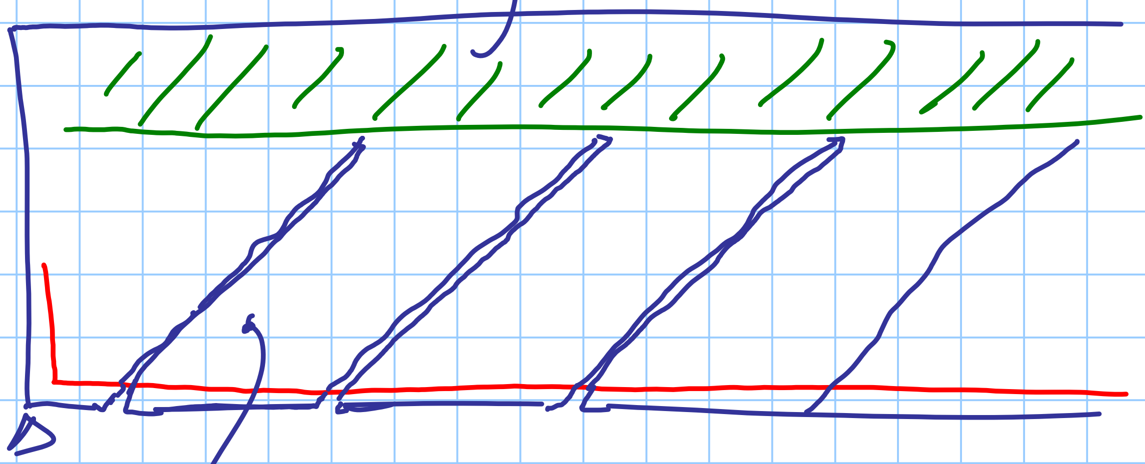
Titolo nota 13/12/2016

dorso del pettine



parte compressa

armatura tesa

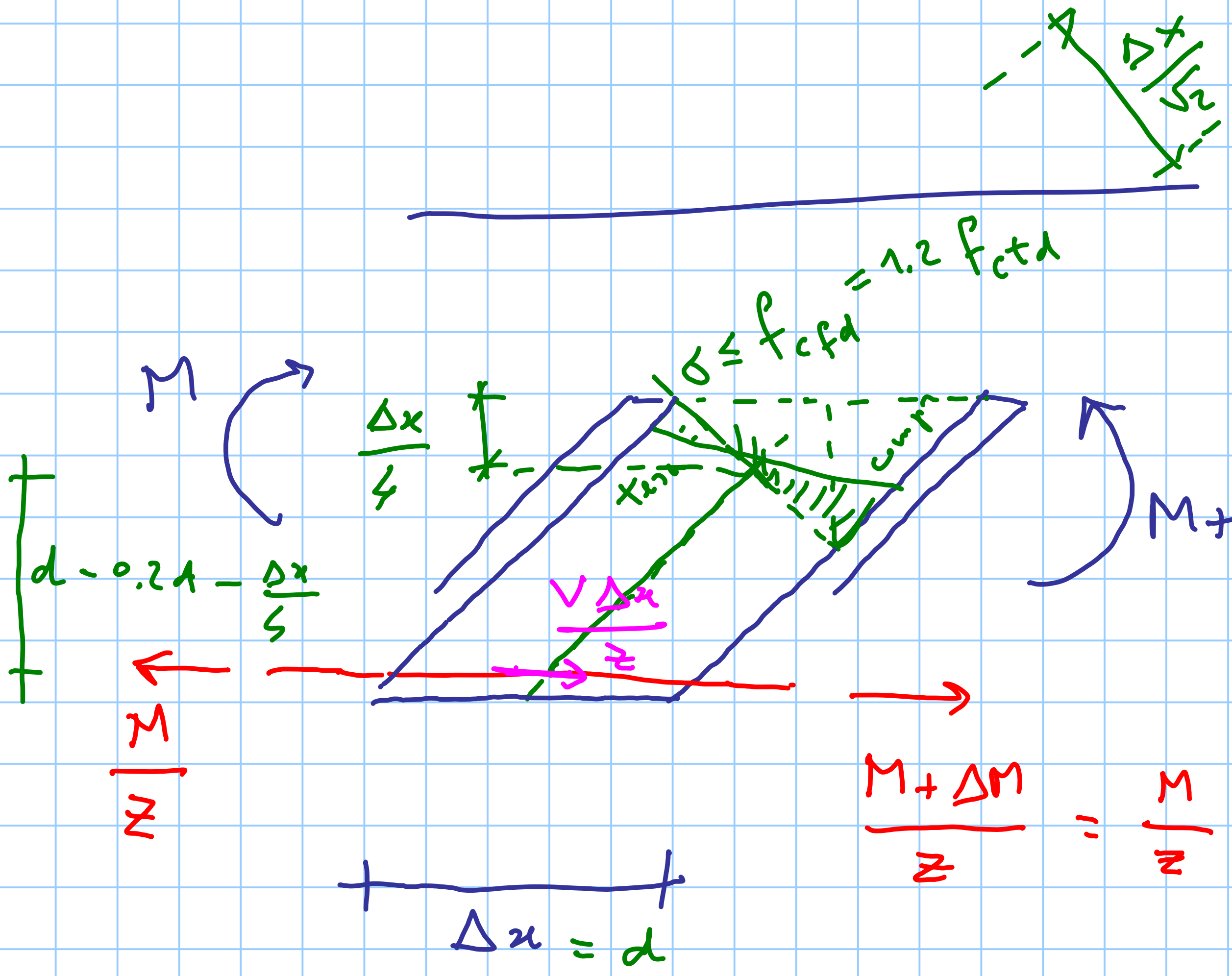
dente del pettine

MODELLO A PETTINE

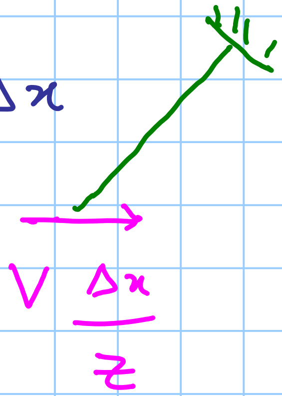
dente:

mensola presso-inflessa

$x = 0.2\,d$

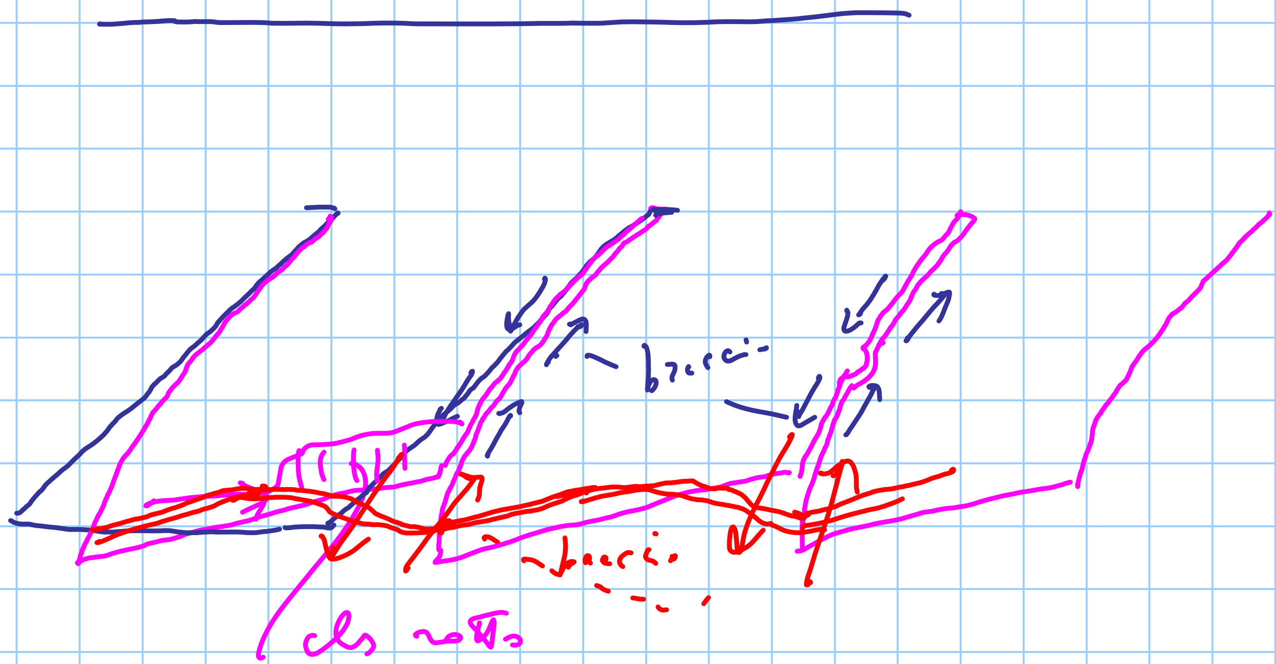


$$M + \Delta M = M + V\Delta x$$



$$\frac{M+\Delta M}{z} = \frac{M}{z} + \frac{V\Delta x}{z}$$

$$V_{Rd} = 0.25\; b\; d\; f_{ctd}$$



1) ingranamento degli inerti - il momento flettente si riduce

2) armatura: effetto spinotto - il momento si riduce

ingranamento degli inerti

$$K = 1 + \sqrt{\frac{200}{d}} \leq 2$$

d [mm]

solaio $h = 24$ cm $d = 21$ cm $K = 1.976$

trave $h = 50$ cm $d = 46$ cm $K = 1.659$

effetto spinotto

$$\rho_\ell = \frac{A_{s,\ell}}{b\, d} \leq 0.02$$

solaio 24+2 $b = 20$ cm $d = 21$ cm

$2\phi 10$/trav $A_{s,\ell} = 3.14$ cm^2 $\rho_\ell = 0.0075$

$2\phi 14$/trav. $\rho \simeq 0.015$

$$V_{Rd,c} = 0.18\, K \sqrt[3]{100\, \rho_e} \cdot \frac{\sqrt[3]{f_{ck}}}{\gamma_c}\, b\, d$$

