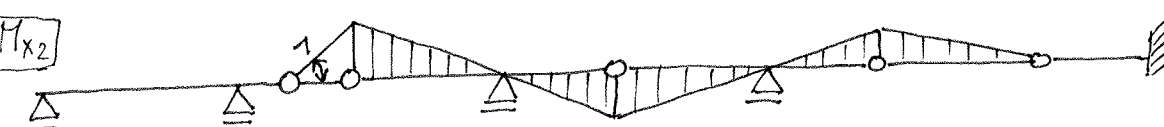
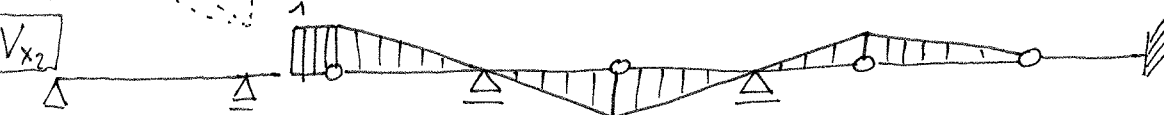
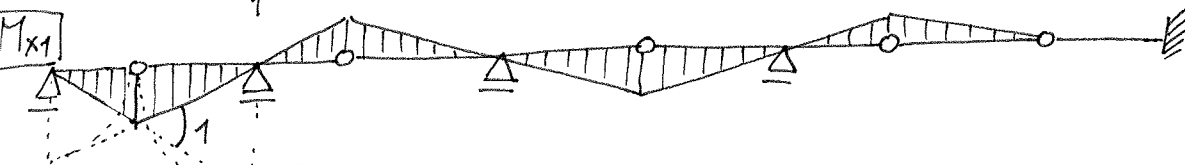
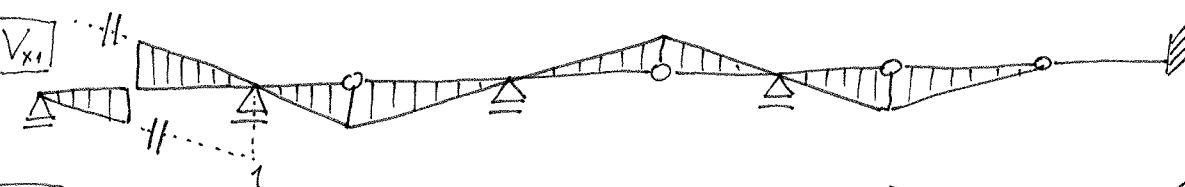
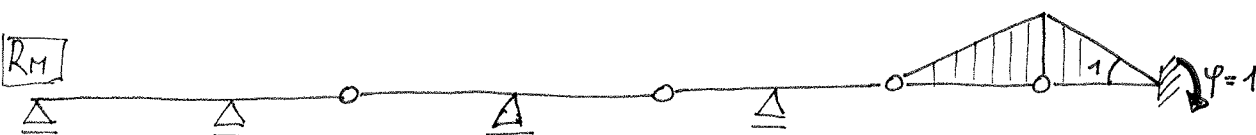
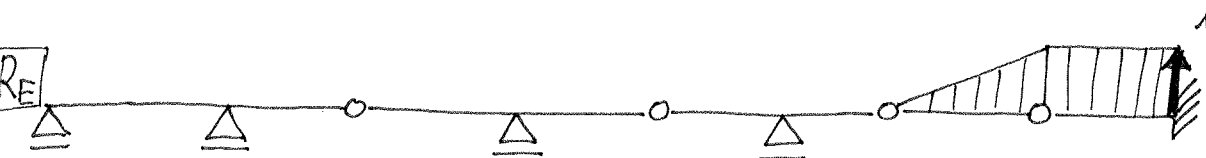
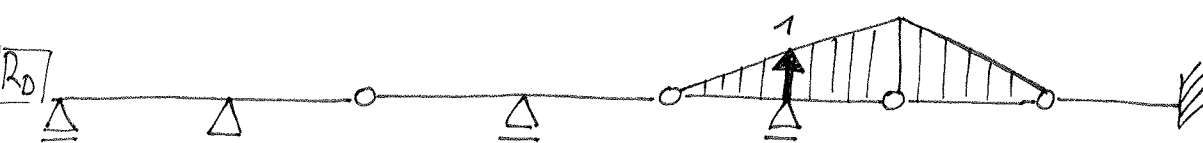
