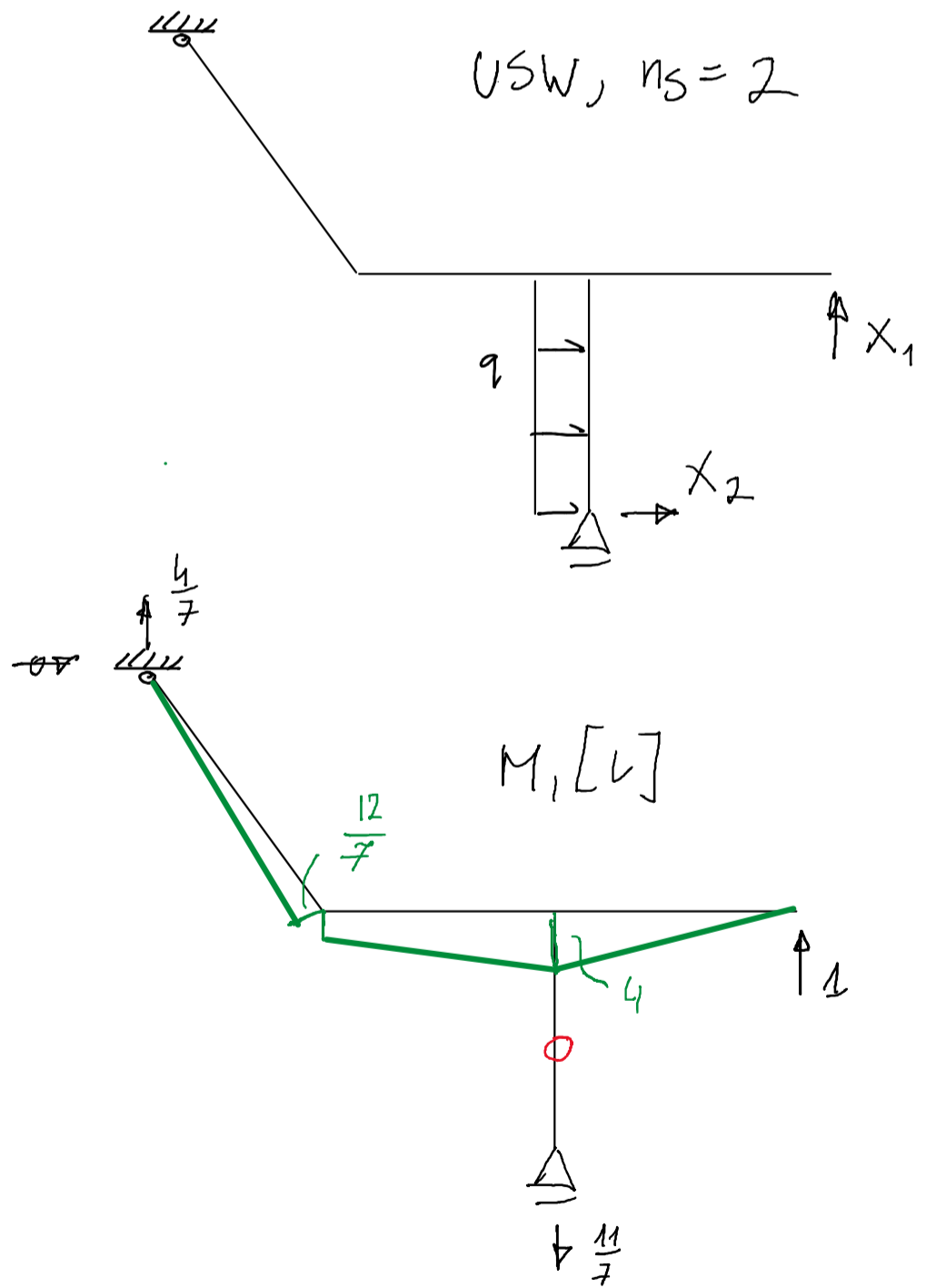
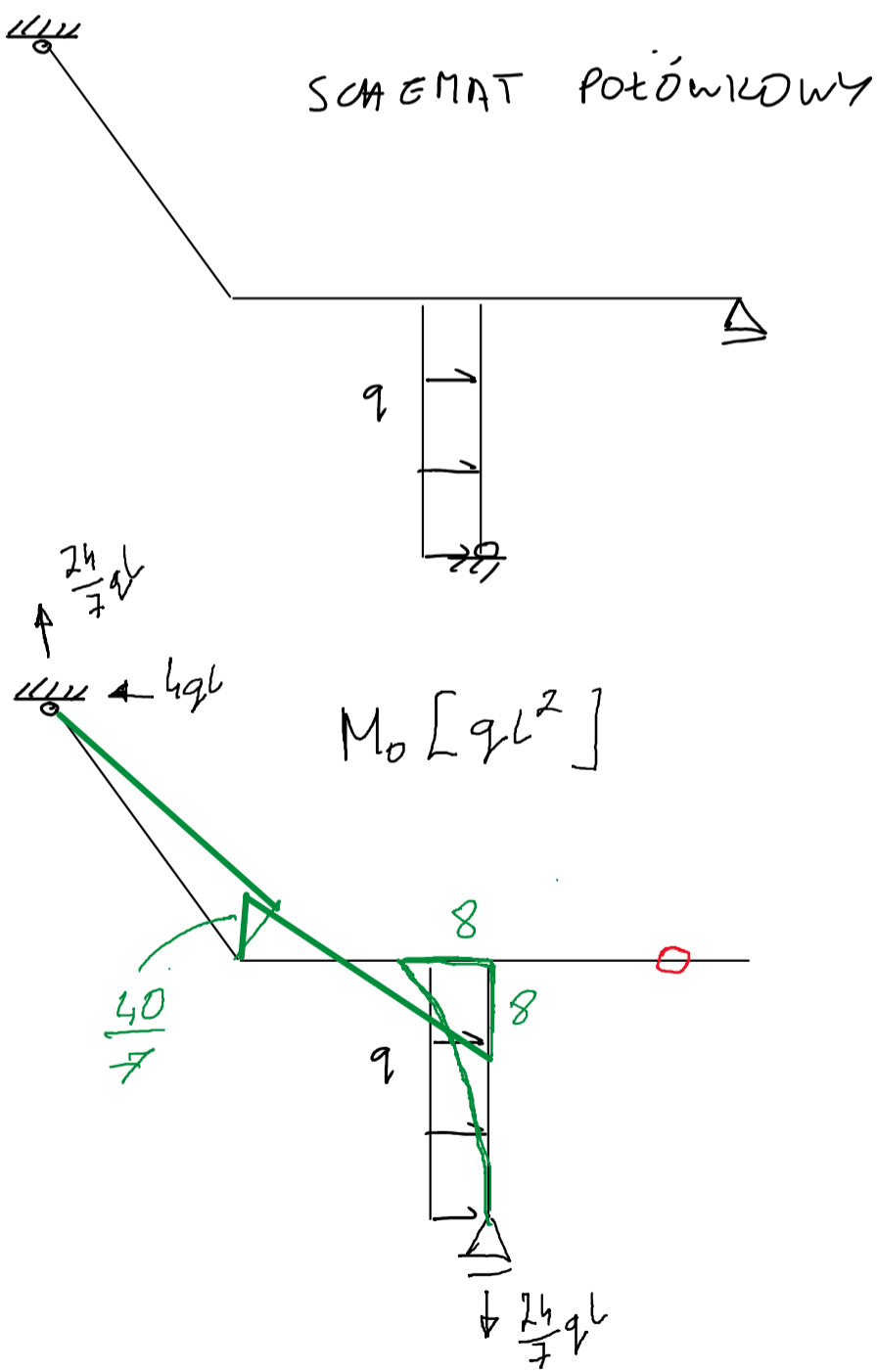
