100.18

$$r = \frac{13}{\sqrt{1065}} = \frac{13}{32,6} = 0,398 \begin{cases} 49 \\ 0,00198 \end{cases}$$

$A_f = 0,25\,A_f = 0,00198 \cdot 1,00 \cdot 32,6 \cong 6,5$ cmq.

$A'_f = 5\,\phi 14$ /ml $= 7,7$ cmq.

$A'_f = 2\,\phi 14$ /ml $= 3,08$ cmq

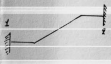
3) Trave a ginocchio

a) - Analisi dei carichi:

- gradino 364/0,30 = 1214 kg/ml
- tompagno 0,30 · 1800 · 3,00 = 1620 "
- p.p 0,3 · 0,7 · 2500 = 525

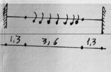
q = 3384 kg/ml.

b) - Caratt. sollec:



$$M_1 = M_2 = \frac{ql^2}{12} = \frac{3384 \cdot 5,6^2}{12} = 8840 \text{ kgm.}$$

$$T = \frac{3284 \cdot 5,6}{2} = 9200 \text{ kg.}$$



$$M_t = \left(\frac{364}{0,30} \cdot \frac{1,2}{2}\right) + 40 \cdot 1,2 + 9 = 725 + 48 + 90 = 863 \text{ kgm/ml}$$

$$M_{t_i}^{(1\text{-}2)} = \frac{836 \cdot 3,6}{2} = 1550 \text{ kgm.}$$

Armatura a flessione - $r = \dfrac{68}{\sqrt{\dfrac{85700}{3}}} = \dfrac{68}{171} = 0,333 \begin{cases} 49 \\ 0,00337 \end{cases}$

$$A'_f = 0,25\,A_f = 10,85 \text{ cmq} \begin{cases} A_f = 6\,\phi 16 = 12,06 \text{ cmq} \\ A'_f = 2\,\phi 16 = 4,02 \text{ "} \end{cases}$$

Armatura a torsione - $a/b = 70/30 = 2,33 \rightarrow \psi = 3,95$

$$\tau_{tot} = \frac{T}{0,9 \cdot b \cdot h} + \psi \cdot \frac{M_t}{a \cdot b^2} = 5,15 + [illegible] = 14,85 \text{ kg/cmq}$$

$$A_{ll} = \frac{155000\,(25+65)}{25 \cdot 55 \cdot 1400} = 6,47 \text{ cmq.}$$

$$\Delta z = \frac{2 \cdot 25 \cdot 65 \cdot 1400 \cdot 0,79}{155000} = 18,8 \text{ cm.}$$

Si arma a torsione con 10 φ10 (Aeff = 7,85 > 6,47) longitud.
e staffe φ 10/20"

Per la trave a ginocchio dell'ultimo piano si arma con $\begin{cases} A'_f = 9\,\phi 16 \\ A_f = 7\,\phi 16 \end{cases}$
per tutte $u_p = 3\,\phi 16$

Dott. Ing. Augusto Romita
ARomita

Scala (con trave a ginocchio e gradini a sbalzo).

1) Gradino (caratteristiche geometriche).

- pedata p = 30 cm.
- alzata a = 16,5 "
- larghezza intrad. gradino $b = \sqrt{30^2 + 16,5^2} = 34,24$ cm.
- lunghezza l = 1,20 ml.
- inclinazione rampa $tg\,\alpha = \frac{16,5}{30} = 0,55 \rightarrow \alpha = 28°49'$
- altezza utile $h = 16,5 \cdot 0,8762 + 5 - 3 = 16,5$ cm.

Analisi dei carichi: (per gradino)

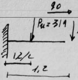
- peso proprio grad. 126 kg.
- marmo rivestim. 46 "
- massetto intonaco 40 "
- sovraccarico (400×1,20×0,30) 144 "

P = 364 kg

Componente normale $P_n = P \cdot \cos\alpha = 364 \cdot \cos 28°49' = 319$ kg.
" orizz. $P_o = P \operatorname{sen}\alpha = 364 \operatorname{sen} 28°49 = 176$ "

Caratteristica flettente

- Schema di calcolo



$$M = 0,5 \cdot 1,2 \cdot 319 + 40 \cdot 1,2 + 90 = 192 + 48 + 90 = 330 \text{ kgm.}$$

$$r = \frac{16,5}{\sqrt{\dfrac{330}{0,3424}}} = \frac{16,5}{31} = 0,532 \begin{cases} 36,5 \\ 0,00144 \end{cases}$$

$A_f = 0,00144 \cdot 31 \cdot 34,24 = 1,59$ cmq ; $A_{eff} = 1\,\phi 14 + 1\,\phi 10 = 2,33$ c

2) Pianerottolo di riposo

a) - Analisi carichi :

- p.p 0,15 · 2500 400 kg/mq.
- marmo 0,02 · 1400 28 "
- pav. intonaco 58 "
- Sovraccarico 400 "

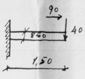
886 kg/mq.

b) - Caratteristiche soll.

$$M_{max} = \frac{886 \cdot 3,1^2}{8} = 1065 \text{ kgm.}$$

$$T = \frac{886 \cdot 3,1}{2} = 1373 \text{ kg.}$$

Verifica a torsione travi 17-19; 20-21



$l_0 = 5{,}5$ mt ; Sez $= 40 \times 65$; $q = 6170$ kg/ml ;

$$M_t = \frac{850 \cdot 1{,}5^2}{2} + 40 \cdot 1{,}5 + 90 = 1110 \text{ kgm/ml}$$

$$M_i = \frac{1110 \cdot 5{,}5}{2} = 3060 \text{ kgm.}$$

$$\frac{a}{b} = \frac{65}{40} = 1{,}62 \rightarrow \psi = 4{,}26$$

$$\tau_{max.} = \frac{6170 \cdot 5{,}5}{2 \cdot 0{,}9 \cdot 40 \cdot 63} + \frac{4{,}26 \cdot 306000}{65 \cdot 40^2} = 7{,}45 + 12{,}5 = 19{,}95 \text{ kg/cmq}$$

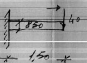
$$A_{fl} = \frac{306000\,(35+60)}{35 \cdot 60 \cdot 1400} = 10{,}8 \text{ cmq}$$

$$\Delta z = \frac{2 \cdot 35 \cdot 60 \cdot 1400 \cdot 0{,}5}{306000} \simeq 30 \text{ cm.}$$

Si armerà a torsione con 14 φ 10 longitudinali e

staffe φ8/25"

Verifica a torsione travi 2-3-4-5-6-7



$l_0 = 3{,}00$ mt ; Sez. 40·50 p.t e I piano

" 30·60 II piano

$M_t = 1110$ kgm/ml ; $M_i = \frac{1110 \cdot 3}{2} = 1665$ kgm.

p.t e I ; $\frac{a}{b} = \frac{50}{40} = 1{,}25 \rightarrow \psi = 4{,}52$

II piano $\frac{a}{b} = \frac{60}{30} = 2$ $\psi = 4{,}07$

p.t. e I $\tau = \frac{5620 \cdot 3}{2 \cdot 0{,}9 \cdot 40 \cdot 48} + \frac{4{,}52 \cdot 166500}{50 \cdot 40^2} = \underline{4{,}85 + 9{,}50} = 14{,}35$ kg/cmq

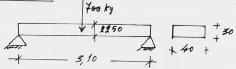
II piano $\tau = \frac{16800}{3130} + \frac{4{,}07 \cdot 166500}{60 \cdot 30^2} = 12{,}7$ kg/cmq

p.t e I $A_{fl} = \frac{166500\,(35+45)}{35 \cdot 45 \cdot 1400} = 6{,}1$ cmq ; $\Delta z = \frac{35 \cdot 45 \cdot 14}{1675} \simeq 16"$ cm

II piano $A_{fl} = \frac{166500\,(25+55)}{25 \cdot 55 \cdot 1400} = 6{,}95$ cmq ; $\Delta z = 14"$ cm.

Si arma con 10 φ10 long e staffe φ8/14"

Travetto 4'-5' di pt. I-II piano.



$$M_{4'}^- = M_{5'}^- = \frac{2250 \cdot \overline{3{,}1}^2}{12} = 1810 + \frac{700 \cdot 3{,}1}{8} = 1810 + 272 = 2082 \text{ kgm.}$$

$$r' = \frac{28}{\sqrt{\frac{20820}{4}}} = \frac{28}{72} = 0{,}389 < \begin{matrix} 51 \\ 205 \end{matrix}$$

$$A'_f = 0{,}25\,A_f = 0{,}00205 \cdot 72 \cdot 40 = 5{,}9 \text{ cmq} < \begin{cases} A_f = 3\phi 16 \\ A'_f = 2\phi 16 + 2\phi 10 \end{cases}$$

$$T = 2250 \cdot 3{,}1/2 + 350 = 3500 + 350 = 3850 \text{ kg}$$

$\tau_1 = \frac{3500}{0{,}9 \cdot 40 \cdot 28} \simeq 3{,}5$ kg/cmq ; $\tau_2 = \frac{350}{1010} \simeq 0{,}346$ kg/cmq

$S_1 = \frac{3{,}5 \cdot 155 \cdot 40}{2} = 10900$; $S_2 = 0{,}346 \cdot 40 \cdot 155 = 2150$

$$S = 13050 ; \begin{cases} u_p \simeq 2\phi 16 \\ u_{st} = \phi 8/25" \end{cases}$$

$$M_{4'-5'}^+ = 1810 + 544 = 2354 \text{ kgm.}$$

$$r' = \frac{28}{\sqrt{\frac{23540}{4}}} = \frac{28}{76{,}5} = 0{,}366 < \begin{matrix} 49 \\ 0{,}00205 \end{matrix}$$

$$A'_f = 0{,}50\,A_f = 0{,}00205 \cdot 76{,}5 \cdot 40 = 6{,}3 \text{ cmq} < \begin{cases} A_f = 3\phi 16 + 2\phi 10 \\ A'_f = 2\phi 16 + 2\phi 10 \end{cases}$$

Cordoli 1-9-17 ; 8-16-22

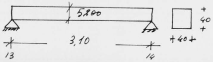
III piano 3φ16 sup. e inf.
p.t. I. II " 4φ16 " " "

Torrino travi 12-19; 13-20;

Armati con 3φ16 sup. e inf. come ela esecutivo.

Seminterrato

trave 13-14 ; 11-12



$M^-_{13} = M^-_{14} = M^+_{13-14} = \frac{5200 \cdot 3{,}1^2}{12} = 4170$ kgm.

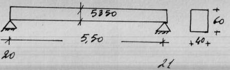
$$r' = \frac{38}{\sqrt{\frac{417000}{4}}} = \frac{38}{107} = 0{,}355 \left\langle \begin{matrix} 53 \\ 0{,}00222 \end{matrix} \right.$$

$A'_f = 0{,}5\, A_f = 0{,}00222 \cdot 107 \cdot 40 = 9{,}55$ cmq $\left\{ \begin{array}{l} A_f = 5\phi16 > 9{,}55 \\ A'_f = 2\phi16 + 2\phi10 > 4{,}775 \end{array} \right.$

$T = \frac{5200 \cdot 3{,}1}{2} = 8080$ kg; $\tau_{max} = \frac{8080}{0{,}9 \cdot 40 \cdot 38} = 5{,}88$ kg/cmq.

$S = \frac{155 \cdot 5{,}88 \cdot 40}{2} = 18200$; $u_p = \frac{7300}{3960} = 2\phi16$; $u_{st} = \frac{10900}{1400} = \phi 8/20''$

trave 20-21; 18-19



$M^-_{20} = M^-_{21} = M^+_{20-21} = 5350 \cdot 5{,}5^2/14 = 11550$ kgm.

$$r' = \frac{58}{\sqrt{\frac{1155000}{4}}} = \frac{58}{169} = 0{,}343 \left\langle \begin{matrix} 55 \\ 0{,}00227 \end{matrix} \right.$$

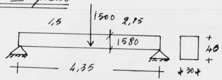
$A'_f = 0{,}5\, A_f = 0{,}00227 \cdot 40 \cdot 169 = 16{,}7$ cmq $< 8\phi16 + 2\phi10$

$T = \frac{5350 \cdot 5{,}5}{2} = 14700$ kg ; $\tau = \frac{14700}{2080} = 7{,}08$ kg/cmq

$S = \frac{7{,}08 \cdot 277 \cdot 40}{2} = 39200$; $u_p = \frac{15700}{3960} = 4\phi16$

$u_{st} = \frac{23500}{1400} = \phi 8/15''$

Travi 4-12; 5-13 di p.t. - I - II piano



$M^-_4 = \frac{1580 \cdot 4{,}35^2}{12} + \frac{1500 \cdot 1{,}5 \cdot 2{,}85^2}{4{,}35^2} = 2490 + 965 = 3455$ kgm.

