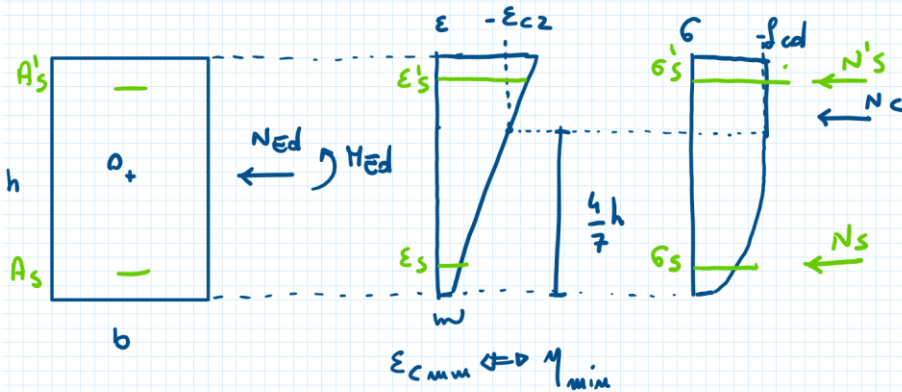


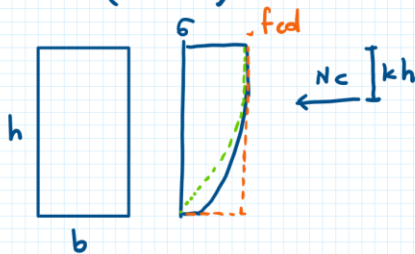
SEZIONE RETTANGOLARE - TUTTA COMPRESSA



1) DETERMINARE $\epsilon_{LIM} \Rightarrow$ DETERMINARE η_{min}

$$N_c(\eta_{min}) + N'_s(\eta_{min}) + N_s(\eta_{min}) = N_{Ed} \Rightarrow \text{RICAVO } \eta_{min} \text{ PER TENTATIVI}$$

• $N_c(\eta_{min})$

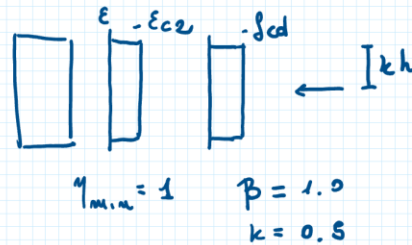
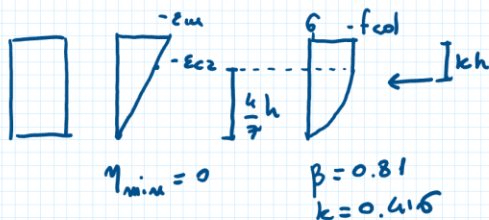


$$N_c = \int \sigma_c dA_c$$

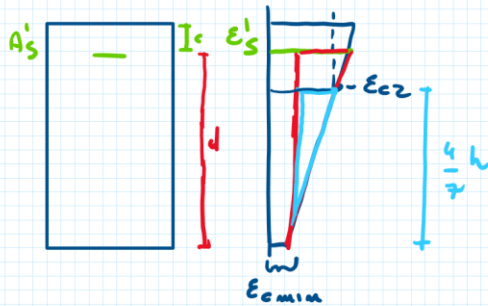
$$N_c = -\beta b h f_{cd}$$

$$\beta = 1 - \frac{4}{21} (1 - \eta_{min})^2 \quad k = \frac{1}{2} \frac{1 - \frac{16}{49} (1 - \eta_{min})^2}{1 - \frac{4}{21} (1 - \eta_{min})^2}$$

PER CAPIRE QUESTE EQUAZIONI, APPLICHIAMOLE IN 2 CASI PARTICOLARI



• $N'_s(\eta_{min})$



$$N'_s = A'_s \sigma'_s$$

$$\downarrow$$

$$\epsilon'_s$$

$$\frac{\epsilon'_s - \epsilon_{cmin}}{d} = \frac{-\epsilon_{c2} - \epsilon_{cmin}}{\frac{4}{7}h}$$

