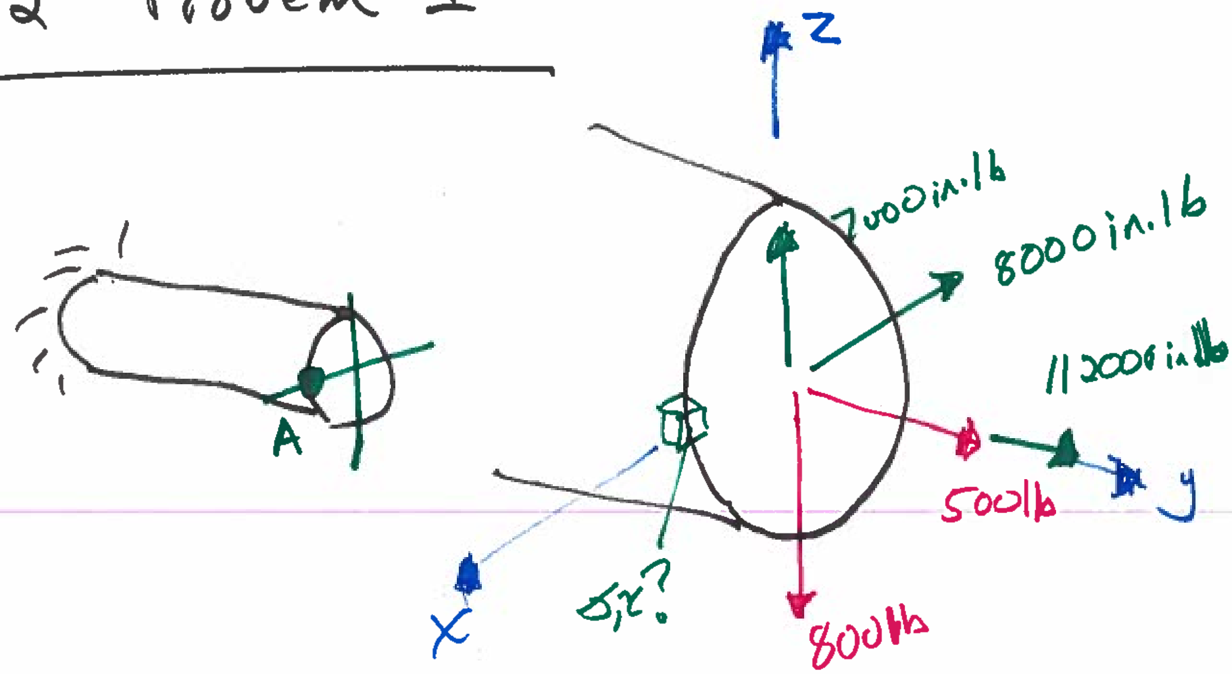
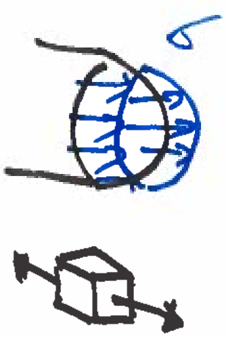
HW#2 Problem 1

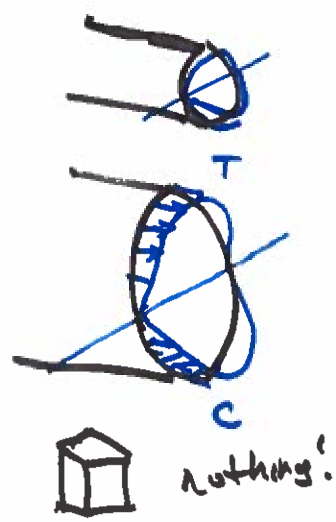


Normal/Axial



+

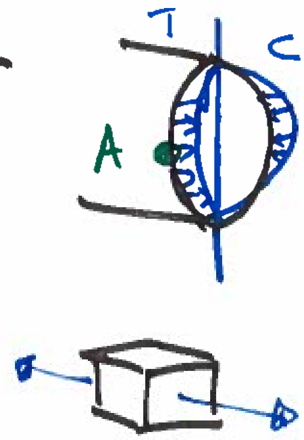
Bending about x



nothing!

