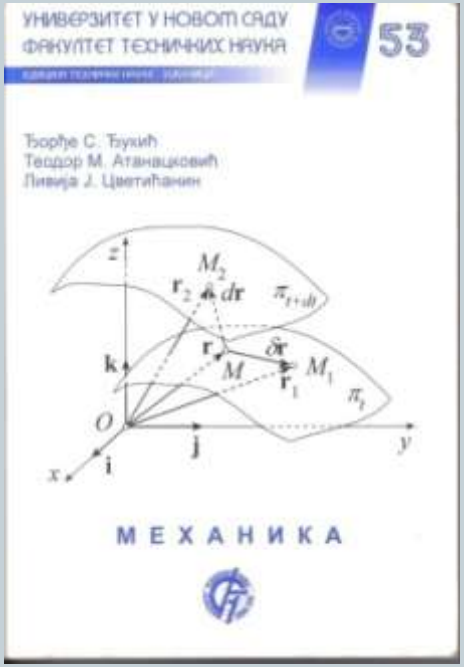
3. Predavanje
Statika

MEHANIKA

MIODRAG ZUKOVIĆ

Literatura

- Đorđe S. Đukić, Teodor M. Atanacković, Livija J. Cvetićanin: **Mehanika**, Fakultet tehničkih nauka u Novom Sadu, Novi Sad, 2003.
  - I deo –Osnovni pojmovi,Statika –strane 1. –81.



Šte ćemo naučiti?

- Sabiranje spregova
- Ravanski sistem sila i spregova
- Ravnoteža ravanskog sistema sila i spregova

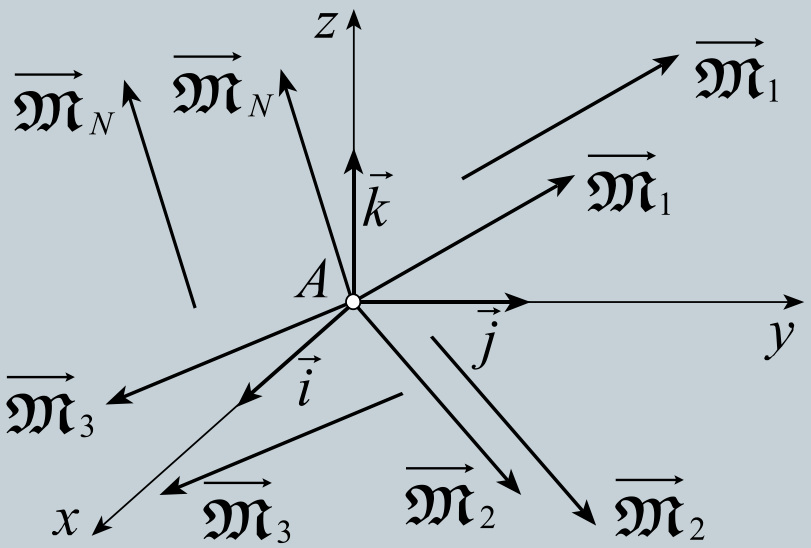
Šte ćemo naučiti?

- Prostorni sistem sila i spregova
- Ravnoteža prostornog sistema sila i spregova
- Varinjonova teorema

Statika

- Sabiranje spregova

$$\overrightarrow{\mathrm{M}}_r = \overrightarrow{\mathrm{M}}_1 + \overrightarrow{\mathrm{M}}_2 + \ldots + \overrightarrow{\mathrm{M}}_N = \sum_{i=1}^{N} \overrightarrow{\mathrm{M}}_i$$



