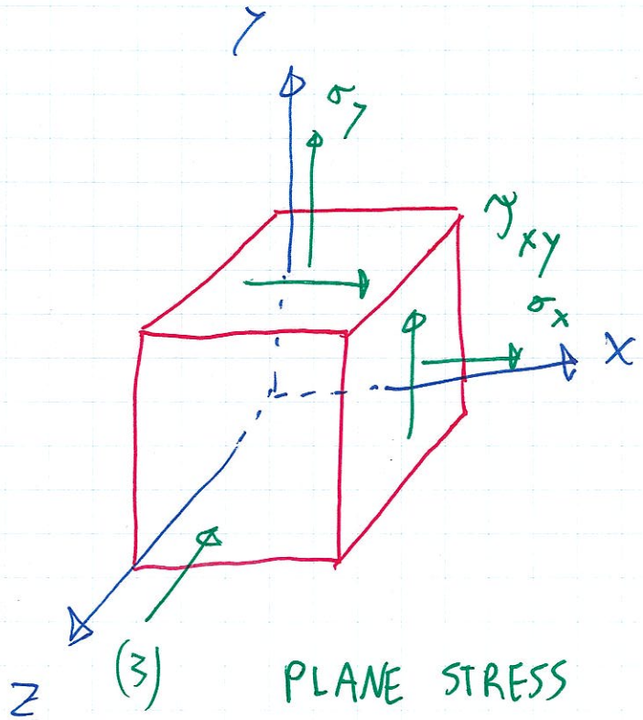
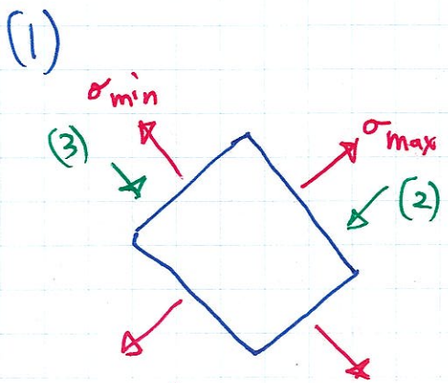
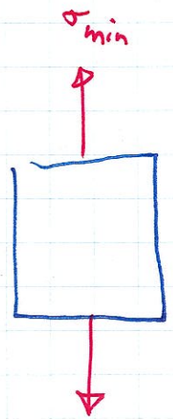
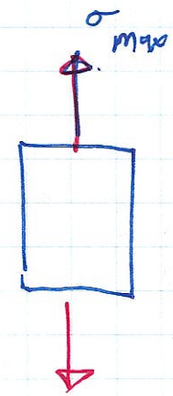
Absolute Maximum Shearing Stress → Special Case of 3D Stress

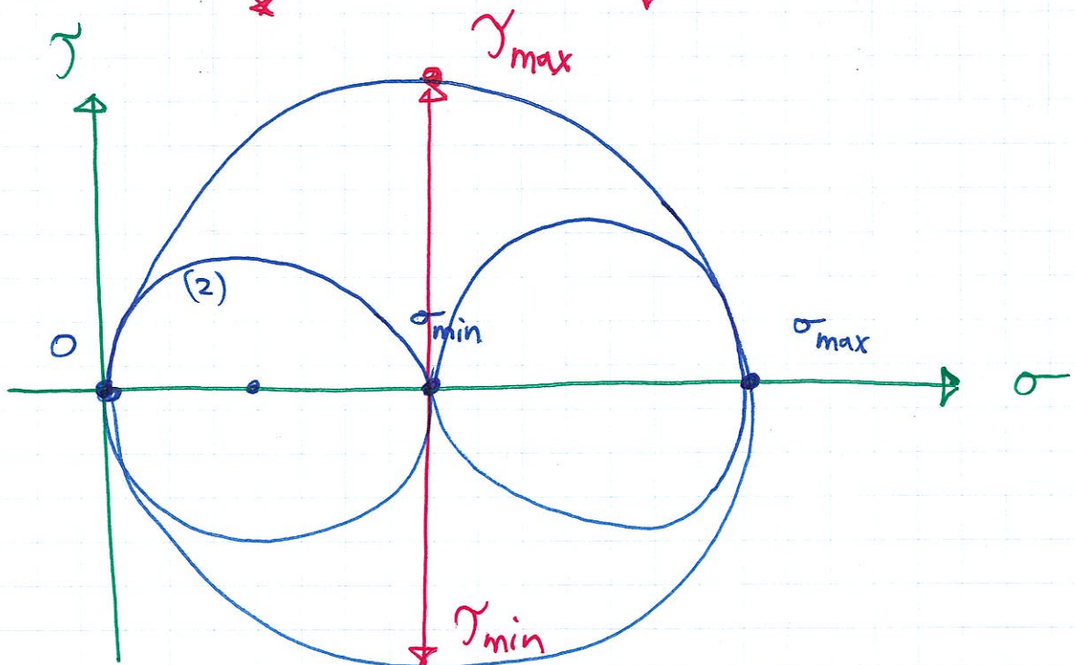


PLANE STRESS









Use the Mohr's circle approach as discussed in class to determine the maximum and minimum normal stresses for the state of stress resulting from the superposition of the two states of stress shown. Enter the magnitudes of your calculated stresses in the blocks provided being sure to indicate the proper sign.

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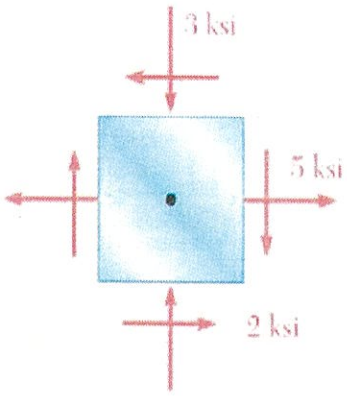
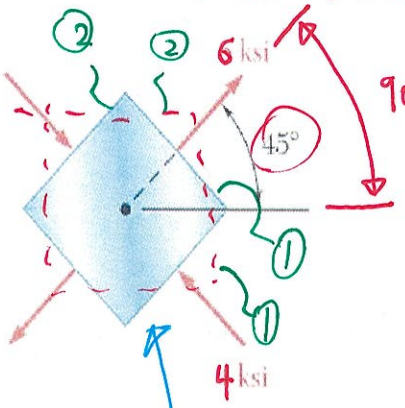


+



$\sigma_{max} = 6^{ksi}$ } PRINCIPAL STRESSES (NO SHEAR)

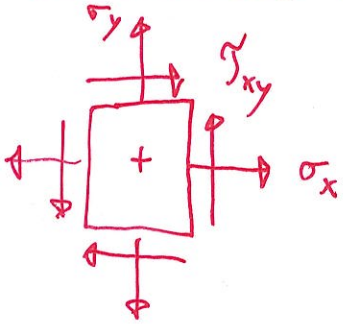
$\sigma_{min} = -4^{ksi}$ }

$\sigma_{AVG} = \frac{6^{ksi} + (-4^{ksi})}{2} = 1^{ksi}$

σ_{max} = [ ] ksi

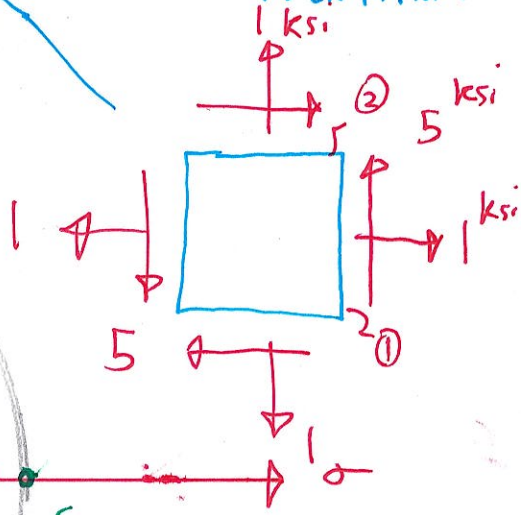
σ_{min} = [ ] ksi

POS. SIGN CONV.

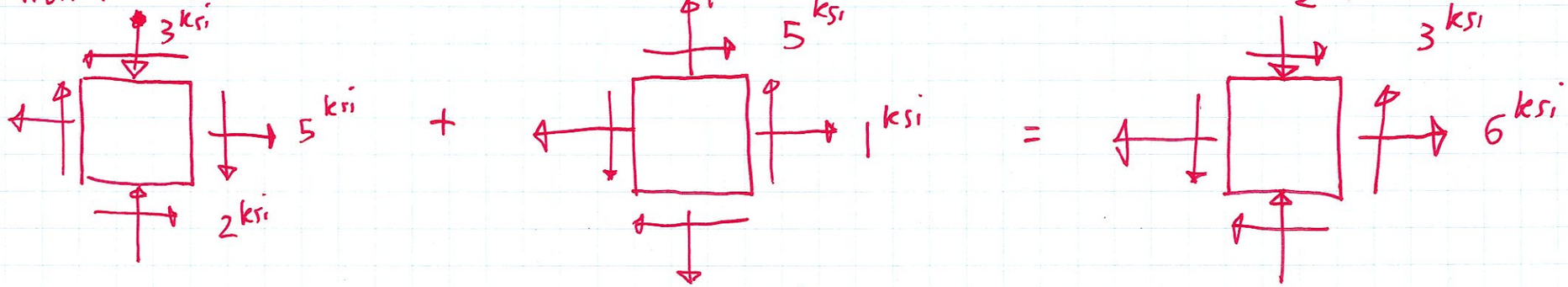


MOHR'S CONV.

ORIGINAL ORIENTATION:

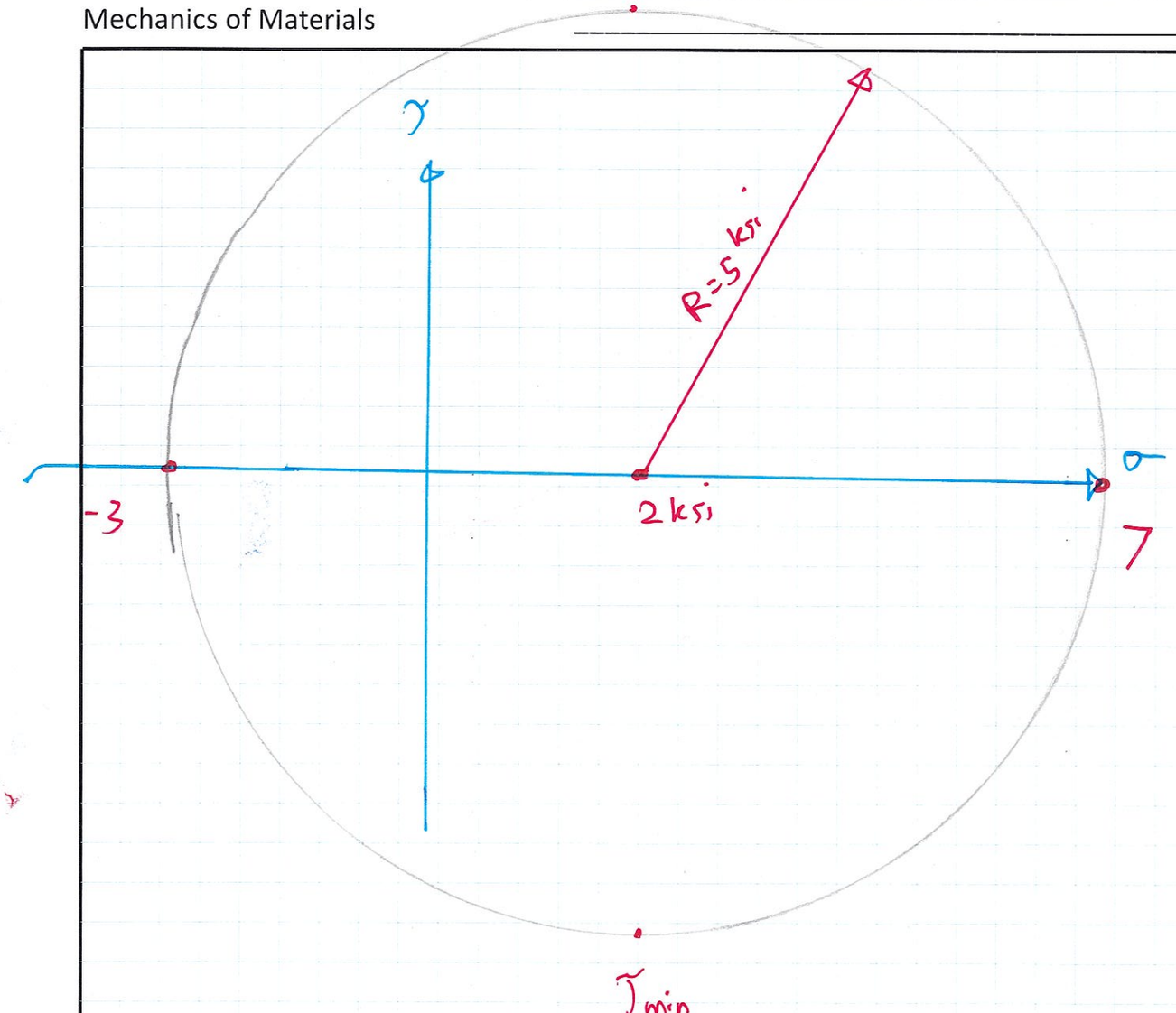


SUPER-POSITION



$$\sigma_{AVG} = \frac{\sigma_x + \sigma_y}{2} = \frac{6-2}{2} = 2 \text{ ksi}$$

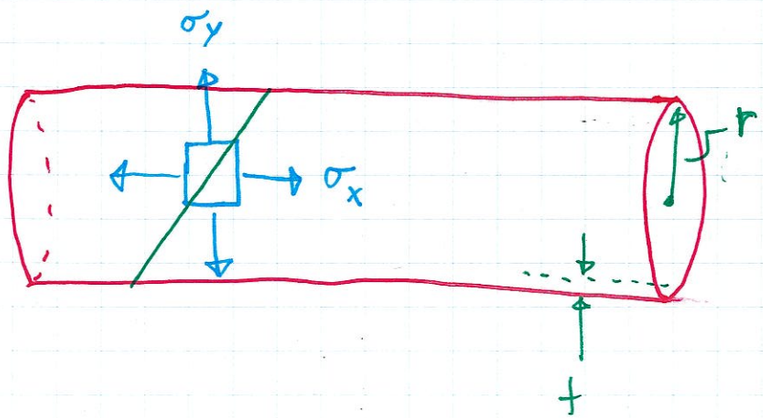
$$\text{Radius} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{4^2 + 3^2} = 5 \text{ ksi}$$



$\sigma_{max} = 7\ ksi$ $\quad \tau_{max} = 5\ ksi$

$\sigma_{min} = -3\ ksi$ $\quad \tau_{min} = -5\ ksi$

PRESSURE VESSELS



$$\sigma_y = \sigma_{Hoop/circum/hotdog} = \frac{Pr}{t}$$

$$\sigma_x = \sigma_{long.} = \frac{Pr}{2t}$$

Do not round intermediate calculations. Give your final answer(s) to three significant figures.

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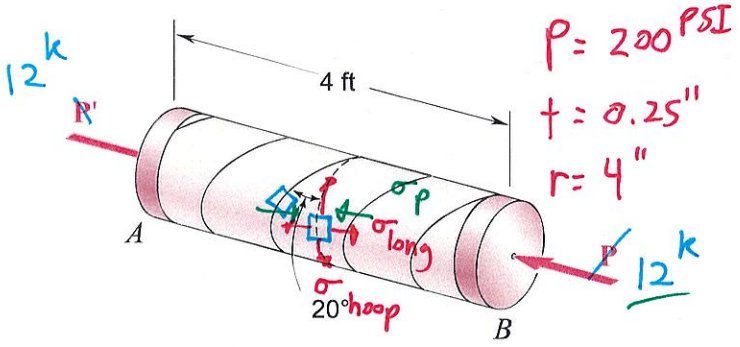
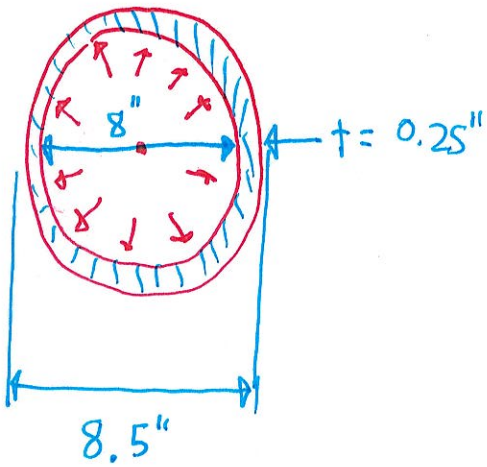
A pressure vessel of 8–in. inner diameter and 0.25–in. wall thickness is fabricated from a 4–ft section of spirally–welded pipe AB and is equipped with two rigid end plates. The gage pressure inside the vessel is 200 psi and 12–kip centric axial forces P and P' are applied to the end plates. Determine the normal stress perpendicular to the weld.



P = 200 PSI

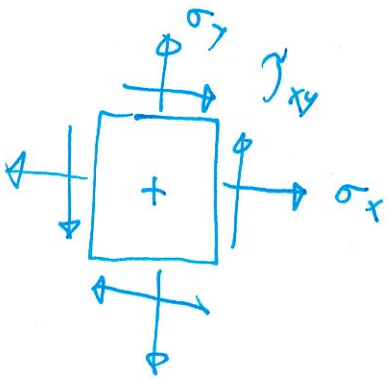
t = 0.25"

r = 4"

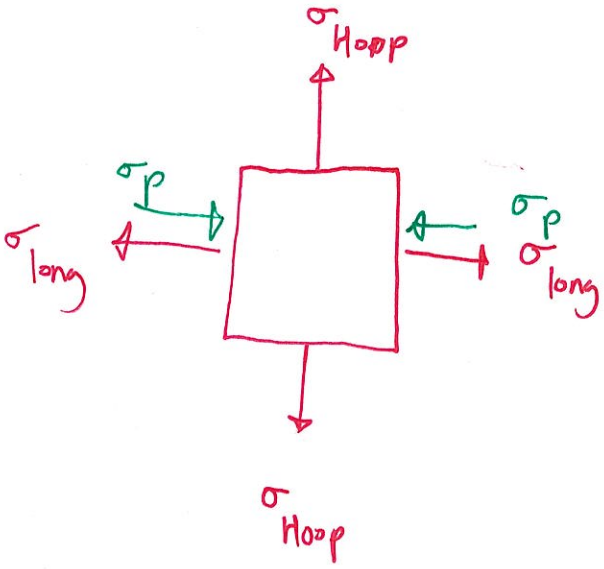


$\sigma_{x'}$ = ____ ksi

POS. SIGN. CONV



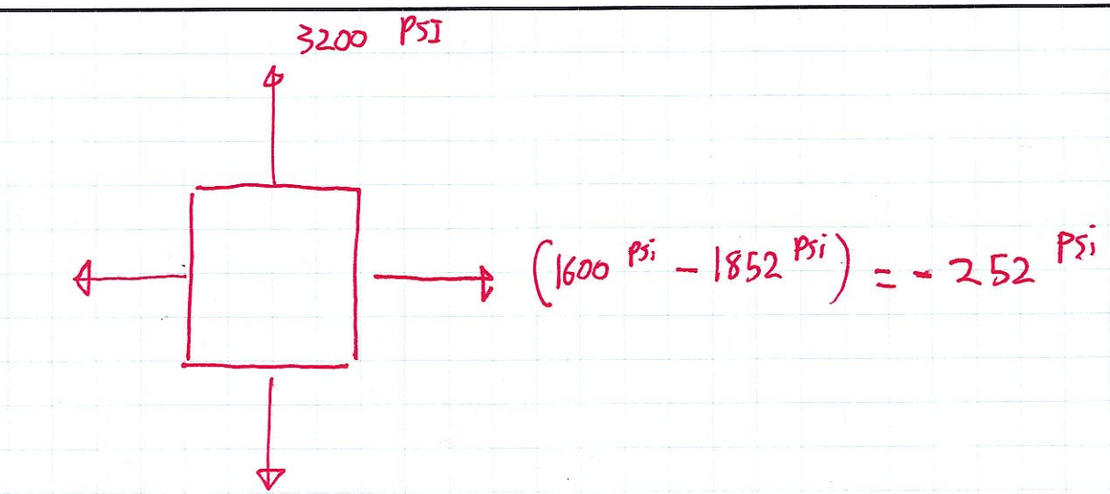
MOHR'S SIGN FOR SHEAR

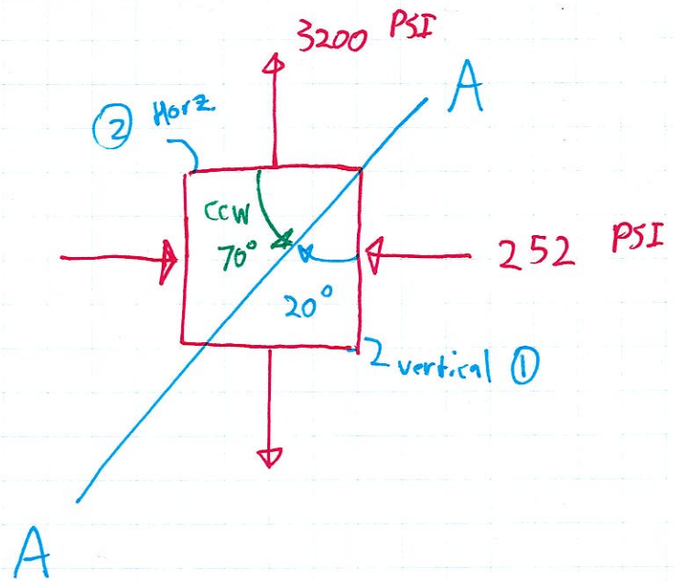


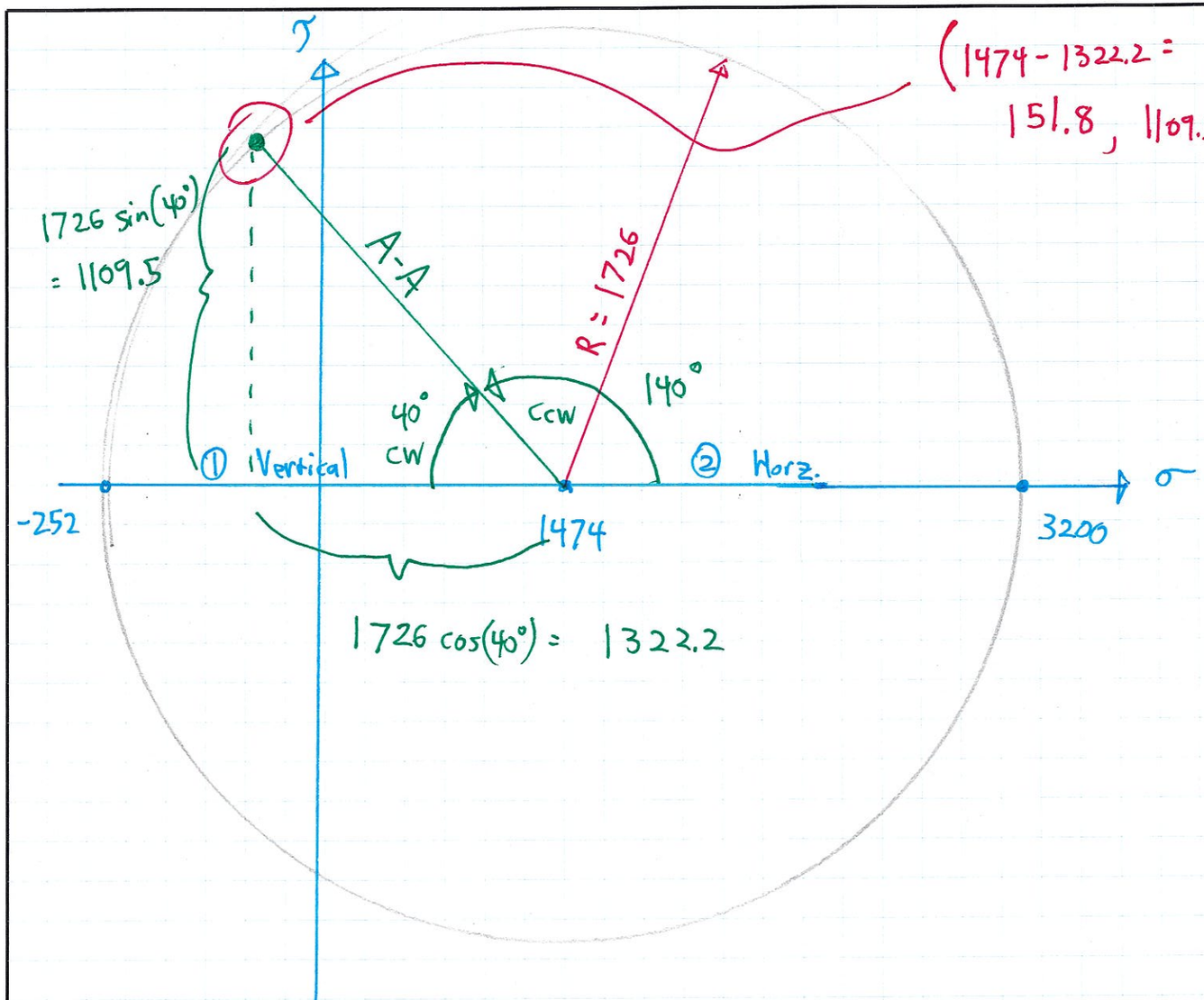
$$\sigma_p = \frac{P}{A} = \frac{12000\ \text{lb}}{\frac{\pi}{4}\left(8.5^2 - 8^2\right)\ \text{in}^2} = 1852\ \text{PSI}$$

$$\sigma_{long} = \frac{pr}{2t} = \frac{(200\ \text{PSI})(4")}{2(0.25")} = 1600\ \text{PSI}$$

$$\sigma_{hoop} = \frac{Pr}{t} = \frac{(200\ \text{PSI})(4")}{(0.25")} = 3200\ \text{PSI}$$







(1474 - 1322.2 = 151.8, 1109.5)

$\sigma_{center} = \left(\frac{\sigma_x + \sigma_y}{2}\right) = \left(\frac{-252 + 3200}{2}\right) = 1474$ PSI

$RAD = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = 1726$ PSI

PROP. ORIENTED SKETCH