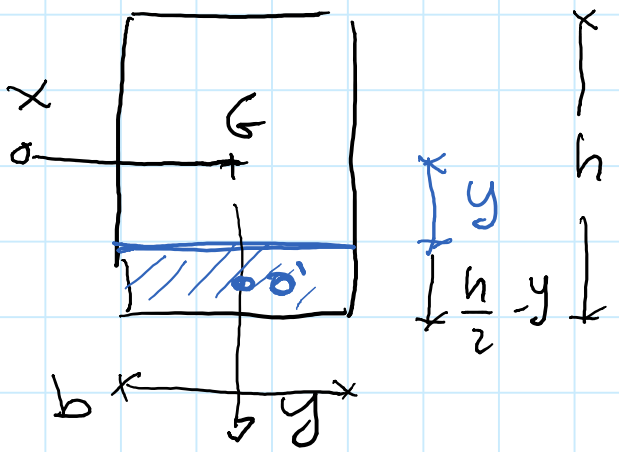
TENSIONI τ IN SEZ. RETTANGOLARE (MATERIALE OMOGENEO E ISOTROPO)

$$\tau = \frac{V_y \cdot S_x}{I_x \cdot b}$$



$S_{INF,G} + S_{SUP\,G} = 0 \Rightarrow$

A MENO DEL SEGNO POSSO CONSIDERARE PARTE SOPRA O SOTTO LA CORDA

$$I = \frac{bh^3}{12}$$

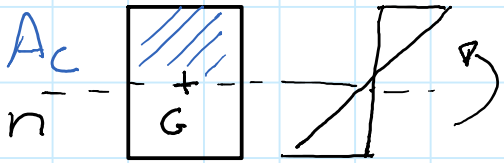
$$S_G = b\left(\frac{h}{2} - y\right)\underbrace{\left[y + \frac{1}{2}\left(\frac{h}{2} - y\right)\right]}_{d'G};$$

$$S_G = b\left(\frac{h}{2} - y\right)\left[y + \frac{h}{4} - \frac{y}{2}\right] = b\left(\frac{h}{2} - y\right)\left[\frac{h}{4} + \frac{y}{2}\right] = \frac{1}{2}b\left(\frac{h^2}{4} - y^2\right)$$

τ_{max} $\quad y = 0$

NEL CASO DI FLESSIONE SEMPLICE

$$\sigma = E \chi y$$



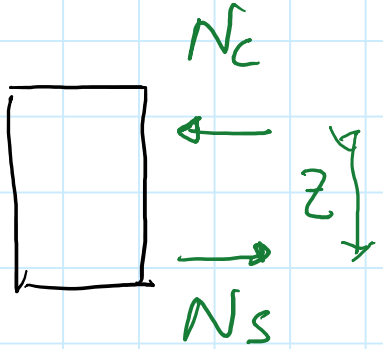
$$N_c = \int_{A_c} \sigma \, dA$$

(RISULTANTE $\sigma < 0$
A_c = AREA COMPRESSA) →

$$N_c = \int_{A_c} E \chi y \, dA = E \chi S_{comp} \rightarrow S_{comp} = \frac{N_c}{E\chi}$$

$$EI\chi = M \rightarrow I = \frac{M}{E\chi}$$

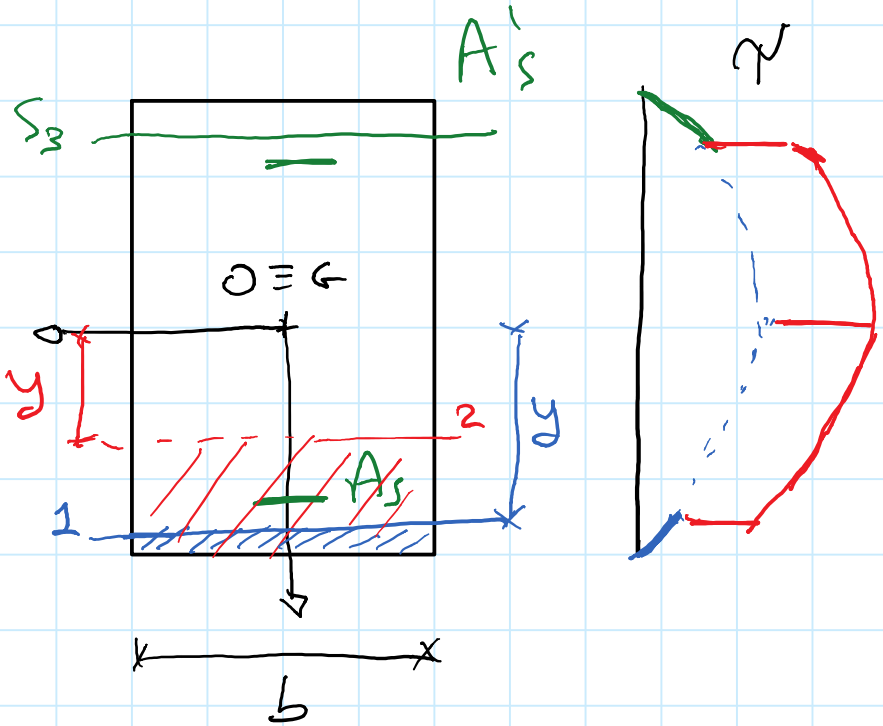
$$\tau = \frac{V_y S}{bI} = \frac{N_c}{E\chi} \frac{V_y}{b} \frac{E\chi}{M}$$



$$\tau_{MAX} = \frac{V_y}{bz}$$

(τ_{max} PERCHÉ LA CORDA È BARICENTRICA)