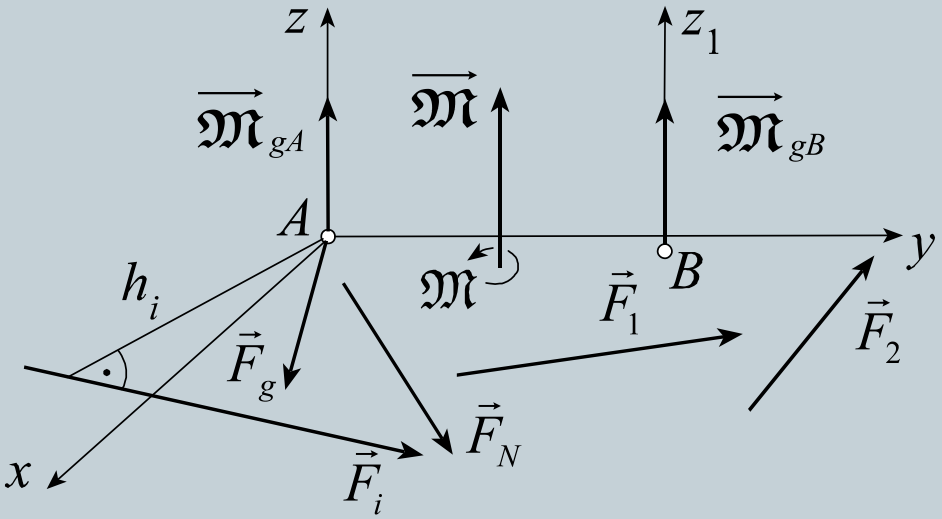
$$\mathrm{M}_{rx} = \sum_{i=1}^{N} \mathrm{M}_{ix}, \quad \mathrm{M}_{ry} = \sum_{i=1}^{N} \mathrm{M}_{iy}, \quad \mathrm{M}_{rz} = \sum_{i=1}^{N} \mathrm{M}_{iz}$$

$$\mathrm{M}_r = \left|\overrightarrow{\mathrm{M}}_r\right| = \sqrt{\mathrm{M}_{rx}^2 + \mathrm{M}_{ry}^2 + \mathrm{M}_{rz}^2}$$

$$\cos\alpha_{\mathrm{M}_r} = \frac{\mathrm{M}_{rx}}{\mathrm{M}_r}, \quad \cos\beta_{\mathrm{M}_r} = \frac{\mathrm{M}_{ry}}{\mathrm{M}_r}, \quad \cos\gamma_{\mathrm{M}_r} = \frac{\mathrm{M}_{rz}}{\mathrm{M}_r}$$

Statika

- Ravanski sistem sila i spregova



$$\vec{F}_g = \sum_{i=1}^{N} \vec{F}_i$$

$$\overrightarrow{\mathrm{M}}_{gA} = \sum_{i=1}^{N} \vec{M}_A^{\vec{F}_i} + \overrightarrow{\mathrm{M}}$$

Statika

- Ravanski sistem sila i spregova

$$\vec{F}_g = \sum_{i=1}^{N} \vec{F}_i = \sum_{i=1}^{N} (F_{ix}\vec{i} + F_{iy}\vec{j}) = F_{gx}\vec{i} + F_{gy}\vec{j}$$

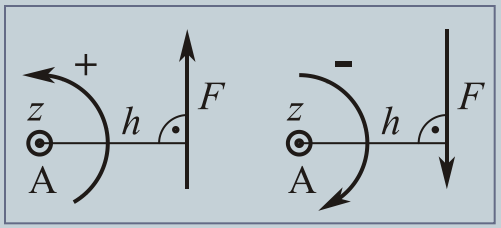
$$F_{gx} = \sum_{i=1}^{N} F_{ix}, \; F_{gy} = \sum_{i=1}^{N} F_{iy}, \; F_g = \sqrt{F_{gx}^{\,2} + F_{gy}^{\,2}}$$

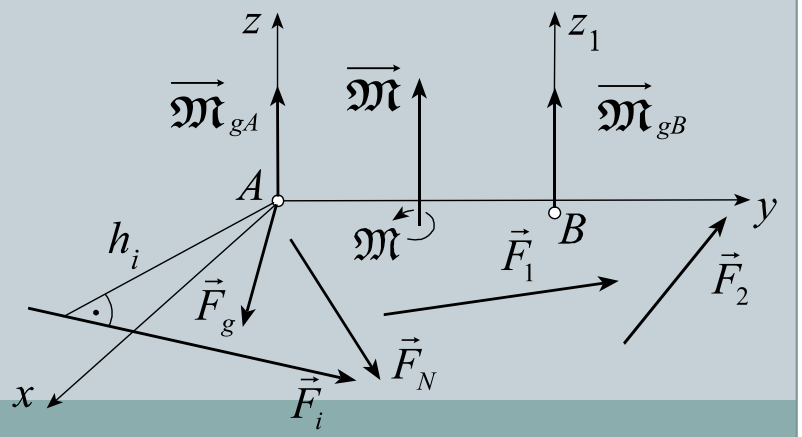
$$\overrightarrow{\mathrm{M}}_{gA} = \sum_{i=1}^{N} \vec{M}_A^{\vec{F}_i} + \overrightarrow{\mathrm{M}}$$

$$= \sum_{i=1}^{N} M_A^{\vec{F}_i}\vec{k} + \mathrm{M}\;\vec{k} = \mathrm{M}_{gA}\vec{k}$$

$$\mathrm{M}_{gA} = \sum_{i=1}^{N} M_A^{\vec{F}_i} + \mathrm{M}$$

$$M_A^{\vec{F}_i} = \pm F_i\, h_i$$





Statika

- Ravnoteža ravanskog sistema sila i spregova
  - Vektorski

$$\vec{F}_g = \sum_{i=1}^{N} \vec{F}_i = 0$$

$$\overrightarrow{\mathrm{M}}_{gA} = \sum_{i=1}^{N} \vec{M}_A^{\vec{F}_i} + \overrightarrow{\mathrm{M}} = 0$$

