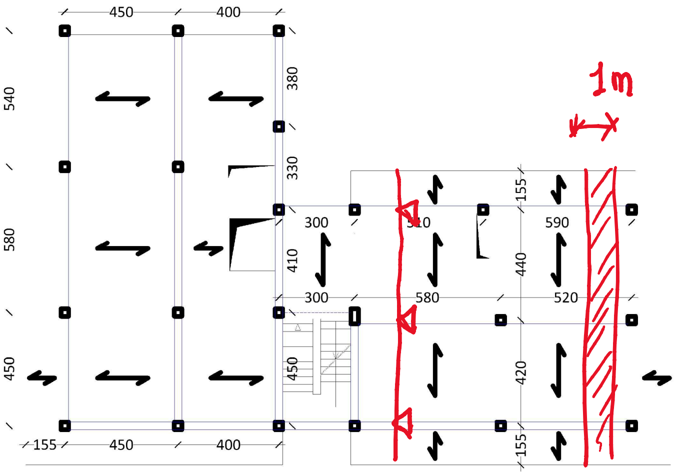
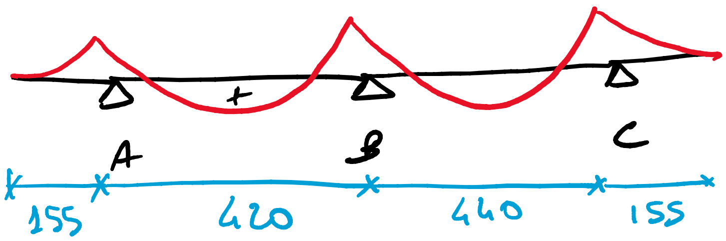
SOLAIO EDIFICIO

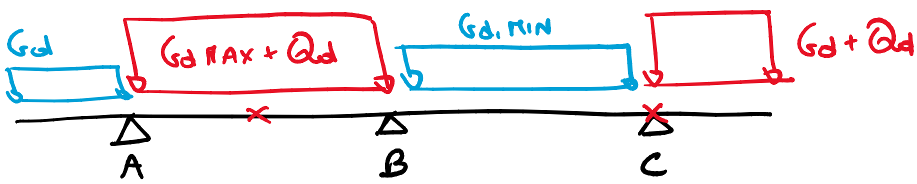
mercoledì 29 aprile 2020 16:55





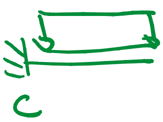
FORMA QUALITATIVA DIAGRAMMA M_{Ed}

DISPOSIZIONE CARICHI M_{max} CAMPATA AB



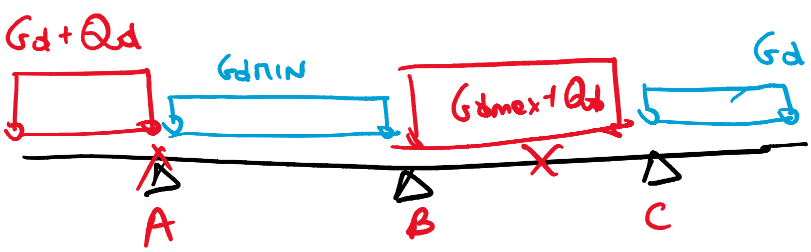
NOTA 1: NEL BALCONE NON HO DISTINZIONE TRA Gd MAX, Gd MIN (NON HO TRAMEZZI)

NOTA 2: LA DISPOSIZIONE DEI CARICHI MASSIMIZZA ANCHE M_{Ed} <0 NELL' APPOGGIO C



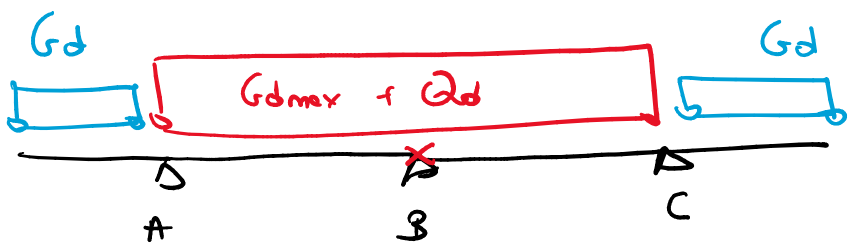
M_c DIPENDE SOLO DAI CARICHI SULLO SBALZO

DISPOSIZIONE CARICHI M_{max} CAMPATA BC

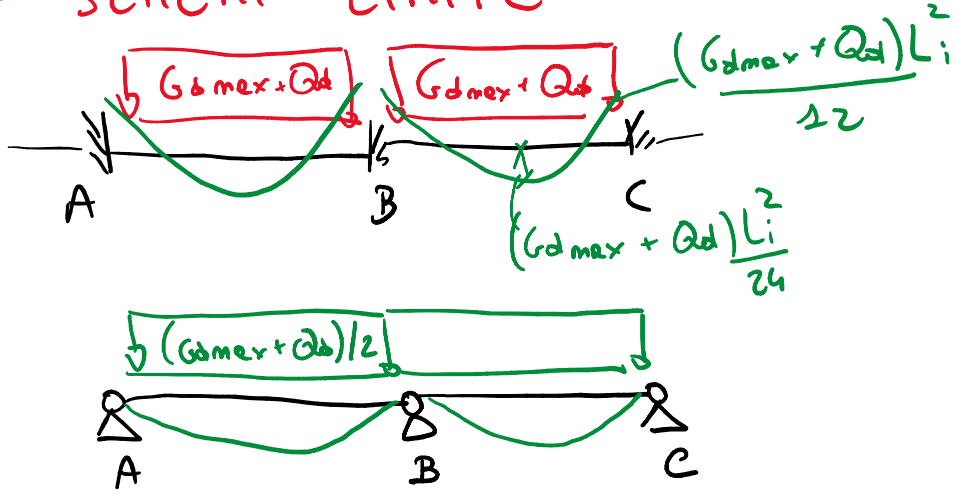


→ OTTENGO ANCHE M_{Ed} <0 MAX IN A

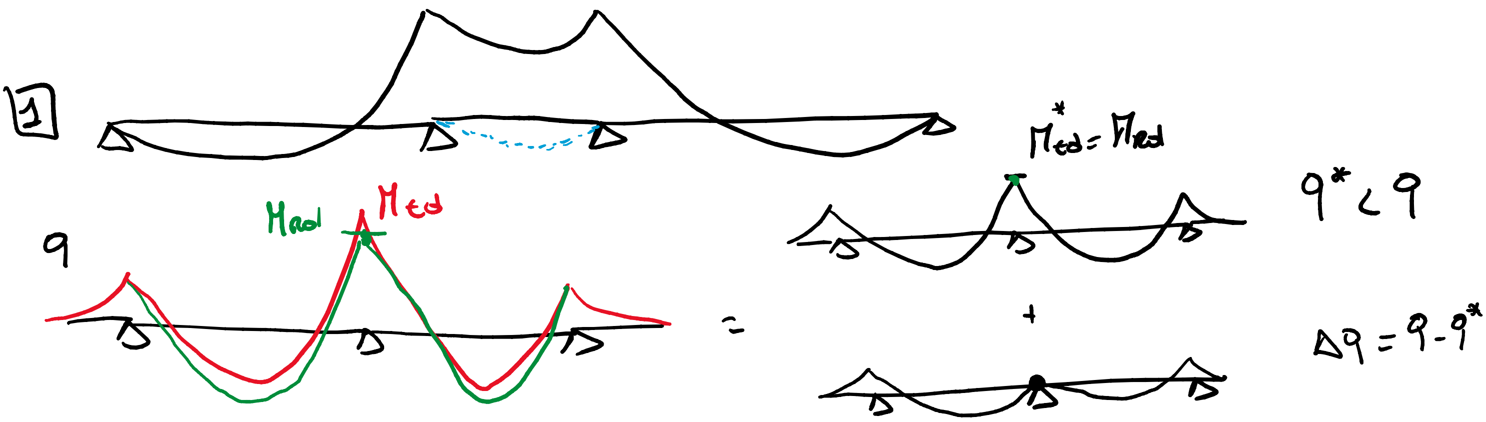
DISPOSIZIONE CARICHI M_{max} IN B



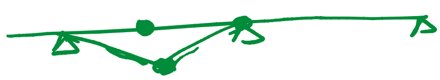
+ SCHEMI LIMITE



MOTIVI PER LO SCHEMA LIMITE

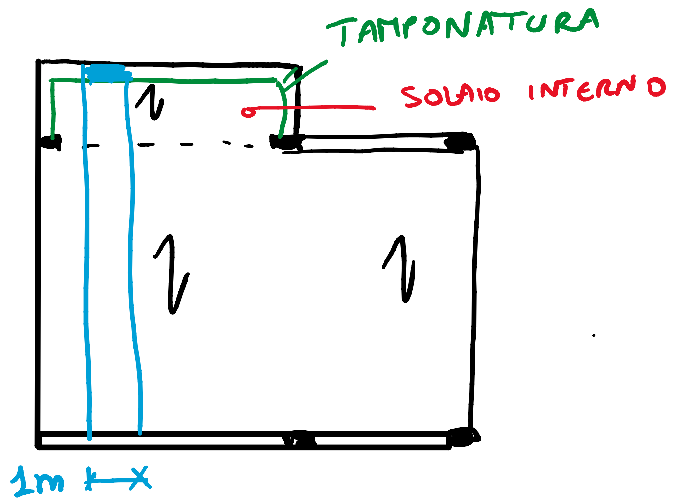


