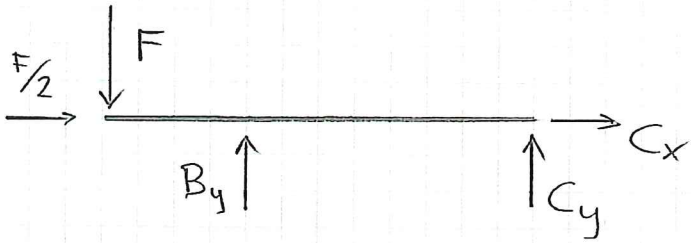
INSTITUTT FOR
KONSTRUKSJONSTEKNIKK
NTNU

TKT 4116 MEKANIKK 1	Dato	Side 1
ØVING 2	Sign AHC	

OPPGAVE 1

FLD:



$\Sigma F_x = 0 \Rightarrow \quad F/2 + C_x = 0 \quad \Rightarrow \underline{C_x = -F/2}$

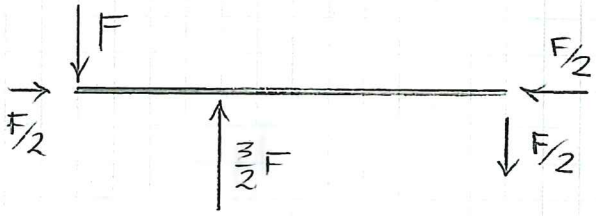
{MAO. MOT VENSTRE}

$\Sigma \overset{B}{M}_C = 0 \Rightarrow \quad -F \cdot \frac{3}{2}L + B_y \cdot L = 0$ $\quad \{F/2, C_x \text{ og } C_y \text{ har null arm}\}$

$\Rightarrow \underline{B_y = \frac{3}{2}F}$

$\Sigma F_y = 0 \Rightarrow \quad -F + \underbrace{\frac{3}{2}F}_{B_y} + C_y = 0 \quad \Rightarrow \quad C_y = -F/2$

Belastningsdiagram:

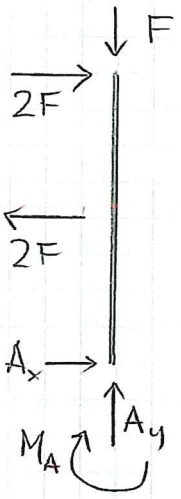


Kontroll: Momentlikevekt om A:

$\Sigma \overset{A}{M}_A = -\frac{3}{2}F \cdot \frac{L}{2} + \frac{F}{2} \cdot \frac{3}{2}L = 0$ $\quad$ OK

OPPGAVE 2

FLD:



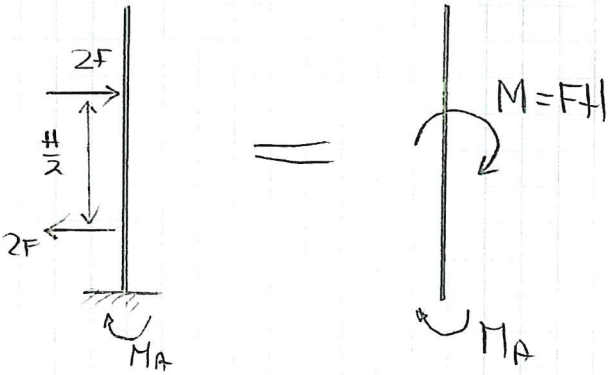
NB: Innspenning i A => Tre ukjente

$\Sigma F_x = 0 \Rightarrow A_x - 2F + 2F = 0$ $\Rightarrow \underline{A_x = 0}$

$\Sigma F_y = 0 \Rightarrow A_y - F = 0$ $\Rightarrow \underline{A_y = F}$

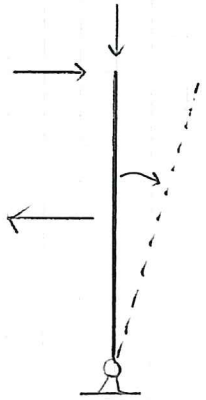
$\Sigma \hat{M}_A = 0 \Rightarrow M_A - 2F \cdot \frac{H}{2} + 2F \cdot H = 0$ $\Rightarrow \underline{M_A = -FH}$

Parallellforskyvning av lastene 2F gir samme M_A så lenge avstanden mellom de to kreftene 2F er $H/2$.
Årsak: Kraftpar = Moment



Leddlager i A:

