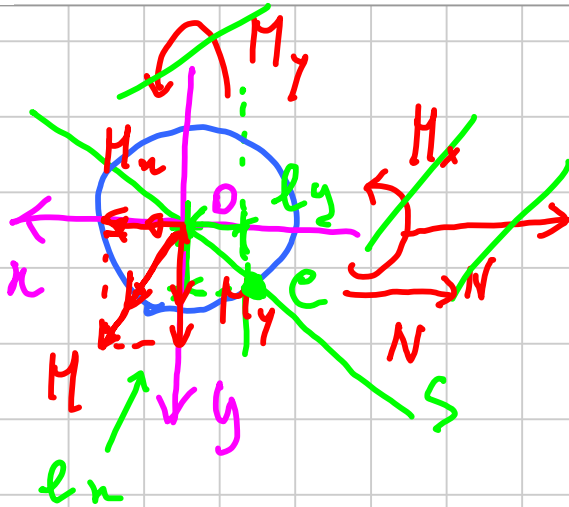


FLESSIONE COMPOSTA

Titolo nota

22/04/2015

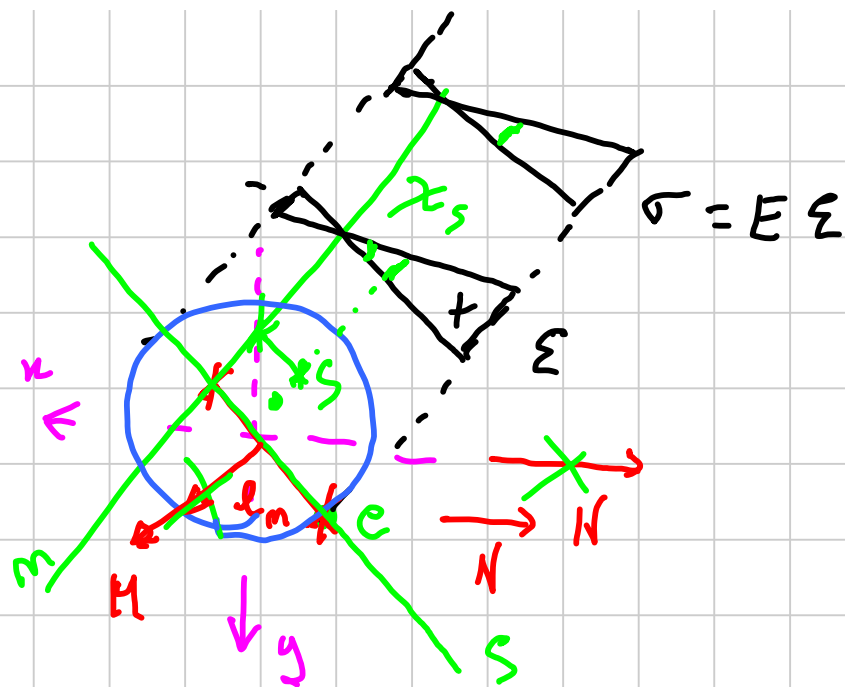


$$\sigma = \frac{N}{A} + \frac{M_x}{I_x} y - \frac{M_y}{I_y} x$$

$$\epsilon = \frac{N}{EA} + \frac{M_x}{EI_x} y - \frac{M_y}{EI_y} x$$

$$e_y = - \frac{M_y}{N}$$

$$e_x = \frac{M_x}{N}$$



$$\epsilon = \chi_s S$$

$$\boxed{\sigma = E \chi_s S}$$

$$E \chi_s = \frac{\sigma}{S}$$

$$N = \int_A \sigma dA = E \chi_s \int_A S dA = E \chi_s S_m$$

$$M_m = \int_A \sigma s dA = E \chi_s \int_A s^2 dA = E \chi_s I_m$$

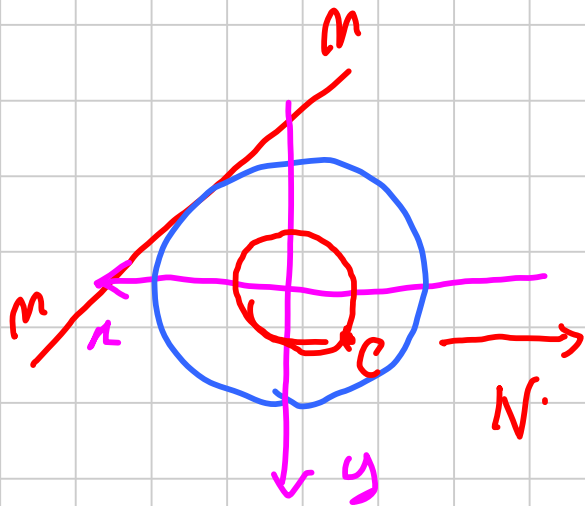
"
N e_m

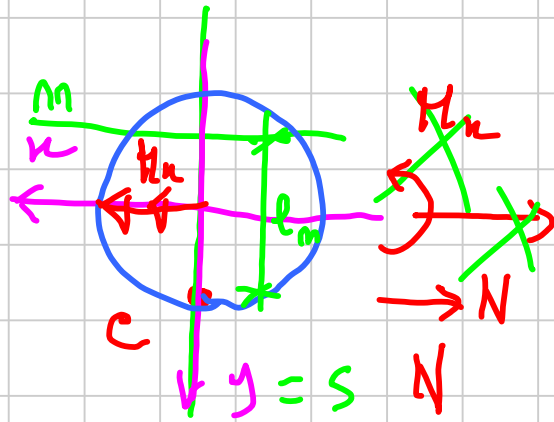
$$N = E X_s S_m = \frac{\sigma}{s} S_m \Rightarrow$$

$$\boxed{\sigma = \frac{N s}{S_m}}$$

$$M_m = N e_m = E X_s I_m = \frac{\sigma}{s} I_m \Rightarrow$$

$$\boxed{\sigma = \frac{N e_m s}{I_m}}$$





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

$$\varepsilon = \frac{N}{EA} + \frac{M}{EI} y$$

$$N = E \chi_s S_m$$

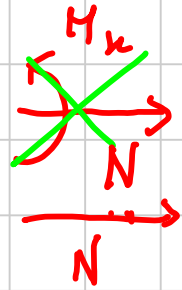
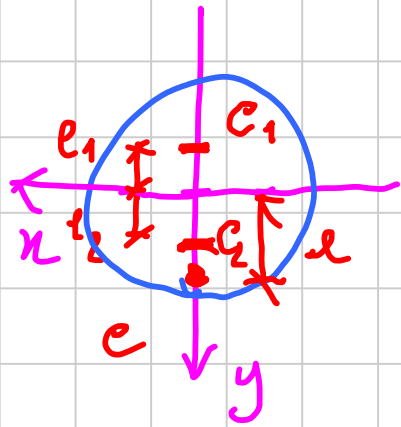
$$N e_m = E \chi_s I_m$$

$$\sigma = \frac{N}{S_m} s$$

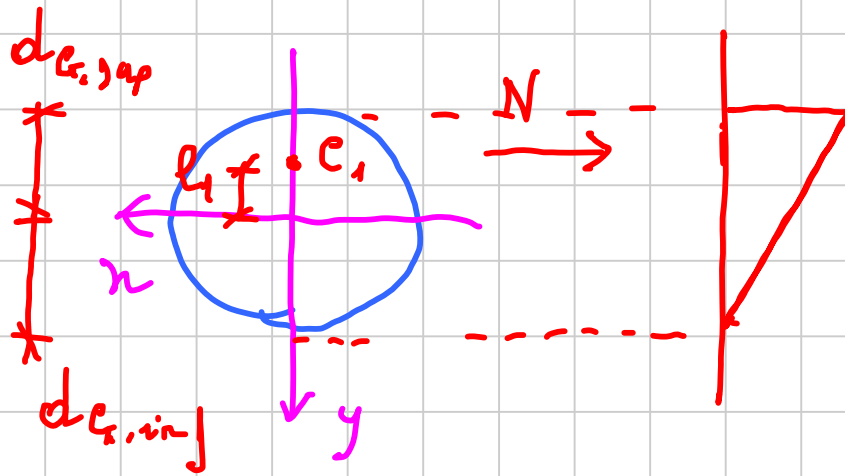
$$\sigma = \frac{N e_m}{I_m} s$$

$$\frac{\cancel{N} e_m}{\cancel{N}} = \frac{\cancel{E} \chi_s I_m}{\cancel{E} \chi_s S_m}$$

$$e_m = \frac{I_m}{S_m}$$



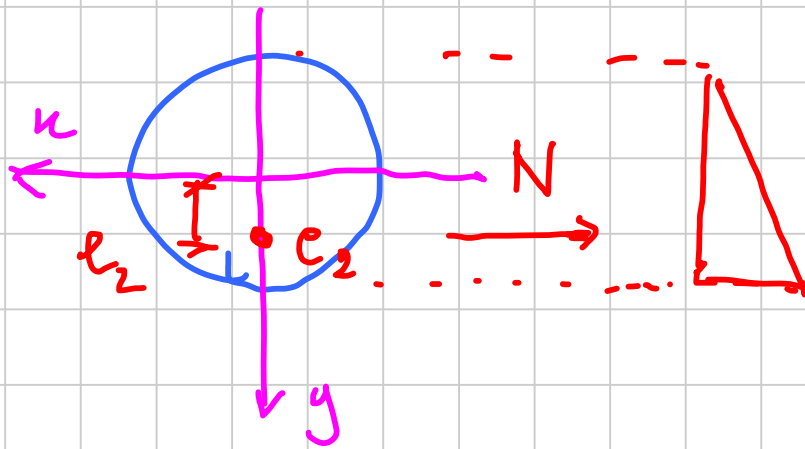
$$e = \frac{M}{N}$$



$$\sigma_{inf} = \frac{N}{A} + \frac{M}{I} d_{G, inf} = \frac{N}{A} - \frac{N e_1 d_{G, inf}}{I} = 0$$

$$e_1 = \frac{I}{A d_{G, inf}}$$

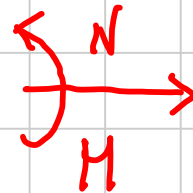
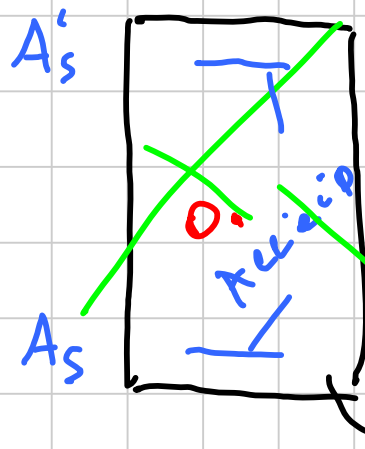
$$\frac{\cancel{N}}{A} = \frac{\cancel{N} e_1 d_{G, inf}}{I}$$



$$\sigma_{sup} = \frac{N}{A} - \frac{N e_2}{I} d_{c, sup} = 0$$

$$e_2 = \frac{I}{A d_{c, sup}}$$

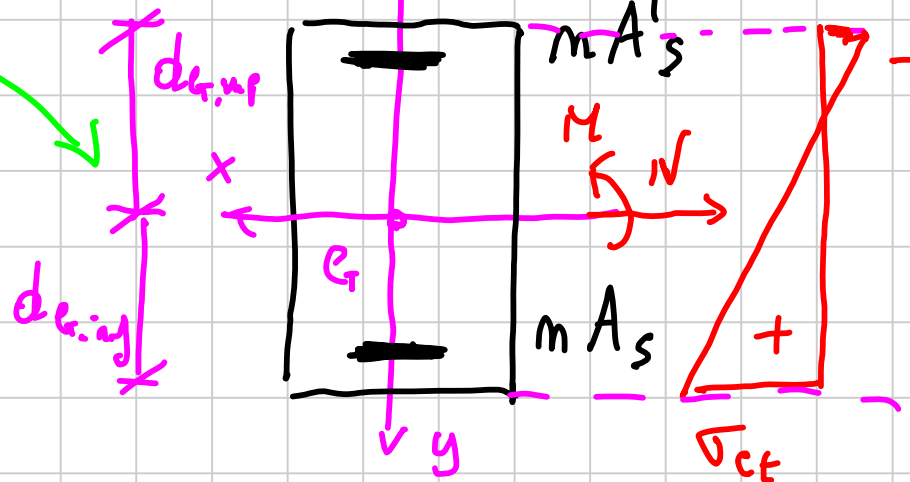
I stadio di comportamento



$$\sigma_{ct} \leq f_{ctk}$$

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

$$m = \frac{E_s}{E_c}$$



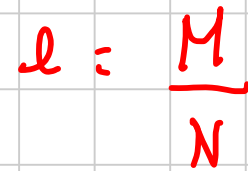
$$S_{sup} = b \frac{h^2}{2} + m A'_s c + m A_s d$$

$$A = b h + m (A'_s + A_s)$$

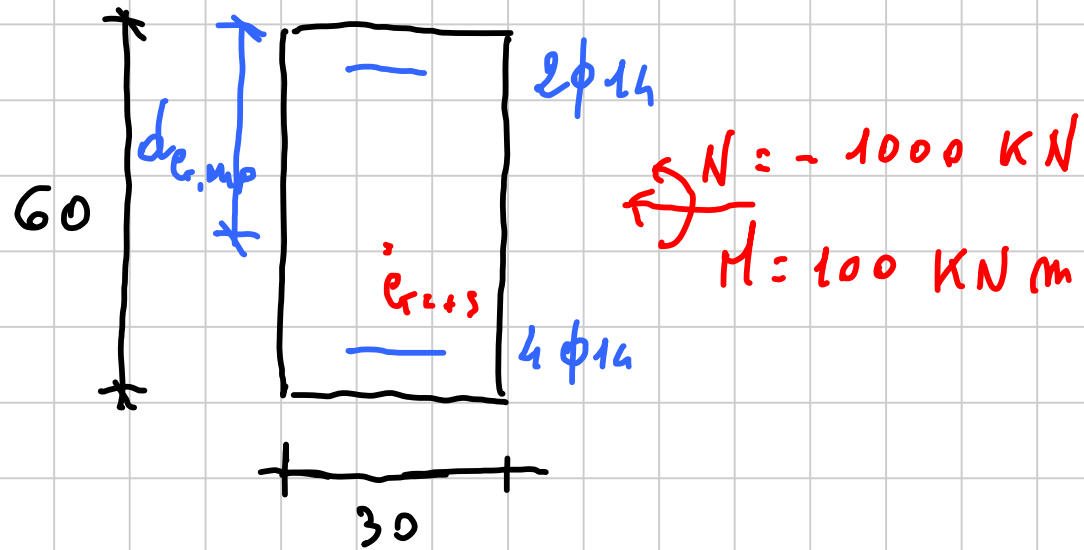
$$S_{sup} = A d_{G, sup} \quad d_{G, sup} = \frac{S_{sup}}{A}$$

$$d_{G, inf} = h - d_{G, sup}$$

$$I = \frac{b d_{G, inf}^3}{3} + \frac{b d_{G, sup}^3}{3} + m A_s (d_{G, inf} - c)^2 + m A'_s (d_{G, sup} - c)^2$$



$$\sigma_{ct} = \frac{N}{A} + \frac{N e_{c+s}}{I} d_{g.ing}$$



$$c = 4 \text{ cm}$$

$$c_{25/30}$$

$$f_{ctk} = 2.16 \text{ MPa}$$

$$S_{mp} = 30 \times \frac{60^2}{2} + 6.35 \times 3.08 \times 4 + 6.35 \times 6.16 \times 56 =$$

$$56268.7 \text{ cm}^3$$

$$n = \frac{200000}{31500} = 6.35$$

$$A = 30 \times 60 + 6,35 (3,08 + 6,16) = 1858,7 \text{ cm}^2$$

$$d_{G, \text{sup}} = \frac{S_{\text{sup}}}{A} = \frac{56268,7}{185,7} = 30,3 \text{ cm}$$

$$d_{G, \text{inf}} = 60 - 30,3 = 29,7 \text{ cm}$$

$$I = 30 \times \frac{29,7^3}{3} + 20 \times \frac{30,3^3}{3} + 6,35 \times 3,08 \times (30,3 - 4)^2 + 6,35 \times 6,16 \times (29,7 - 4)^2 = 579525,8 \text{ cm}^4$$

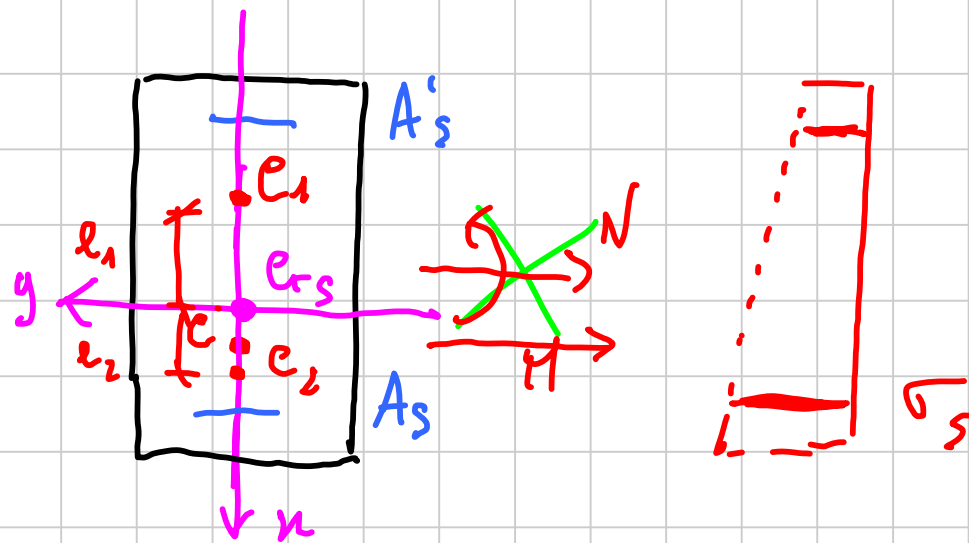
$$e_{e+s} = \frac{M}{N} - \left(\frac{h}{2} - d_{G, \text{inf}} \right) = \frac{100 \times 10^2}{-1000} - (30 - 29,7) = -10,3 \text{ cm}$$

$$\sigma_{ct} = \frac{N}{A} + \frac{N_{e_{cts}}}{I} d_{gring}$$

$$= \frac{-1000}{1858,7} \times 10 + \frac{+1000 \times 10,3}{579525,8} \times 29,7 \times 10 = -0,1 \text{ MPa}$$

$$\sigma_{ct} < f_{ctk} \quad \text{OK!}$$

Verifiche sulle travi in esercizio (II stadio di comportamento)



$$\sigma_c \leq 0.6 f_{ck} \quad 0.45 f_{ck}$$

$$\sigma_s \leq 0.8 f_{yk} \quad \text{non} \quad \text{quasi perm.}$$

travi - flessione con piccole eccentricità

sezione tutta tesa

$$S_{\text{sup}} = A'_s c + A_s d$$

$$A = A'_s + A_s$$

$$d_{\text{cr,mp}} = \frac{S_{\text{sup}}}{A}$$

$$d_{\text{cr,ing}} = h - d_{\text{cr,mp}}$$

$$e_1 = \frac{I}{A d_{\text{cr,ing}}}$$

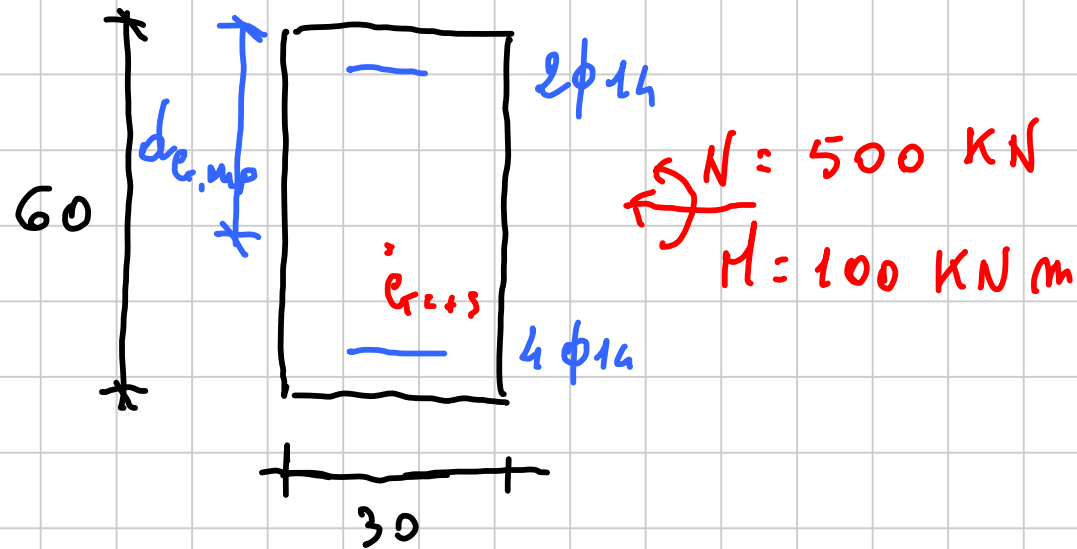
$$e_2 = \frac{I}{A d_{\text{cr,mp}}}$$

$$I = A_s (d_{\text{cr,ing}} - c)^2 + A'_s (d_{\text{cr,mp}} - c)^2$$

$$-l_1 \preceq l_s \preceq l_2$$

$$l_s = \frac{H}{N} - \left(\frac{h}{2} - d_{\text{e.inj}} \right)$$

$$\sigma_s = \frac{N}{A} + \frac{N l_s}{I} (d_{\text{e.inj}} - c)$$



$$S_{sup} = 3.08 \times 4 + 6.16 \times 56 = 357.3 \text{ cm}^3$$

$$A = 3.08 + 6.16 = 9.24 \text{ cm}^2$$

$$d_{e, sup} = \frac{357.3}{9.24} = 38.7 \text{ cm} \quad d_{e, inf} = 21.3 \text{ cm}$$

$$I = 6,16 \times (21,3 - 4)^2 + 3,08 \times (38,7 - 4)^2$$

$$= 5552,2 \text{ cm}^4$$

$$e_1 = \frac{5552,2}{9,24 \times 21,3} = 28,2 \text{ cm}$$

$$e_2 = \frac{5552,2}{9,24 \times 38,7} = 15,5 \text{ cm}$$

$$e_s = \frac{100}{500} \times 10^2 - \left(\frac{60}{2} - 21,3 \right) = 11,3 \text{ cm}$$

$$- l_1 < l_s < l_2$$

$$- 28,2 < 11,3 < 15,5$$

$$\sigma_s = \frac{500}{9,24} \times 10 + \frac{500 \times 11,3}{5552,2} \times (21,3 - 4) \times 10 = 717,2 \text{ MPa}$$

$$\sigma_s \leq 0,8 f_{yk}$$

$$717,2 > 0,8 \times 450 = 360 \text{ MPa}$$

B450c

comb. rene

