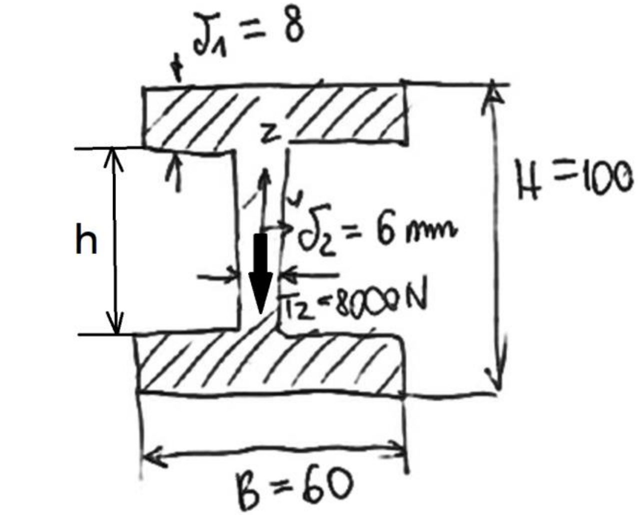
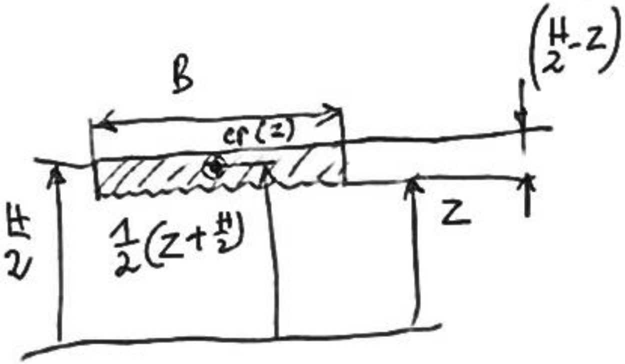
ŚCINANIE DWUTEOWNIKA



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

$$= 2332832\,\mathrm{mm}^4$$

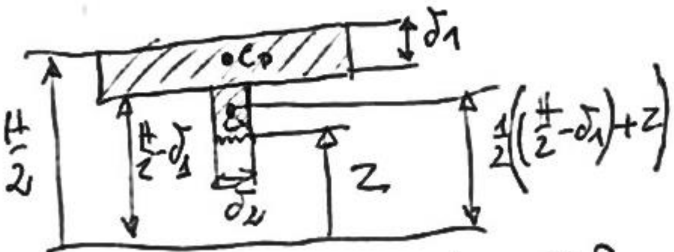
1°) $z \in \left(\frac{H}{2} - \delta_1, \frac{H}{2}\right)$



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

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

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



$$A_p = \delta_1 B$$

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

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

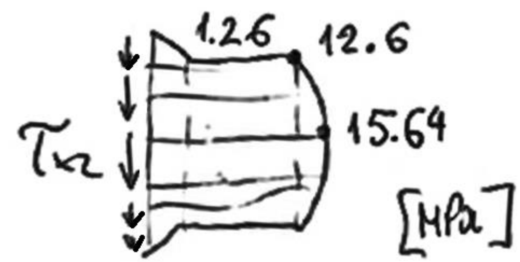
$$S_y(z) = \left(A_p + A_s(z)\right)\cdot z_c = A_p \cdot z_{cp} + A_s(z)\cdot z_{cs}$$

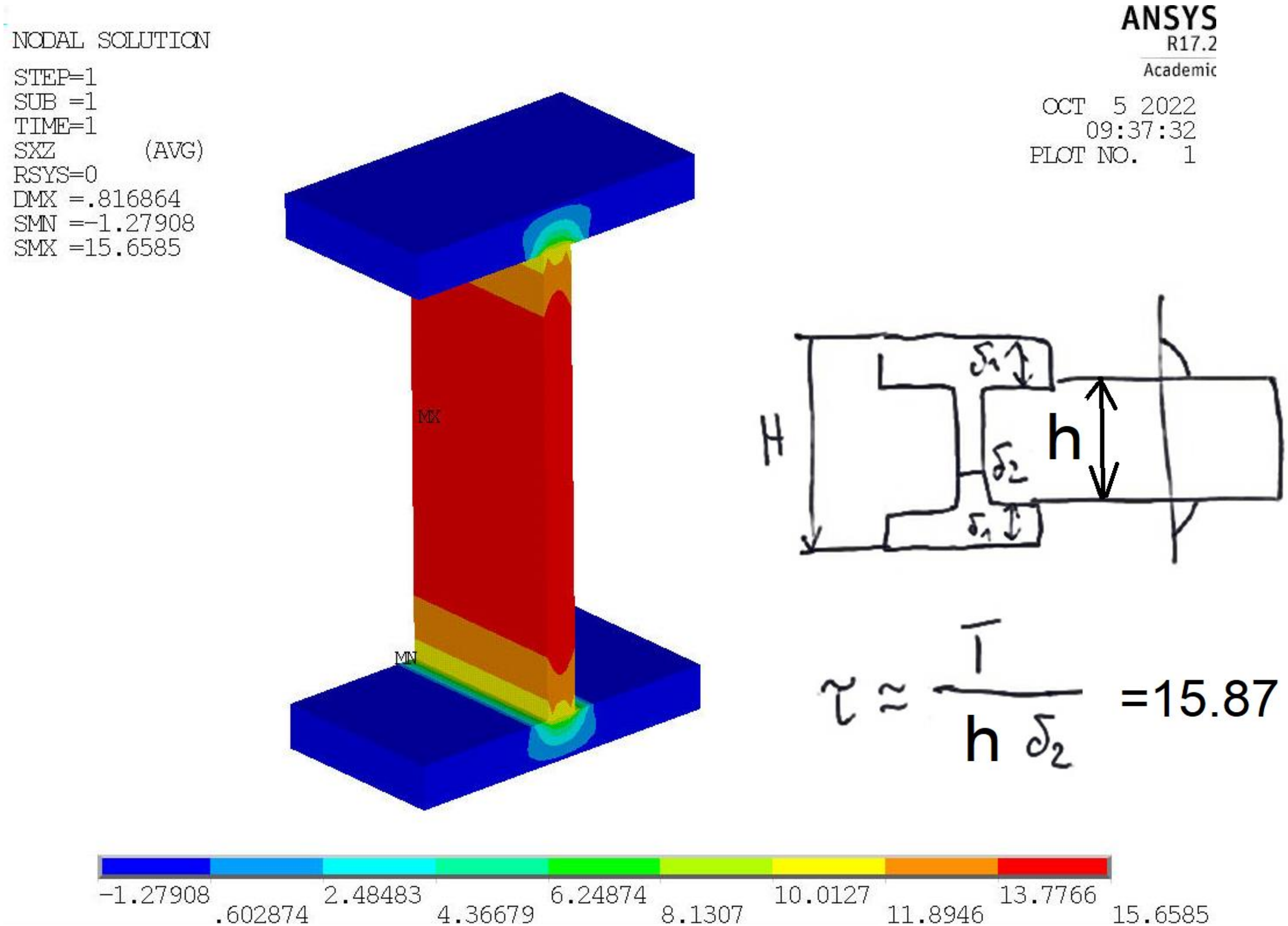
$$= \delta_1 \cdot B \cdot \frac{1}{2}\left(H-\delta_1\right) + \left(\frac{H}{2}-\delta_1 - z\right)\delta_2 \cdot \frac{1}{2}\left(\left(\frac{H}{2}-\delta_1\right)+z\right)$$

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

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

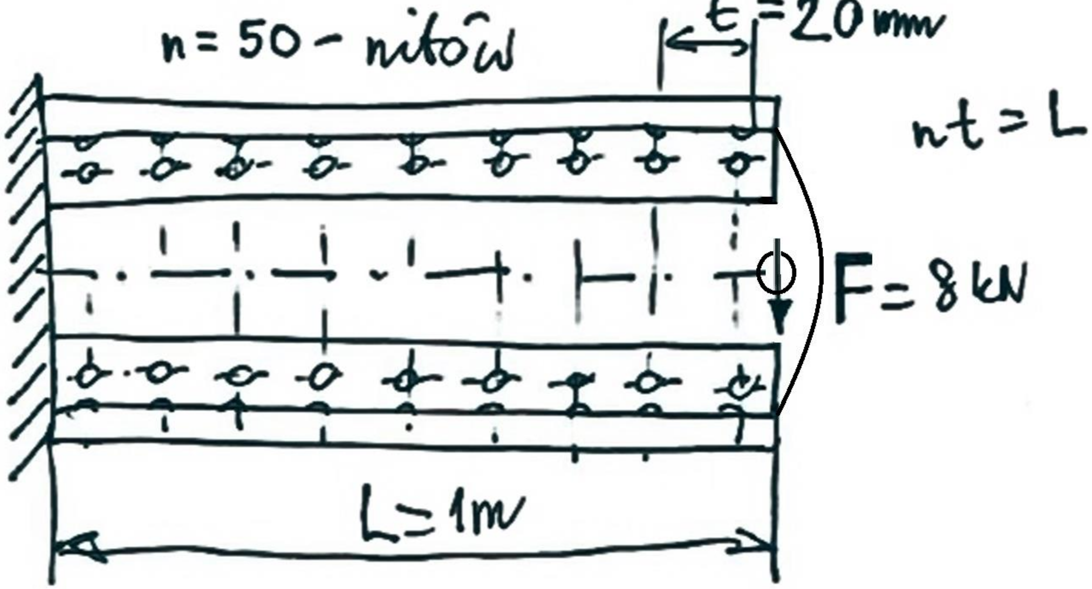
$$\tau_{xz}(z) = \frac{T_z \cdot S_y(z)}{\delta_2 \cdot J_y}$$

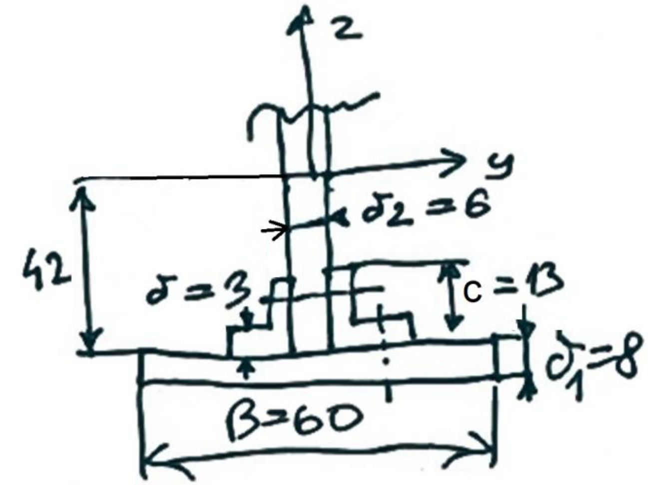




$$\tau \approx \frac{T}{h\,\delta_2} = 15.87 \text{ MPa}$$

Blachownica nitowana





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

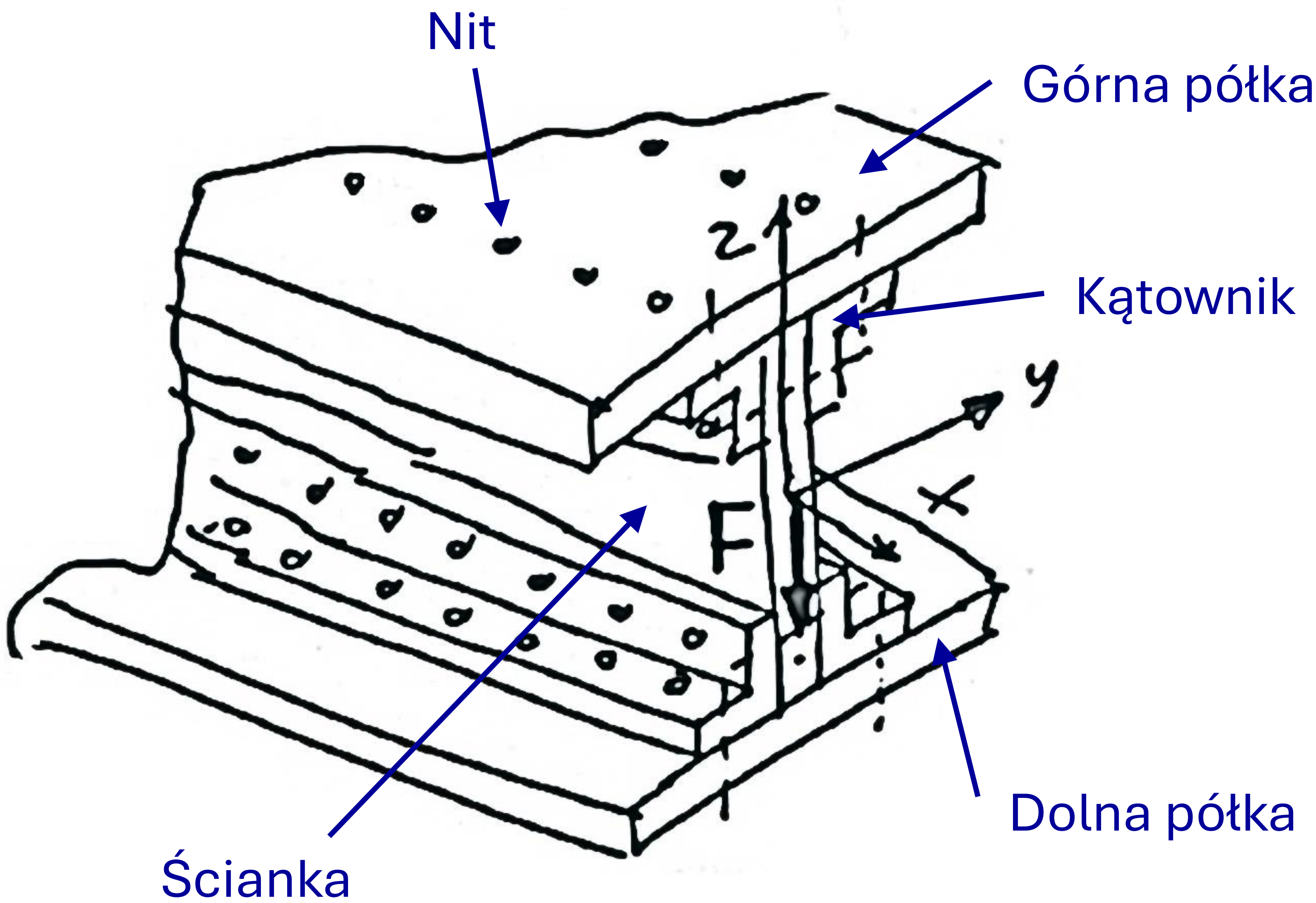
Półki

$$M_p = 2\int_{\frac{H-2\delta_1}{2}}^{\frac{H}{2}} \sigma_x \cdot zB\,dz = 2\int_{\frac{H-2\delta_1}{2}}^{\frac{H}{2}} \frac{BFL\cdot z^2}{J_{y*}}dz = \frac{2BFL}{3J_{y*}} z^3 \Big|_{\frac{H-2\delta_1}{2}}^{\frac{H}{2}} =$$

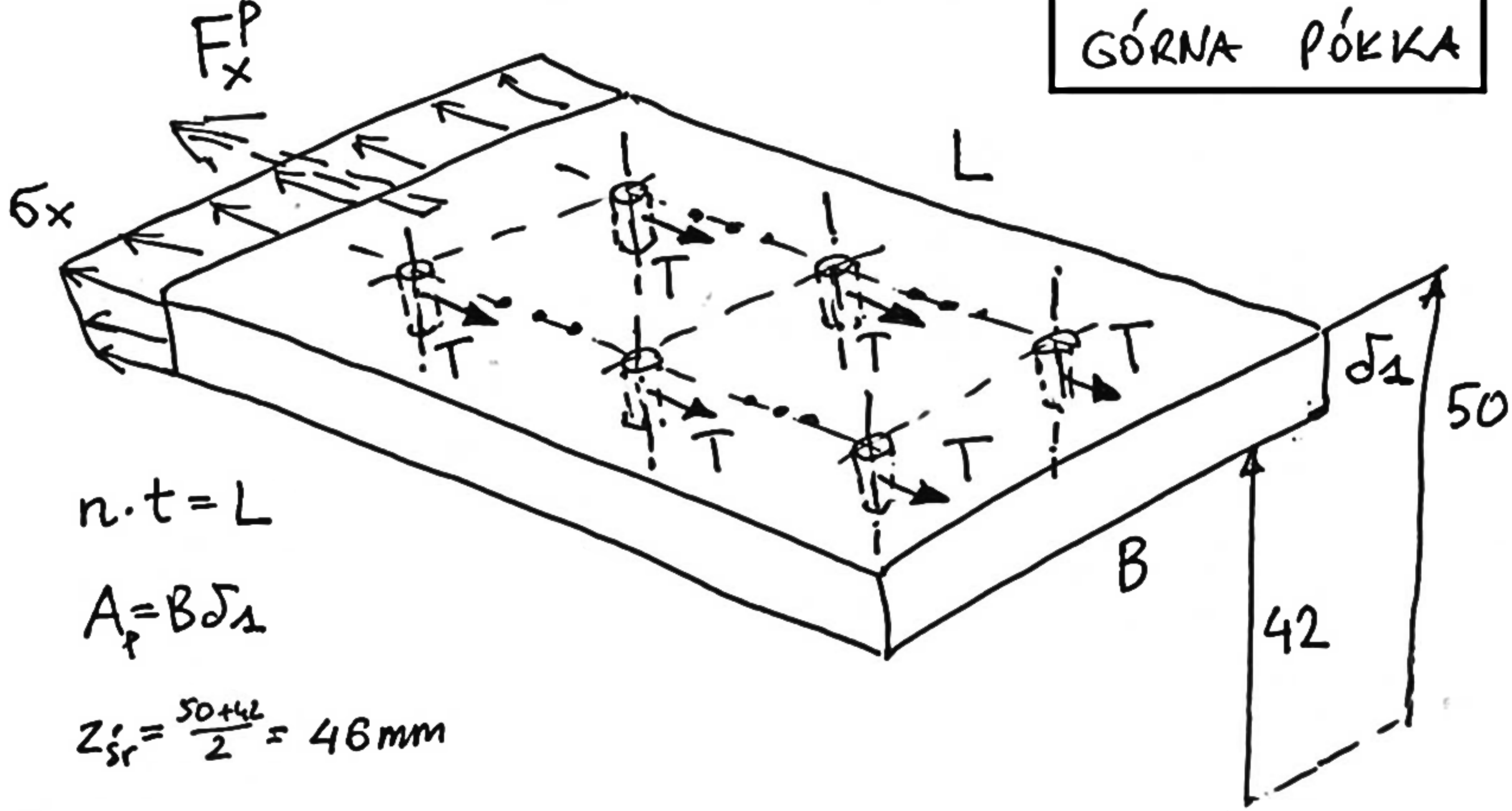
$$= \frac{2BFL}{3J_{y*}}\left(\frac{H^3}{8} - \frac{(H-2\delta_1)^3}{8}\right) = \frac{BFL}{12J_{y*}}\left(H^3 - (H-2\delta_1)^3\right) =$$

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

Profil nitowany



GÓRNA PÓŁKA



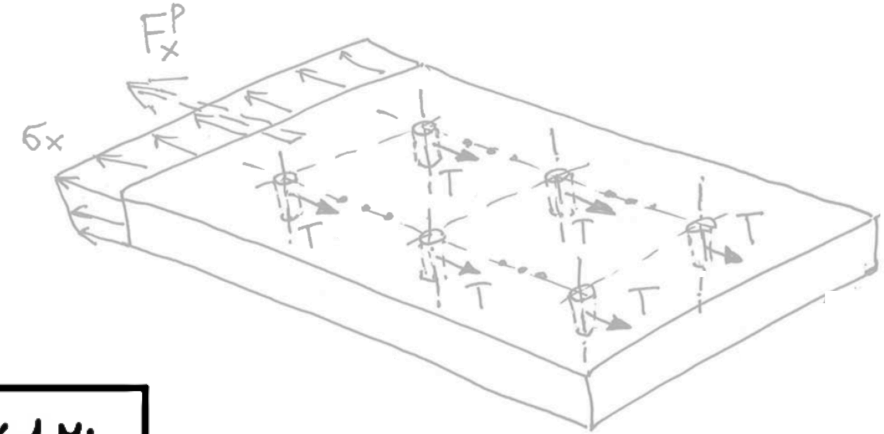
$n \cdot t = L$

$A_p = B\delta_1$

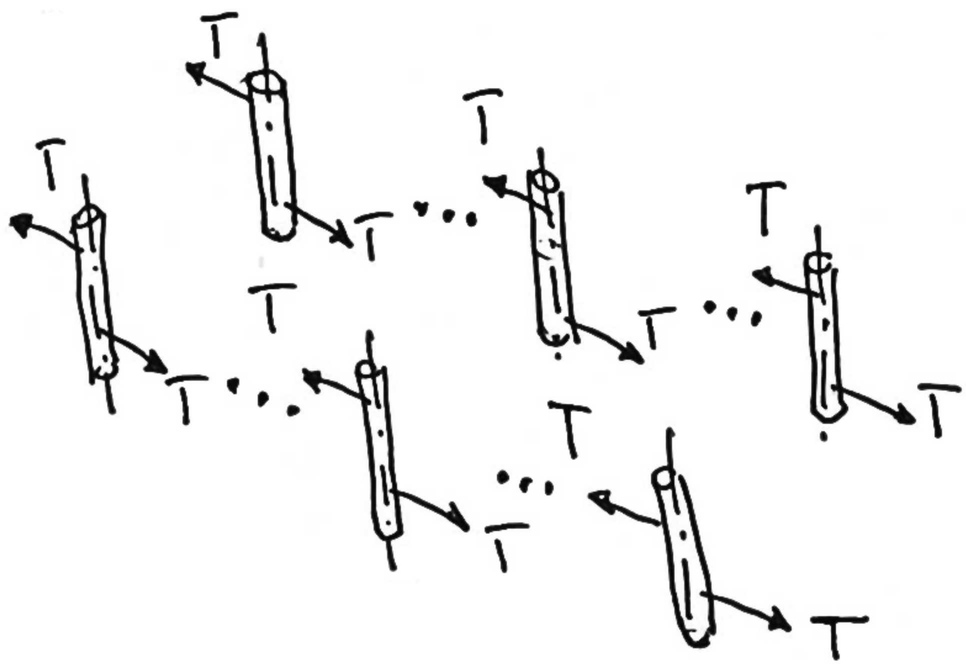
$z_{śr} = \frac{50+42}{2} = 46 mm$

$$F_x^p = \int_{A_p} \sigma_x \, dA_p = \sigma_{śr} \cdot B\delta_1 = \frac{F \cdot L \cdot z_{śr}}{J_y^*} \cdot B\delta_1 = 64{,}739 \text{ kN}$$

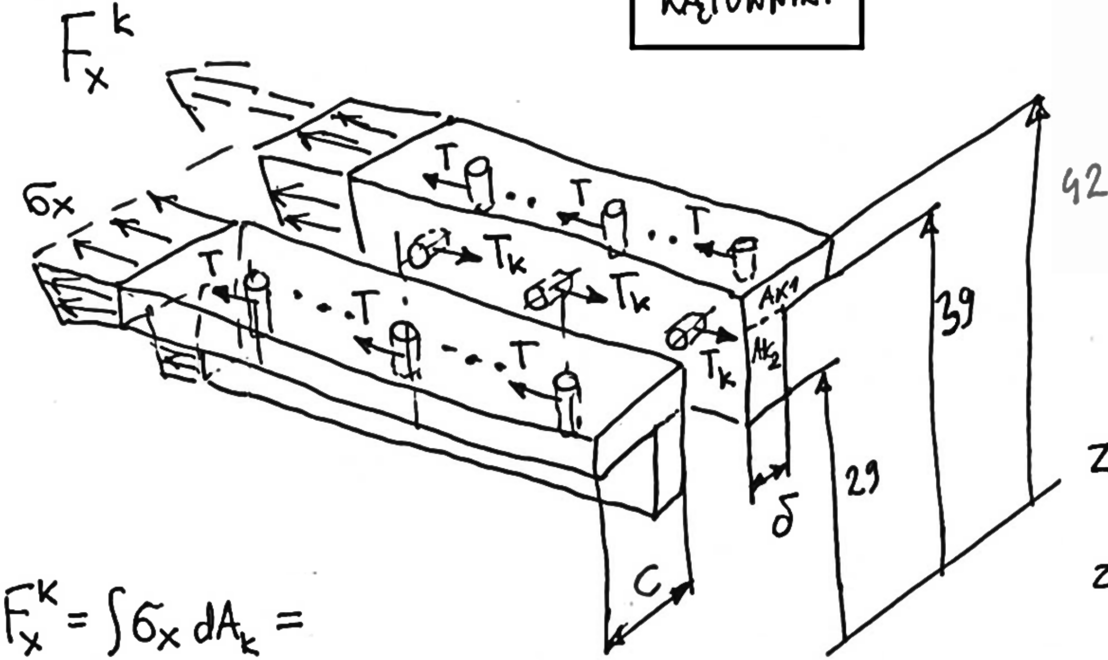
$$F_x^p = 2nT \quad \Rightarrow \quad T = \frac{F_x^p}{2n} = \frac{F \cdot t \cdot z_{śr}}{2J_y^*} \cdot B\delta_1 = 647{,}39 \text{ N}$$

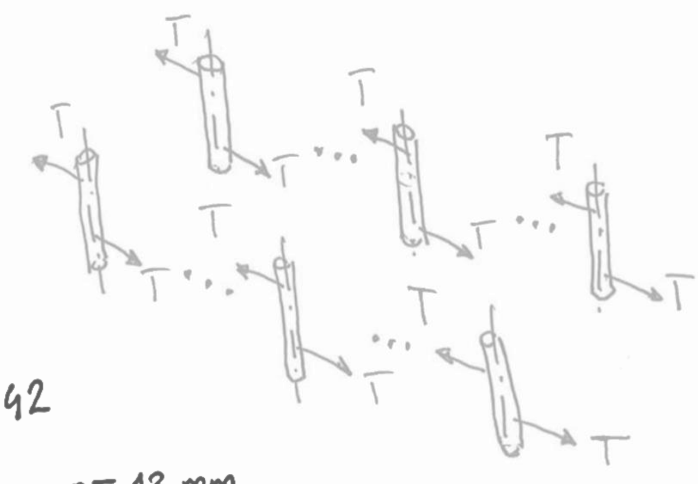


NITY ŁĄCZĄCE PÓŁKĘ Z KĄTOWNIKAMI



KĄTOWNIKI





$c = 13\ mm$

$\delta = 3\ mm$

$z_{śr_1} = \frac{39+42}{2} = 40,5\ mm$

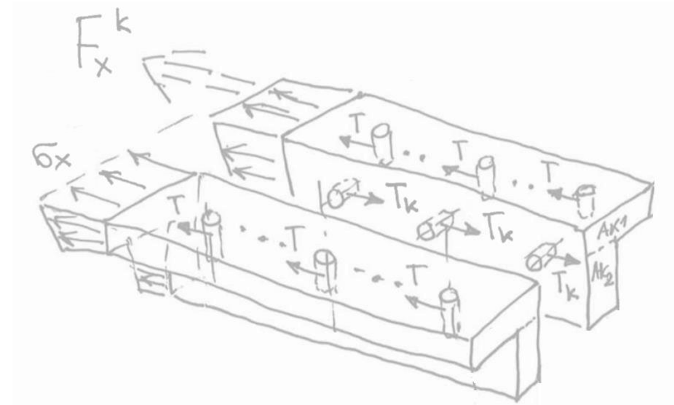
$z_{śr_2} = \frac{29+39}{2} = 34\ mm$

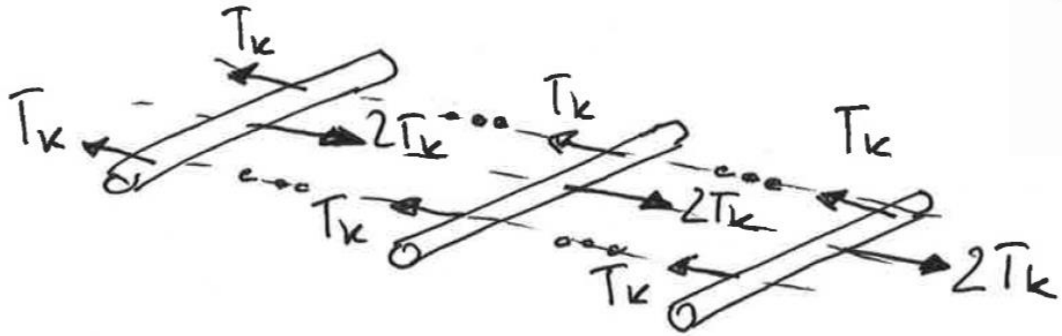
$$F_x^k = \int_{A_k} \sigma_x \, dA_k =$$

$$= \int_{AK1} \sigma_x \, dA_{k1} + \int_{Ak2} \sigma_x \, dA_{k2} = \sigma_{śr1} \cdot c\delta + \sigma_{śr2} \cdot (c-\delta) \cdot \delta = \frac{FL}{J_{y^*}} \left(z_{śr_1} \cdot c\delta + z_{śr_2} \cdot (c-\delta)\delta \right) = 7621,77\ N$$

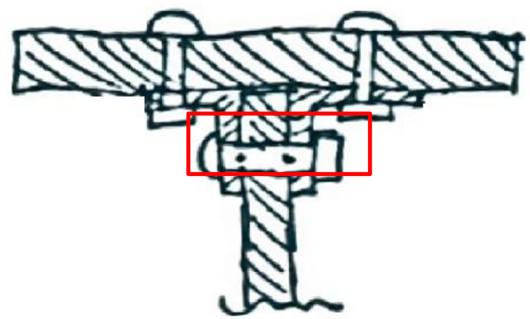
$$n T_k - n T - F_x^k = 0 \quad \Rightarrow \quad T_k = \frac{F_x^k}{n} + T = 799,82\ N$$

NITY ŁĄCZĄCE KĄTOWNIKI ZE ŚCIANKĄ





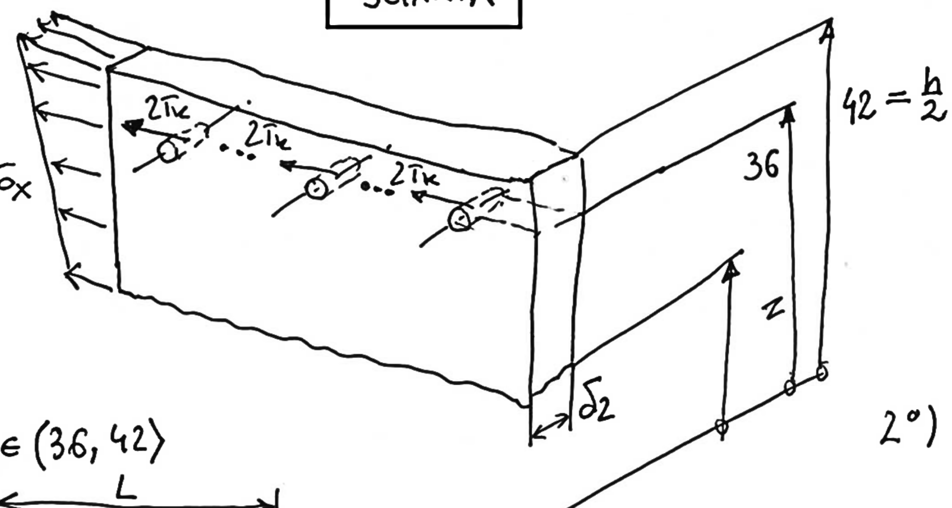
Dobór średnicy nitów

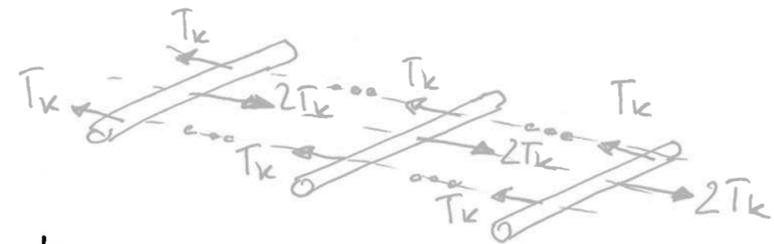


$k_t = 100\,\mathrm{MPa}$

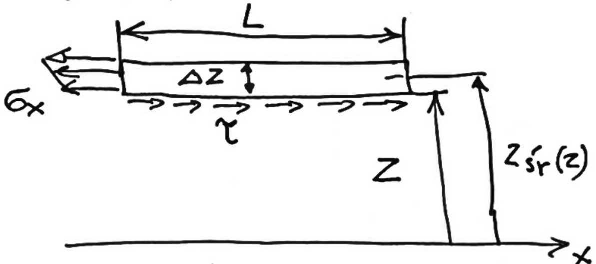
$$\frac{T_k}{\left(\frac{\pi d^2}{4}\right)} \leq k_t \quad \rightarrow \quad d \geq \sqrt[2]{\frac{4 \cdot T_k}{\pi k_t}} = \sqrt{\frac{4 \cdot 799{,}82}{\pi \cdot 100}}\,\mathrm{mm} = 3{,}2\,\mathrm{mm}$$

ŚCIANKA





1°) $z \in (36, 42\rangle$



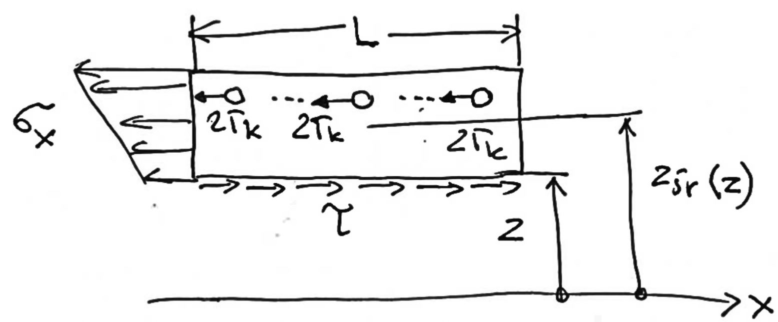
$$\Delta z = \frac{h}{2} - z$$

$$z_{śr}(z) = \left(\frac{h}{2} + z\right)/2$$

$$F_x^s = \int_{A_s} \sigma_x \, dA_s = \sigma_{śr}^s \cdot \Delta z \cdot \delta_2 = \frac{FL \cdot z_{śr}(z)}{J_y^*} \cdot \Delta z \cdot \delta_2$$

$$F_x^s = \tau \cdot \delta_2 \cdot L \Rightarrow \tau = \frac{F_x^s}{\delta_2 \cdot L}$$

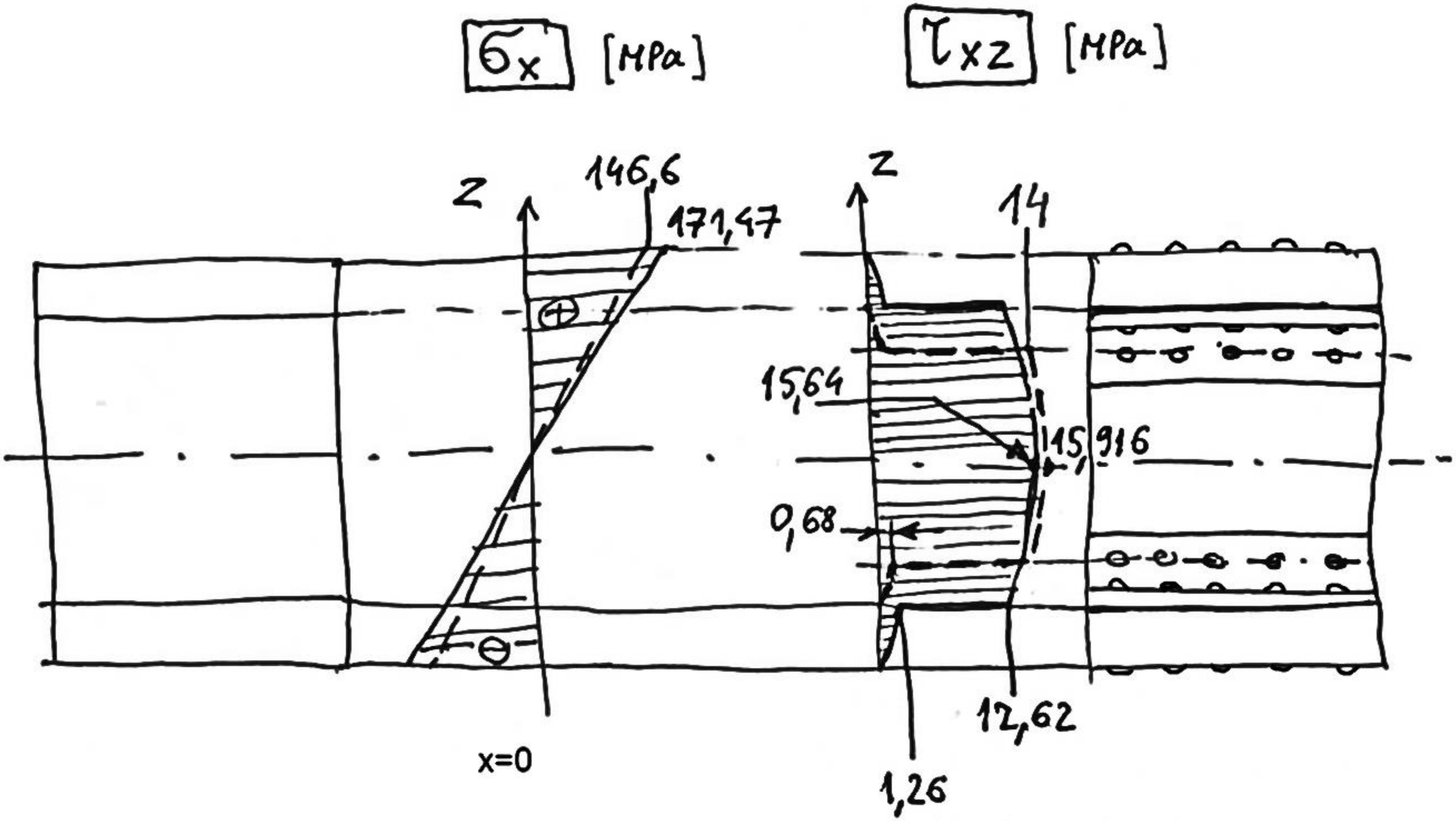
2°) $z \in \langle 0, 36\rangle$



$$\tau \delta_2 \cdot L - n \cdot 2T_k - F_x^s = 0$$

$$\tau = \frac{n \cdot 2T_k + F_x^s}{\delta_2 \cdot L}$$

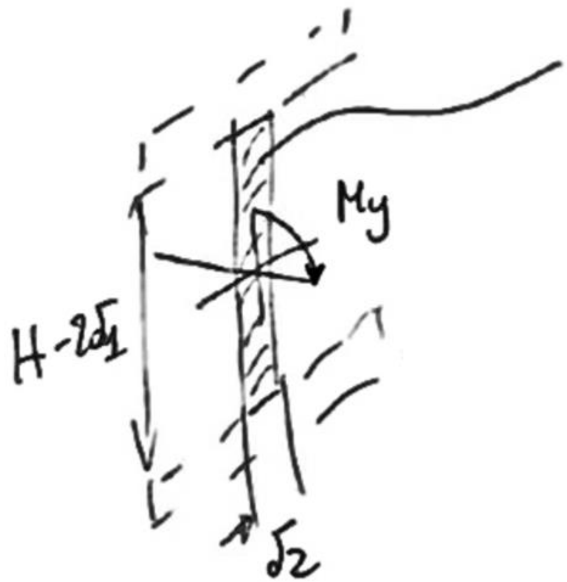
Rozkłady naprężeń



— profil wyciskany

- - - profil nitowany

Naprężenia w ściance po ścięciu nitów



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

$$\sigma_{max}' = \frac{M_y \cdot \frac{H - 2\delta_1}{2}}{J_y'} = 1133\ MPa$$

$> R_e$ dla wszystkich stali konstrukcyjnych