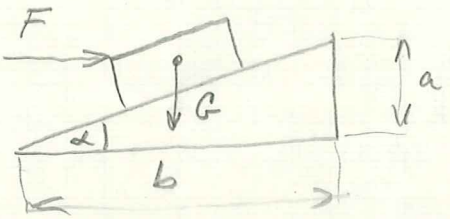
1.131 $\alpha = ?$ $G = 760\,N$ $f_0 = 0{,}22$

$\operatorname{tg}\alpha = f_0 = 0{,}22$

$\alpha = 12{,}4°$

Sélon na G nezávisí

1.132



$f = ?$ $G = 540\,N$

$F = 0$

$a = 74\,mm$

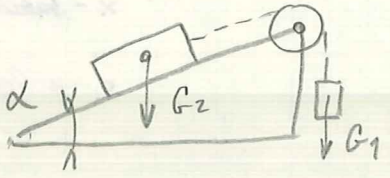
$b = 910\,mm$

$\operatorname{tg}\alpha = \frac{a}{b} = \frac{74}{910} = 0{,}0813$

$\alpha = 4{,}6489°$

$f = 0{,}0813$

1.133

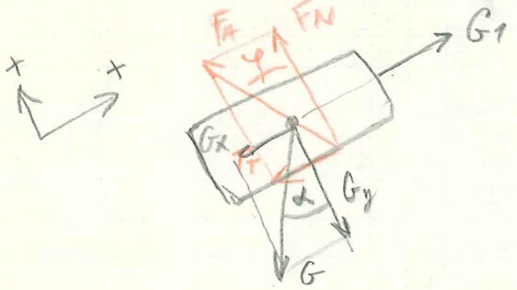


$G_2 = 620\,N$

$G_1 = 185\,N$

a) $\alpha = 32°$; $f = ?$

b) $\alpha = ?$ pro: $f = 0{,}1$ NE!



$G_x = G_2 \sin\alpha = 620 \sin 32° = 328{,}5\,N$

$G_y = G_2 \cos\alpha = 620 \cos 32° = 525{,}8\,N$

$\Sigma F_{ix} = 0 \dots G_1 - G_x - F_T = 0$

$\Sigma F_{iy} = 0 \dots -G_y + F_N = 0$

C.Z. $F_T = f F_N$

$F_N = G_y = 525{,}8\,N$

$F_T = G_1 - G_x = 185 - 328{,}5 = -143{,}2\,N$

$f \cdot F_N = G_1 - G_x$

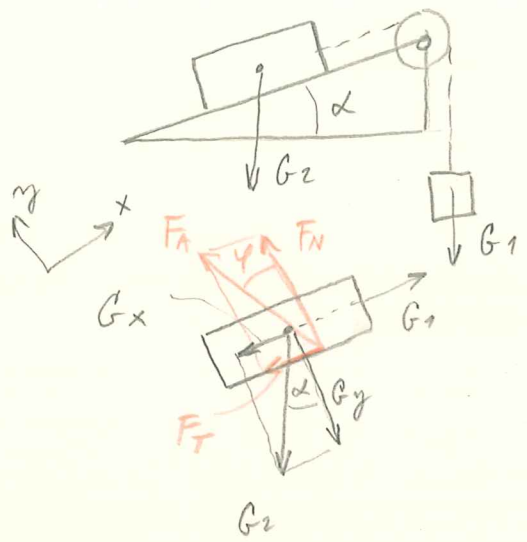
$f = \frac{F_{Tox}}{F_N} = \frac{143{,}2}{525{,}8} = 0{,}272$

1.134

$G_2 = 850\ N \qquad G_1 = ?$

$\alpha = 13°$

$f = 0{,}15$



$G_x = G_2 \sin\alpha = 850 \sin 13° = 191{,}2\ N$

$G_y = G_2 \cos\alpha = 850 \cos 13° = 828{,}2\ N$

$\Sigma F_{ix} = 0 \dots\dots G_1 - G_x - F_T = 0$

$\Sigma F_{iy} = 0 \dots\dots F_N - G_y = 0$

$C.z. \qquad F_T = f F_N$

$F_N = G_y = 828{,}2\ N$

$F_T = f F_N = 0{,}15 \cdot 828{,}2 = 124{,}23\ N$

$G_1 = G_x + F_T = 191{,}2 + 124{,}23 = \underline{315{,}43\ N}$

1.135

obr. 1.134

$G_2 = ?$

$G_1 = 480\ N$

$\alpha = 14°$

$f_0 = 0{,}18$

$G_y = F_N$

$G_x = G_1 - F_T =$

$= G_1 - f F_N = G_1 - f G_y$

$G_2 \sin\alpha = G_1 - f G_2 \cos\alpha$

$G_2 (\sin\alpha + f \cos\alpha) = G_1$

$$G_2 = \frac{G_1}{\sin\alpha + f\cos\alpha} = \frac{480}{\sin 14° + 0{,}18 \cos 14°} =$$

$= \underline{1152{,}3\ N}$

1.138 Plochý závit $D_0 = 36\,mm$ $s = 4\,mm$

Páka $a = 980\,mm$ působí $F = 21{,}6\,N$

$G = ?$ pro zvednutí $f = 0{,}12$

$G_T = ?$ bez tření.

$$\operatorname{tg}\alpha = \frac{s}{\pi D_0} = \frac{4}{\pi \cdot 36}$$

$$\alpha = 2{,}0256°$$

$$\varphi = 6{,}8427°$$

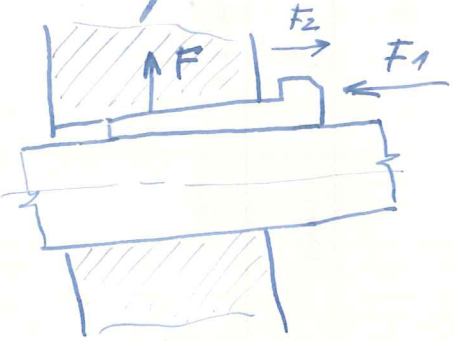
$$F = \frac{G D_0 \operatorname{tg}(\alpha+\varphi)}{2a}$$

$$G = \frac{2aF}{D_0 \operatorname{tg}(\alpha+\varphi)} = \frac{2 \cdot 980 \cdot 21{,}6}{36 \cdot 0{,}156} = \underline{\underline{7141\,N}}$$

$$G_T = \frac{2 \cdot 980 \cdot 21{,}6}{36 \cdot 0{,}0353} = \underline{\underline{31561\,N}}$$

1.139 Nálboj je upevněn klínem 1:100

Jakou silou F_1 klín musíme zarážet do příložek na nálboj silou $F = 1450\,N$. Jaká je síla k vyražení klínu F_2. Souč. tření ocel. $f = 0{,}11$



$G = F$

$F_1 = G\,[f + tg(\alpha + \varphi)]$

$tg\,\varphi = f$ ....

$tg\,\varphi = 0{,}11$ .... $\varphi = 6{,}277°$

$tg\,\alpha = 0{,}01$ .... $\alpha = 0{,}5729°$

$6{,}8499$

$F_1 = G\,[f + tg(\alpha+\varphi)] =$

$= 1450\,[0{,}11\ tg\ 6{,}8499] = 1450\,(0{,}11 + 0{,}120) =$

$= \underline{333{,}5\,N}$

$F_2 = G\,[f + tg(\alpha - \varphi)] = 1450\,[0{,}11 + (0{,}5729 - 6{,}277)$

$= 1450\,(0{,}11 + tg\ -5{,}7041) = 1450\,(0{,}11 - 0{,}09988)$

$= 1450 \cdot 0{,}01012 = \underline{14{,}67\,N}$

$\alpha \leq 2\varphi$ .... $0{,}5729° < 12{,}554°$

1.140

Zarážení klínu

$F = 2$ $\quad F = G$

$F_1 = 260\,N$ $\quad$ úkos 1:80 ; $f = 0{,}12$

$l = 60\,mm$ – délka klínu

$d = 85\,mm$ – průměr čísidela

$D = 780\,mm$ – průměr nálboje

$t = 46\,mm$ – šířka klínu

$\alpha = 0{,}716°$

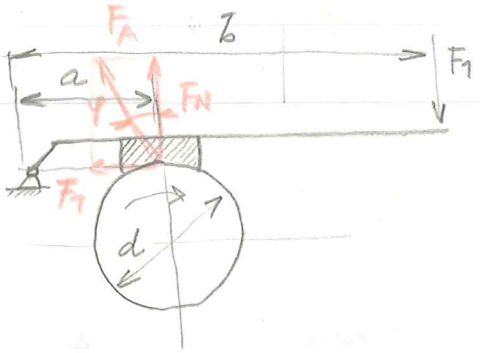
$\varphi = 6{,}842°$

$F_1 = F\,[f + tg(\alpha+\varphi)]$

$F = \dfrac{F_1}{f + tg(\alpha+\varphi)} = \dfrac{260}{0{,}12 + tg\ 7{,}558}$

$= \dfrac{260}{0{,}12 + 0{,}1326} = \underline{1029\,N}$

1.142



$M = 168\ Nm$
$F_1 = 250\ N$
$d = 600\ mm$
$a = 25\ cm$
$b = 140\ cm$
$f = ?$

$\Sigma M = 0 \dots F_T \cdot \frac{d}{2} = M$

$$F_T = \frac{2M}{d} = \frac{2 \cdot 168 \cdot 10^3}{600} = 560\ N$$

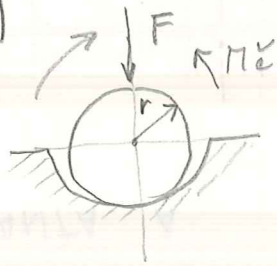
$F_1 \cdot b = F_N \cdot a$

$$F_N = F_1 \frac{b}{a} = 250 \frac{1400}{250} = 1400\ N$$

C. z $\dots F_T = f \cdot F_N$

$$f = \frac{F_T}{F_N} = \frac{560}{1400} = 0{,}4$$

1.143



$d = 36\ mm$
$F = 960\ N$

a) $M_{č0} = ?$
b) $M_č = ?$
c) $M_1 = ?$ potřebný moment pro rozběh čepu
d) $M_2 = ?$ moment pro rovnoměrné otáčení čepu