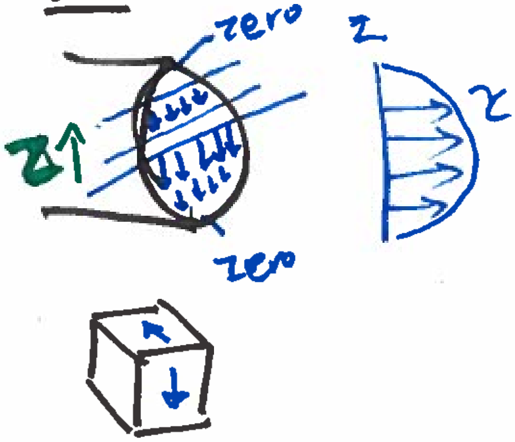
+

Bending about z



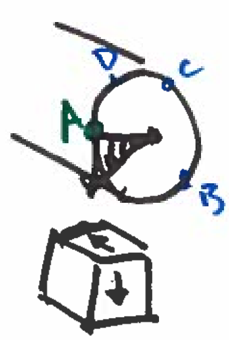
+

Transverse Shear

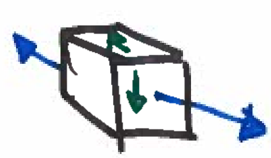


+

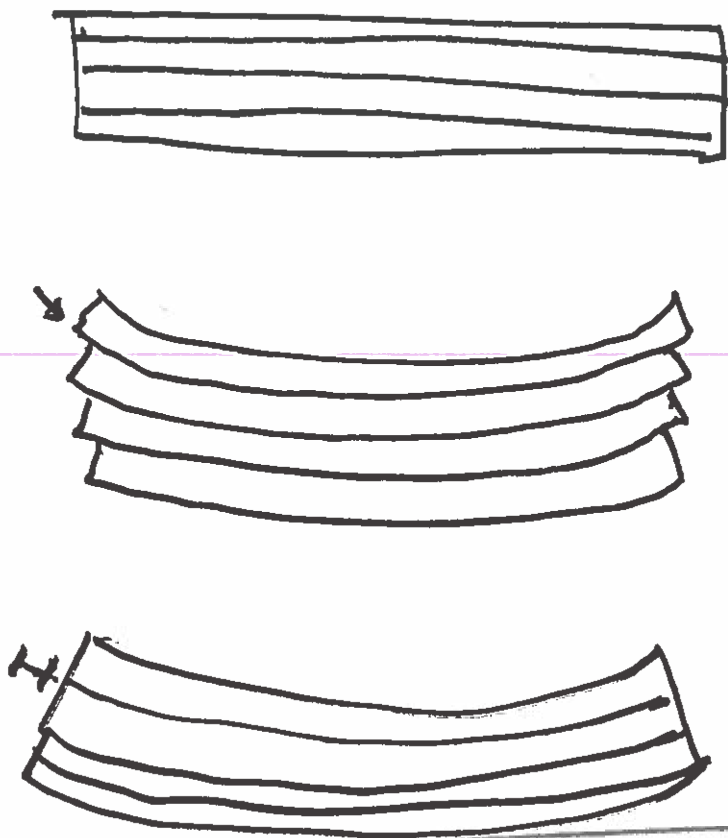
Torsion



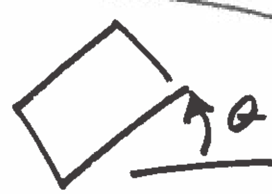
=



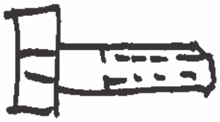
Why bending affects the transverse shear stress.



Mohr's circle



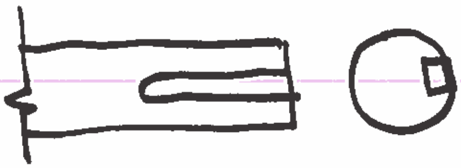
Stress Concentrations



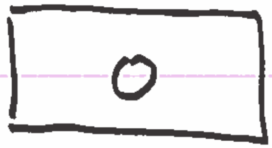
threads head

shoulders

notches



Keyways



holes

Stress raisers : are geometric changes that cause violations to standard stress theory

stress concentrations : regions around stress raisers, when stress changes

Stress concentration factors

$$K_t = \frac{\sigma_{max}}{\sigma_o} \qquad K_{ts} = \frac{\tau_{max}}{\tau_o}$$

σ_{max} – maximum predicted stress at stress raiser

σ_o – nominal stress from theory

normal stress

shear stresses

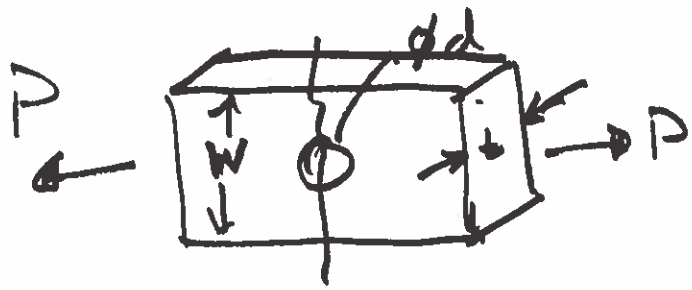
K_t, K_{ts} : determined by experimentation

