TRANSPORTNI UREĐAJI
VJEŽBE - 04

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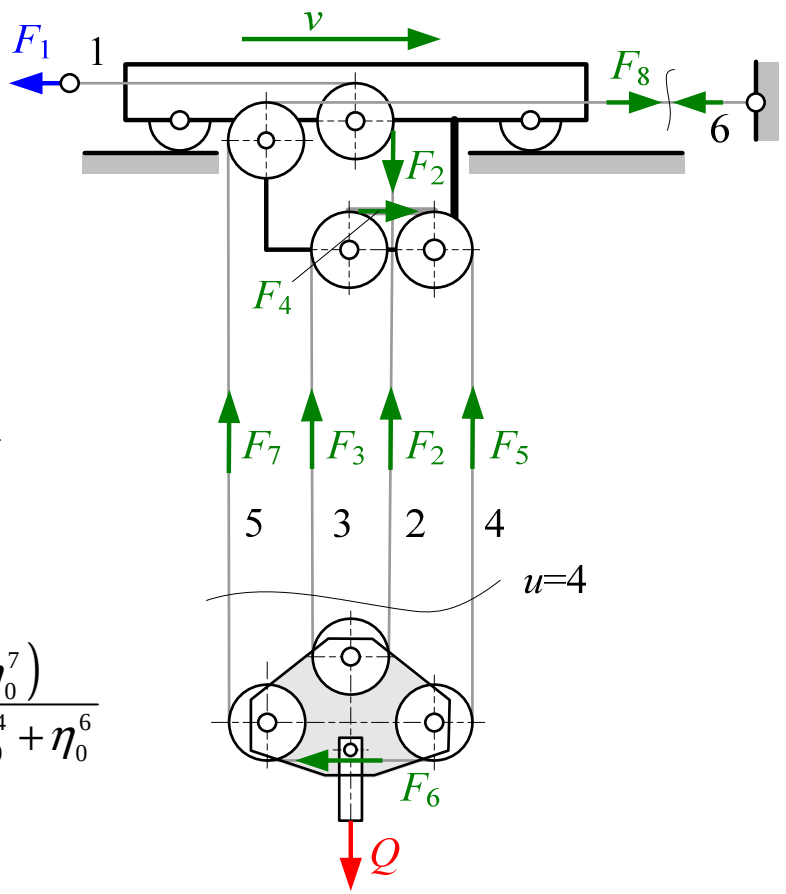
ZADATAK 7 (3)

Za vježbu....
Ležajevi užetnika su valjni. Kolika je iskoristivost tog koloturnika pri dizanju tereta? Koliki su dodatni otpori vožnje uslijed otpora gibanju užeta kroz koloturnik?

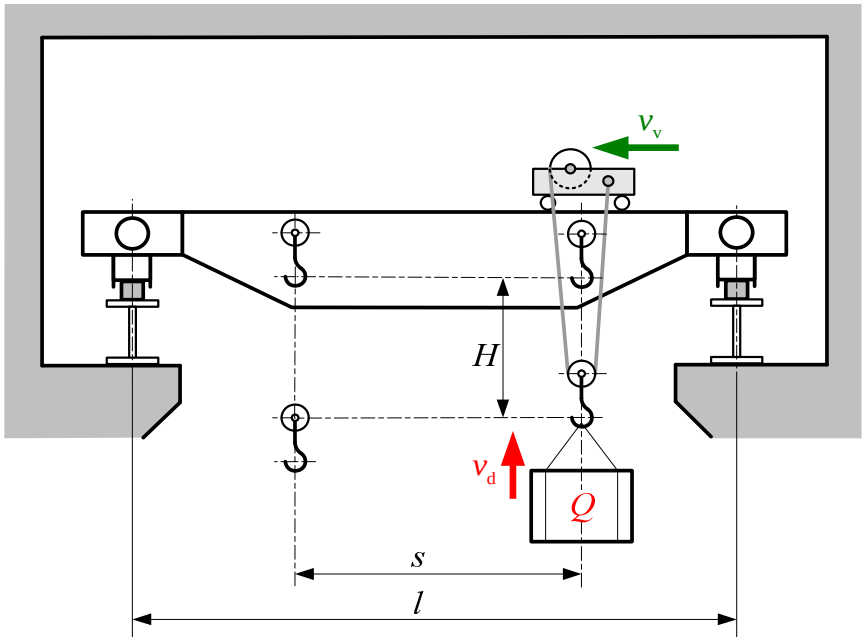


$$\eta_r = \frac{F_{1,te}}{F_1} = \frac{Q / i_{kol}}{\frac{Q}{\eta_0\left(1+\eta_0+\eta_0^3+\eta_0^5\right)}} = \frac{\eta_0\left(1+\eta_0+\eta_0^3+\eta_0^5\right)}{i_{kol}}$$

