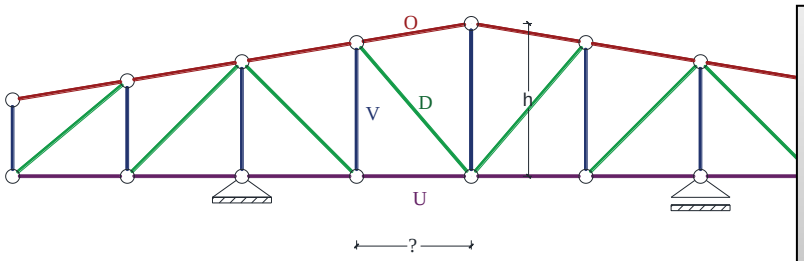
Rešetkasti nosači

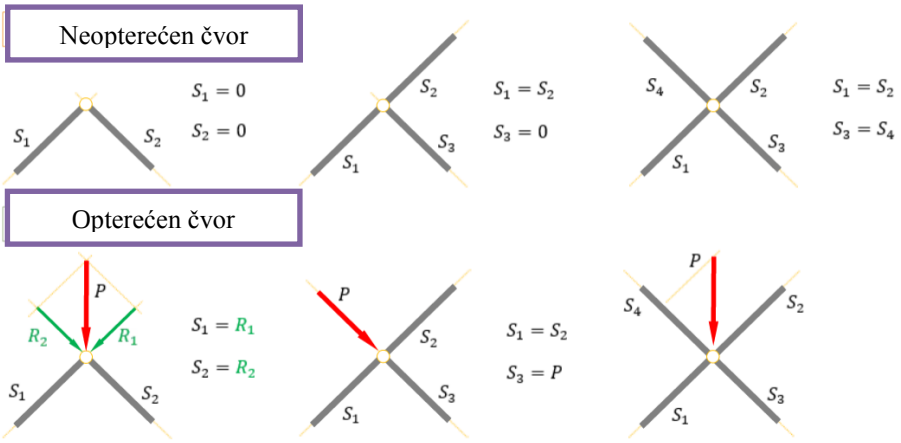
Sastoje se od pravih zglavkasto vezanih štapova kod kojih se opterećenje prenosi uvjek preko čvorova, pri čemu su T i M =0. Normalne sile postoje i one se nazivaju *sile u štapovima.* Nepoznate veličine su: *reakcije oslonaca (Zo) i sile u štapovima (Zs).*



Gornji pojas – O
Donji pojas – U
Dijagonale – D
Vertikale – V
λ-horizontalno odstojanje susjednih čvorova gornjeg ili donjeg pojasa – ***dužina polja***
h-vertikalno rastojanje gornjeg i donjeg pojasa - ***visina rešetke***

Metod čvorova

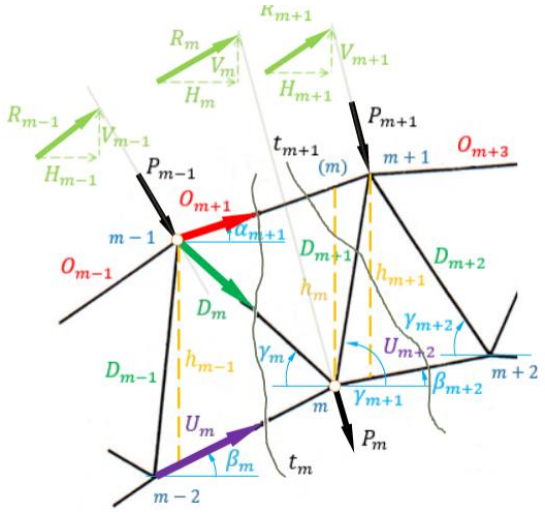
Ukoliko je ispunjen uslov Zs+Zo=2K za svaki čvor je moguće ispisati 2 uslova ravnoteže (SumaV i N) i iz njih dobiti nepoznate u nosaču.



Metod preseka – Riterov postupak

Primenjuje se ukoliko nas interesuju samo sile u nekim štapovima. Može se primeniti ukoliko u preseku ne postoji više od tri nepoznate sile u štapu koje se ne sjeku u jednom čvoru.

Rešetka sa trougaonom ispunom



$$M_{m-1} - U_m\, h_{m-1} \cos\beta_m = 0 \qquad M_m + O_{m+1}\, h_m \cos\alpha_{m+1} = 0$$

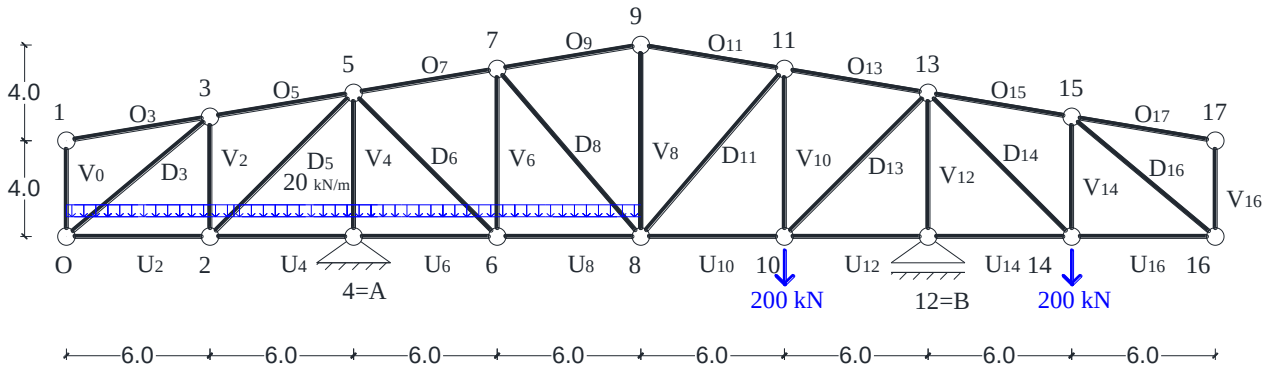
$$U_m = +\frac{M_{m-1}}{h_{m-1}} \sec\beta_m \qquad O_{m+1} = -\frac{M_m}{h_m} \sec\alpha_{m+1}$$

$\sum H = 0$: до пресека t_m са леве стране

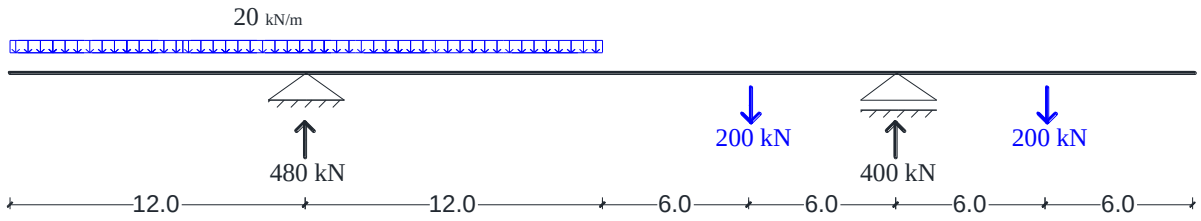
$$D_m \cos\gamma_m + O_{m+1} \cos\alpha_{m+1} + U_m \cos\beta_m + H_m = 0$$

$$D_m = \left(\frac{M_m}{h_m} - \frac{M_{m-1}}{h_{m-1}} - H_m\right) \sec\gamma_m$$

Zadatak: *Za rešetkasti nosač i opterećenje odrediti reakcije oslonaca i sile u štapovima.*



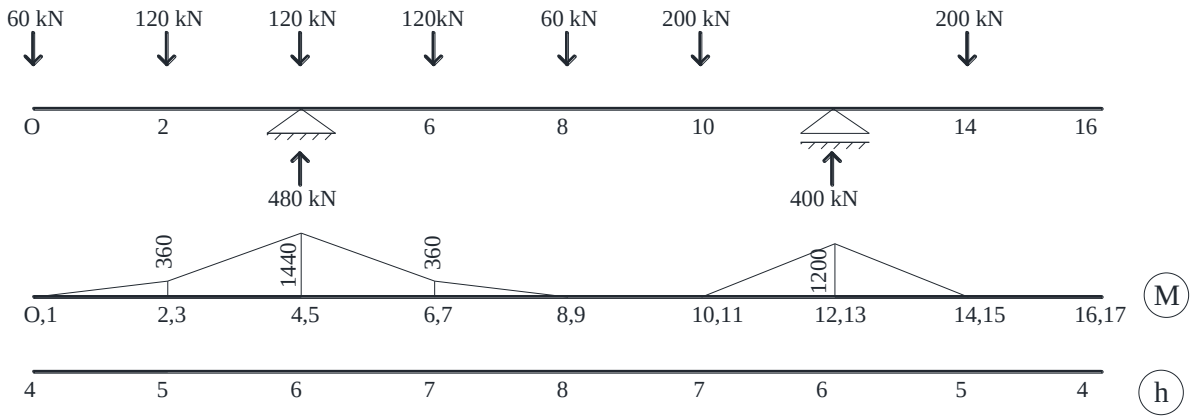
-Reakcije oslonaca



$$\sum M_a = 0 \;\rightarrow B = \frac{200 \cdot 30 + 200 \cdot 18}{24} = 400\ kN$$