COMP. LINEARE ; CLS RESISTENTE A TRAZIONE



CASO : $A'_s = A_s$

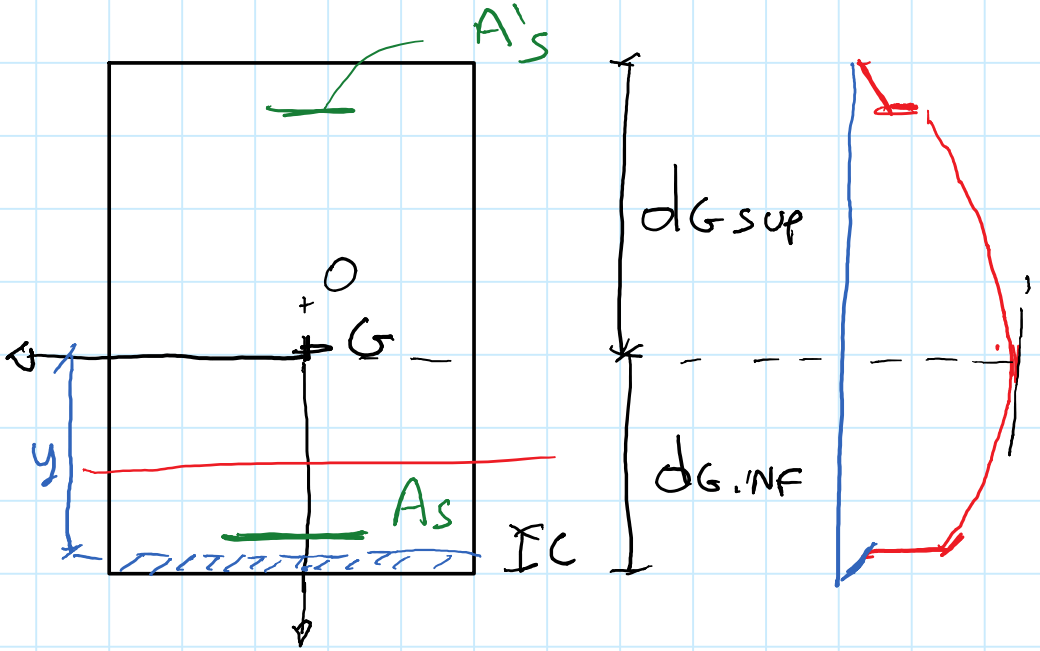
$$I = \frac{bh^3}{12} + nA_s\left(\frac{h}{2}-c\right)^2 + nA'_s\left(\frac{h}{2}-c\right)^2$$

$$\frac{h}{2}-c < y \leq \frac{h}{2} \longrightarrow S_1 = \frac{1}{2}b\left(\frac{h^2}{4}-y^2\right)$$

$$-\left(\frac{h}{2}-c\right) \leq y \leq \left(\frac{h}{2}-c\right) \longrightarrow S_2 = \frac{1}{2}b\left(\frac{h^2}{4}-y^2\right) + nA_s\left(\frac{h}{2}-c\right)$$

$$y < -\left(\frac{h}{2}-c\right) \longrightarrow S_3 = \frac{1}{2}b\left(\frac{h^2}{4}-y^2\right) + nA_s\left(\frac{h}{2}-c\right) - nA'_s\left(\frac{h}{2}-c\right)$$

CASO CON ARMATURE $A'_s \neq A_s$



$$d_{G,sup} = \frac{S_{sup}}{A_{ci}}$$

$$\tau = \frac{VS}{Ib}$$

$$I = \frac{b d_{G,sup}^3}{3} + \frac{b d_{G,INF}^3}{3} + nA_s \left(d_{GINF} - c\right)^2 + nA'_s \left(d_{G,sup} - c\right)^2$$

$$d_{GINF} - c \leq y \leq d_{GINF}$$

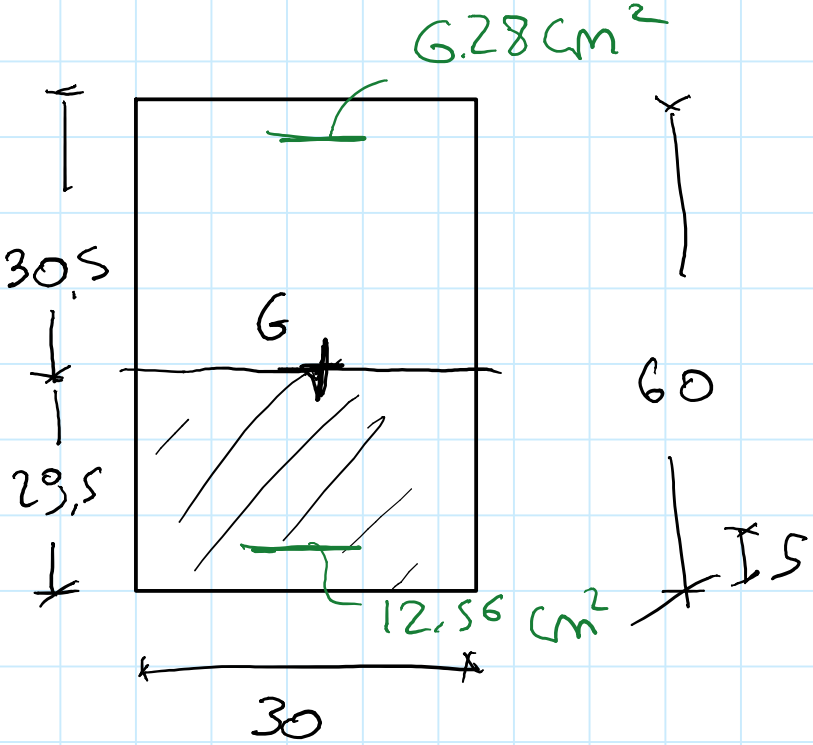
$$S' = b\left(d_{GINF} - y\right)\left[y + \frac{d_{GINF} - y}{2}\right]$$

$$S' = \frac{1}{2} b \left(d_{GINF}^2 - y^2\right)$$

$$-\left(d_{G,sup} - c\right) \leq y \leq d_{GINF} - c$$

$$S = \frac{1}{2} b \left(d_{GINF}^2 - y^2\right) + nA_s \left(d_{GINF} - c\right)$$

ESEMPIO



$A'_s = 6.28\ cm^2$; $A_s = 12,56\ cm^2$

$n = 6.10$; $V_y = 65\ kN$

$\tau_{max} = ?$

1. CALCOLO G $\Rightarrow$

$d_{G,sup} = 30.5\ cm$

$d_{G,INF} = 29.5\ cm$

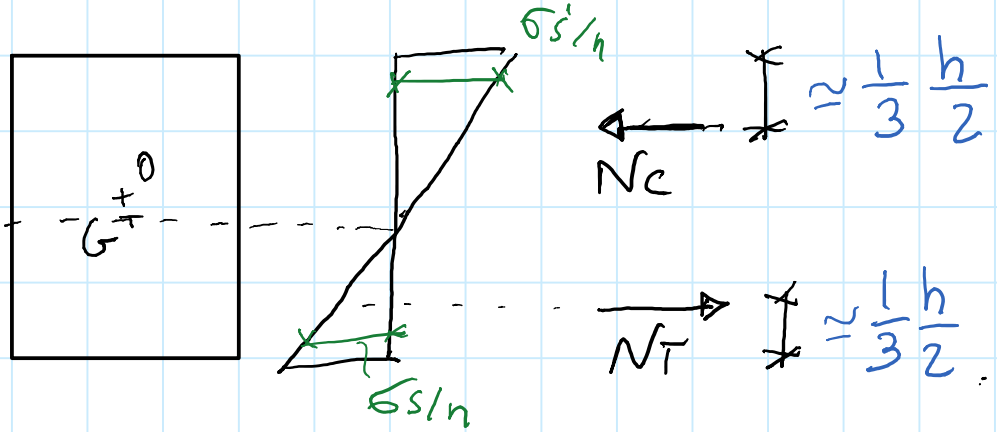
$I = 61349\ cm^4$

$$S'_{xG} = \frac{b \cdot d_{GINF}^2}{2} + nA_s \cdot (d_{GINF} - c)$$

$$= \frac{30 \times 29,5^2}{2} + 6.10 \times 12,56 \left(29,5 - 5\right) = 14930\ cm^3$$

$$\tau_{MAX} = \frac{65\,KN \cdot 14930\,\cancel{cm^3}}{611348\,cm^4 \cdot 30\,cm} \cdot \frac{10^3}{\cancel{10^2}} = 0{,}53\,MPa$$

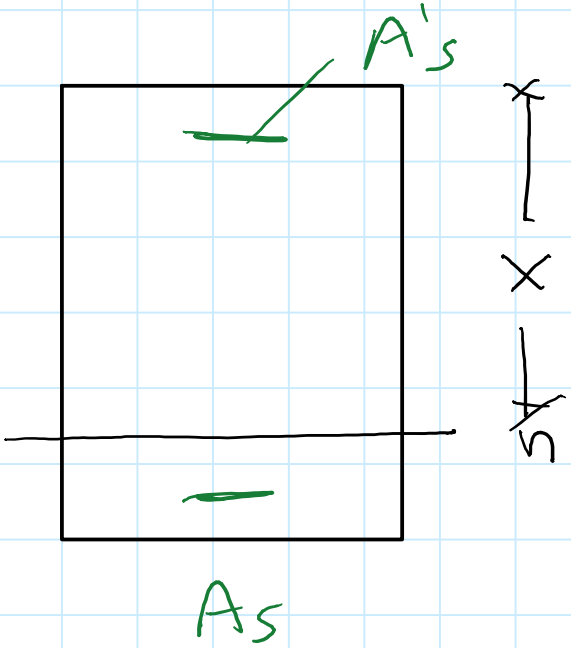
ESEMPIO CON STIMA APPROSSIMATA τ_{MAX}



$z \simeq \frac{2}{3}h \quad (O \simeq G)$

$$\tau_{max,APP} = \frac{65\,KN}{30 \times \frac{2}{3} \times 60\,cm^2} \times 10 = 0{,}54\,MPa$$

CLS NON RESISTENTE A TRAZIONE



PASSO 1: TROVARE n

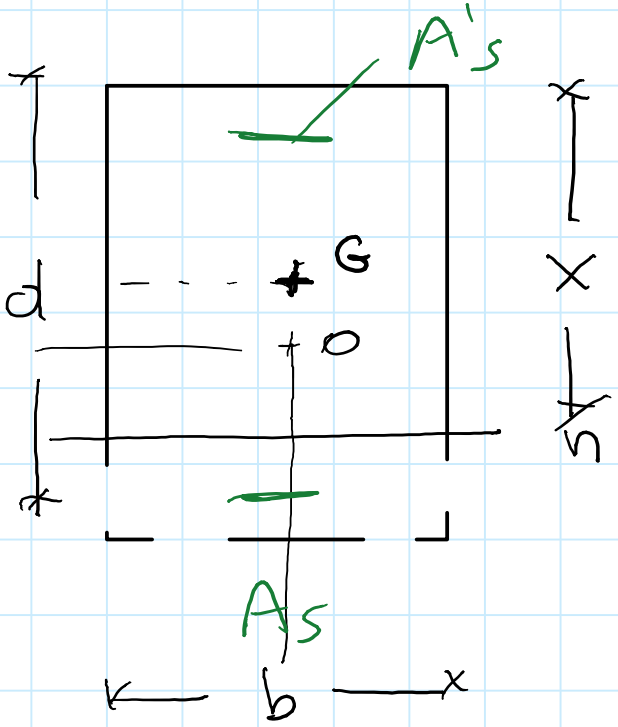
$N < 0 \quad M \neq 0$; PICCOLA ECC. $\Rightarrow$ SEZ INTERAMENTE REAGENTE

II STADIO $\equiv$ I STADIO

$N = 0, \quad M \neq 0 \Rightarrow S_N = 0$

N, M GRANDE ECC $\rightarrow$ $e_n = \frac{I_n}{S_n}$

CLS NON RESISTENTE A TRAZIONE



PASSO 1: TROVARE n

PASSO 2: TROVARE G $\Rightarrow$

$$d_{G,sup} = \frac{S_{sup}}{A}$$

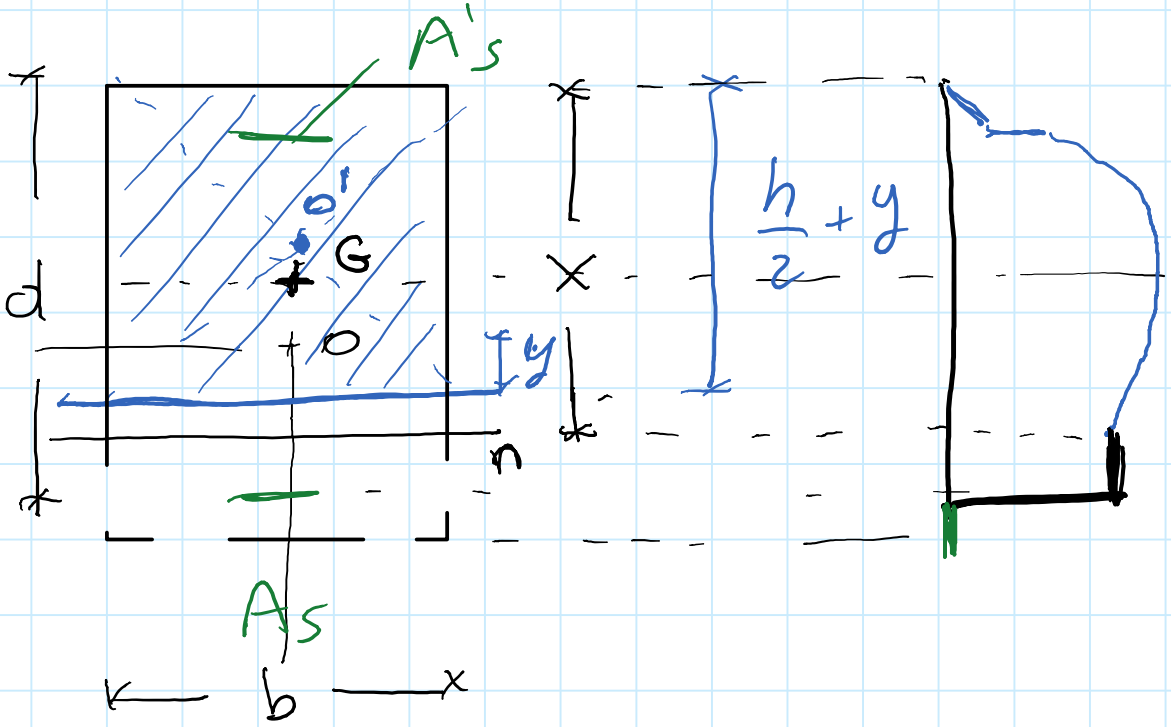
$$S_{sup} = \frac{bx^2}{2} + nA'_s c + nA_s d$$

