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Subject - Structure Analysis II

Department = Civil Engg

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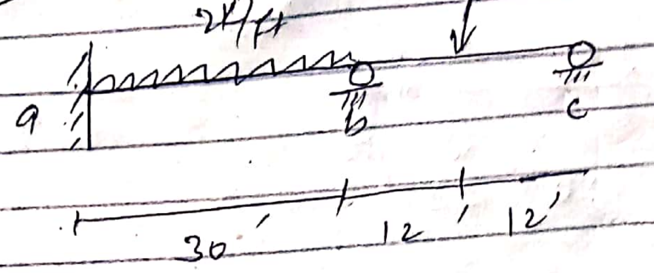
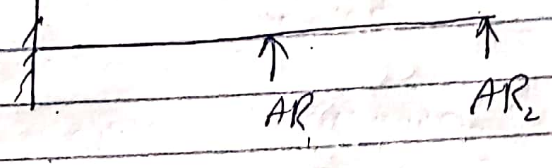
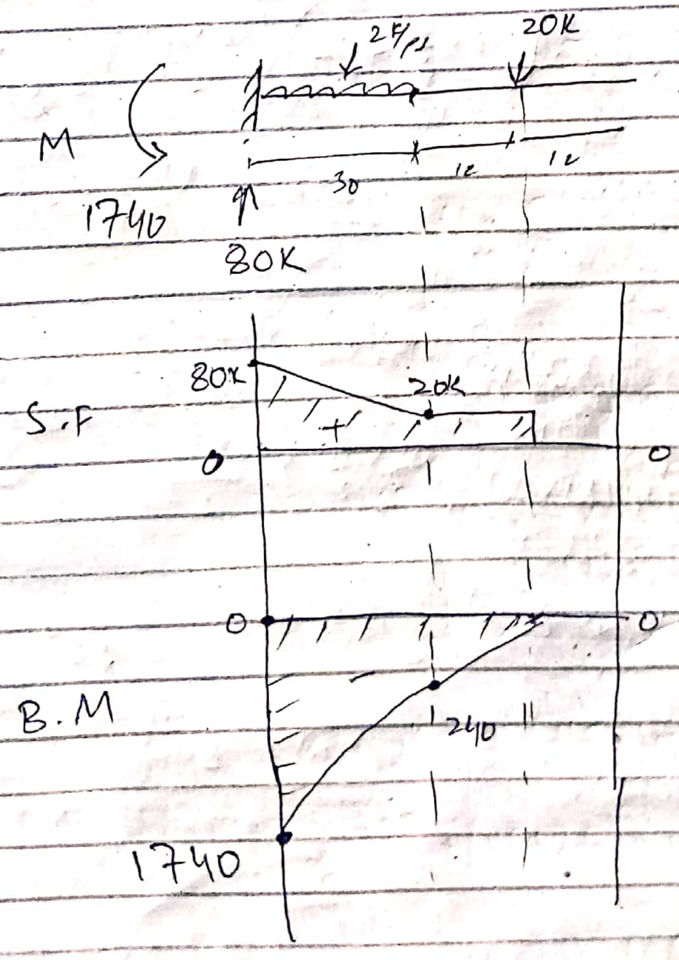
Q1 EI const

