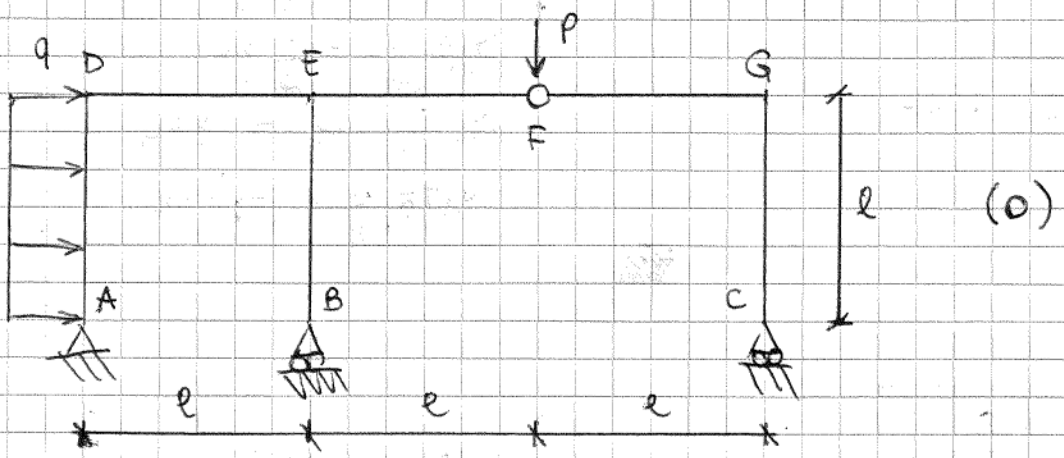
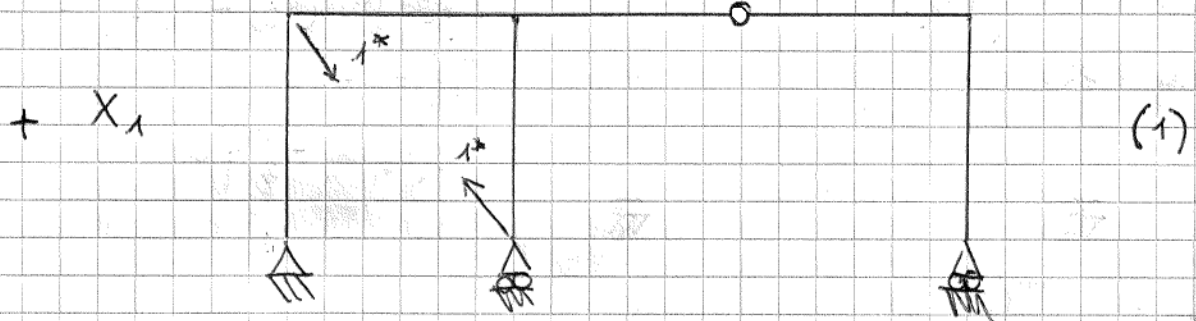
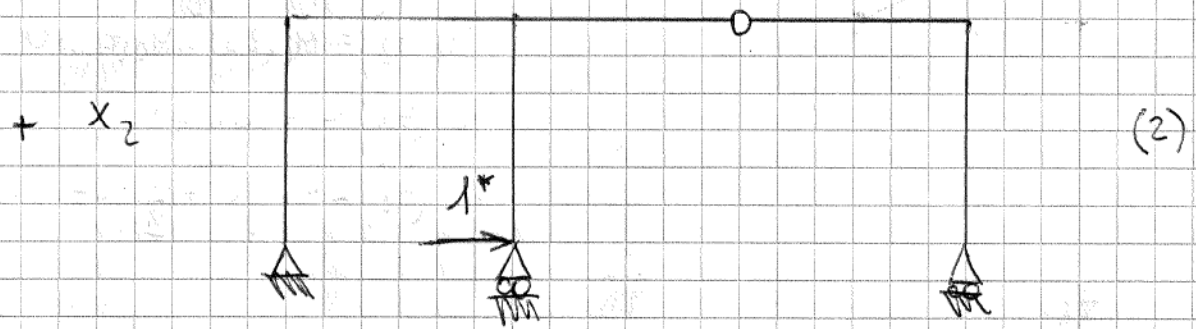
SCRITTO TOTALE SdC 22/01/19



