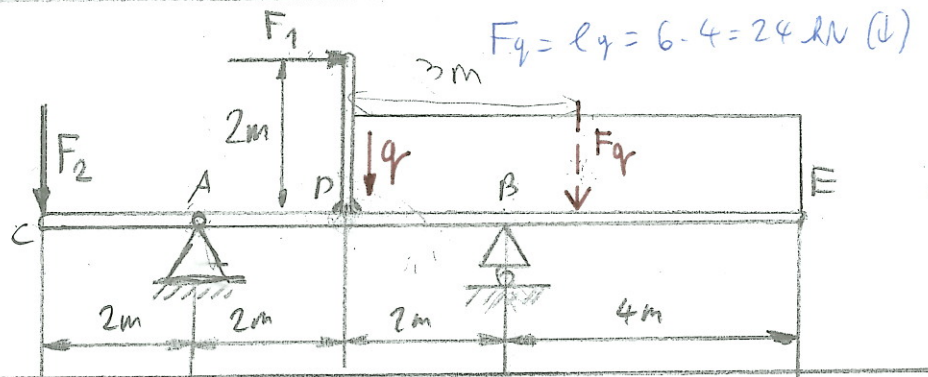


adott:

$$F_1 = 3 \text{ kN}$$

$$F_2 = 4 \text{ kN}$$

$$q = 4 \text{ kN/m}$$



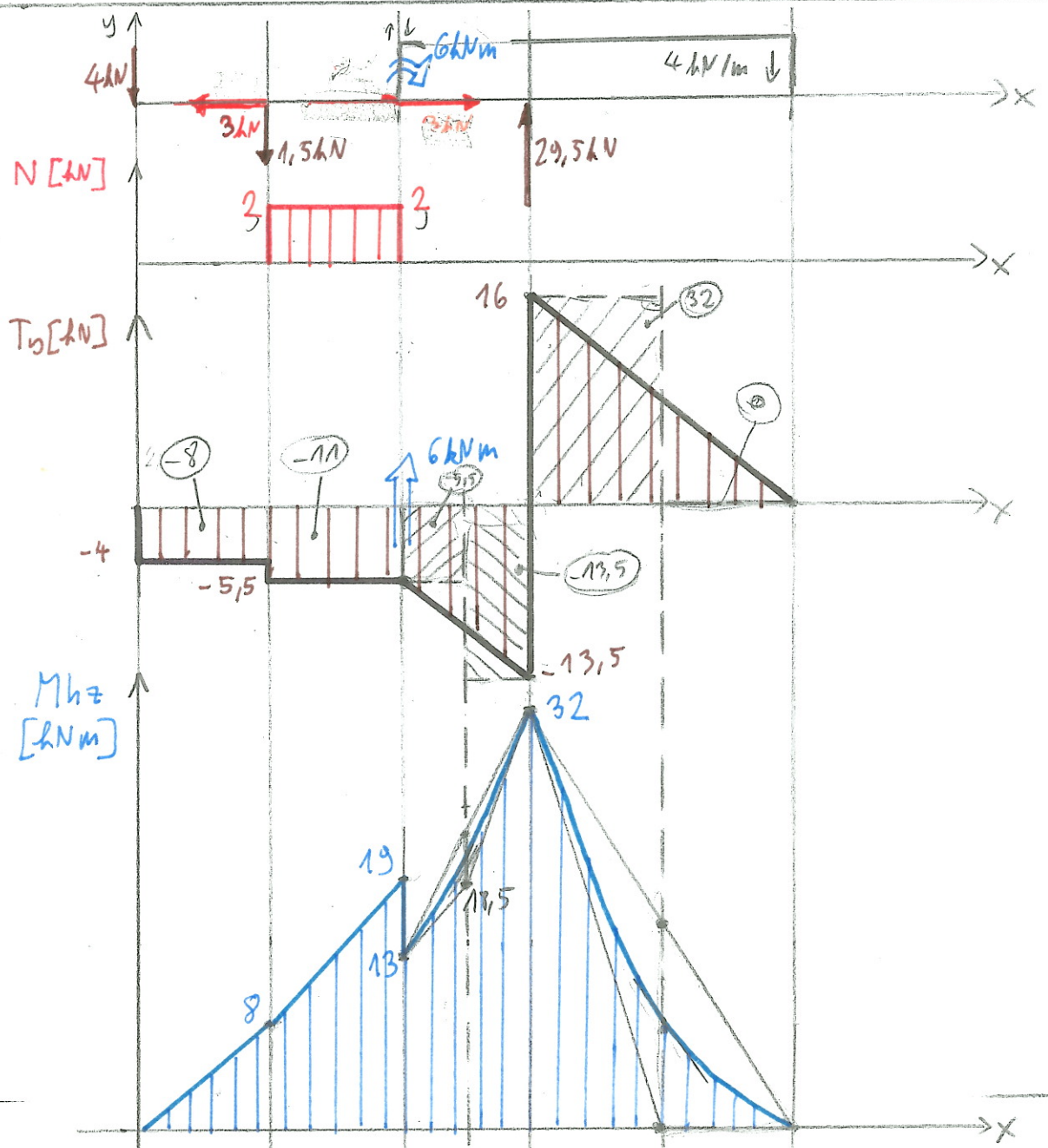
$$a) M_a = 0 = 2F_2 - 2F_1 + 4F_{By} - 5F_{qy} \Rightarrow F_{By} = \frac{-2F_2 + 2F_1 + 5F_{qy}}{4} =$$

$$= \frac{-2 \cdot 4 + 2 \cdot 3 + 5 \cdot 24}{4} = 29,5 \text{ kN}(\uparrow)$$

$$M_b = 0 = 6F_2 - 4F_{Ay} - 2F_1 - 1F_{qy} \Rightarrow F_{Ay} = \frac{6F_2 - 2F_1 - 1F_{qy}}{4} =$$

$$= \frac{6 \cdot 4 - 2 \cdot 3 - 1 \cdot 24}{4} = -1,5 \text{ kN}(\downarrow)$$

$$F_x = 0 = F_{Ax} + F_1 \Rightarrow F_{Ax} = -F_1 = -3 \text{ kN}(\leftarrow)$$



10.1

adott:

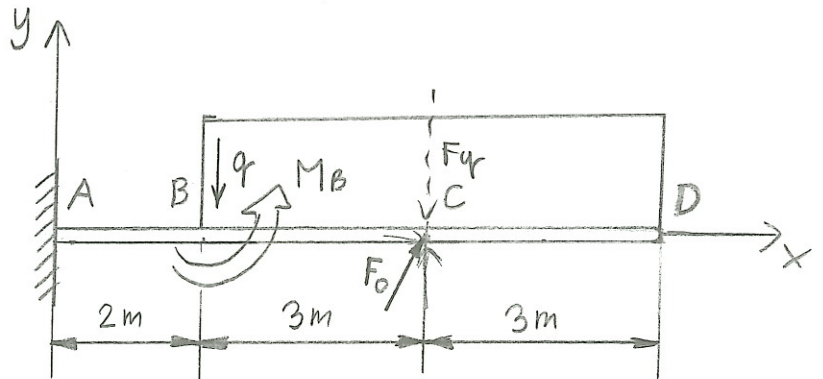
$$\vec{F}_0 = (5\vec{i} + 10\vec{j}) \text{ kN}$$

$$q = 2 \text{ kN/m} \rightarrow F_q = 12 \text{ kN}$$

$$M_B = 8 \text{ kNm}$$

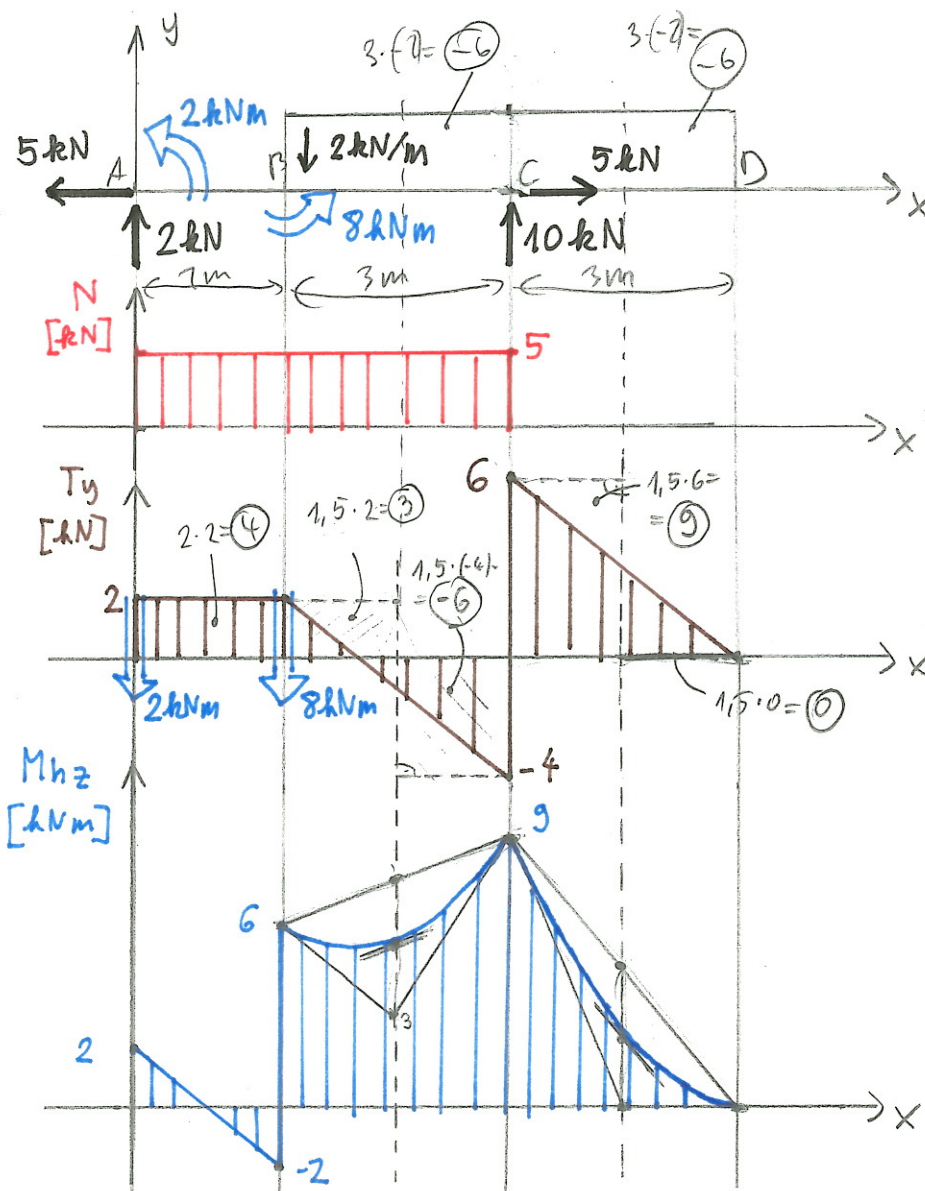
feladat:

- támasztóerők
- igénybevételi ábrák



a)  $F_x = 0 = F_{Ax} + F_{0x} \Rightarrow F_{Ax} = -F_{0x} = -5 \text{ kN} (\leftarrow)$   
 $F_y = 0 = F_{Ay} - F_q + F_{0y} \Rightarrow F_{Ay} = F_q - F_{0y} = 12 - 10 = 2 \text{ kN} (\uparrow)$   
 $M_a = 0 = M_A + M_B - 5F_q + 5F_{0y} \Rightarrow M_A = -M_B + 5F_q - 5F_{0y} =$   
 $= -8 + 5 \cdot 12 - 5 \cdot 10 = 2 \text{ kNm} (\curvearrowright)$

b)



mind  
-1!!

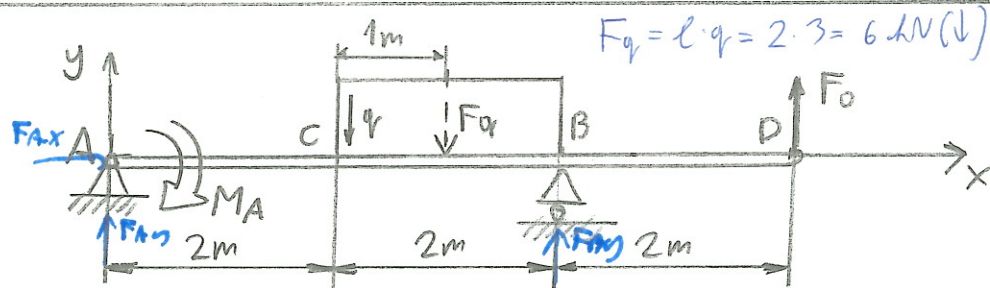
10.5.

adott:

$q = 3 \text{ kN/m}$

$F_0 = 4 \text{ kN}$

$M_A = 5 \text{ kNm}$



$F_q = l \cdot q = 2 \cdot 3 = 6 \text{ kN}(\downarrow)$

a)  $F_x = 0 = F_{Ax}$

$M_a = 0 = -M_A - 3F_q + 4F_{By} + 6F_0 \Rightarrow F_{By} = \frac{M_A + 3F_q - 6F_0}{4} =$

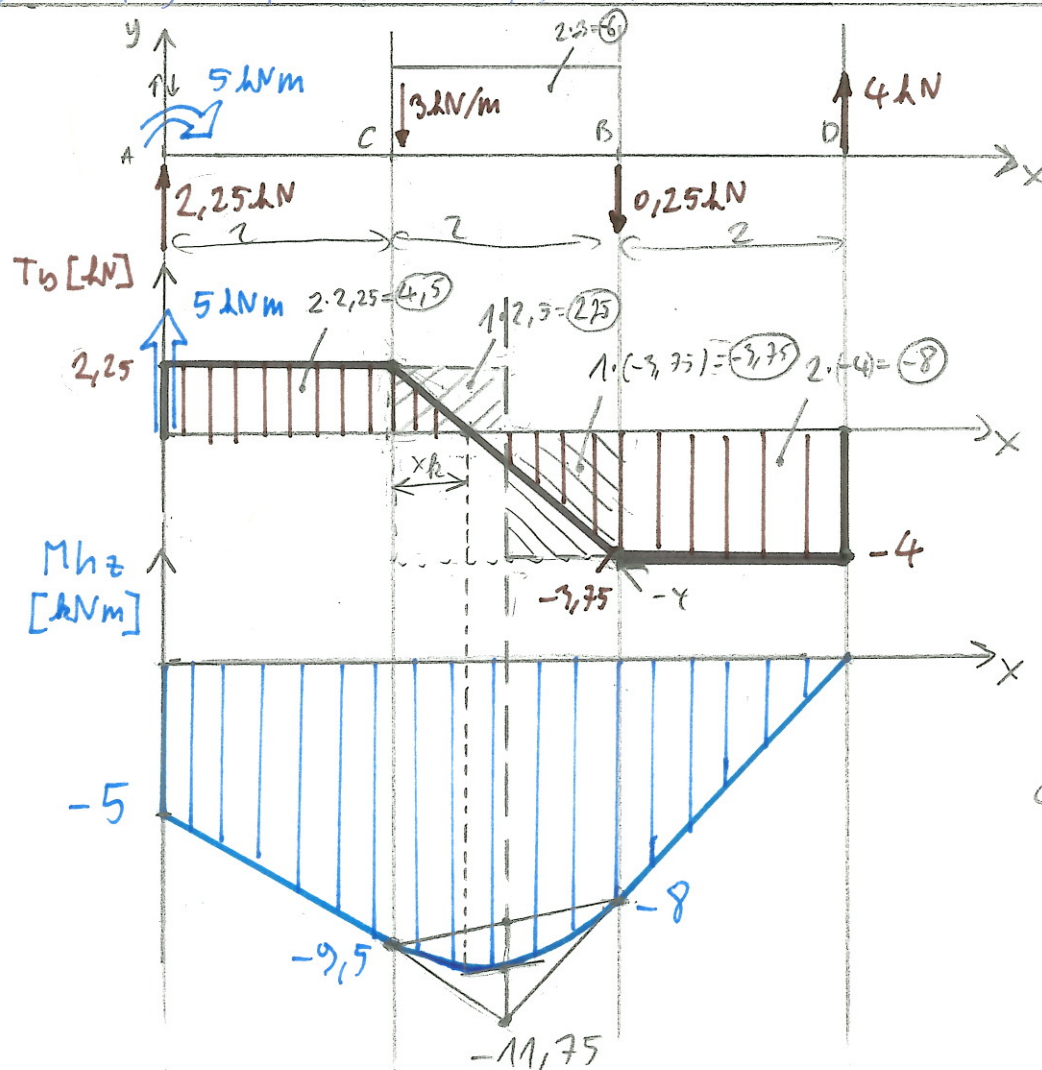
$= \frac{5 + 3 \cdot 6 - 6 \cdot 4}{4} = -0,25 \text{ kN}(\downarrow)$

$M_b = 0 = -4F_{Ay} - M_A + 1F_q + 2F_0 \Rightarrow F_{Ay} = \frac{-M_A + 1F_q + 2F_0}{4} =$

$= \frac{-5 + 1 \cdot 6 + 2 \cdot 4}{4} = 2,25 \text{ kN}(\uparrow)$

VALG  $F_y = 0 = F_{Ay} + F_q + F_{By} + F_0 \Rightarrow F_{Ay} = F_q - F_{By} - F_0 = 6 - (-0,25) - 4 = 2,25 \text{ kN}(\uparrow)$

b)



$x_h \Rightarrow \frac{2}{6} = \frac{x_h}{2,25} \Rightarrow x_h = \frac{2}{6} \cdot 2,25 = 0,75 \text{ m}$

$x_v = 2 + x_h = 2,75 \text{ m}$

$M_{\min} = -9,5 - \frac{2,25 \cdot 0,75}{2} = -10,34 \text{ kNm} \rightarrow |M_{bz\max}| = 10,34 \text{ kNm}$

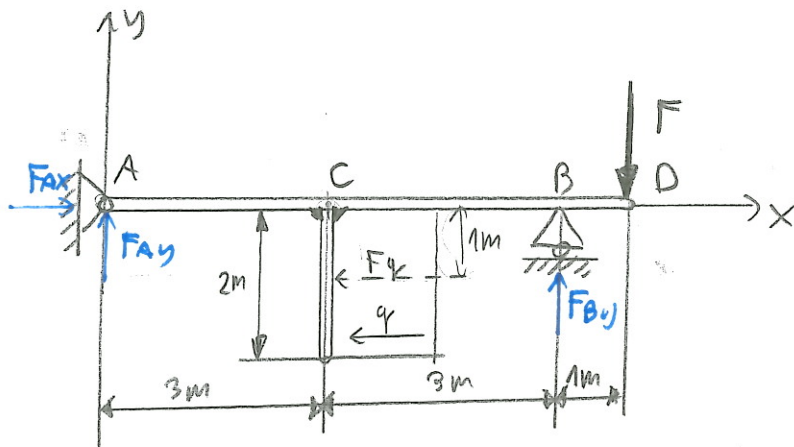
10.6

adott:

$$q = 5 \text{ kN/m}$$

$$F = 12 \text{ kN}$$

Feladat:  
lénybevételi  
ábrák



$$F_q = 2 \cdot 5 = 10 \text{ kN} (\leftarrow)$$

• támasztörvök

$$M_a = 0 = -1 \cdot F_q - 7 \cdot F + 6 F_{By} \Rightarrow F_{By} = \frac{1 \cdot F_q + 7 \cdot F}{6} = \frac{1 \cdot 10 + 7 \cdot 12}{6} = 15,6 \text{ kN} (\uparrow)$$

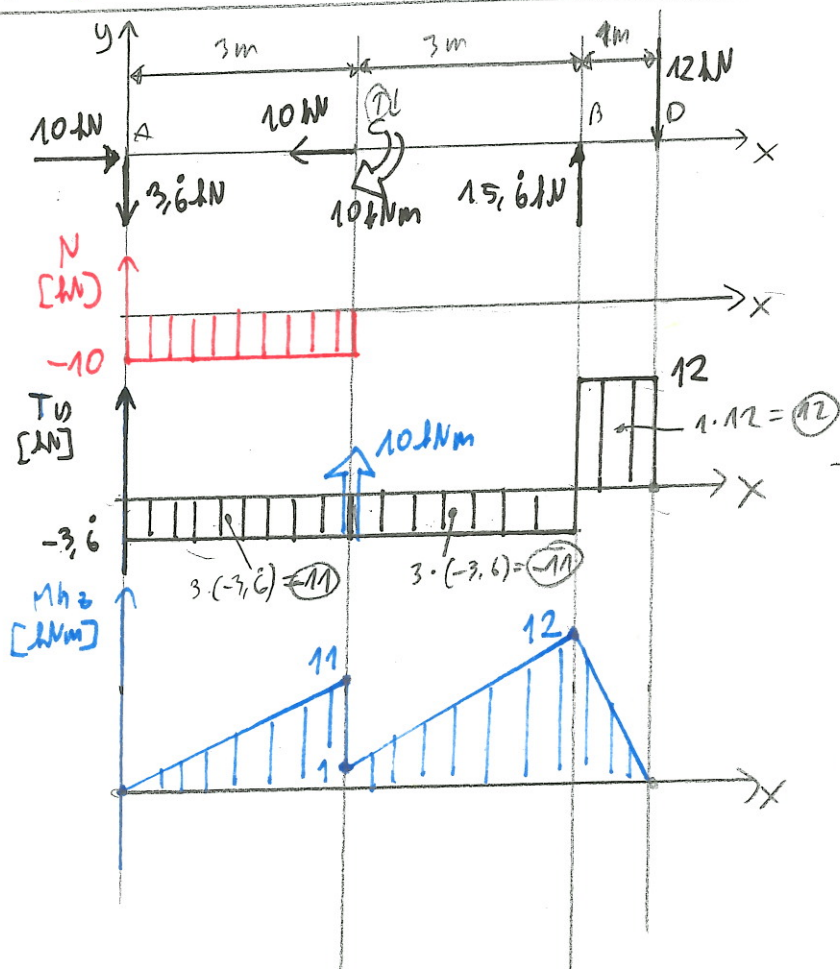
$$F_x = 0 = F_{Ax} - F_q \Rightarrow F_{Ax} = F_q = 10 \text{ kN} (\rightarrow)$$

$$F_y = 0 = F_{Ay} + F_{By} - F \Rightarrow F_{Ay} = F - F_{By} = 12 - 15,6 = -3,6 \text{ kN} (\downarrow)$$

• kiálló rúd szakasz C pontba redukálása

$$F_{Cx} = F_q = 10 \text{ kN} (\leftarrow)$$

$$M_C = -1 \cdot F_q = -1 \cdot 10 = -10 \text{ kNm} (\curvearrowright)$$



$$|M_{kz \max}| = 12 \text{ kNm} \quad x_v = 6 \text{ m}$$

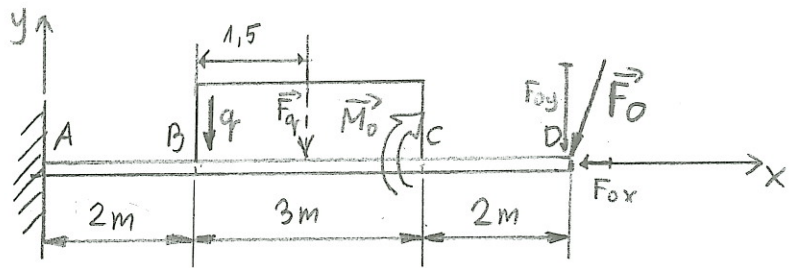
10.2

adott:

$$\vec{F}_0 = (-4\vec{i} - 5\vec{j}) \text{ kN}$$

$$q = 2 \text{ kN/m} \rightarrow F_q = 6 \text{ kN}$$

$$M_0 = 8 \text{ kNm}$$

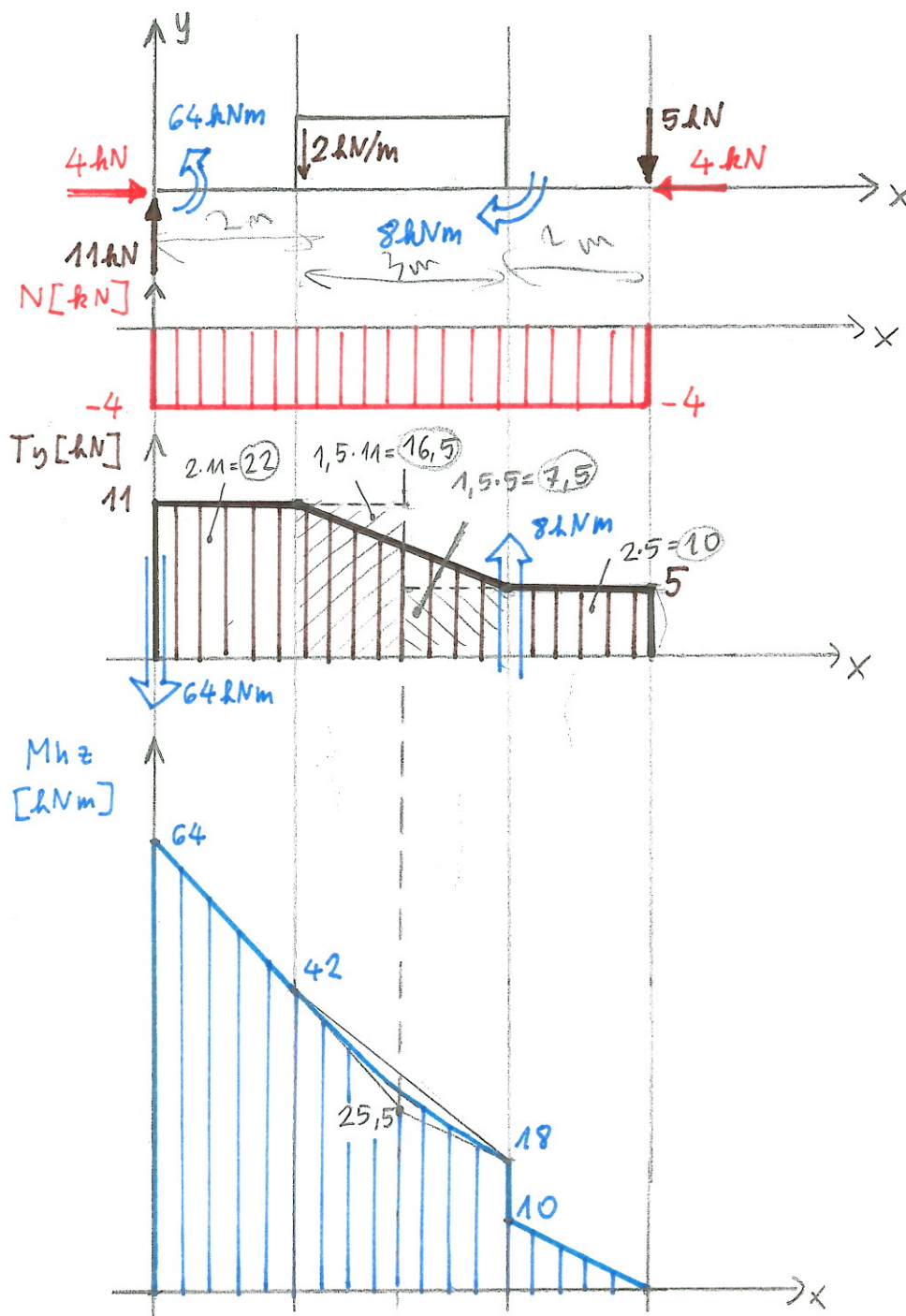


a)  $F_x = 0 = F_{Ax} - F_{0x} \Rightarrow F_{Ax} = F_{0x} = 4 \text{ kN} (\rightarrow)$

$F_y = 0 = F_{Ay} - F_q - F_{0y} \Rightarrow F_{Ay} = F_q + F_{0y} = 6 + 5 = 11 \text{ kN} (\uparrow)$

$M_a = 0 = M_A - M_0 - 3,5 F_q - 7 F_{0y} \Rightarrow M_A = M_0 + 3,5 F_q + 7 F_{0y} = 8 + 3,5 \cdot 6 + 7 \cdot 5 = 64 \text{ kNm} (\curvearrowright)$

b)



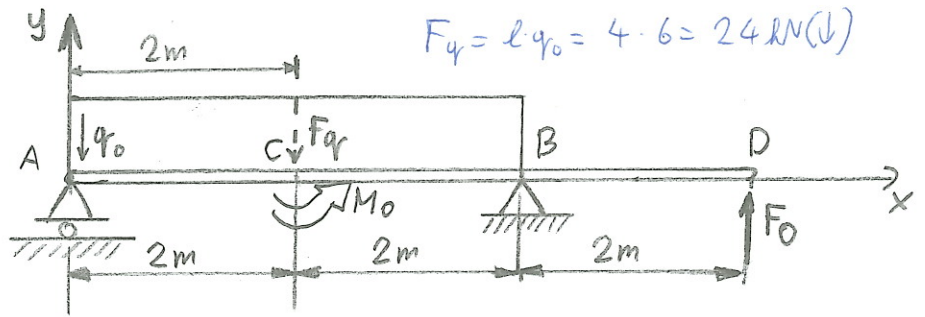
10.3

adott:

$$F_0 = 8 \text{ kN}$$

$$q_0 = 6 \text{ kN/m}$$

$$M_0 = 10 \text{ kNm}$$



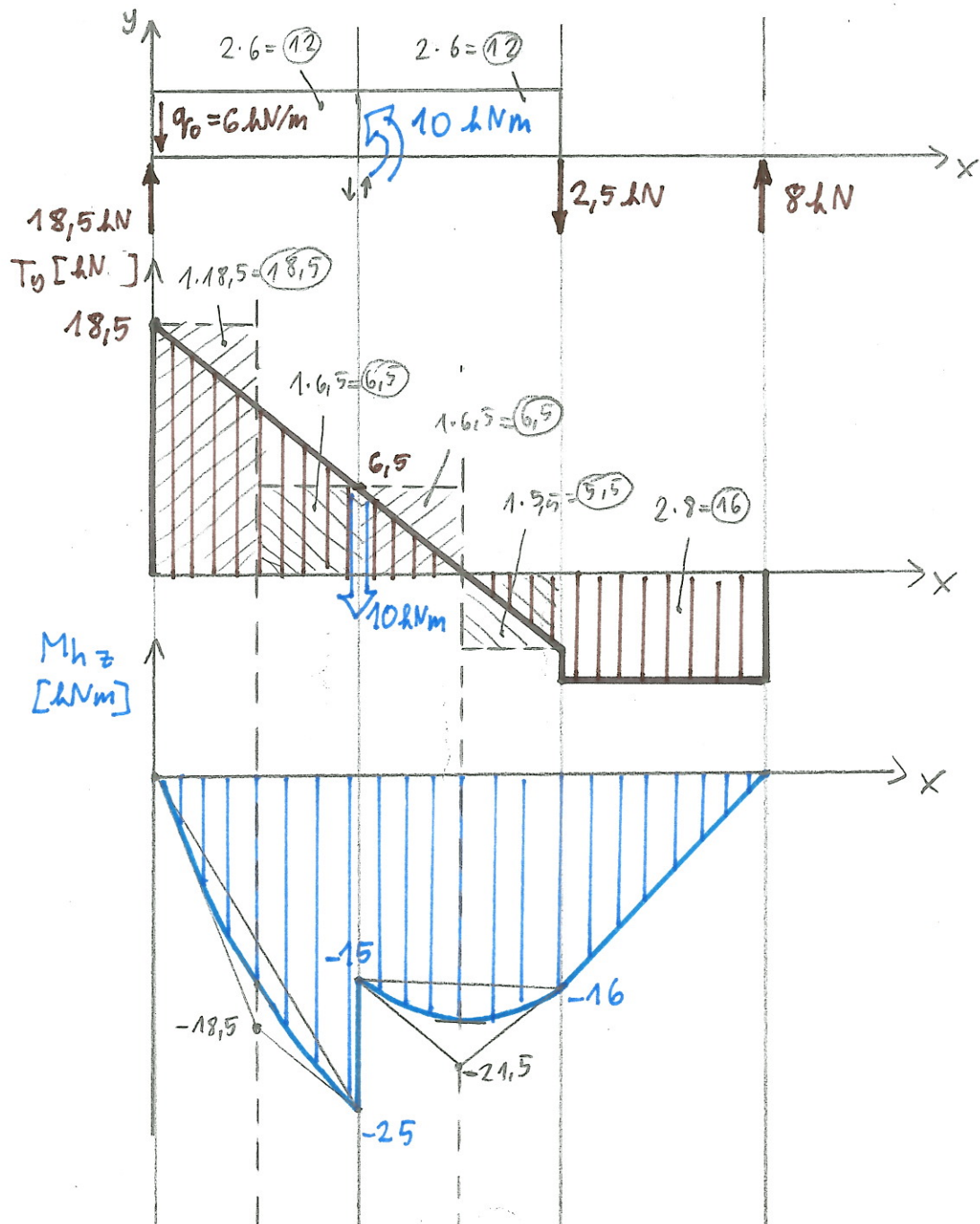
$$a) M_a = 0 = M_0 - 2F_q + 4F_{By} + 6F_0 \Rightarrow F_{By} = \frac{-M_0 + 2F_q - 6F_0}{4} =$$

$$= \frac{-10 + 2 \cdot 24 - 6 \cdot 8}{4} = -2,5 \text{ kN}(\downarrow)$$

$$M_b = 0 = -4F_{Ay} + 2F_q + M_0 + 2F_0 \Rightarrow F_{Ay} = \frac{2F_q + M_0 + 2F_0}{4} =$$

$$= \frac{2 \cdot 24 + 10 + 2 \cdot 8}{4} = 18,5 \text{ kN}(\uparrow)$$

b)

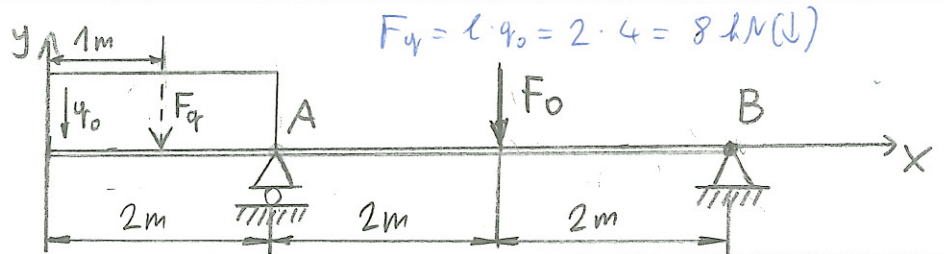


10.4

adott:

$$F_0 = 12 \text{ kN}$$

$$q_0 = 4 \text{ kN/m}$$

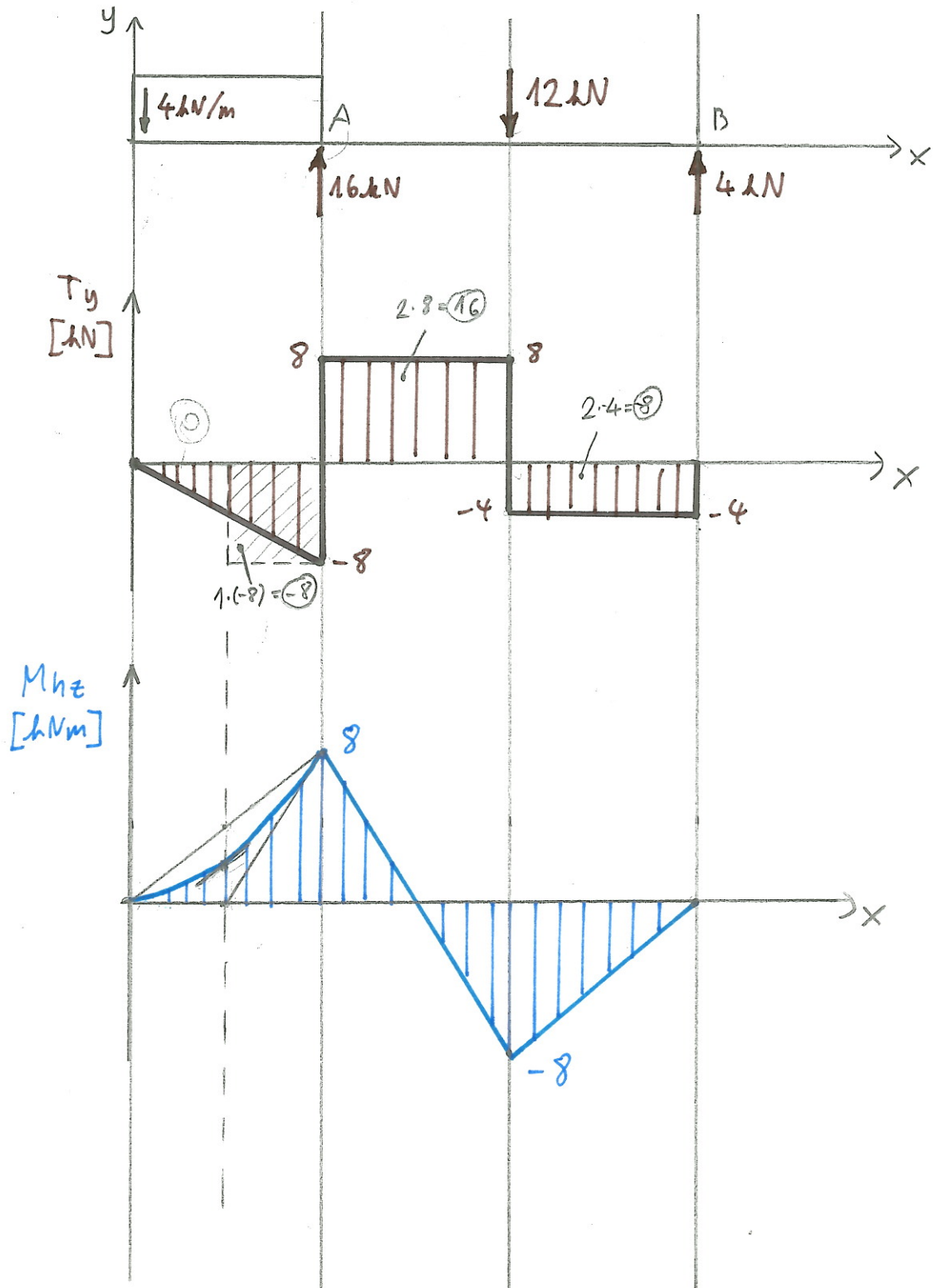


$$F_q = l \cdot q_0 = 2 \cdot 4 = 8 \text{ kN}(\downarrow)$$

a)  $M_A = 0 = 1F_q - 2F_0 + 4F_{By} \Rightarrow F_{By} = \frac{2F_0 - 1F_q}{4} = \frac{2 \cdot 12 - 1 \cdot 8}{4} = 4 \text{ kN}(\uparrow)$

$M_B = 0 = +5F_q - 4F_{Ay} + 2F_0 \Rightarrow F_{Ay} = \frac{5F_q + 2F_0}{4} = \frac{5 \cdot 8 + 2 \cdot 12}{4} = 16 \text{ kN}(\uparrow)$

b)



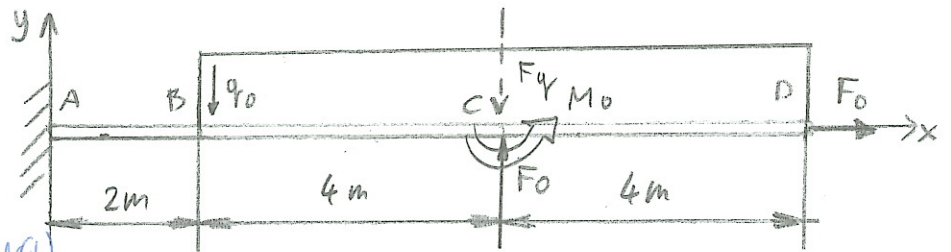
adott:

$$M_0 = 80 \text{ kNm}$$

$$F_0 = 70 \text{ kN}$$

$$q_0 = 10 \text{ kN/m}$$

$$F_q = l q_0 = 8 \cdot 10 = 80 \text{ kN}$$

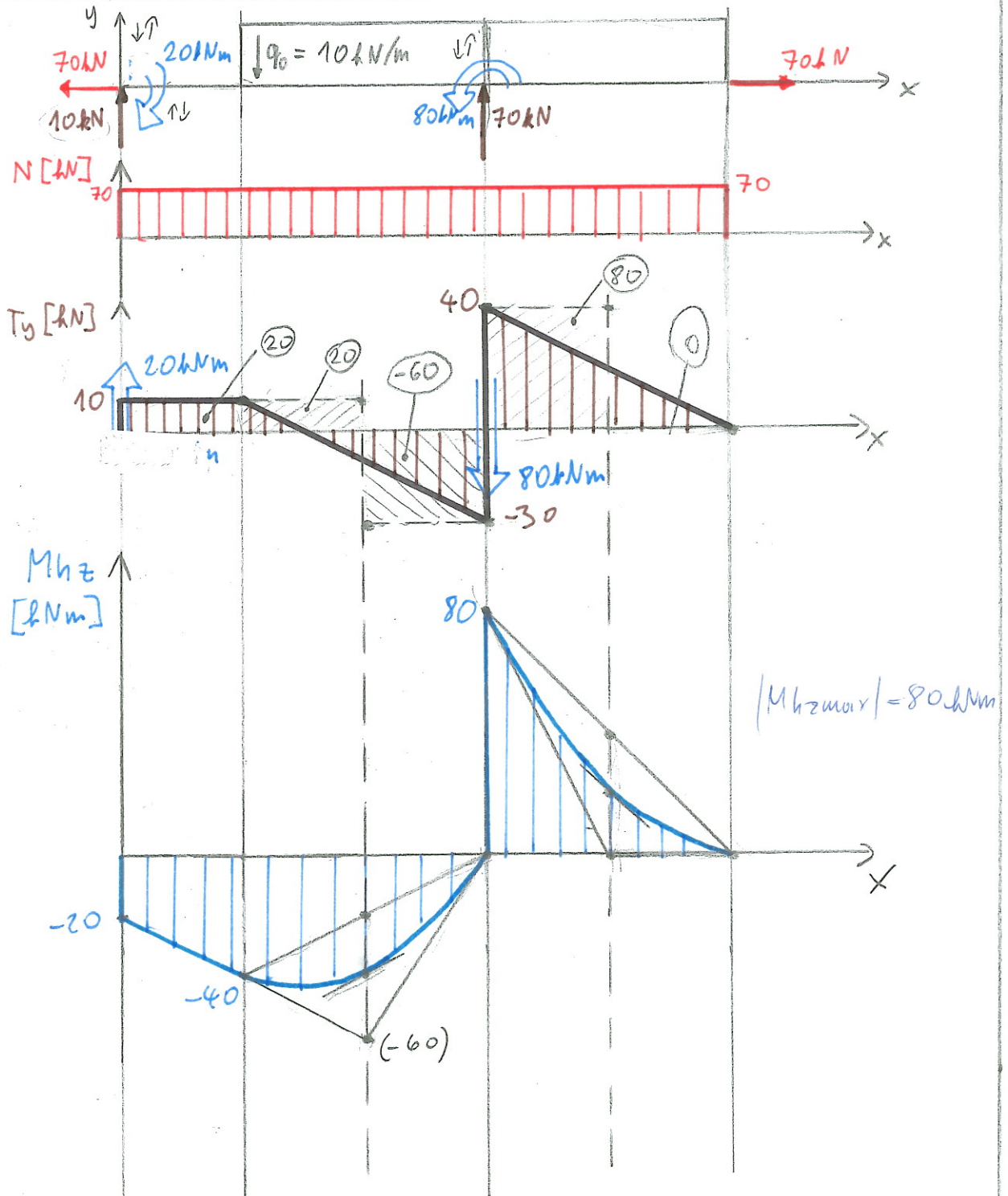


a)  $F_x = 0 = F_{Ax} + F_0 \Rightarrow F_{Ax} = -F_0 = -70 \text{ kN} (\leftarrow)$

$$F_y = 0 = F_{Ay} + F_0 - F_q \Rightarrow F_{Ay} = F_q - F_0 = 80 - 70 = 10 \text{ kN} (\uparrow)$$

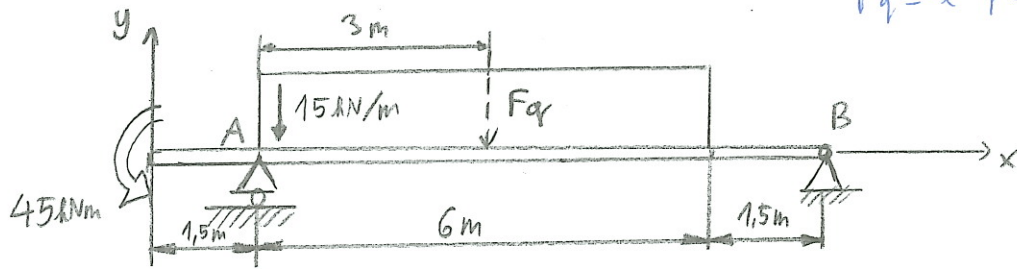
$$M_A = 0 = M_A + M_0 + 6F_0 - 6F_q \Rightarrow M_A = -M_0 - 6F_0 + 6F_q = -80 - 6 \cdot 70 + 6 \cdot 80 = -20 \text{ kNm} (\curvearrowright)$$

b)



adott

$$F_q = l \cdot q = 6 \cdot 15 = 90 \text{ kN(L)}$$



a)  $M_a = 0 = 45 - 3 \cdot 90 + 7,5 F_{By} \Rightarrow F_{By} = \frac{3 \cdot 90 - 45}{7,5} = 30 \text{ kN}(\uparrow)$   
 $M_b = 0 = 45 + 4,5 F_q - 7,5 F_{Ay} \Rightarrow F_{Ay} = \frac{+45 + 4,5 \cdot 90}{7,5} = 60 \text{ kN}(\uparrow)$

