REPUBLIC OF INDONESIA

MINISTRY OF COMMUNICATIONS
DIRECTORATE GENERAL OF LAND TRANSPORT
AND INLAND WATERWAYS

TENDER DOCUMENTS
FOR
NEW RAILWAY LINE FOR CENGKARENG AIRPORT CONSTRUCTION PROJECT

QUANTITIES CALCULATION SHEETS

PACKAGE I CIVIL AND ARCHITECTURAL WORK

3 of 5

AUGUST 1984

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

QUANTITIES CALCULATION SHEETS

CONTENTS

§22. PIER (1 OF 2)

PIER

No. 0-3

NO. (REMARKS / UNIT)	CONCRETE VOLUME WALL, COLUMN CLASS D m³	CONCRETE VOLUME FOUNDATION CLASS D m³	FORM AREA m²	REINFORCING BAR SD 30 kg	LEVELING CONCRETE CLASS F m³	AGGRE-GATE SUB BASE A.S.B.-3 m³	STRUCTURE EXCAVATION VOLUME m³	STRUCTURE EXCAVATION TYPE	FOUNDATION MORTAR σ_{ck} = 400 kg/cm m³	P.C. PILES CLASS B ø500mm L m x N	P.C. PILES CLASS A ø500mm L m x N
P 01	113.4	229.6	299.6	31 012.8	12.4	24.9	635.4	D	0.100	6.0 56	—
02	113.4	229.6	299.6	31 012.8	12.4	24.9	685.2	D	〃	6.0 56	—
03	53.0	67.0	167.0	10 863.7	5.8	11.6	142.2	A	〃	11.0 24	—
04	53.0	67.0	167.0	10 863.8	5.8	11.6	139.9	C	〃	11.0 24	—
05	50.1	41.0	150.4	6 767.8	4.3	8.6	64.5	B	〃	12.0 15	—
06	97.3	106.2	252.2	19 363.3	7.3	14.7	362.8	D	〃	7.0 35	—
07	97.3	106.2	252.2	19 363.3	7.3	14.7	264.8	D	〃	7.0 35	—
08	61.0	106.2	173.9	12 750.4	7.3	14.7	176.7	C	〃	11.0 35	—
09	57.3	106.2	165.9	12 376.1	7.3	14.7	182.6	B	〃	11.0 35	—
10	59.8	106.2	174.6	12 677.2	7.3	14.7	204.6	B	〃	11.0 35	—
11	59.8	106.2	174.6	12 677.2	7.3	14.7	154.7	B	〃	11.0 35	—
12	53.7	41.0	160.3	7 053.1	4.3	8.6	85.1	B	〃	11.0 15	—
13	55.8	67.0	175.2	10 811.8	5.8	11.6	161.0	C	〃	11.0 28	—
14	55.8	67.0	175.2	10 811.8	5.8	11.6	156.0	C	〃	11.0 28	—
15	59.5	67.0	185.1	11 268.4	5.8	11.6	159.5	B	〃	11.0 28	—
16	62.0	185.5	199.3	18 842.7	10.1	20.2	339.0	B	〃	11.0 42	—
17	63.5	185.5	203.0	18 974.8	10.1	20.3	369.0	B	〃	11.0 42	—

JICA

PIER

No. 0-4

NO. / REMARKS / UNIT	CONCRETE VOLUME WALL, COLUMN CLASS D m³	CONCRETE VOLUME FOUNDATION CLASS D m³	FORM AREA m²	REINFORCING BAR SD 30 kg	LEVELING CONCRETE CLASS F m³	AGGRE-GATE SUB BASE A.S.B.-3 m³	STRUCTURE EXCAVATION VOLUME m³	STRUCTURE EXCAVATION TYPE	FOUNDATION MORTAR σ_{ck} = 400 kg/cm² m³	P.C. PILES CLASS B ø500 mm L m x N	P.C. PILES CLASS A ø500 mm L m x N
P 18	63.8	185.5	202.3	18 988.0	10.1	20.2	501.2	C	0.100	11.0 × 42	—
19	192.8	324.4	348.3	44 474.4	16.5	33.0	1092.7	D	〃	6.0 × 77	—
20	190.4	324.4	342.9	44 277.3	16.5	33.0	1200.4	D	〃	6.0 × 77	—
21	69.7	106.2	200.1	13 447.8	7.3	14.7	217.1	B	〃	11.0 × 35	—
22	79.1	229.6	241.8	24 882.1	12.4	24.9	753.6	D	〃	8.0 × 56	—
23	61.3	67.0	189.0	11 563.4	5.8	11.6	147.4	A	〃	8.0 × 28	8.0 × 28
24	127.6	185.5	325.1	26 320.7	10.1	20.2	356.6	C	〃	14.0 × 42	—
25	62.0	67.0	191.0	11 649.8	5.8	11.6	154.4	A	〃	8.0 × 28	8.0 × 28
26	60.3	67.0	186.7	11 810.6	5.8	11.6	156.7	A	〃	8.0 × 24	14.0 × 24
27	67.3	106.2	189.9	13 660.1	7.3	14.7	219.3	C	〃	8.0 × 35	14.0 × 35
28	68.4	106.2	196.5	13 437.0	7.3	14.7	218.6	A	〃	8.0 × 35	14.0 × 35
29	88.6	106.2	232.8	18 073.5	7.3	14.7	380.1	C	〃	8.0 × 35	11.0 × 35
30	80.2	67.0	240.1	14 042.9	5.8	11.6	318.4	C	〃	8.0 × 24	11.0 × 24
31	87.4	106.2	237.6	17 711.8	7.3	14.7	388.2	C	〃	8.0 × 35	8.0 × 35
32	89.3	106.2	243.6	17 860.2	7.3	14.7	331.7	C	〃	8.0 × 35	8.0 × 35
33	57.4	67.0	178.8	11 434.4	5.8	11.6	156.2	A	〃	8.0 × 24	11.0 × 24
34	57.4	67.0	178.8	11 434.4	5.8	11.6	155.0	C	〃	8.0 × 24	11.0 × 24

JICA

PIER

No. 0-5

REMARKS / UNIT / NO.	CONCRETE VOLUME WALL, COLUMN	CONCRETE VOLUME FOUNDATION	FORM AREA	REINFORCING BAR	LEVELING CONCRETE	AGGRE-GATE SUB BASE	STRUCTURE EXCAVATION VORUME	STRUCTURE EXCAVATION TYPE	FOUNDATION MORTAR	P.C. PILES CLASS B	P.C. PILES CLASS A
	CLASS D	CLASS D		SD 30	CLASS F	A.S.B. -3			σ_{ck} = 400 kg/cm	ø 500 mm	ø 500 mm
	m^3	m^3	m^2	kg	m^3	m^3	m^3		m^3	m L x N	m L x N
P 35	58.8	67.0	183.1	11 182.1	5.8	11.6	299.8	D	0.100	14.0 x 28	—
36	59.5	67.0	185.1	11 268.4	5.8	11.6	214.3	D	〃	14.0 x 28	—
37	68.2	67.0	208.7	12 401.9	5.8	11.6	126.5	C	〃	8.0 x 24	7.0 x 24
38	71.2	106.2	194.9	15 646.6	7.3	14.7	195.1	A	〃	8.0 x 35	7.0 x 35
39	71.2	106.2	194.9	15 646.6	7.3	14.7	195.1	A	〃	8.0 x 35	7.0 x 35
40	82.3	185.5	244.2	23 933.1	10.1	20.2	401.3	A	〃	14.0 x 42	—
41	83.3	185.5	246.2	24 080.8	10.1	20.2	441.6	C	〃	14.0 x 42	—
42	104.6	134.3	261.0	21 617.5	8.2	16.4	355.7	C	〃	14.0 x 45	—
43	76.7	185.5	231.2	23 305.0	10.1	20.2	401.3	A	〃	14.0 x 42	—
44	80.3	185.5	239.2	23 872.4	10.1	20.2	380.1	A	〃	14.0 x 42	—
45	80.3	185.5	239.2	23 872.4	10.1	20.2	360.9	A	〃	14.0 x 42	—
46	80.3	185.5	239.2	23 872.4	10.1	20.2	350.8	A	〃	14.0 x 42	—
47	80.3	185.5	239.2	23 872.4	10.1	20.2	340.7	A	〃	14.0 x 42	—
48	103.0	134.3	257.8	21 552.0	8.2	16.4	322.1	C	〃	13.0 x 45	—
49	94.1	187.2	256.3	26 587.8	10.2	20.4	400.6	A	〃	13.0 x 48	—
50	117.5	134.3	281.3	23 226.3	8.2	16.4	341.8	C	〃	13.0 x 45	—
51	128.4	113.4	323.4	15 970.9	8.4	16.8	274.5	C	〃	13.0 x 36	—

JICA

PIER

No. 0-6

REMARKS / UNIT / NO.	CONCRETE VOLUME WALL, COLUMN	CONCRETE VOLUME FOUNDATION	FORM AREA	REINFORCING BAR	LEVELING CONCRETE	AGGRE-GATE SUB BASE	STRUCTURE EXCAVATION VORUME	STRUCTURE EXCAVATION TY-PE	FOUNDA-TION MORTAR	P.C. PILES	
	CLASS D	CLASS D		SD 30	CLASS F	A.S.B. -3			σ_{ck} = 400 kg/cm	CLASS B ø500 mm	CLASS A ø500 mm
	m^3	m^3	m^2	kg	m^3	m^3	m^3		m^3	m L x N	m L x N
P 101	26.4	16.4	89.4	4 480.9	1.8	3.5	30.5	A	0.025	8.0 × 9	7.0 × 9
102	26.4	16.4	89.4	4 480.9	1.8	3.5	30.5	A	〃	〃	〃
103	26.4	16.4	89.4	4 480.9	1.8	3.5	31.4	A	〃	〃	〃
104	27.0	16.4	85.4	4 720.5	1.8	3.5	30.4	A	〃	〃	〃
105	25.1	16.4	85.6	4 317.0	1.8	3.5	30.8	A	〃	〃	〃
106	25.4	16.4	90.6	4 518.8	1.8	3.5	30.5	A	〃	〃	〃
107	23.2	16.4	79.8	4 077.4	1.8	3.5	33.0	A	〃	〃	〃
108	23.2	16.4	83.9	4 241.4	1.8	3.5	32.6	A	〃	〃	〃
109	20.6	16.4	72.2	3 749.6	1.8	3.5	32.2	A	〃	〃	〃
110	19.3	16.4	68.3	3 585.7	1.8	3.5	32.2	A	〃	〃	〃
111	19.4	16.4	72.4	3 762.3	1.8	3.5	32.2	A	〃	〃	〃
112	16.8	16.4	60.6	3 270.5	1.8	3.5	32.2	A	〃	〃	〃
113	15.5	16.4	56.8	3 106.6	1.8	3.5	32.2	A	〃	〃	〃
114	15.8	16.4	61.8	3 308.4	1.8	3.5	35.0	A	〃	〃	〃
115	13.3	16.4	50.1	2 829.2	1.8	3.5	35.0	A	〃	〃	〃
116	12.0	16.4	46.2	2 665.3	1.8	3.5	34.2	A	〃	〃	〃
117	12.0	16.4	50.3	2 829.3	1.8	3.5	34.2	A	〃	〃	〃

JICA

PIER

No. 0 - 7

REMARKS / UNIT / NO.	CONCRETE VOLUME WALL, COLUMN CLASS D m³	CONCRETE VOLUME FONDATION CLASS D m³	FORM AREA m²	REINFORCING BAR SD 30 kg	LEVELING CONCRETE CLASS F m³	AGGRE-GATE SUB BASE A.S.B.-3 m³	STRUCTURE EXCAVATION VORUME m³	STRUCTURE EXCAVATION TY-PE	FOUNDA-TION MORTAR σ_{ck} -400 kg/cm² m³	P.C. PILES CLASS B Ø500mm L m x N	P.C. PILES CLASS A Ø500mm L m x N
P 118	9.4	16.4	38.6	2 337.5	1.8	3.5	33.8	A	0.025	8.0 × 9	7.0 × 9
119	8.5	16.4	35.7	2 224.0	1.8	3.5	35.0	A	〃	8.0 × 9	7.0 × 9
120	9.1	16.4	37.5	2 227.5	1.8	3.5	35.0	A	0.035	8.0 × 9	7.0 × 9
TOTAL											
P01~51											
P101~120	483.5	6 916.4	12 679.3	995 658.7	452.5	904.7	654.3	A	5.620	6 × 266	7 × 274
							1 776.1	B		7 × 70	8 × 56
							5 146.3	C		8 × 601	9 × 70
							5 516.0	D		9 × 56	11 × 107
										11 × 448	14 × 94
										12 × 15	
										13 × 216	
										14 × 395	
										20 784 m	5 499 m

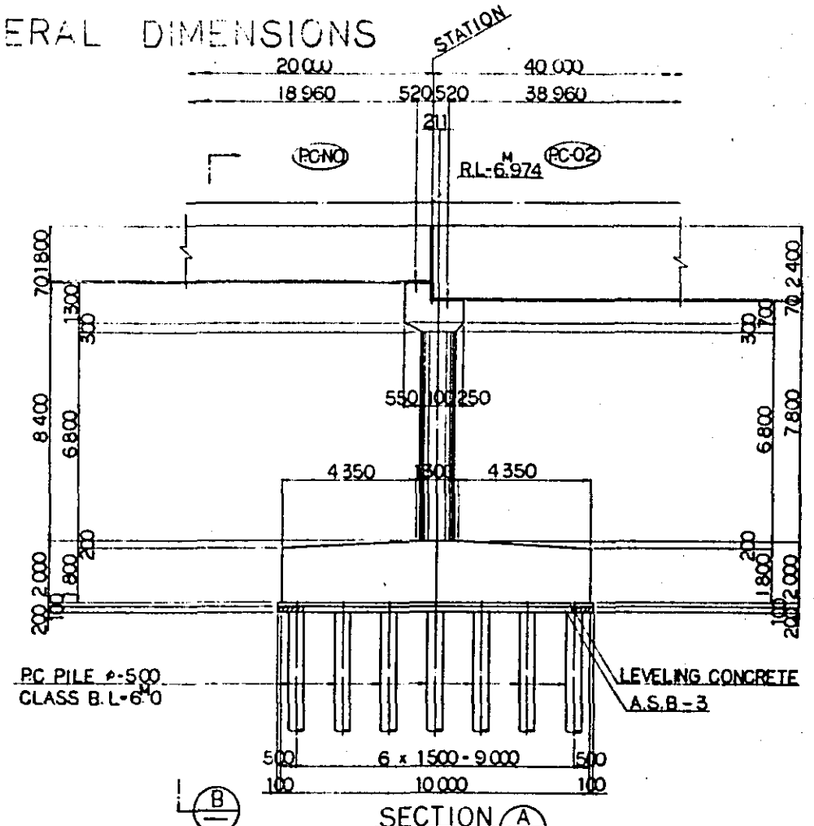
CONTENTS

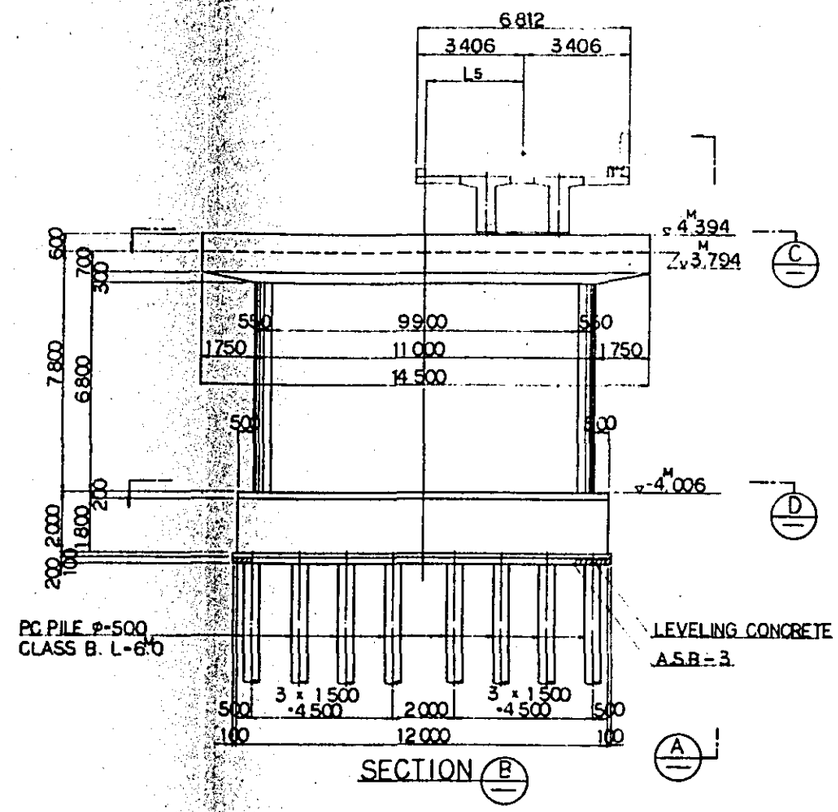
1. PIER 01

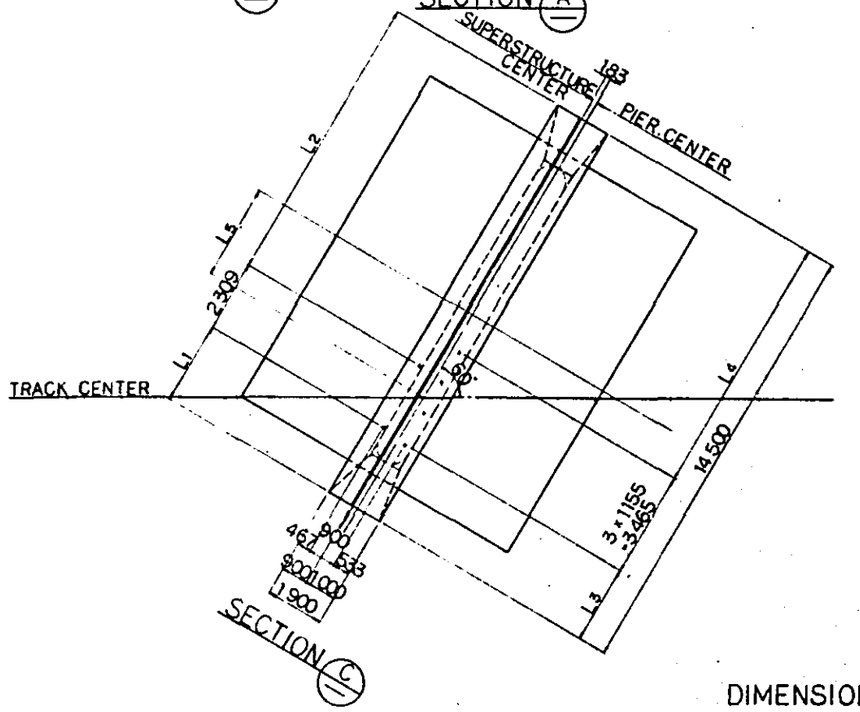
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	32.9	60.0	3040.1	92.4
COLUMN	80.5	158.1	14 005.8	174.0
TOTAL	113.4	218.1	17 045.9	150.3
FOOTING	229.6	81.5	13 966.9	60.8

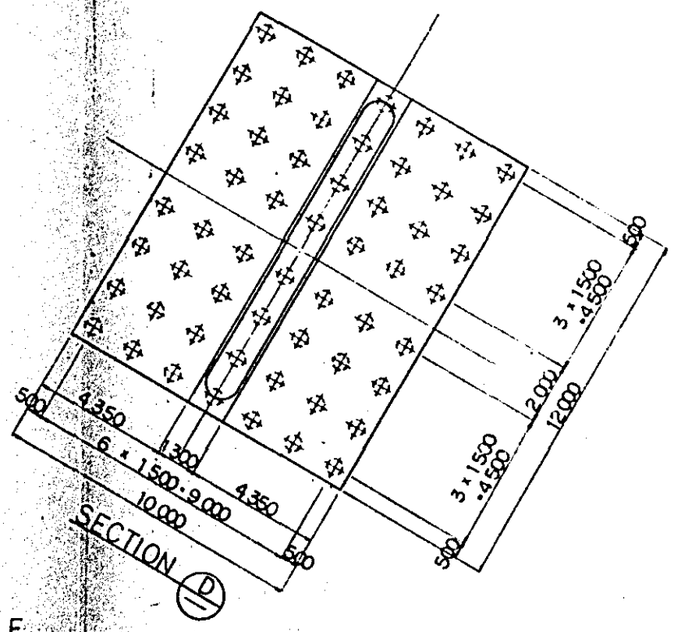
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	12.4	CLASS F
AGGREGATE SUBBASE	m^3	24.9	A.S.B. - B
EXCAVATION	m^3	635.4	
FOUNDATION MORTAR	m^3	0.1	6_{cm} = 400 Kg/cm²
PILE	m × NUMBER	6 × 56	Φ500 - B

1) GENERAL DIMENSIONS









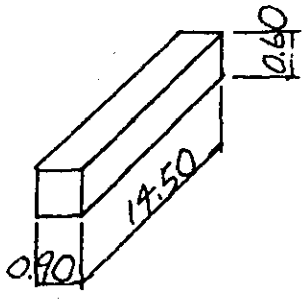
DIMENSION SCHEDULE

PIER NO	STATION	P.C-NO	L1	L2	L3	L4	L5
P - 01	10°999'00	01	2554	9637	2496	8539	3281
P - 02	11°039'00	03 -	3180	8905	2188	8847	3069

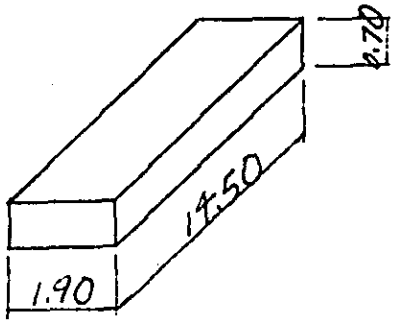
GENERAL VIEW OF P-01 & 02

2) CONCRETE VOLUME

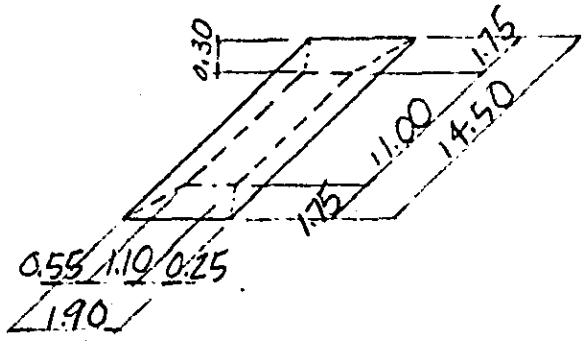
(1) BEAM



$Va = 0.90 \times 0.60 \times 14.50$ = 7.830 m³



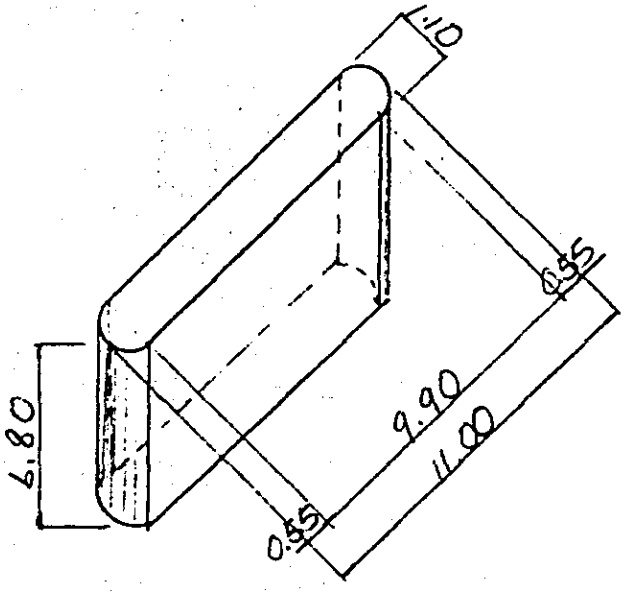
$Vb = 1.90 \times 0.70 \times 14.50$ = 19.285 "



$Vc = \frac{0.30}{6} \times \{ 1.10 \times 11.00 + 1.90 \times 14.50 + (1.10 + 1.90) \cdot (11.00 + 14.50) \}$ = 5.806 "

BEAM TOTAL = 32.923 m³

(2) COLUMN

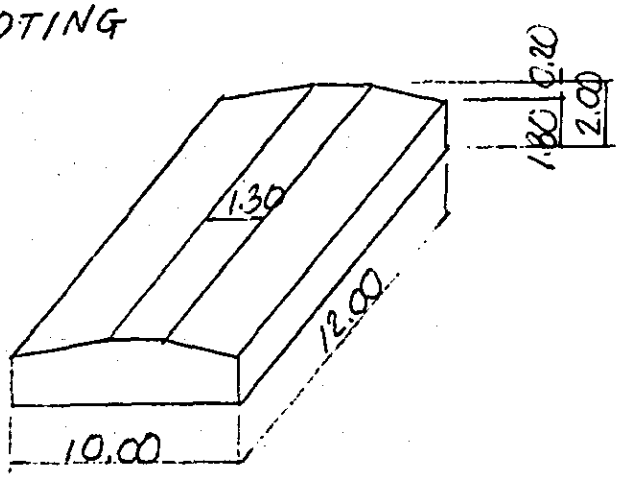


$Va = \frac{1}{4} \times \pi \times 1.10^2 \times 6.80$ = 6.462 m^3

$Vb = 1.10 \times 9.90 \times 6.80$ = 74.052 "

COLUMN TOTAL = 80.514 m^3

(3) FOOTING



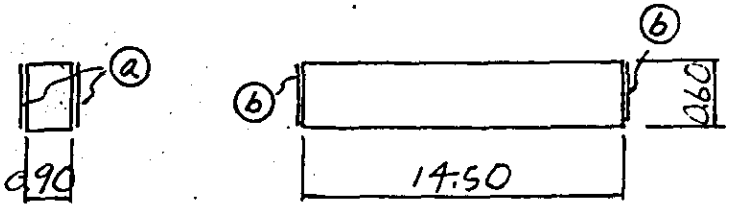
$Va = \frac{1}{2} \times (1.30 + 10.00) \times 0.20 \times 12.00$ = 13.560 m^3

$Vb = 10.00 \times 1.80 \times 12.00$ = 216.000 "

FOOTING TOTAL = 229.560 m^3

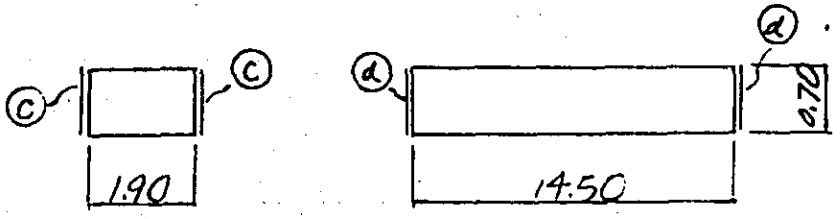
3) FORM AREA

(1) BEAM



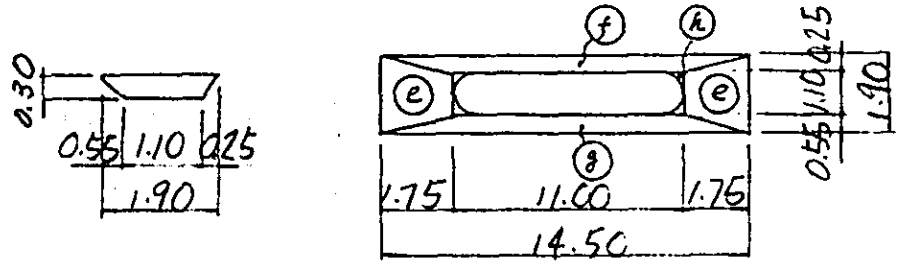
$Ae = 0.60 \times 14.50 \times 2$ = 17.400 m²

$Ab = 0.60 \times 0.90 \times 2$ = 1.080 "



$Ac = 0.70 \times 14.50 \times 2$ = 20.300 "

$Ad = 0.70 \times 1.90 \times 2$ = 2.660 "



$Ae = \frac{1}{2} \times (1.10 + 1.90) \times \sqrt{1.75^2 + 0.30^2} \times 2$ = 5.326 "

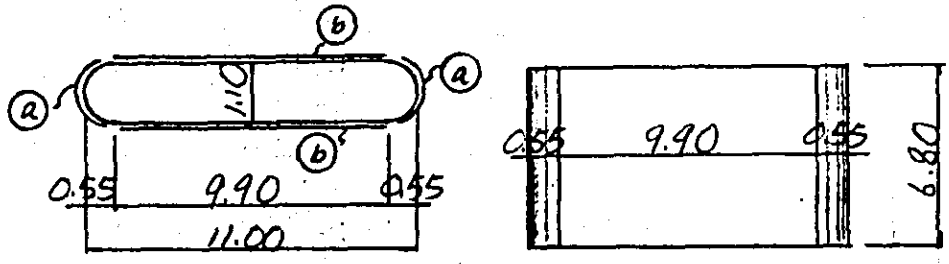
$Af = \frac{1}{2} \times (11.00 + 14.50) \times \sqrt{0.25^2 + 0.30^2}$ = 4.985 "

$Ag = \frac{1}{2} \times (11.00 + 14.50) \times \sqrt{0.55^2 + 0.30^2}$ = 7.982 "

$Ah = (1 - \pi/4) \times 1.10^2$ = 0.260 "

BEAM TOTAL = 59.993 m²

(2) COLUMN

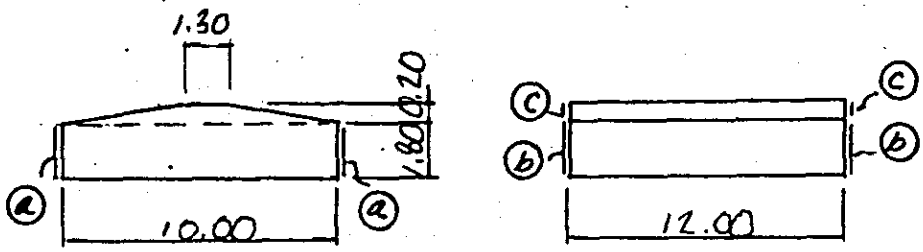


$Aa = \pi \times 1.10 \times 6.80$ = 23.499 m^2

$Ab = 9.90 \times 6.80 \times 2$ = 134.640 "

COLUMN TOTAL = 158.139 m^2

(3) FOOTING



$Aa = 1.80 \times 12.00 \times 2$ = 43.200 m^2

$Ab = 1.80 \times 10.00 \times 2$ = 36.000 "

$Ac = \frac{1}{2} \times (1.30 + 10.00) \times 0.20 \times 2$ = 2.260 "

FOOTING TOTAL = 81.460 m^2

4) REINFORCING BAR

	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1921.7	692.8	2614.5
COLUMN	10819.8					2050.5	1135.5	14005.8
TOTAL	10819.8					3972.2	1828.3	16620.3
FOOTING			7530.8	1396.0		5040.1		13966.9

BEARING BASE —— D16 425.6 kg

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	15 580	13	316 0	
2	D13	0.995	14 400	6	86 0	
3	〃	〃	14 970	2	29 8	
4	〃	〃	14 950	4	59 5	〃 (VAR.)
5	〃	〃	3 490	10	34 7	
6	〃	〃	2 550	6	15 2	
7	D16	1.56	16 800	6	157 2	
8	〃	〃	3 200	97	484 2	
9	D13	0.995	14 400	4	57 3	
10	〃	〃	1 550	4	6 2	
B°1	D16	1.56	3 440	95	509 8	
2	〃	〃	3 090	73	351 9	
3	〃	〃	2 990	22	102 6	〃 (VAR.)
4	D13	0.995	2 290	47	107 1	
5	〃	〃	1 250	47	58 5	
6	〃	〃	2 550	94	238 5	
			SUB TOTAL			
				D16	1 921 3 kg	
				D13	692 8 〃	
					2 614 1 kg	
	COLUMN					
C 1	D32	6.23	9 830	112	6859 0	
2	〃	〃	8 830	72	3960 8	
3	D16	1.56	9 900	106	1637 1	
4	〃	〃	2 500	106	413 4	
C°1	D13	0.995	2 820	266	746 4	
2	〃	〃	1 470	266	389 1	
			SUB TOTAL			
				D32	10 819 8 kg	
				D16	2 050 5 〃	
				D13	1 135 5 〃	
					14 005 8 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	FOOTING					
F 1	D25	3.98	13 000	81	4 190 9	
2	"	"	10 360	81	3 339 9	
3	D22	3.04	11 200	41	1 396 0	
4	D16	1.56	15 340	7	167 5	
5	"	"	15 140	60	1 417 1	(VAR.)
6	"	"	12 200	34	647 1	
7	"	"	12 820	34	680 0	
8	"	"	10 460	8	130 5	
9	"	"	12 460	8	155 5	"
F° 1	D16	1.56	4 440	266	1 842 4	(VAR.)
			SUB TOTAL			
				D25	75308 kg	
				D22	13960 "	
				D16	5090 1 "	
					13 966 9 kg	
			TOTAL			
				D32	108198 kg	
				D25	75308 "	
				D22	13960 "	
				D16	90123 "	
				D13	18283 "	
					305872 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEARING BASE					
	TYPE-A (PER BASE)					
G 1	D16	1.56	1 540	6	14.4	□
2	〃	〃	1 350	8	16.8	〃
			TOTAL	D16	31.2	
	TYPE-B (PER BASE)					
G 3	D16	1.56	1 640	7	17.9	□
4	〃	〃	1 400	9	19.7	〃
			TOTAL	D16	37.6	
	TYPE-C (PER BASE)					
G 5	D16	1.56	1 640	5	12.8	□
6	〃	〃	1 200	9	16.8	〃
			TOTAL	D16	29.6	
	TYPE-D (PER BASE)					
G 7	D16	1.56	1 640	5	12.8	□
8	〃	〃	1 250	9	17.6	〃
			TOTAL	D16	30.4	
	TYPE-E (PER BASE)					
G 9	D16	1.56	1 540	6	14.4	□
10	〃	〃	1 300	8	16.2	〃
			TOTAL	D16	30.6	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	TYPE-F	(PER BASE)				
G 11	D16	1.56	1 640	6	15.4	□
12	〃	〃	1 300	9	18.3	〃
			TOTAL	D16	33.7	
	TYPE-G	(PER BASE)				
G 13	D16	1.56	1 540	7	16.8	□
14	〃	〃	1 450	8	18.1	〃
			TOTAL	D16	34.9	
	TYPE-H	(PER BASE)				
G 15	D16	1.56	1 440	4	9.0	□
16	〃	〃	1 250	5	9.8	〃
			TOTAL	D16	18.8	
	TYPE-I, J	(PER BASE)				
G 17	D16	1.56	1 590	4	9.9	□
18	〃	〃	1 250	6	11.7	〃
			TOTAL	D16	21.6	

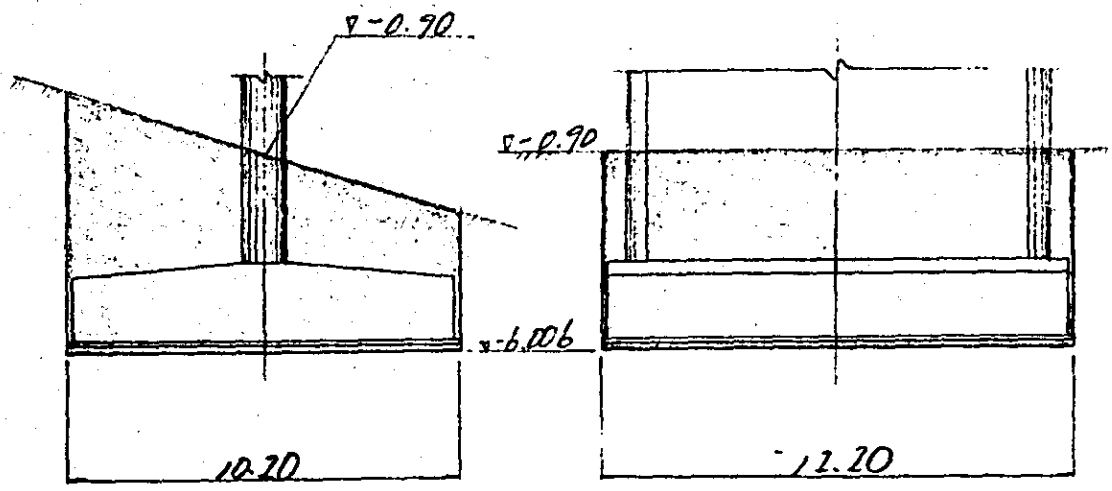
REINFORCING BAR OF BEARING BASE PER PIER

P01	D16	31.2 × 4 + 37.6 × 8	= 425.6 kg
P02	D16	37.6 × 8 + 31.2 × 4	= 425.6 "
P03	D16	18.8 × 4 + 29.6 × 8	= 312.0 "
P04	D16	29.6 × 8 + 18.8 × 4	= 312.0 "
P05	D16	18.8 × 4 + 31.2 × 4	= 200.0 "
P06	D16	31.2 × 4 + 30.4 × 8	= 368.0 "
P07	D16	30.4 × 8 + 31.2 × 4	= 368.0 "
P08	D16	31.2 × 8	= 249.6 "
P09	D16	31.2 × 8	= 249.6 "
P10	D16	31.2 × 4 + 29.6 × 8	= 361.6 "
P11	D16	29.6 × 8 + 31.2 × 4	= 361.6 "
P12	D16	31.2 × 4 + 18.8 × 4	= 200.0 "
P13	D16	18.8 × 4 + 30.6 × 8	= 320.0 "
P14	D16	30.6 × 8 + 18.8 × 4	= 320.0 "
P15	D16	18.8 × 4 + 30.6 × 8	= 320.0 "
P16	D16	30.6 × 16	= 489.6 "
P17	D16	30.6 × 8 + 33.7 × 8	= 514.4 "
P18	D16	33.7 × 12 + 30.6 × 4	= 526.8 "
P19	D16	33.7 × 4 + 30.6 × 4 + 37.6 × 8	= 558.0 "

P20	D16	37.6 × 12 + 33.7 × 4	= 586.0 kg
P21	D16	33.7 × 4 + 37.6 × 4 + 18.8 × 4 =	360.4 "
P22	D16	18.8 × 4 + 37.6 × 8	= 376.0 "
P23	D16	18.8 × 4 + 30.4 × 8	= 318.4 "
P24	D16	30.4 × 16	= 486.4 "
P25	D16	30.4 × 8 + 18.8 × 4	= 318.4 "
P26	D16	18.8 × 4 + 29.6 × 8	= 312.0 "
P27	D16	29.6 × 16	= 473.6 "
P28	D16	29.6 × 8 + 34.9 × 4	= 376.4 "
P29	D16	34.9 × 8	= 279.2 "
P30	D16	34.9 × 4 + 21.6 × 3	= 204.4 "
P31	D16	21.6 × 3 + 33.7 × 8	= 334.4 "
P32	D16	33.7 × 8 + 18.8 × 4	= 344.8 "
P33	D16	18.8 × 4 + 29.6 × 8	= 312.0 "
P34	D16	29.6 × 8 + 18.8 × 4	= 312.0 "
P35	D16	18.8 × 4 + 30.6 × 8	= 320.0 "
P36	D16	30.6 × 8 + 18.8 × 4	= 320.0 "
P37	D16	18.8 × 4 + 34.9 × 4	= 214.8 "
P38	D16	34.9 × 8	= 279.2 "
P39	D16	34.9 × 8	= 279.2 "

P40	D16	34.9 × 4 + 30.6 × 8	= 384.4 kg
P41	D16	30.6 × 8 + 34.9 × 4	= 384.4 "
P42	D16	34.9 × 4 + 30.6 × 8	= 384.4 "
P43	D16	30.6 × 16	= 489.6 "
P44	D16	30.6 × 16	= 489.6 "
P45	D16	30.6 × 16	= 489.6 "
P46	D16	30.6 × 16	= 489.6 "
P47	D16	30.6 × 16	= 489.6 "
P48	D16	30.6 × 16	= 489.6 "
P49	D16	30.6 × 16	= 489.6 "
P50	D16	30.6 × 12 + 34.9 × 4	= 506.8 "
P51	D16	34.9 × 4 + 21.6 × 2	
		30.6 × 4 + 18.8 × 4	= 380.4 "

5) EXCAVATION

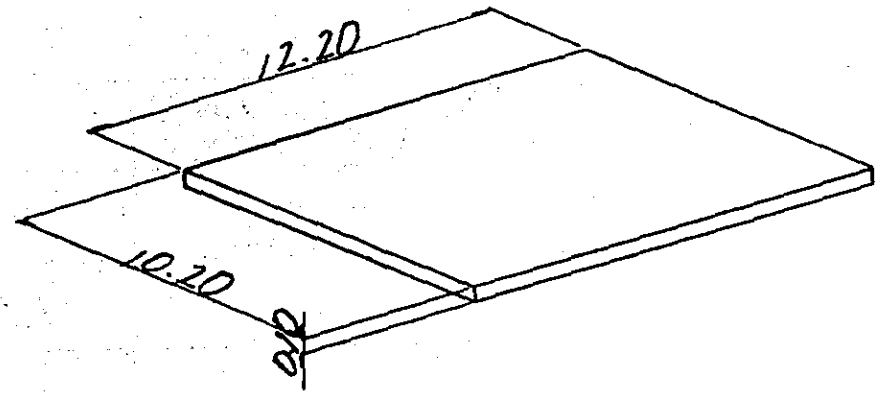


$$Va = 10.20 \times 12.20 \times (6.006 - 0.90) = 635.39\ m^3$$

6) FOUNDATION MORTAR

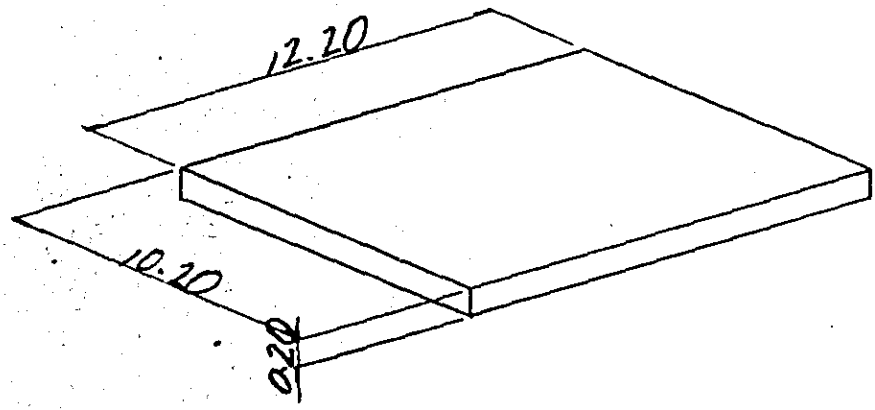
$$Va = \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4$$
$$+ \tfrac{1}{2} \times (0.836 \times 0.636 + 0.80 \times 0.60) \times 0.018 \times 8 = 0.102\ m^3$$

7) LEVELING CONCRETE



$Va = 10.20 \times 12.20 \times 0.10 = 12.447\ m^3$

8) AGGREGATE SUBBASE



$Va = 10.20 \times 12.20 \times 0.20 = 24.888\ m^3$

9) PILE

ϕ - 500

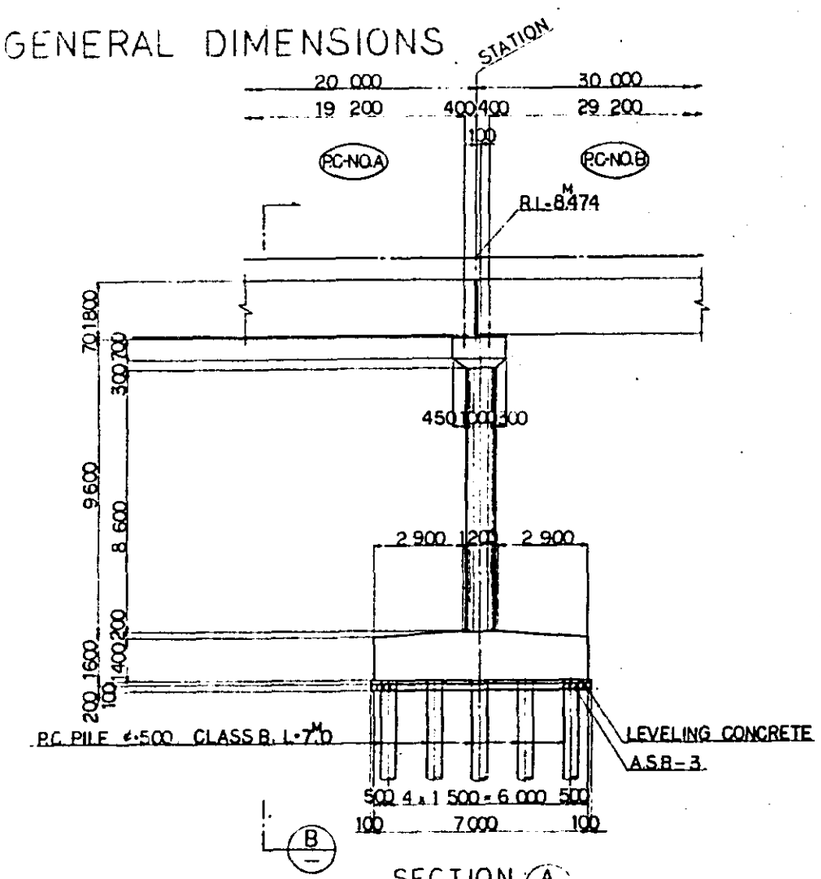
TYPE-B 6 m x 56

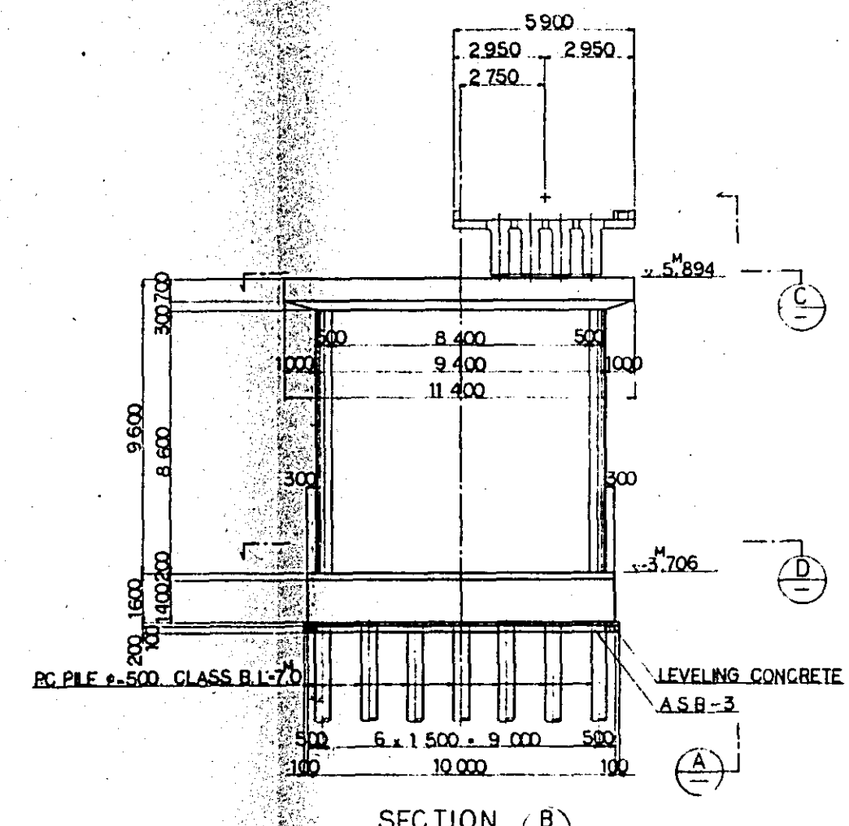
2. PIER 06

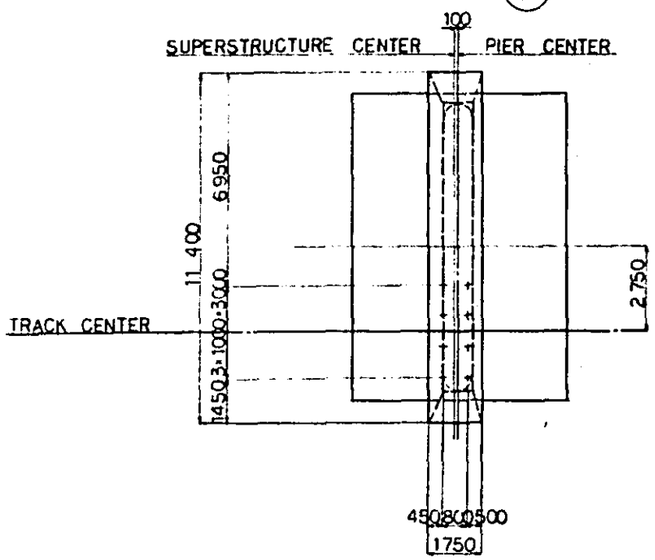
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	18.3	31.5	1696.6	92.7
COLUMN	79.0	171.5	10 882.2	137.7
TOTAL	97.3	203.0	12 578.8	129.3
FOOTING	106.2	49.2	6 784.5	63.9

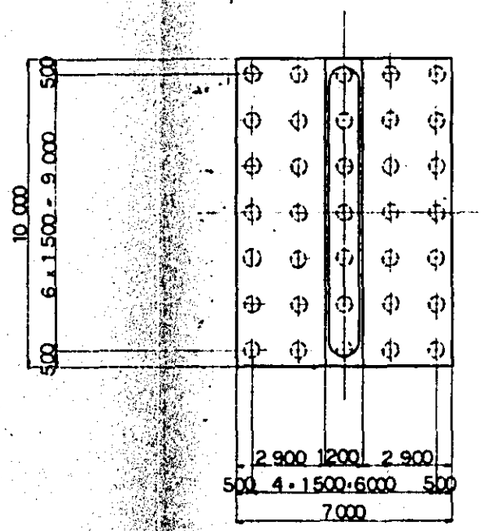
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A. S B. - 3
EXCAVATION	m^2	369.8	
FOUNDATION MORTAR	m^3	0.1	σ_{28} = 400 kg/cm²
PILE	m x NUMBER	7 x 35	φ500 - B

// GENERAL DIMENSIONS







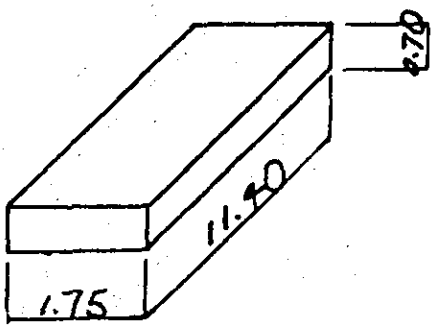


PIER NO	STATION	P.C-NO.A	P.C-NO.B
P-06	13K794.00	05	06
P-07	13K824.00	07	06

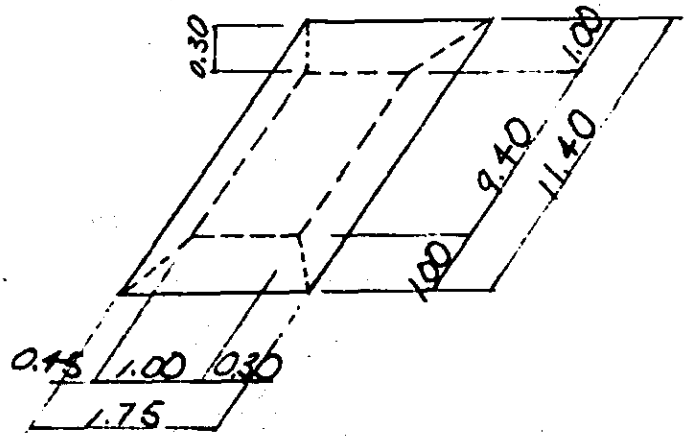
GENERAL VIEW OF P.06 & 07

2) CONCRETE VOLUME

(1) BEAM



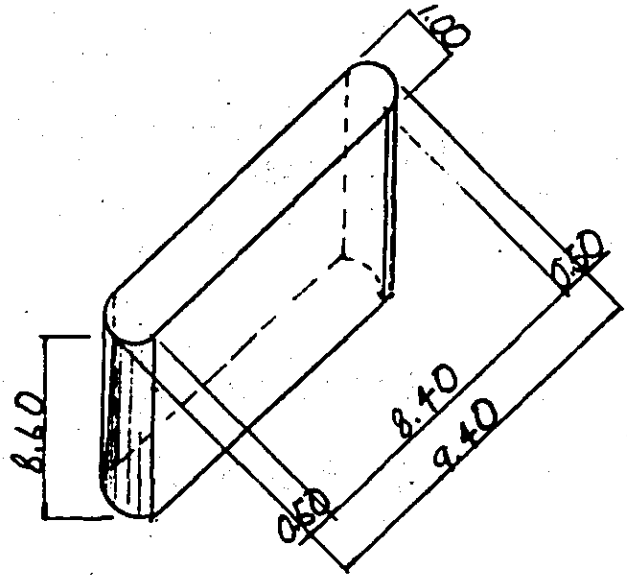
$V_a = 1.75 \times 0.70 \times 11.40$ = 13.965 m^3



$V_b = \frac{0.30}{6} \times \{ 1.00 \times 9.40 + 1.75 \times 11.40 + (1.00 + 1.75) \times (9.40 \times 11.40) \}$ = 4.328 "

BEAM TOTAL = 18.293 m^3

(2) COLUMN

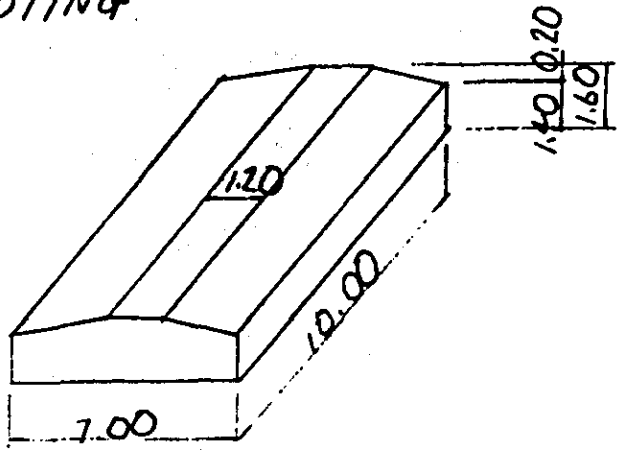


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 8.60$ = 6.754 m^3

$V_b = 1.00 \times 8.40 \times 8.60$ = 72.240 "

COLUMN TOTAL = 78.994 m^3

(3) FOOTING



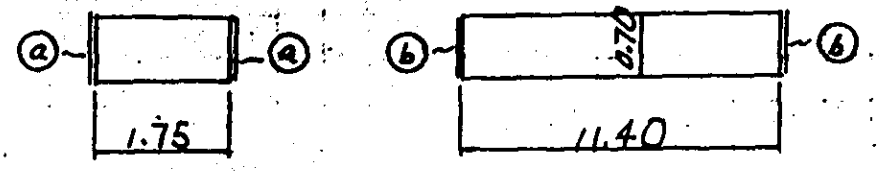
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

FOOTING TOTAL = 106.200 m^3

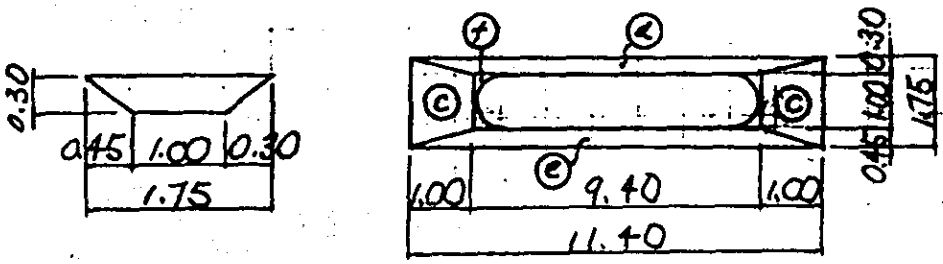
3) FORM AREA

(1) BEAM



A_a = 0.70 × 11.40 × 2 = 15.960 m²

A_b = 0.70 × 1.75 × 2 = 2.450 "



A_c = ½ × (1.00 + 1.75) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2 = 2.871 m²

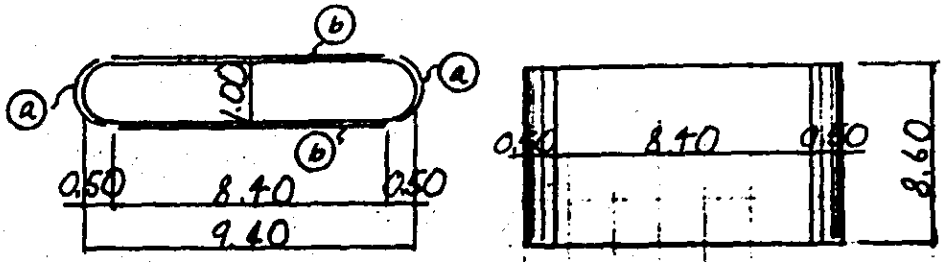
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.30^2 + 0.30^2}$ (0.424) = 4.410 "

A_e = ½ × (9.40 + 11.40) × $\sqrt{0.45^2 + 0.30^2}$ (0.541) = 5.626 "

A_f = (1 − π/4) × 1.00² = 0.215 "

BEAM TOTAL = 31.532 m²

(2) COLUMN

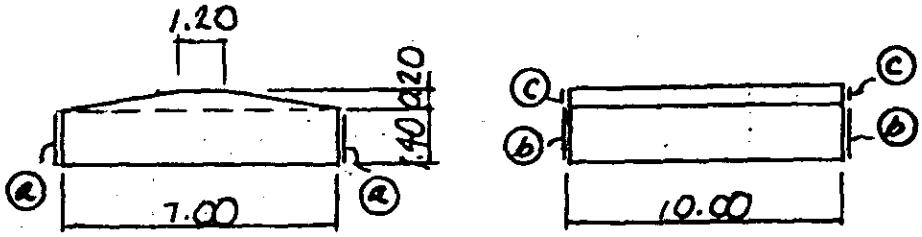


$A_a = \pi \times 1.00 \times 8.60$ = 27.018 m²

$A_b = 8.40 \times 8.60 \times 2$ = 144.480 "

COLUMN TOTAL = 171.498 m²

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$ = 28.000 m²

$A_b = 1.40 \times 7.00 \times 2$ = 19.600 "

$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$ = 1.640 "

FOOTING TOTAL = 49.240 m²

4) REINFORCING BAR

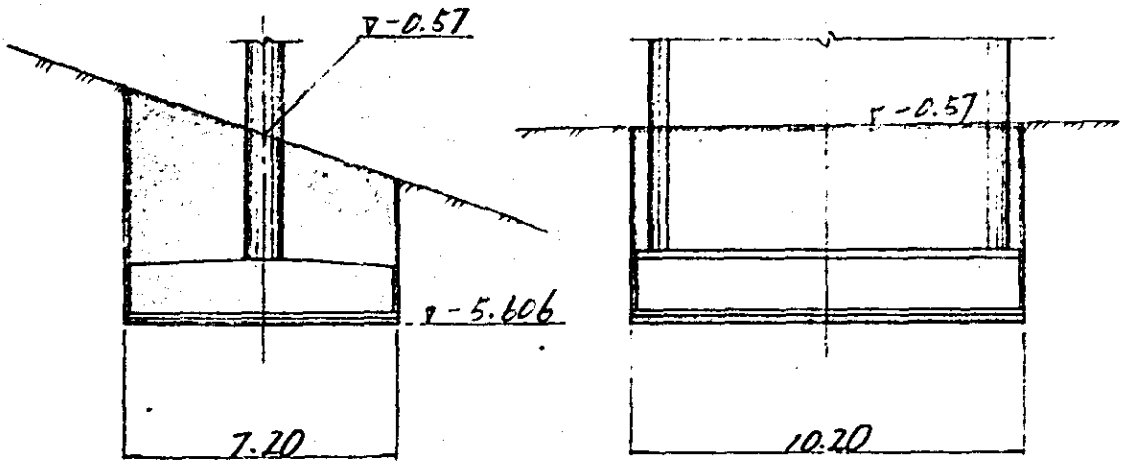
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						980.1	348.5	1328.6
COLUMN	8004.0					1842.9	1035.3	10 882.2
TOTAL	8004.0					2823.0	1383.8	12 210.8
FOOTING	3844.3				631.6	2308.6		6 784.5

BEARING BASE —— D16 368.0 rf

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	12 480	13	253 1	
2	D13	0.995	11 300	6	67 5	
3	〃	〃	11 900	2	23 7	
4	〃	〃	11 880	3	35 5	〃 (VAR.)
5	〃	〃	2 760	12	33 0	
6	〃	〃	2 400	6	14 3	
B' 1	D16	1.56	3 290	75	384 9	
2	〃	〃	2 940	63	288 9	
3	〃	〃	2 840	12	53 2	〃 (VAR.)
4	〃	0.995	2 370	74	174 5	
			SUB TOTAL	D16	980 1 kg	
				D13	348 5 〃	
					1328 6 kg	
	COLUMN					
C 1	D32	6.23	11 230	80	5597 0	
2	〃	〃	7 430	52	2407 0	〃
3	D16	1.56	8 400	110	1441 4	
4	〃	〃	2 340	110	401 5	
C' 1	D13	0.995	2 720	215	581 9	
2	〃	〃	2 420	32	77 1	〃
3	〃	〃	1 570	215	335 9	〃
4	〃	〃	1 270	32	40 4	〃
			SUBTOTAL			
				D32	8004 0 kg	
				D16	1842 9 〃	
				D13	1035 3 〃	
					10882 2 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	FOOTING					
F 1	D32	6.23	9 210	67	3 844 3	
2	D19	2.25	8 020	35	631 6	
3	D16	1.56	12 520	7	136 7	
4	"	"	12 320	40	768 8	" (VAR.)
5	"	"	10 820	24	405 1	
6	"	"	7 460	8	93 1	
7	"	"	10 460	8	130 5	"
F° 1	D16	1.56	3 650	136	774 4	(VAR.)
			SUB TOTAL			
				D32	3 844 3 kg	
				D19	631 6 "	
				D16	2 308 6 "	
					6 784 5 kg	
			TOTAL			
				D32	11 848 3 kg	
				D19	631 6 "	
				D16	5 131 6 "	
				D13	1 383 8 "	
					18 995 3 kg	

5) EXCAVATION



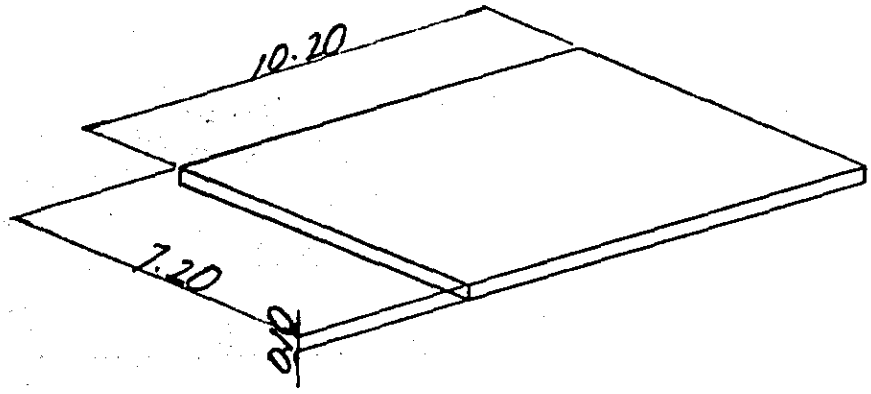
$$Va = 7.20 \times 10.20 \times (5.606 - 0.57) = 369.844\ m^3$$

6) BEARING BASE MORTAR

$$Va = \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4$$

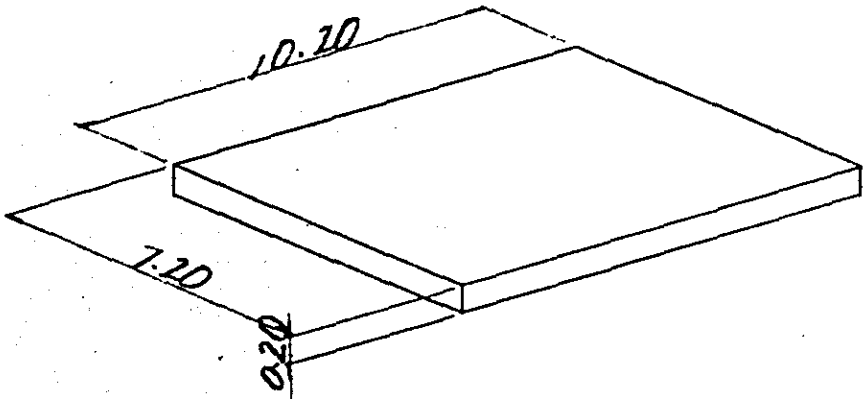
$$+ \tfrac{1}{2} \times (0.836 \times 0.486 + 0.80 \times 0.45) \times 0.018 \times 8 = 0.085\ m^3$$

7) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

8) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

9) PILE

ϕ = 500

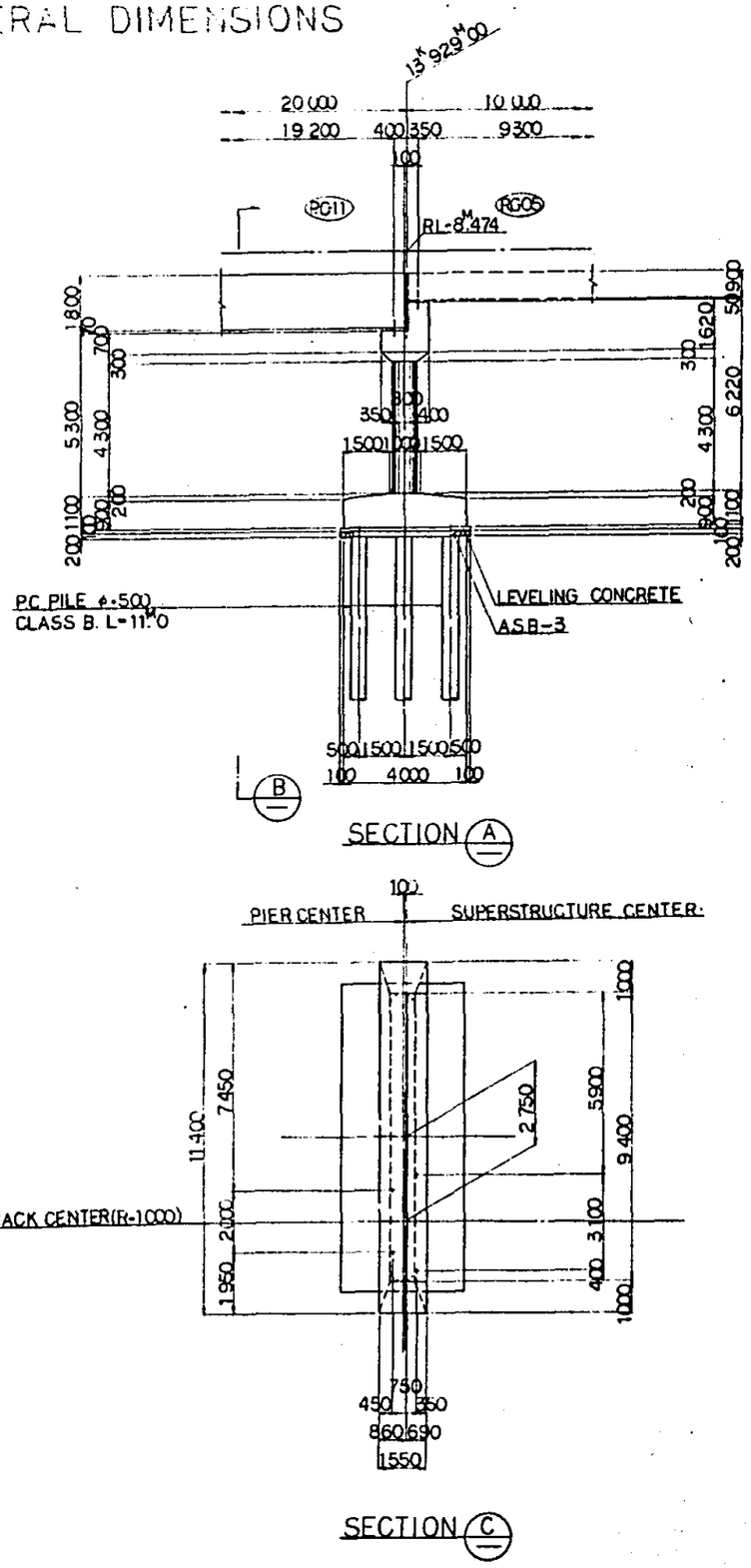
TYPE - B 7 m × 35

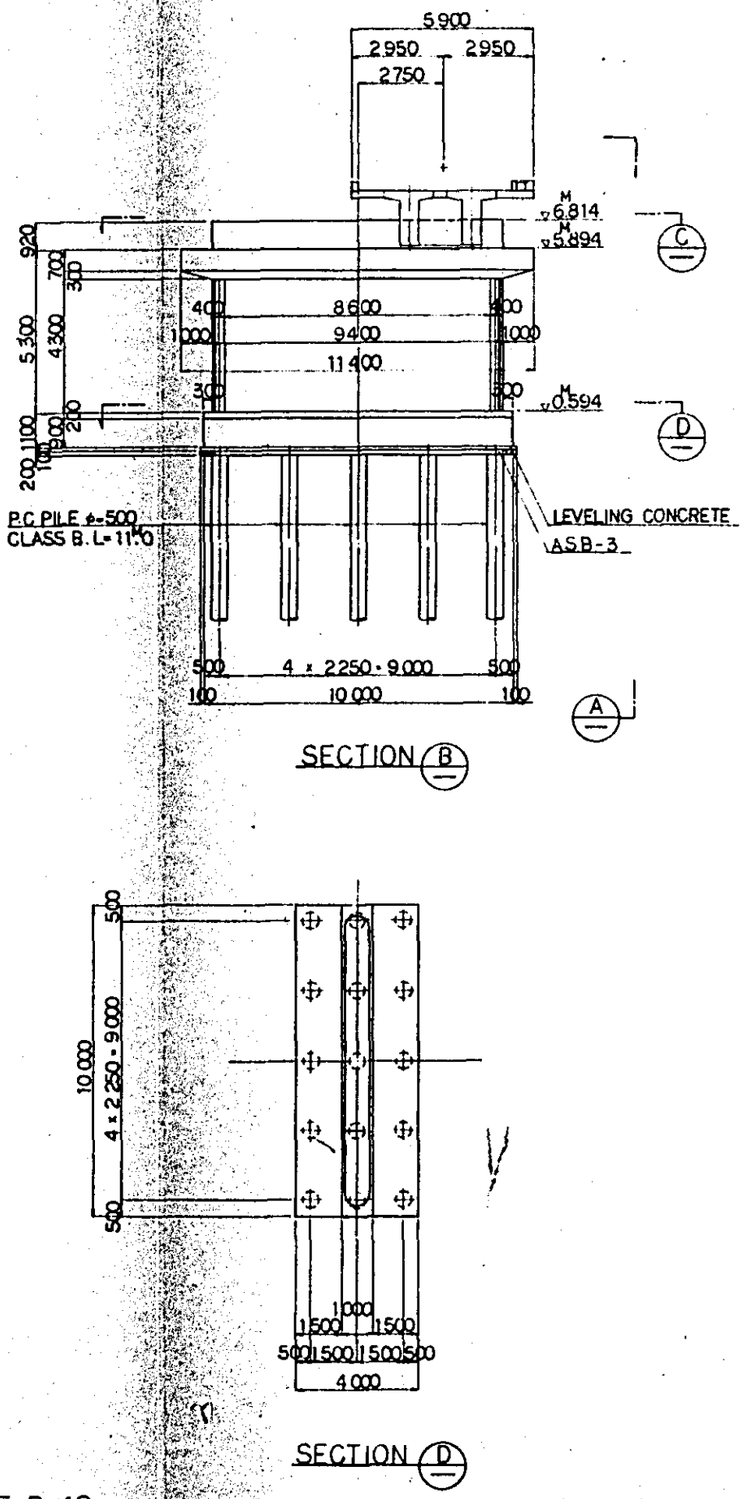
3 PIER 12

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	22.0	49.3	2069.7	94.1
COLUMN	31.7	84.8	2538.2	80.1
TOTAL	53.7	134.1	4607.9	85.8
FOOTING	41.0	26.2	2445.2	59.6

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	4.3	CLASS F
AGGREGATE SUBBASE	m^3	8.6	A.S.B - 3
EXCAVATION	m^3	85.1	
FOUNDATION MORTAR	m^3	0.1	$\sigma_{ck} = 400$ kg/cm^2
PILE	m x NUMBER	11 × 15	φ500 - B

1) GENERAL DIMENSIONS

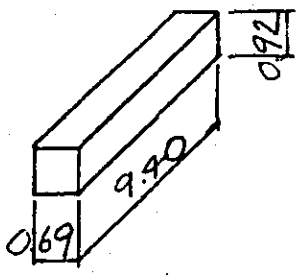




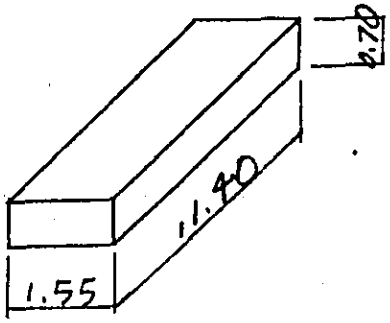
GENERAL VIEW OF P-12

2) CONCRETE VOLUME

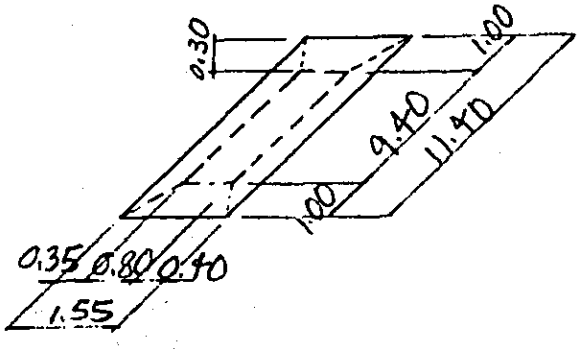
(1) BEAM



$Va = 0.69 \times 0.92 \times 9.40$ = 5.967 m³



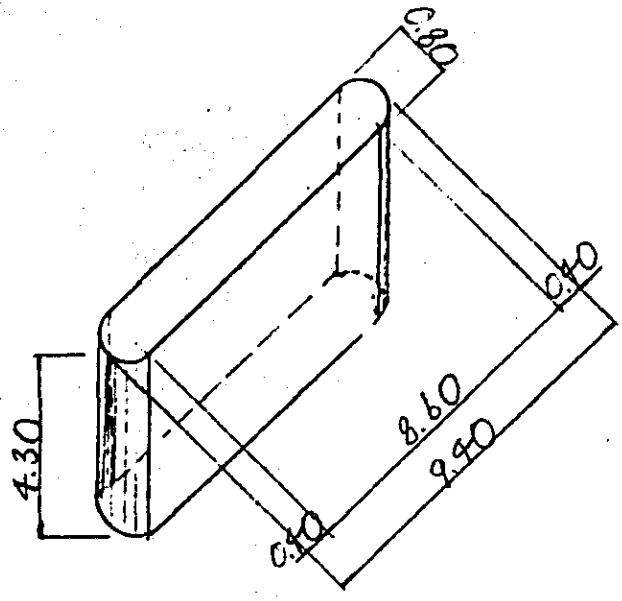
$Vb = 1.55 \times 0.70 \times 11.40$ = 12.369 "



$Vc = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.55 \times 11.40 + (0.80 + 1.55) \times (9.40 + 11.40)\}$ = 3.70 "

BEAM TOTAL = 22.040 m³

(2) COLUMN

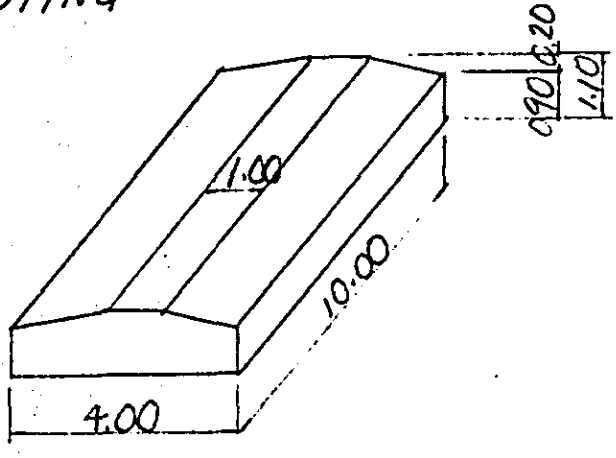


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.30$ = 2.161 m³

$V_b = 0.80 \times 8.60 \times 4.30$ = 29.584 "

COLUMN TOTAL = 31.745 m³

(3) FOOTING



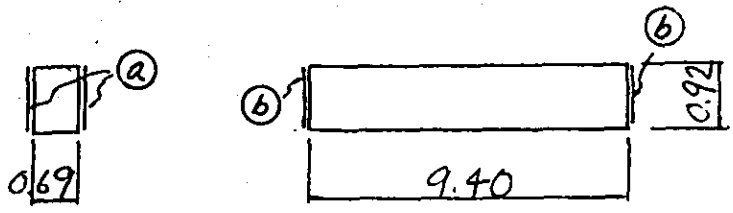
$V_a = \frac{1}{2} \times (1.00 + 4.00) \times 0.20 \times 10.00$ = 5.000 m³

$V_b = 4.00 \times 0.90 \times 10.00$ = 36.000 "

COLUMN TOTAL = 41.000 m³

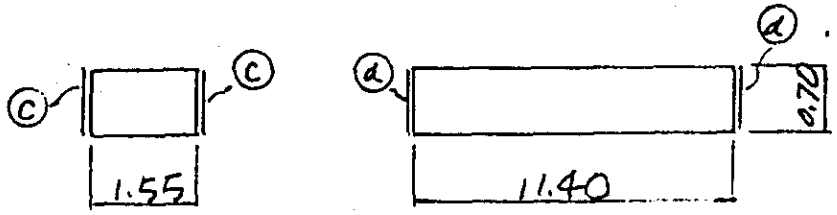
3) FORM AREA

(1) BEAM



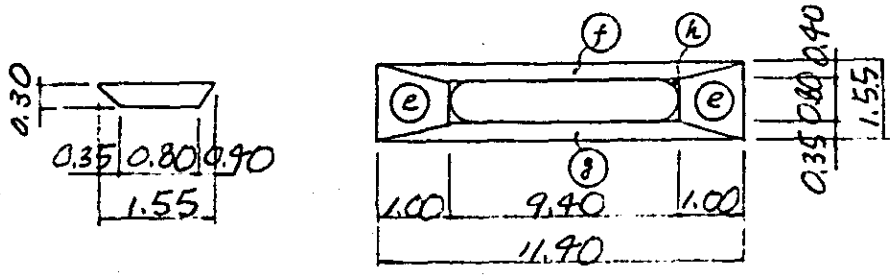
$A_a = 0.92 \times 9.40 \times 2$ = 17.296 m^2

$A_b = 0.92 \times 0.69 \times 2$ = 1.270 "



$A_c = 0.70 \times 11.40 \times 2$ = 15.960 "

$A_d = 0.70 \times 1.55 \times 2$ = 2.170 "



$A_e = \frac{1}{2} \times (0.80 + 1.55) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.453 "

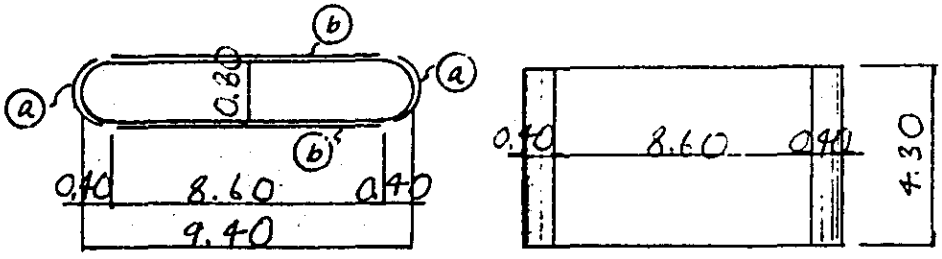
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.40^2 + 0.30^2}$ = 5.200 "

$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.35^2 + 0.30^2}$ = 4.794 "

$A_h = (1 - \pi/4) \times 0.80^2$ = 0.137 "

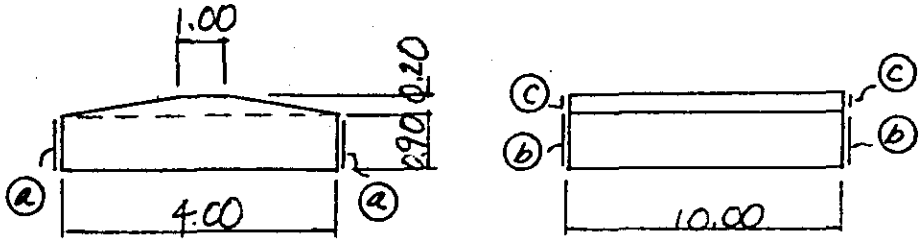
BEAM TOTAL = 49.280 m^2

(2) COLUMN



$Aa = \pi \times 0.80 \times 4.30$	=	10.807 m^2
$Ab = 8.60 \times 4.30 \times 2$	=	73.960 "
COLUMN TOTAL	=	84.767 m^2

(3) FOOTING



$Aa = 0.90 \times 10.00 \times 2$	=	18.000 m^2
$Ab = 0.90 \times 4.00 \times 2$	=	7.200 "
$Ac = \frac{1}{2} \times (1.00 + 4.00) \times 0.20 \times 2$	=	1.000 "
FOOTING TOTAL	=	26.200 m^2

4) REINFORCING BAR

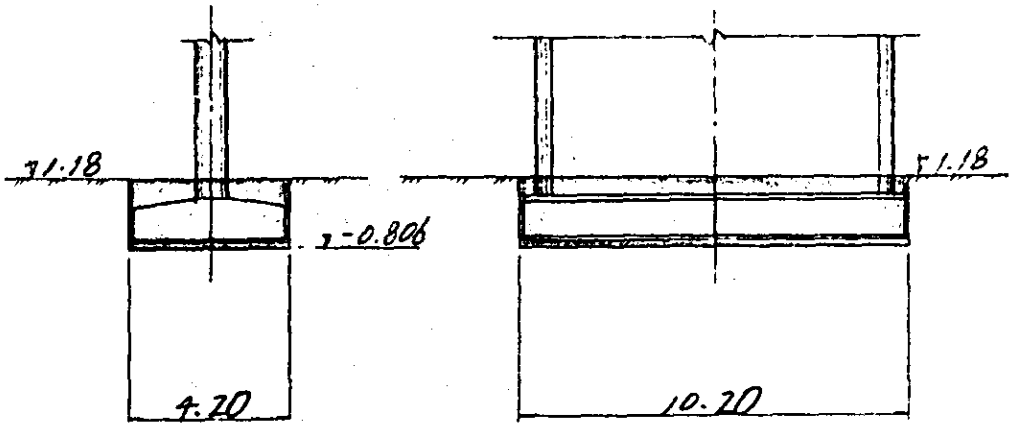
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1 351.0	518.7	1 869.7
COLUMN					1467.2		1071.0	2 538.2
TOTAL					1467 2	1 351.0	1589.7	4 407.9
FOOTING				1 063.2		1 382.0		2 445.2

BEARING BASE —— D16 200.0 rd

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	12 480	11	214 2	⊓
2	D13	0.995	11 300	6	67 5	—
3	〃	〃	11 900	2	23 7	∪
4	〃	〃	11 870	3	35 4	〃 (VARIES)
5	〃	〃	2 760	8	22 0	⌐
6	〃	〃	2 200	8	17 5	⌐
7	D16	1.56	12 300	5	95 9	⊓
8	〃	〃	3 590	63	352 8	⊓
9	D13	0.995	9 300	6	55 5.	—
10	〃	〃	1 340	6	8 0	⊏
B° 1	D16	1.56	3 090	75	361 5	⊓
2	〃	〃	2 780	63	273 2	∪
3	〃	〃	2 850	12	53 4	〃
4	D13	0.995	1 870	44	81 9	⊏
5	〃	〃	1 250	44	54 7	⌐
6	〃	〃	2 190	70	152 5	⊏
		SUB TOTAL				
			D16	1351.0 kg		
			D13	518.7 〃		
				1869.7 kg		
	COLUMN					
C 1	D19	2.25	6 270	104	1467 2	⌊
2	D13	0.995	8 600	54	462 1	—
3	〃	〃	1 860	54	100 0	⊂
C° 1	D13	0.995	2 120	147	310 0	⊔
2	〃	〃	1 360	147	198 9	⊓

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
		SUB TOTAL				
			D 19	1467	2 kg	
			D 13	1071	0 "	
				2538	2 kg	
	FOOTING					
F 1	D22	3.04	5 220	67	1063 2	⊔
2	D16	1.56	4 850	35	264 8	⊓
3	"	"	11 540	7	126 0	—
4	"	"	11 330	20	353 5	⊔ (VARIES)
5	"	"	10 820	14	236 3	⊓
6	"	"	4 470	4	27 9	⊔
7	"	"	10 470	4	65 3	"
F° 1	D16	1.56	2 670	74	308 2	⊔ (VARIES)
		SUB TOTAL				
			D 22	1063	2 kg	
			D 16	1382	0 "	
				2445	2 kg	
		TOTAL				
			D 22	1063	2 kg	
			D 19	1467	2 "	
			D 16	2733	0 "	
			D 13	1589	7 "	
				6853	1 kg	

5) EXCAVATION



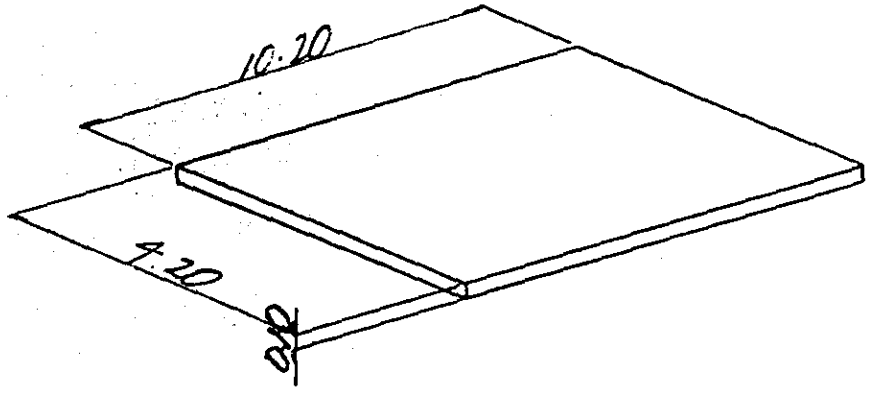
$$Va = 4.20 \times 10.20 \times (1.18 + 0.806) = 85.080 \ m^3$$

6) BEARING BASE MORTAR

$$Va = \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4$$

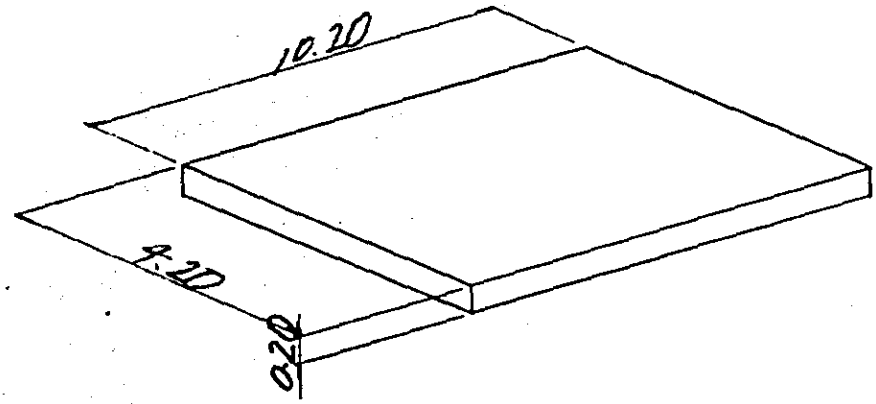
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.086 \ m^3$$