$$= 0.035 \sqrt{K^3 f_{ck}}\, b\, d$$

prendere il maggiore
tra i due

solaio

$K = 1.976$

$\rho_e = 0.0075$

$C25/30 \rightarrow f_{ck} = 25\ MPa$

$$\underbrace{0.18}_{}\ \underbrace{K}_{1.976}\ \underbrace{\sqrt[3]{100\, \underbrace{\rho_e}_{0.0075}}}_{0.909} \cdot \underbrace{\frac{\sqrt[3]{f_{ck}}}{\gamma_c}}_{1.949}\ b\ d$$

0.630

$$0.035 \underbrace{\sqrt{K^3 f_{ck}}}_{} \ b\ d$$

0.486

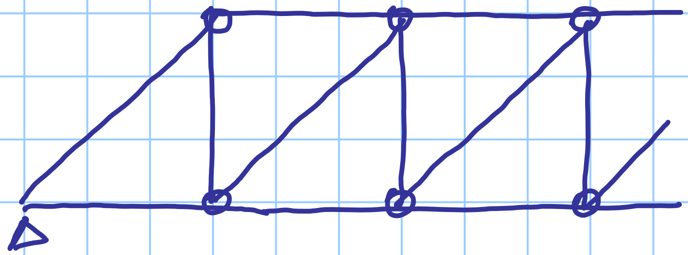
$$V_{Rd,c} = 0.630\, b\, d = 0.630 \times 20 \times 21 \times 10^{-1} = 26.46\ KN$$

SE C'E' ANCHE N

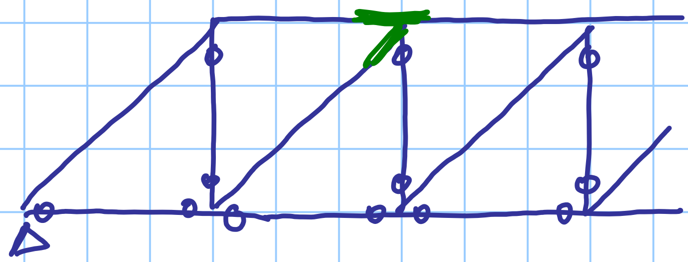
$$V_{Rd,c} = \left[0.18\, K \sqrt[3]{100\, \rho_e} \cdot \frac{\sqrt[3]{f_{ck}}}{\gamma_c} + 0.15\, \sigma_{cp} \right] b\, d$$

$$= \left[0.035 \sqrt{K^3 f_{ck}} + 0.15\, \sigma_{cp} \right] b\, d$$

$$\sigma_{cp} = \frac{N}{A_c} \leq 0.2\, f_{cd}$$ positivo se compressione

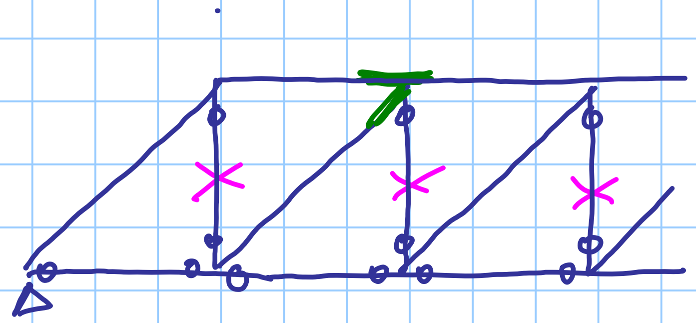


Traliccio isostatico

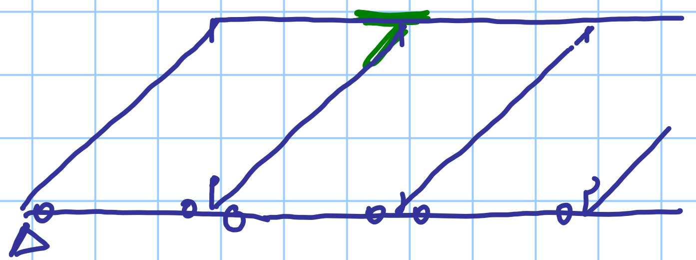


Traliccio iperstatico

in un calcolo elastico lineare i due schemi danno risultati quasi uguali.



se le staffe si snervano [per V_{wd}]
non danno ulteriore contributo



ma rimane il pettine [che porta V_{cd}]

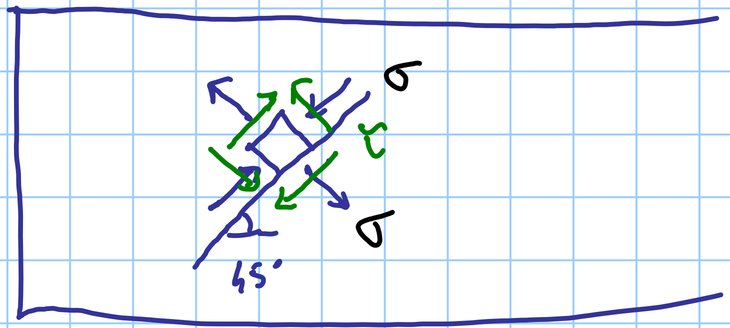
$$V_{Rd} = V_{wd} + V_{cd}$$

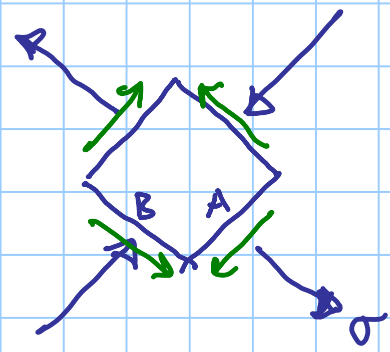
"metodo normale"

