Quiz # 1, 2, 3.

30 Minutes Each

Mechanics of Solids-2

Lecture # 6

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Quiz # 1: Problem

Duration : 30 min.

A cylindrical steel pressure vessel 400 mm in diameter with a wall thickness of 20 mm, is subjected to an internal pressure of 4.5 MN/m^2.

1. Analyze the tangential and longitudinal stresses in the steel.
2. To what value may the internal pressure be increased if the stress in the steel is limited to 120 MN/m^2?
3. If the internal pressure were increased until the vessel burst, sketch the type of fracture that would occur.

Quiz # 2: Problem

Duration : 30 min.

Find the thickness of the metal required for a thick cylindrical shell of internal diameter 18cm to withstand an internal pressure of 20 kN/mm^2. The maximum tensile stress in the section is not to exceed 85 kN/mm^2.

Quiz # 3: Problem

Duration : 30 min.

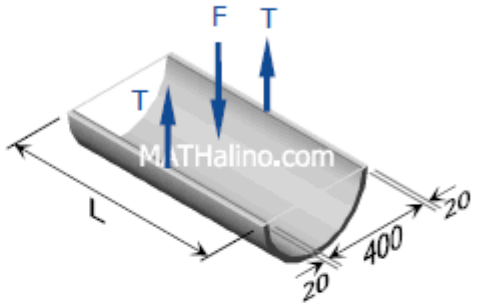
A cylindrical tank of 800mm internal diameter and 2m long is to be filled with an oil of specific weight 8 kN/m^3 under a pressure head of 410 m. If the longitudinal joint efficiency is 64% and circumferential joint efficiency is 50%, find the thickness of the tank required. Take permissible tensile stress as 120 MPa, E=200GPa and μ= 0.3 for the tank material.

Quiz # 1: Problem # 1 (SOLUTION)

Duration : 30 min.

Part (a)

Tangential stress (*longitudinal section*):



Longitudinal Section

$$F = 2T$$

$$pDL = 2(\sigma_t tL)$$

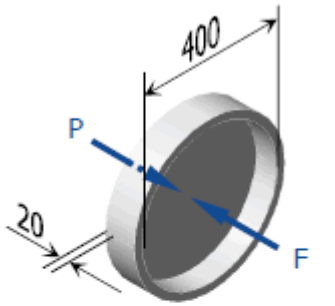
$$\sigma_t = \frac{pD}{2t} = \frac{4.5(400)}{2(20)}$$

$$\sigma_t = 45 \text{ MPa} \qquad \textit{answer}$$

Quiz # 1: Problem # 1 (SOLUTION)

Duration : 30 min.

Longitudinal Stress (*transverse section*):



Transverse Section

$$F = P$$

$$\frac{1}{4}\pi D^2 p = \sigma_l(\pi D t)$$

$$\sigma_l = \frac{pD}{4t} = \frac{4.5(400)}{4(20)}$$

$$\sigma_l = 22.5 \text{ MPa} \qquad \textit{answer}$$

Quiz # 1: Problem # 1 (SOLUTION)

Duration : 30 min.

Part (b)

From (a), $\sigma_t = \frac{pD}{2t}$ and $\sigma_l = \frac{pD}{4t}$ thus, $\sigma_t = 2\sigma_l$, this shows that tangential stress is the critical.

$$\sigma_t = \frac{pD}{2t}$$

$$120 = \frac{p(400)}{2(20)}$$

$$p = 12\,\text{MPa} \qquad \textit{answer}$$

The bursting force will cause a stress in the longitudinal section that is twice to that of the transverse section. Thus, fracture is expected as shown.

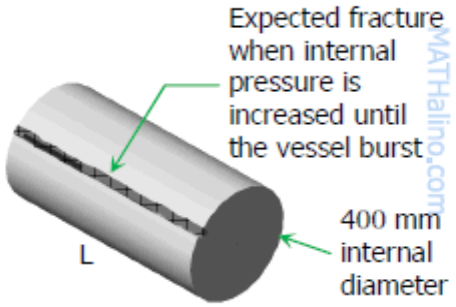


Table of Content for Lecture # 5

- Mastery lies in the simplicity of solution! (Shad)