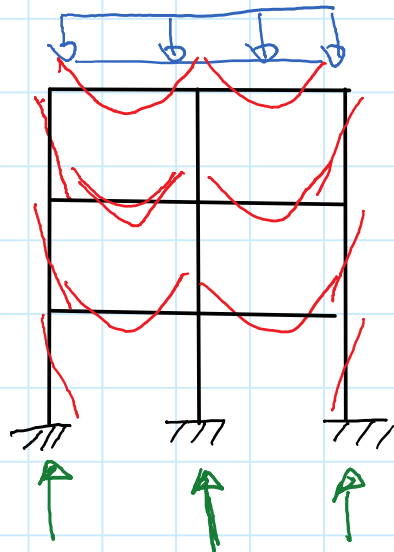
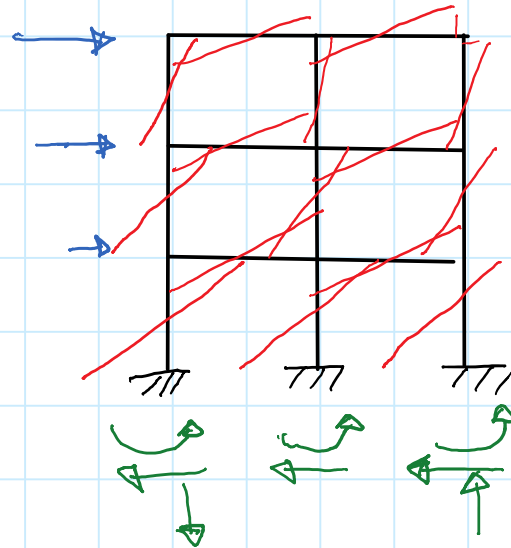


AZIONI SULLA TRAVE IN CONDIZIONI SISMICHE

$$g_k + \psi_2 q_k \approx 0.6 (g_d + q_d)$$

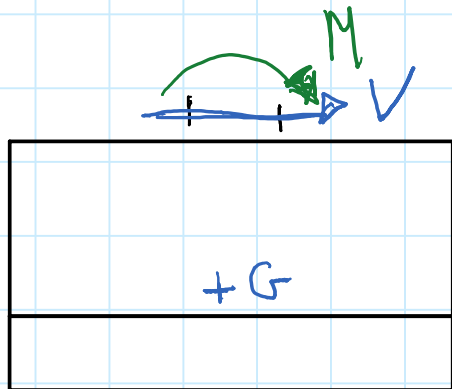


+

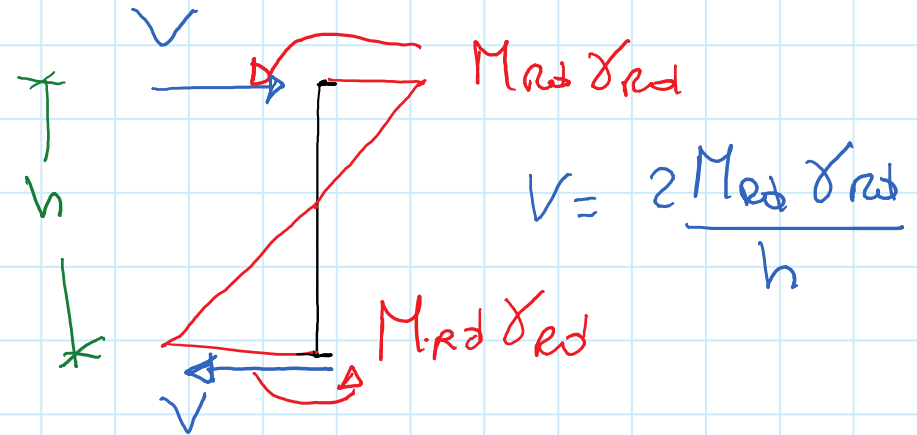
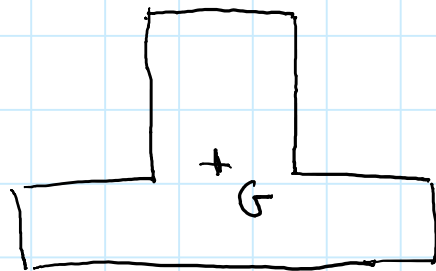


AL PIANO
TERRA
CALCOLO $M_{rd}(N)$

↓
RILAVO DA
EQUILIBRIO V



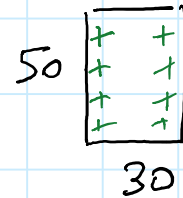
d_G



N.B. IN REALTÀ PUNTO DI NULO NON È A $h/2$



$$F_1 \simeq 0.6 \times 1810 \text{ kN}$$

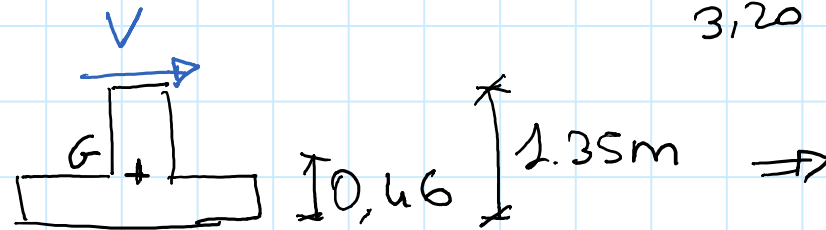


DA DOMINIO MN

$$\Rightarrow M = 140 \text{ kNm}$$

$$V = \frac{2 \times 140}{3.20} = 87.5 \text{ kN}$$

TRASPORTO V

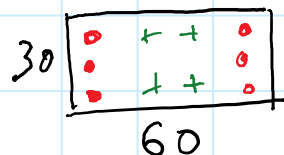


$$\begin{aligned} \Delta M &= 87.5 \times (1.35 - 0.46) \\ &= 77.9 \text{ kNm} \end{aligned}$$

$$\Rightarrow M_{TOT, 1} = 140 + 77.9 = 220 \text{ kNm}$$



$$F_2 \approx 0.6 \times 2180 \text{ kN}$$



$$F_3 \approx 0.6 \times 2554 \text{ kN}$$

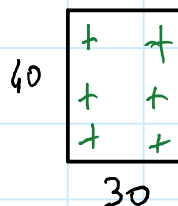
$$M = 405 \text{ kNm}$$

$$V = 253 \text{ kN}$$

$$\Delta M = 225 \text{ kNm}$$

$$M_3 \approx M_2 = 630 \text{ kNm}$$

$$F_4 \approx 0.6 \times 1456 \text{ kN}$$



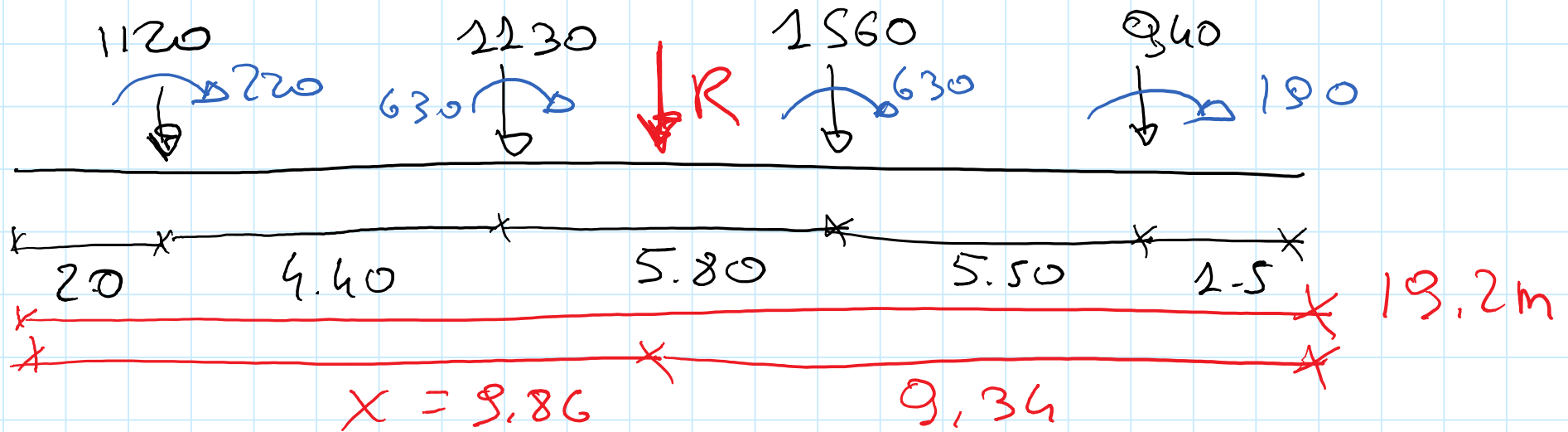
$$M = 120 \text{ kNm}$$

$$V = 75 \text{ kN}$$

$$\Delta M = 67 \text{ kNm}$$

$$M_4 = 187 \text{ kNm}$$

RISULTANTE CARICHI



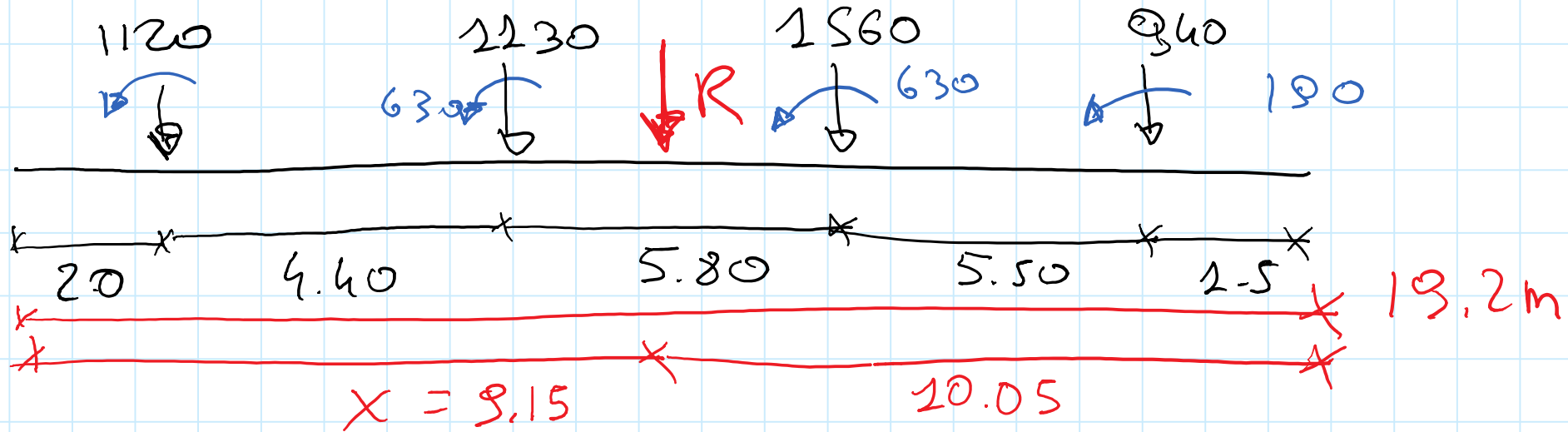
$$1120 \times 2.0 + 1130 \times 6.40 + 1560 \times 12.20 + 940 \times 17.70 + (220 + 630 + 630 + 180) = R \cdot x \Rightarrow$$