$$A = bx + n(A_s + A'_s)$$

$$I_{sup} = \frac{bx^3}{3} + nA'_s c^2 + nA_s d^2$$

$$I_{sup} = I_G + A\, d^2_{G,sup} \Rightarrow I_G = I_{sup} - A\, d^2_{G\,sup}$$

CLS NON RESISTENTE A TRAZIONE



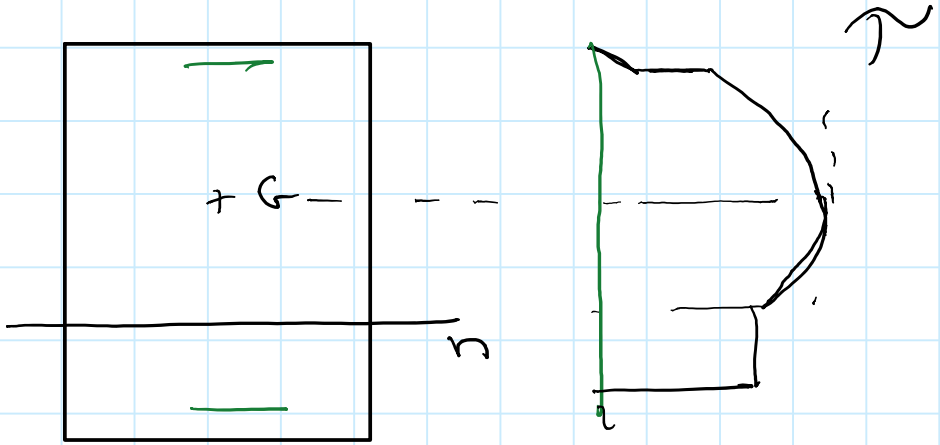
CALCOLO S GUARDANDO LA PARTE SUPERIORE ALLA CORDA E CAMBIO SEGNO

SE LA CORDA È SOTTO A's

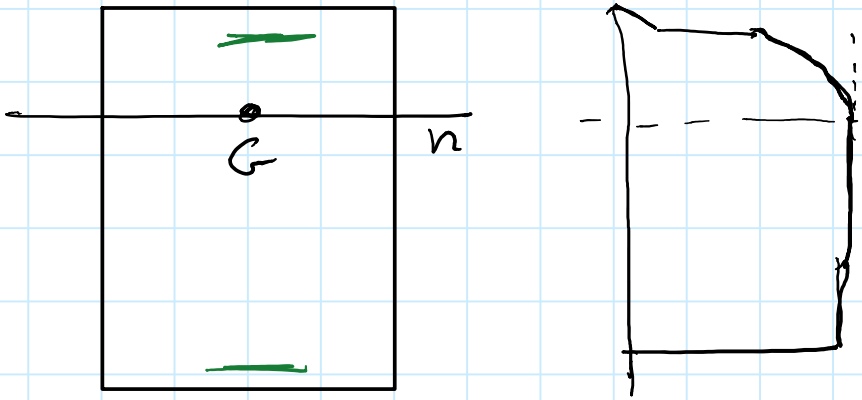
$$S = b\left(\frac{h}{2}+y\right)\left[d_{G\,sup} - \underbrace{d'_{sup}}_{\frac{1}{2}\left(\frac{h}{2}+y\right)}\right] + \overbrace{nA'_s\,(d_{G\,sup}-c)}$$

- PER CORDE SOTTO ASSE NEUTRO NON HO MODIFICHE A S (NON C'È CLS REAGENTE)
- SE $y > \frac{h}{2} - c \Rightarrow$ SI AGGIUNGE: $-nA_s\,(d_{G\,inf}-c) \Rightarrow S=0$

