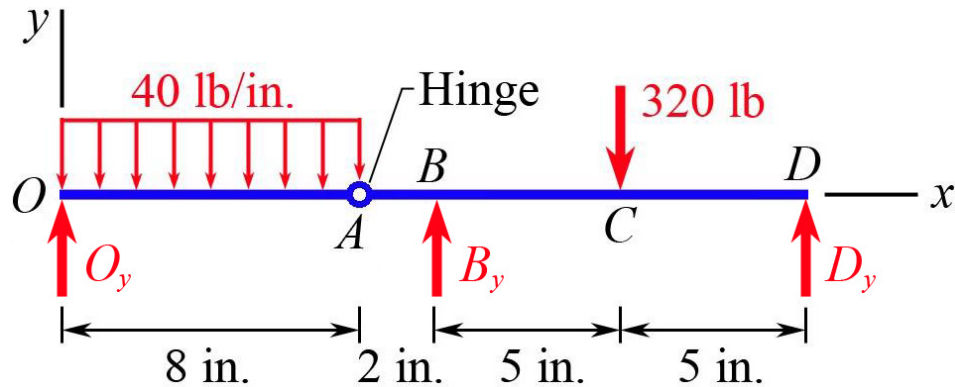


MEEG 4103 Quiz 3.1.091

1. (10 points) A beam is shown. Using singularity functions exclusively, find the magnitudes O_y , B_y , and D_y of the reaction forces at the supports O , B , and D , respectively.



2. (10 points) Referring to Problem 1, write the shear force V and bending moment M in segments OA and BC of the beam.

1.

$$q = O_y \langle x \rangle^{-1} - 40 \langle x \rangle^0 + 40 \langle x - 8 \rangle^0 + B_y \langle x - 10 \rangle^{-1} - 320 \langle x - 15 \rangle^{-1} + D_y \langle x - 20 \rangle^{-1}$$

$$V = O_y \langle x \rangle^0 - 40 \langle x \rangle^1 + 40 \langle x - 8 \rangle^1 + B_y \langle x - 10 \rangle^0 - 320 \langle x - 15 \rangle^0 + D_y \langle x - 20 \rangle^0 \quad \textcircled{3}$$

$$M = O_y \langle x \rangle^1 - 20 \langle x \rangle^2 + 20 \langle x - 8 \rangle^2 + B_y \langle x - 10 \rangle^1 - 320 \langle x - 15 \rangle^1 + D_y \langle x - 20 \rangle^1$$

$$M|_{x=8} = 0: O_y(8) - 20(8)^2 = 0 \quad \therefore O_y = 160 \text{ lb} \quad \textcircled{2}$$

$$M|_{x=20^+} = 0: O_y(20) - 20(20)^2 + 20(12)^2 + B_y(10) - 320(5) = 0 \quad \therefore B_y = 352 \text{ lb} \quad \textcircled{3}$$

$$V|_{x=20^+} = 0: O_y - 40(20) + 40(12) + B_y - 320 + D_y = 0 \quad \therefore D_y = 128 \text{ lb} \quad \textcircled{2}$$

2. **Segment OA**, $0 \leq x \leq 8$: $V = 160 - 40x \text{ lb}$ $\textcircled{2}$ $M = 160x - 20x^2 \text{ lb}\cdot\text{in.}$ $\textcircled{2}$

Segment BC, $10 \leq x \leq 15$:

$$V = O_y - 40x + 40(x - 8) + B_y = 160 - 320 + 352 \quad V = 192 \text{ lb} \quad \textcircled{3}$$

$$\begin{aligned} M &= O_y x - 20x^2 + 20(x - 8)^2 + B_y(x - 10) \\ &= 160x - 20x^2 + 20(x^2 - 16x + 64) + 352(x - 10) \\ &= 192x - 2240 \end{aligned}$$

$$M = 192x - 2240 \text{ lb}\cdot\text{in.} \quad \textcircled{3}$$