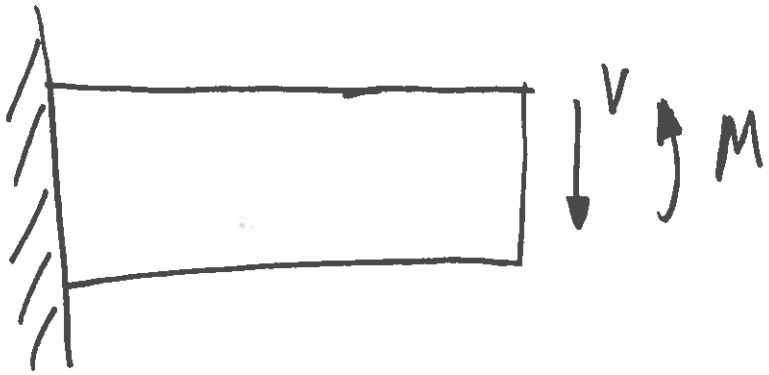
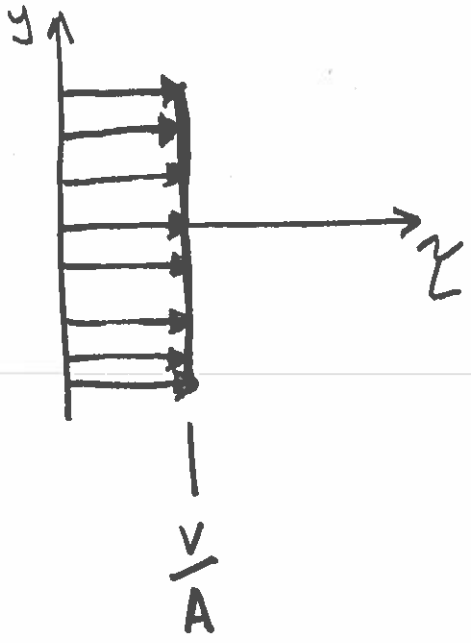


