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|                                                                        |               |                                         |  |                 |                 |
|------------------------------------------------------------------------|---------------|-----------------------------------------|--|-----------------|-----------------|
| <b>GESTIONE CASE LAVORATORI</b><br>LEGGE 14/2/63 N° 60                 |               | <b>INTERVENTO N 1211</b><br>3° TRIENNIO |  | <b>I.A.C.P.</b> |                 |
| <b>QUARTIERE "S. ELIA" BRINDISI</b><br><b>Progetto delle strutture</b> |               |                                         |  | data<br>21-5-71 | N°              |
|                                                                        |               |                                         |  | agg             |                 |
| RELAZIONE DI CALCOLO<br>PRIMA PARTE                                    |               |                                         |  | rapp            | <i>glu 3 ep</i> |
| Dott Arch                                                              | E. NESPÉGA    | Edilizia                                |  |                 |                 |
| Dott Ing                                                               | A. CORRADO    | Edilizia                                |  |                 |                 |
| Dott Ing                                                               | F. CARADORINI | Prog.e Costi                            |  |                 |                 |
| Dott Ing                                                               | M. BOLOGNESE  | Strutt.e Calc.                          |  |                 |                 |
| Dott Ing                                                               | N. VIVARELLI  | Imp.Tecnici                             |  |                 |                 |

Il lotto comprende 4 edifici per un totale di 11 vani scala. L'edificio A, composto da due vani scala, si articola in piano terra a portico, 5 piani abitazione, un piano per cantinole e volumi tecnici; l'edificio A bis è del tutto simile al precedente; l'edificio B, composto da 5 vani scala, si articola in piano terreno a portico, 4 piani abitazione ed un piano per cantinole e volumi tecnici; l'edificio C, composto da due vani scala, si articola in piano terra, parte a portico e parte destinato a cantinole, 4 piani abitazione e volumi tecnici.

Le strutture sono del tipo tradizionale in c.a. costituite da pilastri, travi a spessore di solaio o di calata, solai in latero-cemento, sporti in latero-cemento, scale in c.a. a sbalzo da travi a ginocchio, murature perimetrali a doppia foderatura.

I solai di calpestio e di copertura sono previsti dell'altezza di cm. 25, compresa la soletta collaborante di cm. 5, con interasse di cm. 50, mentre per le zone ribassate dei servizi l'altezza diviene di cm. 18.

Le fondazioni saranno del tipo diretto a travi rovesce, e si assume come tensione del terreno  $\sigma_r = 1,5 \text{ Kg/cm}^2$ .

Si è previsto l'uso di calcestruzzo classe R 250 dosato a 3 ql/mc di cemento tipo 425 (ex 730), ferro tondo omogeneo A<sub>q</sub> 42-50.

Le sollecitazioni massime nel calcestruzzo armato sono:

- 70 Kg/cm<sup>2</sup>. per le strutture sollecitate a flessione e pressoflessione.
- 45 Kg/cm<sup>2</sup>. per le strutture sollecitate a pressione semplice.

Nelle sezioni inflesse ove le sollecitazioni sono maggiori di quelle predette, tenendo conto della doppia armatura e della riduzione a filo pilastri del momento, esse si riducono nei limiti suddetti.

I calcoli sono stati eseguiti coll'ausilio del regolo calcolatore.

- ANALISI GENERALE DEI CARICHI -

S O L A I

Solaio tipo in latero-cemento H = 20" + 5"  
interasse = 50 cm.

|                                                                      |                           |           |
|----------------------------------------------------------------------|---------------------------|-----------|
| p.p.                                                                 |                           | = 160     |
| soletta                                                              | 0,05 x 1,00 x 1,00 x 2500 | = 125     |
| sovracc. perm. (intonaco, massetto,<br>pavimenti, aliquota tramezzi) |                           | = 65      |
| sovracc. accid.                                                      |                           | = 200     |
|                                                                      |                           | <hr/>     |
|                                                                      |                           | 650 Kg/mq |

M U R A T U R E

Muratura di rompagno a doppia fodera, con fodera esterna in mattoni forati da 13" e fodera interna in tufelle da 10"

|                  |                           |            |
|------------------|---------------------------|------------|
| - fodera esterna | 105 x 3,05                | = 330      |
| - fodera interna | 0,10 x 1,00 x 3,05 x 1700 | = 520      |
|                  |                           | <hr/>      |
|                  |                           | 850 Kg/ml. |

B A L C O N I

|                                                                 |              |           |
|-----------------------------------------------------------------|--------------|-----------|
| A sbalzo in latero-cemento                                      | H = 20" + 5" | i = 50"   |
| p.p.                                                            |              | = 160     |
| soletta                                                         |              | = 125     |
| sovracc. perm. (intonaco, massetto,<br>masso pendio, pavimento) |              | = 115     |
| sovracc. accid.                                                 |              | = 400     |
|                                                                 |              | <hr/>     |
|                                                                 |              | 800 Kg/mq |

S C A L E

Scale in c.a. a sbalzo da trave a ginocchio

p.p.  $\frac{20 + 4 \times 1,00 \times 1,00 \times 2500}{2}$  = 300sovracc. perm. (intonaco, massetto,  
grado e sottogrado.) = 150

sovracc. accid. = 400

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850 Kg/mqSOVRACCARICHI TRAVI PIATTE

sovracc. perm. = 165

sovracc. accid. = 200

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365 Kg/mq.

1-0-0 EDIFICIO TIPO A - A bis.

## 1-1-0 - Analisi di carico sulle travi -

1-1-1 COPERTURA

Trave S-12-14-15-16-17-19-S; S-45-47-48-49-50-52-S

|        |                           |            |
|--------|---------------------------|------------|
| Solaio | 650 x 270                 | = 1750     |
| " "    | 650 x 270                 | = 1750     |
| p.p.   | 0,30 x 0,80 x 1,00 x 2500 | = 600      |
|        |                           | <hr/>      |
|        |                           | 4100 Kg/ml |

Trave 21-22; 54-55

|          |                           |           |
|----------|---------------------------|-----------|
| Solaio   | 650 x 1,40/2              | = 450     |
| Sovracc. | 365 x 0,50                | = 200     |
| p.p.     | 0,50 x 0,25 x 1,00 x 2500 | = 300     |
|          |                           | <hr/>     |
|          |                           | 950 Kg/ml |

Trave 21-29; 22-29; 54-61; 55-62

|          |                           |            |
|----------|---------------------------|------------|
| Solaio   | 650 x 1,30/2              | = 400      |
| Sbalzo   | 650 x 0,70                | = 450      |
| Sovracc. | 365 x 0,50                | = 200      |
| p.p.     | 0,50 x 0,25 x 1,00 x 2500 | = 300      |
|          |                           | <hr/>      |
|          |                           | 1350 Kg/ml |

1-1-2 COPERTURA PIANO TIPOTrave 1-2-3-4; 7-8-9-10; 34-35-36-37;  
- 40-41-42-43 ;

|          |                           |            |
|----------|---------------------------|------------|
| Solaio   | 650 x 3,85/2              | = 1250     |
| Sovracc. | 365 x 0,70                | = 250      |
| Tompagno |                           | = 850      |
| p.p.     | 0,70 x 0,25 x 1,00 x 2500 | = 450      |
|          |                           | <hr/>      |
|          |                           | 2800 Kg/ml |

Trave 4-5; 6-7; 37-38; 39-40;

Solaio  $650 \times 3,85/2$

= 1250

Sbalzo  $800 \times 1,15$

= 900

Sovracc.  $365 \times 0,70$

= 250

Tompagno

= 850

p.p.  $0,70 \times 0,25 \times 1,00 \times 2500$

= 450

3700 Kg/ml

Trave 11-12-13-14-15-; 16-17-18-19-20;

44-45-46-47-48; 49-50-51-52-53;

Solaio  $650 \times 3,85/2$

= 1250

Solaio  $650 \times 4,15/2$

= 1350

Sovracc.  $365 \times 0,90$

= 350

p.p.  $0,90 \times 0,25 \times 1,00 \times 2500$

= 550

3500 Kg/ml

Trave 24-25-26-27-; 30-31-32-33;

57-58-59-60; 63-64-65-66;

Solaio  $650 \times 4,15/2$

= 1350

Sovracc.  $365 \times 0,70$

= 250

Tompagno

= 850

p.p.  $0,70 \times 0,25 \times 1,00 \times 2500$

= 450

2900 Kg/ml

Trave 27-28; 29-30; 60-61; 62-63

Solaio  $650 \times 4,15/2$

= 1350

Sbalzo  $800 \times 1,05$

= 850

Sovracc.  $365 \times 0,70$

= 250

Tompagno

= 850

p.p.  $0,70 \times 0,25 \times 1,00 \times 2500$

= 450

3750 Kg/ml

Trave 5-6; 38-39; 21-23; 22-23; 54-56; 55-56;  
23-28; 23-29; 56-61; 56-62;

Tompagno

= 850

p.p. 0,30 x 0,40 x 1,00 x 2500

= 350

1200 Kg/ml

Trave 5-15+21; 6-16-22;

38-48-54; 39-49-55

Rampa 850 x 1,30

= 1100

Tompagno

= 850

p.p. 0,30 x 0,60 x 1,00 x 2500

= 450

2400 Kg/ml

Trave 1-11-24; 10-20-30; 34-44-57;

43-53-66

Tompagno

= 850

Sovracc. 365 x 0,50

= 200

p.p. 0,50 x 0,25 x 1,00 x 2500

= 350

1400 Kg/ml

1-2-0

- Analisi di carico sui pilastri -

1-2-1 COPERTURA

Pilastri 12; 19; 45; 52;

Sbalzo 4100 x 2,10 = 8600

Trave 12-14 4100 x 5,55/2 = 11350

p.p. 0,30 x 0,30 x 2,70 x 2500 = 600

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20550 Kg

Pilastri 14; 17; 47; 50;

Trave 14-12; = 11350

" " 14-15 4100 x 2,75/2 = 5650

p.p. = 600

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17600 Kg

Pilastri 15; 16 48; 49

Trave 15-14 = 5650

" " 15-16 4100 x 3,00/2 = 5650

p.p. = 600

---

12400 Kg

Pilastri 21; 22; 54; 55

Trave 21-22 950 x 1,50/2 = 750

" " 21-28 1350 x 3,35/2 = 2250

p.p. 0,90 x 0,20 x 2,70 x 2500 = 1200

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4200 Kg

Pilastri 21; 29; 61; 62;

Trave 21-28 = 2250

p.p. = 650

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2900 Kg

1-2-2 Copertura piano tipo

Pilastri 1; 10; 34; 43;

Trave 1-2 2800 x 4,00/2 = 5600

" " 1-11 1400 x 4,65/2 = 3250

p.p. 0,30 x 0,40 x 3,05 x 2500 = 950

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9800 Kg

Pilastri 2; 9; 35; 42;

Trave 1-2 = 5600

" " 2-3 2800 x 3,60/2 = 5050

p.p. = 950

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11600 Kg

Pilastri 3; 8; 36; 41

Trave 3-2 = 5050

" " 3-4 2800 x 3,55/2 = 5000

p.p. = 950

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11000 Kg

Pilastri 4; 7; 37; 40

Trave 4-3 = 5000

" " 4-5 3700 x 2,20/2 = 4050

p.p. = 950

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10000 Kg

Pilastri 5; 6; 38; 39;

Trave 5-4 = 4050

" " 5-6 1200 x 2,00/2 = 1200

" " 5-15 2400 x 4,65/2 = 5600

p.p. = 950

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11800 Kg

Pilastri 11; 20; 44; 53;

Trave 11-1

= 3250

" " 11-24 1400 x 4,95/2

= 3450

" " 11-12 3500 x 4,00/2

= 7000

p.p.

= 950

14650 Kg

Pilastri 12; 19; 45; 52;

Trave 12-11

= 7000

" " 12-13 3500 x 3,60/2

= 6300

p.p.

= 950

14250 Kg

Pilastri 13; 18; 46; 51;

Trave 13-12

= 6300

" " 13-14 3500 x 2,90/2

= 5050

p.p.

= 950

12300 Kg

Pilastri 14; 17; 47; 50

Trave 14-13

= 5050

" " 14-15 3500 x 2,75/2

= 9600

p.p.

= 950

15600 Kg

Pilastri 15; 16; 48; 49

Trave 15-14

= 9600

" " 15-5

= 5600

" " 15-21 2400 x 1,65/2

= 2000

p.p.

= 950

18150 Kg

Pilastri 21; 22; 54; 55

Trave 21-15 = 2000

" " 21-23  $1200 \times 1,60/2$  = 950aliquota solaio  $\frac{2,65 \times 650 \times 0,70}{2}$  = 600p.p.  $0,20 \times 0,90 \times 3,05 \times 2500$  = 1450

5000 Kg

Pilastri 23; 56

Trave 23-21 = 950

" " 23-22 = 950

" " 23-28  $1200 \times 1,90/2$  = 1150" " 28-29  $1200 \times 1,90/2$  = 1150p.p.  $0,20 \times 1,90 \times 3,05 \times 2500$  = 2900

7100 Kg

Pilastri 24; 33; 57; 66;

Trave 24-11 = 3450

" " 24-25  $2900 \times 4,00/2$  = 5800

p.p. = 950

10200 Kg

Pilastri 25; 32; 58; 65

Trave 25-24 = 5800

" " 25-26  $2900 \times 2,95/2$  = 4300

p.p. = 950

11050 Kg

Pilastri 26; 31; 59; 64

Trave 26-25 = 4300

" " 26-27  $2900 \times 3,50/2$  = 5050

p.p. = 950

10300 Kg

Pilastri 27; 30; 60; 63

Trave 27-26

= 5050

" " 27-28 3750 x 3,40/2

= 6400

p.p.

= 950

12400 Kg

Pilastri 28; 29; 61; 62

Trave 28-27

= 6400

" " 28-23

= 1150

p.p.

