School of Engineering & Built Environment

MEng/BEng(Hons) in:
Mechanical-Electronic Systems Engineering
Mechanical & Power Plant Systems
Electrical Power Engineering
Computer-Aided Mechanical Engineering

Module: Engineering Design & Analysis 2
(Module No. M2H721926)

Thin Cylinders and Shells under Internal Pressure: A Summary

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GLASGOW CALEDONIAN UNIVERSITY

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ENGINEERING DESIGN & ANALYSIS 2 (M2H721926)

Thin Cylinders and Shells under Internal Pressure
A thin-walled cylinder subjected to internal pressure produces three mutually perpendicular principal stresses, i.e. i) circumferential or hoop stress, ii) radial stress, iii) longitudinal or axial stress.
The ratio of wall thickness to outside diameter of the cylinder is < 1/20. When this condition holds, it is assumed that the hoop and longitudinal stresses are constant across the cylinder wall thickness, and that the value of the radial stress set-up is small in comparison and can be neglected.

Thin Cylinders under Internal Pressure, p:

Hoop or Circumferential Stress (σ_H or σ_θ): $\sigma_H = \dfrac{pd}{2t}$ (N/m^2)

Longitudinal or Axial Stress: $\sigma_L = \dfrac{pd}{4t}$ (N/m^2) ($\sigma_L = \sigma_H/2$)

Changes in Dimensions:

Change in Length: $\Delta L = \dfrac{pdL}{4tE}(1-2\nu)$ (m)

Change in Diameter: $\Delta d = \dfrac{pd^2}{4tE}(2-\nu)$ (m)

Change in Internal Volume: $\Delta V = \dfrac{pdV}{4tE}(5-4\nu)$ (m^3)

Thin Spherical Spheres under Internal Pressure, p

Hoop or Circumferential Stress (σ_H or σ_θ): $\sigma_H = \dfrac{pd}{4t}$ (N/m^2)

Changes in Dimensions:

Change in Internal Volume: $\Delta V = \dfrac{3pdV}{4tE}(1-\nu)$ (m^3)