Department of Civil and Environmental Engineering, Fall Semester, 2015
Due: November 9, 2015.

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.

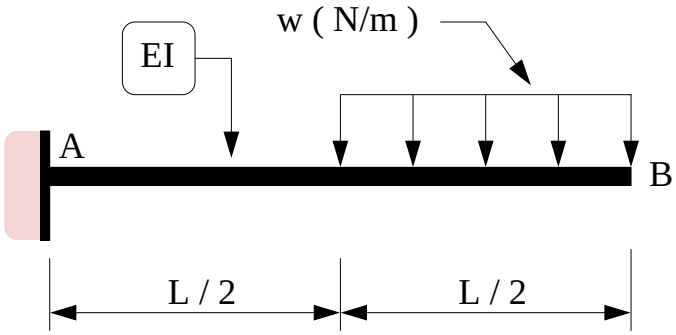

Figure 1: Elevation view of a cantilever beam that carries a uniformly distributed load, w, over half of its length.

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

$$\triangle_B = \left[\frac{41wL^4}{384EI}\right]. \tag{1}$$

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:

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

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 $a = \left[1 - \frac{1}{\sqrt{3}}\right] L$.

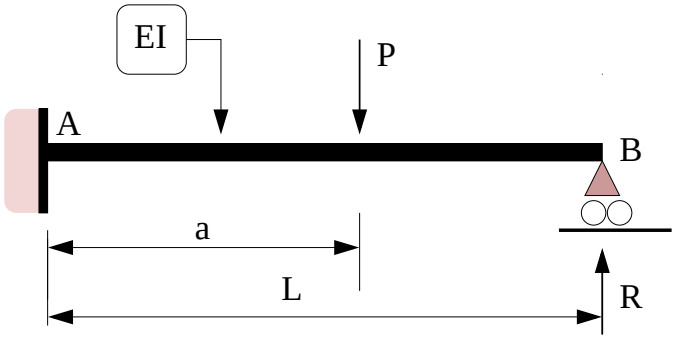

Figure 2: Elevation view of a support cantilever beam that carries a point load P.

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.

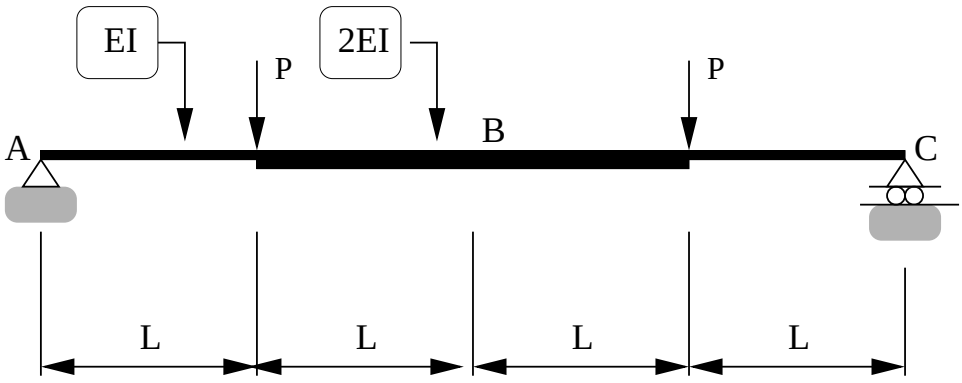

Figure 3: Simple beam structure (symmetric loads P).

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

$$\theta_A = \frac{PL^2}{EI}. \tag{3}$$

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

$$\triangle_B = \frac{13}{12}\frac{PL^3}{EI}. \tag{4}$$