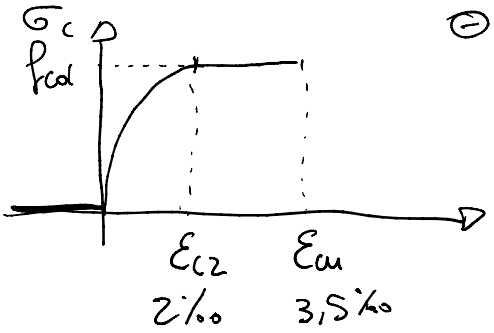
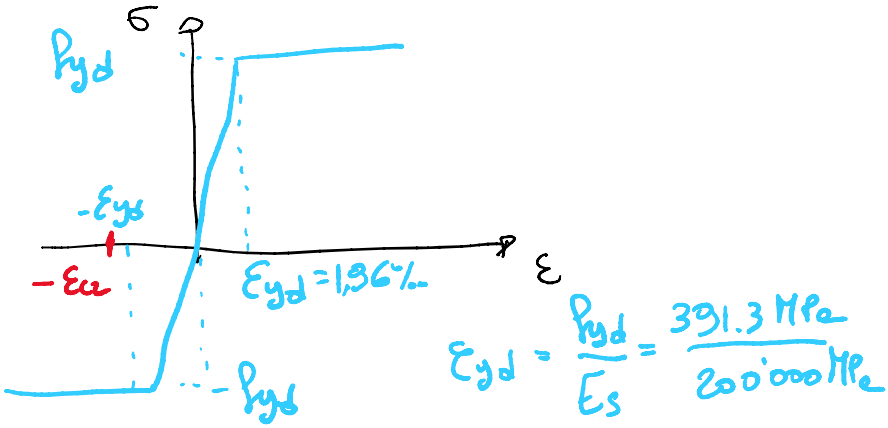
SFORZO NORMALE (III STADIO)

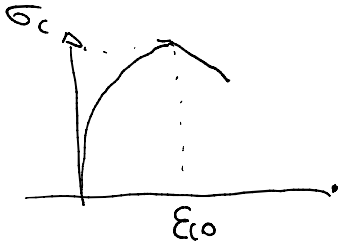
mercoledì 8 aprile 2020 13:04

$N_{Ed} < 0$

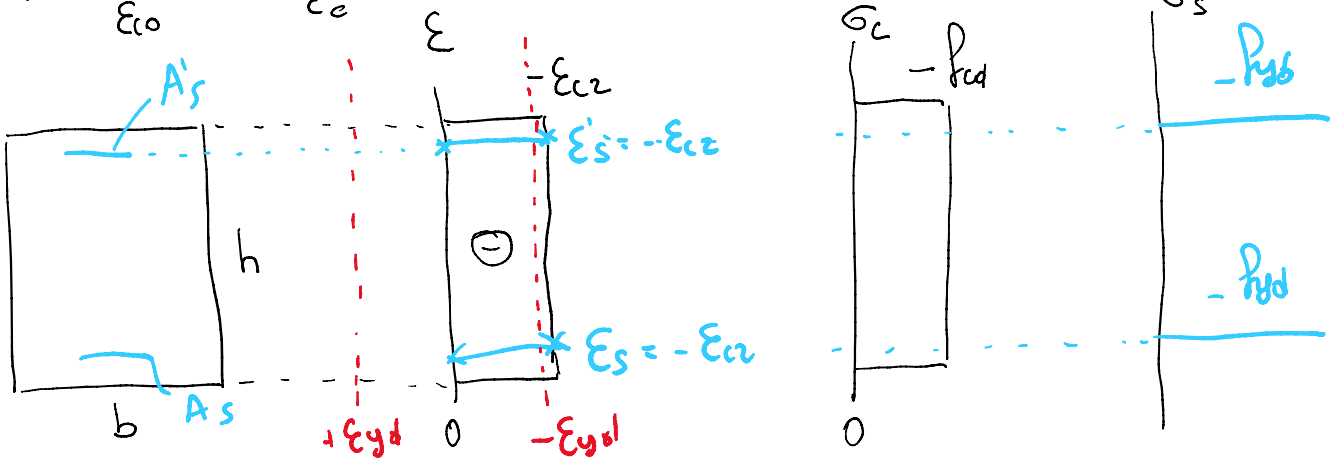




$$\varepsilon_{yd} = \frac{f_{yd}}{E_s} = \frac{391.3\ MPa}{200'000\ MPa}$$



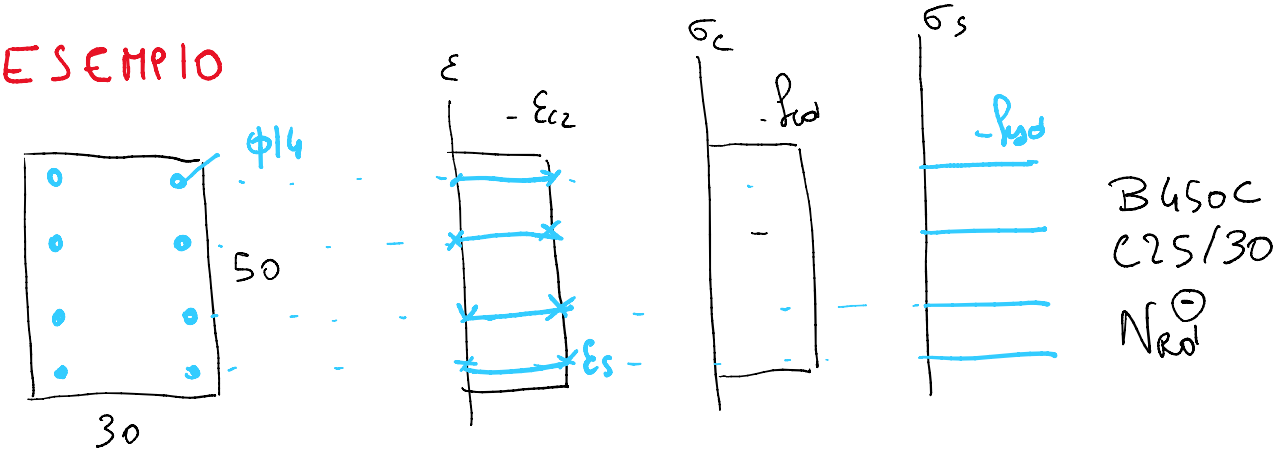
$\varepsilon_{c,lim} = \varepsilon_{c2}$ PER SEZIONI INTERAMENTE COMPRESSE



