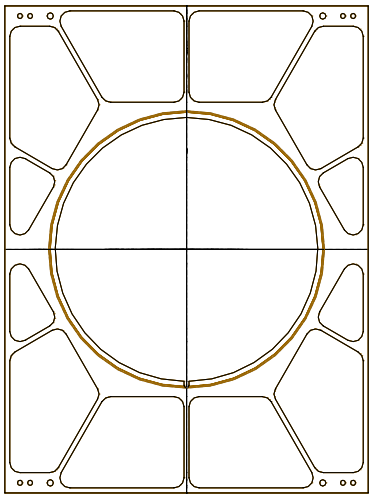
Pressure Vessels
Stresses Under Combined Loads Yield Criteria for Ductile Materials
And Fracture Criteria for Brittle Materials

Example Problems

Example Problem 1:

A precision, large diameter ball bearing is lightly pressed into a 6061-T6 aluminum housing. The bearing is manufactured from high strength steel. The survivability requirements require that the structure be capable of withstanding a decrease in temperature of -90° F.



6061 T6 Material Properties

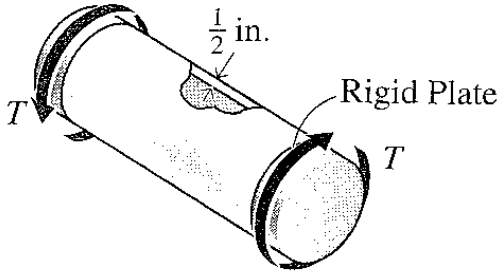
- E = 10,000,000 psi
- α = 13 parts/million/°F

Steel Bearing Properties

- E = 30,000,000
- α = 8 parts/million/°F
- OD = 13.500 in.

Example Problem 2:

The thin walled pressure vessel shown below has an inside diameter of 24 in. and a wall thickness of ½ in. The vessel is subjected to an internal pressure of 300 psi. In addition, a torque of 192,583 Ft-lbs is applied to the vessel through rigid plates at each end. The vessel is manufactured from A-36 structural steel.

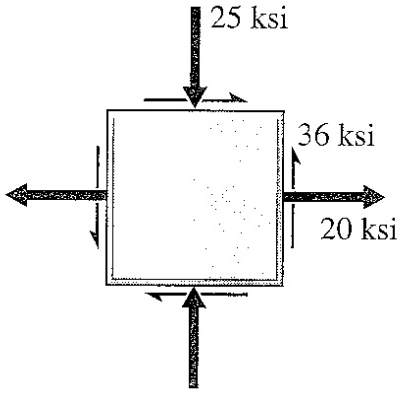


Determine:

1. The maximum normal stress and shear stress at a point on the surface away from the ends.
2. The Von Mises stress.

Example Problem 3:

A structural element is subjected to the state of stress shown below.



Material Specifications:

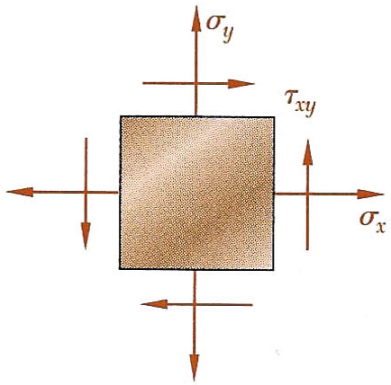
- Cold finished 1215 DGP
- Tensile strength = 78,000 psi
- Yield strength = 60,000 psi
- Elongation ≈ 15% in 2”

Determine the factor of safety with respect to failure by yielding according to:

a) Maximum Normal Stress Theory
b) Maximum Shear Stress Theory
c) Maximum Distortion Energy (von Mises) Theory

Example Problem 4:

A structural element is subjected to the state of stress described below.



σ_x = 10 ksi
σ_y = -6 ksi
τ_{xy} = -4 ksi

Material Specifications:

- Tensile strength = 26,000 psi
- Compressive strength = 97,000 psi
- Elongation ≈ 3% in 2”

Determine if the state of stress is safe based on the Coulomb-Mohr theory.