(0)

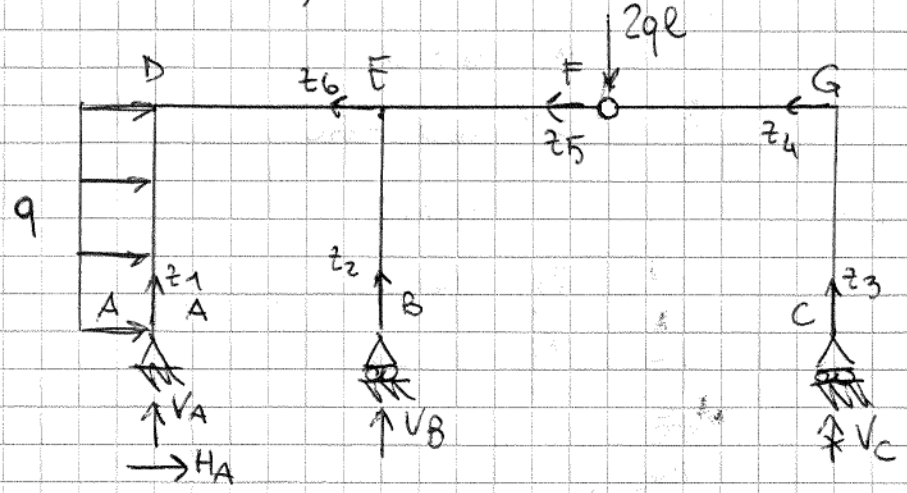


(1)



(2)

SISTEMA (0)



→) $H_A = -q\ell$

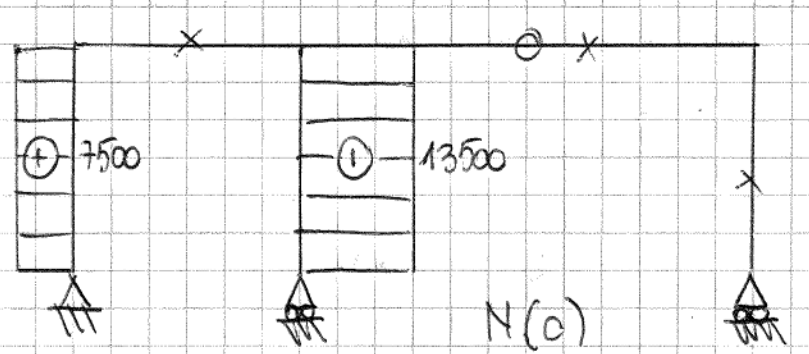
F↑) AUS FGC $V_C = 0$

A↑) $-2q\ell\, 2\ell + V_B \cdot \ell - \frac{q\ell^2}{2} = 0$

$V_B = \frac{9}{2} q\ell$

↑) $V_A + V_B - 2q\ell = 0$

$V_A = -\frac{5}{2} q\ell$



N(0)

