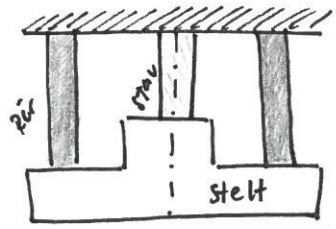
2.2.20 Givet



× Stav: L, A, E, α

× Rör: $2L, 2A, E, \alpha$

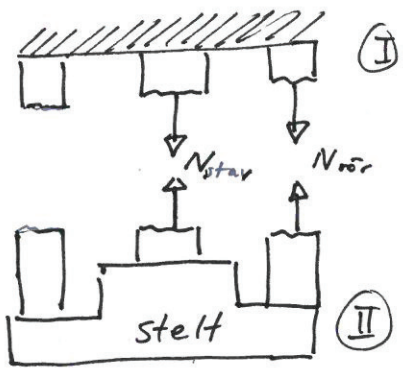
× Lin. termoel. mtrl

Sökt $\sigma_{rör}$ och σ_{stav} pga ΔT

Lösning

(1. Frilägg, 2. Jmv ... ger inget)

3. Snitta



4. Jmv

$\uparrow_{II}$: $N_{stav} + N_{rör} = 0$

$\Rightarrow$ $\underline{N_{stav} = -N_{rör}}$

5. Normalspänning

$\sigma_{rör} = \frac{N_{rör}}{2A}$ $\Rightarrow$ $\underline{\sigma_{stav} = -2\sigma_{rör}}$

$\sigma_{stav} = \frac{N_{stav}}{A}$

6. Konstitutivt samband

$\left[\varepsilon = \frac{\sigma_{mek}}{E} + \alpha\Delta T\right]$ och $\left[\delta = \varepsilon L\right]$ (om $\varepsilon \equiv$ konstant) $\Rightarrow$ $\left[\delta = \left(\frac{\sigma_{mek}}{E} + \alpha\Delta T\right)\cdot L\right]$

dvs $\delta_{rör} = \left(\frac{\sigma_{rör}}{E} + \alpha\cdot\Delta T\right)\cdot 2L$

$\delta_{stav} = \left(\frac{\sigma_{stav}}{E} + \alpha\Delta T\right)\cdot L$

7. Kompabilitet

$\left[\delta_{rör} = \delta_{stav}\right]$

$\Rightarrow$ $\left(\frac{\sigma_{rör}}{E} + \alpha\Delta T\right)\cdot 2 = \left(\frac{\sigma_{stav}}{E} + \alpha\Delta T\right)\cdot 1$

$\frac{2\sigma_{rör}}{E} + 2\alpha\Delta T = \frac{\sigma_{stav}}{E} + \alpha\Delta T$ $\Leftrightarrow$ ($\sigma_{stav} = -2\sigma_{rör}$) $\frac{2\sigma_{rör}}{E} - \frac{-2\sigma_{rör}}{E} = -\alpha\Delta T$

$\Rightarrow$ $\sigma_{rör} = \frac{-E\alpha\Delta T}{4}$ Dim kontr $\frac{N}{m^2}\cdot\frac{1}{K}\cdot K = \frac{N}{m^2} = Pa$ OK!

och $\sigma_{stav} = \frac{E\alpha\Delta T}{2}$