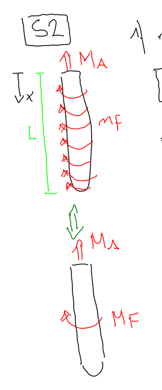
S2



1) $m_f = k \cdot x$

$\left[\frac{\text{Moment}}{\text{Länge}} = \frac{Nm}{m} = N\right]$

$\sum M: \; M^A = M^F$

$M^F = \int_0^L m_f \, dx$

$= \int_0^L k \cdot x \, dx = \left[k \frac{x^2}{2}\right]_0^L$

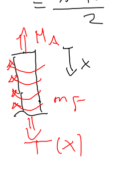
$= k \frac{L^2}{2} = M^A$

$\boxed{\to k = \frac{2M^A}{L^2}}$

2.) $\vartheta_{max} = \vartheta(x=L) = \int_0^L \frac{T(x)}{G I_T \cancel{(x)}} dx$

$I_T = I_p = \int_0^{2\pi}\int_0^R \rho^3 \, d\rho \, d\varphi = 2\pi \left[\frac{\rho^4}{4}\right]_0^R$

$= \frac{\pi R^4}{2}$



$\sum M^{\text{im Schnittufer}}$:

$T(x) = M^A - \int_0^x m_f \, dx$

$= M^A - \int_0^x kx \, dx$

$= M^A - k\frac{x^2}{2}$

$= M^A - \frac{\cancel{2}M^A}{L^2}\frac{x^2}{\cancel{2}}$

$= M^A\left(1 - \frac{x^2}{L^2}\right)$

$\vartheta_{max} = \int_0^L \frac{M^A\left(1-\frac{x^2}{L^2}\right)}{G\frac{\pi R^4}{2}} dx = \frac{M^A 2}{G\pi R^4}\int_0^L 1 - \frac{x^2}{L^2} dx$

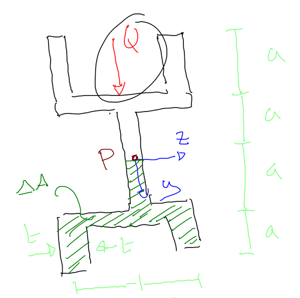
$= \frac{2M^A}{\pi R^4 G}\left[x - \frac{x^3}{3L^2}\right]_0^L = \frac{2M^A}{\pi R^4 G}\underbrace{\left(L - \frac{L^{\cancel{3}}}{3\cancel{L^2}}\right)}_{2/3\, L}$

$= \boxed{\frac{4M^A L}{3\pi R^4 G}}$

3.) $\vartheta_{max} \leq \vartheta_0$

$\frac{4M^A_{zul}L}{3\pi R^4 G} \leq \vartheta_0 \to \boxed{M^A_{zul} \leq \frac{3\pi R^4 G \vartheta_0}{4L}}$

W1



Man bestimme den Betrag der Schubspannung τ_{xy} im Schwerpunkt auf Grund von Q.

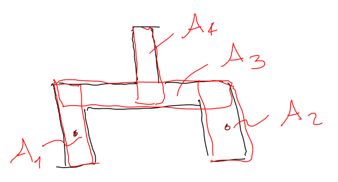
I_z ist gegeben. Dicke ist konstant.

$\tau_{xs}(x,s) = -\frac{\cancel{Q_y}\,Q}{I_z}\frac{H_z(s)}{\cancel{e(s)}\, t} \to \frac{Q}{I_z}\frac{11a^2\cancel{t}}{2\,\cancel{t}} = \frac{Q}{I_z}\frac{11a^2}{2}$

$H_z(P) = H_z^1 + H_z^2 + H_z^3 + H_z^4 = y_s^1 \cdot A_1 + y_s^2 \cdot A_2 + y_s^3 \cdot A_3 + y_s^4 A_4$

$= 2 \cdot 3/2\, a \cdot a \cdot t + a \cdot 2a \cdot t + a/2 \cdot a \cdot t$

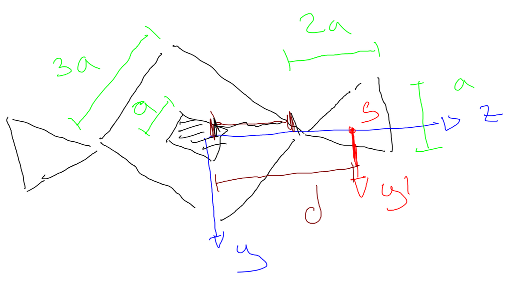
$= a^2 t(3 + 2 + 1/2) = \frac{11}{2}a^2 t$



Schwerpunkt = Schubmittelpunkt

W2

Man bestimme I_y



$I_y^{Total} = I_y^Q - I_y^a + 2I_y^D = \frac{\overset{81a^4}{(3a)^4}}{12} - \frac{a^4}{12} + 2 \cdot 12.16a^4$

