

Balkar

1. Beräkna först resultanten till $w(x)$:

$$w'(0) = 2000$$

$$w(3) = 3600$$

$$\begin{cases} 3K_1 - 9K_2 = 3600 \\ K_1 = 2000 \end{cases} \Rightarrow \begin{cases} K_1 = 2000 \\ K_2 = \frac{800}{3} \end{cases}$$

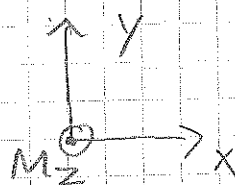
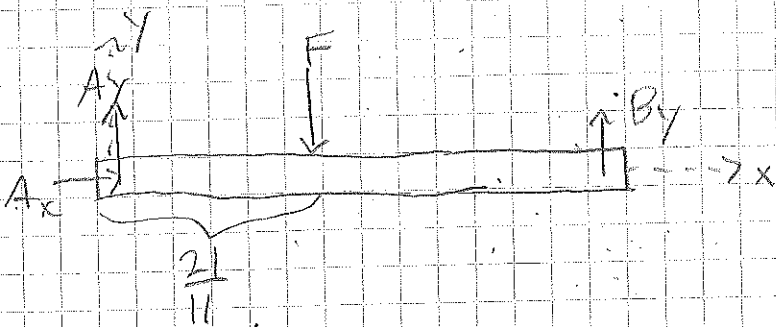
Totala krafterna blir:

$$\int_0^3 2000x - \frac{800x^2}{3} dx = \left[1000x^2 - \frac{800x^3}{9} \right]_0^3 = 6600 \text{ N/m}$$

Placeringen blir:

$$x_R = \frac{\int_0^3 x(2000x - \frac{800x^2}{3}) dx}{6600} = \frac{\int_0^3 2000x^2 - \frac{800x^3}{3} dx}{6600}$$
$$= \frac{\left[\frac{2000x^3}{3} - \frac{800x^4}{12} \right]_0^3}{6600} = \frac{18000 - 5400}{6600} = \frac{21}{11}$$

Friläggning av balken:



1.

(Fortsättning)

Jämviktsekvationer:

$$\rightarrow: A_x = 0$$

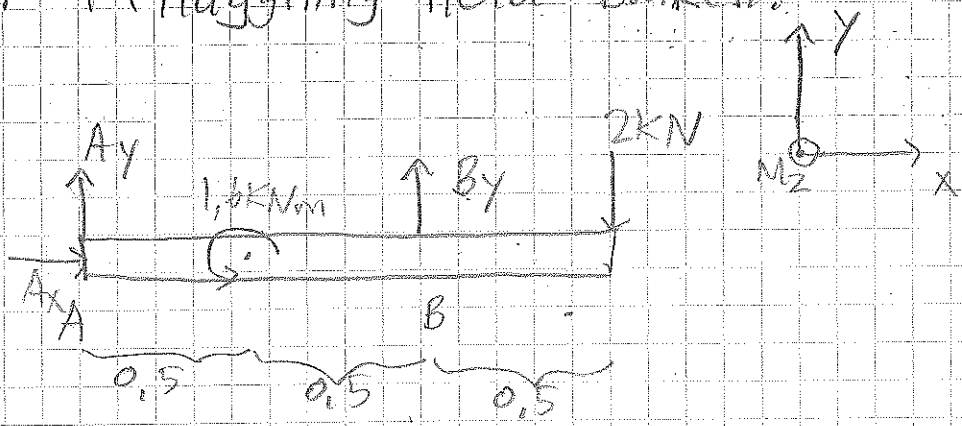
$$\cdot P: A_y + B_y - F = 0$$

$$\curvearrow M_A: -F \cdot \frac{2l}{11} + B_y \cdot 3 = 0$$

$$\Rightarrow B_y = \frac{F \cdot \frac{2l}{11} \cdot 1}{3} = \frac{7}{11} \cdot 6600 = 4200 \text{ N}$$

$$A_y = F - B_y = 6600 - 4200 = 2400 \text{ N}$$

2. Fritläggning hela balkens:



Jämvikt:

$$\rightarrow: A_x = 0$$

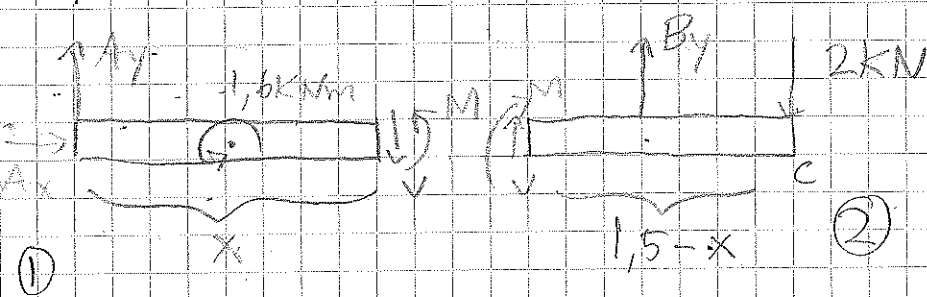
$$\uparrow: A_y + B_y - 2 \text{ kN} = 0$$

$$\curvearrowleft M_A: B_y \cdot 1 - 2 \text{ kN} \cdot 0,5 + 1,6 \text{ kNm} = 0$$

$$\Rightarrow B_y = 1,4 \text{ kN}$$

$$A_y = 0,6 \text{ kN}$$

snitt vänster om B_y : $0 < x < 1$



$$\rightarrow: A_x = 0$$

$$A_x = 0$$

$$\uparrow: A_y - V = 0$$

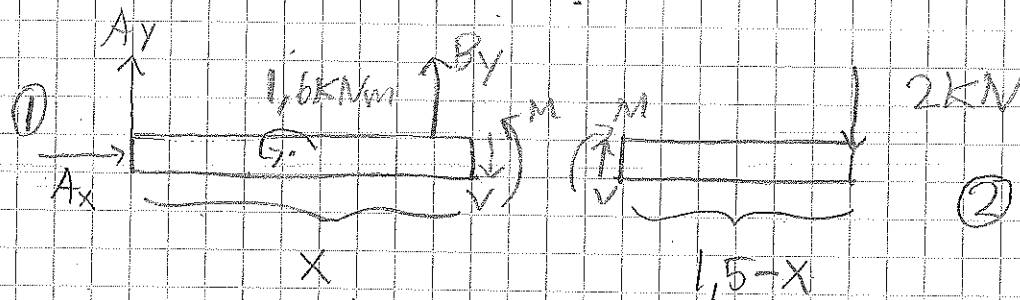
$$\Rightarrow V = 0,6 \text{ kN}$$

$$\curvearrowleft M_A: -Vx + 1,6 \text{ kNm} + M = 0 \quad M = 0,6x \text{ kN} - 1,6 \text{ kNm}$$

2. (Fortsättning). (Endast för kontroll)

2) \rightarrow : — $\Rightarrow V = 0,6 \text{ kN}$
 \uparrow : $B_y - 2 \text{ kN} + V = 0 \Rightarrow M = 0,6 \text{ kN} \cdot x$
 $\curvearrowleft M_c$: $-V(1,5-x) - B_y \cdot 0,5 - M = 0 \Rightarrow -1,6 \text{ kNm}$

