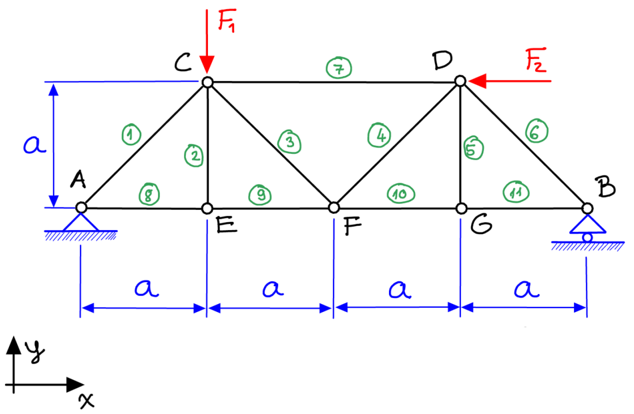
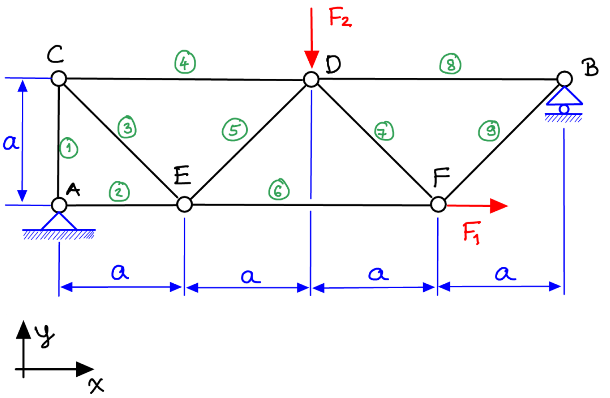
5. Gyakorlat

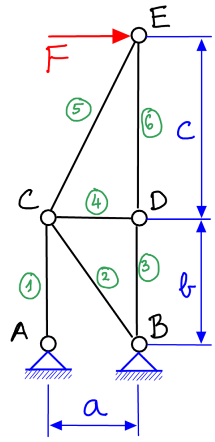
5.1. Példa. Határozzuk meg a reakcióerőket és *csomóponti* módszerrel a rudakban ébredő erőket!
Adatok: $F_1 = 400$ N, $F_2 = 200$ N, $a = 1$ m.
Megoldás: $F_{Ax} = 200$ N, $F_{Ay} = 350$ N, $F_{By} = 50$ N, $N_1 = -350\sqrt{2}$ N, $N_2 = 0$ N, $N_3 = -50\sqrt{2}$ N, $N_4 = 50\sqrt{2}$ N, $N_5 = 0$ N, $N_6 = -50\sqrt{2}$ N, $N_7 = -300$ N, $N_8 = 150$ N, $N_9 = 150$ N, $N_{10} = 50$ N.



5.2. Példa. Határozzuk meg a reakcióerőket, valamint a 6-os és 7-es rudakban ébredő erőket *átmetsző* módszerrel!
Adatok: $F_1 = 100$ N, $F_2 = 200$ N, $a = 1$ m.
Megoldás: $F_{Ax} = -100$ N, $F_{Ay} = 100$ N, $F_{By} = 100$ N, $N_6 = 300$ N, $N_7 = -100\sqrt{2}$ N.

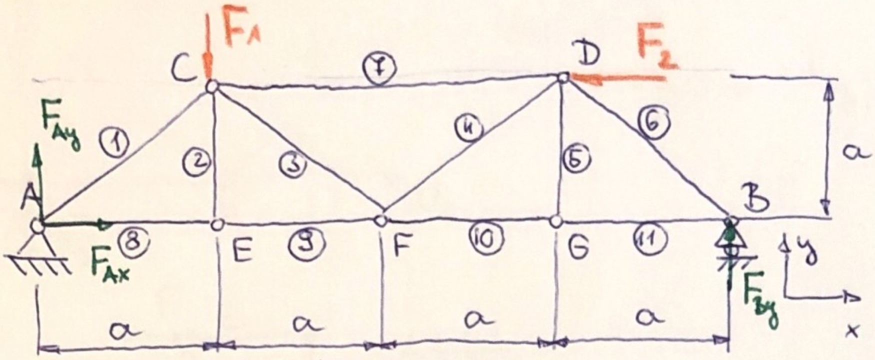


5.3. Példa. Határozzuk meg a reakcióerőket és *csomóponti* módszerrel a rudakban ébredő erőket!
Adatok: $F = 1000$ N, $a = 1$ m, $b = 2$ m, $c = 3$ m.
Megoldás: $F_{Ax} = 0$ N, $F_{Ay} = -5000$ N, $F_{Bx} = -1000$ N, $F_{By} = 5000$ N, $N_1 = 5000$ N, $N_2 = -2236{,}08$ N, $N_3 = -3000$ N, $N_4 = 0$ N, $N_5 = 3162{,}28$ N, $N_6 = -3000$ N.



