Stresses in Thin-Walled Pressure Vessels

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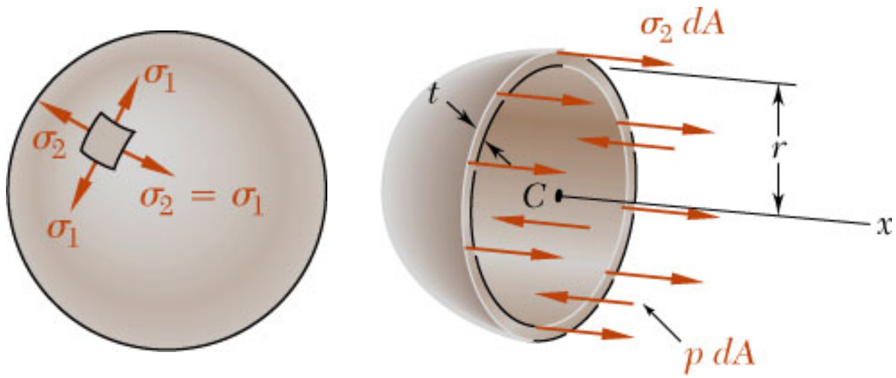

Spherical pressure vessel:

$$\sigma_1 = \sigma_2 = \frac{pr}{2t}$$

Mohr's circle for in-plane transformations reduces to a point

$$\sigma = \sigma_1 = \sigma_2 = \text{constant}$$

$$\tau_{\max(\text{in-plane})} = 0$$

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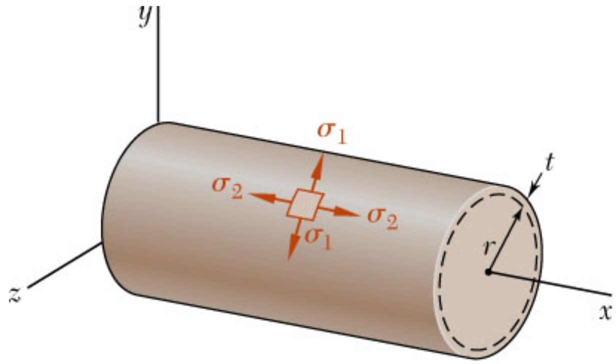
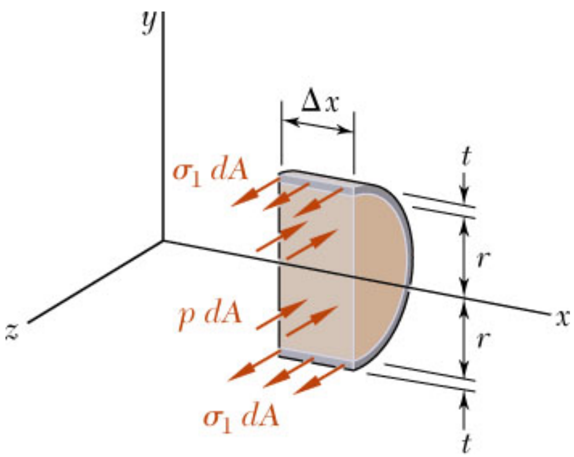


Cylindrical vessel with principal stresses

σ_1 = hoop stress

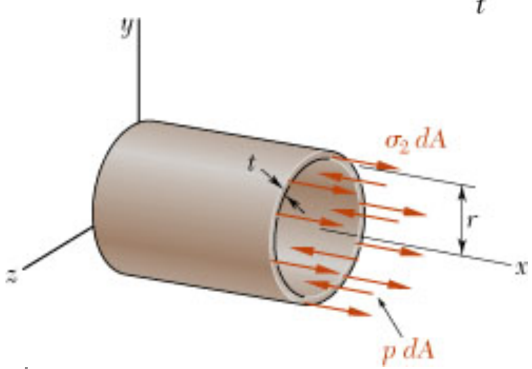
σ_2 = longitudinal stress



Hoop stress:

$$\sum F_z = 0 = \sigma_1 (2t\,\Delta x) - p(2r\,\Delta x)$$

$$\sigma_1 = \frac{pr}{t}$$



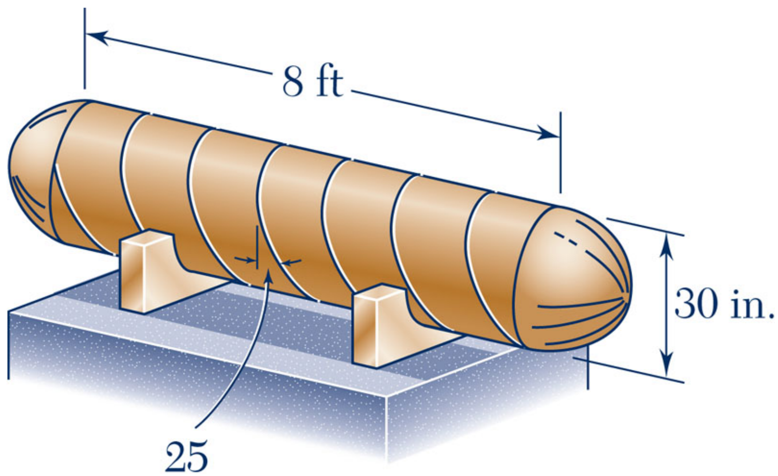
Longitudinal stress:

$$\sum F_x = 0 = \sigma_2 (2\pi r t) - p(\pi r^2)$$

$$\sigma_2 = \frac{pr}{2t}$$

$$\sigma_1 = 2\sigma_2$$

Sample problem 7.5



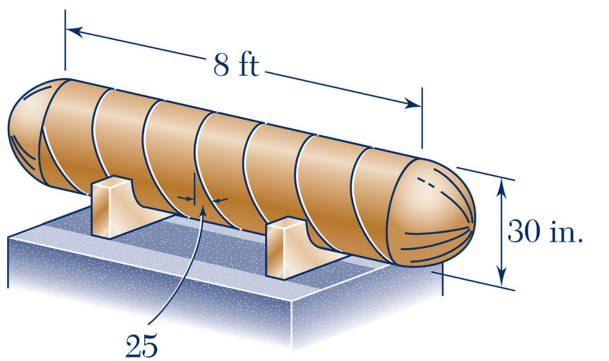
Cylindrical body has an outer diameter of 30 in and is fabricated from 3/8 in steel plate by welding along a helix that forms an angle of 25 degrees with transverse plane What are the stresses parallel and perpendicular to the weld ? Pressure in the vessel is 180 psi.

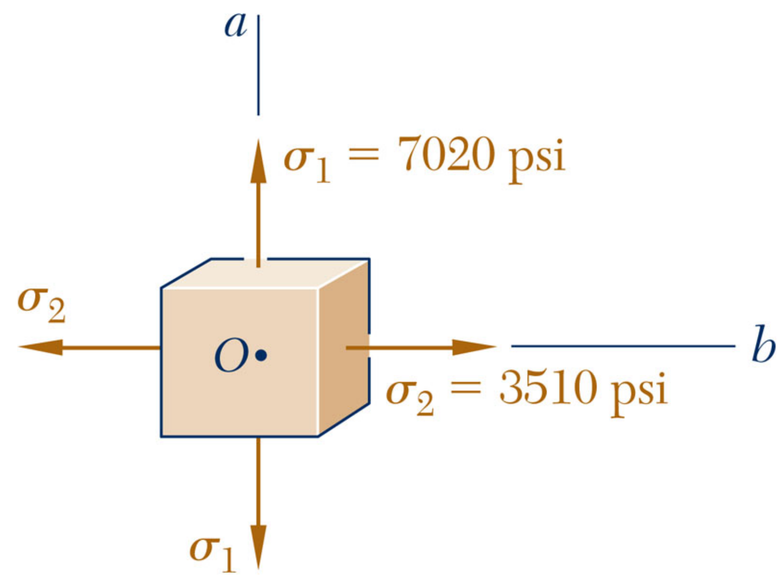
r = 15 in – 3/8 in = 14.645 in
t = 0.375 in