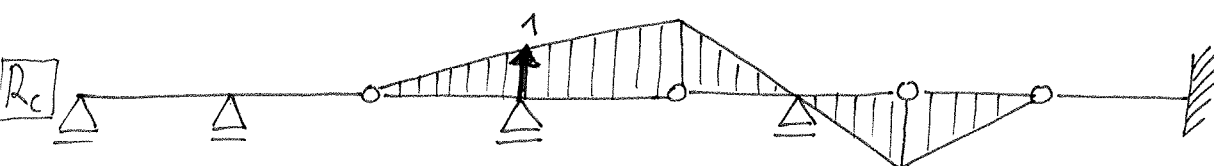
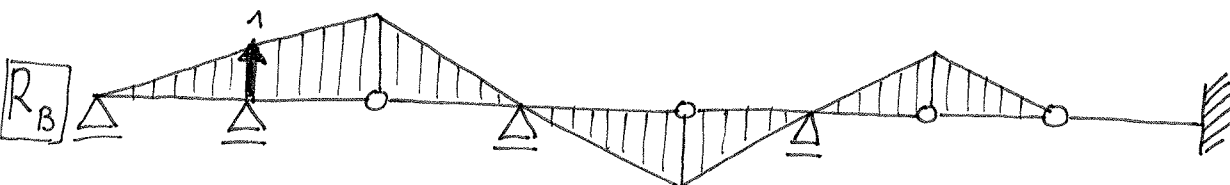
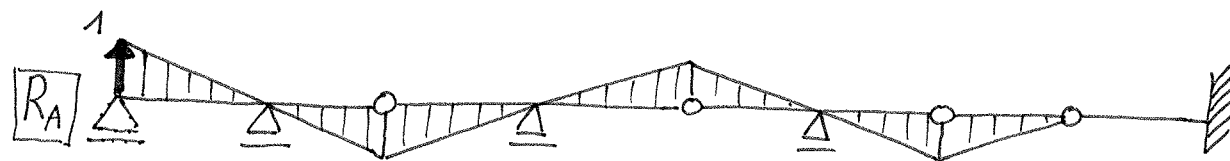
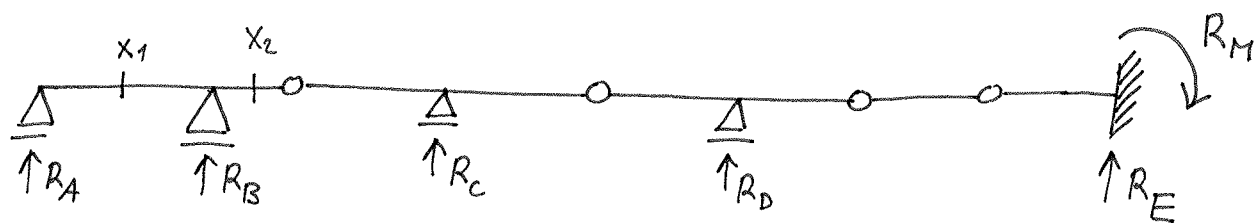
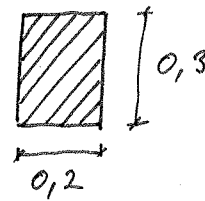
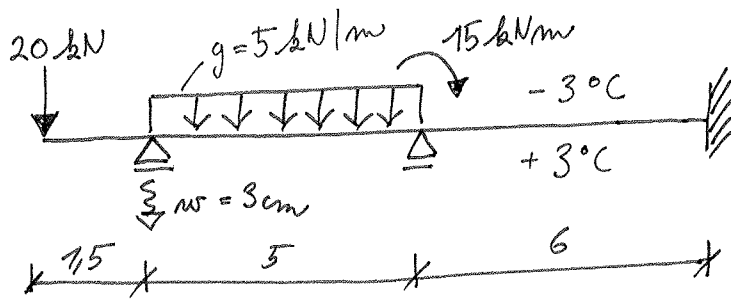


