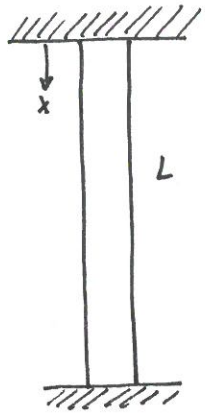
2.1.29 Vertikal pelare



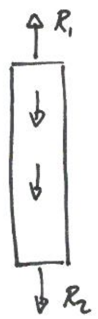
× Tvärsnittsarea A

× Egentyngd

Sökt $\sigma(x)$

Lösning

1. Frilägg

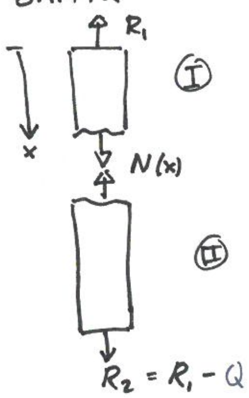


2. Jmv

$$\uparrow: R_1 - \underbrace{\rho g A L}_{Q} - R_2 = 0 \quad \Rightarrow R_2 = R_1 - Q = R_1 - \rho g A L$$

$$R_1 = R_2 + Q = R_2 + \rho g A L$$

3. Snitta



4. Jmv

$$\uparrow_I: \quad R_1 - Q_I - N(x) = 0 \qquad \text{där } Q_I = Q \cdot \frac{x}{L} = \rho g A x$$

dvs $N(x) = R_1 - \rho g A x$

5. Normalspänning

$$\left[\sigma(x) = \frac{N(x)}{A(x)}\right] \Rightarrow \sigma(x) = \frac{R_1 - \rho g A x}{A} = \frac{R_1}{A} - \rho g x$$

∴ statiskt obestämt

6. Konstitutivt samband

$$[\sigma = E\varepsilon] \longrightarrow \varepsilon(x) = \frac{\sigma(x)}{E}$$

7. Kompabilitet

$\delta = 0$ ty inspänd

$$\Rightarrow \delta(x) = \int_0^L \varepsilon(x)\,dx = \int_0^L \left(\frac{R_1}{EA} - \frac{\rho g x}{E}\right) dx = 0$$

$$\Rightarrow \frac{R_1 L}{EA} - \frac{\rho g L^2}{2E} = 0 \Rightarrow \frac{R_1}{A} = \frac{\rho g L}{2} \Rightarrow \underline{R_1 = \frac{\rho g A L}{2}}$$

$$\therefore \underline{\sigma(x) = \frac{\rho g L}{2} - \rho g x = \rho g\left(\frac{L}{2} - x\right)}$$

$$\frac{kg}{m^3} \cdot \frac{m}{s^2} \cdot m \Leftrightarrow \frac{N \cdot m}{m^3} = \frac{N}{m^2} \quad \text{ok!}$$