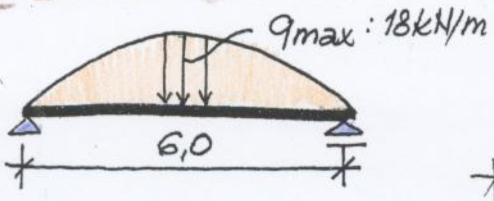
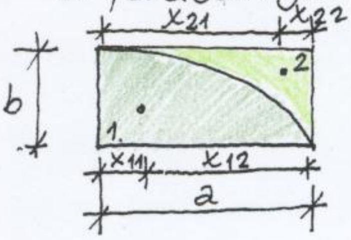
1. pl.: Rajzoljuk meg a tartó T, M ábráit!



a teher másodfokú parabola, a parabola jellemzői:



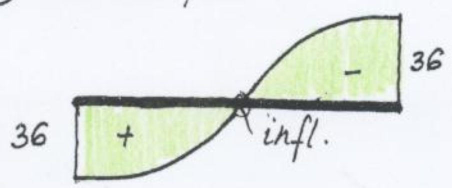
$A_1 = \frac{2}{3} a \cdot b$

$A_2 = \frac{1}{3} a \cdot b$

$x_{11} = \frac{3}{8} a$, $x_{12} = \frac{5}{8} a$,

$x_{21} = \frac{3}{4} a$, $x_{22} = \frac{1}{4} a$

Ⓣ (harmadfokú!)



Támaszerők: $A = B = \frac{18 \cdot 6}{2} \cdot \frac{2}{3} = 36\,kN (\uparrow)$

$M_{max} = \overset{108}{36 \cdot 3} - \overset{40,5}{36 \cdot \frac{3}{8} \cdot 3} = +67{,}5\,kNm$

Ⓜ (negyedfokú!)

Belsőerő fv. összefüggések

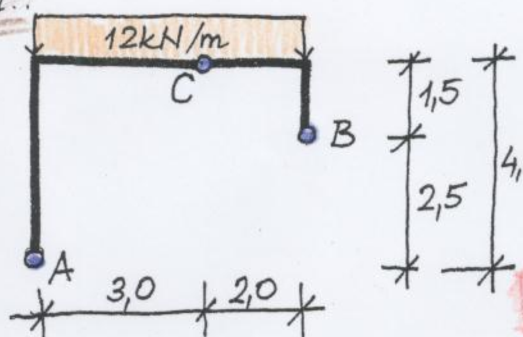
$-\int Q_{(x)} dx = T(x)$ $Q(x) = -dT/dx$

$\int T_{(x)} dx = M(x)$ $T(x) = dM/dx$

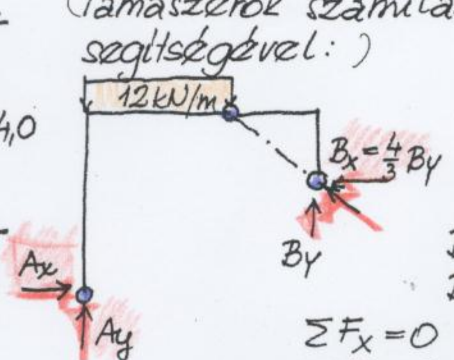
(fv: szélső érték ↔ derivált : ∅)

Rajzoljuk meg a következő 3csuklós tartók belsőerő ábráit!

2. pl.:



(Támaszerők számítása szuperpozíció segítségével:)



$\Sigma M_A = 0$

$\underbrace{3 \cdot 12 \cdot 1{,}5 - B_y 5 - \frac{4}{3} B_y 2{,}5}_{=0}$

$B_y = 6{,}48\,kN (\uparrow)$

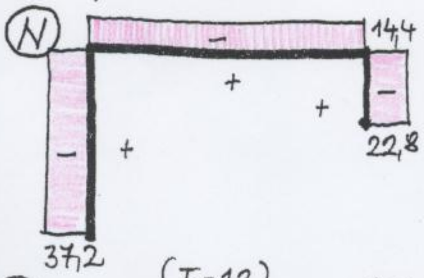
$B_x = 8{,}64\,kN (\leftarrow)$

$\Sigma F_x = 0$ $A_x = 8{,}64\,kN (\rightarrow)$

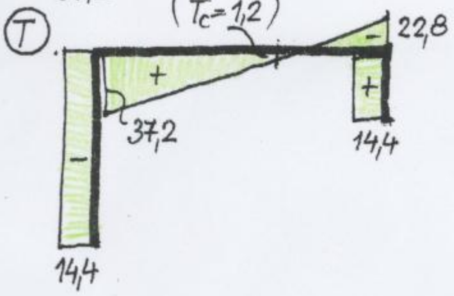
$\Sigma F_y = 0$ $A_y = 29{,}52\,kN (\uparrow)$

