Chapter 8: Thick Cylinders

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Coverage: Lame's equations

1 Review

Recall from Chapter 7 that cylindrically shaped vessels can experience, hoop stress, radial stress, and axial stress. We can distinguish whether a vessel is "thick" using the ratio from earlier.

2 Stresses

The general equations, a.k.a. Lame's Equations, to calculate the stresses are as follows.

$$\text{Hoop Stress,} \quad \sigma_h = A + \frac{B}{r^2} \tag{1}$$

$$\text{Radial Stress,} \quad \sigma_h = A - \frac{B}{r^2} \tag{2}$$

Well now the question has to be asked: What's A and B? A and B are the boundary conditions we get from analyzing the cylinder's geometry. They are derived as follows.

$$A = \frac{p_i r_i^2 - p_o r_o^2}{r_o^2 - r_i^2} \tag{3}$$

$$B = \frac{(p_i - p_o) r_o^2 r_i^2}{r_o^2 - r_i^2} \tag{4}$$

p_i and p_o are internal and external pressure, r_i and r_o are internal and external radius with standalone r being the radius at the point of interest. There is another equation we should account for using means of equilibrium, i.e. axial stress.

$$\text{Axial Stress,} \quad \sigma_a = p_i \frac{r_i^2}{r_o^2 - r_i^2} \tag{5}$$

These formulas will get you most of the way there and is simply a case of finding out how to use them and just conducting the plug and chug.