

U.S.L. n 9 di REGGIO EMILIA

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Nuova Sede dei Servizi di Radioterapia e Med. Nucleare

IMPRESA: COOPSETTE di Castelnovo di Sotto (R.E.)

CALCOLI STATICI (2° Parte)

REGIONE EMILIA - ROMAGNA

SERVIZIO PROVINCIALE PER LA DIFESA DEL SUOLO

RISERVA IDRICHE E RISORSE FORESTALI - REGGIO EM.

(Legge 5-11-1971 n. 1086)

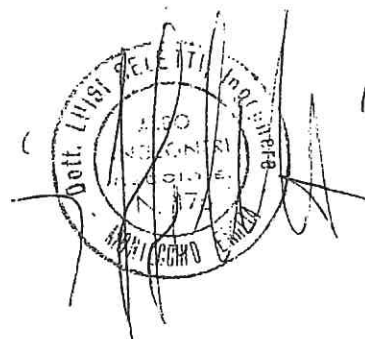
VISTO: per l'avvenuta presentazione  
e deposito con N° Prot. di

Reparto 7804 INT.

Reggio E. 15 FEB. 1991

L'INCARICATO

*Clumbr*



Strutture 11-23-27 e 91-103-115

a) trave 1° piano (copert.)

$$\begin{array}{rcl} \text{solaio } 7,20/2 \times 1220 & = & 4390 \\ \text{ppr. trave} & = & 410 \\ \hline & & 4800 \text{ Kg/ml} \end{array}$$

b) trave p.t.

$$\begin{array}{rcl} \text{solaio } 7,20/2 \times 1190 & = & 4280 \\ \text{ppr. trave} & = & 420 \\ \hline & & 4700 \text{ Kg/ml} \end{array}$$

Strutture 27-44-55 e 83-91

a) trave al 1° piano (copert.) e p.t.

$$\begin{array}{rcl} \text{solaio } 3,60/2 \times 1220 & = & 2200 \\ \text{ppr. trave} & = & 300 \\ \hline & & 2500 \text{ Kg/ml.} \end{array}$$

Struttura 55-83

a) trave a tutti i piani

$$\text{solo p. proprio} \quad 350 \text{ Kg/ml.}$$

Fondazioni di giunto

a) Campate 11-23-27 e 91-103-115

Analisi dei carichi

$$\begin{array}{rcl} \text{trave } 1^{\circ} \text{ piano (copert.)} & = & 4800 \\ \text{trave p. terra} & = & 4700 \\ \text{incid. pil. } 300 \times 10,00/3,50 & = & 860 \\ \hline & & 10360 \text{ Kg/ml.} \end{array}$$

$$\text{ppr. trave } 0,50 \times 1,10 \times 2500 \quad 1380$$

$$\text{sbalzi e magrone} \quad 880$$

$$\hline 12620 \text{ Kg/ml.}$$

Sul terreno  $b = 130$

$$\sigma_{st} = \frac{12620}{130 \times 100} = 0,97 \text{ Kg/cm}^2.$$



## b) Campate 27-44-55 e 83-91

trave 1° piano (copert. corridoio) =	2500
trave p.t. =	2500
trave di gronda loc. refriger.	600
trave 1° p.	2150
trave p.t.	400
incid. pilastri 300x10,00/3,50 =	860
300x15,00/4,00 =	1130
	10140 Kg/ml.
ppr. trave 0,80 x 1,10 x 2500 =	2200
sbalzi e magrone =	600
	12940 Kg/ml.

Sul terreno:  $b = 130$ 

$$St = \frac{12940}{130 \times 100} = 1,00 \text{ Kg/cm}^2.$$

## c) Campata 55 - 83

travi 1° p. e p.t. (parte bassa)	
2 x 350 =	700
trave di gronda (locale refriger.) =	600
trave 1° p.	2150
trave p.t.	400
incidenza pilastri (860+1130) =	1990
	5840 Kg/ml.
ppr. trave =	2200
sbalzi e magrone =	400
	8440 Kg/ml.

Sul terreno  $b = 90$ 

$$St = \frac{8440}{90 \times 100} = 0,94 \text{ Kg/cm}^2.$$

Calcolo della trave

$$M_{23-27} = \frac{1}{14} 10360 \times 3,90^2 = 11270 \text{ Kg}.$$

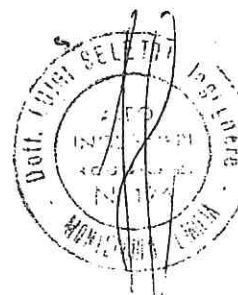
$$Af = 5,37 \text{ cm}^2.$$

$$3\phi 12 + 2\phi 16 = 7,41$$

$$M_{27} = \frac{1}{12} \frac{10360 \times 3,90^2 + 10140 \times 3,10^2}{2} = 10620 \text{ Kg}.$$

$$Af = 5,08 \text{ cm}^2.$$

$$3\phi 12 + 3\phi 16 = 8,42$$



$$M_{27-44} = 10140 \times 3,10^2 = 6970 \text{ Kg}$$

$$Af = 3,32 \text{ cmq.}$$

$$\approx 2\phi 16 + 1\phi 12 = 5,15$$

$$M_{44} = \frac{1}{12} 10140 \times \frac{3,10^2 + 3,00^2}{2} = 7870 \text{ Kg}$$

$$Af = 3,76 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{44-55} = \frac{1}{14} 10140 \times 3,00^2 = 6520 \text{ Kg}$$

$$Af = 3,12 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{55} = \frac{1}{12} \frac{10140 \times 3,00^2 + 5840 \times 4,00^2}{2} = 7750 \text{ Kg.}$$

$$Af = 3,70 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{55-66} = \frac{1}{14} 5840 \times 4,00^2 = 6670 \text{ Kg.}$$

$$Af = 3,19 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{66} = \frac{1}{12} 5840 \times \frac{4,00^2 + 3,00^2}{2} = 6080 \text{ Kg.}$$

$$Af = 2,91 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{66-83} = \frac{1}{14} 5840 \times 3,00^2 = 3760 \text{ Kg.}$$

$$Af = 1,80 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{83} = \frac{1}{12} \frac{5840 + 10140}{2} \times 3,00^2 = 6000 \text{ Kg.}$$

$$Af = 2,86 \text{ cmq.}$$

$$2\phi 16 + 1\phi 12 = 5,15$$

$$M_{83-91} = M_{27-44}$$

$$M_{91} = \frac{1}{12} \frac{10140 \times 3,10^2 + 10360 \times 3,90^2}{2} = 10620 \text{ Kg.}$$

$$Af = 5,08 \text{ cmq.}$$

$$3\phi 12 + 3\phi 16 = 8,42$$

$$m = 10 \quad b = 40 \quad H = 110 \quad h = 106 \quad Sf = 2200$$

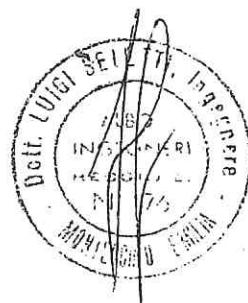
$$r = 106 / \sqrt{\frac{10620}{0,40}} = 0,649 \quad Sc = 36$$

#### Taglio

$$T = \frac{10360 \times 3,90}{2} = 20240 \text{ Kg.}$$

$$t = \frac{20240}{40 \times 0,9 \times 106} = 5,32 \text{ Kg/cmq.}$$

Si dispongono 2 cavallotti  $\phi 16$  e  $st \phi 8/25$



2) Corpo Bunker (oltre il giunto)

a) solaio copert. centrale climatizzaz.

ppr. solaio H= 25+3	= 280
argilla espansa o Leca 0,20x1250	= 250
ghiaia 0,20 x 2000	= 400
sovracc. accid.	= 400
	<hr/>
	1330 Kg/mq.

b) solaio 1°p. (doppio solaio)

ppr. solaio H= 25+3	= 280
pav. e intonaco	= 120
sovracc. accid.	= 700
	<hr/>
	1100 Kg/mq.

ppr. sol. H= 20+3	= 240
sovracc. accid.	= 200
	<hr/>
	440 Kg/mq.

TOTALE 1540 Kg/mq.

c) solaio p. terra (H= 30+5)

(sovracc. 800 Kg/mq)

carico complessivo 1390 Kg/mq.

Analisi dei carichi sulle travi

1) Strutture 56 ÷ 58 e 66 ÷ 68

a) Trave p. copert.

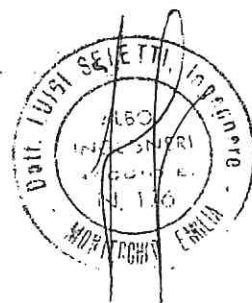
solaio 9,80/2 x 1330	= 6520
ppr. trave	= 430
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	6950 Kg/ml.

b) Trave 1°p. (doppio solaio)

solaio 9,80/2 x 1540	= 7550
ppr. trave 0,30x1,00x2500	= 750
	<hr/>
	8300 Kg/ml.

c) Trave p. terra

solaio 9,80/2 x 1390	= 6810
ppr. trave	= 390
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	7200 Kg/ml.



2) STRUTTURE 58 ÷ 60 e 68 ÷ 70

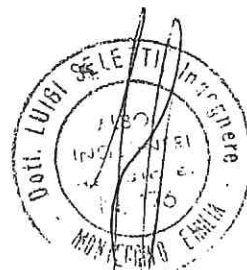
a) Trave p. copert.	= 6950 Kg/ml.
b) Trave 1 <sup>a</sup> p. (doppio solaio)	
solaio 7,00/2 x 1540	= 5390
ppr. trave	= 750
	<hr/>
	6140 Kg/ml.
c) Trave p. terra	
solaio 7,00/2 x 1390	= 4870
ppr. trave	= 390
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	5260 Kg/ml.

3) STRUTTURA 30 - 56 - 66 - 87

a) Trave di gronda	
trave e cornicione (400 + 200)	= 600 Kg/ml.
b) Trave 1 <sup>a</sup> p.	
tamp. 4,00 x 350	= 1400
ppr. trave (altezza dei due solai)	= 750
	<hr/>
	2150 Kg/ml.
c) Trave p.t.	
solo p.pr.	= 400 Kg/ml.

4) STRUTTURE 30 - 31 - 31<sup>e</sup> e 87 - 88 - 88<sup>a</sup>

a) Trave di gronda	
solaio 5,80/2 x 1330	= 3860
trave e cornicione	= 600
	<hr/>
	4460 Kg/ml.
b) Trave 1 <sup>a</sup> p. (con doppio solaio)	
tamp. 4,00 x 350	= 1400
solaio 5,80/2 x 1540	= 4460
ppr. trave 0,30 x 1,00x2500	= 750
	<hr/>
	6610 Kg/ml.
c) Trave p. terra	
solaio 5,80/2 x 1390	= 4020
ppr. trave	= 380
	<hr/>
	4400 Kg/ml.



PILASTRI 56 e 66

Trave copert. 6,40/2 x 6950	= 22240
cornicione 9,80/2 x 400	= 1960
pilastro	= 1000
	<hr/>
	25200 Kg.

1° p.: 25x40 - 4Ø12 - stØ6/18

Trave 1° p. 3,20/2 x 8300	= 13280
tamp. copert. 7,40/2 x (1400+750) e trave	= 7960
pilastro	= 1000
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	22240 tot. 47440

p.t.: 25 x 40 - 4Ø14 - stØ6/20

Trave p.t. 3,20/2 x 7200	= 11520
pilastro	= 1000
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	12520 tot. 59960

p. int.: 25x40 - 4Ø16 - stØ6/20

PILASTRI 57 e 67

Trave 1° p. 6,40/2 x 8300	= 26560
pil.	= 1000
	<hr/>
	27560 Kg.

p.t.: 25 x 40 - 4Ø12 - stØ6/18

Trave p.t. 6,40/2 x 7200	= 23040
pil.	= 1000
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	24040 tot. 51600

p. int.: 25x40 - 4Ø14 - stØ6/20



(4)

PILASTRI 58 e 68

Trave copert. 12,80/2 x 6950 = 44480  
pil. 0,25 x 0,40 x 4,00 x 2500 = 1000  
45480 Kg.

1<sup>^</sup> p.: 25 x 40 - 4Ø14 - stØ6/20

Trave 1<sup>^</sup> p. 3,20/2 x 8300 = 13280  
3,20/2 x 6140 = 9820  
pil. = 1000  
24100 tot. 69580

p.t.: 25 x 40 - 4Ø16 + 2Ø12 - stØ6/20

Trave p.t. 3,40/2 x 7200 = 11520  
3,20/2 x 5260 = 8420  
pil. = 1000  
20940 tot. 90520

p.int.: 40 x 40 - 6Ø16 - stØ6/20

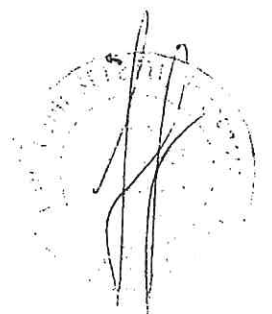
PILASTRI 59 e 69

Trave 1<sup>^</sup> p. 6,40/2 x 6140 = 19650  
pil. = 1000  
20650 Kg.

p.t.: 25 x 40 - 4Ø12 - stØ6/18

Trave p.t.: 6,40/2 x 5260 = 16830  
pil. = 1000  
17830 tot. 38480

p. int.: 25 x 40 - 4Ø14 - stØ6/20





PILASTRI 60 e 70

Trave copert. 6,40/2 x 6950	= 22240
cornicione 9,80/2 x 400	= 1960
pilastro	= 1000
	<hr/>
	25200 Kg.

1° p.: 25 x 40 - 4Ø12 - stØ6/18

Trave 1° p. 6,00/2 x 6140	= 18420
tamp. copert. 7,40/2 x (1400+750)	= 7960
e trave pilastro	= 1000
	<hr/>
	27380 tot. 52580

p.t.: 25 x 40 - 4Ø16 - stØ6/20

Trave p.t. 6,00/2 x 5260	= 15780
pilastro	= 1000
	<hr/>
	16780 tot. 69360

p. int.: 30 x 40 - 4Ø16 + 2Ø12 stØ6/20

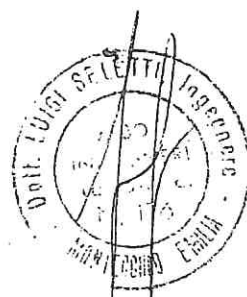
PILASTRI 31 e 88

Trave 1° p.: 6,40/2 x 6540	= 20830
pilastro	= 1000
	<hr/>
	21930 Kg.

p.t.: 25 x 40 - 4Ø12 - stØ6/18

Travi p.t.: 3,20/2 x 8080	= 12930
3,20/2 x 6680	= 10690
pilastro	= 1200
	<hr/>
	24820 tot. 46750

p.int.: 30 x 40 - 4Ø14 - stØ6/20



(9)

TRAVI ROVESCIE 56 ÷ 61 e 66 ÷ 71

a) Campate 56 ÷ 58 e 66 ÷ 68

trave copert.	= 6950
trave 1 <sup>a</sup> p.	= 8300
trave p. terra	= 7200
incid. pil. 3000/3,20	= 940
	<hr/>
	23390 Kg/ml.
ppr. trave	= 1650
sbalzi	= 2500
magrone	= 300
	<hr/>
	27840 Kg/ml.


SUL TERRENO b= 260

$$St = \frac{27840}{260 \times 100} = 1,07 \text{ Kg/cm}^2.$$

b) Campate 58 ÷ 60 e 68 ÷ 70

trave copert.	= 6950
trave 1 <sup>a</sup> p.	= 6140
trave p. terra	= 5260
incid. pil.	= 940
	<hr/>
	19290 Kg/ml.
ppr. trave	= 1650
sbalzi e magrone	= 1900
	<hr/>
	22840 Kg/ml.

SUL TERRENO b= 220

$$St = \frac{22840}{220 \times 100} = 1,04 \text{ Kg/cm}^2.$$


CALCOLO DELLA TRAVE

$$M_{56-57} = \frac{1}{14} 23390 \times 3,20^2 = 17100 \text{ Kgm.}$$

$$Af = 8,16 \text{ cmq.}$$

$$4\emptyset 16 + 2\emptyset 12 = 10,30$$

$$M_{57} = \frac{1}{12} 23290 \times 3,20^2 = 19950 \text{ Kgm.}$$

$$Af = 9,52 \text{ cmq.}$$

$$4\emptyset 16 + 4\emptyset 12 = 12,56$$

$$M_{57-58} = M_{56-57}$$

$$M_{58} = \frac{1}{12} \frac{23390 + 19290}{2} \times 3,20^2 = 18200 \text{ Kgm.}$$

$$Af = 8,68 \text{ cmq.}$$

$$4\emptyset 16 + 3\emptyset 12 = 11,43$$

$$M_{58-59} = \frac{1}{14} 19290 \times 3,20^2 = 14140 \text{ Kgm.}$$

$$Af = 6,75 \text{ cmq.}$$

$$3\emptyset 16 + 2\emptyset 12 = 8,29$$

$$M_{59} = \frac{1}{12} 19290 \times 3,20^2 = 16480 \text{ Kgm.}$$

$$Af = 7,86 \text{ cmq.}$$

$$4\emptyset 16 + 3\emptyset 12 = 11,43$$

$$m = 10 \quad b = 60 \quad H = 110 \quad h = 106 \quad Sf = 2200$$

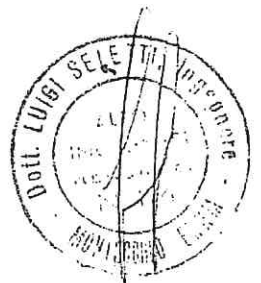
$$r = 106 / \sqrt{\frac{19950}{0,60}} = 0,581$$

$$Sc = 40$$

Taglio

$$T = \frac{23390 \times 3,20}{2} = 37450 \text{ Kg.}$$

$$t = \frac{37450}{60 \times 0,9 \times 106} = 6,55 \text{ Kg/cm.}$$



TRAVI ROVESCIE DI GIUNTO

$$\frac{30 - 31 - 31^{\text{cm}}}{87 - 88 - 88^{\text{cm}}}$$

## Analisi dei carichi

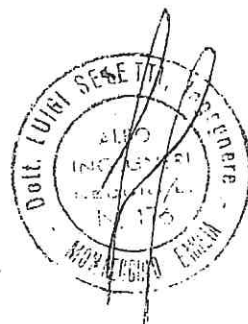
Trave copert.	4460
Trave 1 <sup>a</sup> p.	6610
Trave p.t.	4400
Travi - cordolo 2 x 350	700
incid. pil. 300 x 10,00/3,50	860
	<hr/>
	17030 Kg/ml.
ppr. trave	1650
sbalzi e magrone	1800
	<hr/>
	20480 Kg/ml.

SUL TERRENO      b = 220

$$St = \frac{20480}{220 \times 100} = 0,93 \text{ Kg/cm}^2.$$

Si è tenuto un St basso in quanto è da mettere in conto anche l'appoggio della passerella soprastante in acciaio (÷ 4500 Kg su due pil.)

La presente trave viene armata come le campate 58 - 59 - 60 (di carico leggermente inferiore).



TRAVI 56 ÷ 61 e 66 ÷ 71 al p.t.

(con sovracc. maggiorato a 1600 Kg/mq)

$$\text{Campate } 57 \div 58: \quad q = 7200 + 4,00 \times 800 = 10400 \text{ Kg/ml.}$$

$$\text{Campate } 58 \div 60: \quad q = 5260 + 1,50 \times 800 = 6460 \text{ Kg/ml.}$$

Calcolo della trave.

$$M_{56-57} = \frac{1}{12} 7200 \times 3,20^2 = 6140 \text{ Kgm.}$$

$$Af = 9,41 \text{ cmq.}$$

$$6\emptyset 12 + 2\emptyset 16 = 10,81$$

$$M_{57} = \frac{1}{10} \frac{7200 + 10400}{2} \times 3,20^2 = 9010 \text{ Kgm.}$$

$$Af = 13,80 \text{ cmq.}$$

$$6\emptyset 16 + 2\emptyset 12 + 3\emptyset 10 = 16,64$$

$$M_{57-58} = \frac{1}{14} 10400 \times 3,20^2 = 7610 \text{ Kgm.}$$

$$Af = 11,68 \text{ cmq.}$$

$$5\emptyset 12 + 4\emptyset 16 = 13,69$$

$$M_{58} = \frac{1}{12} \frac{10400 + 6460}{2} \times 3,20^2 = 7210 \text{ Kgm.}$$

$$Af = 11,06 \text{ cmq.}$$

$$4\emptyset 16 + 4\emptyset 12 + 3\emptyset 10 = 14,90$$

$$M_{58-59} = \frac{1}{14} 6460 \times 3,20^2 = 4730 \text{ Kgm.}$$

$$Af = 7,25 \text{ cmq.}$$

$$8\emptyset 12 = 9,05$$

$$M_{59} = \frac{1}{12} 6460 \times 3,20^2 = 5520 \text{ Kgm.}$$

$$Af = 8,46 \text{ cmq.}$$

$$8\emptyset 12 + 3\emptyset 10 = 11,39$$

$$M_{59-60} = \frac{1}{14} 6460 \times 3,20^2 = 4730 \text{ Kgm.}$$

$$Af = 7,25 \text{ cmq.}$$

$$8\emptyset 12 = 9,05$$

$$M_{60} = \frac{1}{10} \frac{6460 \times 3,20^2 + 5260 \times 2,80^2}{2} = 5370 \text{ Kgm.}$$

$$Af = 8,22 \text{ cmq.}$$

$$4\emptyset 12 + 2\emptyset 16 + 3\emptyset 10 = 10,88$$

$$M_{60-61} = \frac{1}{12} 5260 \times 2,80^2 = 3440 \text{ Kgm.}$$

$$Af = 5,27 \text{ cmq.}$$

$$4\emptyset 12 + 2\emptyset 16 = 8,54$$

Calcolo del Sc nella sezione più sollecitata

$$M_{57} (\text{filo}) = 9010 - \frac{10400 \times 3,20}{2} \times 0,125 = 9010 - 2080 = 6930 \text{ Kgm.}$$

$$m = 10 \quad b = 60 + 10 + 10 = 80 \quad H = 35 \quad h = 33 \quad Sf = 2200$$

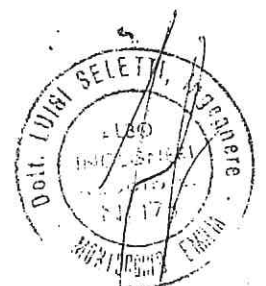
$$r = 33 / \sqrt{\frac{6930}{0,80}} = 0,354 \quad Sc = 71$$

