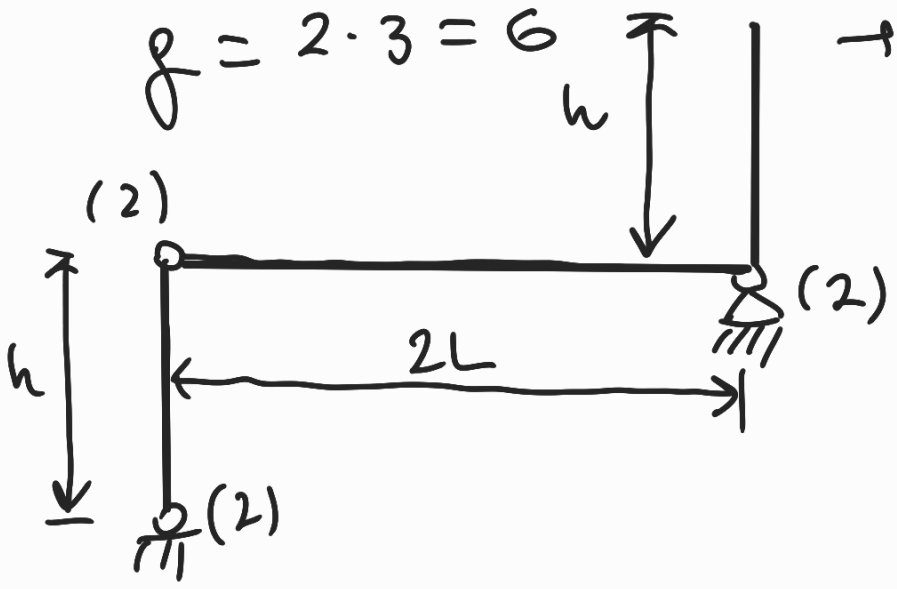
1) • Verifica se la struttura è isostatica

$n_{aste} = 2$ $\quad$ $v = 2+2+2 = 6$

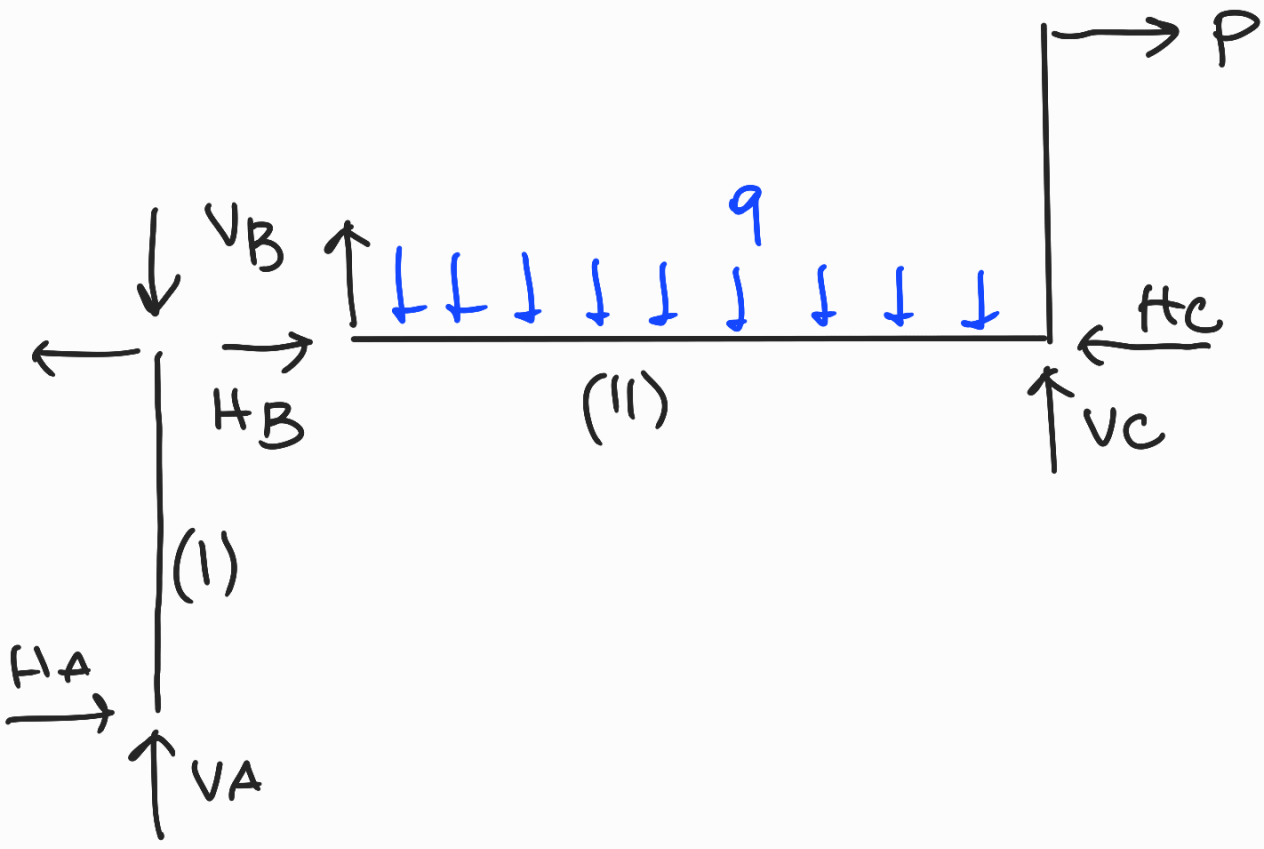
$g = 2 \cdot 3 = 6$ $\quad$ → isostatica



