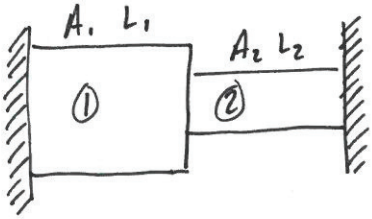
2.1.36 Givet

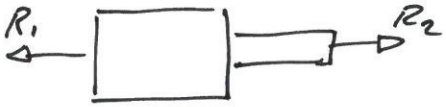


× Lin. termoel. mtrl
× $\sigma(T=0°C) = 0$ Pa

Sökt σ_1 och σ_2 pga ΔT

Lösning

1. Frilägg

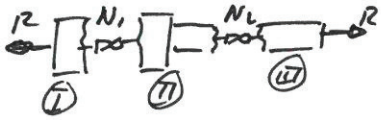


2. Jmv

$\rightarrow$: $-R_1 + R_2 = 0$

$\Rightarrow R_1 = R_2 = R$

3. Snitta



4. Jmv

$\rightarrow$: $-R + N_1 = 0$

$\Rightarrow N_1 = R$

$\rightarrow$: $-N_1 + N_2 = 0$

$\Rightarrow N_1 = N_2 = N$

5. Normalspänning

$$\left[\sigma = \frac{N}{A}\right] \Rightarrow \sigma_1 = \frac{N_1}{A_1} = \frac{N}{A_1} \quad \& \quad \sigma_2 = \frac{N_2}{A_2} = \frac{N}{A_2}$$

6. Konstitutivt samband

Linjärt termoelastiskt; se FS. 3.1 / 3.3

$$\left[\varepsilon = \underbrace{\frac{\sigma_{mek}}{E}}_{\varepsilon_{mek}} + \underbrace{\alpha \Delta T}_{\varepsilon_{term}}\right]$$

$$\varepsilon_{mek} = \frac{N}{EA}$$

$$\Rightarrow \delta = \varepsilon \cdot L = (\varepsilon_{mek} + \varepsilon_{term}) \cdot L$$

$$\delta = \left(\frac{N}{EA} + \alpha \Delta T\right) \cdot L$$

dvs;

$$\delta_1 = \left(\frac{N}{EA_1} + \alpha \Delta T\right) \cdot L_1$$

$$\delta_2 = \left(\frac{N}{EA_2} + \alpha \Delta T\right) \cdot L_2$$

7. Kompabilitet

Fasta väggar; $\delta_{tot} = 0 = \delta_1 + \delta_2$

$$\Rightarrow \left(\frac{N}{EA_1} + \alpha \Delta T\right) \cdot L_1 + \left(\frac{N}{EA_2} + \alpha \Delta T\right) \cdot L_2 = 0$$

$$\frac{N}{E}\left(\frac{L_1}{A_1} + \frac{L_2}{A_2}\right) + \alpha \Delta T (L_1 + L_2) = 0$$

$$N = \frac{-E \alpha \Delta T (L_1 + L_2)}{\frac{L_1}{A_1} + \frac{L_2}{A_2}} = \frac{-E A_1 A_2 \alpha \Delta T (L_1 + L_2)}{A_2 L_1 + A_1 L_2}$$

$$\Rightarrow \sigma_1 = \frac{-E A_2 \alpha \Delta T (L_1 + L_2)}{A_2 L_1 + A_1 L_2} \quad \text{och} \quad \sigma_2 = \frac{-E A_1 \alpha \Delta T (L_1 + L_2)}{A_2 L_1 + A_1 L_2}$$

Dimkontr: $\frac{\frac{N}{m^2} \cdot m^2 \cdot \frac{1}{K} \cdot K\,([m])}{m^2 \cdot m} = \frac{N}{m^2} = Pa$ ok!