

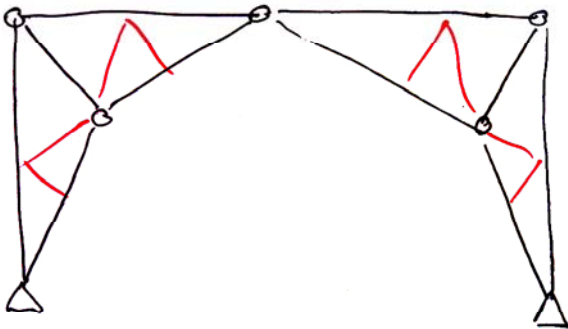
Počet členů: $26 \dots \times 3 = 78 \text{ SV}$

$\Sigma \text{ SV}$

$$78 - 66 \text{ SV} = -8 \text{ SV}$$

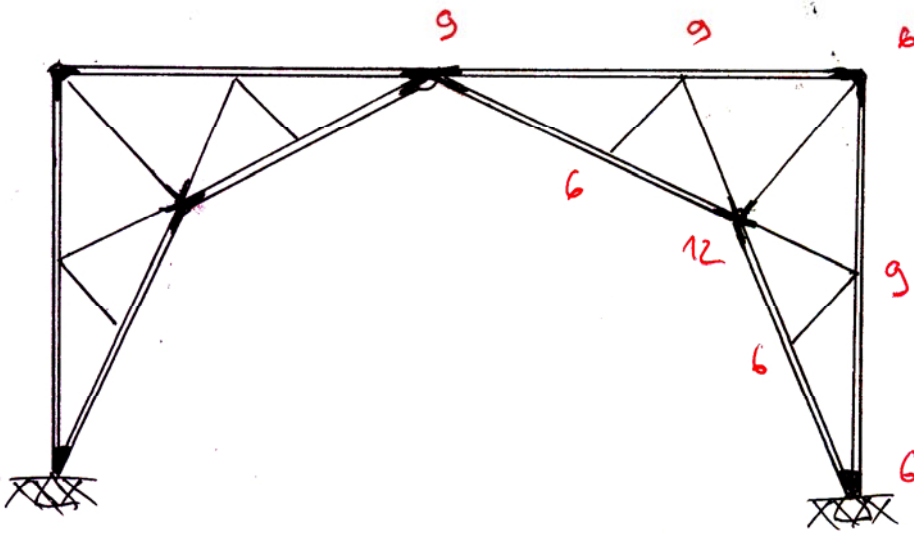
konstrukce je 8x staticky neurčitá ... vnitřní

Jiný postup - zjednodušená na SK konstrukci



na SK

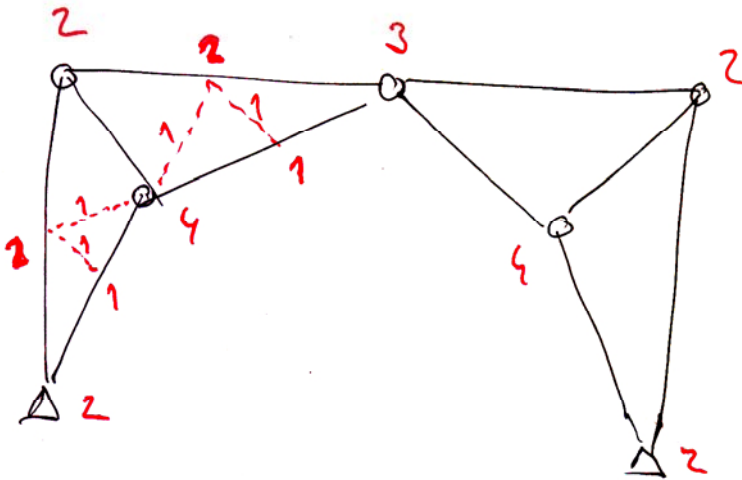
na nově 8 prutů ... $8 \times 1 \text{ SV}$