Rácsos szerkezetek:

5.1



Adatok:

$a = 1\,m$

$F_1 = 400\,N$

$F_2 = 200\,N$

Csomóponti módszer!

Kényszerek meghatározása:

$\sum M_A = 0$

$$-F_1 a + F_2 \cdot a + F_{By} \cdot 4a = 0 \quad \Rightarrow \quad F_{By} = \frac{F_1 - F_2}{4} = \underline{\underline{50N}}$$

$\sum F_{iy} = 0$

$$F_{Ay} - F_1 + F_{By} = 0 \quad \Rightarrow \quad F_{Ay} = F_1 - F_{By} = \underline{\underline{350N}}$$

$\sum F_{ix} = 0$

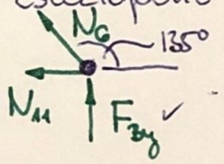
$$F_{Ax} - F_2 = 0 \quad \Rightarrow \quad F_{Ax} = F_2 = \underline{\underline{200N}}$$

Tehát a reakcióerők:

$$\underline{F}_A = \begin{bmatrix} 200 \\ 350 \\ 0 \end{bmatrix} N \qquad \underline{F}_B = \begin{bmatrix} 0 \\ 50 \\ 0 \end{bmatrix} N$$

Csomóponti módszer:

Ⓑ csuklópont



$\sum F_{iy} = 0$: $\quad N_6 \sin 135° + F_{By} = 0$

$$N_6 = -\frac{F_{By}}{\sin 135°} = \underline{\underline{-70{,}71\,N}}$$

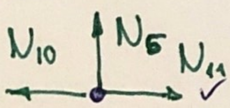
Tehát nyomott a rúd!

$\sum F_{ix} = 0$: $\quad N_6 \cos 135° - N_{11} = 0$

$$N_{11} = N_6 \cos 135° = \underline{\underline{50N}}$$

Tehát húzott a rúd!

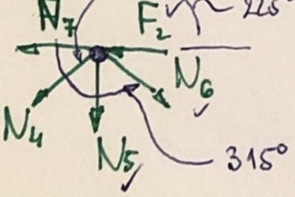
Ⓖ csukló



$\sum F_{iy} = 0$: $\boxed{N_5 = 0}$ $\Rightarrow$ Vakrúd!

$\sum F_{ix} = 0$: $\quad -N_{10} + N_{11} = 0 \quad \Rightarrow \quad N_{10} = N_{11} = \underline{\underline{50N}}$

Ⓓ csukló



$\sum F_{iy} = 0$: $\quad N_4 \sin 225° - N_5 + N_6 \sin 315° = 0$

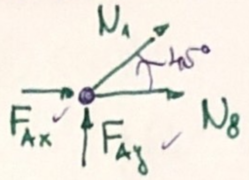
$$N_4 = (N_5 - N_6 \sin 315°)/\sin 225° = \underline{\underline{70{,}71\,N}}$$

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

$$-N_7 + N_4 \cos 225° + N_6 \cos 315° - F_2 = 0$$

$$N_7 = N_4 \cos 225° + N_6 \cos 315° - F_2 = \underline{\underline{-300\,N}}$$

Ⓐ csukló



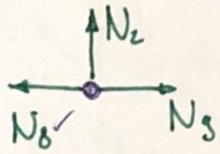
$$\sum F_{iy} = 0 \qquad N_1 \sin 45° + F_{Ay} = 0$$

$$\Rightarrow N_1 = -F_{Ay}/\sin 45° = \underline{\underline{-494{,}98\,N}}$$

$$\sum F_{ix} = 0 \qquad F_{Ax} + N_8 + N_1 \cos 45° = 0$$

$$N_8 = -F_{Ax} - N_1 \cos 45° = \underline{\underline{150\,N}}$$

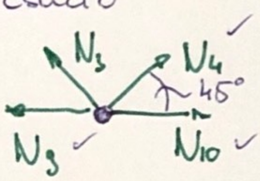
Ⓔ csukló



$$\sum F_{iy} = 0 \qquad \boxed{N_2 = 0}$$

$$\sum F_{ix} = 0 \qquad -N_8 + N_9 = 0 \qquad N_9 = N_8 = \underline{\underline{150\,N}}$$

