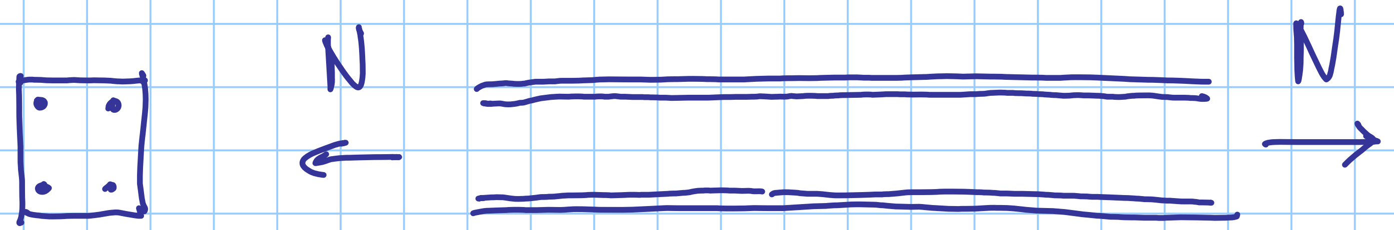
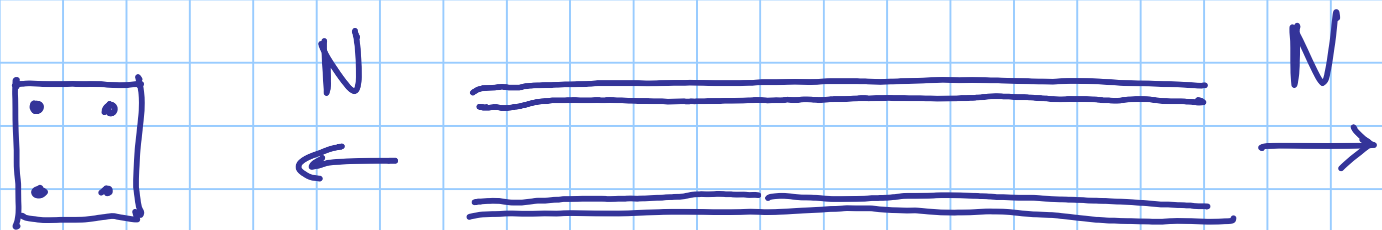


Hp. 1) mantenimento sezione piana — diagr. ε lineare

2) perfetta aderenza — $\varepsilon_c = \varepsilon_s$

modello di comport. 1) cls lineare, resistente a trazione omogeneizzazione $\qquad \varepsilon_s = \varepsilon_c$

coeff. di omogeneizzazione $\qquad \sigma_s = n\,\sigma_c \qquad n = \dfrac{E_s}{E_c}$

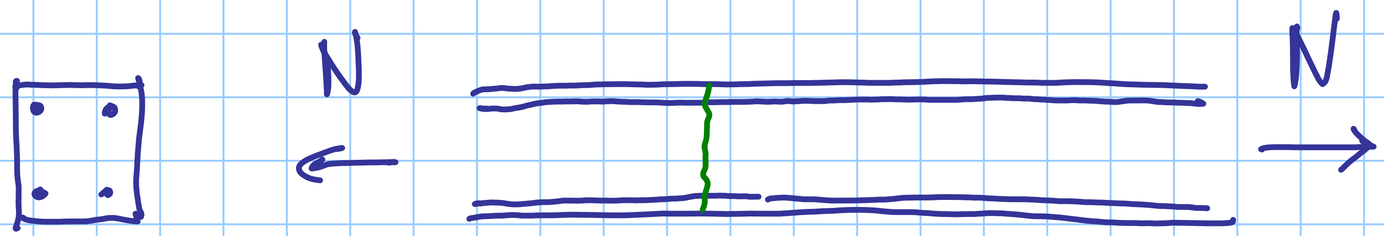


(1° stadio)

$$\sigma_c = \frac{N}{A} = \frac{N}{A_c + n A_s} \qquad \varepsilon_c = \frac{\sigma_c}{E_c} = \frac{N}{E_c A_c + E_s A_s}$$

$$\sigma_s = n\,\sigma_c$$

resistenza a trazione del cls f_{ct}



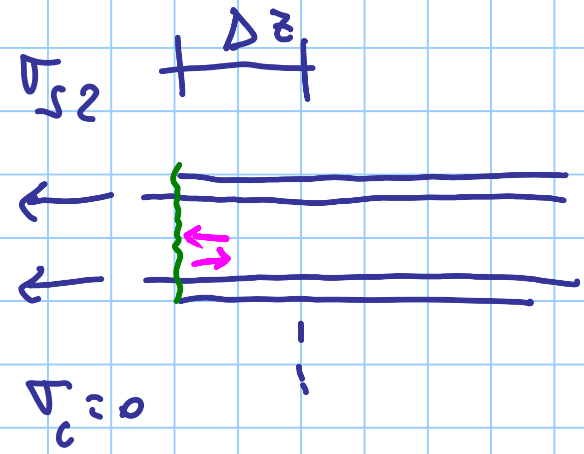
ε_c f_{ct} $N_r = (A_c + n A_s) f_{ct}$

in corrisp. della fessura

2° stadio $\sigma_s = \dfrac{N}{A_s}$ $\varepsilon_s = \dfrac{N}{E_s A_s}$

σ_{s2} ↑ 2° md.

$N = N_2$



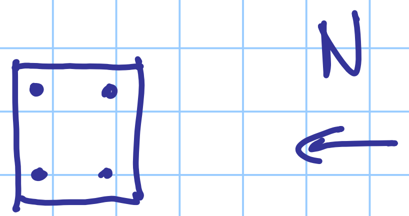
f_b Tensioni di aderenza

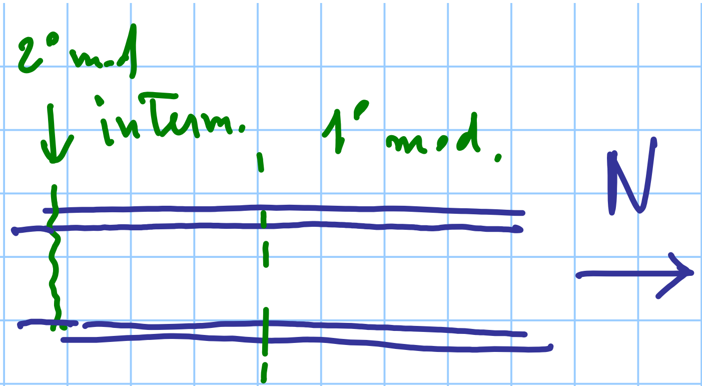
a distanza Δz

$f_b \, n \, \pi \phi \, \Delta z$ forza risultante delle tensioni di aderenza

per cls

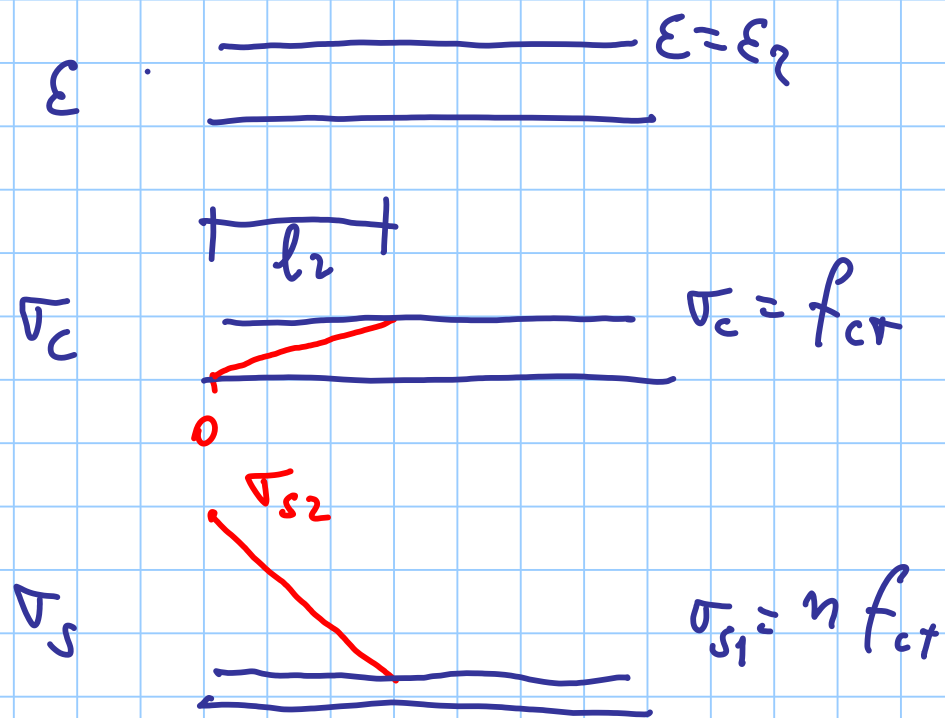
$$\sigma_c = \frac{f_b \, n \, \pi \phi \, \Delta z}{A_{c,eff}}$$





$$N \leq N_2 \quad (N = N_2)$$

$$\varepsilon_2 = \frac{f_{cT}}{E_c}$$



$$N \geq N_2 \quad (N = N_2)$$

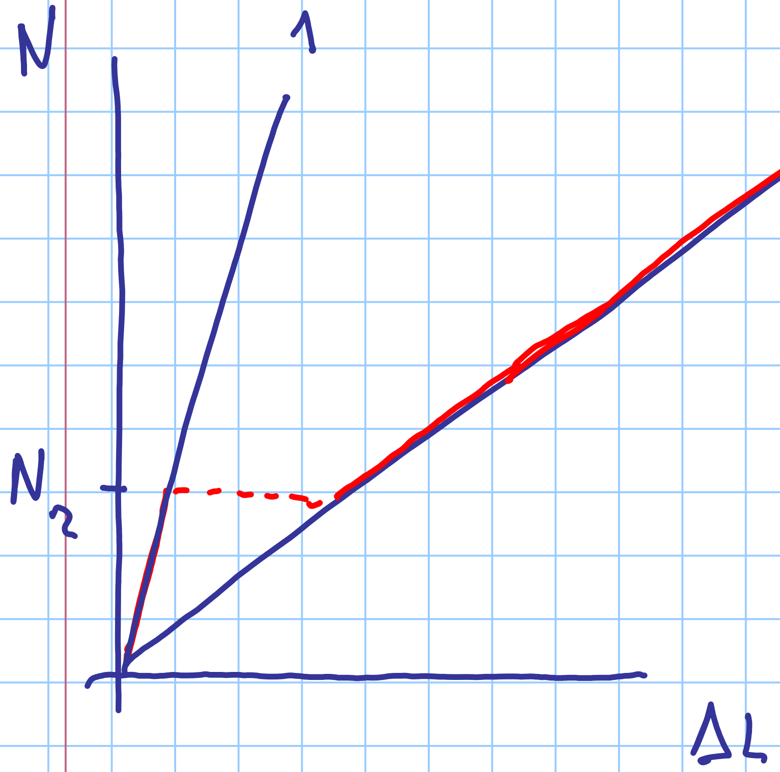
SCALA DIVERSA

$$\sigma_c = \frac{f_b \, n \pi \phi \, \Delta z}{A_{c,eff}} \quad \Rightarrow \quad \sigma_c = f_{ct}$$

$$l_2 = \frac{f_{ct} \quad A_{c,eff}}{f_b \quad n \pi \phi} \cdot \frac{n \pi \phi^2 / 4}{A_s}$$

$$A_s = n \frac{\pi \phi^2}{4} \qquad\qquad l_2 = \frac{1}{4} \frac{f_{ct}}{f_b} \frac{\phi}{\rho_{eff}}$$

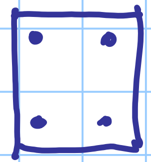
$$\frac{A_s}{A_{c,eff}} = \rho_{eff}$$

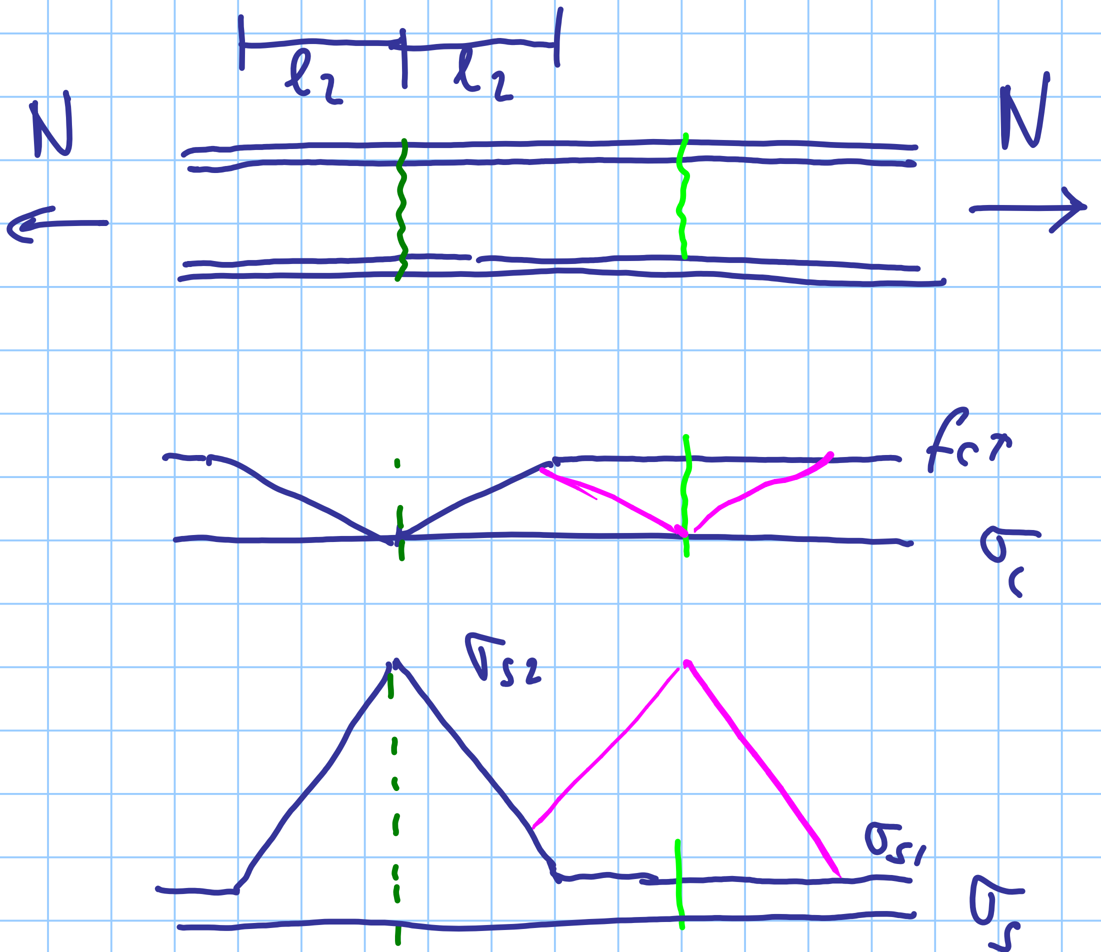


$$\Delta L_1 = \frac{N L}{E_c A_c + E_s A_s}$$

$$\Delta L_2 = \frac{N L}{E_s A_s}$$

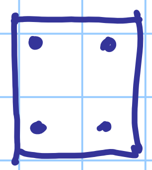
$$\Delta L = \int \varepsilon \, dl = \varepsilon L$$





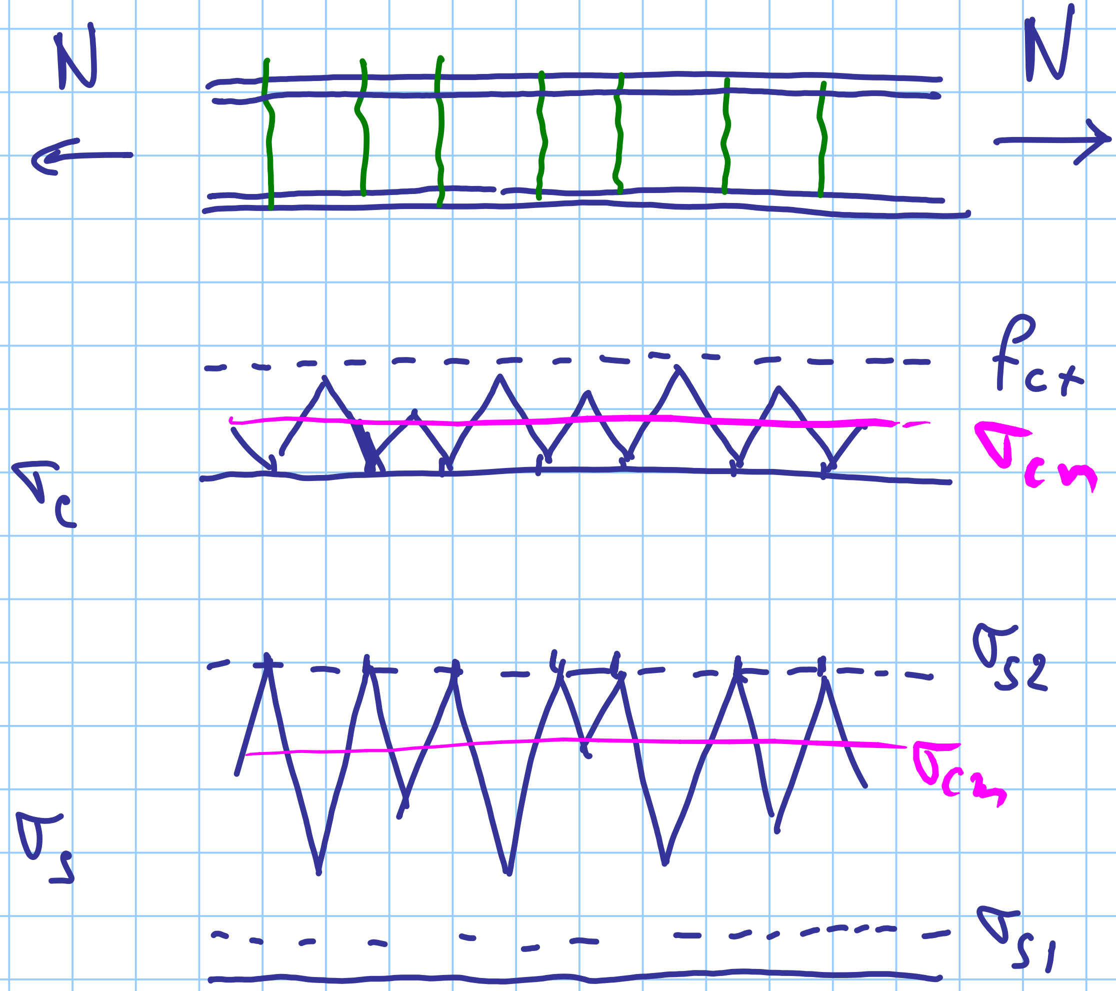
2ª lesione
a distanza
$\geq l_2$

Quando tutte le lesioni si sono formate
le distanze s_r è $\quad l_2 \leq s_r \leq 2\,l_2$



$$\sigma_{cm} = k_t \, f_{ct}$$

$$\varepsilon_{cm} = k_t \, \varepsilon_r$$



$$\varepsilon_{cm} = \frac{\sigma_{cm}}{E_c}$$

$$\varepsilon_{sm} = \frac{\sigma_{sm}}{E_s}$$

$$N_s = N - \sigma_{cm} A_{c,eff} = N - k_t f_{ct} A_{c,eff}$$

$$\sigma_{sm} = \underbrace{\frac{N}{A_s}}_{\sigma_{s2}} - k_t \frac{f_{ct} A_{c,eff}}{A_s}$$

$$\varepsilon_{sm} = \varepsilon_{s2} - k_t \frac{f_{ct} A_{c,eff}}{E_s A_s}$$

Ampiezza fessura: $w = s_r \left(\varepsilon_{sm} - \varepsilon_{cm} \right)$

TENSION STIFFENING

↓ ↓

TRAZIONE IRRIGIDIMENTO

CONTRIBUTO ALLA RIGIDEZZA
DATO DAL CALCESTRUZZO TESO

$$w_k = s_{r,max} \left(\varepsilon_{sm} - \varepsilon_{cm} \right)$$

$$s_{r,max} = K_3 c + K_1 K_2 K_4 \frac{\phi}{\rho_{eff}}$$

ricoprimento

$K_3 = 3,4$ $\qquad$ $K_1 = 0,8$ dipende da f_{ot}/f_b

$K_1 = 1.6$ per barre lisce

$K_2 = 1.0$ per trazione

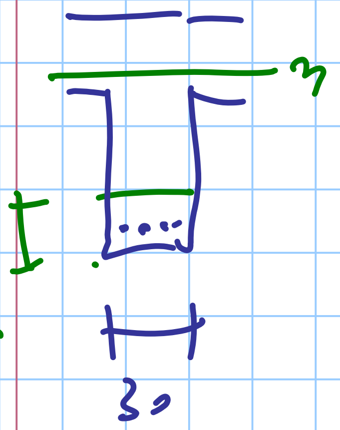
$K_2 = 0.5$ per flessione

$K_h = 0.425$ (1.7×0.25)

$S_{2\,max}/S_{2m}$ $1/4$

Esempio

Trave 30x60 $4\phi 14$ $c = 3$ copr. calc $c = 4$ cm



2.5 c

copriferro di calcolo

$$S_{r,max} = \overset{3.4}{k_3}\,\overset{3}{c} + \overset{0.8}{k_1}\,\overset{0.5}{k_2}\,\overset{0.425}{k_4}\,\frac{\overset{14}{\phi}}{\rho_{eff}}$$

$$\rho_{eff} = \frac{4 \times 1.54}{300}$$

$$A_{eff} = 2.5 \times 4 \times 30 = 300 \text{ cm}^2$$