

$\sum \overset{\curvearrowright}{M} = 0$

$M_{21} = M_{23}$ $M_{32} = M_{34}$

$M_{21} + M_{23} = 0$ $M_{32} + M_{34} = 0$

$$M_{21} = -\frac{1}{8} F L_1 + \frac{4EI}{L_1} \varphi_2 + \frac{2EI}{L_1} \varphi_1 \rightarrow 0$$

$$M_{23} = \frac{1}{12} f L_2^2 + \frac{4EI}{L_2} \varphi_2 + \frac{2EI}{L_2} \varphi_3$$

$$M_{32} = -\frac{1}{12} f L_2^2 + \frac{2EI}{L_2} \varphi_2 + \frac{4EI}{L_2} \varphi_3$$

$$M_{34} = \frac{4EI}{L_3} \varphi_3 + \frac{2EI}{L_3} \varphi_4 \rightarrow 0$$

$$4EI \left(\frac{1}{L_1} + \frac{1}{L_2} \right) \varphi_2 + \frac{2EI}{L_2} \varphi_3 = \frac{1}{8} F L_1 - \frac{1}{12} f L_2^2$$

$$\frac{2EI}{L_2} \varphi_2 + 4EI \left(\frac{1}{L_2} + \frac{1}{L_3} \right) \varphi_3 = \frac{1}{12} f L_2^2$$

$$I = \frac{1}{12} b h^3 = \frac{1}{12} 0,24 \cdot 0,4^3 \text{ m}^4 = 1,28 \cdot 10^{-3} \text{ m}^4$$

$$EI = 20 \cdot 10^9 \cdot 1,28 \cdot 10^{-3} \text{ Nm}^2 = 25,6 \text{ MNm}^2$$

Dodadime u jednolka'de MN, m :

φ_2	φ_3	PS
$102,4 \left(\frac{1}{3,2} + \frac{1}{4} \right)$	$\frac{51,2}{4}$	$\frac{1}{8} \cdot 0,16 \cdot 3,2 - \frac{1}{12} \cdot 0,06 \cdot 4^2$
$\frac{51,2}{4}$	$102,4 \left(\frac{1}{4} + \frac{1}{2} \right)$	$\frac{1}{12} \cdot 0,06 \cdot 4^2$

φ_2	φ_3	PS
57,6	12,8	-0,016
12,8	76,8	0,08

$$\Rightarrow \begin{cases} \varphi_2 = -0,5288 \times 10^{-3} \\ \varphi_3 = 1,1298 \times 10^{-3} \end{cases}$$



$$M_{21} = -\frac{1}{8} FL_1 + \frac{4EI}{L_1} \varphi_2 = \left[-\frac{1}{8} \cdot 0,16 \cdot 3,2 + \frac{102,4}{3,2} \cdot (-0,5288) \cdot 10^{-3} \right] \text{ MNm} = -80,92 \text{ kNm}$$

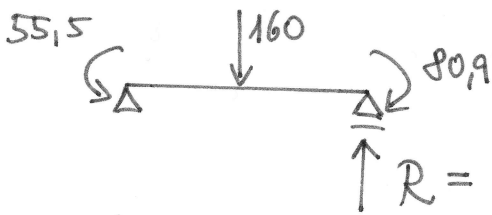
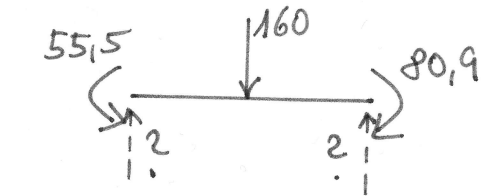
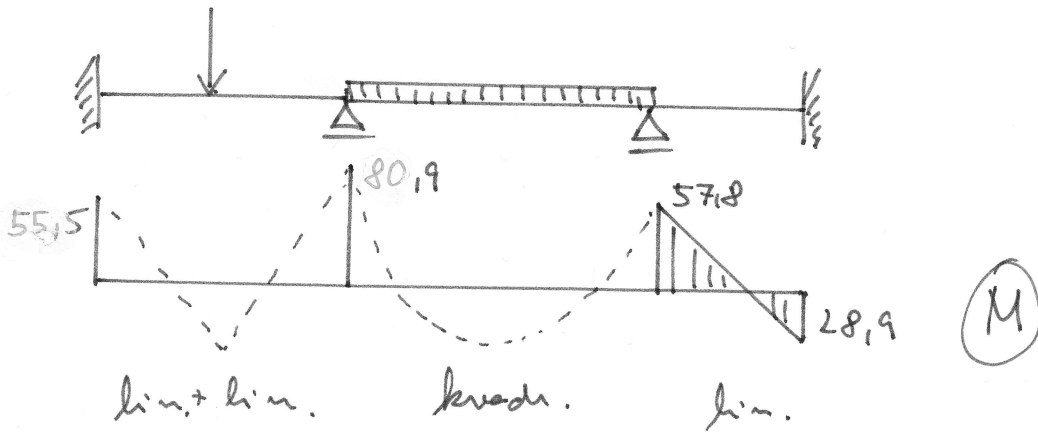
$$M_{23} = \dots = 80,92 \text{ kNm} \quad \rightarrow \text{kontrola}$$

