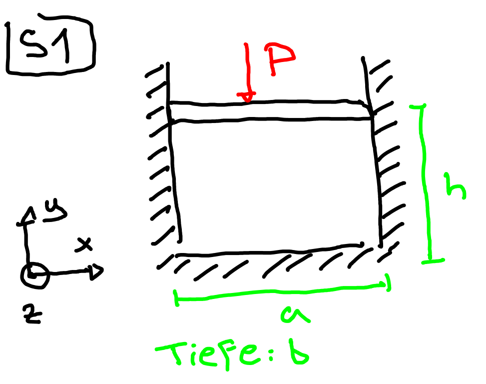
S1



→ Starren Wänden: $\varepsilon_z = \varepsilon_x = 0$

→ homogene Temperaturänderung
↳ Wärmedehnung in alle Richtungen ist gleich: $\sigma_z = \sigma_x = \sigma^*$

→ ΔT hat keinen Einfluss auf σ_y, da der Quader sich in diese Richtung ausdehnen kann

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

$$\varepsilon_x = \frac{1}{E}\left[\sigma_x - \nu\sigma_y - \nu\sigma_z\right] + \alpha\Delta T = 0$$

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

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

$\boxed{\tau_{xy} = \tau_{yz} = \tau_{zx} = 0}$

↳ $\varepsilon_{xy} = \varepsilon_{yz} = \varepsilon_{zx} = 0$

↳ keine Reibung

Verschiebung in y-Richtung

b) $\varepsilon_{yy} = \frac{\partial u_y}{\partial y} \rightarrow u_y = \int \varepsilon_y \, dy$

$$\varepsilon_{yy} = \frac{1}{E}\left[-\nu\sigma_x + \sigma_y - \nu\sigma_z\right] + \alpha\Delta T$$

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

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

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

$$u_y = \int \varepsilon_y \, dy$$

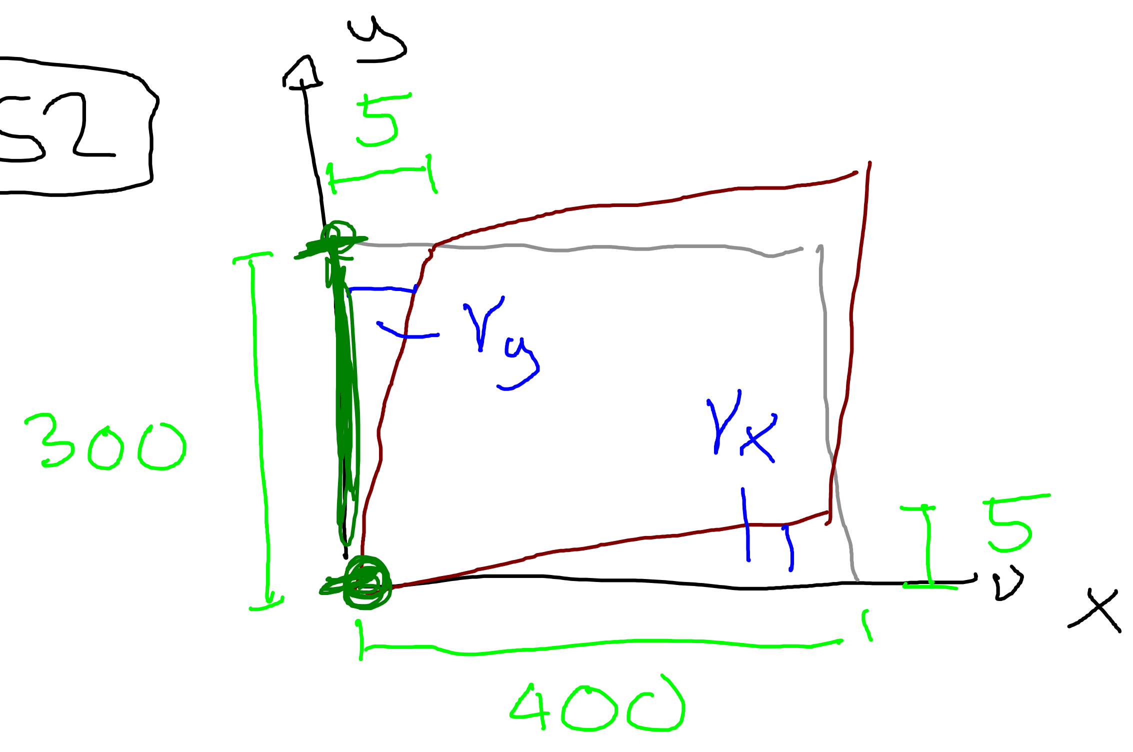
$$= \int \underbrace{-\frac{P}{abE}\left(1 - \frac{2\nu^2}{1-\nu}\right) + (\alpha\Delta T)\left(1 + \frac{2\nu}{1-\nu}\right)}\, dy$$

$$= \left[\qquad \text{"} \qquad\right] y + C$$

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

$$u_y(y=h) = \left[\qquad \text{"} \qquad\right] h$$

S2



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

Aluminium

$$G = \frac{\tau_{xy}}{\gamma_{xy}} = \frac{744\,\text{MPa}}{0.0292} = 25'479\,\text{MPa} \quad \boxed{\hat{=}\ 25'5\,\text{Ga}}$$

$$\gamma_{xy} = \gamma_x + \gamma_y = \frac{5}{300} + \frac{5}{400} = 0.0292$$

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

$\approx 0{,}16665$ $\qquad$ $\approx 0{,}166667$

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

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

$$\gamma = \frac{\partial u}{\partial y} = \frac{5}{300}$$