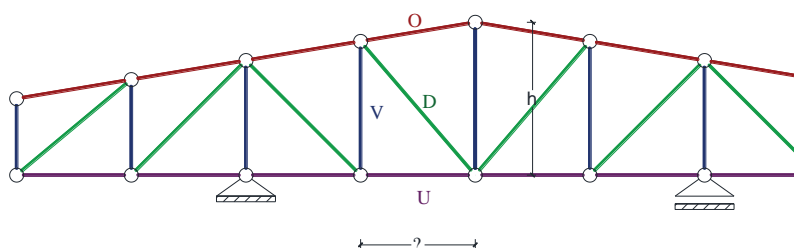


### Rešetkasti nosači

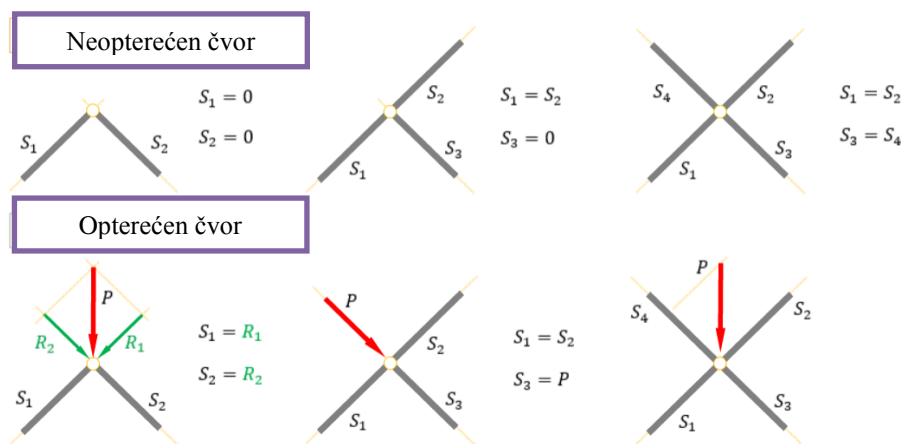
Sastoje se od pravih zglavkasto vezanih štapova kod kojih se opterećenje prenosi uvijek preko čvorova, pri čemu su  $T$  i  $M = 0$ . Normalne sile postoje i one se nazivaju *sile u štapovima*. Nepoznate veličine su: *reakcije oslonaca* ( $Z_o$ ) i *sile u štapovima* ( $Z_s$ ).



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

### Metod čvorova

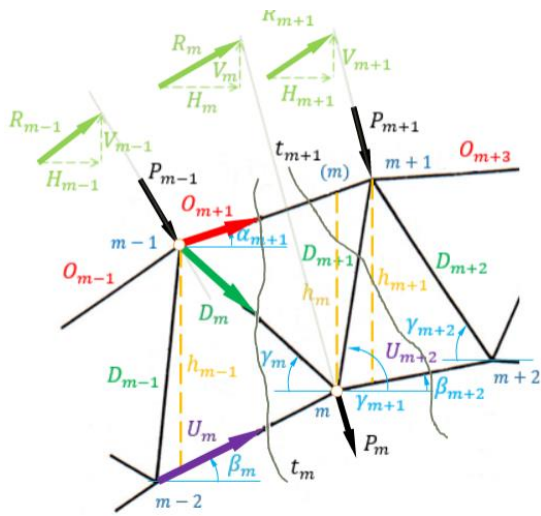
Ukoliko je ispunjen uslov  $Z_s + Z_o = 2K$  za svaki čvor je moguće ispisati 2 uslova ravnoteže (Suma  $V$  i  $N$ ) i iz njih dobiti nepoznate u nosaču.



### Metod preseka – Ritterov postupak

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

Rešetka sa trougaonom ispunom



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

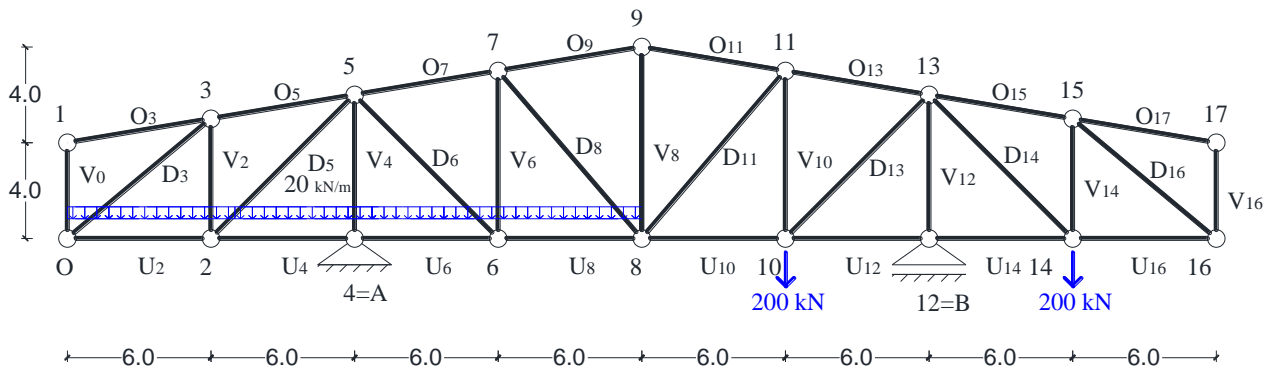
$$U_m = + \frac{M_{m-1}}{h_{m-1}} \sec \beta_m \quad O_{m+1} = - \frac{M_m}{h_m} \sec \alpha_{m+1}$$

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

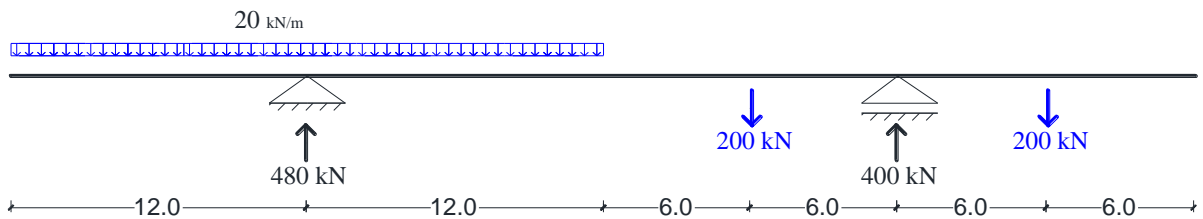
$$D_m \cos \gamma_m + O_{m+1} \cos \alpha_{m+1} + U_m \cos \beta_m + H_m = 0$$

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

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



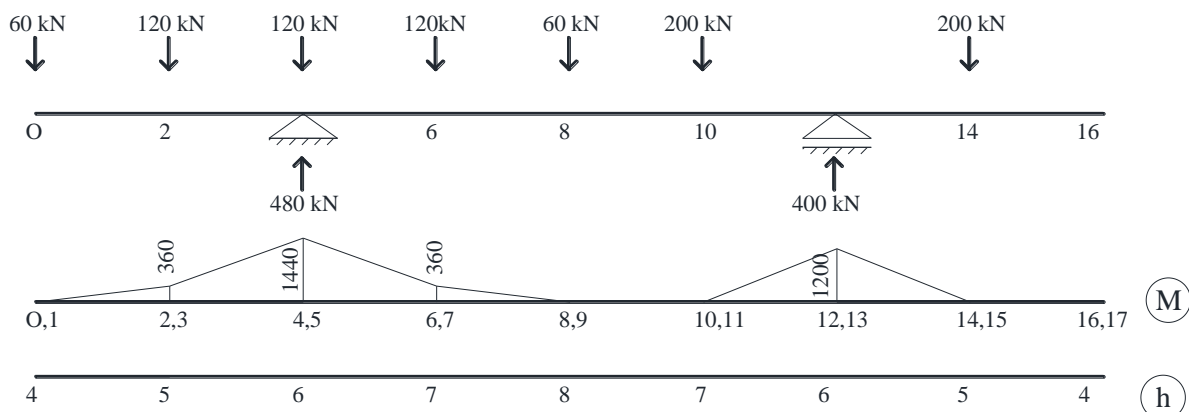
-Reakcije oslonaca



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

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

**-Ekvivalentno čvorno opterećenje**



**-Proračun sila u štapovima**

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

Donji pojas:  $U_m = \frac{M_{m-1}}{h_{m-1}} \frac{1}{\cos\beta_m}$   
 $\cos\beta_m = 1,0$  za sve štapove donjeg pojas