$$R = 1120 + 1130 + 1560 + 940 = 4750 \text{ KN}$$

$$x = \frac{45142 + 2670}{4750} = 9.86 \text{ m} \rightarrow$$

$$L' = 2 \times 9.34 = 18.68 \text{ m}$$

EFFETTO DEL SISMA IN VERSO OPPOSTO



$$X = \frac{45142 - 1670}{4750} = 9.15 \text{ m} \rightarrow L' = 2 \times X = 18.30 \text{ m}$$

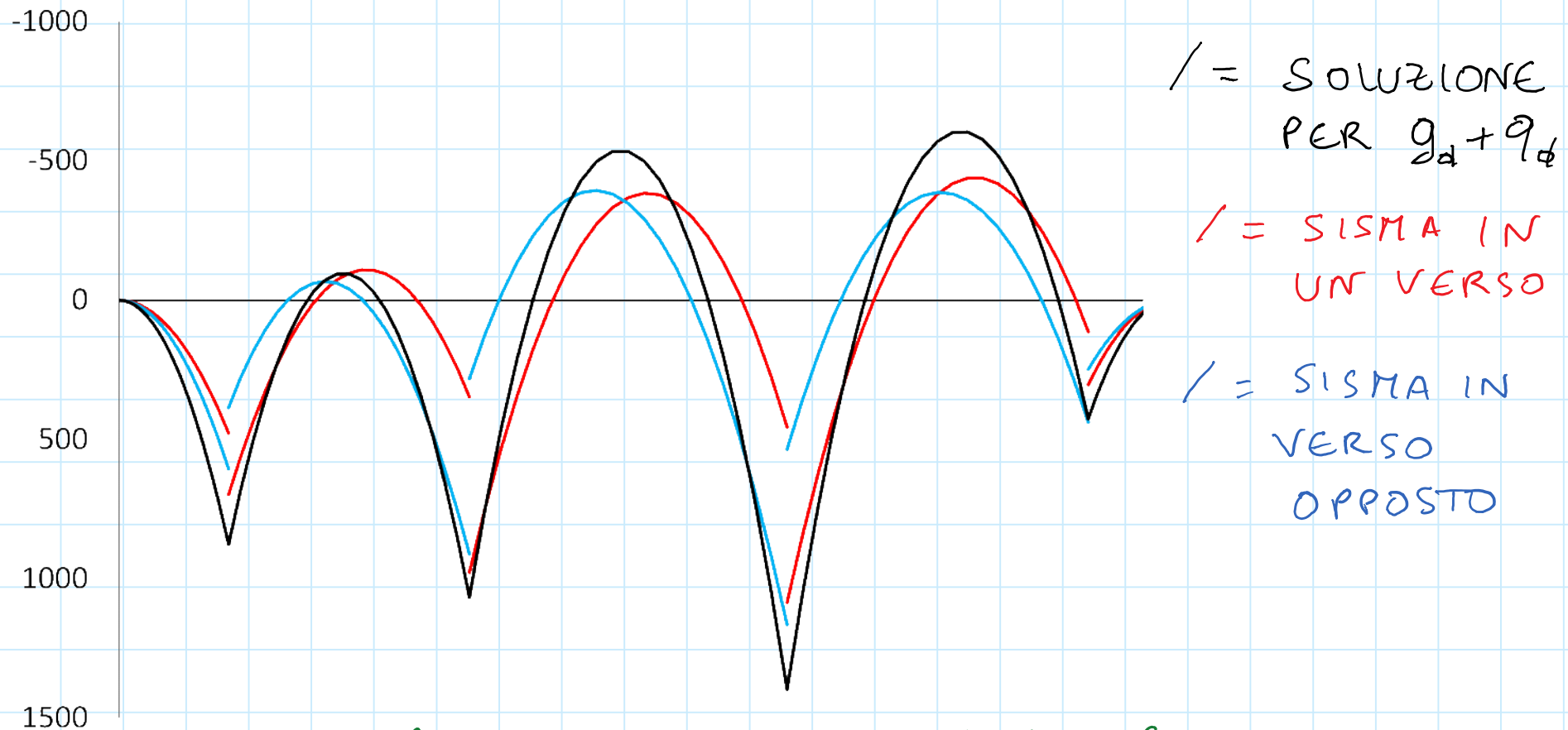
NOTA RISPETTO AL CASO PER CARICHI VERTICALI ALLO SLU HD

- MODESTA RIDUZIONE DI L'
- FORTE RIDUZIONE DI $N_{TOT} \Rightarrow$

IL DIMENSIONAMENTO DELLA BASE PER CARICHI VERTICALI E' PIU' GRAVOSO

INVILUPPO DIAGRAMMI MOMENTO

DALLA SOLUZIONE DELLA TRAVE SU SUOLO ELASTICO SI HA :

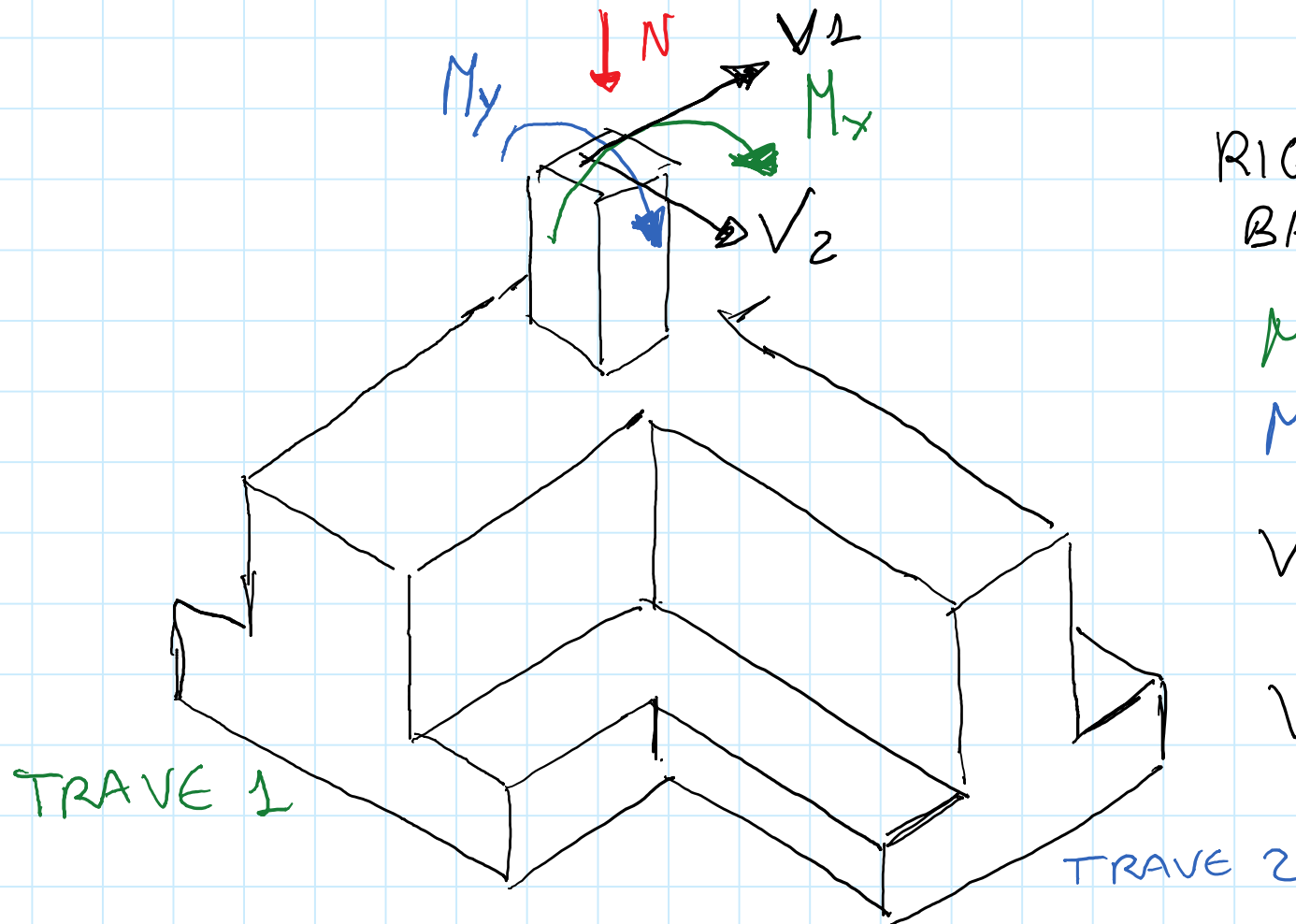


NOTA :

ANCHE IN TERMINI DI CARATTERISTICHE DELLA SOLLECITAZIONE E' PIU' GRAVOSO IL CASO DI SOLI CARICHI VERTICALI

RETICOLO DI TRAVI

IN CASO DI RETICOLO DI TRAVI LE AZIONI TRASMESSE DAL PIASTRO DEVONO ESSERE RIPARTITE TRA TRAVI ORTOGONALI



RIGIDezza TORSIONALE
BASSA \Rightarrow

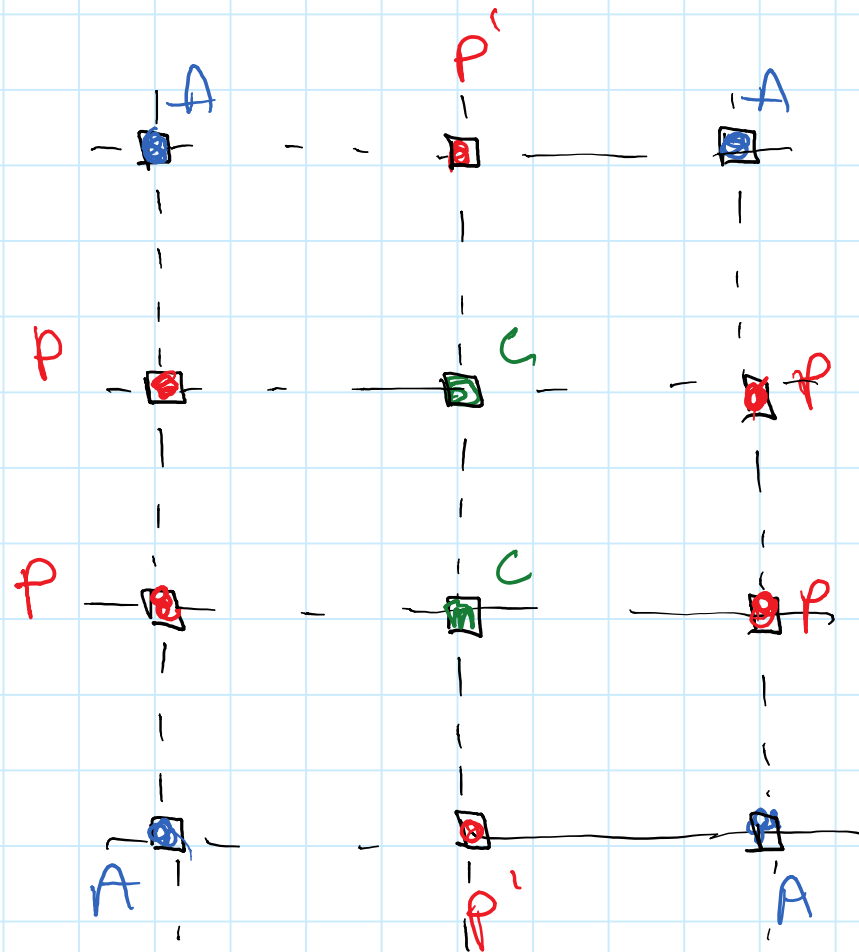
M_x SU TRAVE 1

M_y SU TRAVE 2

V_1 SU TRAVE 1
(DIVENTA SFORZO
NORMALE, TRASCURABILE)

V_2 SU TRAVE 2

RIPARTIZIONE AZIONE VERTICALE TRASMESSA DAI PILASTRI



PILASTRI TIPO C :

- 50% DIREZIONE X
- 50% DIREZIONE Y

PILASTRI TIPO P

- 70 ÷ 80% DIREZIONE Y
- 30 ÷ 20% DIREZIONE X

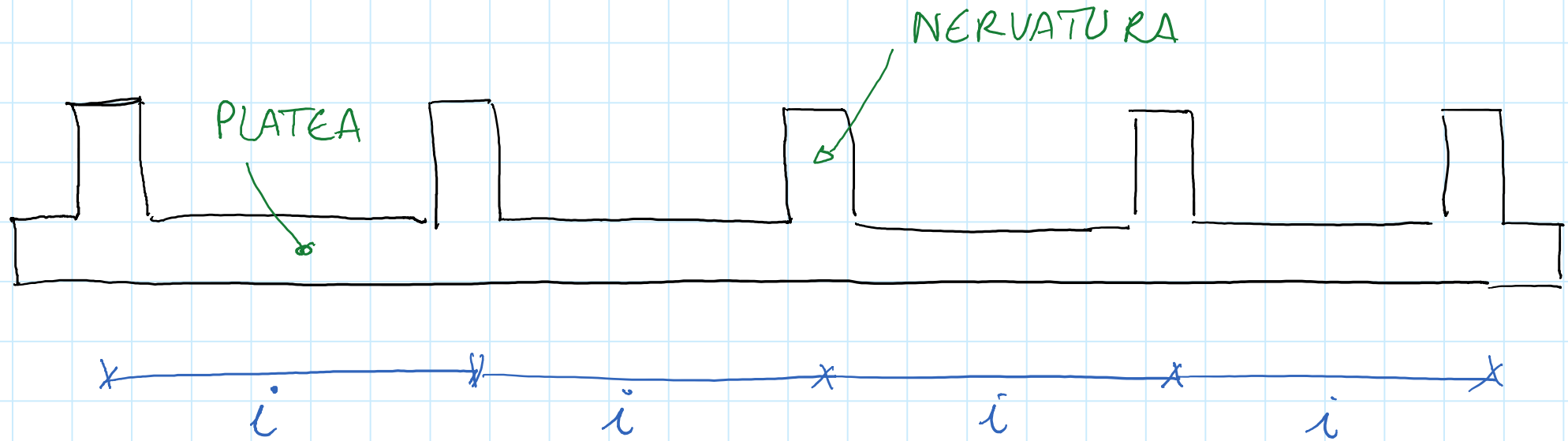
PILASTRI TIPO P'

- 30 ÷ 20% DIREZIONE Y
- 70 ÷ 80% DIREZIONE X

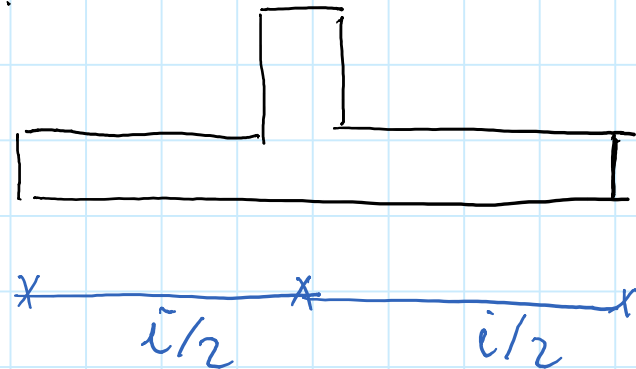
PILASTRI TIPO A

- 50% DIREZIONE X
- 50% DIREZIONE Y

PLATEA NERVATA



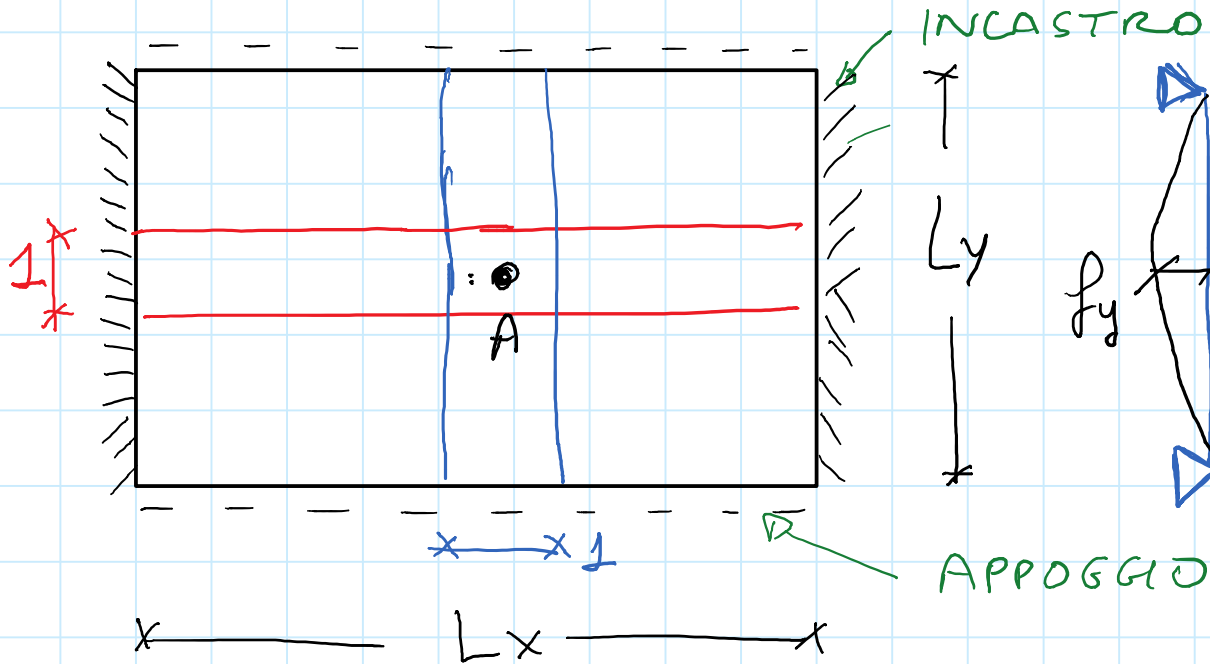
PER PROGETTARE ARMATURE DELLE NERVATURE
CONSIDERO:



⇒ RISOLVO
TRAVE SU
SUOLO
ELASTICO

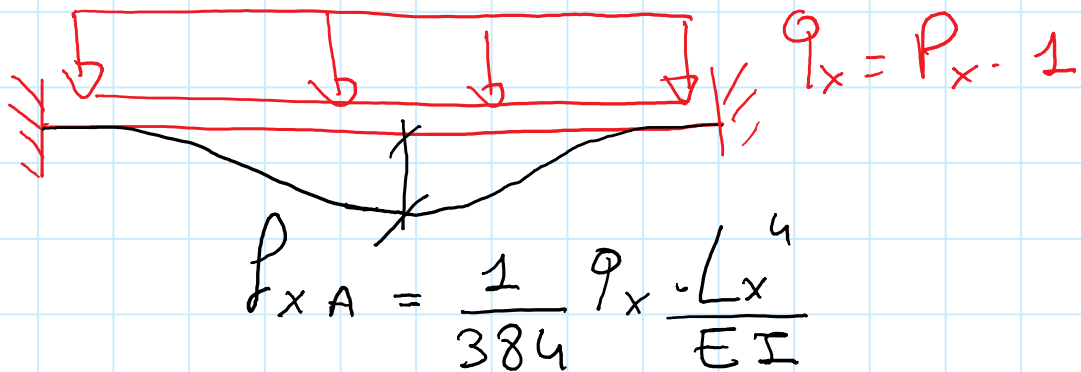
PER PROGETTARE ARMATURA SOLETTA UTILIZZATO
TEORIA DI GRASHOF

TEORIA DI GRASHOF (METODO DELLE STRISCE)



$$f_y(A) = \frac{5}{384} \frac{q_y L_y^4}{EI}$$

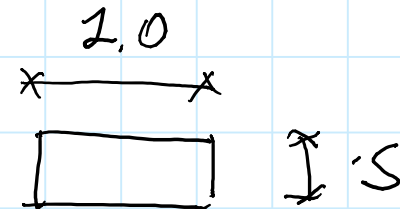
$$q_y = P_y \cdot 1$$



CARICO DISTRIBUITO

$$P \left[\text{KN/m}^2 \right]$$

SEZIONE TRASVERSALE

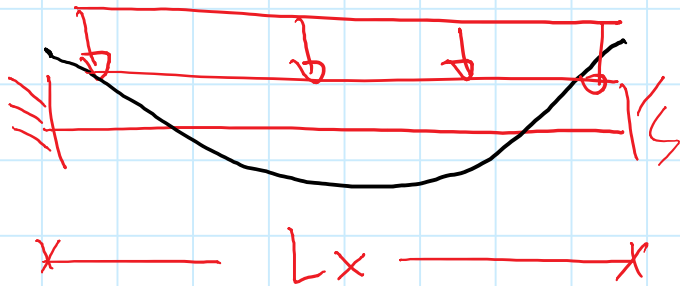


CONDIZIONI DA IMPORRE

$$\begin{cases} \int y(A) = \int x(A) \\ P_x + P_y = P \end{cases} \Rightarrow \begin{cases} \frac{5}{384} \frac{P_y \cdot 1 \cdot L_y^4}{EI} = \frac{1}{384} \frac{P_x \cdot 2 \cdot L_x^4}{EI} \\ P_x + P_y = P \end{cases}$$

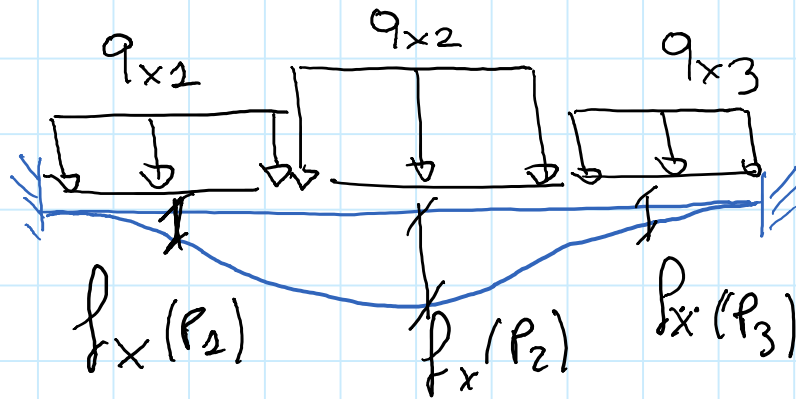
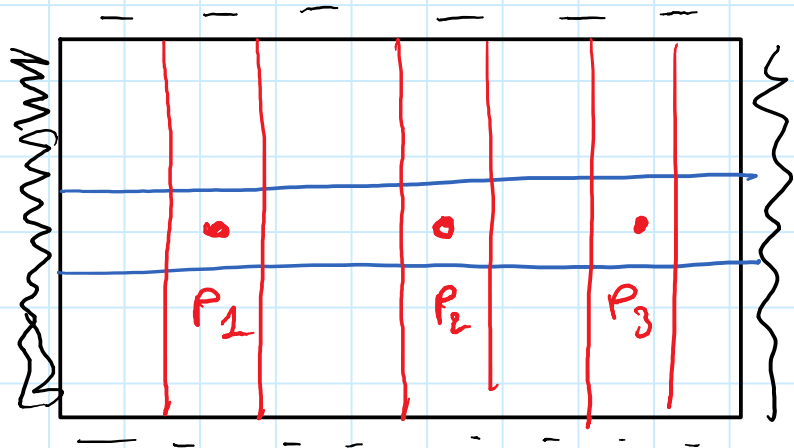
\Rightarrow OTTIENGO P_x, P_y

\Rightarrow DETERMINO MOMENTI FLETTENTI IN

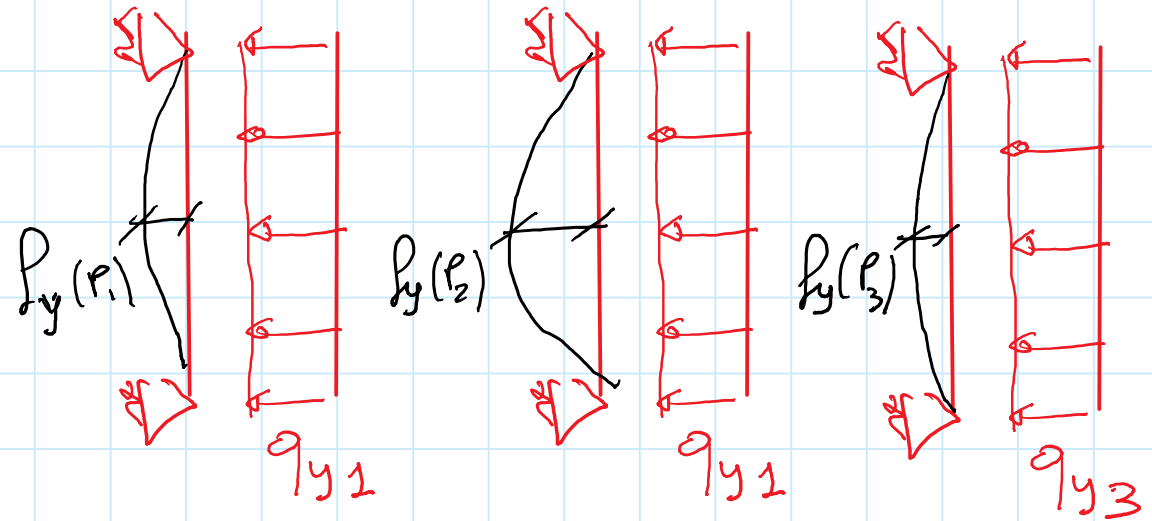


\Rightarrow CALCOLO ARMATURE NELLE DUE DIREZIONI

CONSIDERANDO PIU' STRISCE



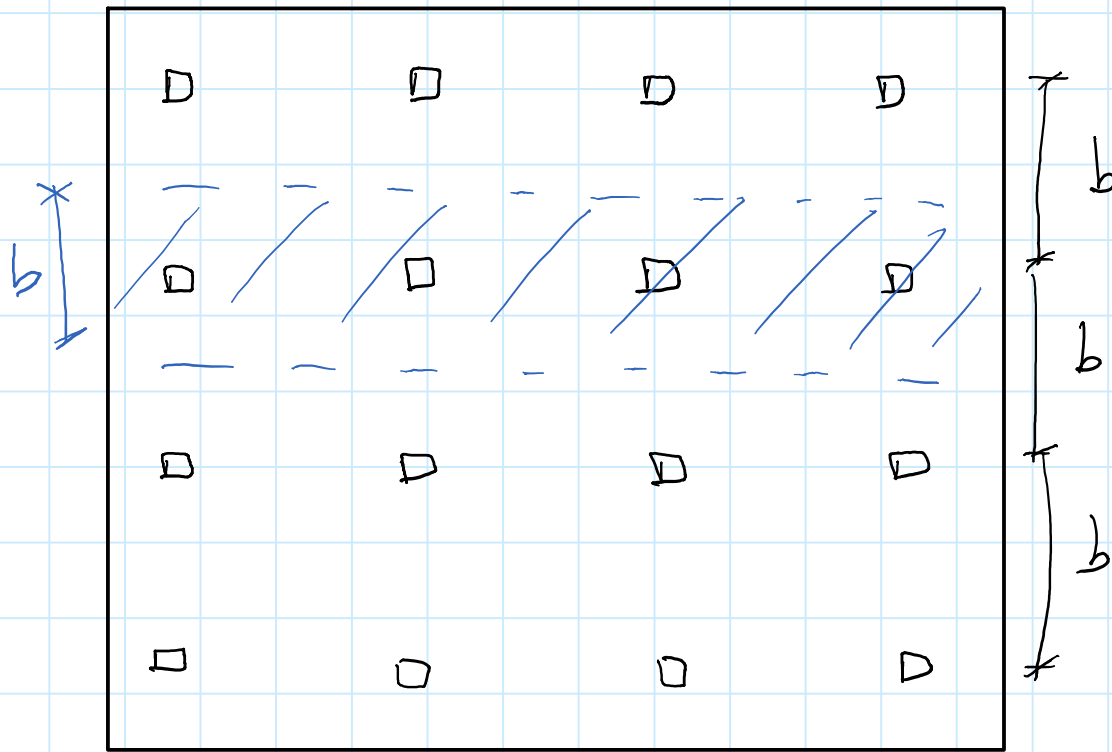
GARICHI



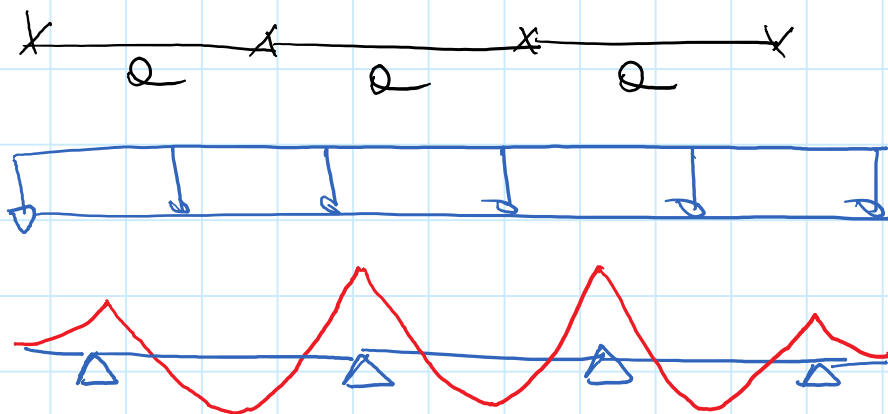
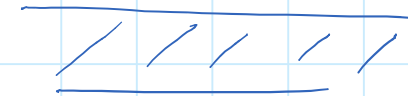
$$\left\{ \begin{array}{l} l_x(P_1) = l_y(P_2) \\ l_x(P_2) = l_y(P_2) \\ l_x(P_3) = l_y(P_3) \end{array} \right.$$

$$\left\{ \begin{array}{l} P_{x1} \cdot 1 + P_{y1} \cdot 1 = P \\ P_{x2} \cdot 1 + P_{y2} \cdot 1 = P \\ P_{x3} \cdot 1 + P_{y3} \cdot 1 = P \end{array} \right.$$

PLATEA DI FONDAZIONE : SOLAIO A FUNGO



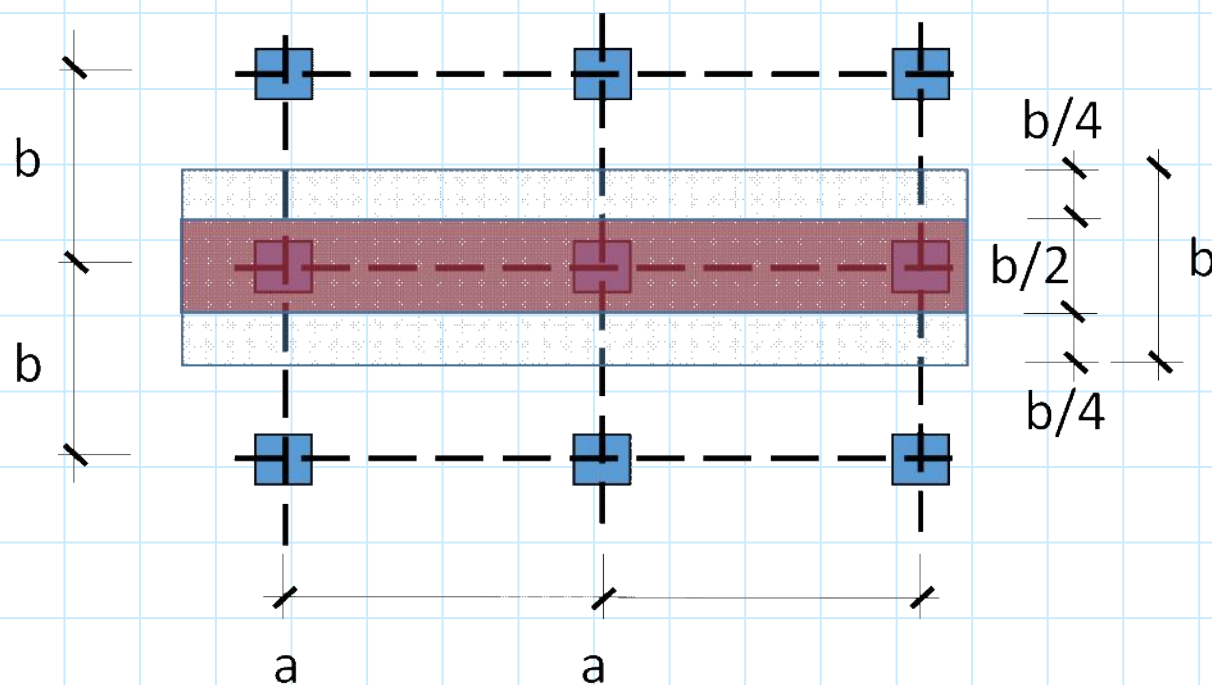
CONSIDERO IN
DIREZIONE x
UNA TRAVE
EQUIVALENTE DI
LARGHEZZA b



$q \cdot b$
 KN/m^2

DETERMINO
DIAGRAMMA M_{ed}
(RIFERITO A
PROFONDITA' b)

RIPARTIZIONE MOMENTO

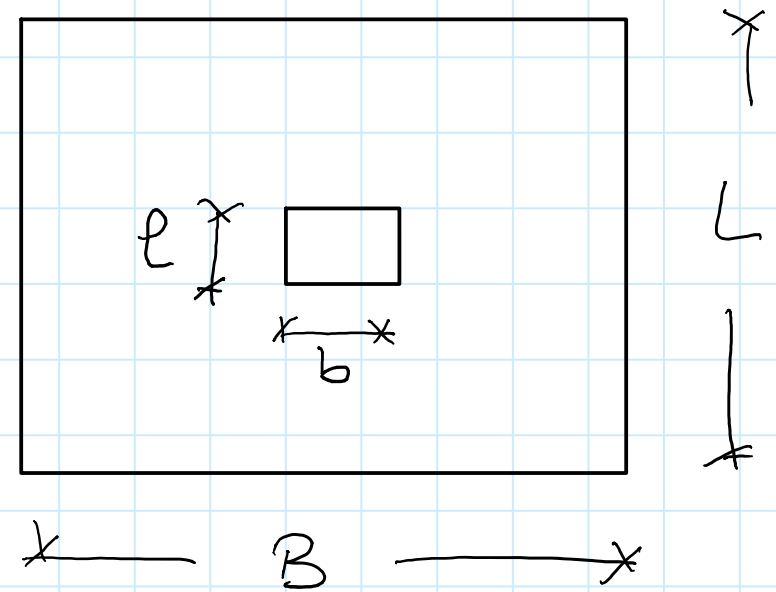
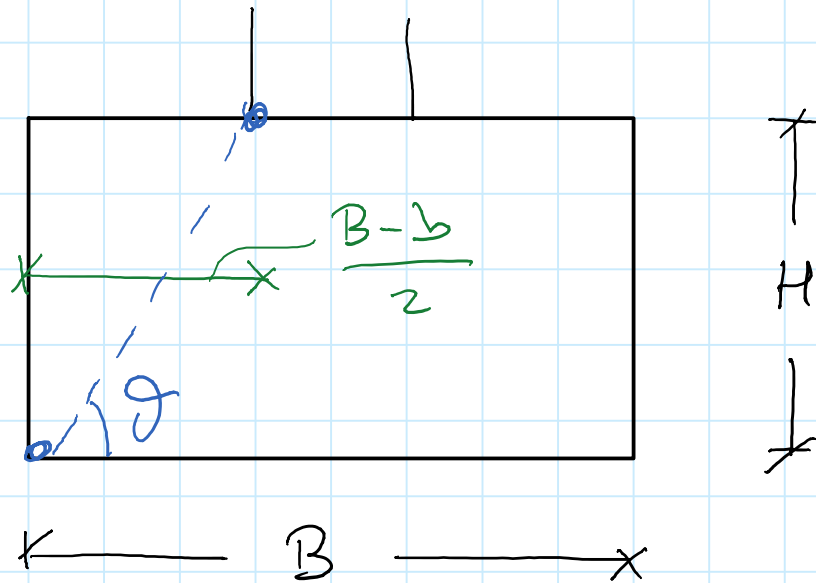


	Momenti negativi	Momenti positivi
Zona sul pilastro	60-80%	50-70%
Zona centrale	40-20%	50-30%

→ NELLA ZONA IN PROSSIMITÀ DEL PILASTRO DEVO DISPORRE PIÙ ARMATURE

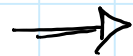
NOTA : RIPETERE IL PROCEDIMENTO IN DIREZIONE Y

CLASSIFICAZIONE PLINTI DI FONDAZIONE



$$\theta = \arctan \frac{2H}{B-b}$$

SE $\theta \geq 60^\circ$



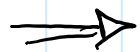
PLINTI TOZZI

SE $\theta \leq 25^\circ$



PLINTI SNELLI

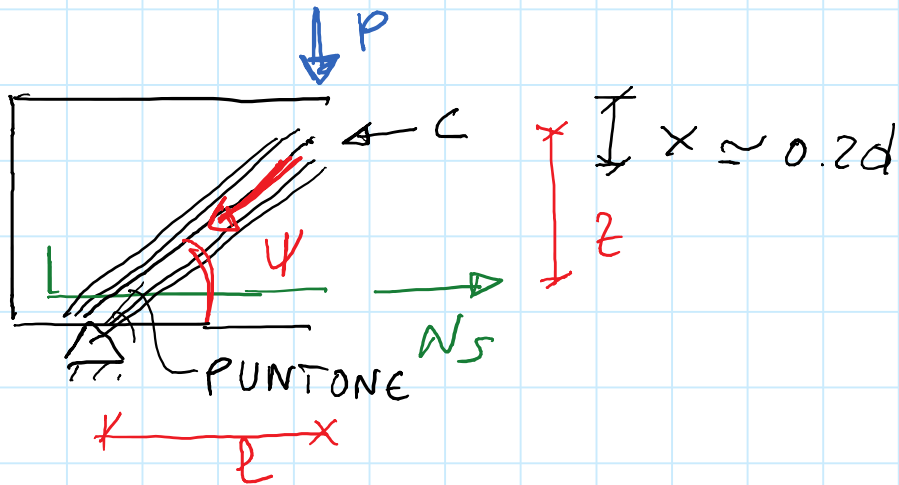
$25^\circ \leq \theta \leq 60^\circ$



INTERMEDI

VERIFICA ELEMENTI TOZZI

(STRUT & TIE)



$$\lambda = \cot \psi = \frac{L}{z}$$



$$N_c = P / \sin \psi$$

$$N_s = P \cdot \cot \psi = P \cdot \lambda$$

PUNTO HA ALTEZZA

$$h = a \sin \psi ; a \approx 2x = 0.4d \rightarrow$$

CRISI PUNTO

$$P = \underbrace{b \cdot 0.4d \sin \psi}_{N_{c \max}} \cdot \sin \psi$$

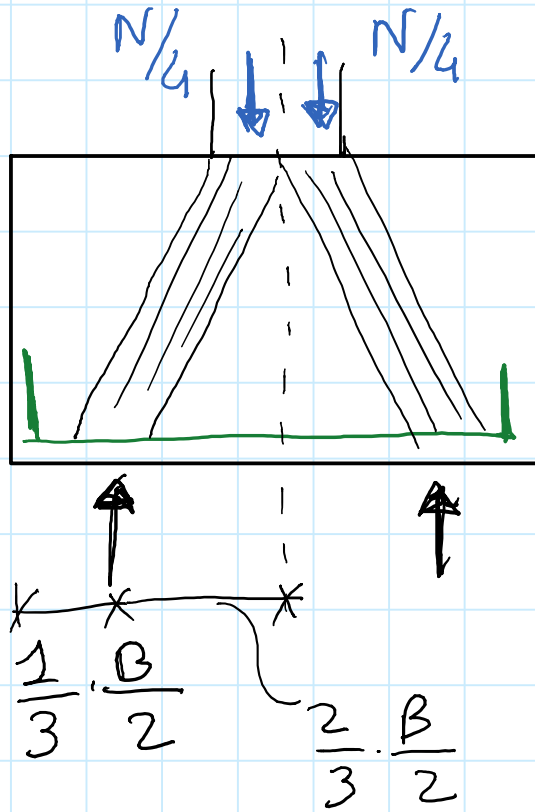
$$\sin^2 \psi = \frac{1}{1 + \cot^2 \psi} = \frac{1}{1 + \lambda^2} \rightarrow P = \frac{0.4bd f_{cd}}{1 + \lambda^2}$$

CRISI ARMATURA

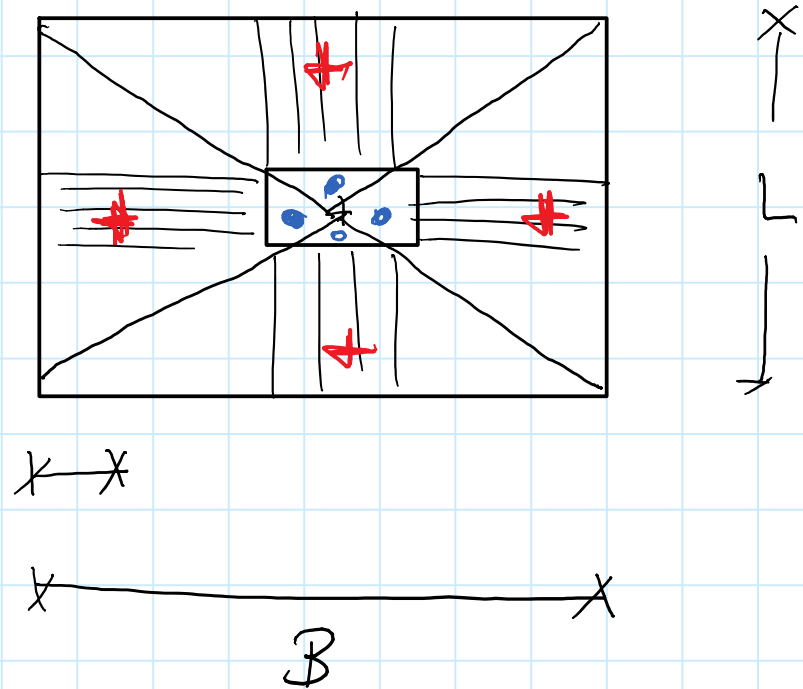
$$N_{s \max} = A_s f_{yd} \rightarrow$$

$$P = A_s f_{yd} / \lambda$$

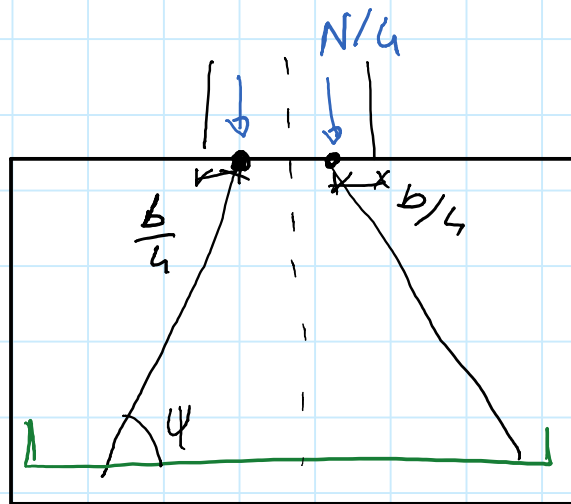
APPLICAZIONI AL PLINTO



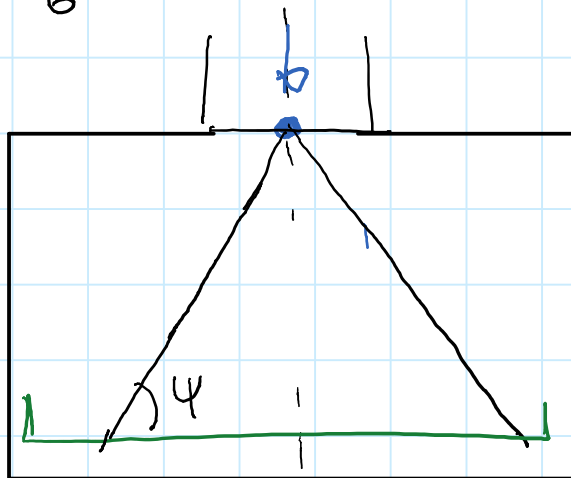
$$\frac{1}{3} \cdot \frac{B}{2}$$



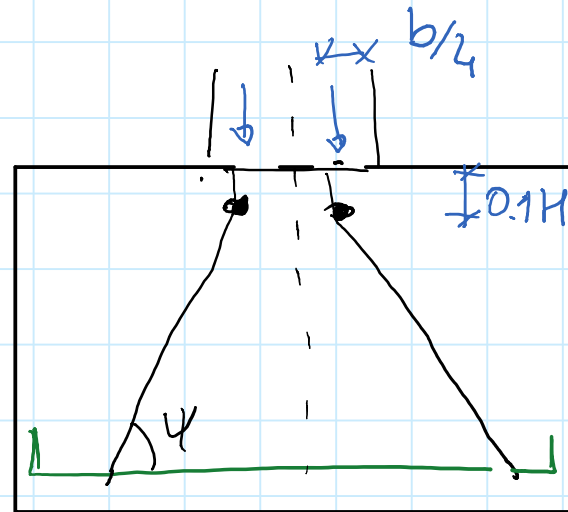
POSSIBILI MODELLI ALTERNATIVI



$$x = \frac{B}{6}$$



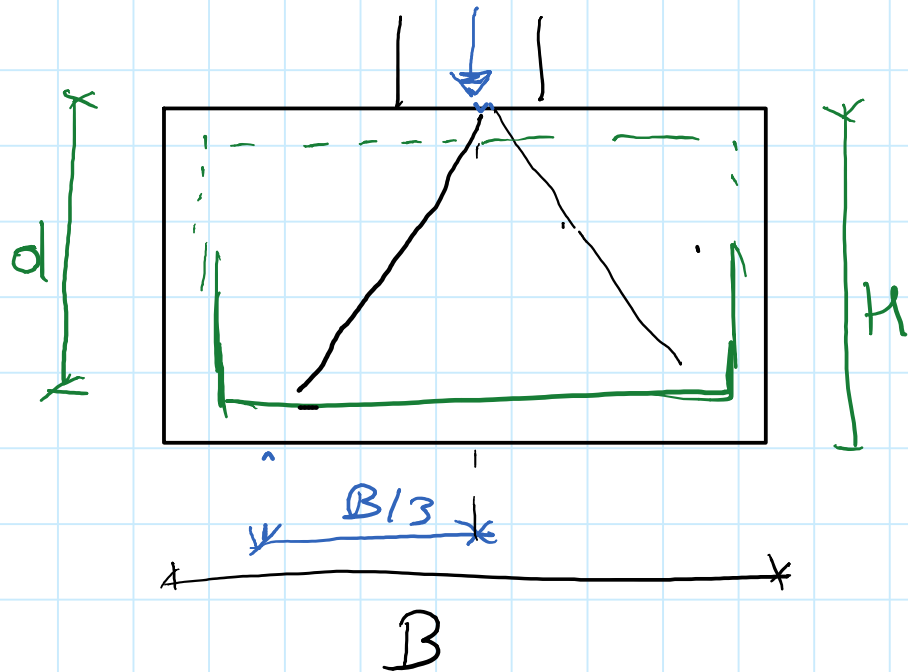
$$x = \frac{B}{6}$$



$$x = \frac{B}{6}$$

IN OGNI CASO NON HO
PROBLEMI PER IL PUNTONE
(N SI DIFFONDE SU AREA
MAGGIORE RISPETTO A
QUELLA DEL PILASTRO) →
PROGETTO Ase