$I_{y'}^D = \frac{a \cdot (2a)^3}{36} = \frac{a \cdot 8a^3}{36} = \frac{2}{9}a^4$

$I_y^D = I_{y'}^D + A \cdot d^2 = \frac{2}{9}a^4 + \frac{2a^2}{2}\underbrace{\left(\frac{3a}{\sqrt{2}} + \frac{2}{3}2a\right)^2}_{\underbrace{\left(\frac{\sqrt{2}\,3}{2} + \frac{4}{3}\right)a}_{\frac{9\sqrt{2}+8}{6}a}}$

$= a^4\left(\frac{2}{9} + \frac{(9\sqrt{2}+8)^2}{36}\right) \approx 12.16a^4$

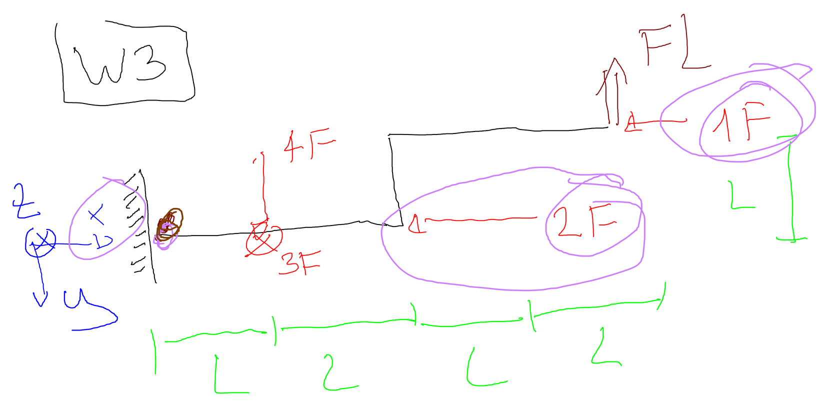
$I_y^{Total} = \frac{80a^4}{12} + 24{,}31a^4$

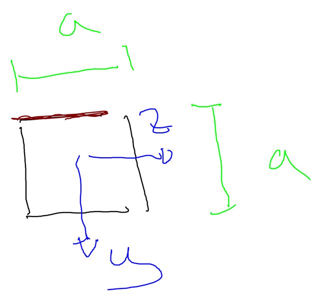
$I_y > I_z$

$C_{yz} = 0$

y & z sind Hauptachsen, weil Symmetrieachsen

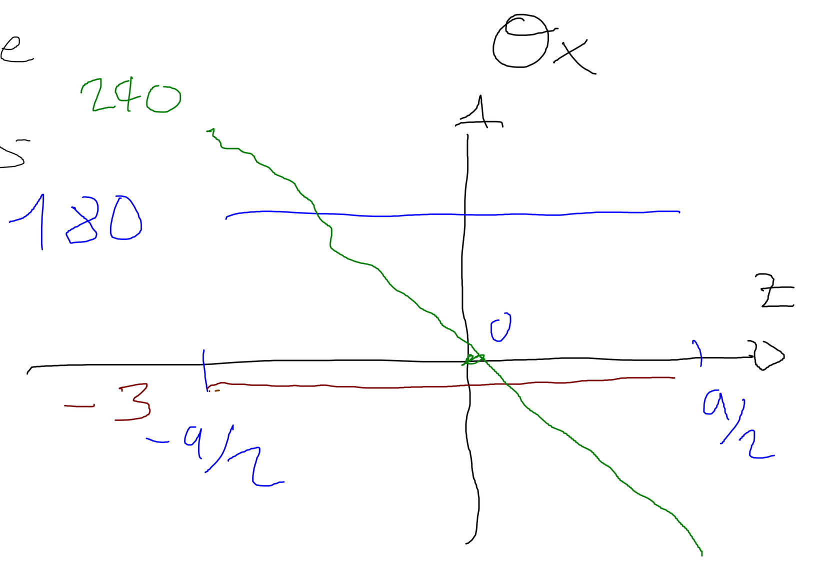
W3





Man bestimme den Normalspannungsverlauf für die obere Kante an der Einspannung

$L = 10a$

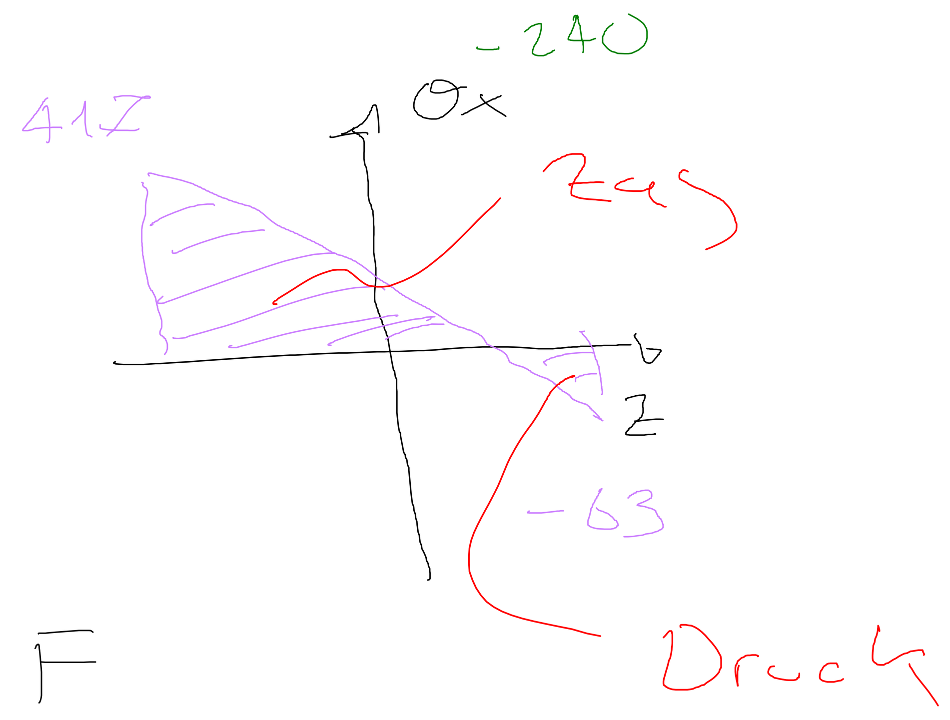


$\sigma_x(x,y,z) = \frac{N(x)}{A(x)} - \frac{M_z(x)}{I_z} \cdot y + \frac{M_y(x)}{I_y} \cdot z$

$\frac{N(x)^{-3F}}{A(x)} = -\frac{3F}{a^2} = \underline{-3\frac{F}{a^2}}$

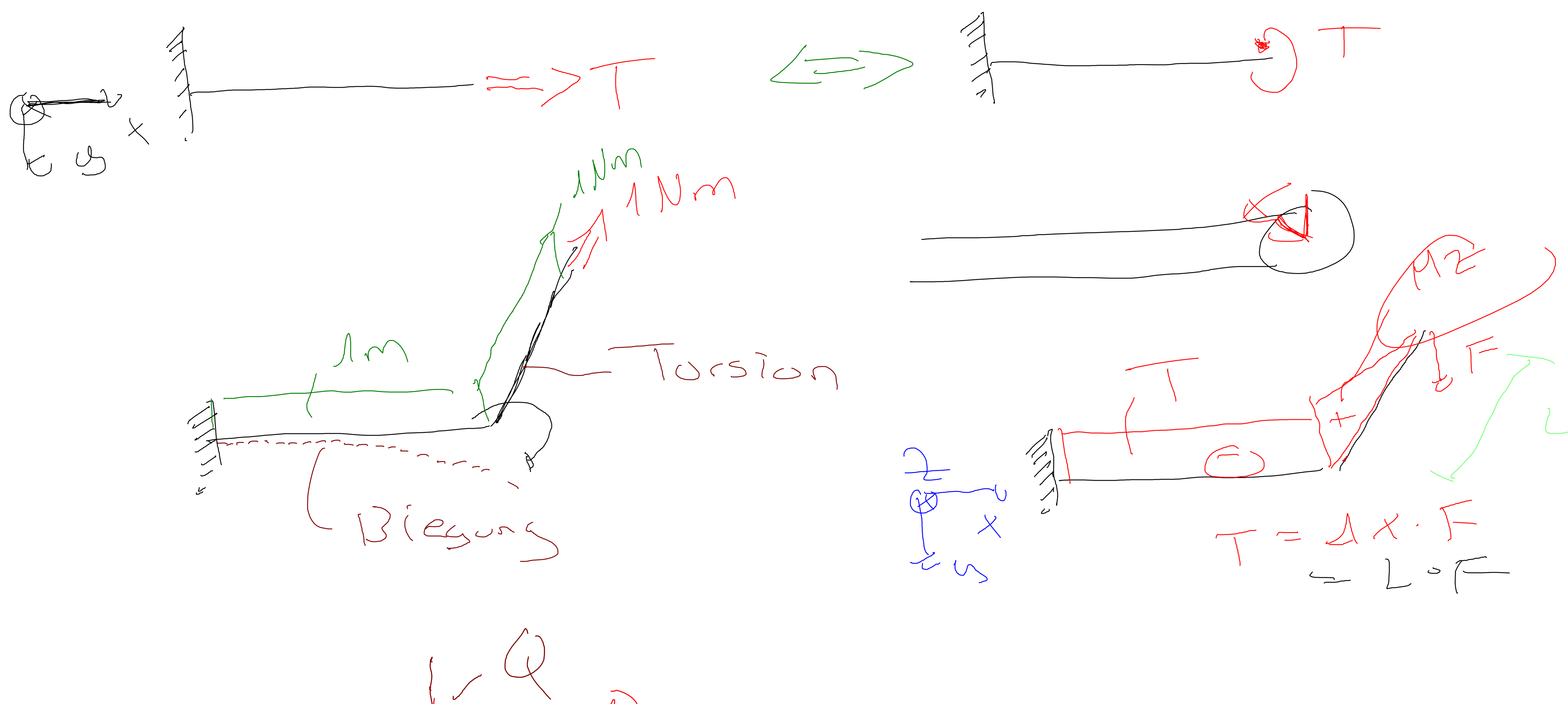
$-\frac{M_z(x)}{I_z} \cdot y^{-a/2} = \frac{\cancel{a}}{2}\frac{12}{a^{\cancel{4}\,3}}\left(4FL - FL\right) = 18\frac{FL}{a^3} = \underline{180\frac{F}{a^2}}$