$$r' = \frac{38}{\sqrt{\frac{34550}{3}}} = \frac{38}{107} = 0{,}355 \left\langle \begin{matrix} 52 \\ 220 \end{matrix} \right.$$

$A'_f = 0{,}5\, A_f = 0{,}00220 \cdot 107 \cdot 30 = 7{,}1$ cmq $< 3\phi16 + 2\phi10$

$T = \frac{1580 \cdot 4{,}35}{2} + \frac{1500 \cdot 2{,}85}{4{,}35} = 3430 + 985$

$\tau_1 = \frac{3430}{1025} = 3{,}35$ kg/cmq ; $\tau_2 = \frac{985}{1025} = 0{,}96$ kg/cmq

$S_1 = \frac{3{,}35 \cdot 217{,}5 \cdot 30}{2} = 11000$; $S_2 = 0{,}96 \cdot 30 \cdot 285 = 8200$

$S = 19200$; $u_p = \frac{7700}{3960} = 2\phi16$

$u_{st} = \frac{11500}{1400} = \phi 8/25''$

$M_{12} = \frac{1580 \cdot 4{,}35^2}{12} + \frac{1500 \cdot 2{,}85 \cdot 1{,}5^2}{4{,}35^2} = 2490 + 476 = 2966$ kgm.

$$r' = \frac{38}{\sqrt{29660/3}} = \frac{38}{99{,}5} = 0{,}382 \left\langle \begin{matrix} 52 \\ 0{,}00215 \end{matrix} \right.$$

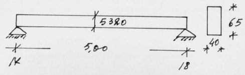
$A'_f = 0{,}25\, A_f = 0{,}00215 \cdot 99{,}5 \cdot 30 = 6{,}42$ cmq $< 3\phi16 + 2\phi10$

$M^+_{4-12} = 2490 + \frac{1500 \cdot 1{,}5^2 \cdot 2{,}85^2}{4{,}35^2} = 2490 + 476 = 3830$ kgm.

$$r' = \frac{38}{\sqrt{\frac{38300}{3}}} = \frac{38}{113} = 0{,}337 \left\langle \begin{matrix} 54 \\ 0{,}00235 \end{matrix} \right.$$

$A'_f = 0{,}75\, A_f = 0{,}00235 \cdot 113 \cdot 30 = 8$ cmq $< 4\phi16$; $A'_f = 3\phi16$

Trave 17-18 di p.t. primo e secondo piano



$M_{17}^- = M_{18}^- = M_{17-18}^+ = \frac{5320 \cdot 5^2}{12} = 11100$ kgm.

$z' = \frac{63}{\sqrt{\frac{111000}{4}}} = \frac{63}{166,5} = 0,378 <$ $\sigma_c = 50$; $t = 0,00205$

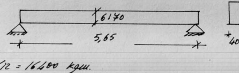
$A_f' = 0,5\,A_f = 0,00205 \cdot 166,5 \cdot 40 = 13,65$; $A_f = 6\phi16 + 2\phi10$

$A_f' = 3\phi16 + 2\phi10$

$T = \frac{5320 \cdot 5}{2} = 13350$; $\tau_{max} = \frac{13350}{2080} = 6,4$;

$S = \frac{250 \cdot 6,4 \cdot 40}{2} = 32000$; $M_p = \frac{12800}{3960} = 3\phi16$; $M_{st} = \frac{19200}{1400} = \phi8/18''$

Trave 18-19 di p.t. primo e secondo piano



$M_{18}^- = M_{19}^- = 6170 \cdot 5,65^2/12 = 16400$ kgm.

$z' = \frac{63}{\sqrt{\frac{164000}{4}}} = \frac{63}{202} <$ 55 ; $0,00252$

$A_f' = A_f = 0,00252 \cdot 202 \cdot 40 = 20,5$ cmq $< 10\phi16$

$M_{18-19}^+ = \frac{6170 \cdot 5,65^2}{18} = 10900$ kgm.

$z' = \frac{63}{\sqrt{\frac{109000}{4}}} = 0,382 <$ 53 ; $0,00315$

$A_f' = 0,25\,A_f = 14,2$ cmq ; $A_f = 7\phi16 + 2\phi10$; $A_f' = 3\phi16 + 2\phi10$

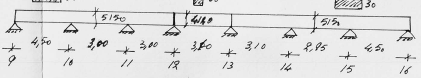
$T = \frac{6170 \cdot 5,65}{2} = 17400$; $\tau_{max} = \frac{17400}{0,9 \cdot 63 \cdot 40} = 7,68$ kg/cmq

$S = 287,5 \cdot 7,68 \cdot 40/2 = 44200$ kg.

$M_p = \frac{17700}{3960} \cong 5\phi16$

$M_{st} = \frac{28500}{1400} = \phi8/15''$

Travi 9-10-11-12-13-14-15-16 di p.t; primo e secondo piano



$K_{10-9} = 0,329$; $K_{10-11} = 0,671$; $K_{11-10} = 0,512$; $K_{11-12} = 0,488$

$K_{12-11} = \frac{3,68}{3,68+2,16} = 0,630$; $K_{12-13} = 0,370$

$M_9 = \frac{5150 \times 4,5^2}{24} = 4340$ kgm; $M_{10-9} = \frac{5150 \times 4,5^2}{8} - 2170 = 6530$

$M_{10-11} = 3870$; $M_{11-12} = 3870$; $M_{12-13} = 3300$

9	10: 0,329	10: 0,671	11: 0,512	11: 0,488	12: 0,630	12: 0,370
-4340	+ 6530	-3870	+3870	-3870	+3870	-3300
	-880_1	-1780_1	- 820	$+445_2$	+222	-292_3
	-74_4	+222	$+445_2$	-250	-500_3	-30_6
	-27_7	-148_4	- 74	$+162_5$	+ 81	-5_9
	-4_{10}	+ 81	$+162_6$	-25	-51_6	
		-54_7	-27	$+26_8$	+13	
		+13	$+26_8$	-4	-8_9	
		-9_{10}	-4	+4		
			+4			
	5545		3512		3627	

