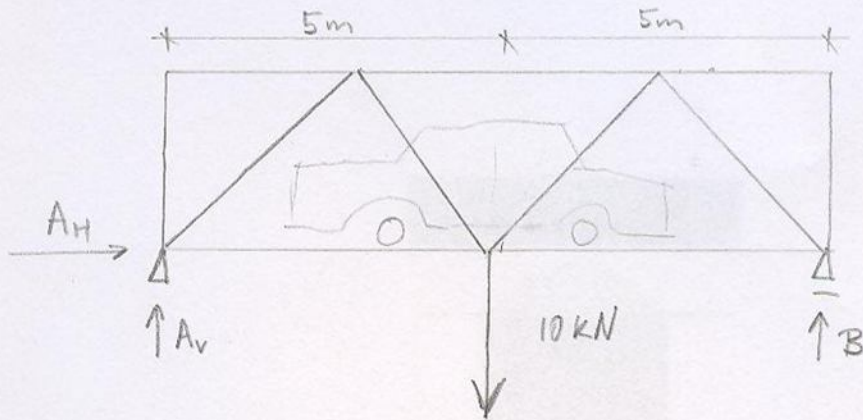


PŘÍHRADOVÉ KONSTRUKCE



- celá konstrukce se chová jako tuhý celek :

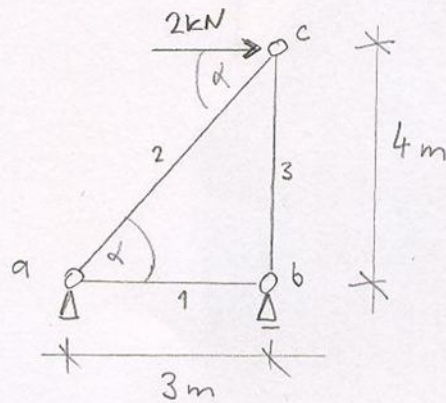
$$\rightarrow : A_H = 0$$

$$\curvearrow a : -5 \cdot 10 + 10 \cdot B = 0 \Rightarrow B = 5 \text{ kN}$$

$$\uparrow : A_V + \underset{\substack{\uparrow \\ 5}}{B} - 10 = 0 \Rightarrow A = 5 \text{ kN}$$

PR 26

Jaké jsou síly v jednotlivých prutech ?



- konstrukce : 3 stupně volnosti

- stěpník : 2 stupně volnosti

$$m = 2 \cdot 3 = 6$$

$$r = 3 \cdot 1 + 2 + 1 = 6$$

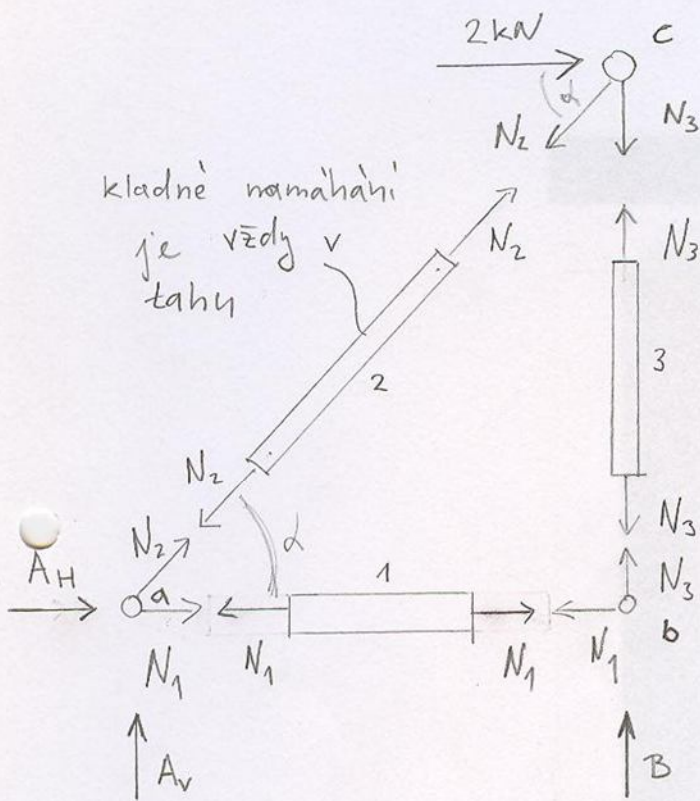
3 pruty

$$S = 0$$

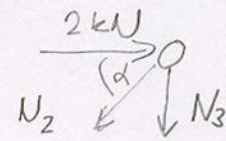
$$\cos \alpha = \frac{3}{5} = 0,6$$

$$\sin \alpha = \frac{4}{5} = 0,8$$

rovnováha jednotlivých stýčnic:



- bod C má 2 neznámé



$$C \rightarrow : 2 - \cos \alpha \cdot N_2 = 0$$

$$N_2 = \frac{2}{0,6} = \underline{\underline{3,33 \text{ kN}}}$$

$$C \uparrow : -\sin \alpha \cdot N_2 - N_3 = 0$$

$$N_3 = -0,8 \cdot 3,33 = \underline{\underline{-2,66 \text{ kN}}}$$

$$b \rightarrow : N_1 = 0$$

$$b \uparrow : \underbrace{-2,66}_{N_3} + B = 0 \Rightarrow \underline{\underline{B = 2,66 \text{ kN}}}$$

$$a \rightarrow : A_H + \underbrace{0}_{N_1} + \cos \alpha \cdot \underbrace{3,33}_{N_2} = 0 \Rightarrow \underline{\underline{A_H = -2 \text{ kN}}}$$

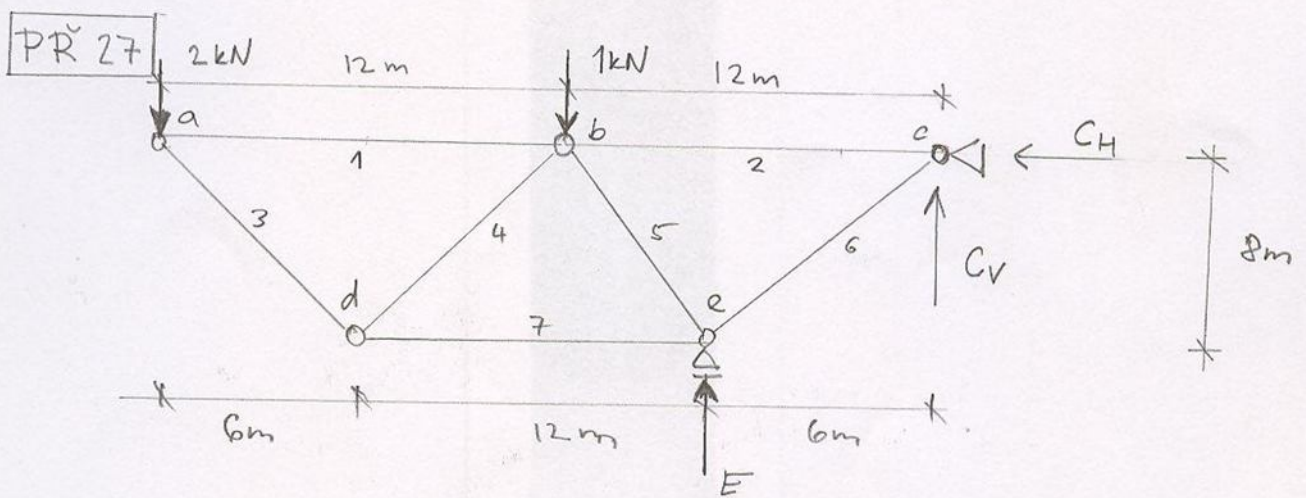
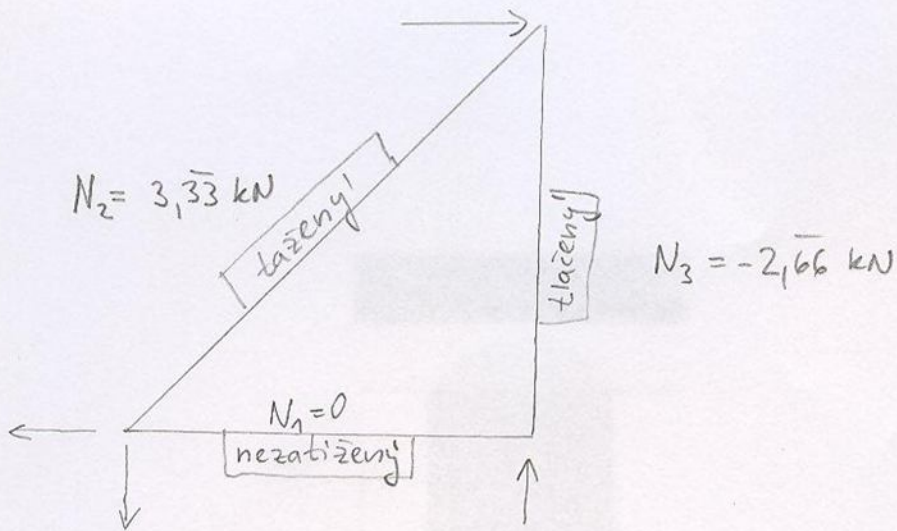
$$a \uparrow : A_V + \sin \alpha \cdot 3,33 = 0 \Rightarrow \underline{\underline{A_V = -2,66 \text{ kN}}}$$

globální rovnováha (kontrola):

$$g \rightarrow : A_H + 2 = 0 \Rightarrow A_H = -2 \text{ kN}$$

$$g \curvearrowright a : 3B - 4 \cdot 2 = 0 \Rightarrow B = 2,66 \text{ kN}$$

$$g \uparrow : A_V + 2,66 = 0 \Rightarrow A_V = -2,66 \text{ kN}$$



$$m = 5 \cdot 2 = 10$$

$$r = 7 \cdot 1 + 2 + 1 = 10$$

$$s = 0$$

globální rovnováha:

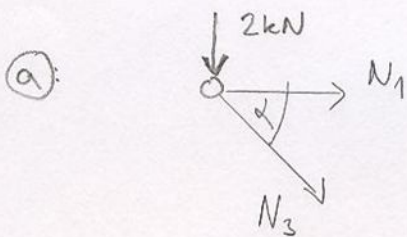
$$\sum \rightarrow : C_H = 0$$

$$\sum \curvearrow C : 24 \cdot 2 + 12 \cdot 1 - 6E = 0$$

$$\Rightarrow E = 10 \text{ kN}$$

$$\sum \uparrow : 10 + C_V - 2 - 1 = 0$$

$$\Rightarrow C_V = -7 \text{ kN}$$



$$\uparrow : -2 - N_3 \cdot \sin \alpha = 0$$

$$\Rightarrow N_3 = -2,5 \text{ kN}$$

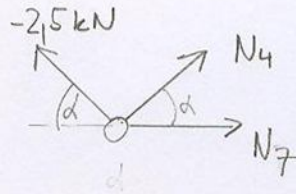
$$\rightarrow : N_1 - 2,5 \cdot \cos \alpha = 0$$

$$\Rightarrow N_1 = 1,5 \text{ kN}$$

$$\cos \alpha = 0,6$$

$$\sin \alpha = 0,8$$

d):



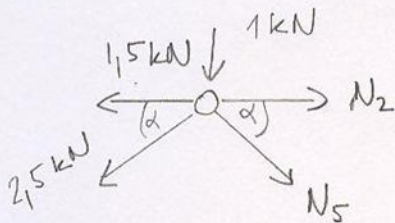
$$\uparrow: -2,5 \cdot \sin \alpha + N_4 \cdot \sin \alpha = 0$$

$$\Rightarrow N_4 = 2,5 \text{ kN}$$

$$\rightarrow: -(-2,5) \cdot \cos \alpha + 2,5 \cdot \cos \alpha + N_7 = 0$$

$$\Rightarrow N_7 = -3 \text{ kN}$$

b):



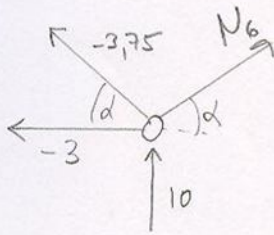
$$\uparrow: -2,5 \cdot \sin \alpha - N_5 \cdot \sin \alpha - 1 = 0$$

$$\Rightarrow N_5 = -3,75 \text{ kN}$$

$$\rightarrow: -1,5 - 2,5 \cdot \cos \alpha + (-3,75) \cdot \cos \alpha + N_2 = 0$$

$$\Rightarrow N_2 = 5,25 \text{ kN}$$

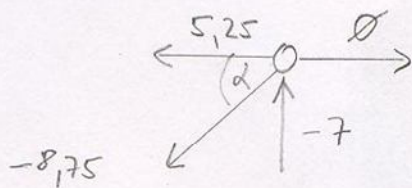
e):



$$\uparrow: -3,75 \cdot \sin \alpha + 10 + N_6 \cdot \sin \alpha = 0$$

$$\Rightarrow N_6 = -8,75 \text{ kN}$$

kontrola: bod e)

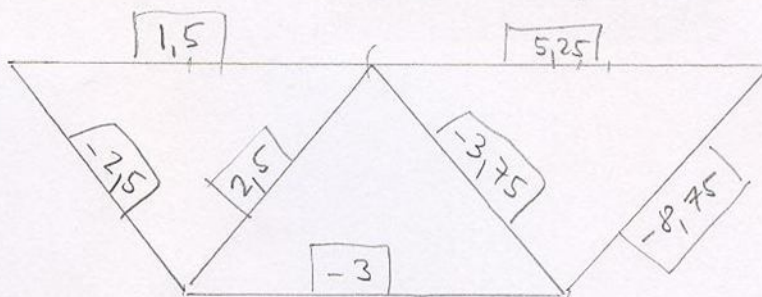


$$\uparrow: -7 - (-8,75) \cdot \sin \alpha = 0$$

$$0 = 0 \quad \checkmark$$

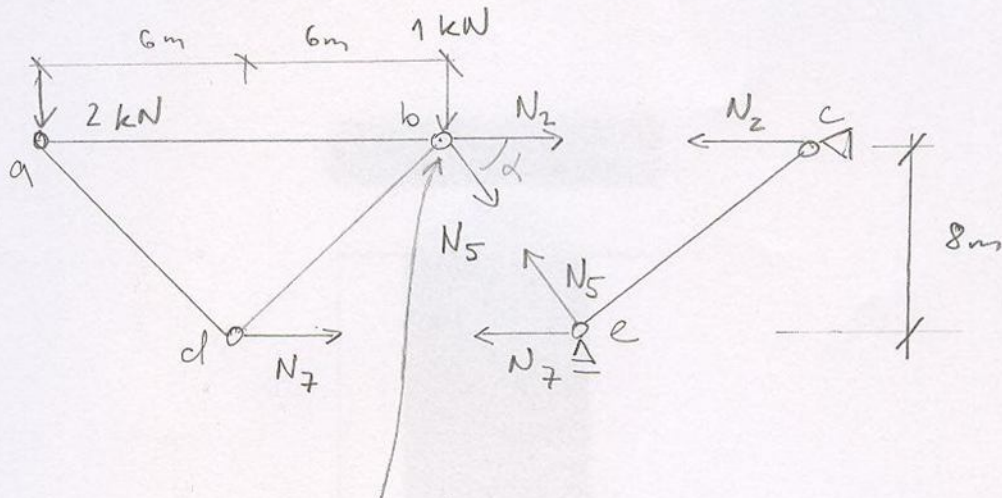
$$\rightarrow: -5,25 - (-8,75) \cdot \cos \alpha = 0$$

$$0 = 0 \quad \checkmark$$



[kN]

Průsečná metoda



vhodně využít momentovou rovnováhu okolo tohoto bodu (průsečík více sil)

- všechny části příhradové kce jsou v rovnováze (nehybou se)

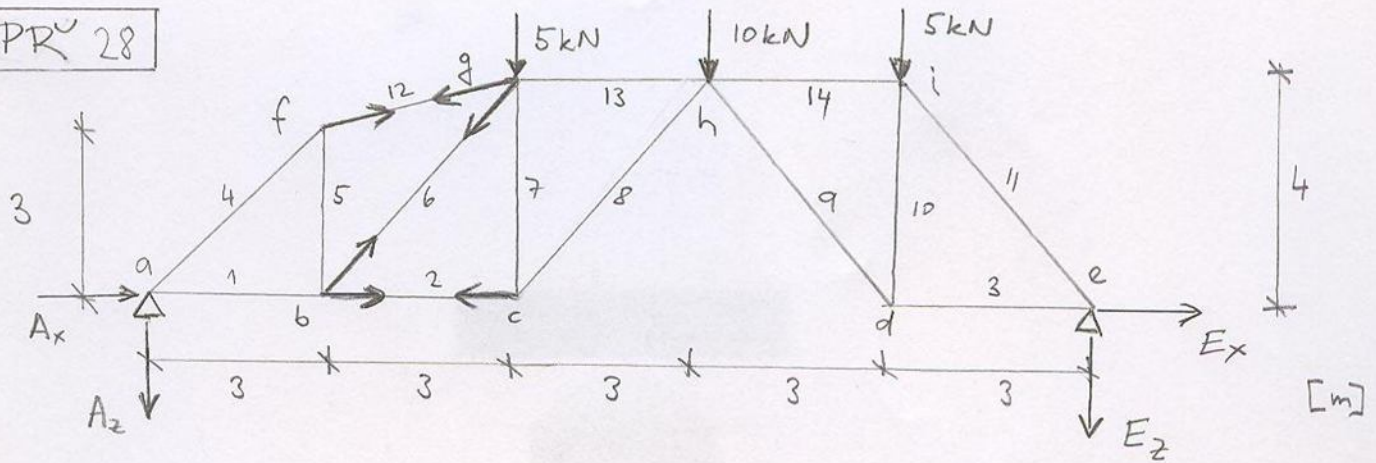
$$\curvearrowright_b: 8N_7 + 12 \cdot 2 = 0 \\ N_7 = -3 \text{ kN}$$

$$\uparrow: -2 - 1 - N_5 \cdot \sin \alpha = 0 \Rightarrow N_5 = -3,75 \text{ kN}$$

$$\rightarrow: N_2 - \underbrace{3}_{N_7} + \underbrace{(-3,75)}_{N_5} \cdot \cos \alpha = 0 \Rightarrow N_2 = 5,25 \text{ kN}$$

Ve 2D je nutné "přetrhnout" maximálně 3 pruty, máme 3 rovnice rovnováhy

PR 28



$$m = 9 \cdot 2 = 18$$

$$r = 14 + 2 + 2 = 18$$

Vnější reakce:

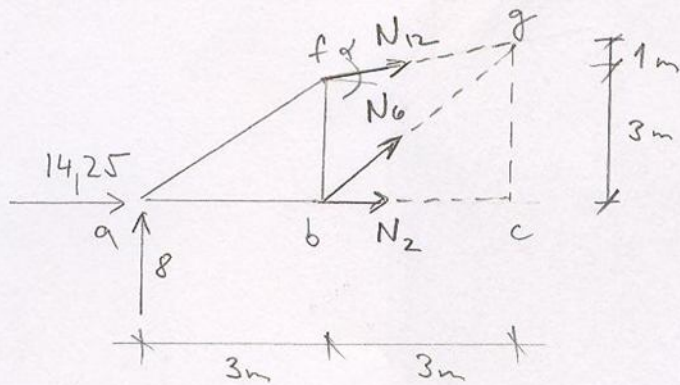
$$\sum \curvearrow_e: 15 \cdot A_2 + 5 \cdot 9 + 10 \cdot 6 + 5 \cdot 3 = 0$$

$$\Rightarrow A_2 = -8 \text{ kN}$$

$$\sum \curvearrow_h: 4A_x + 9(-8) + 15 = 0$$

$$\Rightarrow A_x = 14,25 \text{ kN}$$

sily N_2, N_6, N_{12} průsečnou metodou:



$$\sum \curvearrow_g: 4N_2 + 14,25 \cdot 4 - 8 \cdot 6 = 0 \Rightarrow N_2 = -2,25 \text{ kN}$$

$$\sum \curvearrow_b: -3 \cdot N_{12} \cdot \left(\frac{3}{\sqrt{3^2+1^2}}\right) - 8 \cdot 3 = 0 \Rightarrow N_{12} = -\frac{8\sqrt{10}}{3} = -8,433 \text{ kN}$$

$$\sum \downarrow: -8 - N_{12} \cdot \left(\frac{1}{\sqrt{10}}\right) - N_6 \cdot \frac{4}{\sqrt{3^2+4^2}} = 0 \Rightarrow N_6 = -6,667 \text{ kN}$$

PR 29

Odhadněte síly v prutech (tah, tlak, nic)