$\frac{M_y(x)}{I_y} \cdot z = \frac{12}{a^4}\left(-3FL - FL\right)z = -\frac{48}{a^4}FLz = \underline{-480\frac{F}{a^2}z}$

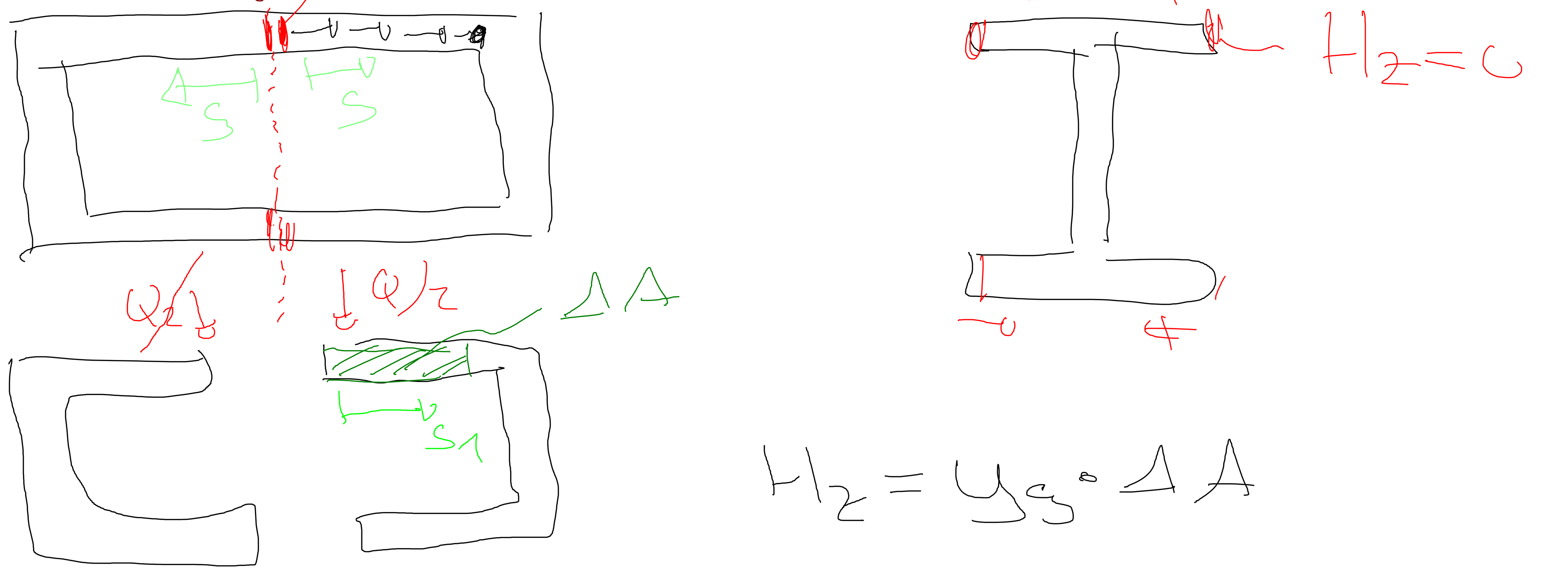


Momente $\begin{cases} M_z \\ \underline{T = \Delta x \cdot F} \end{cases}$

$\sigma_{Druck} < 0$



$T = \Delta x \cdot F$
$= L \cdot F$



$H_z = y_s \cdot \Delta A$