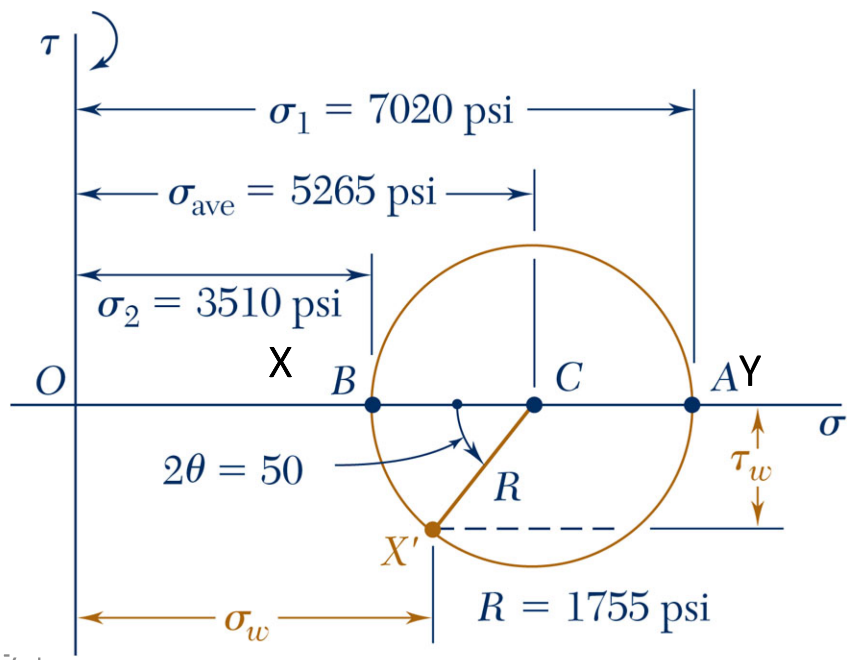
Hoop stress = p r / t

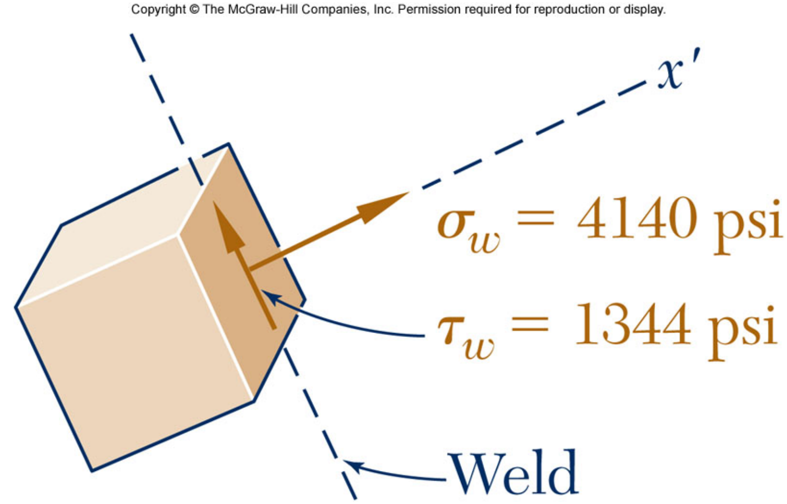
Longitudinal stress = p r / (2 t)

Sample problem 7.5





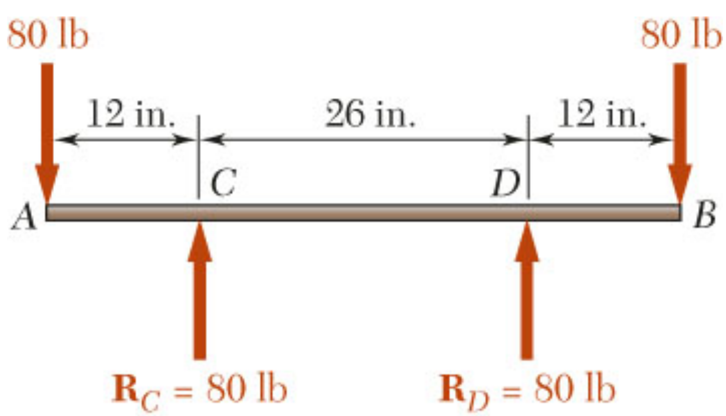




You can collect graded Midterm1 from Peggy Mercurio (6th floor Barus and Holley tomorrow after 2 PM)

