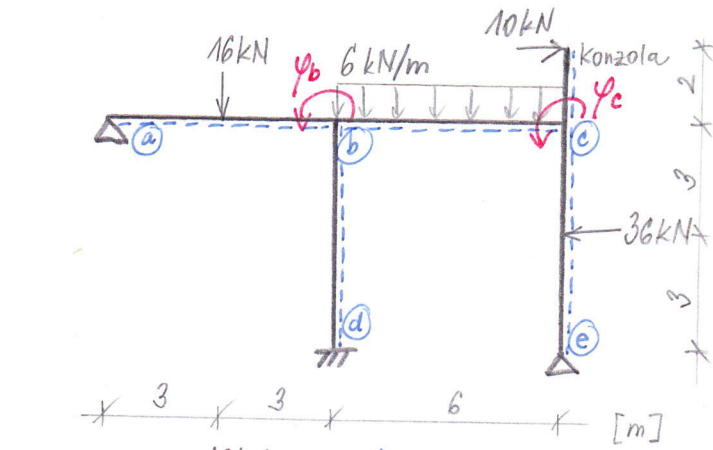


Jednodušenou deformační metodou určete průběh vnitřních sil.



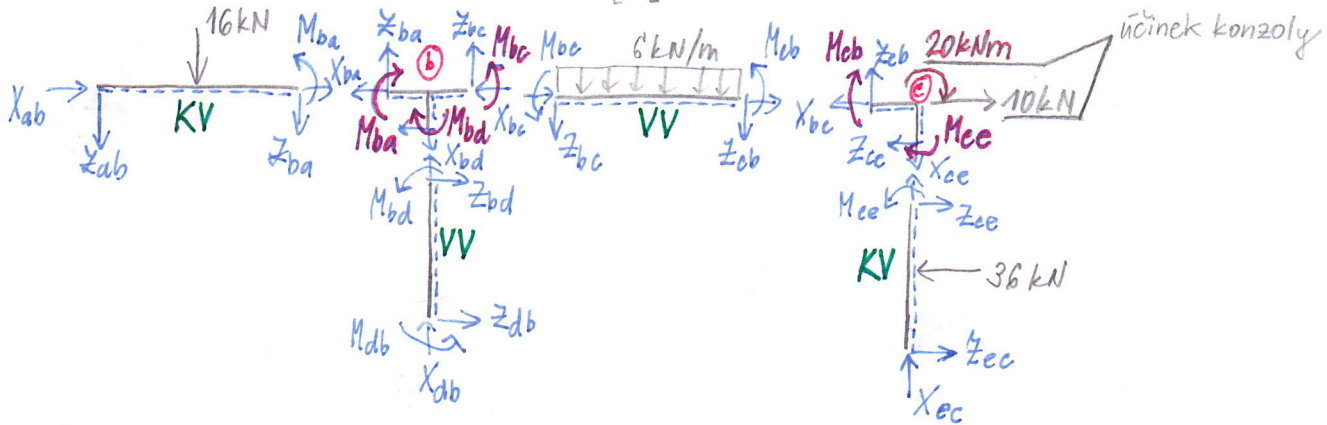
$$EI = 30 \text{ MNm}^2$$

$$J = 3 - 3 - 2 \cdot 2 = -4$$

4x SN kee

ZDM: 2 neznámé: φ_b, φ_c

⇒ momentové podmínky rovnováhy ve styčných bodech (b) a (c)



Podmínky rovnováhy: (b) $M_{ba} + M_{bd} + M_{bc} = 0$

(c) $M_{cb} + M_{ce} + 20 = 0$

$$M_{ba}^{KV} = -\frac{3}{16} \cdot 16 \cdot 6 + \frac{3}{4} \cdot \frac{2 \cdot 30}{6} \cdot 2 \cdot \varphi_b = -18 + 15 \varphi_b$$

$$M_{bd} = \frac{2 \cdot 30}{6} \cdot 2 \cdot \varphi_b = 20 \varphi_b$$

$$M_{bc} = \frac{6 \cdot 6^2}{12} + \frac{2 \cdot 30}{6} (2 \varphi_b + \varphi_c) = 18 + 20 \varphi_b + 10 \varphi_c$$

$$M_{cb} = -\frac{6 \cdot 6^2}{12} + \frac{2 \cdot 30}{6} (\varphi_b + 2 \varphi_c) = -18 + 10 \varphi_b + 20 \varphi_c$$

