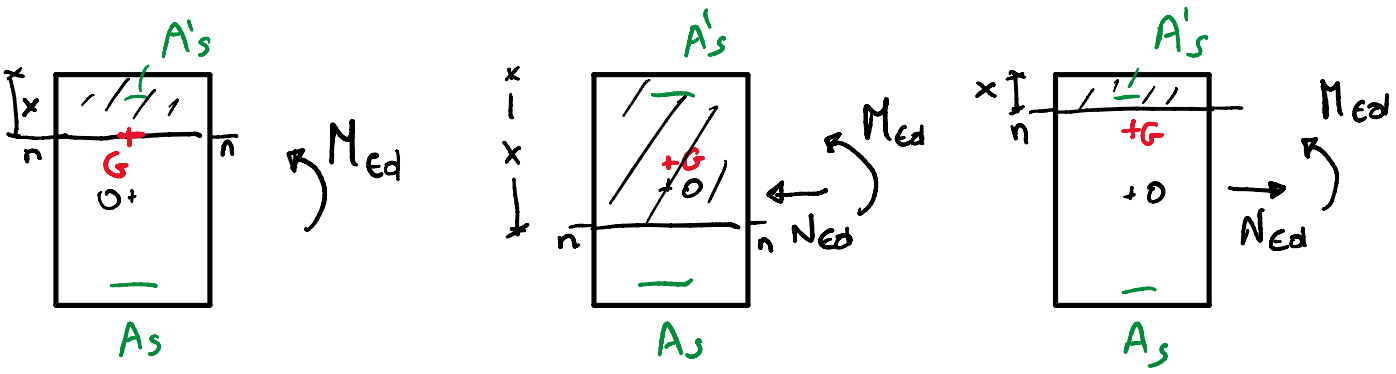
CASO CON CLS NON RESISTENTE A TRAZIONE

mercoledì 3 giugno 2020 13:57

CALCOLO DELLE τ



1. TROVARE x : $N_{Ed}=0 \Rightarrow S_n=0$

$M_{Ed}\neq 0$ $N_{Ed}\neq 0$ (grande ecc.) $\quad e_n=\dfrac{I_n}{S_n}$

2. TROVARE G SEZ. REAGENTE OMOGENEIZZATA

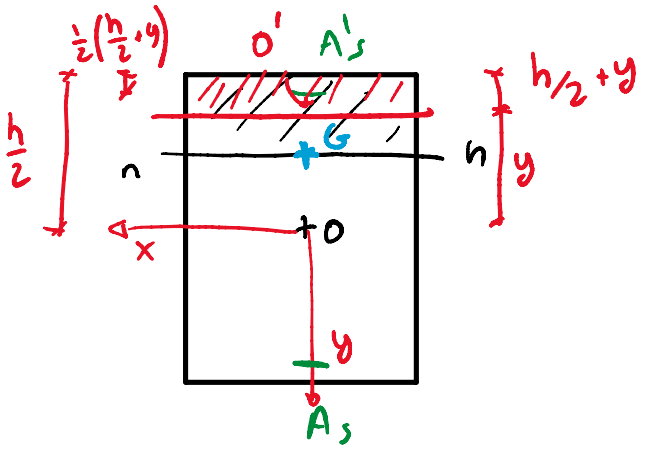
$$d_{G,sup}=\frac{S_{sup}}{A}=\frac{bx^2/2+nA'_sc+nA_sd}{bx+nA'_s+nA_s}$$

3 $\tau=\dfrac{V\cdot S}{I_G b}$ $\Rightarrow$ CALCOLO $I_G=I_{sup}-A\cdot d^2_{Gsup}$

$$I_{sup}=\frac{bx^3}{3}+nA'_sc^2+nA_sd^2$$

PER CALCOLARE S FISSO UNA CORDA A DISTANZA y DA O

CASO CON $N_{Ed}=0$, $M_{Ed}\neq 0$ $\Rightarrow$ ASSE NEUTRO $\equiv$ G



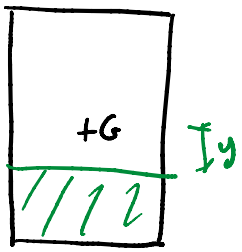
$$-S_{sup,G} = b\left(\frac{h}{2}+y\right)\cdot d_{GO'} + n A'_s\left(d_{GSup}-c\right)$$

$$-\left(\frac{h}{2}-c\right) \le y \le \frac{h}{2}+c$$

$d_{GO'}$ $\rightarrow$ $\left[d_{GSup} - \frac{1}{2}\left(\frac{h}{2}+y\right)\right]$

CONTRIBUTO ARMATURE DA AGGIUNGERE SE $-\left(\frac{h}{2}-c\right) \le y \le \frac{h}{2}+c$

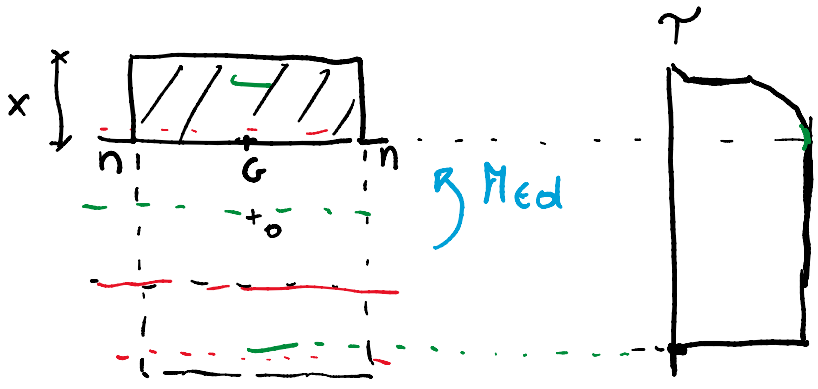
NOTA: CONSIDERO $-S_{Sup,G}$ PERCHÉ



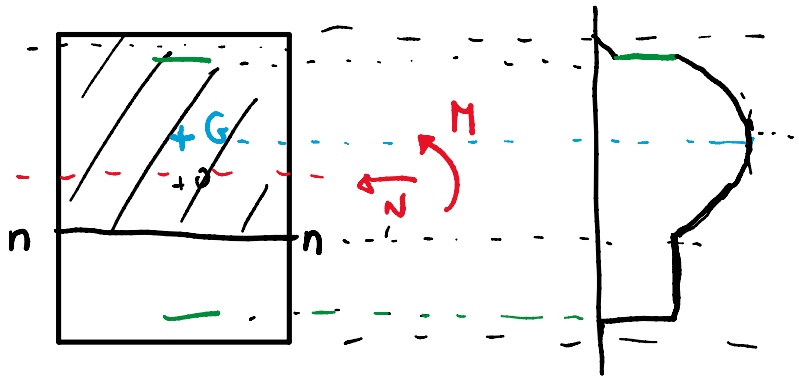
$$S_{INF,G} + S_{Sup\,G} = 0$$ (MOMENTO STATICO SEZIONE RISPETTO A G = 0)

