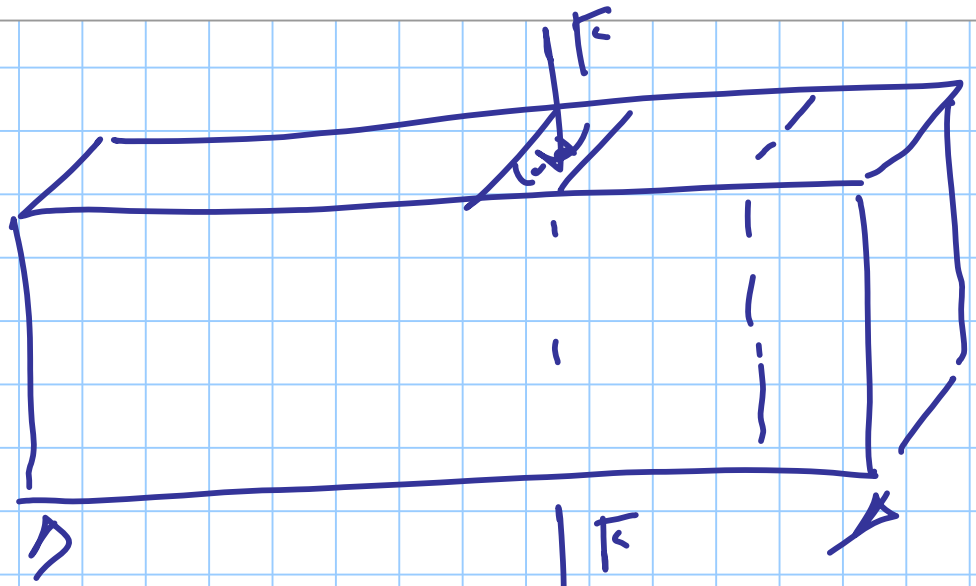
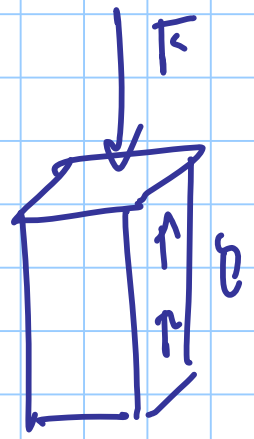
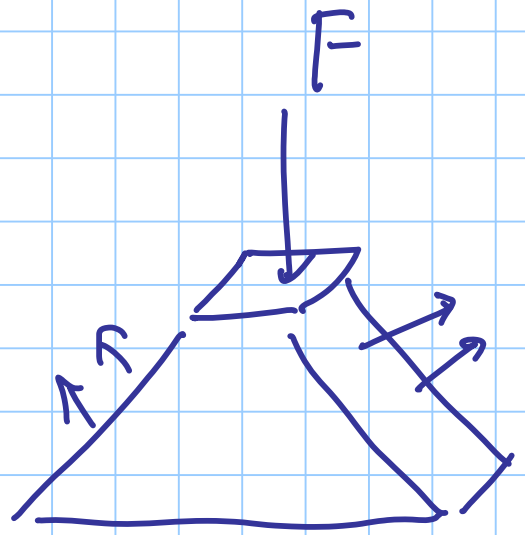
PUNZONAMENTO

