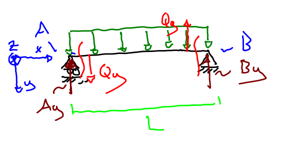
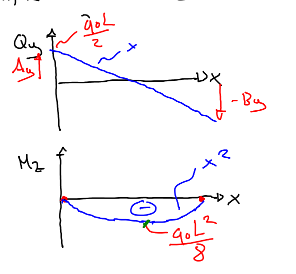
S2



1.) LF0 – reale System $\to Q_0(x), M_0(x)$

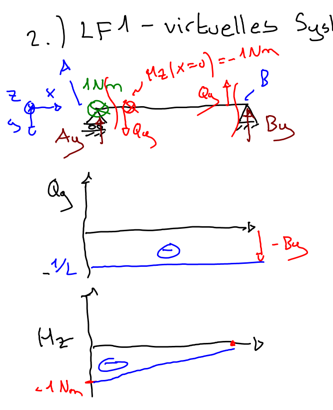
$\to A_y = B_y = \frac{1}{2} q_0 L$ wegen Symmetrie



$Q_y = -\int q_y\,dx = -q_0 x + C_1$
$Q_y(x=0) = C_1 = \frac{q_0 L}{2}$

$M_z = -\int Q_y\,dx = -\int -q_0 x + \frac{q_0 L}{2}\,dx$
$= \frac{q_0 x^2}{2} - \frac{q L x}{2} + C_2$
$M_z(x=0) = 0 \to C_2 = 0$
$M_z(x=\frac{L}{2}) = \frac{q_0 L^2}{8} - \frac{q_0 L^2}{4} = -\frac{q_0 L^2}{8}$

2.) LF1 – virtuelles System $\to Q_1(x), M_1(x)$



$\sum M_z^{inA}: \quad 1 = B_y L \to B_y = 1/L$

$\to Q_y(x=L) = -B_y$
$Q_y = -\int q_y\,dx = 0 + C_1 = -1/L$

$\to M_z = -\int Q_y\,dx = -\overset{-B_y}{A_y} x + C_2$
$M_z(x=0) = -1\,Nm \to C_2 = -1\,Nm$

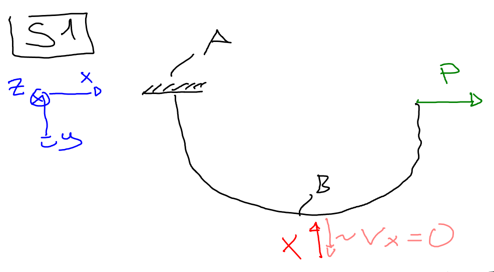
3.) $\Theta = \int_l \frac{M_0 M_1}{EI}\,dx + \int_l \frac{Q_0 Q_1}{GA_s}\,dx$

$= \frac{1}{EI}\int_0^L \ldots dx + \cancel{\frac{1}{GA_s}\int_0^{L/2} \ldots dx} + \cancel{\frac{1}{GA_s}\int_{L/2}^{L} \ldots dx}$

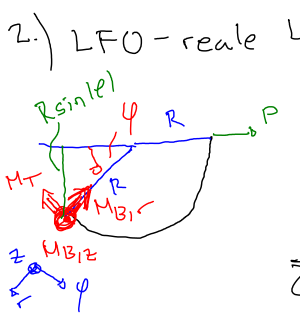
$= \frac{1}{EI}\,\frac{1}{3}\,\frac{qL^2}{8}\cdot 1\cdot L$

$= \boxed{\frac{1}{EI}\,\frac{1}{24}\,qL^3}$

S1

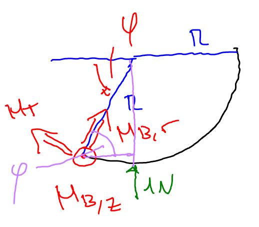


2.) LF0 – reale Lasten $\to M_0, T_0$



$\sum M_r^{\text{im Schnittufer}}: M_{B,r} = 0$
$\sum M_\varphi^{\text{im Schnittufer}}: M_T = 0$
$\sum M_z^{\text{im Schnittufer}}:$
$M_{B,z}^0 = R\sin(\varphi)\cdot P$

3.) LF1 – Hilfskraft am ersetzten Lager mit 1N



$\to M_{B,r} = 0$
$\to M_T = 0$
$\sum M_z^{\text{im Schnittufer}}:$
$M_{B,z}^1 = -1R\cos(\varphi)$

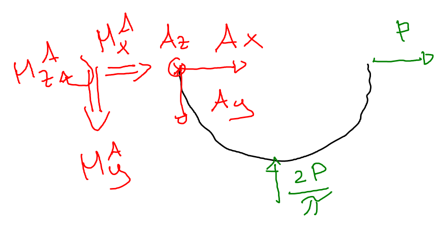
4.) $\delta_{10} = \int_l \frac{M_z^0 M_z^1}{EI_z}\,dx$
$= \frac{1}{EI_z}\int_0^\pi M_{B,z}^0 \cdot M_{B,z}^1\, \rho\, d\varphi$
$= -\frac{1}{EI_z}\int_0^\pi R\sin(\varphi) P R\cos(\varphi) R\,d\varphi$
$= -\frac{PR^3}{EI_z}\int_0^\pi \cancel{\sin(\varphi)\cos(\varphi)}^{1/2}\,d\varphi$
$= -\frac{PR^3}{2EI_z}$

$\delta_{11} = \int_l \frac{M_z^1 M_z^1}{EI_z}\,dx$
$= \frac{1}{EI_z}\int_0^{\pi/2} (M_{B,z}^1)^2 \rho\, d\varphi$
$= \frac{1}{EI_z}\int_0^{\pi/2} R^2\cos^2(\varphi)\, R\,d\varphi$
$= \frac{R^3}{EI_z}\int_0^{\pi/2} \cancel{\cos^2(\varphi)}^{\pi/4}\,d\varphi = \frac{\pi}{4}\frac{R^3}{EI_z}$

5.) $v_x = \delta_{10} + x\cdot\delta_{11} = 0$
$\to x = -\frac{\delta_{10}}{\delta_{11}}$

$x = -\frac{-P\cancel{R^3}\,\cancel{4}^{2}\,\cancel{EI_z}}{\cancel{2}\cancel{EI_z}\,\pi\,\cancel{R^3}} = \boxed{\frac{2P}{\pi} = B_y}$

6.) restliche Lagerkräfte:



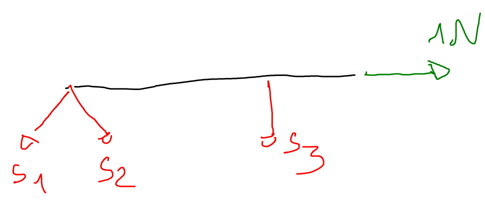
$\sum F_x: \quad A_x = -P$
$\sum F_y: \quad A_y = \frac{2P}{\pi}$
$\sum F_z: \quad A_z = 0$
$\sum M_x^{inA}: \quad M_x^A = 0$
$\sum M_y^{inA}: \quad M_y^A = 0$
$\sum M_z^{inA}: \quad \frac{2PR}{\pi}$

Serie 6 – H2

1.) LF0

$S_1^0 = \frac{\sqrt{2}}{2}(F_1 + F_2)$
$S_2^0 = \frac{\sqrt{2}}{2}(F_1 - F_2)$
$S_3^0 = -2F_1$

2.) LF1 – für u

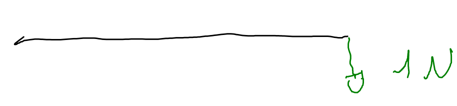


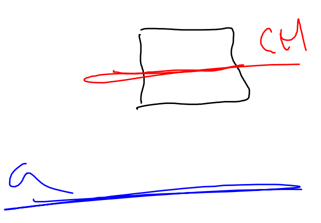
$\sum M_z^{inA}: \quad S_3^1 = 0$
$\sum F_y: \quad S_1 = -S_2$
$\sum F_x: \quad -\frac{\sqrt{2}}{2} S_1 + \frac{\sqrt{2}}{2} S_2 + 1 = 0$
$\to \frac{\sqrt{2}}{2} S_2 + \frac{\sqrt{2}}{2} S_2 + 1 = 0$
$\to S_2^1 = -\frac{\sqrt{2}}{2}$
$\to S_1^1 = \frac{\sqrt{2}}{2}$

3.) $u = \int_{l_1} \frac{\overset{S_1^0 S_1^1}{N_0 N_1}}{EA}\,dx + \int_{l_2} \frac{\overset{S_2^0 S_2^1}{N_0 N_1}}{EA}\,dx + \int_{l_3} \frac{\overset{S_3^0 S_3^1}{N_0 N_1}}{EA}\,dx$

$= \frac{1}{EA}\left[\cancel{\sqrt{2}} L \cancel{\frac{\sqrt{2}}{2}}(F_1 + F_2)\frac{\sqrt{2}}{2} + \cancel{\sqrt{2}} L \cancel{\frac{\sqrt{2}}{2}}(F_1 - F_2)\left(-\frac{\sqrt{2}}{2}\right) + 0\right]$

$= \frac{L}{EA}\left[\frac{\sqrt{2}}{2}(\cancel{F_1} + F_2) - \frac{\sqrt{2}}{2}(\cancel{F_1} - F_2)\right] = \boxed{\frac{L}{EA}\sqrt{2}\,F_2}$





$I_z^a = I_z^{CM} + d^2 A$

$I_z^{CM} = I_z^a - d^2 A$