Department of Civil and Environmental Engineering, Fall Semester, 2015
Due: November 20, 2015.

ENCE 353 Homework 5

Question 1: Principle of Virtual Displacements. Consider the S-shaped beam structure shown in Figure 1.

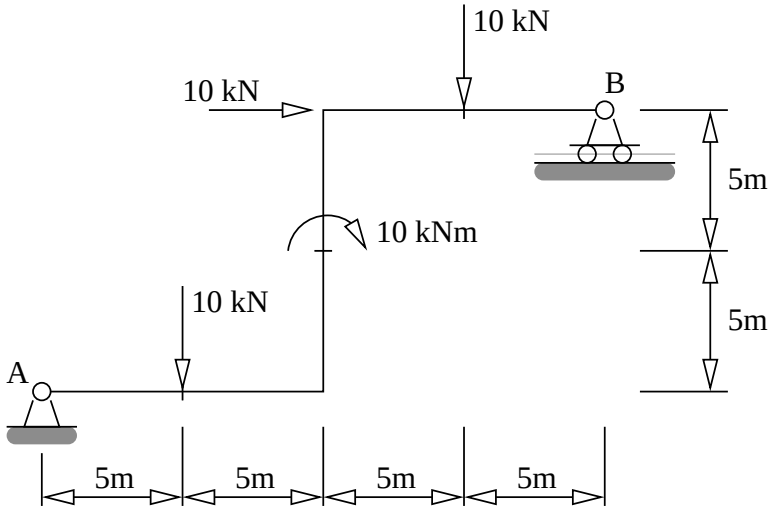

Figure 1: S-shaped beam structure.

Use the principle of virtual displacements to compute the vertical reaction at B.

Question 2: Principle of Virtual Forces. Figure 2 is a front elevation view of a simple truss that supports a horizontal load P at node C. All three truss members have cross section properties AE.

Use the **method of virtual forces** to show that the horizontal deflection at node C is:

$$\triangle = \frac{2PL}{AE}\left[1+\sqrt{2}\right]. \tag{1}$$

Question 3: Principle of Virtual Forces. Figure 3 is a front elevation view of a two-span beam structure that carries a vertical load of 8 kips at the midspan of section A-B. The beam is constructed from a material having modulus of elasticity E = 29,000 ksi.

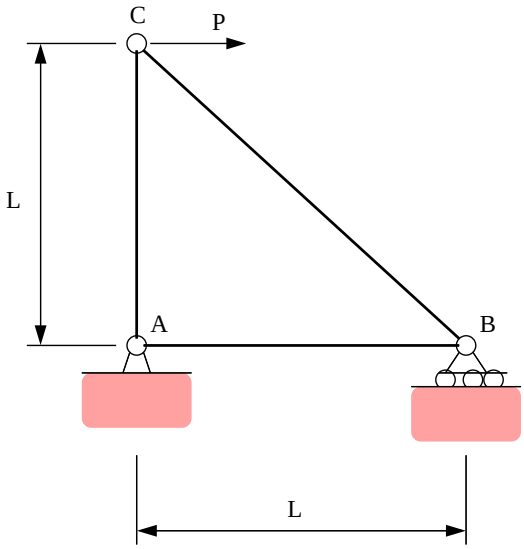

Figure 2: Front elevation view of a simple truss.

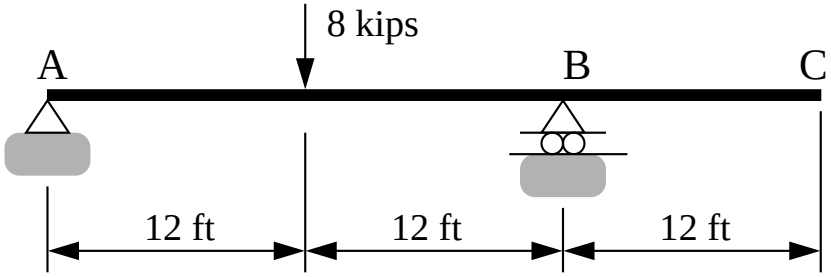

Figure 3: Front elevation view of a two-span beam structure.

[3a] Use the method of virtual work to find the virtical deflection of the beam at the midspan of A-B as a function of I, the beam moment of inertia.

[3b] Use the method of virtual work to compute the rotation of the beam at B as a function of I.

[3c] Use your results from parts [3a] and [3b] to determine the smallest value of I will satisfy the constraint: max vertical deflection is less than 0.5 inches.