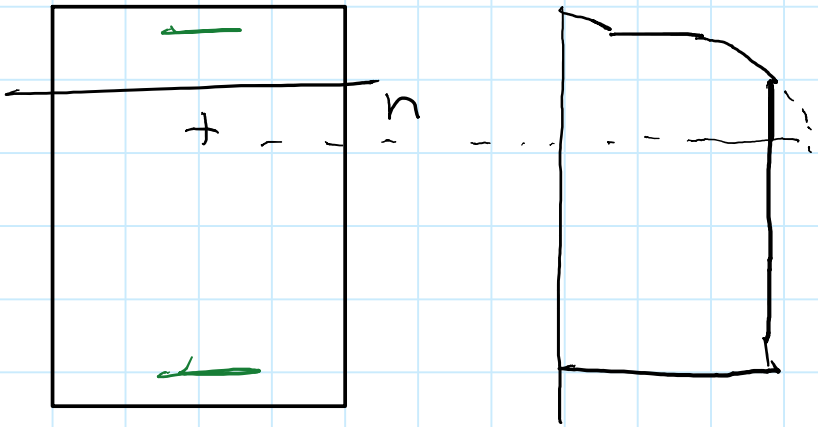
PRESSO - FLESSIONE



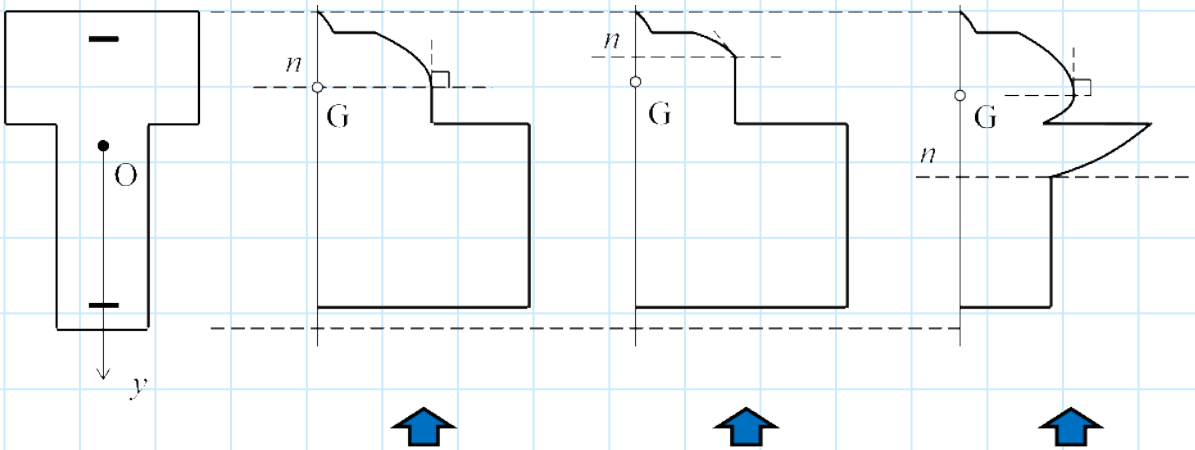
FLESSIONE SEMPLICE



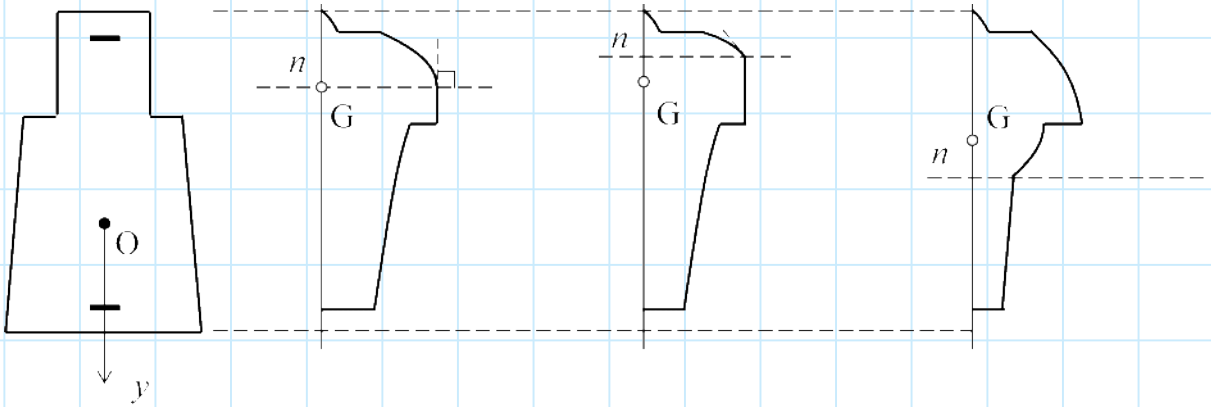
TENSO - FLESSIONE



TENSIONI τ IN SEZIONI NON RETTANGOLARI



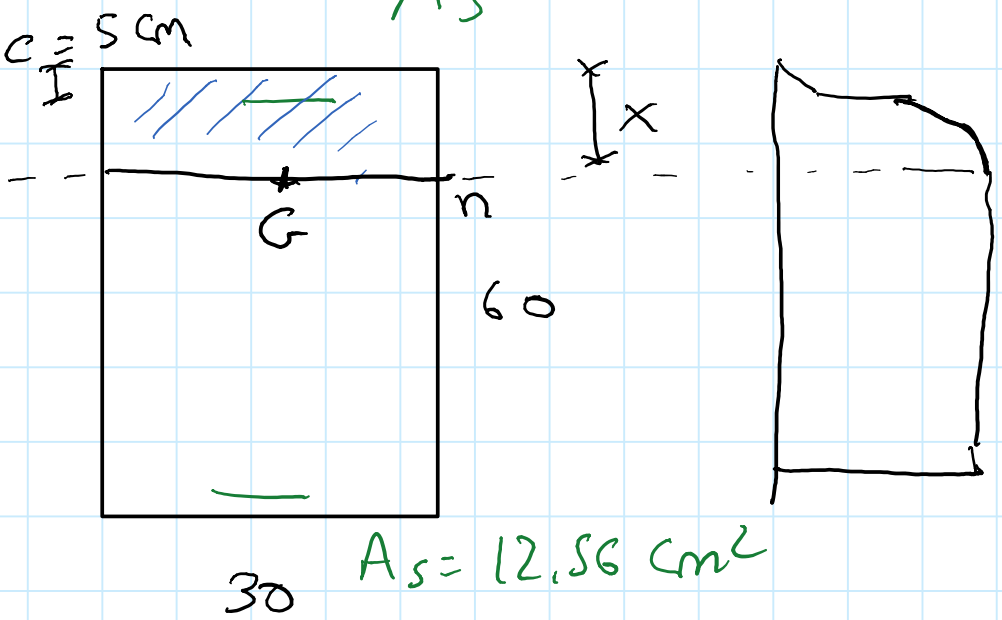
flessione tensoflessione pressoflessione



flessione tensoflessione pressoflessione

ESEMPIO

$A'_s = 6.28\ cm^2$



$N = 0$ $\qquad \tau_{max} = ?$

$M \neq 0$

$V = 150\ KN$

CARICHI LUNGA DURATA

$S_n = 0 \Longrightarrow$

$X = 19\ cm$

$I_{xG} = 331219\ cm^4$

FISSO CONDA $\equiv G$

$$S' = \frac{bx^2}{2} + n A'_s (x - c) = \frac{30 \times 19^2}{2} + 15 \times 6.28 (19 - 5)$$