$f_{č0} = 0{,}1$
$f_č = 0{,}04$

a) $M_{č0} = F r f_{č0} = 960 \cdot \frac{36}{2} \cdot 0{,}1 = 1728\ Nmm$
b) $M_č = F r f_č = 960 \frac{36}{2} \cdot 0{,}04 = 691{,}2\ Nmm$
c) $M_1 = M_{č0} = 1728\ Nmm$
d) $M_2 = M_č = 691{,}2\ Nmm$

$f_č = 0,188$
$f_ō = 0,153$

1.144 Mřížka smýk. tření rad. čepu
a) nezabrknutý
b) zabrknutý
$f = 0,12$ — smykové tření

a) $f_č = 1,6\,f = 1,6 \cdot 0,12 = \underline{0,192}$ — nezabrknutý
b) $f_ō = 1,3\,f = 1,3 \cdot 0,12 = \underline{0,156}$ — zabrknutý

1.145 Ojniční vozík s nákladem $G = 2450\,N$
Mřížka tření jízdního čepu kola $d_{čv} = 12\,mm$ a $f_č = 0,06$

$$G_1 = \frac{G}{4} = \frac{2450}{4} = 612,5\,N$$

$$M_č = G_1 \, r \, f_č = 612,5 \cdot 6 \cdot 0,06 = \underline{220,5\,N}$$

1.146

$G_1 = 1380\,N$
$d = 76$
$D = 160$
$f_č^v = 0,06$

$\Sigma M = 0$ $\quad M_{čv} = F r f_č = (G_1 + G_2)\, r \, f_č$
$M_ō = M$ $\quad M = G_2 \frac{D}{2}$

$$(G_1 + G_2)\, r\, f_č = G_2 \frac{D}{2}$$

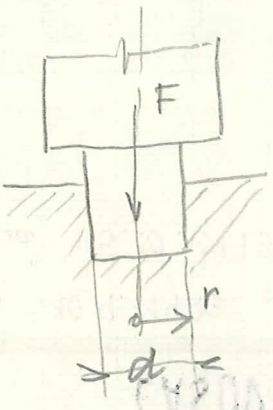
$$G_1 r f_č + G_2 r f_č = G_2 \frac{D}{2}$$

$$G_1 r f_č = G_2 \left(\frac{D}{2} - r f_č\right)$$

$$G_2 = \frac{G_1 r f_č}{\frac{D}{2} - r f_č} = \frac{1380 \cdot 38 \cdot 0,06}{\frac{160}{2} - 38 \cdot 0,06} =$$

$$\underline{G_2 = 40,48\,N}$$

1.147

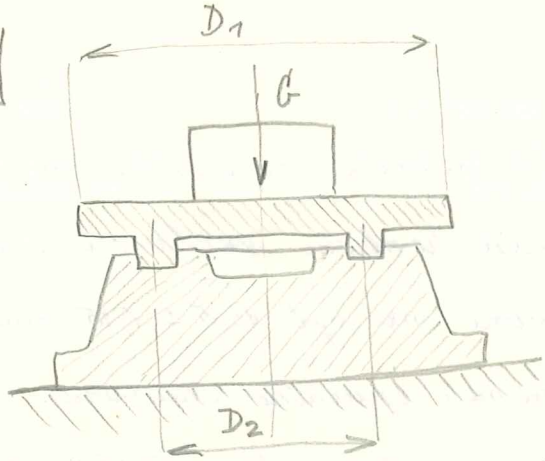


$d = 26\,mm$
$F = 920\,N$
$f = 0,06$
a) $M_č = ?$ nezabrknutý
b) $M_č = ?$ zabrknutý

a) $M_č = \frac{2}{3} F r f = \frac{2}{3} 960 \cdot \frac{26}{2} 0,06 = \underline{449,2\,N_{mm}}$
b) $M_ō = \frac{1}{2} F r f = \frac{1}{2} 960 \cdot \frac{26}{2} 0,06 = \underline{374,4\,N_{mm}}$

1.148 NEPOČÍTAT!

1.149



$D_1 = 5{,}6\,m$

$D_2 = 2{,}5\,m$ – střední průměr

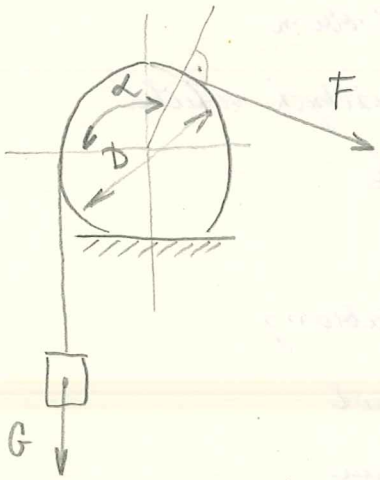
$G = 340\,000\,N$

$f = 0{,}06$

$M_{\check{c}} = ?$

$$M_{\check{c}}^{v} = G\,\frac{D_s}{2}\,f = 340000\,\frac{2{,}5}{2}\,0{,}06 = \underline{25500\,Nm}$$

1.150



$D = 280\,mm$ $\quad \alpha = 210°$

$G = 510\,N$ $\quad f_0 = 0{,}4$

$f = 0{,}25$

a) $F_0 = ?$ aby lůžko bylo nehybné

b) $F_1 = ?$ pro rovnoměrné zvedání

c) $F_2 = ?$ pro rovnoměrné spouštění

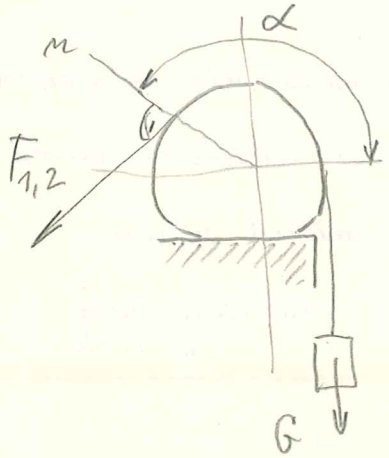
$$\alpha_r = \frac{\pi}{180}\alpha^\circ = \frac{\pi}{180}\cdot 210 = \underline{3{,}665\,rad}$$

a) $F_0 = G / e^{f_0\alpha} = 510 / e^{0{,}4\cdot 3{,}665} = \frac{510}{4{,}3318} = \underline{117{,}73\,N}$

b) $F_1 = G \cdot e^{f\alpha} = 510 \cdot e^{0{,}25\cdot 3{,}665} = 510 \cdot 2{,}4998 = \underline{1274{,}8\,N}$

c) $F_2 = \frac{G}{e^{f\alpha}} = \frac{510}{2{,}4998} = \underline{204\,N}$

1.151



$f = 0{,}3$

$G = 430\,N$

$\alpha = 108°$

$F_1 = ?$ pro zvedání

$F_2 = ?$ pro spouštění

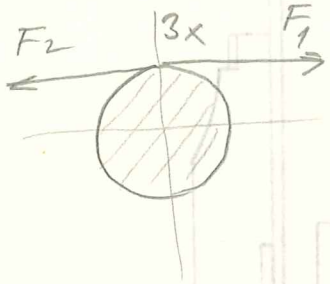
$$\alpha_r = \frac{\pi}{180}\alpha^\circ = \frac{\pi}{180}\cdot 108 = 1{,}885$$

$$F_1 = G\,e^{f\alpha} = 430 \cdot e^{0{,}3\cdot 1{,}885} = 430 \cdot 1{,}76 = \underline{756{,}8\,N}$$

$$F_2 = \frac{G}{e^{f\alpha}} = \frac{460}{1{,}76} = \underline{244\,N}$$

31

1,152



$f_0 = 0,25$

$F_2 = 8400\,N$

$\alpha = 3,360°$

$\alpha_r = 3 \cdot 2\pi = 6\pi$

$$F_1 = \frac{F_2}{e^{f_0 \alpha}} = \frac{8400}{e^{0,25 \cdot 2\pi}} = \frac{8400}{111,3} = \underline{\underline{75,47\,N}}$$

1,153

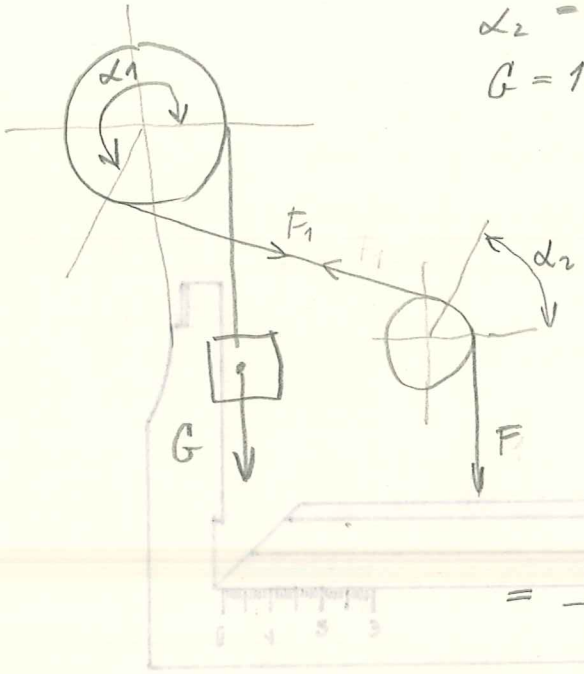
$\alpha_1 = 250°$

$\alpha_2 = 74°$

$G = 1420\,N$

spouštění dřevo-kovový

$f = 0,5$ str. 90 nahoře



$$F_1 = \frac{G}{e^{f\alpha_1}}$$

$$F = \frac{F_1}{e^{f\alpha_2}}$$

$$F = \frac{\frac{G}{e^{f\alpha_1}}}{e^{f\alpha_2}} = \frac{G}{e^{f\alpha_1} \cdot e^{f\alpha_2}} =$$

$$= \frac{G}{e^{f\alpha_1 + f\alpha_2}} = \frac{G}{e^{f(\alpha_1 + \alpha_2)}}$$

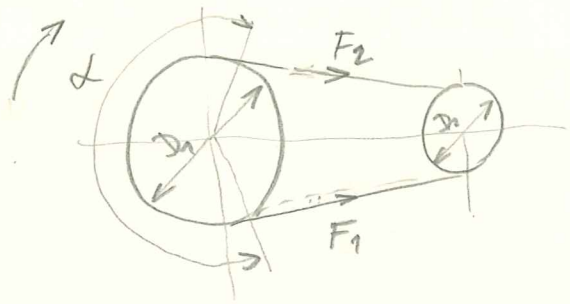
$\alpha = \alpha_1 + \alpha_2 = 250 + 74 = 324°$

