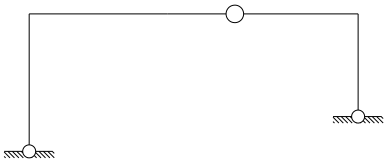
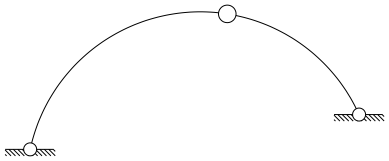
Nosači na tri zgloba

Sastoje se od dve kinematički krute ploče međusobno zglobno povezane, svaka oslonjena na na nepokreto ležište.

- Luk na tri zgloba
- Ram na trizgloba

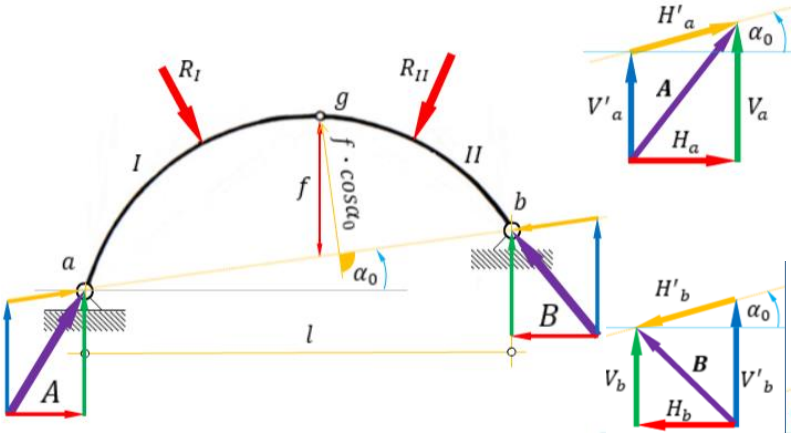
Osnovna karakteristika im je da za bilo koje opterećenje, pa i vertikalno, imaju kose reakcije.





Pravac lučne sile – linija koja spaja oslonačke tačke.
l -raspon luka (hor.rastojanje)
f- strela luka (vert.rastojanje)

Reakcije oslonaca



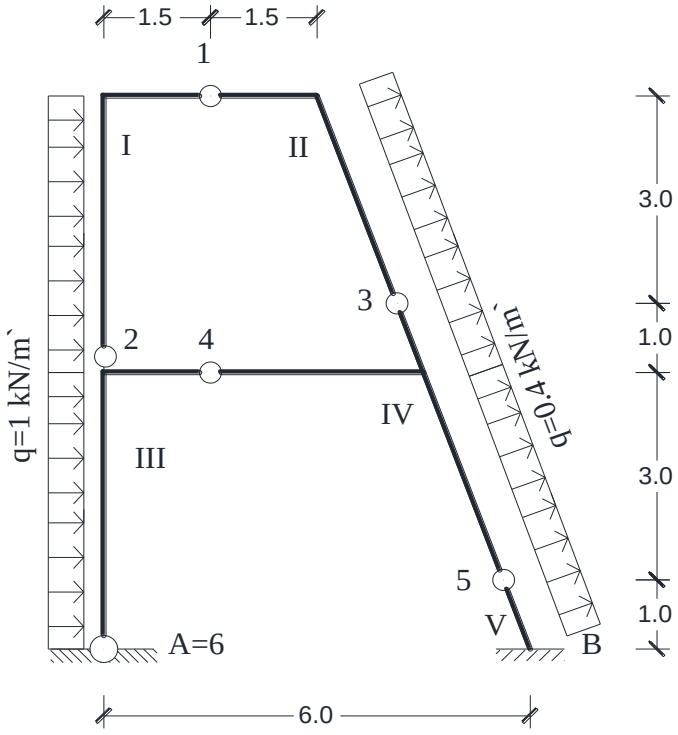
$$\sum M_a = 0 \rightarrow V_b' = \frac{1}{l}\sum M_a,$$
$$\sum M_b = 0 \rightarrow V_a' = \frac{1}{l}\sum M_b,$$

$$\sum M_g{}^l = 0 \rightarrow H_a' = \frac{1}{f\,cos\alpha 0}\sum M_g{}^l,$$
$$\sum M_g{}^d = 0 \rightarrow H_b' = \frac{1}{f\,cos\alpha 0}\sum M_g{}^d,$$

$$H_a' = \frac{H_a}{cos\alpha 0} \rightarrow H_a = \frac{1}{f}\sum M_g{}^l,$$
$$H_b' = \frac{H_b}{cos\alpha 0} \rightarrow H_b = \frac{1}{f}\sum M_g{}^d,$$

$$V_a = V_a' + H_a' sin\alpha o = V_a' + H_a tg\alpha 0$$
$$V_b = V_b' - H_b' sin\alpha o = V_b' - H_b tg\alpha 0$$

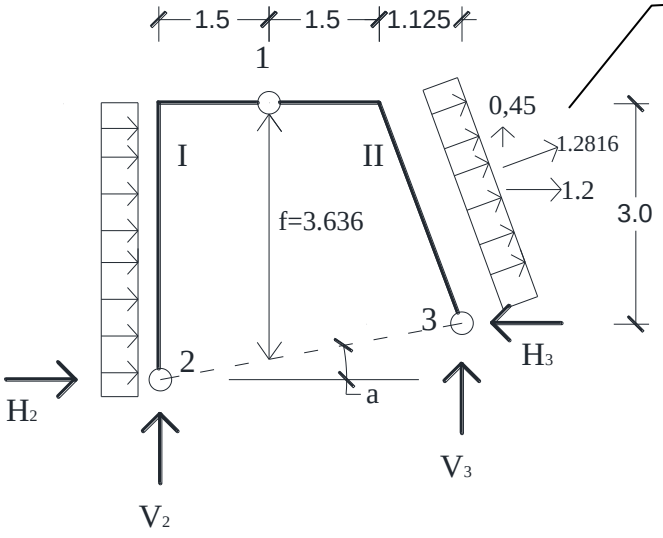
Zadatak: *Za statički određen okvir i nosač odrediti dijagrame presečnih sila i reakcije oslonaca usled opterećenja datog na slici.*



Zg=5, Zz=6 → 3·5-3=2·6 – statički određena ploča

Ploča I i II su u sistemu rama na 3 zgloba, kao i III i IV.
Ploča V je autostabilna (ima 3 spoljašnja elemenata) i prihvata opterećenje od ostalih ploča čvormim silama iz čvora 5.

Ploče I i II

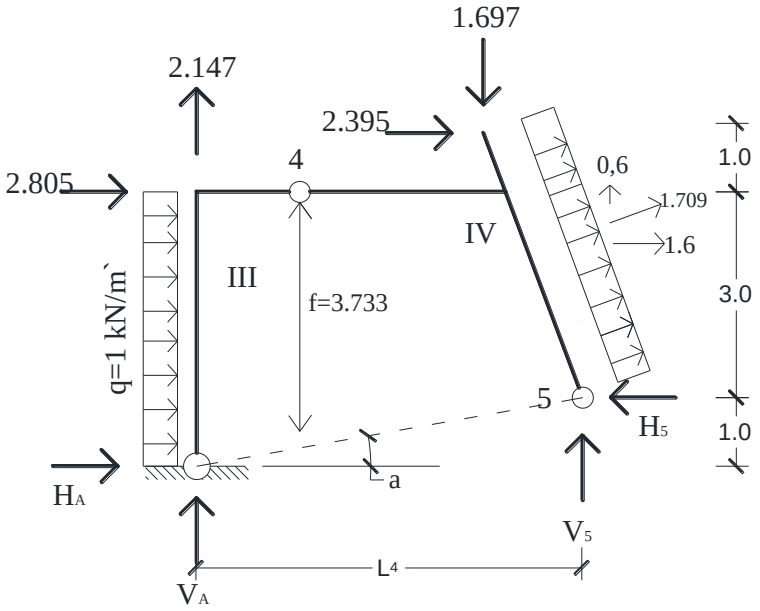


1.2816 · cosα=0.45
1.2816 · sinα=1.20
$\alpha = 69.444°$

$$tg\alpha = \frac{8}{3} \rightarrow \alpha = 69.444°$$
$$l_2 = 3 + 3 \cdot \frac{3}{8} = 4.125m$$
$$tg\alpha_2 = \frac{1}{4.125} = 0.2424$$
$$f_1 = 4 - 1.5 \cdot 0.2424 = 3.636m$$

$$\sum M_3 = 0 \ \rightarrow V_2' = \frac{1}{l}\sum M_3 \rightarrow V_2' = \frac{-1 \cdot 4 \cdot 1 - 0.45 \cdot 0.5625 - 1.2 \cdot 1.5}{4.125} = -1.467\ kN$$
$$\sum M_2 = 0 \ \rightarrow V_3' = \frac{1}{l}\sum M_2 \rightarrow V_3' = \frac{1 \cdot 4 \cdot 2 - 0.45 \cdot 3.5625 + 1.2 \cdot 2.5}{4.125} = 2.278\ kN$$
$$H_2 = \frac{1}{f}\sum {M_1}^l \rightarrow H_2 = \frac{-1 \cdot 4 \cdot 2 - 1.467 \cdot 1.5}{3.636} = -2.805\ kN$$
$$H_3 = \frac{1}{f}\sum {M_1}^d \rightarrow H_3 = \frac{1.2 \cdot 1.5 + 0.45 \cdot 2.0625 + 2.278 \cdot 2.625}{3.636} = 2.395 kN$$
$$V_2 = V_2' + H_2 tg\alpha 2 = -1.467 - 2.805 \cdot 0.2424 = -2.147\ kN$$
$$V_3 = V_3' + H_3 tg\alpha 2 = 2.278 - 2.395 \cdot 0.2424 = 1.697\ kN$$

Ploče III i IV

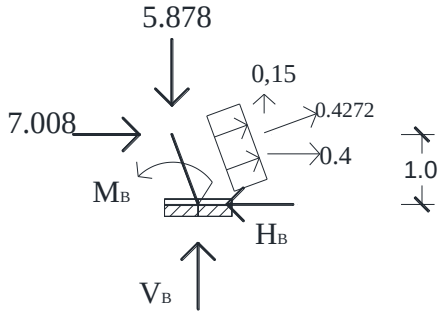


$$l_4 = 6 - 1 \cdot \frac{3}{8} = 5.625m$$
$$tg\alpha_6 = \frac{1}{5.625} = 0.1778$$
$$f_4 = 4 - 1.5 \cdot 0.1778 = 3.733m$$

Posmatramo celi nosač, jer imamo manje uticaja

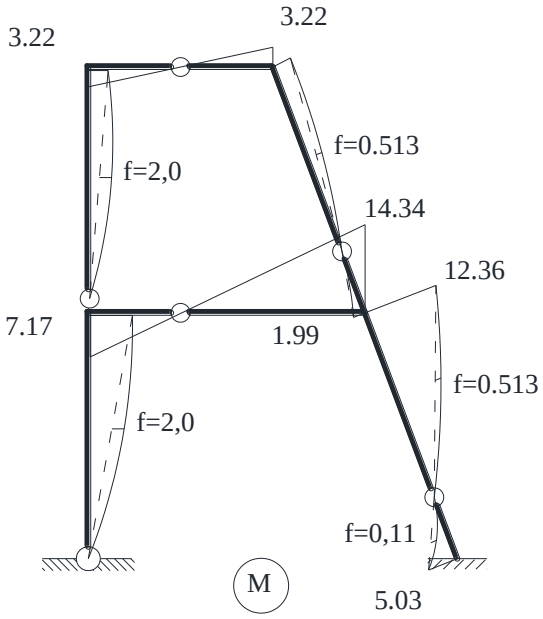
$$\sum M_5 = 0 \ \rightarrow V_A' = \frac{1}{l}\sum M_5 \rightarrow V_A' = \frac{-1 \cdot 8 \cdot 3 - 1.05 \cdot 1.3125 - 2.8 \cdot 3.5}{5.625} = -6.254\ kN$$
$$\sum M_A = 0 \ \rightarrow V_5' = \frac{1}{l}\sum M_A \rightarrow V_5' = \frac{1 \cdot 8 \cdot 4 - 1.05 \cdot 4.3125 + 2.8 \cdot 4.5}{5.625} = 7.124\ kN$$
$$H_A = \frac{1}{f}\sum {M_4}^l \rightarrow H_A = \frac{-1 \cdot 4 \cdot 2 - 6.254 \cdot 1.5 + 2.147 \cdot 1.5}{3.733} = -3.793\ kN$$
$$H_5 = \frac{1}{f}\sum {M_4}^d \rightarrow H_5 = \frac{1.6 \cdot 1.0 + 0.6 \cdot 3.375 + 7.124 \cdot 4.125 - 1.697 \cdot 2.625 - 2.395 \cdot 1.0}{3.733} = 7.008\ kN$$
$$V_A = V_A' + H_A tg\alpha 6 = -6.254 - 3.793 \cdot 0.1778 = -6.928\ kN$$
$$V_5 = V_5' + H_5 tg\alpha 6 = 7.124 - 7.008 \cdot 0.1778 = 5.878\ kN$$

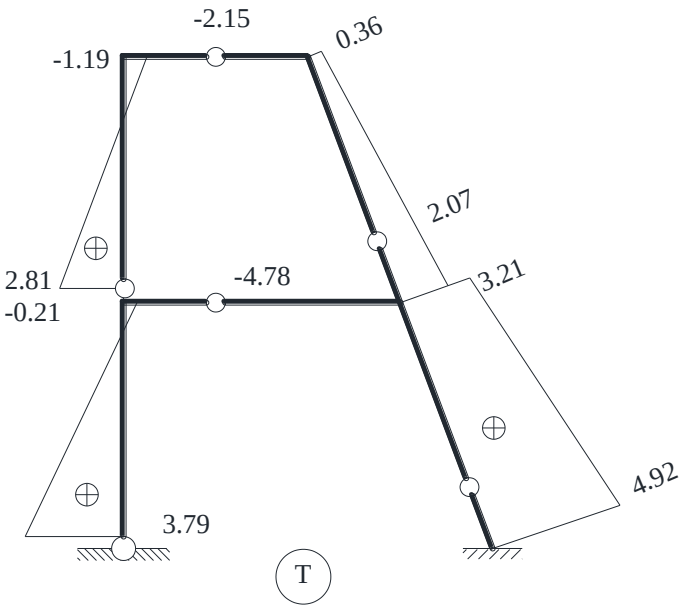
Ploča V

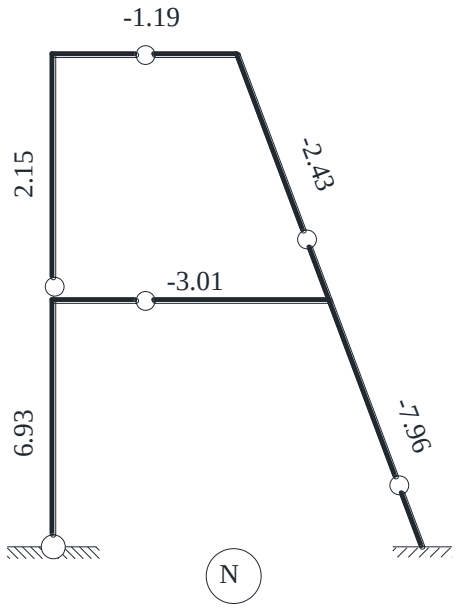


$$\sum H_i = 0 \rightarrow H_B = 7.008 + 0.4 = 7.408\ kN$$
$$\sum V_i = 0 \rightarrow V_B = 5.878 - 0.15 = 5.728\ kN$$
$$\sum M_B = 0 \ \rightarrow M_B = 7.008 \cdot 1 - 5.878 \cdot 0.375 + 0.4 \cdot 0.5 + 0.15 \cdot 0.1875 = 5.032\ kNm$$

-Dijagrami presečnih sila







Čvor „B“

N= -cos69.44· 7.408 - sin69.44·5.728=-7.965 kN
T= sin 69.44· 7.408 - cos69.44·5.728=4.921 kN