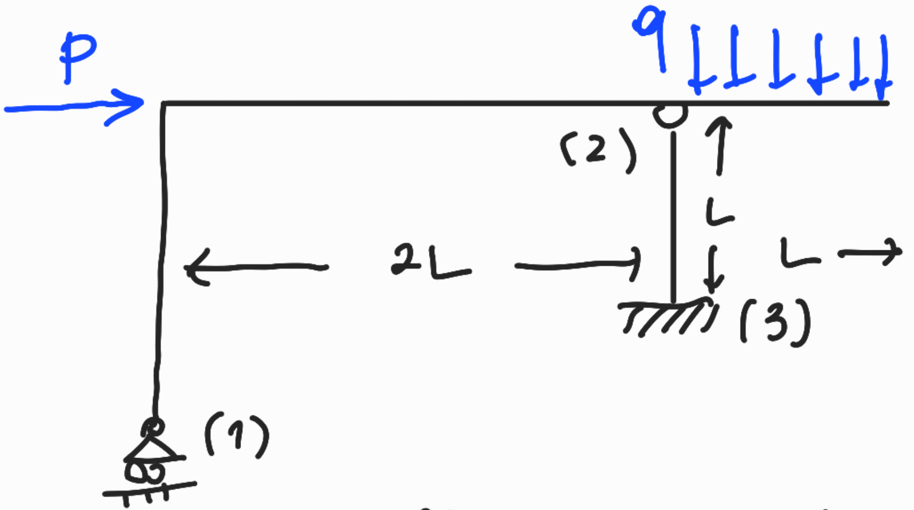
Soluz. Compito Fondam. di Scienza delle Costruz. 13.6.2022

1) • Verifica se la struttura è isostatica

$n_{aste} = 2$ $v = 3+2+1 = 6$

$g = 2 \cdot 3 = 6$ $\rightarrow$ isostatica

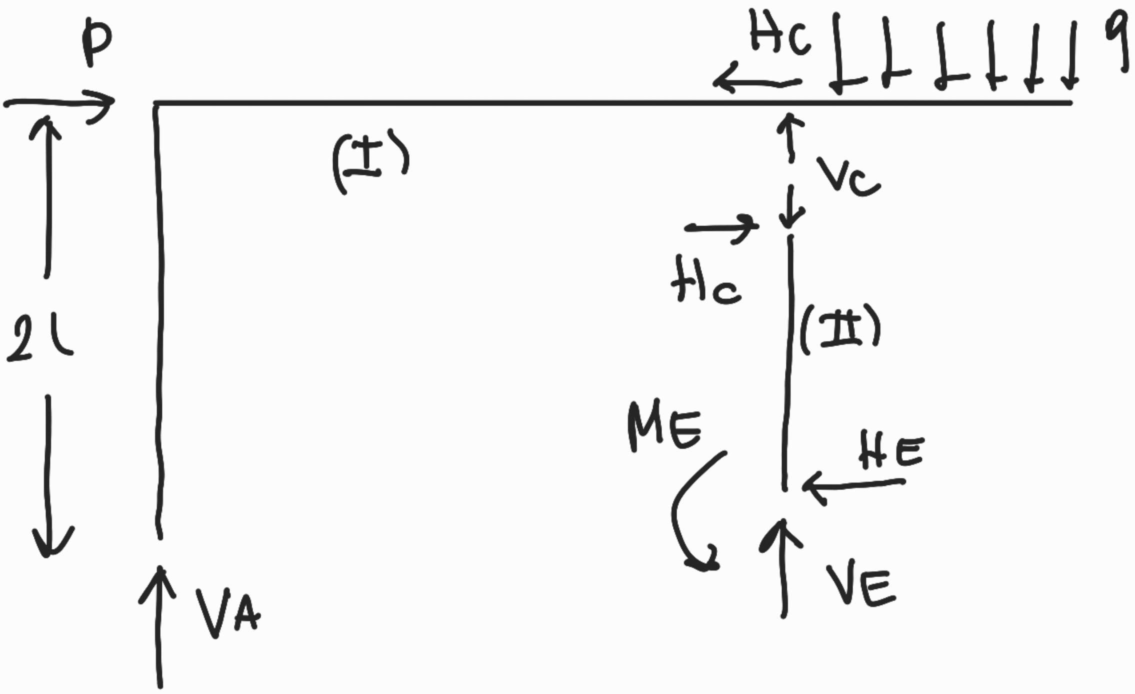


$L = 4\,m$

$P = 20000\,N$

$q = 8000\,N/m$

• Calcolo delle reazioni vincolari



Equilibri delle aste:

$$\text{I}\begin{cases} \xrightarrow{+} & P - H_C = 0 \\ \uparrow & V_A + V_C - qL = 0 \\ \underset{A}{\curvearrowright}: & P \cdot 2L - H_C \cdot 2L + qL\frac{5}{2}L - V_C \cdot 2L = 0 \end{cases}$$

$H_C = P = 20'000\ N$

$$\text{II}\begin{cases} \xrightarrow{+} & H_C - H_E = 0 \\ \uparrow & V_E - V_C = 0 \\ \underset{E}{\curvearrowright}: & -M_E + H_C \cdot L = 0 \end{cases}$$

$H_E = 20\,000\ N$

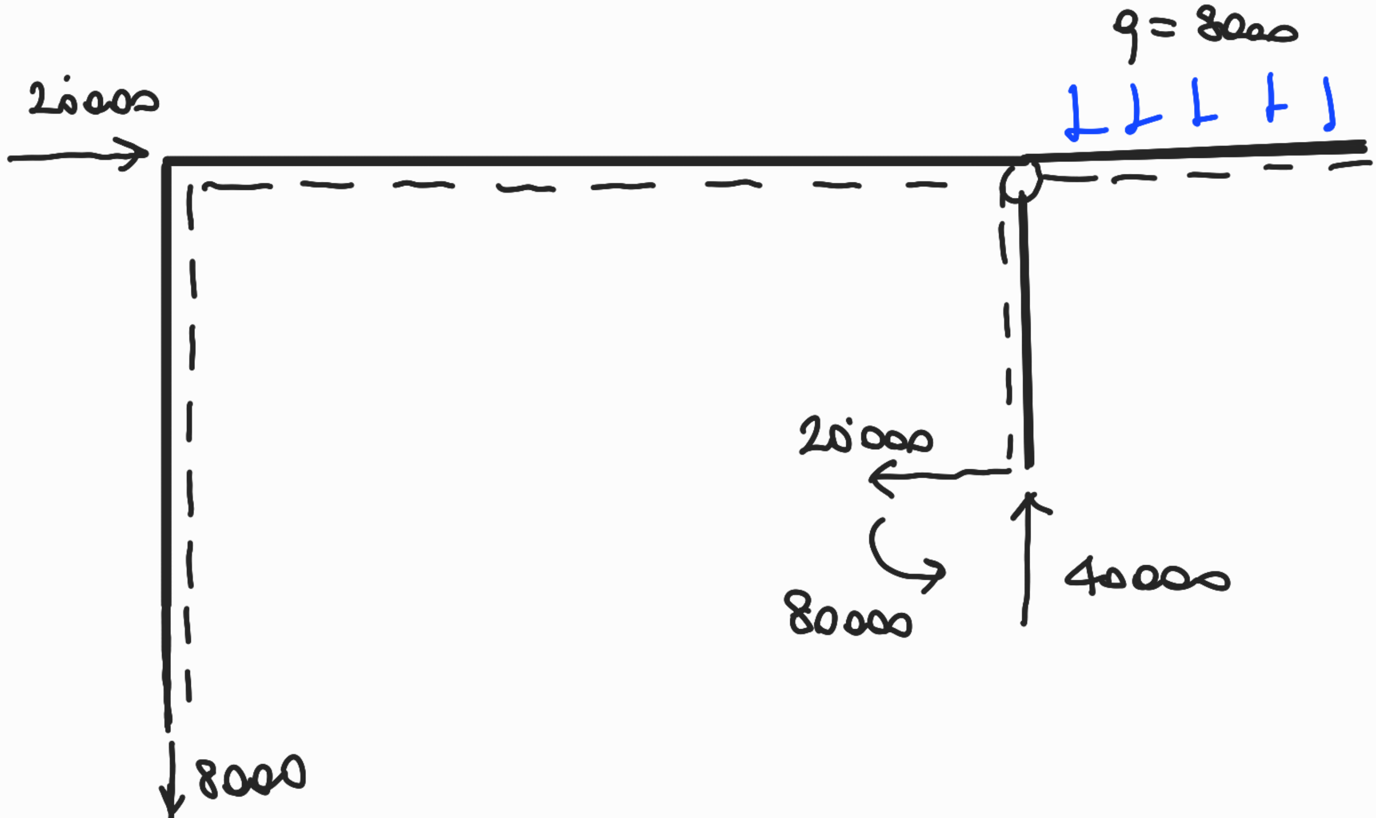
$M_E = 80'000\ Nm$

$$V_C = \frac{\left(P \cdot 2L - H_C \cdot 2L + \frac{5}{2} qL^2\right)}{2L} = 40\,000\ N$$

