Theory of structure (CE 301)

2nd test

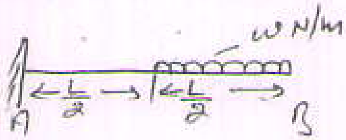
Time = 1hr

MM = 15

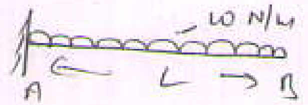
Model Answer

Ans 1

First we find deflection and rotation at B for fully loaded beam, dia. ①



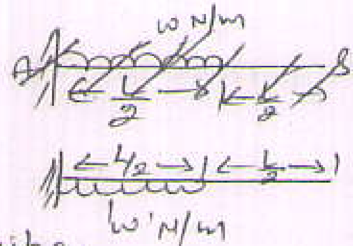
$\theta_{B_1} = \frac{wl^3}{6EI}$ & $y_{B_1} = \frac{wl^4}{8EI}$



— ①

As per dia. ②

$\theta_{B_2} = \frac{wl^3}{48EI}$ $\quad y_{B_2} = \frac{7wl^4}{32 \times 12\,EI}$



— ②

According to principle of superposition.

rotation at B due to actual loading

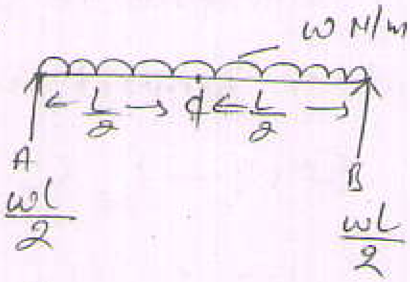
$$\theta_B = \theta_{B_1} - \theta_{B_2} = \frac{wl^3}{6EI} - \frac{wl^3}{48EI} = \frac{(8-1)wl^3}{48EI} = \frac{7wl^3}{48EI}$$

deflection at B due to actual loading.

$$y_B = y_{B_1} - y_{B_2} = \frac{wl^4}{8EI} - \frac{7wl^4}{32 \times 12\,EI} = \frac{48wl^4 - 7wl^4}{32 \times 12\,EI} = \frac{41wl^4}{384\,EI}$$

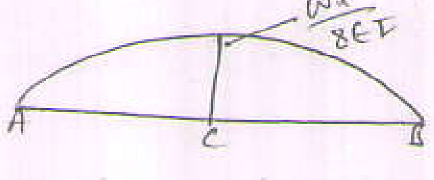
Ans 2

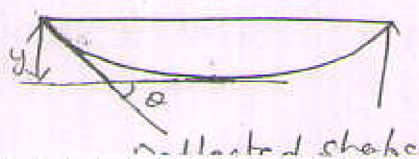
As per Area Moment method.



$M_x = \frac{wl}{2}x - \frac{wx^2}{2}$

$\frac{M}{EI}$ diagram





deflected shaped :

$$\theta_A^C = \sum_{x=0}^{x=l/2} A_{\frac{M}{EI}} = \int_0^{l/2} \left(\frac{wlx}{2EI} - \frac{wx^2}{2EI} \right) dx = \frac{wl^3}{24EI}$$

∴ rotation at point A = $\frac{wl^3}{24EI}$

rotation at point C = 0 due to symmetric loading.

$$d_A^C = \sum_{x=0}^{x=l/2} A_{\frac{M}{EI}} \cdot \bar{x} = \int_{x=0}^{l/2} \left(\frac{wlx^2}{2EI} - \frac{wx^3}{2EI} \right) dx = \frac{5wl^4}{384EI}$$

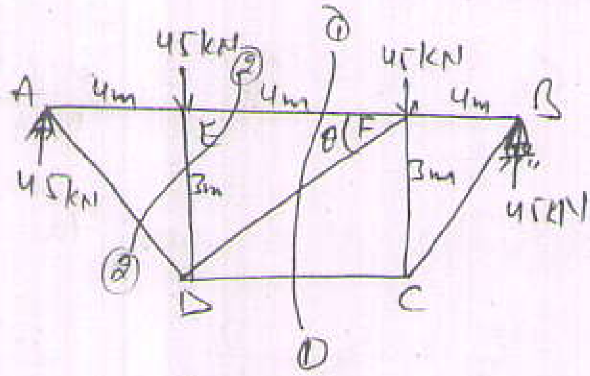
∴ deflection at point C = deviation at point A

$$= \frac{5wl^4}{384EI}$$

and deflection at point A = 0 (due to support.)

Ans 3 :- take cut section ①-①

On taking moment about point D.



$$45 \times 4 + P_{EF} \times 3 = 0$$

$$P_{EF} = -\frac{45 \times 4}{3} = -60\text{ kN}$$

(initially we assume the axial forces (P) in every member is tensile.)

∴ axial force in EF = 60 kN (Compression)

→ take moment about point C

$$60 \times 3 - P_{DF} \times 3 - 45 \times 4 = 0$$

$$P_{DF} = \frac{60 \times 3 - 45 \times 4}{3} = \frac{180 - 180}{3} = 0$$

∴ axial force in DF = 0 kN.

~~take~~ Cut section ②-②

take moment about A.

$$45 \times 4 + P_{ED} \times 4 = 0$$

$$P_{ED} = -\frac{45 \times 4}{4} = -45$$

∴ axial force in ED = 45 kN Compression.