ADERENZA

mercoledì 25 marzo 2020 13:57

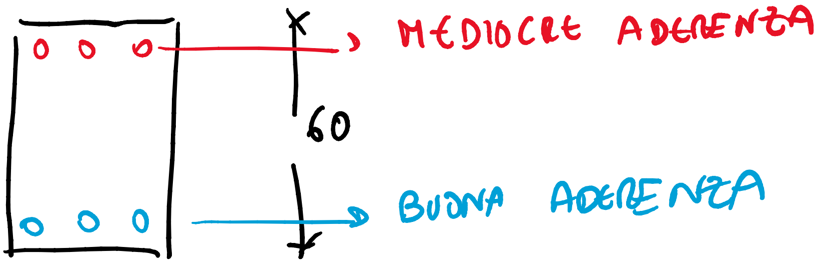
- PROPRIETÀ CLS (f_{ct})
- BARRA

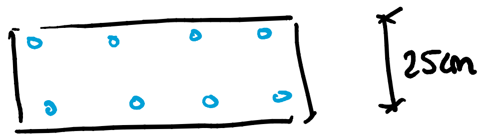
$$f_{bk} = 2.25\,\eta_1\,\eta_2\cdot f_{ctk}; \qquad f_{bd} = \frac{f_{bk}}{\gamma_c} \quad \gamma_c \to 1.5$$

BOND CARATTERISTICO

$$\eta_1 \begin{cases} 1.0 & \text{BUONA ADERENZA} \\ 0.7 & \text{MEDIOCRE ADERENZA} \end{cases}$$

$$\eta_2 = \begin{cases} 1 & \phi \le 32\text{ mm} \\ \dfrac{132-\phi}{100} & \phi > 32\text{ mm} \end{cases}$$





C25/30

$$f_{ctk} = 0{,}7 \times \underbrace{0{,}3\sqrt[3]{f_{ck}^2}}_{f_{ctm}} = 0{,}7 \times 0{,}3\sqrt[3]{25^2} =$$

$$\simeq 1{,}79\text{ MPa}$$

BUONA ADERENZA

$$f_{bk} = 2.25 \times 1 \times 1 \times 1{,}79 = 4{,}04\text{ MPa}$$

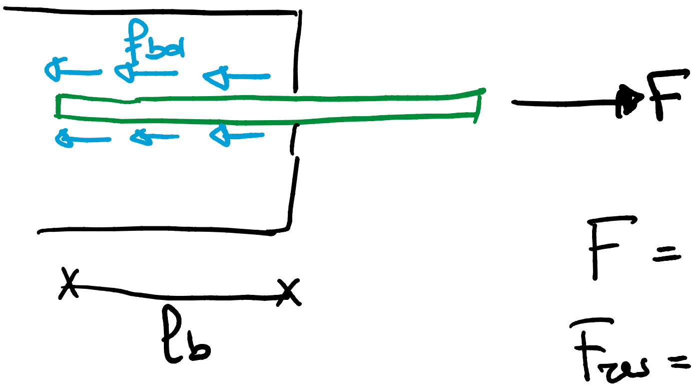
$$f_{bd} = \frac{4{,}04}{1{,}5} = 2{,}69\text{ MPa}$$

MEDIOCRE ADERENZA $\to f_{bd} = 0{,}7 \times 2{,}69 = 1{,}88$ MPa

$\eta_1 = 0.7$

LUNGHEZZA DI ANCORAGGIO

mercoledì 25 marzo 2020 14:15



ϕ = DIAMETRO BARRA

$$F = \sigma_s A = \sigma_s \frac{\pi \phi^2}{4}$$

$$F_{res} = f_{bd} \cdot \pi \phi \cdot \ell_b$$

EQ. TRASLAZIONE $\Rightarrow$ $\sigma_s \cdot \frac{\pi \phi^2}{4} = f_{bd} \cdot \pi \phi \, \ell_b$

$$\ell_b = \frac{\sigma_s \cdot \phi}{4 f_{bd}}$$

SE $\sigma_s = f_{yd} = \frac{450}{1,15} = 391,3 \ N/mm^2$

$$\ell_b = \frac{f_{yd} \cdot \phi}{4 f_{bd}}$$

BUONA ADERENZA $\Rightarrow$ $\ell_b = \frac{391,3}{4 \cdot 2,69} \phi = 36,4 \phi$

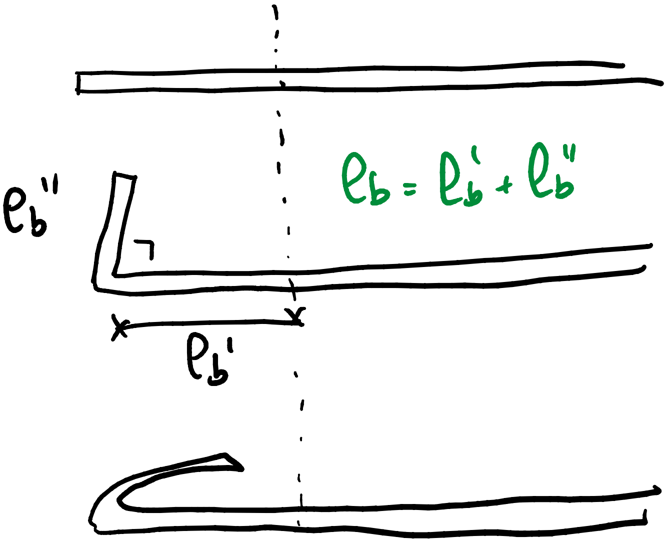
MEDIOCRE ADERENZA $\Rightarrow$ $\ell_b = \frac{391,3}{4 \times 0,7 \times 2,69} \phi = 52 \phi$

NORMATIVA

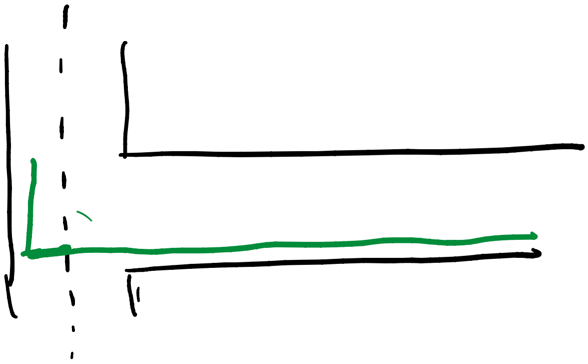
EC2 → $l_{bd} = \alpha_1 \alpha_2 \alpha_3 \alpha_4 \alpha_5 l_b$

$l_b \simeq 40\phi$

EVITARE ANCORAGGI QUANDO σ_s È ELEVATA



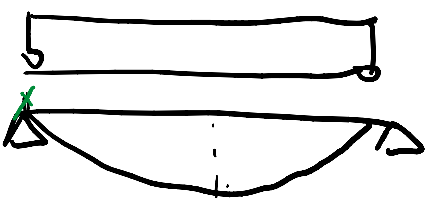
$l_b = l_b' + l_b''$

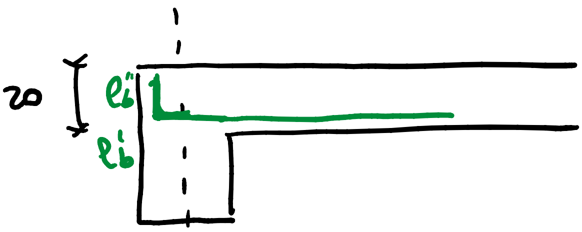


NTC 18

$l_b \geq 20\phi$
15cm

$l_b'' \geq 5\phi,\ 10\ cm$





8.4.4 Design anchorage length

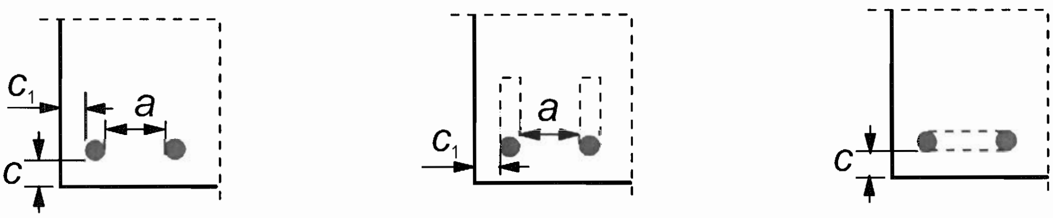
(1) The design anchorage length, l_{bd}, is:

$$l_{bd} = \alpha_1\, \alpha_2\, \alpha_3\, \alpha_4\, \alpha_5\; l_{b,rqd} \geq l_{b,min} \tag{8.4}$$

where α_1, α_2, α_3, α_4 and α_5 are coefficients given in Table 8.2:

α_1 is for the effect of the form of the bars assuming adequate cover (see Figure 8.1).

α_2 is for the effect of concrete minimum cover (see Figure 8.3)



a) Straight bars $c_d = \min(a/2, c_1, c)$

b) Bent or hooked bars $c_d = \min(a/2, c_1)$

c) Looped bars $c_d = c$

Figure 8.3: Values of c_d for beams and slabs

α_3 is for the effect of confinement by transverse reinforcement
α_4 is for the influence of one or more welded transverse bars ($\phi_t > 0{,}6\phi$) along the design anchorage length l_{bd} (see also 8.6)
α_5 is for the effect of the pressure transverse to the plane of splitting along the design anchorage length

The product $(\alpha_2\alpha_3\alpha_5) \geq 0{,}7$ (8.5)

$l_{b,rqd}$ is taken from Expression (8.3)
$l_{b,min}$ is the minimum anchorage length if no other limitation is applied:
[AC1⟩ - for anchorages in tension: $l_{b,min} \geq \max\{0{,}3 l_{b,rqd};\ 10\varphi;\ 100\ \text{mm}\}$ (8.6)
- for anchorages in compression: $l_{b,min} \geq \max\{0{,}6 l_{b,rqd};\ 10\varphi;\ 100\ \text{mm}\}$ ⟨AC1] (8.7)

