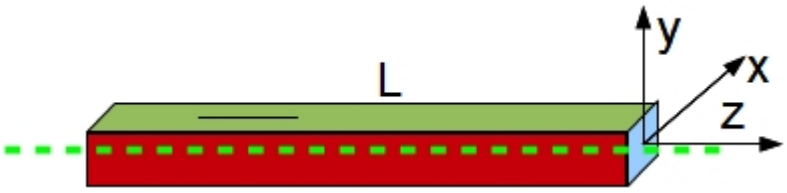
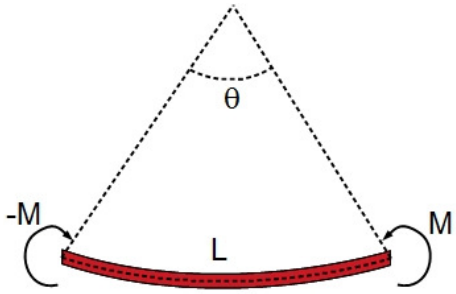
Note about Axes

Students sometimes have difficulty keeping track of the axes. Let's say that the beam lies along the z axis.

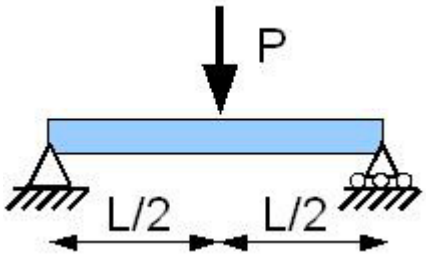


This beam is red in the y-z plane, green in the x-z plane, and light blue in the x-y plane. The dotted light-green line is called the neutral axis.



If you bend this multi-colored beam into an arc (right) as shown above, you're looking at the red face (in the y-z plane).

This is what happens when you have a beam with a weight in the middle which we do all the time:



With the axes we've described at the top of the page, this load P is like a weight in y direction. The moment the beam feels is in x because the load P acts at a distance in z away from the pin & roller at the ends. Force in y, distance in z = moment in x

Think of your thumbs – as your fingers describe how this blue beam bends, your thumbs would be pointing at your chest, in the -x direction. Out of the plane of the y-z plane.

Remember to connect this with the ruler discussion: when it comes to beam bending, it's the cross-section that counts. The cross-section is the light-blue plane at the beam at the top ... the x-y plane. What matters is the amount of material of the cross-section that is at a distance off the green line.

We will look at moments in all three directions. Applying M_x and M_y produce bending. The resistance to those bending moments are given by I_x and I_y. Applying M_z is twisting the beam.

Make very sure before you go on that you understand what moments are produced by bending beams in different directions and how those are related to the cross-section. It is the blue cross-section shown above which governs how much resistance the beam has in bending about the y axis (the x-y face of the beam.)