$$\Delta F = F_1 - F_8 = F_1 - F_1 \cdot \eta_0^7 = F_1 \cdot \left(1-\eta_0^7\right) = \frac{Q \cdot \left(1-\eta_0^7\right)}{\eta_0+\eta_0^2+\eta_0^4+\eta_0^6}$$

ZADATAK 8 (1)

Za mehanizam vožnje vitla mosne dizalice zadano je:
P = 1,5 kW - snaga pogonskog motora, Q_t = 25 t – nosivost, m_v = 5 t - masa vitla, n_{EM} = 975 - brzina vrtnje motora, J_{EM} = 0,0325 kgm² - moment inercije rotora motora, J_S = 0,06 kgm² - moment inercije spojke, D_k = 350 mm – promjer kotača, v_v = 20 m/min – brzina vožnje, η_{red} = 0,90 – stupanj djelovanja reduktora mehanizma za vožnju, f_e = 10 N/kN – specifični otpori vožnje, t_p=3 s - vrijeme ubrzanja, s =10 m – duljina vožnje vitla.



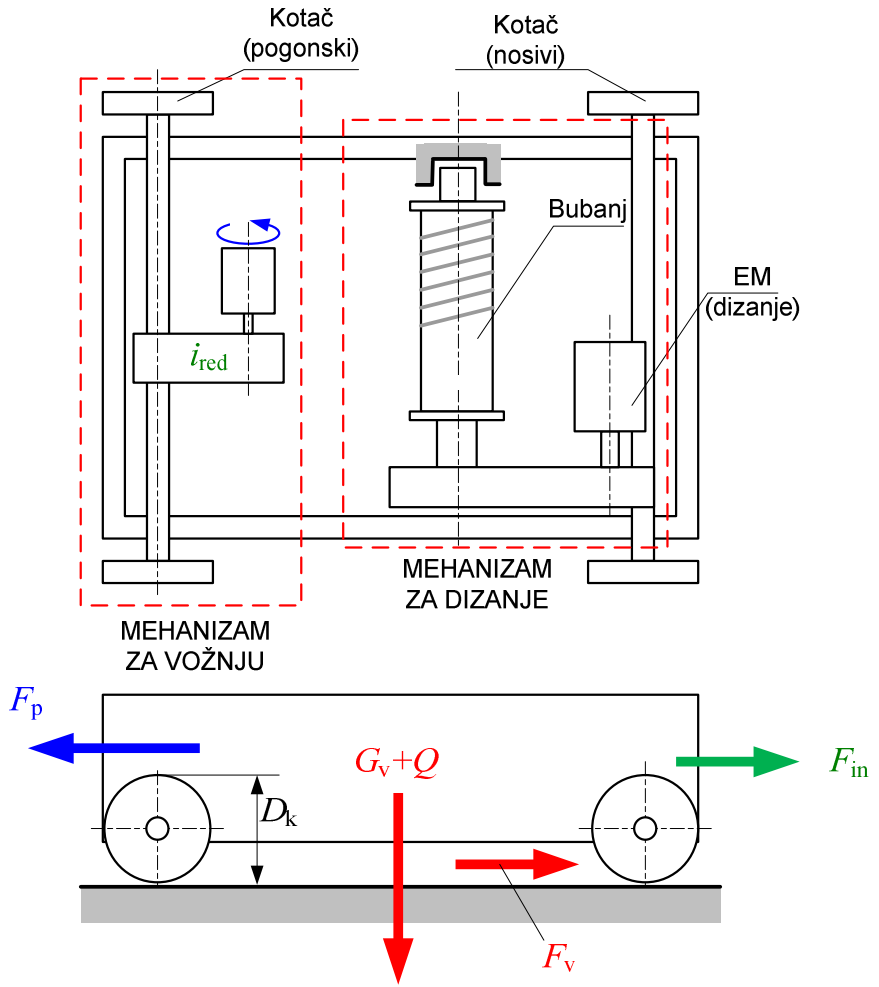
ZADATAK 8 (2)