$L = 4\,m$

$h = 3\,m$

• Calcolo delle reazioni vincolari



Equilibri delle aste:

I
$\rightarrow^{+}$ $H_A - H_B = 0$ $\quad H_B = 0\ N$

$\uparrow$ $V_A - V_B = 0$ $\quad H_A = 0\ N$

$\curvearrowright_A$: $H_B \cdot h = 0$

II
$\rightarrow^{+}$ ~~H_B~~ $- H_C + P = 0$ $\quad H_C = P = 10'000\ N$

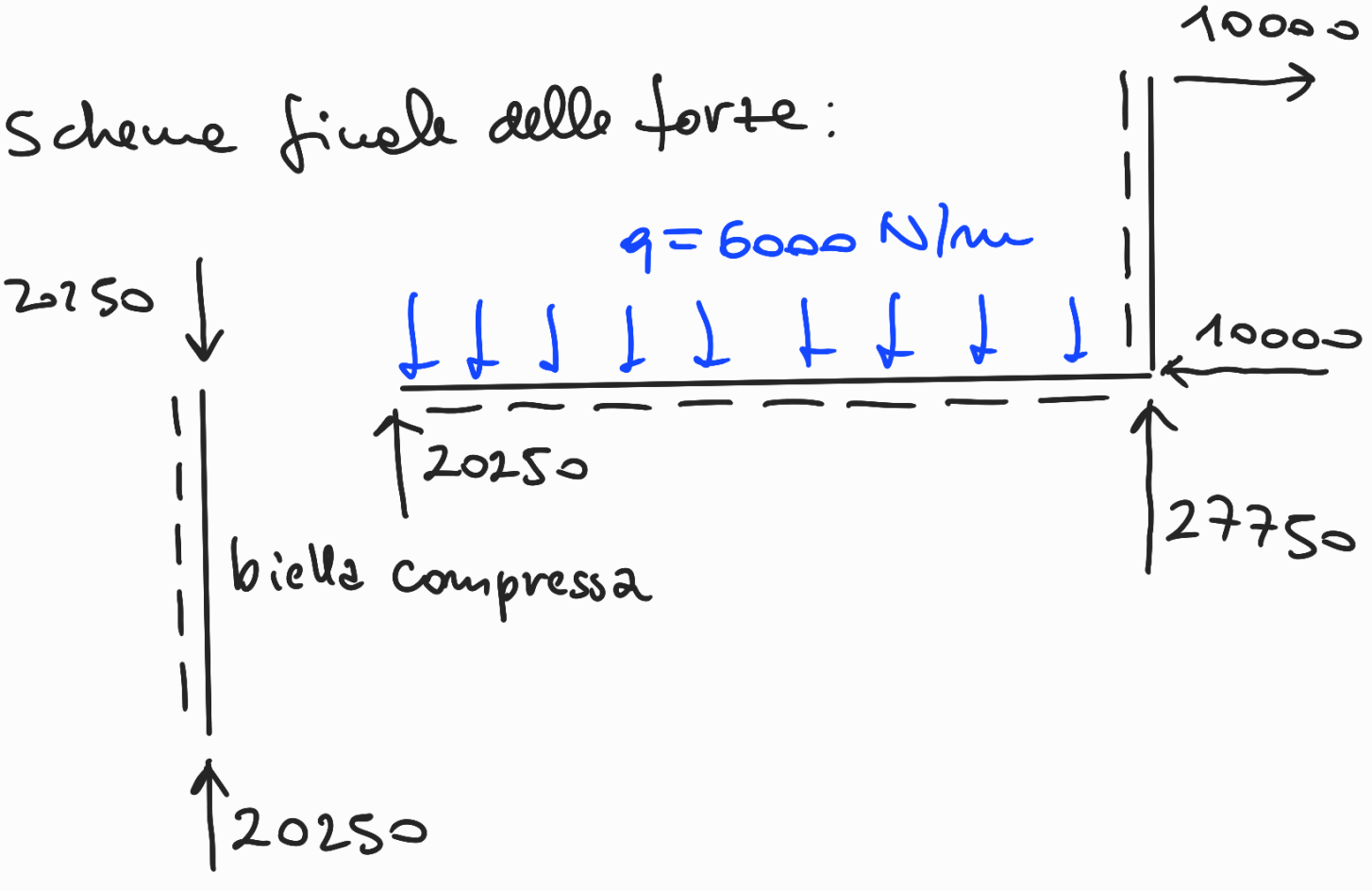
$\uparrow$ $V_B - 2qL + V_C = 0$

$\curvearrowright_B$: $2qL \cdot L - V_C \cdot 2L + Ph = 0$ $\quad V_C = qL + \frac{Ph}{2L} = 27750\ N$

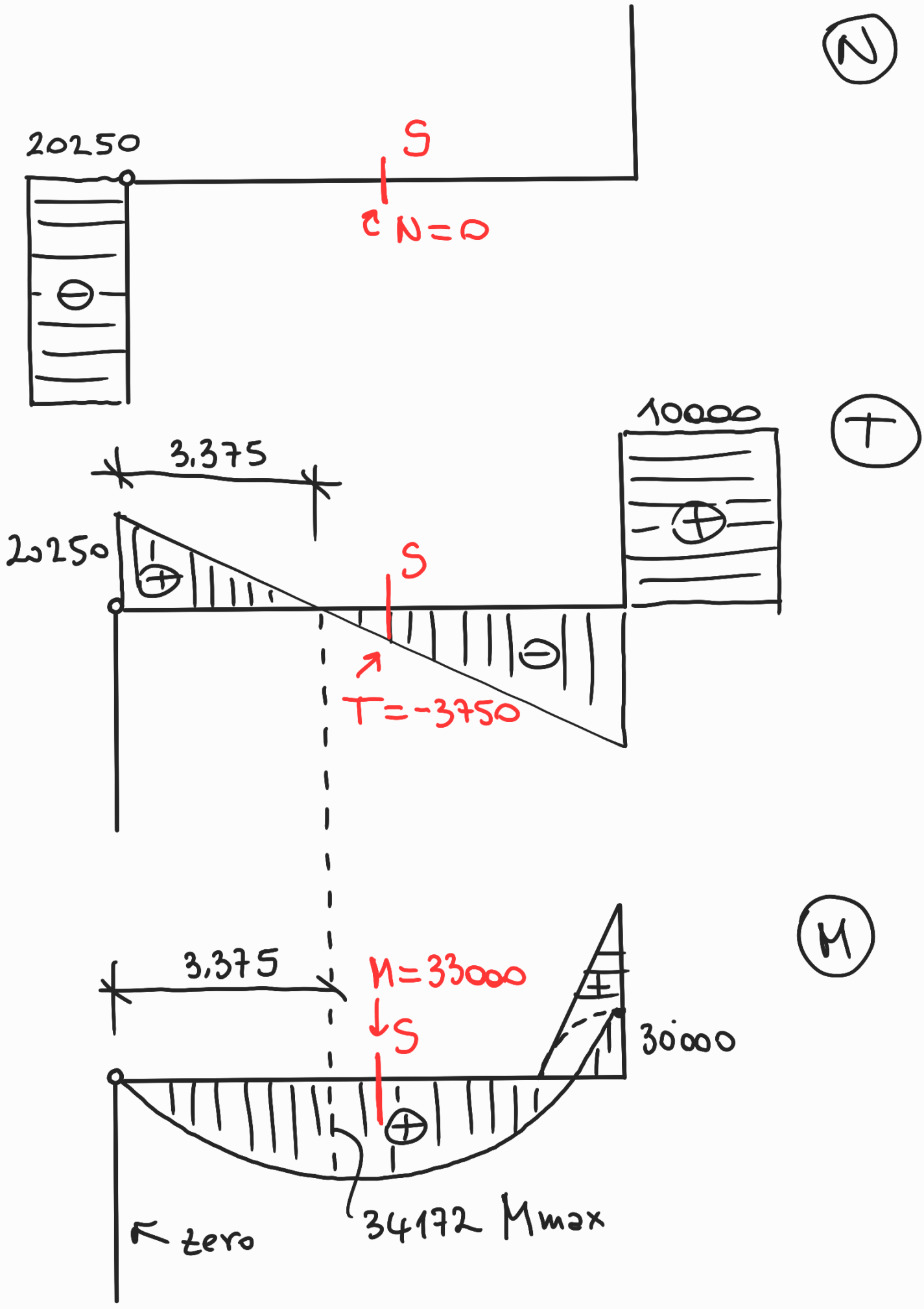
$V_B = 2qL - V_C = 20250\ N$

$V_A = V_B = 20250\ N$

Schema finale delle forze:

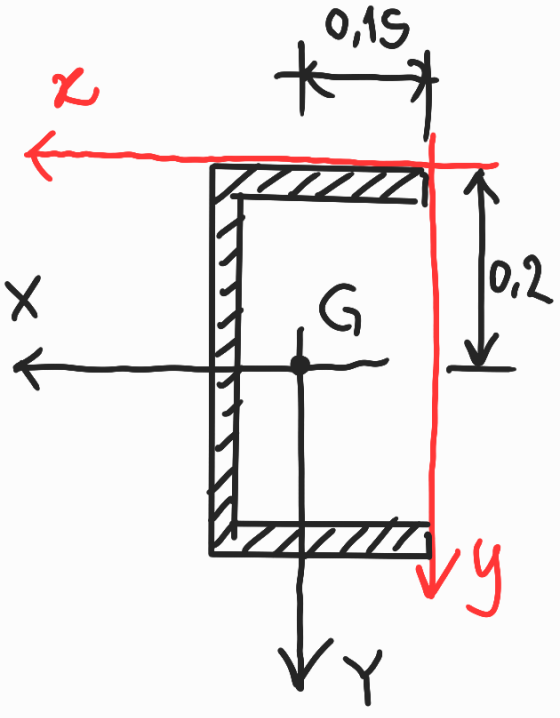


• Diagrammi delle azioni interne



2)

- Caratteristiche geometriche della sezione



$x_G = 0{,}10\ m$

