Name :- Mian Zeeshanullah

ID :- 7906

Section :- A

Subject :- Structure — I

Assignment :- 03

Engr Amjid Islam

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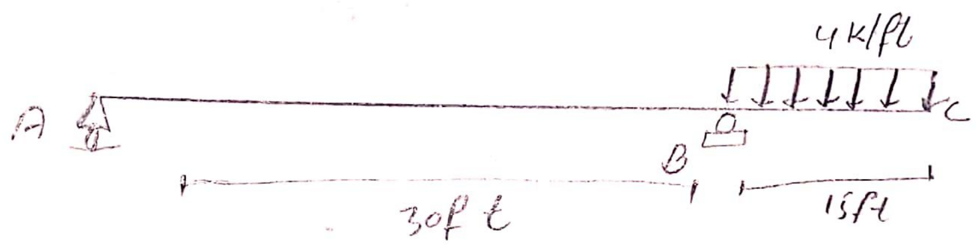
Assignment No : 3

Determine the slope and displacement at C. EI is constant. use the moment-area theorms.



solution :-

$$+\circlearrowright \sum M_A = 0$$

$$-V_B \times 30 + (4 \times 15) \times 3.75 = 0$$

$$V_B = 75k$$

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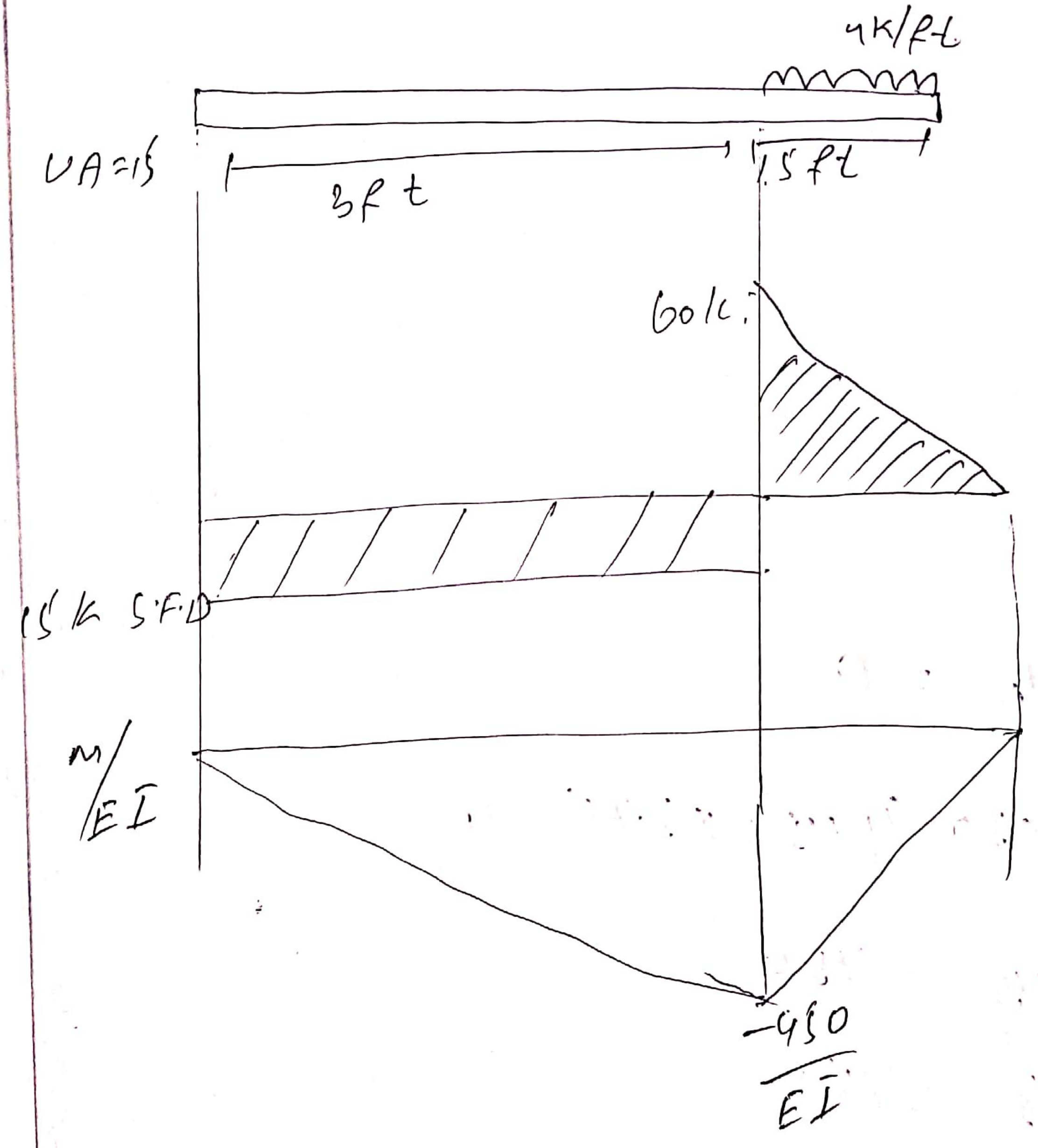
$$\circlearrowright \sum M_B = 0$$