$$N_{Rd} = \int \sigma\, dA = -f_{cd} A_c - f_{yd} A'_s - f_{yd} A_s$$

$$= -f_{cd} A_c - \sum A_{si} f_{yd}$$

ESEMPIO



B450C
C25/30
$N_{Rd}^{\ominus}$

$$f_{cd} = \alpha_{cc} \frac{f_{ck}}{\gamma_c} = 0{,}85 \times \frac{25}{1{,}5} = 14.17 \text{ MPa}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{450}{1{,}15} = 391{,}3 \text{ MPa}$$

$$A_{\phi 14} = \frac{\pi \cdot \phi^2}{4} = 3{,}14 \times \frac{1{,}4^2}{4} = 1.54 \text{ cm}^2$$

$$N_{Rd} = -30 \times 50 \text{ cm}^2 \times 14{,}17 \frac{N}{mm^2} \cdot \frac{10^2}{10^3} - 8 \times 1{,}54 \text{ cm}^2 \times 391{,}3 \frac{N}{mm^2} \frac{1}{10}$$

$$= -2607 \text{ kN}$$

PROGETTO SEZIONE. N_{Ed}

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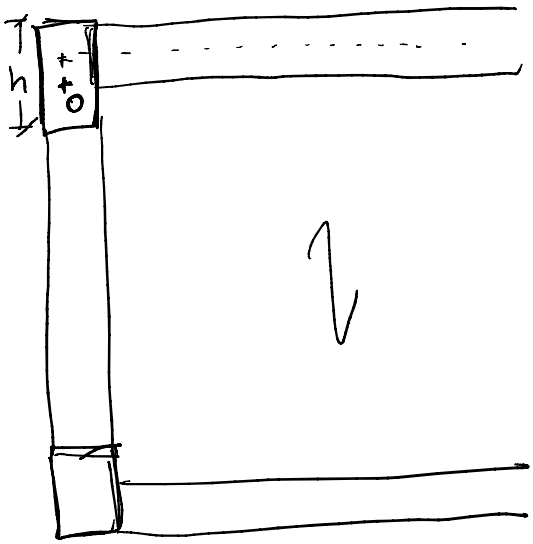


$e \geq 20\,mm$
$\geq 5\%\, h_{sez}$

EC2
NTC08

Se $sez = 30 \times 60 \Rightarrow 5\% \cdot 60 = 3\,cm$

$e \geq 20\,mm$
$\geq \frac{1}{200} l_0$

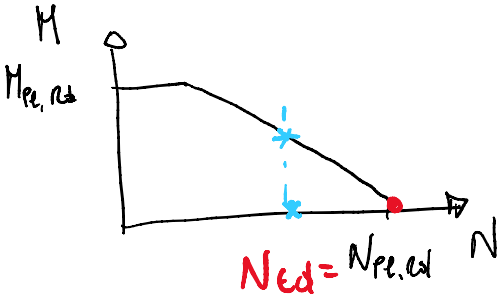
NTC 18

$M_{Ed} = N_{Ed} \cdot e$

SEZIONI IN ACCIAIO

$N_{Ed} = N_{Pl,Rd}$

$N_{Ed} < N_{Pl,Rd}$



CONSIGLIO:
PER PICCOLI M_{Ed} $\Rightarrow$ $\boxed{N_{Rd} \geq 1{,}2\, N_{Ed}}$

INCOGNITE: $A_c, A_s = ?$ $\quad N_{Rd} = A_c f_{cd} + A_s f_{yd}$

INDICAZIONI DI NORMATIVA

1) $A_s f_{yd} = 0.10\, N_{Ed} \Rightarrow A_s \geq \frac{0.2 N_{Ed}}{f_{yd}}$ (CONSIGLIO)
2) $A_s \geq 3‰\, A_c$ DISPOSTA $\Rightarrow$ VINCOLANTE SOLO SE $A_{c,DISP} >> A_{c,NEC}$
3) $A_s \leq 4\%\, A_{c,DISPOSTA}$ (LIMITE NORMATIVO)
4) $A_s \geq 1\%\, A_c$ DISPOSTA (IN ZONA SISMICA)

CONDIZIONI DI PROGETTO

$$\left.\begin{aligned} A_c f_{cd} &\geq N_{Ed} \\ A_s f_{yd} &\geq 0.2 N_{Ed} \end{aligned}\right\} \Rightarrow A_c f_{cd} + A_s f_{yd} \geq 1.2 N_{Ed}$$

$$\rho_{s,NEC} = \frac{A_{s,NEC}}{A_{c,NEC}} \Rightarrow \quad A_{s,NEC} = \frac{0,2\, N_{Ed}}{f_{yd}}$$

$$A_{c,NEC} = \frac{N_{Ed}}{f_{cd}}$$

$$\rho_{s,NEC} = \frac{0,2 N_{Ed}}{f_{yd}} \cdot \frac{f_{cd}}{N_{Ed}} = 0,2 \times \frac{f_{cd}}{f_{yd}}$$

SE UTILIZZO C25/30 B450C $\Rightarrow$ $\rho_{s,NEC} = 0,2 \times \frac{14,17}{391,3} = 7‰$

DETTAGLI STRUTTURALI

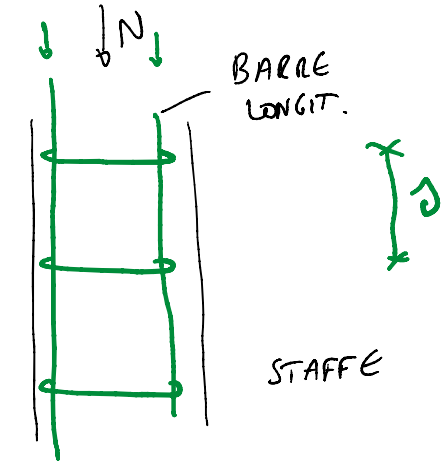
$\phi_{MIN,LONG} \geq 12\,mm$

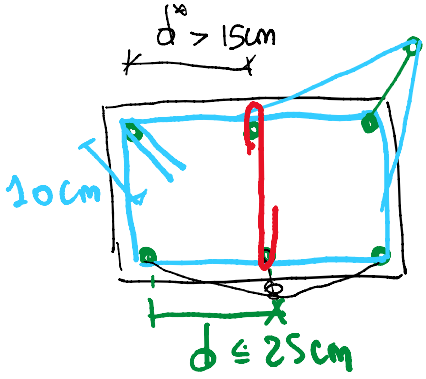
$d_{BARRE} \leq 30\,cm$ CONSIGLIO 25cm

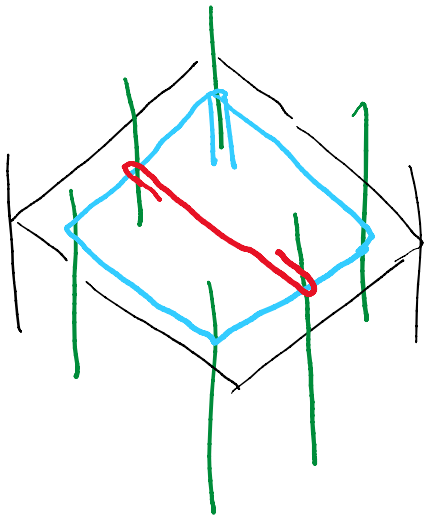
$\phi_{STAFFE} \geq 6\,mm$ PRASSI $\phi 8$

$\geq \frac{1}{4}\phi_{MAX,LONG.}$

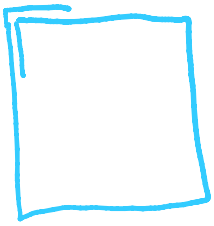
$s \leq \min\{25\,cm;\ 12\phi_{min,long}\}$



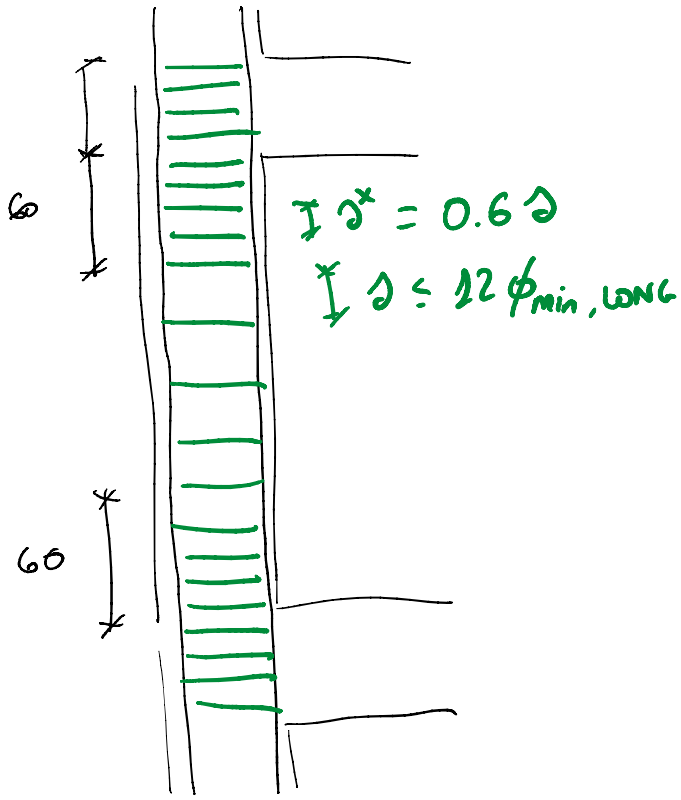




STAFFA MAL REALIZZATA



RAFFITTIMENTO STAFFE



SEZIONE PILASTRO

30X60

ESEMPIO

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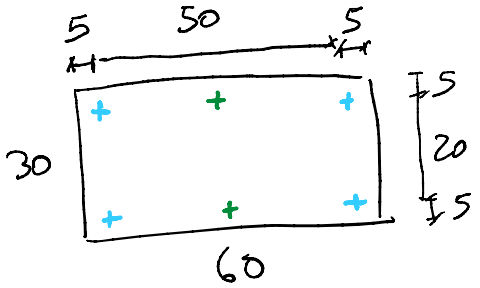
$N_{Ed} = 2500$ KN (DI COMPRESSIONE)

C25/30

$$A_{c,NEC} = \frac{N_{Ed}}{f_{cd}} = \frac{2500\ KN}{14{,}17\ N/mm^2} \times 10 = 1765\ cm^2$$

$$A_{s,NEC} = \frac{N_{Ed}\ 0{,}2}{f_{yd}} = \frac{2500 \times 0{,}2\ KN}{391{,}3\ N/mm^2} \times 10 = 12{,}8\ cm^2$$

30 x 60



$A_c = 1800\ cm^2$

TRAVI E PILASTRI

POSSIBILE TERNA

$\phi 10$, $\phi 14$, $\phi 20$

SOLAIO

$\phi 12$, $\phi 16$, $\phi 20$

SOLAIO

TRAVI PILASTRI

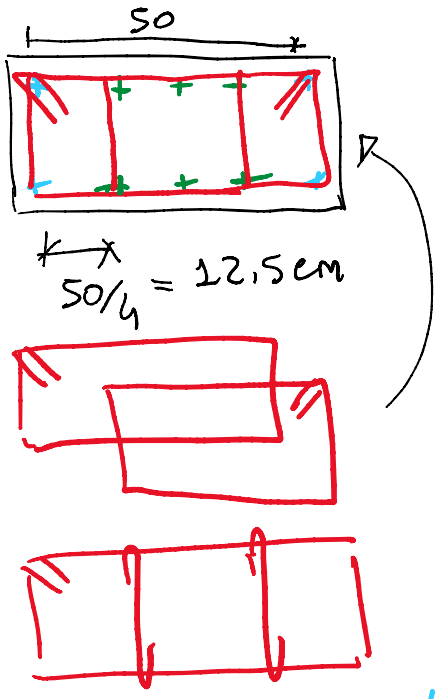
UTILIZZO $\phi 14$ $\longrightarrow$ $n_{barre} = \frac{12{,}8\ cm^2}{1{,}54\ cm^2} = 8{,}31$