Izračunati:

a) Prijenosni odnos reduktora
b) Provjeriti instaliranu snagu motora pri ustaljenoj vožnji.
c) Provjeriti snagu motora pri pokretanju, ako je .

$$M_p = 1{,}8 M_n$$

d) Izračunati graničnu brzinu mosta



ZADATAK 8 (3)

a) Prijenosni odnos reduktora

$$i_{red} = \frac{n_{EM}}{n_k} = \frac{n_{EM}}{2\pi \cdot \omega_k} = \frac{n_{EM}}{2\pi \cdot \frac{v_v}{D_k/2}} = \frac{\pi \cdot D_k \cdot n_{EM}}{v} = \frac{\pi \cdot 0{,}35 \cdot \frac{1000}{60}}{\frac{20}{60}} = 54{,}97 \approx 55$$

b) Provjeriti instaliranu snagu motora pri ustaljenoj vožnji.

$$P_{st} = \frac{F_v \cdot v}{\eta_{uk}} \qquad F_v = (G_{vit} + Q) \cdot f_e$$

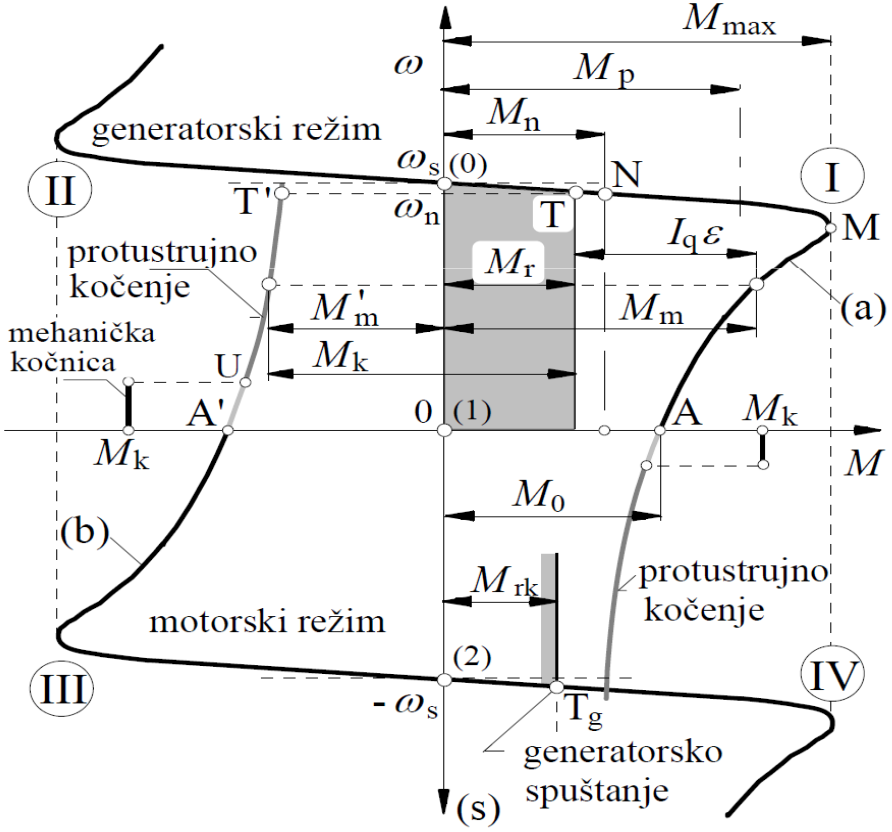
$$P_{st} = \frac{(Q_t + m_v)\, g \cdot f_e \cdot v_v}{\eta_{uk}} = \frac{(25+5) \cdot 9{,}81 \cdot 10 \cdot 20}{0{,}9 \cdot 60} = 1090 \quad \text{W}$$

ZADATAK 8 (4)

c) Provjeriti snagu motora pri pokretanju, ako je $M_p = 1,8 M_n$

Mogućnost kratkotrajnog preopterećenja asinkronog elektromotora

$M_p = 1,7 \ldots\ldots 2 M_n$



ZADATAK 8 (5)

$$M_p = 1{,}8 M_n \geq M_{st} + M_{ub}$$

Nominalni moment EM – na vratilu EM

$$M_n = \frac{P_{EM}}{\omega_{EM}} = \frac{P_{EM}}{2\pi \cdot n_{EM}} = \frac{1500}{2\pi \cdot n_{EM}} = \frac{1500}{2\pi \cdot \frac{975}{60}} = 14{,}69 \quad \text{Nm}$$