  - skalarni

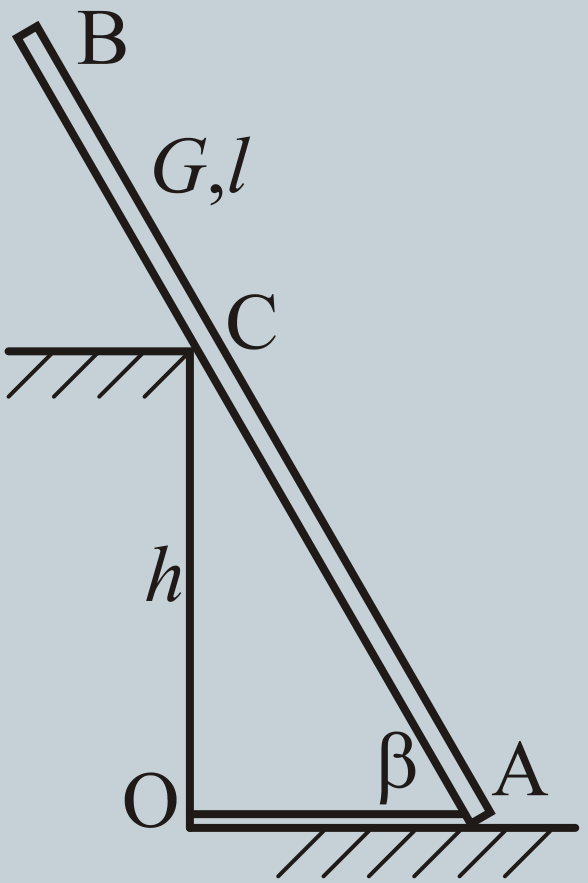
$$\sum_{i=1}^{N} F_{ix} = 0$$

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

$$\sum_{i=1}^{N} M_A^{\vec{F}_i} + \mathrm{M} = 0$$

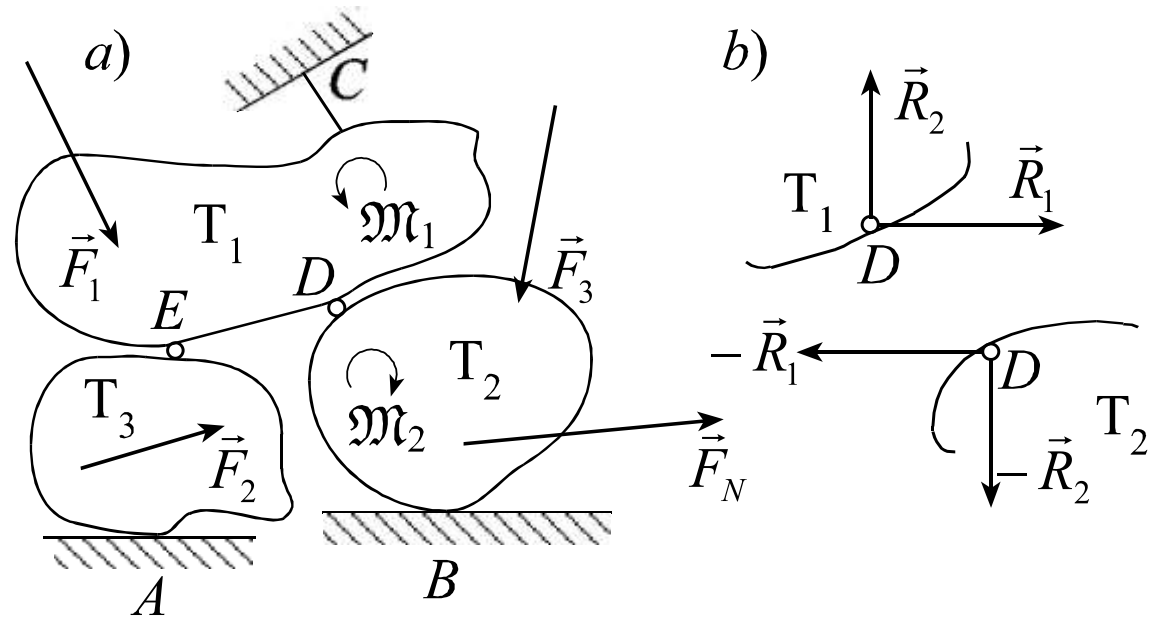
Statika

- **Primer 2.** : Homogena greda AB, težine G i dužine L, oslanja se krajem A o glatki pod, a u tački C na ivicu glatkog zida visine h. U položaju ravnoteže grada sa podom obrazuje ugao b. U tom položaju gredu održava uže OA koje je zategnuto po podu. Odrediti reakcije veza.



