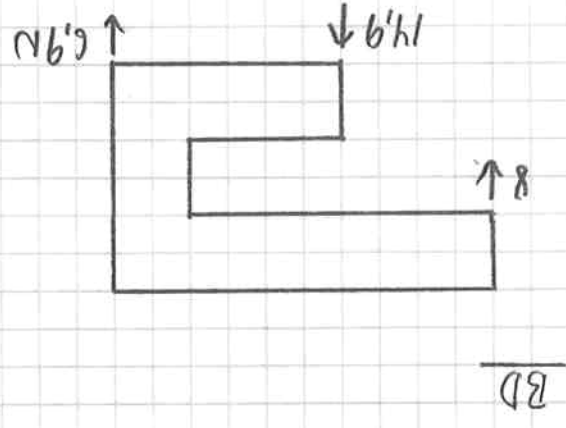


1

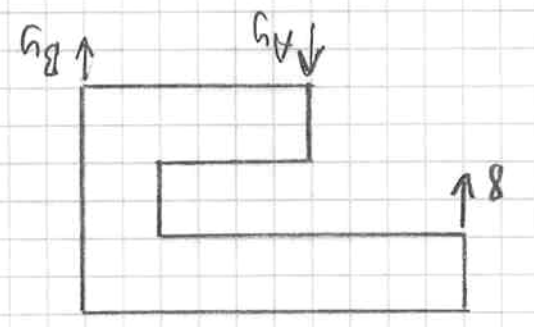


$$\sum F_y = 0 \Rightarrow A_y - 8 - 6.9 = 0$$

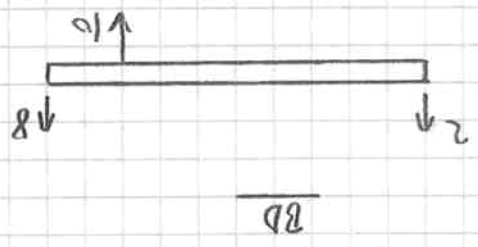
$$\underline{A_y = 14.86 \text{ N}}$$

$$\sum M_A = 0 \Rightarrow B_y \cdot 28 - 8 \cdot 24 = 0$$

$$\underline{B_y = 6.86 \text{ N}}$$



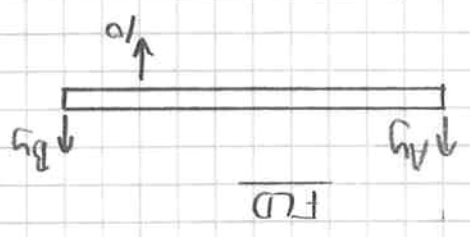
b)



$$\sum F_y = 0 \Rightarrow A_y + 8 - 10 = 0 \Rightarrow \underline{A_y = 2}$$

$$\sum M_A = 0 \Rightarrow 10 \cdot 4 - B_y \cdot 5 = 0$$

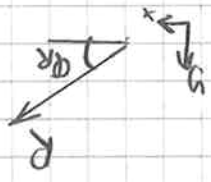
$$\underline{B_y = 8}$$



a)

Oppgave 1

2)



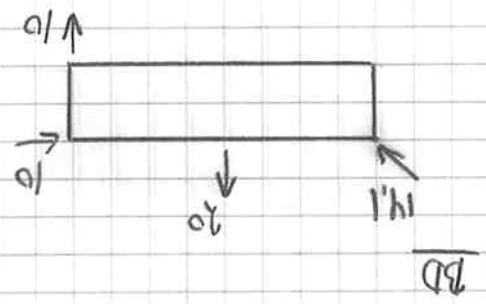
$$\varphi_R = \arctan\left(\frac{R_y}{R_x}\right) = 26,8^\circ$$

$$R = \sqrt{R_x^2 + R_y^2} = 28,1 \text{ N}$$

$$R_y = 10 \sin 30^\circ + 10 \sin 50^\circ = 12,7 \text{ N}$$

$$R_x = 10 + 10 \cos 30^\circ + 10 \cos 50^\circ = 25,1 \text{ N}$$

d)



