4.440 / 4.462 Basic Structural Design
Spring 2009

Assignment #2

1) For the truss illustrated below, make the typical assumptions for truss analysis to determine the internal force in each element.

    a)   What are the external support reactions?

    b)   Solve for the internal forces in the truss using the method of joints. Label each member as tension or compression, together with the value of internal axial force.

    c)   Analyze the same truss using graphical analysis. Label the problem clearly using Bow's notation and determine the internal forces from the resulting force polygon. Compare your graphical solution to the numerical solution from (b) and explain any discrepancies.
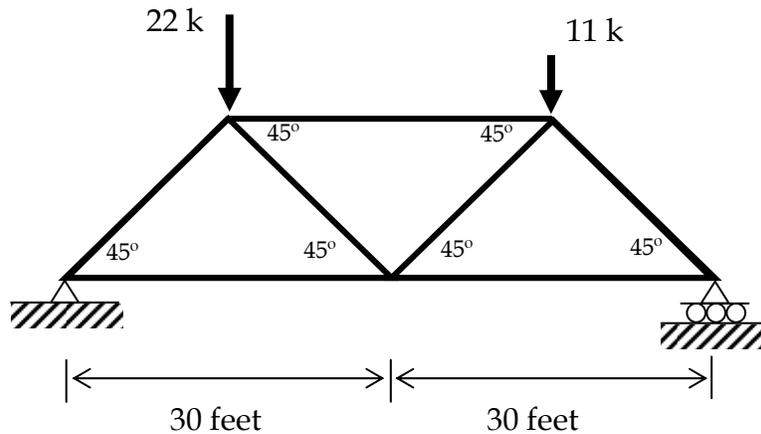
2) Using results from above, which element has the highest compression force? Design this element so that the safety factor against buckling is at least 3.0 due to the applied loads. You may assume that the element is pinned at each end.

    a)   If the member is a steel pipe with an outside diameter of 6", what is the thickness required for the pipe wall to resist buckling with a safety factor of 3.0? (E_{steel} = 29,000 ksi)

    b)   If the member is a solid square timber column, what is the width of the column required to resist buckling with a safety factor of 3.0? (E_{timber} = 1,600 ksi)

    c)   If every element of the truss is made from a 6-inch outer diameter steel pipe with a wall thickness of 0.25 inches, what is the axial stress in each element due to the applied loads?

    d)   Name two things you could change about this truss design in order to reduce the value of compressive force in the most highly stressed element.