$\alpha_r = \frac{\pi}{180} \cdot 324 = 5,654$

$$F = \frac{G}{e^{f\alpha}} = \frac{1420}{e^{0,5 \cdot 5,654}} = \frac{1420}{16,89} = \underline{\underline{84,07\,N}}$$

$f = 0,4$ → $\underline{\underline{147,9\,N}}$

1.154



$f = 0{,}47$ $\quad \alpha = 216°$

$D_1 = 820\ mm$ $\quad F = 310\ N$

$D_2 = 640\ mm$ $\quad$ obvodová síla řemenice

$F_1 = ?$

$F_2 = ?$

$$F_1 = \frac{M_1}{r_1}\,\frac{e^{f\alpha}}{e^{f\alpha}-1} = F\,\frac{e^{f\alpha}}{e^{f\alpha}-1} = 310\,\frac{e^{0{,}47\cdot 3{,}769}}{e^{0{,}47\cdot 3{,}769}-1} =$$

$$= 310\,\frac{5{,}1814}{4{,}1814} = \underline{\underline{373\ N}}$$

$$\alpha_r = \frac{\pi}{180}\cdot\alpha^\circ = \frac{\pi}{180}\cdot 216 = 3{,}769$$

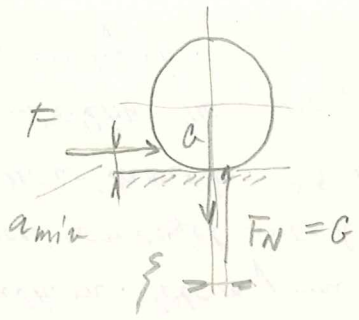
$$F_2 = \frac{F_1}{e^{f\alpha}} = \frac{373}{5{,}1814} = \underline{\underline{63{,}4\ N}}$$

$$\underline{\underline{F_1 - F_2 = F}}$$

1.156 Lifting rules $b = 960\,mm$ $a_{min} = ?$ of reversible sag ξ

$l = 3100\,mm$

$f = 0{,}21$ a tol. $\xi = 1\,mm$



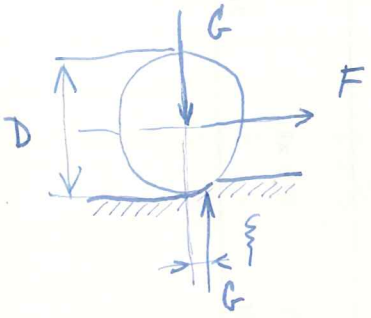
$G \cdot \xi = F_N \cdot a_{min}$ $\quad F = F_T = F_N \cdot f = G \cdot f$

$G \cdot \xi = G \cdot f \cdot a_{min}$

$$a_{min} = \frac{\xi}{f} = \frac{1}{0{,}21} = \underline{\underline{4{,}76\,mm}}$$

1.157 Určit $F = ?$ která udržuje vagon v pohybu o $G = 480\,000\,N$ po ocel. kolejnicích. ϕ kol $D = 560\,mm$. Odporové tření zanedbat.

$\xi = 0{,}5$



$$F \cdot \frac{D}{2} = G \cdot \xi$$

$$F = \frac{2G\xi}{D} = \frac{2 \cdot 480\,000 \cdot 0{,}5}{560}$$

$$F = 857{,}1\,N$$

1.158 Válec na vodorovné podložce $D = 120\,mm$ a $G = 350\,N$ rovnoměrná silou $F = 49\,N$ ve vzdálenosti $a = 43\,mm$ $f = ?$ aj. nevzniklo ani čisté tření

$$G f \cdot a \geq G \xi$$

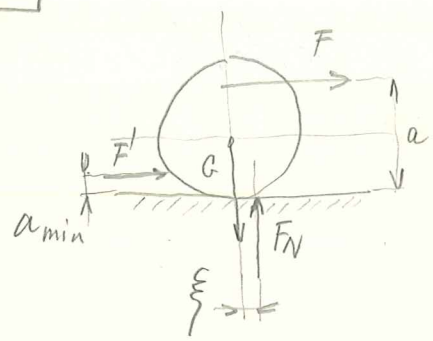
$$f a \geq \xi$$

$$f \geq \frac{\xi}{a} \qquad f \geq 0{,}14$$

$$F = G \cdot f$$

$$f \geq \frac{F}{G} = \frac{49}{350} = 0{,}14$$

1.159 Ocelový válec $D = 780\ mm$ $\xi = 5\ mm$ $a = 510\ mm$
$l = 2{,}5\ m$ $f_0 = 0{,}23$ $\rho = 7850\ kg \cdot m^{-3}$



$a_{min} = ?$
$F = ?$

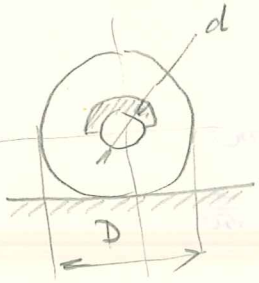
$$a_{min} = \frac{\xi}{f_0} = \frac{5}{0{,}23} = 21{,}74\ mm$$

$$F \cdot a = G \cdot \xi$$

$$F = \frac{G \cdot \xi}{a} = \frac{91993{,}6 \cdot 5}{510} = 901{,}9\ N$$

$$G = \frac{\pi D^2}{4} \cdot l \cdot \rho \cdot g = \frac{\pi \cdot 0{,}78^2}{4} \cdot 2{,}5 \cdot 7850 \cdot 9{,}81 = 91993{,}6\ N$$

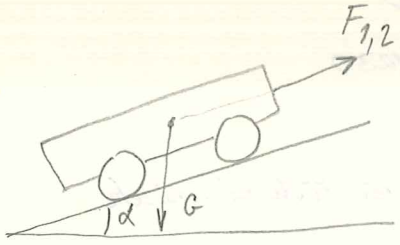
1.160



$f_{tr} = ?$ $d = 20$; $D = 1\ m$; $f_\check{c} = 0{,}07$; $\xi = 1{,}2\ mm$

$$f_{tr} = \frac{\xi + r_\check{c} \cdot f_\check{c}}{R} = \frac{1{,}2 + 10 \cdot 0{,}07}{500} = 0{,}0038$$

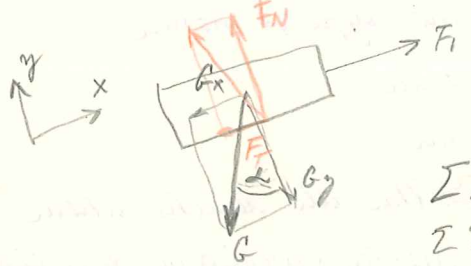
1.161



$F_1 = ?$ pro pohyb nahoru
$F_2 = ?$ pro pohyb dolů

$G = 9700\ N$ $\alpha = 7°$
$D = 0{,}9\ m$ $\xi = 4{,}8\ mm$
$d_\check{c} = 28\ mm$ $f_\check{c} = 0{,}06$

$$f_{tr} = \frac{\xi + r_\check{c} \cdot f_\check{c}}{R} = \frac{4{,}8 + 14 \cdot 0{,}06}{450} = 0{,}0125$$



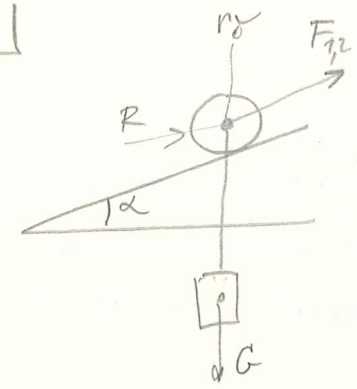
$G_x = G \sin\alpha = 9700 \cdot \sin 7° = 1182\ N$
$G_y = G \cos\alpha = 9700 \cdot \cos 7° = 9627{,}6\ N$

$\Sigma F_{ix} = 0 \dots -G_x - F_T + F_1 = 0$
$\Sigma F_{iy} = 0 \dots -G_y + F_N = 0$
C.Z $F_T = F_N \cdot f_{tr}$

$F_N = G_y = 9627{,}6\ N$
$F_T = F_N \cdot f_{tr} = 9627{,}6 \cdot 0{,}0125 = 120{,}34\ N$
$F_1 = G_x + F_T = 1182 + 120{,}34 = 1302{,}34\ N$

$F_2 = G_x - F_T = 1182 - 120{,}34 = 1061{,}66\ N$

1.162



$G = 6800\,N$
$\alpha = 28°$
$r_\sigma^v = 10\,mm$
$f_\sigma = 0{,}03$
$R = 130\,mm$

$F_1 = ?$ – zvedání
$F_2 = ?$ – spouštění

ocel $\xi = 0{,}5$

$$f_{tr} = \frac{\xi + r_\sigma^v f_\sigma}{R} = \frac{0{,}5 + 10 \cdot 0{,}03}{130} = 0{,}006$$

$$G_x = G \cdot \sin\alpha = 6800 \cdot \sin 28° = 3192{,}4\,N$$
$$G_y = G \cos\alpha = 6800 \cdot \cos 28° = 6004\,N$$

$$F_T = G_y f_{tr} = 6004 \cdot 0{,}006 = 36{,}024\,N$$

$$F_1 = G_x + F_T = 3192{,}4 + 36{,}024 = \underline{3228{,}4\,N} \text{ – zvedání}$$

$$F_2 = G_x - F_T = 3192{,}4 - 36{,}024 = \underline{3155{,}9\,N} \text{ – spouštění}$$

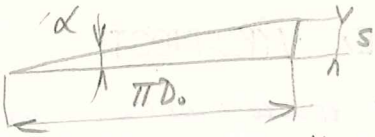
1.163 účinnost šroubu zvedáku $f = 0{,}12$

a) $D_0 = 75\,mm$; $S = 14\,mm$

b) $D_0 = 52\,mm$; $S = 8\,mm$

$f = \operatorname{tg}\varphi \rightarrow \varphi = 6{,}843°$

a) $$\eta = \frac{\operatorname{tg}\alpha}{\operatorname{tg}(\alpha + \varphi)}$$



$$\operatorname{tg}\alpha = \frac{S}{\pi D_0} = \frac{14}{\pi \cdot 75} = 0{,}0594$$

$$\alpha = 3{,}4°$$

$$\eta = \frac{0{,}0594}{\operatorname{tg}(3{,}4 + 6{,}843)} = \underline{0{,}3287}$$

b) $$\operatorname{tg}\alpha = \frac{S}{\pi D_0} = \frac{8}{\pi \cdot 52} = 0{,}0489 \rightarrow \alpha = 2{,}8035°$$

$$\eta = \frac{0{,}0489}{\operatorname{tg}(2{,}8035 + 6{,}843)} = \underline{0{,}2876}$$

1.164 $F_1 = ?$ zředění; $\eta = 0{,}93$; $G = 186\ N$; $F_2 = ?$ sproštění

$$F_1 = \frac{G}{\eta} = \frac{186}{0{,}93} = 200\ N \quad \text{zředění}$$

$$F_2 = G\eta = 186 \cdot 0{,}93 = 172{,}9\ N$$

1.165 $G = ?$ Pevná kladka $F_1 = 520\ N$; $\eta = 0{,}87$

$F_2 = ?$ sproštění

$$F_1 = \frac{G}{\eta} \longrightarrow G = F_1 \cdot \eta = 520 \cdot 0{,}87 = 452{,}4\ N$$

$$F_2 = G \cdot \eta = F_1 \cdot \eta \cdot \eta = F_1 \cdot \eta^2 = 520 \cdot 0{,}87^2 = 393{,}5\ N$$

1.166 $\eta_c = 0{,}94$ – volná kladka

$\eta = ?$ – pevná kladka

$$\eta_i = \frac{1+\eta}{2} \longrightarrow 2\eta_i = 1 + \eta$$

$$\eta = 2\eta_i - 1 = 2 \cdot 0{,}94 - 1 = 0{,}88$$

1.167 $F_1 = 261\ N$ zředění; $G = ?$

$F_2 = 219\ N$ sproštění; $\eta = ?$

$$F_1 = \frac{G}{2}\frac{1}{\eta} \quad ; \quad F_2 = \frac{G}{2}\eta$$

$$G = 2F_1\eta \qquad G = 2F_2 \cdot \frac{1}{\eta}$$

$$2F_1\eta = 2F_2\frac{1}{\eta}$$

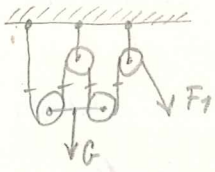
$$\eta^2 = \frac{F_2}{F_1}$$

$$\eta = \sqrt{\frac{F_2}{F_1}} = \sqrt{\frac{219}{261}} = 0{,}916 \doteq 0{,}92$$

$$G = 2F_1\eta = 2 \cdot 261 \cdot 0{,}92 = 480{,}24\ N$$

1.168 $G = ?$ $n = 4$ kladky zvedání ; $\eta_c = 0{,}82$

$F_1 = 260\,N$; $F_2 = ?$



$G = n \cdot F_1 \cdot \eta_c = 4 \cdot 260 \cdot 0{,}82 = \underline{\underline{852{,}8\,N}}$

$F_2 = \frac{G}{n} \cdot \eta_c = \frac{852{,}8}{4} \cdot 0{,}82 = \underline{174{,}8\,N}$

1.169 $n = ?$ jednoduchý kladkový $\eta_c = 0{,}85$ zvedání $G = 7600\,N$

je $F_1 = 1120\,N$

$F_1 \cdot \eta = \frac{G}{n} \longrightarrow n = \frac{G}{F_1 \eta} = \frac{7600}{1120 \cdot 0{,}85} = 7{,}983 = \underline{\underline{8 \text{ kladek}}}$

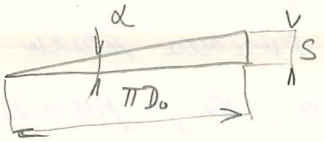
1.170 NEPOSÍTAT

1.171 samosvornost šroubu

$\alpha \leq \varphi$

$f = 0{,}1$

a) $s = 10\,mm$; $D_0 = 65\,mm$
b) $s = 18\,mm$; $D_0 = 51\,mm$
c) $s = 6\,mm$; $D_0 = 38\,mm$
d) $s = 15\,mm$; $D_0 = 47\,mm$



$tg\,\varphi = f = 0{,}1 \dots \underline{\underline{\varphi = 5{,}71°}}$

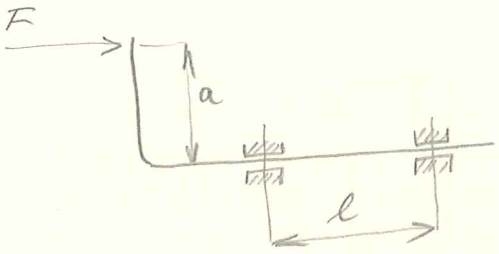
a) $tg\,\alpha = \frac{s}{\pi D_0} = \frac{10}{\pi \cdot 65} = 0{,}0489 \dots \alpha = 2{,}8°$ samosvorný

b) $tg\,\alpha = \frac{18}{\pi \cdot 51} = 0{,}1123 \dots \alpha = 6{,}4°$ není samosvorný

c) $tg\,\alpha = \frac{6}{\pi \cdot 38} = 0{,}0329 \dots \alpha = 1{,}88°$ samosvorný

d) $tg\,\alpha = \frac{15}{\pi \cdot 48} = 0{,}0994 \dots \alpha = 5{,}68°$ samosvorný

1.175



$F = 250\,N$

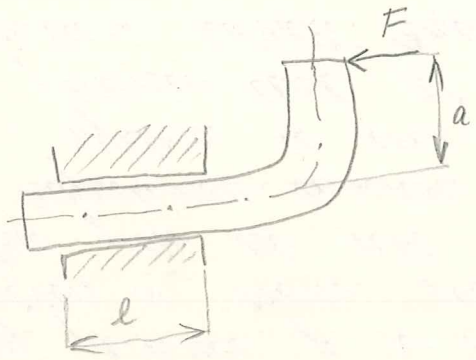
$l = 680\,mm$

$f_0 = 0{,}18$ $\quad a = ?$

$l \leq 2af$

$a \leq \frac{l}{2f} = \frac{680}{2 \cdot 0{,}18} = 1888{,}\overline{8}\,mm$

1.176



F

$a = 980\,mm$

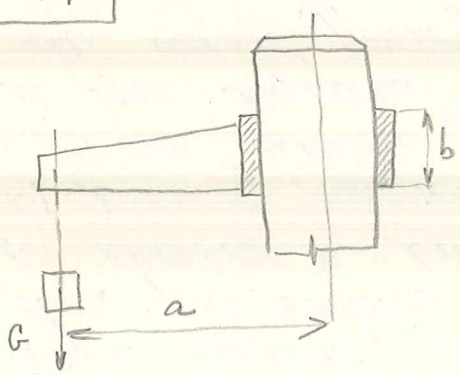
$l = 820\,mm$

$f_0 = ?$

$l = 2af$

$f_0 \leq \frac{l}{2a} = \frac{820}{2 \cdot 980} = 0{,}418$

1.177



$G = 4710\,N$

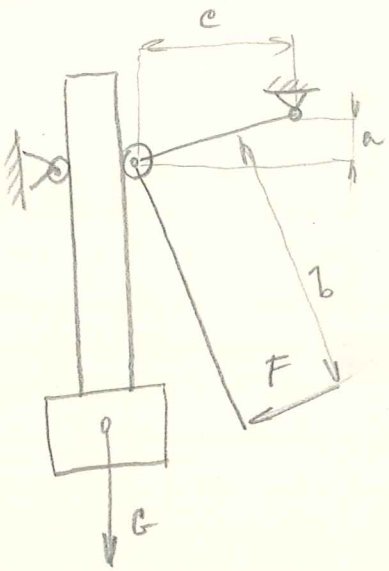
$b = 25\,mm$

$f_0 = 0{,}12$ $\quad$ Musí nastat vzpříčení

$b = 2af_0$

$a \geq \frac{b}{2f_0} = \frac{25}{2 \cdot 0{,}12} \doteq 104{,}2\,mm$

1.178)