$$= 6734\ cm^3$$

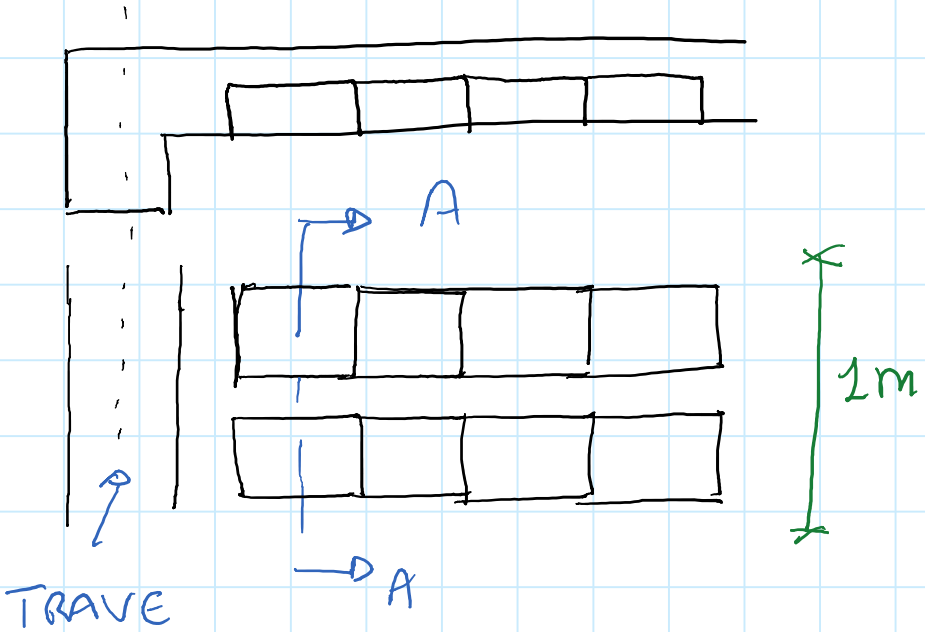
$$\tau_{max} = \frac{150\ KN \cdot 6734\ cm^3}{331219\ cm^4 \cdot 30\ cm} \times 10 = 1.02\ MPa$$

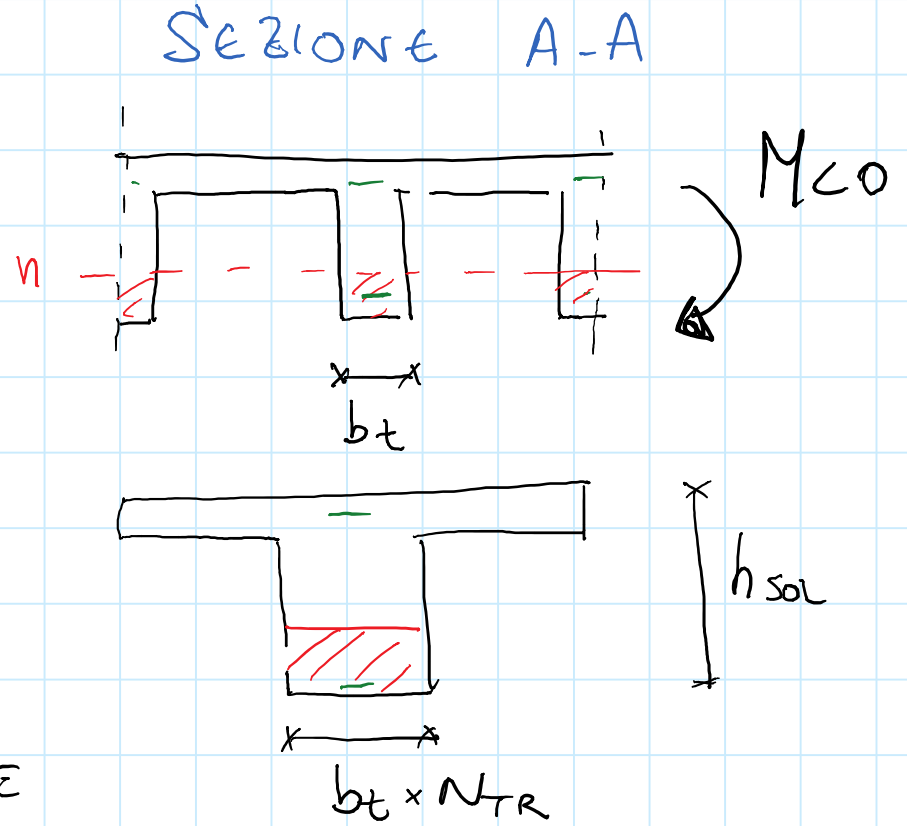
STIMA APPROSSIMATA

$$\tau_{max} = \frac{V}{bz} = \frac{150\ kN}{30\ cm \times \underbrace{0{,}9\,d}_{0{,}9 \times 55\ cm}} \times 10$$

$$= 1.01\ MPa$$

PROGETTO: MOMENTO RESISTENTE DEL CLS





EQUIVALE A SEZ. RETTANGOLARE

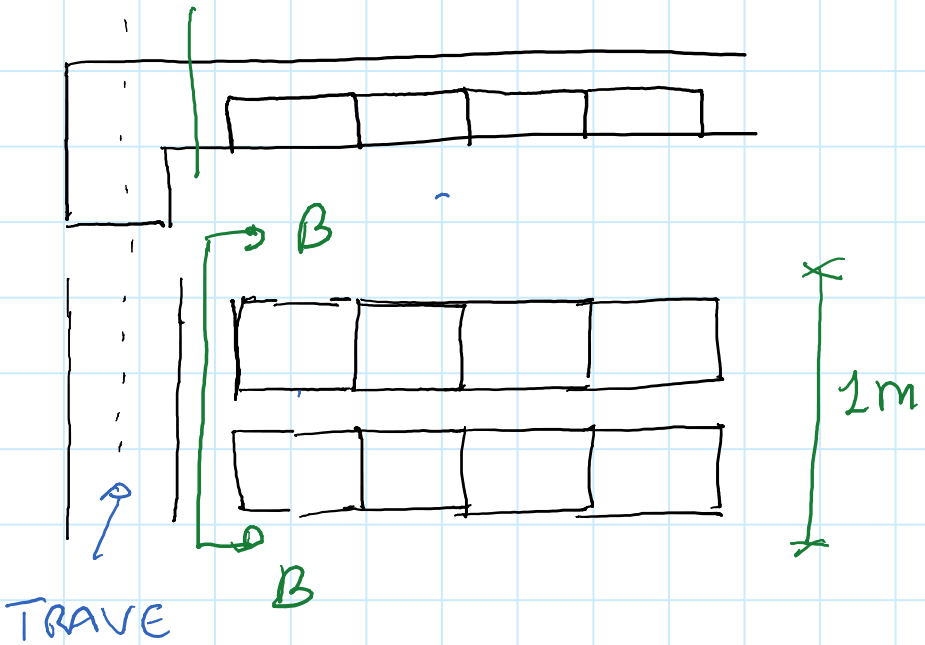
CON BASE = $b_{tR} \times N_{TR}$

NEL CASO DI $N_{TR} = 2 \Rightarrow$

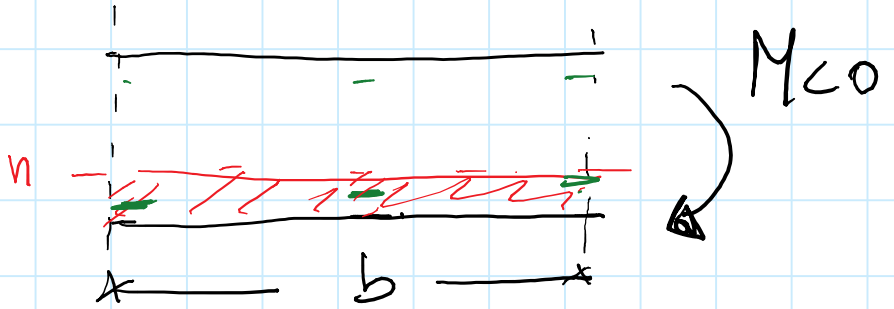
$b = 2 \times 10 = 20\,cm$; $d = 20\,cm \rightarrow$

