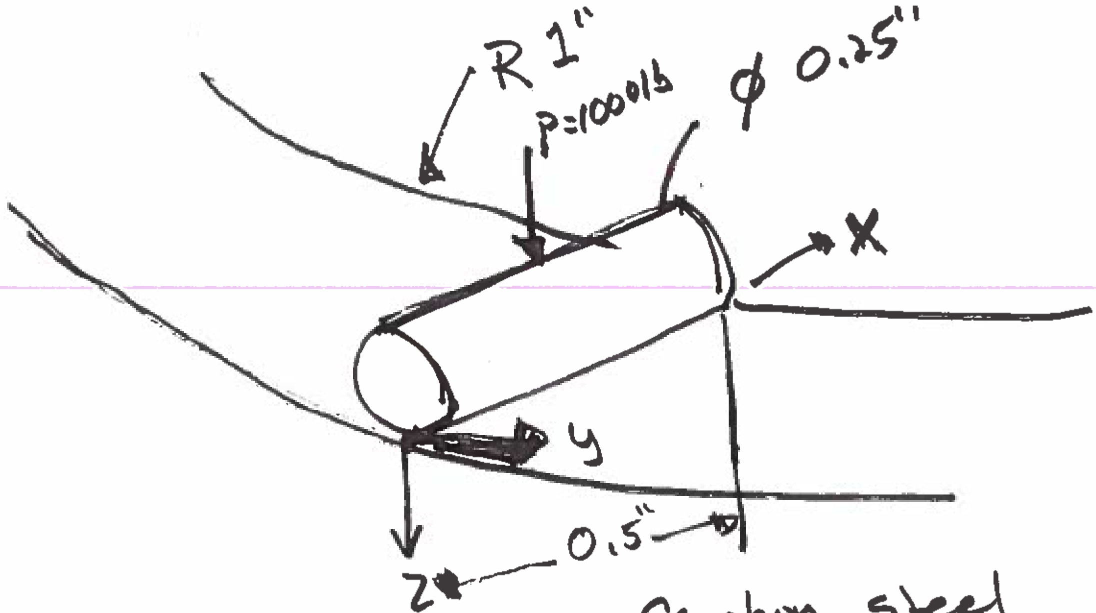
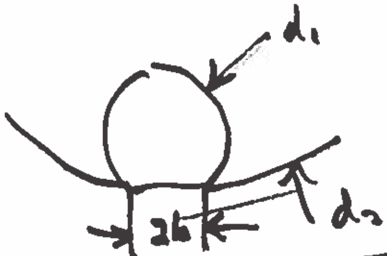
EME 150A FALL 2015 LECTURE 12 OCT 21, 2015

Example: Cylindrical Contact Stress



Carbon steel $E = 30$ Mpsi

$\nu = 0.292$



$$b = \sqrt{\frac{2(1000\,\text{lb})}{\pi(0.5\,\text{in})}\;\frac{(1-0.292^2)/30E6\,\text{psi} + (1-0.292^2)/30E6}{\dfrac{1}{0.25"} - \dfrac{1}{2"}}}$$

$b =$ ~~0.B0~~ 0.00471"

principal stresses @ $z=0$

$$P_{max} = \frac{2(1000\,lb)}{\pi b l} = 849\ ksi$$

$$\sigma_x\Big|_{z=0} = \sigma_1 = -2\nu P_{max} = -496\ ksi$$

$$\sigma_y\Big|_{z=0} = -P_{max} = -849\ ksi$$

$$\sigma_3 = \sigma_2 = \frac{-P_{max}}{\sqrt{1+\cancel{\frac{z^2}{b^2}}} \to 1} = -849\ ksi$$

$$\tau_{max}\Big|_{z=0} = \frac{\sigma_1 - \sigma_3}{2} = 176.6\ ksi$$

Deformation and Stiffness

Chapter 4

Designs for high rigidity

- minimize misalignment
- avoid interference w/ other components
- reduce noise
- reduce wear rates
- reduce stress

Designs for high flexibility

- energy storage and absorbtion
    - springs
- elastic deformation for change in dimensions
    - snap rings

Rigidity deflection per load

$F = Kx$

$K = \frac{F}{x}$

$\frac{x}{F} \Rightarrow R$

- Mod. of Elasticity is good indicator of rigidity
- geometry of component is essential to characterize rigidity
- inverse of "spring constant" or "stiffness