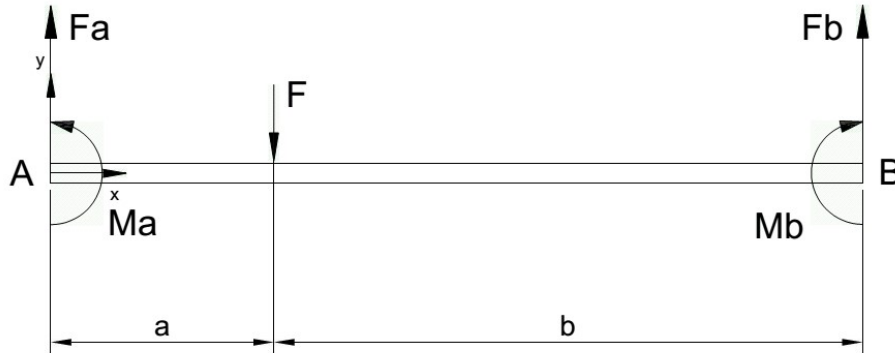


Deflection of a Beam (both clamping points are firmly clamped):

Given:

$$F := 16 \text{ kN} \quad E := 2.1 \cdot 10^5 \text{ N} \cdot \text{mm}^{-2} \quad I := 103 \text{ cm}^4 \quad W_b := 25.8 \text{ cm}^3 \quad a := 260 \text{ mm} \quad b := 540 \text{ mm}$$

$$l := a + b = 800 \text{ mm} \quad \text{Nm} := 1 \text{ N} \cdot \text{m} \quad \text{kNm} := 1 \text{ kN} \cdot \text{m} \quad F := 16 \text{ kN}$$



$$F_a := F \cdot \frac{b^2 (3a + b)}{(a + b)^3} = 12028.5 \text{ N}$$

$$F_b := F \cdot \left(1 - \frac{b^2 (3a + b)}{(a + b)^3} \right) = 3971.5 \text{ N}$$

$$M_a := F \cdot a \cdot \frac{b^2}{(a + b)^2} = 1895.4 \text{ Nm}$$

$$M_b := F \cdot b \cdot \frac{a^2}{(a + b)^2} = 912.6 \text{ Nm}$$

$$M_{bl}(x) = M_a - F_a \cdot x \quad \text{left Moment of bending}$$

$$M_{br}(x) = M_b - F_b \cdot (l - x)$$

right Moment of bending

at sektion a there is:

$$-F_a \cdot a + M_a = -M_b + F_b \cdot b \quad (I)$$

$$y''(x) = -\frac{1}{E \cdot I} \cdot M_b(x)$$

$$F = F_a + F_b \quad (II)$$

$$-F_a \cdot a + M_a = -M_b + (F - F_a) \cdot b \quad \text{Equation (I) in (II)}$$

$$M_b = a \cdot F_a - M_a + b \cdot (F - F_a)$$

Solving the deflection:

$$y_1(0 \text{ mm}) = 0 \text{ mm} \quad y_1'(0 \text{ mm}) = 0$$

$$y_1''(x) = -\frac{1}{E \cdot I} \cdot (M_a - F_a \cdot x)$$

$$y_1 := \text{odesolve}(y_1(x), a)$$

$$y_2(a) = y_1(a) \quad y_2(l) = 0 \text{ mm}$$

$$y_2''(x) = -\frac{1}{E \cdot I} \cdot (M_b - F_b \cdot (l - x))$$

$$y_2 := \text{odesolve}(y_2(x), l)$$

Gleichungslöser Nebenbedingungsätze

Diagrams of deflection, Bending Moment and shear Force :

$$y(x) := \begin{cases} \text{if } 0 \leq x \leq a \\ \quad \parallel \\ \quad y_1(x) \\ \text{if } a < x \leq l \\ \quad \parallel \\ \quad y_2(x) \end{cases} \quad M_b(x) := \begin{cases} \text{if } 0 \leq x \leq a \\ \quad \parallel \\ \quad M_a - F_a \cdot x \\ \text{if } a < x \leq l \\ \quad \parallel \\ \quad M_b - F_b \cdot (l - x) \end{cases} \quad F_Q(x) := \begin{cases} \text{if } 0 \leq x \leq a \\ \quad \parallel \\ \quad F_a \\ \text{if } a < x \leq l \\ \quad \parallel \\ \quad F_a - F \end{cases}$$

$$x := 0, 0.1 \text{ mm} \dots l \quad x_{y_{max}} = 340.426 \text{ mm} \quad y_{max} := y(x_{y_{max}}) = -0.149 \text{ mm}$$

Gleichbergstellung u.6. Gleichzwerge

$$x := 450 \text{ mm}$$

$$y'(x) = 0$$

$$x_{y_{max}} := \text{find}(x)$$