$$M_{Rd} = \frac{0{,}20^2 \times 0.20}{0.018^2} = 24.69\ kNm$$

PROGETTO: MOMENTO RESISTENTE DEL CLS



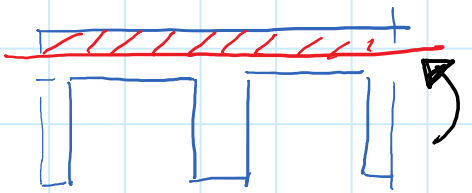
SEZIONE B-B (FASCIA PIENA)



NON HO PIGNATTE $\Rightarrow$ $b = 1m$; $d = 20cm$

$$M_{Rd} = \frac{1.00 \times 0.20^2}{0.018^2} = 123.45 \text{ kNm}$$

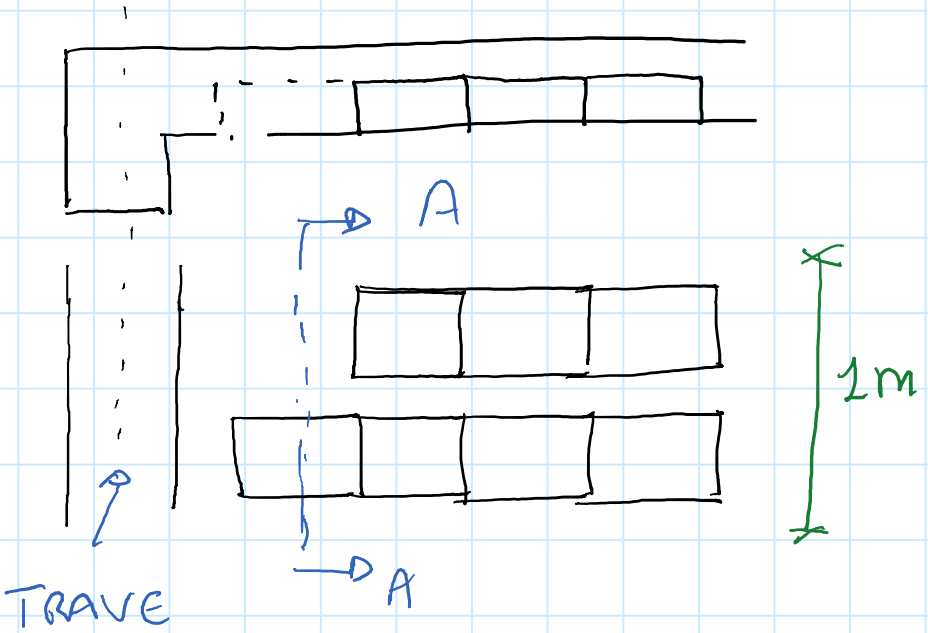
SE $M > 0$ $\Rightarrow$ $b = 1m$ ANCHE DOVE HO PIGNATTE



