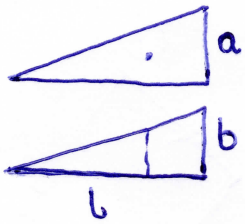
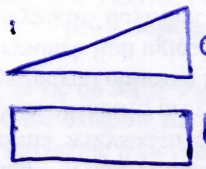
MECHANIKA BUDOWLI – uzupełnienie – CAŁKOWANIE GRAFICZNE WYKRESÓW

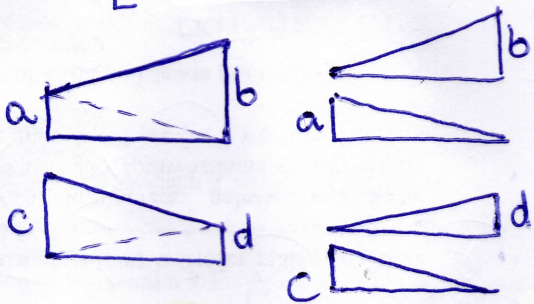
$\left(I = \int_L F_1 F_2 \, dx, \text{ podstawa } L\right)$



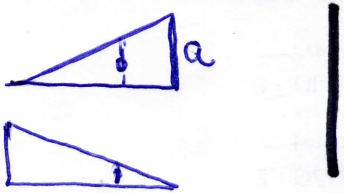
$$I = \frac{1}{2} al \cdot \frac{2}{3} b = \frac{1}{3} abl$$



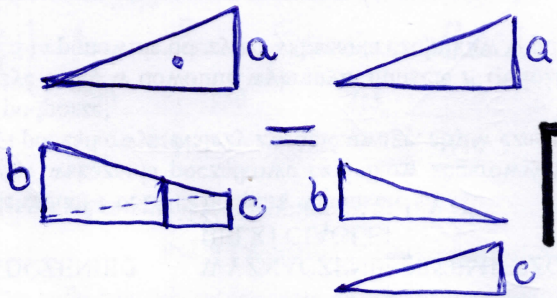
$$I = \frac{1}{2} al \cdot b = \frac{1}{2} abl$$



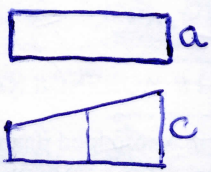
$$I = \frac{1}{3} acl + \frac{1}{3} bdl + \frac{1}{6} adl + \frac{1}{6} bcl$$



$$I = \frac{1}{2} al \cdot \frac{1}{3} b = \frac{1}{6} abl$$



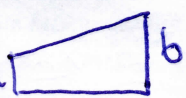
$$I = \frac{1}{2} al \cdot \frac{2}{3} c + \frac{1}{2} al \cdot \frac{1}{3} b =$$
$$= \frac{1}{3} acl + \frac{1}{6} abl$$
$$= \frac{1}{2} al \left(\frac{2}{3} c + \frac{1}{3} b\right)$$



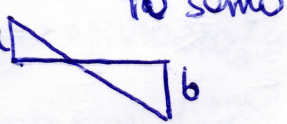
$$I = al \frac{b+c}{2}$$

(ewentualnie na dwa trójkąty – to samo)

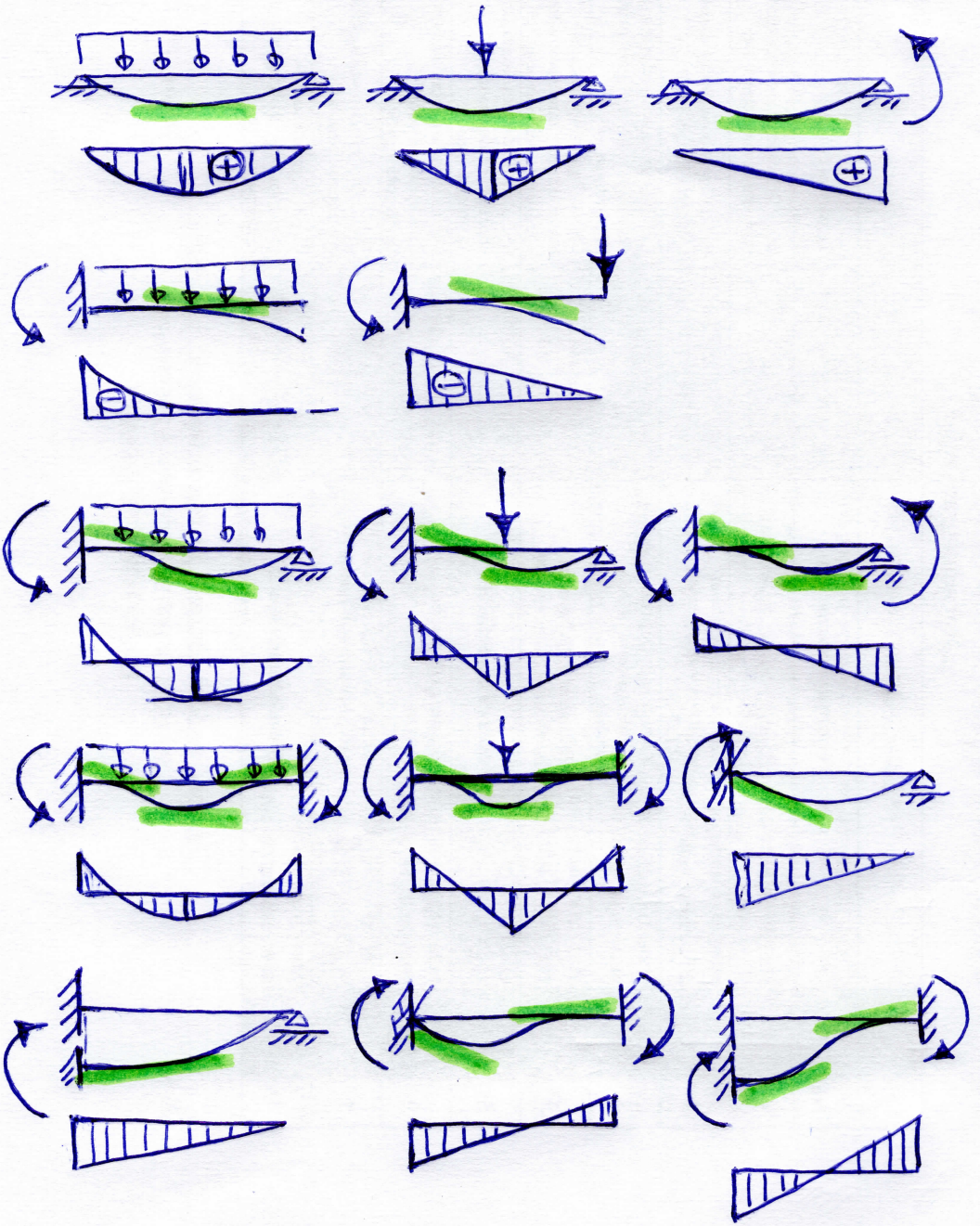
UWAGA:



to samo

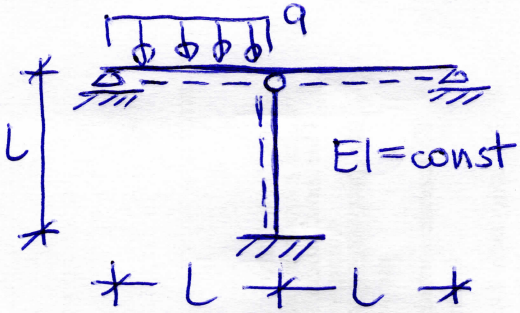


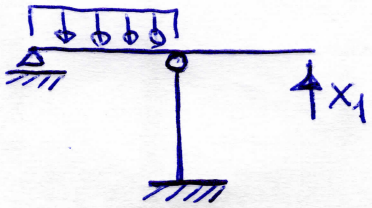
SZKICE LINII UGIĘCIA, ZGODNOŚĆ Z WYKRESAMI MOMENTÓW ZGINAJĄCYCH



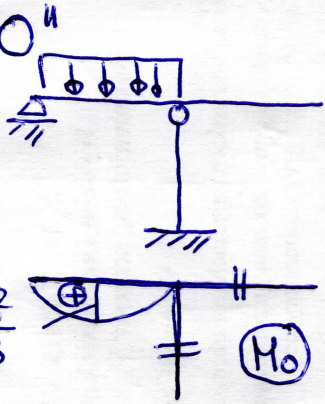
METODA SIŁ – ZADANIA UZUPEŁNIAJĄCE

$t=2 \quad r=7 \quad n_s=7-6=1$

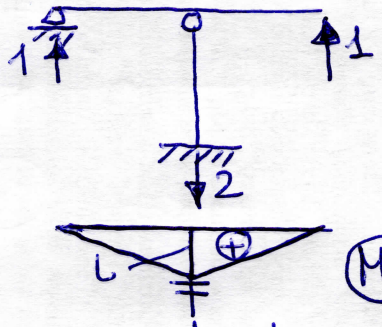




"0"



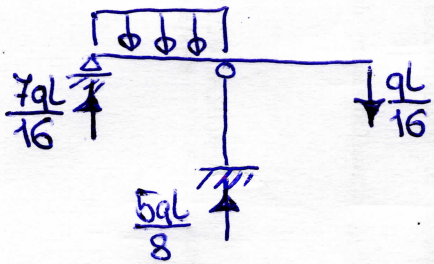
$X_1=1$

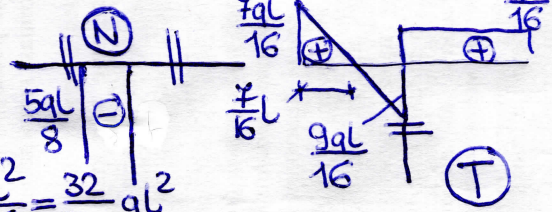


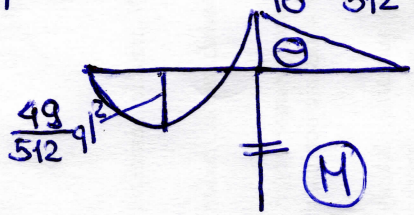
$$\delta_{10}=\frac{1}{EI}\cdot\frac{2}{3}\cdot L\cdot\frac{ql^2}{8}\cdot\frac{L}{2}=\frac{qL^4}{24EI}$$

$$\delta_{11}=\frac{1}{EI}\,2\cdot\frac{1}{3}\cdot L\cdot L\cdot 1=\frac{2L^3}{3EI}$$

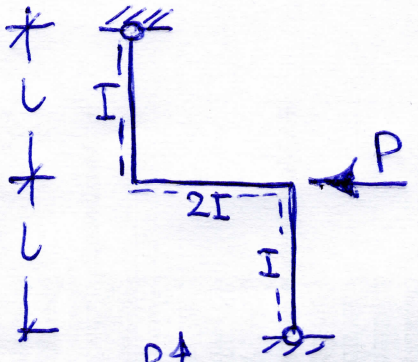
$$X_1=-\frac{qL}{16}$$

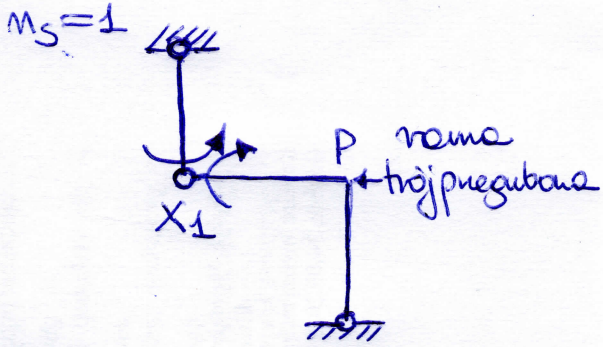


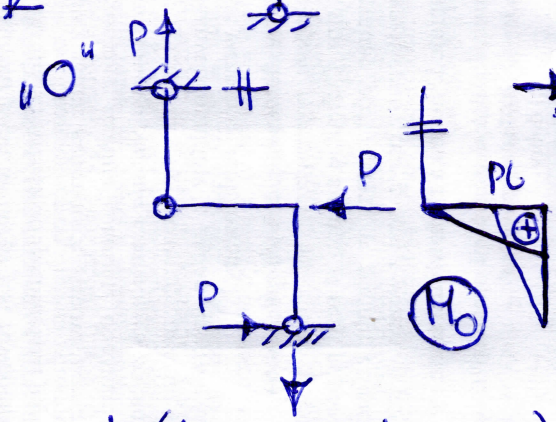


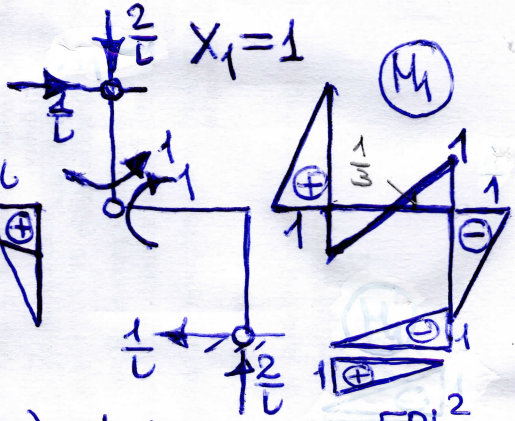


Jest to praktycznie rozwiązanie belkowe, różnica – siła normalna w elemencie pionowym









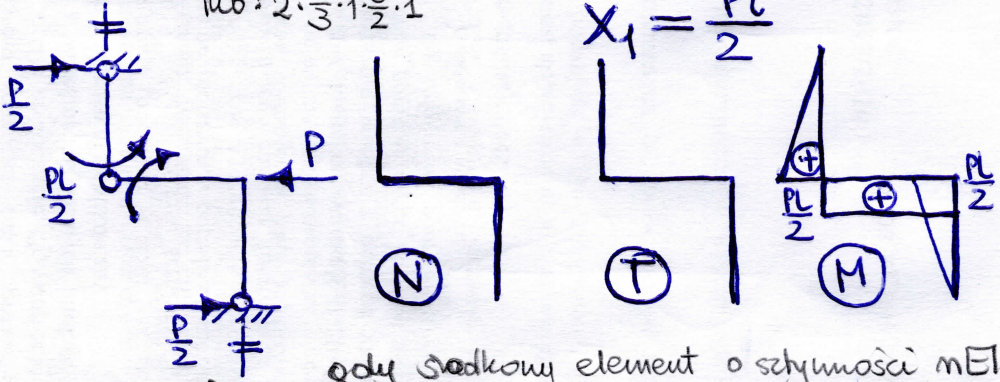
$$\delta_{10}=\frac{1}{2EI}\left(\frac{1}{6}\cdot l\cdot Pl\cdot 1-\frac{1}{3}\cdot l\cdot Pl\cdot 1\right)-\frac{1}{EI}\frac{1}{3}\cdot l\cdot Pl\cdot 1=-\frac{5Pl^2}{12EI}$$

lub: $-\frac{1}{2}\cdot l\cdot Pl\cdot\frac{1}{3}$

$$\delta_{11}=\frac{1}{2EI}\left(2\cdot\frac{1}{3}\cdot l\cdot 1\cdot 1-2\cdot\frac{1}{6}\cdot l\cdot 1\cdot 1\right)+\frac{1}{EI}\cdot 2\cdot\frac{1}{3}\cdot l\cdot 1\cdot 1=\frac{5l}{6EI}$$

lub: $2\cdot\frac{1}{3}\cdot 1\cdot\frac{l}{2}\cdot 1$

$$X_1=\frac{Pl}{2}$$



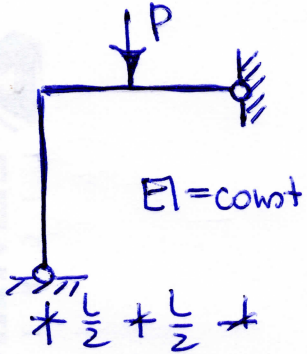
gdy środkowy element o sztywności nEI:

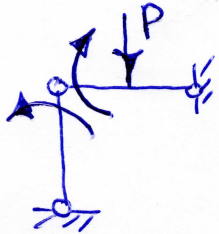
$$\delta_{10}=\frac{-Pl^2}{nEI}\cdot\frac{1}{6}-\frac{Pl^2}{3EI}=\frac{-Pl^2}{6EI}\left(2+\frac{1}{n}\right)$$

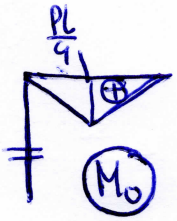
$$\delta_{11}=\frac{l}{nEI}\cdot\frac{1}{3}+\frac{2l}{3EI}=\frac{l}{3EI}\left(2+\frac{1}{n}\right)$$

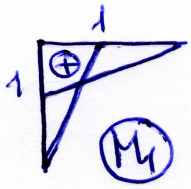
$$X_1=\frac{Pl}{2}$$

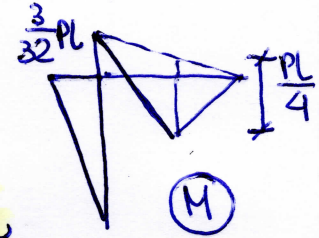
niezależnie od n



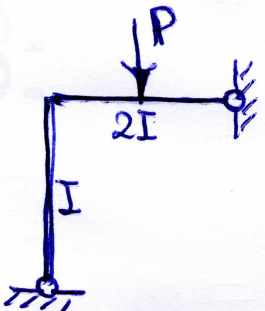




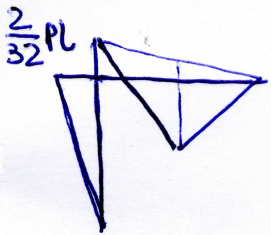


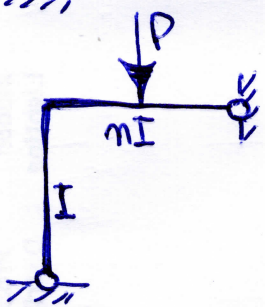


$$\left.\begin{aligned}\delta_{10} &= \frac{1}{EI}\cdot\frac{1}{2}\cdot L\,\frac{Pl}{4}\cdot\frac{1}{2} = \frac{Pl^2}{16EI}\\ \delta_{11} &= \frac{1}{EI}\cdot 2\cdot\frac{1}{3}\cdot L\cdot 1\cdot 1 = \frac{2L}{3EI}\end{aligned}\right\} \quad X_1 = \frac{-3}{32}Pl$$

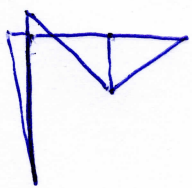


$$\left.\begin{aligned}\delta_{10} &= \frac{1}{2}\cdot\frac{Pl^2}{16EI} = \frac{Pl^2}{32EI}\\ \delta_{11} &= \frac{L}{3EI} + \frac{1}{2}\cdot\frac{L}{3EI} = \frac{L}{2EI}\end{aligned}\right\} \quad X_1 = -\frac{1}{16}Pl$$





$$\left.\begin{aligned}\delta_{10} &= \frac{1}{n}\cdot\frac{Pl^2}{16EI} = \frac{Pl^2}{16n\,EI}\\ \delta_{11} &= \frac{L}{3EI} + \frac{1}{n}\cdot\frac{L}{3EI} = \frac{n+1}{n}\cdot\frac{L}{3EI}\end{aligned}\right\} \quad X_1 = \frac{-3}{16(n+1)}Pl$$



$n \to \infty \Rightarrow$ sztywność stupa zdecydowanie mniejsza od sztywności belki, $X_1 \to 0$