

Structures Homework #7: Beam Deflections

Given: Class #36
Due: Class #39

A simply supported wood beam spans 15 feet and carries a uniformly distributed live load of 200 lb/ft along its length. The beam has a rectangular cross section with a width of $b = 4''$ and a depth of $d = 12''$. The modulus of elasticity of the timber is $E = 1,600,000$ psi and the density is 60 pcf.

- 1) What is the volume of wood and the self-weight of this beam? What is the maximum deflection in inches at the center of this beam due to its own weight? (Hint: use the deflection equation for a simply-supported beam and be certain to be consistent with the units.)
- 2) What is the maximum deflection in inches at the center of the beam due to the live load? Does the total dead load and live load deflection exceed the maximum allowable value of $L/240$?
- 3) What are the maximum bending stresses in the beam due to the combined dead and live load?
- 4) Assuming the same support conditions and loading, redesign the cross-section to use less wood and to make it more efficient for this loading. Your beam proposal must not exceed the allowable deflection of $L/240$ and the maximum bending stresses must be less than 1,000 psi. Due to space limitations, the beam cannot be greater than 12 inches in depth.
- 5) How much material did you save compared to the initial design? Briefly discuss any obvious advantages or disadvantages of your redesign.