Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

Dr. Wayne Whiteman
Senior Academic Professional and Director of the Office of Student Services
Woodruff School of Mechanical Engineering

Georgia Institute of Technology

Module 41 Learning Outcome

- Design engineering structural members to meet a specified Factor of Safety

Design

Create a new engineering component or structure that will meet specifications and performance criteria

Factor of Safety (FoS)

$$Factor\ of\ Safety = FoS = \frac{Failure\ Stress}{Actual\ Stress} = \frac{Strength\ of\ Material}{Max\ Computed\ Stress}$$

$FoS > 1$ **avoids failure**

The design criteria the engineering component/structure must achieve

The designer defines failure; component/structure doesn't meet performance criteria; e.g. excessive deformation, fracture, etc.

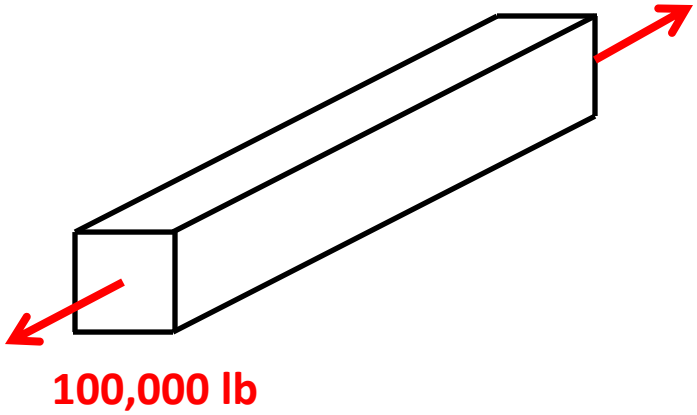
Example:

Truss Members

Example:

A wooden truss member is required to support a 100,000 lb load in tension.
You should design for a $FoS \geq 2$ with respect to yielding.
The Yield Stress for the wood being used is 4000 psi.

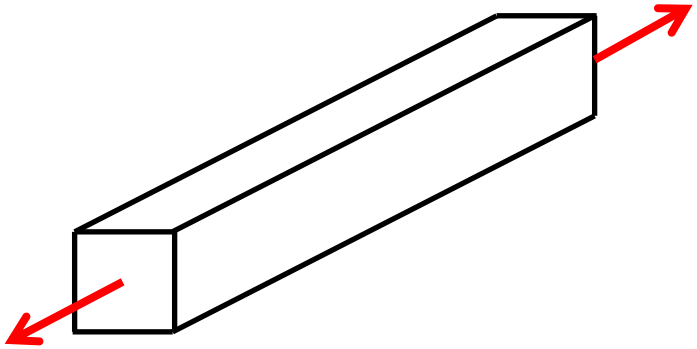
What cross sectional area of beam should be designed for?



Example:

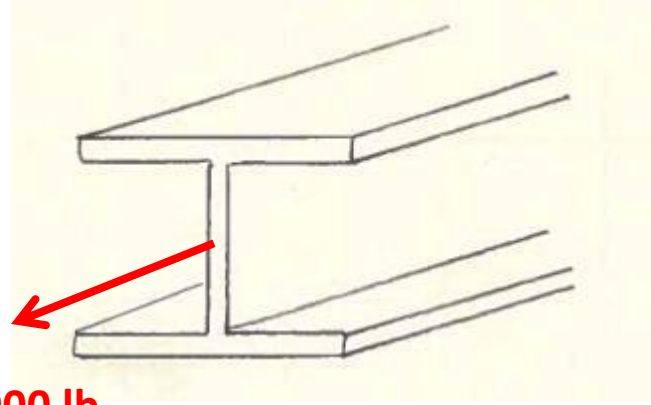
A wooden truss member is required to support a 100,000 lb load in tension. You should design for a $FoS \geq 2$ **with respect to yielding.**
The Yield Stress for the wood being used is 4000 psi.

What cross sectional area of beam should be designed for?



Do by hand

Worksheet:



130,000 lb

An I-beam in Georgia Tech's Campus Recreation Center is made of A36 steel and is subjected to a 130,000 lb tensile load.
The I-beam has a total cross-sectional area of 8.79 square inches and the Yield Stress for A36 steel is 36,000 psi.

If the design calls for a 2.5 Factor of Safety with respect to yielding, is the design with the current I-beam adequate?

Worksheet:

An I-beam in Georgia Tech's Campus Recreation Center is made of A36 steel and is subjected to a 130,000 lb tensile load.
The I-beam has a total cross-sectional area of 8.79 square inches and the Yield Stress for A36 steel is 36,000 psi.

If the design calls for a 2.5 Factor of Safety with respect to yielding, is the design with the current I-beam adequate?