1, Vykreslete průčinovou čáru

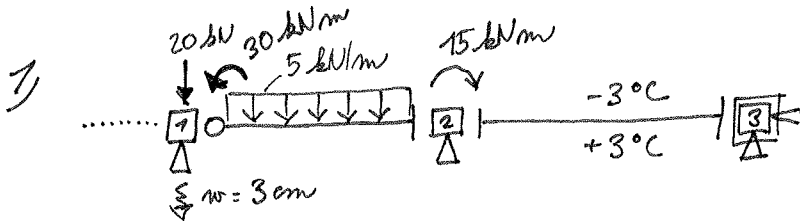


Vyřešte deformační Mav konstrukce.



$$E = 2 \cdot 10^7 \text{ bPa}$$

$$\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$$



$$n_1 = 1; \{r\} = \{\varphi_2\}; \{S\} = \{-15\} M_2$$

2) PRUT 1/2

$$l = 5 \text{ m}$$

$$[K_{1,2}] = \begin{bmatrix} u_1 & w_1 & \varphi_1 & u_2 & w_2 & \varphi_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}; \{\bar{R}_{1,2}\} = \begin{bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{bmatrix}; \{\tilde{R}_{1,2}\} = \begin{bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{bmatrix}$$

$$\{\tilde{R}_{1,2}\} = \begin{bmatrix} u_1 & w_1 & \varphi_1 & u_2 & w_2 & \varphi_2 \\ 0 & 0,03 & 0 & 0 & 0 & 0 \end{bmatrix}^T; \{\tilde{R}_{1,2}\} = [K_{1,2}] \cdot \{\tilde{R}_{1,2}\}$$

PRUT 2/3

$$l = 6 \text{ m}$$

$$[K_{2,3}] = \begin{bmatrix} u_2 & w_2 & \varphi_2 & u_3 & w_3 & \varphi_3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}; \{\bar{R}_{2,3}\} = \begin{bmatrix} X_4 \\ Z_4 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{bmatrix}$$

3)

$$[K] = \begin{bmatrix} \varphi_2 \end{bmatrix}; \{\bar{R}\} = \begin{bmatrix} \end{bmatrix} M_2; \{\tilde{R}\} = \begin{bmatrix} \end{bmatrix} M_2$$

$$\{F\} = \{S\} - \{\bar{R}\} - \{\tilde{R}\} = \begin{bmatrix} \end{bmatrix} M_2$$

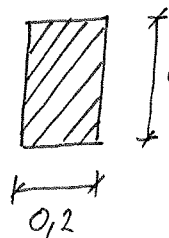
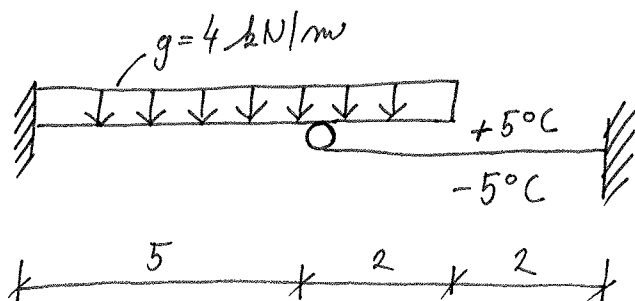
$$[K] \cdot \{r\} = \{F\}$$

$$[11400] \cdot \{\varphi_2\} = \{-16,225\}$$

$$11400 \cdot \varphi_2 = -16,225$$

$$\varphi_2 = 1,4232 \cdot 10^{-3} \text{ rad}; \{r\} = \{1,4232 \cdot 10^{-3}\} \varphi_2$$

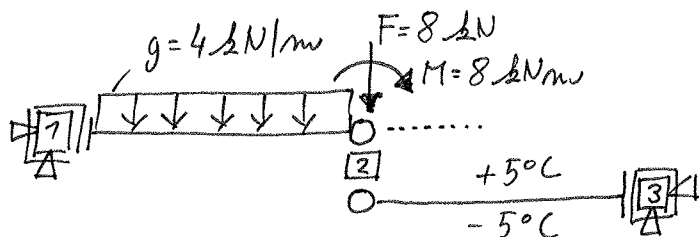
Vyřešte deformační stav konstrukce.



