Predavanje 17. marec 2021

Osnova naloga statike

Uravnovešenje danega sistema sil, določitev sil podpor.

Primer: enostavno podprt togi nosilec.

- Statično določen primer.
- Statično nedoločen primer.

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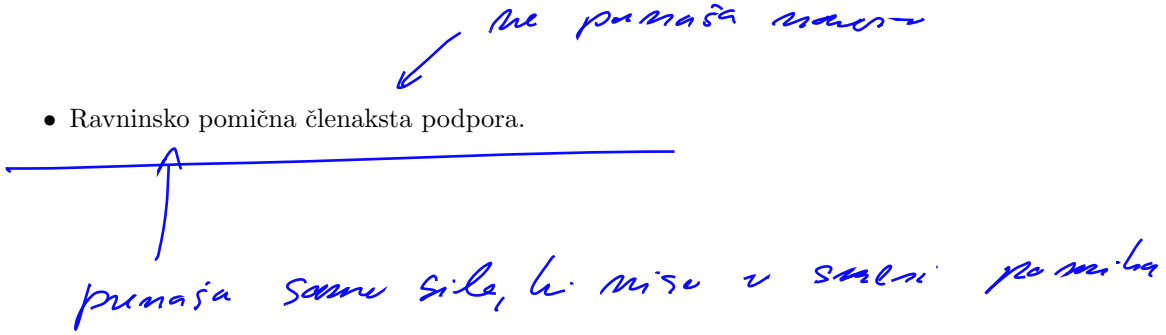
Klasifikacija podpor

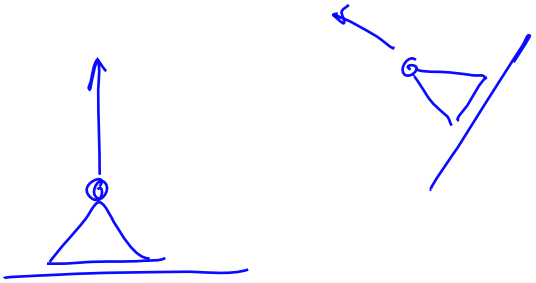
- Vpeta(konzolna) podpora.

- Nepomična členkasta podpora.



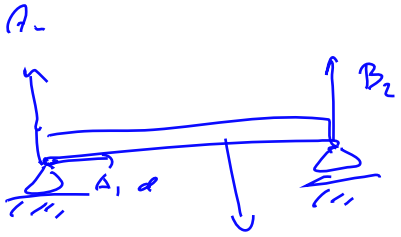
- Ravninsko pomična členaksta podpora.

- Linijsko pomična členaksta podpora.



Osnovni koraki pri reševanju osnovne naloge statike togega telesa

- Identifikacija sil in njihovih prijemališč.
- Postavitev KS in vektorski zapis sil in prijemališč.
- Zapis ravnovesnih enačb.
- Reševanje sistema ravnovesnih enačb.
- Analiza rezultata.



$A_2 = B_2 = \frac{F}{2}$

$\alpha = \frac{\ell}{2}$

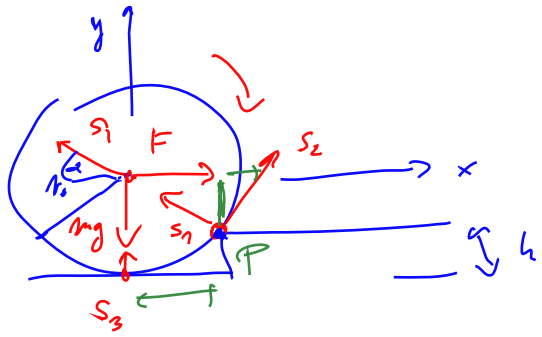
$\vec{0} = \vec{N}(F, A) \Rightarrow \alpha F = \ell B_2 \Rightarrow B_2 = \frac{\alpha}{\ell} F$

$\vec{0} = \vec{N}(F, B) \Rightarrow (\ell - \alpha) F = \ell A_2 \Rightarrow A_2 = \frac{\ell - \alpha}{\ell} F$

$A_2 + B_2 = F$

$\frac{\ell - \alpha}{\ell} F + \frac{\alpha}{\ell} F = F$ ✓

Primer: Določi silo, ki potisne kolo s polmerom r_0 čez robnik višine h; .



