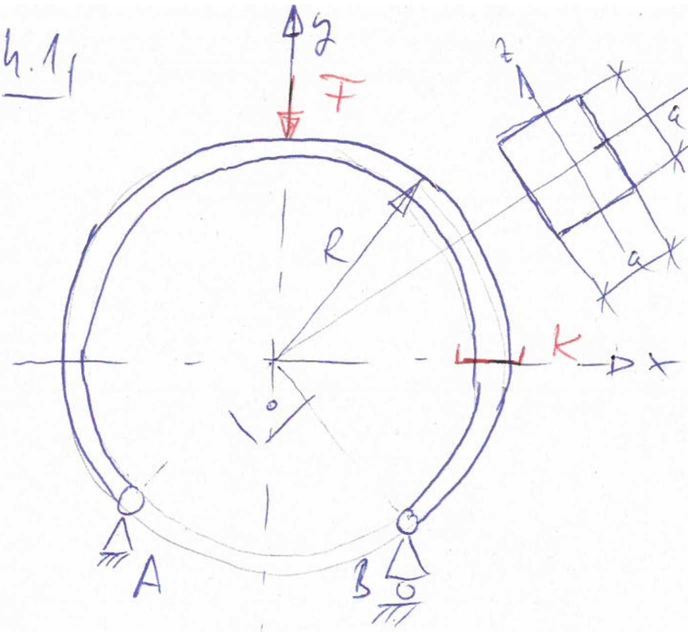
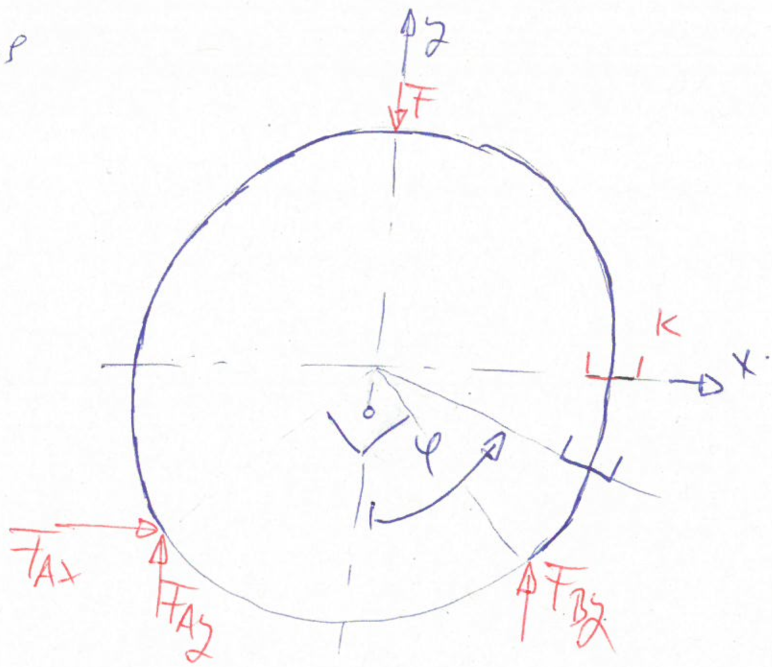
4.1.1





$F = 3000\,N$, $R = 300\,mm$, $a = 40\,mm$

K km feszültségeloszlás?

$x: F_{Ax} = 0$; $y: F_{Ay} + F_{By} - F = 0$; $z: M_A = -F R \sin 45^\circ + F_{By} 2R \sin 45^\circ = 0$

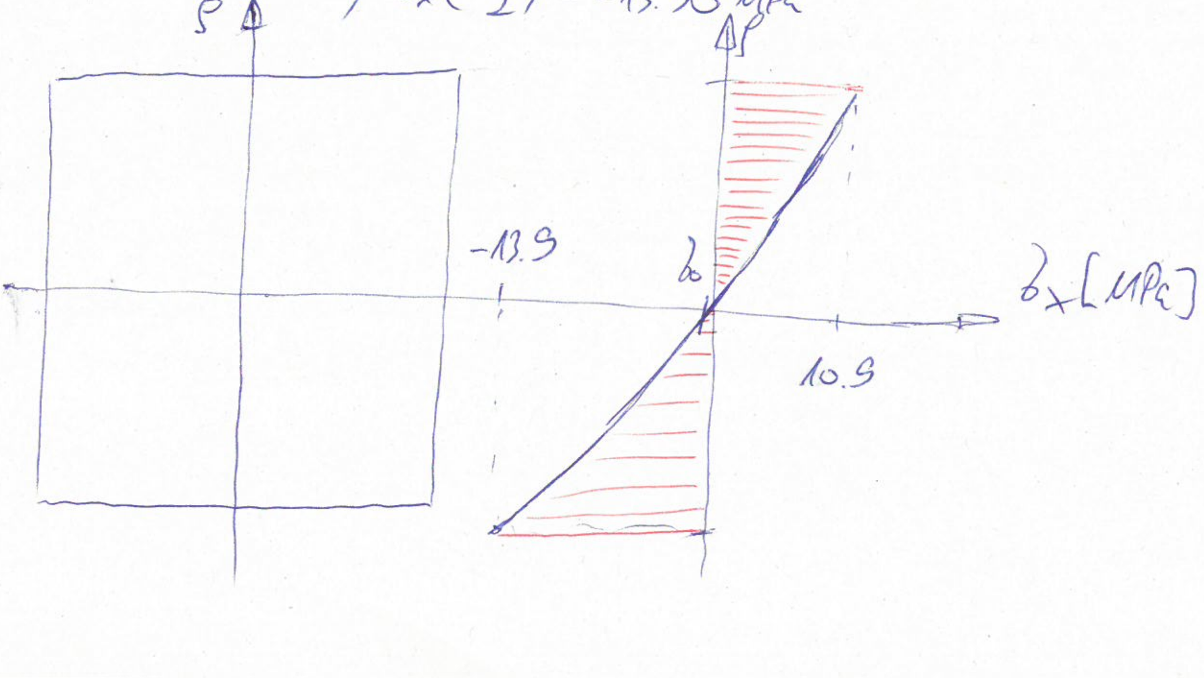
$F_{By} = F_{Ay} = F/2 = 1500\,N$

$N(\varphi) = -F_{By} \sin\varphi$; $V(\varphi) = F_{By}\cos\varphi$; $M_h(\varphi) = F_{By} R\left(\sin\varphi - \sin\frac{\pi}{4}\right)$.

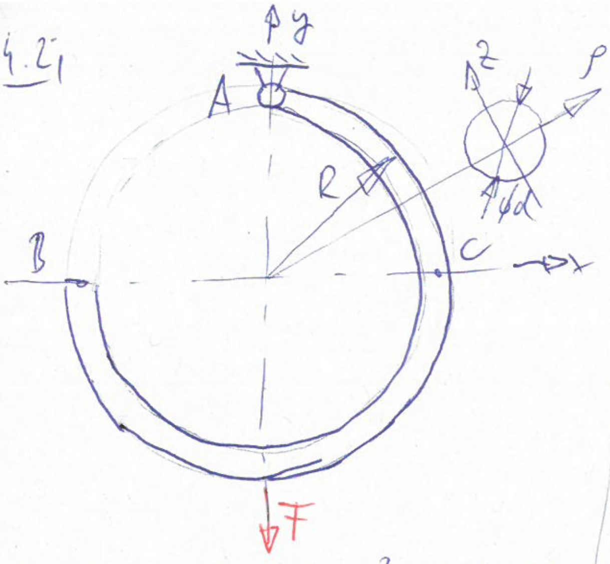
$N_K = N\left(\frac{\pi}{2}\right) = -F_{By}$; $M_{hK} = M_h\left(\frac{\pi}{2}\right) = F_{By} R\left(1 - \frac{1}{\sqrt{2}}\right)$; $A = a^2$; $I_z = \frac{a\,a^3}{12}$; $\frac{R}{a} = 7.5$

$$\sigma_x = \frac{N_K}{A} + \frac{M_{hK}}{RA} + \frac{M_{hK}}{I_z}\cdot\frac{R}{R+\rho}\cdot\rho \Rightarrow \sigma_x(\rho) = \overset{\sigma_0}{-0.663} + \frac{185.3}{0.3+\rho}\,\rho\,[MPa] \text{ ; } z\,[m]\text{-ben}$$

$\sigma_x\left(+\frac{a}{2}\right) = 10.90\,MPa$, $\sigma_x\left(-\frac{a}{2}\right) = -13.90\,MPa$



4.2,



$F = 8000\,N,\ R = 125\,mm,\ \sigma_{meg} = 100\,MPa$

$d = ?$ méretezés Navier

ellenőrzés Grashof

$F_{Ax} = 0,\ F_{Ay} = F \uparrow$

C keresztmetszet a veszélyes $\to M_h$ maximális

$$N_C = F;\quad M_{hC} = -F\cdot R;\quad A = \frac{d^2\pi}{4};\quad I_z = \frac{d^4\pi}{64}$$

Méretezés (Navier)

$$\sigma_{xC} = \frac{M_{hC}}{I_z}\cdot z \to \sigma_{xC}^{MAX} = \left|\frac{M_{hC}}{I_z}\cdot\frac{d}{2}\right| \le \sigma_{meg}$$

$d \ge 46.7\,mm \to d_1 = 47\,mm$

Ellenőrzés (Grashof) $R/d_1 = 2.66$

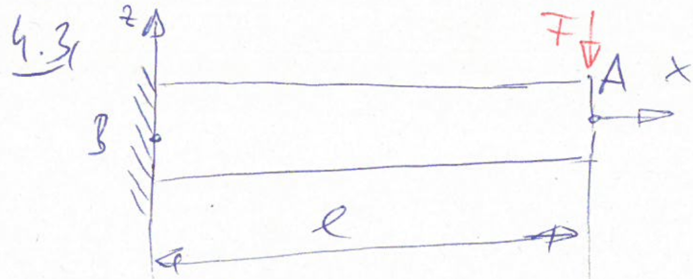
$$\sigma_{xC}^{G} = \frac{N_C}{A} + \frac{M_{hC}}{RA} + \frac{M_{hC}}{I_z}\cdot\frac{R}{R+\rho}\cdot\rho$$

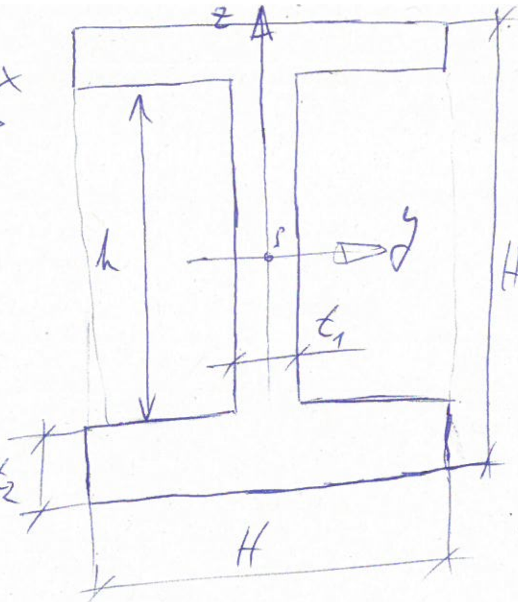
$A,\ I_z$ d_1-gyel számolva

$\sigma_{xC}^{G}\left(\frac{d_1}{2}\right) = -82.58\,MPa;\ \sigma_{xC}^{G}\left(-\frac{d_1}{2}\right) = 120\,MPa$ ✗

d_1 [mm]	$\sigma_{xC}^{G}(d_1/2)$ [MPa]	$\sigma_{xC}^{G}(-d_1/2)$ [MPa]
48	−77.27	114.0
49	−72.39	107.7
50	−67.91	101.9 ✗
51	−63.78	96.47 ✓

4.3,





$t_1 = 40$ mm, $t_2 = 16$ mm

$H = 200$ mm

$l = 0.3$ m

$h = H - 2 \cdot t_2 = 168$ mm

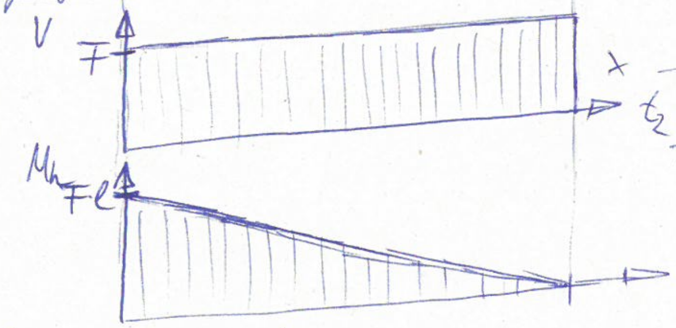
$F = 100$ kN

$I_y = 5.826 \cdot 10^{-5}$ m^4

Szimmetrikus km

σ_x, τ_{xz} keresztmetszetben

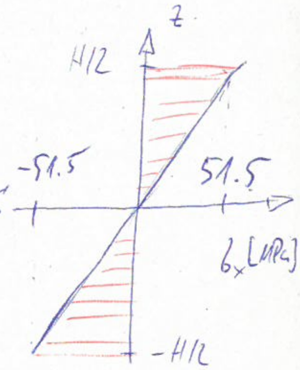
Igénybevételek



σ_x eloszlása 'B'-ben

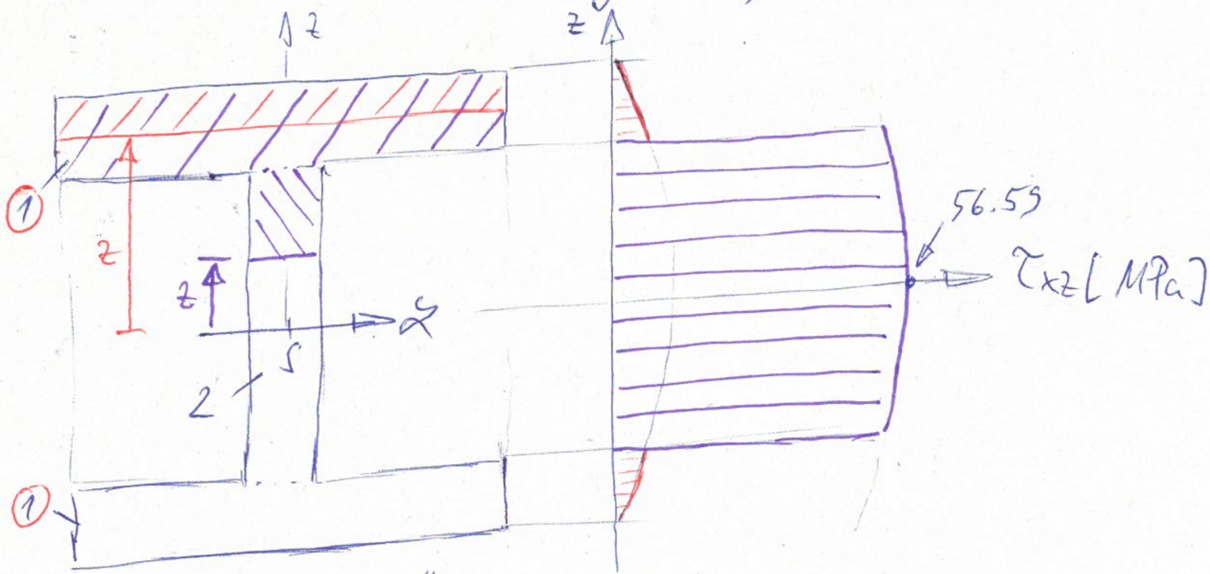
$$\sigma_x(z) = \frac{F \cdot l}{I_y} \cdot z = 514.9\, z \;[MPa]$$

z [m]-ben behelyettesítendő



τ_{xz} eloszlása 'B'-ben

$$\tau_{xz} = \frac{V}{I_y} \cdot \frac{S_y(z)}{a(z)}$$

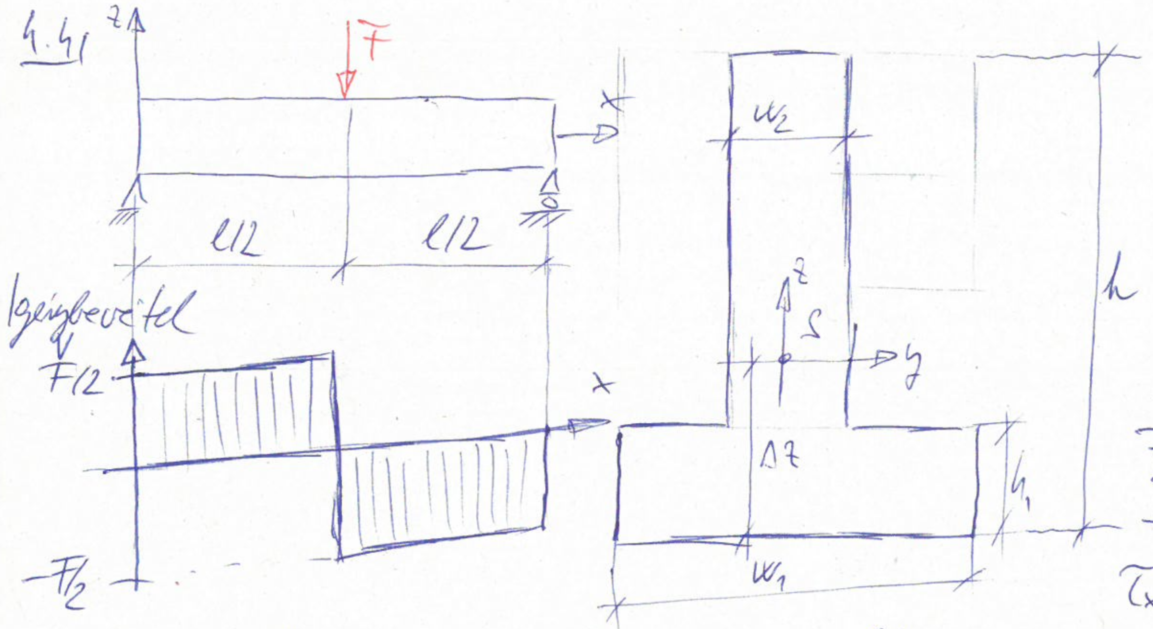


- $S_{y1}(z) = \left(\frac{H}{2} - z\right) \cdot H \cdot \left(z + \frac{\frac{H}{2} - z}{2}\right) \quad z \in \left[-\frac{H}{2}, -\frac{h}{2}\right) \cup \left(\frac{h}{2}, \frac{H}{2}\right]$
- $S_{y2}(z) = S_{y1}\left(\frac{h}{2}\right) + \left(\frac{h}{2} - z\right) \cdot t_1 \left(z + \frac{h/2 - z}{2}\right) \quad z \in [-h/2, h/2]$

$$\tau_{xz1}(z) = \frac{F}{I_y} \cdot \frac{S_{y1}(z)}{H} = 8.58 - 858 z^2 \;[MPa] \quad z\,[m]\text{-ben}$$

$$\tau_{xz2}(z) = \frac{F}{I_y} \cdot \frac{S_{y2}(z)}{t_1} = 56.59 - 858 z^2 \;[MPa] \quad \text{—"—}$$

4.41



$w_1 = 150\,mm$

$h_1 = 50\,mm$

$w_2 = 50\,mm$

$h = 200\,mm$

$\Delta z = 75\,mm$

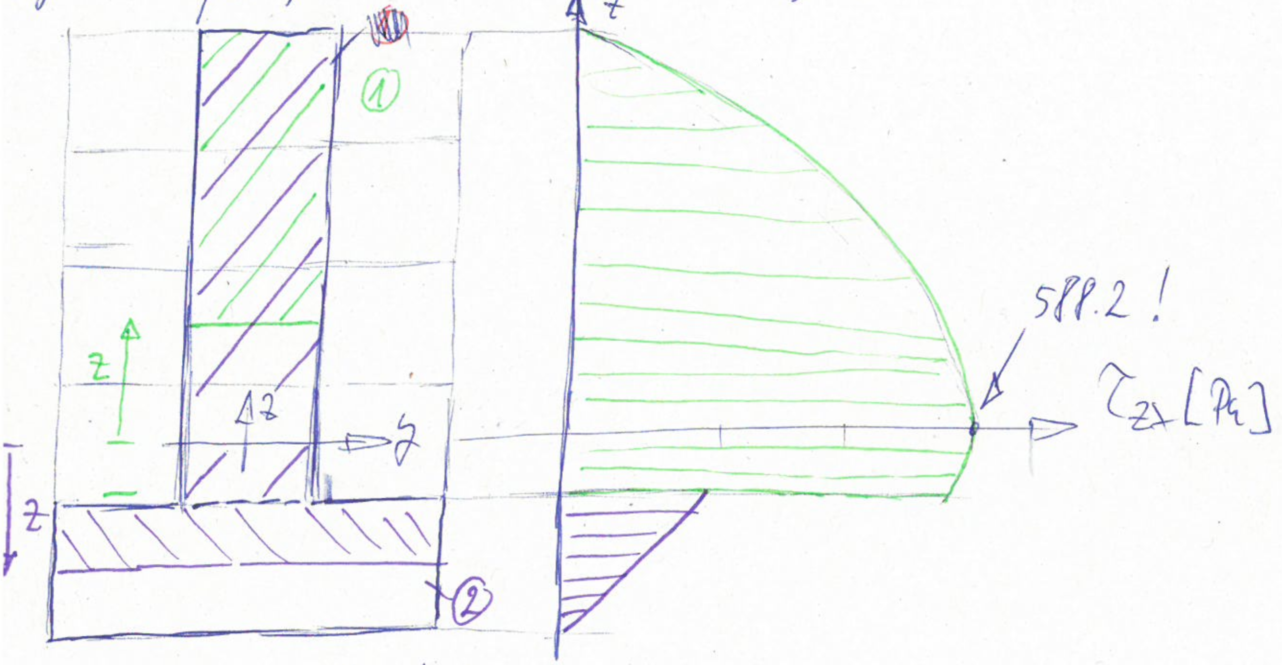
$l = 3.6\,m$

$F = 8\,kN$

$I_y = 5312.5\,cm^4$

τ_{xz} veszélyesben

nyírás szempontjából minden km veszélyes (|V| azonos mindenhol!) $\tau_{xz} = \frac{V}{I_y}\frac{S_y(z)}{a(z)}$



$S_{y1}(z) = (h-\Delta z - z)\, w_2 \left(z + \frac{h-\Delta z - z}{2}\right) \quad z \in [h_1-\Delta z,\ h-\Delta z]$

$S_{y2}(z) = S_{y1}(h_1-\Delta z) + (-z-(\Delta z - h_1)) \cdot w_1 \left(z + \frac{-z-(\Delta z - h_1)}{2}\right) \quad z \in [-\Delta z,\ h_1-\Delta z)$

$\tau_{xz1}(z) = \frac{F/2}{I_y} \cdot \frac{S_{y1}(z)}{w_2} = 588.2 - 37647 z^2\,[Pa]$ z [m]-ben

$\tau_{xz2}(z) = \frac{F/2}{I_y}\, \frac{S_{y2}(z)}{w_1} = 218 - 37647 z^2\,[Pa]$ —〃—