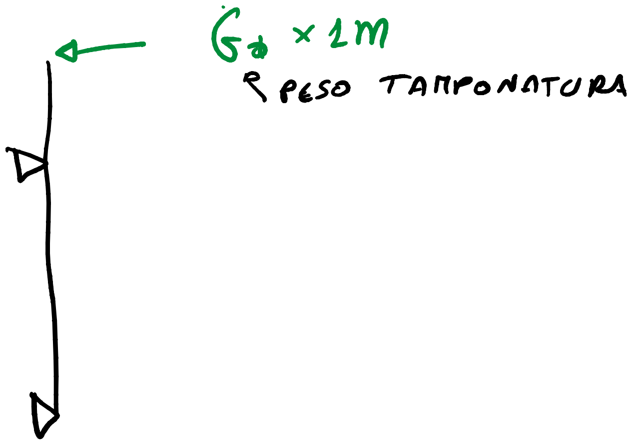
OPPORTUNO ABBONDARE IN CAMPATA

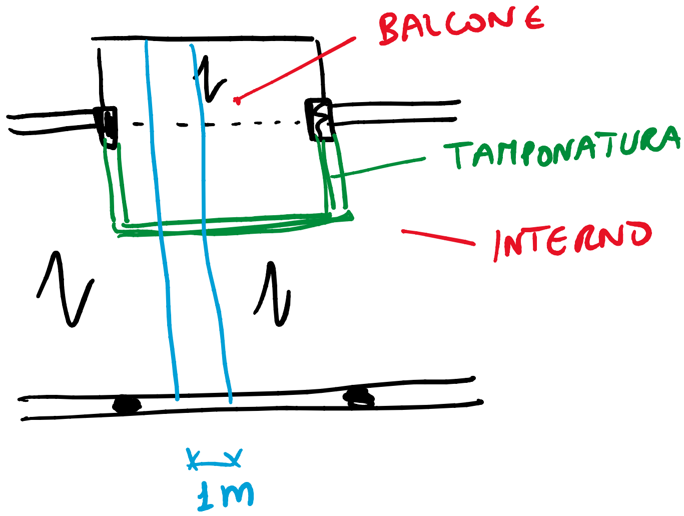


CASI CON FORZA CONCENTRATA

giovedì 30 aprile 2020 14:00

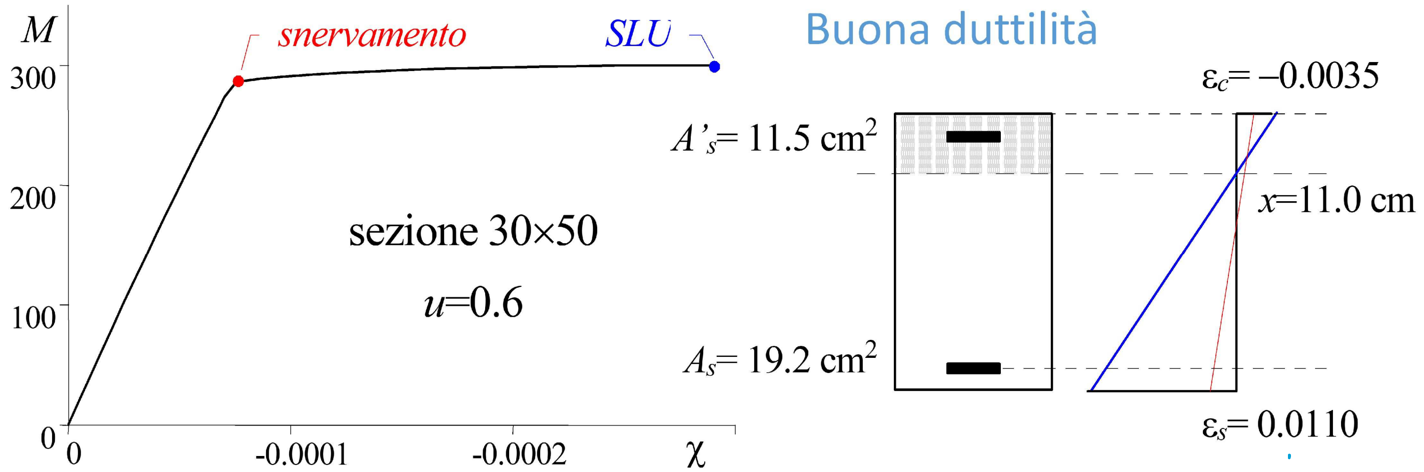


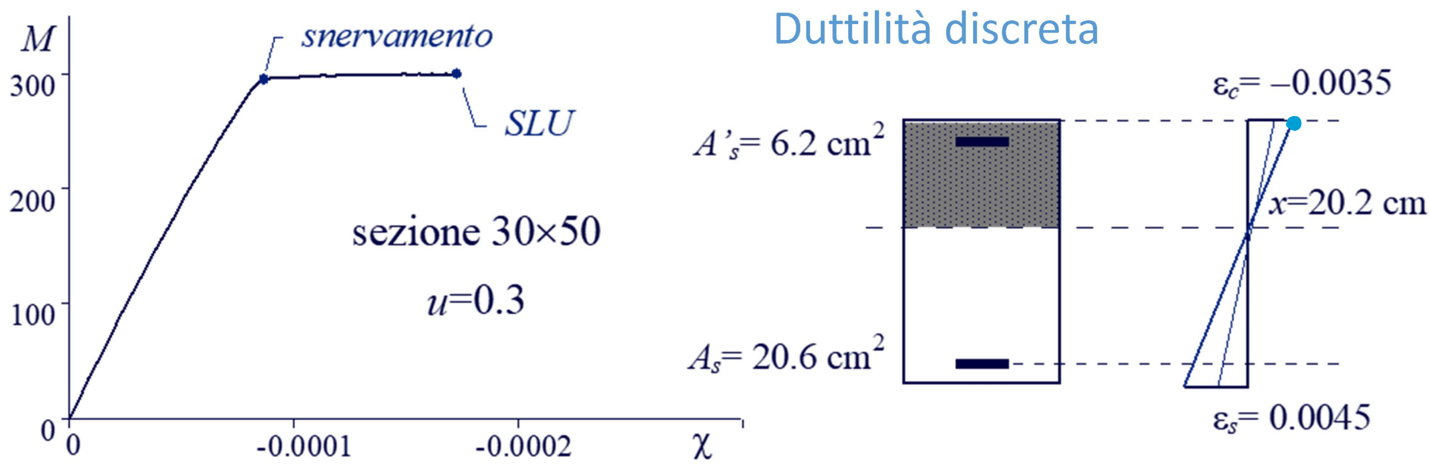


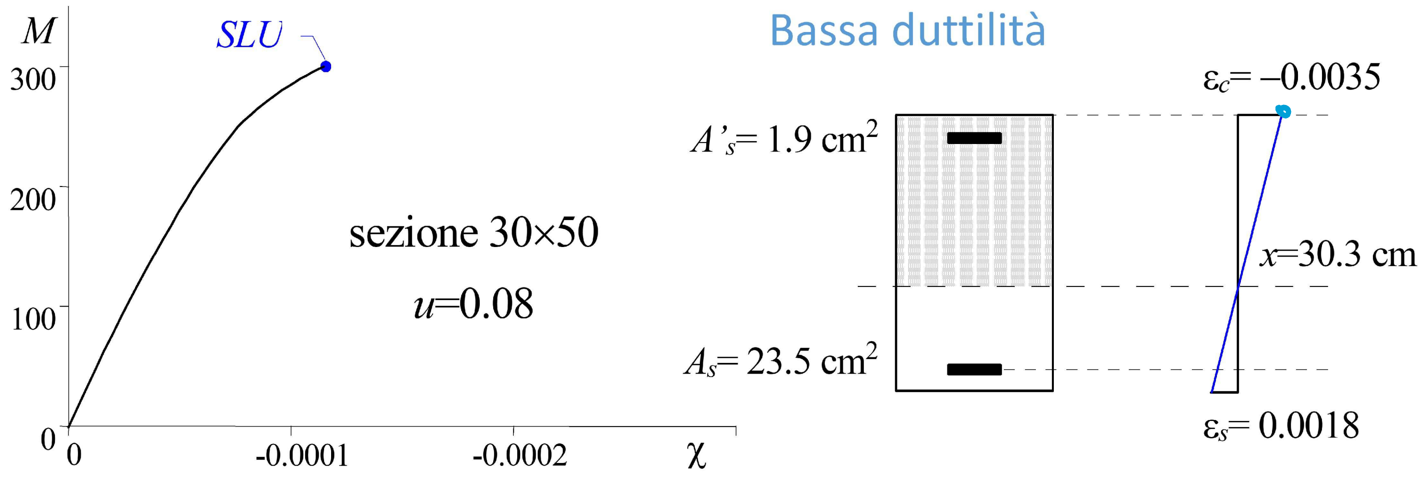


DUTTILITÀ DI SEZIONI IN C.A.

giovedì 30 aprile 2020   14:33



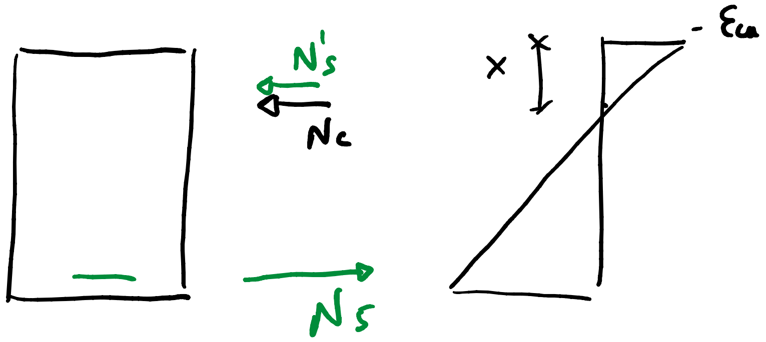




BUONA DUTTILITÀ x_u : $\varepsilon_s \geq 1\%$

BASSA DUTTILITÀ x_u : $\varepsilon_s \leq \varepsilon_{yd}$

CONTRIBUTO ARMATURA COMPRESSA



x È TALE CHE

$$N_c + N'_s + N_s = 0$$

SE AUMENTA $A'_s \Rightarrow$ AUMENTEREBBE $N'_s \Rightarrow$
PER GARANTIRE EQUILIBRIO x DEVE RIDURSI

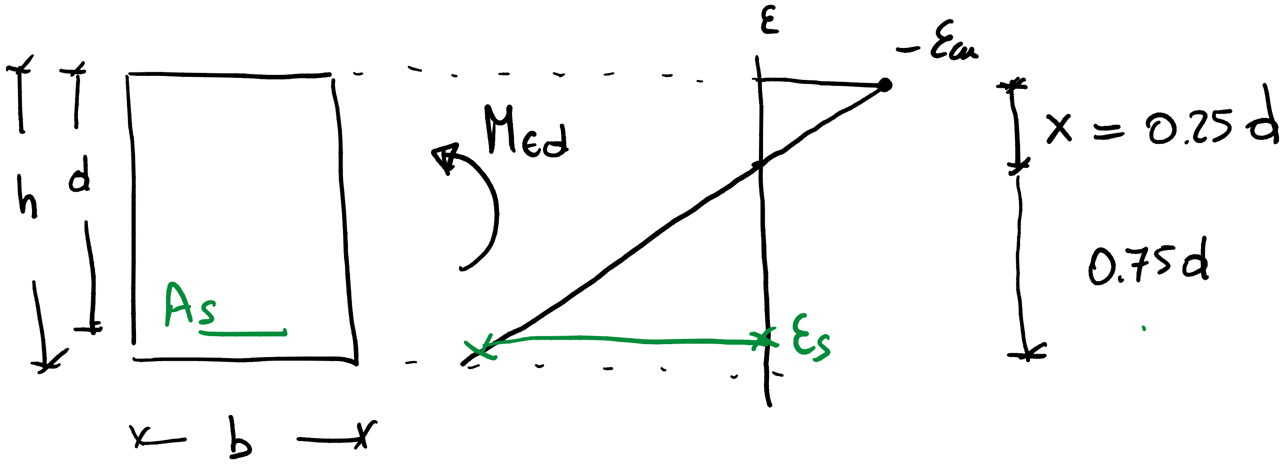
PROGETTO

giovedì 30 aprile 2020 14:45

DATI
- M_{Ed}
- MATERIALI
- DUTTILITÀ

INCOGNITE:
- b, h
- A_s, A'_s

SEZIONE A SEMPLICE ARMATURA

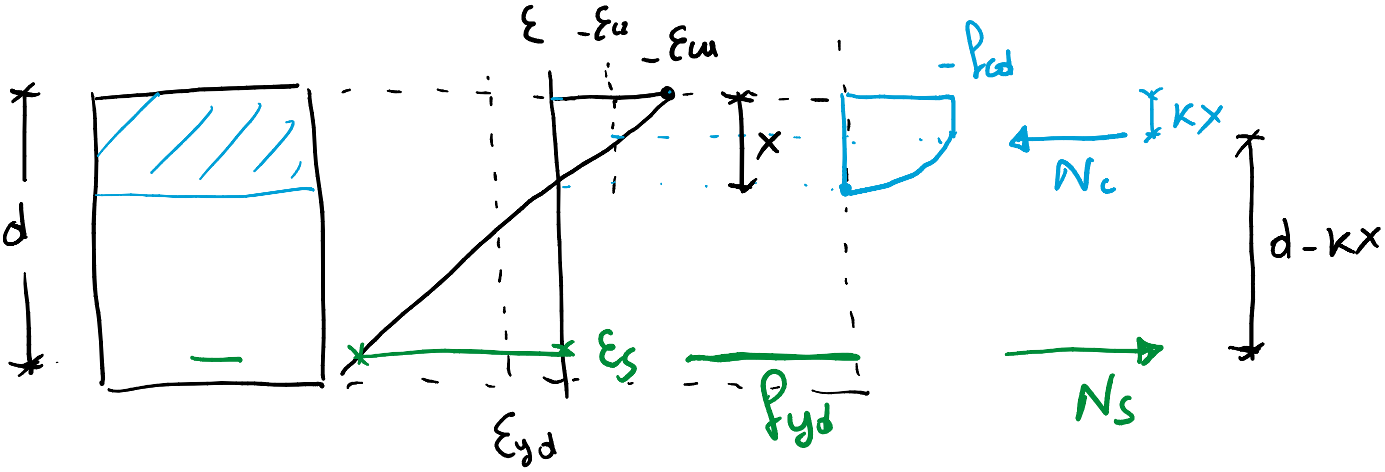


$$\varepsilon_s : 0{,}75\,d = \varepsilon_{cu} : 0{,}25\,d \Rightarrow$$

$$\varepsilon_s = \frac{0{,}75\,\cancel{d}}{0{,}25\,\cancel{d}}\,\varepsilon_{cu} = 3 \times \frac{3{,}5}{1000} = 10‰$$

PER AVERE BUONA DUTTILITÀ $X = 0.25d$

$$\xi = \frac{x}{d} = 0{,}25$$



Eq. ROTAZIONE RISPETTO A N_s

$$\left.\begin{aligned} M &= -N_c\,(d-Kx) \\ N_c &= -\beta b x f_{cd} \end{aligned}\right\} \rightarrow M = \beta b x f_{cd}\,(d-Kx)$$

$$x = \xi d \qquad \longrightarrow M = \beta b \xi d f_{cd}\, d\,(1-K\xi)$$

$$M = bd^2 \cdot \underbrace{\beta \xi f_{cd}\,(1-K\xi)}_{1/r^2} \Rightarrow$$

$$\boxed{M = \frac{bd^2}{r^2}}$$

FORMULA DI PROGETTO PER SEZ. RETTANGOLARI A SEMPLICE ARMATURA

$M = M_{Ed}$

TRAVI EMERGENTI
$b = 30\,cm \Rightarrow d^2 = r^2 \dfrac{M}{b}$

$$d = r\sqrt{\frac{M_{Ed}}{b}}$$

TRAVI A SPESSORE

$$h = h_{solaio} \rightarrow d = h - c \rightarrow b = r^2 \frac{M_{Ed}}{d^2}$$

$$\frac{1}{r^2} = \beta \cdot \xi \cdot f_{cd} (1 - k\xi) \Rightarrow$$

$$r = \sqrt{\frac{1}{\beta \xi f_{cd} (1 - k\xi)}}$$

M_{Ed} kNm

b, d m

f_{cd}: kN/m²

$$C25/30 \rightarrow f_{cd} = 14.16 \text{ MPa} = 14.16 \times 10^3 \text{ kN/m}^2$$

$$r = \sqrt{\frac{1}{0.81 \times 0.25 \times 14.16 \times 10^3 (1 - 0.416 \times 0.25)}}$$

$$= 0.0197$$

$$C30/37 \rightarrow r = 0.018$$

ESEMPIO

$M_{Ed} = 250$ kNm

B 450C

C25/30

$b = 0.30$ m

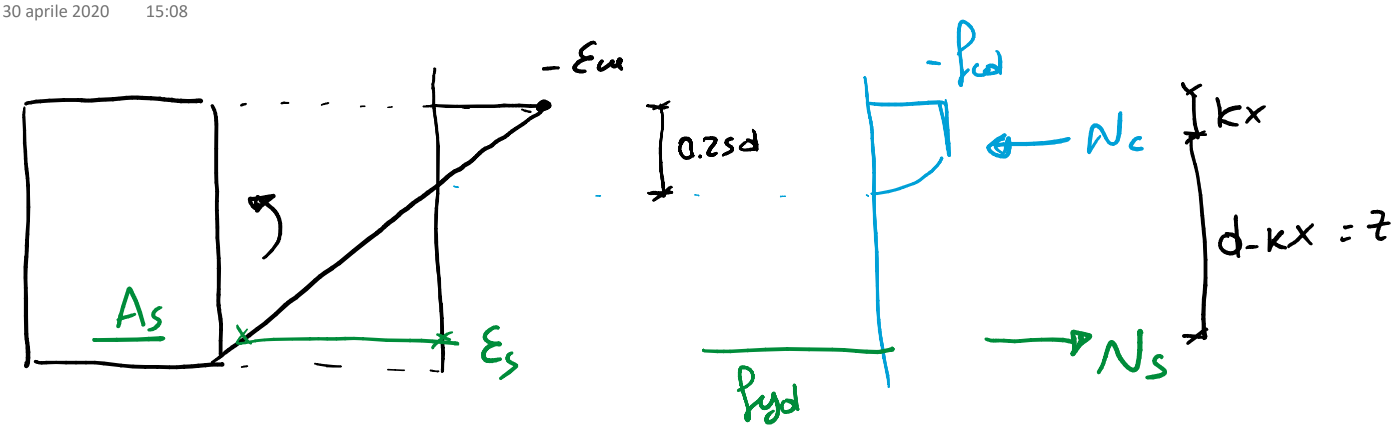
$$M = \frac{bd^2}{r^2} \Rightarrow$$

$$d = 0.0197 \sqrt{\frac{250 \text{ kNm}}{0.30 \text{ m}}} = 0.57 \text{ m}$$

$$h = d + c = 0.57 + 0.05 = 0.62$$

PROGETTO ARMATURA TESA

giovedì 30 aprile 2020 15:08



EQ. ROTAZIONE RISPETTO A N_c

$$\left.\begin{array}{l} M = N_s (d - kx) \\ N_s = A_s f_{yd} \end{array}\right\} \rightarrow M = A_s f_{yd}\, d\,(1 - k\xi)$$

$$M = A_s f_{yd} \cdot d\ \underbrace{(1 - 0{,}416 \times 0.25)}_{0{,}896} \rightarrow$$

$$M = A_s f_{yd} \cdot 0{,}9d \Longrightarrow \boxed{A_s = \frac{M}{0{,}9d \cdot f_{yd}}}$$

ESEMPIO

$h = 70\ \text{cm}$

$M = 250\ \text{KNm}$

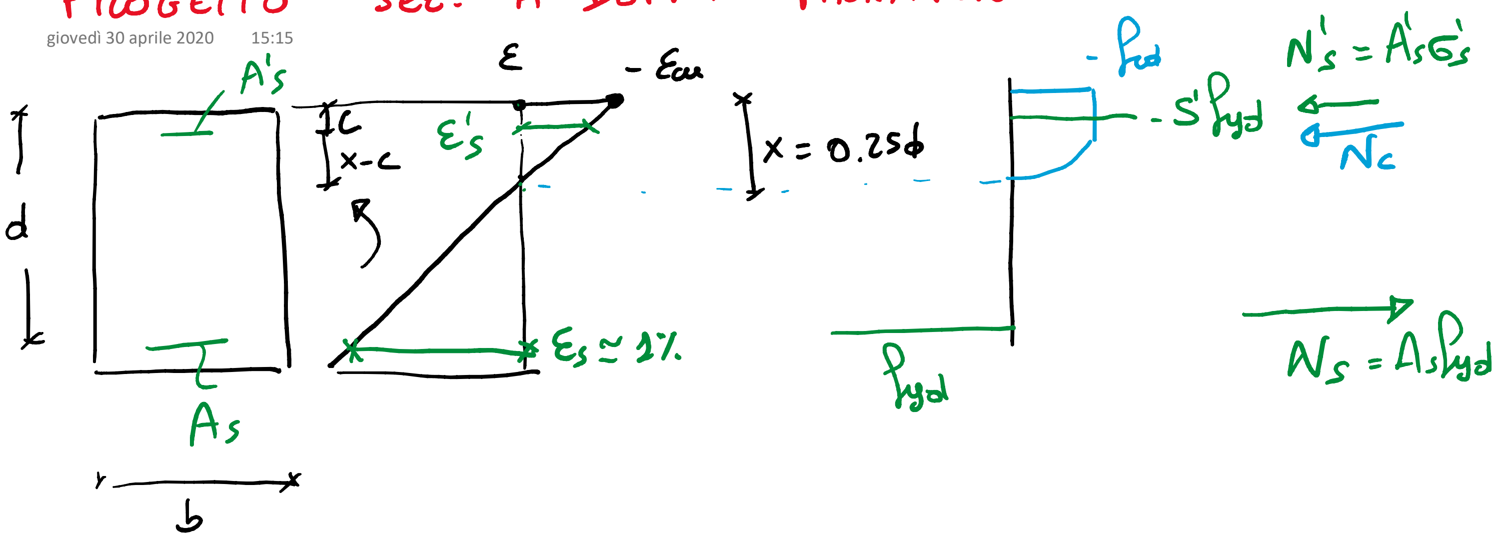
$d = h - c$

$$\rightarrow \quad A_s = \frac{250\ \text{KN}\cancel{\text{m}}}{0{,}9 \times 0{,}65\ \cancel{\text{m}} \times 391{,}3\ \text{N/mm}^2} \times 10$$

$$= 10{,}92\ \text{cm}^2$$

PROGETTO SEZ. A DOPPIA ARMATURA

giovedì 30 aprile 2020 15:15



$$\varepsilon'_s = -\varepsilon_{cu}\frac{(x-c)}{x}$$

$$\sigma'_s = -s' f_{yd} \qquad s' = \frac{-\varepsilon'_s}{\varepsilon_{yd}} = \frac{\varepsilon_{cu}}{\varepsilon_{yd}}\frac{(x-c)}{x} \le 1$$

TRAVI EMERGENTI

ES: 30x60

$x = \xi d$

$c = \gamma \cdot d$

$$\rightarrow s' = \frac{\varepsilon_{cu}}{\varepsilon_{yd}} \cdot \frac{\xi d - c}{\xi d} = \frac{\varepsilon_{cu}}{\varepsilon_{yd}} \frac{\cancel{d}(\xi - \gamma)}{\cancel{d}\,\xi}$$

$$\gamma = c/d = 5/55 = 0{,}091 \Rightarrow s' = \frac{3{,}5}{\cancel{1000}} \cdot \frac{\cancel{1000}}{1{,}96} \cdot \frac{0.25 - 0{,}091}{0{,}25}$$

$$= \cancel{1{,}13} \quad 1$$ SNERVATA

TRAVE A SPESSORE

80x25

c = 4 cm

d = 25 - 4 = 21

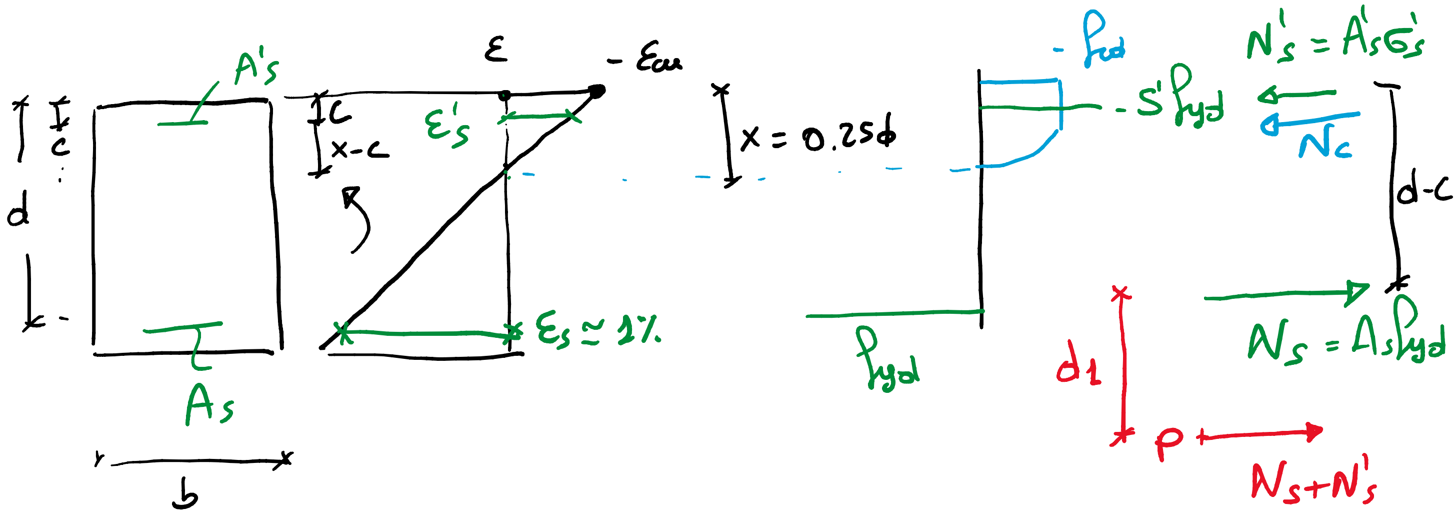
$$\gamma = 4/21 = 0.19 \rightarrow s' = \frac{3{,}5}{1{,}96} \times \frac{0{,}25 - 0.19}{0{,}25} =$$

$$= 0.43 \rightarrow A'_s$$ NON SNERVATA

$$A'_s/A_s = \mu \rightarrow A'_s = \mu A_s \rightarrow N'_s = -\mu A_s \cdot s' f_{yd}$$

$$N_c = -\beta b x f_{cd}$$

$$N_s = A_s f_{yd}$$



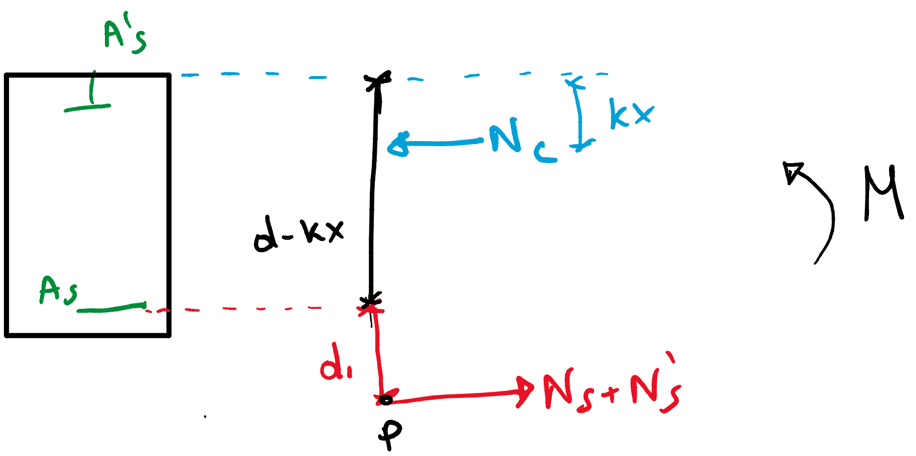
$$N_s + N'_s = A_s f_{yd} - u A_s \cdot s' f_{yd} = A_s f_{yd} (1 - u s')$$

$$N_s d_1 + N'_s \cdot (d_1 + d - c) = 0$$

$$\cancel{A_s f_{yd}}\, d_1 - u \cancel{A_s} \cdot s' \cancel{f_{yd}} (d_1 + d - c) = 0 \quad \Rightarrow d_1$$

$$d_1 - u s' d_1 - u s' (d - c) = 0 \quad \rightarrow$$

$$\boxed{d_1 = \frac{u s' (d-c)}{(1 - u s')} = \frac{u s' (1 - \gamma)}{1 - u s'} d}$$



EQ. ROTAZIONE RISPETTO A P $\Rightarrow$

$$\left.\begin{aligned} M &= -N_c\,(d_1 + d - kx) \\ N_c &= -\beta\, b x f_{cd} \end{aligned}\right\} \rightarrow$$

$$M = \beta\, b \underbrace{x}_{\xi d} f_{cd}\left[\frac{\mu s'(1-\gamma)}{1-\mu s'}\,d + d - k\xi d\right]$$

$$= \beta\, b d^2 \xi f_{cd}\left[1 - k\xi + \frac{\mu s'(1-\gamma)}{1-\mu s'}\right]$$

$$= b d^2\ \underbrace{\underbrace{\beta \xi f_{cd}\,(1-k\xi)}_{\frac{1}{r^2}} \cdot \underbrace{\left[1 + \frac{\mu s'(1-\gamma)}{(1-\mu s')(1-k\xi)}\right]}_{1/k^2}}_{\frac{1}{r'^2}}$$

$$M = \frac{bd^2}{r'^2}$$

FORMULA DI PROGETTO
PER SEZ. RETTANGOLARE A
DOPPIA ARMATURA

$$\frac{1}{k^2} = 1 + \frac{\mu s'\,(\cancel{1-\gamma})}{(1-\mu s')\,(\cancel{1-k\xi})} \simeq \frac{1-\cancel{\mu s'} + \cancel{\mu s'}}{1-\mu s'}$$

TRAVI EMERGENTI

$$1-\gamma = 1 - 0{,}081 \simeq 0.9$$
$$1-k\xi = 1 - 0.416 \times 0.25 \simeq 0.9$$

$$k \simeq \sqrt{1 - \mu s'} < 1$$

$$\tau' = \tau \cdot k < \tau$$

DIPENDE DA : — ρ_{col}

— μ (% ARMATURA COMPRESSA)

— s' (TASSO DI LAVORO A'_s)

TRAVI EMERGENTI

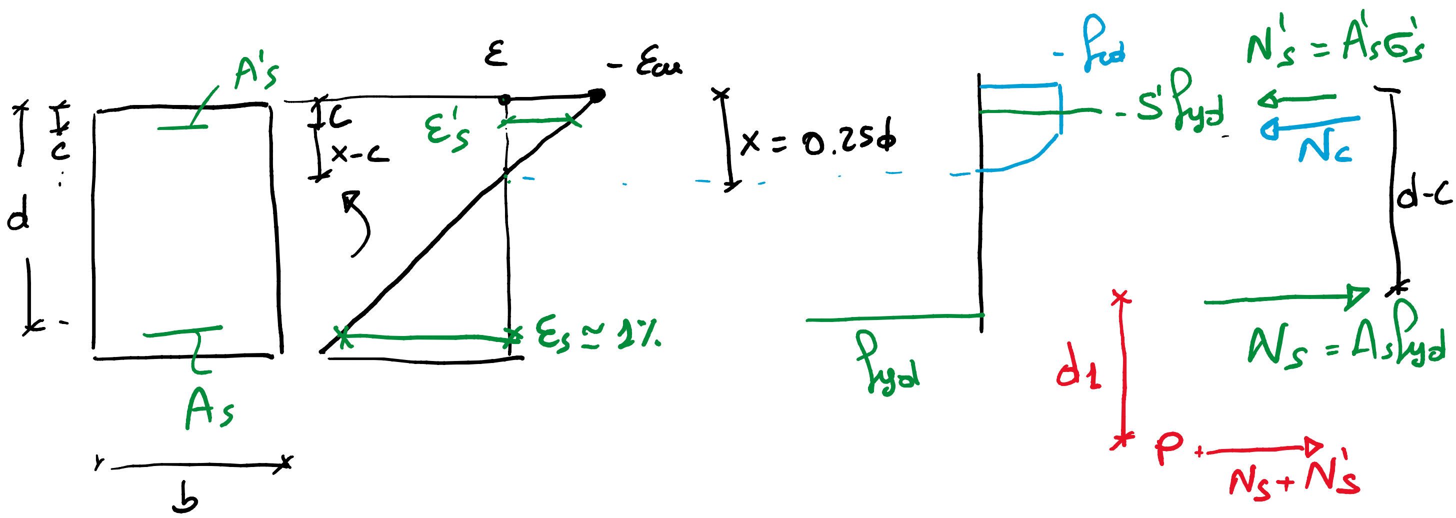
$$M_{Ed} = \frac{bd^2}{\tau'^2} \rightarrow \begin{array}{l} b = 30cm \\ d = \tau' \sqrt{\frac{M}{b}} \end{array}$$

TRAVI A SPESSORE

$$d = h_{solaio} - c \Rightarrow b = \tau'^2 \frac{M}{d^2}$$

PROGETTO ARMATURA TESA

giovedì 30 aprile 2020 15:45



$$\boxed{d_1 = \frac{u s' (d-c)}{(1-us')} = \frac{us'(1-\gamma)}{1-us'}\, d}$$

EQ. ROTAZIONE RISPETTO A N_c ⇒

$$M = (N_s + N'_s)\cdot(d_1 + d - kx)$$

$$= (A_s f_{yd} - u A_s s' f_{yd}) \left[\frac{us'(1-\gamma)}{1-us'} d + d - kx \right]$$

$$= A_s f_{yd} (1-us') \cdot d \left[1 - k\xi + \frac{us'(1-\gamma)}{1-us'} \right]$$

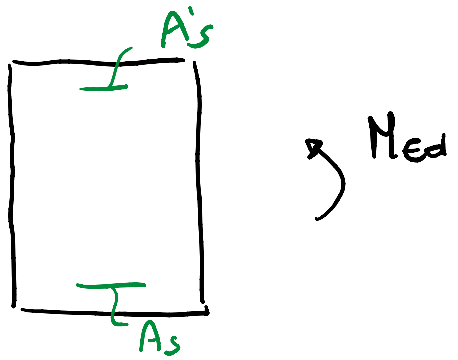
$$= A_s f_{yd} \cdot d\,(1-k\xi) \left[1 - us' + \frac{us'\cancel{(1-\gamma)}\,(\cancel{1-us'})}{\cancel{(1-k\xi)}\,(\cancel{1-us'})} \right]$$

$$= A_s f_{yd}\, d\,(1-k\xi) \left[1 - \cancel{us'} + \cancel{us'} \right]$$

$$M = A_s f_{yd} \cdot d\, 0{,}9 \Rightarrow \boxed{A_s = \frac{M}{0{,}9\, d\, f_{yd}}}$$

PROGETTO ARMATURA COMPRESSA

giovedì 30 aprile 2020 15:53

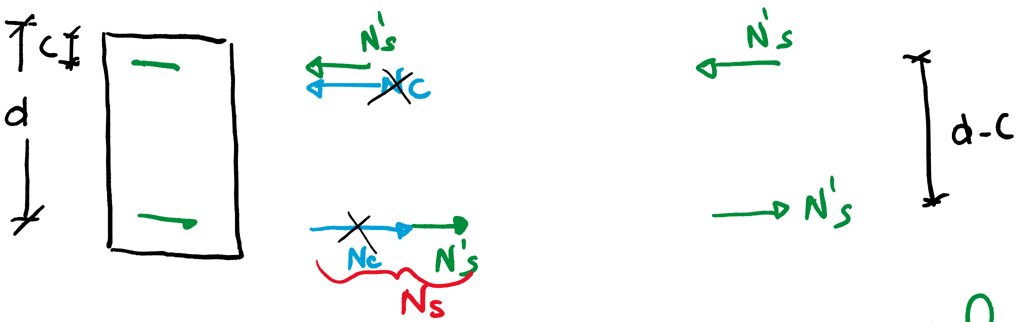


ALTEZZA UTILE DEFINITA DA $M_{Ed} = \frac{bd^2}{r'^2}$

IN ASSENZA DI ARMATURA COMPRESSA ($A'_s = 0$) → $M_{Rd,A'_s=0} = \frac{bd^2}{r^2}$

SE $d \simeq d_{NECESSARIA}$ → $M_{Rd,A'_s=0} < M_{Ed}$ PERCHÉ $r^2 > r'^2$

$$\Delta M = M_{Ed} - M_{Rd,A'_s=0}$$ ⇒ DA AFFIDARE A A'_s



$$N'_s = +\frac{\Delta M}{d-c} \qquad N'_s = A'_s\, s'\, f_{yd} \Rightarrow$$

$$\boxed{A'_s = \frac{\Delta M}{s'\, f_{yd}\,(d-c)}}$$

FORMULA PROGETTO ARMATURA COMPRESSA

DOVE $$s' = \frac{\varepsilon_{cu}}{\varepsilon_{yd}} \frac{(\xi - \gamma)}{\xi} \le 1$$