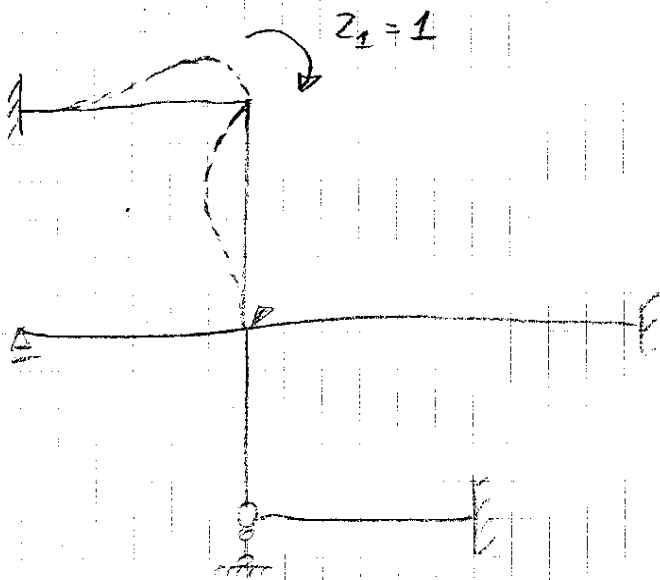
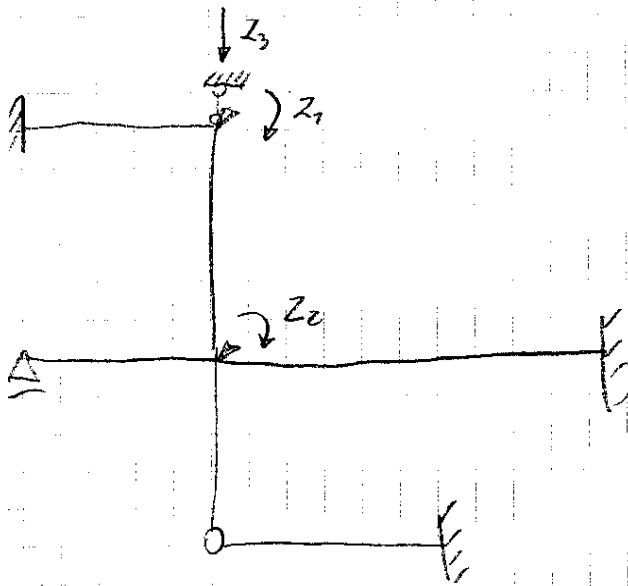
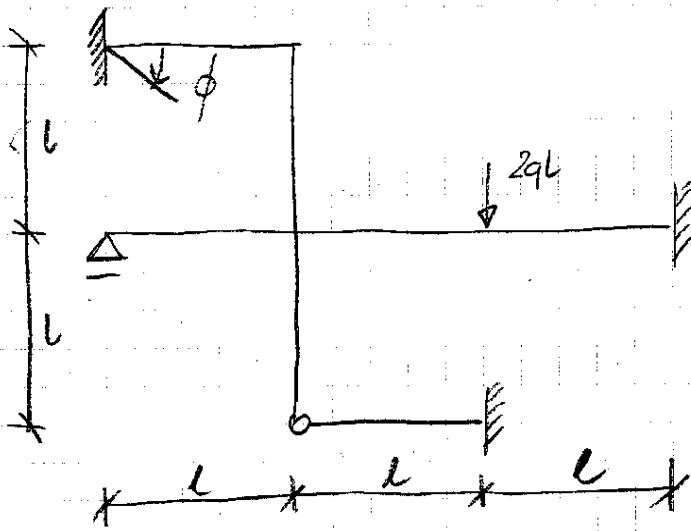
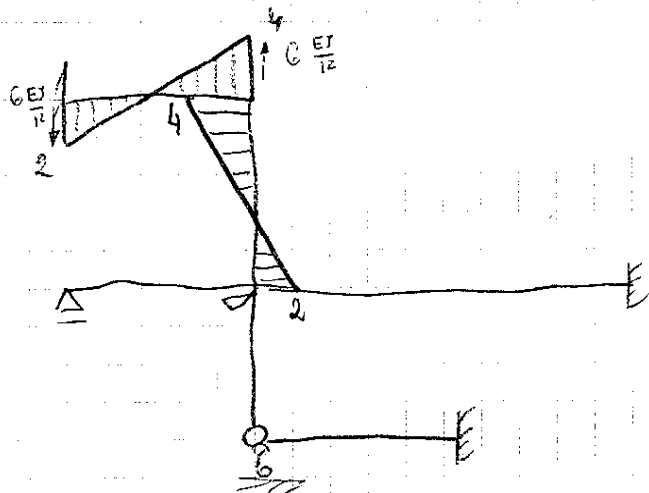


$$n_p = 3$$

$$n_s = 6$$

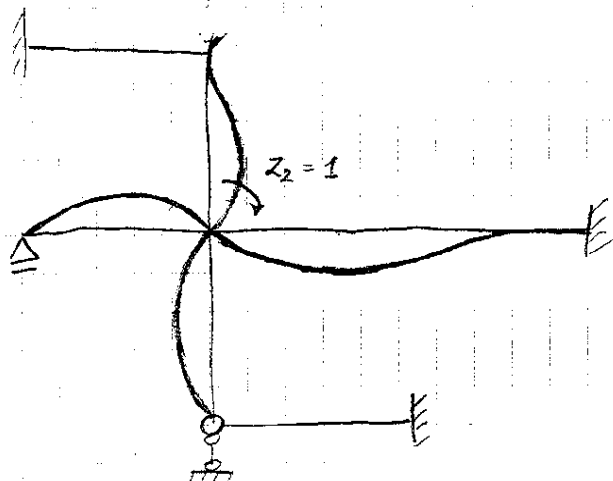


(ϕ_1)

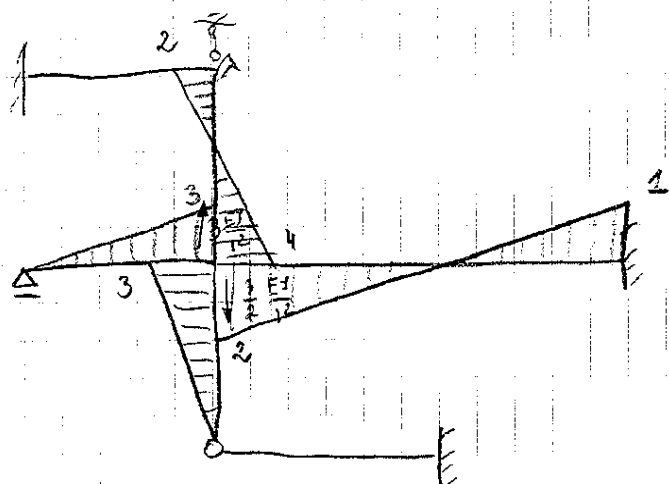


M_1

$\left[\frac{EI}{\lambda} \right]$

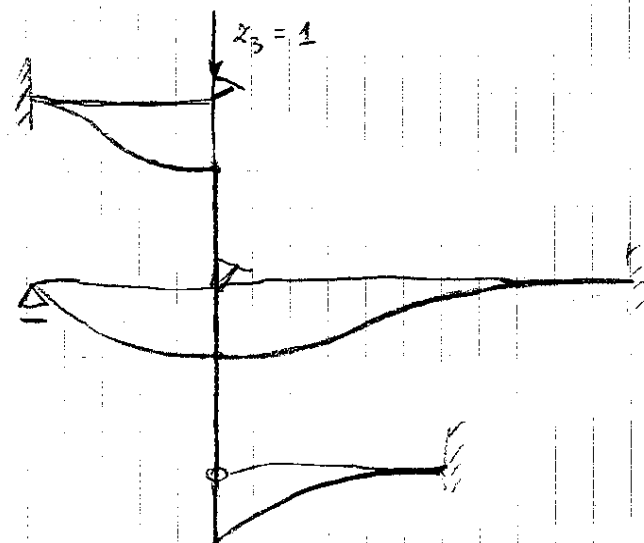


ψ_2

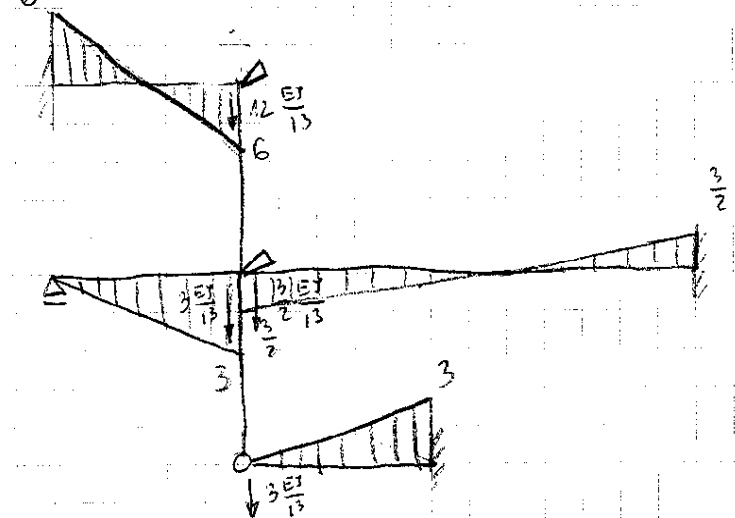


M_2

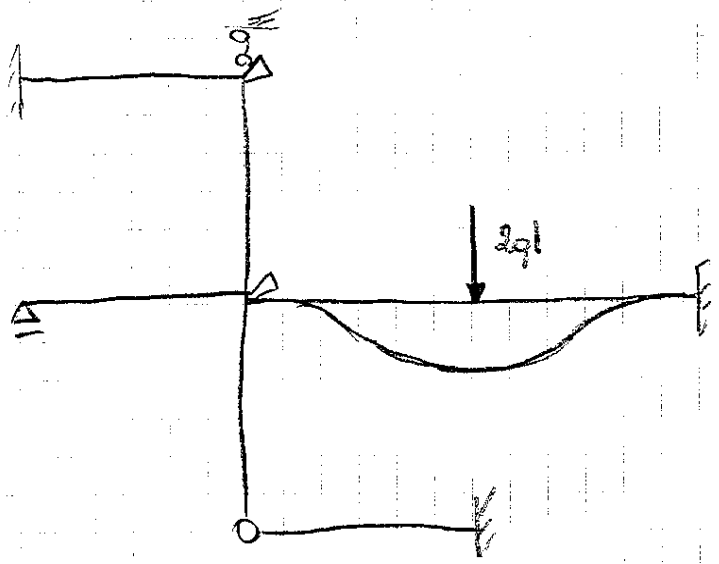
$\left[\frac{EI}{\lambda} \right]$



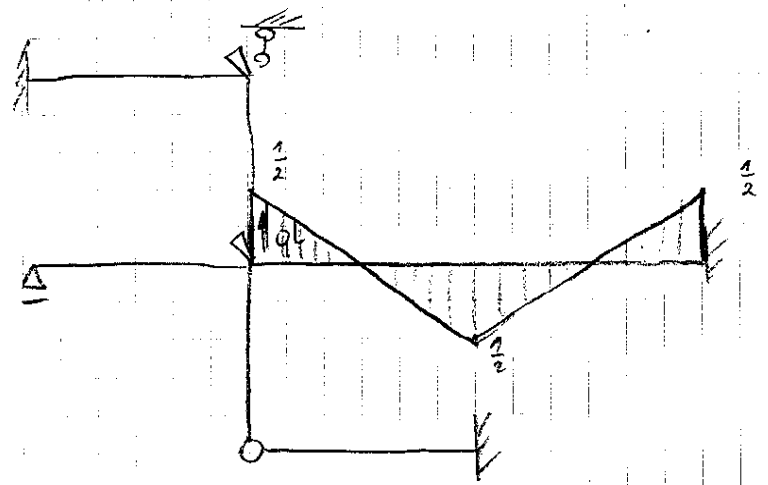
ψ_3



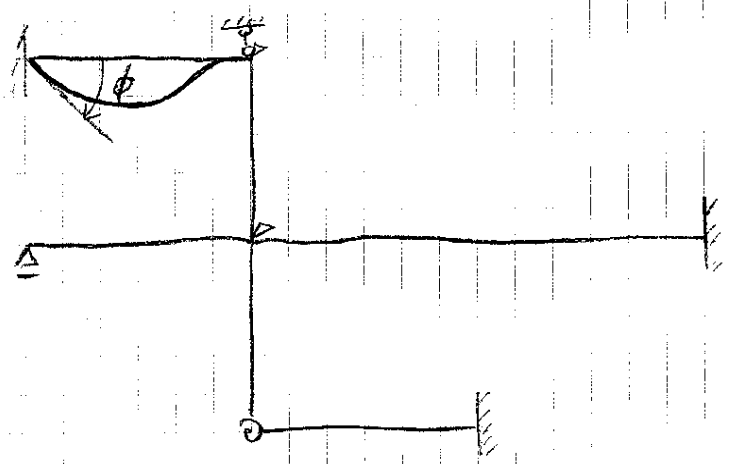
M_3 $\left[\frac{EI}{12} \right]$



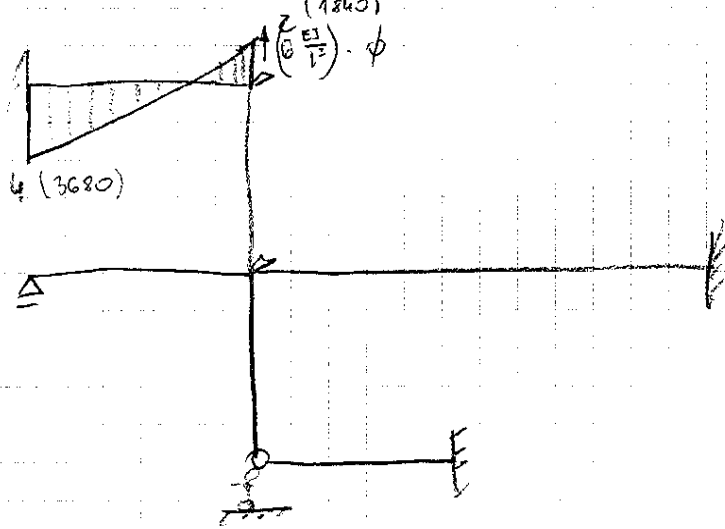
ψ_P



M_P $\left[ql^2 \right]$



ψ_ψ



$$\textcircled{M_\varphi} \quad \left[\frac{EI}{L} \cdot \phi \right]$$

$$N_{11} = \left(\frac{1}{2} + 4 \right) \frac{EI}{L} = 8 \frac{EI}{L}$$

$$N_{12} = 2 \frac{EI}{L}$$

$$N_{13} = -6 \frac{EI}{L^2}$$

$$N_{21} = 2 \frac{EI}{L}$$

$$N_{22} = (3 + 3 + 4 + 2) \frac{EI}{L} = 12 \frac{EI}{L}$$

$$N_{23} = \left(\frac{3}{2} - 3 \right) \frac{EI}{L^2} = -\frac{3}{2} \frac{EI}{L^2}$$

$$N_{31} = -6 \frac{EI}{L^2}$$

