

$l = 2\text{ m}$

$h = 3\text{ m}$

$q = 60\text{ kN/m}$

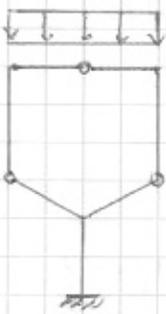
$\alpha = \arctan\left(\frac{2l}{h}\right) = 26.6^\circ$

$H_A = 0$

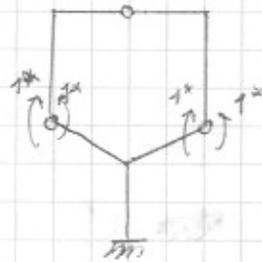
$M_A = 0$

$V_A = 2ql = 80\text{ kN}$

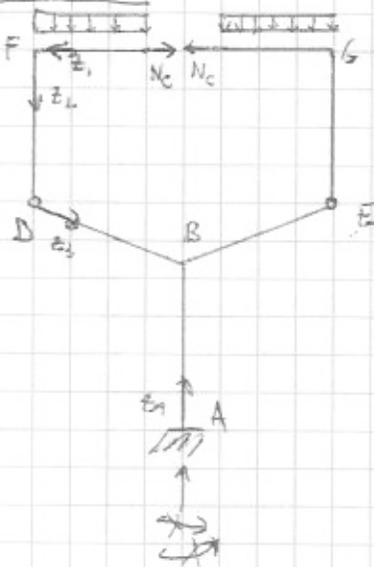
Sistema 0



Sistema 1



SISTEMA 0



$H_A = 0$

$M_A = 0$

$V_A = 2ql = 80\text{ kN}$

Aperto in  $\mathcal{E} =$

$T_C = 0$  per simmetria

$\curvearrowright -q \frac{l}{2} l - N_F l = 0$

$N_F = -q \frac{l}{2} l \cdot \frac{1}{l} = -13.3\text{ kN}$

Tratto CF

$N(z_1) = -13.3\text{ kN}$

$V(z_1) = +qz$

$M(z_1) = -q \frac{z^2}{2}$

Tratto BB

$N(z_3) = -40\text{ mm} + 13.3\text{ cm} \alpha$

$T(z_3) = -40\text{ cm} \alpha - 13.3\text{ mm} \alpha$