Drug pot do rešitve

$\vec{N}(P, 1) = \vec{0}$

$(r_0 \cos\alpha) mg = (r_0 - h) F$

$F = mg \frac{r_0 \cos\alpha}{r_0 - h}$ ✓

$\vec{F} = F\vec{i}$

$m\vec{g} = -mg\vec{j}$

$\vec{S}_1 = S_1(-\cos\alpha\,\vec{i} + \sin\alpha\,\vec{j})$

$r_0 - h = r_0 \sin\alpha$

$S_3 = 0$ $\quad S_2 = 0$ (ni navora reakcije)

$F = mg \frac{\cos\alpha}{\sin\alpha}$ ✓

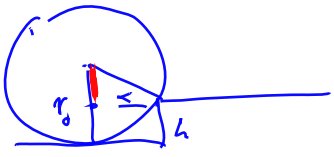
$\vec{0} = \vec{F} + m\vec{g} + \vec{S}_2 = F\vec{i} - mg\vec{j} + S(-\cos\alpha\,\vec{i} + \sin\alpha\,\vec{j})$

$0 = F - S\cos\alpha \Rightarrow F = S\cos\alpha$

$0 = -mg + S\sin\alpha \Rightarrow S = \frac{mg}{\sin\alpha}$

$\Rightarrow F = mg \frac{\cos\alpha}{\sin\alpha}$

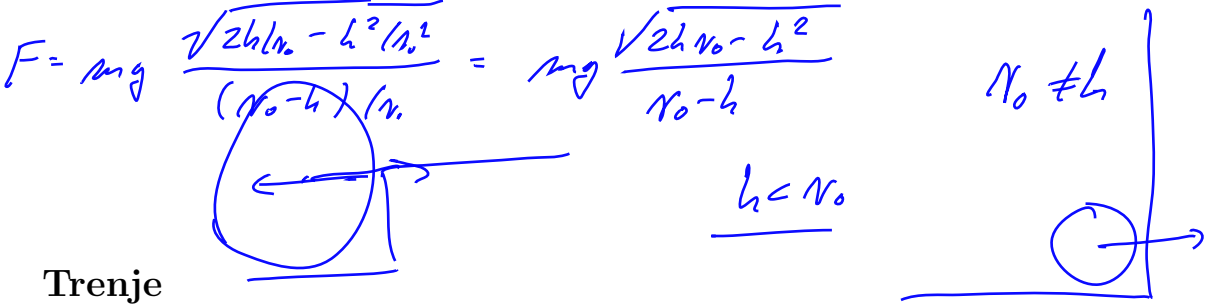
$F = mg \operatorname{ctg}\alpha$



$r_0 = h + r_0 \sin\alpha \Rightarrow \sin\alpha = \frac{r_0 - h}{r_0}$

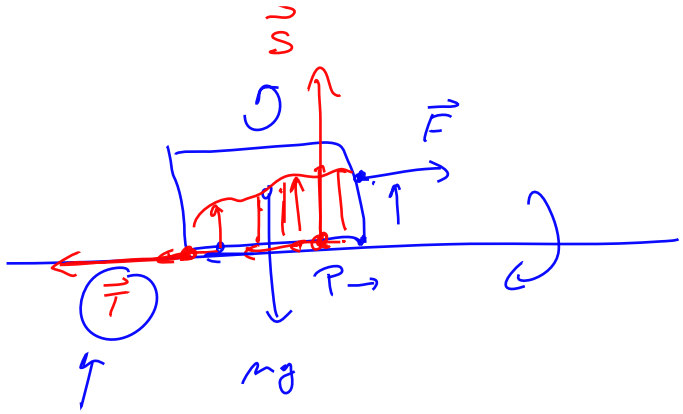
$\cos^2\alpha + \sin^2\alpha = 1 \Rightarrow \cos\alpha = \sqrt{1 - \sin^2\alpha} = \sqrt{1 - (1 - h/r_0)^2} =$

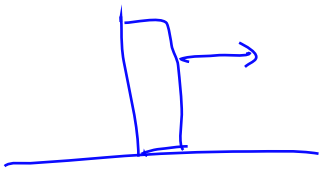
$= \sqrt{1 - 1 + 2h/r_0 - h^2/r_0^2} = \sqrt{2h/r_0 - h^2/r_0^2}$



Trenje

Drsno(dinamično) trenje, dotikalno(oprijemalno, statično) trenje.





Sila trenja = rezultanta sile podlage v tangentni smeri, ki kaže v nasprotno smer gibanja.

