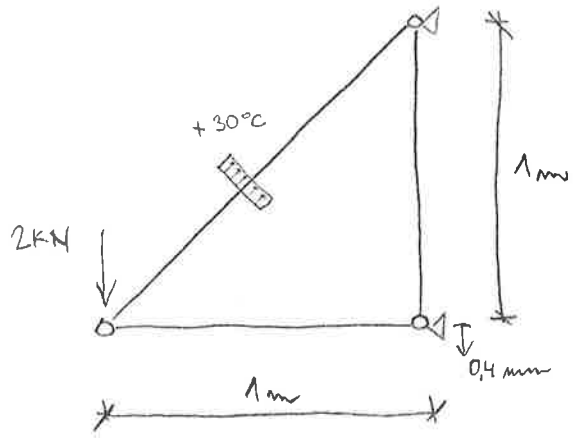
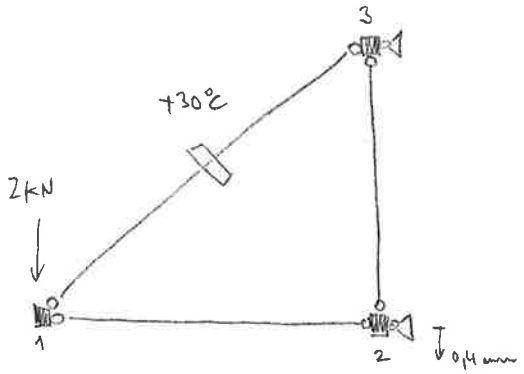


3cm

$E = 210\ GPa$

$A = 7{,}069 \cdot 10^{-4}\ m^2$

$\alpha_T = 10^{-5}\ K^{-1}$



$$\{r\} = \begin{Bmatrix} w_1 \\ w_1 \end{Bmatrix} \qquad \{s\} = \begin{Bmatrix} 0 \\ 2000 \end{Bmatrix}$$

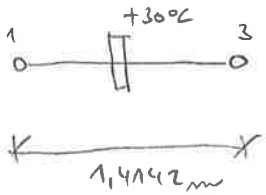
PRUT 12

$$[k_{12}^*] = \begin{array}{c|cccc|c} w_1 & w_{r1} & \varphi_1 & w_2 & w_2 & \varphi_2 & \\ \hline 1{,}484 \cdot 10^8 & 0 & 0 & -1{,}484 \cdot 10^8 & 0 & 0 & X_1 \\ & 0 & 0 & 0 & 0 & 0 & Z_1 \\ & & 0 & 0 & 0 & 0 & M_1 \\ -1{,}484 \cdot 10^8 & & & 1{,}484 \cdot 10^8 & 0 & 0 & X_2 \\ & & & & 0 & 0 & Z_2 \\ & & & & & 0 & M_2 \end{array}$$

$$\{\bar{R}_{12}^*\} = \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{\tilde{R}_{12}^*\} = [K_{12}^*] \cdot \{\tilde{r}_{12}^*\} = \{0\}$$

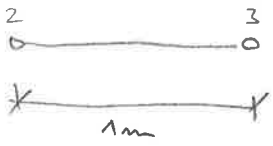
PRUT 13



$$[K_{13}^*] = \begin{bmatrix} 1,05 \cdot 10^8 & & & -1,05 \cdot 10^8 & & \\ & & & & & \\ & & & & & \\ -1,05 \cdot 10^8 & & & 1,05 \cdot 10^8 & & \\ & & & & & \\ & & & & & \end{bmatrix} \begin{matrix} u_1 \\ w_1 \\ \varphi_1 \\ u_3 \\ w_3 \\ \varphi_3 \end{matrix} \quad \begin{matrix} X_1 \\ Z_1 \\ \Pi_1 \\ X_3 \\ Z_3 \\ \Pi_3 \end{matrix}$$

$$\{\bar{R}_{13}^*\} = \begin{Bmatrix} 44535 \\ 0 \\ 0 \\ -44535 \\ 0 \\ 0 \end{Bmatrix}$$

PRUT 23



$$[K_{23}^*] = \begin{bmatrix} 1,484 \cdot 10^8 & & & -1,484 \cdot 10^8 & & \\ & & & & & \\ & & & & & \\ -1,484 \cdot 10^8 & & & 1,484 \cdot 10^8 & & \\ & & & & & \\ & & & & & \end{bmatrix} \begin{matrix} u_2 \\ w_2 \\ \varphi_2 \\ u_3 \\ w_3 \\ \varphi_3 \end{matrix} \quad \begin{matrix} X_2 \\ Z_2 \\ \Pi_2 \\ X_3 \\ Z_3 \\ \Pi_3 \end{matrix}$$

TOTOŽNÁ S $[K_{12}^*]$

$$\{\bar{R}_{23}^*\} = \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{\tilde{R}_{23}^*\} = [K_{23}^*]\{\tilde{r}_{23}^*\}$$

$$\{\tilde{R}_{23}^*\} = [K_{23}^*] \begin{Bmatrix} -0,0004 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} -59\,380 \\ 0 \\ 0 \\ 59\,380 \\ 0 \\ 0 \end{Bmatrix} \begin{matrix} X_2 \\ Z_2 \\ \Pi_2 \\ X_3 \\ Z_3 \\ \Pi_3 \end{matrix}$$

