

SOC. COOP. EDILIZIA
 "LA CASA"
 FASANO DI PUGLIA

IL PRESIDENTE

(Donato Di Carolo)

Leonato Nicolo

COOPERATIVA EDILIZIA "LA CASA,,		FINANZIAMENTO Gesca/ (Legge 14-2-1963 n.60)		STAZIONE APPALTANTE Cooperativa "LA CASA,,	
PALAZZINA CON N°6 ALLOGGI ECONOMICI IN FASANO		(Tipo B) (Tipo D)		data: 21 NOV. 1965	099.
RELAZIONE DI CALCOLO		Archivio		099.	099.
Doct. Ing. GIOVANNI VALENTINI FASANO		PROGETTO		Approvazioni:	
Doct. Ing. AUGUSTO ROMITA BARI		CALCOLO STRUTTURA IN C.A.	•	C.E.C. 10 DIC. 1965	
Doct. Ing. GIOVANNI SABATINO CISTERNINO		IMPIANTI			
Doct. Ing. GIOVANNI VALENTINI FASANO		DIRETTORE DEI LAVORI	ing. C. Valentin	Controllo disegni:	Visto:

A

RELAZIONE DI CALCOLO

per le strutture in C.C.A. di una palazzina
con n°6alloggi economici(Tipo B e Tipo D)in

FASANO

COOPERATIVA EDILIZIA "LA CASA"

(parte prima)

Dott.Ing.A.ROMITA

Dott. Ing. Augusto Romita



1

a) PREMESSA e Criteri generali di calcolo:

La struttura agli effetti dei carichi gravanti su di essa è stata suddivisa in tre telai con andamento parallelo ai due prospetti.

Su detti telai scaricano i relativi solai, che pertanto sono tessuti perpendicolarmente ad essi.

Per l'irrigidimento dei tre telai (controventatura), oltre a quello naturale offerto dai solai e dai cordoli perimetrali, si è provveduto con due cordoli-travi intermedie, che delimitano i due tipi di alloggio e relativo vano scale, dividendo la superficie di pianta in due riquadri.

Per il telaio intermedio e per quello di prospetto sul cortile si è considerata la continuità delle travi eseguendone il calcolo in conseguenza; per il telaio di prospetto principale, non sussistendo più tale continuità per la presenza del vano scale, si è eseguito il calcolo mediante CROSS a nodi fissi e ciò sia per la piccola diversità delle luci e dei carichi, sia per l'irrigidimento trasversale su detto.

Per i pilastri si è eseguito il calcolo a compressione assiale con sollecitazioni inferiori a 45 Kg/cm² ad eccezione di quelli perimetrali del terzo piano per i quali, l'eccentricità non più trascurabile ha imposto il calcolo e la verifica a pressoflessione.

Per i materiali si sono adottate le seguenti sollecit. amm.

Ferro: 5 amm. 1400 Kg/cm², ciò che implica l'impiego

di comuni tondini in ferro omogeneo tipo

Aq 42 + 50.

C.C.: 6 amm. 50 Kg/cm² per cui è previsto l'impiego

di impasto a 3 Q.li/mc di cemento A.R. tipo 730.

b) RELAZIONE GEOTECNICA

Le fondazioni del fabbricato in oggetto poggeranno su roccia calcarea di notevole spessore avente una σ_{amm} . di 7+8 Kg/cmq.

Dette fondazioni saranno pertanto su plinti isolati e nel loro calcolo si è tenuta prudenzialmente una σ_t di 4 Kg/cmq.

c) ANALISI DEI CARICHI

Pesi specifici: Conglomerato cement.armato	2.500 Kg:mc
Muratura di compagno	1.800 "
Sovraccarico utile solaio di copertura	200 Kg/mq
" " solai	250 "
" " Scale	400 "

Solaio di copertura

Soletta	1,00.1,00.0,004.2500	100 Kg/mq
Nervature	1,00x0,10x 0,24x2500 0,35	172 "
Forati	0,870x1,00x0,24x700	147 "
Intonaco	1,00x1,00x0,02x1500	30 "
Masso	1,00x1,00x0,10x1100	110 "
Asfalto		40 "
Campigiane cpmressive di malta		50 "

Totale p.p.649 Kg/mq

Sovraccarico utile 200 "

Totale 850 Kg/mq

Solaio piani intermedi

Soletta	1,00x1,00x0,00x2500	100 Kg/mq
Nervature	1,00x0,15x0,24x2500 0,35	172 "
Forati	0,870x1,00x0,24x700	147 "
Intonaco	1,00x1,00x0,02x1500	30 "
Pavimento	1,00x1,00x0,00x2000	40 "

Sostrato I,00xI,00x0,02xI500

30 Kg/mq

Totale p.p.5I9 Kg/mq

Sovraccarico utile

250 "

Totale 769 Kg/mq

Analisi dei carichi sulle travi

Travi di copertura terzo piano

Trave I-2-3-4-5-6-7-8-9

solaio	850 x 4,15/2 =	1765	Kg/ml
gronda	2500 x 0,30 x 0,30/2	115	"
ringhiera		50	"
trave		<u>600</u>	"
		2520	"

Trave IO-II-I2-I3 ; I4-I5-I6-I7-I8

solaio	850 x (4,50+6,05)/2	4340	"
trave		525	"
ringhiera		<u>40</u>	"
		4905	"

Trave I3-I4

solaio	850 x 4,15/2	1765	"
tompagno	0,30x2,5xI800	1350	"
trave		525	"
incidenza scale		<u>2575</u>	"
		6255	"

Trave I9-20-2I ; 22-23-24-25

solaio	850 x 6,05/2	2570	"
ringhiera		40	"
trave		<u>600</u>	"
		3210	"

Trave 2I-22

scale	920 x 6,05/2	2750	"
tompagno	0,40x2,5xI800	1800	"
trave		<u>700</u>	"
		5250	"

Travi dei piani intermedi.

Trave I-2

solaio	770 x (4,15/2+0,70)	1596	"
ringhiera		40	"

trave		<u>450</u>	Kg/ml
		2625	"
<u>Trave 2-3</u>			
solaio	770 x (4,15/2+0,70)	1596	"
tompagno	0,30x3,00xI800	1620	"
trave		<u>450</u>	"
		3666	"
<u>Trave 3-4</u>			
solaio	770 x (4,15/2+I,20)	2436	"
tompagno	0,30x3,00xI800x0,70	1130	"
trave		<u>450</u>	"
		3016	"
<u>Trave 4-5-6</u>			
solaio	770 x (4,15/2+I,20)	2436	"
tompagno		1130	"
tramezzo		<u>210</u>	"
		3226	"
<u>Trave 6-7-8-</u>			
solaio	770 x 4,15/2	1596	"
tompagno	0,30x3,00xI800x0,65	1050	"
trave		<u>450</u>	"
		3096	"
<u>Trave 8-9</u>			
solaio	770 x 0,50x4,15	1985	"
trave		<u>600</u>	"
		2581	"
<u>Trave 10-11-12-13; 14-15-16-17-18</u>			
solaio	770 x (4,15+6,05)/2	3890	"
trave		<u>600</u>	"
		4490	"
<u>Trave 13-14</u>			
solaio	770 x 4,15/2	1596	"
scale	920 x 6,06/2	2760	"
tompagno	0,3x3,00xI800	1620	"
trave		<u>700</u>	"
		6676	"

Trave I9-20 ; 23-24-25

solaio	770 x 6,05/2	2325	Kg/ml
tompagno	0,30x3,00xI800	I620	"
trave		<u>525</u>	"
		4470	"

Trave 20-2I ; 22-23

solaio	770 x (I,40+6,05/2)	3370	"
tompagno	0;30x3,00x0,6xI800	985	"
trave		<u>525</u>	"
		4885	"

Trave 2I-22

Scale		5530	"
tompagno		I620	"
trave		<u>625</u>	"
		7775	"

Trave I'-2'; 8'-9'

solaio	770 x(0,50+I,20)	I3I0	"
tompagno	0,35x3,00x0,7xI800	III0	"
trave		<u>375</u>	"
		30I5	"

Trave 4'-5'

solaio	770 x (0,50+I,50)	I540	"
tompagno	0,25x3,00xI800	I350	"
trave		<u>300</u>	"
		3I90	"

Trave I-I0

solaio + trave		9I0	"
tompagno + trave		24I5	"
incidenza trave I'-2'		5230	Kg

Trave 2-II ; 8-I7

tompagno	0,35x3,00xI800x0,7	I350	Kg/ml
trave		450	"
incidenza trave I'-2';8'-9'		5230	Kg

Trave 4-I3 ; 5-I4

tompagno	0,25x3,00xI800	I350	Kg/ml
trave		375	"
incidenza trave 4'-5'		32I5	Kg

SCARICHI SUI PILASTRI

Pil.n°	Scarico	3°piano	2°piano	1°piano	piano t.	inter.	
I	trave I-2	3970	4140	4140	4140		
	" I-10	4200	6000	6000	6000		
	pilastro	<u>700</u>	<u>700</u>	<u>900</u>	<u>1200</u>		
		8870 +	10840 +	11040 +	11340	=	42090
2	trave I-2-3	8395	10140	10140	10140		
	" 2-II		5283	5283	5283		
	pilastro	<u>700</u>	<u>700</u>	<u>900</u>	<u>1200</u>		
		9195 +	16130 +	16130 +	16130	=	57585
3	trave 2-3-4	8400 +	12500 +	12500 +	12500		
	pilastro	<u>700</u> +	<u>700</u> +	<u>900</u> +	<u>1200</u>		
		9100	13200	13400	13700	=	49400
4	trave 3-4-5	7385	9175	9175	9175		
	" 4-I3	5870	5870	5870	5870		
	pilastro	<u>700</u> +	<u>700</u> +	<u>900</u> +	<u>1200</u>		
		13955	15745	15945	16245	=	61890
5	trave 4-5-6	6930	8900	8900	8900		
	" 5-I5	5870	5870	5870	5870		
	pilastro	<u>700</u>	<u>700</u>	<u>900</u>	<u>1200</u>		
		13500	15470	15670	15970	=	60610
6	trave 5-6-7	7560	9500	9500	9500		
	pilastro	<u>700</u>	<u>700</u>	<u>900</u>	<u>1200</u>		
		8260	10200	10400	10700	=	39560
7	trave 6-7-8	7560	9288	9288	9288		
	pilastro	<u>700</u>	<u>700</u>	<u>900</u>	<u>1200</u>		
		9260	9988	10188	10488	=	38924
8	trave 7-8-9	8450	9430	9430	9430		
	" 8-I7	7517	7517	7517	7517		
	pilastro	<u>700</u>	<u>700</u>	<u>900</u>	<u>1200</u>		
		9150	17647	17947	18247	=	62998
	trave 8-9	4670	4820	4820	4820		

9	trave 9-I8	4200	84I8	84I8	84I8		52084
	pilastro	<u>700</u> 9570	<u>700</u> I3938	<u>900</u> I4I38	<u>I200</u> I4438		
I0	trave IO-II	8200	7550	7550	7550		82840
	3 I-I0-I9 pilastro	33I0 <u>700</u> I22I0	I4760 <u>900</u> 232I0	I4760 <u>I200</u> 235I0	I4760 <u>I600</u> 239I0		
II	trave IO-II-I2	I6050	I4750	I4750	I4750		8705I
	" 2-II pilastro	<u>700</u> I6750	75I7 <u>700</u> 22967	75I7 <u>I200</u> 23467	75I7 <u>I600</u> 23867		
I2	trave II-I2-I3	I5900	I4600	I4600	I4600		68900
	pilastro	<u>700</u> I6600	<u>700</u> I5300	<u>I200</u> I5800	<u>I600</u> I6200		
I3	trave I2-I3-I4	I7550	I6250	I6250	I6250	2600	I37225
	" 4-I3-2I pilastro	II770 <u>700</u> 30020	II770 <u>I200</u> 29220	II770 <u>I500</u> 29550	II770 <u>I680</u> 29700	I39I5 <u>2250</u> I8765	
I5	trave I4-I5-I6	I47I5	I3470	I3470	I3470		59325
	pilastro	<u>700</u> I54I5	<u>700</u> I4I70	<u>I200</u> I4670	<u>I600</u> I5070		
I7	trave I6-I7-I8	I69I0	I5550	I5550	I5550		83459
	" 8-I7 pilastro	<u>700</u> I76I0	5233 <u>700</u> 2I483	5233 <u>I200</u> 2I983	5233 <u>I600</u> 22383		
I8	trave I7-I8	9550	8800	8800	8800		85025
	" 9-I8 " I8-25 pilastro	I300 I950 <u>700</u> I3500	6725 7I50 <u>700</u> 23375	6725 7I50 <u>I200</u> 23875	6725 7I50 <u>I600</u> 24275		
	trave I9-20	8050	II200	II200	II200		
	" I9-I0	2650	7I50	7I50	7I50		

VERIFICA PIASTRI

Tale verifica si esegue semplicemente per i pilastri perimetrali del III° piano, essendosi verificato che l'eccentricità per i restanti pilastri e per tutti quelli dei piani intermedi è trascurabile.

