TRANSPORTNI UREĐAJI
VJEŽBE - 03

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ZADATAK 8 (1)

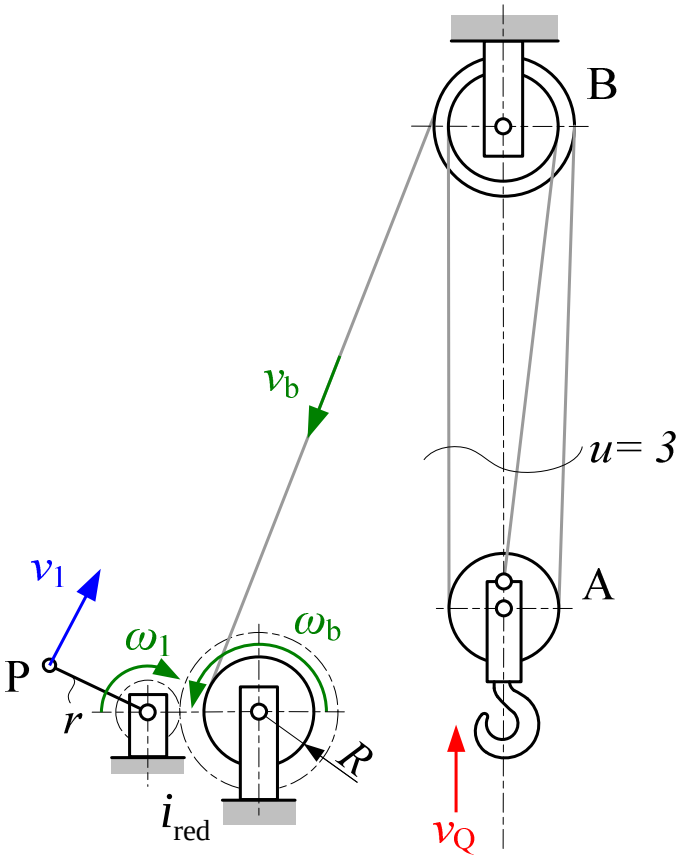
Za vježbu....
Za ručni mehanizam dizanja prema slici poznato je:

v_1 = 1 m/s;
r = 0,35m;
R= 0,15m;
i_{red}=6;

Odrediti brzinu dizanja tereta v_2

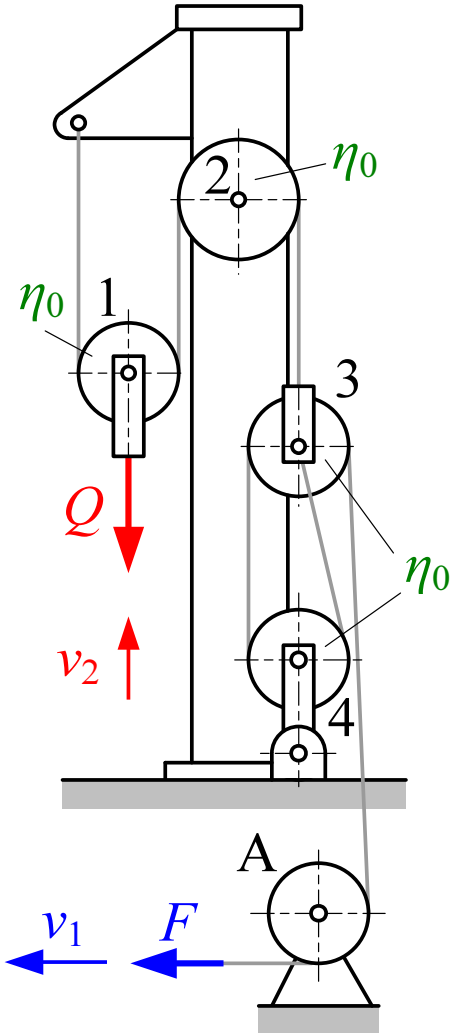
$$v_2 = v_1 \cdot \frac{R}{i_{red} \cdot r \cdot u} = 1 \cdot \frac{0{,}15}{6 \cdot 0{,}35 \cdot 3} = 1 \cdot \frac{1}{42} = 0{,}0238$$

$$i_{uk} = i_{red} \cdot u \cdot \frac{r}{R} = 42$$



ZADATAK 4 (1)

Koloturnik za dizanje tereta prema slici ima pojedinačnu iskoristivost svake užnice $\eta_0 = 0{,}98$ (valjni ležajevi).



