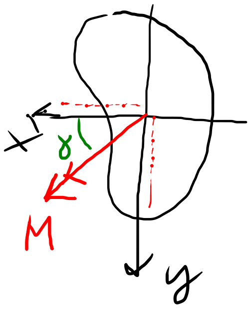
FLESSIONE DEVIATA

SDC, 12/12/23



$$M_x = M\cos\gamma$$

$$M_y = M\sin\gamma$$

$$\sigma_{zz} = \overbrace{\frac{M\cos\gamma}{I_x}}^{M_x} y - \overbrace{\frac{M\sin\gamma}{I_y}}^{M_y} x$$

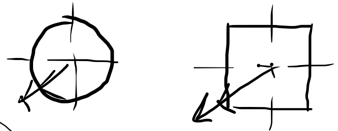
EQ. ASSE NEUTRO - (RETTA BARICENTRICA)

$$\frac{\cancel{M}\cos\gamma}{I_x} y - \frac{\cancel{M}\sin\gamma}{I_y} x = 0$$

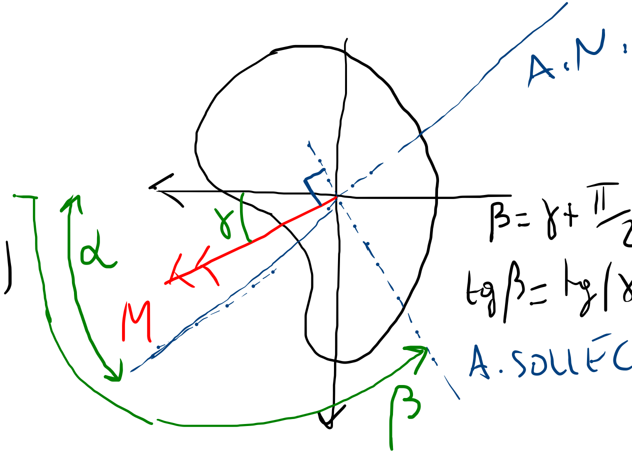
$$y = \overbrace{\frac{\sin\gamma}{\cos\gamma}\frac{I_x}{I_y}}^{tg\,\alpha} x = \overbrace{tg\,\gamma \frac{I_x}{I_y}}^{tg\,\alpha} x$$

QUANDO $I_x = I_y \Rightarrow tg\,\gamma = tg\,\alpha$

IL PROBLEMA È DI FLESSIONE RETTA

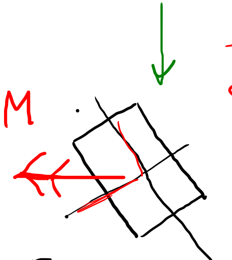


STUDIAMO IL CASO CON $I_x \neq I_y$

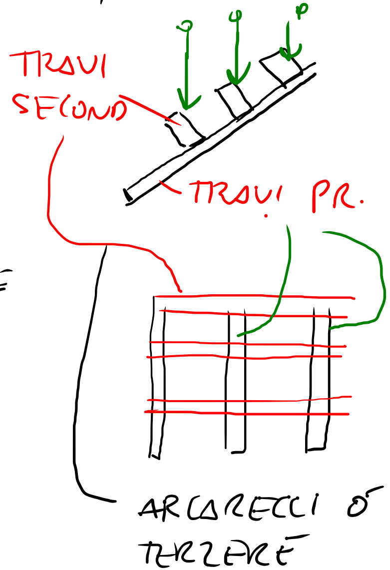


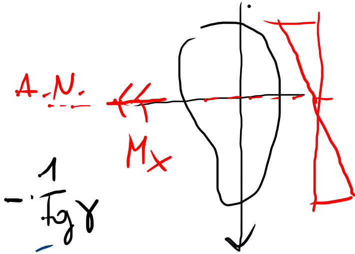
$$\beta = \gamma + \frac{\pi}{2}$$

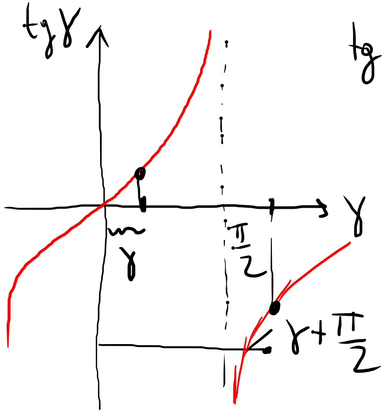
$$tg\,\beta = tg\left(\gamma + \frac{\pi}{2}\right) = -\frac{1}{tg\,\gamma}$$



FLESSIONE DEVIATA







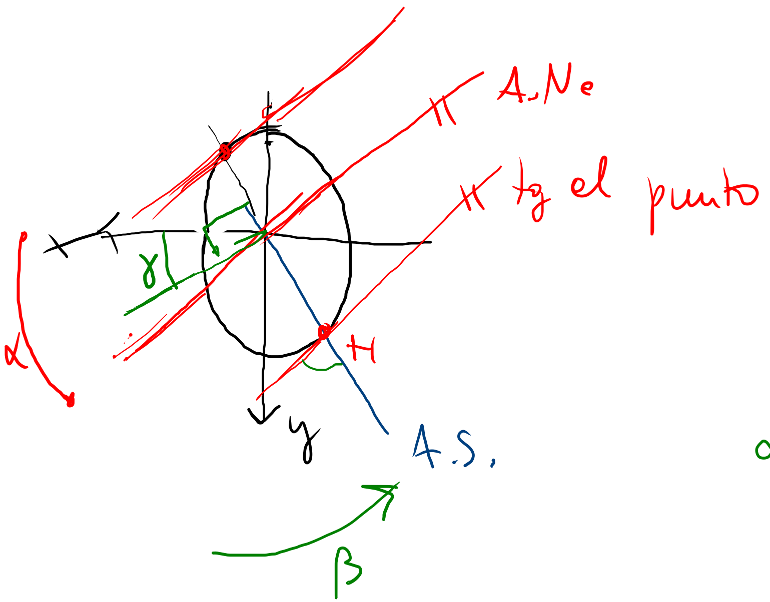
$$tg\beta = tg\left(\gamma+\frac{\pi}{2}\right) = -\frac{1}{tg\gamma} \quad ; \quad tg\gamma = -\frac{1}{tg\beta} \quad ; \quad \boxed{y = \underbrace{-\frac{1}{tg\beta}\frac{I_x}{I_y}}_{tg\alpha}\, x}$$

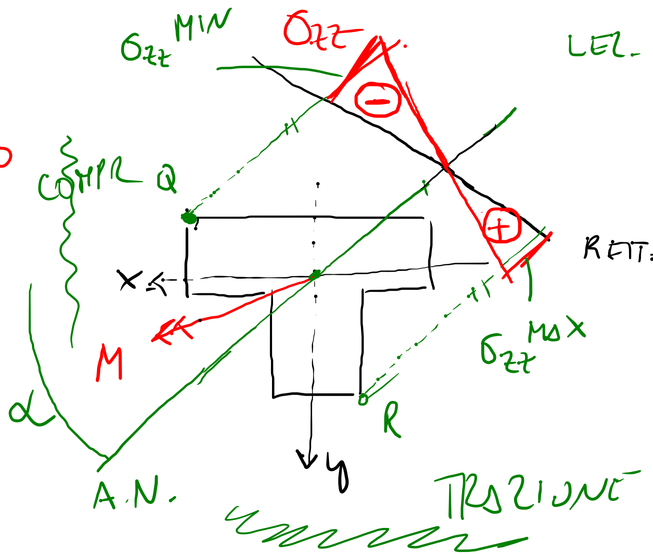
tra $tg\beta$ e $tg\alpha$ c'è questo rapporto:

$$\boxed{tg\alpha \cdot tg\beta = -\frac{I_x}{I_y}}$$

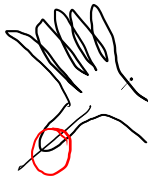
RELAZIONE DI CONIUGIO
TRA ASSE DI SOLLECITAZ.
E ASSE NEUTRO

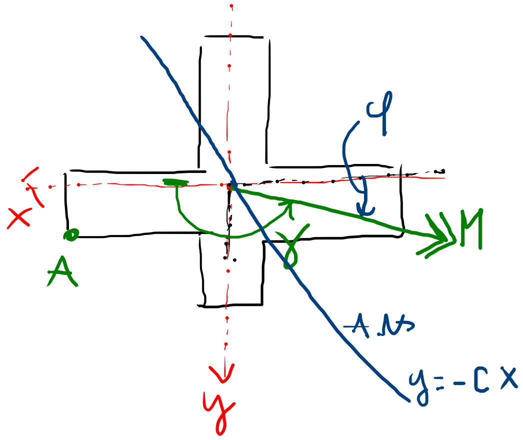
LEZ. GdA 26/10 ?





$\sigma_{zz}(R)$
$\sigma_{zz}(Q)$ si possono esattamente con le formule analitica.





