

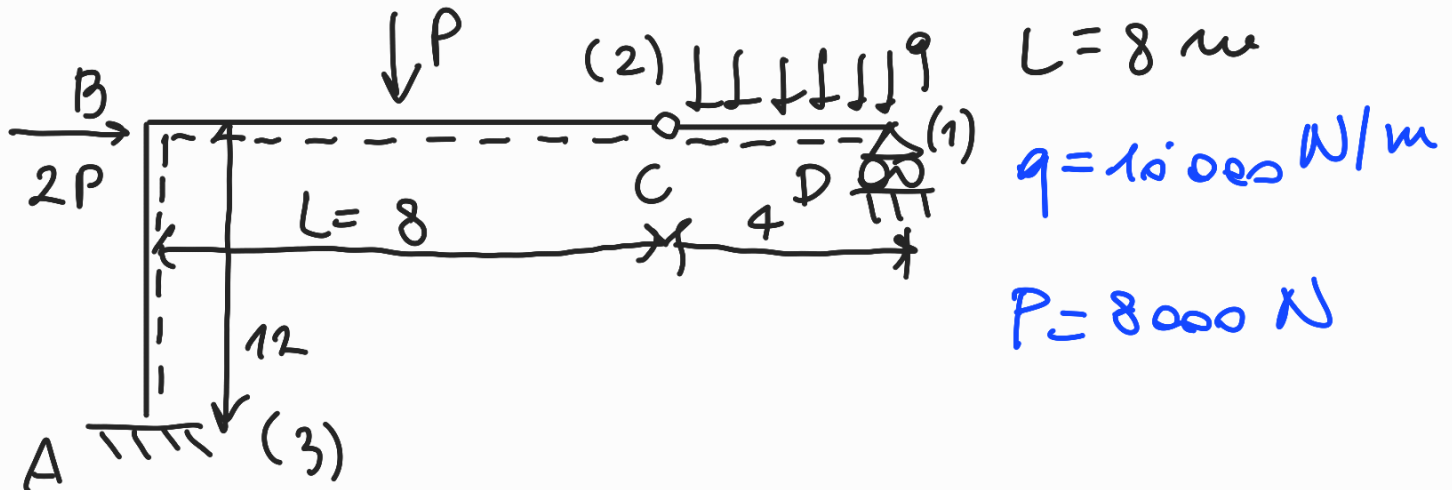
1) • Verifica che la struttura è isostatica