$F = ?$

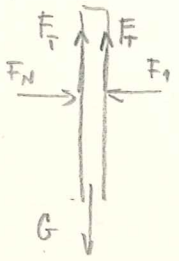
$G = 1650\,N$

$f = 0{,}46$

$a = 240\,mm$

$b = 2600\,mm$

$c = 50\,cm$



$\Sigma F_{ix} = 0 \dots -F_1 + F_N = 0$

$\Sigma F_{iy} = 0 \dots 2F_T - G = 0$

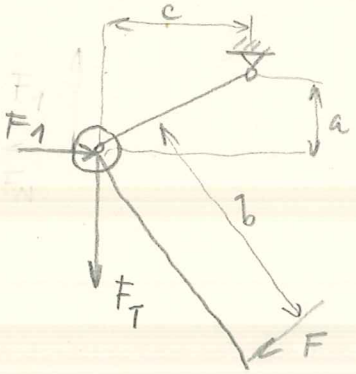
č.ž $\quad F_T = F_N \cdot f$

$F_N = F_1$

$F_T = \frac{G}{2}$

$F_N = \frac{F_T}{f} = \frac{G}{2f} = F_1$

$F_1 = \frac{G}{2f} = \frac{1650}{2 \cdot 0{,}46} = 1793{,}5\,N$



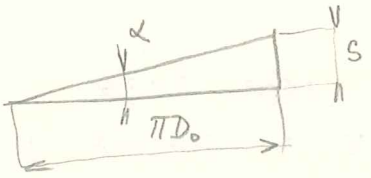
$\Sigma M = 0$

$F \cdot b - F_T \cdot c - F_1 \cdot a = 0$

$F = \frac{F_T \cdot c + F_1 \cdot a}{b} = \frac{\frac{G}{2} \cdot c + \frac{G}{2f} \cdot a}{b} = \frac{\frac{1650}{2} \cdot 500 + \frac{1650}{2 \cdot 0{,}46} \cdot 240}{260}$

$= 324{,}2\,N$

1.172



$G = 2600\,N$ $\quad \alpha = \varphi$

$a = 720\,mm$ $\quad F_2 = ?$ pro prodlení

$F = 25{,}3\,N$ $\quad \eta = ?$

$f = 0{,}1$

$F \cdot a = G\,tg(\alpha+\varphi)\cdot\frac{D_0}{2}$

$tg\varphi = f = 0{,}1$

$\varphi = 5{,}71°$

$D_0 = \frac{2 \cdot Fa}{G\,tg\,2\varphi} = \frac{2 \cdot 25{,}3 \cdot 720}{2600\,tg\,11{,}42°}$

$= 69{,}36 \doteq \underline{70\,mm}$

$s = \pi D_0\,tg\alpha = \pi \cdot 70 \cdot 0{,}1 = 21{,}99 \doteq \underline{22\,mm}$

$F_2 = G\,tg(\alpha-\varphi) = 0$

$\eta = \frac{tg\alpha}{tg(\alpha+\varphi)} = \frac{0{,}1}{tg\,11{,}42°} = 0{,}495 \dots \underline{\eta = 50\%}$

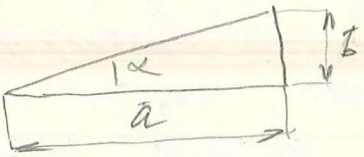
1.173 samosvorný klín

$\underline{\alpha \leq 2\varphi}$ samosv. klínu

$f = 0{,}1$

a) … $\alpha = 15°$

b) … $a = 130\,mm$; $b = 24\,mm$



$tg\varphi = 0{,}1 = f \dots \varphi = 5{,}71°$

a) $\alpha > 2\varphi$ … není samosvorný

b) $tg\alpha = \frac{b}{a} = \frac{24}{130} = 0{,}1846 \dots \alpha = 10{,}45°$

$\alpha < 2\varphi$ … samosvorný

1.174

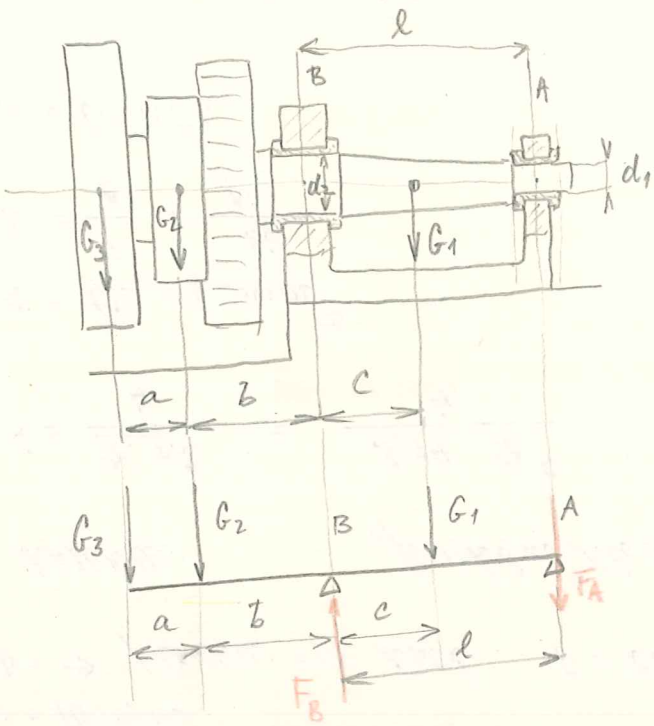
$\alpha = ?$

$f = 0{,}23$

$tg\varphi = f = 0{,}23 \dots \varphi = 12{,}95°$

$\alpha = 2\varphi = 2 \cdot 12{,}95° \doteq \underline{26°}$

1.179



$G_1 = 12500\,N$ $\quad M = ?$ (naprázdno)

$G_2 = 52000\,N$

$G_3 = 98000\,N$

$f_č = 0{,}08$ $\quad a = 380\,mm$

$d_1 = 280\,mm$ $\quad b = 750\,mm$

$d_2 = 460\,mm$ $\quad c = 520\,mm$ $\quad l = 2300\,mm$

$\Sigma F_{ix} = 0 \dots\dots 0$

$\Sigma F_{iy} = 0 \dots G_3 + G_2 - F_B + G_1 + F_A = 0$

$\Sigma M_{iA} = 0 \dots G_3(a+b+l) + G_2(b+l) - F_B l + G_1(l-c) = 0$

$$F_B = \frac{G_3(a+b+l) + G_2(b+l) + G_1(l-c)}{l} =$$

$$= \frac{98(380+750+2300) + 52(750+2300) + 12{,}5(2300-520)}{2300} =$$

$$= \frac{336140 + 158600 + 22250}{2300} = 224{,}7786\,kN = \underline{224778\,N}$$

$$F_A = F_B - G_3 - G_2 - G_1 = 224778 - 98000 - 52000 - 12500 = \underline{62278\,N}$$

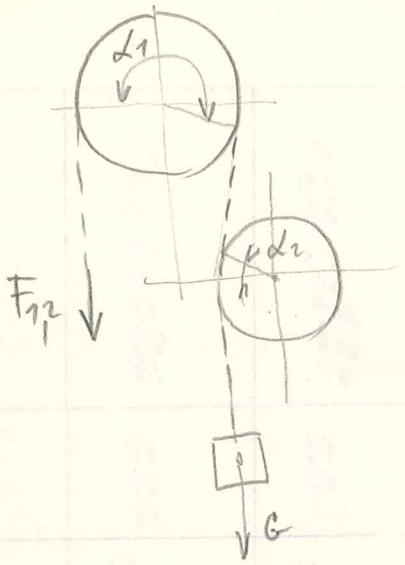
$M_{čA} = F_A \cdot r_{čA} f_č = 62278 \cdot 140 \cdot 0{,}08 = 697513{,}6\,Nmm$

$M_{čB} = F_B \cdot r_{čB} f_č = 224778 \cdot 230 \cdot 0{,}08 = 4135915{,}2\,Nmm$

$M_č = M_{čA} + M_{čB} = 697513{,}6 + 4135915{,}2 = 4833428{,}8\,Nmm$

$= \underline{4833{,}43\,Nm}$

1.180



$G = 530\,N$ $\quad F_1 = ?$ $\quad$ zvedání

$\alpha_1 = 214°$ $\quad F_2 = ?$ $\quad$ povolování

$\alpha_2 = 38°$

$f = 0{,}4$

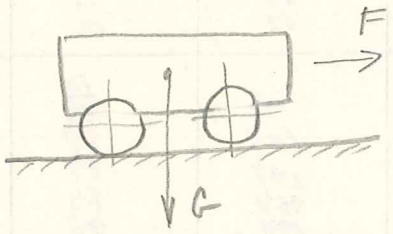
$F_1 = G \cdot e^{f\alpha} =$ $\quad \alpha = \alpha_1 + \alpha_2 = 214 + 38 = 252°$

$= 530 \cdot e^{99{,}44} =$ $\quad \alpha_r = \frac{\pi}{180} \cdot \alpha° \doteq 4{,}4\,rad$

$= 530 \cdot 5{,}812 = \underline{3080\,N}$

$F_2 = \frac{G}{e^{f\alpha}} = \frac{530}{5{,}812} = \underline{91{,}19\,N}$

1.181



$G = 870\,N$ $\quad F = ?$

$D = 1300\,mm$

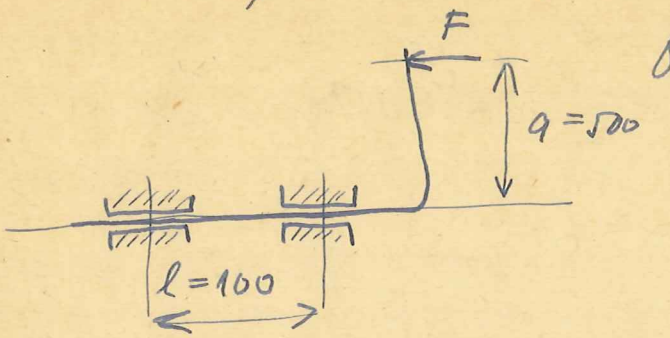
$d = 20\,mm$

$f_0 = 0{,}04$ $\quad \xi = 13\,mm$

$f_{tr} = \frac{\xi + r_c \cdot f_0}{R} = \frac{13 + 10 \cdot 0{,}04}{650} = 0{,}0206$