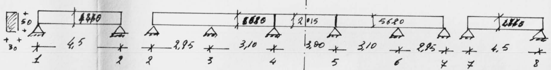
	9	9-10	10	10-11	11	11-12	12	12-13
M_i	4340		5545		3512		3627	
T_i	11427	11600 ± 273	11873 | 8459	7740 ± 419	7021 | 7534	7740 ± 206	7946 | 6400	6400
M^+_{max}		8110		1374		2140		945
	$\sigma_c/\sigma_f = 50,5/1400$ $A_f = 12,1 < 6\phi16 + 2\phi10$	$\sigma_c/\sigma_f = 60/1400$ $A_f' = 0,75\,A_f = 22,6 < 11\phi16$	$\sigma_c/\sigma_f = 53/1400$ $A_f' = 0,5\,A_f = 15,8 < 7\phi16 + 2\phi10$	$\sigma_c/\sigma_f = 26/1400$ $A_f = 3,8 < 2\phi16$	$\sigma_c/\sigma_f = 44/1400$ $A_f = 9,5 < 5\phi16$	$\sigma_c/\sigma_f = 33,5/1400$ $A_f = 5,82 < 3\phi16$	$\sigma_c/\sigma_f = 45,5/1400$ $A_f = 11,3 < 6\phi12$	$\sigma_c/\sigma_f < 25/1400$ $A_f = 2\phi16$

$\tau_{max} = 5,98$ kg/cmq ; $\tau = 3,44$; $\tau = 3,33$

$M_p = 5\phi16$ piegati ; $M_p = 3\phi16$; $M_p = 3\phi16$; $1\phi16$ piegati

$M_{st} = \phi10/13''$; st $= \phi10/13''$; ~~st = φ8/13~~ ; st $\phi8/25''$

Travi 1-2; 2-3-4-5-6-7-8 di secondo piano - primo e piano terra

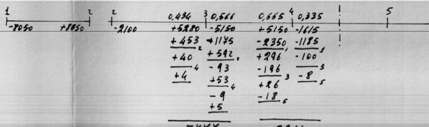


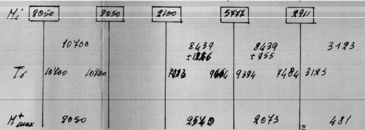
$M_1^- = M_2^- = M_{1-2}^+ = 4770 \times 4{,}5^2/2 = 8050$ kgm.

$M_{3-4} = \frac{5620 \cdot 3{,}1^2}{12} = 5150$; $M_{4-5} = \frac{2015 \times 3{,}0^2}{12} = 1615$

$M_2 = \frac{5620 \cdot 3{,}1^2}{24} = 2100$; $M_{3-2} = \frac{5620 \cdot 3{,}0^2}{8} - 1050 = 5280$

$k_{3-2} = \frac{1}{1+1{,}31} = 0{,}434$; $k_{3-2} = 0{,}566$; $k_{4-3} = \frac{1{,}31}{1{,}30+0{,}677} = 0{,}655$; $k_{4-5} = 0{,}335$





$\sigma_c/\sigma_f = 54/1400$

$A_f' = 0{,}5\,A_f = 11 < 6\phi16$

$A_f = 6\phi16$

$A_f' = 3\phi16$

$A_f = 6\phi16$

$A_f' = 3\phi16$

$\sigma_c/\sigma_f = 33{,}5/1400$

$A_f = 3{,}33 < 2\phi16$

$\sigma_c/\sigma_f = 38/1400$

$A_f = 4{,}1 < 3\phi16$

$\sigma_c/\sigma_f = 55/1400$

$A_f' = 0{,}5\,A_f = 9{,}5 < 5\phi16$

$\sigma_c/\sigma_f = 33{,}5/1600$

$A_f = 3{,}32 < 2\phi16$

$\sigma_c/\sigma_f = 41/1400$

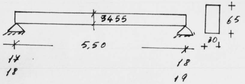
$A_f = 4{,}72 < 2\phi16 + 2\phi10$

$A_f' = A_f = 2\phi16$

$\tau_{max} = 6{,}85$ kg/cmq ; $\tau_{max} = 7{,}45$; $\tau_{max} = 4{,}25$

$u_p = 2\phi16$ piegati ; $u_p = 2\phi16$; $u_p = 2\phi16$

Trave 17-18; 18-19 di terzo piano



$M_{17}^- = M_{18}^- = M_{19}^- = \frac{3455 \times 5{,}5^2}{24} = 4350$ kgm.

$r = \frac{63}{\sqrt{\frac{43500}{3}}} = \frac{63}{\sqrt{14500}} = \frac{63}{120{,}5} = 0{,}522 \left< \begin{matrix} 37{,}5 \\ 0{,}0147 \end{matrix} \right.$

$A_f = 0{,}00147 \times 120{,}5 \times 30 = 5{,}22 < 2\phi16 + 2\phi10$

$T = \frac{3450 \cdot 5{,}5}{2} = 9450$ kg ; $\tau = \frac{9450}{0{,}9 \cdot 63 \cdot 30} = 5{,}55$ kg/cmq

$S = \frac{273 \cdot 30 \cdot 5{,}55}{2} = 22700$; $u_p = \frac{9100}{3960} \simeq 2\phi16$ piegati.

$u_{st} = \frac{13600}{1600} = \phi8/25''$

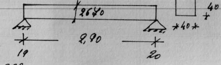
$M_{17-18}^+ = M_{18-19}^+ = \frac{3455 \cdot 5{,}5}{10} = 10450$ kgm.

$r = \frac{63}{\sqrt{\frac{104500}{3}}} = \frac{63}{188} = 0{,}338 \left< \begin{matrix} 57 \\ 0{,}00235 \end{matrix} \right.$

$A_f' = 0{,}50\,A_f = 0{,}00235 \cdot 188 \cdot 30 = 13{,}3$ cmq

$A_f = 6\phi16 + 2\phi10$; $A_f' = 3\phi16 + 2\phi10$

Trave 19-20 del pianerottolo di riposo



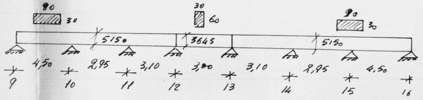
$M_{19}^- = M_{20}^- = M_{19-20}^+ = \frac{2670 \times 3{,}2^2}{12} = 2290$

$r = \frac{38}{\sqrt{\frac{22900}{4}}} = \frac{38}{88} = 0{,}432 \left< \begin{matrix} 46{,}5 \\ 0{,}00180 \end{matrix} \right.$

$A_f = 0{,}00180 \cdot 88 \cdot 40 = 6{,}35$ cmq $< 3\phi16 + 2\phi10$

$T = \frac{2670 \times 2{,}90}{2} = 4280$; $\tau = \frac{4280}{0{,}9 \cdot 40 \cdot 32} = 3{,}13 \begin{cases} u_p = 1\phi16 \\ st.\ \phi8/25'' \end{cases}$