Taglio (nella campata 57 - 58)

$$T = \frac{10400 \times 3,20}{2} = 16650 \text{ Kg.}$$

$$t = \frac{16650}{60 \times 0,9 \times 33} = 9,32 \text{ Kg/cmq.}$$

$$S = \frac{9,36 \times 60 \times 320}{4} = 44700 \text{ Kg.}$$



6Ø16 a 45° assorbono  $12,06 \times 2200 \times 1,41 = 37400 \text{ Kg.}$

Sstaffe = 13000 Kg.

$$n = \frac{13000}{1,01 \times 2200} = 5,87 \quad d = \frac{320}{2 \times 5,87} = 27,2 \text{ cm. stØ8/25}$$

Variante per campate 68 - 68 - 70 - 71 (ribassate di 15 cm.)

$$M_{68} = 7210 \text{ Kgm.} \quad Af = 7,66 \text{ cmq.} \quad 4Ø16 + 3Ø10 = 10,38$$

$$M_{68-69} = 4730 \text{ Kgm.} \quad Af = 5,03 \text{ cmq.} \quad 3Ø12 + 2Ø16 = 7,41$$

$$M_{69} = 5520 \text{ Kgm.} \quad Af = 5,86 \text{ cmq.} \quad 4Ø16 + 3Ø10 = 10,38$$

$$M_{69-70} = M_{68-69}$$

$$M_{70} = 5370 \text{ Kgm.} \quad Af = 5,70 \text{ cmq.} \quad 2Ø16 + 2Ø12 + 3Ø10 = 8,62$$

$$M_{70-71} = 3440 \text{ Kgm.} \quad Af = 3,66 \text{ cmq.} \quad 5Ø12 = 5,65$$

$$m = 10 \quad b = 40 + 10 = 50 \quad H = 50 \quad h = 48 \quad Sf = 2200$$

$$r = 48 / \sqrt{\frac{7210}{0,50}} = 0,399 \quad Sc = 62$$

Taglio

$$T = \frac{6460 \times 3,20}{2} = 10340 \text{ Kg.}$$

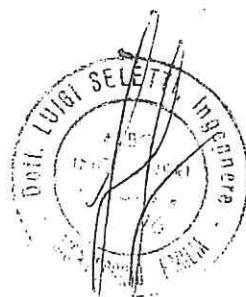
$$t = \frac{10340}{40 \times 0,9 \times 48} = 5,99 \text{ Kg/cmq.}$$

Si dispongono 2 cavallotti Ø16 e stØ8/25

Travi 30 - 31 - 31<sup>te</sup> e 87 - 88 - 88<sup>ta</sup> al p.t.

Analisi dei carichi

solaio 5,70/2 x 1390	=	3960
sovracc. magg. 5,70/2 x 800	=	2280
ppr. trave 0,35 x 0,50 x 2500	=	440
		<hr/>
		6680 Kg/ml.
event. tamp. 4,00 x 350	=	1400
		<hr/>
		8080 Kg/ml.



$$M_{30-31} = \frac{1}{12} 6680 \times 3,20^2 = 5700 \text{ Kgm.} \quad Af = 8,72 \text{ cmq.}$$

$$6\emptyset 12 + 2\emptyset 16 = 10,81$$

$$M_{31} = \frac{1}{10} \frac{6680 + 8080}{2} \times 3,20^2 = 7560 \quad Af = 11,57 \text{ cmq.}$$

$$6\emptyset 16 + 2\emptyset 16 + 3\emptyset 10 = 16,64$$

$$M_{30-31} = \frac{1}{12} 8080 \times 3,20^2 = 6900 \text{ Kgm.} \quad Af = 10,56 \text{ cmq.}$$

$$4\emptyset 12 + 4\emptyset 16 = 12,56$$

Calcolo del Sc nella sezione più sollecitata

$$M_{31} \text{ (filo)} = 7560 - \frac{8080 \times 3,20}{2} \times 0,125 = 7560 - 1610 = 5950 \text{ Kgm.}$$

$$m = 10 \quad b = 50 + 10 = 60 \quad H = 35 \quad h = 33 \quad Sf = 2200$$

$$r = 33 / \sqrt{\frac{5950}{0,60}} = 0,332 \quad Af = 0,5 \text{ Af} \quad Sc = 72$$

Taglio

$$T = \frac{8080 \times 3,20}{2} = 12920 \text{ Kg.}$$

$$t = \frac{12920}{50 \times 0,9 \times 33} = 8,72 \text{ Kg/cmq.}$$

$$S = \frac{8,72 \times 50 \times 320}{4} = 34900 \text{ Kg.}$$

$$6\emptyset 16 \text{ a } 60^\circ \text{ assorbono } 12,06 \times 2200 \times 1,15 = 30550 \text{ Kg.}$$

$$S_{staffe} = \div 13000 \text{ Kg.}$$

$$n = \frac{13000}{1,01 \times 2200} = 5,87 \quad d = \frac{320}{2 \times 5,87} = 27,2 \text{ cm.} \quad st \emptyset 8/25$$

TRAVE - CORDOLO 30 - 56 - 66 - 87 al p.t.

$$q = 400 + 600 = 1000 \text{ Kg/ml.}$$

$$M_{30-56} = \frac{1}{12} \times 1000 \times 5,70^2 = 2710 \text{ Kgm.} \quad Af = 4,15 \text{ cmq.}$$

$$6\emptyset 12 = 6,79$$

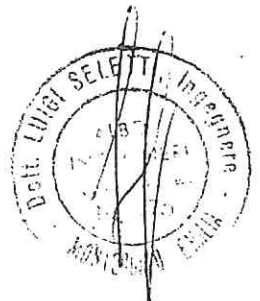
$$M_{56} = \frac{1}{10} 1000 \times \frac{5,70 + 4,00^2}{2} = 2430 \text{ Kgm.} \quad Af = 3,72 \text{ cmq.}$$

$$6\emptyset 12 + 2\emptyset 10 = 8,36$$

$$M_{56-66} = \frac{1}{14} 1000 \times 4,00^2 = 1140 \text{ Kgm.} \quad Af = 1,75 \text{ cmq.}$$

$$4\emptyset 12 = 4,52$$

$$m = 10 \quad b = 40 \quad H = 35 \quad h = 33 \quad Sf = 2200$$



TRAVI 56 ÷ 61 e 66 ÷ 71 al 1 p.

$$q_1 = 8300 \text{ Kg/ml.}$$

$$q_2 = 6140 \text{ Kg/ml.}$$

$$M_{56-57} = \frac{1}{12} 8300 \times 3,20^2 = 7090 \text{ Kgm.}$$

$$Af = 3,56 \text{ cmq. } 5\emptyset 12 = 5,65$$

$$M_{57} = \frac{1}{10} 8300 \times 3,20^2 = 8510 \text{ Kgm.}$$

$$Af = 4,27 \text{ cmq. } 6\emptyset 12 = 6,79$$

$$M_{57-58} = \frac{1}{14} 8300 \times 3,20^2 = 6080 \text{ Kgm.}$$

$$Af = 3,05 \text{ cmq. } 5\emptyset 12 = 5,65$$

$$M_{58} = \frac{1}{12} \frac{8300 + 6140}{2} \times 3,20^2 = 6160 \text{ Kgm.}$$

$$Af = 3,10 \text{ cmq. } 5\emptyset 12 = 5,65$$

$$M_{58-59} = \frac{1}{14} 6140 \times 3,20^2 = 4490 \text{ Kgm.}$$

$$Af = 2,25 \text{ cmq. } 4\emptyset 12 = 4,52$$

$$M_{59} = \frac{1}{12} 6140 \times 3,20^2 = 5240 \text{ Kgm.}$$

$$Af = 2,63 \text{ cmq. } 4\emptyset 12 = 4,52$$

$$M_{59-60} = M_{58-59}$$

$$M_{60} = \frac{1}{10} 6140 \times \frac{3,20^2 + 2,80^2}{2} = 5560 \text{ Kgm.}$$

$$Af = 2,79 \text{ cmq. } 4\emptyset 12 = 4,52$$

$$M_{60-61} = \frac{1}{12} 6140 \times 2,80^2 = 4010 \text{ Kgm.}$$

$$Af = 2,02 \text{ cmq. } 4\emptyset 12 = 4,52$$

$$m = 10 \quad b = 40$$

$$H = 105$$

$$h = 101$$

$$Sf = 2200$$

$$r = 101 / \sqrt{\frac{8510}{0,40}} = 0,692$$

$$Sc = 33$$

Taglio

$$T = \frac{8300 \times 3,20}{2} = 13280$$

$$t = \frac{13280}{40 \times 0,9 \times 101} = 3,65 \text{ Kg/cmq.}$$





TRAVI 30 - 31 - 31\* e 87 - 88 - 88\* al 1° p.

### Analisi dei carichi

doppio solaio 5,70/2 x 1540	= 4390
tamp. 4,00 x 350	= 1400
ppr. trave	= <u>750</u>
	6540 Kg/ml.

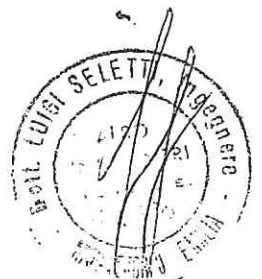
### Calcolo della trave

$$M_{30-31} = \frac{1}{12} 6540 \times 3,20^2 = 5580 \text{ Kgm.} \quad Af = 2,80 \text{ cmq. } 4\phi 12 = 4,52$$

$$M_{31} = \frac{1}{10} 6540 \times 3,20^2 = 6700 \text{ Kgm.} \quad Af = 3,36 \text{ cmq. } 6\phi 12 = 6,79$$

$$m = 10 \quad b = 40 \quad H = 105 \quad h = 101 \quad Sf = 2200$$

Per le verifiche a flessione e taglio vedasi trave precedente 56 ÷ 61



TRAVE 30 - 56 - 66 - 87 al 1<sup>a</sup> p.

$$q = 2150 \text{ Kg/ml.}$$

$$M_{30-56} = \frac{1}{12} 2150 \times 5,70^2 = 5830 \text{ Kgm.} \quad Af = 2,92 \text{ cmq.} \quad 4\emptyset 12 = 4,52$$

$$M_{56} = \frac{1}{10} 2150 \times \frac{5,70^2 + 4,00^2}{2} = 5220 \text{ Kgm.} \quad Af = 2,62 \text{ cmq.} \quad 5\emptyset 12 = 5,65$$

$$M_{56-66} = \frac{1}{14} 2150 \times 4,00^2 = 2460 \text{ Kgm.} \quad Af = 1,23 \text{ cmq.} \quad 3\emptyset 12 = 3,39$$

$$m = 10 \quad b = 40 \quad H = 105 \quad h = 101 \quad Sf = 2200$$

TRAVI 56 - 58 - 60 e 66 - 68 - 70 della copert.

$$q = 6950 \text{ Kg/ml.}$$

$$M_{56-58} = \frac{1}{12} 6950 \times 6,40^2 = 23720 \text{ Kgm.}$$

$$Af = 19,20 \text{ cmq.}$$

$$10\emptyset 16 = 20,11$$

$$M_{58} = \frac{1}{10} 6950 \times 6,40^2 = 28470 \text{ Kgm.}$$

$$Af = 23,05 \text{ cmq.}$$

$$12\emptyset 16 + 3\emptyset 12 = 27,52$$

Calcolo del Sc nella sezione più sollecitata

$$M_{58} (\text{filo}) = 28470 - \frac{6950 \times 6,40}{2} \times 0,200 = 28470 - 4450 = 24020 \text{ Kgm.}$$

$$m = 10 \quad b = 40 \quad H = 65 \quad h = 63 \quad Sf = 2000$$

$$r = 63 / \sqrt{\frac{24020}{0,40}} = 0,258$$

$$Af = Af \quad Sc = 83$$

Taglio

$$T = \frac{6950 \times 6,40}{2} = 22250$$

$$t = \frac{22250}{40 \times 0,9 \times 63} = 9,81 \text{ Kg/cmq.}$$

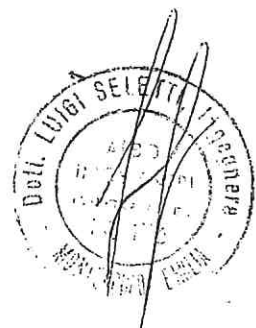
$$S = \frac{9,81 \times 40 \times 640}{4} = 62800 \text{ Kg.}$$

$$10\emptyset 16 \text{ a } 60^\circ \text{ assorbono } 20,11 \times 2200 \times 1,15 = 50900 \text{ Kg.}$$

$$S_{staffe} = \div 25000 \text{ Kg.}$$

$$n = \frac{25000}{1,01 \times 2200} = 11,3$$

$$d = \frac{640}{2 \times 11,3} = 28,4 \text{ cm.} \quad st\emptyset 8/25$$



TRAVI 30 - 32 - 33 e 87 - 89 - 90 DELLA COPERT.

$$q = 4490 \text{ Kg/ml.}$$

$$M_{30-32} = \frac{1}{12} 4490 \times 6,40^2 = 15360 \text{ Kgm.}$$

$$Af = 12,42 \text{ cmq.}$$
$$8\emptyset 16 = 16,08$$

$$M_{32} = \frac{1}{10} 4490 \times 6,40^2 = 18400 \text{ Kgm.}$$

$$Af = 14,87 \text{ cmq.}$$
$$8\emptyset 16 + 3\emptyset 12 = 19,47$$

$$m = 10 \quad b = 40 \quad H = 65 \quad h = 63 \quad Sf = 2200$$

$$r = 63 / \sqrt{\frac{18400}{0,40}} = 0,293$$

$$Af = Af \quad Sc = 77$$

Taglio

$$T = \frac{4490 \times 6,40}{2} = 14380 \text{ Kg.}$$

$$t = \frac{14380}{40 \times 0,9 \times 63} = 6,34 \text{ Kgm/cmq.}$$

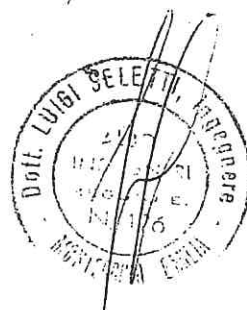
$$S = \frac{6,34 \times 40 \times 640}{4} = 40600 \text{ Kg.}$$

$$6\emptyset 16 \text{ a } 60^\circ \text{assorbono } 12,06 \times 2200 \times 1,15 = 30500 \text{ Kg.}$$

$$Sstaffe = \div 18000 \text{ Kg.}$$

$$n = \frac{18000}{0,57 \times 2200} = 14,35$$

$$d = \frac{640}{2 \times 14,35} = 22,3 \text{ cm.} \quad st\emptyset 6/20$$



TRAVI 30 - 56 - 66 - 87 e 33 - 60 - 70 - 90  
della copertura

$$q = 1000 \text{ Kg/ml.}$$

$$M_{30-56} = \frac{1}{12} 1000 \times 5,70^2 = 2720 \text{ Kgm.}$$

$$Af = 2,200 \text{ cmq.}$$

$$5\phi 12 = 5,66$$

$$M_{56} = \frac{1}{10} 1000 \times \frac{5,70^2 + 4,00^2}{2} = 2430 \text{ Kgm.}$$

$$Af = 1,96 \text{ cmq.}$$

$$6\phi 12 = 6,79$$

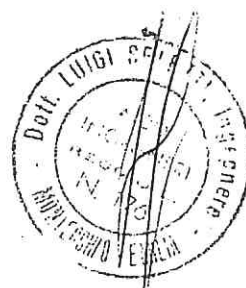
$$M_{56-66} = \frac{1}{14} 1000 \times 4,00^2 = 1150 \text{ Kgm.}$$

$$Af = 0,93 \text{ cmq.}$$

$$4\phi 12 = 4,52$$

$$m = 10 \quad b = 40 \quad H = 65 \quad h = 63$$

$$Sf = 2200$$



BUNKER EST

Pareti 3 x 6,75 x 1,10 x 10,00 x 2500 =	556880
2 x 12,00 x 1,20 x 10,00 x 2500 =	720000
Solette 1 <sup>^</sup> p. 8,70 x 6,75 x (3000+600) =	211410
Soletta p.t. 8,70 x 6,75 x (2500+1000) =	205540
Solaio cop. 13,00/2 x 6,20/2 x 1330 =	26800
Solaio 1 <sup>^</sup> p. 12,00 x 3,00/2 x 1540 =	27720
3,20/2 x 6,00/2 x 1540 =	7390
Solaio p.t. 12,00 x 3,00/2 x 1390 =	25020
3,20/2 x 6,00/2 x 1390 =	6670
	<hr/>
	1787430
Solettone di fond. 16,00 x 13,20 x 1,10 x 2500	580800
	<hr/>
	2368230 Kg.

Sul terreno 13,20 x 16,00

$$St = \frac{2368230}{1320 \times 1600} = 1,12 \text{ Kg/cm}^2.$$

Calcolo dell'armatura

$$M_{\text{sbalzo}} = \frac{11200 \times 2,00^2}{2} = 22400 \text{ Kg/m}.$$

$$Af = 10,70 \text{ cm}^2/\text{ml}.$$

$$5\phi 16 + 3\phi 12 = 13,44$$

$$M^+ = \frac{1}{32} 11200 \times 7,40^2 = 19150 \text{ Kg/m}.$$

$$Af = 9,14 \text{ cm}^2/\text{ml}$$

$$6\phi 16 = 12,06$$

$$M^- = \frac{0,5}{12} 11200 \times 7,40^2 = 25550 \text{ Kg/m}.$$

$$Af = 12,20 \text{ cm}^2/\text{ml}.$$

$$5\phi 16 + 3\phi 12 = 13,44$$

$$m = 10$$

$$b = 100$$

$$H = 110$$

$$h = 106$$

$$Sf = 2200$$

$$r = 106 / \sqrt{\frac{25550}{1,00}} = 0,662$$

$$Sc = 35$$

Con sbalzo di ml. 2,40

$$M = \frac{11200 \times 2,40^2}{2} = 32200 \text{ Kg/m}.$$

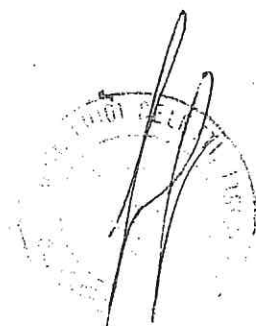
$$Af = 15,38 \text{ cm}^2/\text{ml}$$

$$6\phi 16 + 3\phi 12 = 15,45$$

Taglio

$$T_{\text{max}} = 11200 \times 3,00 = 33600 \text{ Kg/m}.$$

$$t = \frac{33600}{100 \times 0,9 \times 106} = 3,53 \text{ Kg/cm}^2.$$



SOLETTONE 1<sup>a</sup>p.

(con sovracc. 2600 Kg/mq.)

$$q = 2500 + 2600 = 5100 \text{ Kg/mq.}$$

$$M+ = \frac{1}{32} 5100 \times 7,40^2 = 8720 \text{ Kgm/ml.} \quad Af = 6,58 \text{ cmq/ml.}$$

$$6\emptyset 12 + 2\emptyset 16 = 10,81$$

$$M- = \frac{0,5}{12} 5100 \times 7,40^2 = 11630 \text{ Kgm./ml.} \quad Af = 8,78 \text{ cmq/ml.}$$

$$4\emptyset 16 + 4\emptyset 12 = 12,56$$

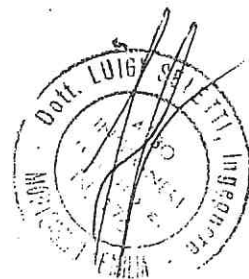
$$m = 10 \quad b = 100 \quad H = 70 \quad h = 67 \quad Sf = 2200$$

$$r = 67 / \sqrt{\frac{11630}{1,00}} = 0,620 \quad Sc = 37$$

Taglio

$$T = 5100 \times 3,00 = 15300 \text{ Kg/ml.}$$

$$t = \frac{15300}{100 \times 0,9 \times 67} = 2,54 \text{ Kg/cmq.}$$



SOLETTONE DI COPERTURA

$$q = 3500 + 600 + (3300 - 2500) \times 1,40 = 5220 \text{ Kg/mq}$$

$$M+ = \frac{1}{24} 5220 \times 7,40^2 = 11920 \text{ Kgm/ml.} \quad Af = 4,82 \text{ cmq/ml}$$

$$M- = \frac{0,33}{12} 5220 \times 7,40^2 = 7860 \text{ Kgm/ml.} \quad Af = 3,18 \text{ cmq/ml.}$$

$$m = 10 \quad b = 100 \quad H = 130 \quad h = 125 \quad Sf = 2200$$

$$r = 125 / \sqrt{\frac{11920}{1,00}} = 1,14 \quad Sc \angle 25$$

Taglio

$$T = 5220 \times 3,00 = 15660 \text{ Kg/ml.}$$

$$t = \frac{15660}{100 \times 0,9 \times 125} = 1,40 \text{ Kg/cmq.}$$

RINFORZO SOTTO IL PILASTRO 33

$$\begin{aligned} P &= 6,40/2 \times 4490 &= 14370 \\ &5,70/2 \times 1000 &= 2850 \\ &0,40 \times 0,40 \times 4,00 \times 2500 &= 1600 \\ &&18820 \text{ Kg.} \end{aligned}$$

$$M+ = 18820 \times 7,40/4 = 34820 \text{ Kgm.}$$

$$m = 10 \quad b = 40 + 30 + 30 = 100 \quad H = 130 \quad h = 125 \quad Sf = 2200$$

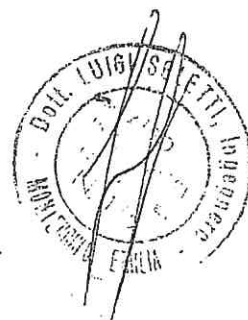
$$r = 125 / \sqrt{\frac{34820}{1,00}} = 0,668 \quad Sc = 34 \quad Af = 14,10 \text{ cmq.}$$

$$8\phi 16 = 16,08$$

Taglio

$$T = 34820/2 = 17410 \text{ Kg.}$$

$$t = \frac{17410}{40 \times 0,9 \times 125} = 3,87 \text{ Kg/cmq.} \quad st \phi 8/25$$





SOLETTE COLLEGAMENTI INTERRATI

$$\text{Soletta } H = 25 = 625$$

$$\text{sovracc. accid.} = 600$$

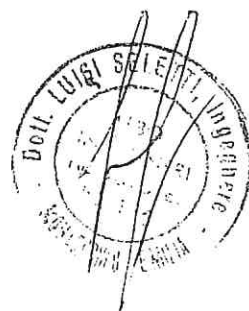
$$\underline{1225 \text{ Kg/mq}}$$

$$M+ = \frac{1}{8} 1225 \times 2,25^2 = 780 \text{ Kg/m}$$

$$m = 10 \quad b = 100 \quad H = 25 \quad h = 23 \quad Sf = 2200$$

$$Af = 1,72 \text{ cmq/ml}$$

$$4\phi 10 = 3,14$$



## Variante (soletta p.t. isolata)

$$q = 5100 \text{ Kg/ml.}$$

$$M_t = \frac{1}{24} \cdot 5100 \times 6,90^2 = 10120 \text{ Kgm/ml.}$$

$$m = 10 \quad b = 100 \quad H = 70 \quad h = 65 \quad Sf = 2200$$

$$Af = 7,87 \text{ cmq/ml.} \quad 6\phi 12 + 2\phi 16 = 10,81$$

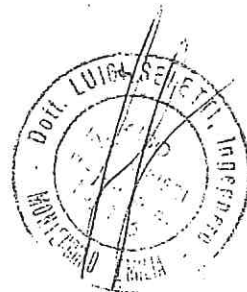
Mensole portanti la soletta

$$P_{\max} = \frac{5100 \times 6,90}{2} = 17600 \text{ Kg/ml.}$$

$$M = 17600 \times 0,25 = 4400 \text{ Kgm/ml.}$$

$$m = 10 \quad b = 100 \quad H = 70 \quad h = 66 \quad Sf = 2200$$

$$Af = 3,37 \text{ cmq/ml.} \quad 4\phi 12 = 4,52$$



STRUTTURE DELLA COPERTURATRAVE 74 ÷ 82 p. COPERT.

$$q = 6500 \text{ Kg/ml.}$$

$$M^- = \frac{1}{16} 6500 \times 3,60^2 = 5260 \text{ Kgm.}$$

$$Af = 4,66 \text{ cmq.} \quad 6\emptyset 12 = 6,79$$

$$M^+ = \frac{1}{12} 6500 \times 3,60^2 = 7020 \text{ Kgm.}$$

$$Af = 6,22 \text{ cmq.} \quad 7\emptyset 12 = 7,92$$

$$M^- = \frac{1}{10} 6500 \times 3,60^2 = 8420 \text{ Kgm.}$$

$$Af = 7,45 \text{ cmq.} \quad 9\emptyset 12 = 10,18$$

$$M^+ = \frac{1}{14} 6500 \times 3,60^2 = 6020 \text{ Kgm.}$$

$$Af = 5,33 \text{ cmq.} \quad 6\emptyset 12 = 6,79$$

$$M^- = \frac{1}{12} 6500 \times 3,60^2 = 7020 \text{ Kgm.}$$

$$Af = 6,22 \text{ cmq.} \quad 8\emptyset 12 = 9,05$$

$$\begin{aligned} \text{Calcolo del } Sc \text{ nella sezione pi\`u sollecitata } M^- (\text{filo}) &= 8420 - \frac{6500 \times 3,60}{2} \times 0,125 = \\ &= 8420 - 1460 = 6960 \text{ Kgm.} \end{aligned}$$

$$m = 10 \quad b = 40 \quad H = 60 \quad h = 57 \quad Sf = 2200$$

$$r = 57,5 / \sqrt{\frac{6960}{0,40}} = 0,433 \quad Sc = 57$$

Taglio

$$T = \frac{6500 \times 3,60}{2} = 11700 \text{ Kg.}$$

$$t = \frac{11700}{40 \times 0,9 \times 57,5} = 5,65 \text{ Kg/cmq.}$$

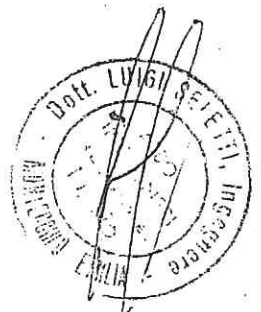
$$S = \frac{5,65 \times 40 \times 360}{4} = 20350 \text{ Kg.}$$

$$5\emptyset 12 \text{ a } 60^\circ \text{ assorbono } 5,66 \times 2200 \times 1,15 = 14300 \text{ Kgm.}$$

$$S \text{ staffe} = \div 8000 \text{ Kg.}$$

$$n = \frac{8000}{0,57 \times 2200} = 6,37$$

$$d = \frac{360}{2 \times 6,37} = 28,2 \text{ cm.} \quad st\emptyset 6/25$$



TRAVI 14 ÷ 22 e 94 ÷ 102 DI GRONDA

$$q = 3630 \text{ Kg/ml.}$$

$$M^- = \frac{1}{16} 3630 \times 3,60^2 = 2940 \text{ Kgm.}$$

$$Af = 4,50 \text{ cmq. } 6\emptyset 12 = 6,79$$

$$M^+ = \frac{1}{12} 3630 \times 3,60^2 = 3920 \text{ Kgm.}$$

$$Af = 6,00 \text{ cmq. } 7\emptyset 12 = 7,92$$

$$M^- = \frac{1}{10} 3630 \times 3,60^2 = 4700 \text{ Kgm.}$$

$$Af = 7,20 \text{ cmq. } 9\emptyset 12 = 10,18$$

$$M^+ = \frac{1}{14} 3630 \times 3,60^2 = 3360 \text{ Kgm.}$$

$$Af = 5,15 \text{ cmq. } 6\emptyset 12 = 6,79$$

$$M^- = \frac{1}{12} 3630 \times 3,60^2 = 3920 \text{ Kgm.}$$

$$Af = 6,00 \text{ cmq. } 8\emptyset 12 = 9,05$$

CALCOLO DEL  $Sc$  NELLA SEZIONE PIU' SOLLECITATA

$$M^- (\text{filo}) = 4700 - \frac{3630 \times 3,60}{2} \times 0,125 = 4700 - 820 = 3880 \text{ Kgm.}$$

$$m = 10 \quad b = 50 \quad H = 35 \quad h = 33 \quad Sf = 2200$$

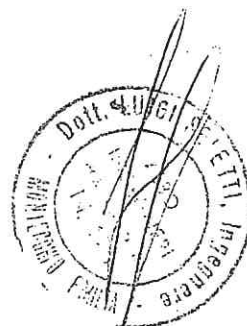
$$r = 33 / \sqrt{\frac{3880}{0,50}} = 0,372 \quad Sc = 67$$

Taglio

$$T = \frac{3630 \times 3,60}{2} = 6540 \text{ Kg.}$$

$$t = \frac{6540}{50 \times 0,9 \times 33} = 4,40 \text{ Kg/cmq.}$$

Si dispongono 2 cavallotti  $\emptyset 12$  e  $st\emptyset 6/20$



TRAVI DI GRONDA 14 - 26 ..... 85 - 94

22 - 29 ..... 86 - 102

$$q = 590 \text{ Kg/ml.}$$

$$M_{\frac{1}{10}} = \frac{1}{10} 590 \times 3,50^2 = 725 \text{ Kgm.}$$

$$A_f = 1,11 \text{ cmq.}$$

$$3\phi 12 = 3,39$$

$$M_{54} = \frac{1}{12} 590 \times \frac{3,50^2 + 7,00^2}{2} = 1510 \text{ Kgm.}$$

$$A_f = 2,31 \text{ cmq.}$$

$$7\phi 12 = 7,92$$

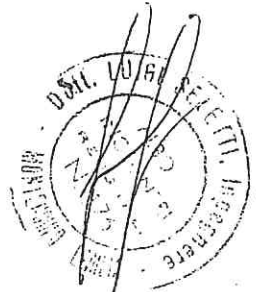
$$M_{54-82} = \frac{1}{12} 590 \times 7,00^2 = 2410 \text{ Kgm.}$$

$$A_f = 3,70 \text{ cmq.}$$

$$6\phi 12 = 6,79$$

$$m = 10 \quad b = 40 \quad H = 35 \quad h = 33 \quad S_f = 2200$$

Le sollecitazioni a flessione e taglio risultano molto modeste.



TRAVI 35 ÷ 43 e 46 ÷ 54 p. copert.

$$q = 4850 \text{ Kg/ml.}$$

$$M_- = \frac{1}{16} 4850 \times 3,60^2 = 3930 \text{ Kgm.}$$

$$Af = 3,48 \text{ cmq.}$$

$$6\phi 12 = 6,79$$

$$M_+ = \frac{1}{12} 4850 \times 3,60^2 = 5230 \text{ Kgm.}$$

$$Af = 4,63 \text{ cmq.}$$

$$7\phi 12 = 7,92$$

$$M_- = \frac{1}{10} 4850 \times 3,60^2 = 6280 \text{ Kgm.}$$

$$Af = 5,56 \text{ cmq.}$$

$$9\phi 12 = 10,18$$

$$M_+ = \frac{1}{14} 4850 \times 3,60^2 = 4480 \text{ Kgm.}$$

$$Af = 3,97 \text{ cmq.}$$

$$6\phi 12 = 6,79$$

$$M_- = \frac{1}{12} 4850 \times 3,60^2 = 5230 \text{ Kgm.}$$

$$Af = 4,63 \text{ cmq.}$$

$$8\phi 12 = 9,05$$

$$m = 10$$

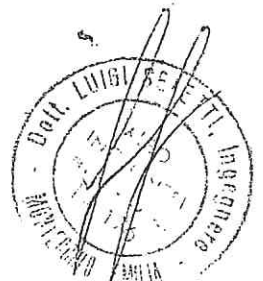
$$b = 40$$

$$H = 60$$

$$h = 57$$

$$Sf = 2200$$

Per le verifiche a flessione e taglio vedasi trave 74 n° 82.