7) LEVELING CONCRETE



$Va = 4.20 \times 10.20 \times 0.10 = 4.284\ m^3$

8) AGGREGATE SUBBASE



$Va = 4.20 \times 10.20 \times 0.20 = 8.568\ m^3$

9) PILE

$\phi = 500$

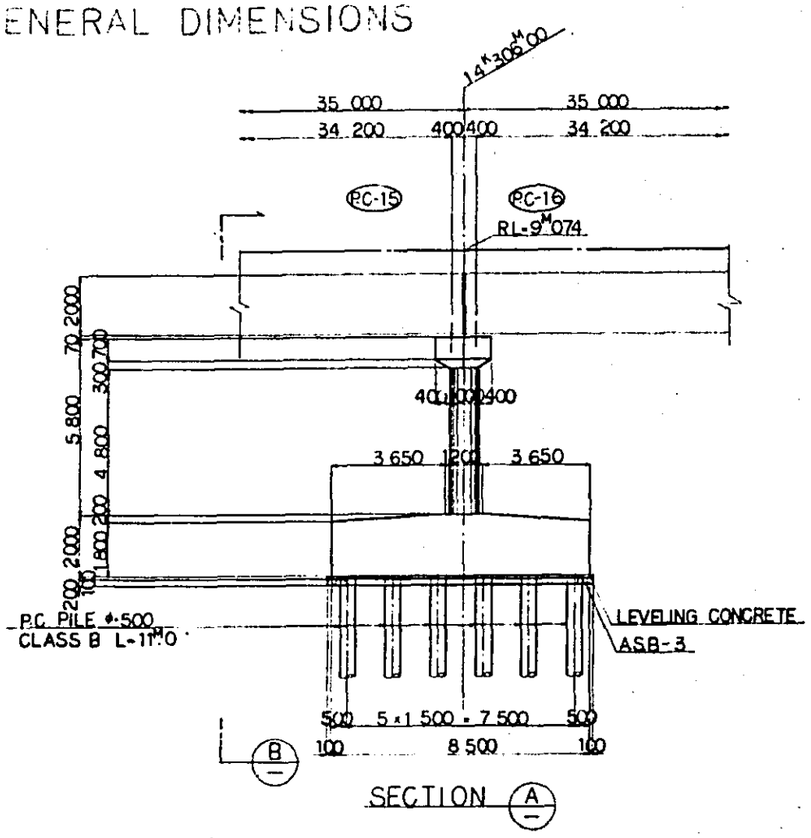
TYPE-B $11^{m} \times 15$

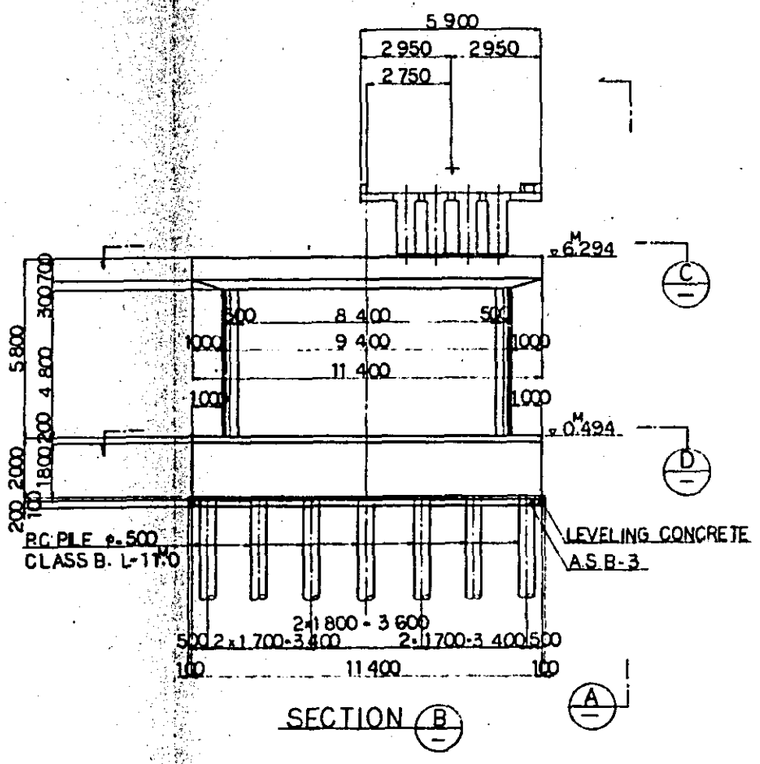
4 PIER 18

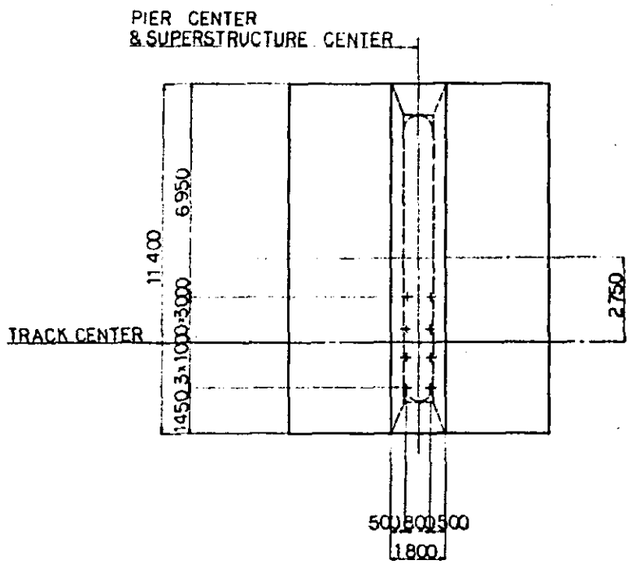
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	21.1	36.0	2036.7	96.5
COLUMN	42.7	92.7	4822.8	112.9
TOTAL	63.8	128.7	6859.5	107.5
FOOTING	185.5	73.6	12128.5	65.4

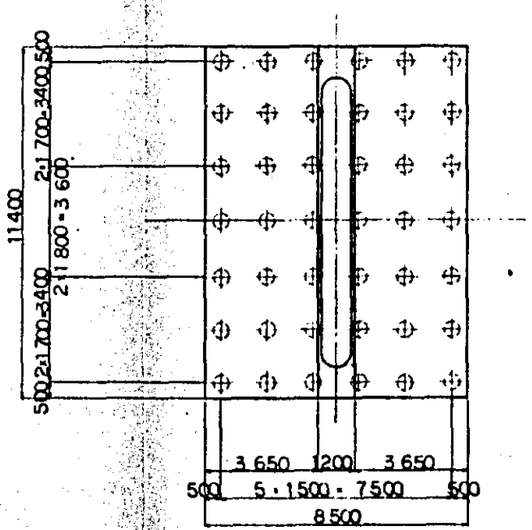
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S B-3
EXCAVATION	m^3	501.2	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	11 x 42	φ500-B

1) GENERAL DIMENSIONS





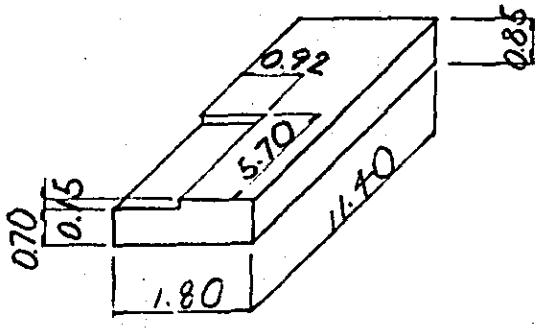




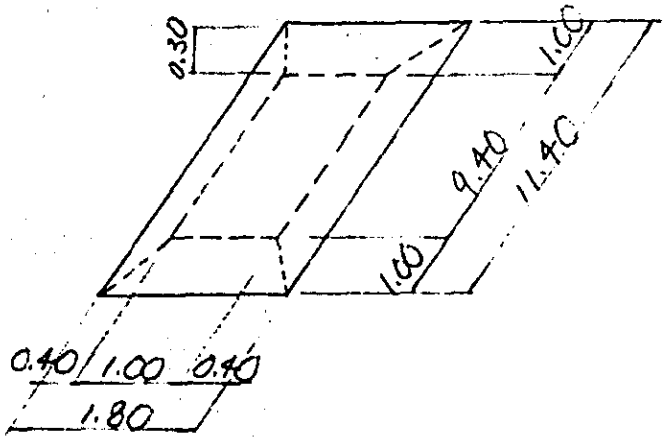
GENERAL VIEW OF P-18

2) CONCRETE VOLUME

(1) BEAM



$$V_a = \underline{1.80} \times 0.85 \times 11.40 - 0.92 \times 0.15 \times \underline{5.70} = \quad 16.655\ m^3$$

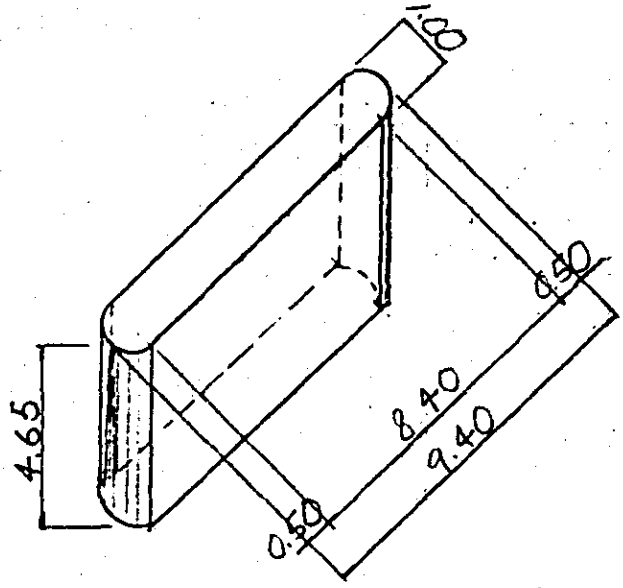


$$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40$$

$$+ (1.00 + 1.80) \times (9.40 + 11.40)\} \quad = \quad 4.406\ m^3$$

BEAM TOTAL = 21.063 m^3

(2) COLUMN

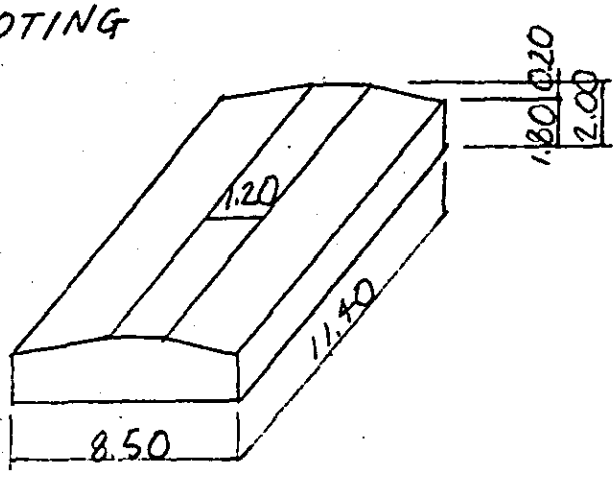


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 4.65$ = 3.652 m^3

$V_b = 1.00 \times 8.40 \times 4.65$ = 39.060

COLUMN TOTAL = 42.712 m^3

(3) FOOTING



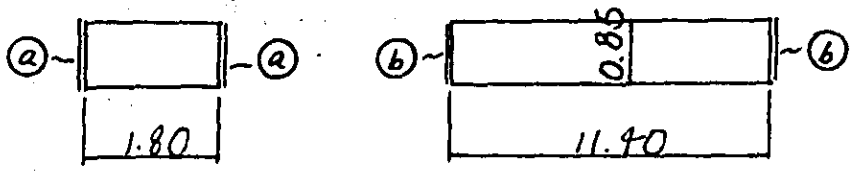
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m^3

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420

FOOTING TOTAL = 185.478 m^3

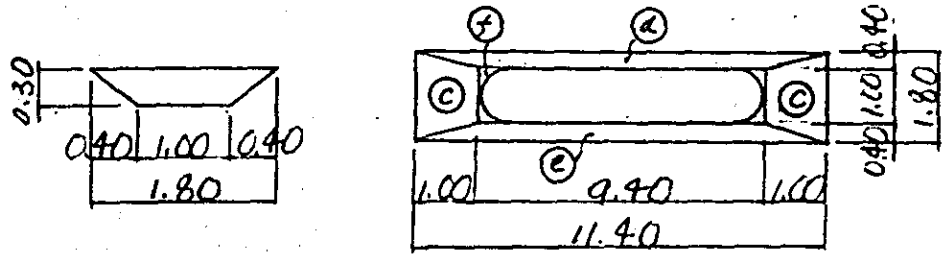
3) FORM AREA

(1) BEAM



A_a = 0.85 × 11.40 × 2 = 19.380 m²

A_b = 0.85 × 1.80 × 2 = 3.060 "



A_c = ½ × (1.00 + 1.80) × $\sqrt{1.00^2 + 0.30^2}$ × 2 = 2.923 "

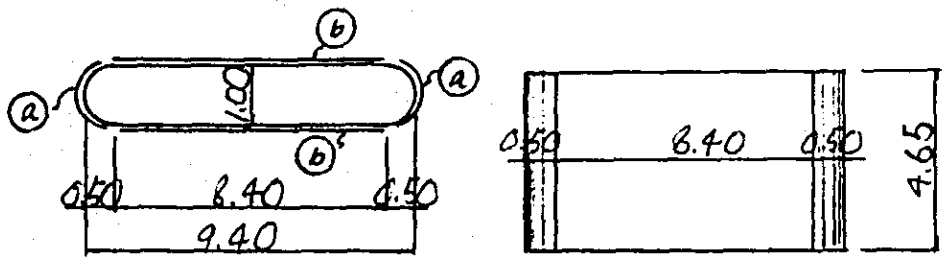
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.40^2 + 0.30^2}$ = 5.200 "

A_e = A_d = 5.200 "

A_f = (1 − π/4) × 1.00² = 0.215 "

BEAM TOTAL = 35.978 m²

(2) COLUMN

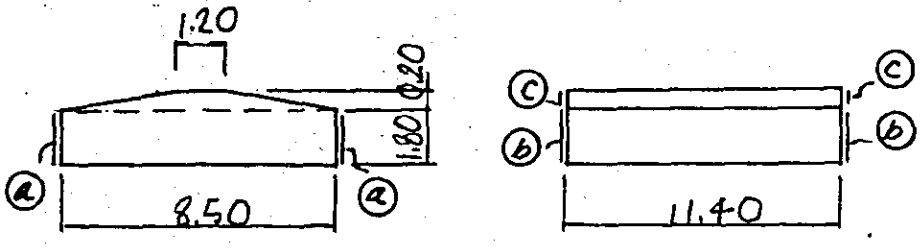


A_a = $\pi \times 1.00 \times 4.65$ = 14.608 m^2

A_b = $8.40 \times 4.65 \times 2$ = 78.120 "

COLUMN TOTAL = 92.728 m^2

(3) FOOTING



A_a = $1.80 \times 11.40 \times 2$ = 41.040 m^2

A_b = $1.80 \times 8.50 \times 2$ = 30.600 "

A_c = $\frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$ = 1.940 "

FOOTING TOTAL = 73.580 m^2

4) REINFORCING BAR

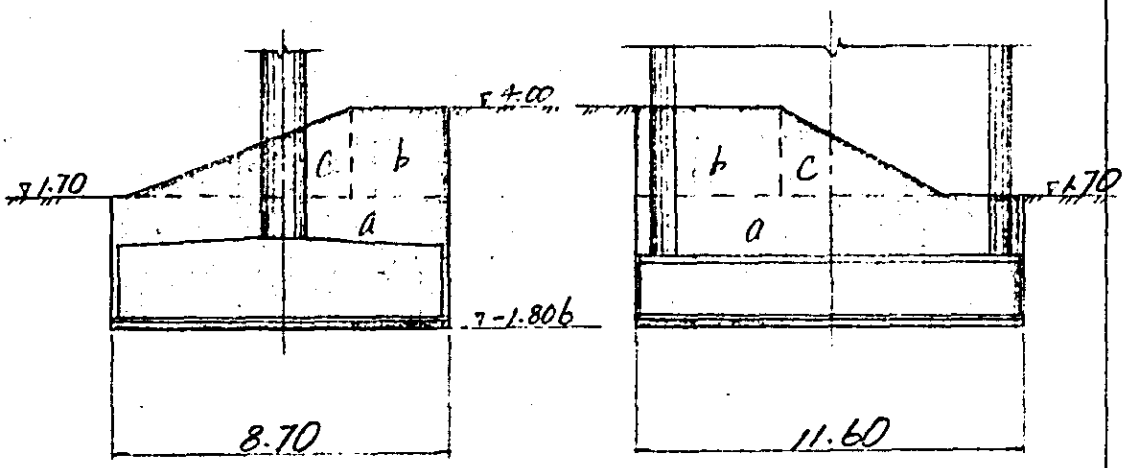
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1156.3	353.6	1 509.9
COLUMN			3 418.9				1 403.9	4 822.8
TOTAL			3 418.9			1156.3	1 757.5	6 332.7
FOOTING	6 663.0				2869.8	2595.7		12 128 5

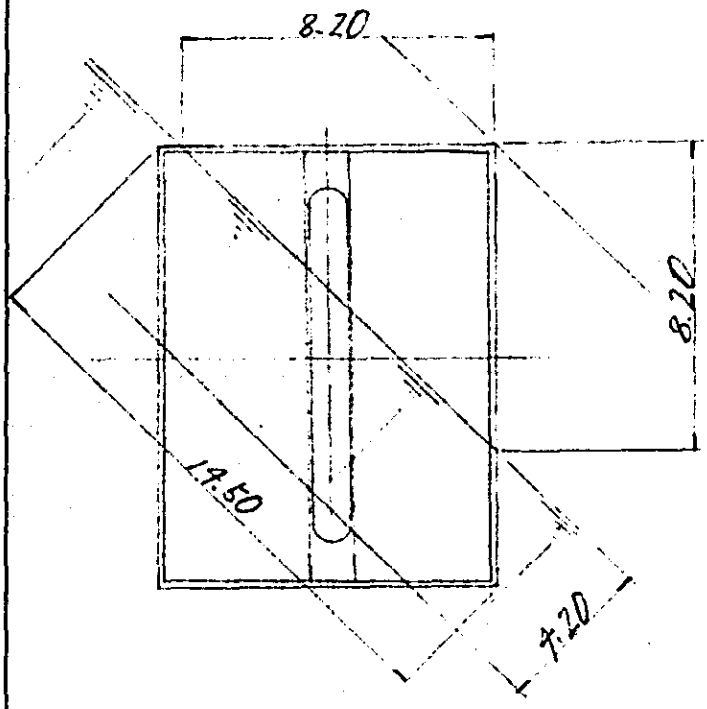
BEARING BASE —— D16 526.8 rd

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D 16	1.56	12 780	6	119 6	⌐¬
2	D 13	0.995	11 300	6	67 5	—
3	〃	〃	11 900	2	23 7	⌣
4	〃	〃	11 860	2	23 6	〃
5	〃	〃	2 760	12	33 0	⌐—
6	〃	〃	2 450	8	19 5	[
7	D 16	1.56	6 970	6	65 2	⌐¬
8	〃	〃	7 240	6	67 8	⌐¬
B° 1	D 16	1.56	3 640	37	210 1	⌐¬
2	〃	〃	2 980	63	292 9	⌣
3	〃	〃	2 880	12	53 9	〃 (VARIES)
4	D 13	0.995	2 530	74	186 3	⊏
5	D 16	1.56	3 340	38	198 0	⌐¬
6	〃	〃	2 510	38	148 8	〃
		SUB TOTAL				
			D 16	1156 3 kg		
			D 13	353 6		
				1509 9 kg		
	COLUMN					
C 1	D 25	3.98	7 650	80	2435 8	↓
2	〃	〃	4 750	52	983 1	〃
3	D 13	0.995	8 400	68	568 3	—
4	〃	〃	2 160	68	146 1	⊂
C° 1	D 13	0.995	2 720	143	387 0	⊓
2	〃	〃	2 420	22	53 10	〃
3	〃	〃	1 560	143	221 9	⌐¬
4	〃	〃	1 260	22	27 6	〃
		SUB TOTAL				
			D 25	3418 9 kg		
			D 13	1403 9		
				4822 8 kg		

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	FOOTING					
F 1	D 32	6.23	11 500	93	6 663.0	⌴
2	D 19	2.25	9 510	47	1 005.7	⌒
3	〃	〃	14 720	9	298.1	⌴
4	〃	〃	14 500	48	1666.0	〃 (VARIES)
5	D 16	1.56	12 220	29	552.8	⌐¬
6	〃	〃	8 960	10	139.8	⌴
7	〃	〃	11 870	10	185.2	〃
F° 1	D 16	1.56	4 370	252	1 717.9	⊟ (VARIES)
		SUB TOTAL				
			D 32	6 663.0	kg	
			D 19	2 869.8	〃	
			D 16	2595.7	〃	
				12 128.5	kg	
		TOTAL				
			D 32	6 663.0	kg	
			D 25	3 418.9	〃	
			D 19	2 869.8	〃	
			D 16	3 752.0	〃	
			D 13	1 757.5	〃	
				18 461.2	kg	

5) EXCAVATION





$V_a = 8.70 \times 11.60 \times (1.70 + 1.806)$ = 353.826 m^3

$V_b = \frac{1}{2} \times 8.20^2 \times (4.00 - 1.70)$ = 77.326 "

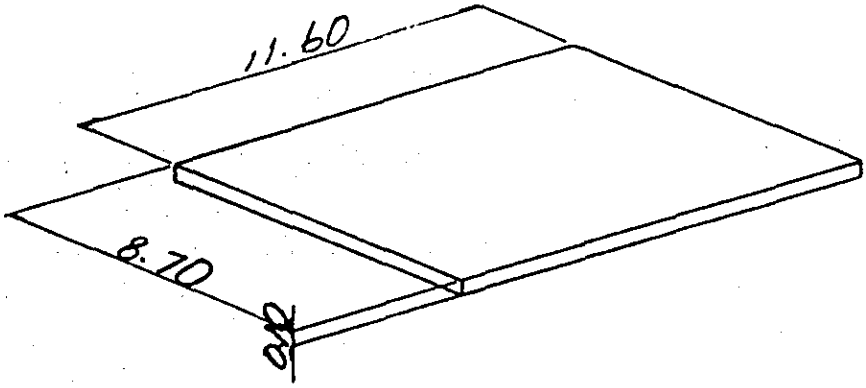
$V_c = "\ \times 4.20 \times (4.00 - 1.70) \times 14.50$ = 70.035 "

EXCAVATION TOTAL = 501.187 m^3

6) BEARING BASE MORTAL

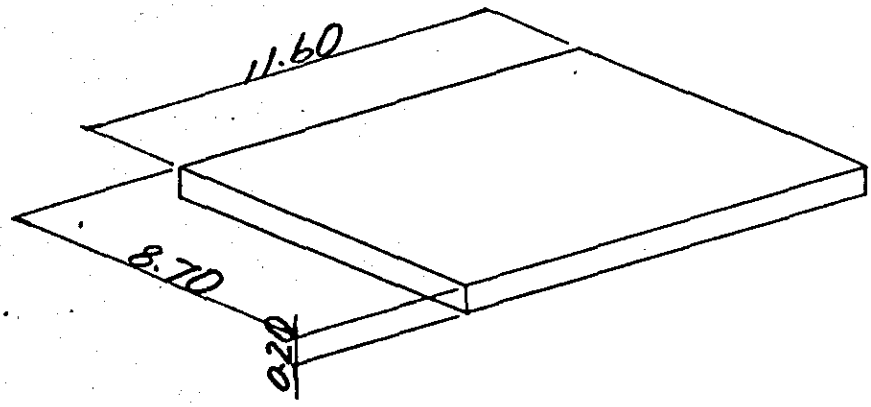
$$Va = \tfrac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 12$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 4 = 0.118\ m^3$$

7) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

8) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

9) PILE

ϕ - 500

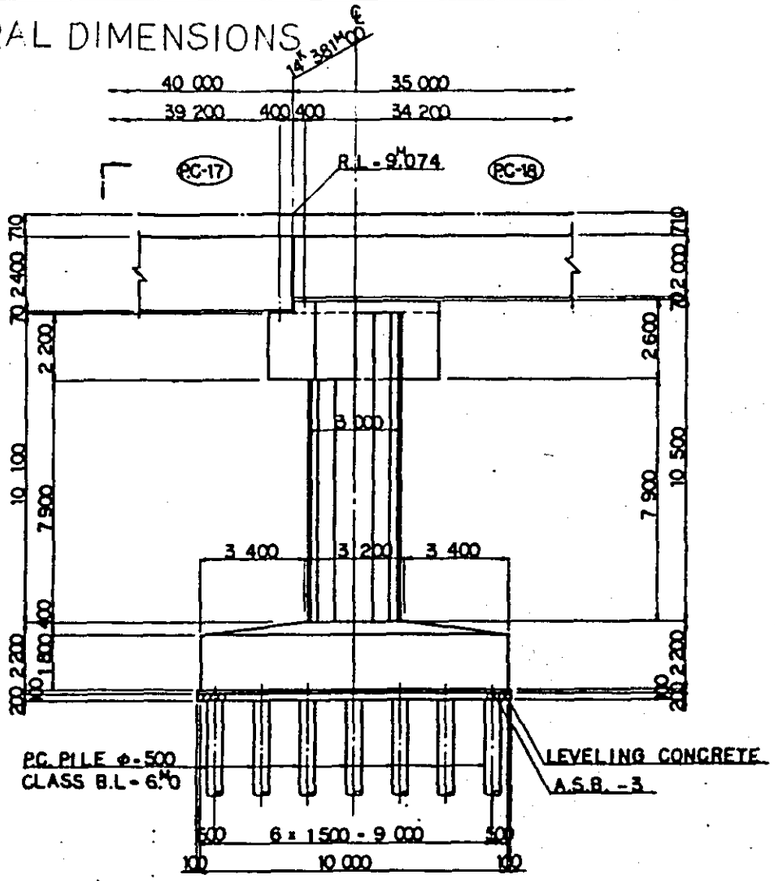
TYPE-B 11 m × 42

5. PIER 20

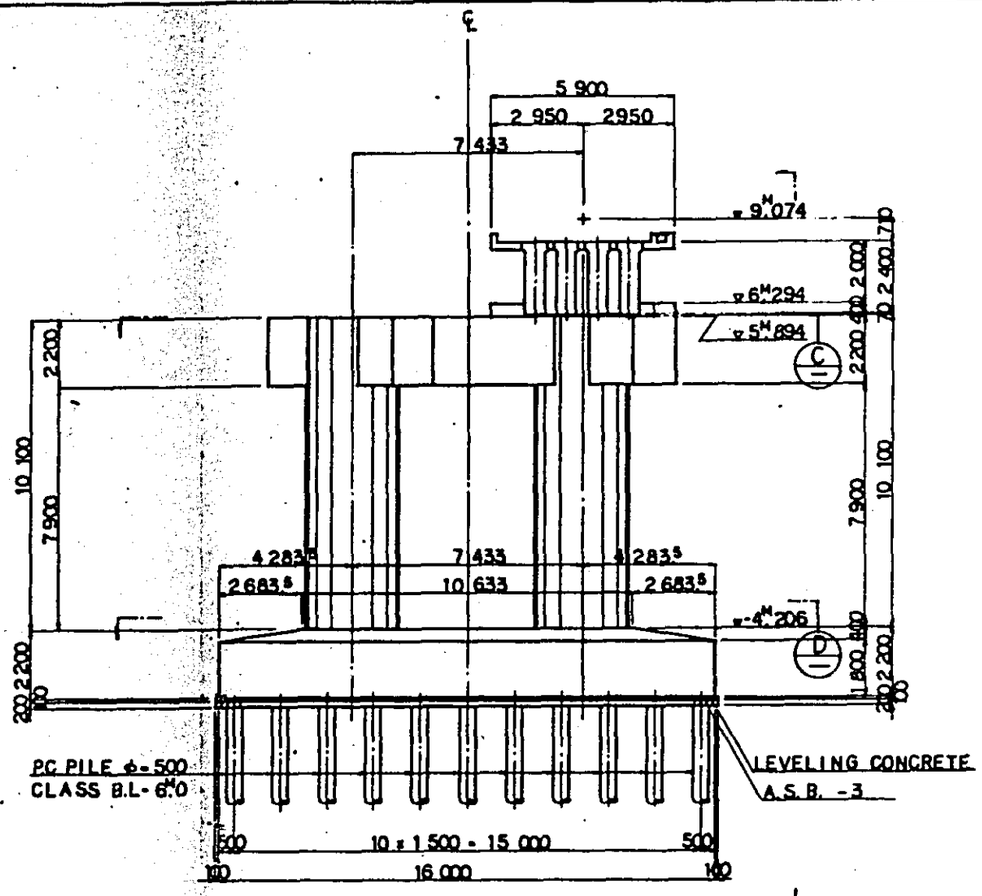
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	78.7	100.4	7 966.7	101.2
COLUMN	111.7	148.9	9 154.6	82.0
TOTAL	190.4	249.3	17 121.3	89.9
FOOTING	324.4	93.6	27 156.0	83.7

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	16.5	CLASS E
AGGREGATE SUBBASE	m^3	33.0	A.S.B. - 3
EXCAVATION	m^3	1200.4	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	6.00 m x 77	φ500 - B

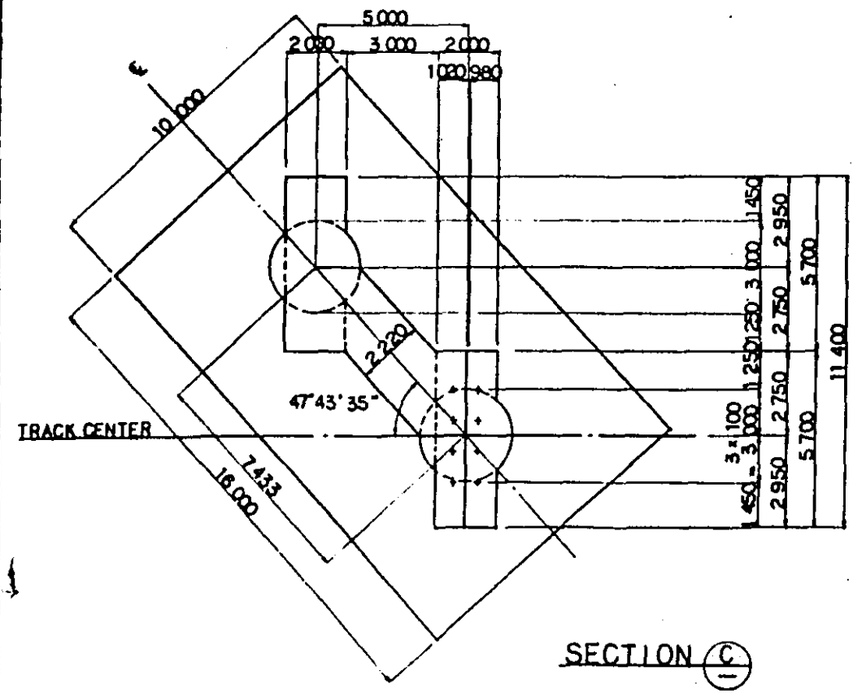
GENERAL DIMENSIONS



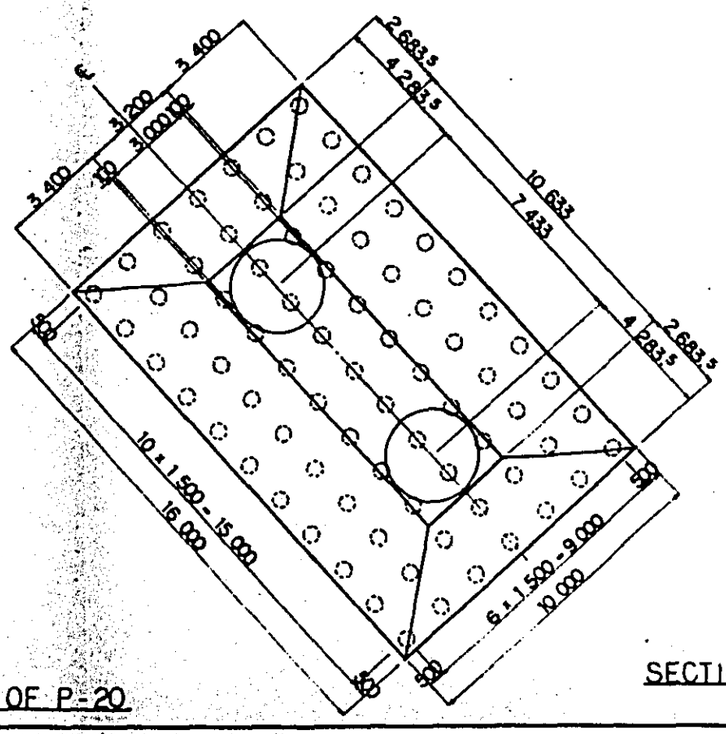
SECTION (A)



SECTION (B)



SECTION (C)

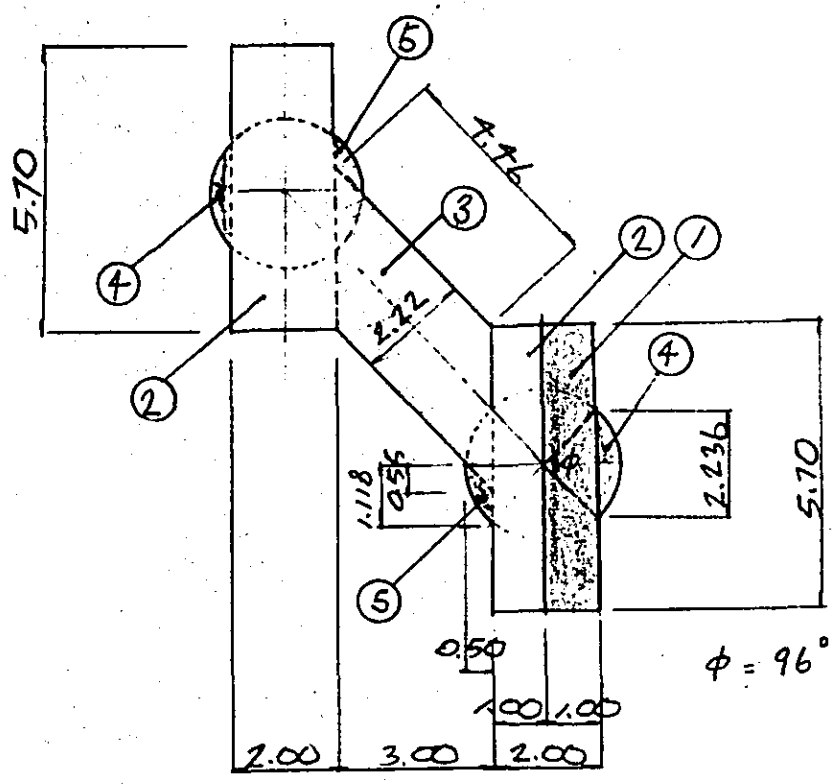


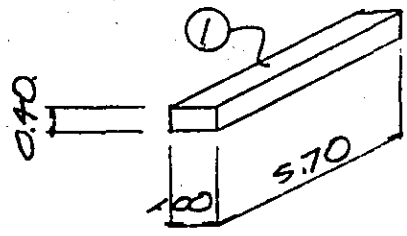
SECTION (D)

GENERAL VIEW OF P-20

2) CONCRETE VOLUME

(1) BEAM

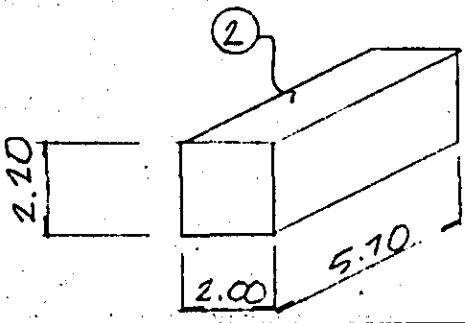




$n = 1$

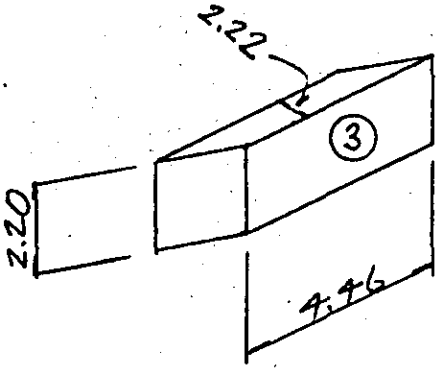
m^3

$V_1 = 1.00 \times 0.40 \times 5.70 \times 1 = 2.280$



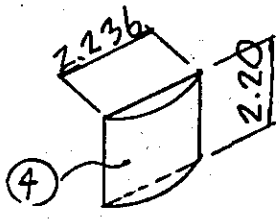
$n = 2$

$V_2 = 2.00 \times 2.20 \times 5.70 \times 2 = 50.160\ m^3$



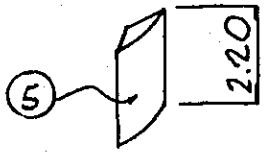
$n = 1$

$V_3 = 2.22 \times 2.20 \times 4.46 = 21.783$ "



$n = 2$

$V_4 = \left(\frac{96.3794^\circ}{360^\circ} \times \pi \times 1.50^2 - \frac{1}{2} \times 2.236 \times 1.00\right) \times 2.20 \times 2 = 3.407$ "

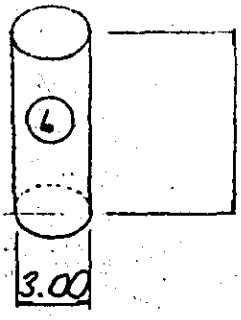


$V_5 = \frac{1}{2} \times V_4 - \frac{1}{2} \times 0.55 \times 0.50 \times 2.20 \times 2$

$= 3.407 \times \frac{1}{2} - 0.605 = 1.099$ "

BEAM TOTAL = $78.729\ m^3$

(2) COLUMN

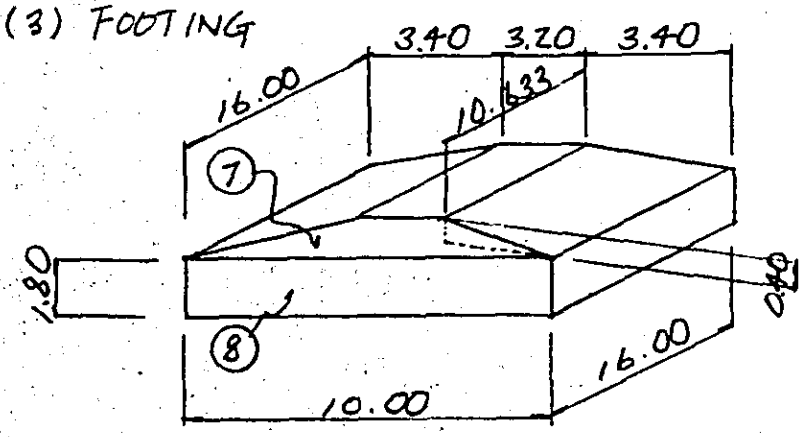


$n = 2$

$$V_6 = \pi/4 \times 3.00^2 \times 7.90 \times 2 = 111.684 \ m^3$$

COLUMN TOTAL = 111.684 m^3

(3) FOOTING



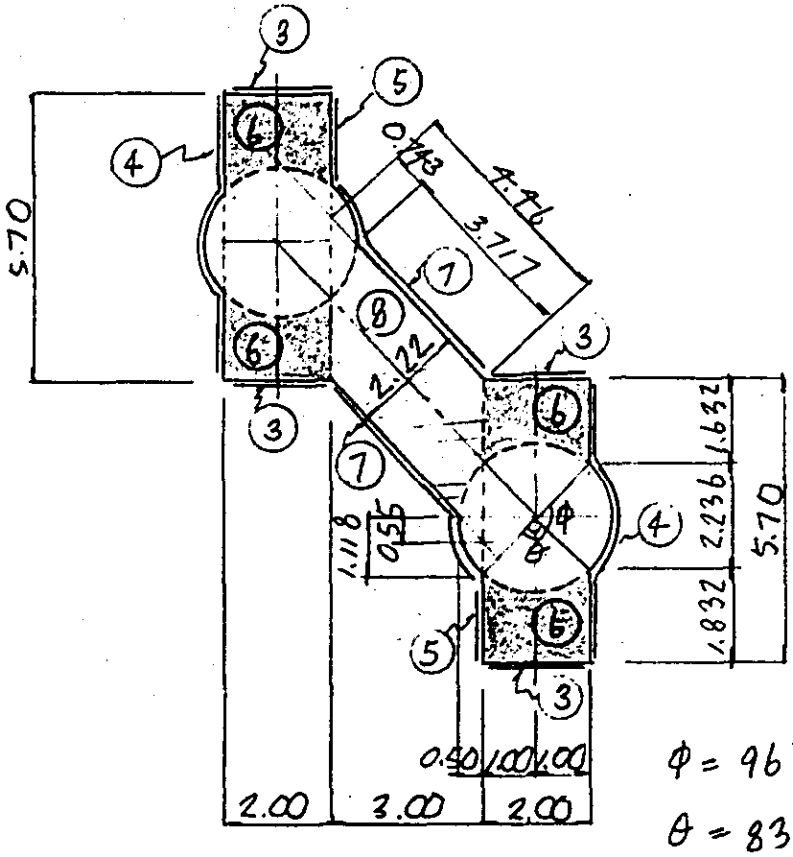
$$V_7 = \frac{0.40}{6} \times (3.20 \times 10.633 + 10.00 \times 16.00 + 13.20 \times 26.633) = 36.372 \ m^3$$

$$V_8 = 1.80 \times 10.00 \times 16.00 = 288.000 \ m^3$$

FOOTING TOTAL = 324.372 m^3

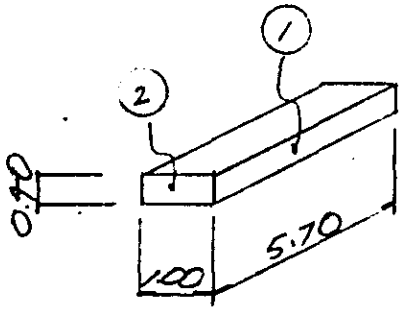
3) FORM AREA

(1) BEAM



$\phi = 96°22'46"$

$\theta = 83°37'14"$



$n = 1$

$A_1 = 0.40 \times 5.70 \times 2 \times 1 = 4.560\ m^2$

$A_2 = 0.40 \times 1.00 \times 2 \times 1 = 0.800\ "$

$A_3 = 2.00 \times 2.20 \times 2 \times 2 = 17.600\ m^2$

$A_4 = (1.832 + \frac{96.3794}{360^\circ} \times \pi \times 3.00 + 1.632) \times 2.20 \times 2 = 26.344$ "

$A_5 = 1.832 \times 2.20 \times 2 = 8.061$ "

$A_6 = (1.832 + 1.632) \times 2.00 \times 2$

$- (\frac{83.6206^\circ}{360^\circ} \times \pi \times 1.50^2 - \frac{1}{2} \times 2.00 \times 1.118) \times 2 \times 2 = 11.760$ "

$A_7 = (3.717 + \frac{96.3794 \times 1/2}{360} \times \pi \times 3.00) \times 2.20 \times 2 = 21.906$ "

$A_8 = 4.46 \times 2.22 - \frac{1}{2} \times 0.55 \times 0.50$

$- (\frac{96.3794 \times 1/2}{360} \times \pi \times 1.50^2 - \frac{1}{2} \times 1.00 \times 1.118) = 9.317$ "

BEAM TOTAL = $100.408\ m^2$

(2) COLUMN

$A_9 = \pi \times 3.00 \times 7.90 \times 2 = 148.911\ m^2$

COLUMN TOTAL = $148.911\ m^2$

(3) FOONIG

$A_{10} = 1.80 \times (10.00 + 16.00) \times 2 = 93.600$ "

FOOTING TOTAL = $93.600\ m^2$

4) REINFORCING BAR

	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM		3 575.0			657.5	3 120.9	27.3	7 380.7
COLUMN			4 255.4		4 899.2			9 154.6
TOTAL		3 575.0	4 255.4		5 556.7	3 120.9	27.3	16 535.3
FOOTING	16 530.1	4 220.6	2 354.2		4 051.1			27 156.0

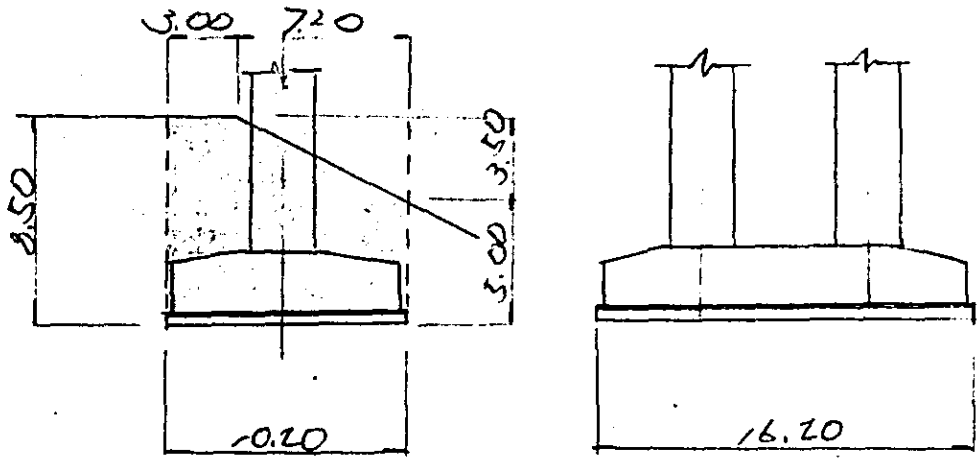
BEARING BASE D16 586.0 Kg

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	029	5.04	13 540	16	1 091 9	(VAR.)
2	〃	〃	13 270	14	936 3	〃 〃
3	〃	〃	10 230	30	1 546 8	〃
4	016	1.56	9 980	12	186 8	〃 〃
5	019	2.25	9 740	30	657 5	
6	016	1.56	6 580	30	307 9	
7	〃	〃	5 560	24	208 2	
8	〃	〃	7 300	7	79 7	
9	〃	〃	2 620	39	159 4	〃
10	〃	〃	5 560	2	17 3	
11	〃	〃	3 390	24	126 9	
12	〃	〃	1 860	2	5 8	〃
B° 1	016	1.56	6 560	27	276 3	
2	〃	〃	3 190	27	134 4	
3	〃	〃	4 890	54	411 9	
4	〃	〃	1 530	54	128 9	
5	〃	〃	6 480	30	303 3	
6	〃	〃	2 980	30	139 5	
7	〃	〃	5 140	60	481 1	
8	〃	〃	1 640	60	153 5	
9	013	0.995	2 550	7	17 8	
10	〃	〃	1 360	7	9 5	
			SUB TOTAL			
				029	3 575 0 kg	
				019	657 5 〃	
				016	3 120 9 〃	
				013	27 3 〃	
					7 380 7 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	COLUMN					
C 1	D25	3.98	12 150	88	4 255 4	
C° 1	D19	2.25	5 090	292	3 344 1	
2	"	"	4 670	148	1 555 1	
			SUB TOTAL			
				D25	4 255 4 kg	
				D19	4 899 2 "	
					9 154 6 kg	
	FOOTING					
F 1	D32	6.23	19 000	67	7 930 8	
2	D29	5.04	16 420	51	4 220 6	
3	D25	3.98	17 360	2	138 2	
4	"	"	17 390	22	1 522 7	(VAR.)
5	"	"	17 420	10	693 3	"
6	D32	6.23	12 900	107	8 599 3	
7	D19	2.25	11 000	2	49 5	
8	"	"	11 030	16	397 1	(VAR.)
9	"	"	11 050	36	895 1	"
10	"	"	16 570	10	372 8	
11	"	"	10 570	10	237 8	
F° 1	D19	2.25	5 110	18	207 0	
2	"	"	1 960	34	149 9	
3	"	"	4 770	40	429 3	(VAR.)
4	"	"	4 630	126	1 312 6	" (")
			SUB TOTAL			
				D32	16 530 1 kg	
				D29	4 220 6 "	
				D25	2 354 2 "	
				D19	4 051 1 "	
					27 156 0 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
			TOTAL			
				D32	16 530.1 kg	
				D29	7 795.6 "	
				D25	6 609.6 "	
				D19	9 607.8 "	
				D16	3 120.9 "	
				D13	27.3 "	
					43 691.3 kg	

5) EXCAVATION



$V_a = (10.20 \times 8.50 - \frac{1}{2} \times 7.20 \times 3.50) \times 16.20 = 1200.420\ m^3$

TOTAL = $1200.420\ m^3$

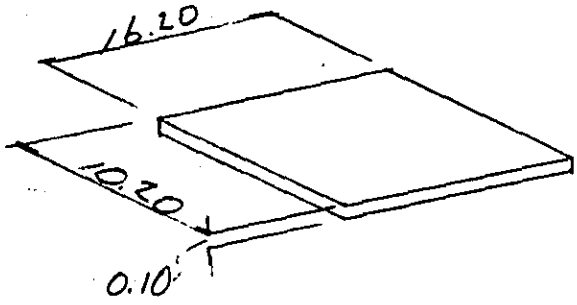
6) BEARING BASE MOTAR

$V_a = \frac{1}{2} \times (0.836 \times 0.636 + 0.80 \times 0.60) \times 0.018 \times 8$

$+ \frac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 8 = 0.140\ m^3$

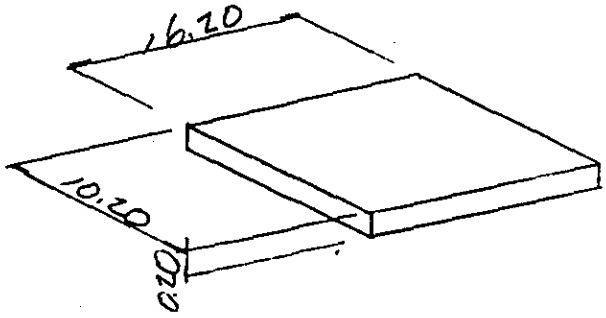
TOTAL = $0.140\ m^3$

7) LEVELING CONCRETE



$V_a = 10.20 \times 16.20 \times 0.10 = 16.524\ m^3$

8) AGGREGATE SUBBASE



$V_a = 10.20 \times 16.20 \times 0.20 = 33.048\ m^3$

9) PILE

ϕ 500

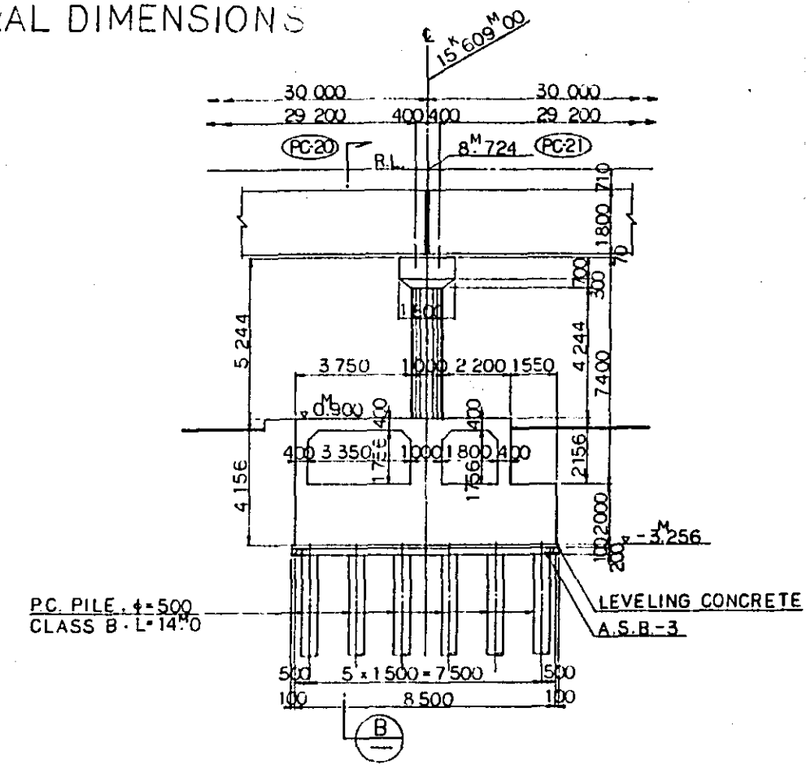
TYPE B 6.00 m × 77

6. PIER 24

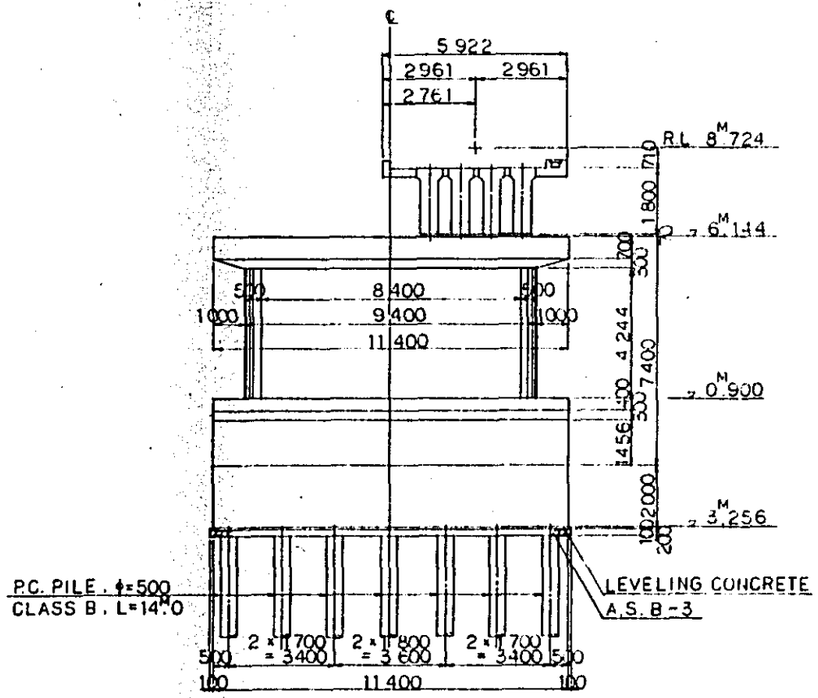
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (kg/m^3)
BEAM	18.8	32.0	1823.8	97.0
COLUMN	108.8	219.5	12047.2	110.7
TOTAL	127.6	251.5	13871.0	108.7
FOOTING	185.5	73.6	12449.7	67.1

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.P. - 3
EXCAVATION	m^3	356.6	
FOUNDATION MORTAR	m^3	0.1	
PILE	m x NUMBER	14 x 42	φ500 - B

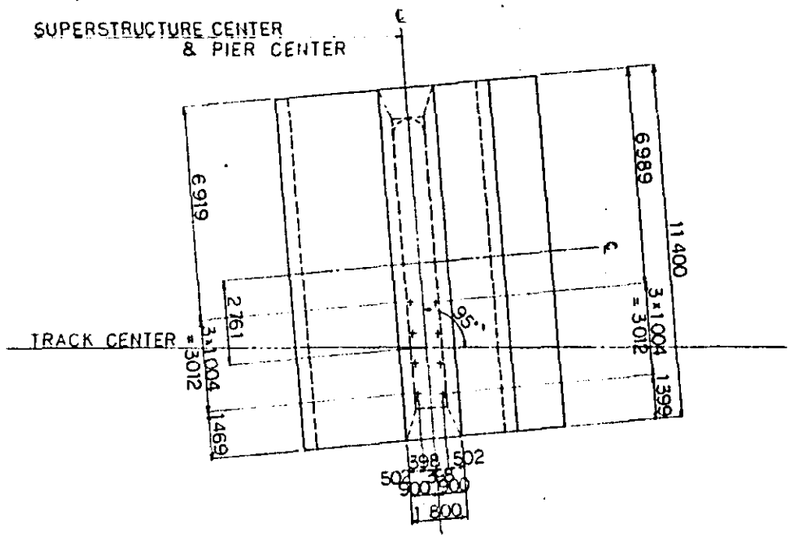
GENERAL DIMENSIONS



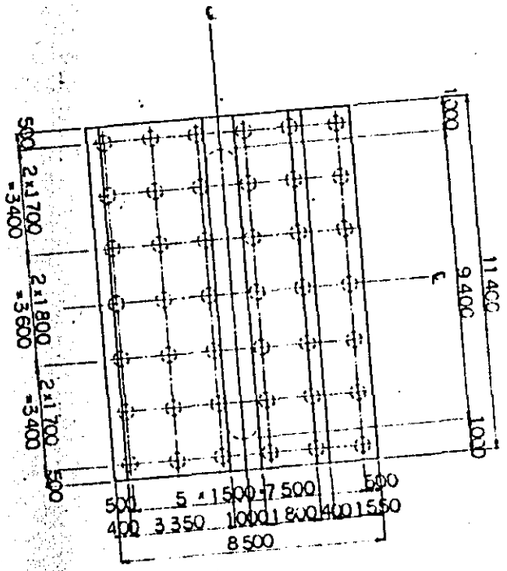
SECTION (A)



SECTION (B)



SECTION (C)

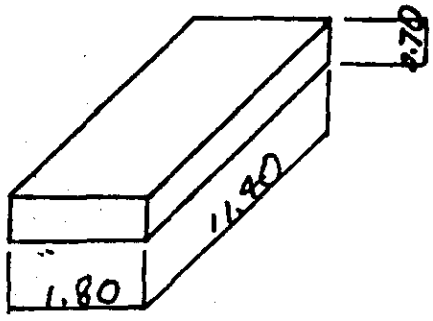


SECTION (D)

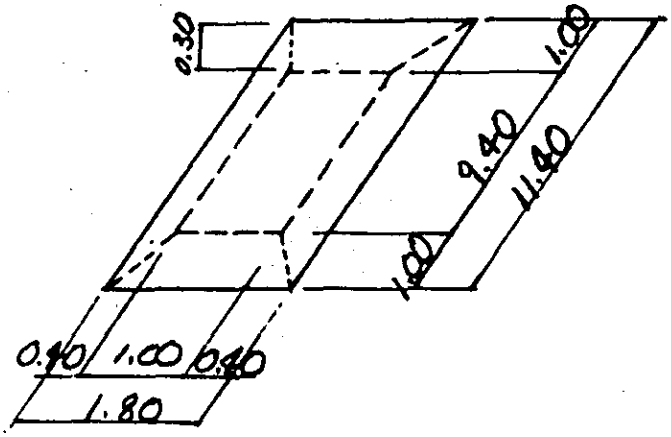
GENERAL VIEW OF P-24

2) CONCRETE VOLUME

(1) BEAM



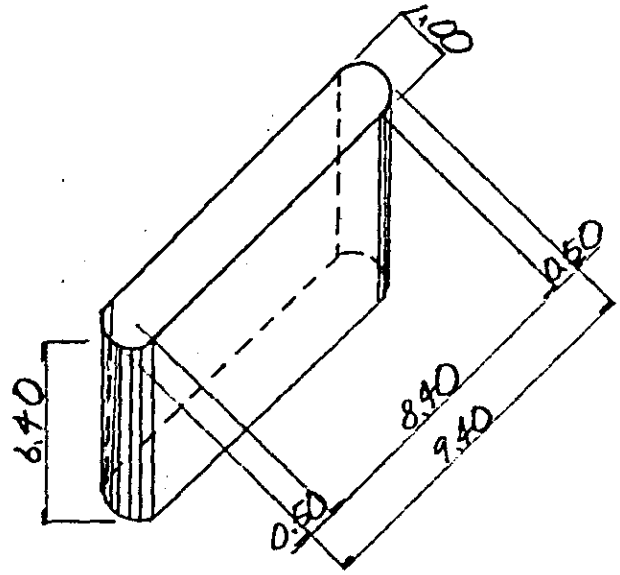
$V_a = 1.80 \times 0.70 \times 11.40 = 14.364$ m³



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\} = 4.408$ m³

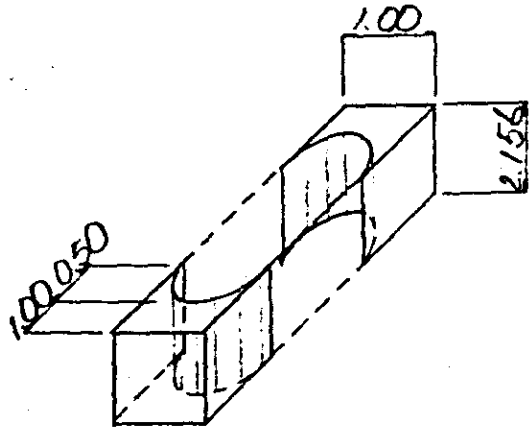
BEAM TOTAL = 18.772 m³

(2) COLUMN



$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 6.40$ = 5.027 m^3

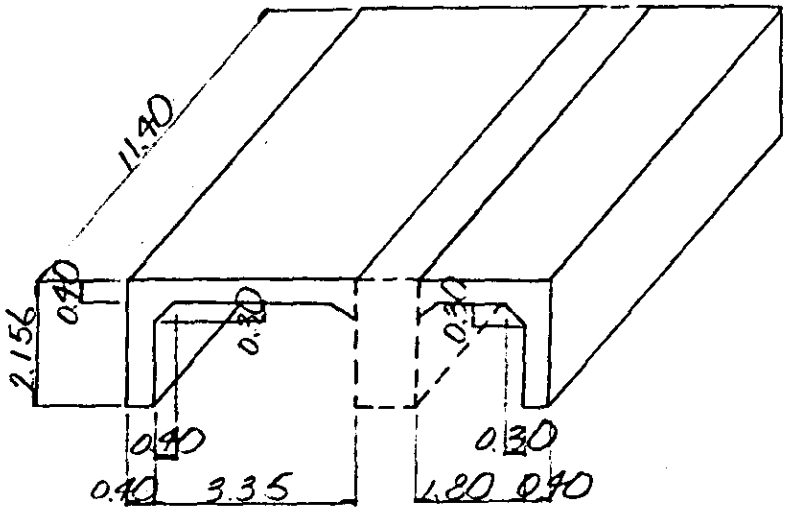
$V_b = 1.00 \times 8.40 \times 6.40$ = 53.760 "



$V_c = (1.00 \times 3.00 - \frac{1}{4} \times \pi \times 1.00^2) \times 2.156$ = 4.775 m^3

COLUMN TOTAL = 63.562 m^3

(3) WALL

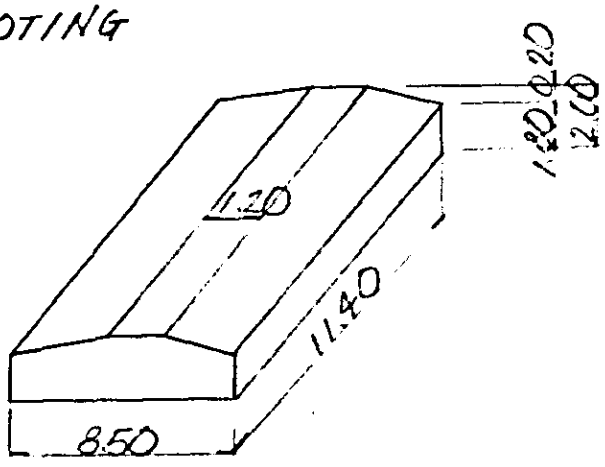


$V_a = (2.156 \times 2 + 3.35 + 1.80) \times 0.40 \times 11.40$ = 43.147 m^3

$V_b = 0.30 \times 0.30 \times 1/2 \times 11.40 \times 4$ = 2.052 "

WALL TOTAL = 45.199 m^3

(4) FOOTING



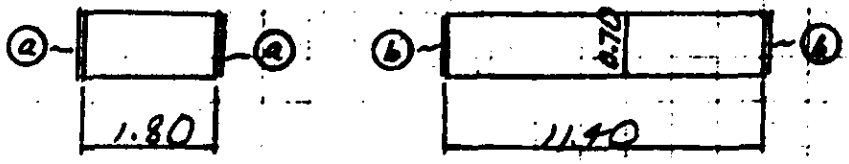
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m^3

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420 "

FOOTING TOTAL = 185.478 m^3

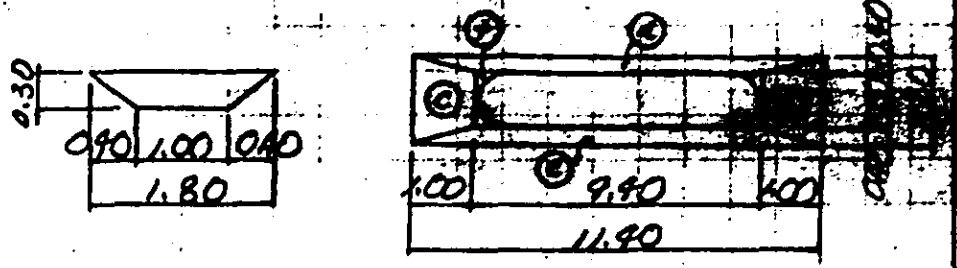
3) FORM AREA

1) BEAM



A_a = 0.70 × 11.40 × 2 = 15.960 m²

A_b = 0.70 × 1.80 × 2 = 2.520 "



A_c = ½ × (1.00 + 1.80) · √(1.00² + 0.30²) × 2 = 2.923 "

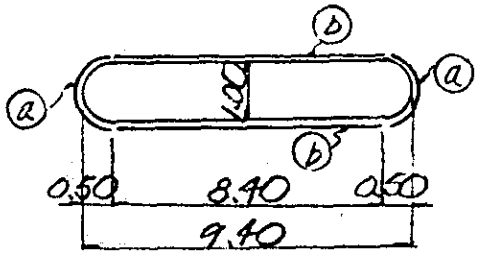
A_d = ½ × (9.40 + 11.40) · √(0.40² + 0.30²) = 5.200 "

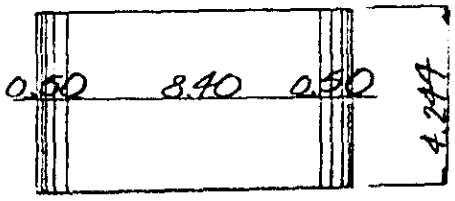
A_e = 〃 = 5.200 "

A_f = (1 − π/4) × 1.00² = 0.215 "

BEAM TOTAL = 32.018 m²

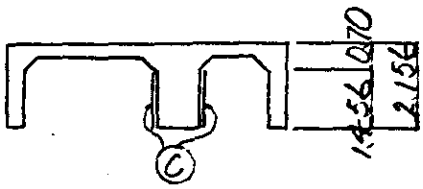
(2) COLUMN

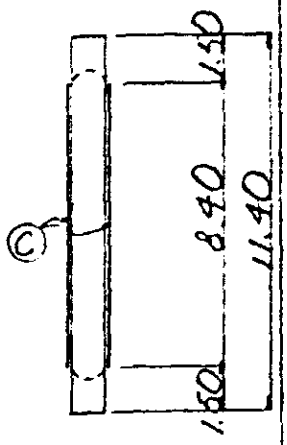




$Aa = \pi \times 1.00 \times 4.244 = 13.335\ m^2$

$Ab = 8.40 \times 4.244 \times 2 = 71.299\ "$

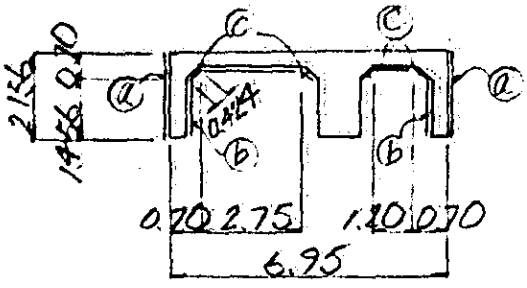


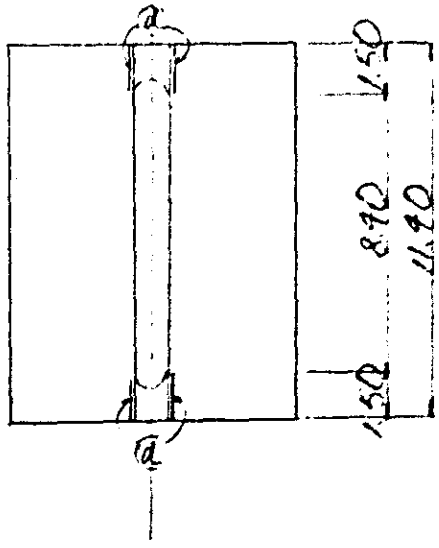


$Ac = 1.456 \times 8.40 \times 2 = 24.461\ m^2$

COLUMN TOTAL = 109.095 m^2

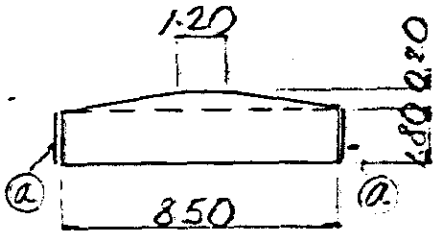
(3) WALL

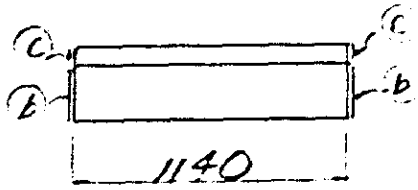




$Aa = 2.156 \times 11.40 \times 2$	=	49.157 m²
$Ab = 1.456 \times 11.40 \times 2$	=	33.197 "
$Ac = 0.424 \times 11.40 \times 4$	=	19.334 "
$Ad = 1.456 \times 1.50 \times 4$	=	8.736 "
WALL TOTAL	=	110.424 m²

(4) FOOTING





$Aa = 1.80 \times 11.40 \times 2$	=	41.040 m²
$Ab = 1.80 \times 8.50 \times 2$	=	30.600 "
$Ac = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$	=	1.940 "
FOOTING TOTAL	=	73.580 m²

4) REINFORCING BAR

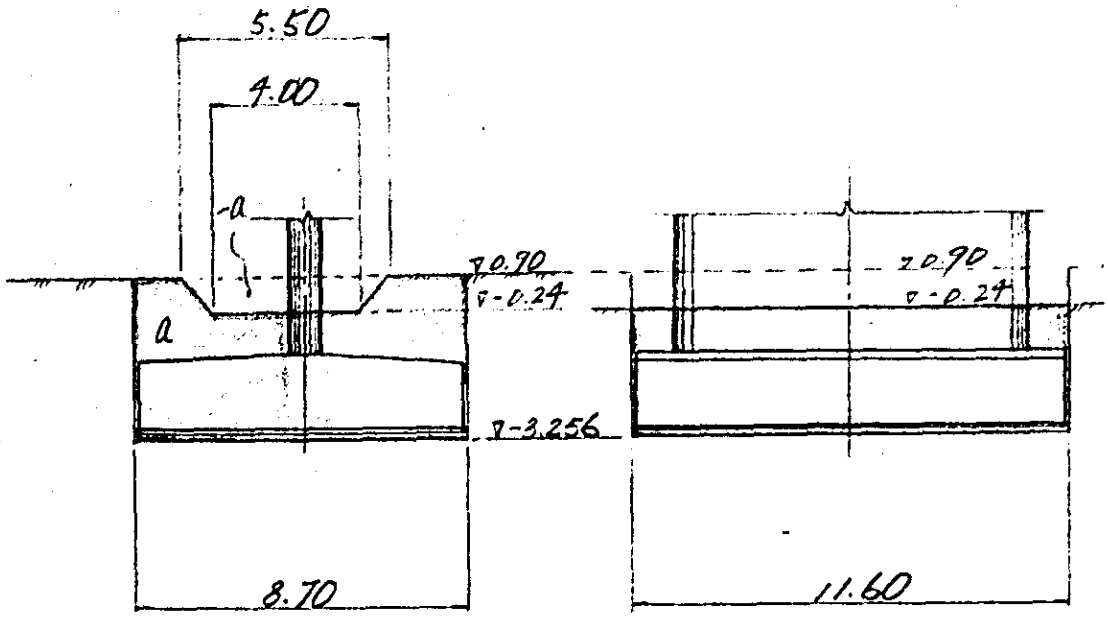
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						971.2	366.2	1337.4
COLUMN	6847.8					1648.3	3551.1	12047.2
TOTAL	6847.8					2619.5	3917.3	13384.6
FOOTING	6894.7				2892.4	2662.6		12449.7

BEARING BASE D16 486.4 kg

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	12 480	12	233 6	
2	D13	0.995	11 300	6	67 5	
3	〃	〃	11 900	2	23 7	
4	〃	〃	11 860	4	47 2	〃 (VAR.)
5	〃	〃	2 760	8	22 0	
6	〃	〃	2 450	8	19 5	
B° 1	D16	1.56	3 340	75	390 8	
2	〃	〃	2 980	63	292 9	
3	〃	〃	2 880	12	53 9	〃 (VAR.)
4	D13	0.995	2 530	74	186 3	
			SUB TOTAL			
				D16	971 2 kg	
				D13	366 2 〃	
					1337 4 kg	
	COLUMN					
C 1	D32	6.23	9 430	80	4 699 9	
2	〃	〃	6 630	52	2 147 9	
3	D16	1.56	9 400	90	1 319 8	
4	〃	〃	2 340	90	328 5	
C° 1	D13	0.995	2 720	176	476 3	
2	〃	〃	2 420	26	62 6	
3	〃	〃	1 570	176	274 9	
4	〃	〃	1 270	26	32 9	
			SUB TOTAL			
				D32	6 847 8 kg	
				D16	1 648 3 〃	
				D13	846 7 〃	
					9 342 8 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	WALL					
W 1	D13	0.995	12 050	39	467 6	
2	〃	〃	7 110	39	275 9	
3	〃	〃	2 830	102	287 2	
4	〃	〃	2 600	156	403 6	
5	〃	〃	11 260	70	784 3	
6	〃	〃	4 840	14	67 4	
W° 1	D13	0.995	1 520	229	346 3	
2	〃	〃	2 130	34	72 1	〃
			SUB TOTAL			
				D13	2704 4 kg	
					2704 4 kg	
	FOOTING					
F 1	D32	6.23	11 900	93	6894 7	
2	D19	2.25	9 500	47	1004 6	
3	〃	〃	14 720	57	1887 8	
4	D16	1.56	12 220	29	552 8	
5	〃	〃	8 960	10	139 8	
6	〃	〃	11 870	10	185 2	〃
F° 1	D16	1.56	4 540	252	1784 8	
			SUB TOTAL			
				D32	6 894 7 kg	
				D19	2 892 4 〃	
				D16	2 662 6 〃	
					12 449 7 kg	
			TOTAL			
				D32	13 742 5 kg	
				D19	2 892 4 〃	
				D16	5 282 1 〃	
				D13	3 917 3 〃	
					25 834 3 kg	

5) EXCAVATION



$$Va = 8.70 \times 11.60 \times (0.90 + 3.256) = 419.424 \ m^3$$

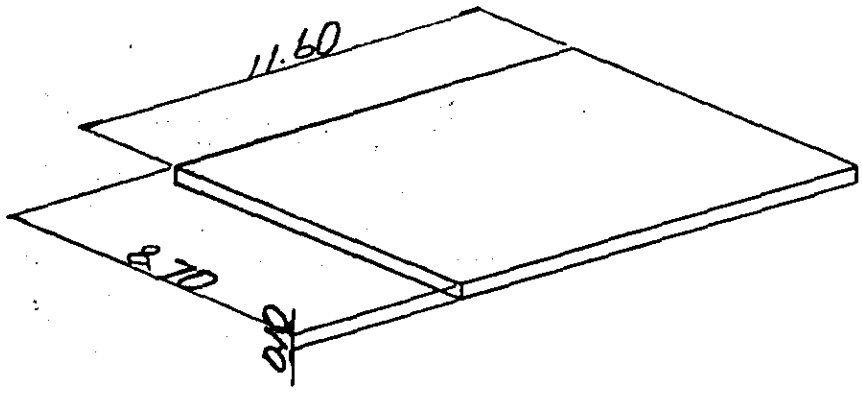
$$-Va = \tfrac{1}{2} \times (5.50 + 4.00) \times 11.60 \times (0.70 + 0.27) = -62.817$$

EXCAVATION TOTAL = 356.610 m^3

6) FOUNDATION MORTAR

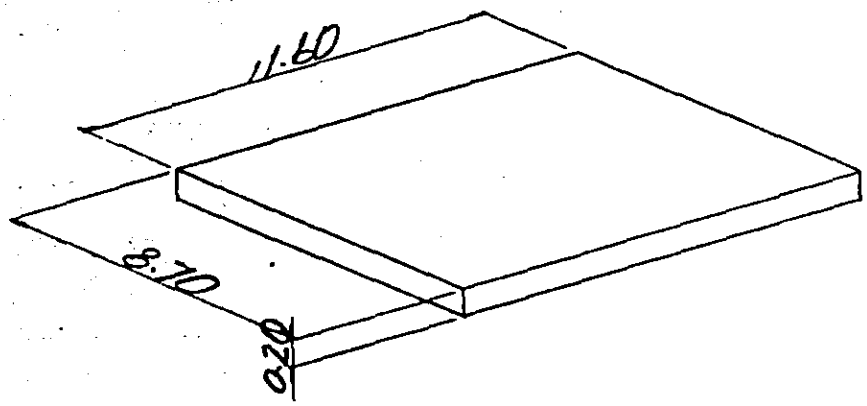
$$Va = \tfrac{1}{2} \times (0.836 \times 0.486 + 0.80 \times 0.45) \times 0.018 \times 16 = 0.110 \ m^3$$

7) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 ..... = 10.092 m^3

8) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 ..... = 20.184 m^3

9) PILE

ϕ - 500

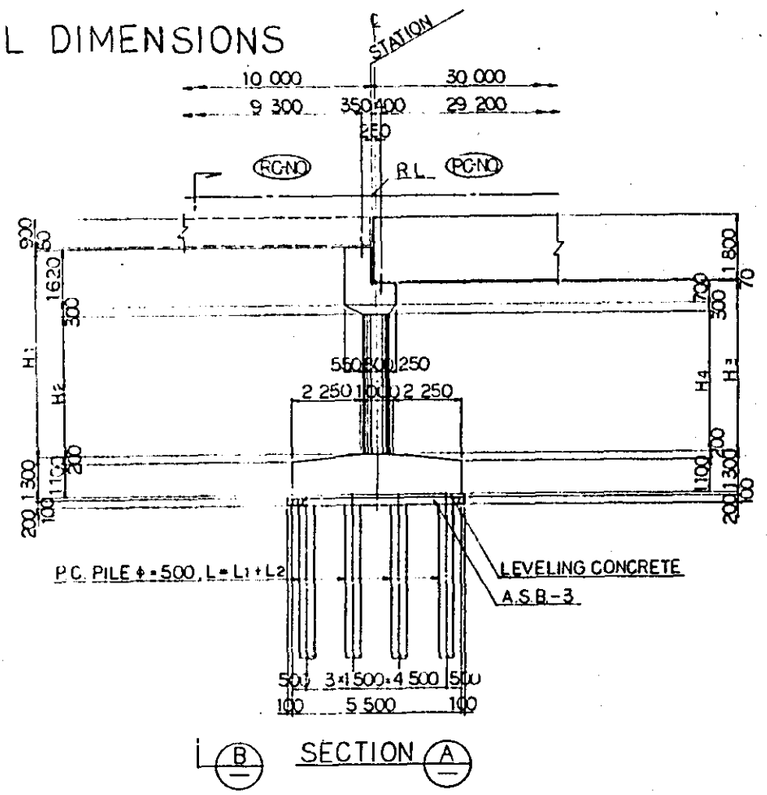
TYPE - B 14 m × 42 .....

