AUTONOMO CASE POPOLARI

BRINDISI

LEGGE 27-5-1975-N166 | PROGRAMMA DI INTERVENTO 001/43/1

progetto per la costruzione di alloggi popolari in brindisi quartiere s. elia est

FABBRICATO 3 ALLOGGI 50 DA VANI 6 = VANI 300

CALCOLO STRUTTURE IN C.A.

TAV. R 1	RELAZIONE DI CALCOLO
RAPP.	
PROGETTO	ufficio progettazione i. a. c. p.
CALCOLI IN C.A.	dott. ing. pantaleo tommasi
IMPRESA	tommasi benvenuto
caratteristiche dei materiali	calcestruzzo R 250 ferro FeB 32 cemento a q.li 3 in fondazione calcestruzzo R 200 ferro FeB 22 cemento a q.li

AUTONOMO CASE POPOLARI per la PROV. BRINDISI

DATA OTT. 197

STUDIO TECNICO
Dott. Ing. Pantaleo Tommasi
Via 13 Giugno, 38 - Tel. 873104
73021 CALIMERA (Le)

TRAV. 1-2-3-4- b = 80
COPERTURA U.TINO PIANO h = 25
ANALISI DEI CARICHI

Campata 1-2	p.p. trave	500	kg/ml
	sovraccarico	150	"
	parapetto 0,10x2500x1,30	325	"
	solaio $\frac{4,70 \times 750}{2}$	1765	"
		2735	=
		2750	kg/ml
Campata 2-3	p.p. trave	500	kg/ml
	sovraccarico	200	"
	solaio $\frac{4,70 \times 750}{2}$	1765	"
	sol. a sbalzo 1,35x900	1215	"
	parapetto	180	"
		3850	kg/ml
Campata 3-4	p.p. trave	500	kg/ml
	sovraccarico	200	"
	parapetto	400	"
	solaio $\frac{4,70 \times 750}{2}$	1765	"
	sol. a Sbalzo 1,25x900	1125	"
		3990	=
		4000	kg/ml

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TRAVE 1-2-3-4-

COPERTURA PIANO TIPO

ANALISI D.T CARICHI

Campata 1-2	p.p. trave	500	kg/ml
b = 80	sovraccarico	125	"
h = 25	muratura 250 x 3,00	750	"
	solaio $\frac{4,70 \times 750}{2}$	1765	"
		3140	=
		3150	kg/ml
Campata 2-3	p.p. trave	625	kg/ml
b = 100	sovraccarico	170	"
h = 25	incidenza muratura	400	"
	solaio $\frac{4,70 \times 750}{2}$	1590	"
	parapetto 0,10 x 2500 x x 1,00	250	"
	solaio a sbalzo 1,35 x 900 =	1215	"
		4330	=
		4350	kg/ml
Campata 3-4	p.p. trave	500	kg/ml
b = 80	sovraccarico	200	"
h = 25	muratura	750	"
	solaio $\frac{4,70 \times 750}{2}$	1765	"
	sol. a Sbalzo 1,25x900	1135	"
		4350	kg/ml

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TRAVE 8-7-6-5-

COPERTURA ULTIMO PIANO

ANALISI DEI CARICHI

b = 100

h = 25

Campata	p.p. trave	625	kg/ml
	sovraccarico	250	"
	solaio $\frac{3,50 \times 4,70}{2} \times 750 =$	3075	"
		3950	=
		4000	kg/ml

STUDIO TECNICO
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73021 CALIMERA (Le)

TRAVE 8-7-6-5 — b = 100

COPERTURA PIANO TIPO — h = 25

ANALISI DEI CARICHI

Campata 8 - 7	p.p. trave	625 Kg/ml.
	sovraccarico	250 "
	solaio 1/2(3,50 x 4,70)750	3075 "
		3950 " =
		4000 Kg/ml.
Campata 7-6	p.p. trave	625 Kg/ml.
	sovraccarico	250 "
	solaio 1/2(3,50 x 4,70)750	3075 "
		3950 " =
		4000 Kg/ml.
Campata 6-5	p.p. trave	625 Kg/ml.
	sovraccarico	250 "
	solaio 1/2(3,50 x 4,70)750	3075 "
		3950 Kg/ml. =
		4000 Kg/ml.

STUDIO TECNICO
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73021 CALIMERA (Le)

TRAVE 9-10-11-12-

COPERTURA ULTIMO PIANO

b = 80

H = 25

ANALISI DEI CARICHI

Campata 9-10	p.p. trave	500	kg/ml
	sovraccarico	150	"
	parapetto 0,10x2,50x1,30 =	325	"
	solaio $\frac{750 \times 3,50}{2}$ =	1315	"
		1990	=
		2000	kg/ml
Campata 10-11	p.p. trave	500	kg/ml
	sovraccarico	200	"
	solaio $\frac{750 \times 3,50}{2}$ =	1315	"
	solaio a sbalzo 1,35x900 =	1215	"
	parapetto	250	"
		3480	"
		3500	kg/ml
Campata 11-12	p.p. trave	500	kg/ml
	sovraccarico	200	"
	parapetto	400	"
	solaio $\frac{3,50 \times 750}{2}$ =	1315	"
	solaio a sbalzo 1,25 x 900=	1125	"
		3540	=
		3550	kg/ml

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TRAVE 9-10-11-12- b = 80
COPERTURA-PIANO TIPO h = 25
ANALISI DEI CARICHI

Campata 9-10	p.p. trave	500	kg/ml
	sovraccarico	125	"
	muratura 250x3,00 =	750	"
	solaio $\frac{750}{2}$ x 3,50	1315	"
		2690	=
		2700	kg/ml
Campata 10-11	p.p. trave	500	kg/ml
	sovraccarico	150	"
	incidenza muratura	970	"
	solaio $\frac{750}{2}$x3,50+900x1,35 =	2530	"
	parapetto 0,10x1,00x2500 =	250	"
		4000	kg/ml
Campata 11-12	p.p. trave	625	kg/ml
	sovraccarico	250	"
	muratura 2,50 x 3,00 =	750	"
	Solaio$(\frac{3,40}{2} + 1,20)750$ =	1275	"
	solai a sbalzo 1,15x900 =	1035	"
		3936	=
		4000	kg/ml

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73021 CALIMERA (Le)

TRAVE 1-8-9-

COPERTURA ULTIMO PIANO

ANALISI DEI CARICHI

Campata 1-8	p.p. trave 0,50x0,80x2500 =	500	kg/ml
b = 80	sovraccarico	175	"
h = 25	parapetto	250	"
		1400	=

Campata 8-9	p.p. trave	375	kg/ml
b = 60	sovraccarico	125	"
	parapetto	250	"
		1250	kg/ml

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73021 CALIMERA (Le)

TRAVI 1-8-9

COPERTURA PIANO TIPO

ANALISI DEI CARICHI

Campata 1-8	p.p. trave 0,25x0,80x2500 =	500	kg/ml
b = 80	sovraccarico	150	"
h = 25	muratura	750	"
		1400	kg/ml

Campata 8 - 9	p.p. trave 0,25x0,60x2500 =	375	kg/ml
b = 60	sovraccarico	100	"
h = 25	muratura	750	"
		1225	=
		1250	kg/ml

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73021 CALIMERA (Le)

TRAVE 4-5-12-0- b = 60

COPERTURA ULTIMO PIANO h = 25

ANALISI DEI CARICHI

Campata 4- 5

p.p. trave		375 Kg/ml.
muratura portante	375 x 2,50 =	935 "
parapetto	0,30 x200 =	60 "
solaio	$\frac{550 \times 2,40}{2}$ =	660 "
pianerottolo	$\frac{1,35 \times 900 \times 2,40}{2 \times 5,50}$ =	265 "
		2295 =
		2300 Kg/ml.

Campata 5 - 12

p.p. trave		375 Kg/ml.
muratura	$\frac{3,50 \times 375 \times 3,00}{4,20}$ =	940 "
parapetto passerella	$\frac{250 \times 1,00}{4,20}$ =	60 "
parapetto	$\frac{0,30 \times 200 \times 3,00}{4,20}$ =	50 "
solaio	$\frac{2,40 \times 550 \times 3,00}{2 \times 4,20}$ =	470 "
incidenza muratura	=	190 "
passerella	$\frac{0,65 \times 900 \times 2,40}{2 \times 4,20}$ =	170 "
pianerottolo	$\frac{900 \times 3,00 \times 2,40}{2 \times 4,20}$ =	775 "
		3030 " =
		3100 Kg/ml.

Sbalzo

p.p. sbalzo		375 "
passerella	$\frac{0,95 \times 900 \times 2,40}{2 \times 1,50}$ =	684 "
parapetto	1,60 x 250 =	400 "
		1459 Kg/ml. =
		1500 Kg/ml.

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73021 CALIMERA (Le)

TRAVE 5 – 12 – 0 → b = 60

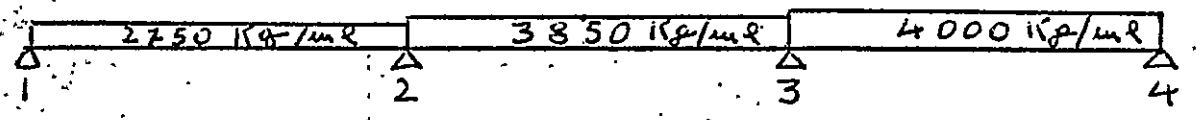
COPERTURA PIANO TIPO h = 25

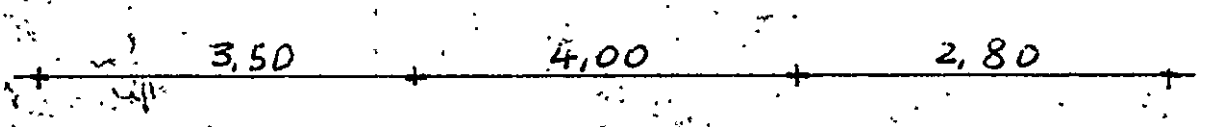
ANALISI DEI CARICHI

P.P. trave	0,60 x 0,25 x 2500 =	375 Kg/ml.
sovraccarico	=	100 "
muratura 250 x 3,00	=	750 "
		1225 " =
		1250 Kg/ml.

TRAVE 1-2-3-4 COPERTURA PIANO ULTIMO

b = 80
h = 25





0,592	0,5333	0,466	0,411	0,588	0,645
-2807 I	I +2807	-5133 I	I +5133	-2613 I	I +2613
+1661 II →	III +830				
+388 III ←	II +796	+696 II →	III +348		
-235 II →	III -117	-589 III ←	II -1178	-1686 II →	III -843
+188 III ←	II +376	+328 II →	III +164	-570 III ←	II -1141
-111 II →	III -55	+83 III ←	II +166	+238 II →	III +119
-7 III ←	II -14	-13 II →	III -6	-38 III ←	II -76
+5 II →	III +3	+9 III ←	II +18	+25 II →	III +12
-3 III ←	II -6	-5 II →	III -2	-4 III ←	II -8
+2 II →	III +1	+1 II	II +2	+4 II →	III +2
	II -1	-1 II			II -1
-910	+4620	-4622	+4681	-4644	+678

1000 | 4800 | 4900 | 1000

4812 ± 1059 | 7700 ± 15 | 5600 ± 1416

3753 | 5871 | 7685 | 7715 | 7016 | 4184

1650 / 1871

30 47 / 3422

1509 / 1742

Af = 2,98 Gc = 32

Af = 5,63 Gc = 45

Af = 14,71 Af' = 3,35 Gc = 70

Af = 10,46 Gc = 64

Af = 15,12 Af' = 7,56 Gc = 71

Af = 5,16 Gc = 43

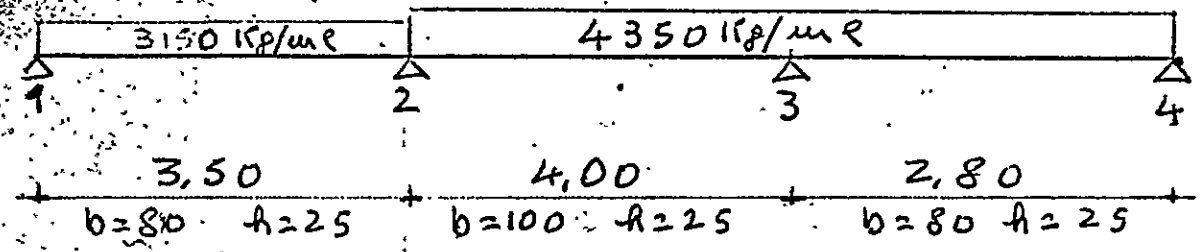
Af = 2,98 Gc = 32

τ = 3,1 kg/

STAFFE φ 8/20

A 4 BRACCIA

$\frac{Gc}{Gf} = \frac{85}{1600}$



3,50 | 4,00 | 2,80

b=80 h=25 | b=100 h=25 | b=80 h=25

0,401 | 0,477 | 0,522 | 0,466 | 0,533 | 0,421

-3215 I | I+3215 | -5800 I | I+5800 | -2842 I | I+2842

+1289 II → III + 644

+462 III ← II +825 | +1012 II → III +506

-185 II → III -92 | -817 III ← II -1611 | -1846 II → III -923

+216 III ← II +433 | +474 II → II +237 | -403 III ← II -807

-86 II → III -43 | +39 II ← II +77 | +88 II → III +44

+1 III ← III +2 | +2 II → II +1 | -9 III ← II -19

+2 III ← II +4 | +4 II → III +2

-1518 | +5084 | -5088 | +5011 | -5008 | +1139

1600 | 5200 | 5200 | 1200

5512 ± 1018

8700 ± 20

6030 ± 1381

4494 | 6530 | 8720 | 8680 | 7471 | 4709

1687 → 2200

3652 → 3800

1407 → 1500

Af = 4,12 Dc = 41

Af = 6,36 Dc = 48

Af = 18,5 Af' = 8,25 Dc = 67

Af = 11,48 Dc = 60

Af = 16,5 Af' = 8,25 Dc = 67

Af = 5,63 Dc = 45

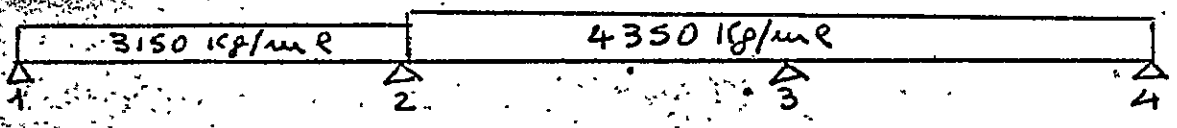
Af = 3,93 Dc = 34

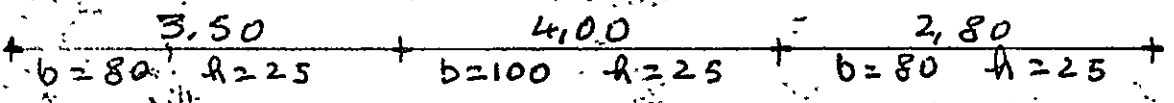
$\frac{Dc}{Df} = \frac{85}{1600}$

$\tau = 4,21 kg/cm^2$

STAFFE $\phi 8/2$

A 4 BRACCIA



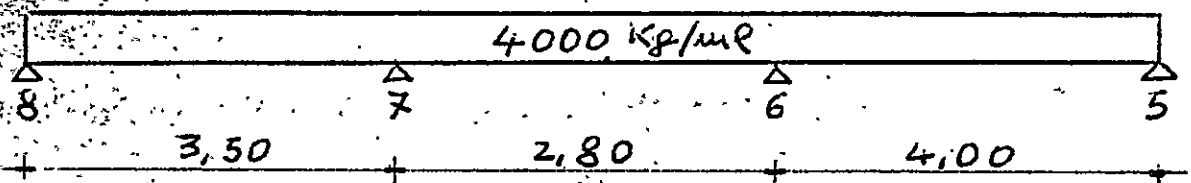


0,421		0,477	0,522		0,466	0,533		0,456
-3215 I		I +3215	-5800 I		I +5800	-2842 I		I +2842
+1353 II	→	III +676						
+455 II	←	II +810	+885 III	→	II +487			
-191 II	→	III -95	-805 III	←	II -1610	-1841 II	→	III -920
+214 III	←	II +429	+469 III	→	III +234	-438 III	←	II -876
-90 II	→	III -45	-47 III	←	II +85	+108 II	→	III +54
		-1	+1			-12 III	←	II -24
			+2 III	←	II +5	+6 II	→	+3
								-1
-1474		+5089	-5091		+5021	-5019		+1078

1500	5200	5200	1200
5512 ± 1032	8400 ± 18	6080 ± 1404	
4480	6544 8718	8682 7497	4683
1711	3645	1441	
2200	3900	1900	

ULTIMO PIANO

h = 25



0,645	0,444	0,555	0,588	0,412	0,544
-4083 I	I + 4083	-2613 I	I + 2613	-5333 I	I + 5333
				-1450 III ←	II - 2901
		+1225 III ←	II + 2451	+1718 II →	III + 859
-588 III ←	II - 1186	-1482 II →	III - 741	-233 III ←	II - 467
+3019 II →	III + 1509	+286 III ←	II + 572	+401 II →	III + 200
-398 III ←	II - 796	-996 II →	III - 498	-54 III ←	II - 108
+257 II →	III + 128	+162 III ←	II + 324	+227 II →	III + 113
-64 III ←	II - 129	-161 II →	III - 80	-30 II ←	II - 61
+41 II →	III + 20	+35 III ←	II + 70	+50 II →	III + 25
-12 III ←	II - 25	-30 II →	III - 15	-7 III ←	II - 13
+8 II →	III + 4	+6 III ←	II + 13	+8 II →	III + 4
-2 III ←	II - 4	-6 II →	II - 3		
-1832	+3594	3574	+4706	-4702	2984

2000 | 3800 | 4500 | 3100

7000 ± 503

5600 ± 404

8000 ± 428

6497 | 7503 | 5196 | 6004 | 8428 | 7572

3444 / 2722

-199 / 1742

4173 / 3555

Af = 5,9 cm² Ge = 42

Af = 10,35 cm² Ge = 51

Af = 11,48 cm² Ge = 60

Af = 5,12 cm² Ge = 31

Af = 15,12 cm² Ge = 63

Af = 12,27 cm² Ge = 58

Af = 9,25 cm² Ge = 52

$\frac{Tc}{Tf} = \frac{85}{1600}$

$\tau = 4$ Kg/cm²

STAFFE $\phi 8/20''$

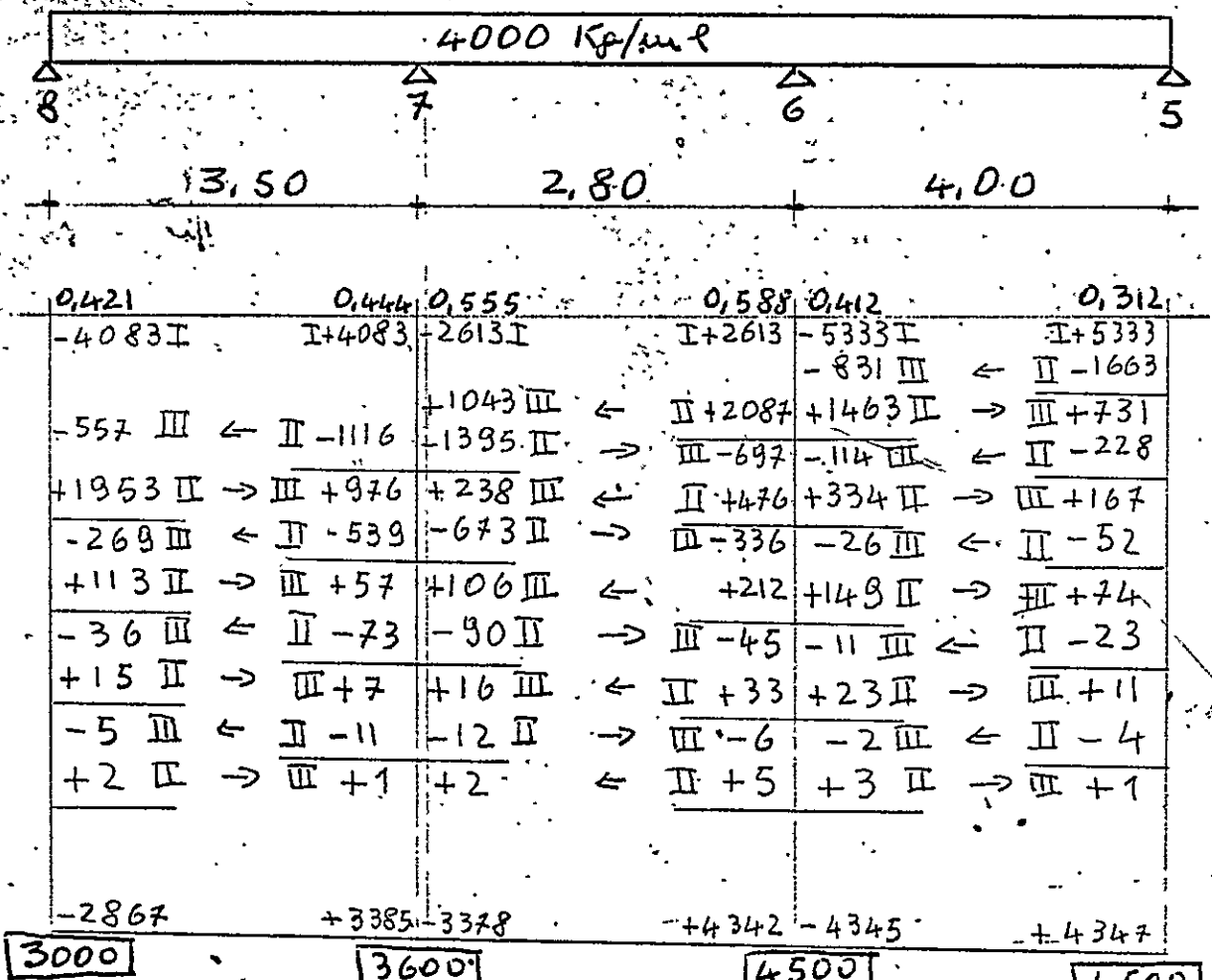
A 4 BRACCIA

CORRENTONI

PIANO TIPO

b = 100

h = 25



0,421	0,444	0,555	0,588	0,412	0,312
-4083 I	I +4083	-2613 I	I +2613	-5333 I	I +5333
				-831 III ←	II -1663
-557 III ←	II -1116	+1043 III ←	II +2087	+1463 II →	III +731
+1953 II →	III +976	-1395 II →	III -697	-114 III ←	II -228
-269 III ←	II -539	+238 III ←	II +476	+334 II →	III +167
+113 II →	III +57	-673 II →	III -336	-26 III ←	II -52
-36 III ←	II -73	+106 III ←	+212	+149 II →	III +74
+15 II →	III +7	-90 II →	III -45	-11 III ←	II -23
-5 III ←	II -11	+16 III ←	II +33	+23 II →	III +11
+2 II →	III +1	-12 II →	III -6	-2 III ←	II -4
		+2 ←	II +5	+3 II →	III +1
-2867	+3385	-3378	+4342	-4345	+4347

3000 | 3600 | 4500 | 4500

7000 ± 148

5600 ± 344

8000 ± 0

6852 | 7148 | 5256 | 5944 | 8000 | 8000

3001 | 2722

74 | 1742

3655 | 3555

$A_f = 8,94$ cmq, $\sigma_c = 51$

$A_f = 8,94$ cmq, $\sigma_c = 51$

$A_f = 10,72$ cmq, $\sigma_c = 58$

$A_f = 5,12$ cmq, $\sigma_c = 31$

$A_f = 13,9$ cmq, $\sigma_c = 66$

$A_f = 11,10$ cmq, $\sigma_c = 59$

$A_f = 13,9$ cmq, $\sigma_c = 66$

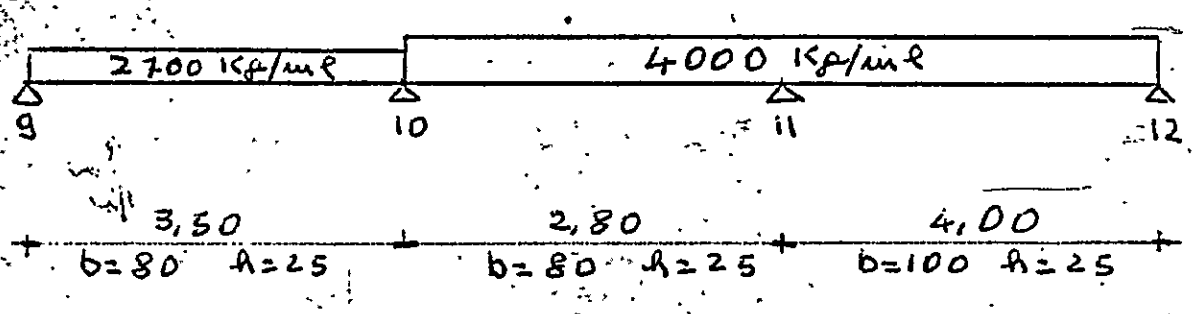
$\frac{\sigma_c}{\sigma_f} = \frac{85}{1600}$

$\tau = 3,8$ Kg/cmq

STAFFE $\phi 8/20''$

A 4 BRACCIA

TRAVE 9-10-11-12 COPERTURA PIANO TIPO



0,421	0,444	0,555	0,533	0,466	0,423
-2756 I	I +2756	-2613 I	I +2613	-5333 I	I +5333
				-1127 II	← II -2255
		+1025 III	← II +2050	+1793 II	→ III +896
-259 III	← II -518	-648 II	→ III -324	-183 III	← II -367
+1269 II	→ III +634	+135 III	← II +270	+236 II	→ III +118
-170 III	← II -341	-426 II	→ III -213	-25 III	← II -50
+72 II	→ III +36	+63 III	← II +126	+110 II	→ III +55
-22 III	← II -44	-55 II	→ III -28	-11 III	← II -23
+9 II	→ III +5	+10 III	← II +21	+18 II	→ III +9
-3 III	← II -7	-8 II	→ III -4	-2 III	← II -4
+1 II	-1	+2 III	← II +4	+2 II	→ III +1
		-1			
-1859	+2520	2516	+4515	4520	+3713

2000 | 2700 | 4700 | 3900

4725 ± 188 | 5600 ± 713 | 8000 ± 201

4537 | 4913 | 4887 | 6313 | 8201 | 7799

1952 | 1837 | 469 | 1742 | 3890 | 3555

$A_f = 5,87$ cm² $\sigma_c = 46$

$A_f = 5,87$ cm² $\sigma_c = 46$

$A_f = 7,99$ cm² $\sigma_c = 55$

$A_f = 5,16$ cm² $\sigma_c = 43$

$A_f = 11,74$; $A_f = 5,87$ $\sigma_c = 62$

$A_f = 9,184$ cm² $\sigma_c = 60$

$A_f = 9,18$ cm² $\sigma_c = 60$

$\tau = 3,9$ Kg/

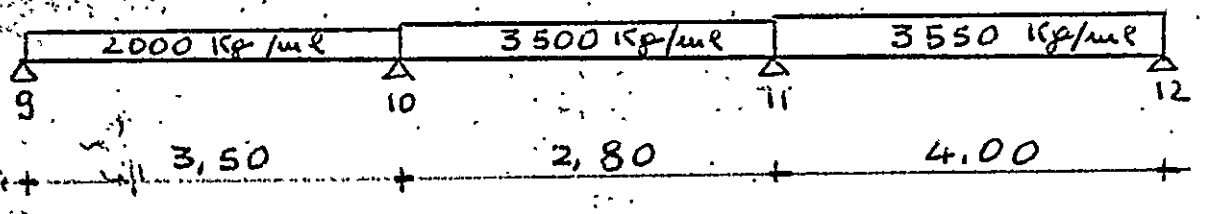
$$\frac{\sigma_c}{\sigma_f} = \frac{85}{1600}$$

STAFFE ϕ 8/20

A 4 BRACCIA

TRAVE 9-10-11-12 — COPERTURA ULTIMO PIANO

b = 80
h = 25



0,592	0,444	0,555	0,588	0,411	0,560
-2041 I	I +2041	-2286 I	I +2286	-4733 I	I +4733
				-1325 III ←	II -2650
		+1108 III ←	II +2217	+1550 II →	III +775
-191 III ←	II -383	-479 II →	III -239	-217 III ←	II -434
+1321 II →	III +66.0	+136 III ←	II +273	+187 II →	III +93
-176 III ←	II -353	-441 II →	III -220	-26 III ←	II -52
+104 II →	III +52	+72 III ←	II +144	+101 II →	III +50
-27 III ←	II -55	-68 II →	III -34	-14 III ←	II -2,8
+16 II →	III +8	+14 III ←	II +28	+20 II →	III +10
-5 III ←	II -10	-12 II →	III -6	-3 III ←	II -6
+3 II →	III +1	+2 III ←	II +5	+4 II →	III +2
	II -1	-2 II			-1
-996	+1960	-1964	+4454	-4456	+2493

1100	2200	4700	2600
3500 ± 275	4900 ± 889	7100 ± 490	
3225	3775 4011	5789 7590	6610
1650 / 1361	333 / 1524	3660 / 3155	
Af = 3,86 cm² Gc = 33	Af = 6,36 Gc = 48	Af = 14,71; A'f = 7,35 Gc = 40	Af = 7,48 Gc = 53
Af = 4,87 cm² Gc = 42	Af = 4,12 cm² Gc = 41	Af = 11; A'f = 5,52 Gc = 61	

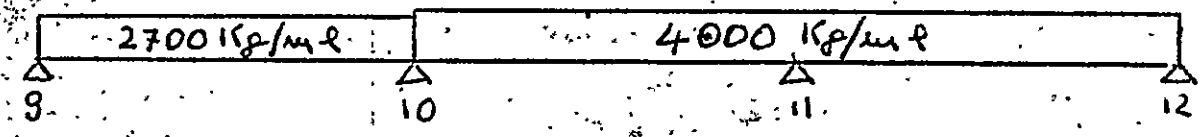
$\frac{Gc}{Gf} = \frac{85}{1600}$

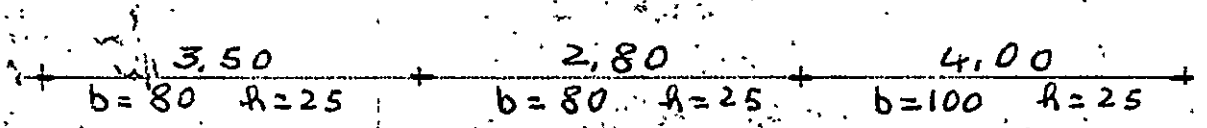
τ = 4,5 Kg/

STAFFE φ 8 /20

A 4 BRACCIA

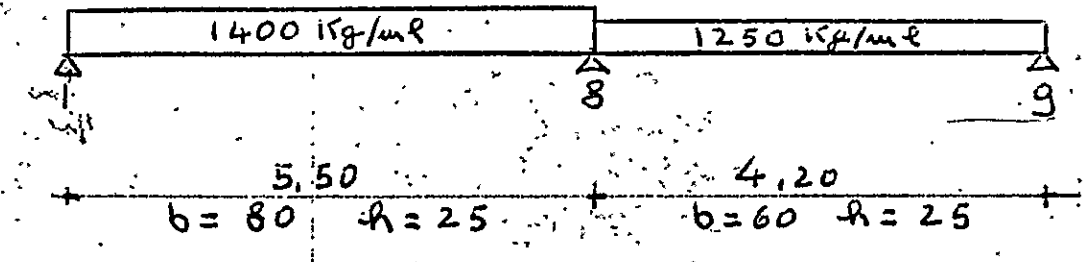
TRAVE 9-10-11-12 I TESA





0,421	0,444	0,555	0,533	0,466	0,412
-2756 I	I +2756	-2613 I	I +2613	-5333 I	I +5333
				-1098 III ←	II -2197
		+1017 III ←	II +2034	+1779 II →	III +889
-257 III ←	II -515	-644 II →	III -322	-183 III ←	II -366
+1268 II →	III +634	+134 III ←	II +269	+235 II →	III +117
-170 III ←	II -340	-426 II →	III -213	-24 II ←	I -48
+71 II →	III +35	+63 III ←	II +126	+110 II →	III +55
-21 III ←	II -43	-54 II →	III -27	-11 III ←	II -22
+9 II →	III +4	+10 III ←	II +20	+17 II →	III +8
-3 III ←	II -6	-8 II →	III -4	-1 III ←	II -3
+2 II →	III +1	+1 III ←	II +3	+2 II →	III +1
-1857	+2526	-2520	-4500	4507	3767

TRAVE 1-8-9 . COPERTURA ULTIMO PIANO



5,50 b = 80 h = 25 | 4,20 b = 60 h = 25

0,480		0,504	0,495		0,476
-3529 I		I +3529	-1837 I		I +1837
+1693 II	→	III +846			
-639 III	←	II -1279	-1256 II	→	II -628
+306 II	→	III +153	-287 III	←	III -575
+34 III	←	II +67	+66 II	→	III +33
-16 II	→	III -8	-8 III	←	II -16
+4 III	←	II +8	+8 II	→	III +4
-2 II	→	III -1	-1 III		II -2
		II +1	+1 II		
-2149		+3316	-3314		+653

2200 | 3500 | 800

3850 ± 212 | 2625 ± 633

3638 | 4062 | 3258 | 1852

2352 | 2576 | 934 | 1225

Af = 6,36 Gc = 48

Af = 7,1 Gc = 53

Af = 10,42 Af' = 5,36 Gc = 60

Af = 3,84 Gc = 43

Af = 2,36 Gc = 32

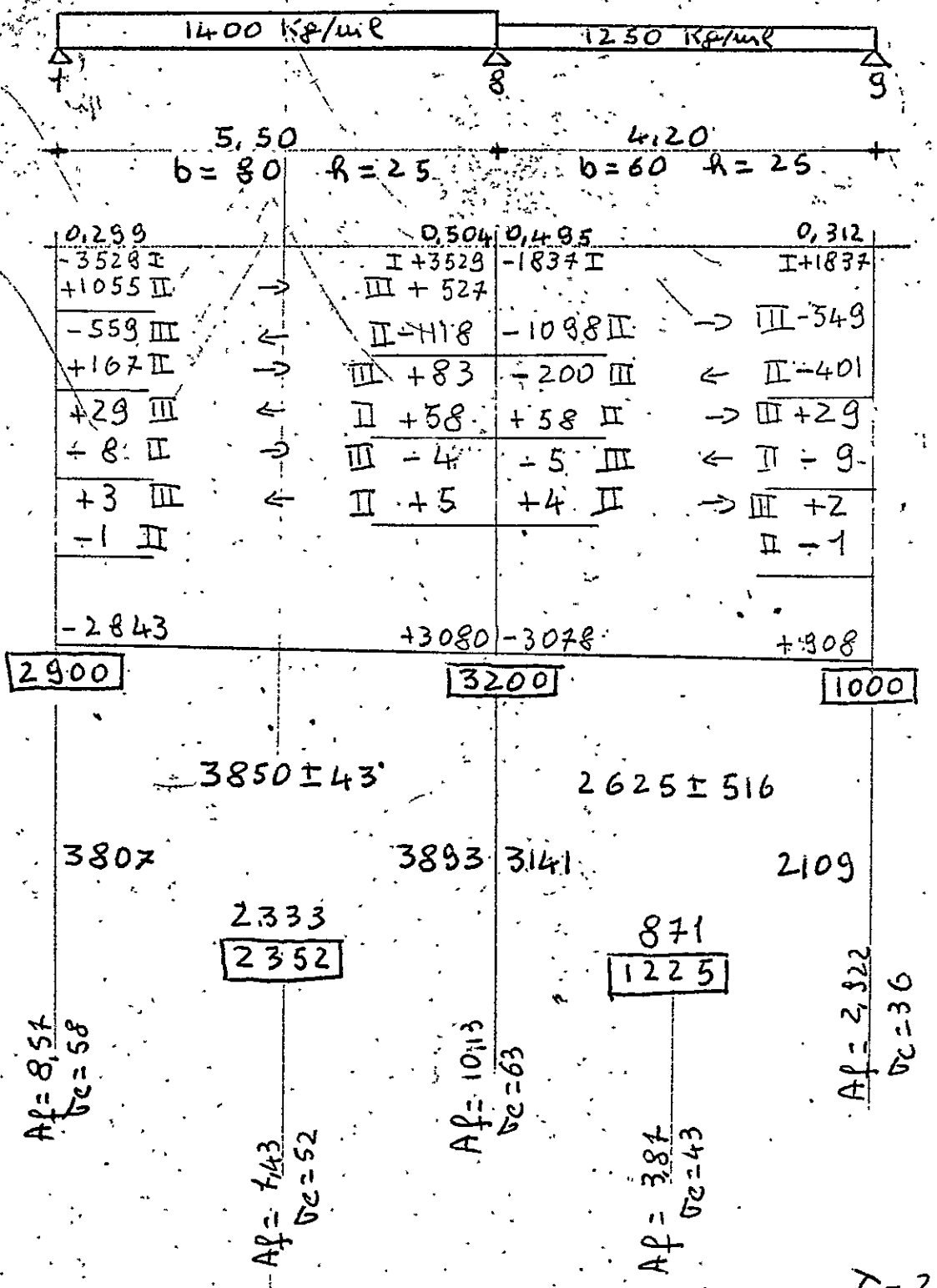
$\tau = 2{,}45$ kg/cm²

STAFFE φ8 /20"

A 4 BRACCIA

$$\frac{\sigma_c}{\sigma_f} = \frac{85}{1600}$$

TRAVE 1-8-9 COPERTURA PIANO TIPO



$\frac{\sigma_c}{\sigma_f} = \frac{85}{1600}$

C = 2,35 kg/

STAFFE φ8/20"

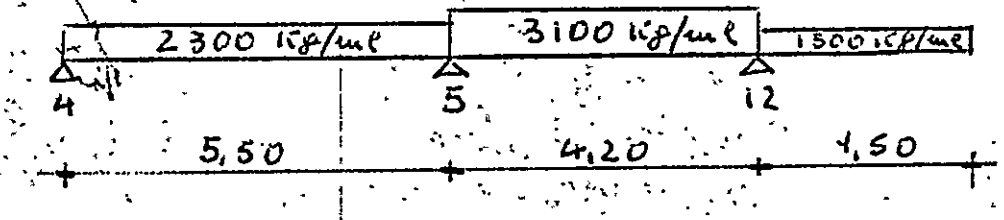
COPERTURA ULTIMO PIANO

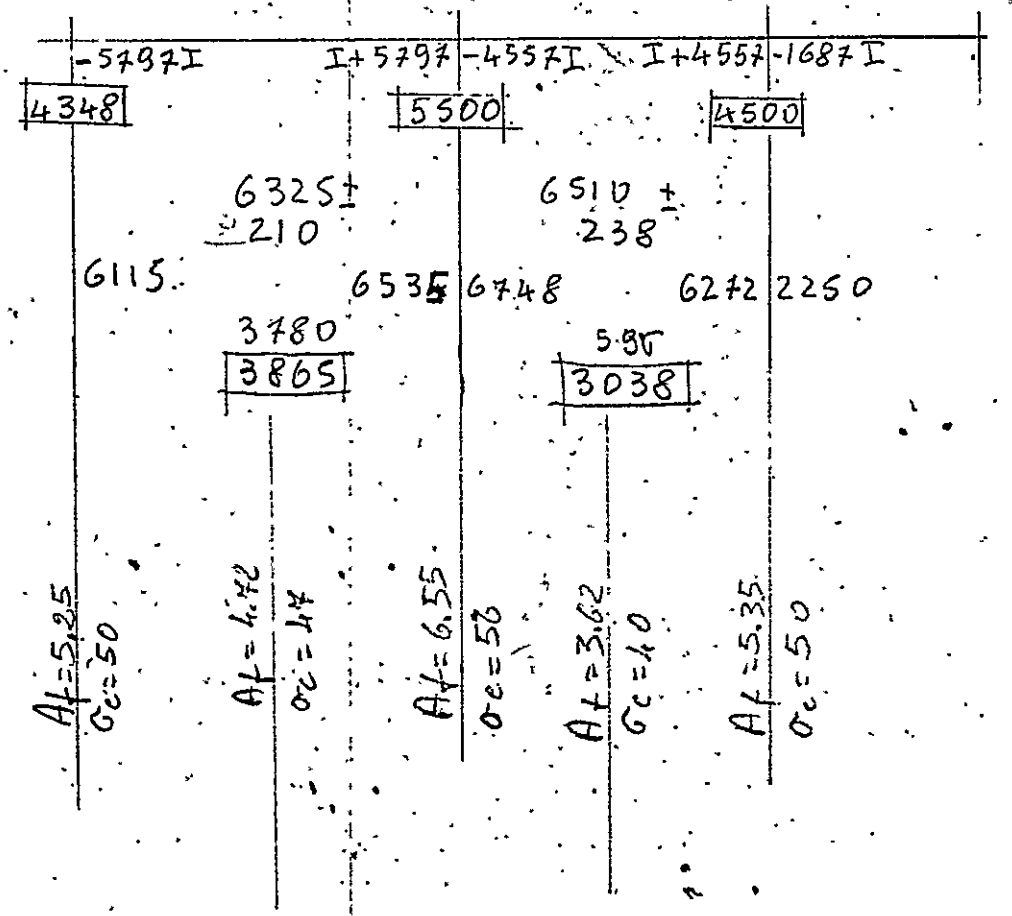
TESA 4

TRAVE 4 - 5 - 12 - 0

b = 60

h = 25





$\tau = 5.26$ Kg/cmq

$S = 13.807$

$S_{staffe} = 6903$

$S_{spilli} = 6.904$

Staffe ϕ 6/20"

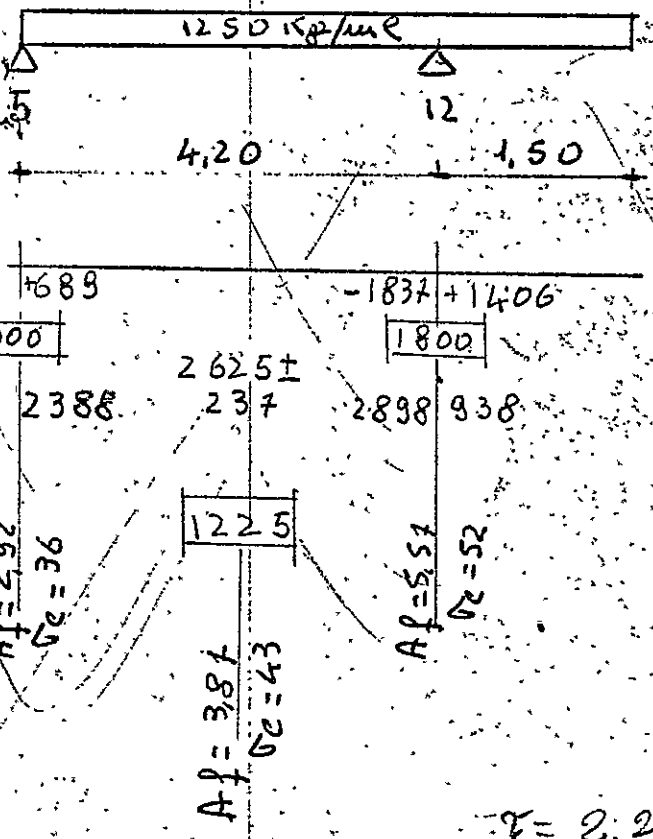
$S_{st} = 1600 \times 0.57 \times 10 = 9120$ Kg

$S_{spilli} = 1600 \times 3.39 \times 1.41 = 7647$ Kg

COPERTURA PIANO TIP

TESE 1-2-3

TRAVE 5-12-0



b=60

h=25

τ= 2,26 Kg/cmq

STAFFE φ6/30"

Balconi piano Tipo

$M = \frac{1}{2} 900 \times \overline{1.50}^2 + 200 \times 1.50 = 1012 + 300 = 1312$ kg·m

$r = \frac{18}{\sqrt{1312}} = \frac{18}{36.22} = 0.497$ $\quad \sigma_c = 42 \quad t = 0.001353$

$A_f = 0.001353 \times 40 \times 36.22 = 1.96$ cmq $\Rightarrow$ 2 ϕ 12 per traverso

Balcone ultimo piano

$M = \frac{1}{2} 900 \times \overline{1.50}^2 + 200 \times 1.50 = 1312$ kg·m

$r = \frac{23}{\sqrt{1312}} = \frac{23}{36.22} = 0.635$ $\quad \sigma_c = 31 \quad t = 0.001019$

$A_f = 0.001019 \times 40 \times 36.22 = 1.48$ cmq

1 ϕ 10 + 1 ϕ 12 per traverso

Bow-windows

$M = \frac{1}{2} 750 \times \overline{1.50}^2 + 750 \times 1.50 = 844 + 1125 = 1969$ kg·m

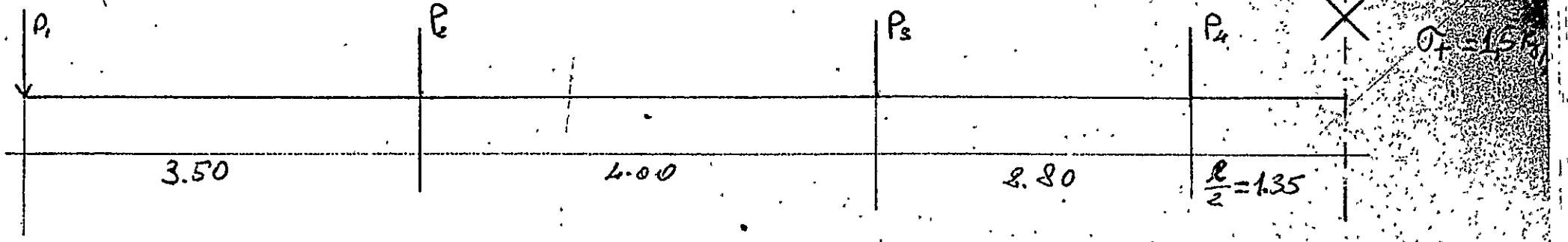
$r = \frac{23}{\sqrt{1969}} = \frac{23}{44.37} = 0.518$ $\quad \sigma_c = 40 \quad t = 0.001294$

$A_f = 0.001294 \times 40 \times 44.37 = 2.30$ cmq

1 ϕ 12 + 1 ϕ 14 per traverso

FONDAZIONI

TRAVE 1-2-3-4-4-3-2-1



$P_1 = 35.386$ Kg

$P_2 = 64.340$ "

$P_3 = 66.608$ "

$P_4 = 50.038$ "

$l_{TOT} = 23.3$ m

$R = 2P_1 + 2P_2 + 2P_3 + 2P_4 = 432.744$ Kg

$H = \frac{1}{4} l_{max} = 1$ m

$b = 50$ cm

$P_p = (2 \times 0.5 + 0.5 \times 0.5) \times 23.3 * 2.500 = 72.813$ Kg

$R_T = 432.744 + 72.813 = 505.557$ Kg

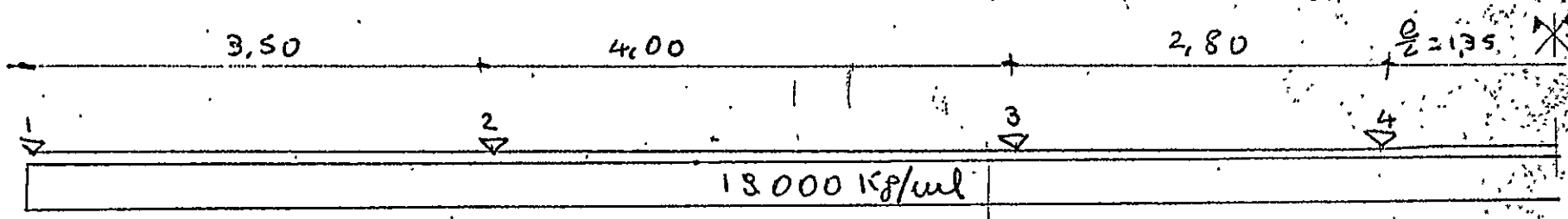
$B = \frac{505.557}{1.5 \times 2330} = 145$ cm $\Rightarrow$ 160 cm

$\sigma_t = \frac{505.557}{160 \times 2330} = 1.35$ Kg/cmq.

$\sigma^* = \frac{432.744}{1.6 \times 23.3} = 11.608$ Kg/cmq

$11.608 \times 1.6 = \frac{432.744}{} = 18572$ Kg/mq $\Rightarrow$ 19.000 Kg/mq.

TRAVE 1-2-3-4-4-3-2-1.



$\mu_{2-1} = \frac{1}{8}\ 18.000 \times 3,5^2 = 29094$ Kgm

$\mu_{2-3} = \frac{1}{12}\ 18.000 \times 4^2 = 25334$ "

$\mu_{3-4} = \frac{1}{12}\ 18.000 \times 2,8^2 = 12414$ "

$\mu_{4-4'} = \frac{1}{12}\ 18.000 \times 2,7^2 = 11543$ "

$W_{2-1} = \frac{3ES}{3,5}$

$W_{2-3} = \frac{4ES}{4} = ES$

$W_{3-4} = \frac{4ES}{2,8}$

$W_{4-4'} = \frac{2ES}{2,7}$

$K_{2-1} = \frac{\frac{3ES}{3,5}}{\frac{3ES}{3,5} + ES} = \frac{\frac{3}{3,5}}{\frac{3}{3,5} + 1} = \frac{0,8571428}{1,8571428} = 0,461$

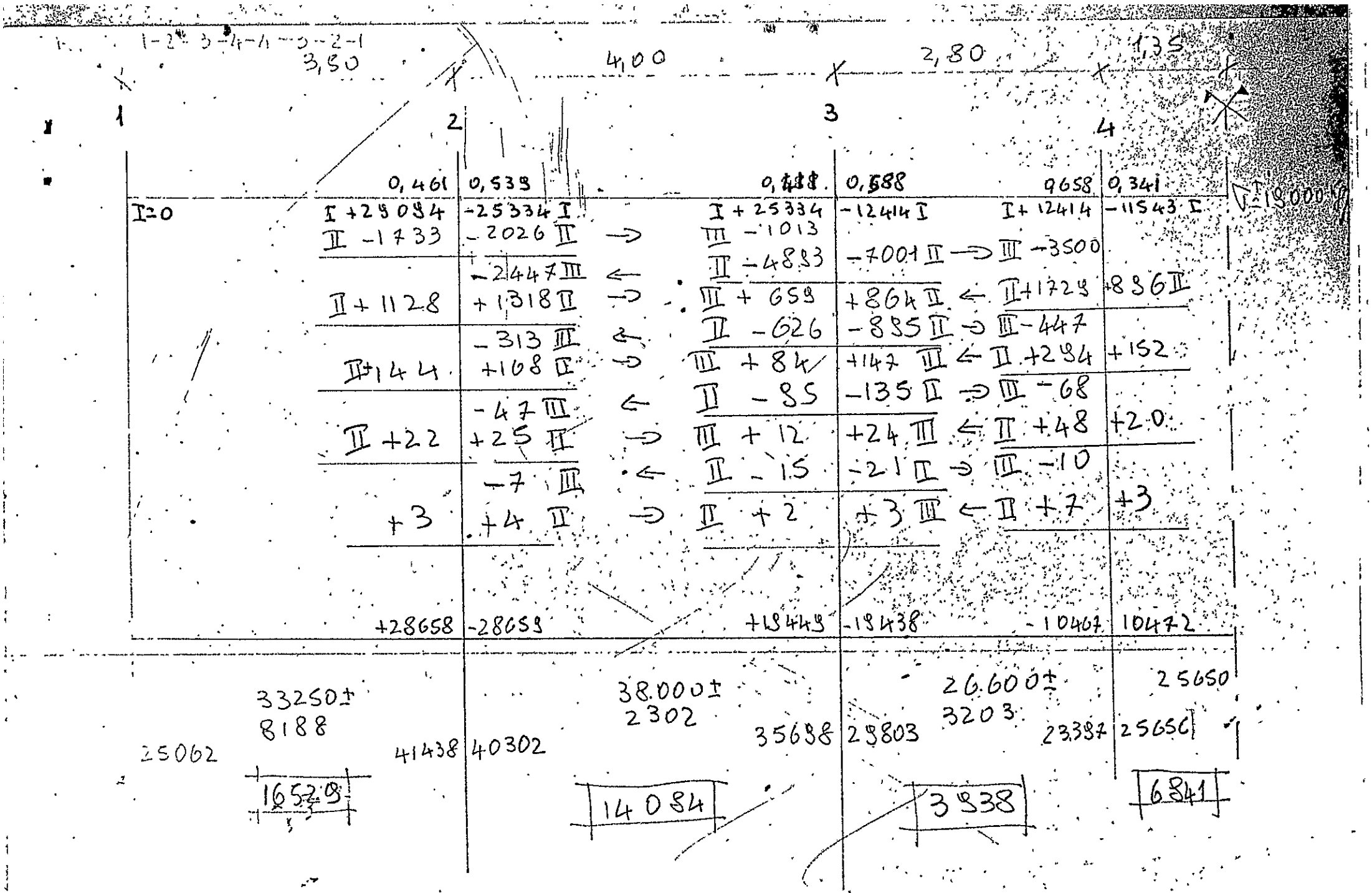
$K_{2-3} = 0,539$

$K_{3-2} = \frac{\frac{4ES}{4}}{ES + \frac{4ES}{2,8}} = \frac{1}{1 + \frac{4}{2,8}} = \frac{1}{2,4285714} = 0,411$

$K_{3-4} = 0,588$

$K_{4-3} = \frac{\frac{4ES}{2,8}}{\frac{4ES}{2,8} + \frac{2ES}{2,7}} = \frac{\frac{4}{2,8}}{\frac{4}{2,8} + \frac{2}{2,7}} = \frac{1,428}{2,1683107} = 0,658$

$K_{4-4} = 0,341$



1-2-3-4-4-3-2-1

3,50 4,00 2,80 1,35

1	2		3		4	
	0,461	0,539	0,418	0,588	0,658	0,341
I=0	I +29094	-25334 I	I +25334	-12414 I	I +12414	-11543 I
	II -1733	-2026 II →	III -1013			
		-2447 III ←	II -4883	-7001 II →	III -3500	
	II +1128	+1318 II →	III +659	+864 II ←	II +1729	+896 II
		-313 III ←	II -626	-885 II →	III -447	
	II +144	+168 II →	III +84	+147 III ←	II +294	+152
		-47 III ←	II -85	-135 II →	III -68	
	II +22	+25 II →	III +12	+24 III ←	II +48	+20
		-7 III ←	II -15	-21 II →	III -10	
	+3	+4 II →	II +2	+3 III ←	II +7	+3
	+28658	-28659	+19449	-19438	-10467	10472

$\sigma = 19000$

33250 ± 8188

25062

16529

41438 | 40302

38.000 ± 2302

14084

35698 | 29803

26.600 ± 3203

3938

23397 | 25656

25650

6841

VERIFICA A TAGLIO

$R_{bk} = 200$

$\sigma_f = 1200$

$\bar{\tau}_{bo} = 4,6$ kg/cm²

TRATTO 1-2

(4)

$T = 41438$ kg

$\tau = \frac{41438}{0,9 \times 60 \times 86} = \frac{41438}{5184} = 7,99 > \bar{\tau}_{bo}$

$4,6 = \frac{T_1}{5184}$; $T_1 = 23847$ kg

$41438 - 19.000x = 23847$; $x = 92$ cm ; $e = 15$

$\ell = 78$ cm

$S = \frac{1}{2}(7,99 + 4,6) \times 78 \times 60 = 28460$ kg

$S_s = 0,45 \times 28460 = 13257$ kg

$S_p = 0,55 \times 28460 = 16203$ "

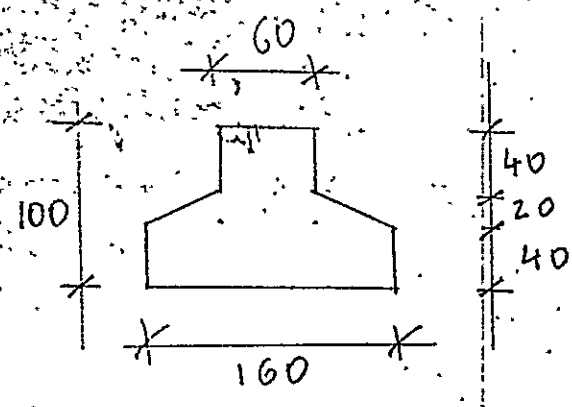
USANDO STAFFE A 4 BR. $\phi 12$

$M_s = \frac{13257}{1200 \times 4 \times 1,13} = 2,44$; $\frac{78}{2,44} = 31,9 \Rightarrow 1\phi 12\ 4\ 80/2$

$M_p = \frac{16203}{1200 \cdot \sqrt{2} \times 2,54} = 3,7 \Rightarrow 4\phi 18$ PIEGATI

ARMATURA TRASVERSALE

(5)



$\sigma = 11608\ Kg/mq$

$l_n = 0{,}5\ m$

$l_e = 0{,}50 + \frac{0{,}30}{4} = 0{,}575\ m$

$M = \frac{1}{2}\, 11608 \times 0{,}575^2 = 1919\ Kg/m$

$h = \frac{47}{\sqrt{1919}} = \frac{47}{43{,}8} = 1{,}07 \rightarrow \sigma_e = 16$

$\rightarrow t = 0{,}00082$

$A_f = 0{,}00082 \times 100 \times 43{,}8 = 3{,}59 \Rightarrow 4\phi 12 = 4{,}52$

$1\phi 12 / 25''$

APPOGGIO:

M = 28.000

$r = \frac{SG}{\sqrt{\frac{2900000}{160}}} = \frac{SG}{134,62} = 0,713$ → $\sigma_c = 24$ → $0,00121$

$A_f = 0,00121 \times 134,62 \times 160 = 26 \text{ cm}^2$ 12 ϕ18

TRATTO 2-3

MEZZERIA

M = 16801

$r = \frac{SG}{\sqrt{\frac{16801000}{60}}} = \frac{SG}{167,83} = 0,572$ → $\sigma_c = 32$ → $\varepsilon = 0,00159$

$A_f = 0,00159 \times 60 \times 167,83 = 16 \text{ cm}^2 \Rightarrow 8\ \phi 18$

APPOGGIO:

M = 20.000,3

$r = \frac{SG}{\sqrt{\frac{2000000}{160}}} = \frac{SG}{111,8} = 0,858$ → $\sigma_c = 20$ → $\varepsilon = 0,00102$

$A_f = 0,00102 \times 160 \times 111,8 = 18,2 \Rightarrow 8\ \phi 18$

TRATTO 3 - 4

MEZZERIA

M = 4725

$r = \frac{8G}{\sqrt{\frac{472500}{60}}} = \frac{8G}{88,74} = 1,08$ → Dc = 16

→ t = 0,00082

$A_f = 0,00082 \times 60 \times 88,74 = 4,36$

TRATTO 4 - 4

MEZZERIA

M = 8210

$r = \frac{8G}{\sqrt{\frac{821000}{60}}} = \frac{8G}{116,87} = 0,820$ → Dc = 21

→ t = 0,00107

$A_f = 0,00107 \times 116,87 \times 60 = 7,5$ 5 ϕ 18

2,12

APPOGGIO

M = 11.000

$r = \frac{8G}{\sqrt{\frac{1100000}{160}}} = \frac{8G}{82,9} = 1,158$ → Dc = 15

→ t = 0,00077

$A_f = 0,00077 \times 82,9 \times 160 = 10,2$ cm² 6 ϕ 18

MEZZERIA 1-2

$M = 19\,835$ Kg · m

$$r = \frac{96}{\sqrt{\frac{1.986.500}{60}}} = \frac{96}{181.95} = 0.472 \qquad \sigma_c = 40 \qquad t = 0.00195$$

$$A_f = 0.00195 \times 60 \times 181.95 = 21.28 \Rightarrow 10\ \phi\ 18$$

$\psi = 18.000$ kg/cm²

VERIFICA A TAGLIO

TRATTO 3 - 4

$R_{bk} = 200$

$\sigma_f = 1200$ kg/cm² $\quad \sigma_0 = 4,6$

$T = 28803$ kg

$\tau = \frac{28803}{0,9 \times 60 \times 80} = 5,7$ kg/cm² $> 4,6$ kg/cm²

$4,6 = \frac{T_1}{5184}$; $T_1 = 23846,4$

$28803 - 18.000\,x_e = 23847$; $x_e = 0,31$ $\quad e = 15$ cm

$\ell = 16$ cm

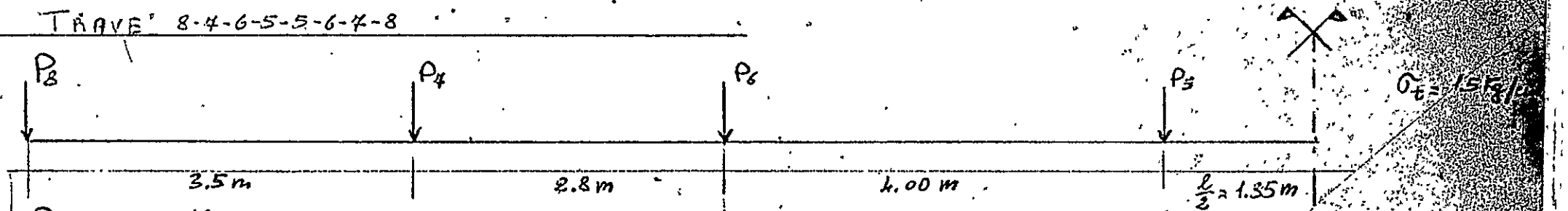
$S = \frac{1}{2}(5,7 + 4,6) \times 16 \times 60 = 4844$ kg

$S_s = 0,45 \times 4844 = 2225$ kg

$S_p = 0,55 \times 4844 = 2719$ kg

$A_p = \frac{2719}{1200 \cdot \sqrt{2} \times 2,54} = 0,63 \Rightarrow 1\,\phi 18$

TRAVE 8-4-6-5-5-6-7-8



$P_8 = 58.815$ Kg
$P_4 = 53.271$ "
$P_6 = 59.604$ "
$P_5 = 79.404$ "

$l_{tot.} = 23.3$ m.

$R = 2P_8 + 2P_4 + 2P_6 + 2P_5 = 502.188$ Kg.

$P_p = (2 \times 0.5 + 0.5 \times 0.65) \times 23.3 \times 2500 = 44.181$ Kg.

$R_t = 502.188 + 44.181 = 546.369$ Kg.

$\sigma' t = \frac{R_t}{B \cdot L}$ $\quad B = \frac{546.369}{1.5 \times 23.30} = 165.7$ cm $\Rightarrow$ 180 cm

$H = \frac{1}{4} l_{max} = 1$ m

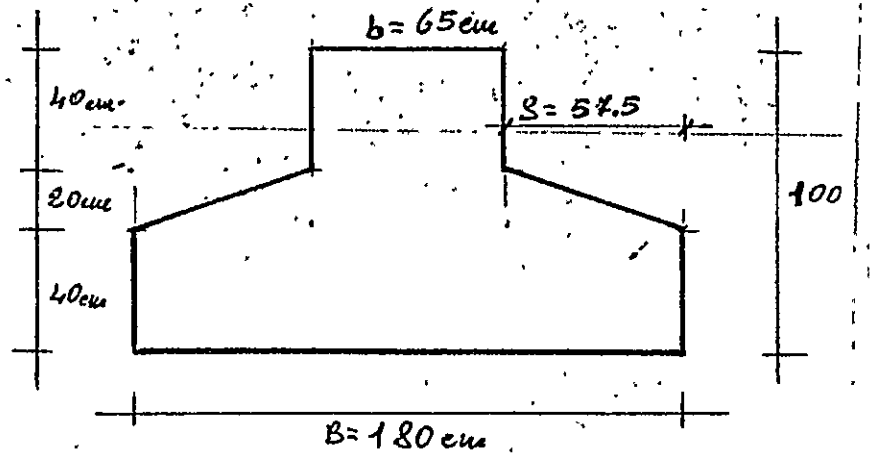
$b = 65$ cm

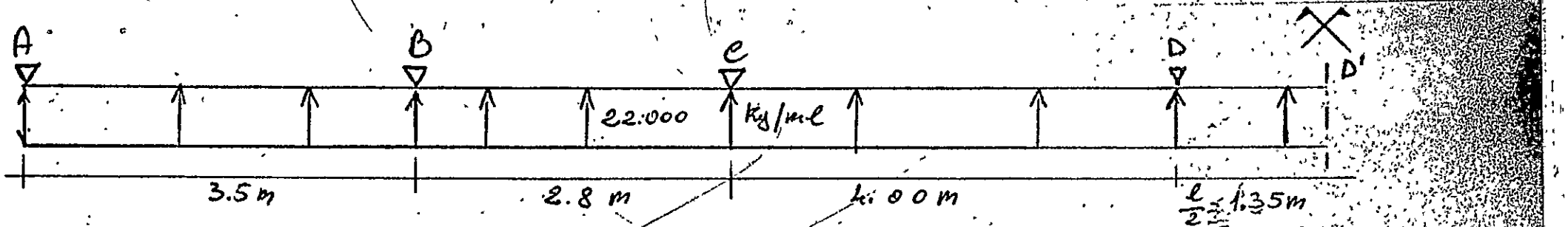
$S = \frac{1}{2}(180 - 65) = 57.5$ cm.

$\sigma t = \frac{546.369}{180 \times 2330} = 1.38$ Kg/cmq.

$\sigma^* = \frac{502.188}{1.8 \times 23.3} = 11.973$ Kg/cmq.

$\sigma^* \times 1.8 = \frac{R}{L} = 21.553$ Kg/ml $= 22.000$ Kg/ml





$\mu_{BA} = \frac{1}{8} 22.000 \times 3.5^2 = 33.688$ Kg/m

$\mu_{Be} = \frac{1}{12} 22.000 \times 2.8^2 = 14.344$ "

$\mu_{De} = \frac{1}{12} 22.000 \times 4.00^2 = 29.334$ "

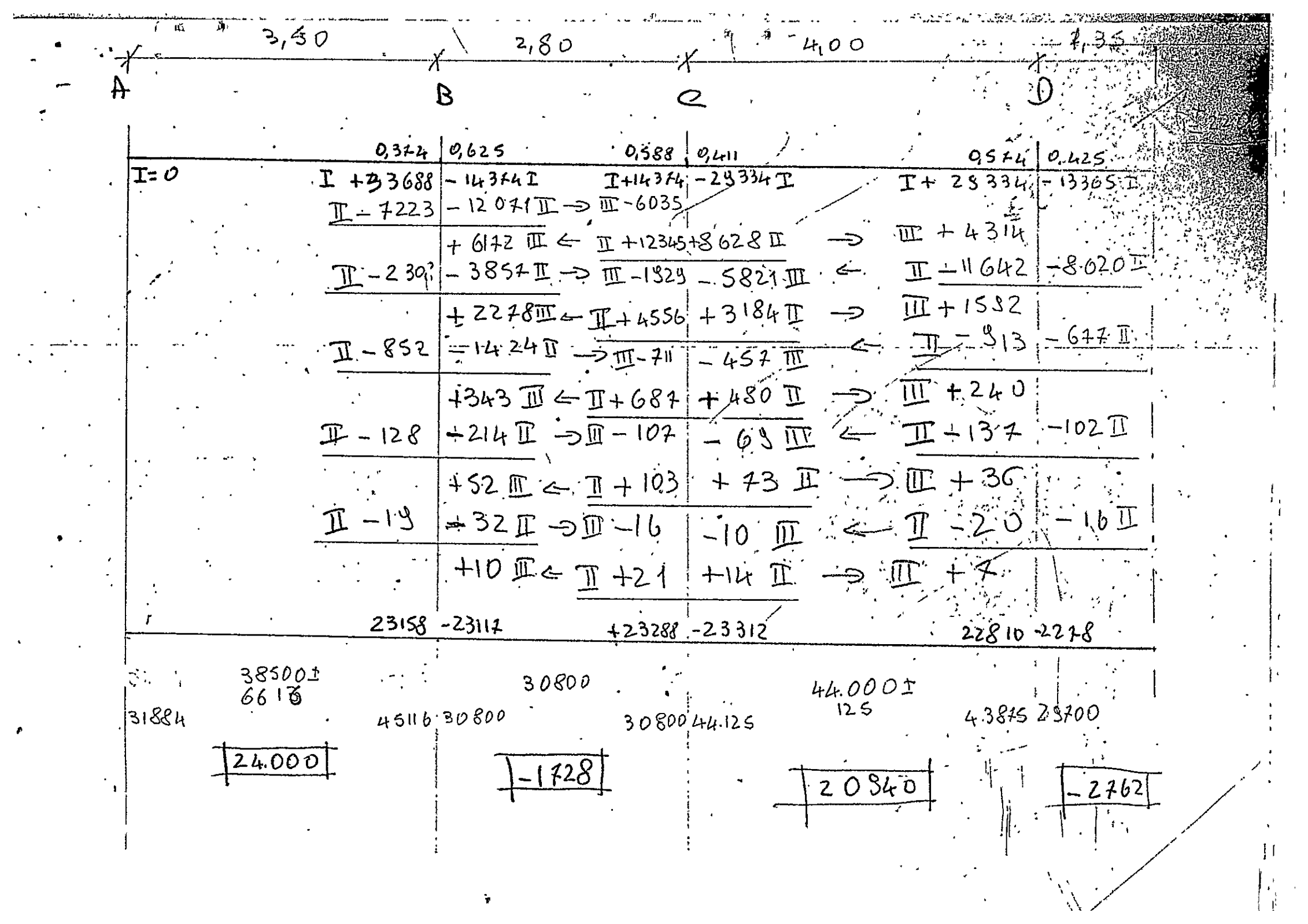
$\mu_{DD'} = \frac{1}{12} 22.000 \times 2.7^2 = 13.365$ "

$W_{BA} = \frac{3EJ}{3.5}$ $W_{Bc} = \frac{4EJ}{2.8}$ $W_{eD} = EJ$ $W_{D.D'} = \frac{2EJ}{2,7}$

$K_{BA} = \frac{\frac{3EJ}{3.5}}{\frac{3EJ}{3.5} + \frac{4EJ}{2.8}} = \frac{\frac{3}{3.5}}{\frac{3}{3.5} + \frac{4}{2.8}} = 0.374$ $K_{Be} = 0.625$

$K_{eB} = \frac{\frac{4EJ}{2.8}}{\frac{4EJ}{2.8} + EJ} = \frac{\frac{4}{2.8}}{\frac{4}{2.8} + 1} = 0.588$ $K_{eD} = 0.411$

$K_{De} = \frac{EJ}{EJ + \frac{2EJ}{2,7}} = \frac{1}{1 + \frac{2}{2.7}} = \frac{1}{1.74074} = 0.574$ $K_{DD'} = 0.425$


3,50
2,80
4,00
7,35
A
B
C
D
0,374
0,625
0,588
0,411
0,574
0,425
I=0
I +23688
-14374 I
I+14374
-29334 I
I+29334
-13305 I
II -7223
-12071 II → III -6035
+6172 III ← II +12345+8628 II → III +4314
II -2307
-3857 II → III -1929
-5821 III ← II -11642
-8020 II
+2278 III ← II +4556
+3184 II → III +1582
II -852
-1424 II → III -711
-457 III ← II -913
-677 II
+343 III ← II +687
+480 II → III +240
II -128
-214 II → III -107
-69 III ← II -137
-102 II
+52 III ← II +103
+73 II → III +36
II -19
-32 II → III -16
-10 III ← II -20
-16 II
+10 III ← II +21
+14 II → III +7
23158 -23117
+23288 -23312
22810 -2278
38500 I
6618
31884
24.000
45116 30800
30800
-1728
30800 44.125
44.000 I
125
20840
43875 25700
-2762

TRATTO 8-7

$R_{bk} = 200$
$\sigma_f = 1200$ $\Rightarrow \sigma_{bo} = 4,6$ kg/cmq

$T = 45116$ kg $\quad e = 3,50$ m

$C = \frac{45116}{0,9 \times 0,5 \times 86} = \frac{45116}{5016} = 8,03$ kg/cmq $> \sigma_{bo}$

$4,6 = \frac{T_1}{5016}$; $T_1 = 25834$ kg

$45116 - 22.000 x = 25834$; $x = 87$ cm $\quad e = 15$

$f = 87 - 15 = 72$

$S = \frac{1}{2}(8,03 + 4,6) \times 72 \times 69 = 29554$ kg

$S_S = 0,45 \times 29554 = 13299$ kg

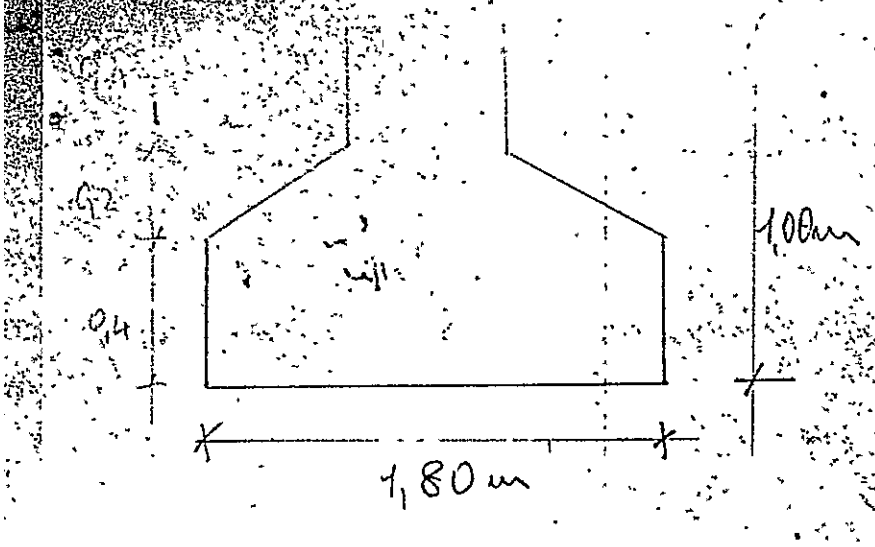
$S_P = 0,55 \times 29554 = 16254$ "

USANDO STAFFE A 4 BR. $\phi 12$ con $\sigma_f = 1200$

$M_S = \frac{13299}{1200 \times 4 \times 1,13} = 2,45 \Rightarrow \frac{72}{2,45} = 29,3$ 1 $\phi 12$ A 4 BRAC /25"

$M_P = \frac{16254}{1200 \cdot \sqrt{2} \times 2,54} = 3,78 \Rightarrow 4\ \phi 18$

TRAVE 8-7-6-5-5-6-7-8



$\sigma_t = 11.973$ Kg/mq $\qquad \sigma_f = 1200$

$\rho_u = 57,5$ cm

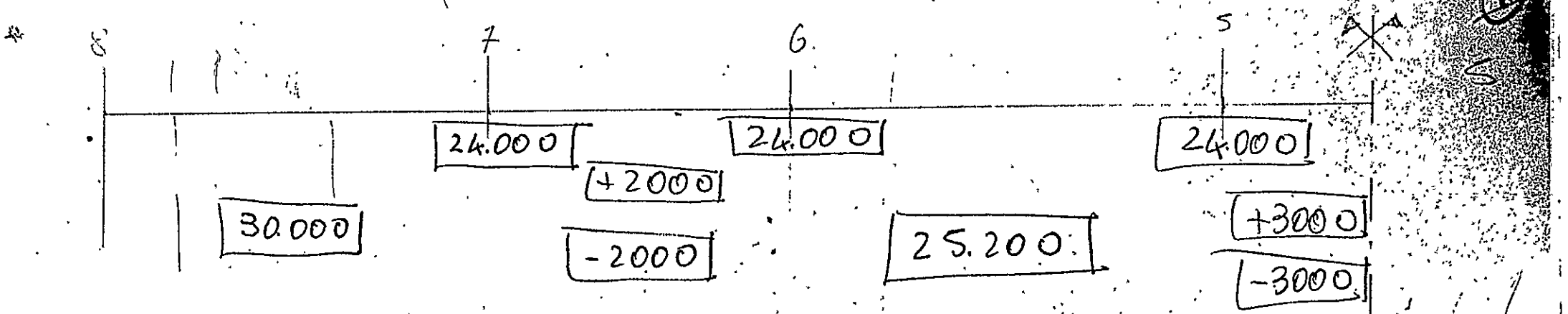
$\rho_e = 0,575 + \frac{0,925}{4} = 0,08125 + 0,575 = 0,656$ m

$M = \frac{1}{2}\, 11973 \times 0,656^2 = 2578$ Kg/m

$r = \frac{47}{\sqrt{2578}} = \frac{47}{50,77} = 0,925 \rightarrow \sigma_e = 18$, $\rightarrow t = 0,00087$

$A_f = 0,00087 \times 100 \times 50,77 = 4,06$ cmq a ml $\Rightarrow 4\phi 12 = 4,52$

CALCOLO ARMATURA TRAVE 8-7-6-5-5-6-7-8



TRATTO 8-7

MEZZERIA

$M = 30.000$ kg/m $\quad \sigma_f = 1200 \quad R_{BK} = 200$

$$r = \frac{8G}{\sqrt{\frac{30.000000}{65}}} = \frac{8G}{\sqrt{214,83}} = 0,446 \rightarrow \sigma_c = 42 \rightarrow \varepsilon = 0,00203$$

$A_f = 0,00203 \times 65 \times 214,83 = 28,34$ cmq $\Rightarrow$ 12 ϕ18

APPOGGIO:

$M = 24.000$ kg/m $\quad \sigma_f = 1200 \quad R_{BK} = 200$

$$r = \frac{8G}{\sqrt{\frac{24.000000}{180}}} = \frac{8G}{115,47} = 0,831 \rightarrow \sigma_c = 21 \rightarrow \varepsilon = 0,00107$$

$\Rightarrow$ 10 ϕ18

TRATTO 7-6

H = 2000 kg/m

$$r = \frac{8G}{\sqrt{\frac{200.000}{GS}}} = \frac{8G}{55,47} = 1,173$$

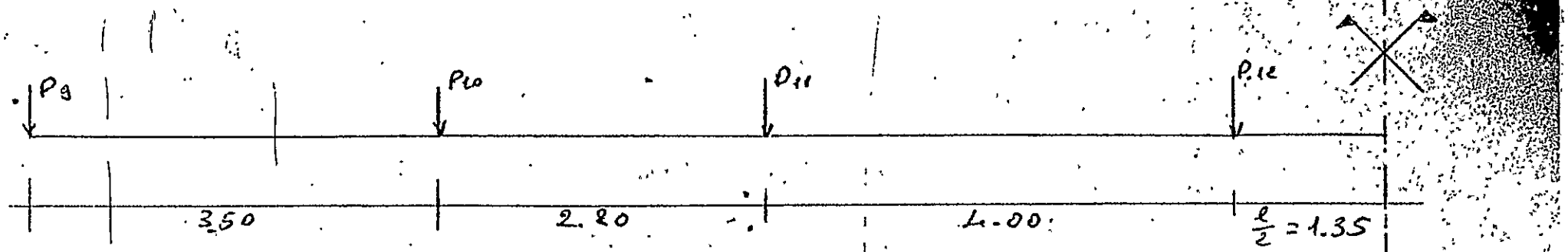
σ_c = 10

ε = 0,00052

$A_f = 0,00052 \times 55,47 \times GS = 1,87 \Rightarrow 1\ \phi 18$

1,125
1,7
0,2
1
1

TRAVE 9-10-11-12-12-11-10-9



$P_9 = 24.184$ Kg

$P_{10} = 40.248$ "

$P_{11} = 60.261$ "

$P_{12} = 53.492$ "

$l_{TOT} = 23.3$ m

$R = 2 \times P_9 + 2 \times P_{10} + 2 \times P_{11} + 2 \times P_{12} = 356.448$ Kg

$P_P = (2 \times 0.5 + 0.5 \times 0.65) \times 23.3 \times 2500 = 47.181$ Kg

$R_+ = 356.448 + 47.181 = 433.629$ Kg

$B = \frac{433629}{1.5 \times 2320} = 124\,cm \Rightarrow 150$ cm

$\sigma_t = \frac{433.629}{1.4 \times 2320} = 1.32$ Kg/cmq

$\sigma^x = \frac{356.448}{1.4 \times 23.3} = 1092$ Kg/mq

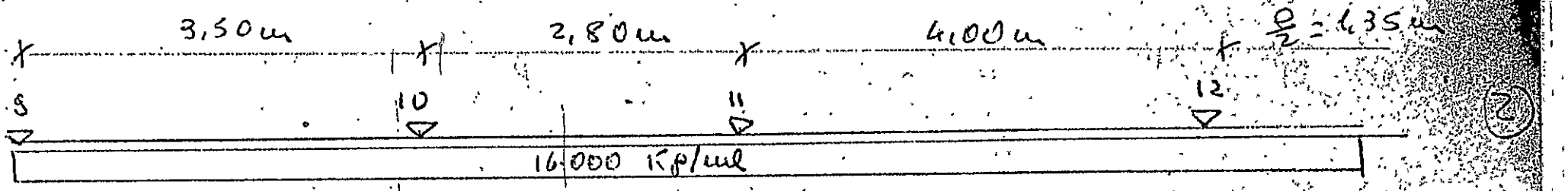
$1092 \times 1.5 = \frac{R}{L} = 15.298$ Kg/ml $\Rightarrow 16.000$ Kg/ml

$H = \frac{1}{4} l_{max} = 1$ m

$b = 50$ cm

TRAVE 8-10-11-12-12-11-10-8

$\sigma_c = 1,5$ kg/cmq



(2)

$\mu_{8-10} = \frac{1}{8}\ 16.000 \times 3,5^2 = 24.500$ kgm

$\mu_{10-11} = \frac{1}{12}\ 16.000 \times 2,8^2 = 10\,453$ "

$\mu_{11-12} = \frac{1}{12}\ 16.000 \times 4^2 = 21\,333$ "

$\mu_{12-12'} = \frac{1}{12}\ 16.000 \times 2,1^2 = 8\,720$ "

$K_{10-8} = 0,374$

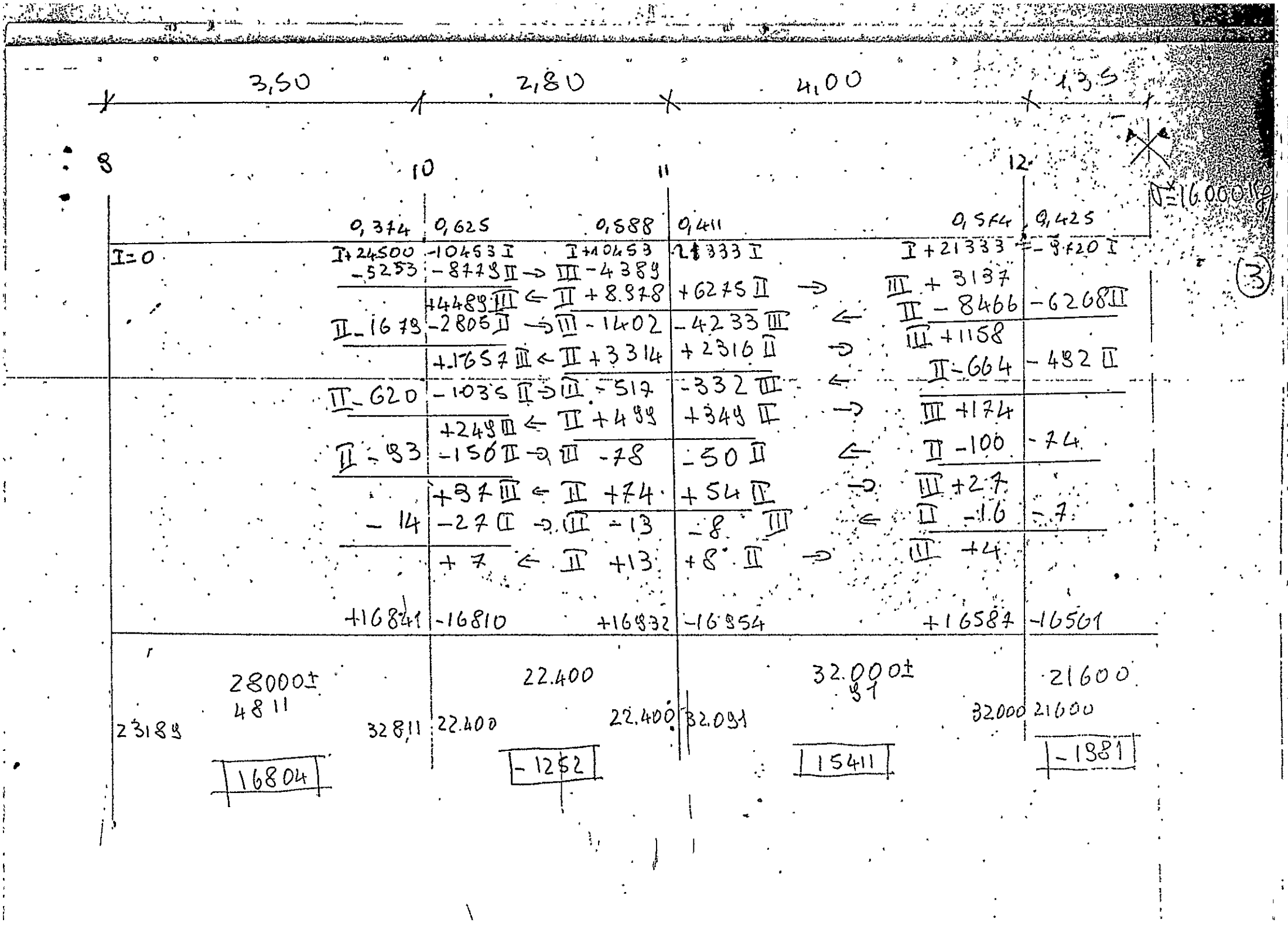
$K_{10-11} = 0,625$

$K_{11-10} = 0,588$

$K_{11-12} = 0,411$

$K_{12-11} = 0,574$

$K_{12-12} = 0,425$


3,50
2,80
4,00
1,35
8
10
11
12
0,374
0,625
0,588
0,411
0,544
0,425
I=0
I+24500
-10453 I
I+10453
I+21333
-9420 I
-5253
-8778 II → III -4389
III +3137
+4489 III ← II +8878
+6275 II →
II -8466
-6268 III
II -1678
-2805 II → III -1402
-4233 III ←
III +1158
+1657 III ← II +3314
+2316 II →
II -664
-482 II
II -620
-1035 II → III -517
-332 III ←
III +174
+249 III ← II +499
+349 II →
II -83
-150 II → III -78
-50 II ←
III +27
+37 III ← II +74
+54 II →
III +2,7
-14
-27 II → III -13
-8 III ←
II -1,6
-7
+7 ← II +13
+8 II →
III +4
+16841
-16810
+16832
-16854
+16587
-16501
28000±
4811
22.400
32.000±
21600
23189
32811
22.400
22.400
32.091
32000
21600
16804
-1252
15411
-1881
Q=16.000 kp
(3)

VERIFICA A TAGLIO TRAVE S-10-11-12-12-11-10-S

TRATTO S-10.

$R_{BK} = 200$

$\sigma_f = 1200$ kg/cmq $\quad \tau_{bo} = 4,61$ kg/cm

$T = 32811$ kg

$l = 3,50$ m

$$\tau = \frac{32811}{0,9 \times 50 \times 86} = \frac{32811}{4320} = 7,59 \text{ kg/cmq} > \tau_{bo}$$

$$4,6 = \frac{T_1}{4320} \; ; \quad T_1 = 19872 \text{ kg}$$

$32811 - 16.000x = 19872 \Rightarrow x = 80$ cm $\quad e = 15$ cm

$l = 65$ cm

$$S = \frac{1}{2}(7,59 + 4,6)\,65 \times 50 = 19808 \text{ kg}$$

$S_s = 0,45 \times 19809 = 8914$ kg

$S_p = 0,55 \times 19809 = 10894$ kg

USANDO STAFFE A 4 BR. $\phi 12$:

$$n_s = \frac{8814}{1200 \times 4 \times 1,13} = 1,64 \quad \frac{65}{1,64} = 39 \Rightarrow 1\,\phi 12 / 30'' \text{ A 4 BR}$$

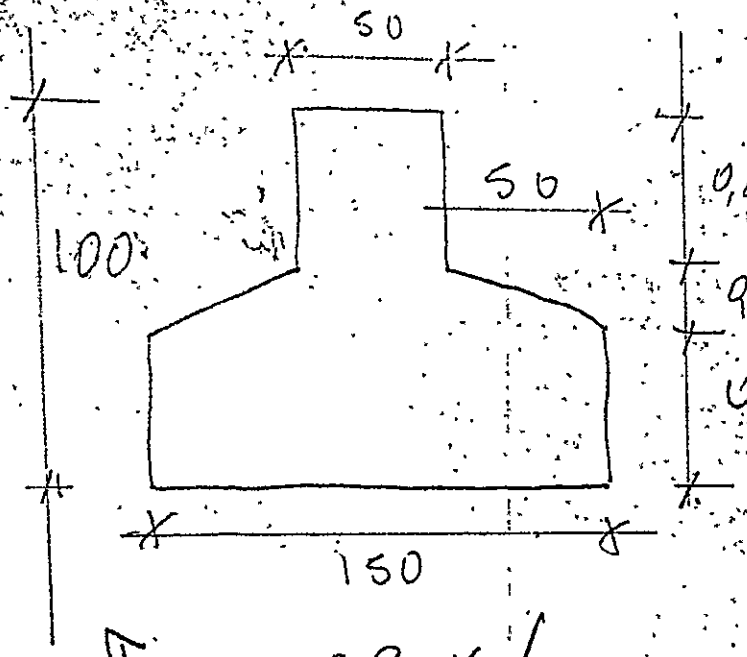
$$n_p = \frac{10894}{1200 \cdot \sqrt{2} \times 254} = 2,53 \Rightarrow 3\,\phi 18$$

④

ARMATURA TRANSVERSALE

B = 150 cm

h = 50 cm



(5)

$\tau_L = 10188$ Kg/mq

$l_u = 50$ cm

$l_c = 0,50 + \frac{0,25}{4} = 0,5625$ m

$M = \frac{1}{2}\, 10188 \times 0,5625^2 = 1613$

$h = \frac{47}{\sqrt{1013}} = \frac{47}{40,1} = 1,17 \rightarrow \sigma_c = 15$

$\rightarrow t = 0,00077$

$A_f = 0,00077 \times 100 \times 40,1 = 3,08$ cmq a m l

B ϕ12 = 3,39

1 ϕ12/30"

TRATTO 9-10

$H = 21.000$ Kg·m

$$x = \frac{9.6}{\sqrt{\frac{2.100.000}{50}}} = \frac{9.6}{\sqrt{42.000}} = \frac{9.6}{204.9} = 0.468 \quad \sigma_c = 40 \quad t = 0.0$$

$A_f = 0.00485 \times 50 \times 204.9 = 19.37$ cmq $\Rightarrow$ 10 ϕ 18

APPOGGI

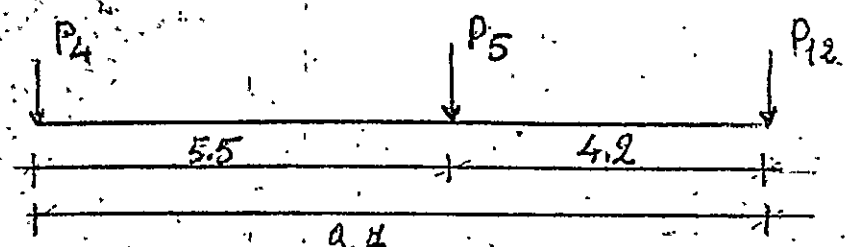
$M = 17.000$ Kg/m

$$x = \frac{9.6}{\sqrt{\frac{1.700.000}{150}}} = \frac{9.6}{106.4} = 0.902 \quad \sigma_c = 20 \quad t = 0.00102$$

$A_f = 0.00102 \times 150 \times 106.4 = 16.27 \Rightarrow 8\ \phi 18$

TRAVE 4 - 5 - 12

$\sigma_L = 1,5$ kg/c



$P_4 = 18.246$ kg
$P_5 = 37.718$ "
$P_{12} = 15.768$ "

$R = 72732$ kg
$P_p = (1 \times 0,5 + 0,5^2) \times 9,7 \times 2500 = 1.8188$ kg
$R_{TOT} = 90920$ kg

$$B = \frac{90.920}{1,5 \times 870} = 62,4 \Rightarrow 80 \text{ cm}$$

$$\sigma_L = \frac{90.920}{80 \times 870} = 1,17 \text{ kg/cmq}$$

$$\sigma_T = \frac{72732}{9,7} = 7498 \text{ kg/ml} \Rightarrow 8000. \text{ kg/ml}$$

$K_{S-4} = 0,432$; $K_{S-12} = 0,567$

$\mu_{S-4} = \frac{1}{8} \cdot 8000 \times 5,5^2 = 30.250$ kg; $\mu_{S-12} = \frac{1}{8} \cdot 8000 \times 4,2^2 = 17640$ kg

	9432	9567	
I = 0	I = 30250	-17640 = I	I = 0
	II +3447	- 7151 II	
	13697	-24791	

25.000

22.000 ± 4545

16.800 ± 5852

17455 | 26545 | 22752 | 10848

17042 | 9938

VERIFICA - STATICO

$R_{bk} = 200$

$\sigma_f = 1200 \Rightarrow \tau_{bo} =$

$T = 26\,545$ kg

$\tau = \dfrac{26\,545}{0,9 \times 50 \times 86} = 6,14$ kg/cmq $\Rightarrow \tau_{bo}$

$4,6 = \dfrac{T_1}{4320}$; $T_1 = 19\,872$ kg

$26.545 - 8000 x = 19.872$; $x = 0,83$ $e = 0,15$

$f = 69$ cm.

$S = \frac{1}{2}(6,1 + 4,6) \times 69 \times 50 = 18\,458$ kg

$S_s = 0,45 \times 18458 = 8306$ kg

$S_p = 0,55 \times 18458 = 10\,152$ kg

USANDO STAFFG A2BR $\phi 12$ $\sigma_f = 1200$

$A_s = \dfrac{8306}{1200 + 2 \times 1,13} = 3,06$; $\dfrac{69}{3,06} = 22,5$ 1 $\phi 12$ A2 BR. ogni 20"

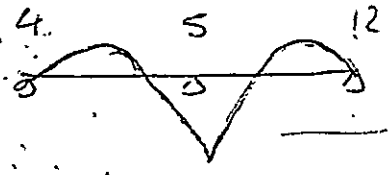
$A_p = \dfrac{10152}{1200 \times \sqrt{2} \times 2,01} = 2,88 \Rightarrow 3\,\phi 16$

$\sigma_f = 1200$ $\bar{\sigma}_{bo} = 4,6$ kg/cmq

$T = 26545$ kg

$$\sigma = \frac{26545}{0,8 \times 80 \times 80} = \frac{26545}{6912} = 3,84 < 4,6 \text{ kg/cmq}$$

ARMATURA A FLESSIONE:



$$r = \frac{86}{\sqrt{\frac{3000000}{80}}} = \frac{86}{\sqrt{37488,9}} = \frac{86}{193,64} = 0,495$$ → $\sigma_c = 37$, → $\omega = 0,00181$

$A_f = 0,00181 \times 193,64 \times 80 = 28$ cmq

$$r = \frac{86}{\sqrt{\frac{3000000}{80}}} = \frac{86}{182,57} = 0,525$$ → 35, → $\omega = 0,00172$

$A_f = 0,00172 \times 80 \times 182,57 =$

$$r = \frac{86}{\sqrt{30000}} = \frac{86}{173,2} = 0,554$$ → $\sigma_c = 33$, → $0,00163$

$A_f = 0,00163 \times 100 \times 173,2 =$

$$r = \frac{8 \cdot 6}{\sqrt{\frac{2500000}{80}}} \Rightarrow \frac{86}{176,77} = 0,543 \rightarrow \delta c = 33 \rightarrow \varepsilon = 0,00163$$

$$Af = 0,00163 \times 80 \times 176,77 = 23 cm^2$$

$$r = \frac{86}{\sqrt{\frac{1704200}{80}}} = \frac{86}{145,95} = 0,57 \rightarrow \delta c = 28 \rightarrow \varepsilon = 0,00140$$

$$Af = 0,00140 \times 80 \times 145,95 = 16,3 \Rightarrow \boxed{7 \cdot \phi 16}$$

$$M = \frac{1}{2} 8000 \times 1,5^2 =$$

$$r = \frac{86}{\sqrt{\frac{900.000}{80}}} = \frac{86}{100} = 0,9 \rightarrow \delta c = 19 \rightarrow \varepsilon = 0,00097$$

$$Af = 0,00097 \times 100 \times 80 = 8,22$$

$$M = 9\,938$$

$$x = \frac{96}{\sqrt{\frac{993.800}{80}}} = \frac{96}{111.45} = 0.861 \qquad \sigma_c = 20 \quad t = 0.0$$

$$A_f = 0.00102 \times 111.45 \times 80 = 9.09 \text{ cm}^2$$