[A1] $\det(\underline{\underline{T}} - \lambda \underline{\underline{I}}) = 0$

[A2] Normalenvektor muss immer normiert sein

$\frac{1}{\sqrt{3}}$

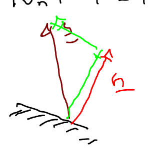
[A4] am negativsten ≠ kleinsten Betrag

[A3] $\underline{s} = \underline{\underline{T}} \cdot \underline{n} = \begin{pmatrix} 0 \\ 3 \\ 1 \end{pmatrix} k$

$\sigma_n = \underline{s} \cdot \underline{n} = 0 \rightarrow \sigma_n = 0$

$\tau_n = \underline{s} - \cancel{\sigma_n}^{0} = \underline{s}$

$|\tau_n| = |\underline{s}| = \boxed{\sqrt{10}\, k}$



[B2] $\gamma_{max} = \varepsilon_{max} - \varepsilon_{min}$

$\varepsilon_I = \underline{0} \cdot 10^{-4}$ $\begin{bmatrix} 12 & -3 \\ -3 & 4 \end{bmatrix}$

$\sqrt{3^2 + 4^2} = 5$

[B1] $\frac{1}{2}\left(\frac{du}{dy} + \frac{dv}{dx}\right)$

$\frac{du}{dx}$ $\begin{bmatrix} -2 & \frac{1}{2}(6+2) \\ = & 3 \end{bmatrix} 10^{-3}$

$\frac{dv}{dy}$

$= \begin{bmatrix} -2 & 4 \\ 4 & 3 \end{bmatrix} 10^{-3}$

[C2] $\sigma_x = \sigma_z$ σ_y, σ_z

$\varepsilon_x = \varepsilon_z = 0$

$\varepsilon_y =$

$\varepsilon_x =$

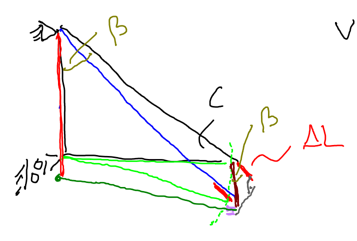
[D1] Löcher haben eine negative Fläche

[E1] $\Sigma_z^{in\,D}$

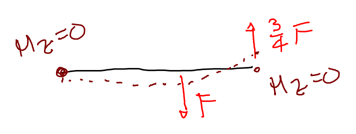
[E3] $\Delta L = \varepsilon L_0 = \frac{\sigma}{E} L = \frac{F_v L}{A E}$

$\boxed{\Delta L = \frac{FL}{AE}}$

[E4] $V_c = \frac{\Delta L}{\cos(\beta)}$



[E5]

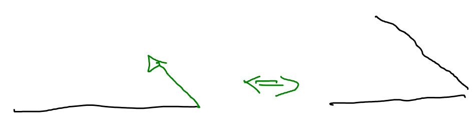


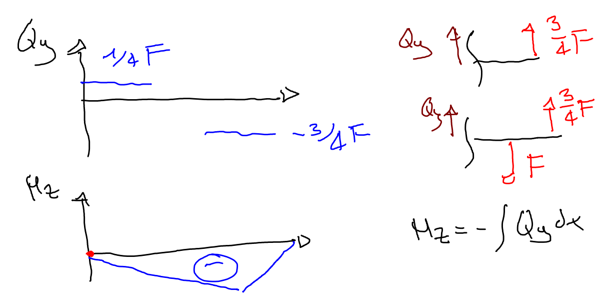
~~B~~ ~~D~~ ~~G/H~~ ~~F~~ ~~E~~

→ Zug auf der Unterseite
→ M_z ist negativ

→ Lager: $M_z = 0$
→ freies Ende: $M_z = 0$

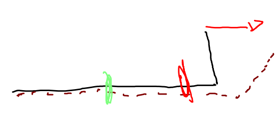
(C)



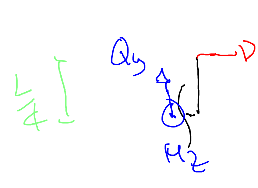


$M_z = -\int Q_y\, dx$

[F1]



→ Zug auf der Oberseite → M_z positiv

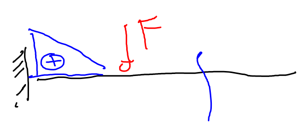


$Q_y = 0$

$M_z = F \frac{L}{4}$

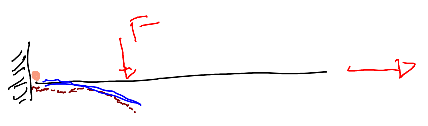
(H)

[G1]



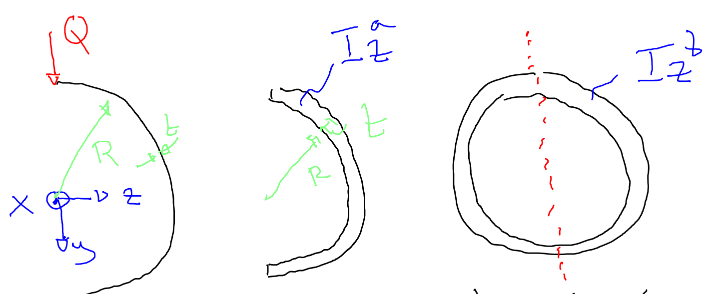
(H)

[G2]



[S1]

$2 I_z^a = I_z^b$



1.) $\tau_{xs}(x,s) = -\frac{Q_y}{I_z} \frac{H_z(s)}{e(s)}$ $Q_y = Q$ $e(s) = t$

$I_z = \frac{1}{2}\frac{\pi}{4}\left((R+t)^4 - R^4\right)$

$= \frac{\pi}{8}\left((R+t)^2(R+t)^2 - R^4\right)$ $t \ll R$

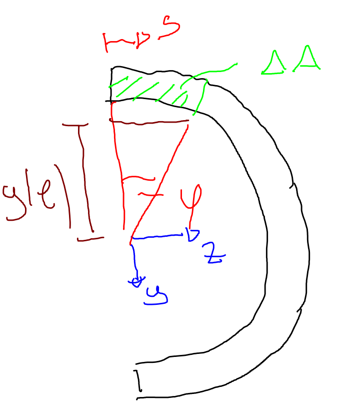
$= \frac{\pi}{8}\left((R^2 + 2Rt + t^2)^2 - R^4\right)$

$= \frac{\pi}{8}\left(\cancel{R^4} + \cancel{4R^2t^2} + \cancel{t^4} + 4R^3t + \cancel{2R^2t^2} + \cancel{4Rt^3} - \cancel{R^4}\right)$

$= \frac{\pi}{8} 4R^3 t = \frac{\pi R^3 t}{2}$

$H_z(s) = \int_0^s y(\varphi)\, \cancel{e(\varphi)}^{t}\, \cancel{\rho}^{R}\, d\varphi$

$y(\varphi) = R\cos(\varphi)(-1)$



$= -tR^2 \int_0^s \cos(\varphi)\, d\varphi$

$= -tR^2 \left[\sin(\varphi)\right]_{\varphi=0}^{\varphi=s}$

$= -tR^2 \sin(s)$

$\tau_{xs}(x,s) = \cancel{-} \frac{Q \cdot 2}{\pi R^{\cancel{3}} t} \frac{\cancel{-t}\cancel{R^2}\sin(s)}{\cancel{t}}$

$= \frac{2Q}{\pi R t}\sin(s)$ $s = \varphi$

3.) $T = \Delta x \cdot F = R \iint_A \tau_{xs}\, dA$

$= R \int_0^{\pi}\int_R^{R+t} \frac{2Q}{\pi R t} \sin(\varphi)\, \rho\, d\rho\, d\varphi$

$= \frac{2Q}{\pi t} \int_0^{\pi}\int_R^{R+t} \sin(\varphi)\, \rho\, d\rho\, d\varphi$

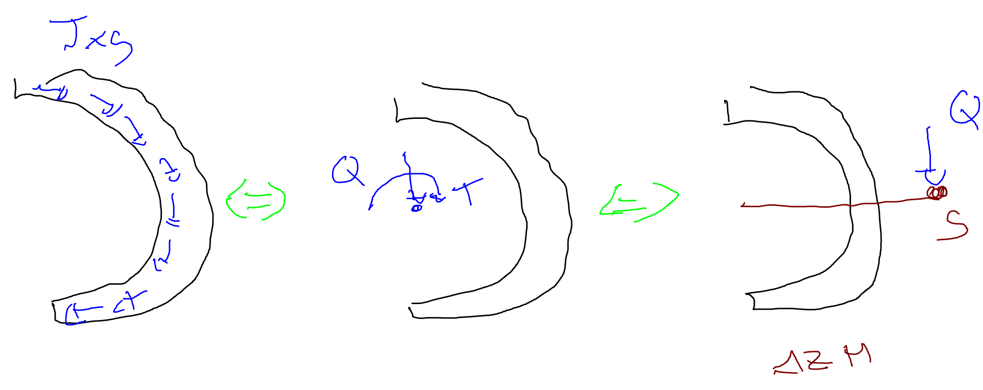
$= \frac{2Q}{\pi t} \int_0^{\pi} \sin(\varphi) \left[\frac{\rho^2}{2}\right]_{\rho=R}^{\rho=R+t} d\varphi$

$= \frac{2Q}{\pi t \cdot 2} \int_0^{\pi} \sin(\varphi) \left[\cancel{R^2} + 2Rt + \cancel{t^2}^{0} - \cancel{R^2}\right] d\varphi$

$= -\frac{2RtQ}{\pi t} \left[\cos(\varphi)\right]_0^{\pi}$

$= -\frac{2RQ}{\pi}(-1-1) = \frac{4RQ}{\pi}$

4.) $\Delta z_M = \frac{T}{Q_y} = \frac{4RQ}{\pi Q} = \boxed{\frac{4R}{\pi} \approx 1{,}27 R}$



https://youtu.be/TjO7WFzdqPE

grosses "O"