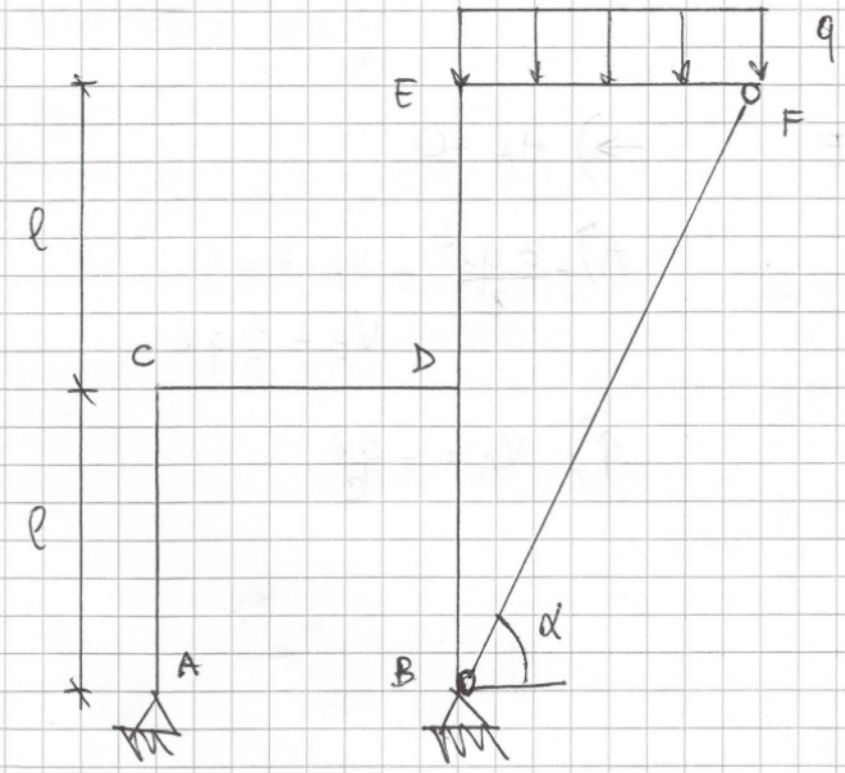
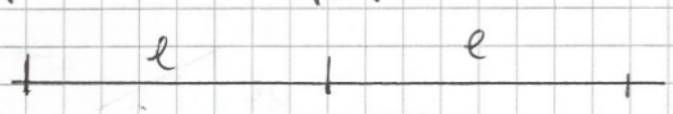
COMPITO SdC 10/06/2019