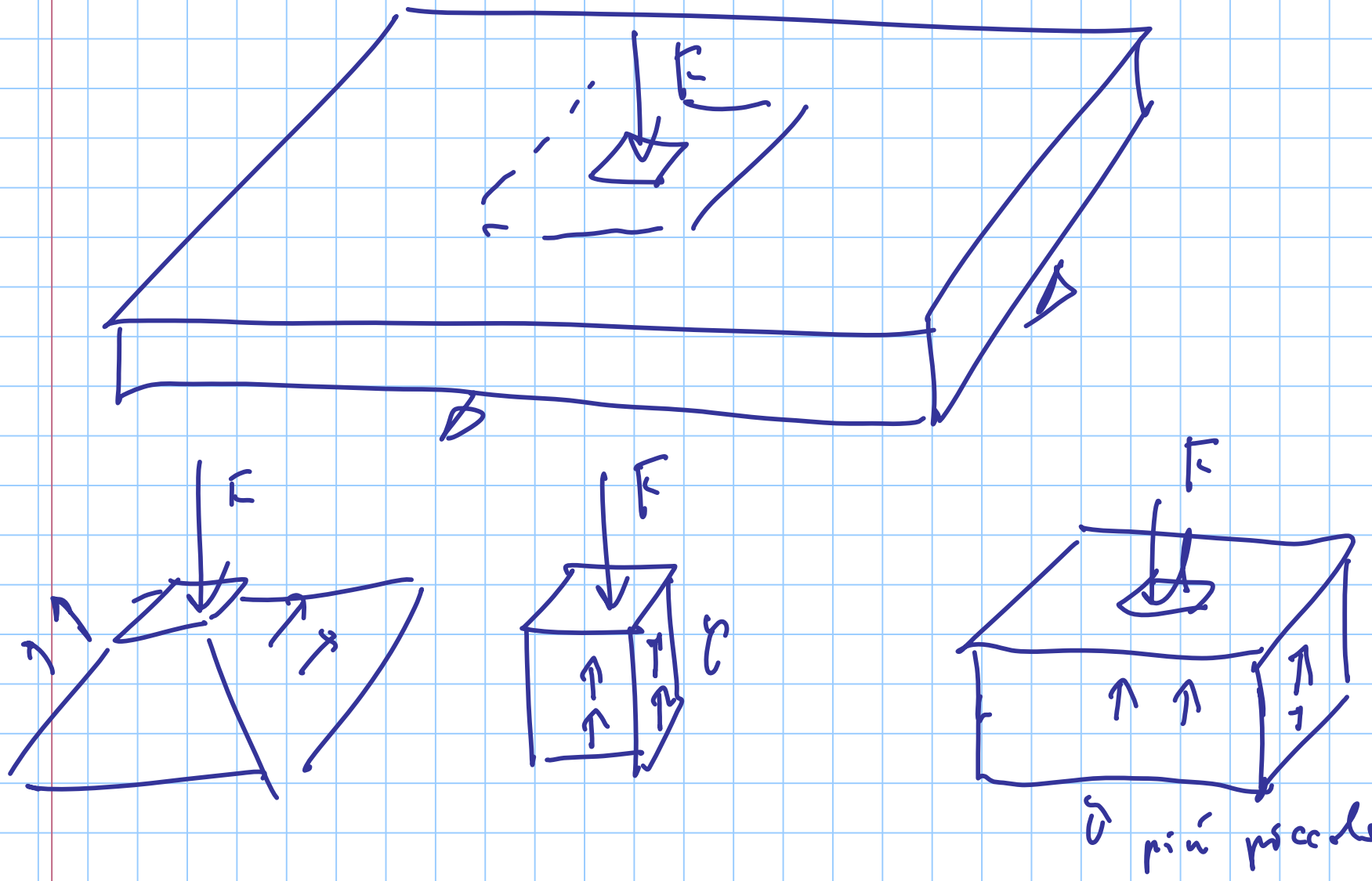
Titolo nota 15/05/2014

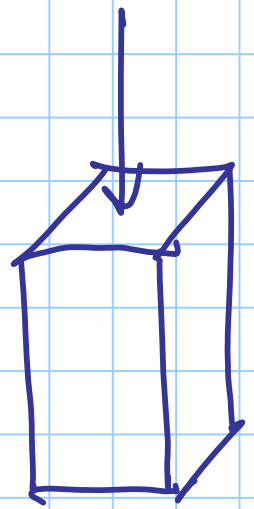


TAGLI-

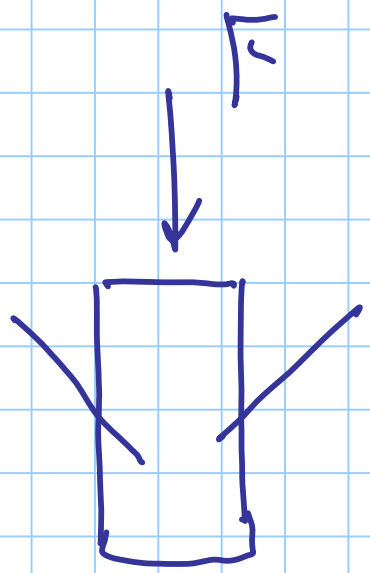





F
F
F
C
O piú piccole



3D

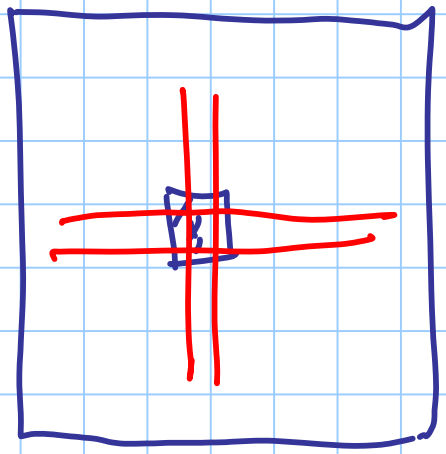


angle = 45°

LATERALE

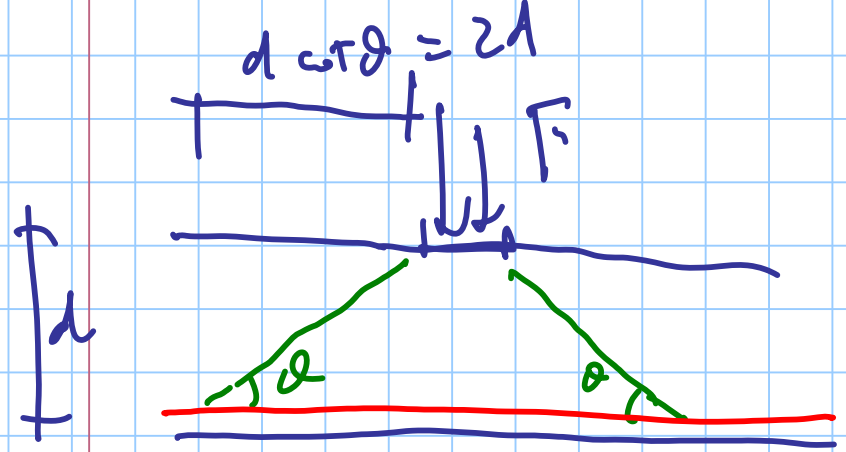
$$\sum N_{xy} = F\sqrt{2}$$

