MAE 343. Intermediate Mechanics

Stress IV : 2-plane Bending, Other Sections

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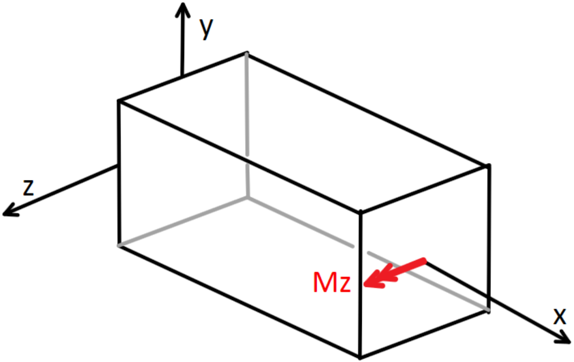
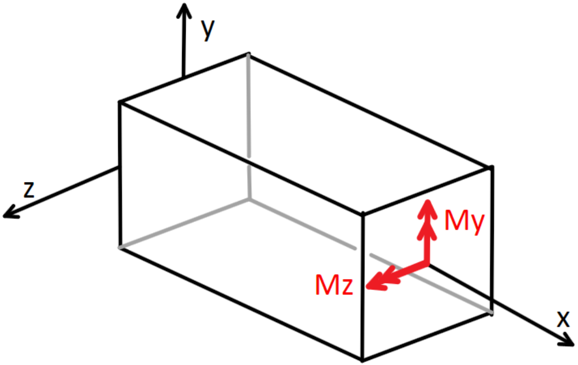
Review: bending on a single plane



Single plane bending, bending on the xy plane.

$$\sigma_x = \frac{-y\, M_z}{I_z}$$

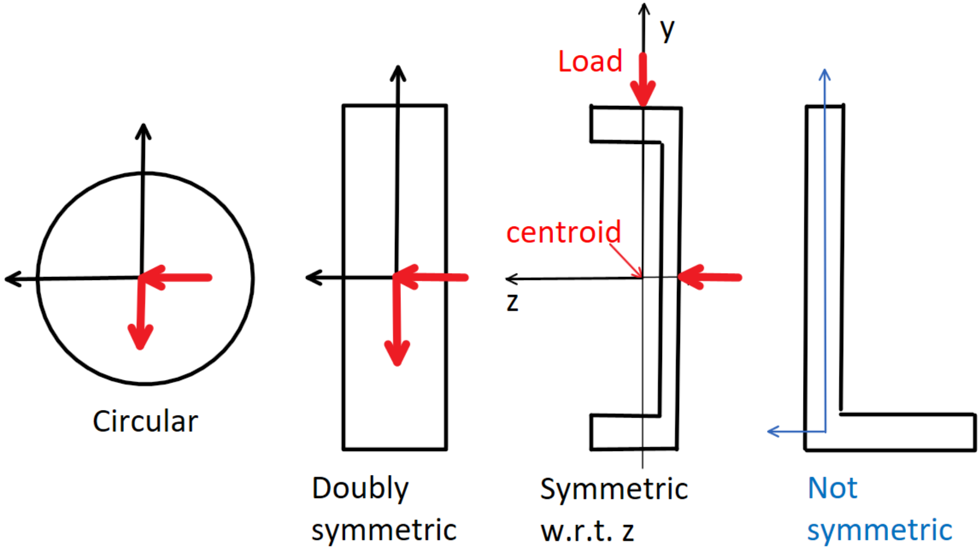
2-plane bending formula



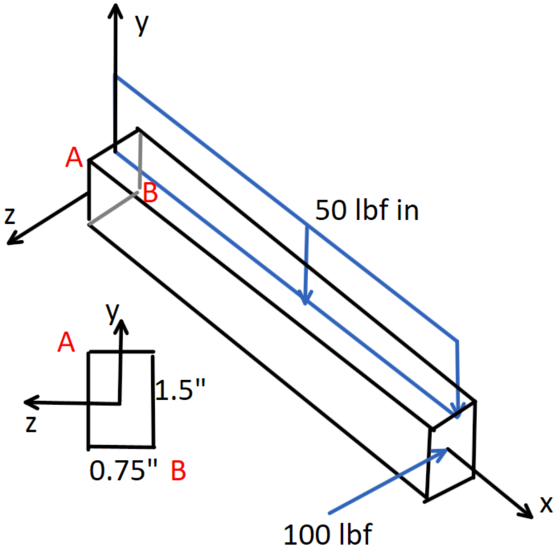
Add bending on the xz plane, with moment M_y.