(2) As a simplified alternative to 8.4.4 (1) the tension anchorage of certain shapes shown in Figure 8.1 may be provided as an equivalent anchorage length, $l_{b,eq}$. $l_{b,eq}$ is defined in this figure and may be taken as:
- $\alpha_1\, l_{b,rqd}$ for shapes shown in Figure 8.1b to 8.1d (see Table 8.2 for values of α_1)
- $\alpha_4\, l_{b,rqd}$ for shapes shown in Figure 8.1e (see Table 8.2 for values of α_4).

where
α_1 and α_4 are defined in (1)
$l_{b,rqd}$ is calculated from Expression (8.3)

Table 8.2: Values of α_1, α_2, α_3, α_4 and α_5 coefficients

Influencing factor	Type of anchorage	Reinforcement bar	
		In tension	In compression
Shape of bars	Straight	$\alpha_1 = 1,0$	$\alpha_1 = 1,0$
	Other than straight (see Figure 8.1 (b), (c) and (d)	$\alpha_1 = 0,7$ if $c_d > 3\phi$ otherwise $\alpha_1 = 1,0$ (see Figure 8.3 for values of c_d)	$\alpha_1 = 1,0$
Concrete cover	Straight	$\alpha_2 = 1 - 0,15\,(c_d - \phi)/\phi$ $\geq 0,7$ $\leq 1,0$	$\alpha_2 = 1,0$
	Other than straight (see Figure 8.1 (b), (c) and (d))	$\alpha_2 = 1 - 0,15\,(c_d - 3\phi)/\phi$ $\geq 0,7$ $\leq 1,0$ (see Figure 8.3 for values of c_d)	$\alpha_2 = 1,0$
Confinement by transverse reinforcement not welded to main reinforcement	All types	$\alpha_3 = 1 - K\lambda$ $\geq 0,7$ $\leq 1,0$	$\alpha_3 = 1,0$
Confinement by welded transverse reinforcement*	All types, position and size as specified in Figure 8.1 (e)	$\alpha_4 = 0,7$	$\alpha_4 = 0,7$
Confinement by transverse pressure	All types	$\alpha_5 = 1 - 0,04p$ $\geq 0,7$ $\leq 1,0$	-

where:

λ $= (\Sigma A_{st} - \Sigma A_{st,min})/ A_s$

ΣA_{st} cross-sectional area of the transverse reinforcement along the design anchorage length l_{bd}

$\Sigma A_{st,min}$ cross-sectional area of the minimum transverse reinforcement $= 0,25\,A_s$ for beams and 0 for slabs

A_s area of a single anchored bar with maximum bar diameter

K values shown in Figure 8.4

p transverse pressure [MPa] at ultimate limit state along l_{bd}

* See also 8.6: For direct supports l_{bd} may be taken less than $l_{b,min}$ provided that there is at least one transverse wire welded within the support. This should be at least 15 mm from the face of the support.

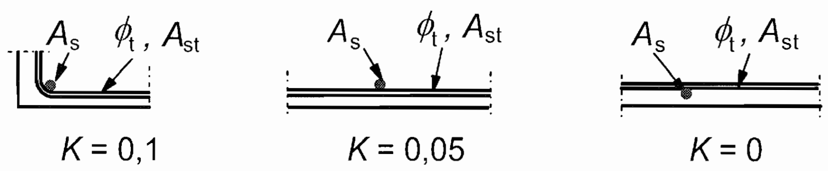
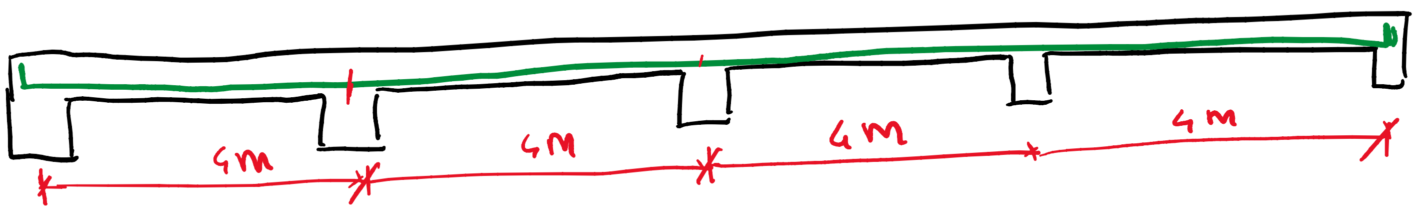