TRANSFORMACE

PRUT 12

$$[K_{12}] = [K_{12}^*]; \quad \{\bar{R}_{12}\} = \{\bar{R}_{12}^*\}$$

PRUT 13

$$[K_{13}] = [T_{13}]^T [K_{13}^*][T_{13}]$$

$$\{\bar{R}_{13}\} = [T_{13}]^T \{\bar{R}_{13}^*\}$$

$$[T_{13}] = \begin{bmatrix} 0{,}707 & -0{,}707 & & & & \\ 0{,}707 & 0{,}707 & & & & \\ & & 1 & & & \\ & & & 0{,}707 & -0{,}707 & \\ & & & 0{,}707 & 0{,}707 & \\ & & & & & 1 \end{bmatrix}$$

$$[K_{13}] = \begin{array}{c|cccccc} & w_1 & w_2 & \varphi_1 & w_3 & w_4 & \varphi_3 \\ \hline w_1 & 5{,}248\cdot 10^7 & -5{,}248\cdot 10^7 & 0 & -5{,}248\cdot 10^7 & 5{,}248\cdot 10^7 & 0 \\ w_2 & & 5{,}248\cdot 10^7 & 0 & 5{,}248\cdot 10^7 & -5{,}248\cdot 10^7 & 0 \\ \varphi_1 & & & 0 & 0 & 0 & 0 \\ w_3 & & & & 5{,}248\cdot 10^7 & -5{,}248\cdot 10^7 & 0 \\ w_4 & & & & & 5{,}248\cdot 10^7 & 0 \\ \varphi_3 & & & & & & 0 \end{array} \begin{array}{c} X_1 \\ Z_1 \\ \Pi_1 \\ X_3 \\ Z_3 \\ \Pi_3 \end{array}$$

$$\{\bar{R}_{13}\} = \begin{Bmatrix} 31491 \\ -31491 \\ 0 \\ -31491 \\ 31491 \\ 0 \end{Bmatrix} \begin{array}{c} X_1 \\ Z_1 \\ \Pi_1 \\ X_3 \\ Z_3 \\ \Pi_3 \end{array}$$

PRUT 23

$$[K_{23}] = \begin{array}{c|cccccc} & w_2 & w_2 & \varphi_2 & w_3 & w_3 & \varphi_3 \\ \hline w_2 & 0 & 0 & 0 & 0 & 0 & 0 \\ w_2 & & 1{,}484\cdot 10^8 & 0 & 0 & -1{,}484\cdot 10^8 & 0 \\ \varphi_2 & & & 0 & 0 & 0 & 0 \\ w_3 & & & & 0 & 0 & 0 \\ w_3 & & & & & 1{,}484\cdot 10^8 & 0 \\ \varphi_3 & & & & & & 0 \end{array} \begin{array}{c} X_2 \\ Z_2 \\ \Pi_2 \\ X_3 \\ Z_3 \\ \Pi_3 \end{array}$$

$$\{\bar{R}_{23}\} = \begin{Bmatrix} 0 \\ 59380 \\ 0 \\ 0 \\ -59380 \\ 0 \end{Bmatrix} \begin{array}{c} X_2 \\ Z_2 \\ \Pi_2 \\ X_3 \\ Z_3 \\ \Pi_3 \end{array}$$

SOUSTAVA

$$[K] = \begin{array}{c|cc|cc} & u_1 & & w_1 & \\ \hline 1{,}484\cdot10^{8} & 5{,}248\cdot10^{7} & 0 & -5{,}248\cdot10^{7} & X_1 \\ & 2{,}009\cdot10^{8} & & -5{,}248\cdot10^{7} & \\ \hline 0 & -5{,}248\cdot10^{7} & 0 & 5{,}248\cdot10^{7} & Z_1 \\ & -5{,}248\cdot10^{7} & & 5{,}248\cdot10^{7} & \end{array}$$

$$\{\bar{R}\} = \begin{Bmatrix} 0 \\ 31491 \\ \hline 0 \\ -31491 \end{Bmatrix}$$

$$\begin{bmatrix} 2{,}009\cdot10^{8} & -5{,}248\cdot10^{7} \\ -5{,}248\cdot10^{7} & 5{,}248\cdot10^{7} \end{bmatrix} \begin{Bmatrix} u_1 \\ w_1 \end{Bmatrix} = \begin{Bmatrix} -31491 \\ 33491 \end{Bmatrix} ; \quad \begin{Bmatrix} u_1 \\ w_1 \end{Bmatrix} = \begin{Bmatrix} 1{,}347\cdot10^{-5} \\ 6{,}516\cdot10^{-4} \end{Bmatrix}$$

$$\{r_{12}\} = \{r_{13}\} = \begin{Bmatrix} 1{,}347\cdot10^{-5} \\ 6{,}516\cdot10^{-4} \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{r_{13}^*\} = \begin{Bmatrix} -4{,}512\cdot10^{-4} \\ 4{,}702\cdot10^{-4} \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{\hat{R}_{12}^*\} - [K_{12}^*]\{r_{12}^*\} = \begin{Bmatrix} 2000 \\ 0 \\ 0 \\ -2000 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{\hat{R}_{13}^*\} = [K_{13}^*]\{r_{13}^*\} = \begin{Bmatrix} -47362 \\ 0 \\ 0 \\ 47362 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{R_{12}^*\} = \{\hat{R}_{12}^*\}$$

$$\{R_{13}^*\} = \{\overline{R}_{13}^*\} + \{\hat{R}_{13}^*\} = \begin{Bmatrix} -2830 \\ 0 \\ 0 \\ 2830 \\ 0 \\ 0 \end{Bmatrix}$$