Musterlösungen
zum Tutorium

„Technische Mechanik 2"
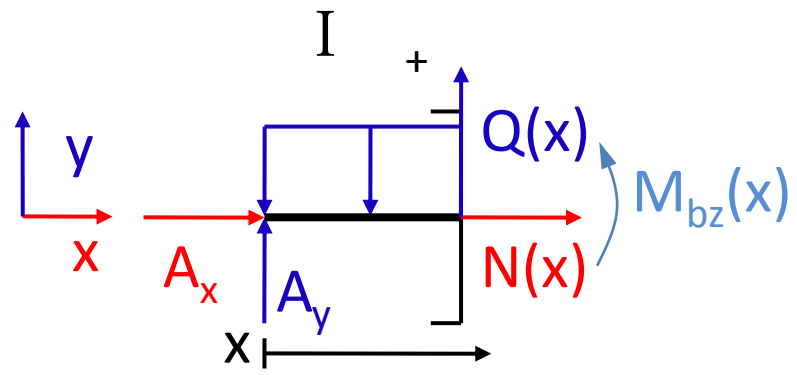
von Stefan Theer

Aufgabe 17

$$\vec{e_x}: \quad A_x + G_x = 0$$

$$\vec{e_y}: \quad A_y - q_o 4a - F + B_y + G_y = 0$$

$$M_A \uparrow: -q_0 4a2a - F2a + B_y 3a + G_y 4a = 0$$

$$\underline{A_x = 0} \quad \underline{A_y = 1{,}67 * 10^4 N} \quad \underline{B_y = 5{,}33 * 10^4 N}$$

$$\text{I}$$

$$\vec{e_x}: \quad -G_x = 0$$

$$\vec{e_y}: \quad -G_y - q_0 2a + C_y = 0$$

$$M_G \uparrow: C_y 2a - q_0 2aa = 0$$

$$\underline{G_y = -q_0 a = -10^4 N}$$

$$\underline{C_y = q_0 a = 10^4 N}$$

$$0 \le x \le 2a$$

$$\vec{e_x}: \quad N(x) + A_x = 0 \qquad\qquad N(x) = 0$$

$$\vec{e_y}: \quad Q(x) + A_y - q_o x = 0 \qquad Q(x) = q_0 x - A_y$$

$$M_S \uparrow: M_{bz}(x) + q_0 x \frac{x}{2} - A_y x = 0 \quad M_{bz}(x) = A_y x - q_0 x \frac{x}{2}$$

Aufgabe 17

$2a \leq x \leq 3a$

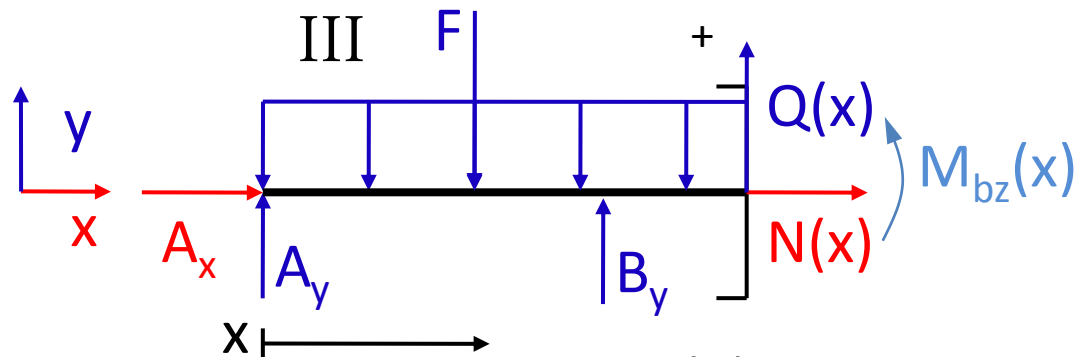$\overrightarrow{e_x}:\quad N(x) + A_x = 0 \qquad\qquad N(x) = 0$

$\underline{e_y}:\quad Q(x) + A_y - q_o x - F = 0 \qquad\qquad Q(x) = F + q_0 x - A_y$

$M_S \uparrow: M_{bz}(x) + q_0 x \dfrac{x}{2} + F(x - 2a) - A_y x = 0 \quad M_{bz}(x) = A_y x - q_0 x \dfrac{x}{2} - F(x - 2a)$

$3a \leq x \leq 4a$

$\overrightarrow{e_x}:\quad N(x) + A_x = 0 \qquad\qquad N(x) = 0$

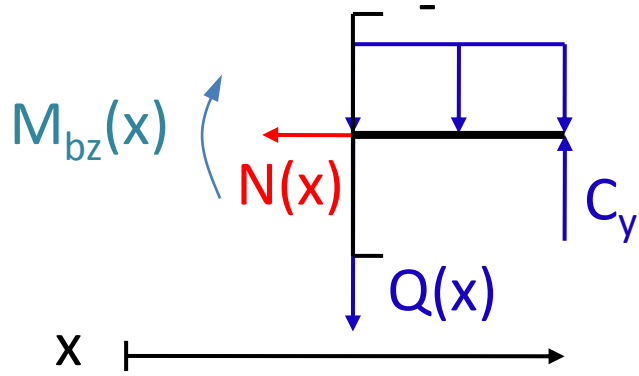$\underline{e_y}:\quad Q(x) + A_y - q_o x - F + B_y = 0 \qquad\qquad Q(x) = F + q_0 x - A_y - B_y$

$M_S \uparrow: M_{bz}(x) q_0 x \dfrac{x}{2} + F(x - 2a) - B_y(x - 3a) - A_y x = 0$

$M_{bz}(x) = A_y x - q_0 x \dfrac{x}{2} - F(x - 2a) + B_y(x - 3a)$

Aufgabe 17

IV

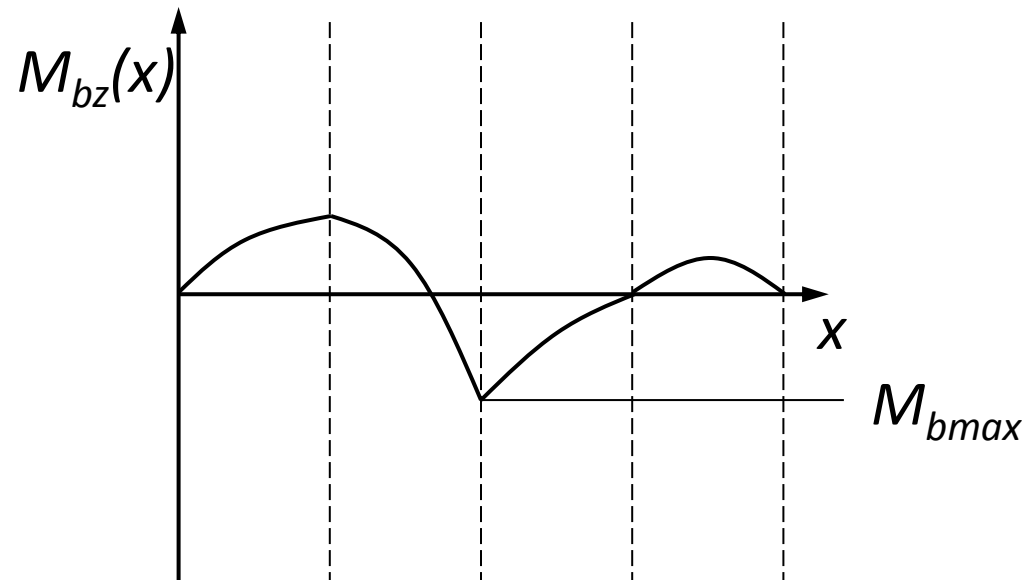$M_{bz}(x)$

$N(x)$

C_y
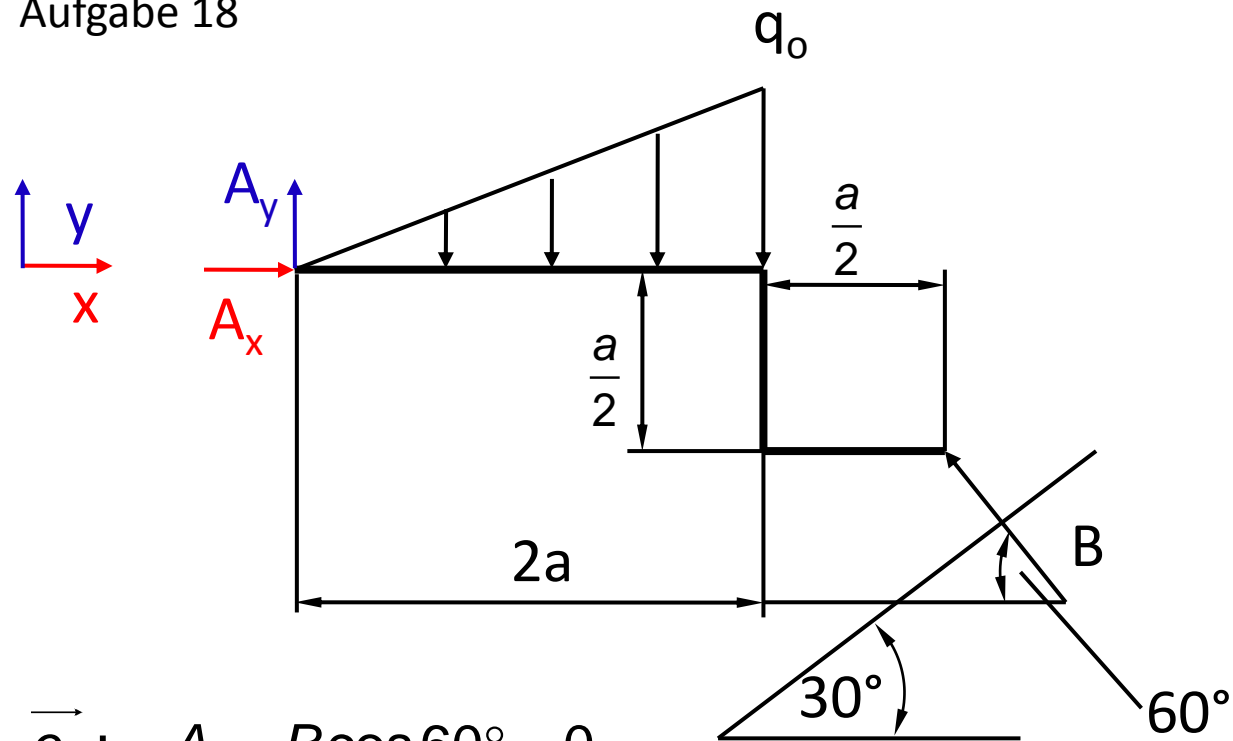
$Q(x)$

x

$4a \leq x \leq 6a$

$\vec{e_x}:$ $\quad -N(x) = 0$ $\qquad\qquad N(x) = 0$

$\vec{e_y}:$ $\quad -Q(x)C_y - q_o(6a-x) = 0$ $\qquad Q(x) = -q_0(6a-x) + C_y$

$M_S \uparrow: -M_{bz}(x) - q_0(6a-x)\dfrac{(6a-x)}{2} + C_y(6a-x) = 0$ $\quad M_{bz}(x) = C_y(6a-x) - q_0\dfrac{(6a-x)^2}{2}$

$Q(x)$

x

$M_{bz}(x)$

x

M_{bmax}

Aufgabe 18

q_o

$\dfrac{a}{2}$

$\dfrac{a}{2}$

$2a$

B

30°

60°

$\vec{e_x}: \quad A_x - B\cos 60° = 0$
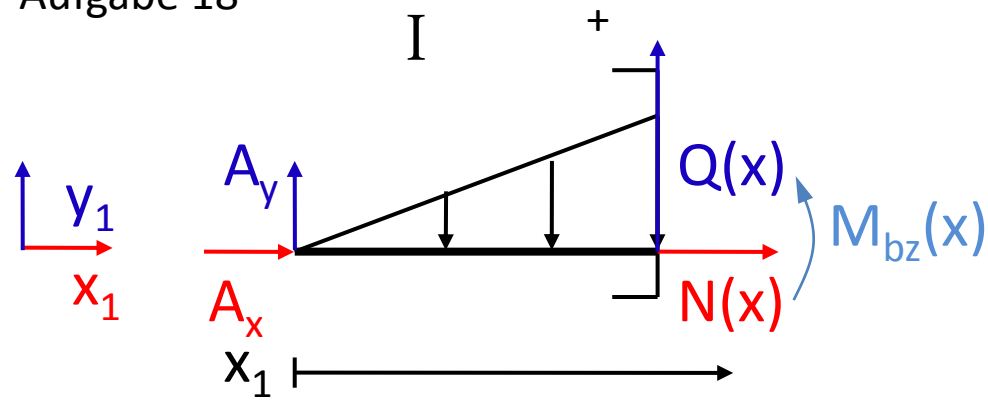
$\vec{e_y}: \quad A_y - \dfrac{1}{2}q_o 2a + B\sin 60° = 0$

$M_A \uparrow: -q_0 \dfrac{1}{2}2a\dfrac{2}{3}2a + B\sin 60° \dfrac{5}{2}a - B\cos 60° \dfrac{a}{2} = 0$

$B\left(\dfrac{5a\sin 60°}{2} - \dfrac{a\cos 60}{2}\right) = q_0 \dfrac{4a^2}{3} = Ba\left(\dfrac{5\sqrt{\dfrac{3}{4}}}{2} - \dfrac{1}{4}\right) = \underline{\underline{B = 0,7q_0 a}}$

$A_y = q_o a - 0,6q_o a = \underline{\underline{A_y = 0,4q_o a}} \quad \underline{\underline{A_x = 0,35q_0 a}}$

Aufgabe 18

$$I \qquad +$$

$$y_1$$
$$x_1$$

$$A_y$$
$$A_x$$
$$x_1$$

$$Q(x)$$
$$M_{bz}(x)$$
$$N(x)$$

$$\frac{q_0}{2a} = \frac{q(x)}{x} \qquad q(x) = \frac{q_0 x}{2a}$$

$$0 \le x_1 \le 2a$$

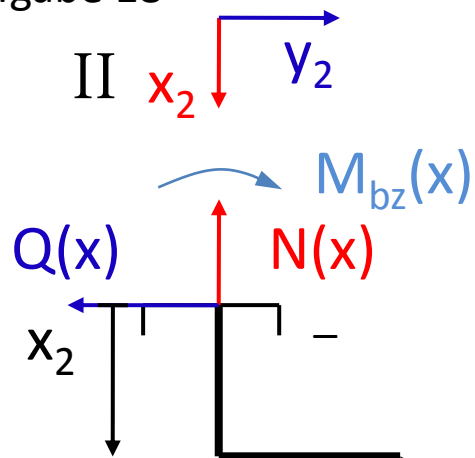$$\vec{e_x}: \quad N(x_1) + A_x = 0 \qquad\qquad N(x_1) = -A_x$$

$$\vec{e_y}: \quad Q(x_1) + A_y - \frac{1}{2}\frac{q_0 x_1}{2a} x_1 = 0 \qquad Q(x_1) = \frac{q_0 x_1}{4a} x_1 - A_y$$

$$M_S \uparrow: M_{bz}(x_1) + \frac{1}{2}\frac{q_0 x_1}{2a} x_1 \frac{2x_1}{3} - A_y x_1 = 0 \qquad M_{bz}(x_1) = A_y x_1 - \frac{q_0 x_1}{2a} x_1 \frac{1 x_1}{3}$$

Aufgabe 18

II $\quad x_2 \quad y_2$

$\quad M_{bz}(x)$

$Q(x) \quad N(x)$

x_2

III

B

$$0 \le x_2 \le \frac{a}{2}$$

$$\vec{\underline{e}_x}: \quad -N(x_2) - B\sin 60° = 0$$

$$\underline{e}_y: \quad -Q(x_2) - B\cos 60° = 0$$
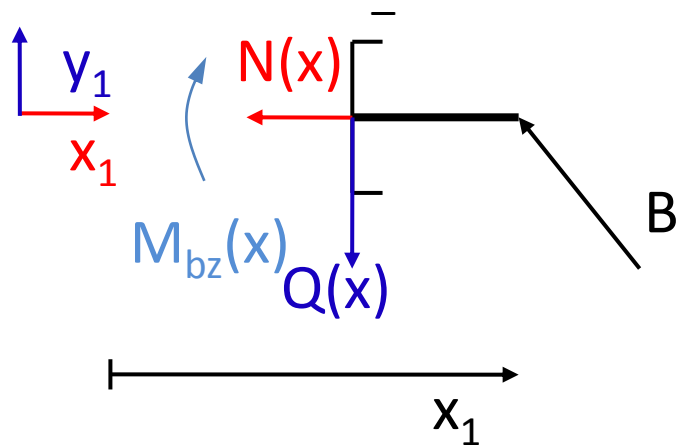
$$M_S \uparrow: -M_{bz}(x_2) + B\sin 60° \frac{a}{2} - B\cos 60°\left(\frac{a}{2} - x_2\right) = 0$$

$$N(x_2) = -B\sin 60°$$
$$Q(x_2) = -B\cos 60°$$

$$M_{bz}(x_2) = B\sin 60° \frac{a}{2} - B\cos 60°\left(\frac{a}{2} - x_2\right)$$

y_1

x_1

$N(x)$

$M_{bz}(x) \quad Q(x)$

B

x_1

$$2a \le x_1 \le \frac{5a}{2}$$

$$\vec{\underline{e}_x}: \quad -N(x_1) - B\cos 60° = 0$$

$$\underline{e}_y: \quad -Q(x_1) + B\sin 60° = 0$$
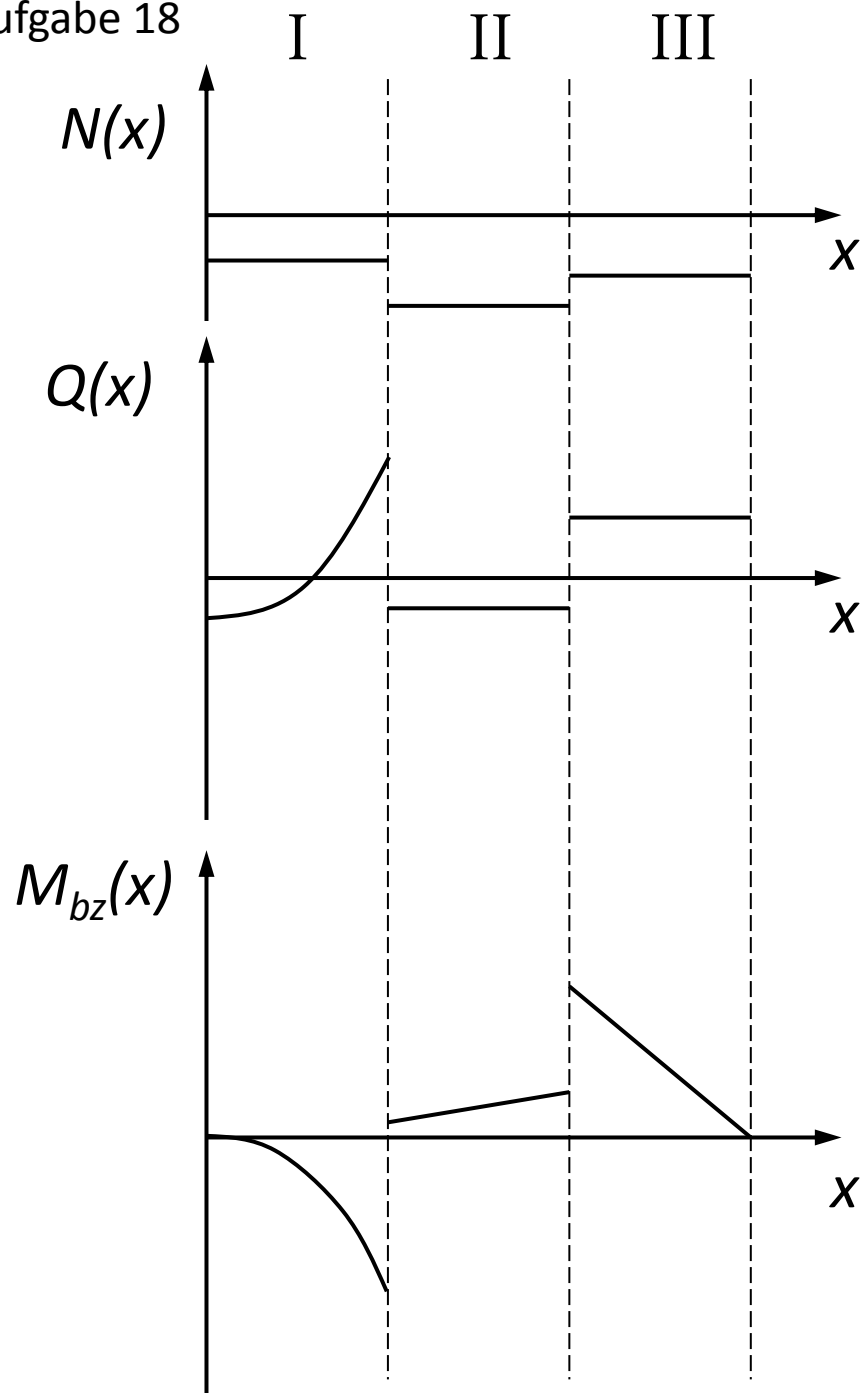
$$M_S \uparrow: -M_{bz}(x_1) + B\sin 60°\left(\frac{5a}{2} - x_1\right) = 0$$

$$N(x_1) = -B\cos 60°$$
$$Q(x_1) = B\sin 60°$$

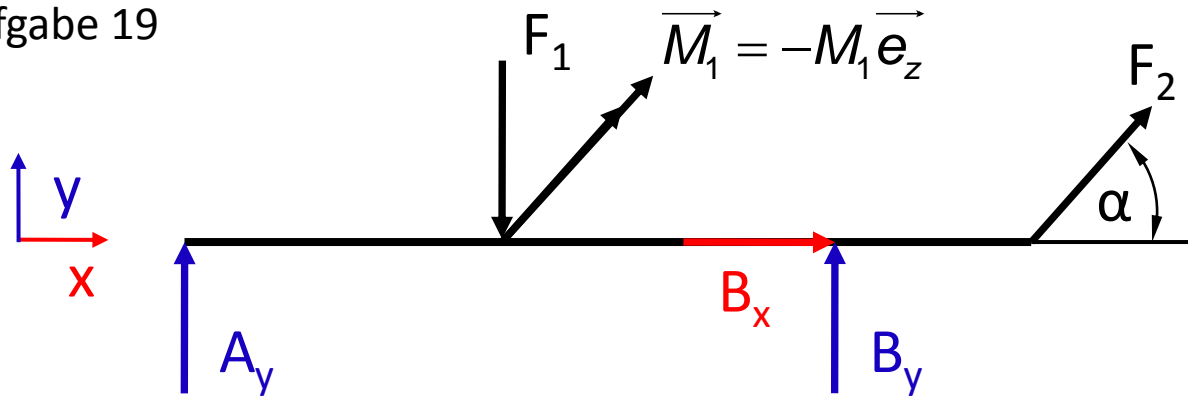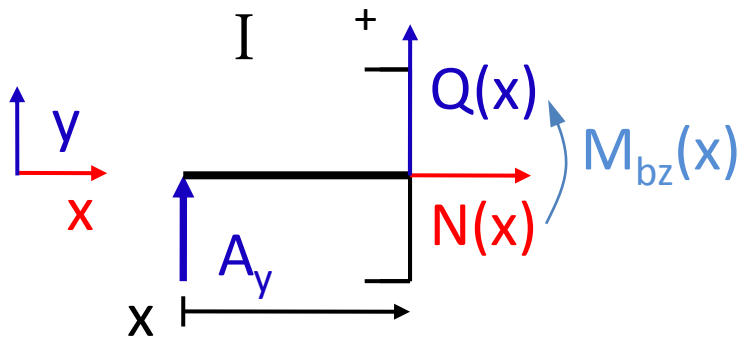$$M_{bz}(x_1) = B\sin 60°\left(\frac{5a}{2} - x_1\right)$$

Aufgabe 18

I II III

N(x)

Q(x)

$M_{bz}(x)$

x

x

x

Aufgabe 19

F_1 $\overrightarrow{M_1} = -M_1\overrightarrow{e_z}$ F_2

y

x

α

A_y B_x B_y

$\overrightarrow{e_x}: \quad B_x + F_2\cos\alpha = 0 \qquad\qquad \underline{B_x = -70{,}7\,N}$

$\overrightarrow{e_y}: \quad A_y - F_1 + B_y + F_2\sin\alpha = 0 \qquad \underline{A_y = 37{,}8\,N}$

$M_A\uparrow: -F_1 0{,}5a - M_1 + B_y a + F_2\sin\alpha(a+b) = 0 \quad \underline{B_y = -58{,}7\,N}$

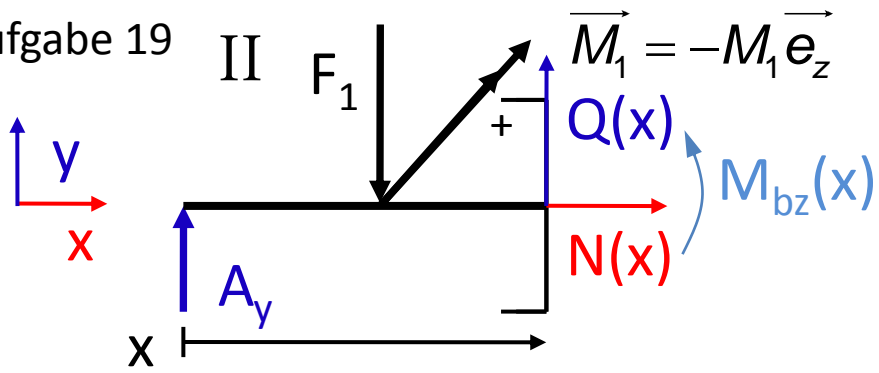I $+$

$Q(x)$

y $M_{bz}(x)$

x $N(x)$

A_y

x

$0 \leq x \leq 0{,}5a$

$\overrightarrow{e_x}: \quad N(x) = 0$

$\overrightarrow{e_y}: \quad Q(x) + A_y = 0 \qquad Q(x) = -A_y$

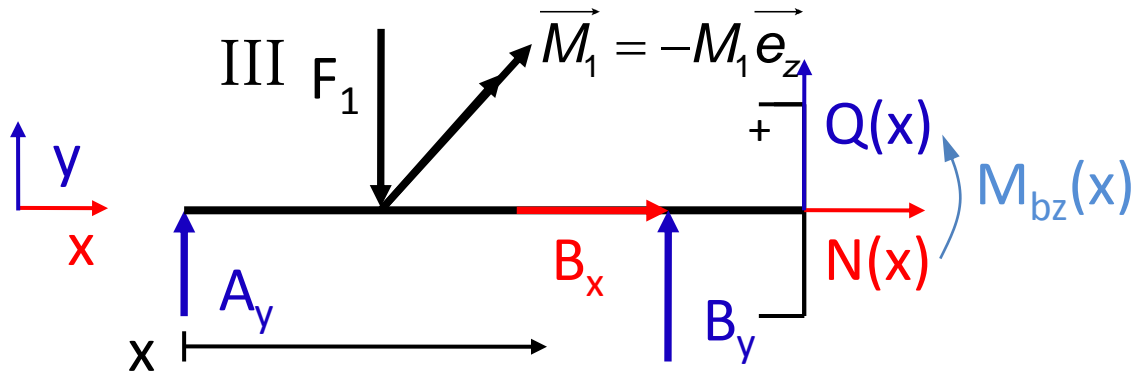$M_S\uparrow: M_{bz}(x) - A_y x = 0 \quad M_{bz}(x) = A_y x$

Aufgabe 19

II F_1 $\vec{M_1} = -M_1\vec{e_z}$

$Q(x)$

$M_{bz}(x)$

$N(x)$

A_y

x

$0{,}5a \leq x \leq a$

$\vec{e_x}:\quad N(x) = 0$

$\vec{e_y}:\quad Q(x) + A_y - F_1 = 0 \qquad\qquad\qquad Q(x) = -A_y + F_1$

$M_S \uparrow: M_{bz}(x) - A_y x + F_1(x - 0{,}5a) - M_1 = 0 \quad M_{bz}(x) = A_y x + M_1 - F_1(x - 0{,}5a)$

III F_1 $\vec{M_1} = -M_1\vec{e_z}$

$Q(x)$

$M_{bz}(x)$

B_x

$N(x)$

A_y

B_y

x

$a \leq x \leq a + b$

$\vec{e_x}:\quad N(x) + B_x = 0 \qquad\qquad\qquad\qquad\qquad N(x) = -B_x$

$\vec{e_y}:\quad Q(x) + A_y - F_1 + B_y = 0 \qquad\qquad\qquad Q(x) = -A_y + F_1 - B_y$

$M_S \uparrow: M_{bz}(x) - A_y x + F_1(x - 0{,}5a) - B_y(x - a) - M_1 = 0$

$M_{bz}(x) = A_y x + M_1 - F_1(x - 0{,}5a) + B_y(x - a)$

Aufgabe 19

I   II   III

$N(x)$

x

$Q(x)$

x

$M_{bz}(x)$

x