$$\begin{aligned}
 U_2 &= \frac{M_3}{h_3} = -72kN & U_8 &= \frac{M_7}{h_7} = -51,43kN & U_{16} &= \frac{M_{15}}{h_{15}} = 0 \\
 U_4 &= \frac{M_5}{h_5} = -240kN & U_{10} &= \frac{M_{11}}{h_{11}} = 0 \\
 U_6 &= \frac{M_5}{h_5} = -240kN & U_{12} &= U_{14} = \frac{M_{13}}{h_{13}} = -200kN
 \end{aligned}$$

Gornji pojas:  $O_{m+1} = -\frac{M_m}{h_m} \frac{1}{\cos\alpha_{m+1}}$   
 $\cos\alpha_{m+1} = 0.986$  za sve štapove gornjeg pojas

$$\begin{aligned}
 O_3 &= -\frac{M_0}{h_0} \frac{1}{0.986} = 0 & O_9 &= O_{11} = -\frac{M_8}{h_8} \frac{1}{0.986} = 0 & O_{17} &= -\frac{M_{16}}{h_{16}} \frac{1}{0.986} = 0 \\
 O_5 &= -\frac{M_2}{h_2} \frac{1}{0.986} = 73,02kN & O_{13} &= -\frac{M_{10}}{h_{10}} \frac{1}{0.986} = 0 \\
 O_7 &= -\frac{M_6}{h_6} \frac{1}{0.986} = 52,16kN & O_{15} &= -\frac{M_{14}}{h_{14}} \frac{1}{0.986} = 0
 \end{aligned}$$

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

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

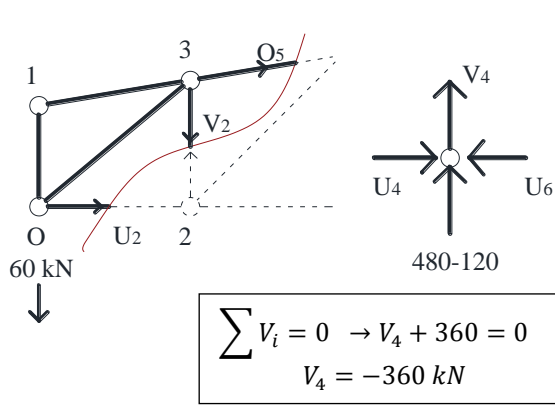
$$\begin{aligned}
 D_3 &= \left( \frac{M_0}{h_0} - \frac{M_3}{h_3} \right) \frac{1}{0,768} = 93,75kN & D_{11} &= \left( \frac{M_8}{h_8} - \frac{M_{11}}{h_{11}} \right) \frac{1}{0,651} = 0 \\
 D_5 &= \left( \frac{M_2}{h_2} - \frac{M_5}{h_5} \right) \frac{1}{\sqrt{2}/2} = 237,7kN & D_{13} &= \left( \frac{M_{10}}{h_{10}} - \frac{M_{13}}{h_{13}} \right) \frac{1}{\sqrt{2}/2} = 282,89kN \\
 D_6 &= \left( \frac{M_6}{h_6} - \frac{M_5}{h_5} \right) \frac{1}{\sqrt{2}/2} = 266,67kN & D_{14} &= \left( \frac{M_{14}}{h_{14}} - \frac{M_{13}}{h_{13}} \right) \frac{1}{\sqrt{2}/2} = 282,89kN
 \end{aligned}$$

# STATIKA KONSTRUKCIJA 1 - VEŽBE

$$D_8 = \left( \frac{M_8}{h_8} - \frac{M_7}{h_7} \right) \frac{1}{0,651} = 79 \text{ kN}$$

$$D_{16} = \left( \frac{M_{16}}{h_{16}} - \frac{M_{15}}{h_{15}} \right) \frac{1}{0,768} = 0$$