7) PIER 25

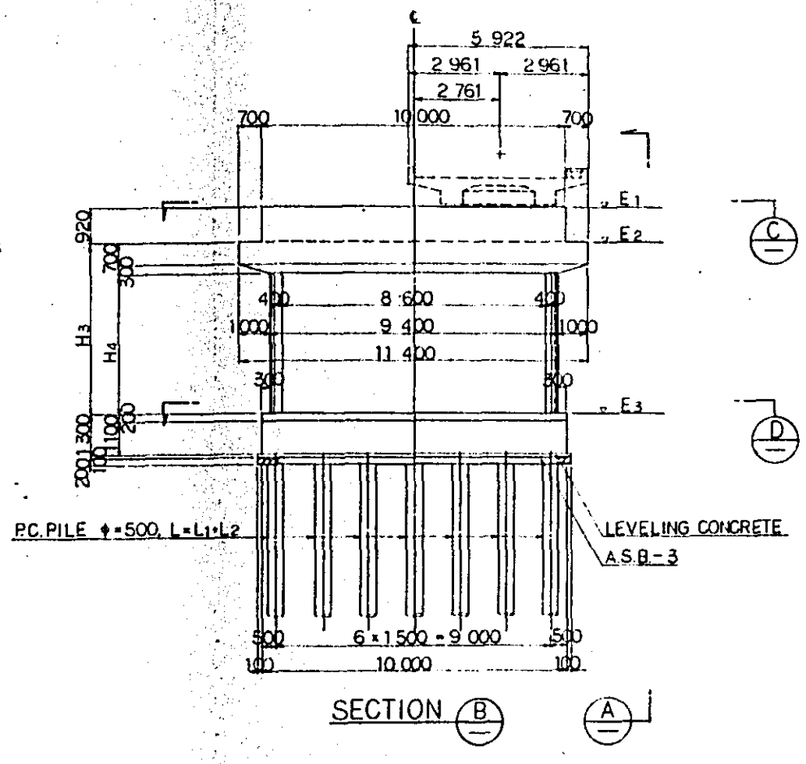
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	22.9	51.1	2247.6	98.1
COLUMN	39.1	104.5	4825.9	123.4
TOTAL	62.0	155.6	7073.5	114.1
FOOTING	67.0	35.4	4576.3	68.3

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B. - 3
EXCAVATION	m^3	154.4	
FOUNDATION MORTAR	m^3	0.1	15 cm = 400 kg/cm²
PILE	m x NUMBER	8 x 28 8 x 28	φ500 - A φ500 - B

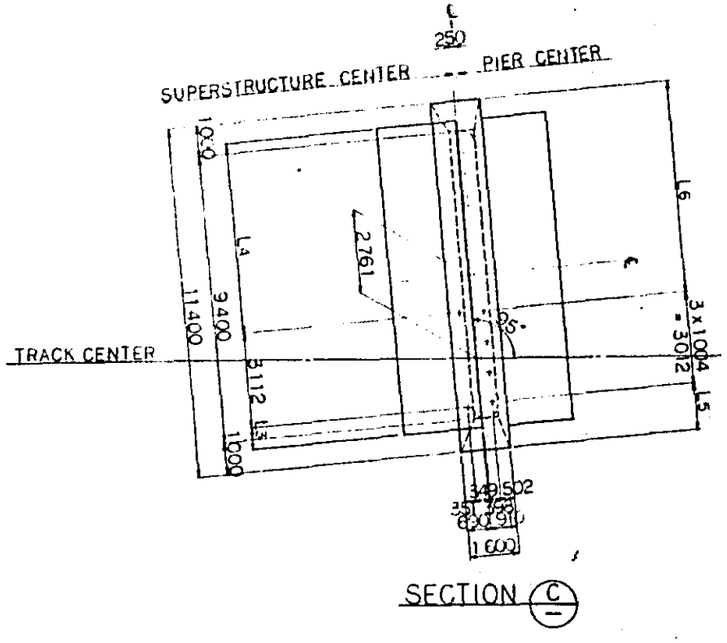
1) GENERAL DIMENSIONS



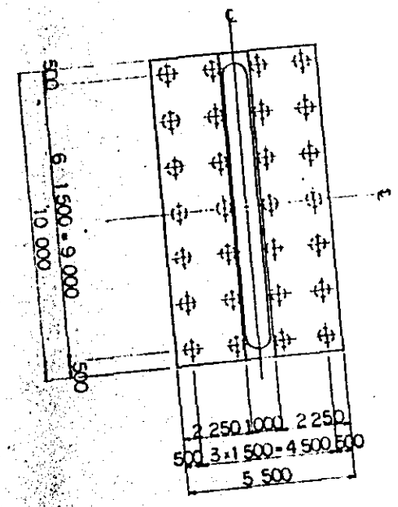
SECTION (B)–(A)



SECTION (B)–(A)



SECTION (C)–(C)



SECTION (D)–(D)

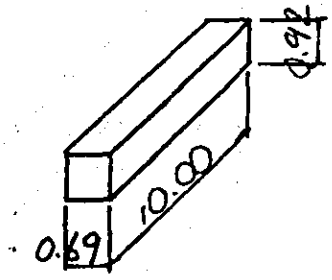
DIMENSION SCHEDULE

PIER NO.	STATION	ALIGNMENT	RC-NO.	PC-NO.	R.L.	E1	E2	E3	H1	H2	H3	H4	L1	L2	L3	L4	L5	L6
P-23	15K579M00	STRAIGHT	12	20	8.M724	7.M064	6.M144	-0.M056	7 120	5 200	6 200	5 200	8.M0	8.M0	714	6 174	1399	6989
P-25	15K639M00	STRAIGHT	13	21	8.M724	7.M064	6.M144	-0.M156	7 220	5 300	6 300	5 300	8.M0	8.M0	654	6 234	1469	6919

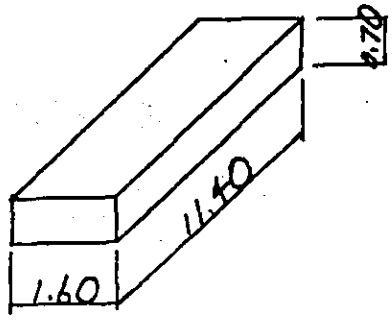
GENERAL VIEW OF P-23 & P-25

2) CONCRETE VOLUME

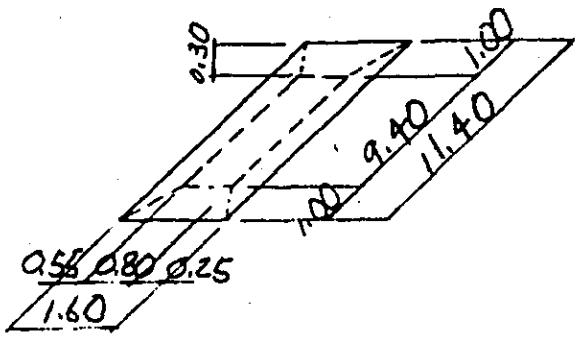
(1) BEAM



$V_a = 0.69 \times 0.92 \times 10.00$ = 6.348 m³



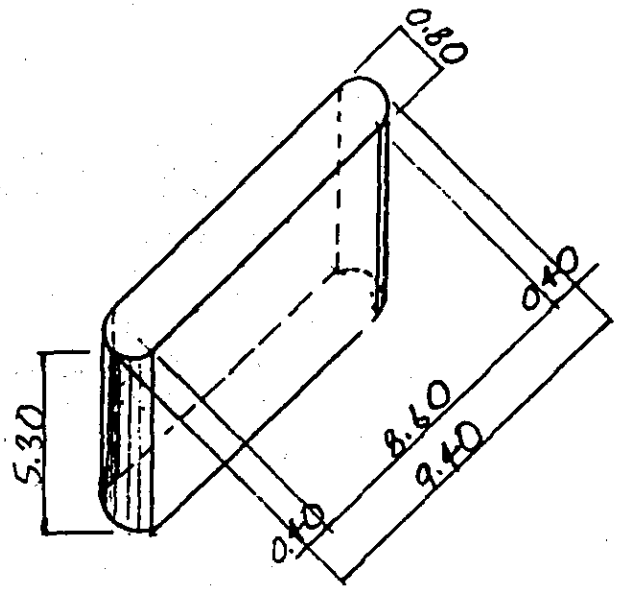
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$V_c = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40)\}$ = 3.784 "

BEAM TOTAL = 22.900 m³

(2) COLUMN

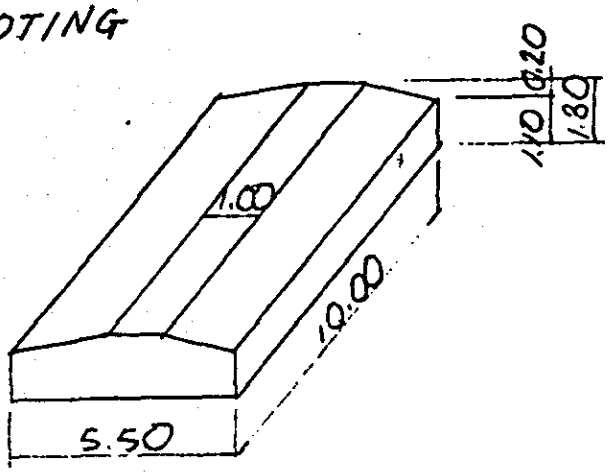


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 5.30$ = 2.664 m³

$V_b = 0.80 \times 8.60 \times 5.30$ = 36.464 "

COLUMN TOTAL = 39.128 m³

(3) FOOTING



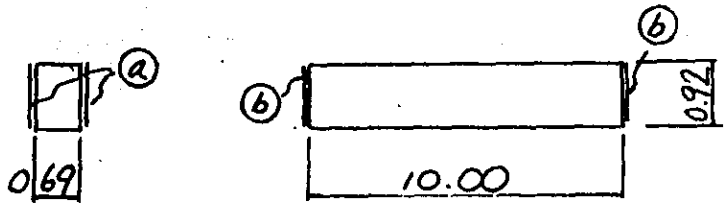
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m³

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m³

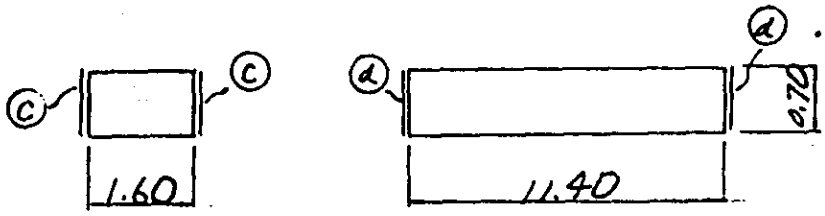
3) FORM AREA

(1) BEAM



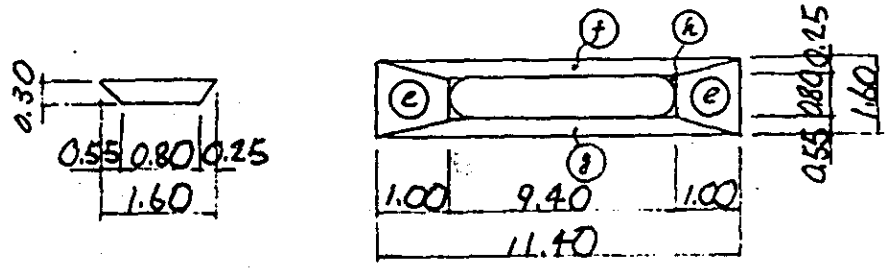
$A_a = 0.92 \times 10.00 \times 2$ = 18.400 m²

$A_b = 0.92 \times 0.69 \times 2$ = 1.270 "



$A_c = 0.70 \times 1.60 \times 2$ = 2.240 "

$A_d = 0.70 \times 11.40 \times 2$ = 15.960 "



$A_e = \frac{1}{2} \times (0.80 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.044) = 2.506 "

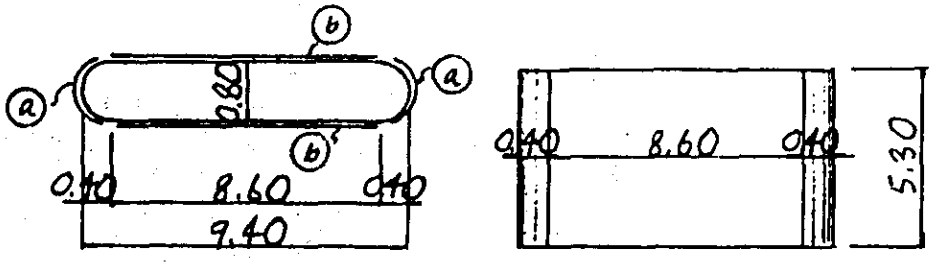
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ (0.391) = 4.066 "

$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.55^2 + 0.30^2}$ (0.627) = 6.510 "

$A_h = (1 - \pi/4) \times 0.80^2$ = 0.137 "

BEAM TOTAL = 51.089 m²

(2) COLUMN

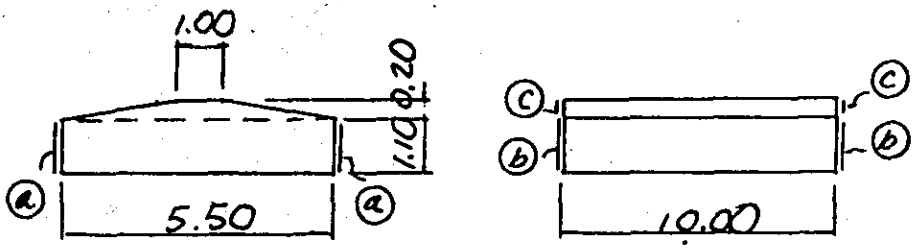


$A_a = \pi \times 0.80 \times 5.30$ = 13.320 m^2

$A_b = 8.60 \times 5.30 \times 2$ = 91.160 "

COLUMN TOTAL = 104.480 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m^2

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m^2

4) REINFORCING BAR

	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1382.0	547.2	1929.2
COLUMN			3449.0				1376.9	4825.9
TOTAL			3449.0			1382.0	1924.1	6755.1
FOOTING		2404.3			513.5	1658.5		4576.3

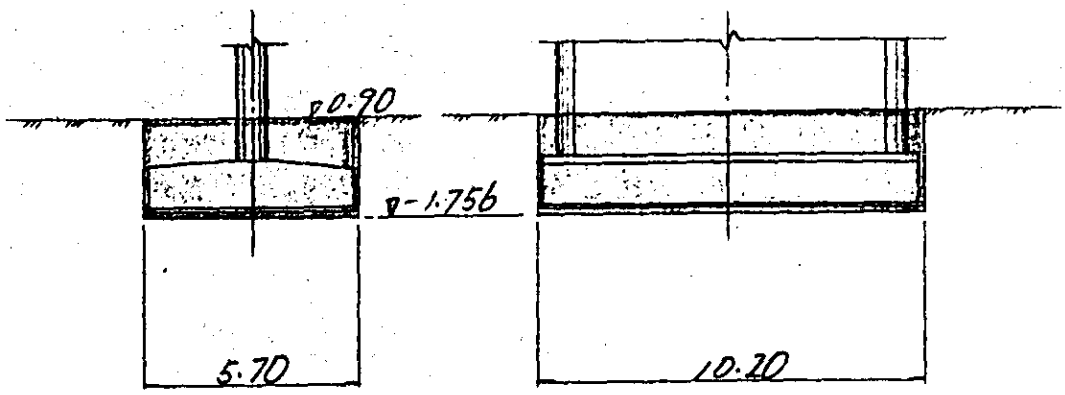
BEARING BASE —— D16 318.4 ㎏

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	12 480	11	214 2	
2	D13	0.995	11 300	6	67 5	
3	〃	〃	11 900	2	23 7	
4	〃	〃	11 880	4	47 3	(VAR.)
5	〃	〃	2 760	6	16 5	
6	〃	〃	2 250	6	13 4	
7	D16	1.56	12 900	5	100 6	
8	〃	〃	3 590	67	375 2	
9	D13	0.995	9 900	6	59 1	
10	〃	〃	1 340	6	8 0	
B' 1	D16	1.56	3 140	75	367 4	
2	〃	〃	2 790	63	274 2	
3	〃	〃	2 690	12	50 4	(VAR.)
4	D13	0.995	1 670	47	87 5	
5	〃	〃	1 250	47	58 5	
6	〃	〃	2 250	74	165 7	
			SUB TOTAL			
				D16	1 382 0 kg	
				D13	547 2 〃	
					1 929 2 kg	
	COLUMN					
C 1	D25	3.98	7 550	80	2 403 9	
2	〃	〃	5 050	52	1 045 1	
3	D13	0.995	8 600	72	616 1	
4	〃	〃	1 850	72	132 5	
C' 1	D13	0.995	2 320	143	330 1	
2	〃	〃	2 120	22	46 4	
3	〃	〃	1 560	143	222 0	
4	〃	〃	1 360	22	29 8	
			SUB TOTAL			
				D25	3 449 0 kg	
				D13	1 376 9 〃	
					4 825 9 kg	

JICA

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	FOOTING					
F 1	D29	5.04	7 120	67	2 404 3	
2	D19	2.25	6 520	35	513 5	
3	D16	1.56	11 920	5	93 0	
4	"	"	11 720	32	585 1	" (VAR.)
5	"	"	10 820	19	320 7	
6	"	"	5 960	6	55 8	
7	"	"	10 460	6	97 9	"
F° 1	D16	1.56	3 060	106	506 0	(VAR.)
			SUB TOTAL			
				D29	2 404 3 kg	
				D19	513 5 "	
				D16	1 658 5 "	
					4 576 3 kg	
			TOTAL			
				D29	2 404 3 kg	
				D25	3 449 0 "	
				D19	513 5 "	
				D16	3 040 5 "	
				D13	1 924 1 "	
					11 331 4 kg	

5) EXCAVATION

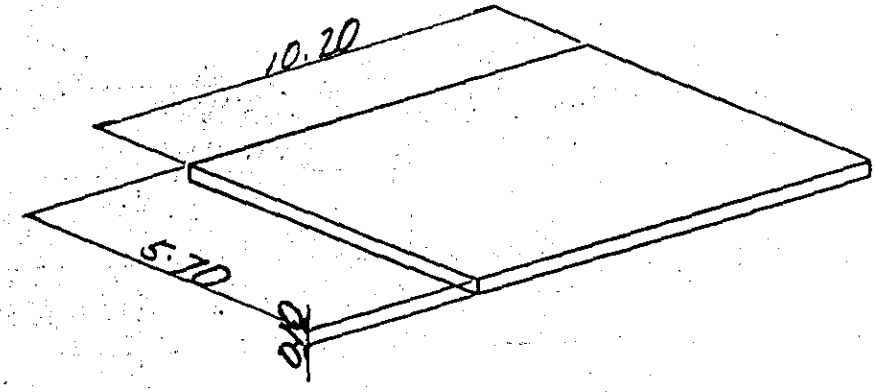


$$Va = 5.70 \times 10.20 \times (0.90 + 1.756) = 154.420 \ m^3$$

6) FOUNDATION MORTAR

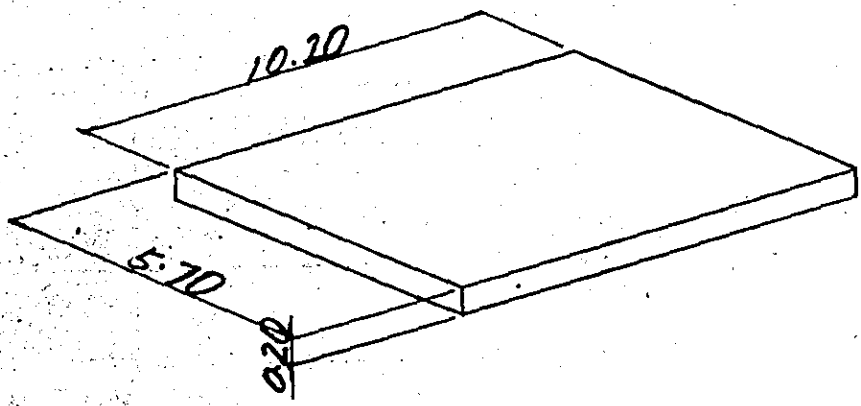
$$Va = \tfrac{1}{2} \times (0.836 \times 0.486 + 0.80 \times 0.45) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.112 \ m^3$$

7) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10 = 5.814\ m^3$

8) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20 = 11.628\ m^3$

9) PILE

$\phi = 500$

TYPE - A $8^m \times 28$

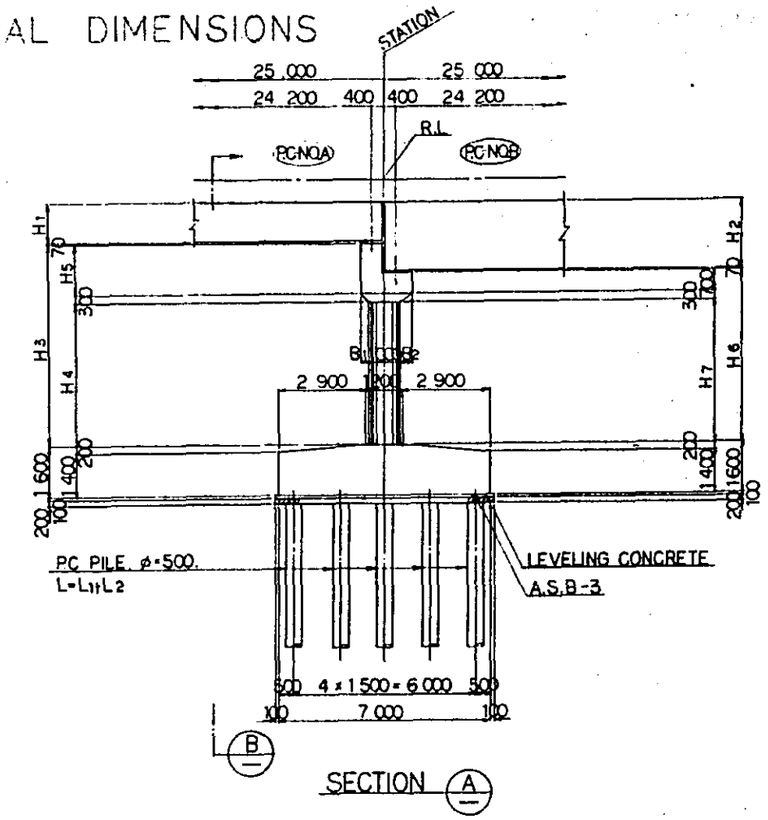
TYPE - B $8^m \times 28$

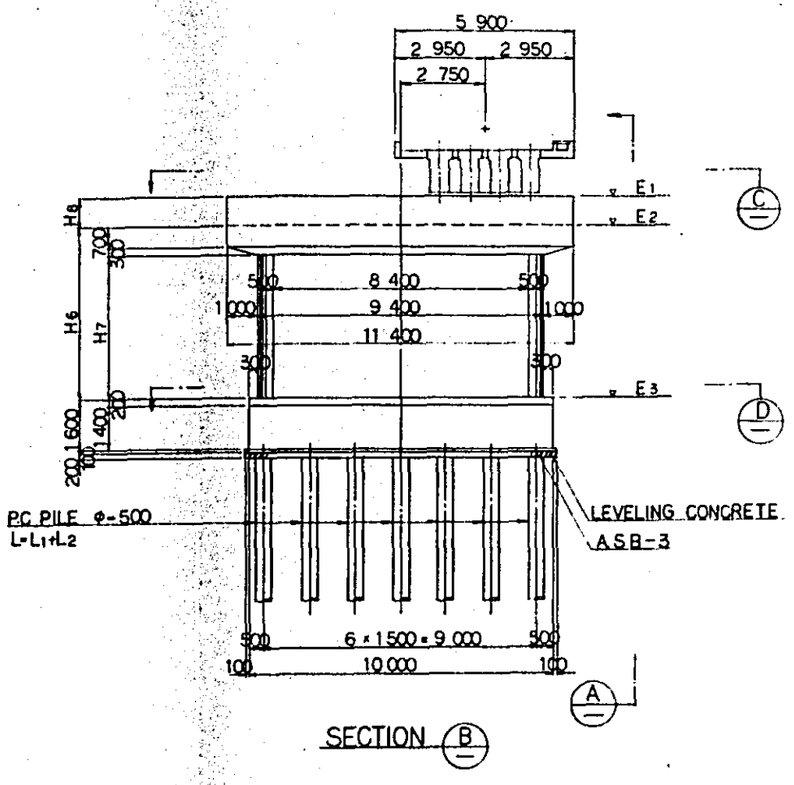
8 PIER 27

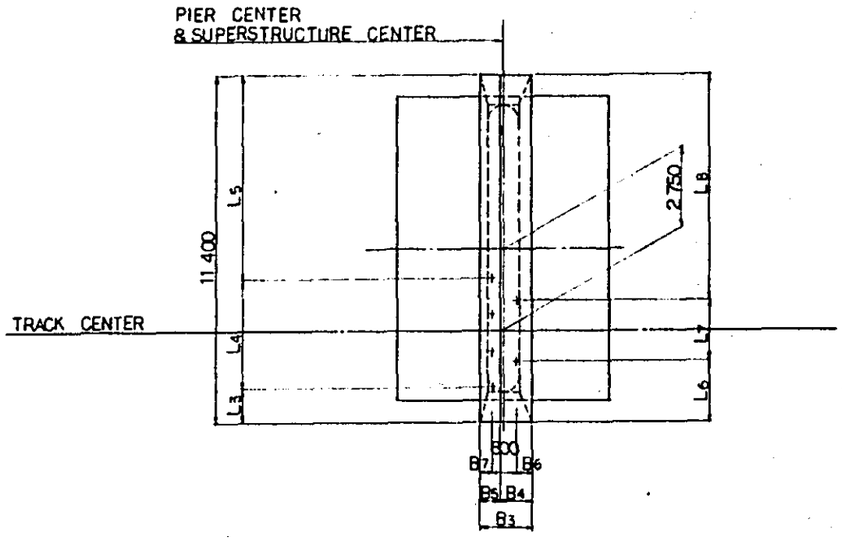
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	15.9	29.0	1676.3	105.4
COLUMN	51.4	111.7	5199.3	101.2
TOTAL	67.3	140.7	6875.6	102.2
FOOTING	106.2	49.2	6784.5	63.9

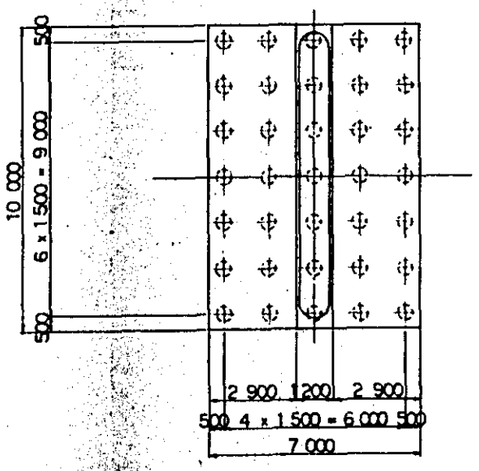
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B - 3
EXCAVATION	m^3	219.3	
FOUNDATION MORTAR	m^3	0.1	G_{ck} = 400 kg/cm^2
PILE	m × NUMBER	14 × 35 8 × 35	φ500 - A φ500 - B

1) GENERAL DIMENSIONS









PIER NO.	STATION	ALINEMENT		P.C NO.A	P.C NO.B
P-27	17K073M00	STRAIGHT	—	22	23
P-28	17K098M00	STRAIGHT	—	23	24
P-29	17K123M00	STRAIGHT	—	24	25
P-38	18K745M00	CURVED	R=500	29	30
P-39	18K770M00	CURVED	R=500	30	31

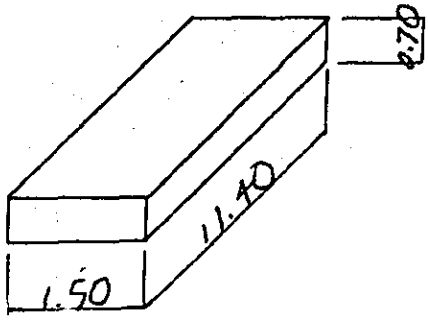
DIMENSION SCHEDULE

PIER NO.	R.L	E1	E2	E3	H1	H2	H3	H4	H5	H6	H7	H8	L1	L2	L3	L4	L5	L6	L7	L8	B1	B2	B3	B4	B5	B6	B7
P-27	8M754	6M574	6M574	-0M026	1 400	1 400	6 600	5 600	700	6 600	5 600	0	8M0	14M0	1 150	3x1200 =3600	6 650	1 150	3x1200x3 600	6 650	250	250	1 500	1 500	0	350	350
P-28	8M754	6M574	5M624	-0M076	1 400	2 350	6 650	4 700	1 650	5 700	4 700	950	8M0	14M0	1 150	3x1200 =3600	6 650	1 950	2 000	7 450	250	400	1 650	920	730	500	350
P-29	8M754	5M624	5M624	-2M976	2 350	2 350	8 600	7 600	700	8 600	7 600	0	8M0	11M0	1 950	2 000	7 450	1 950	2 000	7 450	400	400	1 800	1 800	0	500	500
P-38	10M554	7M424	7M424	0M724	2 350	2 350	6 700	5 700	700	6 700	5 700	0	8M0	7M0	2 028	2 000	7 372	2 028	2 000	7 372	400	400	1 800	1 800	0	500	500
P-39	10M554	7M424	7M424	0M724	2 350	2 350	6 700	5 700	700	6 700	5 700	0	8M0	7M0	2 028	2 000	7 372	2 028	2 000	7 372	400	400	1 800	1 800	0	500	500

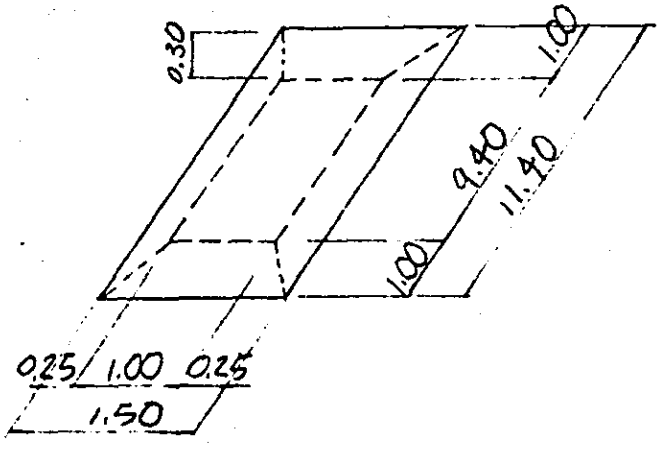
GENERAL VIEW OF P-27, 28, 29, 38 & 39.

2) CONCRETE VOLUME

(1) BEAM



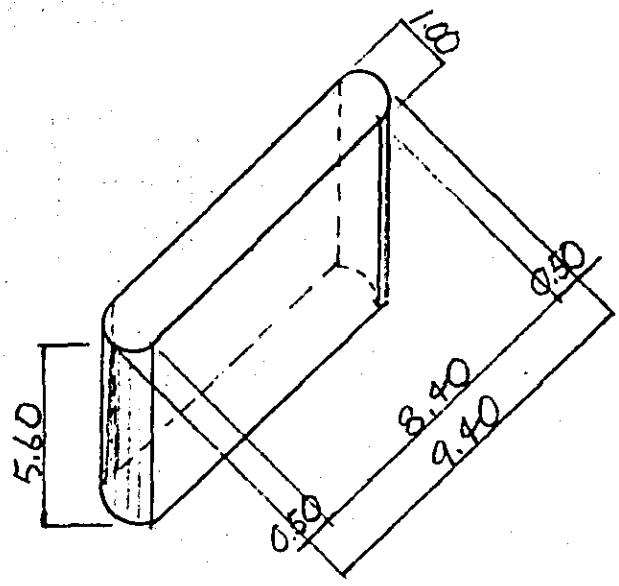
$Va = 1.50 \times 0.70 \times 11.40$ ..... = 11.970 m³



$Vb = \frac{0.30}{6} \times \{ 1.00 \times 9.40 + 1.50 \times 11.40$
$+ (1.00 + 1.50) \cdot (9.40 + 11.40) \}$ ..... = 3.925 "

BEAM TOTAL = 15.895 m³

(2) COLUMN

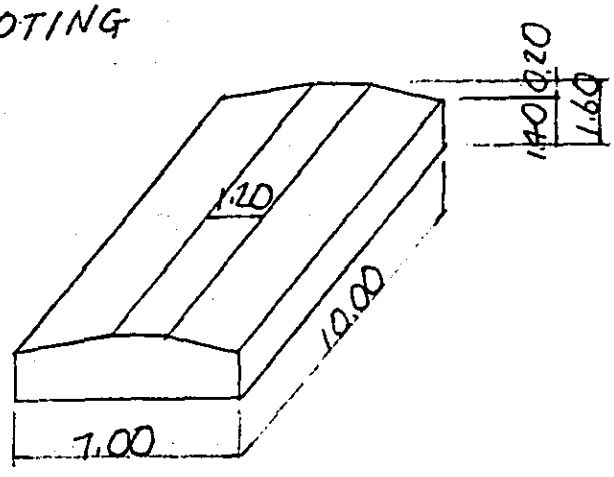


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 5.60$ ..... = 4.398 m^3

$V_b = 1.00 \times 8.40 \times 5.60$ ..... = 47.040 "

COLUMN TOTAL = 51.438 m^3

(3) FOOTING



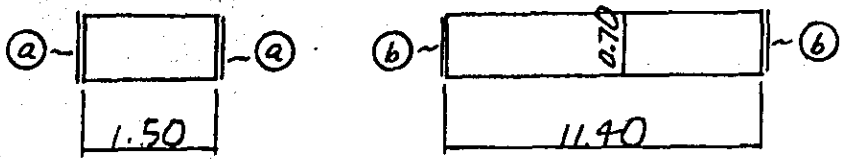
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

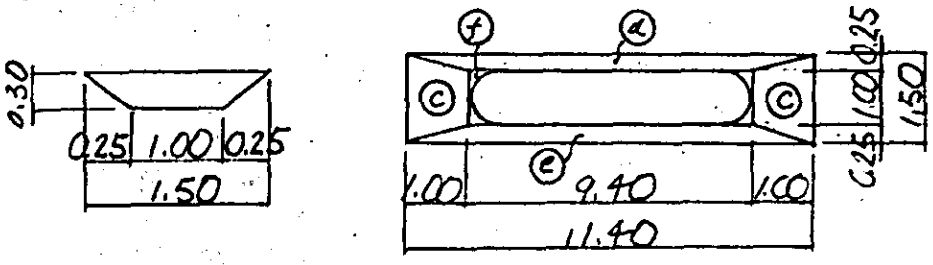
FOOTING TOTAL = 106.200 m^3

3) FORM AREA

(1) BEAM

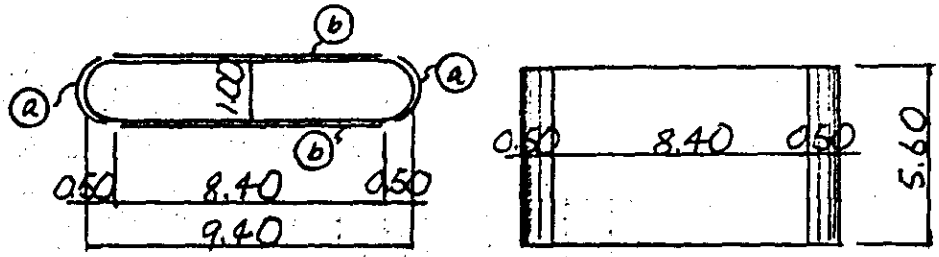


		m^2
A_a = 0.70 × 11.40 × 2	=	15.960
A_b = 0.70 × 1.50 × 2	=	2.100 "



A_c = ½ × (1.00 + 1.50) × $\sqrt{1.00^2 + 0.30^2}$ (1.04) × 2	=	2.610 "
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.25^2 + 0.30^2}$ (0.391)	=	4.066 "
A_e = "	=	4.066 "
A_f = (1 − π/4) × 1.00^2	=	0.215 "
BEAM TOTAL	=	29.017 m^2

(2) COLUMN

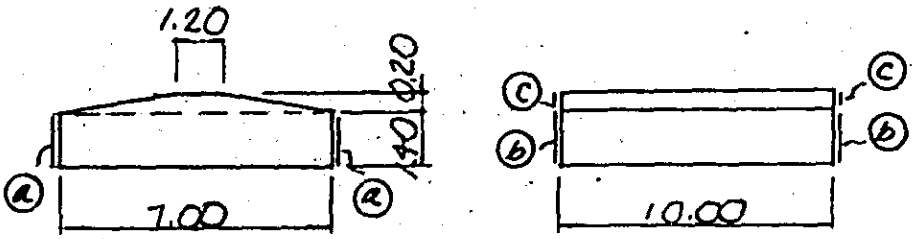


$A_a = \pi \times 1.00 \times 5.60$ = 17.593 m^2

$A_b = 8.40 \times 5.60 \times 2$ = 94.080 "

COLUMN TOTAL = 111.673 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$ = 28.000 m^2

$A_b = 1.40 \times 7.00 \times 2$ = 19.600 "

$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$ = 1.640 "

FOOTING TOTAL = 49.240 m^2

4) REINFORCING BAR

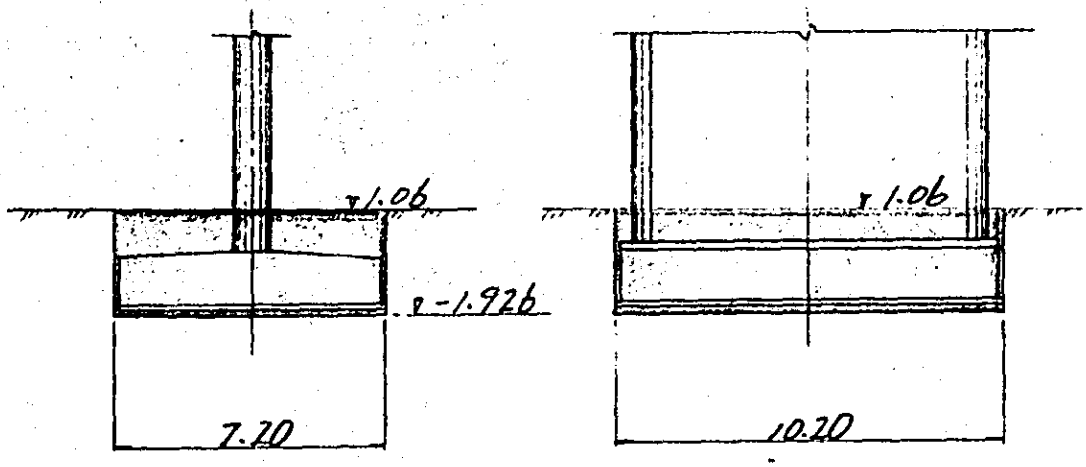
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						889.2	313.5	1202.7
COLUMN			3681.5				1517.8	5199.3
TOTAL			3681.5			889.2	1831.3	6402.0
FOOTING	3844.3				631.6	2308.6		6784.5

BEARING BASE —— D16 473.6 ㎏

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	12 480	11	214 2	
2	D13	0.995	11 380	6	67 5	
3	"	"	11 900	2	23 7	
4	"	"	11 890	2	23 7	(VAR.)
5	"	"	2 760	10	27 5	
6	"	"	2 150	6	12 8	
B° 1	D16	1.56	3 040	75	355 7	
2	"	"	2 750	63	270 3	
3	"	"	2 620	12	49 0	(VAR.)
4	D13	0.995	2 150	74	158 3	
			SUB TOTAL			
				D16	889 2 kg	
				D13	313 5 "	
					1202 7 kg	
	COLUMN					
C 1	D25	3.98	8 150	80	2595 0	
2	"	"	5 250	52	1086 5	
3	D13	0.995	8 400	76	635 2	
4	"	"	2 160	76	163 3	
C° 1	D13	0.995	2 720	150	405 9	
2	"	"	2 420	22	53 0	
3	"	"	1 560	150	2321 8	
4	"	"	1 260	22	27 6	
			SUB TOTAL			
				D25	3681 5 kg	
				D13	1517 8 "	
					5199 3 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	FOOTING					
F 1	D32	6.23	9 210	67	3 844 3	
2	D19	2.25	8 020	35	631 6	
3	D16	1.56	12 520	7	136 7	
4	"	"	12 320	40	768 8	" (VAR.)
5	"	"	10 820	24	405 1	
6	"	"	7 460	8	93 1	
7	"	"	10 460	8	130 5	"
F° 1	D16	1.56	3 650	136	774 4	(VAR.)
			SUB TOTAL			
				D32	3 844 3 kg	
				D19	631 6 "	
				D16	2 308 6 "	
					6 784 5 kg	
			TOTAL			
				D32	3 844 3 kg	
				D25	3 681 5 "	
				D19	631 6 "	
				D16	3 197 8 "	
				D13	1 831 3 "	
					13 186 5 kg	

5) EXCAVATION

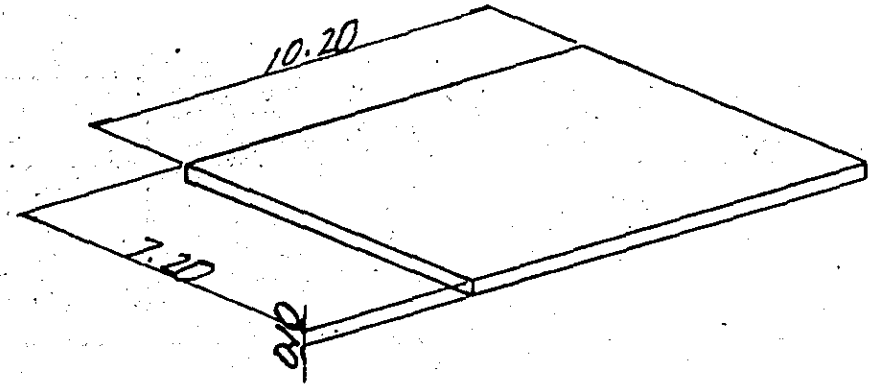


$$Va = 7.20 \times 10.20 \times (1.06 + 1.926) = 219.292\ m^3$$

6) BEARING BASE MORTAR

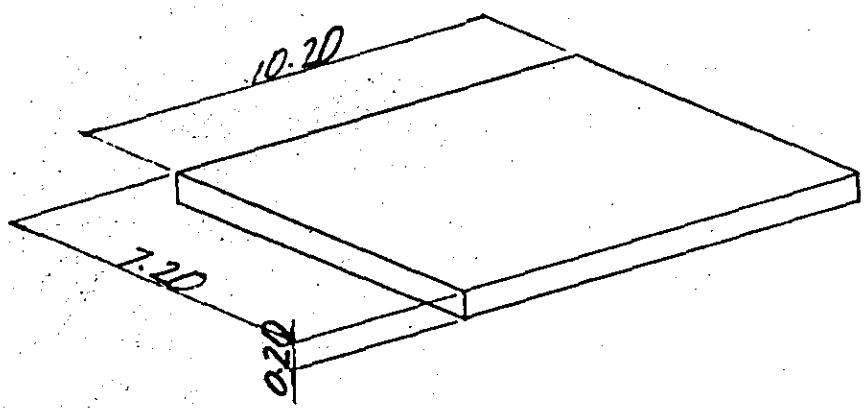
$$Va = 1/2 \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 16 = 0.099\ m^3$$

7) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

8) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

9) PILE

ϕ = 500

TYPE - A 14 m × 35

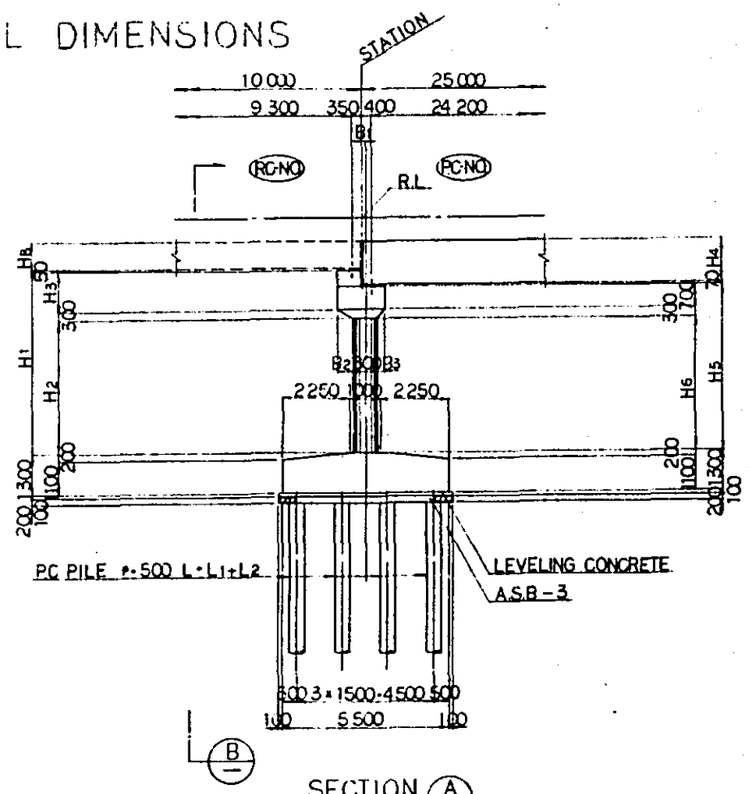
TYPE - B 8 m × 35

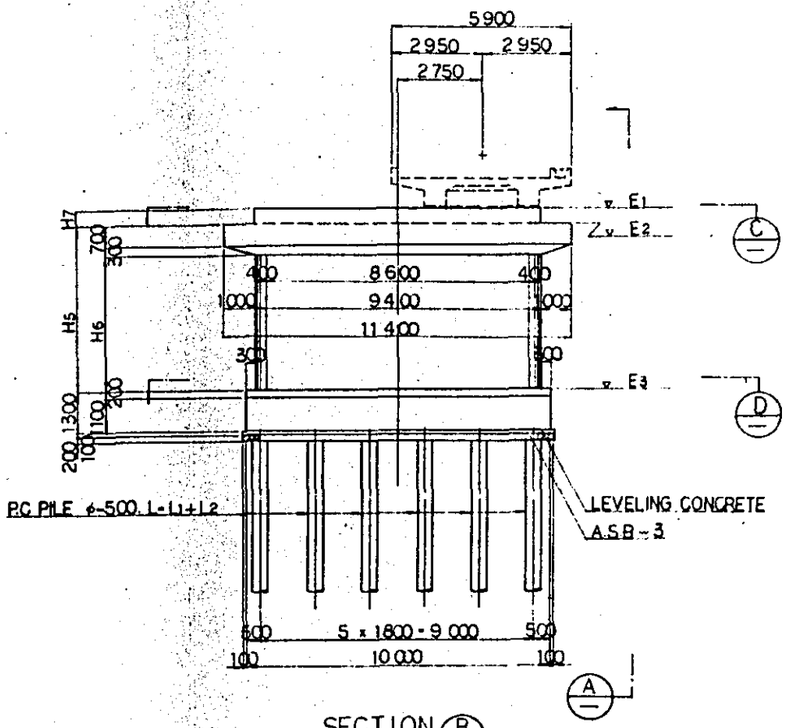
9. PIER 30

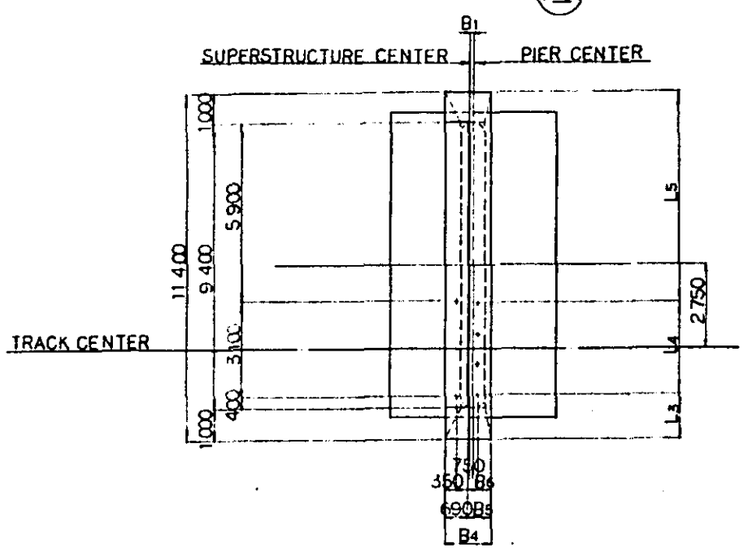
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	24.1	54.9	2189.3	90.8
COLUMN	56.1	149.8	7277.3	129.7
TOTAL	80.2	204.7	9466.6	118.0
FOOTING	67.0	35.4	4576.3	68.3

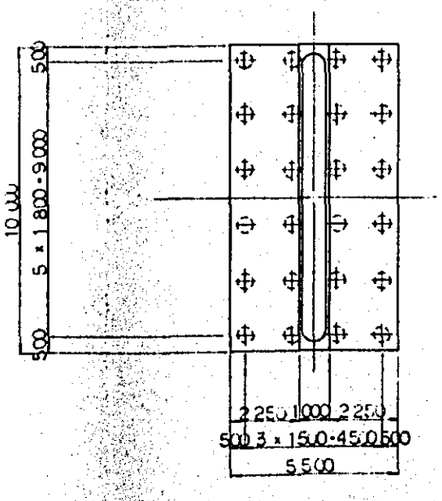
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A. S. B. - 3
EXCAVATION	m^3	318.4	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 Kg/cm^2
PILE	m × NUMBER	11 × 24 8 × 24	φ500 - A φ500 - B

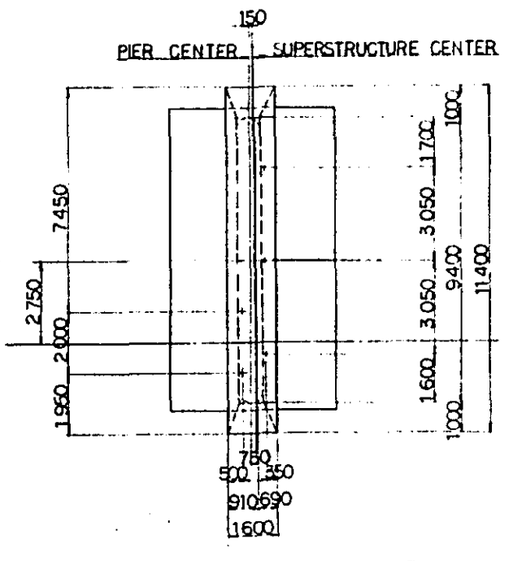
1) GENERAL DIMENSIONS











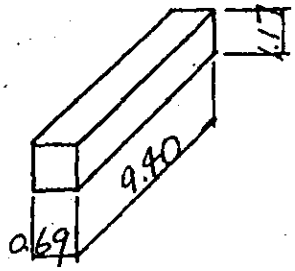
DIMENSION SCHEDULE

PIER NO.	STATION	RC NO.	PC NO.	R.L	E1	E2	E3	H1	H2	H3	H4	H5	H6	H7	H8	L1	L2	L3	L4	L5	B1	B2	B3	B4	B5	B6
P-03	13K655M00	02	04	8.474	6.814	6.294	0.694	6 120	4 600	1 220	1 400	5 600	4 600	520	900	11.0M	0	1150	3×12.00=36.00	6650	200	500	200	1500	810	400
P-30	17K148M00	16	25	8.754	6.794	5.624	2.976	9 770	7 600	1 870	2 350	8 600	7 600	1170	1200	8.0M	11.0M	—	—	—	—	450	350	—	—	—
P-33	17K759M00	28	27	-	7.094	6.574	0.374	6 720	5 200	1 220	1400	6 200	5 200	520	900	-	-	1150	3×12.00=36.00	6 650	200	500	200	1 500	810	400
P-34	17K784M00	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

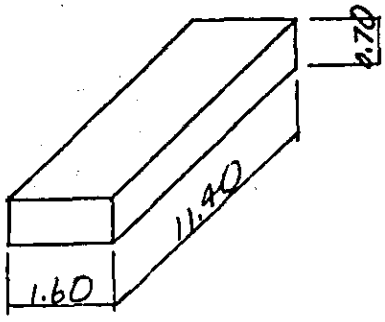
GENERAL VIEW OF P-03, 30, 33 & 34

2) CONCRETE VOLUME

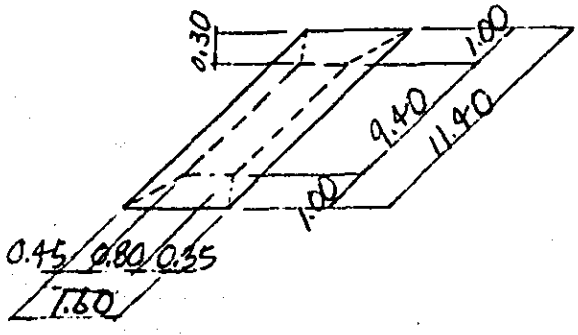
(1) BEAM



$Va = 0.69 \times 1.17 \times 9.40$ = 7.589 m^3



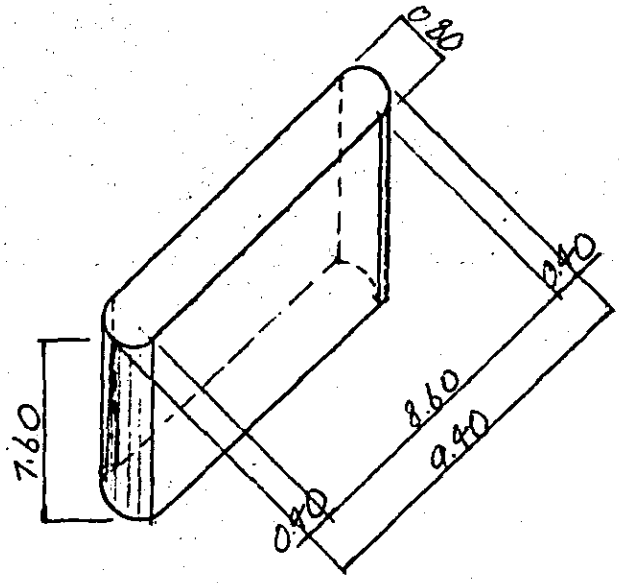
$Vb = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$$Vc = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40)\}$$ = 3.784 "

BEAM TOTAL = 24.141 m^3

(2) COLUMN

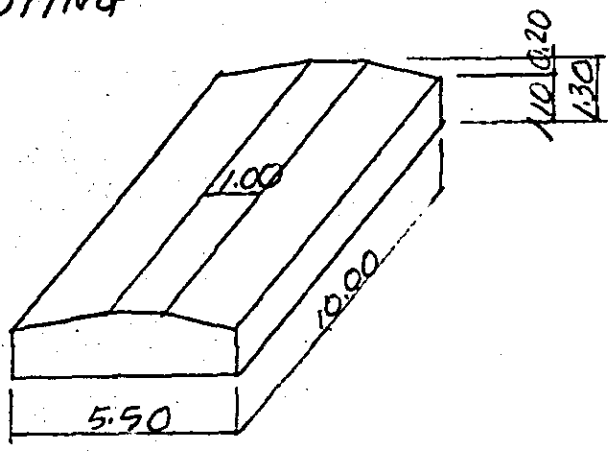


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 7.60$ = 3.820 m^3

$V_b = 0.80 \times 8.60 \times 7.60$ = 52.288 "

COLUMN TOTAL = 56.108 m^3

(3) FOOTING



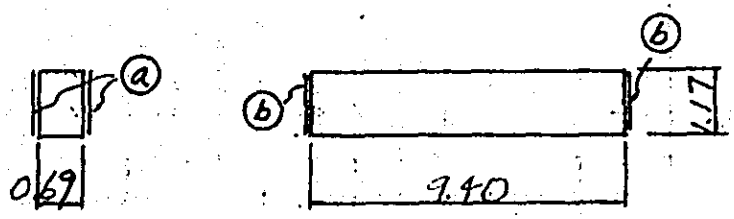
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

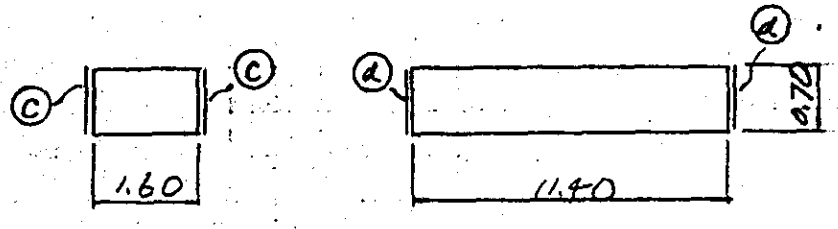
FOOTING TOTAL = 67.000 "

3) FORM AREA

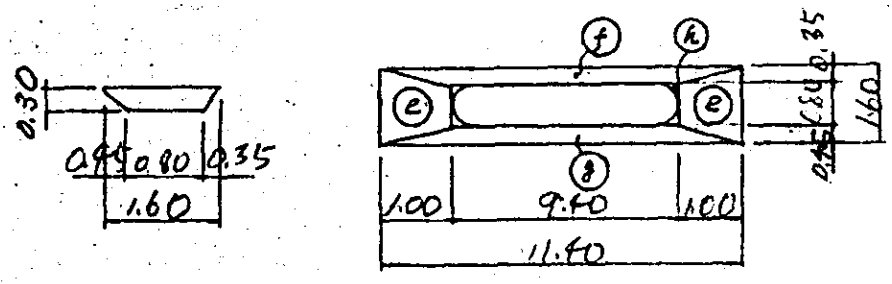
(1) BEAM



Ae = 1.17 × 9.40 × 2	=	21.996 m²
Ab = 1.17 × 0.69 × 2	=	1.615 "

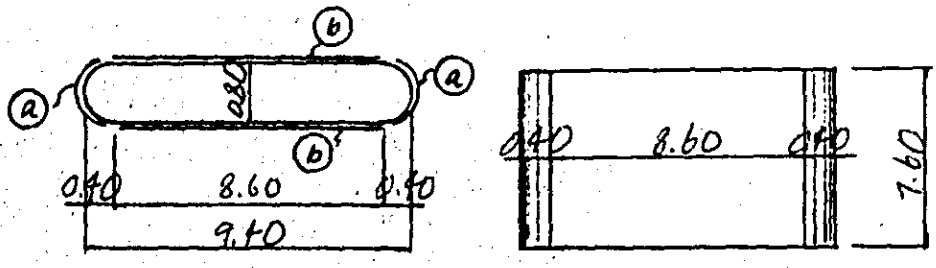


Ac = 0.70 × 11.40 × 2	=	15.960 "
Ad = 0.70 × 1.60 × 2	=	2.240 "



Ae = ½ × (0.80 + 1.60) · √(1.00² + 0.30²) × 2 (1.044)	=	2.506 "
Af = ½ × (9.40 + 11.40) · √(0.35² + 0.30²) (0.461)	=	4.794 "
Ag = ½ × (9.40 + 11.40) · √(0.95² + 0.30²) (0.996)	=	5.126 "
Ah = (1 − π/4) × 0.80²	=	0.137
BEAM TOTAL	=	54.874 m²

(2) COLUMN

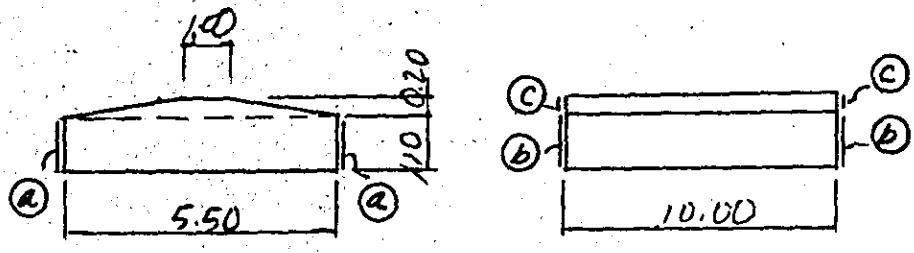


$A_a = \pi \times 0.80 \times 7.60$ = 19.101 m²

$A_b = 8.60 \times 7.60 \times 2$ = 130.720 "

COLUMN TOTAL = 149.821 m²

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m²

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m²

4) REINFORCING BAR

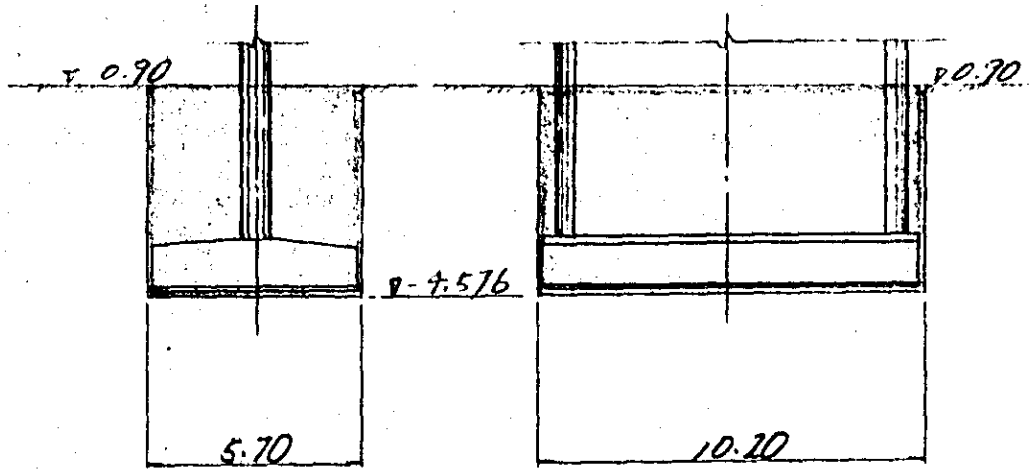
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1397.1	587.8	1984.9
COLUMN		5354.5					1922.8	7277.3
TOTAL		5359.5				1397.1	2510.6	9262.2
FOOTING		2404.3			513.5	1658.5		4576.3

BEARING BASE —— D16 209.4 rf

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	12 480	11	214 2	
2	D13	0.995	11 300	6	67 5	
3	"	"	11 900	2	23 7	
4	"	"	11 870	4	47 2	(VAR.)
5	"	"	2 760	6	16 5	
6	"	"	2 150	6	12 8	
7	D16	1.56	12 900	5	100 6	
8	"	"	4 190	63	411 8	
9	D13	0.995	9 300	8	74 0	
10	"	"	1 340	8	10 7	
B° 1	D16	1.56	3 040	75	355 7	
2	"	"	2 710	63	266 3	
3	"	"	2 590	12	48 5	(VAR)
4	D13	0.995	1 870	58	107 9	
5	"	"	1 250	58	72 1	
6	"	"	2 110	74	155 4	
			SUB TOTAL			
				D16	1397 1 kg	
				D13	587 8 "	
					1984 9 kg	
	COLUMN					
C 1	D29	5.04	8 600	80	3 467 5	
2	"	"	7 200	52	1 887 0	
3	D13	0.995	8 600	102	872 8	
4	"	"	1 860	102	188 8	
C° 1	D13	0.995	2 330	195	952 1	
2	"	"	2 130	30	63 6	
3	"	"	1 570	195	309 6	
4	"	"	1 370	30	40 9	
			SUB TOTAL			
				D29	5359 5 kg	
				D13	1922 8 "	
					7277 3 kg	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	FOOTING					
F 1	D29	5.04	7 120	67	2 404 3	
2	D19	2.25	6 520	35	513 5	
3	D16	1.56	11 920	5	93 0	
4	"	"	11 720	32	585 1	(VAR.)
5	"	"	10 820	19	320 7	
6	"	"	5 960	6	55 8	
7	"	"	10 460	6	97 9	
F' 1	D16	1.56	3 060	106	506 0	(VAR.)
			SUB TOTAL			
				D29	2 404 3 KG	
				D19	513 5 "	
				D16	1 658 5 "	
					4 576 3 KG	
			TOTAL			
				D29	7 758 8 KG	
				D19	513 5 "	
				D16	3 055 6 "	
				D13	2 510 6 "	
					13 838 5 KG	

5) EXCAVATION

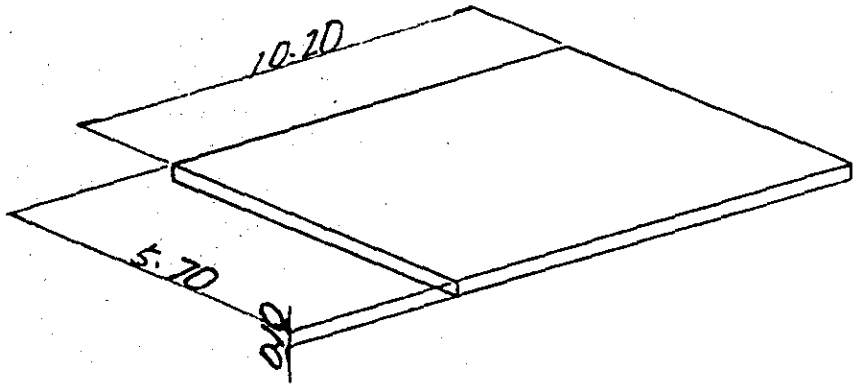


$$Va = 5.70 \times 10.20 \times (0.90 + 4.576) = 318.375 \ m^3$$

6) FOUNDATION MORTAR

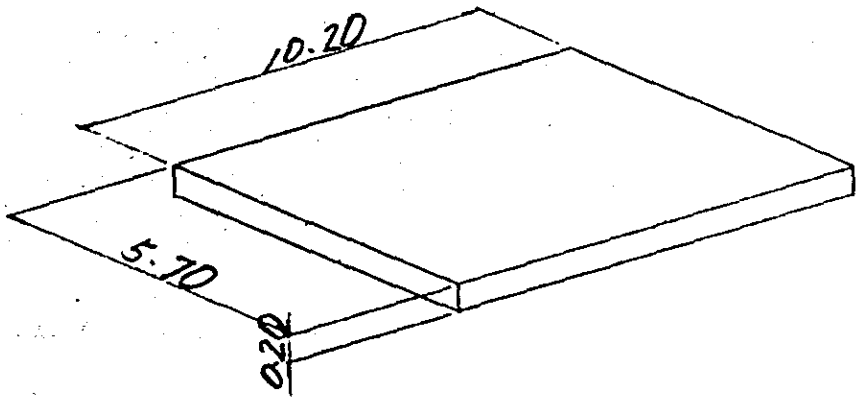
$$Va = \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4$$
$$+ \tfrac{1}{2} \times (0.872 \times 0.572 + 0.80 \times 0.50) \times 0.036 \times 3 = 0.083 \ m^3$$

7) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10 = 5.814\ m^3$

8) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20 = 11.628\ m^3$

9) PILE

$\phi = 500$

TYPE - A $11^{m} \times 24$

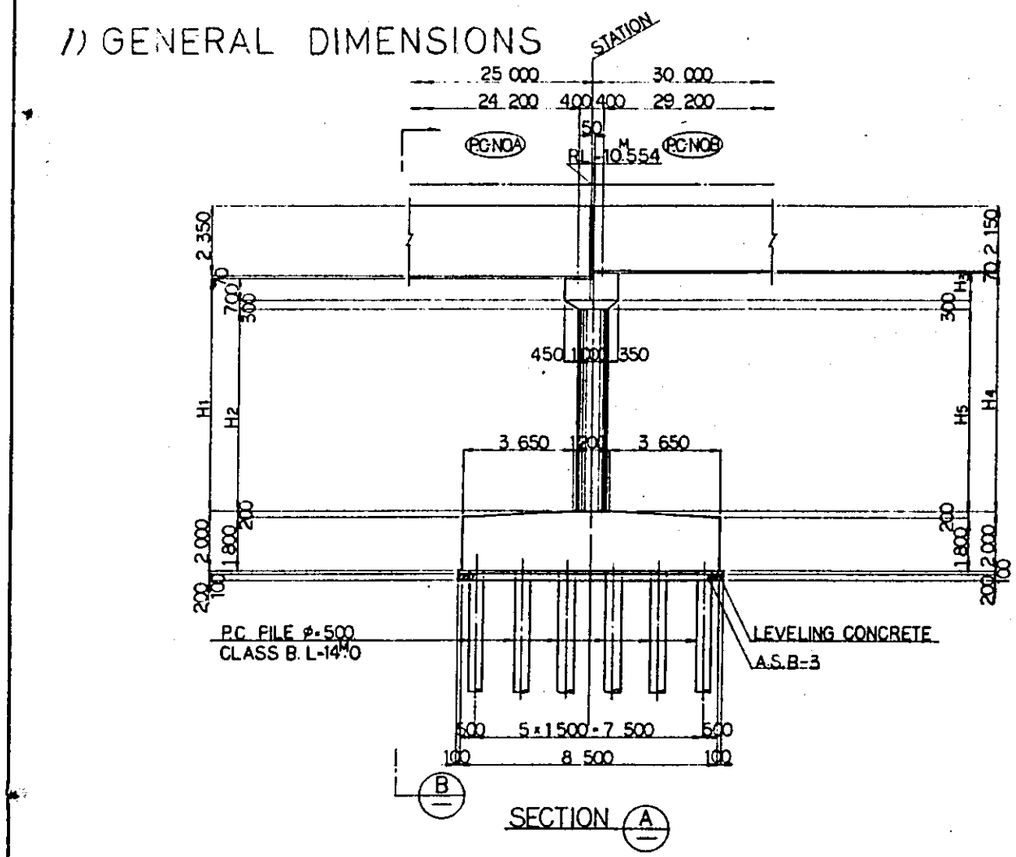
TYPE - B $8^{m} \times 24$

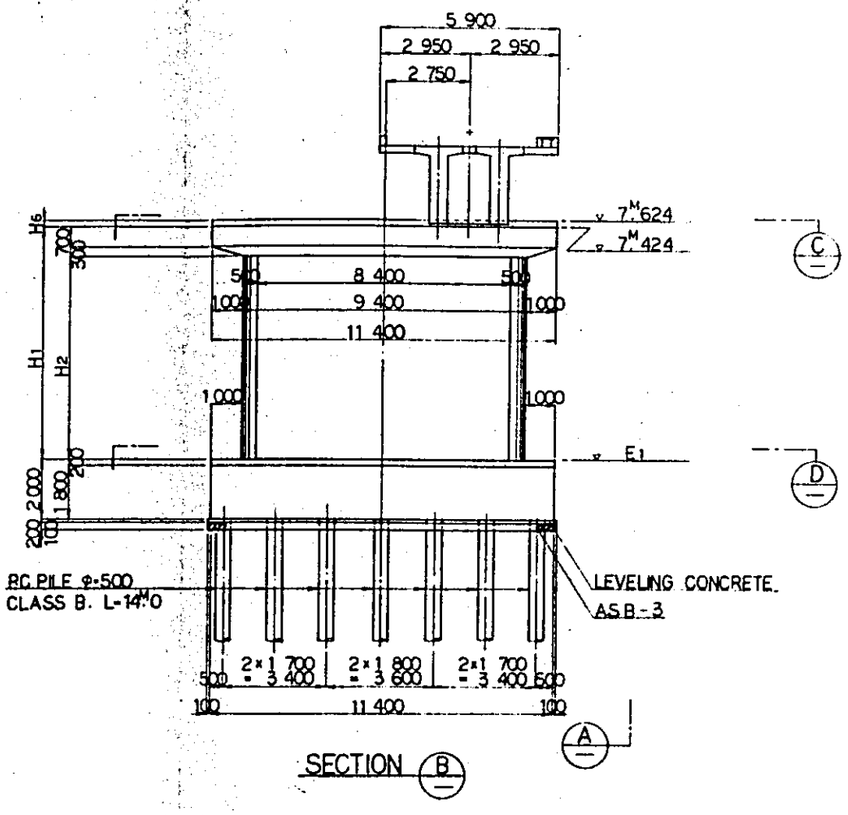
10. PIER 40

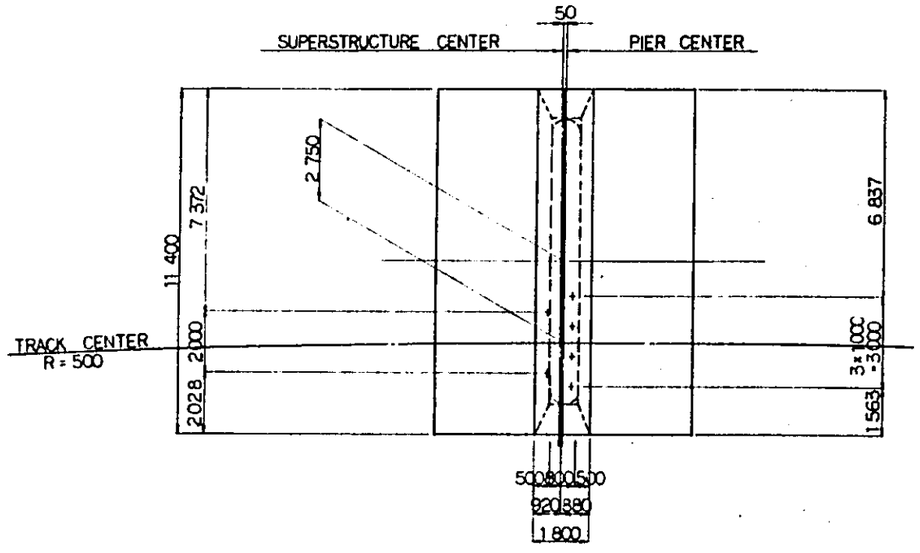
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	20.8	37.0	2110.2	101.5
COLUMN	61.5	133.6	9694.4	157.6
TOTAL	82.3	170.6	11804.6	143.4
FOOTING	185.5	73.6	12128.5	65.4

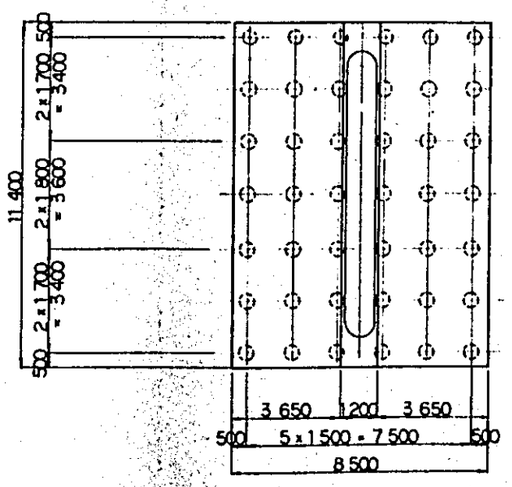
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS E
AGGREGATE SUBBASE	m^3	20.2	A.S.B.-3
EXCAVATION	m^3	401.3	
FOUNDATION MORTAR	m^3	0.1	G_{cr} = 400 Kg/cm^2
PILE	m x NUMBER	14 x 42	ϕ500-B

1) GENERAL DIMENSIONS









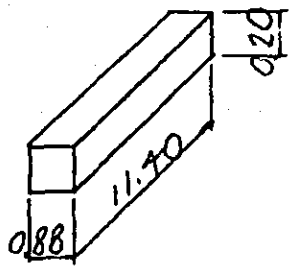
DIMENSION SCHEDULE

PIER NO.	STATION	P.C-NO.A	P.C-NO.B	E1	H1	H2	H3	H4	H5	H6
P-40	18K795M00	31	32	-0.276M	7 700	6 700	900	7 900	6 700	200
P-41	18K825M00	33	32	-0.376M	7 800	6 800	900	8 000	6 800	200

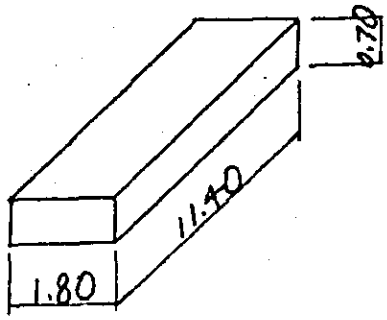
GENERAL VIEW OF P-40 & 41

2) CONCRETE VOLUME

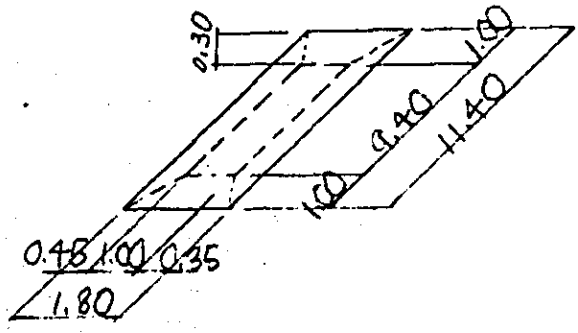
(1) BEAM



$Va = 0.88 \times 0.20 \times 11.40$ = 2.006 m³



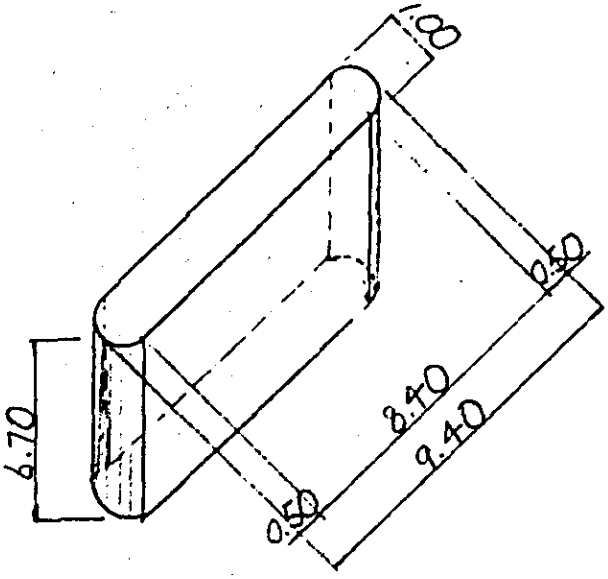
$Vb = 1.80 \times 0.70 \times 11.40$ = 14.364 "



$$Vc = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$$ = 4.408 "

BEAM TOTAL = 20.778 m³

(2) COLUMN

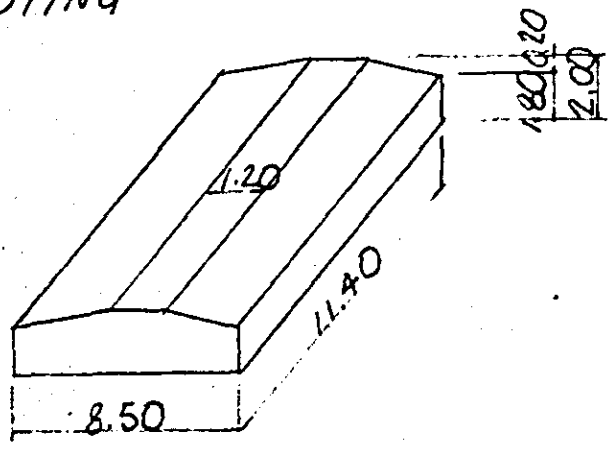


$Va = \frac{1}{4} \times \pi \times 1.00^2 \times 6.70$ = 5.262 m³

$Vb = 1.00 \times 8.40 \times 6.70$ = 56.280 "

COLUMN TOTAL = 61.542 m³

(3) FOOTING



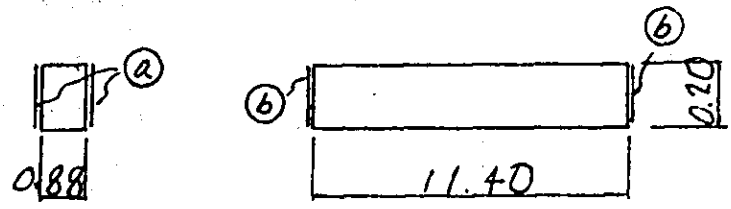
$Va = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m³

$Vb = 8.50 \times 1.80 \times 11.40$ = 174.420 "

FOOTING TOTAL = 185.478 m³

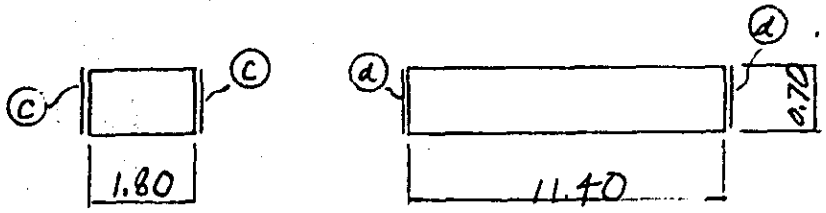
3) FORM AREA

(1) BEAM



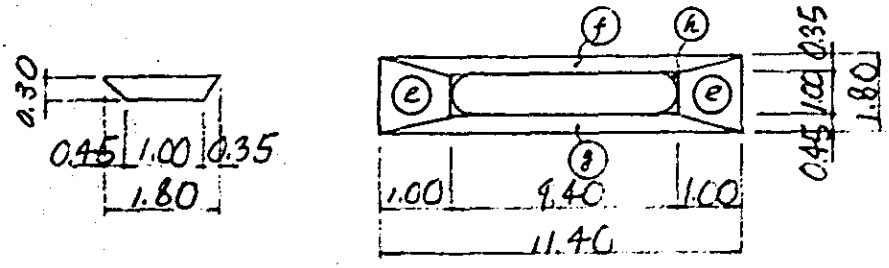
$A_a = 0.20 \times 11.40 \times 2$ = 4.560 m^2

$A_b = 0.20 \times 0.88 \times 2$ = 0.352 "



$A_c = 0.70 \times 11.40 \times 2$ = 15.960 "

$A_d = 0.70 \times 1.80 \times 2$ = 2.520 "



$A_e = \frac{1}{2} \times (1.00 + 1.80) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.923 "

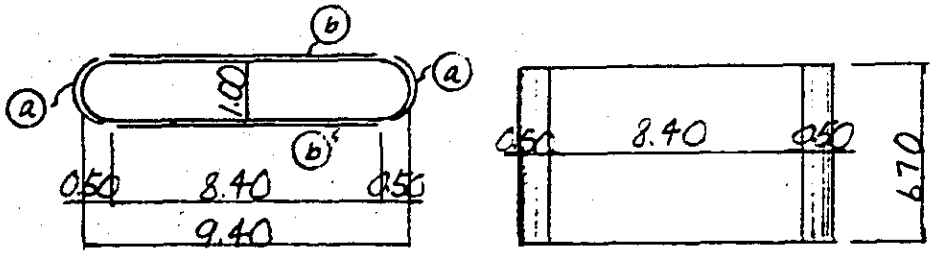
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.35^2 + 0.30^2}$ = 4.794 "

$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$ = 5.626 "

$A_h = (1 - \pi/4) \times 1.00^2$ = 0.215 "

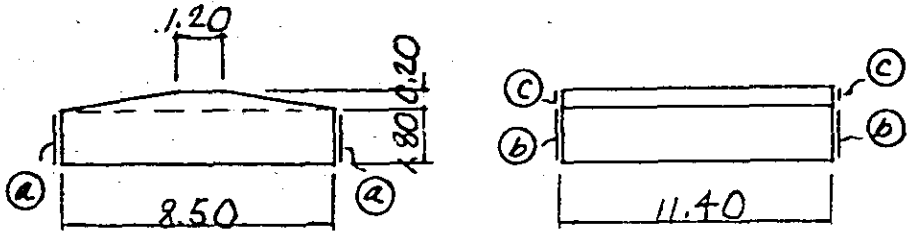
BEAM TOTAL = 36.950 m^2

(2) COLUMN



$Aa = \pi \times 1.00 \times 6.70$	=	21.049 m^2
$Ab = 8.40 \times 6.70 \times 2$	=	112.560 "
COLUMN TOTAL	=	133.609 m^2

(3) FOOTING



$Aa = 1.80 \times 11.40 \times 2$	=	41.040 m^2
$Ab = 1.80 \times 8.50 \times 2$	=	30.600 "
$Ac = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$	=	1.940 "
FOOTING TOTAL	=	73.580 m^2

4) REINFORCING BAR

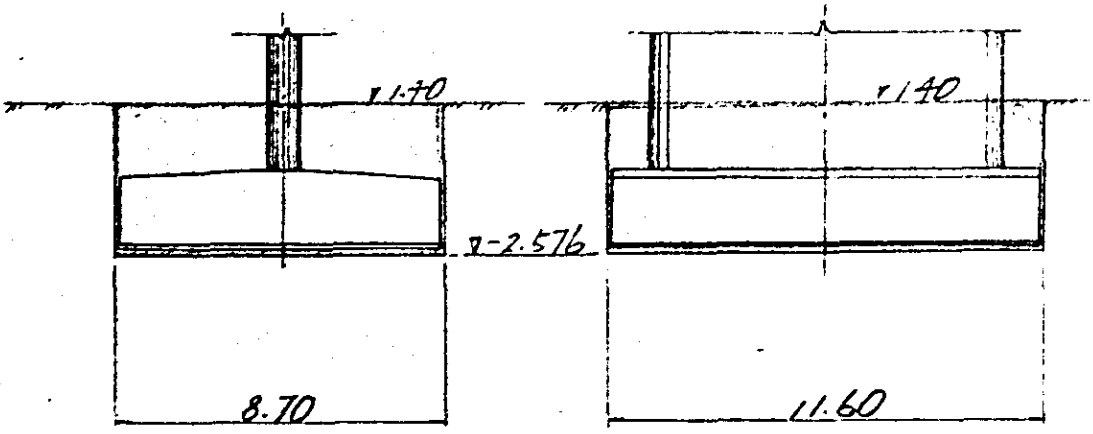
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1 365.9	359.9	1 725.8
COLUMN	7 094.4					1 721.5	878.5	9 694.4
TOTAL	7 094.4					3 087.4	1 238.4	11 420.2
FOOTING	6 663.0				2 869.8	2 595.7		12 128.5

BEARING BASE ----- D16 389.4 ㎡

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D 16	1.56	12 480	12	233.6	
2	D 13	0.995	11 300	6	67.5	
3	〃	〃	11 900	2	23.7	
4	〃	〃	11 870	3	35.4	〃 (VARIES)
5	〃	〃	2 760	10	27.5	
6	〃	〃	2 450	8	19.5	
7	D 16	1.56	12 700	7	138.7	
8	〃	〃	2 180	77	261.9	〃
B° 1	D 16	1.56	3 340	75	390.8	
2	〃	〃	2 920	63	287.0	
3	〃	〃	2 880	12	53.9	〃 (VARIES)
4	D 13	0.995	2 530	74	186.3	
		SUB TOTAL	D 16	1 365.9 kg		
			D 13	359.9 〃		
				1 725.8 kg		
	COLUMN					
C 1	D 32	6.23	9 730	80	4 849.4	
2	〃	〃	6 930	52	2 245.0	〃
3	D 16	1.56	9 400	94	1 378.4	
4	〃	〃	2 340	94	343.1	
C° 1	D 13	0.995	2 720	182	491.4	
2	〃	〃	2 420	28	67.4	〃
3	〃	〃	1 570	182	284.3	
4	〃	〃	1 270	28	35.4	〃

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
		SUB TOTAL				
			D 32	7 094.4	kg	
			D 16	1 721.5	"	
			D 13	878.5	"	
				9 694.4	kg	
	FOOTING					
F 1	D 32	6.23	11 500	93	6 663.0	⌊⌋
2	D 19	2.25	9 510	47	1 005.7	⌒
3	"	"	14 720	9	298 1	⌊⌋
4	"	"	14 500	48	1 666.0	" (VARIES)
5	D 16	1.56	12 220	29	552.8	⌐¬
6	"	"	8 960	10	139.8	⌊⌋
7	"	"	11 870	10	185.2	"
F° 1	D 16	1.56	4 370	252	1 717.9	M (VARIES)
		SUB TOTAL				
			D 32	6663.0	kg	
			D 19	2869.8	"	
			D 16	2696.7	"	
				12128.5	kg	
		TOTAL				
			D 32	13 757.4	kg	
			D 19	2869.8	"	
			D 16	6 683.1	"	
			D 13	1 238.4	"	
				23548.7	kg	

5) EXCAVATION

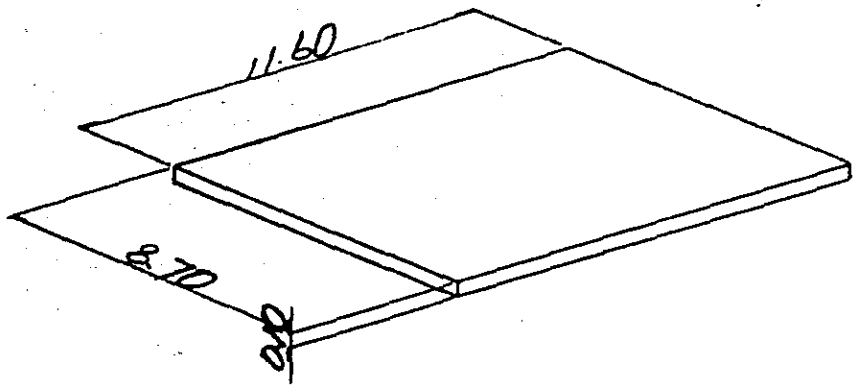


$$Va = 8.70 \times 11.60 \times (2.576 + 1.70) = 401.258 \ m^3$$

6). FOUNDATION MORTAR

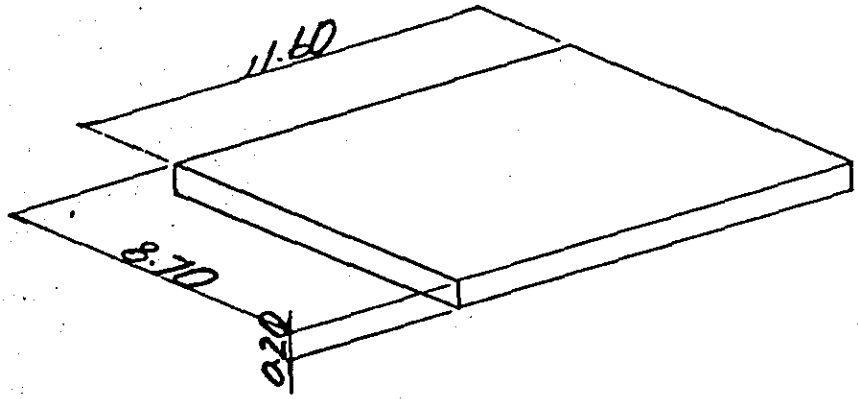
$$Va = \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8 = 0.088 \ m^3$$

7) LEVELING CONCRETE



Va = 8.70 x 11.60 x 0.10 = 10.092 m^3

8) AGGREGATE SUBBASE



Va = 8.70 x 11.60 x 0.20 = 20.184 m^3

9) PILE

ϕ = 500

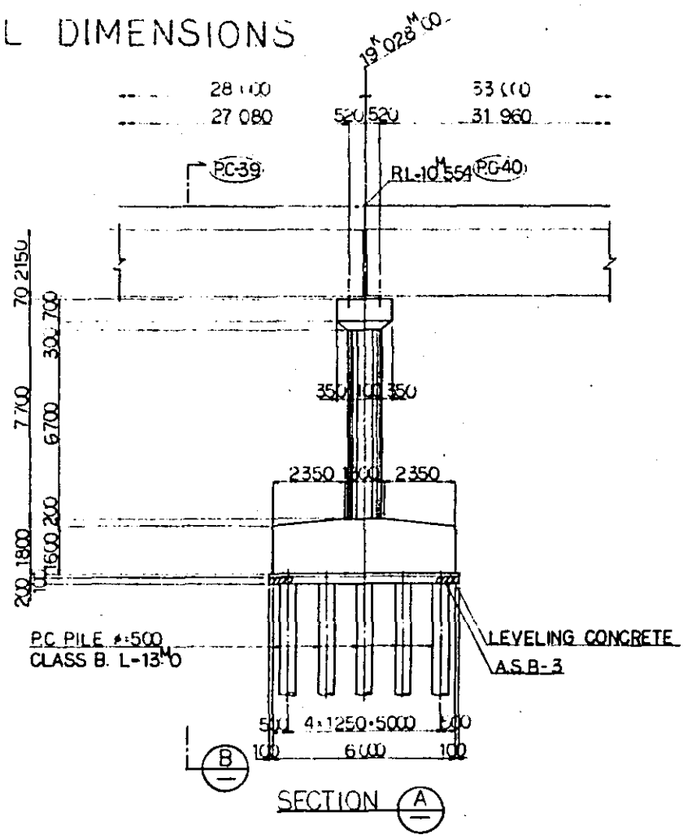
TYPE - B 14 m x 42

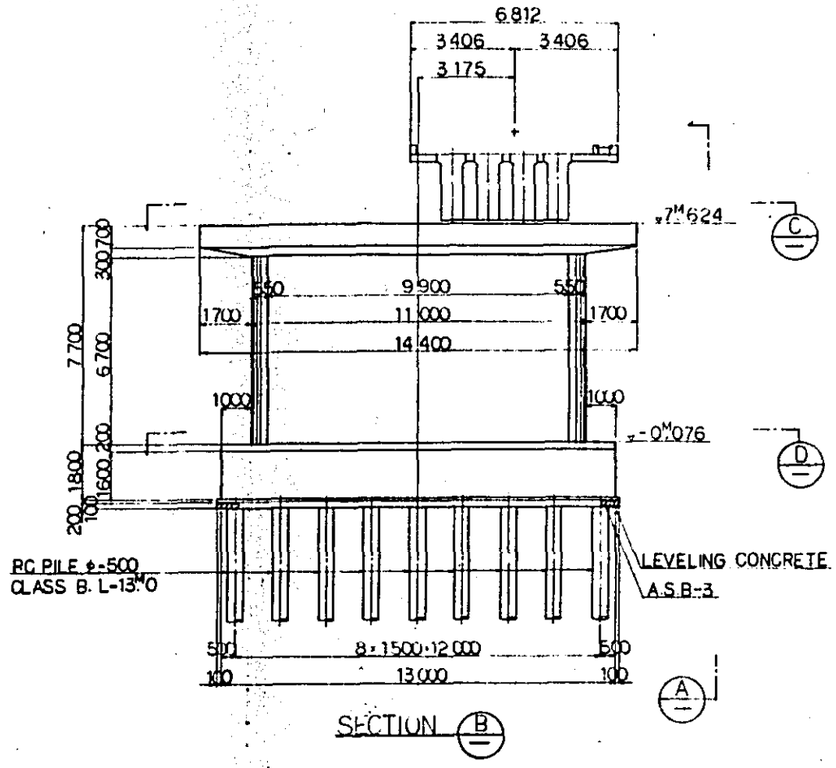
11. PIER 48

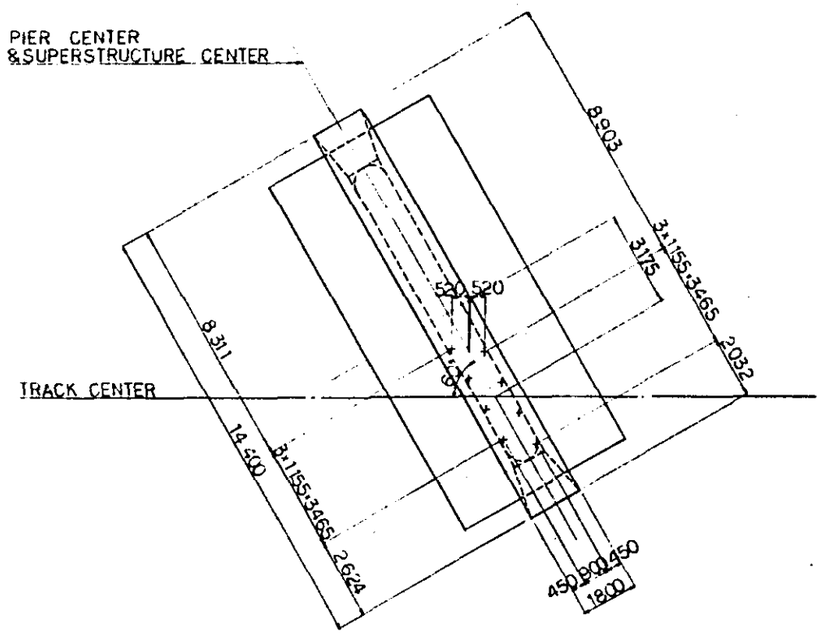
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	23.7	39.7	2115.8	89.3
COLUMN	79.3	155.8	11775.3	148.5
TOTAL	103.0	195.5	13891.1	134.9
FOOTING	134.3	62.3	7660.9	57.0

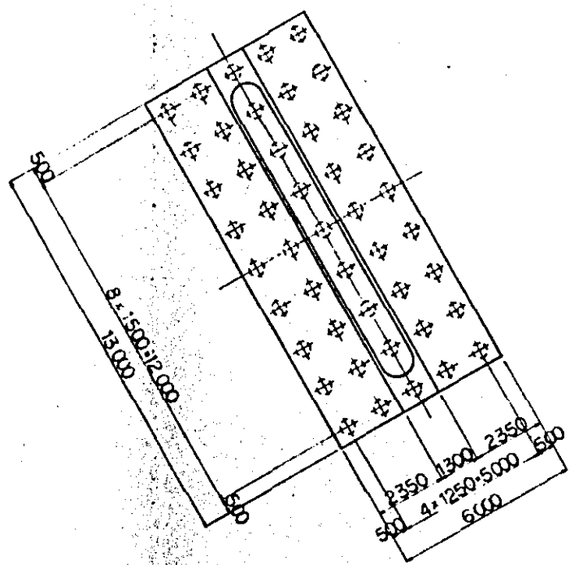
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	8.2	CLASS F
AGGREGATE SUBBASE	m^3	16.4	A.S.B.-3
EXCAVATION	m^2	322.1	
MORTAR	m^3	0.1	For [illegible]
PILE	m x NUMBER	13 x 45	Φ500-B

GENERAL DIMENSIONS





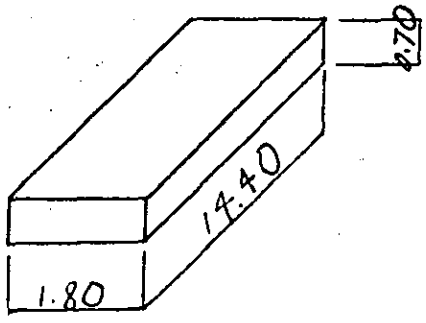




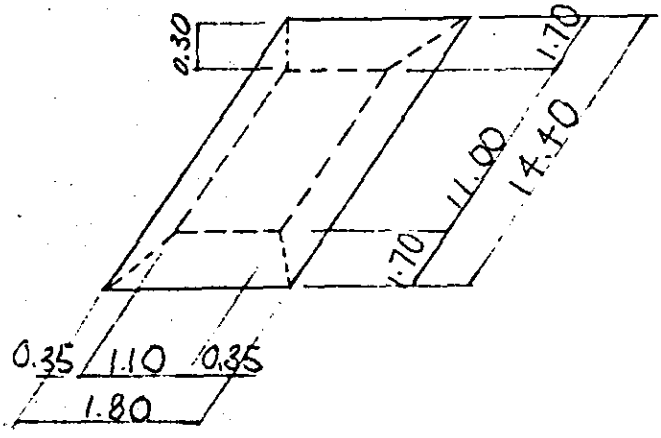
GENERAL VIEW OF P-48

2) CONCRETE VOLUME

(1) BEAM



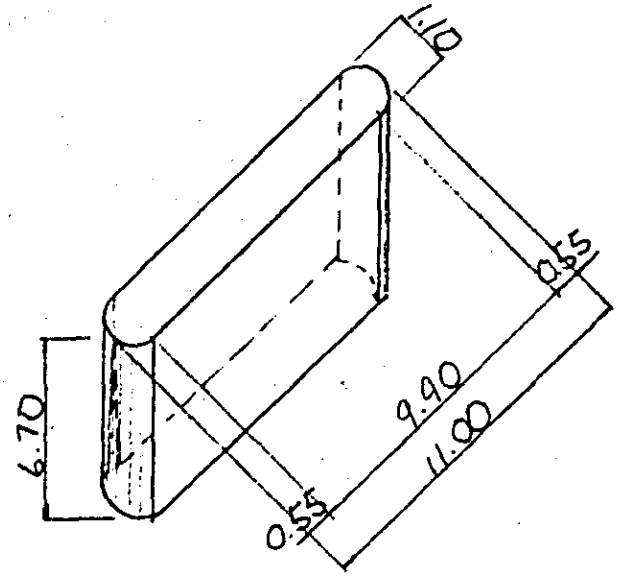
$V_a = 1.80 \times 0.70 \times 14.40$ ..... = 18.144 m³



