# Column Tester

## Purpose:

In MB3 - Columns of Calculation, students calculate the total load that their structure must be able to support and choose an appropriate size and number of columns to support that load. In order to determine what sizes of balsa will support their calculated load, they need to characterize the strength of various balsa sizes. They will do this by methodically testing the failure point of balsa sticks with various heights and widths.

In addition to providing data for students' designs, this exercise also gives students a hands-on understanding of how engineers get data to make decisions.

## Functionality:

The functional goal is to test the compression failure point of various sizes of balsa. Note that the tension or shear failure points will be very different, so loading the balsa while horizontal, or snapping it, will not yield the relevant data.

The testing apparatus holds a stick of balsa standing upright, with a platform resting fully on the top of the stick. The platform can be loaded down with weight to apply increasing compressive force to the balsa stick until it fails (breaks). To keep the platform perched on top of the stick, it slides up and down on four dowels that hold it in place horizontally, but do not support any of its weight vertically. However, a hard-stop is implemented on this sliding motion so that when the balsa does fail, the platform only slides down a short distance, and the weights on top of it do not come crashing down.

The basic setup is sized to accommodate a 10” balsa stick, but a wide 2” or 4” dowel can be added to the base as a spacer to adjust the opening to accommodate an 8” or 6” balsa stick.

## Construction:

The column tester is constructed out of layers, or plates, of 3/4” plywood or MDF, and dowels. When completed, the tester is composed of the bottom assembly, the top assembly, and two spacer dowels.

The bottom assembly consists of the bottom plate, with the second bottom plate glued on top, and four 1/2” dowels glued into their corresponding holes in the bottom plates. The bottom plate is extra large to provide stability to the tester even when it is loaded with a significant amount of weight. The dowels are beveled at the top (like a partially sharpened pencil) so that it is easier to slide them into the top assembly.

The top assembly consists of the three top plates glued together and a single dowel glued into the hole in the center of the first top plate. The dowel is attached to the top plates so that round metal weights can be placed on top, and be roughly held in place. However, if you plan to use sandbag style weights, or some other shape of weights, omit the dowel, make the first top plate larger, and consider adding a lip around its edge to create a tray to hold the weights instead.

To use the tester, place the top assembly on top of the dowels of the bottom assembly so that the dowels are inserted into the holes in the second and third top plates. Note that the holes in the second and third top plates are intentionally drilled larger than the dowels so that the top plate assembly slides easily up and down on the dowels of the bottom assembly. Lift the top assembly up slightly to position a balsa stick in the tester so that one end of the stick sits on the second bottom plate, and the other end supports the first top plate.

It is not recommended to modify the dimensions on this plan because they have been carefully designed to (a) support the potential weight that will be loaded onto the top assembly, and (b) fit 10”, 8”, and 6” balsa sticks so that the top assembly rests on the balsa stick while being guided by the four corner dowels but does not drop far when the stick breaks.

## Graphics:

Page 1: A front view of the complete tester, shown with the top assembly resting on the dowels of the bottom assembly. The drawing is on the left, and each component is labeled to the right.

Page 2: A top view of the bottom plates showing the positions and dimensions of all holes to be drilled. First bottom plate dimensions are 12” by 12”, with holes drilled 6” apart. Second bottom plate dimensions are 7” by 7”, with holes drilled 6” apart.

Note that the holes in the first bottom plate do not go fully through the plate.

Page 3: A top view of the top plates showing the positions and dimensions of all holes to be drilled. First top plate dimensions are 9” by 9” with a hole drilled in the center. Second and third top plate dimensions are 7” by 7”, with holes drilled 6” apart.

Page 4: A side view of all the dowels needed for the tester. Each dowel has its length and width marked, and has a description written above it.