Moment ustaljene vožnje reduciran na vratilo EM-a

$$M_{st} = \left(Q_t + m_v\right) g \cdot f_e \cdot \frac{D_k}{2} \cdot \frac{1}{\eta_{red}} \cdot \frac{1}{i_{red}}$$

$$M_{st} = \left(25+5\right) \cdot 9{,}81 \cdot 10 \cdot \frac{0{,}35}{2} \cdot \frac{1}{0{,}9} \cdot \frac{1}{55} = 10{,}4 \quad \text{Nm}$$

Nm

ZADATAK 8 (6)

Moment ubrzanja masa – mase potrebno reducirati na vratilo EM

$$M_{ub} = \left(J_{rot} + J_{tr} \right) \varepsilon$$

$$J_{rot} = J_{EM} + J_S = 0,0325 + 0,06 = 0,0925 \quad \text{kgm}^2$$

$$\boxed{W = \left(m_v + Q_t \right) \cdot \frac{v_v^2}{2} = J_{tr} \cdot \frac{\omega_{EM}^2}{2} \cdot \eta_{red}}$$

$$J_{tr} = \frac{m_v + Q_t}{\eta_{uk}} \cdot \left(\frac{v}{\omega_{EM}} \right)^2 = \frac{m_v + Q_t}{\eta_{uk}} \cdot \left(\frac{v}{2\pi \cdot n_{EM}} \right)^2$$

$$J_{tr} = \frac{5 + 25}{0,9} \cdot 1000 \cdot \left(\frac{20}{2\pi \cdot 975} \right)^2 = 0,35528 \quad \text{kgm}^2$$

ZADATAK 8 (7)

Kutno ubrzanje – UBRZANJE VRATILA EM-a !!!

$$\varepsilon = \frac{\omega_{EM}}{t} = \frac{2\pi \cdot n_{EM}}{t} = \frac{2\pi \cdot 975}{60 \cdot 3} = 34 \quad \text{s}^{-1}$$

Uvrštavanje....

$$M_{\text{ub}} = \left(J_{\text{rot}} + J_{\text{tr}} \right) \varepsilon = \left(0,0925 + 0,35528 \right) \cdot 34 = 15,21 \quad \text{Nm}$$

$$M_{\text{p}} = 1,8 M_{\text{n}} \geq M_{\text{st}} + M_{\text{ub}}$$

$$1,8 \cdot 14,69 \geq 10,4 + 15,21$$

$$26,44 \geq 25,61$$

ZADOVOLJAVA

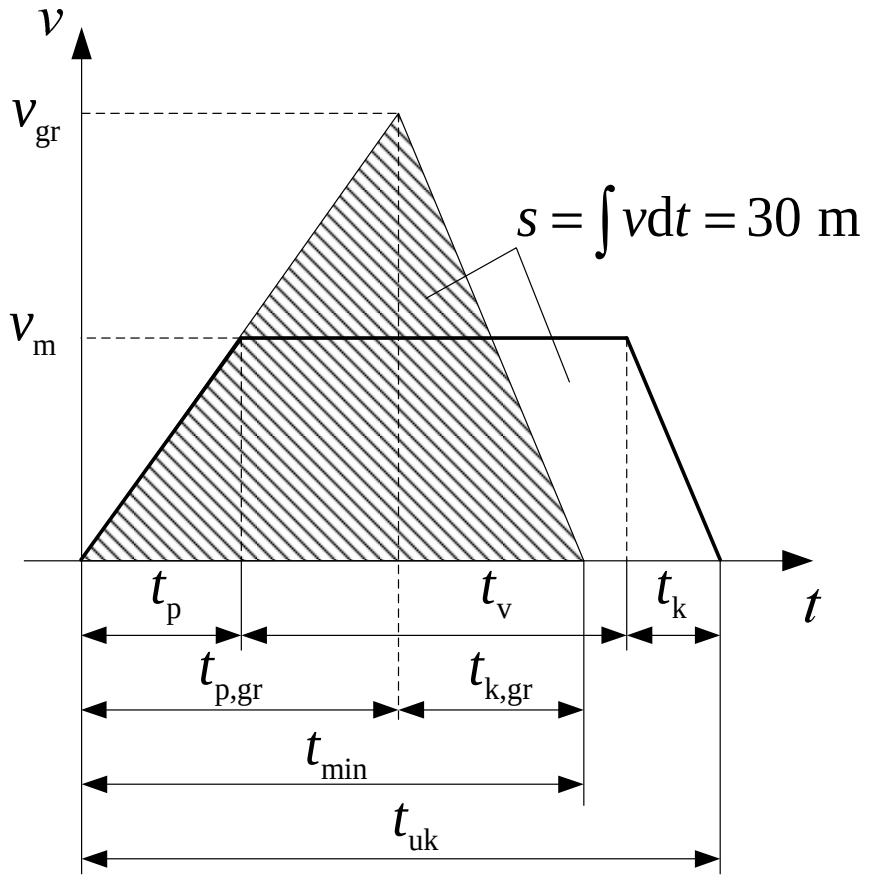
ZADATAK 8 (8)