$$\Rightarrow S_{INF,G} = -S_{Sup,G}$$

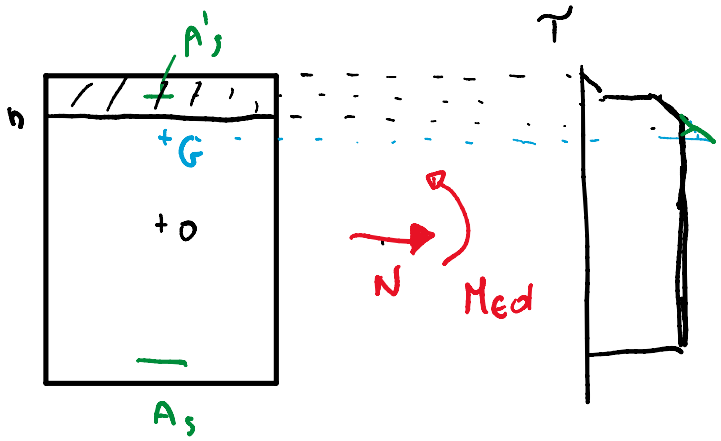
ANDAMENTO τ:



SE FISSO CORDA SOTTO ASSE NEUTRO NON AGGIUNGO CLS REAGENTE $\rightarrow$ τ RIMANE COSTANTE



τ_{max} IN CORRISPONDENZA DI G



CONSIDERAZIONI SULLO STATO TENSIONALE

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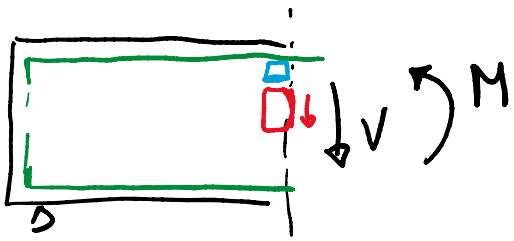
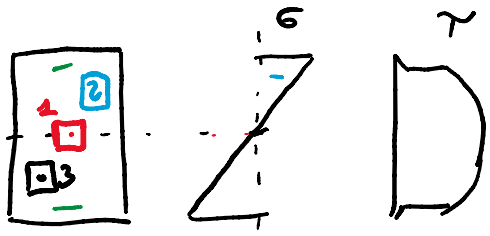
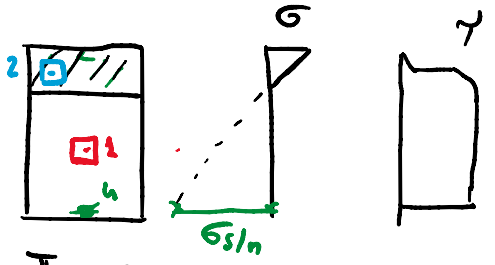


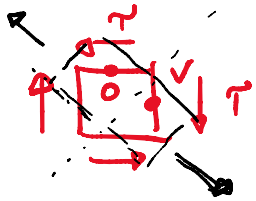


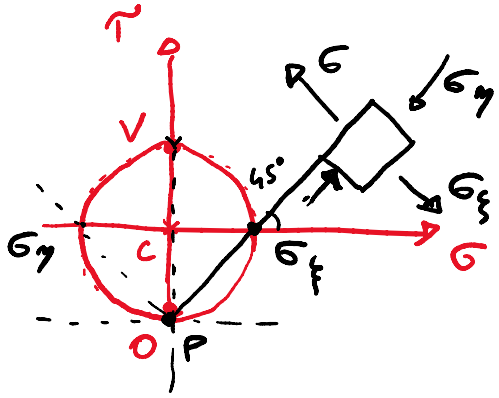
I STADIO



II STADIO

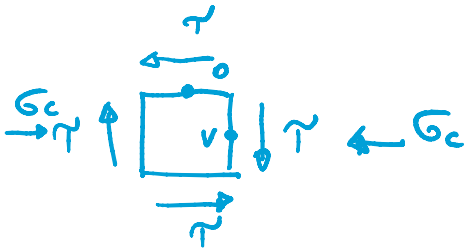
ELEMENTO 1

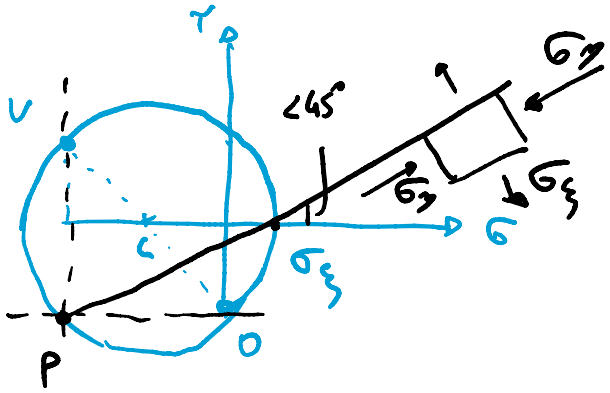




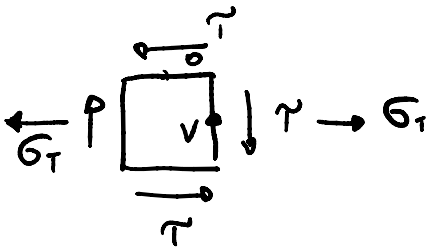
$\tau > 0$ SE DI VERSO ORARIO

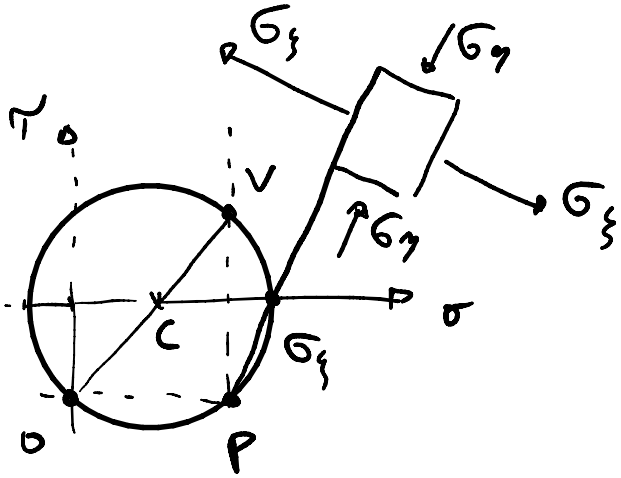
ELEMENTO 2



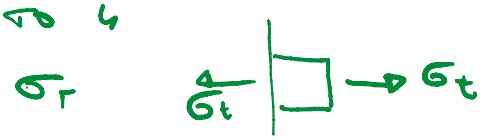


ELEMENTO 3

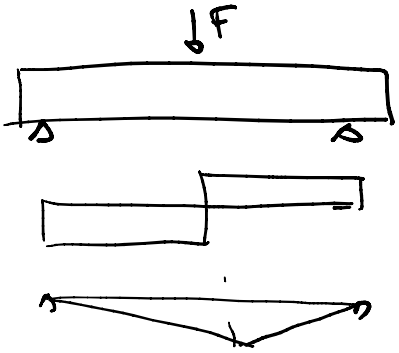


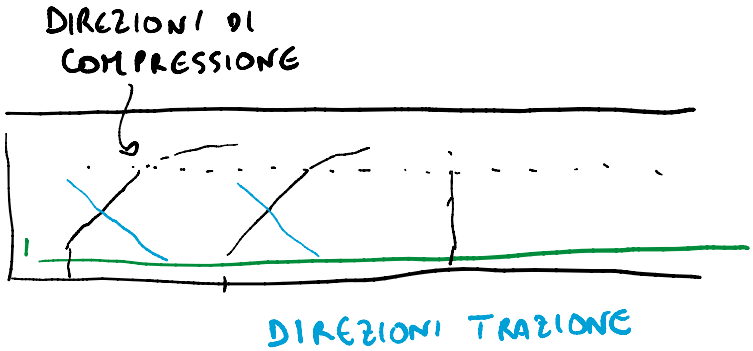


ELEMENTO 4



DIREZ. PRINCIPALI DI COMPRESSIONE

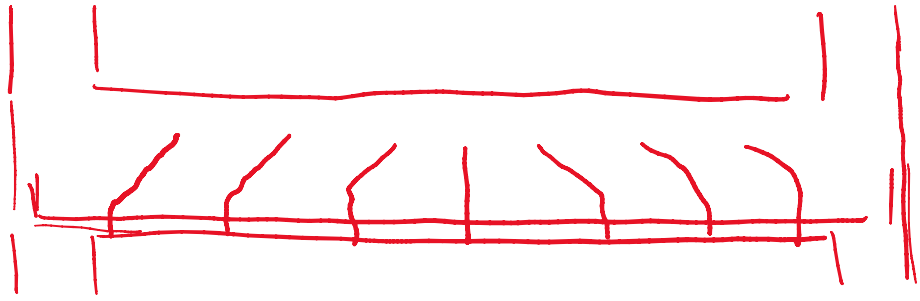




CRESCE F ⇒ AUMENTA V ⇒ AUMENTA σ_ξ

SE σ_ξ SUPERA f_{ct} ⇒ IL CALCESTRUZZO SI LESIONA

LESIONI NEL CLS



1. VALUTARE RESISTENZA PER SLU PER GIUSTIFICARE LA RESISTENZA DI UN ELEMENTO NON ARMATO A TAGLIO → MODELLO A PETTINE

2. PROGETTO ARMATURE PER ASSORBIRE LE σ_ξ (SLU, CAMPO LINEARE)

MODELLO A PETTINE

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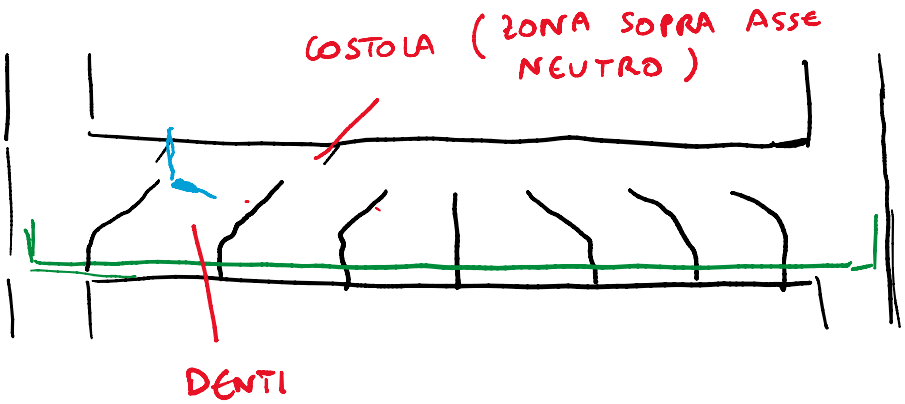
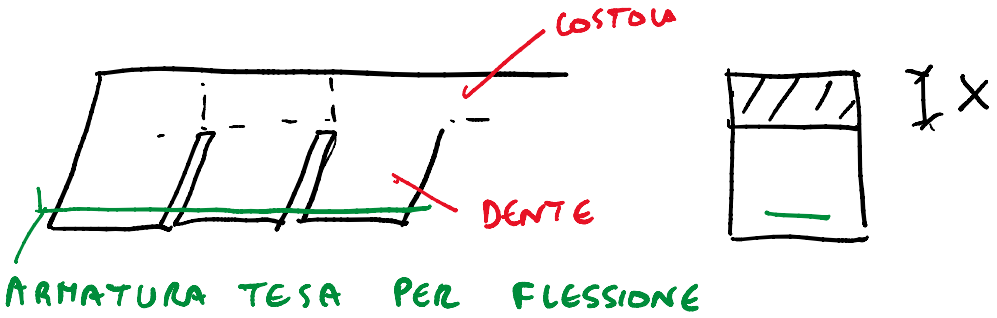


1. CRISI DEL DENTE
2. CRISI DELLA COSTOLA (SEZIONE DI STACCO)



CRISI DEL DENTE

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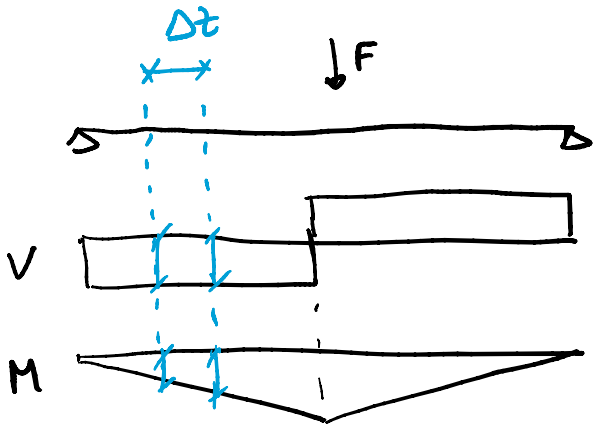
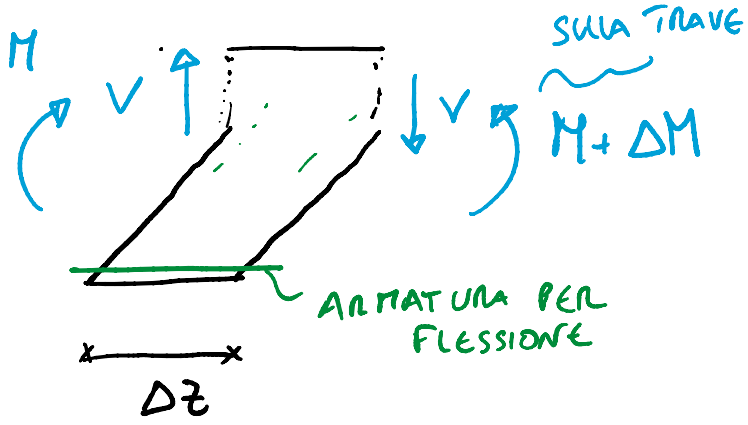
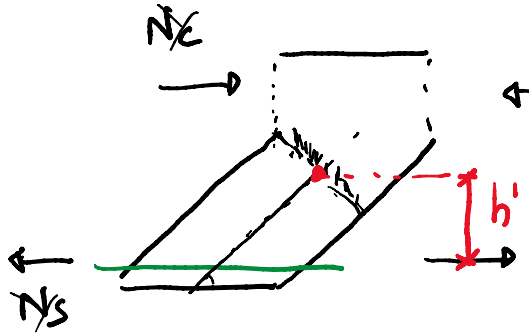


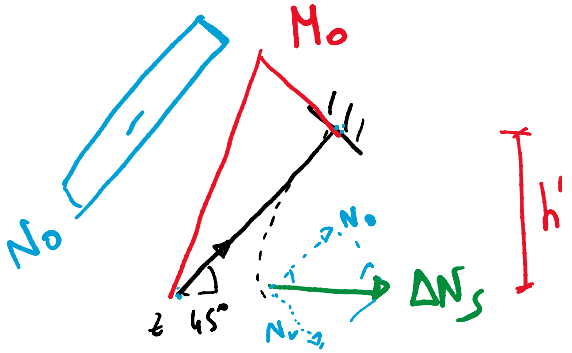


EQ. ROTAZIONE DEL DENTE $\Delta M = V \cdot \Delta z$

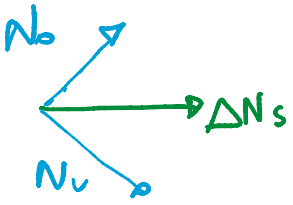


$$N_s + \Delta N_s = \frac{\Delta M}{z}$$

$$\Delta N_s = V \frac{\Delta z}{z}$$



LA SEZIONE D'INCASTRO È PRESSO - INFLESSA

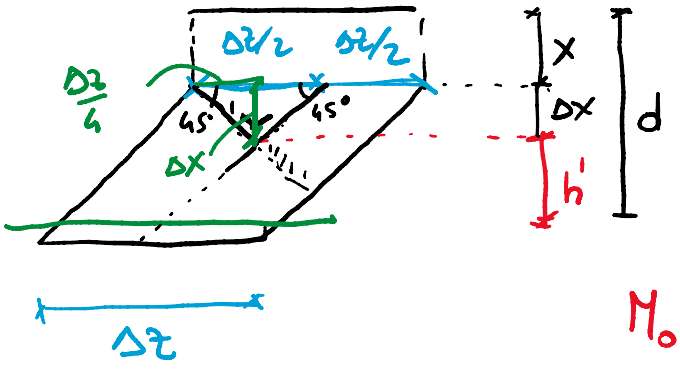


$$N_0 = -\Delta N_s \cdot \frac{\sqrt{2}}{2} = -V \frac{\Delta z}{z} \frac{\sqrt{2}}{2}$$

$$M_0 = -\Delta N_s \cdot h' = -\frac{V \Delta z}{z} h'$$

PRODOTTO DA ΔN_s E AGENTE SUL DENTE

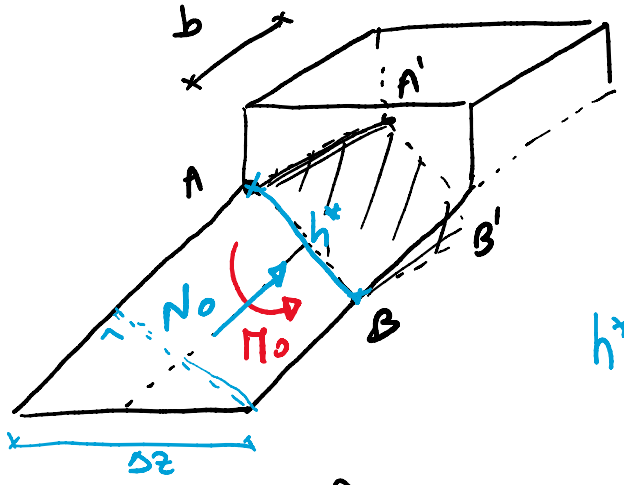
VERIFICA SEZIONE D'INCASTRO DEL DENTE

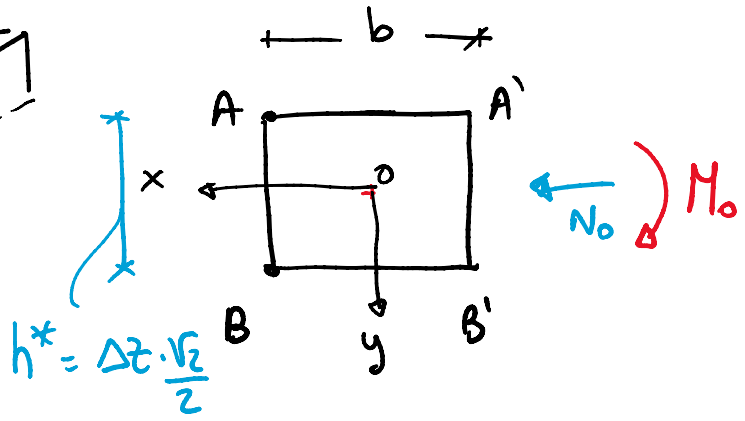


$$h' = d - x - \Delta x$$

$$\Delta x = \Delta z / 4$$

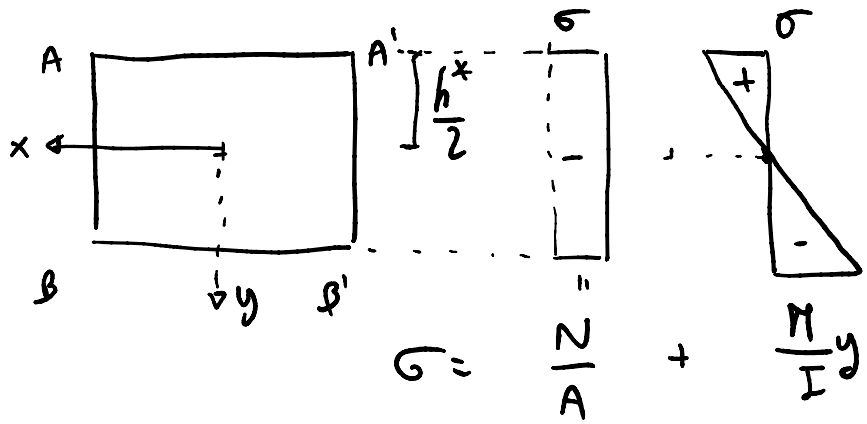
$$M_0 = - \frac{V \Delta z}{z} \cdot \left(d - x - \frac{\Delta z}{4} \right)$$

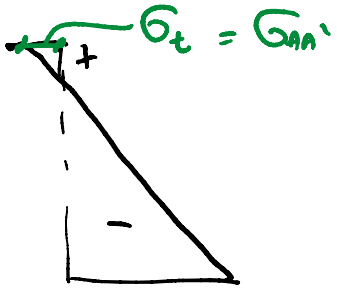




SE $\sigma_{AA'} > f_{cfd}$ $\Rightarrow$ CRISI DEL DENTE

SEZIONE IN CLS NON ARMATA





$$\sigma = \frac{N}{A} + \frac{M}{I} y$$

$$\sigma_{t,max} \Rightarrow y = - h^*/2$$

$$A = b h^* = b \cdot \Delta z \sqrt{2}/2$$

$$\frac{I}{y} = \frac{I}{h^*/2} = \frac{b h^{*3}}{12} \cdot \frac{2}{h^*} = \frac{b h^{*2}}{6} = \frac{b}{6} \cdot \Delta z^2 \cdot \frac{2}{4} \rightarrow \frac{I}{h^*/2} = \frac{b \Delta z^2}{12}$$

$$\sigma = \underbrace{-\frac{V \cancel{\Delta z}}{z} \cdot \frac{\sqrt{2}}{2}}_{N_0} \cdot \underbrace{\frac{1}{b \cancel{\Delta z} \frac{\sqrt{2}}{2}}}_{1/A} + \underbrace{\frac{V \cancel{\Delta z}}{2} \cdot \left(d - x - \frac{\Delta z}{4}\right)}_{M_0} \underbrace{\frac{12}{b \Delta z^2}}_{\frac{h^*}{2I}}$$

$$\sigma = -\frac{V}{bz} + \frac{12 V}{bz \Delta z}\left(d - x - \frac{\Delta z}{4}\right)$$

EVIDENZA SPERIMENTALE $\quad \Delta z \simeq d$

$$x \simeq 0.25 d$$

$$\sigma_t = -\frac{V}{bz} + \frac{12 V}{bz d}\underbrace{\left(d - 0.25d - \frac{d}{4}\right)}_{0,5d}$$

$$= -\frac{V}{bz} + \frac{6 V}{bz} = +\frac{5V}{bz}$$

CRISI SE $\sigma_t = f_{cfd} = 1,2 f_{ctd}$

NEL TESTO $f_{cfd} = 1.6 f_{ctd}$

$$\Rightarrow V_{Rd} = 1,2 f_{ctd} \cdot \frac{bz}{5} = 0.24 f_{ctd} \cdot bz$$

$$z = 0,9d \Rightarrow \boxed{V_{Rd} = 0,216 f_{ctd} \cdot bd}$$

TRASLAZIONE DEL DIAGRAMMA MOMENTI

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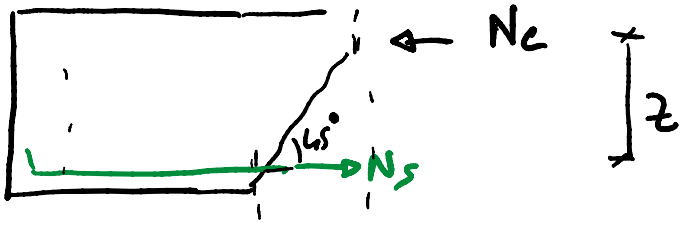
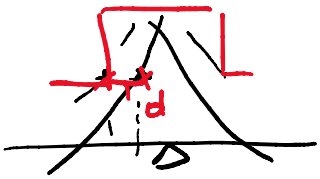
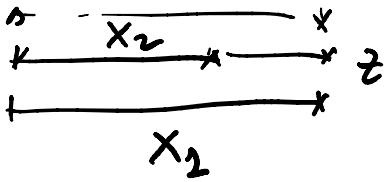
ELEMENTI NON ARMATI A TAGLIO







$$X_1 - X_2 = z \simeq 0.9\,d$$

CRISI SEZIONE DI STACCO

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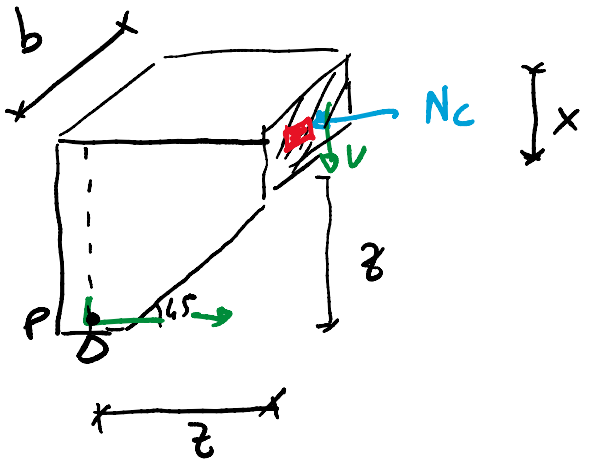


EQ. ROTAZIONE $\Rightarrow$

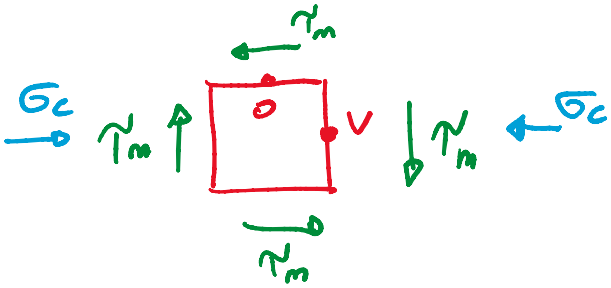
$$N_c \cdot z = V \cdot z \Rightarrow$$

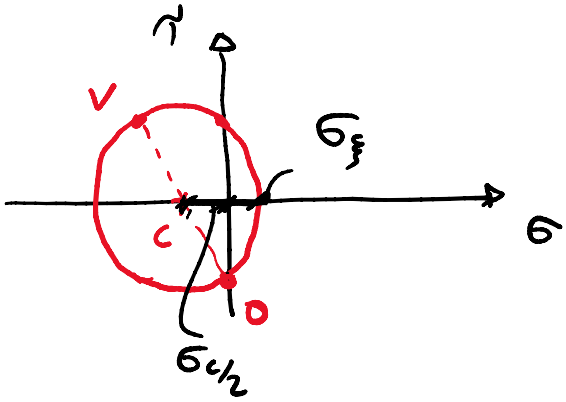
$$N_c = V$$

SUL CORRENTE SUPERIORE HO $\sigma_{cm} = -\dfrac{|N_c|}{bx} = -\dfrac{V}{bx}$

$$\tau_m = \frac{V}{bx}$$

CERCHIO DI MOHR





$$\sigma_f = R + \frac{\sigma_c}{2}$$

$$R = \sqrt{\left(\frac{-V}{2bx}\right)^2 + \left(\frac{V}{bx}\right)^2} = \sqrt{\frac{1}{4}\frac{V^2}{(bx)^2} + \frac{V^2}{(bx)^2}} = \frac{V}{bx}\sqrt{\frac{5}{4}} = \frac{\sqrt{5}}{2}\frac{V}{bx}$$