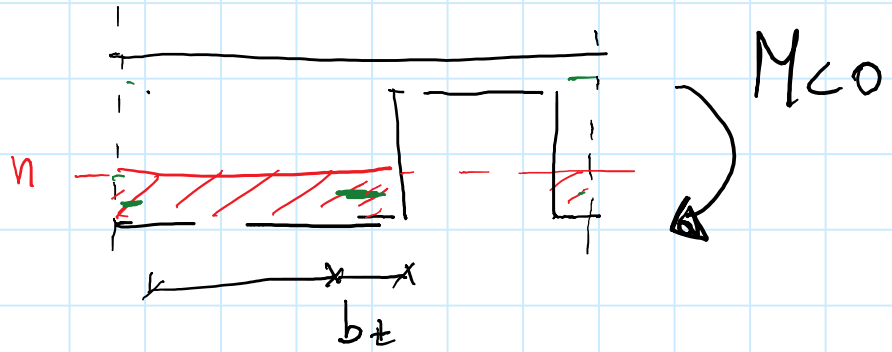
PROGETTO: MOMENTO RESISTENTE DEL CLS

SE $M_{Ed} > M_{Rd}$ CON $b = b_{TR} \times N_{TR} \Rightarrow$

FASCIA SEMIPIENA



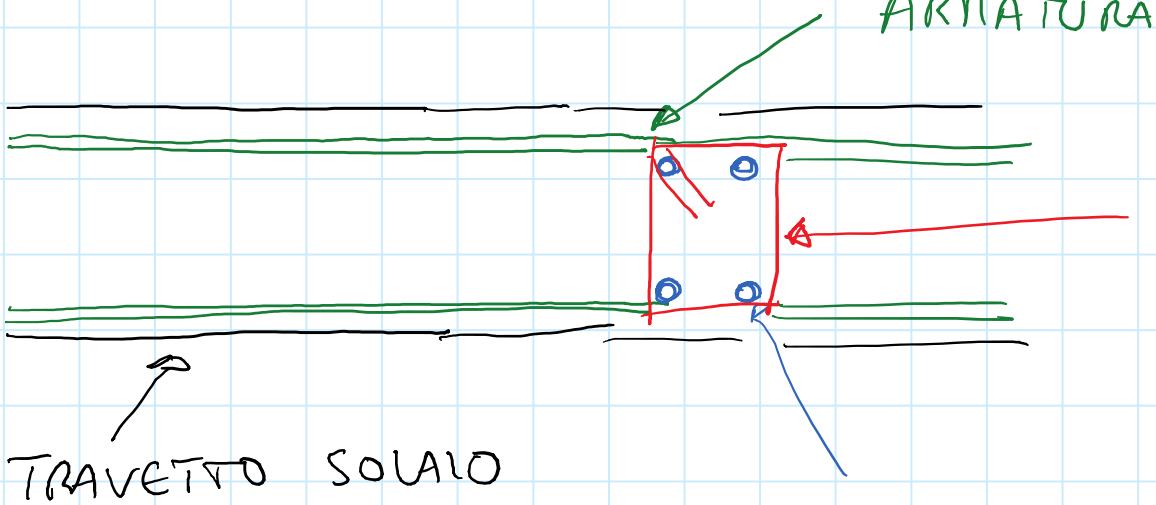
SEZIONE A-A



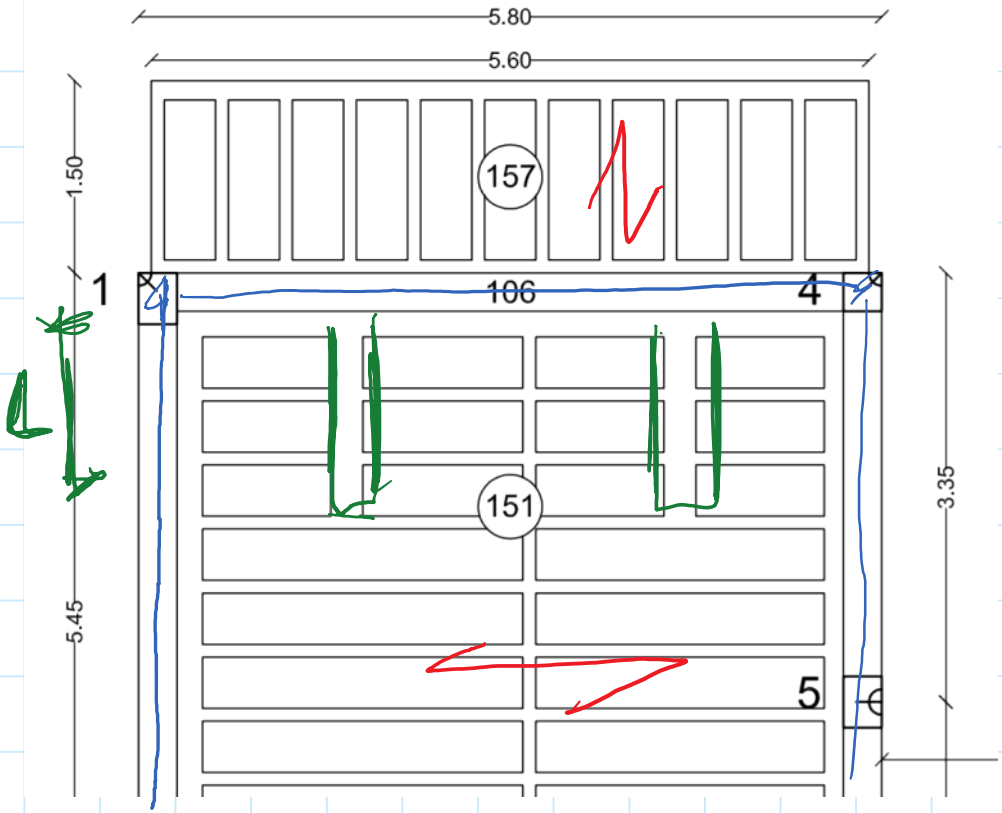
VEDI TAVOLA SOLAIO

ARMATURA TRAVETTO DI RIPARTIZIONE

SE $L_{SOLAIO} \geq 4 \div 4{,}50\,m$ → INSERISCO TRAVETTO RIPARTIZIONE



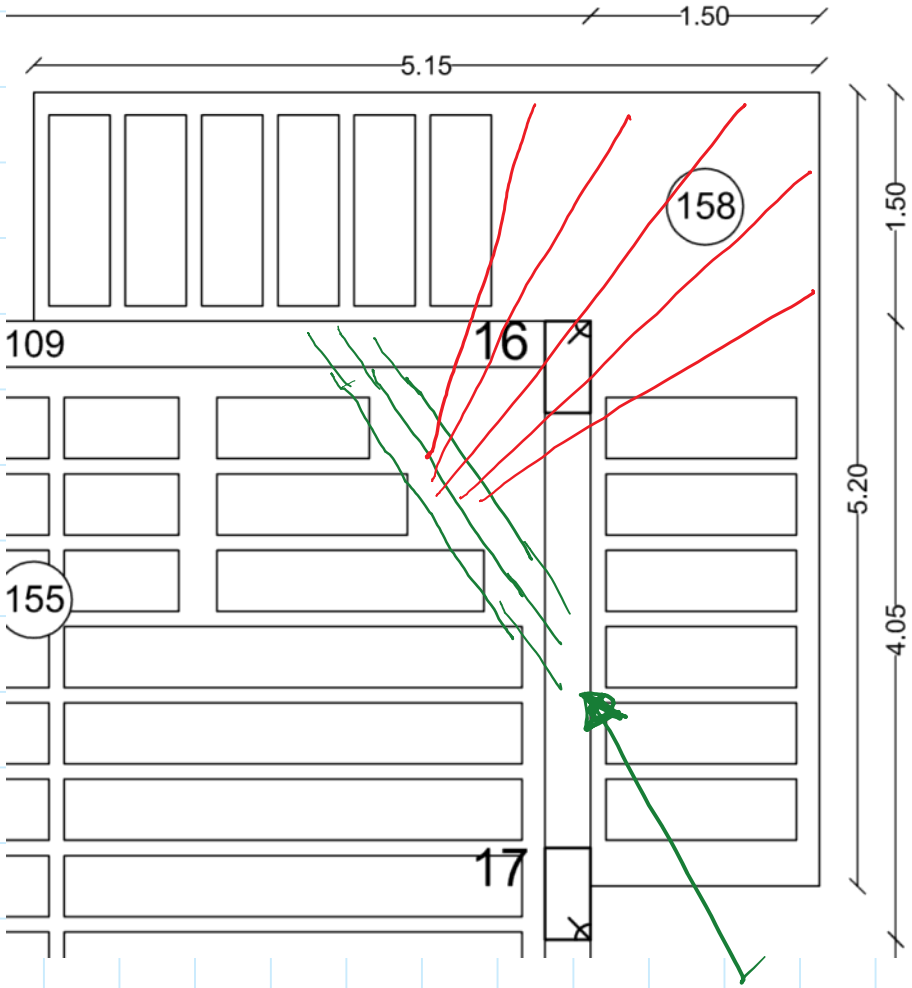
SBALZO LATERALE



PER EVITARE MOMENTO TORCENTE SULLA TRAVE INSERISCO TRAVETTI ELIMINANDO PIGNATTE

$(L \simeq L_{SBALZO})$

SBALZO D'ANGOLO



ARMATURE A RETE

SCHEMA STATICO

PILASTRO

TRAVE DI CONTRAPPESO

TRAVE DI CONTRAPPESO