$M(z_3) = 40\text{ cm} \alpha z + 13.3\text{ mm} \alpha z$

Tratto FD

$N(z_2) = -ql = -40\text{ kN}$

$T(z_2) = -13.3\text{ kN}$

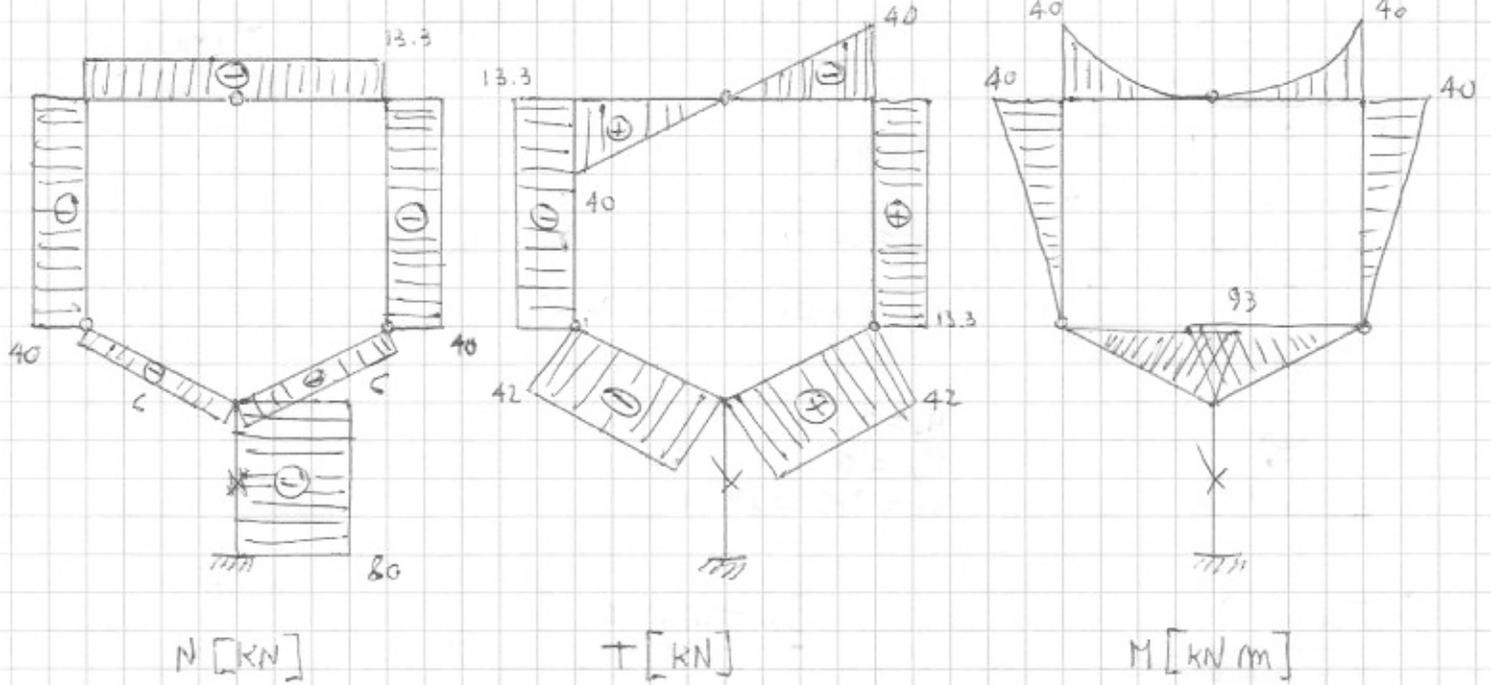
$M(z_2) = -40 + 13.3 z_2$

Tratto AB

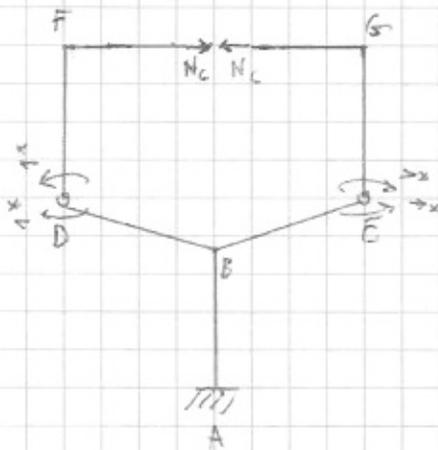
$N(z_4) = -80\text{ kN}$

$T(z_4) = 0$

$M(z_4) = 0$



### SISTEMA 1



$T_c = 0$  per simmetria

~~CF~~  $1^x - N_c h = 0 \rightarrow N_c = \frac{1}{h} = 0.33$

T tratto CF

$N(z_1) = 1/h = 0.33 \text{ kN}$

$T(z_1) = 0$

$M(z_1) = 0$

T tratto FD

$N(z_2) = 0$

$T(z_2) = 0.33 \text{ kN}$

$M(z_2) = -0.33 z$

T tratto DB

$N(z_3) = -\frac{1}{h} \cos \alpha = -0.30$

$T(z_3) = +\frac{1}{h} \sin \alpha = 0.15$

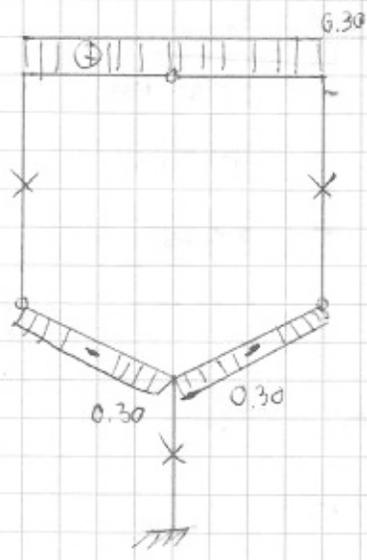
$M(z_3) = -1 - \frac{1}{h} \sin \alpha z$