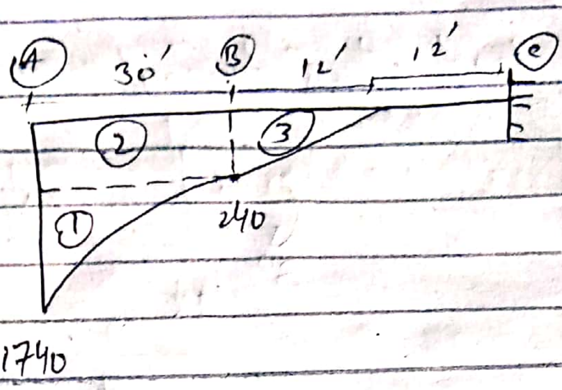


Sol $S.I = r - 3n \Rightarrow 5 - 3 = 2^{\circ}$



DRL





$w_1 = \frac{1}{n+1} bh = \frac{1}{3} \times 1500 \times 30 = 15000\ K$

$w_2 = 240 \times 30 = 7200 K$

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

$\bar{x}_1 = \frac{b}{n+2} = \frac{30}{4} = \boxed{7.5'}$

$\bar{x}_2 = \frac{b}{2} = 30/2 = \boxed{15'}$

$\bar{x}_3 = \frac{2}{3} \times b = \frac{2}{3} \times 12 = \boxed{8'}$

$DRL_1 = w_1 \times x_1 + w_2 \times x_2$

$= 15000 \times 7.5 + 7200 \times 15$

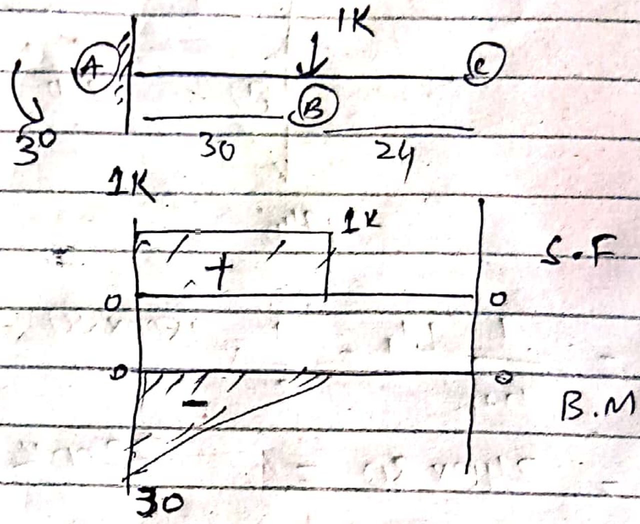
$\boxed{DRL_1 = 220500/EI}$

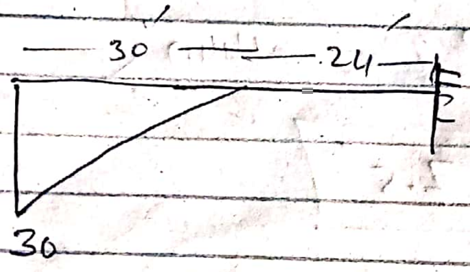
$DRL_2 = w_1 \times (x_1 + 24) + w_2 \times (x_2 + 24) + w_3 \times (x_3 + 12)$

$= 15000 \times (7.5 + 24) + 7200 (15 + 24) + 1440 (8 + 12)$

$\boxed{DRL_2 = 782100/EI}$

Apply unit load at Redundant at (B)



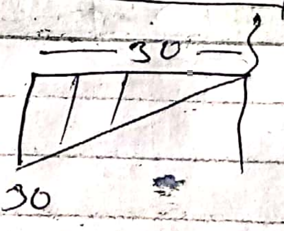


At point (C)

$$\delta_{CB} = \left(\frac{30 \times 30}{2}\right)\left(24 + \left(\frac{2}{3} \times 30\right)\right)$$

$$\boxed{\delta_{CB} = 19800 / EI}$$

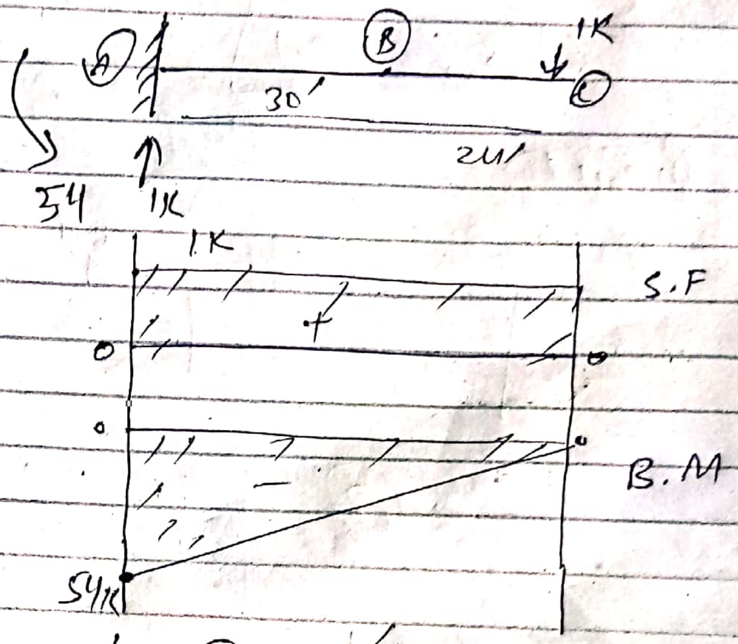
At point (B)

