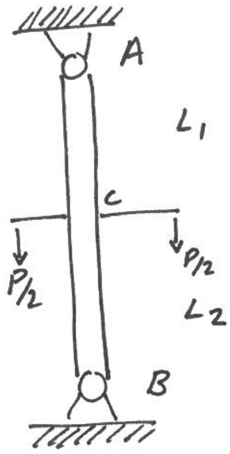
2.1.32 Stag med förspänning σ_0

Givet

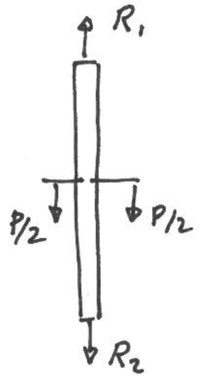


- Stag A-B förspänt m. σ_0
- Tvärsnittsarea A
- Lin. el. mtrl (E)

Sökt Värde på P för spänningslöst i stag B-C

Lösning

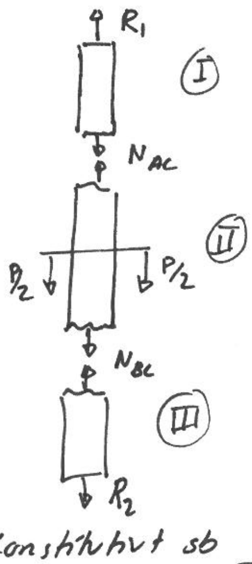
1. Frilägg



2. Jmv

$\uparrow: \; R_1 - \frac{P}{2} - \frac{P}{2} - R_2 = 0 \implies R_1 = R_2 + P$

3. Snitta



4. Jmv

$\uparrow_{I}: \; R_1 - N_{AC} = 0 \implies R_1 = N_{AC}$

$\uparrow_{II}: \; N_{AC} - \frac{P}{2} - \frac{P}{2} - N_{BC} = 0 \implies N_{AC} = N_{BC} + P$

$\uparrow_{III}: \; N_{BC} - R_2 = 0 \implies N_{BC} = R_2$

5. Normalspänning

$\left[\sigma(x) = \frac{N(x)}{A(x)}\right] \longrightarrow \sigma_{AC} = \frac{N_{AC}}{A} \qquad \sigma_{BC} = \frac{N_{BC}}{A}$

6. Konstitutivt sb

$[\sigma = E\varepsilon] \to \varepsilon = \frac{\sigma}{E}$

$\varepsilon_{AC} = \frac{N_{AC}}{EA}$ ...

$\varepsilon_{BC} = \frac{N_{BC}}{EA}$

7. Kompabilitet / Deformation

$\delta_{tot} = \delta_{AC} + \delta_{BC} = 0$ ty inspänt

$\left[\delta = \frac{FL}{EA}\right] \implies \frac{N_{AC} \cdot L_1}{EA} + \frac{N_{BC} \cdot L_2}{EA} = 0$

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forts 2

$$\Longleftrightarrow \quad \frac{(R_1)\cdot L_1}{EA} + \frac{(R_1 - P)\, L_2}{EA} = 0$$

$$R_1 L_1 + R_1 L_2 - P L_2 = 0$$

$$R_1 = \frac{P L_2}{L_1 + L_2}$$

dvs $\sigma_{BC} = \frac{N_{BC}}{A} = \frac{R_2}{A} = \frac{(R_1 - P)}{A} = \frac{P\left(\frac{L_2}{L_1+L_2} - 1\right)}{A}$

$$= \frac{P}{A}\left(\frac{L_2 - (L_1 + L_2)}{L_1 + L_2}\right)$$

$$\therefore \quad \underline{\sigma_{BC} = -\frac{P}{A} \cdot \frac{L_1}{L_1 + L_2}}$$

– Obs. vi har alltså en förspänning i stång A-B
dvs vi behöver superponera spänningsläget:

$$\Longrightarrow \sigma_{BC} = \sigma_0 - \frac{P}{A} \cdot \frac{L_1}{L_1 + L_2}$$

– Då det efterfrågas spänningsfritt ($\sigma_{BC} = 0$) fås P:

$$0 = \sigma_0 - \frac{P}{A} \cdot \frac{L_1}{L_1 + L_2}$$

$$\Longrightarrow \underline{\underline{P = \frac{A\,\sigma_0 (L_1 + L_2)}{L_1} = \sigma_0 A \left(1 + \frac{L_2}{L_1}\right)}}$$

$\frac{N}{m^2} \cdot m^2 \left([-] + \frac{m}{m}\right)$ ok!