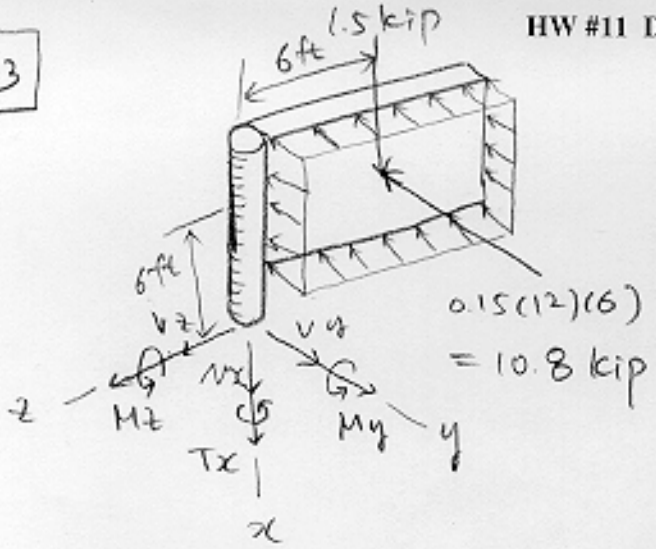
3/4

HW #11 Due: 12/1/2000

8-43



• Equilibrium;

$\Sigma F_x = 0$; $1.5 + N_x = 0$; $N_x = -1.5$ kip

$\Sigma F_y = 0$; $V_y - 10.8 = 0$; $V_y = 10.8$ kip

$\Sigma F_z = 0$; $V_z = 0$

$\Sigma M_x = 0$; $T_x - 10.8(6) = 0$; $T_x = 64.8$ kip·ft

$\Sigma M_y = 0$; $M_y - 1.5(6) = 0$; $M_y = 9.0$ kip·ft

$\Sigma M_z = 0$; $10.8(6) + M_z = 0$; $M_z = -64.8$ kip·ft

• Section;

$A = \pi(3^2 - 2.15^2) = 1.4315\pi$ in^2

$I_y = I_z = \frac{\pi}{4}(3^4 - 2.15^4) = 18.6992$ in^4

$(Q_C)_z = (Q_D)_y = 0$

$$(Q_C)_y = (Q_D)_z = \frac{4(3)}{3\pi}\left[\frac{1}{2}\pi(3^2)\right] - \frac{4(2.15)}{3\pi}\left[\frac{1}{2}\pi(2.15^2)\right]$$

$= 4.13542$ in^3

$J = \frac{\pi}{2}(3^4 - 2.15^4) = 37.3984$ in^4

• Normal stress

$$\sigma = \frac{N}{A} - \frac{M_z}{I_z}\cdot y + \frac{M_y}{I_y}\cdot z$$

$$\sigma_F = \frac{-1.5}{1.4315\pi} - \frac{(-64.8)(12)(0)}{18.6992} + \frac{9.0(12)(-3)}{18.6992} = \underline{-17.1 \text{ ksi (C)}}$$

$$\sigma_E = \frac{-1.5}{1.4315\pi} - \frac{(64.8)(12)(-3)}{18.6992} + \frac{9(12)(0)}{18.6992} = \underline{-125 \text{ ksi (C)}}$$

• Shear stress

shear stress can be considered

using $\tau_V = \frac{VQ}{I_b}$ and $\tau_{twist} = \frac{Tr}{J}$

$$(\tau_{xz})_E = -\tau_{twist} = \frac{64.8(12)(3)}{37.3984} = \underline{-62.4 \text{ ksi}}$$

$(\tau_{xy})_E = \tau_{V_y} = \underline{0}$

$$(\tau_{xy})_F = \tau_{V_y} + \tau_{twist} = \frac{10.8(4.1354)}{18.6992(2)(0.15)} + \frac{64.8(12)(3)}{37.3984} = \underline{61.2 \text{ ksi}}$$