$\left(\frac{\sigma_c}{2}\right)^2$ $\quad$ τ^2

$$\rightarrow \sigma_f = \frac{\sqrt{5}}{2}\frac{V}{bx} - \frac{V}{2bx} = \frac{V}{bx}\left[\frac{\sqrt{5}}{2} - 0{,}5\right] = 0{,}618\,\frac{V}{bx}$$

SE CRESCE $V \Rightarrow$ CRESCE σ_ξ

HO LA CRISI SC $\sigma_\xi = f_{ctd} \rightarrow$

$$V_{Rd} = f_{ctd} \cdot bx \frac{1}{0.618} = 1.618\, f_{ctd} \cdot bx$$

CONFRONTO TRA LE DUE RESISTENZE

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DENTE

$V_{Rd} = 0.216 f_{ctd} \cdot bd$

SEZIONE DI STACCO

$V_{Rd} = 1.618 \cdot f_{ctd} \cdot bx$

$0.216\, d$ $\qquad$ $1.618 \cdot x$

CRISI NEL DENTE SE $0.216\, d < 1.618\, x \Rightarrow$

$$x > \frac{0.216}{1.618} d = 0.13 d$$

SE NO FLESSIONE SEMPLICE $x \simeq 0.25 d$

$\Rightarrow$ CRISI NEL DENTE

SOLO IN CASO DI TENSO-FLESSIONE POSSO AVERE CRISI NELLA SEZIONE DI STACCO

EFFETTI CHE INCREMENTANO LA RESISTENZA A TAGLIO

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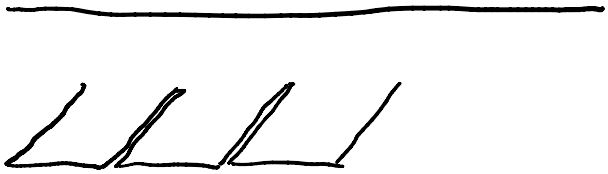
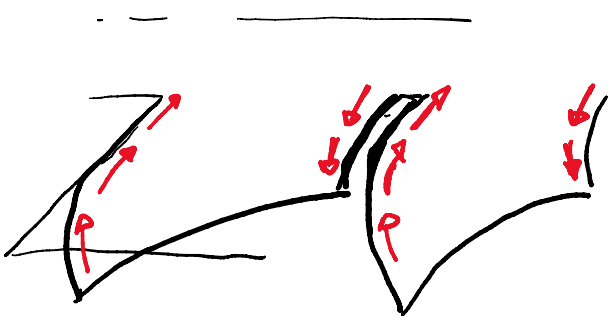
INGRANAMENTO INERTI

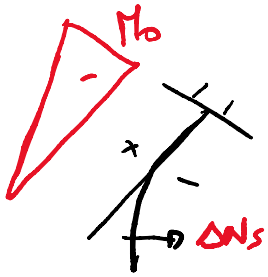


EFFETTO TANTO PIÙ GRANDE QUANTO PIÙ LE FESSURE SONO PICCOLE

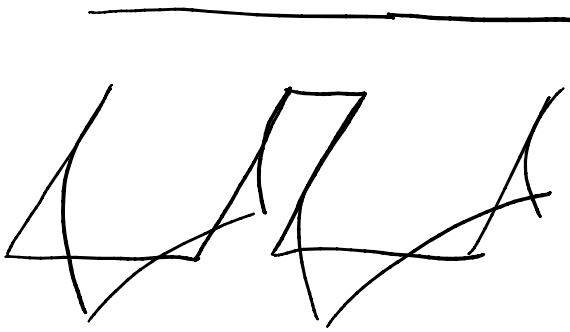
↓

TRAVE BASSA



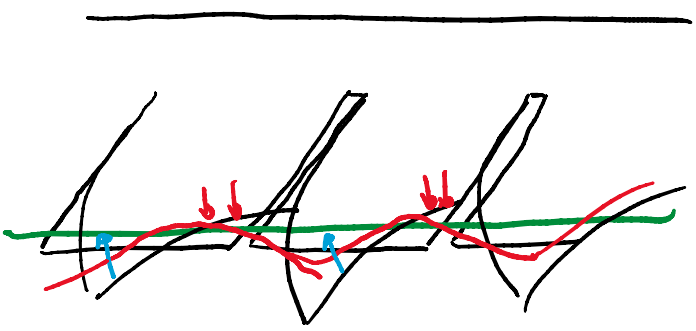


SUL DENTE NASCE UN MOMENTO OPPOSTO A M_0



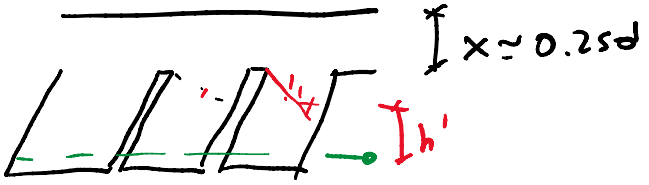
EFFETTO TRASCURABILE SE LE FESSURE SONO AMPIE (TRAVI ALTE)

EFFETTO SPINOTTO



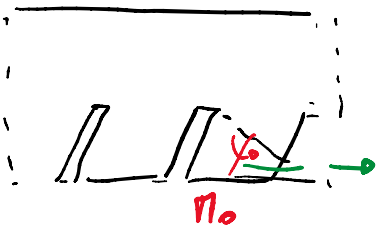
L'ARMATURA SPINGE SUL CLS CAUSANDO ESPULSIONE DEL RICOPRIMENTO ⇒ PRODUCE UN ΔM_{Ed} CHE SI OPPONE A M_0

EVENTUALE COMPRESSIONE SULL'ELEMENTO



$N_{Ed} = 0 \rightarrow x \simeq 0.25d$

SE M_0 N_{Edco}



↓ h' SI RIDUCE

↓

M_0 SI RIDUCE

INDICAZIONI DI NORMATIVA

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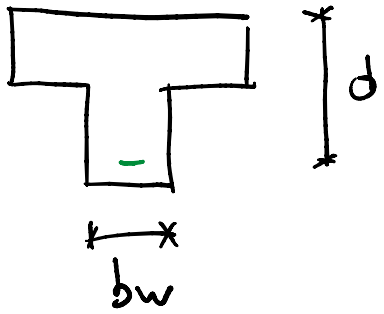
$$V_{Rd} = \max \begin{cases} \left[0.18\, k \sqrt[3]{\frac{100\, \rho_e f_{ck}}{\gamma_c}} + 0.15\, \sigma_{cp}\right] b_w d & (1) \\ \left[0.035\, k^{3/2} f_{ck}^{1/2} + 0.15\, \sigma_{cp}\right] b_w d & (2) \end{cases}$$