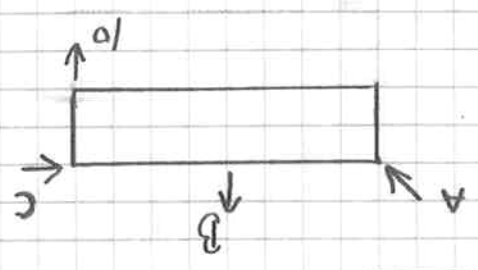
$$\underline{C = 10 \text{ N}}$$

$$\rightarrow \sum F_x = 0 \Rightarrow 14,1 \cos 45^\circ - C = 0$$

$$\underline{A = 10\sqrt{2} = 14,1 \text{ N}}$$

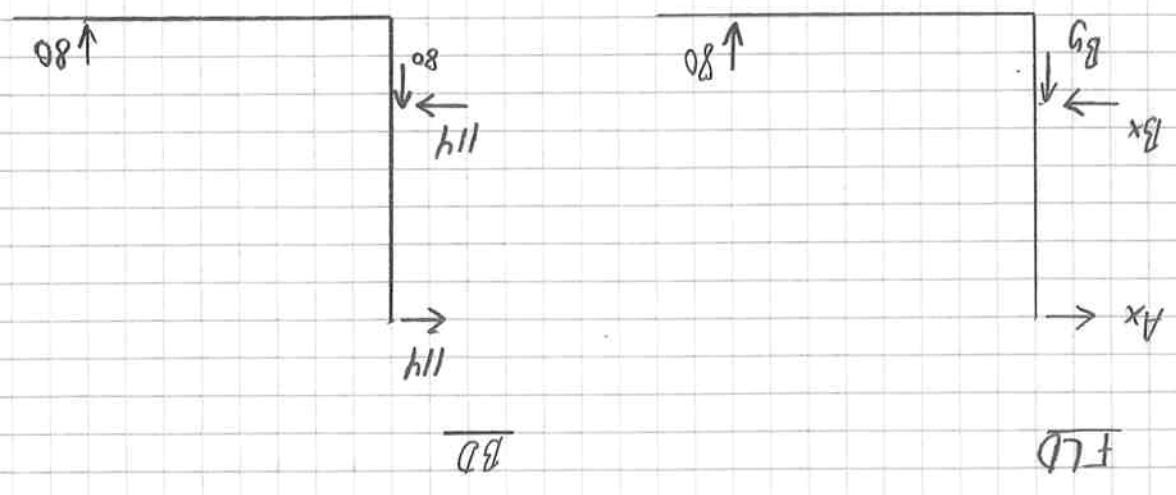
$$\downarrow \sum F_y = 0 \Rightarrow 20 - 10 - A \sin 45^\circ = 0$$

$$\uparrow \sum M_A = 0 \Rightarrow 10 \cdot 80 - B \cdot 40 = 0 \Rightarrow B = 20 \text{ N}$$