$y_G = \frac{S_x}{A} = 0{,}2\ m$

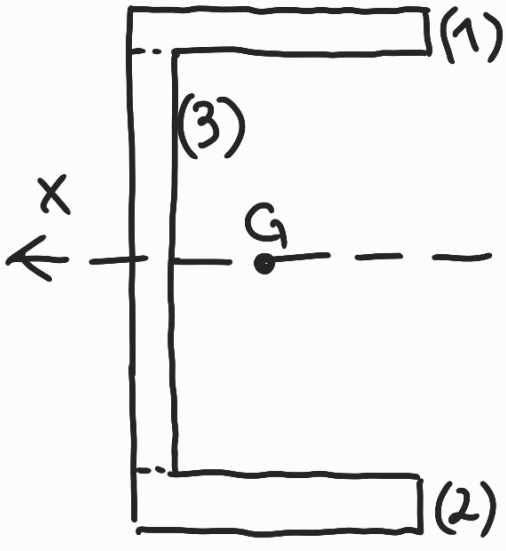
$A = 2 \cdot 0{,}2 \cdot 0{,}01 + 2 \cdot 0{,}2 \cdot 0{,}01 = 0{,}008\ m^2$

$S_x = 0{,}2 \cdot 0{,}01 \cdot \frac{0{,}01}{2} + 0{,}4 \cdot 0{,}01 \cdot 0{,}2 + 0{,}2 \cdot 0{,}01 \cdot 0{,}1 = 0{,}0016\ m^3$

