

$$F_x = F \cos \alpha = 3,54 \text{ kN}$$

$$F_z = F \sin \alpha = 3,54 \text{ kN}$$

$$Q_1 = q_1 \cdot 3 / 2 = 4,5 \text{ kN}$$

$$Q_2 = q_2 \cdot 2 = 4 \text{ kN}$$

$$\sum M_{ia} = 0 \quad \checkmark$$

$$-F_z \cdot 1 - Q_1 \cdot 3 + R_{bz} \cdot 4 - Q_2 \cdot 5 = 0$$

$$R_{bz} = 9,26 \text{ kN} \quad (\uparrow)$$

$$\sum M_{ib} = 0 \quad \checkmark$$

$$-R_{axz} \cdot 4 + F_z \cdot 3 + Q_1 \cdot 1 - Q_2 \cdot 1 = 0$$

$$R_{axz} = 2,78 \text{ kN} \quad (\uparrow)$$

Kontrola?

$$\sum F_{iz} = 0 :$$

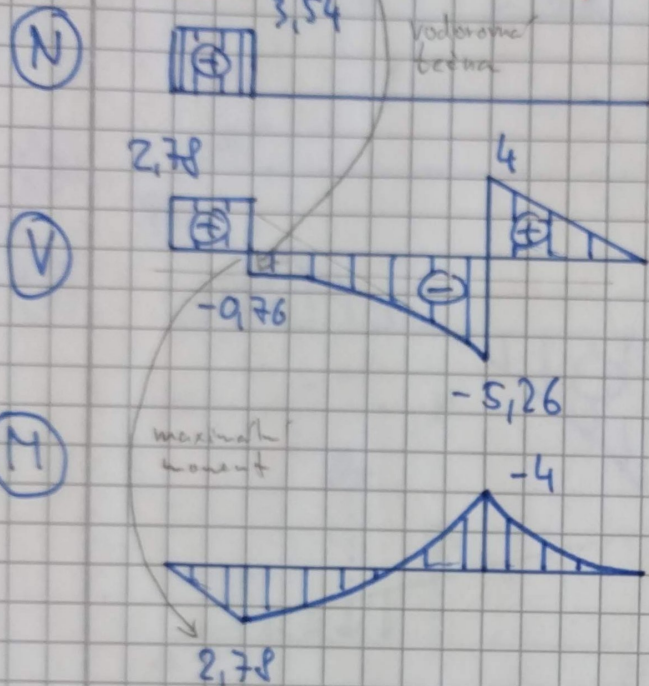
$$-2,78 + F_z + Q_1 - 9,26 + Q_2 = 0 \quad \checkmark$$

$$\sum F_{ix} = 0 :$$

$$R_{ax} = 3,54 \text{ kN} \quad (\leftarrow)$$

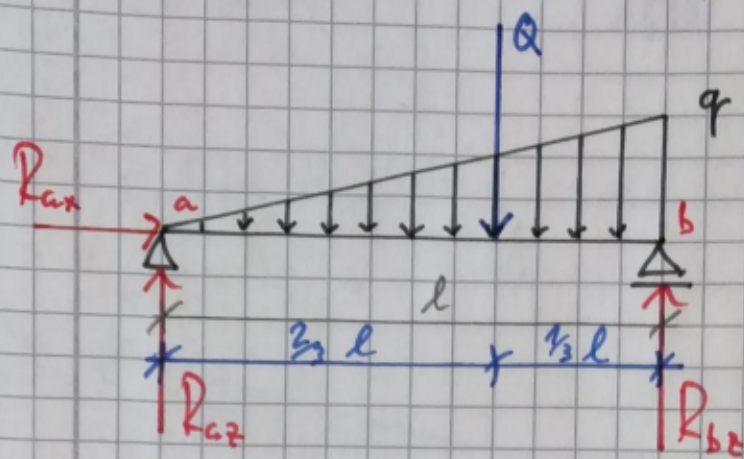
$$M_c = R_{axz} \cdot 1 = 2,78 \text{ kNm}$$