c) FLD

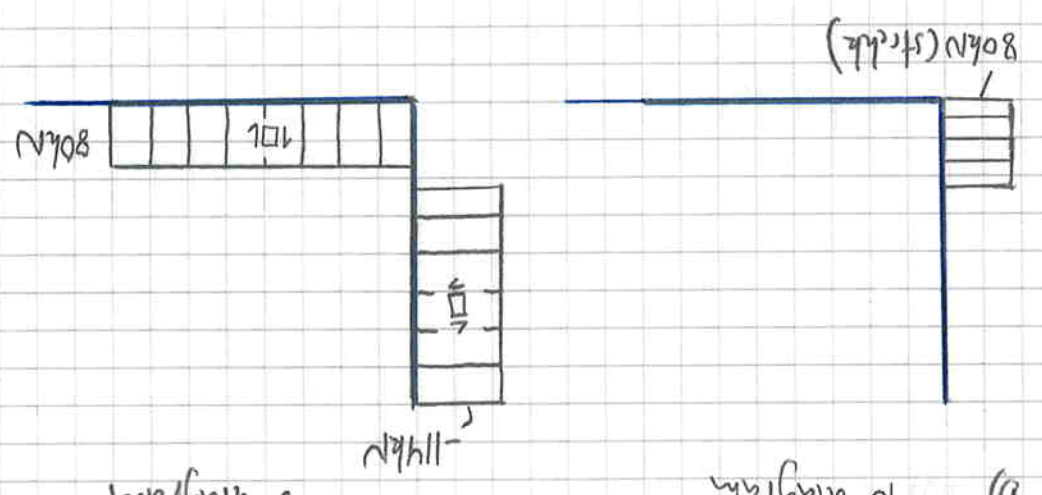
a) FLD



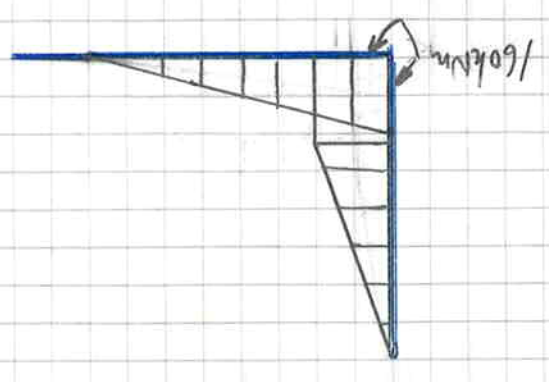
$$\sum M_B = 0 \Rightarrow 80 \cdot 2 - A_x \cdot 14 = 0 \Rightarrow A_x = 114 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow B_y = 80 \text{ kN}, \quad \sum F_x = 0 \Rightarrow B_x = 114 \text{ kN}$$

b) N-diagram



M-diagram

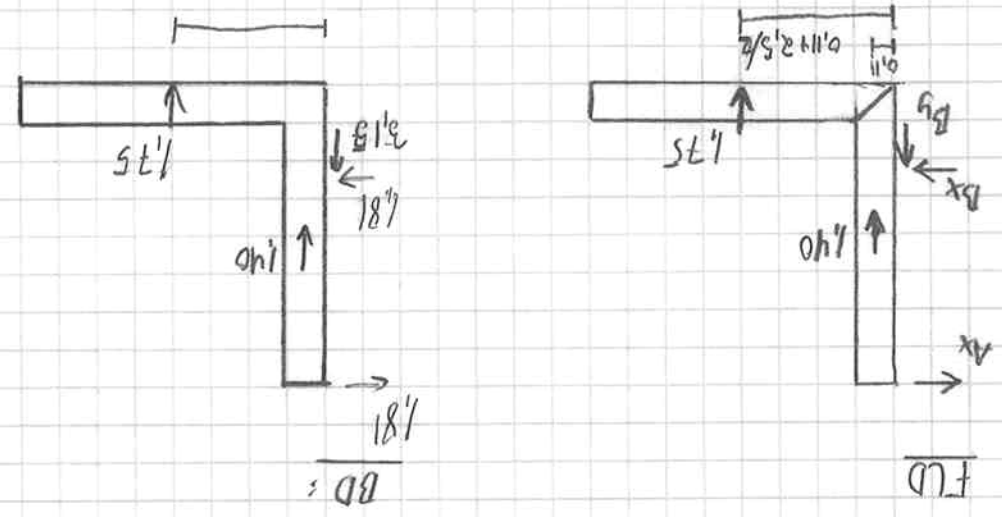


4

$$B_x = A_x$$

$$\sum M_B = 0 \Rightarrow 1,75 \cdot 1,36 + 1,4 \cdot 0,11 - A_x \cdot 1,4 = 0 \Rightarrow A_x = 1,81 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow B_y = 1,40 + 1,75 = B_y = 3,15 \text{ kN}$$



$$G_2 = 2,5 \cdot 71,5 \cdot 9,81 = 1,75 \text{ kN}$$

$$G_1 = 2,715 \cdot 71,5 \cdot 9,81 = 1,4 \text{ kN}$$

d) HE220B vater 71,5 kg/m

$$\sigma = \frac{M}{W} + \frac{N}{A} = \frac{160 \cdot 10^6}{736 \cdot 10^3} + \frac{80 \cdot 10^3}{9100} = 217 + 8,8 = 226 \text{ MPa} < \sigma_{tillatt}$$

