

Demonstrating Buckling with a PVC Pipe

LEARNING OBJECTIVES

This is a demonstration in class so that students understand the concept of buckling and how a shorter column can take significantly more compressive load than a taller column.

After this activity, students should be able to:

- Predict which column can hold more load, given identical columns of varying lengths
- Demonstrate a qualitative understanding of how length affects buckling

Materials List

- PVC pipe, cut to two sizes, one twice the size of the other (suggestion: 2 feet and 4 feet)

Background

Important to the design of steel buildings is the concept of buckling. Because steel is so strong, not much material is typically needed. However, buckling can become an issue when steel is in compression.

In this activity, two 1/2" diameter sections of Schedule 40 PVC pipes are used to demonstrate the principles of buckling. One pipe should be approximately twice the length of the other (e.g. 30" and 60" length). First, show the students the two pipes and ask them to consider which will carry more load before buckling. Then, demonstrate the varying strength by pushing down on both, showing that the taller pipe is easy to bend while the shorter is significantly more difficult. It may be helpful to then show the equation for Euler Buckling, showing that the shorter pipe carries 4x the amount of load before buckling, which is why it was so much harder to buckle.

You can make this activity more quantitative by using a luggage scale to

measure the amount of force required to cause the pipes to buckle, and attempt to match the measurements to predictions based on Euler's buckling formula. See the paper referenced below for further details on this extension.

References

Active Learning Demonstrations in Engineering Mechanics, Mark Diller.

[cut out pipe models - consider recoloring or placing on darker solid background]