Static Loading

Ductile Materials: stress con. factors are not generally necessary

if used, you are being conservative

Brittle Materials: stress con. factors are definitely needed



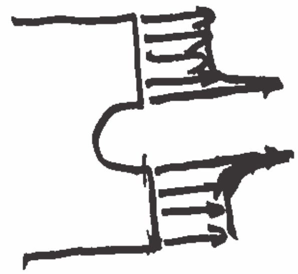
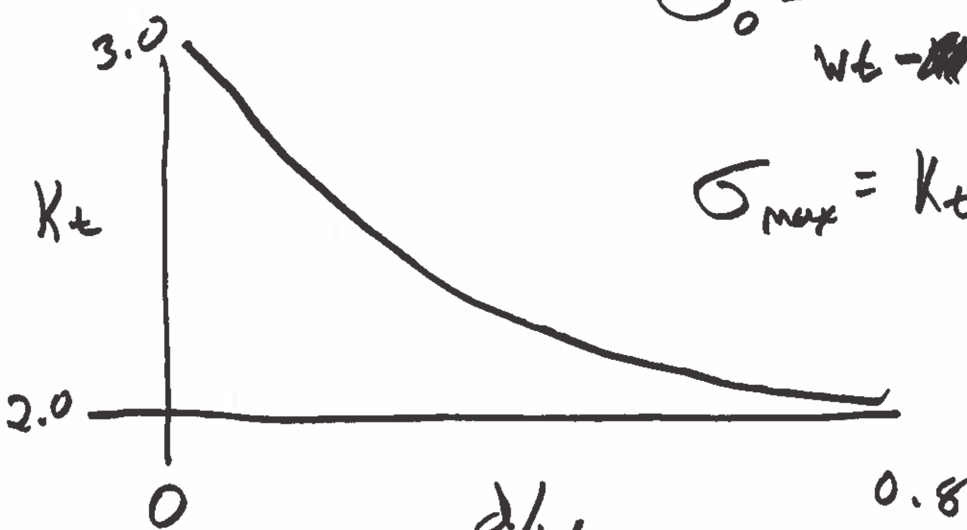