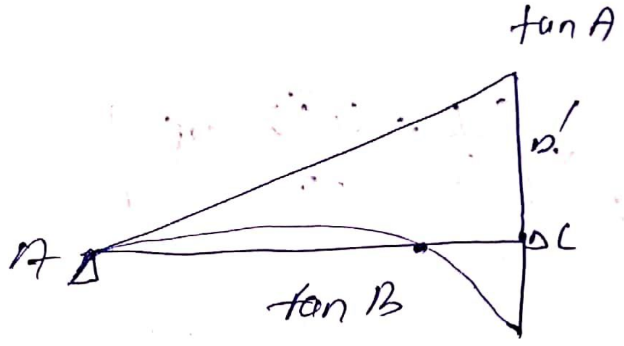
$V_A \times 30 + (4 \times 15) \times 7.5 = 0$

$V_A = -15\ k.$



Thus M/EI consist of triangle and parabol sagment

For displacement



$$t_{C/A} = DC + D'$$

$$DC = t_{C/A} - D' \longrightarrow (1)$$

$$\frac{D'}{45} = \frac{t_{B/A}}{30}$$

$$D' = \frac{3}{3} t_{B/A}$$

eq (1)

$$DC = t_{C/A} - \frac{3}{2} t_{B/A}$$

$t_{c/a}$:

$$t_{c/A} = \left[\frac{-450}{EI} \times 30 \times \frac{1}{2}\right] \times \left[15 + \frac{1}{3} \times 30\right]$$

$$+ \left[\frac{3}{4} \times 15\right] \times \left[\frac{1}{3} \times \frac{450}{EI} \times 15\right]$$

$$\frac{t_c}{a} = \frac{168750}{EI} - \frac{25312.5}{EI}$$

$$t_{c/a} = -194062.5/EI$$

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For $t_{B/a}$:-

$$t_{B/A} = \left(\frac{-450}{EI} \times \frac{30}{2}\right] \times \left[\frac{1}{3} \times 30\right]$$

$$t_{B/A} = -67500/EI$$

$$DC = \frac{-19406.5}{2} - \left(\frac{67500}{EI}\right) \times \frac{3}{2}$$

$$DC = \frac{-295312.5}{EI} \ k \cdot ft^3$$

for slopE at B

$$\theta_B = \frac{DC}{15}$$

$$= \left(\frac{295312.5}{EI}\right) \Big/ 15$$

$$\theta_B = \frac{19687.5}{EI} \ k/ft^2$$

solpe of the free end at point C. is nearly equal to zero

2 →

Determine the slope A and displacement at C of the beam in the figure by moment of Area theorm. Take E = 200 GPa. $I = 6(10^6)\,mm^4$

Required:

$\theta A = ?$

$\Delta C = ?$

And in the question we have given the following data.