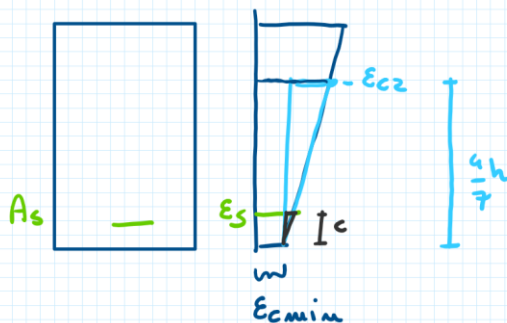
$$\epsilon'_s = \frac{d}{\frac{4}{7}h} (-\epsilon_{c2} - \epsilon_{cmin}) + \epsilon_{cmin}$$

$$\epsilon'_s = -\epsilon_{c2} \left[\frac{d}{\frac{4}{7}h} \left(1 - \frac{\epsilon_{cmin}}{-\epsilon_{c2}} \right) + \frac{\epsilon_{cmin}}{-\epsilon_{c2}} \right]$$

$$\epsilon'_s = -\epsilon_{c2} \left[\frac{d}{\frac{4}{7}h} (1 - \eta_{min}) + \eta_{min} \right]$$

nota $\epsilon'_s \Rightarrow$ se $\epsilon'_s \leq -\epsilon_{yd} \Rightarrow \sigma'_s = -f_{yd}$
 se $-\epsilon_{pl} \leq \epsilon'_s \leq \epsilon_{yd} \Rightarrow \sigma'_s = \frac{\epsilon'_s}{\epsilon_{yd}} f_{yd}$
 se $\epsilon'_s \geq \epsilon_{yd} \Rightarrow \sigma'_s = f_{yd}$

• $N_s(\eta_{min})$



$$N_s = A_s \sigma_s$$

$$\downarrow$$

$$\epsilon_s$$

$$\frac{\epsilon_s - \epsilon_{cmin}}{c} = \frac{-\epsilon_{c2} - \epsilon_{cmin}}{\frac{4}{7}h}$$

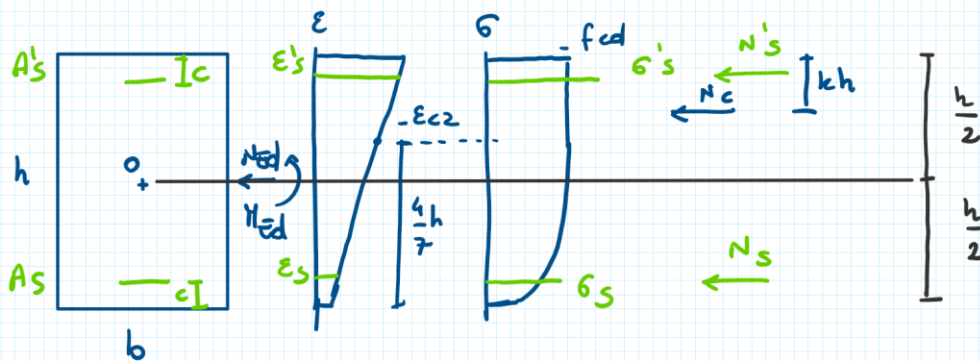
$$\epsilon_s = \frac{c}{\frac{4}{7}h} (-\epsilon_{c2} - \epsilon_{cmin}) + \epsilon_{cmin}$$

$$\epsilon_s = -\epsilon_{c2} \left[\frac{c}{\frac{4}{7}h} \left(1 - \frac{\epsilon_{c\min}}{-\epsilon_{c2}} \right) + \frac{\epsilon_{c\min}}{-\epsilon_{c2}} \right]$$

$$\epsilon_s = -\epsilon_{c2} \left[\frac{c}{\frac{4}{7}h} (1 - \eta_{\min}) + \eta_{\min} \right]$$

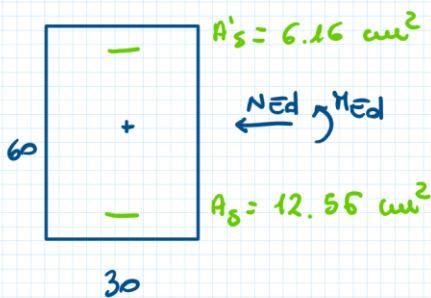
Nota $\epsilon_s \Rightarrow$ Se $\epsilon_s \leq -\epsilon_{yd} \Rightarrow \sigma_s = -f_{yd}$
 Se $-\epsilon_{pl} \leq \epsilon_s \leq \epsilon_{yd} \Rightarrow \sigma_s = \frac{\epsilon_s}{\epsilon_{yd}} f_{yd}$
 Se $\epsilon_s \geq \epsilon_{yd} \Rightarrow \sigma_s = f_{yd}$

2) $M_{Rd}(N_{Ed})$



$$M_{Rd}(N_{Ed}) = -N_c \left(\frac{h}{2} - kh \right) - N'_s \left(\frac{h}{2} - c \right) + N_s \left(\frac{h}{2} - c \right)$$

ESEMPIO



$$N_{Ed} = -2700 \text{ kN}$$

$$M_{Ed} = 200 \text{ kNm}$$

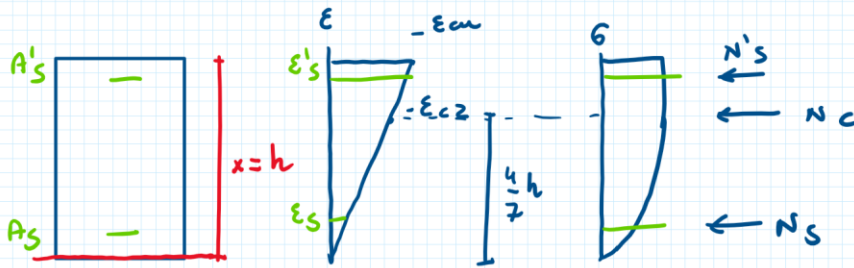
$$c = 5 \text{ cm}$$

VERIFICA SLU

0) SEZ. PARZ. O TUTTA COMPRESSA ?

POICHÉ N_{Ed} È DI COMPRESSIONE, DEVO CAPIRE SE LA SEZ. È PARZIALIZZATA O TUTTA COMPRESSA \Rightarrow IPOTIZZO L'ASSE N SUL BORDO INF. E RICOVO IL RISULTANTE DELLE TENSIONI

$$x = h = 60 \text{ cm} \Rightarrow$$



$$N_c = -\beta b x \int_{cd} = -0.81 \times 30 \times 60 \times \frac{14.17}{10} = -2070.36 \text{ kN}$$

$$N'_s = A'_s \sigma'_s = 6.16 \times \left(\frac{-391.3}{10} \right) = -241.0 \text{ kN}$$

$$\epsilon'_s = -\frac{x-c}{x} \epsilon_{cu} = -\frac{60-5}{60} 0.0035 = -0.00321$$

$$\sigma'_s = -391.3 \text{ MPa}$$

$$N_s = A_s \sigma_s = 12.56 \times \left(\frac{-58.33}{10} \right) = -73.27 \text{ kN}$$

$$\epsilon_s = -\frac{x-d}{x} \epsilon_{cu} = -0.000292$$

$$\sigma_s = \frac{\epsilon_s}{\epsilon_{yd}} \sigma_{yd} = -\frac{0.000292}{0.00197} \times 391.3 = -58.33 \text{ MPa}$$

$$\overset{N_c}{=} -2070.36 - \overset{N'_s}{=} 241.0 - \overset{N_s}{=} 73.27 = -2384.67 \text{ kN}$$

DEVO CONFRONTARE -2384.67 CON $N_{Ed} = -2700 \text{ kN}$

POICHÉ $|2384.67| < |2700| \Rightarrow$ SEZ. TUTTA COMPRESSA

1) DETERMINARE $\epsilon_{LH} \Rightarrow \eta_{min}$

$$N_c(\eta_{min}) + N'_s(\eta_{min}) + N_s(\eta_{min}) = N_{Ed}$$

$$\text{DA EXCEL} \Rightarrow \eta_{min} = 0.247$$

H	I	J	K	L	M	N	O	P	Q	R	S	T
14.2			h	60	cm	Ned	-2700	kN	fcd	14.2	MPa	
0.00196			c	5	cm				epsyd	0.00196		
0.0035			A's	6.16	cm2				eps cu	0.0035		
0.002			As	12.56	cm3				eps c2	0.002		
			d	55	cm							

SEZ. TUTTA COMPRESSA

$$\epsilon'_s = -\epsilon_{cz} \left[\frac{d}{\frac{4}{3}h} (1 - \eta_{min}) + \eta_{min} \right]$$

$$\epsilon_s = -\epsilon_{cz} \left[\frac{c}{\frac{4}{3}h} (1 - \eta_{min}) + \eta_{min} \right]$$

$$N_c = -\beta b h f_d$$

ηmin	0.247				
eps's	-0.0029101	sigma's	-391.3	MPa	β
eps s	-0.000713	sigma s	-142.651	MPa	k
Nc	-2279.79	bc	-2.60	cm	
N's	-241.04	b's	-25.00	cm	
Ns	-179.17	bs	25.00	cm	
Somma N	-2700.00	kN			
Mrd	74.66	kNm			

$$\beta = 1 - \frac{4}{21} (1 - \eta_{min})^2$$

$$k = \frac{1}{2} \frac{1 - \frac{16}{49} (1 - \eta_{min})^2}{1 - \frac{4}{21} (1 - \eta_{min})^2}$$

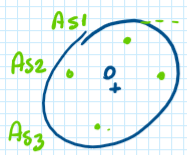
Ricerca obiettivo ?

Imposta la cella:

Al valore:

Cambiando la cella:

SEZ. NON RETTANGOLARE

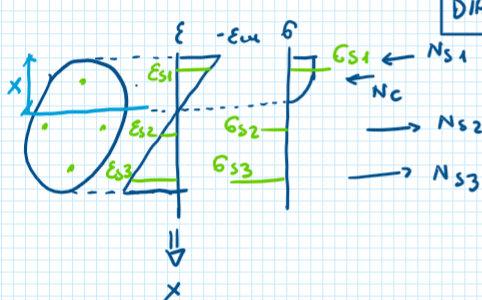


0) SEZ. PARZ. O TUTTA COMPRESSA

1) DIAGR. ϵ_{LIN}

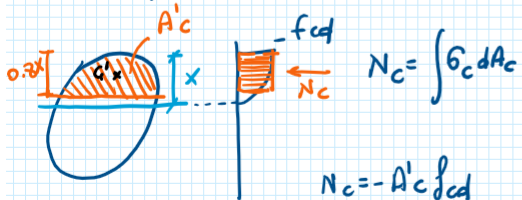
2) $M_{Rd}(N_{Ed})$ RISPETTO "O"

SEZIONE PARZIALIZZATA



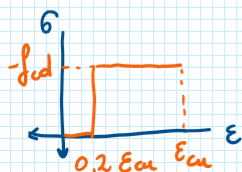
$$N_c(x) + N_{s1}(x) + N_s(x) + N_{s3}(x) = N_{Ed}$$

• $N_c(x)$



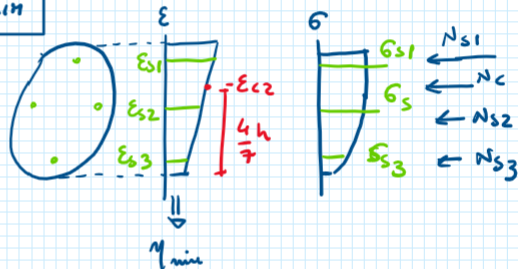
$$N_c = -A'_c f_{cd}$$

$$A'_c = f(0.3x)$$



SEZIONE TUTTA COMPRESSA

DIAGR. ϵ_{LIN}



$$N_c(\eta_{min}) + N_{s1}(\eta_{min}) + N_{s2}(\eta_{min}) + N_{s3}(\eta_{min}) = N_{Ed}$$

