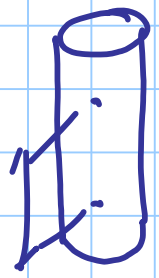
CALCESTRUZZO

Titolo nota 12/03/2015

modulo elastico

$$E = \frac{\Delta\sigma}{\Delta\varepsilon}$$



prove cicliche di carico e scarico

$\frac{1}{3}$ $\frac{2}{3}$ $\frac{3}{3}$

modul elastic - formula di normativa

$$E_c = 22000 \left(\frac{f_{cm}}{10}\right)^{0.3}$$

$$f_{cm} = f_{ck} + 8\ MPa$$

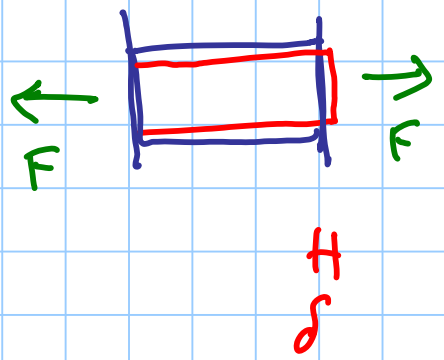
C 25/30 $\quad f_{ck} = 25\ MPa \quad R_{ck} = 30\ MPa$

$$f_{cm} = 33\ MPa$$

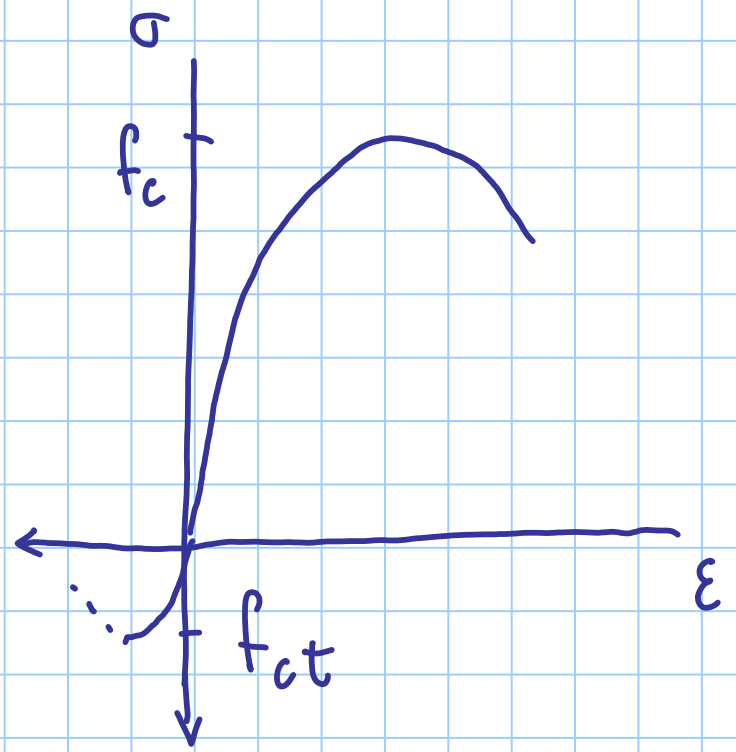
$$E_c = 22000 \left(\frac{33}{10}\right)^{0.3} = 31476 \simeq 31500\ MPa$$

RESISTENZA A TRAZIONE

prova a trazione diretta



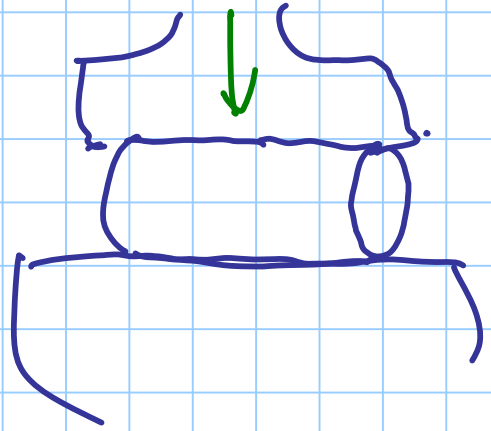
$$\sigma = \frac{F}{A} \qquad \varepsilon = \frac{\delta}{L}$$

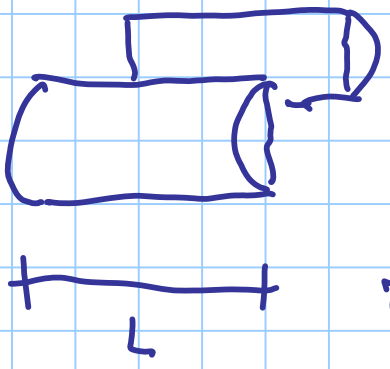


$$f_{ct} << f_c$$

prova a trazione indiretta

(prova brasiliana oppure SPLITTING TEST)

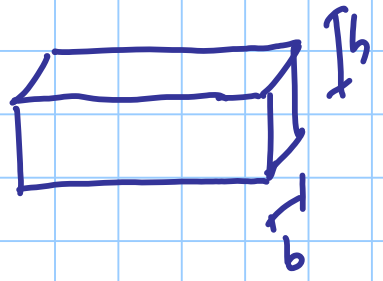




$$\sigma_{spl} = \frac{F}{\pi z L}$$

$$f_{ct} = 0.9\ \sigma_{spl}$$

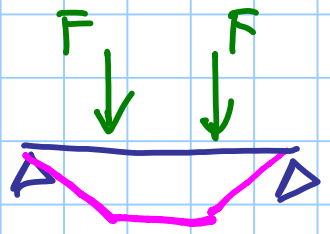
prova a flessione



$$\sigma_{max} = \frac{M}{W} = \frac{6M}{bh^2} = \sigma_{fl}$$

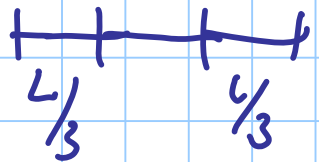
$$W = \frac{bh^2}{6}$$

$$f_{ct} = 0.5\ \sigma_{fl}$$



M

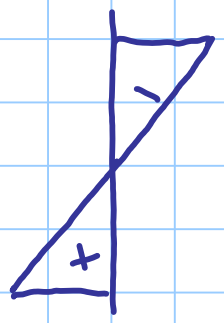
$$M_{...} = \frac{FL}{3}$$



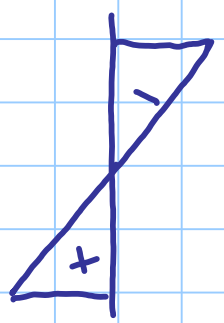
$$\sigma = E\,\varepsilon$$

$$\int \sigma\, dA = \int \sigma\, b\, dy =$$

