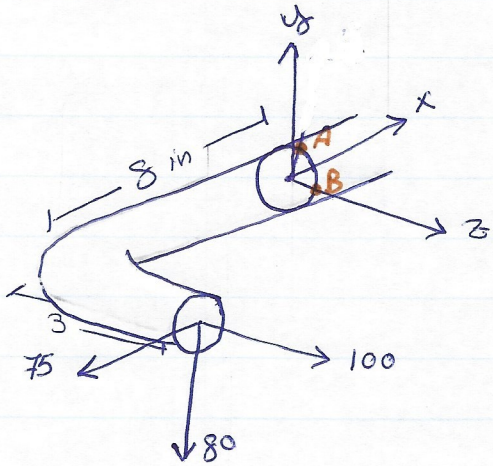
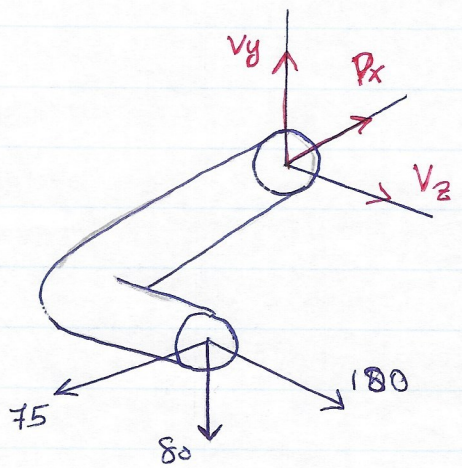
8.54



1. First find V_y, V_z, P_x using
$\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$

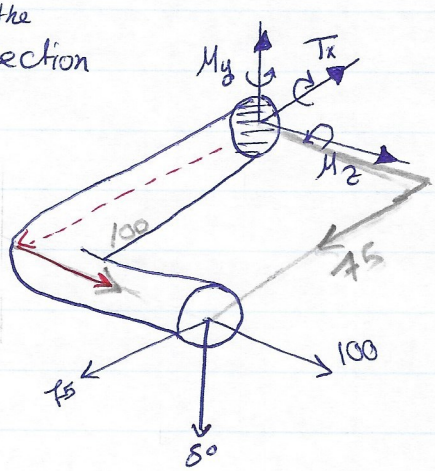
* $\Sigma F_y = 0$
$V_y - 80 = 0 \Rightarrow V_y = 80$ lb
* $\Sigma F_x = 0$
$P_x - 75 = 0 \Rightarrow P_x = 75$ lb
* $\Sigma F_z = 0$
$V_z + 100 = 0 \Rightarrow V_z = -100$ lb

ملاحظات :-
• عادة ما يعطى السؤال العزم الموجب لكل محور من (x, y, z) التزم بهذا العزم و اعزم V_x, V_y, V_z بالاتجاه الموجب



→ Results until Now :-
$V_y = 80$ lb , $P_x = 75$ lb , $V_z = -100$ lb

2- Find Moments : M_z, M_y, T_x ← moment around x is called Torque
we need to find resultants moments from moving 100, 80, 75 to the section



* To move 100
we need one move → one moment around y and it's in positive Direction (+y)
$M_y + (100)(8) - (75)(3) = 0$
$M_y = -575$ lb.in (-y)

(Moving to needs one move → negative moment in y direction)

* To move 80 :

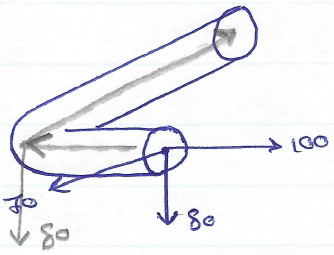
We need two moves → two moments

around x (+x) | around z (+z)

$\Sigma M_x = 0$

$T_x + (80)(3) = 0$

$T_x = -240$ lb.in



$\Sigma M_z = 0$

$M_z + (80)(8) = 0$

$M_z = -640$ lb.in

→ Results until Now:

$M_z = -640$, $T_x = -240$, $M_y = -575$

3- We find Stress acting on Point B

σ_x , σ_z , σ_y

σ_x : caused by P_x

σ_z : caused by M_z

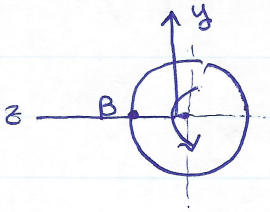
σ_y : caused by M_y

$A = \frac{\pi}{4} d^2 = \frac{\pi}{4}(1) = 0.785$

$I = \frac{\pi}{4} r^4 = \frac{\pi}{4}(0.5)^4 = 0.049$

$\sigma_x = \frac{P_x}{A} = \frac{75}{0.785} = 95.54$ psi (positive)

$\sigma_z = \frac{M_z y}{I} = \frac{(640)(0)}{I} = 0$

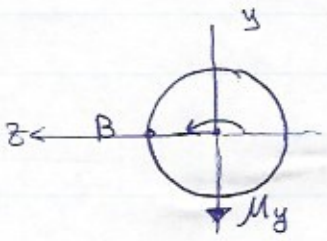


النقطة B تقطع خط الـ z فالبعد المسافة العمودية بينها وبينه (تذكر y هي المسافة العمودية بين النقطة والمحور الذي حدث الـ moment عليه

$$\sigma_y = \frac{M_y z}{I} = \frac{(575)(\frac{1}{2})}{0.049} \quad \text{(compression)}$$

$$= -5859.87$$

$$= -5.8598 \text{ ksi}$$



Now $\sigma_B = -5.8598 \times 10^3 + 95.54 = -5764.3 \text{ psi} = \ominus 5.76 \text{ ksi}$ (compression)

1. we find shear stresses acting on point B

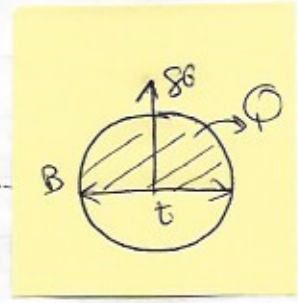
τ_{xy} , τ_{xz} , $(\tau_{xy})_{\text{from Torque}}$

τ_{xy}: caused by V_y

τ_{xz}: caused by V_z

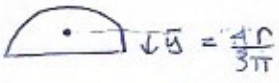
$(\tau_{xy})_{Tor}$: caused by T_x

$I = 0.049$



$$\tau_{xy} = \frac{V_y Q}{I t} = \frac{(80)(\bar{y}A)}{(0.049)(1)}$$

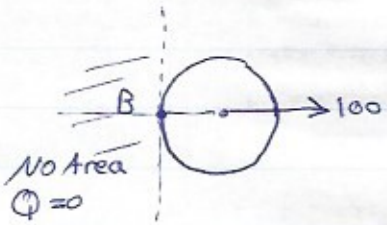
$$Q = \bar{y}A = \left(\frac{4r}{3\pi}\right)\left(\frac{\pi(0.5)^2}{2}\right)$$



$$= 0.0833$$

$$\tau_{xy} = +136.05 \text{ psi}$$

$$\tau_{xz} = \frac{V_z Q}{I t} = 0$$



$$(\tau_{xy})_{Tor} = \frac{Tc}{J} = \frac{(240)(0.5)}{\frac{\pi}{2}(0.5)^4} = +1222.93 \text{ psi}$$

So $(\tau_{xy})_{Total} = 136.05 + 1222.93 = 1358.97 \text{ psi} = 1.358 \text{ ksi}$