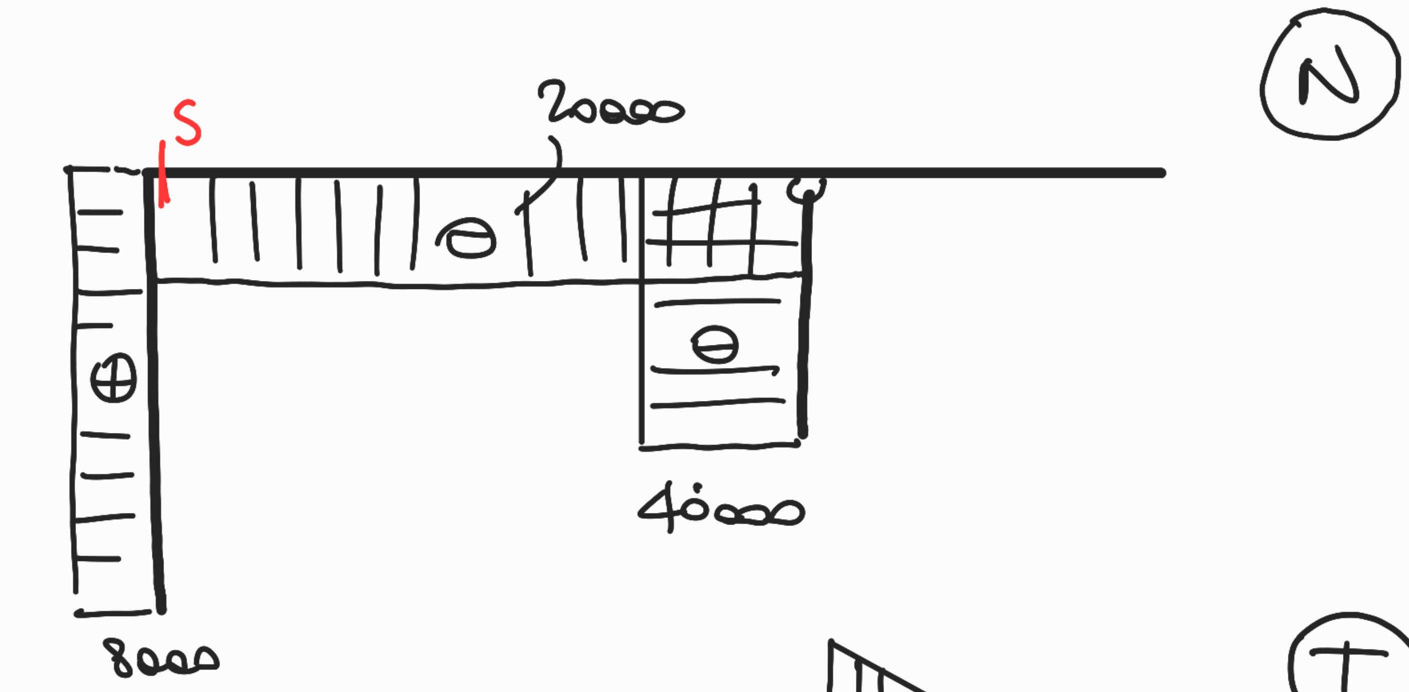
$V_A = qL - V_C = -8000\ N$

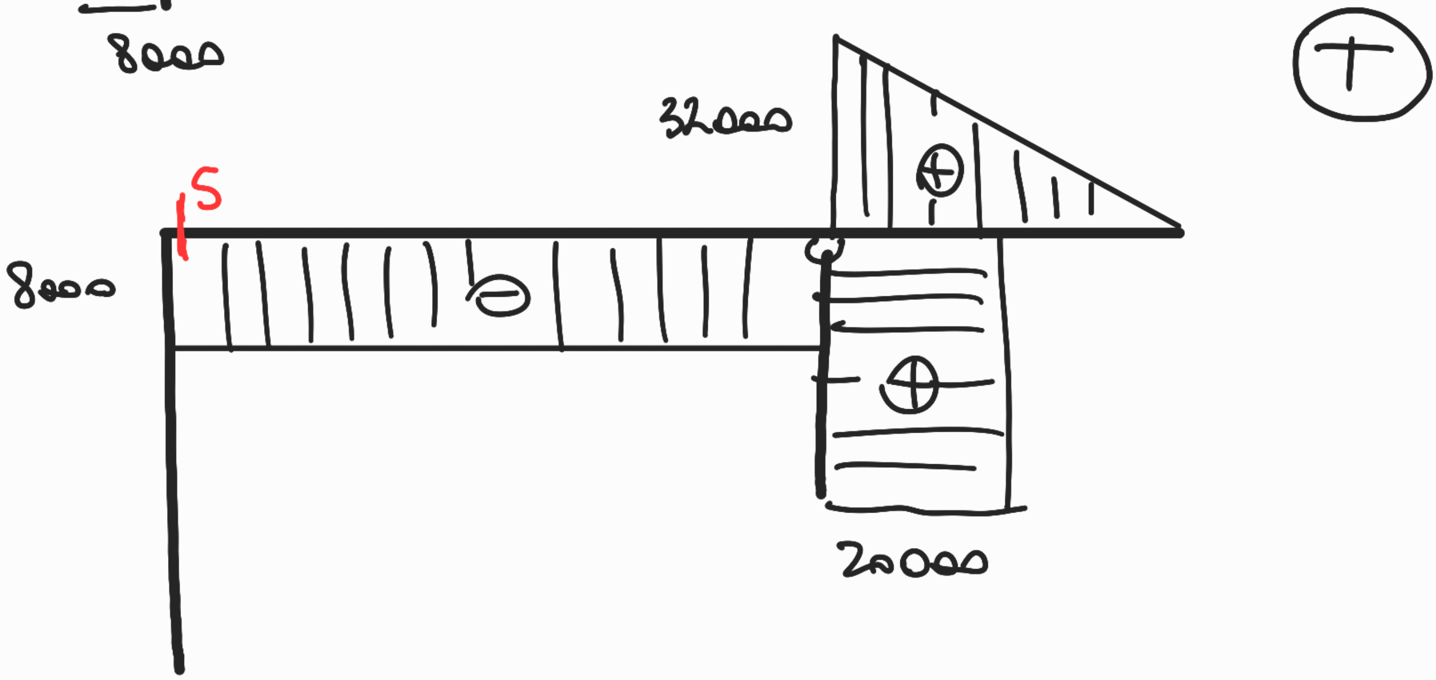
