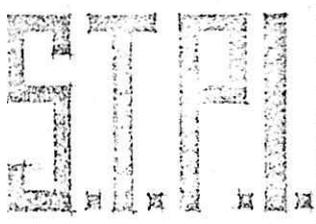# STUDIO TEC. PROF. INGEGNERIA

72100 - BRINDISI

VIA PALESTRO, 5 - TEL. 26836 - 26580

REDATTO: *ing. A. MALDARI*

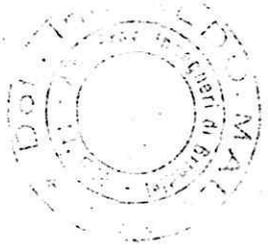**COMMITTENTE:** *I.A.C.P. - BRINDISI*

LAVORI: *PROGRAMMA D'INTERVENTO n.010/33/1*

ESECUTORE: *impresa PATI - BRINDISI*

RELAZIONE CALCOLI STRUTTURE

TAV

DATA: _____

AGG. _____

AGG. _____

AGG. _____

DIS. _____

CONT. _____

RAPP. _____

Impresa VITO PATI

BRINDISI

Relazione di calcolo strutture per
la realizzazione del programma
di intervento n. 010/3/1 IACP

Mesagne

Analisi elementari

- **muratore perimetrali di tamponamento**
  - tavolato esterno semipieno : $\dfrac{013 \times 1100}{100} = 132\ \text{kg/m}$
  - " interno — 100 "
  - intonaco 3 strati — $\dfrac{75}{307\ \text{kg/m}}$
  - peso a ml = $307 \times 3.06 = 939\ \text{kg/ml} \simeq 1\ \text{t/ml}$.

- **solaio t/80+4 cal perio piano abitabim**
  - peso proprio 360 kg/m
  - pav + intonaco
  - + malta alett + incid. trav. 140
  - sovracc. accid. $\dfrac{250}{650\ \text{kg/m}}$

  Il medesimo carico si assume sulla copertura piana.

- **solaio alla perito balcom**
  - peso proprio : 300 kg/m
  - sov. : 400 "
  - pav + int + imp : 100 "
  - $\overline{800\ \text{kg/m}}$

- **gradino scala**
  - soletta : $034 \times 150 = 51\ \text{kg}$
  - gradino $\dfrac{030 + 016}{2} \times 2500$. 60 "
  - ped. 27
  - frontino 8
  - malta 11
  - intonaco 10
  - sovr. acci 120
  - $\overline{\simeq 290\ \text{kg/ml}}$ ogni gradino

  carico a ml : $\dfrac{290}{030} \simeq 1000\ \text{kg/m}$.

  Il medesimo carico si adotta per i pianerottoli.

Copertura scala

Trave 25-13
25-20

- Jelaio 13 : $0,30 \times 0,15 \times 2500 = 112\frac{}{}$
- trave : $0,15 \times 0,80 \times 2500 = 300$ u
- faccia piena $= 200$
- intonaco $0,55 \times 400 = 820$
- Solaio : $\frac{2,90 \times 650}{2} = 780$

$\overline{1612}$

750: $(118+300) \times \frac{300}{2}$ 750 u

|← 0,50 →| 4.40 |← 0,50 →|
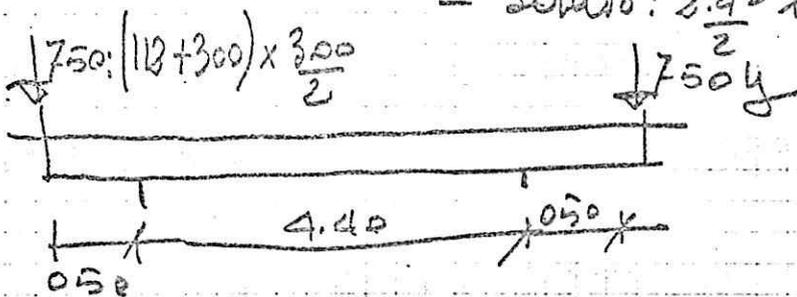
$R_{25} = R_{13} = 1612/(2,20+0,50)+750 = 5108\frac{}{}$

Analisi di carico al piano di copertura (5° impalcato)

Trave 1-2-3-4-5-6-7-8

a) Nel tratto 1-2-3 ; 6-7-8

- Muro di attico : $1.40 \times 0.12 \times 2500 = 420$ 4/ml
- Trave : $0.80 \times 0.24 \times 2500 = 480$ "
- Solaccio : $400 \times 0.80 = 320$ "
- Solaio : $\dfrac{3.30}{2} \times 650 = \underline{1072}$ "

$$2292 \text{ 4/ml} \simeq 2.3 \text{ t/ml}$$

b) Nel tratto 3-4-5-6

$$c.s. + 1.50 \times 800 = 3.5 \text{ t/ml}$$

$R_1 = (0.50 + 1.70) \times 2.3 = 5.06 \text{ t}$

$R_2 = \dfrac{(3.40 + 2.80)}{2} \times 2.3 = 7.13 \text{ t}$

$R_3 = 1.40 \times 2.3 + \dfrac{2.70}{2} \times 3.5 = 7.95 \text{ t}$

$R_4 = \dfrac{(2.70 + 4)}{2} \times 3.5 = 11.73 \text{ t}$

$R_5 = 4 \times 3.5 = 14 \text{ t}$

$R_6 = \dfrac{4}{2} \times 3.5 + \dfrac{2.80}{2} \times 2.3 = 10.22 \text{ t}$

$R_7 = \left(\dfrac{2.80}{2} + 0.50\right) \times 2.3 = 4.37 \text{ t}$

TRAVE 8-9-10-11-12-13-14-15

A) pp + sole : 800 4/ml

tot.

$\dfrac{3.30 + 1.80}{2} \times 650 = 2632$ "

3.5 t/ml

$R_8 = (1.70 + 0.50) \times 3.5 = 7.70 \text{ t}$

$R_9 = \dfrac{(3.40 + 2.80)}{2} \times 3.5 = 10.85 \text{ t}$

$R_{13} = R_{10} = \dfrac{(2.80 + 4)}{2} \times 3.5 = 11.90 \text{ t}$

B) Nel tratto 14-15

pp + sole. 1000

Muro attico 420

Solaio : $\dfrac{4.80}{2} \times 650 = 1560$

3 t/ml

$R_{12} = R_{11} = \dfrac{(4 + 2.70)}{2} \times 3.5 = 11.73$

$R_{14} = 3.5 \times 1.4 + 1.7 \times 3 = 10 \text{ t}$

$R_{15} = 3 \times (1.70 + 0.50) = 6.6 \text{ t}$

TRAVE 16-17-18-19 ; 20-21-22-23

$$pp + sole: \quad 1000 \ kg/me$$
$$Muro \ attico \quad 420$$
$$Solaio \quad 1560$$
$$\overline{\qquad 3 t/me}$$

— sul tratto 17-18-19:

$$CS + 1,20 \times 800 \simeq 4 t/me$$

$$R_{16} = R_{23} = (0,50 + 1,70) \times 4 = 8,8 \ t/m$$
$$R_{17} = R_{22} = 1,70 \times 3 + \frac{4,00}{2} \times 4 = 13,1 \ t/m$$
$$R_{18} = R_{21} = \left(\frac{4 + 2,80}{2}\right) \times 4000 = 13,6 \ t/m$$
$$R_{19} = R_{20} = \frac{2,80}{2} \times 4000 = 5,60 \ t.$$

TRAVE 1-8-16-15-23 ; 7-14

$$Muro \ attico \quad 420$$
$$Trave + sole \quad : 600$$
$$\overline{1020 \ kg/me} \simeq 1 t/me$$

$$R_1 = 0,50 + 2,10 = 2,60 \ t.$$
$$R_8 = \frac{5,40}{2} + 2,10 = 4,8 \ t$$
$$R_{16} = \frac{5,40}{2} + 0,80 = 3,5 \ t.$$
$$R_7 = (0,50 + 2,10) \times 1,4 = 3,64 \ t$$
$$R_{14} = 3,64 \ t$$
$$R_{15} = R_{23} = 3,5 \ t.$$

TRAVE 11-24-19 ; 18-25-20

1500

1300 Kg/ml

1500+600 ≃ 2100 Kg . (trave 50×24+ muratura + muretto
(perimetrale attico)

↑ 1.40 ↓ 4.55 ↓ 1.70 ↓

⑪ ㉔ ⑲

muratura 1000

pp trave 300
_____
1300

- R₁₁ = 1300 × 0,70 = 910 ≃ 1t + 0,70 × 1500 = 2t

TRAVE 25-26 - R₂₄ = 2,96 ≃ 3t - R₁₉ = 7.27 t
+ 0,70 × 1500 = 4t

Sol. reale : $\dfrac{4,40}{2}$ × 1000 = 2200

trave : 0,60 × 0,20 × 2500 = 300

muurat. = 1000

sol. trave 500 × 0,60 = 300
_____
3.8 t/ml

R₂₅ = R₂₆ = 1.50 × 3,8 = 5.7 t.

TRAVE 19-20 (a metà pian. appo)

muurat : 1000 Kg/ml

sol. reale a sbalzo : 0,70 × 1000 = 700

pp trave : 0,20 × 0,90 × 2500 = 450

sole. 500 × 0,90 = 450
_____
soletta reale 2200
_____
3,8 t/ml

R₁₉ = R₂₀ = 3,8 × 1.50 = 5.7 t

Analisi di carico del solaio piano tipo (4°-3°-2° imp.)

TRAVE 1-2-3-4-5-6-7

Solaio: $\frac{3.25}{2} \times 650 = 1056$ K/ml

Murat. $\qquad = 1000$

Mp + sole $\qquad = 800$
$\qquad \qquad \qquad \overline{}$
$\qquad \qquad \simeq 3t/ml$

- tratto 3-4-5-6 :

$\qquad c_3 + 1.50 \times 800 = 4.2 \, t/ml$

$\qquad + $ muro attico : 100 K/ml $\simeq 4.3 \, t/ml$

$R_1 = (0.20 + 1.70) \times 3 = 5.7 \, t$

$R_2 = (1.70 + 1.40) \times 3 = 9.3 \, t$

$R_3 = 1.6 + (1.40 \times 3) + 1.35 \times 4.3 = 11.61 \, t$

$R_4 = (2 + 1.35) \times 4.3 = 14.40 \, t$

$R_5 = 4 \times 4.3 = 17.2 \, t$

$R_6 = (2 + 1.90) \times 3 + 1.3 \times 2 + 1.6 = 14.4 \, t$

$R_7 = (1.40 + 0.20) \times 3 = 4.8 \, t$

TRAVE 8-9-10-11-12-13-14-15

$\qquad$ *come al solaio di copertura.*

TRAVE 16-17-18-19 ; 20-21-22-23

Solaio $\frac{5.00}{2} \times 650 = 1625$ K/ml

Murat. $\qquad = 1000$

Mp trave + sole $\qquad = 800$
$\qquad \qquad \qquad \overline{3425} \simeq 3.5 \, t/ml$

tratto 17-18-19 : $c_3 + 800 \times 1.20 + 100 \simeq 4.5 \, t/ml$

$R_{16} = (1.70 \cdot 0.20) \times 3.5 = 5.95\,t$

$R_{17} = 1.6 + 3.5 \times 1.7 + \dfrac{3.70}{2} \times 4.5 = 15.88\,t$

$R_{18} : 1.6 + 4.5 \left(\dfrac{3.70}{2} + 1.40 \right) = 16.23\,t$

$R_{19} : 4.5 \times 1.40 = 6.30\,t.$

TRAVE 1-8-16

$pp + solv = 600$

$uwr. = \dfrac{1000}{1.6\,t/ul}$

$R_1 = (0.20 + 3.10) \times 1.6 = 3.68\,t.$

$R_8 = \left(\dfrac{4.20 + 5.40}{2} \right) \times 1.6 = 7.68\,t.$

$R_{16} = \left(\dfrac{0.50 + 5.40}{2} \right) \times 1.6 = 5.12\,t$

TRAVE 15-23

$q = 1.6\,t/ul$

$R_{15} = 1.6 \times \left(\dfrac{0.50 + 5.40}{2} \right) \times 1.6 = R_{23}$

TRAVE 7-14

$R_7 = R_{14} = 1.6 \times 2.10 = 3.36\,t$

TRAVE 11-25-19

come copertura.

$R_{11} = 8\,t \quad ; \quad R_{19} = 7.27\,t \quad ; \quad R_{25} = R_{26} = 4\,t.$

TRAVE 25-26

come copertura.

$R_{25} = R_{26} = 5.7\,t$

TRAVE 19-20   come copertura

$R_{19} = R_{20} = 5.7\,t.$

VARIANTI AL I° IMPALCATO (ad interessare Carichi precedenti)

Trave 7-24

$q = 3\,t/ul$

$R_{24} = R_7 = 5.7\,t$

Trave 14-15

plaio: 1056

$R_{14} = R_{15} = 1.70 \times 1056 = 1.8\,t$

Trave 24-15

$pp + solv = 400$

attico $\dfrac{600}{1000}\,t/ul$

$R_{24} = R_{15} = 2.10\,t.$

Analisi di Carico sui pilastri

Pilastro 1

$5°$: $3.06 + 3.60 + 7.50 \longrightarrow 8.41$ t : 30×30 ; $4\phi 12$

4 : $5.70 + 3.68 + 7.50 \longrightarrow 18.54$ t : 30×30 ; $4\phi 16$

3 : " " " $\longrightarrow 28.67$ t : 30×30 ; $4\phi 16$

2 : " " " $\longrightarrow 38.80$ t : 30×30 ; $4\phi 16$

1 : " " $1.500 \longrightarrow 49.68$ t : 30×40 ; $4\phi 16$

0 : $1500 \left(\dfrac{3.90 \cdot 3}{2}\right) = 5.18 \longrightarrow 54.86$ t : 30×40 ; $4\phi 16$

PILASTRO 2

$5°$: $7.13 + 0.75 \longrightarrow 7.88$ t : $30 \times 30 - 4\phi 12$

$4°$: $9.3 + 0.75 \longrightarrow 17.93$ t : $30 \times 30 - 4\phi 12$

$3°$: " " $\longrightarrow 27.98$ t : $30 \times 30 - 4\phi 16$

$2°$: " $0.90 \longrightarrow 38.18$ t : $30 \times 30 - 4\phi 16$

$1°$: " $1.5 \longrightarrow 48.98$ t : $30 \times 40 - 4\phi 16$

$0°$: $(1.50 + 1.40) \times 1.5 = 4.35 \longrightarrow 53.33$ t : $30 \times 40 - 4\phi 16$

PILASTRO 3

$5°$: $7.95 + 0.75 \longrightarrow 8.7$ t : $30 \times 30 - 4\phi 12$

$4°$: 11.61 " " $\longrightarrow 21.06$ t : $30 \times 30 - 4\phi 16$

$3°$: $11.61 +$ " $\longrightarrow 33.42$ t : $30 \times 30 - 4\phi 16$

$2°$: $11.61 + 0.9 \longrightarrow 45.93$ t : $30 \times 40 - 4\phi 16$

$1°$: $11.61 + 1.5 \longrightarrow 59.04$ t : $30 \times 40 - 4\phi 16$

$0°$: $2.8 \times 1.5 = 4.2 \longrightarrow 63.84$ t : $30 \times 40 - 4\phi 16$

PILASTRO 1

5°: 11,73 + 1 + 0,75 → 13,48 t : 30x30 - 4φ12

4°: 14,40 + 1 + 0,75 → 29,63 t : 30x30 - 4φ16

3°: " " " → 45,78 t : 30x30 - 4φ16

2°: " " 0,9 → 62,08 t : 30x40 - 4φ16

1°: " " 2,00 → 79,48 t : 40x40 - 6φ16

0°: 3x1,5 = 4,5 → 83,98 t : 40x40 - 6φ16

PILASTRO 5

5°: 14 + 0,75 → 14,75 t : 30x30 - 4φ12

4°: 17,2 + 1 + 0,75 → 34,45 t : 30x30 - 4φ16

3°: " " " → 54,15 t : 30x40 - 4φ16

2°: " " + 0,9 → 74,00 t : 30x40 - 4φ16

1°: " " + 2,00 → 94,95 t : 40x40 - 6φ16

0°: 3,6 x 1,5 = 5,4 → 100,35 t : 40x40 - 6φ16

PILASTRO 6

5°: 10,22 + 0,75 → 10,97 t : 30x30 - 4φ12

4°: 14,4 + " → 26,12 t : 30x30 - 4φ16

3°: " " → 41,27 t : 30x30 - 4φ16

2°: " + 0,9 → 56,57 t : 30x40 - 4φ16

1°: " + 2,00 → 72,97 t : 40x40 - 6φ16

0°: 2,8 x 1,5 = 4,2 t → 77,17 t : 40x40 - 6φ16

PILASTRO 7

5° : 4.37 + 3.64 + 0.75 ⟶ 8.76 t : 30×30 - 4φ12
4° : 4.8 + 3.96 + 0.75 ⟶ 18.27 t : 30×30 - 4φ16
3° : " " " ⟶ 27.78 t : 30×30 - 4φ16
2° : " " + 0.9 ⟶ 37.44 t : 30×30 - 4φ16
1° : 4.8 + 3.36 + 5.7 + 1.5 ⟶ 58.80 t : 30×40 - 4φ16
0° : 2.4×1.5 = 3.6 t ⟶ 56.40 t : 30×40 - 4φ16

PILASTRO 8 - 15

5° : 7.70 + 4.8 + 0.75 ⟶ 13.25 t : 30×30 - 4φ12
4° : 7.70 + 7.68 + " ⟶ 29.38 t : 30×30 - 4φ16
3° : " " " ⟶ 45.51 t : 30×30 - 4φ16
2° : " " 0.9 ⟶ 61.79 t : 30×40 - 4φ16
1° : " " 2.00 ⟶ 79.17 t : 40×40 (30×40 p.t.15) - 6φ16
                                                        4φ16
0° : $\frac{(3.90 + 5.00)}{2}$ ×1.5 = 6.7 t ⟶ 85.87 t : 40×40 (30×40 p.t.15) - 6φ16
                                                                                    4φ16

PILASTRO 9 - 14

5° : 10.85 + 0.75 ⟶ 11.60 t : 30×30 - 4φ12
4° : " " ⟶ 23.20 t : 30×30 - 4φ16
3° : " " ⟶ 34.80 t : 30×30 - 4φ16
2° : " + 0.9 t ⟶ 46.55 t : 30×40 - 4φ16
1° : " + 2.00 t ⟶ 58.40 t : 40×40 ; (30×40) 6φ16
                                            p.t.15 (4φ16)
0° : (1.50 + 1.20) ×1.5 = 4.05 t ⟶ 63.45 t : 40×40 ; (") 6φ16
                                                            (4φ16)

PILASTRO 10-13

5° : 11.90 + 075 —— 12.65 : 30x30 - 4φ12

4° : " " —— 25.30 : 30x30 - 4φ16

3° : " " —— 37.95 : 30x30 - 4φ16

2° : " + 09 —— 50.75 : 30x40 - 4φ16

1° : " + 2.00 —— 64.65 : 40x40 - 6φ16

0° : $\frac{(3.6+29)}{2}$ x1.5 = 4.5t —— 69.15t : 40x40 - 6φ16

PILASTRO 11-12

5° : 11.73 + 075 —— 12.48 t : 30x30 - 4φ12

4° : " " +1.00 —— 25.96 t : 30x30 - 4φ16

3° : " " " —— 39.44 t : 30x30 - 4φ16

2° : " + 09 +1 —— 53.07 t : 30x40 - 4φ16

1° : " + 2.00 +1.00 —— 67.80 t : 40x40 - 6φ16

0° : 4.5 —— 72.30 t. : 40x40 - 6φ16

PILASTRO 85-26

6° : 5.10 + 075 —— 5.85 t : 20x30 - 4φ12

5° : 3.00 + 5.7 +1 + 075 —— 16.30 t : 20x40 - 4φ12

4° : " " " " —— 26.75 t : 20x50 - 4φ12

3° : " " " " —— 37.20 t : 20x50 - 4φ12

2° : " " " 09 —— 47.80 t : 20x60 - 6φ12

1° : " " " 2.00 —— 59.50 t : 25x60 - 6φ16

0° : (7.5+0.5)x1.5 = 6.00 t. —— 65.50 t : 25x60 - 6φ16

PILASTRO 16-23

5° : 8.8 +3.5 +0.75 ——— 13.05 t : 30×30 - 4Φ16

4° : 5.95 + 5.12 + " ——— 24.87 t : 30×30 - 4Φ16

3° : " " " ——— 36.69 t : 30×30 - 4Φ16

2° : " " +0.9 ——— 48.66 : 30×40 - 4Φ16

1° : " " . 1.5 ——— 61.83 t : 30×40 - 4Φ16

0° : (2.5+1.5)×1.5 = 6t ——— 67.23 t : 30×40 - 4Φ16

PILASTRO 17-22

5° : 13.1 + 0.75 ——— 13.85 t : 30×30 - 4Φ12

4° : 15.88 + " ——— 30.48 t : 30×30 - 4Φ16

3° : " " ——— 47.11 t : 30×30 - 4Φ16

2° : " + 0.9 ——— 63.89 t : 30×40 - 4Φ16

1° : " + 2.00 ——— 81.77 t : 40×40 - 6Φ16

0° : 3.5×1.5 = 5.25 t ——— 87.02 t : 40×40 - 6Φ16

PILASTRO 18-21

5° : 13.6 + 0.75 ——— 14.35 t. : 30×30 - 4Φ12

4° : 16.23 + 0.75 ——— 31.33 t. : 30×30 - 4Φ16

3° : " " ——— 48.31 t : 30×30 - 4Φ16

2° : " + 0.9 ——— 65.44 t : 30×40 - 4Φ16

1° : " + 2.00 ——— 83.67 t. : 40×40 - 6Φ16

0° : (2.00+1.5+1.5)×1.5 = 7.5 t ——— 91.17 t : 40×40 - 6Φ16

PILASTRO 13-2a

6° : 5.10   + 075 ——— 5.85 t : 20x30 - 4φ16

5° : 5.60 +7.27 +57 +075 ——— 25.17 t : 20x90 - 6φ18

4° : 6.30 +7.27 +57 +075 ——— 45.19 t : 20x90 - 6φ18

3° : " " " +09 ——— 65.36 t : 20x90 - 8φ18

2° : " " " +1.2 ——— 85.83 t : 20x90 - 8φ18

1° :   +2.00 ——— 107.10 t : 25x90 - 8φ16 +4φ12

0° : (3.5+1.5+3)×1.5   = 10.5 t ——— 117.60 t : 25x90 - 8φ16

Calcolo delle fondazioni

TRAVE 1·2-3-4-5-6-7-2A

$$q_{F2} = \frac{53.33 \times 10^3}{\frac{2.80 + 2.40}{2}} = 17.20 \, t/ml \qquad q_{F3} = \frac{63.24 \times 10^3}{2.80} = 22.58 \, t/ml$$

$$q_4 = \frac{84.00 \times 10^3}{\frac{2.70 + 4.00}{2}} = 25.07 \, t/ml \qquad q_{45} = \frac{100.39 \times 10^3}{4.00} = 25.097 \, t/ml$$

$$q_6 = \frac{77.12 \times 10^3}{\frac{3.80 + 4.00}{2}} = 22.7 \, t/ml \qquad q_{6F} = \frac{58.00 \times 10^3}{\frac{2.80 + 3.24}{2}} = 18.19 \, t/ml$$

Si assume un carico di 25.10 t/ml.

peso proprio: $\quad 0.50 \times 1.50 \times 2500 = 1875 \, t/ml$
$$0.50 \times 0.90 \times 2500 = \underline{1125} \; "$$
$$3 \, t/ml$$

$q_{tot} = 28 \, t/ml.$ $\qquad \sigma_F = \frac{28.000}{150 \times 100} = 1.87 \, k/cy.$

considerando il maggiore $\sigma_F = \frac{28.000}{180 \times 100} \simeq 1.55 \, k/cy$

- $l = 3.40 \, lut.$

$$M_{max} = \frac{3.40^2}{12} \times 28.000 = 24.083 \, k/m$$
$$50 \times 140$$
$$\overline{\sigma}_F = 1800$$
$$\overline{\tau}_c = 30 \qquad A_F = 11 \, cy.$$

$T_{max} = 1.70 \times 28.000 = 48.500 \, k$ $\qquad \tau_{max} = \frac{42.500}{0.9 \times 50 \times 185} = 6.99 \, k/cy$

Tot $\phi \, 8/_{15}^{u}$ a due braccia

$$Tst = 3 \times 0.5 \times 1800 \times 0.9 \times \frac{1.35}{0.15} = 81.870 \, k$$

$$A_{/p} = \left(\frac{48.500 - 21.870}{2 \times 25.000}\right)^2 \times \frac{1}{0.9 \times 1.35} \times \frac{1}{\sqrt{2} \times 1800} = 2.76 \, cy.$$

- $l = 4.00 \, lut.$

$$M_{max} = 33.330 \, k/m \qquad \overline{\tau}_c = 37 \, k/cy$$
$$50 \times 140 \qquad \overline{\sigma}_F = 1800 \, k/cy \qquad A_F = 15 \, cy$$

$T = 50 \, t.$

$$\tau_{max} = 8.23 \, k/cy$$

$$A_{/p} = \frac{(50.000 - 21.870)^2}{50.000} \times \frac{1}{3.083} = 5.13 \, cy.$$

TRAVE 8-9-10-11-12-13-14-15

$$q_{t9} = \frac{63.45 \times 10^3}{\frac{3.40 + 2.80}{2}} = 20.46 \ t/ml \qquad q_{T10} = \frac{69.15 \times 10^3}{\frac{4.00 + 2.80}{2}} = 20.34 \ t/ml$$

$$q_{t13} = q_{t10} \qquad q_{t14} = q_{t9}$$

$$q_{t11} = \frac{72.30}{\frac{4.00 + 2.60}{2}} = 21.90 \ t/ml \simeq 22 \ t/ml.$$

si adottano per le luci ricorrenti
le medesime armature delle travi precedenti.

TRAVE 16-17-18-19-20-21-22-23

$$q_{t} = \frac{87.02 \times 10^3}{\frac{3.90 + 3.40}{2}} = 24 \ t/ml.$$

si adottano le medesime armature delle
travi 1-2-3 ecc.

TRAVE 1-8-16

$$q_{t1} = \frac{54.86}{1.50 + 1.85} \times 10^3 = 16.38 \ t/ml$$

si adotta $q = 16.38 \ t/ml$

$$q_{t8} = \frac{2/3 \times 85.8 \times 10^3}{\frac{3.90}{2} + \frac{3.00}{2}} = 18.8 \ t/ml$$

$$G_{f} = \frac{18.000}{120 \times 100} = 1.58 \ t/q.$$

peso proprio: $0.50 \times 0.90 \times 2500 = 1125$
$0.50 \times 1.20 \times 2500 = 1500$
$q_{tot} = 16380 + 2625 = 19 \ t/ml$
$\underline{2.625 \ t/ml}$

$l = 4.20$ $\qquad M_{max} = \frac{4.20^2}{12} \times 16380 = 27.93 \ tm$

50×120 $\qquad \overline{\tau_c} = 31$ $\qquad \overline{\tau_F} = 1800$ $\qquad A_f = 18 \ cq.$

$l = 3.40$ $\qquad M_{max} = \frac{5.40^2}{12} \times 18.830 = 39.8 \ tm$

50×120 $\qquad \overline{\tau_c} = 39$ $\qquad \overline{\tau_F} = 1800$ $\qquad A_f = 18 \ cq$

$$T = 2.70 \times 16.380 = 44226 \ \flat$$

$$A_{pp} = \frac{(44226 - 21.870)^2}{8 \times 16380} \times \frac{1}{3083} = 4.95 \ cq.$$

TRAVE 11-13-13

$$P_{4/8} = 36.15 \, t.$$

$$P_{35} = 65.50 \, t$$

$$P_{13} \times \frac{2}{3} = \frac{78.40 \, t}{180 t.}$$

$$l = 1.40 + 4.70 + 0.90 = 7.00 \qquad q_t = \frac{180.000}{7.00} = 25.72 \, t/m$$

$$l = 4.70 \qquad M_{max} = \frac{4.70^2}{12} \times 25.72 = 47.34 \, t m$$

$$40 \times 140 \qquad r_c = 30 \qquad \sigma_f = 1800 \qquad A_f = 22 \, cq$$

$$T_{max} = 2.35 \times 25.72 = 60.44 \, t$$

$$\tau_{sx} = \frac{60440}{40 \times 0.9 \times 1.35} = 12.44 \, t/q$$

$\Phi 8/15$ a tre braccia

$$T_{ota} \; 21870 \qquad \Omega_{fp} = \frac{(60440 - 21.870)^2}{2 \times 85.720} \times \frac{1}{2083} = 9.33 \, cq$$

Armatura suole travi:

$$M_{max} = \frac{0.50^2}{2} \times 15700 = 2337 \, t/m$$

se allarghiamo il magione di 15cm per parte
per tenere una sollecitazione più ridotta sul
terreno

$$\sigma_{max} = \frac{28.000}{180 \times 100} = 1.55 \, t/cq$$

$$M_{max} = 15500 \times \frac{0.65^2}{2} = 3873 \, t/m$$

$$A_f = \frac{3873 \, 00}{0.9 \times 45 \times 1800} = 4.49 \, cmq/ml.$$

Armatura soletione

$$l = 2.20 \qquad q = 15000 \, t/mq$$

$$M_{max} = 6049 \, t/m / \, b = 1 mt. \qquad A_f = \frac{6049 \, 00}{0.9 \times 45 \times 1800} = 8.3 \, cq / \, b = 1 mt.$$

Armatura Scatoli di fondazione

Si consideri una muratura di tufo di altezza mt. 2.40 :

peso proprio : 500 Y/mc

muro : 0.35 × 2.40 × 1600 : 960 "

Intonaco 35 × 2 × 2.40 : 120 "
_____
1580 Y/mc

Si consideri una condizione di vincolo appoggio:

- luce max : mt. 4.80

$$M_{max} = \frac{4.80^2}{8} \times 1580 = 4550 \; Y_m$$

Sz. 30 × 50

$\sigma_c = 51$

$\sigma_f = 1800$ $A_f = 6 \, cq.$ - armatura simmetrica

Struttura Scala

① Soletta Scala:

luce ut. 3.90 $l_t = 4.10$

Carico: 1120 kg/mq (J. Analisi)

$$M_{max} = \frac{4.10^2}{12} \times 1120 = 1568 \; kg/m$$

$\sigma_c = 32$
$\sigma_f = 1800$ $A_f = 5.4 \; cq.$

si adottano $6\phi12$.

Sullo sbalzo in corrispondenza pianerottolo 2°piano

$$M_{max} = \frac{0.80^2}{2} \times 1000 + 1000 \times 0.80 = 320 + 800 = 1120 \; kg/m$$

— si adotta la medesima armatura a momento negativo delle solette —

② trave 60×20 in corrispondenza pianerottolo 2°piano:

- peso proprio trave : 300 kg/m
- muratura   1000
- soletta a sbalzo : 800
- soletta a pianecchio: 2000
                       _____
                       4100 kg/m
- sovraccarico   360
  600×0.60 _____
- totale a ssd.: 4500 kg/m

$l_u = 2.90; \quad l_t = 2.50$

- in mezzeria: $\dfrac{2.50^2}{10} \times 4500 = 2812 \; kg/m$

$\sigma_c = 77$ $\sigma_f = 1800$ $A_f = 9.5 \; cq.$

- all' incastro: $A_f = \dfrac{9.5}{1.2} = 8 \; cq.$

③ trave 60×24 in corrispondenza pianerottolo antro:

peso proprio: 360
solz: $600 \times 0.60 = 360$
murat.   1000
soletta scala 2000
            _____
            3720 kg/m

(+)

$$M_{max} = \frac{1}{10} \times 2.50^2 \times 3720 = 2312 \; kg/m$$

$\sigma_c = 56$ $\sigma_f = 1800$ $A_f = 6.5 \; cq$

- all'incastro $A_f = 6.5/1.2 = 5.4 \; cq.$

③ Copertura scala:

- trave 18-20 ; 25-26.

$$solaio \frac{q.70 \times 600}{2} = 1410 \ kg/ml$$

velette: 0.15×0.80×2500 = 300

sol.a sbalzo: 1.00×600 = 600

peso proprio   300

Vincolo: appoggio

sovracc. 400×0.60 = $\frac{240}{2850} \ kg/ml$

$$M_{max} = \frac{2.5^2}{8} \times 2850 = 2286 \ kg/m$$

60×20

$\tau_e = 70$ $\sigma_f = 1800$

$A_f = 8 \ cm$

TRAVI AL 2⁶ IMPALCATO (copertura)

Trave 1-2-3-4-5-6-7-24

$q_a = 2.3 \ t/ml$ J. Au.

$q_b = 3.5 \ t/ml$

- $l = 3.40$; $q = 2.3 \ t/ml$; 80×24

  $M = 2329 \ kgm$ $\tau_e = 50$; $\sigma_f = 2200$; $A_f = 5 \ cm$

- $l = 8.80$; $q = 2.3 \ t/ml$; 80×24

  $M = 1501 \ kgm$ $\tau_e = 40$; $\sigma_f = 2200$ $A_f = 3.4 \ cm$

- $l = 8.80$; $q = 3.5 \ t/ml$; 80×24

  $M = 2883 \ kgm$ $\tau_e = 50$ $\sigma_f = 2200$ $A_f = 5.1 \ cm$

- $l = 4.00$; $q = 3.5 \ t/ml$; 80×24

  $M = 9665 \ kgm$ $\tau_e = 78$ $\sigma_f = 2200$ $A_f = 10.7 \ cm$

- $l = 4.00$; $q = 3.5 \ t/ml$ $P = 2.10 t$.

  80×24

  $M = 9665 + \frac{1}{6} \times 4 \times 2100 = 1400 + 9665 = 6065 \ kg/m$

       $\tau_e = 83$ $\sigma_f = 2000$ $A_f = 16 \ cm$

soletta a sbalzo: (AL primo tipo)

$$M_{max} = \frac{1.60^2}{2} \times 800 + 200 \times 1.60 = 1344 \ kgm/b = 1mt.$$

       $\tau_e = 41$ $\sigma_f = 2200$ $A_f = 3.7 \ cm/b = 1mt.$

soletta in copertura   1.85 cm/b = 50 cm   2∅12 oppure

$M_{max} = \frac{1.60^2}{2} \times 800 + 300 \times 1.60 = 1824 \ kg m/b = 1mt.$ 1∅12 + 1∅10

100×24 $\tau_e = 38$ $\sigma_f = 2200$ $A_f = 4.1 cm/m$

TRAVE 8-9-10-11-12-13-14-15

$$q = 3.5 \ t/ml.$$

$l = 3.40$ $M_{max}^{(+-)} = 3.37 \ t/m - 80 \times 24$ $\sigma_c = 64$ $A_f = 7.8 \ cmq$
$\sigma_f = 2200 \ kg/cm$

$l = 2.80$ $M_{max}^{(+-)} = 2.29 \ t.m - 80 \times 24$ $\sigma_c = 51$ $A_f = 5.3 \ cmq$
$\sigma_f = 2200$

$l = 4.00$ $M_{max}^{(+-)} = 4.67 \ t.m - 80 \times 24$ $\sigma_c = 79$ $A_f = 11 \ cm.$
$\sigma_f = 2200 \ kg/cm$

TRAVE 16-17-18-19 ; 20-21-22-23

$$q_1 = 3.00 \ t/ml$$
$$q_2 = 4 \ t/ml$$

$- l = 3.40$; $q = 3 \ t/ml$ $M_{max}^{(+-)} = 2.89 \ t/m$ $\sigma_c = 52$ $A_f = 6.6 \ cm.$
97×24 $\sigma_f = 2200$

$- l = 4.00$; $q = 4 \ t/ml$ $M_{max}^{(+-)} = 5.34 \ t.m$ $\sigma_c = 75$ $A_f = 12.5 \ cm$
97×24 $\sigma_f = 2200$

$- l = 2.80$; $q = 4 \ t/ml$ $M_{max} = 2.68 \ t.m$ $\sigma_c = 49$ $A_f = 6 \ cm.$
$\sigma_f = 2200$

TRAVE 20-13

peso trave: $0.50 \times 0.24 \times 2500 = 300 \ kg/ml$
sovraccarico $= 200$
muratura : $= 1000$
muretto attico $= 500$
$\overline{} \ 2000 \ kg/ml$

$$M_{max}^{(+)} = \frac{2.60^2}{8} \times 2000 = 1.69 \ t.m$$

$m. \ 50 \times 24$ $\sigma_c = 56$ $A_f = 3.9 \ cm$
$\sigma_f = 2200$

$$T = 2.4 \ t$$

TRAVE 1-8-16; 15-23; 7-14

$$q = 1020 \ kg/ml.$$

$l = 4.20$; $M_{max} = 1.5 \ tm$ $\bar{\sigma}_c = 40$ $\sigma_f = 1800$ $A_f = 4.15 \ cq.$ sez. 67x24

$l = 3.40$; $M_{max} = 2.5 \ tm$ $\bar{\sigma}_c = 55$ $\sigma_f = 1800$ $A_f = 7 cq$

TRAVE 11-25-19 - mensole.

$$M_{max} = \frac{4.35^2}{12} \times 1300 = 2212 \ kg_m \quad sez. \ 20 \times 50$$