$$A_{xy} = \frac{F\sqrt{2}}{\sigma_s}$$



piano

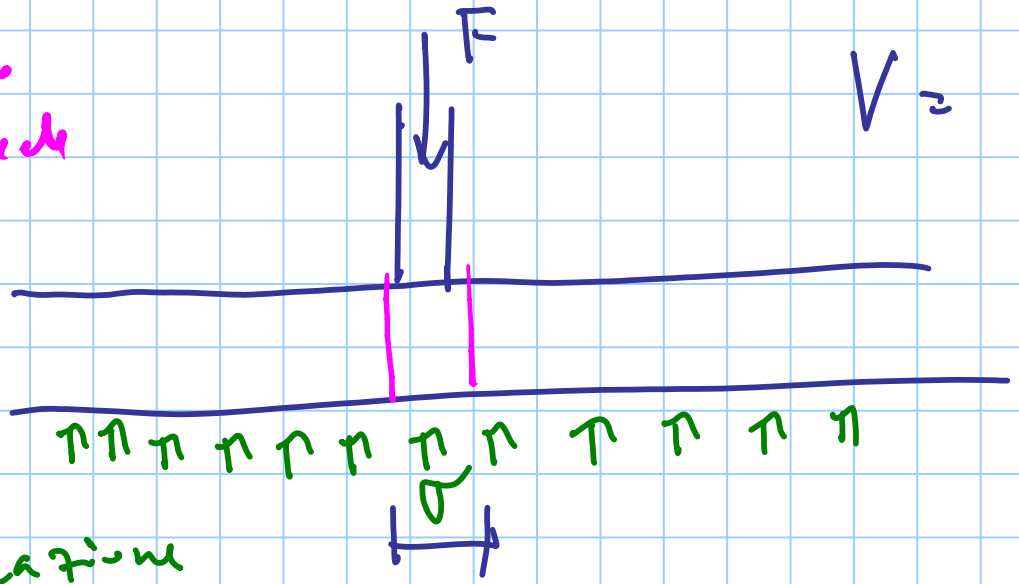
OGGI SLU



$\cot\vartheta = 2$

SEZIONE

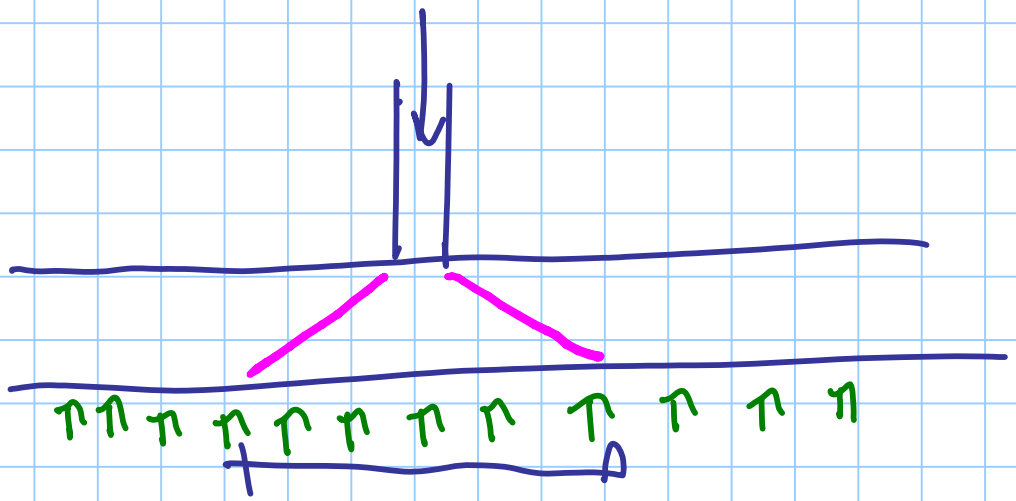
taglio verticale



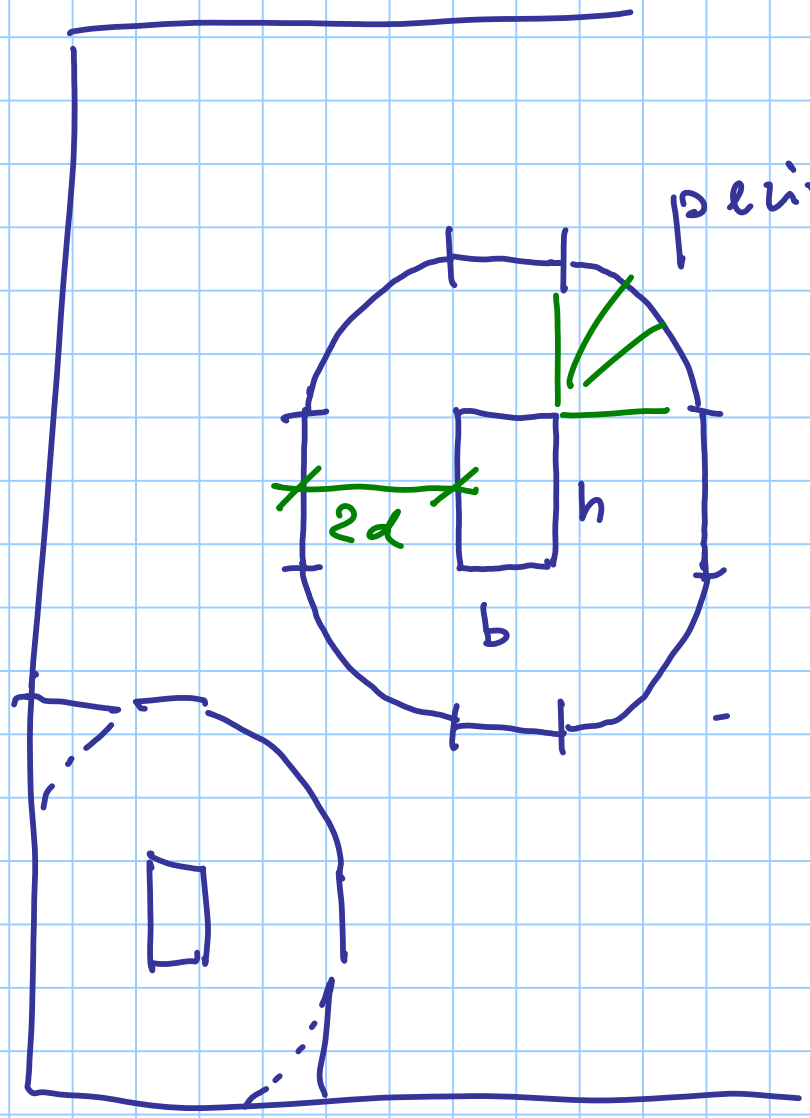
reazione del terreno

$$V = F - A\sigma$$

taglio inclinato



reazione del terreno



perimetro crítico

$$u = 2b + 2h + 2\pi(2d)$$

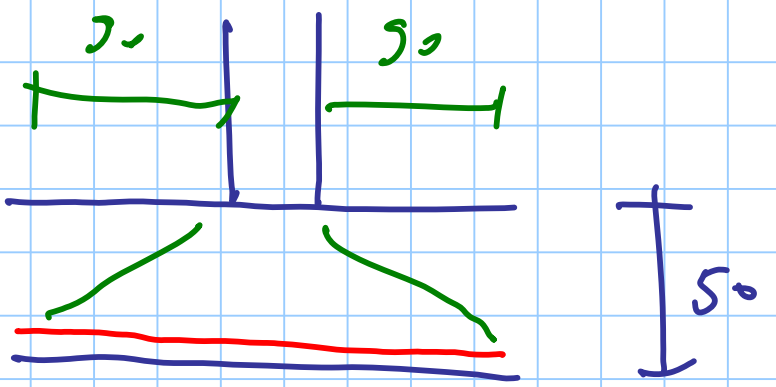
$$A = 2b(2d) + 2h(2d) + \pi(2d)^2 + bh$$

$$= 4(b+h)d + bh + 4\pi d^2$$

pilastr. 30×60

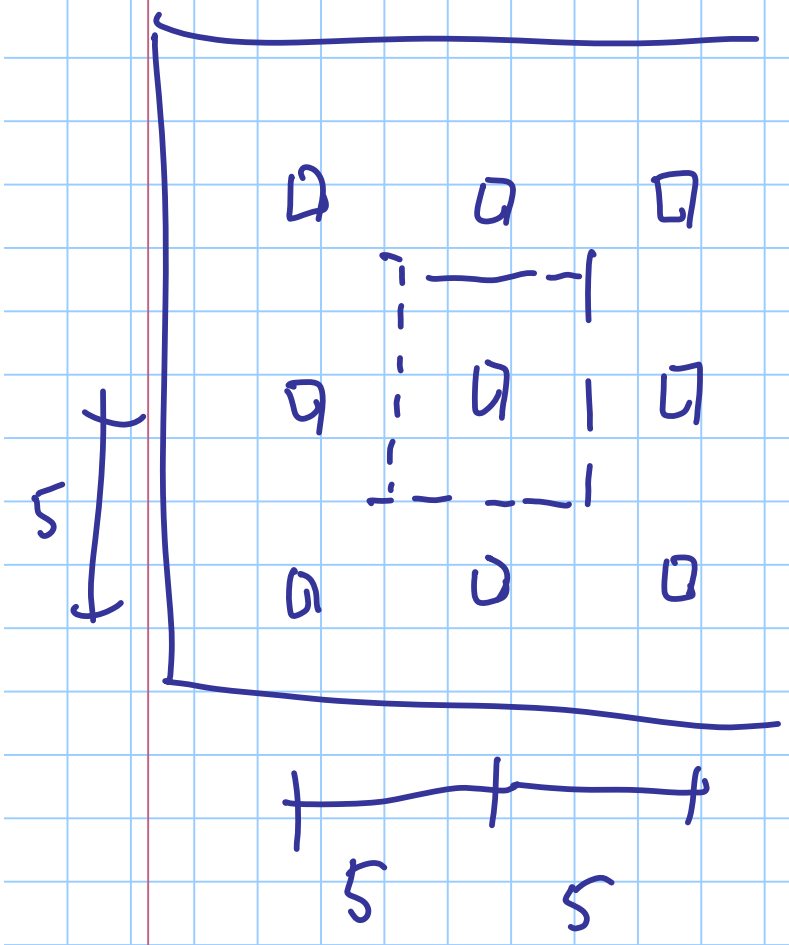
plošča $h = 50$ cm

$d = 45$ cm



$$u = \underbrace{2\times 30 + 2\times 60}_{180} + \underbrace{2\pi(2\times 45)}_{565} = 745 \text{ cm}$$

$$A = \underbrace{4(30+60)45}_{16200} + \underbrace{30\times 60}_{1800} + \underbrace{4\pi 45^2}_{25447} = 43447 \text{ cm}^2 = 4.34 \text{ m}^2$$



$5 \times 5 = 25\ m^2$

$N_{Ed} = 2000\ kN$

$$\sigma_t = \frac{2000 \times 10^3}{25 \times 10^6} = 0.08\ MPa$$

$$V_{Rd} = 2000 - 4.34 \times 10^6 \times \underbrace{\frac{0.08}{1000}}_{347} =$$

$$= 1653\ kN$$

nella trave V_{Ed} taglio (Forze)

nell'elemento bidimensionale $v_{Ed} = \frac{V_{Ed}}{u\, d}\,\beta$ taglio per unità di superficie (tensione)

β per tener conto di eccentricità

$$v_{Ed} = \frac{1653 \times 10^3}{745 \times 45 \times 10^2} = 0.493 \ N/mm^2$$

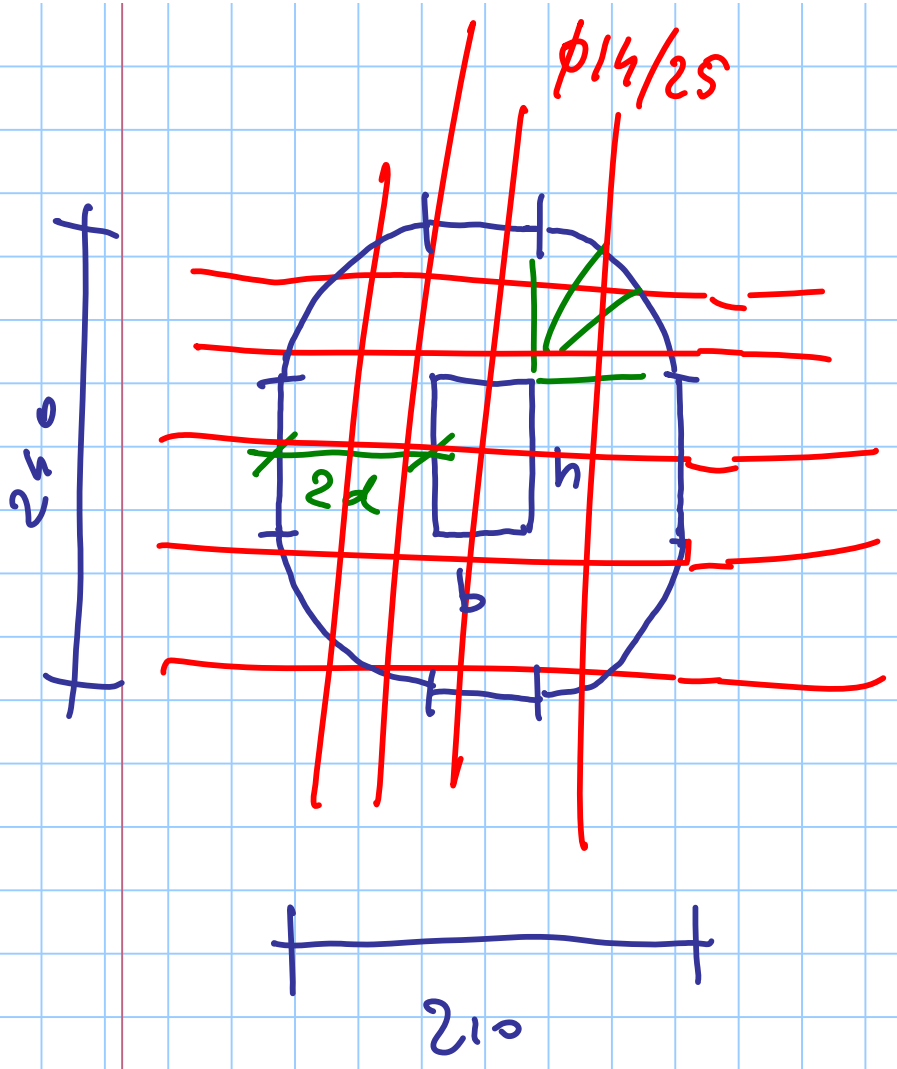
resistenza a punzonamento

in assenza di armatura

$$V_{Rd,c} = \underbrace{\frac{0.18}{\gamma_c}}_{0.035} k \sqrt[3]{100 \rho_l f_{ck}} + 0.10 \sigma_{cp}$$

$$\geq 0.035 \sqrt{k^3 f_{ck}}$$

Trovo $V_{Rd,c} \geq 0.377 \text{ MPa} < V_{Ed}$



armătură

$$\rho = \frac{A_s}{b\,d}$$

$$\rho_x = \frac{1.54}{30 \times 45} = 0.00112$$

$\frac{A_{sx}}{b}$ = armătură pe m

$$\frac{1\phi 14}{30} = \frac{1.54\ cm^2}{30\ cm}$$

$$\frac{A_{sy}}{b} > \frac{1.54}{25}$$

$$\rho_y = \frac{1.54}{25 \times 45} = 0.00137$$

$$\rho_l = \sqrt{\rho_{lx} \cdot \rho_{ly}} = \sqrt{0.00112 \times 0.00137} = 0.00124$$