$$M_{32} = \dots = -57,85 \text{ kNm}$$

$$M_{34} = \dots = 57,85 \text{ kNm} \quad \rightarrow \text{kontrola}$$

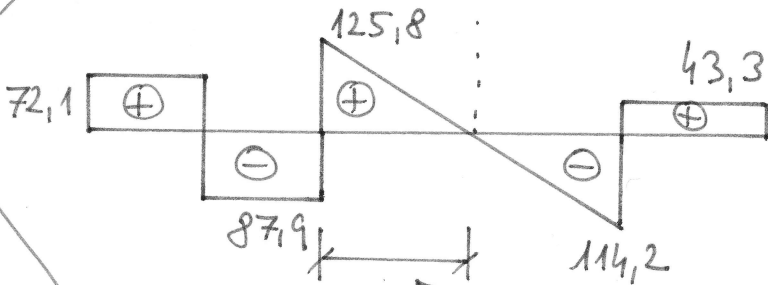
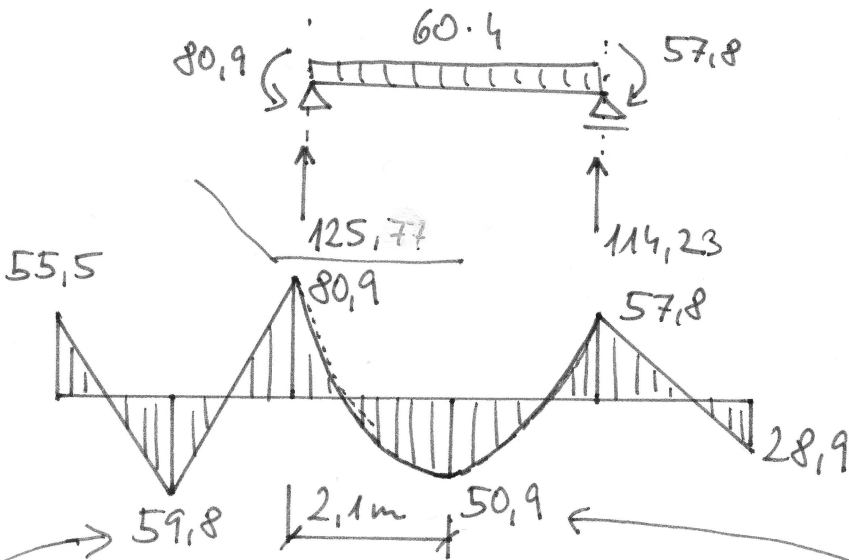
$$M_{12} = \frac{1}{8} FL_1 + \frac{2EI}{L_1} \varphi_2 = \dots = 55,51 \text{ kNm}$$

$$M_{43} = \frac{2EI}{L_3} \varphi_3 = \dots = 28,92 \text{ kNm}$$



$\uparrow 160 - 87,9 = 72,1$

$$R = \frac{-55,5 + 160 \cdot 1,6 + 80,9}{3,2} \text{ kN} = 87,9 \text{ kN}$$



$-55,5 + 72,06 \cdot 1,6 = 59,79$

$-80,92 + \frac{1}{2} \cdot 125,77 \cdot 2,096 = 50,89$

$\frac{125,77}{125,77 + 114,23} \cdot 4 = 2,096$

Maximální normálové a smykové napětí:

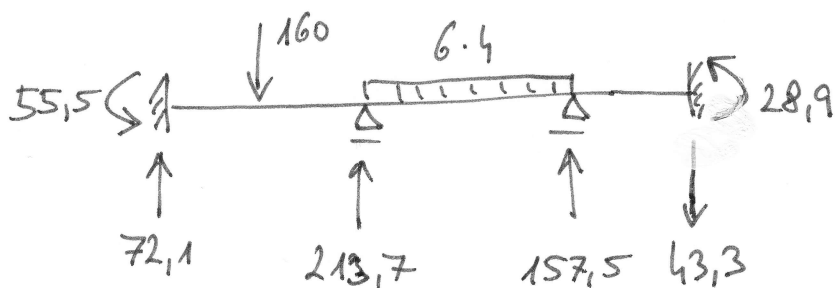
$$\max M = 80,9 \text{ kNm}$$

$$\max \sigma = \frac{\max M}{I} \cdot \frac{h}{2} = \frac{80,9}{1,28 \cdot 10^{-3}} \cdot \frac{0,4}{2} \text{ kPa} = 12,6 \text{ MPa}$$

$$\max Q = 125,8 \text{ kN}$$

$$\max \tau = \frac{\max Q \cdot \bar{S}_{\max}}{b I} = \frac{125,8 \cdot 0,24 \cdot 0,2 \cdot 0,1 \text{ kPa}}{0,24 \cdot 1,28 \cdot 10^{-3}} = 1,97 \text{ MPa}$$

Stanovení reakcí:



Kontrola rovnováhy:

$$\downarrow : -72,1 + 160 - 213,7 + 6 \cdot 4 - 157,5 + 43,3 \stackrel{?}{=} 0$$

$$0 = 0 \dots \text{ok}$$

$$\begin{aligned} \curvearrowleft : & 55,5 - 160 \cdot 1,6 + 213,7 \cdot 3,2 - 6 \cdot 4 \cdot 5,2 + 157,5 \cdot 7,2 - \\ & - 43,3 \cdot 9,2 + 28,9 \stackrel{?}{=} 0 \end{aligned}$$

$$-0,12 \text{ kNm} \stackrel{?}{=} 0$$

chyba zaokrouhlování... přijatelná!