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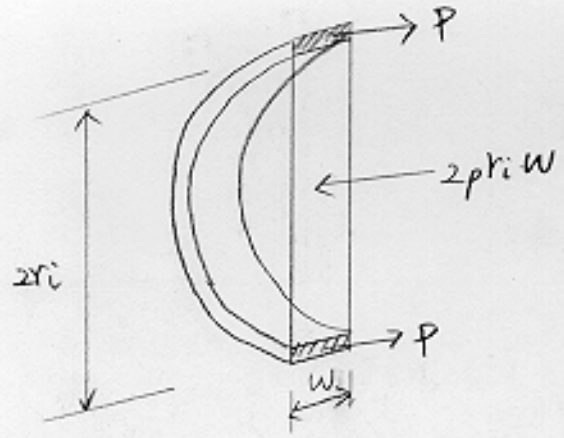

Equilibrium:

$\Sigma F_x = 0$; $2P - 2p r_i w = 0$

$$P = p r_i w$$

stress & strain:

$$\sigma_1 = \frac{P}{A} = \frac{p r_i w}{(r_o - r_i) w} = \frac{p r_i}{r_o - r_i}$$

Hooke's Law:

$$\varepsilon_1 = \frac{\sigma_1}{E} = \frac{p r_i}{E(r_o - r_i)} \quad \cdots (1)$$

and also

$$\varepsilon_1 = \frac{2\pi(\bar{r}_i) - 2\pi r_i}{2\pi r_i} = \frac{\delta r_i}{r_i} \quad (2)$$

By (1) & (2)

$$\frac{\delta r_i}{r_i} = \frac{p r_i}{E(r_o - r_i)}$$

$$\delta r_i = \frac{p r_i^2}{E(r_o - r_i)}$$