$$N_{32} = \left(\frac{3}{2} - 3 \right) \frac{EI}{L^2} = -\frac{3}{2} \frac{EI}{L^2}$$

$$N_{33} = \left(12 + 3 + \frac{3}{2} + 3 \right) \frac{EI}{L^3} = \frac{39}{2} \frac{EI}{L^3}$$

$$R_{1P} = 0$$

$$R_{2P} = -\frac{1}{2} q l^2$$

$$R_{3P} = -q l$$

$$R_{1\varphi} = 2 \frac{EI}{L} \cdot \varphi$$

$$R_{2\varphi} = 0$$

$$R_{3\varphi} = -6 \frac{EI}{L^2} \cdot \varphi$$

$$\begin{cases} 8 \frac{EI}{L} z_1 + 2 \frac{EI}{L} z_2 - 6 \frac{EI}{L^2} z_3 = 0 \\ 2 \frac{EI}{L} z_2 + 12 \frac{EI}{L} z_2 - \frac{3}{2} \frac{EI}{L^2} z_3 - \frac{1}{2} q l^2 = 0 \\ -6 \frac{EI}{L} z_2 - \frac{3}{2} \frac{EI}{L^2} z_2 + \frac{39}{2} \frac{EI}{L^3} z_3 - q l = 0 \end{cases}$$

$$\begin{cases} z_1 = \frac{9}{230} \frac{q l^3}{EI} = \frac{27}{690} \frac{q l^3}{EI} \\ z_2 = \frac{1}{20} \frac{q l^3}{EI} = \frac{30}{690} \frac{q l^3}{EI} \\ z_3 = \frac{1}{15} \frac{q l^4}{EI} = \frac{46}{690} \frac{q l^4}{EI} \end{cases}$$

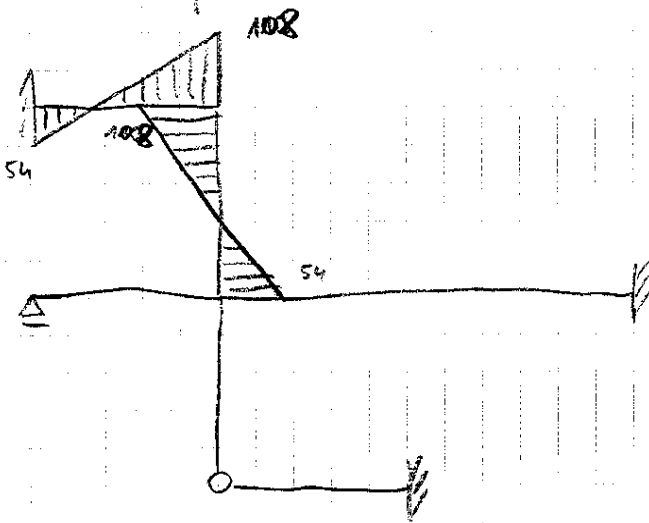
die sity z_1

$$\begin{cases} 8 \frac{EI}{L} Z_1 + 2 \frac{EI}{L} Z_2 - 6 \frac{EI}{L^2} Z_3 + 2 \frac{EI}{L} \varphi = 0 \\ 2 \frac{EI}{L} Z_1 + 12 \frac{EI}{L} Z_2 - \frac{3}{2} \frac{EI}{L^2} Z_3 = 0 \\ -6 \frac{EI}{L} Z_1 - \frac{3}{2} \frac{EI}{L^2} Z_2 + \frac{33}{2} \frac{EI}{L^3} Z_3 - 6 \frac{EI}{L^2} \varphi = 0 \end{cases}$$

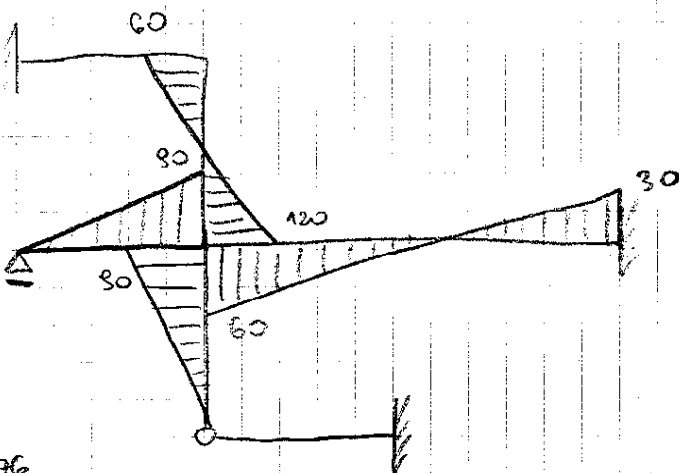
$$\begin{cases} Z_1 = -\frac{33}{920} \varphi = -\frac{33}{920} \varphi \\ Z_2 = \frac{1}{23} \varphi = \frac{40}{920} \varphi \\ Z_3 = \frac{3}{10} \varphi \cdot L = \frac{276}{920} \varphi \cdot L \end{cases}$$

