$\nu = 0.5$

Titolo nota 21/12/2016

TORSIONE

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

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

$$T_{Rd,lon} = \frac{A_{l,tot}}{u_k} 2 A_k f_{yd} \frac{1}{\cot\theta}$$

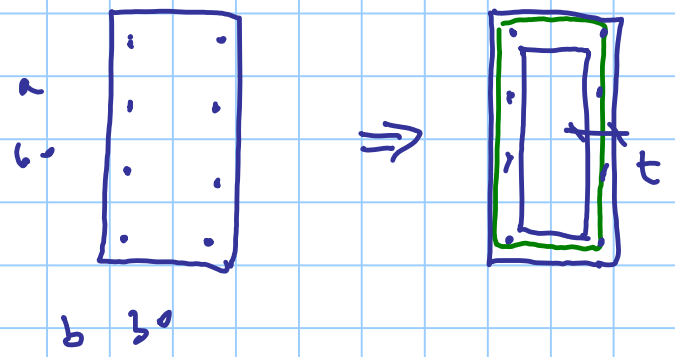
TAGLIO

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

$$V_{Rd,st} = \frac{A_{st}}{s} z f_{yd} \cot\theta$$

$$V_{Rd,pm} = A_{pm} f_{yd} \frac{1}{\cot\theta}$$

sezione 30 x 60 staffe φ8/20 armatura long. 8φ14



$$t = MAX\left(2c\ ;\ \frac{A}{u}\right)$$

$$\frac{A}{u} = \frac{30 \times 60}{2 \times (30+60)} = 10\ cm$$

$t = 10\ cm$

$a_k = 50\ cm$

$b_k = 20\ cm$

$u_k = 140\ cm$

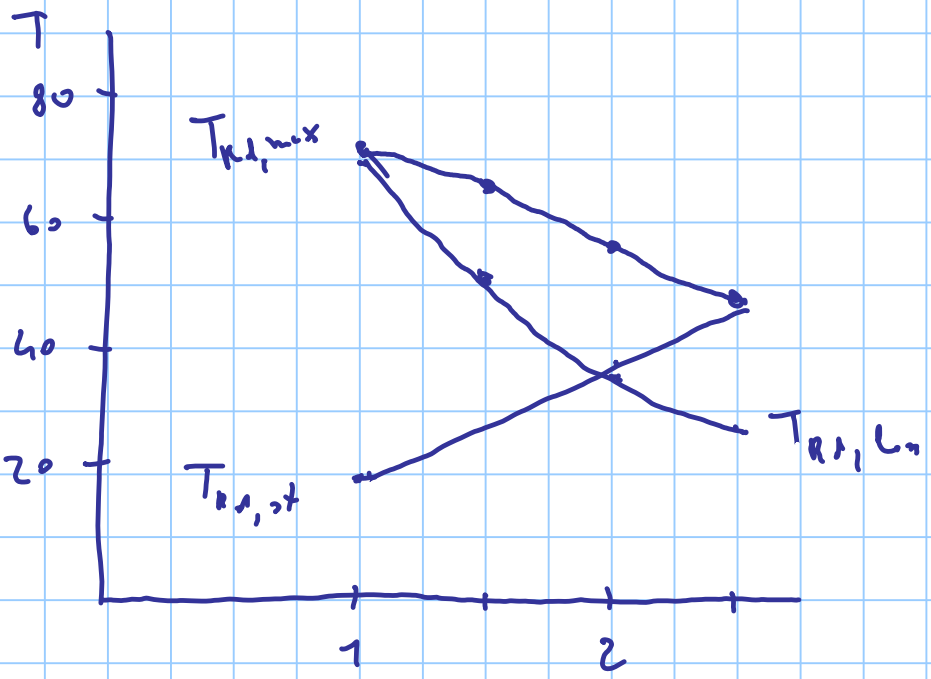
$A_k = 1000\ cm^2$

$$T_{Rd,max} = 2 A_x t \nu f_{cd} \frac{\cot\theta}{1+\cot^2\theta} = \underbrace{2 \times 1000 \times 10 \times 0.5 \times 14.17 \times 10^{-3}}_{141.7} \cdot \frac{\cot\theta}{1+\cot^2\theta}$$

$$T_{Rd,st} = \frac{A_{st}}{s} 2 A_x f_{yd} \cot\theta = \underbrace{\frac{0.5}{20} \times 2 \times 1000 \times 391.3 \times 10^{-3}}_{19.6} \cot\theta$$

$$T_{Rd,lon} = \frac{A_{l,m}}{m_x} 2 A_x f_{yd} \frac{1}{\cot\theta} = \underbrace{\frac{12.32}{140} \times 2 \times 1000 \times 391.3 \times 10^{-3}}_{68.9} \frac{1}{\cot\theta}$$

	$\cot\theta = 1$	1.5	2	2.5
$T_{Rd,max}$	70.8	65.4	56.7	48.9
$T_{Rd,st}$	19.6	29.4	39.2	49.0
$T_{Rd,lon}$	68.9	45.9	34.5	27.6



$$\cot\vartheta = \sqrt{\frac{12.32/140}{0.5/20}} = 1.876$$

$$T_{Rd,st} = T_{Rd,lon} = 36.8\ KN_m$$

intersezione T_{Rd} $T_{Rd,st}$ e $T_{Rd,lon}$

$$T_{Rd,st} = T_{Rd,lon}$$

$$\frac{A_{st}}{s}\cot\vartheta = \frac{A_{lon}}{u_k}\frac{1}{\cot\vartheta}$$

$$\cot^2\vartheta = \frac{A_{lon}/u_k}{A_{st}/s}$$

$$\cot\vartheta = \sqrt{\frac{A_{lon}/u_k}{A_{st}/s}}$$

sezione 30×60 $\quad T_{Ed} = 50 \ kN_m$

progetto staffe

$$T_{Rd,t} = \frac{A_{st}}{s} 2 A_k f_{yd} \cot\theta \Rightarrow A_{st} = \frac{T_{Ed} \ s}{2 A_k f_{yd} \cot\theta} = \frac{50 \times 100}{2 \times 1000 \times 391.3 \times 10^{-3} \cot\theta}$$

con $\cot\theta = 2$ (per cui $T_{Rd,max} > T_{Ed}$)

$$= \frac{6.39}{\cot\theta} \ cm^2/m$$

ho $A_{st} = 3.2 \ cm^2/m$

$3.33 = \frac{6.39}{\cot\theta} \rightarrow \cot\theta = \frac{6.39}{3.33} = 1.92$

posso usare $\phi 8/15 \rightarrow 3.33 \ cm^2/m$

$$T_{Rd,lon} = \frac{A_{l,m}}{u_k} 2 A_k f_{yd} \frac{1}{\cot\theta}$$

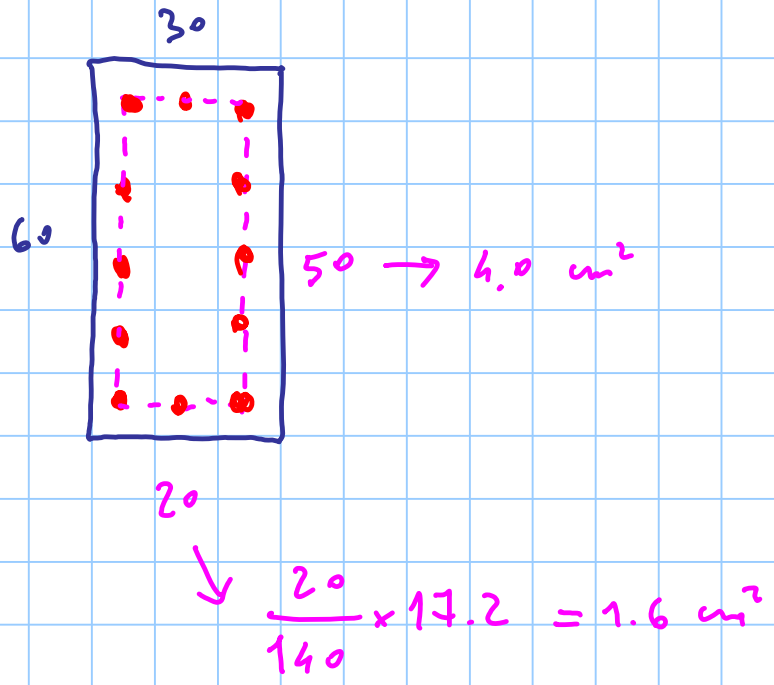
$$A_{l,m} \geq \frac{T_{Ed}\, u_k \cot\theta}{2 A_k f_{yd}} = \frac{50 \times 140 \times 1.92}{2 \times 1000 \times 391.3 \times 10^{-3}} = 17.2 \text{ cm}^2$$