Izračunati:

a) prijenosni odnos koloturnika – vježbe 02;

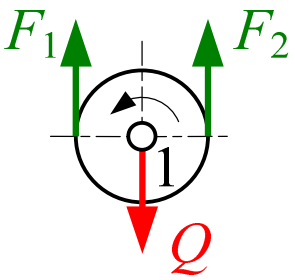
b) odnos F/Q pri jednolikom dizanju i spuštanju tereta

c) rezultirajuću silu na osovini užnice A.

ZADATAK 4 (6)

b) odnos F/Q pri jednolikom dizanju i spuštanju tereta

UŽNICA 1

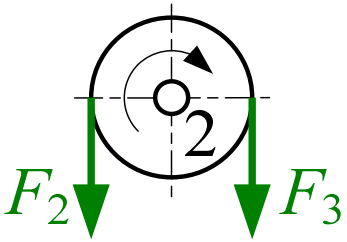


$$F_2 > F_1 \Rightarrow F_1 = F_2 \cdot \eta_0$$

$$Q = F_1 + F_2$$

$$F_2 = \frac{Q}{1+\eta_0}$$

UŽNICA 2

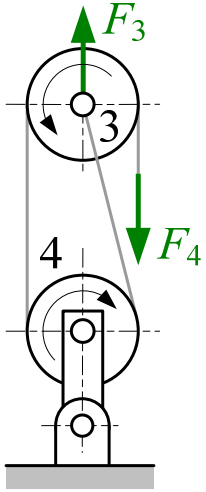


$$F_3 > F_2 \Rightarrow F_2 = F_3 \cdot \eta_0$$

$$F_3 = \frac{Q}{(1+\eta_0)\cdot\eta_0}$$

ZADATAK 4 (7)

UŽNICE 3 i 4



$$F_3 = \frac{Q}{(1+\eta_0)\cdot\eta_0} \qquad v_8 = 6\cdot v_2 \qquad v_6 = 2\cdot v_2$$

$$\eta_{\text{fk2,r}} = \frac{1}{u_2}\cdot\frac{1-\eta_0^{u_2}}{1-\eta_0} = \frac{1}{3}\cdot\frac{1-0{,}98^3}{1-0{,}98} = 0{,}98013$$

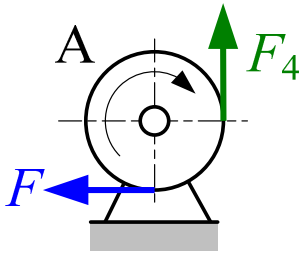
ZAKON OČUVANJA ENERGIJE

$$\eta_{\text{fk2,r}}\cdot F_4\cdot v_8 = F_3\cdot v_6$$

$$\eta_{\text{fk2,r}}\cdot F_4\cdot 6\cdot v_2 = \frac{Q}{(1+\eta_0)\cdot\eta_0}\cdot 2\cdot v_2 \quad \Rightarrow \quad F_4 = \frac{Q}{3\cdot(1+\eta_0)\cdot\eta_0\cdot\eta_{\text{fk2,r}}}$$

ZADATAK 4 (8)

SKRETNI UŽETNIK



$$F > F_4 \quad \Rightarrow \quad F_4 = F \cdot \eta_0$$

$$F \cdot \eta_0 = \frac{Q}{3 \cdot (1+\eta_0) \cdot \eta_0 \cdot \eta_{\text{fk2,r}}}$$

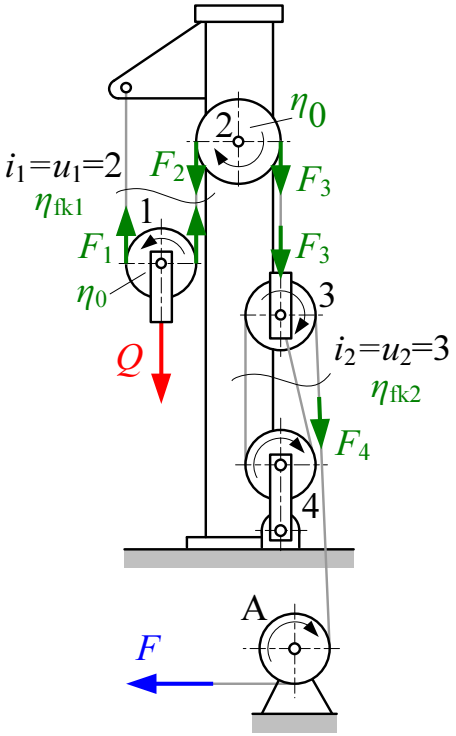
$$\frac{F}{Q} = \frac{1}{3 \cdot (1+\eta_0) \cdot \eta_0^2 \cdot \eta_{\text{fk2,r}}} = \frac{1}{3 \cdot (1+0{,}98) \cdot 0{,}98^2 \cdot 0{,}98013} = 0{,}178845$$

ZADATAK 4 (8)

BEZ GUBITAKA

$$\frac{F}{Q}=\frac{1}{3\cdot(1+1)\cdot 1^2\cdot 1}=\frac{1}{6}\approx 0{,}1666$$

SKRAĆENO



$$\left.\begin{aligned}F_1&=F_2\cdot\eta_0\\ Q&=F_1+F_2\end{aligned}\right\}\quad F_2=\frac{Q}{1+\eta_0}$$

$$F_3>F_2\ \Rightarrow\ F_2=F_3\cdot\eta_0\ \Longrightarrow\ F_3=\frac{Q}{(1+\eta_0)\cdot\eta_0}$$

$$F_4=\frac{F_3\cdot i_2}{\eta_{fk2,r}}\ \Longrightarrow\ F_4=\frac{Q}{i_2\cdot(1+\eta_0)\cdot\eta_0\cdot\eta_{fk2,r}}\qquad \eta_{fk2,r}=\frac{1}{u_2}\frac{1-\eta_0^{u_2}}{1-\eta_0}$$

$$F_4=F\cdot\eta_0\ \Longrightarrow\ \frac{F}{Q}=\frac{1}{3\cdot(1+\eta_0)\cdot\eta_0^2\cdot\eta_{fk2,r}}=0{,}1788$$

ZADATAK 4 (9)

JOŠ KRAĆE

$$F \cdot \eta_{\text{uk,r}} = \frac{Q}{i_{\text{uk}}} \qquad \Rightarrow \qquad \frac{F}{Q} = \frac{1}{i_{\text{uk}} \cdot \eta_{\text{uk,r}}} = \frac{1}{6 \cdot 0,9319} = 0,17885$$

$$i_{\text{uk}} = i_{\text{fk1}} \cdot i_{\text{fk2}} = 2 \cdot 3 = 6$$

$$\eta_{\text{uk,r}} = \eta_0 \cdot \eta_{\text{fk2,r}} \cdot \eta_0 \cdot \eta_{\text{fk1,r}} = 0,98 \cdot 0,99 \cdot 0,98 \cdot 0,98013 = 0,9319$$

$$\eta_{\text{fk1,r}} = \frac{1}{u_1} \cdot \frac{1-\eta_0^{u_1}}{1-\eta_0} = \frac{1+\eta_0}{2} = 0,99 \qquad \eta_{\text{fk2,r}} = \frac{1}{u_2} \cdot \frac{1-\eta_0^{u_2}}{1-\eta_0} 0,98013$$

ZADATAK 4 (9)

ODNOS $\frac{F}{Q}$ PRI JEDNOLIKOM SPUŠTANJU TERETA

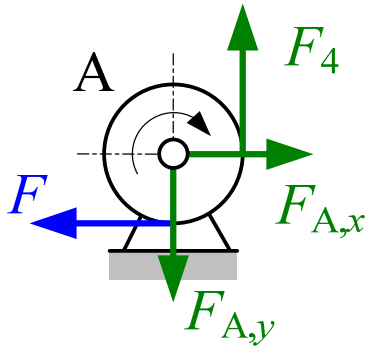
$$\frac{F}{Q}=\frac{1}{i_{uk}}\cdot\eta_{uk,k}=\frac{1}{6}\cdot 0,9306=0,1551$$

$$\eta_{uk,k}=\left(2-\frac{1}{\eta_{fk1,r}}\right)\cdot\left(2-\frac{1}{\eta_0}\right)^2\cdot\left(2-\frac{1}{\eta_{fk2,r}}\right)$$

$$\eta_{uk,k}=\left(2-\frac{1}{0,99}\right)\cdot\left(2-\frac{1}{0,98}\right)^2\cdot\left(2-\frac{1}{0,98013}\right)=0,9306$$

ZADATAK 4 (10)

REZULTIRAJUĆA SILA NA OSOVINI UŽNICE A



$$\sum F_x = 0 \qquad F_{A,x} = F$$

$$\sum F_y = 0 \qquad F_{A,y} = F_4$$

$$F < F_4 \quad \Rightarrow \quad F_4 = F \cdot \eta_0$$

$$F_A = \sqrt{F_{A,x}^2 + F_{A,y}^2}$$

$$F_{A,x} = F = 0{,}1788 \cdot Q$$

$$F_{A,y} = F_4 = F \cdot \eta_0 = 0{,}1788 \cdot Q \cdot 0{,}98 = 0{,}17527 \cdot Q$$

$$F_A = \sqrt{(0{,}1788 \cdot Q)^2 + (0{,}1788 \cdot Q)^2}$$

$$F_A = 0{,}25041 \cdot Q$$

ZADATAK 6 (1)

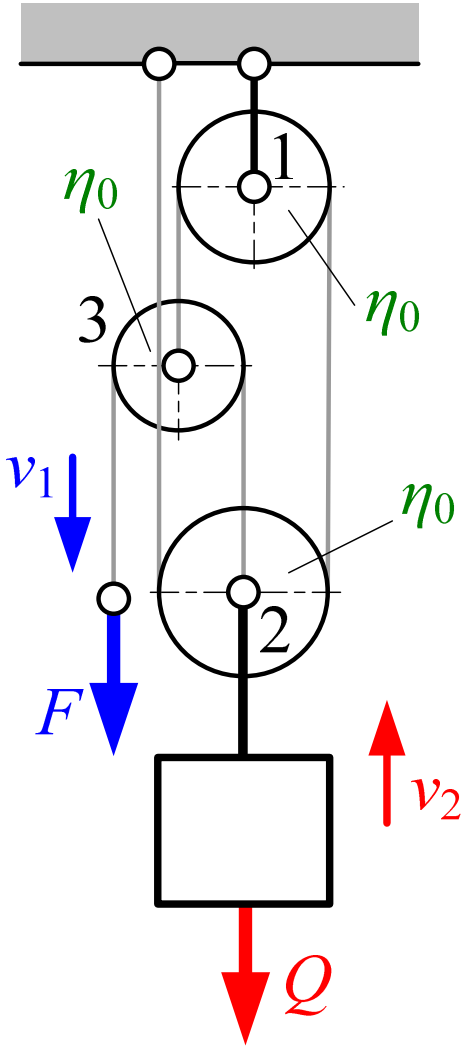
Za koloturnik prema slici odrediti

a) prijenosni odnos v_1/v_2 – vježbe 02

b) stupanj iskoristivosti pri dizanju i spuštanju tereta

c) veličinu sile F pri jednolikom dizanju i jednolikom spuštanju tereta.

Pojedinačni stupanj iskoristivosti užnica je $\eta_0 = 0{,}98$ (valjni ležajevi).



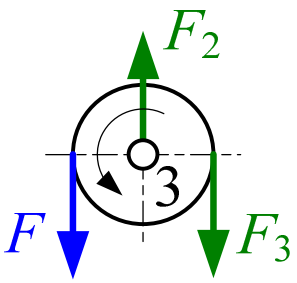
ZADATAK 6 (5)

b) stupanj iskoristivosti pri dizanju i spuštanju tereta

$$\eta_r = \frac{F_{te}}{F}$$

$$F_{te}\, v_1 = Q\, v_2 \qquad \Rightarrow \qquad F_{te} = Q\frac{v_2}{v_1} = \frac{Q}{i_{kol}} = \frac{Q}{5}$$

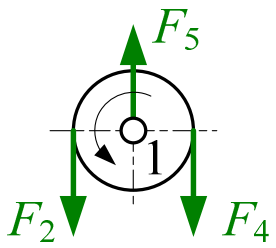
UŽNICA 3



$$\left.\begin{array}{l} F + F_3 = F_2 \\ F > F_3 \;\Rightarrow\; F_3 = F\,\eta_0 \end{array}\right\} \quad F_2 = F\left(1+\eta_0\right)$$

ZADATAK 6 (6)

UŽNICA 1



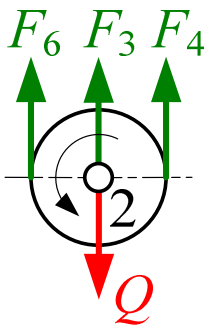
$$\left.\begin{aligned} F_5 &= F_2 + F_4 \\ F_2 > F_4 \;&\Rightarrow\; F_4 = F_2 \cdot \eta_0 \end{aligned}\right\} \quad F_5 = F_2 \cdot (1+\eta_0)$$

$$\left.\begin{aligned} F_2 &= F(1+\eta_0) \\ F_4 &= F_2 \cdot \eta_0 \end{aligned}\right\} \quad F_4 = F \cdot (1+\eta_0) \cdot \eta_0$$

$$\left.\begin{aligned} F_2 &= F(1+\eta_0) \\ F_5 &= F_2 \cdot (1+\eta_0) \end{aligned}\right\} \quad F_5 = F \cdot (1+\eta_0)^2$$

ZADATAK 6 (7)

UŽNICA 2



$$F_4 + F_3 + F_6 = Q$$

$$F_4 > F_6 \quad \Rightarrow F_6 = F_4 \cdot \eta_0$$

$$\left.\begin{aligned} F_4 &= F \cdot (1+\eta_0) \cdot \eta_0 \\ F_6 &= F_4 \cdot \eta_0 \end{aligned}\right\} \quad F_6 = F \cdot (1+\eta_0) \cdot \eta_0^2$$

ZADATAK 6 (7)

$$F_4 = F \cdot (1+\eta_0) \cdot \eta_0 \qquad F_3 = F\,\eta_0 \qquad F_6 = F \cdot (1+\eta_0) \cdot \eta_0^2$$

$$F_4 + F_3 + F_6 = Q \quad \Rightarrow \quad F = \frac{Q}{\eta_0 \left(2 + 2\eta_0 + \eta_0^2\right)}$$

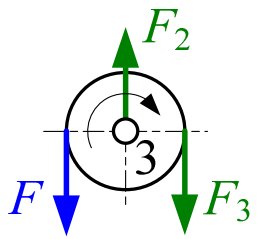
$$\eta_r = \frac{F_{te}}{F} = \frac{\dfrac{Q}{i_{kol}}}{\dfrac{Q}{\eta_0 \left(2 + 2\eta_0 + \eta_0^2\right)}} = \frac{\eta_0 \left(2 + 2\eta_0 + \eta_0^2\right)}{i_{kol}} = 0,9644$$

ZADATAK 6 (8)

SPUŠTANJE TERETA

$$\eta_{\mathrm{k}} = \frac{F_{\mathrm{k}}}{F_{\mathrm{te}}}$$

UŽNICA 3

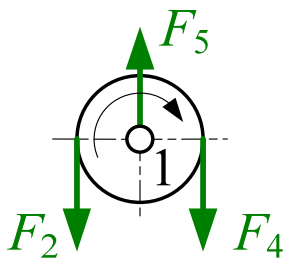


$$\left.\begin{array}{l} F + F_3 = F_2 \\ F_3 > F \quad \Rightarrow \quad F_3 = F/\eta_{0,\mathrm{k}} \end{array}\right\} \quad F_2 = F \cdot \left(1 + 1/\eta_{0,\mathrm{k}}\right)$$

$$\left(\eta_{0,\mathrm{k}} = 2 - \frac{1}{\eta_0}\right)$$

ZADATAK 6 (9)

UŽNICA 1



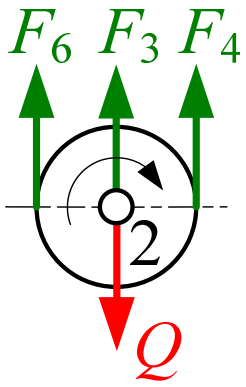
$$\left.\begin{aligned} F_5 &= F_2 + F_4 \\ F_4 &= F_2/\eta_{0,k} \end{aligned}\right\} \quad F_5 = F_2 \cdot \left(1+1/\eta_{0,k}\right)$$

$$\left.\begin{aligned} F_2 &= F \cdot \left(1+1/\eta_{0,k}\right) \\ F_4 &= F_2/\eta_{0,k} \end{aligned}\right\} \quad F_4 = F \cdot \left(1+1/\eta_{0,k}\right)/\eta_{0,k}$$

$$\left.\begin{aligned} F_2 &= F \cdot \left(1+1/\eta_{0,k}\right) \\ F_5 &= F_2 \cdot \left(1+1/\eta_{0,k}\right) \end{aligned}\right\} \quad F_5 = F \cdot \left(1+1/\eta_{0,k}\right)^2$$

ZADATAK 6 (10)

UŽNICA 2



$$F_4 + F_3 + F_6 = Q$$

$$F_6 > F_4 \implies F_6 = F_4 / \eta_{0,k}$$

$$\left.\begin{aligned} F_4 &= F \cdot \left(1 + 1/\eta_{0,k}\right)/\eta_{0,k} \\ F_6 &= F_4/\eta_{0,k} \end{aligned}\right\} \quad F_6 = F\left(1 + 1/\eta_{0,k}\right)/\eta_{0,k}^2$$

ZADATAK 6 (11)

$$F_3 = F/\eta_{0,k} \qquad F_4 = F\cdot\left(1+1/\eta_{0,k}\right)/\eta_{0,k} \qquad F_6 = F\left(1+1/\eta_{0,k}\right)/\eta_{0,k}^2$$

$$F_4 + F_3 + F_6 = Q \quad\Rightarrow\quad F_k = Q\frac{\eta_{0,k}^3}{1+2\eta_{0,k}+2\eta_{0,k}^2}$$

$$\eta_r = \frac{F_{te}}{F_k} = \frac{\frac{Q}{i_{kol}}}{Q\frac{\eta_{0,k}^3}{1+2\eta_{0,k}+2\eta_{0,k}^2}} = \frac{i_{kol}\,\eta_{0,k}^3}{1+2\eta_{0,k}+2\eta_{0,k}^2} = 0,96345$$

ZADATAK 6 (11)

veličinu sile F pri jednolikom dizanju i jednolikom spuštanju tereta.

$$F_{\mathrm{r}} = \frac{Q}{i_{\mathrm{kol}}\,\eta_{\mathrm{r}}} = \frac{Q}{5 \cdot 0,9644} = 0,2074\,Q$$

$$F_{\mathrm{k}} = \frac{Q}{i_{\mathrm{kol}}}\,\eta_{\mathrm{k}} = Q\,\frac{0,96345}{5} = 0,19269\,Q$$

$$F_{\mathrm{te}} = \frac{Q}{i_{\mathrm{kol}}} = \frac{Q}{5} = 0,2 \cdot Q$$

ZADATAK 7 (1)

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?