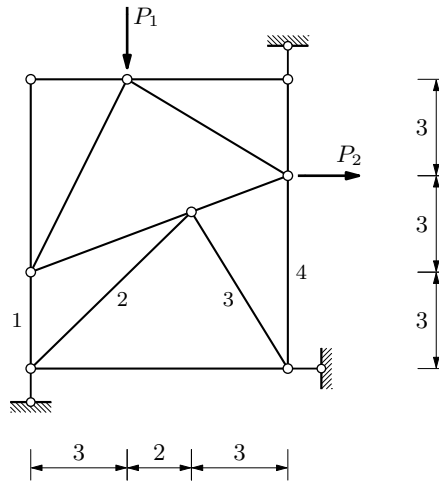


# K-rešetka – Culmannov i Ritterov postupak

Culmannovim i Ritterovim postupkom odredite vrijednosti sila u štapovima 1, 2, 3 i 4!

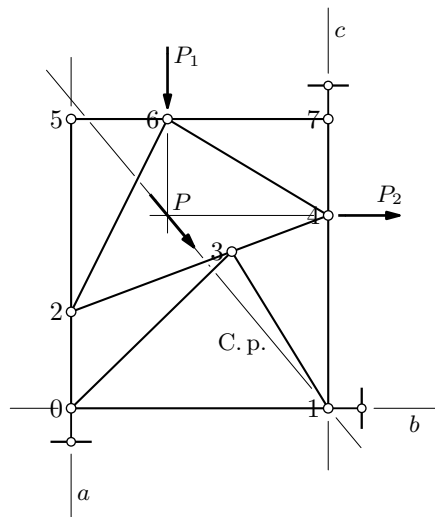
$$P_1 = 120 \text{ kN}$$

$$P_2 = 100 \text{ kN}$$

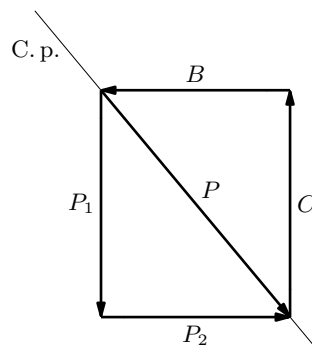


Culmannov postupak:

orijentacije i intenziteti reakcija:



$$\text{C. p.: } (P \cap a) \cup (b \cap c)$$



mjerilo sila:

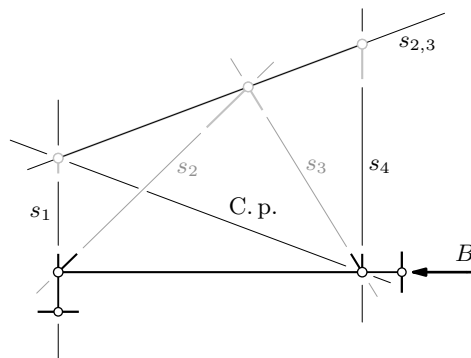
$$1 \text{ cm} :: 40 \text{ kN}$$

$$A = 0$$

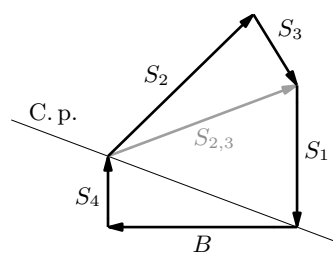
$$B = 100 \text{ kN}$$

$$C = 120 \text{ kN}$$

orijentacije i intenziteti sila u štapovima:



$$\text{C. p.: } (B \cap s_4) \cup (s_1 \cap s_{2,3})$$



$$S_1 = 75 \text{ kN (tlak)}$$

$$S_4 = 37,5 \text{ kN (vlak)}$$

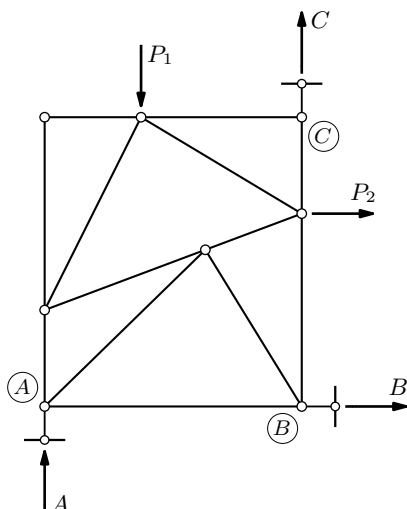
$$S_{2,3} = 106,8 \text{ kN}$$

$$S_2 = 107,4 \text{ kN (vlak)}$$

$$S_3 = 44,0 \text{ kN (tlak)}$$

Ritterov postupak:

vrijednosti reakcija:



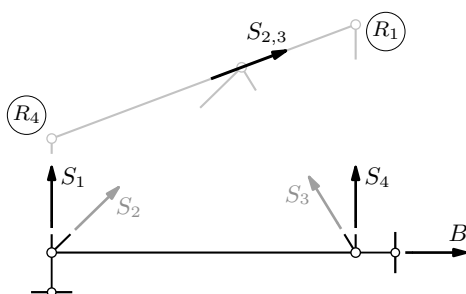
$$\sum_{\text{cijeli}} M/B = 0 : \quad -8 \cdot A + 5 \cdot P_1 - 6 \cdot P_2 = 0 \quad \Rightarrow \quad A = 0$$

$$\sum_{\text{cijeli}} F_x = 0 : \quad B + P_2 = 0 \quad \Rightarrow \quad B = -P_2 = -100 \text{ kN}$$

budući da ćemo pri izračunavanju vrijednosti sila u štapovima odbaciti dio nosača iznad presjeka kroz štapove, vrijednost sile  $C$  ne treba računati

$$\begin{aligned} \text{provjera } A \text{ \&Oslash; } B: \quad \sum_{\text{cijeli}} M/C &= -8 \cdot A + 5 \cdot P_1 + 3 \cdot P_2 + 8 \cdot B \\ &= -8 \cdot 0 + 5 \cdot 120 + 3 \cdot 100 + 9 \cdot (-100) = 0 \end{aligned}$$

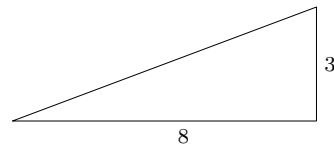
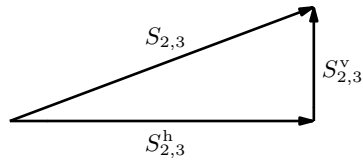
vrijednosti sila u štapovima:



$$\sum_{\text{donji dio}} M/R_1 = 0 : \quad -8 \cdot S_1 + 6 \cdot B = 0 \quad \Rightarrow \quad S_1 = \frac{3}{4} \cdot (-100) = -75 \text{ kN}$$

$$\sum_{\text{donji dio}} M/R_4 = 0 : \quad 8 \cdot S_4 + 3 \cdot B = 0 \quad \Rightarrow \quad S_4 = -\frac{3}{8} \cdot (-100) = 37,5 \text{ kN}$$

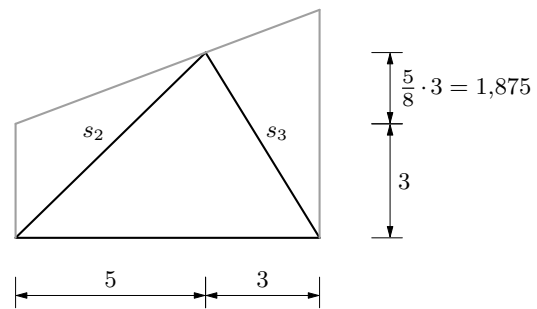
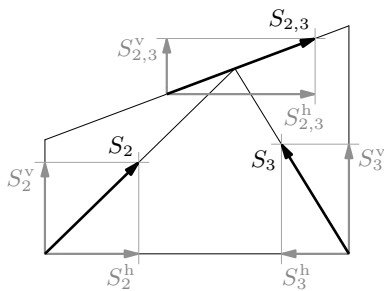
$$\sum_{\text{donji dio}} F_x = 0 : \quad S_{2,3}^h + B = 0 \quad \Rightarrow \quad S_{2,3}^h = -(-100) = 100 \text{ kN}$$



$$\frac{S_{2,3}^v}{S_{2,3}^h} = \frac{3}{8} \Rightarrow S_{2,3}^v = \frac{3}{8} S_{2,3}^h = 37,5 \text{ kN}$$

$$S_{2,3} = \sqrt{(S_{2,3}^h)^2 + (S_{2,3}^v)^2} = 106,80 \text{ kN}$$

provjera:  $\sum_{\text{donji dio}} F_z = -S_1 - S_{2,3}^v - S_4 = -(-75) - 37,5 - 37,5 = 0$



$$\left. \begin{aligned} S_2^h - S_3^h &= S_{2,3}^h \\ S_2^v + S_3^v &= S_{2,3}^v \end{aligned} \right\}$$

$$\frac{S_2^h}{S_2} = \frac{5}{s_2} = \frac{5}{\sqrt{5^2 + 4,875^2}} = 0,716 \Rightarrow S_2^h = 0,716 \cdot S_2$$

$$\frac{S_2^v}{S_2} = \frac{4,875}{s_2} = 0,6981 \Rightarrow S_2^v = 0,6981 \cdot S_2$$

$$\frac{S_3^h}{S_3} = \frac{3}{s_3} = \frac{3}{\sqrt{3^2 + 4,875^2}} = 0,524097 \Rightarrow S_3^h = 0,524097 \cdot S_3$$

$$\frac{S_3^v}{S_3} = \frac{4,875}{s_3} = 0,851658 \Rightarrow S_3^v = 0,851658 \cdot S_3$$

$$\left. \begin{aligned} 0,716000 \cdot S_2 - 0,524097 \cdot S_3 &= 100,0 \\ 0,698100 \cdot S_2 + 0,851658 \cdot S_3 &= 37,5 \end{aligned} \right\}$$

$$S_2 = 107,435 \text{ kN} \quad \& \quad S_3 = -44,0319 \text{ kN}$$

još jedna provjera:

$$S_2^h = 0,716 \cdot S_2 = 76,9235 \quad \& \quad S_3^h = 0,524097 \cdot S_3 = -23,0770$$

$$\sum_{\text{donji dio}} F_x = S_2^h - S_3^h + B = 76,9235 - (-23,0770) + (-100) = 0,0005 \simeq 0$$