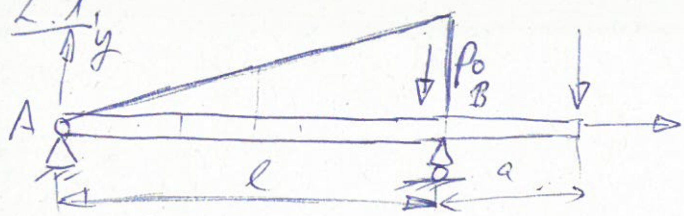
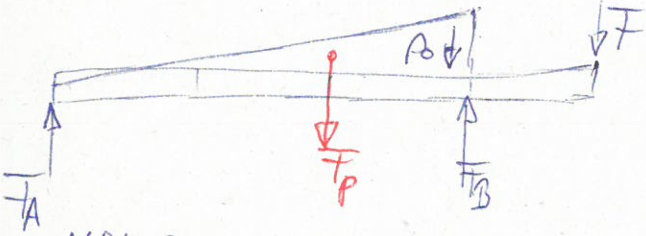
2.1.



$l = 0.9 m$, $a = 0.3 m$, $p_0 = 4 kN/m$

$F = 1 kN$, $F_A = 0.2\dot{6} kN$, $F_B = +2.5\dot{3} kN$

$d = 40 mm$, $\sigma_{meg} = 100 MPa$ ellenőrzés veszélyes km.



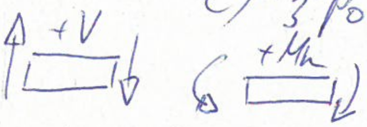
$x: \quad 0 = 0$

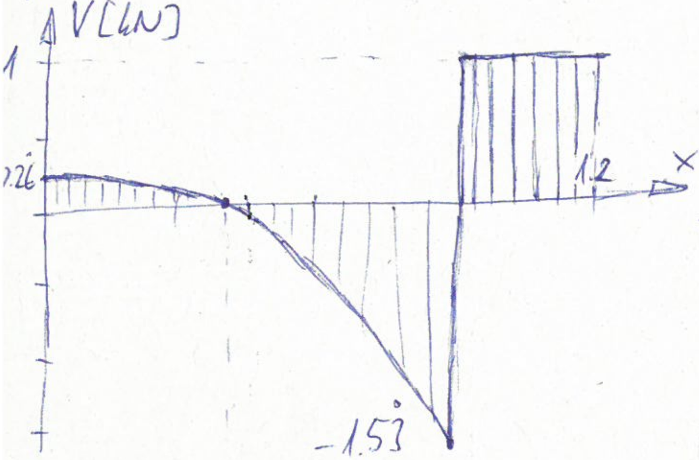
$y: \quad F_A - \frac{1}{2} p_0 l + F_B - F = 0$