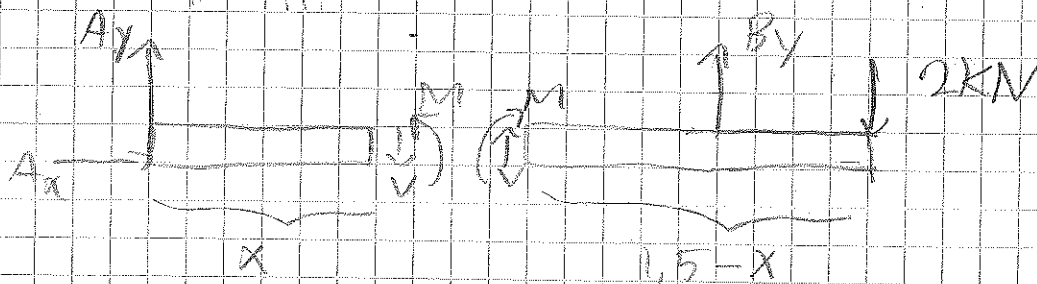
Snitt höger om B_y : $1 < x < 1,5$



1) \rightarrow : $A_x = 0$
 \uparrow : $A_y + B_y - V = 0$
 $\curvearrowleft M_A$: $B_y \cdot 1 + 1,6 \text{ kNm} + M - V \cdot x = 0$

$\Rightarrow V = 2 \text{ kN}$
 $M = 2 \text{ kNm} \cdot x - 3 \text{ kNm}$

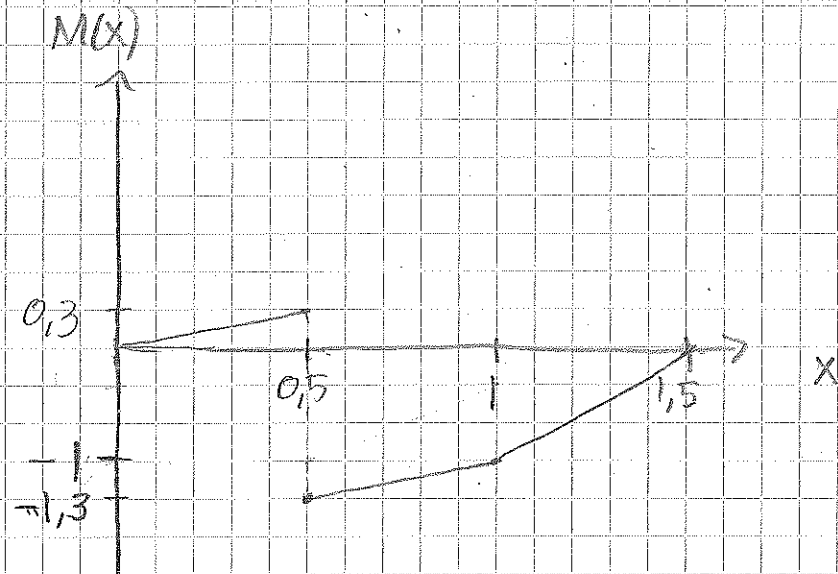
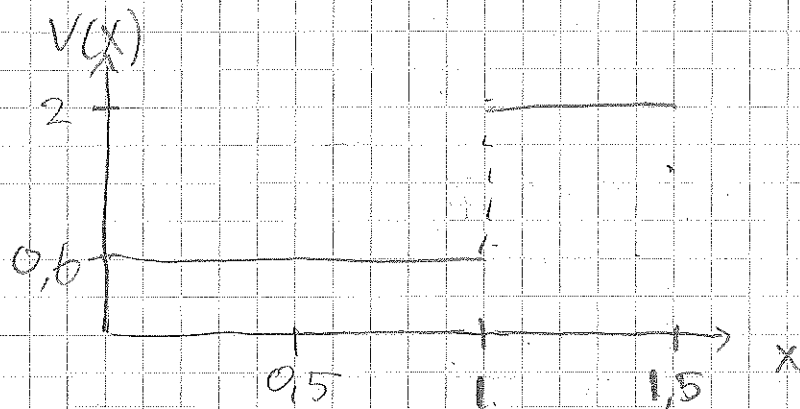
Snitt vänster om momentet: $0 < x < 0,5$