C25/30

$$K = 1 + \sqrt{\frac{200}{450}} = 1.667$$

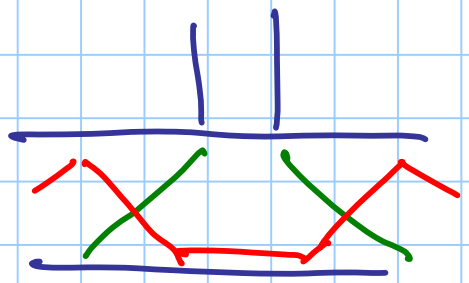
$$\frac{0.18}{\gamma_c} K \sqrt[3]{100 \rho_l f_{ck}} = \frac{0.18}{1.5} 1.667 \sqrt[3]{100 \times 0.00124 \times 25} =$$

$$= 0.292 \text{ MPa}$$

$$0.035 \sqrt{K^3 f_{ck}} = 0.035 \sqrt{1.667^3 \times 25} = 0.377 \text{ MPa}$$

verifica armatura

$$V_{Rd,S} = \frac{A_{sw} f_{yd}}{\sqrt{2}\, n\, d} + 0{,}75\, V_{Rd,c}$$



A_{sw}

$$\frac{A_{sw} f_{yd}}{\sqrt{2}\, n\, d}$$

$$v_{Rd,s} = 0.75\, v_{Rd,c} + 1.5 \frac{d}{s_r} \frac{A_s f_y}{u_1 d} \sin\alpha$$

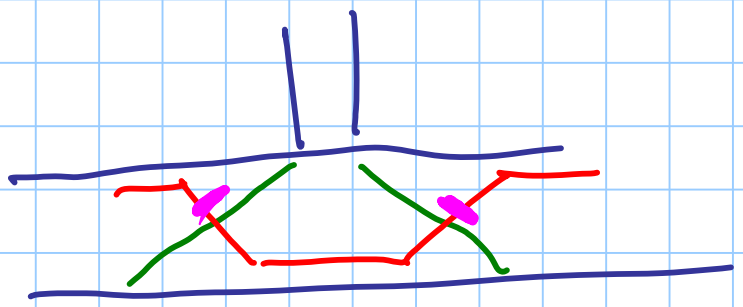
$$v_{Ed} \leq v_{Rd,s} = 0.75\, v_{Rd,c} + \frac{A_{sy} f_{yd}}{n d \sqrt{2}}$$

$$v_{Ed} - 0.75\, v_{Rd,c} \leq A_{sy} \frac{f_y}{n d \sqrt{2}}$$

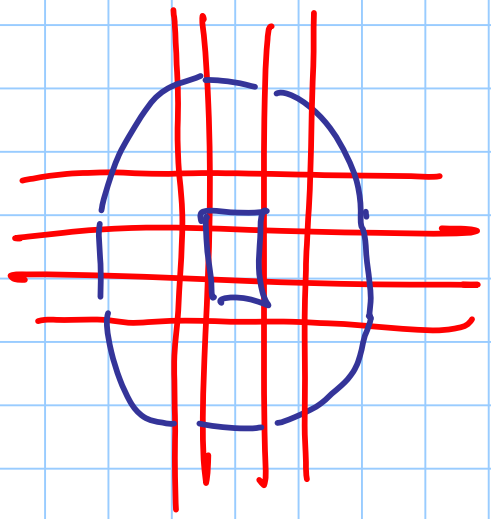
$$A_{sy} \geq \frac{v_{Ed} - 0.75\, v_{Rd,c}}{f_{yd}} (n d \sqrt{2})$$

$$\frac{0.495 - 0.75 \times 0.377}{391.3} \times 745 \times 45 \sqrt{2} =$$

$$= 25.7 \text{ cm}^2$$



una barra ogni
× 2



bastarebbero 2+2 ϕ20

meglio 4+4 ϕ14

se li vogli più diffusi

Resistenza max

Taglio $V_{Rd,max} = b z \nu_1 f_{cd} \frac{\cot\vartheta}{1+\cot^2\vartheta}$

$\frac{\cot\vartheta}{1+\cot^2\vartheta} = 0.5 \cdot \cot\vartheta = 1$

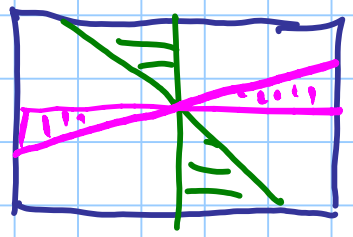
$\tau_{Rd,max} = 0.5 \nu_1 f_{cd}$

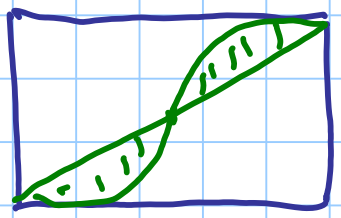
$\tau_{Rd,max} = 3.55\ MPa \gg \tau_{Ed}$ nell'esempio

TORSIONE

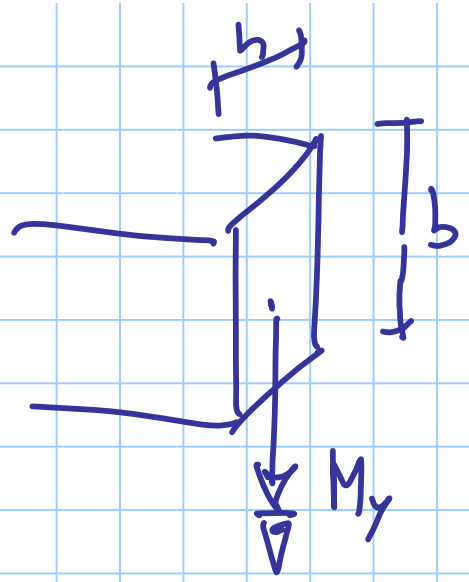
richiami di S.d.C. vedi lez. 17/12/13

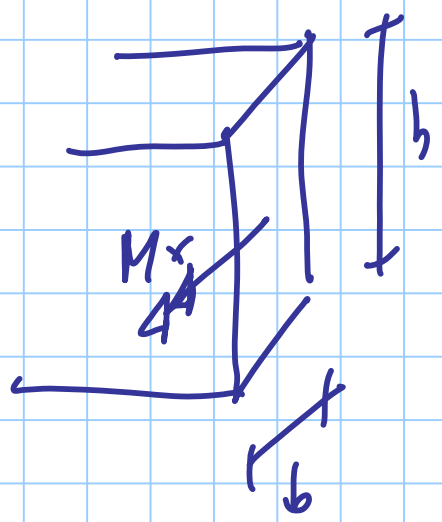
SEZIONE RETTANGOLARE



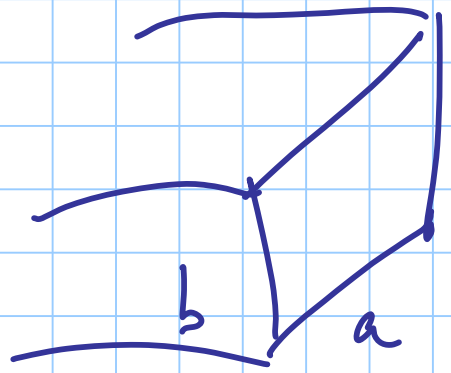


ingobbimento
(la sezione non
si mantiene piana)



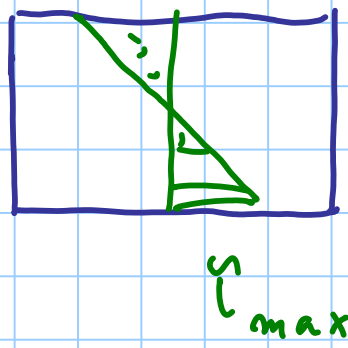


FLESSIONE



TORSIONE

$a \geq b$



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

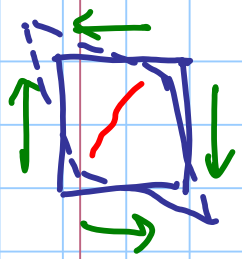
$$\psi = 3 + \frac{1.8}{a/b} \quad \text{opp} \quad = 3 + \frac{2.6}{0.45 + a/b}$$

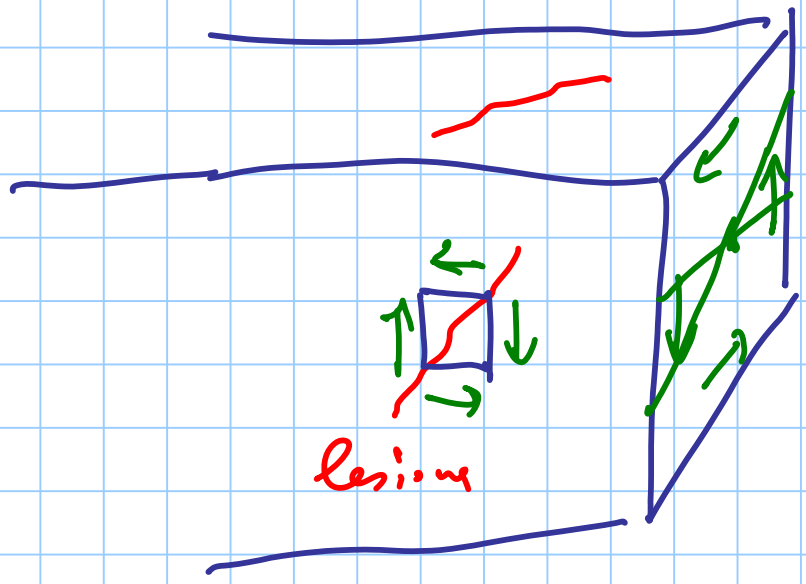
per $\frac{a}{b} = 1 \qquad \psi = 4.8$

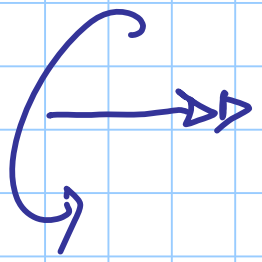
$\frac{a}{b} \to \infty \qquad \psi \to 3$

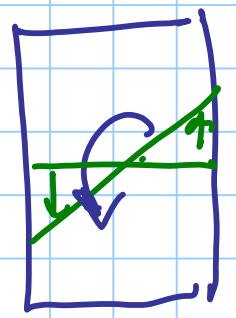
1° modello di comportamento $\longrightarrow$ τ per sez CLS

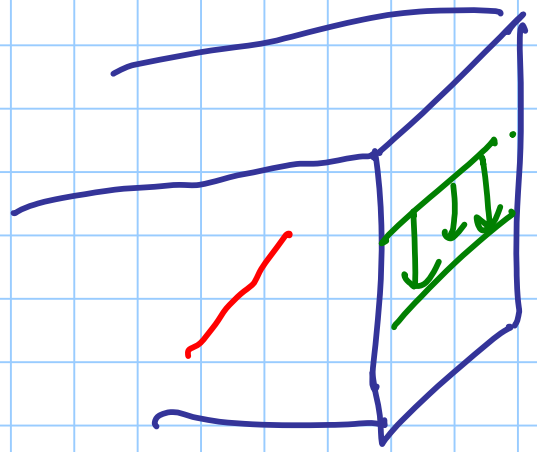
$$T = \int \vec{C} \, dA \cdot \tau$$

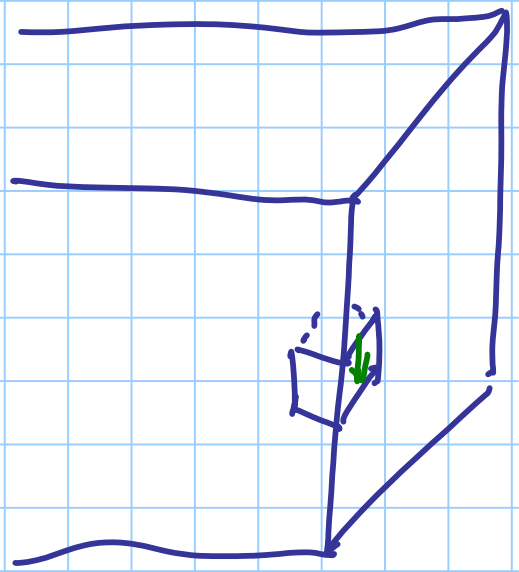


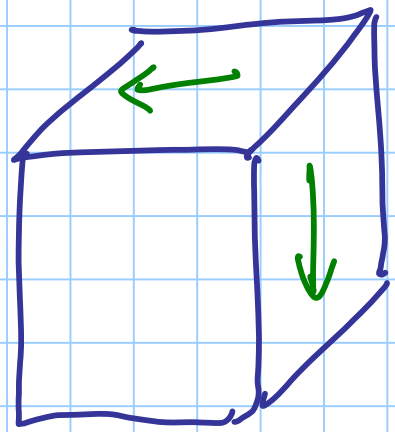




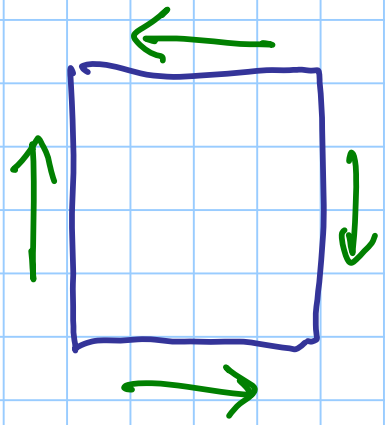








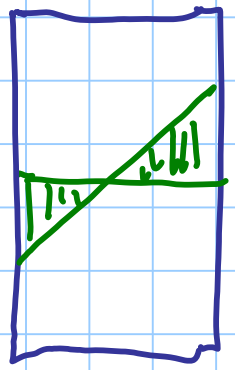
3D



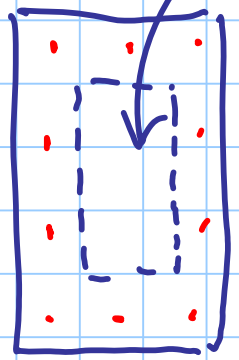
LAT.

da 1° a 2° modello

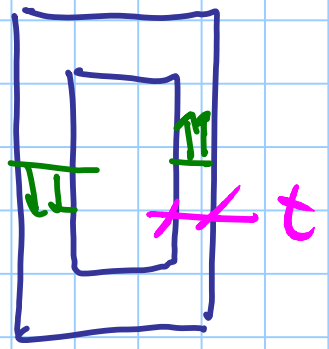
1°



2°



$\Rightarrow$



BREDT

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

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

A_K = area racchiusa dalla linea media