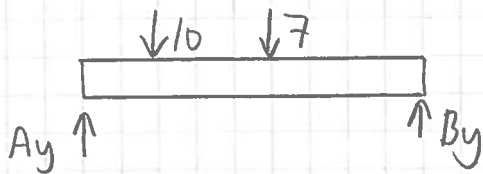


Oppgave 1

a) FLD:



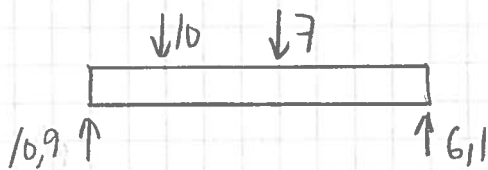
$$\sum M_A = 0 \Rightarrow 10 \cdot 1 + 7 \cdot 2,5 - B_y \cdot 4,5 = 0$$

$$\Rightarrow \underline{B_y = 6,1 \text{ kN}}$$

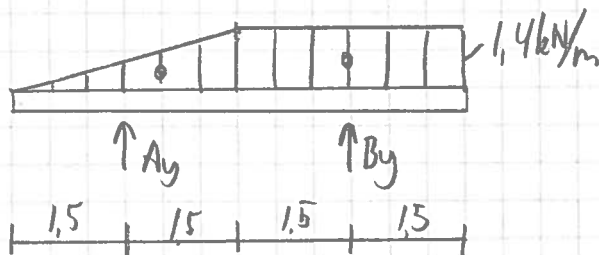
$$\sum F_y = 0 \Rightarrow A_y + 6,1 - 10 - 7 = 0$$

$$\Rightarrow \underline{A_y = 10,9 \text{ kN}}$$

BD:



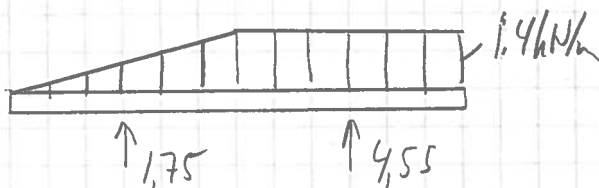
b) FLD:



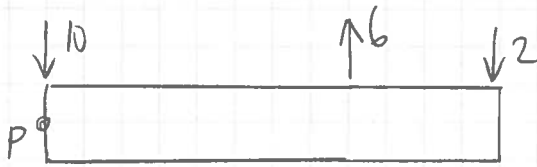
$$\sum M_A = 0 \Rightarrow 3 \cdot 1,4 \cdot 3 + \frac{1}{2} \cdot 3 \cdot 1,4 \cdot 0,5 - B_y \cdot 6 = 0 \Rightarrow \underline{B_y = 4,55 \text{ kN}}$$

$$\sum F_y = 0 \Rightarrow A_y + 4,55 - 1,4 \cdot 3 \cdot 1,5 = 0 \Rightarrow \underline{A_y = 1,75 \text{ kN}}$$

BD:



c)



$$\downarrow R_y = 10 - 6 + 2 = 6 \text{ N}$$

$$\uparrow \sum M_P = 6 \cdot 4 - 2 \cdot 6 = 12 \text{ Nm}$$

$$a_R = \frac{M_P}{R} = 2 \text{ m}$$



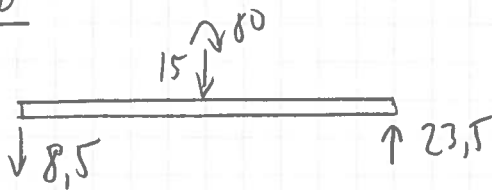
d) FLD



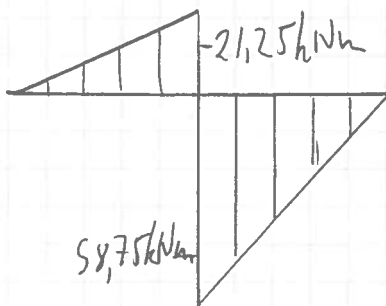
$$\begin{aligned} \uparrow \sum M_A = 0 &\Rightarrow 15 \cdot 2,5 + 80 - B_y \cdot 5 = 0 \\ &\Rightarrow \underline{B_y = 23,5 \text{ kN}} \end{aligned}$$

$$\begin{aligned} \uparrow \sum F_y = 0 &\Rightarrow A_y + 23,5 - 15 = 0 \\ &\Rightarrow A_y = -8,5 \text{ kN} \end{aligned}$$

BD



(M)

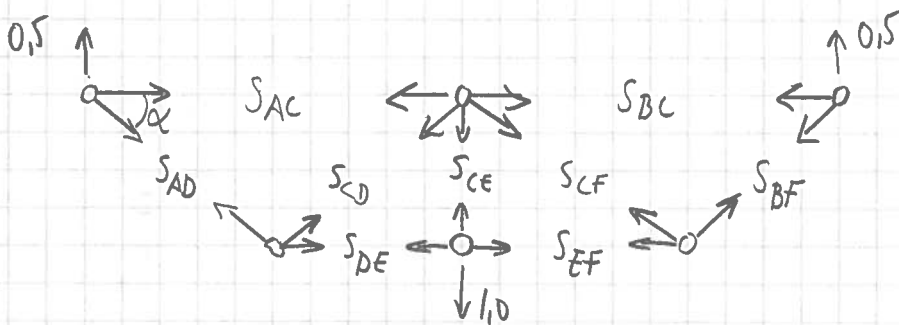


Oppgave 2

$$a) \quad \left. \begin{array}{l} 0 = 3 \\ s = 9 \\ k = 6 \end{array} \right\} \Rightarrow 0 + s = 12 \quad \left. \begin{array}{l} \\ \\ \Rightarrow 2k = 12 \end{array} \right\} \text{dus statisk bestemt}$$

Symmetri gir at $A_y = B_y = 0,5 \text{ kN}$
 $A_x = 0$

Knøtepunkttdiagram



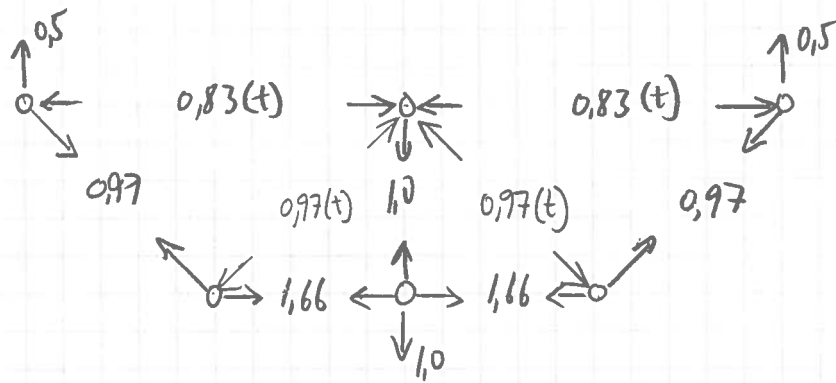
b) Symmetri gir at vi kun må beregne halvparten

$$\tan \alpha = \frac{15}{25} \Rightarrow \alpha = 31^\circ$$

KP-A: $\uparrow \Sigma F_y = 0 \Rightarrow 0,5 - S_{AD} \sin 31^\circ = 0 \Rightarrow S_{AD} = 0,97 \text{ kN}$
 $\rightarrow \Sigma F_x = 0 \Rightarrow S_{AC} + 0,97 \cos 31^\circ = 0 \Rightarrow S_{AC} = -0,83 \text{ kN}$

KP-D: $\uparrow \Sigma F_y = 0 \Rightarrow 0,97 \sin 31^\circ + S_{CD} \sin 31^\circ = 0 \Rightarrow S_{CD} = -0,97 \text{ kN}$
 $\rightarrow \Sigma F_x = 0 \Rightarrow S_{DE} + (-0,97) \cos 31^\circ - 0,97 \cos 31^\circ = 0 \Rightarrow S_{DE} = 1,66 \text{ kN}$

BD :



c) star DE og EF forstørst strekk:

$$\phi 16 \times 1,50 \text{ mm} \Rightarrow A = \frac{\pi}{4} (16^2 - 13^2) = 68,3 \text{ mm}^2$$

$$\sigma_N = \frac{1660}{68,3} = 24,3 \text{ MPa}$$

$$n = \frac{160}{24,3} = 6,6$$

$$\Delta L = \frac{FL}{EA} = \frac{1660 \cdot 250}{70000 \cdot 68,3} = 0,087 \text{ mm}$$

$$d) I = \frac{\pi}{64} (16^4 - 13^4) = 1815 \text{ mm}^4$$

$$i = \sqrt{\frac{I}{A}} = \sqrt{\frac{1815}{68,3}} = 5,15 \text{ mm}$$

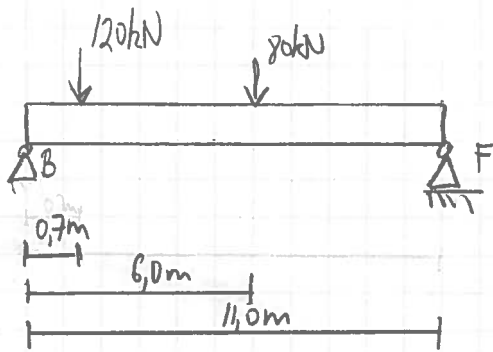
$$\lambda = \frac{L_k}{i} = \frac{500}{5,15} = 97$$

$$F_k = \frac{\pi^2 EI}{L_k^2} = \frac{\pi^2 \cdot 70000 \cdot 1815}{500^2} = 5016$$

$$n = \frac{5016}{1660} = 3,0$$

Oppgave 3

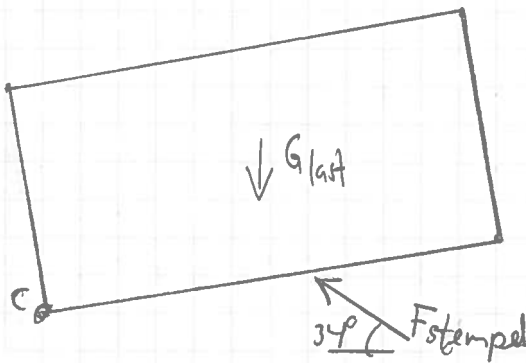
a)



$$\sum M_B = 0 \Rightarrow 120 \cdot 0,7 + 80 \cdot 6,0 - F_y \cdot 11,0 = 0 \Rightarrow \underline{F_y = 12 \text{ kN}}$$

$$\sum F_y = 0 \Rightarrow B_y + 12 - 80 - 120 = 0 \Rightarrow \underline{B_y = 188 \text{ kN}}$$

b)



$$\sum M_c = 0 \Rightarrow 80 \cdot 2,8 - F_{\text{stempel}} \cdot 3,85 = 0 \Rightarrow \underline{F_{\text{stempel}} = 58,2 \text{ kN}}$$

$$\downarrow R_y = 120 - 58,2 \cdot \sin 34^\circ = 87,5 \text{ kN}$$

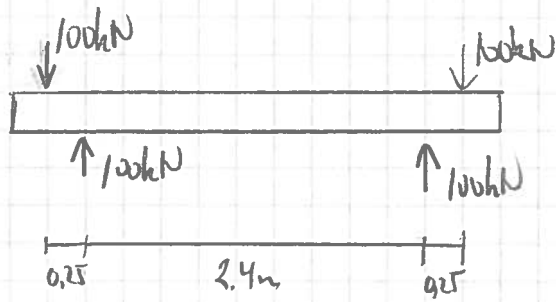
$$\leftarrow R_x = 58,2 \cos 34^\circ = 48,2 \text{ kN}$$

$$R = \sqrt{87,5^2 + 48,2^2} = 99,9 \text{ kN}$$

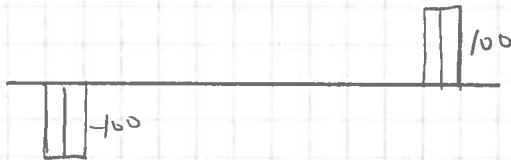
$$\alpha_R = \tan^{-1} \left(\frac{87,5}{48,2} \right) = 61^\circ$$



d)



V



M



e)

$$\sigma_B = \frac{M_{\text{dim}}}{W} = \frac{25 \cdot 10^6}{\frac{\pi}{32} \cdot 150^3} = 75,5 \text{ MPa}$$

$$\tau = 1,33 \frac{V}{A} = 1,33 \cdot \frac{100000}{\frac{\pi}{4} \cdot 150^2} = 7,5 \text{ MPa}$$

$$\sigma_j = \sigma_B = 75,5 \text{ MPa}$$

f)

stempelstang:

$$\sigma_A = \frac{58200}{\frac{\pi}{4} \cdot 40^2} = 46,3 \text{ MPa}$$

Hydr. tryk:

$$p = \frac{58200}{\frac{\pi}{4} \cdot 100^2} = 7,4 \text{ MPa (overtryk)}$$