$$\Downarrow$$

$$11.2\ \phi 14$$

$$\Downarrow$$

$$12\ \phi 14$$



progetto della sezione

$T_{Ed} = 110\ kNm$

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

$$A_k \cdot t = \frac{T_{Ed}}{2\ \nu f_{cd} \underbrace{\frac{\cot\theta}{1+\cot^2\theta}}_{0.5 - 0.34}} = \frac{110 \times 10^3}{2 \times 0.5 \times 14.17 \times 0.4} = 19407\ cm^3$$

provo con $t = 12\ cm \rightarrow A_k = 1617\ cm^2$

provo con 50×60

$$t = \frac{50 \times 60}{2 \times (50+60)} = 13.6\ cm \rightarrow A_k = 1427\ cm^2$$

p.m. mm 50 × 60 $t = 13.6$ cm

$a_k = 46.4$ cm $b_k = 36.4$ cm $u_k = 165.6$ cm $A_k = 1689$ cm^2

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

$$\frac{\cot\theta}{1+\cot^2\theta} = \frac{T_{Ed}}{2 A_k t \nu f_{cd}} = \frac{110 \times 10^3}{2 \times 1689 \times 13.6 \times 0.5 \times 16.17} = 0.338 \rightarrow \cot\theta = 2.5$$

alternativa 50 x 50

$$t = \frac{2500}{200} = 12.5$$

$a_k = 37.5\ cm = b_k$ $\quad u_k = 150\ cm$ $\quad A_k = 1406.2\ cm^2$

$$\frac{\cot\theta}{1+\cot^2\theta} = \frac{T_{Ed}}{2\,A_k\,t\,\nu\,f_{cd}} = \frac{110 \times 10^3}{2 \times 1406.2 \times 12.5 \times 0.5 \times 14.17} = 0.442 \rightarrow \cot\theta = 1.659$$

$$\frac{\cot\theta}{1+\cot^2\theta} = 0.442 \qquad \frac{\cot\theta}{0.442} = 1 + \cot^2\theta \qquad \cot^2\theta - 2.262\cot\theta + 1 = 0$$