$$M_b = Q_2 \cdot 1 = -4 \text{ kNm}$$

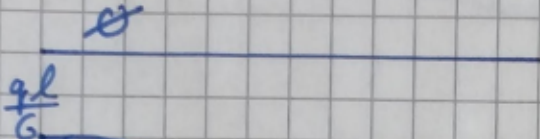




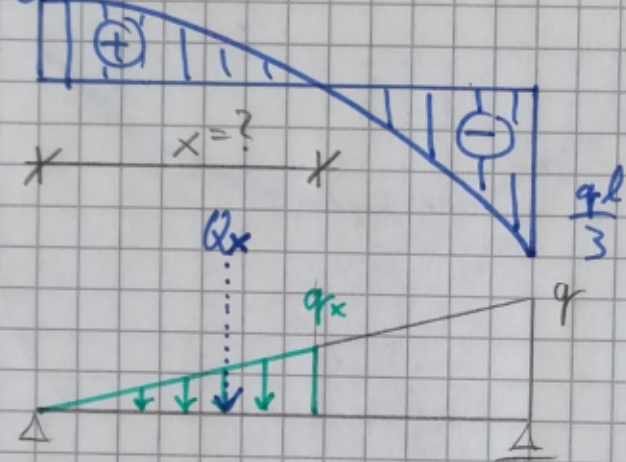
# trojúhelníkové zatížení



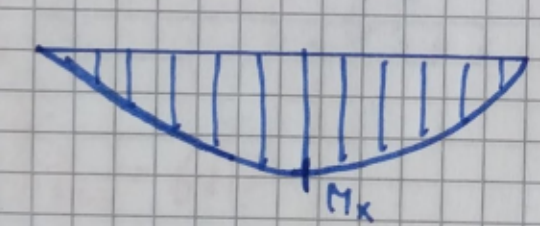
(N)



(V)



(M)



$$Q = \frac{q \cdot l}{2}$$

$$\sum F_{ix} = 0 : R_{ax} = 0$$

$$\sum M_{ia} = 0 \text{ (a)} :$$

$$-Q \cdot \frac{2}{3}l + R_{bz} \cdot l = 0$$

$$R_{bz} = \frac{Q \cdot \frac{2}{3}l}{l} = \frac{2}{3} \frac{q \cdot l}{2}$$

$$R_{bz} = \frac{q \cdot l}{3}$$

$$\sum M_{ib} = 0 \text{ (b)} :$$

$$-R_{az} \cdot l + Q \cdot \frac{1}{3}l = 0$$

$$R_{az} = \frac{Q \cdot \frac{1}{3}l}{l} = \frac{q \cdot l}{2} \cdot \frac{1}{3}$$

$$R_{az} = \frac{q \cdot l}{6}$$

Kontrola:

$$\sum F_{iz} = 0 :$$

$$\frac{q \cdot l}{2} - \frac{q \cdot l}{3} - \frac{q \cdot l}{6} = 0$$

$$V_a - Q_x = 0 \Rightarrow Q_x = V$$

$$Q_x = q_x \cdot x / 2$$

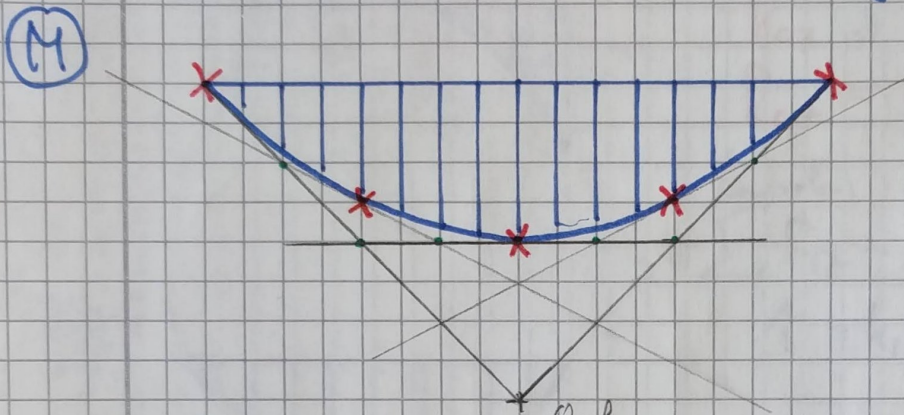
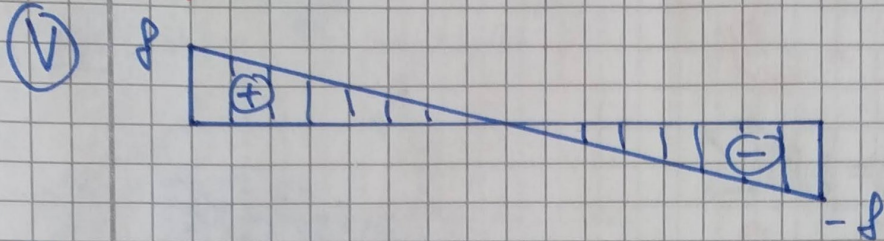
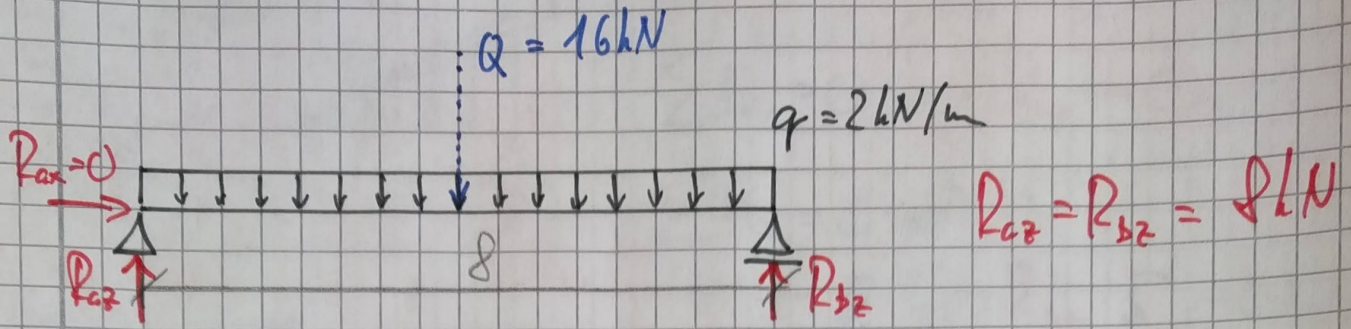
$$\frac{q_x}{x} = \frac{q}{l} \Rightarrow q_x = \frac{q \cdot x}{l}$$

$$Q_x = \frac{q \cdot x^2}{2l} \Rightarrow x = \sqrt{\frac{Q \cdot 2l}{q}}$$

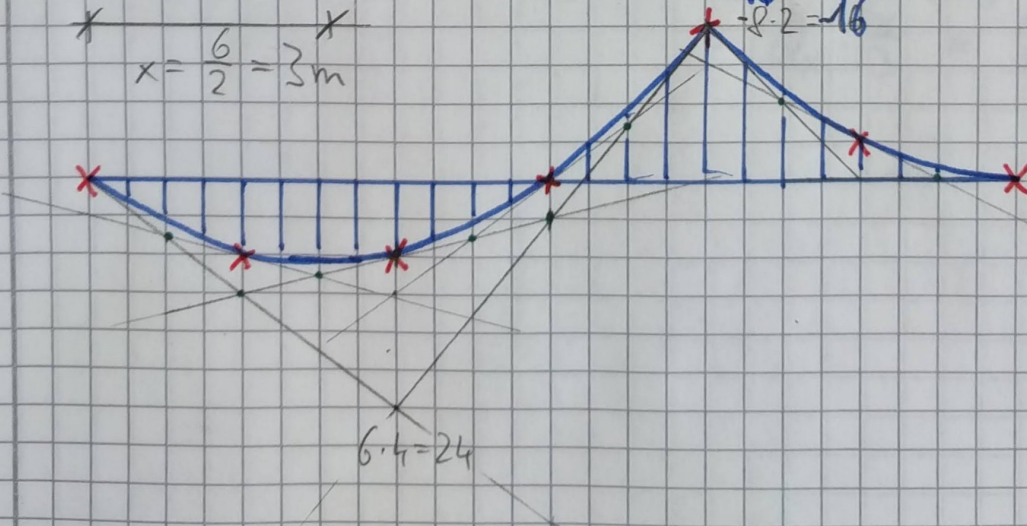
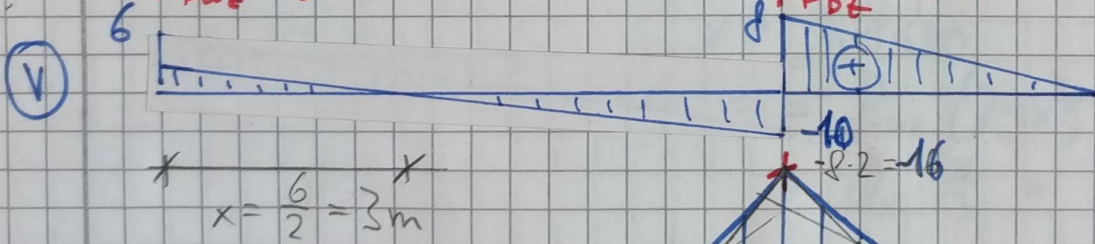
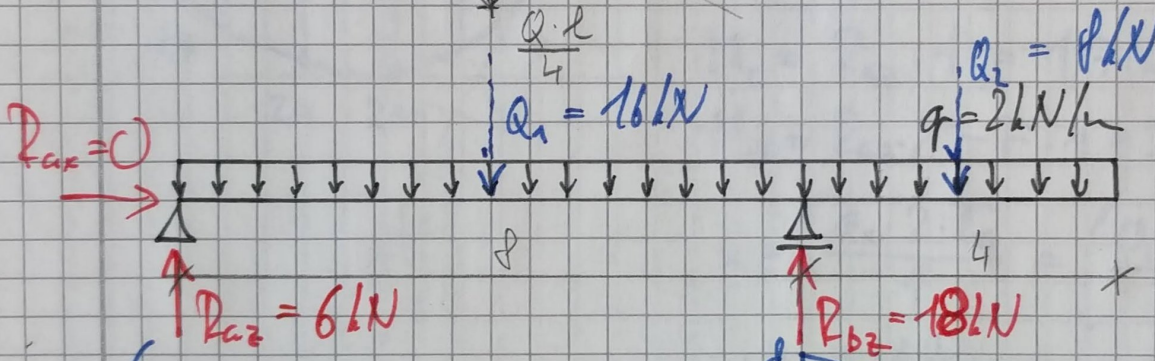
$$M_x = R_{az} \cdot x - Q_x \cdot \frac{x}{2}$$



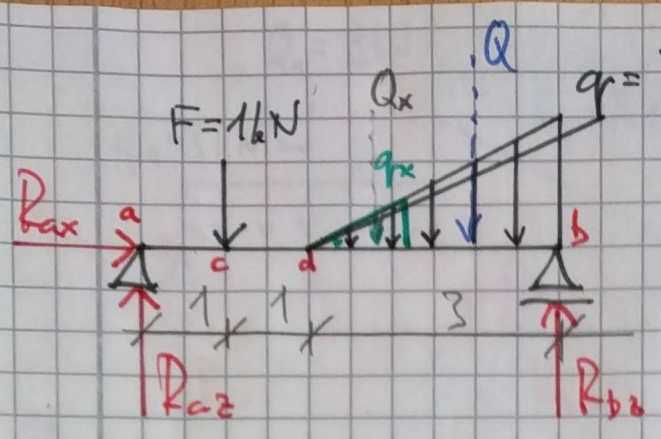
# tečnový polygon



dotyky  
 x body tečen  
 • body pod  
 "nahradními silami"







$$Q = \frac{3 \cdot 3}{2} = 4,5 \text{ kN}$$

$$\sum F_{ix} = 0 \Rightarrow R_{ax} = 0$$

$$\sum M_{ia} = 0 \quad (\uparrow)$$

$$-F \cdot 1 - Q \cdot 4 + R_{bz} \cdot 5 = 0$$

$$R_{bz} = 3,8 \text{ kN} \quad (1)$$

$$\sum M_{ib} = 0 \quad (\uparrow)$$

$$-R_{az} \cdot 5 + F \cdot 4 + Q \cdot 1 = 0$$

$$R_{az} = 1,7 \text{ kN} \quad (1)$$

Kontrol:

$$\sum F_{iz} = 0:$$

$$1 + 4,5 - 3,8 - 1,7 = 0 \quad \checkmark$$

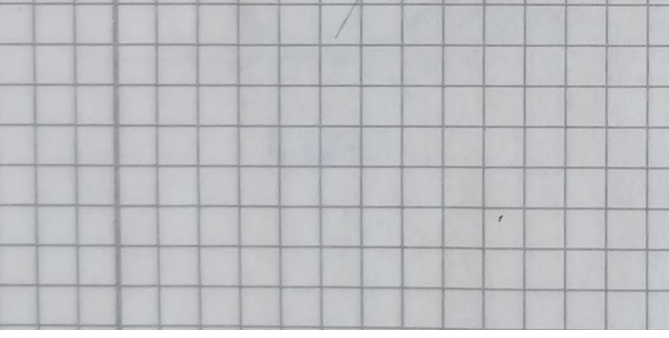
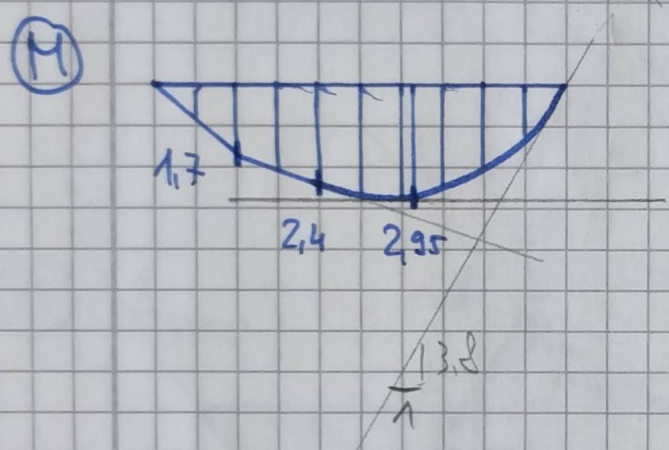
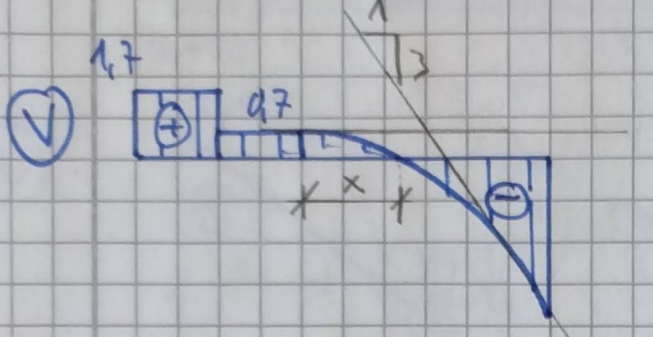
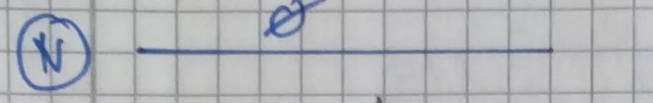
$$M_c = R_{az} \cdot 1 = 1,7 \text{ kNm}$$