$$\sigma_x = -\frac{y\,M_z}{I_z} + \frac{z\,M_y}{I_y}$$

2-plane bending formula, applicability



Example 3-6



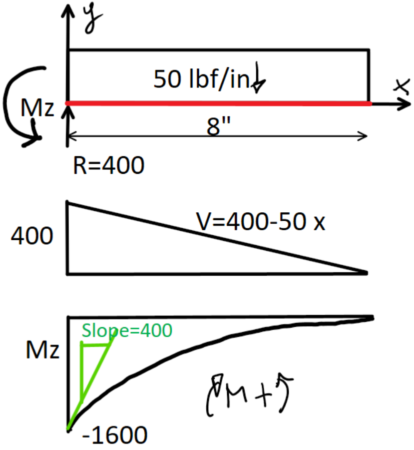
$$I_z = \frac{0.75 \times 1.5^3}{12} = 0.2109 \text{in}^4$$

$$I_y = \frac{1.5 \times 0.75^3}{12} = 0.05273 \text{in}^4$$

At A: $y = 1.5/2 = 0.75''$; $z = 0.75/2 = 0.375''$

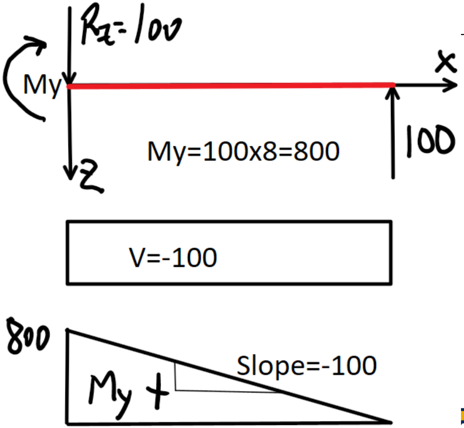
At B: $y = -0.75''$; $z = -0.375''$

Example 3-6, 2/5

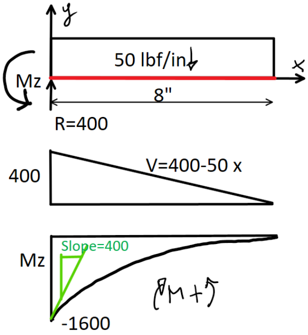


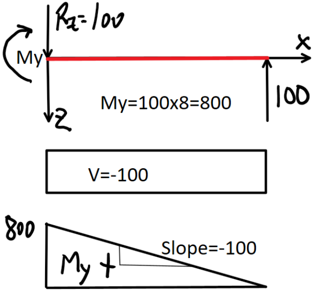
R=50x8=400

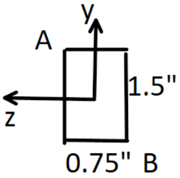
M=400x4=1600



Example 3-6, point A





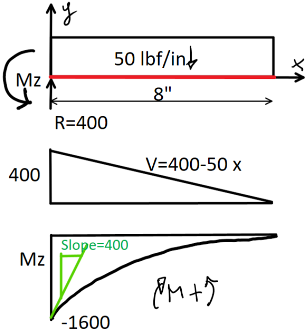


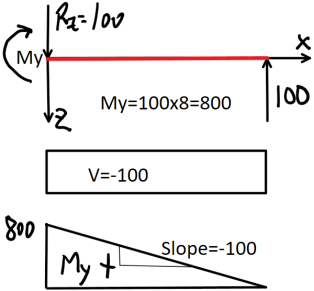
$$\sigma_x = -\frac{M_z\, y}{I_z} + \frac{M_y\, z}{I_y}$$

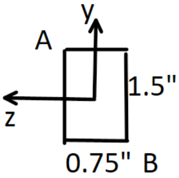
$$\sigma_x^A = -\frac{-1600 \times 0.75}{0.2109} + \frac{800 \times 0.375}{0.05273}$$

$$\sigma_x^A = 11380 \text{ psi}$$

Example 3-6, point B







$$\sigma_x = -\frac{M_z\, y}{I_z} + \frac{M_y\, z}{I_y}$$

$$\sigma_x^B = -\frac{-1600 \times -0.75}{0.2109} + \frac{800 \times -0.375}{0.05273}$$

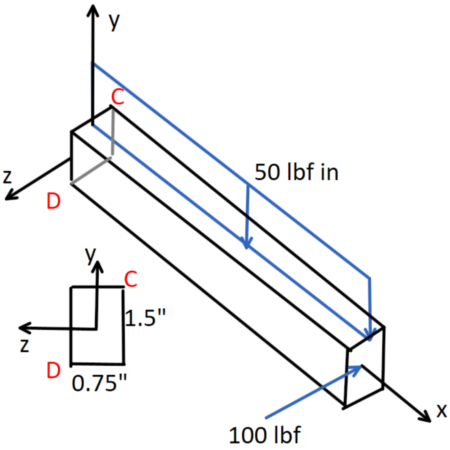
$$\sigma_x^B = -11380 \text{ psi}$$

Example 3-6, at the remaining corners

$$\sigma_x = -\frac{M_z\, y}{I_z} + \frac{M_y\, z}{I_y}$$

$$\sigma_x^C = -\frac{-1600 \times 0.75}{0.2109} + \frac{800 \times -0.375}{0.05273} = 0$$

$$\sigma_x^D = -\frac{-1600 \times -0.75}{0.2109} + \frac{800 \times 0.375}{0.05273} = 0$$



Summary

- With at least one axis of symmetry, the 2-term formula is applicable
- Just do 2 sets of diagrams, one for the xy-plane and another for xz-plane
- Must check all corners to find out which one has the largest stress

Thank you!

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