$\downarrow$ MPa



FORMULA TEORICA

$$V_{Rd} = 0.216\, f_{cd} \cdot b\, d$$

$\sqrt[3]{f_{ck}}$, $\sqrt{f_{ck}}$ $\rightarrow$ MISURE INDIRETTE DELLA RESISTENZA A TRAZIONE

$\uparrow$ IN MPa

$k = 1 + \sqrt{\frac{200}{d}} \leq 2$ $\quad d$ in mm $\Rightarrow$ TIENE CONTO DI INGRANAMENTO INERTI

$\rho_e = \frac{A_{s\,tesa}\ (\text{BEN ANCORATA})}{b_w d} \leq 0.02 \Rightarrow$ TIENE CONTO EFFETTO SPINOTTO

$\sigma_{cp} = \frac{N_{Ed}}{A_c} \leq 0.2 f_{cd}$ $\quad \sigma_{cp} > 0$ SE DI COMPRESSIONE

L'EQUAZIONE 2 GARANTISCE UN MINIMO V_{Rd} ANCHE QUANDO $\rho_e \rightarrow 0$

CONFRONTO V_{Ed} E V_{Rd}

Se $V_{Ed} < V_{Rd}$

- SOLAIO → NON HO BISOGNO DI ARMATURA A TAGLIO
- TRAVI PILASTRI → POSSO DISPORRE ARMATURA A TAGLIO SECONDO MINIMI DI NORMATIVA

APPLICAZIONE AL SOLAIO

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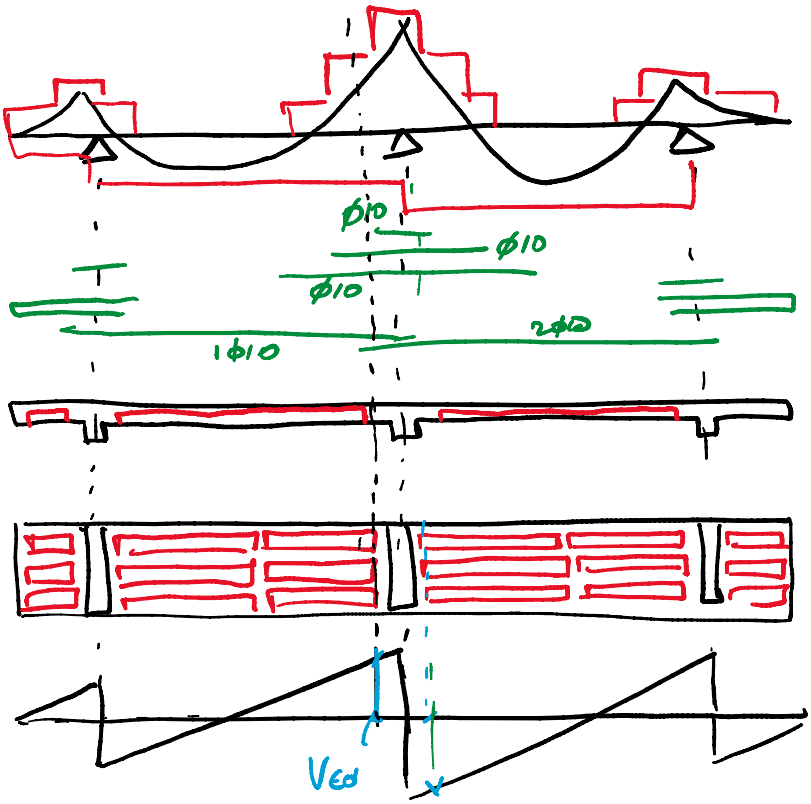
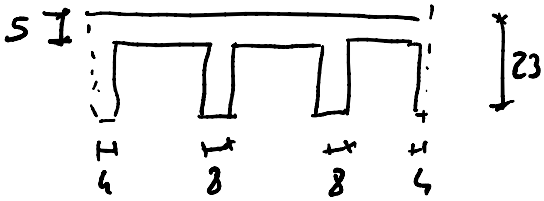
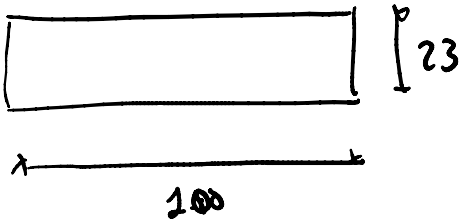


SEZIONE FASCIA ALLEGGERITA



SEZIONE FASCIA PIENA



NELLA FASCIA PIENA $b_w = 100$

ALLEG. $b_w = 3 \times 8 = 24$ cm (2 NERVATURE)

⇒ VALUTO V_{Ed} IN CORRISPONDENZA DELLA FILA DI PIGNATTE PIÙ VICINA ALL'APPOGGIO

$$\rho_{sl} = \frac{A_{sl}}{b_w d} = \frac{3 \times (2 \times A_{\phi 10})}{3 \times 8 \times 20\,cm}$$

NUM. TRAVETTI

NUMERO TRAVETTI

AREA TESA BEN ANCORATA

$d = h - 3 = 20$ cm

$$\rho_{sl} = \frac{2 \times 0{,}785\,cm^2}{8 \times 20\,cm^2} = 9{,}8 \cdot 10^{-3} \leq 0.02 \quad \text{ok}$$

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

(d in mm)

$\sigma_{cp} = 0$

$$V_{Rd}^{①} = \left[0.18 \times 2 \times \sqrt[3]{\frac{100 \times 9{,}8\,10^{-3} \times 25}{1{,}5}} \right] \times 24\,cm \times 20\,cm \times \frac{1}{10} = 33.46\ KN$$

(MPa; cm^2)

$$V_{Rd}^{②} = 0.035 \cdot 2^{3/2} \cdot \sqrt{25} \times 24 \times 20\ cm^2 \times \frac{1}{10} = 23{,}76\ KN$$

(MPa)

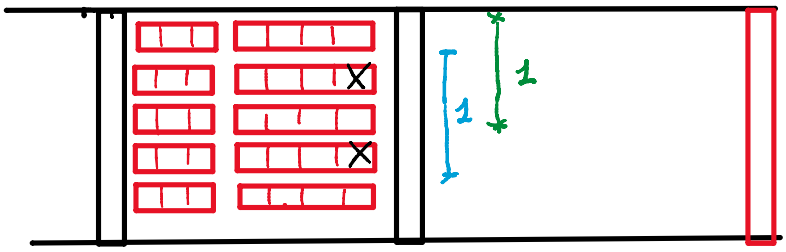
$$V_{Rd} = \max(33{,}46 ; 23{,}76) = 33{,}46\ KN$$