$$E = 2 \cdot 10^7 \text{ sPa}$$

$$\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$$

1)



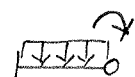
$$n_1 = 1$$

$$\{r\} = \{w_2\}; \{S\} = \{8\}Z_2$$

2) PRUT 1,2

$$l = 5 \text{ m}$$

$$[K_{1,2}] = \begin{bmatrix} u_1 & w_1 & \varphi_1 & u_2 & \textcircled{w_2} & \varphi_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

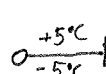


$$\{\bar{R}_{1,2}\} = \begin{Bmatrix} \vdots \\ + \end{Bmatrix} = \begin{Bmatrix} \vdots \\ \vdots \end{Bmatrix} \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}$$

PRUT 2,3

$$l = 4 \text{ m}$$

$$[K_{2,3}] = \begin{bmatrix} u_2 & \textcircled{w_2} & \varphi_2 & u_3 & w_3 & \varphi_3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$



$$\{\bar{R}_{2,3}\} = \begin{Bmatrix} \vdots \\ \vdots \end{Bmatrix} \begin{Bmatrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{Bmatrix}$$

3)

$$[K] = \begin{bmatrix} & w_2 \\ & \end{bmatrix} w_2; \{\bar{R}\} = \begin{Bmatrix} \vdots \end{Bmatrix} Z_2$$

$$\{F\} = \{S\} - \{\bar{R}\} = \begin{Bmatrix} \vdots \end{Bmatrix} Z_2$$

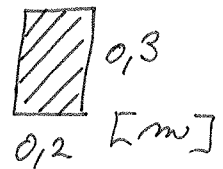
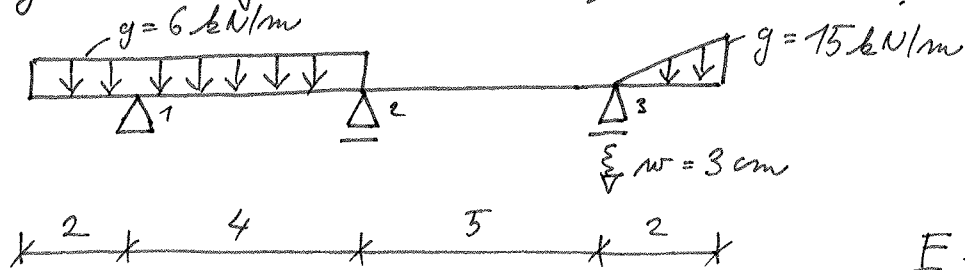
$$[K] \cdot \{r\} = \{F\}$$

$$[637,875] \{w_2\} = \{19,025\}$$

$$637,875 \cdot w_2 = 19,025$$

$$w_2 = 2,9826 \cdot 10^{-2} \text{ m}; \{r\} = \{2,9826 \cdot 10^{-2}\} w_2$$

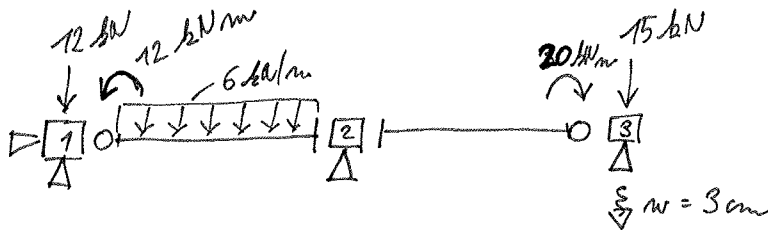
Výřešle deformační sloh konstrukce.



$$E = 2 \cdot 10^7 \text{ Pa}$$

$$\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$$

1)



$$n_1 = 1; \quad \{r\} = \{\varphi_2\}; \quad \{S\} = \{0\} M_2$$

2) PRUT 1,2
 $l = 4 \text{ m}$

$$[K_{12}] = \begin{bmatrix} m_1 & m_1 & \varphi_1 & m_2 & m_2 & \varphi_2 \\ m_1 & m_1 & \varphi_1 & m_2 & m_2 & \varphi_2 \\ \varphi_1 & \varphi_1 & \varphi_1 & \varphi_2 & \varphi_2 & \varphi_2 \\ m_2 & m_2 & \varphi_2 & m_3 & m_3 & \varphi_3 \\ m_2 & m_2 & \varphi_2 & m_3 & m_3 & \varphi_3 \\ \varphi_2 & \varphi_2 & \varphi_2 & \varphi_3 & \varphi_3 & \varphi_3 \end{bmatrix} \quad \{R_{12}\} = \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}$$

