Structure Analysis

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Sec :- A

Assignment :- 03

Date :- 13/7/2020

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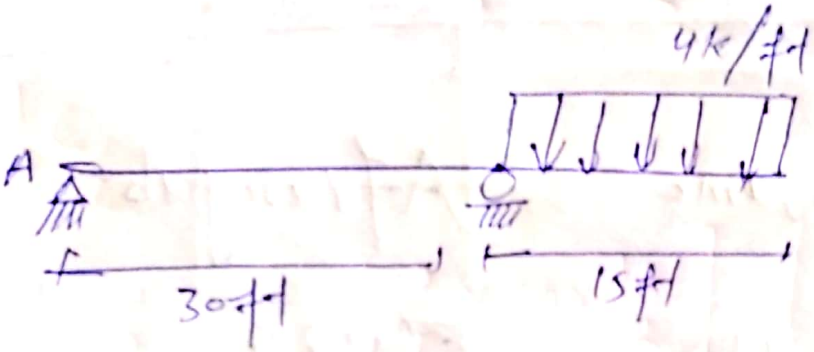
Q:- Determine the slope and displacement at C . EI is Constant.

Use the moment area theorem.



Solution:

$$+\circlearrowleft \sum M_A = 0$$

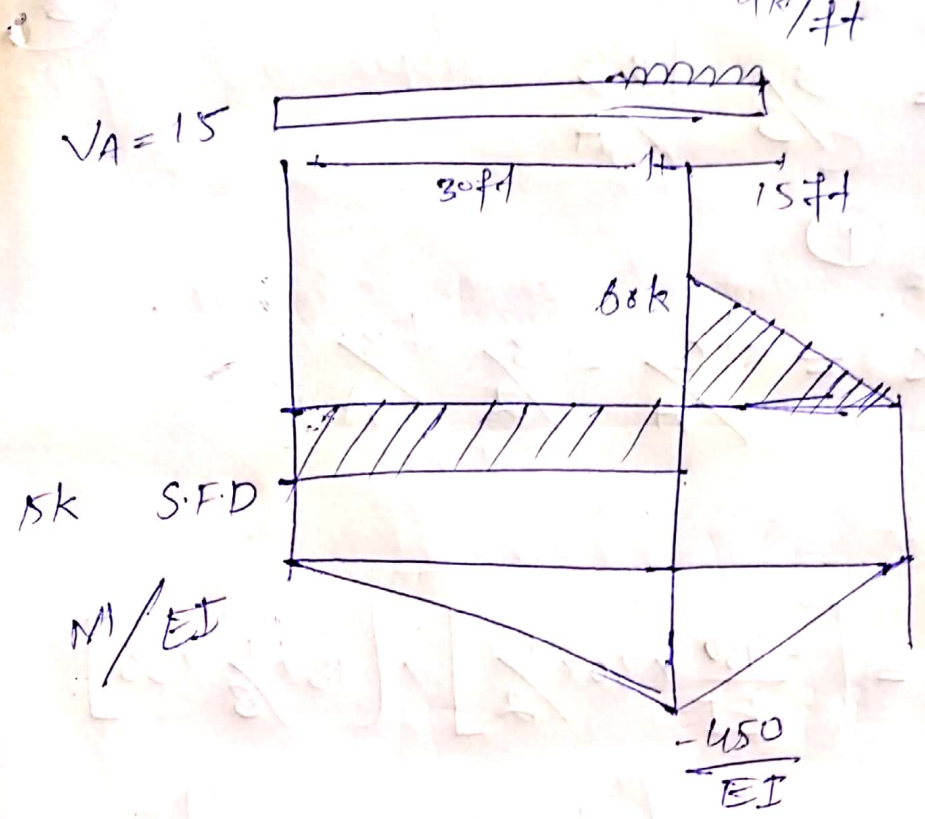
$$-V_B + 30 + (4 \times 15) \times 3.75 = 0$$

$$V_B = 75\ k$$

$$\downarrow \sum M_B = 0$$

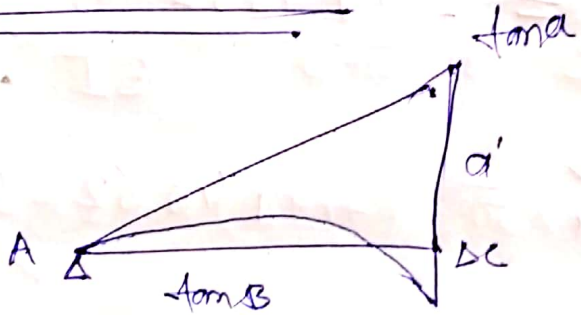
$$V_A \times 30 + (4 \times 15) \times 7.5 = 0$$

$$V_A = -15\ k$$



Thus M/EI consist of triangle and parabola segment.

