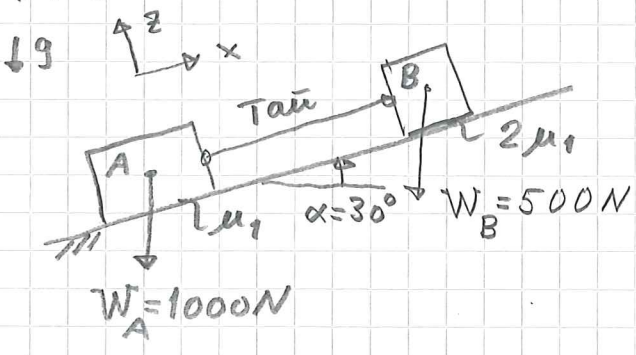
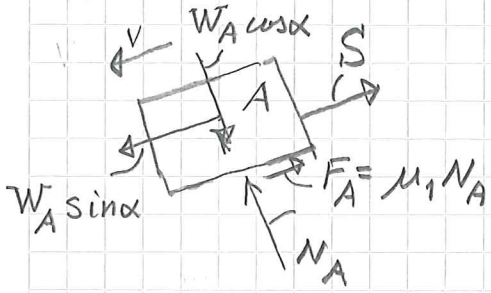
TKT4118, Lösningsforslag ØVING 9

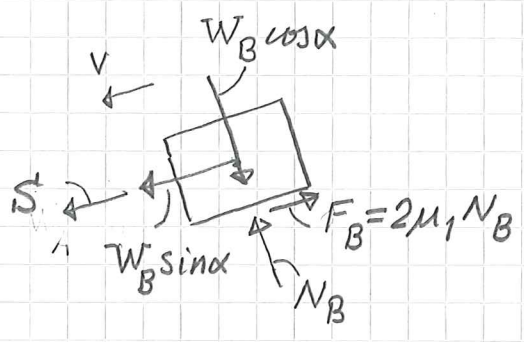
Oppgave 1



Stramt tau.
Konstant hastighet.
Finn μ_1 og tilhørende kraft S i tauet.

Tegn FLD for hver blokk





$\uparrow \Sigma F_z=0 \Rightarrow N_A=W_A\cos\alpha$

$\rightarrow \Sigma F_x=0 \Rightarrow S+F_A=W_A\sin\alpha$ (1)

$\uparrow \Sigma F_z=0 \Rightarrow N_B=W_B\cos\alpha$

$\rightarrow \Sigma F_x=0 \Rightarrow -S+F_B=W_B\sin\alpha$ (2)

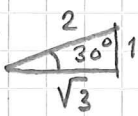
(1)+(2) gir: $F_A+F_B=(W_A+W_B)\sin\alpha$; sees også direkte

Setter inn:

$$\mu_1 W_A\cos\alpha + 2\mu_1 W_B\cos\alpha = (W_A+W_B)\sin\alpha$$

$$\mu_1(W_A+2W_B)\cos\alpha = (W_A+W_B)\sin\alpha \Rightarrow \mu_1 = \frac{W_A+W_B}{W_A+2W_B}\tan\alpha$$

eller: $\mu_1 = \dfrac{1+W_B/W_A}{1+2\,W_B/W_A}\cdot\tan\alpha$



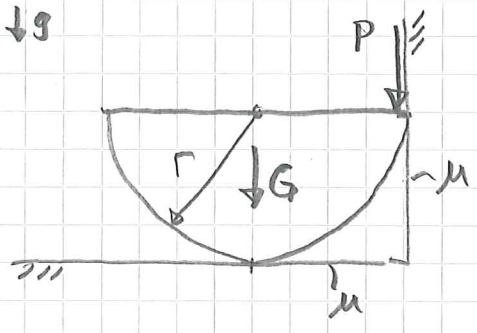
Innsatt: $\underline{\mu_1 = \frac{1+1/2}{1+2\cdot 1/2}\cdot\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{4} = 0{,}433}$

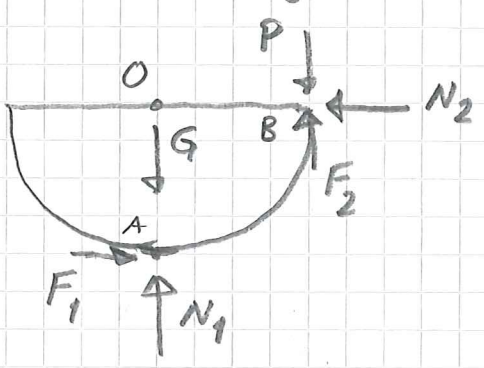
(1) gir: $S=W_A\sin\alpha - F_A = W_A\sin\alpha - \mu_1 W_A\cos\alpha = W_A(\sin\alpha-\mu_1\cos\alpha)$

Innsatt: $\underline{S=1000\left(\frac{1}{2}-\frac{\sqrt{3}}{4}\cdot\frac{\sqrt{3}}{2}\right)=1000\cdot\frac{1}{8}=125\,N}$

Oppgave 2

a) FLD for halvsylinder





b) Like for glidning:

$F_1 = \mu N_1$ og $F_2 = \mu N_2$, Beregn P

Ukjente: N_1, N_2 og P. Vi har 3 ligninger

$$\curvearrowright \Sigma M_0 = 0 \Rightarrow Pr - F_1 r - F_2 r = 0 \Rightarrow P = F_1 + F_2 = \mu N_1 + \mu N_2 \quad (1)$$

$$\curvearrowright \Sigma M_A = 0 \Rightarrow Pr - F_2 r - N_2 r = 0 \Rightarrow F_2 = P - N_2 \Rightarrow \mu N_2 = P - N_2 \quad (2)$$

$$\curvearrowright \Sigma M_B = 0 \quad N_1 r - F_1 r - Gr = 0 \Rightarrow F_1 = N_1 - G \Rightarrow \mu N_1 = N_1 - G \quad (3)$$