-Vertikale

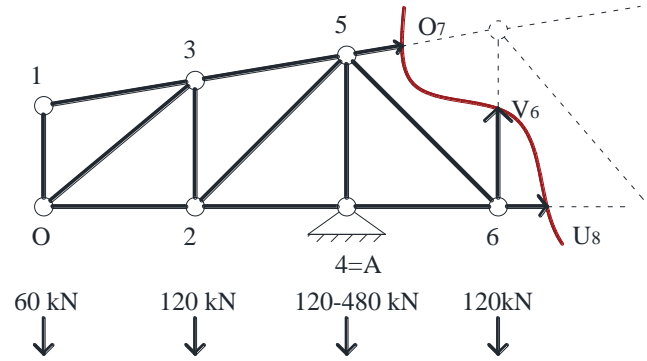


$$\sum V_i = 0 \rightarrow V_4 + 360 = 0$$

$$V_4 = -360 \text{ kN}$$

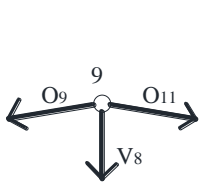
$$\sum V_i = 0 \rightarrow -60 - V_2 + \sin\alpha_5 O_5 = 0$$

$$V_2 = -48 \text{ kN}$$



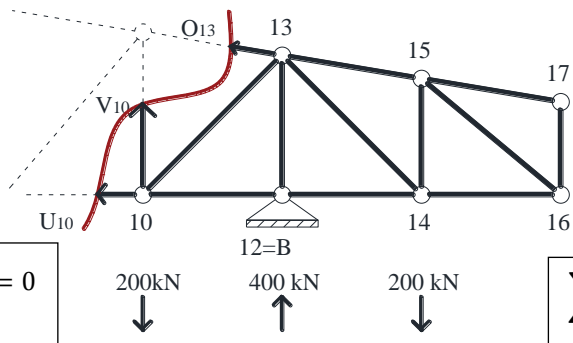
$$\sum V_i = 0 \rightarrow 60 + V_6 + \sin\alpha_7 O_7 = 0$$

