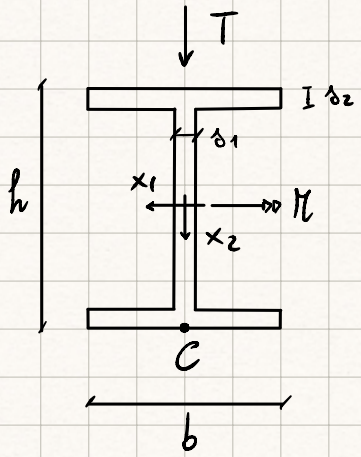
Esercizio



$h = 150\ mm$ $\quad b = 100\ mm$

$s_1 = 10\ mm$ $\quad s_2 = 8\ mm$

$A = 2330\ mm^2$ $\quad I_1 = 10,1 \cdot 10^6\ mm^4$

$F = 10\ KN$ (forza di compressione applicata in C)

$M = 2,5 \cdot 10^3\ Nm$ $\quad T = 5\ KN$

$\sigma_{AMM} = 160\ MPa$

Svolgimento

Determiniamo le sollecitazioni agenti sulla sezione.

$N = -F$ ⇒ Forza Normale Eccentrica ⇒ σ_{33}

$M_1 = -M$ ⇒ Flessione Retta ⇒ σ_{33}

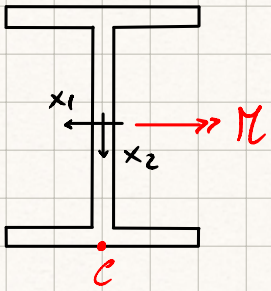
$T_2 = T$ ⇒ Taglio ⇒ τ_{3i}

Determiniamo le Tensioni assiali

$$\sigma_{33}^{(N)} = \frac{N}{A} + \frac{N x_{1c}}{I_2} x_1 + \frac{N x_{2c}}{I_1} x_2 =$$

$$= -\frac{10000}{2330} - \frac{10000 \cdot 0}{I_2} - \frac{10000 \cdot 75}{10,1 \cdot 10^6} x_2 =$$

$$= -4,29 - 0,074 x_2$$



$$\sigma_{33}^{(M_1)} = \frac{M_1}{I_1} x_2 = \frac{2,5 \cdot 10^6}{10,1 \cdot 10^6} x_2 = -0,25\, x_2$$

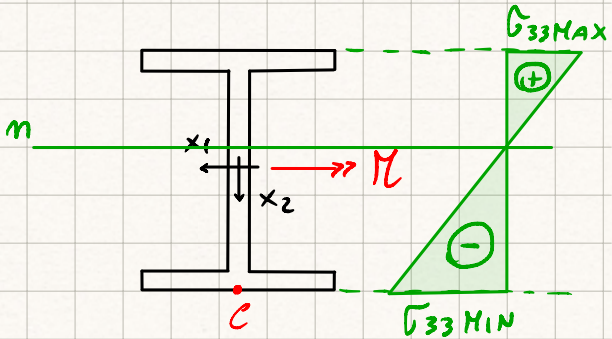
$$\sigma_{33} = \sigma_{33}^{(N)} + \sigma_{33}^{(M_1)} = -4,29 - 0,074\, x_2 - 0,25\, x_2 = -4,29 - 0,32\, x_2$$

$$\boxed{\sigma_{33} = -4,29 - 0,32\, x_2}$$

Asse Neutro:

$\sigma_{33} = 0 \Rightarrow -4,29 - 0,32\, x_2 = 0 \Rightarrow$

$\Rightarrow x_2 = -13,40$



$$\sigma_{33\,MIN} = \sigma_{33}(75) = -4,29 - 0,32 \cdot 75 = -28,29\ MPa$$

$\sigma_{33\,MAX} = \sigma_{33}(-75) = -4{,}25 - 0{,}32(-75) = 19{,}71\ MPa$

Nei punti più sollecitati la Tensione assiale vale $-28{,}25\ MPa$ ($|\sigma_{33\,MIN}| > |\sigma_{33\,MAX}|$).

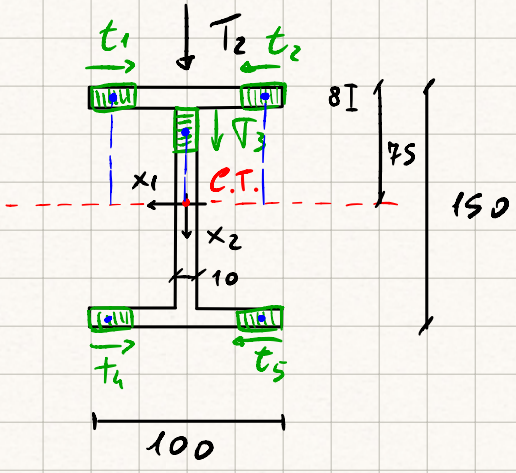
Determiniamo le Tensioni Tangenziali.

$$\tau_{3i} = -\frac{T_2 S_1^*}{I_1 s_i}$$

$$S_1^{*(1)} = -8\tau_1 \cdot (75-4)$$

$$S_1^{*(2)} = S_1^{*(1)}$$

$$S_1^{*(3)} = 2(-8 \cdot 50 \cdot 71) - 10\tau_3\left(75 - 8 - \frac{\tau_3}{2}\right)$$

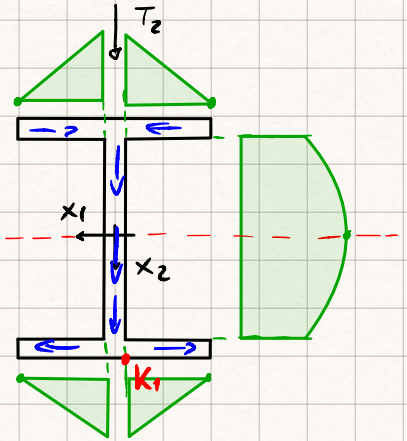


$$S_1^{*(4)} = -S_1^{*(1)} \; ; \qquad S_1^{*(5)} = -S_1^{*(2)}$$

$$\tau_{31}^{(1)} = -\frac{5000\,(-8\sqrt{1}\cdot 71)}{10{,}1\cdot 10^6\cdot 8} \qquad \tau_{31}^{(2)} = \tau_{31}^{(1)}$$

$$\tau_{32}^{(3)} = -\frac{5000\left[2\,(-8\cdot 50\cdot 71) - 10\sqrt{3}\left(75 - 8 - \frac{\sqrt{3}}{2}\right)\right]}{10{,}1\cdot 10^6\cdot 10}$$

$$\tau_{31}^{(4)} = -\tau_{31}^{(1)} \qquad \tau_{31}^{(5)} = -\tau_{31}^{(2)}$$



$$\tau_{31}(K_1) = \frac{5000\,(-8\cdot 45\cdot 71)}{10{,}1\cdot 10^6\cdot 8} = -1{,}58\ \text{MPa}$$

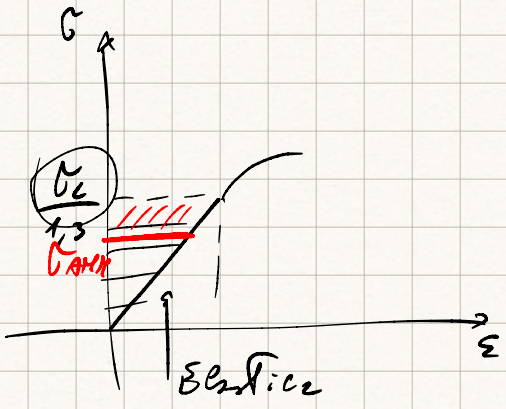
Nei punti più sollecitati della sezione si ha:

$\sigma_{33} = -28,73\ MPa$; $\tau_{31} = -1,58\ MPa$

Verifichiamo la sezione con Von Mises.

$$\sigma_{id} = \sqrt{\sigma_{33}^2 + 3\tau_{3i}^2} =$$

$$= \sqrt{(-28,73)^2 + 3(-1,58)^2} = 28,86\ MPa$$



Poiché σ_{id} nei punti maggiormente sollecitati è inferiore di σ_{AMM} ($28,86\ MPa < 160\ MPa$) la sezione risulta verificata.