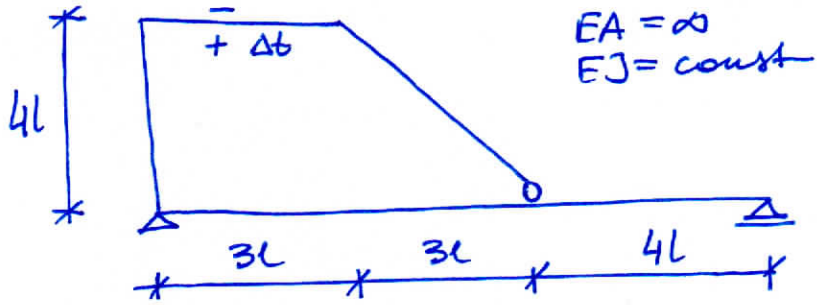
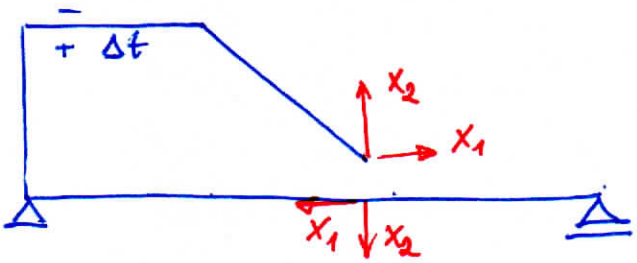
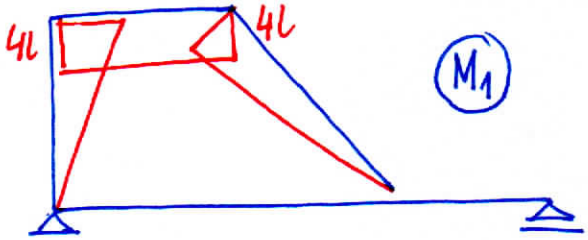
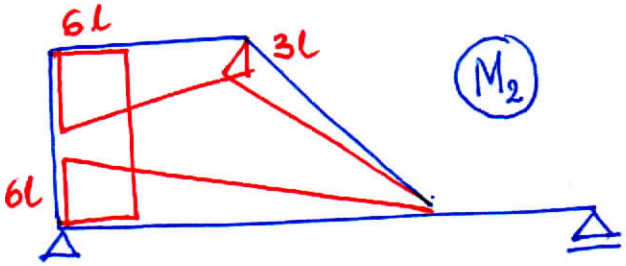
MK1 kol 1.1 2023/2024 środa



$EA = \infty$
$EJ = const$







$\delta_{11} = 96 \frac{l^3}{EJ}$

$\delta_{22} = 294 \frac{l^3}{EJ}$

$\delta_{12} = 122 \frac{l^3}{EJ}$

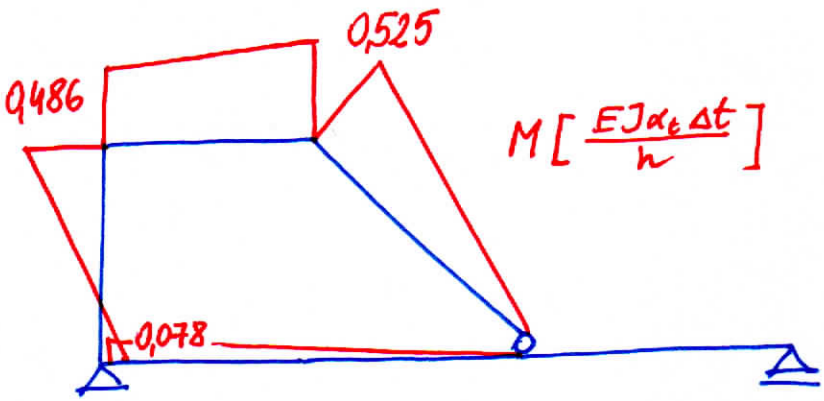
$\delta_{10} = 12 \frac{\alpha_t \Delta t l^2}{h}$