dla kąta obrotu

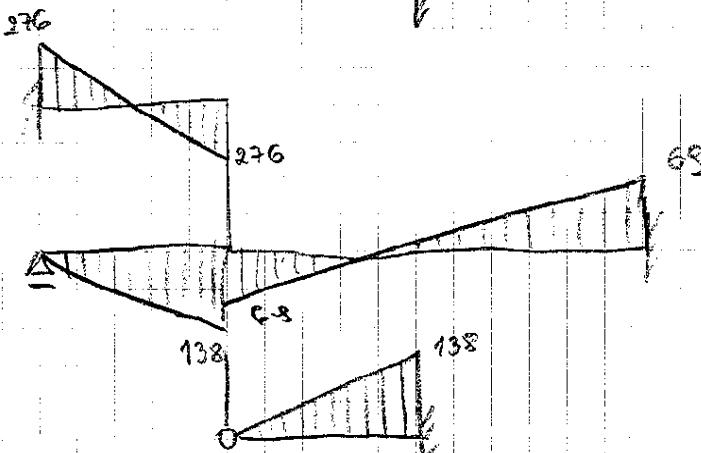
Siła Q_1



$$M_1 \cdot Z_1 \quad \left[\times \frac{1}{680} q l^2 \right]$$

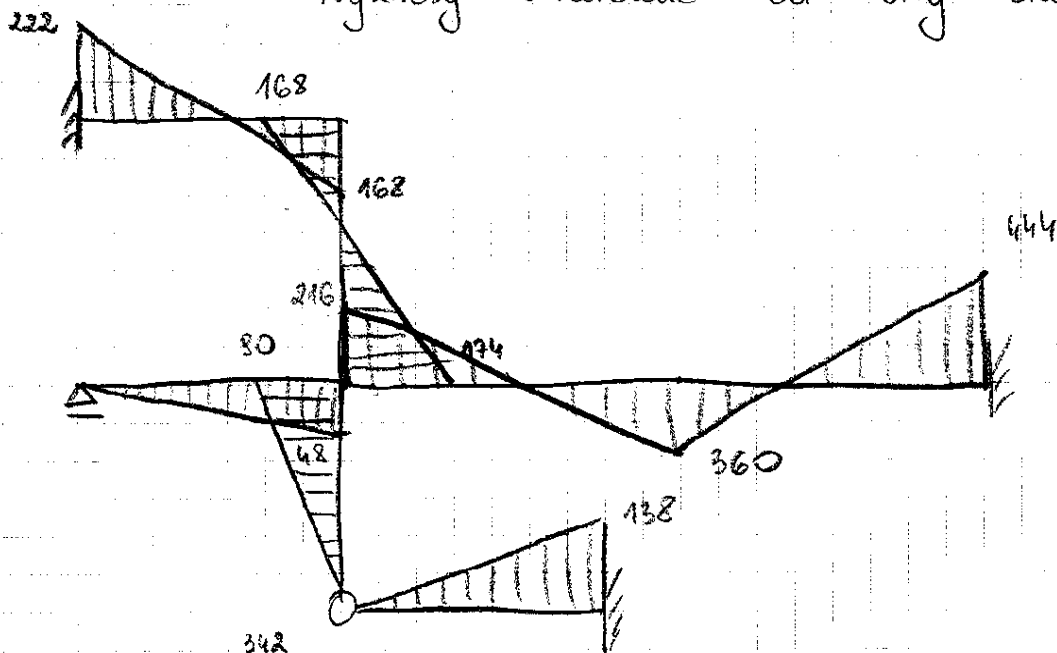


$$M_2 \cdot Z_2 \quad \left[\times \frac{1}{680} q l^2 \right]$$

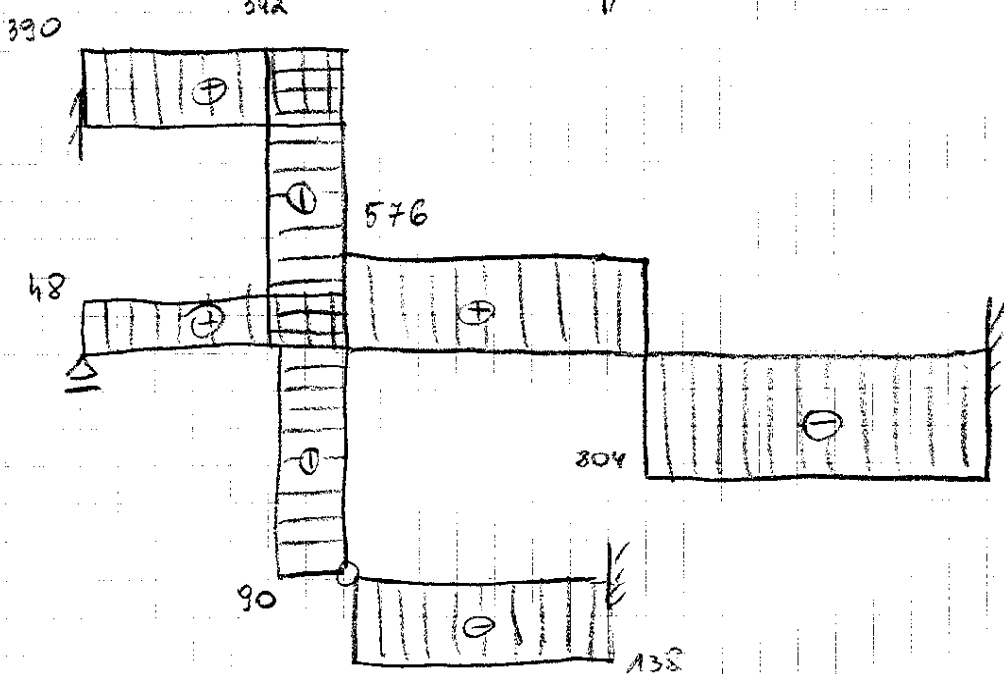


$$M_3 \cdot Z_3 \quad \left[\times \frac{1}{680} q l^2 \right]$$

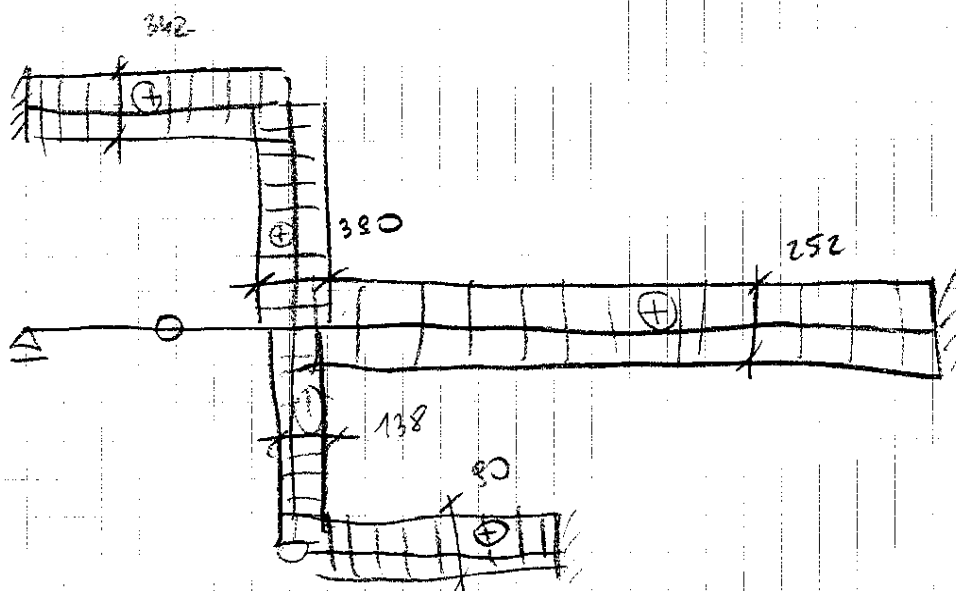
Nyknesy ostateczne od siły skupionej 2q_l



(M) $\left[\times \frac{1}{690} q_l^2 \right]$



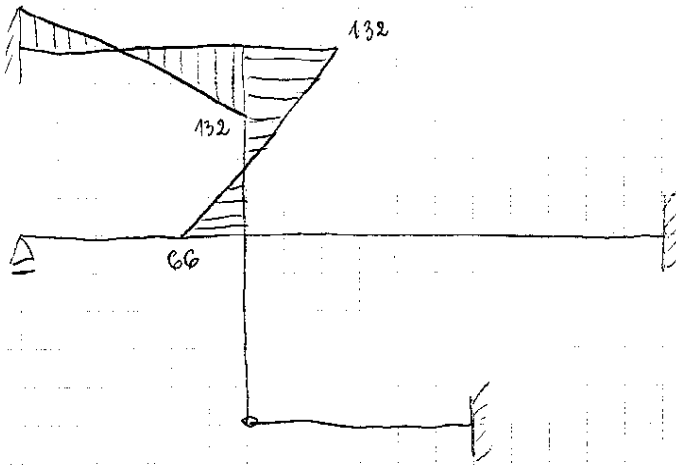
(T) $\left[\times \frac{1}{690} q_l \right]$



(N) $\left[\times \frac{1}{690} q_l \right]$

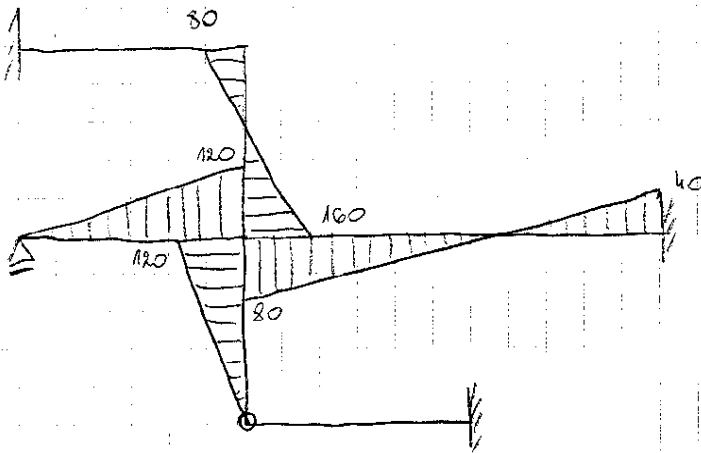
kąt obrotu

66



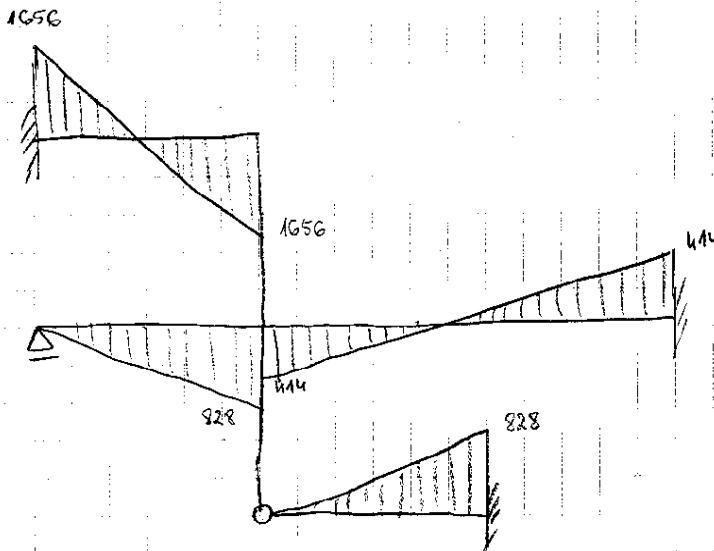
$M_1 \cdot Z_1$

$$\left[\times \frac{1}{320} \frac{EJ}{\lambda} \cdot \varphi \right]$$



$M_2 \cdot Z_2$

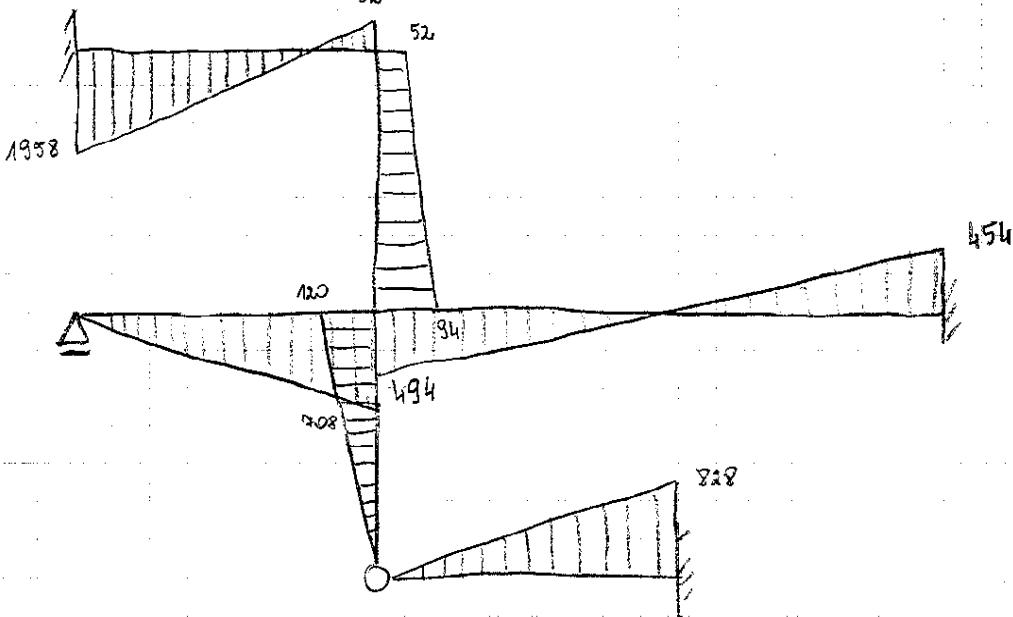
$$\left[\times \frac{1}{320} \frac{EJ}{\lambda} \cdot \varphi \right]$$