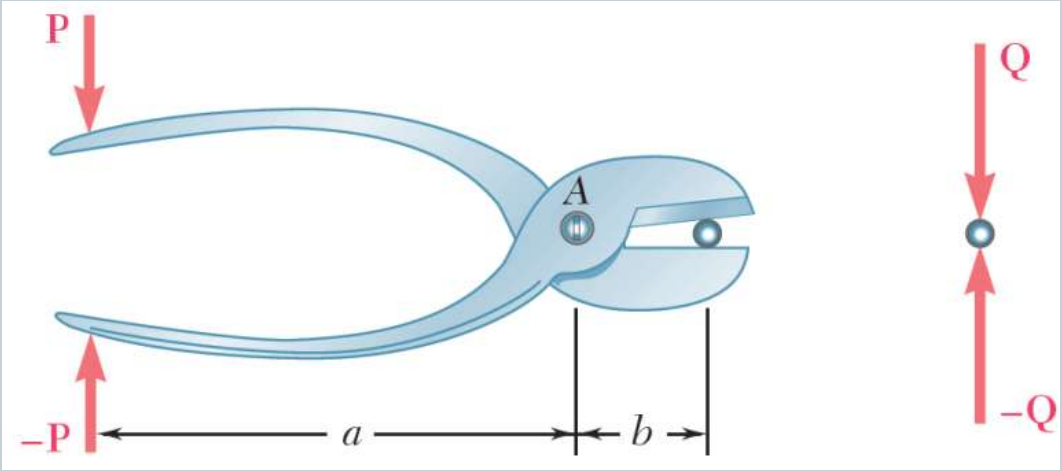
Statika

- Ravnoteža ravanskog sistema krutih tela



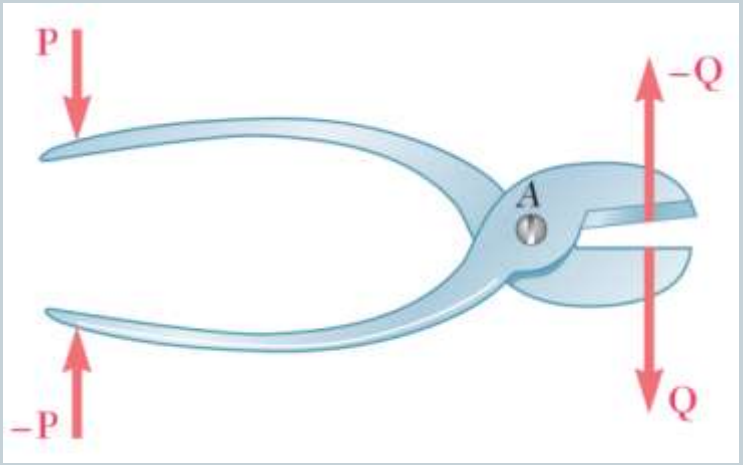
Statika

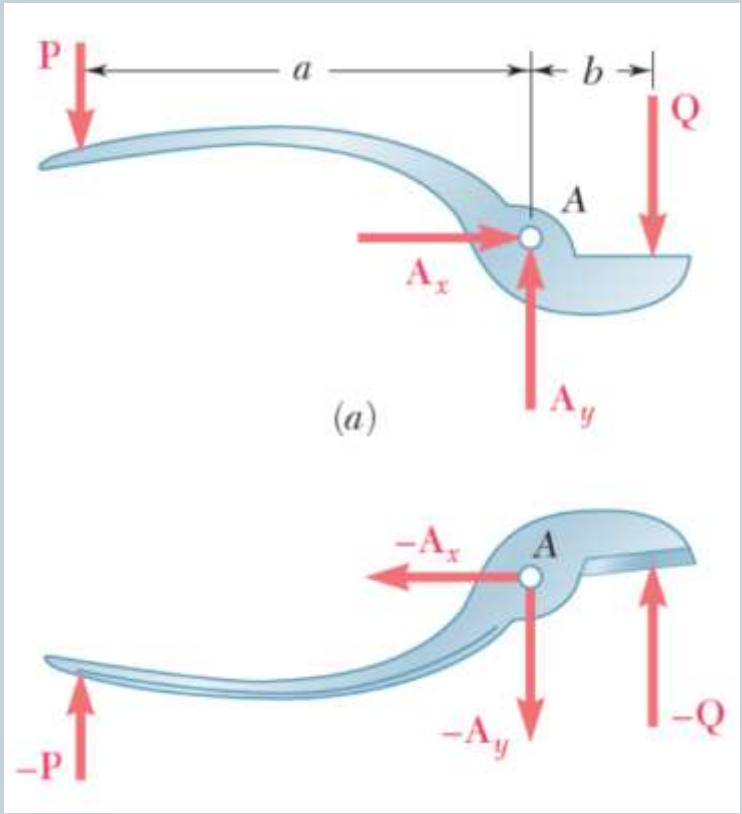
- **Primer 2.** : Odrediti kolikom silom Q klješta deluju na žicu, ako na njih delujemo silom intenziteta P (vidi sliku). Odrediti i reakciju veze u tački A.



Statika

- Primer: rešenje





Statika

- Moment sile za osu

$$M_z^{\vec{F}} = \vec{M}_A^{\vec{F}} \cdot \vec{k} = \vec{M}_B^{\vec{F}} \cdot \vec{k}$$

$$\vec{M}_B^{\vec{F}} \cdot \vec{k} = (\overrightarrow{BC} \times \vec{F}) \cdot \vec{k} = ((\overrightarrow{BA} + \overrightarrow{AC}) \times \vec{F}) \cdot \vec{k}$$