$$\tau = \frac{V}{A} \quad \text{or} \quad \tau = \frac{VQ}{Ib}$$

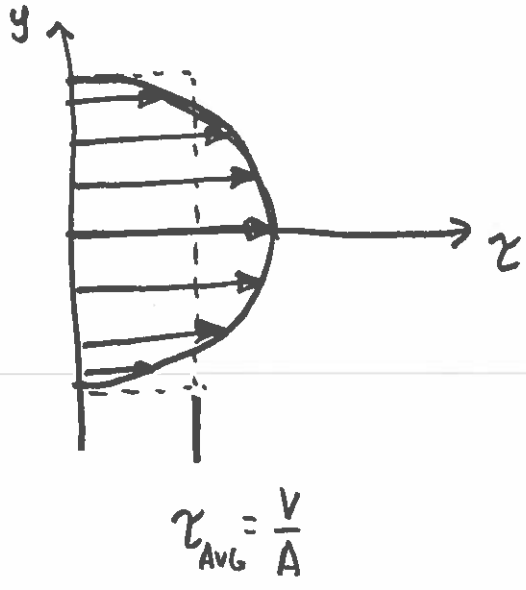
shear with no moment

shear with moment

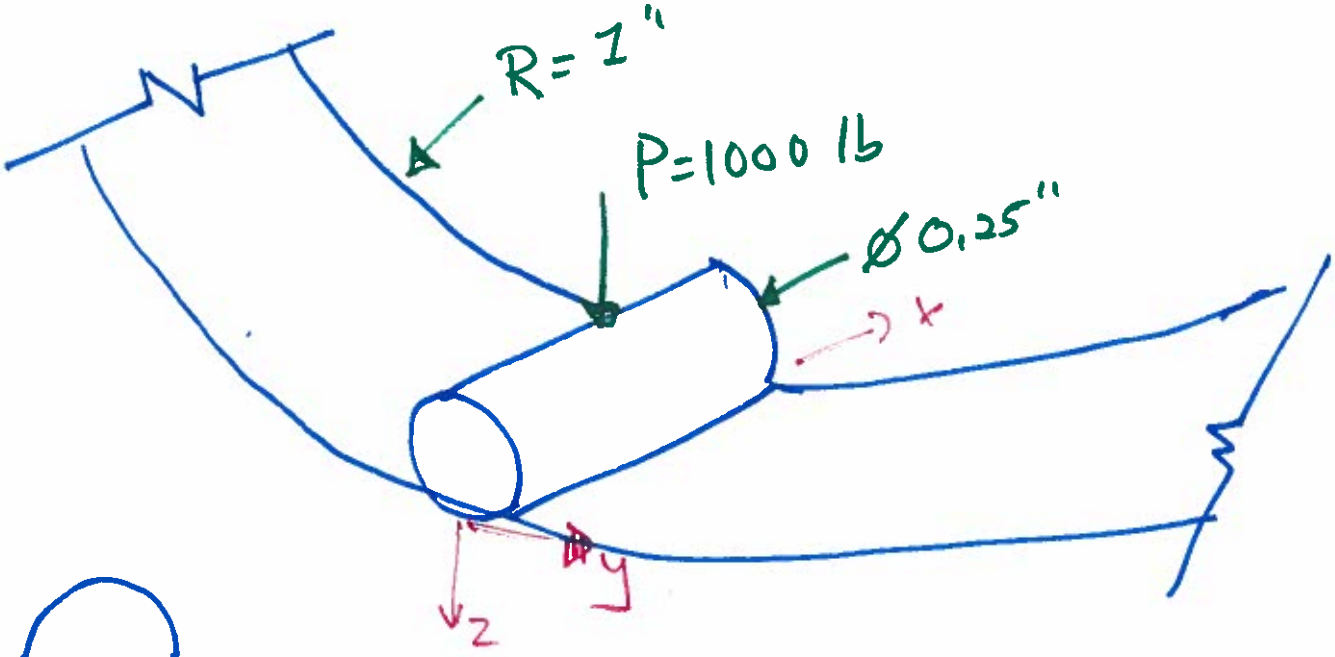
$M = 0$



$M > 0$



Example: Cylindrical Contact Stress



Carbon steel

$E = 30$ Mpsi

$\nu = 0.292$

$$b = \sqrt{\frac{2(1000\,lb)}{\pi(0.5in)} \frac{(1-0.292^2)/_{30E6} + \frac{(1-0.292^2)}{30E6}}{\frac{1}{0.25''} - \frac{1}{2''}}}$$

$$b = 0.00471''$$

Contact Stress

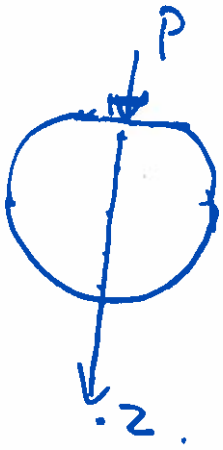
$$\sigma_x = -2\nu p_{max}\left(\sqrt{1+\frac{z^2}{b^2}} - \left|\frac{z}{b}\right|\right)$$

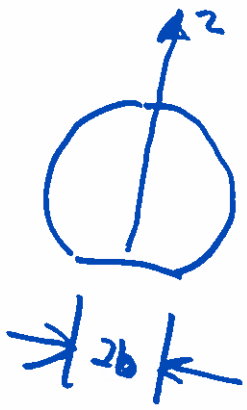
$$\sigma_y = -p_{max}\left(\frac{1+2\frac{z^2}{b^2}}{\sqrt{1+\frac{z^2}{b^2}}} - 2\left|\frac{z}{b}\right|\right)$$

Cylinders

$$\sigma_z = \sigma_3 = \frac{-p_{max}}{\sqrt{1+z^2/b^2}}$$

z: depth into either sphere





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

↑ at contact face

@ $z = 0$

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

$$\sigma_y\Big|_{z=0} = -P_{max} = -849\ ksi \quad \underline{\sigma_2}$$

$$\sigma_z\Big|_{z=0} = \sigma_3 = \frac{-P_{max}}{1} = -849\ ksi \quad \underline{\sigma_3}$$

$$\tau_{max}\Big|_{z=0} = \frac{\sigma_1 - \sigma_3}{2} = 176.\ ksi$$

$$\underline{176.6\ ksi}$$