ENCE 353 Introduction to Structural Analysis,

Spring Semester, 2020

Homework 5 (Due: Friday, May 8, 2020)

Question 1: 8 points

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



Figure 1: Problem 1. S-shaped beam structure.

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

Question 2: 6 points

Consider the truss structure shown in Figure 3.



Figure 3: Elevation view of a pin-jointed truss.

The horizontal and vertical degrees of freedom are fully-fixed at supports A and G. The truss carries a vertical load P at node E. All frame members have cross section properties AE.

2 (a). Use the <u>method of joints</u> to identify all of the zero-force members. Label these members on Figure 3.

(b). Compute the support reactions at A and G as a function of P and L.

2 (c). Derive an expression for the vertical deflection at node E, as a function of P, L and AE.

Question 3: 6 points (Note: Show all work, provide all answers in inches and radians)

(a). Use virtual work to determine the vertical displacement of C.

(b). Use virtual work to determine the horizontal displacement of E.

Area of members: $A_{AB} = A_{AC} = A_{BC} = 3 in^2$ and $A_{BD} = A_{CD} = A_{CE} = A_{DE} = 5 in^2$. $E = 29,000 \ ksi$ for all members.



Figure 3: Problem 3. A simple truss structure.