Chapter 4:
Pure Bending

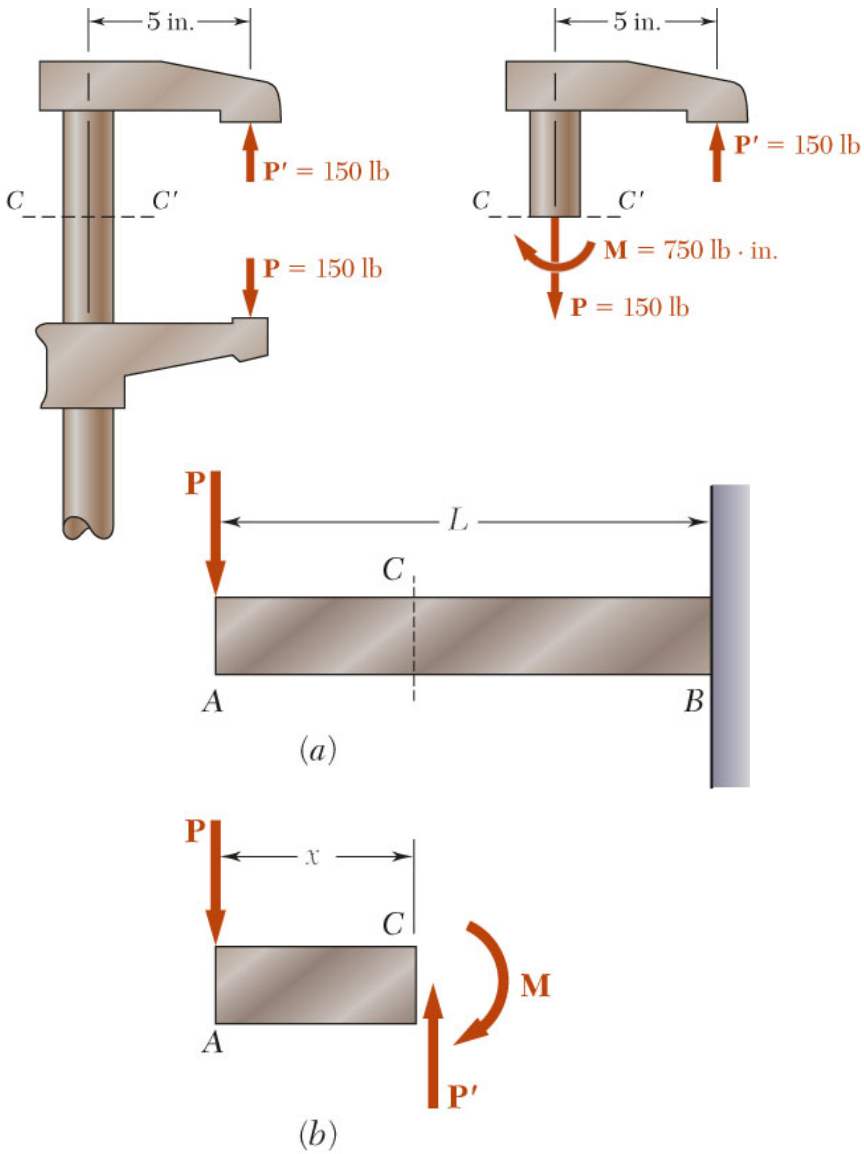
Pure Bending:
Prismatic members subjected to equal and opposite couples acting in the same longitudinal plane



(a)

(b)

Other Loading Types

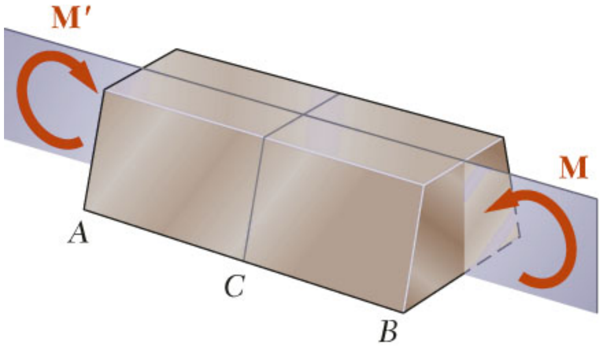


Eccentric Loading: Axial loading which does not pass through section centroid produces internal forces equivalent to an axial force and a couple

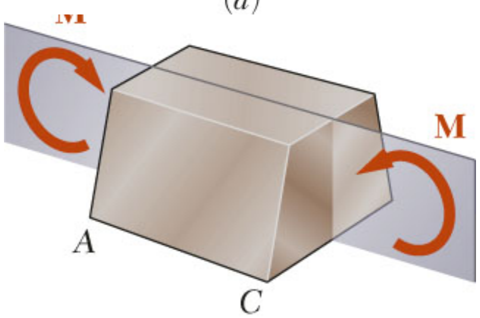
Transverse Loading: Concentrated or distributed transverse load produces internal forces equivalent to a shear force and a couple

Principle of Superposition: The normal stress due to pure bending may be combined with the normal stress due to axial loading and shear stress due to shear loading to find the complete state of stress.

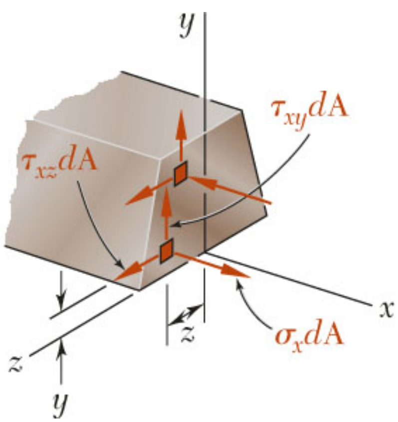
Symmetric Member in Pure Bending



(*a*)



(*b*)



Internal forces in any cross section are equivalent to a couple. The moment of the couple is the section *bending moment*.

From statics, a couple M consists of two equal and opposite forces.

The sum of the components of the forces in any direction is zero.

The moment is the same about any axis perpendicular to the plane of the couple and zero about any axis contained in the plane.

These requirements may be applied to the sums of the components and moments of the statically indeterminate elementary internal forces.

$$F_x = \int \sigma_x \, dA = 0$$

$$M_y = \int z\sigma_x \, dA = 0$$

$$M_z = \int -y\sigma_x \, dA = M$$

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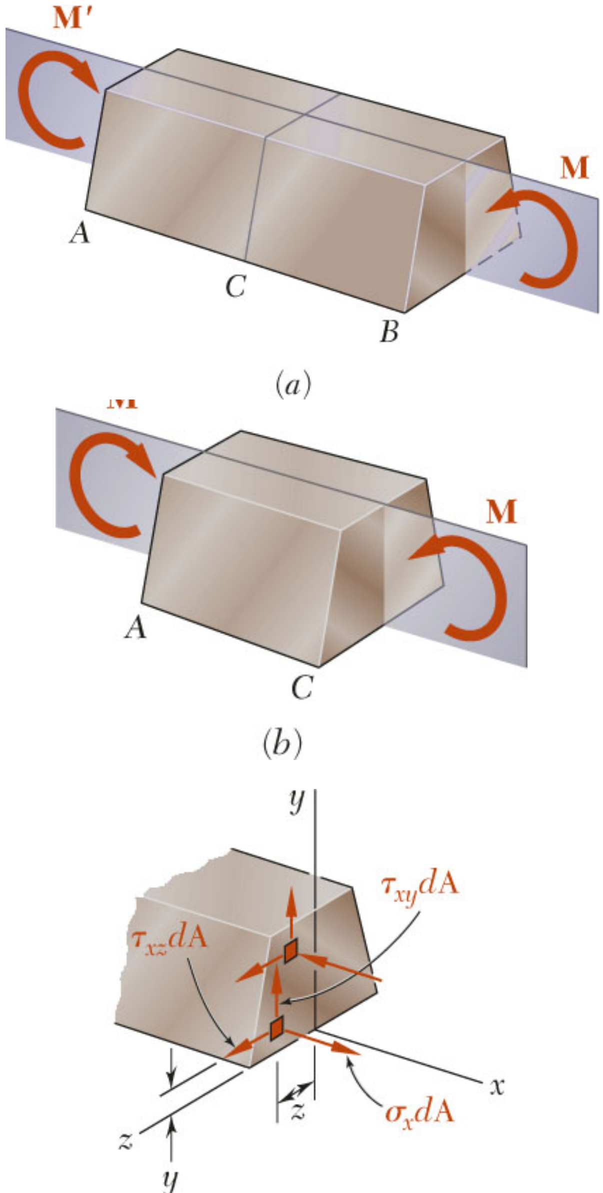

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