

ENCE 353 Homework 4

Question 1: Figure 1 is an elevation view of a cantilever beam that carries a uniformly distributed load, w (N/m), over half of its length.

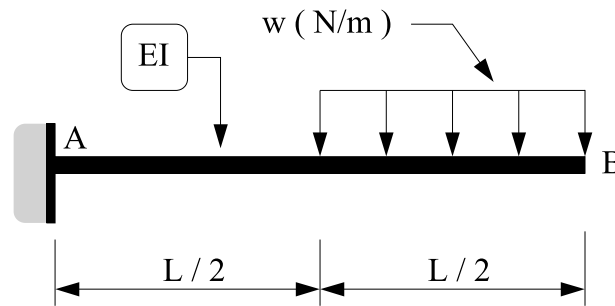


Figure 1: Elevation view of a cantilever beam that carries a uniformly distributed load, w , over half of its length.

Use the moment-area method to show that the vertical deflection at point B is:

$$\Delta_B = \left[\frac{41wL^4}{384EI} \right]. \quad (1)$$

Question 2: Figure 2 is an elevation view of a cantilever beam of length that is supported at its tip and carries a point load P at distance “ a ” from the left-hand support.

Use the moment-area method and the principle of superposition to show that the vertical support reaction at point B is:

$$R = \frac{3P}{2} \left[\frac{a}{L} \right]^2 \left[1 - \frac{1}{3} \frac{a}{L} \right]. \quad (2)$$

Notice that when $a = 0$, $R = 0$ and when $a = L$, the support reaction $R = P$.

Show that the maximum bending moment at A occurs when $a = \left[1 - \frac{1}{\sqrt{3}} \right] L$.

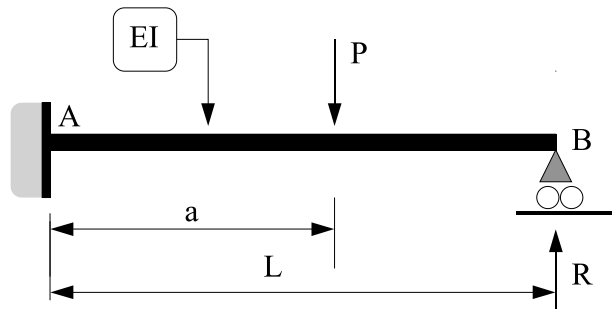


Figure 2: Elevation view of a support cantilever beam that carries a point load P .

Question 3: Figure 3 is a front elevation view of a simple beam structure carrying two external loads P . The beam has section properties EI near the supports and $2EI$ in the center section.

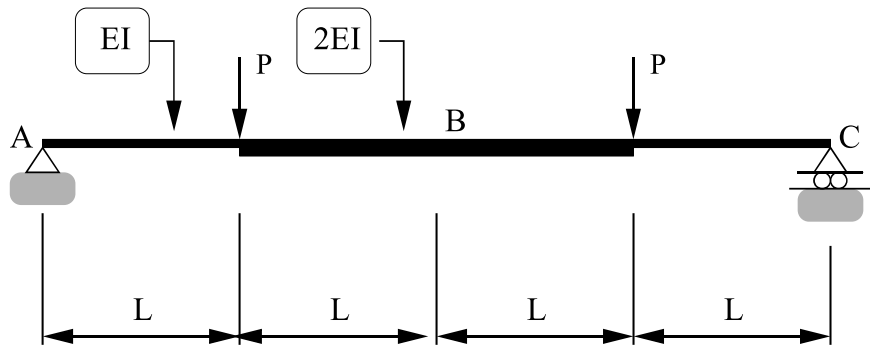


Figure 3: Simple beam structure (symmetric loads P).

Use the method of moment area to show that the end rotation at A (measured clockwise) is:

$$\theta_A = \frac{PL^2}{EI}. \quad (3)$$

Use the method of moment area to show that the vertical beam deflection at B is:

$$\Delta_B = \frac{13 PL^3}{12 EI}. \quad (4)$$