d) Izračunati graničnu brzinu mosta

$$s = \int_0^t v\,\mathrm{d}t = \frac{1}{2} \cdot v_{\mathrm{gr}} \left(t_{\mathrm{p,gr}} + t_{\mathrm{k,gr}} \right)$$

$$t_{\mathrm{p,gr}} = \frac{v_{\mathrm{gr}}}{a_{\mathrm{p,t}}} \qquad t_{\mathrm{k,gr}} = \frac{v_{\mathrm{gr}}}{a_{\mathrm{k,t}}}$$

$$a_{\mathrm{p,gr}} = a_{\mathrm{p}} \qquad a_{\mathrm{k,gr}} = a_{\mathrm{k}}$$



ZADATAK 8 (9)

$$a_{\mathrm{p}} = \frac{v_{\mathrm{v}}}{t_{\mathrm{p}}} = \frac{20}{60 \cdot 3} = 0{,}111 \qquad a_{\mathrm{k}} = a_{\mathrm{p}} = 0{,}111$$

$$v_{\mathrm{gr}} = \sqrt{\frac{2 \cdot s \cdot a_{\mathrm{p,t}} \cdot a_{\mathrm{k,t}}}{a_{\mathrm{p,t}} + a_{\mathrm{k,t}}}} = \sqrt{\frac{2 \cdot 10 \cdot 0{,}111 \cdot 0{,}111}{0{,}111 + 0{,}111}}$$

$$v_{\mathrm{gr}} = 1{,}02 \qquad v_{\mathrm{gr}} = 61{,}58$$

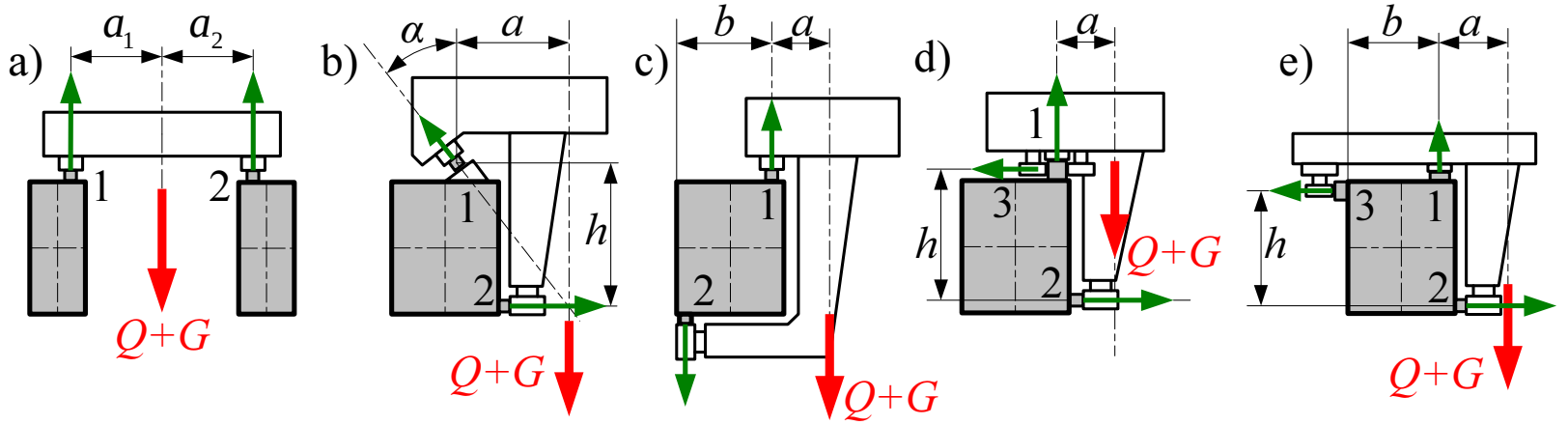
$$k = \frac{v_{\mathrm{v}}}{v_{\mathrm{gr}}} = \frac{20}{61{,}58} = 0{,}32 \approx \frac{1}{3}$$