= 950

8500 Kg

## 1-3-0 - Verifica ed armatura pilastri -

1-3-1 Carichi al piede dei pilastri

| Pilastri    | Copertura | Cop. V | Cop. IV | Cop. III | Cop. II | Cop. I | Cop. portico<br>fondazione |
|-------------|-----------|--------|---------|----------|---------|--------|----------------------------|
| 1,10,34,43, |           | 9800   | 19600   | 29400    | 39200   | 49000  | 58800                      |
| 2,9,35,42,  |           | 11600  | 23200   | 34800    | 46400   | 58000  | 69600                      |
| 3,8,36,41   |           | 11000  | 22000   | 33000    | 44000   | 55000  | 65000                      |
| 4,7,37,40   |           | 10000  | 20000   | 30000    | 40000   | 50000  | 60000                      |
| 5,6,38,39   |           | 11800  | 23600   | 35400    | 47200   | 59000  | 70800                      |
| 11,20,44,53 |           | 14600  | 29300   | 43900    | 58600   | 73200  | 87900                      |
| 12,19,45,52 | 20550     | 37600  | 51850   | 66100    | 80350   | 94600  | 108850                     |
| 13,18,46,51 |           | 12300  | 24600   | 36900    | 49200   | 61500  | 73800                      |
| 14,17,47,50 | 17600     | 33200  | 48800   | 64400    | 80000   | 95600  | 111200                     |
| 15,16,48,49 | 12400     | 35500  | 53600   | 71800    | 89900   | 108100 | 126200                     |
| 21,22,54,55 | 4200      | 9200   | 14200   | 19200    | 24200   | 29200  | 34200                      |
| 23,56       |           | 7100   | 14200   | 21300    | 28400   | 35500  | 42600                      |
| 24,33,57,66 |           | 10200  | 20400   | 30600    | 40800   | 51000  | 61200                      |
| 25,32,58,65 |           | 11000  | 22000   | 33000    | 44000   | 55000  | 65000                      |
| 26,31,59,64 |           | 10300  | 20600   | 30900    | 41200   | 51500  | 61800                      |
| 27,30,60,63 |           | 12400  | 24800   | 37200    | 49600   | 62000  | 74400                      |
| 28,29,61,62 | 3000      | 11500  | 20000   | 28500    | 37000   | 45500  | 54000                      |

1-3-2 Sezione ed armatura pilastri fondazione e portico

| N°          | P<br>tn | A' c<br>cmq | A f<br>cmq | Armatura    | Sezione<br>cm x cm | A c i<br>cmq | σ c<br>Kg/cmq |
|-------------|---------|-------------|------------|-------------|--------------------|--------------|---------------|
| 1,10,34,43  | 59      | 1200        | 9,6        | 4Ø14 + 4Ø12 | 30 x 40            | 1307         | 45            |
| 2,9,35,42   | 70      | 1450        | 11,6       | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 43            |
| 3,8,36,41   | 65      | 1350        | 10,8       | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 40            |
| 4,7,37,40   | 60      | 1250        | 10,0       | 4Ø14 + 4Ø12 | 30 x 40            | 1307         | 45            |
| 5,6,38,39   | 71      | 1450        | 11,6       | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 43            |
| II,20,44,53 | 88      | 1800        | 14,4       | 10 Ø 14     | 30 x 60            | 1954         | 45            |
| 12,19,45,52 | 109     | 2250        | 18         | 12 Ø 14     | 40 x 60            | 2584         | 42            |
| 13,18,46,51 | 74      | 1500        | 12         | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 45            |
| 14,17,47,50 | 111     | 2300        | 18,4       | 12 Ø 14     | 40 x 60            | 2584         | 43            |
| 15,16,48,49 | 126     | 2600        | 20,8       | 14 Ø 14     | 40 x 70            | 3015         | 41            |
| 21,22,54,55 | 34      | 700         | 5,6        | 14 Ø 10     | 20 x 90            | 1910         | 17            |
| 23,56       | 43      | 900         | 7,2        | 24 Ø 10     | 20 x 190           | 4037         | 10            |
| 24,33,57,66 | 61      | 1250        | 10         | 4Ø14 + 4Ø12 | 30 x 40            | 1307         | 45            |
| 25,32,58,65 | 66      | 1350        | 10,8       | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 40            |
| 26,31,59,64 | 62      | 1300        | 10,4       | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 38            |
| 27,30,60,63 | 75      | 1550        | 12,4       | 4Ø14 + 6Ø12 | 30 x 50            | 1629         | 45            |
| 28,29,61,62 | 54      | 1100        | 8,8        | 4Ø14 + 4Ø12 | 30 x 40            | 1307         | 41            |

Staffe Ø 8" / 15"

1-3-3 Sezione ed armatura pilastri piano I e II

| N°          | P<br>tn | A' c<br>cmq | Af<br>cmq | Armatura    | Sezione<br>cm x cm | A ci<br>cmq | σ c<br>Kg/cmq |
|-------------|---------|-------------|-----------|-------------|--------------------|-------------|---------------|
| 1,10,34,43  | 49      | 1000        | 8         | 8 Ø 12      | 30 x 40            | 1290        | 38            |
| 2,9,35,42   | 58      | 1200        | 9,6       | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 44            |
| 3,8,36,41   | 55      | 1150        | 9,2       | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 42            |
| 4,7,37,40   | 50      | 1050        | 8,4       | 8 Ø 12      | 30 x 40            | 1290        | 38            |
| 5,6,38,39   | 59      | 1250        | 10        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 45            |
| 11,20,44,53 | 73      | 1500        | 12        | 4Ø14 + 6Ø12 | 30 x 50            | 1629        | 44            |
| 12,19,45,52 | 95      | 1950        | 15,6      | 10 Ø 14     | 40 x 50            | 2154        | 44            |
| 13,18,46,51 | 62      | 1300        | 10,4      | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 45            |
| 14,17,47,50 | 96      | 2000        | 16        | 10 Ø 14     | 40 x 50            | 2150        | 44            |
| 15,14,48,49 | 108     | 2250        | 18        | 12 Ø 14     | 40 x 60            | 2585        | 41            |
| 21,22,54,55 | 29      | 600         | 4,8       | 14 Ø 10     | 20 x 90            | 1910        | <10           |
| 23,56       | 36      | 750         | 6         | 24 Ø 10     | 20 x 90            | 4037        | <10           |
| 24,33,57,66 | 51      | 1050        | 8,4       | 8 Ø 12      | 30 x 40            | 1290        | 39            |
| 25,32,58,65 | 55      | 1150        | 9,2       | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 42            |
| 26,31,59,64 | 52      | 1100        | 8,8       | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 39            |
| 27,30,60,63 | 62      | 1300        | 10,4      | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 45            |
| 28,29,61,62 | 46      | 950         | 7,6       | 8 Ø 12      | 30 x 40            | 1290        | 35            |

Staffe Ø 6" / 15"

1-3-4 Sezione ed armatura pilastri piano III e IV

| N°          | P<br>tn | A' c<br>cmq | Af<br>cmq | Armatura    | Sezione<br>cm x cm |
|-------------|---------|-------------|-----------|-------------|--------------------|
| 1,10,34,43  | 30      | 650         | 5,2       | 4Ø12 + 4Ø10 | 30 x 30            |
| 2,9,35,42   | 35      | 750         | 6         | 4Ø12 + 4Ø10 | 30 x 30            |
| 3,8,36,41   | 33      | 700         | 5,6       | 4Ø12 + 4Ø10 | 30 x 30            |
| 4,37,40     | 30      | 650         | 5,2       | 4Ø12 + 4Ø10 | 30 x 30            |
| 5,6,38,39   | 36      | 750         | 6         | 4Ø12 + 4Ø10 | 30 x 30            |
| 11,20,44,53 | 44      | 900         | 7,2       | 8 Ø 12      | 30 x 40            |
| 12,19,45,52 | 66      | 1350        | 10,8      | 4Ø14 + 6Ø12 | 30 x 50            |
| 13,18,46,51 | 37      | 800         | 6,4       | 4Ø12 + 4Ø10 | 30 x 30            |
| 14,17,47,50 | 65      | 1350        | 10,8      | 4Ø14 + 6Ø12 | 30 x 50            |
| 15,16,48,49 | 72      | 1500        | 12        | 4Ø14 + 6Ø12 | 30 x 50            |
| 21,22,54,55 | 19      | 400         | 3,2       | 14 Ø 10     | 20 x 90            |
| 23,56       | 21      | 450         | 3,6       | 24 Ø 10     | 20 x 190           |
| 24,33,57,66 | 31      | 650         | 5,2       | 4Ø12 + 4Ø10 | 30 x 30            |
| 25,32,58,65 | 33      | 700         | 5,6       | 4Ø12 + 4Ø10 | 30 x 30            |
| 26,31,59,64 | 31      | 650         | 5,6       | 4Ø12 + 4Ø10 | 30 x 30            |
| 27,30,60,63 | 37      | 750         | 6         | 4Ø12 + 4Ø10 | 30 x 30            |
| 28,29,61,62 | 29      | 600         | 4,8       | 4Ø12 + 4Ø10 | 30 x 30            |

Staffe Ø 6" /15"

1-3-5 Sezione ed armatura pilastri piano V e Vol. tecnici

| N°          | P<br>tn | A' c<br>cmq | Af<br>cmq | Armatura    | Sezione<br>cm x cm |
|-------------|---------|-------------|-----------|-------------|--------------------|
| 1,10,34,43  | 10      | 200         | 1,6       | 8 Ø 10      | 30 x 30            |
| 2,9,35,42   | 12      | 250         | 2         | 8 Ø 10      | 30 x 30            |
| 3,8,36,41   | 11      | 250         | 2         | 8 Ø 10      | 30 x 30            |
| 4,7,37,40   | 10      | 200         | 1,6       | 8 Ø 10      | 30 x 30            |
| 5,6,38,39   | 12      | 250         | 2         | 8 Ø 10      | 30 x 30            |
| 11,20,44,53 | 15      | 300         | 2,4       | 8 Ø 10      | 30 x 30            |
| 12,19,45,52 | 38      | 800         | 6,4       | 4Ø12+4Ø10   | 30 x 30            |
| 13,18,46,51 | 12      | 250         | 2         | 8 Ø 10      | 30 x 30            |
| 14,17,47,50 | 33      | 700         | 5,6       | 4Ø12 + 4Ø10 | 30 x 30            |
| 15,16,48,49 | 36      | 750         | 6         | 4Ø12 + 4Ø10 | 30 x 30            |
| 21,22,54,55 | 9       | 200         | 1,6       | 14 Ø 8      | 20 x 90            |
| 23,56       | 7       | 150         | 1,2       | 24 Ø 8      | 20 x 190           |
| 24,33,57,66 | 10      | 200         | 1,6       | 8 Ø 10      | 30 x 30            |
| 25,32,58,65 | 10      | 200         | 1,6       | 8 Ø 10      | 30 x 30            |
| 26,31,59,64 | 10      | 200         | 1,6       | 8 Ø 10      | 30 x 30            |
| 27,30,60,63 | 12      | 250         | 2         | 8 Ø 10      | 30 x 30            |
| 28,29,61,62 | 12      | 250         | 2         | 8 Ø 10      | 30 x 30            |

Staffe Ø 6" / 15"

1-4-0 Fondazioni

## 1-4-1 -Analisi di carico sul terreno-

pilastrì 2453400

trave 313200

2766600 Kg

## 1-4-2 -Tensione sul terreno-

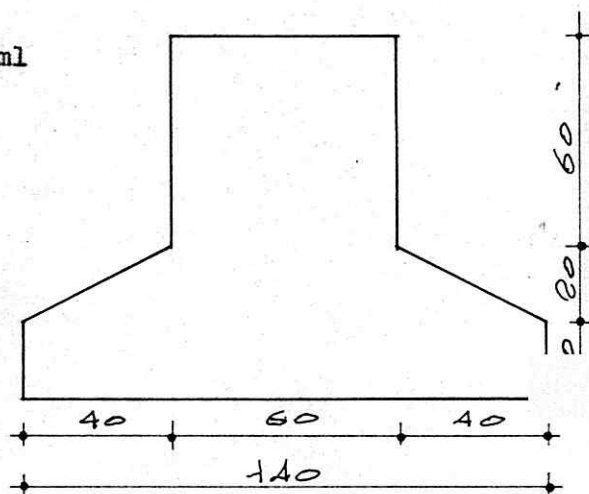
$$\sigma_t = \frac{2766600}{1936800} = 1,43 \text{ Kg/cm}^2$$

1-4-3 Travi 1-2-3-4-5-6-7-8-9-10; 24-25-26-27-28-29-30-31-32-33-34-35-36  
37-38-39-40-41-42-43; 57-58-59-60-61-62-63-64-65-66

Carico sulla trave

$$q = \frac{2453400}{1936800} \times 100 \times 140 = 17750 \text{ Kg/ml}$$

-Caratteristiche geometriche-  
Vedi disegno



-Armatura a flessione-

$$M_{inc} = \frac{1}{12} 17750 \times 3,85^2 = 21900 \text{ Kg} \cdot \text{m}$$

$$H = 100'' \quad b = 60''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 38 \text{ Kg/cm}^2$$

$$A_f = 17,3 \text{ cm}^2$$

$$M_{camp} = 21900 \text{ Kg} \cdot \text{m}$$

$$H = 100''$$

$$b = 140''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 24 \text{ Kg/cm}^2$$

$$A_f = 17 \text{ cm}^2$$

-Armatura trasversale-

$$M = \frac{1}{2} 17750 \times 0,40^2 = 1450 \text{ Kg} \cdot \text{m}$$

$$H = 40''$$

$$b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 18 \text{ Kg/cm}^2$$

$$A_f = 2,7 \text{ cm}^2$$

1-4-4 Travi 11-12-13-14-15-16-17-18-19-20; 44-45-46-47-48-49-50-51-52-53

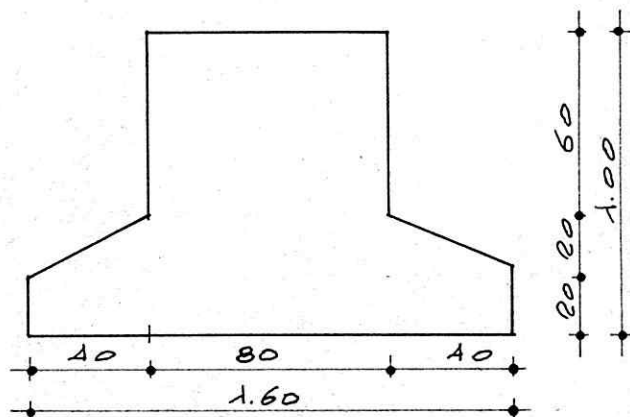
Carico sulla trave

$$q = \frac{2453400}{1936800} \times 100 \times 160 = 20250 \text{ Kg/ml}$$

1936800

Caratteristiche geometriche

Vedi disegno



-Armatura a flessione-

$$M_{inc} = \frac{1}{12} 20250 \times 3,85^2 = 25000 \text{ Kgm} \quad H = 100'' \quad b = 80''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 35 \text{ Kg/cm}^2$$

$$A_f = 19,7 \text{ cm}^2$$

$$M_{camp} = 25000 \text{ Kgm}$$

$$H = 100''$$

$$b = 160''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 24 \text{ Kg/cm}^2$$

$$A_f = 19,4 \text{ cm}^2$$

-Armatura trasversale-

$$M = \frac{1}{2} 20250 \times 0,40^2 = 1600 \quad b = 100'' \quad H = 40''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 20 \text{ Kg/cm}^2$$

$$A_f = 3,2 \text{ cm}^2$$

1-4-5 Travi 1-11-24; 10-20-33; 34-44-57; 43-53-66

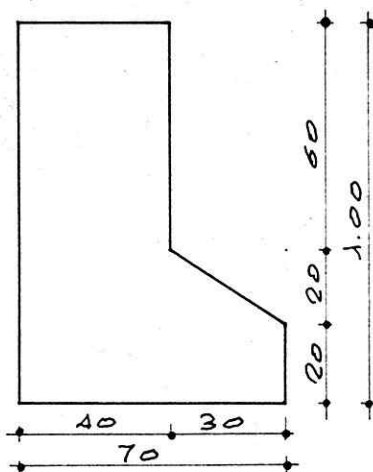
Carico sulla trave

$$q = \frac{2453400}{1936800} \times 100 \times 70 = 8850 \text{ Kgm}$$

1936800

Caratteristiche geometriche

Vedi disegno



**-Armatura a flessione-**

$$M_{inc} = \frac{1}{12} 8850 \times 4,95^2 = 18050 \text{ Kgm}$$

$$H = 100'' \quad b = 40''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 43 \text{ Kg/cm}^2$$

$$A_f = 14,2 \text{ cm}^2$$

$$M_{camp} = 18050 \text{ Kgm}$$

$$H = 100''$$

$$b = 70''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 31 \text{ Kg/cm}^2$$

$$A_f = 13,9 \text{ cm}^2$$

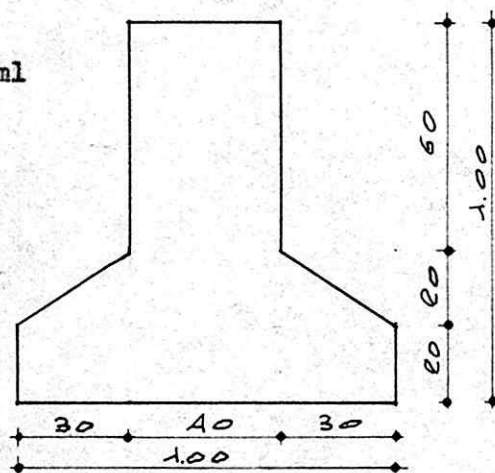
1-4-6 Travi 2-12-25; 3-13-26; 4-14-27; 5-15-21-23-28; 6-16-22-23-29-7-17-30;  
8-18-31; 9-19-32; 35-45-58; 36-46-59; 37-47-60; 38-48-54-56-61; 39-49  
55-56-62; 40-50-63-41-51-64; 42-52-65

Carico sulla trave

$$q = \frac{2453400}{1936800} \times 100 \times 100 = 12650 \text{ Kg/ml}$$

Caratteristiche geometriche

Vedi disegno

**-Armatura a flessione-**

$$M_{inc} = \frac{1}{12} 12650 \times 4,95^2 = 25850 \text{ Kgm}$$

$$H = 100'' \quad b = 40''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 53 \text{ Kg/cm}^2$$

$$A_f = 20,4 \text{ cm}^2$$

$$M_{camp} = 25850 \text{ Kgm}$$

$$H = 100''$$

$$b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 31 \text{ Kg/cm}^2$$

$$A_f = 20 \text{ cm}^2$$

1-5-0 - Vano Scala -

1-5-1 Calcolo del gradino

Analisi di carico

$$\text{p.p.} \quad \frac{0,235 + 0,07}{2} \times 0,30 \times 1,00 \times 2500 = 115$$

sovracc. perm. ( intonaco, grado

$$\text{sottogradio e massetto } ) = 150 \times 0,30 = 45$$

$$\text{sovracc. accid.} = 400 \times 0,30 = 120$$

280 Kg/ml

$$M = \frac{1}{2} 280 \times 1,20^2 = 200 \text{ Kgm} \quad H = \frac{0,235 \times 0,07}{2} = 0,15 \quad b = 30 \text{ cm}$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 36 \text{ Kg/cm}^2 \quad A_f = 1,10 \text{ cm}^2$$

1-5-2 Calcolo dei pianerottoliSolaio in latero-cemento  $H = 16'' + 4''$   $i = 50''$ 

Analisi di carico

$$\text{p.p.} = 140$$

$$\text{soletta} \quad 0,04 \times 1,00 \times 1,00 \times 2500 = 100$$

$$\text{sovracc. accid. ( intonaco, massetto, pavimento )} = 110$$

$$\text{sovracc. perm.} = 400$$

750 Kg/cm<sup>2</sup>

$$M_{inc} = \frac{1}{12} 750 \times 2,70^2 = 455 \text{ Kgm} \quad H = 20'' \quad b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 22 \text{ Kg/cm}^2 \quad A_f = 0,96 \text{ cm}^2 / 50''$$

$$M_{camp} = \frac{1}{14} 750 \times 2,70^2 = 390 \text{ Kgm} \quad H = 20'' \quad b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma = 20 \text{ Kg/cm}^2 \quad A_f = 0,82 \text{ cm}^2 / 50''$$

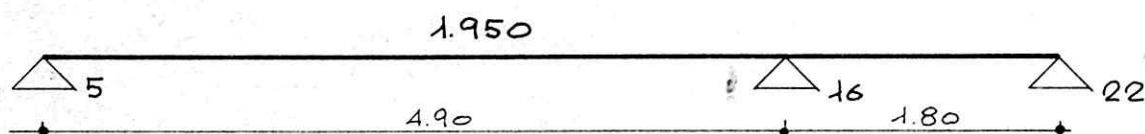
**1-5-3 Calcolo delle travi a ginocchio**

Analisi di carico

|          |                           |                   |
|----------|---------------------------|-------------------|
| Rampa    | 850 x 1,20                | = 1100            |
| tompagno |                           | = 400             |
| p.p.     | 0,30 x 0,60 x 1,00 x 2500 | = 450             |
|          |                           | <u>1950 Kg/ml</u> |

Verifica ed armatura a flessione

Schema di calcolo



$$M_5 = M_{5-16} = \frac{1}{14} 1950 \times 4,90^2 = 3350 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 35 \text{ Kg/cm}^2 \quad A_f = 4,4 \text{ cm}^2$$

$$M_{16} = \frac{1}{10} 1950 \times 4,90^2 = 4700 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 43 \text{ Kg/cm}^2 \quad A_f = 6,3 \text{ cm}^2$$

$$M_{16-22} = \frac{1}{8} 1950 \times 1,80^2 = 4700 = -3900 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 39 \text{ Kg/cm}^2 \quad A_f = 5,3 \text{ cm}^2$$

$$M_{22} = \frac{1}{12} 1950 \times 1,80^2 = 550 \text{ Kgm} \quad H = 50'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c < 15 \text{ Kg/cm}^2 \quad A_f = 1,5 \text{ cm}^2$$

Verifica a torsione della trave 5-16

$$m_i = \frac{1}{2} 850 \times 1,20^2 = 612 \text{ Kgm}$$

$$m_t = 612 + 1020 \times 0,15 = 765 \text{ Kgm}$$

$$t_i = 850 \times 1,20 = 1020 \text{ Kgm}$$

$$M_t = 765 \times \frac{4,90}{2} = 1875 \text{ Kgm}$$

$$\gamma = 3 + \frac{2,6}{0,45 + \frac{60}{30}} = 4,061$$

$$\tau = \frac{4,061 \times 187500}{60 \times 30^2} = 14,1 \text{ Kg/cm}^2$$

-Armatura a torsione-

$$F = 55 \times 25 = 1375 \text{ cm}^2$$

$$V = (55 + 25) \times 2 = 160 \text{ cm}$$

$$\Sigma_{f1} = \frac{187500}{2 \times 1400 \times 1375} = 160 = 7,8 \text{ cm}^2$$

$$\Sigma_{fs} = \frac{187500}{2 \times 1400 \times 1375} = 0,0487 \text{ cm}^2/\text{cm}$$

#### 1-5-4 Calcolo della trave al pianerottolo di riposo

$$M = \frac{1}{12} 1200 \times 3,00^2 = 900 \text{ Kg} \cdot \text{m}$$

$$H = 40'' \quad b = 20''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 34 \text{ Kg/cm}^2 \quad A_f = 1,8 \text{ cm}^2$$

1-6-0 BALCONI

$$q = 800 \text{ Kg/mq} \quad H = 20 + 5 \text{ cm} \quad b = 100 \text{ cm}$$

$$M = \frac{1}{2} 800 \times 1,05^2 = 440 \text{ Kgm}$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 17 \text{ Kg/cm}^2 \quad A_f = 1,6 \text{ cm}^2/\text{ml}$$

$$i = 50 \text{ cm} \quad A_f = 0,8 \text{ cm}^2$$

$$M = \frac{1}{2} 800 \times 1,15^2 = 530 \text{ Kgm}$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 18 \text{ Kg/cm}^2 \quad A_f = 1,7 \text{ cm}^2/\text{ml}$$

$$i = 50 \text{ cm} \quad A_f = 0,85 \text{ cm}^2/50$$

1-7-0

SOLAI PIANO TIPOCarico per nervatura  $q = 650 \times 0,50 = 325 \text{ Kg/ml}$  $\sigma_f = 1400 \text{ Kg/cm}^2$   $b = 50 \text{ cm}$ luce netta  $3,68 \times 1,05 = 3,85 \text{ m.}$ incastro  $M = \frac{1}{12} 325 \times 3,85^2 = 400 \text{ Kg} \cdot \text{m}$   $H = 25 \text{ cm}$   $\sigma_c = 23 \text{ Kg/cm}^2$   $A_f = 1,32 \text{ cm}^2$ campata  $M = \frac{1}{14} 325 \times 3,85^2 = 345 \text{ Kg} \cdot \text{m}$   $H = 25 \text{ cm}$   $\sigma_c = 21 \text{ Kg/cm}^2$   $A_f = 1,12 \text{ cm}^2$ luce netta  $4,28 \times 1,05 = 4,50 \text{ m.}$ incastro  $M = \frac{1}{12} 325 \times 4,50^2 = 550 \text{ Kg} \cdot \text{m}$   $H = 25 \text{ cm}$   $\sigma_c = 27 \text{ Kg/cm}^2$   $A_f = 1,8 \text{ cm}^2$  $H = 18 \text{ cm}$   $\sigma_c = 36 \text{ Kg/cm}^2$   $A_f = 2,35 \text{ cm}^2$ campata  $M = \frac{1}{14} 325 \times 4,50^2 = 470 \text{ Kg} \cdot \text{m}$   $H = 25 \text{ cm}$   $\sigma_c = 25 \text{ Kg/cm}^2$   $A_f = 1,55 \text{ cm}^2$  $H = 18 \text{ cm}$   $\sigma_c = 33 \text{ Kg/cm}^2$   $A_f = 2,0 \text{ cm}^2$ luce netta  $2,83 \times 1,05 = 3,00 \text{ m.}$ incastro  $M = \frac{1}{12} 325 \times 3,00^2 = 250 \text{ Kg} \cdot \text{m}$   $H = 25 \text{ cm}$   $\sigma_c = 18 \text{ Kg/cm}^2$   $A_f = 0,85 \text{ cm}^2$ campata  $M = \frac{1}{14} 325 \times 3,00^2 = 200 \text{ Kg} \cdot \text{m}$   $H = 25 \text{ cm}$   $\sigma_c < 15 \text{ Kg/cm}^2$   $A_f = 0,70 \text{ cm}^2$

## 1-8-0 - Calcolo a flessione delle travi -

1-8-1 Si effettua il Cross per il telaio 1-2-3-4-5-6-7-8-9-10-34-35-36-37-38-39-40-41-42-43

Lo schema di carico e le grandezze geometriche sono riportate in disegno.

Calcolo dei momenti di inerzia

Pilastri 1-10; 4-7; 10-11; 9-12; 12-19; 8-13; 13-18; 7-14; 14-17; 6-15; 15-16

$$J = 90000 \text{ cm}^4$$

Pilastri 2-9; 3-8; 5-6

$$J = 112500 \text{ cm}^4$$

Pilastri 20-21; 21-30; 30-31; 19-22; 22-29; 29-32; 18-23; 23-28; 28-33; 17-24; 24-27; 27-34; 16-25; 25-26; 26-35

$$J = 67500 \text{ cm}^4$$

Travi

$$J = 91145 \text{ cm}^4$$

## 1-8-2 - Calcolo dei fattori di rigidità -

$$K_{65} = K_{83} = K_{92} = 4 E x 300$$

$$K_{74} = K_{104} = 4 E x 240$$

$$K_{615} = K_{1516} = K_{714} = K_{1417} = K_{813} = K_{1318} = K_{912} = K_{1219} = K_{1011} = K_{1120} = 4 E x 273$$

$$K_{1225} = K_{2526} = K_{2635} = K_{1724} = K_{2427} = K_{2734} = K_{1823} = K_{2328} = K_{2833} = K_{1922} = K_{2229} = K_{2932} = K_{2021} = K_{2130} = K_{3031} = 4 E x 205$$

$$K_{67} = K_{1514} = K_{1617} = K_{2524} = K_{2627} = K_{3534} = 4 E x 414$$

$$K_{78} = K_{1413} = K_{1718} = K_{2423} = K_{2728} = K_{3430} = 4 E x 268$$

$$K_{89} = K_{1312} = K_{1819} = K_{2322} = K_{2829} = K_{3332} = 4 E x 253$$

$$K_{910} = K_{1211} = K_{1920} = K_{2221} = K_{2930} = K_{3231} = 4 E \times 237$$

1-8-3 - Calcolo dei fattori di ripartizione-

Nodo 6

$$6-5 = \underline{0,30} \quad 6-7 = \underline{0,42} \quad 6-15 = \underline{0,28}$$

Nodo 7

$$7-4 = \underline{0,20} \quad 7-6 = \underline{0,35} \quad 7-14 = \underline{0,23} \quad 7-8 = \underline{0,22}$$

Nodo 8

$$8-3 = \underline{0,27} \quad 8-7 = \underline{0,24} \quad 8-13 = \underline{0,26} \quad 8-9 = \underline{0,23}$$

Nodo 9

$$9-2 = \underline{0,28} \quad 9-8 = \underline{0,24} \quad 9-12 = \underline{0,26} \quad 9-10 = \underline{0,22}$$

Nodo 10

$$10-1 = \underline{0,32} \quad 10-9 = \underline{0,31} \quad 10-11 = \underline{0,37}$$

Nodo 11

$$11-10 = 11-20 = \underline{0,35} \quad 11-12 = \underline{0,30}$$

Nodo 12

$$12-9 = 12-19 = \underline{0,26} \quad 12-11 = \underline{0,23} \quad 12-13 = \underline{0,25}$$

Nodo 13

$$13-8 = 13-19 = \underline{0,26} \quad 13-12 = \underline{0,23} \quad 13-14 = \underline{0,24}$$

Nodo 14

$$14-7 = 14-17 = \underline{0,22} \quad 14-13 = \underline{0,21} \quad 14-15 = \underline{0,35}$$

Nodo 15

$$15-6 = 15-16 = \underline{0,28} \quad 15-14 = \underline{0,44}$$

Nodo 16

$$16-15 = \underline{0,31} \quad 16-25 = \underline{0,23} \quad 16-17 = \underline{0,46}$$

Nodo 17

$$17-14 = \underline{0,23} \quad 17-16 = \underline{0,36} \quad 17-24 = \underline{0,18} \quad 17-18 = \underline{0,23}$$

Nodo 18

$$18-13 = \underline{0,27} \quad 18-17 = \underline{0,27} \quad 18-23 = \underline{0,21} \quad 18-19 = \underline{0,25}$$

Nodo 19

$$19-18 = \underline{0,26} \quad 19-22 = \underline{0,22} \quad 19-20 = \underline{0,24} \quad 19-12 = \underline{0,28}$$

Nodo 20

$$20-19 = \underline{0,33} \quad 20-21 = \underline{0,29} \quad 20-11 = \underline{0,31}$$

Nodo 21-30

$$21-20 = 21-30 = 30-21 = 30-31 = \underline{0,32} \quad 21-22 = 30-29 = 0,36$$

Nodo 22-29

$$22-19 = 22-29 = 29-32 = \underline{0,23} \quad 22-21 = 29-30 = \underline{0,26} \quad 22-23 = 29-28 = \underline{0,28}$$

Nodo 23-28

$$23-18; 23-28; 28-33 = \underline{0,22} \quad 23-22 = 28-29 = \underline{0,27} \quad 23-24 = 28-27 = \underline{0,29}$$

Nodo 24-27

$$24-17; 24-27; 27-34 = \underline{0,18} \quad 24-23 = 27-28 = \underline{0,25} \quad 24-25 = 27-26 = \underline{0,39}$$

Nodo 25-26

$$25-16; 25-26; 26-35 = \underline{0,25} \quad 25-24 = 26-27 = \underline{0,50}$$

Nodo 31

$$31-30 = 0,46 \quad 31-32 = 0,54$$

Nodo 32

$$32-29 = \underline{0,30} \quad 32-31 = \underline{0,34} \quad 32-33 = \underline{0,36}$$

Nodo 33

$$33-32 = \underline{0,35} \quad 33-28 = \underline{0,28} \quad 33-34 = \underline{0,37}$$

Nodo 34

$$34-33 = \underline{0,30} \quad 34-27 = \underline{0,23} \quad 34-35 = \underline{0,37}$$

Nodo 35

$$35-26 = \underline{0,33} \quad 35-34 = \underline{0,67}$$

1-7-3 - Momenti d'incastro perfetto -

Travi da 2,20 m.

$$M = \frac{1}{12} \quad 3700 \times 2,20^2 = 1500 \text{ Kgm}$$

Travi da 3,40 m.

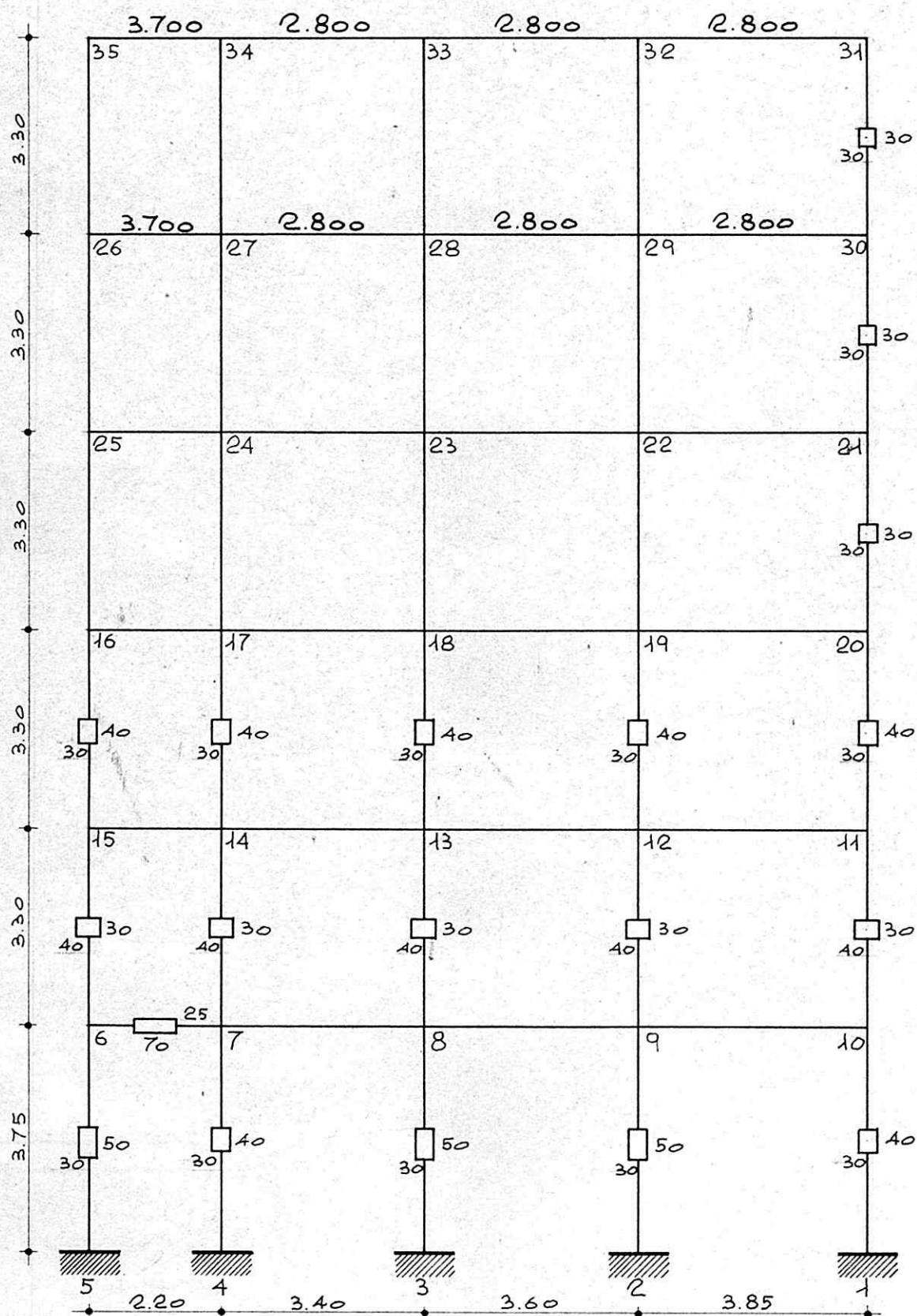
$$M = \frac{1}{12} \quad 2800 \times 3,40^2 = 2700 \text{ Kgm}$$

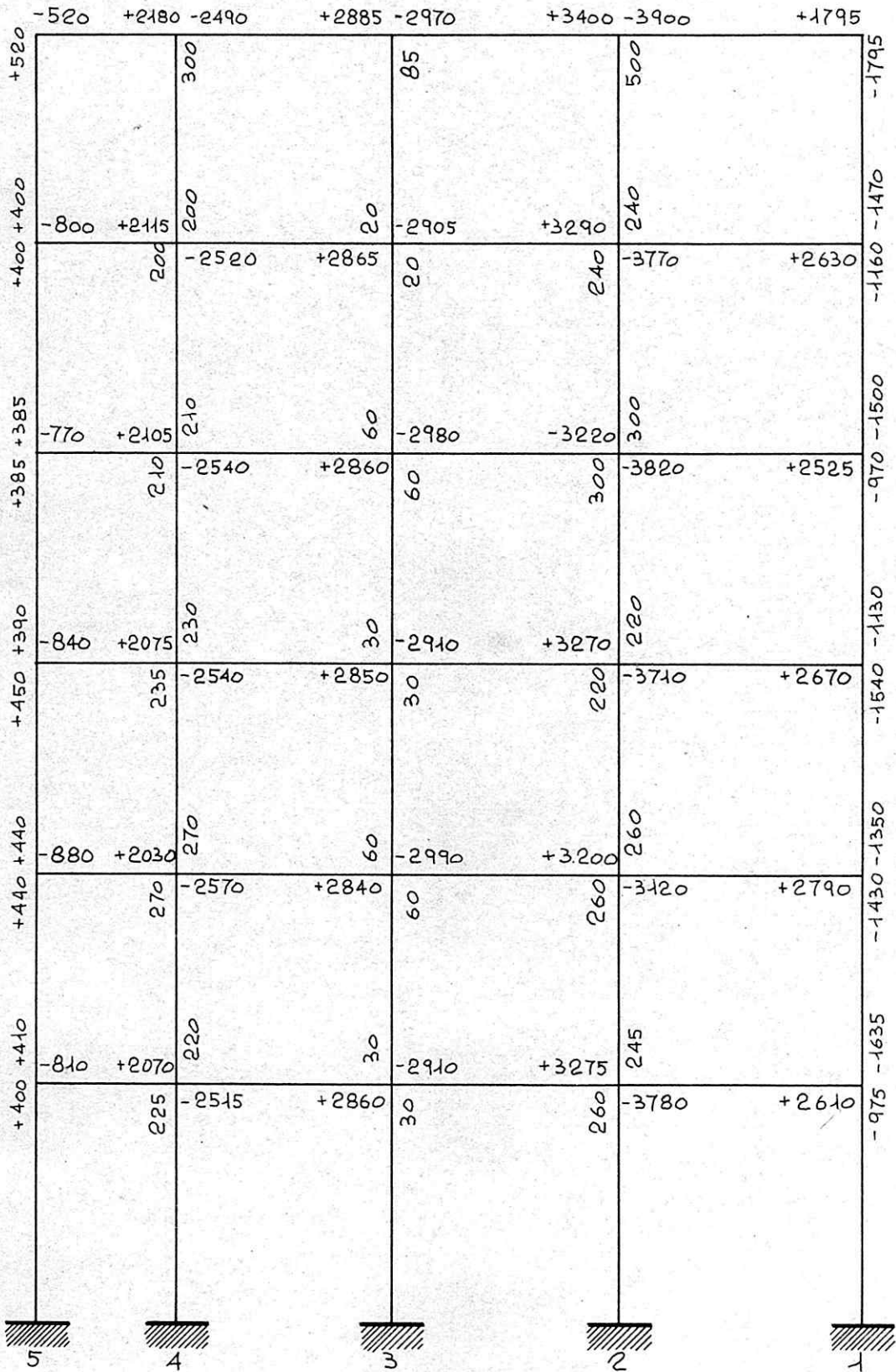
Travi da 3,60 m.

$$M = \frac{1}{12} \quad 2800 \times 3,60^2 = 3050 \text{ Kgm}$$

Travi da 3,85 m.

$$M = \frac{1}{12} \quad 2800 \times 3,85^2 = 3450 \text{ Kgm}$$





**1-8-4 Verifica ed armatura travi**

Travi 1-2 ai piani tipo

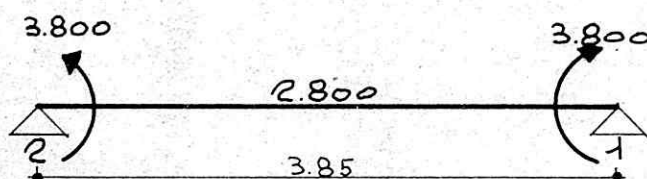
$R_2 = 5730 \text{ Kg}$

$R_1 = 5050 \text{ Kg}$

$x = 2,05 \text{ m. da 2}$

$M_{\text{max}} = 2060 \text{ Kgm}$

$\tau_{\text{max}} = 3,9 \text{ Kg/cm}^2$



Verifiche ed armatura

$H = 25 \text{ cm} \quad b = 70 \text{ cm}$

$\sigma_f = 1400 \text{ Kg/cm}^2$

Sezione 1  $M = 2500 \text{ Kgm}$

$\sigma_c = 53 \text{ Kg/cm}^2$

$A_f = 8,4 \text{ cm}^2$

Sezione 1-2  $M = 2050 \text{ Kgm}$

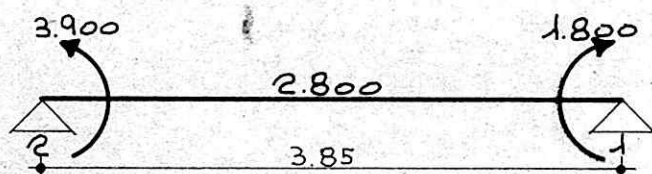
$\sigma_c = 47 \text{ Kg/cm}^2$

$A_f = 6,9 \text{ cm}^2$

Sezione 2  $M = 3800 \text{ Kgm}$

$\sigma_c = 69 \text{ Kg/cm}^2$

$A_f = 13,1 \text{ cm}^2$

**1-8-5 Travi 1-2 alla copertura**

$R_2 = 5950 \text{ Kg}$

$R_1 = 4850 \text{ Kg}$

$x = 2,15 \text{ m.}$

$M_{\text{max}} = 2450 \text{ Kgm}$

$\tau_{\text{max}} = 4,1 \text{ Kg/cm}^2$

Verifiche ed armatura

$H = 25 \text{ cm} \quad b = 70 \text{ cm}$

$\sigma_f = 1400 \text{ Kg/cm}^2$

Sezione 1  $M = 1800 \text{ Kgm}$

$\sigma_c = 44 \text{ Kg/cm}^2$

$A_f = 6,1 \text{ cm}^2$

Sezione 1-2  $M = 2450 \text{ Kgm}$

$\sigma_c = 53 \text{ Kg/cm}^2$

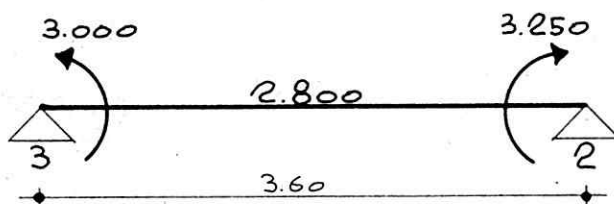
$A_f = 8,3 \text{ cm}^2$

Sezione 2  $M = 3900 \text{ Kgm}$

$\sigma_c = 70 \text{ Kg/cm}^2$

$A_f = 13,5 \text{ cm}^2$

## 1-8-6 Travi 2-3



$$R_3 = 4950 \text{ Kg}$$

$$R_2 = 5150 \text{ Kg}$$

$$x = 1,75 \text{ m.}$$

$$M_{\max} = 1400 \text{ Kgm}$$

$$\tau_{\max} = 3,5 \text{ Kg/cm}^2$$

Verifiche ed armatura  $H = 25 \text{ cm}$   $b = 70 \text{ cm}$ 

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

Sezione 2  $M = 3250 \text{ Kgm}$ 

$$\sigma_c = 63 \text{ Kg/cm}^2$$

$$A_f = 11,2 \text{ cm}^2$$

Sezione 2-3  $M = 1400 \text{ Kgm}$ 

$$\sigma_c = 43 \text{ Kg/cm}^2$$

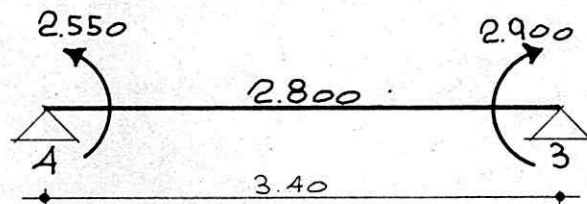
$$A_f = 5,8 \text{ cm}^2$$

Sezione 3  $M = 3000 \text{ Kgm}$ 

$$\sigma_c = 60 \text{ Kg/cm}^2$$

$$A_f = 10,4 \text{ cm}^2$$

## 1-8-7 Trave 3-4



$$R_4 = 4700 \text{ Kg}$$

$$R_3 = 4800 \text{ Kg}$$

$$x = 1,65 \text{ m.}$$

$$M_{\max} = 1400 \text{ Kgm}$$

$$\tau_{\max} = 3,3 \text{ Kg/cm}^2$$

Verifiche ed armatura  $H = 25 \text{ cm}$   $b = 70 \text{ cm}$ 

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

Sezione 3  $M = 2900 \text{ Kgm}$ 

$$\sigma_c = 59 \text{ Kg/cm}^2$$

$$A_f = 10 \text{ cm}^2$$

Sezione 4-3  $M = 1400 \text{ Kgm}$ 

$$\sigma_c = 43 \text{ Kg/cm}^2$$

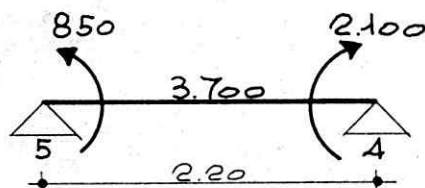
$$A_f = 5,8 \text{ cm}^2$$

Sezione 4  $M = 2550 \text{ Kgm}$ 

$$\sigma_c = 55 \text{ Kg/cm}^2$$

$$A_f = 8,8 \text{ cm}^2$$

1-8-8 Travi 4-5



$$R_5 = 3500 \text{ Kg}$$

$$R_4 = 4650 \text{ Kg}$$

$$x = 0,95 \text{ m.}$$

$$M_{\max} = 800 \text{ Kgm}$$

$$\tau_{\max} = 3,2 \text{ Kg/cm}^2$$

Verifiche ed armatura  $H = 25 \text{ cm}$   $b = 70 \text{ cm}$   $\sigma_F = 1400 \text{ Kg/cm}^2$

Sezione 4  $M = 2100 \text{ Kg}$   $\sigma_c = 49 \text{ Kg/cm}^2$   $A_F = 7,2 \text{ cm}^2$

Sezione 4-5  $M = 800 \text{ Kgm}$   $\sigma_c = 28 \text{ Kg/cm}^2$   $A_F = 2,8 \text{ cm}^2$

Sezione 5  $M = 850 \text{ Kgm}$   $\sigma_c = 29 \text{ Kg/cm}^2$   $A_F = 2,9 \text{ cm}^2$

1-8-9 Verifica in testa del pilastro 1

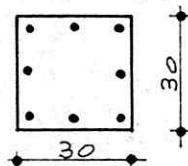
$R = 9000 \text{ Kg}$   $M = 1800 \text{ Kgm}$   $A_c = 30 \times 30$   $A_F = 8 \text{ } \varnothing 10$

$a = 30 \text{ cm}$  ;  $b = 30 \text{ cm}$  ;  $h = 28 \text{ cm}$  ;  $h' = 20 \text{ cm}$

$A_F = A'_F = 2,36 \text{ cm}^2$   $e = 20 \text{ cm}$

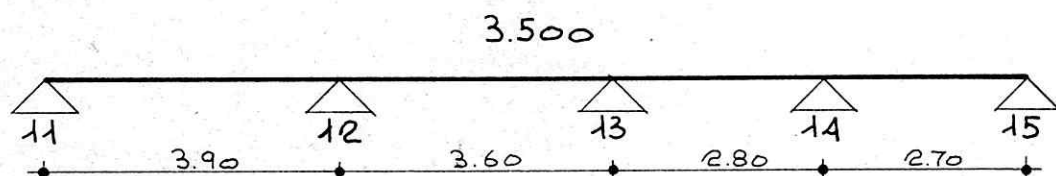
$d = 33 \text{ cm}$   $d' = 7 \text{ cm}$  ricaviamo la posizione dell'asse neutro

$x = 10,1 \text{ cm}$   $\sigma_c = 69 \text{ Kg/cm}^2$



Esaminati i risultati del Cross e le relative verifiche sulle travi si adottano dei coefficienti nella soluzione delle altre strutture.

1-8-10 Travi 11-12-13-14-15; 16-17-18-19-20; 44-45-46-47-48; 49-50-51-52-53



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$H = 25 \text{ cm}$$

$$b = 90 \text{ cm}$$

Sezione 11; 11-12

$$M = \frac{1}{14} 3500 \times 3,90^2 = 3800 \text{ Kgm} \quad \sigma_c = 60 \text{ Kg/cm}^2 \quad A_f = 13,2 \text{ cm}^2$$

Sezione 12

$$M = \frac{1}{10} 3500 \times 3,90^2 = 5300 \text{ Kgm} \quad \sigma_c = 73 \text{ Kg/cm}^2 \quad A_f = 18,5 \text{ cm}^2$$

Sezione 12-13

$$M = \frac{1}{16} 3500 \times 3,60^2 = 2800 \text{ Kgm} \quad \sigma_c = 50 \text{ Kg/cm}^2 \quad A_f = 9,6 \text{ cm}^2$$

Sezione 13

$$M = \frac{1}{12} 3500 \times 3,60^2 = 3800 \text{ Kgm} \quad \sigma_c = 60 \text{ Kg/cm}^2 \quad A_f = 13,2 \text{ cm}^2$$

Sezione 13-14

$$M = \frac{1}{16} 3500 \times 2,80^2 = 1700 \text{ Kgm} \quad \sigma_c = 37 \text{ Kg/cm}^2 \quad A_f = 5,8 \text{ cm}^2$$

Sezione 14

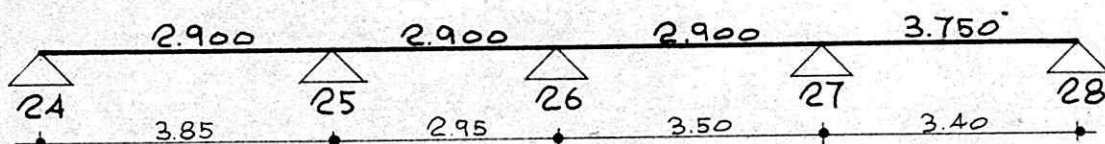
$$M = \frac{1}{10} 3500 \times 2,70^2 = 2550 \text{ Kgm} \quad \sigma_c = 47 \text{ Kg/cm}^2 \quad A_f = 8,7 \text{ cm}^2$$

Sezione 14-15; 15

$$M = \frac{1}{14} 3500 \times 2,70^2 = 1800 \text{ Kgm} \quad \sigma_c = 38 \text{ Kg/cm}^2 \quad A_f = 6,0 \text{ cm}^2$$

$$\text{Taglio massimo } T = 6800 \text{ Kg} \quad \tau_{\max} = \frac{6800}{90 \times 0,9 \times 23} = 3,6 \text{ Kg/cm}^2$$

1-8-11 Travi 24-25-26-27-28; 29-30-31-32-33  
57-58-59-60-61; 62-63-64-65-66



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 70 \text{ cm}$$

Sezione 24; 24-25;

$$M = \frac{1}{14} 2900 \times 3,85^2 = 3050 \text{ Kgm} \quad \sigma_c = 61 \text{ Kg/cm}^2 \quad A_f = 10,6 \text{ cm}^2$$

Sezione 25

$$M = \frac{1}{10} 2900 \times 3,85^2 = 4300 \text{ Kgm} \quad \sigma_c = 76 \text{ kg/cm}^2 \quad A_f = 15,4 \text{ cm}^2$$

Sezione 25-26

$$M = \frac{1}{16} 2900 \times 2,95^2 = 1550 \text{ kgm} \quad \sigma_c = 40 \text{ kg/cm}^2 \quad A_f = 5,2 \text{ cm}^2$$

Sezione 26

$$M = \frac{1}{12} 2900 \times 3,50^2 = 2950 \text{ Kgm} \quad \sigma_c = 60 \text{ Kg/cm}^2 \quad A_f = 10,2 \text{ cm}^2$$

Sezione 26-27

$$M = \frac{1}{16} 2900 \times 3,50^2 = 2200 \text{ Kgm}$$

$$\sigma_c = 50 \text{ Kg/cm}^2$$

$$A_f = 7,5 \text{ cm}^2$$

Sezione 27

$$M = \frac{1}{10} 3750 \times 3,40^2 = 4300 \text{ Kgm}$$

$$\sigma_c = 76 \text{ Kg/cm}^2$$

$$A_f = 15,4 \text{ cm}^2$$

Sezione 27-28; 28

$$M = \frac{1}{14} 3750 \times 3,40^2 = 3100 \text{ Kgm}$$

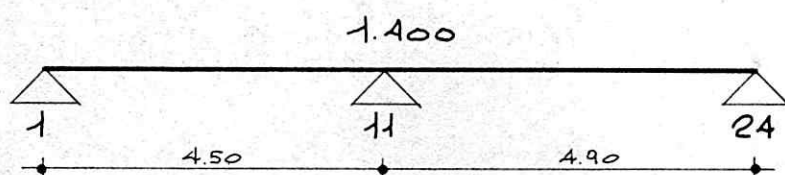
$$\sigma_c = 61 \text{ Kg/cm}^2$$

$$A_f = 10,7 \text{ cm}^2$$

Taglio massimo  $T = 6300 \text{ Kg}$

$$\tau_{\max} = \frac{6300}{70 \times 0,9 \times 23} = 4,3 \text{ Kg/cm}^2$$

1-8-12 Travi 1-11-24; 10-20-33; 34-44-57; 43-53-66



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$H = 25 \text{ cm}$$

$$b = 50 \text{ cm}$$

Sezione 1; 1-11

$$M = \frac{1}{14} 1400 \times 4,50^2 = 2050 \text{ Kgm}$$

$$\sigma_c = 59 \text{ Kg/cm}^2$$

$$A_f = 7,1 \text{ cm}^2$$

Sezione 11

$$M = \frac{1}{12} 1400 \times 4,90^2 = 2800 \text{ Kgm}$$

$$\sigma_c = 71 \text{ Kg/cm}^2$$

$$A_f = 9,8 \text{ cm}^2$$

Sezione 11-24; 24

$$M = \frac{1}{14} 1400 \times 4,90^2 = 2400 \text{ Kgm}$$

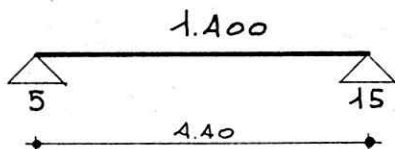
$$\sigma_c = 65 \text{ Kg/cm}^2$$

$$A_f = 8,5 \text{ cm}^2$$

Taglio massimo  $T = 3450 \text{ Kg}$

$$\tau_{\max} = \frac{3450}{50 \times 0,9 \times 23} = 3,3 \text{ Kg/cm}^2$$

1-8-13 Travi 5-15; 6-16; 38-48; 39-49

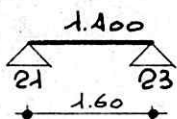


- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 50 \text{ cm}$$

Sezione 5; 5-15; 15

$$M = \frac{1}{12} 1400 \times 4.40^2 = 2250 \text{ Kgm} \quad \sigma_c = 62 \text{ Kg/cm}^2 \quad A_f = 7.8 \text{ cm}^2$$

1-8-14 Travi 21-23; 21-24; 23-28; 23-29;  
54-56; 55-56; 56-61; 56-62

Sezione 21; 21-23; 23

$$H = 25 \text{ cm} \quad b = 20 \text{ cm}$$

$$M = \frac{1}{12} 1400 \times 1.60^2 = 300 \text{ Kgm} \quad \sigma_c = 32 \text{ Kg/cm}^2 \quad A_f = 1.2 \text{ cm}^2$$

## 1-9-0 - Calcolo della soletta ascensore -

## 1-9-1 Analisi di carico

|                 |                                            |       |
|-----------------|--------------------------------------------|-------|
| p.p.            | $0,25 \times 1,00 \times 1,00 \times 2500$ | = 625 |
| sovracc. perm.  |                                            | = 75  |
| sovracc. accid. |                                            | = 150 |

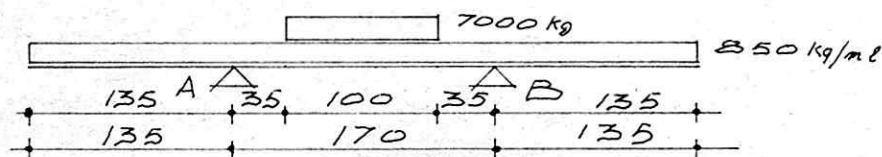
850 Kg/mq

macchinario = 6000

basamento = 1000

7000 Kg

## 1-9-2 Condizioni di carico



$$M_A = M_B = 770 \text{ Kgm}$$

$$M_{AB} = \frac{1}{8} 850 \times 1,70^2 + \frac{1}{8} 7000 \times 1,00 \times 1,70 \left(1 + 2 \frac{0,35}{1,70}\right) - 770 = 1630 \text{ Kgm}$$

Armando simmetricamente verifichiamo il momento massimo

$$M = 1630 \quad H = 25 \text{ cm} \quad h = 23 \text{ cm} \quad h' = 2 \text{ cm} \quad b = 100 \text{ cm}$$

$$A_f = A'_f = 10,78 \text{ cmq} \left(1 + 1014/15\right) \quad A_f^x = 21,56 \text{ cmq} \quad h^x = 12,5 \text{ cm}$$

$$\gamma = \frac{A_f}{A'_f} = 1 \quad x = 5,47 \text{ cm}$$

$$\sigma_c = 19 \text{ Kg/cmq} \quad \sigma_f = 608 \text{ Kg/cmq}$$

## 1-9-3 Coefficienti di sicurezza

$$\text{nel calcestruzzo} \quad \xi_c = \frac{180}{19} = 9,4$$

$$\text{nel ferro} \quad \xi_f = \frac{4200}{608} = 6,9$$

## 1-9-4 - Travi portasolette -

## Analisi di carico

travi 28-23

soletta  $850 \times 1,50/2 \times 7000/2$  = 4150sbalzo  $850 \times 1,25$  = 1050

tompagno = 800

p.p.  $0,20 \times 0,60 \times 1,00 \times 2500$  = 500

---

6500 Kg/ml

Travi 23-21

soletta  $850 \times 1,50/2$  = 650sbalzo  $850 \times 1,25$  = 1050

tompagno = 800

p.p. = 400

---

2900 Kg/ml

## Armatura a flessione

 $M_{\max} = 2100 \text{ Kgm}$      $H = 60 \text{ cm}$      $b = 20 \text{ cm}$      $\sigma_f = 1400 \text{ Kg/cm}^2$  $\sigma_o = 34 \text{ Kg/cm}^2$      $A_f = 2,85 \text{ cm}^2$

## 1-10-0 - Copertura Volumi tecnici -

## 1-10-1 -Solai-

Carico per nervatura  $q = 650 \times 0,50 = 325 \text{ Kg/ml}$  $\sigma_f = 1400 \text{ Kg/cm}^2$   $H = 25 \text{ cm}$   $b = 50 \text{ cm}$ 

luce netta 2,70 m.

$$M = \frac{1}{2} 325 \times 2,70^2 = 1150 \text{ Kgm} \quad \sigma_c = 41 \text{ Kg/cm}^2 \quad A_f = 3,85 \text{ cm}^2$$

luce netta 1,50 m.

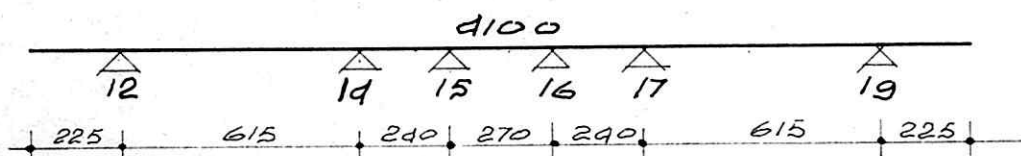
$$M = \frac{1}{2} 325 \times 1,50^2 = 360 \text{ Kgm} \quad \sigma_c = 21 \text{ Kg/cm}^2 \quad A_f = 1,15 \text{ cm}^2$$

luce netta = 2,70 x 1,05 = 2,85 m.

$$M = \frac{1}{12} 325 \times 2,83^2 = 200 \text{ Kgm} \quad \sigma_c < 15 \text{ Kg/cm}^2 \quad A_f = 1 \text{ cm}^2$$

1-10-2 Travi S-12-14-15-16-17-19-S

S-45-47-48-49-50-52-S



- Armatura a flessione -

$\sigma_f = 1400 \text{ Kg/cm}^2$

$H = 80 \text{ cm}$

$b = 30 \text{ cm}$

Sezione 12, 14

$$M = \frac{1}{12} 4100 \times 6,15^2 = 12900 \text{ Kgm}$$

$\sigma_c = 55 \text{ Kg/cm}^2$

$A_f = 13 \text{ cm}^2$

Sezione 12-14

$$M = \frac{1}{16} 4100 \times 6,15^2 = 9700 \text{ Kgm}$$

$\sigma_c = 47 \text{ Kg/cm}^2$

$A_f = 9,8 \text{ cm}^2$

Sezione 14-15, 15-16,

$$M = \frac{1}{18} 4100 \times 2,70^2 = 1650 \text{ Kgm}$$

$\sigma_c = 17 \text{ Kg/cm}^2$

$A_f = 1,6 \text{ cm}^2$

Sezione 15

$$M = \frac{1}{12} 4100 \times 2,70^2 = 2500 \text{ Kgm}$$

$\sigma_c = 22 \text{ Kg/cm}^2$

$A_f = 2,45 \text{ cm}^2$

Taglio massimo  $T = 12600 \text{ Kg}$

$$\tau_{\max} = \frac{12600}{30 \times 0,9 \times 78} = 5,9 \text{ Kg/cm}^2$$

$$30 \times 0,9 \times 78$$

2-0-0 EDIFICIO TIPO B1

## 2-1-0 - Analisi di carico sulle travi -

2-1-1 COPERTURA

Trave 9-12-14-15-16-17-19-9; 9-45-47-48-49-50-52-9

Solaio 650 x 270 = 1750

" " 650 x 270 = 1750

p.p. 0,30 x 0,80 x 1,00 x 2500 = 600

4100 Kg/ml

Trave 21-22; 54-55

Solaio 650 x 1,40/2 = 450

Sovracc. 365 x 0,50 = 200

p.p. 0,50 x 0,25 x 1,00 x 2500 = 300

950 Kg/ml

Trave 21-29; 22-29; 54-61; 55-62

Solaio 650 x 1,30/2 = 490

Sbalzo 650 x 0,70 = 450

Sovracc. 365 x 0,50 = 200

p.p. 0,50 x 0,25 x 1,00 x 2500 = 300

1350 Kg/ml

2-1-2 COPERTURA PIANO TIPO

Trave 1-2-3-4; 7-8-9-10; 34-35-36-37

40-41-42-43;

Solaio 650 x 3,85/2 = 1250

Sovracc. 365 x 0,70 = 250

Tompagno = 850

p.p. 0,70 x 0,25 x 1,00 x 2500 = 450

2800 Kg/ml

Trave 4-5; 6-7; 37-38; 39-40

Solaio  $650 \times 3,85/2$  = 1250

Sbalzo  $800 \times 1,15$  = 900

Sovracc.  $365 \times 0,70$  = 250

Tompagno = 850

p.p.  $0,70 \times 0,25 \times 1,00 \times 2500$  = 450

---

3700 Kg/ml

Trave 11-12-13-14-15; 16-17-18-19-20;

44-45-46-47-48; 49-50-51-52-53

Solaio  $650 \times 3,85/2$  = 1250

Solaio  $650 \times 4,15/2$  = 1350

Sovracc.  $365 \times 0,90$  = 350

p.p.  $0,90 \times 0,25 \times 1,00 \times 2500$  = 550

---

3500 Kg/ml

Trave 24-25-26-27; 30-31-32-33;

57-58-59-60; 63-64-65-66

Solaio  $650 \times 4,15/2$  = 1350

Sovracc.  $365 \times 0,70$  = 250

Tompagno = 850

p.p.  $0,70 \times 0,25 \times 1,00 \times 2500$  = 450

---

2900 Kg/ml

Trave 27-28; 29-30; 60-61; 62-63;

Solaio  $650 \times 4,15/2$  = 1350

Sbalzo  $800 \times 1,05$  = 850

Sovracc.  $365 \times 0,70$  = 250

Tompagno = 850

p.p.  $0,70 \times 0,25 \times 1,00 \times 2500$  = 450

---

3750 Kg/ml

Trave 5-6; 38-39; 21-23; 22-23; 54-56; 55-56;  
23-28; 23-29; 56-61; 56-62

Tompagno

= 850

p.p. 0,30 x 0,40 x 1,00 x 2500

= 350

1200 Kg/ml

Trave 5-15-21; 6-16-22;

38-48-54; 39-49-55

Rampa 850 x 1,30

= 1100

Tompagno

= 850

p.p. 0,30 x 0,60 x 1,00 x 2500

= 450

2400 Kg/ml

Trave 1-11-24; 10-20-30; 34-44-57;

43-53-66

Tompagno

= 850

Sovracc. 365 x 0,50

= 200

p.p. 0,50 x 0,25 x 1,00 x 2500

= 350

1400 Kg/ml

2-2-0

- Analisi di carico sui pilastri -

2-2-1

COPERTURA

Pilastri 12; 19; 45; 52;

Sbalzo 4100 x 2,10

= 8600

Trave 12-14 4100 x 5,55/2

= 11350

p.p. 0,30 x 0,30 x 2,70 x 2500

= 600

---

20550 Kg

Pilastri 14; 17; 47; 50

Trave 14-12

= 11350

" " 14-15 4100 x 2,75/2

= 5650

p.p.

= 600

---

17600 Kg

Pilastri 15; 16; 48; 49

Trave 15-14

= 5650

" " 15-16 4100 x 3,00/2

= 6150

p.p.

= 600

---

12400 Kg

Pilastri 21; 22; 54; 55

Trave 21-22 950 x 1,50/2

= 750

" " 21-28 1350 x 3,35/2

= 2250

p.p. 0,90 x 0,20 x 2,70 x 2500

= 1200

---

4200 Kg

Pilastri 21; 29; 61; 62

Trave 21-28

= 2250

p.p.

= 650

---

2900 Kg

2-2-2 Copertura piano tipo

Pilastri 1; 10; 34; 43

Trave 1-2 2800 x 4,00/2

= 5600

" " 1-11 1400 x 4,65/2

= 3250

p.p. 0,30 x 0,40 x 3,05 x 2500

= 950

---

9800 Kg

Pilastri 2; 9; 35; 42

Trave 1-2

= 5600

" " 2-3 2800 x 3,60/2

= 5050

p. p.

= 950

---

11600 Kg

Pilastri 3; 8; 36; 41

Trave 3-2

= 5050

" " 3-4 2800 x 3,55/2

= 5000

p.p.

= 950

---

11000 Kg

Pilastri 4; 7; 37; 40

Trave 4-3

= 5000

" " 4-5 3700 x 2,20/2

= 4050

p.p.

= 950

---

10000 Kg

Pilastri 5; 6; 38; 39;

Trave 5-4

= 4050

" " 5-6 1200 x 2,00/2

= 1200

" " 5-15 2400 x 4,65/2

= 5600

p.p.

= 950

---

11800 Kg

Pilastrini 11; 20; 44; 53

Trave 11-1

= 3250

" " 11-24 1400 x 4,95/2

= 3450

" " 11-12 3500 x 4,00/2

= 7000

p.p.

= 950

---

14650 Kg

Pilastrini 12; 19; 45; 52

Trave 12-11

= 7000

" " 12-13 3500 x 3,60/2

= 6300

p.p.

= 950

---

14250 Kg

Pilastrini 13; 18; 46; 51

Trave 13-12

= 6300

" " 13-14 3500 x 2,90/2

= 5050

p.p.

= 950

---

12300 Kg

Pilastrini 14; 17; 47; 50

Trave 14-13

= 5050

" " 14-15 3500 x 2,75/2

= 9600

p.p.

= 950

---

15600 Kg

Pilastrini 15; 16; 48; 49

Trave 15-14

= 9600

" " 15-5

= 5600

" " 15-21 2400 x 1,65/2

= 2000

p.p.

= 950

---

18150 Kg

Pilastri 21; 22; 54; 55

Trave 21-15 = 2000

" " 21-23  $1200 \times 1,60/2$  = 950aliquota solaio  $\frac{2,65 \times 650 \times 0,70}{2}$  = 600p.p.  $0,20 \times 0,90 \times 3,05 \times 2500$  = 1450

5000 Kg

Pilastri 23; 56

Trave 23-21 = 950

" " 23-22 = 950

" " 23-28  $1200 \times 1,90/2$  = 1150" " 28-29  $1200 \times 1,90/2$  = 1150p.p.  $0,20 \times 1,90 \times 3,05 \times 2500$  = 2900

7100 Kg

Pilastri 24; 33; 57; 66

Trave 24-11 = 3450

" " 24-25  $2900 \times 4,00/2$  = 5800

p.p. = 950

10200 Kg

Pilastri 25; 32; 58; 65

Trave 25-24 = 5800

" " 25-26  $2900 \times 2,95/2$  = 4300

p.p. = 950

11050 Kg

Pilastri 26; 31; 59; 64

Trave 26-25 = 4300

" " 26-27  $2900 \times 3,50/2$  = 5050

p.p. = 950

10300 Kg

Pilastrini 27; 30; 60; 63

Trave 27-26

= 5050

" " 27-28 3750 x 3,40/2

= 6400

p.p.

= 950

---

12400 Kg

Pilastrini 28; 29; 61; 62

Trave 28-27

= 6400

" " 28-23

= 1150

p.p.

= 950

---

8500 Kg

## 2-3-0 - Verifica ed armatura pilastri -

2-3-1

Carichi al piede dei pilastri

| Pilastri    | Copertura | Cop. IV | Cop. III | Cop. II | Cop. I | Cop. portico<br>fondazione |
|-------------|-----------|---------|----------|---------|--------|----------------------------|
| 1,10,34,43  |           | 9800    | 19600    | 29400   | 39200  | 49000                      |
| 2,9,35,42   |           | 11600   | 23200    | 34800   | 46400  | 58000                      |
| 3,8,36,41   |           | 11000   | 22000    | 33000   | 44000  | 55000                      |
| 4,7,37,40   |           | 10000   | 20000    | 30000   | 40000  | 50000                      |
| 5,6,38,39   |           | 11800   | 23600    | 35400   | 47200  | 59000                      |
| 11,20,44,53 |           | 14650   | 29300    | 43950   | 58600  | 73000                      |
| 12,19,45,52 | 20550     | 37600   | 51850    | 66100   | 80350  | 95000                      |
| 13,18,46,51 |           | 12300   | 24600    | 36900   | 49200  | 62000                      |
| 14,17,47,50 | 17600     | 33200   | 48800    | 64400   | 80000  | 96000                      |
| 15,16,48,49 | 12400     | 35500   | 53650    | 71800   | 89950  | 108000                     |
| 21,22,54,55 | 4200      | 9200    | 14200    | 19200   | 24200  | 29000                      |
| 23,56       |           | 7100    | 14200    | 21300   | 28400  | 36000                      |
| 24,33,57,66 |           | 10200   | 20400    | 30600   | 40800  | 51000                      |
| 25,32,58,65 |           | 11050   | 22100    | 33150   | 44200  | 55000                      |
| 26,31,59,64 |           | 10300   | 20600    | 30900   | 41200  | 52000                      |
| 27,30,60,63 |           | 12400   | 24800    | 37200   | 49600  | 62000                      |
| 28,29,61,62 | 3000      | 11500   | 20000    | 28500   | 37000  | 46000                      |

2-3-2 Sezione ed armatura pilastri fondazione e portico

| N°          | P<br>tn | A' c<br>cmq | A f<br>cmq | Armatura    | Sezione<br>cm x cm | A ci<br>cmq | σ c<br>Kg/cmq |
|-------------|---------|-------------|------------|-------------|--------------------|-------------|---------------|
| 1,10,34,43  | 49      | 1000        | 8          | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 38            |
| 2,9,35,42   | 58      | 1200        | 9,6        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 44            |
| 3,8,36,41   | 55      | 1150        | 9,2        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 42            |
| 4,7,37,40   | 50      | 1050        | 8,4        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 38            |
| 5,6,38,39   | 59      | 1200        | 9,6        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 45            |
| 11,20,44,53 | 73      | 1500        | 12         | 4Ø14 + 6Ø12 | 30 x 50            | 1629        | 44            |
| 12,19,45,52 | 95      | 1950        | 15,6       | 10 Ø 14     | 40 x 50            | 2154        | 44            |
| 13,18,46,51 | 62      | 1300        | 10,4       | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 45            |
| 14,17,47,50 | 96      | 2000        | 16         | 10 Ø 14     | 40 x 50            | 2154        | 44            |
| 15,16,48,49 | 108     | 2250        | 18         | 12 Ø 14     | 40 x 60            | 2585        | 41            |
| 21,22,54,55 | 29      | 600         | 4,8        | 14 Ø 10     | 20 x 90            | 1910        | <10           |
| 23,56       | 36      | 750         | 6          | 24 Ø 10     | 20 x 190           | 4037        | <10           |
| 24,33,57,66 | 51      | 1050        | 8,4        | 4Ø14 + 1Ø12 | 30 x 40            | 1307        | 38            |
| 25,32,58,65 | 55      | 1150        | 9,2        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 42            |
| 26,31,59,64 | 52      | 1050        | 8,4        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 39            |
| 27,30,60,63 | 62      | 1300        | 10,4       | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 45            |
| 28,29,61,62 | 46      | 950         | 7,6        | 4Ø14 + 4Ø12 | 30 x 40            | 1307        | 35            |

Staffe Ø 8" / 15"

2-3-3 Sezione ed armatura pilastri piano I e II

| N°          | P<br>tn | A' c<br>cmq | Af<br>cmq | Armatura                            | Sezione<br>cm x cm | A ci<br>cmq | $\sigma$ c<br>Kg/cmq |
|-------------|---------|-------------|-----------|-------------------------------------|--------------------|-------------|----------------------|
| 1,10,34,43  | 39      | 800         | 6,4       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 39                   |
| 2,9,35,42   | 46      | 950         | 7,6       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 45                   |
| 3,8,36,41   | 44      | 900         | 7,2       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 44                   |
| 4,7,37,40   | 40      | 850         | 6,8       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 40                   |
| 5,6,38,39   | 47      | 950         | 7,6       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 45                   |
| 11,20,44,53 | 59      | 1200        | 9,6       | 4 $\emptyset$ 14 + 4 $\emptyset$ 12 | 30 x 40            | 1307        | 45                   |
| 12,19,45,52 | 80      | 1650        | 13,2      | 4 $\emptyset$ 14 + 6 $\emptyset$ 12 | 40 x 50            | 2129        | 37                   |
| 13,18,46,51 | 40      | 850         | 6,8       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 40                   |
| 14,17,47,50 | 80      | 1650        | 13,2      | 4 $\emptyset$ 14 + 6 $\emptyset$ 12 | 40 x 50            | 2129        | 37                   |
| 15,16,48,49 | 90      | 1850        | 14,8      | 10 $\emptyset$ 14                   | 40 x 50            | 2154        | 41                   |
| 21,22,54,55 | 24      | 500         | 4,0       | 14 $\emptyset$ 10                   | 20 x 90            | 1910        | <10                  |
| 23,56       | 28      | 550         | 4,4       | 24 $\emptyset$ 10                   | 20 x 190           | 4037        | <0                   |
| 24,33,57,66 | 41      | 850         | 6,8       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 40                   |
| 25,32,58,65 | 44      | 900         | 7,2       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 45                   |
| 26,31,59,64 | 41      | 850         | 6,8       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 40                   |
| 27,30,60,63 | 50      | 1000        | 8,4       | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 45                   |
| 28,29,61,62 | 37      | 750         | 6         | 8 $\emptyset$ 12                    | 30 x 30            | 990         | 37                   |

Staffe  $\emptyset$  6" / 15"

2-3-4 Sezione ed armatura pilastri piano III e IV

| N°          | P<br>tn | A' c<br>cmq | Af<br>cmq | Armatura    | Sezione<br>cm x cm |
|-------------|---------|-------------|-----------|-------------|--------------------|
| 1,10,34,43  | 20      | 400         | 3,2       | 8 Ø 10      | 30 x 30            |
| 2,9,35,42   | 23      | 450         | 3,6       | 8 Ø 10      | 30 x 30            |
| 3,8,36,41   | 22      | 450         | 3,6       | 8 Ø 10      | 30 x 30            |
| 4,7,37,40   | 20      | 400         | 3,2       | 8 Ø 10      | 30 x 30            |
| 5,6,38,39   | 24      | 500         | 4,0       | 8 Ø 10      | 30 x 30            |
| 11,20,44,53 | 29      | 600         | 4,8       | 4Ø12 + 4Ø10 | 30 x 30            |
| 12,19,45,52 | 52      | 1100        | 8,8       | 8 Ø 12      | 30 x 40            |
| 13,18,46,51 | 25      | 500         | 4,0       | 8 Ø 10      | 30 x 30            |
| 14,17,47,50 | 49      | 1000        | 8,0       | 8 Ø 12      | 30 x 40            |
| 15,16,48,49 | 54      | 1100        | 8,8       | 8 Ø 12      | 30 x 40            |
| 21,22,54,55 | 14      | 300         | 2,4       | 14 Ø 8      | 20 x 90            |
| 23,56       | 14      | 300         | 2,4       | 24 Ø 8      | 20 x 19            |
| 24,33,57,66 | 20      | 400         | 3,2       | 8 Ø 10      | 30 x 30            |
| 25,32,58,65 | 22      | 450         | 3,6       | 8 Ø 10      | 30 x 30            |
| 26,31,59,64 | 21      | 450         | 3,6       | 8 Ø 10      | 30 x 30            |
| 27,30,60,63 | 25      | 500         | 4,0       | 8 Ø 10      | 30 x 30            |
| 28,29,61,62 | 20      | 400         | 3,2       | 8 Ø 10      | 30 x 30            |

Staffe Ø 6" / 15"

2-3-5 Sezione ed armatura pilastri piano Volumi -tecnici

| N°          | P<br>tn | A' c<br>cmq | Armatura           | Sezione<br>cm x cm |
|-------------|---------|-------------|--------------------|--------------------|
| 12,19,45,52 | 21      | 450         | 8 $\varnothing$ 10 | 30 x 30            |
| 14,17,47,50 | 18      | 400         | 8 $\varnothing$ 10 | 30 x 30            |
| 15,16,48,49 | 12      | 250         | 8 $\varnothing$ 10 | 30 x 30            |
| 21,22,54,55 | 4       |             | 14 $\varnothing$ 8 | 20 x 90            |
| 28,29,61,62 | 3       |             | 8 $\varnothing$ 10 | 30 x 30            |
|             |         |             |                    |                    |

Staffe  $\varnothing$  6" / 15"

2-4-0 Fondazioni

## 2-4-1 -Analisi di carico sul terreno-

pilastri 2036000

trave 276900

2312900 Kg

## 2-4-2 -Tensione sul terreno-

$$\sigma_t = \frac{2312900}{1764600} = 1,31 \text{ Kg/cm}^2$$

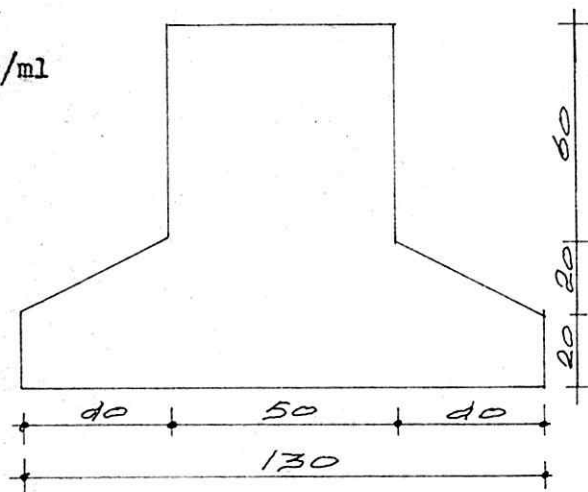
2-4-3 Travi 1-2-3-4-5-6-7-8-9-10; 24-25-26-27-28-29-30-31-32-33; 34-35-36-37  
38-39-40-41-42-43; 57-58-59-60-61-62-63-64-65-66

Carico sulla trave

$$q = \frac{2036000}{1764600} \times 100 \times 130 = 15000 \text{ Kg/ml}$$

## -Caratteristiche geometriche-

Vedi disegno



## -Armatura a flessione-

$$M_{inc} = \frac{1}{12} 15000 \times 3,85^2 = 18500 \text{ Kgm}$$

$$H = 100'' \quad b = 50''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 39 \text{ Kg/cm}^2$$

$$A_f = 14,7 \text{ cm}^2$$

$$M_{camp} = 18500 \text{ Kgm}$$

$$H = 100''$$

$$b = 130''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 23 \text{ Kg/cm}^2$$

$$A_f = 14,0 \text{ cm}^2$$

## -Armatura trasversale-

$$M = \frac{1}{2} 15000 \times 0,40^2 = 1200$$

$$b = 100''$$

$$H = 40''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 16 \text{ Kg/cm}^2$$

$$A_f = 2,3 \text{ cm}^2$$

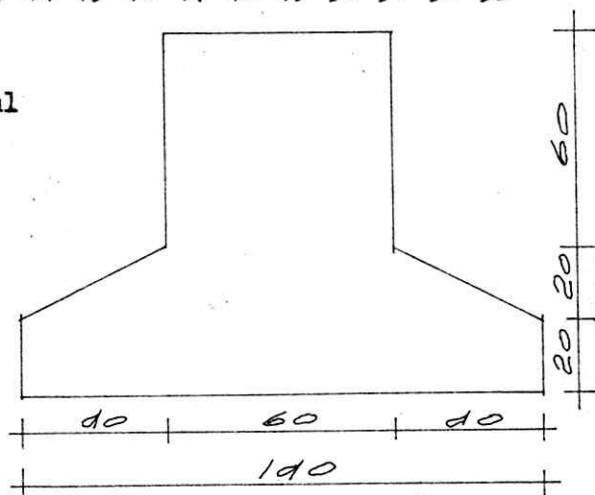
2-4-4 Travi 11-12-13-14-15-16-17-18-19-20; 44-45-46-47-48-49-50-51-52-53

Carico sulla trave

$$q = \frac{2036000}{1764600} \times 100 \times 140 = 16150 \text{ Kg/ml}$$

-Caratteristiche geometriche-

Vedi disegno



-Armatura a flessione-

$$M_{inc} = \frac{1}{12} 16150 \times 9,85^2 = 20000 \text{ Kgm}$$

$$H = 100'' \quad b = 60''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 37 \text{ Kg/cm}^2$$

$$A_f = 16 \text{ cm}^2$$

$$M_{camp} = 20000 \text{ Kgm}$$

$$H = 100''$$

$$b = 40''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 23 \text{ Kg/cm}^2$$

$$A_f = 15,6 \text{ cm}^2$$

-Armatura trasversale-

$$M = \frac{1}{2} 6150 \times 0,40^2 = 1300 \text{ Kgm}$$

$$H = 40''$$

$$b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 17 \text{ Kg/cm}^2$$

$$A_f = 2,6 \text{ cm}^2$$

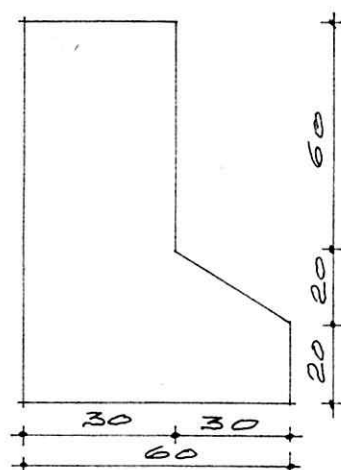
2-4-5 Travi 1-11-24; 10-20-33; 34-44-57; 43-53-66

Carico sulla trave

$$q = \frac{2036000}{1764600} \times 100 \times 60 = 7000 \text{ Kg/ml}$$

-Caratteristiche geometriche-

Vedi disegno



-Armatura a flessione-

$$M_{inc} = \frac{1}{12} 7000 \times 4,95^2 = 14300 \text{ Kgm}$$

$$H = 100''$$

$$b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 45 \text{ Kg/cm}^2$$

$$A_f = 11,4 \text{ cm}^2$$

$$M_{camp} = 14300 \text{ Kgm}$$

$$H = 100''$$

$$b = 60''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 30 \text{ Kg/cm}^2$$

$$A_f = 11,2 \text{ cm}^2$$

2-4-6 Travi 2-12-25; 3-13-26; 4-14-27; 5-15-21-23-28; 6-16-22-23-29-7-17-30;  
8-18-31; 9-19-32; 35-45-58; 36-46-59; 37-47-60; 38-48-54-56-61; 39-49-  
55-56-62; 40-50-63-41-51-64; 42-52-65

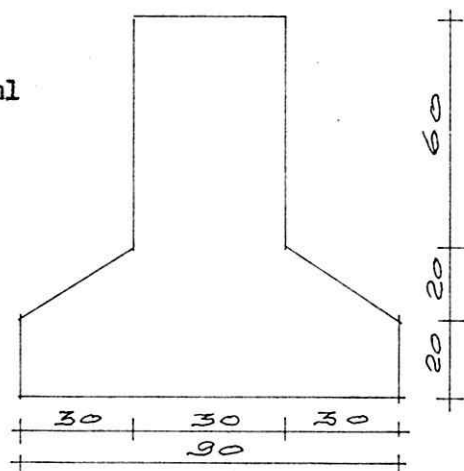
Carico sulla trave

$$q = \frac{2036000}{100} \times 100 \times 90 = 10350 \text{ Kg/ml}$$

$$1764600$$

-Caratteristiche geometriche-

Vedi disegno



-Armatura a flessione-

$$M_{inc} = \frac{1}{12} 10350 \times 4,95^2 = 21150 \text{ Kgm} \quad H = 100'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 56 \text{ Kg/cm}^2 \quad A_f = 17,0 \text{ cm}^2$$

$$M_{camp} = 21150 \text{ Kgm} \quad H = 100'' \quad b = 90''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 30 \text{ Kg/cm}^2 \quad A_f = 16,7 \text{ cm}^2$$

2-5-0 - Vano scala -

2-5-1 Calcolo del gradino

Analisi di carico

$$\text{p.p.} \quad \frac{0,235 + 0,07}{2} \times 0,30 \times 1,00 \times 2500 = 115$$

sovracc. perm. (intonaco, grado

$$\text{sottogradio e massetto) = } 150 \times 0,30 = 45$$

$$\text{sovracc. accid.} = 400 \times 0,30 = 120$$

280 Kg/ml

$$M = \frac{1}{2} 280 \times 1,20^2 = 200 \text{ Kgm} \quad H = \frac{0,235 \times 0,07}{2} = 0,15 \quad b = 30 \text{ cm}$$

$$\sigma_f = 1400 \text{ Kg/cmq} \quad \sigma_c = 36 \text{ Kg/cmq} \quad A_f = 1,10 \text{ cmq}$$

2-5-2 Calcolo dei pianerottoliSolaio in latero-cemento  $H = 16'' + 4''$   $i = 50''$ 

Analisi di carico

$$\text{p.p.} = 140$$

$$\text{soletta } 0,04 \times 1,00 \times 1,00 \times 2500 = 100$$

$$\text{sovracc. accid. (intonaco, massetto, pavimento) = 110}$$

$$\text{sovracc. perm.} = 400$$

750 Kg/cmq

$$M_{inc} = \frac{1}{12} 750 \times 2,70^2 = 455 \text{ Kgm} \quad H = 20'' \quad b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cmq} \quad \sigma_c = 22 \text{ Kg/cmq} \quad A_f = 0,96 \text{ cmq} / 50''$$

$$M_{camp} = \frac{1}{14} 750 \times 2,70^2 = 390 \text{ Kgm} \quad H = 20'' \quad b = 100''$$

$$\sigma_f = 1400 \text{ Kg/cmq} \quad \sigma = 20 \text{ Kg/cmq} \quad A_f = 0,82 \text{ cmq} / 50''$$

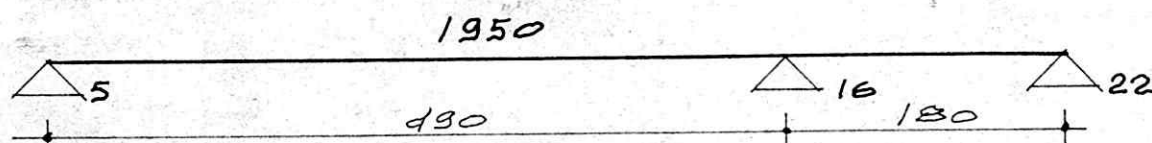
**2-5-3 Calcolo delle travi a ginocchio**

Analisi di carico

|          |                                            |                   |
|----------|--------------------------------------------|-------------------|
| Rampa    | $850 \times 1,20$                          | = 1100            |
| tompagno |                                            | = 400             |
| p.p.     | $0,30 \times 0,60 \times 1,00 \times 2500$ | = 450             |
|          |                                            | <u>1950 Kg/ml</u> |

Verifica ed armatura a flessione

Schema di calcolo



$$M_5 = M_{15-16} = \frac{1}{14} 1950 \times 4,90^2 = 3350 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 35 \text{ Kg/cm}^2 \quad A_f = 4,4 \text{ cm}^2$$

$$M_{15} = \frac{1}{10} 1950 \times 4,90^2 = 4700 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 43 \text{ Kg/cm}^2 \quad A_f = 6,3 \text{ cm}^2$$

$$M_{16-22} = \frac{1}{8} 1950 \times 1,80^2 - 4700 = -3900 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 39 \text{ Kg/cm}^2 \quad A_f = 5,3 \text{ cm}^2$$

$$M_{22} = \frac{1}{12} 1950 \times 1,80^2 = 550 \text{ Kgm} \quad H = 60'' \quad b = 30''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c < 15 \text{ Kg/cm}^2 \quad A_f = 1,5 \text{ cm}^2$$

Verifica a torsione della trave 5-16

$$m_1 = \frac{1}{2} 850 \times 1,20^2 = 612 \text{ Kgm} \quad m_t = 612 + 1020 \times 0,15 = 765 \text{ Kgm}$$

$$t_1 = 850 \times 1,20 = 1020 \text{ Kgm} \quad M_t = 765 \times \frac{4,90}{2} = 1875 \text{ Kgm}$$

$$\varphi = 3 + \frac{2,6}{0,45 + \frac{60}{30}} = 4,061$$

$$\tau = \frac{4,061 \times 187500}{60 \times 30^2} = 14,1 \text{ Kg/cm}^2$$

-Armatura a torsione-

$$F = 55 \times 25 = 1375 \text{ cm}^2$$

$$V = (55 + 25) \times 2 = 160 \text{ cm}$$

$$\sum f_l = \frac{187500}{2 \times 1400 \times 1375} = 160 = 7,8 \text{ cm}^2$$

$$\sum f_s = \frac{187500}{2 \times 1400 \times 1375} = 0,0487 \text{ cm}^2/\text{cm}$$

2-5-4 Calcolo della trave al pianerottolo di riposo

$$M = \frac{1}{12} 1200 \times 3,00^2 = 900 \text{ Kgm}$$

$$H = 40''$$

$$b = 20''$$

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$\sigma_c = 34 \text{ Kg/cm}^2$$

$$A_f = 1,8 \text{ cm}^2$$

2-6-0 BALCONI

$$q = 800 \text{ Kg/mq} \quad H = 20 + 5 \text{ cm} \quad b = 100 \text{ cm}$$

$$M = \frac{1}{2} 800 \times 1,05^2 = 440 \text{ Kgm}$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 17 \text{ Kg/cm}^2 \quad A_f = 1,6 \text{ cm}^2/\text{ml}$$

$$i = 50 \text{ cm} \quad A_f = 0,8 \text{ cm}^2$$

$$M = \frac{1}{2} 800 \times 1,15^2 = 530 \text{ Kgm}$$

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad \sigma_c = 18 \text{ Kg/cm}^2 \quad A_f = 1,7 \text{ cm}^2/\text{ml}$$

$$i = 50 \text{ cm} \quad A_f = 0,85 \text{ cm}^2/50$$

2-7-0

SOLAI PIANO TIPOCarico per nervatura  $q = 650 \times 0,50 = 325 \text{ Kg/ml}$ 

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$b = 50 \text{ cm}$$

$$\text{luce netta } 3,68 \times 1,05 = 3,85 \text{ m.}$$

$$\text{incastro } M = \frac{1}{12} 325 \times 3,85^2 = 400 \text{ Kg} \quad H = 25 \text{ cm} \quad \sigma_c = 23 \text{ Kg/cm}^2 \quad A_f = 1,32 \text{ cm}^2$$

$$\text{campata } M = \frac{1}{14} 325 \times 3,85^2 = 345 \text{ Kg} \quad H = 25 \text{ cm} \quad \sigma_c = 21 \text{ Kg/cm}^2 \quad A_f = 1,12 \text{ cm}^2$$

$$\text{luce netta } 4,28 \times 1,05 = 4,50 \text{ m.}$$

$$\text{incastro } M = \frac{1}{12} 325 \times 4,50^2 = 550 \text{ Kg} \quad H = 25 \text{ cm} \quad \sigma_c = 27 \text{ Kg/cm}^2 \quad A_f = 1,8 \text{ cm}^2$$

$$H = 18 \text{ cm} \quad \sigma_c = 36 \text{ Kg/cm}^2 \quad A_f = 2,35 \text{ cm}^2$$

$$\text{campata } M = \frac{1}{14} 325 \times 4,50^2 = 470 \text{ Kg} \quad H = 25 \text{ cm} \quad \sigma_c = 25 \text{ Kg/cm}^2 \quad A_f = 1,55 \text{ cm}^2$$

$$H = 18 \text{ cm} \quad \sigma_c = 33 \text{ Kg/cm}^2 \quad A_f = 2,0 \text{ cm}^2$$

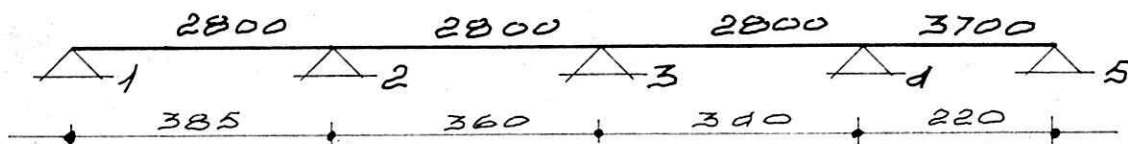
$$\text{luce netta } 2,83 \times 1,05 = 3,00 \text{ m.}$$

$$\text{incastro } M = \frac{1}{12} 325 \times 3,00^2 = 250 \text{ Kg} \quad H = 25 \text{ cm} \quad \sigma_c = 18 \text{ Kg/cm}^2 \quad A_f = 0,85 \text{ cm}^2$$

$$\text{campata } M = \frac{1}{14} 325 \times 3,00^2 = 200 \text{ Kg} \quad H = 25 \text{ cm} \quad \sigma_c = 15 \text{ Kg/cm}^2 \quad A_f = 0,70 \text{ cm}^2$$

## 2-8-0 -Calcolo a flessione della trave -

2-8-1 Travi 1-2-3-4-5; 6-7-8-9-10;  
34-35-36-37-38; 39-40-41-42-43

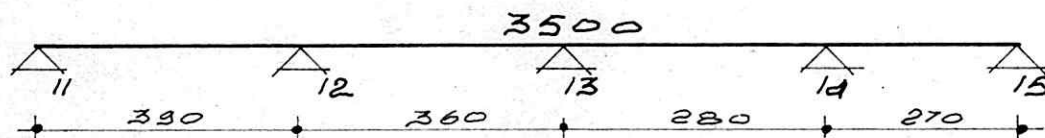


- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 70 \text{ cm}$$

Vedi Cross effettuato per il fabbricato A - Abis.

2-8-2 Travi 11-12-13-14-15; 16-17-18-19-20;  
44-45-46-47-48; 49-50-51-52-53



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 90 \text{ cm}$$

Sezione 11; 11-12

$$M_s = \frac{1}{14} 3500 \times 3,90^2 = 3800 \text{ Kgm} \quad \sigma_c = 60 \text{ Kg/cm}^2 \quad A_f = 13,2 \text{ cm}^2$$

Sezione 12

$$M = \frac{1}{10} 3500 \times 3,90^2 = 5300 \text{ Kgm} \quad \sigma_c = 73 \text{ Kg/cm}^2 \quad A_f = 18,5 \text{ cm}^2$$

Sezione 12-13

$$M = \frac{1}{16} 3500 \times 3,60^2 = 2800 \text{ Kgm} \quad \sigma_c = 50 \text{ Kg/cm}^2 \quad A_f = 9,6 \text{ cm}^2$$

Sezione 13

$$M = \frac{1}{12} 3500 \times 3,60^2 = 3800 \text{ Kgm} \quad \sigma_c = 60 \text{ Kg/cm}^2 \quad A_f = 13,2 \text{ cm}^2$$

Sezione 13-14

$$M = \frac{1}{16} 3500 \times 2,80^2 = 1700 \text{ Kgm} \quad \sigma_c = 37 \text{ Kg/cm}^2 \quad A_f = 5,8 \text{ cm}^2$$

Sezione 14

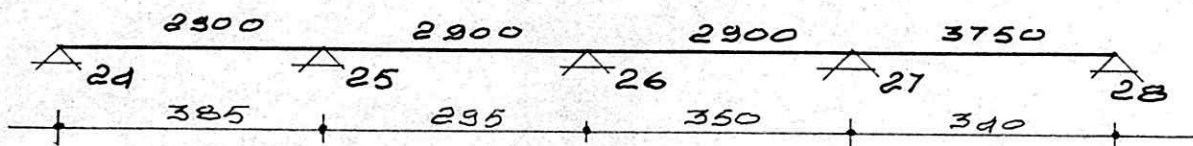
$$M = \frac{1}{10} 3500 \times 2,70^2 = 2550 \text{ Kgm} \quad \sigma_c = 47 \text{ Kg/cm}^2 \quad A_f = 8,7 \text{ cm}^2$$

Sezione 14-15; 15

$$M = \frac{1}{14} 3500 \times 2,70^2 = 1800 \text{ Kgm} \quad \sigma_c = 38 \text{ Kg/cm}^2 \quad A_f = 6,0 \text{ cm}^2$$

$$\text{Taglio massimo } T = 6800 \text{ Kg} \quad \tau_{\max} = \frac{6800}{90 \times 0,9 \times 23} = 3,6 \text{ Kg/cm}^2$$

2-8-3 Travi 24-25-26-27-28; 29-30-31-32-33;  
57-58-59-60-61; 62-63-64-65-66



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 70 \text{ cm}$$

Sezione 24; 24-25

$$M = \frac{1}{14} 2900 \times 3,85^2 = 3050 \text{ Kgm} \quad \sigma_c = 61 \text{ Kg/cm}^2 \quad A_f = 10,6 \text{ cm}^2$$

Sezione 25

$$M = \frac{1}{10} 2900 \times 3,85^2 = 4300 \text{ Kgm} \quad \sigma_c = 76 \text{ Kg/cm}^2 \quad A_f = 15,4 \text{ cm}^2$$

Sezione 25-26

$$M = \frac{1}{16} 2900 \times 2,95^2 = 1550 \text{ Kgm} \quad \sigma_c = 40 \text{ Kg/cm}^2 \quad A_f = 5,2 \text{ cm}^2$$

Sezione 26

$$M = \frac{1}{12} 2900 \times 3,50^2 = 2950 \text{ Kgm} \quad \sigma_c = 60 \text{ Kg/cm}^2 \quad A_f = 10,2 \text{ cm}^2$$

Sezione 26 - 27

$$M = \frac{1}{16} 2900 \times 3,50^2 = 2200 \text{ Kgm} \quad \sigma_c = 50 \text{ Kg/cm}^2 \quad A_f = 7,5 \text{ cm}^2$$

Sezione 27

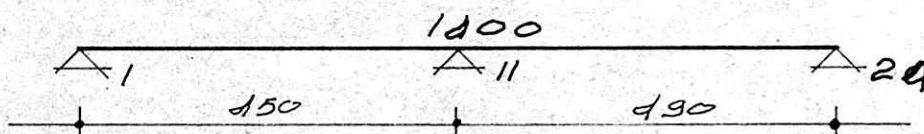
$$M = \frac{1}{10} 3750 \times 3,40^2 = 4300 \text{ Kgm} \quad \sigma_c = 76 \text{ Kg/cm}^2 \quad A_f = 15,4 \text{ cm}^2$$

Sezione 27-28; 28

$$M = \frac{1}{14} 3750 \times 3,40^2 = 3100 \text{ Kgm} \quad \sigma_c = 61 \text{ Kg/cm}^2 \quad A_f = 10,7 \text{ cm}^2$$

$$\text{Taglio massimo } T = 6300 \text{ Kg} \quad \tau_{\max} = \frac{6300}{\quad} = 4,3 \text{ Kg/cm}^2$$

2-8-4 Travi 1-11-24; 10-20-33; 34-44-57; 43-53-66



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 50 \text{ cm}$$

Sezione 1; 1-11

$$M = \frac{1}{14} 1400 \times 4,50^2 = 2050 \text{ Kgm} \quad \sigma_c = 59 \text{ Kg/cm}^2 \quad A_f = 7,1 \text{ cm}^2$$

Sezione 11

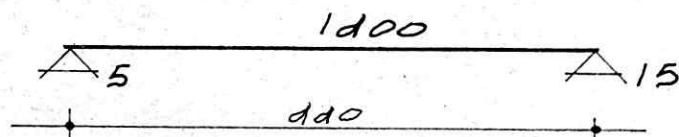
$$M = \frac{1}{12} 1400 \times 4,90^2 = 2800 \text{ Kgm} \quad \sigma_c = 71 \text{ Kg/cm}^2 \quad A_f = 9,8 \text{ cm}^2$$

Sezione 11-24; 24

$$M = \frac{1}{14} 1400 \times 4,90^2 = 2400 \text{ Kgm} \quad \sigma_c = 65 \text{ Kg/cm}^2 \quad A_f = 8,5 \text{ cm}^2$$

$$\text{Taglio massimo } T = 3450 \text{ Kg} \quad \tau_{\max} = \frac{3450}{50 \times 0,9 \times 23} = 3,3 \text{ Kg/cm}^2$$

2-8-5 Travi 5-15; 6-16; 38-48; 39-49



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2 \quad H = 25 \text{ cm} \quad b = 50 \text{ cm}$$

Sezione 5; 5-15; 15

$$M = \frac{1}{12} 1400 \times 4,40^2 = 2250 \text{ Kgm} \quad \sigma_c = 62 \text{ Kg/cm}^2 \quad A_f = 7,8 \text{ cm}^2$$

2-8-6 Travi 21-23; 21-24; 23-28; 23-29;  
54-56; 55-56; 56-61; 56-62Sezione 21; 21-23; 23

$$H = 25 \text{ cm} \quad b = 20 \text{ cm}$$

$$M = \frac{1}{12} 1400 \times 1,60^2 = 300 \text{ Kgm} \quad \sigma_c = 32 \text{ Kg/cm}^2 \quad A_f = 1,2 \text{ cm}^2$$

2-9-0

- Calcolo della soletta ascensore -

## 2-9-1 Analisi di carico

p.p.  $0,25 \times 1,00 \times 1,00 \times 2500$ 

= 625

sovracc. perm.

= 75

sovracc. accid.

= 150

---

850 Kg/ml

macchinario

= 6000

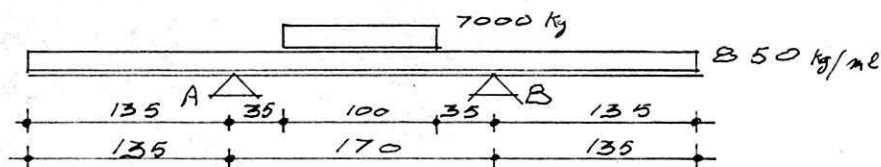
basamento

= 1000

---

7000 Kg

## 2-9-2 Condizioni di carico



$$M_A = M_B = 770 \text{ Kgm}$$

$$M_{AB} = \frac{1}{8} 850 \times 1,70^2 + \frac{1}{8} 7000 \times 1,00 \times 1,70 \left(1 + 2 \frac{0,35}{1,70}\right) - 770 = 1630 \text{ Kgm}$$

Armando simmetricamente verificiamo il momento massimo

$$M = 1630 \text{ Kgm} \quad H = 25 \text{ cm} \quad h = 23 \text{ cm} \quad h' = 2 \text{ cm} \quad b = 100 \text{ cm}$$

$$A_f = A'_f = 10,78 \text{ cmq} \left(1 + 1014/15\right) \quad A_f^x = 21,56 \text{ cmq} \quad h^x = 12,5 \text{ cm}$$

$$\gamma = \frac{A_f}{A'_f} = 1 \quad x = 5,47 \text{ cm}$$

$$\sigma_c = 19 \text{ Kg/cmq} \quad \sigma_f = 608 \text{ Kg/cmq}$$

## 2-9-3 Coefficienti di sicurezza

$$\text{nel calcestruzzo} \quad \xi_c = \frac{180}{19} = 9,4$$

$$\text{nel ferro} \quad \xi_f = \frac{4200}{608} = 6,9$$

## 2-9-4 - Travi portasolette -

## Analisi di carico

travi 28-23

soletta  $850 \times 1,50/2 \times 7000/2$  = 4150sbalzo  $850 \times 1,25$  = 1050

tompagno = 800

p.p.  $0,20 \times 0,60 \times 1,00 \times 2500$  = 500

---

6500 Kg/ml

Travi 23-21

soletta  $850 \times 1,50/2$  = 650sbalzo  $850 \times 1,25$  = 1050

tompagno = 800

p.p. = 400

---

2900 Kg/ml

## Armatura a flessione

 $M_{\max} = 2100 \text{ Kgm}$  $H = 60 \text{ cm}$  $b = 20 \text{ cm}$  $\sigma_f = 1400 \text{ Kg/cm}^2$  $\sigma_c = 34 \text{ Kg/cm}^2$  $A_f = 2,85 \text{ cm}^2$

## 2-10-0 - Copertura Volumi tecnici-

## 2-10-1 -Solai-

Carico per nervatura  $q = 650 \times 0,50 = 325 \text{ Kg/ml}$  $\sigma_f = 1400 \text{ Kg/cm}^2$   $H = 25 \text{ cm}$   $b = 50 \text{ cm}$ 

luce netta 2,70 m.

$$M = \frac{1}{2} 325 \times 2,70^2 = 1150 \text{ Kgm} \quad \sigma_c = 41 \text{ Kg/cm}^2 \quad A_f = 3,85 \text{ cm}^2$$

luce netta 1,50 m.

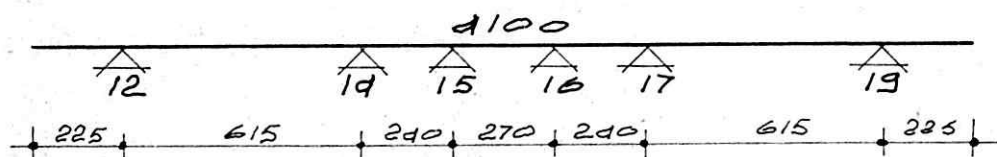
$$M = \frac{1}{2} 325 \times 1,50^2 = 360 \text{ Kgm} \quad \sigma_c = 21 \text{ Kg/cm}^2 \quad A_f = 1,15 \text{ cm}^2$$

luce netta =  $2,70 \times 1,05 = 2,85 \text{ m.}$ 

$$M = \frac{1}{12} 325 \times 2,83^2 = 200 \text{ Kgm} \quad \sigma_c \leq 15 \text{ Kg/cm}^2 \quad A_f = 1 \text{ cm}^2$$

2-10-2 Travi S-12-14-15-16-17-19-S

S-45-47-48-49-50-52-S



- Armatura a flessione -

$$\sigma_f = 1400 \text{ Kg/cm}^2$$

$$H = 80 \text{ cm}$$

$$b = 30 \text{ cm}$$

Sezione 12, 14

$$M = \frac{1}{12} 4100 \times 6,15^2 = 12900 \text{ Kgm}$$

$$\sigma_c = 55 \text{ Kg/cm}^2$$

$$A_f = 13 \text{ cm}^2$$

Sezione 12-14

$$M = \frac{1}{16} 4100 \times 6,15^2 = 9700 \text{ Kgm}$$

$$\sigma_c = 47 \text{ Kg/cm}^2$$

$$A_f = 9,8 \text{ cm}^2$$

Sezione 14-15, 15-16

$$M = \frac{1}{18} 4100 \times 2,70^2 = 1650 \text{ Kgm}$$

$$\sigma_c = 17 \text{ Kg/cm}^2$$

$$A_f = 1,6 \text{ cm}^2$$

Sezione 15

$$M = \frac{1}{12} 4100 \times 2,70^2 = 2500 \text{ Kgm}$$

$$\sigma_c = 22 \text{ Kg/cm}^2$$

$$A_f = 2,45 \text{ cm}^2$$

Taglio massimo  $T = 12500 \text{ Kg}$ 

$$\tau_{\max} = \frac{12600}{30 \times 0,9 \times 78} = 5,9 \text{ Kg/cm}^2$$

$$30 \times 0,9 \times 78$$