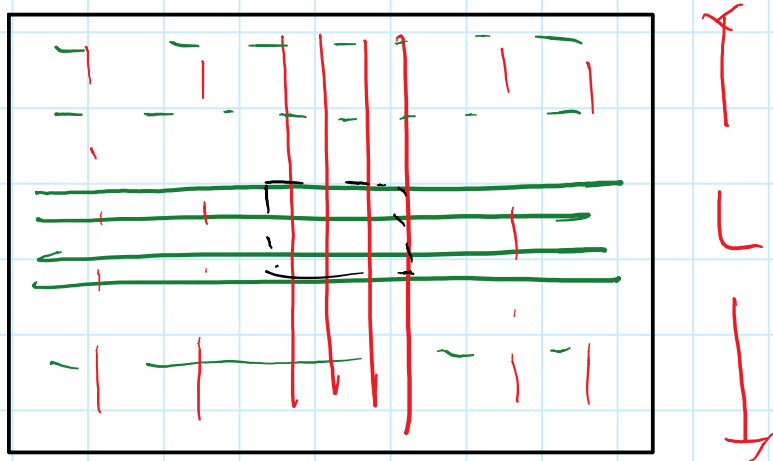
PROGETTO ARMATURE



$$\cotg \varphi = \frac{B}{3 \cdot d}$$

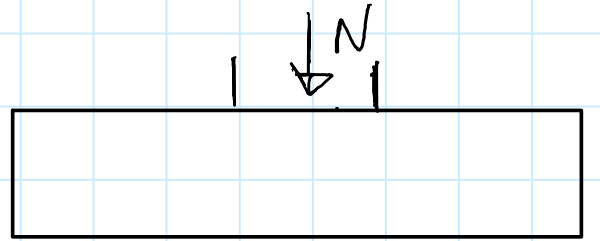
$$N_s = \frac{N}{\zeta} \cdot \cotg \varphi$$

$$A_s = \frac{N}{\zeta} \frac{\cotg \varphi}{f_{yd}}$$

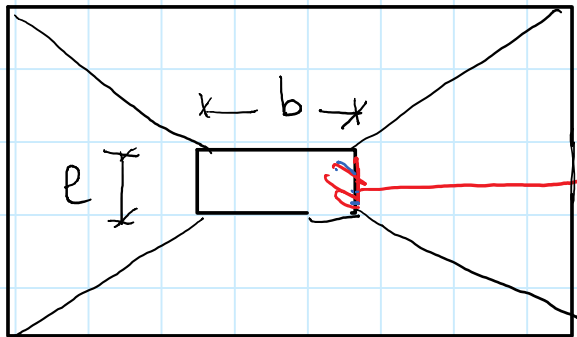


$$\cotg \varphi = \frac{L}{3d}$$

PLINTI SNELLI



$\text{---} B \text{---}$



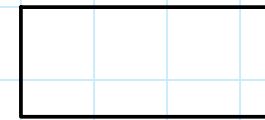
$\text{---} L \text{---}$



$\text{---} (B-b)/2 \text{---}$

SONO SCHEMATIZZATI
MEDIANTE 4 MENSOLE

SEZIONE TRASVERSALE

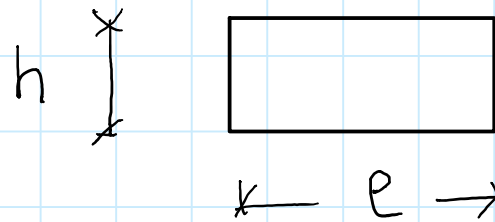
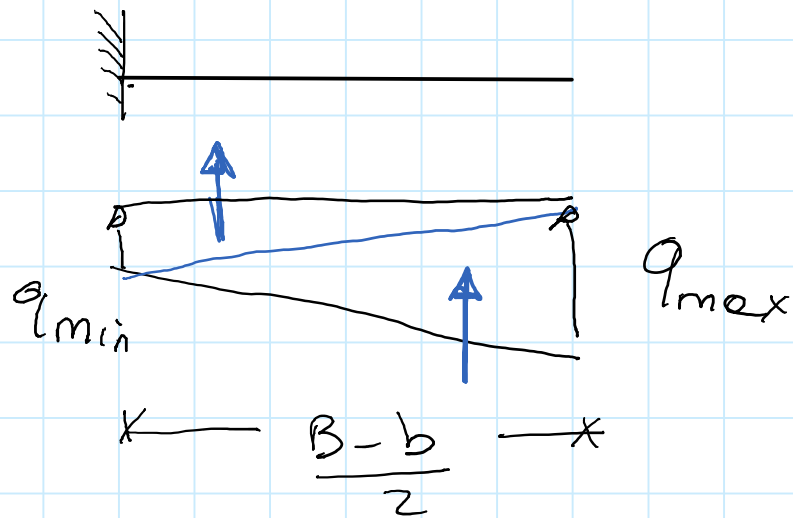


$\text{---} e < e^* < L \text{---}$

$$q_{max} = \frac{N}{BL} \cdot L$$

$$q_{min} = \frac{N}{BL} \cdot e$$

VALUTAZIONE M_{max}



SEZIONE
ALL'INCASTRO

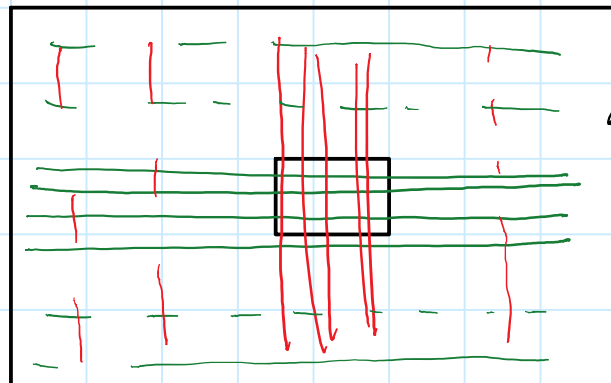
$$M_{max} = \frac{1}{2} q_{min} \left(\frac{B-b}{2} \right)^2 \cdot \frac{1}{3} + \frac{1}{2} q_{max} \cdot \left(\frac{B-b}{2} \right)^2 \cdot \frac{2}{3}$$

VERIFICA h PUNTO $\Rightarrow M_{max} \leq b d^2 / \gamma'^2$

PROGETTO ARMATURE

$$A_{se} = \frac{M_{max}}{0.9 d f_{yd}}$$

DISPOSIZIONE ARMATURE



ARMATURA FUORI CALCOLO

ARMATURA NECESSARIA

RIPETENDO CON LE MENSOLE
IN DIREZIONE ORTOGONALE
PROGETTO //



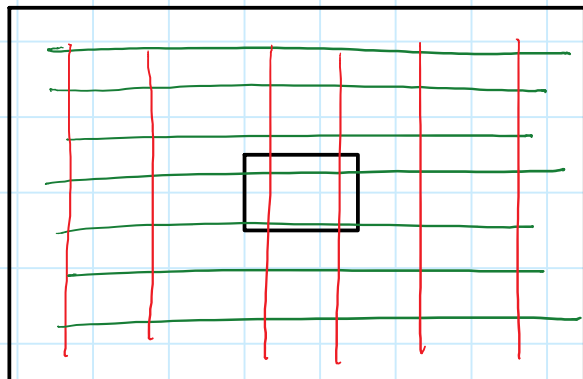
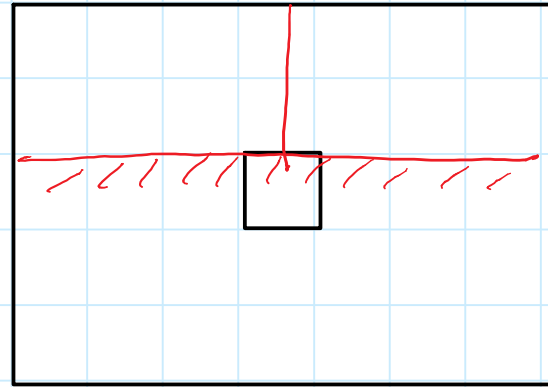
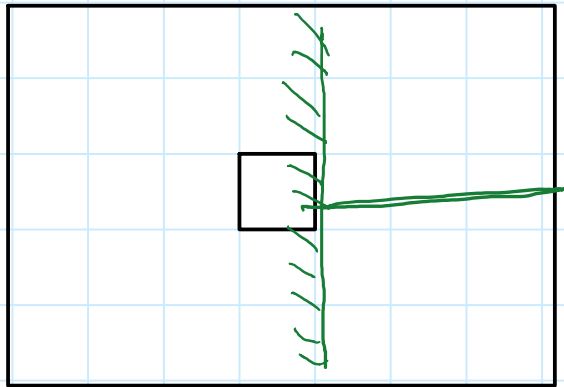
FUORI CALCOLO

FUORI
CALCOLO

NECESSARIA

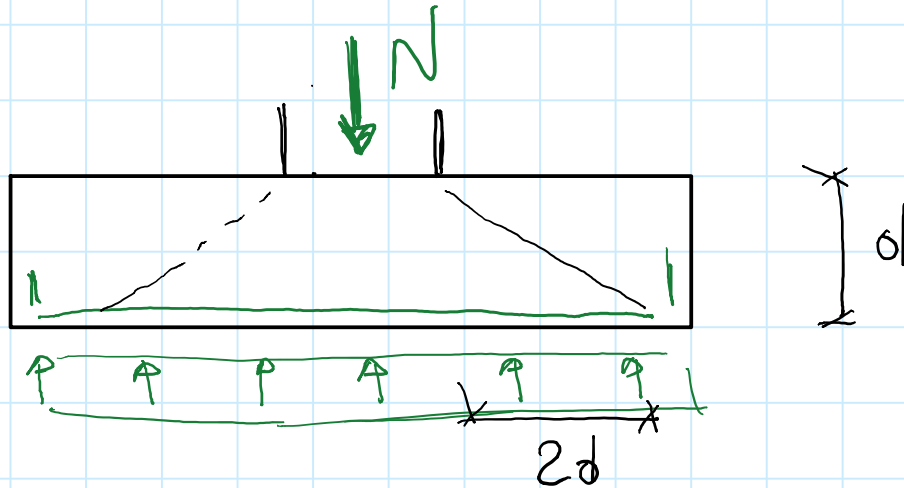
NOTA : VALORI DI A_s NECESSARIA
SIMILI SE CALCOLATI CON
MODELLO A MENSOLO O
CON STRUT & TIE

ALTRA POSSIBILE SCHEMATIZZAZIONE



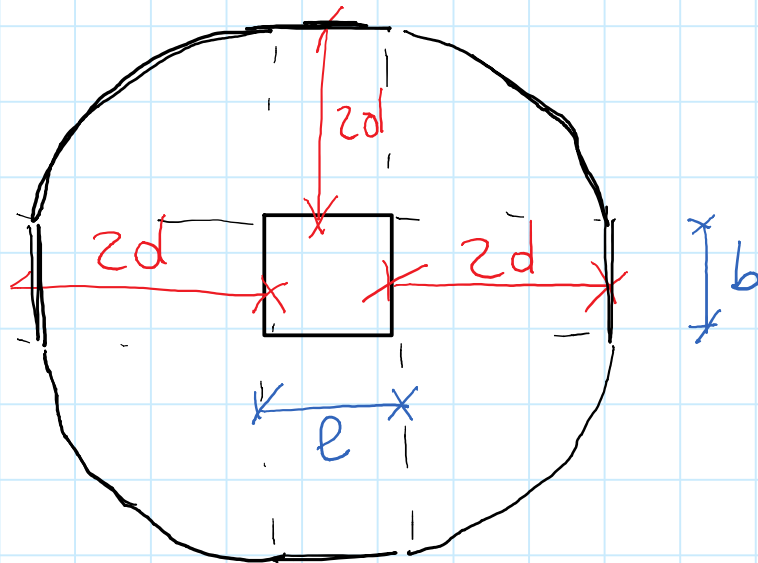
IL CARICO APPLICATO È
MAGGIORE \Rightarrow TROVO
UNA MAGGIORE ARMATURA
NECESSARIA (DA DISPORRE
IN SEZIONE D'INCASTRO PIÙ
AMPIA)

VERIFICA A PUNZONAMENTO



PERIMETRO
CRITICO

$$u_{cr} = 2(l + b) + \pi 2d$$



$$v_{ed} = \frac{N - \sigma \cdot A_{cr}}{u_{cr} \cdot d}$$

A_{cr} = AREA RACCHIUSA
NEL PERIMETRO
CRITICO

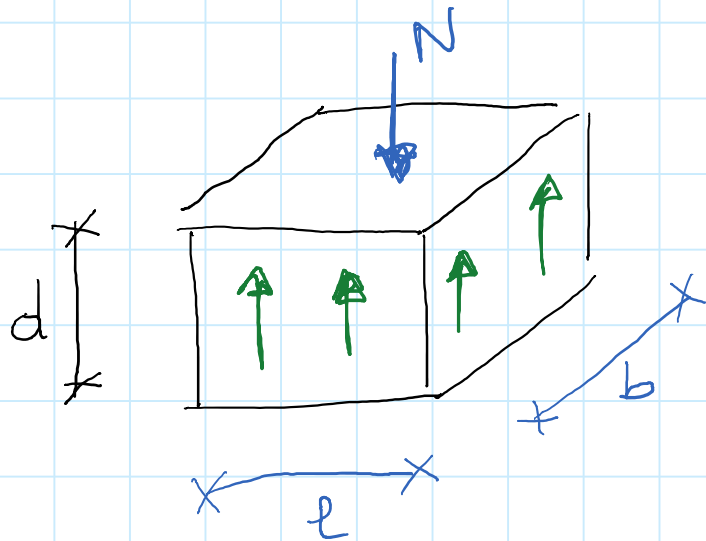
σ = REAZIONE TERRENO

ARMATURE A PUNZONAMENTO NON NECESSARIE SE

$$\tau_{ed} \leq \tau_{rd,c}$$

$$\tau_{rd,c} = \max \left\{ \begin{array}{l} 0.18 k \sqrt[3]{\frac{100 \rho_l f_{ck}}{\gamma_c}} \\ 0.035 k^{3/2} \rho_l^{1/2} f_{ck}^{1/2} \end{array} \right.$$

VERIFICA DELLA SEZIONE DI CLS A FILO PIASTRO

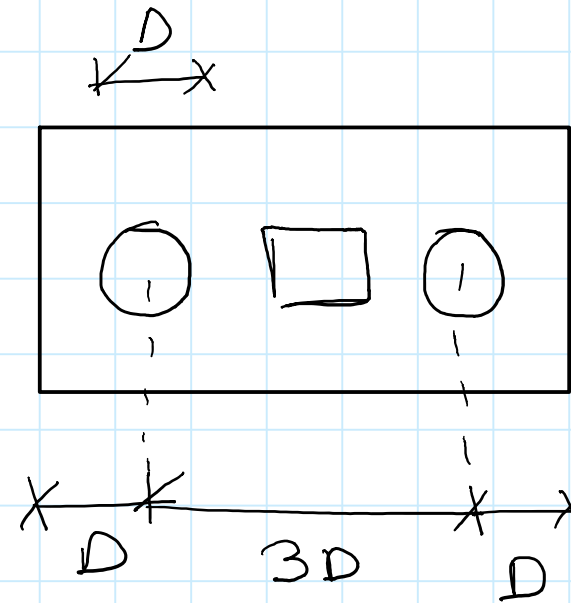
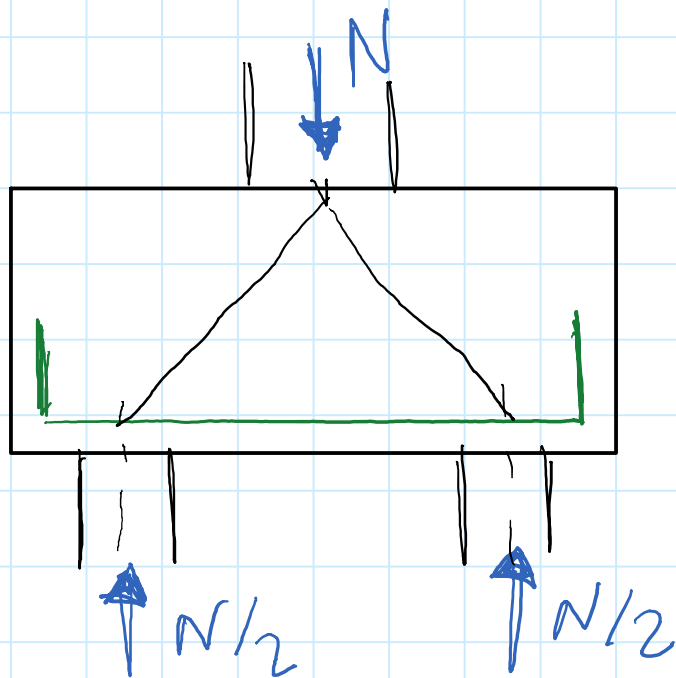


$$\tau_{ed} = \frac{N}{2(l+b) \cdot d} \leq \tau_{rd,max}$$

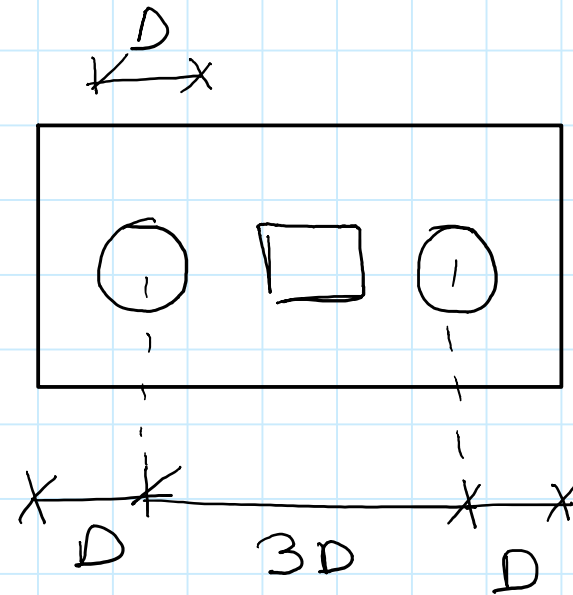
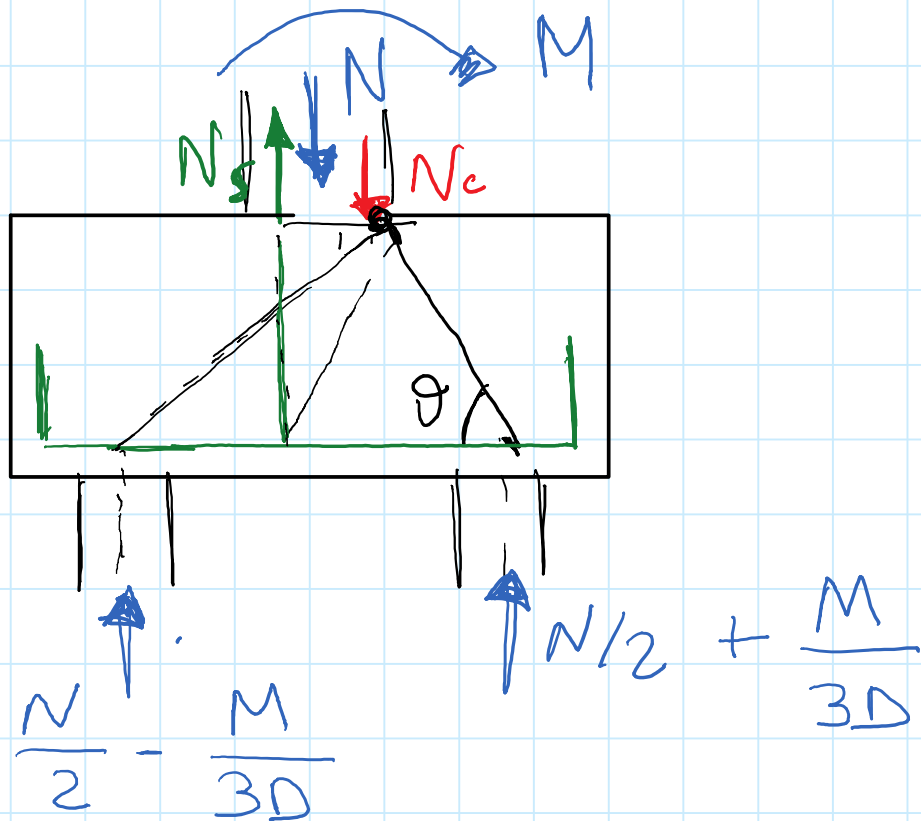
$$\tau_{rd,max} = 0,5 \gamma f_{ctd}$$

NOTA : SE HO ECCENTRICITA'
AMPLIFICO τ_{ed} PER β

PLINTO SU DUE PALI



PLINTO SU DUE PALI



$$N_s = \left(\frac{N}{2} + \frac{M}{3D} \right) \cot \theta$$

\downarrow
 N_s

DA MODELLO A
MENSOLA