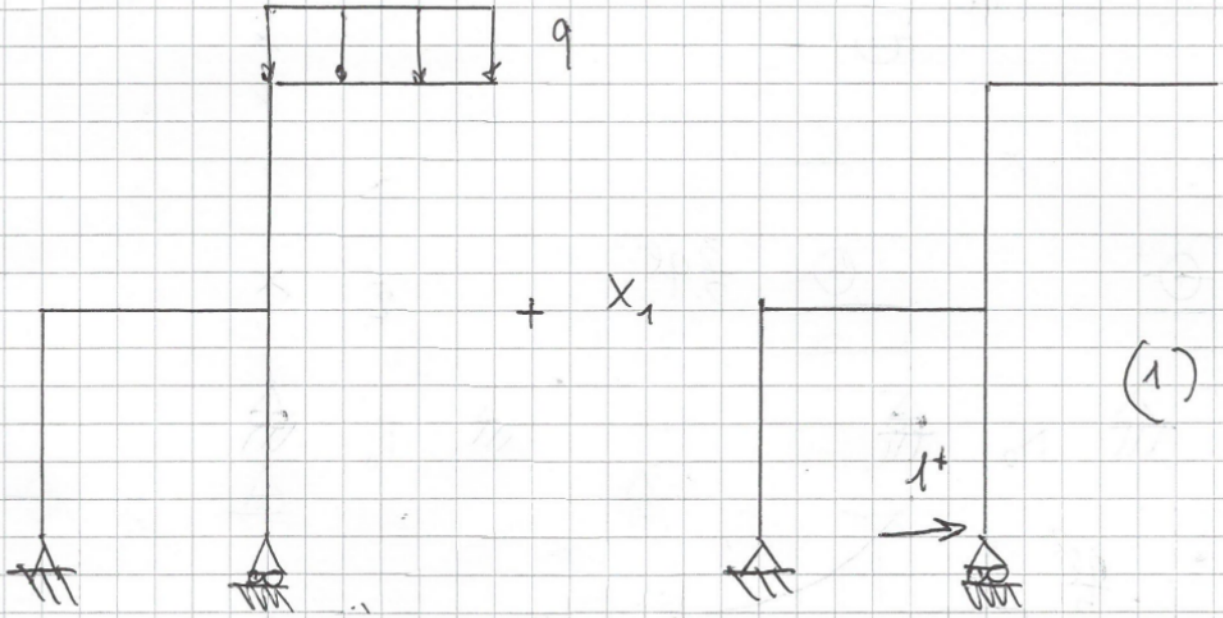


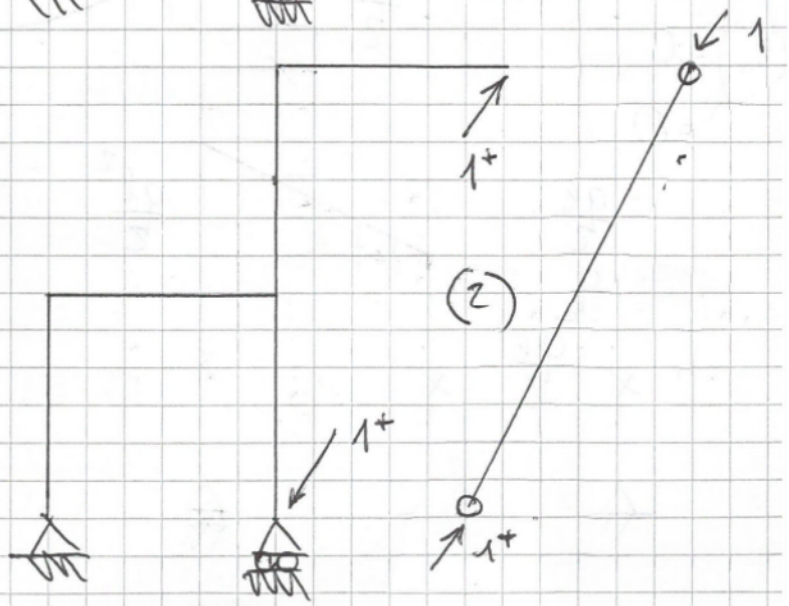
$q = 3000\ N/m$

$\ell = 4\ m$

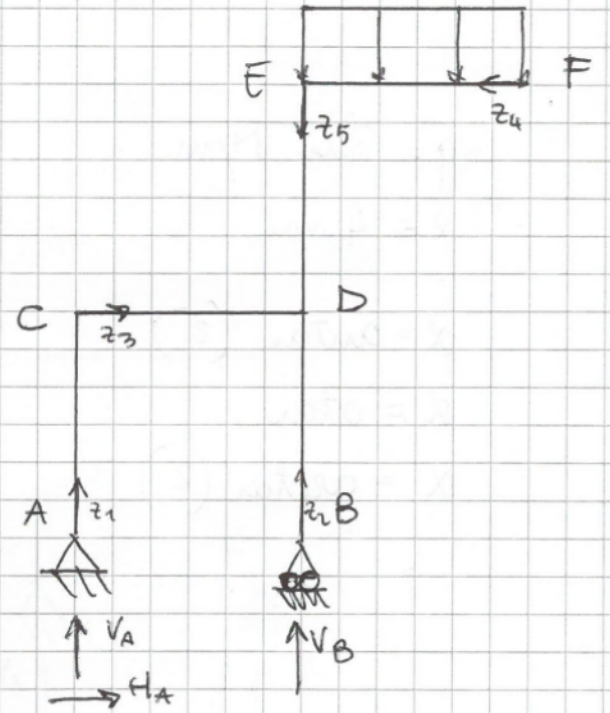
$\alpha = \arctan(2)$







SISTEMA (0)

