ME 323: Mechanics of Materials **Homework H12.1**

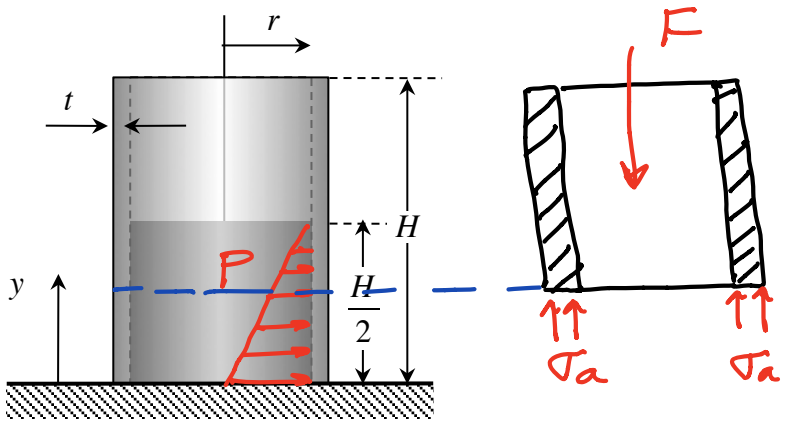
Summer 2019 SOLUTION

An open-top, thin-walled tank is half-filled with a liquid with a mass density of ρ. The tank has a wall thickness of t and an inner radius of r (with $t/r = 0.05$) and is made up of a material with a mass density of 10ρ.

a) Determine the hoop stress σ_h and axial stress σ_a in the wall of the tank, each as a function of the height y. Leave your answers in terms of, at most, H, ρ and r.

b) Make sketches of σ_h and σ_a vs. y.

c) At what height in the tank wall are the hoop and axial stress components equal to each other?



(a). • p = hydrostatic pressure due to liquid

$= \rho g\left(\frac{H}{2} - y\right)$

$\sigma_h = \frac{pr}{t} = \frac{\rho g r\left(\frac{H}{2} - y\right)}{t} = 10\rho g(H - 2y)$

$(\sigma_h)_{max} = 10\rho g H$ @ $y = 0$

• F = weight of tank above height

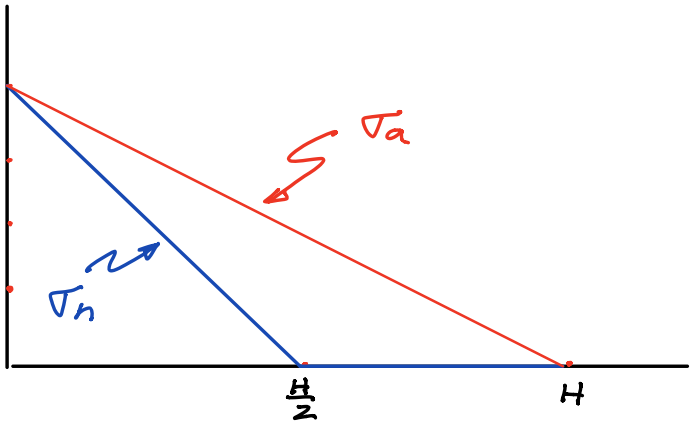
$= (10\rho g)(H - y)(2\pi r t)$

$\sigma_a = \frac{F}{A}$; A = area of tank cross-section $= 2\pi r t$

$= 10\rho g(H - y)$

$(\sigma_a)_{max} = 10\rho g H$ @ $y = 0$

(b)



(c) $\sigma_n = \sigma_a$ @ $y=0$ (bottom) & $y=H$ (top)