$x_G = \frac{S_y}{A} = 0{,}15\ m$

$S_y = 2 \cdot 0{,}2 \cdot 0{,}01 \cdot 0{,}1 + 0{,}4 \cdot 0{,}01 \cdot 0{,}2 = 0{,}0012\ m^3$

Momento d'inerzia I_X:



trascurabile

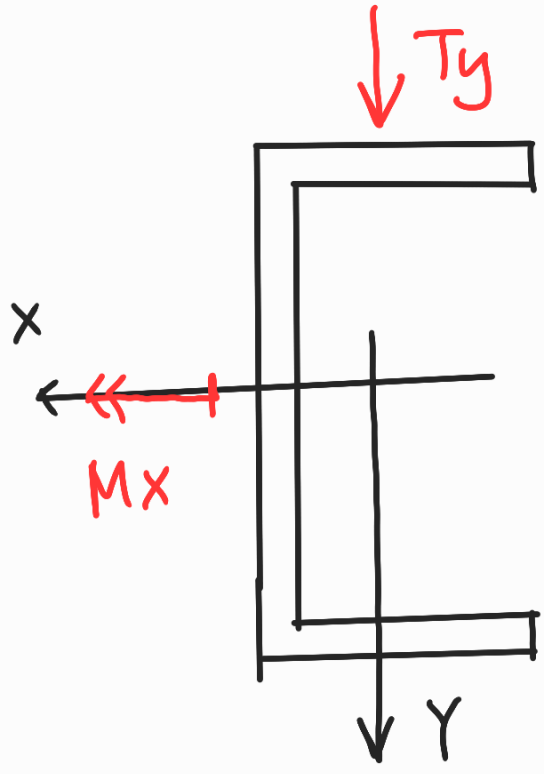
$I_x^{(1)} = I_x^{(2)} = \frac{0{,}2 \cdot 0{,}01^3}{12} + 0{,}2 \cdot 0{,}01 \cdot 0{,}2^2 \simeq 0{,}00008\ m^4$

$I_x^{(3)} = \frac{0{,}01 \cdot 0{,}4^3}{12} = 0{,}000053\ m^4$

$= I_x^{(1)} + I_x^{(2)} + I_x^{(3)}$

$I_x = 2.13 \cdot 10^{-4}\ m^4$

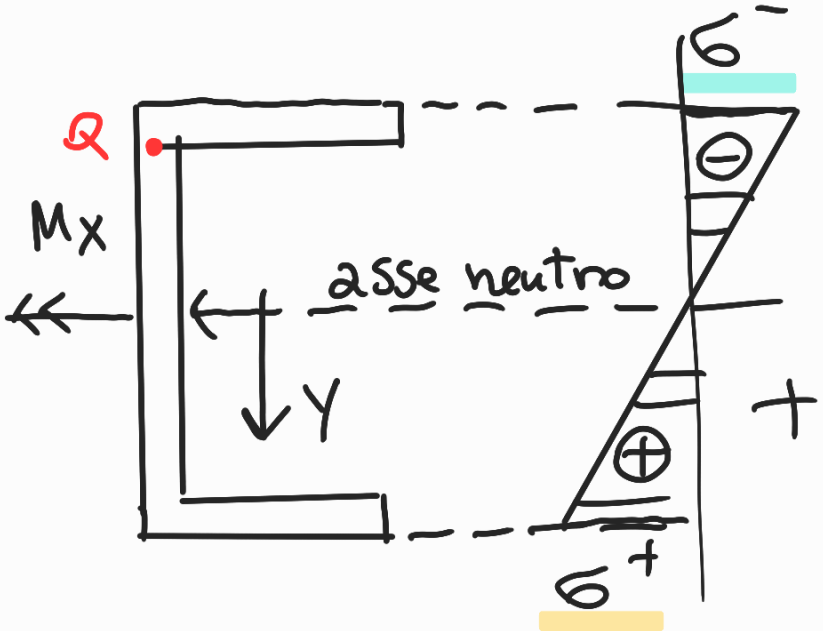
• Calcolo delle tensioni nella sez. S



$T_y = 3750\ N$

$M_x = 33000\ N \cdot m$

- Flessione retta:



$$\sigma_z = \frac{M}{I_x} \cdot (-0,2) =$$

$$= \frac{33000}{2.13 \cdot 10^{-4}} \cdot (-0,2) =$$

$$= -30,9\ MPa$$

$$\sigma_z^+ = \frac{M}{I_x} (0,2) = 30,9\ MPa$$

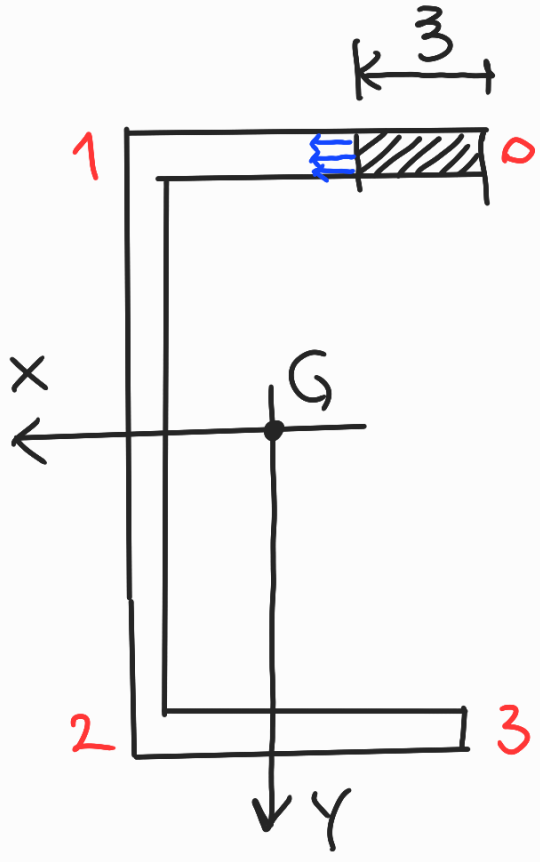
$$\sigma_z(Q) \cong -30,9\ MPa$$

- taglio (formula di Jourawski)

$$\tau_{zs}(s) = -\frac{T_y \cdot S_x^*}{I_x \cdot b}$$

Tratto 0-1

$$\tau_{zx}(\zeta) = -\frac{T_y \cdot S_x^*(\zeta)}{I_x \cdot t}$$



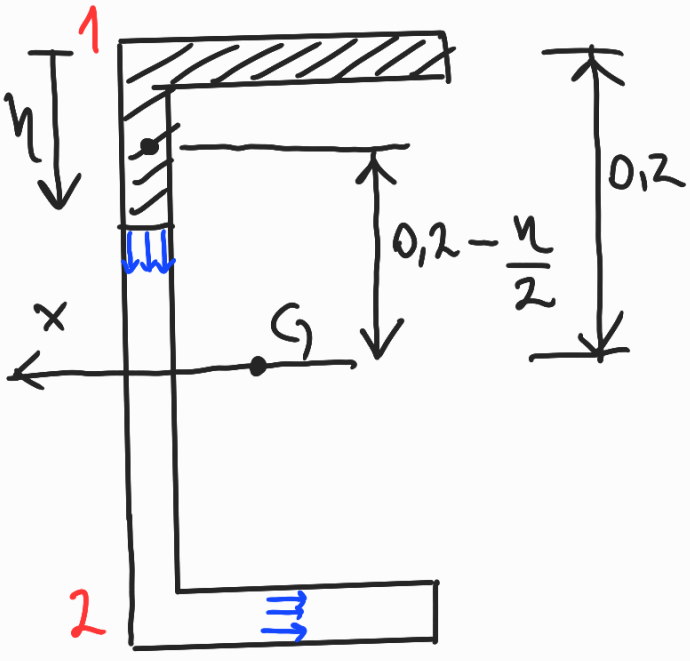
$$S_x^* = -\zeta \cdot 0{,}01 \cdot 0{,}2$$

$$= -0{,}002\,\zeta \ m^3$$

$$\tau_{zx}(\zeta) = \frac{+3750 \cdot 0{,}002\,\zeta}{2.13 \cdot 10^{-4} \cdot 0{,}01}$$