Verifica pilastro n° I

Sez. 30 x 30 cmq.; Af = A'f = 3 Ø I6 = 6,03 cmq.

N = 8170 Kg; M = 1260 Kgm; e = 126000/8170 = 15,45 Cm.; d = 0,45 cm.

Asse Neutro

$$\frac{30}{6} y^3 + \frac{30 \times 0,45}{2} y^2 + 10 \times 6,03 (0,45 + 0,21) + 6,03 (0,45 + 2) y - 10 \times 6,03 \times 28 (0,45 + 28) + 6,03 \times 2 (0,45 + 2) = 0 \quad y = 14,8 \text{ cm.}$$

$$\sigma_c = \frac{8170 (0,45 + 28)}{\frac{30 \times 14,8}{2} (28 - \frac{14,8}{3}) + \frac{10 \times 6,03}{14,08} (28 - 2)} = 43,8 \text{ Kg/cm}^2$$

$$\sigma_f = 10 \times 43,8 \frac{28 - 14,8}{14,8} = 392 \text{ Kg./cm}^2$$

VERIFICA PIASTRO n° IO

Sez. 30x30; Af = A'f = 4Ø I6 = 8,04 cmq.

N = 11510 Kg.; M = 2280 Kgm.; e = $\frac{228.000}{11.510} = 19,8 \text{ cm.}$

d = 19,8 - 15 = 4,8 cm.; h = 28 cm.; h' = 2 cm.

$$5y^3 + 72y^2 + 3186 y - 75.450 = 0 ; y = 14,4 \text{ cm; } \frac{\sigma_c}{\sigma_f} = 50,5 / 490 \text{ kg/cm}^2$$

Verifica Pilastro n° 19

Sez. 30 x 30 cmq ; $Af=A'f=4 \emptyset I6 = 8,04 \text{ cmq}$;

$N = 11400 - 700 = 10700 \text{ Kg}$; $M = 1831 \text{ Kgm}$; $e = 183100/10700 = 17,1 \text{ cm}$;

$d = 2,1 \text{ cm}$.

Asse neutro: $5y^3 + 31,5y^2 + 2750y - 68660 = 0$

$y = 15,3 \text{ cm}$; $\sigma_c/\sigma_f = 45,7/406 \text{ Kg/cmq}$

Verifica Pilastro n° 25

Sez. 30 x 30 cmq ; $Af=A'f=3 \emptyset I6 = 6,03 \text{ cmq}$;

$N = 9150 - 700 = 8450 \text{ Kg}$; $M = 1200 \text{ Kgm}$; $e = 120000/8450 = 14,2 \text{ cm}$;

$d = -0,8 \text{ cm}$

Asse neutro : $5y^3 - 14,6y^2 + 1712,4y - 46145 = 0$

$y = 16,8 \text{ cm}$; $\sigma_c/\sigma_f = 32,8/439 \text{ Kg/cmq}$

Verifica a Torsione Pilastro n° 20 (III piano)

$M = 7445 \text{ kgm}$; Sez. 30 x 60 cmq ; $A'f=Af = 10,4 \text{ cmq}$.

$y=10 \times 20,8/30(-1 + 1+60 \times 10,4 \times 60/10 \times 434) = 14,66 \text{ cm}$;

$y/3 = 3,88 \text{ cm}$; $h-y/3 = 54,12 \text{ cm}$

$T=744500/54,12 = 13650 \text{ kg}$; $M_t = 13650 \times 0,30 = 410000 \text{ kgcm}$

$\tau_{\max} = 4,33 \times 410000/60 \times 1600 = 1775000/96000 = 18,5 \text{ kg/cmq}$

$A_{fl} = 410000(35+55)/35 \times 55 \times 1400 = 13,6 \text{ cmq}$

$d = 35 \times 55 \times 1400 \times 2,27/410000 = 15 \text{ cmq}$

Verifica a Torsione Pilastro n° 23 (III piano)

$M = 6571 \text{ kgm}$; Sez. 30 x 60 ; $A'f=Af = 10,7 \text{ cmq}$

$y=14,57 \text{ cm}$; $h-y/3 = 54,14 \text{ cm}$; $T = 657100/54,14 = 12100 \text{ kg}$

$M_t = 12100 \times 30 = 362500 \text{ kgcm}$; $\tau_{\max} = 4,07 \times 362 \times 500/128000 = 11,5 \text{ cm}$

FONDAZIONI SU PLINTI

-Plinto tipo A

Pilastrini 1,2,3,4,5,6,7,8;9.-

Scarico max = 62998 Kg (Plastro n°8)

Sezione pilastrini 40 x 40; Ferro 8 Ø I6 = 16,08 cmq; $\sigma_c = 62998/1760,5 = 35,8$

Per una pressione di 4 Kg/cm² si ha

Pt = 69300 kg; $\sigma_{tn} = 3,22$ kg/cm²

Asp = 140 x 140 cm²

R = 13000; d = 23,75 cm; M = 309000 kgcm

$\sigma_c / \sigma_f = 36/1400$; $A_f = \frac{309000}{0,9 \times 45 \times 1400} = 5,45$ cm²

$\sigma_{max} = \frac{13000 - 3090/0,48}{0,9 \times 48 \times 40} = 4,78$ kg/cm²

-Plinto tipo B

Pilastrini 12,15,16,19,24,25,10,11,17,18.-

Scarico max = 87100 kg (Pilastro n°11)

Sezione pilastrini 45 x 45; Ferro 10 Ø I6 = 201 cm²; $\sigma_c = 87100/2221 = 39,2$

Pt = 95810 kg; $\sigma_{tn} = 3,63$ kg/cm²

Asp = 155 x 155 cm²

R = 21700 kg; d = 26,10 cm; M = 565000 kgcm;

$\sigma_c / \sigma_f = 33/1400$; $A_f = \frac{565000}{0,9 \times 55 \times 1400} = 9,6$ cm²

$\sigma_{max} = \frac{21700 - 5650/0,58}{0,9 \times 45 \times 58} = 5,08$ kg/cm²

-Plinto tipo C

Pilastrini 13,14,21,22.-

Scarico max = 143650 kg (Pilastro n°21)

Sezione pilastrini 50 x 60; Ferro 12 Ø I8 = 30,53 cm²; $\sigma_c = \frac{143650}{3305} = 43,4$

Pt = 151000 kg; $\sigma_{tn} = 3,78$ cm²;

Asp = 190 x 200 cm²

$$R = 32400 \text{ kg} ; d = 38,30 \text{ cm} ; M = 1240000 \text{ kgcm}$$

$$A = \frac{1240000}{0,9 \times 60 \times 1400} = 12,4 \text{ cmq} ; \sigma_c / \sigma_f = 35 / 1400$$

$$\sigma_{max} = \frac{324000 - 12400 / 0,6 \text{ III}}{0,9 \times 60 \times 80} = 2,8 \text{ kg/cmq}$$

-Plinto tipo D

Pilastro n°23

$$\text{Scarico max} = 89150 \text{ kg} ; \text{Ferro IO } \emptyset 18 = 25,54 \text{ cmq} ; c = 23,1 \text{ kg/cmq}$$

$$\text{Sezione pilastro } 40 \times 90 ; Pt = 95000 \text{ kg} ; \sigma_{tn} = 3,72 \text{ kg}$$

$$\text{Asp} = 120 \times 200 \text{ cmq} ;$$

$$R = 16350 \text{ kg} ; d = 32,05 \text{ cm} ; M = 524000 \text{ kgcm} ;$$

$$\sigma_c / \sigma_f = 37 / 1400 ; A_f = \frac{524000}{0,9 \times 60 \times 1400} = 6,95 \text{ cmq}$$

$$\sigma_{max} = \frac{16350 - 5240 / 0,508}{0,9 \times 60 \times 40} = 2,33 \text{ kg/cmq}$$

-Plinto tipo E

Pilastro n°20

$$\text{Scarico max} = 98320 \text{ kg}$$

$$\text{Sez. Pil. } 40 \times 75 \text{ cmq} ; \text{Ferro IO } \emptyset 18 = 25,54 \text{ cmq} ; \sigma_c = 30,2 \text{ kg/cmq}$$

$$Pt = 103320 \text{ kg} ; \sigma_{tn} = 3,88 \text{ kg/cmq}$$

$$\text{Asp} = 130 \times 195 \text{ cmq}$$

$$R = 24000 \text{ kg} ; d = 25,85 \text{ cm} ; M = 620000 \text{ kgcm}.$$

$$A_f = \frac{620000}{0,9 \times 60 \times 1400} \text{ cmq} ; \sigma_c / \sigma_f = 29 / 1400$$

$$\sigma_{max} = \frac{24000 - 6200 / 0,417}{0,9 \times 75 \times 60} = 2,27 \text{ kg/cmq}$$

Dott. Ing. Augusto Romita


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COOPERATIVA EDILIZIA "LA CASA"

CALCOLI STATICI (parte seconda)

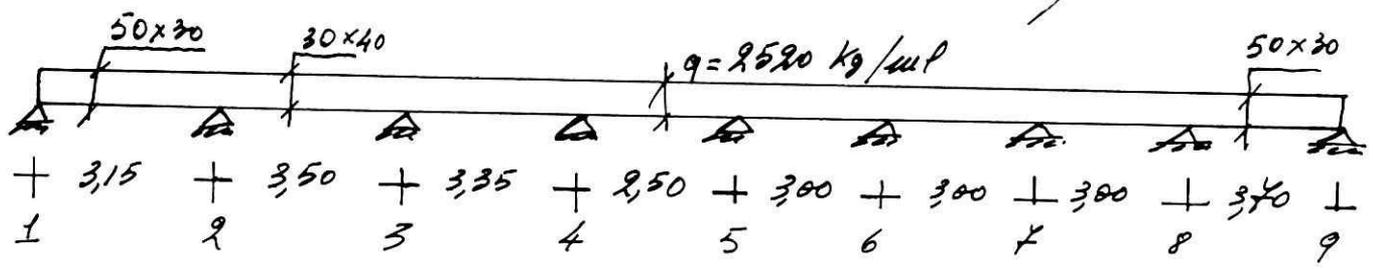
Dott. Ing. A ROMITA

Dott. Ing. Augusto Romita



Calcolo travi

Trave 1-2-3-4-5-6-7-8-9 di ferro piatto



$$K_{2-1} = 0,34 ; K_{2-3} = 0,63 ; K_{3-2} = \frac{3,35}{6,85} = 0,489 ; K_{3-4} = 0,511$$

$$K_{4-3} = \frac{2,5}{5,85} = 0,428 ; K_{4-5} = 0,572 ; K_{5-4} = \frac{3,00}{5,5} = 0,545 ; K_{5-6} = 0,455$$