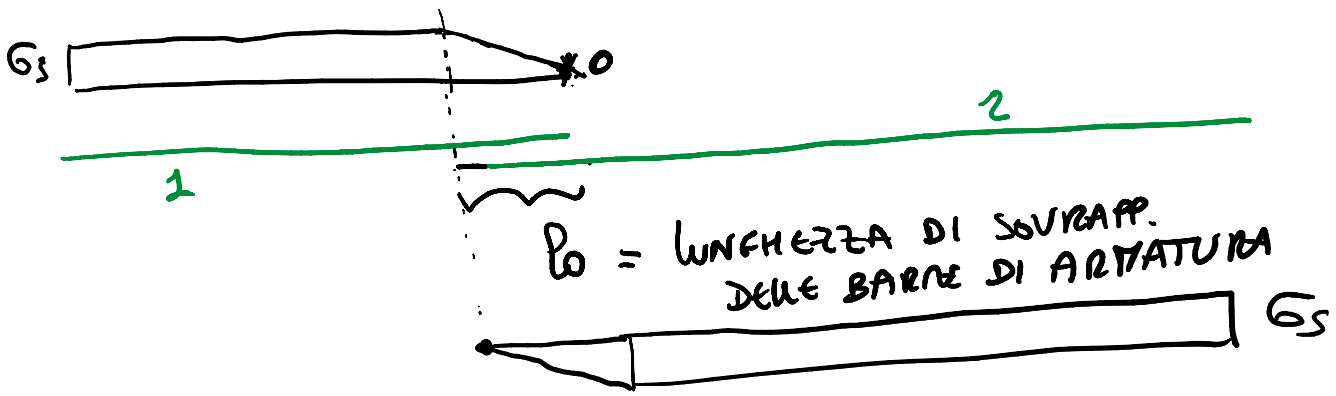
Figure 8.4: Values of K for beams and slabs

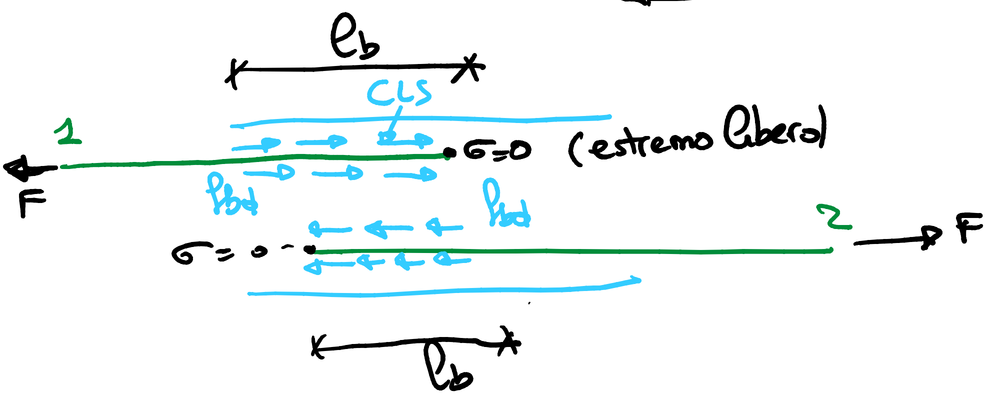
LUNGHEZZA DI SOVRAPPOSIZIONE

mercoledì 25 marzo 2020 14:37



$L_{BARRE} \leq 12\ m$

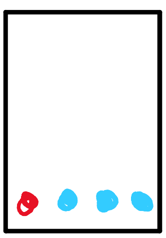




$\ell_0 = \alpha_6 \ell_b$ DOVE $\alpha_6 = 1$ SE SOVRAPPONGO $N_b \leq \frac{1}{4} N_{TOT}$

$\alpha_6 = 1.5$ SE INTERROMPO $N_b \geq \frac{1}{2} N_{TOT}$

ESEMPIO SEZ. TRASVERSALE



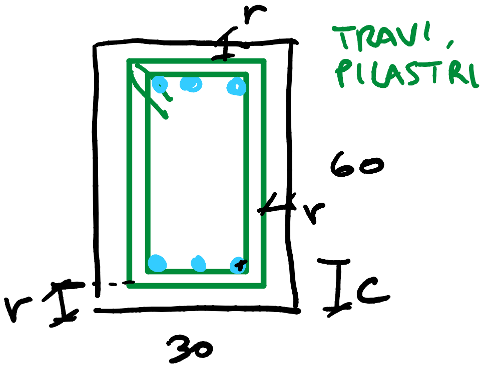
- SE IN UNA DATA SEZIONE INTERROMPO SOLO L'ARMATURA IN ROSSO → $\alpha_6 = 1 \rightarrow \ell_b = \ell_0$
- SE NE INTERROMPO 2 → $\alpha_6 = 1.5$

CONSIGLI

$\ell_b = 40\phi \Rightarrow \ell_0 = 60\phi$

RICOPRIMENTO – COPRIFERRO DI CALCOLO

mercoledì 25 marzo 2020 14:54

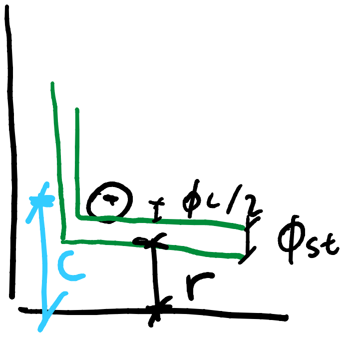


RICOPRIMENTO:
- $r \geq \phi_L$ BARRA LONGITUDINALE
- $r \geq 10$ mm
- r ... TIPO DI DEGRADO

$r + \Delta r$

↳ TOLLERANZA DI POSA

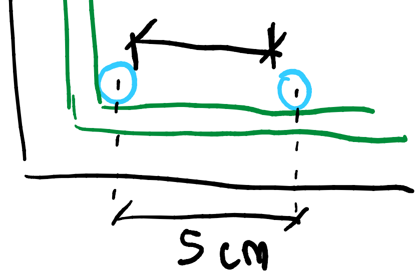
Δr:
- 0
- 5 mm →
- 10 mm



TRAVE, PILASTRO $\qquad c = r + \phi_{st} + \frac{\phi_L}{2}$

SOLAIO $\qquad c = r + \frac{\phi_L}{2}$

$i \geq 2$ cm; $i \geq \phi$ BARRA



i = INTERFERRO

CLASSE DI ESPOSIZIONE XC3

↓

CONDIZIONE AMBIENTALE ORDINARIA

SOLAIO → $r = 20mm + \Delta r = 25\ mm$

C25/30 (Δr ↓ 5mm)

ϕ_L SOLAIO $\leq 14\ mm$

$$C = r + \frac{\phi_L}{2} = 25mm + \frac{14}{2} = 32\ mm$$

$$+ \frac{10}{2} = 30mm$$

TRAVI O PILASTRI

C25/30 → $r = 25mm + \Delta r = 30\ mm$

$$C = r + \phi_{st} + \frac{\phi_L}{2} = 30 + 8 + 10$$

$$= 48mm$$

SE $\phi_L = 20mm$

$\phi_{st} = 8\ mm$

ESEMPIO CARBONATAZIONE

mercoledì 25 marzo 2020 15:16

a/c	k (mm anno $^{-1/2}$)
0.4	3.8
0.5	7.0
0.6	10.1
0.7	12.3
0.8	15.1

$$S_c = K\sqrt{t}$$

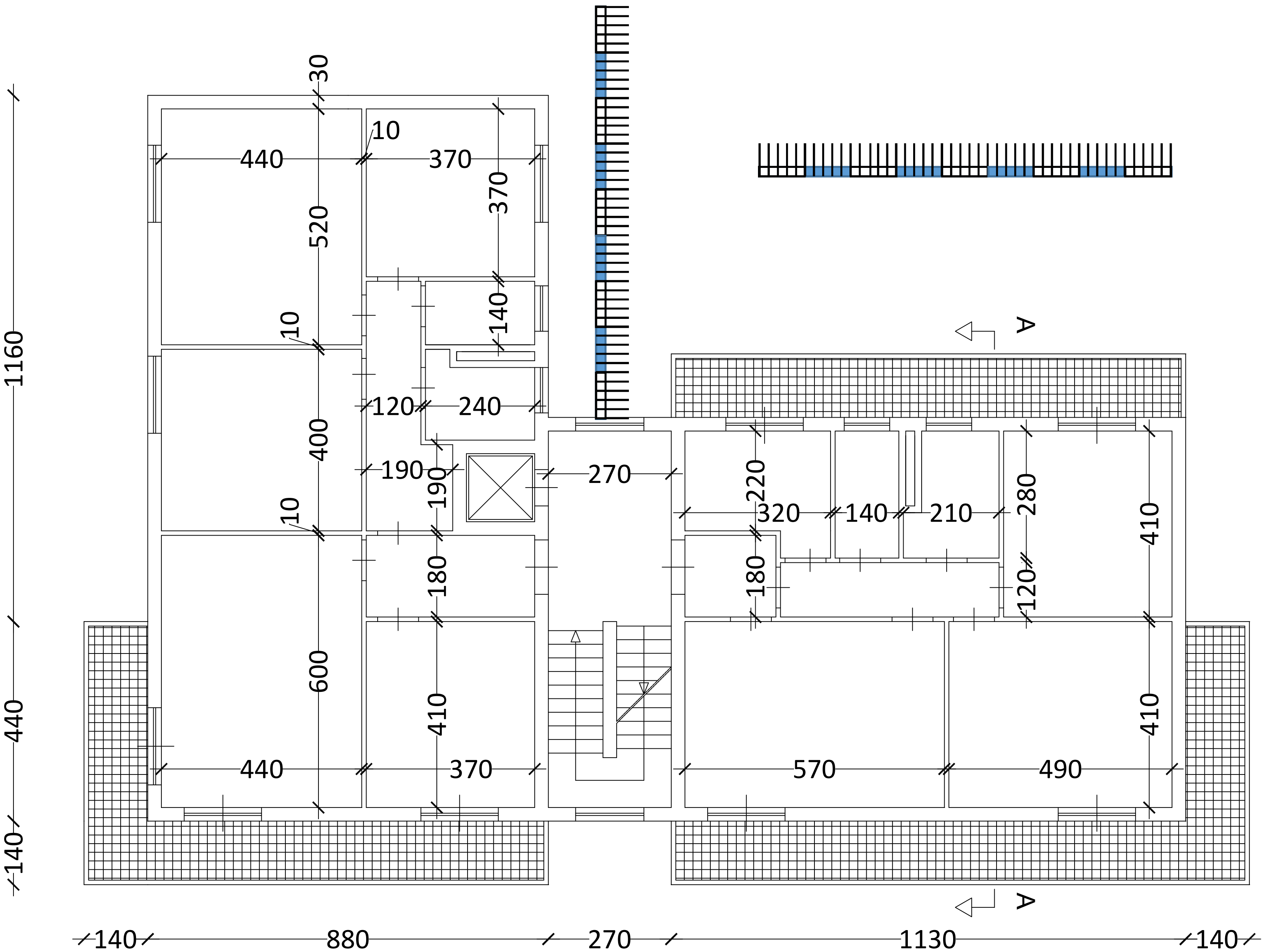
$$S_c = 25\ mm$$

se a/c = 0.7 $\Rightarrow K = 12{,}3\ mm \cdot anno^{-1/2}$

$$\sqrt{t} = \frac{25}{12{,}3} \Rightarrow t = \left(\frac{25}{12{,}3}\right)^2 =$$