$z: \quad M_A = -\frac{2}{3}\frac{1}{2} p_0 l + F_B l - F(a+l) = 0$

$F_A = -\frac{a}{l} F + \frac{1}{6} p_0 l$

$F_B = F\left(1 + \frac{a}{l}\right) + \frac{1}{3} p_0 l$



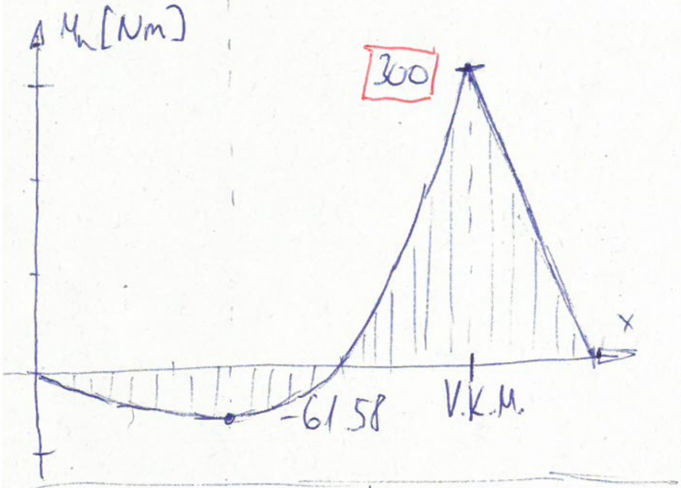


$V(x) = \int p(x)\,dx$

$p_1(x) = -p_0 \frac{x}{l} \quad x \in [0, l]$

$V_1(x) = F_A - \frac{1}{2} p_0 \frac{x^2}{l} \quad x \in [0, l]$

$V_2(x) = F \quad x \in [l, l+a]$



$M_h(x) = -\int V(x)\,dx$

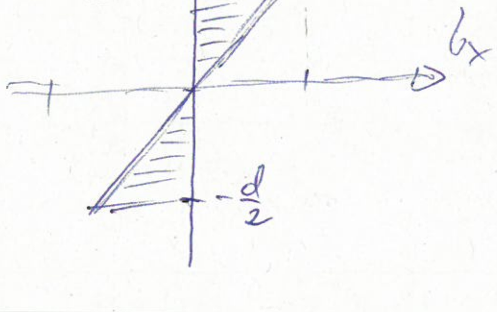
$M_h^1(x) = \frac{1}{6}\frac{x}{l}\left(6aF + p_0(x^2 - l^2)\right)$

$M_h^2(x) = F(a + l - x)$

állandó keresztmetszet

$I_z = \frac{d^4 \pi}{64} = 1.257 \cdot 10^{-7} m^4 = 1.257 \cdot 10^{5} mm^4$

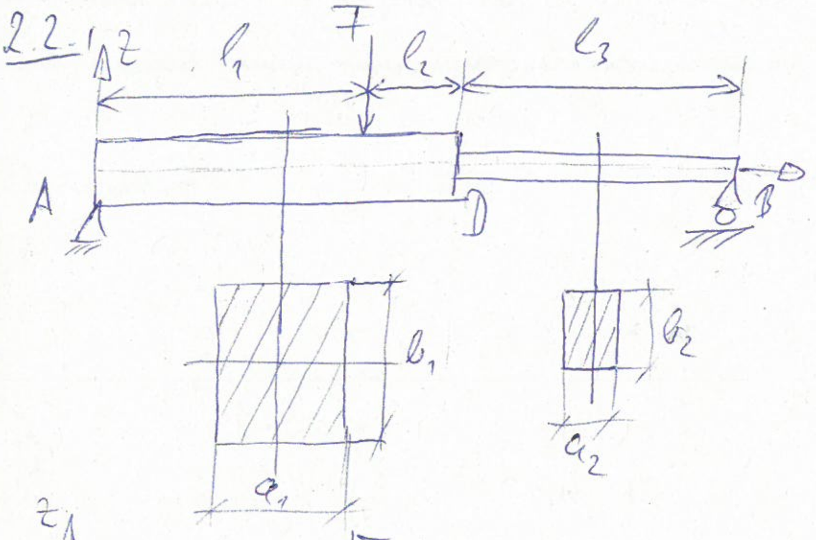
$\cancel{M_{hz}(y) = \frac{M_h^{max}}{I_z} y \quad y \in \left[-\frac{d}{2}, \frac{d}{2}\right]}$

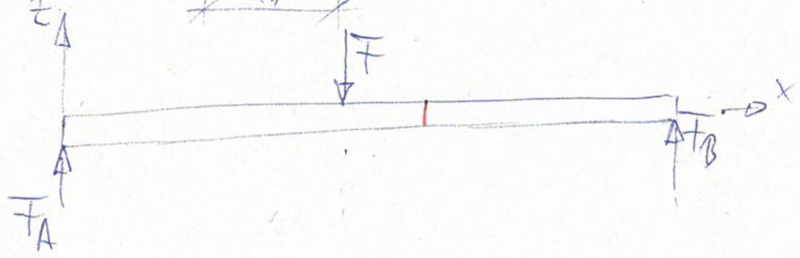


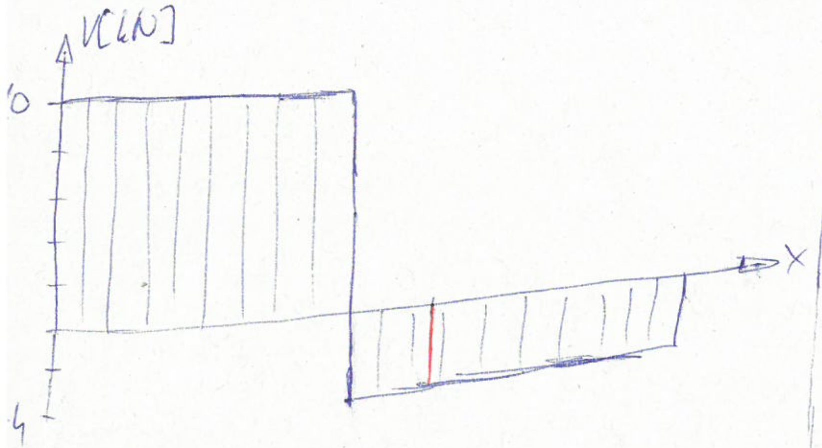
$\sigma_x(x) = \frac{M_{hz}^{max}}{I_z} y \quad y \in \left[-\frac{d}{2}, \frac{d}{2}\right]$