$\delta_{20} = 13{,}5 \frac{\alpha_t \Delta t l^2}{h}$

$X_1 = -0{,}141\, a$

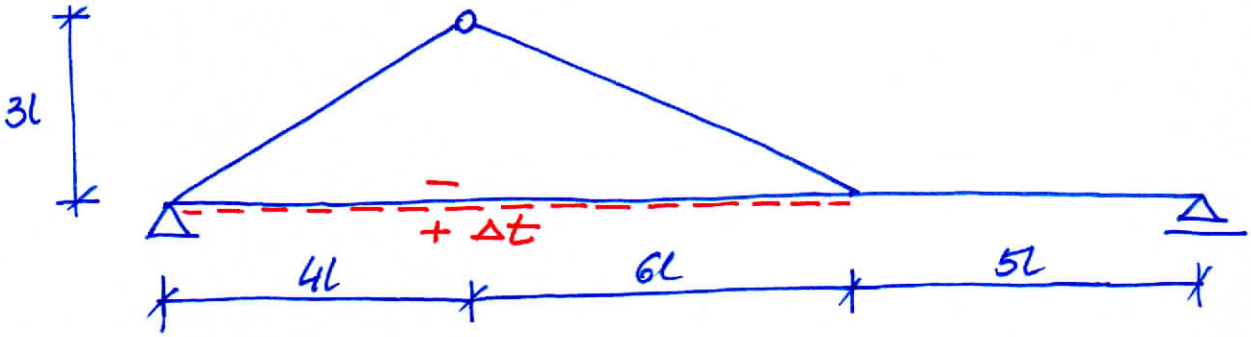
$X_2 = 0{,}013\, a$

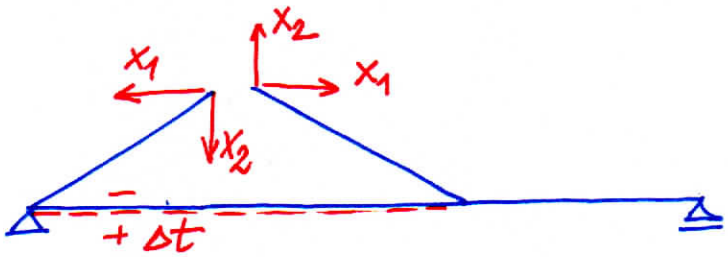
$a = \frac{EJ\alpha_t \Delta t}{hl}$

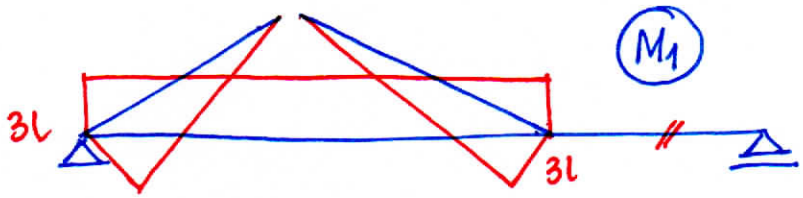


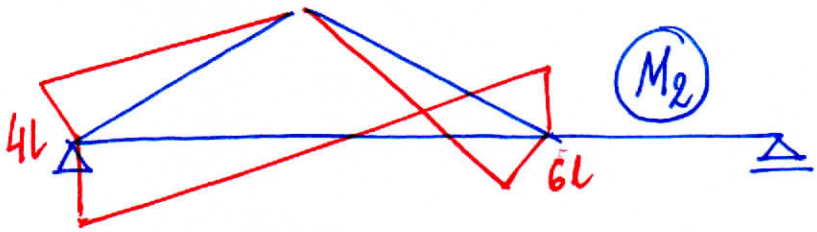
opracował Jan Pelczyński

MK1 Kol 1.1 2023/2024 czwartek









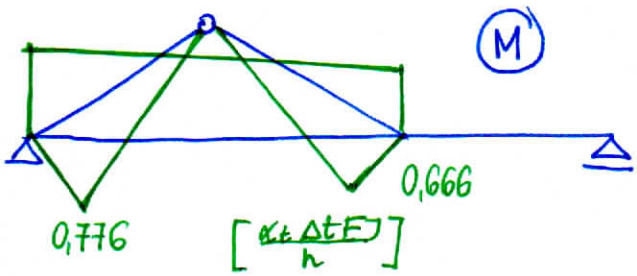
$$\delta_{11} = (105 + 9\sqrt{5})\frac{l^3}{EJ}$$