$E = 200\,GPa = 200 \times 10^9\,Pa$.

$I = 6 \times 10^6\,mm^4 = 6 \times 10^{6} \cdot 10^{-12}\,m^4$

$I = 6 \times 10^{-6}\,m^4$

First we find support Reaction

$\Sigma Fy = 0 \quad \uparrow^{+} \downarrow^{-}$

$RA + RB = 8$

$\Sigma M = 0 \quad \circlearrowright^{-} \curvearrowright^{+}$

$-RB \times 12 + 2 \times 9 + 4 \times 6 + 2 \times 3 = 0$

$-12RB + 18 + 24 + 6 = 0$

$\frac{\cancel{12}RB}{\cancel{12}} = \frac{48}{12}$

$\boxed{RB = 4}$

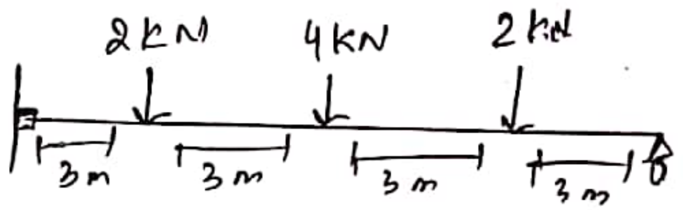
As we know that

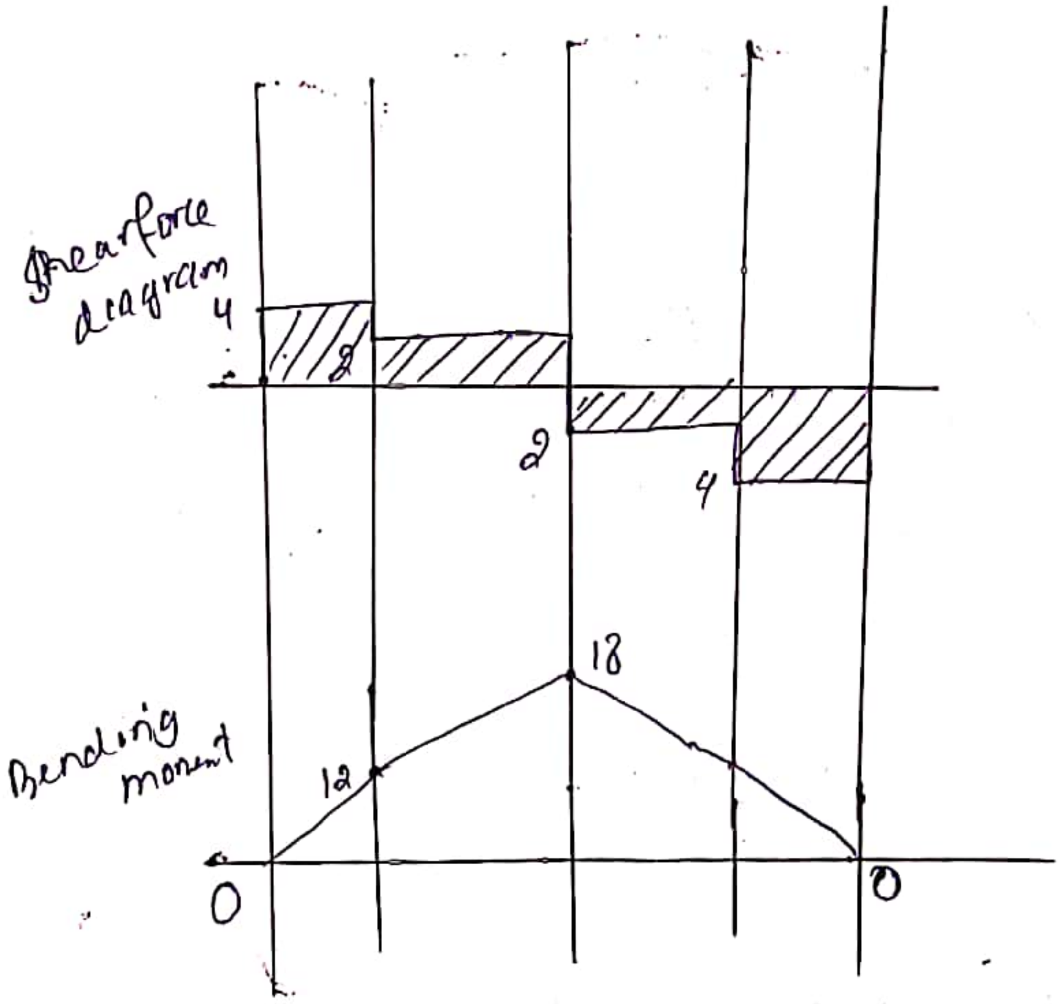
$RA + RB = 8$

$RA + 4 = 8$

$\boxed{RA = 4}$

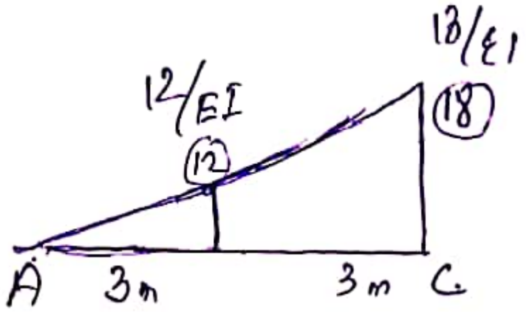
Now we draw the Bending diagram of the following beam.





First we find the slope at point "A" of the beam.

$\theta A \Rightarrow$ Area b/w the Points A and C



$$\theta_A = \left(\frac{12 \times 3}{2}\right) + \left(\frac{12+18}{2}\right) \times 3 = \frac{63}{EI} \; (\text{kN/m}^2)$$