ZADATAK 9 (1)

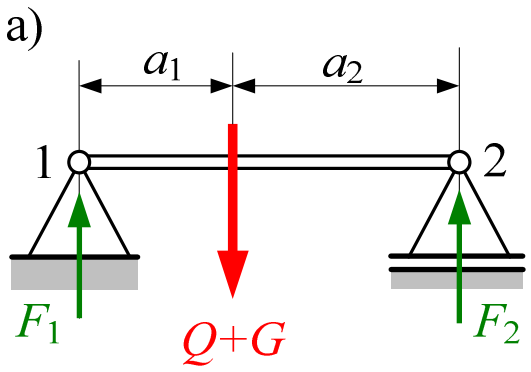
Za različite načine oslanjanja vitla prema slici, potrbno izračunati i usporediti opterećenje kotača i veličinu otpora vožnje, ako je zadano:

$Q+G=100$ kN; $a=0{,}6$ m; $a_1=0{,}9$ m; $a_2=1{,}1$ m;

$b=0{,}75$ m; $h=1$ m; $f=0{,}01$



ZADATAK 9 (2)



$$\sum F_y = 0 \;\Rightarrow\; F_1 + F_2 = Q + G$$

$$\sum M_2 = 0 \;\Rightarrow\; F_1\left(a_1 + a_2\right) = \left(Q + G\right)\cdot a_2$$

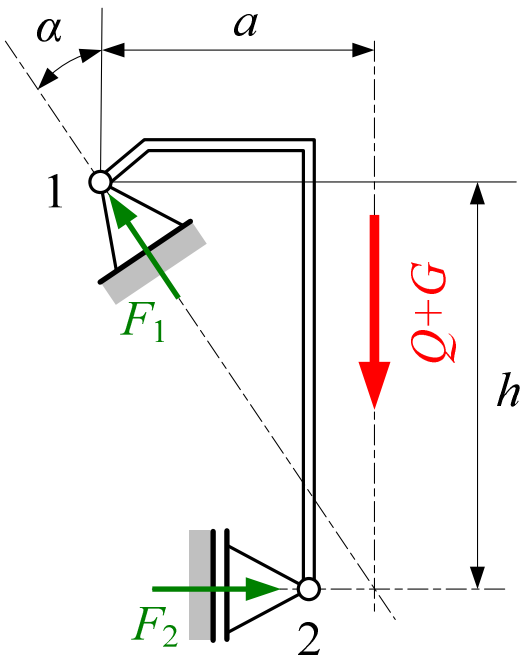
$$F_1 = \frac{a_2}{a_1 + a_2}\cdot\left(Q + G\right)$$

$$F_1 = \frac{1{,}1}{0{,}9 + 1{,}1}\cdot 100 = 55$$

$$F_2 = Q + G - F_1 = 100 - 55 = 45$$

$$F_{\mathrm{f}} = \left(F_1 + F_2\right)\cdot f = \left(55 + 45\right)0{,}01 = 1$$

ZADATAK 9 (3)



$$\sum M_1 = 0 \quad \Rightarrow \quad F_2 \cdot h = (Q+G) \cdot a$$

$$F_2 = (Q+G) \cdot \frac{a}{h} = 100 \cdot \frac{0,6}{1} = 60$$

$$\tan\alpha = \frac{a}{h} = \frac{0,6}{1} \Rightarrow \alpha = 30,96°$$

$$\sum F_y = 0 \quad \Rightarrow \quad F_1 \cdot \cos\alpha = Q+G$$

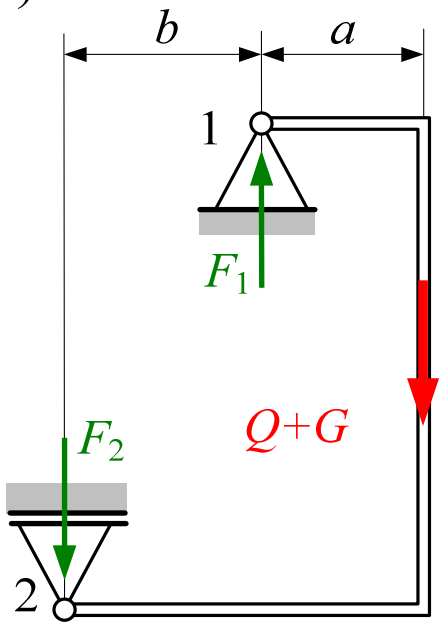
$$F_1 = \frac{Q+G}{\cos\alpha} = \frac{100}{\cos 30,96°} = 116,6$$

