The University of Nottingham
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Mechanics of Solids
MMME2053

Thick Cylinders
Worked Example 2

Analysis of Thick Cylinders

- The hoop and radial stresses at any point (radius, *r*) in the wall cross-section of a thick cylinder can be determined using *Lame's equations*:

$$\sigma_\theta = A + \frac{B}{r^2}$$

$$\sigma_r = A - \frac{B}{r^2}$$

- Where *A* and *B* are *Lame's constants* (constants of integration)

Analysis of Thick Cylinders

- Displacements can be obtained using:

$$\varepsilon_\theta = \frac{u}{r} = \frac{1}{E}\left(\sigma_\theta - \nu(\sigma_r + \sigma_z)\right)$$

$$\varepsilon_z = \frac{\Delta l}{l} = \frac{1}{E}\left(\sigma_z - \nu(\sigma_r + \sigma_\theta)\right) = \text{constant}$$

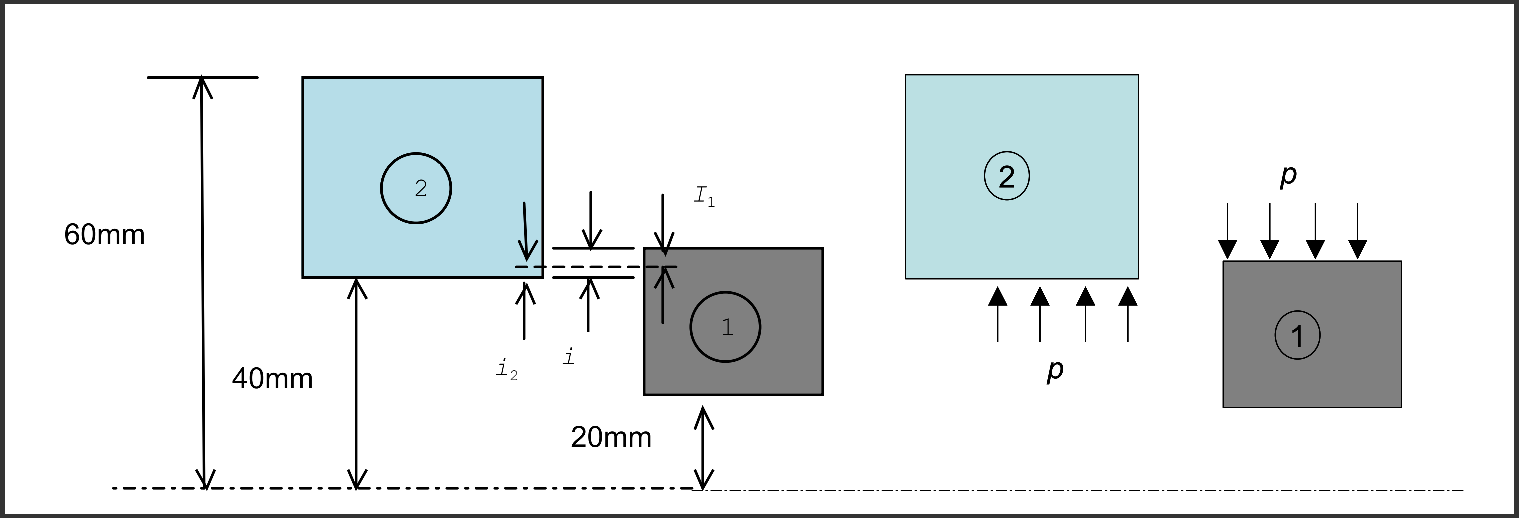
Worked Example 2

A pair of mild steel cylinders (E = 200 GPa) of equal length have the following dimensions:

- 40mm bore and 80.06mm outside diameter
- 80mm bore and 120mm outside diameter

(i.e. there is a diametral interference of 0.06mm)

The larger cylinder is heated, placed around and allowed to shrink onto the smaller cylinder. Calculate the stresses after assembly.



Worked Example 2

Assumptions

i. After assembly, the radial interference pressure, p, will be the same on both cylinders, i.e. Cylinder 1 will have an external pressure, p, and Cylinder 2 will have an internal pressure, p, as indicated in the figure.

ii. The decrease in the outside radius of Cylinder 1, i_1, plus the increase in the inside radius of Cylinder 2, i_2, will be equal to the radial interference, i.e. $i = i_1 + i_2$

iii. Axial stresses are assumed to be zero (or negligible)

Worked Example 2