$F = G \cdot f_{tr} = 870 \cdot 0{,}0206 = \underline{17{,}92\,N}$

6) Nastane vzpříčení páky podle obrázku



$f = 0{,}1$ $F = 100\,N$

$l \geq 2fa$

$100 \geq 2 \cdot 0{,}1 \cdot 500$

$100 = 100$ — hranice povolená

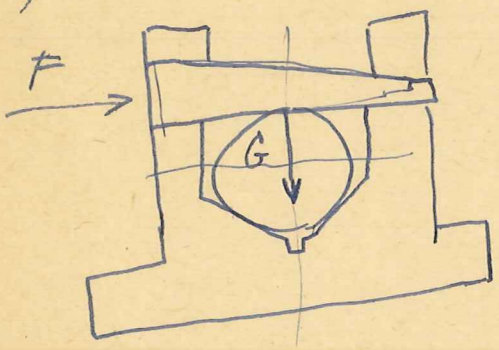
Vzpříčení může nastat

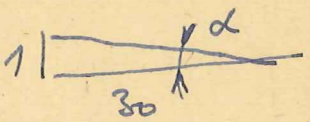
---

7) Mýtnání pomáhá klínem --- $G = 2000\,N$

$F = ?$ $f = 0{,}1$

klín 1:30





$F = G\left[f + tg(\alpha+\varphi)\right] = 2000\left[0{,}1 + tg(1{,}909+5{,}71)\right] =$

$tg\alpha = \frac{1}{30}$ $tg\varphi = f$ $= 2000\,(0{,}1 + 0{,}1337) =$

$\alpha = 1{,}909°$ $\varphi = 5{,}71°$ $= \underline{467{,}4\,N}$

---

8) Tření na šroubu — plocha závitu — Jak velké břemeno $m = ?$ musíme svedat silou $F = 300\,N$

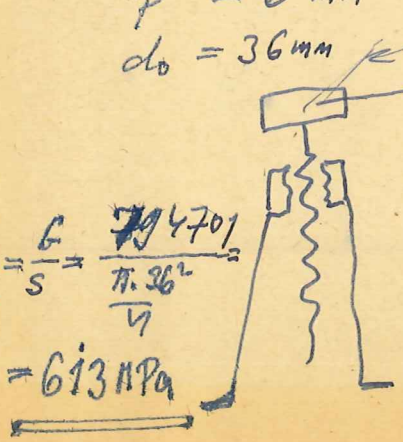
$d_2 = 38\,mm$

$p = 6\,mm$

$d_0 = 36\,mm$

$f = 0{,}1$

$a = 200\,mm$



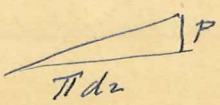
$F \cdot a = G\,tg(\alpha+\varphi) \cdot \frac{d_2}{2}$

$G = \frac{2Fa}{tg(\alpha+\varphi)} = \frac{2 \cdot 300 \cdot 200}{tg\,8{,}587} =$ ($tg\,8{,}587 = 0{,}151$)

$= \underline{794701\,N}$

$\sigma_d = \frac{G}{S} = \frac{794701}{\frac{\pi \cdot 36^2}{4}} =$

$= 613\,MPa$



$tg\alpha = \frac{p}{\pi d_2} = 0{,}05026$

$\alpha = 2{,}877°$ $\varphi = 5{,}71°$

$m = \frac{G}{g} = 81009\,kg$

$\underline{m = 81\,t}$

$\Sigma F_x = 0$

$-F_{1x} + F_{2x} + F_{3x} = 0$

$F_{3x} = F_{1x} - F_{2x} = 289,6 - 112,1 = \underline{177,5\ N}$

$F_{3x} = F_3 \cos\gamma'$

$\cos\gamma' = \frac{F_{3x}}{F_3} = \frac{177,5}{329} = 0,5395$

$\gamma' = 57,34°$

$\underline{\gamma} = 90 - \gamma' = 90 - 57,34 = \underline{32,65°}$

$\Sigma F_y = 0$

$+F - F_{1y} - F_{2y} - F_{3y} = 0$

$F = F_{1y} + F_{2y} + F_{3y} =$

$= 429,4 + 264,1 + 276,9 = \underline{970,4\ N}$

$F_{3y} = F_3 \sin\gamma' =$

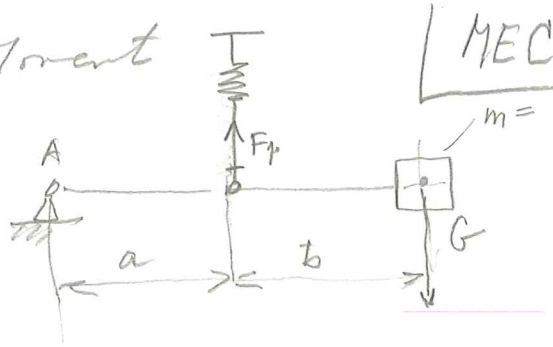
$= 329 \sin 57,34 =$

$= 276,9\ N$

③ Moment

MEC1

A)



Rovnováha

$\Sigma M_i = 0$

$m = 50\,kg$

$a = 150\,mm$

$b = 250\,mm$

$F_p = ?$

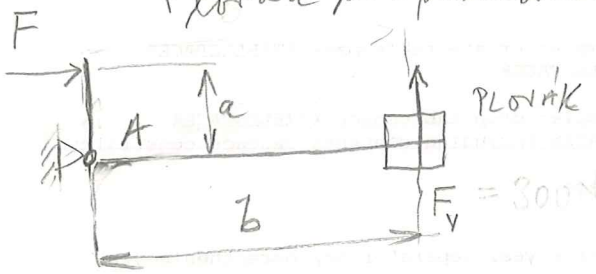
$G = mg = 50 \cdot 9{,}81 = 490{,}5\,N$

$G \cdot (a+b) - F_p \cdot a = 0$

$F_p = G \frac{a+b}{a} = 490{,}5 \frac{150+250}{150} = 1307{,}9\,N$

Plovák v splavenině

B)



$F_V = 300\,N$

$a = 100\,mm$

$b = 300\,mm$

$F = ?$

Rtuť $\frac{4}{3}\pi R^3$

$\Sigma M_i = 0$

$F \cdot a - F_V \cdot b = 0$

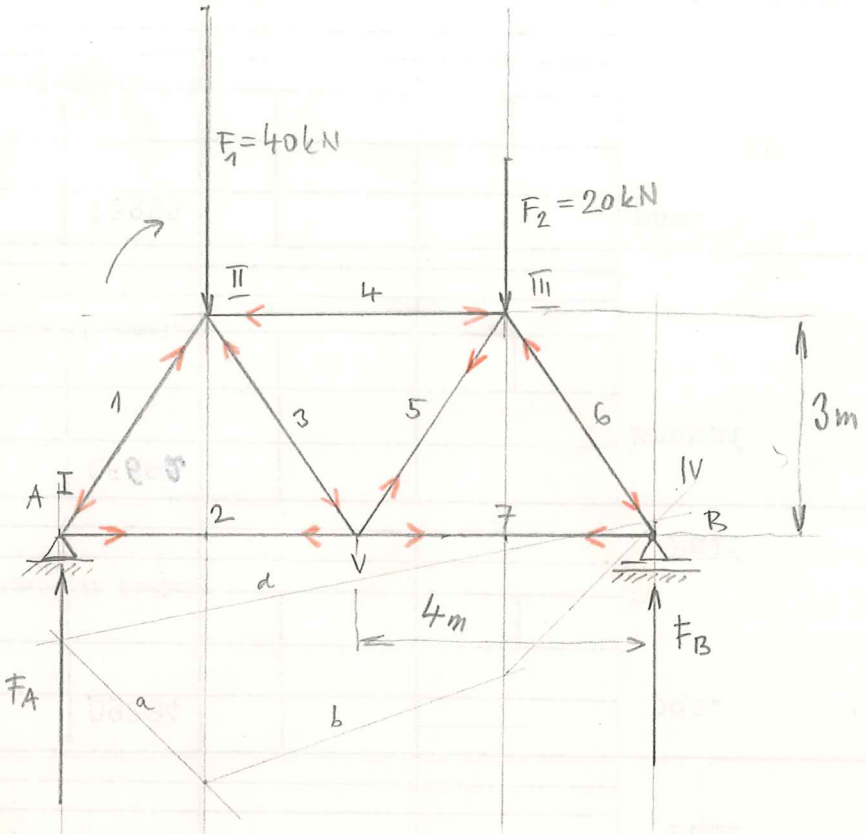
$F = F_V \frac{b}{a} = 300 \frac{300}{100} = 900\,N$

↻

Bv

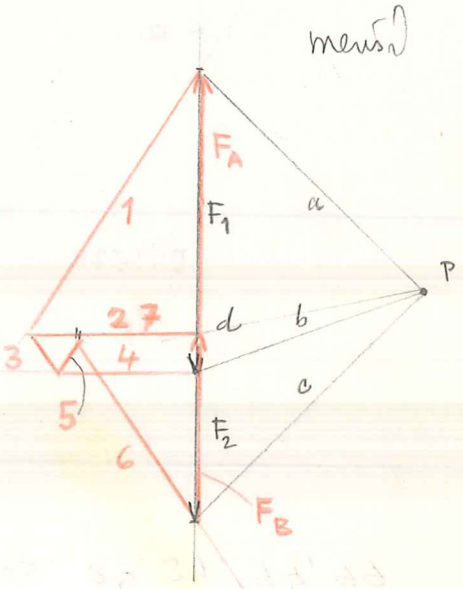
η_1 5 6 24

3B)