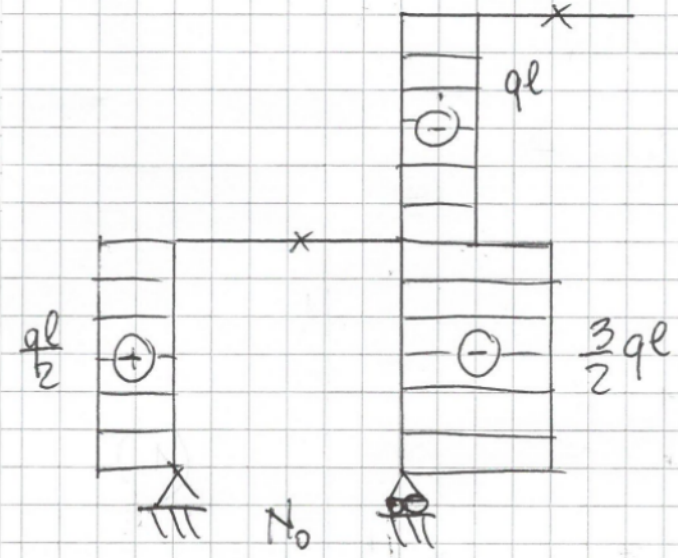


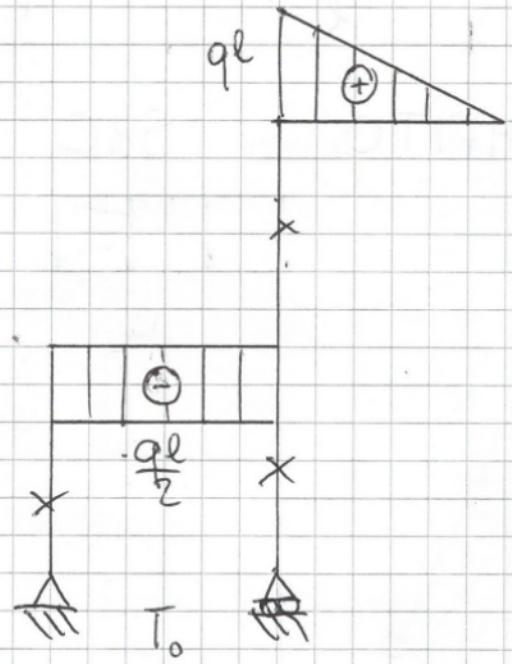
$\rightarrow) \; H_A = 0$

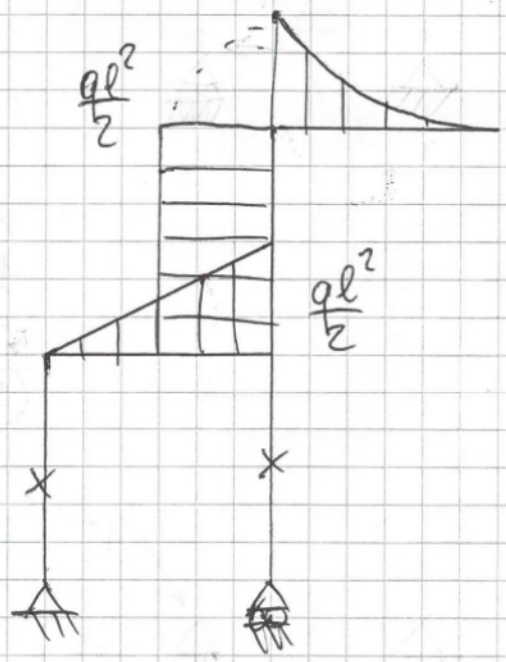
$A) \; -\frac{3ql^2}{2} + V_B \cdot l = 0$

$V_B = \frac{3}{2}ql$

$\uparrow) \; V_A = -\frac{ql}{2}$







$M_0(z_1) = 0$

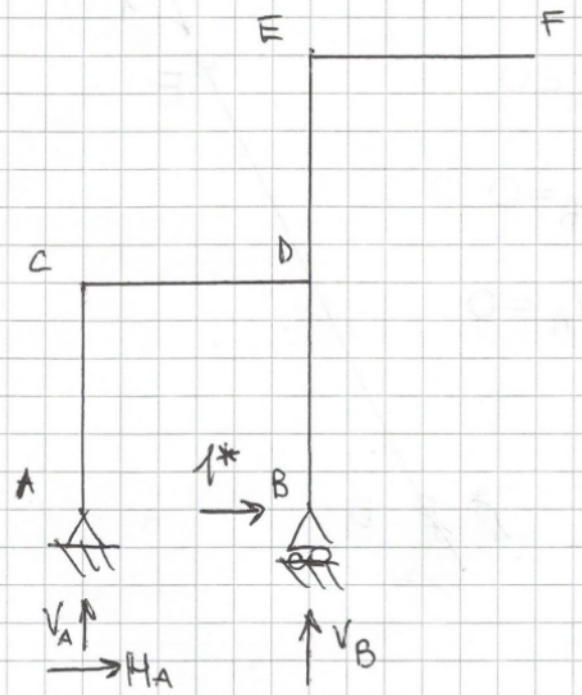
$M_0(z_2) = 0$

$M_0(z_3) = -\frac{ql}{2}z$

$M_0(z_4) = -\frac{qz^2}{2}$

$M_0(z_5) = -\frac{ql^2}{2}$

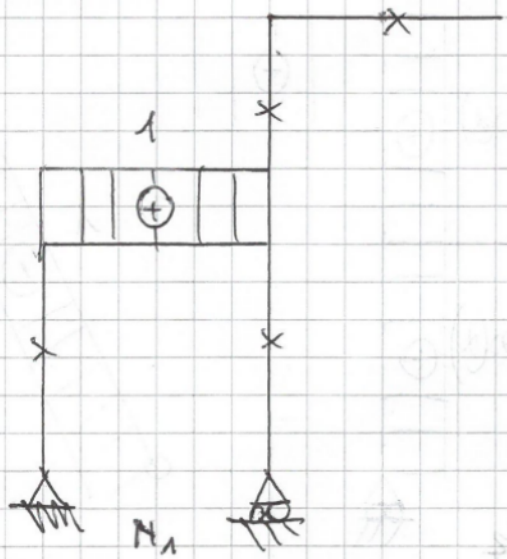
SISTEMA (1)

