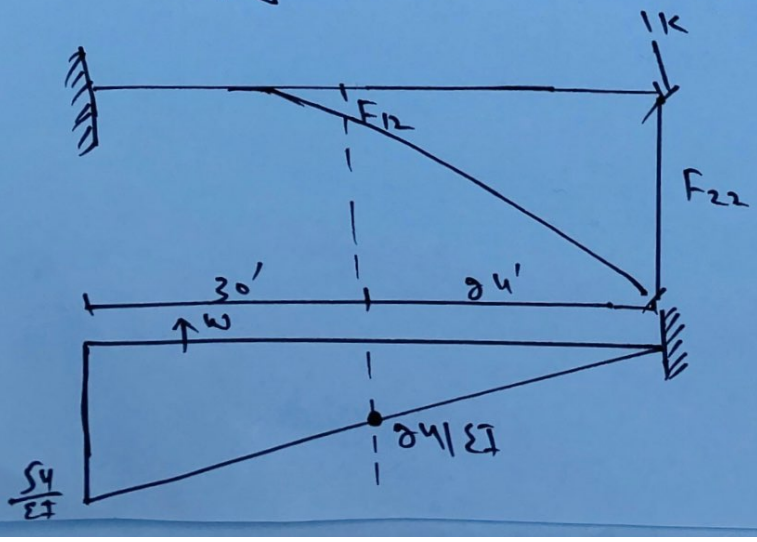
$= 450/EI$

So,

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

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

b) Now Apply unit load on $AR_2$




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

$= 1170/EI$

Scanned with CamScanner

(5)

(d) Now the distance.

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

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

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

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

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

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

Hence

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

~~Se~~ Step 4 compute the value of AR

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

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

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

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

$$|F| = (9000 \times 47876.4 - 19796.4 \times 19800) - (430887600 - 391968720)$$

$$|F| = 38918880$$

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 & -729000 \\ 0 & -1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{38918880} \begin{bmatrix} 47876.4 & -19796.4 \\ -198000 & 9000 \end{bmatrix}$$

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

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

Q 2

| Force Methode | Displacement methode. |
| --- | --- |
| => It is also known as flexibility matrix methode or compatibility methode. | => It is called equilibrium stifness methode matrix |
| => In force methode the unknown are taken as force or reaction | => In displacement methode the unknown are taken as Joint displacement. => =DK. |
| => In this the number of redundant = $D_s$ | => In this the displacement are found by equilibrium equation of force. |
| => In this the force are found by compability equation of displacement. | |
| => It is suitable when $D_s < DK$ | => Its suitable when $DS > DK$. |

# Suitable Methode.

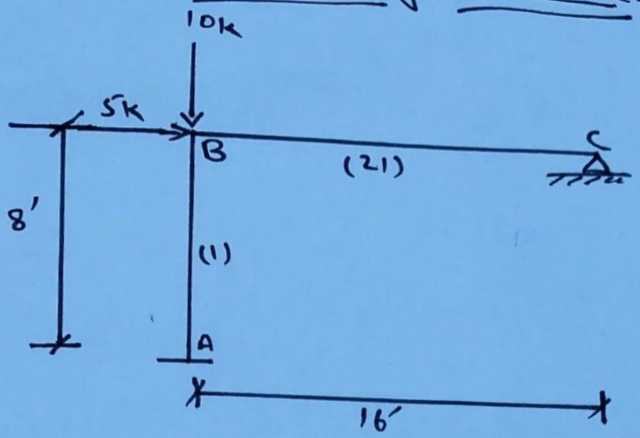
① For Analysis Structure of matrix approch both the force methode or displacement methode can be used depend upon solution.

② when the degree of static indeterminancy (Ds) is less than the degree of ~~kinetic~~ kimamatic Indeterminancy (Dk) example: Ds < Dk than Its suggested to use force methode of analysis.

③ when the degree of Static Indeterminancy (Ds) is more than the degree of kinematic Indetermancy (Dk), Dk < Ds. Then it is suggested to use the displacement methode of analysis.

Q3:.

