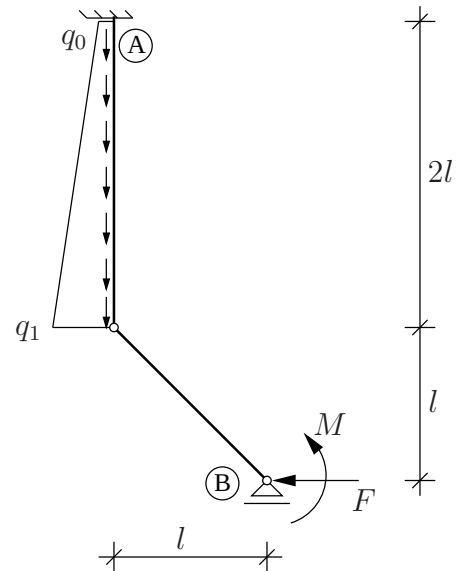
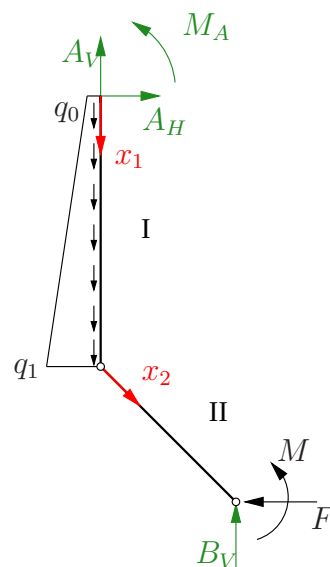


Aufgabe 3

Berechnen Sie für das nebenstehende System die Schnittgrößenverläufe. Verwenden Sie hierzu die Schnittgrößendifferentialgleichungen. Stellen Sie die Verläufe graphisch dar.

Geg.: $F = 3 \text{ kN}$, $M = 2 \text{ kNm}$, $q_0 = 1 \text{ kN/m}$,
 $q_1 = 3 \text{ kN/m}$, $l = 2 \text{ m}$.

**Lösung****1. Freischnitt**

Geradengleichung

$$y = \frac{q_1 - q_0}{4}x + q_0$$

2. Auflagerkräfte

$$\begin{aligned} \Sigma H : A_H &= F & \Rightarrow A_H &= 3 \text{ kN} \\ \Sigma M_{P_0} : B_V \cdot 2 + M - F \cdot 2 &= 0 & \Rightarrow B_V &= 2 \text{ kN} \\ 2B_V &= 2F - M \\ \Sigma V : A_V + B_V - q_0 \cdot 4 - \frac{1}{2}(q_1 - q_0) \cdot 4 &= 0 & \Rightarrow A_V &= 6 \text{ kN} \\ A_V &= q_0 \cdot 4 + \frac{1}{2}(q_1 - q_0) \cdot 4 - 2 \text{ kN} \\ \Sigma M_{P_0} : A_H \cdot 4m - M_A &= 0 & \Rightarrow M_A &= 12 \text{ kNm} \end{aligned}$$

3. Schnittgrößenverläufe

3.1 Bereich I

$$Q_1(x_1) = - \int q(x_1) dx_1 + C_1 = C_1$$

$$M_1(x_1) = + \int Q_1(x_1) dx_1 + C_2 = C_1 x_1 + C_2$$

$$N_1(x_1) = - \int n(x_1) dx_1 + C_3 = - \int \frac{q_1 - q_0}{4m} x_1 + q_0 + C_3 = - \frac{q_1 - q_0}{8m} x_1^2 + q_0 x_1 + C_3$$

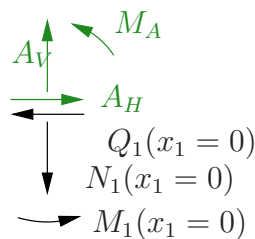
3.2 Bereich II

$$Q_2(x_2) = C_4$$

$$M_2(x_2) = C_4 x_2 + C_5$$

$$N_2(x_2) = C_6$$

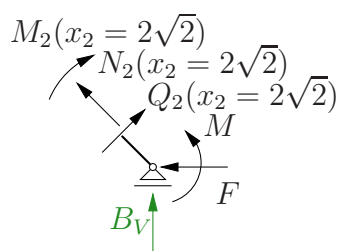
3.3 Randbedingungen



$$Q_1(x_1 = 0) = +A_H = 3kN \quad (1)$$

$$N_1(x_1 = 0) = A_V = 6kN \quad (2)$$

$$M_1(x_1 = 0) = -M_A = -12kNm \quad (3)$$



$$M_2(x_2 = 0) = 0 \quad (4)$$

$$M_2(x_2 = 2\sqrt{2}) = 2 \quad (5)$$

$$N_2(x_2 = 2\sqrt{2}) + 2 \cdot \frac{\sqrt{2}}{2} + 3 \cdot \frac{\sqrt{2}}{2}$$

$$N_2(x_2 = 2\sqrt{2}) = -\frac{5}{2}\sqrt{2} \quad (6)$$

$$Q_2(x_2 = 2\sqrt{2}) + \frac{\sqrt{2}}{2} \cdot 2 - \frac{\sqrt{2}}{2} \cdot 3 = 0$$

$$Q_2(x_2 = 2\sqrt{2}) = \frac{\sqrt{2}}{2}kN \quad (7)$$

3.4 Lösung der Differentialgleichung

$$Q_1(x_1 = 0) = C_1 = 3kN$$

$$M_1(x_1 = 0) = 0 + C_2 = -12kNm$$

$$N_1(x_1 = 0) = C_3 = 6kN$$

$$M_2(x_2 = 0) = C_5 = 0$$

$$Q_2(x_2 = 2\sqrt{2}) = C_4 = \frac{\sqrt{2}}{2}kN$$

$$N_2(x_2 = 2\sqrt{2}) = C_6 = -\frac{5}{2}\sqrt{2}kN$$

Schnittgrößendifferentialgleichung

$$Q_1(x_1) = 3kN$$

$$M_1(x_1) = 3kNx_1 - 12kNm$$

$$N_1(x_1) = -\frac{q - q_0}{8m}x_1^2 - q_0x_1 + 6kN = -\frac{2\frac{kN}{m}}{4m}x_1^2 - x_1 + 6$$

$$Q_2(x_2) = \frac{\sqrt{2}}{2}kN$$

$$M_2(x_2) = \frac{\sqrt{2}}{2}kNx_2$$

$$N_2(x_2) = -\frac{5}{2}\sqrt{2}kN$$

3.5 Graphische Darstellung