Travi 9-10-11-12-13-14-15-16 di terzo piano



$K_{10-9} = 0{,}329$; $K_{10-11} = 0{,}671$; $K_{11-10} = 0{,}512$; $K_{11-12} = 0{,}488$

$K_{12-11} = \frac{3{,}68}{3{,}68+2{,}16} = 0{,}630$; $K_{12-13} = 0{,}370$

$M_9 = \frac{5150 \times 4{,}5^2}{32} = 3270$ kgm; $M_{10-9} = \frac{5150 \times 4{,}5^2}{8} - 1635 = 11365$

$M_{10-11} = 3620$; $M_{11-12} = 4130$; $M_{12-13} = 2730$

9	0,329	10 0,671	0,512	11 0,488	0,630	12 0,370
-3270	+11365	-3620	+3620	-4130	+4130	-2730
	-2545_1	-5220_1	-2610	$+1520_2$	+760	-700_3
	-58_5	+175	$+1600_2$	-680	-1360_3	-63_5
	-9_7	-114_5	$+350_4$	$+330_4$	+165	-9_8
		+25	-58	-52	-104_5	
		-17_7	+51	$+49_6$	+25	
		+4	-8	-8	-16_8	
			$+8_9$	$+8_9$	+4	

M_i 3270 8764 2963 3604

T_i 10380 | 11160 ±1220 | 12380 9565 | 7600 ±1965 | 5635 7783 | 7920 ±207 | 8197 7750 | 7750

M^+_{max} 7180 186 2917 2226

$\sigma_c/\sigma_f = 32/1400$
$A_f = 9{,}15 < 10\phi16$
$\sigma_c/\sigma_f = 60/1400$
$A'_f = 0{,}5 A_f = 20 < 10\phi16$
$A'_f = 5\phi16 + 2\phi10$
$\sigma_c/\sigma_f = 57/1400$
$A'_f = A_f = 23{,}2 < 11\phi16$
$A_f = 2\phi16$
$\sigma_c/\sigma_f = 41/1400$
$A_f = 8{,}22 < 4\phi16 + 2\phi10$
$\sigma_c/\sigma_f = 60/1400$
$A_f = 8{,}7 < 4\phi16 + 2\phi10$
$\sigma_c/\sigma_f = 45{,}5/1400$
$A_f = 10{,}0 < 5\phi16 + 2\phi10$
$\sigma_c/\sigma_f = 28/1400$
$A_f = 2{,}9 < 2\phi16$

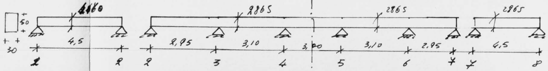
$\tau_{max} = 4{,}6$ kg/cmq ; $\tau_{max} = 4{,}25$; $\tau_{max} = 3{,}44$; $\tau_{max} = 4{,}94$

$n_p = 5\phi16$ piegati ; $n_p = 4\phi16$; $n_p = 2\phi16$; $n_p = 2\phi16$

staffe $\phi10/13''$; st. $\phi10/13''$

Calcolo travi

Travi 1-2; 2-3-4-5-6-7-8 di terzo piano



$M_1^- = M_2^- = \frac{2865 \times 4{,}5^2}{24} = 2420$ kgm; $M_{1-2}^+ = \frac{2865 \times 4{,}5^2}{10} = 5800$ kgm;

$\mu_{3-4} = \frac{2865 \cdot 3{,}1^2}{12} = 2300$; $\mu_{4-5} = 2150$

$\mu_2 = \frac{2865 \cdot 2{,}95^2}{24} = 1040$; $\mu_{3-2} = \frac{2865 \cdot 2{,}95}{8} - 400 = 2725$

$K_{3-2} = \frac{1}{1+1{,}31} = 0{,}435$; $K_{3-4} = 0{,}565$; $K_{4-3} = \frac{1{,}31}{1{,}31+0{,}655}$; $K_{4-5} = 0{,}333$

1	2	2	0,435	3 0,565	0,667	4 0,333	5
		-1040	+2425	-2300	+2300	-2150	
			-185_1	-240_1	-120	-10_2	
			$+4_3$	-10	-20_2	+1	
				$+6_2$	+3		
			2544		2163		

M_i 2420 2420 1040 2544 2163

T_i 6450 | 6450 ±000 | 6450 | 3750 | 4230 ±480 | 4710 4353 | 4230 ±123 | 4107 4230 | 4230

M^+_{max} 5800 3400 456 957

$\sigma_c/\sigma_f = 36{,}5/1400$
$A_f = 3{,}88$ cmq $< 2\phi16$
$\sigma_c/\sigma_f = 55/1400$
$A'_f = 0{,}5 A_f = 9{,}5 < 5\phi16$
$\sigma_c/\sigma_f = 36{,}5/1400$
$A_f = 3{,}88$ cmq $< 2\phi16$
$\sigma_c < 25$
$A_f = 2\phi16$
$\sigma_c/\sigma_f = 44/1400$
$A_f = 5{,}42 < 3\phi16$
$\sigma_c/\sigma_f = 38/1400$
$A_f = 4{,}00$ cmq $< 2\phi16$
$\sigma_c < 25$
$A_f = 2\phi16$
$\sigma_c/\sigma_f = 34{,}5/1400$
$A_f = 3{,}47 < 2\phi16$
$\sigma_c < 25$
$A_f = 2\phi16$

Per tutte le travi: $T_{max} = \frac{2865 \cdot 4{,}5}{2} = 6450$; $\tau_{max} = \frac{6450}{2865} = 3{,}88$ kg/cmq

$2\phi16$ piegati; staffe $\phi8/25''$

Verifica a torsione pilastro n°18

Sez. pilastro 35×75 ; **trave 17-18** : $M = 4350$ kgm.

$A_f = 8\phi16 = 16{,}08$ cmq.

$A'_f = 2\phi16 + 2\phi10 = 5{,}59$ cmq

$b = 30 \; ; \; h = 63$

trave 18-19 : idem

Asse neutro : $Y = 10 \cdot \frac{21{,}64}{30} \left[-1 + \sqrt{1 + 60 \frac{450{,}24 + 11{,}18}{4695{,}9}} \right] = 11{,}95$ cm.

$h - Y/3 = 63 - 3{,}98 = 59{,}02.$

$F = \frac{435000}{59{,}02} = 7380$ kg

$\frac{a}{b} = \frac{75}{35} = 2{,}14 \longrightarrow \Psi = 4{,}02$

$M_t = 7380 \cdot 60 = 442\,800$ kgcm.

$\tau = \frac{4{,}02 \cdot 442\,800}{75 \cdot 35^2} = 18{,}4$ kg/cmq.