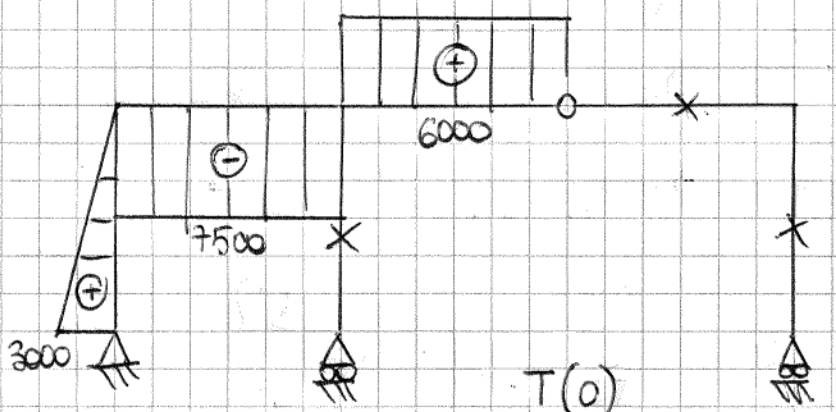
$N_0(z_1) = +\frac{5}{2}ql$

$N_0(z_2) = -\frac{9}{2}ql$

$N_0(z_3) = 0 = N_0(z_4)$

$N_0(z_5) = N_0(z_6) = 0$

N(0)



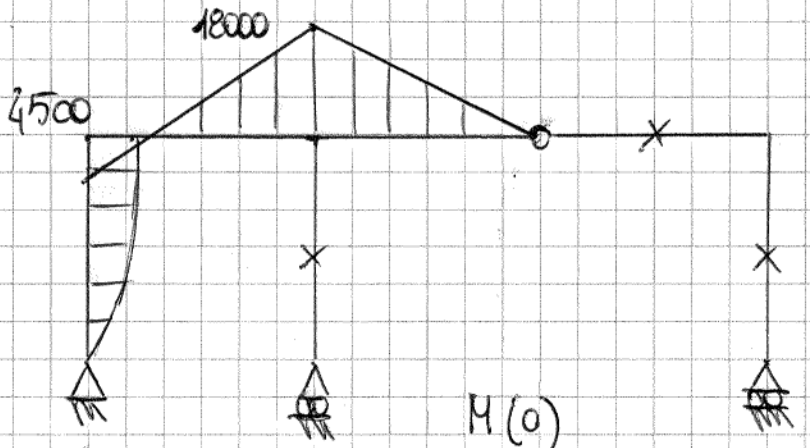
T(0)

$T_0(z_1) = ql - qz$

$T_0(z_2) = T_0(z_3) = T_0(z_4) = 0$

$T_0(z_5) = 2ql$

$T_0(z_6) = -\frac{5}{2}ql$



M(0)

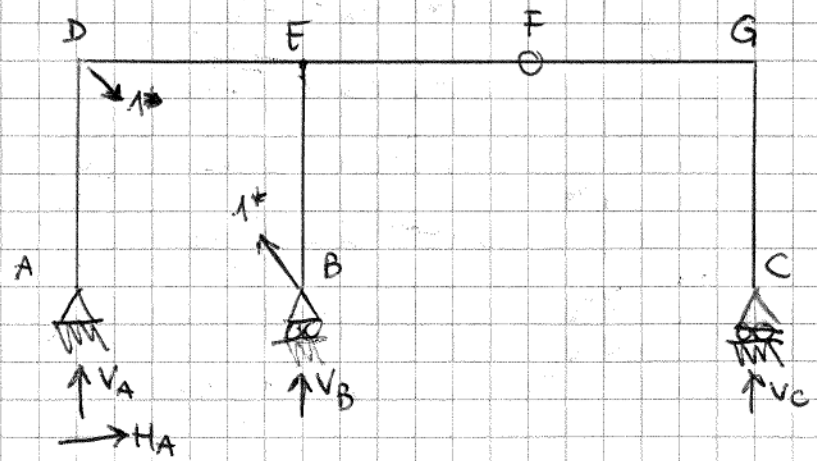
$M_0(z_1) = qlz - \frac{qz^2}{2}$

$M_0(z_2) = M_0(z_3) = M_0(z_4) = 0$

$M_0(z_5) = -2qlz$

$M_0(z_6) = -2ql^2 + \frac{5}{2}qlz$

SISTEMA (1)