m_F ... 1 mm = 1000 N

m_L ... 1 mm = 100 mm



$R_A = 35\,kN$

$R_B = 25\,kN$

$S_1 = -42\,kN$

$S_2 = +22\,kN$

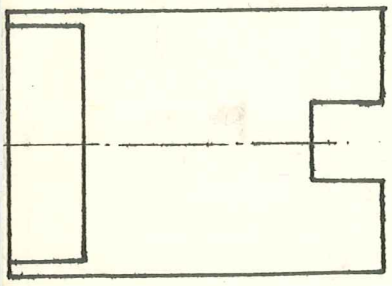
$S_3 = -7\,kN$

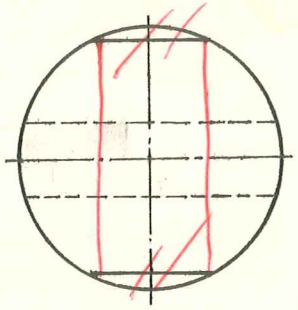
$S_4 = -13{,}5\,kN$

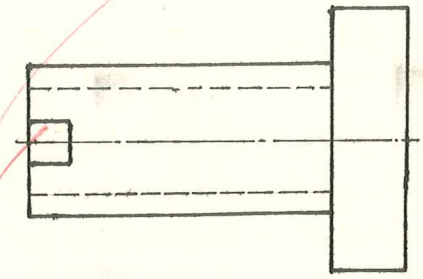
$S_5 = +7\,kN$

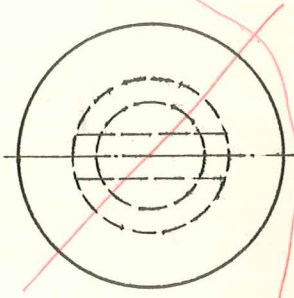
$S_6 = -29\,kN$

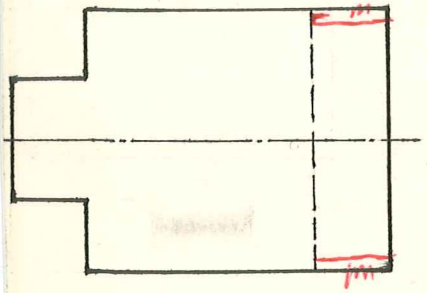
$S_7 = +16\,kN$

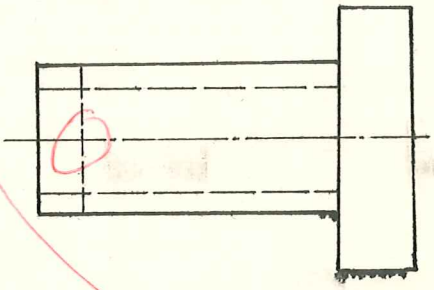


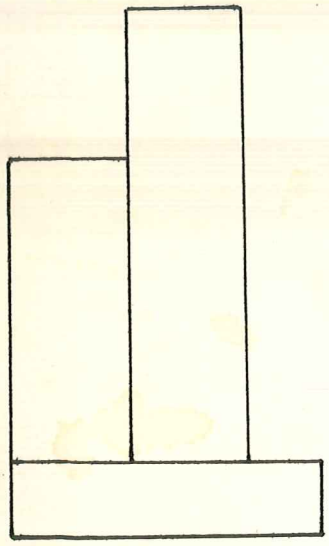


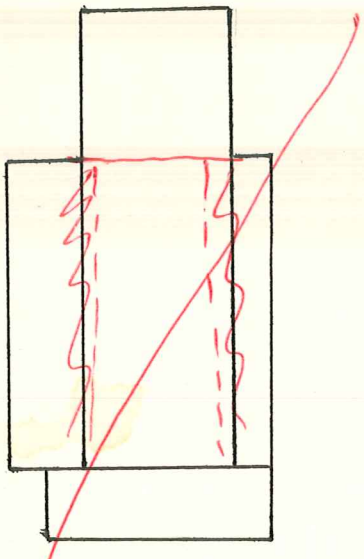


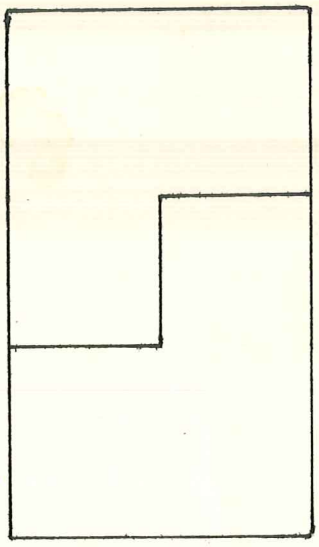


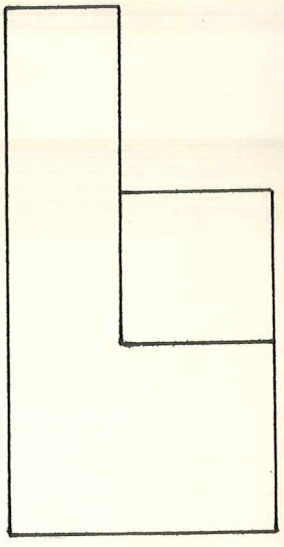


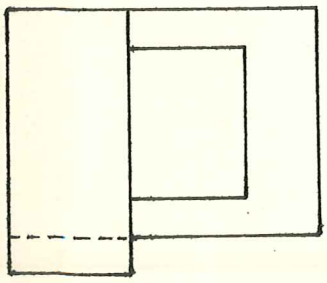


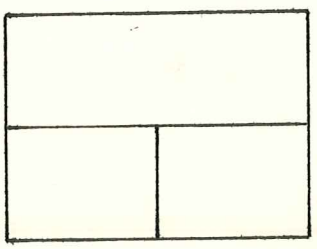






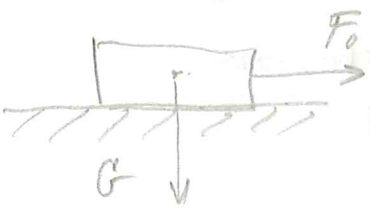






2.G	ZOBRAZOVÁNÍ II	KOTRLA D.

1) Posunem jsme zjistili sílu $F_0 = 122,6\ N$ z klidu
$m = 50\ kg$ $F = 105\ N$ při pohybu



$$F_0 = f_0 F_N = f_0\, m \cdot g$$

$$f_0 = \frac{F_0}{mg} = \frac{122,6}{50 \cdot 9,81} = \underline{0,249}$$

$$f = \frac{F}{mg} = \frac{105}{50 \cdot 9,81} = \underline{0,214}$$

2

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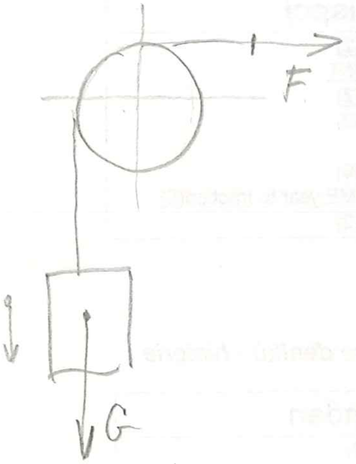
2) $1\frac{1}{4}$ obtočení vlákna ; $f = 0,15$

$m = 200\ kg$ $F = ?$



$$\alpha = 360 + 90 = 450^\circ$$

$$\alpha_r = \frac{\pi}{180} \cdot \alpha^\circ = \frac{\pi}{180} \cdot 450 = 7,853\ rad.$$

$$F = \frac{G}{e^{f\alpha}} = \frac{mg}{e^{f\alpha}} = \frac{200 \cdot 9,81}{e^{0,15 \cdot 7,853}} = \frac{1962}{3,247} = \underline{604,2\ N}$$

1,17795

3

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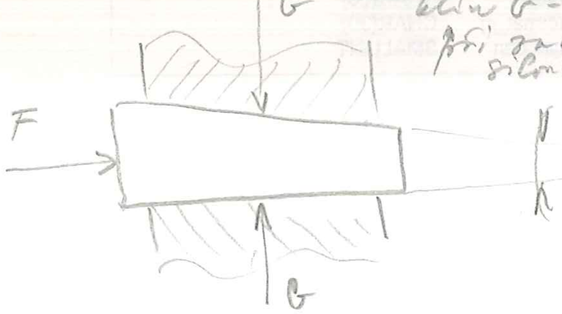
3) Jakou sílu vyvine klín G=? při zaražení silou F



$\alpha = 5^\circ$
$f = 0,1$
$F = 1000\ N$

$$F = G\left[f + tg(\alpha + \varphi)\right]$$

$$G = \frac{F}{f + tg(\alpha + \varphi)} = \frac{1000}{0,1 + tg(5 + 5,71)} = \underline{3460\ N}$$

ok

0,189

0,289

4

$tg\ \varphi = 0,1$
$\varphi = 5,71^\circ$

Jak velký musí být úhel α, aby se síla $\underline{G = 4F = 4000\ N}$

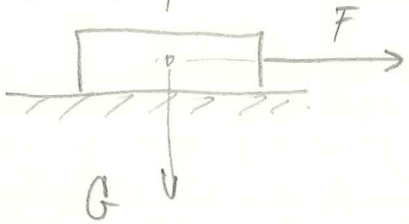
$$tg(\alpha + \varphi) = \frac{F}{G} - f = \frac{1000}{4000} - 0,1 = 0,15$$

$$\alpha + \varphi = 8,53^\circ \Longrightarrow \alpha = 8,53 - \varphi = 8,53 - 5,71 = \underline{2,82^\circ}$$

1) $G = 1000\,N$ $f_0 = 0{,}15$ $f = 0{,}12$ (A)

$F_0 = ?$ pro počátek pohybu

$F = ?$ pro udržení pohybu



$F_N = G$

$F_0 = f_0 F_N = 0{,}16 \cdot 1000 = \underline{160\,N}$

$F = f F_N = 0{,}12 \cdot 1000 = \underline{120\,N}$

2

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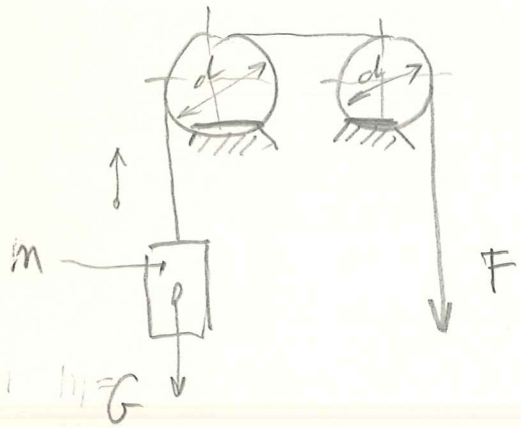
2) Vlastní břemeno $F = ?$ $d = 50\,mm$

