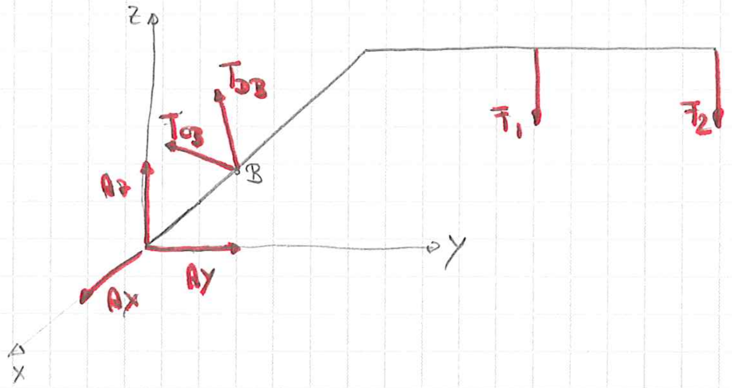
Topic

Location | Time | Date

Aufgabe 4:



Kraftvektoren:

$\underline{T}_{DB} = T_{DB}\,\underline{e}_{DB}$ $\qquad \underline{e}_{DB} = \dfrac{\underline{r}_{DB}}{|\underline{r}_{DB}|}$ $\qquad \underline{r}_{DB} = \begin{pmatrix}-a\\0\\c_1\end{pmatrix} - \begin{pmatrix}0\\b_1\\c_2\end{pmatrix} = \begin{pmatrix}-a\\-b_1\\c_1-c_2\end{pmatrix} = \begin{pmatrix}-2\\-1\\2\end{pmatrix}m$

$\underline{T}_{DB} = \dfrac{T_{DB}}{3}\begin{pmatrix}-2\\-1\\2\end{pmatrix}$ $\qquad \underline{e}_{DB} = \dfrac{1}{3}\begin{pmatrix}-2\\-1\\2\end{pmatrix}$ $\qquad |\underline{r}_{DB}| = \sqrt{2^2+1^2+2^2} = 3$

$\underline{r}_{CB} = \begin{pmatrix}a\\0\\c_1\end{pmatrix} - \begin{pmatrix}0\\b_1\\c_2\end{pmatrix} = \begin{pmatrix}a\\-b_1\\c_1-c_2\end{pmatrix} = \begin{pmatrix}2\\-1\\2\end{pmatrix}m$

$\underline{T}_{CB} = \dfrac{T_{CB}}{3}\begin{pmatrix}2\\-1\\2\end{pmatrix}$ $\qquad \underline{e}_{CB} = \dfrac{1}{3}\begin{pmatrix}2\\-1\\2\end{pmatrix}$ $\qquad |\underline{r}_{CB}| = 3$

$\underline{F}_1 = -F_1\,\underline{e}_z \quad , \quad \underline{F}_2 = -F_2\,\underline{e}_z$

$\underline{A} = \begin{pmatrix}A_x\\A_y\\A_z\end{pmatrix}$

Gleichgewicht:

$\sum_i \underline{F}_i = \underline{0} \quad : \quad \underline{A} + \underline{T}_{DB} + \underline{T}_{CB} + \underline{F}_1 + \underline{F}_2 = \underline{0} \qquad (1)$

$\sum_i \underline{M}_i^{(A)} = \underline{0} \quad : \quad \underline{r}_{AB} \times \underline{T}_{CB} + \underline{r}_{AB} \times \underline{T}_{DB} + \underline{r}_{A1} \times \underline{F}_1 + \underline{r}_{A2} \times \underline{F}_2 = \underline{0} \qquad (2)$

mit $\underline{r}_{AB} = \begin{pmatrix}0\\b_1\\c_2\end{pmatrix}$, $\underline{r}_{A1} = \begin{pmatrix}0\\b_1+b_2+b_4\\c_3\end{pmatrix}$, $\underline{r}_{A2} = \begin{pmatrix}0\\b_1+b_2+b_3\\c_3\end{pmatrix}$

$\underline{r}_{AB} = \begin{pmatrix}0\\1\\1\end{pmatrix}m$, $\underline{r}_{A1} = \begin{pmatrix}0\\4\\2\end{pmatrix}m$, $\underline{r}_{A2} = \begin{pmatrix}0\\5.5\\2\end{pmatrix}m$

aus (2):

$$\begin{vmatrix} e_x & e_y & e_z \\ 0 & 1 & 1 \\ \frac{2}{3} & -\frac{1}{3} & \frac{2}{3} \end{vmatrix} T_{CB} + \begin{vmatrix} e_x & e_y & e_z \\ 0 & 1 & 1 \\ -\frac{2}{3} & -\frac{1}{3} & \frac{2}{3} \end{vmatrix} T_{DB} + \begin{vmatrix} e_x & e_y & e_z \\ 0 & 4 & 2 \\ 0 & 0 & -F_1 \end{vmatrix} + \begin{vmatrix} e_x & e_y & e_z \\ 0 & 5.5 & 2 \\ 0 & 0 & -F_2 \end{vmatrix} =$$

$$= \begin{bmatrix} \left(\frac{2}{3}+\frac{1}{3}\right)T_{CB} + \left(\frac{2}{3}+\frac{1}{3}\right)T_{DB} - 4F_1 - 5.5F_2 \\ \frac{2}{3}T_{CB} - \frac{2}{3}T_{DB} \\ -\frac{2}{3}T_{CB} + \frac{2}{3}T_{DB} \end{bmatrix} = \underline{0}$$

e_y oder e_x liefern: $\frac{2}{3}T_{CB} = \frac{2}{3}T_{DB} \longrightarrow \underline{\underline{T_{CB} = T_{DB}}}$

e_x: $T_{CB} + T_{DB} - 4F_1 - 5.5F_2 = 0$

$2T_{CB} = 4F_1 + 5.5F_2 = 34\,kN$

$\underline{\underline{T_{CB} = T_{DB} = 17\,kN}}$

$\underline{T_{CB}} = \frac{17}{3}\begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix} kN$, $\underline{T_{DB}} = \frac{17}{3}\begin{pmatrix} -2 \\ -1 \\ 2 \end{pmatrix} kN$

aus (1)

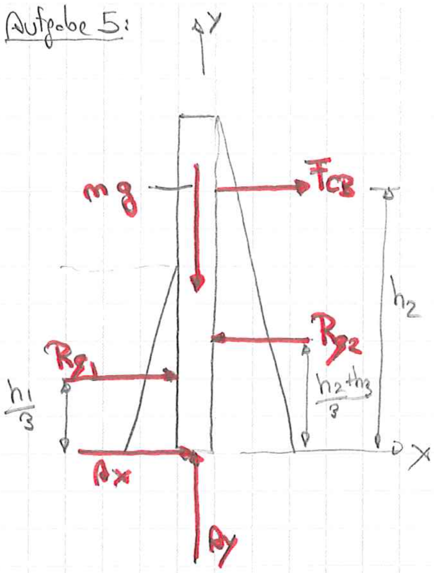
e_x: $A_x + T_{DB_x} + T_{CB_x} = 0 \longrightarrow \underline{\underline{A_x}} = -T_{DB_x} - T_{CB_x} = \frac{17}{3}(2-2) = \underline{\underline{0}}$

e_y: $A_y + T_{DB_y} + T_{CB_y} = 0 \longrightarrow \underline{\underline{A_y}} = -T_{DB_y} - T_{CB_y} = \frac{17}{3}(1+1) = \underline{\underline{\frac{34}{3}\,kN}} = 11.3\,kN$

e_z: $A_z + T_{DB_z} + T_{CB_z} + F_{1_z} + F_{2_z} = 0$

$\rightarrow \underline{\underline{A_z}} = -T_{DB_z} - T_{CB_z} - F_{1_z} - F_{2_z} = \frac{17}{3}(-2-2) + 3 + 4 = \underline{\underline{15.7\,kN}}$

Aufgabe 5:



$$R_{q_1} = \frac{q_{1max} \cdot h_1}{2} = 236\,\text{kN}$$

$$R_{q_2} = \frac{q_{2max}(h_2+h_3)}{2} = 1007.5\,\text{kN}$$

Dreieckslast

Gleichgewicht:

$$\sum_i M_i^{(A)} = 0 \; : \; -R_{q_1} \cdot \frac{h_1}{3} + R_{q_2} \cdot \frac{h_2+h_3}{3} - F_{CB} h_2 = 0 \qquad (1)$$

$$\sum_i F_{ix} = 0 \; : \; A_x + R_{q_1} - R_{q_2} + F_{CB} = 0 \qquad (2)$$

$$\sum_i F_{iy} = 0 \; : \; A_y - mg = 0 \qquad (3)$$

aus (3): $\underline{A_y} = mg = \underline{7.85\,\text{kN}}$

aus (1) $\underline{\underline{F_{CB}}} = \frac{1}{h_2}\left(-R_{q_1}\frac{h_1}{3} + R_{q_2}\frac{h_2+h_3}{3}\right) = \underline{\underline{311.38\,\text{kN}}}$

aus (2) $\underline{A_x} = R_{q_2} - R_{q_1} - F_{CB} = \underline{460.12\,\text{kN}}$

Topic

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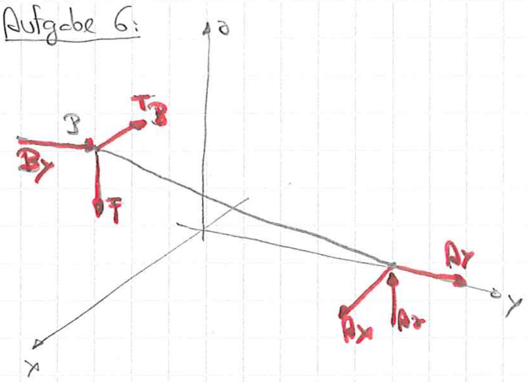
Aufgabe 6:



Richtungen sind hier vorab klar, keine Kraftvektoren nötig.

Ggw.:

$$\sum_i \underline{F}_i = \underline{0}: \quad \underline{A} + T_B(-\underline{e}_x) + F(-\underline{e}_z) + B_y\,\underline{e}_y = \underline{0} \qquad (1)$$

$$\sum_i \underline{M}_i^{(A)} = \underline{0}: \quad \underline{r}_{AB} \times (\underline{F} + \underline{B}_y + \underline{T}_B) = \underline{0} \qquad (2)$$

wobei $\underline{r}_{AB} = \begin{pmatrix} 0 \\ b \\ 0 \end{pmatrix} - \begin{pmatrix} a \\ 0 \\ c \end{pmatrix} = \begin{pmatrix} -a \\ -b \\ -c \end{pmatrix}$

e_x

e_z $\quad e_y$

$-e_y \quad e_z \quad 0$

also: $(-a\,\underline{e}_x + b\,\underline{e}_y - c\,\underline{e}_z) \times (-F\,\underline{e}_z + B_y\,\underline{e}_y - T_B\,\underline{e}_x) = \underline{0}$

$+e_x \quad 0 \quad -e_z$

$0 \quad -e_x \quad e_y$

$$-F a\,\underline{e}_y - B_y a\,\underline{e}_z - F b\,\underline{e}_x + T_B b\,\underline{e}_z + B_y c\,\underline{e}_x + T_B c\,\underline{e}_y = \underline{0}$$

Koeff.-Vgl. aus (2):

e_x: $-F \cdot b + B_y \cdot c = 0 \longrightarrow \underline{B_y} = +F \cdot \frac{b}{c} = \underline{+25\,\mathrm{kN}}$

e_y: $-F \cdot a + T_B \cdot c = 0 \longrightarrow \underline{T_B} = F \cdot \frac{a}{c} = \underline{25\,\mathrm{kN}}$

e_z: $-B_y \cdot a + T_B \cdot b = 0 \longrightarrow$ ✓ wahre Aussage

Koeff.-Vgl. aus (1):

e_x: $A_x - T_B = 0 \longrightarrow \underline{A_x} = T_B = \underline{25\,\mathrm{kN}}$

e_y: $A_y + B_y = 0 \longrightarrow \underline{A_y} = -B_y = \underline{-25\,\mathrm{kN}}$

e_z: $A_z - F = 0 \longrightarrow \underline{A_z} = F = \underline{50\,\mathrm{kN}}$

$$\underline{A} = \begin{pmatrix} 25 \\ -25 \\ 50 \end{pmatrix} \mathrm{kN}$$