# Flexibility Methode.

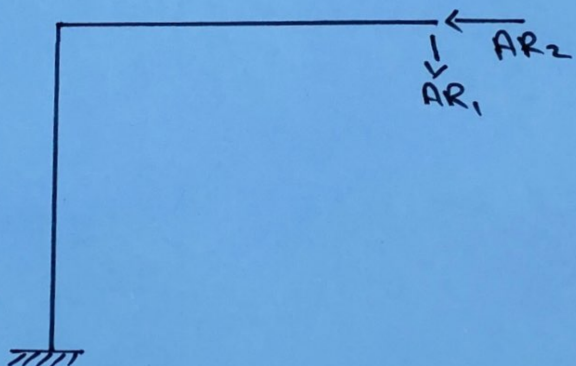



**Solution:.**

Total Statical inderminacy

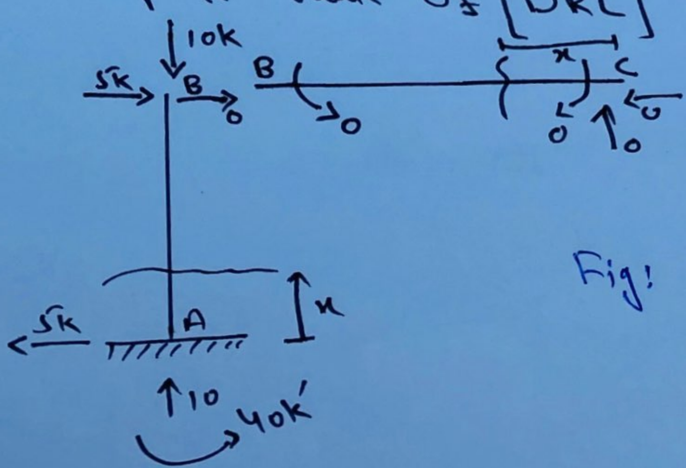
$\Rightarrow R-3 = 5-3 = 2^{\circ}$

**Step 1** Identify Redundant Action




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

**Step 2** Compute value of [DRL]




Fig! AML Value (M-values)

## Step 3: [F] or [AMR]

(a)

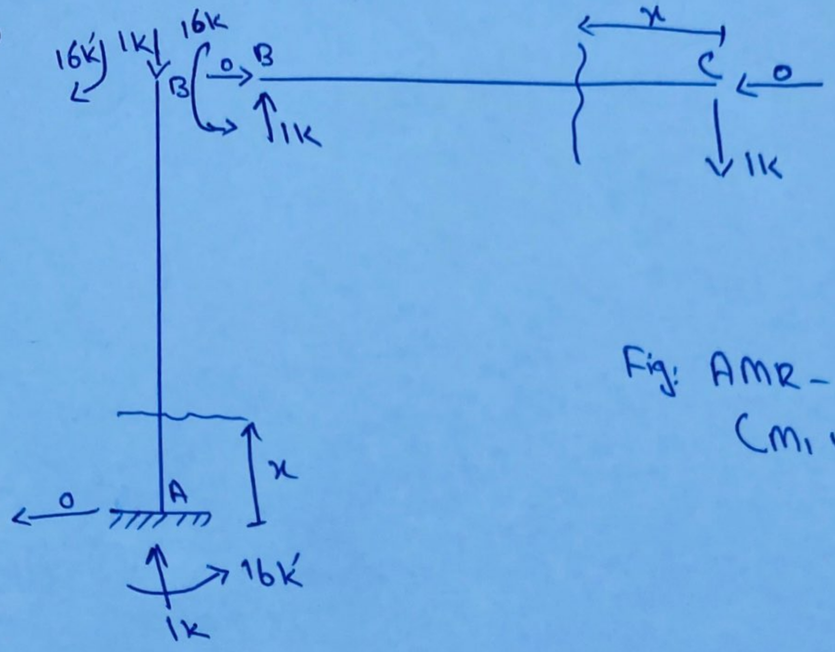



Fig: AMR-values ($m_1$ values)

(b)

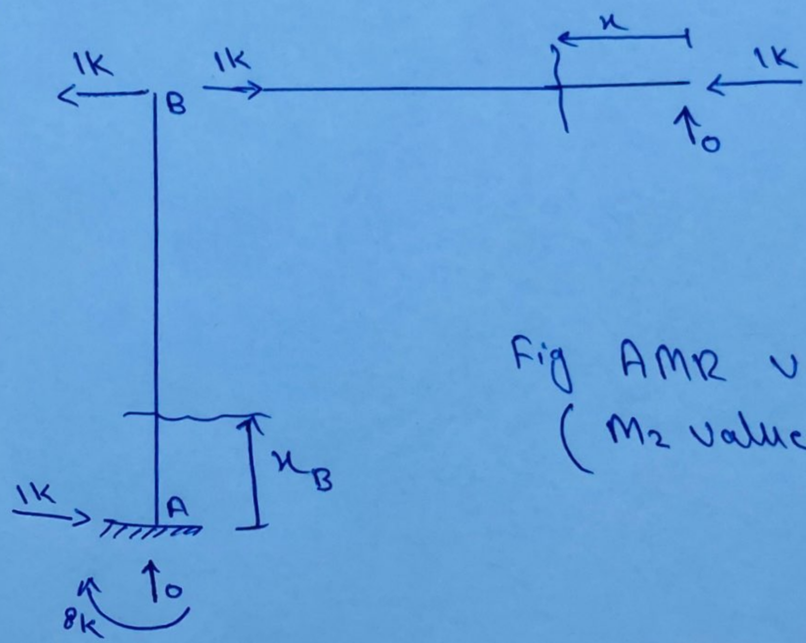



Fig AMR value ($M_2$ value)

| 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 |

Finding values of DRL

$$DRL_1 = \int_0^8 \frac{M_{AB} \cdot m_1(AB)}{EI} + \int_0^{16} \frac{M_{BC} \cdot m_2(BC)}{EI}$$

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

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

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

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

=> <u>Compute Flexibility Matrix</u>.

$$F_{2\times 2 \to 2^\circ} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}$$

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

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

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

$$\Rightarrow F_{12} = F_{21} = \int_0^8 m_1(AB) \cdot m_2(AB) + \int_0^{16} m_1(BC) \cdot m_2(BC)$$

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

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

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

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

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

As we know

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

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

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

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.00005 \\ 4.97 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$

The End.