Nå: Ingen innspenning, dvs $M_A = 0$



⇒ Søylen roterer om A

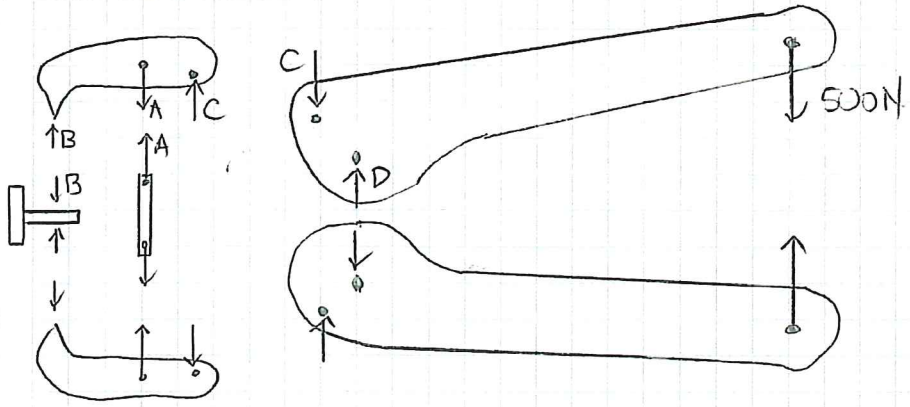
Har ikke momentlikevekt

$\Sigma M_A = 2F \cdot H - 2F \cdot \frac{H}{2} = FH$ (med urviser)

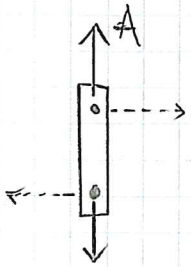
↳ SUMMEN AV MOMENTER OM PKT. A

OPPGAVE 4

Regner i N og mm

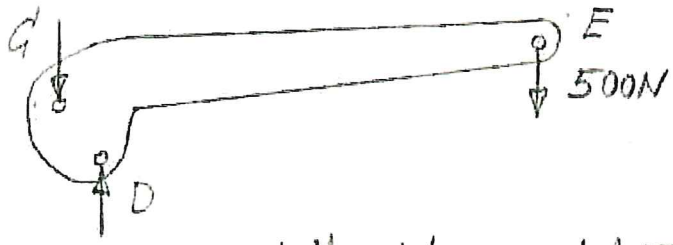


MERK: Alle horisontale krefter (x-retning) må være null. Hvis ikke, er det umulig å få likevekt av vertikaldelen

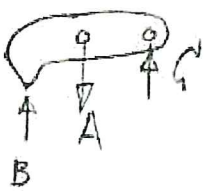


Kraften B mot bolten

I



II



Likevekt av del I krever

$$\Sigma M_D = 0 \Rightarrow C \cdot 15 - 500 \cdot (600-15) = 0$$

$$\Rightarrow C = 1{,}95 \cdot 10^4 N$$

Likevekt av del II krever

$$\Sigma M_A = 0 \Rightarrow B \cdot 30 - C \cdot 90 = 0$$

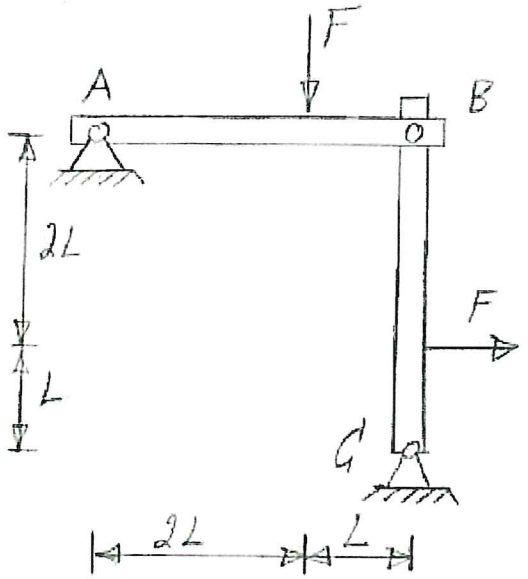
$$\Rightarrow B = 5{,}85 \cdot 10^4 N$$

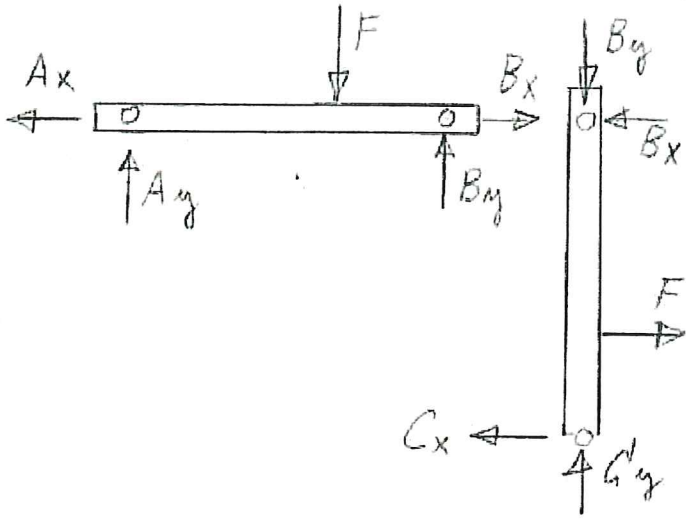
$$B = \underline{\underline{59\ kN}}$$ (knappe 6 tonn)

$$B = \overbrace{\left(\frac{90}{30}\right)}^{3} \overbrace{\left(\frac{600-15}{15}\right)}^{39} \cdot 500$$

Oppgave 3

3





Lagerreaksjonene A_x, A_y, C_x, C_y og bolltrekraften B.

