Mechanics of Materials III:

Beam Bending

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

Georgia Institute of Technology

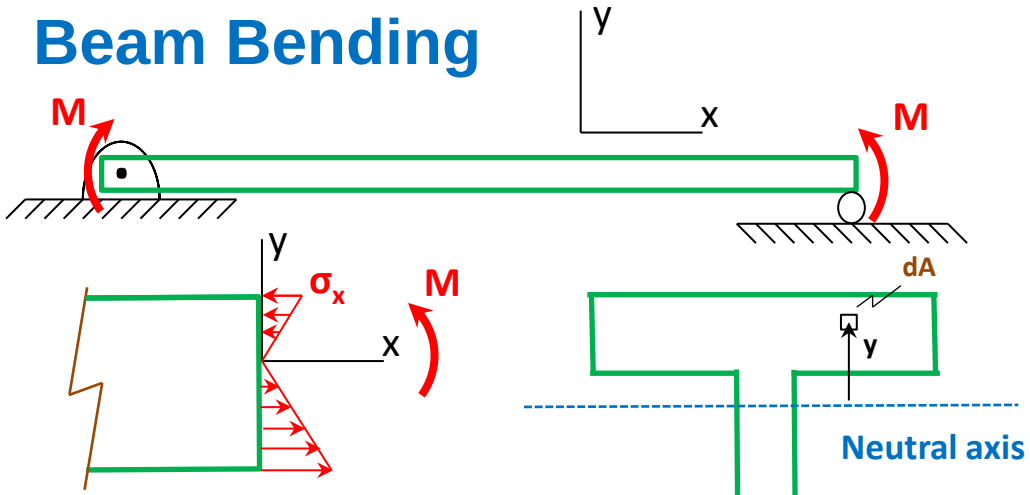
Mechanics of Materials III: Beam Bending

- ✓ Shear Force and Bending Moment Diagrams
- ✓ Elastic Flexural Stresses and Strains
- ✓ Elastic Flexural Formula
- ❑ Properties of Sections
- ❑ Inelastic Bending
- ❑ Shear Stress in Beams
- ❑ Principal Stresses in Bending

Module 11 Learning Outcome

- Determine how to find the section property of Area Moment of Inertia, I

Beam Bending



Elastic Flexural Formula

$$\sigma_x = -\frac{M\ y}{I}$$

Area Moment of Inertia, I

$$I = \int_A r^2\ dA$$

A cross section's resistance to bending about a certain axis

Area Moment of Inertia, I

$$I = \int_A r^2 \, dA$$

A cross section's resistance to bending about a certain axis

How to find:

- **integrate directly**
- **many textbooks/web sites have tables for standard shapes**

For composite shapes (parallel axis theorem):

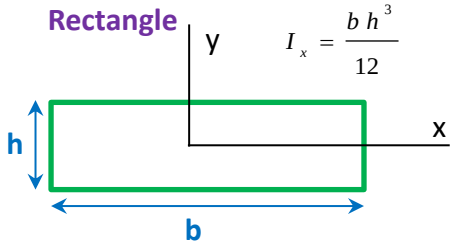
$$I_{\substack{NEUTRAL \\ AXIS}} = I_{\substack{STANDARD \\ NEUTRAL}} \; {}_{\substack{SHAPE \\ AXIS}}{}'_S + A\,d^2$$

Area Moment of Inertia, I

For composite shapes (parallel axis theorem):

$$I_{NEUTRAL\ AXIS} = I_{STANDARD\ SHAPE\ 'S\ NEUTRAL\ AXIS} + A\,d^{2}$$

Standard Shape: Rectangle



$$I_x = \frac{b\,h^3}{12}$$

Example: