

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

IL PRESIDENTE
 (Donato Di Carofo)
Donato Di Carofo

OPERATIVA EDILIZIA "LA CASA",		FINANZIAMENTO GesCa/ (Legge 14-2-1963 n.60)		STAZIONE APPALTANTE Cooperativa "LA CASA",	
PALAZZINA CON N° 6 ALLOGGI CONOMICI IN FASANO				data: 21 NOV. 1966 ogg. ogg. B	
LAZIONE DI CALCOLO				Archivio	
Ing. GIOVANNI VALENTINI FASANO	PROGETTO			Approvazioni: C.E.C. 10 DIC. 1965	
Ing. AUGUSTO ROMITA BARI	CALCOLO STRUTTURA IN C.A.		<i>Donato Di Carofo</i>		
Ing. GIOVANNI SABATINO CISTERNINO	IMPIANTI				
Ing. GIOVANNI VALENTINI FASANO	DIRETTORE DEI LAVORI		<i>Ing. Di Carofo</i>	Controllo disegni:	Visto:

RELAZIONE DI CALCOLO

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

COOPERATIVA EDILIZIA "LA CASA"

CALCOLI STATICI (parte seconda)

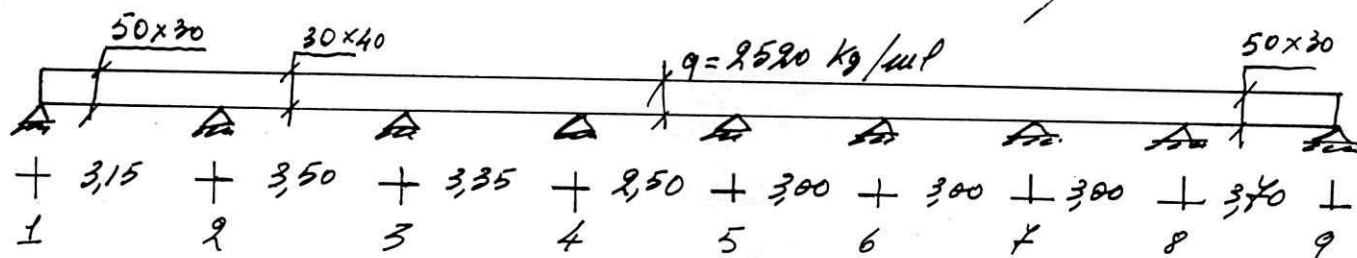
Dott.Ing.A ROMITA

Dott. Ing. Augusto Romita

A handwritten signature in dark ink, appearing to read 'A. Romita', written in a cursive style.

Calcolo travi

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



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

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

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

$$\mu_1 = \frac{2520 \times 3,15^2}{20} = 1260 \text{ kgm} ; \mu_9 = \frac{2520 \times 3,4^2}{20} = 1430 \text{ kgm}$$

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

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

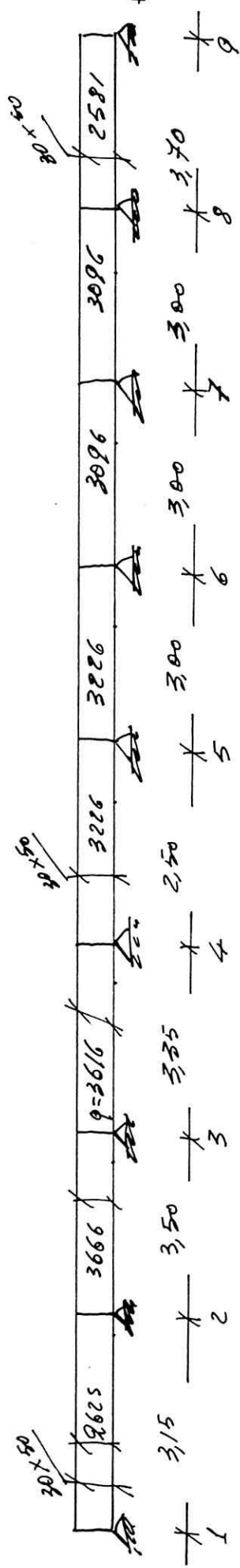
	1	2	3	4	5	6	7	8	9
	0,340	0,630	0,489	0,511	0,428	0,572	0,545	0,500	0,405
	-1260	+2500	-2580	+2365	-1310	+1890	-1890	+1890	-1430
	+30	+50	+25	-122	-61	-540	-285	+393	+192
	-2	-59	-118	-212	-424	-235	-48	-96	-12
		+65	+129	-52	-103	+5	+10	+30	+61
		-4	-12	+135	+67	-137	-68	+8	+9
		+5	-2	-14	-29	-38	-19	+40	+20
		-3	+10	-5	-14	-14	-4	-12	-12
			+11	-10	+24	-7	-15	-6	-12
kgm.	2526	2624	2	+6	-14	+21	+4	+3	+9
				1809	1462	2068	1592		

14

Per tutte le trovi: $T_{max} = 4994 \text{ kg}$; $C_{max} = \frac{4994}{1855} = 4,31 \text{ kg/cup.}$; $X_0 = \frac{4994}{2520} = 1,98 \text{ cm.}$

$$\begin{aligned} S &= \frac{194.4 \cdot 31.50}{2} = 2/300 \text{ kg;} \\ \mu_p &= \frac{8000}{3060} = 2.616 \\ \mu_{st} &= \frac{12000}{1400} = 8.571 \end{aligned}$$

$\begin{array}{r} 50 + \\ 30 + \\ \hline 80 \end{array}$



$$K_{2-1} = 0,830; \quad K_{2-3} = 0,440; \quad K_{3-2} = 0,489; \quad K_{3-4} = 0,511; \quad K_{4-3} = 0,644; \quad K_{4-5} = 0,386$$

$$K_{5-4} = 0,302 ; K_{5-6} = 0,698 ; K_{6-5} = K_{6-4} = K_{4-8} = 0,50 ; K_{8-4} = 0,444 ; K_{8-9} = 0,226$$

$$\mu_1 = \frac{8625 \times 3.15^2}{18} = 1450 \text{ kgm}; \quad \mu_{1-3} = \frac{3666 \times 3.5^2}{18} = 3450 \text{ kgm}; \quad \mu_{3-4} = 3390 \text{ kgm};$$

$\mu_{4.5} = 1680 \text{ kg/m}$; $\mu_{5.6} = 2480$; $\mu_{6.7} = \mu_{7.8} = 2320$
 $\mu_{p-q} = \frac{2581 \times 34^2}{8} = 985 = 3145$

$$9625 \cdot 3,15^2 = 9555 \text{ kgm.}$$

[illegible]

*Caractérist. collée. Travi 1-9 di piano intonaco di
collée. ed armatura.*

Pa le trans: 1-2, 4-5, 8-9;
 $T_{max} = 5183 \text{ kg}$; $x_0 = \frac{5183}{2591} = 198$; $\epsilon = 468 \text{ kg/comp}$;

$$S = \frac{4,480 \cdot 198.50}{2} = 22,400.19$$

ρ_{cl} de $2-3-4$; $5-6-4-8$; $T_{max} = 6751 \text{ kg}$; $x_0 = \frac{6751}{3666} = 184 \text{ cm}$; $\alpha = \frac{6751}{1895} = 5.21 \text{ kg/cm}^2$.

$$S = \frac{5,210,184.50}{2} = 14,600,471; \quad \left\{ \begin{array}{l} u_0 = \frac{5,200,328.66}{3800} \\ u_1 = \frac{8650}{1200} = 7.208\overline{3} \end{array} \right.$$

14



$$k_{11-12} = \frac{0,895}{0,414} ; k_{11-13} = 0,583 ; k_{11-14} = 0,508 ; k_{12-13} = 0,498 ; k_{13-12} = 0,55 ;$$

$K_{14-18} = 0.364$.

$$\mu_{10} = \frac{4905 \times 3.35^2}{24} = 1280 \text{ kgm} ; \mu_{18} = \frac{4905 \times 3.9^2}{21} = 3090 \text{ kgm} ; \mu_{11-10} = \frac{4905 \times 3.35^2}{8} = 1140 = 5460$$

$\mu_{15-16} = 3680$; $\mu_{16-17} = 3680$ kgm

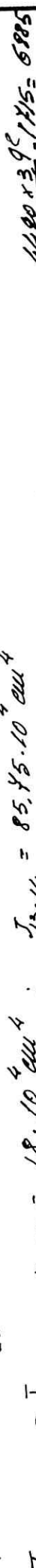
Caratteristiche al varo, 12 anni 10 ÷ 18 di III piano
 Sollec. ed armatura.

	10	11	12	13	14	15	16	17	18
M_i	2980	5015	4068	4405	3740	3805	3083	6140	3720
T_i	7395	9025	8166	7574	7894	8183	9432	8468	7379
M_{max}	3320	1795	2299	4375	1810	9155	1050	4530	
	8210 ± 815	7870 ± 296	8090 ± 193	9100 ± 332	7400 ± 21	7480 ± 240	7400 ± 1030	9600 ± 630	
	$A_f = 6,82 < 4 \phi 16$	$A'_f = A_f = 12,4 < 7 \phi 16$	$A_f = 6,10 < 3 \phi 16 + 8 \phi 10$	$A'_f = A_f = 11,55 < 6 \phi 16$	$A_f = 4,9 < 3 \phi 16$	$A'_f = A_f = 10,5 < 4 \phi 16 + 8 \phi 10$	$A_f = 7,40 < 4 \phi 16$	$A'_f = A_f = 12,9 < 10 \phi 16$	$A_f = 8,6 < 5 \phi 16$
	$\sigma_c = 46,5$	$\sigma_c = 46$	$\sigma_c = 37$	$\sigma_c = 50$	$\sigma_c = 34,5$	$\sigma_c = 44$	$\sigma_c = 27$	$\sigma_c = 54$	$\sigma_c = 44,5$
	$A_f = 9,25 < 5 \phi 16$	$A'_f = A_f = 14,25 < 8 \phi 16$	$A_f = 4,80 < 3 \phi 16$	$A_f = 4,9 < 3 \phi 16$	$A_f = 10,5 < 6 \phi 16$	$A'_f = A_f = 5,00 < 3 \phi 16$	$A_f = 7,40 < 4 \phi 16$	$A'_f = A_f = 15,8 < 8 \phi 16$	$A_f = 8,6 < 5 \phi 16$
	$\sigma_c = 46,5$	$\sigma_c = 49$	$\sigma_c = 32$	$\sigma_c = 34,5$	$\sigma_c = 33,5$	$\sigma_c = 44$	$\sigma_c = 27$	$\sigma_c = 54$	$\sigma_c = 44,5$

Trave 13-14; $M_{max} = 9432 \text{ kg}$; $\sigma = \frac{9432}{0,68 \cdot 30} = 5,18 \text{ kg/cm}^2$; $\sigma_0 = \frac{9432}{6255} = 15,1$; $\sigma = \frac{15,1 \cdot 30 \cdot 5,18}{2} = 11450$
 $\sigma_p = 2610$
 $\sigma_s = 6725$

Per tutte le viciuante travi; $M_{max} = 10230 \text{ kg}$; $\sigma = \frac{10230}{2020} = 5,1 \text{ kg/cm}^2$; $\sigma_0 = \frac{10230}{4205} = 200$
 $\sigma = \frac{209 \times 80 \times 5,1}{2} = 42400 \text{ kg}$; $\sigma_p = \frac{42100}{3960} = 4 \phi 16$
 $\sigma_s = \frac{25600}{1600} = 68/18$

19



$$= \frac{4480 \times 39^2}{8} = 8625$$

$$12 = \frac{4490 \times 32^2}{12} = 3840 \quad ; \quad \mu_{12-13} = 4100, \mu_{13-14} = 3480, \mu_{14-15} = 4090, \mu_{15-16} = 4090, \mu_{16-17} = 3480, \mu_{17-18} = 4090, \mu_{18-19} = 3480, \mu_{19-20} = 4090, \mu_{20-21} = 3480, \mu_{21-22} = 4090, \mu_{22-23} = 3480, \mu_{23-24} = 4090, \mu_{24-25} = 3480, \mu_{25-26} = 4090, \mu_{26-27} = 3480, \mu_{27-28} = 4090, \mu_{28-29} = 3480, \mu_{29-30} = 4090, \mu_{30-31} = 3480, \mu_{31-32} = 4090, \mu_{32-33} = 3480, \mu_{33-34} = 4090, \mu_{34-35} = 3480, \mu_{35-36} = 4090, \mu_{36-37} = 3480, \mu_{37-38} = 4090, \mu_{38-39} = 3480, \mu_{39-40} = 4090, \mu_{40-41} = 3480, \mu_{41-42} = 4090, \mu_{42-43} = 3480, \mu_{43-44} = 4090, \mu_{44-45} = 3480, \mu_{45-46} = 4090, \mu_{46-47} = 3480, \mu_{47-48} = 4090, \mu_{48-49} = 3480, \mu_{49-50} = 4090, \mu_{50-51} = 3480, \mu_{51-52} = 4090, \mu_{52-53} = 3480, \mu_{53-54} = 4090, \mu_{54-55} = 3480, \mu_{55-56} = 4090, \mu_{56-57} = 3480, \mu_{57-58} = 4090, \mu_{58-59} = 3480, \mu_{59-60} = 4090, \mu_{60-61} = 3480, \mu_{61-62} = 4090, \mu_{62-63} = 3480, \mu_{63-64} = 4090, \mu_{64-65} = 3480, \mu_{65-66} = 4090, \mu_{66-67} = 3480, \mu_{67-68} = 4090, \mu_{68-69} = 3480, \mu_{69-70} = 4090, \mu_{70-71} = 3480, \mu_{71-72} = 4090, \mu_{72-73} = 3480, \mu_{73-74} = 4090, \mu_{74-75} = 3480, \mu_{75-76} = 4090, \mu_{76-77} = 3480, \mu_{77-78} = 4090, \mu_{78-79} = 3480, \mu_{79-80} = 4090, \mu_{80-81} = 3480, \mu_{81-82} = 4090, \mu_{82-83} = 3480, \mu_{83-84} = 4090, \mu_{84-85} = 3480, \mu_{85-86} = 4090, \mu_{86-87} = 3480, \mu_{87-88} = 4090, \mu_{88-89} = 3480, \mu_{89-90} = 4090, \mu_{90-91} = 3480, \mu_{91-92} = 4090, \mu_{92-93} = 3480, \mu_{93-94} = 4090, \mu_{94-95} = 3480, \mu_{95-96} = 4090, \mu_{96-97} = 3480, \mu_{97-98} = 4090, \mu_{98-99} = 3480, \mu_{99-100} = 4090, \mu_{100-101} = 3480, \mu_{101-102} = 4090, \mu_{102-103} = 3480, \mu_{103-104} = 4090, \mu_{104-105} = 3480, \mu_{105-106} = 4090, \mu_{106-107} = 3480, \mu_{107-108} = 4090, \mu_{108-109} = 3480, \mu_{109-110} = 4090, \mu_{110-111} = 3480, \mu_{111-112} = 4090, \mu_{112-113} = 3480, \mu_{113-114} = 4090, \mu_{114-115} = 3480, \mu_{115-116} = 4090, \mu_{116-117} = 3480, \mu_{117-118} = 4090, \mu_{118-119} = 3480, \mu_{119-120} = 4090, \mu_{120-121} = 3480, \mu_{121-122} = 4090, \mu_{122-123} = 3480, \mu_{123-124} = 4090, \mu_{124-125} = 3480, \mu_{125-126} = 4090, \mu_{126-127} = 3480, \mu_{127-128} = 4090, \mu_{128-129} = 3480, \mu_{129-130} = 4090, \mu_{130-131} = 3480, \mu_{131-132} = 4090, \mu_{132-133} = 3480, \mu_{133-134} = 4090, \mu_{134-135} = 3480, \mu_{135-136} = 4090, \mu_{136-137} = 3480, \mu_{137-138} = 4090, \mu_{138-139} = 3480, \mu_{139-140} = 4090, \mu_{140-141} = 3480, \mu_{141-142} = 4090, \mu_{142-143} = 3480, \mu_{143-144} = 4090, \mu_{144-145} = 3480, \mu_{145-146} = 4090, \mu_{146-147} = 3480, \mu_{147-148} = 4090, \mu_{148-149} = 3480, \mu_{149-150} = 4090, \mu_{150-151} = 3480, \mu_{151-152} = 4090, \mu_{152-153} = 3480, \mu_{153-154} = 4090, \mu_{154-155} = 3480, \mu_{155-156} = 4090, \mu_{156-157} = 3480, \mu_{157-158} = 4090, \mu_{158-159} = 3480, \mu_{159-160} = 4090, \mu_{160-161} = 3480, \mu_{161-162} = 4090, \mu_{162-163} = 3480, \mu_{163-164} = 4090, \mu_{164-165} = 3480, \mu_{165-166} = 4090, \mu_{166-167} = 3480, \mu_{167-168} = 4090, \mu_{168-169} = 3480, \mu_{169-170} = 4090, \mu_{170-171} = 3480, \mu_{171-172} = 4090, \mu_{172-173} = 3480, \mu_{173-174} = 4090, \mu_{174-175} = 3480, \mu_{175-176} = 4090, \mu_{176-177} = 3480, \mu_{177-178} = 4090, \mu_{178-179} = 3480, \mu_{179-180} = 4090, \mu_{180-181} = 3480, \mu_{181-182} = 4090, \mu_{182-183} = 3480, \mu_{183-184} = 4090, \mu_{184-185} = 3480, \mu_{185-186} = 4090, \mu_{186-187} = 3480, \mu_{187-188} = 4090, \mu_{188-189} = 3480, \mu_{189-190} = 4090, \mu_{190-191} = 3480, \mu_{191-192} = 4090, \mu_{192-193} = 3480, \mu_{193-194} = 4090, \mu_{194-195} = 3480, \mu_{195-196} = 4090, \mu_{196-197} = 3480, \mu_{197-198} = 4090, \mu_{198-199} = 3480, \mu_{199-200} = 4090, \mu_{200-201} = 3480, \mu_{201-202} = 4090, \mu_{202-203} = 3480, \mu_{203-204} = 4090, \mu_{204-205} = 3480, \mu_{205-206} = 4090, \mu_{206-207} = 3480, \mu_{207-208} = 4090, \mu_{208-209} = 3480, \mu_{209-210} = 4090, \mu_{210-211} = 3480, \mu_{211-212} = 4090, \mu_{212-213} = 3480, \mu_{213-214} = 4090, \mu_{214-215} = 3480, \mu_{215-216} = 4090, \mu_{216-217} = 3480, \mu_{217-218} = 4090, \mu_{218-219} = 3480, \mu_{219-220} = 4090, \mu_{220-221} = 3480, \mu_{221-222} = 4090, \mu_{222-223} = 3480, \mu_{223-224} = 4090, \mu_{224-225} = 3480, \mu_{225-226} = 4090, \mu_{226-227} = 3480, \mu_{227-228} = 4090, \mu_{228-229} = 3480, \mu_{229-230} = 4090, \mu_{230-231} = 3480, \mu_{231-232} = 4090, \mu_{232-233} = 3480, \mu_{233-234} = 4090, \mu_{234-235} = 3480, \mu_{235-236} = 4090, \mu_{236-237} = 3480, \mu_{237-238} = 4090, \mu_{238-239} = 3480, \mu_{239-240} = 4090, \mu_{240-241} = 3480, \mu_{241-242} = 4090, \mu_{242-243} = 3480, \mu_{243-244} = 4090, \mu_{244-245} = 3480, \mu_{245-246} = 4090, \mu_{246-247} = 3480, \mu_{$$

$$-10 = \frac{0,84}{1,25 + 0,84} = 0,410; K_{12-12} = 0,590; K_{12-11} = \frac{33}{33+3,2} = 0,509; K_{12-13} = 0,491; K_{12-12} = \frac{545+3428}{545+3428} = 0,612, 1924$$

$$-13 = K_{13-14} ; K_{14-15} = K_{13-12} ; K_{15-14} = K_{15-16} = 0,500 ; K_{16-15} = \frac{200}{595} = 0,336 ; K_{17-16} = 0,443 ; K_{18-17} = 0,51 + 0,84$$

[illegible]

Caratteristi di sollec. Travi 10-18 di primo intermedio
Sollec. ed armatura

	9	10	11	12	13	14	15	16	17	18
H_i	0890	4697	3758	4117	3903	4697	6118	5135	3430	
T_i	1124	8349	8478	6928	4388	7578	7960	8440	6950	8440
H_{max}	3120	4120	3120	4120	3120	4120	3120	4120	3120	4120
	$A_f = 9,48 < 5 \phi 16$ $C_c/C_t = 41/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 10,5 < 5 \phi 16 + 2 \phi 10$ $C_c = 50$	$A_f = 6,15 < 3 \phi 16 + 2 \phi 10$ $C_c = 37$	$A_f = 9,05 < 4 \phi 16 + 2 \phi 10$ $C_c = 46$	$A_f = 5,9 < 3 \phi 16$ $C_c = 36$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 45/1400$	$A'_f = 13,4 < 4 \phi 16$ $C_c = 48$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A_f = 4,23 < 3 \phi 16$ $C_c = 30$	$A'_f = A_f = 13,5 < 6 \phi 16 + 2 \phi 10$ $C_c = 48$	$A'_f = A_f = 9,4 < 5 \phi 16$ $C_c = 41$	$A'_f = A_f = 14,4 < 4 \phi 16 + 2 \phi 10$ $C_c = 50$	$A'_f = A_f = 11,8 < 5 \phi 16 + 2 \phi 10$ $C_c = 47$
	$A_f = 8,4 < 4 \phi 16 + 2 \phi 10$ $C_c/C_t = 4$									

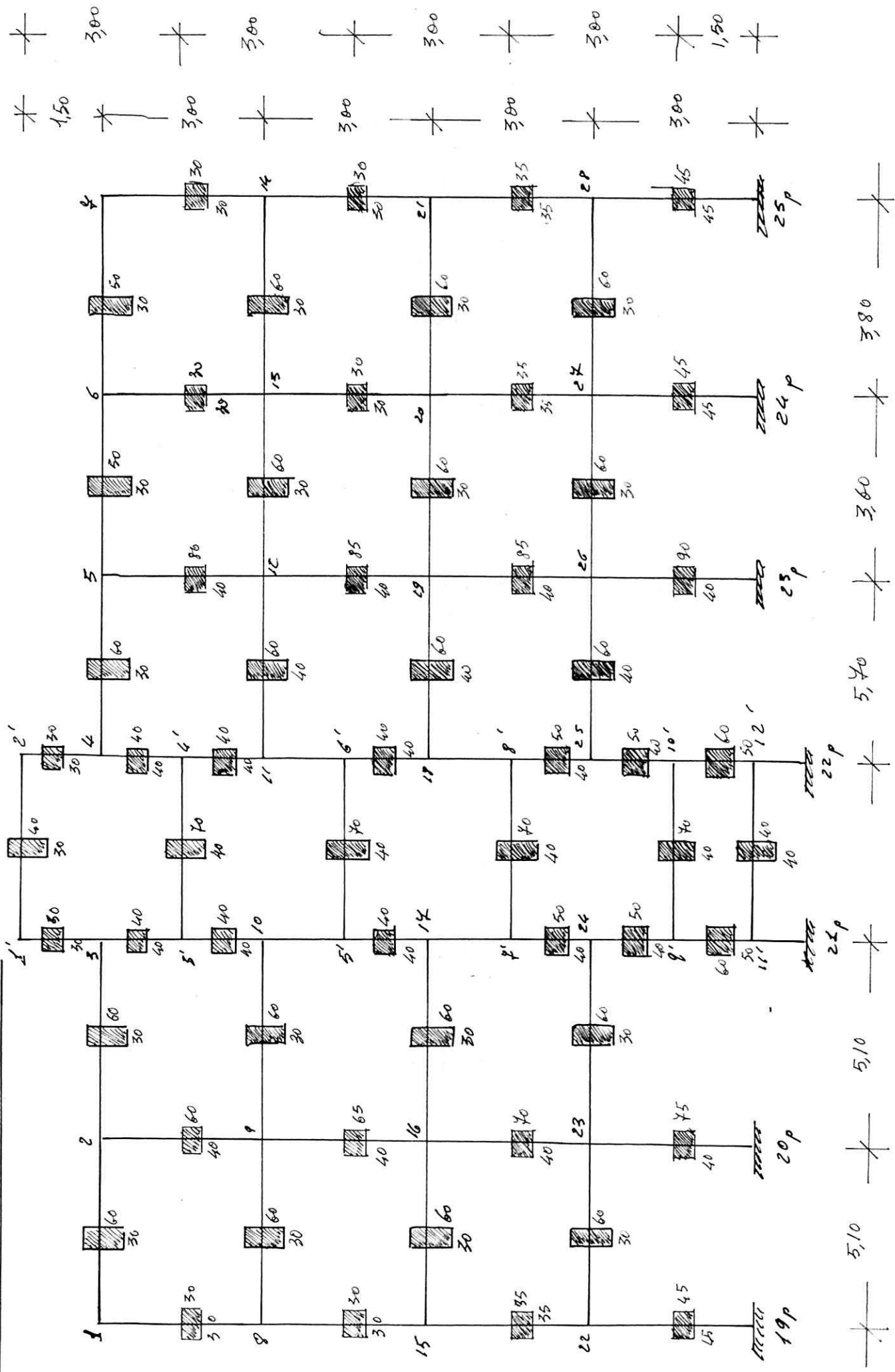
Trave 13-14: $T_{max} = 7960 \text{ kg}$; $C = \frac{7960}{0,9 \cdot 30 \cdot 68} = 4,33 \text{ kg/cm}$; $X_0 = \frac{7960}{6646} = 119 \text{ cm}$;

$$S = \frac{119 \cdot 30 \cdot 4,33}{2} = 4460 \text{ kg}$$

Per tutte le rimanenti travi: $T_{max} = 9939 \text{ kg}$; $C = \frac{9939}{0,9 \cdot 30 \cdot 68} = 4,58 \text{ kg/cm}$; $X_0 = \frac{9939}{6646} = 149 \text{ cm}$

$S = \frac{4,58 \cdot 206 \cdot 80}{2} = 34100 \text{ kg}$; $\left\{ \begin{array}{l} u_p = \frac{15050}{3940} = 4 \phi 16 \text{ piegati} \\ u_{st} = \frac{22600}{1400} = 16 \phi 12 \end{array} \right.$

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



Momenti d'inerzia:

$$J_{1-2-3} = J_{4-5} = J_{8-9-10} = J_{12-13-14} = J_{15-16-17} = J_{19-20-21} = J_{22-23-24} = J_{26-27-28} =$$

$$= \frac{30 \times 60^3}{12} = 540.000 \text{ cm}^4.$$

$$J_{5-6-7} = \frac{30 \times 50^3}{12} = 312.500 \text{ cm}^4;$$

$$J_{2-9} = J_{11-18} = J_{18-19} = J_{25-26} = \frac{40 \times 60^3}{12} = 720.000 \text{ cm}^4$$

$$J_{1-8-15} = J_{6-13-20} = J_{7-14-21} = \frac{30 \times 30^3}{12} = 225.000 \text{ cm}^4$$

$$J_{15-22} = J_{20-27} = J_{21-28} = \frac{35 \times 35^3}{12} = 124.500 \text{ cm}^4$$

$$J_{22-19} = J_{27-24} = J_{28-25} = \frac{45 \times 45^3}{12} = 341.720 \text{ cm}^4$$

$$J_{5-12} = \frac{80 \times 40^3}{12} = 426.666 \text{ cm}^4; J_{12-29-26} = \frac{85 \times 40^3}{12} = 453.333 \text{ cm}^4;$$

$$J_{26-24} = \frac{90 \times 40^3}{12} = 480.000 \text{ cm}^4; J_{9-16} = \frac{65 \times 40^3}{12} = 346.666 \text{ cm}^4; J_{16-23} = \frac{70 \times 40^3}{12} =$$

$$= 373.333 \text{ cm}^4; J_{23-20} = \frac{75 \times 40^3}{12} = 400.000 \text{ cm}^4;$$

$$J_{3-10-17} = J_{4-11-18} = \frac{40 \times 40^3}{12} = 213.333 \text{ cm}^4$$

$$J_{17-24-25} = J_{18-25-12} = \frac{50 \times 40^3}{12} = 266.666 \text{ cm}^4; J_{11-21} = J_{12-22} = \frac{60 \times 50^3}{12} = 625.000 \text{ cm}^4$$

$$J_{5'-4'} = J_{5-6} = J_{7-8} = J_{9'-10} = \frac{40 \times 40^3}{12} = 400.000 \text{ cm}^4$$

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: $k = \frac{\frac{J_i}{L_i}}{\frac{J_1}{L_1} + \frac{J_2}{L_2} + \frac{J_3}{L_3}} =$

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

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

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

$$K_{5-4} = 0,293; K_{5-6} = 0,264; K_{5-12} = 0,440;$$

$$K_{6-5} = 0,453; K_{6-7} = 0,430; K_{6-13} = 0,117$$

$$K_{7-6} = 0,786; K_{9-14} = 0,214;$$

$$K_{8-1} = 0,145; K_{8-9} = 0,440; K_{8-15} = 0,145$$

$$K_{9-8} = 0,238; K_{9-10} = 0,238; K_{9-2} = 0,252; K_{9-16} = 0,242 -$$

$$K_{10-9} = 0,242; K_{10-5'} = 0,364; K_{5'-3} = K_{5'-10} = 0,213; K_{5'-4'} = 0,544;$$

$$K_{4'-5'} = 0,544; K_{4'-4} = K_{4'-11} = 0,213; K_{11-12} = 0,306; K_{11-4'} = K_{11-6'} = 0,347$$

$$K_{12-11} = 0,220; K_{12-13} = 0,264; K_{12-5} = 0,250; K_{12-19} = 0,266;$$

$$K_{13-18} = 0,445; K_{13-6} = 0,067; K_{13-14} = 0,421; K_{13-20} = 0,067$$

$$K_{14-7} = 0,120; K_{14-13} = 0,460; K_{14-21} = 0,120$$

$$K_{15-16} = 0,624; K_{15-8} = 0,128; K_{15-22} = 0,246$$

$$K_{16-15} = K_{16-17} = 0,233; K_{16-9} = 0,246; K_{16-23} = 0,298$$

$$K_{17-16} = 0,230; K_{17-5'} = K_{17-7'} = 0,385; K_{5'-10} = K_{5'-17} = 0,213; K_{5'-6'} = 0,544$$

$$K_{18-19} = 0,262; K_{18-6'} = K_{18-8'} = 0,369; K_{6'-5'} = 0,544; K_{6'-11'} = K_{6'-18} = 0,347$$

$$K_{19-18} = 0,218; K_{19-20} = 0,260; K_{19-12} = K_{19-26} = 0,261$$

$$K_{20-19} = 0,422; K_{20-21} = 0,398; K_{20-13} = 0,063; K_{20-24} = 0,117$$

$$K_{21-20} = 0,690; K_{21-14} = 0,109; K_{21-28} = 0,201$$

$$K_{22-15} = 0,159; K_{22-23} = 0,406; K_{22-19_p} = 0,435$$

$$K_{23-22} = 0,219; K_{23-16} = 0,242; K_{23-24} = 0,219; K_{23-20_p} = 0,292;$$

$$K_{24-23} = 0,230; K_{24-7'} = K_{24-9'} = 0,385; K_{7'-17} = K_{7'-24} = 0,240; K_{7'-8'} = 0,520$$

$$K_{25-26} = 0,262; K_{25-8'} = K_{25-10'} = 0,369; K_{8'-7'} = 0,520$$

$$K_{26-25} = 0,215; K_{26-19} = 0,258; K_{26-27} = 0,255; K_{26-23_p} = 0,242;$$

$$K_{27-26} = 0,335; K_{27-20} = 0,094; K_{27-28} = 0,317; K_{27-24_p} = 0,254$$

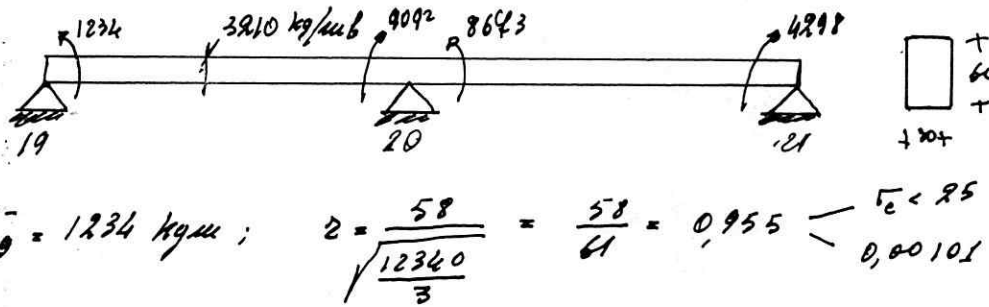
$$K_{28-27} = 0,448; K_{28-21} = 0,139; K_{28-25_p} = 0,383;$$

$$K_{9'-10'} = 0,327 = K_{10'-9'}; K_{9'-24} = K_{10'-25} = 0,141; K_{9'-11'} = K_{10'-12'} = 0,532$$

$$K_{11-12'} = K_{12'-11'} = 0,040; K_{11'-21_p} = K_{12'-22_p} = 0,310;$$

Travi 19-20-21 (III piano)

24



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

$$A_f = 2 \phi 16$$

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

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

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

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

Momento di campata 19-20

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

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

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

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

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

Momento di campata 20-21

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

$$u_p = 3 \phi 16$$

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

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

Campata 19-20

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

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

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

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

$$M_{19-20}^+ = \frac{13290^2}{8940} - 13444 = 6356 \text{ kgm};$$

$$\lambda = \frac{58}{\sqrt{\frac{63560}{3}}} = \frac{58}{143,5} = 0,408 < \begin{matrix} 52 \\ 0,00194 \end{matrix}$$

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

$$T_{max} = \frac{4440 \times 5,10}{2} + \frac{13444 - 3564}{5,1} = 13290 \text{ kg.}$$

$$x_0 = \frac{13290}{4440} = 294 \text{ cm}; \quad c_{max} = \frac{13290}{1565} = 8,5 \text{ kg/cm}^2$$

$$S = \frac{8,5 \cdot 294 \cdot 30}{2} = 37400 \text{ kg} : \begin{cases} \mu_f = \frac{15100}{3960} = 4\phi 16 \\ \mu_{st} = \frac{22400}{1400} = \phi 8/18'' \end{cases}$$

Campata 20-21

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

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

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

$$x_0 = \frac{13520}{4880} = 277 \text{ cm}; \quad c_{max} = \frac{13520}{1565} = 8,65 \text{ kg/cm}^2$$

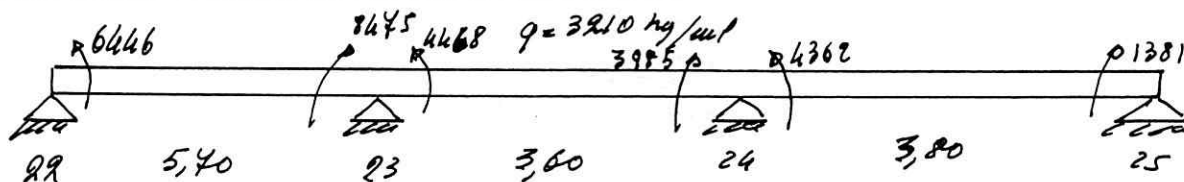
$$S = \frac{277 \cdot 8,65 \cdot 30}{2} = 36000 \text{ kg} : \begin{cases} \mu_f = \frac{14400}{3960} = 4\phi 16 \text{ piegati.} \\ \mu_{st} = \frac{21400}{1400} = \phi 8/18'' \end{cases}$$

$$M_{max}^+ = \frac{13520^2}{9460} - 11429 = 7041 \text{ kgm.}$$

$$\lambda = \frac{58}{\sqrt{\frac{70410}{3}}} = \frac{58}{154} = 0,377 < \begin{matrix} 50 \\ 0,00206 \end{matrix}$$

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

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



Сампата 22-23:

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

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

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

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

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

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

$$S = \frac{5,64 \cdot 2,43 \cdot 30}{2} = 23,200 \text{ кг}; \quad \mu_p = \frac{2300}{3960} = 2 \phi 16; \quad \mu_{st} = \frac{13400}{1400} = 9,8/25$$

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

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

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

Сампата 23-24

$$H_{24} = 4368 \text{ кгм}; \quad z = \frac{48}{\sqrt{\frac{43680}{3}}} = \frac{48}{121} = 0,397 < \begin{matrix} 44 \\ 120 \end{matrix}$$

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

$$T_{\max} = 5942 \text{ кг}; \quad \epsilon = \frac{5942}{1220} = 4,61 \text{ кг/см}; \quad \chi_0 = \frac{5942}{3210} = 1,86 \text{ см}$$

$$S = \frac{1,86 \cdot 4,61 \cdot 30}{2} = 19,900 \text{ кг}; \quad \mu_p = \frac{5150}{3960} = 2 \phi 16; \quad \mu_{st} = \frac{4440}{1400} = 3,1/25$$

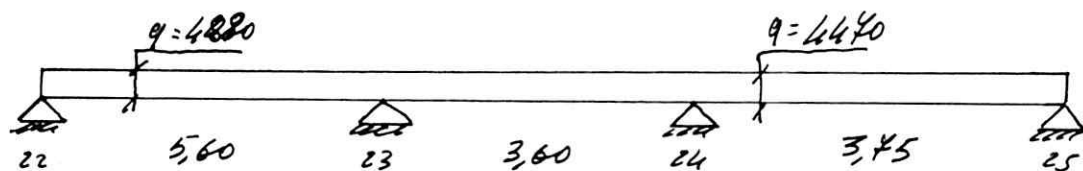
$$H_{\max}^+ = \frac{5942^2}{6420} - 4368 = 5520 - 4368 = 1082 \text{ кгм} < \begin{matrix} \tau_c < 25 \\ A_f' = A_f = 2 \phi 16 \end{matrix}$$

Сампата 24-25:

$$H_{25} = 1381; \quad z = \frac{48}{\sqrt{\frac{13810}{3}}} = \frac{48}{68} = 0,408 < \begin{matrix} 24 \\ 108 \end{matrix} \quad A_f' = 8,8 \text{ см} < 2 \phi 16$$

$$T = 6865 \text{ кг}; \quad \epsilon = 5,21 \text{ кг/см}; \quad \mu_p = 2 \phi 16; \quad \mu_{st} = 3,1/25$$

$$H_{\max}^+ = \frac{6865^2}{6420} - 4362 = 2988; \quad z = \frac{48}{100} = 0,480 < \begin{matrix} 41,5 \\ 102 \end{matrix}; \quad A_f' = 3 \phi 16 > 4,86 \text{ см}$$



Calcolo 22-23:

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

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

$$M_{23} = 13765 \text{ kgm}; \quad z = \frac{58}{186} = 0,312 < \frac{55}{252} \quad A_f = A_f = 18,8 < 9 \phi 16 + 2 \phi 10$$

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

$$x_0 = \frac{12945}{4880} = 266 \text{ cm}; \quad S = \frac{266 \cdot 40 \cdot 6,22}{2} = 33100 \quad \begin{matrix} \mu_p = 4 \phi 16 \\ \mu_{st} = \phi 8/18 \end{matrix}$$

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

$$z = \frac{58}{134,5} = 0,423 < \frac{48}{185} \quad A_f = 10,8 \text{ cm}^2 < 5 \phi 16 + 2 \phi 10$$

Calcolo 23-24

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

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

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

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

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

Calcolo 24-25:

$$M_{25} = 3309 \text{ kgm}; \quad z = \frac{58}{106,5} = 0,545 < \frac{36}{0,00142}$$

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

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

$$M_{max}^+ = \frac{9520^2}{8940} - 5941 = 5041; \quad z = \frac{58}{130} = 0,446 < \frac{45}{144}$$

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

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

28

$$M_{max} = 6489 \text{ kgm}; \quad r = \frac{68}{\sqrt{\frac{64890}{4}}} = \frac{68}{193} = 0,552 < \frac{35}{138}$$

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

$$T_{max} = \frac{4480 \cdot 3,30}{2} + \frac{6469 - 6124}{3,3} = 12800 + 104 = 12904 \text{ kg}.$$

$$c_{max} = \frac{12904}{0,9 \cdot 40 \cdot 68} = \frac{12904}{2448} = 5,3 \text{ kg/cm}^2; \quad x_0 = \frac{12904}{4480} = 166 \text{ cm}.$$

$$S = \frac{166 \cdot 5,3 \cdot 40}{2} = 17500 \text{ kg} \quad \left\{ \begin{array}{l} u_p = \frac{8450}{3960} = 2 \phi 16 \\ u_{st} = \frac{10500}{1400} = \phi 8/20'' \end{array} \right.$$

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

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

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

Armatura a torsione

$$M_t = 965 \text{ kg/cm}^2; \quad M_t = \frac{965 \cdot 33}{2} = 1514 \text{ kgm}.$$

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

$$c_{tot} = 5,3 + \frac{4,18 \cdot 1540}{40 \cdot 1600} = 5,3 + 5,45 = 11,05 < 14 \text{ kg/cm}^2$$

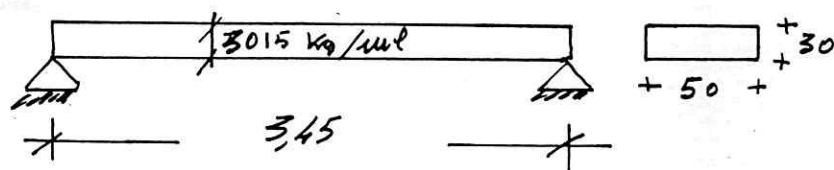
Realizzando l'armatura a torsione con femi long. e staffe

$$A_{ft} = \frac{154000 (65+35)}{65 \cdot 35 \cdot 1400} = 4,9 \text{ cm}^2 < 3 \phi 16$$

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

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

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



Momenti negativi:

$$M_1 = M_2 = \frac{3015 \cdot 3.45^2}{12} = 9900 \text{ kgm}$$

$$z = \frac{28}{\sqrt{29000/5}} = \frac{28}{46} = 0,368 < \begin{matrix} 48,5 \\ 0,00210 \end{matrix}$$

$$A_f' = A_f = 0,00210 \cdot 46 \cdot 50 = 8 \text{ cmq} < 4 \phi 16$$

Momento di campo

$$M = \frac{3015 \cdot 3.45^2}{8} = 4500 \text{ kgm}$$

$$z = \frac{28}{\sqrt{9000}} = \frac{28}{95} = 0,295 < \begin{matrix} \sqrt{c} = 54 \\ 0,00260 \end{matrix}$$

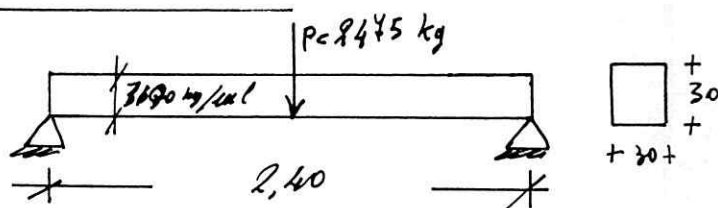
$$A_f' = A_f = 0,00260 \cdot 95 \cdot 50 = 12,4 \text{ cmq} < 4 \phi 16$$

$$T_{max} = \frac{3015 \cdot 3.45}{2} = 5230 \text{ kg}; \quad c = \frac{5230}{0,9 \cdot 50 \cdot 28} = 4,18 \text{ kg/cmq}$$

$$X_0 = \frac{5230}{3015} = 1,72,5 \text{ cm}; \quad S = \frac{4,18 \cdot 1,72,5 \cdot 50}{2} = 18100 \text{ kg}$$

$$\mu_p = \frac{4200}{3960} \approx 2 \phi 16; \quad \mu_{st} = \frac{10900}{1400} = 8/20"$$

Tracce 4'-5'



$$M_4 = M_5 = M = \frac{3180 \cdot 2.4^2}{12} + \frac{8445 \cdot 2.4}{8} = 1530 + 445 = 2245 \text{ kgm}$$

$$z = \frac{28}{\sqrt{\frac{22450}{3}}} = \frac{28}{84} = 0,322 < \begin{matrix} 52 \\ 0,00245 \end{matrix}$$

$$A_f' = A_f = 0,00245 \cdot 84 \cdot 30 = 6,4 \text{ cmq} < 3 \phi 16 + 2 \phi 10$$

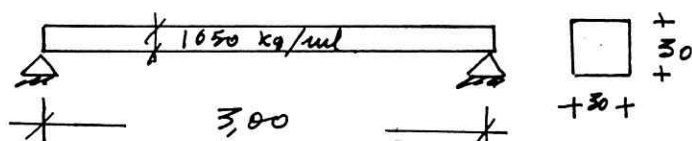
$$\sigma_z = \frac{3190 \cdot 2,40}{2} + 1934 = 3820 + 1935 = 5065 \text{ kg}.$$

$$c_1 = \frac{5065}{465} = 6,6 \text{ kg/cm}^2; \quad c_2 = \frac{1934}{465} = 1,62.$$

$$S = \frac{6,6 + 1,62}{2} \cdot 12030 = 14800 \text{ kg}.$$

$$\mu_p = \frac{5930}{5960} \approx 2 \phi 16; \quad \mu_{st} = \frac{8800}{1000} = 8 \phi 20''$$

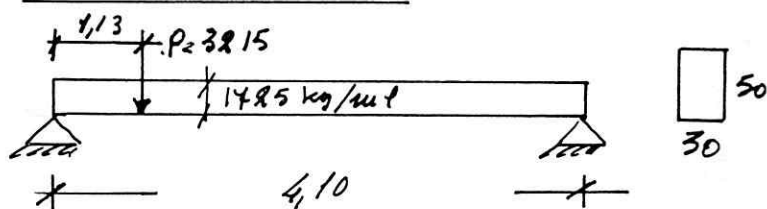
Trave 4"-13'



$$M^+ = \frac{1650 \cdot 3^2}{8} = 1920 \text{ kgm}; \quad z = \frac{88}{485} = 0,354 < \frac{50}{225} \quad A_f' = A_f = 5,3 < 3 \phi 16$$

$$c_{max} = \frac{8480}{465} = 3,24 \text{ kg/cm}^2; \quad \text{st. } \phi 8/20''$$

Trave 4-13; 5-14:



$$M_{4-5}^- = \frac{1485 \cdot 4,10^2}{12} + \frac{3815 \cdot 1,13 \cdot 2,94^2}{4,1^2} = 4360 \text{ kgm}.$$

$$z = \frac{48}{\sqrt{\frac{43600}{3}}} = \frac{48}{121} = 0,394 < \frac{43}{0,00190}$$

$$A_f' = A_f = 0,00190 \cdot 121 \cdot 30 = 6,9 < 3 \phi 16 + 2 \phi 10$$

$$M_{13-14}^- = 8480 + 440 = 3160 \text{ kgm}; \quad z = 0,465 < \frac{43}{0,00164} \quad A_f = 5,2 < 3 \phi 16.$$

$$\sigma_{max} = \frac{1485 \cdot 4,10}{2} + \frac{3815 \cdot 2,94}{4,1} = 5840 \text{ kg}; \quad c_{max} = \frac{5840}{1290} = 4,55.$$

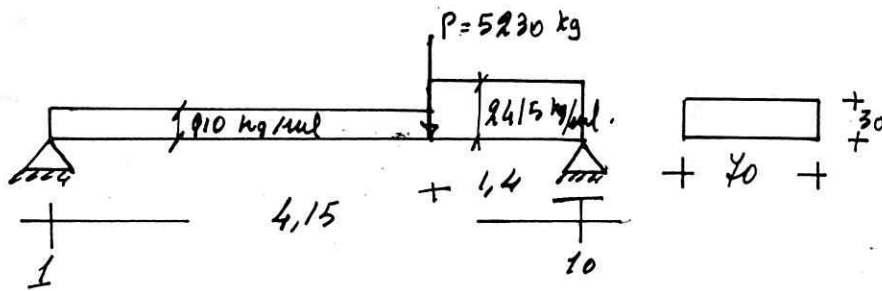
$$x_0 = \frac{5840}{1425} = 1,54$$

$$M^+ = 5840 \cdot 1,54 - \frac{1485 \cdot 1,54^2}{2} - 3815 \cdot 0,41 = 2180 = 4540 \text{ kgm}.$$

$$z = \frac{48}{\sqrt{\frac{45400}{3}}} = \frac{48}{1235} = 0,384 < \frac{52}{0,00210} \quad A_f' = 0,85 A_f = 4,8 \text{ cm}^2 < 4 \phi 16$$

$$S = S_1 + S_2 \quad \left\{ \begin{array}{l} S_1 = \frac{2,44 \cdot 805 \cdot 30}{2} = 8500 \\ S_2 = 1,81 \cdot 113 \cdot 30 = 6150 \end{array} \right. \quad \begin{array}{l} \mu_p = 2 \phi 16 \\ \mu_{st} = 8 \phi 20'' \end{array}$$

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



$$M_1^- = \frac{910 \cdot 4.15^2}{12} + \frac{(2415 - 910) \cdot 3.45 \cdot 0.4^2}{4.15^2} + \frac{5230 \cdot 2.45 \cdot 1.4^2}{4.15^2} = 3108 \text{ kgm.}$$

$$M_{10}^- = 1330 + \frac{1505 \cdot 0.4 \cdot 3.45^2}{4.15^2} + 3250 = 5310 \text{ kgm.}$$

$$T_1^+ = \frac{910 \cdot 4.15}{2} + \frac{5230 \cdot 1.4}{4.15} + \frac{1505 \cdot 1.4^2}{2 \cdot 4.15} + \frac{M_1 - M_2}{l} = 3504 \text{ kg.}$$

$$T_{10}^- = 1890 + \frac{5230 \cdot 2.45}{4.15} + \frac{1505 \cdot 1.4 \cdot 3.45}{4.15} = 4618 \text{ kg}$$

$$x_0 = 2.45; \quad c_{max} = \frac{4618}{1765} = 4.32 \text{ kg/cmq.}$$

$$M^+ = 3504 \cdot 2.45 - \frac{910 \cdot 2.45^2}{2} - \frac{3108}{2} = 4656 \text{ kgm.}$$

$$S = S_1 + S_2 + S_3 - S_4 = 25460 \text{ kg} \quad \left\{ \begin{array}{l} S_1 = \frac{1.0\% \cdot 40 \cdot 2.0\% \cdot 5}{2} = 4440 \\ S_2 = 1.0\% \cdot 40 \cdot 2.45 = 19300 \\ S_3 = 0.20\% \cdot 40 \cdot 2.45 = 3980 \\ S_4 = 0.28\% \cdot 40 \cdot 2.45 = 5340 \end{array} \right.$$

$$4p = \frac{10300}{3960} = 3\phi 16$$

$$A_{st} = \frac{15450}{1400} = \phi 8/15''$$

$$M_1^- = 3108; \quad \lambda = \frac{28}{\sqrt{\frac{31080}{4}}} = \frac{28}{66.8} = 0.419 < \frac{48}{185}$$

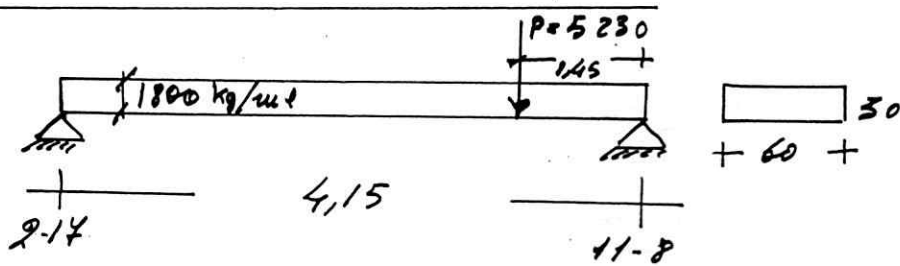
$$A_f = 0.00185 \cdot 66.5 \cdot 40 = 8.6 \text{ cmq} < 4\phi 16 + 2\phi 10$$

$$M_{10}^- = 5310; \quad \lambda = \frac{28}{\sqrt{\frac{53100}{4}}} = \frac{28}{84} = 0.322 < \frac{53}{0.00245}$$

$$A_f' = A_f = 0.00245 \cdot 70 \cdot 84 = 14.9 \text{ cmq} < 7\phi 16 + 2\phi 10$$

$$M^+ = 4656; \quad \lambda = \frac{28}{49.5} = 0.353 < \frac{48}{225}$$

$$A_f' = A_f = 12.5 \text{ cmq} < 6\phi 16 + 2\phi 10$$



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

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

$$A_f' = A_f = 0.00835 \cdot 84.4 \cdot 60 = 10 \text{ cm} < 5 \phi 16$$

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

$$z = \frac{28}{\sqrt{\frac{58100}{6}}} = \frac{28}{98.5} = 0.284 < \frac{54}{865}$$

$$A_f' = A_f = 0.00865 \cdot 98.5 \cdot 60 = 15.6 \text{ cm} < 8 \phi 16$$

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

$$T_{11-8} = 3750 + 3480 + 344 = 7514 \text{ kg.}$$

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

$$M_{max}^+ = 7514 \cdot 1.45 - \frac{1800 \cdot 1.45^2}{2} - \frac{5810}{2} = 10900 - 1200 - 2905 = 6695 \text{ kgm.}$$

$$z = \frac{28}{\sqrt{\frac{66950}{6}}} = \frac{28}{100.5} = 0.280 < \frac{58}{845}$$

$$A_f' = A_f = 0.00845 \cdot 100.5 \cdot 60 = 16.5 \text{ cm} < 8 \phi 16 + 2 \phi 10$$

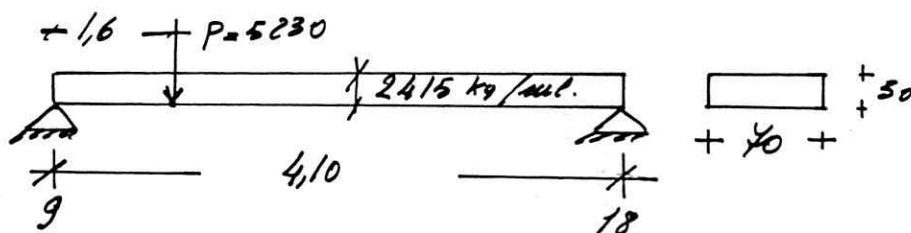
$$S = S_1 + S_2 + S_3 = 34400 \text{ kg}$$

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

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

$$\mu_{sf} = \frac{22600}{1400} = 8 \phi 15$$

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



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

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

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

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

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

$$c_{\max} = \frac{2418}{0.9 \cdot 40 \cdot 28} = 4.48 \text{ kg/cm}^2$$

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

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

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

$$A_f' = A_f = 0.00260 \cdot 95.5 \cdot 40 = 14.4 \text{ cm}^2 < 8 \phi 16 + 2 \phi 10$$

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

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

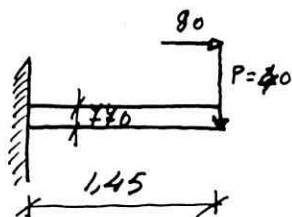
$$M^+ = 7105; \quad \eta = \frac{28}{\sqrt{\frac{71050}{4}}} = \frac{28}{100} = 0.280 < \frac{60}{249}$$

$$A_f' = A_f = 0.00279 \cdot 100 \cdot 40 = 19.8 < 10 \phi 16$$

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.t.)

Luce max: trave 3-4; $l = 335 \text{ cm}$; $Sez. = 30 \times 50 \text{ cmq.}$



$$M_t = \frac{40 \cdot 1.45^2}{2} + 40 \cdot 1.45 + 90 = 963 \text{ kgm/m.}$$

$$M_i = \frac{963 \cdot 3.35}{2} = 1610 \text{ kgm.}$$

$$\frac{Q}{S} = \frac{50}{30} = 1.67 \rightarrow \psi = 4.25.$$

$$\epsilon_{max} = \frac{161000 (25+45)}{25 \cdot 45 \cdot 1400} = 13.7 \text{ kg/cm.}$$

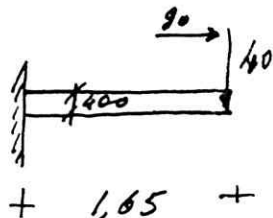
$$A_{st} = \frac{161000 (25+45)}{25 \cdot 45 \cdot 1400} = 4.95 \text{ cmq}$$

$$\Delta_2 = \frac{2 \cdot 25 \cdot 45 \cdot 1400 \cdot 0.49}{161000} = 15.4 \text{ cm.}$$

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; $l = 565 \text{ cm}$; $Sez. = 40 \times 60 \text{ cmq.}$



$$M_t = \frac{40 \cdot 1.65^2}{2} + 40 \cdot 1.65 + 90 = 406 \text{ kgm/m.}$$

$$M_i = \frac{406 \cdot 5.65}{2} = 1980 \text{ kgm.}$$

$$\Sigma_{max} = \frac{4,33 \cdot 198000}{60 \cdot 40^3} = 8,95 \text{ kg/cm}^2$$

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

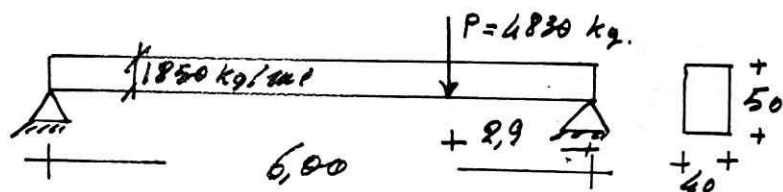
$$A_{fl} = \frac{198000 (35+55)}{35 \cdot 55 \cdot 1400} = 6,68 \text{ cm}^2$$

$$\Delta_2 = \frac{8 \cdot 35 \cdot 55 \cdot 1400 \cdot 0,49}{198000} = 21,4 \text{ cm}$$

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

Travi a spessore: Si disponiamo in corrispondenza di ogni appoggio 4 $\phi 18$ perpendicolari alle travi.

Travi 13-21; 14-22 (semininterrato)



$$M_{max} = \frac{1850 \cdot 36}{12} + \frac{4830 \cdot 2,9 \cdot 3,1^2}{36} = 5550 + 3760 = 9310 \text{ kgm}$$

$$e = \frac{48}{\sqrt{\frac{93100}{4}}} = \frac{48}{158} = 0,316 < \frac{53}{0,00240}$$

$$A'_f = A_f = 0,00240 \cdot 158 \cdot 40 = 14,6 \text{ cm}^2 < 7 \phi 16 + 2 \phi 10$$

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

$$e = \frac{48}{\sqrt{\frac{58350}{4}}} = \frac{48}{188} = 0,394 < \frac{48}{0,00200}$$

$$A'_f = 0,50 A_f = 0,00200 \cdot 188 \cdot 40 = 9,8 \text{ cm}^2 < 5 \phi 16$$

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

$$\Sigma_{max} = \frac{7965}{1720} = 4,68 \text{ kg/cm}^2$$

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

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

Trave 21-22; 13-14 (seminterrato)

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

$$A_f = 0,00148 \cdot 40 \cdot 86,5 = 6,15 \text{ cmq} < 3 \phi 16 + 2 \phi 10$$

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

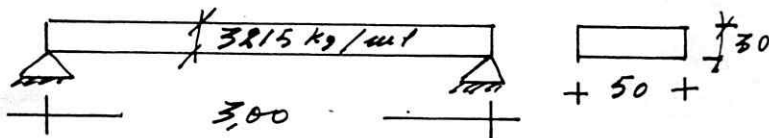
$$A_f = 0,00134 \cdot 40 \cdot 64 = 3,65 \text{ cmq} < 2 \phi 16$$

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

$$S = \frac{4,35 \cdot 40 \cdot 150}{2} = 13000 \text{ kg}; \quad u_p = \frac{5200}{3960} \approx 2 \phi 16$$

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

Trave 13-14 (seminterrato)



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

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

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

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

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

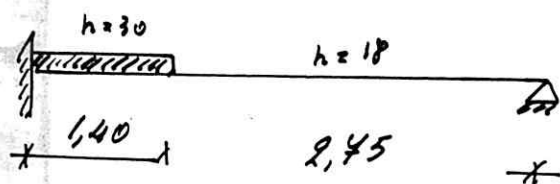
$$M^+ = \frac{3215 \cdot 9}{14} = 2040 \text{ kgm};$$

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

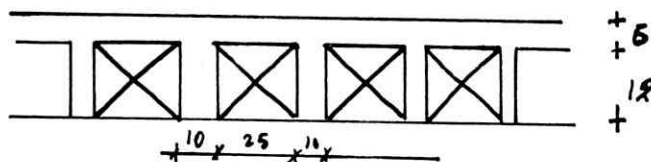
$$A_f = 0,00181 \cdot 64,5 \cdot 50 = 5,85 \text{ cmq} < 3 \phi 16$$

Scala (rampa tipo)

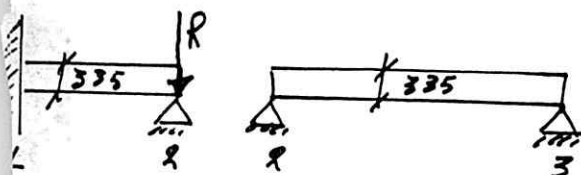
37



Soletta rampante unita



Schema di calcolo



Analisi dei carichi

p. proprio	250 kg/mq
gradini rip.	200 "
pav. unita	100 "
Sommatorio	400 "
	950 kg/mq

Carico della soletta rampante:

per travetto

$$950 \times 0,35 = 335 \text{ kg/m}$$

$$M_2 = M_3 = M_{2-3} = \frac{1}{2} \cdot 335 \cdot 2,45^2 = 222 \text{ kgm}$$

$$\eta' = \frac{16}{\sqrt{2220}} = \frac{16}{47} = 0,341 < \begin{matrix} 50,5 \\ 0,00825 \end{matrix}$$

$$A_f' = A_f = 0,00825 \cdot 47 \cdot 10 = 1,06 \text{ cmq} < 1 \phi 14$$

$$R = \frac{335 \cdot 2,45}{2} = 460 \text{ kg} ; \quad \epsilon_{max} = \frac{460}{0,9 \cdot 10 \cdot 16} = \frac{460}{144} = 3,18 \text{ kg/cm}^2$$

1 $\phi 14$ sagomato.

Calcolo del pianerottolo:

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

$$\eta' = \frac{28}{\sqrt{9720}} = \frac{28}{98,5} = 0,284 < \begin{matrix} \eta_c < 60 \\ \eta = 0,00849 \end{matrix}$$

$$A_f' = A_f = 0,00849 \cdot 10 \cdot 98,5 = 2,46 \text{ cmq} < 2 \phi 14$$

$$T = 335 \cdot 1,4 + 480 = 440 + 480 = 920 \text{ kg}$$

$$\epsilon = \frac{920}{0,9 \cdot 10 \cdot 28} = 3,83 \text{ kg/cm}^2 ; \quad 1 \phi 14 \text{ sagomato}$$

Dott. Ing. Augusto Romita

Augusto Romita