\rightarrow : $A_x = 0$
 \uparrow : $A_y - V = 0 \Rightarrow V = 0,6 \text{ kN}$
 $\curvearrowleft M_A$: $M - Vx = 0 \Rightarrow M = 0,6x \text{ kNm}$

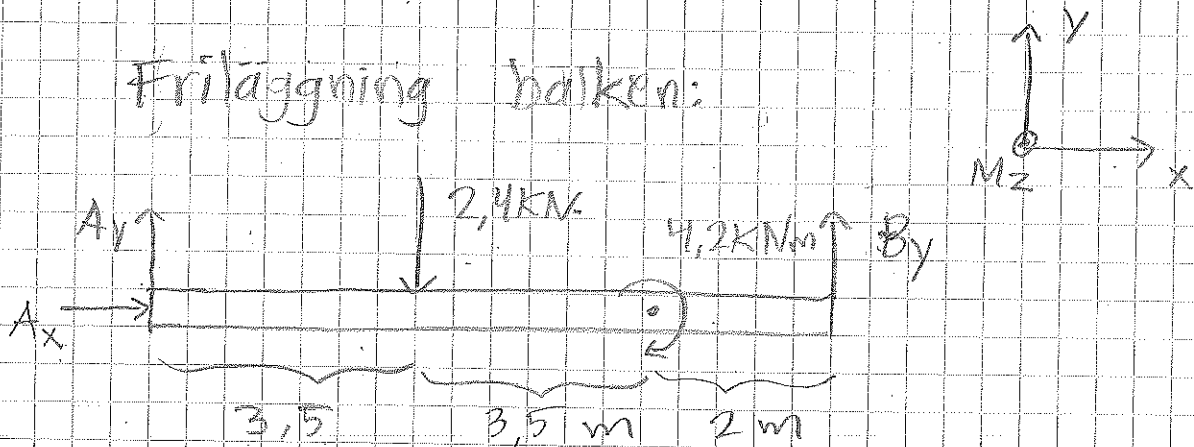
2. (Fortsättning)

Diagram:



3. Resultanten av den utbredda lasten blir $800 \cdot 3 \text{ kN} = 2,4 \text{ kN}$ och pga symmetri verkar den i $x = 3,5$.

Friläggning balken:



Jämvikt:

$$\rightarrow: A_x = 0$$

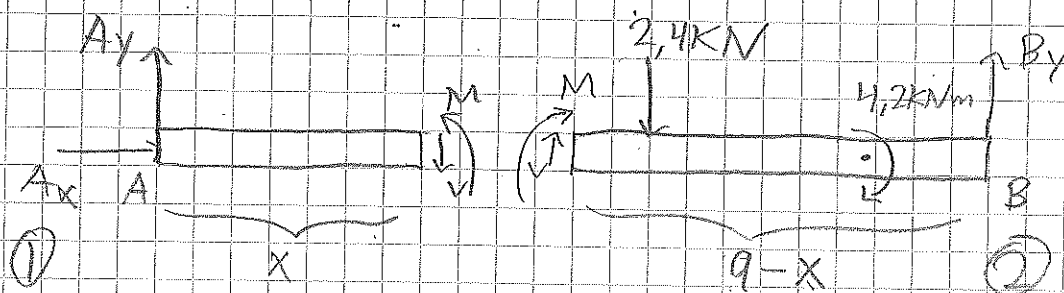
$$\uparrow: A_y + B_y - 2,4 \text{ kN} = 0$$

$$\overset{\curvearrowright}{M}_A: -2,4 \text{ kN} \cdot 3,5 \text{ m} + B_y \cdot 9 \text{ m} - 4,2 \text{ kNm} = 0$$

$$\Rightarrow B_y = 1,4 \text{ kN}$$

$$A_y = 1 \text{ kN}$$

Snitt vänster om 2,4 kN: $0 < x < 3,5$



$$\rightarrow: A_x = 0 \quad V = 1 \text{ kN}$$

$$\uparrow: A_y - V = 0 \quad \Rightarrow M = x \text{ kNm}$$

$$\overset{\curvearrowright}{M}_A: M - Vx = 0$$

2)

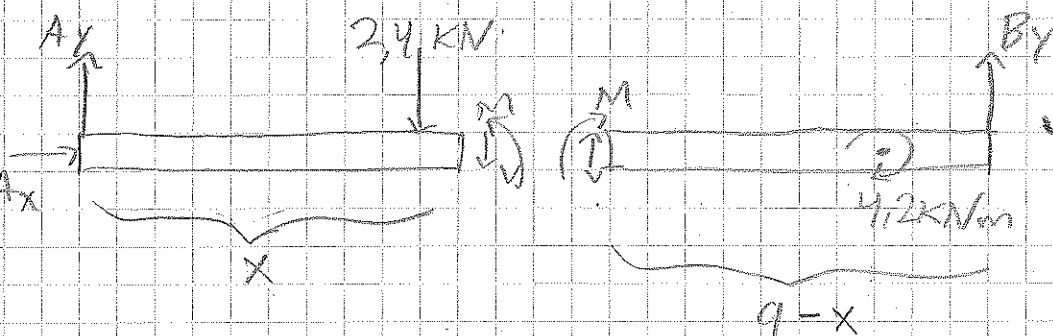
$$\rightarrow: \text{---} \quad \Rightarrow V = 1 \text{ kN}$$

$$\uparrow: V + B_y - 2,4 \text{ kN} = 0$$

$$\overset{\curvearrowright}{M}_B: -V(9-x) + 2,4 \cdot 5,5 - 4,2 \text{ kNm} - M = 0 \quad M = x \text{ kNm}$$

3. (Fortsättning)

snitt till höger om 2,4 kN: $3,5 < x < 5,5$



$$\rightarrow: A_x = 0$$

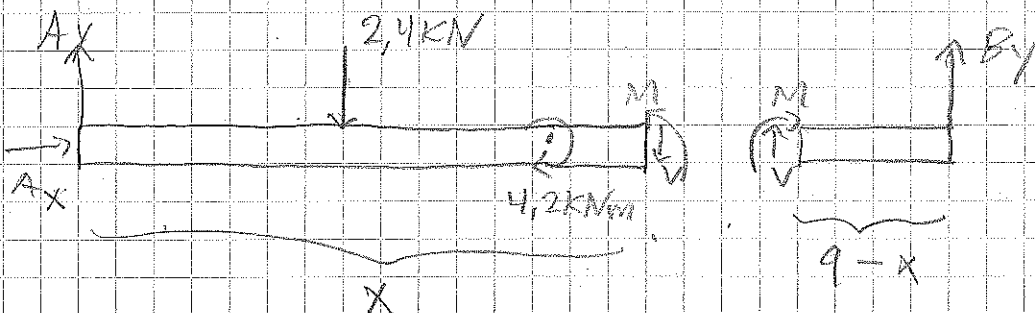
$$\uparrow: A_y - V - 2,4 \text{ kN} = 0$$

$$\curvearrowleft: -Vx + M - 2,4 \cdot 3,5 = 0$$

$$\Rightarrow V = -1,4 \text{ kN}$$

$$M = -1,4x + 8,4$$

snitt höger om momentet: $7 < x < 9$



$$\rightarrow: A_x = 0$$

$$\uparrow: A_y - 2,4 \text{ kN} - V = 0$$

$$\curvearrowleft: M - Vx - 2,4 \text{ kN} \cdot 3,5 - 4,2 \text{ kNm}$$

$$\Rightarrow V = -1,4 \text{ kNm}$$

$$M = -1,4 \text{ kNm} + 12,6 \text{ kNm}$$

Hur välja skärpunkter?

Hur kan $V(x)$ vara linjär?