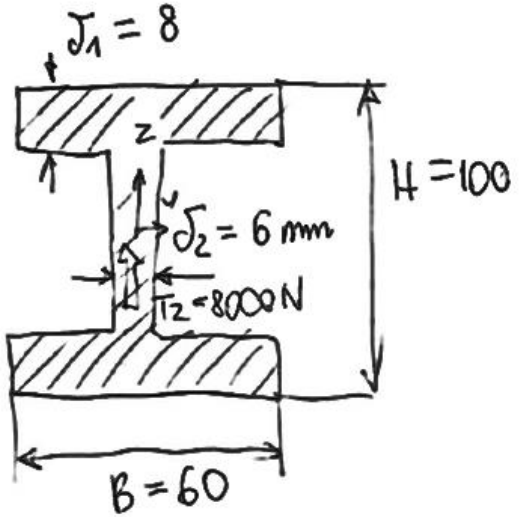
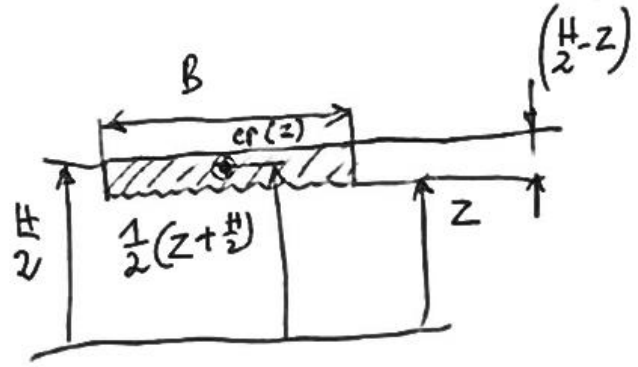
ŚCINANIE DWUTEOWNIKA



$$J_y = \frac{BH^3}{12} - \frac{(B-\delta_2)\cdot(H-2\delta_1)^3}{12}$$

$$= 2332832\,mm^4$$

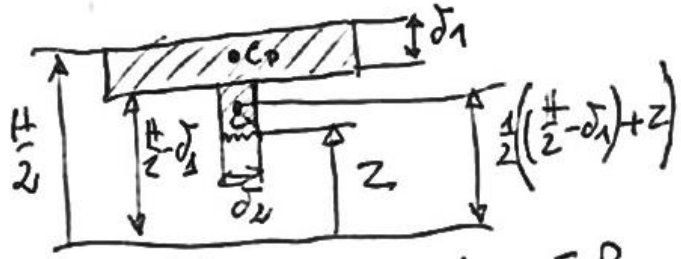


1°) $z \in \left(\frac{H}{2}-\delta_1, \frac{H}{2}\right)$

$$S_y(z) = B\left(\frac{H}{2}-z\right)\cdot\frac{1}{2}\left(z+\frac{H}{2}\right)$$

$$\tau_{xz}(z) = \frac{T_z S_y(z)}{B\cdot J_y}$$

2°) $z \in \left\langle 0, \frac{H}{2}-\delta_1\right)$



$$A_p = \delta_1 B$$

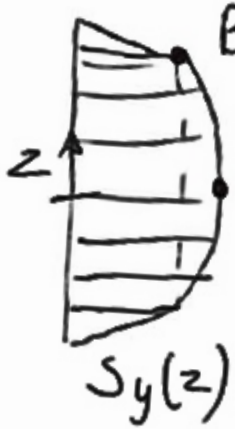
$$A_s(z) = \left(\frac{H}{2}-\delta_1-z\right)\cdot\delta_2$$

$$z_c = \frac{A_p\cdot z_{cp} + A_s(z) z_{cs}}{A_p + A_s(z)}$$

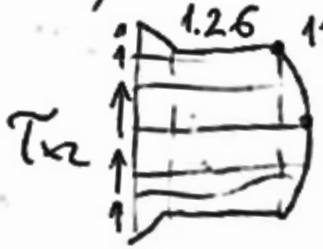
$$S_y(z) = (A_p + A_s) \cdot z_c = A_p \cdot z_{cp} + A_s \cdot z_{cs}$$

$$= \delta_1 \cdot B \cdot \frac{1}{2}(H - \delta_1) + \left(\frac{H}{2} - \delta_1 - z\right)\delta_2 \cdot \frac{1}{2}\left(\left(\frac{H}{2} - \delta_1\right) + z\right)$$

$$B\left(\frac{H}{2} - \frac{H}{2} + \delta_1\right) \cdot \frac{1}{2}\left(\frac{H}{2} - \delta_1 + \frac{H}{2}\right) = B\delta_1 \cdot \frac{1}{2}(H - \delta_1) = 22080\ mm^3$$



$$\delta_1 B \cdot \frac{1}{2}(H - \delta_1) + \left(\frac{H}{2} - \delta_1\right) \cdot \delta_2 \cdot \frac{1}{2}\left(\frac{H}{2} - \delta_1\right) = 27372\ mm^3$$



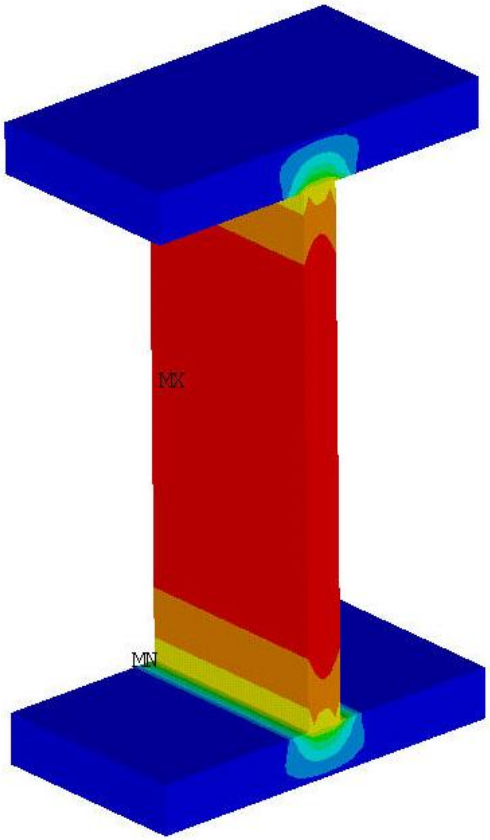
$$\tau_{xz}(y) = \frac{T_z \cdot S_y(z)}{\delta_2 \cdot J_y}$$

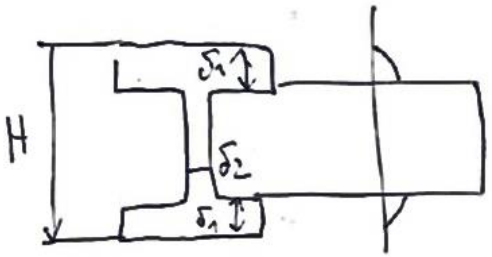
NODAL SOLUTION

STEP=1
SUB =1
TIME=1
SXZ (AVG)
RSYS=0
DMX =.816864
SMN =-1.27908
SMX =15.6585

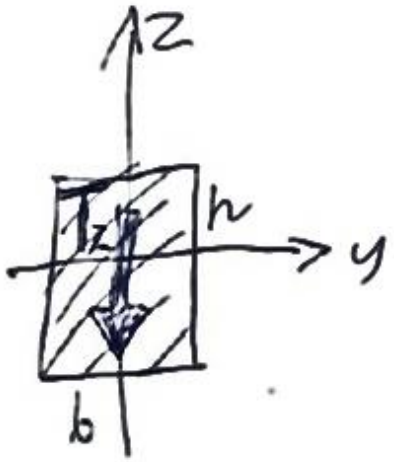
ANSYS
R17.2
Academic

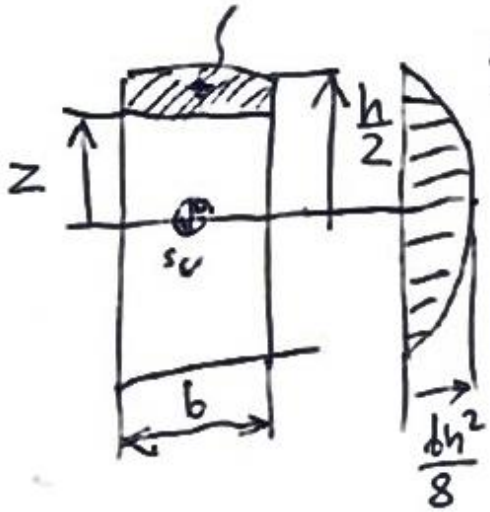
OCT 5 2022
09:37:32
PLOT NO. 1





$$\tau \approx \frac{T}{(H-2\delta_1)\delta_2}$$





$$S_y(z) = \underbrace{b\left(\frac{h}{2}-z\right)}_{\text{pole}(z)} \cdot \frac{1}{2}\left(z+\frac{h}{2}\right) = \frac{b}{2}\left(\frac{h^2}{4}-z^2\right)$$

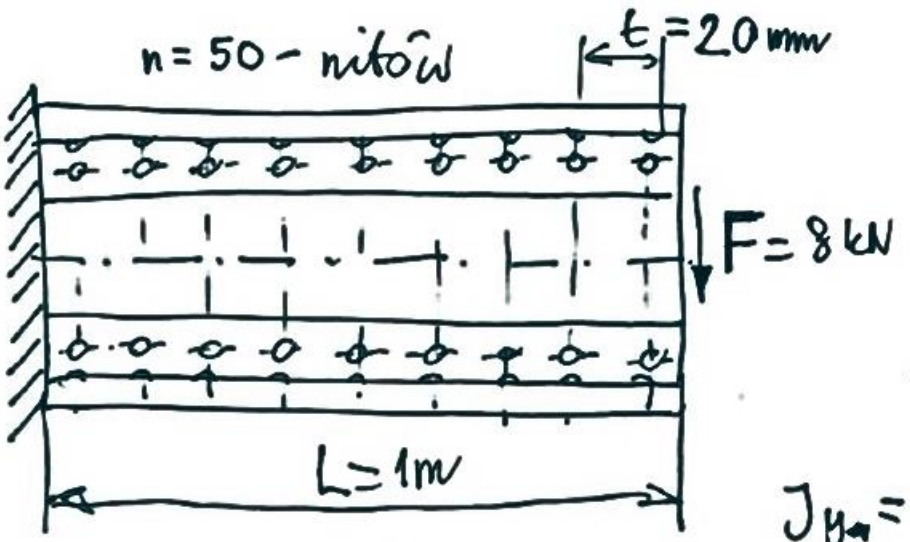
$$J_y = \frac{bh^3}{12} \qquad A = bh$$

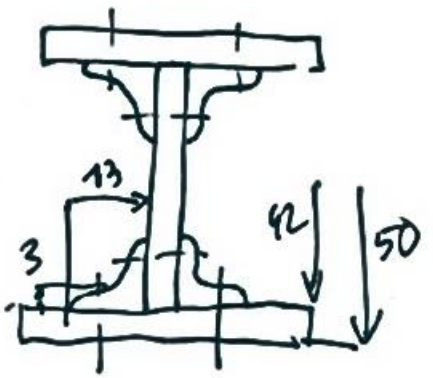
$$\tau_{xz}(z) = \frac{T_z \cdot S_y(z)}{b(z)\, J_y}$$

$$\tau_{xz}(0) = \frac{T_z \cdot S_y(0)}{b(0)\cdot J_y} = \frac{T_z \cdot \frac{bh^2}{8}}{b\,\frac{bh^3}{12}} = \frac{3}{2}\frac{T_z}{A}$$

(koto $\frac{4}{3}\frac{T_z}{A}$)

Blachownica nitowana





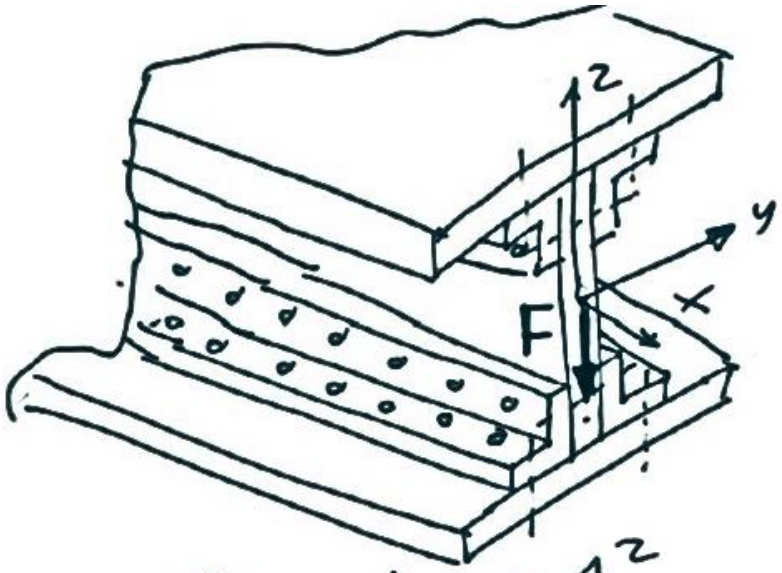
$J_{y*} = 2728500\ mm^4$

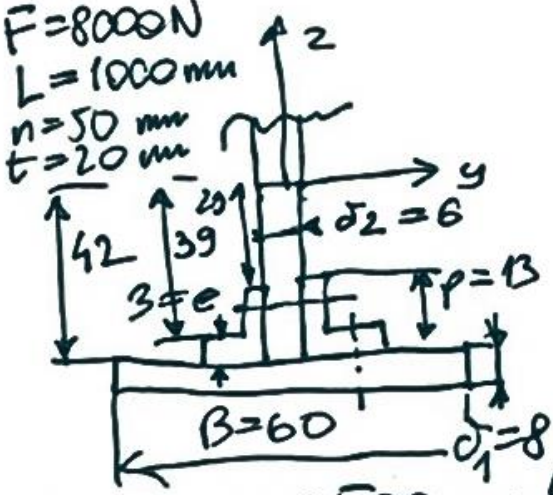
Półki

$$M_p = 2\int_{\frac{H-2t_1}{2}}^{\frac{H}{2}} \sigma_x \cdot z B\, dz = 2\int_{\frac{H-2t_1}{2}}^{\frac{H}{2}} \frac{BFL\cdot z^2}{J_{y*}}\, dz = \frac{2BFL}{3J_{y*}} z^3 \Big|_{\frac{H-2t_1}{2}}^{\frac{H}{2}} =$$

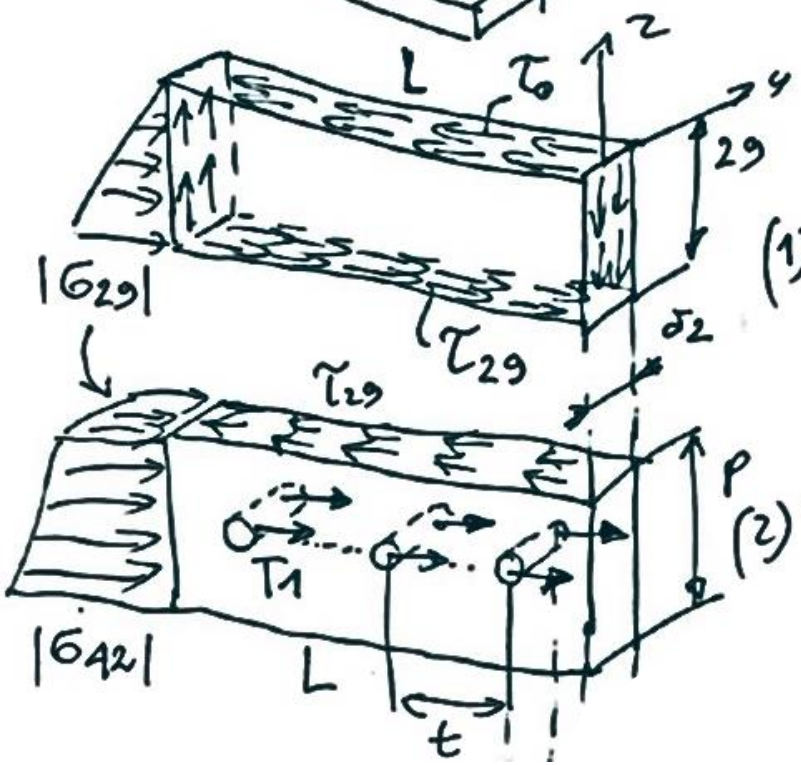
$$= \frac{2BFL}{3J_{y*}}\left(\frac{H^3}{8} - \frac{(H-2t_1)^3}{8}\right) = \frac{BFL}{12J_{y*}}\left(H^3 - (H-2t_1)^3\right) =$$

$$= \frac{60}{12\cdot 2728500}\left(100^3 - 84^3\right) FL = 0{,}75\, FL$$





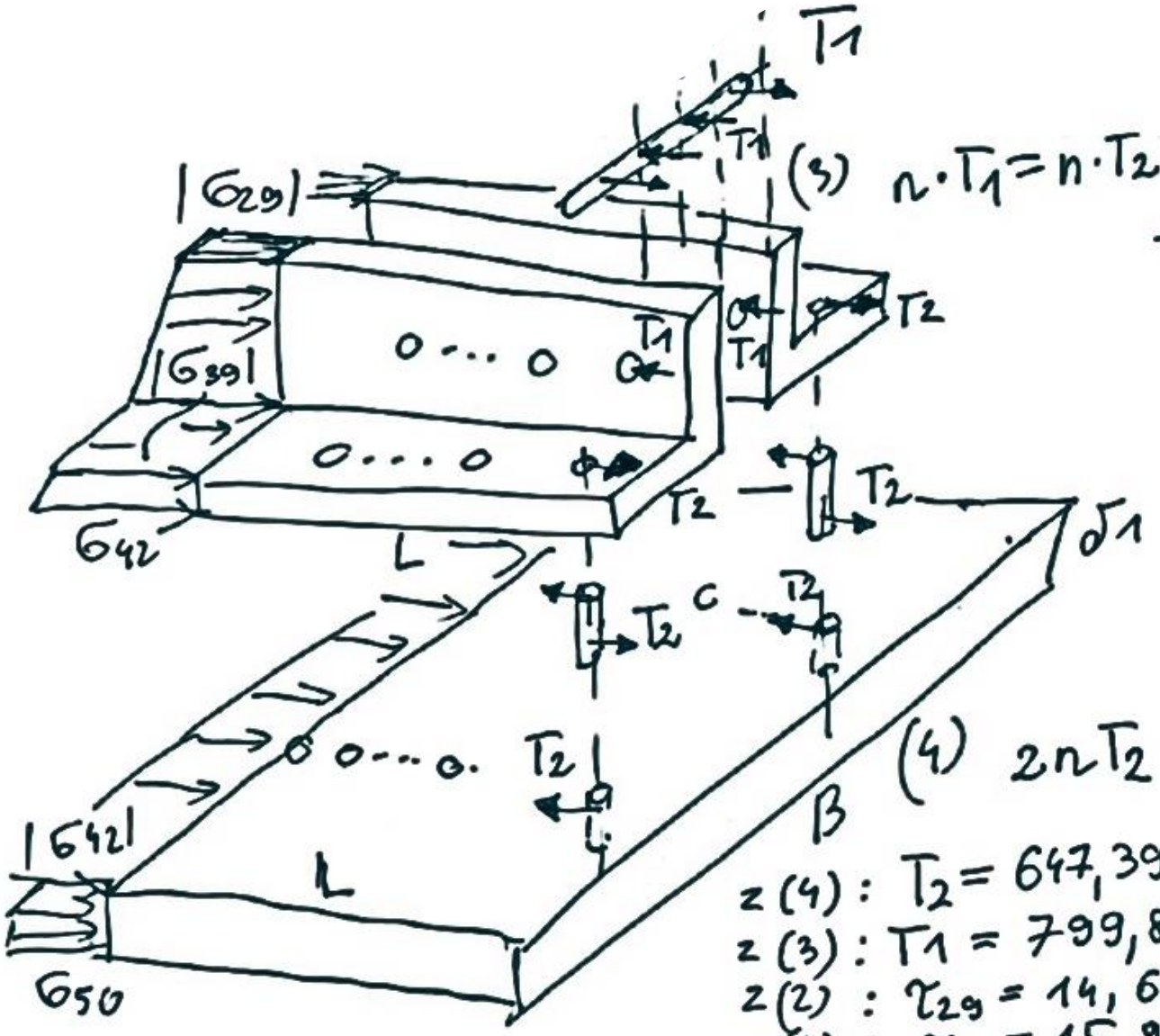
$J_{y*} = 272500\ mm^4$



(1) $\tau_0 \cdot \delta_2 \cdot L = \tau_{29} \cdot \delta_2 \cdot L + \frac{|\sigma_{29}|}{2} \cdot 29 \cdot \delta_1$

$|\sigma_{29}| = \frac{FL}{J_{y*}} \cdot 29mm$

(2) $\tau_{29} \cdot \delta_2 L = 2n \cdot T_1 + \frac{|\sigma_{29}| + |\sigma_{42}|}{2} \cdot \rho \cdot \delta_2$



(3) $n \cdot T_1 = n \cdot T_2 + \frac{|\sigma_{39}| + |\sigma_{42}|}{2} \cdot p \cdot e + \frac{|\sigma_{29}| + |\sigma_{39}|}{2} \cdot (p \cdot e) e$

(4) $2nT_2 = \overbrace{\frac{|\sigma_{42}| + |\sigma_{50}|}{2}}^{134,87\ MPa} \cdot B \delta_1$

z (4) : $T_2 = 647,39\ N$

z (3) : $T_1 = 799,825\ N$

z (2) : $\tau_{29} = 14,68\ MPa$

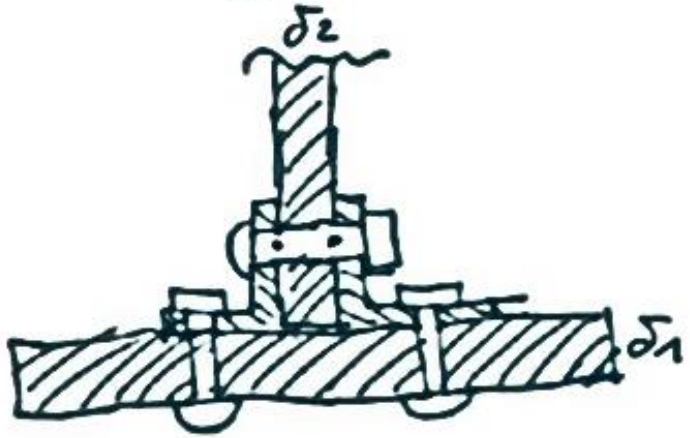
z (1) : $\tau_0 = 15,92\ MPa$

Dobór średnicy nitów $k_t = 100\ MPa$

$$\frac{T_1}{\left(\frac{\pi d^2}{4}\right)} \leq k_t \rightarrow d \geq \sqrt[2]{\frac{4 \cdot T_1}{\pi k_t}} =$$

