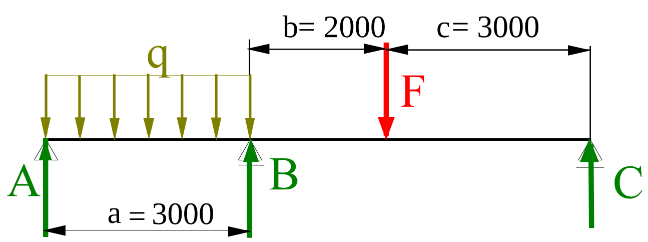


Streckenlast:

$$q(x) = q_0 - q_0\{x-a\}^0$$

Querkraft:

$$Q(x) = -q_0 x + q_0\{x-a\}^1 - F\{x-a-b\}^0 + A + B\{x-a\}^0$$

Biegemoment:

$$M_b(x) = Ax - \frac{q_0 x^2}{2} + \frac{q_0}{2}\{x-a\}^2 + B\{x-a\}^1 - F\{x-a-b\}^1 + \overset{\to 0}{C}$$

Biegelinie:

$$EIz''(x) = -M_b(x)$$

C, C_1, C_2 sind Integrationskonstanten

$$EIz'(x) = -\frac{A}{2}x^2 + \frac{q_0}{6}x^3 - \frac{q_0}{6}\{x-a\}^3 - \frac{B}{2}\{x-a\}^2 + \frac{F}{2}\{x-a-b\}^2 + C_1$$

$$EIz(x) = -\frac{A}{6}x^3 + \frac{q_0}{24}x^4 - \frac{q_0}{24}\{x-a\}^4 - \frac{B}{6}\{x-a\}^3 + \frac{F}{6}\{x-a-b\}^3 + C_1 x + C_2\ ;$$

Randbedingung am Lager A: $EIz(0) = C_2 = 0$

Randbedingung am Lager B: $EIz(a) = -\frac{A}{6}a^3 + \frac{q_0}{24}a^4 + C_1 a = 0$; $C_1 = \frac{A}{6}a^2 - \frac{q_0}{24}a^3$

Randbedingung am Lager C:

$$EIz(a+b+c) = -\frac{A}{6}(a+b+c)^3 + \frac{q_0}{24}(a+b+c)^4 - \frac{q_0}{24}(b+c)^4 - \frac{B}{6}(b+c)^3 + \frac{F}{6}c^3 + \left(\frac{A}{6}a^2 - \frac{q_0}{24}a^3\right)(a+b+c) = 0 \qquad (1)$$

Mit $\sum M_{i,C} = 0$: $B(b+c) = q_0 a\left(\frac{a}{2}+b+c\right) + F\cdot c - A(a+b+c)$ (2)

$$\rightarrow -B(b+c)^3 = -q_0 a\left(\frac{a}{2}+b+c\right)(b+c)^2 - F\cdot c(b+c)^2 + A(a+b+c)(b+c)^2$$

in (1) eingesetzt und nach A geordnet: $A\left[(a+b+c)^3 - (a+b+c)(b+c)^2 - a^2(a+b+c)\right] =$

$$= F\cdot c\left[c^2 - (b+c)^2\right] + \frac{q_0}{4}\left[(a+b+c)^4 - (b+c)^4 - a^3(a+b+c) - 4a\left(\frac{a}{2}+b+c\right)(b+c)^2\right]$$

$$A = \frac{(25{,}6kN/4m)\left[8^4 - 5^4 - 3^3\cdot 8 - 4\cdot 3\cdot 6{,}5\cdot 5^2\right]m^4 + 43{,}5kN\cdot 3\left[3^2 - 5^2\right]m^3}{\left(8^3 - 8\cdot 5^2 - 3^2\cdot 8\right)m^3}\ ;$$

A = 26,1kN

zu Aufgabe 3, Aufgabenblatt 4:

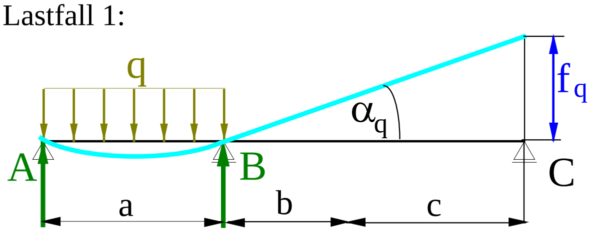
aus (2):

$$B = \frac{q_0\, a\left(\frac{a}{2} + b + c\right) + F\cdot c - A(a + b + c)}{(b + c)} = \frac{25{,}6\,\frac{kN}{m}\cdot 3\,m\cdot 6{,}5\,m + 43{,}5\,kN\cdot 3\,m - 21{,}6\,kN\cdot 8\,m}{5\,m}$$

$B = 84{,}18\,kN$; $\qquad C = F + q_0\, a - B - A = 10{,}02\,kN$

Lösung durch Überlagerung:

Lastfall 1:

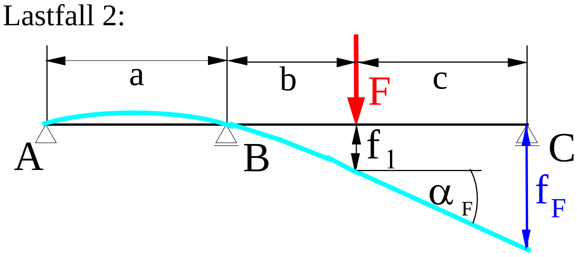


$$f_q = -(b + c)\tan\alpha_q$$

nach Vorlesung: $\tan\alpha_q = \left|\frac{q_0\, a^3}{24\,E\,I}\right|$

$$f_q = -(b + c)\frac{q_0\, a^3}{24\,E\,I}$$

Lastfall 2:



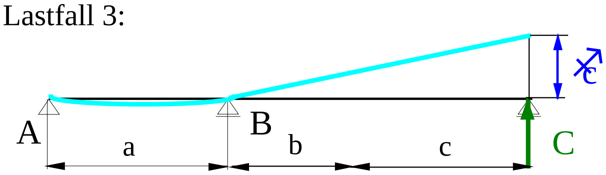
nach Dubbel: $f_1 = \frac{F\,a\,b^2}{3\,E\,I}\left(1 + \frac{b}{a}\right)$

$\tan\alpha_F = \frac{F\,a\,b}{6\,E\,I}\left(2 + 3\frac{b}{a}\right)$;

$$f_F = f_1 + c\cdot\tan\alpha_F$$

$$f_F = \frac{F\,b}{6\,E\,I}\left(2(a\,b + b^2) + c(2\,a + 3\,b)\right)$$

Lastfall 3:



$$f_C = -\frac{C\cdot a(b + c)^2}{3\,E\,I}\left(1 + \frac{b + c}{a}\right)$$

$$f_C = -\frac{C\cdot (b + c)^2}{3\,E\,I}(a + b + c)$$

Überlagerung:

$$f_{ges} = f_q + f_F + f_C = 0$$

$$f_{ges} = -(b + c)\frac{q_0\, a^3}{24\,E\,I} + \frac{F\,b}{6\,E\,I}\left(2(a\,b + b^2) + c(2\,a + 3\,b)\right) - \frac{C\cdot (b + c)^2}{3\,E\,I}(a + b + c) = 0$$

$$C = \frac{-(b + c)(q_0\, a^3/8) + (F\,b/2)(2(a\,b + b^2) + c(2\,a + 3\,b))}{(a + b + c)(b + c)^2}$$

$$C = \frac{-5\,m\,(25{,}6\,kN\cdot 3^3\,m^3/8) + (43{,}5\,kN\cdot 2\,m/2)(2(3\cdot 2 + 2^2) + 3(6 + 6))\,m^2}{8\cdot 5^2\,m^3} = 10{,}02\,kN$$

$\sum M_{i,A} = 0$: $\qquad B = q_0\frac{a}{2} + F\frac{a + b}{a} - C\frac{a + b + c}{a} = 84{,}18\,kN$

$\sum F_{i,y} = 0$: $\qquad A = F + q_0\, a - B - C = 26{,}1\,kN$