$\tau_{zx}(\zeta = 0{,}2) = 7{,}04 \cdot 10^5$ Pa uscenti dall'area

Tratto 1-2



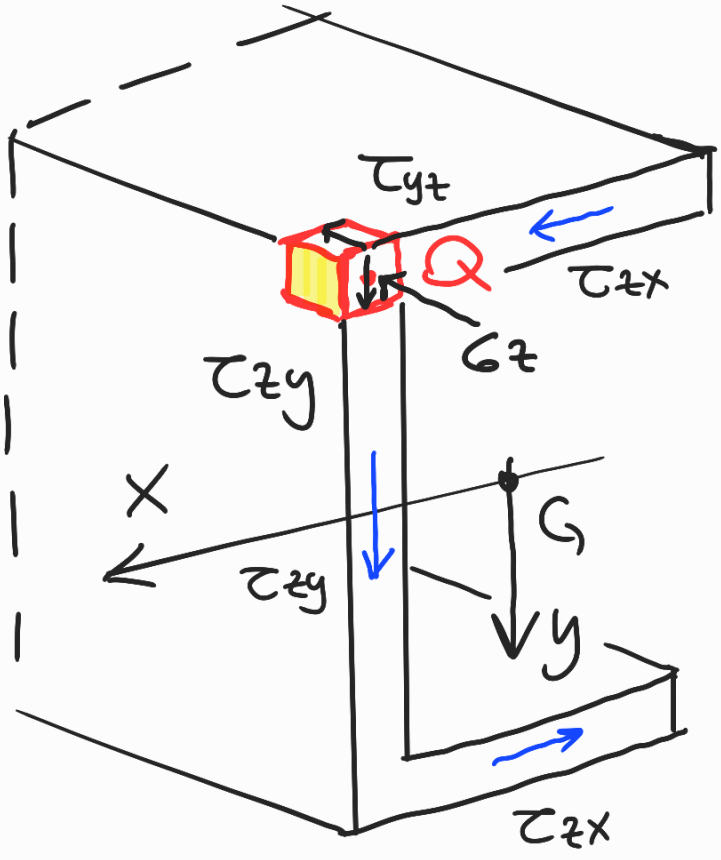
$$S_x^*(\eta) = -0{,}2 \cdot 0{,}01 \cdot 0{,}2 - \eta \cdot 0{,}01 \cdot \left(0{,}2 - \frac{\eta}{2}\right)$$

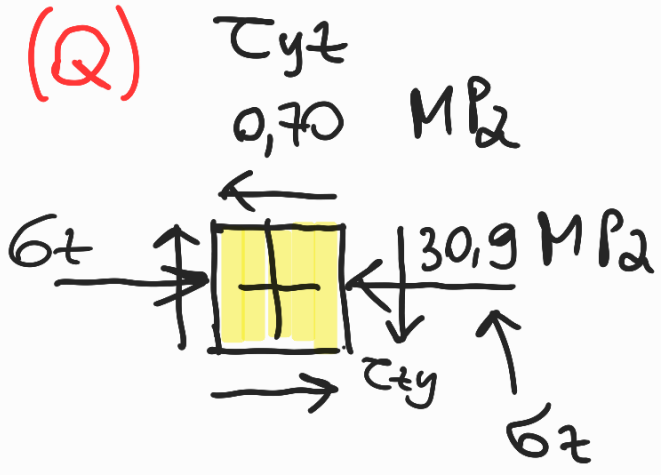
$$= -0{,}0004 - 0{,}002\eta + 0{,}005\eta^2$$

$$\tau_{zy}(\eta=0{,}2) = \frac{3750 \cdot 0{,}0006}{2.13 \cdot 10^{-4} \cdot 0{,}01} = 1{,}06 \cdot 10^{6}\ Pa$$

$$\tau_{zy}(\eta=0) = \frac{3750 \cdot 0{,}0004}{2.13 \cdot 10^{-4} \cdot 0{,}01} = 7{,}04 \cdot 10^{5}\ Pa$$