$\bar{\sigma}_c = 42.5$ $A_f = 3 cq$
$\sigma_f = 1800$

sulla mensole: $M_{max} = \frac{1.60^2}{2} \times 1300 + 2400 \times 1.60 = 5508 \ kg_m \quad 5504$

sez. 20x50 $\bar{\sigma}_c = 75$ $\sigma_f = 1800$

$A_f = 7.5 cq$

TRAVI ALL'IMPALCATO TIPO (4°-3°-2°)

TRAVE 1-2-3-4-5-6-7

$$q_1 = 3 t/ml$$
$$q_2 = 4.3 t/ml.$$

$-l = 3.40$ $q = 3 t/ml$ $M_{max} = 2.82 \ tm$
  80x24 $\bar{\sigma}_c = 58$ $\sigma_f = 2200$ $A_f = 6.5 cq$

$-l = 2.80$ $q = 3 t/ml.$ $M_{max} = 1.96 \ tm.$
  80x24 $\bar{\sigma}_c = 46$ $\sigma_f = 2200$ $A_f = 4.4 cq$

$-l = 2.80$ $q = 4.3$ $M_{max} = 2.81 \ tm$
  80x24 $\bar{\sigma}_c = 57$ $\sigma_f = 2200$ $A_f = 6.4 cq$

$-l = 9.00$ $q = 4.3$ $M_{max} = 5.74 \ tm$
    $\bar{\sigma}_c = 84$ $\sigma_f = 1800$ $A_f = 17. cq$

$-l = 4.00$ $q = 4.3$; $P = 2.10 t.$ $M_{max} = 7.13 \ tm$
    $\bar{\sigma}_c = 87$ $\sigma_f = 1800$ $A_f = 21 cq !$

TRAVE 8-9-10-11-12-13-14-15

1. Impalcato di copertura.

TRAVE 16-17-18-19

$$q_1 = 3 \, t/ml$$

$$q_2 = 4.10 \, t/ml$$

$l = 3.40$; $q = 3 \, t/ml$ $M_{max} = 2.83 \, tm$
    $32: 80 \times 24$ $\tau_c = 58$ $\sigma_f = 2200$ $A_f = 6.7 \, cm$

$l = 4.00$; $q = 4.10 \, t/ml$ $M_{max} = 5.47 \, tm$
    $32: 80 \times 24$ $\tau_c = 81$ $\sigma_f = 1800$ $A_f = 16 \, cm$

$l = 2.80$; $q = 4.10 \, t/ml$ $M_{max} = 2.68 \, tm$
    $32: 80 \times 24$ $\tau_c = 56$ $\sigma_f = 2200$ $A_f = 6.1 \, cm$

TRAVE 11-25-19

Si adotta la sezione costante 20×50:

peso proprio $850 \, y/ml$
imitazione $\dfrac{1000}{12.50} \, y/ml$
carico concentrato
sulle mensole: $(1.40 + 1.20) \times 1000 = 2600 \, y$.

$$M_{max}^{(-)} = \frac{1.00^2}{2} \times 1250 + 2600 \times 1.00 = 3225 \, ym$$
    20×50 $\tau_c = 58$ $\sigma_f = 2200$ $A_f = 3.5 \, cm$

$M_{max}^{(+)}$ in campata: $\dfrac{4.50^2}{12} \times 1300 = 2193 \, ym$.
    $\tau_c = 46$ $\sigma_f = 2200$ $A_f = 2.3 \, cm$

TRAVE 1-8-16 ; 7-11 ; 15-23

$q = 1.6 \, t/ml$ (1. analisi)

- $l = 1.20$ $M_{max} = 2.36 \, tm$ 60×24 $\tau_c = 61$ $A_f = 5.4 \, cm$
    $\sigma_f = 2200$

- $l = 5.40$ $M_{max} = 3.83 \, tm$ 60×24
    $\tau_c = 78$
    $\sigma_f = 1800$ $A_f = 11.4 \, cm$

Soletta tra le travi 4·5·6

$$M_{max} = \frac{800 \times 1.60^2}{2} + 200 \times 1.60 = 1344 \; kg/b = 1mt.$$

Sez. 100×20 $\sigma_c = 41$ $\sigma_f = 2200$ $A_f = 3.70 \, cm/b = 1mt.$

Soletta tra le travi: 18-19 ; 20-21

$$M_{max} = \frac{650 \times 1.50^2}{2} + 1000 \times 1.35 = 2081 \; kg/b = 1mt.$$

Sez. 100×24 - $\sigma_c = 42$; $\sigma_f = 2200 \; k/q$ $A_f = 4.65 \, cm.$

VARIANTI AL I° IMPALCATO

TRAVE 19-12

$q = 3500 + muratl = 4500 \; k/ml$

$l = 3.40$ $M_{max}^{(+-)} = 4.31 \, tm$ 80×24 $\sigma_c = 79$
$\sigma_f = 2200$ $A_f = 10 \, cm$

TRAVE 7-14

peso proprio: $300 \; k/ml$ 30×24
muratura 1000 "

Tot. $1300 \; k/ml$

$l = 4.20$

$M_{max} = 1.93 \, tm$ $\sigma_c = 61$ $A_f = 4.4 \, cm.$
$\sigma_f = 2200$

TRAVE 7-22

Sez. 80×20 $l = 3.40$
peso proprio: 400 k/ml
solacc. : 320 "
solaio : $1.60 \times 650 = 1040$ "
_____
$1760 \; k/ml$

$M_{max} = 1,7 \, tm$ $\sigma_c = 50$; $\sigma_f = 1800$ $A_f = 3.8 \, cm.$

TRAVE 21-15

peso proprio: $200 \; k/ml$

si arma con armatura simmetrica $3+3\emptyset/12$