$$K_{6-5} = K_{6-7} = 0,50 = K_{7-6} = K_{7-8} ; K_{8-7} = 0,405$$

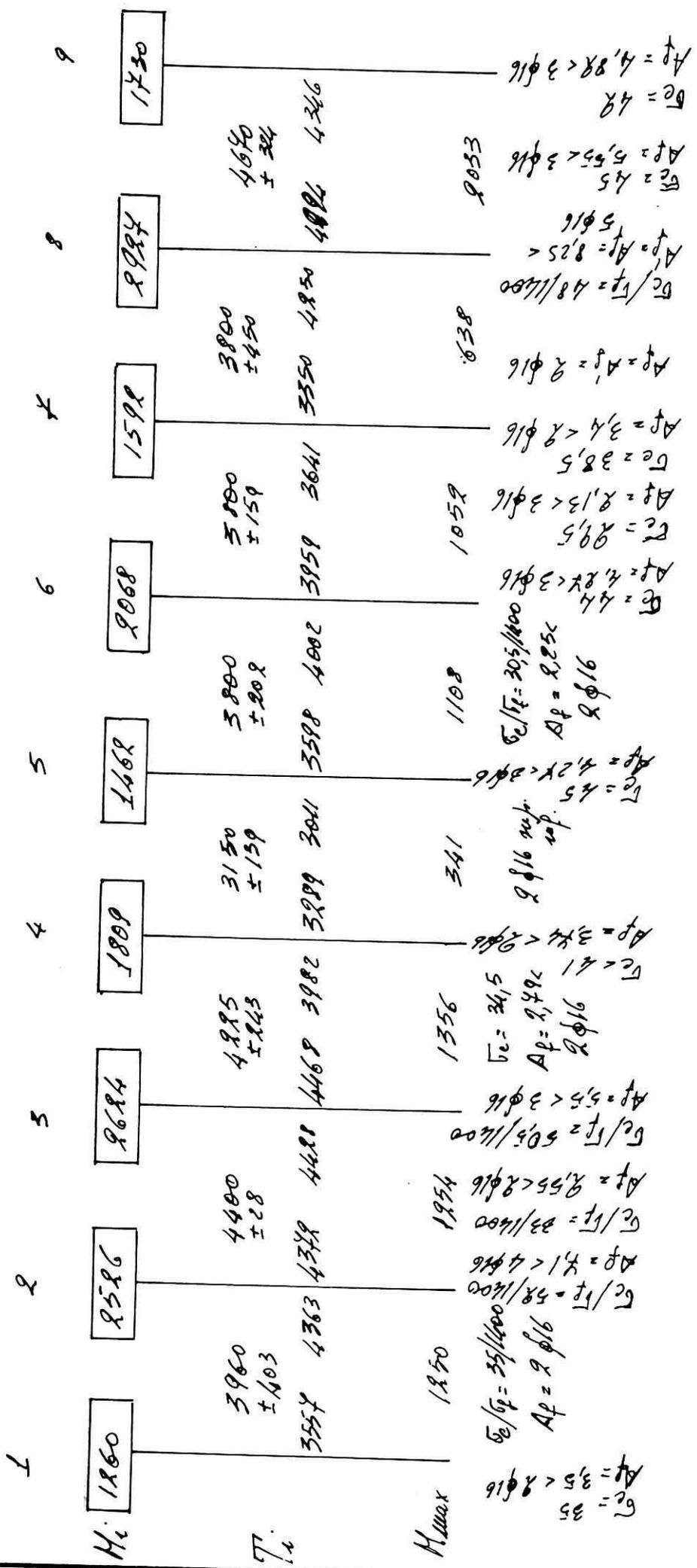
$$\mu_1 = \frac{2520 \times 3,15^2}{20} = 1260 \text{ kgm} ; \mu_9 = \frac{2520 \times 3,4^2}{20} = 1480 \text{ kgm}$$

$$\mu_2 = \frac{2520 \times 3,15^2}{8} - 630 = 2500 \text{ kgm} ; \mu_8 = \frac{2520 \times 3,4^2}{8} - 865 = 3455 \text{ kgm}$$

$$\mu_{2-3} = 2580 ; \mu_{3-4} = 2365 ; \mu_{4-5} = 1310 ; \mu_{5-6} = 1890 ; \mu_{6-7} = \mu_{7-8} = 1890$$

	1	2	3	4	5	6	7	8	9					
	0,340	0,630	0,489	0,511	0,428	0,572	0,545	0,455	0,5	0,5	0,405	0,295		
	-1260	+2500	-2580	+2580	-2365	+2365	-1310	+1310	-1890	+1890	-1890	+1890	-2455	+1480
	+30	+50	+25	-122	-61	-570	-285	+393	+192	-96	-48	+24	+12	+486
	-2	-59	-118	-212	-424	-835	-420	-48	-96	+12	+24	-6	+1020	+41
		+65	+129	-52	-103	+5	+10	+30	+61	-134	-264	+535	-133	+4
		-4		+135	+67	-137	-68	+8	-9	+61	+30	-264	-6	+99
		+5	-2	-14	29	-38	-19	+40	+4	-12	-6	-12	-12	18
		-3	+10	-5	29	-14	-14	+4	+20	-12	-12	+69	-13	+9
				+11	-10	+24	-7	+5	-12	-6	-12	-25	+9	
kgm.	2526	2624		1809	1462	2068	1592					2924		

Caratterini. poll. travi 1 ÷ 9 di III piano
Sollec. ed armatura



Per tutte le travi: $T_{max} = 4994 \text{ kg}$; $C_{max} = \frac{4994}{1.865} = 4.31 \text{ kg/cm}^2$; $X_0 = \frac{4994}{2520} = 1.98 \text{ cm}$.

$S = \frac{1.98 \cdot 4.31 \cdot 50}{2} = 21300 \text{ kg}$; $U_p = \frac{8000}{3060} = 2.616$

$U_{st} = \frac{12000}{1400} = 8.571$

Caratterist. delle travi 1-9 di pino intermedio
Sollec. ed ammetta.

	1	2	3	4	5	6	7	8	9
N_i	1450	8864	3953	9764	1858	8180	8048	5140	1940
T_i	1150 ±459	6440 ±311	6060 ±355	4050 ±308	4900 ±109	4680 ±94	4680 ±94	4680 ±94	4800 ±323
M_{max}	1160	9843	1837	963	1408	1350	888	1820	1820
	$A_f = 3,98 < 8 \phi 16$	$C_c / C_t = 4,4 / 1400$ $A_f = 3,22 < 8 \phi 16$	$C_c / C_t = 4,4 / 1400$ $A_f = 8,18 < 5 \phi 16$	$C_c / C_t = 3,3 / 1400$ $A_f = 3,29 < 8 \phi 16$	$C_c = 4,9$ $A_f = 6,52 < 4 \phi 16$	$C_c = 2,0$ $A_f = 2,45 < 8 \phi 16$	$C_c < 2,5$ $A_f = 4,8 < 4 \phi 16$	$C_c = 2,5$ $A_f = 5,84 < 3 \phi 16$	$C_c = 4,5$ $A_f = 2,82 < 8 \phi 16$
	$C_c = 3,5$ $A_f = 3,56 < 8 \phi 16$	$C_c = 3,0$ $A_f = 2,82 < 8 \phi 16$	$C_c = 2,5$ $A_f = 2,82 < 8 \phi 16$	$C_c = 4,5$ $A_f = 5,84 < 3 \phi 16$	$C_c = 4,5$ $A_f = 5,84 < 3 \phi 16$	$C_c = 2,5$ $A_f = 2,82 < 8 \phi 16$	$C_c = 4,6$ $A_f = 5,8 < 3 \phi 16$	$C_c = 2,8$ $A_f = 2,36 < 8 \phi 16$	$C_c = 4,9$ $A_f = 8,8 < 5 \phi 16$
	$C_c = 2,5$ $A_f = 2,82 < 8 \phi 16$	$C_c = 4,5$ $A_f = 5,84 < 3 \phi 16$	$C_c = 2,5$ $A_f = 2,82 < 8 \phi 16$	$C_c = 4,5$ $A_f = 5,84 < 3 \phi 16$	$C_c = 4,5$ $A_f = 5,84 < 3 \phi 16$	$C_c = 2,5$ $A_f = 2,82 < 8 \phi 16$	$C_c = 4,6$ $A_f = 5,8 < 3 \phi 16$	$C_c = 2,8$ $A_f = 2,36 < 8 \phi 16$	$C_c = 4,9$ $A_f = 8,8 < 5 \phi 16$

Per le travi 1-2, 4-5, 8-9: $T_{max} = 5123 \text{ kg}$; $X_0 = \frac{5123}{2581} = 1,98$; $\alpha = 4,68 \text{ kg/cm}^2$;
 $S = \frac{4,48 \cdot 198 \cdot 50}{2} = 22200 \text{ kg}$; $W_p = \frac{11100}{3960} = 2,8 \phi 16$
 $W_{st} = \frac{13300}{1600} = 8,3 \phi 20$

Per le travi 2-3-4, 5-6-7-8; $T_{max} = 6751 \text{ kg}$; $X_0 = \frac{6751}{3660} = 1,84 \text{ cm}$; $\alpha = \frac{6751}{1995} = 3,38 \text{ kg/cm}^2$;
 $S = \frac{5,21 \cdot 184 \cdot 50}{2} = 14600 \text{ kg}$; $W_p = \frac{4900}{3860} = 1,2 \phi 16$
 $W_{st} = \frac{8650}{1200} = 7,2 \phi 20$

Caratterist. di sol. trav. 10÷18 di III piano
Sollec. ed armatura.

Trave	10	11	12	13	14	15	16	17	18
M_i	2280	5015	4068	4705	3740	3805	3083	6170	3720
T_i	7395	9025	8166	4574	7894	8183	9438	8468	7379
M_{max}	3320	1795	2299	4375	1810	9155	1050	4530	
$\sigma_c/\sigma_t = 3/5$	$A_f = 6,82 < 4 \phi 16$	$\sigma_c = 46,5$	$A_f = 9,25 < 5 \phi 16$	$\sigma_c = 49$	$A_f = 14,35 < 8 \phi 16$	$\sigma_c = 49$	$A_f = 15,8 < 8 \phi 16$	$\sigma_c = 47$	$A_f = 8,6 < 5 \phi 16$
	$\sigma_c = 32$	$A_f = 4,80 < 3 \phi 16$	$\sigma_c = 46$	$A_f = 12,4 < 7 \phi 16$	$\sigma_c = 37$	$A_f = 6,10 < 3 \phi 16 + 2 \phi 10$	$\sigma_c = 50$	$A_f = 11,55 < 6 \phi 16$	$\sigma_c = 34,5$
	$A_f = 4,80 < 3 \phi 16$	$\sigma_c = 33,5$	$A_f = 5,00 < 3 \phi 16$	$\sigma_c = 44$	$A_f = 10,5 < 6 \phi 16$	$\sigma_c = 35,5$	$A_f = 7,40 < 4 \phi 16$	$\sigma_c = 44,5$	$A_f = 8,55 < 4 \phi 16 + 2 \phi 10$
	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 35$	$A_f = 7,40 < 4 \phi 16$	$\sigma_c = 35$	$A_f = 7,40 < 4 \phi 16$	$\sigma_c = 35$	$A_f = 3,62 < 2 \phi 16$	$\sigma_c = 54$	$A_f = 19,9 < 10 \phi 16$
	$\sigma_c = 44$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 87$	$A_f = 3,62 < 2 \phi 16$	$\sigma_c = 44,5$
	$\sigma_c = 44,5$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44,5$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44,5$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44,5$	$A_f = 15,8 < 8 \phi 16$	$\sigma_c = 44,5$
	$\sigma_c = 44,5$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44,5$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44,5$	$A_f = 10,5 < 4 \phi 16 + 2 \phi 10$	$\sigma_c = 44,5$	$A_f = 15,8 < 8 \phi 16$	$\sigma_c = 44,5$