$$n_{\text{aste}} = 2$$

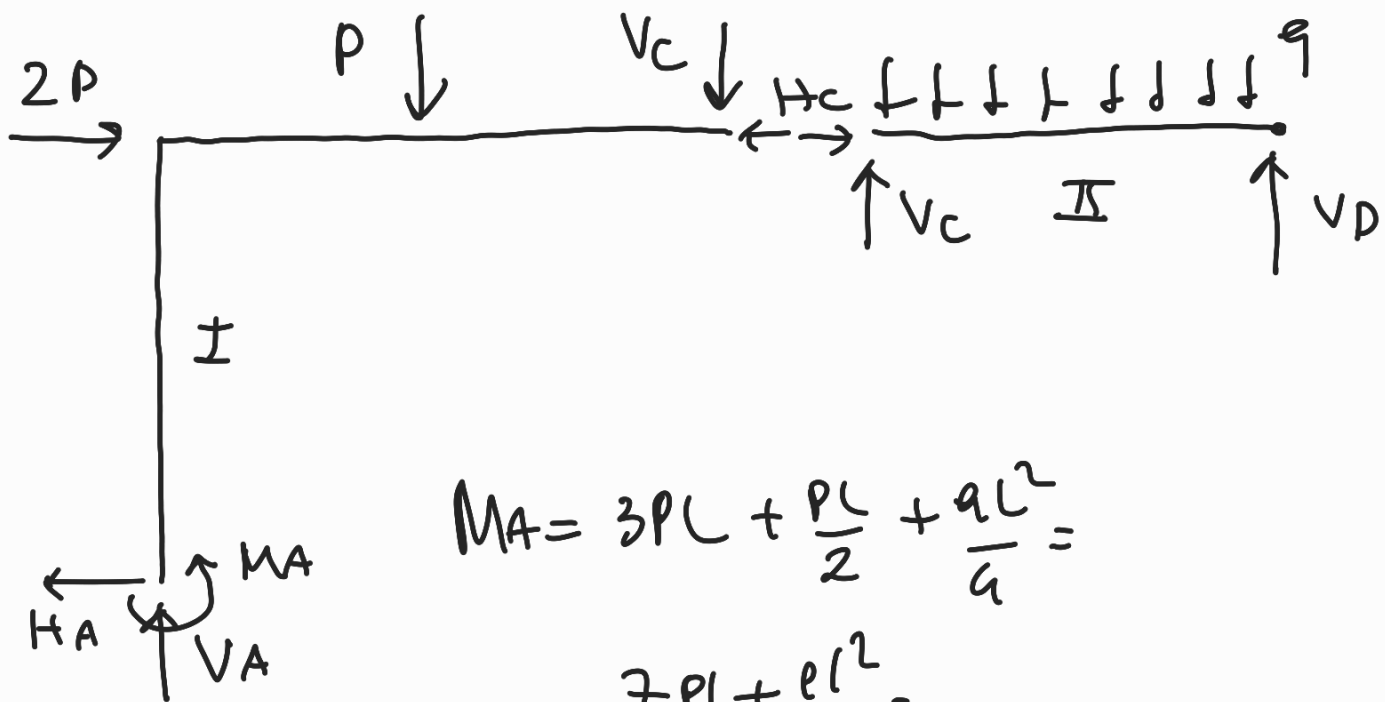
$$v = 3 + 2 + 1 = 6$$

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

→ isostatica



• Calcolo delle reazioni vincolari



$$M_A = 3PL + \frac{PL}{2} + \frac{qL^2}{9} =$$

$$\frac{7PL}{2} + \frac{qL^2}{9} =$$

Equilibri delle aste;

$$I \begin{cases} \rightarrow^+ & -H_A + 2P - H_C = 0 \\ \uparrow & V_A - V_C - P = 0 \\ \curvearrowright_A & -M_A + 2P \cdot \frac{3L}{2} + P \frac{L}{2} + V_C \cdot L - H_C \cdot \frac{3L}{2} = 0 \end{cases}$$

$$H_A = 2P = 16000 \text{ N}$$

$$V_C = \frac{9L}{4} = 20000 \text{ N}$$

$$V_D = \frac{9L}{4} = 20000 \text{ N}$$

$$V_A = P + \frac{9L}{4} = 28000 \text{ N}$$

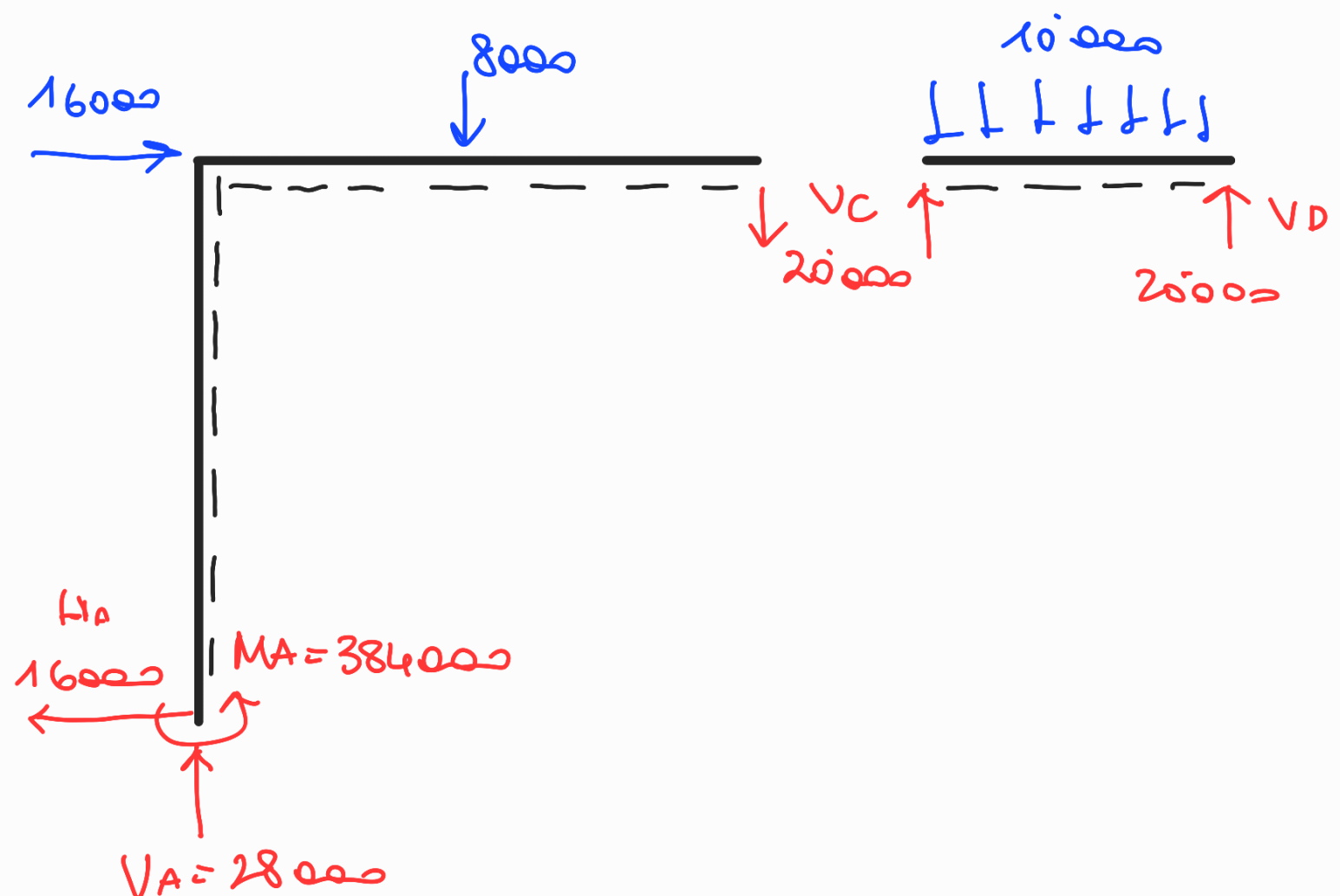
$$H_C = 0$$

$$M_A = \frac{7}{2} PL + \frac{9L^2}{4} =$$

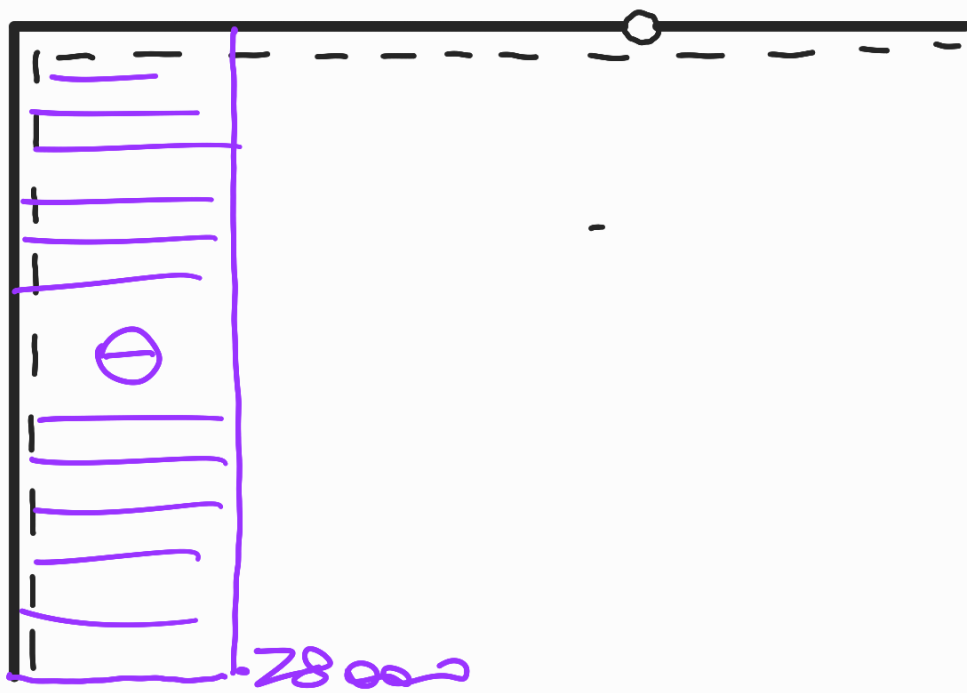
$$= 384000 \text{ Nm}$$

$$II \begin{cases} \rightarrow^+ & -H_C = 0 \\ \uparrow & +V_C - 9 \frac{L}{2} + V_D = 0 \\ \curvearrowright_D & V_C \cdot \frac{L}{2} - 9 \frac{L}{2} \cdot \frac{L}{4} = 0 \end{cases}$$

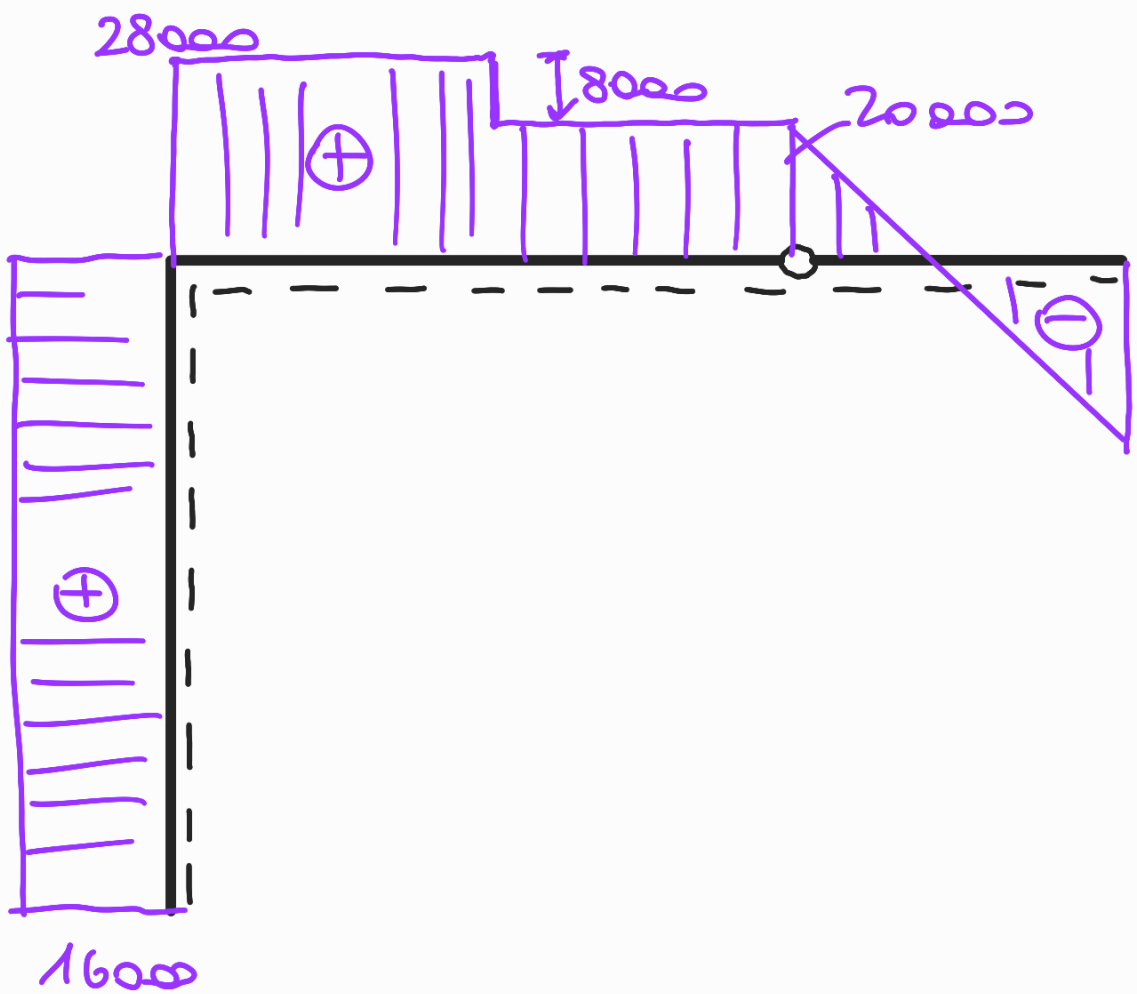
Schema finale delle forze attive e reattive



• Diagrammi delle azioni interne

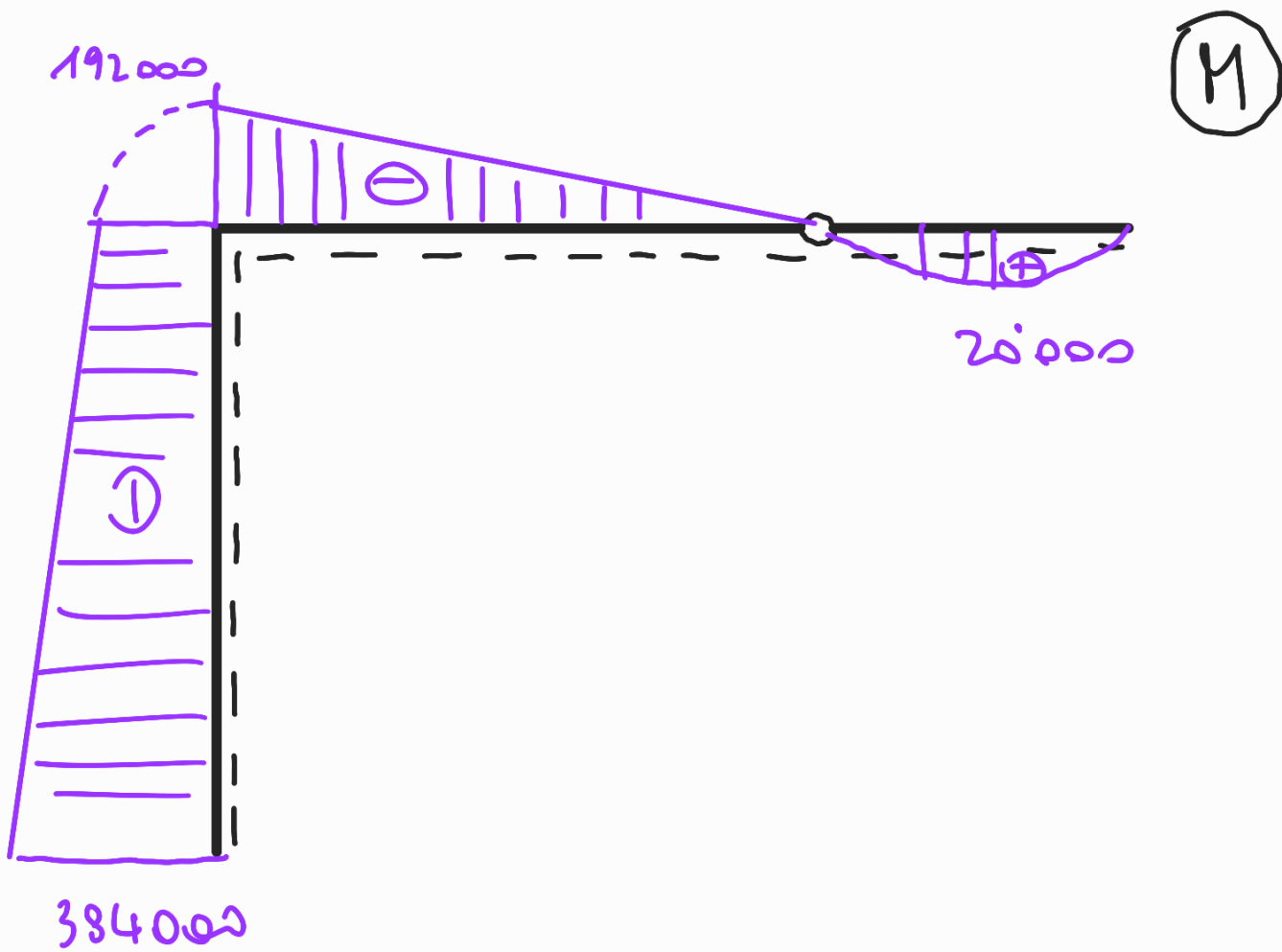


(N)



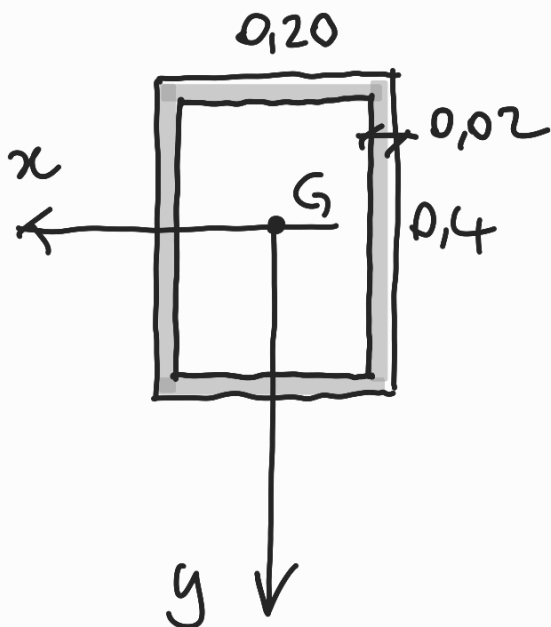
(T)

20000



2)

● Caratteristiche geometriche della sezione



$$A = 0,2 \cdot 0,4 - 0,16 \cdot 0,36 = 0,0224 \text{ m}^2$$

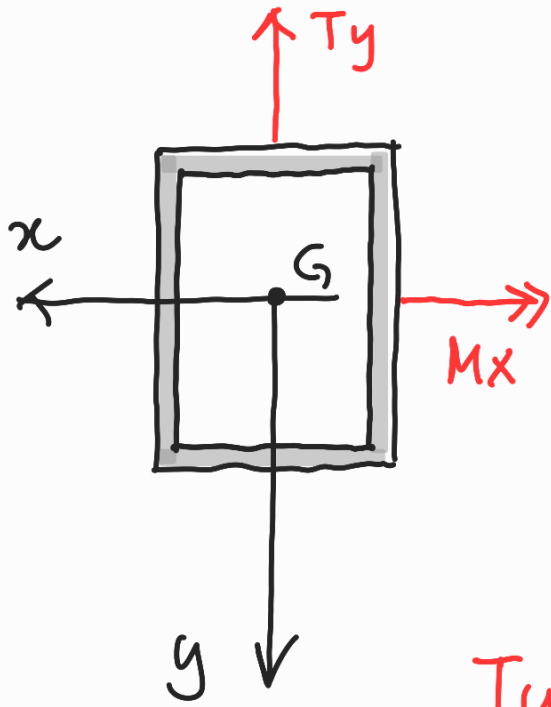
$$I_x = \frac{0,2 \cdot 0,4^3}{12} - \frac{0,16 \cdot 0,36^3}{12} =$$

$$= 4,446 \cdot 10^{-4} \text{ m}^4$$

Il momento di inerzia I_y non è

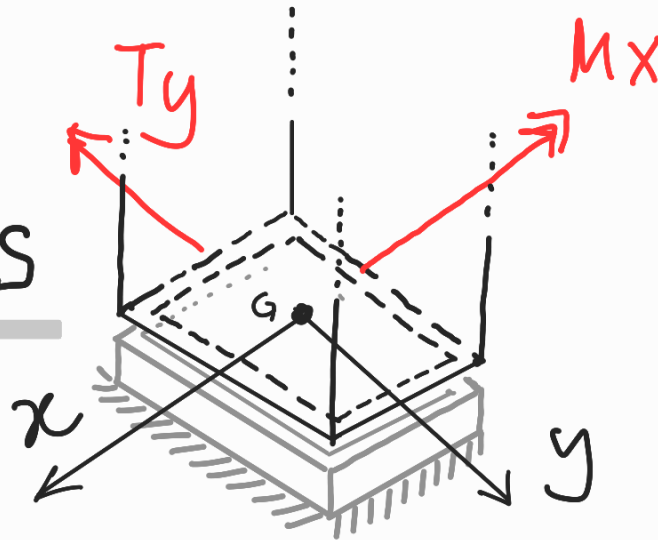
necessario.

● Calcolo delle Tensioni nelle sez. S

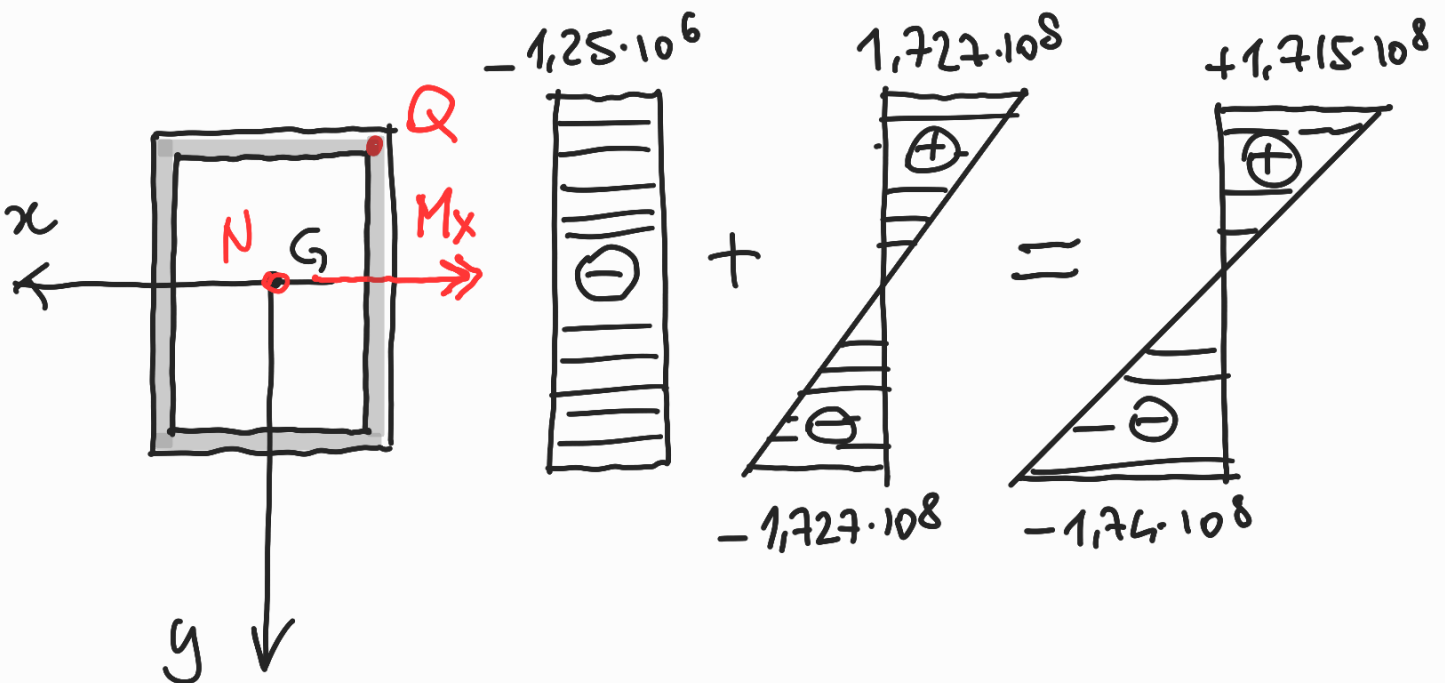


$$\left. \begin{aligned} N &= -28000 \text{ N} \\ T &= 16000 \text{ N} \\ M_x &= 384000 \text{ Nm} \end{aligned} \right\}$$

Sez. S-S



● Sforzo normale eccentrico



$$G_z(y) = \frac{N}{A} \pm \frac{M_x}{I_x} \cdot y$$

$$= \frac{-28000}{0,024} \pm \frac{384000}{4,446 \cdot 10^{-4}} \cdot y$$

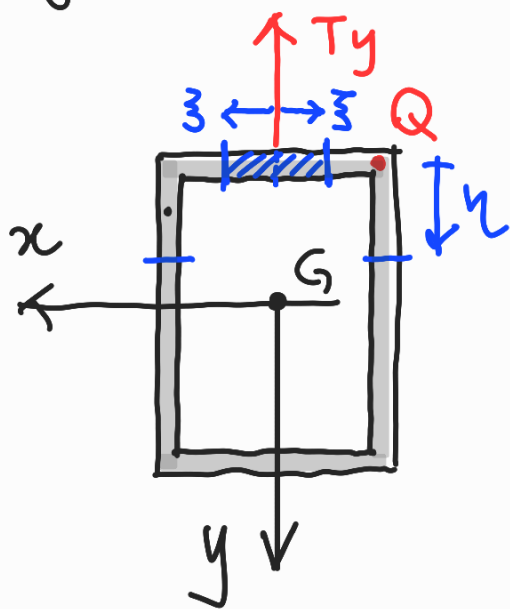
$$= -1,15 \cdot 10^6 \pm 8,64 \cdot 10^8 \cdot y =$$

$$y = \pm 0,2$$

$$\left. \begin{array}{l} 1,715 \cdot 10^8 \text{ Pa} \\ -1,74 \cdot 10^8 \text{ Pa} \end{array} \right\}$$

$$G_z(Q) = 1,715 \cdot 10^8 \text{ Pa}$$

● Taglio (f. di Jourawski) $\tau_{zs} = - \frac{T_y S_x^*}{I_x \cdot b}$



$$\tau_{zx}(z) = - \frac{T_y \cdot 2z \cdot a}{I_x \cdot 2t}$$

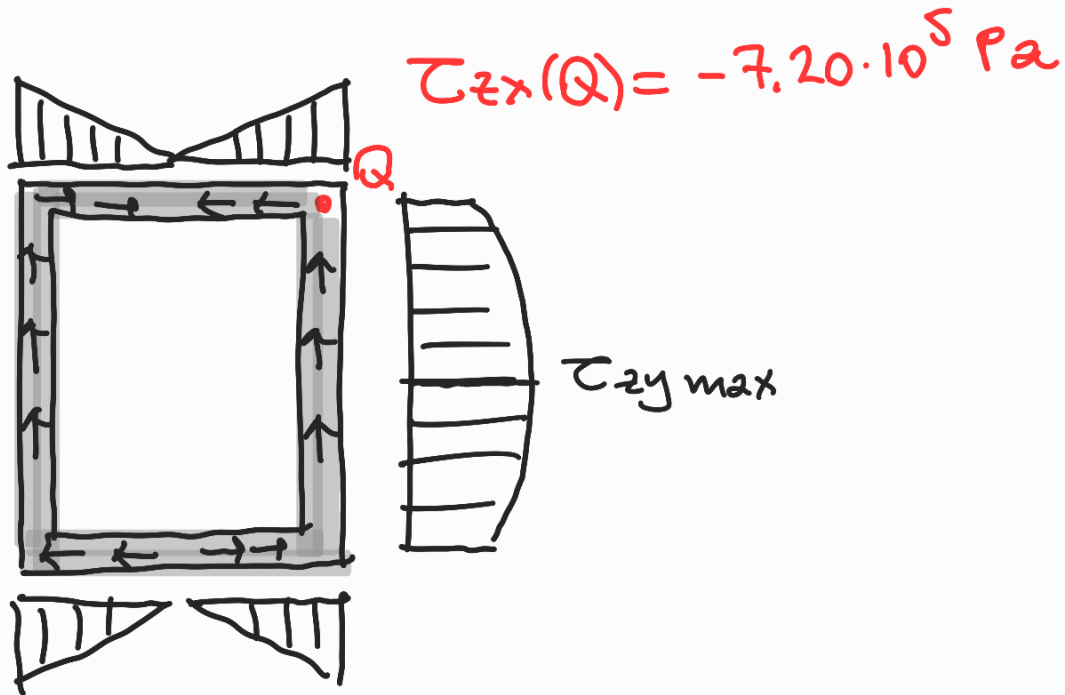
$$\tau_{zx}(z=0,1) = \frac{-16000 \cdot (2 \cdot 0,2 \cdot 0,02 \cdot 0,1)}{4,446 \cdot 10^{-4} \cdot 0,02 \cdot 2} = -7,20 \cdot 10^5 \text{ Pa}$$

entrante

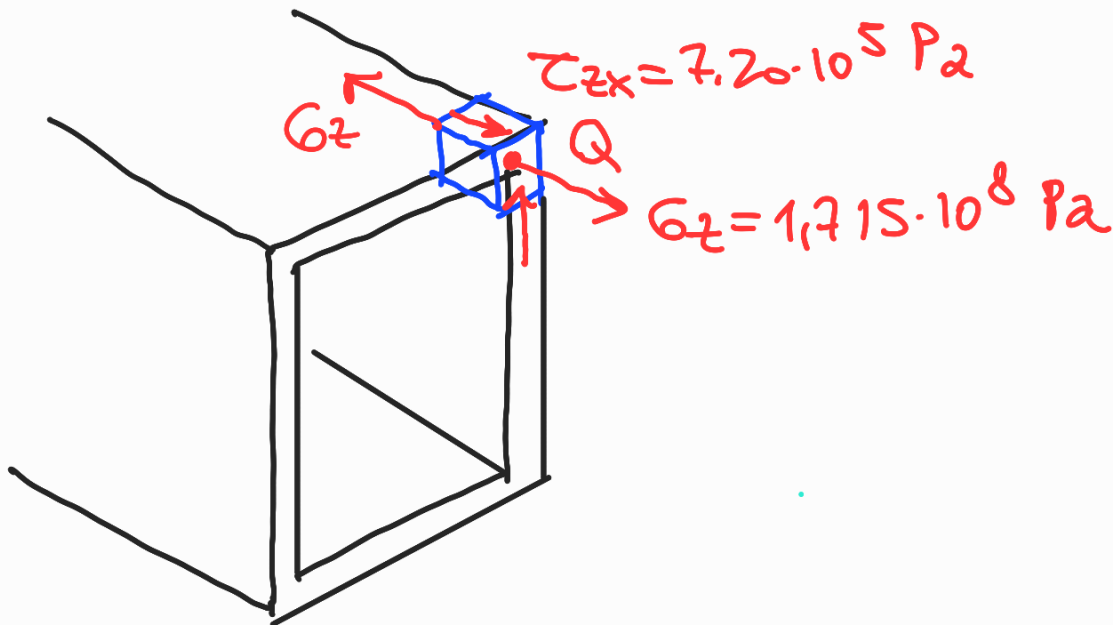
$$\tau_{zy}(y) = \frac{-T_y \left[-0,2 \cdot 0,02 \cdot 0,2 - 2 \cdot y \cdot 0,02 \cdot \left(a - \frac{y}{2} \right) \right]}{4,446 \cdot 10^{-4} \cdot 2 \cdot 0,02}$$

$$\tau_{zy}(y=92) = \frac{-16000 \cdot 1,6 \cdot 10^{-3}}{4,446 \cdot 10^{-4} \cdot 2 \cdot 0,02} = 1,44 \cdot 10^6 \text{ Pa}$$

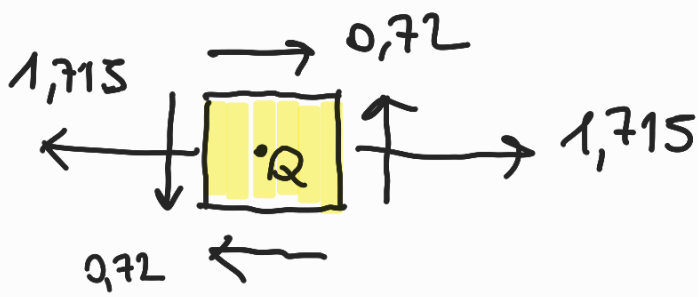
$\tau_{zy \max}$



- Verifica di resistenza nel punto Q delle set S
e cerchio di Mohr

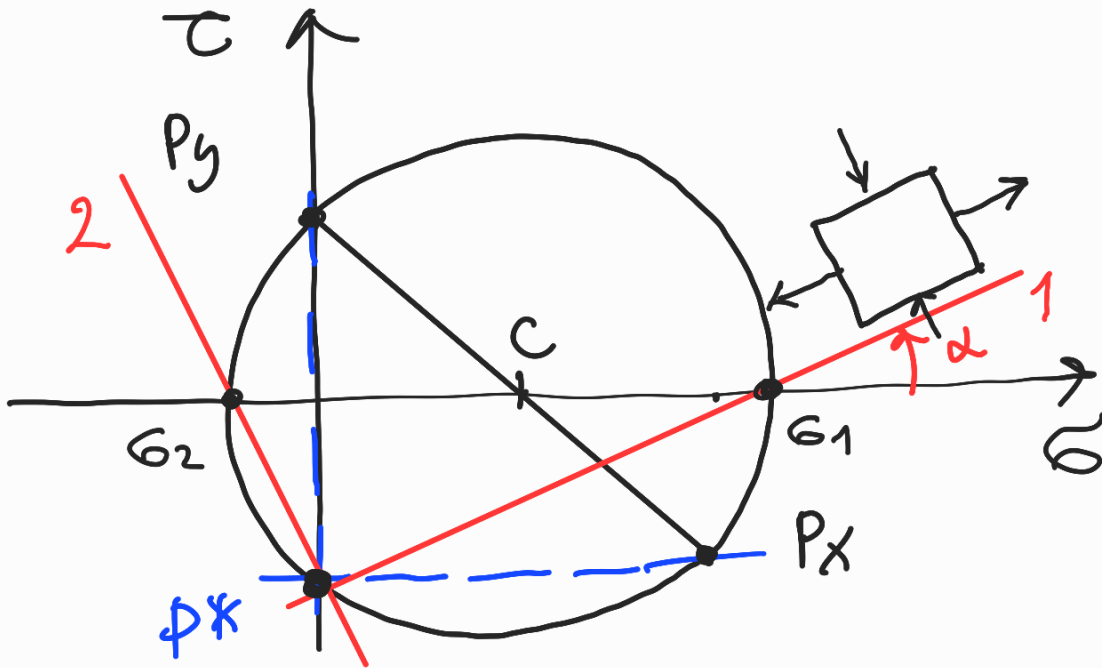


Punto Q (MPa)



$$P_x = (1,715 ; -0,72)$$

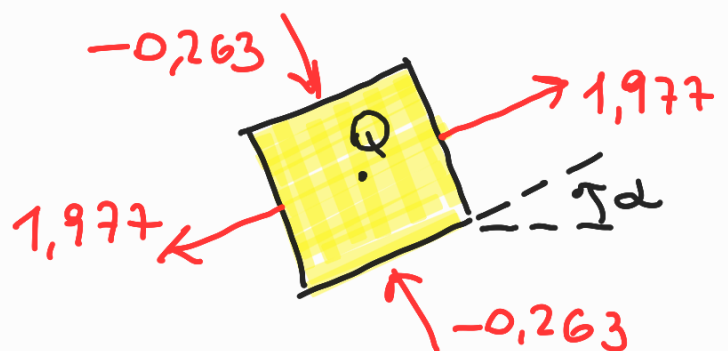
$$P_y = (0 ; +0,72)$$



$$x_c = 0,857 \text{ MPa} \quad r = 1,12 \text{ MPa}$$

$$\begin{cases} \sigma_1 = x_c + r = 1,977 \text{ MPa} \\ \sigma_2 = x_c - r = -0,263 \text{ MPa} \end{cases}$$

$$\alpha = \frac{1}{2} \arctg \frac{\tau_{xy}}{\frac{\sigma_x - \sigma_y}{2}} = +20,02 \text{ antiorario}$$



• Verifiche di resistenza

1. Criterio di Von Mises

$$\sigma_{eq. VM} = \sqrt{\sigma^2 + 3\tau^2} = 2,12 \text{ MPa} < 160 \text{ MPa}$$

verificato

2. Criterio di Tresca

$$\sigma_{eq. TR} = \sqrt{\sigma^2 + 4\tau^2} = 2,24 \text{ MPa} < 160 \text{ MPa}$$

verificato