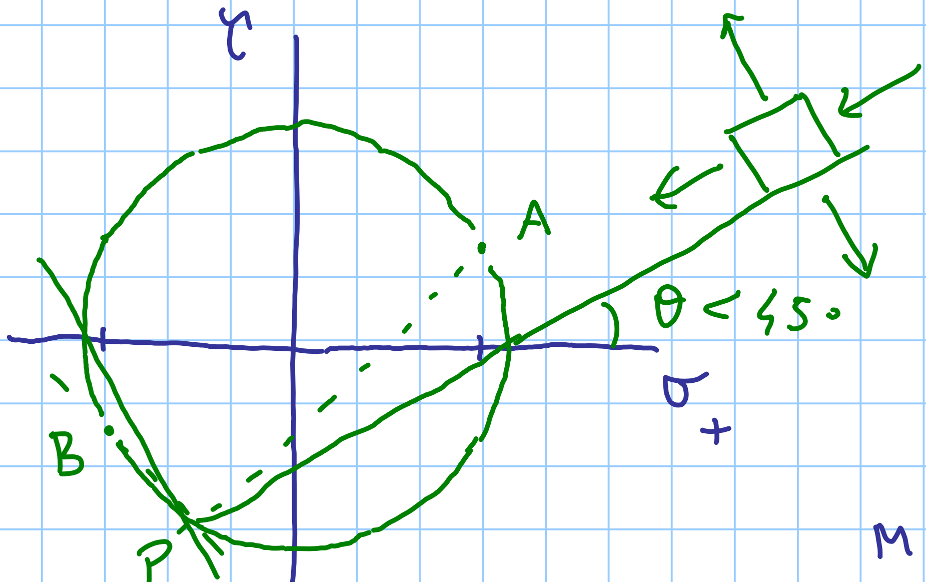
EC2 anni '90

norme italiane 1996

in verde: azione per ingranamento inerti

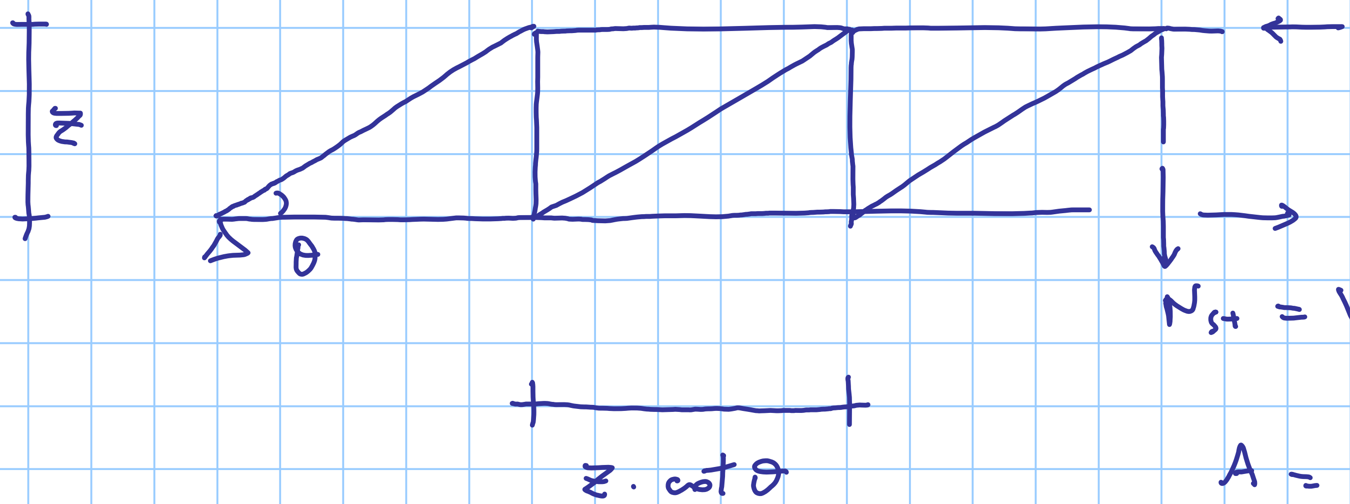






l'inclinazione θ del puntone si riduce

MODELLO AD INCLINAZIONE VARIABILE DEL PUNTONE



$\vartheta = 45°$ $\cot\vartheta = 1$

$\vartheta < 45°$ $\cot\vartheta > 1$

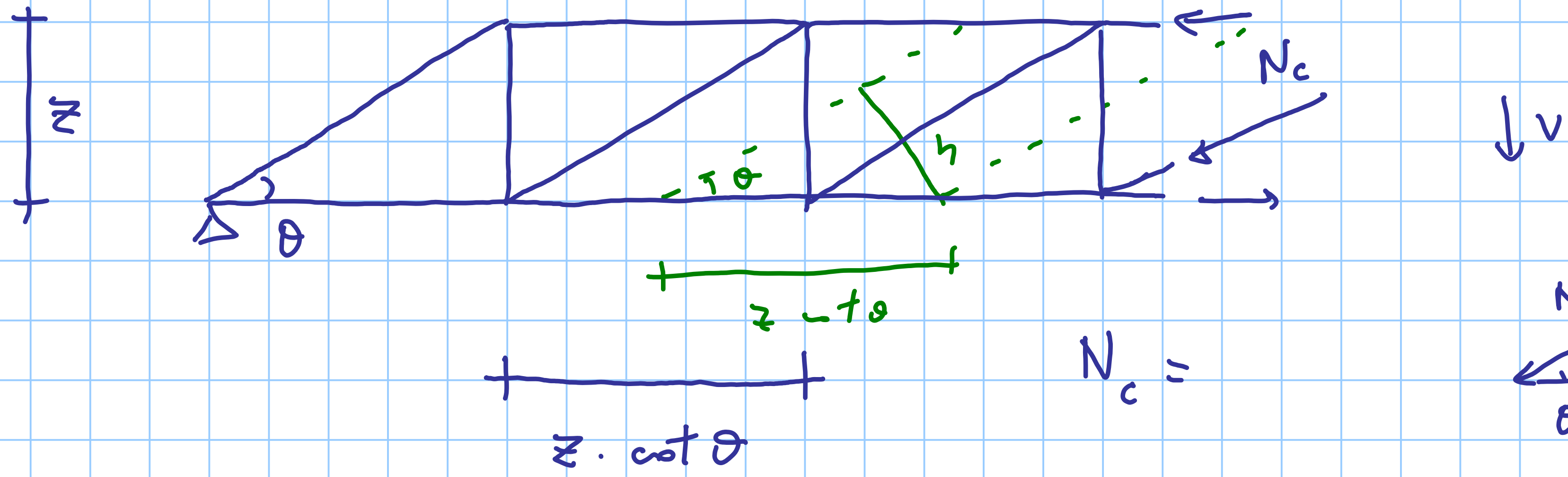
$1 \leq \cot\vartheta \leq 2.5$

$$A = \frac{V}{\sigma_{s,max}}$$

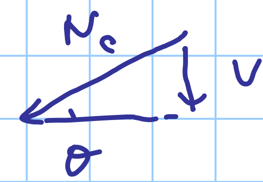
$$\frac{A_{st}}{s} z \cot\theta = \frac{V}{f_{yd}}$$

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

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



$N_c =$



$$N_c = \frac{V}{\sin\theta}$$

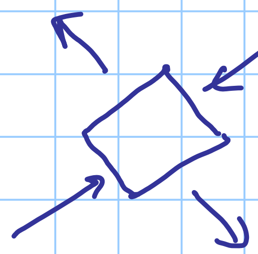
$$h = z \cot\theta \cdot \sin\theta =$$

$$= z \cos\theta$$

$$\sigma_c = \frac{N_c}{b\, z \cos\theta} = \frac{V}{b\, z \sin\theta \cos\theta} = \frac{V}{b\, z} \; \frac{1+\cot^2\theta}{\cot\theta} \leq f_{cd}$$

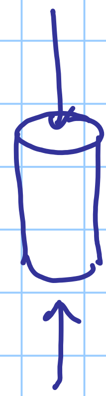
?

$$\frac{(\sin\theta \cdot \cos\theta)\,/\sin^2\theta}{(\sin^2\theta + \cos^2\theta)\,/\sin^2\theta} = \frac{\cot\theta}{1+\cot^2\theta}$$



$$\sigma_c \le f'_{cd} = 0.5\, f_{cd}$$

puntone compresso



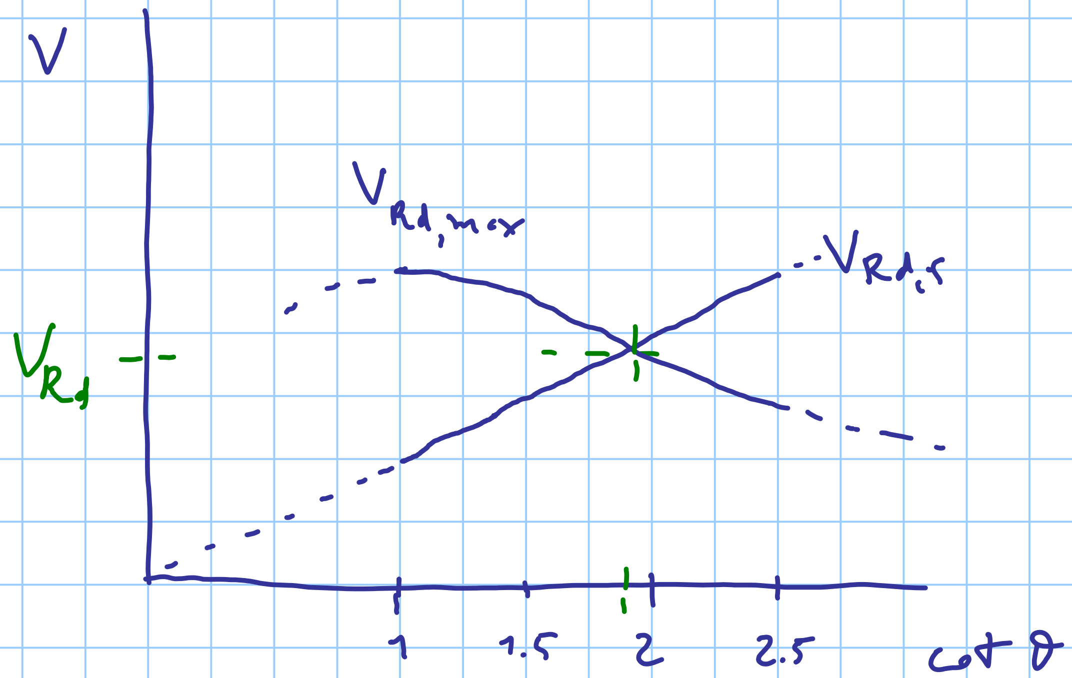
$\Rightarrow f_{ck}$

$$\frac{V}{b\,z}\,\frac{1+\cot^2\theta}{\cot\theta} \le \frac{1}{2} f_{cd}$$

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

al crescere di $\cot\theta$

$V_{Rd,max}$ si riduce



$$V_{Rd} = MIN\left(V_{Rd,s}\ ;\ V_{Rd,max}\right)$$

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

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

VERIFICA incognita $\cot\theta$

il massimo si ha quando $V_{Rd,s} = V_{Rd,max}$

$$\frac{A_{st}}{s} \cancel{z} f_{yd} \cancel{\cot\theta} = b \cancel{z} \frac{1}{2} f_{cd} \frac{\cancel{\cot\theta}}{1+\cot^2\theta}$$

$$1+\cot^2\theta = \frac{b \cdot \frac{1}{2} f_{cd}}{\frac{A_{st}}{s} f_{yd}}$$

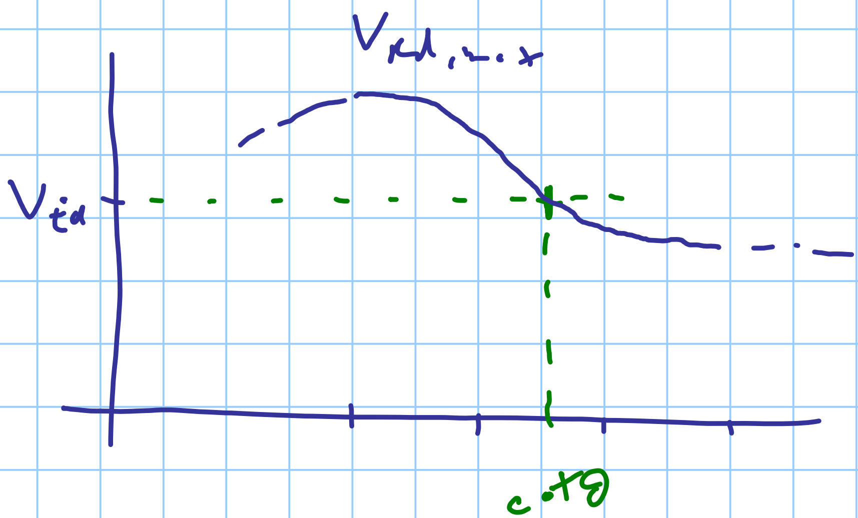
$$\cot\theta = \sqrt{\frac{\frac{1}{2} b f_{cd}}{\frac{A_{st}}{s} f_{yd}} - 1}$$

PROGETTO   conosco V_{Ed} incognite A_{st} e s (?) ... (sezione)

progetto sezione — da $V_{Rd,max}$

assegno $\cot\theta$ (es. 2) e calcolo bz $\rightarrow$ b, h

progetto staffe



$V_{Rd,max} = V_{Ed}$

con questo $\cot\theta$ progetto staffe.