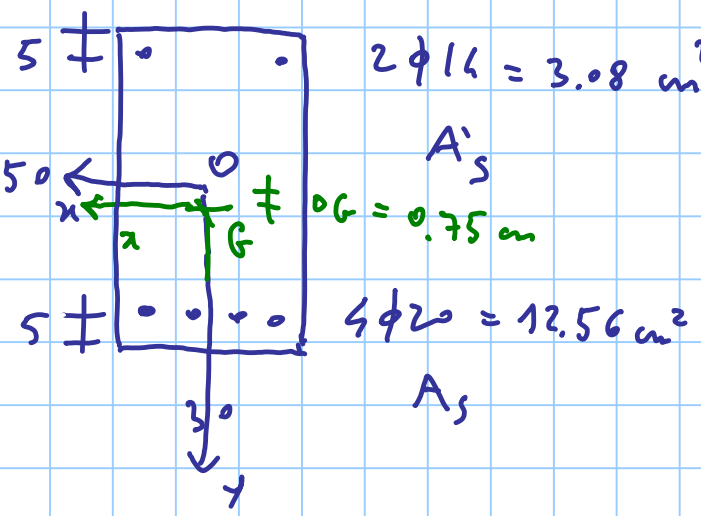
FLESSIONE COMPOSTA - I n.d. comp

Titolo nota 22/11/2016

C 25/30



O = baricentro della sezione di calcestruzzo

N = 200 kN (trazione) applicata in O

M_x = 80 kNm

n = 6.35 all'applicazione del carico

n = 15 a tempo infinito

con $n = 6.35$

$$A_{ci} = A_c + n A_{s,tot} = 30 \times 50 + (12.56 + 3.08) \times 6.35 = 1599 \text{ cm}^2$$

momento ad asse x pari a

$$S = n(A_s - A'_s)\left(\frac{h}{2} - c\right) = (12.56 - 3.08) \times 20 \times 6.35 = 1204 \text{ cm}^3$$

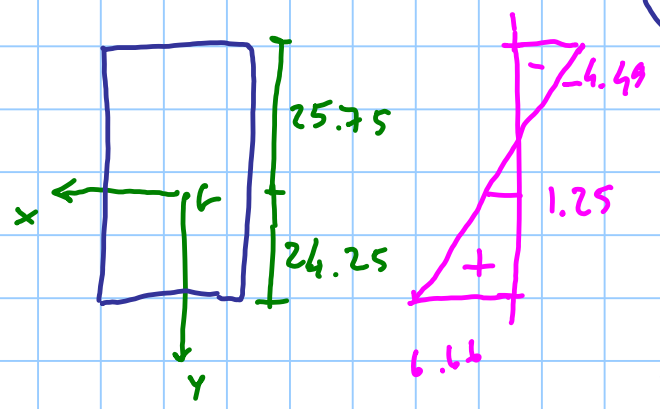
$$d_{oc} = \frac{S}{A_{ci}} = \frac{189.6}{1599} = 0.75 \text{ cm}$$

$$I_x = \frac{bh^3}{12} + bh\, d_{oc}^2 + n A_s \left(\frac{h}{2} - c - d_{oc}\right)^2 + n A'_s \left(\frac{h}{2} - c + d_{oc}\right)^2 =$$

$$312500 + 844 + 29555 + 8421 = 351320 \text{ cm}^3$$

$$\sigma = \frac{N}{A} + \frac{M_{x,G}}{I_x}\, y$$

$$M_{x,G} = M_x - N\, d_{oG} = 78.5\ kN_m$$



$$\sigma_{c,inf} = \underbrace{\frac{200 \times 10^3}{1599 \times 10^2}}_{1.25} + \underbrace{\frac{78.5 \times 10^6}{351320 \times 10^4}}_{0.0223} (24.25 \times 10) = 6.66\ MP_a$$

$$\sigma_{c,sup} = 1.25 + 0.0223\,(-25.75 \times 10) = -4.49\ MP_a$$

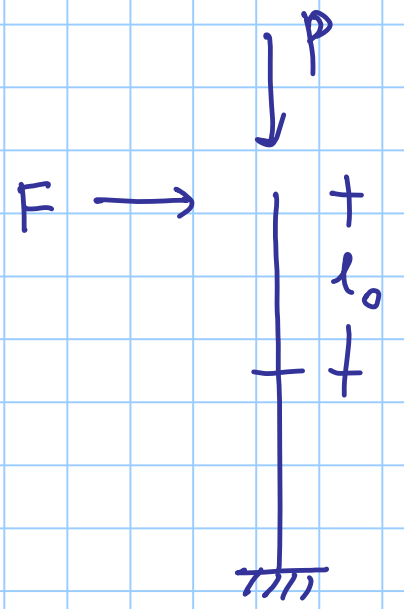
$$\sigma_{s,inf} = n\left[1.25 + 0.0223\,(19.25 \times 10)\right] = 35.2\ MP_a$$

FESSURAZIONE

$$\sigma = \frac{N}{A} + \frac{M_x - N d_{oc}}{I_x} y$$

$\sigma \rightarrow f_{cfk}$

$y \rightarrow y_{c,inf}$



$N = -P$

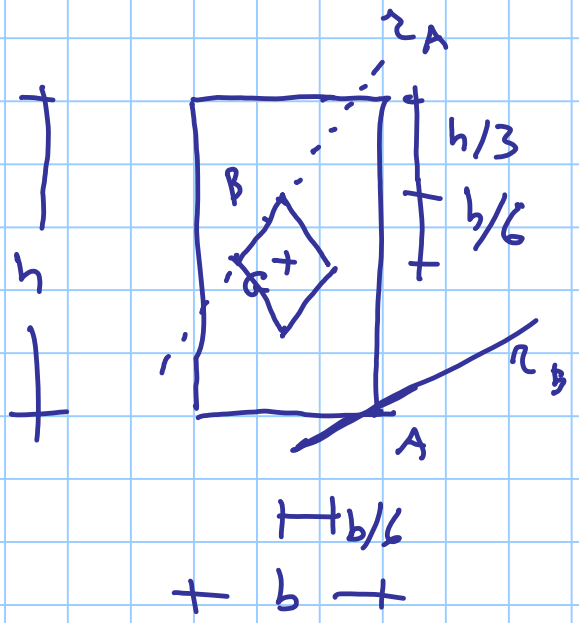
$M(l_0) = F l_0$

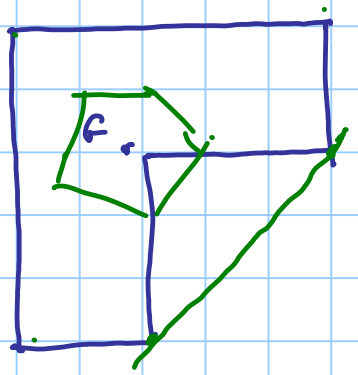
$$f_{cfk} = \frac{-P}{A} + \frac{F l_0 + P d_{oc}}{I_x} y_{c,inf}$$

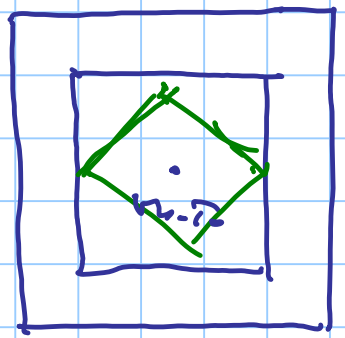
posso calcolare il valore di l_0 di inizio della fessurazione

II modelli di comportamento

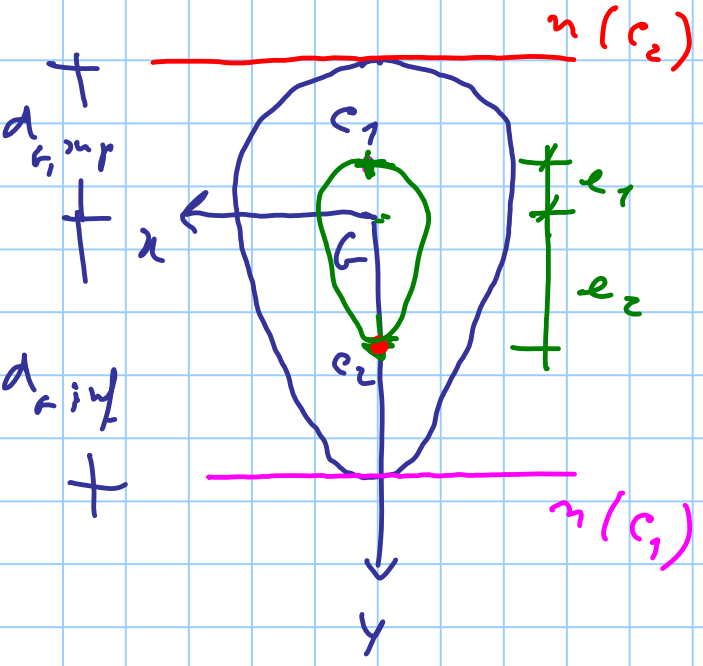
nocciolo d'inerzia (SLE)







FLESSIONE COMPOSTA RETTA



base nocciolo e_1 e_2

punto $C \in$ asse y

N applicata in C_1 > 0

$M = -N e_1$

$$\sigma = \frac{N}{A} + \frac{M}{I_x} y$$

$\sigma \downarrow 0$ $\quad y \downarrow d_{a,inf}$

$$\frac{N}{A} + \frac{-N e_1}{I_x} d_{a,inf} = 0$$

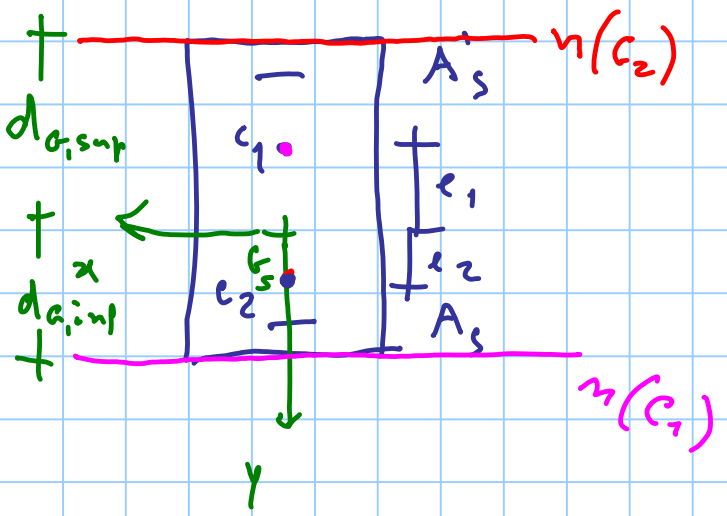
$$e_1 = \frac{I_x}{A\, d_{a,inf}} \qquad e_2 = \frac{I_x}{A\, d_{a,sup}}$$

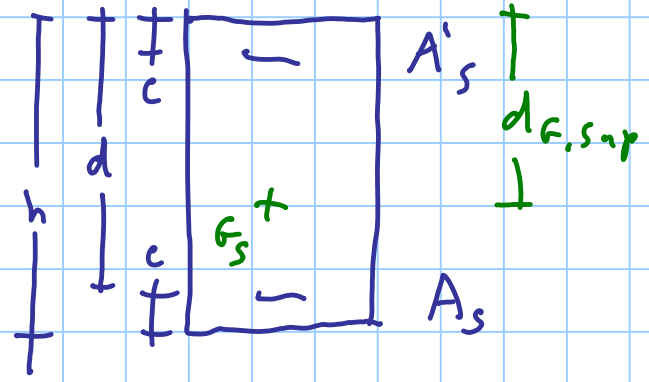
$N > 0$ TRAZIONE

sezione tutta tesa

sola armatura

G_s baricentro armatura





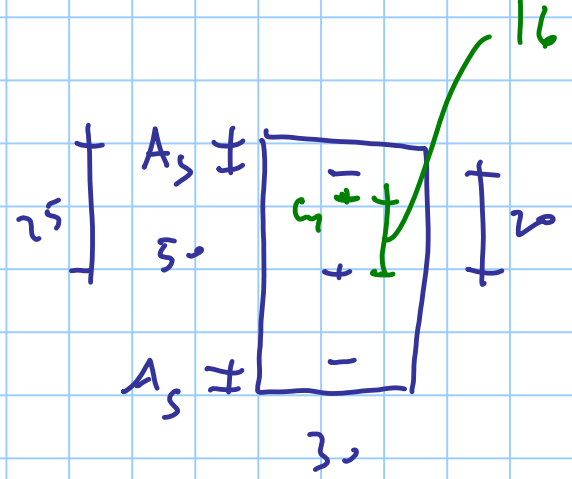
$$d_{G,sup} = \frac{A_s\, d + A'_s\, c}{A_s + A'_s}$$

$$e_1 = \frac{I_x}{A\, d_{G,inf}} \qquad e_2 = \frac{I_x}{A\, d_{G,sup}}$$

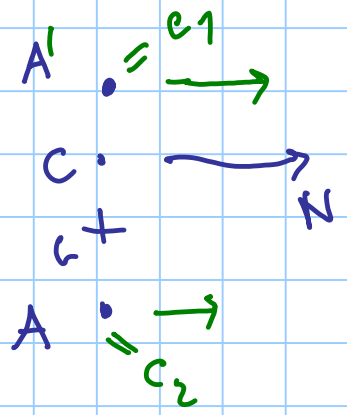
$$I_x = A_s \left(d - d_{G,sup}\right)^2 + A'_s \left(d_{G,sup} - c\right)^2$$

$$e_1 = \frac{A_s\, A'_s}{A_s + A'_s} \cdot \frac{(d-c)^2}{A_s c + A'_s d}$$

$\approx$ $A_s = A'_s$ $\qquad e_1 = e_2 = \dfrac{(d-c)^2}{2h}$



SAC



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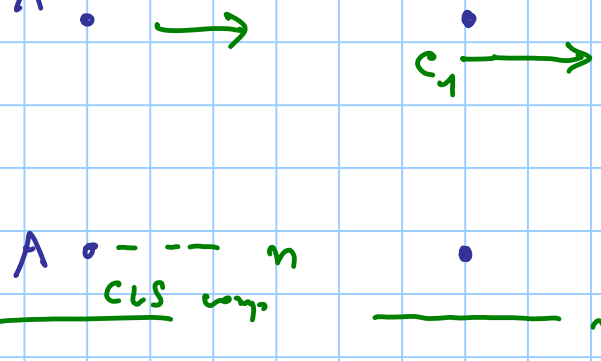
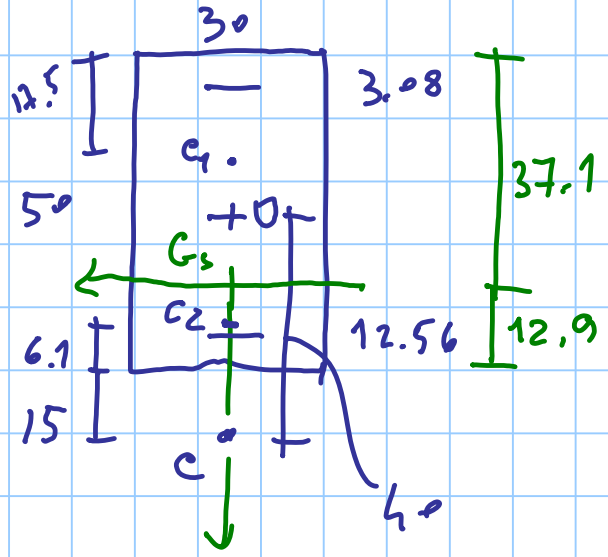




$$d_{G,sup} = \frac{12.56 \times 45 + 3.08 \times 5}{12.56 + 3.08} = 37.1 \text{ cm}$$

$$e_1 \simeq \underbrace{\frac{12.56 \times 3.08}{12.56 + 3.08}}_{2.473} \underbrace{\frac{40^2}{12.56 \times 5 + 3.08 \times 45}}_{201.4} = 19.6 \text{ cm}$$

$$e_2 = 6.8 \text{ cm}$$

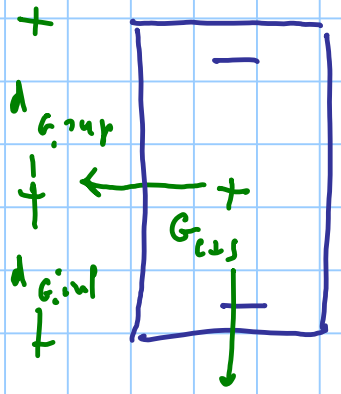
$N = 200$ kN >0 traction appl. in O

$M = 80$ kN m

$$e_{+,O} = \frac{M}{N} = \frac{80}{200} = 0.4 \text{ m}$$

$$= 40 \text{ cm}$$

$N < 0$ compression



par l'exemple 30×50 4 ϕ 20 + 2 ϕ 14 $n = 6.35$

$I_x = 351320 \text{ cm}^4$

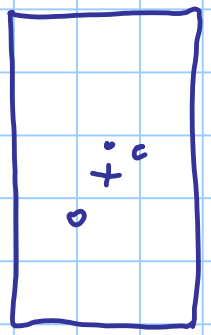
$A = 1599 \text{ cm}^2$

$d_{G,inf} = 24.25 \text{ cm}$

$$e_1 = \frac{351320}{1599 \times 24.25} = 9.1 \text{ cm}$$

$e_2 = 9.6 \text{ cm}$

C.



$N = -200\ kN$

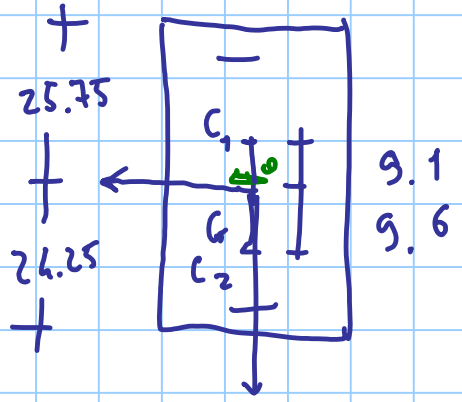
$M = 80\ kN_m$

$e = -0.40\ m = 40\ cm$

$N = -2000\ kN$

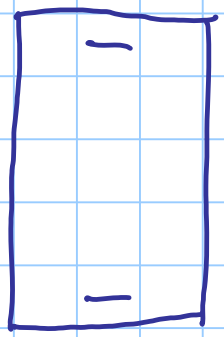
$M = 80\ kN_m$

$e = -0.04\ m = 4\ cm$



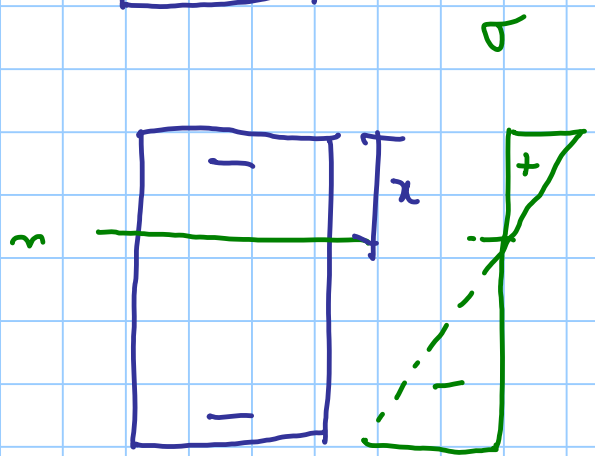
SEZIONE PARZIALIZZATA

$$e_n = \frac{I_n}{S_n}$$



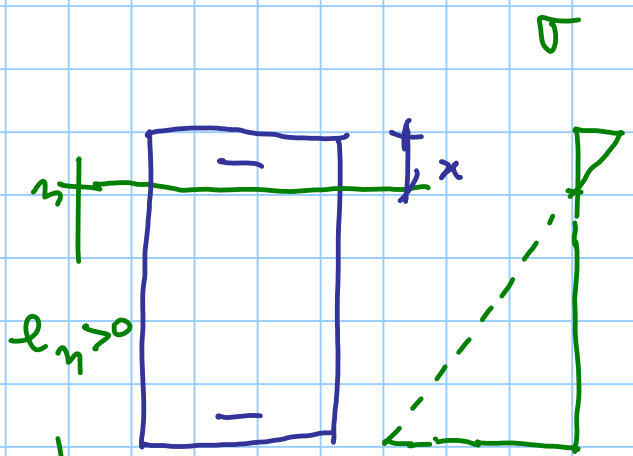
$M > 0$

flessione $e_n = \infty \Rightarrow S_n = 0$



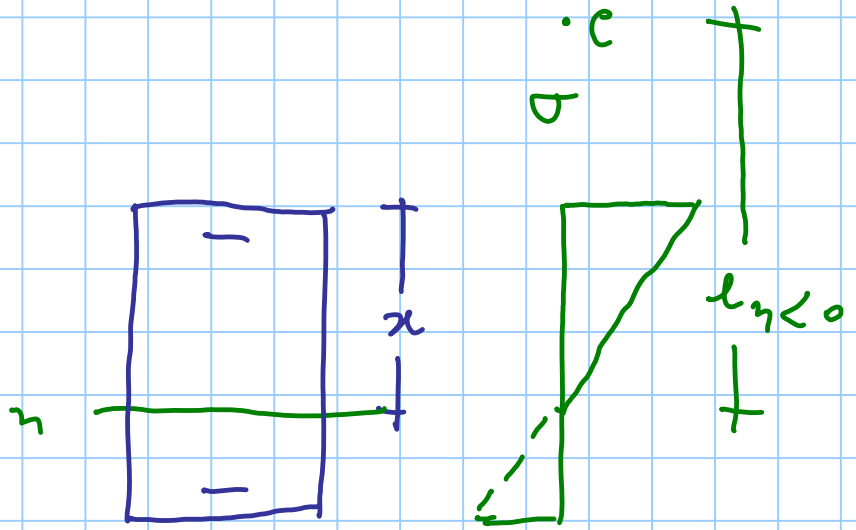
$N = 0$ C all'∞

flessione



$N > 0$

tens.-flessione

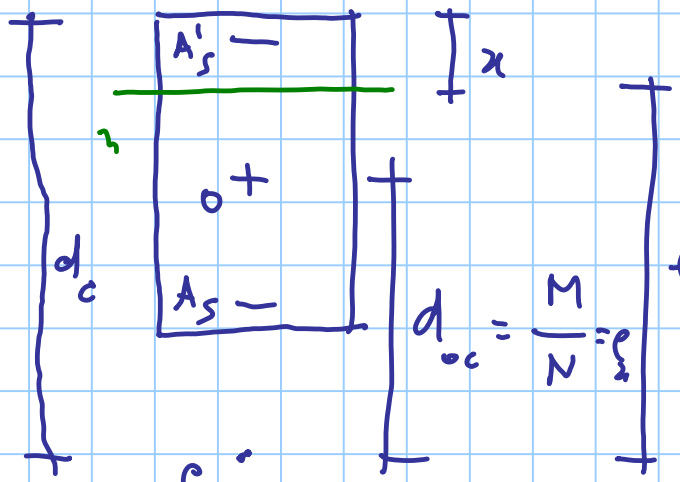


$N < 0$

pres.-flessione

$$e_n \, S_n - I_n = 0$$

equazione di Tutto grado



$$e_n = \underbrace{e_x + \frac{h}{2}}_{d_c} - x$$

$$d_c = e_x + \frac{h}{2}$$

$$S_n = -\frac{b x^2}{2} + nA_s(d-x) - nA'_x(x-c)$$

$$I_n = \frac{b x^3}{3} + n A_s (d-x)^2 + n A'_s (x-c)^2$$

$$x^3 - 3 d_c x^2 + \frac{6n}{b}\left[A_s (d - d_c) + A'_s (c - d_c)\right] x +$$

$$- \frac{6n}{b}\left[A_s d (d - c) + A'_s c (c - d_c)\right] = 0$$

$$\sigma_c = \frac{M_n}{I_n} s \qquad \sigma_c = \frac{N}{S_n} s$$