CONFRONTO V_{Rd} CON V_{Ed}

SE $V_{Rd} \geq V_{Ed} \Rightarrow$ VERIFICA SODDISFATTA

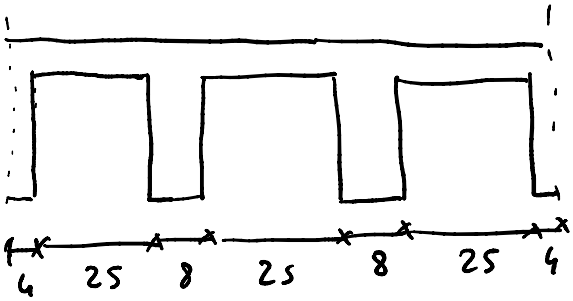
SE $V_{Rd} \leq V_{Ed} \Rightarrow$ PASSO A UNA FASCIA SEMIPIENA

STRALCIO DI CARPENTERIA



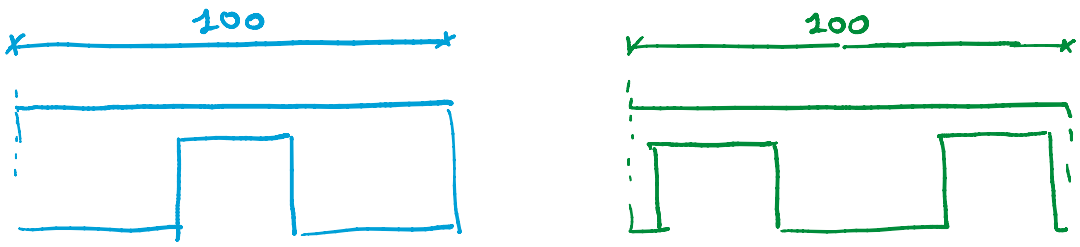
X = PIGNATTE DA ELIMINARE

PER SOLAIO CON 3 TRAVETTI AL METRO



ELIMINO 1+1/2 PIGNATTA AL m ⇒

$b = 3 \times 8 + 1{,}5 \times 25 = 61.5\ cm$



PER SOLAI CON 2 TRAVETTI AL m → ELIMINO 1 PIGNATTA AL m

$$bw = 2 \times 10 + 40 = 60 \text{ cm}$$

ALTRE INDICAZIONI DI NORMATIVA

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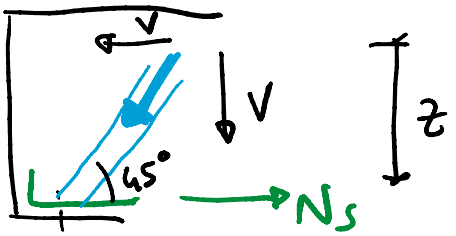
IN CORRISPONDENZA DEGLI APPOGGI LE ARMATURE LONGITUDINALI DEVONO ASSORBIRE UNA FORZA DI TRAZIONE PARI AL TAGLIO



SBALZO LATERALE

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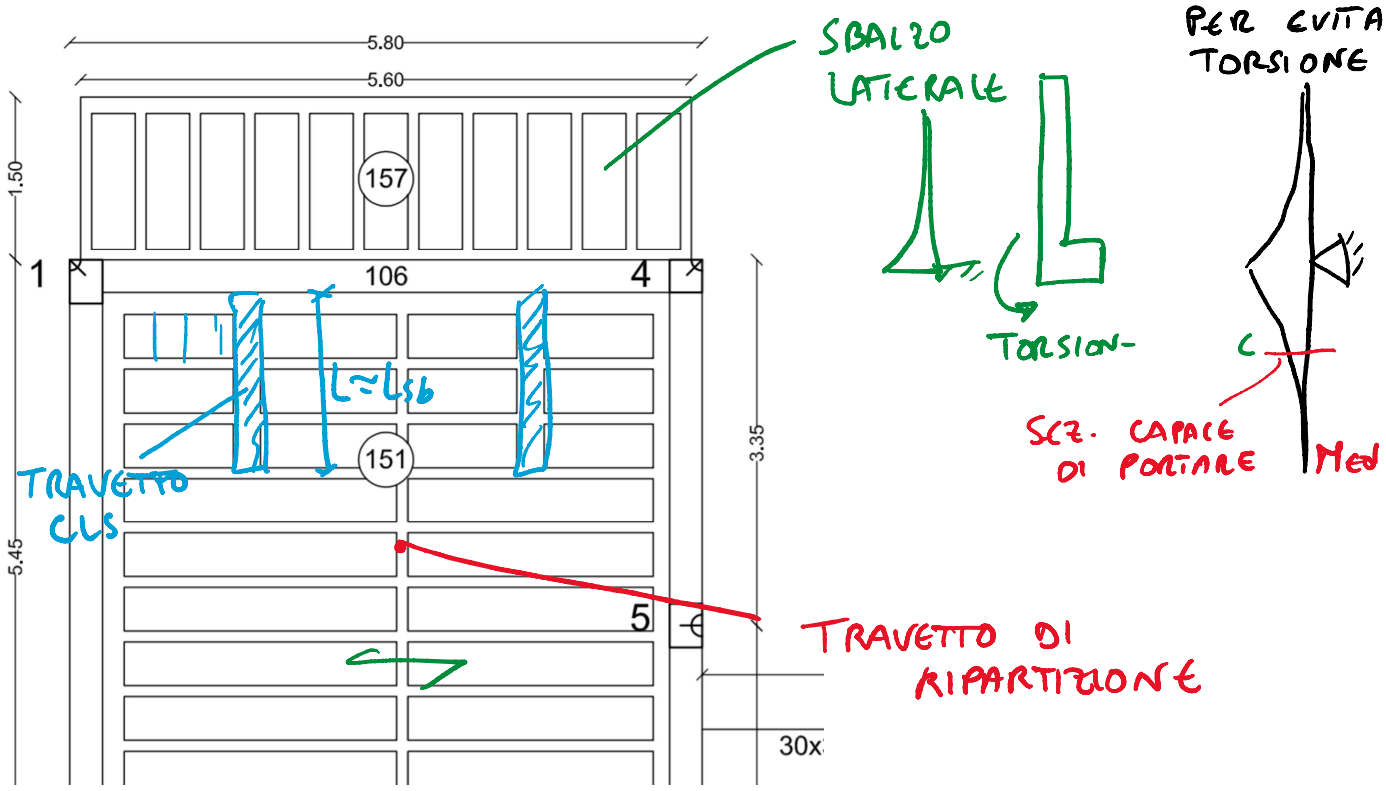

SBALZO D'ANGOLO

mercoledì 3 giugno 2020 16:55