Analyse.

Ukjente reaksjoner: A_x, A_y, C_x, C_y, B_x, B_y $\Rightarrow$ $r = 6$

Elementer: AB og BC $\Rightarrow$ $e = 2$. Likevektsl.: $l = 3e = 6$

$\Rightarrow$ Statisk bestemt problem.

Løsning.

Likevekt krever for

Bjelke AB: $\Sigma M_A = 0 \Rightarrow B_y \cdot 3L - F \cdot 2L = 0 \Rightarrow B_y = 2F/3$

$\Sigma F_y = 0 \Rightarrow A_y + B_y - F = 0 \Rightarrow A_y = F/3$

Bjelke BC: $\Sigma F_y = 0 \Rightarrow C_y - B_y = 0 \Rightarrow C_y = 2F/3$

$\Sigma M_C = 0 \Rightarrow B_x \cdot 3L - F \cdot L = 0 \Rightarrow B_x = F/3$

$\Sigma F_x = 0 \Rightarrow C_x + B_x - F = 0 \Rightarrow C_x = 2F/3$

Bjelke AB: $\Sigma F_x = 0 \Rightarrow A_x - B_x = 0 \Rightarrow A_x = F/3$

Bolltrekraft i B: $B = \sqrt{B_x^2 + B_y^2} = \sqrt{5}F/3$

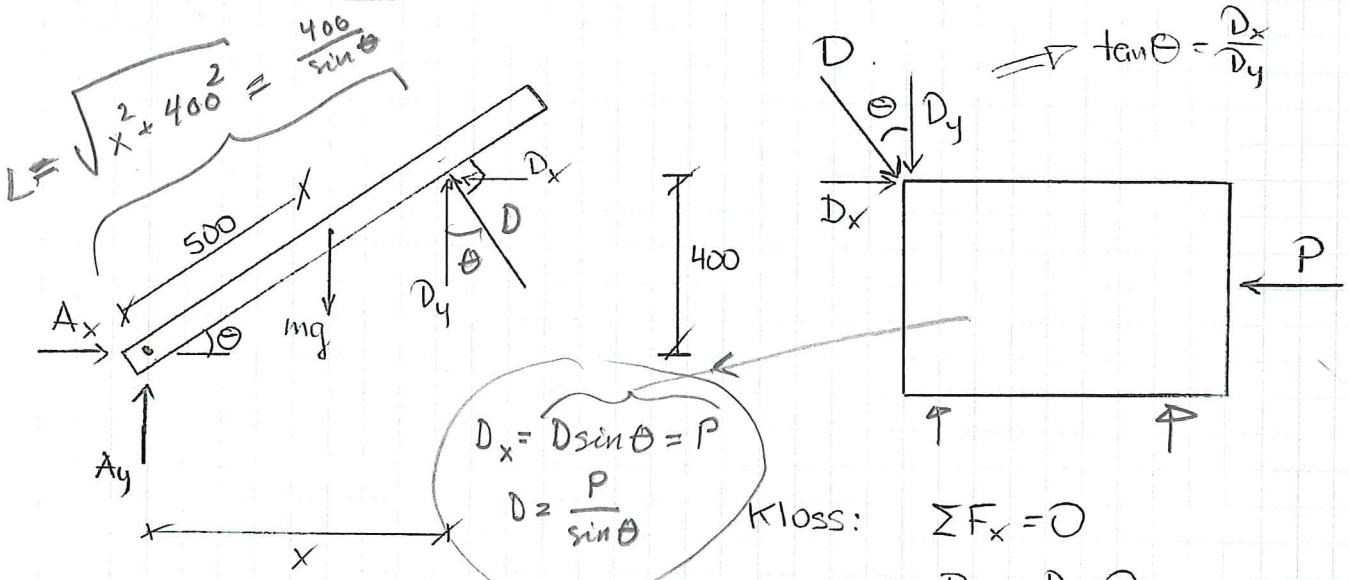
Svar: $A_x = F/3 \leftarrow$, $A_y = F/3 \uparrow$, $C_x = 2F/3 \leftarrow$, $C_y = 2F/3 \uparrow$