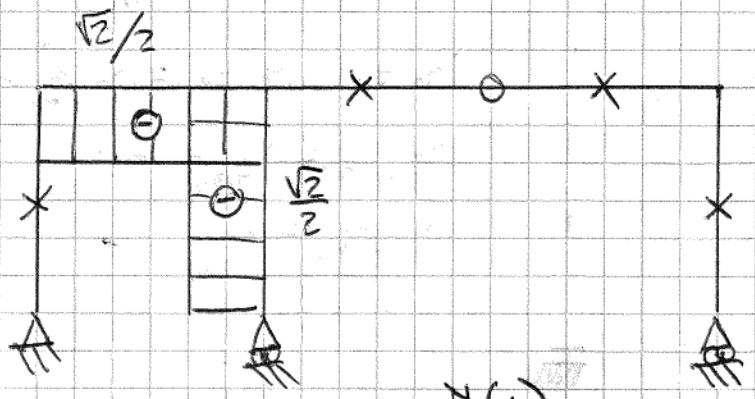
→) $H_A = 0$

F↑ AUS FGC

$V_C = 0$

B) $V_A = 0$

↑) $V_B = 0$



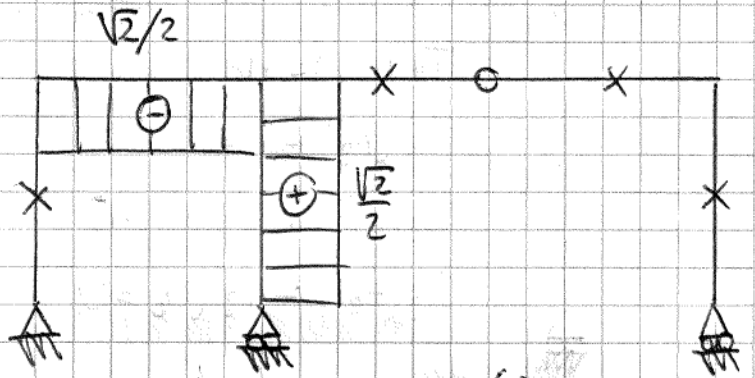
N(1)

$N_1(z_1) = 0$

$N_1(z_2) = -\sqrt{2}/2$

$N_1(z_3) = N_1(z_4) = N_1(z_5) = 0$

$N_1(z_6) = -\sqrt{2}/2$



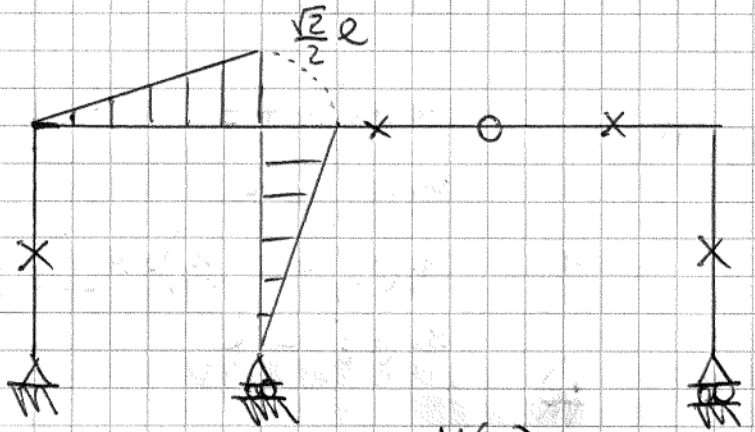
T(1)

$T_1(z_1) = 0$

$T_1(z_2) = \sqrt{2}/2$

$T_1(z_3) = T_1(z_4) = T_1(z_5) = 0$

$T_1(z_6) = -\sqrt{2}/2$



M(1)

