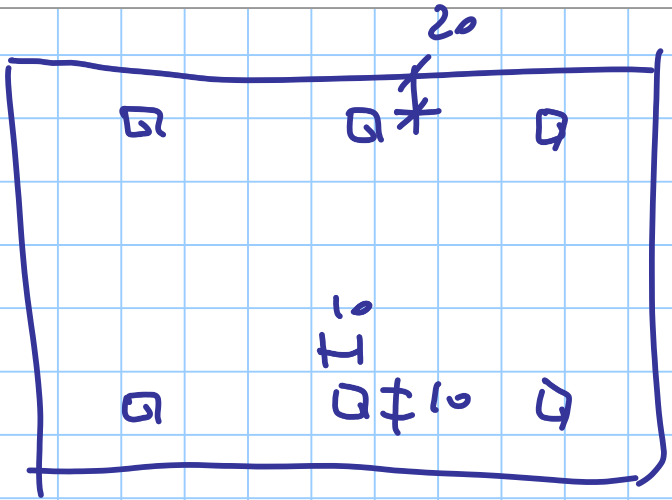
Titolo nota 14/05/2015



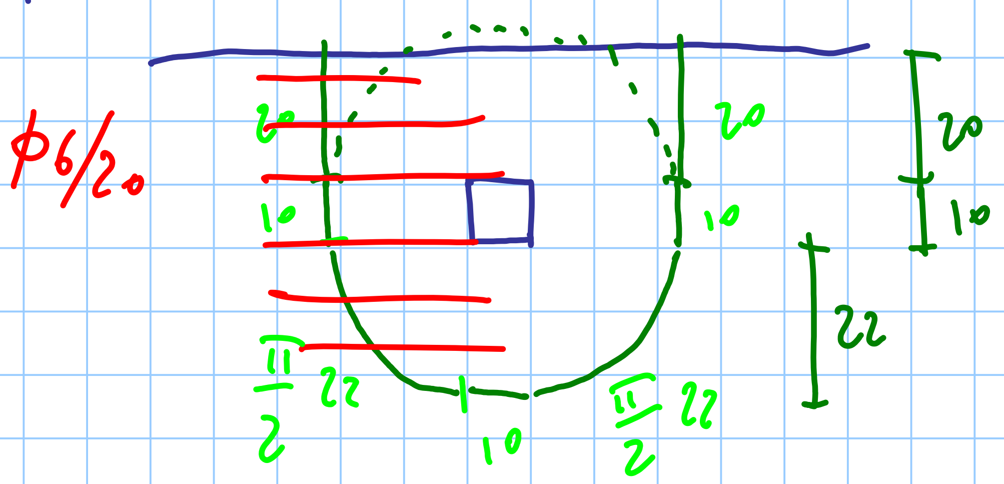
C 20/25

rete $\phi 6/20 \times 20$

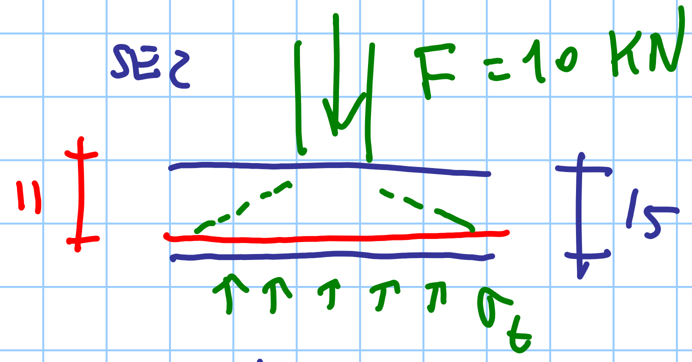
PIANTA

SEZ

PIANTA



SEZ



$d = 11$ cm

$u = 139$ cm

$V = F - A\,\sigma_t$

Trascuro σ_t

$$v_{Ed} = \frac{V_{Ed}}{u\,d} = \frac{10 \times 10^3}{139 \times 11 \times 10^2} = 0.065 \text{ MPa}$$

$$v_{Rd,c} = \frac{0.18\, K \sqrt[3]{100\, \rho_l\, f_{ck}}}{\gamma_c}$$

le più grande

$$0.035 \sqrt{K^3 f_{ck}}$$

$$K = 1 + \sqrt{\frac{200}{d}} \rightarrow K = 2 \qquad d = 110 \text{ mm}$$

$$\rho_l = \sqrt{\rho_{l,x} \cdot \rho_{l,y}} \qquad \rho_{lx} = \rho_{ly} = \frac{A(\phi 6)}{20 \times 11} = \frac{0.28}{220} =$$

$$= 0.00127$$

$$0.18\,K\,\frac{\sqrt[3]{100\,\rho_\ell\,f_{ck}}}{\gamma_c} = 0.18 \times 2 \times \frac{\sqrt[3]{100 \times 0.00127 \times 20}}{1{,}5} =$$