$$M_{ce}^{KV} = \frac{3}{16} \cdot 36 \cdot 6 + \frac{3}{4} \cdot \frac{2 \cdot 30}{6} \cdot 2 \cdot \varphi_c = 40,5 + 15 \varphi_c$$

$$-18 + 15 \varphi_b + 20 \varphi_b + 18 + 20 \varphi_b + 10 \varphi_c = 0$$

$$-18 + 10 \varphi_b + 20 \varphi_c + 40,5 + 15 \varphi_c + 20 = 0$$

$$55 \varphi_b + 10 \varphi_c = 0$$

$$42,5 + 10 \varphi_b + 35 \varphi_c = 0$$

$$\varphi_c = -5,5 \varphi_b$$

$$42,5 - 182,5 \varphi_b = 0$$

$$\varphi_b = 0,232876412 \text{ mrad}$$

$$\varphi_c = -1,280821918 \text{ mrad}$$

• výpočty koncových momentů

$$M_{ba} = -18 + 15 \cdot 0,232876712 = -14,51 \text{ kNm}$$

$$M_{bd} = 20 \cdot 0,232876712 = 4,66 \text{ kNm}$$

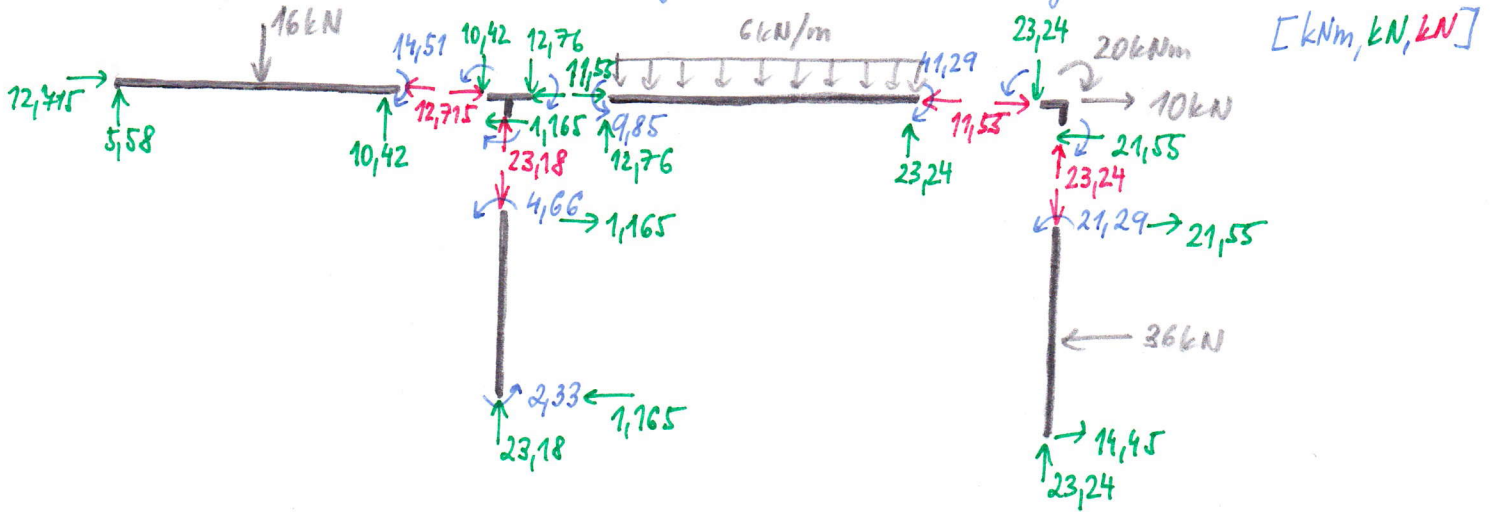
$$M_{bc} = 18 + 20 \cdot 0,232876712 + 10 \cdot (-1,280821918) = 9,85 \text{ kNm}$$

$$M_{cb} = -18 + 10 \cdot 0,232876712 + 20 \cdot (-1,280821918) = -41,29 \text{ kNm}$$