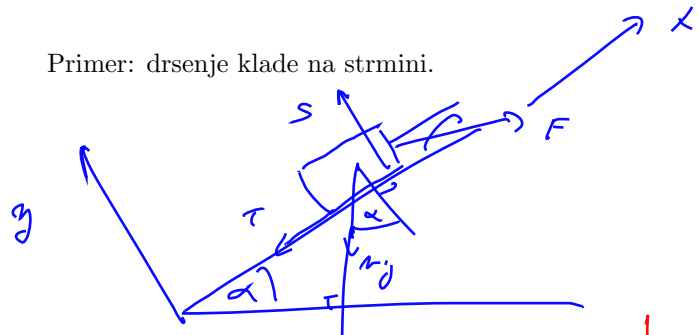
Sila podlage, tangentna komponenta, normalna komponenta. Sila trenja je komponenta sile podlage v tangentni smeri in kaže v nasprotno smer kot gibanje.

Prijemališče sile podlage.

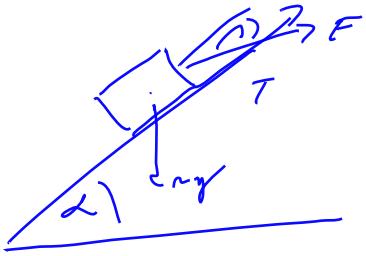
Coulombov zakon trenja

Tabela koeficientov oprijemalnega(koeficient lepenja) in drsnega trenja.

Primer: drsenje klade na strmini.



drsenje



spuščanje

$m\vec{g} = mg(-\sin\alpha\,\vec{i} - \cos\alpha\,\vec{j})$

$\vec{S} = S\vec{j}$

$\vec{F} = F(\cos\varphi\,\vec{i} - \sin\varphi\,\vec{j})$

$\vec{T} = -T\vec{i}$ $\quad \vec{T} = -T\vec{i} = -aT\vec{i}$ $\quad \vec{T} = T\vec{i} = -aT\vec{i}$

spuščanje $a = -1$ $\quad \vec{T} = a\vec{i}$ $\quad$ drsenje $a = 1$

$\vec{0} = m\vec{g} + \vec{S} + \vec{F} + \vec{T}$

$$\begin{cases} 0 = -mg\sin\alpha + F\cos\varphi \mp aT \\ 0 = -mg\cos\alpha + S - F\sin\varphi \end{cases}$$

F, T, S

$T = kS$

$S = mg\cos\alpha + F\sin\varphi$

$0 = -mg\sin\alpha + F\cos\varphi \mp ak(mg\cos\alpha + F\sin\varphi)$

$0 = mg(\mp ak\cos\alpha - \sin\alpha) + F(\cos\varphi \mp ak\sin\varphi)$

$F = mg\dfrac{\sin\alpha \pm ak\cos\alpha}{\cos\varphi \mp ak\sin\varphi}$

$k = \operatorname{tg}\alpha_0 = \dfrac{\sin\alpha_0}{\cos\alpha_0}$

α_0 tornilo

$F = mg\dfrac{\sin\alpha\cos\alpha_0 \pm a\sin\alpha_0\cos\alpha}{\cos\varphi\cos\alpha_0 \mp a\sin\alpha_0\sin\varphi}$

$a\sin\alpha_0$

$a = 1 \Rightarrow a\sin\alpha_0 = \sin(a\alpha_0)$

$a = -1 \Rightarrow a\sin\alpha_0 = -\sin\alpha_0 = \sin(-\alpha_0) = \sin(a\alpha_0)$ $\Rightarrow$

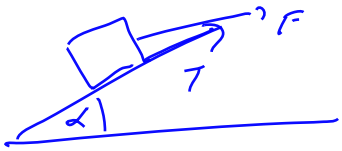
$a \sin\alpha_0 = \sin(a\alpha_0)$ za $a = 1$ in $a = -1$

$\cos\alpha_0 = \cos(-\alpha_0) \Rightarrow \cos(a\alpha_0) = \cos(\alpha_0)$

$$F = mg \frac{\sin\alpha\cos(a\alpha_0) + \sin(a\alpha_0)\cos\alpha}{\cos\beta\cos(a\alpha_0) - \sin(a\alpha_0)\sin\beta} = mg \frac{\sin(\alpha + a\alpha_0)}{\cos(\beta + a\alpha_0)}$$

Dvigovanje: $a = 1$ $\quad F = mg \dfrac{\sin(\alpha+\alpha_0)}{\cos(\beta+\alpha_0)}$

Spuščanje $a = -1$ $\quad F = mg \dfrac{\sin(\alpha-\alpha_0)}{\cos(\beta-\alpha_0)}$



$F > 0 \quad \alpha > \alpha_0$ $\qquad F = 0 \quad \alpha = \alpha_0$

$F < 0 \quad \boxed{\alpha < \alpha_0}$

Primer: vijačna dvigalka.

$$M = Gr_0 \tan(\alpha + a\alpha_0),$$

α strmina vijačnice, α_0 torni kot.