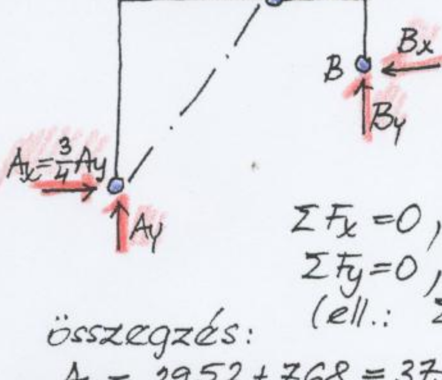
(ell.: $\Sigma M_{C bal} = 0$!)

Ⓝ



Ⓣ





$\Sigma M_B = 0$

$12 \cdot 2 \cdot 1 - 5 A_y + 2{,}5 \cdot \frac{3}{4} A_y = 0$

$A_y = 7{,}68\,kN (\uparrow)$

$A_x = 5{,}76\,kN (\rightarrow)$

$\Sigma F_x = 0$, $B_x = 5{,}76\,kN (\leftarrow)$

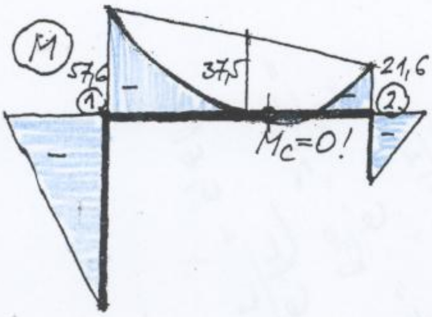
$\Sigma F_y = 0$, $B_y = 16{,}32\,kN (\uparrow)$

(ell.: $\Sigma M_{C jobb} = 0$!)

összegzés:

$A_y = 29{,}52 + 7{,}68 = 37{,}2\,kN$ $B_y = 22{,}8\,kN$

$A_x = 8{,}64 + 5{,}76 = 14{,}4\,kN$ $B_x = 14{,}4\,kN$

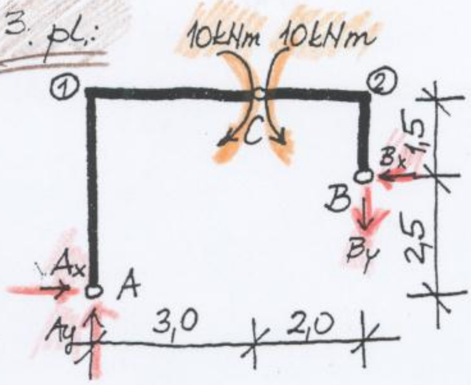


$M_1 = 14{,}4 \cdot 4 = 57{,}6\,kNm$

$M_2 = 14{,}4 \cdot 1{,}5 = 21{,}6\,kNm$

$be = \frac{1}{8} \cdot 5^2 \cdot 12 = 37{,}5$ -"-

3. pl.:



Támaszerők:

$\Sigma M_B = 0; \quad 5A_y - 2{,}5A_x = 0; \quad A_x = 2A_y$

$\Sigma M_{Cb} = 0; \quad 3A_y - 4A_x + 10 = 0$

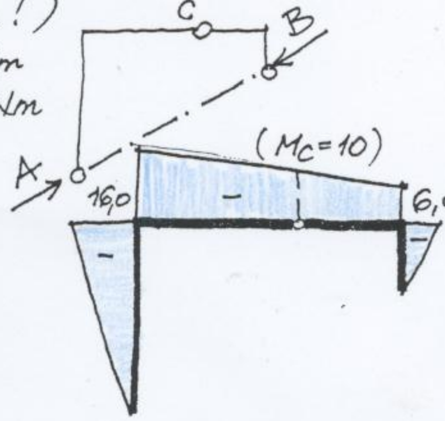
$A_y = \frac{10}{5} = 2{,}0\,kN\,(\uparrow); \quad A_x = 2 \cdot 2 = 4\,kN\,(\rightarrow)$

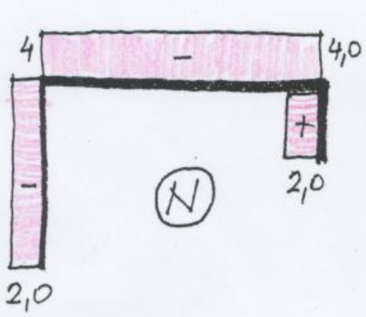
$\Sigma F_y = 0, \; B_y = 2{,}0\,kN\,(\downarrow), \; \Sigma F_x = 0, \; B_x = 4{,}0\,kN\,(\leftarrow)$

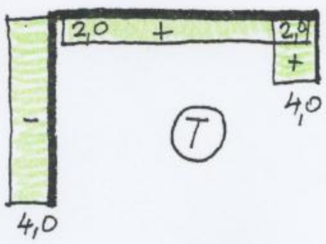
(Nincs külső erő, a támaszerők egy vonalban!)

$M_1 = 4 \cdot 4 = 16{,}0\,kNm$

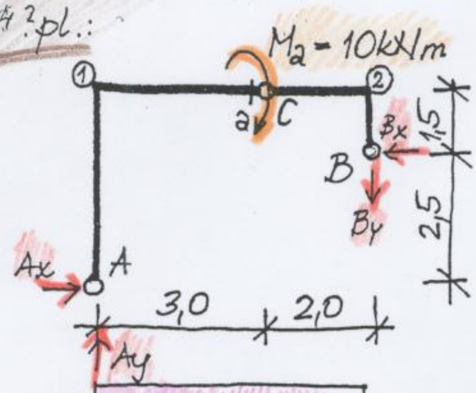
$M_2 = 1{,}5 \cdot 4 = 6{,}0\,kNm$







4. pl.:



Támaszerők:

$\Sigma M_B = 0, \quad 5A_y - 2{,}5A_x + 10 = 0 \qquad /\cdot(-3/5)$

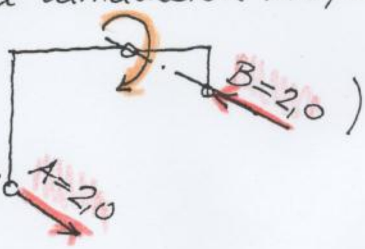
$\Sigma M_{Cb} = 0, \quad \underline{3A_y - 4A_x + 10 = 0}$

$- 2{,}5A_x + \frac{20}{5} = 0$

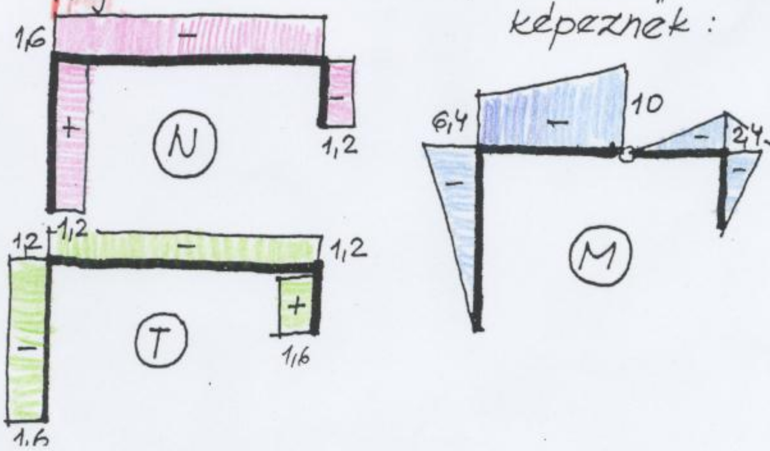
$A_x = 1{,}6\,kN\,(\rightarrow) \quad A_y = -1{,}2\,kN\,(\downarrow)$

$B_x = 1{,}6\,kN\,(\leftarrow) \quad B_y = -1{,}2\,kN\,(\uparrow)$

(A teher „M" – a támaszerők erőpárt képeznek:



)

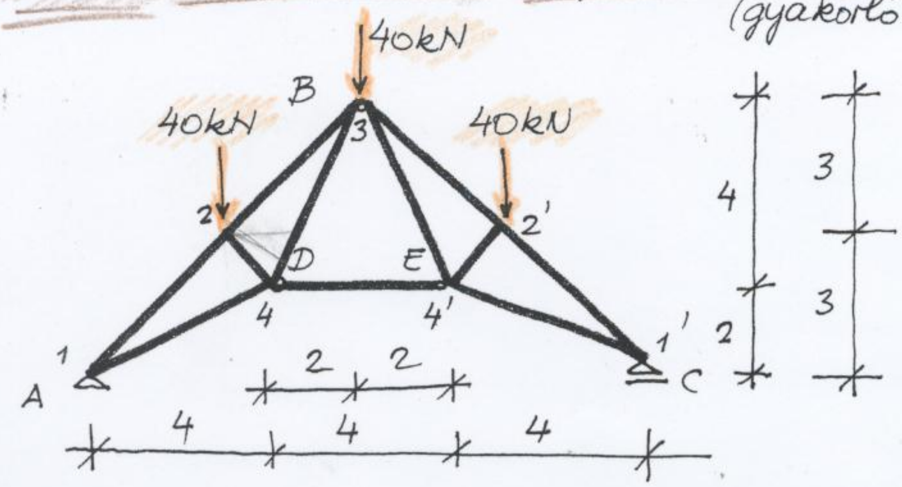


$M_1 = 4 \cdot 1{,}6 = 6{,}4\,kNm$

$M_2 = 1{,}5 \cdot 1{,}6 = 2{,}4\,kNm$

N. 11. – F. 1. gyak.:

3. pl.: Határozzuk meg a rácsostartó rúderőit!
(gyakorló – HF)



Támaszerők:

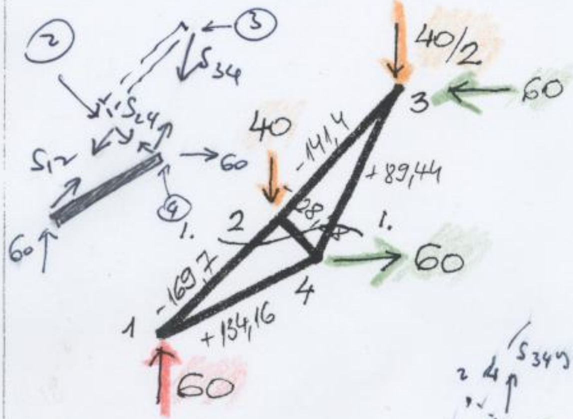
A = 60kN (↑)

B = 60kN (↑)

Háromcsuklós tartóként:

$DE = \frac{\sum M_{B_j}}{4} = \frac{3 \cdot 40 - 6 \cdot 60}{4} = 60\,kN\ (+)$

Minden rúd ferde, ezért a csomóponti módszer kevésbé használható!



1.-1. átmetszés: $+\frac{S_{12}}{\sqrt{2}} \cdot 4 - \frac{S_{12}}{\sqrt{2}} 2 = S_{12}\frac{2}{\sqrt{2}} = S_{12}\sqrt{2}$

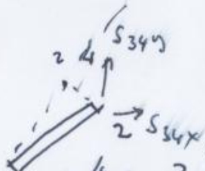
$\sum M_4 = 0$, $\quad (+)$

$60 \cdot 4 + 1{,}414 \cdot S_{12} = 0$,

$S_{12} = \frac{240}{1{,}414} = -169{,}7\,kN$ (–) nyomott!

$S_{12x} = \frac{169{,}7}{1{,}414} = 120\,kN = S_{12y}$

$\sum M_3 = 0$,



$60 \cdot 6 - 60 \cdot 4 + \overset{(+)}{S_{2-4}} \cdot 3 \cdot \sqrt{2} = 0$,

$\sum M_2 = 0$, $\quad -1 \cdot \frac{4}{\sqrt{20}} S_{34} - \frac{2}{\sqrt{20}} S_{34}$ (+)

$S_{2-4} = \frac{360 - 240}{4{,}24} = 28{,}28\,kN$ (–)

$60 \cdot 3 - 60 \cdot 1$ ~~...~~ $= 0$,

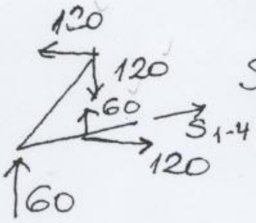
$S_{2-4x} = S_{2-4y} = 20\,kN$

$S_{3-4x}' = \frac{120}{1{,}414} =$ ~~84,85~~ 80 kN $\quad 20\sqrt{20}$

$S_{3-4y}' = 84{,}85/3 =$ ~~28,28~~ 40 kN $\Big\}\ S_{3-4} = \sqrt{80{,}00^2 + 40{,}00^2} = 89{,}44\,kN\ (+)$

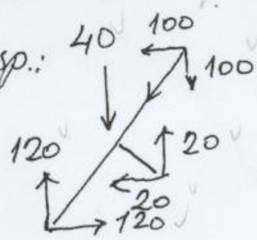
Kiegészítés csomópont kimetszéssel:

1. csp.:



$S_{1-4} = \sqrt{60^2 + 120^2} = 134{,}16\,kN\ (+)$

2. csp.:



$S_{2-3} = \sqrt{2} \cdot 100 = 141{,}4\,kN$ (–)