PRUT 2,3
 $l = 5 \text{ m}$

$$[K_{23}] = \begin{bmatrix} m_2 & m_2 & \varphi_2 & m_3 & m_3 & \varphi_3 \\ m_2 & m_2 & \varphi_2 & m_3 & m_3 & \varphi_3 \\ \varphi_2 & \varphi_2 & \varphi_2 & \varphi_3 & \varphi_3 & \varphi_3 \\ m_3 & m_3 & \varphi_3 & m_4 & m_4 & \varphi_4 \\ m_3 & m_3 & \varphi_3 & m_4 & m_4 & \varphi_4 \\ \varphi_3 & \varphi_3 & \varphi_3 & \varphi_4 & \varphi_4 & \varphi_4 \end{bmatrix} \quad \{R_{23}\} = \begin{Bmatrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{Bmatrix}$$

$$\{\tilde{r}_{23}\} = \{0, 0, 0, 0, 0, 0\}^T; \quad \{\tilde{R}_{23}\} = [K_{23}] \cdot \{\tilde{r}_{23}\}$$

3)

$$[K] = [K_{12}] + [K_{23}] \quad \{R\} = \{M_2\}; \quad \{\tilde{R}\} = \{M_2\}$$

$$\{F\} = \{S\} - \{R\} - \{\tilde{R}\} = \{M_2\}$$

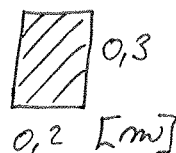
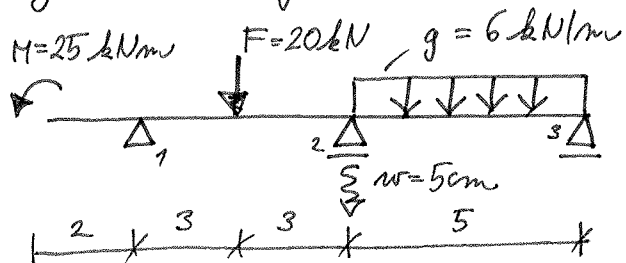
$$[K] \cdot \{r\} = \{F\}$$

$$[12 \ 150] \cdot \{\varphi_2\} = \{-16,4\}$$

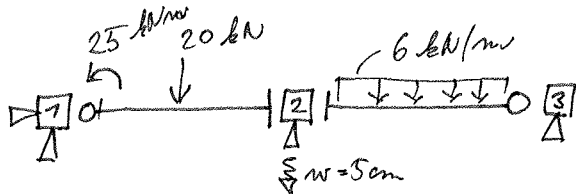
$$12 \cdot 150 \cdot \varphi_2 = -16,4$$

$$\varphi_2 = -1,3498 \cdot 10^{-3} \text{ rad}; \quad \{r\} = \{-1,3498 \cdot 10^{-3}\} \varphi_2$$

Vyřešte deformační slovo konstrukce.



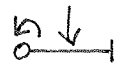
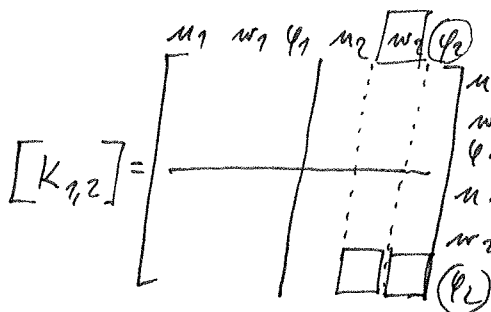
$E = 2 \cdot 10^7 \text{ kPa}$
 $\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$



$n_f = 1$; $\{r\} = \{\varphi_2\}$; $\{S\} = \{0\} M_2$

1) PRUT 1,2

$l = 6 \text{ m}$



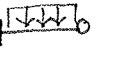
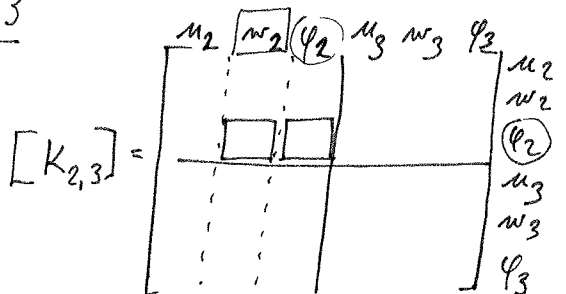
$\{R_{1,2}\} = \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}$

$\{R_{1,2}\} = \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}$

$\{\tilde{r}_{1,2}\} = \begin{Bmatrix} u_1 & w_1 & \varphi_1 & u_2 & w_2 & \varphi_2 \\ 0 & 0 & 0 & 0 & 0,05 & 0 \end{Bmatrix}^T$; $\{\tilde{R}_{1,2}\} = [K_{1,2}] \cdot \{\tilde{r}_{1,2}\}$

PRUT 2,3

$l = 5$



$\{R_{2,3}\} = \begin{Bmatrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{Bmatrix}$

$\{R_{2,3}\} = \begin{Bmatrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{Bmatrix}$

$\{\tilde{r}_{2,3}\} = \begin{Bmatrix} u_2 & w_2 & \varphi_2 & u_3 & w_3 & \varphi_3 \\ 0 & 0,05 & 0 & 0 & 0 & 0 \end{Bmatrix}^T$; $\{\tilde{R}_{2,3}\} = [K_{2,3}] \cdot \{\tilde{r}_{2,3}\}$

3)

$[K] = \begin{bmatrix} & \varphi_2 \\ & \end{bmatrix}$; $\{R\} = \{ \} M_2$; $\{\tilde{R}\} = \{ \} M_2$

$\{F\} = \{S\} - \{R\} - \{\tilde{R}\} = \{ \} M_2$

$[K] \cdot \{r\} = \{F\}$

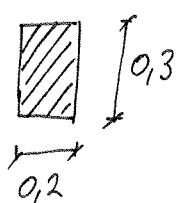
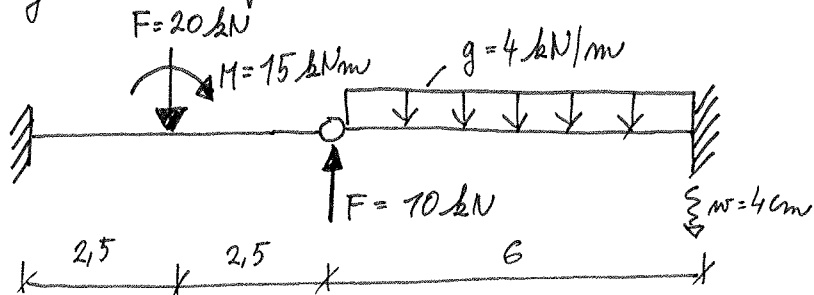
$[9900] \cdot \{\varphi_2\} = \{7,75\}$

$9900 \cdot \varphi_2 = 7,75$

$\varphi_2 = 7,8283 \cdot 10^{-4} \text{ rad}$

$\{r\} = \{7,8283 \cdot 10^{-4}\} \varphi_2$

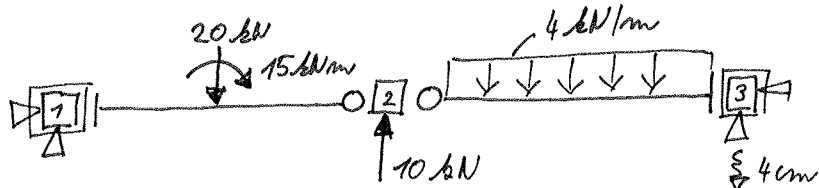
Vyřešte deformační stav konstrukce.



$$E = 2 \cdot 10^7 \text{ bPa}$$

$$\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$$

1)



$$w_1 = 1$$

$$\{r\} = \{w_2\}; \{S\} = \{-10\}Z_2$$

2)

PRUT 1,2

$$l = 5 \text{ m}$$

$$[K_{1,2}] = \begin{bmatrix} u_1 & w_1 & \varphi_1 & u_2 & \textcircled{w_2} & \varphi_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

$$\{\bar{R}_{1,2}\} = \begin{Bmatrix} \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \end{Bmatrix} = \begin{Bmatrix} \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \end{Bmatrix} \begin{matrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{matrix}$$

PRUT 2,3

$$l = 6 \text{ m}$$

$$[K_{2,3}] = \begin{bmatrix} u_2 & \textcircled{w_2} & \varphi_2 & u_3 & \textcircled{w_3} & \varphi_3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

$$\{\bar{R}_{2,3}\} = \begin{Bmatrix} \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \end{Bmatrix} = \begin{Bmatrix} \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \vdots \end{Bmatrix} \begin{matrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{matrix}$$

$$\{\tilde{r}_{2,3}\} = \begin{Bmatrix} u_2 & w_2 & \varphi_2 & u_3 & w_3 & \varphi_3 \\ 0 & 0 & 0 & 0 & 0,04 & 0 \end{Bmatrix}^T; \{\tilde{R}_{2,3}\} = [K_{2,3}] \cdot \{\tilde{r}_{2,3}\}$$

3)

$$[K] = \begin{bmatrix} & w_2 \\ & \end{bmatrix} w_2; \{\bar{R}\} = \{ \quad \} Z_2; \{\tilde{R}\} = \{ \quad \} Z_2$$

$$\{F\} = \{S\} - \{\bar{R}\} - \{\tilde{R}\} = \{ \quad \} Z_2$$

$$[K] \cdot \{r\} = \{F\}$$

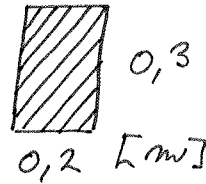
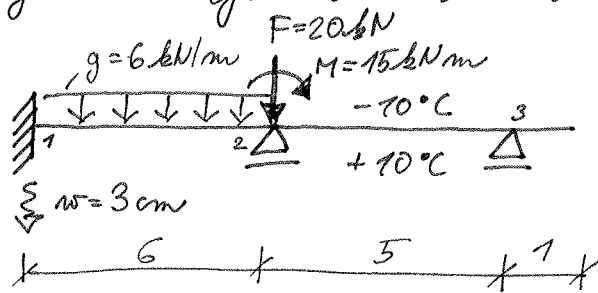
$$[341] \cdot \{w_2\} = \{13,625\}$$

$$341 \cdot w_2 = 13,625$$

$$w_2 = 3,9956 \cdot 10^{-2} \text{ m}$$

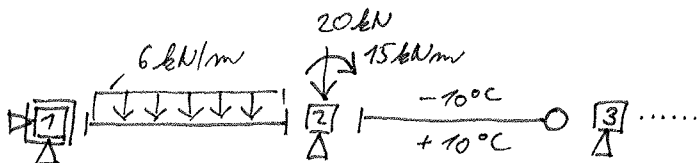
$$\{r\} = \{3,9956 \cdot 10^{-2}\} w_2$$

Vyřešte deformační MDM konstrukce.



$$E = 2 \cdot 10^7 \text{ kPa}$$

$$\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$$



$$n_1 = 1; \quad \{r\} = \{\varphi_2\}; \quad \{S\} = \{-15\} M_2$$

2) PRUT 1,2

$$l = 6 \text{ m}$$

$$[K_{1,2}] = \begin{bmatrix} u_1 & w_1 & \varphi_1 & u_2 & w_2 & \varphi_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

$$\{\bar{R}_{1,2}\} = \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}; \quad \{\tilde{R}_{1,2}\} = \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}$$

$$\{\tilde{r}_{1,2}\} = \begin{Bmatrix} u_1 & w_1 & \varphi_1 & u_2 & w_2 & \varphi_2 \\ 0 & 0.03 & 0 & 0 & 0 & 0 \end{Bmatrix}^T; \quad \{\tilde{R}_{1,2}\} = [K_{1,2}] \cdot \{\tilde{r}_{1,2}\}$$

PRUT 2,3

$$l = 5 \text{ m}$$

$$[K_{2,3}] = \begin{bmatrix} u_2 & w_2 & \varphi_2 & u_3 & w_3 & \varphi_3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

$$\{\bar{R}_{2,3}\} = \begin{Bmatrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{Bmatrix}$$

$$3) \quad [K] = \begin{bmatrix} \varphi_2 \end{bmatrix}; \quad \{\bar{R}\} = \{ \} M_2; \quad \{\tilde{R}\} = \{ \} M_2$$

$$\{F\} = \{S\} - \{\bar{R}\} - \{\tilde{R}\} = \{ \} M_2$$

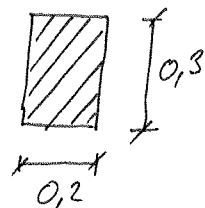
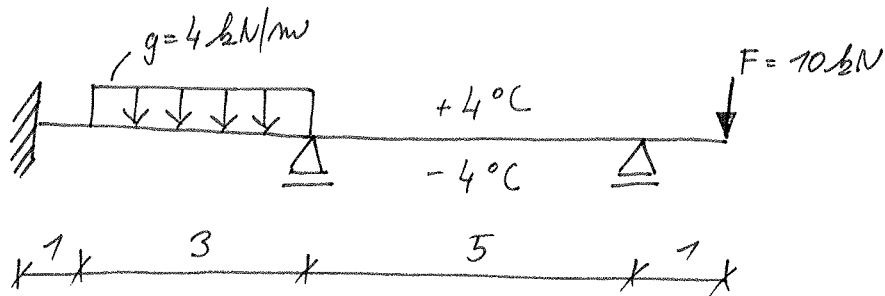
$$[K] \cdot \{r\} = \{F\}$$

$$[11400] \cdot \{\varphi_2\} = \{39\}$$

$$11400 \cdot \varphi_2 = 39$$

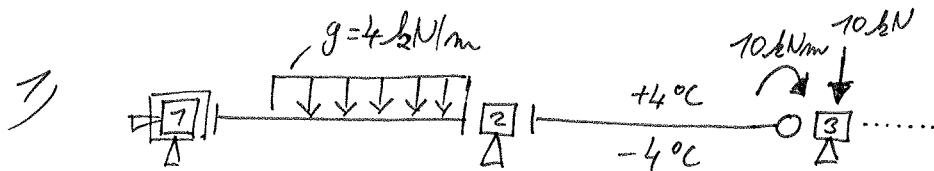
$$\varphi_2 = 3,4211 \cdot 10^{-3} \text{ rad}; \quad \{r\} = \{3,4211 \cdot 10^{-3}\} \text{ rad}$$

Vyřešte deformační stav konstrukce.



$$E = 2 \cdot 10^7 \text{ kPa}$$

$$\alpha = 1 \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$$



$$m_1 = 1; \{r\} = \{\varphi_2\}; \{S\} = \{0\}$$

3) PRUT 1,2

$$l = 4 \text{ m}$$

$$[K_{1,2}] = \begin{bmatrix} m_1 & w_1 & \varphi_1 & m_2 & w_2 & \varphi_2 \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \end{bmatrix}$$

$$\{R_{1,2}\} = \begin{Bmatrix} X_1 \\ Z_1 \\ M_1 \\ X_2 \\ Z_2 \\ M_2 \end{Bmatrix}$$

PRUT 2,3

$$l = 5 \text{ m}$$

$$[K_{2,3}] = \begin{bmatrix} m_2 & w_2 & \varphi_2 & m_3 & w_3 & \varphi_3 \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \end{bmatrix}$$

$$\{R_{2,3}\} = \begin{Bmatrix} X_2 \\ Z_2 \\ M_2 \\ X_3 \\ Z_3 \\ M_3 \end{Bmatrix}$$

$$[K] = [\quad] \varphi_2; \{R\} = \{ \quad \} M_2$$

$$\{F\} = \{S\} - \{R\} = \{ \quad \} M_2$$

$$[K] \cdot \{r\} = \{F\}$$

$$[14 \ 400] \cdot \{\varphi_2\} = \{13,6625\}$$

$$14400 \cdot \varphi_2 = 13,6625$$

$$\varphi_2 = 9,4878 \cdot 10^{-4} \text{ rad}$$

$$\{r\} = \{9,4878 \cdot 10^{-4}\} \text{ rad}$$