($A_{s,tot}$ / $A_{\phi 14}$)

OPZIONE 1 $\Rightarrow$ $10\phi14$

$$A_{s\,tot} = 10 \times 1{,}54\,cm^2 = 15{,}4\,cm^2$$

$$\frac{A_{s,disp}}{A_{c,disp}} = \frac{15{,}4}{1800} = 8{,}5\,‰$$

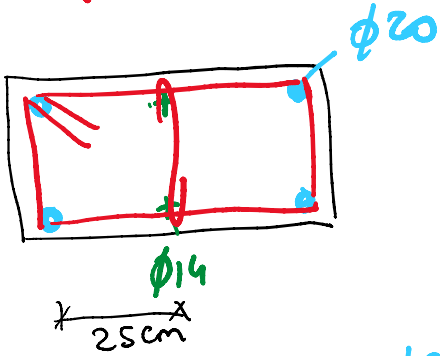


OPZIONE 2 $\Rightarrow$ $4\phi20 \equiv 8\phi14$

$4 \times 3{,}14 \simeq 8 \times 1{,}54$

$\Rightarrow 2\phi14$

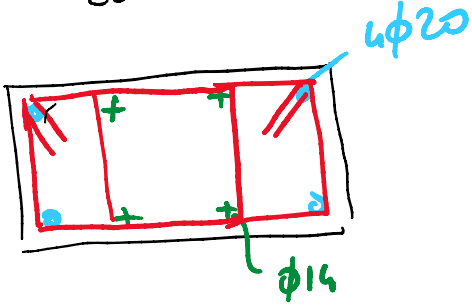
$$A_{s,tot} = 4 \times 3{,}14\,cm^2 + 2 \times 1{,}54\,cm^2 = 15{,}64\,cm^2$$



OPZIONE 3 $4\phi20 + 4\phi14$

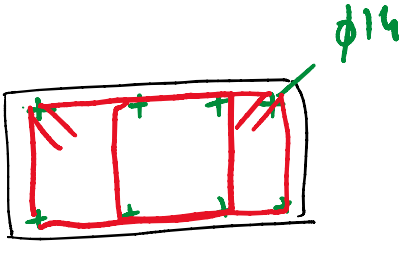
$$A_{s,tot} = 4 \times 3{,}14 + 4 \times 1{,}54 = 18{,}72\,cm^2$$

$$\rho_s = \frac{A_{stot}}{A_c} = \frac{18{,}72}{1800} > 1\%$$



OPZIONE 4

$8\phi14 \Rightarrow < A_{s,NEC}$



CONSIGLIO UTILIZZARE $\phi20$ AGLI SPIGOLI PER SEZIONI CON $h \geq 60$ cm

OPZIONE 5

$\phi 16 \rightarrow A_{\phi 16} = 2\,cm^2 \Rightarrow n_b = \frac{12,8\,cm^2}{2} > 6$ BARRE

$8\phi 16$

PASSO STAFFE

$\phi_{14}, \phi_{20} \Rightarrow \phi_{MIN,LONG} = 14\,mm$

$\Rightarrow s \leq 12\phi_{MIN} = 12 \times 14 = 16,8\,cm$

15 cm

$\phi 8/15$

ESTREMI PILASTRO: $s \leq 0.6 \times 12\phi_{MIN} = 0,6 \times 16,8\,cm = 10,08\,cm$

10 cm

SE PRESENTE M_{Ed}

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NEL VOSTRO PROGETTO IN FUNZIONE DELL'AZIONE DEL VENTO

SE $P_K \simeq 1{,}5\ KN/m^2 \Rightarrow$

↓

NASCONO PICCOLI M_{Ed} NON

INCREMENTARE ULTERIORMENTE

$A_{c,nec}$ ↓ $1{,}2\ A_{c,nec}$;

$A_{s,nec}$ DEL 20% ↓ $1{,}2\ A_{s,nec}$

CARICHI ASSIALI SUI PILASTRI

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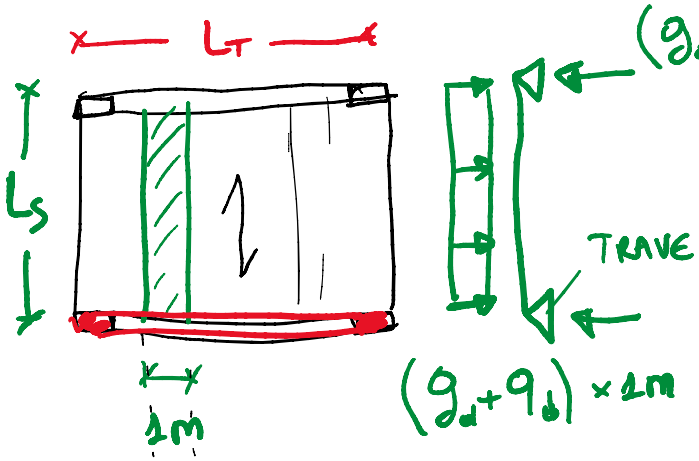
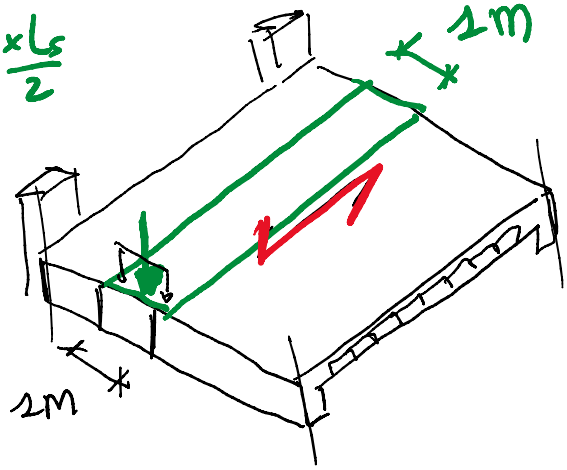
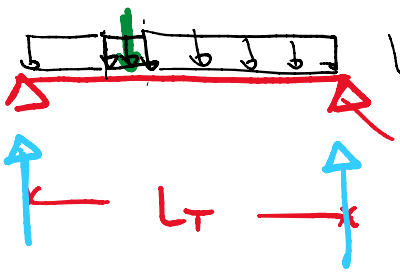


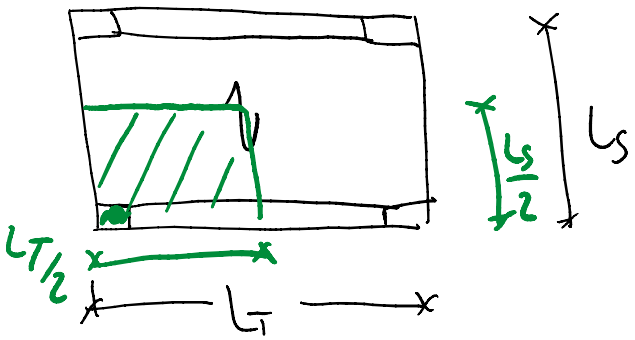


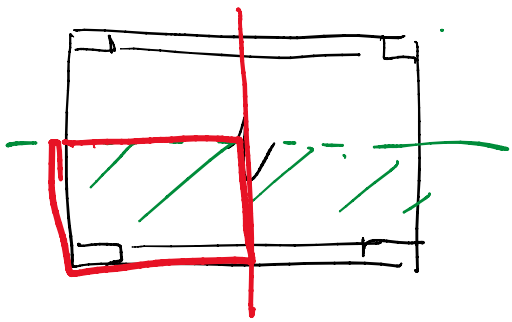


$(g_d+q_d)\cdot \frac{L_S}{2} \times \frac{1m}{1m}$ CARICO SULLA TRAVE

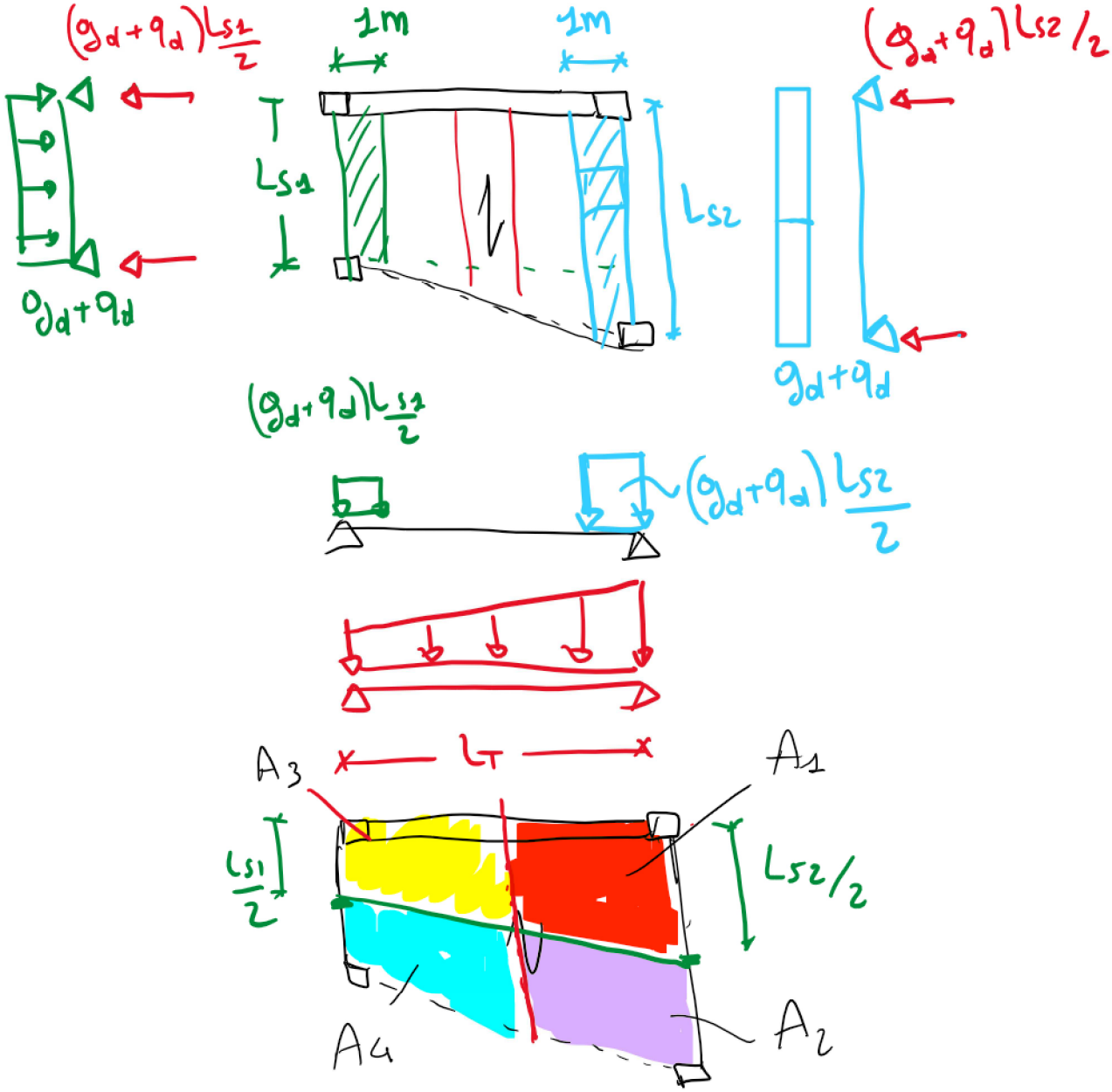
$(g_d+q_d)\frac{L_S}{2} \times \frac{L_T}{2} = F_V$ SUL PILASTRO

CARICO A m^2 — AREA DI INFLUENZA





CASO DI TRAVI CON ASSE INCLINATO



IN CASO DI TRAVI CONTINUE

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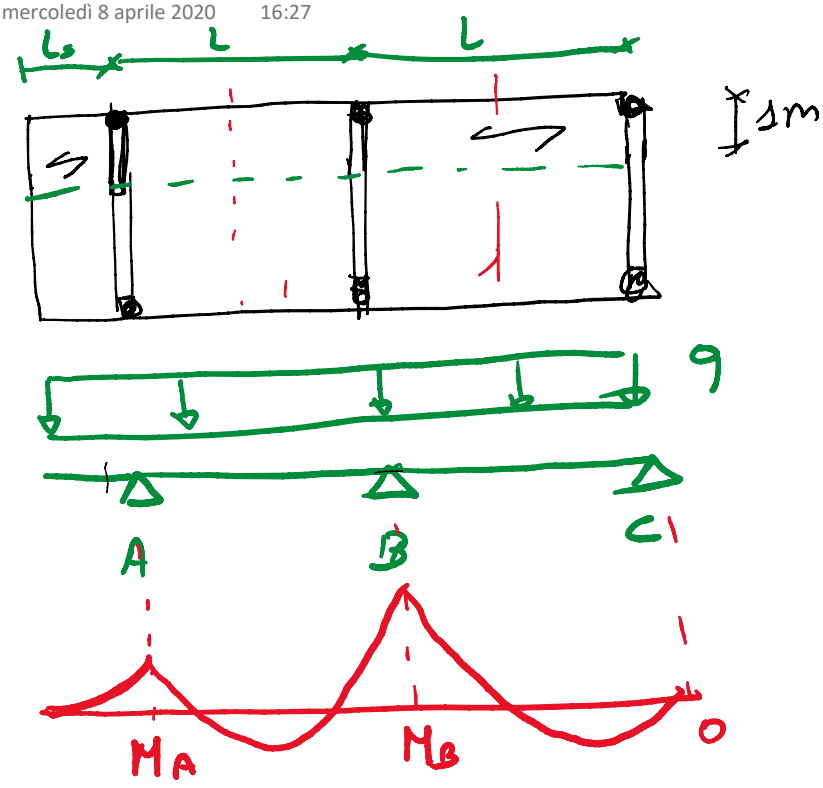
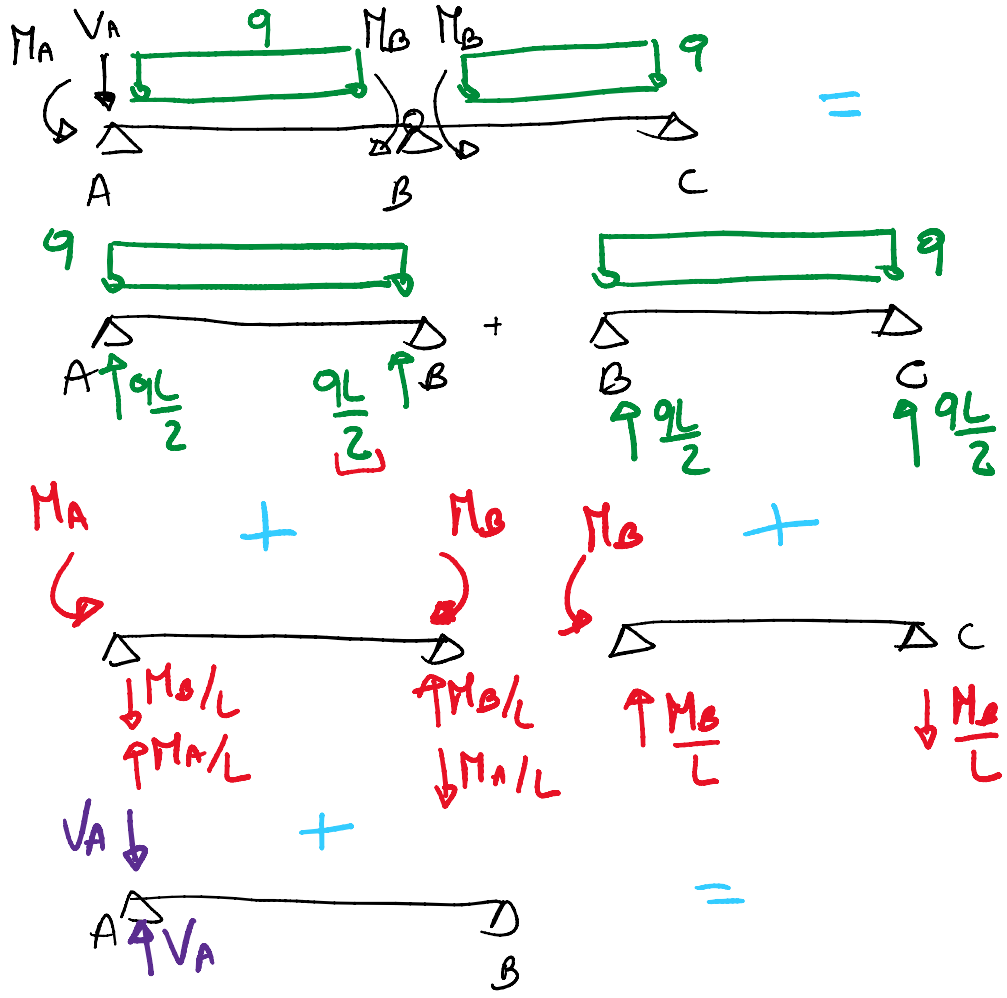


DOVE

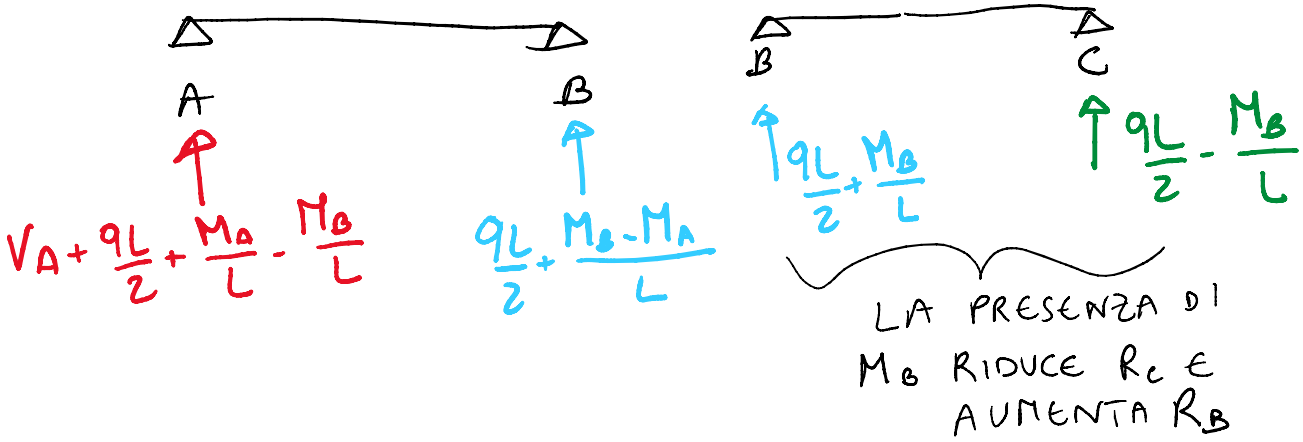
$M_A = \frac{qL_s^2}{2}$

$\uparrow V_A = qL_s$

NOTO DIAGRAMMA M CONSIDERO LA SOVRAPPOSIZIONE DI PIU' SCHEMI



REAZIONI TOTALI



CASI PARTICOLARI

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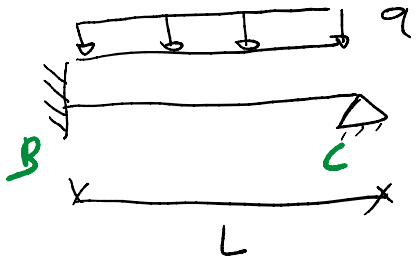
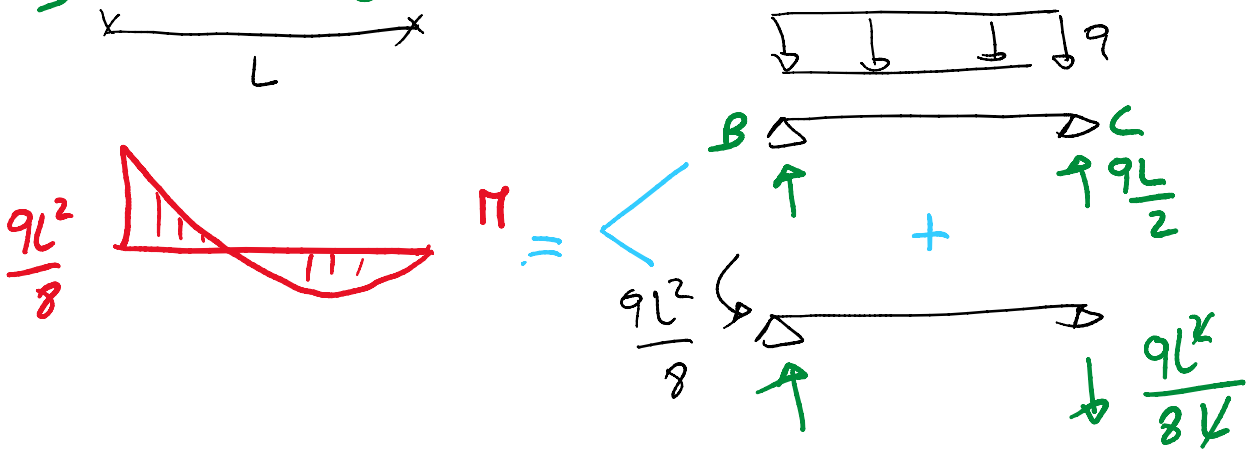


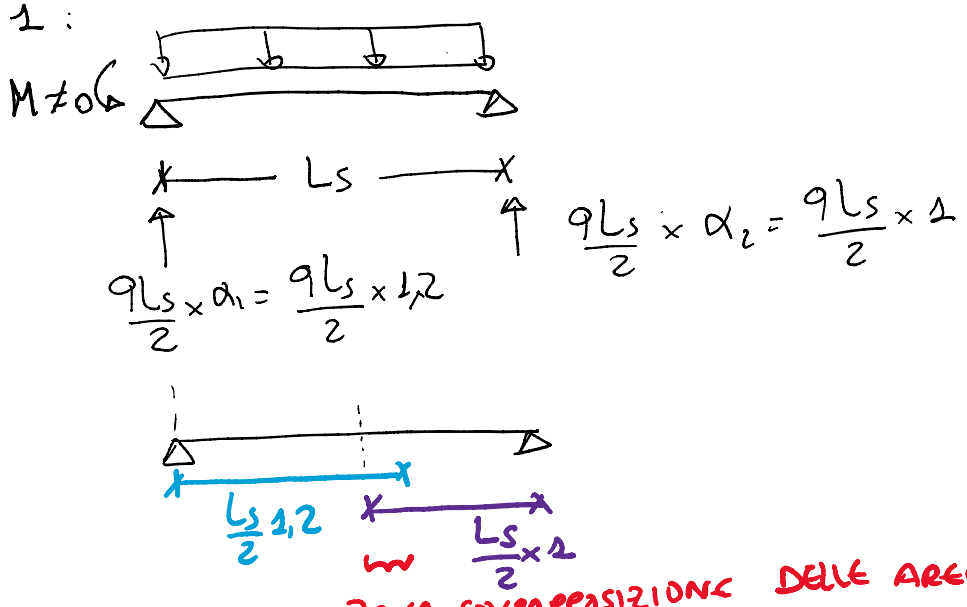


$$R_B = \frac{9L}{2} + \frac{9L}{8} = \frac{9L}{2}\left(1 + \frac{1}{4}\right) = \frac{9L}{2} \times \cancel{1{,}25}\ 1{,}20 = \frac{9L}{2}\alpha_1$$

$$R_C = \frac{9L}{2} - \frac{9L}{8} = \frac{9L}{2}\left(1 - \frac{1}{4}\right) = \frac{9L}{2}\ \cancel{0{,}75}\ 1.00 = \frac{9L}{2}\alpha_2$$

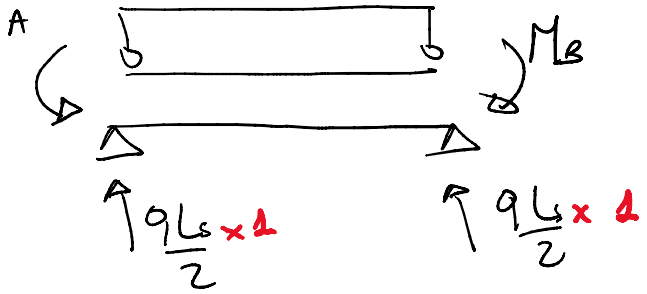
α : COEFF. DI CONTINUITÀ ≥ 1

RIEPILOGO CASO 1:



M

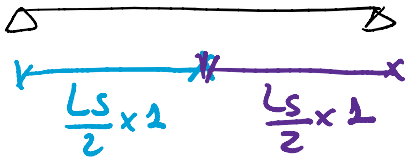
CASO 2



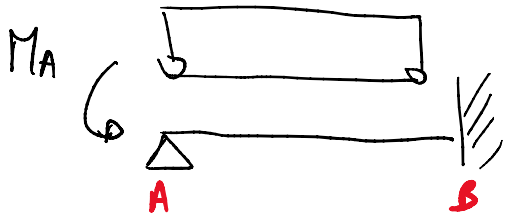
$M_A = M_B$

$\alpha_1 = 1$

$\alpha_2 = 1$



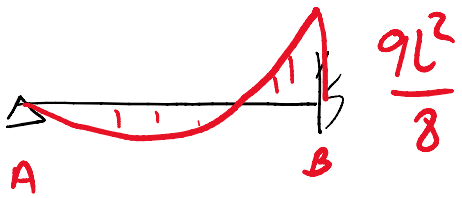
CASO 3



=

IPOTESI

$M_A = M_B/2$



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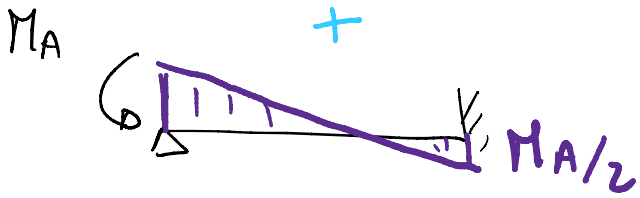
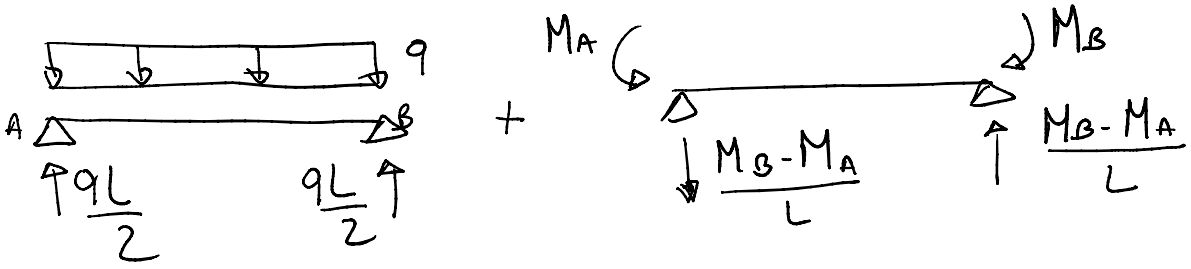


$$M_B = \frac{9L^2}{8} - \frac{M_A}{2} = \frac{9L^2}{8} - \frac{M_B}{4} \Rightarrow$$

$$M_B + \frac{1}{4}M_B = \frac{9L^2}{8} \Rightarrow \frac{5}{4}M_B = \frac{9L^2}{8\,2} \Rightarrow$$

$$M_B = 9L^2/20 \quad ; \quad M_A = M_B/2 = 9L^2/20$$

REAZIONI AGLI APPOGGI



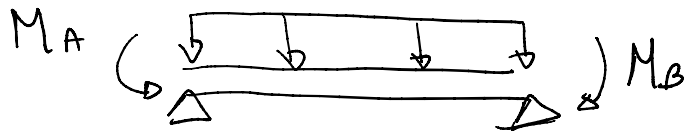
$$R_A = \frac{qL}{2} - \frac{M_B - M_A}{L} = \frac{qL}{2} - \left(\frac{qL^2}{10} - \frac{qL^2}{20}\right)\cdot\frac{1}{L}$$

$$R_B = \frac{qL}{2} + \frac{M_B - M_A}{L} = \frac{qL}{2} + \frac{qL}{10} - \frac{qL}{20}$$

$$R_B = \frac{qL}{2}\left(1 + \frac{1}{5} - \frac{1}{10}\right) = 1.1\,\frac{qL}{2} = \alpha_2\,qL/2$$

$$R_A = \frac{qL}{2}\left(1 - \frac{1}{5} + \frac{1}{10}\right) = \cancel{0.9}\,1\,\frac{qL}{2} = \alpha_2\frac{qL}{2}$$

RIEPILOGO CASO 3



$M_A = M_B/2$

$\frac{qL_s}{2} \times \alpha_1 = \frac{qL_s}{2} \times 1$

$\frac{qL_s}{2} \times \alpha_2 = \frac{qL_s}{2} \times 1{,}1$