$A_{fl} = \frac{442\,800 \cdot (30+70)}{30 \cdot 70 \cdot 1400} = 15$ cmq ; $\Delta z = \frac{2 \cdot 30 \cdot 70 \cdot 1400 \cdot 0{,}79}{442\,800} = 10{,}5$

Si armerà solo con staffe $\phi10/10''$

Verifica a torsione pilastro n°2

Sez. pilastro 30×75 ; **trave 1-2** ; $M = 2420$ kgm.

$A_f = 4\phi16 + 2\phi10 = 9{,}61$ cmq

$A'_f = 3\phi16 = 6{,}03$ cmq

$b = 30 \; ; \; h = 48$

trave 2-3 ; $M = 1040$ kgm.

$A_f = 2\phi16 + 2\phi10 = 5{,}77$ cmq

$A'_f = 2\phi16 = 4{,}02$

$b = 30 \; ; \; h = 48$

Trave 1-2

Asse neutro sez. incastro: $Y = \frac{10 \cdot 15{,}64}{30} \left(-1 + \sqrt{1 + 60 \frac{461{,}28 + 11{,}06}{2460}} \right) = 13{,}3$ cm.

$h - \frac{Y}{3} = 48 - 13{,}3/3 = 33{,}57$ cm.

$F = \frac{242000}{33{,}57} = 6990$ kg

Trave 2-3

Asse neutro sez. incastro : $Y = \frac{10 \cdot 9{,}79}{30} \left(-1 + \sqrt{1 + 60 \frac{276{,}96 + 8{,}04}{960}} \right) = 10{,}8$ cm.

$h - Y/3 = 48 - 3{,}6 = 44{,}4$ cm.

$F = \frac{104000}{44{,}4} = 2350$ kg.

$M_t = 2350 \cdot 60 + (6990 - 2350) \cdot 22{,}5 = 245\,500$ kgcm.

$\frac{a}{b} = \frac{75}{30} = 2{,}5 \longrightarrow \Psi = 3{,}82$

$\tau = \frac{3{,}82 \cdot 245\,500}{75 \cdot 30^2} = 13{,}90$ kg/cmq.

$A_{fl} = \frac{245\,500 \cdot (70+25)}{70 \cdot 25 \cdot 1400} = 9{,}9$ cmq.

L'armatura regol. è già suff. si dispongono staffe $\phi8/10''$

Verifica pilastri perimetrali di 3° piano

Pilastri 1-8:

$A_c = 30 \times 30$; $A_f = A'_f = 3 \phi 18 = 7{,}63$ cmq
$M = 2420$ kgm; $N = 7900$ kg
$e = 2420/7900 = 0{,}307$ $\quad d = 0{,}157$

Asse neutro:

$$\frac{30}{6} y^3 + \frac{30 \cdot 15{,}7}{2} y^2 + 10\left[7{,}63(15{,}7+28) + 7{,}63(15{,}7+2)\right] y =$$

$$= 10\left[7{,}63 \cdot 28 (15{,}7+28) + 7{,}63 \cdot 2 (15{,}7+2)\right];$$

$$5y^3 + 236 y^2 + 4690 y = 95000 ; \quad y = 11{,}9 \text{ cm.}$$

Sollecitaz. $$\sigma_c = \frac{7900}{\frac{30 \cdot 11{,}9}{2} + 10 \cdot 7{,}63\left(2 - \frac{30}{11{,}9}\right)} = 44{,}5 \text{ kg/cmq.}$$

$$\sigma_f = \frac{44{,}5 \cdot 10}{11{,}9} (28 - 11{,}9) = 605 \text{ kg/cmq}$$

Pilastri 9-16:

$M = 3270$ kgm ; $N = 15230$ kg.
$A_c = 30 \times 30$ cmq ; $A_f = A'_f = 7{,}63$ cmq.
$e = 3270/15230 = 0{,}214$; $d = 0{,}064$

Asse neutro:

$$5y^3 + 96 y^2 + 3270 y = 75000$$

$$y = 13{,}7 \text{ cm.}$$

$$\sigma_c = \frac{15230}{30 \cdot \frac{13{,}7}{2} + 10 \cdot 7{,}63\left(2 - \frac{30}{13{,}7}\right)} = 69{,}5 \text{ kg/cmq.}$$

$$\sigma_f = 725 \text{ kg/cmq.}$$

Pilastri 17-22;

$M = 3270$ kgm; $N = 11000$ kg.
$A_c = 30 \times 30$ cmq ; $A_f = A'_f = 7{,}63$ cmq.
$e = 3270/11000 = 29{,}7$ cm ; $d = 14{,}7$ cm.

Asse neutro: $$5y^3 + 220{,}5 y^2 + 3750 y = 94000 ; \quad y = 13{,}3 \text{ cm.}$$

$$\sigma_c / \sigma_f = 50/552 \text{ kg/cmq.}$$

- **Plinto tipo C**

Pilastri I2-I3-I9-20

Scarico max= I578I5 Kg (Pilastri I9-20)

Sezione pilastri 60 x 60 cmq; Ferro I2 Ø I8 = 30,54 cmq

σ_c= 33,7 kg/cmq;

P_t= I658I5 Kg ; σ_{tn}= 3,94 Kg/cmq
A_{sp}= 200 x 200 cmq
R = 35850 Kg/cmq; d = 40,5 cm; M=I4520 kgcm
σ_c / σ_f = 32/I400 ; A_f = I2,7 cmq
τ_{max}= 2,63 Kg/cmq.

- **Plinto tipo D**

Piastri 2-8-I8-2I

Scarico Max = I30725 (Pilastro I8)

Sezione pilastri 40 x 85 cmq; Ferro I0 Ø I8 = 25,45 cmq

P_t= I37725 Kg ; σ_{tn}= 3,58 Kg/cmq
A_{sp}= I70 x 2I5 cmq
R = 35000 Kg ; d = 37,25 cm; M=I3037 Kgcm
σ_c / σ_f=42,5/I400 ; A_f = I2,2 cmq
τ_{max}= 2,32 Kg/cmq

FONDAZIONI SU PLINTI

- Plinto tipo A

Pilastri I-3-4-5-6-8-II-I4

Scarico max = 68660 Kg(Pilastri II-I4)

Sezione pilastri 40 x40 ; Ferro 6 Ø I8 = I5,27 cmq ;

σ_c = 68660/I752,7 = 39,2 Kg/cmq

Per una pressione di 4 Kg/cmq si ha:

A_{tn}= 72.000/4 = I7950 cmq; A_b= I40 x I40

σ_{tn}=3,5 Kg/cmq

R = I3000 Kg; D = 23,75 cm ; M = 309000 Kgcm;

σ_c/σ_f= 36/I400 ; A_f= 309000:0,9x45xI400=

= 5,45 cmq ; τ_{max}=(I3000-3090/0,48):0,9x48x40=

= 4,78 Kg/cmq.