$V_b = \frac{0.30}{6} \times \{1.10 \times 11.00 + 1.80 \times 14.40 + (1.10 + 1.80) \cdot (11.00 + 14.40)\}$ = 5.584 "

BEAM TOTAL = 23.728 m³

(2) COLUMN

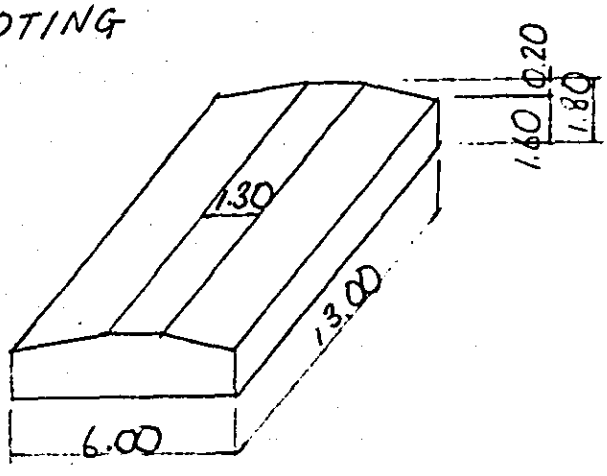


$V_a = \frac{1}{4} \times \pi \times 1.10^2 \times 6.70$ = 6.367 m³

$V_b = 1.10 \times 9.90 \times 6.70$ = 72.963 "

COLUMN TOTAL = 79.330 m³

(3) FOOTING



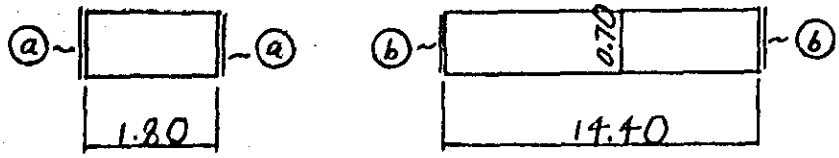
$V_a = \frac{1}{2} \times (1.30 + 6.00) \times 0.20 \times 13.00$ = 9.490 m³

$V_b = 6.00 \times 1.60 \times 13.00$ = 124.800 "

FOOTING TOTAL = 134.290 m³

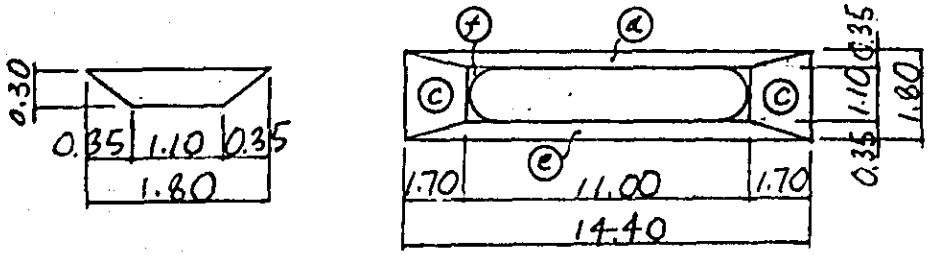
3) FORM AREA

(1) BEAM



A_a = 0.70 × 1.80 × 2 = 2.520 m²

A_b = 0.70 × 14.40 × 2 = 20.160 "



A_c = ½ × (1.10 + 1.80) × $\sqrt{1.70^2 + 0.30^2}$ × 2 = 5.005 m²

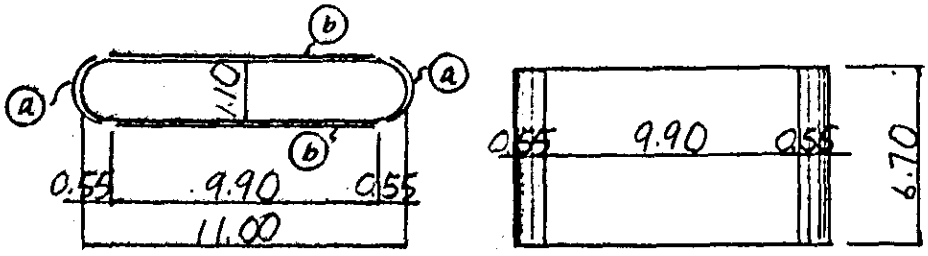
A_d = ½ × (11.00 + 14.40) × $\sqrt{0.35^2 + 0.30^2}$ = 5.855 "

A_e = " = 5.855 "

A_f = $(1 - \pi/4) \times 1.10^2$ = 0.260 "

BEAM TOTAL = 39.655 m²

(2) COLUMN

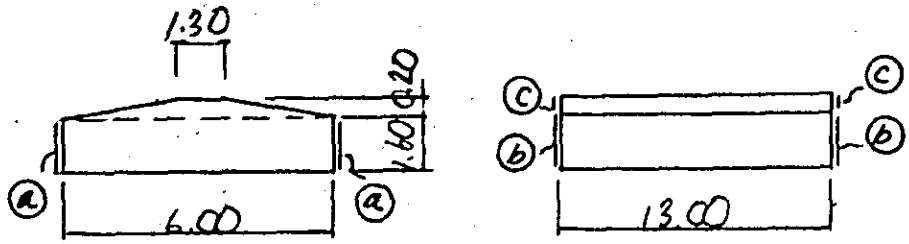


$A_a = \pi \times 1.10 \times 6.70$ = 23.154 m^2

$A_b = 9.90 \times 6.70 \times 2$ = 132.660 "

COLUMN TOTAL = 155.814 m^2

(3) FOOTING



$A_a = 1.60 \times 13.00 \times 2$ = 41.600 m^2

$A_b = 1.60 \times 6.00 \times 2$ = 19.200 "

$A_c = \frac{1}{2} \times (1.30 + 6.00) \times 0.20 \times 2$ = 1.460 "

FOOTING TOTAL = 62.260 m^2

4) REINFORCING BAR

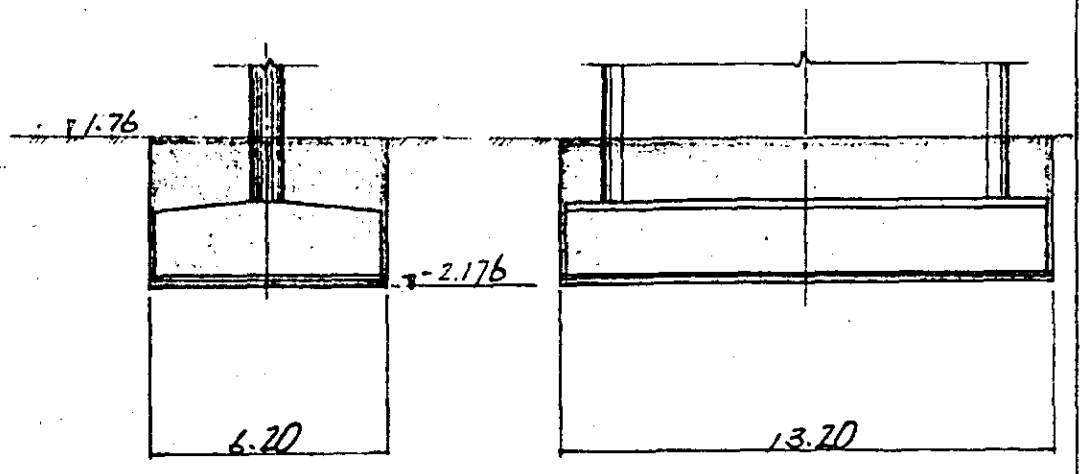
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1 167.9	423.9	1 591.8
COLUMN	8 538.6					2 190.2	1 046.5	11 775.3
TOTAL	8 538.6					3 358.1	1 470.4	13 367.1
FOOTING		3 770.9			2 163.6	1 726.4		7 660.9

BEARING BASE —— D16 524.0 ㎏

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D 16	1.56	12 480	12	233.6	
2	D 13	0.995	11 300	6	67.5	
3	〃	〃	14 870	2	29.6	
4	〃	〃	14 850	2	29.6	〃
5	〃	〃	3 440	12	41.1	
6	〃	〃	2 450	8	19.5	
B° 1	D 16	1.56	3 340	95	495.0	
2	〃	〃	2 990	73	340.5	
3	〃	〃	2 880	22	98.8	〃 (VARIES)
4	D 13	0.995	2 530	94	236.6	
		SUB TOTAL	D 16	1167.9	kg	
			D 13	423.9	〃	
				1591.8	kg	
	COLUMN					
C 1	D 32	6.23	9 530	92	5462.2	
2	〃	〃	8 230	60	3076.4	〃
3	D 16	1.56	11 000	104	1784.6	
4	〃	〃	2 500	104	405.6	
C° 1	D 13	0.995	2 920	210	610.1	
2	〃	〃	2 620	28	73.0	〃
3	〃	〃	1 570	210	328.0	
4	〃	〃	1 270	28	35.4	〃

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
		SUB TOTAL				
			D 32	8 538	6 kg	
			D 16	2 190	2 "	
			D 13	1 046	5 "	
				11 775	3 kg	
	FOOTING					
F 1	D 29	5.04	8 600	87	3 770 9	⌴
2	D 19	2.25	7 020	45	710 8	⌒
3	"	"	15 920	9	322 4	⌴
4	"	"	15 700	32	1130 4	" (VARIES)
5	D 16	1.56	13 820	21	452 7	⌐¬
6	"	"	6 460	10	100 8	⌴
7	"	"	13 470	10	210 1	"
F° 1	D 16	1.56	4 060	152	962 8	⋒ (VARIES)
		SUB TOTAL				
			D 29	3770	9 kg	
			D 19	2163	6 "	
			D 16	1726	4 "	
				7660	9 kg	
		TOTAL	D 32	8 538	6 kg	
			D 29	3 770	9 "	
			D 19	2163	6 "	
			D 16	5 084	5 "	
			D 13	1 470	4 "	
				21028	0 "	

5) EXCAVATION

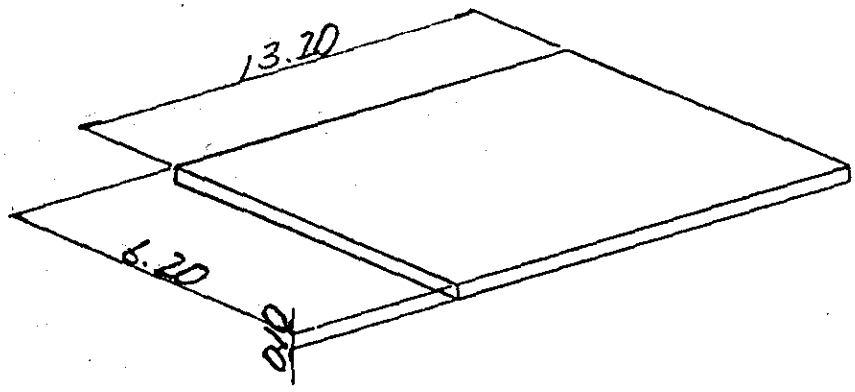


$$Va = 6.20 \times 13.20 \times (1.76 + 2.176) = 322.122 \ m^3$$

6) FOUNDATION MORTAR

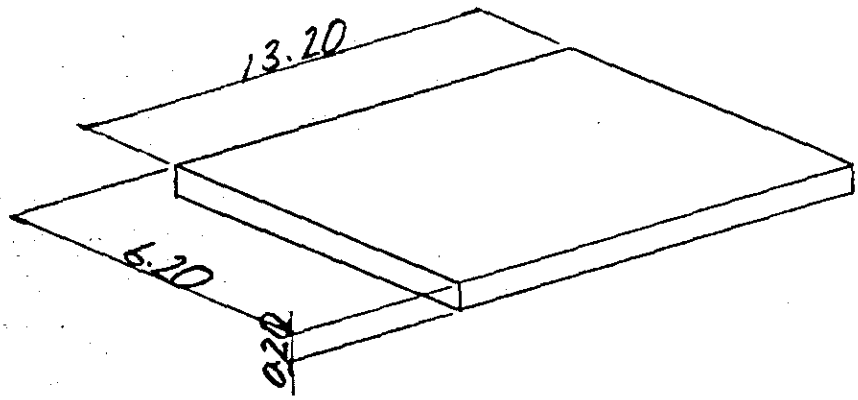
$$Va = \frac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 16 = 0.107 \ m^3$$

7) LEVELING CONCRETE



Va = 6.20 × 13.20 × 0.10 = 8.184 m^3

8) AGGREGATE SUBBASE



Va = 6.20 × 13.20 × 0.20 = 16.368 m^3

9) PILE

ϕ - 500

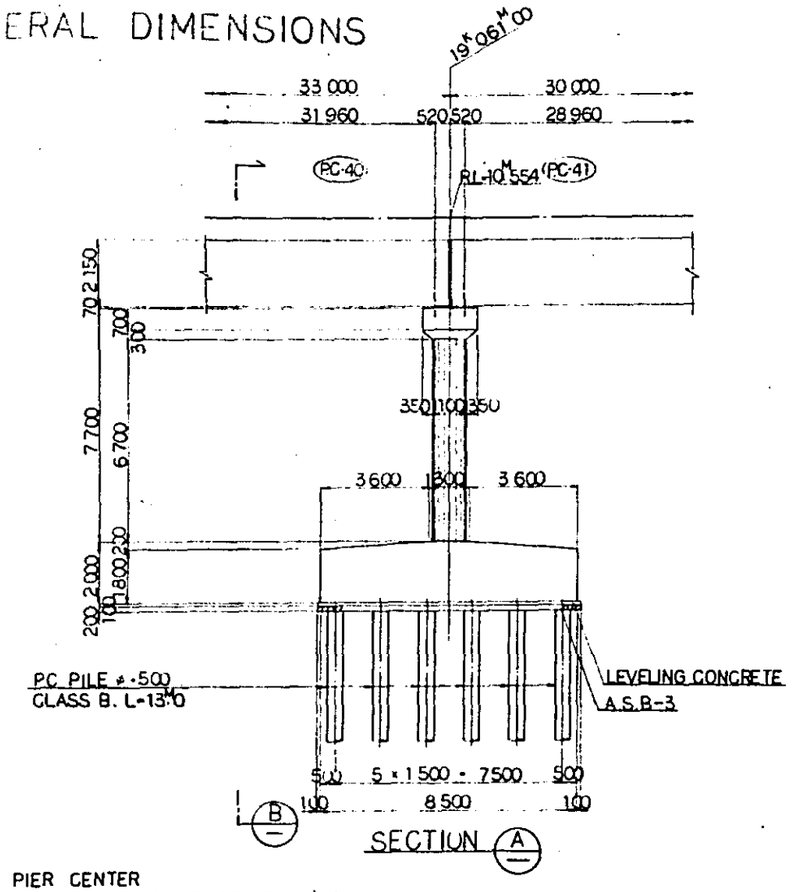
TYPE – B. 13 m × 45

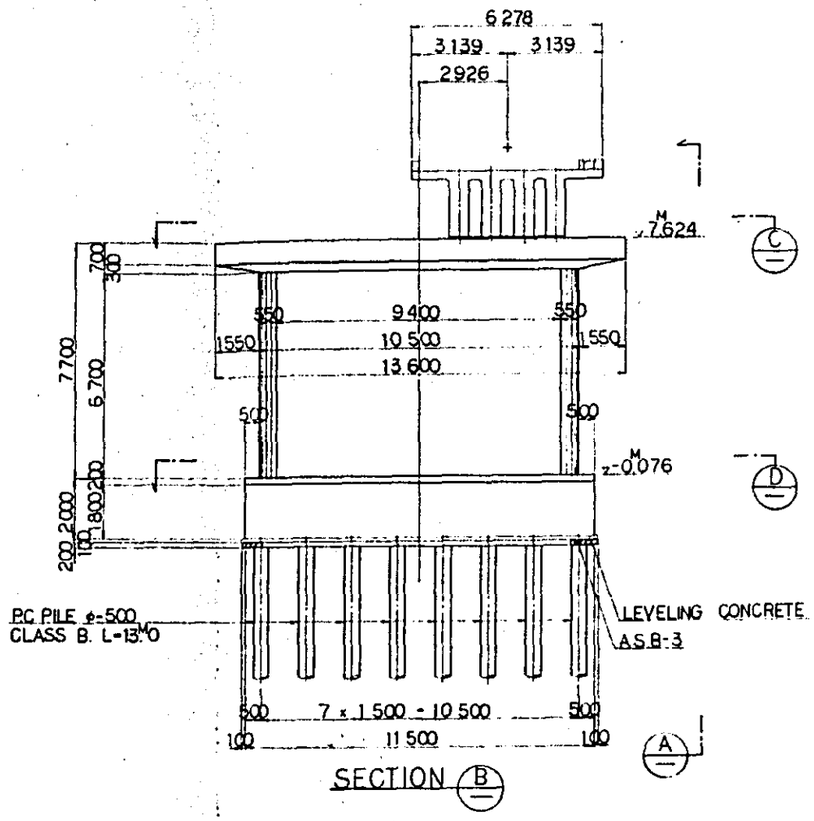
12. PIER 49

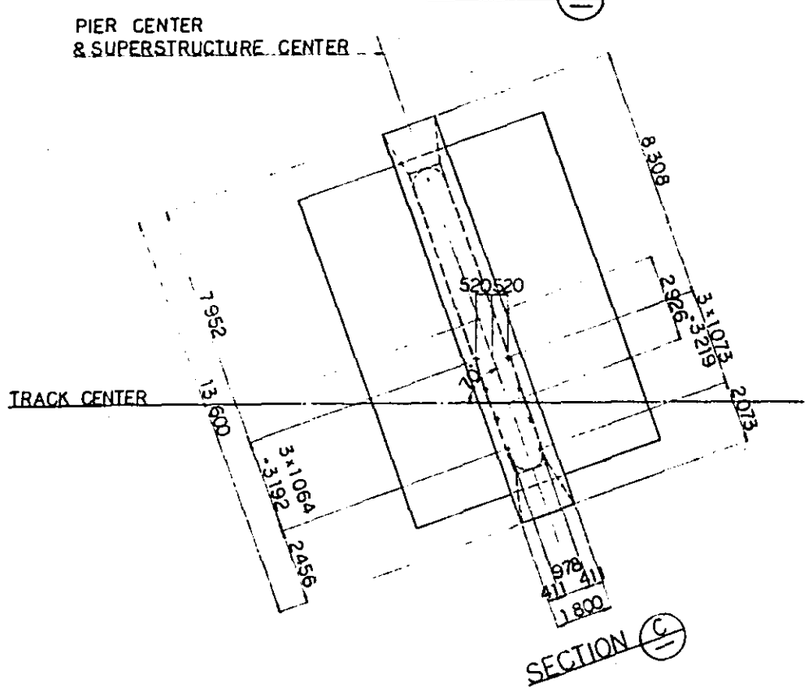
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	18.5	33.2	2 120.6	114.6
COLUMN	75.6	149.1	12 895.4	170.6
TOTAL	94.1	182.3	15 016.0	159.6
FOOTING	187.2	74.0	11 571.8	61.8

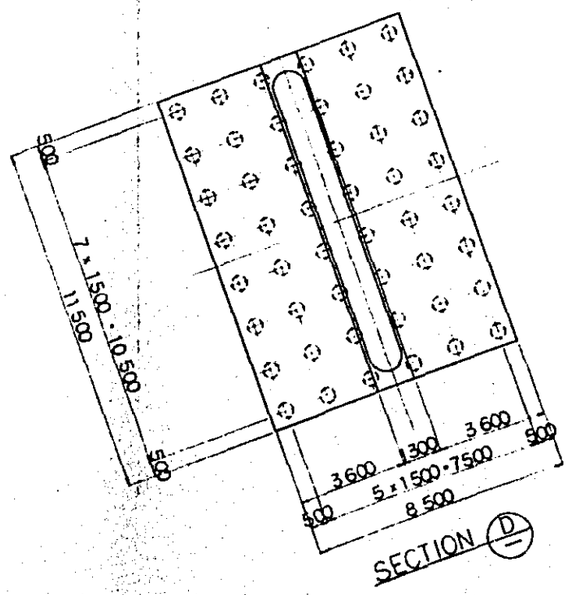
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.2	CLASS E
AGGREGATE SUBBASE	m^3	20.4	A.S.B.-3
EXCAVATION	m^3	400.6	
FOUNDATION MORTAR	m^3	0.1	F_{ck} = 400 kg/cm^2
PILE	m x NUMBER	13 x 48	ϕ500-B

1. GENERAL DIMENSIONS





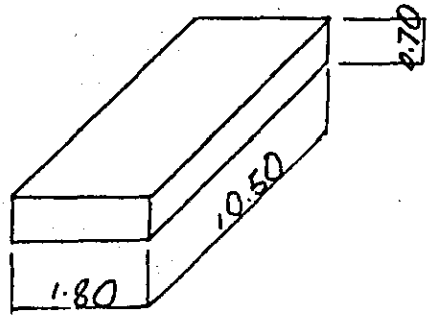




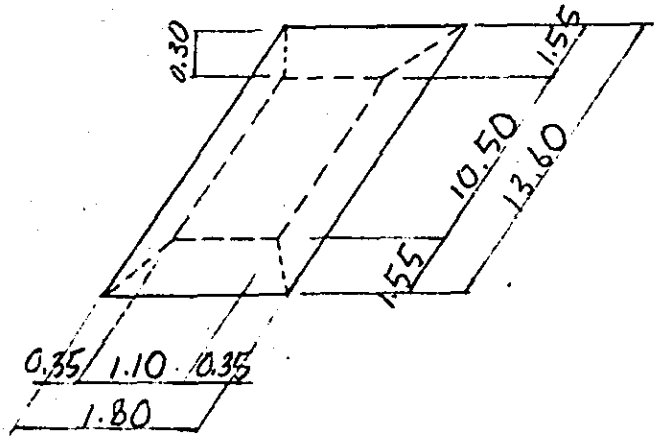
GENERAL VIEW OF P-49

2) CONCRETE VOLUME

(1) BEAM



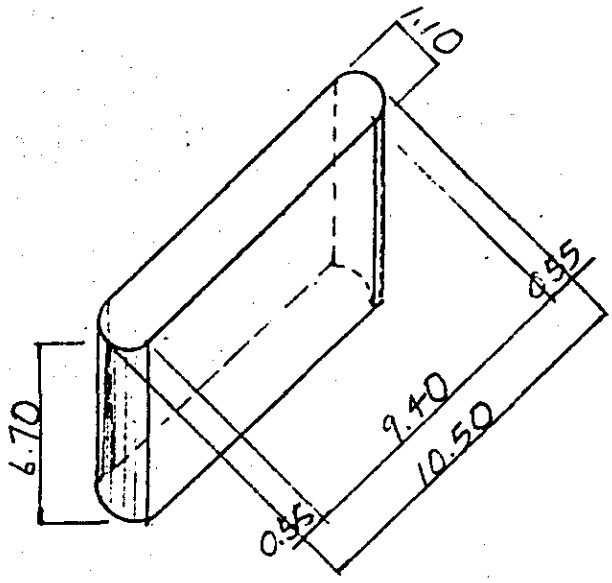
$V_a = 1.80 \times 0.70 \times 10.50$ = 13.230 m^3



$V_b = \frac{0.30}{6} \times \{1.10 \times 10.50 + 1.80 \times 13.60$
$+ (1.10 + 1.80) \cdot (10.50 + 13.60)\}$ = 5.296 "

BEAM TOTAL = 18.526 m^3

(2) COLUMN

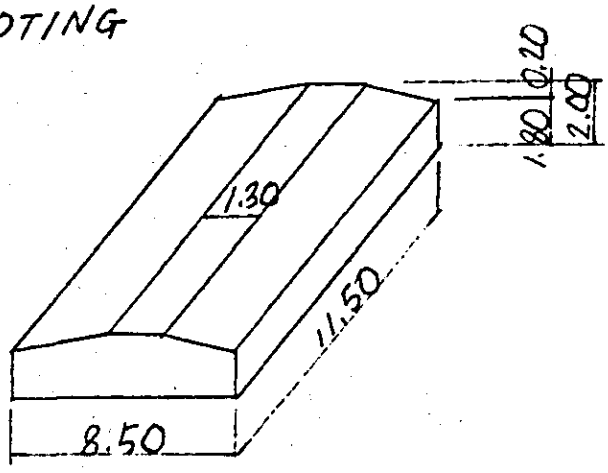


$V_a = \frac{1}{4} \times \pi \times 1.10^2 \times 6.70$ = 6.367 m³

$V_b = 1.10 \times 9.40 \times 6.70$ = 69.278 "

COLUMN TOTAL = 75.645 m³

(3) FOOTING



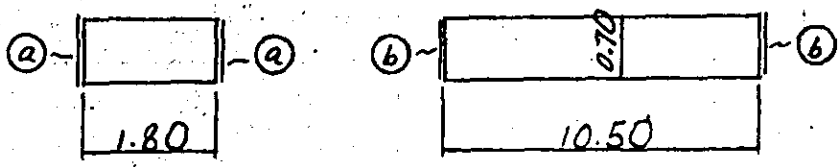
$V_a = \frac{1}{2} \times (1.30 + 8.50) \times 0.20 \times 11.50$ = 11.270 m³

$V_b = 8.50 \times 1.80 \times 11.50$ = 175.950 "

FOOTING TOTAL = 187.220 m³

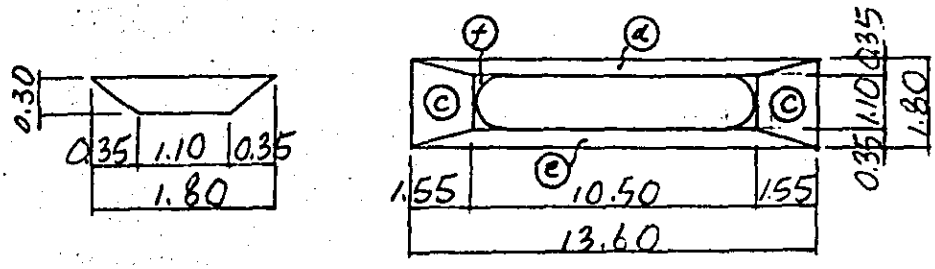
3) FORM AREA

(1) BEAM



A_a = 0.70 × 10.50 × 2 = 14.700 m²

A_b = 0.70 × 1.80 × 2 = 2.520 "



A_c = ½ × (1.10 + 1.80) × $\sqrt{1.55^2 + 0.30^2}$ × 2 = 4.579 "

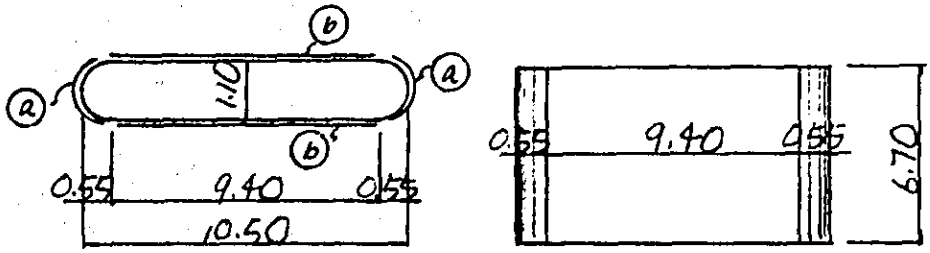
A_d = ½ × (10.50 + 13.60) × $\sqrt{0.35^2 + 0.30^2}$ = 5.555 "

A_e = 〃 = 5.555 "

A_f = (1 − π/4) × 1.10² = 0.260 "

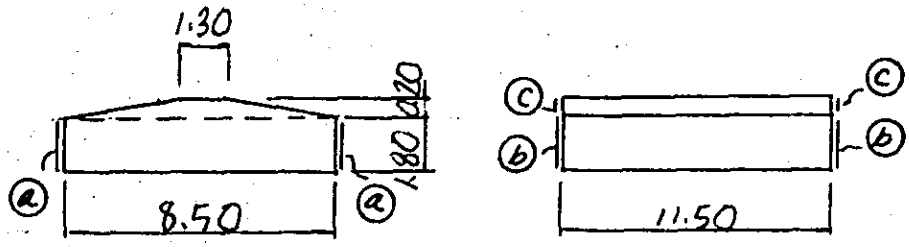
BEAM TOTAL = 33.169 m²

(2) COLUMN



$Aa = \pi \times 1.10 \times 6.70$	=	23.154 m^2
$Ab = 9.40 \times 6.70 \times 2$	=	125.960 "
COLUMN TOTAL	=	149.114 m^2

(3) FOOTING



$Aa = 1.80 \times 11.50 \times 2$	=	41.400 m^2
$Ab = 1.80 \times 8.50 \times 2$	=	30.600 "
$Ac = \frac{1}{2} \times (1.30 + 8.50) \times 0.20 \times 2$	=	1.960 "
FOOTING TOTAL	=	73.960 m^2

4) REINFORCING BAR

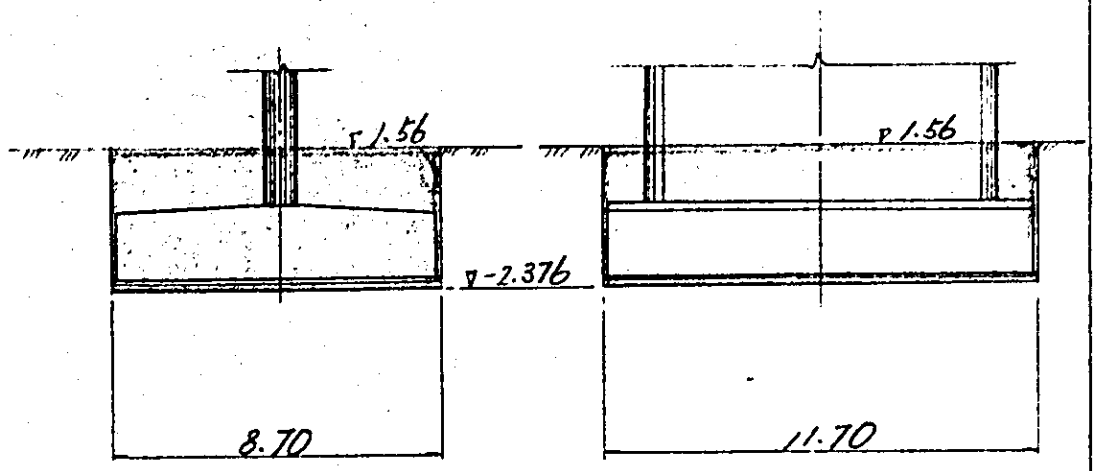
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						1 150.2	412.0	1 562.2
COLUMN	9 906.2					1 856.4	1 132.8	12 895.4
TOTAL	9 906.2					3 006.6	1 544.8	14 457.6
FOOTING	6 663.0				1 005.7	3 903.1		11 571.8

BEARING BASE —— D16 558.4 rJ

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D16	1.56	14 680	12	274.8	⌐
2	D13	0.995	13 500	6	80.6	—
3	〃	〃	14 080	2	28.0	⌣
4	〃	〃	14 060	2	28.0	〃
5	〃	〃	3 300	12	39.4	⌐
6	〃	〃	2 450	8	19.5	⊐
B° 1	D16	1.56	3 340	89	463.7	⊓
2	〃	〃	2 990	69	321.8	∪
3	〃	〃	2 880	20	89.9	〃 (VARIES)
4	D13	0.995	2 530	86	216.5	⊐
		SUB TOTAL				
			D16	1150.2 kg		
			D13	412.0 〃		
				1562.2 kg		
	COLUMN					
C 1	D32	6.23	9 730	108	6 546.7	∣
2	〃	〃	7 930	68	3 359.5	〃
3	D16	1.56	9 400	100	1 466.4	—
4	〃	〃	2 500	100	390.0	C
C° 1	D13	0.995	2 820	238	667.8	∐
2	〃	〃	2 770	28	77.2	〃
3	〃	〃	1 470	238	348.2	⊓
4	〃	〃	1 420	28	39.6	〃

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
		SUB TOTAL				
			D 32	9 906	2 kg	
			D 16	1 856	4 "	
			D 13	1 132	8 "	
				12 895	4 kg	
	FOOTING					
F 1	D 32	6.23	11 500	93	6 663	0 ⌴
2	D 19	2.25	9 510	47	1 005	7 ⌒
3	D 16	1.56	14 820	9	208	1 ⌴
4	"	"	14 600	48	1 093	2 " (VARIES)
5	"	"	12 320	29	557	4 ⌐
6	"	"	8 960	10	139	8 ⌴
7	"	"	11 970	10	186	7 "
F° 1	D 16	1.56	4 370	252	1 717	9 ⊟ (VARIES)
		SUB TOTAL				
			D 32	6 663	0 kg	
			D 19	1 005	7 "	
			D 16	3 903	1 "	
				11 571	8 kg	
		TOTAL				
			D 32	16 569	2	
			D 19	1 005	7	
			D 16	6 909	7	
			D 13	1 544	8	
				26 029	4	

5) EXCAVATION

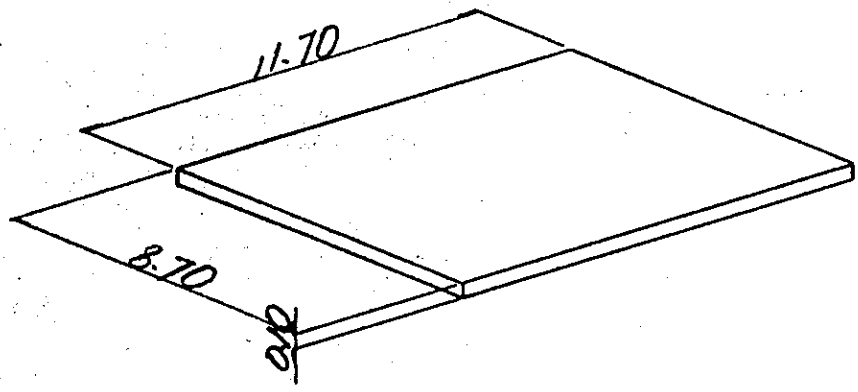


$$Va = 8.70 \times 11.70 \times (1.56 + 2.376) = 400.645 \ m^3$$

6) FOUNDATION MORTAR

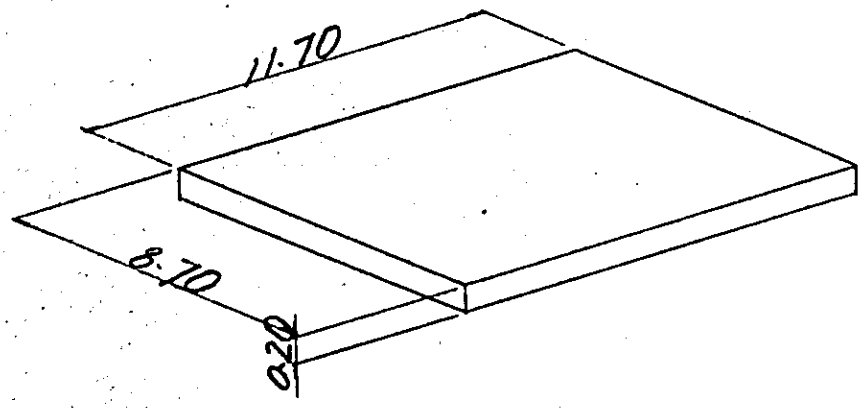
$$Va = \frac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 16 = 0.107 \ m^3$$

7) LEVELING CONCRETE



Va = 8.70 × 11.70 × 0.10 = 10.179 m^3

8) AGGREGATE SUBBASE



Va = 8.70 × 11.70 × 0.20 = 20.358 m^3

9) PILE

ϕ - 500

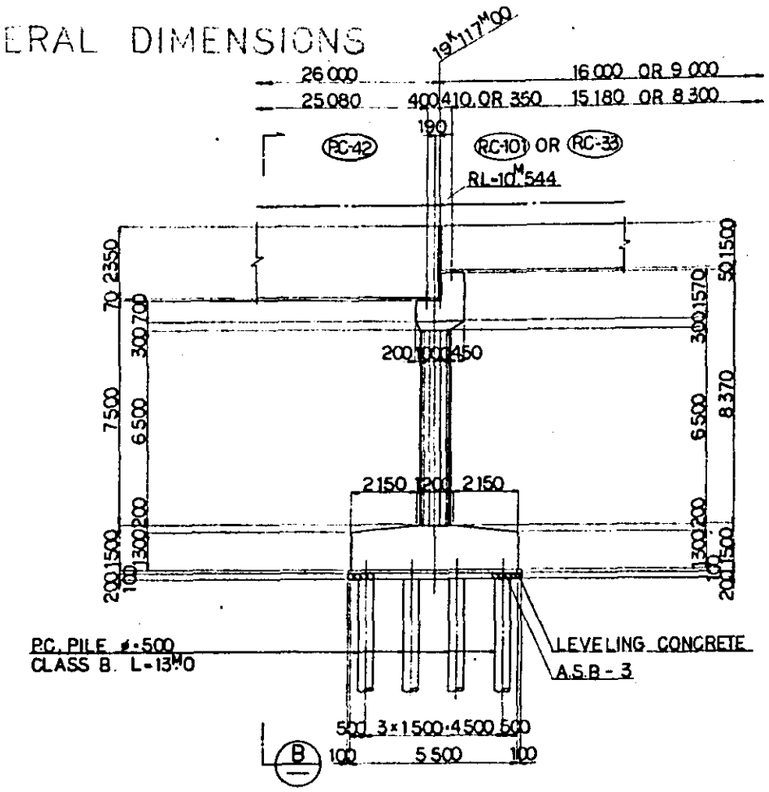
TYPE-B 13 m × 48

13. PIER 51

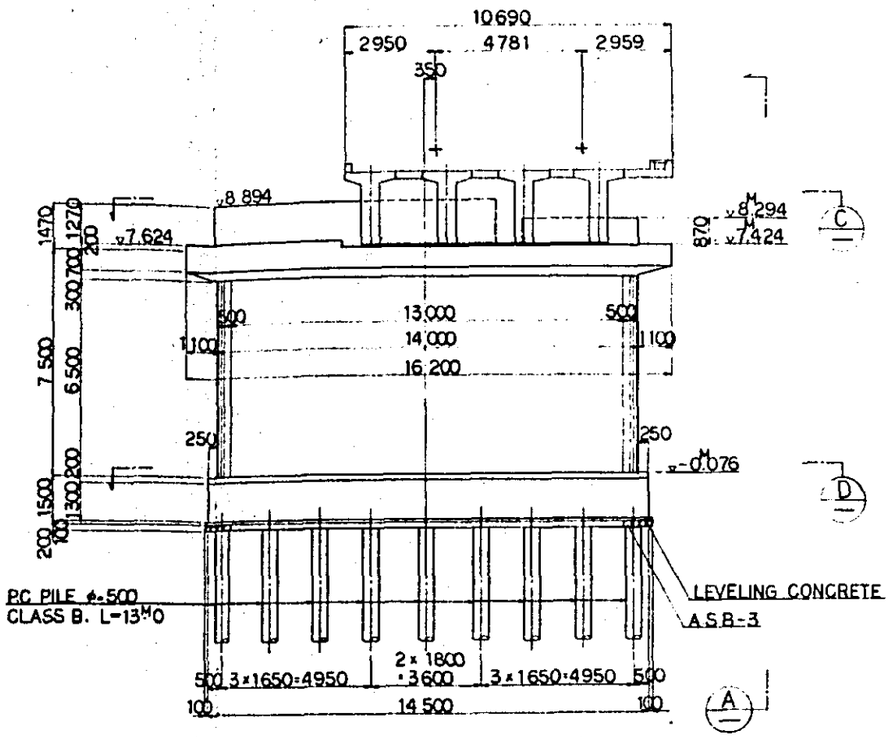
	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	38.8	80.7	3183.8	82.1
COLUMN	89.6	189.4	6933.5	77.4
TOTAL	128.4	270.1	10117.3	78.8
FOOTING	113.4	53.3	5853.6	51.6

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	8.4	CLASS F
AGGREGATE SUBBASE	m^3	16.8	A.S.B.-3
EXCAVATION	m^2	274.5	
FOUNDATION MORTAR	m^3	0.1	G_{ck} = 400 kg/cm²
PILE	m x NUMBER	13 x 36	φ500-B

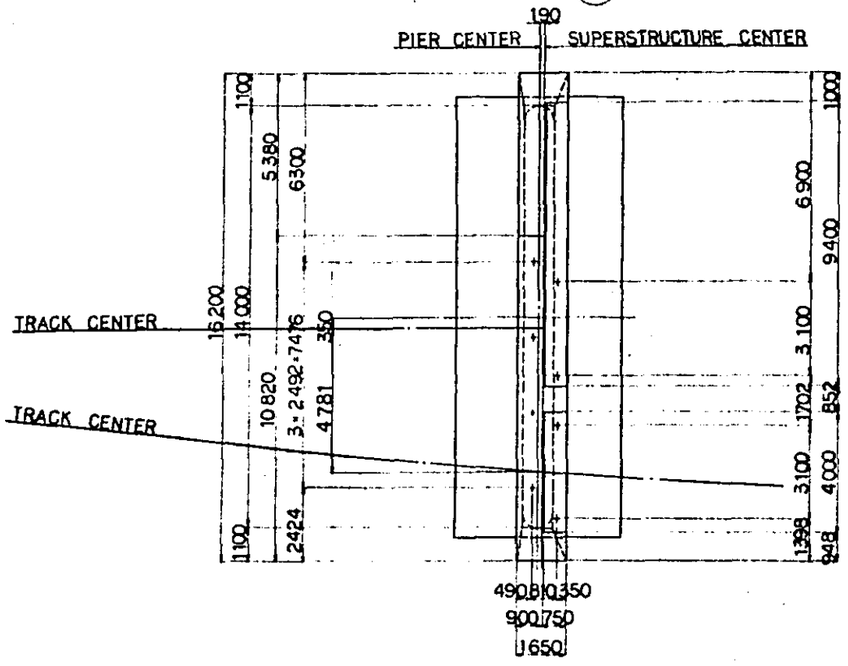
1) GENERAL DIMENSIONS



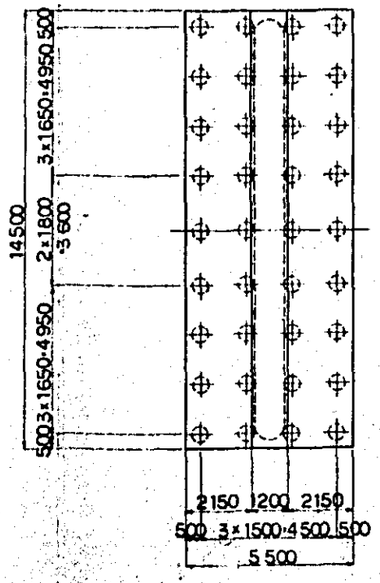
SECTION (A)



SECTION (B)



SECTION (C)

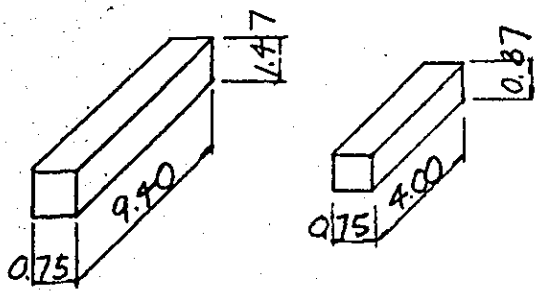


SECTION (D)

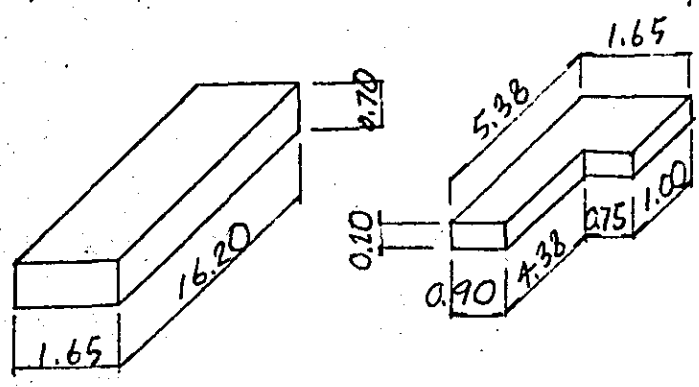
GENERAL VIEW OF P-51

2) CONCRETE VOLUME

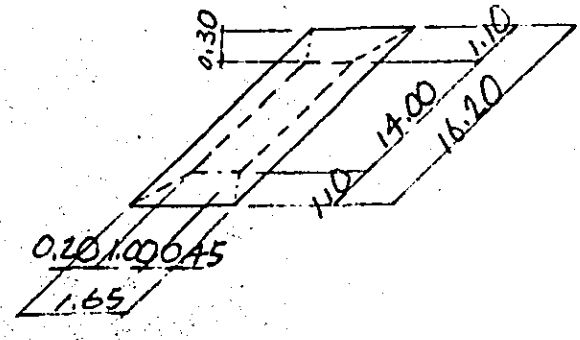
(1) BEAM



			m³
$Va = 0.75 \times 1.47 \times 9.40$	=	10.364	
$Vb = 0.75 \times 0.87 \times 4.00$	=	2.610	"



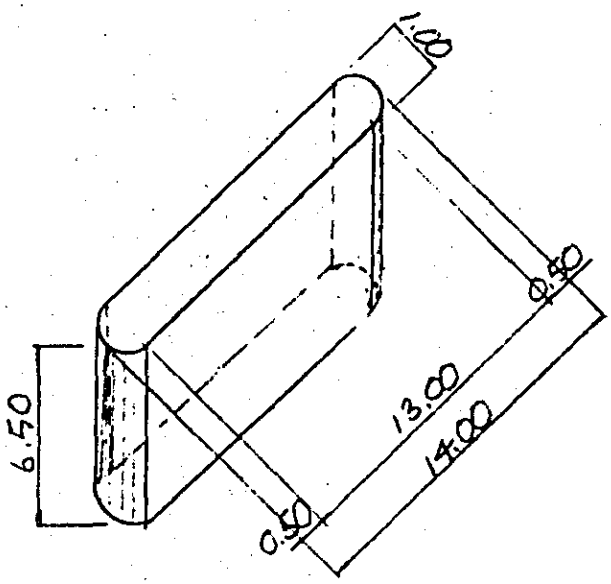
$Vc = 1.65 \times 0.70 \times 16.20$	=	18.711	"
$Vd = (0.90 \times 4.38 + 1.65 \times 1.00) \times 0.20$	=	1.118	"



$$Ve = \frac{0.30}{6} \times \{1.00 \times 14.00 + 1.65 \times 16.20 + (1.00 + 1.65) \cdot (14.00 + 16.20)\}$$ = 6.038 "

BEAM TOTAL = 38.841 m³

(2) COLUMN

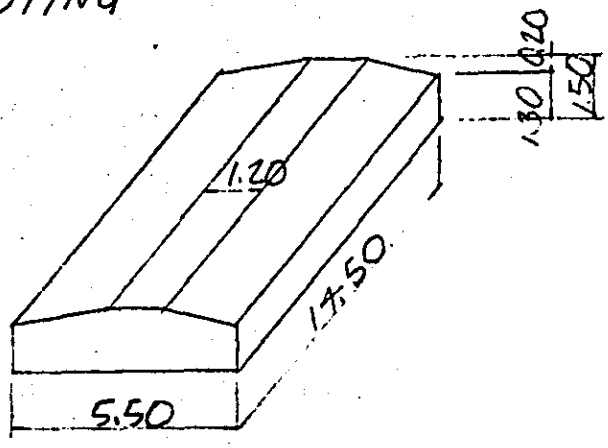


$Va = \frac{1}{4} \times \pi \times 1.00^2 \times 6.50$ = 5.105 m³

$Vb = 1.00 \times 13.00 \times 6.50$ = 84.500 "

COLUMN TOTAL = 89.605 m³

(3) FOOTING



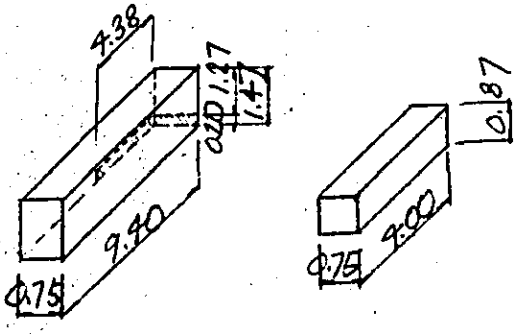
$Va = \frac{1}{2} \times (1.20 + 5.50) \times 0.20 \times 14.50$ = 9.715 m³

$Vb = 5.50 \times 1.30 \times 14.50$ = 103.675 "

FOOTING TOTAL = 113.390 m³

3) FORM AREA

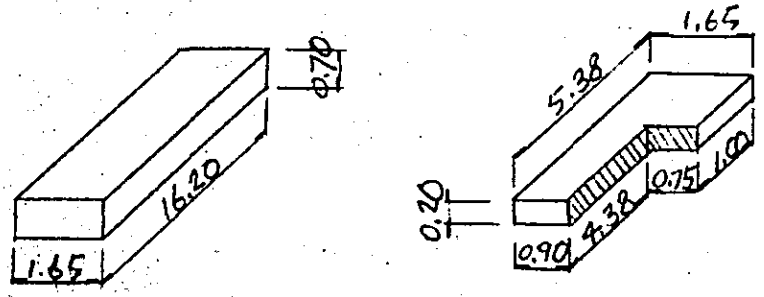
1) BEAM



m^2

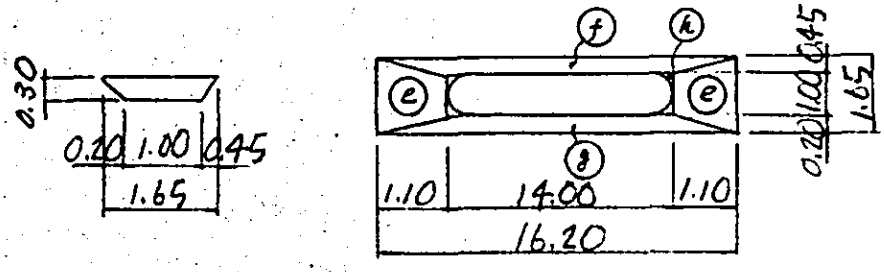
$Ae = 1.47 \times (0.75 + 9.40) \times 2 - 0.20 \times (0.75 + 4.38) =$ 28.815

$Ab = 0.87 \times (0.75 + 4.00) \times 2 =$ 8.265"



$Ac = 0.70 \times (1.65 + 16.20) \times 2 =$ 24.990"

$Ad = 0.20 \times (0.90 + 5.38 + 1.65 + 1.00) =$ 1.786"



$Ae = \frac{1}{2} \times (1.00 + 1.65) \cdot \sqrt{1.10^2 + 0.30^2} \times 2 =$ 3.021" (1.140)

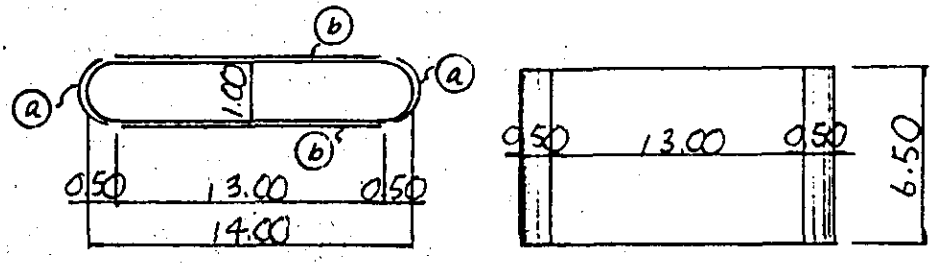
$Af = \frac{1}{2} \times (14.00 + 16.20) \cdot \sqrt{0.45^2 + 0.30^2} =$ 8.169" (0.541)

$Ag = \frac{1}{2} \times (14.00 + 16.20) \cdot \sqrt{0.20^2 + 0.30^2} =$ 5.451" (0.361)

$Ah = (1 - \pi/4) \times 1.00^2 =$ 0.215"

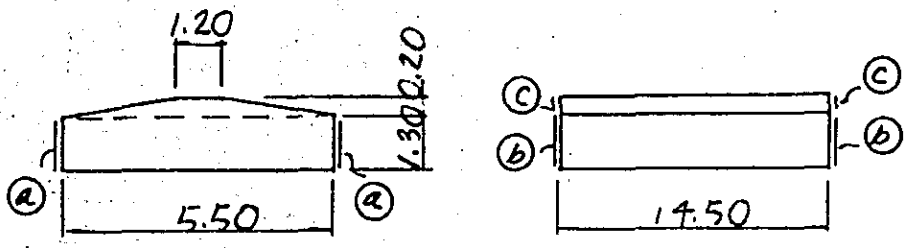
BEAM TOTAL = 80.712 m^2

(2) COLUMN



$A_a = \pi \times 1.00 \times 6.50$	=	20.420 m²
$A_b = 13.00 \times 6.50 \times 2$	=	169.00 "
COLUMN TOTAL	=	189.420 m²

(3) FOOTING



$A_a = 1.30 \times 14.50 \times 2$	=	37.700 m²
$A_b = 1.30 \times 5.50 \times 2$	=	14.300 "
$A_c = \frac{1}{2} \times (1.20 + 5.50) \times 0.20 \times 2$	=	1.340 "
FOOTING TOTAL	=	53.340 m²

4) REINFORCING BAR

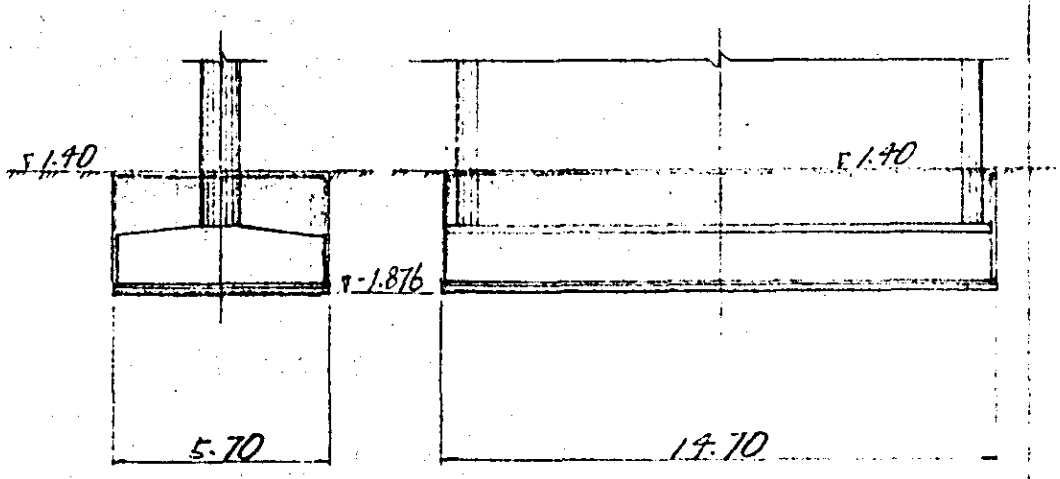
	D32	D29	D25	D22	D19	D16	D13	TOTAL
BEAM						2114.2	672.4	2 786.6
COLUMN				4 500.4			2 433.1	6 933.5
TOTAL				4 500.4		2 114.2	3 105.5	9 720.1
FOOTING			2 895.5			2 958.1		5 853.6

BEARING BASE —— D16 397.2 rd

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
	BEAM					
B 1	D 16	1.56	12 390	11	212.6	
2	〃	〃	6 770	11	116.2	
3	D 13	0.995	16 100	6	96.1	
4	〃	〃	5 280	2	10.5	〃
5	〃	〃	16 700	6	99.7	
6	〃	〃	16 670	2	33.2	〃 (VARIES)
7	〃	〃	2 860	10	28.5	
8	〃	〃	2 300	9	20.6	
9	D 16	1.56	13 300	5	103.7	
10	〃	〃	4 650	63	457.0	〃
11	D 13	0.995	9 300	10	92.5	
12	D 16	1.56	6 700	5	52.3	
13	〃	〃	3 450	27	145.3	〃
14	D 13	0.995	3 900	6	23.3	
15	〃	〃	1 400	16	22.3	
B° 1	D 16	1.56	3 570	35	194.9	
2	〃	〃	3 170	72	356.0	〃
3	〃	〃	2 870	93	416.4	
4	〃	〃	2 740	14	59.8	〃 (VARIES)
5	D 13	0.995	2 330	106	245.7	
		SUB TOTAL				
			D 16	2 114.2 kg		
			D 13	672.4 〃		
				2 786.6 kg		
	COLUMN					
C 1	D 22	3.04	8 900	116	3 138.5	
2	〃	〃	5 600	80	1 361.9	〃
3	D 13	0.995	13 000	84	1 086.5	
4	〃	〃	2 170	84	181.4	

REINF. NO.	DIA. (mm)	U. WEIGHT (kg/m)	LENGTH (mm)	NUMBER	WEIGHT (kg)	REMARKS
C° 1	D 13	0.995	2 730	273	741.5	⊔
2	〃	〃	1 560	〃	423.7	⊓
		SUB TOTAL				
			D 22	4500	4 kg	
			D 13	2433	1 〃	
				6933	5 kg	
	FOOTING					
F 1	D 25	3.98	7 500	97	2895.5	⊔
2	D 16	1.56	6 340	49	484.6	∩
3	〃	〃	16 840	9	236.4	⊔
4	〃	〃	16 620	28	726.0	〃 (VARIES)
5	〃	〃	15 320	19	454.1	⊏⊐
6	〃	〃	5 960	6	55.8	⊔
7	〃	〃	14 970	6	140.1	〃
F° 1	D 16	1.56	3 450	160	861.1	⊔ (VARIES)
		SUB TOTAL				
			D 25	2895.5	kg	
			D 16	2958.1	〃	
				5853.6	kg	
		TOTAL				
			D 25	2895.5	kg	
			D 22	4500.4	〃	
			D 16	5072.3	〃	
			D 13	3165.5	〃	
				15573.7	kg	

5) EXCAVATION

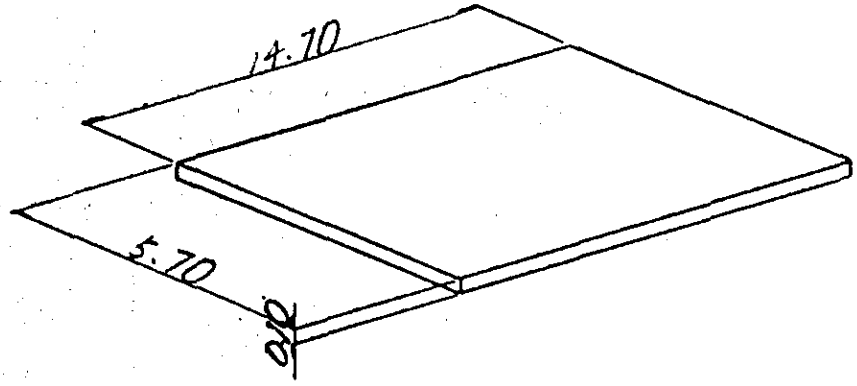


$$V_a = 5.70 \times 14.70 \times (1.40 + 1.876) = 274.496 \ m^3$$

6) FOUNDATION MORTAR

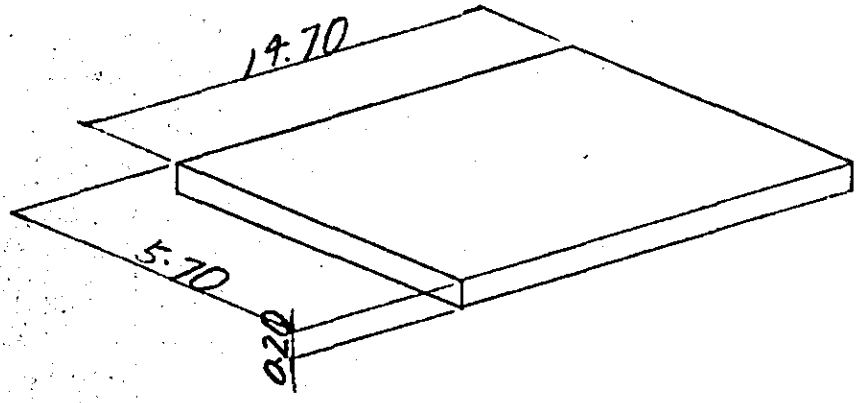
$$V_a = \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4$$
$$+ \tfrac{1}{2} \times (0.83 \times 0.53 + 0.80 \times 0.50) \times 0.015 \times 2$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.015 \times 4$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.131 \ m^3$$

7) LEVELING CONCRETE



Va = 5.70 × 14.70 × 0.10 = 8.379 m^3

8) AGGREGATE SUBBASE



Va = 5.70 × 14.70 × 0.20 = 16.758 m^3

9) PILE

ϕ - 500

TYPE-B 13 m × 36

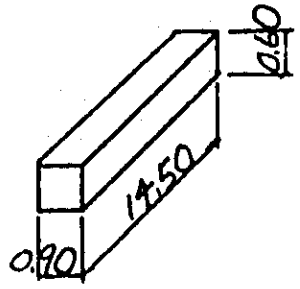
14- PIER 02

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^2)
BEAM	32.9	60.0	3040.1	92.4
COLUMN	80.5	158.1	14 025.8	174.0
TOTAL	113.4	218.1	17 075.9	150.3
FOOTING	229.6	81.5	13 966.9	60.8

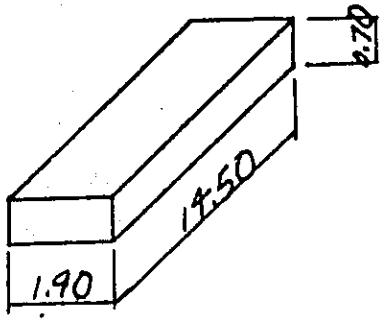
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	12.4	CLASS B
AGGREGATE SUBBASE	m^3	24.9	A.S.B.-B
EXCAVATION	m^3	685.2	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	6 x 56	φ500-B

1) CONCRETE VOLUME

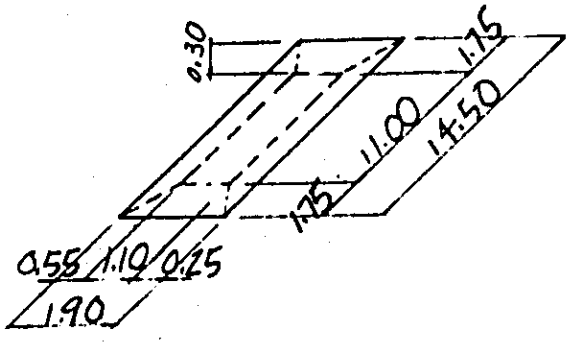
(1) BEAM



$V_a = 0.90 \times 0.60 \times 14.50$ = 7.830 m³



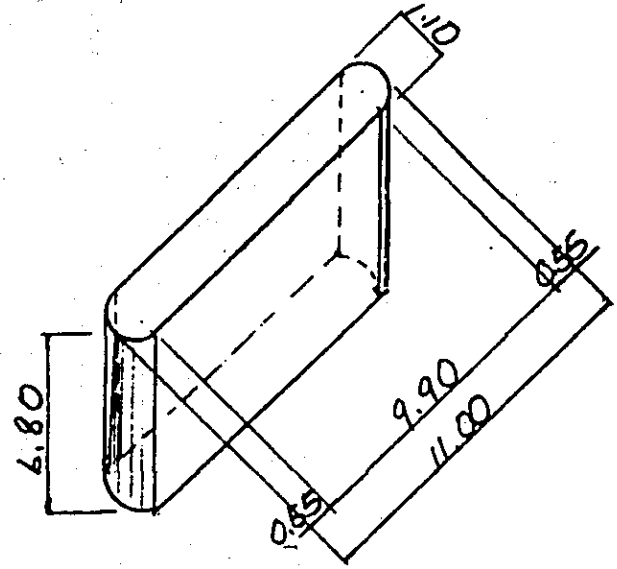
$V_b = 1.90 \times 0.70 \times 14.50$ = 19.285 "



$V_c = \frac{0.30}{6} \times \{ 1.10 \times 11.00 + 1.90 \times 14.50 + (1.10 + 1.90) \cdot (11.00 + 14.50) \}$ = 5.808 "

BEAM TOTAL = 32.923 m³

(2) COLUMN

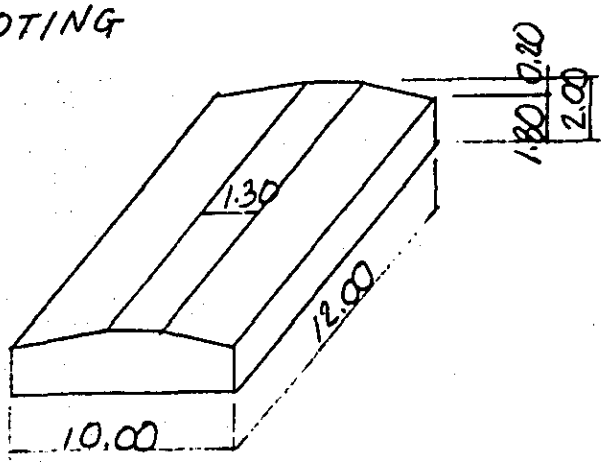


$V_a = \frac{1}{4} \times \pi \times 1.10^2 \times 6.80$ = 6.462 m^3

$V_b = 1.10 \times 9.90 \times 6.80$ = 74.052 "

COLUMN TOTAL = 80.514 m^3

(3) FOOTING



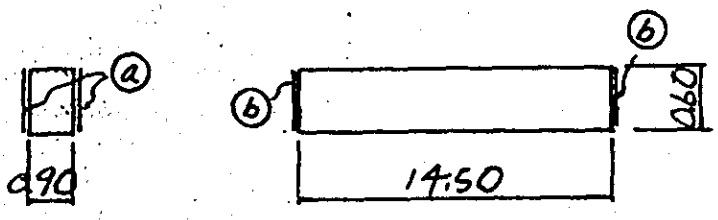
$V_a = \frac{1}{2} \times (1.30 + 10.00) \times 0.20 \times 12.00$ = 13.560 m^3

$V_b = 10.00 \times 1.80 \times 12.00$ = 216.000 "

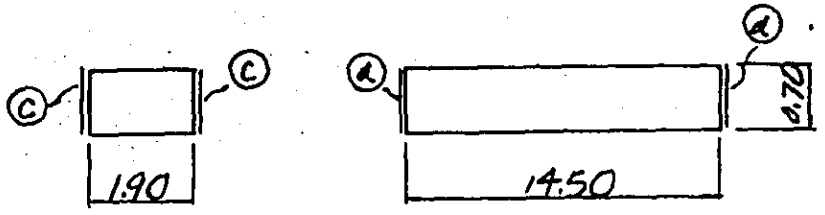
FOOTING TOTAL = 229.560 m^3

2) FORM AREA

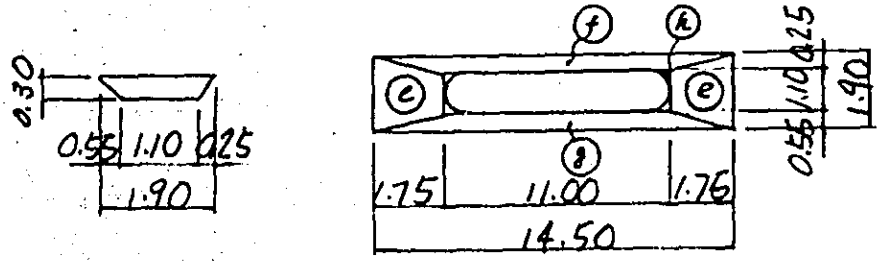
(1) BEAM



$Ae = 0.60 \times 14.50 \times 2$	=	17.400 m^2
$Ab = 0.60 \times 0.90 \times 2$	=	1.080 "

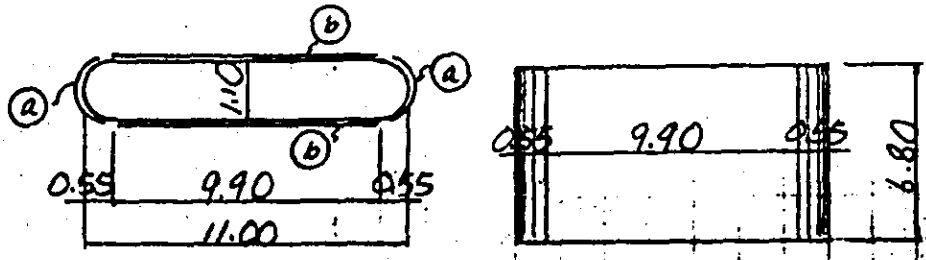


$Ac = 0.70 \times 14.50 \times 2$	=	20.300 "
$Ad = 0.70 \times 1.90 \times 2$	=	2.660 "



$Ae = \frac{1}{2} \times (1.10 + 1.90) \times \sqrt{1.75^2 + 0.30^2} \times 2$ (1.775)	=	5.328 "
$Af = \frac{1}{2} \times (11.00 + 14.50) \times \sqrt{0.25^2 + 0.30^2}$ (0.391)	=	4.985 "
$Ag = \frac{1}{2} \times (11.00 + 14.50) \times \sqrt{0.55^2 + 0.30^2}$ (0.626)	=	7.982 "
$Ah = (1 - \pi/4) \times 1.10^2$	=	0.260 "
BEAM TOTAL	=	59.995 m^2

(2) COLUMN

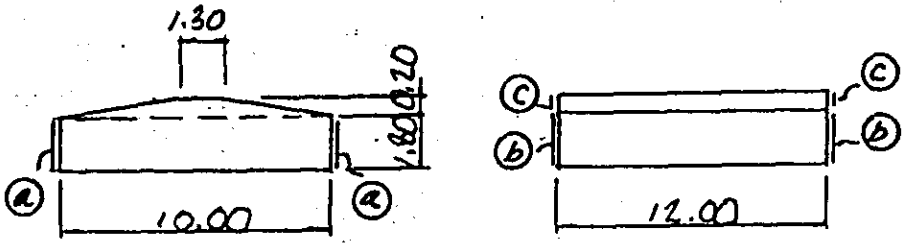


$A_a = \pi \times 1.10 \times 6.80$ = 23.499 m²

$A_b = 9.90 \times 6.80 \times 2$ = 134.640 "

COLUMN TOTAL = 158.139 m²

(3) FOOTING



$A_a = 1.80 \times 12.00 \times 2$ = 43.200 m²

$A_b = 1.80 \times 10.00 \times 2$ = 36.000 "

$A_c = \frac{1}{2} \times (1.30 + 10.00) \times 0.20 \times 2$ = 2.260 "

FOOTING TOTAL = 81.460 m²

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	32.9	79.468	2614.5
COLUMN	80.5	173.985	14005.8
FOOTING	229.6	60.831	13966.9

BEARING BASE D16 ~~925.6~~ kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

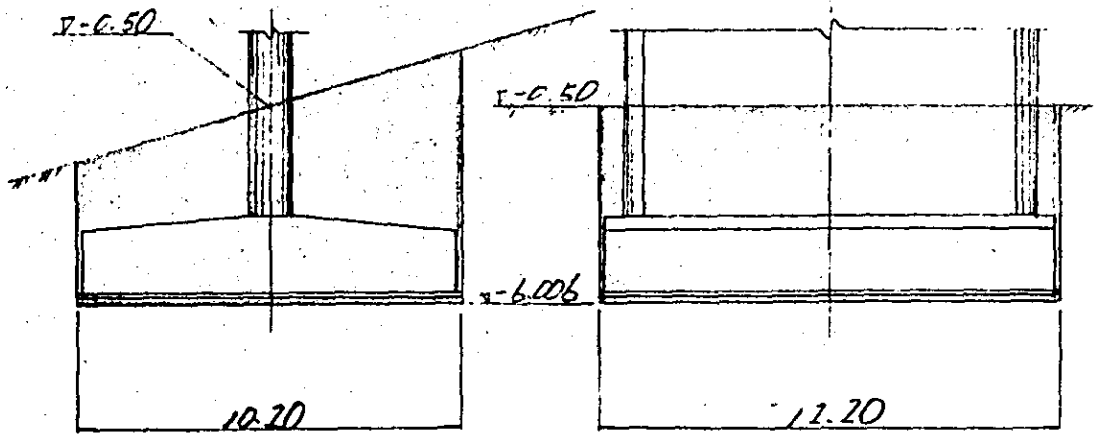
$$R = \frac{\text{REINFORCING BAR OF Po1}}{\text{CONCRETE VOLUME OF Po1}}$$

$$R_B = \frac{2614.1}{32.9} = 79.456$$

$$R_C = \frac{14005.8}{80.5} = 173.985$$

$$R_F = \frac{13966.9}{229.6} = 60.831$$

4) EXCAVATION



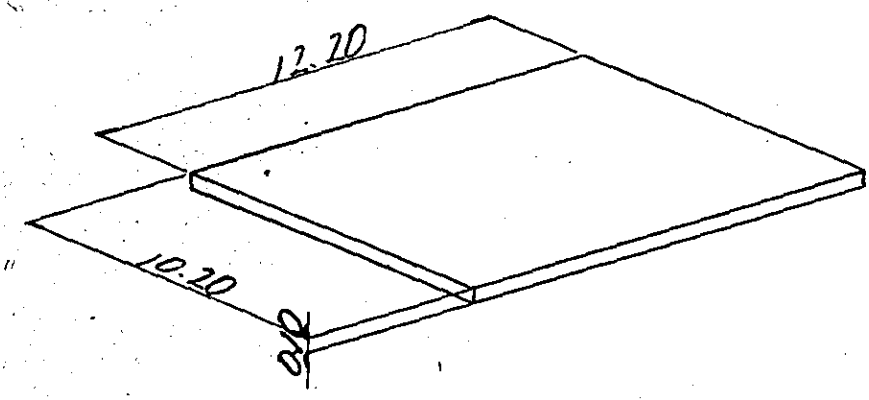
$$Va = 10.20 \times 12.20 \times (6.006 - 0.50) = 685.167 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4$$

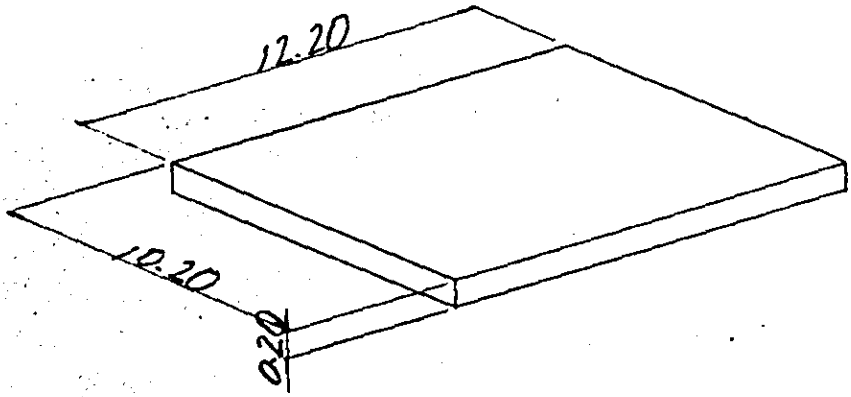
$$+ \tfrac{1}{2} \times (0.836 \times 0.636 + 0.80 \times 0.60) \times 0.018 \times 8 = 0.102 \ m^3$$

6) LEVELING CONCRETE



$Va = 10.20 \times 12.20 \times 0.10 = 12.499\ m^3$

7) AGGREGATE SUBBASE



$Va = 10.20 \times 12.20 \times 0.20 = 24.888\ m^3$

8) PILE

ϕ - 500

TYPE-B. $6^{m} \times 56$

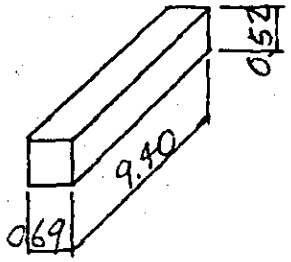
15 PIER 03

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	19.0	40.9	1876.9	98.8
COLUMN	34.0	90.7	4410.5	129.7
TOTAL	53.0	131.6	6287.4	118.6
FOOTING	67.0	35.4	4576.3	68.3

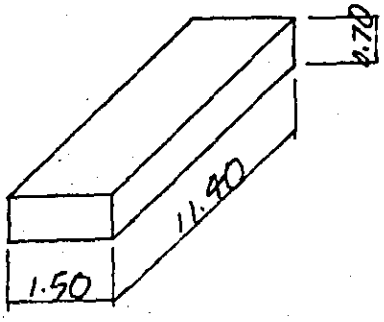
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS P
AGGREGATE SUBBASE	m^3	11.6	A.S.B.-3
EXCAVATION	m^3	142.2	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm^2
PILE	m x NUMBER	11 x 24	ϕ500-B

1) CONCRETE VOLUME

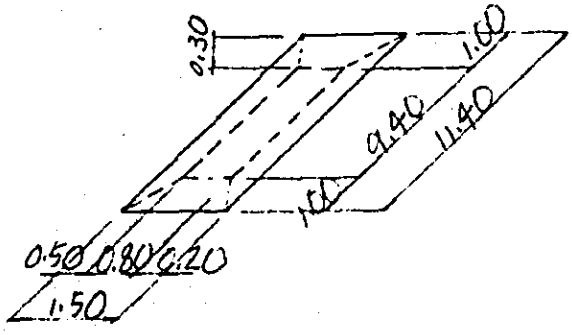
(1) BEAM



$Va = 0.69 \times 0.52 \times 9.40$ = 3.373 m^3



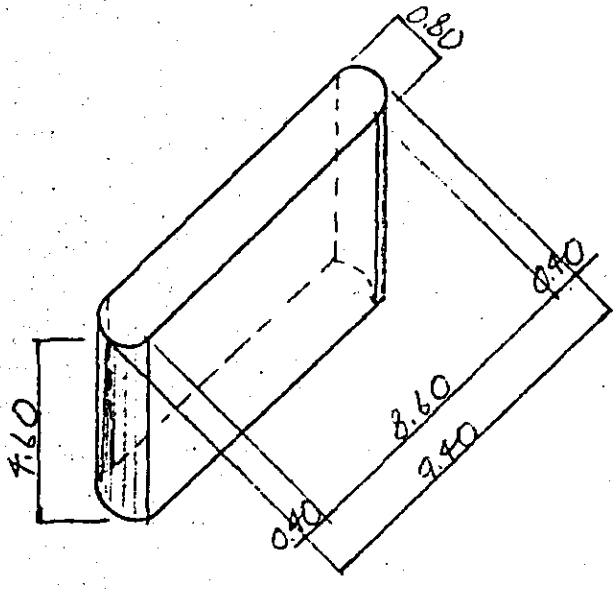
$Vb = 1.50 \times 0.70 \times 11.40$ = 11.970 "



$Vc = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.50 \times 11.40 + (0.80 + 1.50) \cdot (9.40 + 11.40)\}$ = 3.623 "

BEAM TOTAL = 18.966 m^3

(2) COLUMN

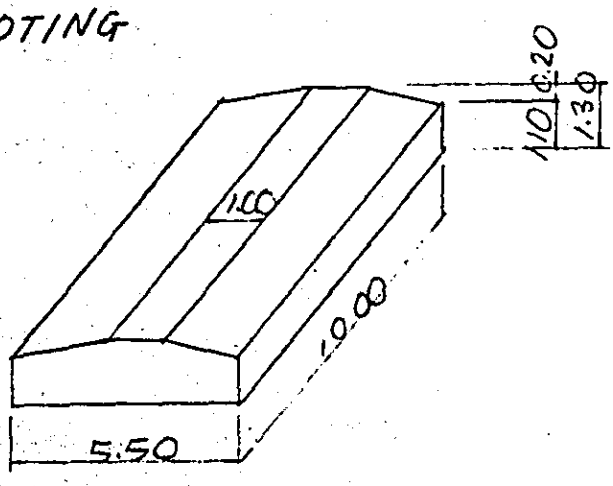


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.60$ = 2.312 m^3

$V_b = 0.80 \times 8.60 \times 4.60$ = 31.648 "

COLUMN TOTAL = 33.960 m^3

(3) FOOTING



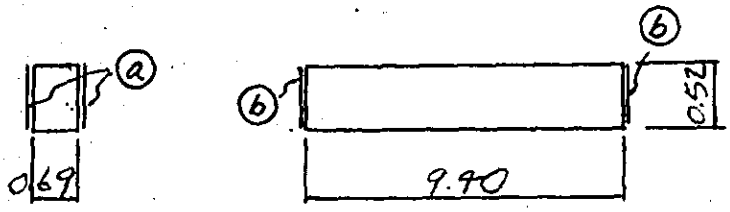
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500

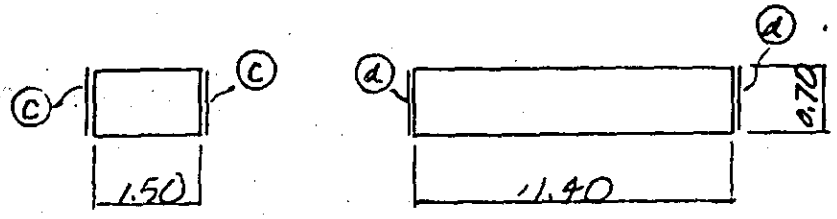
FOOTING TOTAL = 67.000 m^3

2) FORM AREA

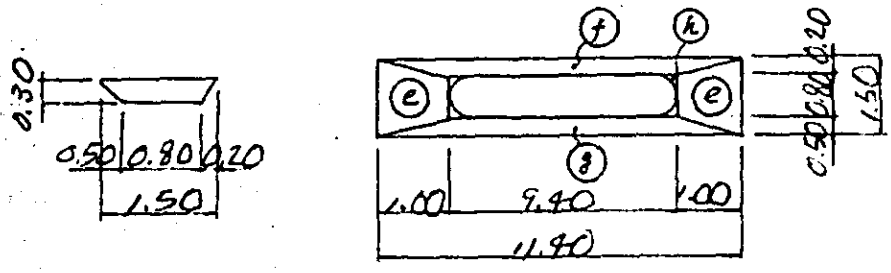
(1) BEAM



$Ae = 0.52 \times 9.40 \times 2$	=	9.776 m^2
$Ab = 0.52 \times 0.69 \times 2$	=	0.718 "

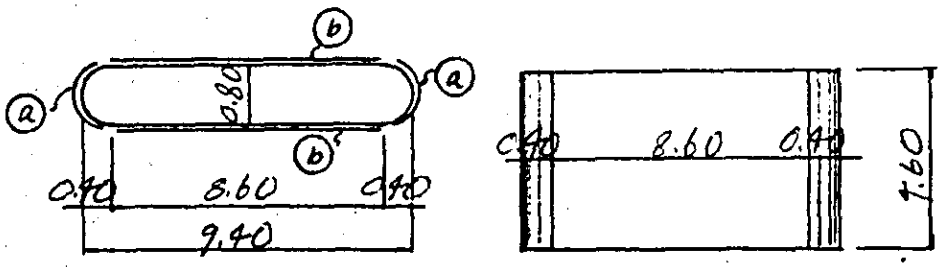


$Ac = 0.70 \times 11.40 \times 2$	=	15.960 "
$Ad = 0.70 \times 1.50 \times 2$	=	2.100 "



$Ae = \frac{1}{2} \times (0.80 + 1.50) \times \sqrt{1.00^2 + 0.30^2} \times 2$	=	2.401 "
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.20^2 + 0.50^2}$	=	3.154 "
$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.50^2 + 0.30^2}$	=	6.063 "
$Ah = (1 - \pi/4) \times 0.80^2$	=	0.137 "
BEAM TOTAL	=	40.901 m^2

(2) COLUMN

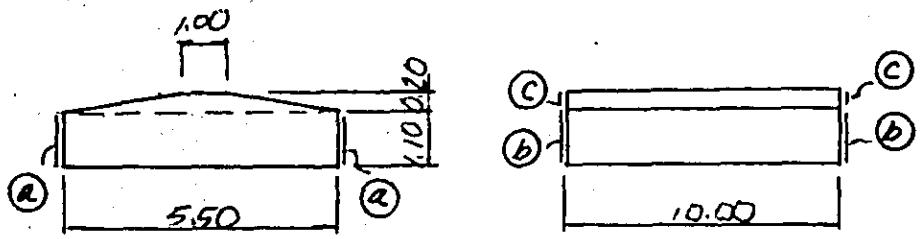


$Aa = \pi \times 0.80 \times 9.60$ = 11.561 m²

$Ab = 8.60 \times 9.60 \times 2$ = 79.120 "

COLUMN TOTAL = 90.681 m²

(3) FOOTING



$Aa = 1.10 \times 10.00 \times 2$ = 22.000 m²

$Ab = 1.10 \times 5.50 \times 2$ = 12.100

$Ac = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300

FOOTING TOTAL = 35.400 "

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	19.0	82.361	1564.9
COLUMN	34.0	129.720	4410.5
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 312.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

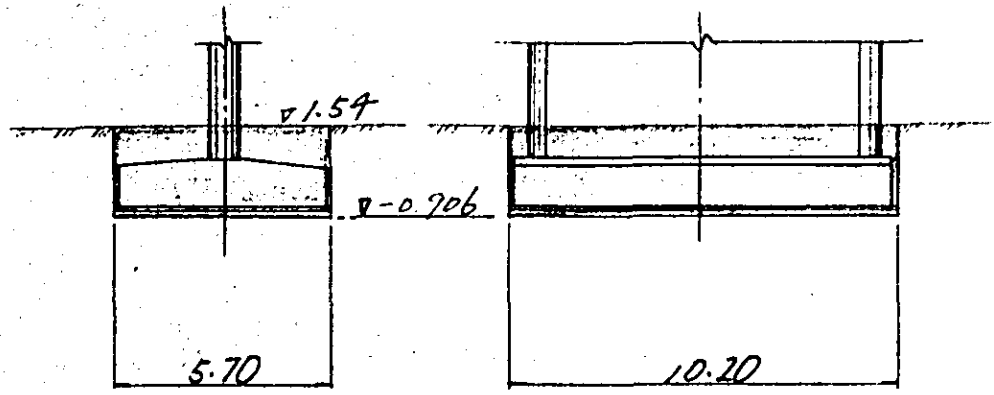
$$R = \frac{\text{REINFORCING BAR OF P30}}{\text{CONCRETE VOLUME OF P30}}$$

$$R_B = \frac{1984.9}{24.1} = 82.361$$

$$R_C = \frac{7277.3}{56.1} = 129.720$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION



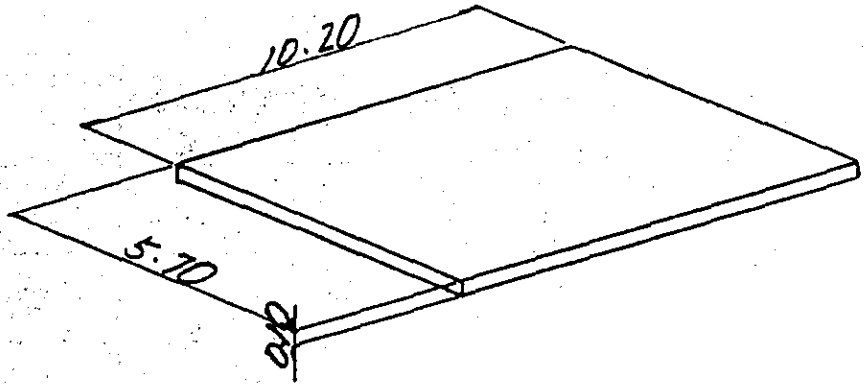
$$Va = 5.70 \times 10.20 \times (1.54 + 0.906) = 142.210 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$

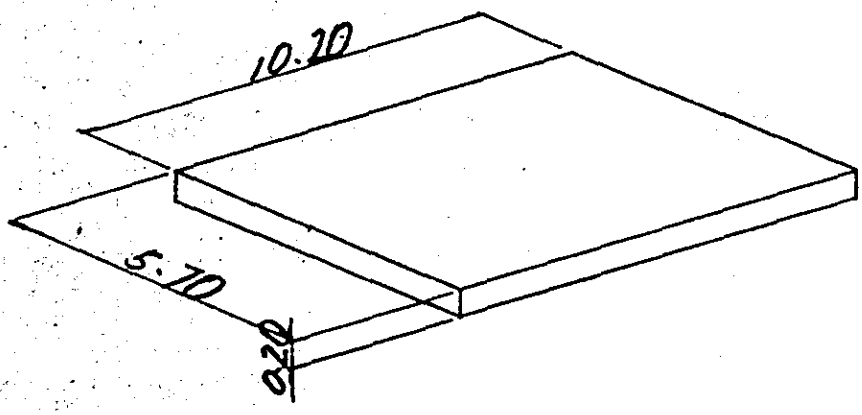
$$+ \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8 = 0.106 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

ϕ - 500

TYPE - B 11 m × 29

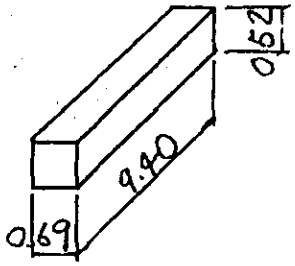
16 PIER 04

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (kg/m^3)
BEAM	19.0	40.9	1876.9	98.8
COLUMN	34.0	90.7	4410.5	129.7
TOTAL	53.0	131.6	6287.4	118.6
FOOTING	67.0	35.4	4576.3	68.3

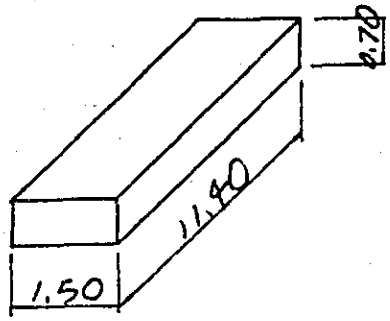
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B - 3
EXCAVATION	m^3	139.9	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	11 x 24	ϕ500 - B

1) CONCRETE VOLUME

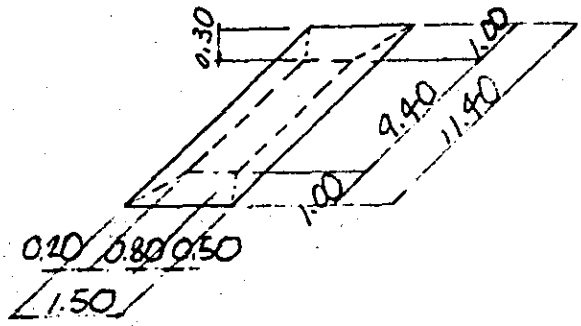
(1) BEAM



$Va = 0.69 \times 0.52 \times 9.40$ = 3.373 m³



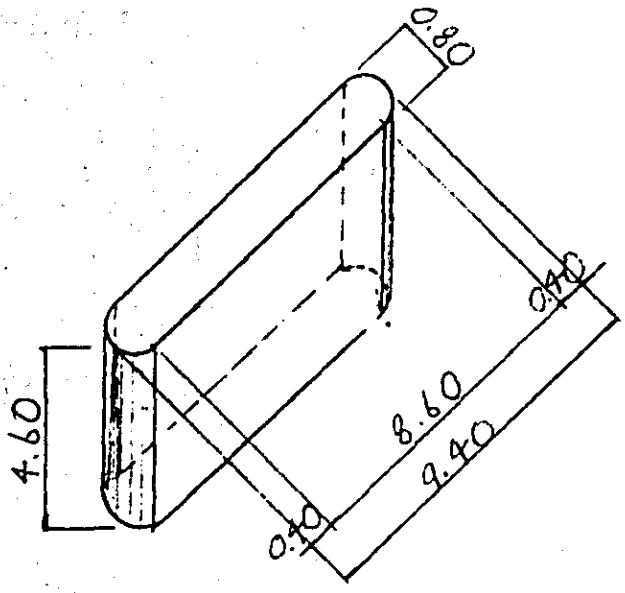
$Vb = 1.50 \times 0.70 \times 11.40$ = 11.970 "



$Vc = \frac{0.30}{6} \times \{ 0.80 \times 9.40 + 1.50 \times 11.40 + (0.80 + 1.50) \cdot (9.40 + 11.40) \}$ = 3.623 "

BEAM TOTAL = 18.966 m³

(2) COLUMN

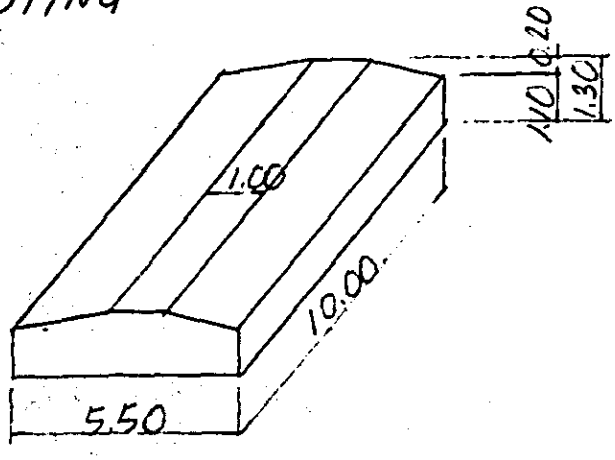


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.60$ = 2.312 m³

$V_b = 0.80 \times 8.60 \times 4.60$ = 31.648 "

COLUMN TOTAL = 33.960 m³

(3) FOOTING



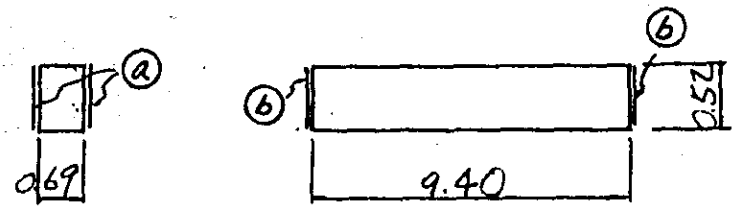
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m³

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

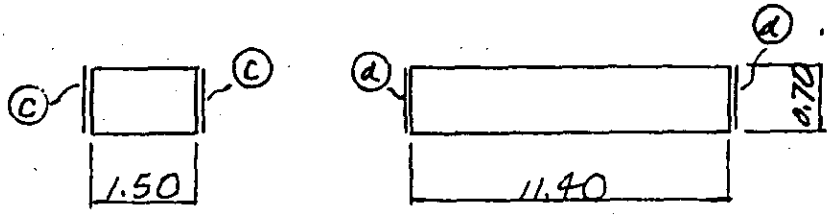
FOOTING TOTAL = 67.000 m³

2) FORM AREA

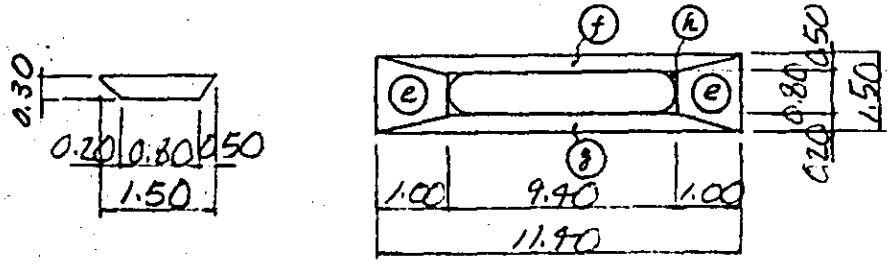
(1) BEAM



$Ae = 0.52 \times 9.40 \times 2$	=	9.776	m^2
$Ab = 0.52 \times 0.69 \times 2$	=	0.718	"

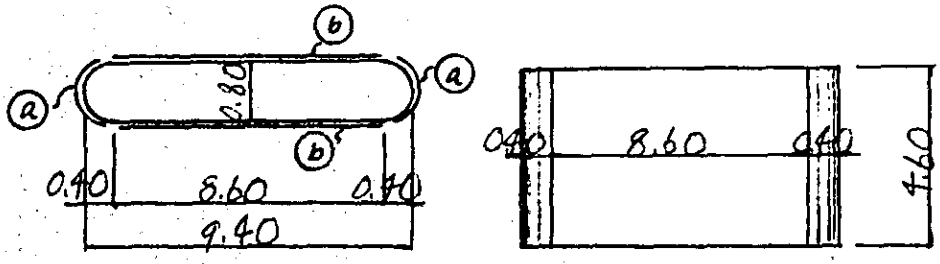


$Ac = 0.70 \times 11.40 \times 2$	=	15.960	"
$Ad = 0.70 \times 1.50 \times 2$	=	2.100	"



$Ae = \frac{1}{2} \times (0.80 + 1.50) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.04)	=	2.401	"
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.50^2 + 0.30^2}$ (0.58)	=	6.063	"
$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.20^2 + 0.30^2}$ (0.36)	=	3.754	"
$Ah = (1 - \pi/4) \times 0.80^2$	=	0.137	"
BEAM TOTAL	=	40.909	m^2

(2) COLUMN

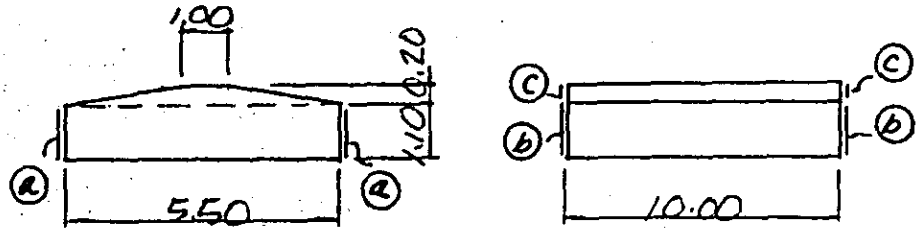


$A_a = \pi \times 0.80 \times 4.60$ = 11.561 m^2

$A_b = 8.60 \times 4.60 \times 2$ = 79.120 "

COLUMN TOTAL = 90.681 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m^2

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	19.0	82.361	1564.9
COLUMN	34.0	129.720	4410.5
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 312.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

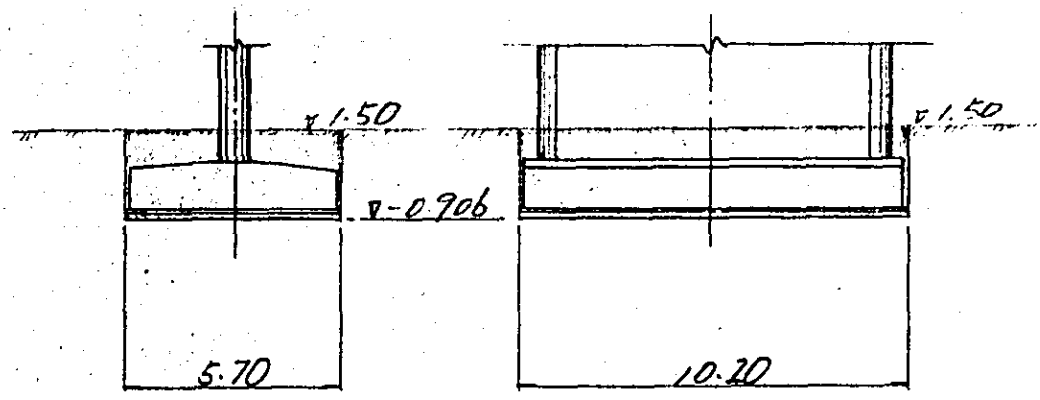
$$R = \frac{\text{REINFORCING BAR OF } P_{30}}{\text{CONCRETE VOLUME OF } P_{30}}$$

$$R_B = \frac{1984.9}{24.1} = 82.361$$

$$R_C = \frac{7277.3}{56.1} = 129.720$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION

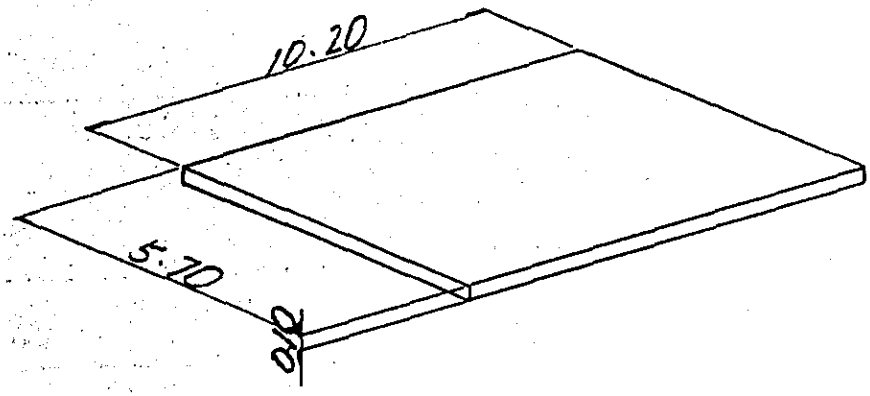


$$Va = 5.70 \times 10.20 \times (1.50 + 0.906) = 139.885 \ m^3$$

5) FOUNDATION MORTAR

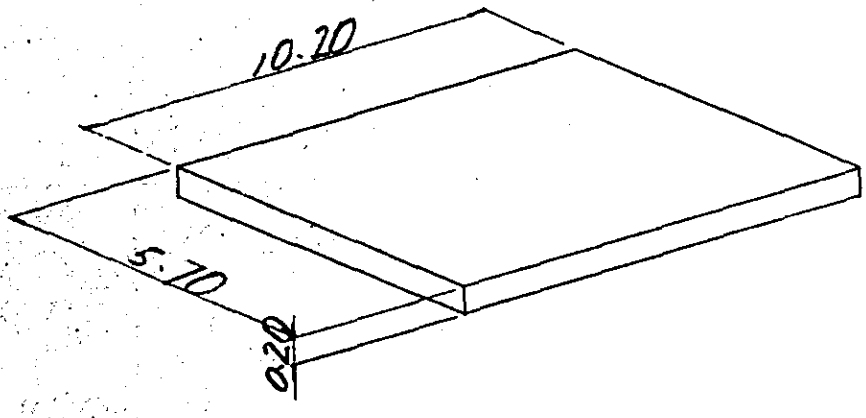
$$Va = \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.106 \ m^3$$

6) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10 = 5.814\ m^3$

7) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20 = 11.628\ m^3$

8) PILE

ϕ - 500

TYPE - B 11 m x 24

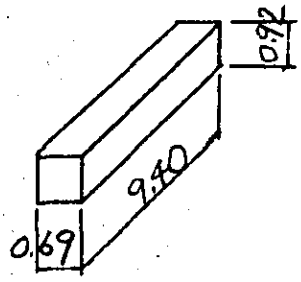
17 PIER 05

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	22.0	49.3	2069.7	94.1
COLUMN	28.1	74.9	2249.9	80.1
TOTAL	50.1	124.2	4319.6	86.2
FOOTING	41.0	26.2	2445.2	59.6

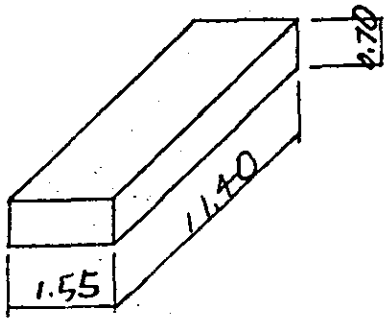
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	4.3	CLASS F
AGGREGATE SUBBASE	m^3	8.6	A.S.B.-3
EXCAVATION	m^2	64.5	
FOUNDATION MORTAR	m^3	0.1	G_{cr} = 400 kg/cm²
PILE	m × NUMBER	12 × 15	φ500-B

1) CONCRETE VOLUME

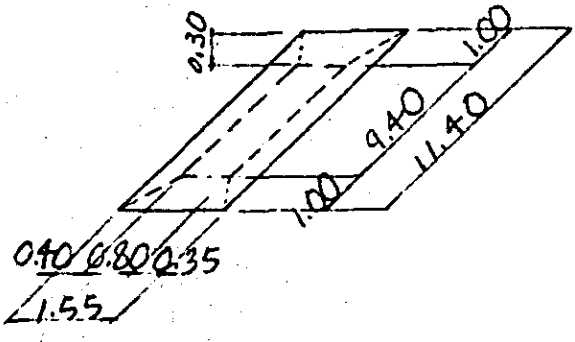
(1) BEAM



$Va = 0.69 \times 0.92 \times 9.40$ ..... = 5.967 m^3



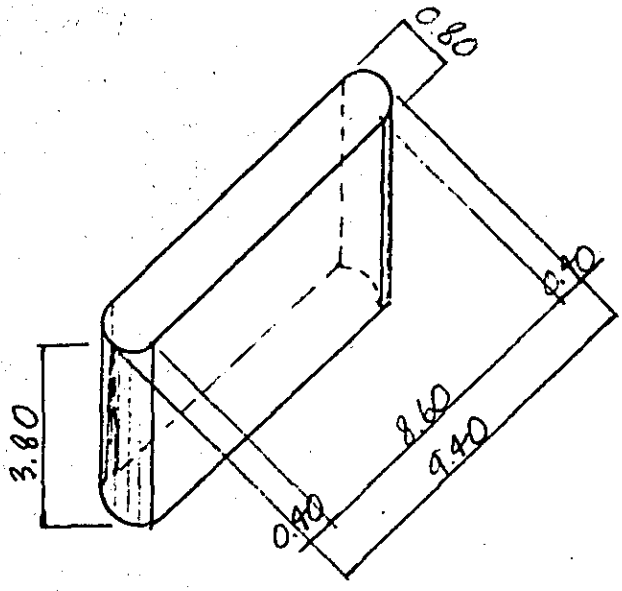
$Vb = 1.55 \times 0.70 \times 11.40$ = 12.369 "



$Vc = \frac{0.30}{6} \times \{ 0.80 \times 9.40 + 1.55 \times 11.40 + (0.80 + 1.55) \cdot (9.40 + 11.40) \}$ = 3.704 "

BEAM TOTAL = 22.040 m^3

(2) COLUMN

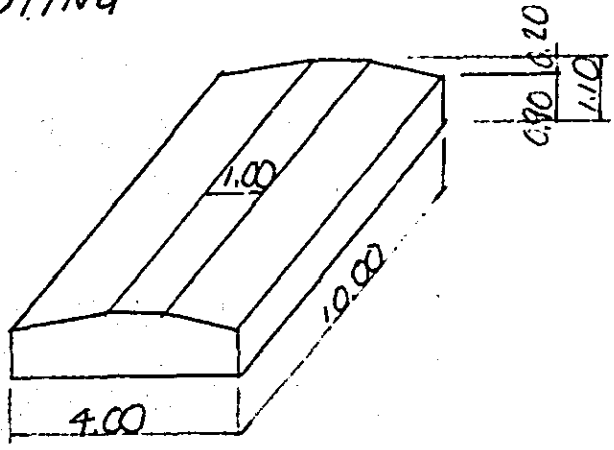


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 3.80$ = 1.910 m^3

$V_b = 0.80 \times 8.60 \times 3.80$ = 26.144 "

COLUMN TOTAL = 28.054 m^3

(3) FOOTING



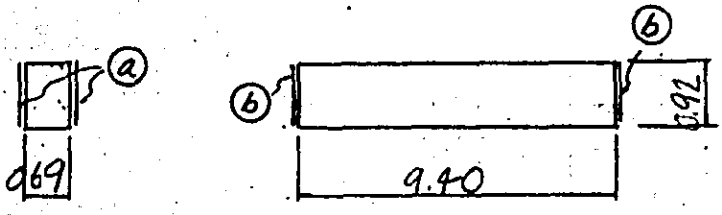
$V_a = \frac{1}{2} \times (1.00 + 4.00) \times 0.20 \times 10.00$ = 5.000 m^3

$V_b = 4.00 \times 0.90 \times 10.00$ = 36.000

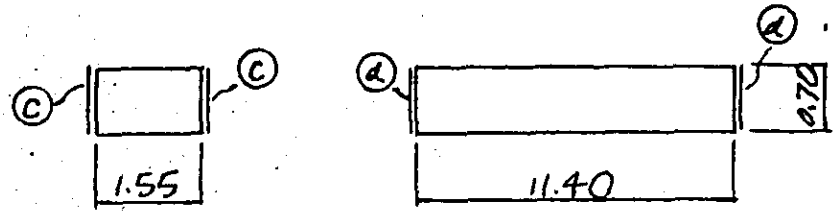
FOOTING TOTAL = 41.000 m^3

2) FORM AREA

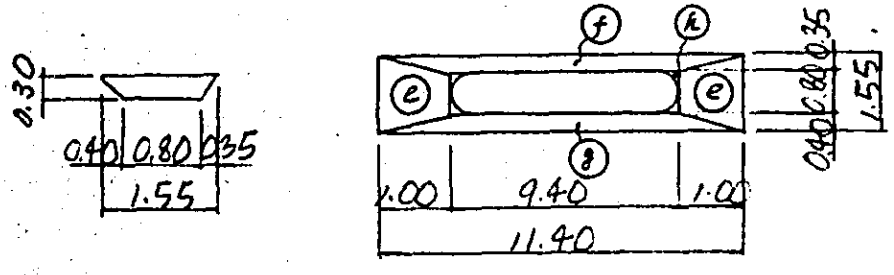
(1) BEAM



Ae = 0.92 × 9.40 × 2	=	17.296 m²
Ab = 0.92 × 0.69 × 2	=	1.270 "

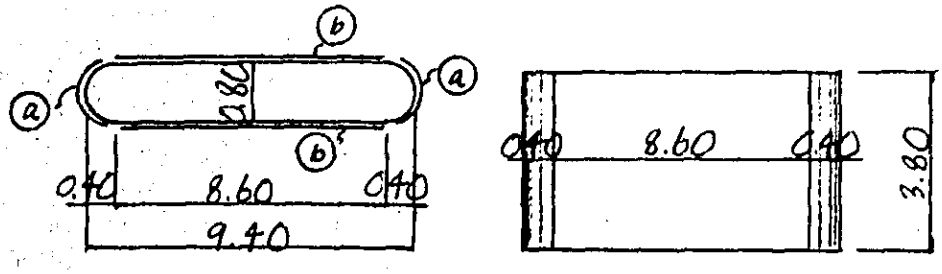


Ac = 0.70 × 11.40 × 2	=	15.960 "
Ad = 0.70 × 1.55 × 2	=	2.170 "



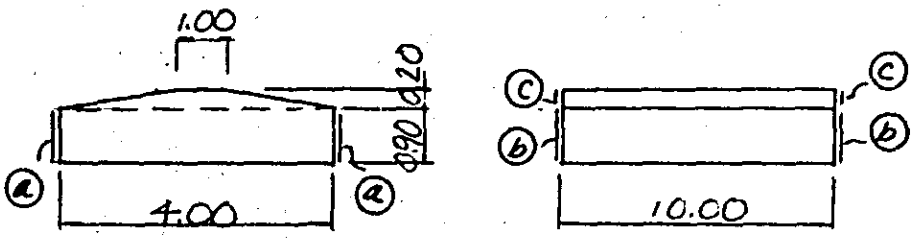
Ae = ½ × (0.80 + 1.55) × √(1.00² + 0.30²) × 2	=	2.453 "
Af = ½ × (9.40 + 11.40) × √(0.35² + 0.30²)	=	4.194 "
Ag = ½ × (9.40 + 11.40) × √(0.40² + 0.30²)	=	5.200 "
Ah = (1 − π/4) × 0.80²	=	0.137 "
BEAM TOTAL	=	49.286 m²

(2) COLUMN



$Aa = \pi \times 0.80 \times 3.80$	=	$9.550\ m^2$
$Ab = 8.60 \times 3.80 \times 2$	=	$65.360\ "$
COLUMN TOTAL	=	$74.910\ m^2$

(3) FOOTING



$Aa = 0.90 \times 10.00 \times 2$	=	$18.000\ m^2$
$Ab = 0.90 \times 4.00 \times 2$	=	$7.200\ "$
$Ac = \frac{1}{2} \times (1.00 + 4.00) \times 0.20 \times 2$	=	$1.000\ "$
FOOTING TOTAL	=	$26.200\ m^2$

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	22.0	84.986	1869.7
COLUMN	28.1	80.069	2 249.9
FOOTING	41.0	59.639	2 445.2

BEARING BASE D16 200.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

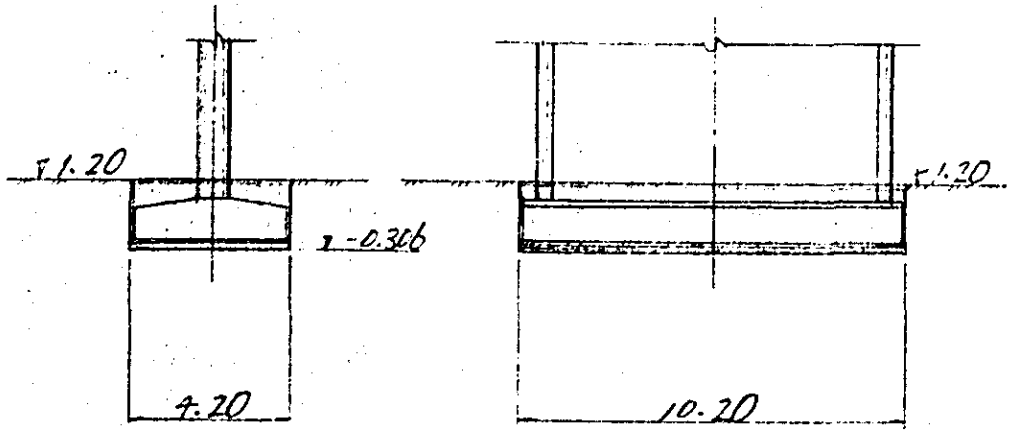
$$R = \frac{\text{REINFORCING BAR OF } P_{12}}{\text{CONCRETE VOLUME OF } P_{12}}$$

$$R_B = \frac{1869.7}{22.0} = 84.986$$

$$R_C = \frac{2538.2}{31.7} = 80.069$$

$$R_F = \frac{2445.2}{41.0} = 59.639$$

4) EXCAVATION

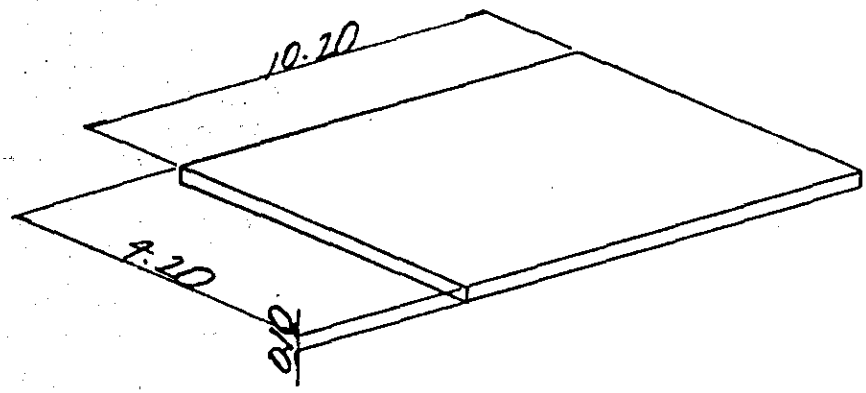


$$Va = 4.20 \times 10.20 \times (1.20 + 0.306) = 64.517 \ m^3$$

5) FOUNDATION MORTAR

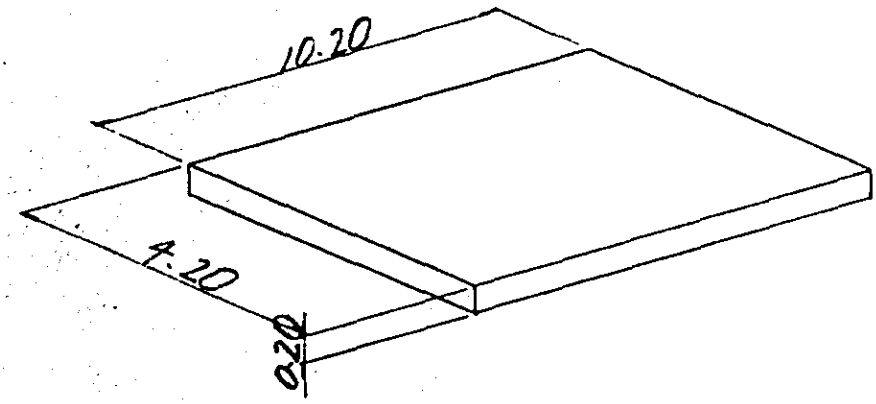
$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4 = 0.086 \ m^3$$

6) LEVELING CONCRETE



Va = 4.20 × 10.20 × 0.10 = 4.284 m^3

7) AGGREGATE SUBBASE



Va = 4.20 × 10.20 × 0.20 = 8.568 m^3

8) PILE

ϕ - 500

TYPE-B 12 m × 15

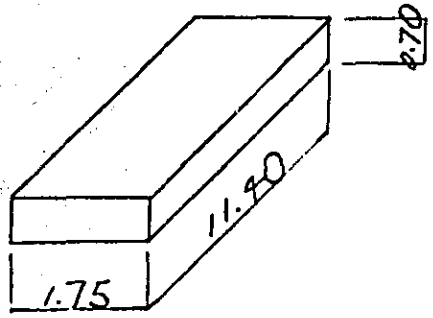
18 PIER 07

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	18.3	31.5	1696.6	92.7
COLUMN	79.0	171.5	10 882.2	137.7
TOTAL	97.3	203.0	12 578.8	129.3
FOOTING	106.2	49.2	6 784.5	63.9

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^3	264.8	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	7 x 35	φ500 - B

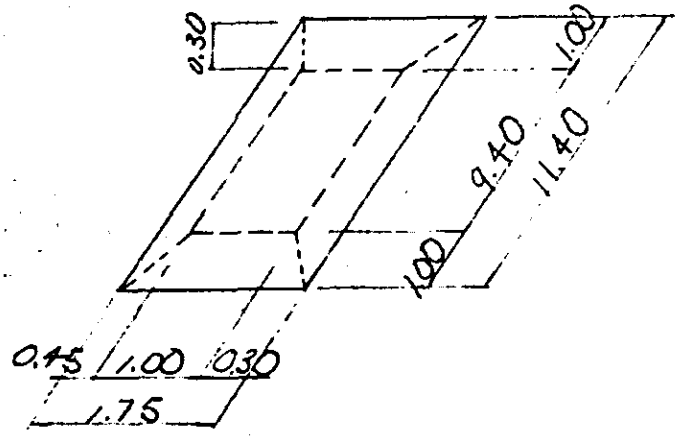
1) CONCRETE VOLUME

(1) BEAM



m^3

$V_a = 1.75 \times 0.70 \times 11.40$ ..... = 13.965

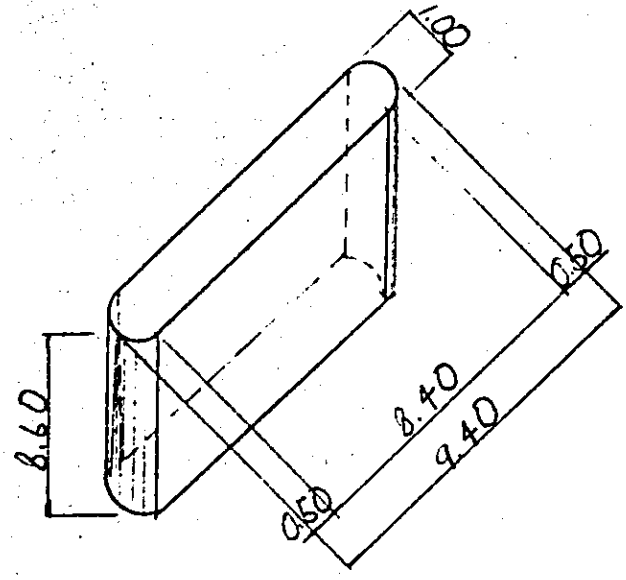


$V_b = \frac{0.30}{6} \times \{ 1.00 \times 9.40 + 1.75 \times 11.40$

$+ (1.00 + 1.75) \times (9.40 \times 11.40) \}$ .. = 4.328 "

BEAM TOTAL = 18.293 m^3

(2) COLUMN

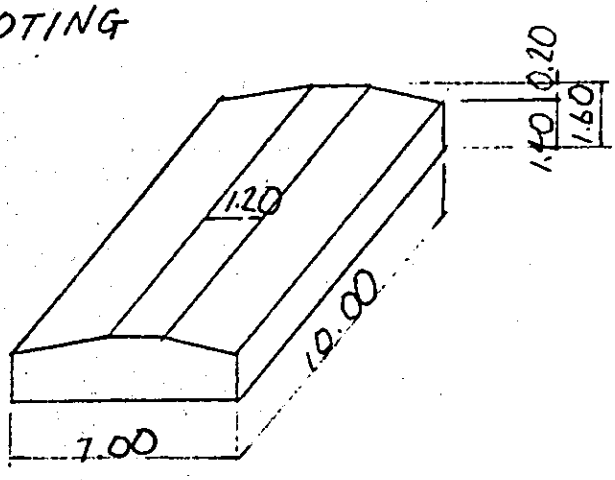


$Va = \frac{1}{4} \times \pi \times 1.00^2 \times 8.60$ = 6.754 m^3

$Vb = 1.00 \times 8.40 \times 8.60$ = 72.240 "

COLUMN TOTAL = 78.994 m^3

(3) FOOTING



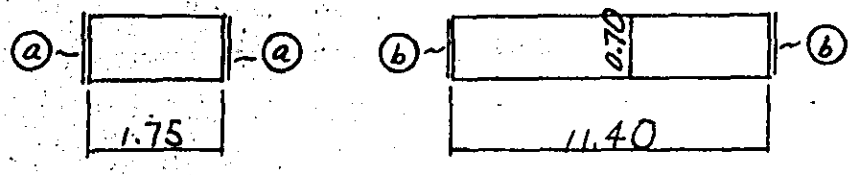
$Va = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$Vb = 7.00 \times 1.40 \times 10.00$ = 98.000 "

FOOTING TOTAL = 106.200 m^3

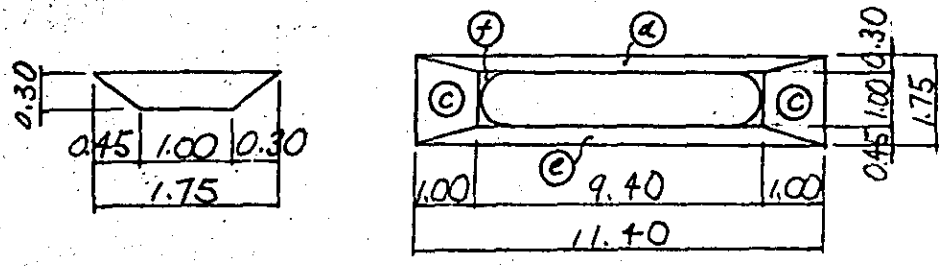
2) FORM AREA

1) BEAM



Aa = 0.70 × 11.40 × 2 = 15.960 m^2

Ab = 0.70 × 1.75 × 2 = 2.450 "



Ac = ½ × (1.00 + 1.75) × $\sqrt{1.00^2 + 0.30^2}$ × 2 = 2.871 m^2

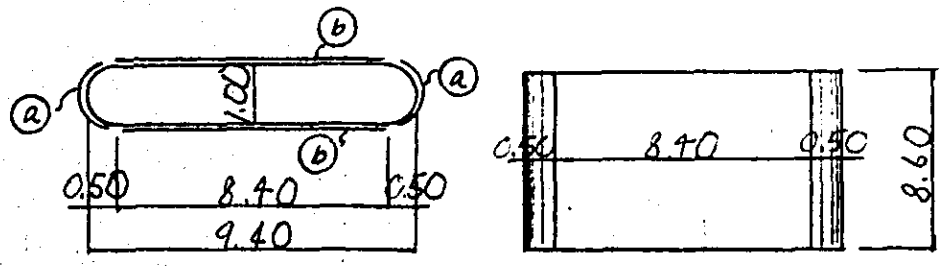
Ad = ½ × (9.40 + 11.40) × $\sqrt{0.30^2 + 0.30^2}$ = 4.410 "

Ae = ½ × (9.40 + 11.40) × $\sqrt{0.45^2 + 0.30^2}$ = 5.626 "

Af = $(1 - \pi/4) \times 1.00^2$ = 0.215 "

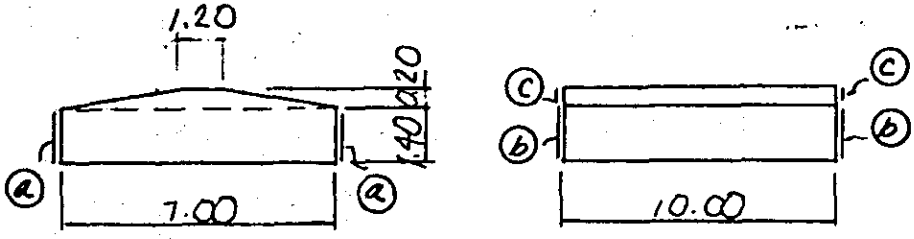
BEAM TOTAL = 31.532 m^2

(2) COLUMN



$A_a = \pi \times 1.00 \times 8.60$	=	27.018 m^2
$A_b = 8.40 \times 8.60 \times 2$	=	144.480 "
COLUMN TOTAL	=	171.498 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$	=	28.000 m^2
$A_b = 1.40 \times 7.00 \times 2$	=	19.600 "
$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	1.640 "
FOOTING TOTAL	=	49.240 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	18.3	72.601	1328.6
COLUMN	79.0	137.749	10882.2
FOOTING	106.2	63.884	6784.5

BEARING BASE DIG 368.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

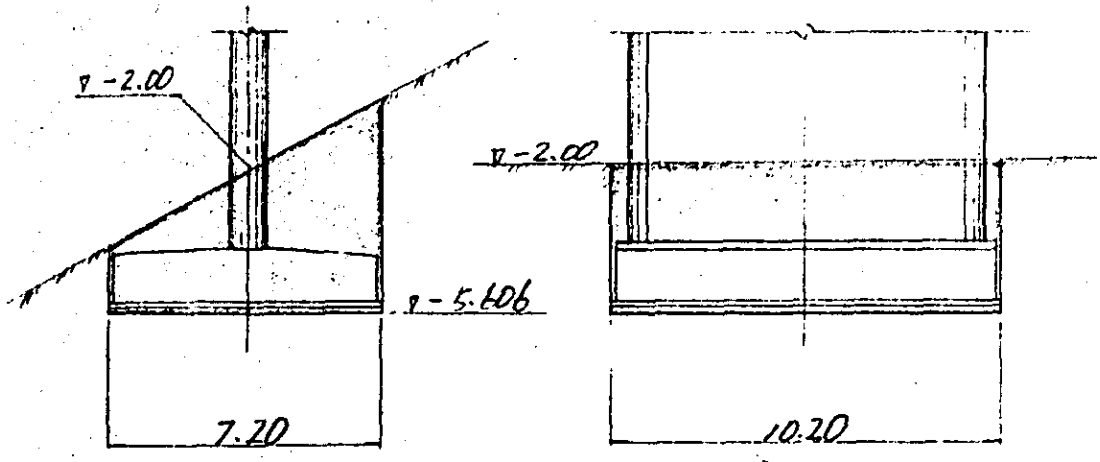
$$R = \frac{\text{REINFORCING BAR OF P06}}{\text{CONCRETE VOLUME OF P06}}$$

$$R_B = \frac{1328.6}{18.3} = 72.601$$

$$R_C = \frac{10882.2}{79.0} = 137.749$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

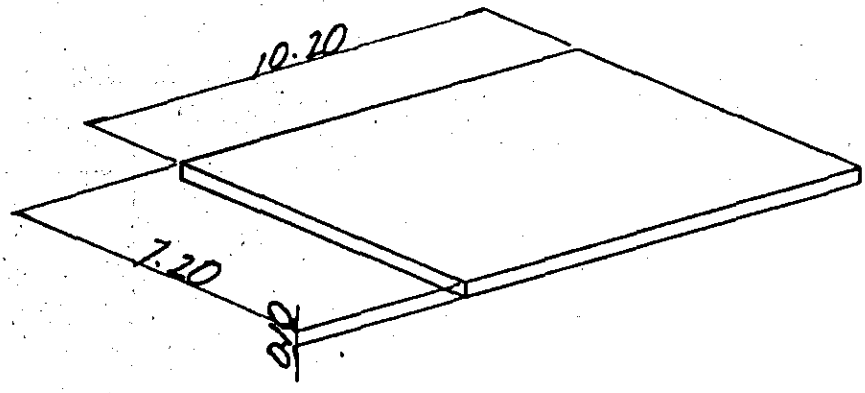


$$Va = 7.20 \times 10.20 \times (5.606 - 2.00) = 264.825\ m^3$$

5) FOUNDATION MORTAR

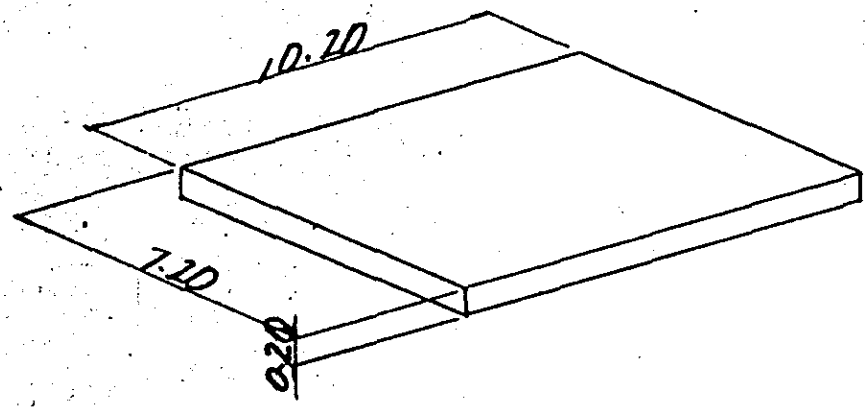
$$Va = \tfrac{1}{2} \times (0.836 \times 0.486 + 0.80 \times 0.45) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4 = 0.085\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ - 500

TYPE - B. 7 m × 35

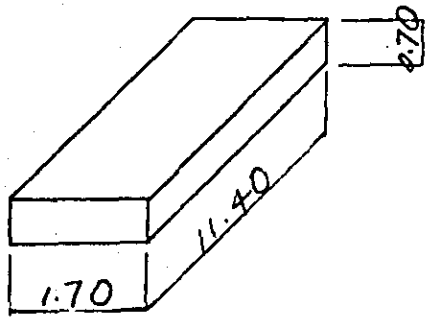
19. PIER 08

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	17.8	31.0	1596.0	89.7
COLUMN	43.2	93.7	4369.9	101.2
TOTAL	61.0	124.7	5965.9	97.8
FOOTING	106.2	49.2	6784.5	63.9

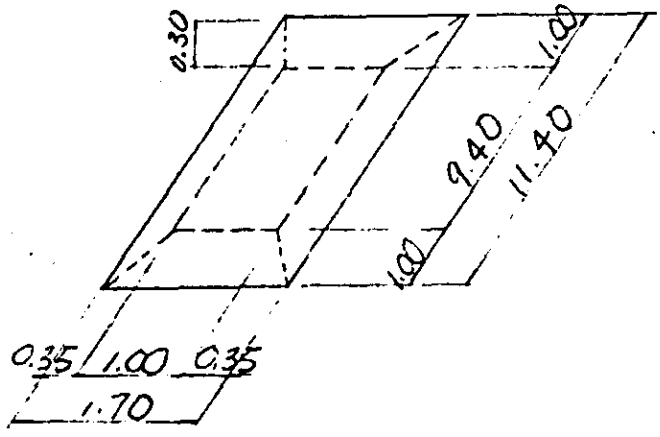
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^2	176.7	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 [illegible]
PILE	m x NUMBER	11 x 35	ϕ500-B

1) CONCRETE VOLUME

11) BEAM



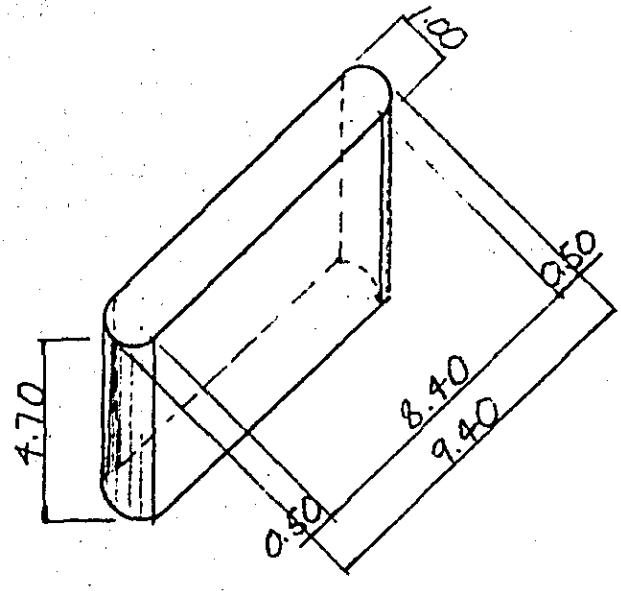
$V_a = 1.70 \times 0.70 \times 11.40$ = 13.566 m³



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.70 \times 11.40 + (1.00 + 1.70) \cdot (9.40 + 11.40)\}$ = 4.247 m³

BEAM TOTAL = 17.813 m³

(2) COLUMN

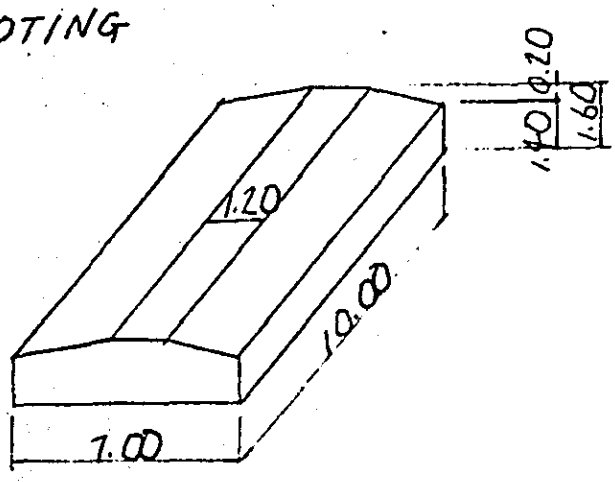


$Va = \frac{1}{2} \times \pi \times 1.00^2 \times 4.70$ ..... = 3.691 m³

$Vb = 1.00 \times 8.40 \times 4.70$ ..... = 39.480 "

COLUMN TOTAL = 43.171 m³

(3) FOOTING



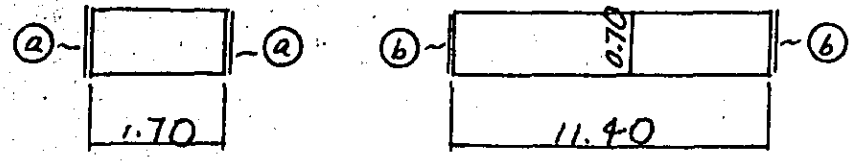
$Va = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m³

$Vb = 7.00 \times 1.40 \times 10.00$ = 98.000

FOOTING TOTAL = 106.200 m³

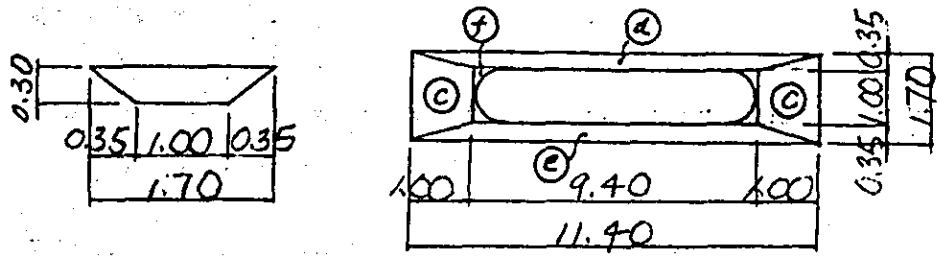
2) FORM AREA

(1) BEAM



Aa = 0.70 × 11.40 × 2 = 15.960 m²

Ab = 0.70 × 1.70 × 2 = 2.380 "



Ac = ½ × (1.00 + 1.70) × $\sqrt{1.00^2 + 0.30^2}$ × 2 = 2.819 "

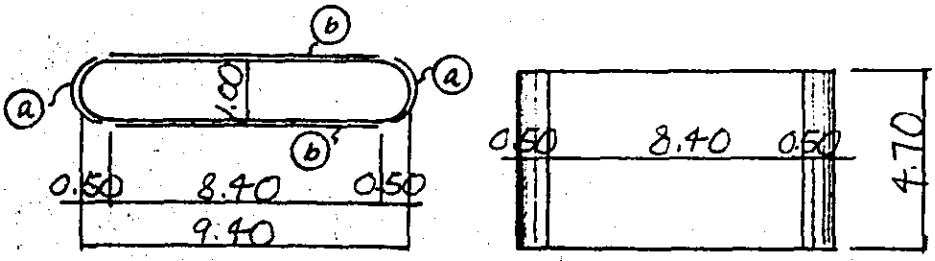
Ad = ½ × (9.40 + 11.40) × $\sqrt{0.35^2 + 0.30^2}$ = 4.794 "

Ae = " = 4.794 "

Af = (1 − π/4) × 1.00² = 0.215 "

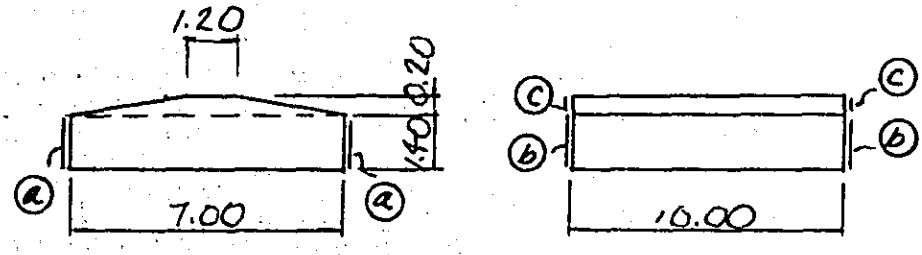
BEAM TOTAL = 30.962 m²

(2) COLUMN



$Aa = \pi \times 1.00 \times 4.70$	=	$14.765\ m^2$
$Ab = 8.40 \times 4.70 \times 2$	=	$78.960\ m^2$
COLUMN TOTAL	=	$93.725\ m^2$

(3) FOOTING



$Aa = 1.40 \times 10.00 \times 2$	=	$28.000\ m^2$
$Ab = 1.40 \times 7.00 \times 2$	=	$19.600\ m^2$
$Ac = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	$1.640\ m^2$
FOOTING TOTAL	=	$49.240\ m^2$

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	17.8	75.642	1346.4
COLUMN	43.2	101.154	4369.9
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 279.6 kg

V --- CONCRETE VOLUME

W --- REINFORCING BAR

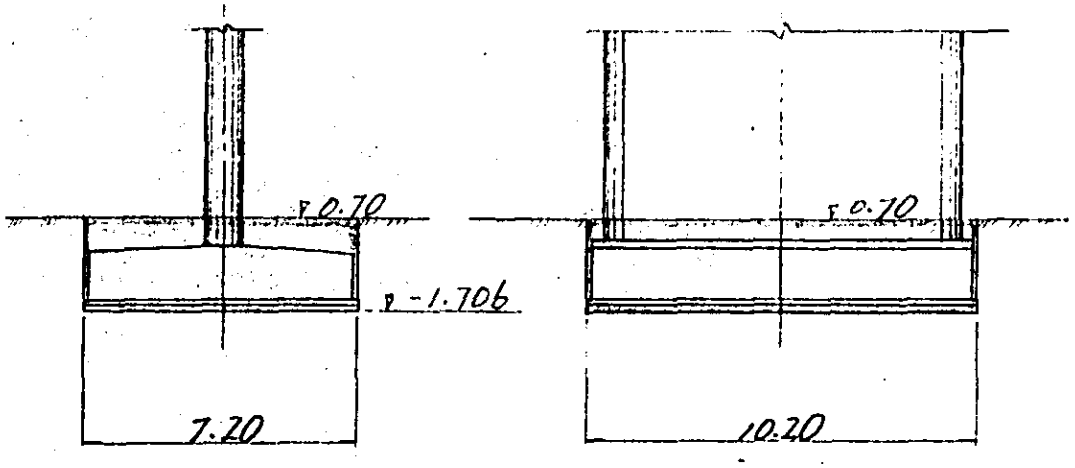
$R = \frac{\text{REINFORCING BAR OF } P_{27}}{\text{CONCRETE VOLUME OF } P_{27}}$

$R_B = \frac{1202.7}{15.9} = 75.642$

$R_C = \frac{5199.3}{51.4} = 101.154$

$R_F = \frac{6784.5}{106.2} = 63.884$

4) EXCAVATION

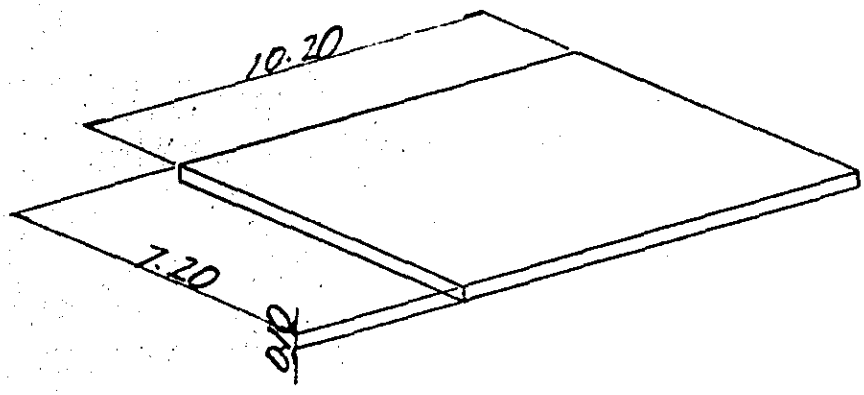


$$Va = 7.20 \times 10.20 \times (0.70 + 1.706) = 176.697 \ m^3$$

5) FOUNDATION MORTAR

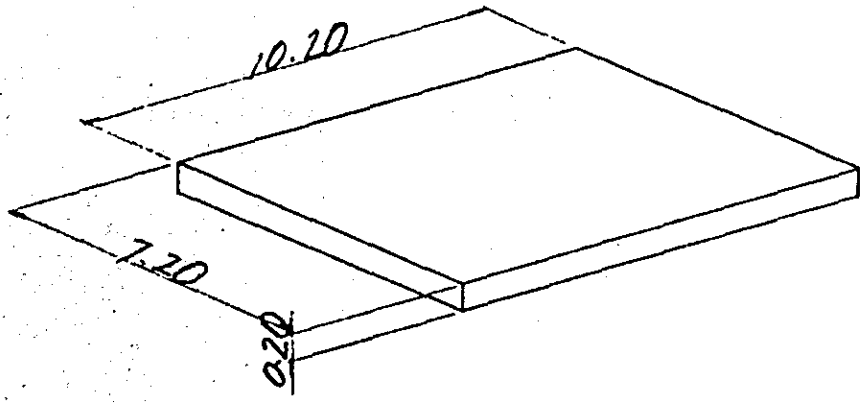
$$Va = \frac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 8 = 0.059 \ m^3$$

6) LEVELING CONCRETE



$Va = 7.20 \times 10.20 \times 0.10 = 7.344\ m^3$

7) AGGREGATE SUBBASE



$Va = 7.20 \times 10.20 \times 0.20 = 14.688\ m^3$

8) PILE

$\phi = 500$

TYPE - B $11^{m} \times 35$

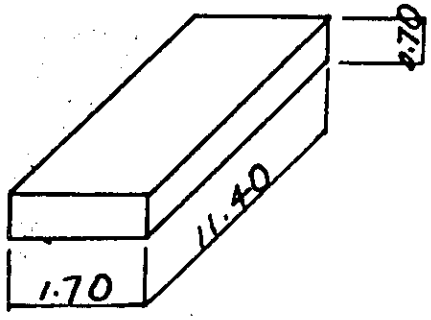
20. PIER 09

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	17.8	31.0	1696.0	89.7
COLUMN	39.5	85.7	3995.6	101.2
TOTAL	57.3	116.7	5591.6	97.6
FOOTING	106.2	49.2	6784.5	63.9

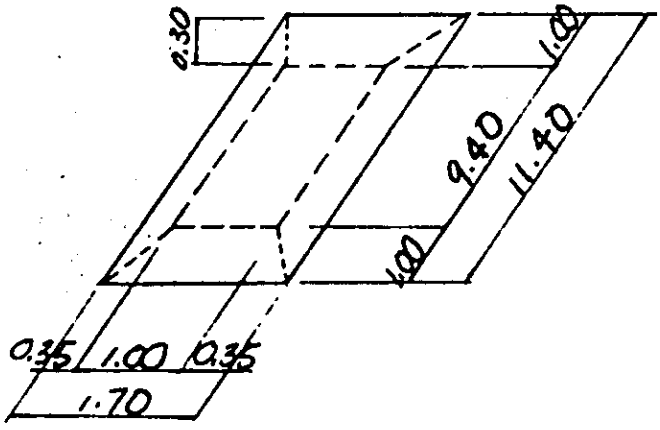
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^3	182.6	
FOUNDATION MORTAR	m^3	0.1	For = 450 [illegible]
PILE	m x NUMBER	11 x 35	φ500-B

1) CONCRETE VOLUME

11) BEAM



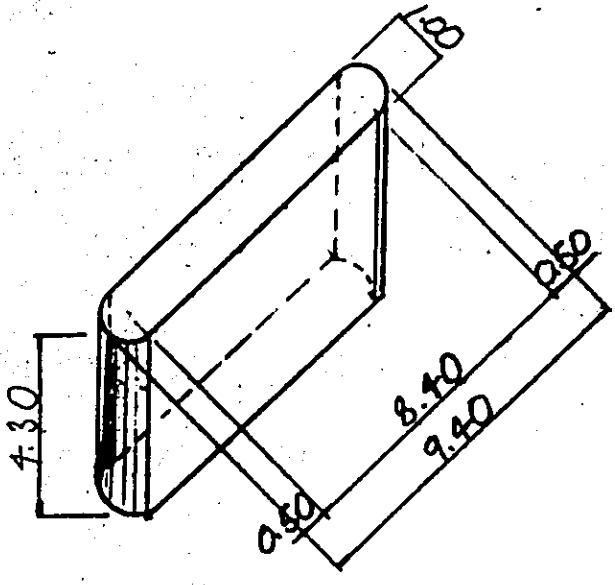
$V_a = 1.70 \times 0.70 \times 11.40$ = 13.566 m³



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.70 \times 11.40 + (1.00 + 1.70) \cdot (9.40 + 11.40)\}$ = 4.247 "

BEAM TOTAL = 17.813 m³

(2) COLUMN

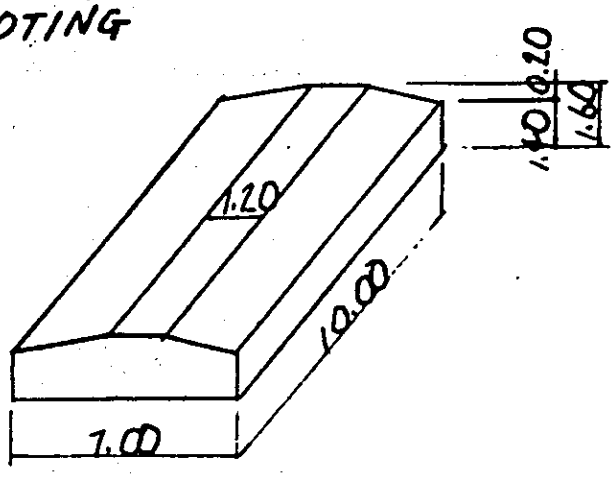


$V_a = \frac{1}{2} \times \pi \times 1.00^2 \times 4.30$ = 3.377 m^3

$V_b = 1.00 \times 8.40 \times 4.30$ = 36.120 "

COLUMN TOTAL = 39.497 m^3

(3) FOOTING



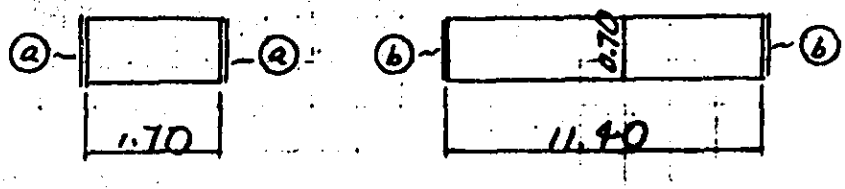
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

FOOTING TOTAL = 106.200 m^3

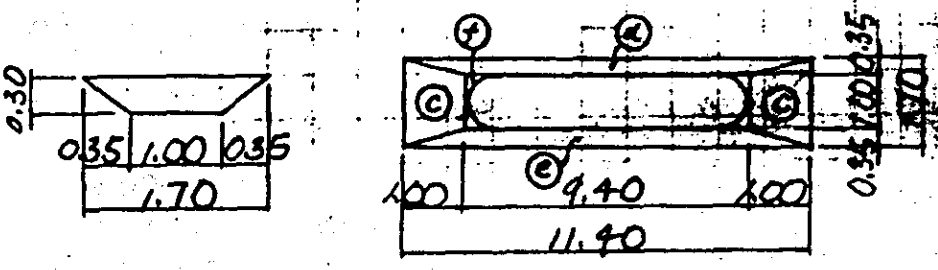
2) FORM AREA

1) BEAM



A_a = 0.70 × 11.40 × 2 = 15.960 m²

A_b = 0.70 × 1.70 × 2 = 2.380 m²



A_c = ½ × (1.00 + 1.70) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2 = 2.819 m²

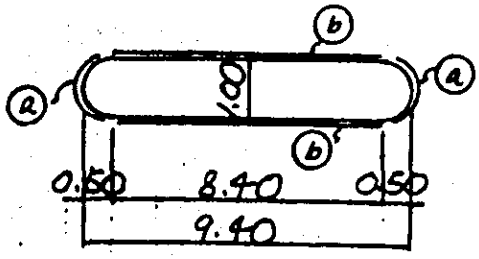
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.35^2 + 0.30^2}$ (0.461) = 4.794 m²

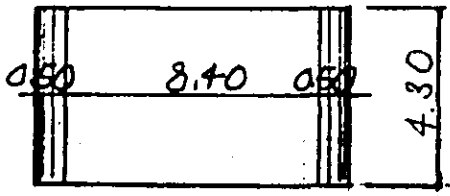
A_e = 〃 = 4.794 m²

A_f = (1 − π/4) × 1.00² = 0.215 m²

BEAM TOTAL = 30.962 m²

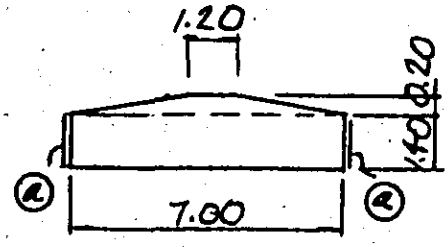
(2) COLUMN

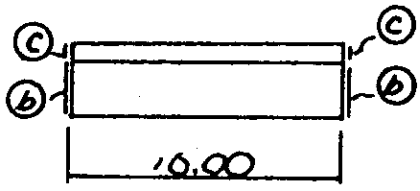




$A_a = \pi \times 1.00 \times 4.30$	=	13.509 m^2
$A_b = 8.40 \times 4.30 \times 2$	=	72.240 "
COLUMN TOTAL	=	85.749 m^2

(3) FOOTING





$A_a = 1.40 \times 10.00 \times 2$	=	28.000 m^2
$A_b = 1.40 \times 7.00 \times 2$	=	19.600 "
$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	1.640 "
FOOTING TOTAL	=	49.240 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	17.8	75.642	1346.4
COLUMN	39.5	101.154	3995.6
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 249.6 kg

V — CONCRETE VOLUME

W — REINFORCING BAR

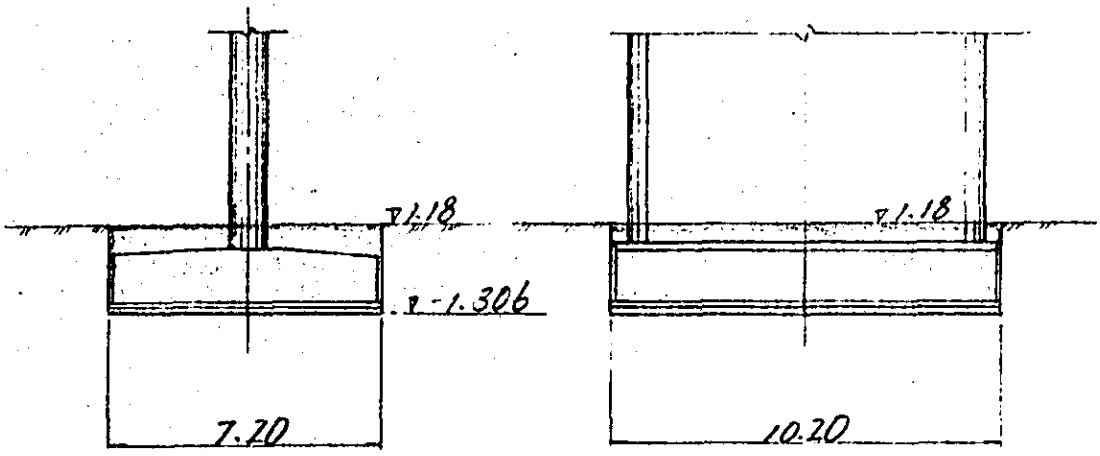
$$R = \frac{\text{REINFORCING BAR OF } F_{27}}{\text{CONCRETE VOLUME OF } P_{27}}$$

$$R_B = \frac{1202.7}{16.9} = 75.642$$

$$R_C = \frac{5199.3}{51.4} = 101.154$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

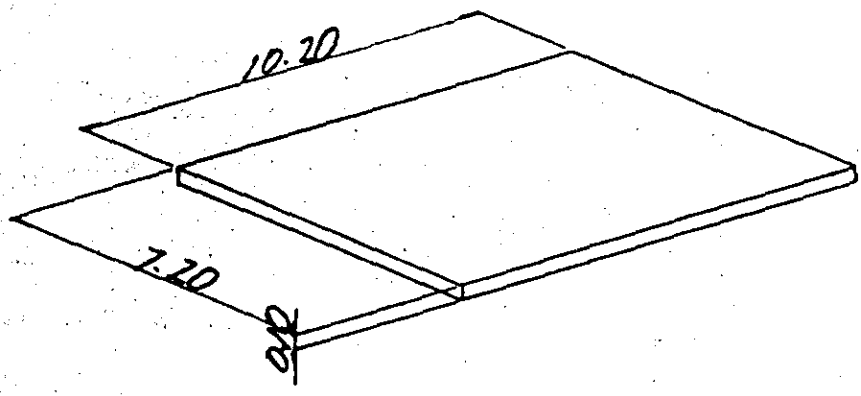


$$Va = 7.20 \times 10.20 \times (1.18 + 1.306) = 182.572 \ m^3$$

5) FOUNDATION MORTAR

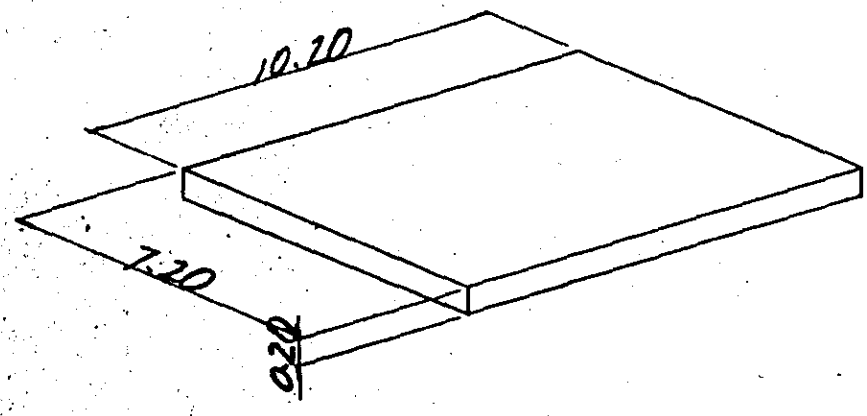
$$Va = \frac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 8 = 0.059 \ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ - 500

TYPE - B. 11 m × 35

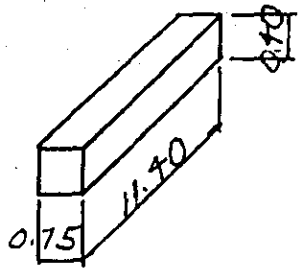
21. PIER 10

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	20.3	39.7	1897.1	93.5
COLUMN	39.5	85.7	3995.6	101.2
TOTAL	59.8	125.4	5892.7	98.5
FOOTING	106.2	49.2	6784.5	63.9

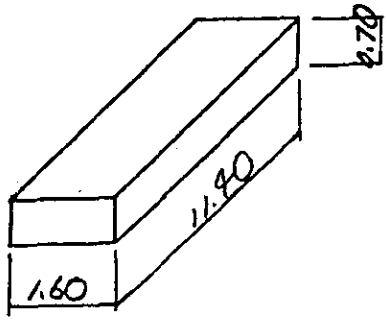
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS E
AGGREGATE SUBBASE	m^3	14.7	A.S.B - 3
EXCAVATION	m^3	204.6	
FOUNDATION MORTAR	m^3	0.1	[illegible]
PILE	m x NUMBER	11 x 35	φ500 - B

1) CONCRETE VOLUME

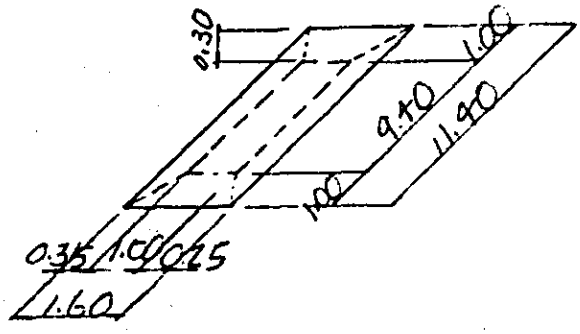
(1) BEAM



$Va = 0.75 \times 0.40 \times 11.40$ = 3.420 m³



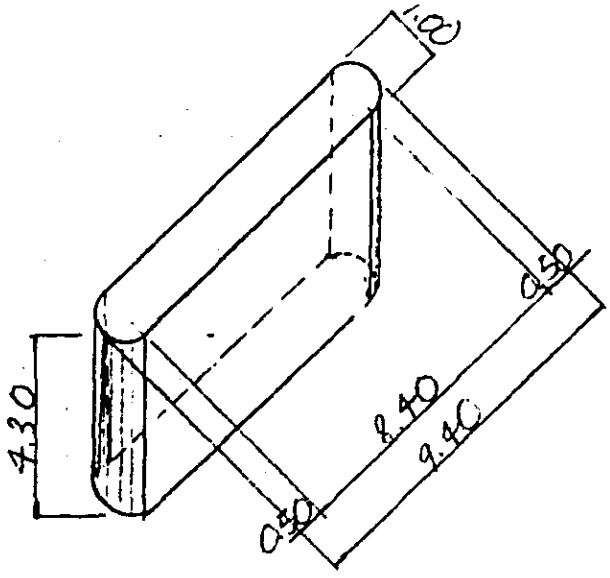
$Vb = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$Vc = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.60 \times 11.40 + (1.00 + 1.60) \cdot (9.40 + 11.40)\}$ = 4.084 "

BEAM TOTAL = 20.274 m³

(2) COLUMN

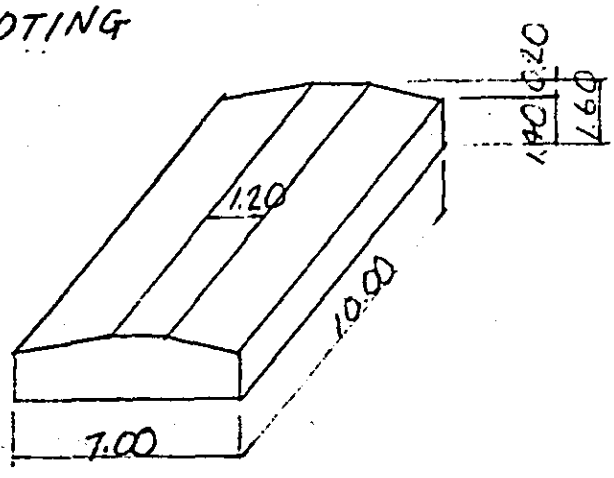


$Va = \frac{1}{4} \times \pi \times 1.00^2 \times 4.30$ = 3.377 m^3

$Vb = 1.00 \times 8.40 \times 4.30$ = 36.120 "

COLUMN TOTAL = 39.497 m^3

(3) FOOTING



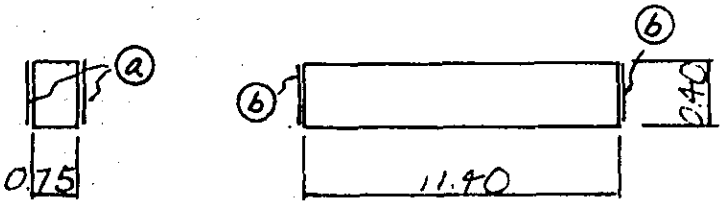
$Va = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$Vb = 7.00 \times 1.40 \times 10.00$ = 98.000 "

FOOTING TOTAL = 106.200 m^3

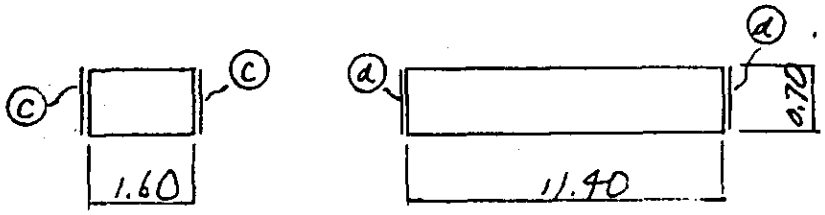
2) FORM AREA

(1) BEAM



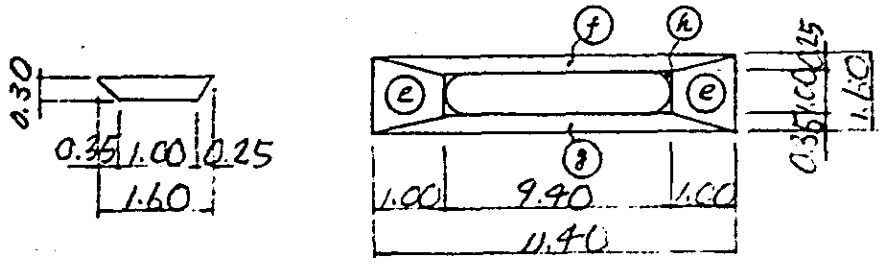
$Ae = 0.40 \times 11.40 \times 2$ = 9.120 m^2

$Ab = 0.40 \times 0.75 \times 2$ = 0.600 "



$Ac = 0.70 \times 11.40 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.60 \times 2$ = 2.240 "



$Ae = \frac{1}{2} \times (1.00 + 1.60) \times \sqrt{1.60^2 + 0.30^2} \times 2$ = 2.714 "

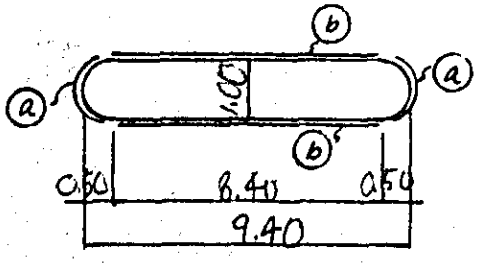
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ = 4.066 "

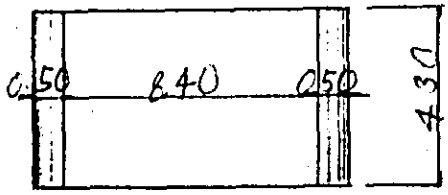
$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.35^2 + 0.30^2}$ = 4.714 "

$Ah = (1 - \pi/4) \times 1.00^2$ = 0.215 "

BEAM TOTAL = 39.709 m^2

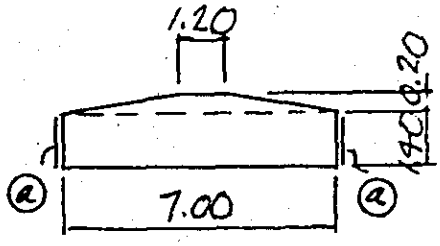
(2) COLUMN

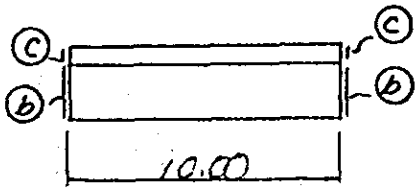




$A_a = \pi \times 1.00 \times 4.30$	=	13.509 m^2
$A_b = 8.40 \times 4.30 \times 2$	=	72.240 "
COLUMN TOTAL	=	85.749 m^2

(3) FOOTING





$A_a = 1.40 \times 10.00 \times 2$	=	28.000 m^2
$A_b = 1.40 \times 7.00 \times 2$	=	19.600 "
$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	1.640 "
FOOTING TOTAL	=	49.240 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	20.3	75.642	1535.5
COLUMN	39.5	101.154	3995.6
FOOTING	106.2	63.884	6784.5

BEARING BASE : D16 361.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

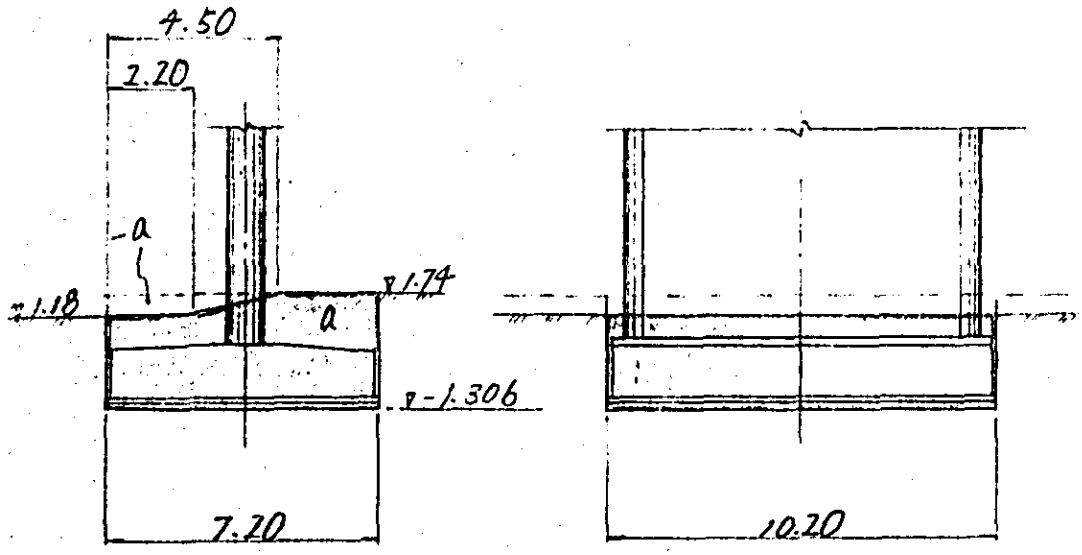
$$R = \frac{\text{REINFORCING BAR OF } P_{27}}{\text{CONCRETE VOLUME OF } P_{27}}$$

$$R_B = \frac{1202.7}{16.9} = 75.642$$

$$R_C = \frac{5199.3}{51.4} = 101.154$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION



$$Va = 7.20 \times 10.20 \times (1.74 + 1.306) = 223.698\ m^3$$

$$-Va = \tfrac{1}{2} \times (4.50 + 2.20) \times 10.20 \times (1.74 - 1.18) = -19.135\ "$$

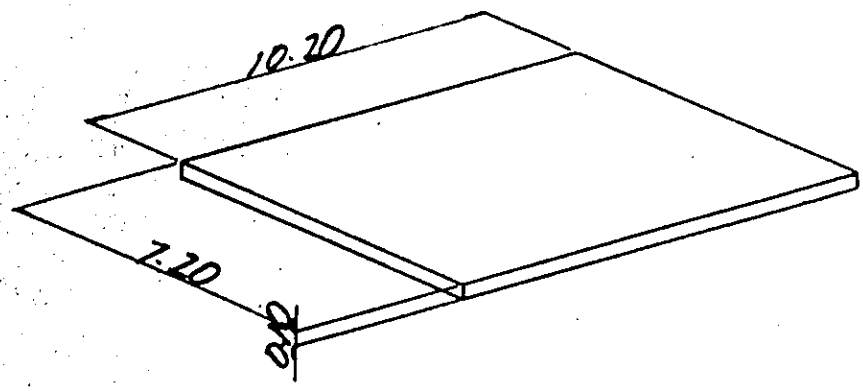
$$\text{TOTAL} = 204.563\ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4$$

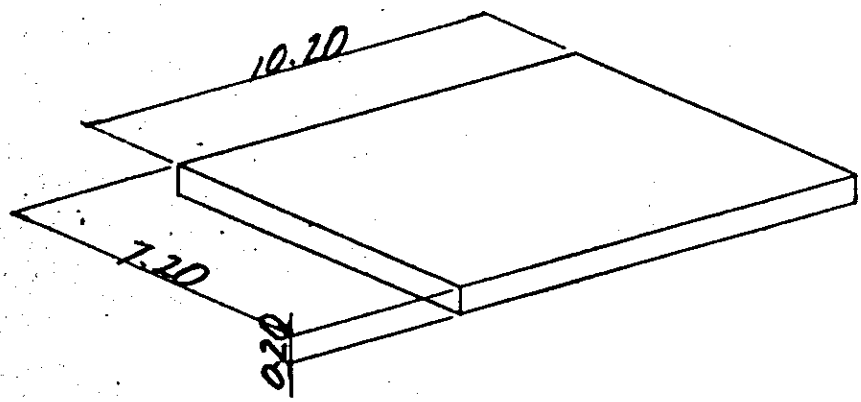
$$+ \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8 = 0.079\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ = 500

TYPE - B 11 m × 35

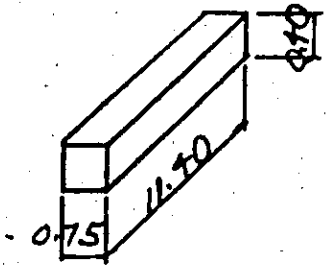
22. PIER 11

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	20.3	39.7	1897.1	93.5
COLUMN	39.5	85.7	3995.6	101.2
TOTAL	59.8	125.4	5892.7	98.5
FOOTING	106.2	49.2	6784.5	63.9

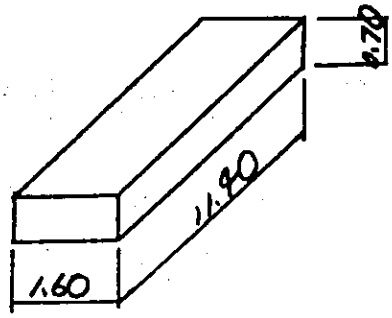
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^2	154.7	
FOUNDATION MORTAR	m^3	0.1	[illegible] = 400 [illegible]
PILE	m x NUMBER	11 x 35	φ500-B

1) CONCRETE VOLUME

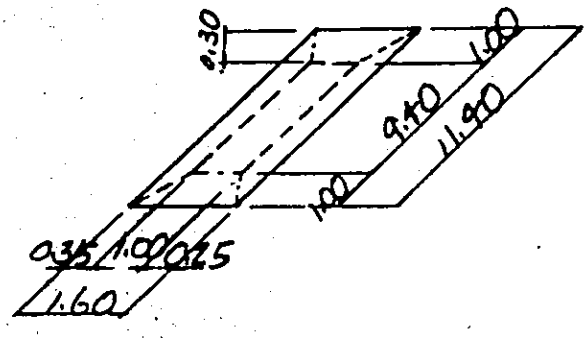
a). BEAM



$V_a = 0.75 \times 0.40 \times 11.40$ = 3.420 m³



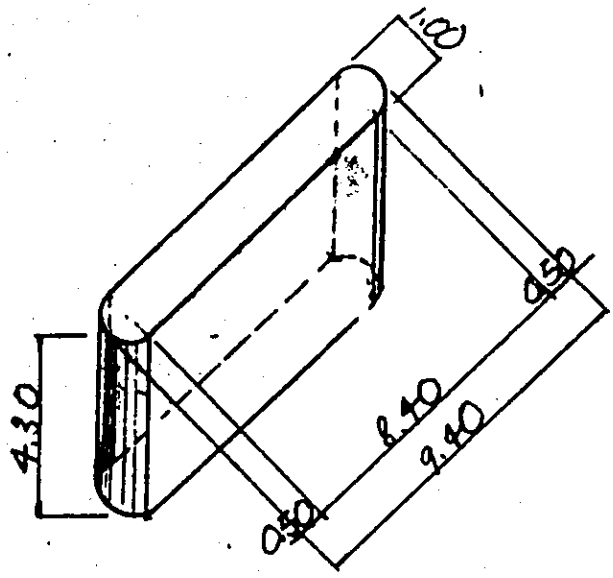
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$V_c = \frac{0.30}{6} \times \{ 1.00 \times 9.40 + 1.60 \times 11.40 + (1.00 + 1.60) \cdot (9.40 + 11.40) \}$ = 4.086 "

BEAM TOTAL = 20.274 m³

(2) COLUMN

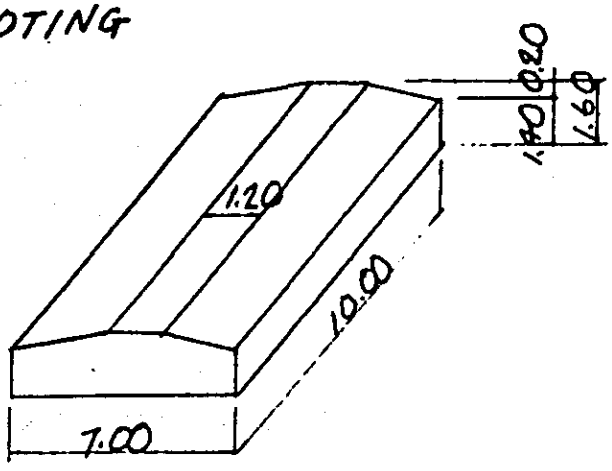


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 4.30$ = 3.377 m³

$V_b = 1.00 \times 8.40 \times 4.30$ = 36.120 "

COLUMN TOTAL = 39.497 m³

(3) FOOTING



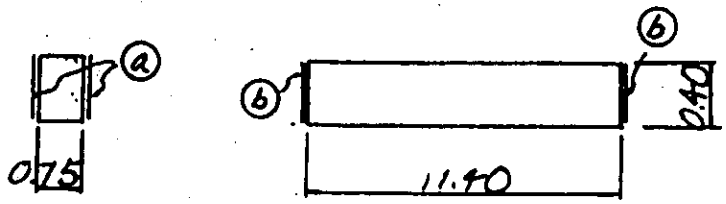
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m³

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

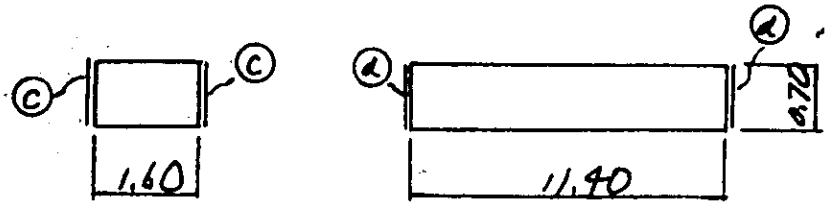
FOOTING TOTAL = 106.200 m³

2) FORM AREA

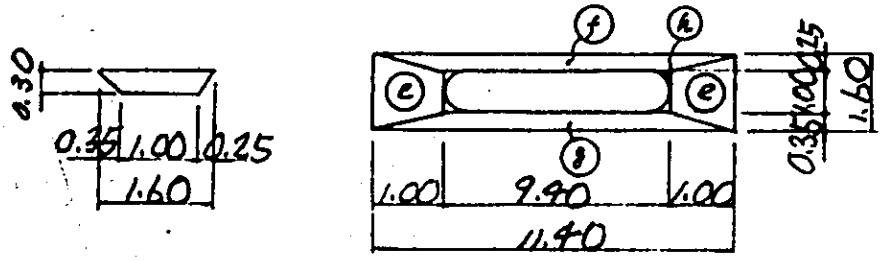
(1) BEAM



Ae = 0.40 × 11.40 × 2	=	9.120 m²
Ab = 0.40 × 0.75 × 2	=	0.600 "

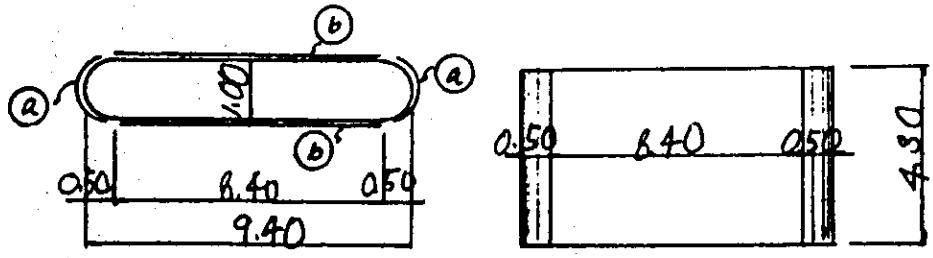


Ac = 0.70 × 11.40 × 2	=	15.960 "
Ad = 0.70 × 1.60 × 2	=	2.240 "



Ae = ½ × (1.00 + 1.60) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2	=	2.714 "
Af = ½ × (9.40 + 11.40) × $\sqrt{0.25^2 + 0.30^2}$ (0.391)	=	4.066 "
Ag = ½ × (9.40 + 11.40) × $\sqrt{0.35^2 + 0.30^2}$ (0.461)	=	4.794 "
ⓗ Ah = (1 − π/4) × 1.00²	=	0.215 "
BEAM TOTAL	=	39.109 m²

(2) COLUMN

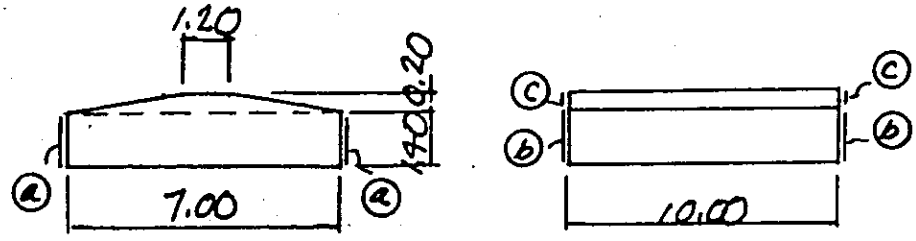


$A_a = \pi \times 1.00 \times 4.30$ = 13.509 m^2

$A_b = 8.40 \times 4.30 \times 2$ = 72.240 "

COLUMN TOTAL = 85.749 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$ = 28.000 m^2

$A_b = 1.40 \times 7.00 \times 2$ = 19.600 "

$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$ = 1.640 "

FOOTING TOTAL = 49.240 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	20.3	75.642	1535.5
COLUMN	39.5	101.154	3995.6
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 361.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

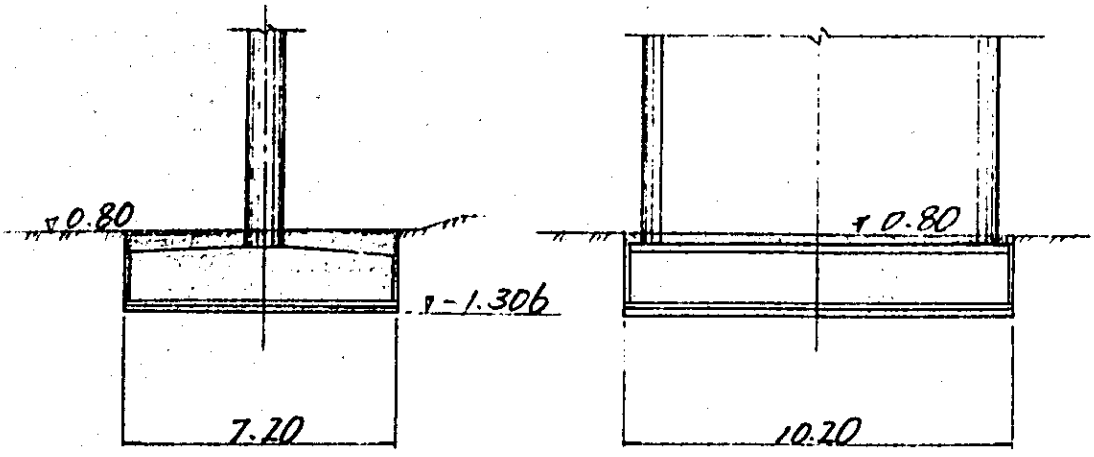
$$R = \frac{\text{REINFORCING BAR OF } P_{27}}{\text{CONCRETE VOLUME OF } P_{27}}$$

$$R_B = \frac{1202.7}{16.9} = 75.642$$

$$R_C = \frac{5199.3}{51.4} = 101.154$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

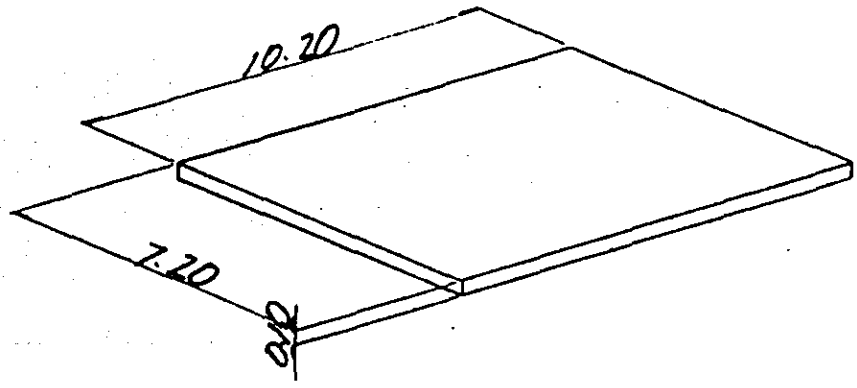


$$Va = 7.20 \times 10.20 \times (0.80 + 1.306) = 154.665\ m^3$$

5) FOUNDATION MORTAR

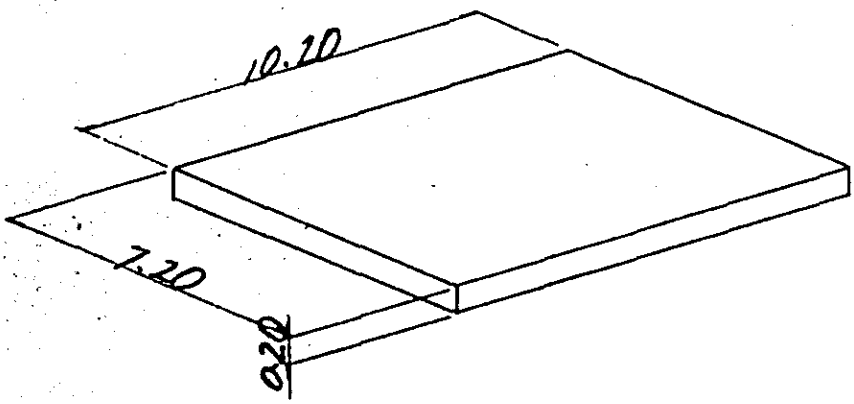
$$Va = \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.586 + 0.70 \times 0.55) \times 0.018 \times 4 = 0.079\ m^3$$

6) LEVELING CONCRETE



$Va = 7.20 \times 10.20 \times 0.10$ = $7.344\ m^3$

7) AGGREGATE SUBBASE



$Va = 7.20 \times 10.20 \times 0.20$ = $14.688\ m^3$

8) PILE

$\phi = 500$

TYPE - B $11^{m} \times 35$

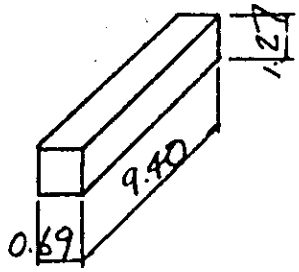
23 PIER 13

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	24.8	57.0	2409.3	97.1
COLUMN	31.0	82.8	3826.2	123.4
TOTAL	55.8	139.8	6235.5	111.7
FOOTING	67.0	35.4	4576.3	68.3

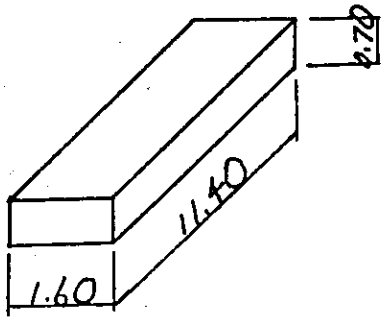
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B.-3
EXCAVATION	m^3	161.0	
FOUNDATION MORTAR	m^3	0.1	Bar = 400 [illegible]
PILE	m x NUMBER	11 x 28	φ500-B

1) CONCRETE VOLUME

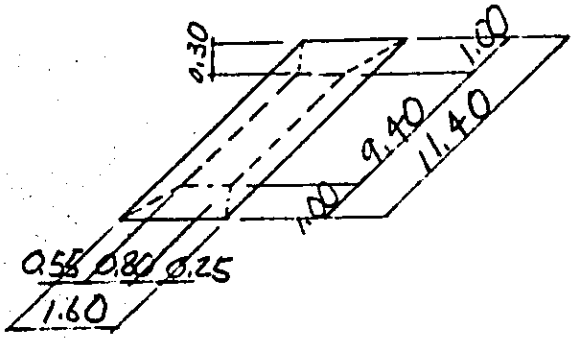
(1) BEAM



$V_a = 0.69 \times 1.27 \times 9.40$ = 8.237 m³



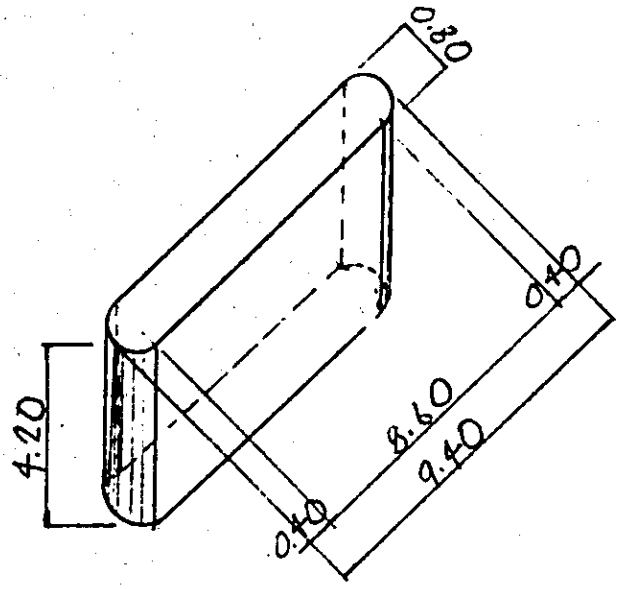
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$V_c = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40)\}$ = 3.784 "

BEAM TOTAL = 24.789 m³

(2) COLUMN

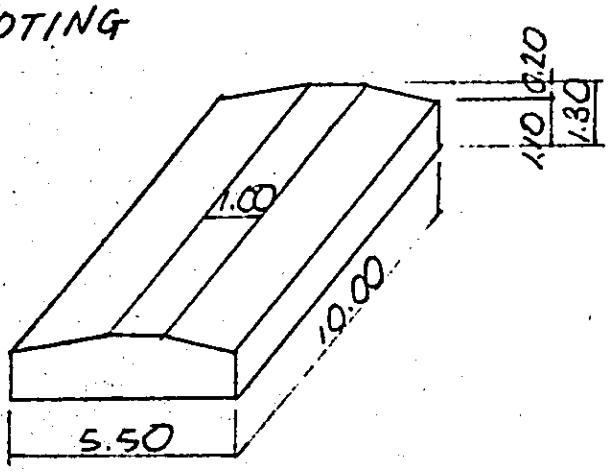


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.20$ = 2.111 m³

$V_b = 0.80 \times 8.60 \times 4.20$ = 28.896 "

COLUMN TOTAL = 31.007 m³

(3) FOOTING



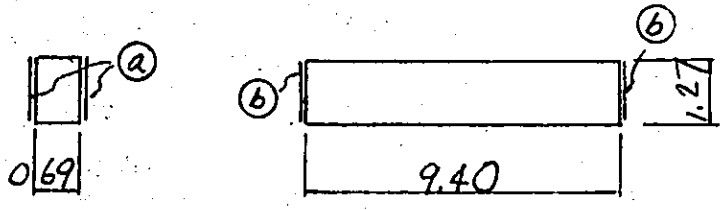
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m³

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m³

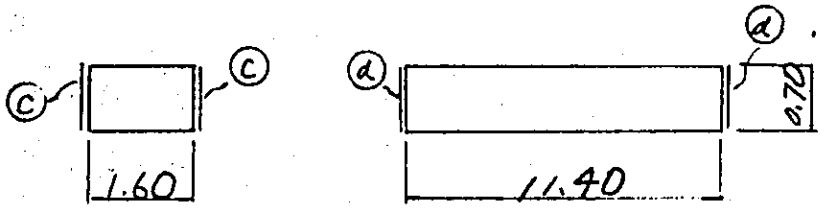
2) FORM AREA

(1) BEAM



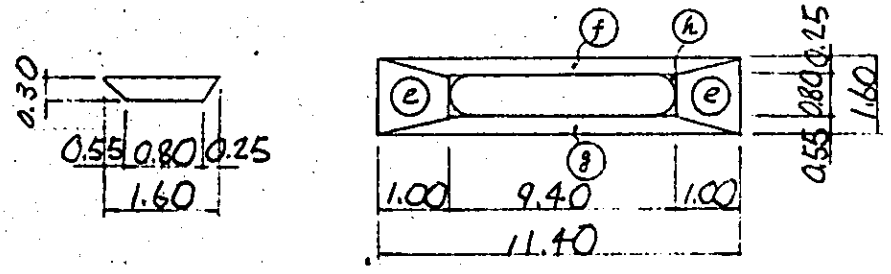
$Ae = 1.27 \times 9.40 \times 2$ = 23.876 m²

$Ab = 1.27 \times 0.69 \times 2$ = 1.753 "



$Ac = 0.70 \times 1.60 \times 2$ = 2.240 "

$Ad = 0.70 \times 11.40 \times 2$ = 15.960 "



$Ae = \frac{1}{2} \times (0.80 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.044) = 2.506 "

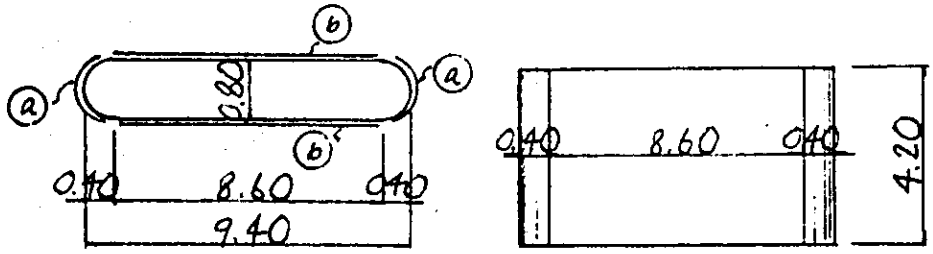
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ (0.391) = 4.066 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.55^2 + 0.30^2}$ (1.171) = 6.510 "

$Ah = (1 - \pi/4) \times 0.80^2$ = 0.137 "

BEAM TOTAL = 57.048 m²

(2) COLUMN

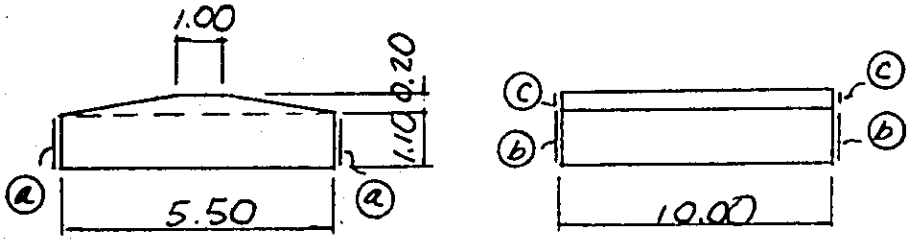


$A_a = \pi \times 0.80 \times 4.20$ = 10.556 m^2

$A_b = 8.60 \times 4.20 \times 2$ = 72.240 "

COLUMN TOTAL = 82.796 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m^2

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	24.8	84.245	2089.3
COLUMN	31.0	123.425	3826.2
FOOTING	67.0	68.303	4576.3

BEARING BASE DIG 370.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

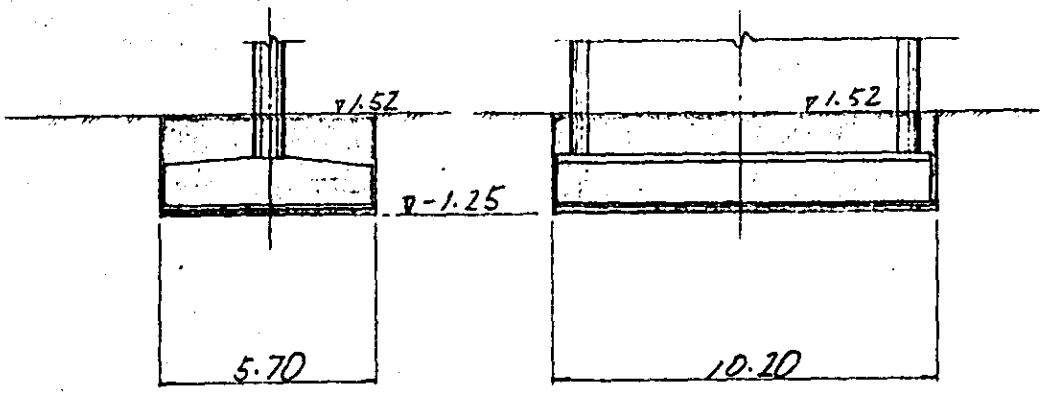
$R = \frac{\text{REINFORCING BAR OF } P_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$

$R_B = \frac{1929.2}{22.9} = 84.245$

$R_C = \frac{4825.9}{39.1} = 123.425$

$R_F = \frac{4576.3}{67.0} = 68.303$

4) EXCAVATION



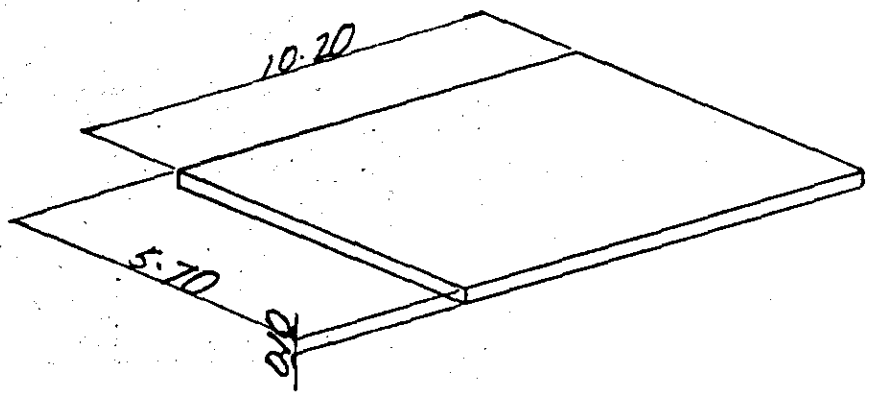
$$Va = 5.70 \times 10.20 \times (1.52 + 1.25) = 161.048 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$

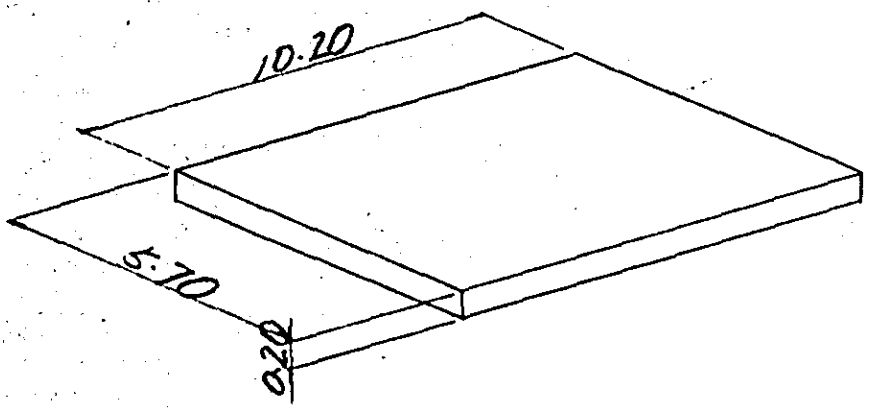
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8 = 0.111 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7.) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

ϕ - 500

TYPE - B. 11 m × 28

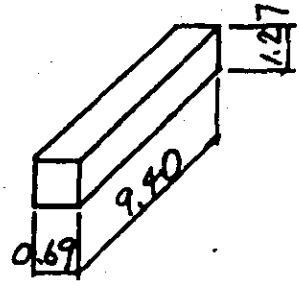
24. PIER 14

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	24.8	57.0	2409.3	97.1
COLUMN	31.0	82.8	3826.2	123.4
TOTAL	55.8	139.8	6235.5	111.7
FOOTING	67.0	35.4	4576.3	68.3

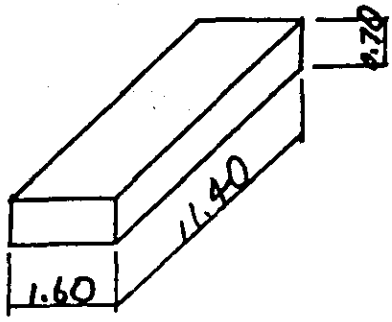
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B.-3
EXCAVATION	m^3	156.0	
FOUNDATION MORTAR	m^3	0.1	6 sk = 400 Kg/cm²
PILE	m ×NUMBER	11 × 28	φ500 - B

1) CONCRETE VOLUME

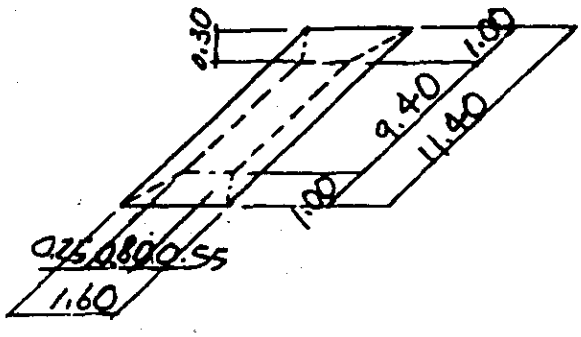
a) BEAM



$Va = 0.69 \times 1.27 \times 9.40$ ..... = 8.237 m³



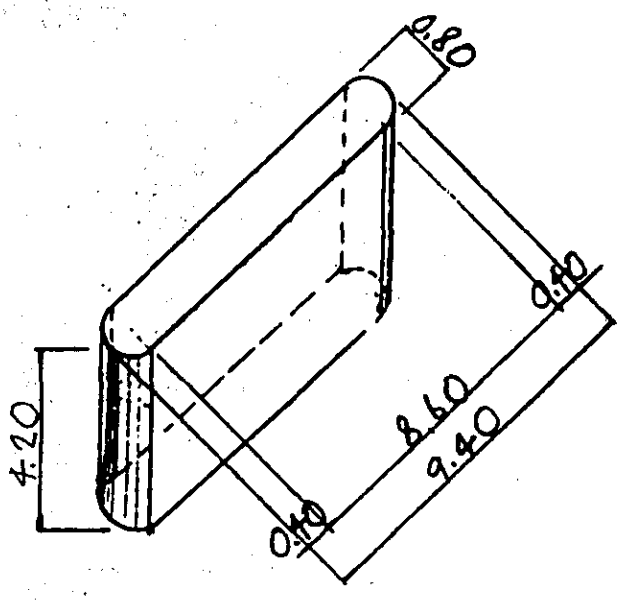
$Vb = 1.60 \times 0.70 \times 11.40$ = 12.768



$$Vc = \frac{0.30}{6} \times \{ 0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40) \} = 3.784$$

BEAM TOTAL = 24.789 m³

(2) COLUMN

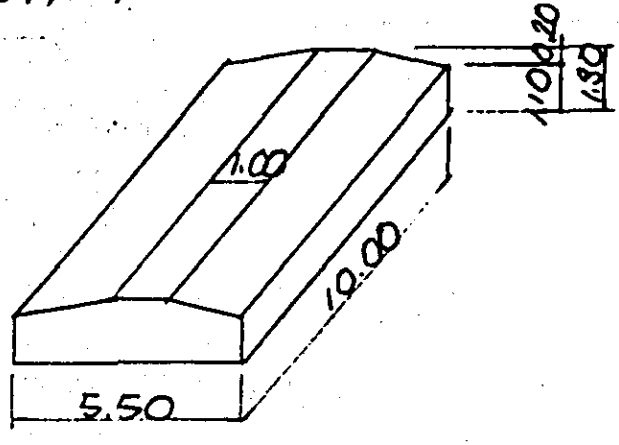


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.20$ = 2.111 m³

$V_b = 0.80 \times 8.60 \times 4.20$ = 28.896 "

COLUMN TOTAL = 31.007 m³

(3) FOOTING



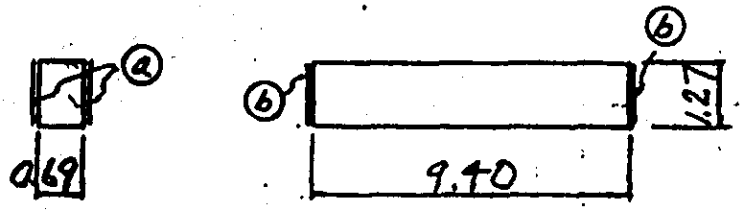
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m³

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m³

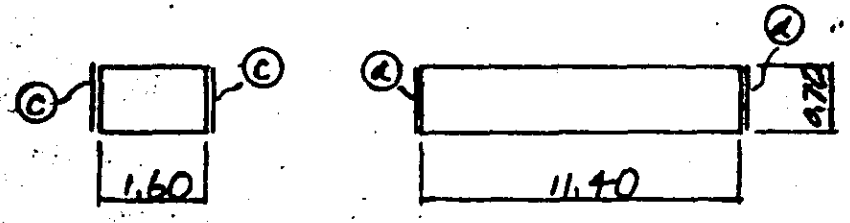
2) FORM AREA

1) BEAM



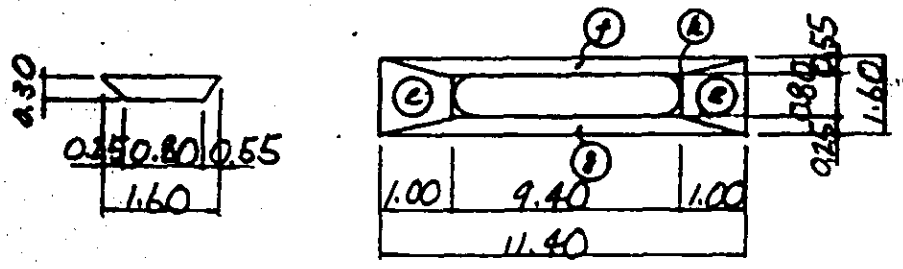
Ae = 1.27 × 9.40 × 2 = 23.876 m²

Ab = 1.27 × 0.69 × 2 = 1.753 "



Ac = 0.70 × 11.40 × 2 = 15.960 "

Ad = 0.70 × 1.60 × 2 = 2.240 "



Ae = ½ × (0.80 + 1.60) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2 = 2.506 "

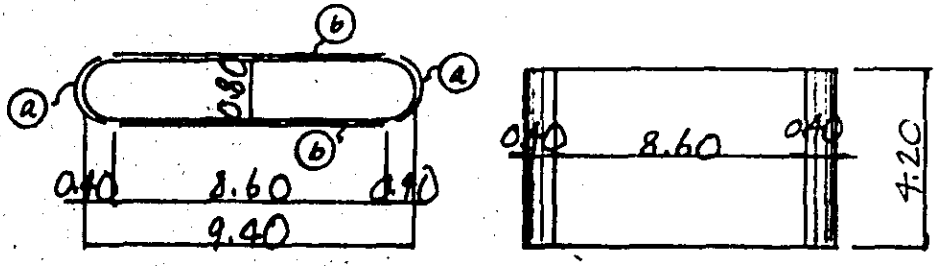
Af = ½ × (9.40 + 11.40) × $\sqrt{0.55^2 + 0.30^2}$ (c.f.h) = 6.510 "

Ag = ½ × (9.40 + 11.40) × $\sqrt{0.25^2 + 0.30^2}$ (0.391) = 4.066 "

Ah = (1 − π/4) × 0.80² = 0.137 "

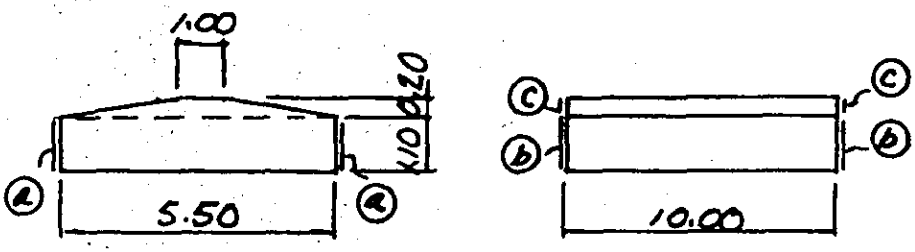
BEAM TOTAL = 57.048 m²

(2) COLUMN



$A_a = \pi \times 0.80 \times 4.20$	=	10.556 m²
$A_b = 8.60 \times 4.20 \times 2$	=	72.240 "
COLUMN TOTAL	=	82.796 m²

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$	=	22.000 m²
$A_b = 1.10 \times 5.50 \times 2$	=	12.100 "
$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$	=	1.300 "
FOOTING TOTAL	=	35.400 m²

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	24.8	84.245	2089.3
COLUMN	31.0	123.425	3826.2
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 320.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

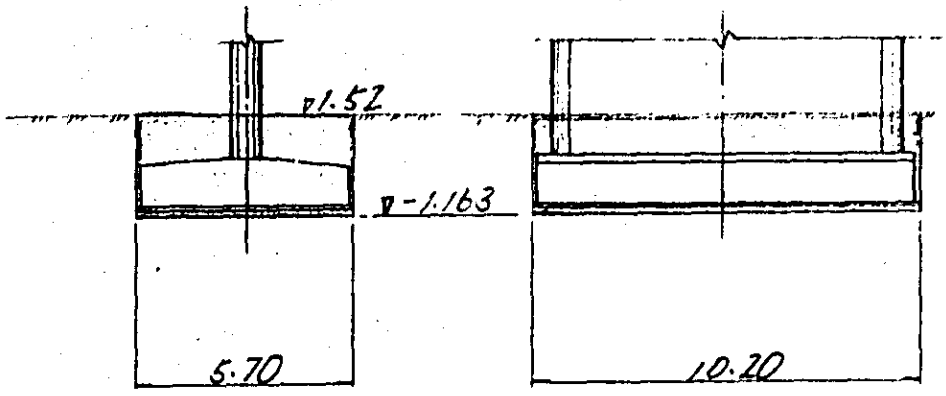
$$R = \frac{\text{REINFORCING BAR OF } F_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$$

$$R_B = \frac{1929.2}{22.9} = 84.245$$

$$R_C = \frac{4825.9}{39.1} = 123.425$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION

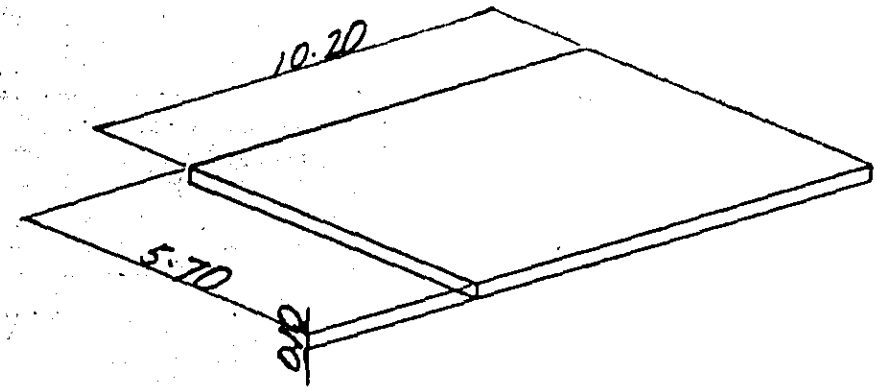


$$Va = 5.70 \times 10.20 \times (1.52 + 1.163) = 155.990 \ m^3$$

5) FOUNDATION MORTAR

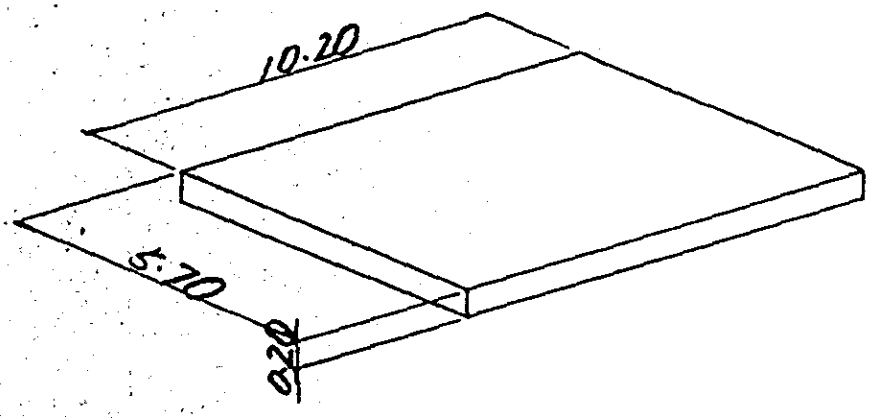
$$V_a = 1/2 \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8$$
$$+ 1/2 \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.111 \ m^3$$

6) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10 = 5.814\ m^3$

7) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20 = 11.628\ m^3$

8) PILE

$\phi = 500$

TYPE – B. $11^{m} \times 28$

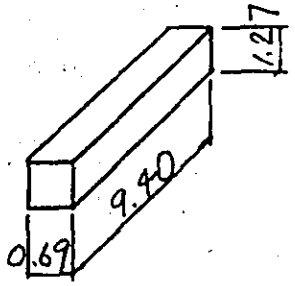
25 PIER 15

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	24.8	57.0	2 409.3	97.1
COLUMN	34.7	92.7	4 282.8	123.4
TOTAL	59.5	149.7	6 692.1	112.5
FOOTING	67.0	35.4	4 576.3	68.3

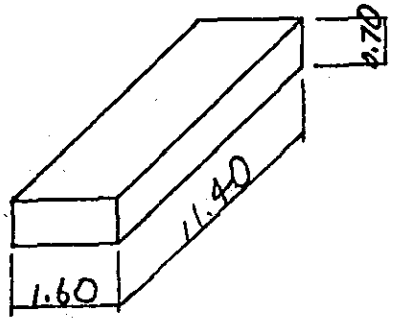
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS B
AGGREGATE SUBBASE	m^3	11.6	A.S.B.-3
EXCAVATION	m^3	159.5	
FOUNDATION MORTAR	m^3	0.1	$\bar{\sigma}_{ck}$ = 400 Kg/cm^2
PILE	m x NUMBER	11 x 28	ϕ500-B

1) CONCRETE VOLUME

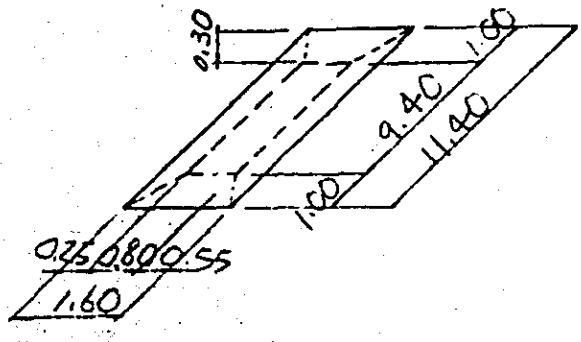
(1) BEAM



$Va = 0.69 \times 1.27 \times 9.40$ = 8.237 m³



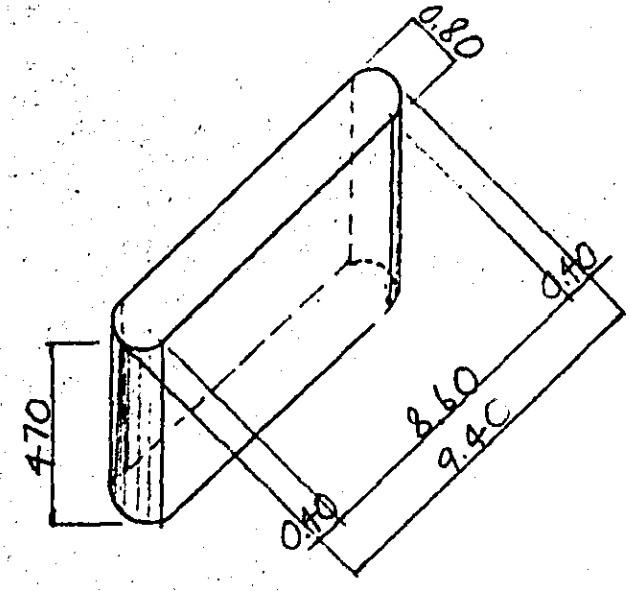
$Vb = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$$Vc = \frac{0.30}{6} \times \{ 0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40) \} = 3.784$$

BEAM TOTAL = 24.789 m³

(2) COLUMN

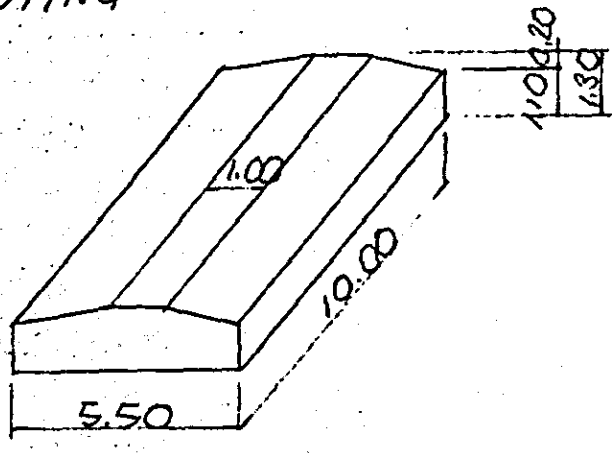


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.70$ = 2.362 m^3

$V_b = 0.80 \times 8.60 \times 4.70$ = 32.336 "

COLUMN TOTAL = 34.698 m^3

(3) FOOTING



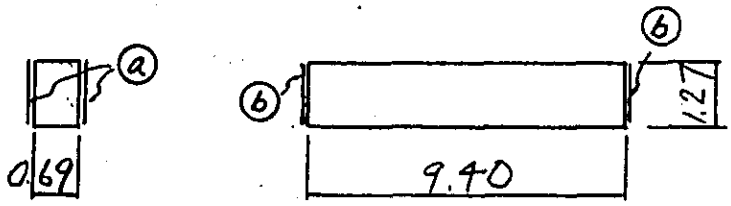
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m^3

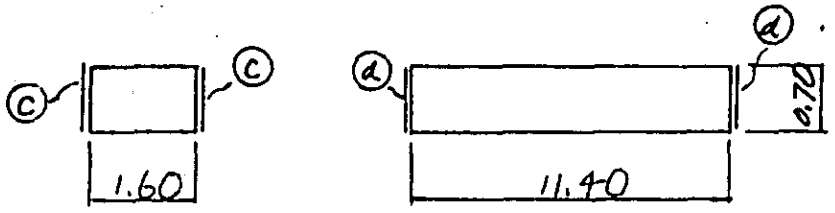
2) FORM AREA

(1) BEAM



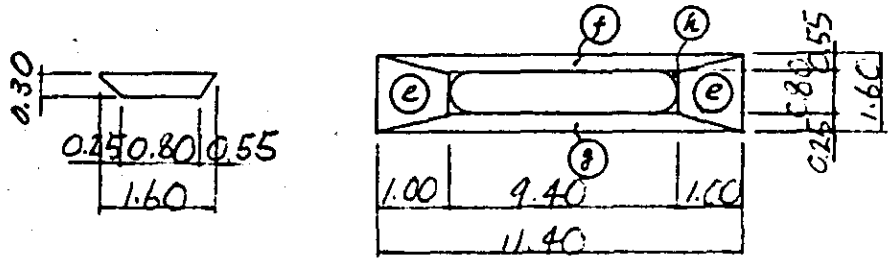
$A_a = 1.27 \times 9.40 \times 2$ = 23.876 m²

$A_b = 1.27 \times 0.69 \times 2$ = 1.753 "



$A_c = 0.70 \times 11.40 \times 2$ = 15.960 "

$A_d = 0.70 \times 1.60 \times 2$ = 2.240 "



$A_e = \frac{1}{2} \times (0.80 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.506 "

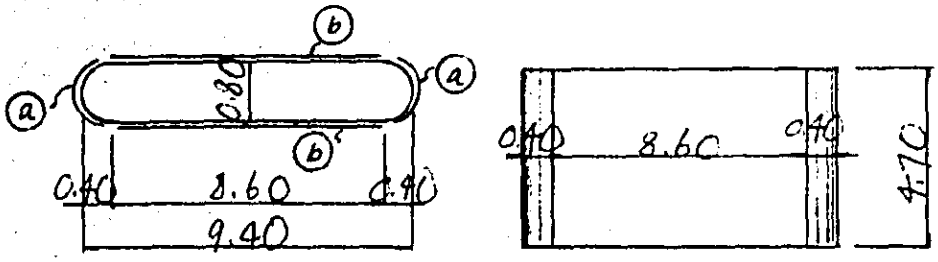
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.55^2 + 0.30^2}$ = 6.510 "

$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ = 4.066 "

$A_h = (1 - \pi/4) \times 0.80^2$ = 0.137 "

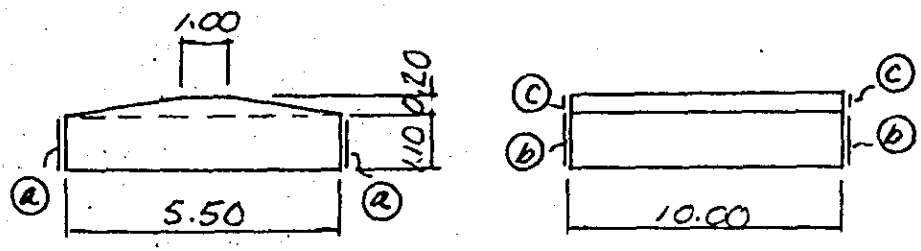
BEAM TOTAL = 57.048 m²

(2) COLUMN



$Aa = \pi \times 0.80 \times 4.70$	=	11.812 m^2
$Ab = 8.60 \times 4.70 \times 2$	=	80.840 "
COLUMN TOTAL	=	92.652 m^2

(3) FOOTING



$Aa = 1.10 \times 10.00 \times 2$	=	22.000 m^2
$Ab = 1.10 \times 5.50 \times 2$	=	12.100 "
$Ac = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$	=	1.300 "
FOOTING TOTAL	=	35.400 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	24.8	84.245	2089.3
COLUMN	34.7	123.425	4282.8
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 330.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

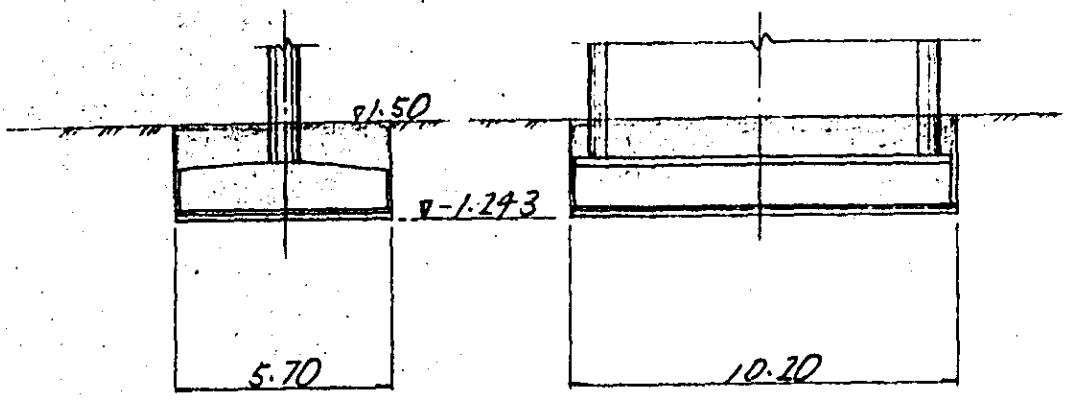
$$R = \frac{\text{REINFORCING BAR OF } F_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$$

$$R_B = \frac{1929.2}{22.9} = 84.245$$

$$R_C = \frac{4825.9}{39.1} = 123.425$$

$$R_F = \frac{4576.3}{67.0} = 68\ 303$$

4) EXCAVATION



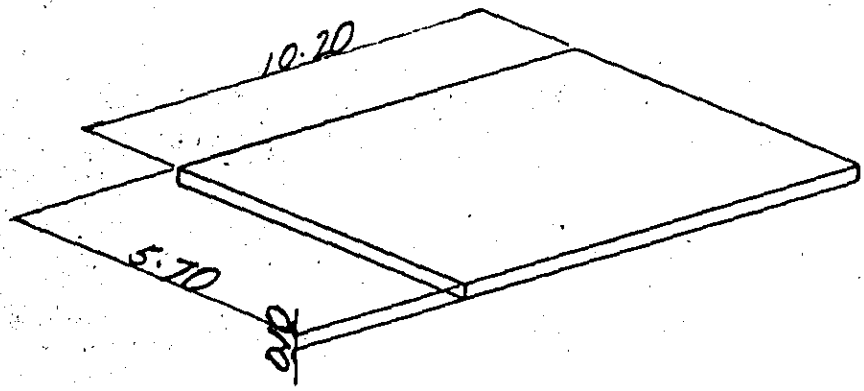
$$Va = 5.70 \times 10.20 \times (1.50 + 1.243) = 159.478 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$

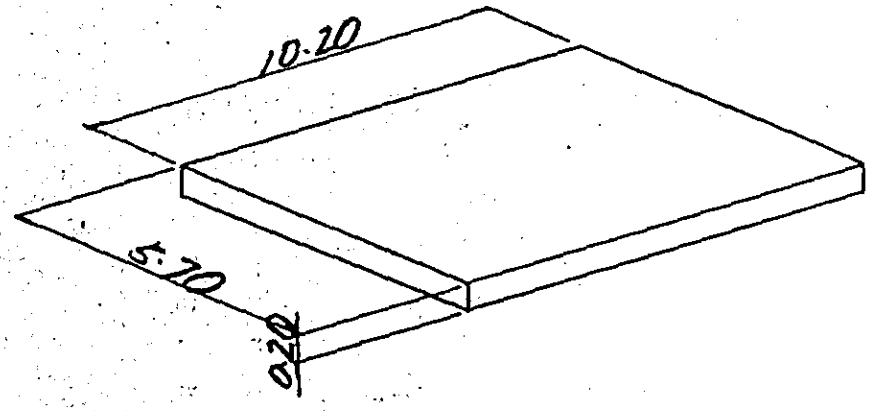
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8 = 0.111 \ m^3$$

6) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10$ = $5.814\ m^3$

7) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20$ = $11.628\ m^3$

8) PILE

$\phi = 500$

TYPE – B. $11\ m \times 28$

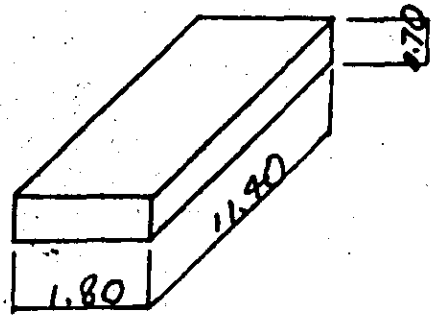
26 PIER 16

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	18.8	32.0	1834.9	97.6
COLUMN	43.2	93.7	4 879.3	112.9
TOTAL	62.0	125.7	6 714.2	108.3
FOOTING	185.5	73.6	12 128.5	65.4

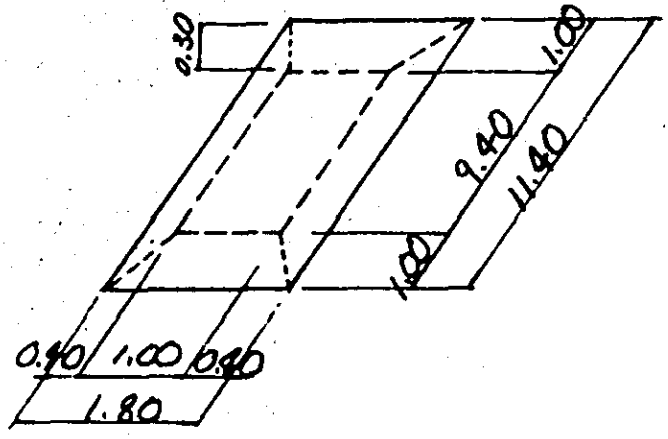
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B.-3
EXCAVATION	m^3	339.0	
FOUNDATION MORTAR	m^3	0.1	Sck = 420 kg/cm²
PILE	m x NUMBER	11 x 42	φ500-B

1) CONCRETE VOLUME

(1) BEAM



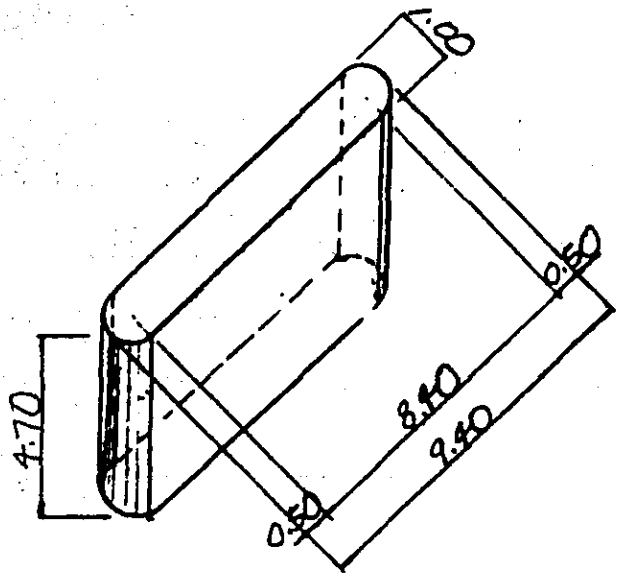
$V_a = 1.80 \times 0.70 \times 11.40$ = 14.364 m³



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m³

(2) COLUMN

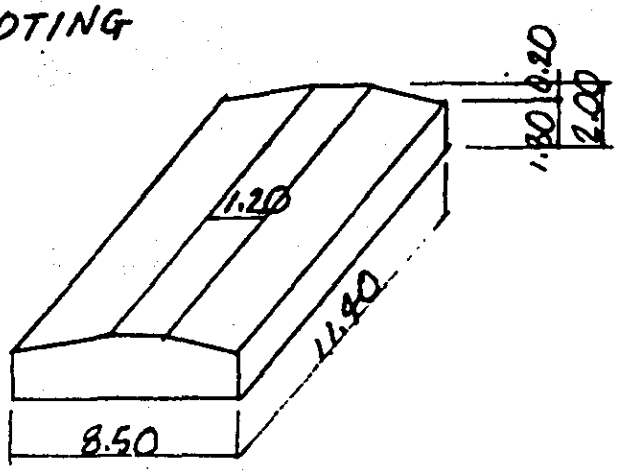


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 4.70$ = 3.691 m³

$V_b = 1.00 \times 8.40 \times 4.70$ = 39.480 "

COLUMN TOTAL = 43.171 m³

(3) FOOTING



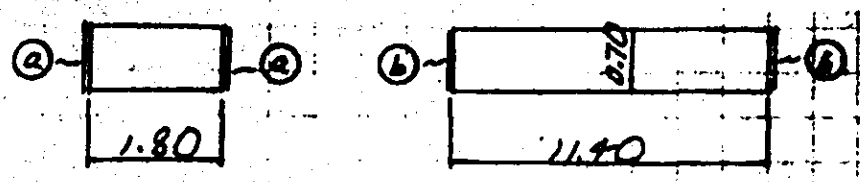
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m³

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420 "

FOOTING TOTAL = 185.478 m³

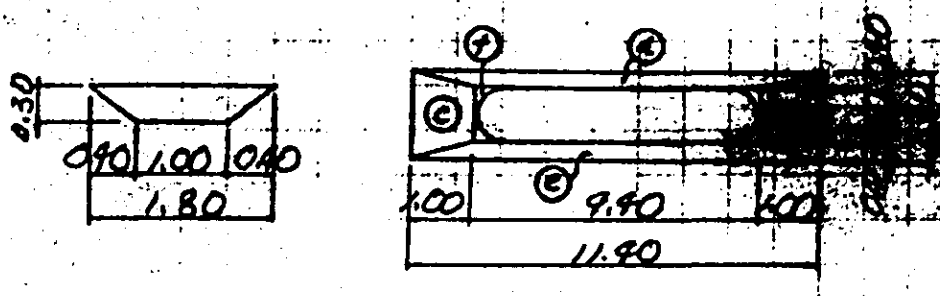
2) FORM AREA

1) BEAM



Aa = 0.70 × 11.40 × 2 = [illegible]

Ab = 0.70 × 1.80 × 2 = 2.520



Ac = ½ × (1.00 + 1.80) · √(1.00² + 0.30²) × 2 = [illegible]

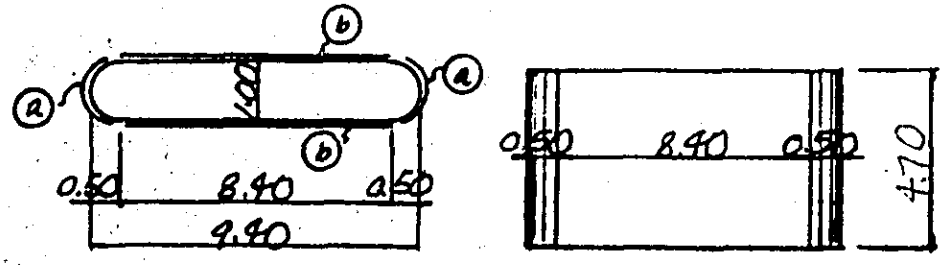
Ad = ½ × (9.40 + 11.40) · √(0.40² + 0.90²) = [illegible]

Ae = " = 6.200

Af = (1 − π/4) × 1.00² = 0.215

BEAM TOTAL = 32.018 m²

(2) COLUMN

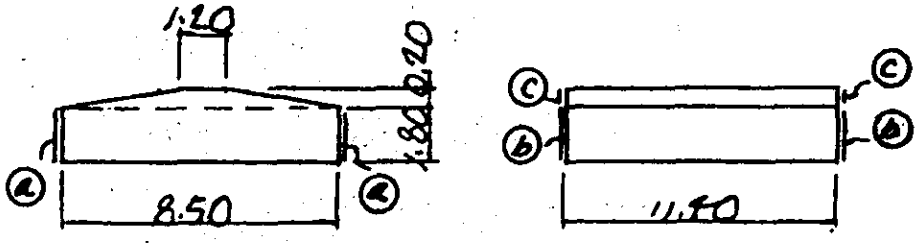


$A_a = \pi \times 1.00 \times 4.70$ = 14.765 m²

$A_b = 8.40 \times 4.70 \times 2$ = 78.960 "

COLUMN TOTAL = 93.725 m²

(3) FOOTING



$A_a = 1.80 \times 11.40 \times 2$ = 41.040 m²

$A_b = 1.80 \times 8.50 \times 2$ = 30.600 "

$A_c = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$ = 1.940 "

FOOTING TOTAL = 73.580 m²

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	18.8	71.559	1345 3
COLUMN	43.2	112.946	4 879.3
FOOTING	185.5	65.383	12 128.5

BEARING BASE D16 489.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

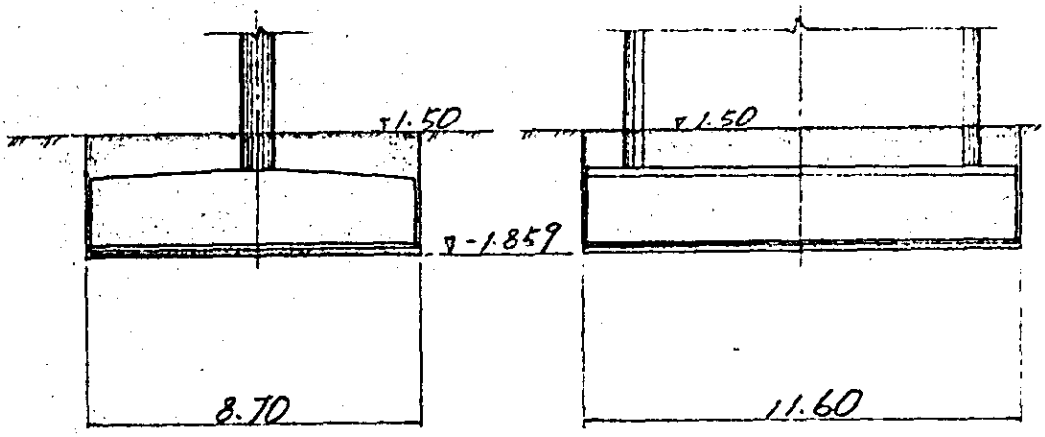
$$R = \frac{\text{REINFORCING BAR OF P 18}}{\text{CONCRETE VOLUME OF P18}}$$

$$R_B = \frac{1509.9}{21.1} = 71.559$$

$$R_C = \frac{4\,822.8}{42.7} = 112.946$$

$$R_F = \frac{12128.5}{180.5} = 65.383$$

4) EXCAVATION

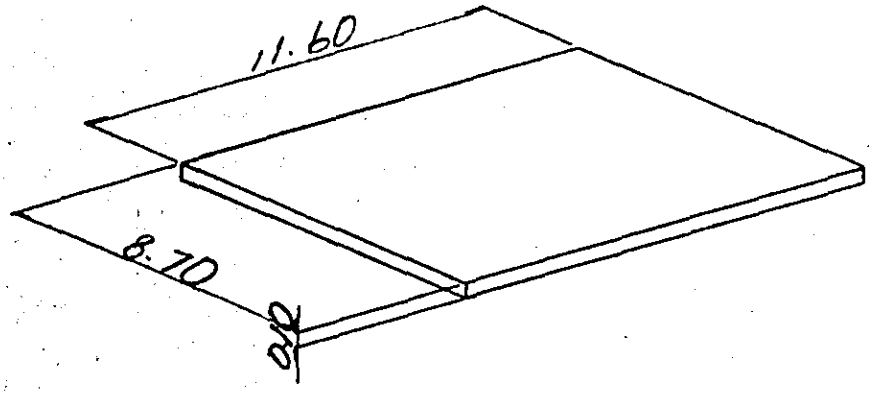


$Va = 8.70 \times 11.60 \times (1.50 + 1.859) = 338.990\ m^3$

5) FOUNDATION MORTAR

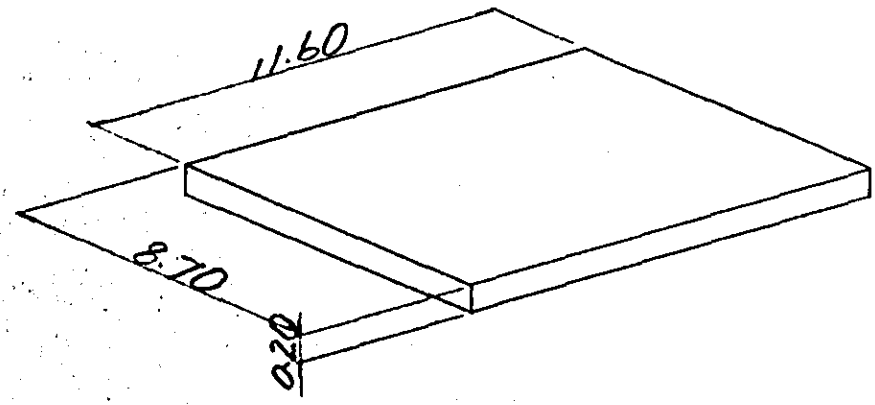
$Va = \frac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 16 = 0.107\ m^3$

6) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

7) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

8) PILE

ϕ - 500

TYPE - B 11 m × 42

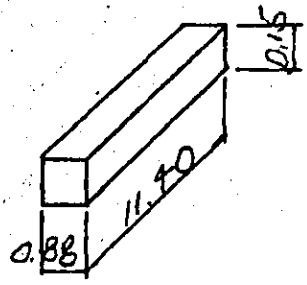
27 PIER 17

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	20.3	35.7	1967.0	96.9
COLUMN	43.2	93.7	4879.3	112.9
TOTAL	63.5	129.4	6846.3	107.8
FOOTING	185.5	73.6	12128.5	65.4

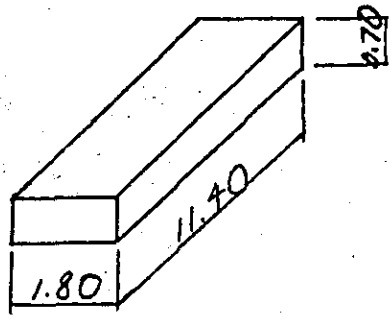
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B.-3
EXCAVATION	m^2	369.0	
FOUNDATION MORTAR	m^3	0.1	f_{ck} = 400 kg/cm²
PILE	m × NUMBER	11 × 42	φ500-B

1) CONCRETE VOLUME

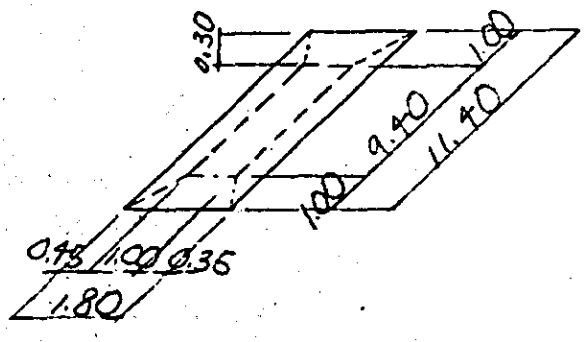
(1) BEAM



$Va = 0.88 \times 0.15 \times 11.40$ = 1.505 m³



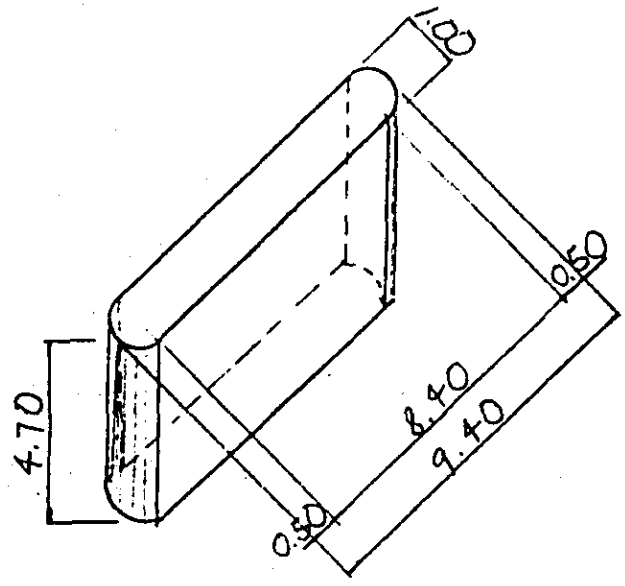
$Vb = 1.80 \times 0.70 \times 11.40$ = 14.364 "



$$Vc = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\} = 4.408 \text{ "}$$

BEAM TOTAL = 20.277 m³

(2) COLUMN

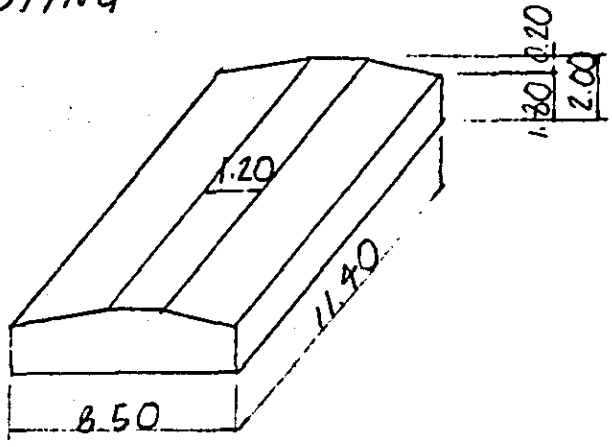


$Va = \frac{1}{4} \times \pi \times 1.00^2 \times 4.70$ = 3.691 m^3

$Vb = 1.00 \times 8.40 \times 4.70$ = 39.480 "

COLUMN TOTAL = 43.171 m^3

(3) FOOTING



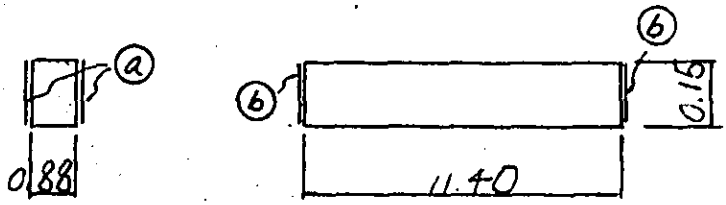
$Va = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m^3

$Vb = 8.50 \times 1.80 \times 11.40$ = 174.420 "

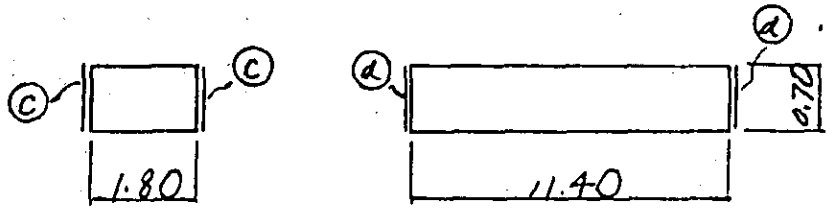
FOOTING TOTAL = 185.478 "

2) FORM AREA

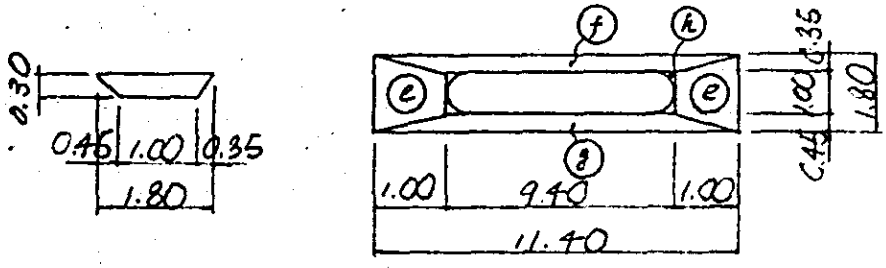
(1) BEAM



$Ae = 0.15 \times 11.40 \times 2$	=	3.420 m^2
$Ab = 0.15 \times 0.88 \times 2$	=	0.264 "

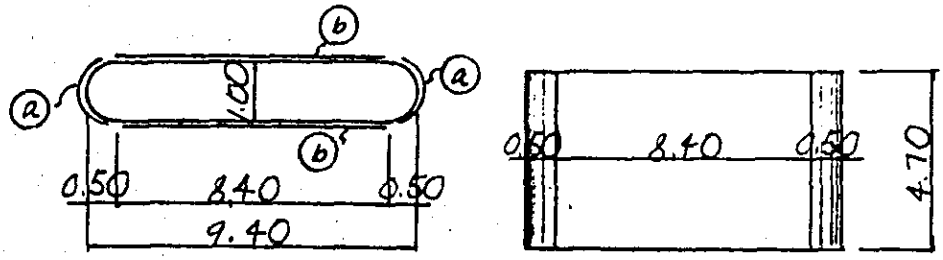


$Ac = 0.70 \times 11.40 \times 2$	=	15.960 "
$Ad = 0.70 \times 1.80 \times 2$	=	2.520 "



$Ae = \frac{1}{2} \times (1.00 + 1.80) \times \sqrt{1.00^2 + 0.30^2} \times 2$	=	2.923 "
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.35^2 + 0.30^2}$	=	4.794 "
$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$	=	5.626 "
$Ah = (1 - \pi/4) \times 1.00^2$	=	0.215 "
BEAM TOTAL	=	35.722 m^2

(2) COLUMN

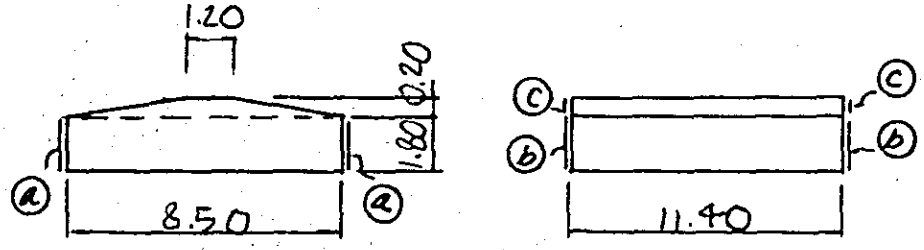


$Aa = \pi \times 1.00 \times 4.70$ = 14.765 m^2

$Ab = 8.40 \times 4.70 \times 2$ = 78.960 "

COLUMN TOTAL = 93.725 m^2

(3) FOOTING



$Aa = 1.80 \times 11.40 \times 2$ = 41.040 m^2

$Ab = 1.80 \times 8.50 \times 2$ = 30.600 "

$Ac = 1/2 \times (1.20 + 8.50) \times 0.20 \times 2$ = 1.940 "

FOOTING TOTAL = 73.580 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	20.3	71.559	1452.6
COLUMN	43.2	112.946	4879.3
FOOTING	185.5	65.383	12128.5

BEARING BASE D16 514.4 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

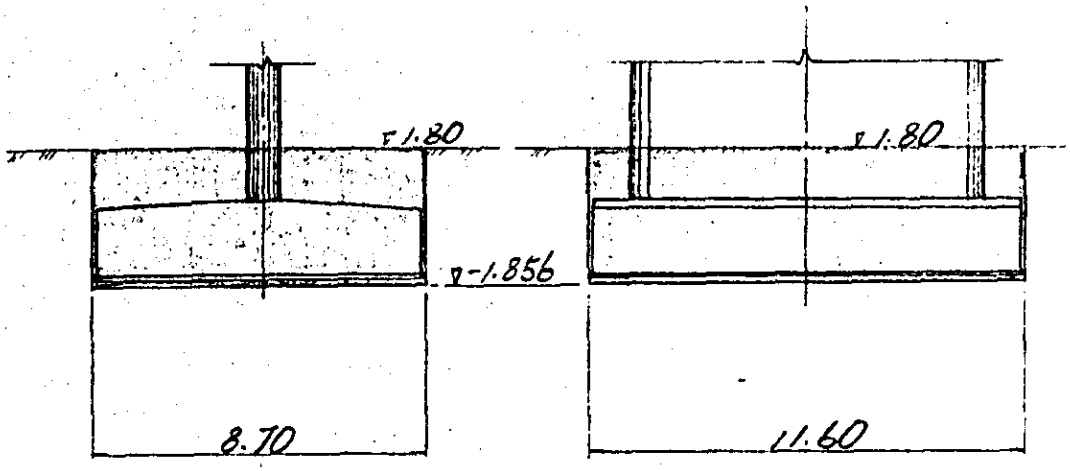
$$R = \frac{\text{REINFORCING BAR OF P 18}}{\text{CONCRETE VOLUME OF P18}}$$

$$R_B = \frac{1509.9}{21.1} = 71.559$$

$$R_C = \frac{4822.8}{42.7} = 112.946$$

$$R_F = \frac{12128.5}{185.5} = 65.383$$

4) EXCAVATION

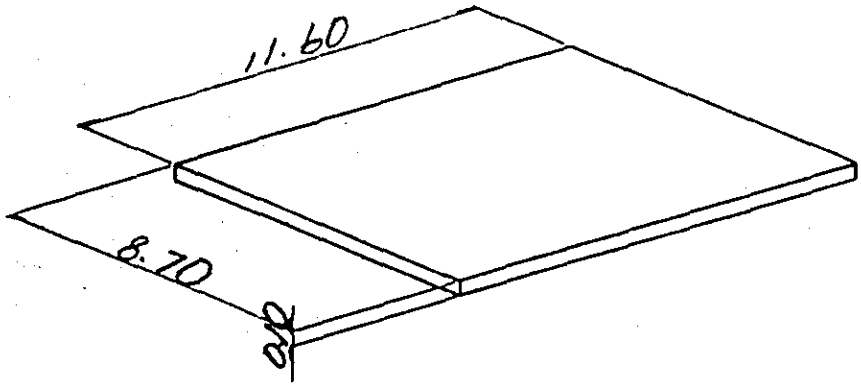


$$Va = 8.70 \times 11.60 \times (1.80 + 1.856) = 368.967\ m^3$$

5). FOUNDATION MORTAR

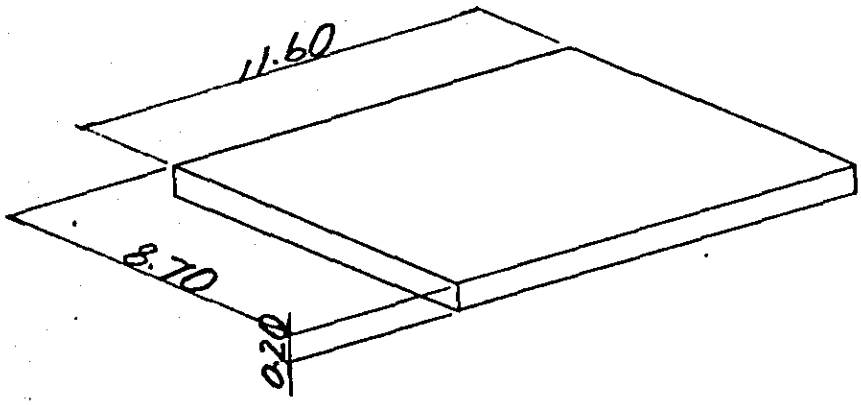
$$Va = \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 8 = 0.115\ m^3$$

6) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

7) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

8) PILE

Φ - 500

TYPE - B 11 m × 42

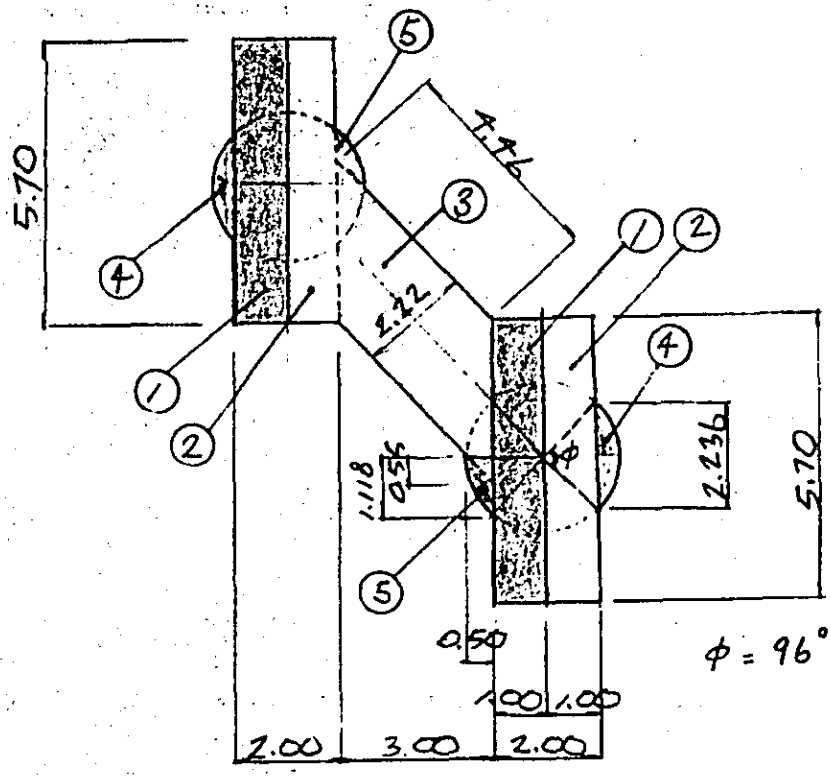
28. PIER 19.

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	81.1	105.8	8163.8	100.7
COLUMN	111.7	148.9	9154.6	82.0
TOTAL	192.8	254.7	17318.4	89.8
FOOTING	324.4	93.6	27156.0	83.7

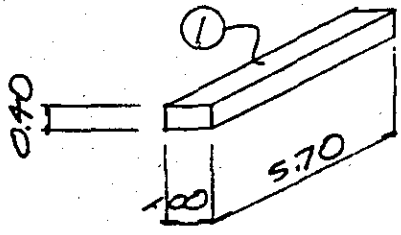
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	16.5	CLASS F
AGGREGATE SUBBASE	m^3	33.0	A.S.B. - 3
EXCAVATION	m^3	1092.7	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm^2
PILE	m x NUMBER	6.00 m x 77	φ500 - B

1). CONCRETE VOLUME

1) BEAM



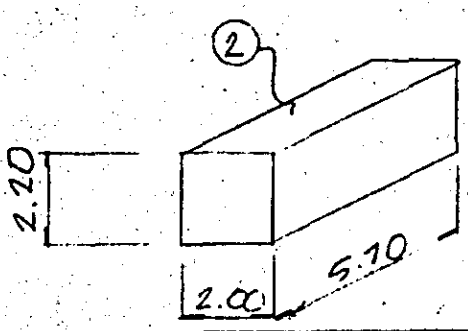
$\phi = 96°22'46"$



$n = 2$

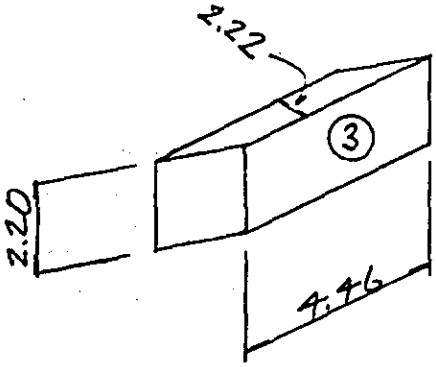
m^3

$V_1 = 1.00 \times 0.40 \times 5.70 \times 2 = 4.560$



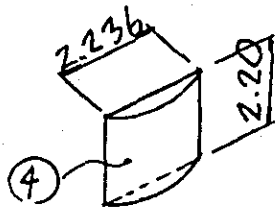
$n = 2$

$V_2 = 2.00 \times 2.20 \times 5.70 \times 2 = 50.160\ m^3$



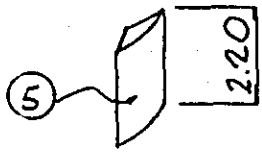
$n = 1$

$V_3 = 2.22 \times 2.20 \times 4.46 = 21.783$ "



$n = 2$

$V_4 = \left(\frac{96.3794^\circ}{360^\circ} \times \pi \times 1.50^2 - \frac{1}{2} \times 2.236 \times 1.00\right) \times 2.20 \times 2 = 3.407$ "

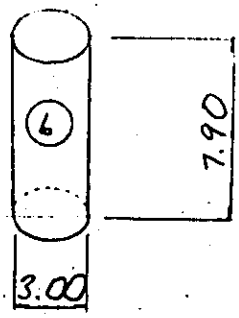


$V_5 = \frac{1}{2} \times V_4 - \frac{1}{2} \times 0.55 \times 0.50 \times 2.20 \times 2$

$= 3.407 \times \frac{1}{2} - 0.605 = 1.099$ "

BEAM TOTAL = $81.004\ m^3$

(2) COLUMN

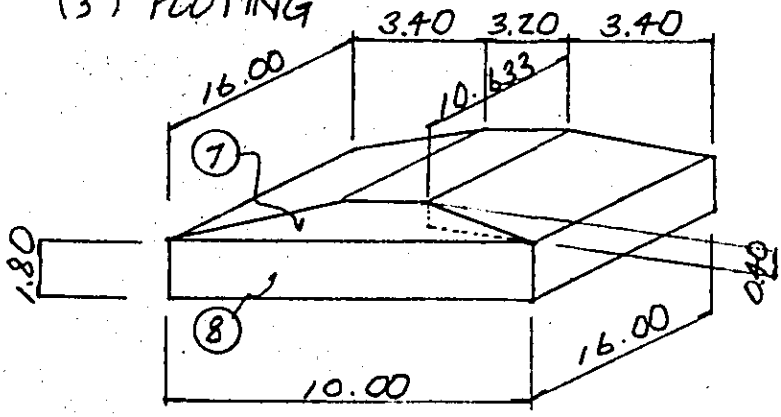


$n = 2$

$$V_6 = \pi/4 \times 3.00^2 \times 7.90 \times 2 = 111.684 \ m^3$$

COLUMN TOTAL = 111.684 M^3

(3) FOOTING



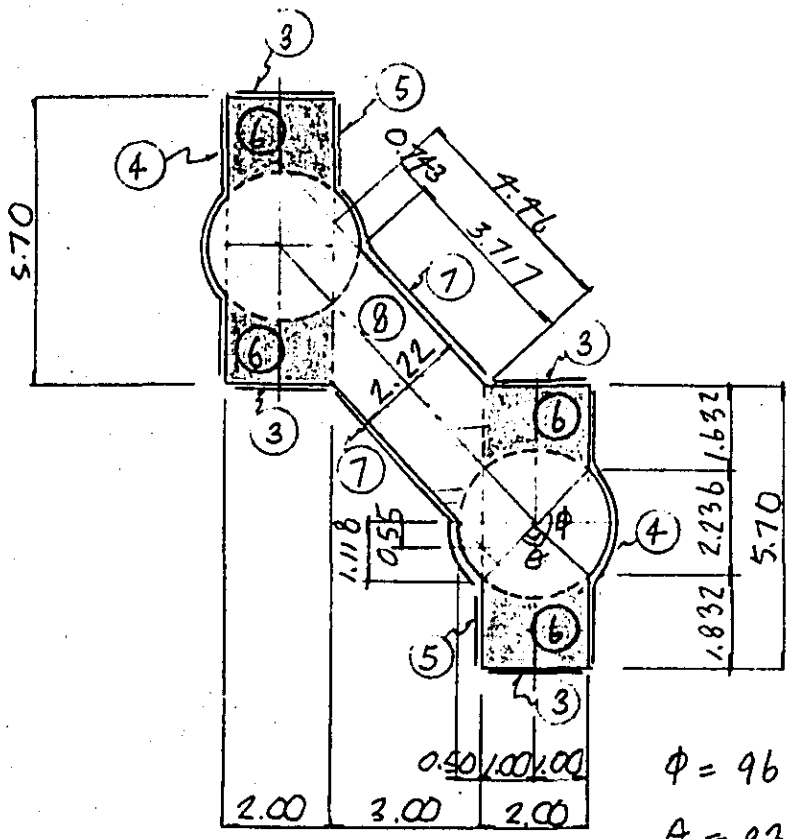
$$V_7 = \frac{0.40}{6} \times (3.20 \times 10.633 + 10.00 \times 16.00 + 13.20 \times 26.633) = 36.372 \ m^3$$

$$V_8 = 1.80 \times 10.00 \times 16.00 = 288.000 \ ''$$

FOOTING TOTAL = 324.372 M^3

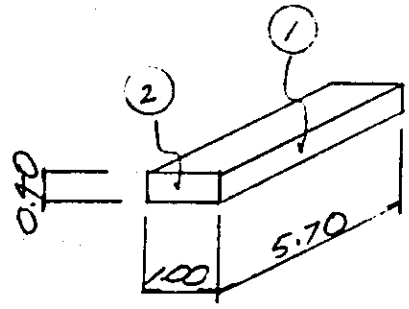
2) FORM AREA

(1) BEAM



$\phi = 96°22'46''$

$\theta = 83°37'14''$



$n = 2$

$A_1 = 0.40 \times 5.70 \times 2 \times 2 = 9.120\ m^2$

$A_2 = 0.40 \times 1.00 \times 2 \times 2 = 1.600\ "$

$A_3 = 2.00 \times 2.20 \times 2 \times 2 = 17.600\ m^2$

$A_4 = (1.832 + \frac{96.3794}{360^\circ} \times \pi \times 3.00 + 1.632) \times 2.20 \times 2 = 26.344$ "

$A_5 = 1.832 \times 2.20 \times 2 = 8.061$ "

$A_6 = (1.832 + 1.632) \times 2.00 \times 2$

$- (\frac{83.6206^\circ}{360^\circ} \times \pi \times 1.50^2 - \frac{1}{2} \times 2.00 \times 1.118) \times 2 \times 2 = 11.760$ "

$A_7 = (3.717 + \frac{96.3794 \times \frac{1}{2}}{360} \times \pi \times 3.00) \times 2.20 \times 2 = 21.906$ "

$A_8 = 4.46 \times 2.22 - \frac{1}{2} \times 0.55 \times 0.50$

$- (\frac{96.3794 \times \frac{1}{2}}{360} \times \pi \times 1.50^2 - \frac{1}{2} \times 1.00 \times 1.118) = 9.317$ "

BEAM TOTAL = $105.768\ m^2$

(2) COLUMN

$A_9 = \pi \times 3.00 \times 1.90 \times 2 = 148.911\ m^2$

COLUMN TOTAL = $148.911\ m^2$

(3) FOONIG

$A_{10} = 1.80 \times (10.00 + 16.00) \times 2 = 93.600$ "

FOOTING TOTAL = $93.600\ m^2$

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	81.1	93.783	7 605.8
COLUMN	111.7	81.957	9 154.6
FOOTING	324.4	83.711	27 156.0

BEARING BASE D16 558.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

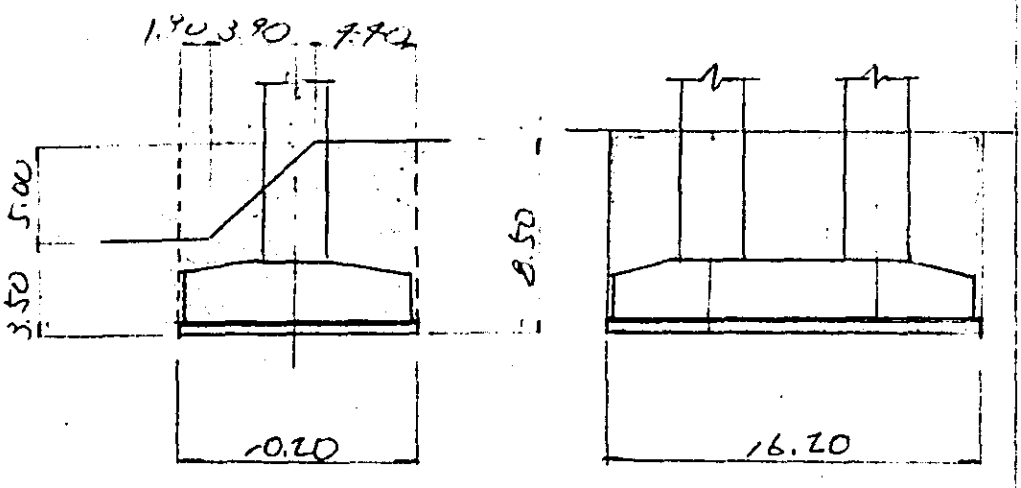
$$R = \frac{\text{REINFORCING BAR OF P 20}}{\text{CONCRETE VOLUME OF P20}}$$

$$R_B = \frac{7\,380.7}{78.7} = 93.783$$

$$R_C = \frac{9\,154.6}{111.7} = 81.957$$

$$R_F = \frac{27\,156.0}{324.4} = 83.711$$

4) EXCAVATION



$$Va = (10.20 \times 8.50 - 1.90 \times 5.00 - \tfrac{1}{2} \times 3.90 \times 5.00) \times 16.20 \quad m^3$$

$$= 1092.60 \ m^3$$

$$TOTAL = 1092.60 \ m^3$$

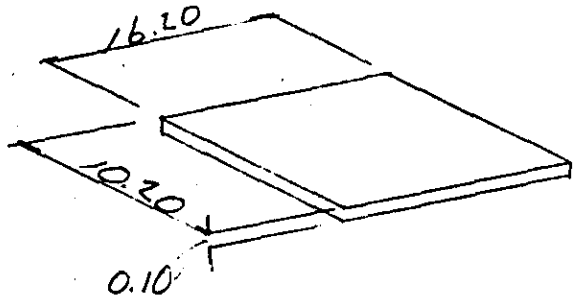
5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 4$$

$$+ \tfrac{1}{2} \times (0.836 \times 0.636 + 0.80 \times 0.60) \times 0.018 \times 8$$

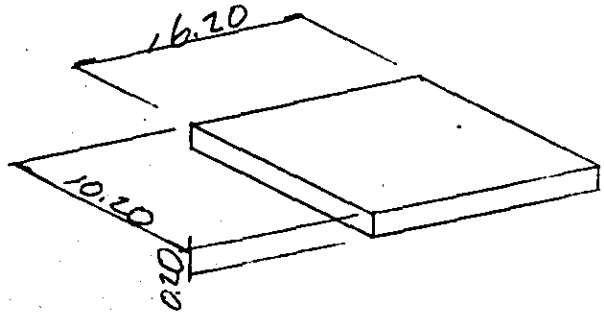
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 4 = 0.130 \ m^3$$

6) LEVELING CONCRETE



$Va = 10.20 \times 16.20 \times 0.10 = 16.524\ m^3$

7) AGGREGATE SUBBASE



$Va = 10.20 \times 16.20 \times 0.20 = 33.048\ m^3$

9) PILE

ϕ 500

TYPE-B 6.00 m × 77

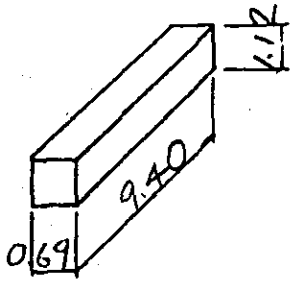
29 PIER P-21

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (kg/m^3)
BEAM	29.3	6.3.2	2 576.7	87.9
COLUMN	40.4	87.7	4 086.6	101.2
TOTAL	69.7	150.9	6 663.3	95.6
FOOTING	106.2	49.2	6 784.5	63.9

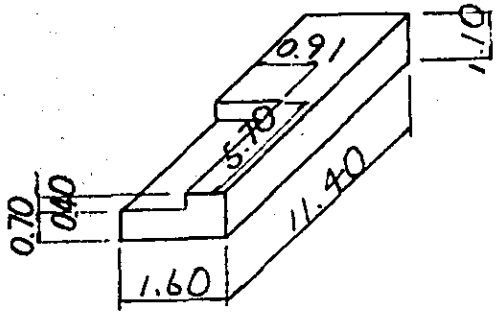
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^3	217.1	
FOUNDATION MORTAR	m^3	0.1	[illegible] = 400 kg/cm²
PILE	m x NUMBER	11 x 35	φ500-B

1) CONCRETE VOLUME

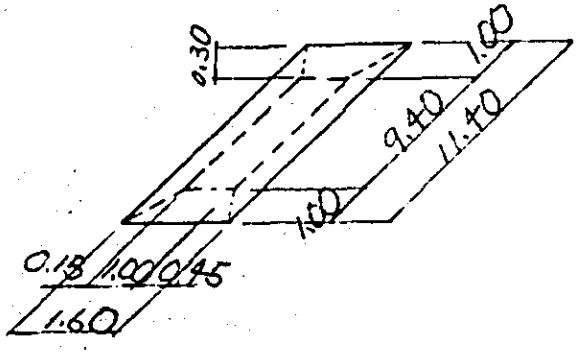
(1) BEAM



$Va = 0.69 \times 1.12 \times 9.40$ = 7.264 m³



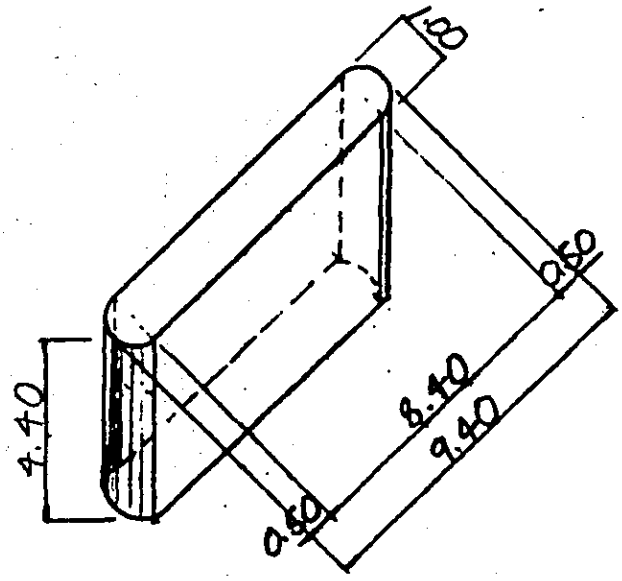
$Vb = 1.60 \times 1.10 \times 11.40 - 0.91 \times 5.70 \times 0.40$ = 17.989 "



