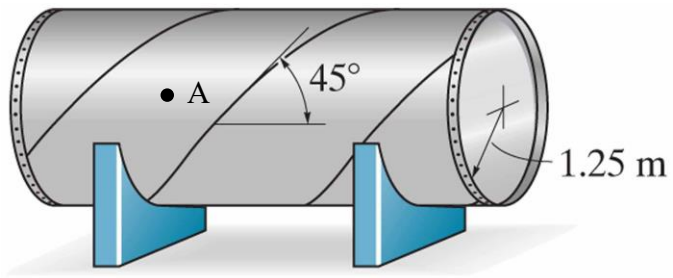
**Q1 (10 Points):** The cylindrical pressure vessel has an inner radius of 1.25 m and a wall thickness of 15 mm. It is made from steel plates that are welded along the 45 °seam. If the vessel is subjected to an internal pressure of 8 MPa,

a) Draw the stress element for point A.

b) Determine the three principles stresses and absolute maximum shear stress for point A.

c) Use Mohr's circle to determine the normal and tangential stresses along the seam.



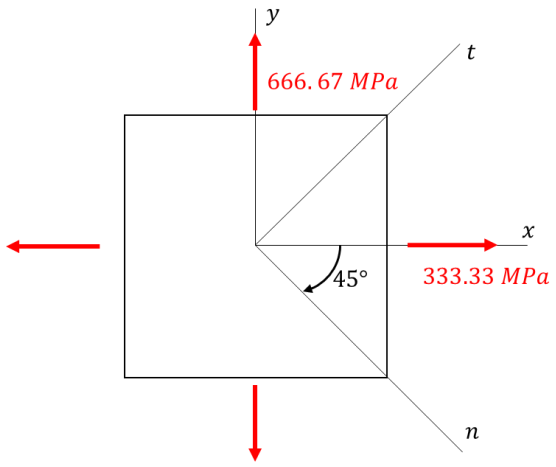

**Solution:**

a)

$$\sigma_h = \frac{pd}{2t} = \frac{8 \times 2500}{2 \times 15} = 666.67 \ \ MPa$$

$$\sigma_a = \frac{pd}{4t} = \frac{8 \times 2500}{4 \times 15} = 333.33 \ \ MPa$$

Assuming that the x axis lies along the cylinder axis, the stress element can be represented as:



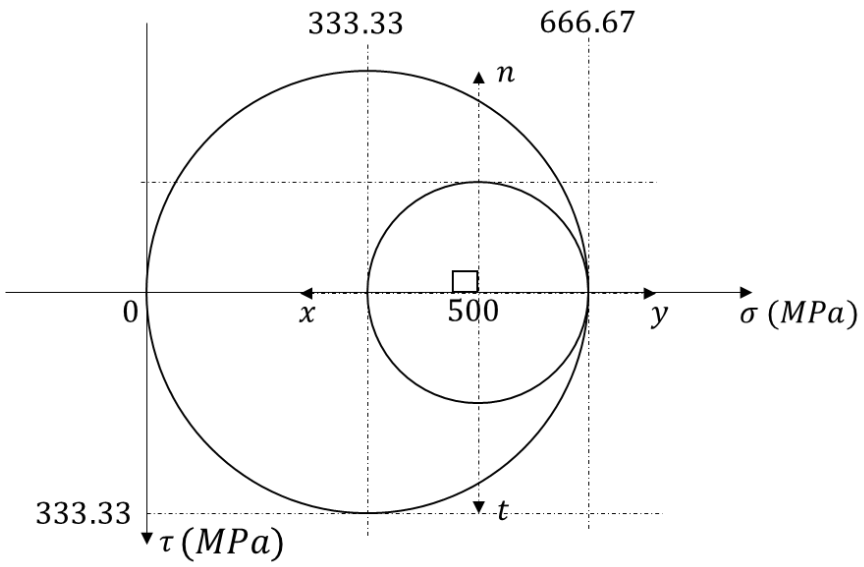

b) Since there is no shear stress $\tau_{xy}$, the element is already oriented as per principal stresses:

In plane principal stresses,

$$\sigma_1 = \sigma_h = 666.67 \ \ MPa = \sigma_{max}$$
$$\sigma_2 = \sigma_a = 333.33 \ \ MPa$$
$$\sigma_3 = 0 = \sigma_{min}$$

$$\therefore \tau_{abs,max} = \frac{\sigma_{max} - \sigma_{min}}{2} = 333.33 \ \ MPa$$

c) Note that the normal axis is oriented $45°$ clockwise w.r.t the $x$ axis. The Mohr's circle can be represented as:




From the Mohr's circle,

$$\sigma_n = \sigma_t = 500\ \ MPa$$
$$\tau_{nt} = 166.67\ \ MPa$$