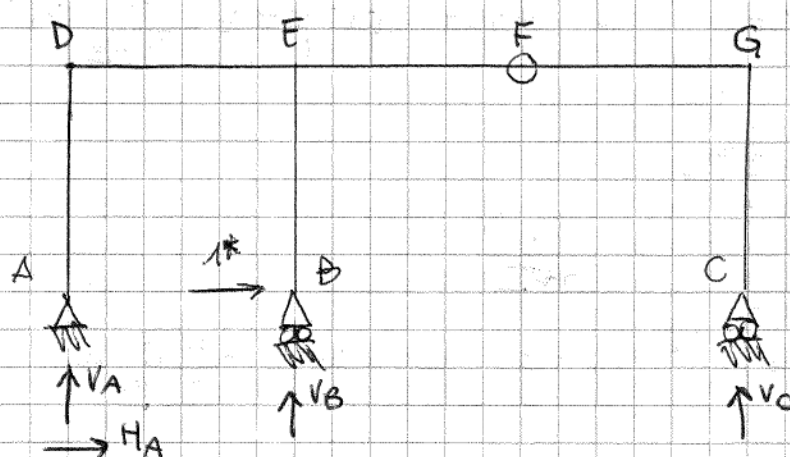
$M_1(z_1) = 0$

$M_1(z_2) = -\frac{\sqrt{2}}{2} z$

$M_1(z_3) = M_1(z_4) = M_1(z_5) = 0$

$M_1(z_6) = -\frac{\sqrt{2}}{2}\ell + \frac{\sqrt{2}}{2} z$

SISTEMA (2)



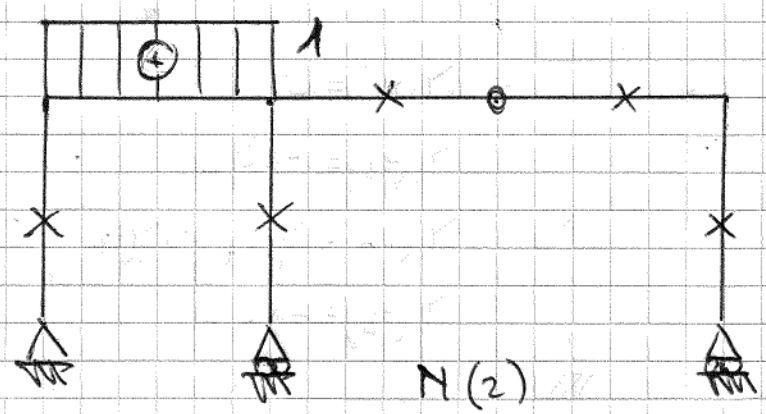
$\rightarrow) \; H_A = -1$

$F\uparrow$ AUS FGC

$V_C = 0$

$A\uparrow \; V_B = 0$

$\uparrow) \; V_C = 0$

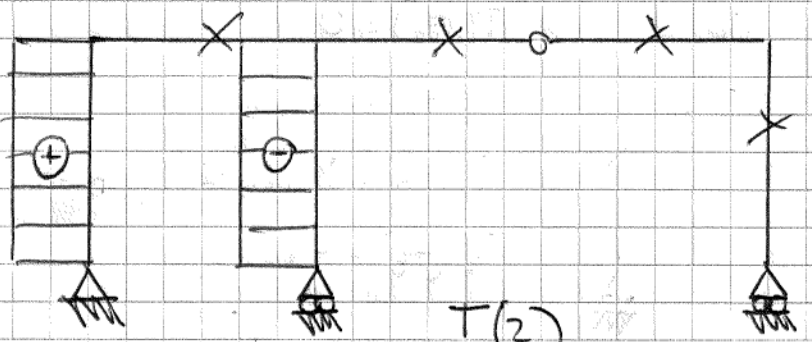


N(z)

$N_2(z_1) = N_2(z_2) = N_2(z_3) = 0$

$N_2(z_4) = N_2(z_5) = 0$

$N_2(z_6) = 1$



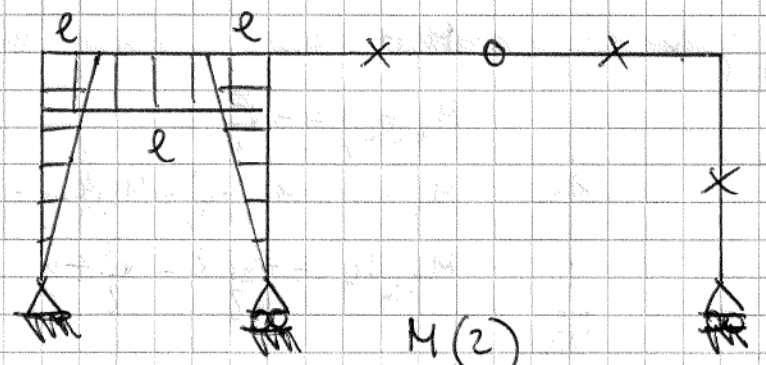
T(z)

$T_2(z_1) = 1$

$T_2(z_2) = -1$

$T_2(z_3) = T_2(z_4) = 0$

$T_2(z_5) = T_2(z_6) = 0$



M(z)

$M_2(z_1) = +z$

$M_2(z_2) = z$

$M_2(z_3) = M_2(z_4) = M_2(z_5) = 0$

$M_2(z_6) = \ell$

$$\eta_{10} = \frac{1}{EI}\left[\int_0^{\ell}\left(\frac{\sqrt{2}}{2}z - \frac{\sqrt{2}}{2}\ell\right)\left(\frac{5}{2}q\ell z - 2q\ell^2\right)dz\right] = \frac{7\sqrt{2}}{24EI}q\ell^4$$

$$\eta_{20} = \frac{1}{EI}\left[\int_0^{\ell}(z)\left(q\ell z - q\frac{z^2}{2}\right)dz + \int_0^{\ell}(\ell)\left(\frac{5}{2}q\ell z - 2q\ell^2\right)dz\right] = -\frac{13}{24EI}q\ell^4$$

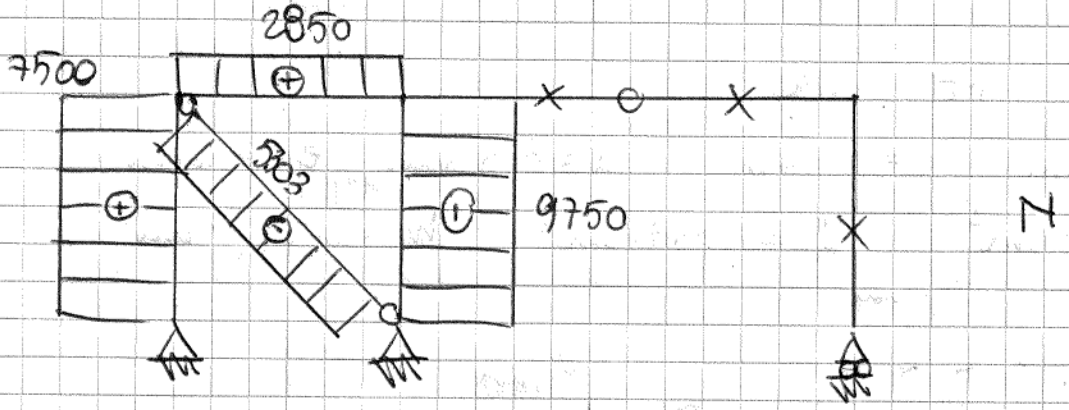
$$\eta_{11} = \frac{2}{EI}\int_0^{\ell}\left(\frac{\sqrt{2}}{2}z\right)^2 dz = \frac{\ell^3}{3EI}$$

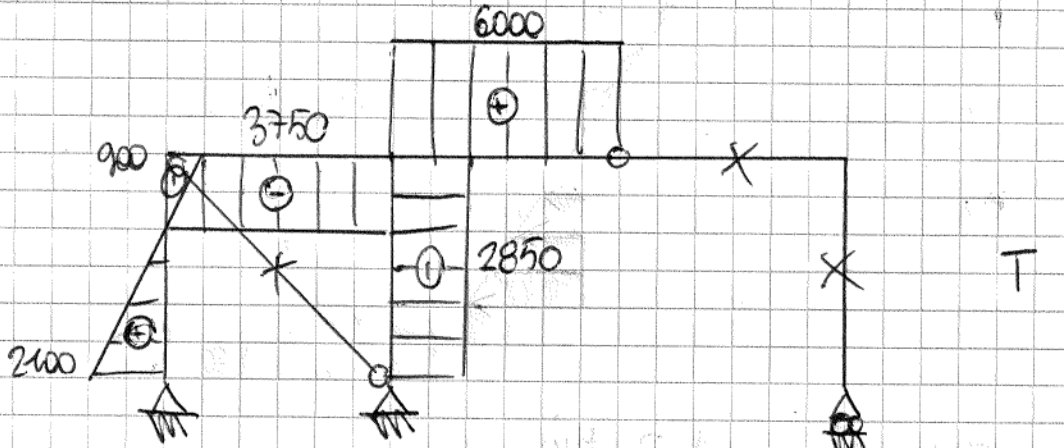
$$\eta_{22} = \frac{1}{EI}\left[2\int_0^{\ell} z^2\,dz + \int_0^{\ell}\ell^2\,dz\right] = \frac{5\ell^3}{3EI}$$

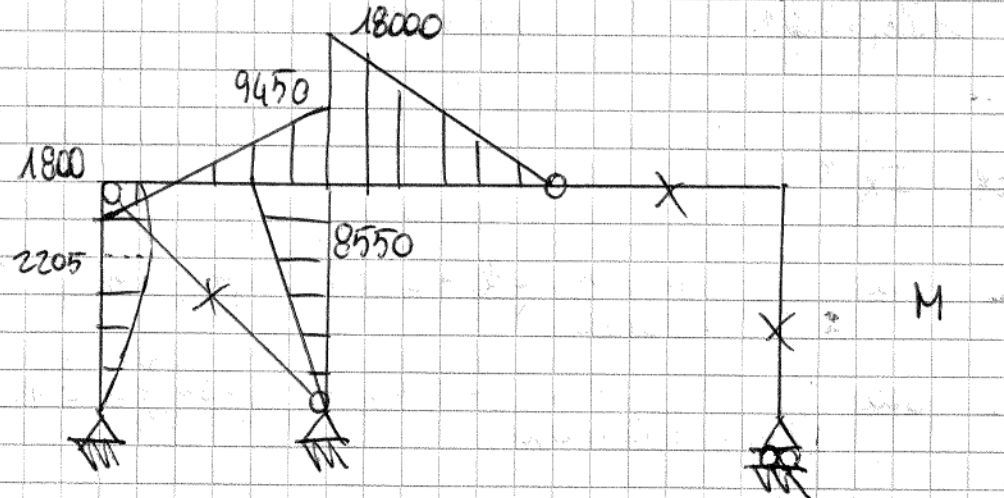
$$\eta_{12} = \frac{1}{EI}\left[\int_0^{\ell}(z)\left(-\frac{\sqrt{2}}{2}z\right)dz + \int_0^{\ell}(\ell)\left(-\frac{\sqrt{2}}{2}\ell + \frac{\sqrt{2}}{2}z\right)dz\right] = -\frac{5\sqrt{2}}{12EI}\ell^3$$

$$(1) \rightarrow \begin{cases} \delta_{11} \cdot X_1 + \delta_{12} \cdot X_2 = -\delta_{10} \\ (2) \rightarrow \quad \delta_{12} \cdot X_1 + \delta_{22} \cdot X_2 = -\delta_{20} \end{cases}$$

$X_1 = -5303\ N$ $\qquad$ $X_2 = -900\ N$







2) $M = 18000\ Nm$ $\quad \sigma_{amm} = 190\ MPa$

$T = 6000\ N$ $\quad E = 210000\ MPa$

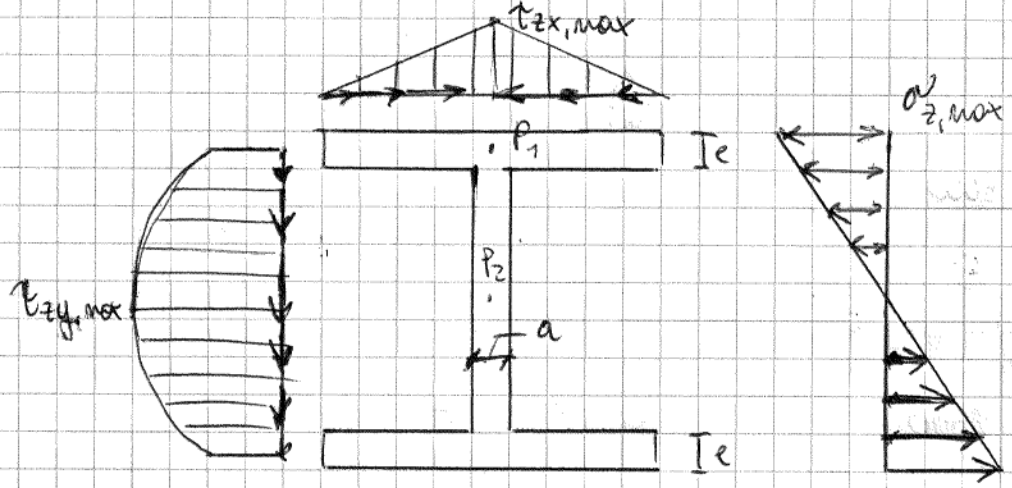
$N = 0\ N$

$$W_{min} = \frac{18000 \cdot 1000}{190} = 94737\ mm^3$$

ADOTTO IPE 180

$h = 180\ mm$ $\quad b = 91\ mm$ $\quad a = 5,3\ mm$ $\quad e = 8\ mm$

$A = 23,95\ cm^2$ $\quad I_x = 1317\ cm^4$ $\quad W_x = 146,3\ cm^3$



$$\sigma_z = \frac{M}{W_x} = \frac{18000 \cdot 10^3}{146,3 \cdot 10^3} = 123\ MPa$$

$$\tau_{zs} = -\frac{T_y \cdot S_x^*}{b_s \cdot I_x}$$

$$\tau_{zx,max} = -\frac{6000 \cdot (8 \cdot 91 \cdot 0,5 \cdot (-90+4))}{8 \cdot 13170000} = 1,78\ MPa$$

$$\tau_{zy,max} = -\frac{6000 \cdot (8 \cdot 91 \cdot (-90+4) + 5,3 \cdot 82 \cdot (-41))}{5,3 \cdot 13170000} = 6,91\ MPa$$

$$\sigma_{id,P_1} = \sqrt{123^2 + 3 \cdot 1,78} = 123,1\ MPa < 190\ ok!$$

$$\sigma_{id,P_2} = \sqrt{3^2 \cdot 6,91^2} = 12\ MPa < 190\ ok!$$

3) $\Delta_y = -1\,cm$ $\qquad M_{11}^{N} = \int_0^{\sqrt{2}\,\ell} \frac{1^2}{EA}\,dz = \frac{\sqrt{2}\,\ell}{EA}$

$$M_{11}^{TOT} = \frac{\sqrt{2}\,\ell}{EA} + \frac{\ell^3}{3EJ}$$

$$(1) \rightarrow \begin{cases} 0 \cdot \Delta_y = M_{11} \cdot X_{11} + M_{12} \cdot X_2 + M_{10} \\ (2) \rightarrow \quad 0 \cdot \Delta_y = M_{12} \cdot X_{12} + M_{22} \cdot X_2 + M_{20} \end{cases}$$

$X_1 = -5267\ N \qquad X_2 = -887\ N$