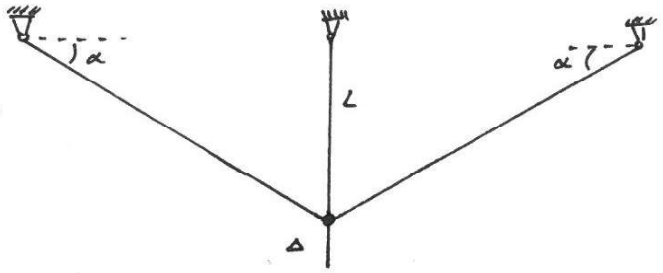
2.2.15 Fachverk

× Tvärsnittsarea $A$
× Lin. el. mtrl $E$
× $\Delta \ll L$



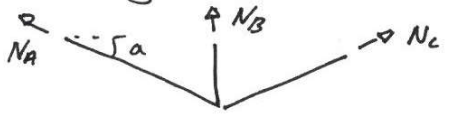

Givet

Sökt Stångkrafter om knutpunkt förskjuts $\Delta$ nedåt

Lösning

(1. Frilägg, 2. Jmv)
p.s.s som 2.1.14

3. Snittning




4. Jmv

↑: $N_B + \sin\alpha \cdot N_A + \sin\alpha \cdot N_C = 0$

→: $-N_A \cdot \cos\alpha + N_C \cdot \cos\alpha = 0$

$\Rightarrow \underline{N_A = N_C}$

5. Normalspänning

$[\sigma = \frac{N}{A}] \Rightarrow \sigma_A = \frac{N_A}{A} \quad \sigma_B = \frac{N_B}{A} \quad \sigma_C = \frac{N_C}{A}$

obs. $L_A = L_C = \frac{L}{\sin\alpha}$

6. Konstitutivt samband

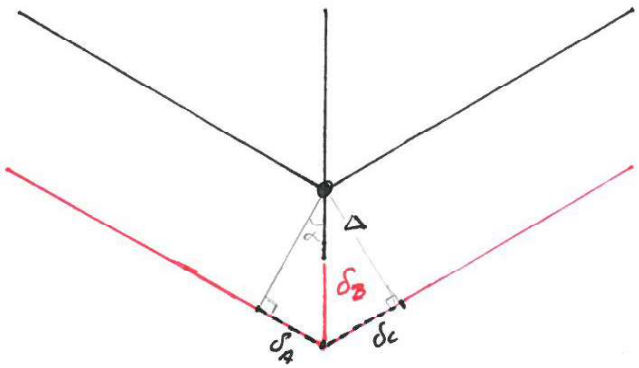
Lin. el. mtrl: $\sigma = E\varepsilon$ → tsm m. $\varepsilon = \frac{\delta}{L} \Rightarrow [\delta = \frac{N \cdot L}{E \cdot A}] \Rightarrow$

$$\begin{cases} \delta_A = \dfrac{N_A \cdot \frac{L}{\sin\alpha}}{E \cdot A} \\ \delta_B = \dfrac{N_B \cdot L}{E \cdot A} \\ \delta_C = \dfrac{N_C \cdot \frac{L}{\sin\alpha}}{E \cdot A} \end{cases}$$

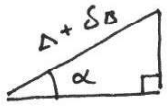
obs. $L_B \approx L$ ty $\Delta \ll L$

7. Kompabilitet

Deformationssamband:




$\Rightarrow$




$\delta_A = \delta_C = \sin\alpha \cdot (\Delta + \delta_B)$

...som tillsammans med $\delta_A$, $\delta_B$ och $\delta_C$ från 6. ger:

$$\frac{N_A \cdot \frac{L}{\sin\alpha}}{EA} = \sin\alpha \left(\Delta + \frac{N_B \cdot L}{E \cdot A}\right)$$

$$\Rightarrow N_A = \frac{\sin^2\alpha \cdot \Delta \cdot EA}{L} + \sin^2\alpha \cdot N_B = N_C$$

Dim mtrl $\frac{m \cdot \frac{N}{m^2} \cdot m^2}{m} = N$ ok!

3 obekanta
3 ekvationer

... isatt jmv-sb fås

$$N_B + \sin\alpha \cdot \left(\frac{\sin^2\alpha \cdot \Delta \cdot EA}{L} + \sin^2\alpha \cdot N_B\right) + \sin\alpha \cdot \left(\frac{\sin^2\alpha \cdot \Delta \cdot EA}{L} + \sin^2\alpha \cdot N_B\right) = 0$$

$$\Leftrightarrow \begin{cases} N_B = \dfrac{-2 \cdot \sin^3\alpha \cdot \Delta \cdot EA}{L(1 + 2\sin^3\alpha)} \\ N_A = N_C = \dfrac{\sin^2\alpha \cdot \Delta \cdot EA}{L(1 + 2\sin^3\alpha)} \end{cases}$$

Dim mtrl $\frac{[m] \cdot [\frac{N}{m^2}] \cdot (m^2)}{[m][-]} = [N]$ ok

$\frac{[m] \cdot [\frac{N}{m^2}] \cdot [m^2]}{[m]} = [N]$ ok