T tratto AB

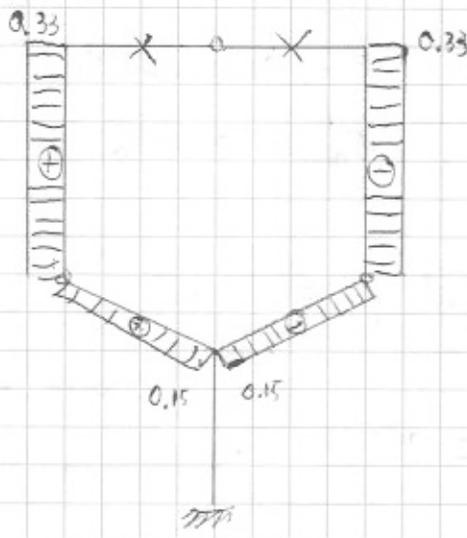
$N(z_4) = 0$

$T(z_4) = 0$

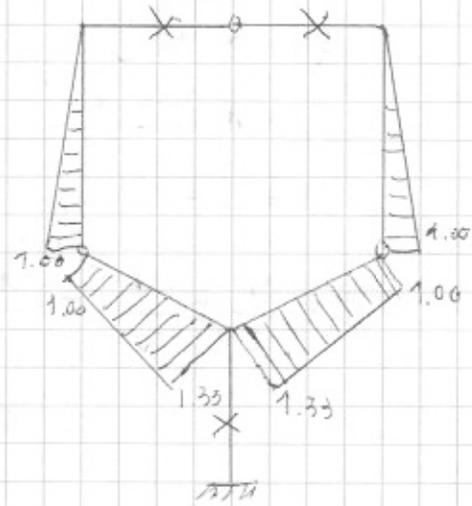
$M(z_4) = 0$



N [kN]



T [kN]



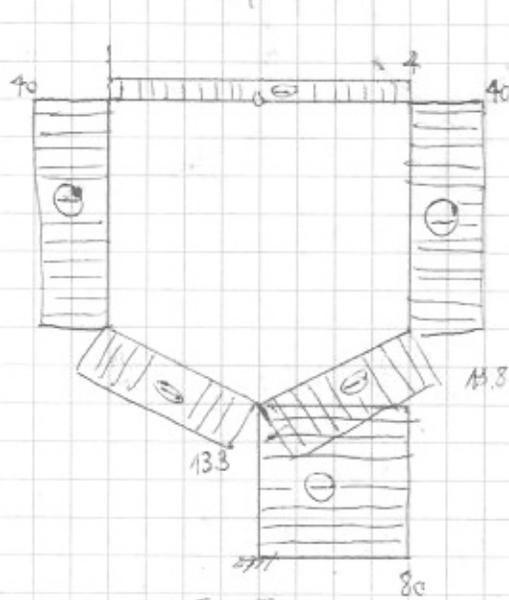
M [kN/m]

$$L^* = \sqrt{5}$$

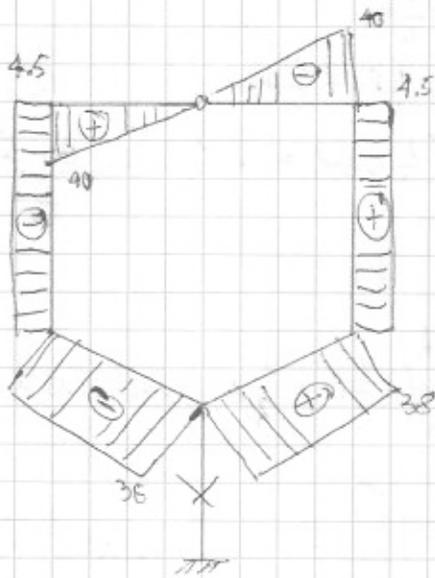
$$h_{10} = \frac{2}{EJ} \left[ \int_0^h \left(-\frac{1}{2}z\right) (-40 + 13.3z) dz + \int_0^{L^*} \left(-1 - \frac{1}{h} \sin \alpha z\right) (40 \cos \alpha z + 13.3 \sin \alpha z) dz \right] = -\frac{215.2}{EJ}$$

$$h_{11} = \frac{2}{EJ} \left[ \int_0^h \left(-\frac{1}{2}z\right)^2 dz + \int_0^{L^*} \left(-1 - \frac{1}{h} \sin \alpha z\right)^2 dz \right] = \frac{8.4}{EJ}$$

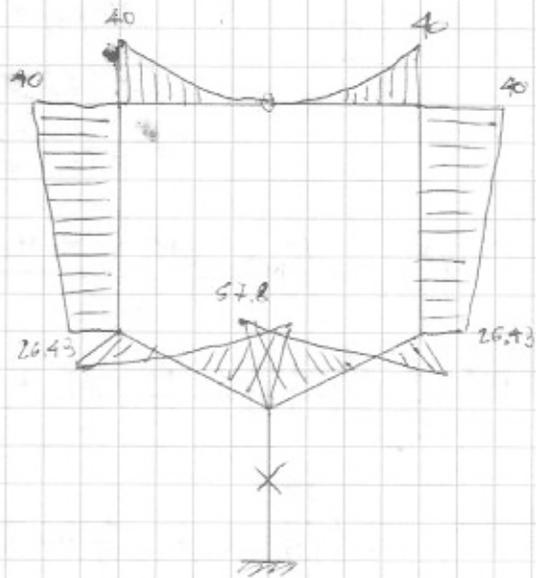
$$X_1 = -\frac{h_{10}}{h_{11}} = 26.43$$



N [kN]



T [kN]



M [kN·m]

2) IPE 180

$$A = 23.95 \text{ cm}^2$$

$$J_y = 1317 \text{ cm}^4$$

$$W = 146.3 \text{ cm}^3$$

$$E = 210.000 \text{ MPa}$$

$$\sigma_{amm} = 220 \text{ MPa}$$

Solentomom

$$M = 57.8 \text{ KNm}$$

$$N = 13.8 \text{ KN}$$

$$T = 38 \text{ KN}$$

$$\sigma_z = \frac{N}{A} \pm \frac{M}{W} = \frac{13.8 \cdot 10^3}{23.95} \pm \frac{57.8 \cdot 10^3}{146.3}$$

$$= 5.76 \pm 395.08$$

$400.76 \text{ MPa} > \sigma_{amm}$   
 $-389.24 < \sigma_{amm}$

Adatto profilo IPE 240

$$\sigma_z = \frac{N}{A} \pm \frac{M}{W} = \frac{13.8 \cdot 10^3}{3912} \pm \frac{57.8 \cdot 10^3}{324.3}$$

$$= 3.52 \pm 176$$

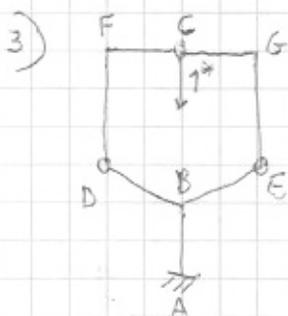
$181 \text{ MPa} < \sigma_{amm}$   
 $-174.48 < \sigma_{amm}$

IPE 240

$$A = 39.12 \text{ cm}^2$$

$$J_y = 3892 \text{ cm}^4$$

$$W = 324.3 \text{ cm}^3$$



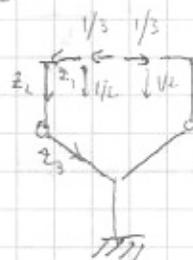
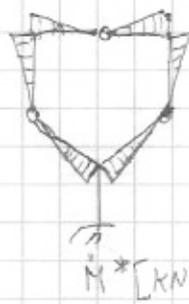
$T_C = 0$  per simmetria

$$D) -\frac{1}{6} l - N_c h = 0 \quad N_c = \frac{1}{2} \frac{l}{h} = -\frac{1}{3}$$

$$M(z_1) = -\frac{1}{2} z_1$$

$$M(z_2) = -\frac{1}{2} l + \frac{1}{3} z_2$$

$$M(z_3) = \frac{1}{2} \cos \alpha z + \frac{1}{3} \sin \alpha z$$



$$1^* \delta_c = \int (M^* \cdot \frac{(M_0 + X_1 M_1)}{EJ}) dz$$

$$1\delta^* = \frac{1}{EJ} \left[ \int_0^l \left(-\frac{1}{2} z\right) \left(-\frac{1}{2} z\right) dz + \int_0^h \left(-\frac{1}{2} l + \frac{1}{3} z\right) \left(-40 + 13.3 z + X_1 \left(-\frac{1}{h} z\right)\right) dz + \right.$$

$$\left. + \int_0^{l^*} \left(\frac{1}{2} \cos \alpha z + \frac{1}{3} \sin \alpha z\right) \left[ \left(40 \cos \alpha z + 13.3 \sin \alpha z\right) + X_1 \left(-1 - \frac{1}{h} \sin \alpha z\right) \right] dz \right]$$

$$= 0.0287 \text{ m}$$