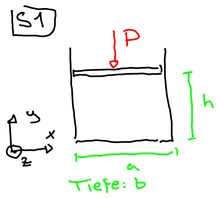
S1



- starre Wände: $\varepsilon_z = \varepsilon_x = 0$
- Symmetrie: $\sigma_z = \sigma_x = \sigma^*$
- ΔT hat keinen Einfluss auf σ_y, da der Quader sich in diese Richtung ausdehnen kann

a) $\varepsilon_x = \frac{1}{E}\left[\sigma_x - \nu\sigma_y - \nu\sigma_z\right] + \alpha\Delta T$ ($\varepsilon_x = 0$, $\sigma_x = \sigma^*$, $\sigma_z = \sigma^*$)

$$\sigma_y = \frac{F}{A} = -\frac{P}{ab}$$

$$\frac{1}{E}\left[\sigma^* + \nu\frac{P}{ab} - \nu\sigma^*\right] + \alpha\Delta T = 0$$

$$\sigma^* = -\frac{E\alpha\Delta T + \nu\frac{P}{ab}}{1-\nu} = \sigma_z = \sigma_x$$

$$\gamma_{xy} = \gamma_{yz} = \gamma_{zx} = 0$$

- $\varepsilon_{xy} = \varepsilon_{yz} = \varepsilon_{zx} = 0$
- keine Reibung

b) $\varepsilon_y = \frac{\partial u_y}{\partial y} \rightarrow u_y = \int \varepsilon_y \, dy$ (u_y: Verschiebung in y-Richtung)

$$\varepsilon_y = \frac{1}{E}\left[-\nu\sigma^* + \sigma_y - \nu\sigma^*\right] + \alpha\Delta T$$

$$= \frac{1}{E}\left[-\nu\sigma^* - \frac{P}{ab} - \nu\sigma^*\right] + \alpha\Delta T$$

$$= \frac{1}{E}\left[-2\nu\sigma^* - \frac{P}{ab}\right] + \alpha\Delta T$$

$$= \frac{1}{E}\left[2\nu\frac{E\alpha\Delta T + \nu\frac{P}{ab}}{1-\nu} - \frac{P}{ab}\right] + \alpha\Delta T$$

$$= -\frac{P}{abE}\left(1 - \frac{2\nu^2}{1-\nu}\right) + (\alpha\Delta T)\left(1 + \frac{2\nu}{1-\nu}\right)$$

$$u_y = \left[\quad\right] y + C$$

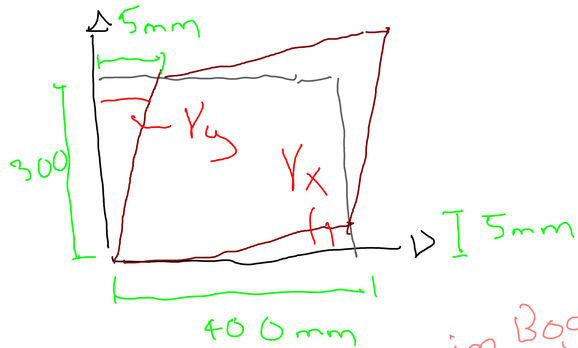
RB: $u_y(y=0) = 0 \rightarrow C = 0$

$$u_y(y=h) = \left[\quad\right] h$$

S2 $\quad \gamma_{xy} = G \cdot \tau_{xy}$

$$\rightarrow G = \frac{\tau_{xy}}{\gamma_{xy}} = \frac{7{,}44\,\text{MPa}}{0{,}0292} = 25{,}476\,\text{MPa} = 25{,}5\,\text{GPa}$$

$$\gamma_{xy} = \gamma_x + \gamma_y = \frac{\partial u_y}{\partial x} + \frac{\partial u_x}{\partial y} = \frac{5}{300} + \frac{5}{400} = 0.0292$$



$$\gamma_y = \arctan\left(\frac{5}{300}\right) \approx \frac{5}{300}$$

(im Bogenmass)

$\hat{=} 0{,}16655 \qquad \hat{=} 0{,}16667$

$$\gamma_x = \arctan\left(\frac{5}{400}\right) \approx \frac{5}{400}$$

$$\arctan(x) = x - \frac{x^3}{3} + \frac{x^5}{5} - \dots$$