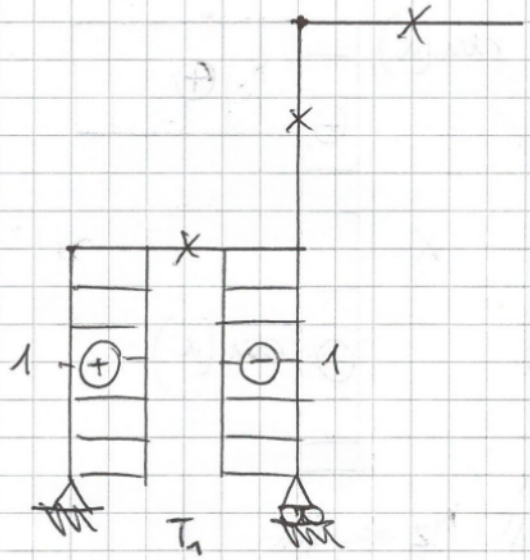


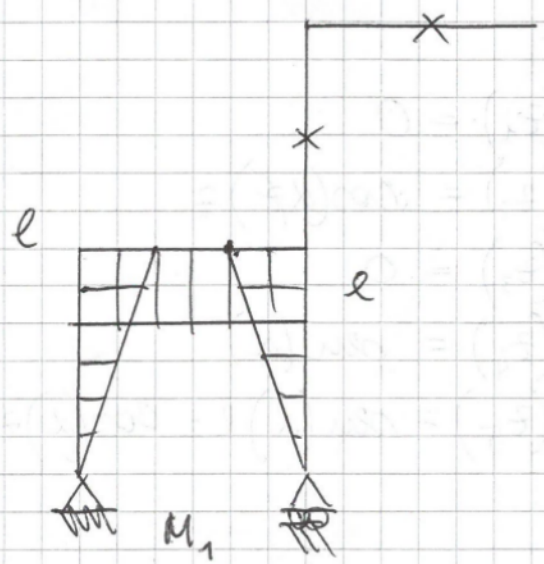
$\rightarrow) \; H_A = -1$

$A\uparrow) \; V_B = 0$

$\uparrow) \; V_A = 0$







$M_1(z_1) = z$

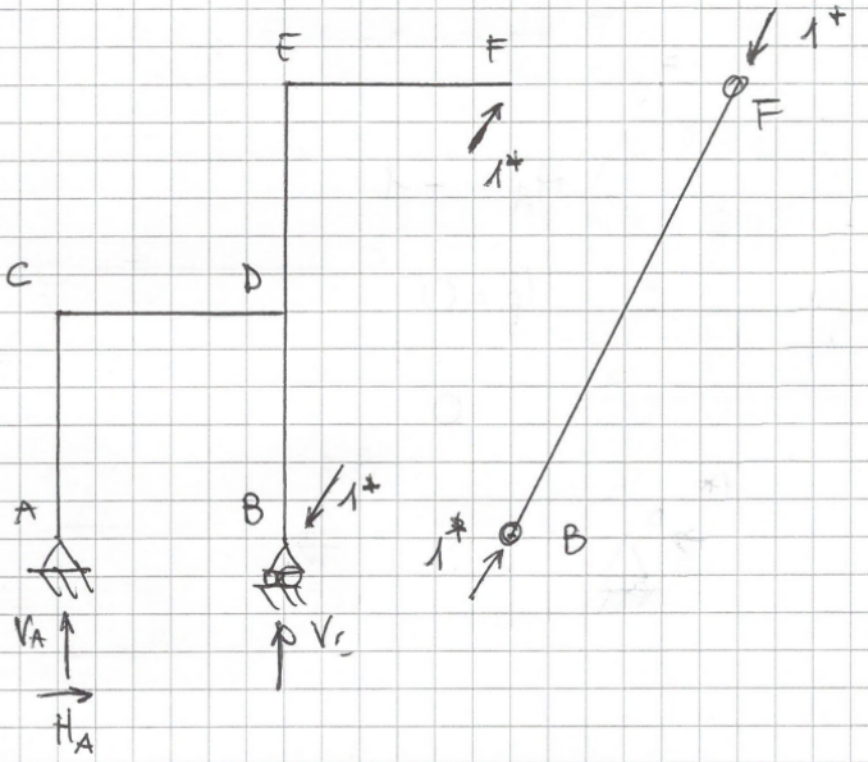
$M_1(z_2) = -z$

$M_1(z_3) = \ell$

$M_1(z_4) = 0$

$M_1(z_5) = 0$

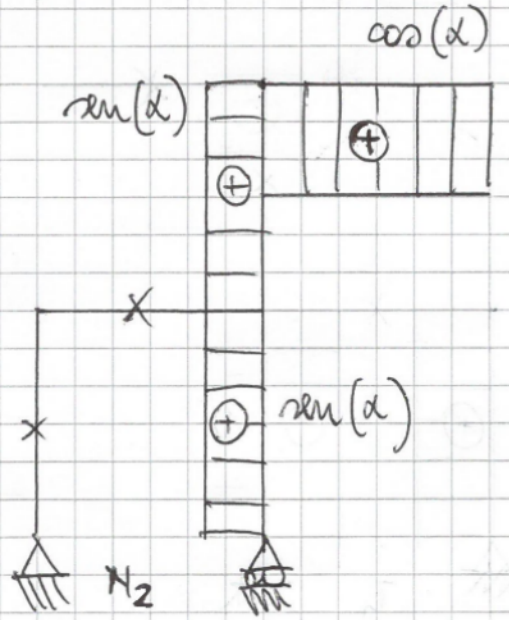
SISTEMA (2)

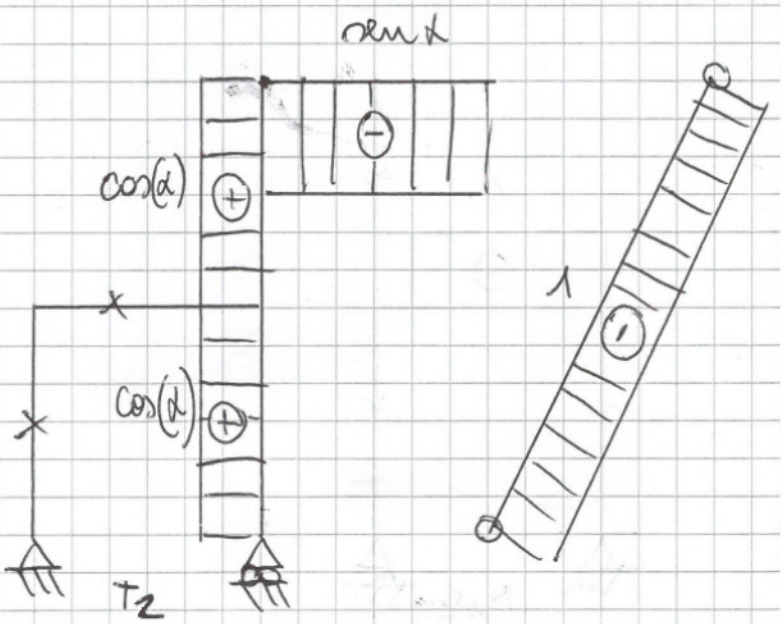


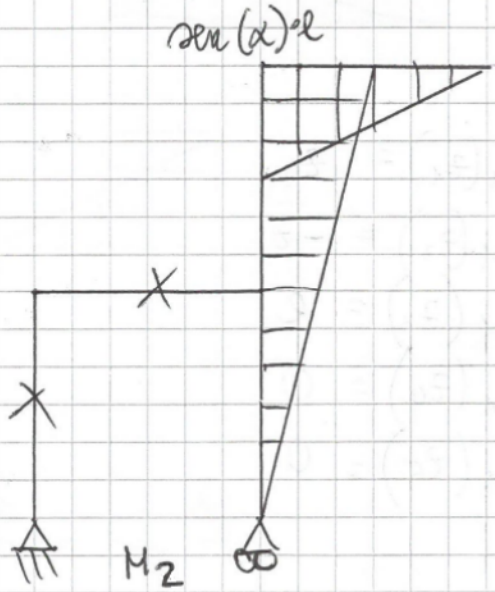
$\rightarrow) \; H_A = 0$

$A \curvearrowright \; V_B = 0$

$\uparrow) \; V_A = 0$







$M_2(z_1) = 0$

$M_2(z_2) = \cos(\alpha \hat{z})\, z$

$M_2(z_3) = 0$

$M_2(z_4) = \operatorname{sen}(\alpha)$

$M_2(z_5) = \operatorname{sen}(\alpha)\,\ell - \cos(\alpha) z$

$$\eta_{10} = \frac{1}{EJ}\int_0^{\ell}\left(-\frac{q\ell z}{2}\right)(\ell)\,dz = -\frac{q\ell^4}{4EJ}$$

$$\eta_{20} = \frac{1}{EJ}\left[\int_0^{\ell}\left(-\frac{qz^2}{12}\right)(\operatorname{sen}(\alpha))\,dz + \int_0^{\ell}\left(-\frac{q\ell^2}{2}\right)(\operatorname{sen}(\alpha)\ell - \cos(\alpha)z)\,dz\right]$$