As from the question

$$E = 200 \times 10^{9} \; Pa$$

$$I = 6 \times 10^{-6} \; m^4$$

$$\theta A = \frac{63}{200 \times 10^{9} \times 6 \times 10^{-6}}$$

$$\boxed{\theta A = 0.0525 \text{ rad}}$$

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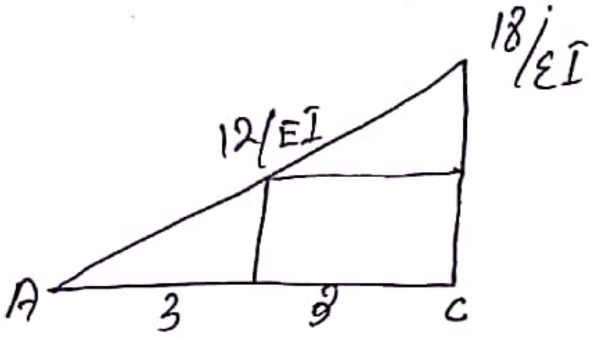
Now we find the deflection at (2

Point 'B' of The beam.

So, Dc (Deflection at mid-span) will be equal to first moment of area between point A and C.



$$Dc = \frac{2}{3}\times 3\left(\frac{12\times 3}{2}\right) + \left[\left(3+\frac{3}{2}\right)(12\times 3)\right]$$

$$+\left[\left(3+\left(\frac{2}{3}\times 3\right)\right)\left(\frac{2\times 6}{2}\right)\right]$$

$$Dc = 36 + 162 + 45 \Rightarrow 243\ \mathrm{kN\cdot m^3}/EI$$

$$Dc = \frac{243\times 10^3\, m^3}{200\times 10^9 \times 6\times 10^{-6}}$$

$$\boxed{Dc = 0.2025\, m}$$

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