$m = 50\,kg$

$f = 0{,}2$



$G = m \cdot g = 50 \cdot 9{,}81 = 490{,}5\,N$

$\alpha = 90° + 90° = 180°$

$\alpha_r = \frac{\pi}{180} \cdot \alpha = \frac{\pi}{180} \cdot 180 = \pi$

$F = G\, e^{f\alpha} = 490{,}5 \cdot e^{0{,}2 \cdot \pi} = 490{,}5 \cdot 1{,}874$

$= \underline{919{,}19\,N}$

3

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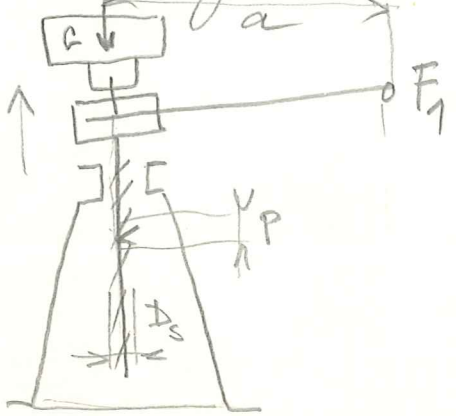
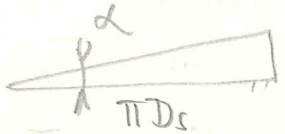
3) Šroubový závdavek - zvedání



$D_s = 40\,mm$; $P = 4\,mm$

$f = 0{,}1$; $a = 500\,mm$

$G = 6000\,N$



$tg\alpha = \frac{P}{\pi D_s} = \frac{4}{\pi \cdot 40} = 0{,}0318$

$\alpha = 1{,}823°$

4

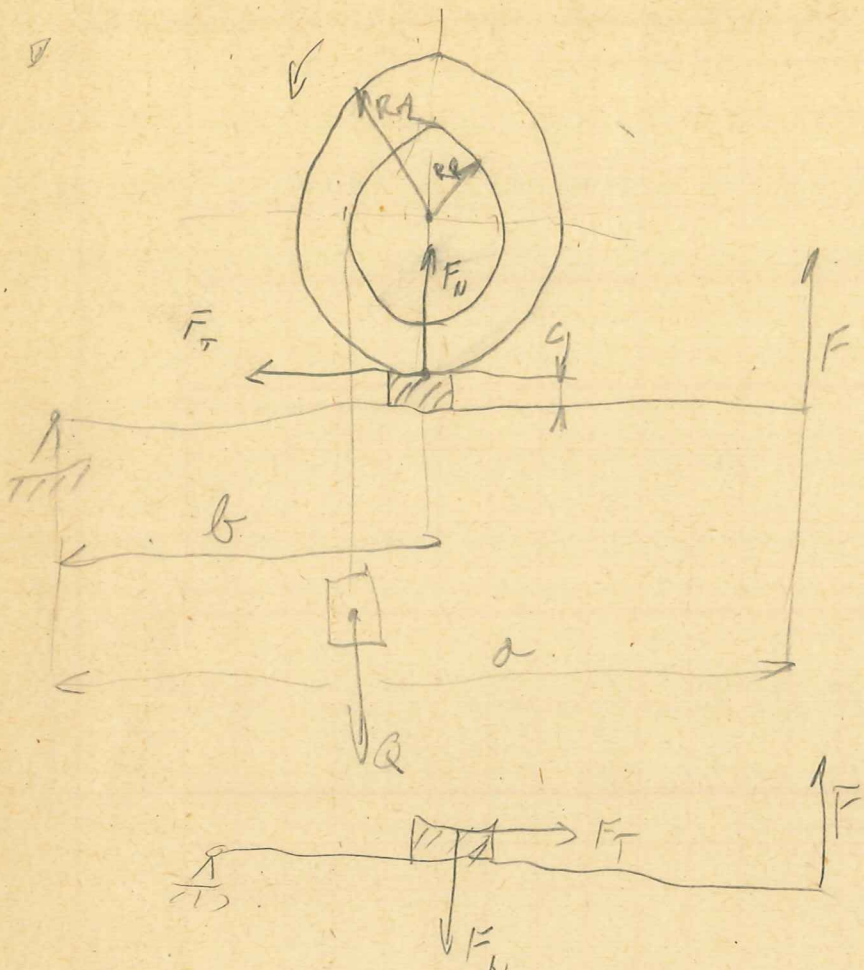
$tg\varphi = f = 0{,}1$

$\varphi = 5{,}71°$

$F = G \cdot tg(\alpha + \varphi) = 6000\, tg(1{,}823 + 5{,}71) = 6000 \cdot 0{,}1322 = \underline{793{,}4\,N}$

$F_1 \cdot a = F \cdot \frac{D_s}{2} \Rightarrow F_1 = F \frac{D_s}{2 \cdot a} = 793{,}4 \cdot \frac{40}{2 \cdot 500} = \underline{31{,}73\,N}$

KŘIVSKÝ



$F = 100\,N$

$Q = 150\,N$

$R_1 = 600\,mm$

$R_2 = 100\,mm$

$a = 1000\,mm$

$b = 90\,mm$

$c = 100\,mm$

$\Sigma M_1 = 0$

$F_N \cdot b + F_T \cdot c - F \cdot a = 0$

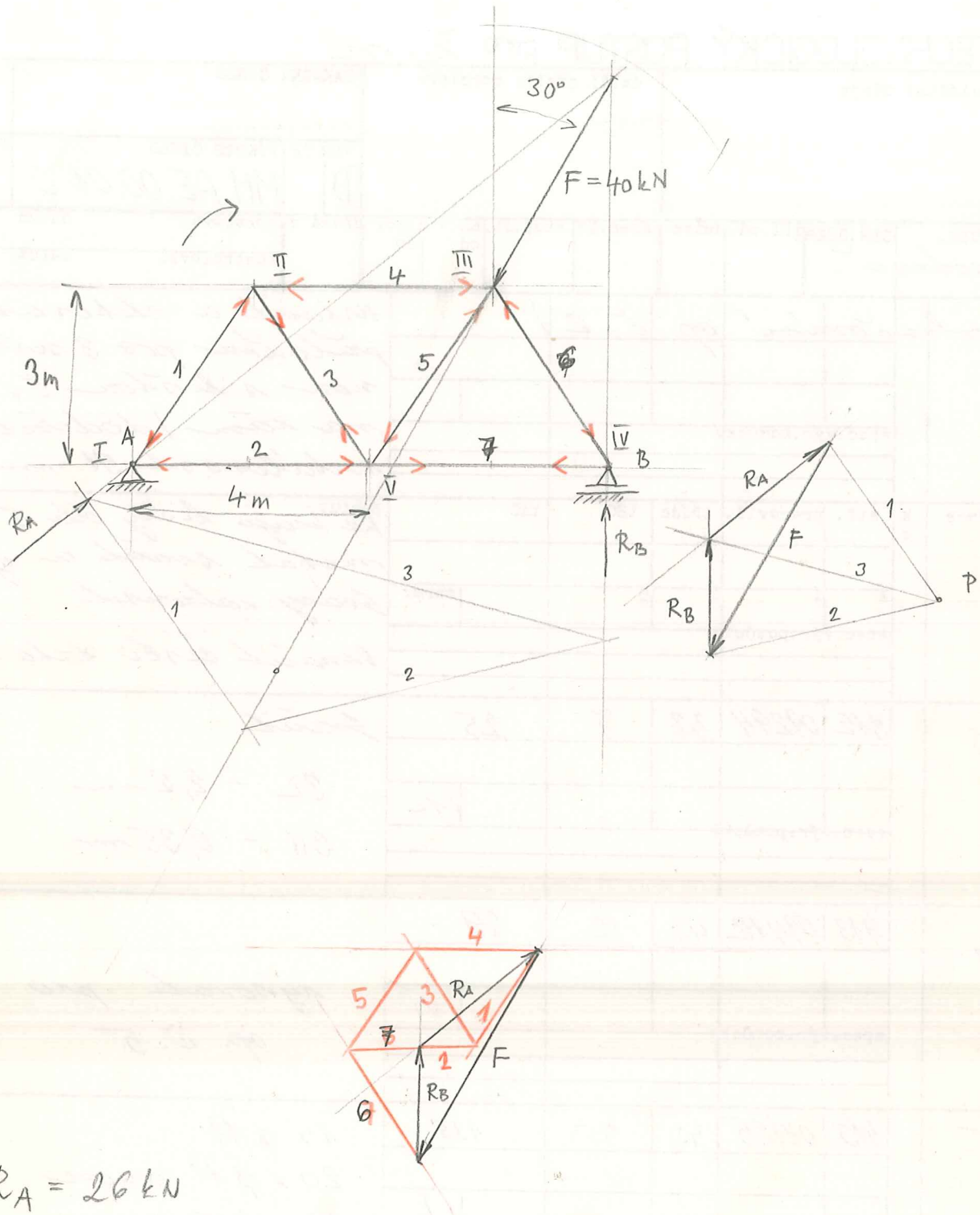
$F_T = F_N$ $\qquad F_N = \frac{F a - F_T c}{b} = \frac{100 \cdot 1000 - 100}{90} = 833{,}3\,N$

$\Sigma M_1 = 0 \qquad Q \cdot r_2 - F_T \cdot r_1 = 0$

$F_T = \frac{Q \cdot r_2}{r_1} = \frac{150 \cdot 100}{600} = 25\,N$ $\qquad f = \frac{F_T}{F_N} = 0{,}3$

3A)

1B



$R_A = 26\,kN$

$R_B = 19\,kN$

$S_1 = -19\,kN$

$S_2 = -10\,kN$

$S_3 = +18{,}5\,kN$

$S_4 = -20{,}5\,kN$

$S_5 = -18{,}5\,kN$

$S_7 = +12\,kN$

$S_6 = -22\,kN$