Trave 13-14; $T_{max} = 9432 \text{ kg}$; $\sigma_c = \frac{9432}{0,68 \cdot 30} = 5,18 \text{ kg/cm}^2$; $x_0 = \frac{9432}{6255} = 1,51$; $\rho = \frac{15 \cdot 30 \cdot 5,18}{2} = 11450 - 11450 - 11450$

Per tutte le velleanti: $T_{max} = 10230 \text{ kg}$; $\sigma_c = \frac{10230}{2020} = 5,1 \text{ kg/cm}^2$; $x_0 = \frac{10230}{4805} = 2,13$

$$S = \frac{209 \times 80 \times 5,1}{2} = 42400 \text{ kg}$$

$$u_p = \frac{14100}{5960} = 2,37$$

$$u_{st} = \frac{25600}{1400} = 18,3$$

Caratterist di solee. Travi 10-18 di pino intermedio
Solee. ed armatura

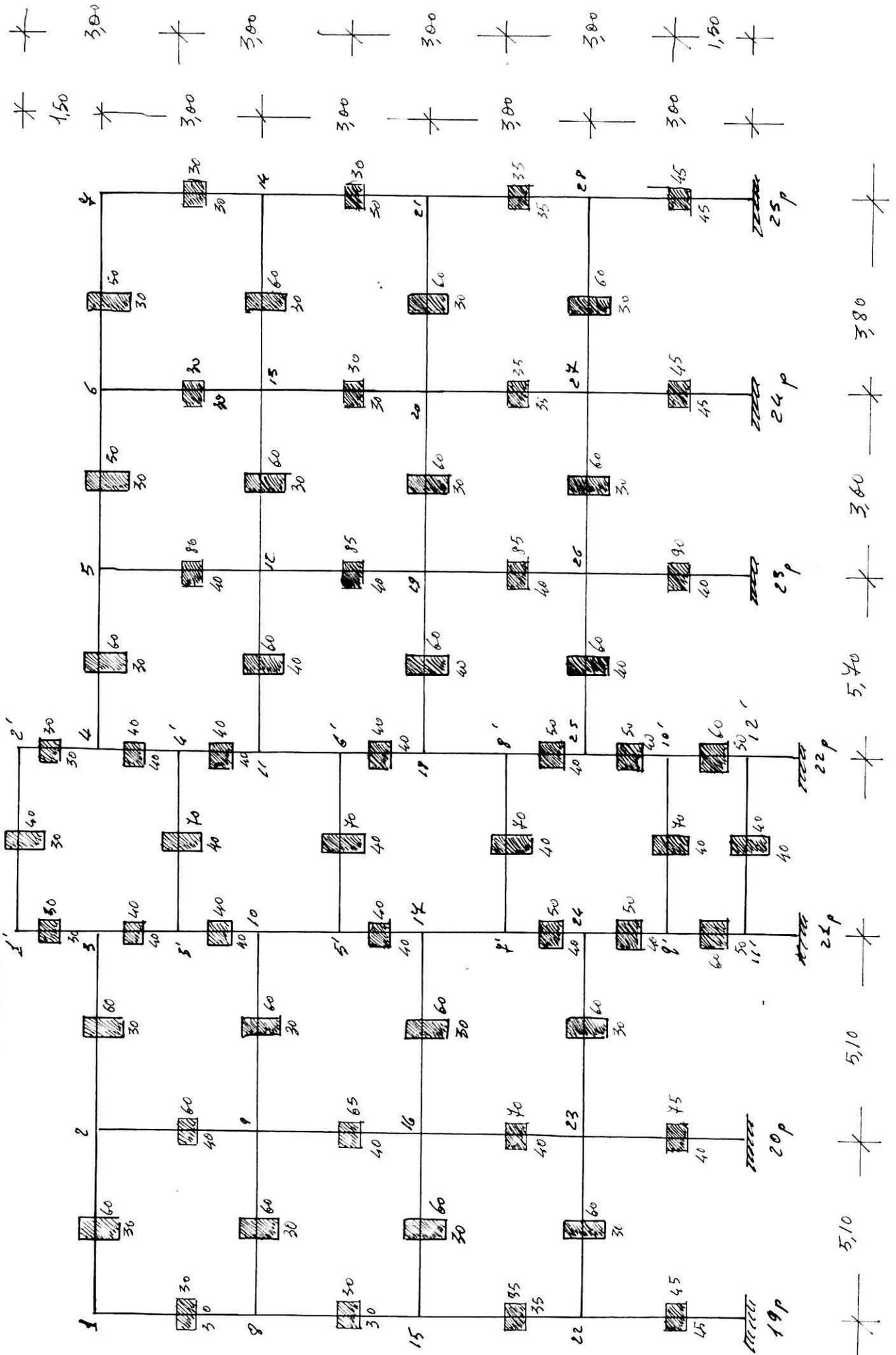
	10	11	12	13	14	15	16	17	18					
H_1	2895	4644	3558	4114	3203	4997	3128	513	5315	3438				
T_1	1121	8349	4428	3288	7528	2528	8240	6959	8240	6889	5042	6828	9839	4563
H_{max}	3120	3120	1560	2828	563	2158	593	593	138	138	593	593	4363	
	$U_1/U_2 = 45/1400$	$A_f = 8,4 < 5\phi/16 + 2\phi/10$	$A_f = 4,23 < 3\phi/16$	$A_f = 6,15 < 3\phi/16 + 2\phi/10$	$A_f = 9,05 < 4\phi/16 + 2\phi/10$	$A_f = 13,5 < 6\phi/16 + 2\phi/10$	$A_f = 9,4 < 5\phi/16$	$A_f = 2\phi/16$	$A_f = 18,2 < 6\phi/16$	$A_f = 11,8 < 5\phi/16 + 2\phi/10$				
	$U_c/U_t = 41/1400$	$U_c = 48$	$U_c = 30$	$U_c = 32$	$U_c = 46$	$U_c = 48$	$U_c = 41$	$U_c < 25$	$U_c < 25$	$U_c < 25$	$U_c < 25$	$U_c = 45$	$U_c = 44$	

Trave 13-14: $T_{max} = 7960 \text{ kg}$; $U = \frac{7960}{0,9 \cdot 30 \cdot 68} = 4,33 \text{ kg/cm}^2$; $X_0 = \frac{7960}{6646} = 119 \text{ cm}$;

$S = \frac{119 \cdot 30 \cdot 4,33}{2} = 7760 \text{ kg}$ $U_p = 1,416$
 $U_{st} = 68/25$

Per tutte le rimanenti travi: $T_{max} = 9239 \text{ kg}$; $d = \frac{9239}{8015} = 4,58 \text{ kg/cm}^2$; $X_0 = \frac{9239}{4690} = 206 \text{ cm}$
 $S = \frac{4,58 \cdot 206 \cdot 80}{2} = 37100 \text{ kg}$; $U_p = \frac{15050}{3240} = 4,65 \text{ kg/cm}^2$
 $U_{st} = \frac{22600}{1400} = 16,14$

Cross: Schema di calcolo telaio 19-20-21-22-23-24-25



Teleio 19-20-21-22-23-24-25

22

Momenti d'inerzia:

$$J_{1-2-3} = J_{4-5} = J_{8-9-10} = J_{12-13-14} = J_{15-16-17} = J_{19-20-21} = J_{22-23-24} = J_{26-27-28} = \\ = \frac{30 \times 60^3}{12} = 540'000 \text{ cm}^4.$$

$$J_{5-6-7} = \frac{30 \times 50^3}{12} = 312'500 \text{ cm}^4;$$

$$J_{2-9} = J_{11-12} = J_{18-19} = J_{25-26} = \frac{40 \times 60^3}{12} = 720'000 \text{ cm}^4$$

$$J_{1-8-15} = J_{6-13-20} = J_{7-14-21} = \frac{30 \times 30^3}{12} = 225'000 \text{ cm}^4$$

$$J_{15-22} = J_{10-27} = J_{21-28} = \frac{35 \times 35^3}{12} = 124'500 \text{ cm}^4$$

$$J_{22-19} = J_{24-24p} = J_{28-25p} = \frac{45 \times 45^3}{12} = 341'420 \text{ cm}^4$$

$$J_{5-12} = \frac{80 \times 40^3}{12} = 426'667 \text{ cm}^4; J_{12-29-26} = \frac{85 \times 40^3}{12} = 453'333 \text{ cm}^4;$$

$$J_{28-24p} = \frac{90 \times 40^3}{12} = 480'000 \text{ cm}^4; J_{9-16} = \frac{65 \times 40^3}{12} = 346'666 \text{ cm}^4; J_{16-23} = \frac{40 \times 40^3}{12}$$

$$= 373'333 \text{ cm}^4; J_{23-20p} = \frac{75 \times 40^3}{12} = 400'000 \text{ cm}^4;$$

$$J_{3-10-17} = J_{4-11-18} = \frac{40 \times 40^3}{12} = 213'333 \text{ cm}^4$$

$$J_{17-24-16'} = J_{18-25-12'} = \frac{50 \times 40^3}{12} = 266'666 \text{ cm}^4; J_{11'-21p} = J_{12'-22p} = \frac{60 \times 50^3}{12} = 625'000 \text{ cm}^4$$

$$J_{5'-4'} = J_{5'-6'} = J_{7'-8'} = J_{9'-10''} = \frac{40 \times 40^3}{12} = 400'000 \text{ cm}^4$$

Momenti d'inerzia perfetto:

$$\mu_{1-2}, \mu_{2-3} = 6920 \text{ kgm}; \mu_{4-5} = 8400 \text{ kgm}; \mu_{5-6} = 3440; \mu_{6-7} = 3840$$

$$\mu_{8-9} = \mu_{15-16} = \mu_{22-23} = 9420; \mu_{9-10} = \mu_{16-17} = \mu_{23-24} = 10550 \text{ kgm};$$

$$\mu_{11-12}, \mu_{18-19} = \mu_{25-26} = 13225 \text{ kgm}; \mu_{12-13} = \mu_{19-20} = \mu_{26-27} = 4830 \text{ kgm};$$

$$\mu_{13-14} = \mu_{20-21} = \mu_{27-28} = 5840 \text{ kgm};$$

$$\mu_{5'-4'} = \mu_{5'-6'} = \mu_{7'-8'} = \mu_{9'-10''} = 8500 \text{ kgm}; \mu_{11'-12'} = 2980 \text{ kgm}.$$

Coefficienti di ripartizione: $k = \frac{J_i}{J_1 + J_2 + J_3}$

$$k_{1-2} = 0,830; k_{1-3} = 0,17$$

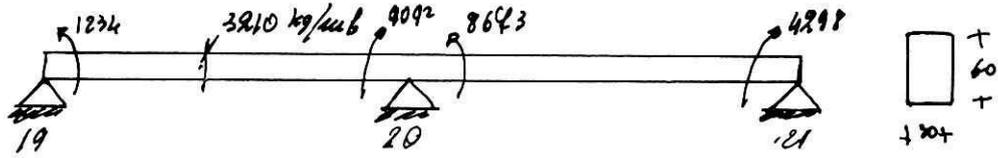
$$k_{2-1} = \frac{1060}{1060 + 1060 + 412} = 0,328; k_{2-3} = 0,328; k_{2-17} = 0,336;$$

$$k_{3-2} = 0,242; k_{3-1'} = k_{3-5'} = 0,364; k_{4-5} = 0,242; k_{4'-2'} = k_{4'-4'} = 0,364;$$

$$k_{5-1} = 0,295; k_{5-6} = 0,264; k_{5-12} = 0,440;$$

$$\begin{aligned}
&K_{6-5} = 0,453; \quad K_{6-4} = 0,430; \quad K_{6-13} = 0,114 \\
&K_{4-6} = 0,786; \quad K_{9-14} = 0,214; \\
&K_{8-1} = 0,145; \quad K_{8-9} = 0,410; \quad K_{8-15} = 0,145 \\
&K_{9-8} = 0,238; \quad K_{9-10} = 0,238; \quad K_{9-2} = 0,252; \quad K_{9-16} = 0,242; \\
&K_{10-9} = 0,242; \quad K_{10-5'} = 0,364; \quad K_{5'-3} = K_{5'-10} = 0,213; \quad K_{5'-4'} = 0,544; \\
&K_{4'-5'} = 0,544; \quad K_{4'-4} = K_{4'-11} = 0,213; \quad K_{11-12} = 0,306; \quad K_{11-4'} = K_{11-6'} = 0,347 \\
&K_{12-11} = 0,220; \quad K_{12-13} = 0,264; \quad K_{12-5} = 0,250; \quad K_{12-19} = 0,266; \\
&K_{13-18} = 0,445; \quad K_{13-6} = 0,064; \quad K_{13-14} = 0,421; \quad K_{13-20} = 0,064 \\
&K_{14-7} = 0,120; \quad K_{14-13} = 0,460; \quad K_{14-21} = 0,120 \\
&K_{15-16} = 0,624; \quad K_{15-8} = 0,188; \quad K_{15-22} = 0,246 \\
&K_{16-15} = K_{16-14} = 0,233; \quad K_{16-9} = 0,246; \quad K_{16-23} = 0,298 \\
&K_{14-16} = 0,230; \quad K_{14-5'} = K_{14-7'} = 0,385; \quad K_{5'-10} = K_{5'-14} = 0,213; \quad K_{5'-6'} = 0,544 \\
&K_{18-19} = 0,262; \quad K_{18-6'} = K_{18-8'} = 0,369; \quad K_{6'-5'} = 0,544; \quad K_{6'-11'} = K_{6'-18} = 0,347 \\
&K_{19-18} = 0,218; \quad K_{19-20} = 0,260; \quad K_{19-12} = K_{19-26} = 0,261 \\
&K_{20-19} = 0,422; \quad K_{20-21} = 0,398; \quad K_{20-13} = 0,063; \quad K_{20-24} = 0,114 \\
&K_{21-20} = 0,690; \quad K_{21-14} = 0,109; \quad K_{21-28} = 0,201 \\
&K_{22-15} = 0,159; \quad K_{22-23} = 0,406; \quad K_{22-19_p} = 0,435 \\
&K_{23-22} = 0,219; \quad K_{23-16} = 0,242; \quad K_{23-24} = 0,219; \quad K_{23-20_p} = 0,292; \\
&K_{24-23} = 0,230; \quad K_{24-4'} = K_{24-9'} = 0,385; \quad K_{4'-14} = K_{4'-24} = 0,240; \quad K_{4'-8'} = 0,520 \\
&K_{25-26} = 0,262; \quad K_{25-8'} = K_{25-10'} = 0,369; \quad K_{8'-7'} = 0,520 \\
&K_{26-25} = 0,215; \quad K_{26-19} = 0,258; \quad K_{26-27} = 0,255; \quad K_{26-23_p} = 0,242; \\
&K_{24-26} = 0,335; \quad K_{24-20} = 0,094; \quad K_{24-28} = 0,314; \quad K_{24-24_p} = 0,254 \\
&K_{28-24} = 0,448; \quad K_{28-21} = 0,139; \quad K_{28-25_p} = 0,383; \\
&K_{9'-10'} = 0,327 = K_{10'-9'}; \quad K_{9'-24} = K_{10'-25} = 0,141; \quad K_{9'-11'} = K_{10'-12'} = 0,532 \\
&K_{11-12'} = K_{12'-11'} = 0,040; \quad K_{11-21_p} = K_{12'-22_p} = 0,310;
\end{aligned}$$

Trave 19-20-21 (II piano)



$$M_{19}^- = 1234 \text{ kgm}; \quad z = \frac{58}{\sqrt{\frac{12340}{3}}} = \frac{58}{61} = 0,955 < \begin{matrix} \sigma_c = 25 \\ 0,00101 \end{matrix}$$

$$A_f = 2 \phi 16$$

$$M_{20}^- = 9092 \text{ kgm}; \quad z = \frac{58}{\sqrt{\frac{90920}{3}}} = \frac{58}{175} = 0,333 < \begin{matrix} 52 \\ 0,00230 \end{matrix}$$

$$A'_f = A_f = 0,00230 \cdot 30 \cdot 175 = 12,1 < 6 \phi 16 + 2 \phi 10$$

$$T_{max} = 9440 \text{ kg}; \quad c_{max} = \frac{9440}{1565} = 6,25 \text{ kg/cm}^2;$$

$$u_p = 3 \phi 16; \quad u_{st} = \phi 8/25''$$

Momento di campata 19-20

$$M_{max}^+ = \frac{9440^2}{6420} - 9092 = 7916 \text{ kgm}; \quad z = \frac{58}{\sqrt{\frac{79160}{3}}} = \frac{58}{162} = 0,368 < \begin{matrix} 52 \\ 0,00206 \end{matrix}$$

$$A'_f = 0,50 A_f = 0,00206 \cdot 30 \cdot 162 = 10,5 \text{ cm}^2 < 5 \phi 16 + 2 \phi 10$$

$$M_{21}^- = 4298 \text{ kgm};$$

$$z = \frac{58}{\sqrt{\frac{42980}{3}}} = \frac{58}{120} = 0,482 < \begin{matrix} 41,5 \\ 0,00161 \end{matrix}$$

$$A_f = 0,00161 \cdot 30 \cdot 120 = 5,85 \text{ cm}^2 < 3 \phi 16$$

Momento di campata 20-21

$$M_{max}^+ = \frac{9155^2}{6420} - 8643 = 4358 \text{ kgm}. \quad \begin{matrix} \sigma_c = 41,5 \text{ kg/cm}^2 \\ A_f = 5,85 < 3 \phi 16 \end{matrix}$$

$$u_p = 3 \phi 16; \quad u_{st} = \phi 8/25''$$

Trave 19-20-21 (I - I - piano terra)

Campata 19-20

$$M_{19}^- = 6159 \text{ kgm}; \quad z = \frac{58}{\sqrt{\frac{61590}{3}}} = 0,404 < \begin{matrix} 50,5 \\ 0,00194 \end{matrix}$$

$$A_f = 0,00194 \cdot 30 \cdot 143,5 = 8,38 \text{ cm}^2 < 4 \phi 16 + 2 \phi 10$$

$$M_{20}^- = 13444 \text{ kgm}; \quad z = \frac{58}{211} = 0,275 < \begin{matrix} 59 \\ 249 \end{matrix}$$

$$A'_f = A_f = 0,00249 \cdot 30 \cdot 211 = 15,65 < 8\phi 16 + 2\phi 10$$

$$M_{19-20}^+ = \frac{13290^2}{8960} - 13644 = 6356 \text{ kgm};$$

$$z = \frac{58}{\sqrt{\frac{63560}{3}}} = \frac{58}{143,5} = 0,408 < \frac{52}{0,00194}$$

$$A'_f = 0,00194 \cdot 30 \cdot 143,5 = 8,33 < 4\phi 16 + 2\phi 10$$

$$T_{max} = \frac{4440 \times 5,10}{2} + \frac{13644 - 3564}{5,1} = 13290 \text{ kg.}$$

$$x_0 = \frac{13290}{4440} = 2,99 \text{ em}; \quad c_{max} = \frac{13290}{1565} = 8,5 \text{ kg/emq}$$

$$S = \frac{8,5 \cdot 2,99 \cdot 30}{2} = 37700 \text{ kg}; \quad \left\{ \begin{array}{l} \mu_p = \frac{15100}{3960} = 4\phi 16 \\ \mu_{st} = \frac{22400}{1400} = \phi 8/18'' \end{array} \right.$$

Campata 20-21

$$M_{21}^- = 7463 \text{ kgm}; \quad z = \frac{58}{\sqrt{\frac{74630}{3}}} = \frac{58}{158} = 0,367 < \frac{52}{215}$$

$$A'_f = 0,50 A_f = 0,00215 \cdot 158 \cdot 30 = 10,9 \text{ emq} < 5\phi 16 + 2\phi 10$$

$$T_{max} = \frac{4880 \times 5,10}{2} + \frac{12343 - 6900}{5,10} = 13520 \text{ kg.}$$

$$x_0 = \frac{13520}{4880} = 2,77 \text{ em}; \quad c_{max} = \frac{13520}{1565} = 8,65 \text{ kg/emq.}$$

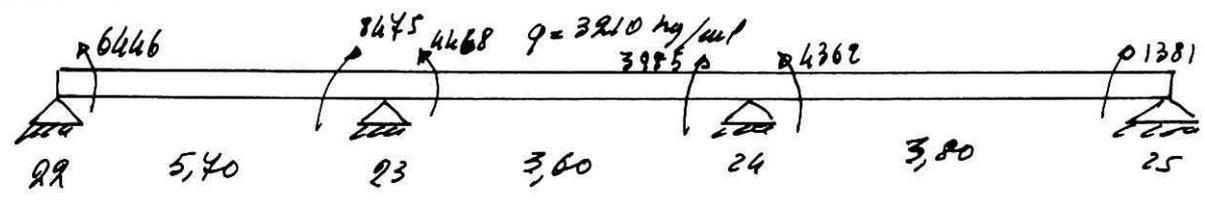
$$S = \frac{2,77 \cdot 8,65 \cdot 30}{2} = 36000 \text{ kg}; \quad \left\{ \begin{array}{l} \mu_p = \frac{14400}{3960} = 4\phi 16 \text{ pizcati.} \\ \mu_{st} = \frac{21400}{1400} = \phi 8/18'' \end{array} \right.$$

$$M_{max}^+ = \frac{13520^2}{9760} - 11429 = 7071 \text{ kgm.}$$

$$z = \frac{58}{\sqrt{\frac{70710}{3}}} = \frac{58}{154} = 0,377 < \frac{50}{0,00206}$$

$$A'_f = 0,50 A_f = 0,00206 \cdot 154 \cdot 30 = 9,55 < 5\phi 16$$

Trave 22-23-24-25 (III piloni)



Сампата 22-23 :

$$M_{22} = 6446 \text{ кгм}; \quad z = \frac{58}{\sqrt{\frac{64460}{3}}} = \frac{58}{146,5} = 0,395 < \begin{matrix} 50 \\ 0,00199 \end{matrix}$$

$$A_f' = 0,85 A_f = 0,00199 \cdot 146,5 \cdot 30 = 8,45 < 4 \phi 16 + 2 \phi 10$$

$$M_{23} = 8445 \text{ кгм}; \quad z = \frac{58}{\sqrt{\frac{84450}{3}}} = \frac{58}{168} = 0,345 < \begin{matrix} 50 \\ 0,00225 \end{matrix}$$

$$A_f' = A_f = 0,00225 \cdot 168 \cdot 30 = 11,35 \text{ см} < 6 \phi 16$$

$$T_{\max} = \frac{3210 \cdot 5,40}{2} + \frac{6446 - 8445}{5,40} = 8483 \text{ кг}$$

$$\epsilon_{\max} = \frac{8483}{1560} = 5,64 \text{ кг/см} < \chi_0 = \frac{8483}{3210} = 2,43 \text{ см}$$

$$S = \frac{5,64 \cdot 2,43 \cdot 30}{2} = 23,200 \text{ кг}; \quad \mu_p = \frac{2300}{3960} = 2 \phi 16; \quad \mu_{st} = \frac{13400}{1400} = \phi 8/250$$

$$M_{\max}^+ = \frac{8483^2}{6420} - 6446 = 5554 \text{ кгм}$$

$$z = \frac{58}{\sqrt{\frac{55540}{3}}} = \frac{58}{136} = 0,424 < \begin{matrix} 44,5 \\ 0,00183 \end{matrix}$$

$$A_f' = 0,00183 \cdot 136 \cdot 30 = 4,5 \text{ см} < 3 \phi 16 + 2 \phi 10$$

Сампата 23-24

$$M_{24} = 4368 \text{ кгм}; \quad z = \frac{48}{\sqrt{\frac{43680}{3}}} = \frac{48}{121} = 0,397 < \begin{matrix} 44 \\ 190 \end{matrix}$$

$$A_f' = A_f = 6,95 \text{ см} < 3 \phi 16 + 2 \phi 10$$

$$T_{\max} = 5942 \text{ кг}; \quad \epsilon = \frac{5942}{1290} = 4,61 \text{ кг/см}; \quad \chi_0 = \frac{5942}{3210} = 1,86 \text{ см}$$

$$S = \frac{186 \cdot 4,61 \cdot 30}{2} = 19,900 \text{ кг}; \quad \mu_p = \frac{5150}{3960} = 2 \phi 16; \quad \mu_{st} = \frac{4460}{1400} = \phi 8/254$$

$$M_{\max}^+ = \frac{5942^2}{6420} - 4368 = 5520 - 4368 = 1082 \text{ кгм} < \begin{matrix} \tau_c < 25 \\ A_f' = A_f = 2 \phi 16 \end{matrix}$$