$$= (\overrightarrow{BA} \times \vec{F}) \cdot \vec{k} + (\overrightarrow{AC} \times \vec{F}) \cdot \vec{k} = 0 + \vec{M}_A^{\vec{F}} \cdot \vec{k}$$

$$M_z^{\vec{F}} = M_A^{\vec{F}} \cos\alpha = M_B^{\vec{F}} \cos\beta$$

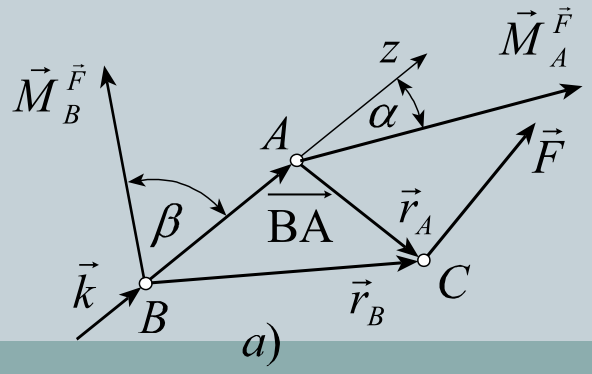
$$\vec{M}_A^{\vec{F}} = \overrightarrow{AB} \times \vec{F}$$

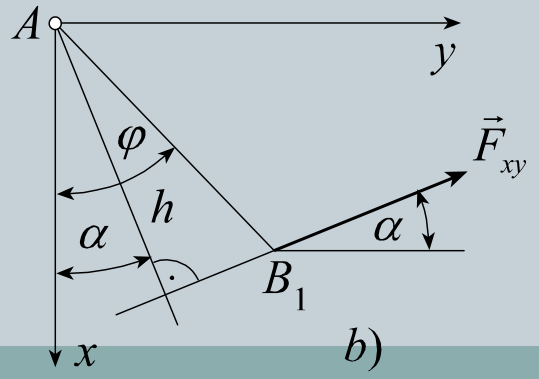
$$\vec{M}_A^{\vec{F}} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ x & y & z \\ F_x & F_y & F_z \end{vmatrix}$$

$$\vec{M}_A^{\vec{F}} = (yF_z - zF_y)\vec{i} + (zF_x - xF_z)\vec{j} + (xF_y - yF_x)\vec{k}$$

$$\vec{M}_A^{\vec{F}} = (M_x^{\vec{F}})\vec{i} + (M_y^{\vec{F}})\vec{j} + (M_z^{\vec{F}})\vec{k}$$

