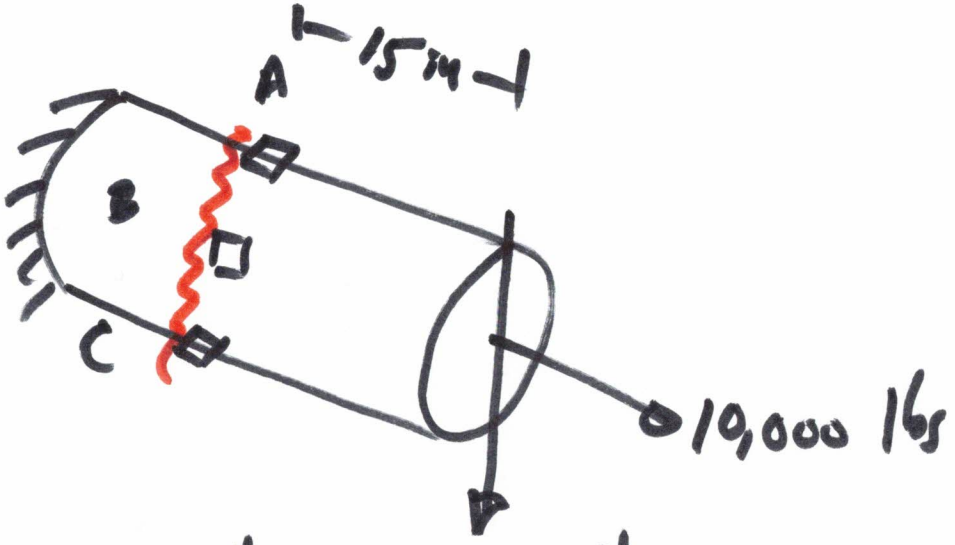
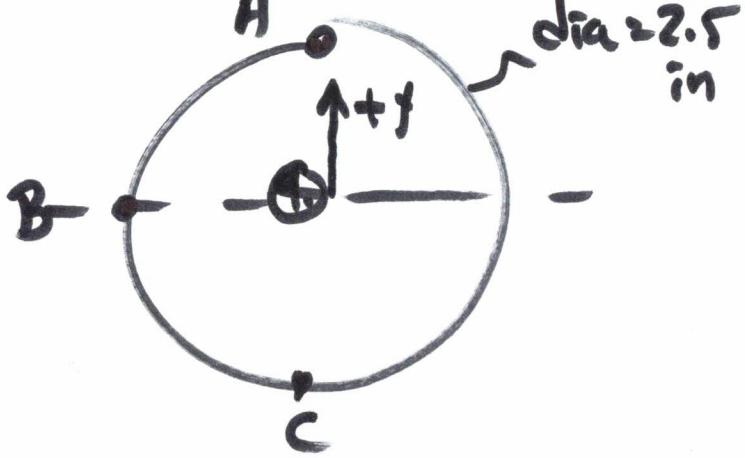
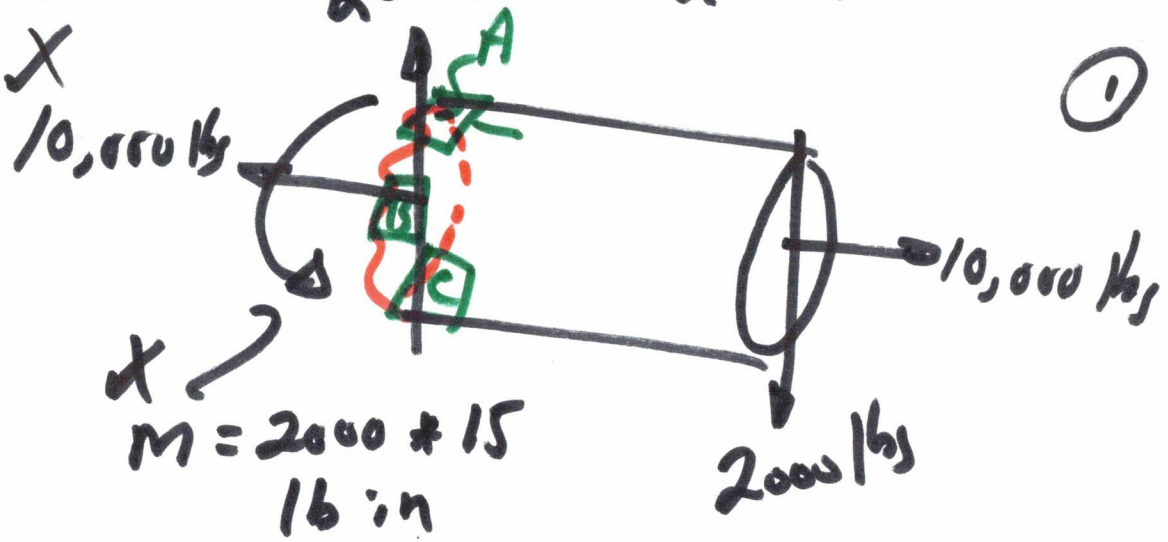
B. Combined Loading





