Buckling of a Slender Member

The purpose of this lab is to characterize the relationship between the length of slender members and their critical buckling load. The specimens to be tested will be metal strips representing potential truss members. The end conditions of the members will be fixed, meaning the ends are not free to rotate. These end conditions are diagrammed in Figure 1.

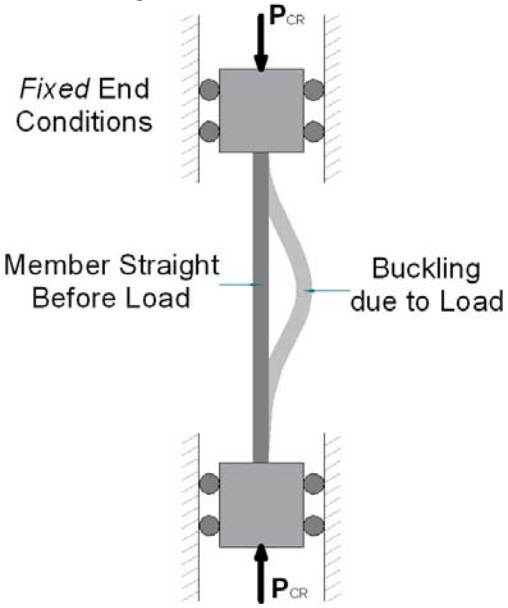


Figure 1. Diagram buckling setup.

Metal strips with varying lengths will be loaded using fixed end conditions until they buckle. The load needed to buckle a member is called the critical load (P_{cr}). To investigate the nature of the relationship between the lengths of the members and the load required to buckle them, the critical loads will be plotted versus their lengths. In addition, the effect of laminating multiple strips together will be explored.

Three specimens will be tested for each length. The first specimen will be a single layer strip, the second specimen will two layers thick, and the third sample will be three layers thick. To create the laminated members, rivets will be used on a 1-inch center-to-center spacing to hold the layers together. Use the diagram shown in Figure 2 to determine the correct spacing for the rivets. Notice that the rivets start 1.5 inches from the ends. Use the hand punches with the 1/8th inch punch to create the holes for the rivets.

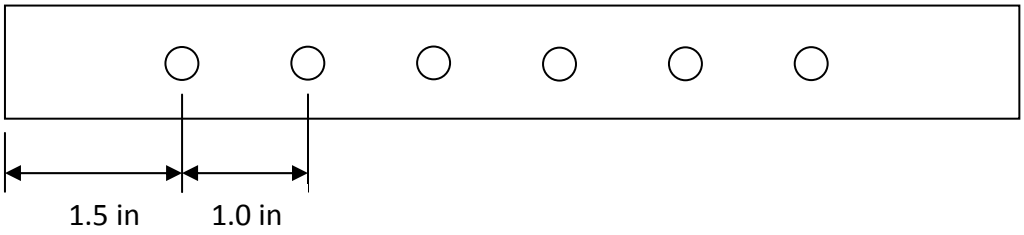


Figure 2. Diagram for the placement of rivets for the laminated samples.

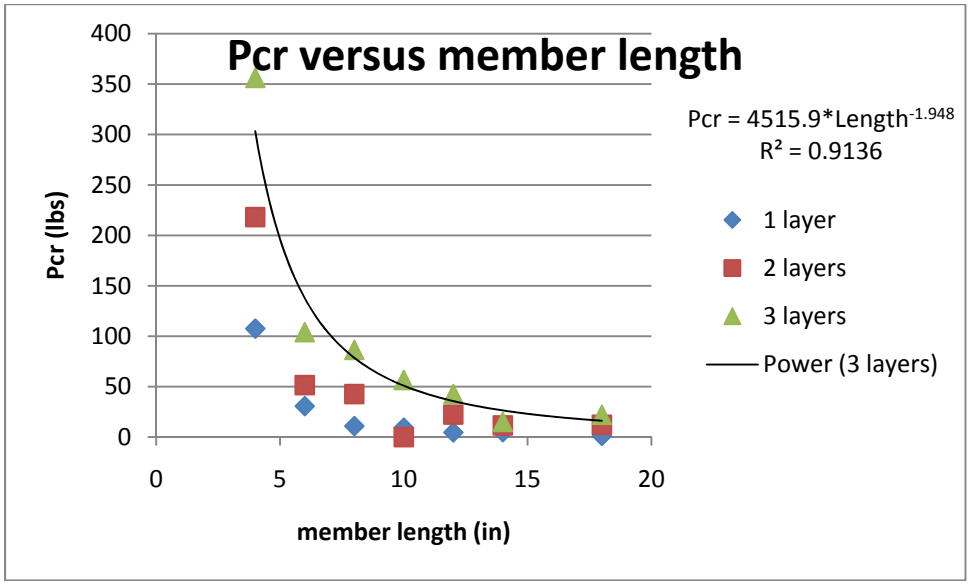
For this assignment, please complete (on an individual basis) the following activities. Submit your work on the assigned date as you would a homework assignment.

1. Write a paragraph describing the preparations and setup – include the model number and a picture (or diagram) of the testing machine. Include a picture or diagram of the test setup.

2. Create a table showing the data from all sections (if provided) – include the buckling load (P_{cr}), the member length, and the member thickness.

Sample Number	Length (in)	Thickness (in)	P_{cr} (lb)

3. Create a graph where critical loads are plotted versus lengths. Since three different thicknesses of specimens were used in the lab, three sets of data should be included on the graph.



4. Fit three curves to the critical load versus length data, one for each thickness (1 layer, 2 layers, 3 layers thick). Your equations must be listed on the graph relating critical load to length. Based on the theory presented in section 11.2 of the textbook, you should probably use a power fit (i.e. $\mathbf{P_{CR} = a \times L^b}$ where your fit finds a and b).

5. Write a concluding paragraph that provides the key results (highest buckling load and lowest buckling load) and the key trends that you have discovered. How can you use the results to help you design your truss? Comment on any inconsistencies in the data.

THIS ASSIGNMENT IS PART OF THE MINIMUM REQUIREMENTS OF THE COURSE. FAILURE TO COMPLETE IT WILL RESULT IN A FAILING GRADE IN THE COURSE