$M_x < 0 \quad ; \quad M_x = M \cos\gamma$

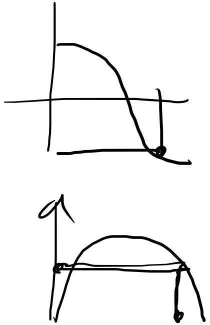
$M_y > 0 \quad\quad M_y = M \sin\gamma$

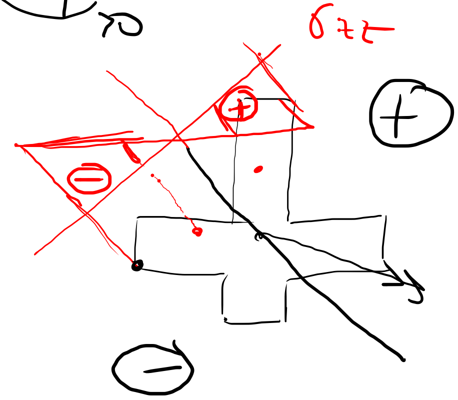
$$\sigma_{zz} = \frac{M_x}{I_x} y - \frac{M_y}{I_y} x$$

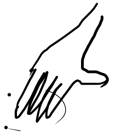
$$M_x = - M \underbrace{\cos\varphi}_{>0}$$

$$M_y = + M \underbrace{\sin\varphi}_{>0}$$

DIAGR. QUALITATIVO







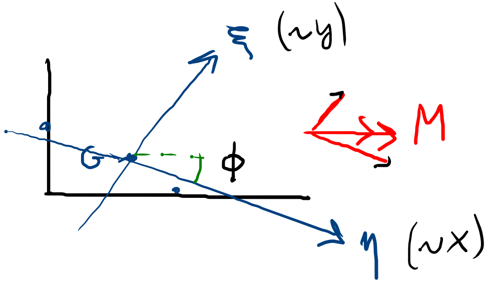
$$\sigma_{zz} = \frac{-M\cos\varphi}{I_x} y - \frac{M \sin\varphi}{I_y} x$$

A.N.

$$\frac{\cos\varphi}{I_x} y + \frac{\sin\varphi}{I_y} x = 0$$

$$y = - \frac{\sin\varphi}{I_y} \frac{I_x}{\cos\varphi} x = - \overbrace{\operatorname{tg}\varphi \frac{I_x}{I_y}}^{c} x$$

$$\sigma_{zz}(A) = - \frac{M\cos\varphi}{I_x} y_A^{>0} - \frac{M\sin\varphi}{I_y} x_A^{>0} < 0$$



$I_\xi > I_\eta$

PROBL. FLESSIONE DEVIATA

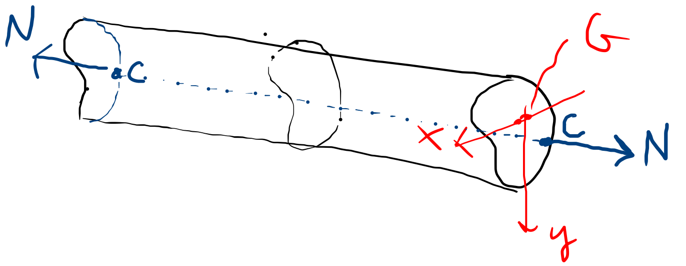
$$\sigma_{zz} = \frac{M_\eta}{I_\eta}\xi - \frac{M_\xi}{I_\xi}\eta$$

$$M_\eta = + M\cos\phi$$

$$M_\xi = + M\sin\phi$$

TENSOFLESSIONE (o FORZA NORMALE ECCENTRICA)
($N > 0$)

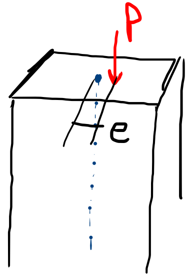
C: CENTRO DI PRESSIONE



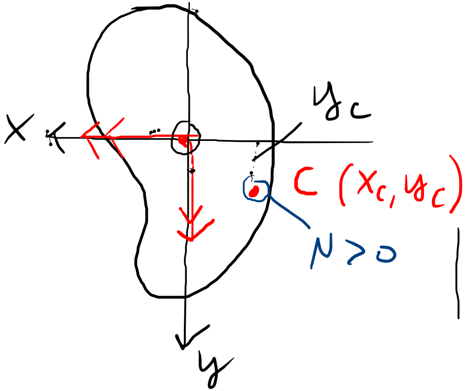
(TENSO FLESSIONE)

M_x, M_y, N:

$$\sigma_{zz} = \underbrace{\frac{N}{A}}_{\text{FORZA NORMALE}} + \underbrace{\frac{M_x}{I_x} y - \frac{M_y}{I_y} x}_{\text{FL. DEV.}}$$



PRESSOFLESSIONE
($N < 0$)



$$\left.\begin{array}{l} N > 0 \\ x_c < 0 \\ y_c > 0 \end{array}\right\} \quad \begin{array}{l} M_x = N y_c > 0 \\ M_y = -N x_c > 0 \end{array}$$

$$\boxed{\sigma_{zz} = \frac{N}{A} + \frac{N \overset{\text{ASS.}}{y_c}}{I_x} y + \frac{N \overset{\text{ASS.}}{x_c}}{I_y} x}$$

$$\sigma_{zz}(G) = \frac{N}{A}$$
$(y_G = x_G = 0)$

$I_x = \rho_x^2 A$

$I_y = \rho_y^2 A$

$$\sigma_{zz} = \frac{N}{A} \left[1 + \frac{y_c\, y}{\rho_x^2} + \frac{x_c\, x}{\rho_y^2} \right]$$

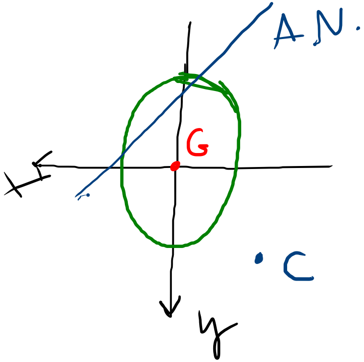
A.N.: $\sigma_{zz} = 0$

$$\left[1 + \frac{y_c}{\rho_x^2} y + \frac{x_c}{\rho_y^2} x = 0 \right]$$

EQ. RETTA NON BARICENTRICA

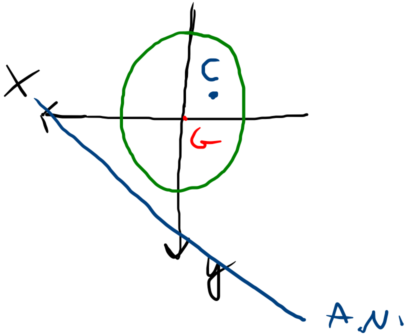
$y = mx + q$

L'EQ DELL' A.N. CORRISP. A QUELLA CHE GOVERNA IL RAPPORTO PUNTO E ANTIPOLARE NELLA POLARITÀ AVENTE COME CONICA FONDAMENTALE L'ELLISSE PRINCIPALE D'INERZIA



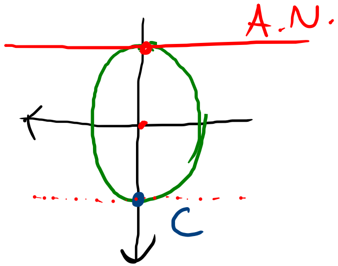
C esterno all'ellisse

A.N. interseca l'ellisse



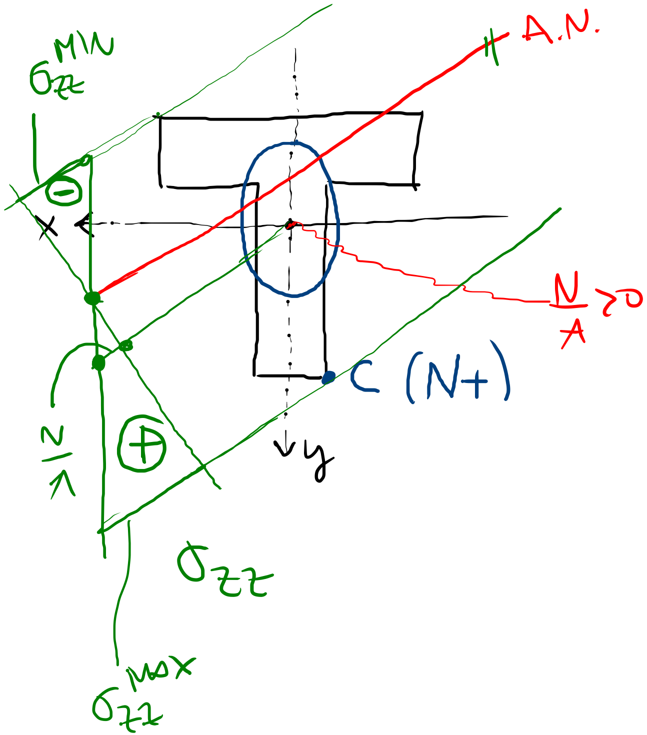
C interno all'ellisse

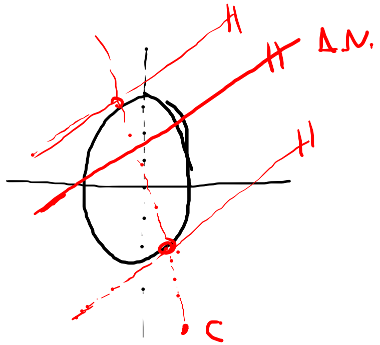
A.N. esterno



$C \in$ all'ellisse

A.N. tangente all'ellisse





G
C

LIMITI IMPORTANTI

$C \to G$ A.N. $\to$ ALLA RETTA IMPROPRIA (INFINITO) $\Rightarrow$ FORZA NORMALE

($\sigma_{zz} \to$ COSTANTI)

$C \to \infty$ A.N. $\to$ BARICENTRO $\Rightarrow$ FLESSIONE DEVIATA

$\sigma_{zz}(G) \to 0$