$$t = 4.13\ anni$$

se a/c = 0.4 $\rightarrow K = 3{,}8 \rightarrow t = \left(\frac{25}{3{,}8}\right)^2 = 43\ anni$



A
A
1160
440
140
30
10
440
370
520
370
140
10
120
240
400
190
190
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320
140
210
280
410
10
180
180
120
600
410
410
440
370
570
490
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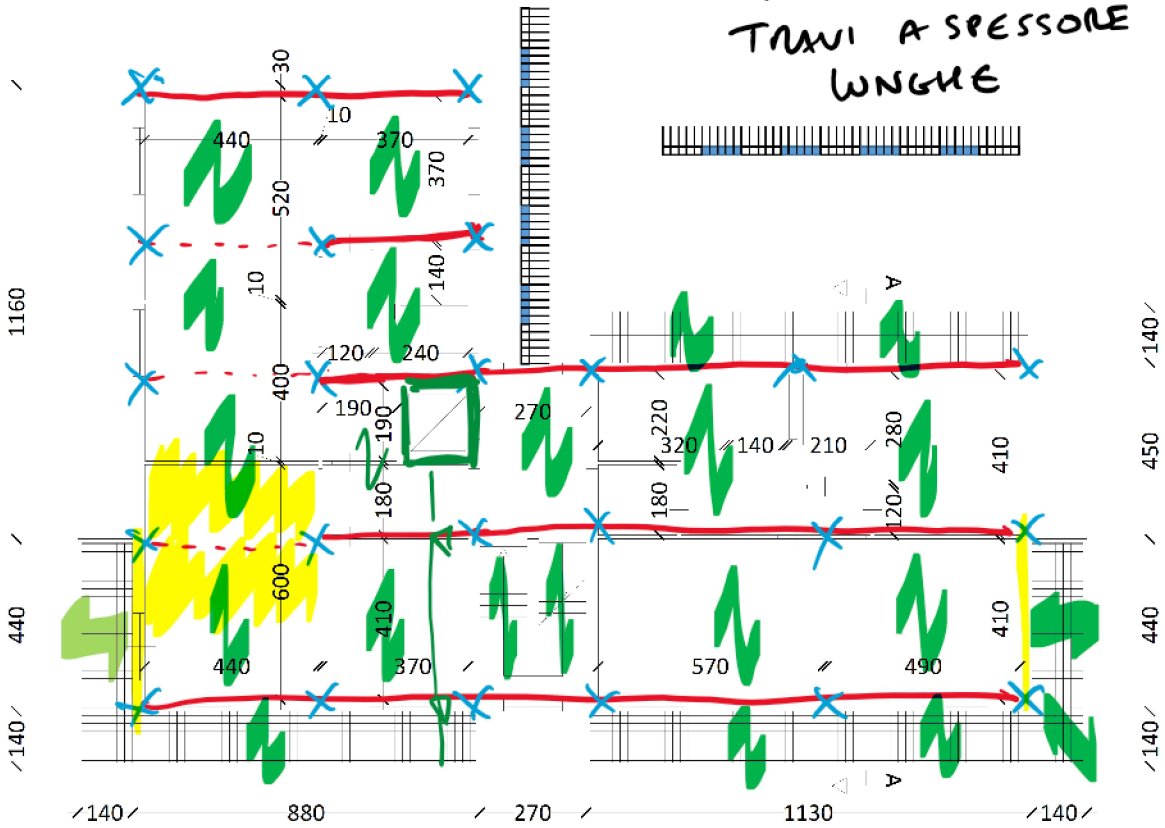
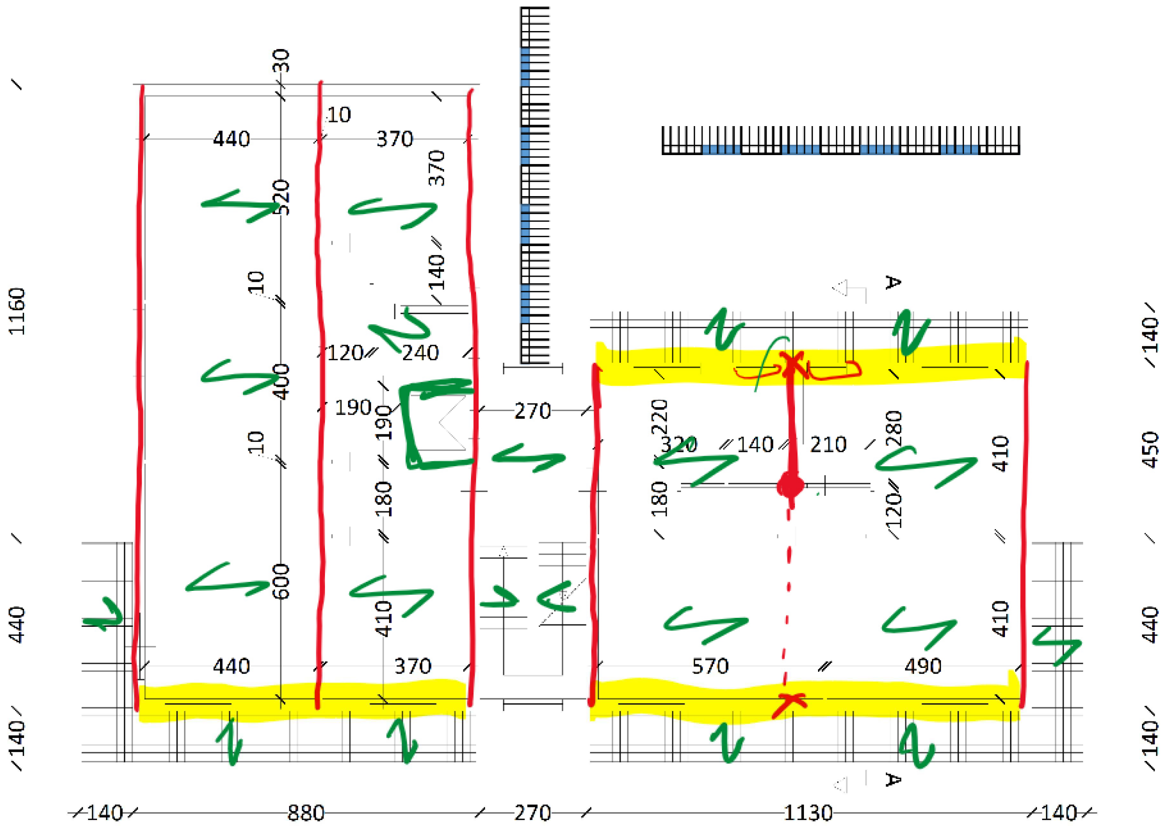
450
440
140
140
880
270
1130
140