$$M_d = R_{az} \cdot 2 - F \cdot 1 = 2,4 \text{ kNm}$$

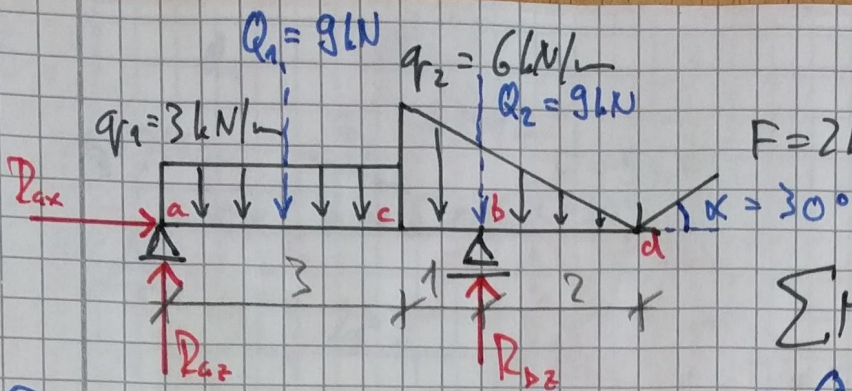
$$x = \sqrt{\frac{q_x \cdot 2 \cdot l_0}{q}} = \sqrt{\frac{0,7 \cdot 2 \cdot 3}{3}}$$

$$x = 1,18 \text{ m}$$

$$M_x = R_{az} (2+x) - F(1+x) - Q_x \cdot \frac{x}{3} = 2,95 \text{ kNm}$$







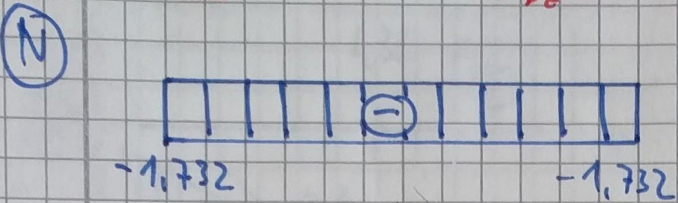
$$\sum F_{ix} = 0$$

$$R_{ax} = F \cdot \cos \alpha = 1,732 \text{ kN}$$

$$\sum M_{ra} = 0: \curvearrowright$$

$$-Q_1 \cdot \frac{3}{2} + R_{bz} \cdot 4 - Q_2 \cdot 4 - F \sin \alpha \cdot 6 = 0$$

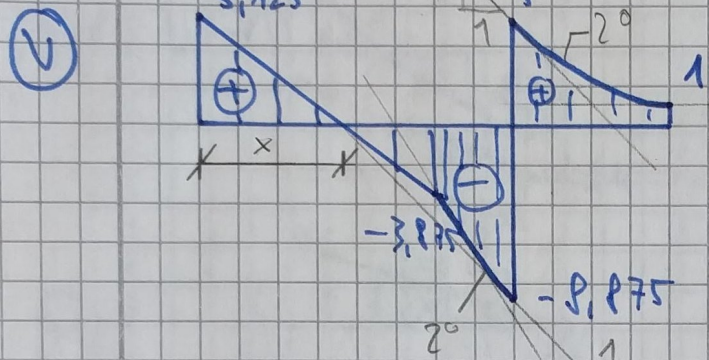
$$R_{bz} = 13,875 \text{ kN} \quad (\uparrow)$$