- Plinto tipo B

Pilastri 9-I0-I5-I6-22

Scarico max = 87880 Kg (Pilastri 9-I6)

Sezione Pilastri 40 X 50 ; 6 Ø I8 = I5,27 cmq ;

σ_c=87880/2203,6 = 39,7 cmq

P_t= 92880 Kg; σ_{tn}= 3,65 Kg/cmq;

A_{sp}= I50 X I60 cmq

R = 3,65Kg; d = 28,75 cm; M = 580000 Kgcm;

σ_c / σ_f =29,5/I400 ; A_f= 580000/0,9x60xI400=

= 7,65 cmq; τ_{max}=(20I00-5800/0,46I)3230=

= 2,34 Kg/cmq ;

TABELLA DEI PILASTRI

PIL. n°	Piano	Sez. cmq	A_c cmq	Armat.	A_f cmq	A_i cmq	Sollecit. Kg/cmq	Staffe
I-8	III	30x30	900	6ØI8	I5,27	I052,7	8,I9	Ø6/I5"
2-7	"	30x75	2250	9ØI6	I8,09	2430,9	5,5	Ø8/I0"
3-6	"	30x30	900	4ØI6	8,04	980,4	9,8	Ø6/I5"
4-5	"	"	"	"	"	"	"	"
9-I6	"	"	"	6ØI8	I5,27	I052,7	I5,7	"
I0-I5	"	"	"	4ØI6	8,04	980,4	20,2	"
II-I4	"	"	"	"	"	"	I7,0	"
I2-I3	"	"	"	6ØI6	I2,06	I020,6	26,8	"
I7-22	"	"	"	6ØI8	I5,27	I052,7	II,I8	"
I8-2I	"	35x75	2625	9ØI6	I8,09	2805,9	6,9	ØI0/I0"
I9-20	"	30x30	900	6ØI6	I2,06	I020,6	3I,6	Ø6/I5"
I-8	II	30x30	900	6ØI6	I2,06	I020,6	24,5	Ø6/I5"
2-7	"	30x75	2250	9ØI6	I8,09	2430,9	I4,4	Ø8/I0"
3-6	"	30x30	900	4ØI6	8,04	980,4	28,3	Ø6/I5"
4-5	"	"	"	"	"	"	27,4	"
9-I6	"	30x40	I200	6ØI6	I2,06	I320,6	3I,5	"
I0-I5	"	"	"	"	"	"	29,5	"
II-I4	"	"	"	"	"	"	24,2	"
I2-I3	"	40X40	I600	6ØI8	I5,27	I752,7	32	Ø6/20"
I7-22	"	30x40	I200	6ØI6	I2,06	I320,6	24,3	Ø6/I5"
I8-2I	"	35x85	2975	I0ØI6	20,I0	3I75	I9,3	ØI0/I0"
I9-20	"	40x40	I600	6ØI8	I5,27	I752,7	36,3	Ø6/20"
I-8	I	35x40	I400	6ØI6	I2,06	I520,6	27,3	Ø6/I5"
2-7	"	35x85	2975	I0ØI8	25,45	3229,5	I5,I	Ø8/I0"
3-6	"	35x40	I400	6ØI6	I2,06	I520,6	35,5	Ø6/I5"
4-5	"	"	"	"	"	"	29,2	"
9-I6	"	40x40	I600	6ØI8	I5,27	I752,7	35,8	"
I0-I5	"	35x45	I575	"	"	"	34,7	"
II-I4	"	40x40	I600	"	"	"	29,0	"
I2-I3	"	45x50	2250	8ØI8	2453,5		34,7	Ø6/20"
I7-22	"	40x40	I600	6ØI8	I5,27	I752,7	30,7	"
I8-2I	"	35x85	2975	I0ØI8	25,45	3229,6	26,7	ØI0/I0"
I9-20	"	45x50	2250	8ØI8	20,36	2453,6	39,I	Ø6/20"
I-8	P.ter.	40x40	I600	6ØI8	I5,27	I752,7	33,5	Ø6/20"
2-7	"	40x85	3400	I0ØI8	25,45	3654,5	2I,3	Ø8/I0"
3-6	"	40x40	I600	6ØI8	I5,27	I752,7	37,8	Ø6/20"
4-5	"	"	"	"	"	"	36,0	"
9-I6	"	40x50	2000	8ØI8	20,36	2203,6	39,7	"
I0-I5	"	"	"	"	"	"	37,0	"
II-I4	"	40x40	I600	6ØI8	I5,27	I752,7	39,2	"
I2-I3	"	50x50	2500	8ØI8	20,36	2703,6	42,7	"
I7-22	"	40x50	2000	"	"	2203,6	34,6	"
I8-2I	"	40x85	3400	I0ØI8	25,45	3654,5	35,8	ØI0/I0"
I9-20	"	50x50	2500	"	"	2754,5	46,7	Ø6/20"
I2-I3	Inter.	60x60	3600	I2ØI8	30,54	3905,4	33,7	Ø6/20"
I9-20	"	60x60	"	"	"	"	40,6	"