$$= 0.327$$

$$0.035\,\sqrt{K^3\,f_{ck}} = 0.035\,\sqrt{2^3 \times 20} = 0.443$$

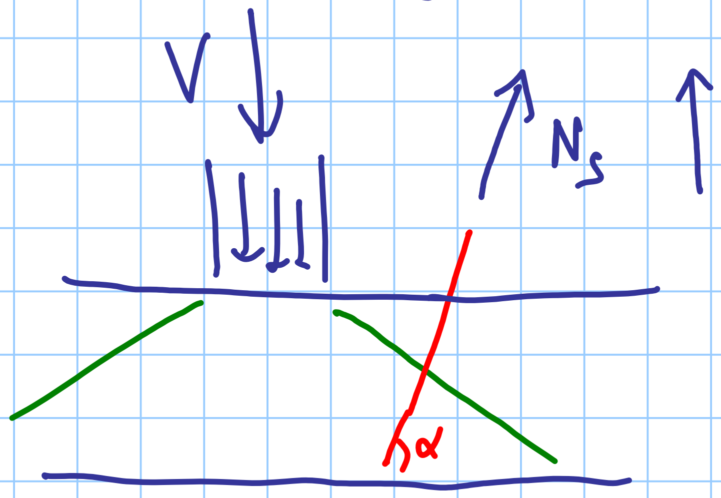
$$v_{Rd,c} = 0.443\ \text{MPa}$$

$$v_{Ed} = 0.065\ \text{MPa} < v_{Rd,c}$$

non occorre armature

$v_{Rd} = 0.75\, v_{Rd,c}$ + contr. armature V_{wd}

(VEDI MODELLO "NORMALE")



$N_s = A_s f_{yd}$

$A_s f_{yd} \sin\alpha$

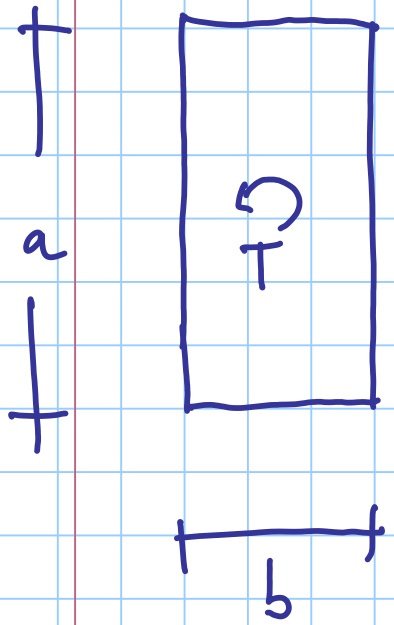
$\alpha = 45°$

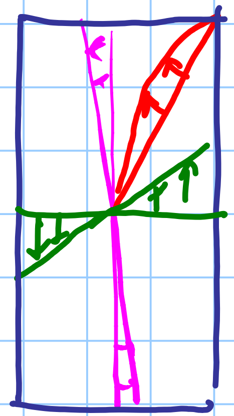
$\alpha = 50°$

$V_{wd} = A_{s,tot} f_{yd} \sin\alpha$

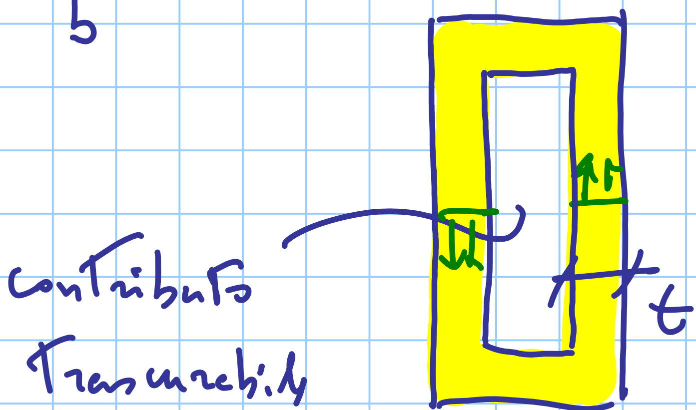
tutta l'armatura che attraversa perim critico

