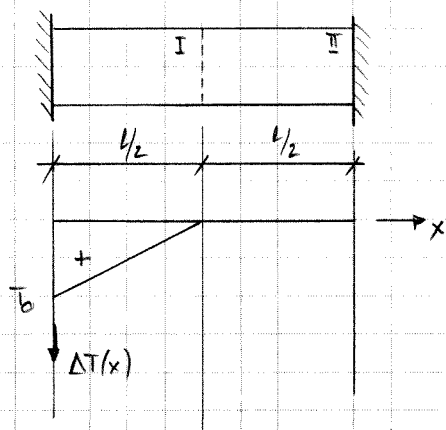


$EA = \text{konst.}, q = 0$



Gleichgewicht:

$$q = -\frac{dN}{dx} = 0 \rightarrow N(x) = N_0 = \text{konst.}$$

kin. Relation:

$$\epsilon = \frac{du}{dx}$$

Stoffgesetz:

$$N = EA \cdot \epsilon$$

→ Differentialgleichung: $N(x) = EA \cdot \left(\frac{du}{dx} - \alpha_T \Delta T(x) \right)$

• Bereich I:

$$N_I(x) = EA \cdot \left(\frac{du_I}{dx} - \alpha_T \cdot T_0 \cdot \left(1 - \frac{2x}{l} \right) \right) = N_0$$

$$N_0 \cdot x = EA \cdot \left(u_I - \alpha_T T_0 x + \alpha_T T_0 \frac{x^2}{l} + C_1 \right)$$

$$= EA \cdot \left(u_I + \alpha_T T_0 x \left(\frac{x}{l} - 1 \right) + C_1 \right)$$

$$\rightarrow u_I = \frac{N_0}{EA} x + \alpha_T T_0 x \left(1 - \frac{x}{l} \right) - C_1$$

• Bereich II:

$$N_{II}(x) = N_0$$

$$= EA \cdot \frac{du_{II}}{dx}$$

$$N_0 \cdot x = EA \cdot u_{II} + C_2$$

$$\rightarrow u_{II} = \frac{N_0}{EA} x - C_2$$

RB / UB:

$$u_I(x=0) = 0 \rightarrow C_1 = 0$$

$$u_{II}(x=l) = 0 \rightarrow C_2 = \frac{N_0 l}{EA} = -\frac{\alpha_T T_0 l}{4}$$

$$u_I(x=l/2) = u_{II}(x=l/2)$$

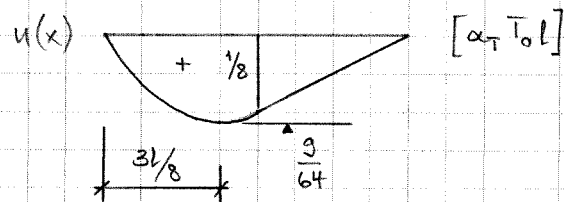
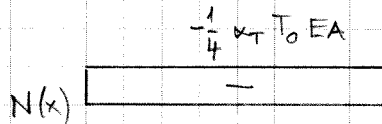
$$\rightarrow \frac{N_0 l}{2EA} + \frac{\alpha_T T_0 l}{4} = -\frac{N_0 l}{2EA} \rightarrow \underline{\underline{N_0 = -\frac{1}{4} \alpha_T T_0 \cdot EA}}$$

Lösung:

$$u(x) = \begin{cases} \alpha_T T_0 x \left(\frac{3}{4} - \frac{x}{l} \right) & 0 \leq x \leq \frac{l}{2} \quad \text{parabolisch} \\ \frac{1}{4} \alpha_T T_0 (l-x) & \frac{l}{2} < x \leq l \quad \text{linear} \end{cases}$$

Maximum: $\frac{du}{dx} = \alpha_T T_0 \left(\frac{3}{4} - \frac{2x}{l} \right) \stackrel{!}{=} 0 \rightarrow \underline{x_{max} = \frac{3l}{8}}$

$u_{max} = u_T \left(x = \frac{3l}{8} \right) = \underline{\underline{\frac{9}{64} \alpha_T T_0 l}}$



Knicken:

$$T_0 = 100^\circ C$$

$$\alpha_T = 10^{-5} / ^\circ C$$

$$E = 210 \text{ GPa}$$

$$A = 14900 \text{ mm}^2$$

$$i_z = 75.8 \text{ mm}$$

$$N_0 = -\frac{1}{4} \alpha_T T_0 EA = -782.3 \text{ kN}$$

$$N_{k,pd} = \chi_k \cdot \frac{f_{td} A}{\gamma_m} = \chi_k \cdot \frac{235 \cdot 14900}{1.05} = \chi_k \cdot 3335 \text{ kN} \stackrel{!}{=} 782 \text{ kN} \quad (\text{SIA 263, 7.5})$$

$$\chi_k = \frac{782}{3335} = 0.235 \quad \text{Kurve c)} \quad \bar{\lambda}_k = \frac{\lambda_k}{\lambda_E} = 1.8$$

$$\lambda_k = \bar{\lambda}_k \cdot \lambda_E = 1.8 \cdot 33.9 = 169 = \frac{l_k}{i_z}$$

$$l_k = \lambda_k \cdot i_z = 169 \cdot 75.8 = 12.81 \text{ m} = 0.5 \cdot l$$

$$\underline{\underline{l_{max} = 2 \cdot l_k = 25.6 \text{ m}}}$$