$Vc = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.60 \times 11.40 + (1.00 + 1.60) \cdot (9.40 + 11.40)\}$ = 4.066 "

BEAM TOTAL = 29.339 m³

(2) COLUMN

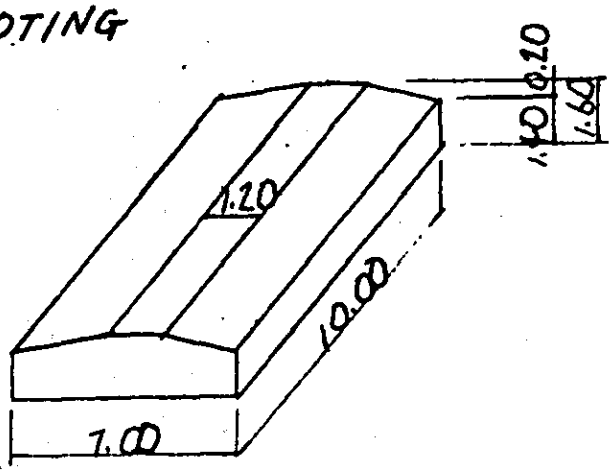


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 4.40$ = 3.456 m^3

$V_b = 1.00 \times 8.40 \times 4.40$ = 36.960 "

COLUMN TOTAL = 40.416 m^3

(3) FOOTING



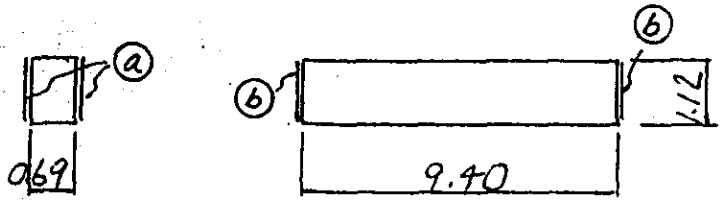
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

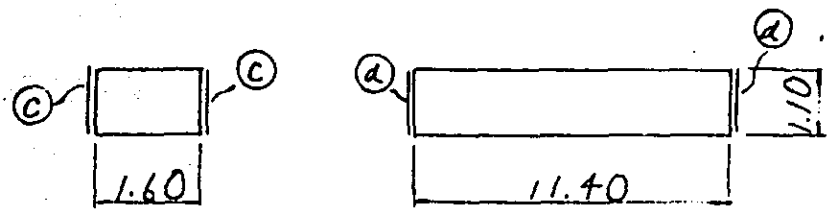
FOOTING TOTAL = 106.200 m^3

2) FORM AREA

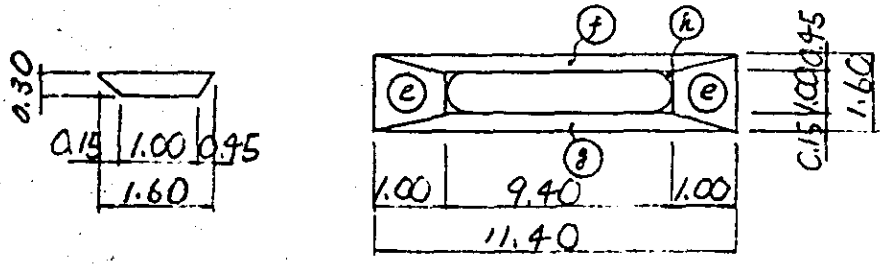
(1) BEAM



		m²
$A_e = 1.12 \times 9.40 \times 2$	=	21.056
$A_b = 1.12 \times 0.69 \times 2$	=	1.546 "

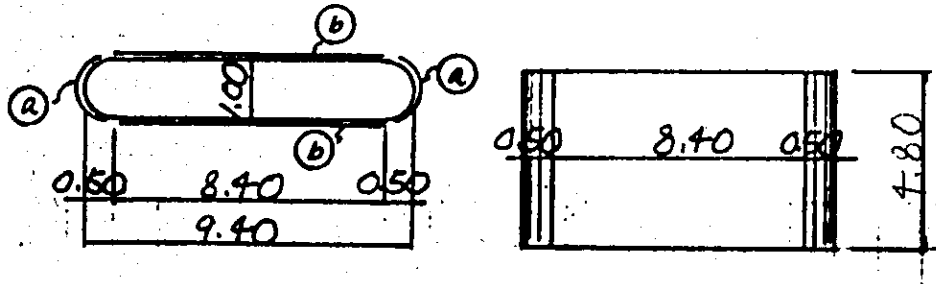


$A_c = 1.10 \times 11.40 \times 2$	=	25.080 "
$A_d = 1.10 \times 1.60 \times 2$	=	3.520 "



$A_e = \frac{1}{2} \times (1.00 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.04)	=	2.714 "
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$ (0.54)	=	5.626 "
$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.15^2 + 0.30^2}$ (0.335)	=	3.484 "
$A_h = (1 - \pi/4) \times 1.00^2$	=	0.215 "
BEAM TOTAL	=	63.241 m²

(2) COLUMN

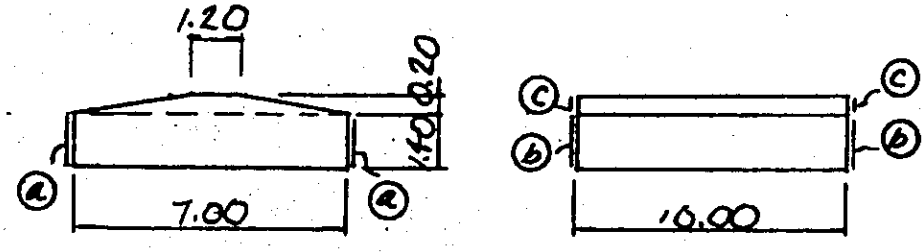


Aa = π × 1.00 × 4.40 = 13.823 m²

Ab = 8.40 × 4.40 × 2 = 73.920 "

COLUMN TOTAL = 87.743 m²

(3) FOOTING



Aa = 1.40 × 10.00 × 2 = 28.000 m²

Ab = 1.40 × 7.00 × 2 = 19.600 "

Ac = ½ × (1.20 + 7.00) × 0.20 × 2 = 1.640 "

FOOTING TOTAL = 49.240 m²

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	29.3	75.642	2216.3
COLUMN	40.4	101.154	4086.6
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 360.4 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

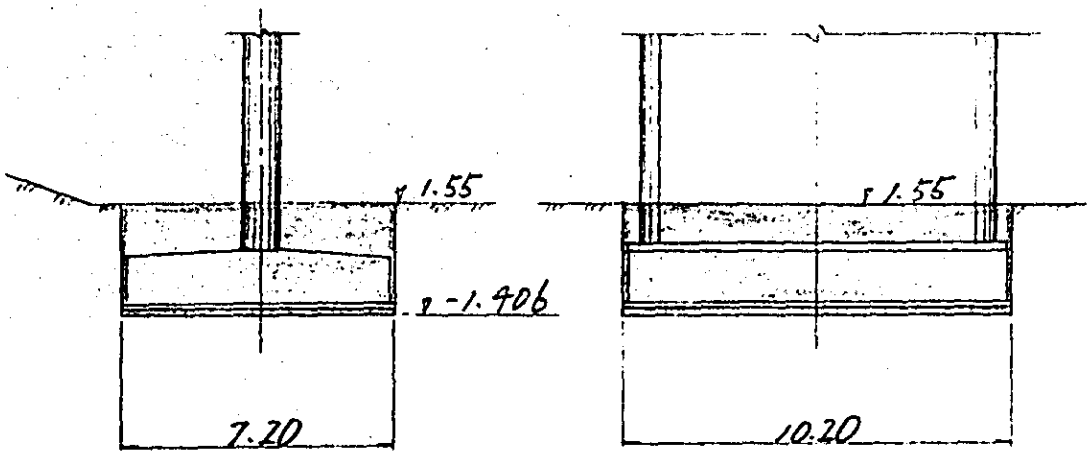
$$R = \frac{\text{REINFORCING BAR OF } P_{27}}{\text{CONCRETE VOLUME OF } P_{27}}$$

$$R_B = \frac{1202.7}{16.9} = 75.642$$

$$R_C = \frac{5199.3}{51.4} = .101.154$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

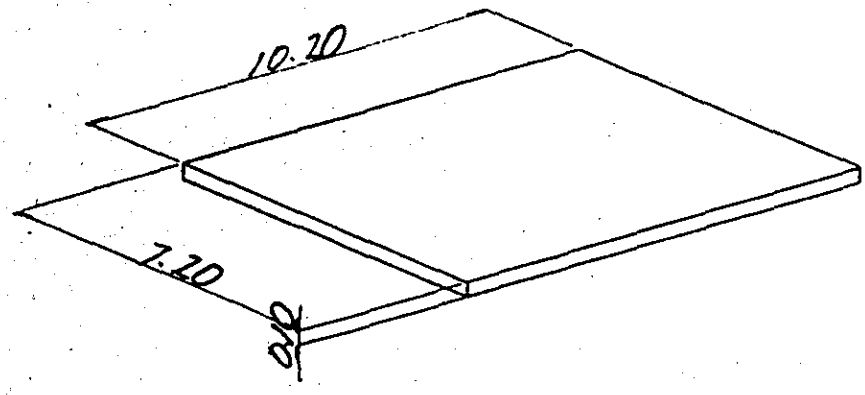


$$Va = 7.20 \times 10.20 \times (1.55 + 1.406) = 217.089 \ m^3$$

5) FOUNDATION MORTAR

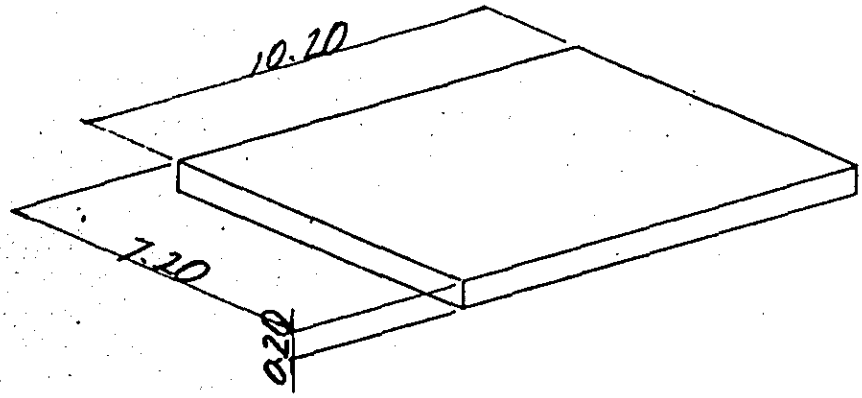
$$Va = \tfrac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 4$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$
$$+ \tfrac{1}{2} \times (0.836 \times 0.636 + 0.80 \times 0.60) \times 0.018 \times 4 = 0.124 \ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ - 500

TYPE - B 11 m × 35

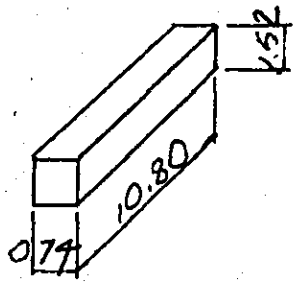
20. PIER 22

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (kg/m^3)
BEAM	34.1	71.9	3085.9	90.5
COLUMN	45.0	88.4	7829.3	174.0
TOTAL	79.1	160.3	10 915.2	138.0
FOOTING	229.6	81.5	13 966.9	60.8

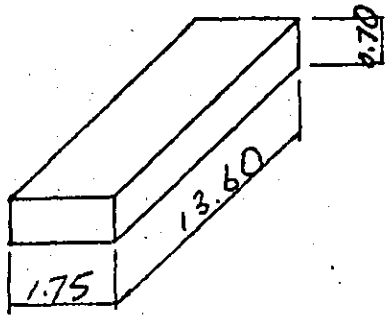
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	12.4	CLASS F
AGGREGATE SUBBASE	m^3	24.9	A.S.B. - 3
EXCAVATION	m^3	753.6	
FOUNDATION MORTAR	m^3	0.1	G.. = 4[illegible]
PILE	m × NUMBER	9 × 56	φ500 - B

1) CONCRETE VOLUME

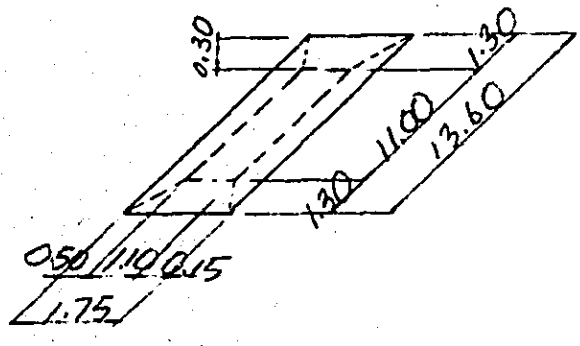
(1) BEAM



$Va = 0.74 \times 1.52 \times 10.80$ = 12.148 m³



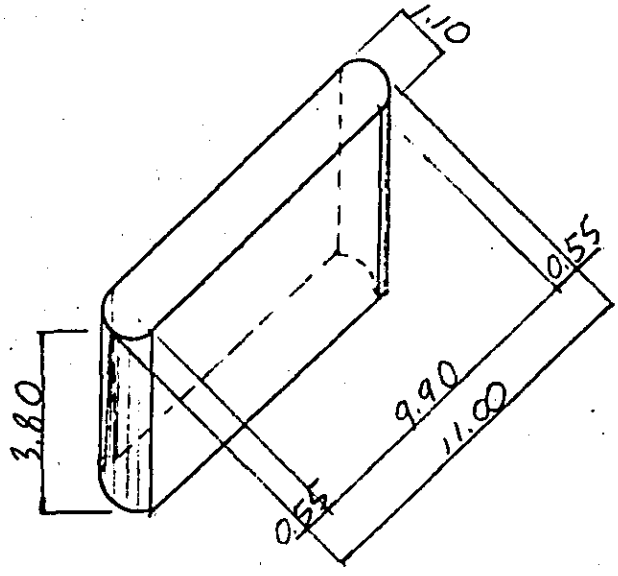
$Vb = 1.75 \times 0.70 \times 13.60$ = 16.660 "



$Vc = \frac{0.30}{6} \times \{1.10 \times 11.00 + 1.75 \times 13.60 + (1.10 + 1.75) \cdot (11.00 + 13.60)\}$ = 5.301 "

BEAM TOTAL = 34.109 m³

(2) COLUMN

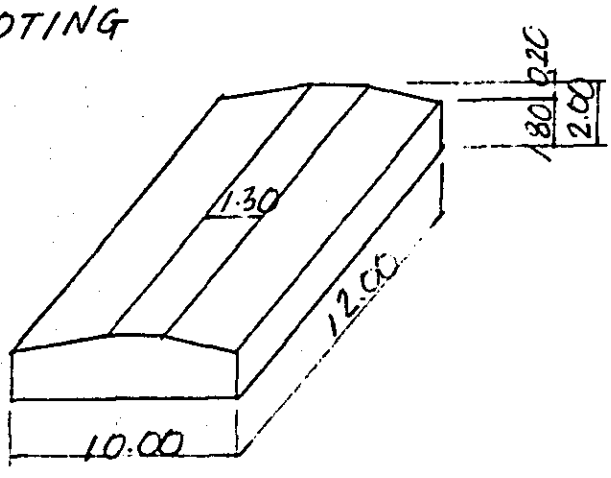


$V_a = \frac{1}{4} \times \pi \times 1.10^2 \times 3.80$ = 3.611 m^3

$V_b = 1.10 \times 9.90 \times 3.80$ = 41.382 "

COLUMN TOTAL = 44.993 m^3

(3) FOOTING



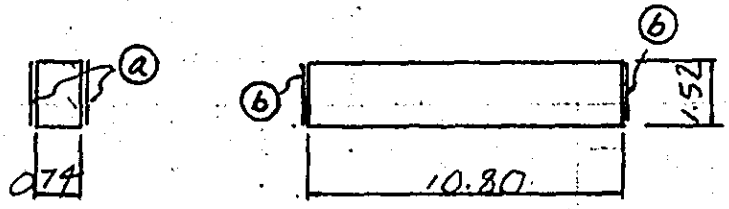
$V_a = \frac{1}{2} \times (1.30 + 10.00) \times 0.20 \times 12.00$ = 13.560 m^3

$V_b = 10.00 \times 1.80 \times 12.00$ = 216.000 "

FOOTING TOTAL = 229.560 m^3

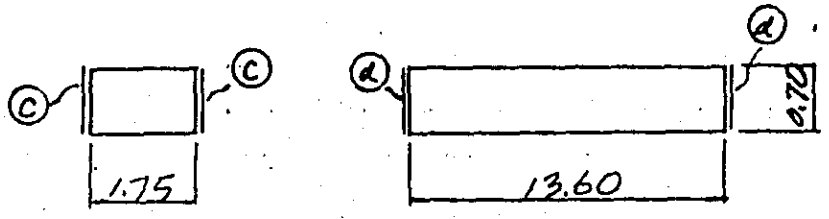
2) FORM AREA

(1) BEAM



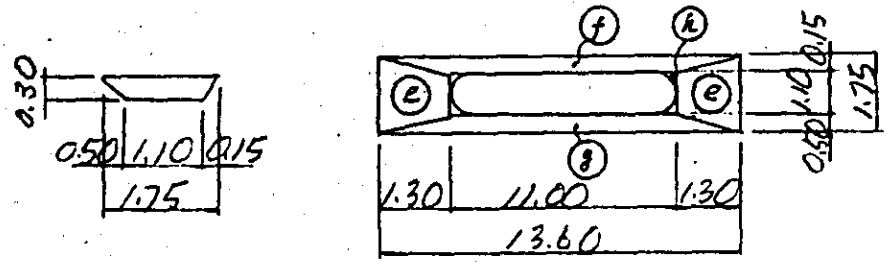
$Ae = 1.52 \times 10.80 \times 2$ = 32.832 m²

$Ab = 1.52 \times 0.74 \times 2$ = 2.250 "



$Ac = 0.70 \times 13.60 \times 2$ = 19.040 "

$Ad = 0.70 \times 1.75 \times 2$ = 2.450 "



$Ae = \frac{1}{2} \times (1.10 + 1.75) \times \sqrt{1.30^2 + 0.30^2} \times 2$ = 3.802 "

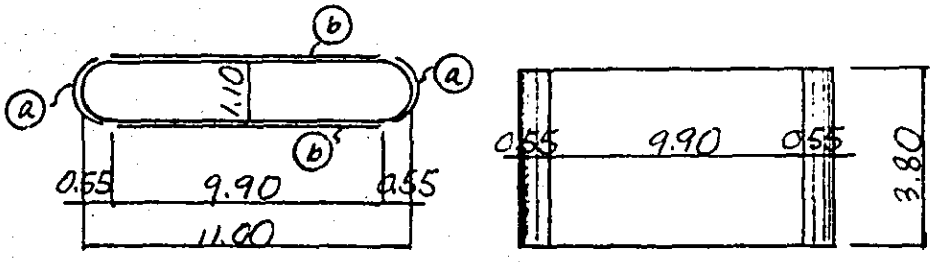
$Af = \frac{1}{2} \times (11.00 + 13.60) \times \sqrt{0.15^2 + 0.30^2}$ = 4.121 "

$Ag = \frac{1}{2} \times (11.00 + 13.60) \times \sqrt{0.50^2 + 0.30^2}$ = 7.171 "

$Ah = (1 - \pi/4) \times 1.10^2$ = 0.260

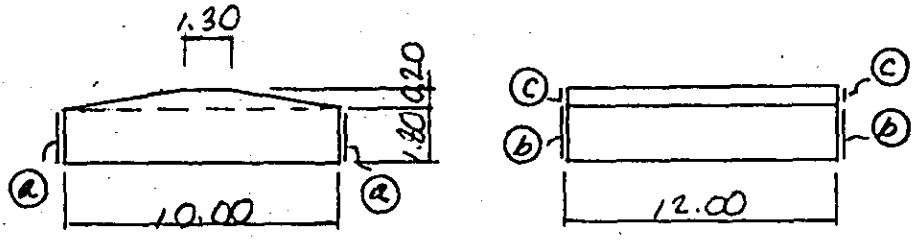
BEAM TOTAL = 71.926 m²

(2) COLUMN



$Aa = \pi \times 1.10 \times 3.80$	=	13.132 m^2
$Ab = 9.90 \times 3.80 \times 2$	=	75.240 "
COLUMN TOTAL	=	88.372 m^2

(3) FOOTING



$Aa = 1.80 \times 12.00 \times 2$	=	43.200 m^2
$Ab = 1.80 \times 10.00 \times 2$	=	36.000 "
$Ac = \frac{1}{2} \times (1.30 + 10.00) \times 0.20 \times 2$	=	2.260 "
FOOTING TOTAL	=	81.460 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	34.1	79.468	2709.9
COLUMN	45.0	173.985	7829.3
FOOTING	229.6	60.831	13 966.9

BEARING BASE D16 376.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

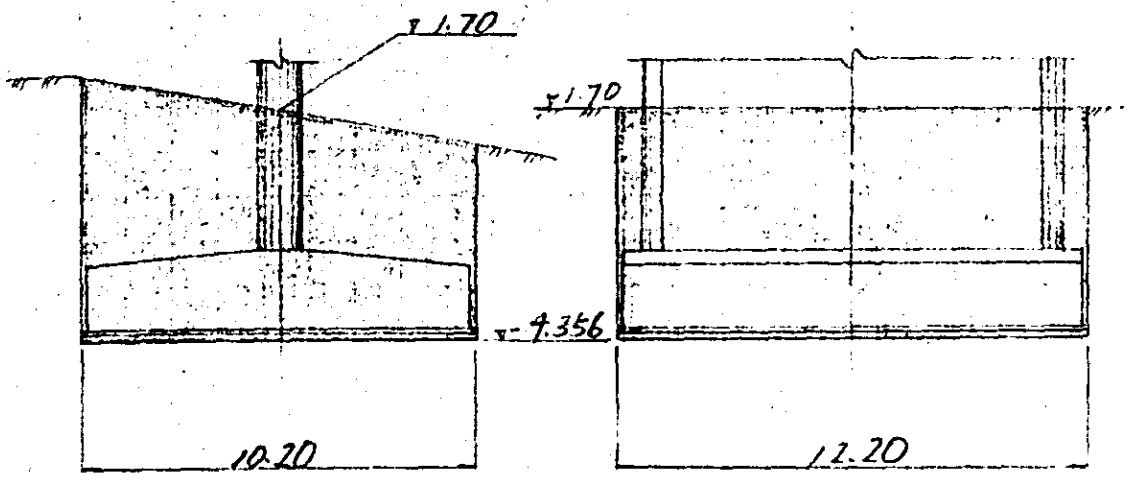
$$R = \frac{\text{REINFORCING BAR OF Po1}}{\text{CONCRETE VOLUME OF Po1}}$$

$$R_B = \frac{2614.5}{32.9} = 79.468$$

$$R_C = \frac{14\,005.8}{80.5} = 173.985$$

$$R_F = \frac{13\,966.9}{229.6} = 60.831$$

4) EXCAVATION

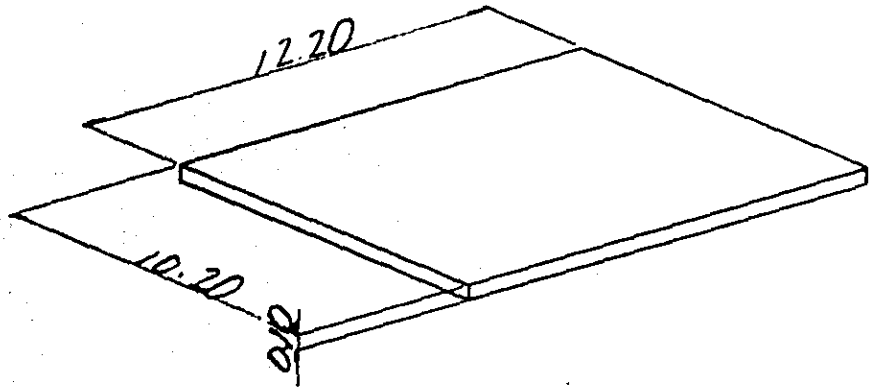


$$Va = 10.20 \times 12.20 \times (4.356 + 1.70) = 753.607 \ m^3$$

5) FOUNDATION MORTAR

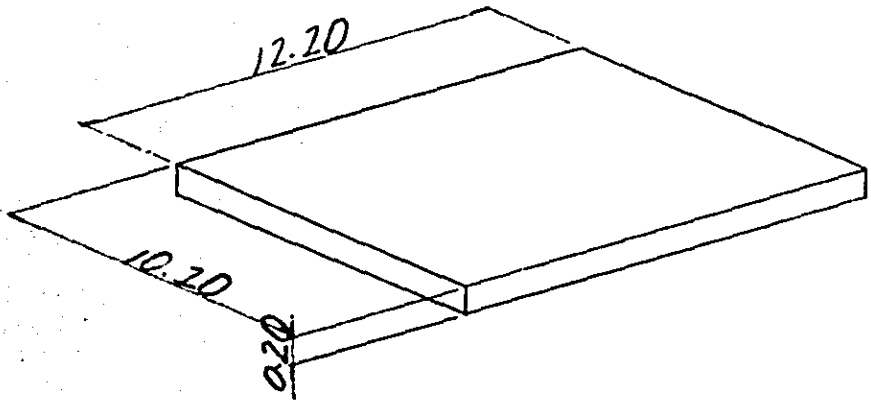
$$Va = 1/2 \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$
$$+ 1/2 \times (0.836 \times 0.636 + 0.80 \times 0.60) \times 0.018 \times 8 = 0.130 \ m^3$$

6) LEVELING CONCRETE



Va = 10.20 × 12.20 × 0.10 ..... = 12.747 m^3

7) AGGREGATE SUBBASE



Va = 10.20 × 12.20 × 0.20 = 24.888 m^3

8) PILE

ϕ - 500

TYPE-B 9 m × 56

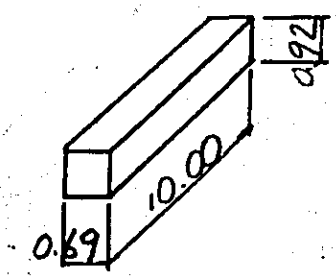
31 PIER 23

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	22.9	51.1	2247.6	98.1
COLUMN	38.4	102.5	4739.5	123.4
TOTAL	61.3	153.6	6987.1	114.0
FOOTING	67.0	35.4	4576.3	68.3

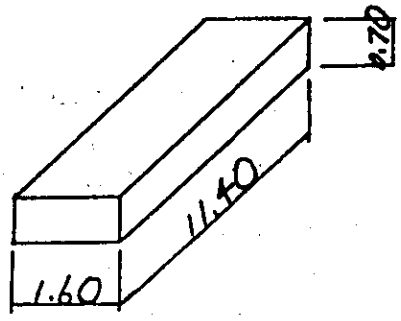
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B. - 3
EXCAVATION	m^3	147.4	
FOUNDATION MORTAR	m^3	0.1	G_{CH} = 4000 kg/cm²
PILE	m × NUMBER	8 × 28 8 × 28	φ500 - A φ500 - B

1) CONCRETE VOLUME

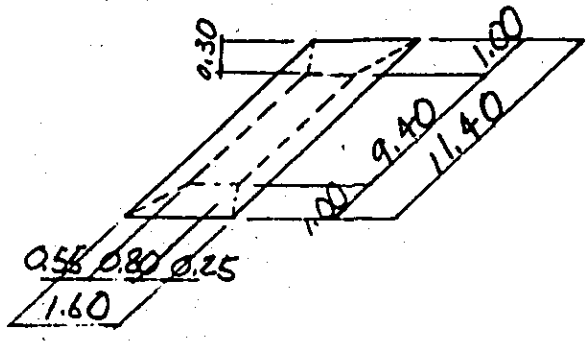
(1) BEAM



$V_a = 0.69 \times 0.92 \times 10.00$ ..... = 6.348 m³



$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "

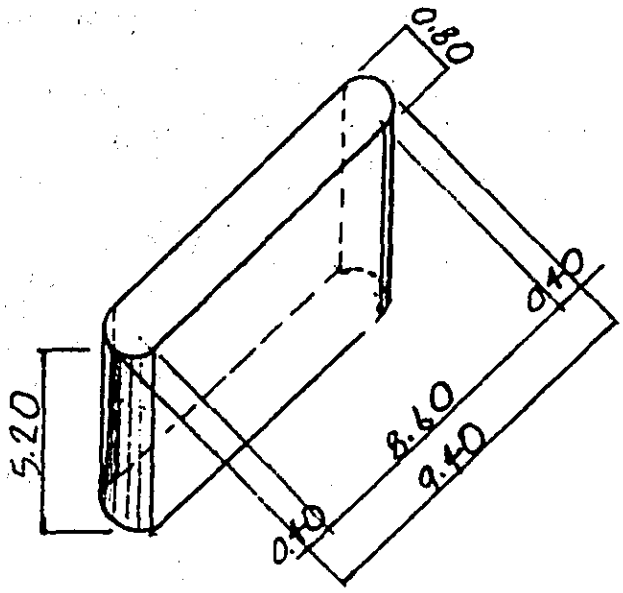


$V_c = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.60 \times 11.40$

$+ (0.80 + 1.60) \cdot (9.40 + 11.40)\}$ = 3.784 "

BEAM TOTAL = 22.900 m³

(2) COLUMN

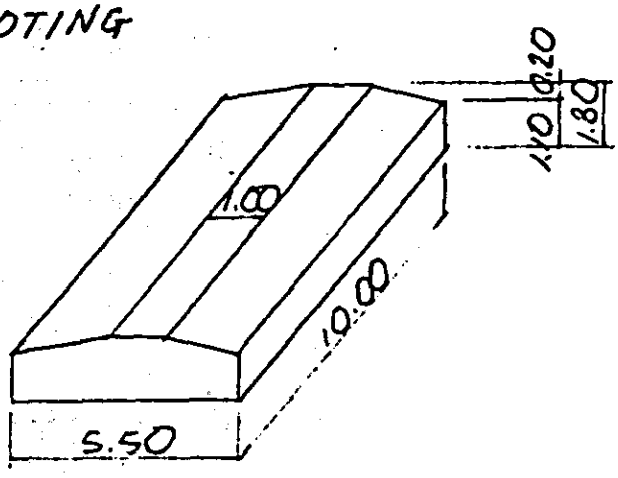


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 5.20$ = 2.614 m^3

$V_b = 0.80 \times 8.60 \times 5.20$ = 35.776 "

COLUMN TOTAL = 38.390 m^3

(3) FOOTING



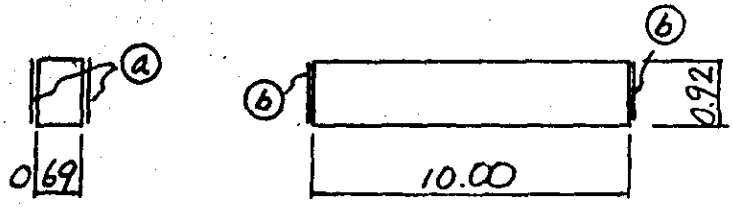
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m^3

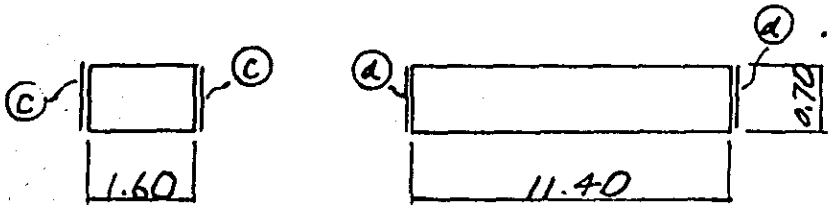
2) FORM AREA

(1) BEAM



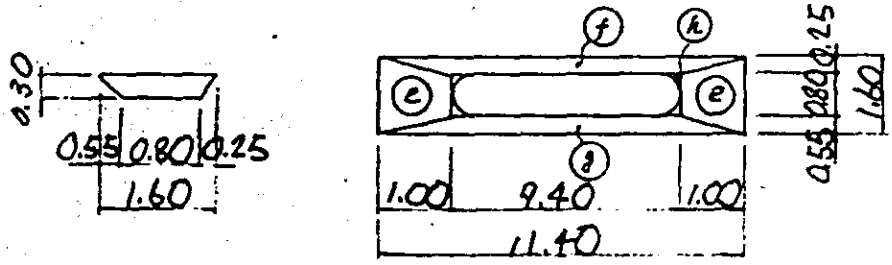
$A_c = 0.92 \times 10.00 \times 2$ = 18.400 m²

$A_b = 0.92 \times 0.69 \times 2$ = 1.270 "



$A_c = 0.70 \times 1.60 \times 2$ = 2.240 "

$A_d = 0.70 \times 11.40 \times 2$ = 15.960 "



$A_e = \frac{1}{2} \times (0.80 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.044) = 2.506 "

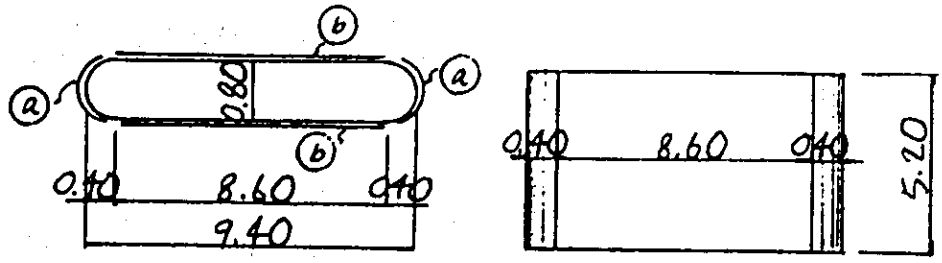
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ (0.391) = 4.066 "

$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.55^2 + 0.30^2}$ (0.627) = 6.510 "

$A_h = (1 - \pi/4) \times 0.80^2$ = 0.137 "

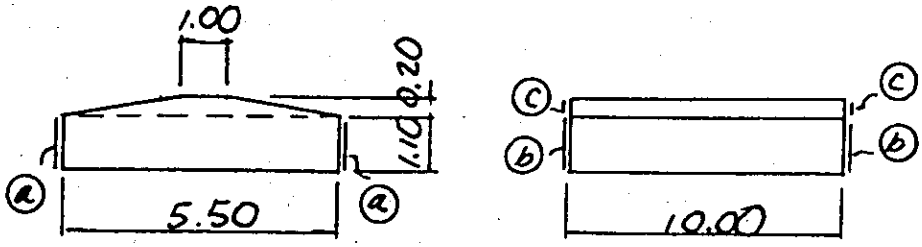
BEAM TOTAL = 51.089 m²

(2) COLUMN



$A_a = \pi \times 0.80 \times 5.20$	=	13.069 m^2
$A_b = 8.60 \times 5.20 \times 2$	=	89.440 "
COLUMN TOTAL	=	102.509 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$	=	22.000 m^2
$A_b = 1.10 \times 5.50 \times 2$	=	12.100 "
$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$	=	1.300 "
FOOTING TOTAL	=	35.400 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	22.9	84.245	1929.2
COLUMN	38.4	123.425	4739.5
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 318.4 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

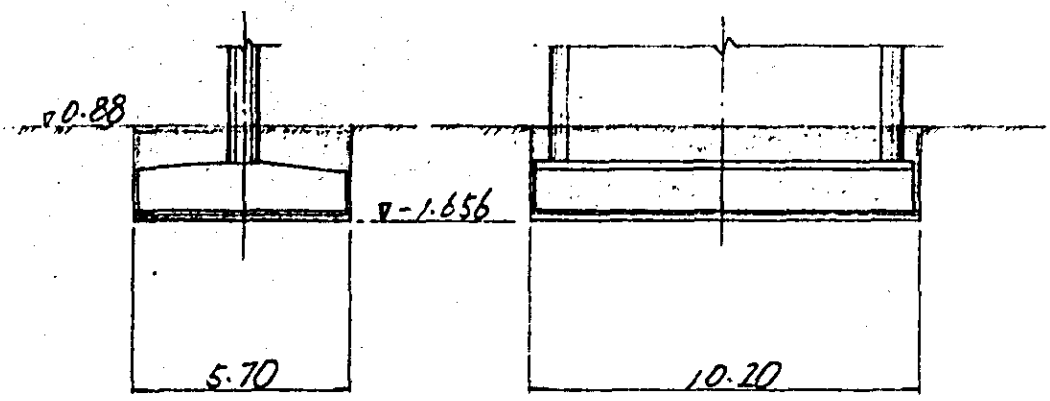
$$R = \frac{\text{REINFORCING BAR OF } F_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$$

$$R_B = \frac{1929.2}{22.9} = 84.245$$

$$R_C = \frac{4825.9}{39.1} = 123.425$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION



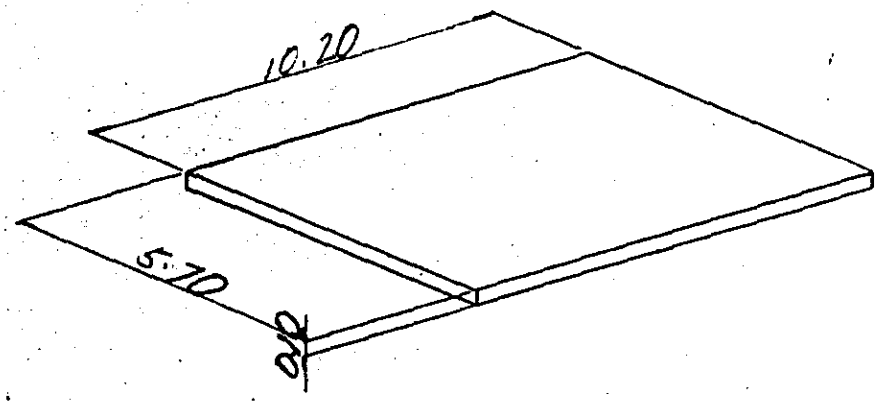
$$Va = 5.70 \times 10.20 \times (0.88 + 1.656) = 147.743 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$

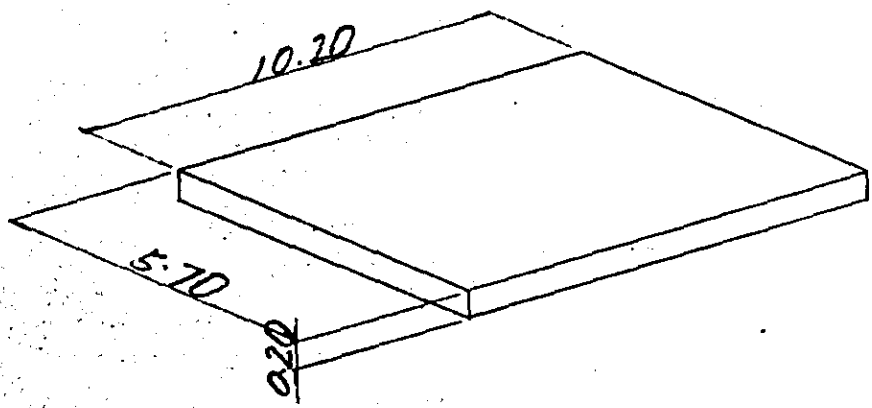
$$+ \tfrac{1}{2} \times (0.836 \times 0.486 + 0.80 \times 0.45) \times 0.018 \times 8 = 0.112 \ m^3$$

6) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10 = 5.814\ m^3$

7) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20 = 11.628\ m^3$

8) PILE

$\phi = 500$

TYPE - A $8^{m} \times 28$

TYPE - B $8^{m} \times 28$

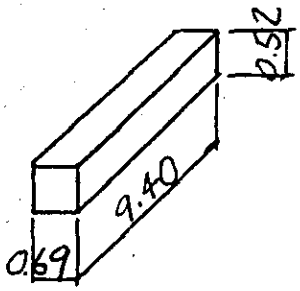
32 PIER 26

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	19.0	40.9	1876.9	98.8
COLUMN	41.3	110.4	5357.4	129.7
TOTAL	60.3	151.3	7234.3	120.0
FOOTING	67.0	35.4	4576.3	68.3

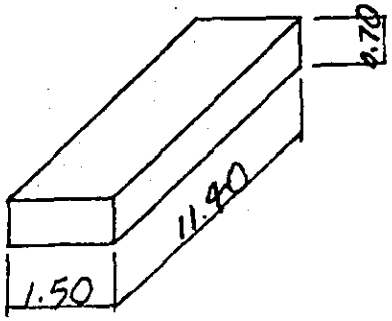
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B-3
EXCAVATION	m^3	156.7	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	14 x 24 8 x 24	φ500-A φ500-B

1) CONCRETE VOLUME

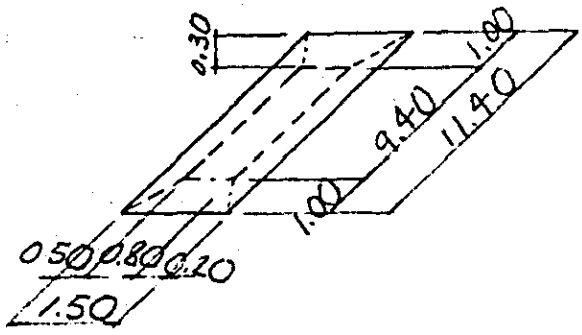
(1) BEAM



$Va = 0.69 \times 0.52 \times 9.40$ = 3.313 m³



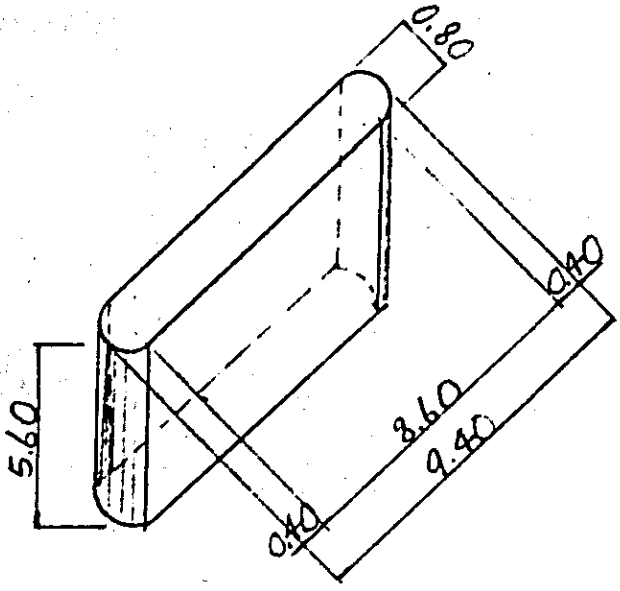
$Vb = 1.50 \times 0.70 \times 11.40$ = 11.970 "



$Vc = \frac{0.30}{6} \times \{ 0.80 \times 9.40 + 1.50 \times 11.40 + (0.80 + 1.50) \cdot (9.40 + 11.40) \}$ = 3.623 "

BEAM TOTAL = 18.966 m³

(2) COLUMN

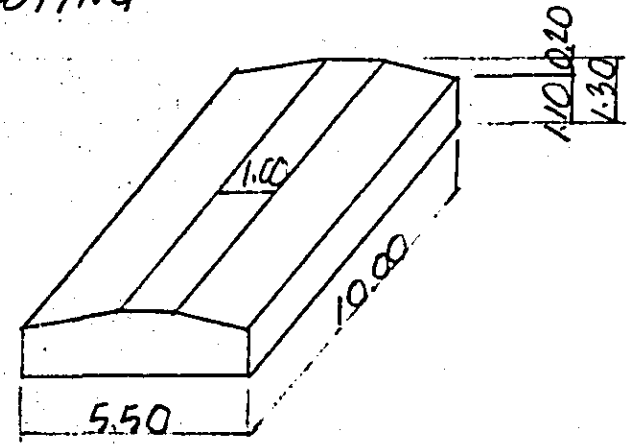


$Va = \frac{1}{4} \times \pi \times 0.80^2 \times 5.60$ = 2.815 m^3

$Vb = 0.80 \times 8.60 \times 5.60$ = 38.528 "

COLUMN TOTAL = 41.343 m^3

(3) FOOTING



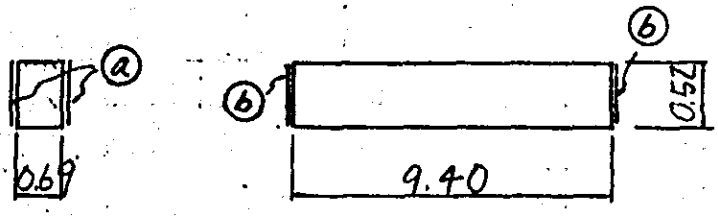
$Va = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$Vb = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m^3

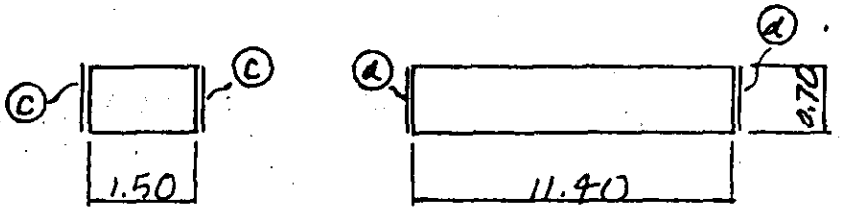
2) FORM AREA

(1) BEAM



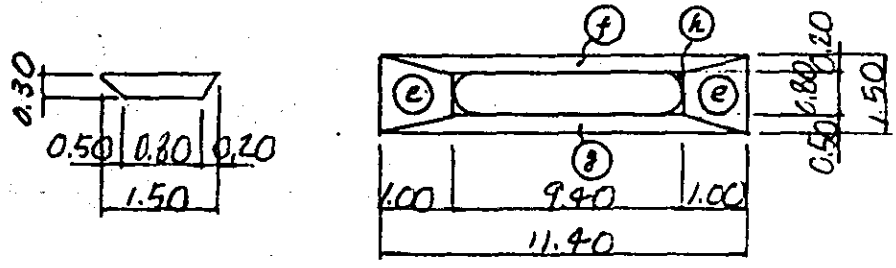
$Ae = 0.52 \times 9.40 \times 2$ = 9.776 m²

$Ab = 0.52 \times 0.69 \times 2$ = 0.718 "



$Ac = 0.70 \times 11.40 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.50 \times 2$ = 2.100 "



$Ae = \frac{1}{2} \times (0.80 + 1.50) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.401 "

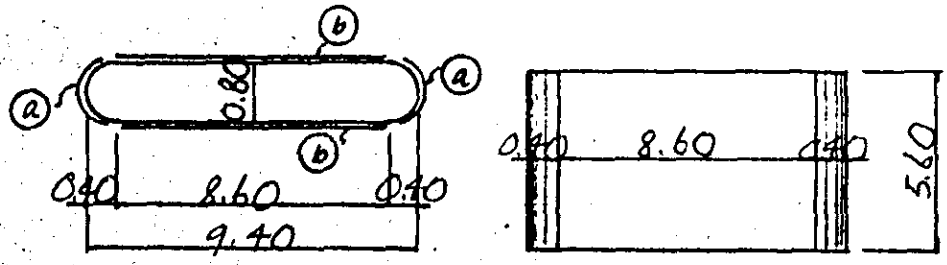
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.20^2 + 0.30^2}$ = 3.754 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.50^2 + 0.30^2}$ = 6.063 "

$Ah = (1 - \pi/4) \times 0.80^2$ = 0.137 "

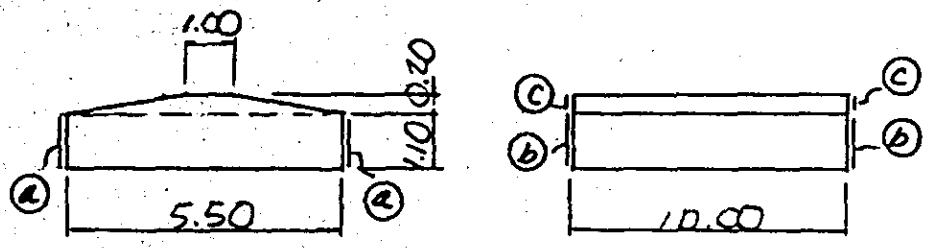
BEAM TOTAL = 40.909 m²

(2) COLUMN



A_a = $\pi \times 0.80 \times 5.60$	=	14.074 m^2
A_b = $8.60 \times 5.60 \times 2$	=	96.320 "
COLUMN TOTAL	=	110.394 m^2

(3) FOOTING



A_a = $1.10 \times 10.00 \times 2$	=	22.000 m^2
A_b = $1.10 \times 5.50 \times 2$	=	12.100 "
A_c = $\frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$	=	1.300
FOOTING TOTAL	=	35.400 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W=V·R (kg)
BEAM	19.0	82.361	1564.9
COLUMN	41.3	129.720	5357.4
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 312.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

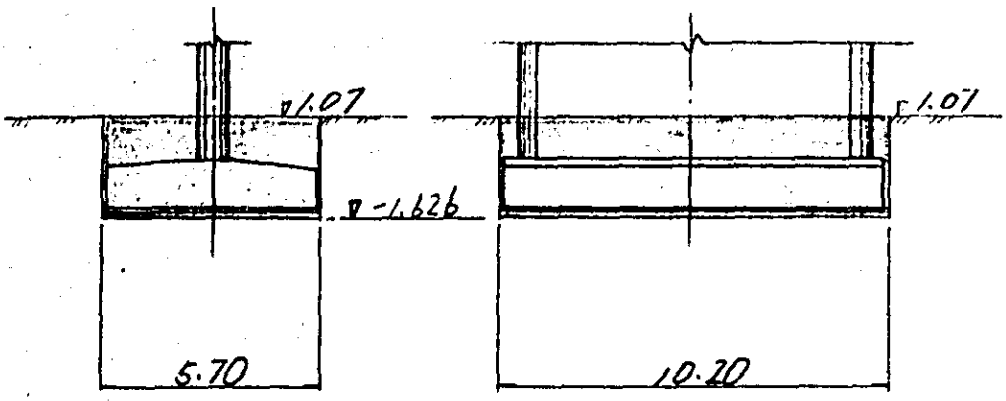
$$R = \frac{\text{REINFORCING BAR OF } F_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$$

$$R_B = \frac{1784.9}{24.1} = 82.361$$

$$R_C = \frac{7277.3}{56.1} = 129.720$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION



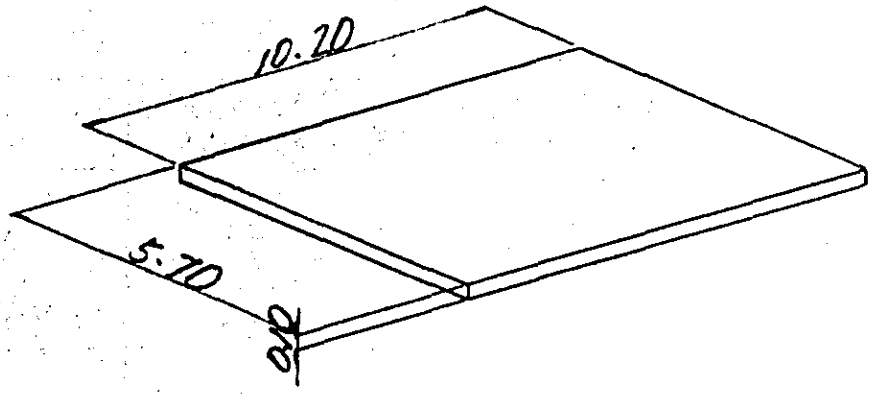
$$Va = 5.70 \times 10.20 \times (1.07 + 1.626) = 156.775 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$

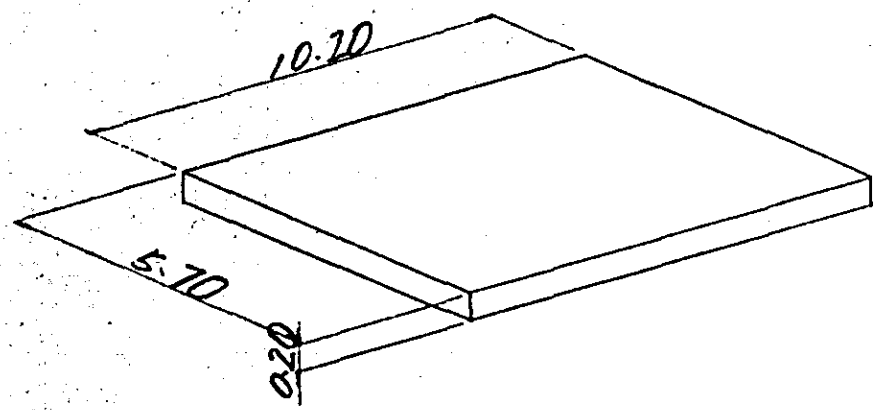
$$+ \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8 = 0.106 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

ϕ - 500

TYPE - A 14 m × 27

TYPE - B 8 m × 24

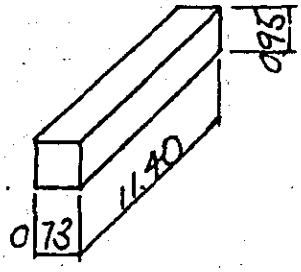
33 PIER 28

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	25.2	53.6	2282.6	90.6
COLUMN	43.2	93.7	4369.9	101.2
TOTAL	68.4	147.3	6652.5	97.3
FOOTING	106.2	49.2	6789.5	63.9

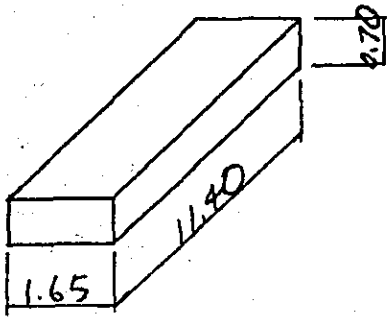
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS B
AGGREGATE SUBBASE	m^3	14.7	A.S.B-3
EXCAVATION	m^3	218.6	
FOUNDATION MORTAR	m^3	0.1	Ger = [illegible]
PILE	m x NUMBER	14 x 35 8 x 35	φ500-A φ500-B

1) CONCRETE VOLUME

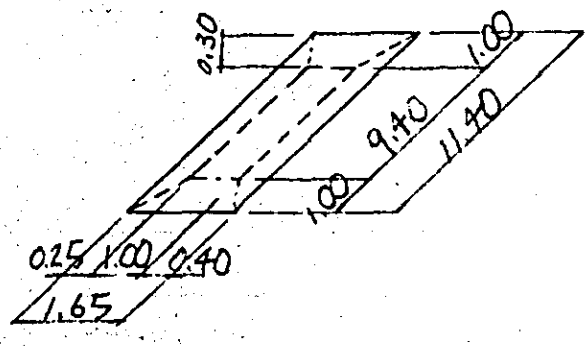
(1) BEAM



$Va = 0.73 \times 0.95 \times 11.40$ = 7.906 m³



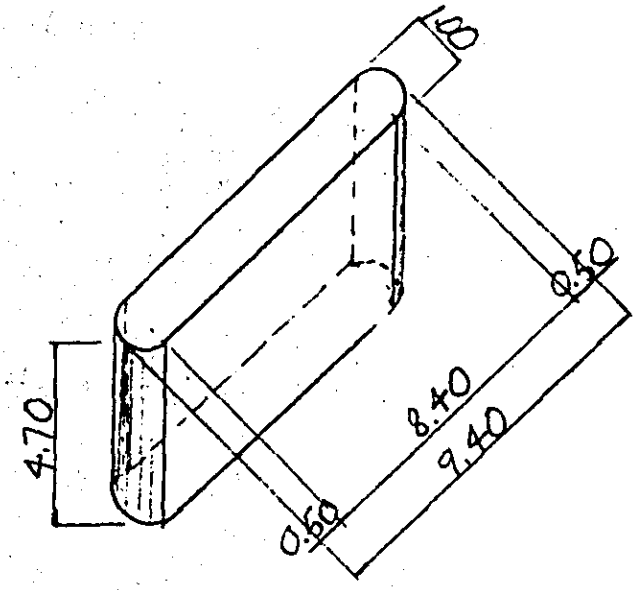
$Vb = 1.65 \times 0.70 \times 11.40$ = 13.167 "



$$Vc = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.65 \times 11.40 + (1.00 + 1.65) \cdot (9.40 + 11.40)\} = 4.167 \text{ "}$$

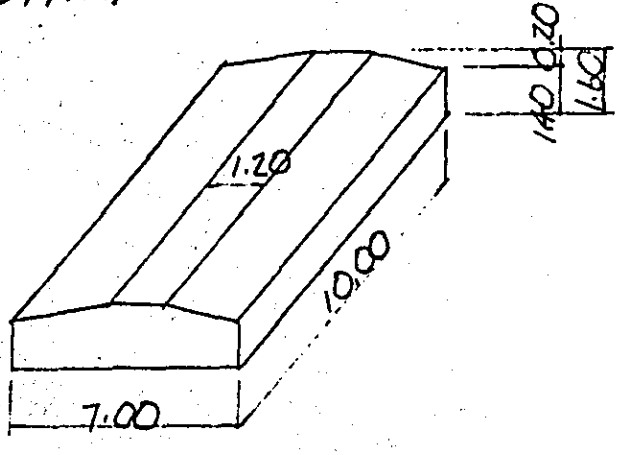
BEAM TOTAL = 25.240 m³

(2) COLUMN



$Va = \frac{1}{4} \times \pi \times 1.00 \times 4.70$	=	3.691 m^3
$Vb = 1.00 \times 8.40 \times 4.70$	=	39.480 "
COLUMN TOTAL	=	43.171 m^3

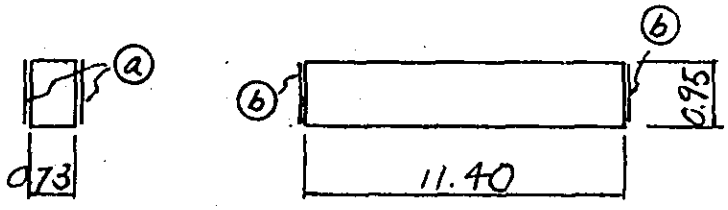
(3) FOOTING



$Va = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$	=	8.200 m^3
$Vb = 7.00 \times 1.40 \times 10.00$	=	98.000 "
FOOTING TOTAL	=	106.200 m^3

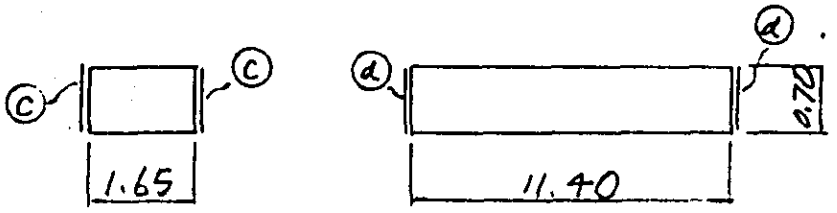
2) FORM AREA

(1) BEAM



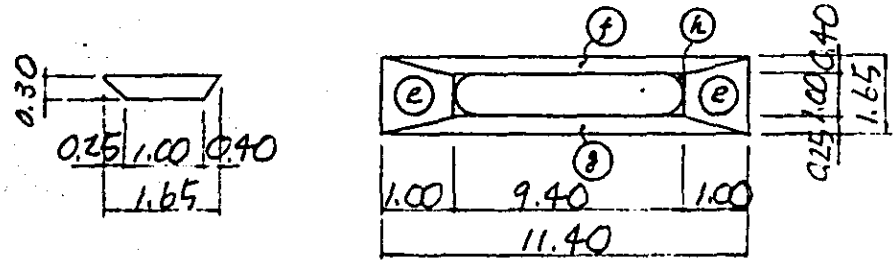
$Ae = 0.95 \times 11.40 \times 2$ = 21.660 m^2

$Ab = 0.95 \times 0.73 \times 2$ = 1.387 "



$Ac = 0.70 \times 11.40 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.65 \times 2$ = 2.310 "



$Ae = \frac{1}{2} \times (1.00 + 1.65) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.767 "

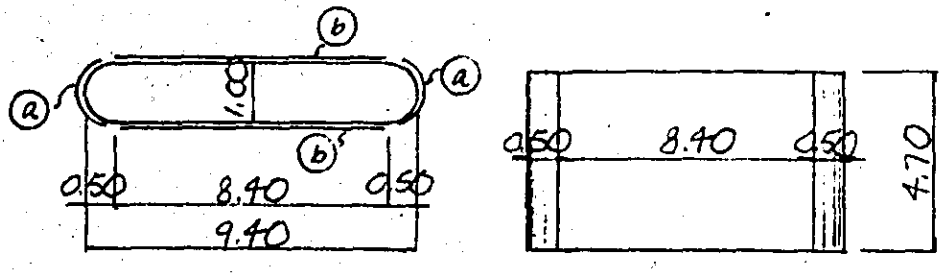
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.40^2 + 0.30^2}$ = 5.200 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ = 4.066 "

$Ak = (1 - \pi/4) \times 1.00^2$ = 0.215 "

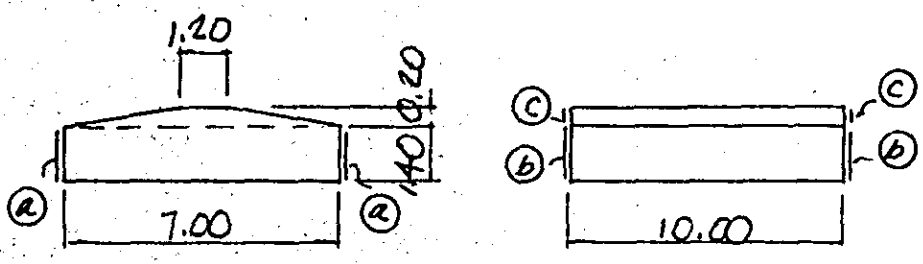
BEAM TOTAL = 53.565 m^2

(2) COLUMN



$A_a = \pi \times 1.00 \times 4.70$	=	14.765 m^2
$A_b = 8.40 \times 4.70 \times 2$	=	78.960 "
COLUMN TOTAL	=	93.725 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$	=	28.000 m^2
$A_b = 1.40 \times 7.00 \times 2$	=	19.600 "
$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	1.640 "
FOOTING TOTAL	=	49.240 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	25.2	75.642	1906.2
COLUMN	43.2	101.154	4369.9
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 376.4 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

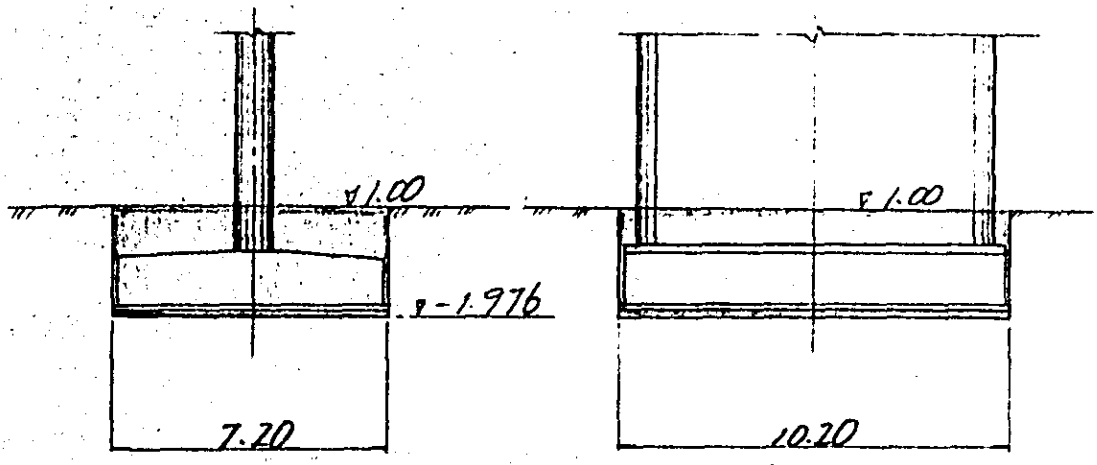
$$R = \frac{\text{REINFORCING BAR OF } P_{27}}{\text{CONCRETE VOLUME OF } P_{27}}$$

$$R_B = \frac{1202.7}{16.9} = 75.642$$

$$R_C = \frac{5199.3}{51.4} = 101.154$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION



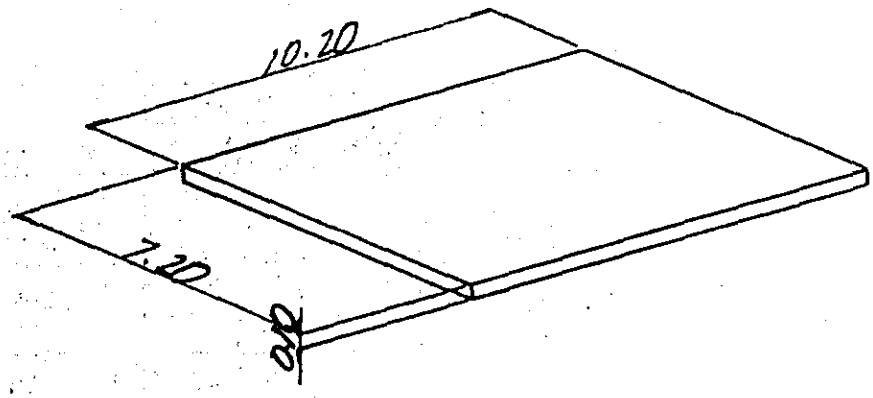
$$Va = 7.20 \times 10.20 \times (1.00 + 1.976) = 218.557\ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8$$

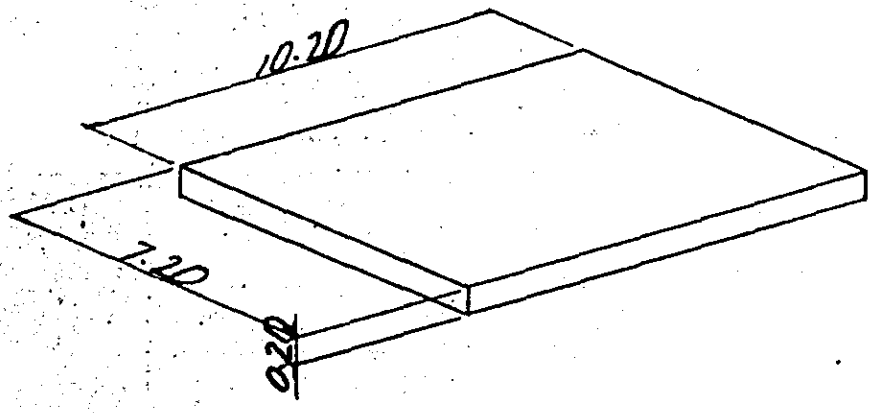
$$+ \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4 = 0.084\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ = 500

TYPE - A 14 m × 35

TYPE - B 8 m × 35

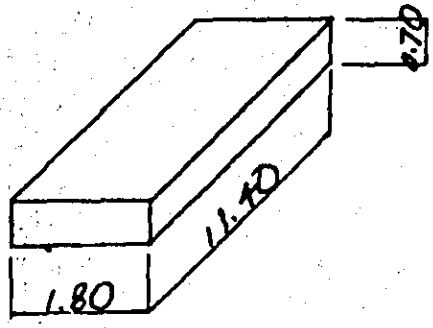
34 PIER 29

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	18.8	32.0	1644.1	87.5
COLUMN	69.8	151.6	9614.9	137.7
TOTAL	88.6	183.6	11259.0	127.1
FOOTING	106.2	49.2	6789.5	63.9

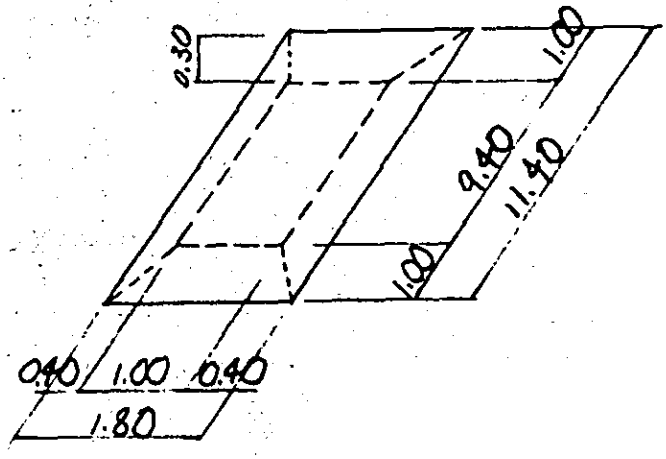
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B. - 3
EXCAVATION	m^3	380.1	
FOUNDATION MORTAR	m^3	0.1	G_{CK} = [illegible] kg/cm^2
PILE	m x NUMBER	11 x 35 8 x 35	φ500 - A φ500 - B

1) CONCRETE VOLUME

(1) BEAM



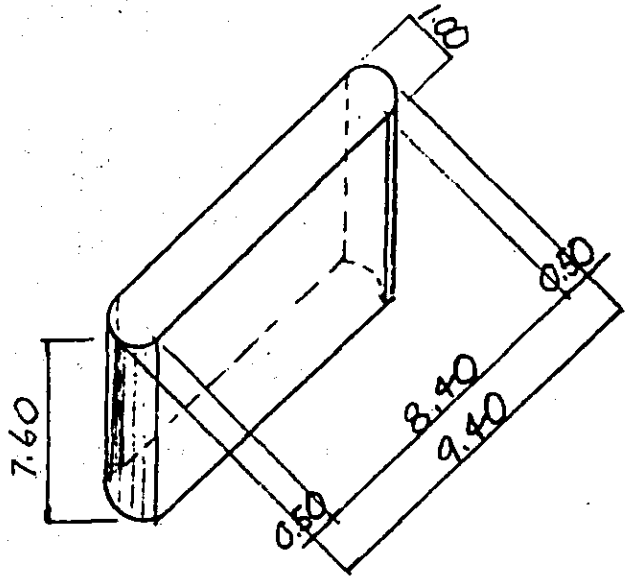
$V_a = 1.80 \times 0.70 \times 11.40$ = 14.364 m^3



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m^3

(2) COLUMN

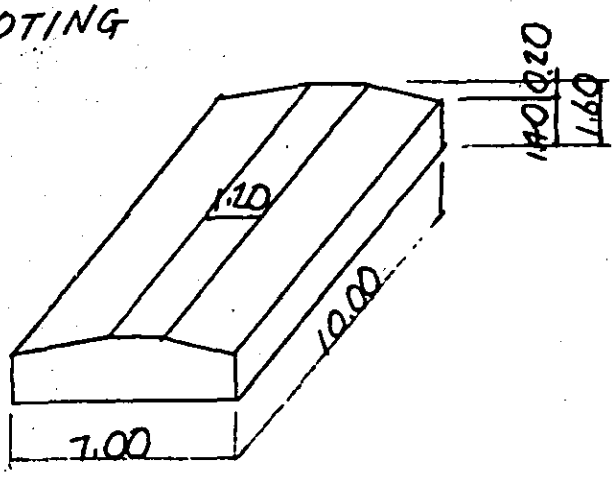


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 7.60$ = 5.969 m^3

$V_b = 1.00 \times 8.40 \times 7.60$ = 63.840 "

COLUMN TOTAL = 69.809 m^3

(3) FOOTING



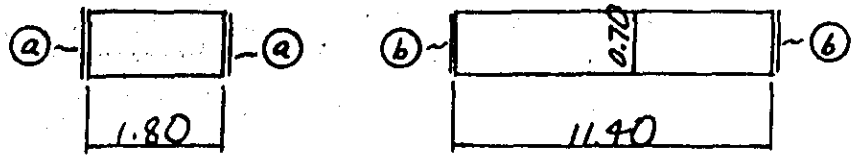
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

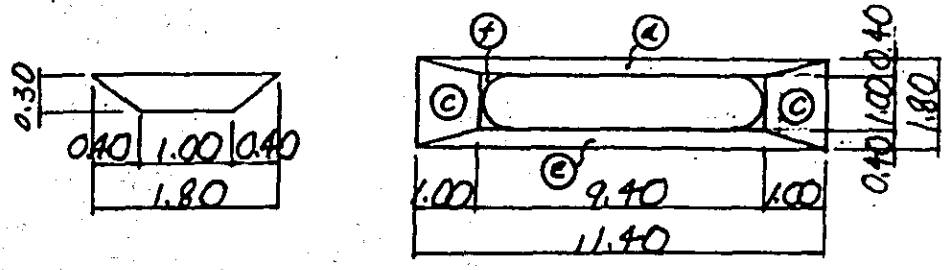
FOOTING TOTAL = 106.200 m^3

2) FORM AREA

1) BEAM

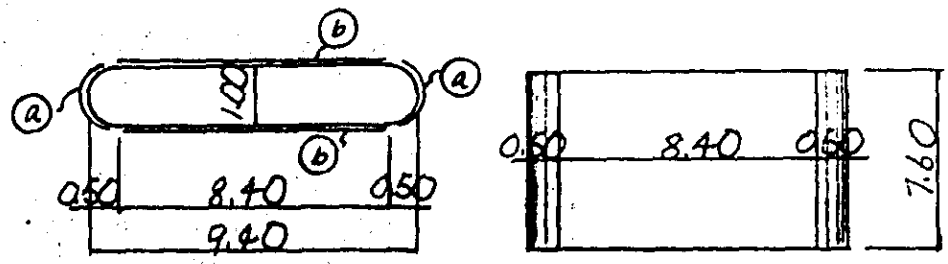


A_a = 0.70 × 11.40 × 2	=	15.960 m^2
A_b = 0.70 × 1.80 × 2	=	2.520 "



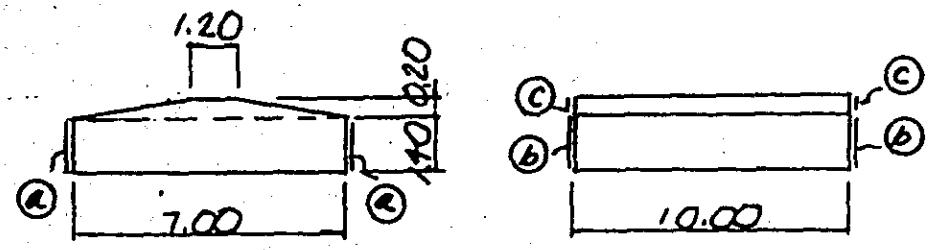
A_c = ½ × (1.00 + 1.80) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2	=	2.923 "
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.40^2 + 0.30^2}$ (0.500)	=	5.200 "
A_e = "	=	5.200 "
A_f = (1 − π/4) × 1.00²	=	0.215 "
BEAN TOTAL	=	32.018 m^2

(2) COLUMN



$A_a = \pi \times 1.00 \times 7.60$	=	23.876 m^2
$A_b = 8.40 \times 7.60 \times 2$	=	127.680 "
COLUMN TOTAL	=	151.556 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$	=	28.000 m^2
$A_b = 1.40 \times 7.00 \times 2$	=	19.600 "
$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	1.640 "
FOOTING TOTAL	=	49.240 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W=V·R (kg)
BEAM	18.8	72.601	1364.9
COLUMN	69.8	137.749	9619.9
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 279.2 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

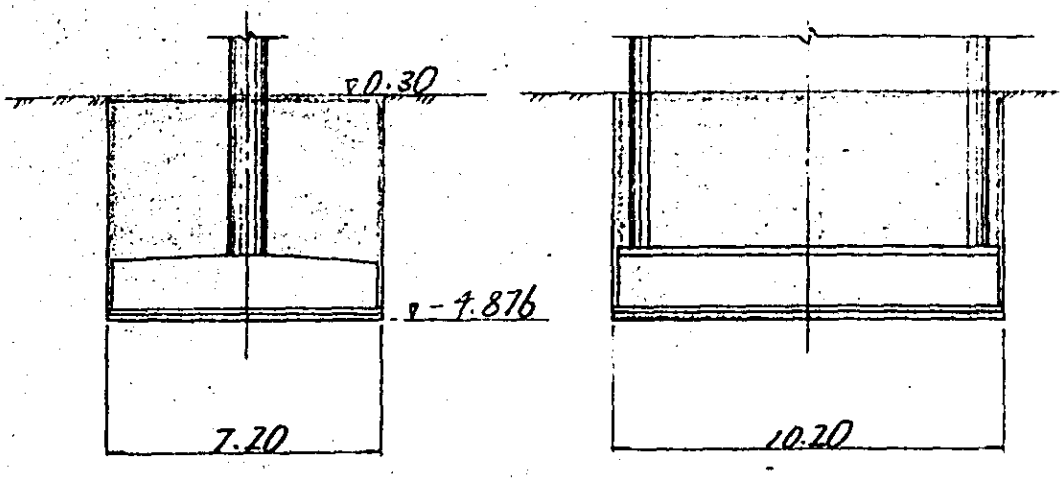
$$R = \frac{\text{REINFORCING BAR OF Po6}}{\text{CONCRETE VOLUME OF Po6}}$$

$$R_B = \frac{1328.6}{18.3} = 72.601$$

$$R_C = \frac{10882.2}{79.0} = 137.749$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

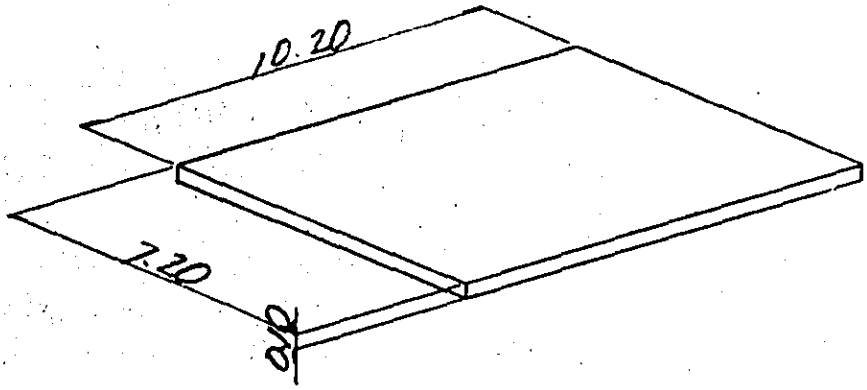


$$Va = 7.20 \times 10.20 \times (0.30 + 7.876) = 380.125\ m^3$$

5) FOUNDATION MORTAR

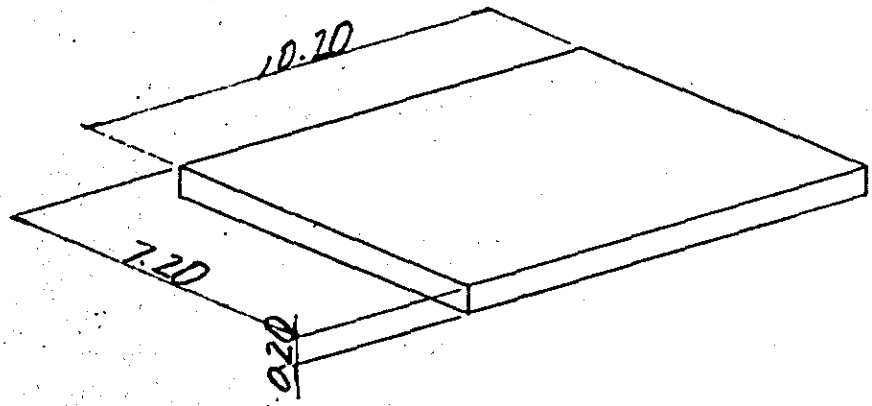
$$Va = \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 8 = 0.069\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7.) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ = 500

TYPE - A 11 m × 35

TYPE - B. 8 m × 35

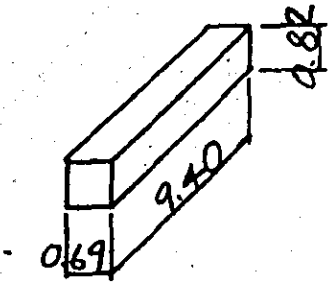
35 PIER 31

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	22.2	46.8	1946.1	87.7
COLUMN	65.2	141.6	8981.2	137.7
TOTAL	87.4	188.4	10927.3	125.0
FOOTING	106.2	49.2	6784.5	63.9

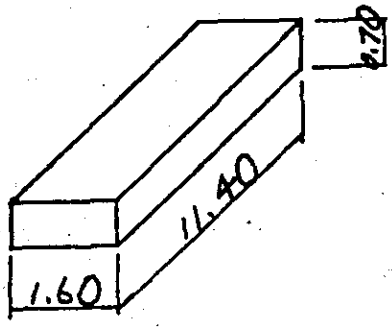
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B. - 3
EXCAVATION	m^3	388.2	
FOUNDATION MORTAR	m^3	0.1	For [illegible]
PILE	m x NUMBER	9 x 35 8 x 35	φ500 - A φ500 - B

1) CONCRETE VOLUME

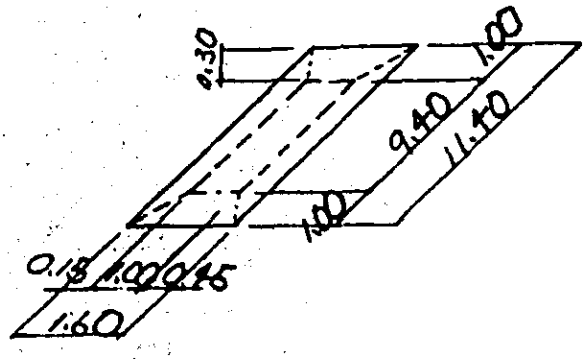
a) BEAM



$V_a = 0.69 \times 0.82 \times 9.40$ = 5.319 m³



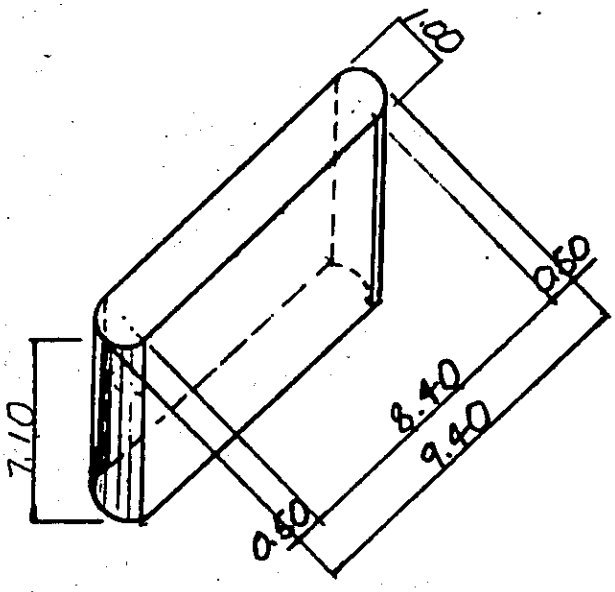
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$V_c = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.60 \times 11.40 + (1.00 + 1.60) \cdot (9.40 + 11.40)\}$ = 4.086 "

BEAM TOTAL = 22.173 m³

(2) COLUMN

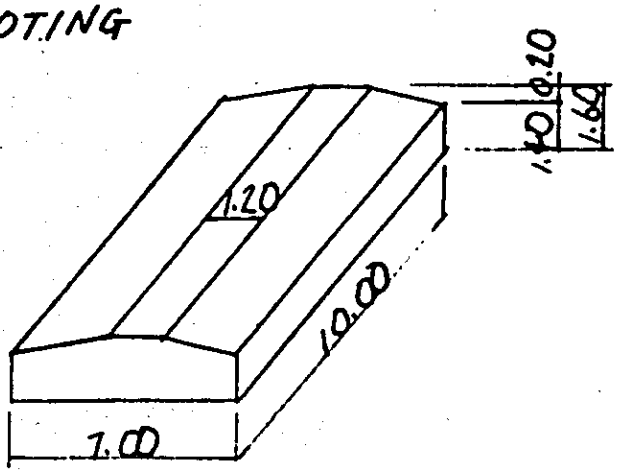


$V_a = \frac{1}{2} \times \pi \times 1.00^2 \times 7.10$ = 5.576 m^3

$V_b = 1.00 \times 8.40 \times 7.10$ = 59.640 "

COLUMN TOTAL = 65.216 m^3

(3) FOOTING



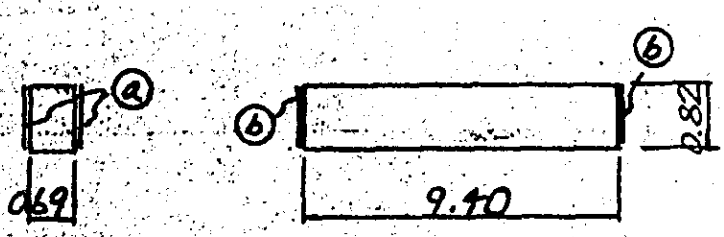
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

FOOTING TOTAL = 106.200 m^3

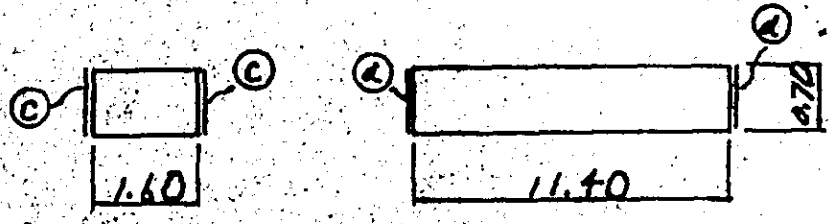
2) FORM AREA

a) BEAM



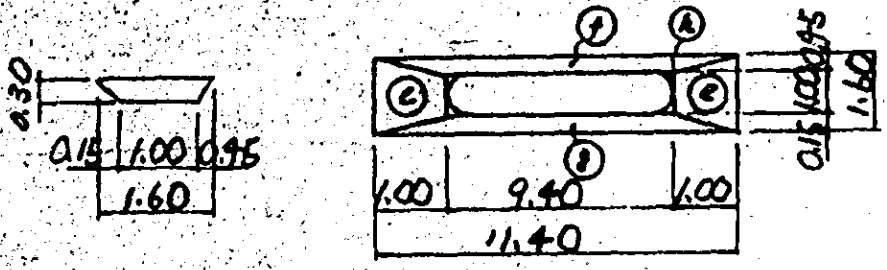
$Ac = 0.82 \times 9.40 \times 2$ = 15.416 m²

$Ab = 0.82 \times 0.69 \times 2$ = 1.132 "



$Ac = 0.70 \times 11.40 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.60 \times 2$ = 2.240 "



$Ae = \frac{1}{2} \times (1.00 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.044) = 2.714 "

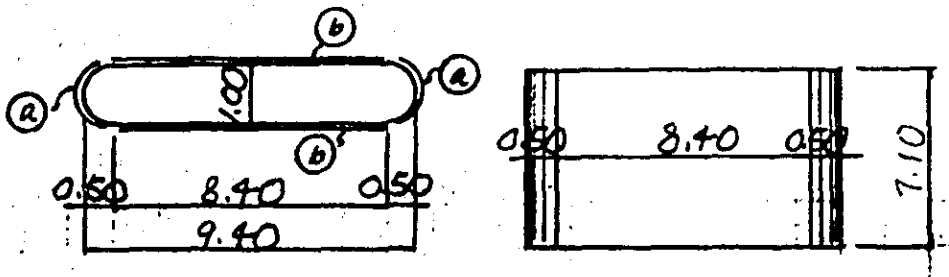
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$ (0.541) = 5.626 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.15^2 + 0.30^2}$ (0.335) = 3.484 "

$Ah = (1 - \pi/4) \times 1.00^2$ = 0.215 "

BEAM TOTAL = 46.787 m²

(2) COLUMN

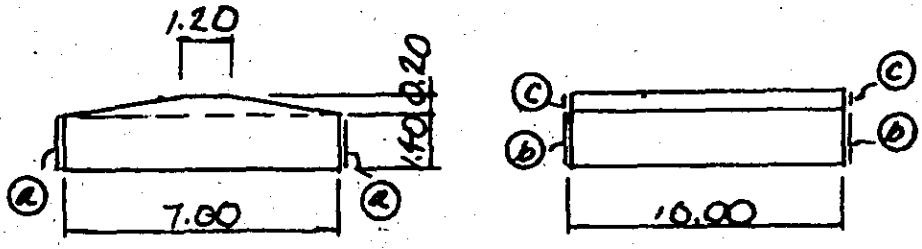


Aa = π × 1.00 × 7.10 = 22.305 m²

Ab = 8.40 × 7.10 × 2 = 119.280 "

COLUMN TOTAL = 141.585 m²

(3) FOOTING



Aa = 1.40 × 10.00 × 2 = 28.000 m²

Ab = 1.40 × 7.00 × 2 = 19.600 "

Ac = ½ × (1.20 + 7.00) × 0.20 × 2 = 1.640 "

FOOTING TOTAL = 49.240 m²

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W = V · R (kg)
BEAM	22.2	72.601	1611.7
COLUMN	65.2	137.749	8981.2
FOOTING	106.2	63.884	6789.5

