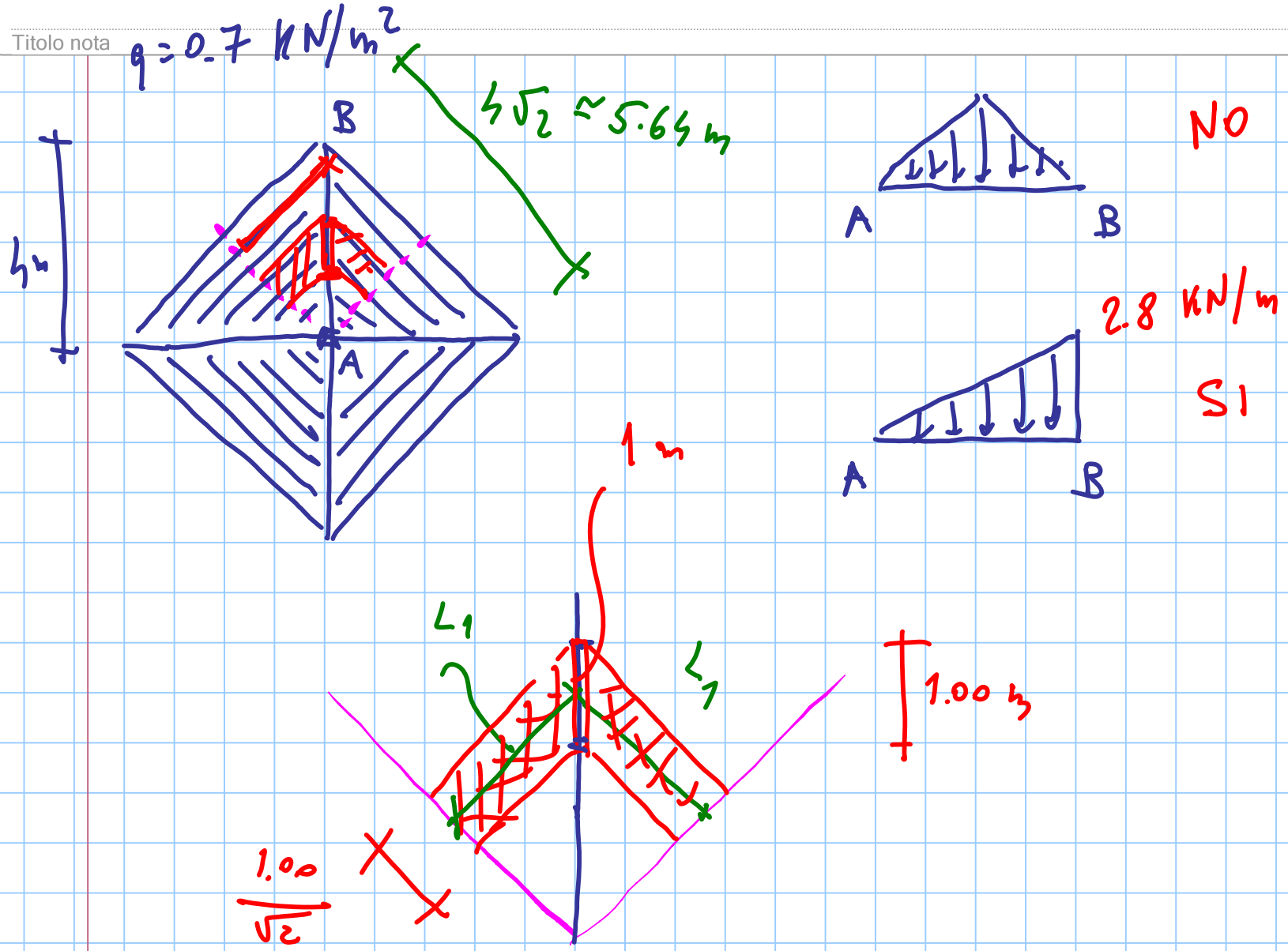
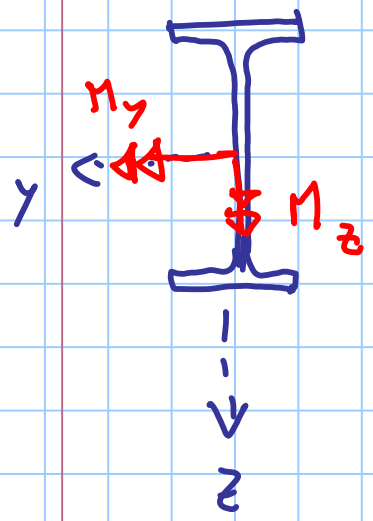
Titolo nota 18/11/2014



FLESSIONE DEVIATA



legame lineare → asse neutro per G

$$\sigma = \frac{M_y}{I_z} z - \frac{M_z}{I_z} y$$

$$\sigma_{max} = \frac{M_y}{W_{el,y}} + \frac{M_z}{W_{el,z}}$$

verifica flessione retta

$$\frac{|M_y|}{W_{el,y}} \leq \sigma_{max} \begin{cases} \bar{\sigma}_s & \text{T.A.} \\ \dfrac{f_y}{\gamma_{M0}} & \text{SLU } 3^a \text{ classe} \end{cases}$$

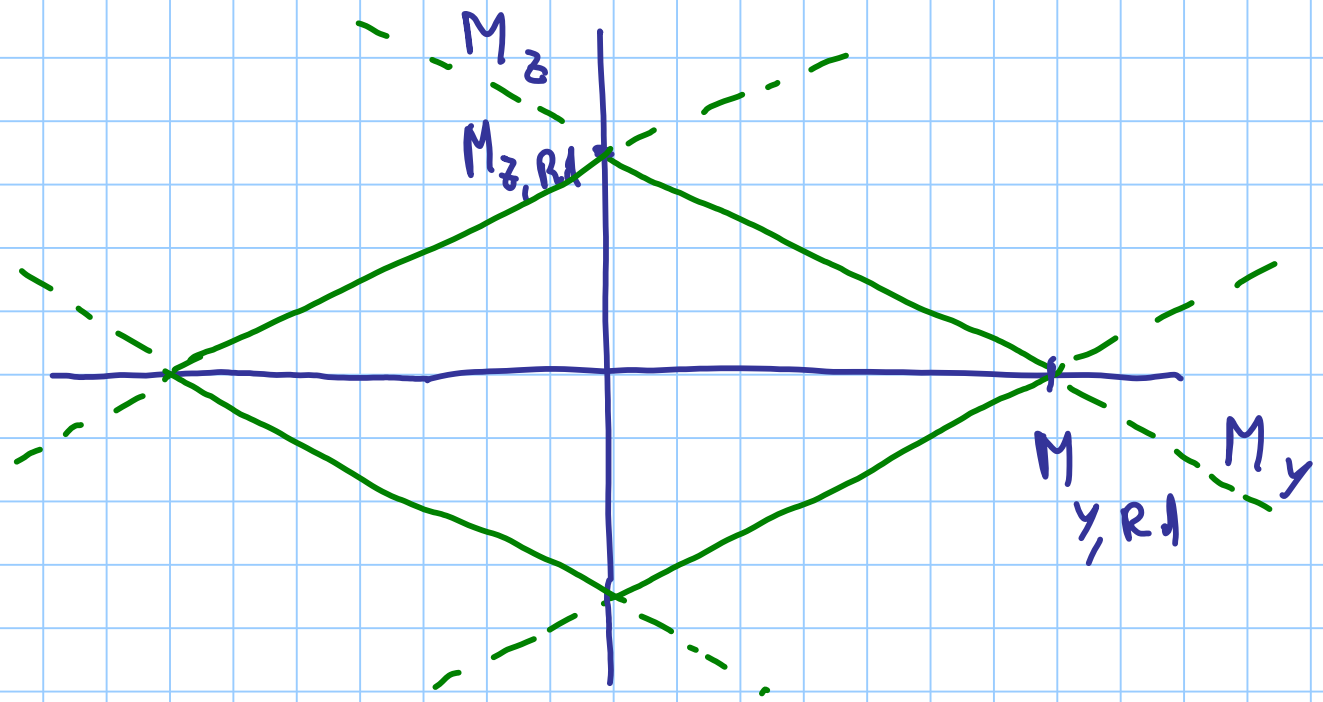
verifica

flessione deviata

$$\frac{|M_y|}{W_{el,y}} + \frac{|M_z|}{W_{el,z}} \leq \frac{f_y}{\gamma_{M0}}$$

$$\frac{|M_{y,Ed}|}{W_{el,y}\, f_y/\gamma_{M0}} + \frac{|M_{z,Ed}|}{W_{el,z}\, f_y/\gamma_{M0}} \leq 1$$

$$\left|\frac{M_{y,Ed}}{M_{y,Rd}}\right| + \left|\frac{M_{z,Ed}}{M_{z,Rd}}\right| \leq 1$$

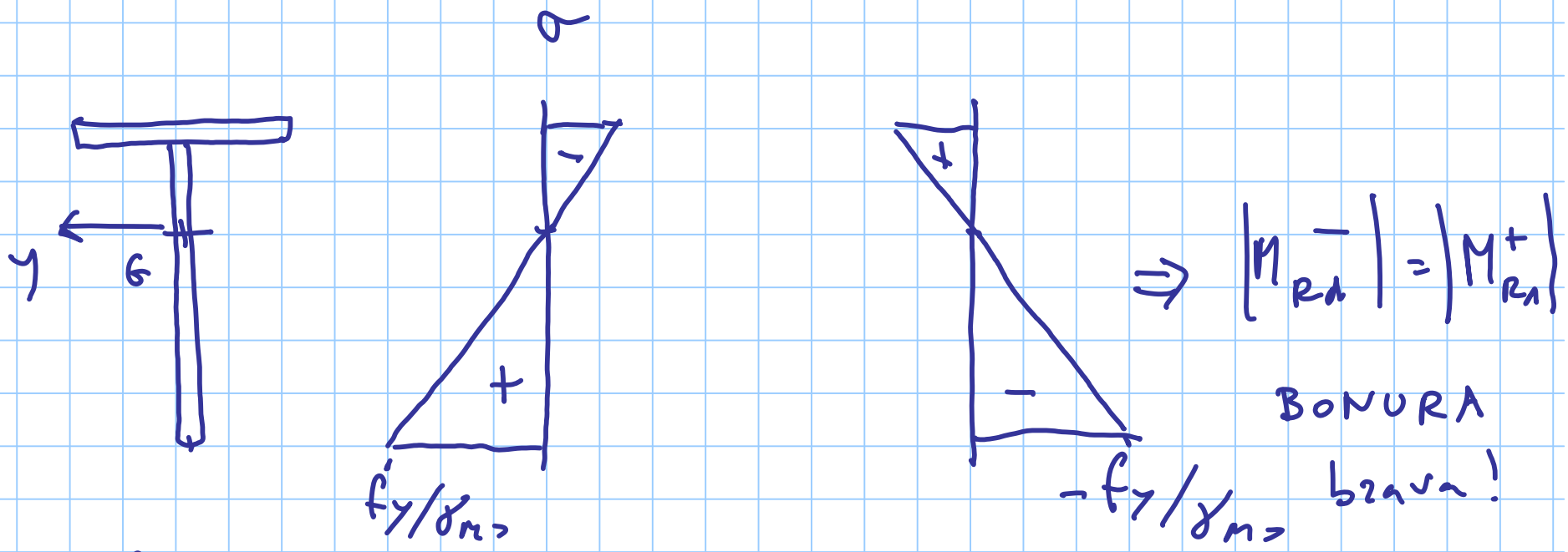


curva di interazione M_x M_y

dominio di resistenza M_x M_y

$$M^{+}_{y,Rd} = |M^{-}_{y,Rd}|$$

per sezioni non simmetriche ?



$$\Rightarrow |M^{-}_{Rd}| = |M^{+}_{Rd}|$$

BONURA brava!

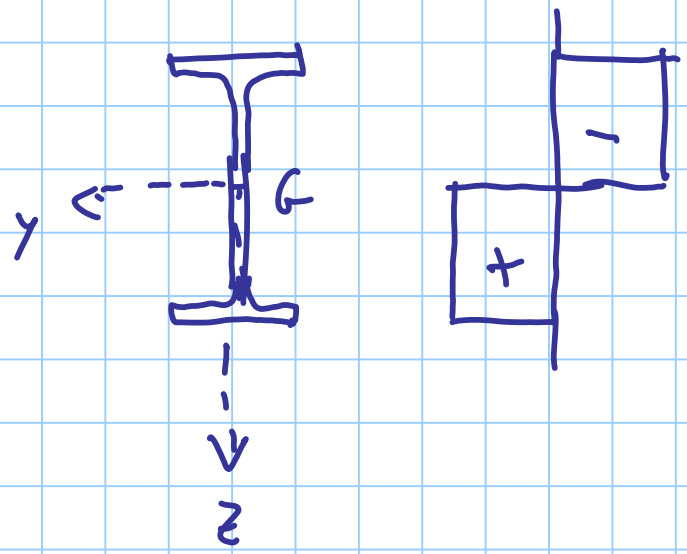
modello lineare

$$M^{+}_{Rd} = W_{el,inf,y} \frac{f_y}{\gamma_{M0}}$$

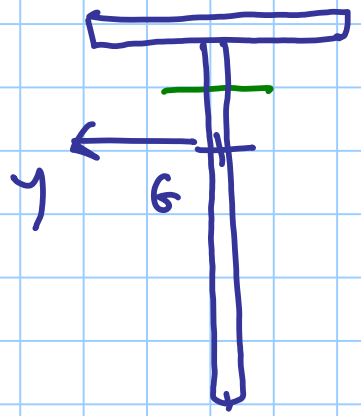
legame costitutivo non lineare

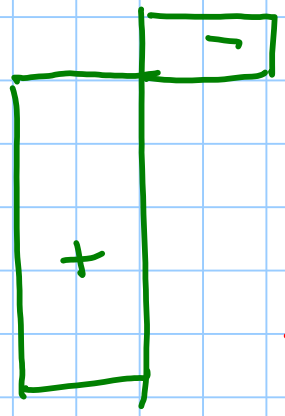
piena plasticizzazione della sezione

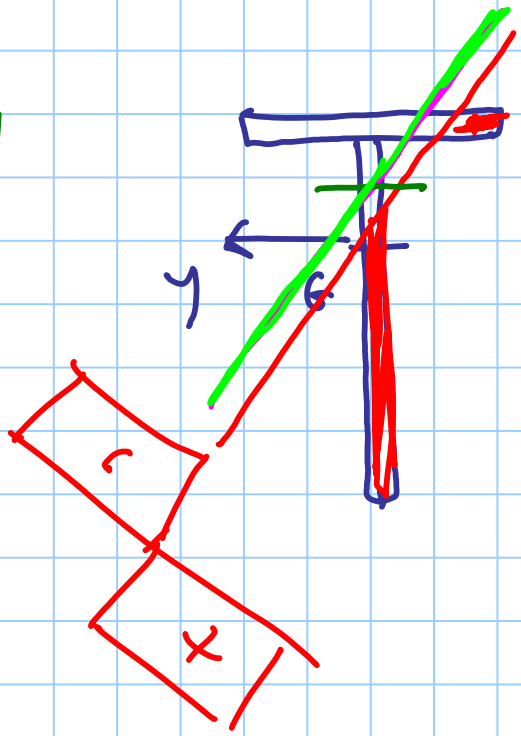
l'asse neutro divide la sezione in due parti di area uguale



l'asse neutro divide la sezione in 2 parti:
di area uguale anche per flessione deviata

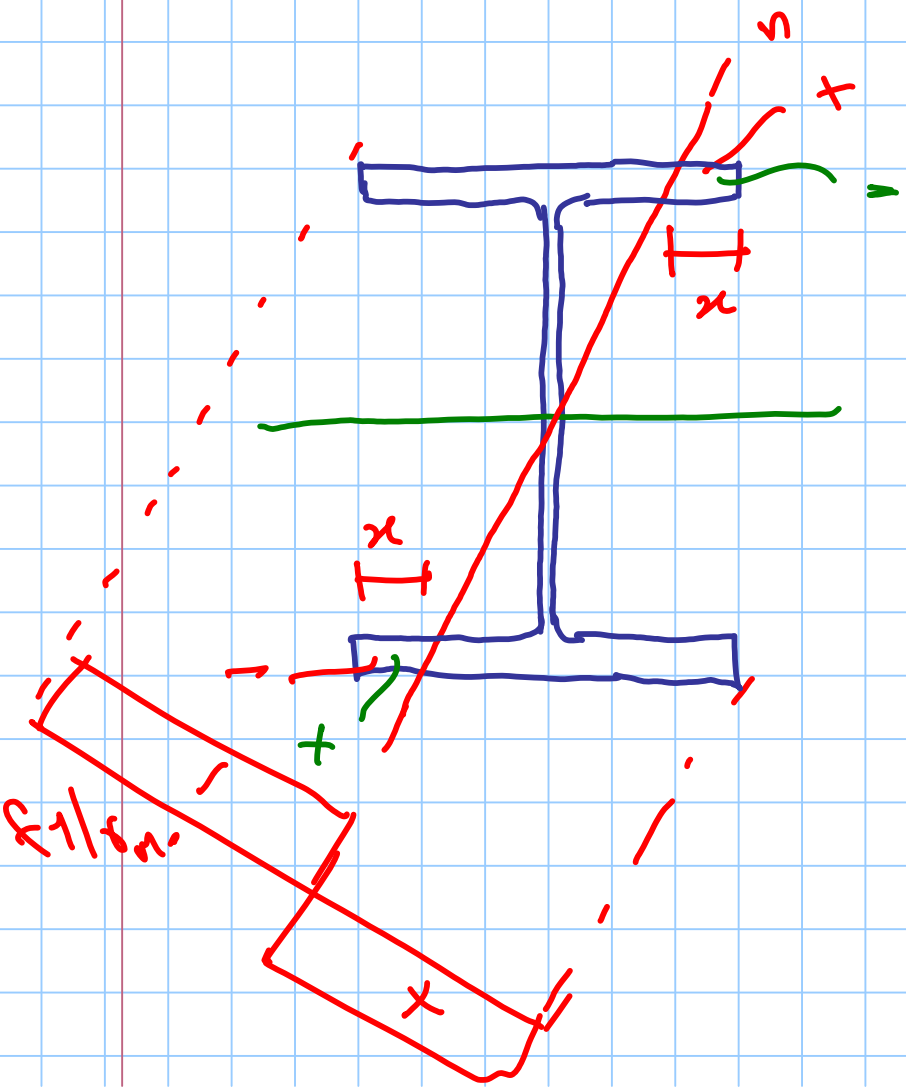






va bene? No

con -



per un
assegnato

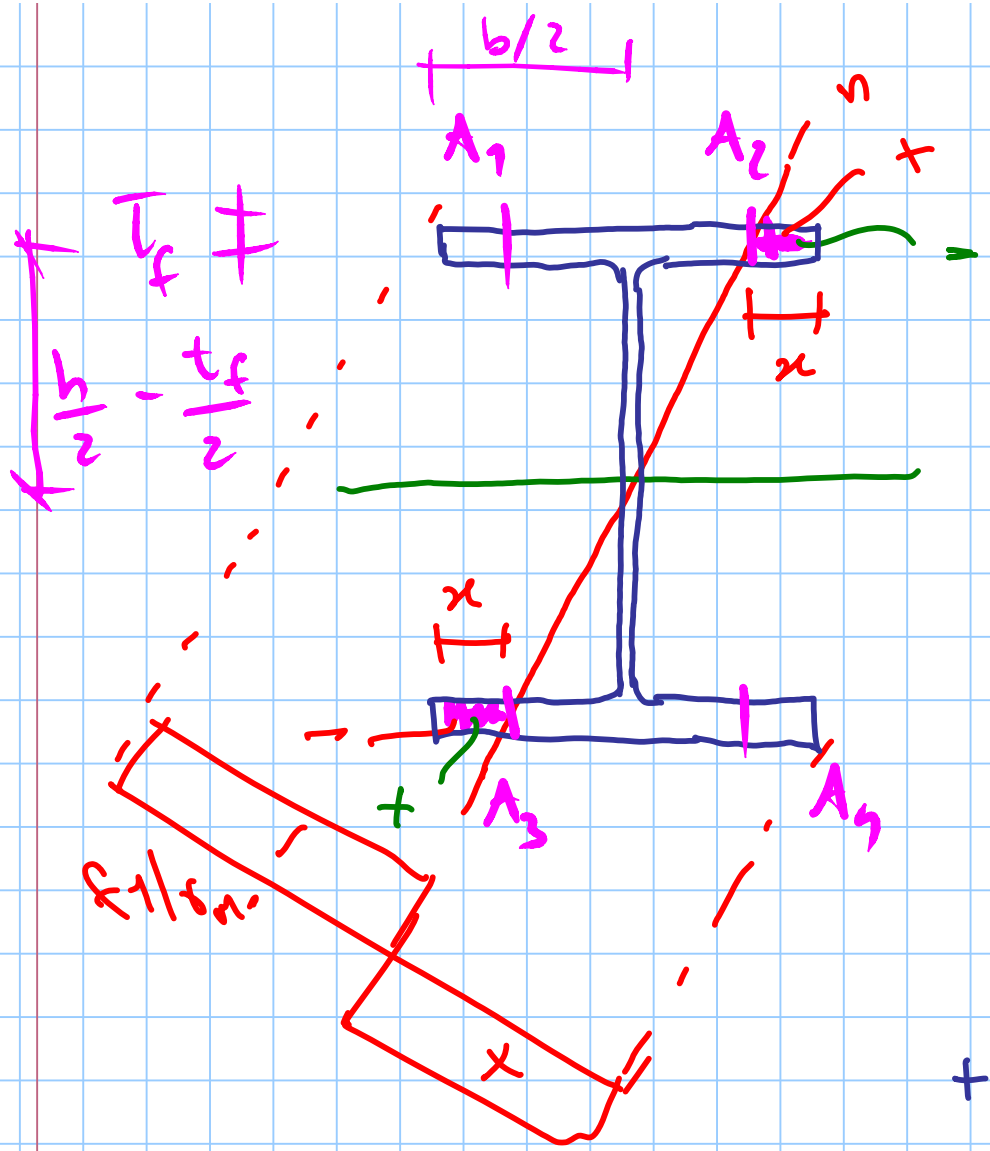
$$M_{y,Rd} = \int \sigma z \, dA$$

$$M_{z,Rd} = -\int \sigma y \, dA$$

Troviamo una
coppia $M_{y,Rd} - M_{z,Rd}$

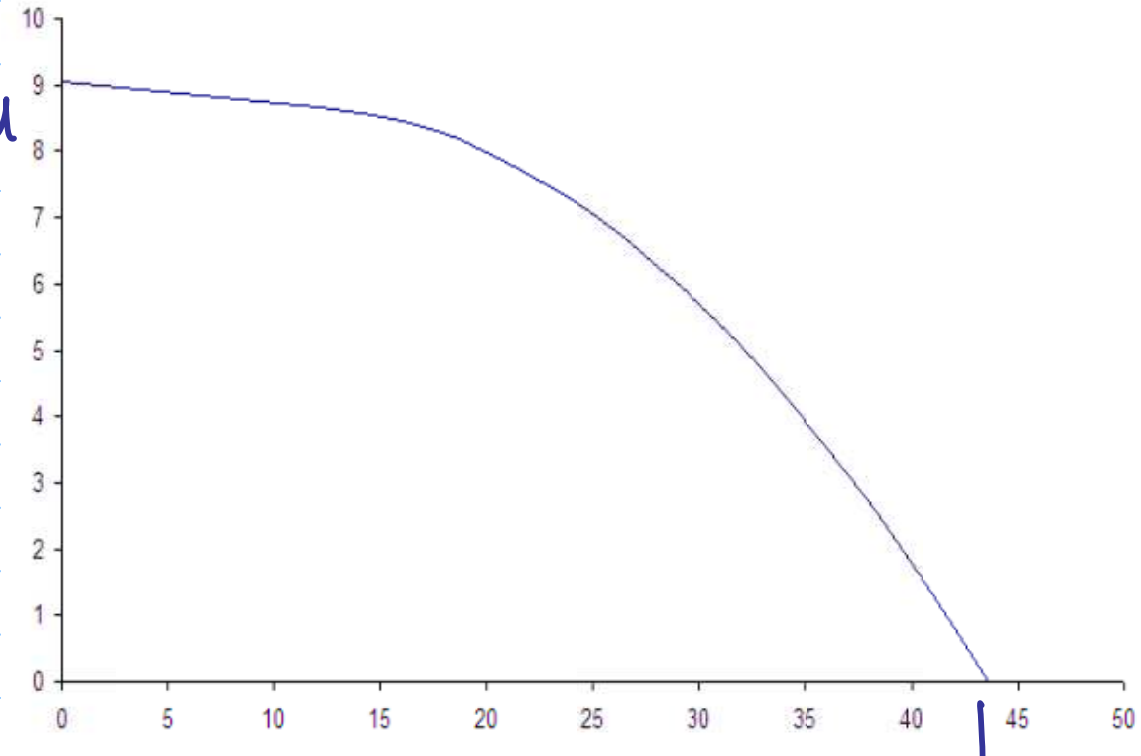
⇓

un punto del
contorno dominio

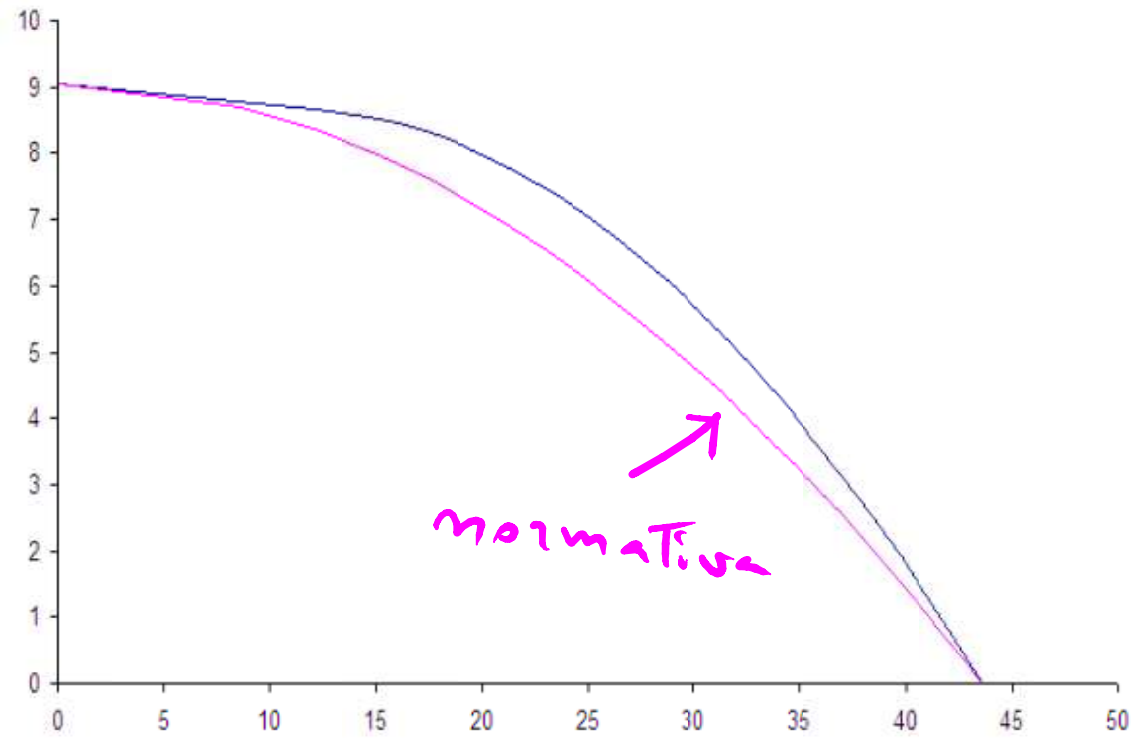


$$M_y = M_{y,Rd} - \tfrac{1}{4}\, x\, t_f \left(\frac{h}{2} - \frac{t_f}{2}\right) \frac{f_y}{\gamma_{M0}}$$

$$M_z = 0 + \tfrac{1}{4}\, x\, t_f \left(\frac{b}{2} - \frac{x}{2}\right) \frac{f_y}{\gamma_{M0}}$$



facendo variare
n



$$\left(\frac{M_{y,Ed}}{M_{y,Rd}}\right)^2 + \left|\frac{M_{z,Ed}}{M_{z,Rd}}\right| \leq 1$$

COMPRESSIONE

TRAZIONE

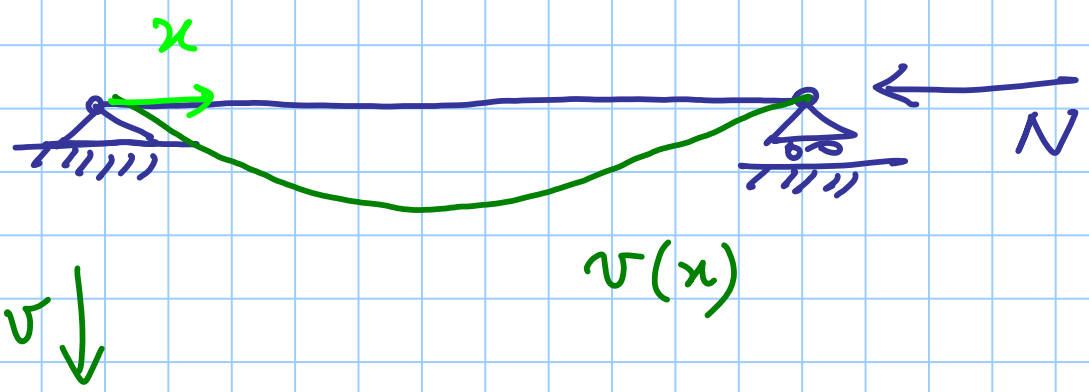
- $N_{pl,Rd} = A \frac{f_y}{\gamma_{M0}}$
- $N_{u,Rd} = 0.9\, A_{net} \frac{f_u}{\gamma_{M2}}$ in presenza di fori

COMPRESSIONE

sezione $N_{pl,Rd} = A \frac{f_y}{\gamma_{M0}}$

\+ INSTABILITA'

asta lung. L



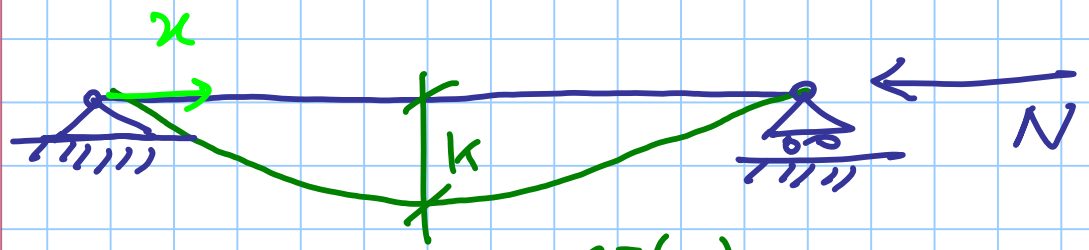
nasce momento flettente $M = N v$

$$v'' = -\frac{M}{EI} \qquad M = -EI\,v''$$

dalla 2 : $EI\,v'' + N v = 0$

possible solution

$$v = K \sin \frac{\pi x}{L}$$



v ↓

$$v'' = - K \frac{\pi^2}{L^2} \sin \frac{\pi x}{L}$$

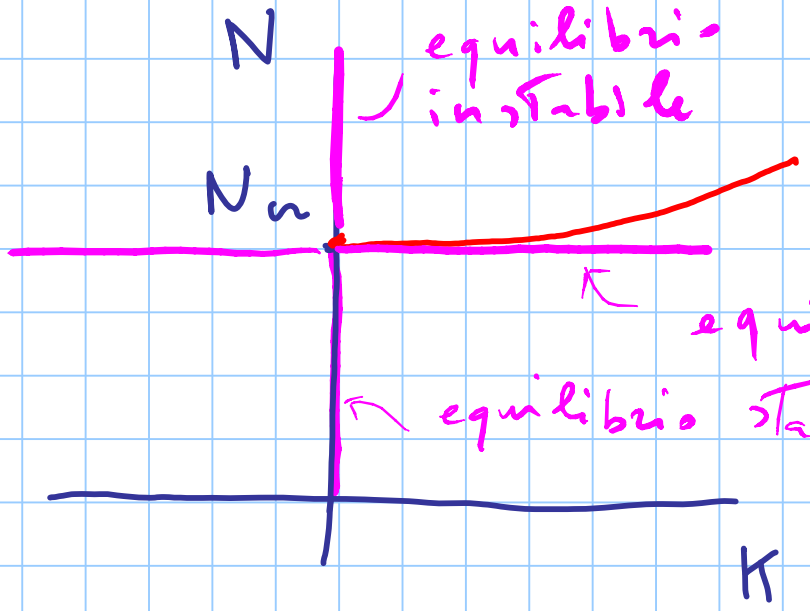
$$-EI\,K\,\frac{\pi^2}{L^2}\sin\frac{\pi x}{L} + N\,K\sin\frac{\pi x}{L} = 0$$

$$-\frac{\pi^2 E I}{L^2}K + N K = 0$$

$K = 0$ soluzione banale (non si deforma flessionalm.)

$$N = \frac{\pi^2 E I}{L^2} = N_{cr}$$ sforzo normale critico

INSTABILITÀ Eulariana o flessionale



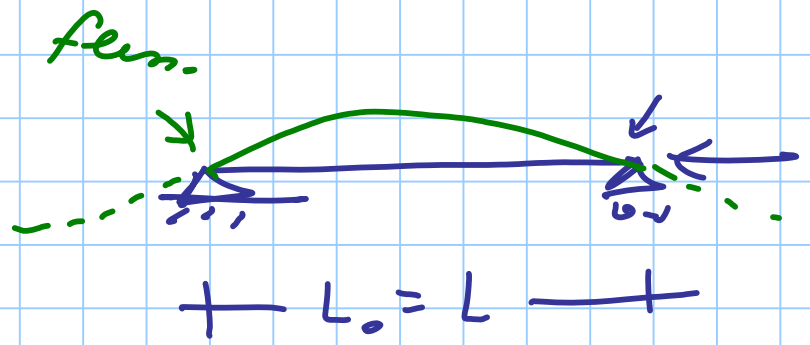
equilibrio instabile

grandi spostamenti: eq. stabile

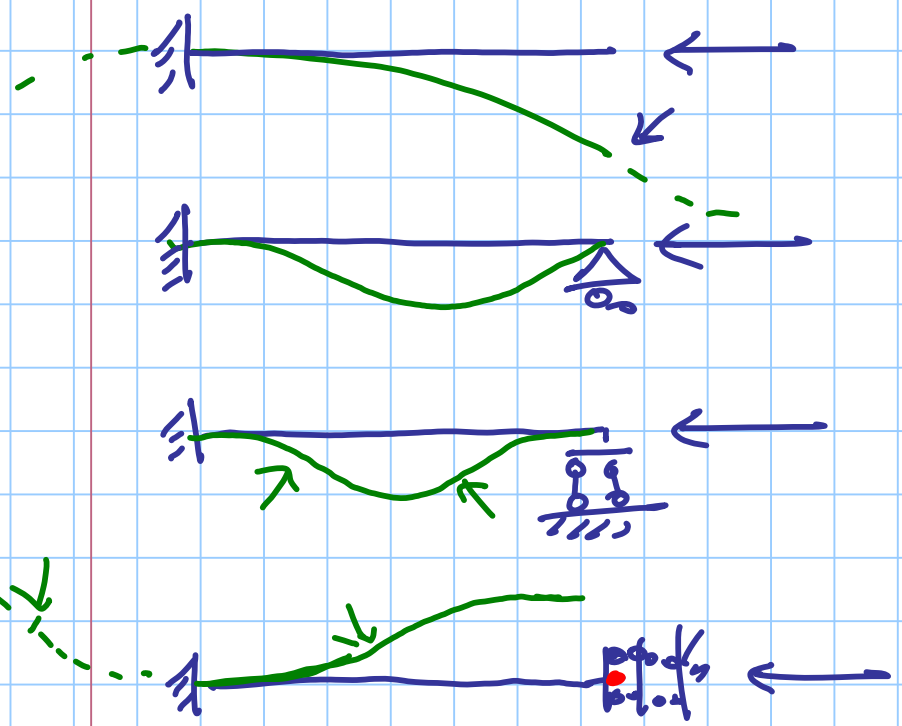
equilibrio indifferente (piccoli spostamenti)

equilibrio stabile

$$N_{cr} = \frac{\pi^2 E I}{L_0^2}$$



L_0 lunghezza libera di inflessione



$L_0 = 2L$

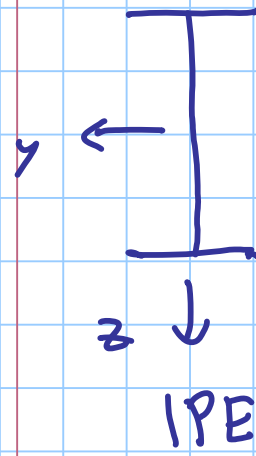
$L_0 = L/\sqrt{2}$

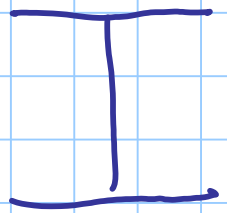
$L_0 = L/2$

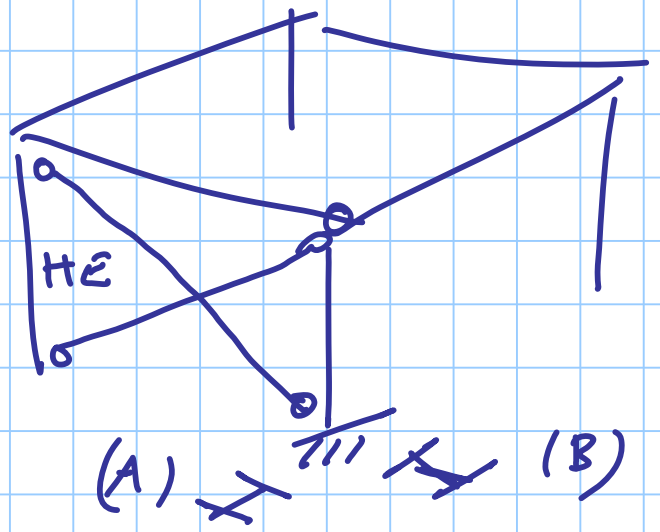
$L_0 = L$

N_{cr} → problem in 3D

considerare vincoli e I in 3D







$I_z << I_y$ → $N_{cr,z} << N_{cr,y}$ instabil. (A)