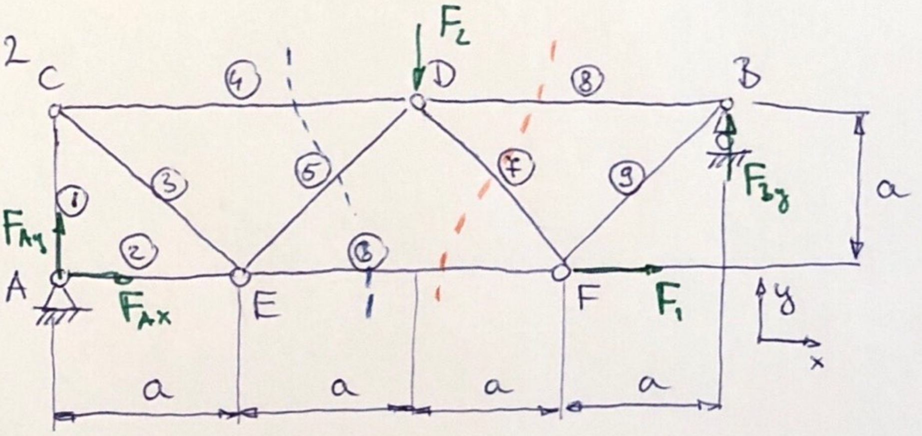
Ⓕ csukló



$$\sum F_{iy} = 0 \qquad N_4 \sin 45° + N_3 \sin 135° = 0$$

$$N_3 = -N_4 \sin 45° / \sin 135° = \underline{\underline{-70{,}71\,N}}$$

5.2



Adatok:

$a = 1\,m$

$F_1 = 100\,N$

$F_2 = 200\,N$

Átmetsző módszer!

(6-os és 7-es rúdeVő!)

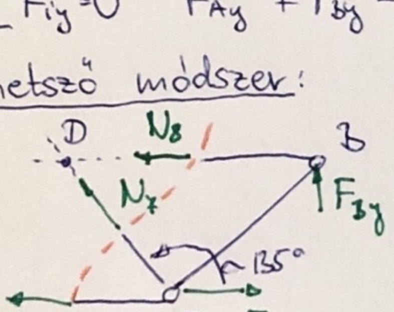
Kényszerek meghatározása:

$$\sum M_A = 0 \qquad F_{By} \cdot 4a - F_2 \cdot 2a = 0 \qquad \Rightarrow \qquad F_{By} = \frac{1}{2} F_2 = \underline{\underline{100\,N}}$$

$$\sum F_{ix} = 0 \qquad F_{Ax} + F_1 = 0 \qquad \Rightarrow \qquad F_{Ax} = -F_1 = \underline{\underline{100\,N}}$$

$$\sum F_{iy} = 0 \qquad F_{Ay} + F_{By} - F_2 \qquad \Rightarrow \qquad F_{Ay} = F_2 - F_{By} = \underline{\underline{100\,N}}$$

Átmetsző módszer:



$$\sum M_D = 0 \qquad -N_6 \cdot a + F_1 a + F_{By} \cdot 2a = 0$$

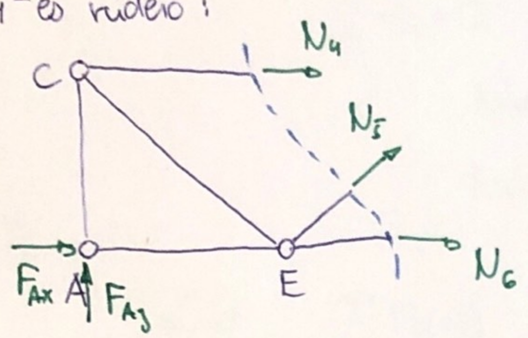
$$N_6 = F_1 + 2F_{By} = \underline{\underline{300\,N}}$$

$$\sum F_{iy} = 0 \qquad N_7 \cdot \sin 135° + F_{By} = 0$$

$$N_7 = -F_{By}/\sin 135° = \underline{\underline{-141{,}42\,N}}$$

2

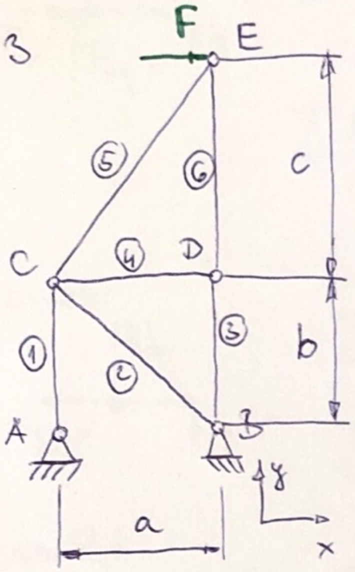
4-es rúderő:



$\sum M_E = 0$

$-N_4 \cdot a - F_{Ay} \cdot a = 0 \Rightarrow N_4 = -F_{Ay} = \underline{\underline{-100N}}$

5.3



<u>Adatok</u>:

$a = 1m$

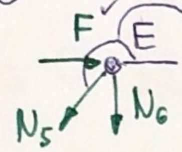
$b = 2m$

$c = 3m$

$F = 1000N$

Csomóponti módszer!

Ⓔ csukló



$251{,}565° = 180° + \arctan\frac{c}{a}$

$\sum F_{ix} = 0 \quad F + N_5 \cos 251{,}565° = 0$

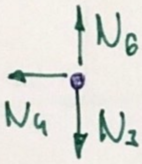
$N_5 = -F/\cos 251{,}565° =$

$= \underline{3162{,}28} N$

$\sum F_{iy} = 0 \quad N_5 \, \overset{\sin}{\cancel{\cos}} \, 251{,}565° - N_6 = 0$

$N_6 = N_5 \sin 251{,}565° = \underline{\underline{-3000N}}$

Ⓓ csukló



$\sum F_{ix} = 0 \quad -N_4 = 0 \quad \Rightarrow \boxed{N_4 = 0}$

Vakrúd

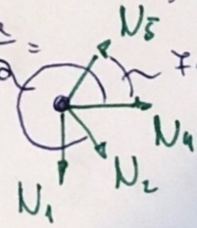
$\sum F_{iy} = 0 \quad N_6 - N_3 = 0$

$N_3 = N_6 = \underline{\underline{-3000N}}$

Ⓒ csukló

$270° + \arctan\frac{a}{b} =$

$= 296{,}565°$



$\sum F_{ix} = 0$

$N_5 \cos 71{,}565° + N_4 + N_2 \cos 296{,}565° = 0$

$N_2 = (-N_4 - N_5 \cos 71{,}565°)/\cos 296{,}565°$

$= \underline{\underline{-2236{,}08}} N$

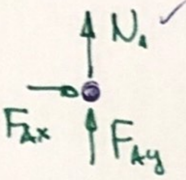
$$\sum F_{iy} = 0$$

$$N_5 \sin 71{,}565° + N_2 \sin 296{,}565° - N_1 = 0$$

$$N_1 = N_5 \sin 71{,}565° + N_2 \sin 296{,}565° = \underline{\underline{5000}}\,N$$

<u>Reakcióerő:</u>

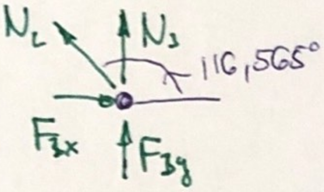
(A) csukló:



$$\sum F_{iy} = 0 \qquad N_1 + F_{Ay} = 0 \qquad\qquad \sum F_{ix} = 0$$

$$F_{Ay} = -N_1 = \underline{\underline{-5000}}\,N \qquad\qquad F_{Ax} = \underline{\underline{0}}\,N$$

(B) csukló



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

$$N_2 \cos 116{,}565° + F_{Bx} = 0$$

$$F_{Bx} = -N_2 \cos 116{,}565° = \underline{\underline{-1000}}\,N$$

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

$$N_2 \sin 116{,}565° + N_3 + F_{By} = 0$$

$$F_{By} = -N_3 - N_2 \sin 116{,}565° = \underline{\underline{5000}}\,N$$