$$\sum V_i = 0 \;\rightarrow A = 200 + 200 + 20 \cdot 24 - 400 = 480\ kN$$

-Ekvivalentno čvorno opterećenje



-Proračun sila u štapovima

m-1 – Riterova tačka za štap Um
$cos\beta_m$- ugao koji traženi štap zaklapa

Donji pojas: $\boldsymbol{U_m = \frac{M_{m-1}}{h_{m-1}} \frac{1}{cos\beta_m}}$

$cos\beta_m = 1{,}0$ *za sve štapove donjeg pojas*

$U_2 = \frac{M_3}{h_3} = -72kN$

$U_4 = \frac{M_5}{h_5} = -240kN$

$U_6 = \frac{M_5}{h_5} = -240kN$

$U_8 = \frac{M_7}{h_7} = -51{,}43kN$

$U_{10} = \frac{M_{11}}{h_{11}} = 0$

$U_{12} = U_{14} = \frac{M_{13}}{h_{13}} = -200kN$

$U_{16} = \frac{M_{15}}{h_{15}} = 0$

Gornji pojas: $\boldsymbol{O_{m+1} = -\frac{M_m}{h_m} \frac{1}{cos\alpha_{m+1}}}$

$cos\alpha_{m+1} = 0.986$ *za sve štapove gornjeg pojas*

$O_3 = -\frac{M_0}{h_0} \frac{1}{0.986} = 0$

$O_5 = -\frac{M_2}{h_2} \frac{1}{0.986} = 73.02kN$

$O_7 = -\frac{M_6}{h_6} \frac{1}{0.986} = 52{,}16kN$

$O_9 = O_{11} = -\frac{M_8}{h_8} \frac{1}{0.986} = 0$

$O_{13} = -\frac{M_{10}}{h_{10}} \frac{1}{0.986} = 0$

$O_{15} = -\frac{M_{14}}{h_{14}} \frac{1}{0.986} = 0$

$O_{17} = -\frac{M_{16}}{h_{16}} \frac{1}{0.986} = 0$

$\boldsymbol{H_m}$ *– horizontalne sile sa jedne strane preseka*
$\frac{M_m}{h_m}$*–donji čvor dijagonale*
$\frac{M_{m-1}}{h_{m-1}}$*-gornji čvor dijagonale*

Dijagonale: $\boldsymbol{D_m = \left(\frac{M_m}{h_m} - \frac{M_{m-1}}{h_{m-1}} - H_m\right) \frac{1}{cos\gamma_m}}$

$cos\gamma_3 = cos\gamma_{16} = 0{,}768$
$cos\gamma_5 = cos\gamma_6 = cos\gamma_{13} = cos\gamma_{14} = \sqrt{2}/2$
$cos\gamma_8 = cos\gamma_{11} = 0{,}651$

$D_3 = \left(\frac{M_0}{h_0} - \frac{M_3}{h_3}\right) \frac{1}{0{,}768} = 93.75kN$

$D_5 = \left(\frac{M_2}{h_2} - \frac{M_5}{h_5}\right) \frac{1}{\sqrt{2}/2} = 237{,}7kN$

$D_6 = \left(\frac{M_6}{h_6} - \frac{M_5}{h_5}\right) \frac{1}{\sqrt{2}/2} = 266{,}67kN$

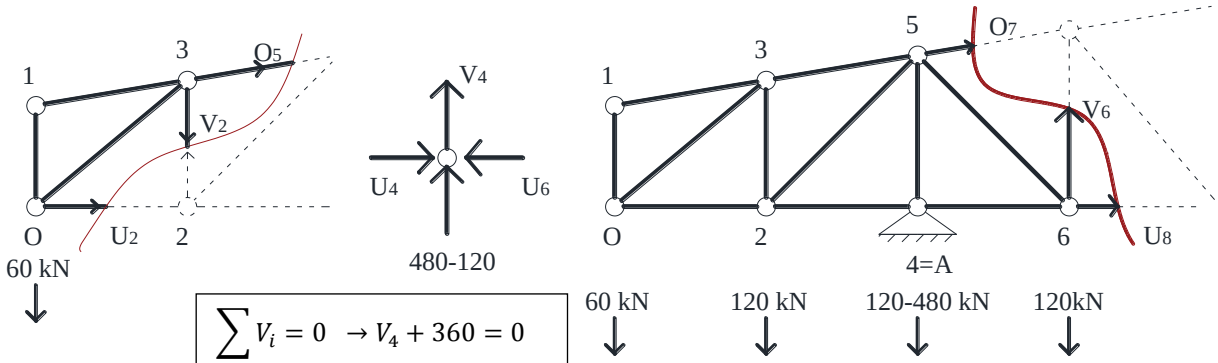
$D_{11} = \left(\frac{M_8}{h_8} - \frac{M_{11}}{h_{11}}\right) \frac{1}{0{,}651} = 0$