For Displacement :-



$$+C/_A = \Delta C + D'$$

$$\Delta C = +C/_A - D' \quad \text{—— (1)}$$

$$\frac{D'}{45} = \frac{+B/_A}{30}$$

$$D' = \frac{3}{3} \; {}^{+B'}/_{A}$$

eq (1)

$$DC = {}^{+C}/_{A} - \frac{3}{2} \; {}^{+B}/_{A}$$

$${}^{+C}/_{a} :$$

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

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

$$\frac{{}^{+C}}{a} = \frac{168750}{EI} - \frac{25312.5}{EI}$$

$${}^{+C}/_{a} = -\frac{194062.5}{EI}$$

$${}^{+C}/_{a} = -194062.5/EI$$

for ${}^{+B}/_{a}$ =

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

$${}^{+B}/_{A} = -\frac{67500}{EI}$$

$$DC = \frac{-19406.5}{2} - \left(\frac{67500}{EI}\right) \times \frac{3}{5}$$

$$DC = -\frac{29531.5}{EI} \text{ k-ft}^3$$

for slope at B

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

$$= \left(\frac{-29531.5}{EI}\right) / 15$$

$$\theta_B = \frac{196875}{EI} \text{ k/ft}^3$$

Slope of the free end at point C.

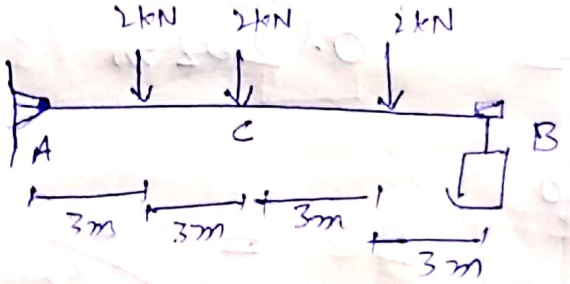
It nearly equal to zero.

Q No 2

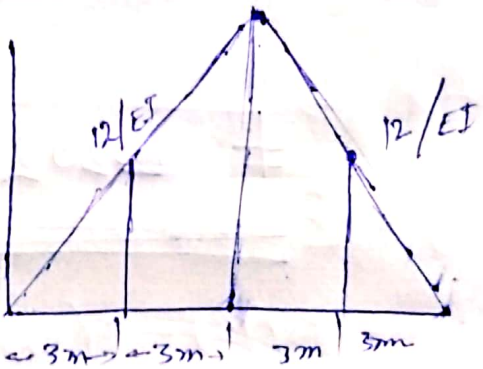
Determine the Slope at A and displacement at C of the Beam in the figure moment area Theorm.

Take $E = 200 GPa$, $I = 6(10^6) mm^4$

Given



Solution,



$$\frac{Q_A}{C} = \frac{1}{2}\left(\frac{12}{EI}\right)(3) + \left(\frac{12}{EI}\right)3 + \frac{1}{2}\left(\frac{6}{EI}\right)(3)$$

$$\theta_{A/C} = \frac{18}{EI} + \frac{36}{EI} + \frac{9}{EI}$$

$$\theta_{A/C} = \frac{63}{EI} \Rightarrow \frac{63}{(200\times10^6)(6\times10^6)(1000)^{-4}}$$

$\theta_{A/C} = 0.0525$ rad

$$\boxed{\theta_A = 0.0525 \text{ rad}}$$

$$t_{A/C} = \left[\frac{1}{2}\left(\frac{12}{EI}\right)(3)\right]\left(\frac{2}{3}(3)\right) + \left[\frac{12}{EI}(3)\right]\left(3 + \frac{1}{2}(3)\right] + \left[\frac{1}{2}\left(\frac{6}{EI}\right)(3)\right]\left(3 + \frac{2}{3}(3)\right]$$

$$= 0.202 \text{ m}$$

So $\Delta_C = t_{A/C} = 0.202 \text{ m}$

$$\boxed{= 202 \text{ mm}}$$ Ans