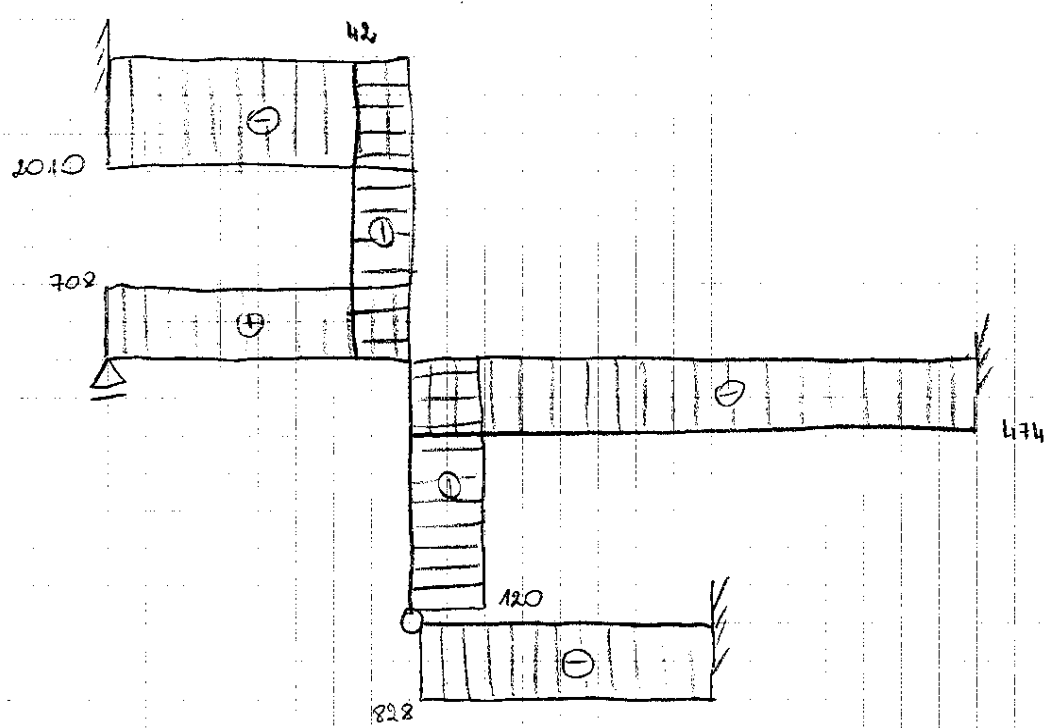
$M_3 \cdot Z_3$

$$\left[\times \frac{1}{320} \frac{EJ}{\lambda} \cdot \varphi \right]$$

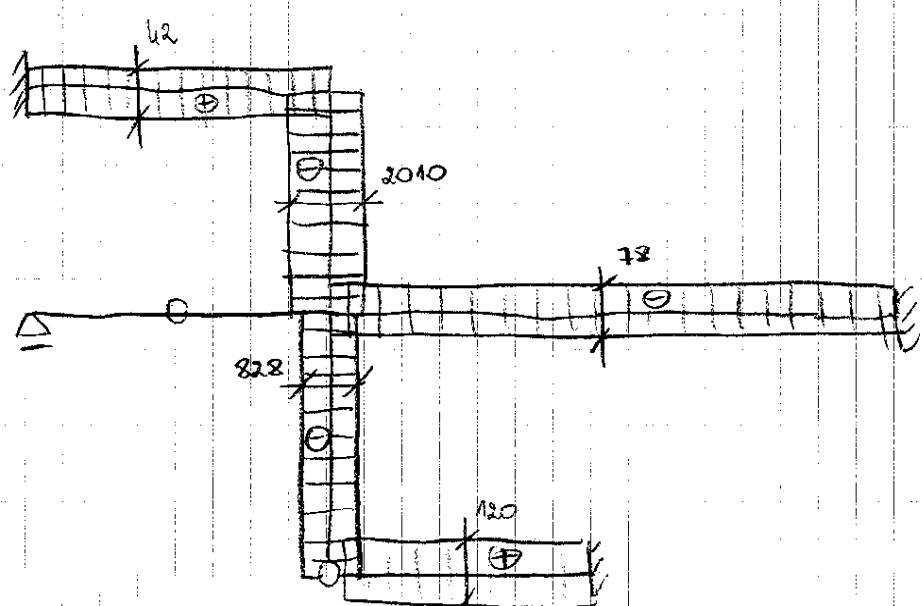
Wykresy ostateczne od kąta obrotu ϕ



(M) $\left[\times \frac{1}{920} \frac{EJ}{l} \psi \right]$

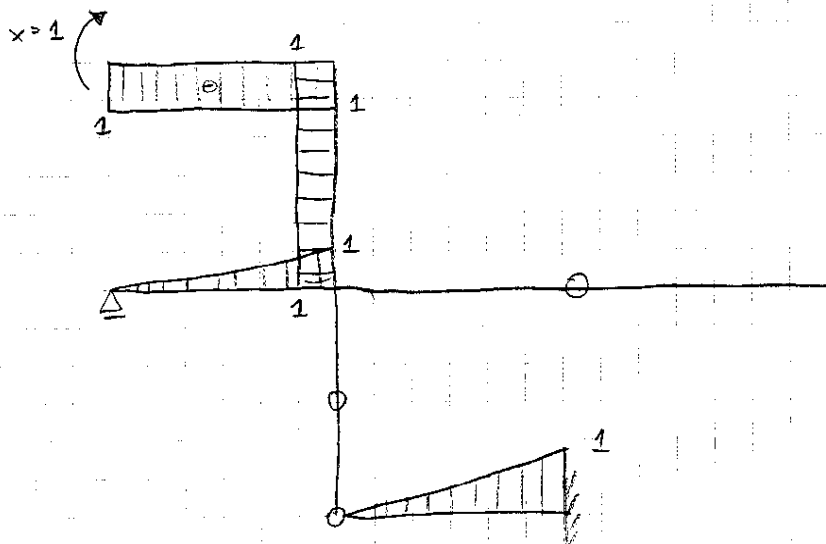


(T) $\left[\times \frac{1}{920} \frac{EJ \psi}{l^2} \right]$

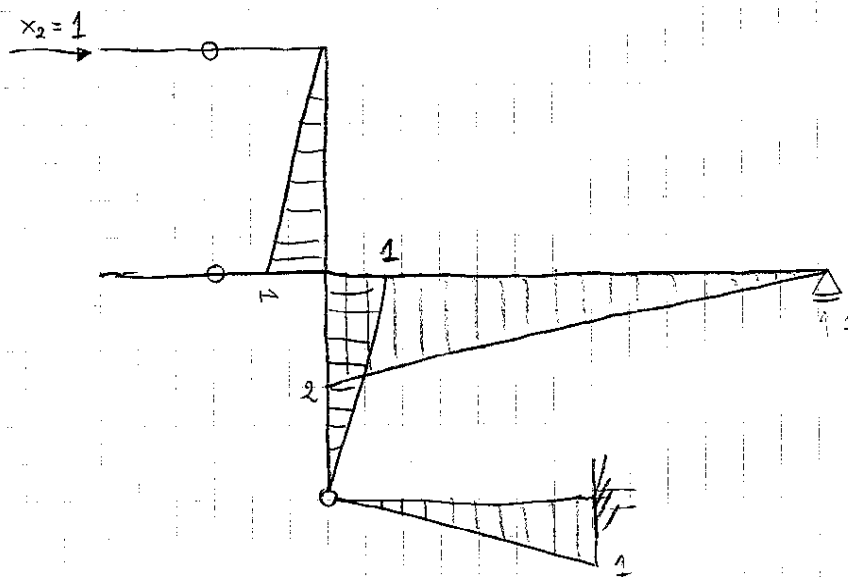


(N) $\left[\times \frac{1}{920} \frac{EJ \psi}{l^2} \right]$

Sprawdzenie



\bar{M}_1



\bar{M}_2

a) siła skupiona 2ql

$$f_1 = \frac{1}{EJ} \left[\frac{1}{2} \cdot \frac{222}{690} \cdot 1 \cdot (-1) + \frac{1}{2} \cdot \frac{168}{690} \cdot 1 \cdot 1 + \frac{1}{2} \cdot \frac{168}{690} \cdot 1 \cdot 1 + \frac{1}{2} \cdot \frac{174}{690} \cdot 1 \cdot (-1) + \frac{1}{2} \cdot \frac{18}{690} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{138}{690} \cdot 1 \cdot \left[\frac{2}{3}\right] \right] = 0$$

$$f_2 = \frac{1}{EJ} \left[\frac{1}{2} \cdot \frac{168}{690} \cdot 1 \cdot \frac{1}{3} + \frac{1}{2} \cdot \frac{174}{690} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{90}{690} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{138}{690} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{216}{690} \cdot 2 \cdot (-1) + \frac{1}{2} \cdot \frac{222}{690} \cdot 2 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot 1 \cdot 1 \cdot \frac{2}{3} + \frac{1}{2} \cdot 1 \cdot 1 \cdot \left[\frac{1}{3}\right] \right] = 0$$

b) kąt obrotu

$$f_1 = \frac{1}{EJ} \left[\frac{1}{2} \cdot \frac{1952}{920} \cdot 1 \cdot 1 + \frac{1}{2} \cdot \frac{52}{920} \cdot 1 \cdot (-1) + \frac{52}{920} \cdot 1 \cdot (-1) + \frac{1}{2} \cdot \frac{42}{920} \cdot 1 \cdot (-1) + \frac{1}{2} \cdot \frac{308}{920} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{928}{920} \cdot 1 \cdot \left[\frac{2}{3}\right] \right] - 1 = 0$$

$$f_2 = \frac{1}{EJ} \left[\frac{52}{920} \cdot 1 \cdot \left(-\frac{1}{2}\right) + \frac{1}{2} \cdot \frac{42}{920} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{122}{920} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{828}{920} \cdot 1 \cdot \left(-\frac{2}{3}\right) + \frac{1}{2} \cdot \frac{434}{920} \cdot 2 \cdot \frac{1}{3} + \frac{1}{2} \cdot \frac{454}{920} \cdot 2 \cdot \left(-\frac{2}{3}\right) \right] = 0$$