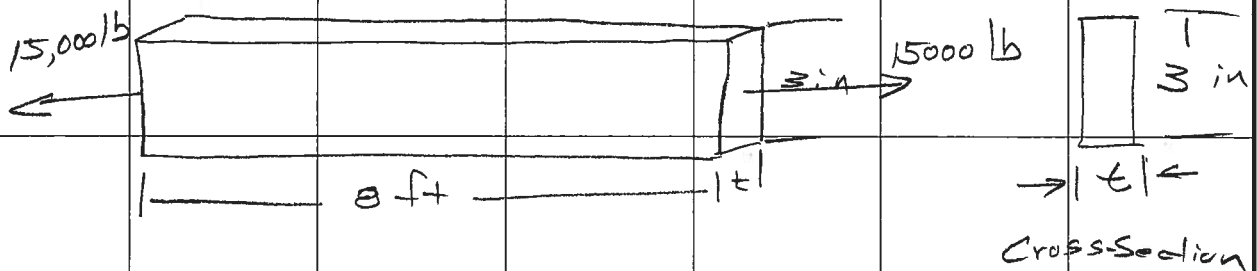


A 3 inch wide tensile member that is 8 ft long is to be fabricated using structural steel. The steel used has an allowable tensile stress of 20,000 psi and an allowable shearing stress of 12,000 psi. In addition, the axial deformation of the member should be less than 0.050 in. Using these criteria, determine the minimum thickness of the member, if it must carry a tensile load of 15,000 lb. Assume $E = 30 \times 10^6$ psi.



There are three independent criteria that must be considered: $\sigma_{max} \leq 20,000$ psi, $\tau_{max} \leq 12,000$ psi, and $\delta_{max} \leq 0.050$ in.

First Consider $\tau_{max} \leq 20,000$ psi:

$$\tau_{\text{Allowable}} \geq \frac{P}{A} \quad (1)$$

$$20000 \text{ psi} \geq \frac{15000/b}{3t} \quad (2)$$

So

$$t \geq .25 \text{ in} \quad (3)$$

Next Consider $\tau_{\max} \leq 12,000 \text{ psi}$

$$\tau_{\text{allowable}} \geq \frac{P}{2A} \quad (4)$$

$$12000 \text{ psi} \geq \frac{15000/b}{2(3t)} \quad (5)$$

$$t \geq .21 \text{ in} \quad (6)$$

Finally consider $S_{\max} \leq .050$

$$S_{\max} \geq \frac{PL}{AE} \quad (7)$$

$$0.050 \text{ in} \geq \frac{(15000/b)(8t)(12 \frac{\text{in}}{\text{ft}})}{(3 \text{ in } t)(30 \times 10^6 \frac{\text{lb}}{\text{in}^2})}$$

$$t \geq .32 \text{ in}$$

It would appear that the thickness of the member is controlled by the deformation criteria. Therefore, the thickness of the member must be at least 0.32 in