$B = \sqrt{5}F/3$ $\angle 2$ på bjelke AB

Kontroll: likevekt av hele konstruksjonen: $\Sigma F_x = 0$, $\Sigma F_y = 0$, OK

$\Sigma M_C = 0 \Rightarrow A_y \cdot 3L - A_x \cdot 3L - F \cdot L/3 + F \cdot L/3 = 0$, O.K

OPPGAVE 5



Trigonometri: $\tan\theta = \frac{400}{x}$

$\frac{400}{L} = \sin\theta = \frac{400}{\sqrt{x^2+400^2}}$

$\frac{x}{L} = \cos\theta = \frac{x}{\sqrt{x^2+400^2}}$

Kloss: $\Sigma F_x = 0$

$\Rightarrow D_x - P = 0$

$D_x = D\sin\theta$

NB: Null friksjon $\Rightarrow$ D $\perp$ AB's lengdeakse

Stang: $\curvearrowleft \Sigma M_A = mg \cdot 500 \cdot \cos\theta - D_x \cdot 400 - D_y \cdot x = 0$

$\Rightarrow mg \cdot 500 \cdot \cos\theta - D_x \cdot 400 - \frac{D_x}{\tan\theta} \cdot x = 0$

$mg \cdot 500 \cdot \frac{x}{\sqrt{x^2+400^2}} - \underbrace{P}_{=D_x} \cdot 400 - \underbrace{P}_{=D_x} \cdot \underbrace{\frac{x}{400}}_{\frac{1}{\tan\theta}} \cdot x = 0$

$mg \cdot 500 \cdot \frac{x}{\sqrt{x^2+400^2}} - P\left(400 + \frac{x^2}{400}\right) = 0$

$mg \cdot \frac{500x}{\sqrt{x^2+400^2}} - P \cdot \frac{400^2+x^2}{400} = 0$

$$P = \frac{400 \cdot 500x}{(x^2+400^2)^{3/2}} mg$$

$\curvearrowleft \Sigma M_A = 0$

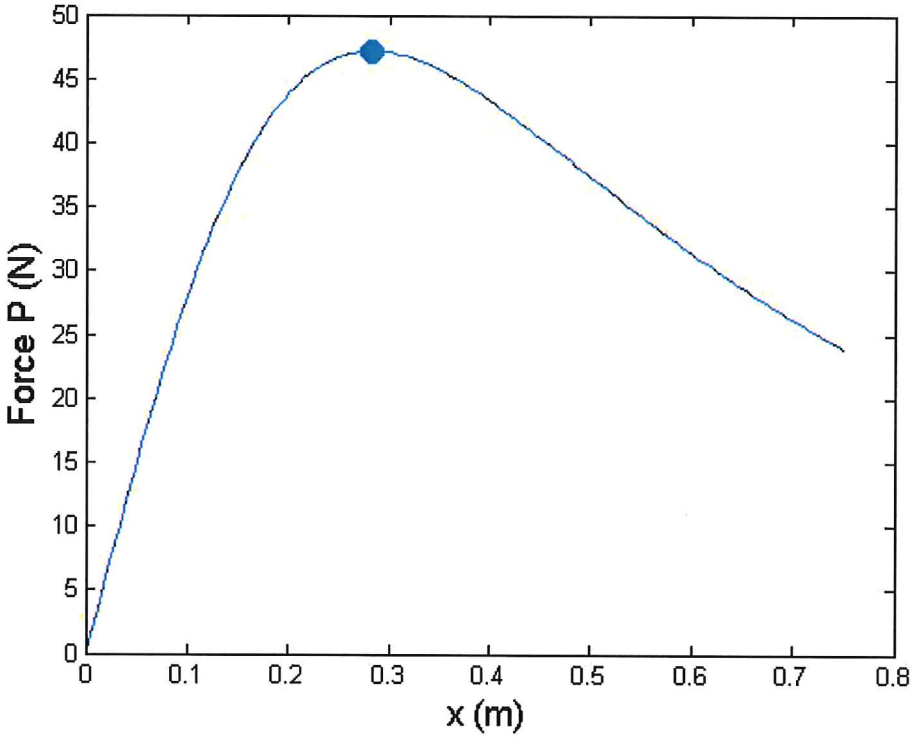
$mg\,500\cos\theta - D \cdot L = 0$

$mg\,500\cos\theta - \frac{P \cdot L}{\sin\theta} = 0$

$P = mg\,500\,\frac{\sin\theta\cos\theta}{L}$

$P = mg\,500\,\frac{400}{L} \cdot \frac{x}{L} \cdot \frac{1}{L}$

$P = mg\,500 \cdot 400\,\frac{x}{L^3}$



Maximum block force, P_max = 47.2N, at x = 283.0mm