$$= b \int \sigma\, dy \quad x\ b = cost$$

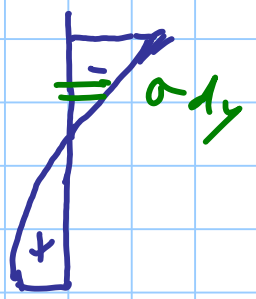


→ σ_{teor}



No

σ



d_y neutro

resistenza a trazione – formule di normative

$$f_{ctm} = 0.30 \sqrt[3]{f_{ck}^2}$$

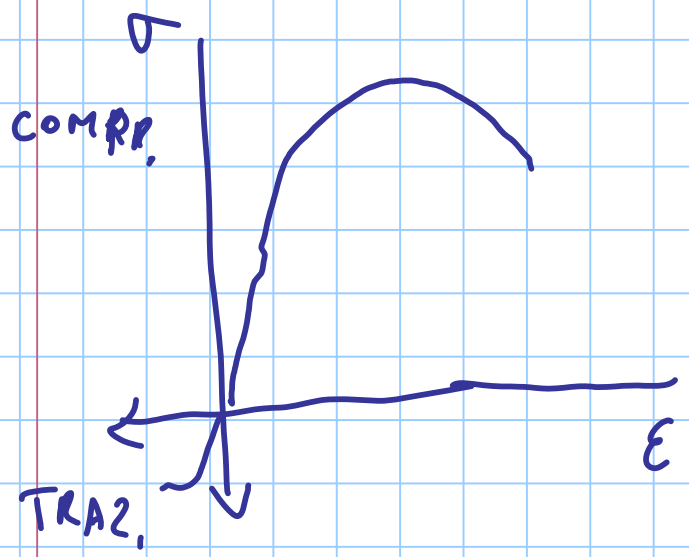
$$f_{ctk} = 0.7 \; f_{ctm} \quad \text{f.f.t. 5\%}$$

$$1.3 \; f_{ctm} \quad \text{f.f.t. 95\%}$$

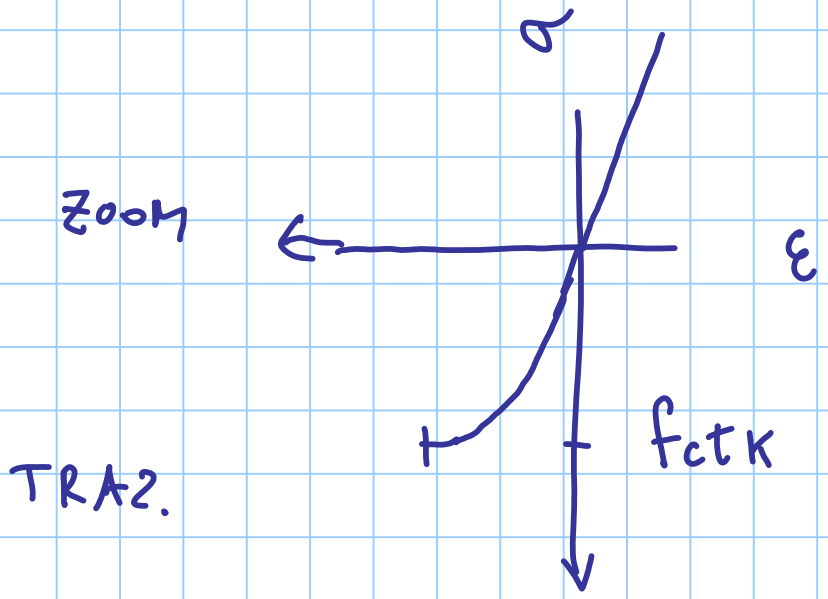
C 25/30

$$f_{ctm} = 0.30 \sqrt[3]{25^2} = 2.56 \text{ MPa}$$

$$f_{ctk} = 0.7 \times 2.56 = 1.80 \text{ MPa}$$

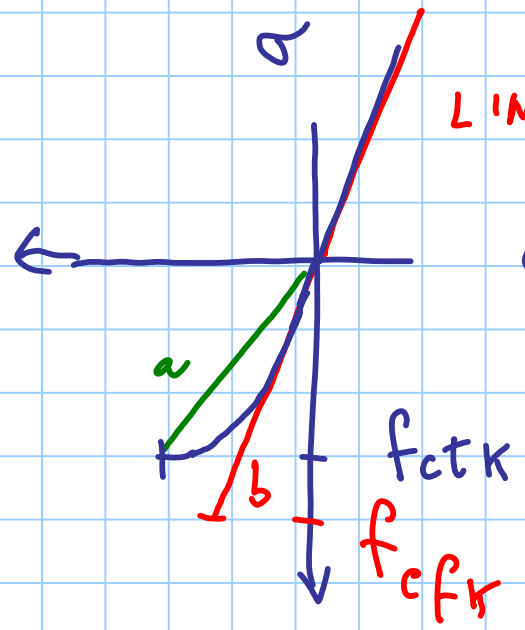


come modellare il CLS a compressione ?



come modellare il CLS a Trazione ?