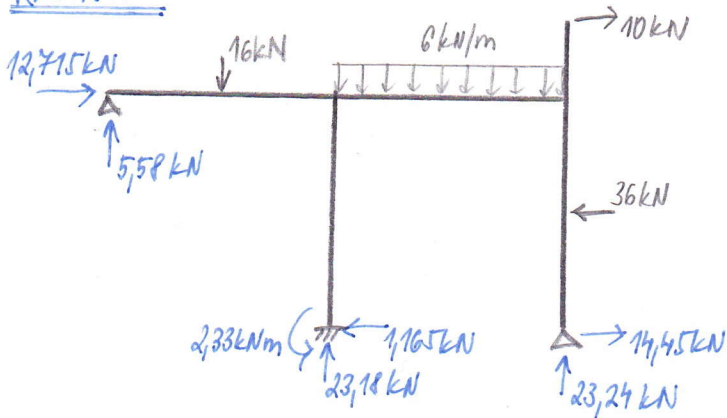
$$M_{ce} = 40,5 + 15 \cdot (-1,280821918) = 21,29 \text{ kNm}$$

$$M_{db} = 10 \cdot y_b = 10 \cdot 0,232876712 = 2,33 \text{ kNm}$$

• dopočítání koncových sil z rovnováhy na prutech a ve stýčnicích



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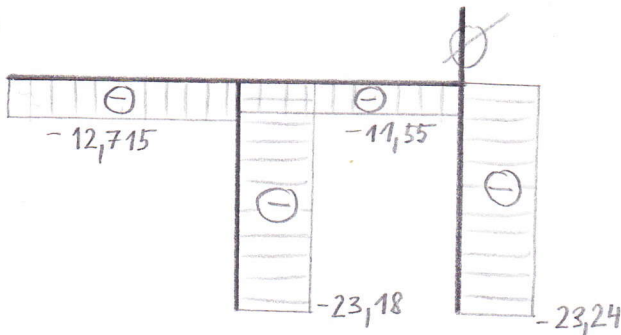
Kontrola vnitřní rovnováhy:

$$\uparrow: 5,58 + 23,18 + 23,24 - 16 - 6 \cdot 6 = 0 \quad \checkmark$$

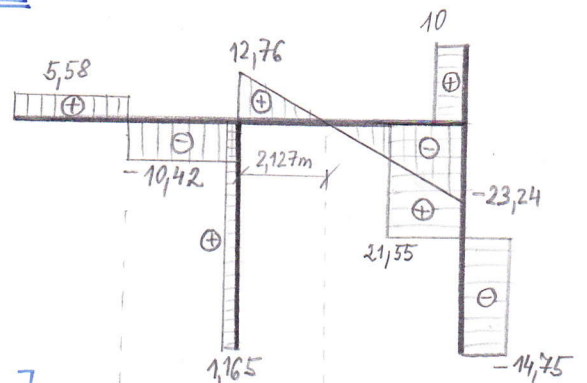
$$\rightarrow: 12,715 - 1,165 + 14,45 + 10 - 36 = 0 \quad \checkmark$$

$$\text{vd): } -12,715 \cdot 6 - 5,58 \cdot 6 + 16 \cdot 3 - 6 \cdot \frac{6^2}{2} - 10 \cdot 8 + 36 \cdot 3 + 23,34 \cdot 6 + 2,33 = 0 \quad \checkmark$$

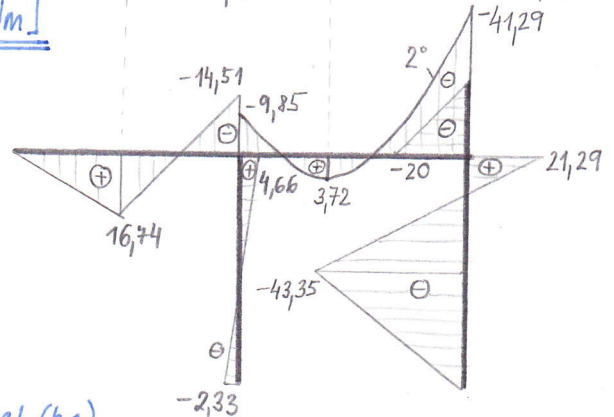
N[kN]



V[kN]



M[kNm]



interval (b,e)

$$V(x) = 12,76 - 6x$$

$$M(x) = -9,85 + 12,76x - 6 \cdot \frac{x^2}{2}$$

$$V(x_{ext}) = 0 \Rightarrow x_{ext} = 2,127 \text{ m}$$

$$M_{ext} = M(x_{ext}) = 3,72 \text{ kNm}$$