Сампата 24-25 :

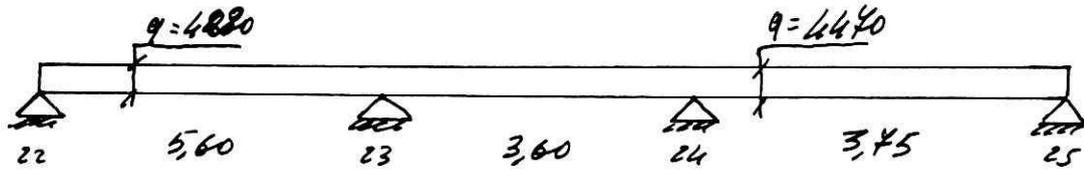
$$M_{25} = 1381; \quad z = \frac{48}{\sqrt{\frac{13810}{3}}} = \frac{48}{68} = 0,408 < \begin{matrix} 24 \\ 108 \end{matrix} \quad A_f' = 2,2 \text{ см} < 2 \phi 16$$

$$T = 6865 \text{ кг}; \quad \epsilon = 5,21 \text{ кг/см}; \quad \mu_p = 2 \phi 16; \quad \mu_{st} = \phi 8/254$$

$$M_{\max}^+ = \frac{6865^2}{6420} - 4362 = 2988; \quad z = \frac{48}{100} = 0,480 < \begin{matrix} 41,5 \\ 162 \end{matrix}; \quad A_f' = 3 \phi 16 > 4,86 \text{ см}$$

Trave 22-23-24-25 (II - I - piano terra)

24



Calcolo 22-23:

$$M_{22}^- = 9654 \text{ kgm}; \quad z = \frac{58}{\sqrt{\frac{96540}{4}}} = \frac{58}{155} = 0,374 < \frac{50}{208}$$

$$A_f' = 0,50 A_f = 0,00208 \cdot 40 \cdot 155 = 13 \text{ cm}^2 < 4 \phi 16$$

$$M_{23}^- = 13765 \text{ kgm}; \quad z = \frac{58}{186} = 0,312 < \frac{55}{252} \quad A_f' = A_f = 18,8 < 4 \phi 16 + 2 \phi 10$$

$$T = \frac{4880 \cdot 5,6}{2} + \frac{9654 - 13765}{5,60} = 12945 \text{ kg}; \quad t = \frac{12945}{2080} = 6,22 \text{ kg/cm}^2$$

$$x_0 = \frac{12945}{4880} = 2,66 \text{ cm}; \quad S = \frac{2,66 \cdot 40 \cdot 6,22}{2} = 33100 < \begin{matrix} u_p = 4 \phi 16 \\ u_{st} = \phi 8/18'' \end{matrix}$$

$$M_{max}^+ = \frac{12945^2}{9460} - 9654 = 7546 \text{ kgm}$$

$$z = \frac{58}{134,5} = 0,433 < \frac{48}{185} \quad A_f = 10,8 \text{ cm}^2 < 5 \phi 16 + 2 \phi 10$$

Calcolo 23-24

$$M_{24}^- = 5940 \text{ kgm}; \quad z = \frac{58}{141} = 0,412 < \frac{49,5}{190}$$

$$A_f = 0,00190 \cdot 141 \cdot 30 = 8,05 \text{ cm}^2 < 4 \phi 16$$

$$T = \frac{4440 \cdot 3,6}{2} + \frac{1643}{3,6} = 8505; \quad t = 5,42 \text{ kg/cm}^2; \quad x_0 = 190 \text{ cm}$$

$$S = \frac{190 \cdot 30 \cdot 5,42}{2} = 15450; \quad u_p = 2 \phi 16; \quad u_{st} = \phi 8/25''$$

$$M_{max}^+ = \frac{8505^2}{8940} - 6844 = 1222; \quad z = \frac{58}{69} = < \frac{25}{69} \quad A_f = 2 \phi 16$$

Calcolo 24-25:

$$M_{25}^- = 3309 \text{ kgm}; \quad z = \frac{58}{106,5} = 0,545 < \frac{36}{106,5}$$

$$A_f = 0,00142 \cdot 106,5 \cdot 30 = 4,53 \text{ cm}^2 < 2 \phi 16 + 2 \phi 10$$

$$T_{max} = 9520 \text{ kg}; \quad t_{max} = 6,08 \text{ kg/cm}^2; \quad S = 18900 \text{ kg}; \quad \begin{matrix} u_p = 2 \phi 16 \\ u_{st} = \phi 8/25'' \end{matrix}$$

$$M_{max}^+ = \frac{9520^2}{8940} - 5941 = 5041; \quad z = \frac{58}{130} = 0,446 < \frac{45}{130}$$

$$A_f = 6,85 \text{ cm}^2 < 3 \phi 16 + 2 \phi 10$$

Travi 5'6"; 5'4"; 4'8"; 9'10"; del pannello di riposo.

$$M_{max} = 6469 \text{ kgm}; \quad \gamma = \frac{68}{\sqrt{\frac{64690}{4}}} = \frac{68}{123} = 0,552 < \frac{35}{138}$$

$$A_f = 0,00138 \cdot 40 \cdot 123 = 6,8 \text{ cmq} < 3 \phi 16 + 2 \phi 10$$

$$T_{max} = \frac{7780 \cdot 3,30}{2} + \frac{6469 \cdot 6124}{3,3} = 12800 + 104 = 12904 \text{ kg}$$

$$\epsilon_{max} = \frac{12904}{0,9 \cdot 40 \cdot 68} = \frac{12904}{2448} = 5,3 \text{ kg/cmq}; \quad x_0 = \frac{12904}{7780} = 166 \text{ cm}$$

$$S = \frac{166 \cdot 5,3 \cdot 40}{2} = 17500 \text{ kg} \quad \left\{ \begin{array}{l} u_p = \frac{8750}{3960} = 2 \phi 16 \\ u_{st} = \frac{10500}{1400} = \phi 8/20'' \end{array} \right.$$

$$M_{max}^+ = \frac{12904^2}{15560} - 6469 = 4291 \text{ kgm}$$

$$\gamma = \frac{68}{\sqrt{\frac{42910}{4}}} = \frac{68}{104} = 0,652 < \frac{29}{116}$$

$$A_f = 0,00116 \cdot 104 \cdot 40 = 4,83 \text{ cmq} < 2 \phi 16 + 2 \phi 10$$

Armatura a torsione

$$M_t = 965 \text{ kg/ml}; \quad M_t = \frac{965 \cdot 33}{2} = 1544 \text{ kgm}$$

$$\frac{\alpha}{\beta} = \frac{40}{40} = 1,45; \quad \gamma = 4,18$$

$$\epsilon_{tot} = 5,3 + \frac{4,18 \cdot 1540}{40 \cdot 1600} = 5,3 + 5,45 = 11,05 < 14 \text{ kg/cmq}$$

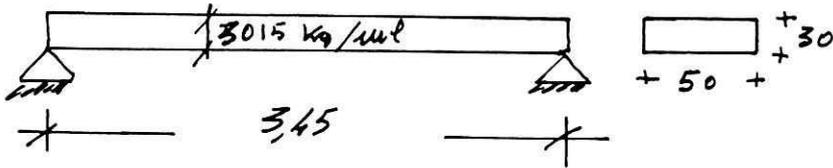
Realizzando l'armatura a torsione con ferri long. e staffe

$$A_{fp} = \frac{154000 (65+35)}{65 \cdot 35 \cdot 1400} = 4,9 \text{ cmq} < 3 \phi 16$$

$$\frac{st}{u} = \frac{2 \cdot 35 \cdot 85 \cdot 1400 \cdot 0,5}{154000} = 20,4 \text{ cm}$$

si usano staffe $\phi 8/20''$

Tracci 1'-2' ; 8'-9' a spessore di II - I - p. t.



Momenti negativi:

$$M_1 = M_2 = \frac{3015 \cdot 3,45^2}{12} = 2900 \text{ kgm}$$

$$\lambda = \frac{28}{\sqrt{29000/5}} = \frac{28}{76} = 0,368 < \begin{matrix} 48,5 \\ 0,00210 \end{matrix}$$

$$A_f' = A_f = 0,00210 \cdot 76 \cdot 50 = 8 \text{ cm}^2 < 4 \phi 16$$

Momento di campo:

$$M_c = \frac{3015 \cdot 3,45^2}{8} = 4900 \text{ kgm}$$

$$\lambda = \frac{28}{\sqrt{9000}} = \frac{28}{95} = 0,295 < \begin{matrix} \sqrt{c} = 57 \\ 0,00260 \end{matrix}$$

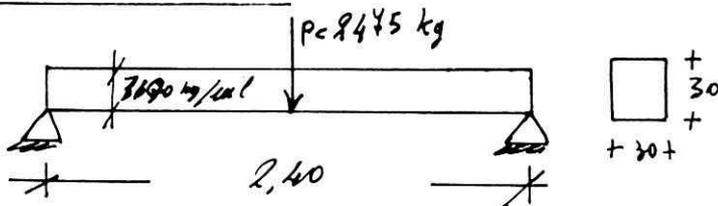
$$A_f' = A_f = 0,00260 \cdot 95 \cdot 50 = 12,4 \text{ cm}^2 < 4 \phi 16$$

$$T_{max} = \frac{3015 \cdot 3,45}{2} = 5230 \text{ kg}; \quad t = \frac{5230}{0,9 \cdot 50 \cdot 28} = 4,18 \text{ kg/cm}^2$$

$$x_0 = \frac{5230}{3015} = 1,735 \text{ cm}; \quad S = \frac{4,18 \cdot 1,735 \cdot 50}{2} = 18100 \text{ kg}$$

$$\mu_p = \frac{4900}{3960} \approx 2 \phi 16; \quad \mu_{st} = \frac{10900}{1400} = \phi 8/20''$$

Tracce 4'-5'



$$M_4 = M_5 = M_c = \frac{3180 \cdot 2,4^2}{12} + \frac{2475 \cdot 2,4}{8} = 1530 + 745 = 2275 \text{ kgm}$$

$$\lambda = \frac{28}{\sqrt{\frac{22750}{3}}} = \frac{28}{87} = 0,322 < \begin{matrix} 52 \\ 0,00245 \end{matrix}$$

$$A_f' = A_f = 0,00245 \cdot 87 \cdot 30 = 6,4 \text{ cm}^2 < 3 \phi 16 + 2 \phi 10$$

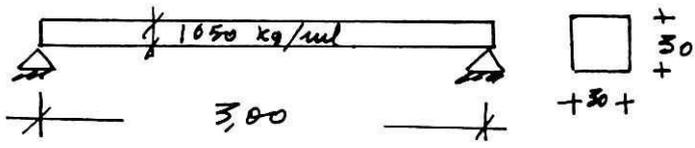
$$\sigma_2 = \frac{3190 \cdot 2,40}{2} + 1234 = 3830 + 1234 = 5065 \text{ kg}$$

$$c_1 = \frac{5065}{465} = 10,98 \text{ kg/cm}^2 ; c_2 = \frac{1234}{465} = 2,65$$

$$S = \frac{10,98 + 2,65}{2} \cdot 12030 = 14800 \text{ kg}$$

$$u_p = \frac{5930}{2960} \approx 2 \phi 16 ; u_{st} = \frac{8800}{1400} = \phi 8/20''$$

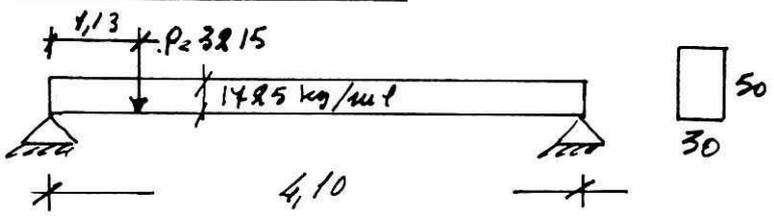
Trave 4"-13'



$$M^+ = \frac{1650 \cdot 3^2}{8} = 1930 \text{ kgm}; z = \frac{88}{48,5} = 1,81 < \frac{50}{225} \quad A'_f = A_f = 5,3 < 3 \phi 16$$

$$c_{max} = \frac{2480}{465} = 5,33 \text{ kg/cm}^2 ; st. \phi 8/20''$$

Trave 4-13; 5-14:



$$M_{4-5}^- = \frac{1425 \cdot 4,10^2}{12} + \frac{3215 \cdot 1,13 \cdot 2,97^2}{4,1^2} = 4360 \text{ kgm}$$

$$z = \frac{48}{\sqrt{\frac{43600}{3}}} = \frac{48}{121} = 0,397 < \frac{43}{0,00190}$$

$$A'_f = A_f = 0,00120 \cdot 121 \cdot 30 = 4,2 < 3 \phi 16 + 2 \phi 10$$

$$M_{13-14}^- = 2420 + 440 = 2860 \text{ kgm}; z = 0,465 < \frac{43}{0,00167} \quad A_f = 5,2 < 3 \phi 16$$

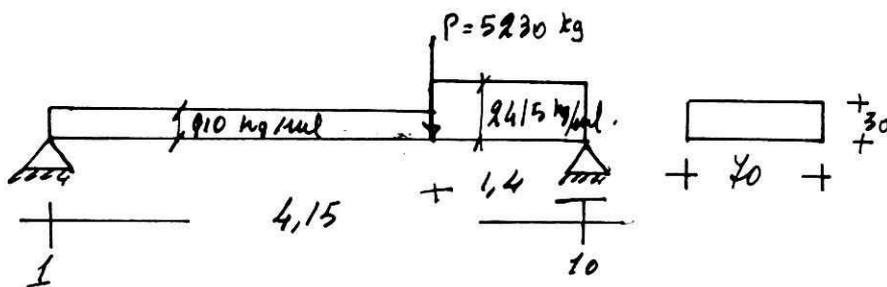
$$\sigma_{max} = \frac{1425 \cdot 4,10}{2} + \frac{3215 \cdot 2,97}{4,1} = 5840 \text{ kg/cm}^2 ; c_{max} = \frac{5840}{1220} = 4,78$$

$$M^+ = 5840 \cdot 1,54 - \frac{1425 \cdot 1,54^2}{2} - 3215 \cdot 0,41 - 2180 = 4540 \text{ kgm}$$

$$z = \frac{48}{\sqrt{\frac{45400}{3}}} = \frac{48}{123,5} = 0,389 < \frac{52}{0,00210} \quad A'_f = 0,25 A_f = 4,9 \text{ cm}^2 < 4 \phi 16$$

$$S = S_1 + S_2 \quad \left\{ \begin{array}{l} S_1 = \frac{2,44 \cdot 205 \cdot 30}{2} = 8500 \\ S_2 = 1,81 \cdot 113 \cdot 30 = 6150 \end{array} \right. \quad \left\{ \begin{array}{l} u_p = 2 \phi 16 \\ u_{st} = \phi 8/20'' \end{array} \right.$$

Task 1-10 (II - I. p.t.)



$$M_I = \frac{910 \cdot 4,15^2}{18} + \frac{(2415 - 910) \cdot 3,45 \cdot 0,4^2}{4,15^2} + \frac{5230 \cdot 2,45 \cdot 1,4^2}{4,15^2} = 3108 \text{ kgm.}$$

$$M_{10} = 1330 + \frac{1505 \cdot 0,4 \cdot 3,45^2}{4,15^2} + 3250 = 5310 \text{ kgm.}$$

$$T_I = \frac{910 \cdot 4,15}{2} + \frac{5230 \cdot 1,4}{4,15} + \frac{1505 \cdot 1,4^2}{2 \cdot 4,15} + \frac{M_I - M_{10}}{l} = 3507 \text{ kg.}$$

$$T_{10} = 1890 + \frac{5230 \cdot 2,45}{4,15} + \frac{1505 \cdot 1,4 \cdot 3,45}{4,15} = 4618 \text{ kg}$$

$$x_0 = 2,45; \quad c_{max} = \frac{4618}{1765} = 4,32 \text{ kg/cmq.}$$

$$M^+ = 3507 \cdot 2,45 - \frac{910 \cdot 2,45^2}{2} - \frac{3108}{2} = 4656 \text{ kgm.}$$

$$S = S_1 + S_2 + S_3 - S_4 = 25410 \text{ kg} \quad \left\{ \begin{array}{l} S_1 = \frac{1,04 \cdot 40 \cdot 204,5}{2} = 4240 \\ S_2 = 1,02 \cdot 40 \cdot 245 = 19300 \\ S_3 = 0,204 \cdot 40 \cdot 245 = 3980 \\ S_4 = 0,284 \cdot 40 \cdot 245 = 5360 \end{array} \right.$$

$$u_p = \frac{10300}{3960} = 2,6$$

$$u_{st} = \frac{15450}{1400} = 11,04$$

$$M_I^+ = 3108; \quad \lambda = \frac{28}{\sqrt{\frac{31080}{4}}} = \frac{28}{66,8} = 0,419 < \frac{48}{185}$$

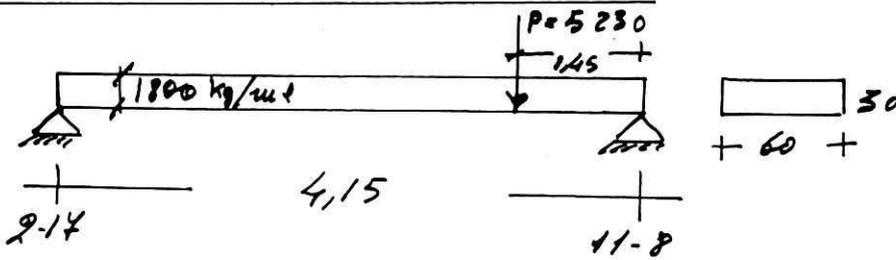
$$A_f = 0,00185 \cdot 66,5 \cdot 40 = 4,9 \text{ cmq} < 4 \phi 16 + 2 \phi 10$$

$$M_{10}^- = 5310; \quad \lambda = \frac{28}{\sqrt{\frac{53100}{4}}} = \frac{28}{84} = 0,333 < \frac{53}{0,00245}$$

$$A_f' = A_f = 0,00245 \cdot 70 \cdot 84 = 14,9 \text{ cmq} < 7 \phi 16 + 2 \phi 10$$

$$M^+ = 4656; \quad \lambda = \frac{28}{\sqrt{49,5}} = 0,353 < \frac{48}{225}$$

$$A_f' = A_f = 12,5 \text{ cmq} < 6 \phi 16 + 2 \phi 10$$



$$M_{2-14}^- = \frac{1800 \cdot 4.15^2}{2} + \frac{5230 \cdot 2.40 \cdot 1.45^2}{4.15^2} = 2580 + 1730 = 4310 \text{ kgm.}$$

$$z = \frac{28}{\sqrt{\frac{43100}{6}}} = \frac{28}{84.4} = 0.331 < \frac{57}{835}$$

$$A_f' = A_f = 0.00235 \cdot 84.4 \cdot 60 = 10 \text{ cm}^2 < 5 \phi 16$$

$$M_{11-8}^- = 2580 + \frac{5230 \cdot 1.45 \cdot 2.4^2}{4.15^2} = 2580 + 3230 = 5810 \text{ kgm.}$$

$$z = \frac{28}{\sqrt{\frac{58100}{6}}} = \frac{28}{98.5} = 0.284 < \frac{57}{265}$$

$$A_f' = A_f = 0.00265 \cdot 98.5 \cdot 60 = 15.6 \text{ cm}^2 < 8 \phi 16$$

$$T_{2-14} = \frac{1800 \cdot 4.15}{2} + \frac{5230 \cdot 1.45}{4.15} = 3750 + 1830 \cdot 344 = 5233 \text{ kgm.}$$

$$T_{11-8} = 3750 + 3420 + 344 = 7514 \text{ kg.}$$

$$\tau_{\max} = \frac{7514}{1510} = 4.98 \text{ kg/cm}^2.$$

$$M_{\max}^+ = 7514 \cdot 1.45 - \frac{1800 \cdot 1.45^2}{2} - \frac{5810}{2} = 10900 - 1900 - 2905 = 6095 \text{ kgm.}$$

$$z = \frac{28}{\sqrt{\frac{60980}{6}}} = \frac{28}{100.5} = 0.280 < \frac{58}{245}$$

$$A_f' = A_f = 0.00245 \cdot 100.5 \cdot 60 = 16.5 \text{ cm}^2 < 8 \phi 16 + 2 \phi 10$$

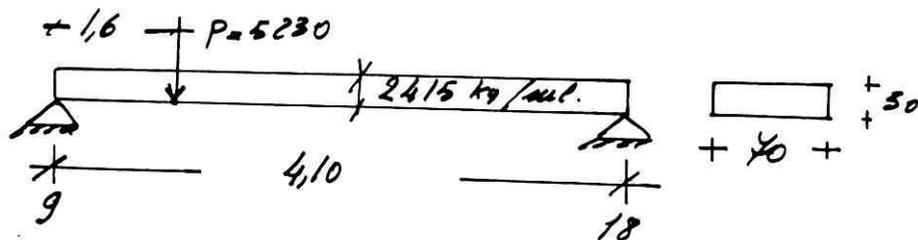
$$S = S_1 + S_2 + S_3 = 37400 \text{ kg}$$

$$\begin{cases} S_1 = \frac{2.48 \cdot 208 \cdot 60}{2} = 15500 \text{ kg.} \\ S_2 = 2.24 \cdot 145 \cdot 60 = 19850 \text{ " } \\ S_3 = 0.829 \cdot 145 \cdot 60 = 2000 \text{ " } \end{cases}$$

$$M_p = \frac{15000}{3960} = 4 \phi 16$$

$$M_{st} = \frac{22600}{1400} = \phi 8/15''$$

Theme 9-18 (II; I; p.t)



$$M_9^- = \frac{2415 \cdot 4.10^2}{12} + \frac{5230 \cdot 1.6 \cdot 2.5^2}{4.1^2} = 3340 + 3000 = 6340 \text{ kgm.}$$

$$M_{18}^- = 3340 + \frac{5230 \cdot 2.5 \cdot 1.6^2}{4.1^2} = 5240 \text{ kgm.}$$

$$T_9 = \frac{2415 \cdot 4.1}{2} + \frac{5230 \cdot 2.5}{4.1} + \frac{6340 - 5240}{4.1} = 2418 \text{ kgm.}$$

$$T_{18} = 4950 + 2040 - 268 = 6722 \text{ kg.}$$

$$M_{\text{max}}^+ = 2418 \cdot 1.6 - \frac{2415 \cdot 1.6^2}{2} - \frac{6340}{2} = 7105 \text{ kgm.}$$

$$e_{\text{max}} = \frac{2418}{0.940 \cdot 28} = 4.48 \text{ kg/cm}^2$$

$$S = S_1 + S_2 + S_3 = 40936 \text{ kg}; \quad \begin{cases} S_1 = \frac{2.81 \cdot 205 \cdot 40}{2} = 20200 \text{ kg} \\ S_2 = 1.81 \cdot 160 \cdot 40 = 20300 \text{ " } \\ S_3 = 0.00152 \cdot 410 \cdot 40 = 436 \text{ " } \end{cases}$$

$$u_p = \frac{16400}{3960} \approx 4 \phi 16; \quad u_{st} = \phi 8/15''$$

$$M_9^- = 6340; \quad z = \frac{28}{\sqrt{\frac{63400}{4}}} = \frac{28}{95.5} = 0.293 < \frac{56}{260}$$

$$A_f' = A_f = 0.00260 \cdot 95.5 \cdot 40 = 17.4 \text{ cm}^2 < 8 \phi 16 + 2 \phi 10$$

$$M_{18}^- = 5240; \quad z = \frac{28}{\sqrt{\frac{52400}{4}}} = \frac{28}{75} = 0.373 < \frac{53}{240}$$

$$A_f' = A_f = 0.00240 \cdot 75 \cdot 40 = 14.6 < 7 \phi 16 + 2 \phi 10$$

$$M^+ = 7105; \quad z = \frac{28}{\sqrt{\frac{71050}{4}}} = \frac{28}{100} = 0.280 < \frac{60}{249}$$

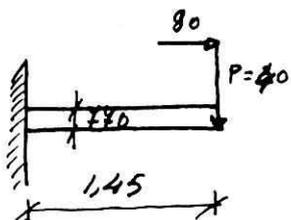
$$A_f' = A_f = 0.00249 \cdot 100 \cdot 40 = 19.8 < 10 \phi 16$$

Cordoli: 10-19; 13-21; 14-22; 18-25

Armatura con 6 $\phi 16$ superiori ed inferiori
dei quali 2 sagomati;
Staffe $\phi 8/25''$

Verifica a torsione travi 3-4-5-6 (II-I-p+)

Luce max: trave 3-4; $l = 335 \text{ cm}$; $Per. = 30 \times 60 \text{ cmq.}$



$$M_f = \frac{40 \cdot 1,45^2}{2} + 40 \cdot 1,45 + 90 = 963 \text{ kgm/cm.}$$

$$M_i = \frac{963 \cdot 3,35}{2} = 1610 \text{ kgm.}$$

$$\frac{Q}{S} = \frac{50}{30} = 1,67 \rightarrow \psi = 4,25.$$

$$\epsilon_{max} = \frac{161000 (25+45)}{25 \cdot 45 \cdot 1400} = 13,7 \text{ kg/cmq.}$$

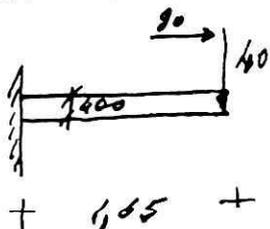
$$A_{pl} = \frac{161000 (25+45)}{25 \cdot 45 \cdot 1400} = 4,95 \text{ cmq}$$

$$\Delta_2 = \frac{2 \cdot 25 \cdot 45 \cdot 1400 \cdot 0,49}{161000} = 15,4 \text{ cm.}$$

Si armerà a torsione con 4 ferri longitudinali $\phi 16$
e staffe $\phi 10/15''$

Verifica a torsione travi 20-21; 22-23

Luce max: trave 20-21; $l = 565 \text{ cm}$; $Per. = 40 \times 60 \text{ cmq.}$



$$M_f = \frac{400 \cdot 1,65^2}{2} + 40 \cdot 1,65 + 90 = 706 \text{ kgm/cm.}$$

$$M_i = \frac{706 \cdot 5,65}{2} = 1980 \text{ kgm.}$$

$$\Sigma_{max} = \frac{4,33 \cdot 198000}{60 \cdot 40^3} = 8,95 \text{ kg/cm}^3$$

$$\frac{a}{b} = 1,5 \rightarrow \psi = 4,33$$

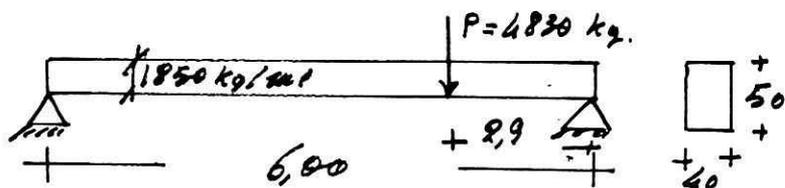
$$A_{fl} = \frac{198000 (35+55)}{35 \cdot 55 \cdot 1400} = 6,68 \text{ cm}^2$$

$$A_2 = \frac{2 \cdot 35 \cdot 55 \cdot 1400 \cdot 0,49}{198000} = 21,4 \text{ cm}^2$$

Si annera a torsione con 4 femi longit. $\phi 16$ e staffe $\phi 10/20''$

Travi a spessore: Si disponiamo in corrispondenza di ogni appoggio 4 $\phi 12$ perpendicolari alle travi.

Travi 13-21; 14-22 (semitenato)



$$M_{max} = \frac{1850 \cdot 36}{12} + \frac{4830 \cdot 2,9 \cdot 3,12}{36} = 5550 + 3760 = 9310 \text{ kgm}$$

$$\delta = \frac{48}{\sqrt{\frac{93100}{4}}} = \frac{48}{152} = 0,316 < \frac{53}{0,00240}$$

$$A'_f = A_f = 0,00240 \cdot 152 \cdot 40 = 14,6 \text{ cm}^2 < 7 \phi 16 + 2 \phi 10$$

$$M_{max}^+ = \frac{1850 \cdot 36}{20} + 2415 \cdot 3 - \frac{4830 \cdot 6}{8} = 5835 \text{ kgm}$$

$$\delta = \frac{48}{\sqrt{\frac{58350}{4}}} = \frac{48}{182} = 0,264 < \frac{48}{0,00200}$$

$$A'_f = 0,50 A_f = 0,00200 \cdot 182 \cdot 40 = 9,8 \text{ cm}^2 < 5 \phi 16$$

$$T = 1850 \cdot 3,00 + 2415 = 5550 + 2415 = 7965 \text{ kg}$$

$$\Sigma_{max} = \frac{7965}{1720} = 4,62 \text{ kg/cm}^3$$

$$N_p = \frac{11200}{3960} = 3 \phi 16 \text{ piegati}$$

$$N_{st} = \phi 8/25''$$

Trave 21-22; 13-14 (seminterrato)

$$M = 2980 \text{ kgm}; \quad r = \frac{37}{\sqrt{\frac{29800}{4}}} = \frac{38}{86,5} = 0,440 < \frac{46}{0,00148}$$

$$A_f = 0,00148 \cdot 40 \cdot 86,5 = 6,15 \text{ cmq} < 3 \phi 16 + 2 \phi 16$$

$$M^+ = 1480 \text{ kgm}; \quad r = \frac{38}{\sqrt{\frac{14800}{4}}} = \frac{38}{64} = 0,565 < \frac{34}{0,00134}$$

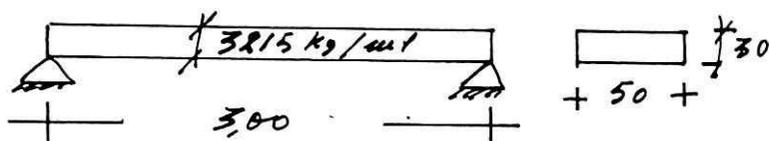
$$A_f = 0,00134 \cdot 40 \cdot 64 = 3,65 \text{ cmq} < 2 \phi 16$$

$$T = \frac{3960 \cdot 3}{2} = 5950 \text{ kg}; \quad c = \frac{5950}{1340} = 4,35 \text{ kg/cmq};$$

$$S = \frac{4,35 \cdot 40 \cdot 150}{2} = 13000 \text{ kg}; \quad u_p = \frac{5900}{3960} \approx 2 \phi 16$$

$$u_{st} = \phi 8 / 20''$$

Trave 13-14 (seminterrato)



$$M = \frac{3215 \cdot 9}{12} = 2480 \text{ kgm};$$

$$r = \frac{28}{\sqrt{\frac{24800}{5}}} = \frac{28}{69,5} = 0,404 < \frac{45}{0,00186}$$

$$A_f = 0,5 A_f = 0,00186 \cdot 69,5 \cdot 50 = 6,5 < 4 \phi 16$$

$$T = 3215 \cdot 1,5 = 4830 \text{ kg}; \quad x_0 = \frac{4830}{3215} = 1,50;$$

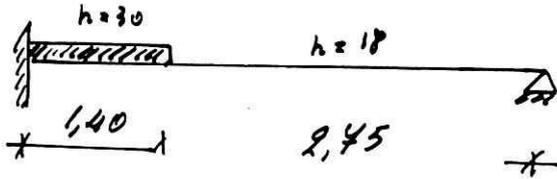
$$c_{max} = \frac{4830}{1260} = 3,83 \text{ kg/cmq}; \quad 1 \phi 16 \text{ perno; } u \phi 8 / 20''$$

$$M^+ = \frac{3215 \cdot 9}{14} = 2040 \text{ kgm};$$

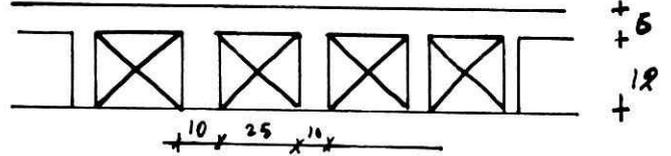
$$r = \frac{28}{\sqrt{\frac{20400}{5}}} = \frac{28}{64,5} = 0,434 < \frac{44}{0,00181}$$

$$A_f = 0,00181 \cdot 64,5 \cdot 50 = 5,85 \text{ cmq} < 3 \phi 16$$

Scala (rampa tipo)

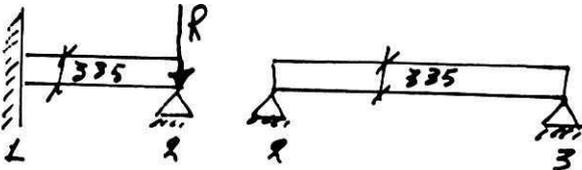


Soletta rampante unita



Schema di calcolo

Analisi di carichi



p. proprio	250 kg/mq.
gradini rip.	200 "
par. vitou.	100 "
Somma carico	400 "
	<u>950 kg/mq.</u>

Calcolo della soletta rampante:

per travetto

$950 \times 0,35 \approx 335 \text{ kg/ml}$

$M_2^- = M_3^- = M_{2-3}^+ = \frac{1}{12} \cdot 335 \cdot 2,45^2 = 299 \text{ kgm}$

$\xi' = \frac{16}{\sqrt{2990}} = \frac{16}{44} = 0,341 < \begin{matrix} 50,5 \\ 0,00225 \end{matrix}$

$A_f' = A_f = 0,00225 \cdot 44 \cdot 10 = 1,06 \text{ cmq} < 1 \phi 14$

$R = \frac{335 \cdot 2,45}{2} = 460 \text{ kg} ; \xi_{max} = \frac{460}{0,9 \cdot 10 \cdot 16} = \frac{460}{144} = 3,18 \text{ kg/cmq.}$

1 $\phi 14$ sagomato.

Calcolo del pianerottolo:

$M_1^- = \frac{335 \cdot 1,4^2}{2} + 460 \cdot 1,4 = 328 + 644 = 972 \text{ kgm.}$

$\xi' = \frac{98}{\sqrt{9720}} = \frac{98}{98,5} = 0,284 < \begin{matrix} \xi_c < 60 \\ t = 0,00249 \end{matrix}$

$A_f' = A_f = 0,00249 \cdot 10 \cdot 98,5 = 2,46 \text{ cmq} < 2 \phi 14$

$T = 335 \cdot 1,4 + 480 = 440 + 480 = 950 \text{ kg.}$

Dott. Ing. Augusto Romita

$\xi = \frac{950}{0,9 \cdot 10 \cdot 28} = 3,83 \text{ kg/cmq} ; 1 \phi 14 \text{ sagomato}$