Korrigeres for  $\sigma_A$ :

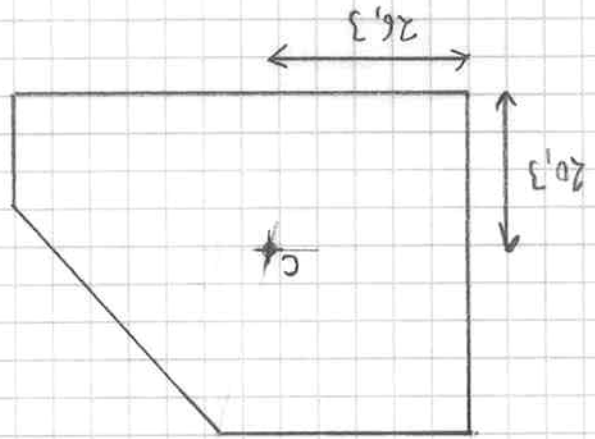
HE220B har  $W_x = 736 \text{ cm}^3$  og  $A = 91,0 \text{ cm}^2$

$$\sigma = \frac{M}{W} \Rightarrow W_{krv} = \frac{M_{dim}}{\sigma_{tillatt}} = \frac{160 \cdot 10^6}{253} = 631000 \text{ mm}^3 = 631 \text{ cm}^3$$

$$M_{dim} = 160 \text{ kNm}$$

c)  $\sigma_{tillatt} = \frac{R_c}{n} = \frac{355}{1,4} = 253 \text{ MPa}$

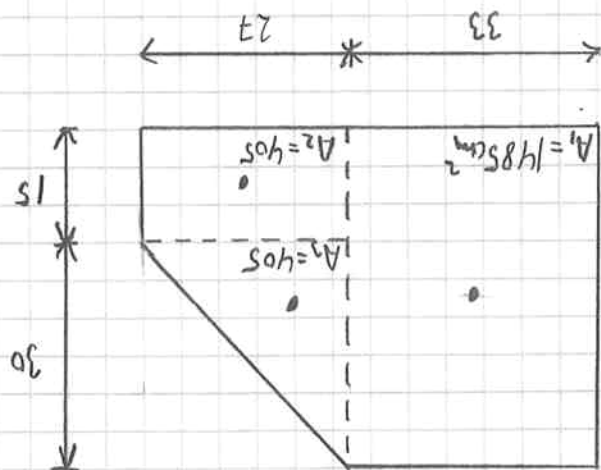
5



$$\bar{y} = \frac{2295}{1485 \cdot 22.5 + 405 \cdot 7.5 + 405 \cdot 25} = 20.3 \text{ cm}$$

$$\bar{x} = \frac{2295}{1485 \cdot 16.5 + 405 \cdot 46.5 + 405 \cdot 42} = 26.3 \text{ cm}$$

$$A = 1485 + 2 \cdot 405 = 2295 \text{ cm}^2$$



2)

Oppgave 3

9

$$\sigma_{\text{Kittling}} = \frac{N}{A} = \frac{3540}{25,1} = 141 \text{ MPa}$$

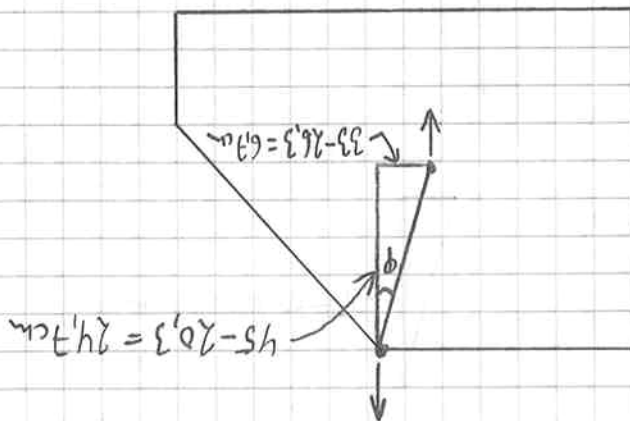
Kittlingstrichmittl:  $A = 2 \cdot \frac{\pi}{4} \cdot d^2 = 25,1 \text{ mm}^2$

$$G = \rho g V = 7850 \cdot 9,81 \cdot 45,9 \cdot 10^{-3} = 3535 \text{ N} = 3,54 \text{ kN}$$

$$V = 2295 \cdot 20 = 45900 \text{ cm}^3 = 45900 \cdot 10^{-6} \text{ m}^3 = 45,9 \cdot 10^{-3} \text{ m}^3$$

c)  $\rho = 785 \text{ t/m}^3$

$$\tan \phi = \frac{G'}{T'} = \phi = 15,2^\circ$$



b) Klossen in orientiere see silik ut trykspunktet befinnas see rett under opphangingpunktet

⑥

$$\overline{F_H = 0,77 \text{ kN}}$$

$$\downarrow \sum F_y = 0 \Rightarrow 2F_H + 2 \cdot 1,00 - 3,54 = 0$$

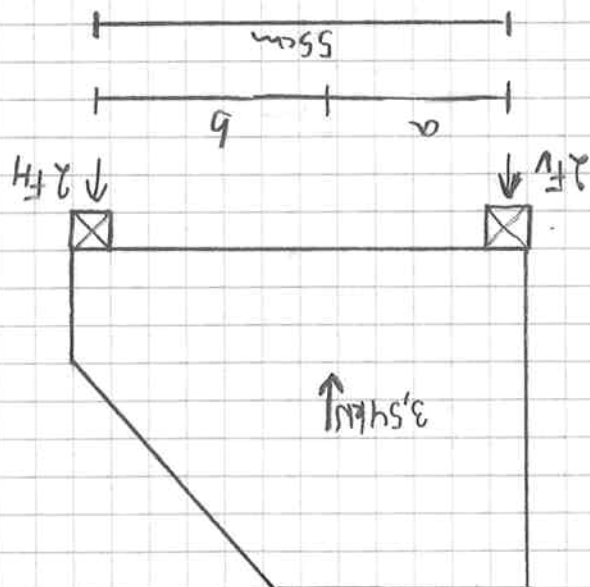
$$\Rightarrow \overline{F_V = 1,00 \text{ kN}}$$

$$\curvearrow \sum M_H = 0 \Rightarrow -3,54 \cdot 2,5 + 2F_V \cdot 55 = 0$$

Moment am heyre kluss ;

$$b = 60 - 26,3 - 2,5 = 31,2 \text{ cm}$$

$$a = 26,3 - 2,5 = 23,8 \text{ cm}$$



d)



Oppgave 4

a) Bøyemoment i C:  $M = 60 \cdot 1,8 = 108 \text{ kNm}$

Notstørrelsesmoment i C:  $M = \frac{6}{1} 20 \cdot 400^2 = 533 \cdot 10^3 \text{ mm}^3$

$$\sigma_{\text{bo}} = \frac{M}{W} = \frac{108 \cdot 10^6}{533 \cdot 10^3} = 203 \text{ MPa}$$

b) Vi finner da største skjærspenningsene ved A og B:

$$\tau_{\text{max}} = \frac{1}{5} \frac{V}{A} = \frac{1}{5} \cdot \frac{60000}{20 \cdot 150} = 30 \text{ MPa}$$

$$\sigma_j = \sqrt{3} \tau = 52 \text{ MPa}$$

c)

$$M = 60x$$

$$W = \frac{6}{1} 20 \left( 150 + \frac{1}{8} x \right)^2 = 3,33 (150 + 1,39x)^2$$

$$\sigma_{\text{bo}} = \frac{M}{W} = \frac{60 \cdot 10^6 x}{3,33 (150 + 1,39x)^2}$$

$$x = 1,08 \text{ m} \quad M = 60 \cdot 1,08 = 64,8 \text{ kNm}$$

$$W = \frac{6}{1} 20 \left( 150 + \frac{1}{8} \cdot 250 \right)^2 = 3000000 \text{ mm}^3$$

$$\sigma_{\text{bo max}} = \frac{M}{W} = \frac{64,8 \cdot 10^6}{3000000} = 216 \text{ MPa}$$