1) deformazioni molto piccole



LINEARE — compressione

trazione

(a) lineare con pendenza minore

$E_{ct} < E_c$ nel passato

(b) lineare con stessa pendenza

con resistenza fittiziamente

maggiore

$f_{cfk} = 1.2\, f_{ctk}$

MODELLO ELASTICO LINEARE traz/comp

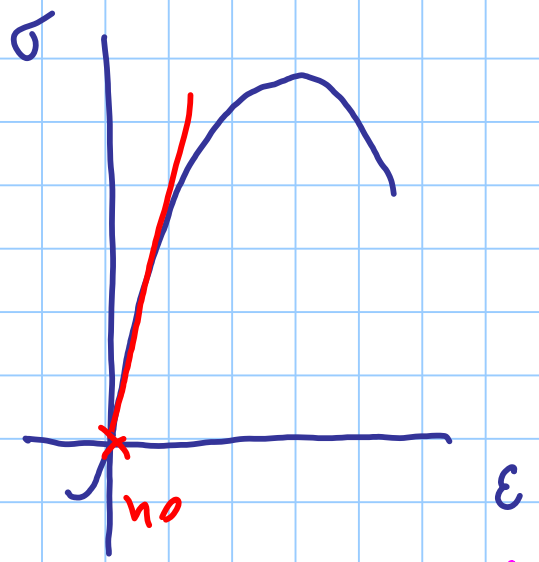
TEORIA ELAST. LINEARE

2) deformazioni medie

(tali che il CLS si è fessurato)

si assume che il CLS non resiste più a trazione

CLS compresso con comportamento elastico lineare



modello elastico lineare a compressione

nessuna resistenza a trazione

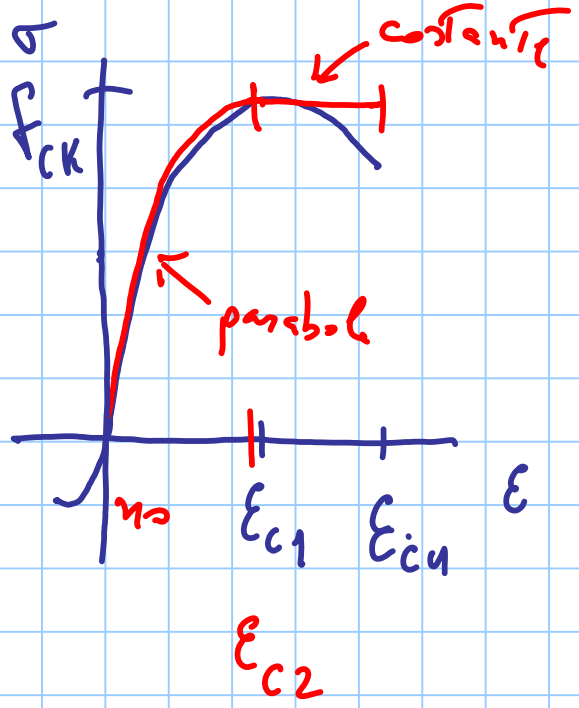
TEORIA ELASTICITÀ LINEARE?

SI se ≤ 0.6 per CLS compr.

3) deformazioni elevate

(come 2 - nessuna resistenza a trazione)

modello del CLS compresso non lineare



OBIETTIVO - Valutare RESISTENZA

⇓

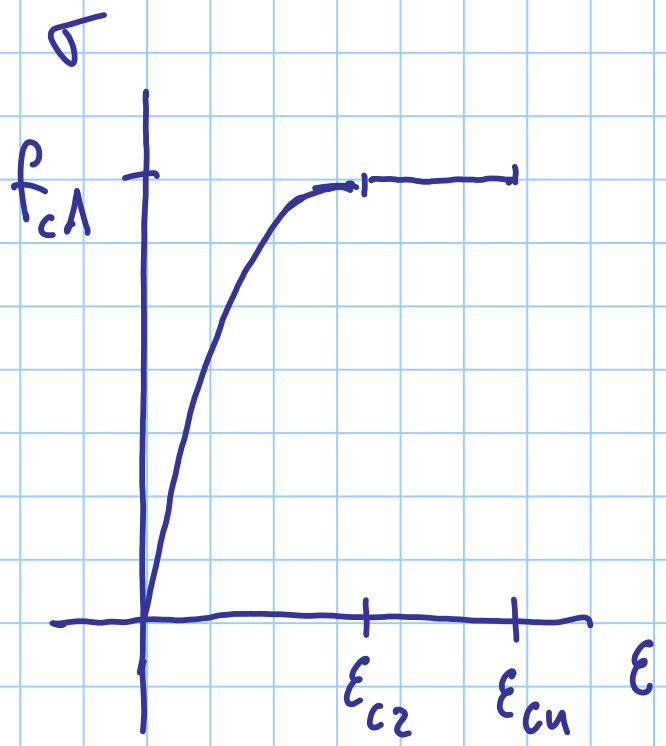
parabola - rettangolo

OBIETTIVO - DUTTILITA'

(deformazione ultima)

⇓

altri modelli



modelli per verifiche SLU

valore di calcolo della resistenza

$$f_{cd} = \alpha_{cc} \frac{f_{ck}}{\gamma_c}$$

$\gamma_c = 1.5$

[$\gamma_c = 1.4$ in situazioni di forte controllo]

$\alpha_{cc} = 0.85$ riduzione di resistenza per carichi di lunga durata

$= 1$?

C 25/30 $\qquad f_{ck} = 25\ MPa$

$$f_{cd} = 0{,}85\ \frac{25}{1.5} = 14.17\ MPa$$

$\varepsilon_{c2} = 0{,}002 \qquad 2 \times 10^{-3}$

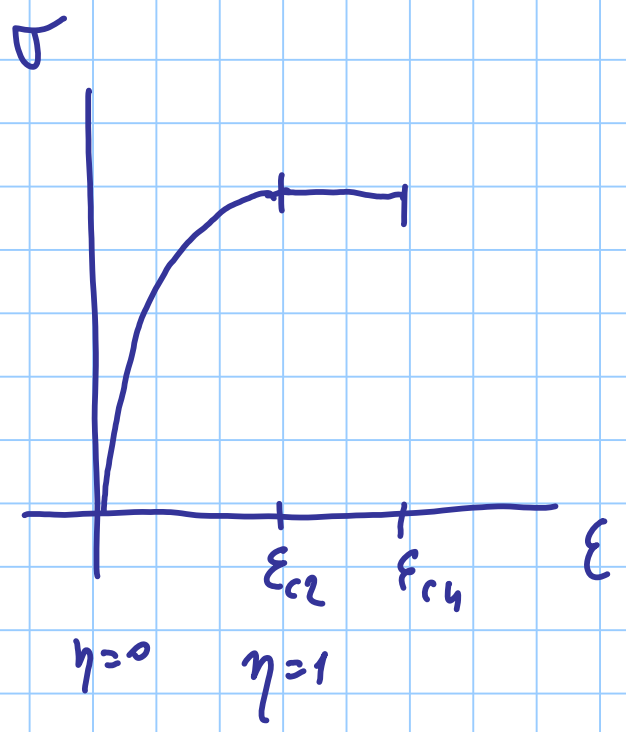
$\varepsilon_{cu} = 0{,}0035 \qquad 3.5 \times 10^{-3}$

} fino a C50/60

< 0 per la compressione

$$\eta = -\frac{\varepsilon_c}{\varepsilon_{c2}} \qquad > 0$$

$\varepsilon_{c2} = -0.002$



legame costitutivo

per $-0.002 \leq \varepsilon_c \leq 0 \qquad 0 \leq \eta \leq 1$

$$\sigma_c = -\eta(2-\eta) f_{cd}$$

per $-0.0035 \leq \varepsilon_c \leq -0.002 \qquad 1 \leq \eta \leq \frac{7}{5}$

$$\sigma_c = -f_{cd}$$