$D_{13} = \left(\frac{M_{10}}{h_{10}} - \frac{M_{13}}{h_{13}}\right) \frac{1}{\sqrt{2}/2} = 282{,}89kN$

$D_{14} = \left(\frac{M_{14}}{h_{14}} - \frac{M_{13}}{h_{13}}\right) \frac{1}{\sqrt{2}/2} = 282{,}89kN$

$$D_8 = \left(\frac{M_8}{h_8} - \frac{M_7}{h_7}\right)\frac{1}{0{,}651} = 79kN \qquad D_{16} = \left(\frac{M_{16}}{h_{16}} - \frac{M_{15}}{h_{15}}\right)\frac{1}{0{,}768} = 0$$

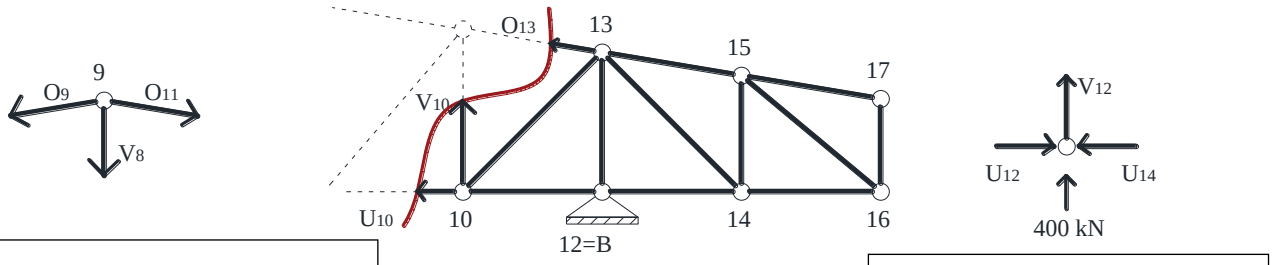
-Vertikale



$$\sum V_i = 0 \;\rightarrow V_4 + 360 = 0$$
$$V_4 = -360\ kN$$

$$\sum V_i = 0 \;\rightarrow -60 - V_2 + sin\alpha_5 O_5 = 0$$
$$V_2 = -48\ kN$$

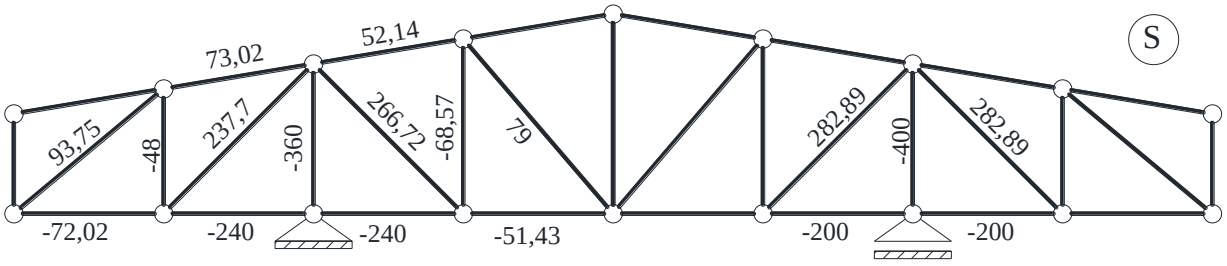
$$\sum V_i = 0 \;\rightarrow 60 + V_6 + sin\alpha_7 O_7 = 0$$
$$V_6 = -68{,}57\ kN$$