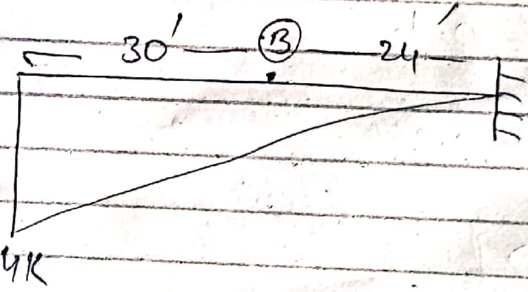


$$\delta_{BB} = \frac{30 \times 30}{2} \times \frac{2}{3} \times 30$$

$$\boxed{\delta_{BB} = 9000\ EI}$$

Apply unit load at Redundant at point (C)



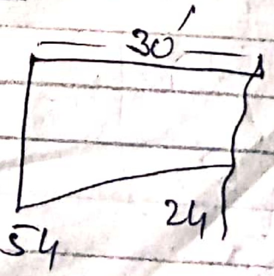


At point (C)

$$\delta_{CC} = \left(\frac{54 \times 54}{2}\right) \times \left(\frac{2}{3} \times 54\right)$$

$$\boxed{\delta_{CC} = 52488\ EI}$$

At point (B)



$$\delta_{BC} = 1170 \times 16.922$$

$$\boxed{\delta_{BC} = 19800/EI}$$

$$W = \frac{54+24}{2} \times 30$$

$$\boxed{W = 1170}$$

$$\bar{x} = \frac{30}{3}\left[\frac{2\times 54 + 24}{54 + 24}\right]$$

$$\boxed{\bar{x} = 16.9}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} \delta_{BB} & \delta_{BC} \\ \delta_{CB} & \delta_{CC} \end{bmatrix}^{-1} \times \begin{bmatrix} 220500 \\ 782100 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 9000 & 19800 \\ 19800 & 52488 \end{bmatrix}^{-1} \times \begin{bmatrix} 220500 \\ 782100 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -48.68 \\ 33.26 \end{bmatrix}$$

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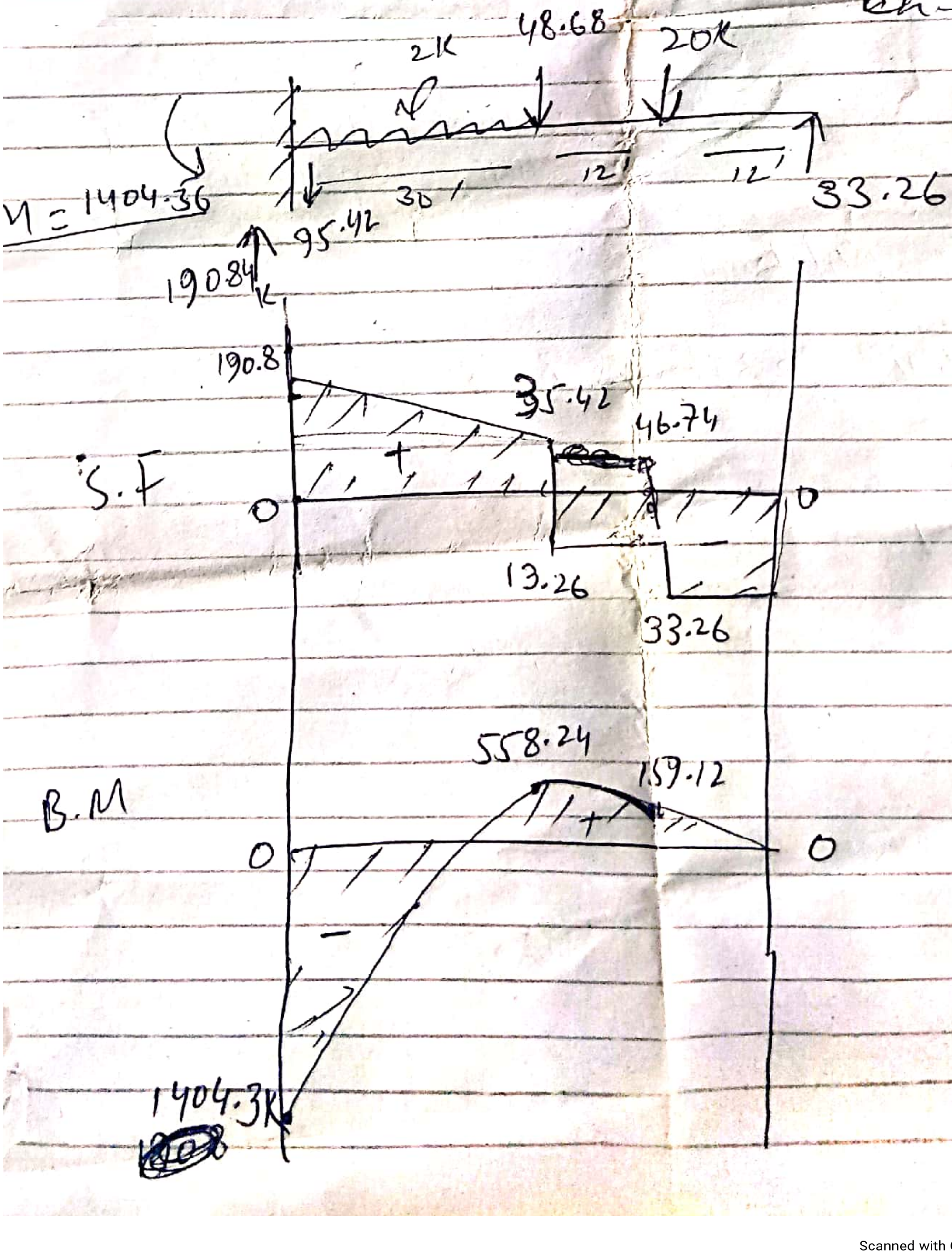


Q2 Differentiate Force & displacement method

Force method

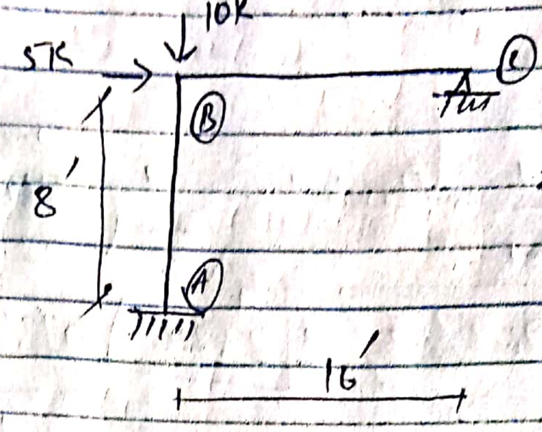
In The Force method of analysis primary unknown are Forces in this method compatibility Eq are written for displacement & rotation (which are calculated by Force displacement eq) solving these eq redundant Force are calculated. One the redundant Force are calculated the remaining reaction are evaluated by eq of equilibrium

Displacement method

In the displacement of analy. The primary unknown are displacement in this method. First Force-displacement relation are computed & subsequently eq are written satisfying the equilibrium condition of the structure

Force Method	Displacement Method
① unknowns are taken redundant Force/reaction	① unknown are taken displacement
② To find unknown Forces or redundant compatibility eq are written	② To find unknown displacement joint eq condition are written
③ The number of compatibility eq needed equal to the degree of static indeterminacy	③ The number of eq condition needed is equal to the degree of kinematic indeterminacy

Q3 Analyze the rigid joint F-J

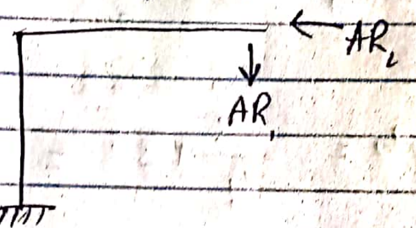


EI = Constant

Sol

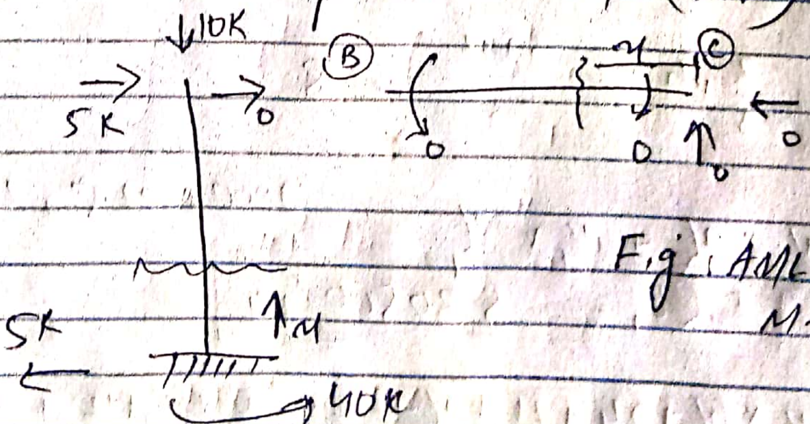
$$S.I = 5-3 = 2^{\circ}$$

step 01 identify redundant



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

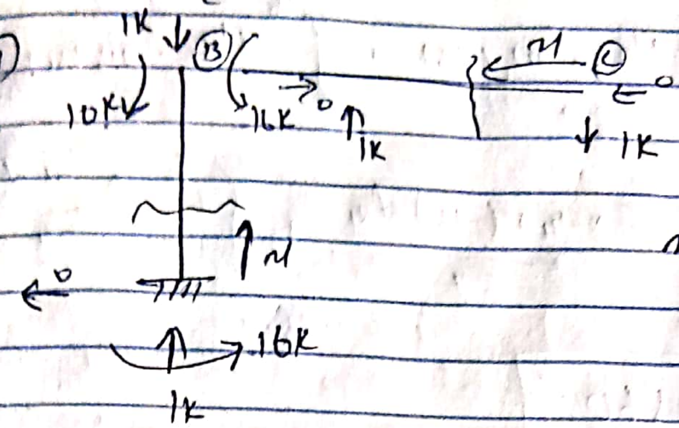
step 02 Compute value of (DRL)



E.g. AML value
M-value

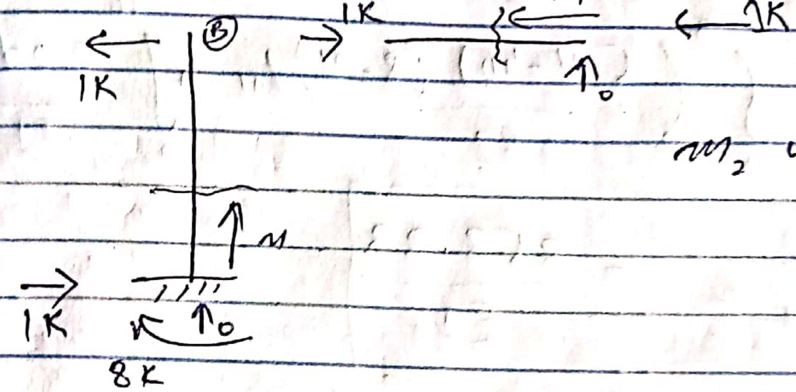
step # 3 [AMR] or [F]

(a)



m_1 - values

(b)



m_2 values

member	AB	BC
origin	A	C
Limits	0-8	0-16
I	I	I
M	$5x-40$	0
m_1	-16	x
m_2	$8-x$	0

For Finding values of DRL

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

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

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

$$DRL_2 = \int_0^8 \left(\frac{(5x-40)}{EI}(8-x)\right)dx + \int_0^{16} \frac{0 \cdot 0\,dx}{EI}$$

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

Compute Flexibility Matrix

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

$$F_{11} = \int_0^8 \frac{m_{1\,BA}^2}{EI} + \int_0^{16} \frac{m_{1\,BC}^2}{EI}$$

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

$$\boxed{F_{11} = 4906.67/EI}$$

(10)

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

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

$$F_{12} = F_{21} = -512/EI$$

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

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

$$F_{22} = 170.67$$

We know

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

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

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

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 4906.67 & -512 \\ -512 & 170.67 \end{bmatrix}^{-1} \begin{bmatrix} -2560 \\ 853.33 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.0000178 \\ 4.9990 \end{bmatrix}$$