SCARICHI SUI PILASTRI

PIL.n°	SCARICO	3°Piano	2°Piano	I°Piano	Piano t.	Inter.	TOtale
I	Trave I-2	6450	I0500	I0500	I0500		37850
	" I-9	I450	4750	4750	4750		I5700
	Pilastro	700	700	I200	I200	800	5I00
		8600	I6450	I6450	I6450	800	58750
2	Trave 2-I	6350	I0500	I0500	I0500		37850
	" 2-3	4300	8430	8430	8430		29590
	Pilastro	I700	I920	2250	2550	I700	II050
		I2350	20850	2I300	2I480	I700	77780
3	Trave2-3-4	8900	I7400	I7400	I7400		6II00
	Pilastro	700	900	I200	I200	800	4800
		9600	I8300	I8600	I8600	800	65900
4	Trave 4-3	8900	9000	9000	9000		35900
	" 4-5		3030	3030	3030		9090
	" 4-I2		4380	4380	4380		I3I40
	Pilastro	700	900	II00	I350	800	4800
		9600	I73I0	I75I0	I7750	800	62970
9	Trave 9-I0	II330	II330	II330	II330		45320
	" 9-I	I680	4750	4750	4750		I5930
	" 9-I7	2220	6270	6270	6270		2I030
	Pilastro	700	900	I000	I500	I000	5I00
		I5930	23250	23550	24050	I000	87880
I0	Trave9-I0-II	I9055	I9055	I9055	I9055		76220
	Pilastro	700	900	I200	I500	I000	5300
		I9755	I9955	20255	20455	I000	8I520
II	TraveI0-II-I2	I5965	I5965	I5965	I5965		63860
	Pilastro	700	900	I200	I200	800	4800
		I6665	I6865	I7I65	I7I65		68660
I2	Trave I2-I9	3220					3220
	Pilastro	620					620
	Trave I2-II	8250	8250	8250	8250	8330	33080
	" I2-I3	5395	6I80	6I80	6I80	4000	27935
	" I2-I9	9I95	9I95	9I95	9I95	9I95	45975
	" I2-4		3925	3925	3925		II775
	Pilastro	700	I200	I520	I890	2250	8I70
		27380	28750	29070	29440	23775	I30685
I7	Trave I7-I8	8800	I3550	I3550	I3550		49450
	" I7-9	2220	6270	6270	6270		2I030
	Pilastro	700	I200	I200	I500	I000	5600
		II700	2I020	2I020	2I320	I000	76080
I8	Trave I7-I8	8800	I3550	I3550	I3550		49450
	" I8-I9	9500	I6970	I6970	I6970		604I0
	" 20-2I					9660	
	Pilastro	I700	2550	2550	2550	I700	II050
		20000	33070	33075	33075	II360	I30725
I9	Trave I2-I9	3220					3220
	Pilastro	620					620
	TraveI9-20	4275	4275	4275	4275	4275	2I375
	" I2-I9	9I95	9I95	9I95	9I95	9I95	45970
	" I8-I9	I4300	I6970	I6970	I6970	I3250	78460
	Pilastro	700	I200	I520	2000	2250	8I70
		32310	3I640	3I960	32460	327I0	I578I5

Trave I8-I9;20-2I

Solaio	850x6,00/2	2550	kg/ml
balcone	I000xI,50	I500	"
tompagno	0,40x3,00xI800x0,70	I520	"
trave	0,40x0,60x2500	600	"
		6I70	

Trave I9-20

Tompagno	0,40x3,00xI800	2I70	"
trave	0,40x0,50x2500	500	"
		2670	

Trave I2-I9;I3-20(Torrno)

Solaio	500x2,80/2	700	"
trave	0,30x0,60x2500	450	"
		II50	

Travi seminterrato

Trave I2-I3

Tompagno	0,40x3,00xI800	2I70	"
trave	0,40x0,50x2500	500	"
		2670	

Trave I3-I4

Solaio	850x6,20/2	2630	"
tompagno	0,40x3,00xI800	2I70	"
trave	0,40x0,40x2500	400	"
		5200	

Trave 20-2I

Solaio	850x6,30/2	2630	"
tompagno	0,40x3,00xI800	2I70	"
trave	0,40x0,55x2500	5350(((	
		5350	

Travi 2-3-4;5-6-7

Solaio	850x4,7/2	2000	Kg/ml
Balcone	I,50xI000	I500	"
tompagno	0,40x3,00xI800x0,70	I520	"
trave	0,40x0,40x2500	600	"
		5620	

Trave 4-5

Solaio	850xI,50/2	640	"
balcone	I000xI,00	I000	"
trave	0,30x0,50x2500	375	"
		20I5	

Trave 4'-5'

Solaio	850x3,00/2	I275	"
tompagno	0,25x3,0xI800x0,5	675	"
trave	0,30x0,40x2500	300	"
		2250	

reazione trave 4"-I2'	700	Kg

Trave 9-I0-II-I2;I3-I4-I5-I6

Solaio	8,50x(4,7+6,0)/2	4550	"
trave	0,30x0,80x2500	600	"
		5I50	

Trave I2-I3

Solaio	850x4?7/2	2000	"
tompagno	0,30x3,00xI800	I620	"
trave	0,40x0,50x2500	500	"
		4I20	

Trave 4"-I2'

Tompagno	0,20x3,00xI800	I085	"
trave	0,30x0,40x2500	300	
		I385	

Trave I7-I8;2I-22

Solaio	850x6,00/2	2550	"
tompagno	0,40x3,00xI800	2I70	"
trave	0,40x0,60x2500	600	"
		6I70	

A) ANALISI DEI CARICHI(pesi specifici come nel B e D)

Travi di copertura III piano

Trave I-2-3-4-5-6-7-8

Solaio	850 x 4,7/2		kg/ml
gronda	(0,20x0,30+0,6x0,3/2)x2500		"
ringhiera			"
trave	0,30x0,50x2500		"

Travi 9-I0-II-I2;I3-I4-I5-I6

Solaio	850x(4,7+6,0)/2		"
trave	0,30x0,80x2500		"

Trave I2-I3

Solaio	850x4,7/2	)	"
Tompagno	0,25x2,70x25000	)	"
trave	0,30x0,60x2500	)	"
		)	

Travi I7-I8-I9;20-2I-22

Soàaio	850x6,00/2	2550	"
gronda		375	"
ringhiera		40	"
trave	0,30x0,65x2500	3455	"
		3455	

Trave I9-20

Tompagno	0,40x3,00xI800	2I70	"
trave	0,40x0,50x2500	500	"
		2670	

Travi di P.T.-I-II-III piano

Travi I-2;7-8

Solaio	850x4?70/2	2000	"
tompagno		2I70	"
trave	0,40x0,60x2500	600	"
		4770	

SOC. COOP. EDILIZIA
"LA CASA"
FASANO DI PUGLIA
IL PRESIDENTE
(Donato Di Carolo)
Donato Di Carolo

COOPERATIVA EDILIZIA "LA CASA"	FINANZIAMENTO GesCal (Legge 14-2-1963 n° 60)	STAZIONE APPALTANTE Cooperativa "LA CASA"

PALAZZINA CON N° 6 ALLOGGI (TIPO C)
ECONOMICI IN FASANO

data: 21 NOV. 1966
ogg.
ogg.
ogg.

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RELAZIONE DI CALCOLO

Dott. Ing. GIOVANNI VALENTINI FASANO	PROGETTO	
Dott. Ing. AUGUSTO ROMITA BARI	CALCOLO STRUTTURA IN C.A.	●
Dott. Ing. GIOVANNI SABATINO CISTERNINO	IMPIANTI	
Dott. Ing. GIOVANNI VALENTINI FASANO	DIRETTORE DEI LAVORI	ing. GValentini

Archivio:

Approvazioni:

C.E.C. 10 DIC. 1965

Controllo disegni:

Visto: