ME 314 Midterm #2 Winter 2019

#1) S_{ut} for AISI 1010 $S_{ut} = 47$ KSi (Hot Rolled)

#2) $\tau = \frac{F}{A_t} = \frac{5000}{1.11} = 4504$ Psi ←

where $A_t = \pi d\,(t) = \pi(2)(0.17675) = 1.11$ in^2

and $t = 0.707\,h = 0.707\,(0.25)$

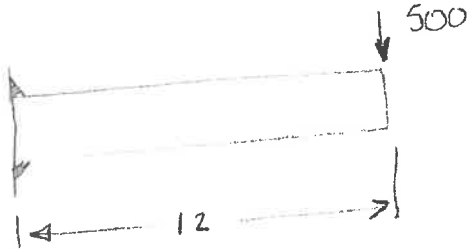
$t = 0.17675$

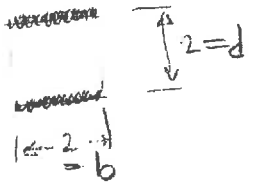
#3)

$\tau = 8000$ Psi

$n = \frac{0.3\,S_{ut}}{\tau} = \frac{0.3\,(62)}{8} = 2.3$

#4)





$\tau = \frac{Mc}{I_t} = \frac{500\,(12)\,(1)}{0.707} = 8486.5$ Psi

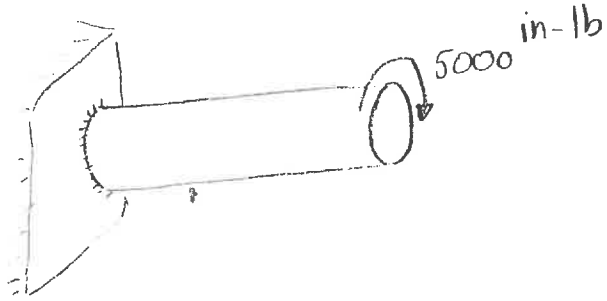
where $I_t = I_u \cdot t = 4\,(0.17675)_2 = 0.707$

And $I_u = \frac{bd^2}{2} = \frac{2(2)^2}{2} = 4$

#5)

$$\tau = \frac{Tr}{J_t} = \frac{8000\,(1)}{1.11}$$

$$\tau = 7207 \text{ psi}$$



where

$$J_t = J_u \cdot t$$

$$J_t = (2\pi r^3) \cdot t = (2\pi * 1^3) \cdot 0.17675$$

$$J_t = 1.11$$

#6)

$\tau_b = 40$ out of plane

$\tau_t = 25$ in plane

$$\tau = \sqrt{\tau_b^2 + \tau_t^2} = \sqrt{40^2 + 25^2} = 47.2 \text{ ksi}$$

#7)

$$\tau_{actual} = K_{fs}\,\tau_{nom} = 1.5\,(5) = 7.5 \text{ ksi}$$

where $K_{fs} = 1.5$

$$S_{es} = K_a K_c S_e' = 0.657\,(0.59)\left(\frac{62}{2}\right) \cong 12 \text{ ksi}$$

where $K_a = a\,S_{ut}^{\,b} = 39.9\,(62)^{-0.995} = 0.657$

$$n = \frac{S_{es}}{\tau_{actual}} = \frac{12}{7.5} = 1.6$$

#8)

$$n = \frac{S_{ys}}{\tau} \qquad S_{ys} = 0.3\ S_{ut}$$

$$= 0.3(62) = 18.6$$

$$2.5 = \frac{18.6}{\tau}$$

$$\tau = 7.44 \text{ ksi}$$

$$\tau = \frac{Tr}{J_t} = \frac{F(8)(1.5)}{3.748} = 7.440$$

$$J_t = F_u t = 21.2\,(0.707)(0.25) = 3.748$$

$$J_u = 2\pi r^3 = 2\pi\,(1.5)^3 = 21.2 \text{ in}^3$$

$$\Rightarrow F = 2324 \text{ lbs} \leftarrow$$

#9)

$L_{F_{min}} = 3$ $\quad$ $L_{F_{max}} = 2$

$F_{min} = 10$ $\quad$ $F_{max} = 50$

$\Delta F = K \Delta X$

$(50-10) = K(3-2) \Rightarrow K = 40$ lb/in

$\Delta F = K \Delta X$

$(50-0) = 40(L_o - 2) \Rightarrow L_o - 2 = \frac{50}{40} = 1.25$

$\Rightarrow L_o = 3.25$ inch ←

#10)

$$K = \frac{d^4 G}{8D^3 N} = \frac{(0.1)^4 * 11.5*10^6}{8(1.5)^3(12)} = 3.55 \text{ lbs/in} \leftarrow$$

#10)

$L_o = 3$

$N = 10$

$K = 20$ lb/in

$N_t = N + 2$

$N_t = 10 + 2 = 12$

$\Delta F = K \Delta X$

$F_s - 0 = K(L_o - L_s)$

$F_s = 20(3 - 1.2) = 36$ lbs ←

where $L_s = N_t d = 12(0.1) = 1.2$"

#12)

$$L_o > 2.63 \frac{D}{\alpha}$$

where $D = 0.5$

$\alpha = 0.5$

$$L_o < 2.63$$

#13) $d = 0.1$

$D = 1$

$F_s = 55$ lbs

$$\tau = K_B \frac{8 F_s D}{\pi d^3} = 1.135 \frac{8(40)(1)}{\pi (0.1)^3} = 115610$$

where

$$K_B = \frac{4C+2}{4C-3} = \frac{40+2}{40-3} = 1.135$$

And

$$C = \frac{D}{d} = \frac{1}{0.1} = 10$$

$$\tau = 115.6 \text{ ksi}$$

#14 $\tau = 68$ ksi

$$S_{ut} = \frac{A}{d^m} = \frac{201}{(0.1)^{0.145}} = 280.67 \text{ ksi}$$

$$n = \frac{0.45\, S_{ut}}{\tau} = \frac{0.45(280.67)}{68} = 1.86$$

#15 $\tau_{min} = 15$

$\tau_{max} = 35$

$$S_{es} = \frac{35}{1 - (55/S_{as})} = \frac{35}{1 - \frac{55}{188}} = 49.47 \text{ ksi}$$

Where $S_{as} = 0.67\, S_{ut} = 0.67(280.67) = 188$ ksi

#16

$$f = \frac{F_s - F_{max}}{F_{max}}$$

$$= \frac{50 - 40}{40} = 0.25 \leftarrow$$