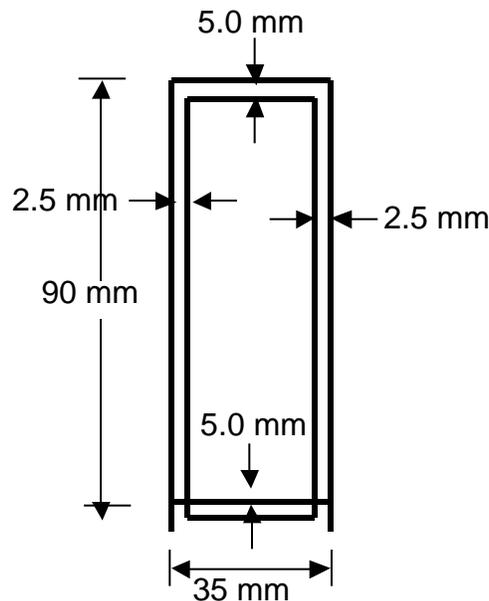


HOME ASSIGNMENT #7

Warm-Up Exercises

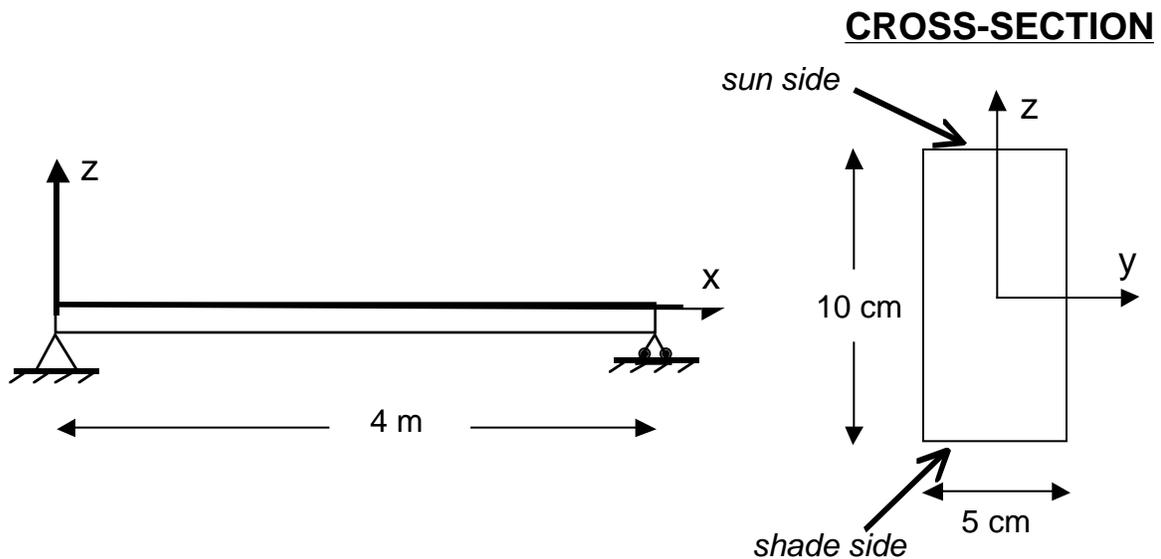
In the last home assignment, two cross-sections were considered (a C-section and an I-section) for their torsional capabilities. The torsional constant J was determined to be 6300 mm^4 . Let's explore what happens if we use the same amount of material (aluminum with $E = 70 \text{ GPa}$ and $\nu = 0.3$) but close the cross-section. This is done by dividing the vertical part in half and placing it on each end of the horizontal pieces:



1. Determine the new torsion constant of this cross-section.
2. Determine the ratio of the angle of twist between the two end faces of the same structural configuration subjected to the same loading from the last home assignment when the current cross-section is used as compared to the previous cross-section(s).
3. Find the maximum resultant shear stress and its location.
4. Compare all these results to the results from Problem #5 from Home Assignment #6 and comment.

Practice Problems

5. A space truss is made of individual aluminum members, each 4 m in length. These are simply-supported. The members have rectangular cross-sections 5 cm by 10 cm. As a member goes into full sun, it is subjected to a quadratic temperature distribution with the sun side at 80°C and the shade side at -90°C . The properties of this aluminum are $E = 71.4 \text{ GPa}$, $\nu = 0.3$, $\alpha = 7.2 \mu\text{strain}/^{\circ}\text{C}$. The zero stress temperature of the members is 0°C .



- (a) Determine the stress distribution in the beam.
- (b) Determine the displacements of the beam (axial, u_0 , and vertical, w) as a function of x .

Application Tasks

6. Examine the approximation for thin, closed cross-sections by considering a circular tube made from an isotropic material (choose one as necessary). Consider the “engineering applicability” of the approximation as a function of the wall thickness for the determination of:

- (a) the angle of twist.
- (b) the maximum shear stress.

If/as necessary, pose a particular structural configuration and loading in order to perform this assessment. A suggestion is to plot the error induced via the approximation as the thickness increases. In order to be quantitative, indicate the limits on thickness, for the two different items, if a 15% error is considered to be an acceptable approximation error.