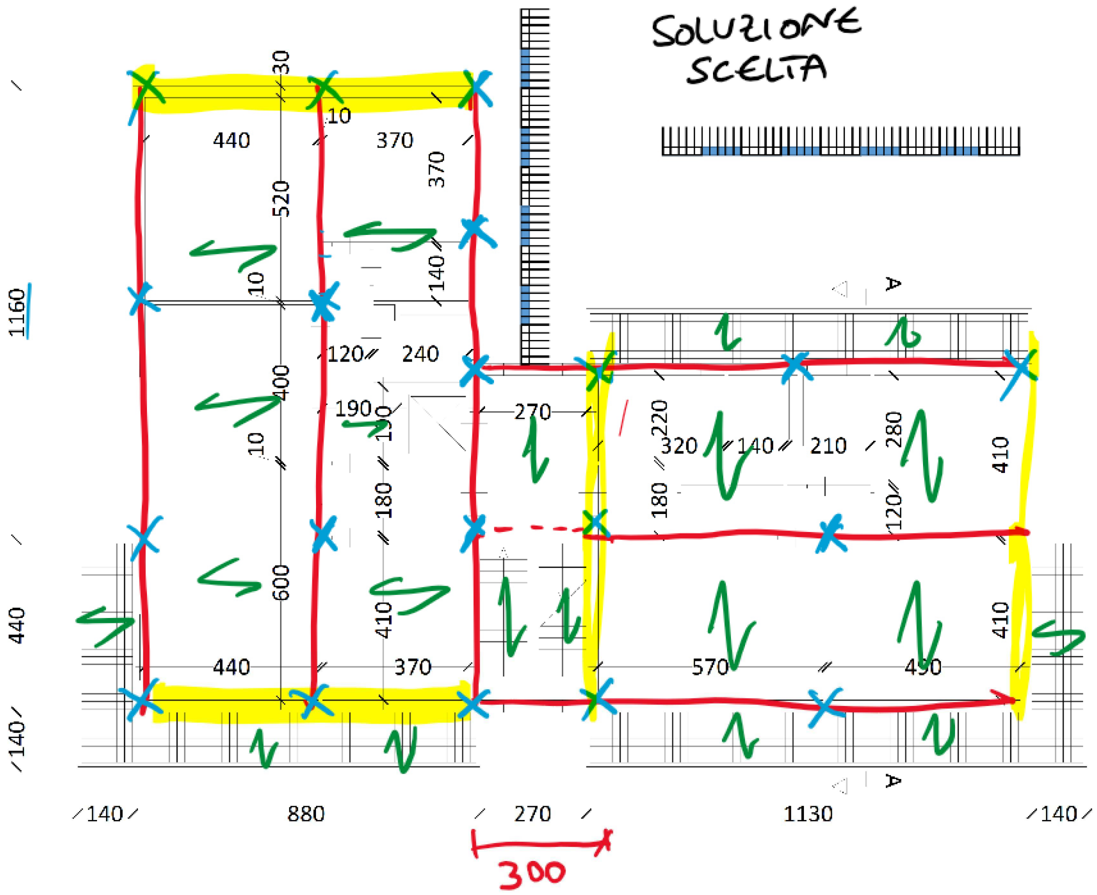
CARPENTERIA EDIFICIO

mercoledì 25 marzo 2020 16:16

PUNTO DEBOLE
TRAVI A SPESSORE
LUNGHE






SOLUZIONE SCELTA
440
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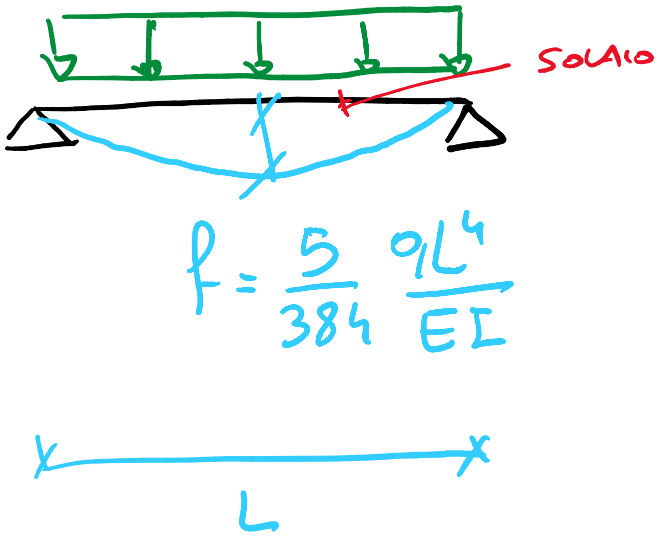
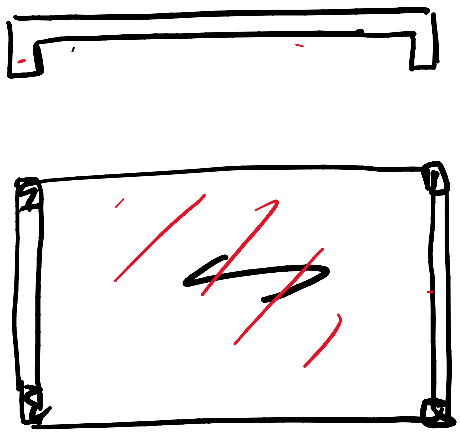
DEFINIZIONE ALTEZZA SOLAIO

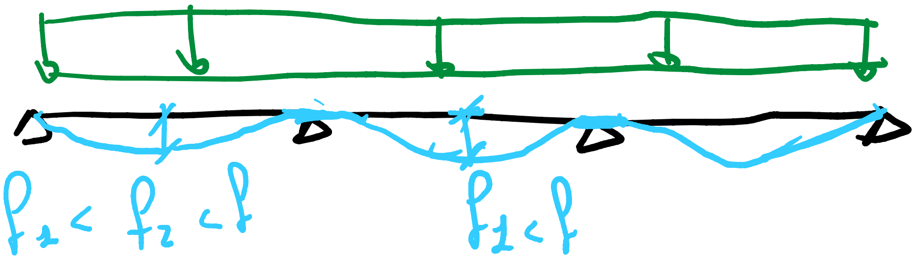
mercoledì 25 marzo 2020 16:38

PER VERIFICA DI DEFORMAZIONE (SLE)



$$f = \frac{5}{384} \frac{qL^4}{EI}$$





f DIPENDE DA
- SCHEMA STRUTTURALE
- CARICO
- LUCE
- I.

COME CALCOLO I PER STRUTTURE IN C.A.?
(PROBLEMI CON FESSURAZIONE) ⟹

APPROCCIO SEMPLIFICATO