TORSIONE



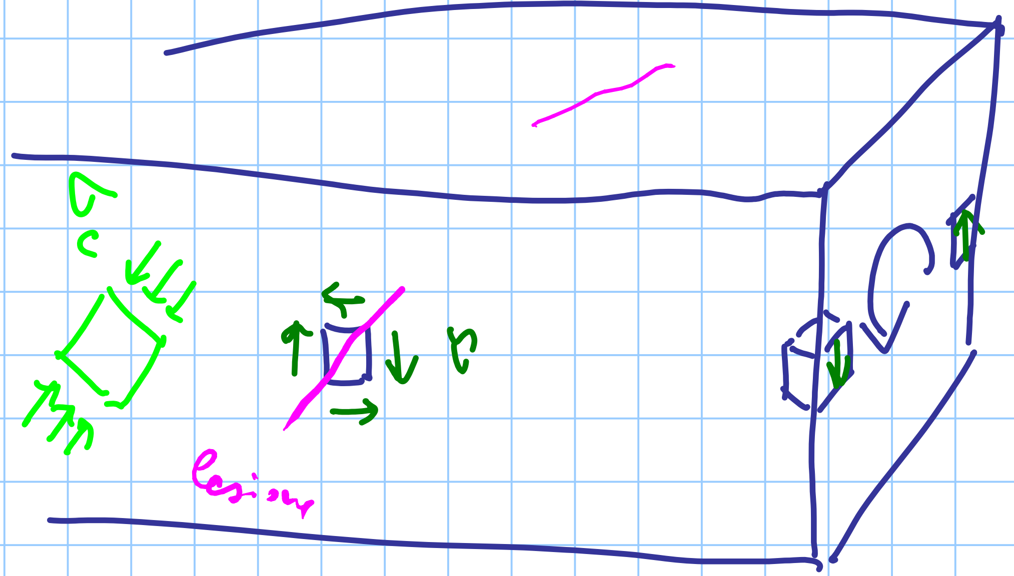


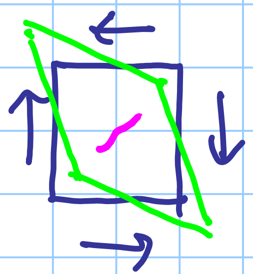
$$\tau_{max} = \psi \frac{T}{a\, b^2}$$

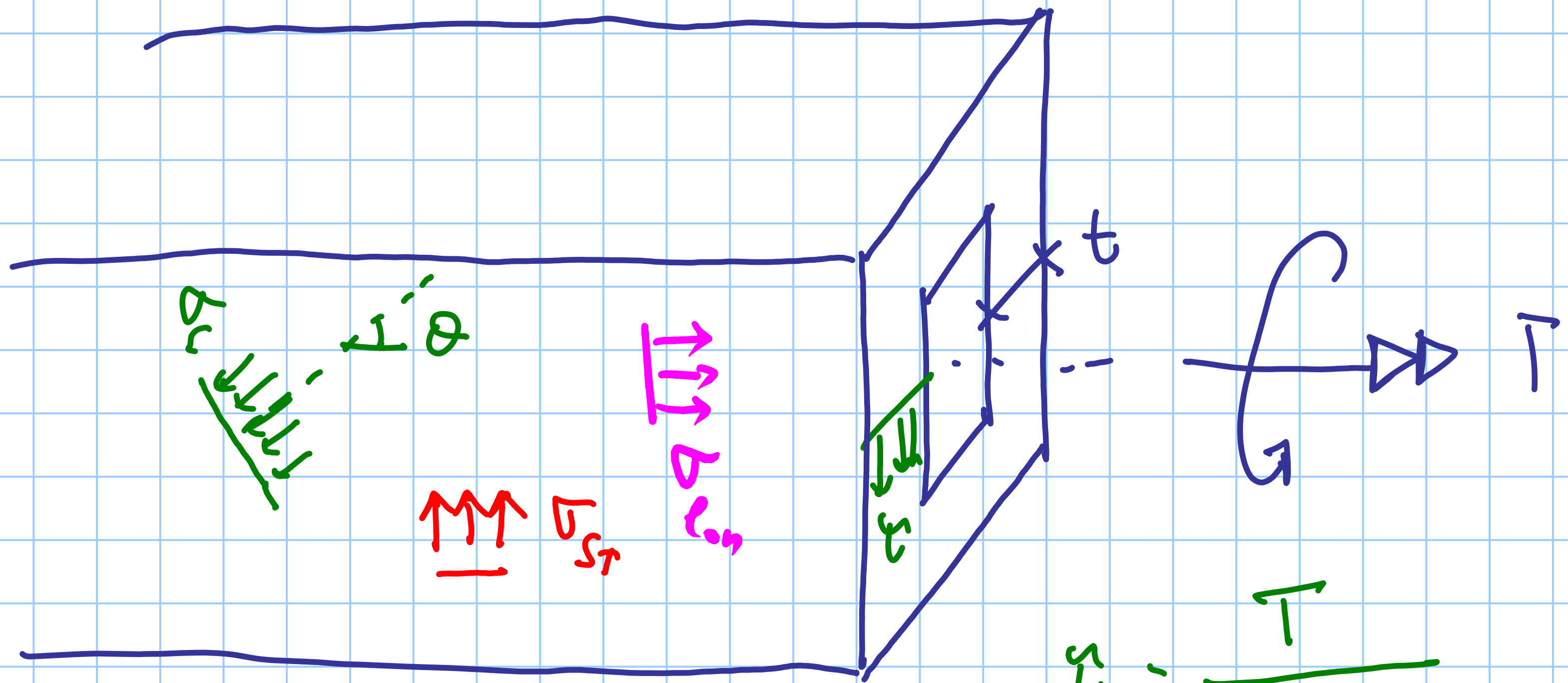


la torsione è portata da una sezione "scatolare"

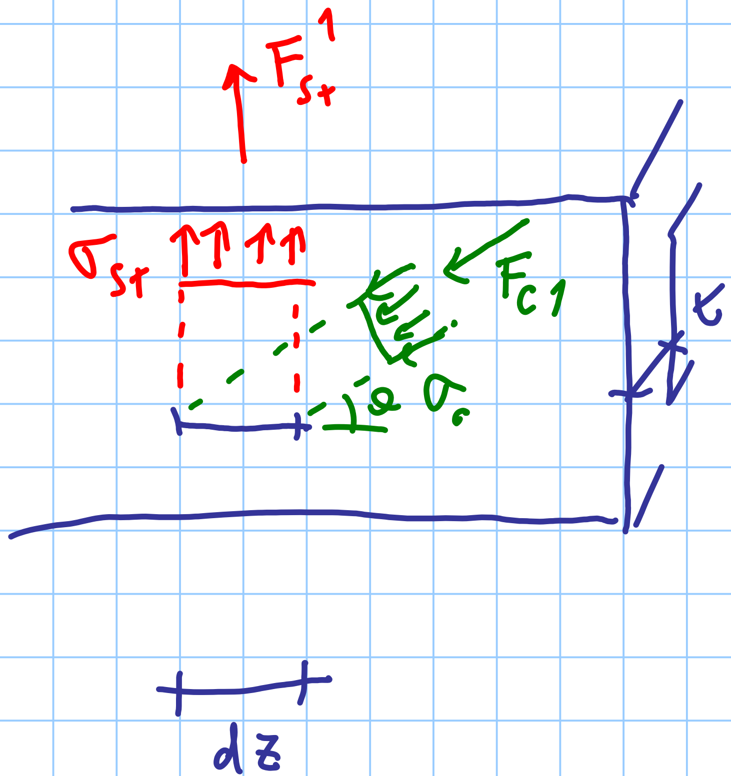
$$\tau = \frac{T}{2 A_k t}$$


σ_c
τ
lesion



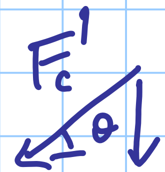


$$\tau = \frac{T}{2 A_k t}$$



$$F_{st}^{1} = \frac{A_{st}}{s}\, dz\, \sigma_{st}$$

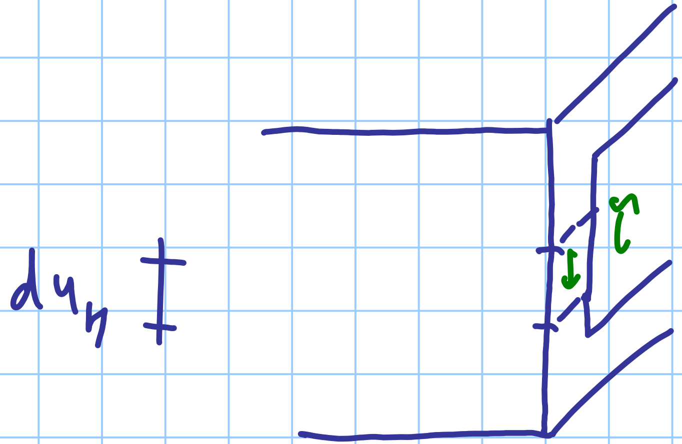
$$F_c^{1} = dz \sin\theta\, t\, \sigma_c$$



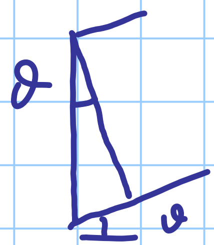
$F_c^{1} \sin\theta$

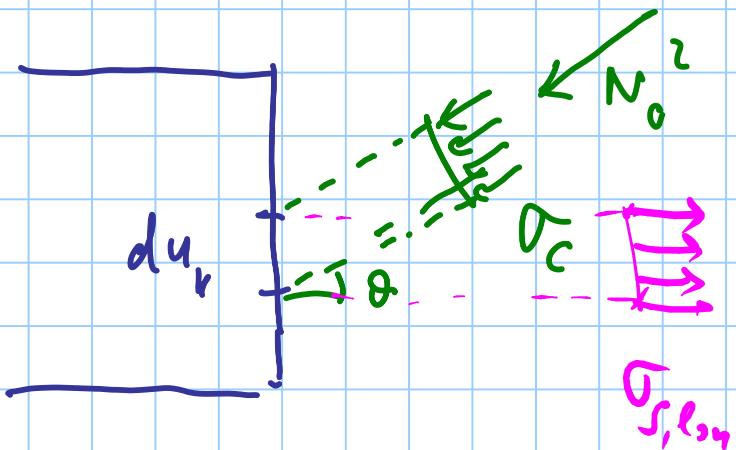
equil. Trasla. verticale

$$\frac{A_{st}}{s}\, \cancel{dz}\, \sigma_{st} = \cancel{dz} \sin^2\theta\, t\, \sigma_c$$



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





$$\downarrow N_c^2 \sin\vartheta = \tau\, t\, du_k$$

$$= \frac{T}{2A_k}\, du_k$$

$$N_c^2 = du_k \cos\vartheta \cdot t \cdot \sigma_c$$

$$\cancel{du_k} \cos\vartheta \; t \; \sigma_c \sin\vartheta = \frac{T}{2A_k} \cancel{du_k}$$

$$\sigma_c = \frac{T}{2A_k \, t \sin\vartheta \cos\vartheta} \leq \nu f_{cd}$$

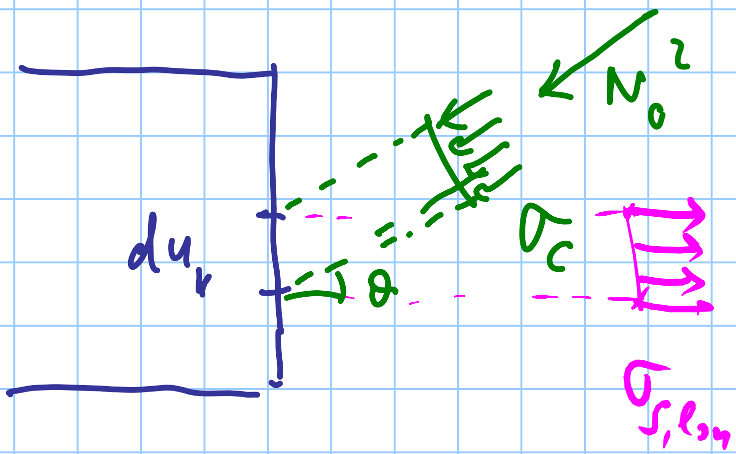
$$T_{Rd,max} = 2A_k \, t \, \nu f_{cd} \sin\vartheta \cos\vartheta =$$