$$= \sqrt{\frac{4 \cdot 800}{\pi \cdot 100}}\ mm =$$

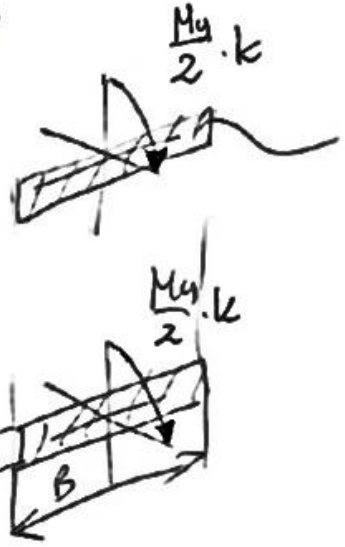
$$\doteq \sqrt{\frac{3200}{314{,}15}} = 3{,}2\ mm$$



Skrajne przypadki po ścięciu połączenia nitowego

$k \in \langle 0,1 \rangle$

1) przy $k = 1$

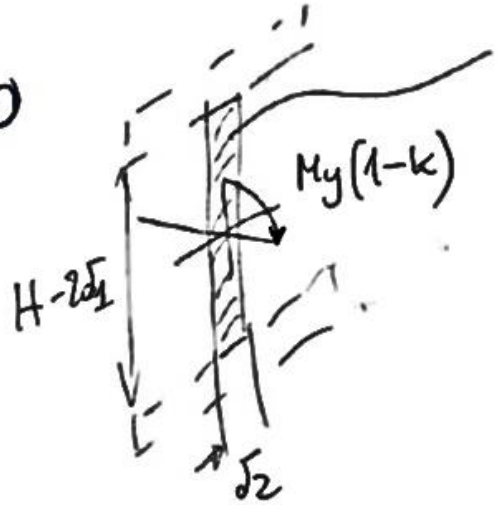


$$J_y^I = \frac{B\delta_1^3}{12} = 2560\ mm^4$$

$$\sigma_{max}^I = k \cdot \frac{\frac{My}{2} \cdot \frac{\delta_2}{2}}{J_y^I} = k \cdot 6250\,HPa =$$

$$= 6250\,HPa \gg Re$$

przy $k = 0$



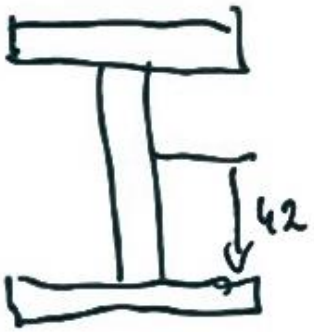
$$J_y^{II} = \frac{\delta_2 \cdot (H - 2\delta_1)^3}{12}$$

$$\sigma_{max}^{II} = \frac{(1-k)My \cdot \frac{H-2\delta_1}{2}}{J_y^{II}} =$$

$$= (1-k) \cdot 1133\,HPa = 1133\,HPa$$

$> Re$ dla zastosowanych stali konstrukcyjnych

Obliczenia z twierdzenia momentów statycznych:



$$\tau_{max} \cdot \delta_2 \cdot L = \sigma_{21} \cdot A1 \cdot \delta_2 + \tau_{42} \delta_2 \cdot L$$

$$\tau_{max} = \frac{F L 342 \cdot \delta_2}{J_y \delta_2 L} + \tau_{42} = 15.64 \text{ MPa}$$

$$\frac{\sigma_{42} + \sigma_{50}}{2} \cdot B \cdot \delta_1 = \tau_{42} \cdot \delta_2 \cdot L$$

$$\tau_{42} = \frac{FL}{J_y} \cdot 46\,mm \cdot \frac{B J_1}{L \delta_2} = \frac{8000 \cdot 1000}{2332832} \cdot 46 \frac{60 \cdot 8}{1000 \cdot 8} = 12.619 \text{ MPa}$$