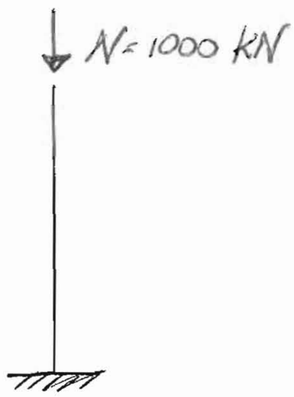
Esercitazione T.A

Ex. 1. - Elementi Compressi



Materiali

Cls $R_{ck} = 25\,MPa$

Acciaio FeB 38 K $\Rightarrow \tilde{\sigma}_s = 220\,MPa$

- Calcolo tensione amm. del cls

$$\bar{\sigma}_c = 6 + \frac{R_{ck} - 15}{4} = 8{,}5\,MPa$$

per elementi semplicemente compressi

$$\bar{\bar{\sigma}}_c = 0{,}7\,\bar{\sigma}_c = 5{,}95\,MPa$$

- Progetto

$$A_c = \frac{N}{\bar{\bar{\sigma}}_c} = \frac{1000 \cdot 10^3 N}{5{,}95} = 168067\,mm^2 = 1680\,cm^2$$

$$\Downarrow$$

$$A_c^{eff} = 30 \times 60 = 1800\,cm^2$$

- Calcolo minimi normativi di armatura

$$A_s^{min} = 0{,}3\%\,A_c^{eff} = 0{,}003 \cdot 1800 = 5{,}4\,cm^2$$

$$A_s^{min} = 0{,}8\%\,A_c = 0{,}008 \cdot 1680 = 13{,}44\,cm^2$$

$$A_s = \max\left(A_{s,i}^{min}\right) = 13{,}44\,cm^2 \Rightarrow 8\phi16 \quad A_s^{eff} = 16{,}08\,cm^2$$

- Calcolo massimi normativi

$$A_s^{max} = 6\%\,A_c^{eff} = 0{,}06 \cdot 1800 = 108\,cm^2 > A_s^{eff} \rightarrow \text{Verificato}$$

- Verifica delle massime tensioni nel cls e acciaio

$$A_{id} = A_c + n A_s = 1800 + 15 \cdot 16{,}08 = 2041{,}2\ cm^2$$

$$\sigma_c = \frac{1000 \cdot 10^{-3} N}{A_{id}} = 4{,}90\ MPa \leq 5{,}95\ MPa\ (\bar{\bar{\sigma}}_c) \quad \text{Verificato}$$

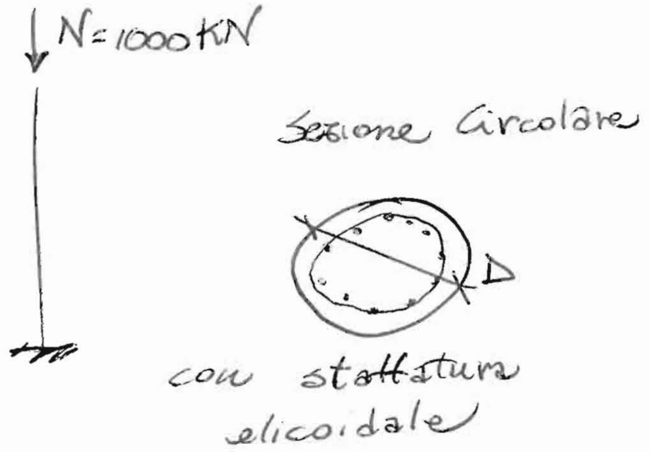
$$\sigma_s = n \sigma_c = 73{,}5\ MPa < 220\ MPa\ (\tilde{\sigma}_s) \quad \text{Verificato}$$

Ex. 2 - Pilastro cerchiato

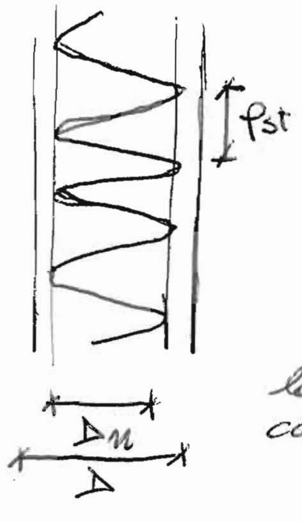
Caratteristiche materiali

$R_{ck} = 25\ MPa \rightarrow \bar{\bar{\sigma}}_c = 5{,}95\ MPa$

$Fe\ B\ 38\ K \rightarrow \bar{\sigma}_s = 220\ MPa$



- Occorre considerare il contributo della staffatura



- Equilibrio tra pressione cls e tensione nella staffa

$$\sigma_\ell \cdot p_{st} \cdot D_n = f_y\, 2\, \omega_s$$

σ_ℓ → tensione laterale di confinamento

$$\sigma_\ell = \frac{2 \omega_s f_y}{p_{st} D_n} \cdot \frac{D_n 2 \pi}{D_n 2 \pi} = \frac{\omega_s D_n \pi}{p_{st}} \cdot \frac{4}{\pi D_n^2} \cdot \frac{f_y}{2}$$

$\frac{\pi D_n^2}{4} = A_c'$ (Area del nucleo di cls)

$\frac{\omega_s D_n \pi}{p_{st}} = A_{st}$

$$\sigma_\ell = \frac{A_{st}}{A'_c} \cdot \frac{f_y}{2}$$

- Calcolo tensione biassiale

$$f_{cc} = f_c + 4{,}1\,\sigma_\ell$$

- Progetto

$$N = A'_c\, f_{cc} + A_{sL} f_y$$

sostituendo f_{cc}

$$N = A'_c f_c + \cancel{A'_c} \cdot \overset{2{,}05}{\cancel{4{,}1}} \cdot \frac{A_{st}}{\cancel{A'_c}} \cdot \frac{f_y}{\cancel{2}} + A_{sL} f_y$$

in termini di T.A si ottiene (ponendo $\bar{\sigma}_s = n\bar{\sigma}_c$)

$$\bar{N}_{amm} = A'_c\, \bar{\bar{\sigma}}_c + n\, A_{sL}\, \bar{\bar{\sigma}}_c + 2{,}05\, n\, A_{st}\, \bar{\bar{\sigma}}_c$$

$$\bar{N}_{amm} = A_{id} \cdot \bar{\bar{\sigma}}_c \qquad \text{dove} \qquad A_{id} = A'_c + n A_{sL} + 2\, n\, A_{st}$$

- Ipotesi di sezione $\Delta = 60\,cm$ $\quad A_{sL} = 8\phi 20$ $\quad \omega_s \; 1\phi 10 \; (A = 0{,}78\,cm^2)$
  $\Delta_n = 54\,cm$ $\quad A_{sL} = 25{,}12\,cm^2$ $\quad p_{st} = 15\,cm$
- Verifica

$$A_{st} = \frac{\omega_s\, \pi\, \Delta_n}{p_{st}} = \frac{0{,}78 \cdot 3{,}14 \cdot 54\,cm}{15\,cm} = 8{,}87\,cm^2$$

$$\bar{N} = 5{,}95\,MPa \left[\frac{3{,}14 \cdot 540^2}{4} + 15 \cdot 2512 + 2 \cdot 15 \cdot 887 \right] = 1745000\,N$$

$$\downarrow$$

$$1745\,kN > N_{soll}$$

Verificato