Poisson's Ratio

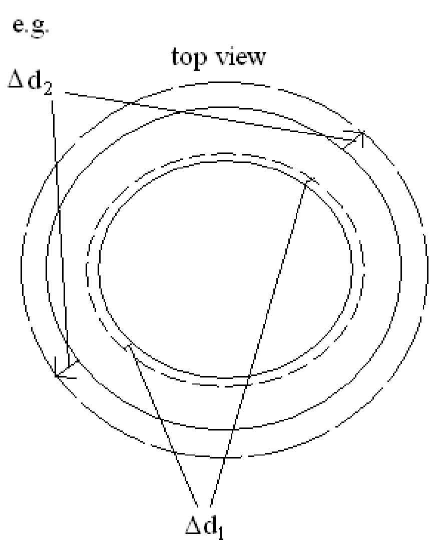
$$\text{Lateral strain} = \frac{\text{change in lateral length}}{\text{initial lateral length}} = \varepsilon' \text{ (no units)}$$

$\varepsilon' = \nu\varepsilon$ where ν = Poisson's ratio (material property) and recall the definition of ε from the beginning of this chapter

(change in lateral length)=-(initial lateral length)(ν)(ε)

note: only applies to isotropic materials (same elastic properties in axial, lateral, or any direction). Concrete and most metals are isotropic. Wood is an example of an anisotropic (non-isotropic) material (it is much tougher against the grain).

e.g.
Given: Hollow polymer pipe of length 4 ft, outside diameter d_2 = 6 in., inside diameter d_1 = 4.5 in., is compressed by 140 kip normal force. E = 3000 ksi, ν = .3
Find: Increase in wall thickness Δt.



$$\Delta d_1 = d_1 \nu \left(\frac{P}{AE}\right) = 4.5(.3)\left(\frac{140}{\pi/4\,(6^2 - 4.5^2)(3000)}\right) = .00509in$$

$$\Delta d_2 = d_2 \nu \left(\frac{P}{AE}\right) = 6(.3)\left(\frac{140}{\pi/4\,(6^2 - 4.5^2)(3000)}\right) = .00679in$$

$$\Delta t = \Delta r_2 - \Delta r_1 = \frac{\Delta d_2 - \Delta d_1}{2} = \boldsymbol{.00085in}$$

note: under compression, outer diameter, inner diameter, and thickness all increase.

note: follow the same process for the lateral elongation (or shortening) for *each* dimension of a rectangular bar.