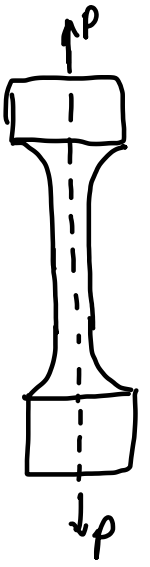
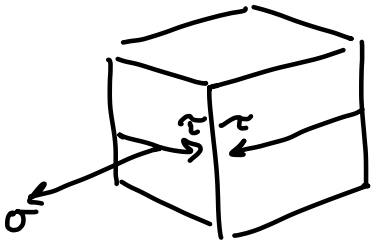
Lezione 16 - Verifica di resistenza statica dei materiali metallici

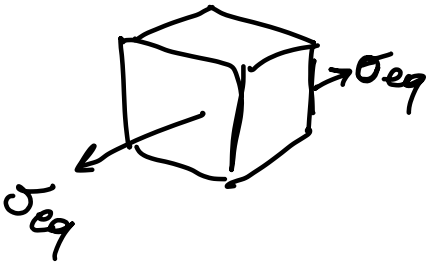
$$\sigma \leq \frac{\sigma_{lim}}{\eta} \rightarrow$$



σ_{lim}
- statico
  - σ_m → duttili
  - σ_{sn} → fragili
- dinamico → σ_f



Sforzo monoassiale equivalente in termini di pericolo di cedimento



Criteri
- materiali fragili
  - ↳ rottura per scivolamento, piano normale a sforzo principale massimo

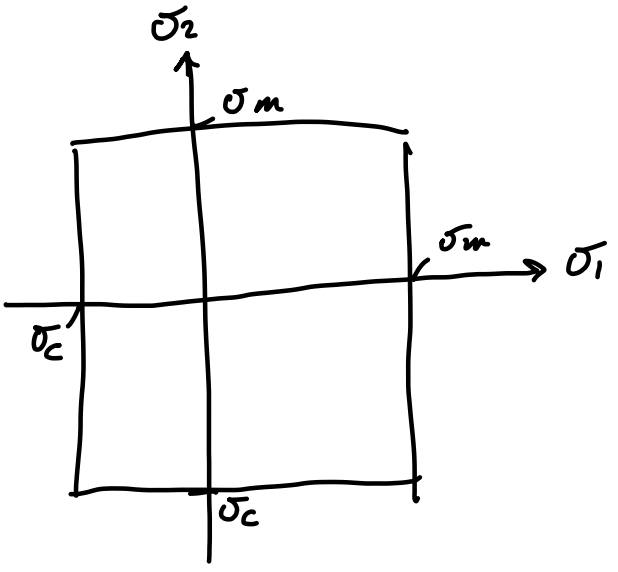
Criterio Galileo

$\sigma_{eq} = \sigma_{prima} \quad \sigma > 0$

$\sigma_{eq} = |\sigma_{prima}| \quad \sigma < 0$

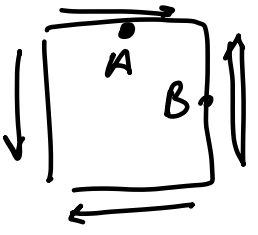
$\sigma_{eq} \leq \frac{\sigma_m}{\eta} \quad \sigma > 0$

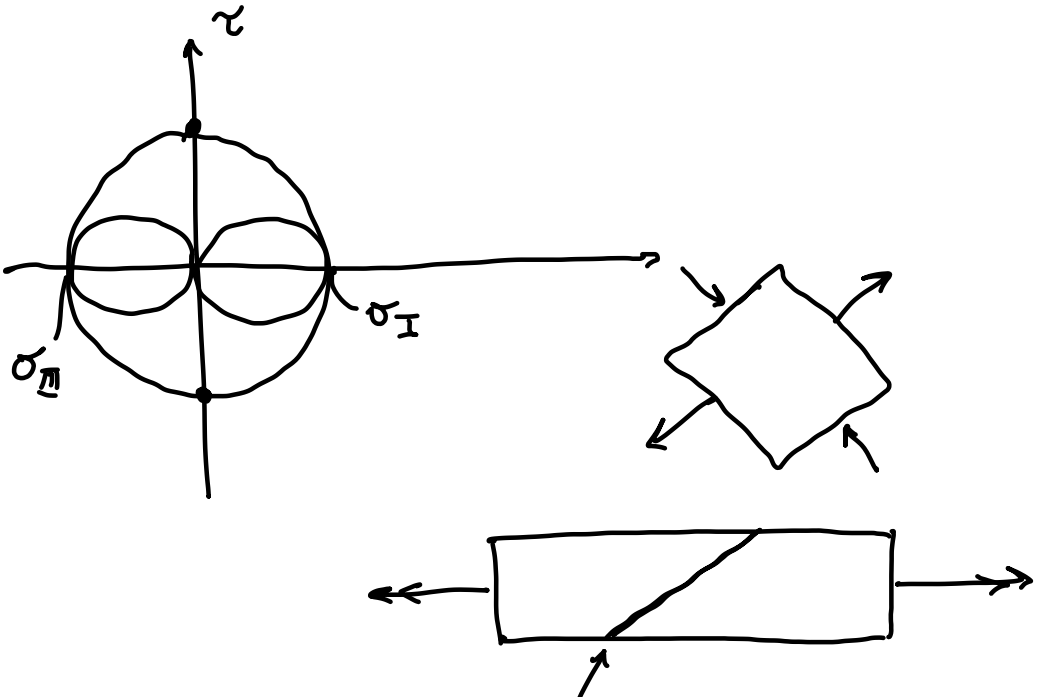
$|\sigma_{eq}| \leq \frac{|\sigma_c|}{\eta} \quad \sigma < 0$



Per i materiali fragili uno stato di sforzo deve esser diverso a questa forma per non rompersi.

Esempi





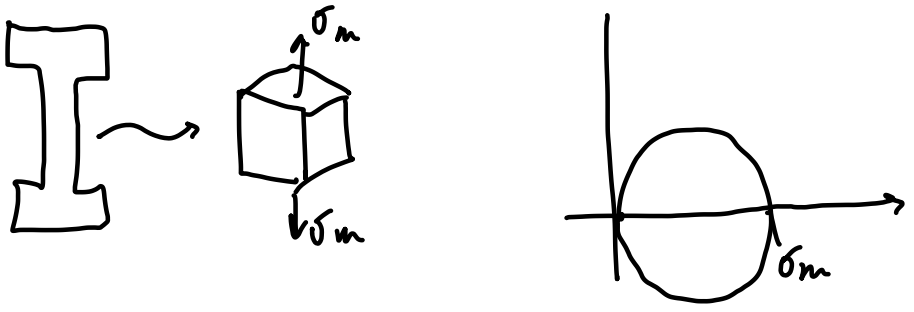
È un elica, però questo è solo 1 angolo

Materiali Duttili

Criterio di Guest–Tresca

$$\tau_{MAX} \leq \frac{\tau_{su}}{\eta}$$

Come trovare τ_{su}? (Peraltro non dato)

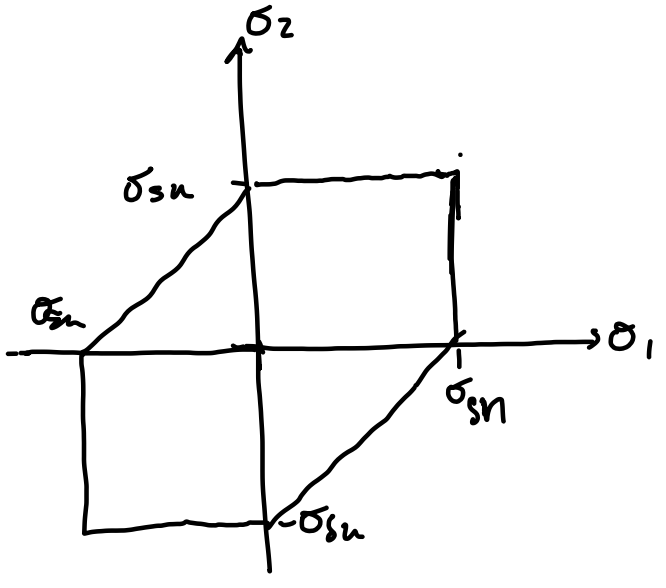


$$\tau_{MAX} = \frac{\sigma}{2}$$

$$\frac{\sigma_{pmax} - \sigma_{pmin}}{2} \leq \frac{\sigma_{su}}{\eta}$$

$$\sigma_{pmax} - \sigma_{pmin} \leq \frac{\sigma_{su}}{\eta} \qquad \sigma_3 = 0$$

$\hookrightarrow \sigma_{eqG}$



$\sigma_1 > \sigma_2 > 0 \quad \sigma_{eq} = \sigma_1 = \sigma_{su}$

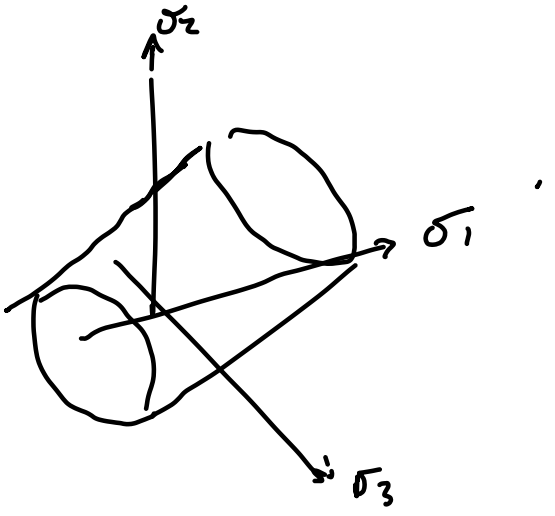
Condizione limite

$\sigma_2 \geq \sigma_1 > 0 \quad \sigma_{eq} = \sigma_2 = \sigma_{su}$

Condizione limite

$\sigma_1 < \sigma_2 < 0 \quad \sigma_{eq} = |\sigma_1|$

$\sigma_1 > 0 \quad e \quad \sigma_2 < 0 \quad \sigma_{eq} = \sigma_1 - \sigma_2$



$\sigma_1 - \sigma_2 = \sigma_{lim}$

Von Mises → Basata su energia

Guarda slide:

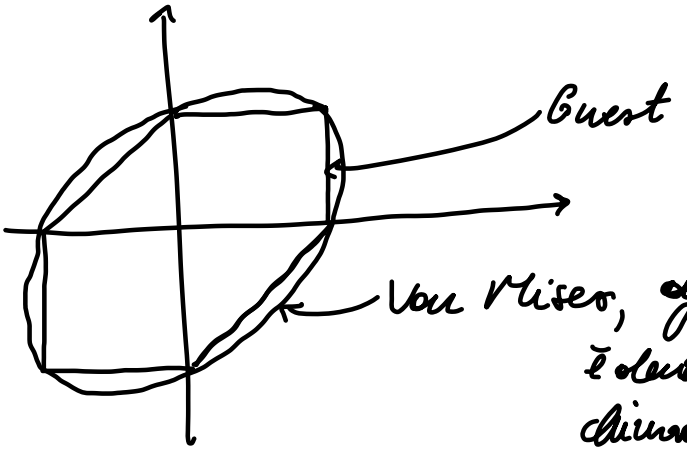
$\sigma_m = \frac{\sigma_1 + \sigma_2 + \sigma_3}{3}$ → variazione volume

$\sigma_1\ \sigma_2\ \sigma_3$ — $S_i = \sigma_1 - \sigma_m$ → variazione di forma

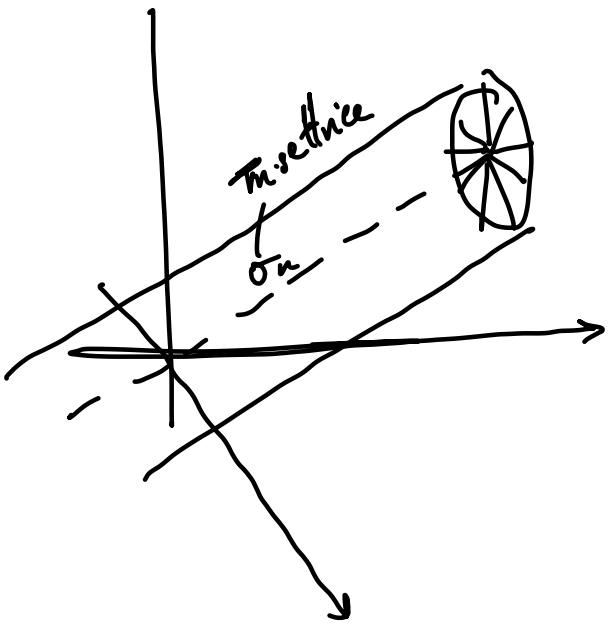
(Troppi passi teorici che non importano per gli esercizi)

$$\sigma_{VM} = \sqrt{\sigma_I^2 + \sigma_{II}^2 + \sigma_{III}^2 - \sigma_I\sigma_{II} - \sigma_{II}\sigma_{III} - \sigma_I\sigma_{III}}$$

Ellisse



Von Mises, ogni stato di Guest è dentro a Von Mises, quindi Guest è più restrittivo di Von Mises.



Se ci muoviamo lungo σ_n non provoca cedimento, 3 stati compressivi non provocano cedimento

Componente deviatorica

↳ come si modifica sul piano

Da ricordare

Fragile Galileo - Rankine $\sigma_{eq} = \sigma_{max}$ $\sigma_{eq} = \frac{\sigma_{rott}}{\eta}$

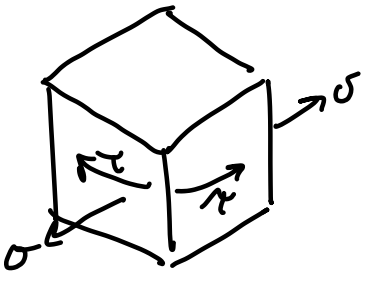
Duttili

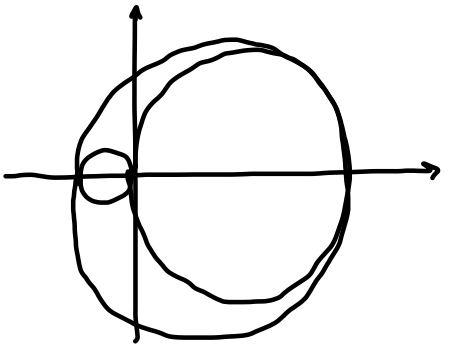
Guest $\sigma_{eq} = \frac{\sigma_{max} - \sigma_{min}}{2}$

Von Mises $\sigma_{vm}^* = \sqrt{\sigma_I^2 + \sigma_{II}^2 + \sigma_{III}^2 - \sigma_I\sigma_{II} - \sigma_I\sigma_{III} - \sigma_{II}\sigma_{III}}$

$$\sigma_{eq} = \frac{\sigma_{cr}}{\eta}$$

Caso di Flessione - Torsione





$$\sigma_I = \frac{\sigma}{2} + \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2}$$

$$\sigma_{II}$$

$$\sigma_{III} = \frac{\sigma}{2} - \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2}$$

$$\sigma_{GT}^{ab} = \sigma_{max} - \sigma_{min} = 2\sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2}$$

$$= \sqrt{\sigma^2 + 4\tau^2}$$

$$\sigma_{VM}^{ab} = \sqrt{\sigma^2 + 3\tau^2}$$