$$V_6 = -68,57 \text{ kN}$$



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

$$V_8 = 0$$

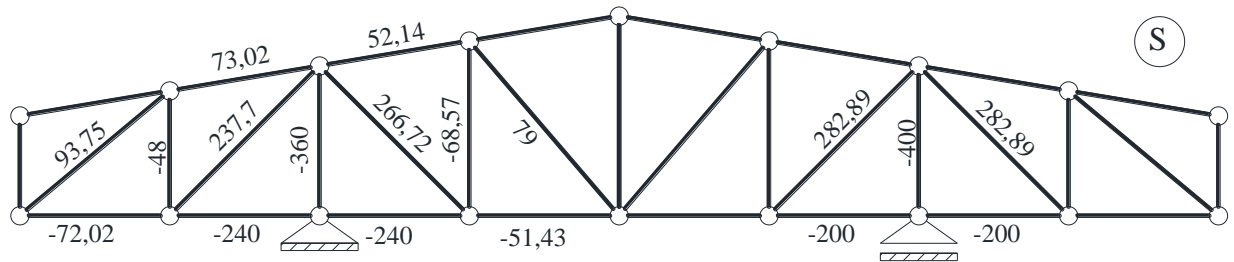


$$\sum V_i = 0 \rightarrow V_{12} + 400 = 0$$

$$V_{12} = -400 \text{ kN}$$

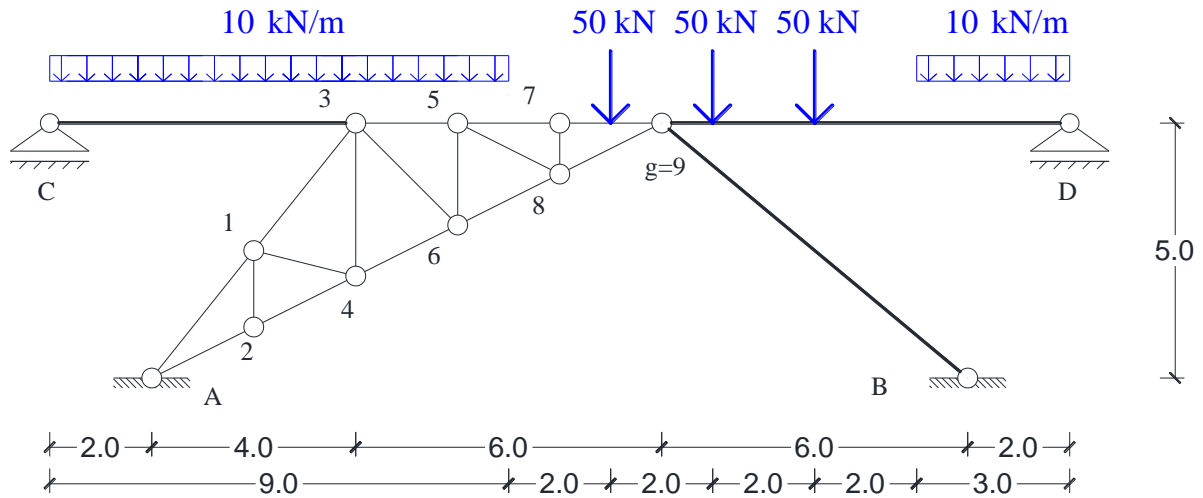
$$\sum V_i = 0 \rightarrow -V_{10} - \sin\alpha_{13} O_{13} = 0$$

$$V_{10} = 0$$

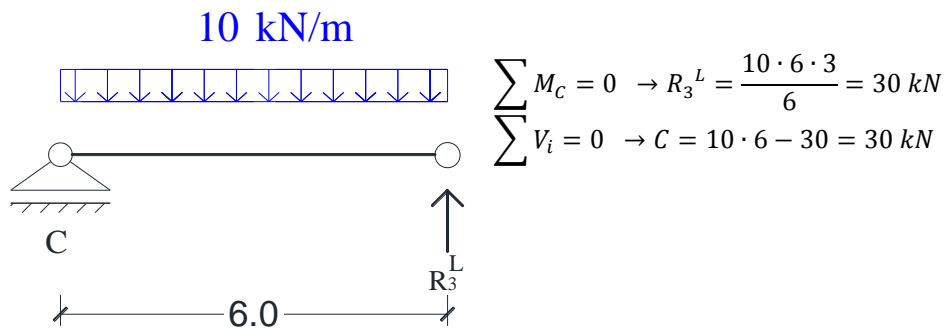


# STATIKA KONSTRUKCIJA 1 - VEŽBE

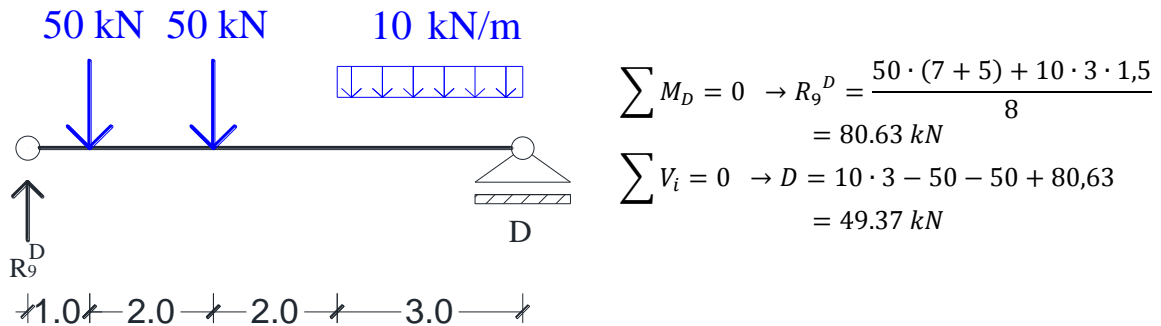
**Zadatak:** Za nosač i opterećenje sa slike odrediti reakcije oslonaca i dijagrame presečnih sila.



-Ploča I (prosta greda)

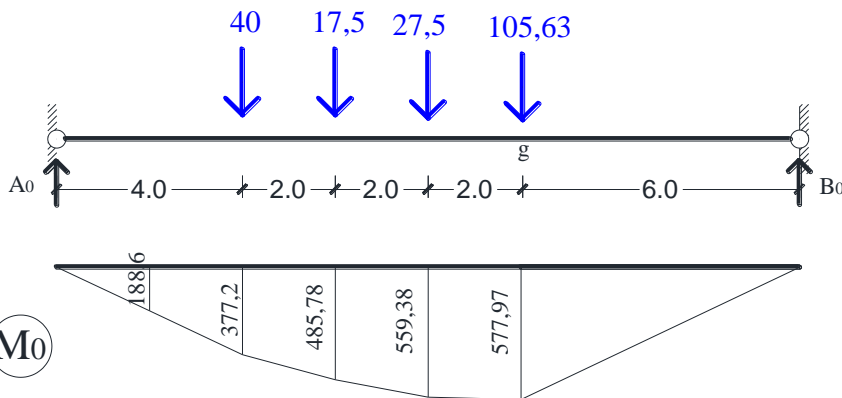
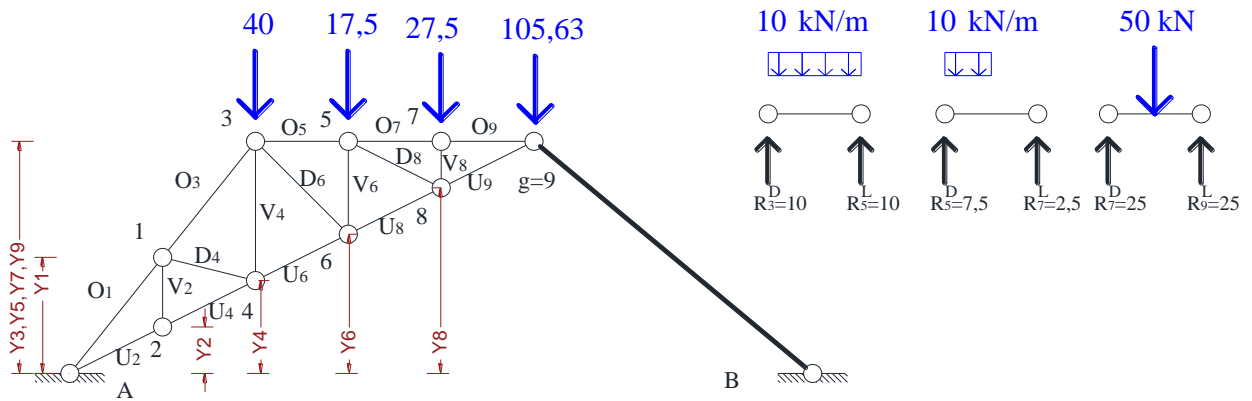


-Ploča II (prosta greda)



# STATIKA KONSTRUKCIJA 1 - VEŽBE

-Ploče III i IV (luk na tri zgloba)



$$\sum M_{B0} = 0 \rightarrow A_0 = \frac{40 \cdot 12 + 17,5 \cdot 10 + 27,5 \cdot 8 + 105,63 \cdot 6}{16} = 94,30 \text{ kN}$$

$$\sum V_i = 0 \rightarrow B_0 = 40 + 17,5 + 27,5 + 105,63 - 94,3 = 96,33 \text{ kN}$$

$$H = \frac{M_{g0}}{f} = \frac{96,33 \cdot 6}{5} = 115,6 \text{ kN}$$

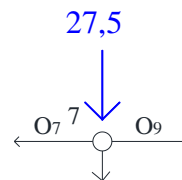
Gornji pojas:  $O_{m+1} = -\frac{M_m}{h_m \cos\alpha_{m+1}}$   
 $\cos\alpha_1 = \cos\alpha_3 = 0.6247$ ;  $\cos\alpha_5 = \cos\alpha_7 = \cos\alpha_9 = 1.0$

$$O_1 = -\frac{M_2}{h_2 \cos\alpha_1} = -\frac{188,6 - 115,6 \cdot 1}{1,5 \cdot 0,6247} = -77,9 \text{ kN}$$

$$O_3 = -\frac{M_4}{h_4 \cos\alpha_3} = -\frac{377,2 - 115,6 \cdot 2}{3 \cdot 0,6247} = -77,9 \text{ kN}$$

$$O_5 = -\frac{M_6}{h_6 \cos\alpha_5} = -\frac{485,78 - 115,6 \cdot 3}{2 \cdot 1} = -69,49 \text{ kN}$$

$$O_7 = -\frac{M_8}{h_8 \cos\alpha_7} = -\frac{559,38 - 115,6 \cdot 4}{1 \cdot 1} = -96,98 \text{ kN}$$



$$\sum H_i = 0 \rightarrow O_7 = O_9 = -96,98 \text{ kN}$$

$$\sum V_i = 0 \rightarrow V_8 = -27,5 \text{ kN}$$

STATIKA KONSTRUKCIJA 1 - VEŽBE

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

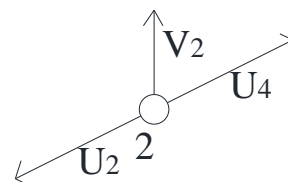
$\cos\beta_m = 0,8944$  za sve štapove donjeg pojas

$$U_4 = \frac{M_1}{h_1} \frac{1}{\cos\beta_4} = \frac{188,6 - 115,6 \cdot 2,5}{1,5} \frac{1}{0,8944} = -74,84 \text{ kN}$$

$$U_6 = \frac{M_3}{h_3} \frac{1}{\cos\beta_6} = \frac{377,2 - 115,6 \cdot 5}{3} \frac{1}{0,8944} = -74,84 \text{ kN}$$

$$U_8 = \frac{M_5}{h_5} \frac{1}{\cos\beta_8} = \frac{485,76 - 115,6 \cdot 5}{2} \frac{1}{0,8944} = -51,55 \text{ kN}$$

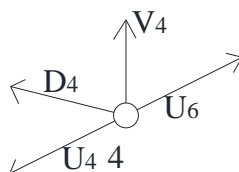
$$U_9 = \frac{M_7}{h_7} \frac{1}{\cos\beta_8} = \frac{559,38 - 115,6 \cdot 5}{1} \frac{1}{0,8944} = -20,82 \text{ kN}$$



$$\sum H_i = 0 \rightarrow U_2 = U_4 = -74,84 \text{ kN}$$

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

$\cos\gamma_6 = \sqrt{2}/2$ ;  $\cos\gamma_8 = 0,8944$



$$U_6 = U_4 \rightarrow D_4 = 0$$

$$\sum V_i = 0 \rightarrow V_4 = 0$$

$$D_6 = \left( \frac{M_6}{h_6} - \frac{M_3}{h_3} - H \right) \frac{1}{\cos\gamma_6} = \left( \frac{485,78 - 115,6 \cdot 3}{2} - \frac{377,2 - 115,6 \cdot 5}{3} - 115,6 \right) \frac{1}{\sqrt{2}/2}$$

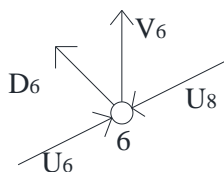
$$= 29,45 \text{ kN}$$

$$D_8 = \left( \frac{M_8}{h_8} - \frac{M_5}{h_5} - H \right) \frac{1}{\cos\gamma_8} = \left( \frac{559,38 - 115,6 \cdot 4}{1} - \frac{485,78 - 115,6 \cdot 5}{2} - 115,6 \right) \frac{1}{0,8944}$$

$$= 30,74 \text{ kN}$$

-Vertikale

$V_2 = V_4 = 0$ ;  $V_8 = -27,5 \text{ kN}$



$$\sum V_i = 0 \rightarrow \cos 45 D_6 + V_6 + \sin \beta U_6 - \sin \beta U_8 = 0$$

$$\rightarrow V_6 = -31,26 \text{ kN}$$

# STATIKA KONSTRUKCIJA 1 - VEŽBE

-Dijagrami presečnih sila