- Verifica di resistenza nel punto Q della sez S e cerchio di Mohr

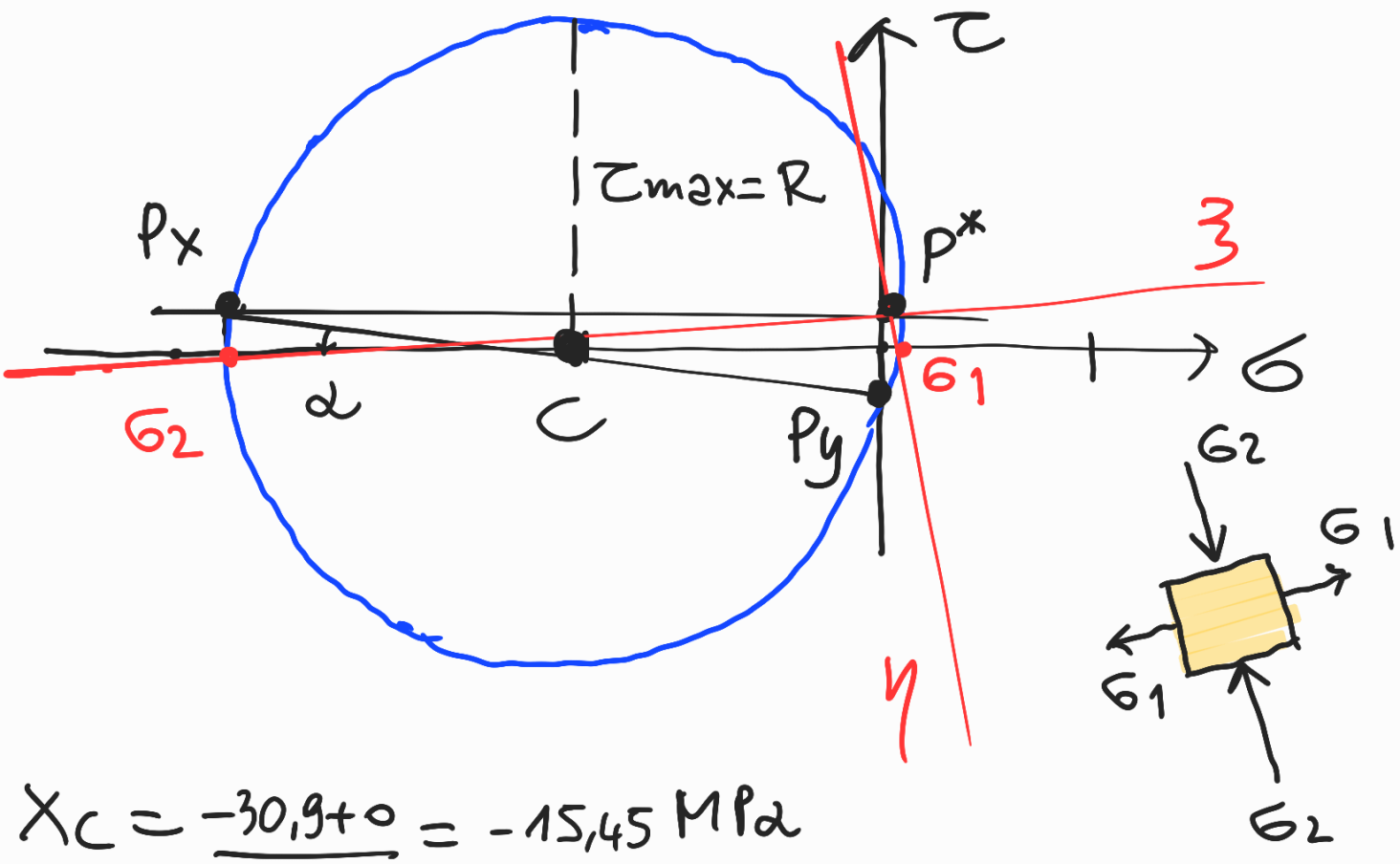




$$P_x = (-30{,}9\ ;\ 0{,}70)$$

$$P_y = (0\ ;\ -0{,}70)$$

Cerchio di Mohr nel punto Q



$$X_C = \frac{-30,9+0}{2} = -15,45 \text{ MPa}$$

$$R = \sqrt{15,45^2 + 0,7^2} = 15,46 \text{ MPa}$$

$\sigma_1 = X_C + R = 0,01$ MPa

$\sigma_2 = X_C - R = -30,92$ MPa

tensione amm.

$\sigma_{amm} = 50$ MPa

Criterio di Tresca :

$$\tau_{max} = R = 15,46 \leq \frac{\sigma_{amm}}{2} = 25 \text{ MPa}$$

verificato

Direzioni principali di tensione :

$$\alpha = \frac{1}{2}\,\text{arctg}\,\frac{2\tau_{zy}}{\sigma_x - \sigma_y} = +1{,}30°$$

antiorario