$$= -\frac{q\ell^4\sqrt{5}}{15EJ}$$

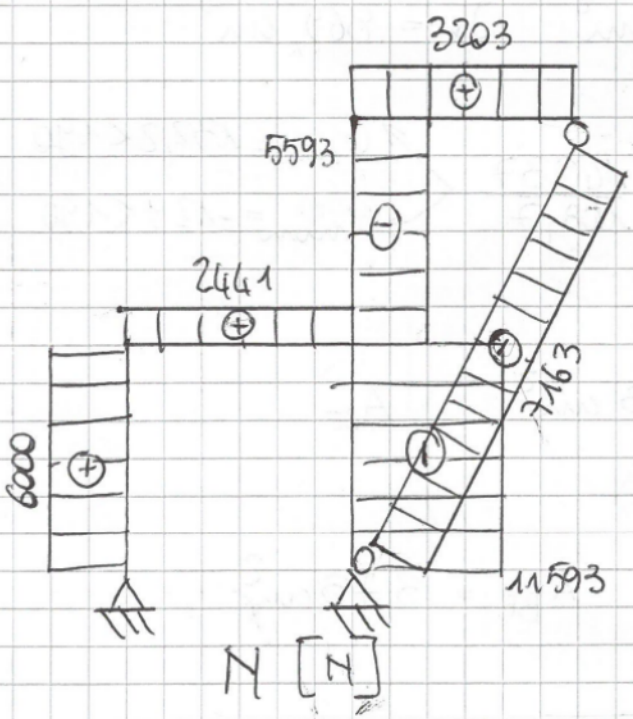
$$\eta_{11} = \frac{1}{EJ}\left[2\int_0^{\ell}(z)^2\,dz + \int_0^{\ell}\ell^2\,dz\right] = \frac{5\ell^3}{3EJ}$$

$$\eta_{22} = \frac{1}{EJ}\left[\int_0^{2\ell}(\cos(\alpha)z)^2\,dz + \int_0^{\ell}(\operatorname{sen}(\alpha)z)^2\,dz\right] = \frac{4\ell^3}{5EJ}$$

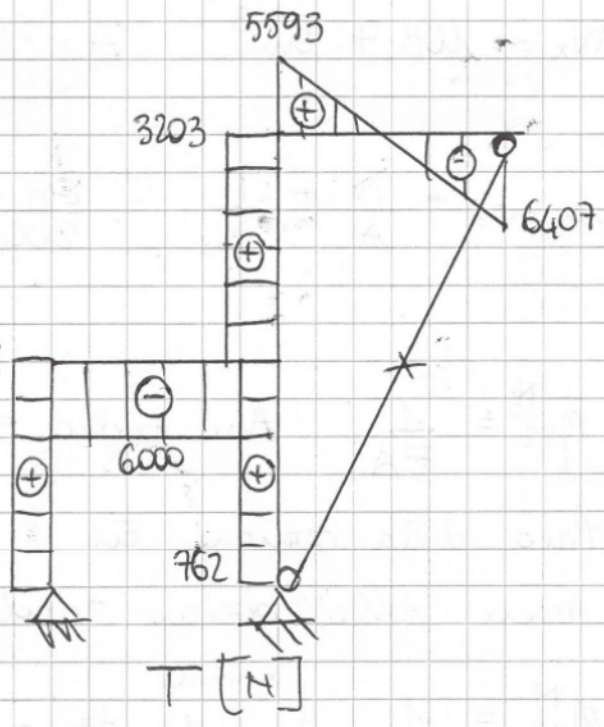
$$\eta_{12} = \frac{1}{EJ}\int_0^{\ell}(-z)(\cos(\alpha)z)\,dz = -\frac{\sqrt{5}\ell^3}{15EJ}$$

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

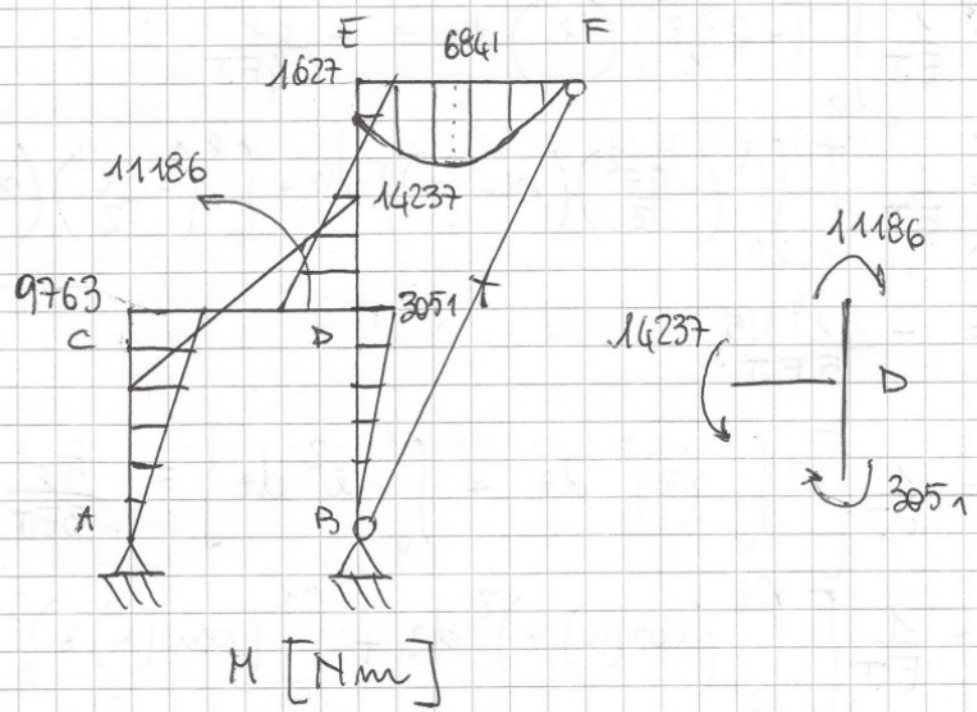
$X_1 = 2441\ N$ $\qquad$ $X_2 = 7163\ N$



N [N]



T [N]



M [Nm]

2) $M_{max} = M_{DC} = 14237\ Nm$ $\quad N_{DC} = 2441\ N$ $\quad \sigma_{am} = 190\ MPa$

SEMI PROGETTO

$$W_{min} = \frac{M}{\sigma_{am}} = \frac{14237000}{190} = 74932\ mm^3$$

ADOTTO IPE 160

$W_x = 108,7\ cm^3$ $\quad A = 20,09\ cm^2$ $\quad J_x = 869,\ cm^3$

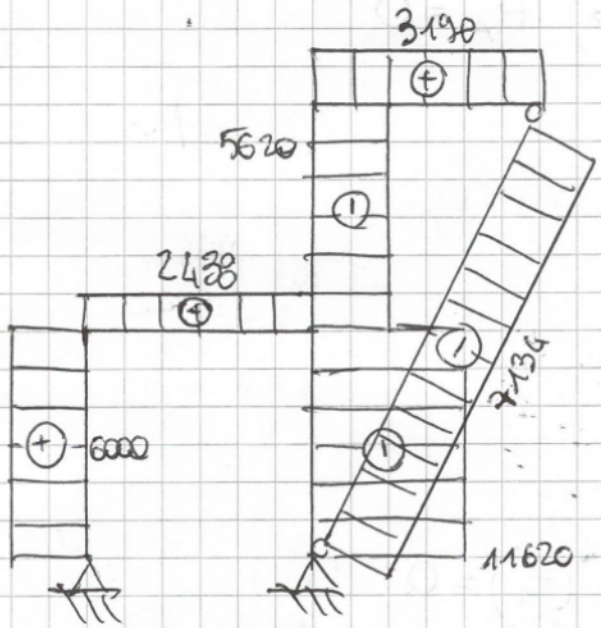
$$\sigma_{min,max} = \frac{N}{A} \pm \frac{M}{W_x} = \frac{2441}{2009} \pm \frac{14237}{108,7} \begin{cases} \sigma_{max} = 132,2 < 190 \\ \sigma_{min} = -129 < 190 \end{cases}$$

3) Area della sezione tubolare $A_{BF} = 3,73\ cm^2$

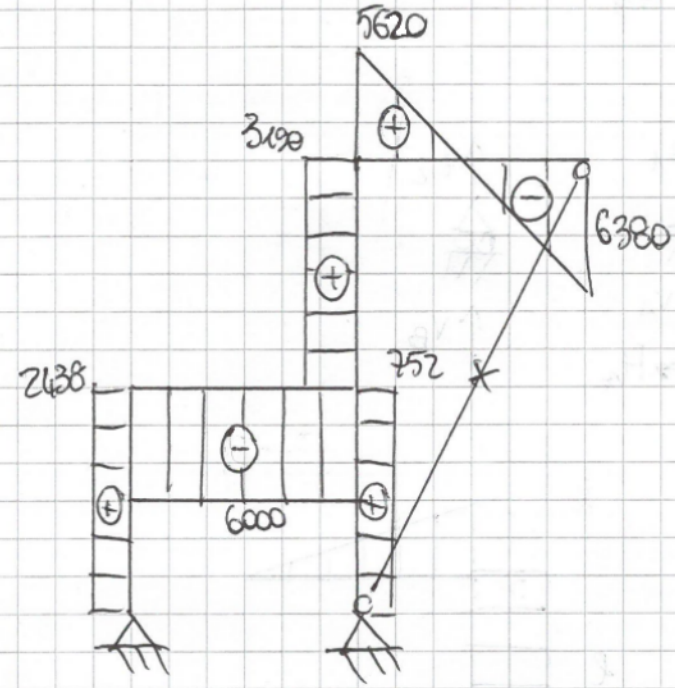
$$M_{22}^{N} = \frac{1}{E A_{BF}} \int_0^{l/\cos\alpha} 1 \, dz = \frac{l}{E A_{BF} \cos(\alpha)}$$

$$(1) \Rightarrow \quad \begin{cases} \eta_{11} \cdot X_1 + \eta_{12} \cdot X_2 = -\eta_{10} \\ \eta_{12} \cdot X_1 + \left(\eta_{22} + \eta_{22}^{N}\right) \cdot X_2 = -\eta_{20} \end{cases}$$

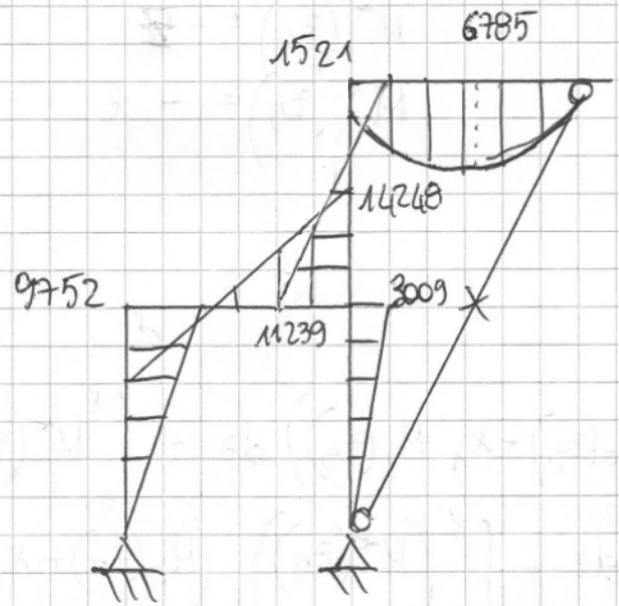
$X_1 = 2438\ N$ $\qquad$ $X_2 = 7134\ N$



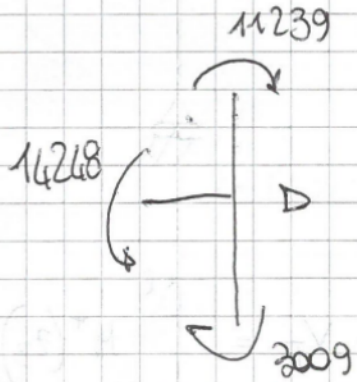
N [N]



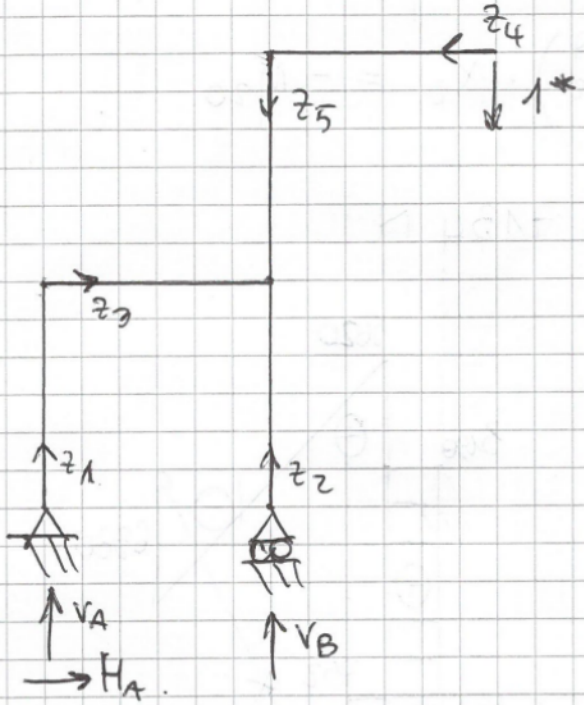
T [N]



M [Nm]



SISTEMA (3)

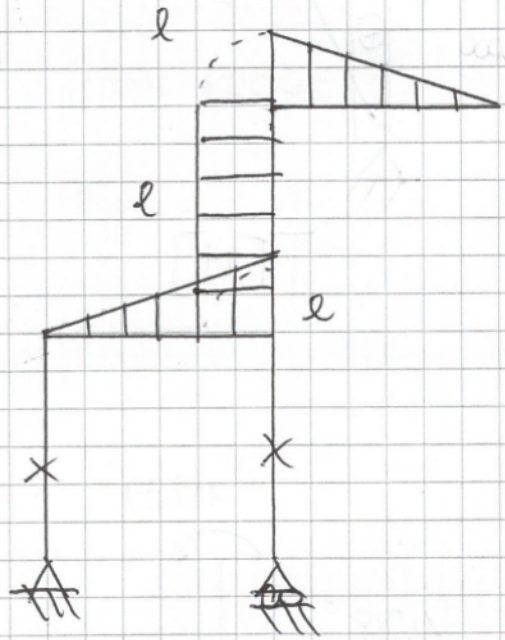


$\overrightarrow{A}$) $V_B \cdot \ell - 1 \cdot 2\ell = 0$

$V_B = 2$

↑) $V_A = -1$

→) $H_A = 0$



$M^*(z_1) = 0$

$M^*(z_2) = 0$

$M^*(z_3) = -z$

$M^*(z_4) = -z$

$M^*(z_5) = -\ell$

$$1^* \cdot V_F = \int_0^\ell M^*(z_3) \cdot \left(M_0(z_3) + X_1 M_1(z_3)\right) dz + \int_0^\ell M^*(z_4) \cdot \left(M_0(z_4) + X_2 \cdot M_2(z_4)\right) dz + \int_0^\ell M^*(z_5) \cdot \left(M_0(z_5) + X_2 M_2(z_5)\right) dz =$$

$$= 47{,}99 \text{ mm}$$