TRAVI AL p.t. e 1° p. (integrativa)

TRAVE 11 - 23 - 27 - 44 - 55 - 83 - 91 - 103 - 115 .

al p. terra e 1° p.

$$q_1 = 4800 \text{ Kg/ml.}$$

$$q_2 = 2540 \text{ Kg/ml.}$$

$$M_{23-27} = \frac{1}{14} 4800 \times 3,90^2 = 5220 \text{ Kgm.}$$

$$Af = 7,96 \text{ cmq.}$$

$$6\emptyset 12 + 2\emptyset 16 = 10,81$$

$$M_{27} = \frac{1}{12} \frac{4800 \times 3,90^2 + 2540 \times 3,15^2}{2} = 4090 \text{ Kgm.}$$

$$Af = 6,25 \text{ cmq.}$$

$$2\emptyset 16 + 4\emptyset 12 + 2\emptyset 10 = 10,11$$

$$M_{27-44} = \frac{1}{14} 2540 \times 3,15^2 = 1800 \text{ Kgm.}$$

$$Af = 2,75 \text{ cmq.}$$

$$5\emptyset 12 = 5,66$$

$$M_{44} = \frac{1}{12} 2540 \times \frac{3,15^2 + 3,00^2}{2} = 2010 \text{ Kgm.}$$

$$Af = 3,07 \text{ cmq.}$$

$$4\emptyset 12 + 2\emptyset 10 = 6,09$$

$$M_{55-83} = \frac{1}{14} 1000 \times 7,00^2 = 3500 \text{ Kgm.}$$

$$Af = 5,35 \text{ cmq.}$$

$$7\emptyset 12 = 7,91$$

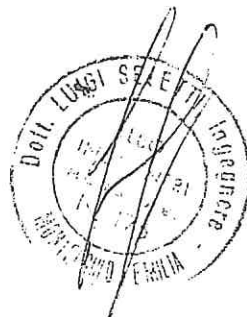
$$m = 10$$

$$b = 50$$

$$H = 35$$

$$h = 33$$

$$Sf = 2200$$



TRAVE AL p. terra 82 - 86 - 102 - 114

$$q = 2540 \text{ Kg/ml.}$$

$$M_{86} = \frac{1}{10} 2540 \times \frac{2,70^2 + 4,30^2}{2} = 3280 \text{ Kgm.}$$

$$Af = 5,01 \text{ cmq.}$$

$$5\emptyset 12 + 2\emptyset 10 = 7,23$$

$$M_{86-102} = \frac{1}{14} 2540 \times \frac{2,70^2 + 4,30^2}{2} = 3360 \text{ Kgm.}$$

$$Af = 5,12 \text{ cmq.}$$

$$5\emptyset 12 + 1\emptyset 10 = 6,45$$

TRAVE AL 1^ p. 82 - 86 - 102 - 114

$$q = 4000 \text{ Kg/ml.}$$

$$M_{82-86} = \frac{1}{12} 4000 \times 2,70^2 = 2430 \text{ Kgm.}$$

$$Af = 3,71$$

$$M_{86} = \frac{1}{10} 4000 \times \frac{2,70^2 + 4,30^2}{2} = 5160 \text{ Kgm.}$$

$$Af = 7,89$$

$$M_{86-102} = \frac{1}{14} 4000 \times 4,30^2 = 5280 \text{ Kgm.}$$

$$Af = 8,06$$

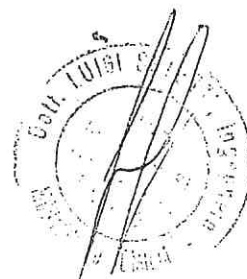
$$m = 10$$

$$b = 50$$

$$H = 35$$

$$h = 33$$

$$Sf = 2200$$





TRAVI 1 - 13 - 25 - 34 ecc. al 1° p.

12 - 24 - 28

92 - 104 - 116

---

$$q = 2850 \text{ Kg/ml.}$$

$$M_- = \frac{1}{12} 2850 \times 3,50^2 = 2800 \text{ Kgm.}$$

$$Af = 4,30 \text{ cmq.}$$

$$6\phi 12$$

$$M_+ = \frac{1}{14} 2850 \times 3,50^2 = 2490 \text{ Kgm.}$$

$$Af = 3,83 \text{ cmq.}$$

$$5\phi 12$$


---

$$M_+ = \frac{1}{14} 2850 \times 3,00^2 = 1830 \text{ Kgm.}$$

$$Af = 2,50 \text{ cmq.}$$

$$3\phi 12 + 2\phi 10$$

$$m = 10$$

$$b = 40$$

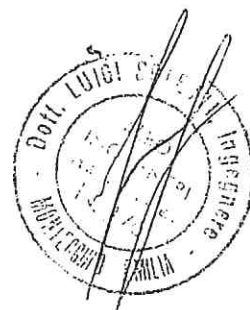
$$H = 35$$

$$h = 33$$

$$Sf = 2200$$

$$M_{24-28} = \frac{1}{12} 2850 \times 3,90^2 = 3610 \text{ Kgm.}$$

$$Af = 5,52 \text{ cmq.}$$



CORDOLI SULLE FINESTRE

## Analisi dei carichi

parete esterna	$1,20 \times 200 =$	240
parete interna	$1,00 \times 150 =$	150
ppr. trave	$0,35 \times 0,18 \times 2500 =$	170
		<hr/> 560 Kg/ml.

$$M+ = \frac{1}{12} 560 \times 3,60^2 = 600 \text{ Kgm.}$$

$$Af = 1,02 \text{ cmq. } 2\emptyset 12 = 2,26$$

$$M- = \frac{1}{10} 560 \times 3,60^2 = 730 \text{ Kgm.}$$

$$Af = 1,23 \text{ cmq. } 3\emptyset 12 = 339$$

$$m = 10$$

$$b = 18$$

$$H = 35$$

$$h = 33$$

$$Sf = 2200$$

SOLETTA IN CALCESTRUZZO NORMALE (H= 35)

(fra i pil. 16-18-37-39)

$$q = 1710 \text{ Kg/mq.}$$

$$M^+ = \frac{1}{12} 1710 \times 7,00^2 = 6990 \text{ Kgm/ml.}$$

$$A_f = 11,07 \text{ cmq/ml.}$$

$$4\phi 12 + 4\phi 16 = 12,56$$

$$M^- = \frac{1}{10} 1710 \times \frac{7,00^2 + 3,00^2}{2} = 4960 \text{ Kgm/ml.}$$

$$A_f = 7,84 \text{ cmq/ml.}$$

$$4\phi 16 + 4\phi 10 = 11,18$$

$$m = 10 \quad b = 100 \quad H = 35 \quad h = 33 \quad S_f = 2200$$

$$r = 33 / \sqrt{\frac{6990}{1,00}} = 0,394 \quad S_c = 63$$

Taglio

$$T = \frac{1710 \times 7,00}{2} = 5980 \text{ Kg/ml.}$$

$$t = \frac{5980}{100 \times 0,9 \times 33} = 2,01 \text{ Kg/cm.}$$

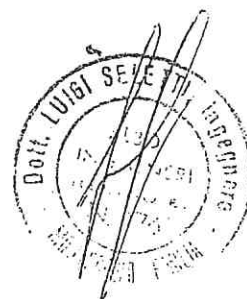
RINFORZO PER PARETI BARITICHE

$$p = 0,18 \times 3300 \times 4,20 = 2500 \text{ Kg/ml.}$$

$$M^+ = \frac{1}{12} 2500 \times 7,00^2 = 10200 \text{ Kgm.}$$

$$m = 10 \quad b = 100 \quad H = 35 \quad h = 33 \quad S_f = 2200 \quad A_f = 15,68 \text{ cmq.}$$

$$8\phi 16 = 16,08$$



SOLETTA IN CALC. BARITICO (H = 60)  
 (fra i pil. 20-22-43-41 al 1° p.)

$$q = 2810 \text{ Kg/mq.}$$

$$M^+ = \frac{1}{10} 2810 \times 7,00^2 = 13770 \text{ Kgm./ml.}$$

$$Af = 12,20 \text{ cmq/ml.}$$

$$6\emptyset 16 + 2\emptyset 12 = 14,32$$

$$M^- = \frac{1}{12} 2810 \times \frac{7,00^2 + 3,00^2}{2} = 6800 \text{ Kgm/ml.}$$

$$Af = 6,03 \text{ cmq/ml.}$$

$$6\emptyset 16 + 4\emptyset 10 = 15,19$$

$$m = 10$$

$$b = 100$$

$$H = 60$$

$$h = 57$$

$$Sf = 2200$$

$$r = 57 / \sqrt{\frac{13770}{1,00}} = 0,484$$

$$Sc = 50$$

Taglio

$$T = \frac{2810 \times 7,00}{2} = 9840 \text{ Kg/ml.}$$

$$t = \frac{9840}{100 \times 0,9 \times 57} = 1,92 \text{ Kg/cmq.}$$

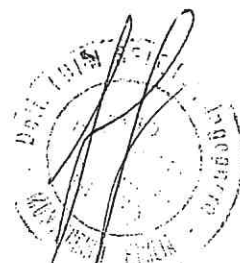
BLOCCO CENTRALE PROTETTO (52-54-82-80)

Carico totale gravante

Copertura	10,00 x 6500	= 65.000
	10,00 x 4850	= 48.500
pilastri 1°p.	6x(0,25x0,40x4,00)x2500	= 6.000
solaio p.t. e 1°p.	2x(7,00/2x1190)x10,00	= 83.300
	2x(3,00/2x1390)x10,00	= 41.700
Solette baritiche	4,30x6,80x2900	= 84.800
	4,30x6,80x2410	= 70.500
	4,70x6,70x3560	= 112.100
	4,70x6,70x2410	= 75.800
pareti baritiche	(2x4,30+7,40)x4,50x	
	x(0,30x3300)	= 71.300
	2(4,70+7,40)x4,50x	
	x(0,35x3300)	= 125.800
pareti c.a.	(2x4,30+7,40)x4,50x(0,30x2500)	= 54.000
	2x(4,70+7,40)x4,50x(0,35x2500)	= 95.300
		<hr/>
		934.100 Kg.
Solettone	12,00x9,90x0,50x2500	= 148.700
		<hr/>
		1.082.800 Kg.

Sul terreno 12,00 x 9,90

$$St = \frac{1.082.800}{12,00 \times 9,90} = 0,91 \text{ Kg/cm}^2.$$



CALCOLO DELLE FONDAZIONI A LASTRA  
(in condizioni di semincastro)

$$l_1 = 5,00$$

$$l_2 = 7,10$$

$$l_2/l_1 = 1,42$$

$$M_{1+} = \frac{1}{24} 9100 \times 5,00^2 = 8480 \text{ Kgm/ml.}$$

$$A_f = 7,66 \text{ cmq.}$$

$$4\phi 12 + 2\phi 16 = 8,54$$

$$M_{2+} = \frac{1}{48} 9100 \times 5,00^2 = 4240 \text{ Kgm/ml.}$$

$$A_f = 383 \text{ cmq.}$$

$$4\phi 12 = 4,52$$

$$M_- = \frac{0,802}{12} 9100 \times 5,00^2 = 15200 \text{ Kgm/ml.}$$

$$A_f = 13,73 \text{ cmq.}$$

$$6\phi 16 + 4\phi 12 = 16,58$$

$$M_{\text{sbalzo}} = \frac{9100 \times 1,40}{2} = 8920 \text{ Kgm/ml.}$$

$$A_f = 8,05 \text{ cmq.}$$

$$4\phi 12 + 2\phi 16 = 8,54$$

$$M_{\text{sbalzo}} = \frac{9100 \times 1,00^2}{2} = 4550 \text{ Kgm/ml.}$$

$$A_f = 4,11 \text{ cmq.}$$

$$4\phi 12 = 4,52$$

$$m = 10 \quad b = 100 \quad H = 60 \quad h = 56$$

$$S_f = 2200$$

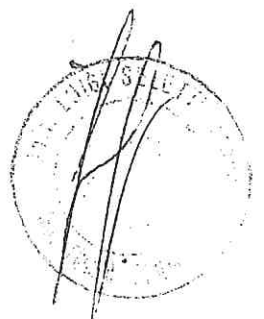
$$r = 56 / \sqrt{\frac{15200}{1,00}} = 0,454$$

$$S_c = 53$$

Taglio

$$T = \frac{9100 \times 5,00}{2} = 22750 \text{ Kg.}$$

$$t = \frac{22750}{100 \times 0,9 \times 65} = 3,89 \text{ Kg/cmq.}$$



PARETE 80 - 81 - 82

a) Campata 80 - 81

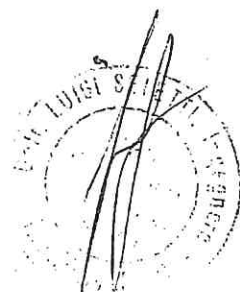
Trave della copert.	6500
incid. pil. 1°p. 1000/3,60	280
	<hr/>
solaio 1°p. 7,00/2 x 1190	4170
soletta baritico H=50 7,00/2 x 2900	10150
parete barit. 0,25 x 3300 x 4,00	3300
	<hr/>
p.t. 24400 Kg/ml.	
 solaio p.t. 7,00/2 x 1190 =	4170
solett. bar. H= 35 7,00/2 x 2410=	8430
parete c.a. 0,25 x 2500 x 4,00 =	2500
	<hr/>
	15100 Tot. 39500

parete b= 25      10/10/25 sui due lati.

## b) Campata 81 - '82 .

Trave copert.	6500
incid. pil.	280
sol. 1°p.	4170
soletta barit. $H = 70 \text{ } 7,00/2 \times 3560 =$	12460
parete barit. $0,35 \times 3,300 \times 4,00$	4620
	<hr/> 28030 Kg/ml.
solai p.t.	4170
soletta bar. $H = 35$	8430
parete c.a. $0,35 \times 2500 \times 4,00$	3500
	<hr/> 16100 tot. 44.130

parete b= 35 con 10/25 sui due lati.



SOLETTA AL P. TERRA

Si calcolano la lastre in condizioni di semincastro.

$$l_1 = 5,00 \quad l_2 = 7,10 \quad l_2/l_1 = 1,42$$

$$q = 2410 \text{ Kg/mq.}$$

$$M_{1+} = \frac{1}{20} 2410 \times 5,00^2 = 3010 \text{ Kgm/ml.}$$

$$A_f = 4,91 \text{ cmq/ml.}$$

$$6\phi 12 = 6,79$$

$$M_{2+} = \frac{1}{40} 2410 \times 5,00^2 = 1510 \text{ Kgm/ml.}$$

$$A_f = 2,46 \text{ cmq/ml.}$$

$$4\phi 12 = 4,52$$

$$M_{1-} = \frac{0,802}{12} 2410 \times 5,00^2 = 4020 \text{ Kgm/ml.}$$

$$A_f = 6,55 \text{ cmq/ml.}$$

$$6\phi 12 + 3\phi 10 = 9,13$$

$$M_{2-} = \frac{1}{24} 2410 \times 5,00^2 = 2510 \text{ Kgm/ml.}$$

$$A_f = 4,09 \text{ cmq./ml.}$$

$$4\phi 10 + 2\phi 12 = 5,40$$

$$n = 10 \quad b = 100 \quad H = 35 \quad h = 31 \quad S_f = 2200$$

$$r = 31 / \sqrt{\frac{4020}{1,00}} = 0,490 \quad S_c = 49$$

Taglio

$$T = \frac{2410 \times 5,00}{2} = 6020 \text{ Kg/ml.}$$

$$t = \frac{6020}{100 \times 0,9 \times 31} = 2,16 \text{ Kg/cmq.}$$





SOLETTE AL 1° p.

a)  $l_1 = 5,00$   $l_2 = 7,10$   
 $q = 3560 \text{ Kg/mq.}$   $l_2/l_1 = 1,42$

$$M_{1+} = \frac{1}{8} 3560 \times 5,00^2 = 4980 \text{ Kgm/ml.}$$

$$Af = 3,88 \text{ cmq./ml.}$$

$$6\phi 12 = 6,79$$

$$M_{2+} = \frac{1}{36} 3560 \times 5,00^2 = 2490 \text{ Kgm/ml.}$$

$$Af = 1,94 \text{ cmq./ml.}$$

$$4\phi 12 = 4,52$$

$$M_{1-} = \frac{0,802}{12} 3560 \times 5,00^2 = 5930 \text{ Kgm/ml.}$$

$$Af = 4,62 \text{ cmq./ml.}$$

$$6\phi 12 + 3\phi 10 = 9,13$$

$$M_{2-} = \frac{1}{24} 3560 \times 5,00^2 = 3710 \text{ Kgm/ml.}$$

$$Af = 2,88 \text{ cmq./ml.}$$

$$4\phi 10 + 2\phi 12 = 5,40$$

$$m = 10 \quad b = 100 \quad H = 70 \quad h = 65$$

$$Sf = 2200$$

$$r = 65 / \sqrt{\frac{5930}{1,00}} = 0,842 \quad Sc = \angle \angle 40$$

Taglio

$$T = \frac{3560 \times 5,00}{2} = 8900 \text{ Kg.}$$

$$t = \frac{8900}{100 \times 0,9 \times 65} = 1,53 \text{ Kg/cmq.}$$

b)

$$q = 2900 \quad \text{Kg/mq.}$$

$$l_1 = 4,80$$

$$l_2 = 7,10$$

$$l_2/l_1 = 1,48$$

$$M_{1+} = \frac{1}{20} 2900 \times 4,80^2 = 3340 \text{ Kg/m.}$$

$$Af = 3,75 \text{ cmq/ml.}$$

$$6\emptyset 12 = 6,79$$

$$M_{2+} = \frac{1}{40} 2900 \times 4,80^2 = 1670 \text{ Kg/m.}$$

$$Af = 1,88 \text{ cmq/ml.}$$

$$4\emptyset 12 = 4,52$$

$$M_{1-} = \frac{0,802}{12} 2900 \times 4,80^2 = 4460 \text{ Kg/m.}$$

$$Af = 5,00 \text{ cmq/ml.}$$

$$6\emptyset 12 + 3\emptyset 10 = 9,13$$

$$M_{2-} = \frac{1}{24} 2900 \times 4,80^2 = 2780 \text{ Kg/m.}$$

$$Af = 3,12 \text{ cmq/ml.}$$

$$4\emptyset 10 + 2\emptyset 12 = 5,40$$

$$m = 10$$

$$b = 100$$

$$H = 50$$

$$h = 45$$

$$Sf = 2200$$

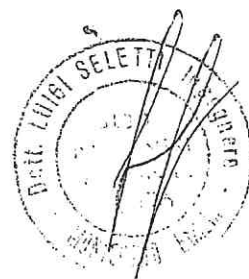
$$r = 45 / \sqrt{\frac{4460}{1,00}} = 0,673$$

$$Sc = 34$$

Taglio

$$T = \frac{2900 \times 4,80}{2} = 6960 \text{ Kg.}$$

$$t = \frac{6960}{100 \times 0,9 \times 45} = 1,72 \text{ Lg/cmq.}$$



PASSERELLA DI COLLEGAMENTO

## a) Solaio di calpestio

ppr. solaio	H= 16	= 230
pavimento e sottofondo		= 120
isolamento		= 100
sovraccarico accid.		= <u>600</u>
		1050 Kg/mq.

## b) Solaio di copertura

ppr. solaio	H = 16	= 230
impermeab. e isolamento (media)		= 220
sovracc. accid.		= <u>150</u>
		600 Kg/mq.

## Analisi dei carichi su una trave-parete

solaio portante	3,10/2 x 1050	= 1630
solaio copert.	3,10/2 x 600	= 930
parete esterna	3,50 x 120	= 420
parete c.a.	3,50 x 0,15 x 2500	= 1320
parete interna	2,50 x 100	= <u>250</u>
		4550 Kg/ml.

$$M_t = \frac{1}{8} 4550 \times 11,00^2 = 68800 \text{ Kgm.}$$

$$m = 10 \quad b = 15 + 15 = 30 \quad H = 290 \quad h = 278 \quad Sf = 2200$$

$$r = 278 / \sqrt{\frac{68800}{0,30}} = 0,581 \quad Sc = 40 \quad Af = 12,53 \text{ cmq.}$$

$$8\phi 16 = 16,08$$

## Taglio

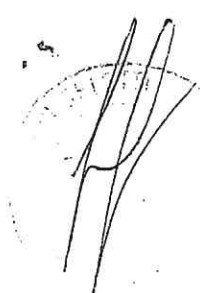
$$T = \frac{4550 \times 11,00}{2} = 25.000 \text{ Kg}$$

$$t = \frac{25000}{15 \times 0,9 \times 278} = 6,67 \text{ Kg/cmq.}$$

$$S = \frac{6,67 \times 15 \times 1100}{4} = 27550 \text{ Kg.}$$

Si adottano sole staffe

$$n = \frac{27550}{1,01 \times 2200} = 12,4 \quad d = \frac{1100}{2 \times 12,4} = 44,3 \quad st \phi 8/30$$



Portale delle passerelle

$$\text{Passerelle } 2 \times (11,00/2 + 0,60) \times 4550 = 55510$$

$$R_a = 55510 \times 5,70/6,40 + 55510 \times 2,50/6,40 = \\ = 49400 + 21700 = 71100 \text{ Kg.}$$

$$R_b = 55510 \times 0,70/6,40 + 55510 \times 3,90/6,40 = \\ = 6100 + 33800 = 39900 \text{ Kg.}$$

Carico sui piedritti

$$\text{Traverso in acciaio } 6,80/2 \times 300 = 1020$$

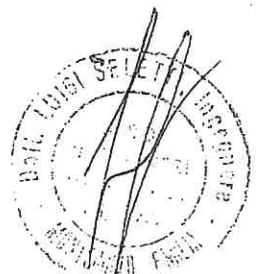
$$\text{Piedritto in acciaio } 3,20 \times 150 = \frac{480}{1500}$$

Piedritto Ovest

$$71100 + \\ 1500 \\ \hline 72600 \text{ Kg.}$$

Piedritto est

$$39900 + \\ 1500 \\ \hline 41400 \text{ Kg.}$$



LOCALE SCARICHI RADIATIVI

a) Muro contro terra

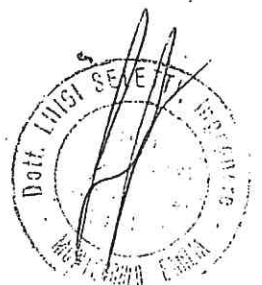
$$p = 1600 \times 4,50 \times 0,30 = 2160 \text{ Kg/mq.}$$

$$M = \frac{2160 \times 4,50^2}{6} = 7300 \text{ Kgm/ml.}$$

$$m = 10 \quad b = 100 \quad H = 40 \quad h = 36 \quad Sf = 2200$$

$$r = 36 / \sqrt{\frac{7300}{1,00}} = 0,420 \quad Sc = 58 \quad Af = 10,28 \text{ cmq./ml.}$$

$$4\phi 16 + 4\phi 12 = 12,56$$



CAMERA NORD INTERRATA

a) Muro contro terra

$$p_2 = 1600 \times 4,20 \times 0,30 = 2020 \text{ Kg/mq.}$$

$$M^+ = \frac{1}{15,6} 2020 \times 4,20^2 = 2280 \text{ Kg/ml.}$$

$$m = 10 \quad H = 25 \quad h = 23 \quad Sf = 2200$$

$$Af = 5,02 \text{ cmq/ml.} \quad 2\emptyset 12 + 2\emptyset 16 = 6,28 \text{ cmq/ml.}$$



TRAVE ROVESCIA SU DIAFRAMMA

$$q = 15.000 \text{ Kg/ml.}$$

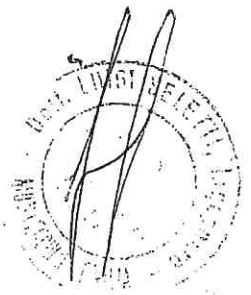
$$M^+ = \frac{1}{8} 15000 \times 3,00^2 = 16900 \text{ Kgm.}$$

$$m = 10 \quad b = 60 \quad H = 70 \quad h = 67 \quad S_f = 2200$$

$$A_f = 12,70 \text{ cmq.}$$

$$r = 67 / \sqrt{\frac{16900}{0,60}} = 0,399$$

$$7\phi 16 = 14,07$$



ASCENSORE

Analisi dei carichi (aggiuntivi)

pareti 2x (1,40+1,70) x 14,00 x 0,15 x 2500 = 32.500

soletta 3,00 x 1,50 x 0,40 x 2500 = 4.500  
37.000

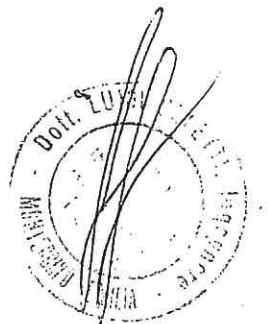
macchinario + basamento 7.000

44.000 Kg.

Sul terreno 300 x 150

$$St = \frac{44.000}{300 \times 150} = 0,98 \text{ Kg/cm}^2.$$

Si esegue la piastra di H = 40 armata con doppia maglia Ø 12/25





SCALE DI EMERGENZA  
(a sezione circolare)

Analisi dei carichi

$$\begin{aligned}
 \text{Anello esterno } (2 \times 3,14 \times 2,00) \times 12,00 \times 0,20 \times 2500 &= 75.400 \\
 \text{quadrato interno } 2 \times (0,90 + 0,60) \times 12,00 \times 0,15 \times 2500 &= 13.500 \\
 \text{solette rampe } 4 \times (2,00^2 \times 3,14) \times 1100 &= 55.200 \\
 &\underline{\hspace{1cm}} \\
 &144.100 \text{ Kg.}
 \end{aligned}$$

$$\begin{aligned}
 \text{Solettone } (3,14 \times 2,80^2) \times 0,60 \times 2500 &= 37.400 \\
 &\underline{\hspace{1cm}} \\
 &181.500 \text{ Kg.}
 \end{aligned}$$

Sul terreno: piastra  $\varnothing 520$

$$St = \frac{181.500}{2,60^2 \times 3,14} = 0,86 \text{ Kg/cm}^2.$$

Calcolo dell'armatura

$$M_{\max} = \frac{1}{32} 8600 \times 3,50^2 = 3300 \text{ Kgm.}$$

$$m = 10 \quad b = 100 \quad H = 50 \quad h = 45 \quad Sf = 2200$$

$$Af = 3,70 \text{ cm}^2/\text{ml.} \quad 4\varnothing 12 = 4,52$$

Soletta del corridoio

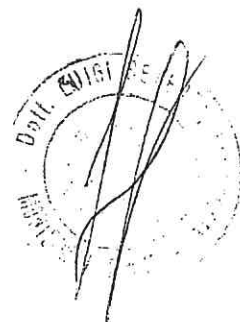
$$M^+ = \frac{1}{10} 8600 \times \frac{2,20^2}{2} = 4160 \text{ Kgm/ml.}$$

b) Pareti

Vengono armate con  $\varnothing 10 / 25$  al p. interrato e  $\varnothing 8 / 25$  al p. terra su entrambi i lati.

Carico max al piede:

$$\frac{144.100}{2 \times 3,14 \times 2,80} = 8220 \text{ Kg/ml.}$$



## c) Rampe

$$q = 1100 \text{ Kg/mq.}$$

$$M \pm = \frac{1}{10} 1100 \times 1,65^2 = 300 \text{ Kgm/ml.}$$

$$m = 10 \quad H = 16 \quad h = 14 \quad Sf = 2200$$

$$Af = 1,08 \text{ cmq/ml.} \quad 3\varnothing 8 = 1,51$$

Si è tenuta la larghezza di 100 cm. invece dei 90 cm. dei tre gradini.

## d) Pianerottoli

Si considera l'area pari a quella della rampa e si dispone della stessa armatura ( $3\varnothing 8 = 1,51$ )

## e) Nasi di appoggio delle passerelle

Carico a ml.

$$\text{Armatura metallica (max)} \quad 2400/10,00 = 240$$

$$\text{sovracc. accid. (folla)} \quad 600 \times 1,50 = \frac{900}{1140} \text{ Kg/ml.}$$

~~Carico max all'estremità~~

$$P = 1140 \times 10,00/2 = 5700 \text{ Kg.}$$

$$M = 5700 \times 0,40 = 2280 \text{ Kgm.}$$

$$m = 10 \quad H = 25 \quad h = 23 \quad Sf = 2200$$

$$Af = 5,00 \text{ cmq.} \quad (3+3)\varnothing 12 = 6,78$$

Taglio

$$Af = \frac{5700}{2200} = 2,60 \text{ cmq.} \quad 4\varnothing 12 = 4,52$$

BOCCHE DI LUPO

## a) Parete contro terra

Si considera il muro appoggiato in sommità e semincastrato alla base.

$$Q = 0,33$$

$$\text{tg}^2 (45 - q/2) = 0,30$$

$$St = 1600 \text{ Kg/mc.}$$

Si considera la spinta dovuta ai sovraccarichi mobili pari a 1,00 m. di terra.

$$p_1 = 1600 \times 1,00 \times 0,30 = 480 \text{ Kg/mq.}$$

$$p_2 = 1600 \times 2,50 \times 0,30 = 1200 \text{ Kg/mq.}$$

$$p_3 = 1600 \times 5,00 \times 0,30 = 2400 \text{ Kg/mq.}$$

$$M_{1-2} = \frac{1}{12} 480 \times 1,50^2 + \frac{1}{18} (1200 - 480) \times 1,50^2 = 90 + 90$$

$$= 180 \text{ Kgm/ml.} \quad Af = 0,41 \text{ cmq/ml.}$$

$$M_2 \text{ (sin)} = \frac{1}{10} 480 \times 1,50^2 + \frac{1}{15} (1200 - 480) \times 1,50^2$$

$$= 110 + 110 = 220 \text{ Kgm/ml.} \quad Af = 0,50 \text{ cmq/ml.}$$

$$M_2 \text{ (dex)} = \frac{1}{12} 1200 \times 2,50^2 + \frac{1}{20} (2400 - 1200) \times 2,50^2 =$$

$$= 625 + 375 = 1000 \text{ Kgm/ml.} \quad Af = 2,24 \text{ cmq/ml.}$$

$$M_{2-3} = \frac{1}{16} 1200 \times 2,50^2 + \frac{1}{24} (2400 - 1200) \times 2,50^2 =$$

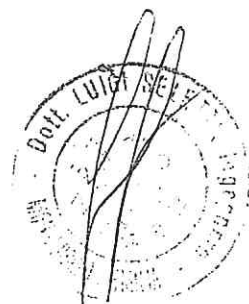
$$= 470 + 310 = 780 \text{ Kgm/ml.} \quad Af = 1,75 \text{ cmq/ml.}$$

$$M_3 = \frac{1}{12} 1200 \times 2,50^2 + \frac{1}{15} (2400 - 1200) \times 2,50^2 =$$

$$= 625 + 500 = 1125 \text{ Kgm./ml.} \quad Af = 2,52 \text{ cmq/ml.}$$

$$m = 10 \quad b = 100 \quad H = 25 \quad h = 22,5 \quad Sf = 2200$$

Nella eventualità di cedimenti dei puntoni a metà altezza si verifica il muro con appoggio in sommità e semincastro alla base.



$$M_{\text{mezz}} = \frac{1}{12} 480 \times 4,00^2 + \frac{1}{24} (2400 - 480) \times 4,00^2 =$$

$$= 640 + 1280 = 1920 \text{ Kgm/ml.}$$

$$Af = 4,31 \text{ cmq/ml.}$$

$$4\emptyset 12 = 4,52$$

$$M_{\text{inc}} = \frac{1}{12} 480 \times 4,00^2 + \frac{1}{15} (2400 - 480) \times 4,00^2 =$$

$$= 640 + 2050 = 2690 \text{ Kgm/ml.}$$

$$Af = 6,04 \text{ cmq/ml}$$

$$4\emptyset 10 + 2\emptyset 16 = 7,16$$

b) Trave reggispinta a metà altezza

Carico gravante

$$q = 480 \times 4,00/2 + \frac{(1200 - 480) \times 1,50}{3} + \frac{(2400 - 1200) \times 2,50}{6} =$$

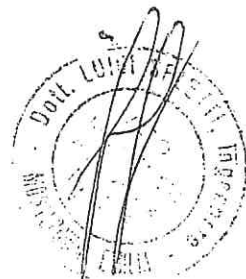
$$= 960 + 360 + 500 = 1820 \text{ Kg/ml.}$$

$$M_{\text{tr}} = \frac{1}{12} 1920 + 360^2 = 2080 \text{ Kg.}$$

$$m = 10 \quad H = 25 \quad h = 23 \quad Sf = 2200$$

$$Af = 4,56 \text{ cmq.}$$

$$2\emptyset 16 + 1\emptyset 12 = 5,15$$



c) Fondazione 106 - 115 (con bocche di lupo)

Carico sul lato interno (trave rovescia)

dal pil. 108  $19200/3,60 = 5340$ ppr. trave  $,40 \times 0,60 \times 2500 = \underline{600}$ 

5940 Kg/ml.

Calcolo dell'armatura

$$M^+ = \frac{1}{12} 5940 \times 3,60^2 = 6420 \text{ Kgm.} \quad A_f = 3,06 \text{ cmq.} \quad 2\emptyset 16 = 4,02$$

$$M^- = \frac{1}{10} 5940 \times 3,60^2 = 7710 \text{ Kgm.} \quad A_f = 3,67 \text{ cmq.} \quad 3\emptyset 16 = 6,03$$

$$M^+ = \frac{1}{14} 5940 \times 3,60^2 = 5510 \text{ Kgm.} \quad A_f = 2,63 \text{ cmq.} \quad 2\emptyset 16 = 4,02$$

$$M^- = \frac{1}{12} 5940 \times 3,60^2 = 6420 \text{ Kgm.} \quad A_f = 3,06 \text{ cmq.} \quad 3\emptyset 16 = 6,03$$

m= 10      b= 30      H= 110      h= 106      Sf= 2200

d) Fondazione comune

trave interna		= 5940
tamp.	4,00 x 350	= 1400
muro c.a.	5,00 x 0,25 x 2500	= 3130
fondazione	1,90 x 0,40 x 2500	= 1900
magrone	1,90 x 0,05 x 2200	= <u>210</u>
		12580 Kg/ml.

Sul terreno      b= 190

$$St = \frac{12.580}{190 \times 100} = 0,67 \text{ Kg/cmq.}$$

$$M^+ = \frac{1}{12} 6700 \times 1,60^2 = 1430 \text{ Kgm/ml.}$$

m= 10      H= 40      h= 30      Sf= 2200

Af= 2,41 cmq/ml.      4\emptyset 10 = 3,14

Si arma il solettone con 4\emptyset 10/ml. (staffoni)