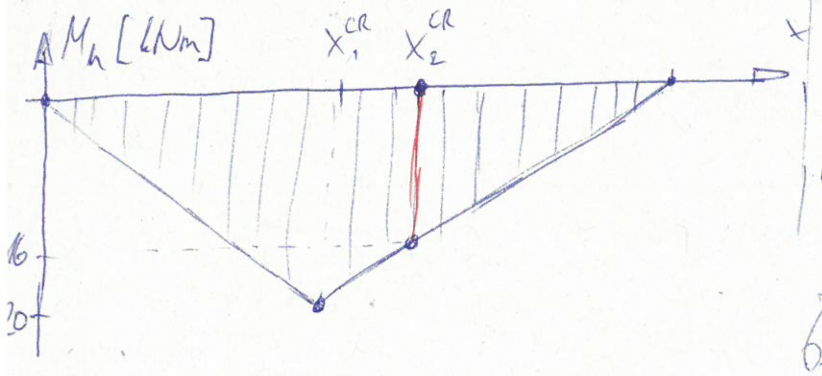
$\left|\sigma_x^{max}\left(\frac{d}{2}\right)\right| = \left|\sigma_x^{max}\left(-\frac{d}{2}\right)\right| = 47.7 MPa < \sigma_{meg}$ ✓

2.2.









$l_1 = 2m$, $l_2 = 1m$, $l_3 = 4m$

$F = 14kN$, $\sigma_{meg} = 100\,MPa$

méretezés $b_1/a_1 = b_2/a_2 = 2$, $a_1 = ?$, $a_2 = ?$

x : $0 = 0$

z : $F_A - F + F_B = 0$

y : $M_A = -F(l_1) + F_B(l_1 + l_2 + l_3) = 0$

$$F_A = \frac{F(l_2 + l_3)}{l_1 + l_2 + l_3} = 10\,kN$$

$$F_B = \frac{F\,l_1}{l_1 + l_2 + l_3} = 4\,kN$$

$x_1^{CR} = l_1$; $x_2^{CR} = l_1 + l_2$

$M_h(x_1^{CR}) = -F_A \cdot l_1 = -20\,kNm$

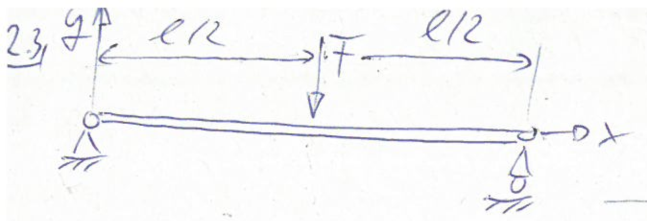
$M_h(x_2^{CR}) = -F_B \cdot l_3 = -16\,kN$

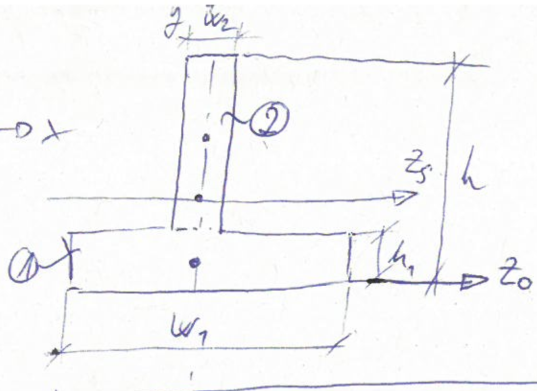
$$I_{1y} = \frac{b_1^3 a_1}{12} = \frac{8a_1^4}{12} ; \quad I_{2y} = \frac{8a_2^4}{12}$$

$$\sigma_{1x}^{max} = \frac{M_h(x_1^{CR})}{I_{1y}} \cdot a_1 \le \sigma_{meg} \Rightarrow \underline{a_1 \ge 66.9\,mm}$$

$$\sigma_{2x}^{max} = \frac{M_h(x_2^{CR})}{I_{2y}} \cdot a_2 \le \sigma_{meg} \Rightarrow \underline{a_2 \ge 62.1\,mm}$$

2.3.