$V_E = V_C = 40'000\ N$

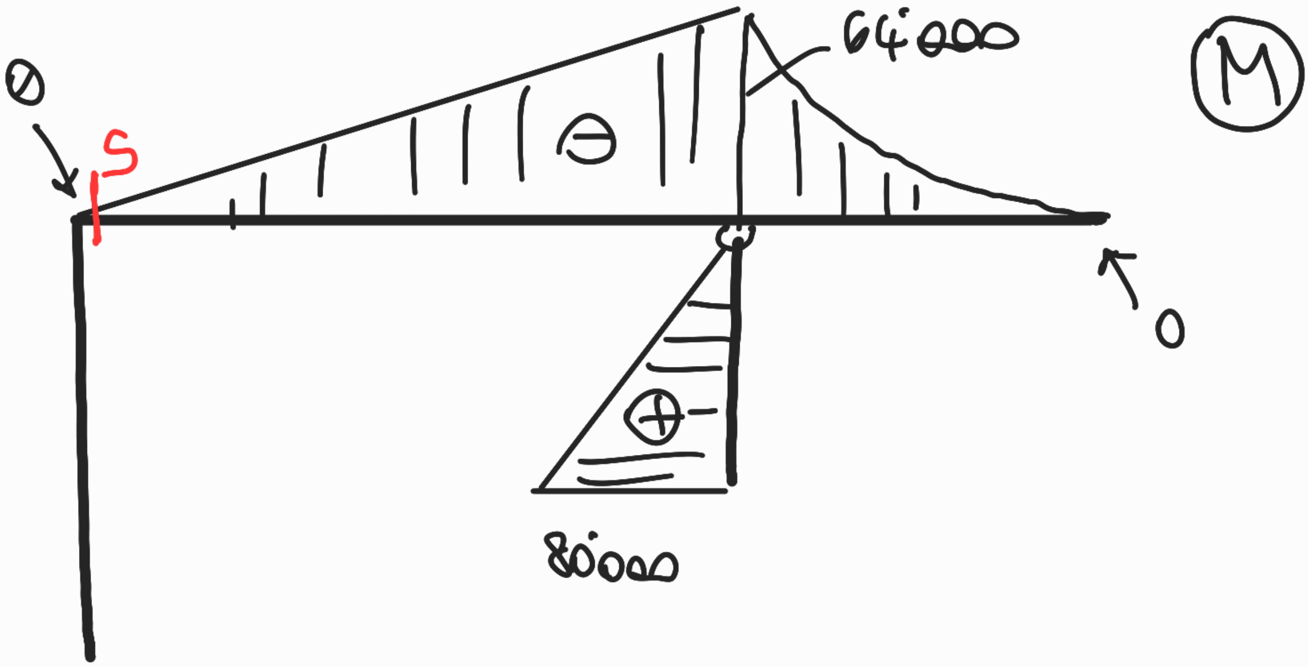
Schema finale delle forze:



• Diagrammi delle azioni interne

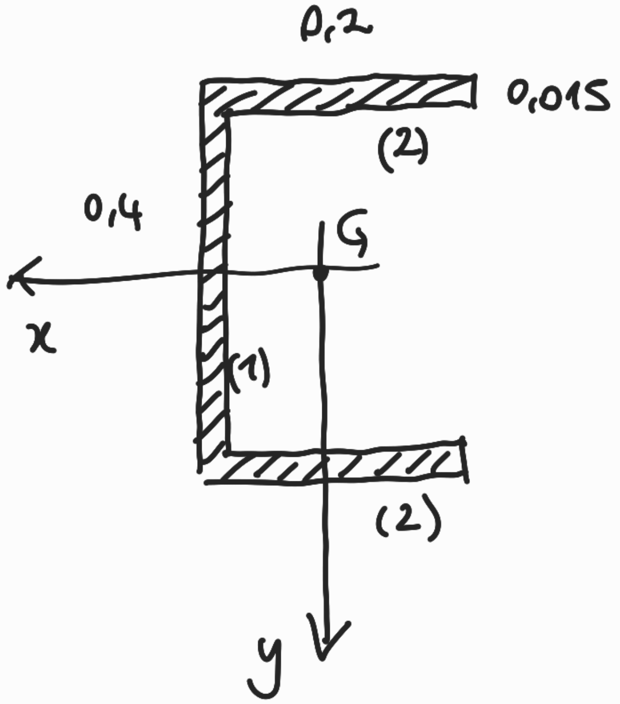






2)

- **Caratteristiche geometriche della sezione**



$$A = (0{,}4 + 2 \cdot 0{,}2) \cdot 0{,}015 = 0{,}012 \ m^2$$

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

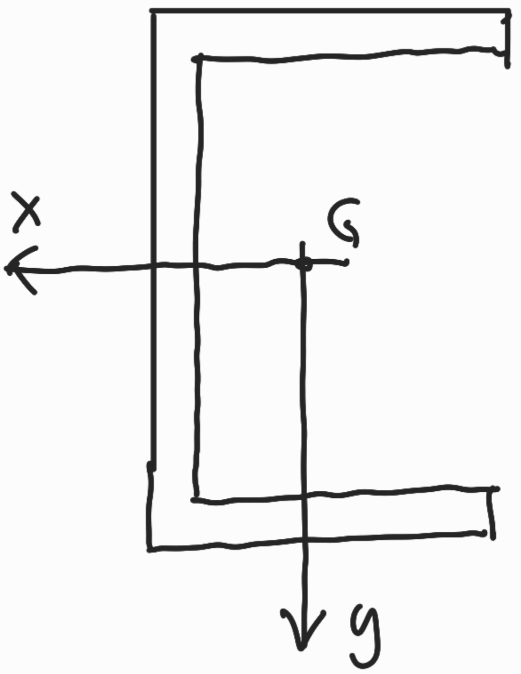
$$I_x = \frac{0{,}015 \cdot 0{,}4^3}{12} + 2 \cdot \left[\frac{0{,}2 \cdot 0{,}015^3}{12} + 0.2 \cdot 0{,}015 \cdot 0{,}2^2 \right]$$

$$= 0{,}00008 + 0{,}00024 =$$

$$= 0{,}00032 \ m^4$$

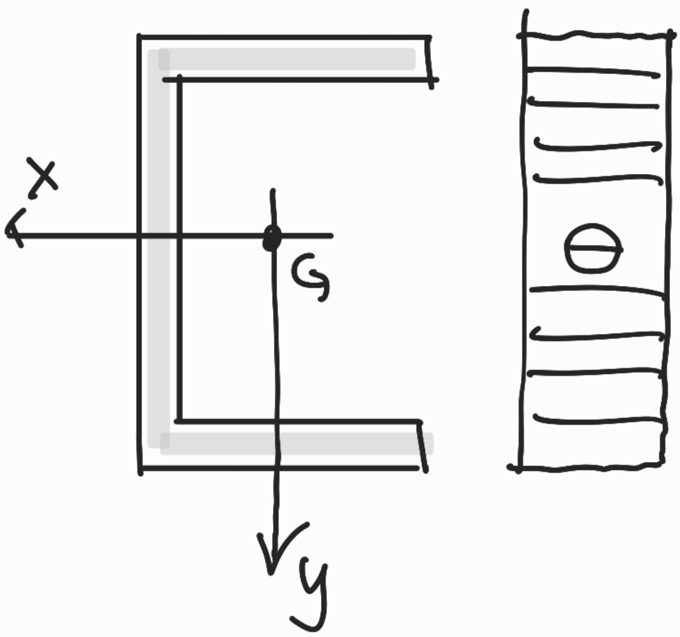
Il momento d'inerzia I_y non è necessario così come la pos. x_G del baricentro

• Calcolo delle Tensioni nella sez. S



$$\begin{cases} N = -20'000 \\ T_y = 8000\ N \\ M_x = 0\ Nm \end{cases}$$

- Sforzo normale centrato

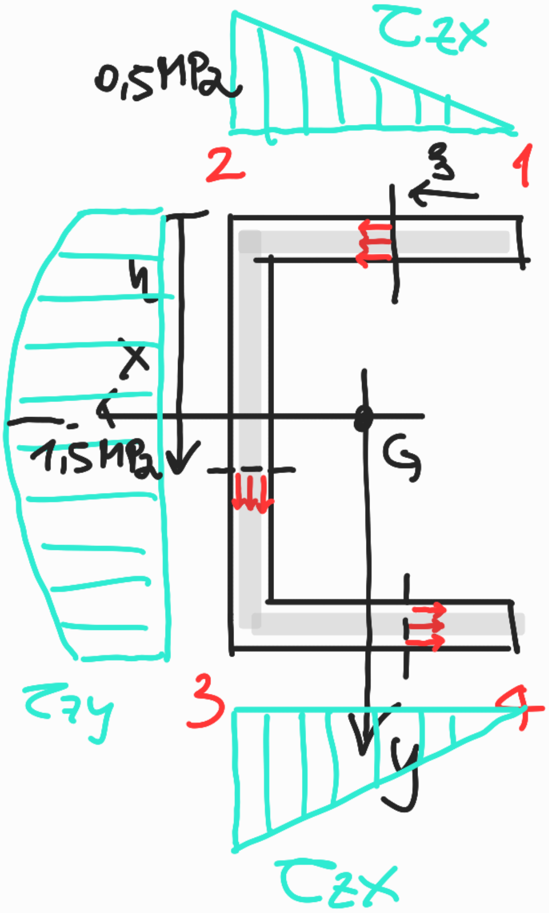


$$\sigma_z = \frac{N}{A} =$$

$$= -\frac{20'000}{0{,}0012} = -1{,}67 \cdot 10^6\ Pa$$

- Taglio (formula di Jourawski)

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



tratto 1-2 e 3-4

$$\tau_{zx}(z) = +\frac{8000 \cdot (0{,}015 \cdot z \cdot 0{,}1)}{I_x \cdot 0{,}015}$$

$$S_x^* = 0{,}015 \cdot z \cdot 0{,}1$$

$$\tau_{zx}(0{,}2) = \frac{8000 \cdot (0{,}015 \cdot 0{,}2 \cdot 0{,}1)}{0{,}00032 \cdot 0{,}015}$$

$$= 5 \cdot 10^5 \text{ Pa} \quad (Q)$$

uscente dall'area

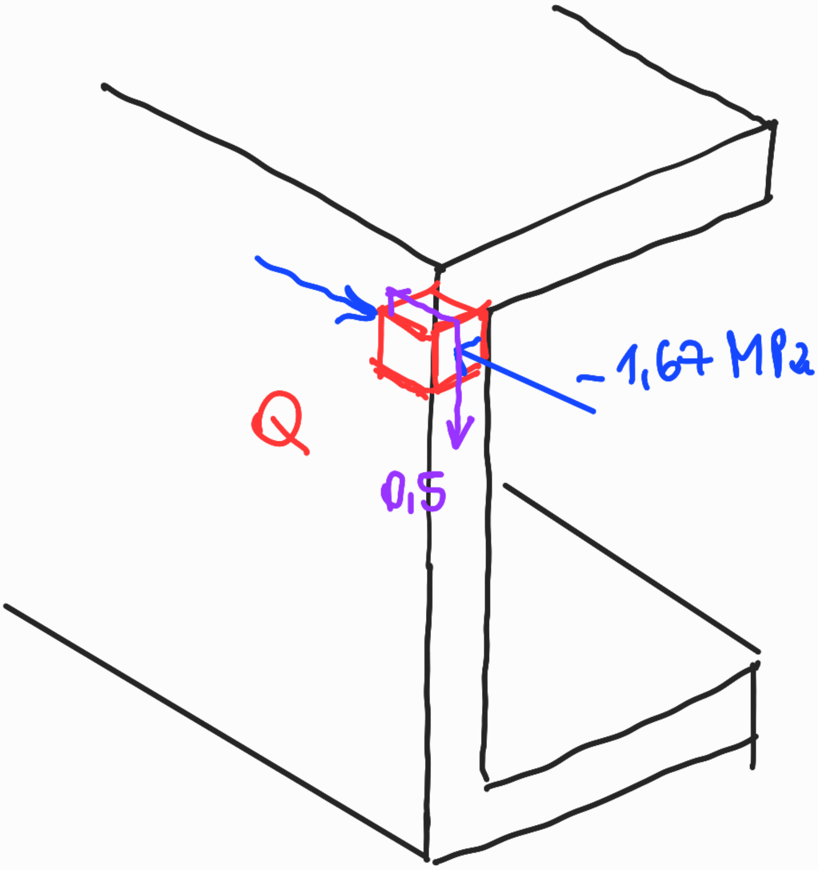
tratto 2-3

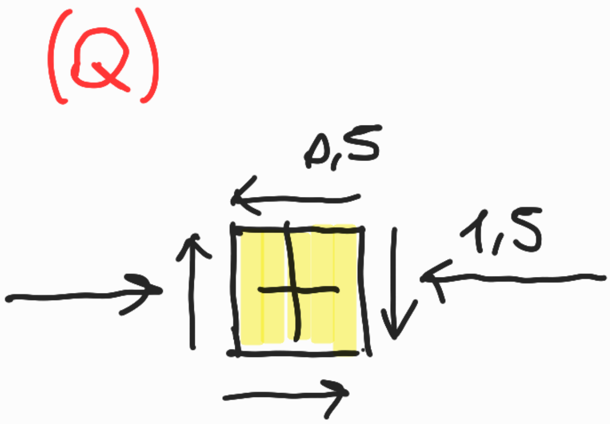
$$\tau_{zy}(\eta) = \frac{8000\left(0{,}2 \cdot 0{,}015 \cdot (-0{,}1) + \eta \cdot 0{,}015 \cdot \left(-0{,}2 + \frac{\eta}{2}\right)\right)}{I_x \cdot 0{,}015}$$

$$\tau_{zy}(\eta = 0{,}2) = \tau_{zy\,max} = 1{,}5 \cdot 10^6 \text{ Pa} \quad (G)$$

$$S_x^*(\eta = 0{,}2) = -0{,}0009 \text{ m}^3$$

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

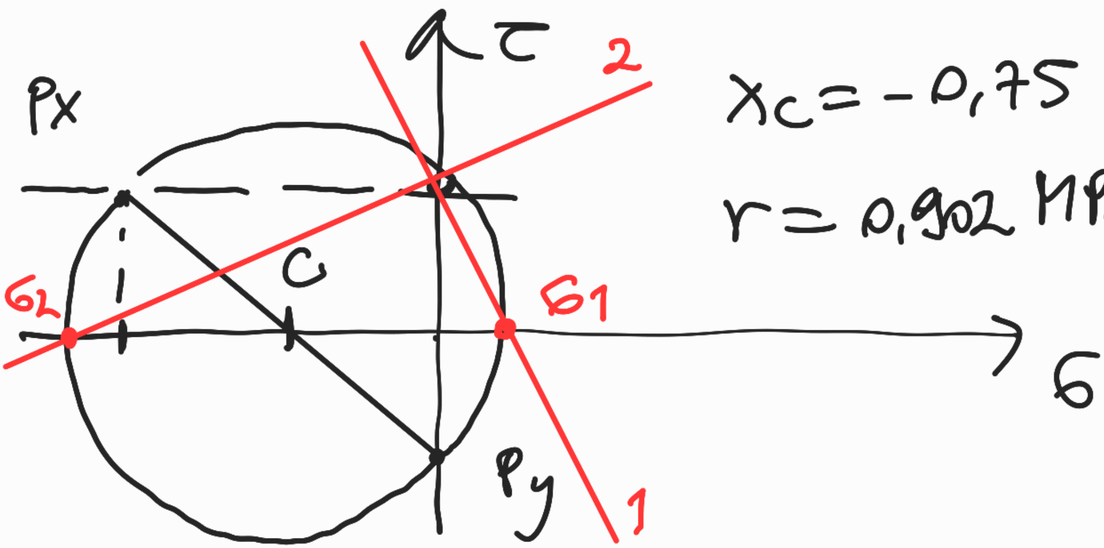




$P_x = (-1{,}5\ \text{MPa},\ 0{,}5\ \text{MPa})$

$P_y = (0\ ,\ -0{,}5\ \text{MPa})$

Cerchio di Mohr nel punto Q

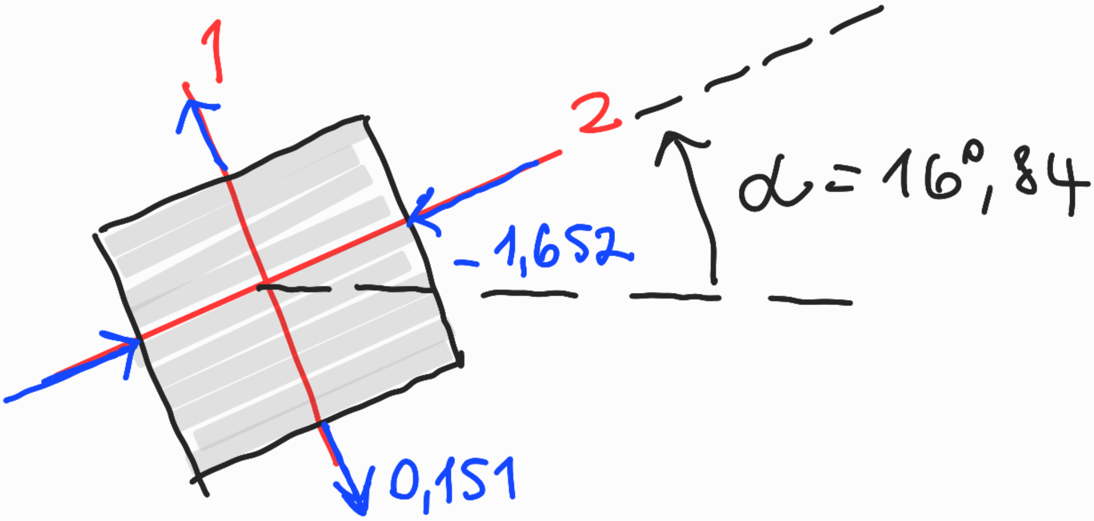


$x_c = -0{,}75\ \text{MPa}$

$r = 0{,}902\ \text{MPa}$

$\sigma_1 = x_c + r = 0{,}151 \text{ MPa}$

$\sigma_2 = x_c - r = -1{,}652 \text{ MPa}$



$\sigma_{t,amm} = 1 \text{ MPa}$

$\sigma_{c,amm} = 10 \text{ MPa}$

Verifica di resistenza (crit. di Rankine)

$\sigma_1 = 0{,}151 < \sigma_{t,amm}$ verificato

$\sigma_2 = |-1{,}652| < \sigma_{c,amm}$ verificato

$\alpha = \frac{1}{2} \operatorname{arctg} \frac{2\tau_{zy}}{\sigma_x - \sigma_y} = +16°{,}84$ antiorario