$$F_f = (F_1 + F_2) \cdot f$$

$$F_f = (116,6+60) \cdot 0,01 = 1,766$$

ZADATAK 9 (4)

c)



$$\sum M_1 = 0 \quad \Rightarrow \quad F_2 \cdot b = (Q+G) \cdot a$$

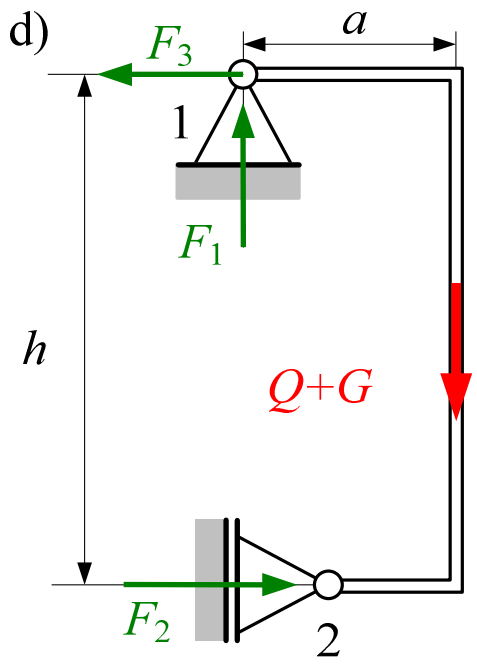
$$\sum F_y = 0 \quad \Rightarrow \quad F_2 = (Q+G) \cdot \frac{a}{b} = 100 \cdot \frac{0,6}{0,75} = 80$$

$$F_1 = F_2 + Q + G = 80 + 100 = 180$$

$$F_f = (F_1 + F_2) \cdot f$$

$$F_f = (180 + 80) \cdot 0,01 = 2,6$$

ZADATAK 9 (5)



$$\sum M_1 = 0 \Rightarrow F_2 \cdot h = (Q+G) \cdot a$$

$$\sum F_y = 0 \Rightarrow F_1 = Q+G = 100$$

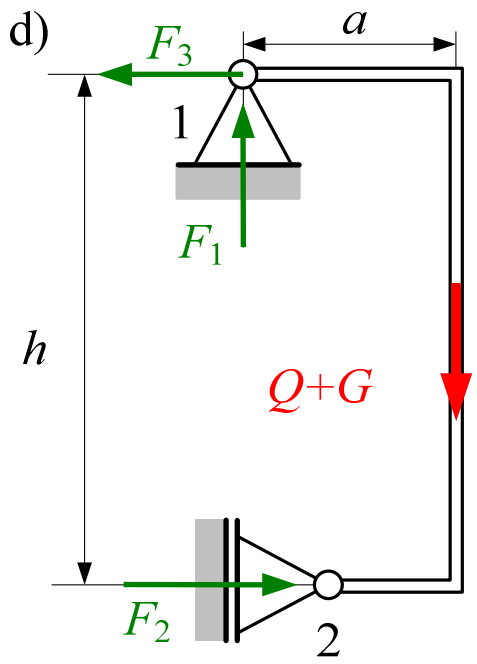
$$\sum F_x = 0 \Rightarrow F_2 = (Q+G) \cdot \frac{a}{h} = 100 \cdot \frac{0,6}{1} = 60$$

$$F_3 = F_2 = 60$$

$$F_f = (F_1 + F_2 + F_3) \cdot f$$

$$F_f = (100+60+60) \cdot 0,01 = 2,2$$

ZADATAK 9 (5)