26 desel ... 78 sv

$\Sigma 117 sv$

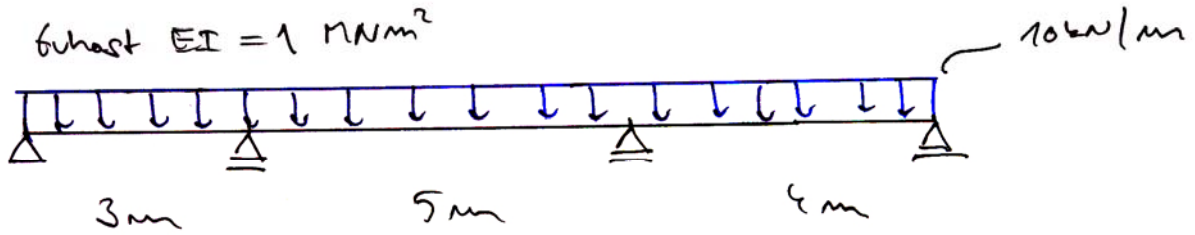
$\Rightarrow 39 \times SN$



Uvedeno 39 uzavet

Silová metoda

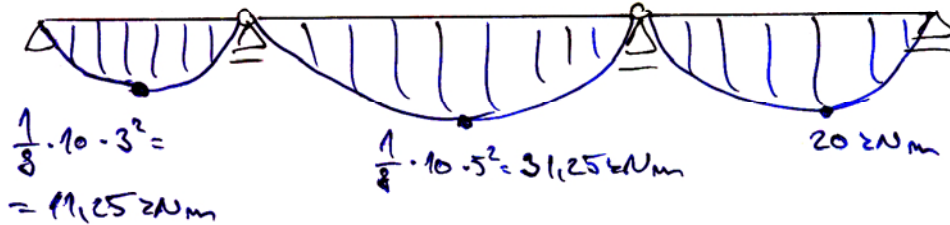
Pr. 1 - PRŮBĚH SIL NA SPOJITÉM NOSNÍKU



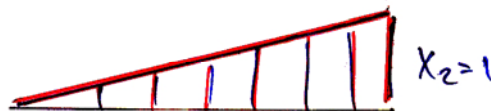
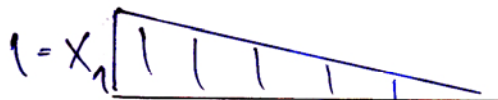
- 1) Urdíme stupeň statické nadvýbavosti ---- 2
- 2) Urdíme 2 vavby, vytvoříme základní sílu konstrukci, zavedeme příslušné SN vavby.



- 3) Na základní soustavě urdíme vnitřní síly od zatížení \bar{M}_f



- 4) Na základní soustavě urdíme vnitřní síly \bar{M}_i od jednotkových SN vavb $X_i = 1$



5) Vypočítame δ_{ij}, δ_{if}

$$\delta_{if} = \sum_1 \int_0^L \frac{\bar{\pi}_i(x) \bar{\pi}_f(x)}{EI} dx$$

$$\delta_{1f} = \frac{1}{3} (-1) \cdot 11,25 \cdot 3 = -11,25$$

$$+ \frac{1}{3} (-1) \cdot 31,25 \cdot 5 = -52,0833$$

$$\Sigma = -63,333$$

$$\delta_{2f} = \frac{1}{3} (-1) \cdot 20 \cdot 4 = -26,667$$

$$+ \frac{1}{3} (-1) \cdot 31,25 \cdot 5 = -52,0833$$

$$\Sigma = -78,75$$

$$\delta_{11} = \frac{1}{3} (-1) \cdot (-1) \cdot 3 + \frac{1}{3} (-1) \cdot (-1) \cdot 5 = 1 + \frac{5}{3} = \frac{8}{3} = 2,667$$

$$\delta_{22} = \frac{1}{3} (-1) \cdot (-1) \cdot 4 + \frac{1}{3} (-1) \cdot (-1) \cdot 5 = \frac{4}{3} + \frac{5}{3} = 3$$

$$\delta_{12} = \emptyset + \frac{1}{6} (-1) \cdot (-1) \cdot 5 = 0,8333$$

6) Soustava rovnice:

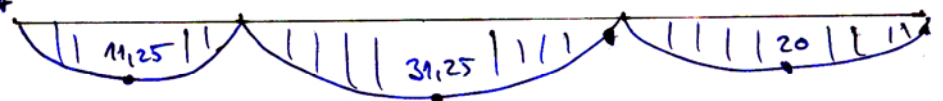
$$\begin{bmatrix} \delta_{11} & \delta_{12} \\ \delta_{12} & \delta_{22} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} -\delta_{1f} \\ -\delta_{2f} \end{bmatrix}$$

$$x_1 = 17,0225$$

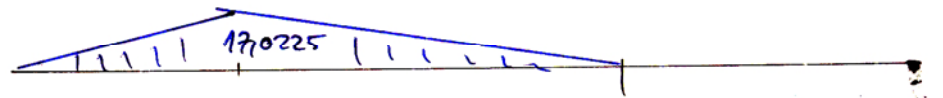
$$x_2 = 21,5217$$

7) Vypočítame vnútornú silu na skľapanej neutrálnej konštrukcii určíme jeho kombináciu

$$M = \bar{\pi}_f + x_1 \bar{\pi}_1 + x_2 \bar{\pi}_2$$



$x_1 \bar{\pi}_1$

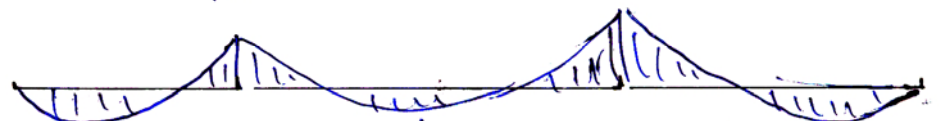


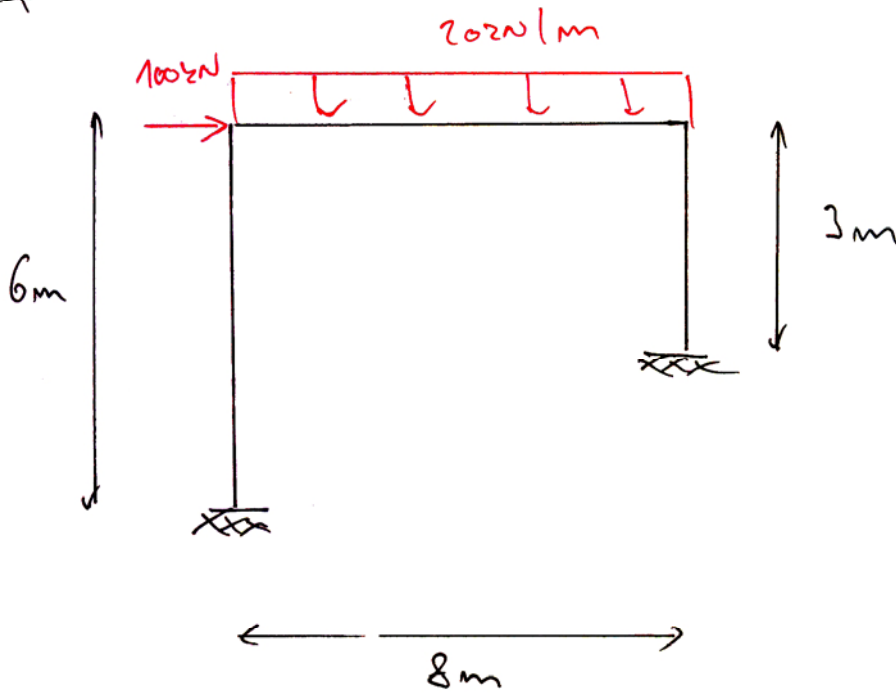
$x_2 \bar{\pi}_2$



17,0225

21,52



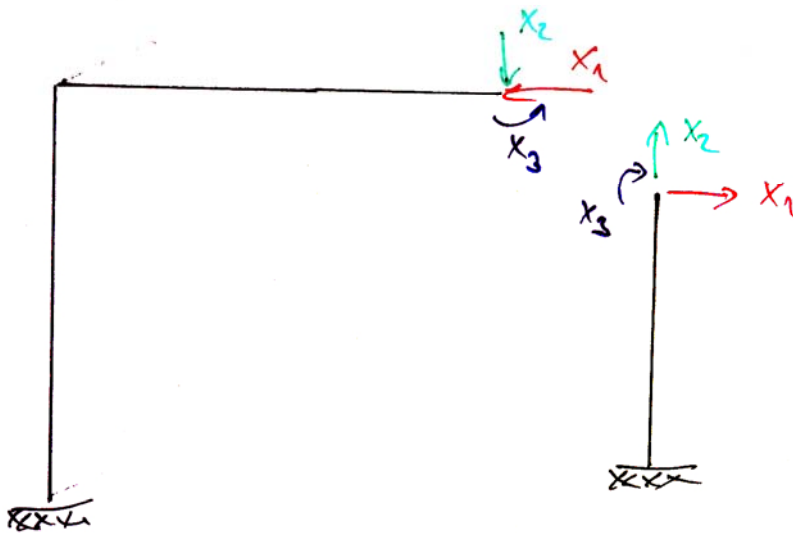


$EA = 56N = 50007N$

$EI = 5077N\cdot m^2$

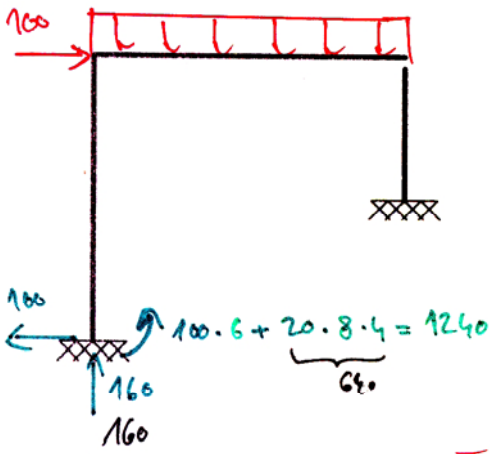
Silovou metodu využijte zadání konstrukce: – problémy uvnitřních síl.
 Všechny součtové členy zanedbávejte; prozoborněte uhlíkové státnílosti; práce na výsledné problémy!

⊗ Konstrukce rozdělíme na dvě součásti: ... = základní soustava, zavedeme veličiny $x_1 - x_3$

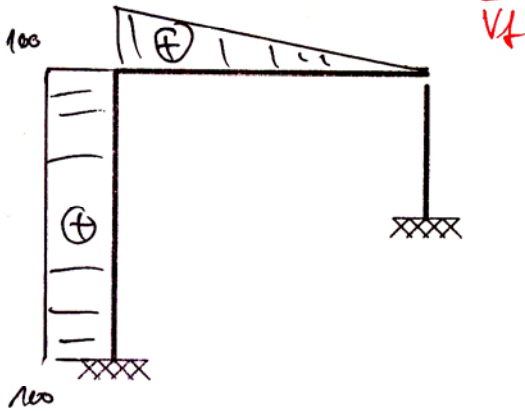
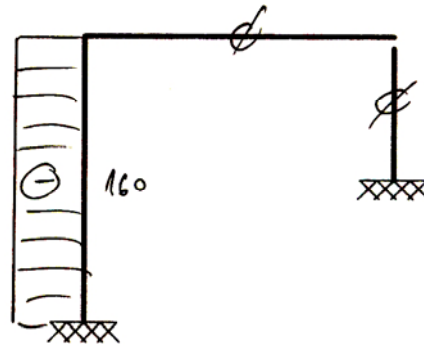


Na základní soustavě vyřadíme působení uvnitř síl!

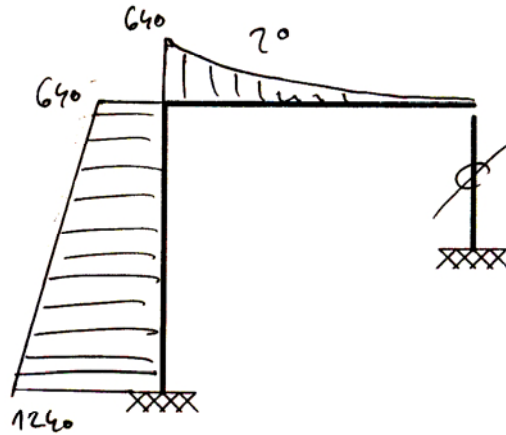
rozřez/m



\bar{M}_1



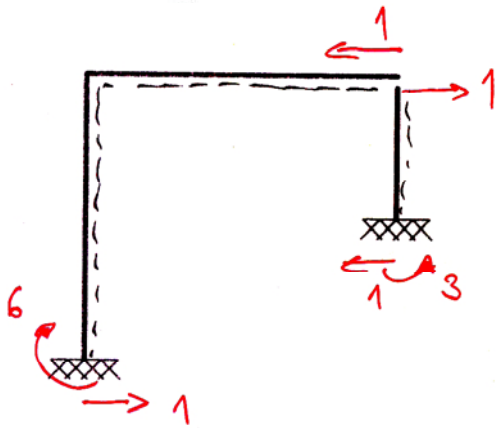
\bar{V}_1



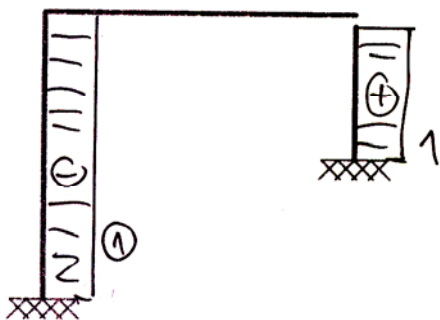
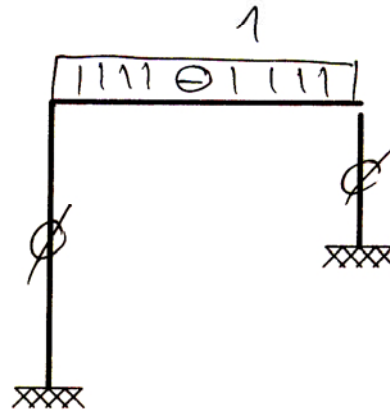
\bar{M}_1

Virt. stav X_1

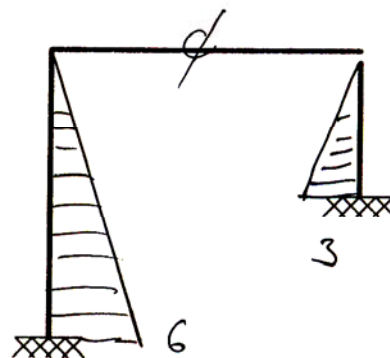
Zatížení + reakce



\bar{V}_1



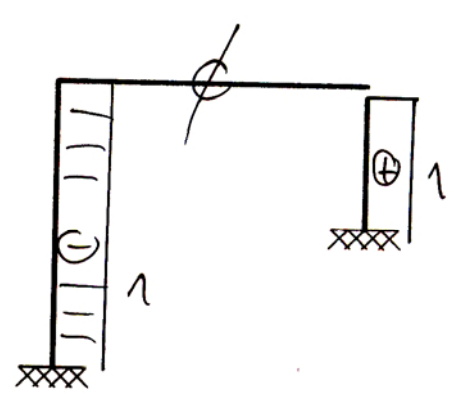
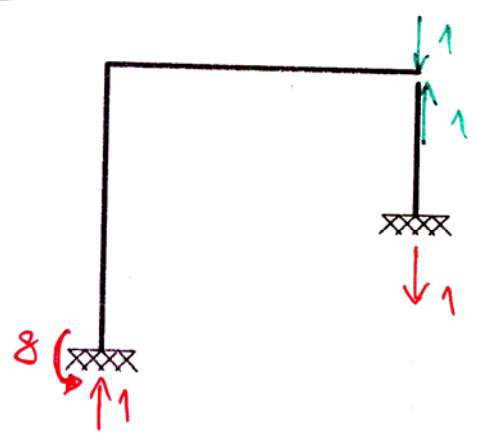
\bar{V}_1



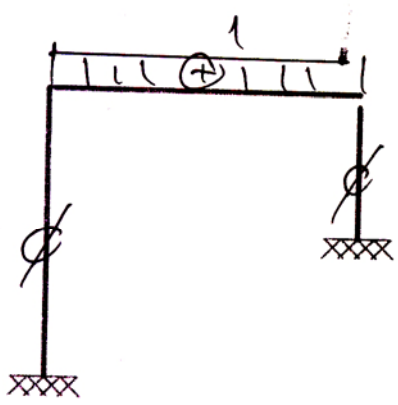
\bar{M}_1

Virtualni stav X_2

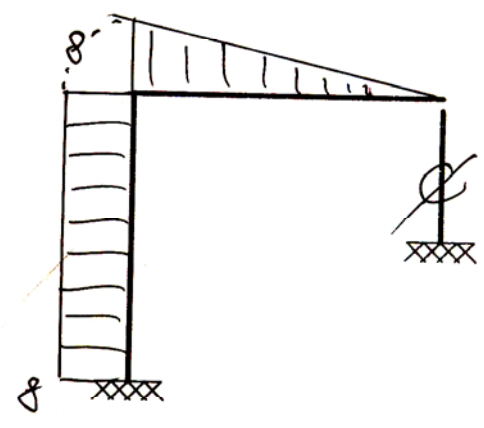
Zatvorenica:



\bar{N}_2



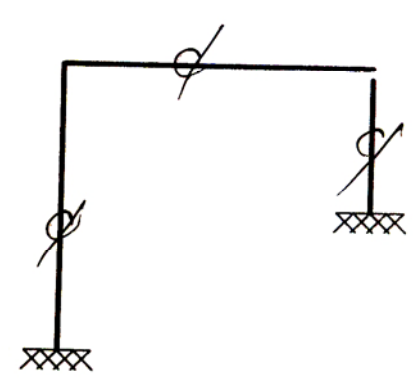
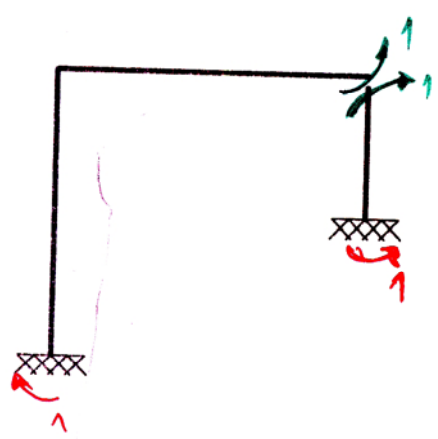
\bar{V}_2



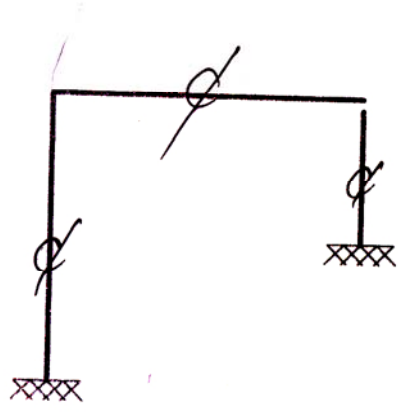
\bar{M}_2

Virtualni stav X_3

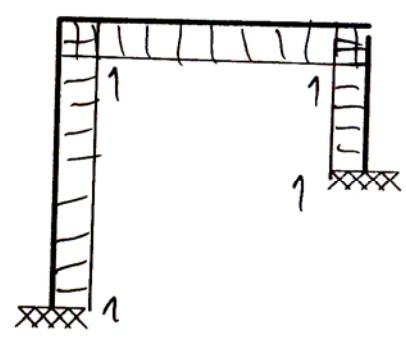
Zatvorenica + razluc



\bar{N}_3



\bar{V}_3



\bar{M}_3

Výpočet veličin $\delta_{ij}^N, \delta_{ij}^M$

$$\bullet \delta_{11}^M = \frac{1}{EI} \cdot \frac{1}{6} \cdot 6 \left(2(-1240) + (-640) \right) \cdot 6 = -18720/EI = -374,4$$

$$\delta_{11}^N = \frac{1}{EA} \cdot \emptyset = 0$$

$$\bullet \delta_{21}^M = \frac{1}{EI} \cdot \left[\frac{1}{2} \cdot 8 \left(640 + 1240 \right) \cdot 6 + \frac{1}{4} \cdot 640 \cdot 8 \cdot 8 \right] = \frac{45120 + 10240}{50} = 1107,2$$

$$\delta_{21}^N = \frac{1}{EA} \cdot 160 \cdot 6 = 0,192$$

$$\bullet \delta_{31}^M = \frac{1}{EI} \left[\frac{1}{2} \cdot (-1) \left(640 + 1240 \right) \cdot 6 + \frac{1}{3} \cdot (-1) \cdot 640 \cdot 8 \right] = \frac{-5640 - 1706,67}{50} = -146,933$$

$$\delta_{31}^N = \frac{1}{EA} \cdot \emptyset = 0$$

$$\bullet \delta_{11}^M = \frac{1}{EI} \cdot \left[\frac{1}{3} \cdot 6^2 \cdot 6 + \frac{1}{3} \cdot 3^2 \cdot 3 \right] = \frac{72 + 9}{50} = 1,62$$

$$\bullet \delta_{11}^N = \frac{1}{EA} \cdot (4)^2 \cdot 8 = \frac{8}{5000} = 0,0016$$

$$\bullet \delta_{12}^M = \frac{1}{EI} \left[\frac{1}{2} \cdot 6 \cdot (-8) \cdot 6 \right] = \frac{-144}{50} = -2,88$$

$$\bullet \delta_{12}^N = \frac{1}{EA} \cdot [0] = 0$$

$$\bullet \delta_{13}^M = \frac{1}{EI} \left[\frac{1}{2} \cdot 6 \cdot 1 \cdot 6 + \frac{1}{2} \cdot 3 \cdot 1 \cdot 3 \right] = \frac{18 + 4,5}{50} = 0,45$$

$$\bullet \delta_{13}^N = 0$$

$$\bullet \delta_{22}^M = \frac{1}{EI} \left[8^2 \cdot 6 + \frac{1}{3} \cdot 8^2 \cdot 8 \right] = \frac{384 + 1706,67}{50} = 11,0933$$

$$\bullet \delta_{22}^N = \frac{1}{EA} \cdot [6+3] = \frac{9}{5000} = 0,0018$$

$$\bullet \delta_{23}^{\Pi} = \frac{1}{EI} \left[-8 \cdot 6 + \frac{1}{2}(-8) \cdot 8 \right] = \frac{-48 - 32}{50} = -1,6$$

$$\delta_{23}^N = 0$$

$$\bullet \delta_{33}^{\Pi} = \frac{1}{EI} [6 + 8 + 3] = 0,34$$

$$\delta_{33}^N = 0$$

→ sestavíme soustavu lineárních rovnic pro neznámé X_1, X_2, X_3

$$\begin{bmatrix} \delta_{11} & \delta_{12} & \delta_{13} \\ \delta_{12} & \delta_{22} & \delta_{23} \\ \delta_{13} & \delta_{23} & \delta_{33} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} -\delta_{1f} \\ -\delta_{2f} \\ -\delta_{3f} \end{bmatrix}$$

$$\Rightarrow X_1 = 105,6457$$

$$X_2 = -94,0578$$

$$X_3 = -150,294$$

pro uvořené δ_{ij}^N

$$X_1 = 105,444$$

$$X_2 = -94,1072$$

$$X_3 = -150,26$$

Zatlechná soustava:

SMB, cv. 11, str. 80

