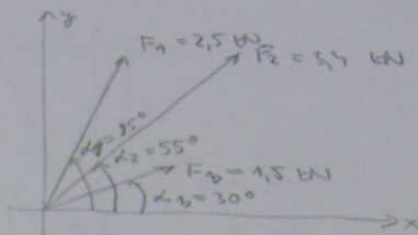
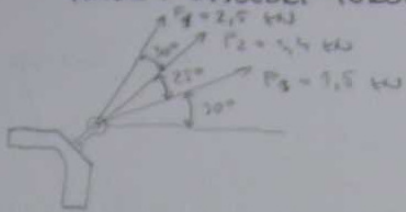


Pr. 1: URČITE POČETNÉ AĽ GRAFICKY VÝLEDNICY SÍL, PÔSOBIACU NA KONŠTRUKČIU

PRUOK - VÝSLEDKI POROVNAJTE.



ANALYTICKÉ RIEŠENIE

$$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$$

$$F_{Rx} = \sum_{i=1}^3 F_{ix} = F_1 \cdot \cos \alpha_1 + F_2 \cdot \cos \alpha_2 + F_3 \cdot \cos \alpha_3 =$$

$$= 2,5 \cdot \cos 85^\circ + 3,5 \cdot \cos 55^\circ + 1,5 \cdot \cos 30^\circ = 3,467 \text{ kN}$$

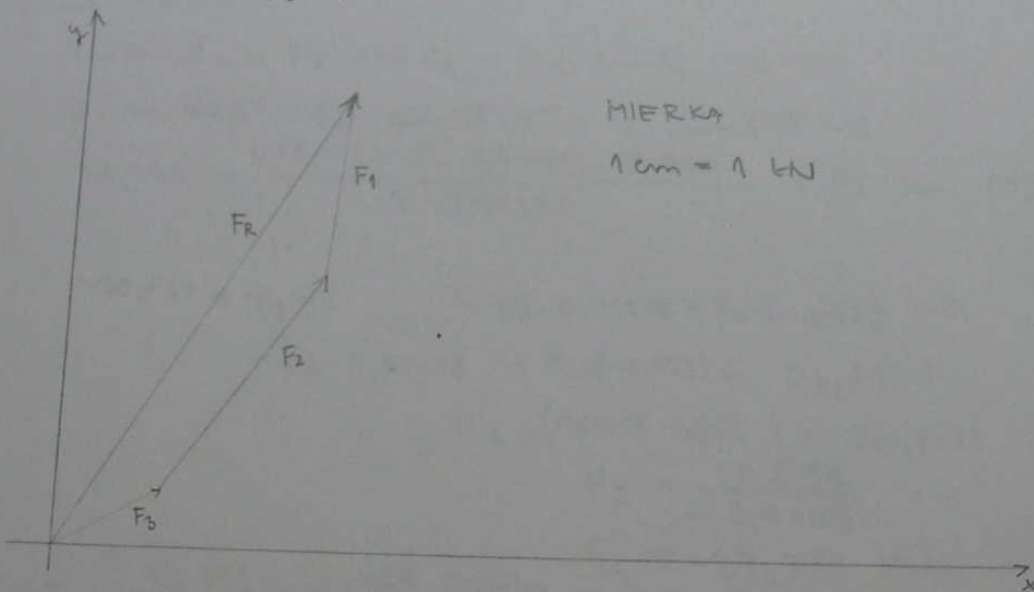
$$F_{Ry} = \sum_{i=1}^3 F_{iy} = F_1 \cdot \sin \alpha_1 + F_2 \cdot \sin \alpha_2 + F_3 \cdot \sin \alpha_3 =$$

$$= 2,5 \cdot \sin 85^\circ + 3,5 \cdot \sin 55^\circ + 1,5 \cdot \sin 30^\circ = 6,025 \text{ kN}$$

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} = \sqrt{3,467^2 + 6,025^2} = 6,951 \text{ kN}$$

$$\alpha_R = \frac{F_{Ry}}{F_{Rx}} = \frac{6,025}{3,467} = 60,082^\circ$$

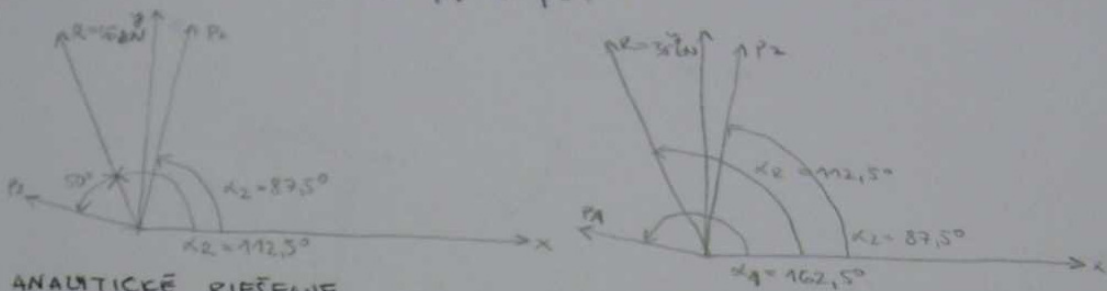
GRAFICKÉ RIEŠENIE



POROVNANIE ANALYTICKÉHO A GRAFICKÉHO RIEŠENIA

	ANALYTICKE RIEŠENIE	GRAFICKE RIEŠENIE
$F_R$	6,951 kN	6,9 kN
$\alpha_R$	60,082°	60°

PR. 2: DANÚ SILU  $\vec{R}$  ROZLOŽTE DO DVOCH SÍL  $\vec{F}_1$  A  $\vec{F}_2$ , PŮSOJACÍCH V DVOCH ZADANÝCH SMĚROCH  $P_1$  A  $P_2$ .



ANALYTICKÉ ŘEŠENÍ

$$\vec{R} + \vec{F}_1 + \vec{F}_2 = 0$$

$$\sum_{i=1}^n F_{ix} = 0$$

$$R \cdot \cos \alpha_R + F_1 \cdot \cos \alpha_1 + F_2 \cdot \cos \alpha_2 = 0$$

$$35 \cdot \cos 112,5^\circ + F_1 \cdot \cos 162,5^\circ + F_2 \cdot \cos 87,5^\circ = 0$$

$$-13,393 + F_1 \cdot (-0,9537) + F_2 \cdot 0,0436 = 0$$

$$F_1 = \frac{13,393 - F_2 \cdot 0,0436}{-0,9537}$$

$$\sum_{i=1}^n F_{iy} = 0$$

$$R \cdot \sin \alpha_R + F_1 \cdot \sin \alpha_1 + F_2 \cdot \sin \alpha_2 = 0$$

$$35 \cdot \sin 112,5^\circ + F_1 \cdot \sin 162,5^\circ + F_2 \cdot \sin 87,5^\circ = 0$$

$$32,535 + \frac{(13,393 - F_2 \cdot 0,0436) \cdot 0,300}{(-0,9537)} + F_2 \cdot \sin 87,5^\circ = 0 \quad | \cdot (-0,9537)$$

$$-30,837 + 40,179 - F_2 \cdot 0,01308 + F_2 \cdot (-0,952) = 0$$

$$-F_2 \cdot 0,01308 + F_2 \cdot (-0,952) = -26,8191$$

$$F_2 \cdot (-0,01308 - 0,952) = -26,8191$$

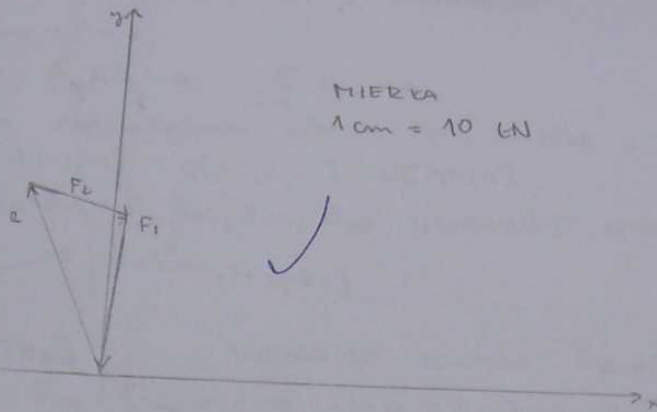
$$F_2 = \frac{26,8191}{-0,96508}$$

$$F_2 = -27,789 \text{ kN}$$

$$F_1 = \frac{13,393 - (-27,789) \cdot 0,0436}{-0,9537}$$

$$F_1 = -12,772 \text{ kN}$$

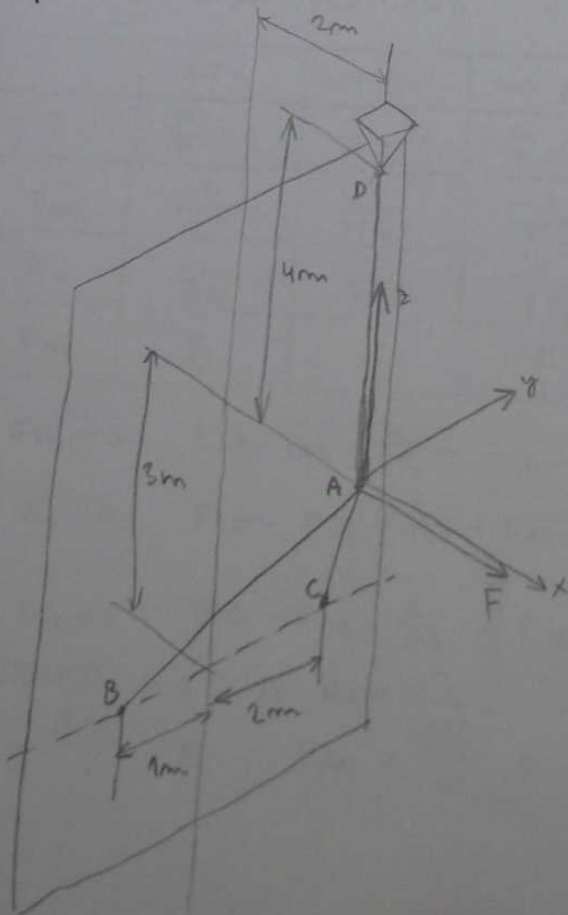
### GRAFICKÉ RIEŠENIE



### POROVNANIE RIEŠENÍ

	ANALYTICKÉ R.	GRAFICKÉ R.
$F_1$	12,772 kN	15 kN
$F_2$	27,789 kN	27,8 kN

PR. 5.: NA HODNOTNÝ BOD V TRIESTORE PRISOHĽ TIAŽ BREMENÁ O ZADANEJ HODNOTNOSTI, RESP. SÍLA ALBO SÚSTAVA SÍL DANÉHO SMERU A VEĽKOSTI. URČTE SÍLY V PRŮTOCH AB, AC, AD



SILY  $\vec{F}$ ,  $\vec{F}_{AB}$ ,  $\vec{F}_{AC}$ ,  $\vec{F}_{AD}$  MUSIA BYŤ V ROVNOVÁHE.

$$\vec{F}_{AB} + \vec{F}_{AC} + \vec{F}_{AD} + \vec{F} = 0$$

$$\sum_{i=1}^3 F_{ix} = 0 \quad \sum_{i=1}^3 F_{iy} = 0 \quad \sum_{i=1}^3 F_{iz} = 0$$

VO ZVOLENEJ PRAVOTOČINOM SÚRADNICOVOM SYSTÉME SÚ SÚRADNICE BODOV  
 $A[0,0,0]$   $B[-2,-1,-3]$   $C[-2,2,-5]$   $D[0,0,4]$

SÚRADNICE VEKTOROV  $\vec{F}$ ,  $\vec{F}_{AB}$ ,  $\vec{F}_{AC}$ ,  $\vec{F}_{AD}$  VYJADRÍME NASLEDUJNE

$$\vec{F}_{AB} \rightarrow B = [x_B, y_B, z_B]$$

$$A = [x_A, y_A, z_A]$$

$$\text{SÚRADNICE VEKTORA } \vec{F}_{AB} = [x_B - x_A, y_B - y_A, z_B - z_A]$$

$$\vec{F} = [F, 0, 0] \quad \vec{F}_{AB} = [-2 - 0, -1 - 0, -3 - 0] = [-2, -1, -3]$$

$$\vec{F}_{AC} = [-2 - 0, 2 - 0, -5 - 0] = [-2, 2, -5]$$

$$\vec{F}_{AD} = [0 - 0, 0 - 0, 4 - 0] = [0, 0, 4]$$

DĹŽKY VEKTOROV

$$|\vec{F}| = \sqrt{(F-0)^2 + (0-0)^2 + (0-0)^2} = F$$

$$|\vec{F}_{AB}| = \sqrt{(-2)^2 + (-1)^2 + (-3)^2} = \sqrt{14}$$

$$|\vec{F}_{AC}| = \sqrt{(-2)^2 + 2^2 + (-5)^2} = \sqrt{17}$$

$$|\vec{F}_{AD}| = \sqrt{0^2 + 0^2 + 4^2} = 4$$

SMEROVÉ UHLY VEKTOROV:  $\cos \alpha = \frac{F_x}{F}$  ;  $\cos \beta = \frac{F_y}{F}$  ;  $\cos \gamma = \frac{F_z}{F}$

	$\cos \alpha_i$	$\cos \beta_i$	$\cos \gamma_i$	$\cos^2 \alpha_i + \cos^2 \beta_i + \cos^2 \gamma_i = 1$
F	$\frac{F}{F} = 1$	$\frac{0}{F} = 0$	$\frac{0}{F} = 0$	$1^2 + 0^2 + 0^2 = 1$
$F_{AB}$	$\frac{-2}{\sqrt{14}}$	$\frac{-1}{\sqrt{14}}$	$\frac{-3}{\sqrt{14}}$	$\left(\frac{-2}{\sqrt{14}}\right)^2 + \left(\frac{-1}{\sqrt{14}}\right)^2 + \left(\frac{-3}{\sqrt{14}}\right)^2 = 1$
$F_{AC}$	$\frac{-2}{\sqrt{17}}$	$\frac{2}{\sqrt{17}}$	$\frac{-5}{\sqrt{17}}$	$\left(\frac{-2}{\sqrt{17}}\right)^2 + \left(\frac{2}{\sqrt{17}}\right)^2 + \left(\frac{-5}{\sqrt{17}}\right)^2 = 1$
$F_{AD}$	$\frac{0}{4}$	$\frac{0}{4}$	$\frac{4}{4}$	$0^2 + 0^2 + 1^2 = 1$

$$\sum_{i=1}^3 F_{ix} = 0 \quad F \cdot 1 - F_{AB} \cdot \frac{2}{\sqrt{14}} - F_{AC} \cdot \frac{2}{\sqrt{17}} + 0 \cdot F_{AD} = 0$$

$$\sum_{i=1}^3 F_{iy} = 0 \quad F \cdot 0 - F_{AB} \cdot \frac{1}{\sqrt{14}} + F_{AC} \cdot \frac{2}{\sqrt{17}} + 0 \cdot F_{AD} = 0$$

$$\sum_{i=1}^3 F_{iz} = 0 \quad F \cdot 0 - F_{AB} \cdot \frac{3}{\sqrt{14}} - F_{AC} \cdot \frac{5}{\sqrt{17}} + 1 \cdot F_{AD} = 0$$

RIEŠENIE SÚSTAVY ROVNÍC

$$F_{AB} = \frac{\sqrt{14}}{3} \cdot F \quad ; \quad F_{AC} = \frac{\sqrt{17}}{6} \cdot F \quad ; \quad F_{AD} = \frac{5}{2} \cdot F$$