$$= 2A_k \, t \, \nu f_{cd} \frac{\cot\theta}{1+\cot^2\theta}$$

$$\sigma_{st} = \frac{\sin^2\vartheta \; t \; \sigma_c}{\frac{A_{st}}{s}} = \frac{\sin^2\vartheta \; \cancel{t} \; \frac{T}{2 A_k \cancel{t} \cancel{\sin\vartheta} \cos\vartheta}}{\frac{A_{st}}{s}} =$$

$$= \frac{T}{2 A_k \cot\vartheta \; \frac{A_{st}}{s}} \leq f_{y1}$$

$$T_{Rd,st} = 2 A_k \frac{A_{st}}{s} f_{y1} \cot\vartheta$$



$$N_0^2 \cos\vartheta =$$

$$= \frac{A_{s,lon}}{u}\, du_K\, \sigma_{s,lon}$$

$$\cancel{du_K}\cos^2\vartheta \cdot t \cdot \sigma_c = \frac{A_{s,lon}}{u}\, \cancel{du_K}\, \sigma_{s,lon}$$

$$\sigma_{s,lon} = \frac{\cos^2\vartheta \; t \; \sigma_c}{\frac{A_{s,lon}}{u}} = \frac{\cos^2\vartheta \; \cancel{t} \; \frac{T}{2 A_K \cancel{t} \sin\vartheta \cancel{\cos}\vartheta}}{\frac{A_{s,lon}}{u}}$$

$$\sigma_{s,lon} = \frac{T \cot\theta}{2 A_k \frac{A_{s,lon}}{u}} \leq f_{yd}$$

$$T_{Rd,lon} = 2 A_k \frac{A_{s,lon}}{u} f_{yd} \frac{1}{\cot\theta}$$

$$T_{Rd,max} = 2 A_k\, t\, \nu\, f_{cd} \frac{\cot\vartheta}{1+\cot^2\vartheta}$$

$$T_{Rd,st} = 2 A_k \frac{A_{st}}{s} f_{yd} \cot\vartheta$$

$$T_{Rd,lon} = 2 A_k \frac{A_{s,lon}}{u} f_{yd} \frac{1}{\cot\vartheta}$$

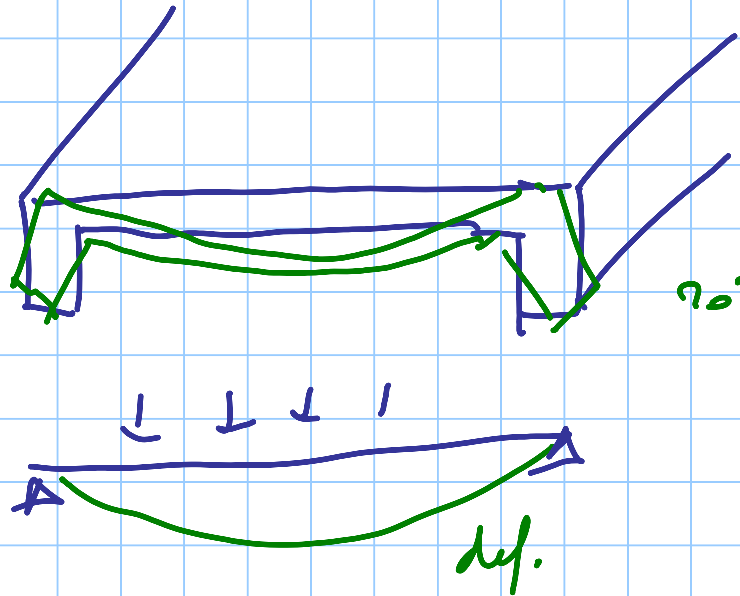
$$V_{Rd,max} = z\, b\, \nu\, f_{cd} \frac{\cot\vartheta}{1+\cot^2\vartheta}$$

$$V_{Rd,s} = z \frac{A_{sw}}{s} f_{yd} \cot\vartheta$$

$$V_{Rd,par} = z \frac{A_{par}}{z} f_{yd} \frac{1}{\cot\vartheta\ (2)}$$

TORSIONE PER CONGRUENZA SI TRASCURA

〃 PER EQUILIBRIO



rotazione torsionale della trave
per congruenza

$$t = \frac{A}{n} \geq 2c$$

Exemple 30×50

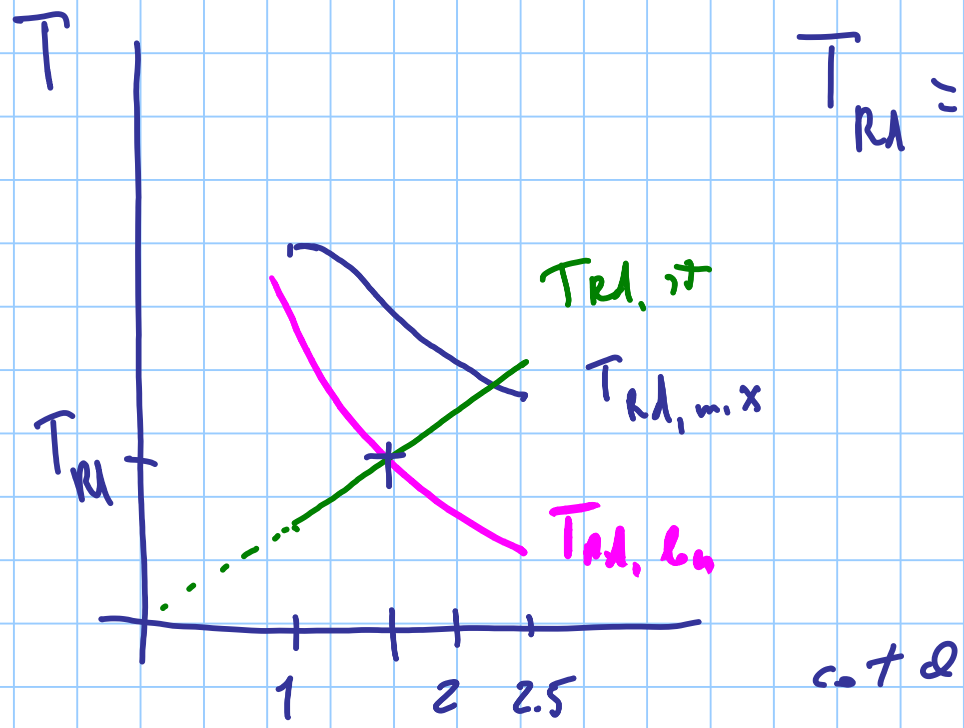
$A = 1500\ cm^2$

$n = 160\ cm$

$c = 4\ cm$

$$t = \frac{1500}{160} = 9.4\ cm$$

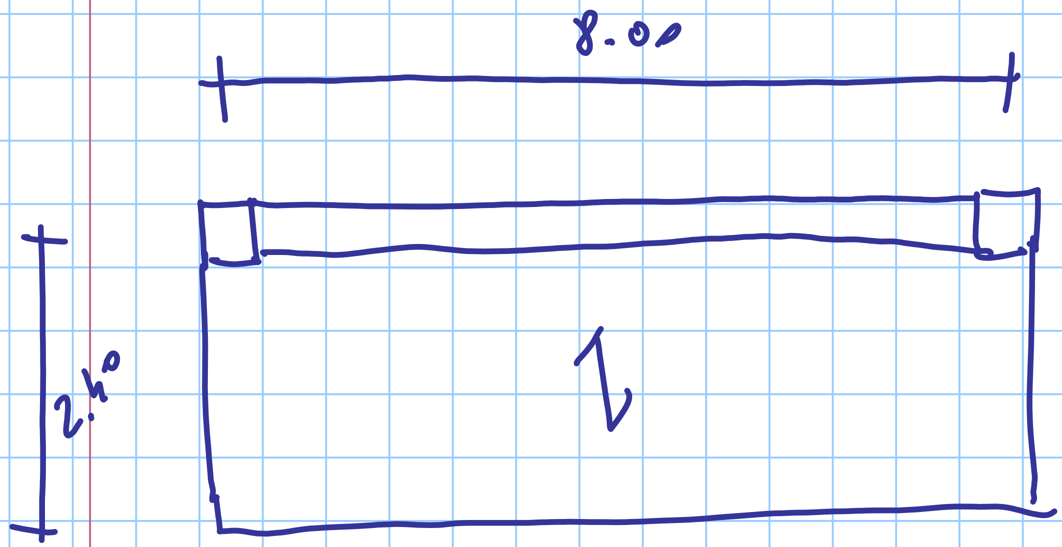
$x\quad c = 5\ cm \qquad t = 10\ cm$



$$T_{Rd} = \mathrm{MIN}\left(T_{Rd,max};\ T_{Rd,st};\ T_{Rd,ln}\right)$$

$$T_{Rd,max} = \sqcup \frac{\cot\theta}{1+\cot^2\theta}$$

$$T_{Rd,st} = \sqcup \cot\theta \qquad T_{Rd,ln} = \sqcup \frac{1}{\cot\theta}$$



PIANTA

solaio

$g_k = 3.0 \ kN/m^2$

$q_k = 1.0 \ kN/m^2$

$g_d + q_d = 5.4 \ kN/m^2$

Trave

$g_k = 3 \ kN/m$

$g_d = 3.9 \ kN/m$

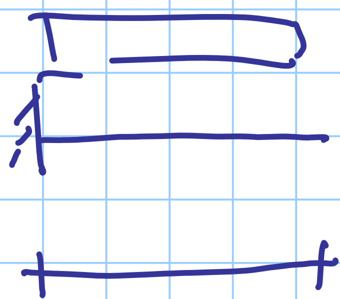
carico su trave - verticale   car. torcente

$g_A + q_A$

solaio	2.40	13.0
p.p. trave		3.9

$q = 16.9$ KN/m $t = 15{,}55$ KNm/m

pensilina

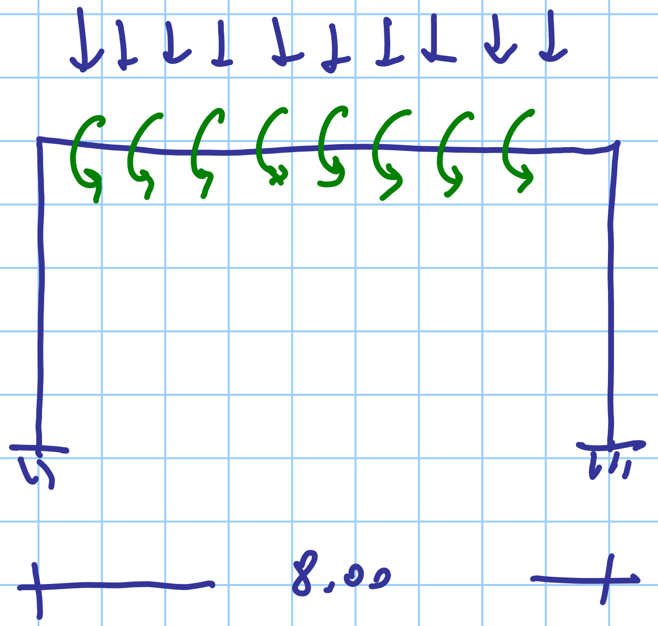


$q = 5.4$ kN/m

2.40

↓ $q \times 2.40$

$q \times 2.40^2/2 = 15.55$ KNm

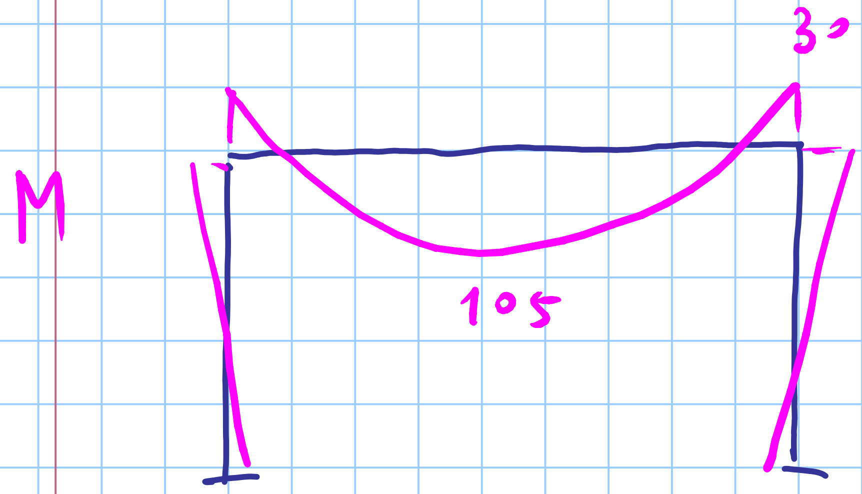


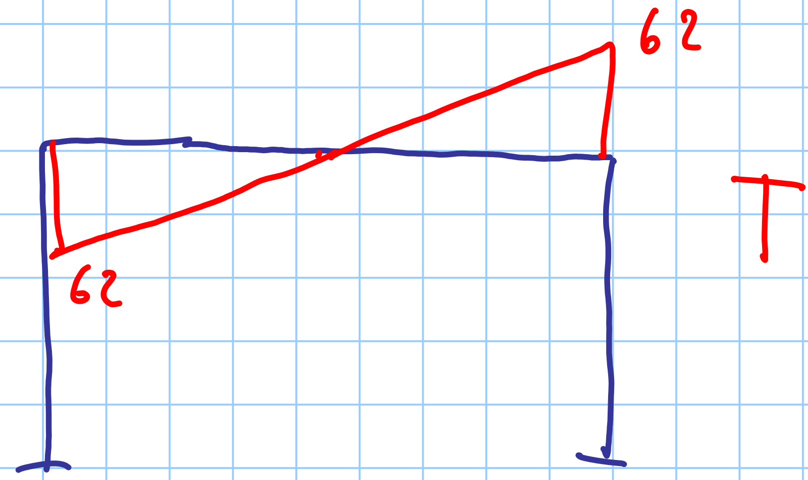
$q = 16.9$ KN/m

$t = 15.55$ KNm/m

$$\frac{ql^2}{12} = 90.1 \text{ KNm}$$

$$\frac{ql^2}{8} = 135.2 \text{ KNm}$$





$$T_{max} = t\,\frac{\ell}{2} = 62.2 \text{ KN}_m$$

$$V_{max} = 67.6 \text{ KN}$$

dimensionamento per torsione

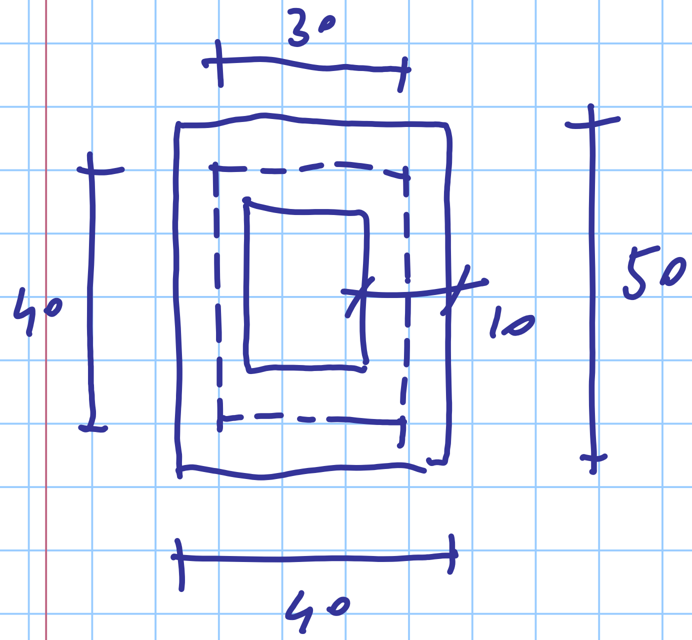
$$2\nu f_{cd} = 14.2 \text{ MPa}$$

$$T_{Rd,max} = \overbrace{2 A_k t}\,\overbrace{\nu f_{cd}}\;\underbrace{\frac{\cot\vartheta}{1+\cot^2\vartheta}}_{0.4}$$

$$A_k \cdot t = \frac{T_{Rd,max}}{2\nu f_{cd}\,\frac{\cot\vartheta}{1+\cot^2\vartheta}} = \frac{62.2\times10^6}{14.2\times0.4}\times10^3 =$$

$$= 10\,950 \text{ cm}^3$$

se $t = 10$ cm $\quad A_k = 1095 \text{ cm}^2 \quad \longrightarrow \quad 30\times40$



40×50

$$t = \frac{2000}{180} = 11.1 \text{ cm}$$

$$b_k = 40 - 11.1 = 28.9 \text{ cm}$$

$$A_k \cdot t = 28.9 \times 38.9 \times 11.1 = 12479 \text{ cm}^3 > 10550$$