Fig 3-24



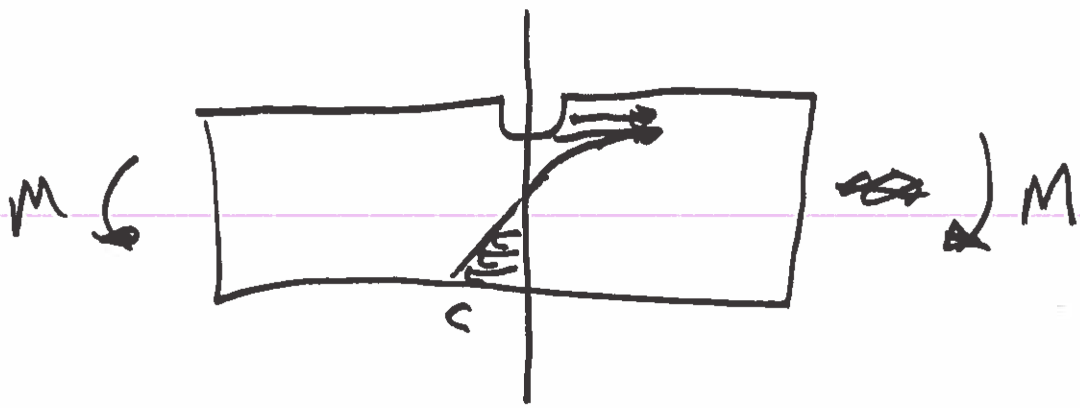
$$\sigma_0 = \frac{P}{wt - dt}$$

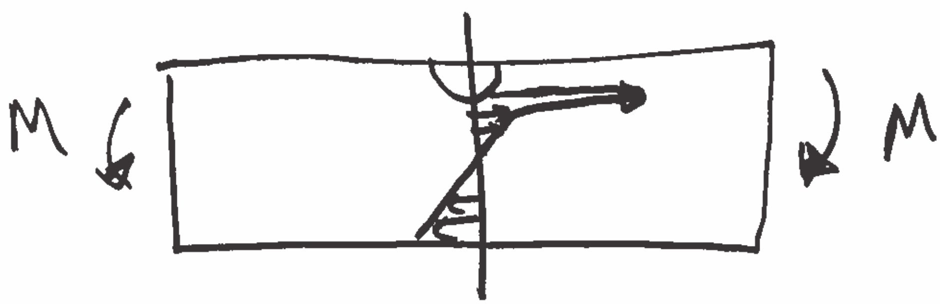
$$\sigma_{max} = K_t \sigma_0$$

$A' = wt - dt$

Tables A-15, A-16 in book

Notch





Remember

$$K_{t_{\text{normal}}} > K_{t_{\text{bending}}}$$

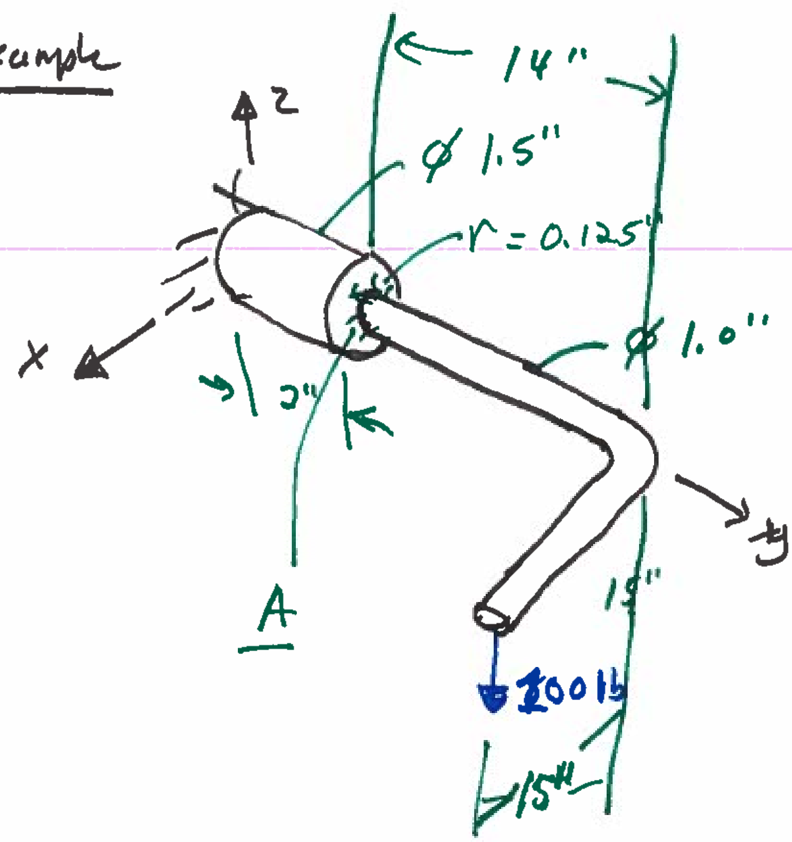
conservative by choosing $K_{t,\text{axial}}$ when $K_{t,\text{bending}}$ isn't available

$K_{t,\,axial} > K_{t\ bending}$

generally

conservative => use $K_{t\ axial}$

Example



Hardened material

$$\sigma_x = \frac{M_A c}{I}$$

$$\tau_{xy} = \frac{Tr}{J} = \frac{(15)(100)\frac{1}{2}}{\frac{\pi d^4}{32}}$$

$$M_A = (14)(100) = 1400$$

$$I = \frac{\pi d^4}{64} \qquad c = \frac{d}{2}$$

$$\tau_{xy\,0} = 7.64\ \text{Kpsi}$$

$$\therefore\ \sigma_{x0} = 14.26\ \text{Kpsi}$$

Tables A-15 (and 9)

$$D/d = \frac{1.5}{1} = 1.5$$

$$K_{ts} \cong 1.39$$

$$\frac{r}{d} = \frac{.125}{1} = .125$$

$$\boxed{\tau_{max} = 10.6\ \text{Kpsi}}$$

$K_t \cong 1.58 \Rightarrow \sigma_{max} = 22.5$ Kpsi

$$\frac{r}{d} = \frac{0.125''}{1''} \Rightarrow K_t \approx 1.58$$

$$\underline{\sigma_{max} = 22.5 \text{ Kpsi}}$$

<u>shear</u>

$$\frac{D}{d} = \frac{1.5''}{1''} = 1.5$$

$$K_{ts} \approx 1.39$$

$$\tau_{max} = \underline{10.6 \text{ Kpsi}}$$