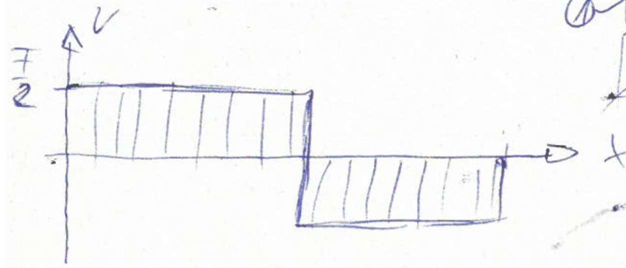
$l=3.6\,m,\ F=8\,kN$

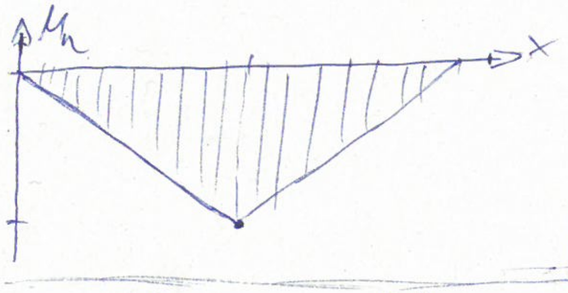
$\sigma_F^{hu}=30\,MPa,\ \sigma_F^{ny}=60\,MPa$

biztonsági tényező?

$w_1=150\,mm,\ h_1=50\,mm$

$w_2=50\,mm,\ h=200\,mm$





$$M_h^{max}=-\frac{1}{2}F\frac{l}{2}=-7.2\,kNm$$

$$A_1=w_1\cdot h_1,\quad A_2=w_2\cdot h_2 \qquad h_2=h-h_1$$

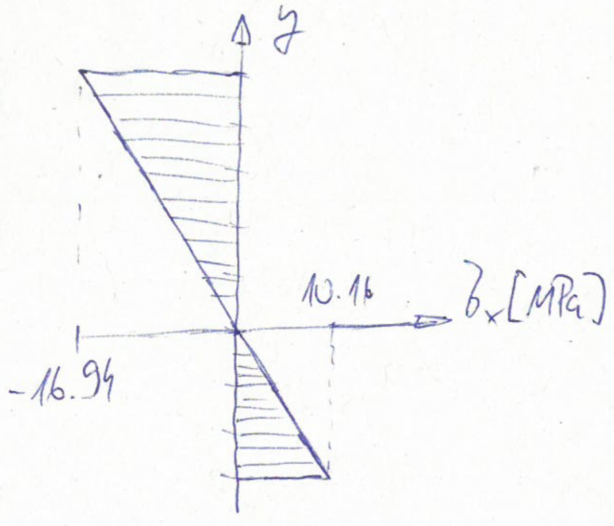
$$S_{z0}=A_1\cdot h_1/2+A_2\cdot(h_1+h_2/2)=1.125\cdot 10^{-3}\,m^3$$

$$y_S=\frac{S_{z0}}{A_1+A_2}=75\,mm$$

$$I_{1z}=\frac{h_1^3w_1}{12};\quad I_{2z}=\frac{h_2^3w_2}{12};\quad I_{zS}=\left[I_{1z}+A_1\left(y_S-\frac{h_1}{2}\right)^2\right]+\left[I_{2z}+A_2\left(y_S-\left(h_1+\frac{h_2}{2}\right)\right)^2\right]=$$

$$=5.31\cdot 10^{-5}\,m^4=5.31\cdot 10^{7}\,mm^4$$

$$\sigma_x(y)=\frac{M_h^{max}}{I_{zS}}\cdot y\quad,\ y\in[-y_S,\ h-y_S],\ y\in[-75\,mm,\ 125\,mm]$$

