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Section : B

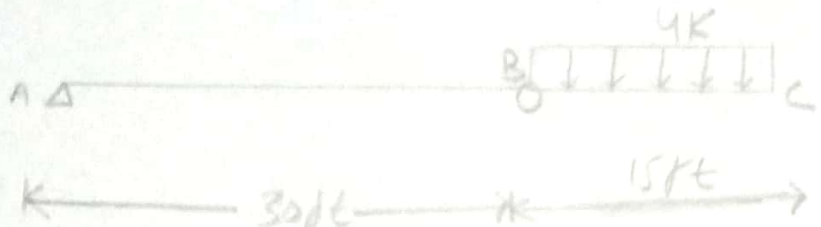
Department : BS. Civil

Subject : Structural Analysis

Assignment No : 03

Submitted To : Engr. Amjed Sahib

Pb 1:



Slope (θ_c) = ?

Displacement (Δ_c) = ?

Firstly we have to draw M/EI diagram.

So,

$\curvearrowleft + \Sigma M_A = 0$

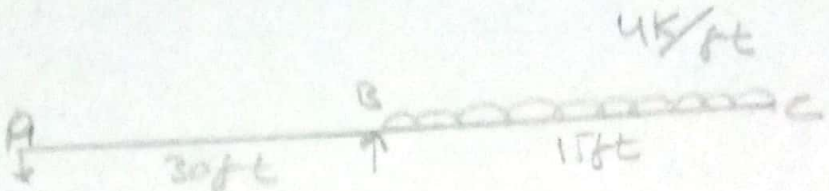
$-V_B \times 30 + (4 \times 15) \times 37.5 = 0$

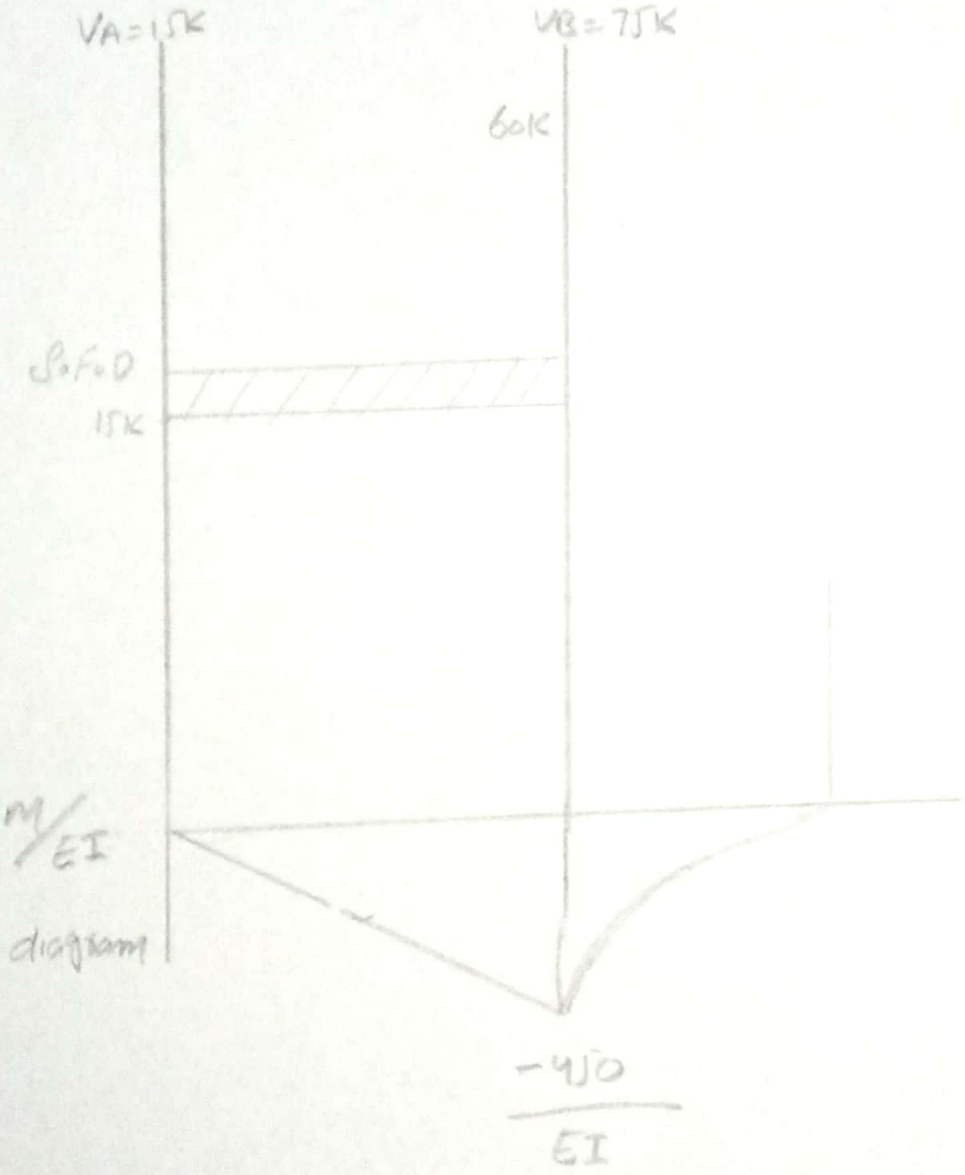
$$V_B = 75\ K$$

$\curvearrowleft + \Sigma M_B = 0$

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

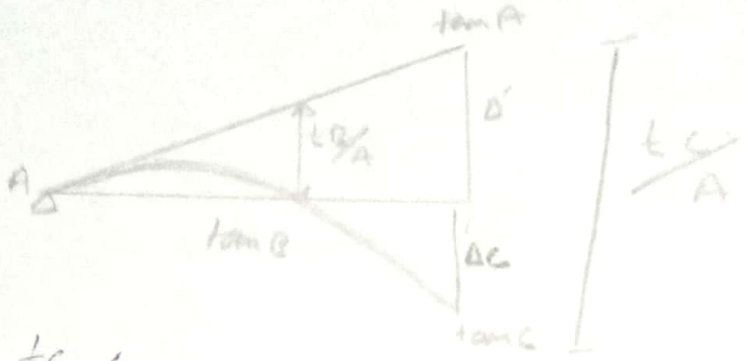
$$V_A = -15\ K$$





This M/EI diagram consist of triangular & parabolic segment.

For Displacement :-



$$t_{C/A} = \Delta_C + \Delta'$$

$$\boxed{\Delta_C = t_{C/A} - \Delta'} \rightarrow (i)$$

By proportionality of triangles

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

$$\boxed{\Delta' = 3/2\ t_{B/A}}$$

eq (i) =>

$$\boxed{\Delta_C = t_{C/A} - 3/2\ t_{B/A}} \rightarrow (ii)$$

For $t_{C/A}$:-

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

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

$$t_{C/A} = \frac{-168750}{EI} - \frac{25312.5}{EI}$$

$$\boxed{\frac{t_C}{A} = \frac{-194062.5}{EI}}$$

For $t_{B/A}$:-

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

$$\boxed{t_{B/A} = \frac{-67500}{EI}}$$

Putting the values in eq (ii)

$$\Delta_C = \frac{-194062.5}{2} - \left(\frac{67500}{EI}\right) \times 3/2$$

$$\boxed{\Delta_C = \frac{-295312.5}{EI} K - 7t^3} \downarrow$$

For slope at Point B

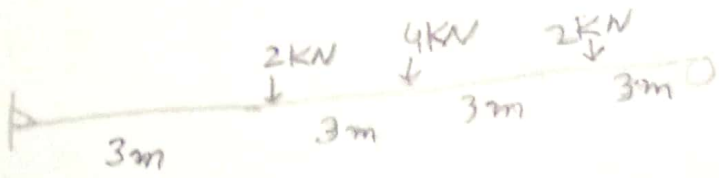
$$\theta_B = \frac{\Delta_C}{15}$$

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

$$Q_B = \frac{19687.5K - 7L^2}{EI}$$

Q) Slope of the free end i.e Point C is nearly equal to zero.

Pb 2:-



Given Data:-

$E = 200 GPa$, $I = 6 \times 10^6 mm^4$

Required data:-

Slope at Point (Q_A) = ?

Deflection At Point D = ?

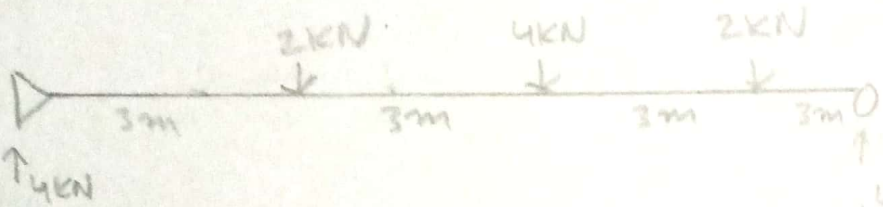
Sol:- As beam is symmetrical

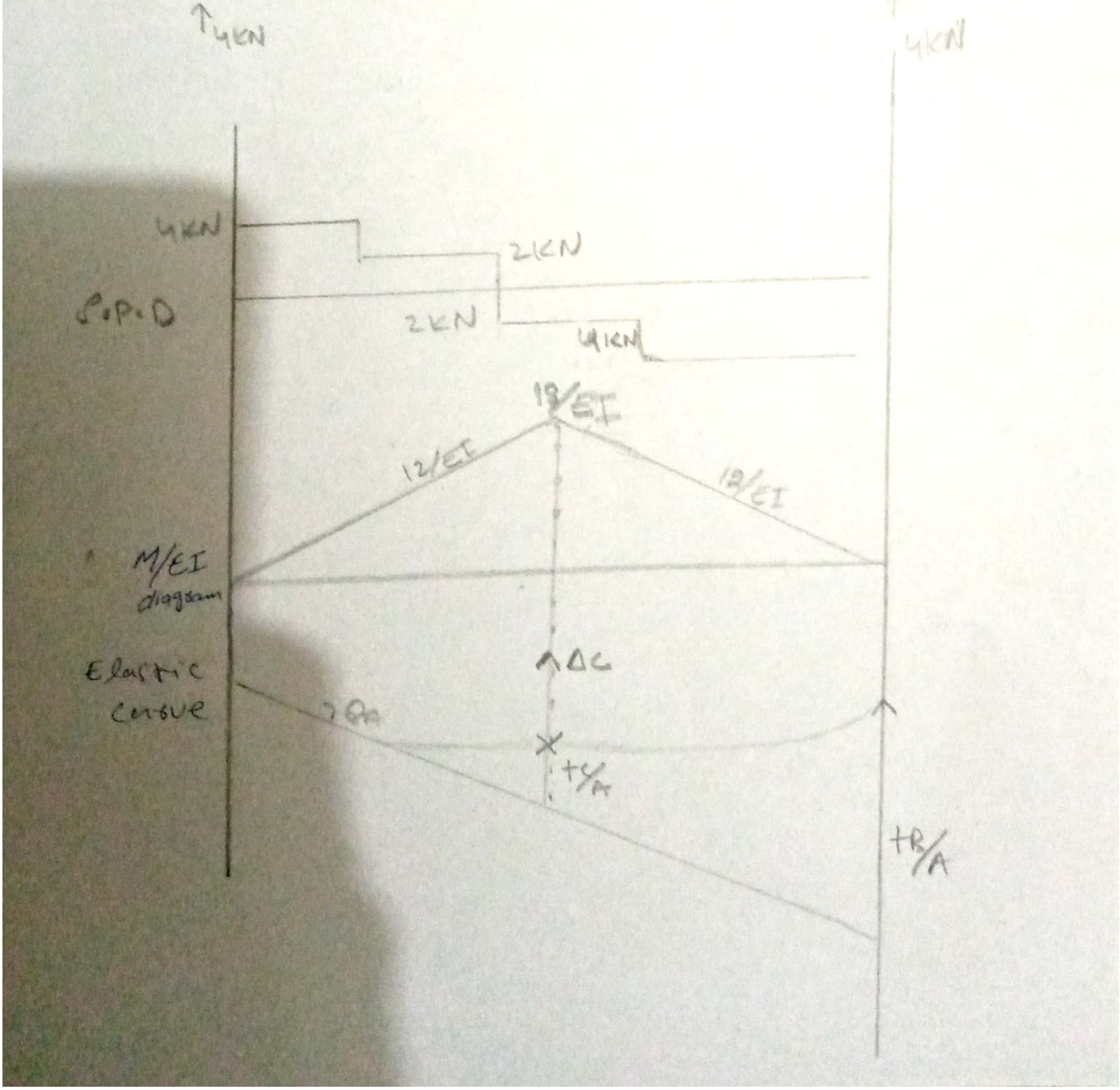
So,

$$V_A = V_B = (2+4+2)/2$$

$$V_A = V_B = 4KN$$

For M/EI diagram





(1)

$$\theta_A = t_{B/A} / 12 \rightarrow (i)$$

$$\theta_A = \frac{\Delta_C + t_{C/A}}{6}$$

$$\Delta_C = 6\theta_A - t_{C/A} \rightarrow (ii)$$

for slope θ_A

$$t_{B/A} = \int_A^B \frac{M}{EI}\, \bar{x}$$

$$= \frac{1}{EI}\left\{\left(\frac{18\times 6}{2}\right)\left(\frac{2}{3}\times 6\right) + \left(\frac{18\times 6}{2}\right)\times\left(6\times \tfrac{2}{3}\right)\right.$$

$$t_{B/A} = \frac{1}{EI}\left(216 + 432\right)$$

$$t_{B/A} = \frac{648}{EI}$$

eq (i) $\theta_A = \left(\frac{648}{EI}\right)/12$

$\theta_A = 54\ KN\,m^2$

$$\frac{200 \times 10^9 \times 6 \times 10^6}{(1000)^4}$$

$$\theta_A = 0.045\ rad \text{ clockwise}$$

for displacement Δ_c

$$t_{C/A} = \frac{1}{EI}\left[\frac{18 \times 6}{2} \times \frac{1}{3} \times 6\right]$$

$$t_{C/A} = \frac{108}{EI}\ KN\text{-}m^3$$

eq (ii)

$$\Delta_c = \frac{6 \times 54}{EI} - \frac{108}{EI}$$

$$\Delta_c = \frac{324 - 108}{EI}$$

$$\Delta_c = \frac{216}{EI}$$

(9)

$$\Delta c = \frac{216}{200 \times 10^9 \times 6\,(10^6)}$$

$$\Delta c = 0.18\,m$$

$$\boxed{\Delta c = 18\,cm}$$