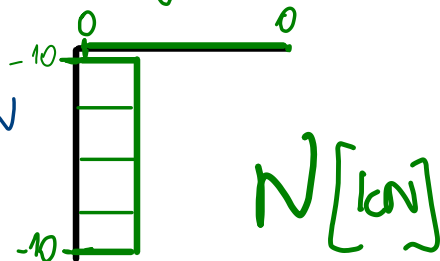


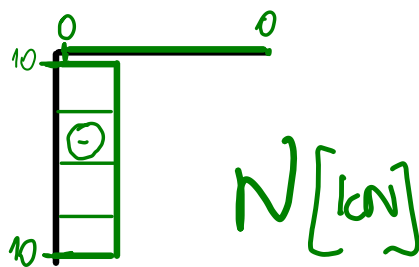
$Q [kN]$

$M_y [kNm]$

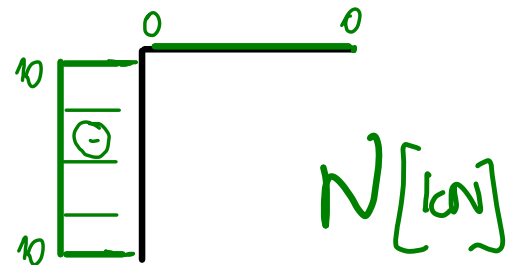
WERSJA 1.



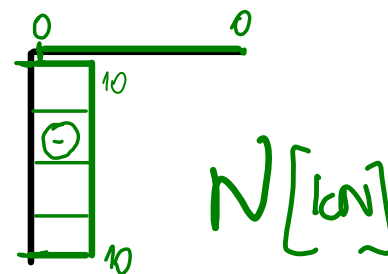
WERSJA 2.

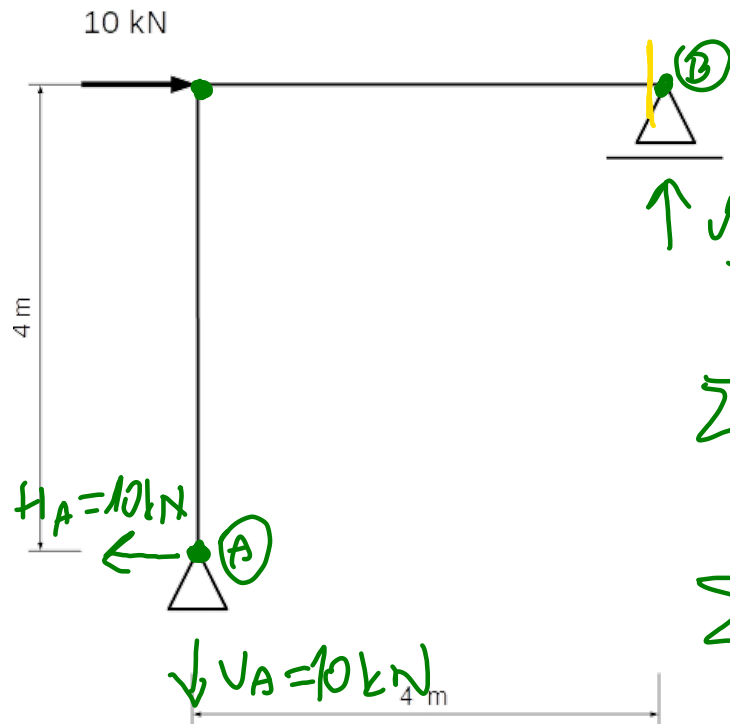


WERSJA 4.



WERSJA 3.



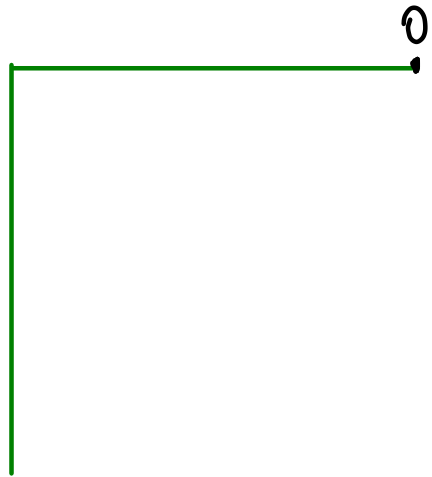


$$\uparrow V_B = 10 \text{ kN}$$

$$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$



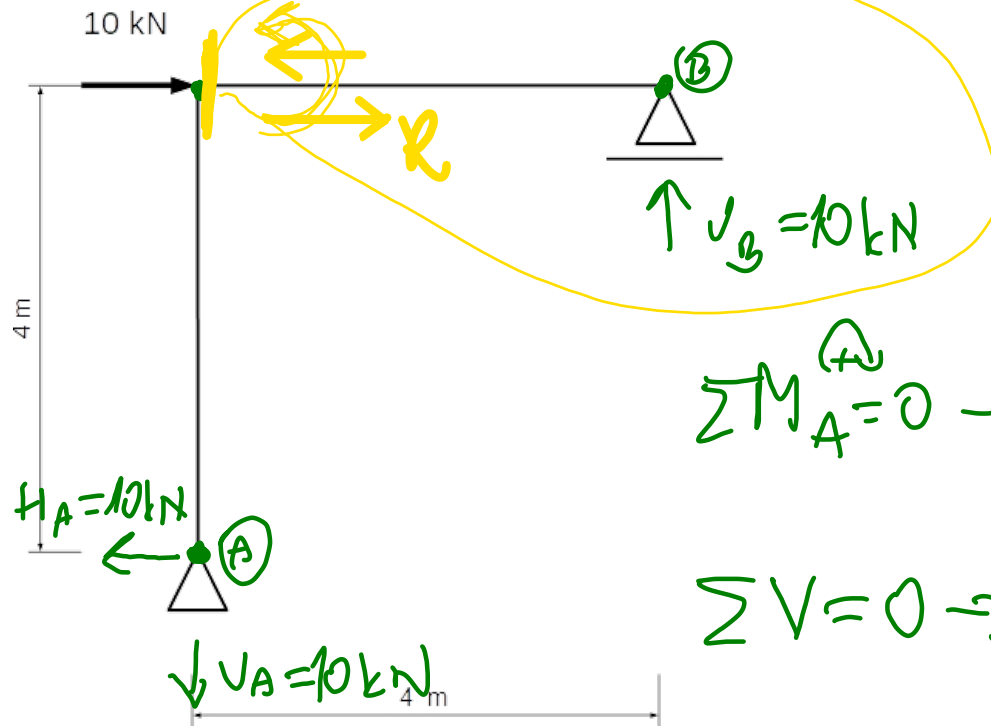
$M_y [\text{kNm}]$



$Q_z [\text{kN}]$



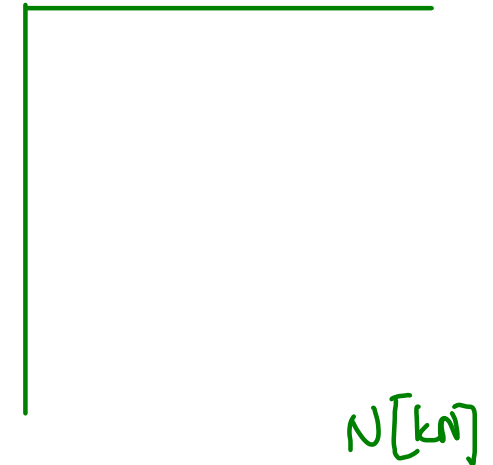
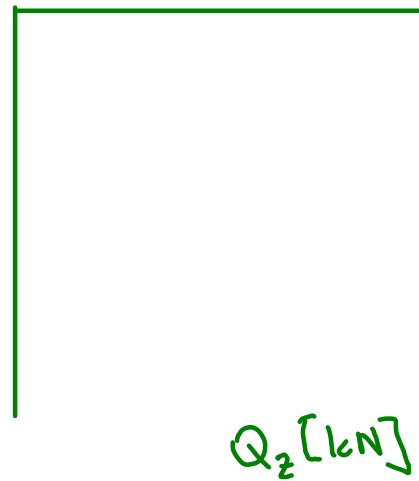
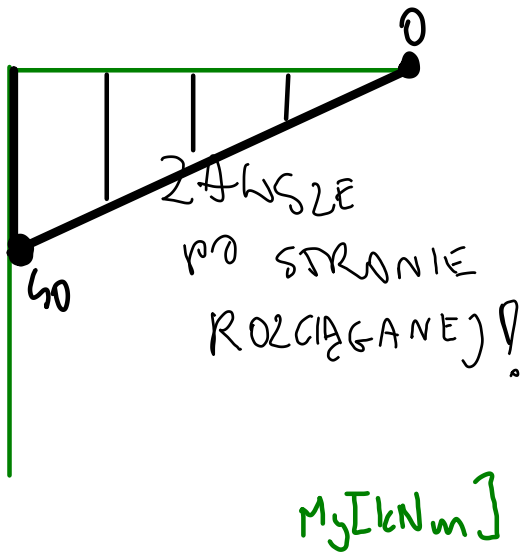
$N [\text{kN}]$

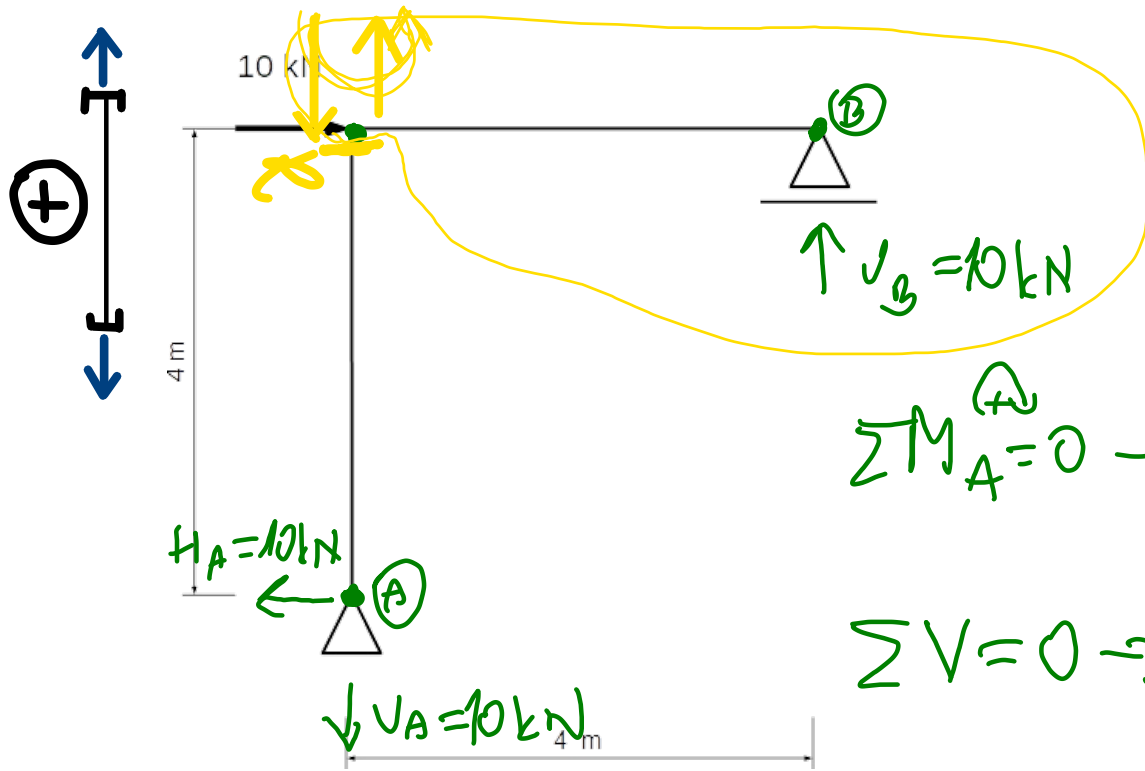


$$\sum M_A^{\text{A}} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$



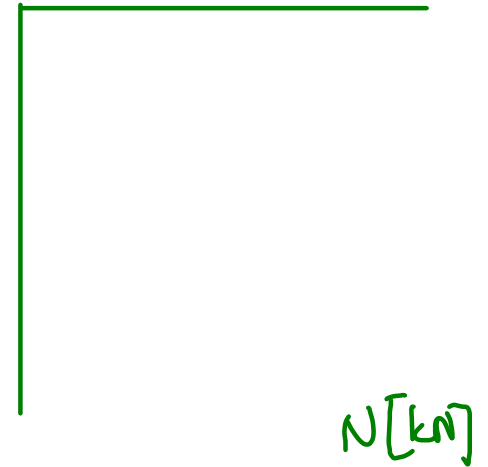
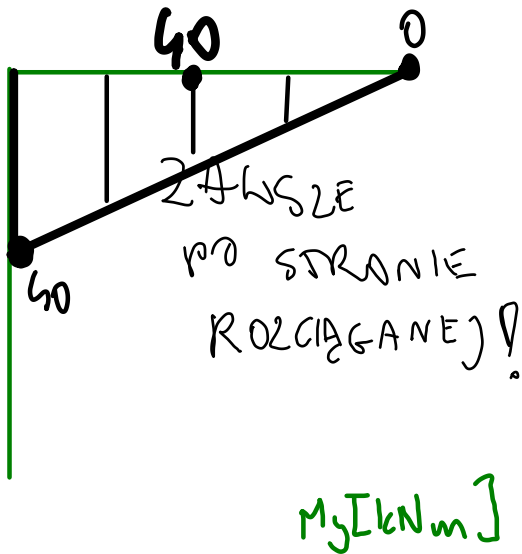


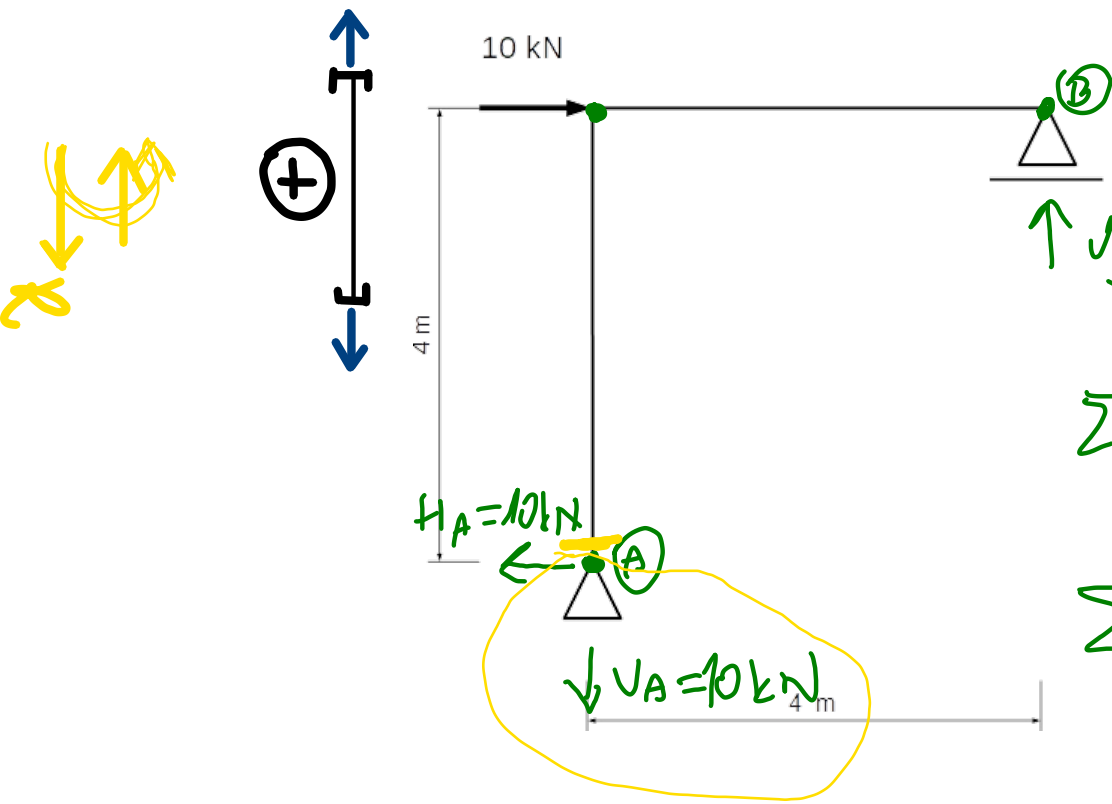
$$\uparrow V_B = 10 \text{ kN}$$

$$\sum M_A^{\circlearrowleft} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

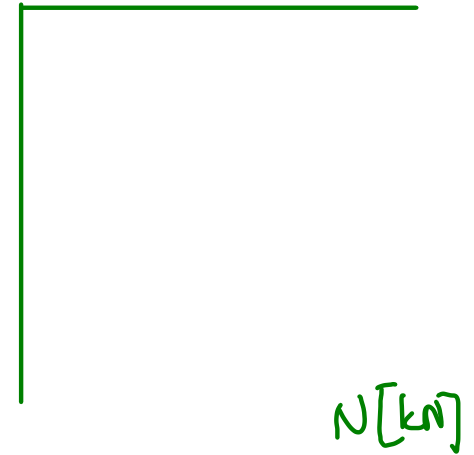
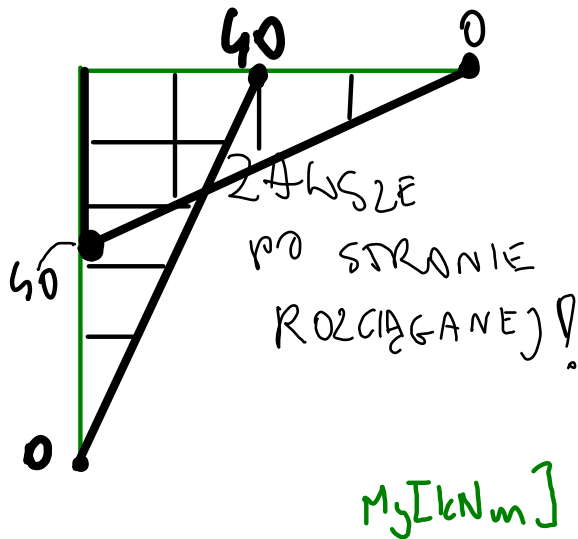


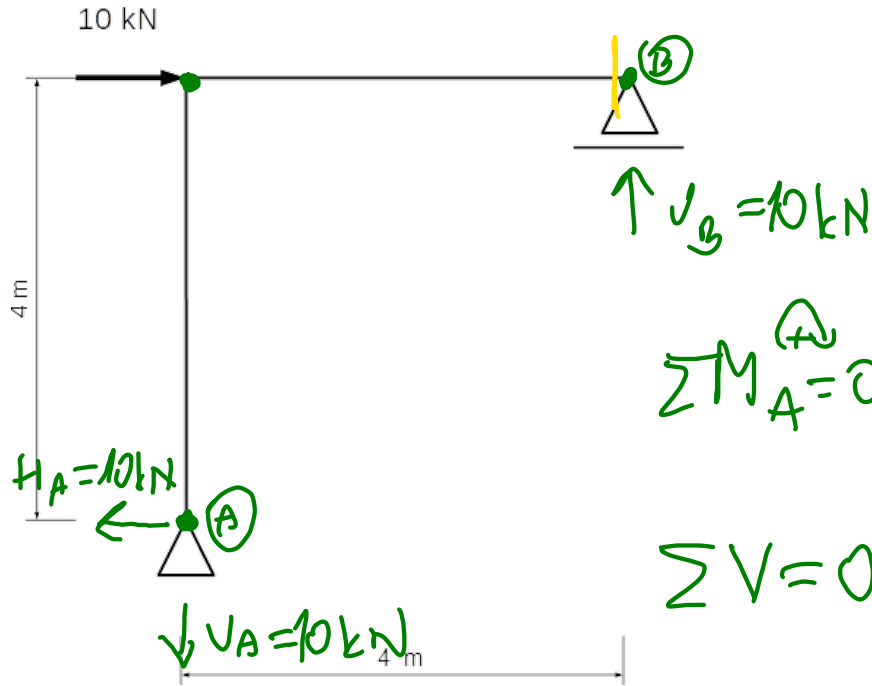
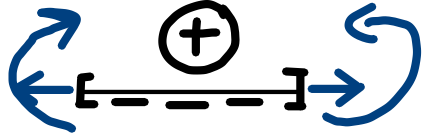


$$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

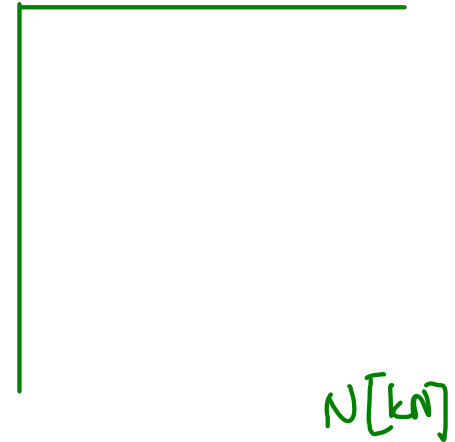
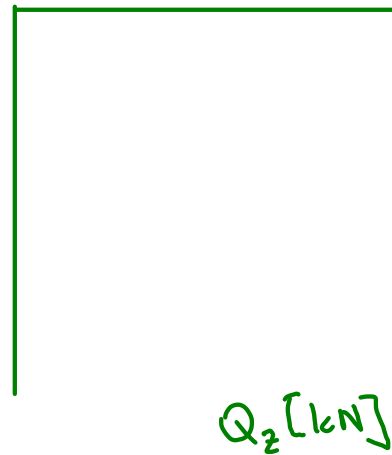
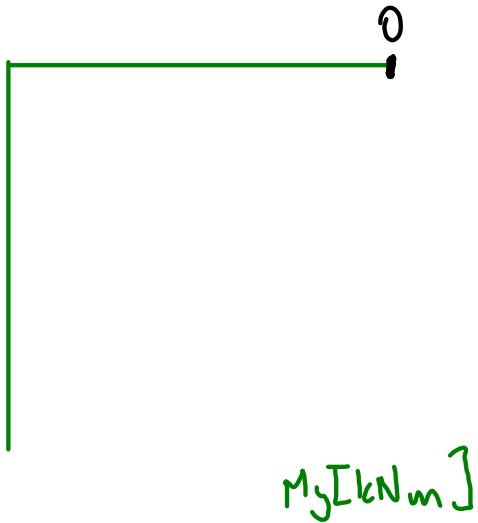


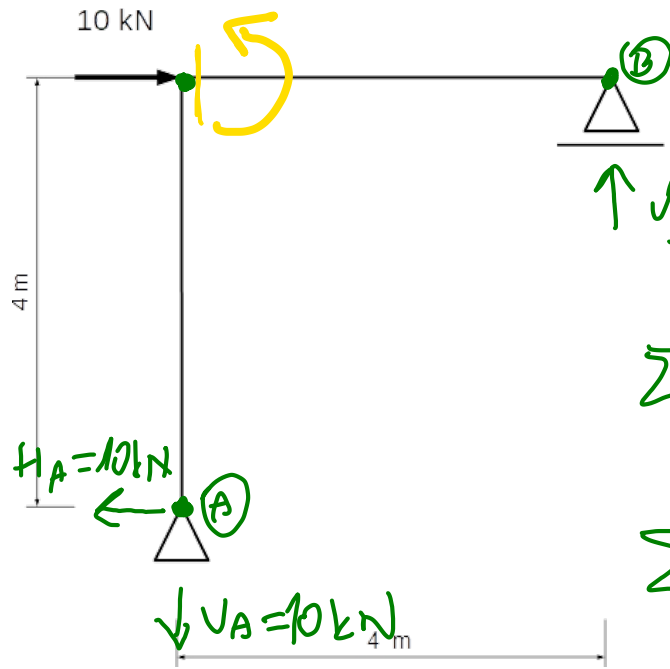
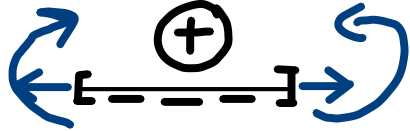


$$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

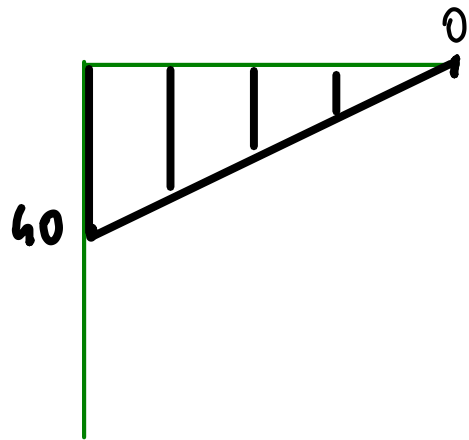




$$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

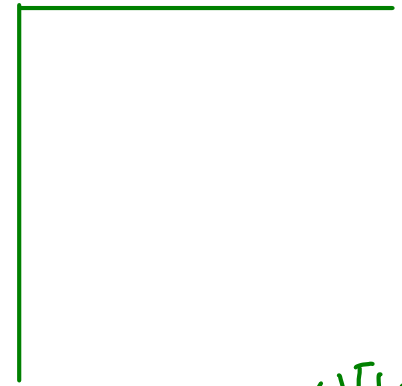
$$V_B = +10 \text{ kN}$$



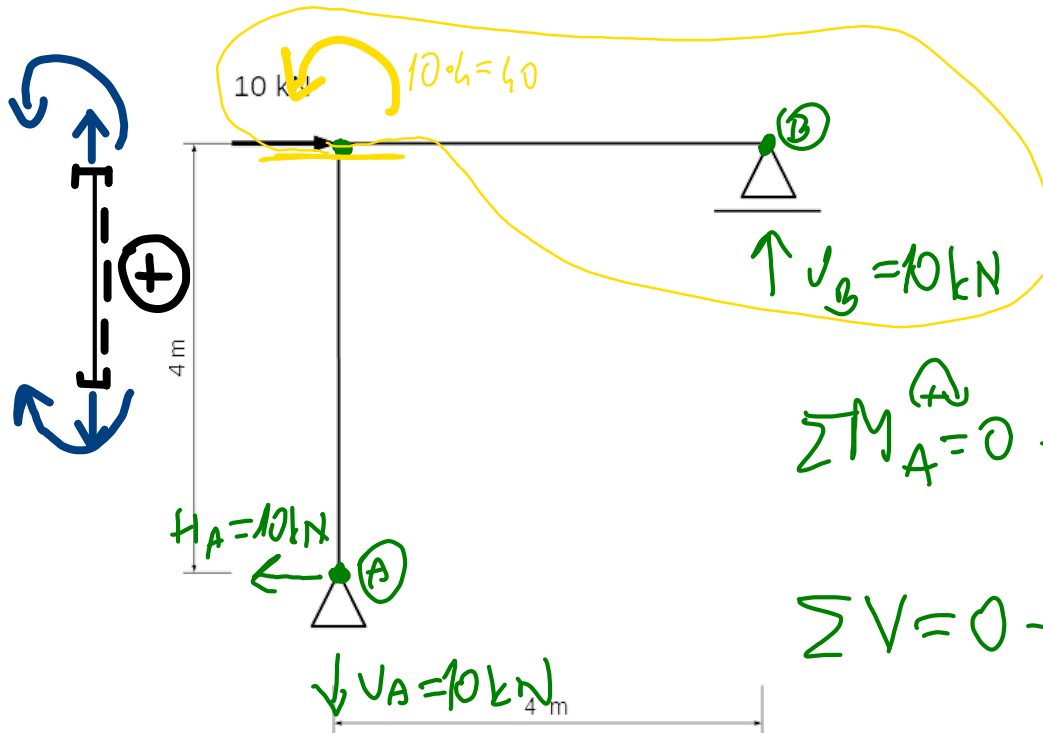
$M_1 [\text{kNm}]$



$Q_2 [\text{kN}]$



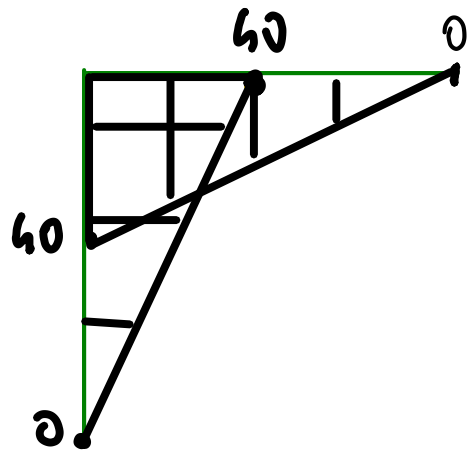
$N [\text{kN}]$



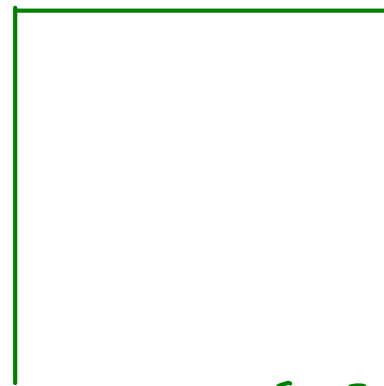
$$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

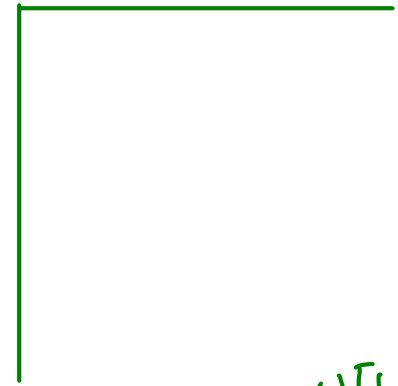
$$\sum V = 0 \rightarrow V_A = -V_B$$



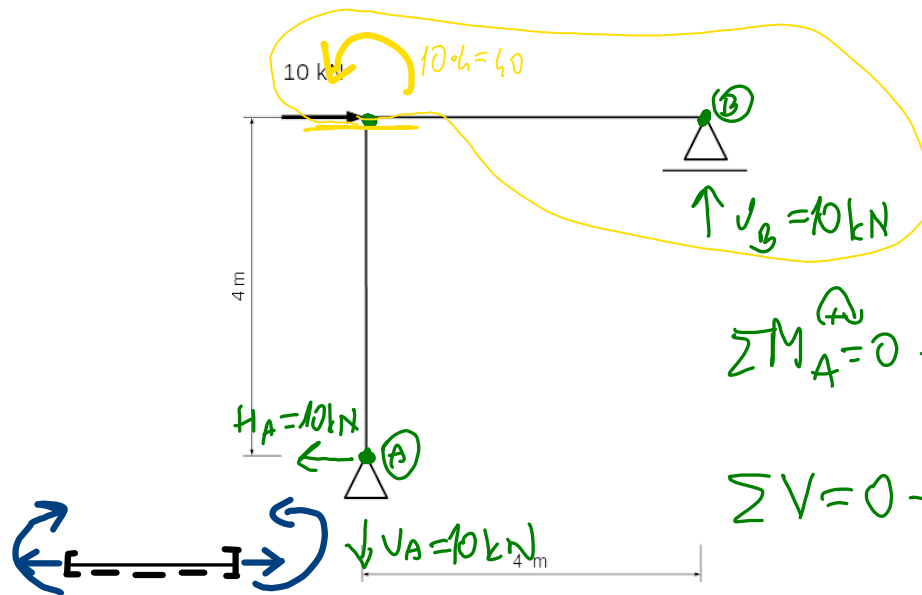
$M_y [\text{kNm}]$



$Q_z [\text{kN}]$



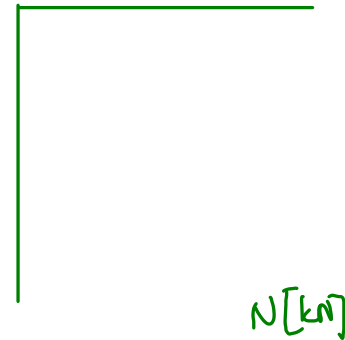
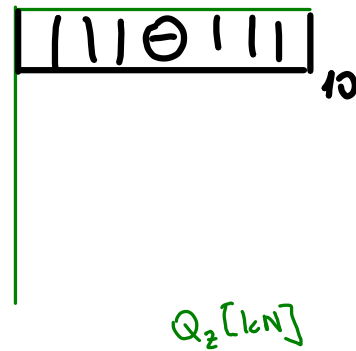
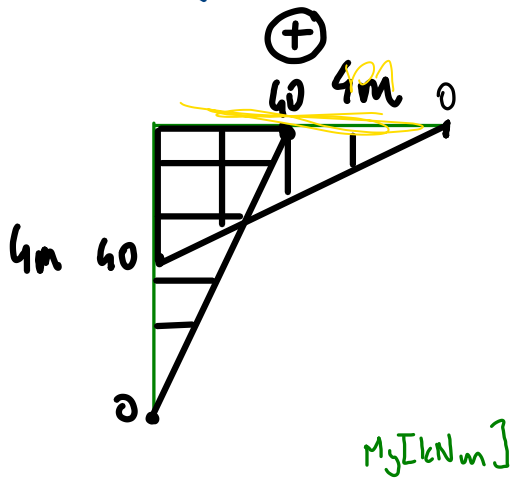
$N [\text{kN}]$



$$\sum M_A^{\text{A}} = 0 \rightarrow +10\text{ kN} \cdot 4\text{ m} - V_B \cdot 4\text{ m} = 0$$

$$V_B = +10\text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$



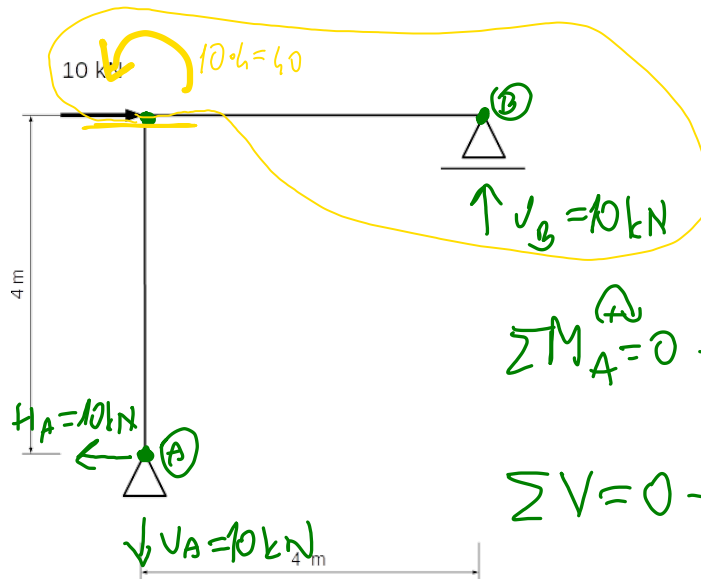
$$Q_2(x) = M_2'(x)$$

W PRZEDZIALE: $Q = \frac{\Delta M}{\Delta tUG} = \frac{M_P - M_L}{\Delta tUG}$
PRZEM. PRZEM.

P1:

$$Q = \frac{-40\text{ kNm}}{4\text{ m}} = -10\text{ kN}$$

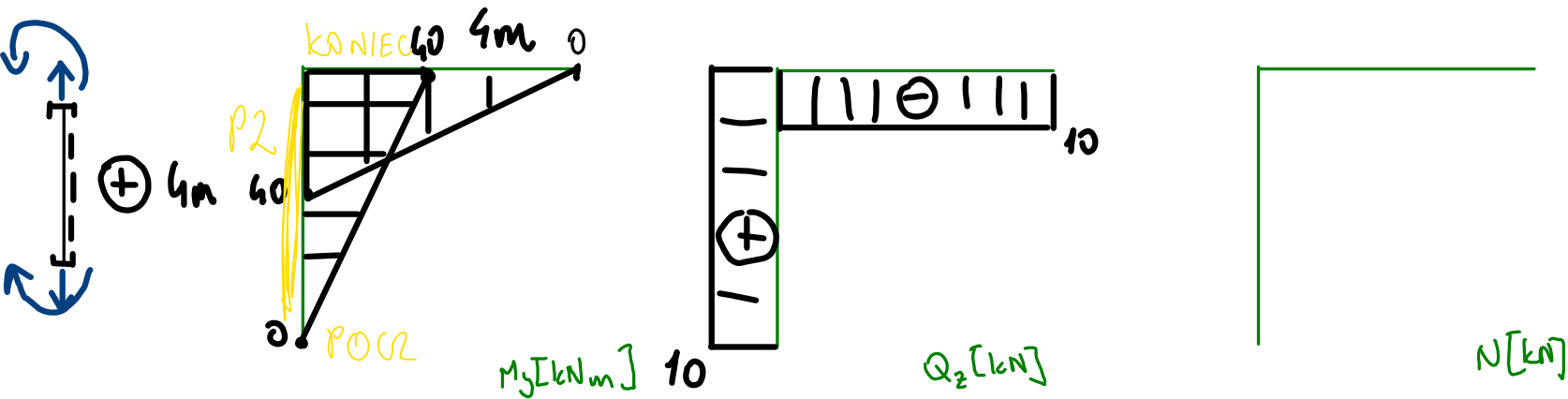
$$Q = \frac{0\text{ kNm} - (+40\text{ kNm})}{4\text{ m}} = -10\text{ kN}$$



$$\sum M_A^{\text{A}} = 0 \rightarrow +10\text{kN} \cdot 4\text{m} - V_B \cdot 4\text{m} = 0$$

$$V_B = +10\text{kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$



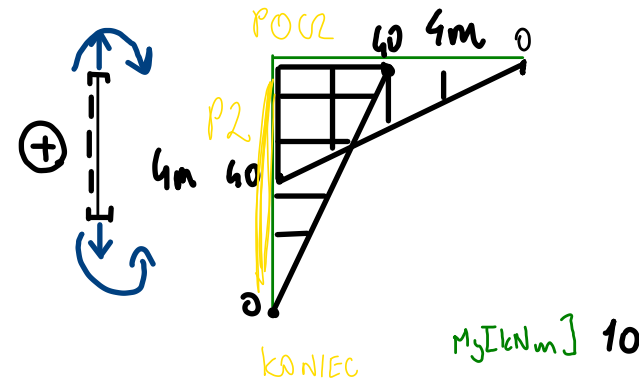
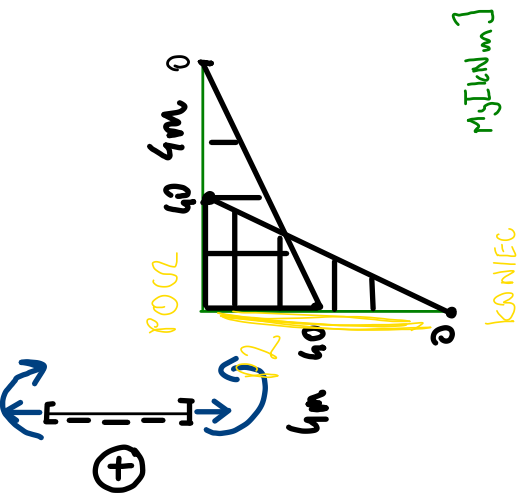
$$Q_z(x) = M_y'(x)$$

W PRZEDZIALE: $Q = \frac{\Delta M}{\Delta L \text{ UC PRZEC.}} = \frac{M_P - M_L}{\Delta L \text{ UC PRZEC.}}$

p2:

$$Q = \frac{+40\text{kNm}}{4\text{m}} = +10\text{kN}$$

$$Q = \frac{40\text{kNm} - 0\text{kNm}}{4\text{m}} = +10\text{kN}$$



$$Q_2(x) = M_y'(x)$$

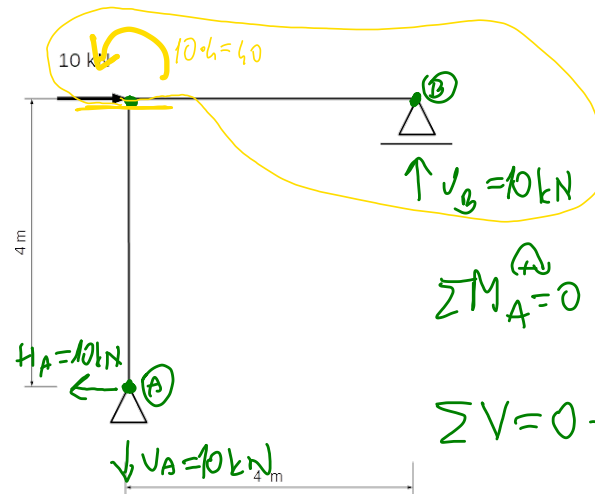
W PRZEDZIALE: $Q = \frac{\Delta M}{\Delta tUG} = \frac{M_P - M_L}{\Delta tUG}$

PRZEM. PRZEM.

P2:

$$Q = \frac{+40 kNm}{4m} = +10 kN$$

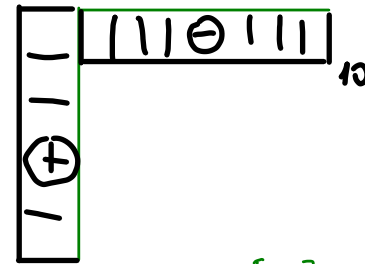
$$Q = \frac{40 kNm - 0 kNm}{4m} = +10 kN$$

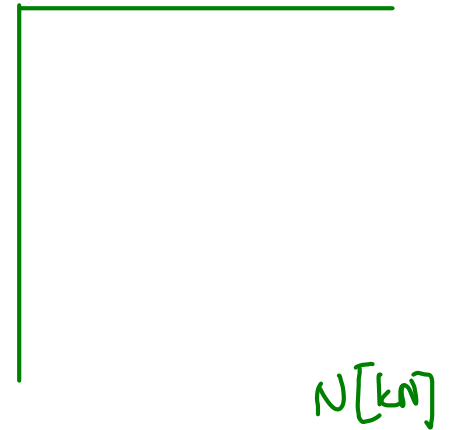
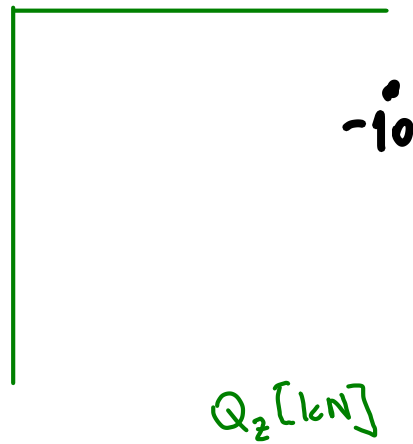
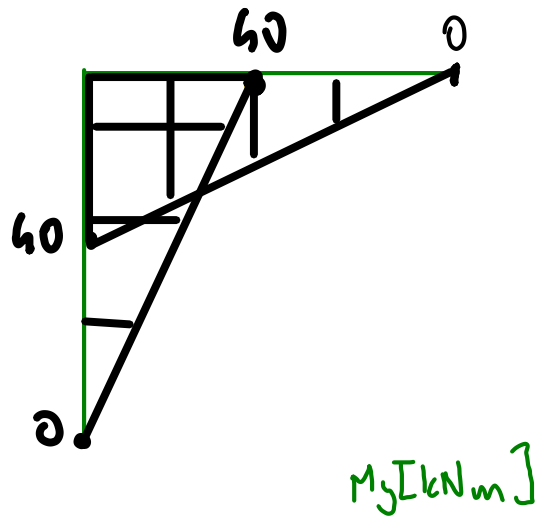
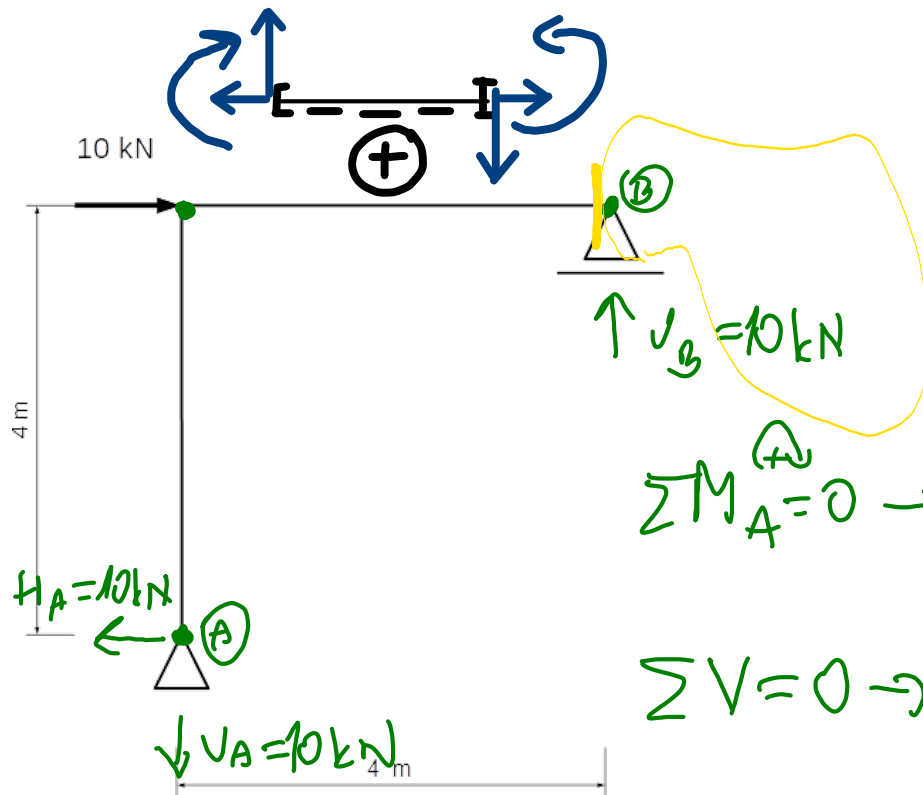


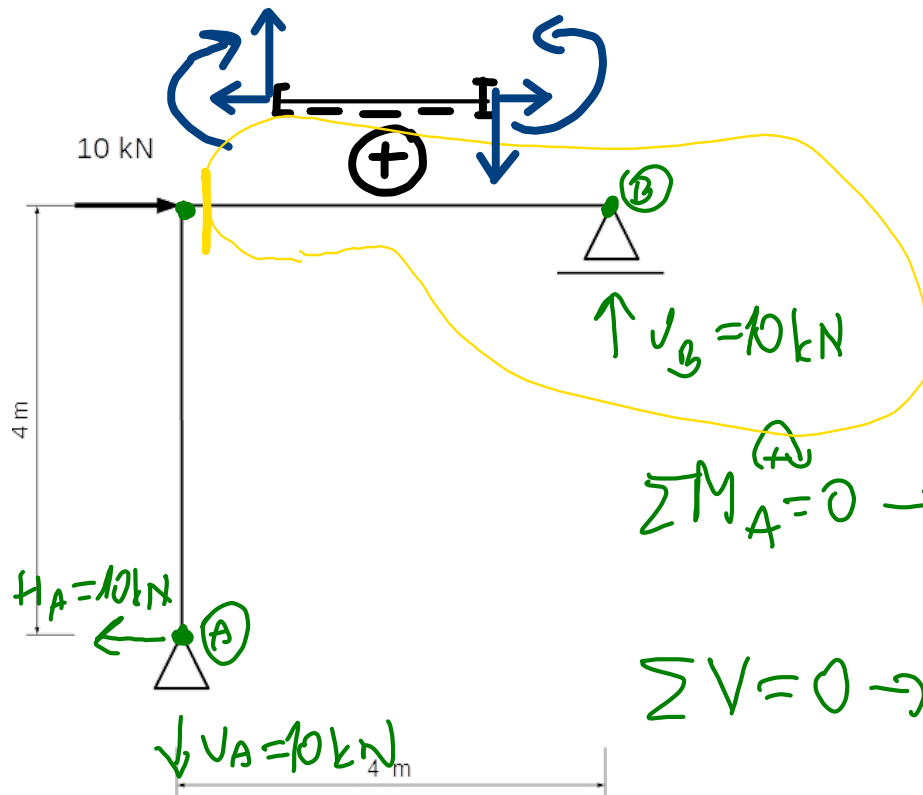
$$\sum M_A = 0 \rightarrow +10 kN \cdot 4m - V_B \cdot 4m = 0$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

$V_B = +10 kN$



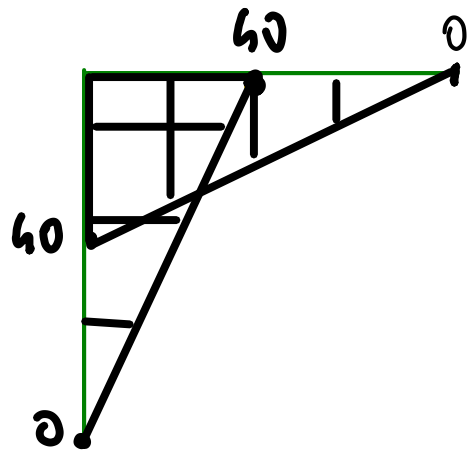




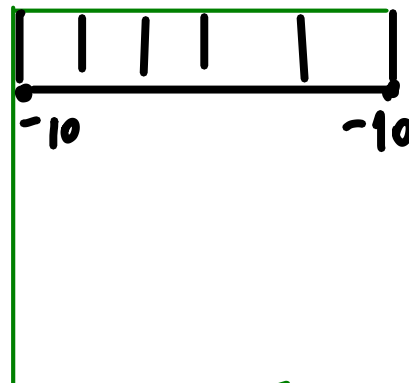
$$\sum M_A = 0 \rightarrow +10kN \cdot 4m - V_B \cdot 4m = 0$$

$$V_B = +10kN$$

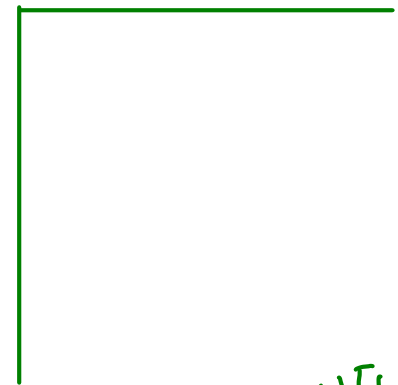
$$\sum V = 0 \rightarrow V_A = -V_B$$



$M_y [kNm]$

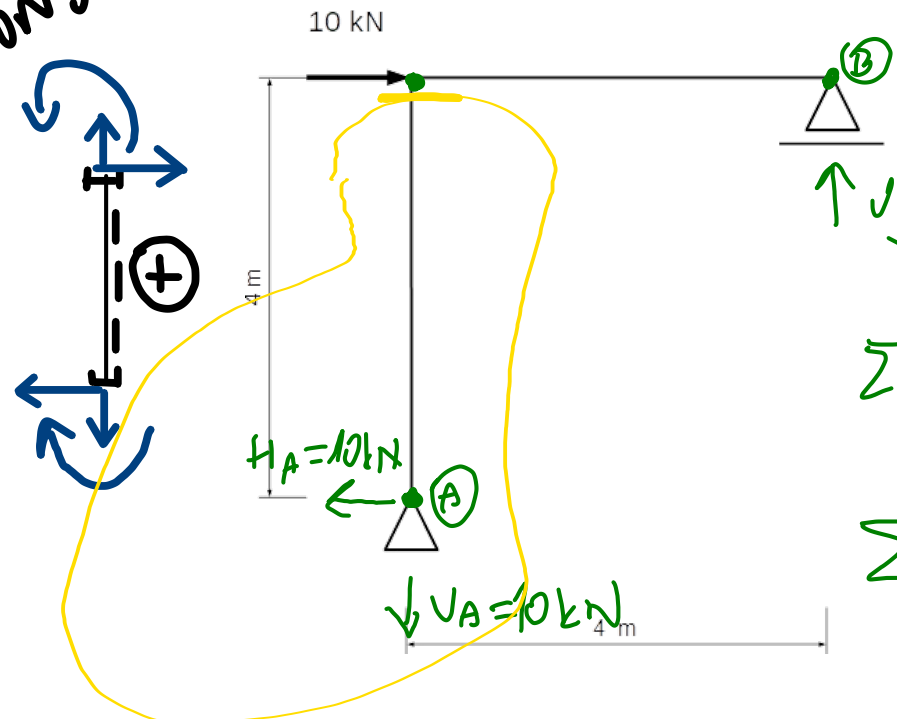


$Q_z [kN]$



$N [kN]$

KONSEKVENTNIE (2)

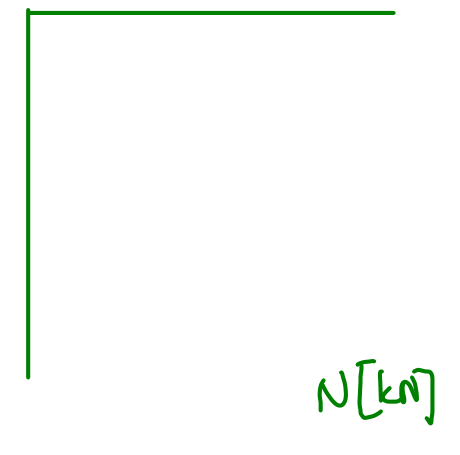
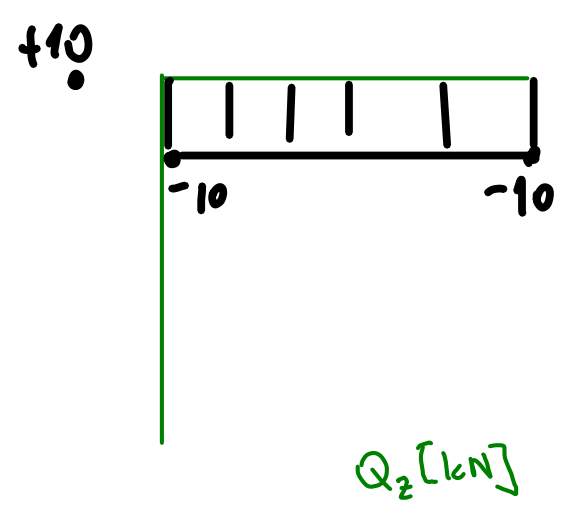
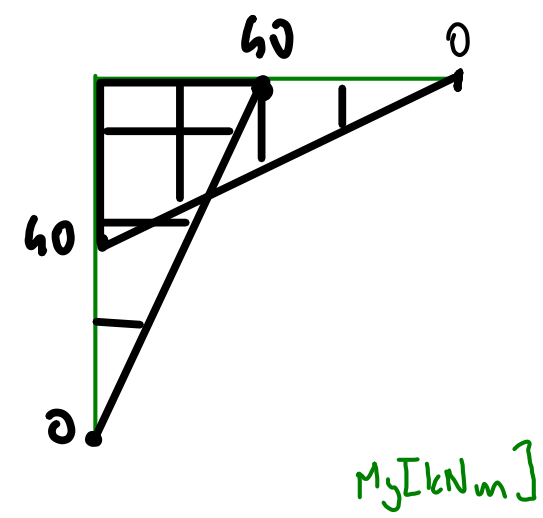


$$\uparrow V_B = 10 \text{ kN}$$

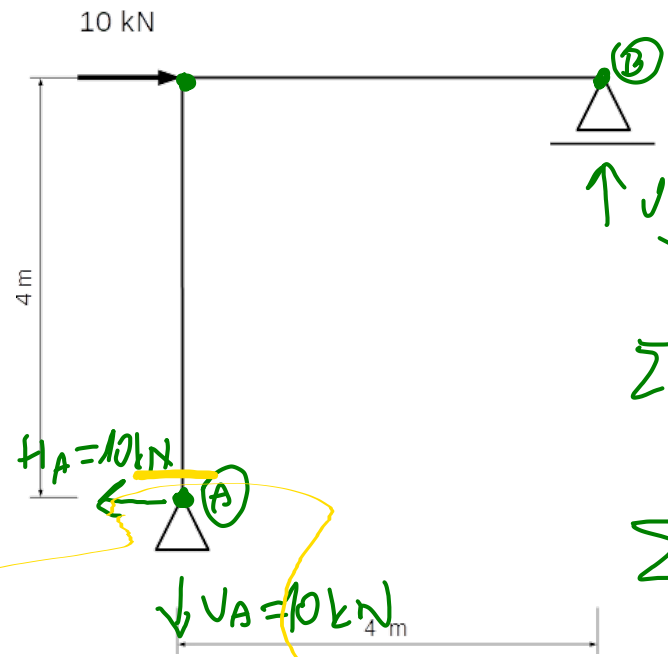
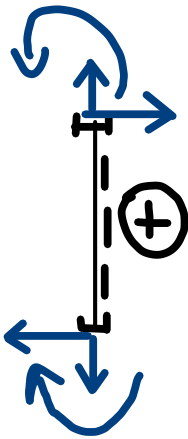
$$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$



KONSEKVENTNIE (M)

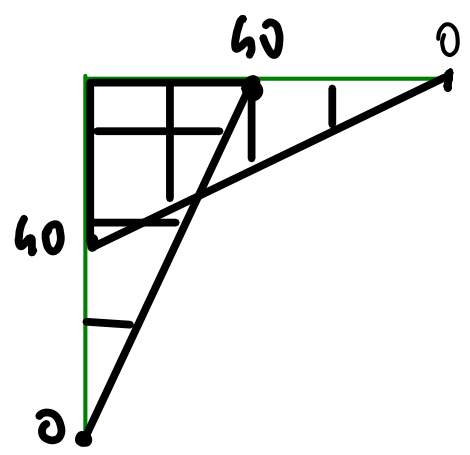


$\uparrow V_B = 10 \text{ kN}$

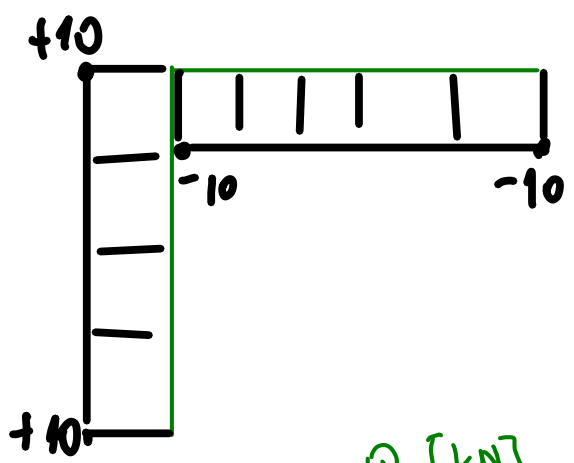
$\sum M_A^{\oplus} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$

$V_B = +10 \text{ kN}$

$\sum V = 0 \rightarrow V_A = -V_B$



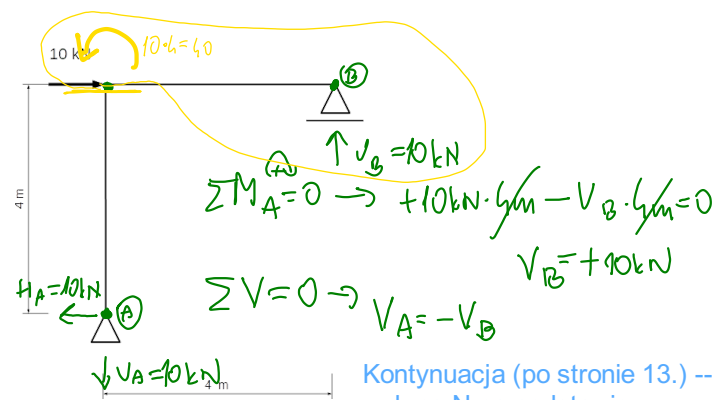
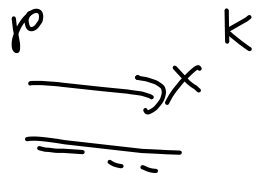
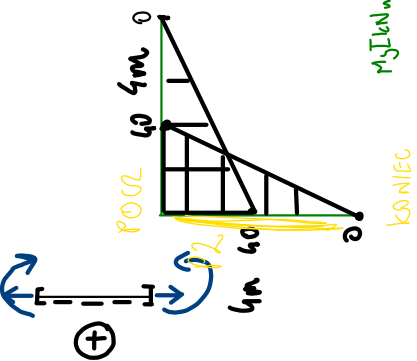
$M_1 [\text{kNm}]$



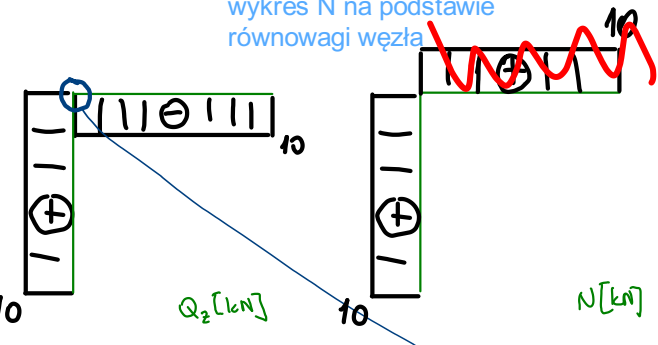
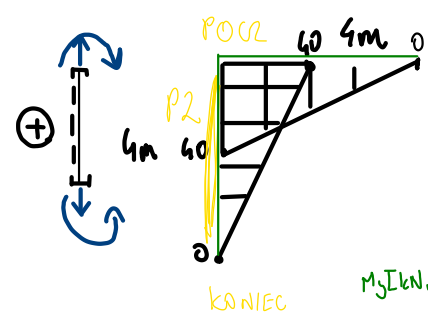
$Q_2 [\text{kN}]$



$N [\text{kN}]$



Kontynuacja (po stronie 13.) -- wykres N na podstawie równowagi węzła



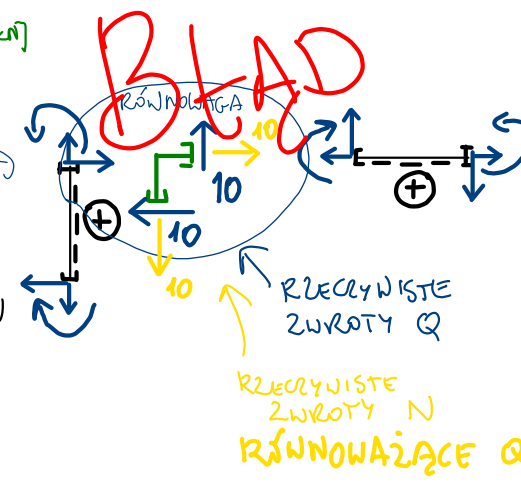
$$Q_2(x) = M_y'(x)$$

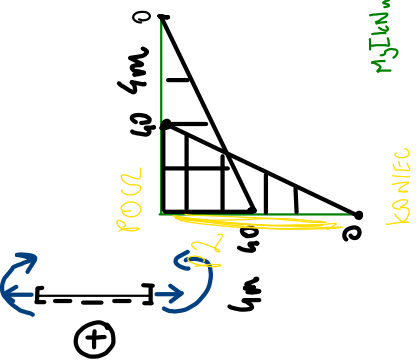
W PRZEDZIALE: $Q = \frac{\Delta M}{\Delta L} = \frac{M_P - M_L}{\Delta L}$

P2:

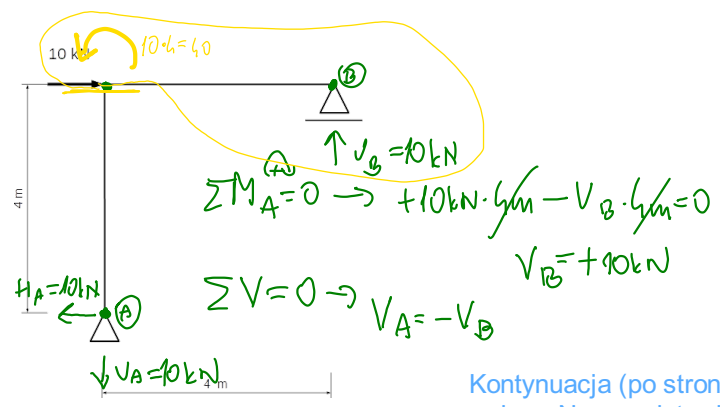
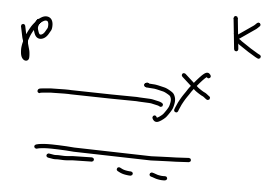
$$Q = \frac{+40 \text{ kNm}}{4 \text{ m}} = +10 \text{ kN}$$

$$Q = \frac{40 \text{ kNm} - 0 \text{ kNm}}{4 \text{ m}} = +10 \text{ kN}$$

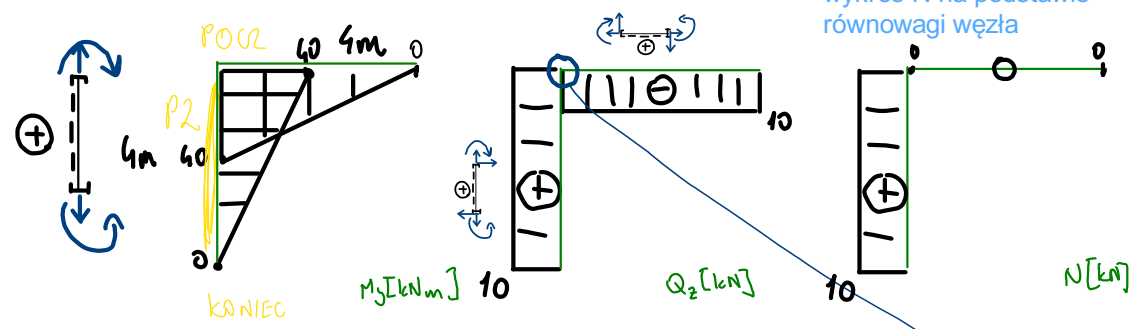




M [kNm]



Kontynuacja (po stronie 13.) -- wykres N na podstawie równowagi węzła



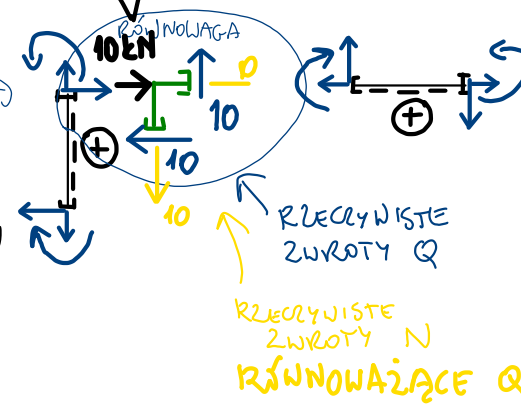
$$Q_2(x) = M_y'(x)$$

W PRZEDZIALE: $Q = \frac{\Delta M}{\Delta L} = \frac{M_P - M_L}{\Delta L}$

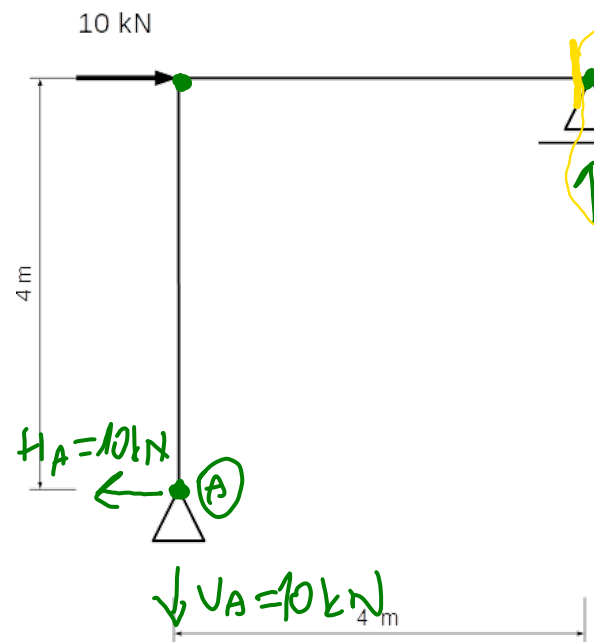
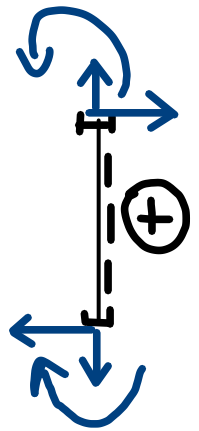
P2: $Q = \frac{+40 \text{ kNm}}{4 \text{ m}} = +10 \text{ kN}$

$$Q = \frac{40 \text{ kNm} - 0 \text{ kNm}}{4 \text{ m}} = +10 \text{ kN}$$

MUSIMY UWZGLĘDNIĆ SIŁY ZEWNĘTRZNE!



KONSEKwentnie (M)

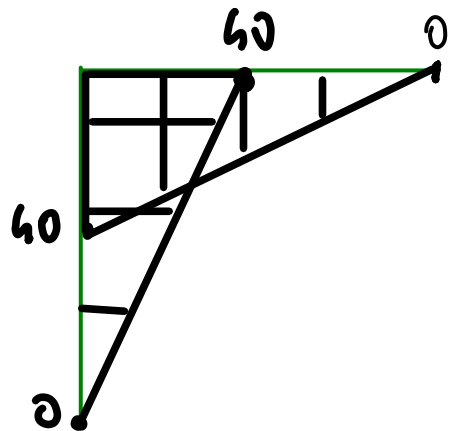


$$\sum M_A = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

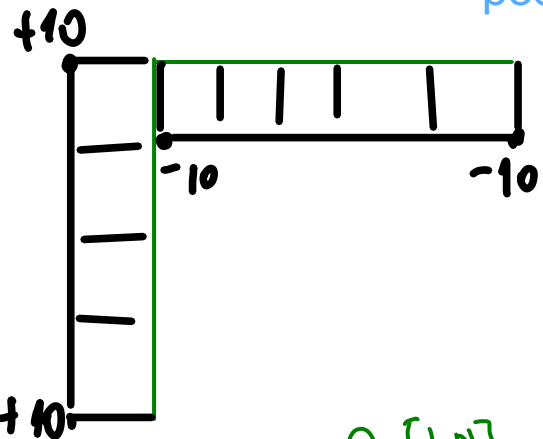
$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

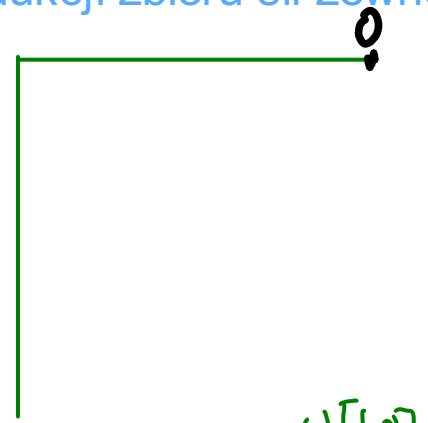
Kontynuacja (po stronie 18.) -- wykres N na podstawie redukcji zbioru sił zewnętrznych



$M_1 [kNm]$

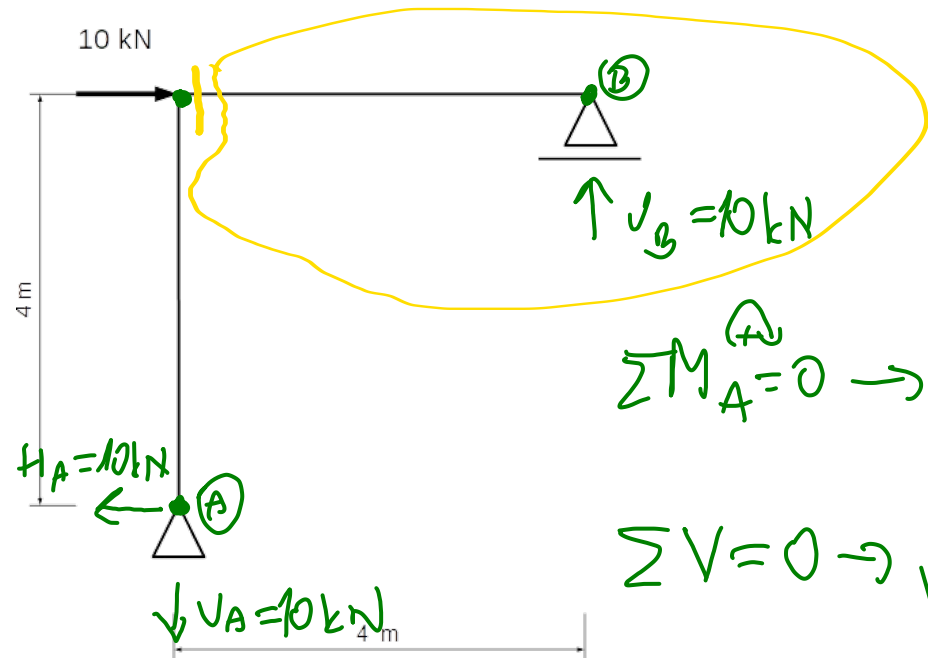
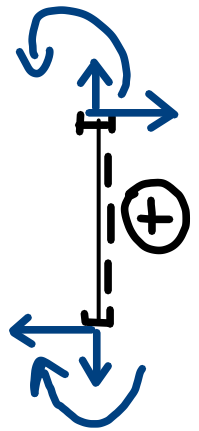


$Q_2 [kN]$



$N [kN]$

KONSEKVENTNIE (M)

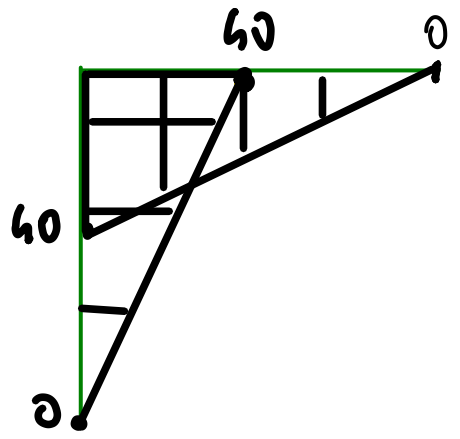


$$\sum M_A^{\text{A}} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

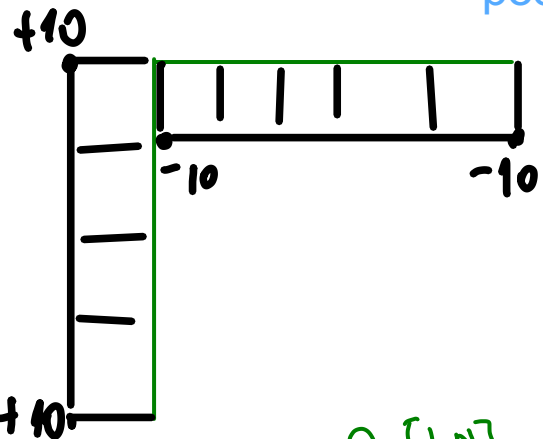
$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

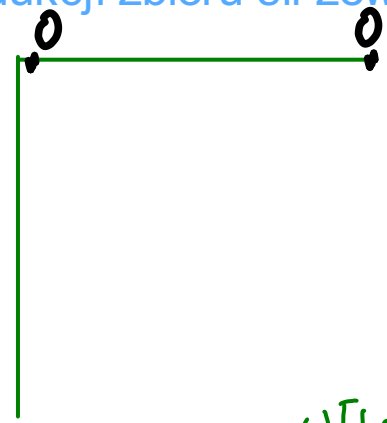
Kontynuacja (po stronie 18.) -- wykres N na podstawie redukcji zbioru sił zewnętrznych



M_2 [kNm]

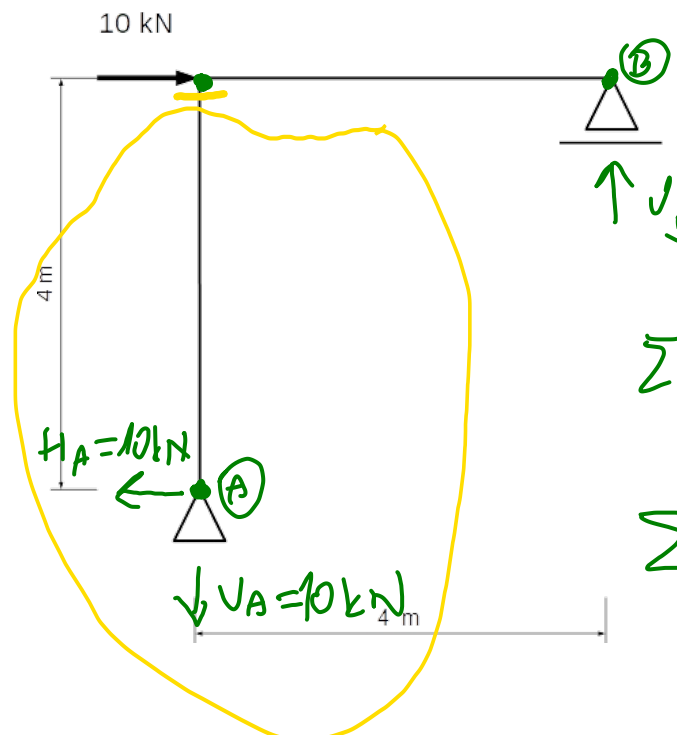
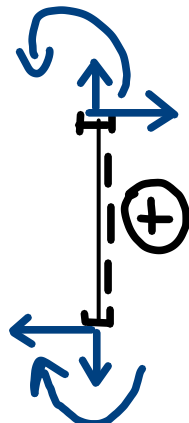


Q_2 [kN]



N [kN]

KONSEKwentnie (M)



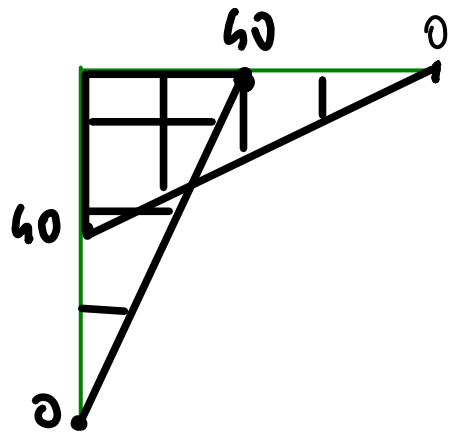
$$\uparrow V_B = 10 \text{ kN}$$

$$\sum M_A^{\text{clockwise}} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

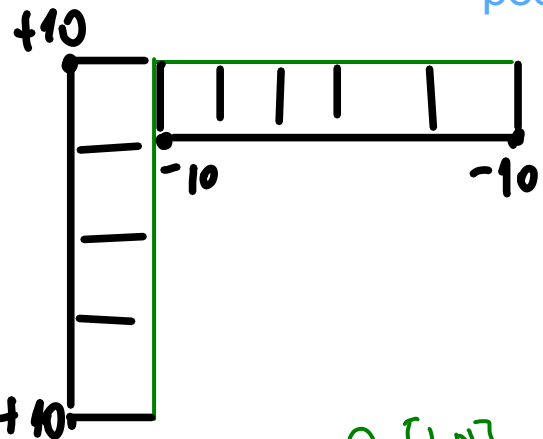
$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

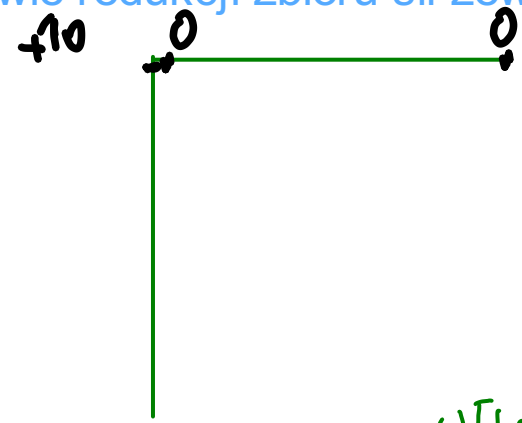
Kontynuacja (po stronie 18.) -- wykres N na podstawie redukcji zbioru sił zewnętrznych



$M_1 [\text{kNm}]$

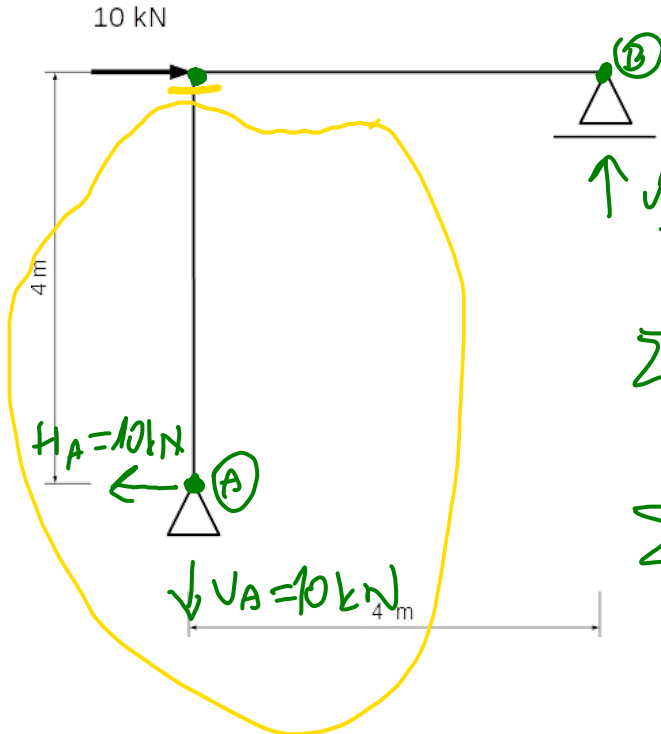
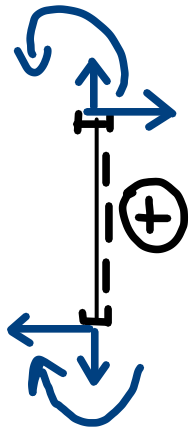


$Q_2 [\text{kN}]$



$N [\text{kN}]$

KONSEKwentNIE (M)



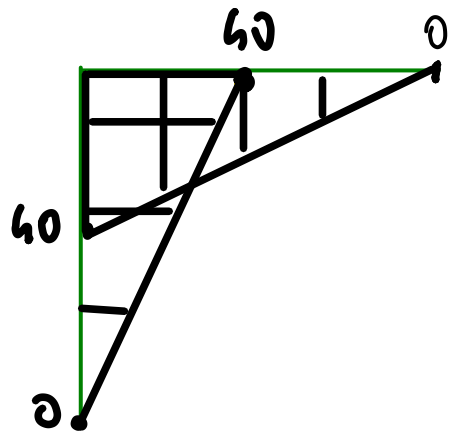
$$\uparrow V_B = 10 \text{ kN}$$

$$\sum M_A^{\circlearrowleft} = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

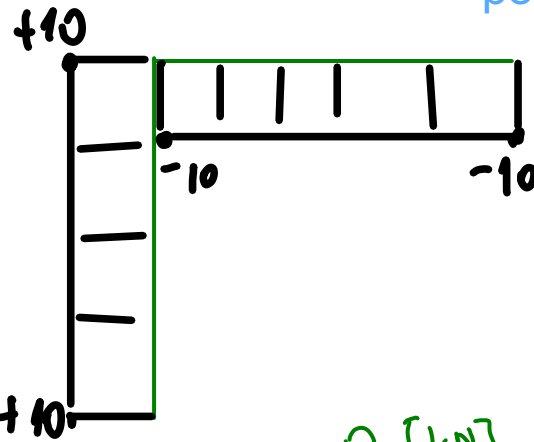
$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

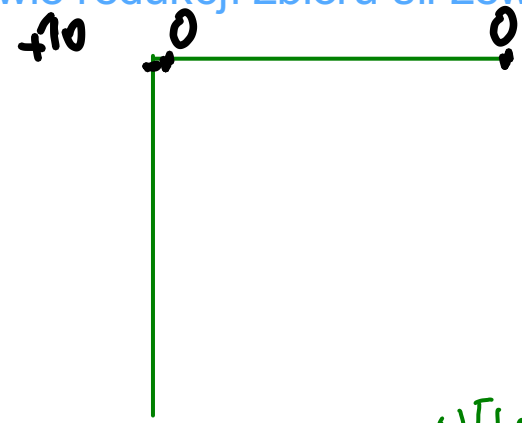
Kontynuacja (po stronie 18.) -- wykres N na podstawie redukcji zbioru sił zewnętrznych



$M_1 [\text{kNm}]$

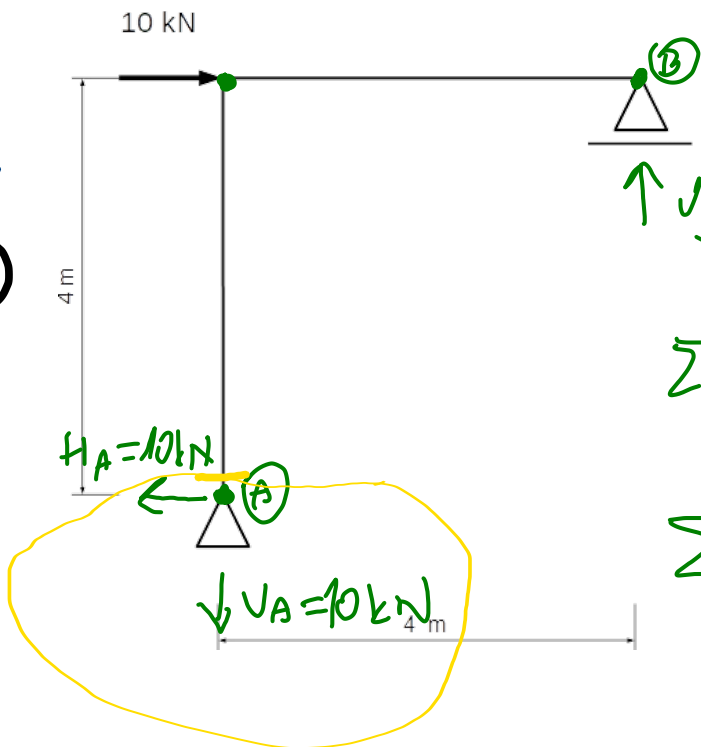
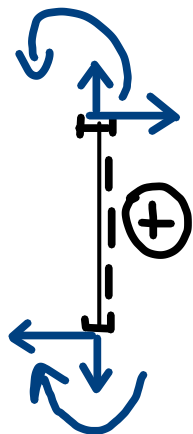


$Q_2 [\text{kN}]$



$N [\text{kN}]$

KONSEKVENTNIE (2)



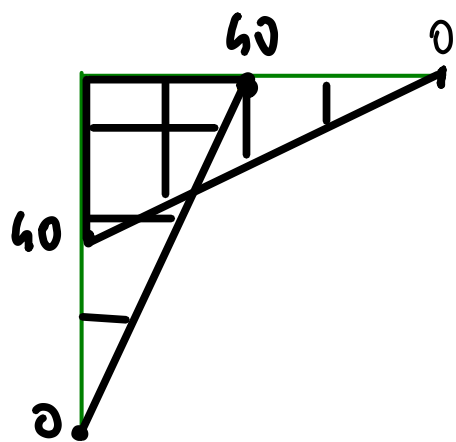
$$\uparrow V_B = 10 \text{ kN}$$

$$\sum M_A = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$$

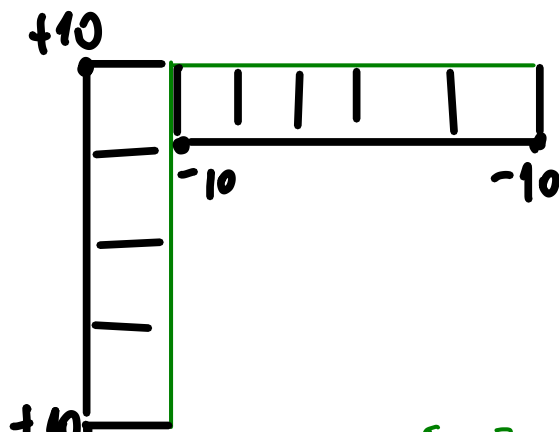
$$V_B = +10 \text{ kN}$$

$$\sum V = 0 \rightarrow V_A = -V_B$$

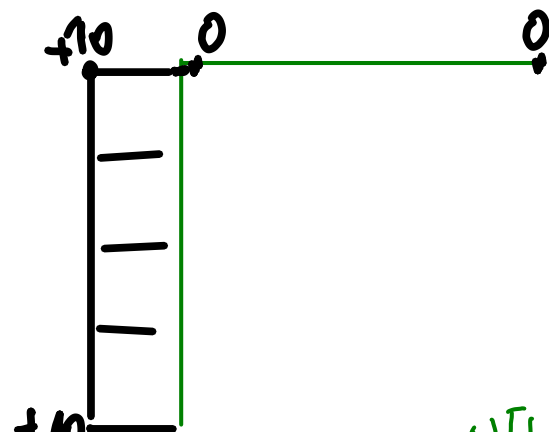
Kontynuacja (po stronie 18.) -- wykres N na podstawie redukcji zbioru sił zewnętrznych



$M_1 [\text{kNm}]$

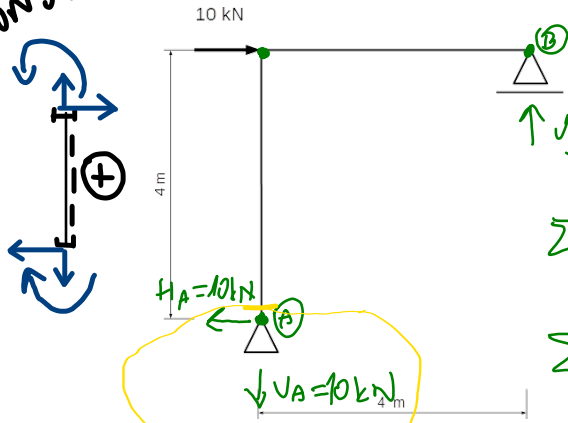


$Q_2 [\text{kN}]$



$N [\text{kN}]$

KONSEKWENTNIE (M)



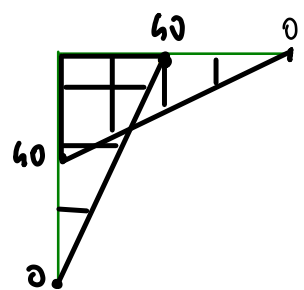
$\uparrow V_B = 10 \text{ kN}$

$\sum M_A = 0 \rightarrow +10 \text{ kN} \cdot 4 \text{ m} - V_B \cdot 4 \text{ m} = 0$

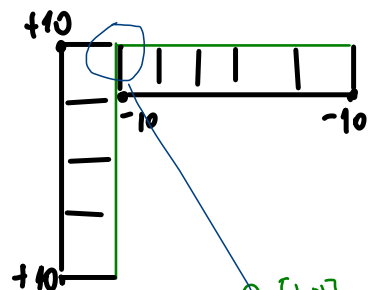
$V_B = +10 \text{ kN}$

$\sum V = 0 \rightarrow V_A = -V_B$

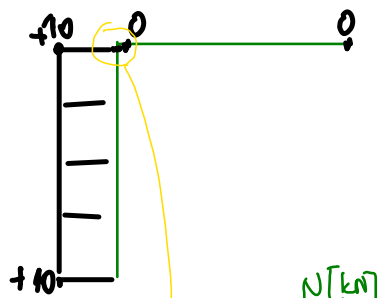
Kontynuacja (po stronie 18.) -- wykres N na podstawie redukcji zbioru sił zewnętrznych



$M_y [\text{kNm}]$

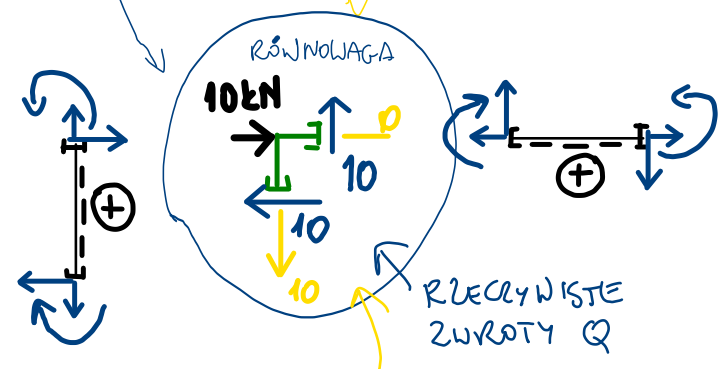


$Q_z [\text{kN}]$

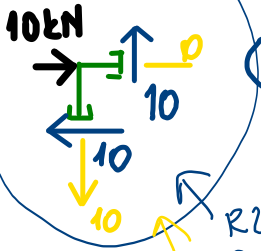


$N [\text{kN}]$

MUSIMY SPRAWDZIĆ RÓWNOWAGĘ WĘZŁA

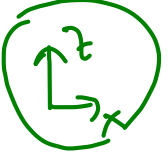


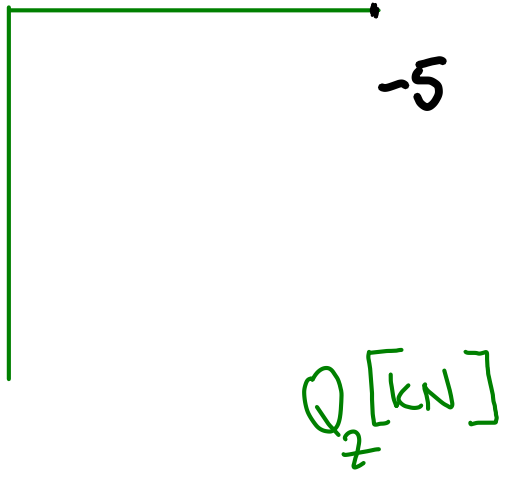
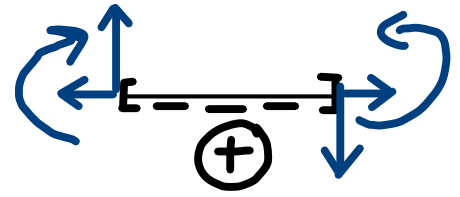
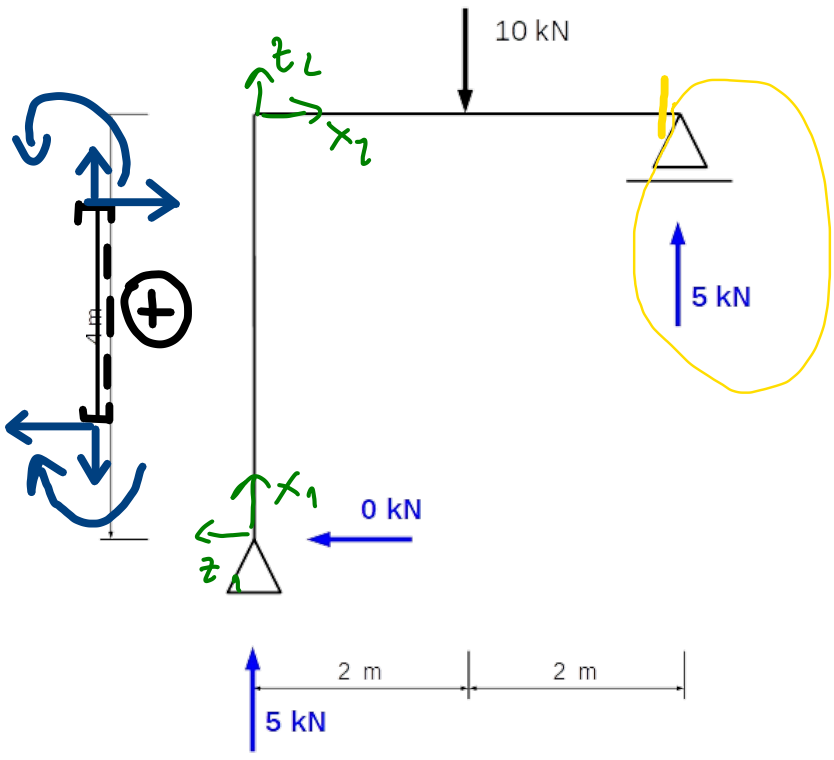
RÓWNOWAGA



RZECYWISTE ZWROTY Q

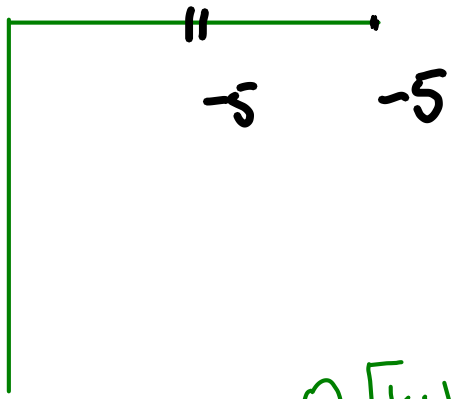
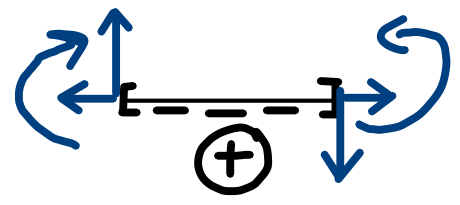
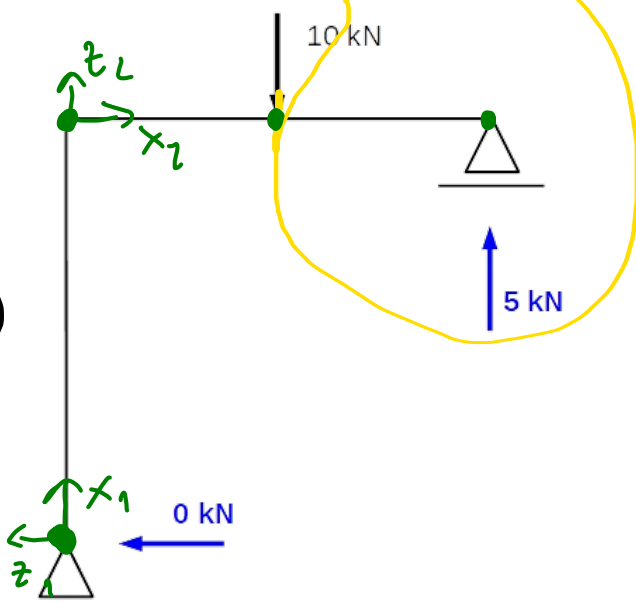
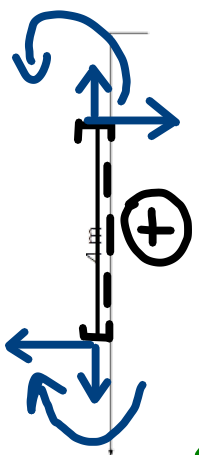
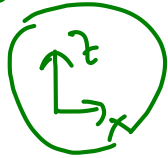
RZECYWISTE ZWROTY N

pt. RMS.
 u.f.




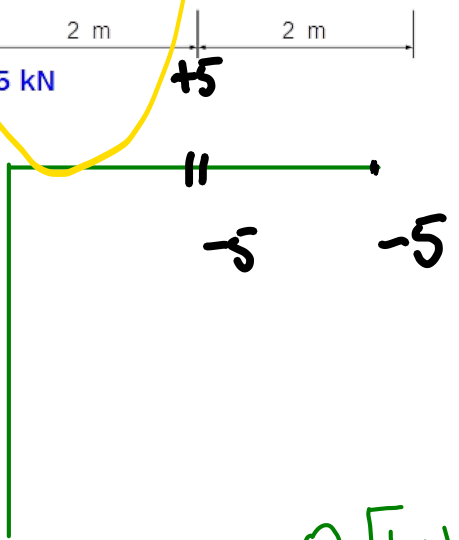
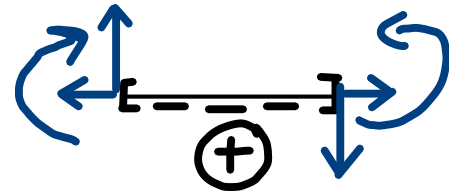
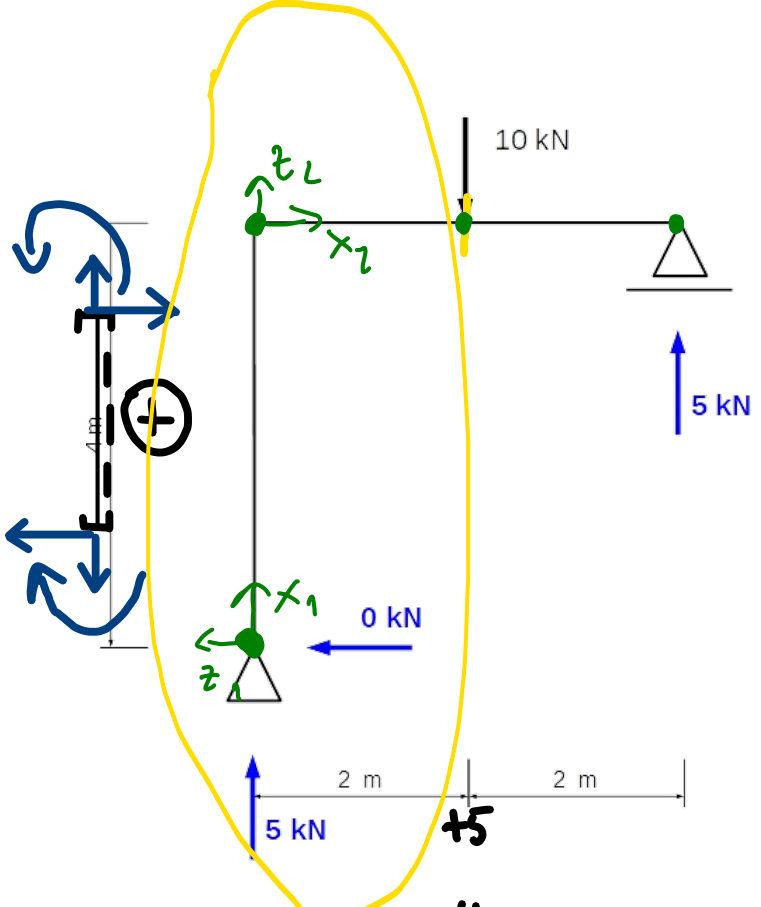
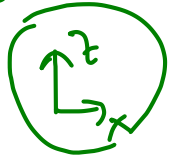
pt. RMS.

u.f.



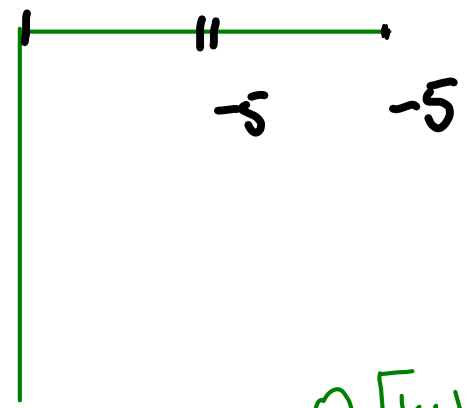
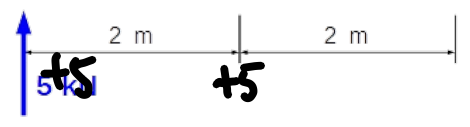
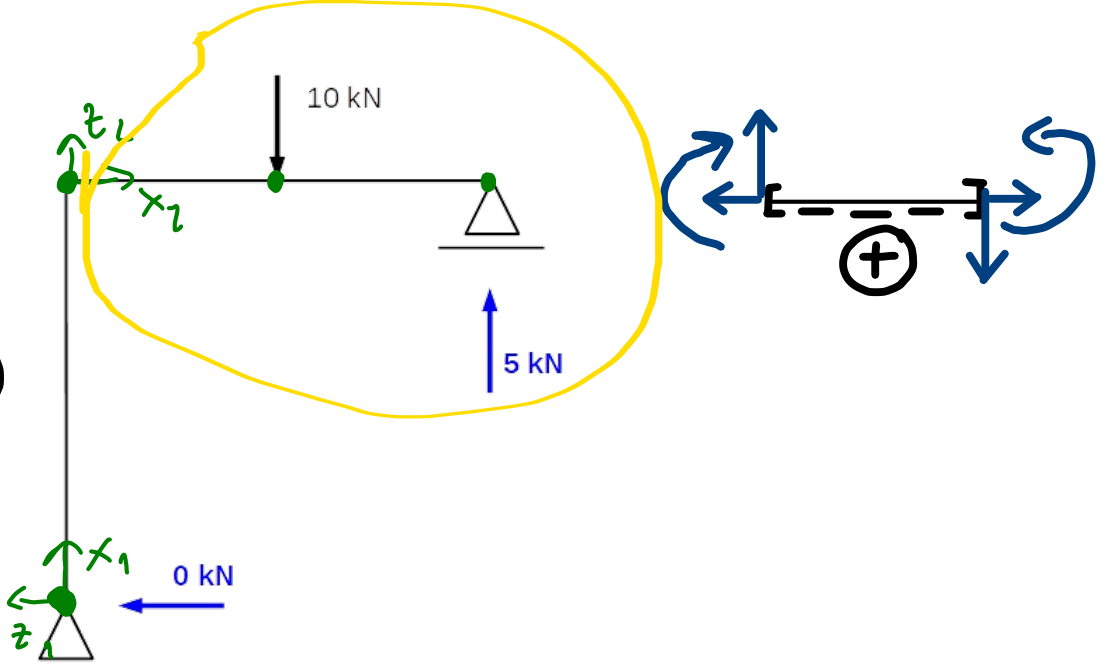
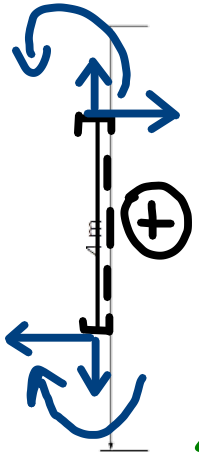
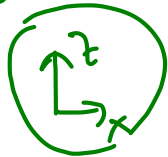
Q_2 [kN]

pt. RMS.
u.f.

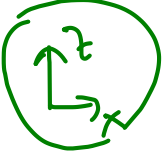


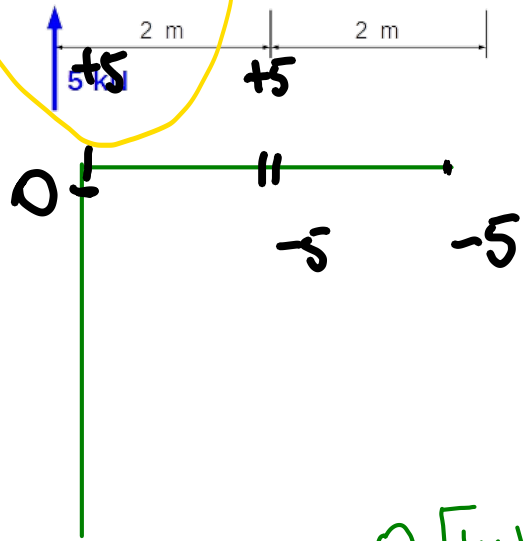
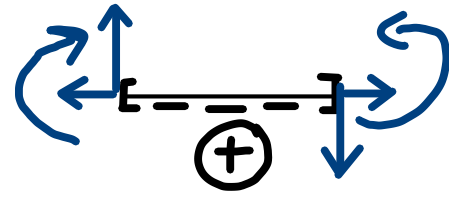
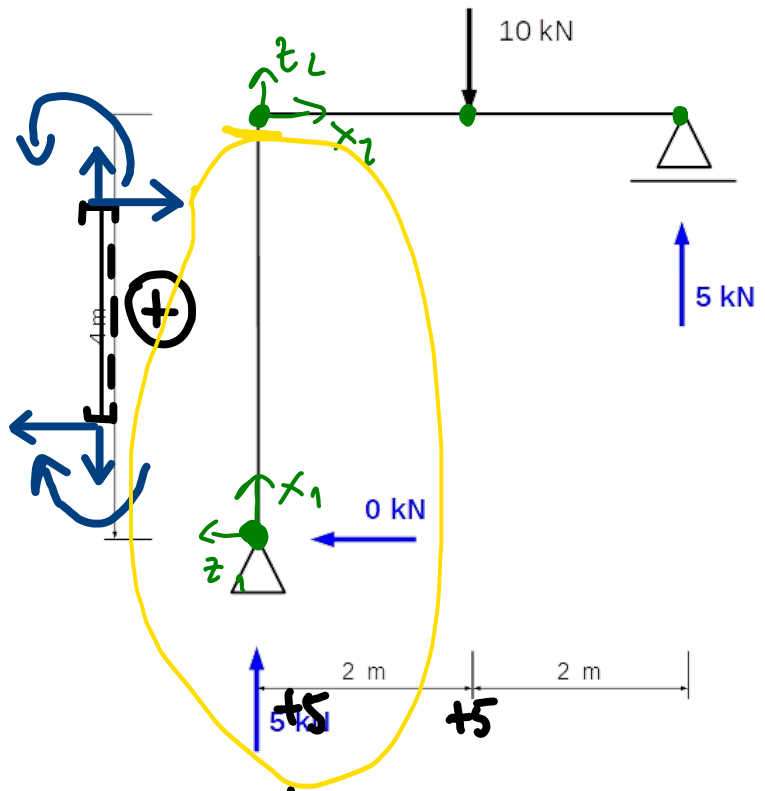
Q_z [kN]

pt. RMS.
u.f.



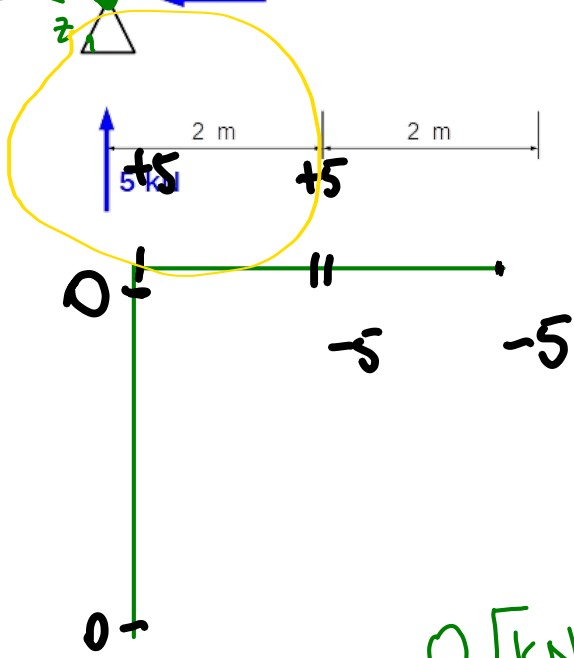
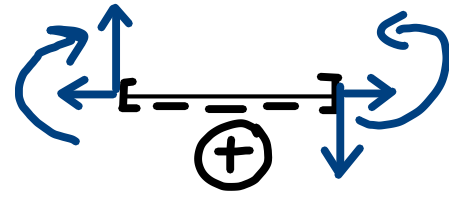
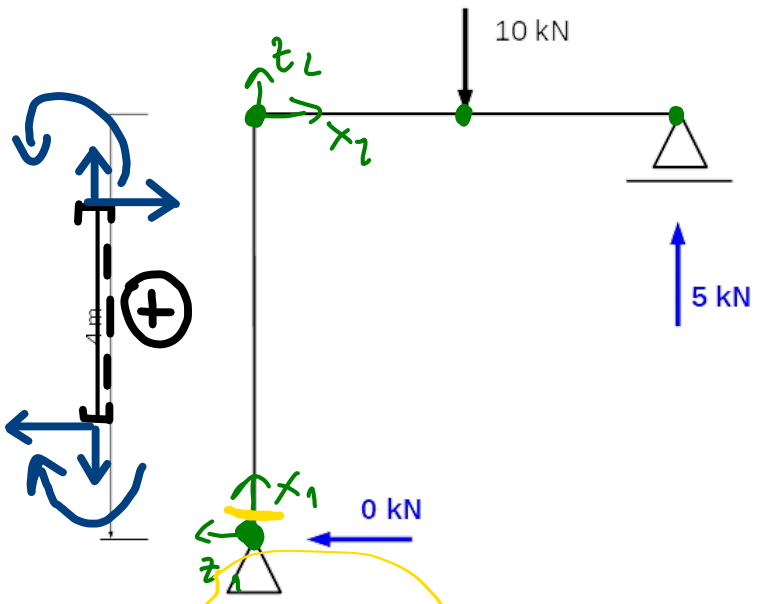
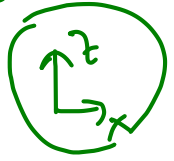
Q_z [kN]

pt. RMS.
 u.f.


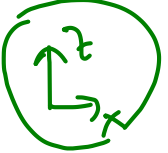


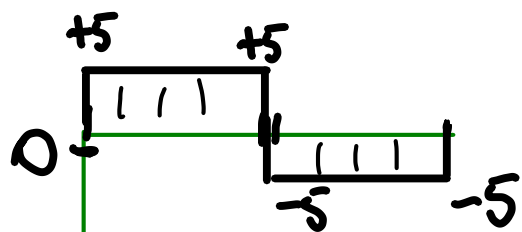
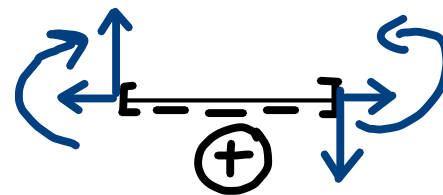
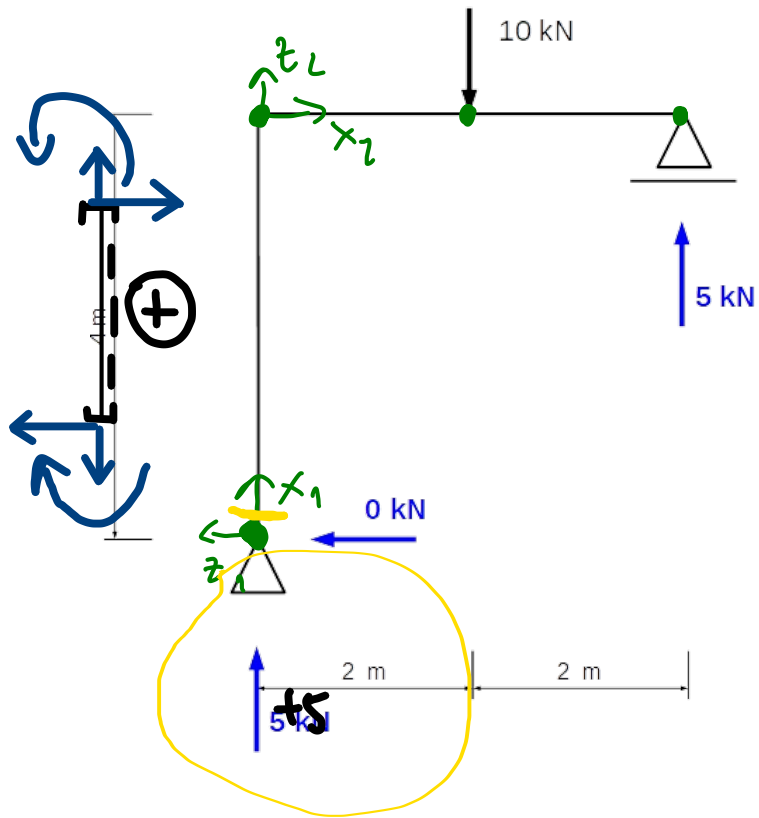
Q_z [kN]

pt. RMS.
u.f.

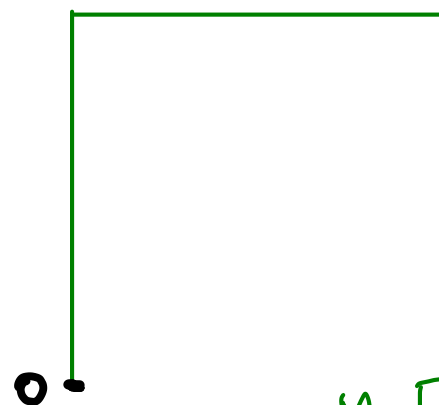


Q_z [kN]

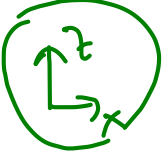
pt. RMS.
 u.f.


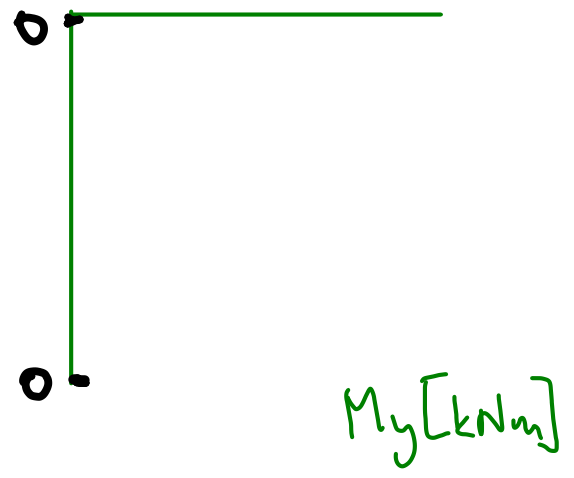
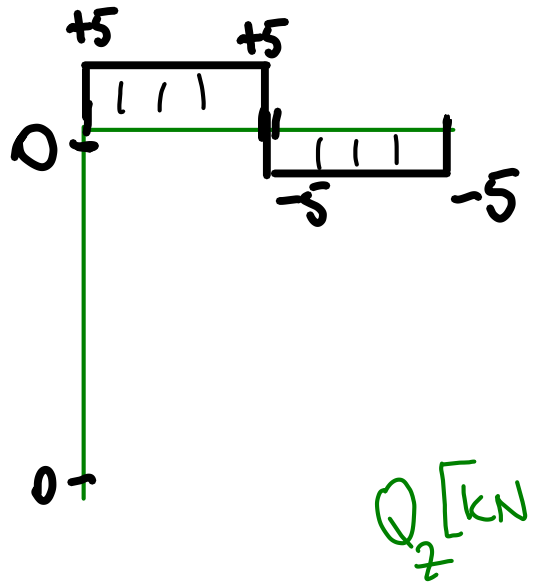
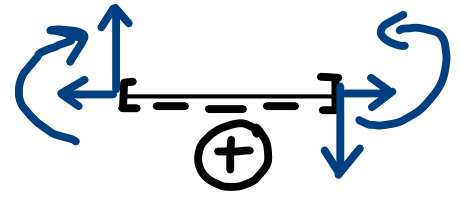
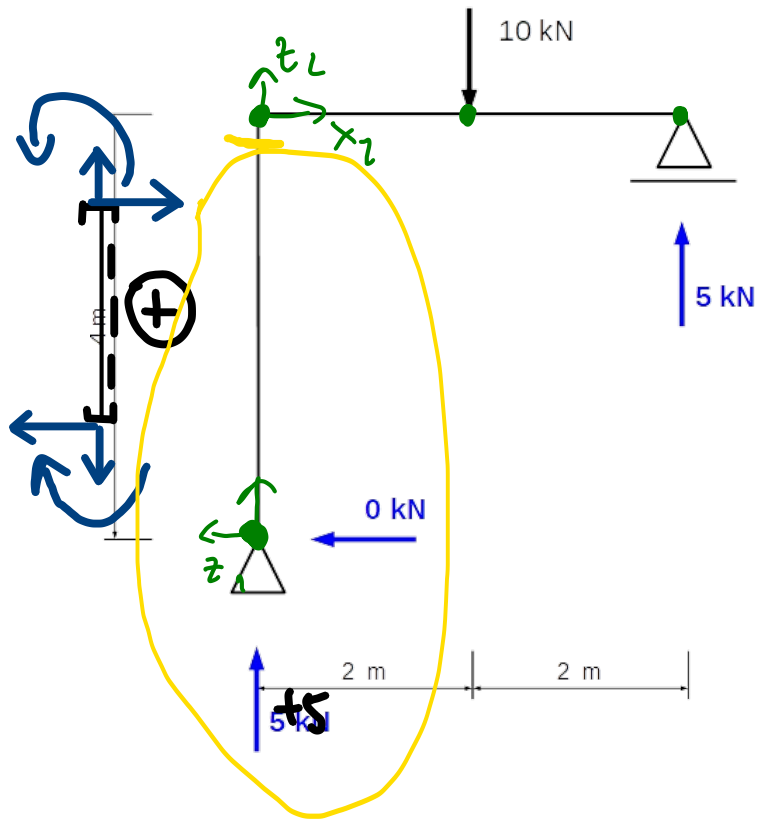


Q_z [kN]

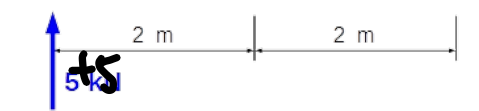
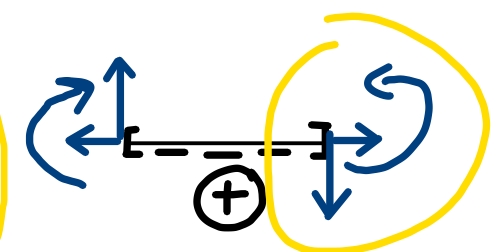
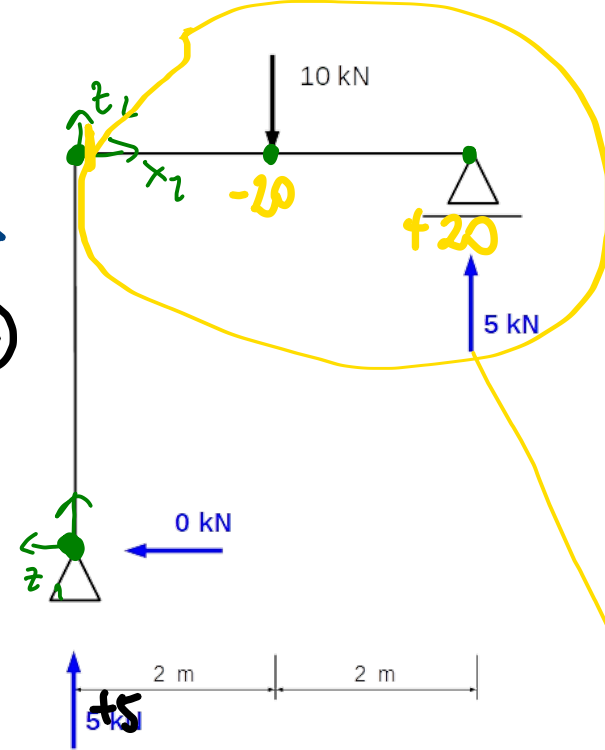
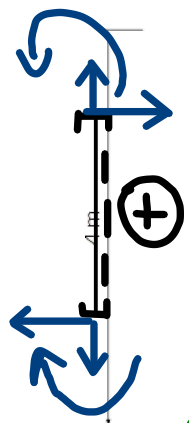


M_y [kNm]

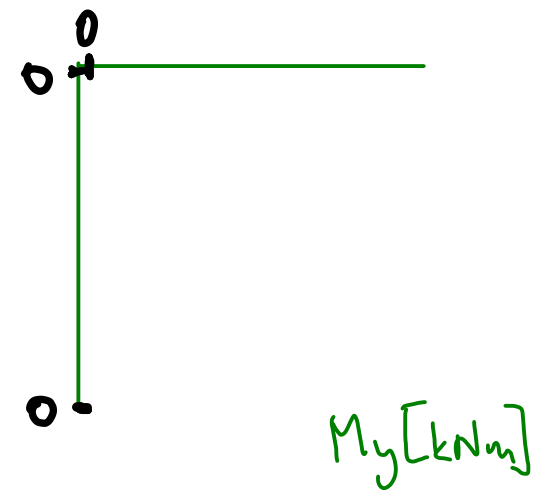
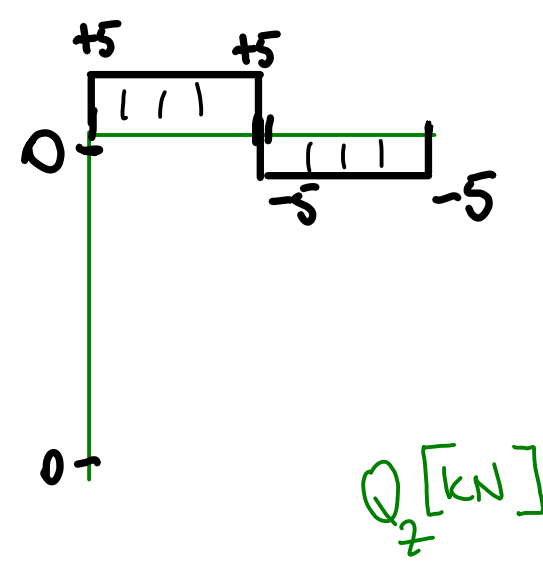
pt. RMS.
 u.f.




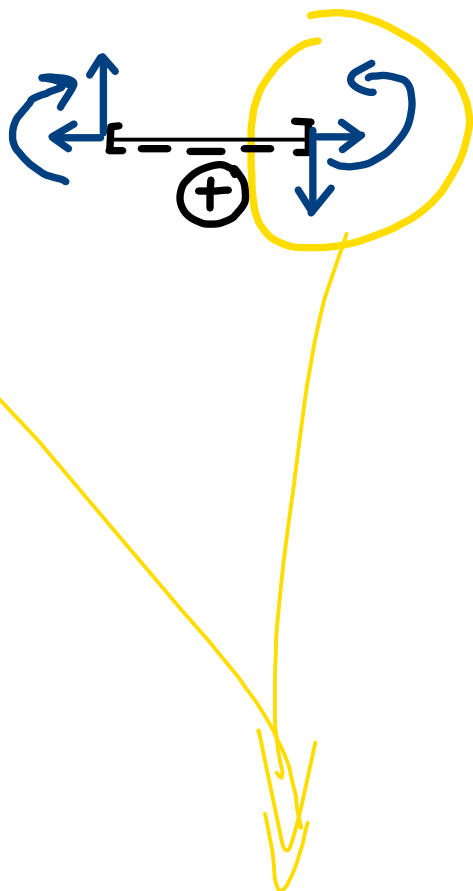
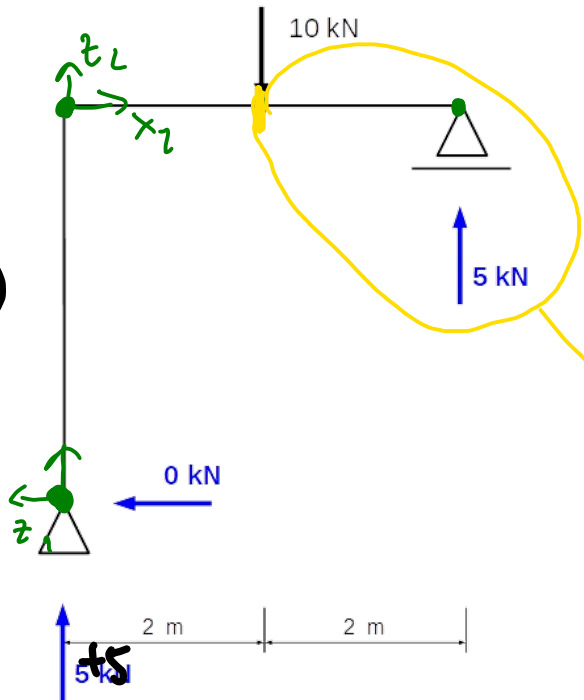
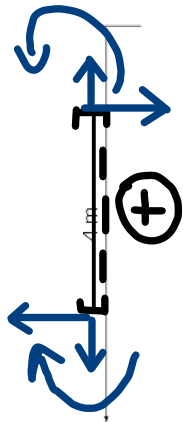
pt. RMS.
u.f.



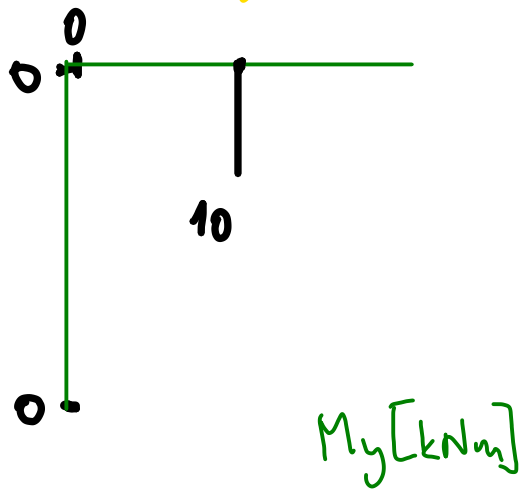
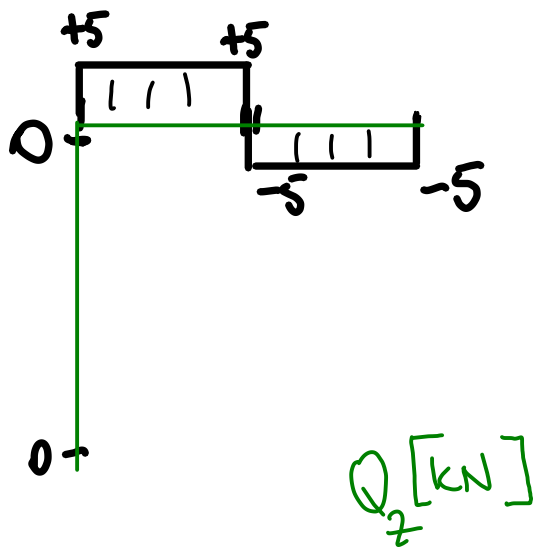
RÓWNOWAGA
WĘZŁA!



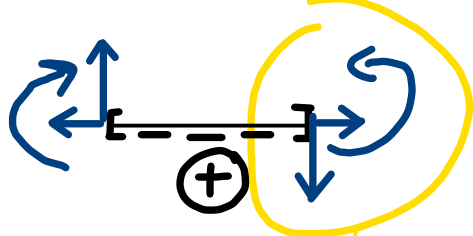
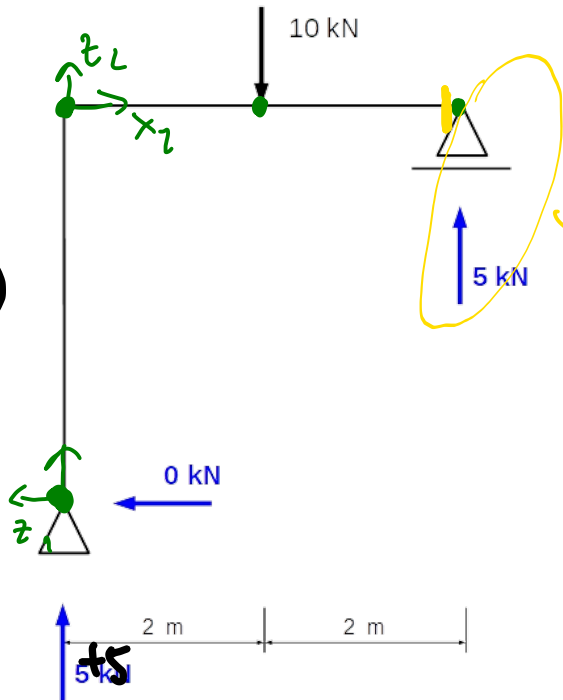
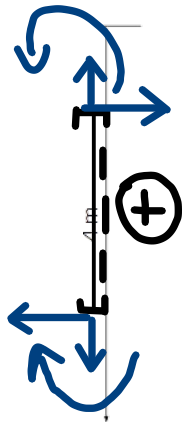
pt. RMS.
u.f.



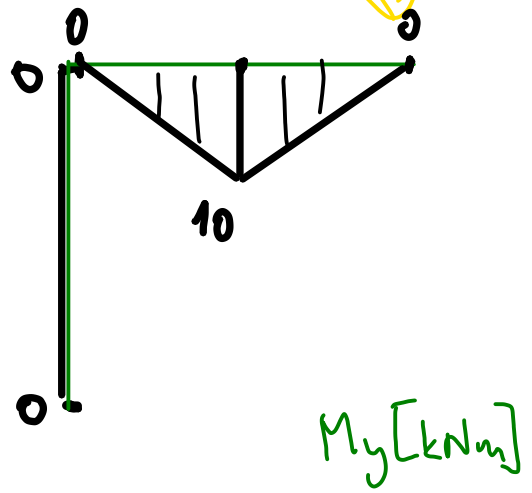
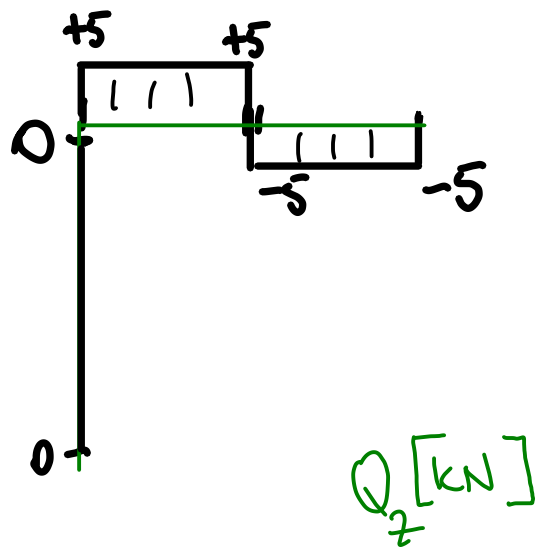
RÓWNOWAG
A WĘZŁA!



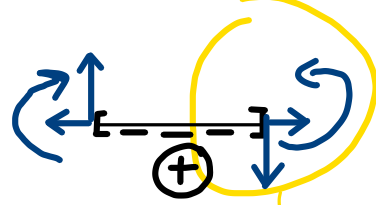
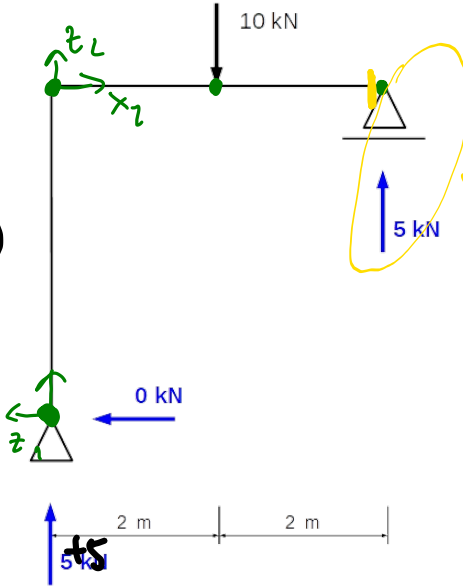
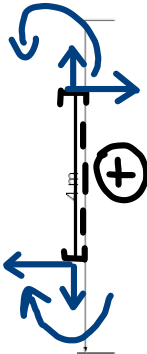
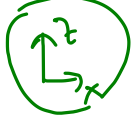
pt. RMS.
u.f.



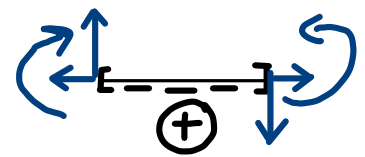
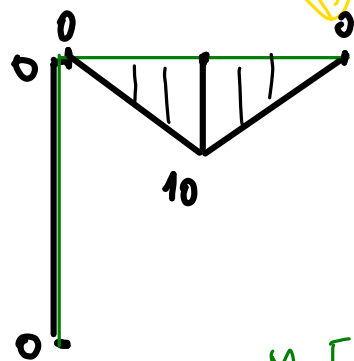
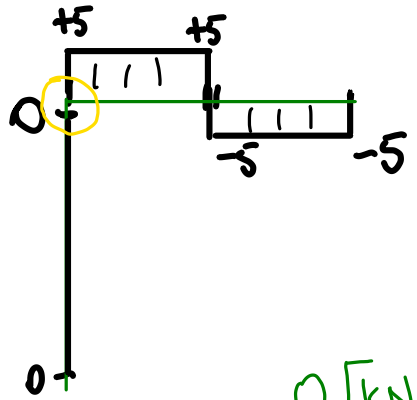
RÓWNOWAG
A WĘZŁA!



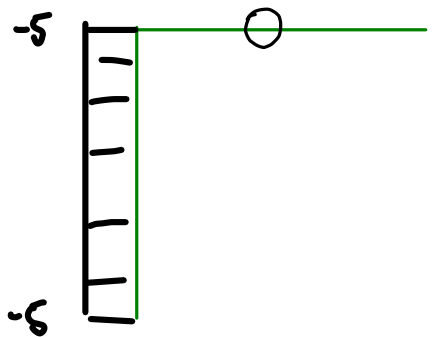
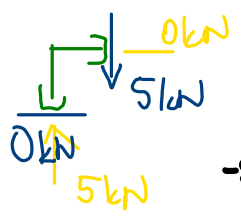
pk - RMS.
u.f.



RÓWNOWAG
A WĘZŁA!

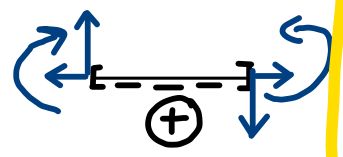
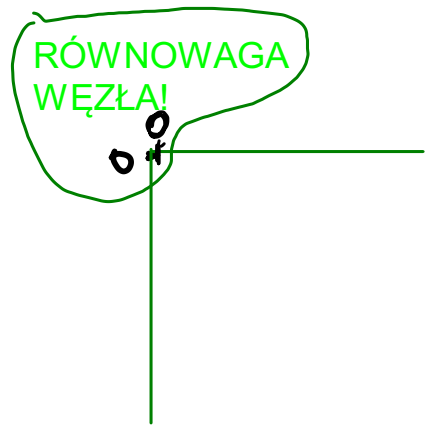
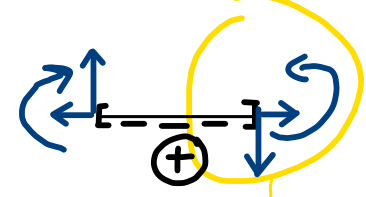
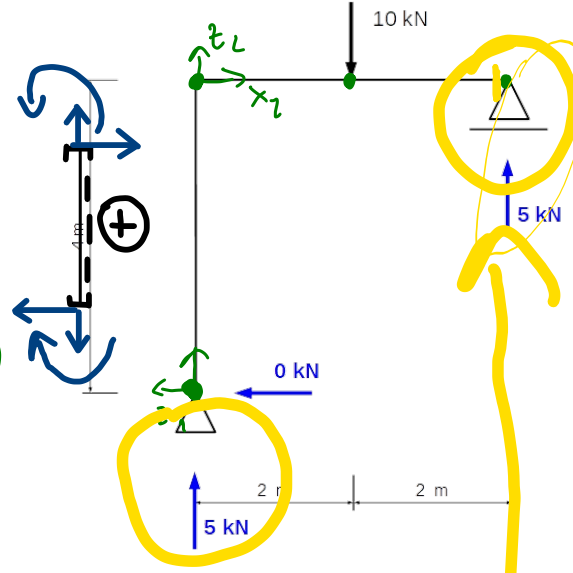


BRĄK
OBC.
ZEWNEJ.

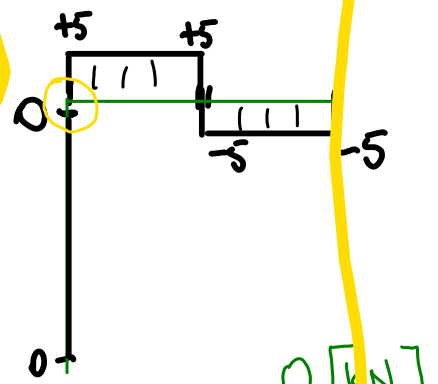
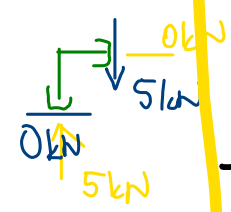


N [kN]

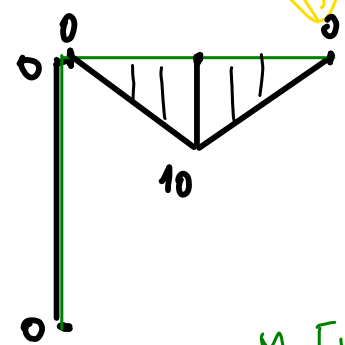
pt. RMS.
u.f.



BRAK
OBC.
ZEWNET.

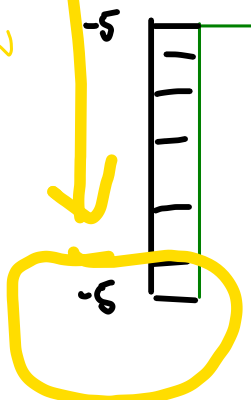


$Q [kN]$

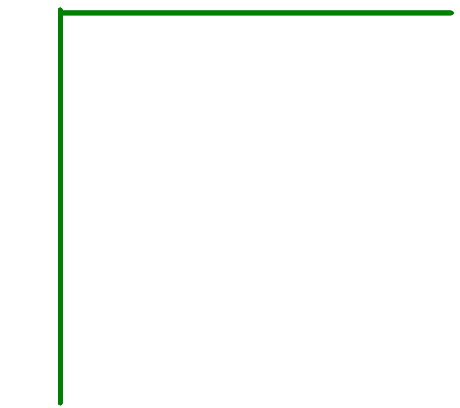
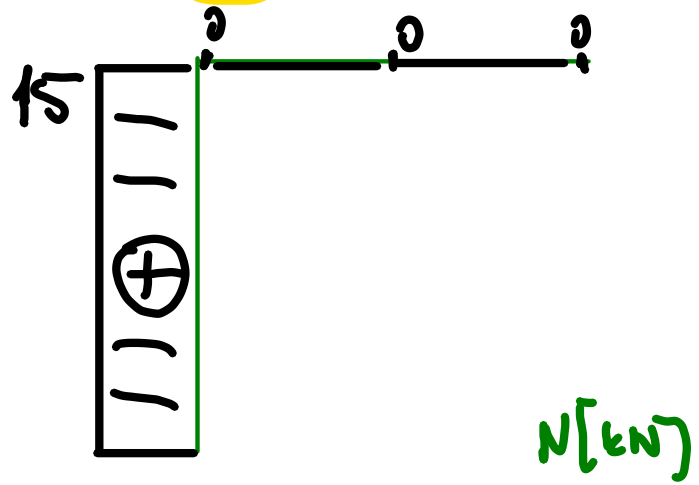
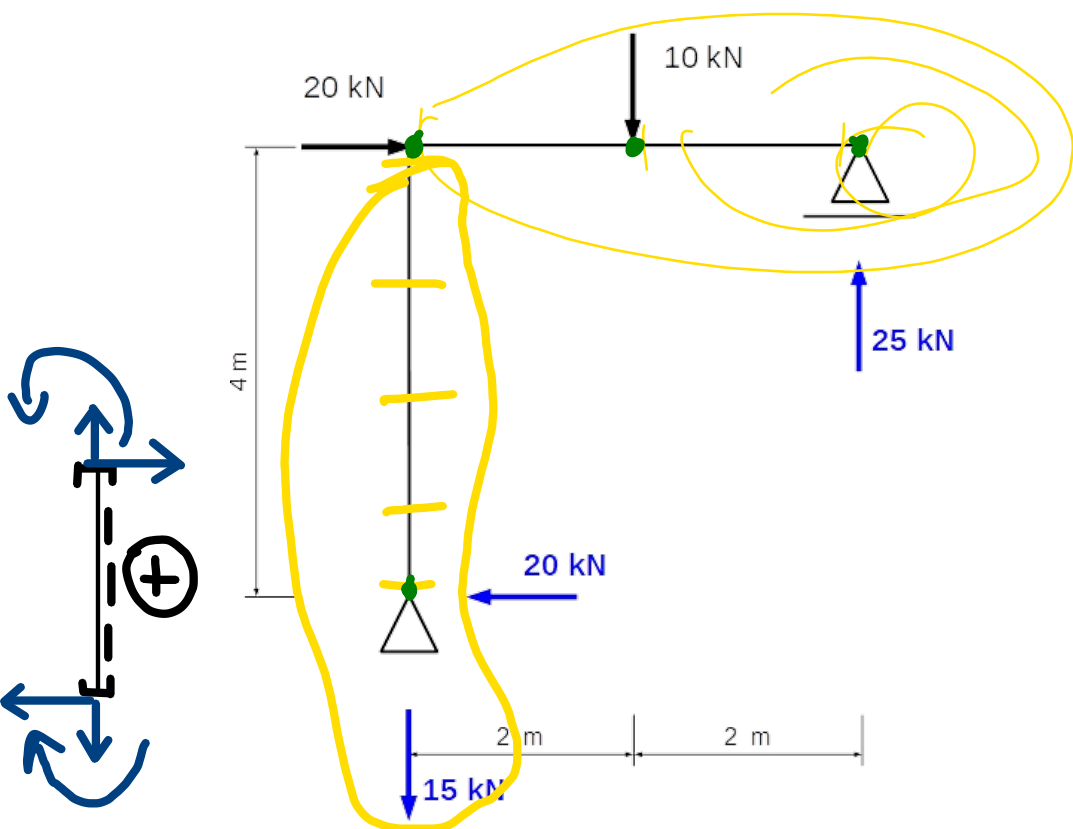


$M_y [kNm]$

SPRAWDZENIE
POPRAWNOŚCI
WYKRESÓW

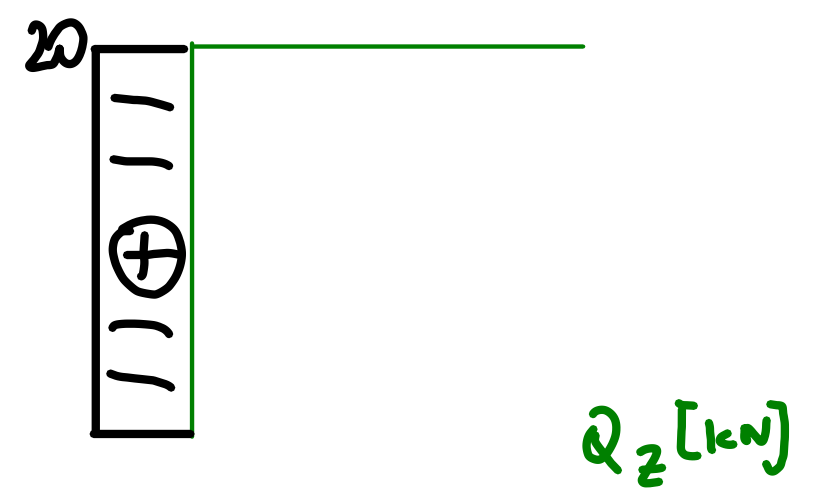
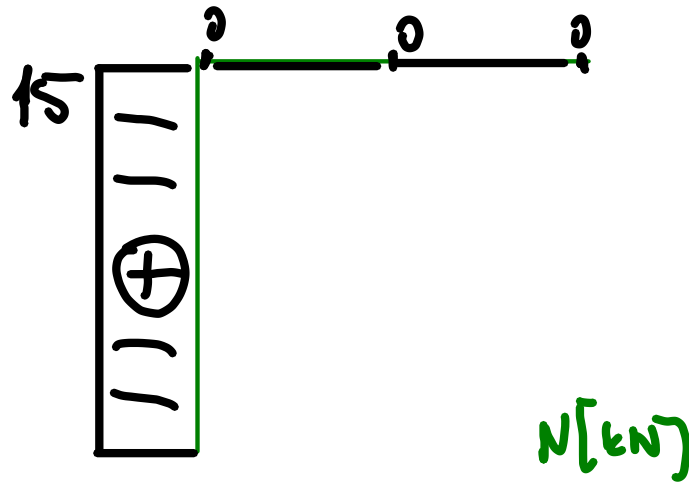
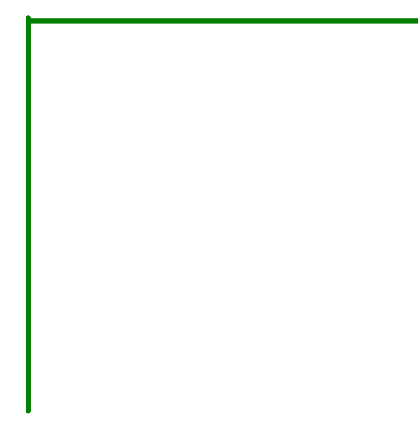
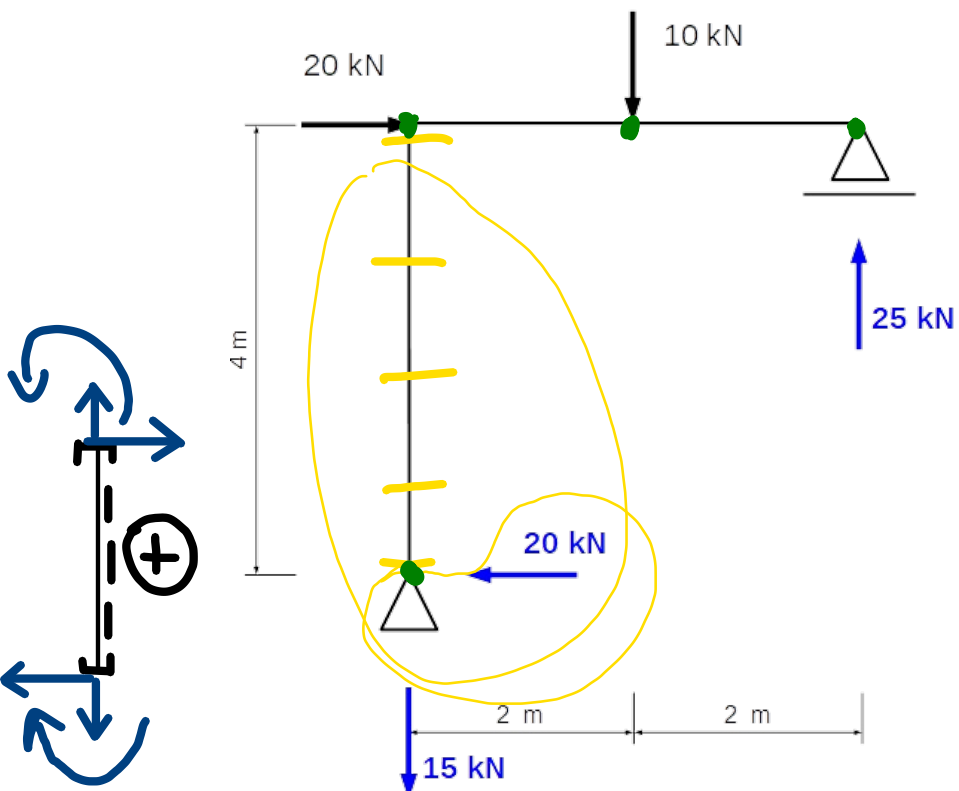


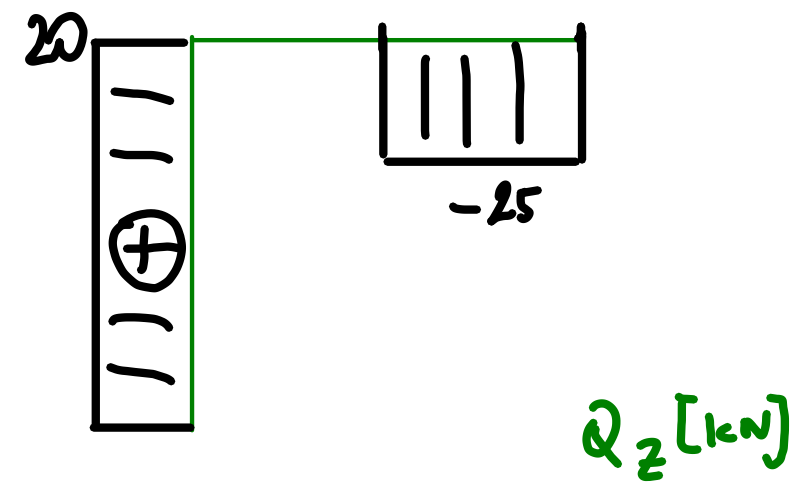
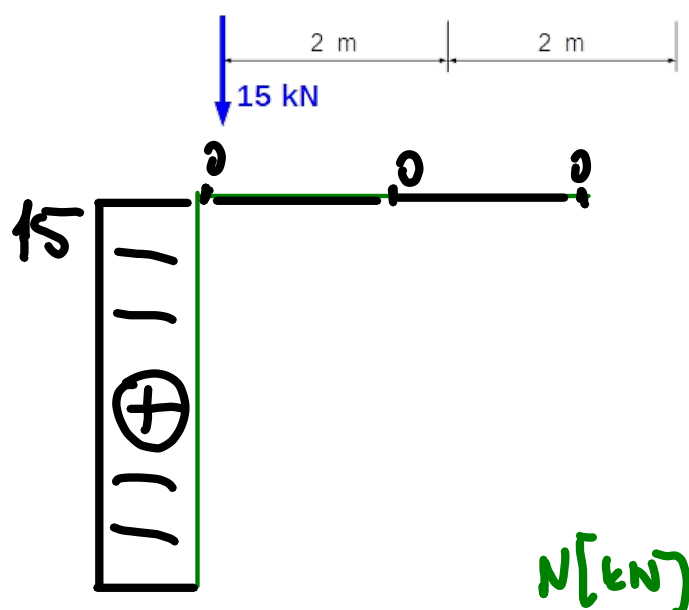
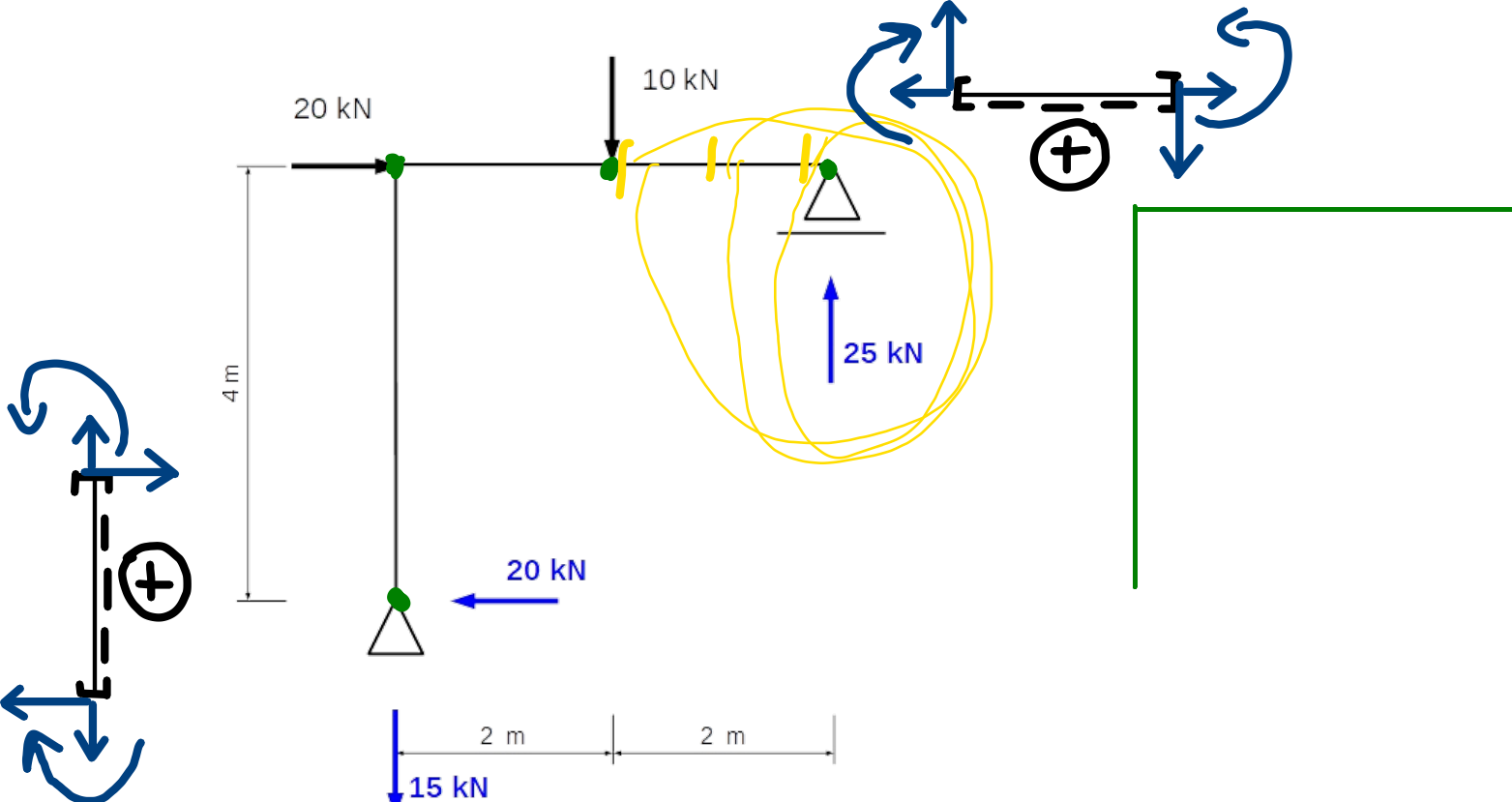
$N [kN]$

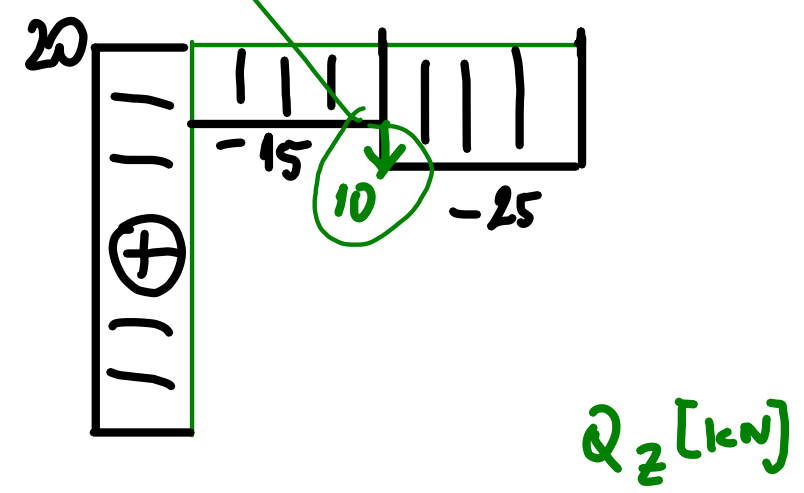
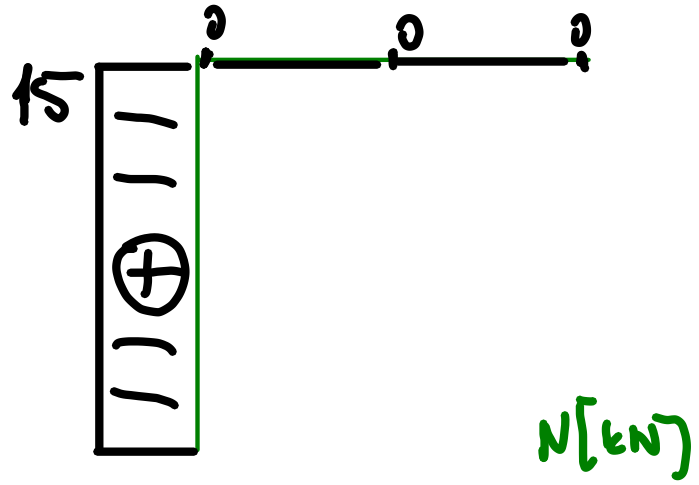
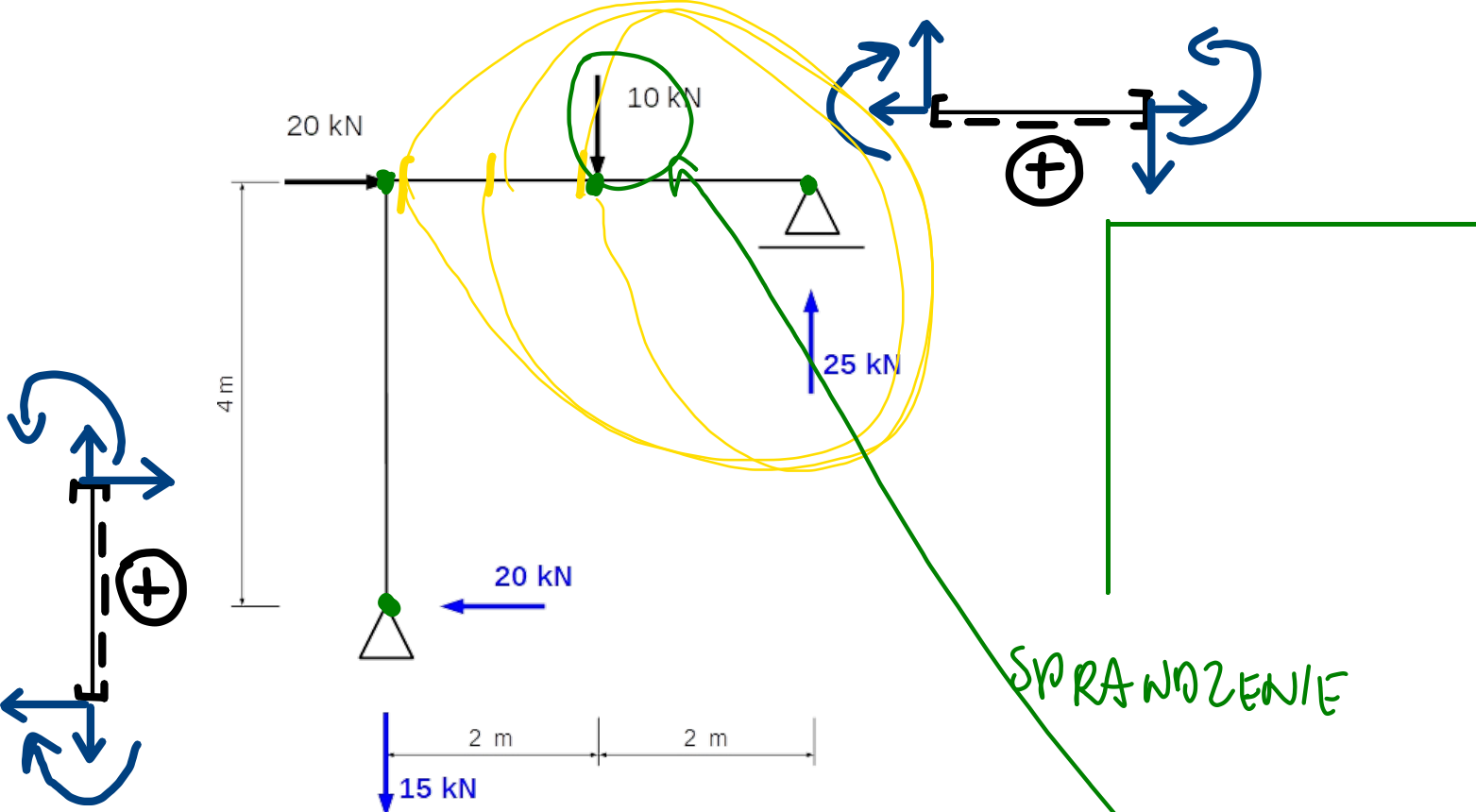


$Q_z [kN]$

$N [kN]$







SPRAWDZENIE