$$\cot\theta = 1.131 - \sqrt{1.131^2 - 1} = 1.659$$

TORSIONE + TAGLIO

verifica sezione: nel paret. $\tau_V + \tau_T \leq \tau_{c1}$

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

verifica / progetto armatura

progetto assegnato $\cot\theta$

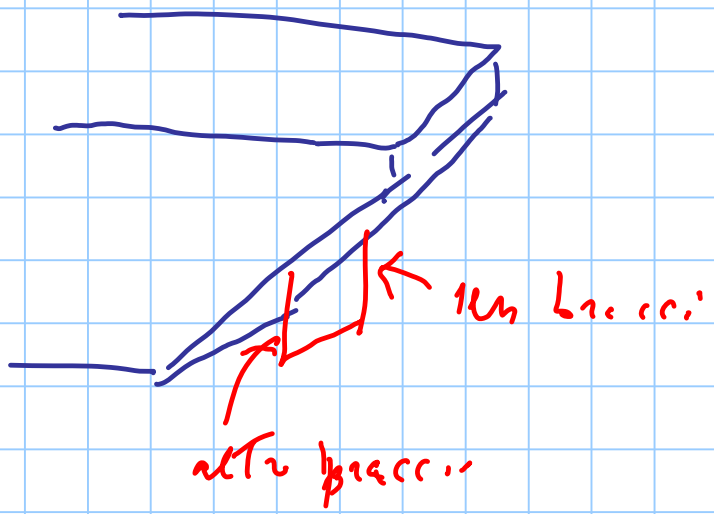
calcolo $A_{st,V}$ $A_{st,T}$

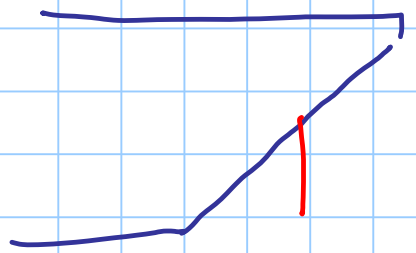
c'è anche M → $A_{s,inf}$

