

Corso di laurea in Ingegneria civile strutturale e geotecnica

# Tecnica delle costruzioni

## modulo A

22 - Torsione

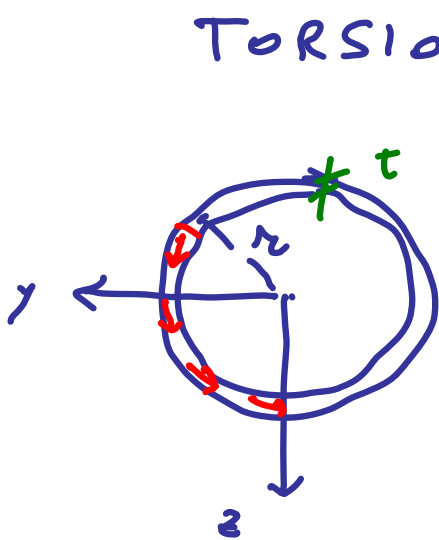
Aurelio Gherzi

18/11/2020

# Torsione

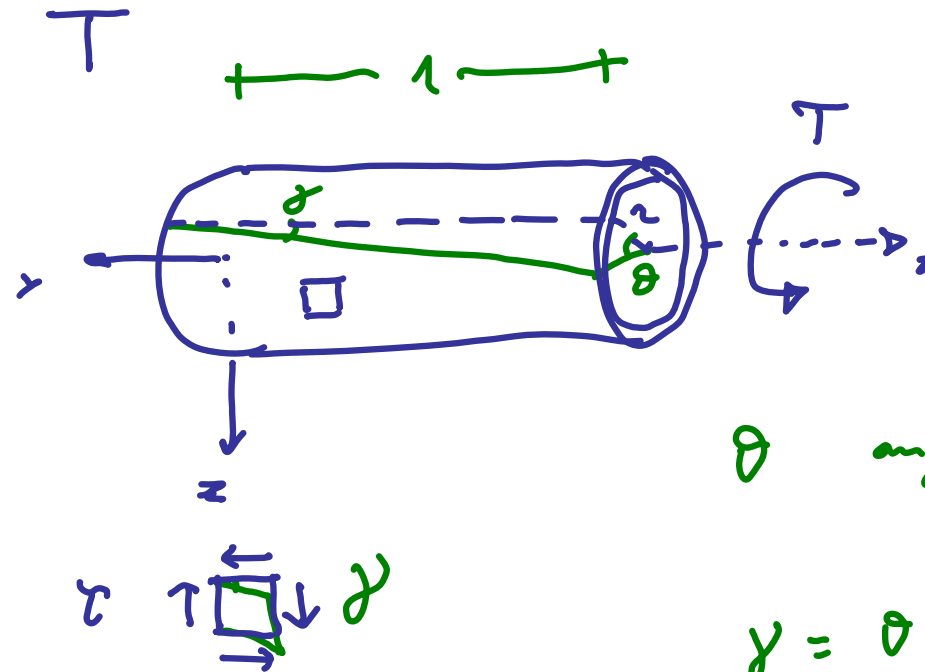
richiami, modello elastico lineare

TORSIONE



$$\tau = G \gamma$$

$$\tau = \frac{T r}{I_p}$$



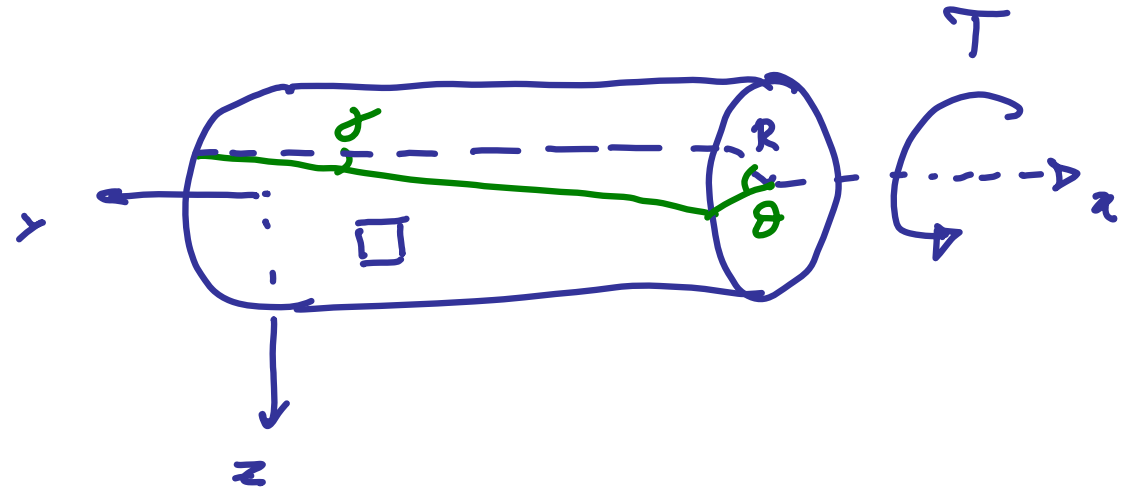
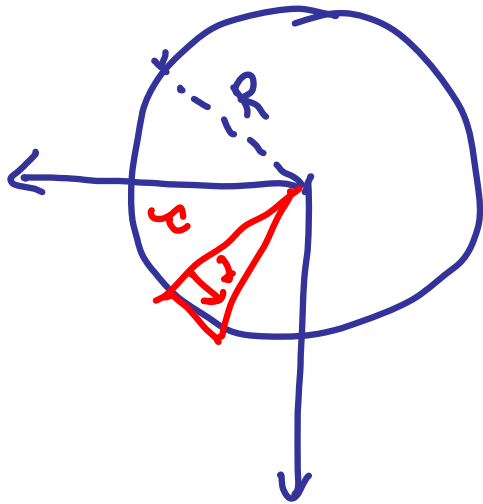
$$T = \int \tau r dA = \tau \cdot r \cdot 2\pi r$$

$\theta$  ang. l. unitaria  
di rotazione

$$\gamma = \theta r \quad \theta = \frac{\varphi}{r}$$

# Torsione

richiami, modello elastico lineare



$$\varphi = \frac{T}{I_p} z$$

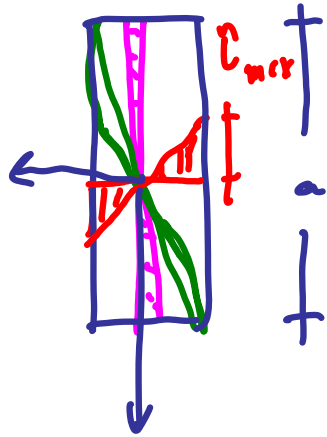
$$\varphi_{max} = \frac{T}{I_p} R$$

varia linearmente in funzione  
della distanza

$$\gamma = \frac{\varphi}{c} = \frac{T}{c I_p} r$$

# Torsione

richiami, modello elastico lineare



$$\tau_{max} = \psi \frac{T}{a b^2}$$

$\psi$  dipende da  $\frac{b}{a}$

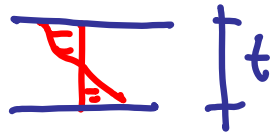
per  $\frac{b}{a} \rightarrow 0 \quad \psi \rightarrow 3$

$$\tau_{max} = 3 \frac{T}{a b^2}$$

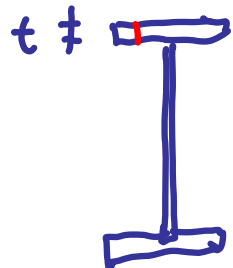
$+ b +$

$a \geq b$

zoom



$$T = \frac{a t^3}{3}$$



profili in acciaio aperti

$b \rightarrow t$  molto piccolo  $\rightarrow$

il profilo non è  
in grado di portare  
una torsione elevata

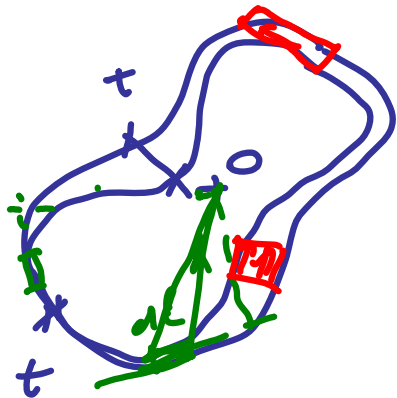
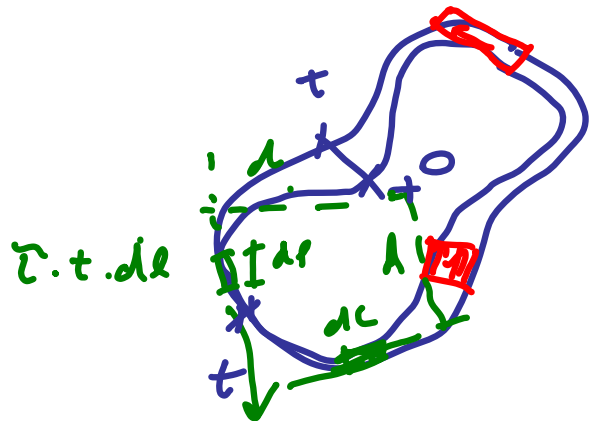
# Torsione

richiami, modello elastico lineare

SEZIONE CHIUSA

$t$  variabile,  $\Rightarrow \tau \cdot t \cdot dl$

$$\tau \cdot t = \text{cost}$$



area triang.  $\cdot 2$

$$\frac{dl \cdot d}{2}$$

BREDT

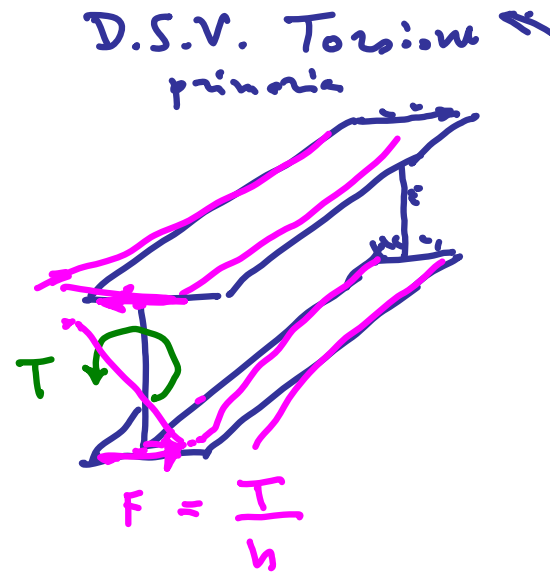
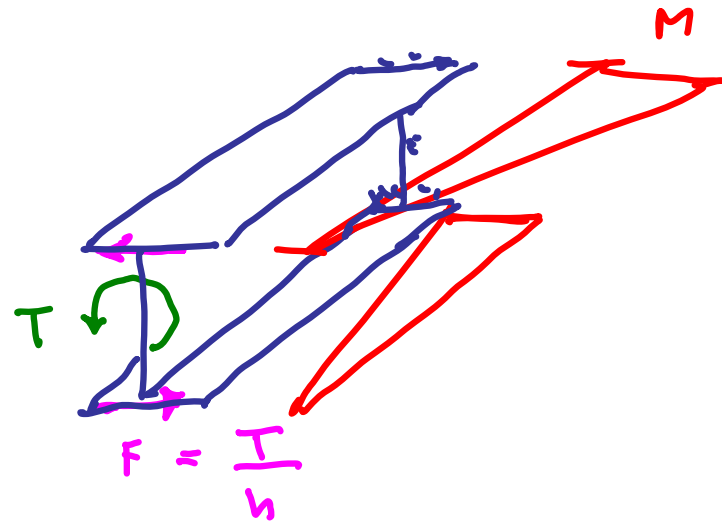
$$T = \int \tau \cdot t \cdot dl = \tau \cdot t \cdot 2 \int dl \cdot d = \tau \cdot t \cdot 2 A_k$$

$$\tau \cdot t \cdot dl \cdot d = 2 dA_k$$

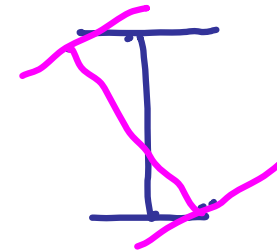
$A_k$  area racchiusa  
da linea media

$$\tau = \frac{T}{2 t A_k}$$

# Torsione



torsione secondo  
VLASOV



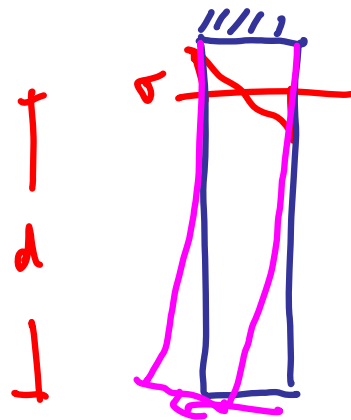
B bimomento

$$B = M \cdot h$$

$w$  : coordinata torsionale

$$\sigma = \frac{B}{I_w} \cdot w$$

$$I_w = \int w^2 dA$$



ALA SUP.

$$M = F \cdot d = \frac{T}{h} d$$

maximo  $\sigma$



ALA INF.

# Torsione

## considerazioni generali

- Quando si ha una torsione non trascurabile è fortemente consigliato di usare un profilo chiuso

$$\tau = \frac{T}{2 t A_k}$$

$$T_{Rd} = 2 t A_k \frac{f_y / \sqrt{3}}{\gamma_{M0}}$$

- La torsione può essere necessaria per l'equilibrio oppure nascere per congruenza
  - La torsione per congruenza può (deve) essere trascurata
  - La torsione per equilibrio deve necessariamente essere considerata