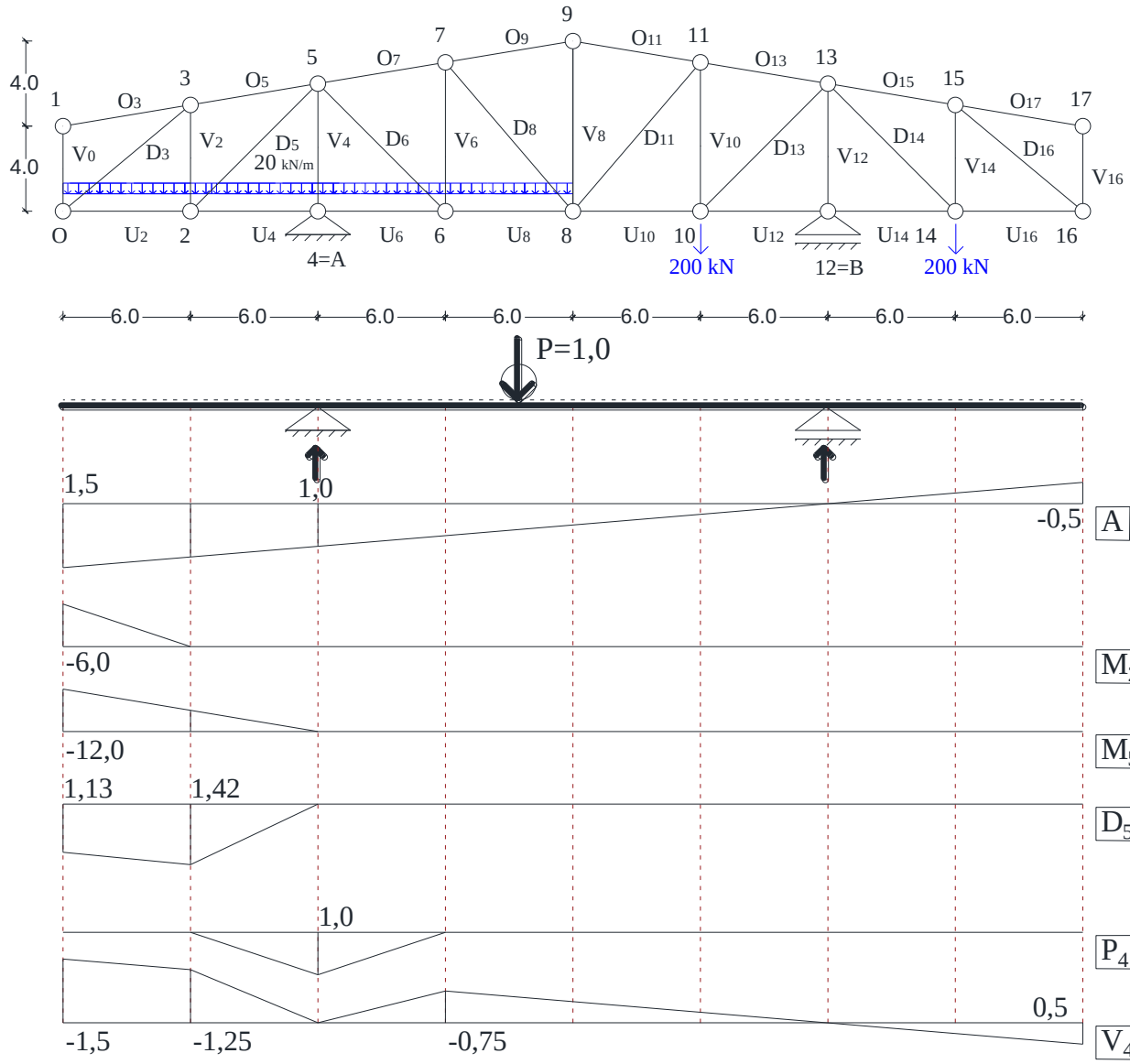
$$\sum V_i = 0 \;\rightarrow V_8 + sin\alpha(O_9 + O_{11}) = 0$$
$$V_8 = 0$$

$$\sum V_i = 0 \;\rightarrow V_{12} + 400 = 0$$
$$V_{12} = -400\ kN$$

$$\sum V_i = 0 \;\rightarrow -V_{10} - sin\alpha_{13} O_{13} = 0$$
$$V_{10} = 0$$



Uticajne linije za sile u štapovima



$$\sum M_b = 0 \;\rightarrow A = \frac{P \cdot u_b}{24}$$

$M_2 = -P \cdot u_2$
$M_5 = -P \cdot u_5$

$$D_5 = \left(\frac{M_2}{h_2} - \frac{M_5}{h_5}\right)\frac{1}{\sqrt{2}/2} = 0{,}2828M_2 - 0{,}2357M_5$$

$V_4 = P_4 - A$