$$A_k = 1124 \text{ cm}^2$$

verifiche della sezione

a flessione $M_{Ed} \leq M_{Rd}$

a taglio e torsione

$$\frac{V_{Ed}}{V_{Rd,max}} + \frac{T_{Ed}}{T_{Rd,max}} \leq 1$$

da questo vediamo quale $\cot\theta$ si può usare

Es. $\cot\theta = 2$

flessione $\quad A_s = \dfrac{M}{0.9\, d\, f_{yd}}$ $\quad$ mezz. 105 $\rightarrow$ 6.6 cm^2

appr. 30 $\rightarrow$ 1.9 cm^2

taglio e Torsione

STAFFE

$$A^V_{st} = \frac{V\ s}{z\, f_{yd}\, \cot\theta} = \frac{67.6 \times 100 \times 10}{40.5 \times 391.3 \times 2} = 2.1\ cm^2/s$$

ogni staffa vale $\times$ n bracci

$$A^T_{st} = \frac{T\ s}{2\, A_M\, f_{yd}\, \cot\theta} = \frac{62.2 \times 100 \times 10^3}{2 \times 1124 \times 391.3 \times 2} = 3.5\ cm^2$$

staffe da disporre $\frac{2.1}{2} + 3.5 = 4.55 \ cm^2 / m$

$\phi 8 = 0.5 \ cm^2$ 9.1 staffe/m $\phi 8/10$

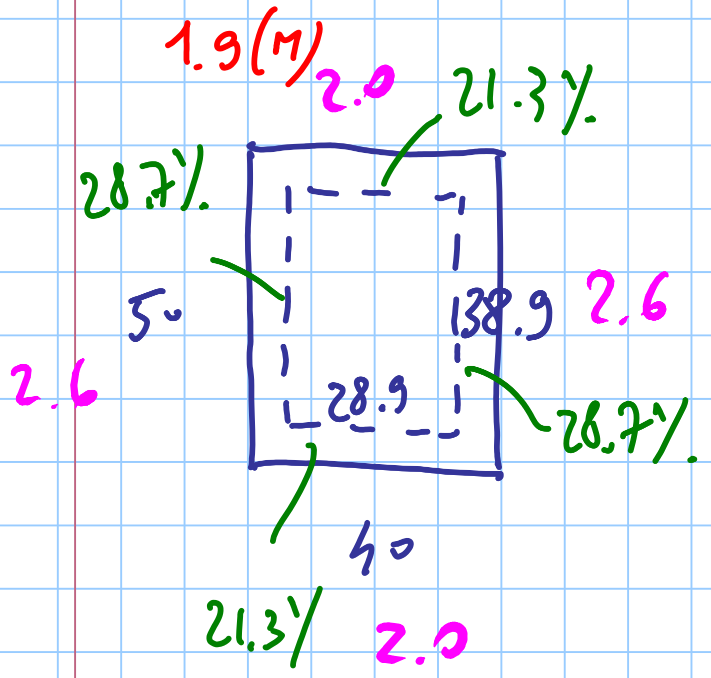
$5 \ cm^2/m$

quindi $5 > 4.55$ potevo usare $\cot\vartheta < 2$

$[\cot\vartheta = 1.82]$

armature longitudinale

$$A_{s,l} = \frac{T\, u\, \cot\theta}{2\, A_k\, f_{yd}} = 9.2\ cm^2$$



$$u_k = 2\,(28.9 + 38.9) = 135.6$$

$$\frac{28.9}{135.6} = 0{,}213$$

$$\frac{38.9}{135.6} = 0.287$$