Answer on Question #52016-Engineering-Other

A piece of material (v = 0.3 and E = 5GPa) shaped like a cigarette packet (1cm x 3cm x 5cm) is subjected to a pressure of $\sigma = 200 \frac{MN}{m^2}$. Calculate the new volume?

Solution

Let $\sigma = \sigma_x = \sigma_y = \sigma_z$, because we don't know the direction of the pressure. Then

$$\varepsilon = \varepsilon_x = \varepsilon_y = \varepsilon_z = \frac{1}{E}\big(\sigma(1+v) - v(\sigma + \sigma + \sigma)\big) = \frac{\sigma(1-2v)}{E} = \frac{200\frac{MN}{m^2}(1 - 2 \cdot 0.3)}{5GPa} = 0.08.$$

Thus, the new volume is

$$V' = (1+\varepsilon)^3 V = (1+0.08)^3 \cdot 1 \cdot 3 \cdot 5 \; cm^3 = 18.9 \; cm^3.$$

Answer: $18.9 \; cm^3$.