$$\delta_{12} = (10 + 18\sqrt{5})\frac{l^3}{EJ}$$

$$\delta_{22} = (120 + 36\sqrt{5})\frac{l^3}{EJ}$$

$$\delta_{10} = -30\,\frac{\alpha_t \Delta t l^2}{h}$$

$$\delta_{20} = -10\,\frac{\alpha_t \Delta t l^2}{h}$$

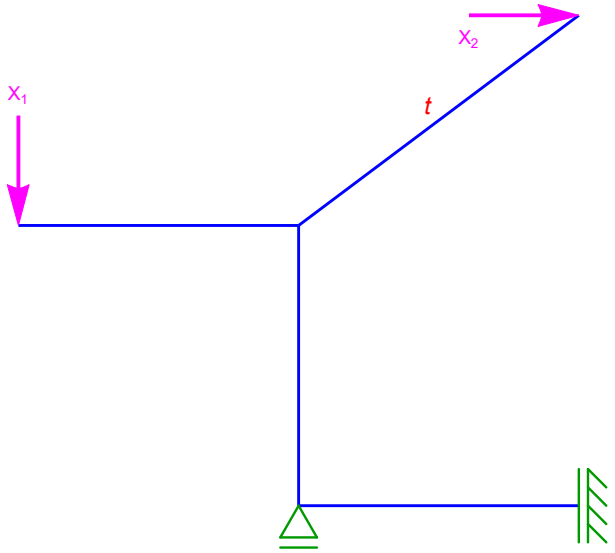


$$X_1 = 0.244\,\frac{\alpha_t \Delta t EJ}{hl}$$

$$X_2 = -0,011\,\frac{\alpha_t \Delta t EJ}{hl}$$

opracował Jan Pierzyński

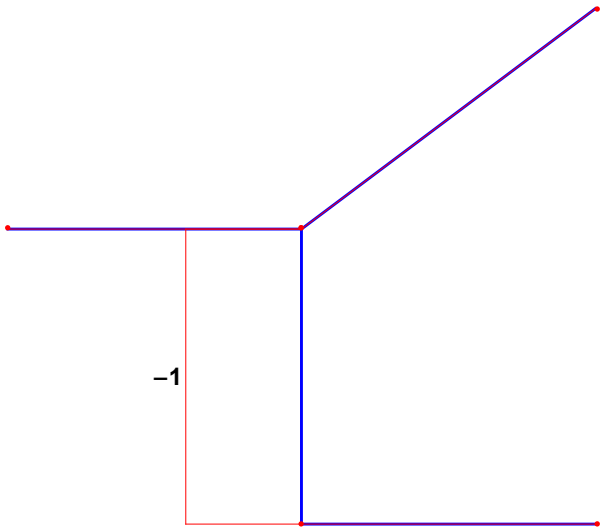
Uk‡ad zastŒpczy:



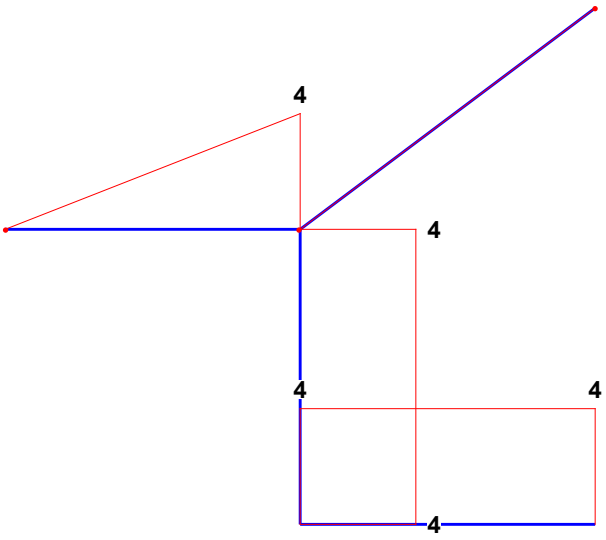
Wykresy si‡ wewnŒtrznych od jednostkowych si‡ nadliczbowych:

- od si‡y $X_1 = 1$:

$N_1[1]$:

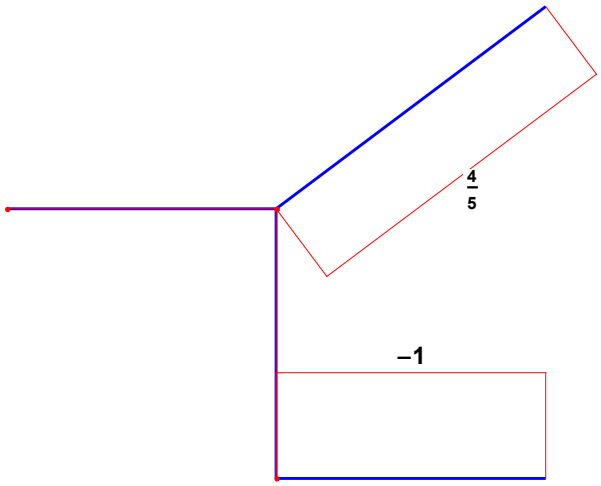


$M_1[l]$:

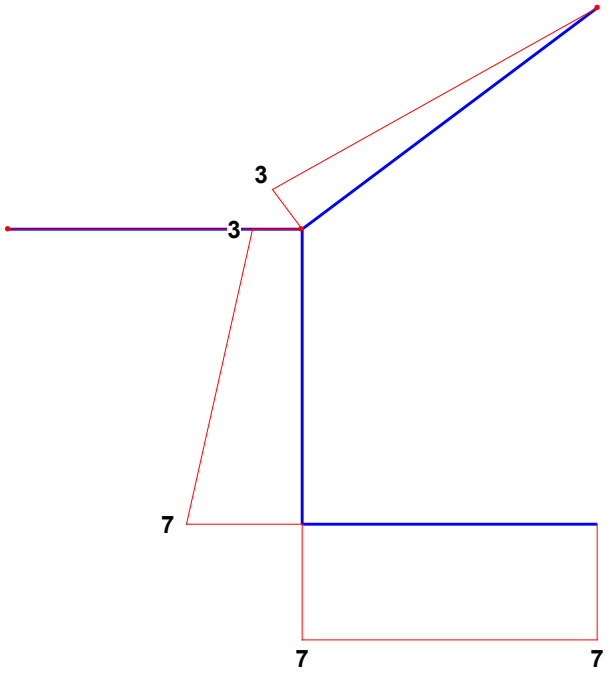


- od si‡y $X_2 = 1$:

$N_2[1]$:



$M_2[l]$:



Przemieszczenia od obci„¿enia temperatur„:

$$\delta_{10}^t = 0$$

$$\delta_{20}^t = \left(\frac{4}{5}\right)(t\,\alpha)(5\,l) = 4\,l\,t\,\alpha$$

Przemieszczenia od jednostkowych si‡ nadliczbowych:

$$\delta_{11} = \frac{1}{EJ}[(4l\cdot 4\,l)(4l)] + \frac{1}{EJ}\left[\left(\frac{1}{2}\cdot 4l\cdot 4\,l\right)\left(\frac{2}{3}\cdot 4l\right)\right] + \frac{1}{EJ}[(4l\cdot 4\,l)(4l)] = \frac{448}{3}\frac{l^3}{EJ}$$

$$\delta_{12} = \delta_{21} = \frac{1}{EJ}\left[(4l\cdot 4\,l)\left(\frac{1}{2}\cdot(-7l)+\frac{1}{2}\cdot(-3l)\right)\right] + \frac{1}{EJ}[(4l\cdot 4\,l)(-7l)] = -192\frac{l^3}{EJ}$$

$$\delta_{22} = \frac{1}{EJ}\left[\left(\frac{1}{2}\cdot 7l\cdot 4\,l\right)\left(\frac{2}{3}\cdot 7l+\frac{1}{3}\cdot 3l\right)+\left(\frac{1}{2}\cdot 3l\cdot 4\,l\right)\left(\frac{1}{3}\cdot 7l+\frac{2}{3}\cdot 3l\right)\right] + \frac{1}{EJ}\left[\left(\frac{1}{2}\cdot 3l\cdot 5\,l\right)\left(\frac{2}{3}\cdot 3l\right)\right] + \frac{1}{EJ}[(7l\cdot 4\,l)(7$$

Równania nierozdzielno□ci:

$$\begin{pmatrix}\delta_{11} & \delta_{12}\\ \delta_{21} & \delta_{22}\end{pmatrix}\begin{pmatrix}X_1\\ X_2\end{pmatrix}+\begin{pmatrix}\delta_{10}^t\\ \delta_{20}^t\end{pmatrix}=\begin{pmatrix}0\\ 0\end{pmatrix}$$

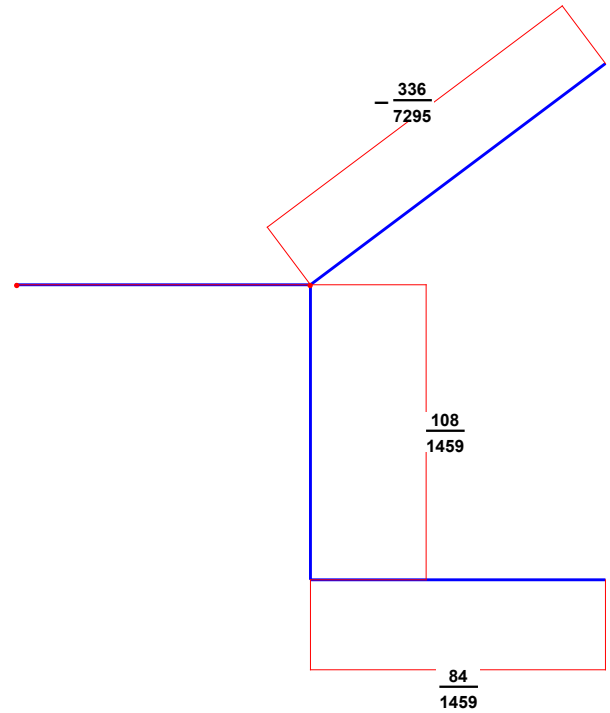
$$\begin{pmatrix}\frac{448\,l^3}{3\,EJ} & -\frac{192\,l^3}{EJ}\\ -\frac{192\,l^3}{EJ} & \frac{949\,l^3}{3\,EJ}\end{pmatrix}\begin{pmatrix}X_1\\ X_2\end{pmatrix}+\begin{pmatrix}0\\ 4\,l\,t\,\alpha\end{pmatrix}=\begin{pmatrix}0\\ 0\end{pmatrix}$$

Rozwi„zanie metody si‡:

$$\begin{pmatrix}X_1\\ X_2\end{pmatrix}=\begin{pmatrix}-\frac{108\,EJ\,t\,\alpha}{1459\,l^2}\\ -\frac{84\,EJ\,t\,\alpha}{1459\,l^2}\end{pmatrix}$$

Wykresy si‡ wewnŒtrznych:

N[$\frac{EJ\,t\,\alpha}{l^2}$]:



M[$\frac{EJ\,t\,\alpha}{l}$]: