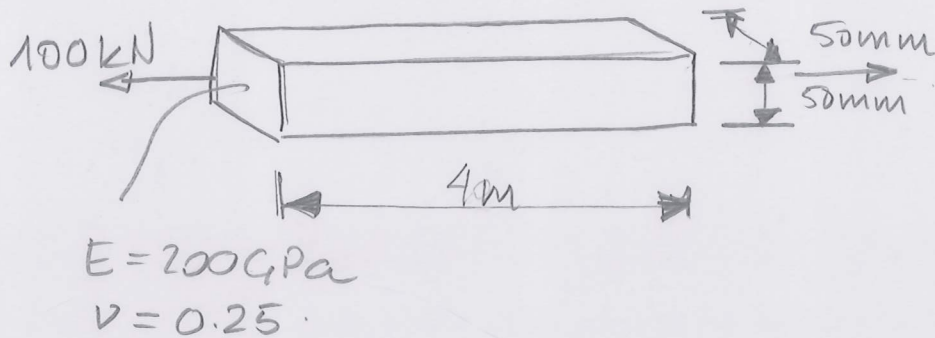


A.3.4

GIVET:



SÖKT: Stängens volymökning.

LÖSNING:

$$L = 4000 \text{ mm}$$

$$a = 50 \text{ mm}$$

$$P = 100.000 \text{ N}$$

$$E = 200.000 \text{ MPa}$$

$$\nu = 0.25$$

1.- Rakna ut init. volym.

$$V_0 = L \cdot a^2$$

2.- Rakna töjningar vid P. m.h.a Hookes lag.

$$\epsilon_x = \frac{\sigma_x}{E} = \frac{P}{Ea^2} \rightarrow \delta_x = \epsilon_x \cdot L = \frac{PL}{Ea^2}$$

$$\epsilon_y = -\nu \frac{\sigma_x}{E} = -\frac{\nu P}{Ea^2} \rightarrow \delta_y = \epsilon_y \cdot a = -\frac{\nu P}{Ea}$$

$$\epsilon_z = -\nu \frac{\sigma_x}{E} = -\frac{\nu P}{Ea^2} \rightarrow \delta_z = \epsilon_z \cdot a = -\frac{\nu P}{Ea}$$

$$V_p = (L + \delta_x)(a + \delta_y)(a + \delta_z)$$

⇒ Töjning ar blev: $-\frac{\nu P}{Ea} \left(1 - \frac{\nu P}{Ea}\right) =$

$$\epsilon_x = \frac{P}{Ea^2}$$

$$\epsilon_y = \left(\frac{\nu P}{Ea^2} \frac{P}{Ea^2} \right) a^2 \left(1 - \frac{\nu P}{Ea^2} \right)^2$$

$$\epsilon_z = \frac{-\nu P}{Ea^2}$$

3. - Volymökning

$$\Delta V = V_P - V_0 = V_0^2 (1 + \epsilon_z)(1 + \epsilon_x)(1 + \epsilon_y) - V_0 =$$

$$\Delta V = V_0 (1 + \epsilon_x + \epsilon_y + \epsilon_z + \underbrace{\epsilon_x \epsilon_y + \epsilon_x \epsilon_z + \epsilon_y \epsilon_z + \epsilon_x \epsilon_y \epsilon_z}_{\ll (\epsilon_x + \epsilon_y + \epsilon_z)}) - V_0$$

små deformationer $\ll (\epsilon_x + \epsilon_y + \epsilon_z)$

$$\Delta V \approx V_0 (1 + \epsilon_x + \epsilon_y + \epsilon_z) - V_0$$

$$\boxed{\Delta V = (\epsilon_x + \epsilon_y + \epsilon_z) V_0}$$

$$\Delta V = \frac{P}{Ea^2} (1 - 2\nu) (La^2) = (1 - 2\nu) \frac{PL}{E}$$

$$\left\{ \begin{array}{l} E = 200.000 \text{ MPa} \\ \nu = 0.25 \\ P = 100.000 \text{ N} \\ L = 4000 \text{ mm} \end{array} \right\} \Rightarrow \underline{\underline{\Delta V = 1000 \text{ mm}^3}}$$