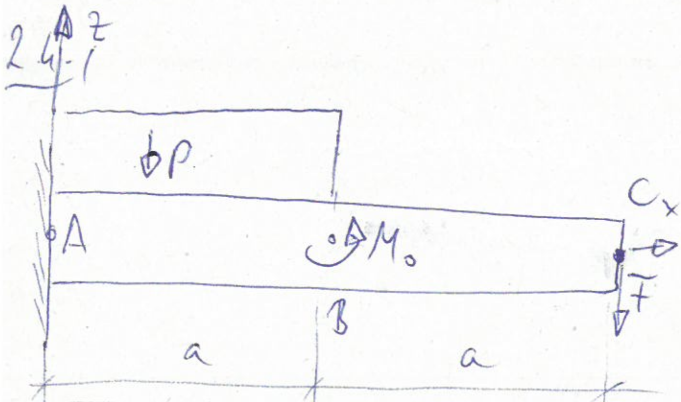


$$n_1=\frac{|\sigma_x(-y_S)|}{\sigma_F^{hu}}=2.95$$

$$n_2=\frac{|\sigma_x(h-y_S)|}{\sigma_F^{ny}}=3.54$$

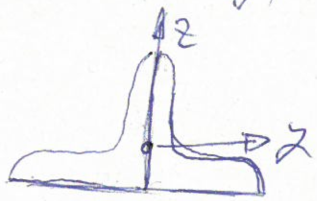
$$\left.\begin{matrix}n_1\\n_2\end{matrix}\right\}\ n=2.95$$

2.4.1

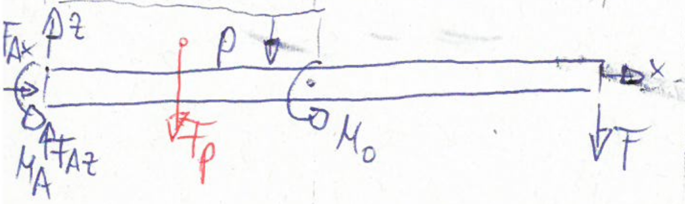


$M_0=2000\,Nm$, $p=500\,N/m$, $F=1000\,N$

$a=1m$, σ_{meg}, méretezés $\sigma_{meg}=150\,MPa$



milyen hengerelt L-acél?



x: $F_{Ax}=0$

z: $F_{Az}-p\cdot a-F=0$

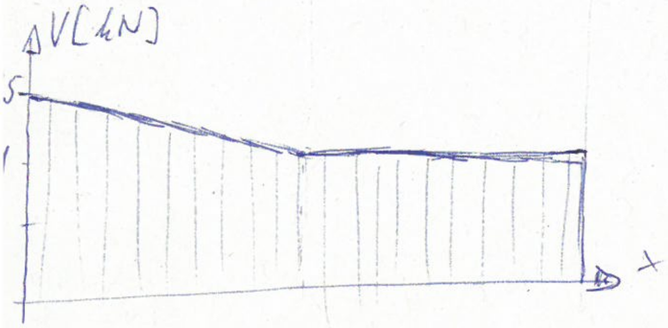
y:[A] $M_A-p\cdot a\cdot\frac{a}{2}+M_0-F\cdot 2\cdot a=0$

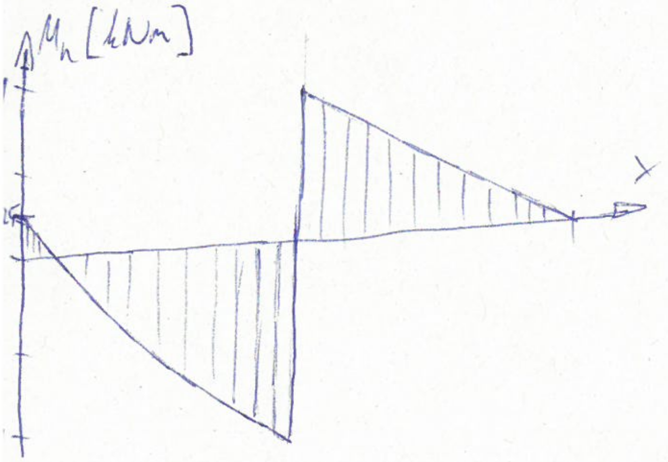
$F_{Az}=1500\,N$, $M_A=250\,Nm$

$V_1(x)=F_{Az}-p\,x$ $\quad x\in[0,a]$

$M_h^1(x)=M_A-F_{Az}\cdot x+p\frac{x^2}{2}$

2. részen jobboldalról indulunk





$\sigma_x^{max}=\frac{M_h^{max}}{K_{min}}\le\sigma_{meg}\Rightarrow K_{min}\ge 6.\dot{6}\cdot 10^{-6}\,m^3$

$K_{min}\ge 6.\dot{6}\,cm^3$

$K_{L\,min}\ge 3.\dot{3}\,cm^3 \Rightarrow 50.50.6$