(2) gir: $N_2 = \dfrac{P}{1+\mu}$

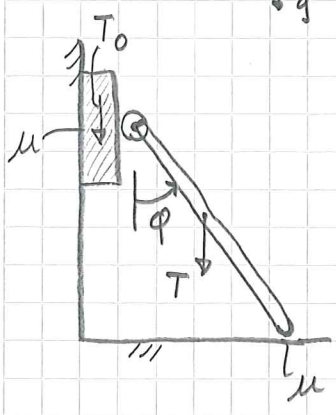
(3) gir: $N_1 = \dfrac{G}{1-\mu}$

(1) gir $P = \dfrac{\mu G}{1-\mu} + \dfrac{\mu P}{1+\mu}$

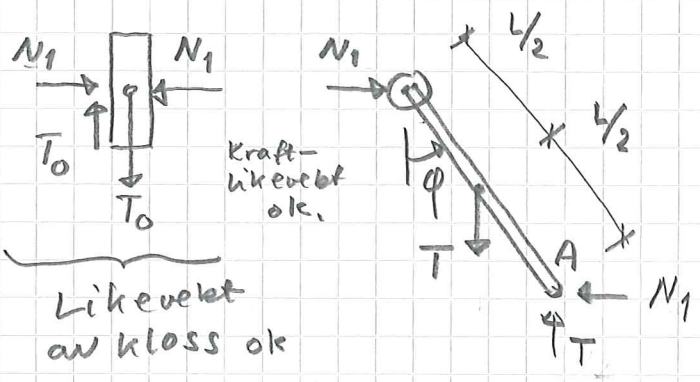
$$\Rightarrow \underbrace{P\left(1 - \frac{\mu}{1+\mu}\right)}_{\frac{1}{1+\mu}} = \frac{\mu G}{1-\mu} \Rightarrow P = \frac{\mu(1+\mu)}{1-\mu} G$$

Krav: $\mu < 1$, ellers blir det ikke glidning.

Oppgave 3



a) FLD for kloss og stav



$$\Sigma M_A = 0 \Rightarrow N_1 L\cos\varphi = T\frac{L}{2}\sin\varphi$$

$$\Rightarrow N_1 = \frac{T}{2}\tan\varphi$$

b) Kloss holdes oppe $\Rightarrow$

$$T_0 \leq \mu N_1 = \mu\frac{T}{2}\tan\varphi \Rightarrow \tan\varphi \geq \frac{2T_0}{\mu T}$$

Stav holdes oppe $\Rightarrow$

$$N_1 \leq \mu T \Rightarrow \frac{T}{2}\tan\varphi \leq \mu T \Rightarrow \tan\varphi \leq 2\mu$$

$$\underline{\underline{\frac{2T_0}{\mu T} \leq \tan\varphi \leq 2\mu}}$$

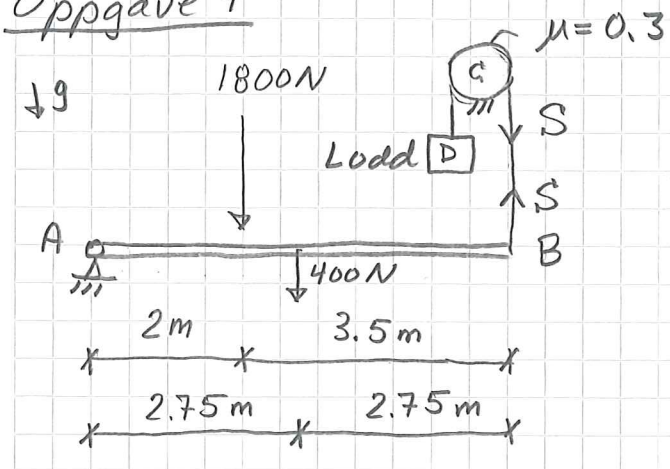
c) $\mu = 0.5$, $\frac{T}{T_0} = 10$

$$\frac{2}{0.5\cdot 10} \leq \tan\varphi \leq 2\cdot 0.5 \Rightarrow 0.4 \leq \tan\varphi \leq 1.0$$

eller

$$\underline{\underline{21.8^\circ \leq \varphi \leq 45^\circ}}$$

Oppgave 4



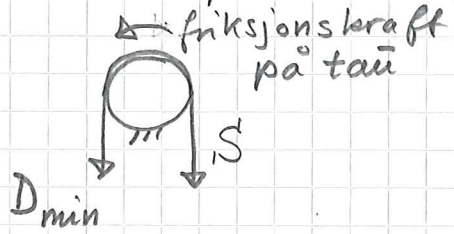
Bjelken: $\circlearrowright \sum M_A = 0 \Rightarrow$

$1800 \cdot 2 + 400 \cdot 2.75 = S \cdot 5.5$

$3600 + 1100 = 5.5\,S$

$\Rightarrow \underline{S = 854.55\,N}$

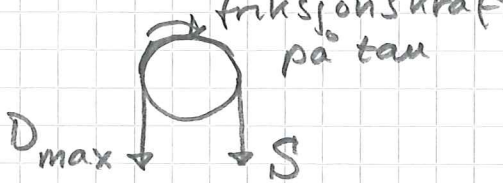
Minste vekt på loddet



$$D_{min} = S\,e^{-\mu\pi}$$

$$\underline{D_{min}} = 854.55\,e^{-0.3\pi} = \underline{330\,N}$$

Største vekt på loddet



$$D_{max} = S\,e^{\mu\pi}$$

$$\underline{D_{max}} = 854.55\,e^{0.3\pi} = \underline{2190\,N}$$