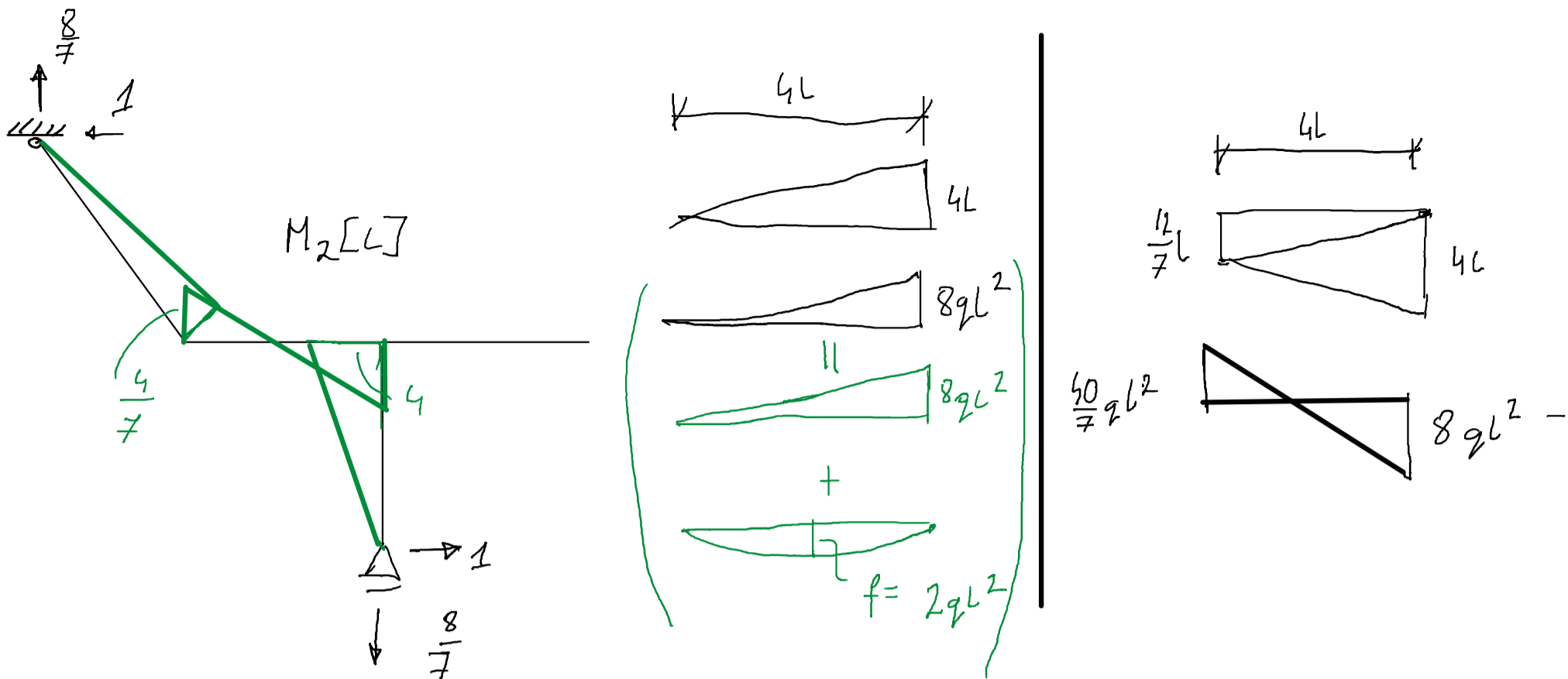


ZADANIE ANTYSYMETRYCZNE





$$\begin{aligned} \sigma_{w0} = \frac{1}{EJ} & \left[ \frac{1}{2} \cdot 4L \cdot \frac{12}{7} L \left( -\frac{2}{3} \cdot \frac{40}{7} qL^2 + \frac{1}{3} \cdot 8qL^2 \right) + \frac{1}{2} \cdot 4L \cdot 4L \left( -\frac{1}{3} \cdot \frac{40}{7} qL^2 + \frac{2}{3} \cdot 8qL^2 \right) \right. \\ & \left. + \frac{1}{2} \cdot 5L \cdot \frac{40}{7} qL^2 \cdot \left( -\frac{2}{3} \right) \cdot \frac{12}{7} L \right] = \frac{352}{49} \frac{qL^4}{EJ} \approx 7,184 \frac{qL^4}{EJ} \end{aligned}$$

$$\begin{aligned} \sigma_{20} = \frac{1}{EJ} & \left[ \frac{1}{2} \cdot 4L \cdot 8qL^2 \cdot \frac{2}{3} \cdot 4L + \frac{2}{3} \cdot 2qL^2 \cdot 4L \cdot \left( -\frac{1}{2} \right) \cdot 4L + \right. \\ & \left. + \frac{1}{2} \cdot 4L \cdot 8qL^2 \left( -\frac{1}{3} \cdot \frac{4}{7} L + \frac{2}{3} \cdot 4L \right) + \frac{1}{2} \cdot 4L \cdot \frac{40}{7} qL^2 \left( \frac{2}{3} \cdot \frac{4}{7} L - \frac{1}{3} \cdot 4L \right) + \right. \\ & \left. + \frac{1}{2} \cdot 5L \cdot \frac{40}{7} qL^2 \cdot \frac{2}{3} \cdot \frac{4}{7} L \right] = \frac{9728}{147} \frac{qL^4}{EJ} \approx 66,177 \frac{qL^4}{EJ} \end{aligned}$$

$$\begin{aligned} \sigma_{11} = \frac{1}{EJ} & \left[ \frac{1}{2} \cdot 4L \cdot 4L \cdot \frac{2}{3} \cdot 4L + \frac{1}{2} \cdot 4L \cdot \frac{12}{7} L \left( \frac{1}{3} \cdot \frac{12}{7} L + \frac{1}{3} \cdot 4L \right) + \frac{1}{2} \cdot 4L \cdot 4L \left( \frac{1}{3} \cdot \frac{12}{7} L + \right. \right. \\ & \left. \left. + \frac{2}{3} \cdot 4L \right) + \frac{1}{2} \cdot 5L \cdot \frac{12}{7} L \cdot \frac{2}{3} \cdot \frac{12}{7} L \right] = \frac{8912}{147} \frac{L^3}{EJ} \approx 60,626 \frac{L^3}{EJ} \end{aligned}$$

$$\begin{aligned} \sigma_{12} = \sigma_{21} = \frac{1}{EJ} & \left[ \frac{1}{2} \cdot 4L \cdot \frac{12}{7} L \left( -\frac{2}{3} \cdot \frac{4}{7} L + \frac{1}{3} \cdot 4L \right) + \frac{1}{2} \cdot 4L \cdot 4L \left( -\frac{1}{3} \cdot \frac{4}{7} L + \frac{2}{3} \cdot 4L \right) + \right. \\ & \left. + \frac{1}{2} \cdot 5L \cdot \frac{12}{7} L \cdot \left( -\frac{2}{3} \right) \cdot \frac{4}{7} L \right] = \frac{3152}{147} \frac{L^3}{EJ} \approx 21,442 \frac{L^3}{EJ} \end{aligned}$$

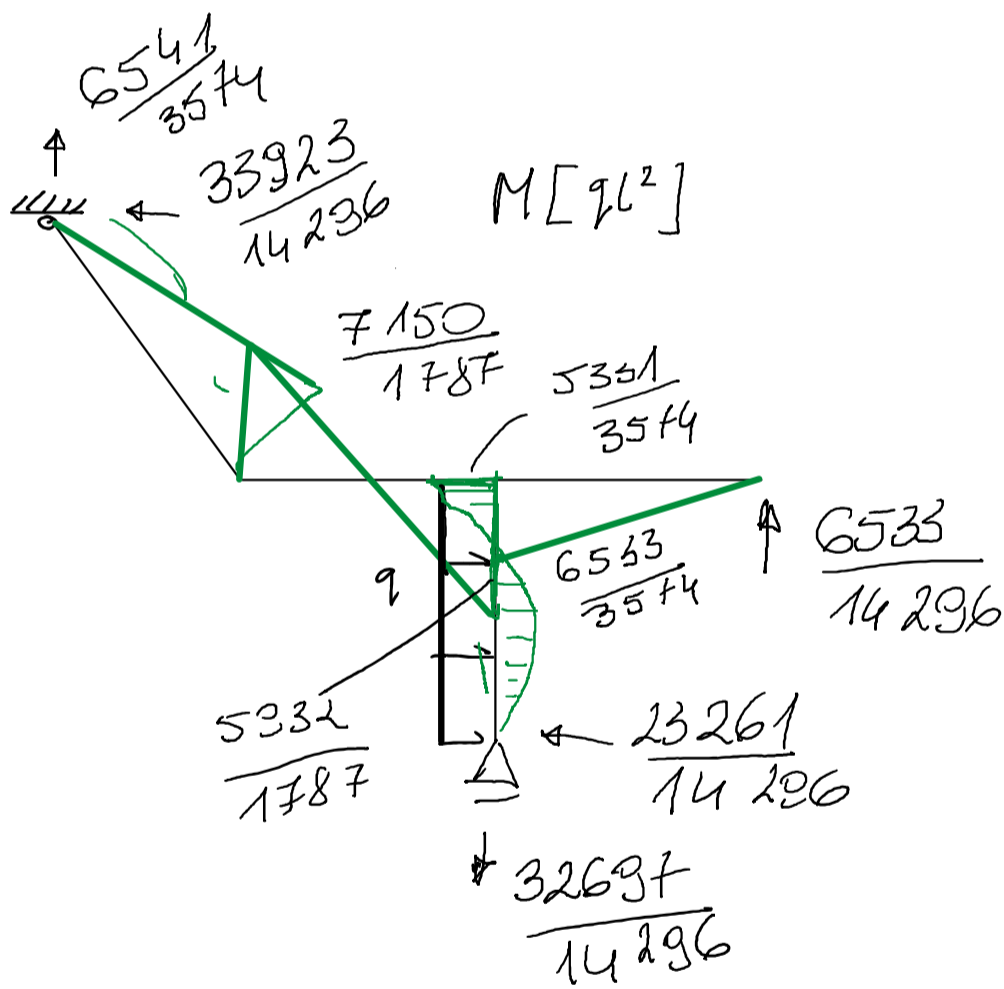
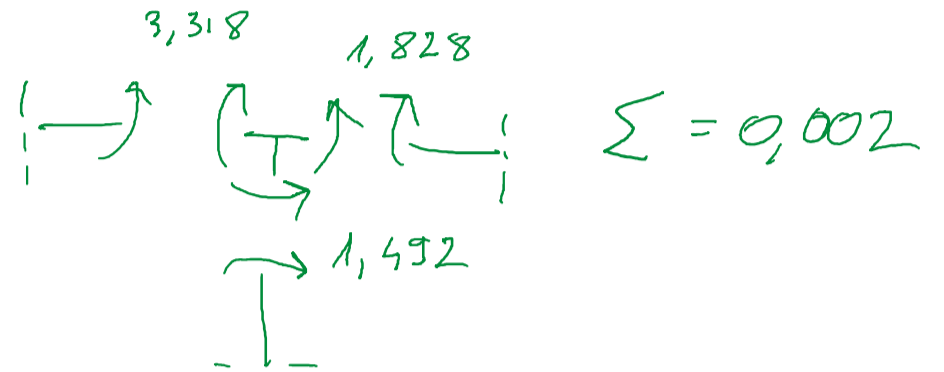
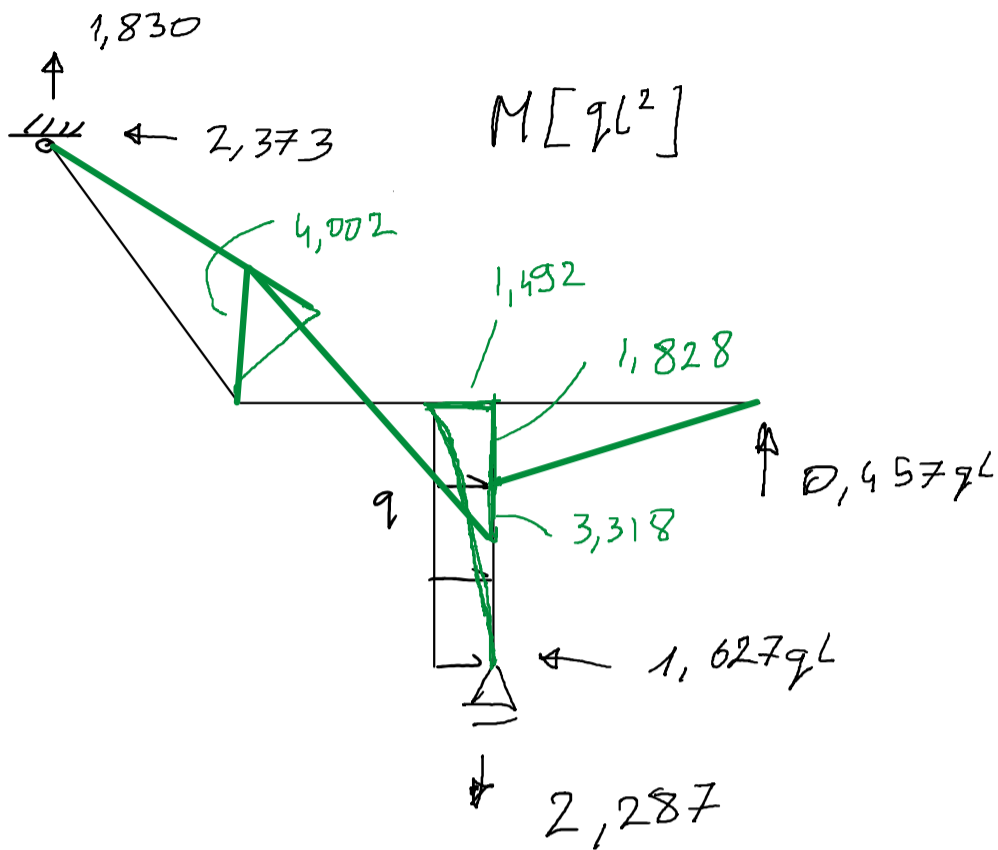
$$\begin{aligned} \sigma_{22} = \frac{1}{EJ} & \left[ \frac{1}{2} \cdot 4L \cdot 4L \cdot \frac{2}{3} \cdot 4L + \frac{1}{2} \cdot 4L \cdot 4L \cdot \left( \frac{2}{3} \cdot 4L + \frac{1}{3} \cdot \frac{4}{7} L \right) + \frac{1}{2} \cdot 4L \cdot \frac{4}{7} L \left( \frac{2}{3} \cdot \frac{4}{7} L - \right. \right. \\ & \left. \left. + \frac{1}{3} \cdot 4L \right) + \frac{1}{2} \cdot 5L \cdot \frac{4}{7} L \cdot \frac{2}{3} \cdot \frac{4}{7} L \right] = \frac{2288}{49} \frac{L^3}{EJ} \approx 46,694 \frac{L^3}{EJ} \end{aligned}$$

$$\begin{cases} \sigma_{11} x_1 + \sigma_{12} x_2 + \sigma_{w0} = 0 \\ \sigma_{21} x_1 + \sigma_{22} x_2 + \sigma_{20} = 0 \end{cases}$$

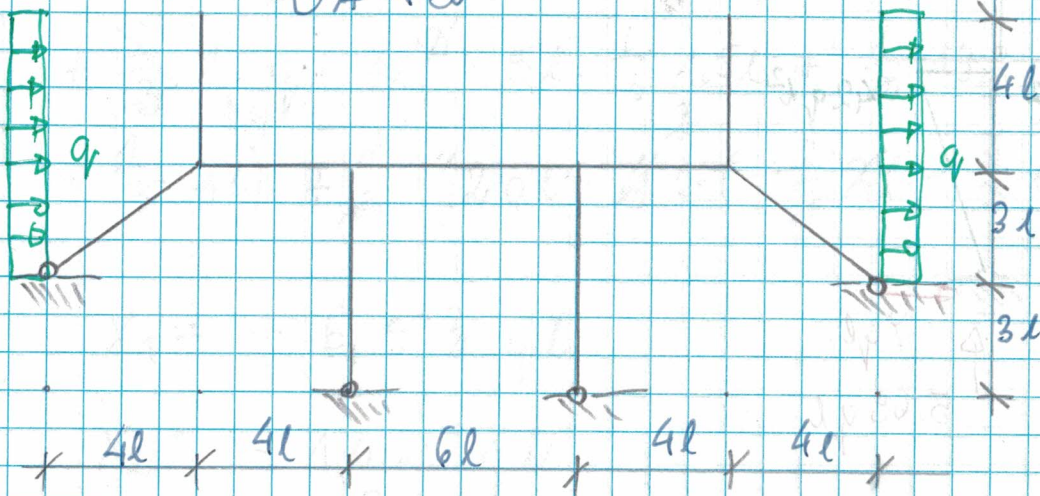
$$D \cdot x + D_0 = 0 \Rightarrow x = -D^{-1} D_0$$

$$x_1 \approx 0,457 qL$$

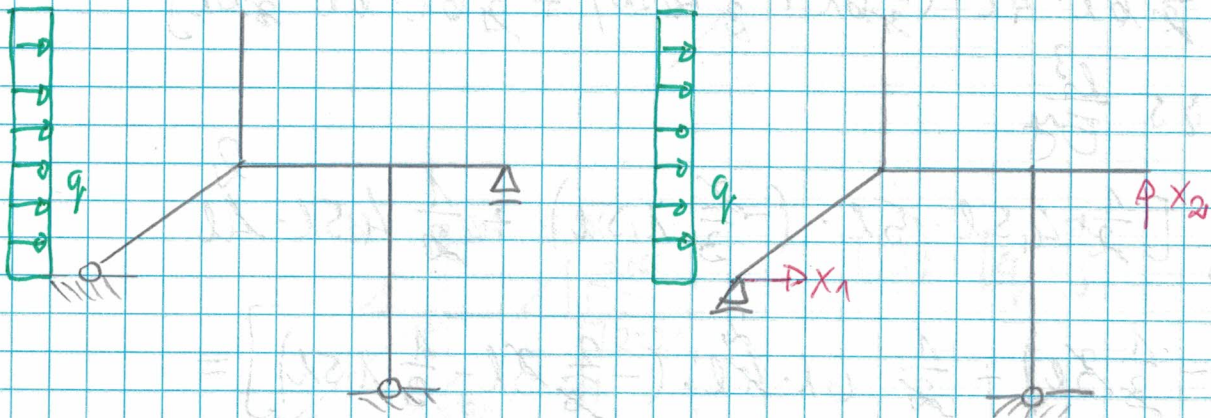
$$x_2 = -1,627 qL$$



$EI = \text{const.}$   
 $EA \rightarrow \infty$



schemat podporowy USW

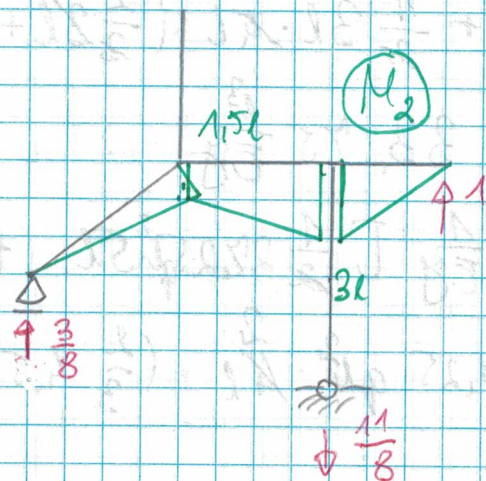
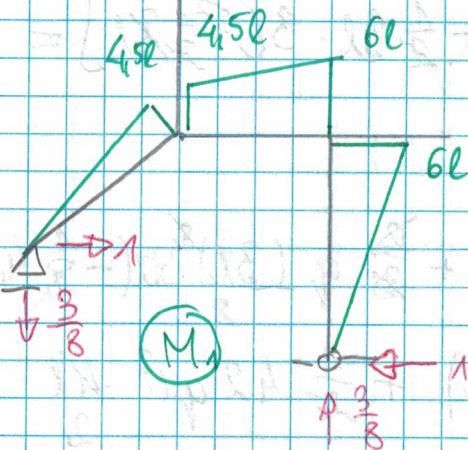


Równania zgodności

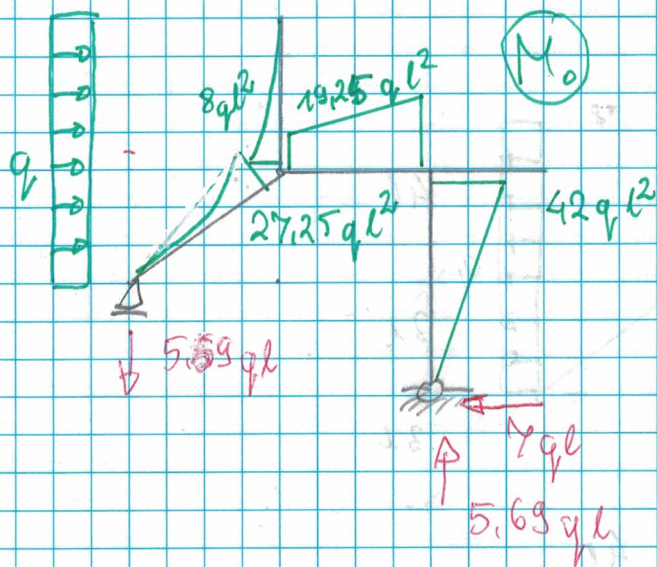
$$\begin{cases} \delta_{11} X_1 + \delta_{12} X_2 + \delta_{10} = 0 \\ \delta_{21} X_1 + \delta_{22} X_2 + \delta_{20} = 0 \end{cases}$$

Stan  $X_1 = 1$

Stan  $X_2 = 1$



Stamm "01"



$$\begin{aligned} \delta_{11} &= \frac{1}{EI} \left[ \frac{1}{2} \cdot 4.5l \cdot 5l \cdot \frac{2}{3} \cdot 4.5l + \frac{1}{2} \cdot 4.5l \cdot 4l \cdot \left( \frac{2}{3} \cdot 4.5l + \right. \right. \\ &+ \left. \left. \frac{1}{2} \cdot 6l \right) + \frac{1}{2} \cdot 6l \cdot 4l \cdot \left( \frac{2}{3} \cdot 6l + \frac{1}{3} \cdot 4.5l \right) + \frac{1}{2} \cdot 6l \cdot 6l \cdot \frac{2}{3} \cdot 6l \right] = \\ &= 216.25 \frac{l^3}{EI} \end{aligned}$$

$$\begin{aligned} \delta_{12} &= \frac{1}{EI} \left[ \frac{1}{2} \cdot 4.5l \cdot 5l \cdot \left( -\frac{2}{3} \cdot 1.5l \right) + \frac{1}{2} \cdot 4.5l \cdot 4l \cdot \right. \\ &\left. \left( \frac{2}{3} \cdot 1.5l - \frac{1}{2} \cdot 6l \right) + \frac{1}{2} \cdot 6l \cdot 4l \cdot \left( -\frac{2}{3} \cdot 6l - \frac{1}{3} \cdot 1.5l \right) \right] = \\ &= -59.25 \frac{l^3}{EI} \end{aligned}$$

$$\begin{aligned} \delta_{22} &= \frac{1}{EI} \left[ \frac{1}{2} \cdot 1.5l \cdot 5l \cdot \frac{2}{3} \cdot 1.5l + \frac{1}{2} \cdot 1.5l \cdot 4l \cdot \left( \frac{2}{3} \cdot 1.5l + \right. \right. \\ &\left. \left. \frac{1}{2} \cdot 6l \right) + \frac{1}{2} \cdot 3l \cdot 4l \cdot \left( \frac{2}{3} \cdot 6l + \frac{1}{3} \cdot 1.5l \right) + \frac{1}{2} \cdot 3l \cdot 3l \cdot \frac{2}{3} \cdot 6l \right] = \\ &= 33.75 \frac{l^3}{EI} \end{aligned}$$

$$\begin{aligned} \delta_{10} &= \frac{1}{EI} \left[ \frac{1}{2} \cdot 27.25ql \cdot 5l \cdot \left( +\frac{2}{3} \cdot 4.5l \right) + \frac{2}{3} \cdot q \cdot \left( 3l \cdot 5l \cdot \left( -\frac{1}{2} \cdot 4.5l \right) \right. \right. \\ &+ \left. \left. \frac{1}{2} \cdot 19.25ql^2 \cdot 4l \cdot \left( \frac{2}{3} \cdot 4.5l + \frac{1}{2} \cdot 6l \right) + \frac{1}{2} \cdot 42ql^2 \cdot 4l \cdot \right. \right. \end{aligned}$$

$$\cdot \left( \frac{2}{3} \cdot 6l + \frac{1}{3} \cdot 4,5l \right) + \frac{1}{2} \cdot 42 \cdot ql^2 \cdot 6l \cdot \frac{2}{3} \cdot 6l \Big] = 1354,44 \frac{ql^4}{EI}$$

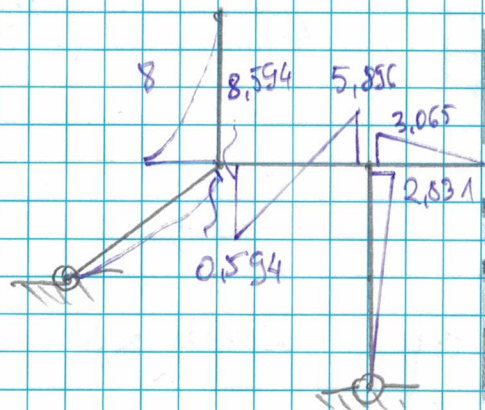
$$\begin{aligned} \delta_{20} = \frac{1}{EI} & \left[ \frac{1}{2} \cdot 27,25 \cdot ql^2 \cdot 5l \cdot \left( -\frac{2}{3} \cdot 1,5l \right) + \right. \\ & + \frac{2}{3} \cdot \frac{1}{8,4l} \cdot q \cdot (3l)^2 \cdot 5l \cdot \frac{1}{2} \cdot 1,5l + \frac{1}{2} \cdot 19,25 \cdot ql^2 \cdot 4l \cdot \left( -\frac{2}{3} \cdot 1,5l \right) \\ & \left. - \frac{1}{3} \cdot 3l \right) + \frac{1}{2} \cdot 42 \cdot ql^2 \cdot 4l \cdot \left( -\frac{2}{3} \cdot 3l - \frac{1}{3} \cdot 1,5l \right) \Big] = -352,31 \frac{ql^4}{EI} \end{aligned}$$

$$X_1 = -6,53 \cdot ql$$

$$X_2 = -1,02 \cdot ql$$

Odp.

antysymetria



(M) [kNm]