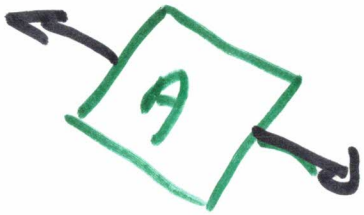
Find state of stress at A, B, C



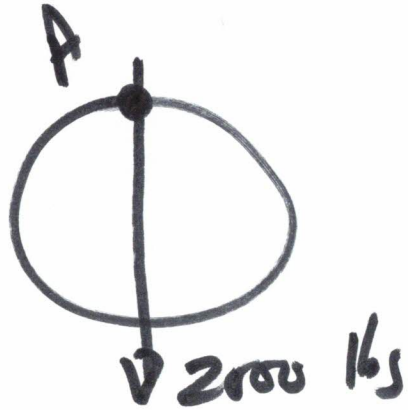
① Find RXNs at point(s) of interest (DRAW FBD!)

② See how the RXNs cause stress at the point(s) of interest

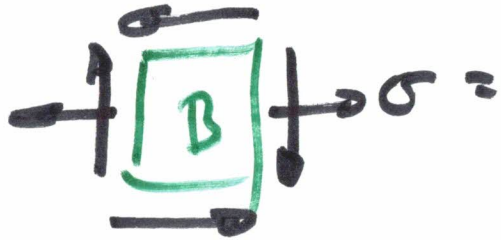
$$\frac{P}{A} + \frac{Mc}{I}$$



$$\sigma = \frac{10{,}000}{\pi/4\,(2.5)^2} + \frac{(2000)(15)\,\frac{2.5}{2}}{\pi/64\,(2.5)^4}$$

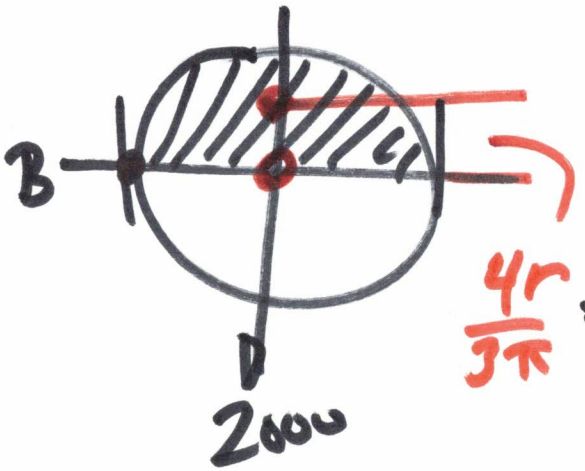


$$\tau = \frac{VQ}{It} \qquad Q = 0$$



$$\sigma = \frac{10{,}000}{\pi/4\,(2.5)^2} + \frac{M\,(0)}{I}$$

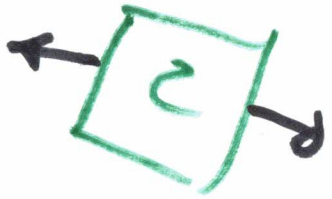
(0) on Neutral axis



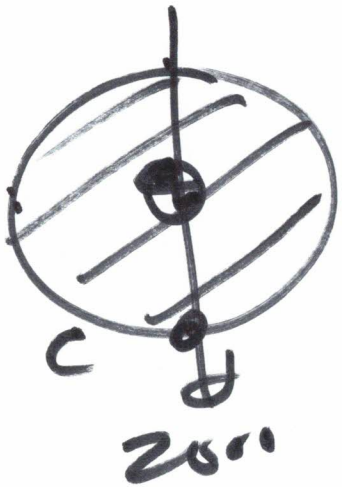
$$\frac{4r}{3\pi} = \bar{y}$$

$$\tau = \frac{VQ}{It} = \frac{2000\ \frac{4\,2.5}{3\pi}\left[\frac{1}{2}\,\frac{\pi}{4}\,(2.5)^2\right]}{\pi/64\ (2.5)^4\ (2.5)}$$

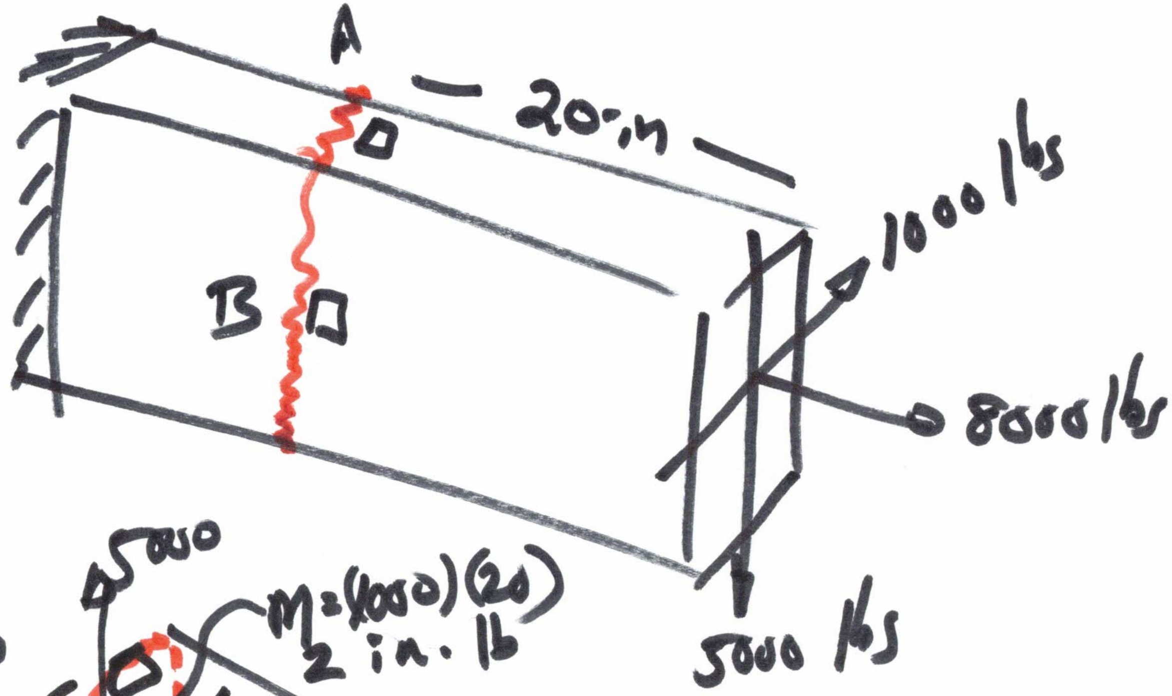
$\bar{y}$ $\quad$ A

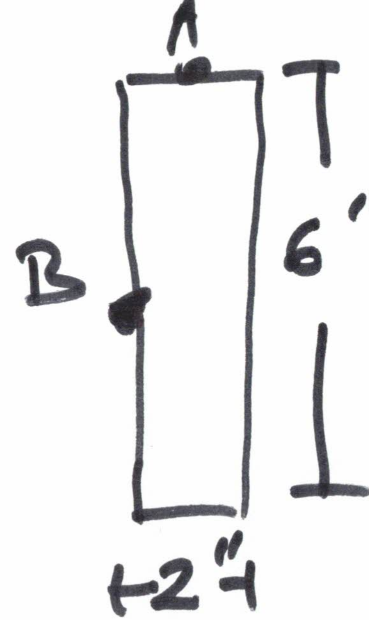


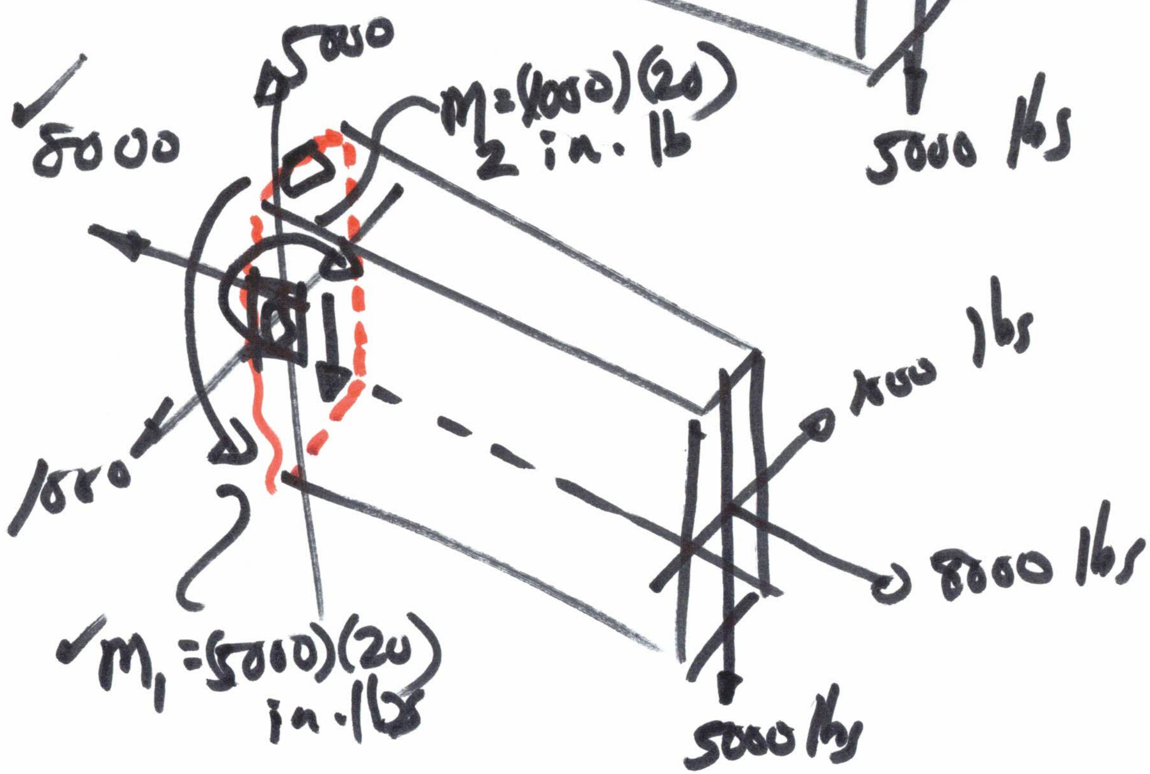
$$\frac{10,000}{\pi/4\,(2.5)^2} - \frac{(2000)(5)\,\frac{2.5}{2}}{\pi/64\,(2.5)^4} \quad psi$$

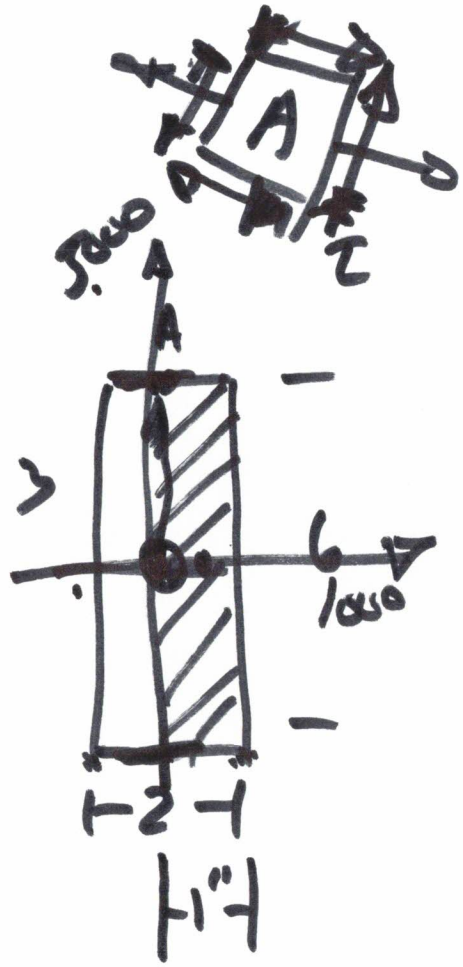


$Q = 0$


A
20 in
B
1000 lbs
8000 lbs
5000 lbs


A
B
6"
2"

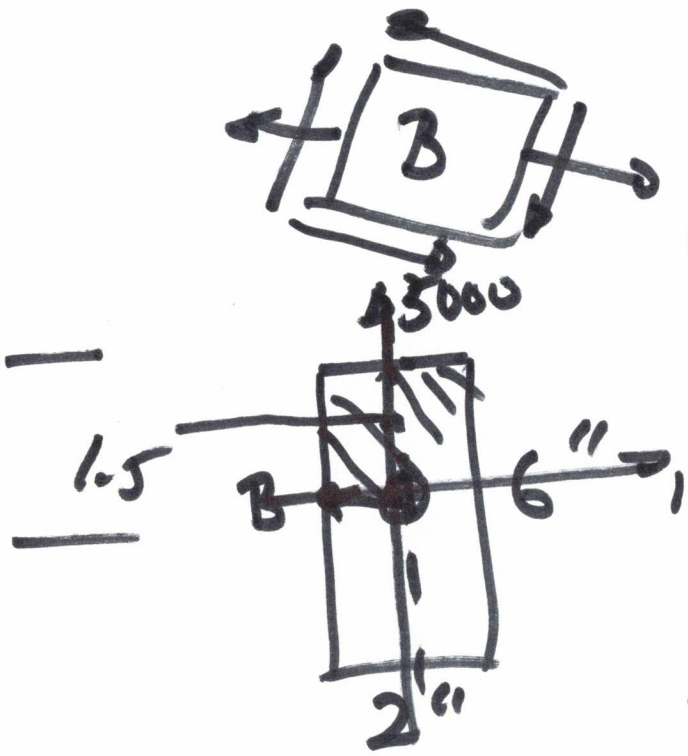

5000
8000
1000
M = (1000)(20)
2 in. lb
M1 = (5000)(20)
in. lbs
1000 lbs
8000 lbs
5000 lbs



$$\frac{8000}{(16)(2)} + \frac{(5000)(20)(3)}{\frac{1}{12}(2)(16)^3}$$

$$\tau = \frac{VQ}{It} \qquad Q = \underbrace{(6)(1)}_{A}\frac{1}{2}$$

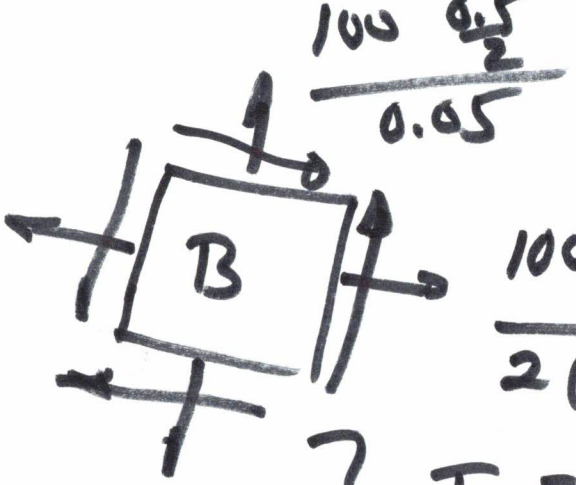
$$\tau = \frac{(1000)(6)(1)\frac{1}{2}}{\frac{1}{12}(1)(2)^3\ 6}$$



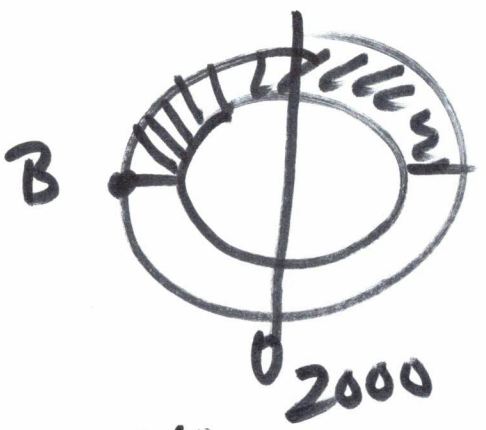
$$\frac{8000}{(2)(6)} + \frac{(1000)(20)(1)}{\frac{1}{12}(6)(2)^3}$$

$$\tau = \frac{VQ}{It} = \frac{5000\ \overbrace{(3)(2)}^{A}\ \overbrace{1.5}^{\bar{y}}}{\frac{1}{12}(2)(6)^3(2)}$$

N.A principle stress state, 7+ has shear stress.



$$\frac{100\ \frac{5.0}{2}}{2(0.05)}$$

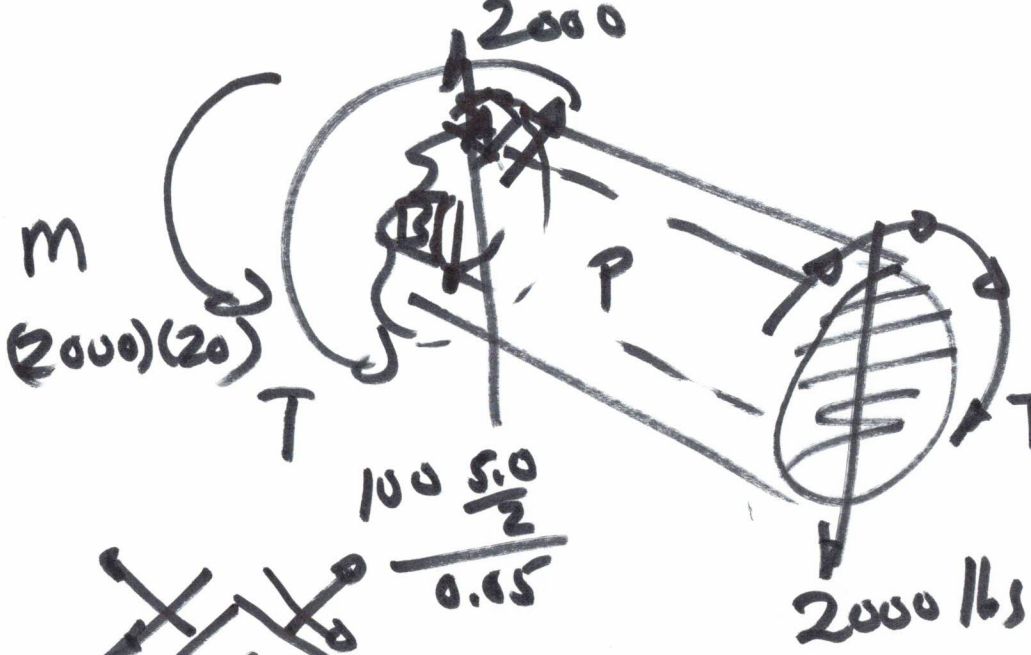


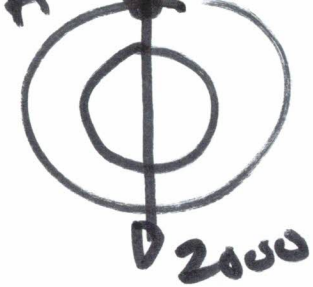
$$\tau = \frac{(2000)(14)\ \frac{5.1}{2}}{\pi/32\,(5.1^4 - 5.0^4]} - \frac{VQ}{It}$$

$$\frac{VQ}{It} = \frac{2000\ Q}{\pi/64\,[5.1^4 - 5.0^4)\ \ (0.1)}$$

Q  $= Q$  $- Q$ 

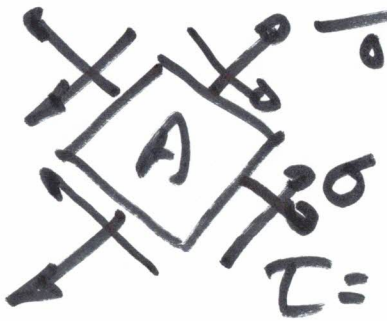
$$q = \frac{1}{2}\pi\left(\frac{5.1}{2}\right)^2 \frac{4\ \frac{5.1}{2}}{3\pi} - \frac{1}{2}\pi\left(\frac{5.0}{2}\right)^2 \frac{4\ \frac{5.0}{2}}{3\pi}$$





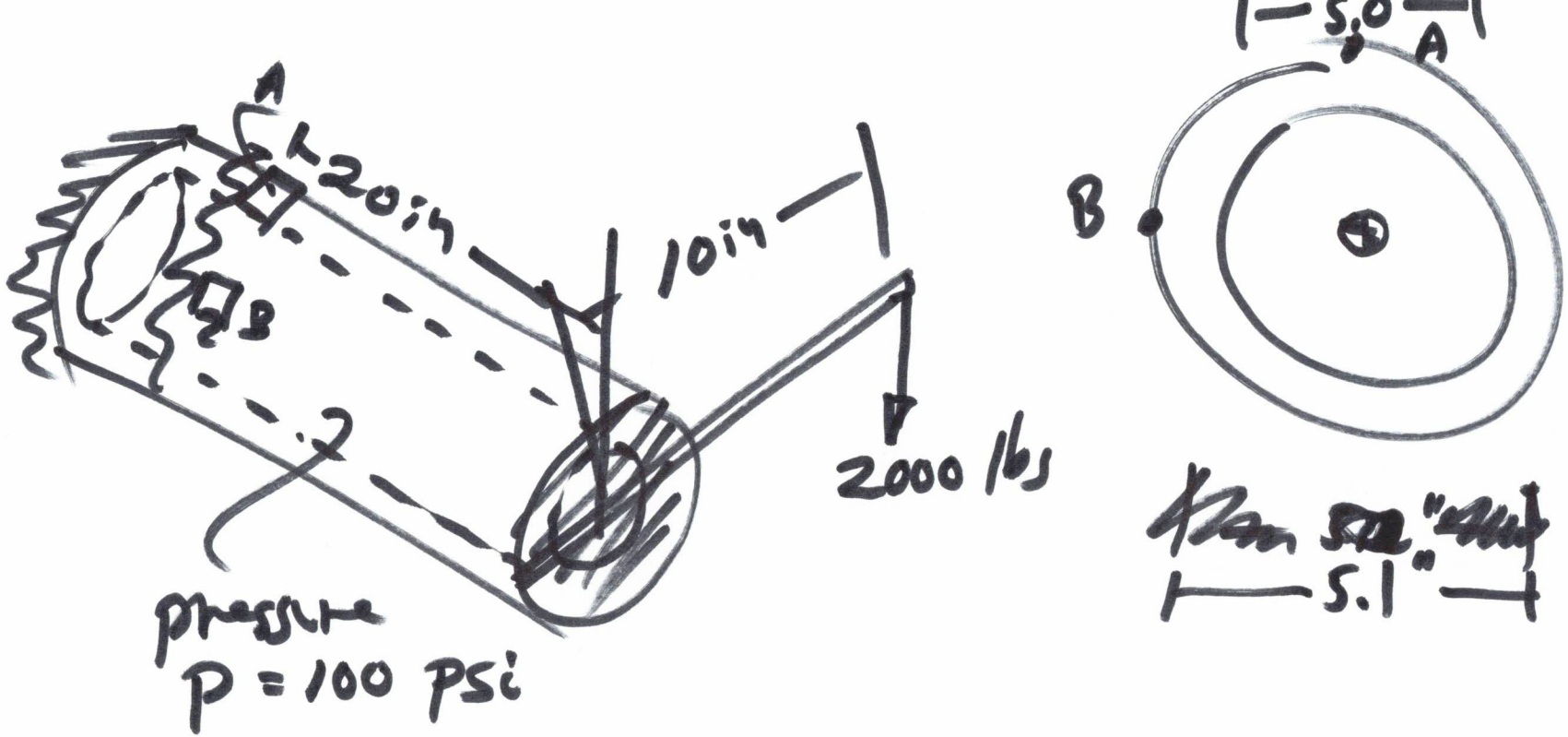
$\tau = \frac{Tq}{Jt}$

$T = 2000 \cdot 10 \text{ in} \cdot \text{lb}$

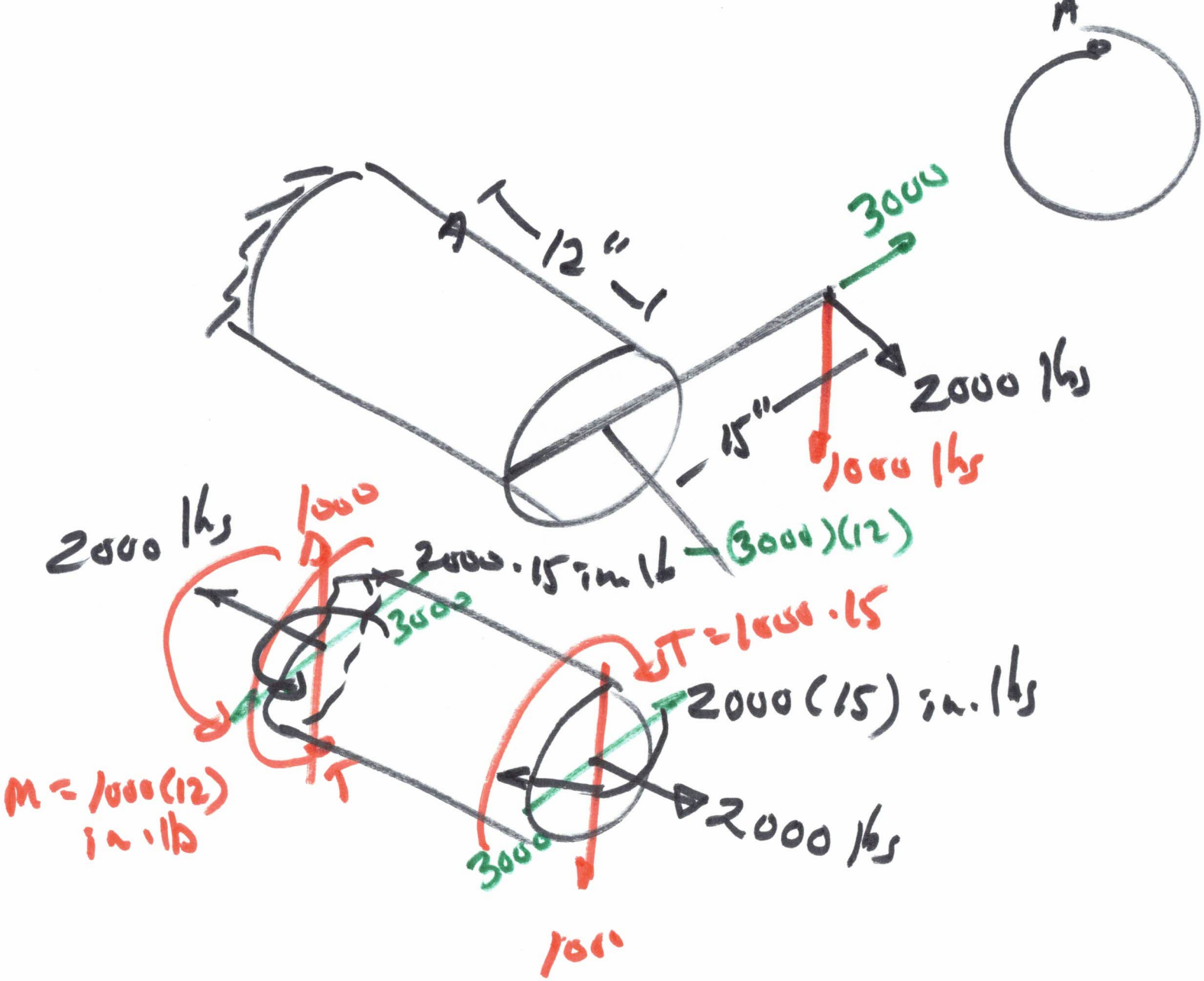


$$\tau = \frac{(2000)(10)\,\frac{5.1}{2}}{\frac{\pi}{32}\left(5.1^4 - 5.0^4\right)}$$

$$\sigma = \frac{(2000)(20)\,5.1/2}{\frac{\pi}{64}\left[5.1^4 - 5.0^4\right]} + \frac{100\,\frac{5.0}{2}}{(2)\,0.05}$$



① Simplify the statics
(Move force to centroid of X-section)


A
12"
3000
2000 lbs
15"
1000 lbs
(3000)(12)
2000 lbs
1000
2000 · 15 in lb
3000
T = 1000 · 15
2000 (15) in. lbs
M = 1000 (12) in. lb
T
2000 lbs
3000
1000