$$\sum M_{ib} = 0: \curvearrowright$$

$$-R_{az} \cdot 4 + Q_1 \cdot 2,5 + Q_2 \cdot 0 - F \sin \alpha \cdot 2 = 0$$

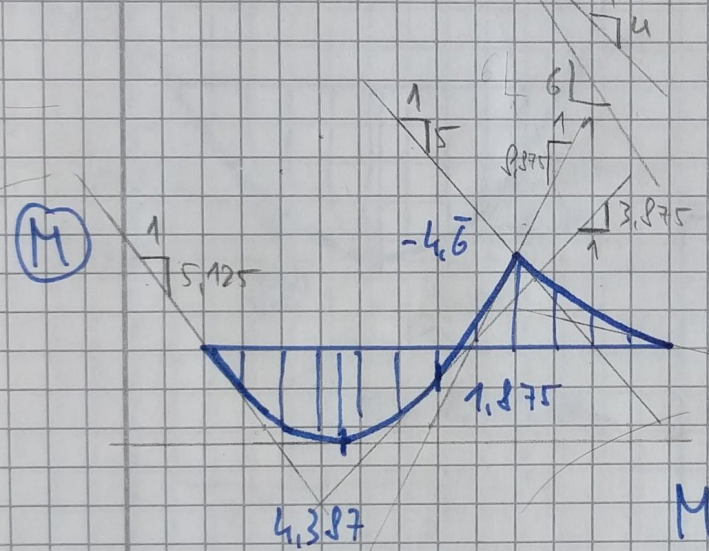
$$R_{az} = 5,125 \text{ kN} \quad (\uparrow)$$



Kontrol:

$$\sum F_{iz} = 0:$$

$$9 + 9 + 1 - 13,875 - 5,125 = 0$$



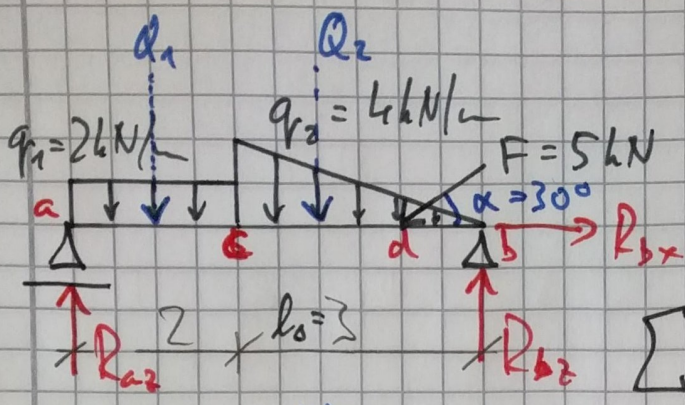
$$x = \frac{V_a}{q_1} = 1,708 \text{ m}$$

$$M_x = R_{az} \cdot x - \frac{q_1 \cdot x^2}{2} = 4,378 \text{ kNm}$$

$$M_c = R_{az} \cdot 3 - \frac{q_1 \cdot 3^2}{2} = 1,875 \text{ kNm}$$

$$M_d = -F_2 \cdot 2 - \frac{q_2 \cdot 2}{2} \cdot \frac{2}{3} = -4,667 \text{ kNm}$$





$Q_1 = 4 \text{ kN}$     $Q_2 = 6 \text{ kN}$   
 $F_x = 4,330 \text{ kN}$   
 $F_z = 2,5 \text{ kN}$

$\sum F_{ix} = 0 \quad R_{bx} = 4,330 \text{ kN} (\rightarrow)$

$\sum M_{ia} = 0 \quad (\checkmark)$

$-Q_1 \cdot 1 - Q_2 \cdot 3 - F_z \cdot 4 + R_{bz} \cdot 5 = 0$   
 $R_{bz} = 6,400 \text{ kN} (\uparrow)$

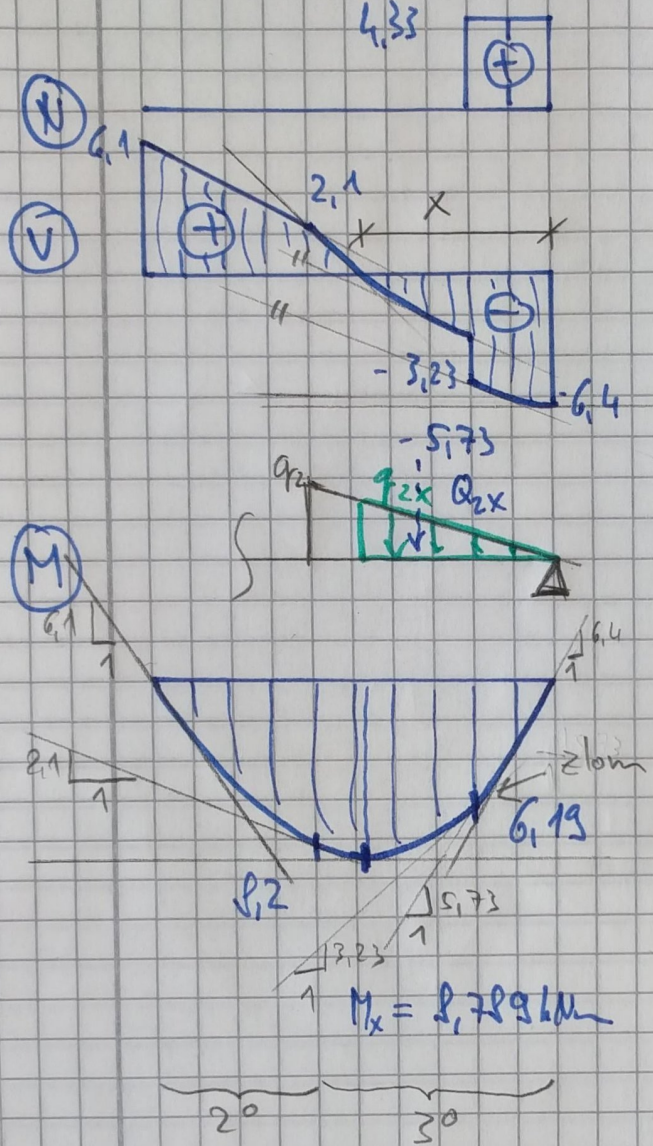
$\sum M_{ib} = 0 \quad (\checkmark)$

$-R_{az} \cdot 5 + Q_1 \cdot 4 + Q_2 \cdot 2 + F_z \cdot 1 = 0$   
 $R_{az} = 6,100 \text{ kN} (\uparrow)$

Kontrol:

$\sum F_{iz} = 0$

$Q_1 + Q_2 + F_z - R_{az} - R_{bz} = 0 \quad (\checkmark)$



$M_c = R_{az} \cdot 2 - \frac{q_1 \cdot 2^2}{2} = 9,2 \text{ kNm}$

$M_d = R_{bz} \cdot 1 - \frac{q_2 \cdot 1}{3 \cdot 2} \cdot \frac{1}{3} = 6,177 \text{ kNm}$

$Q_{2x} = |V_b| - F_z = 3,9 \text{ kN}$

$\frac{q_{2x}}{x} = \frac{q_2}{l_2} \Rightarrow q_{2x} = \frac{q_2 \cdot x}{l_2}$

$Q_{2x} = \frac{q_2 \cdot x}{l_2} \cdot x$

$x = \sqrt{\frac{Q_{2x} \cdot 2 \cdot l_2}{q_2}} = 2,419 \text{ m}$

$M_x = R_{bz} \cdot x - Q_{2x} \cdot \frac{1}{3} x - F_z \cdot (x-1) = 9,789 \text{ kNm}$