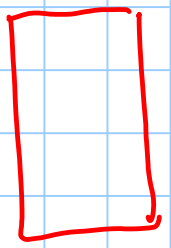
$A_{s,sup}$

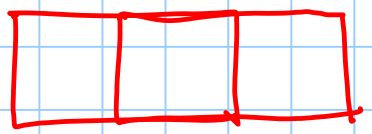
$A_{long,T}$ distribuita tra i lati

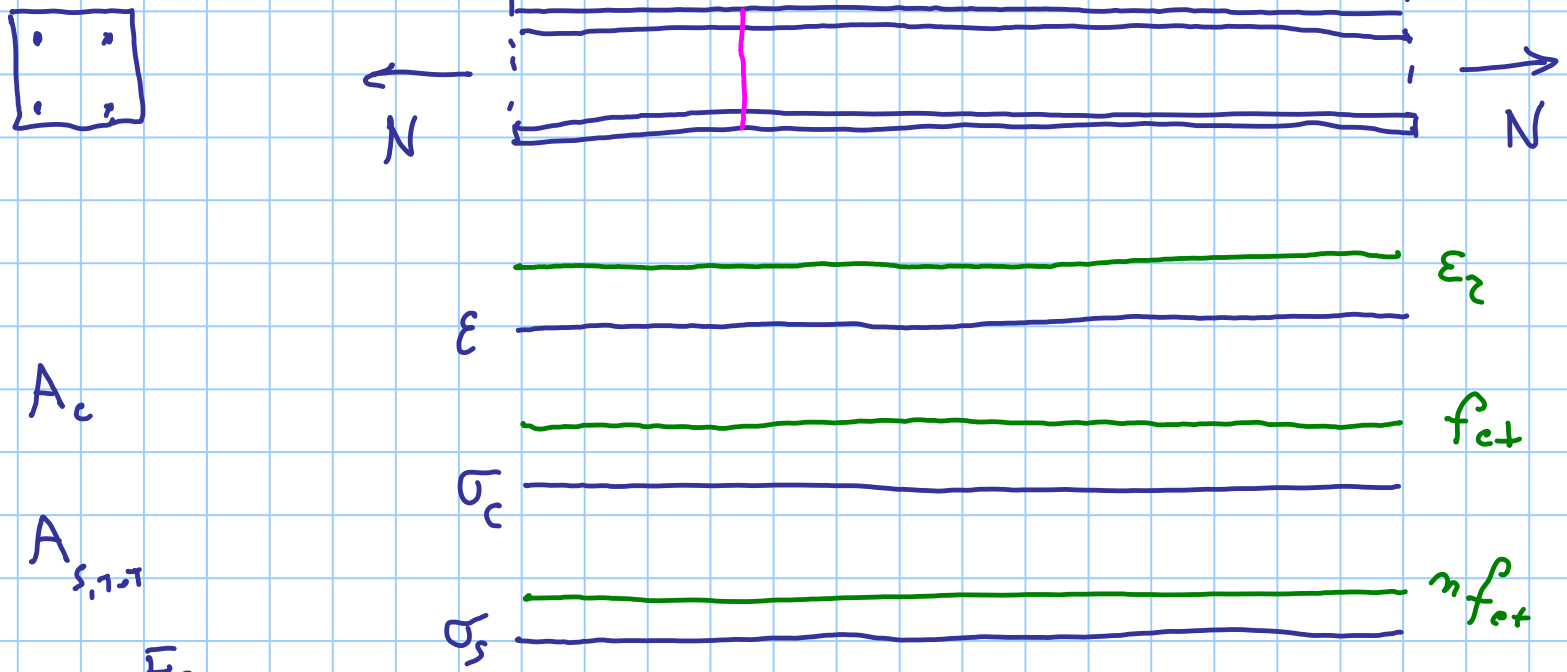
A_{par} " " pareti


1 braccio
altre braccia




2 braccia


4 braccia



A_c

$A_{s,tot}$

$n = \frac{E_s}{E_c}$

$A_c + n A_{s,tot}$

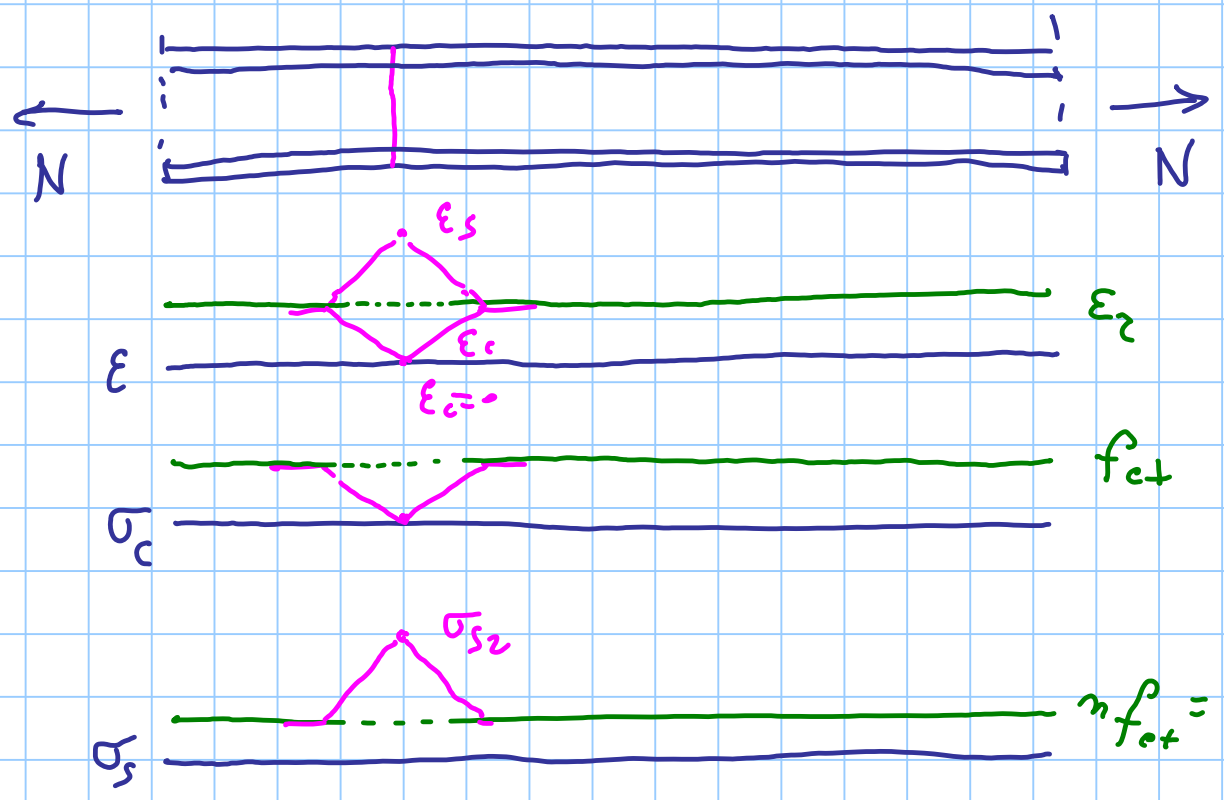
$\varepsilon_c = \varepsilon_s = \frac{N}{E\left(A_c + n A_{s,tot}\right)}$

$\varepsilon_2 = \frac{N_2}{E\left(A_c + n A_{s,tot}\right)}$

$\sigma_c = \frac{N}{A_c + n A_{s,tot}}$

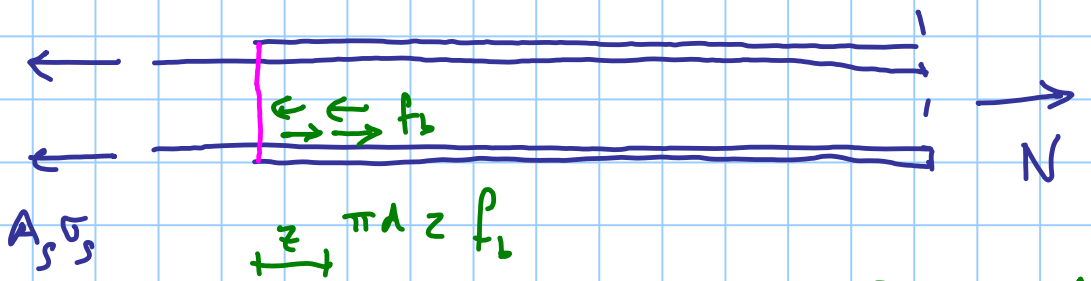
$\sigma_s = n \sigma_c = n \frac{N}{A_c + n A_{s,tot}}$

$$\sigma_c = \frac{N}{A_c + n A_{s,inf}} = f_{ct} \Rightarrow N_r = \left(A_c + n A_{s,inf}\right) f_{ct}$$



$\sigma_c = 0$

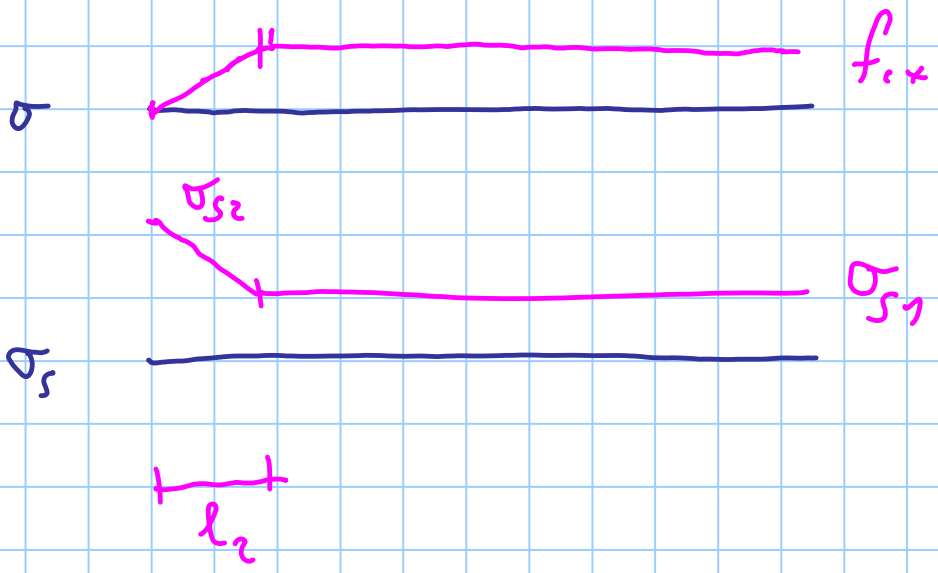
$\sigma_{s_2} = \frac{N_r}{A_{s,inf}}$



$$\frac{\pi d z f_b}{A_{c,\tau}} = \Delta\sigma_c$$

$$\Delta\sigma_s = \frac{\pi d z f_b}{\pi d^2/4}$$

$$\frac{\pi d l_2 f_b}{A_{ct}} = f_{ct}$$



$$l_2 = \frac{A_{ct} f_{ct}}{\pi d f_b}$$