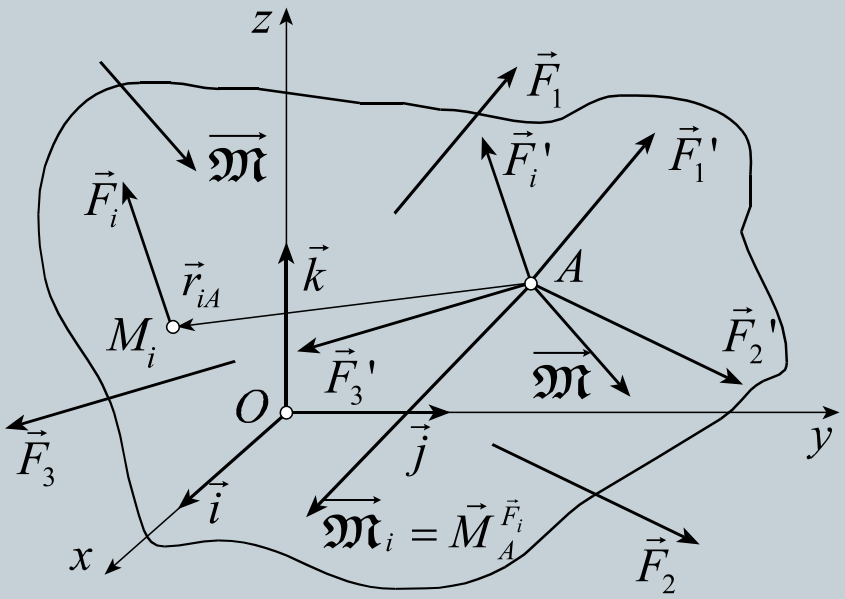
$$M_z^{\vec{F}} = F_{xy} h$$





Statika

- Prostorni sistem sila i spregova



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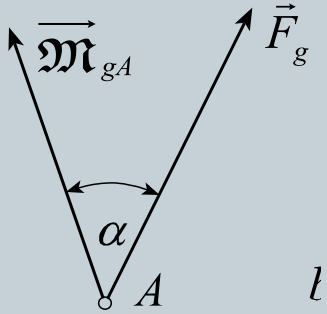

Statika

- Ravanski sistem sila i spregova

$$\vec{F}_g = \sum_{i=1}^{N} \vec{F}_i = \sum_{i=1}^{N} (F_{ix}\vec{i} + F_{iy}\vec{j} + F_{iz}\vec{k}) = F_{gx}\vec{i} + F_{gy}\vec{j} + F_{gz}\vec{k}$$

$$F_{gx} = \sum_{i=1}^{N} F_{ix}, \; F_{gy} = \sum_{i=1}^{N} F_{iy}, \; F_{gz} = \sum_{i=1}^{N} F_{iz}$$

$$\overrightarrow{\mathrm{M}}_{gA} = \sum_{i=1}^{N} \vec{M}_A^{\vec{F}_i} + \overrightarrow{\mathrm{M}} = \sum_{i=1}^{N} (M_{Ax}^{\vec{F}_i}\vec{i} + M_{Ay}^{\vec{F}_i}\vec{j} + M_{Az}^{\vec{F}_i}\vec{k}) + \mathrm{M}_x\vec{i} + \mathrm{M}_y\vec{j} + \mathrm{M}_z\vec{k}$$

$$= \mathrm{M}_{gAx}\vec{i} + \mathrm{M}_{gAy}\vec{j} + \mathrm{M}_{gAz}\vec{k}$$

Statika

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  - Vektorski

$$\vec{F}_g = \sum_{i=1}^{N} \vec{F}_i = 0$$

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  - skalarni

$$\sum_{i=1}^{N} F_{ix} = 0, \sum_{i=1}^{N} F_{iy} = 0, \sum_{i=1}^{N} F_{iz} = 0$$

$$\sum_{i=1}^{N} M_x^{\vec{F}_i} + \mathrm{M}_x = 0, \sum_{i=1}^{N} M_y^{\vec{F}_i} + \mathrm{M}_y = 0, \sum_{i=1}^{N} M_z^{\vec{F}_i} + \mathrm{M}_z = 0$$

Statika

- Varinjonova teorema
  - Moment rezultante za bilo koju tačku O, jednak je vektorskoj sumi momenata komponentnih sila za istu momentnu tačku.
  - Moment rezultante za bilo koju osu *z*, jednak je algebarskoj sumi momenata komponentnih sila za istu osu.

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