$$\sum M_1 = 0 \Rightarrow F_2 \cdot h = (Q+G) \cdot a$$

$$\sum F_y = 0 \Rightarrow F_1 = Q+G = 100$$

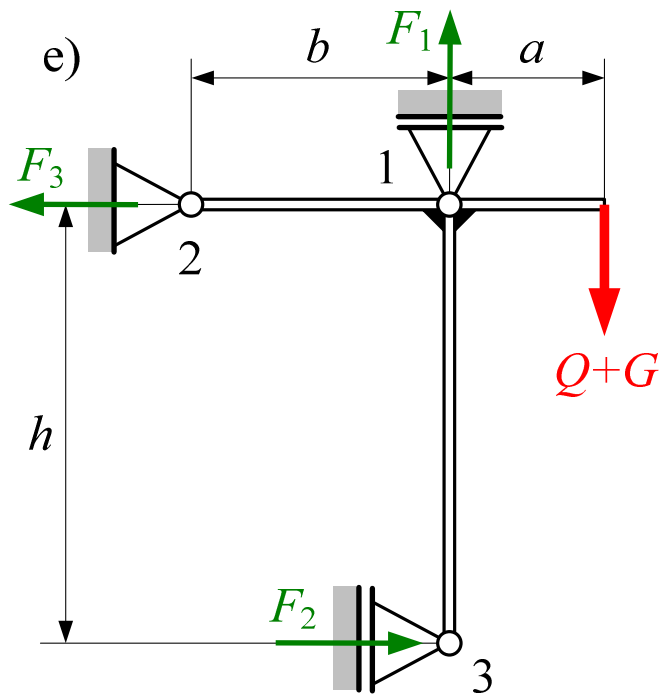
$$\sum F_x = 0 \Rightarrow F_2 = (Q+G) \cdot \frac{a}{h} = 100 \cdot \frac{0,6}{1} = 60$$

$$F_3 = F_2 = 60$$

$$F_f = (F_1 + F_2 + F_3) \cdot f$$

$$F_f = (100+60+60) \cdot 0,01 = 2,2$$

ZADATAK 9 (6)



$$\sum M_1 = 0 \quad \Rightarrow \quad F_2 \cdot h = (Q+G) \cdot a$$

$$F_2 = (Q+G) \cdot \frac{a}{h} = 100 \cdot \frac{0,6}{1} = 60$$

$$\sum F_y = 0 \quad \Rightarrow F_1 = Q+G = 100$$

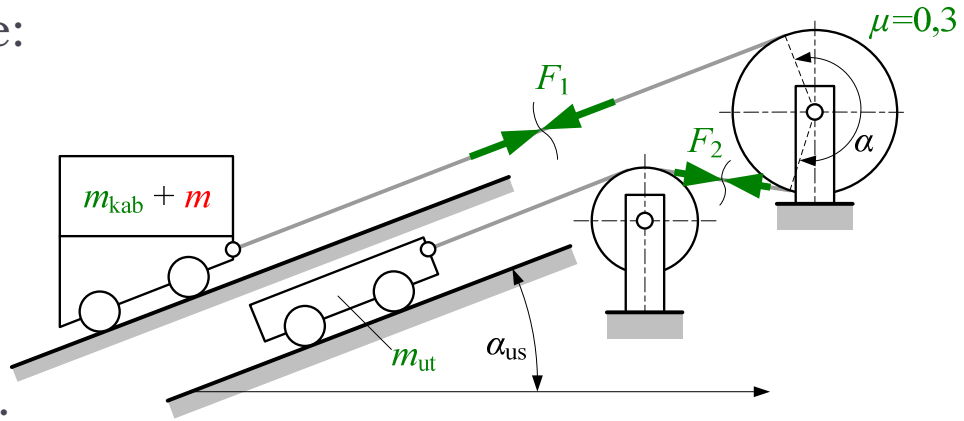
$$\sum F_x = 0 \quad \Rightarrow F_3 = F_2 = 60$$

$$F_f = (F_1 + F_2 + F_3) \cdot f$$

$$F_f = (100+60+60) \cdot 0,01 = 2,2$$

ZADATAK 10 (1)

Za kosi lift prema slici zadano je:



$m_{kab} = 1600$ kg, masa kabine;

$m = 800$ kg, nosivost lifta;

$v = 1{,}5$ m/s, brzina vožnje;

$a_1 = 0{,}5\ \mathrm{m/s^2}$ ubrzanje pri pokretanju i kočenju;

$\alpha = \frac{7}{6}\pi$ obuhvatni kut

α_{us} uspon staze 45%

$f = 0{,}02$ specifični otpori vožnje.

Odrediti (težinu užeta zanemariti):
- optimalnu masu utega iz uvjeta što manje pogonske sile;
- snagu pogona (ukupna iskoristivost $\eta = 0{,}7$) za izračunatu masu protuutega;