CRITERI PROGETTUALI

PROGETTAZIONE:

- TIPOLOGIA STRUTTURALE
- MATERIALI
- DIMENSIONAMENTO
- VERIFICA

• DIMENSIONAMENTO TRAVI INFLESSE

• APPROCCIO CLASSICO ALLE T.A.

$$d = \alpha \sqrt{\frac{M}{B}} \qquad A_s = \frac{M}{0.9\, d\, \sigma_{s,amm}} \qquad B = \alpha^2 \frac{M}{d}$$

• APPROCCIO MODERNO, CRITERI:

(a) BUON FUNZIONAMENTO IN ESERCIZIO (FESSURE E FRECCE)

$$\sigma_{s,es} \leq 180 \div 260 \text{ MPa}$$

$$\sigma_{c,es} \leq 8{,}0 \div 10{,}0 \text{ MPa}$$ (freccia) (fatica)

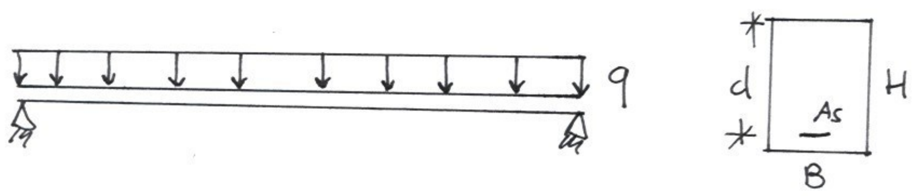
$$\sigma_{c,es} \leq 4.0 \div 6.0 \text{ MPa}$$ (viscosità)

(b) DURABILITÀ (MIX DESIGN, FESSURAZIONE)

(c) DUTTILITÀ, SEZIONI DUTTILI

$$\rho = \frac{A_s}{Bd} < 0.6 \div 1.0\,\%$$ garantisce buona duttilità.

PROPOSTA DI PREDIMENSIONAMENTO
(IN ESERCIZIO)



a) $H = L/\alpha$ $\qquad$ (TRAVI IN SPESSORE) $\alpha = 15 \div 25$ limitare la freccia

$\alpha = 6 \div 7$ (mensole)

(b) $A_s = \dfrac{M_{es}}{0.9\, d\, \sigma_{s,es}}$ $\qquad \sigma_{s,es} \leq 180 \div 260$ MPa

(c) $\rho = \dfrac{A_s}{Bd} = 0.6 \div 1.0\ \%$

$\rightarrow B = \dfrac{A_s}{\rho d}$

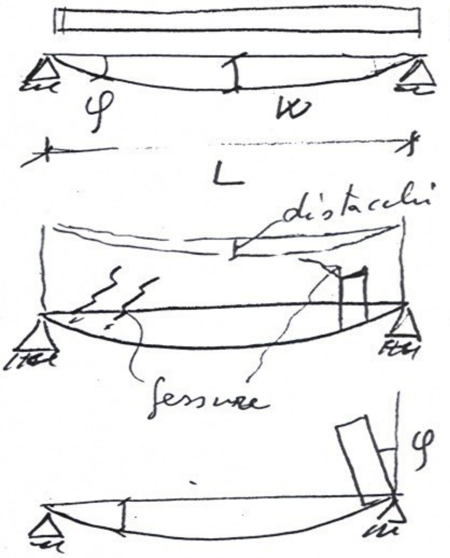
CONTROLLO DELLE DEFORMAZIONI

TRAVI APPOGGIATE

A) Significato del controllo della freccia:

$$\frac{w}{L} = \frac{1}{250} \div \frac{1}{1000}$$

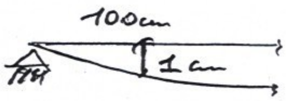
$$\varphi = 3{,}2\ w/L \quad (*)$$



inclinazione mobili, vibrazioni

per $w/L = 1/300$

$\varphi \simeq 1/100$



in alcuni casi valore inaccettabile

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*

$$\varphi = \frac{PL^3}{24EJ} \qquad w = \frac{5}{384}\frac{PL^4}{EJ} \rightarrow \frac{w}{L} = \frac{120}{384}\varphi$$

criterio per contenere la freccia

$$\boxed{\frac{w}{L} = \frac{40}{384}\,\frac{1}{E_c}\left(\sigma_c + \sigma_s/n\right)\frac{L}{h}} \quad *$$

per valori elevati di L/h si può contenere la freccia riducendo il tasso di lavoro

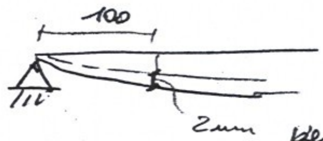
NB

1) adottando : $\sigma_c = 10$ MPa ; $\sigma_s/n = 30$ MPa ; $E_c = 30000$ MPa

$$\frac{w}{L} = \frac{1}{7200}\,\frac{L}{H} \quad \Rightarrow \text{per } \frac{w}{L} = \frac{1}{300} \longrightarrow \varphi = \frac{1}{100} \longrightarrow \frac{L}{H} = \frac{7200}{300} = 22.5$$

2) in esercizio per gli accidentali q (g = permanenti)

$$\Delta\varphi = \frac{q}{g+q}\,\varphi \simeq 20\%\,\varphi$$



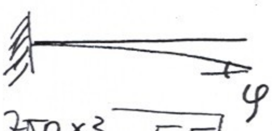
per $\varphi = \frac{1}{100}$

MENSOLE

$$\boxed{\frac{w}{L} = \frac{1}{E_c}\left(\sigma_c + \sigma_s/n\right)} \quad (**) \qquad \varphi = \frac{PL^3}{6EJ} = \frac{4}{3}\,\frac{w}{L}$$

per $\sigma_c = 10$ MPa ; $\sigma_s/n = 30$ MPa ; $E_c = 30{\cdot}000$ MPa

$$\frac{w}{L} = \frac{1}{750}\,\frac{L}{h} \qquad \text{per } \varphi = \frac{1}{100}$$



$$\frac{w}{L} = \frac{3}{400} \rightarrow \boxed{\frac{L}{h} = \frac{750\times 3}{400} = 5.5}$$

(*) $$w = \frac{5}{384}\,\frac{PL^4}{EJ} = \frac{5\times 8}{384}\left(\frac{PL^2}{8}\,\frac{1}{EJ}\right)L^2 = \frac{40}{384}\,y''\,L^2$$

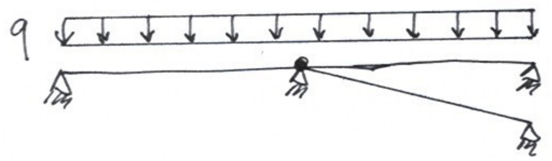
essendo : $$y'' = \frac{\varepsilon_c + \varepsilon_s}{h} = \left(\frac{\sigma_c}{E_c} + \frac{\sigma_s}{E_s}\right)\frac{1}{h} = \frac{1}{E_c}\left(\sigma_c + \sigma_s/n\right)\frac{1}{h}$$

(**) $w = PL^4/8EJ$

$$\frac{w}{L} = \frac{PL^2}{8EJ}\,L = y''\,L = \frac{\varepsilon_c + \varepsilon_s}{h}\,L = \left(\frac{\sigma_c}{E_c} + \frac{\sigma_s}{E_s}\right)\frac{L}{h}$$

- **IMPORTANZA DELLA DUTTILITÀ:**

"IN UNA STRUTTURA DUTTILE, LA CAPACITÀ PORTANTE È INDIPENDENTE DA DISTORSIONI E CEDIMENTI"



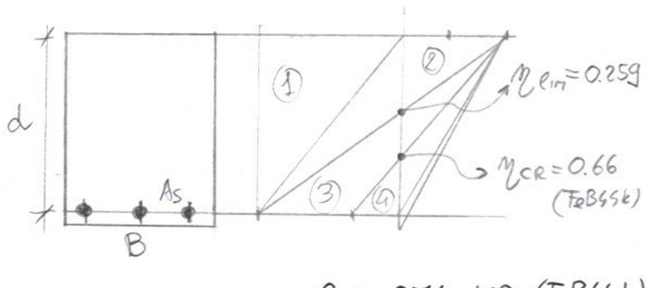
q_u INDIPENDENTE da η

q_u INDIPENDENTE da ΔT

(1) RISOLVE I PROBLEMI DELLE INCERTEZZE SUI CEDIMENTI, VARIAZIONI TERMICHE, RITIRO.

(2) RISOLVE I PROBLEMI DELLE INCERTEZZE SUI VINCOLI DELLE STRUTTURE IDEALMENTE ISOSTATICHE.

Eq. TRASL. (S.L.U)



$$0.8 \times B f'cd = fsd\, A_s$$

$$x = \frac{fsd \cdot A_s}{0.8\, B\, f'cd}$$

$$\frac{x}{d} = \eta = \frac{A_s}{0.8\, Bd} \frac{fsd}{f'cd} = \frac{1}{0.8} \frac{fsd}{f'cd} \rho$$

$fsd = 374$ MPa (FeB44k)

$f'cd = 11.02$ MPa (Rck 25)

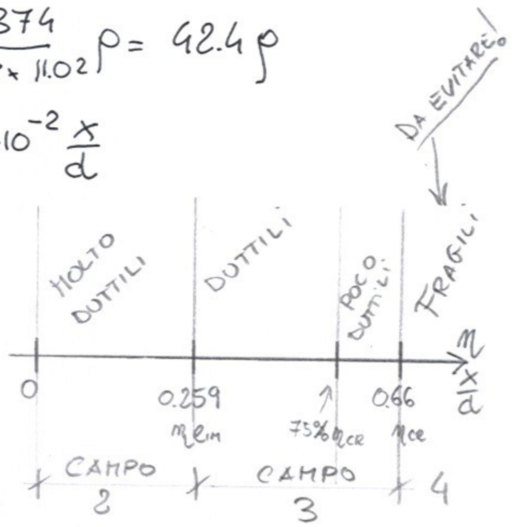
$$\Longrightarrow \eta = \frac{\rho \alpha}{0.8} \qquad \Longrightarrow \frac{x}{d} = \eta = \frac{374}{0.8 \times 11.02} \rho = 42.4 \rho$$

$$\rho = 2{,}36 \times 10^{-2} \frac{x}{d}$$

(a) $\eta_{lim} = 0.259$ $\quad \rho = 0.61\,\%$

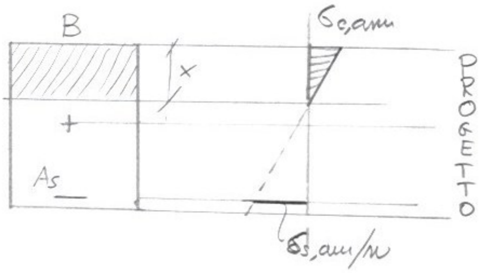
(b) $\eta_{CR} = 0.66$ $\quad \rho = 1.56\,\%$

CONSIGLIABILE $\rho < 1\% \rightsquigarrow 0.75\,\eta_{CR}$



Eq. TRASL. (T.A - METODO n)

$$\frac{1}{2}\sigma_{c,am}Bx - \sigma_{s,am}A_s = 0$$



$$\frac{A_s}{B} = \frac{1}{2}x\frac{\sigma_{c,am}}{\sigma_{s,am}}$$

$$\frac{A_s}{Bd} = \frac{1}{2}\frac{x}{d}\frac{\sigma_{c,am}}{\sigma_{s,am}} \quad , \quad \frac{x}{d} = \frac{\sigma_{c,am}}{\sigma_{c,am} + \frac{\sigma_{s,am}}{n}} = \frac{1}{1 + \frac{\sigma_{s,am}}{\sigma_{c,am}}\frac{1}{n}}$$

$$\Rightarrow \rho = \frac{1}{2}\frac{\sigma_{c,am}}{\sigma_{s,am}}\frac{1}{1+\frac{\sigma_{s,am}}{\sigma_{c,am}}\cdot\frac{1}{n}} \quad \Rightarrow \rho = \rho(\sigma_{c,am};\sigma_{s,am};n)$$

- R_{ck} 25 MPa $\rightarrow \sigma_{c,am} = 8.5$ MPa
- FeB 44 K $\rightarrow \sigma_{s,am} = 255$ MPa

$\rightarrow \frac{x}{d} = 0.333$

$$\rho = \frac{1}{2}\times 0.333 \times \frac{8.5}{255} = 0.55\%$$ $\longrightarrow$ SEZIONI DUTTILI !!

$\Longrightarrow$ SEZIONI DUTTILI $\quad \rho \leq 0.6\% \div 1.0\%$

ESEMPIO:

$M_{sdu} = 200$ KNm

$$M_{es} \simeq \frac{M_{sdu}}{1.4 \div 1.5} \cong 140 \text{ KNm}$$

Fisso $B = 300$ mm (foori spessore) $R_{ck} = 25$ MPa $\sigma_{c,es} \leq 8.0$ MPa

$\sigma_{s,es} \leq 250$ MPa

(limita la freccia, ...)

$$\cdot\ A_s = \frac{M_{es}}{0.9 \cdot d \cdot \sigma_{s,es}} \qquad \cdot\ \rho = \frac{A_s}{B\,d}$$

$$\Rightarrow \quad \rho = \frac{M_{es}}{0.9\, d^2 \sigma_{s,es} \cdot B}$$

SCELGO ρ pari a 0.6% (MOLTO DUTTILE)

(DIPENDE ANCHE da R_{ck})

$$d = \sqrt{\frac{M_{es}}{0.9\ \sigma_{s,es} \cdot B\,\rho}} = \sqrt{\frac{140 \times 10^6}{0.9 \times 250 \times 300 \times 0.6 \times 10^{-2}}} = 588 \text{ mm}$$

$d \geq 588$ mm

$$A_s = \frac{140 \times 10^6}{0.9 \times 600 \times 250} = 1037 \text{ mm}^2$$

$M_{Rd} = 305$ kNm ($d = 588$ e $A_s = 1037$ mm²)

per esempio

$d = 600$ mm

$H = 640$ mm

$B = 300$ mm

$A_s = 2\phi16 + 2\phi20 = 1030$ mm²

$M_{Rdu} = 208$ kNm (da calcolo)