BEARING BASE D16 334.4 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

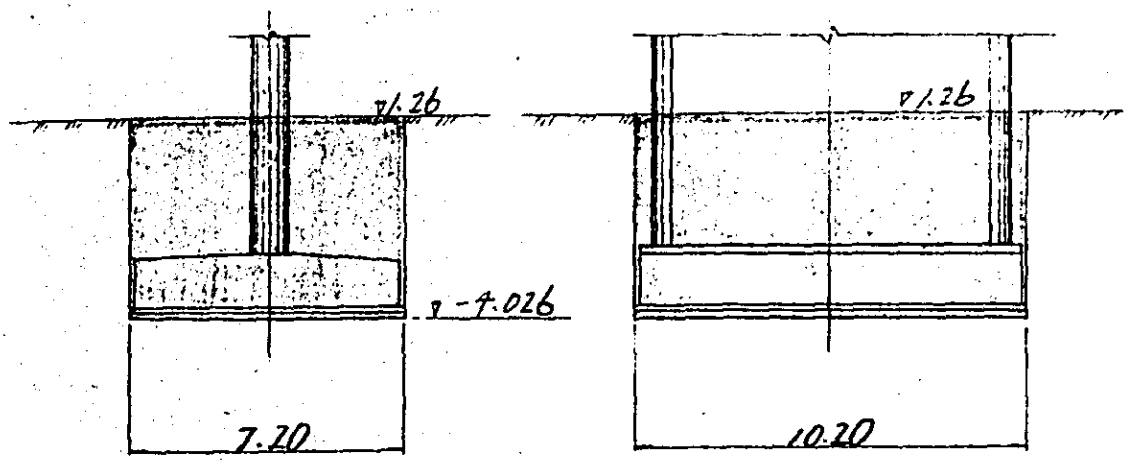
$$R = \frac{\text{REINFORCING BAR OF P06}}{\text{CONCRETE VOLUME OF P06}}$$

$$R_B = \frac{1328.6}{18.3} = 72.601$$

$$R_C = \frac{10882.2}{79.0} = 137.749$$

$$R_F = \frac{6789.5}{106.2} = 63.884$$

4) EXCAVATION

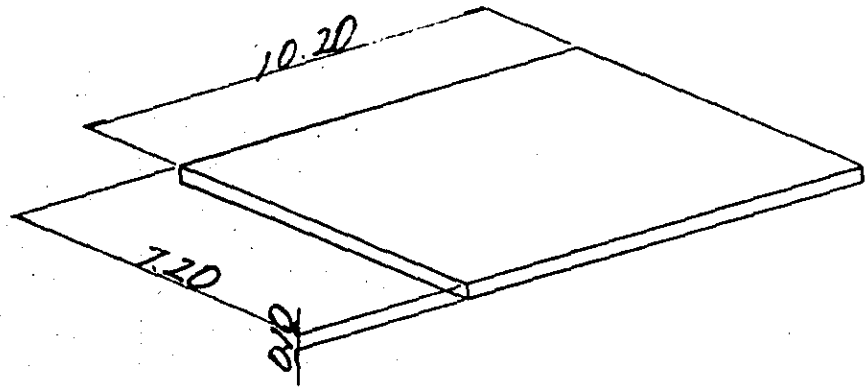


$$Va = 7.20 \times 10.20 \times (1.26 + 4.026) = 388.204\ m^3$$

5) FOUNDATION MORTAR

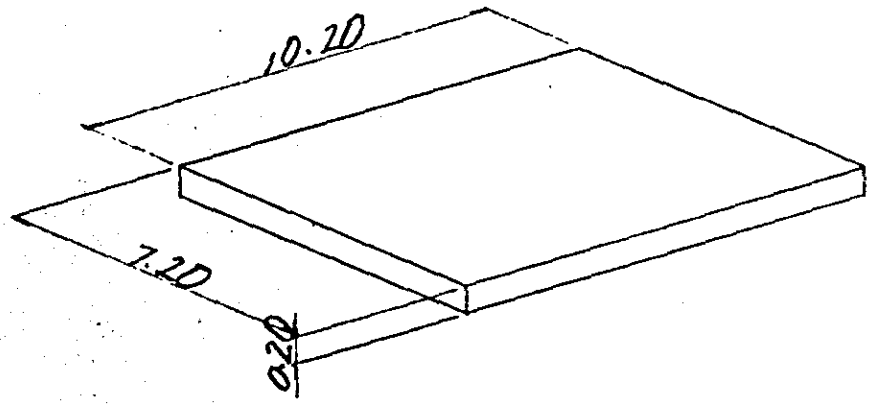
$$Va = \tfrac{1}{2} \times (0.872 \times 0.572 + 0.80 \times 0.50) \times 0.036 \times 3$$
$$+ \tfrac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 8 = 0.110\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ = 500

TYPE - A 9 m × 35

TYPE - B 8 m × 35

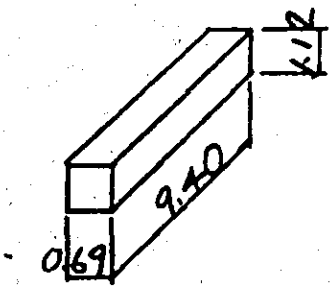
36 PIER 32

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	24.1	52.8	2094.5	86.9
COLUMN	65.2	141.6	8981.2	137.7
TOTAL	89.3	194.4	11075.7	124.0
FOOTING	106.2	49.2	6784.5	63.9

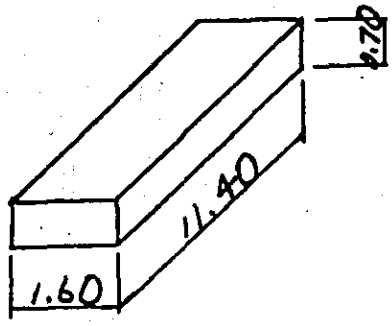
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS II
AGGREGATE SUBBASE	m^3	14.7	A.S.B - 3
EXCAVATION	m^3	331.7	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 Kg/cm²
PILE	m × NUMBER	9 × 35 8 × 35	φ500 - A φ500 - B

1) CONCRETE VOLUME

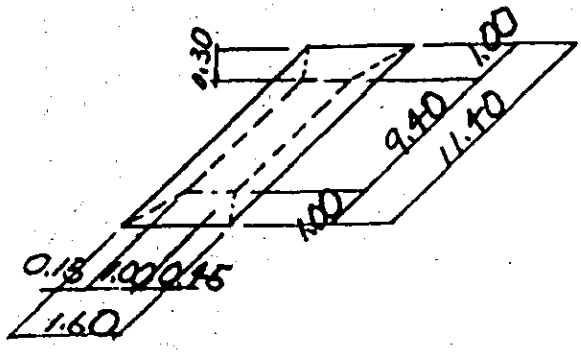
a) BEAM



$V_a = 0.69 \times 1.12 \times 9.40$ ..... = 7.264 m³



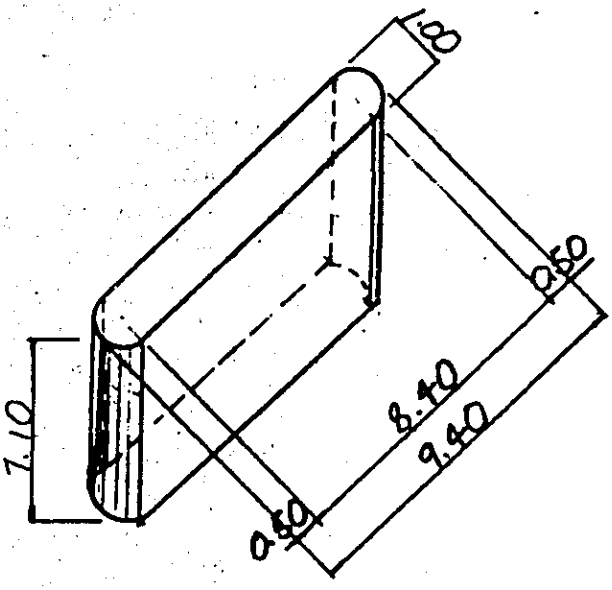
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$V_c = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.60 \times 11.40$
$+ (1.00 + 1.60) \cdot (9.40 + 11.40)\}$ = 4.086 "

BEAM TOTAL = 24.118 m³

(2) COLUMN

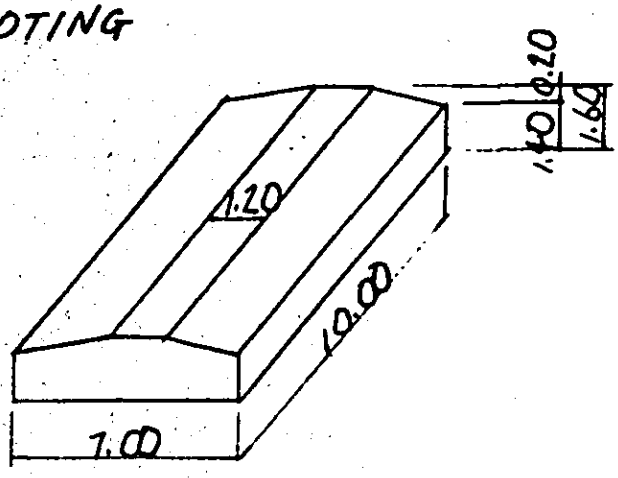


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 7.10$ = 5.576 m^3

$V_b = 1.00 \times 8.40 \times 7.10$ = 59.640 "

COLUMN TOTAL = 65.216 m^3

(3) FOOTING



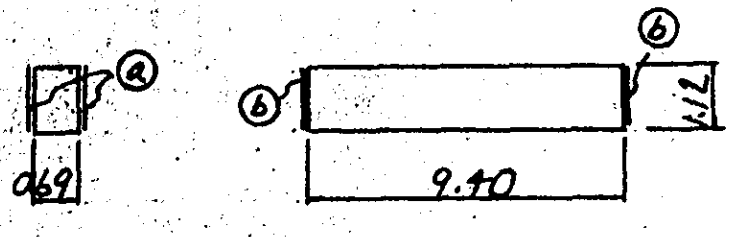
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

FOOTING TOTAL = 106.200 m^3

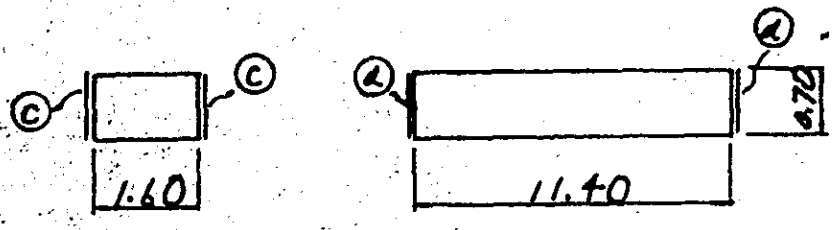
2) FORM AREA

a) BEAM



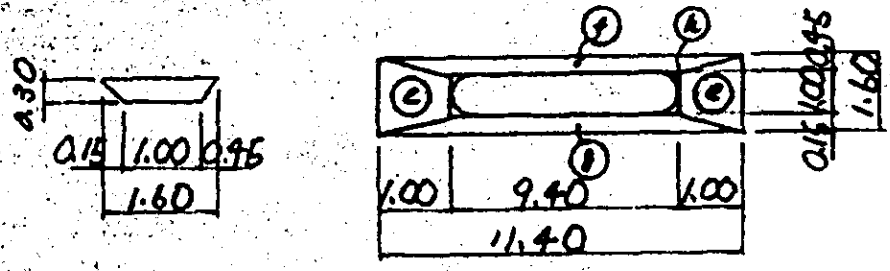
$A_a = 1.12 \times 9.40 \times 2$ = 21.056 m²

$A_b = 1.12 \times 0.69 \times 2$ = 1.546 "



$A_c = 0.70 \times 11.40 \times 2$ = 15.960 "

$A_d = 0.70 \times 1.60 \times 2$ = 2.240 "



$A_e = \frac{1}{2} \times (1.00 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.044) = 2.714 "

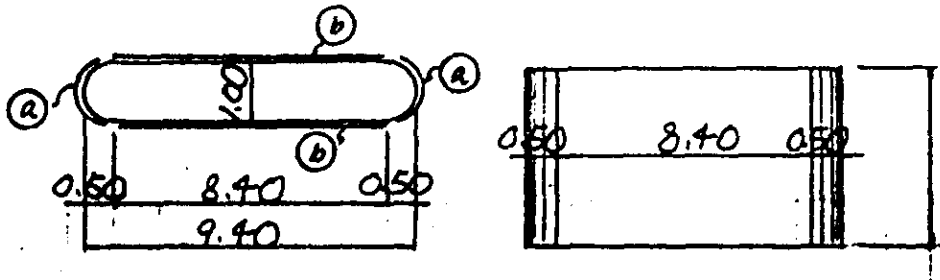
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$ (0.541) = 5.626 "

$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.15^2 + 0.30^2}$ (0.335) = 3.484 "

$A_h = (1 - \pi/4) \times 1.00^2$ = 0.215 "

BEAM TOTAL = 52.841 m²

(2) COLUMN

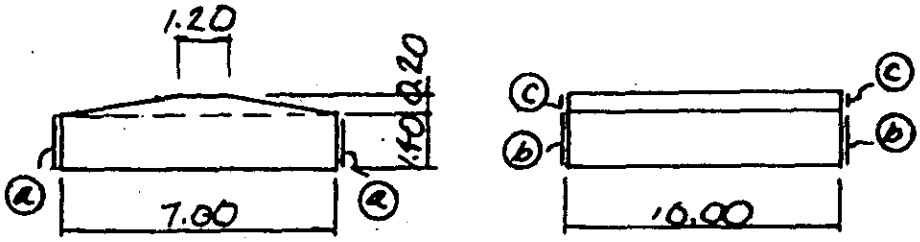


Aa = π × 1.00 × 7.10 = 22.305 m²

Ab = 8.40 × 7.10 × 2 = 119.280

COLUMN TOTAL = 141.585 m²

(3) FOOTING



Aa = 1.40 × 10.00 × 2 = 28.000 m²

Ab = 1.40 × 7.00 × 2 = 19.600 "

Ac = ½ × (1.20 + 7.00) × 0.20 × 2 = 1.640 "

FOOTING TOTAL = 49.240 m²

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	24.1	72.601	1749.7
COLUMN	65.2	137.749	8981.2
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 347.8 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

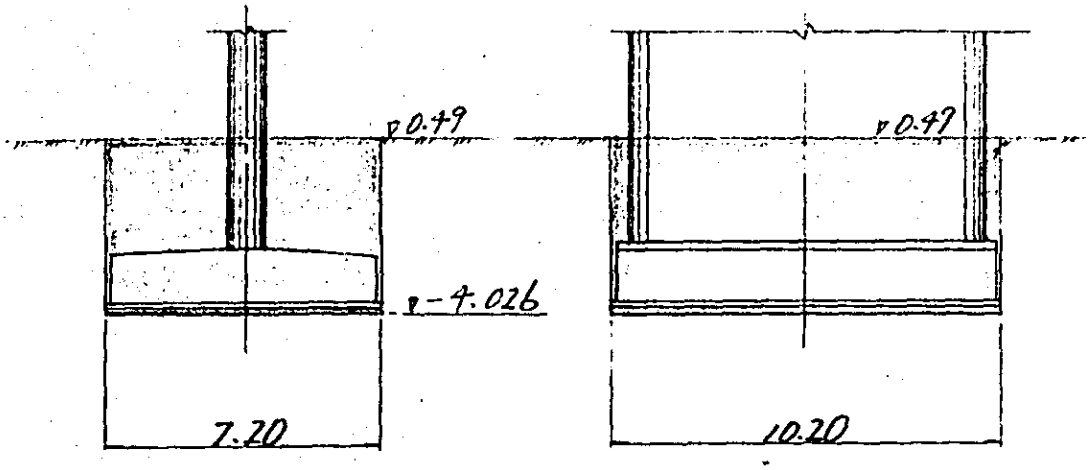
$$R = \frac{\text{REINFORCING BAR OF Fo6}}{\text{CONCRETE VOLUME OF Fo6}}$$

$$R_B = \frac{1328.6}{18.3} = 72.601$$

$$R_C = \frac{10882.2}{79.0} = 137.749$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

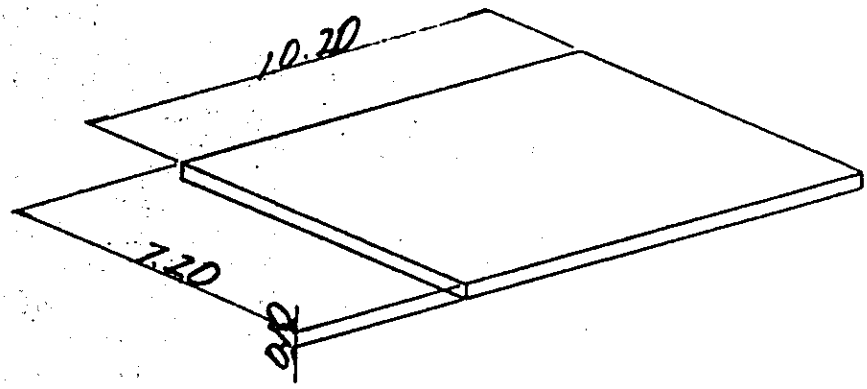


$$Va = 7.20 \times 10.20 \times (0.49 + 4.026) = 331.655\ m^3$$

5) FOUNDATION MORTAR

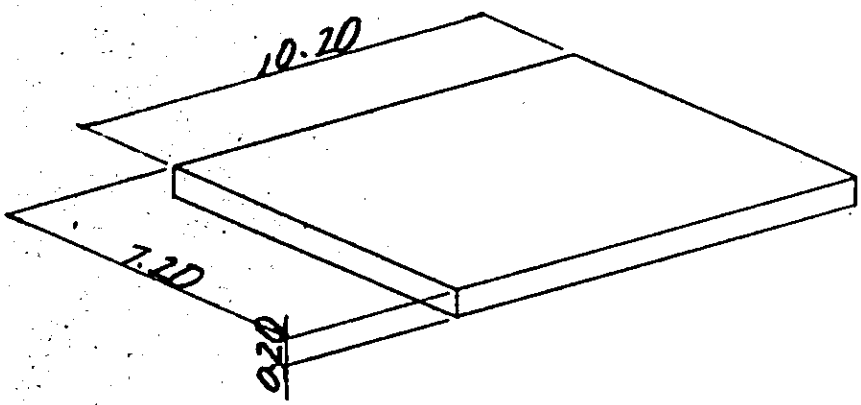
$$Va = \tfrac{1}{2} \times (0.836 \times 0.536 + 0.80 \times 0.50) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.118\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ = 500

TYPE - A 9 m × 35

TYPE - B 8 m × 35

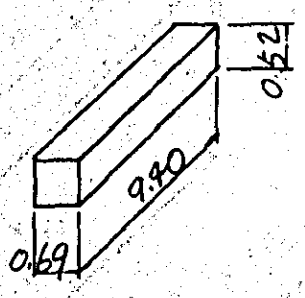
37 PIER 33.

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	19.0	40.9	1876.9	98.8
COLUMN	38.4	102.5	4981.2	129.7
TOTAL	57.4	143.4	6858.1	119.5
FOOTING	67.0	35.4	4576.3	68.3

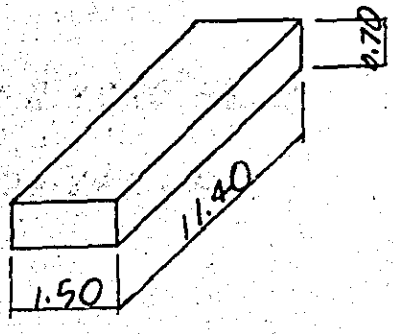
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B.-3
EXCAVATION	m^3	156.2	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm-
PILE	m. × NUMBER	11 × 24 8 × 24	φ500-A φ500-B

1) CONCRETE VOLUME

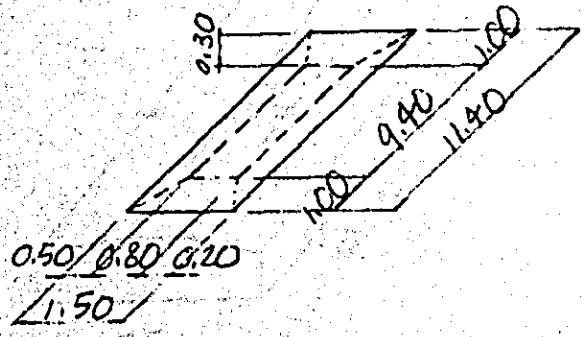
(1) BEAM



$Va = 0.69 \times 0.52 \times 9.40$ = 3.373 m³



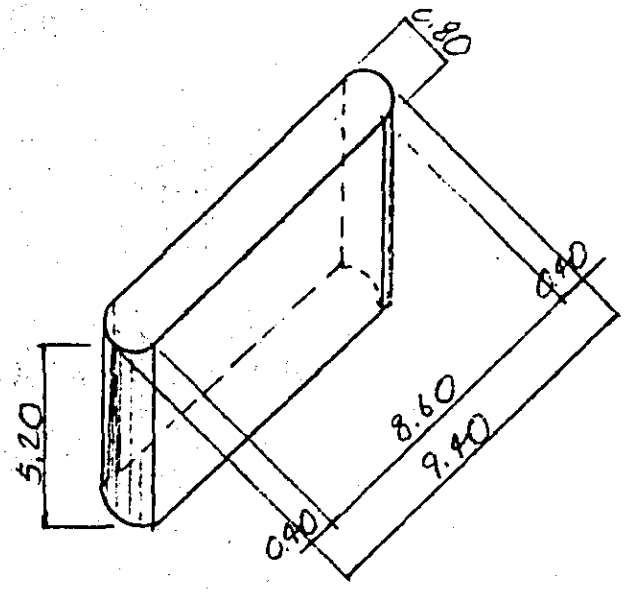
$Vb = 1.50 \times 0.70 \times 11.40$ = 11.970 "



$Vc = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.50 \times 11.40 + (0.80 + 1.50) \cdot (9.40 + 11.40)\}$ = 3.623 "

BEAM TOTAL = 18.966 m³

(2) COLUMN

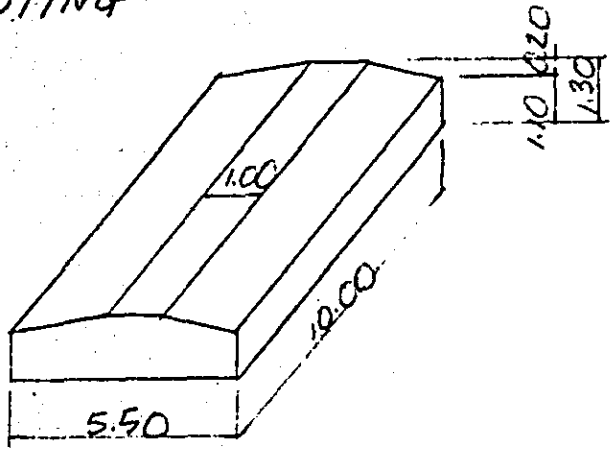


$Va = \frac{1}{4} \times \pi \times 0.80^2 \times 5.20$ = 2.614 m^3

$Vb = 0.80 \times 8.60 \times 5.20$ = 35.776 "

COLUMN TOTAL = 38.390 m^3

(3) FOOTING



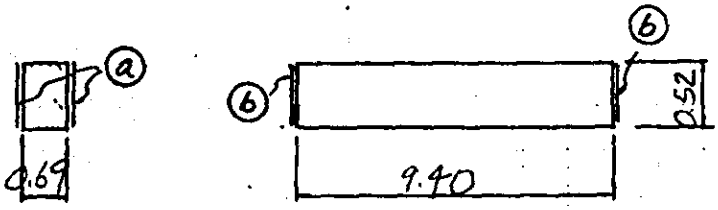
$Va = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$Vb = 5.50 \times 1.10 \times 10.00$ = 60.500

FOOTING TOTAL = 67.000 m^3

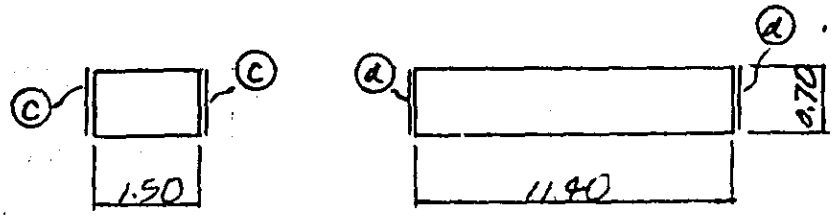
2) FORM AREA

(1) BEAM



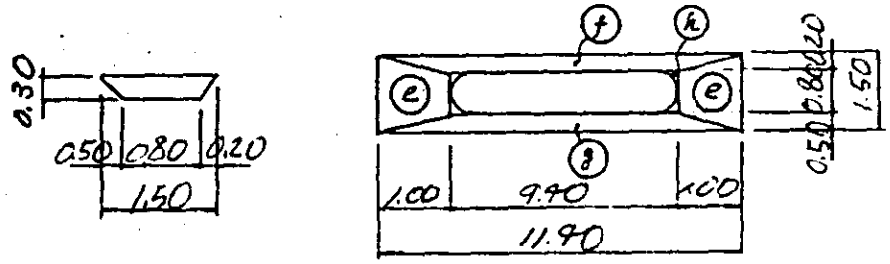
Ae = 0.52 × 9.40 × 2 = 9.776 m²

Ab = 0.52 × 0.69 × 2 = 0.718 "



Ac = 0.70 × 11.40 × 2 = 15.960 "

Ad = 0.70 × 1.50 × 2 = 2.100 "



Ae = ½ × (0.80 + 1.50) × √(1.00² + 0.30²) × 2 = 2.401 "

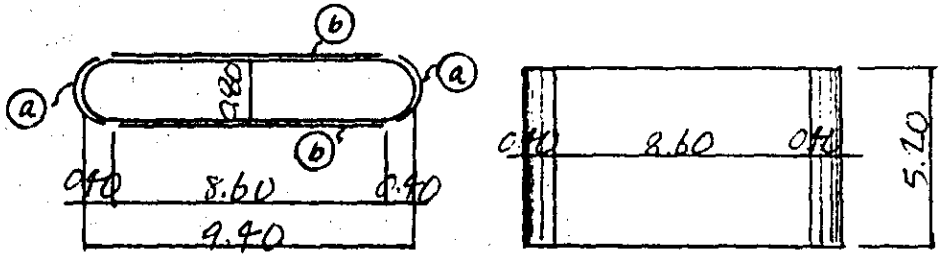
Af = ½ × (9.40 + 11.40) × √(0.20² + 0.30²) = 3.754 "

Ag = ½ × (9.40 + 11.40) × √(0.50² + 0.30²) = 6.063 "

Ah = (1 − π/4) × 0.80² = 0.137 "

BEAM TOTAL = 40.909 m²

(2) COLUMN

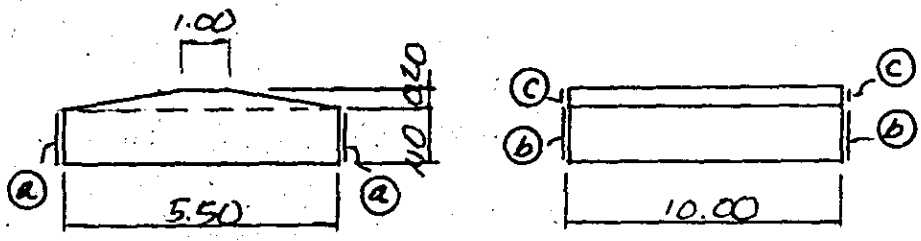


$A_a = \pi \times 0.80 \times 5.20$ = 13.069 m^2

$A_b = 8.60 \times 5.20 \times 2$ = 89.440 "

COLUMN TOTAL = 102.509 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m^2

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = 1/2 \cdot (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	19.0	82.361	1564.9
COLUMN	38.4	129.720	4981.2
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 312.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

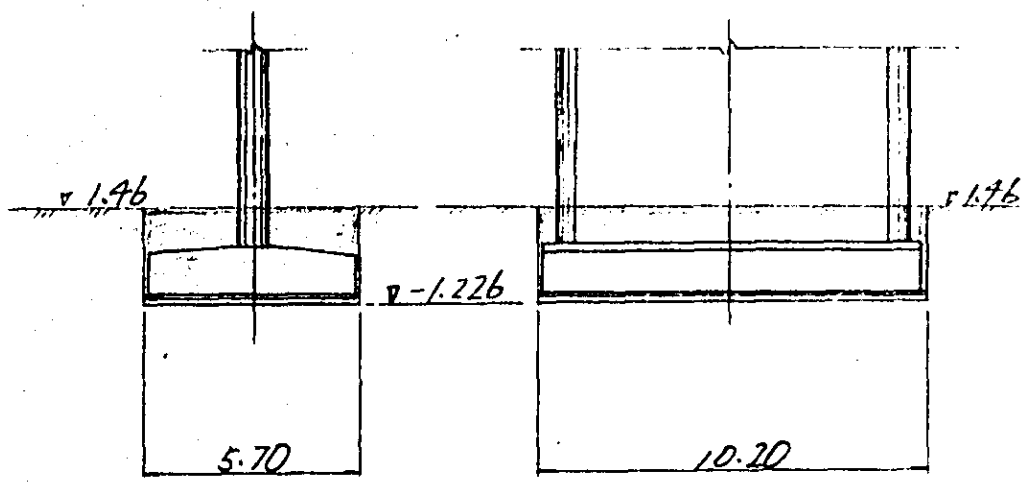
$$R = \frac{\text{REINFORCING BAR OF } P_{30}}{\text{CONCRETE VOLUME OF } P_{30}}$$

$$R_B = \frac{1984.9}{24.1} = 82.361$$

$$R_C = \frac{7277.3}{56.1} = 129.720$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION

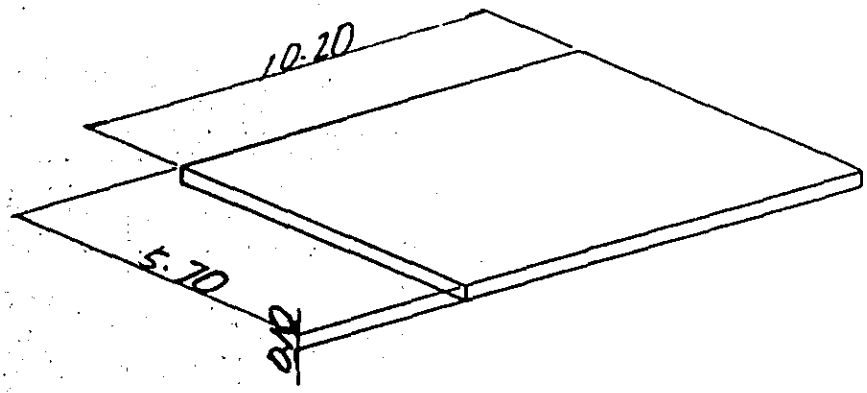


$$Va = 5.70 \times 10.20 \times (1.46 + 1.226) = 156.164 \ m^3$$

5) FOUNDATION MORTAR

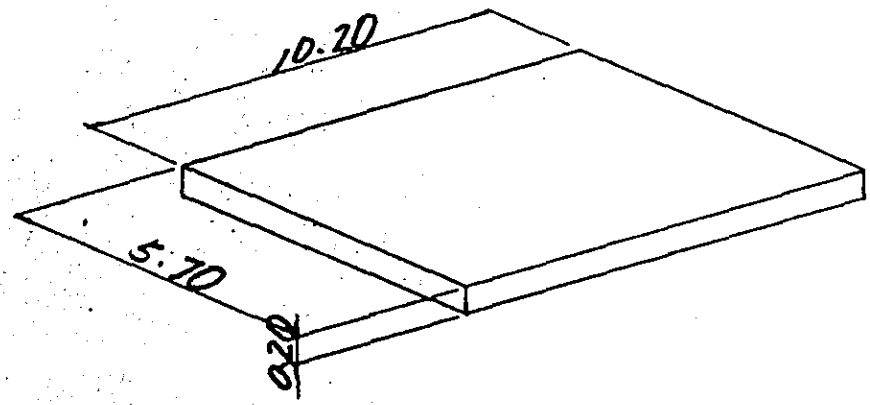
$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$
$$+ \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.70) \times 0.018 \times 8 = 0.106 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

ϕ = 500

TYPE - A 11 m × 24

TYPE - B 8 m × 24

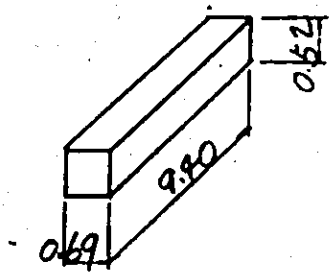
38 PIER 34

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	19.0	40.9	1876.9	98.8
COLUMN	38.4	102.5	4981.2	129.7
TOTAL	57.4	143.4	6858.1	119.5
FOOTING	67.0	35.4	4576.3	68.3

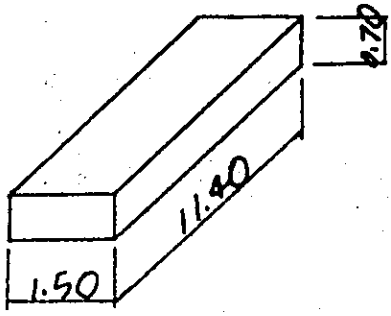
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B. - 3
EXCAVATION	m^3	155.0	
FOUNDATION MORTAR	m^3	0.1	[illegible]
PILE	m x NUMBER	11 x 24 8 x 24	φ500 - A φ500 - B

1) CONCRETE VOLUME

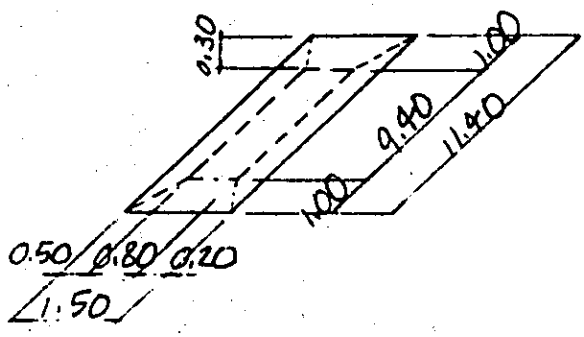
(1) BEAM



$Va = 0.69 \times 0.52 \times 9.40$ = 3.373 m³



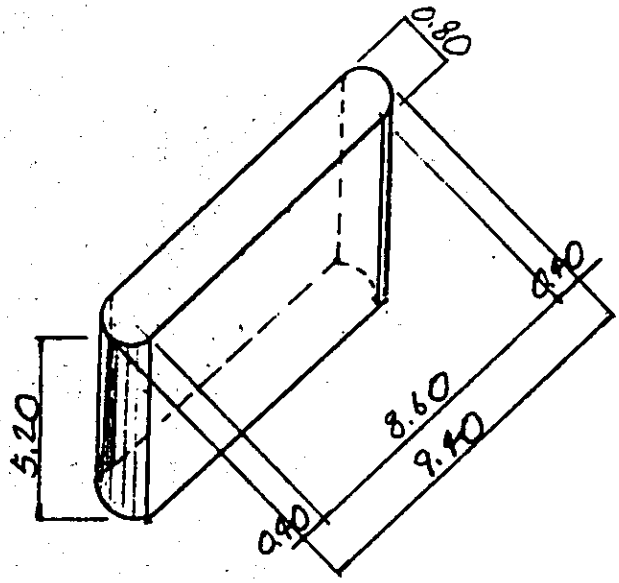
$Vb = 1.50 \times 0.70 \times 11.40$ = 11.970 "



$Vc = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.50 \times 11.40 + (0.80 + 1.50) \cdot (9.40 + 11.40)\}$ = 3.623 "

BEAM TOTAL = 18.966 m³

(2) COLUMN

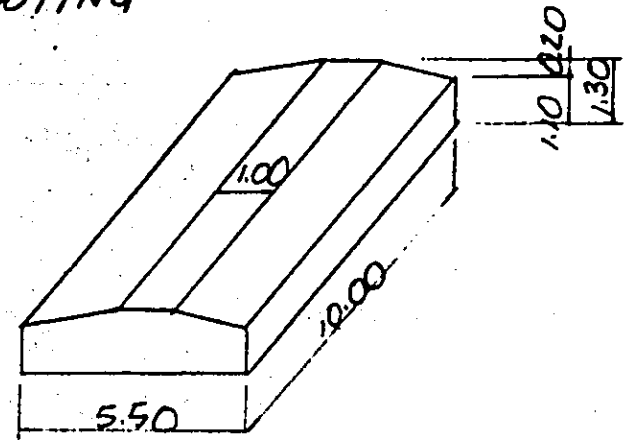


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 5.20$ = 2.614 m^3

$V_b = 0.80 \times 8.60 \times 5.20$ = 35.776 "

COLUMN TOTAL = 38.390 m^3

(3) FOOTING



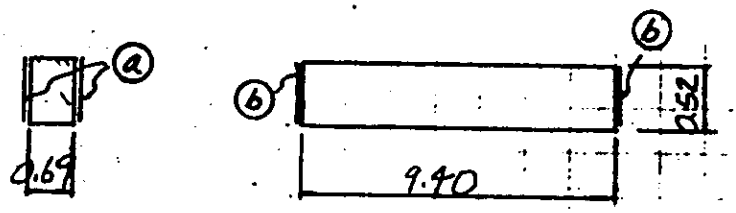
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m^3

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m^3

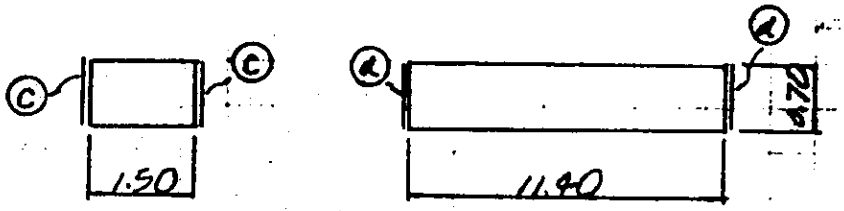
2) FORM AREA

(1) BEAM



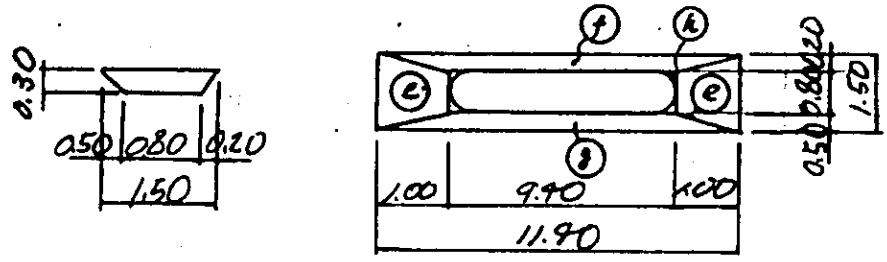
$Ae = 0.52 \times 9.40 \times 2$ = 9.776 m²

$Ab = 0.52 \times 0.69 \times 2$ = 0.718 "



$Ac = 0.70 \times 11.90 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.50 \times 2$ = 2.100 "



$Ae = \frac{1}{2} \times (0.80 + 1.50) \times \sqrt{100^2 + 0.30^2} \times 2$ (1.644) = 2.401 "

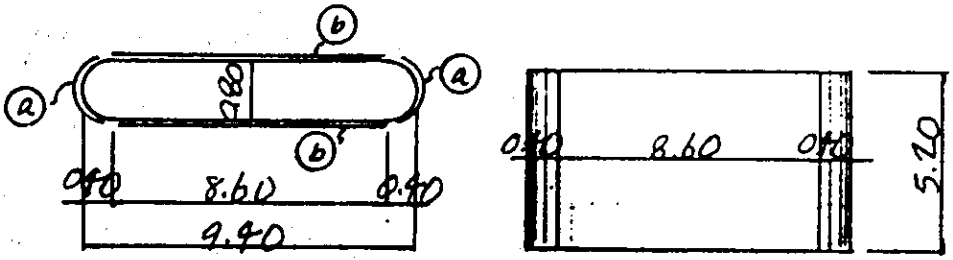
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.20^2 + 0.30^2}$ (0.361) = 3.754 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.50^2 - 0.30^2}$ (0.583) = 6.063 "

$Ah = (1 - \pi/4) \times 0.80^2$ = 0.137 "

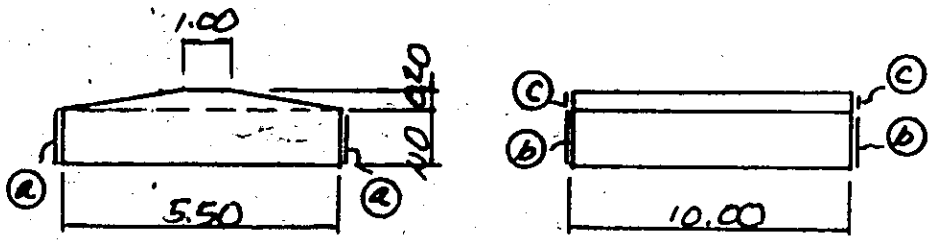
BEAM TOTAL = 40.909 m²

(2) COLUMN



$Aa = \pi \times 0.80 \times 5.20$	=	13.069 m^2
$Ab = 8.60 \times 5.20 \times 2$	=	89.44 "
COLUMN TOTAL	=	102.509 m^2

(3) FOOTING



$Aa = 1.10 \times 10.00 \times 2$	=	22.000 m^2
$Ab = 1.10 \times 5.50 \times 2$	=	12.100 "
$Ac = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$	=	1.300 "
FOOTING TOTAL	=	35.400 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	19.0	82.361	1564.9
COLUMN	38.4	129.720	4981.2
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 312.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

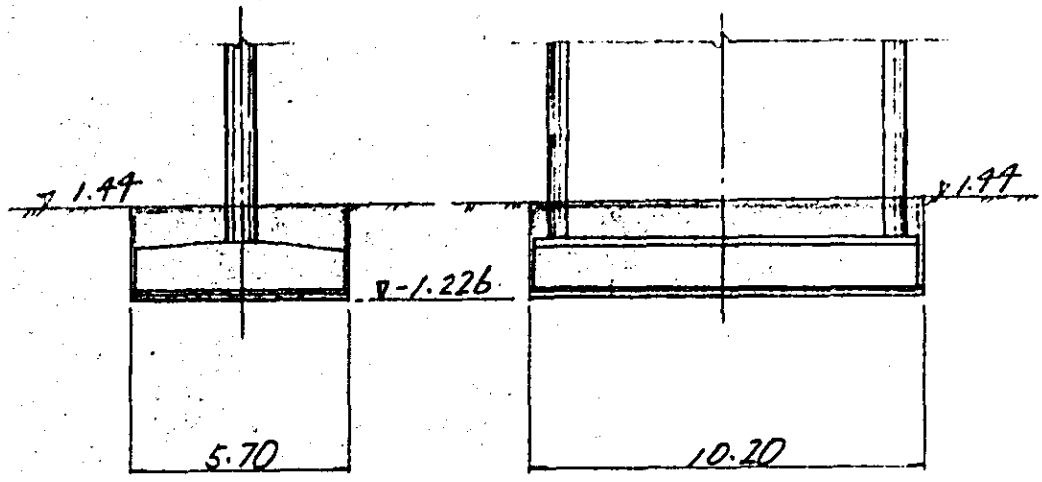
$$R = \frac{\text{REINFORCING BAR OF } F_{30}}{\text{CONCRETE VOLUME OF } P_{30}}$$

$$R_B = \frac{1984.9}{24.1} = 82.361$$

$$R_C = \frac{7277.3}{56.1} = 129.720$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION

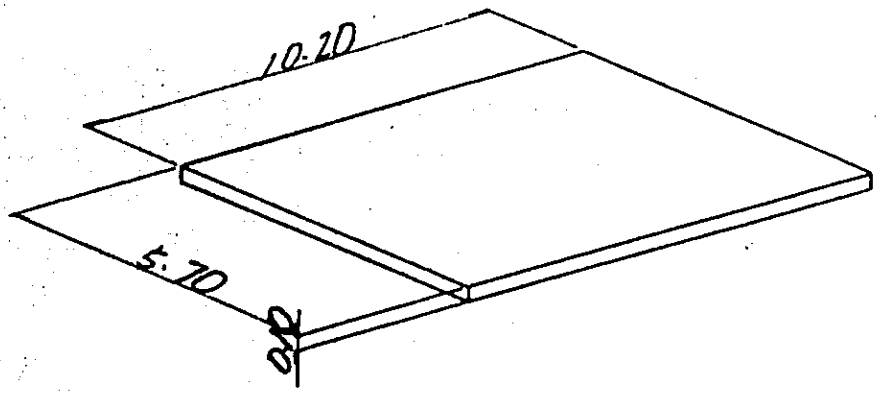


$$Va = 5.70 \times 10.20 \times (1.44 + 1.226) = 155.001 \ m^3$$

5) FOUNDATION MORTAR

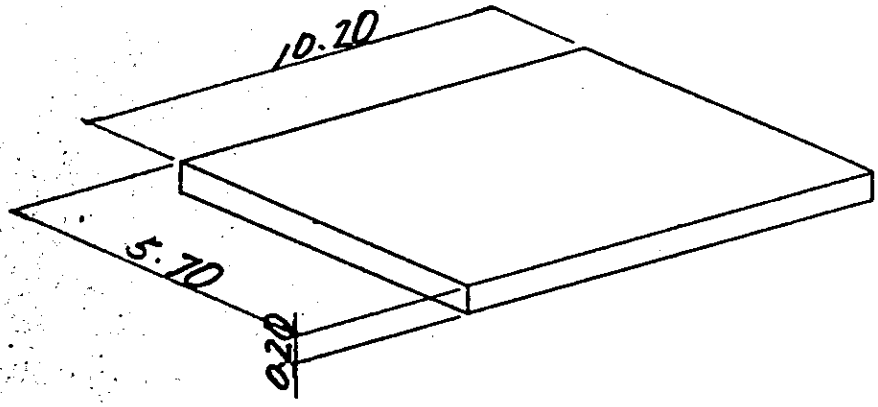
$$Va = \tfrac{1}{2} \times (0.836 \times 0.436 + 0.80 \times 0.40) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.106 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

φ - 500

TYPE - A 11 m × 24

TYPE - B 8 m × 24

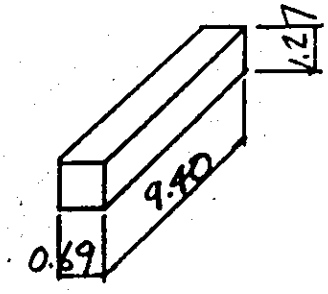
139 PIER 35

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	24.8	57.0	2 409.3	97.1
COLUMN	34.0	90.7	4 196.5	123.4
TOTAL	58.8	147.7	6 605.8	112.3
FOOTING	67.0	35.4	4 576.3	68.3

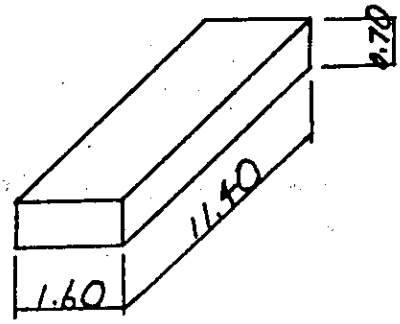
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B - 3
EXCAVATION	m^3	299.8	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm^2
PILE	m x NUMBER	14 x 28	ϕ500 - B

1) CONCRETE VOLUME

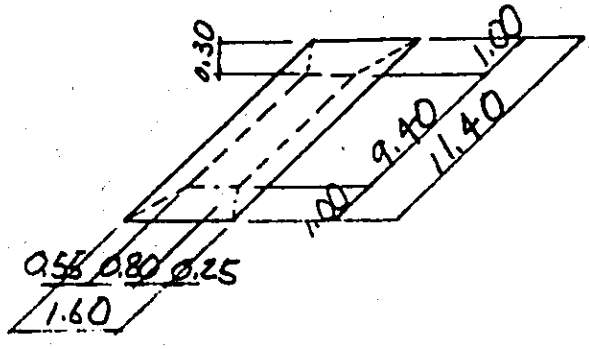
(1) BEAM



$V_a = 0.69 \times 1.27 \times 9.40$ = 8.237 m³



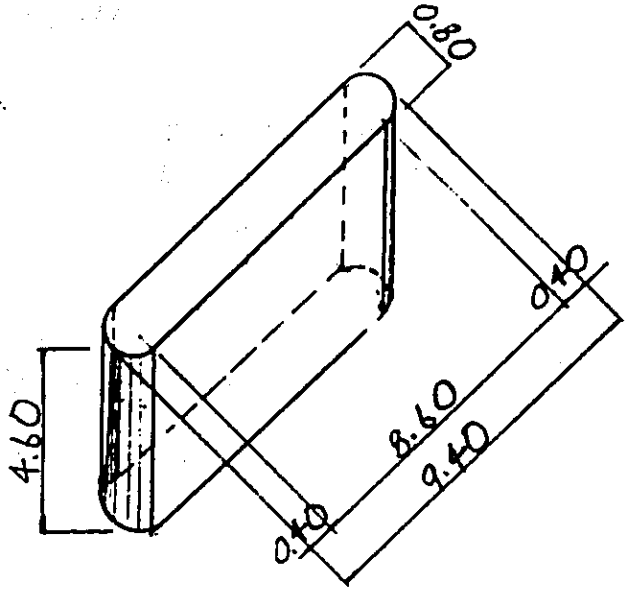
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$V_c = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.60 \times 11.40$
$+ (0.80 + 1.60) \cdot (9.40 + 11.40)\}$ = 3.784 "

BEAM TOTAL = 24.789 m³

(2) COLUMN

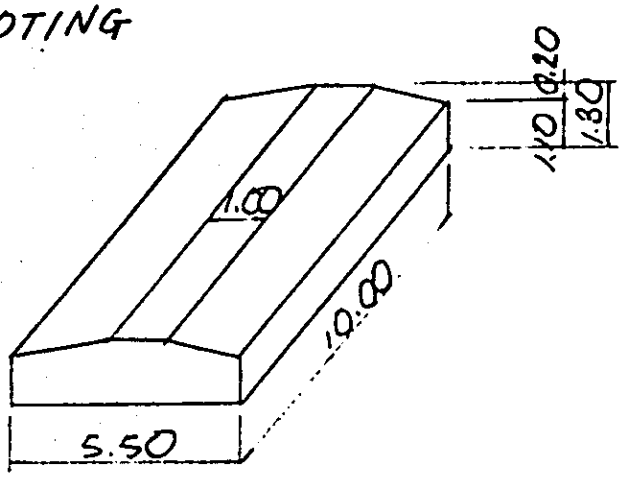


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.60$ = 2.312 m³

$V_b = 0.80 \times 8.60 \times 4.60$ = 31.648 "

COLUMN TOTAL = 33.960 m³

(3) FOOTING



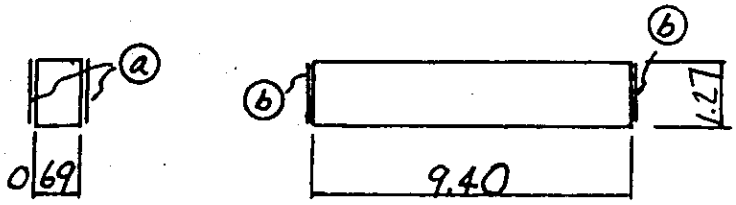
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m³

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

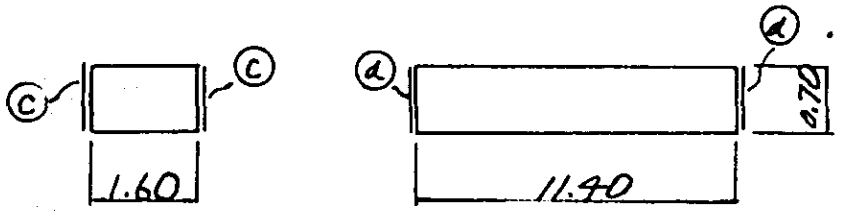
FOOTING TOTAL = 67.000 m³

2) FORM AREA

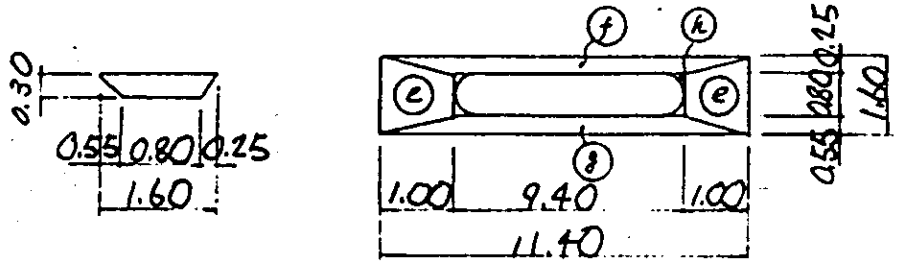
(1) BEAM



$A_a = 1.27 \times 9.40 \times 2$	=	23.876	m²
$A_b = 1.27 \times 0.69 \times 2$	=	1.753	"

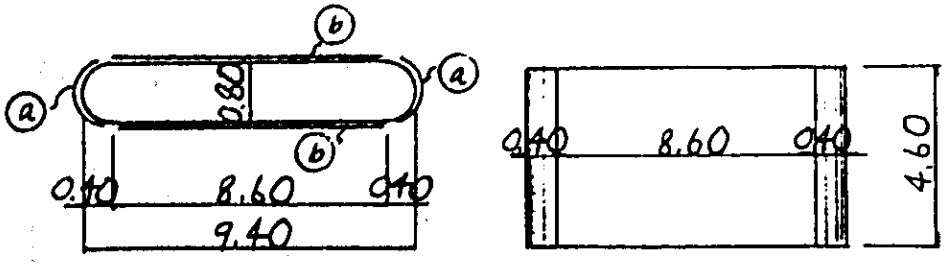


$A_c = 0.70 \times 1.60 \times 2$	=	2.240	"
$A_d = 0.70 \times 11.40 \times 2$	=	15.960	"



$A_e = \frac{1}{2} \times (0.80 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (1.044)	=	2.506	"
$A_f = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.25^2 + 0.30^2}$ (0.391)	=	4.066	"
$A_g = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.55^2 + 0.30^2}$ (1.121)	=	6.510	"
$A_k = (1 - \pi/4) \times 0.80^2$	=	0.137	"
BEAM TOTAL	=	57.048	m²

(2) COLUMN

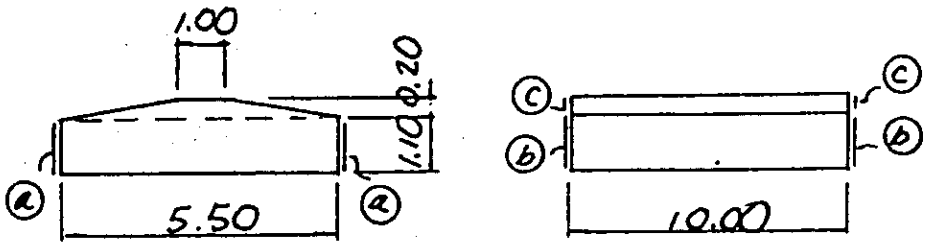


$A_a = \pi \times 0.80 \times 4.60$ = 11.561 m²

$A_b = 8.60 \times 4.60 \times 2$ = 79.120 "

COLUMN TOTAL = 90.681 m²

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m²

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m²

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	24.8	84.245	2089.3
COLUMN	34.0	123.425	4196.5
FOOTING	67.0	68.303	4576.3

BEARING BASE DIG 320.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

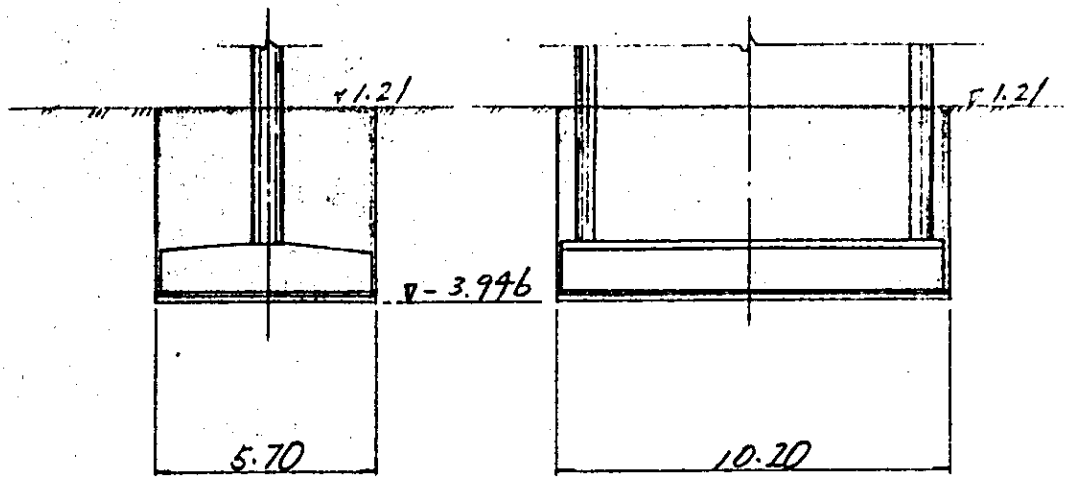
$$R = \frac{\text{REINFORCING BAR OF } F_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$$

$$R_B = \frac{1929.2}{22.9} = 84.245$$

$$R_C = \frac{4825.9}{39.1} = 123.425$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION



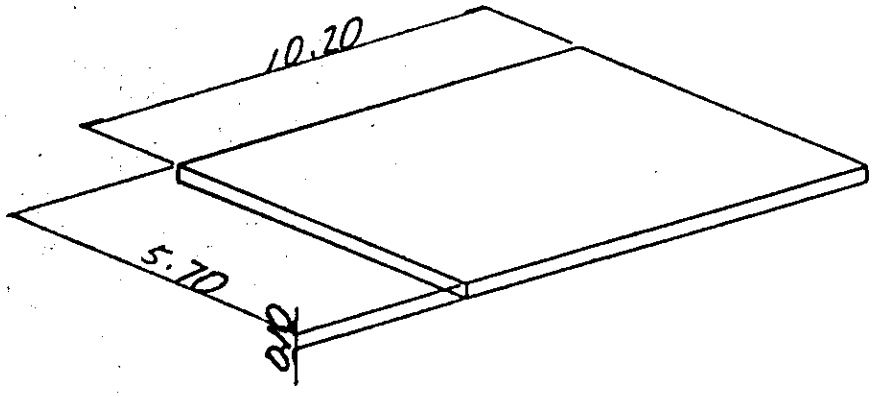
$$Va = 5.70 \times 10.20 \times (1.21 + 3.946) = 299.170 \ m^3$$

5) FOUNDATION MORTAR

$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4$$

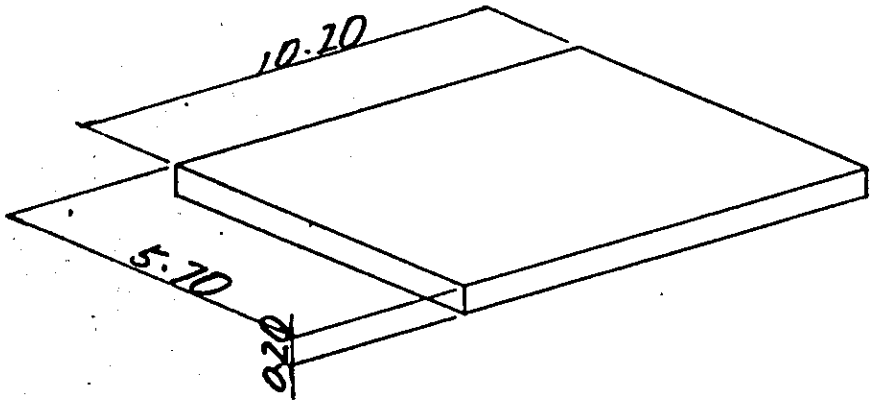
$$+ \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8 = 0.111 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

ϕ - 500

TYPE - B. 14 m × 28

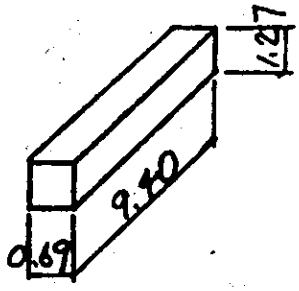
40 PIER 36

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	24.8	57.0	2 409.3	97.1
COLUMN	34.7	92.7	4 282.8	123.4
TOTAL	59.5	149.7	6 692.1	112 5
FOOTING	67.0	35.4	4 576.3	68.3

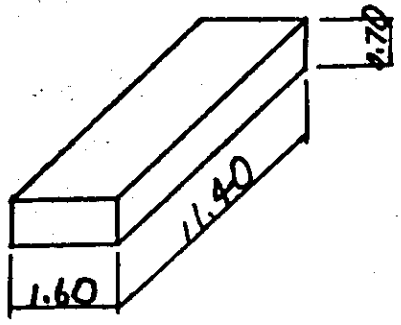
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS E
AGGREGATE SUBBASE	m^3	11.6	A.C.P. - 3
EXCAVATION	m^2	214.3	
FOUNDATION MORTAR	m^3	0.1	[illegible]
PILE	m x NUMBER	14 x 28	φ500 - B

1) CONCRETE VOLUME

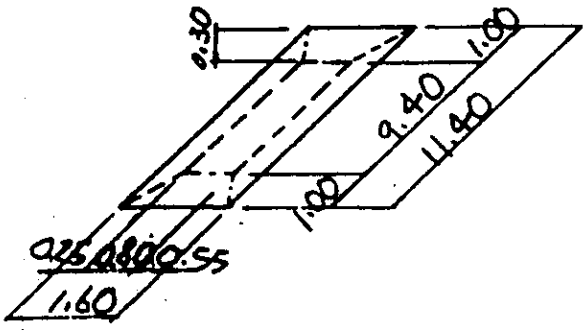
a) BEAM



$V_a = 0.69 \times 1.27 \times 9.40$ = 8.237 m³



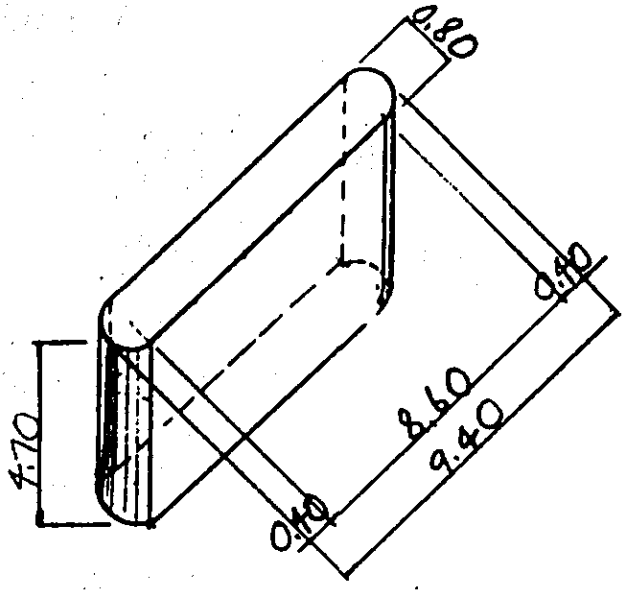
$V_b = 1.60 \times 0.70 \times 11.40$ = 12.768



$V_c = \frac{0.30}{6} \times \{ 0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40) \}$ = 3.784

BEAM TOTAL = 24.789 m³

(2) COLUMN

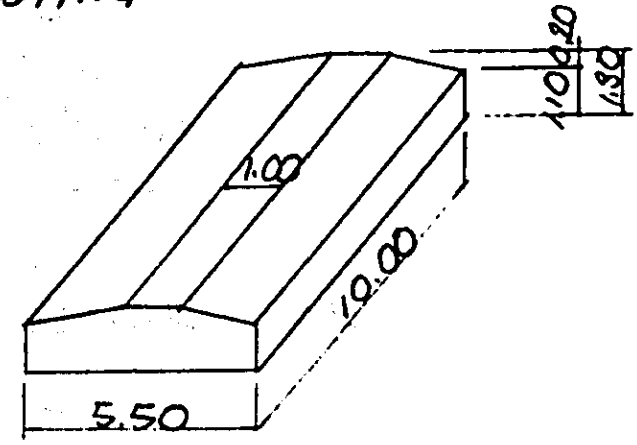


$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 4.70$ = 2.362 m³

$V_b = 0.80 \times 8.60 \times 4.70$ = 32.336 "

COLUMN TOTAL = 34.698 m³

(3) FOOTING



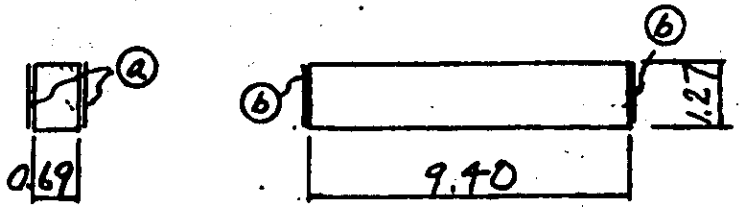
$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$ = 6.500 m³

$V_b = 5.50 \times 1.10 \times 10.00$ = 60.500 "

FOOTING TOTAL = 67.000 m³

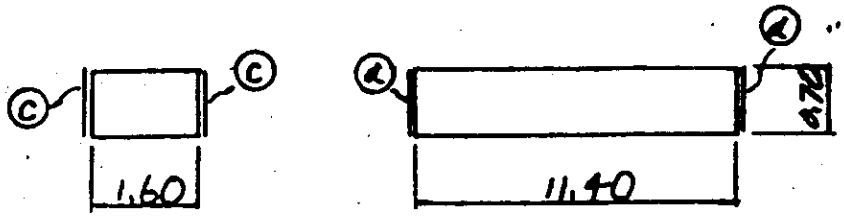
2) FORM AREA

1) BEAM



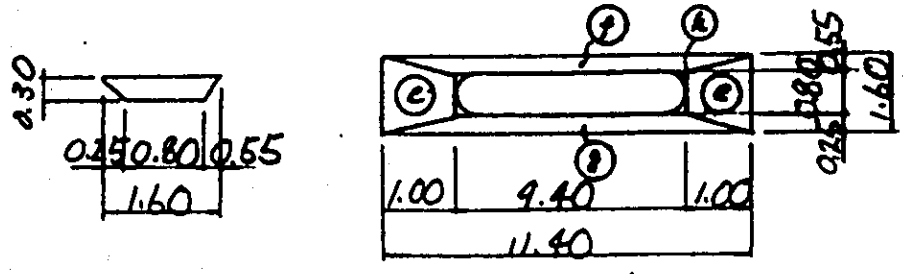
Ac = 1.27 × 9.40 × 2 = 23.876 m²

Ab = 1.27 × 0.69 × 2 = 1.753 "



Ac = 0.70 × 11.40 × 2 = 15.960 "

Ad = 0.70 × 1.60 × 2 = 2.240 "



Ae = ½ × (0.80 + 1.60) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2 = 2.506 "

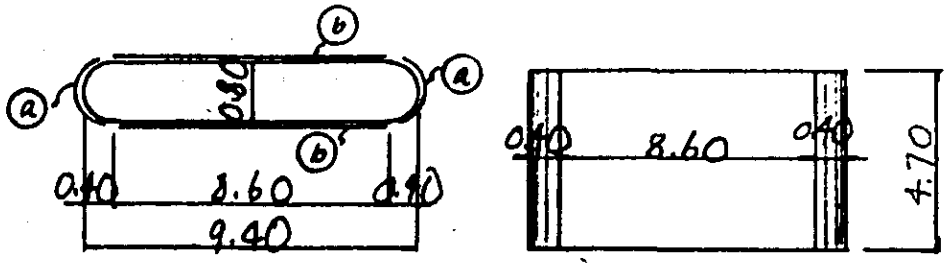
Af = ½ × (9.40 + 11.40) × $\sqrt{0.55^2 + 0.30^2}$ (c.t.c.) = 6.510 "

Ag = ½ × (9.40 + 11.40) × $\sqrt{0.25^2 + 0.30^2}$ (0.391) = 4.066 "

Ah = (1 − π/4) × 0.80² = 0.137 "

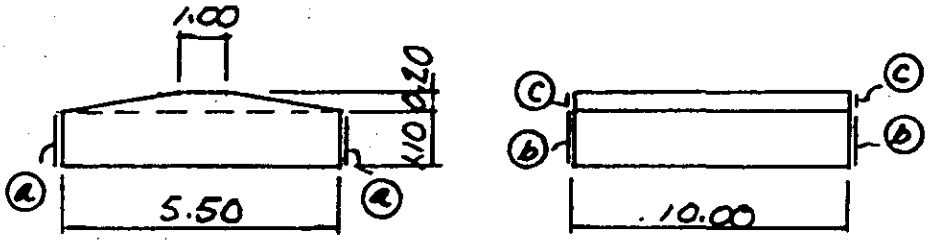
BEAM TOTAL = 57.048 m²

(2) COLUMN



$A_a = \pi \times 0.80 \times 4.70$	=	11.812 m^2
$A_b = 8.60 \times 4.70 \times 2$	=	80.840 "
COLUMN TOTAL	=	92.652 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$	=	22.000 m^2
$A_b = 1.10 \times 5.50 \times 2$	=	12.100 "
$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$	=	1.300 "
FOOTING TOTAL	=	35.400 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	24.8	84.245	2089.3
COLUMN	34.7	123.425	4282.8
FOOTING	67.0	68.303	4576.3

BEARING BASE D16 320.0 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

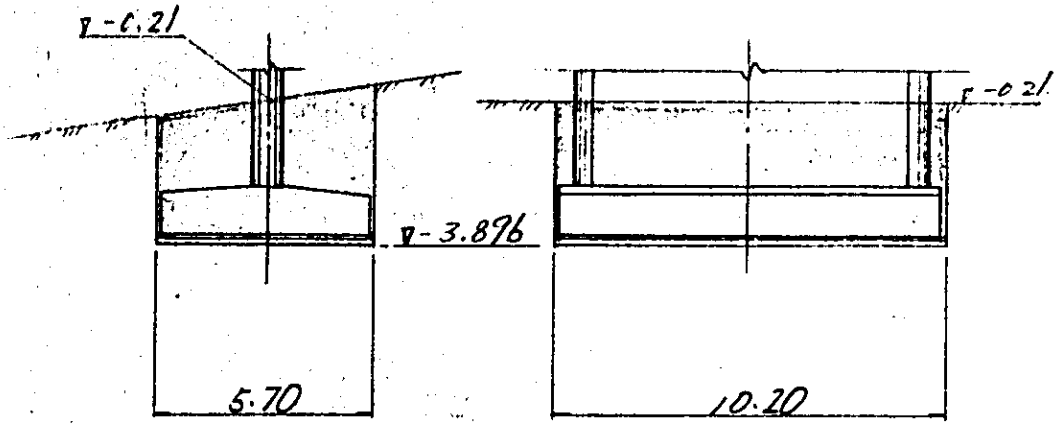
$$R = \frac{\text{REINFORCING BAR OF } P_{25}}{\text{CONCRETE VOLUME OF } P_{25}}$$

$$R_B = \frac{1929.2}{22.9} = 84.245$$

$$R_C = \frac{4825.9}{39.1} = 123.425$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION

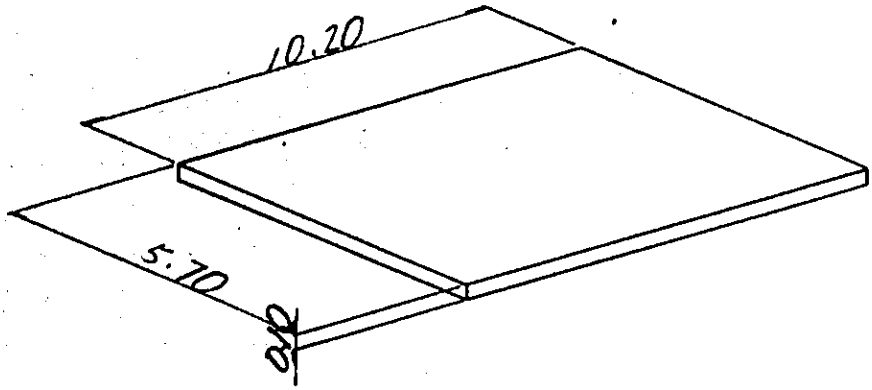


$$Va = 5.70 \times 10.20 \times (3.896 - 0.21) = 214.304 \ m^3$$

5) FOUNDATION MORTAR

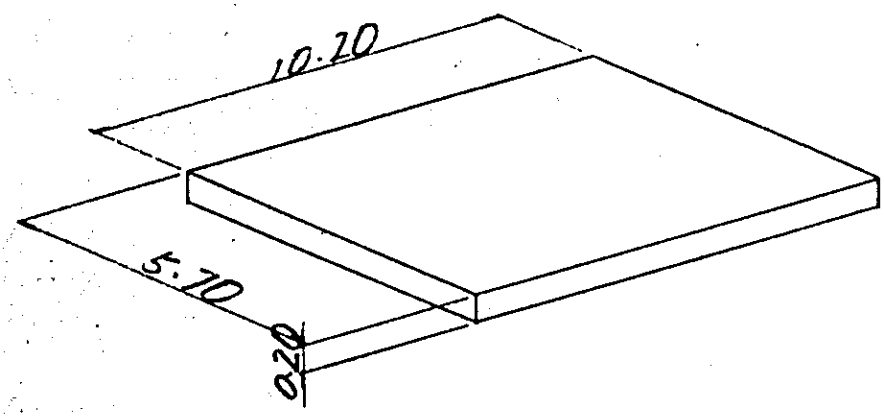
$$Va = \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.036 \times 4 = 0.111 \ m^3$$

6) LEVELING CONCRETE



Va = 5.70 × 10.20 × 0.10 = 5.814 m^3

7) AGGREGATE SUBBASE



Va = 5.70 × 10.20 × 0.20 = 11.628 m^3

8) PILE

ϕ - 500

TYPE - B. 14 m × 28

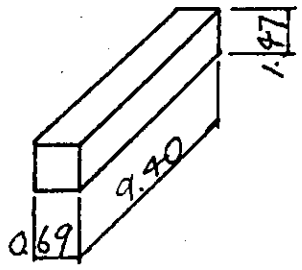
41 PIER 3.7

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	26.1	60.9	2364.4	90.6
COLUMN	42.1	112.4	5461.2	129.7
TOTAL	68.2	173.3	7825.6	114.7
FOOTING	67.0	35.4	4576.3	68.3

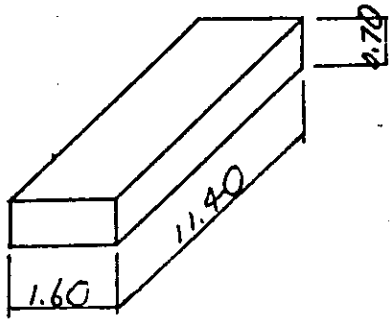
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	5.8	CLASS F
AGGREGATE SUBBASE	m^3	11.6	A.S.B. - 3
EXCAVATION	m^3	126.5	
FOUNDATION MORTAR	m^3	0.1	
PILE	m x NUMBER	7 x 24 8 x 24	φ500 - A φ500 - B

1) CONCRETE VOLUME

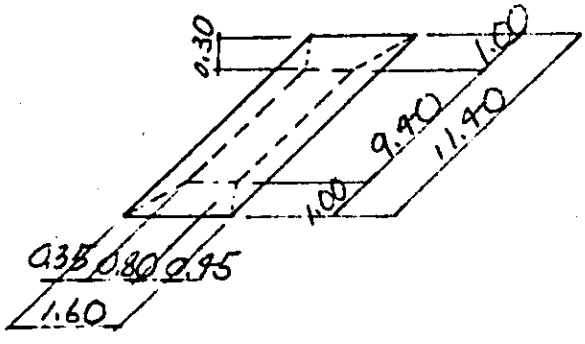
(1) BEAM



$Va = 0.69 \times 1.47 \times 9.40$ = 9.534 m³



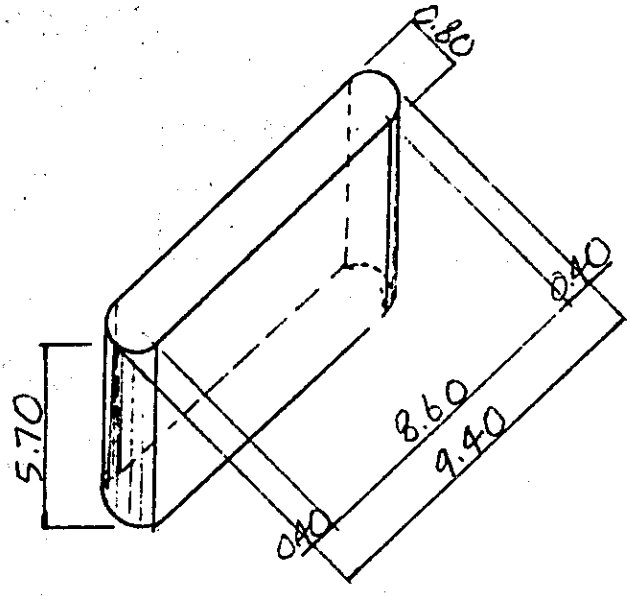
$Vb = 1.60 \times 0.70 \times 11.40$ = 12.768 "



$Vc = \frac{0.30}{6} \times \{0.80 \times 9.40 + 1.60 \times 11.40 + (0.80 + 1.60) \cdot (9.40 + 11.40)\}$ = 3.784 "

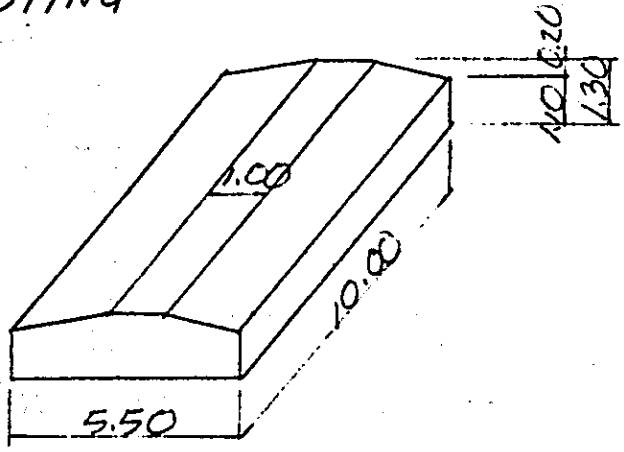
BEAM TOTAL = 26.086 m³

(2) COLUMN



$V_a = \frac{1}{4} \times \pi \times 0.80^2 \times 5.70$	=	2.865 m^3
$V_b = 0.80 \times 8.60 \times 5.70$	=	39.216 "
COLUMN TOTAL	=	42.081 m^3

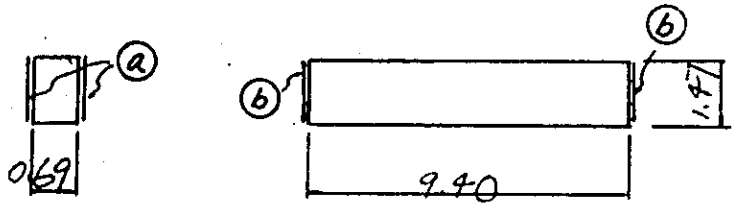
(3) FOOTING



$V_a = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 10.00$	=	6.500 m^3
$V_b = 5.50 \times 1.10 \times 10.00$	=	60.500 "
FOOTING TOTAL	=	67.000 m^3

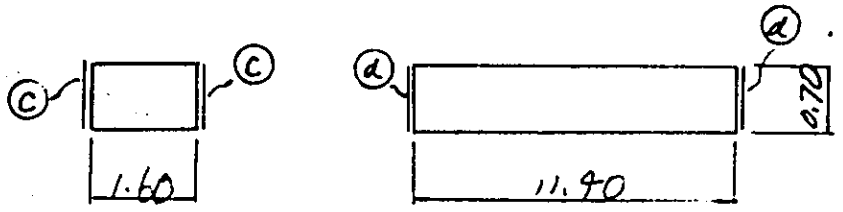
2) FORM AREA

(1) BEAM



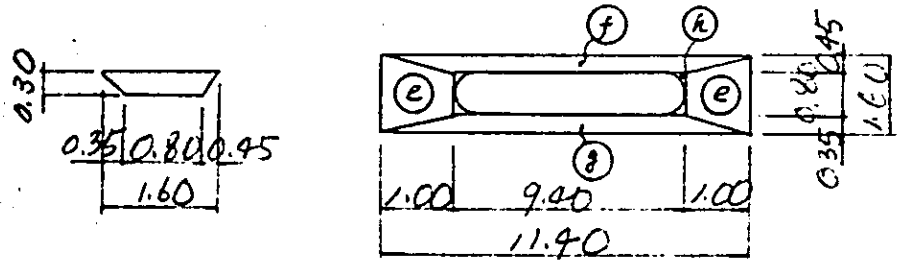
$Ae = 1.47 \times 9.40 \times 2$ = 27.636 m^2

$Ab = 1.47 \times 0.69 \times 2$ = 2.029 "



$Ac = 0.70 \times 11.40 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.60 \times 2$ = 2.240 "



$Ae = \frac{1}{2} \times (0.80 + 1.60) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.506 "

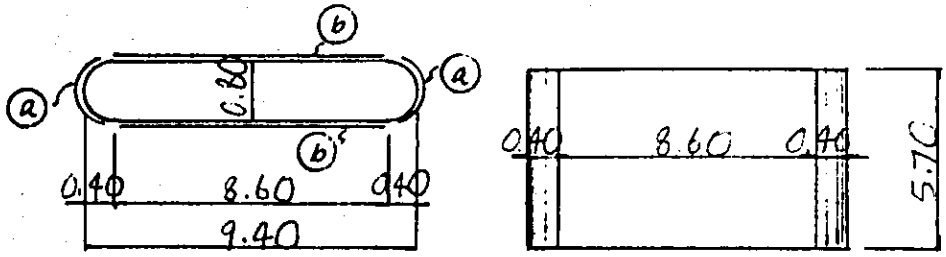
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$ = 5.626 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.35^2 + 0.30^2}$ = 4.794 "

$Ah = (1 - \pi/4) \times 0.80^2$ = 0.137 "

BEAM TOTAL = 60.928 m^2

(2) COLUMN

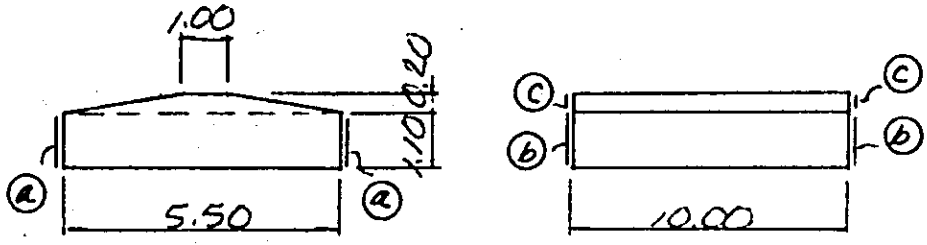


$A_a = \pi \times 0.80 \times 5.70$ = 14.326 m^2

$A_b = 8.60 \times 5.70 \times 2$ = 98.040 "

COLUMN TOTAL = 112.366 m^2

(3) FOOTING



$A_a = 1.10 \times 10.00 \times 2$ = 22.000 m^2

$A_b = 1.10 \times 5.50 \times 2$ = 12.100 "

$A_c = \frac{1}{2} \times (1.00 + 5.50) \times 0.20 \times 2$ = 1.300 "

FOOTING TOTAL = 35.400 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	26.1	82.361	2149.6
COLUMN	42.1	129.720	5461.2
FOOTING	67.0	68.303	4576.3

BEARING BASE DIG 214.8 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

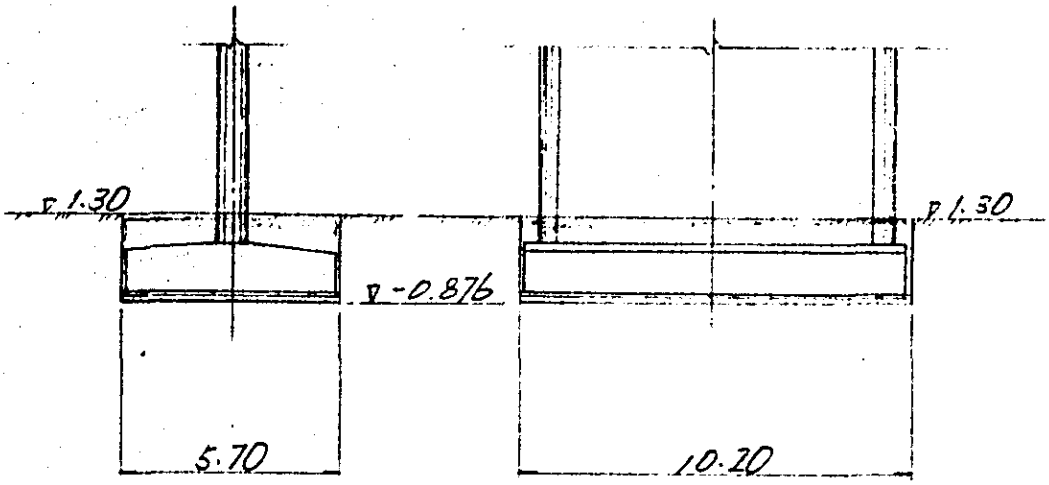
$$R = \frac{\text{REINFORCING BAR OF } P_{30}}{\text{CONCRETE VOLUME OF } P_{30}}$$

$$R_B = \frac{1984.9}{24.1} = 82.361$$

$$R_C = \frac{7277.3}{56.1} = 129.720$$

$$R_F = \frac{4576.3}{67.0} = 68.303$$

4) EXCAVATION

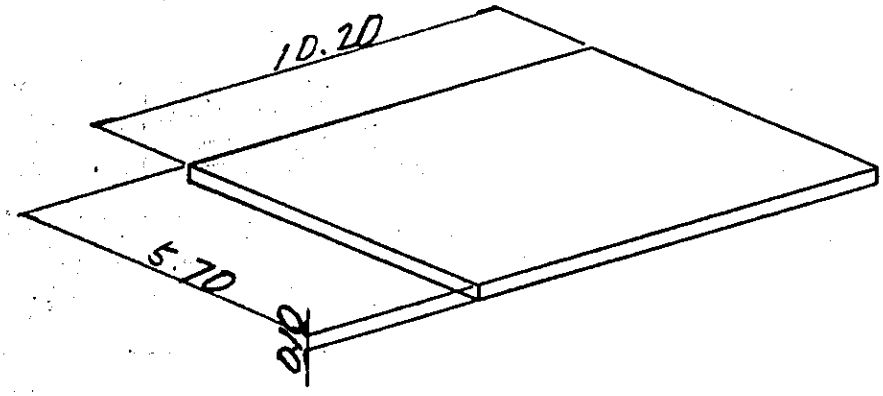


$$Va = 5.70 \times 10.20 \times (1.30 + 0.876) = 126.513 \ m^3$$

5) FOUNDATION MORTAR

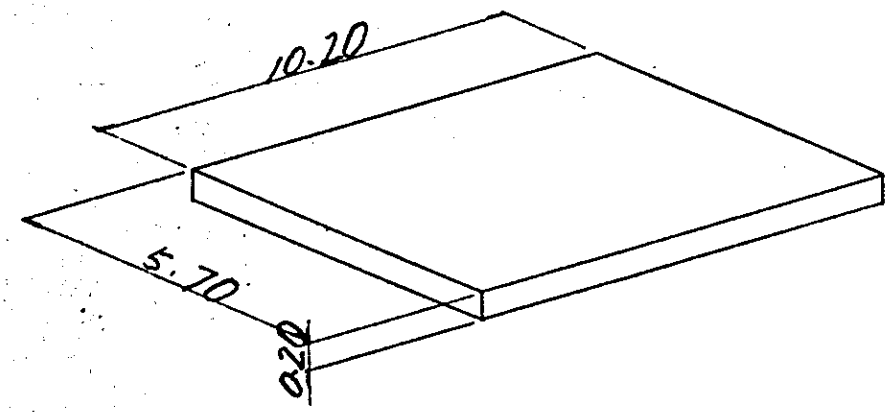
$$Va = \tfrac{1}{2} \times (0.772 \times 0.572 + 0.70 \times 0.50) \times 0.306 \times 4$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4 = 0.072 \ m^3$$

6) LEVELING CONCRETE



$Va = 5.70 \times 10.20 \times 0.10 = 5.814\ m^3$

7) AGGREGATE SUBBASE



$Va = 5.70 \times 10.20 \times 0.20 = 11.628\ m^3$

8) PILE

$\phi = 500$

TYPE - A $7^{m} \times 24$

TYPE - B $8^{m} \times 24$

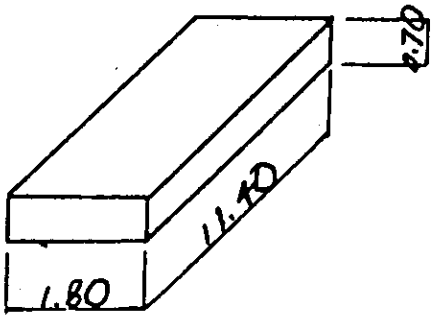
42 PIER 38

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	18.8	32.0	1644.1	87.5
COLUMN	52.4	113.7	7 218.0	137.7
TOTAL	71.2	145.7	8 862.1	124.5
FOOTING	106.2	49.2	6 784.5	63.9

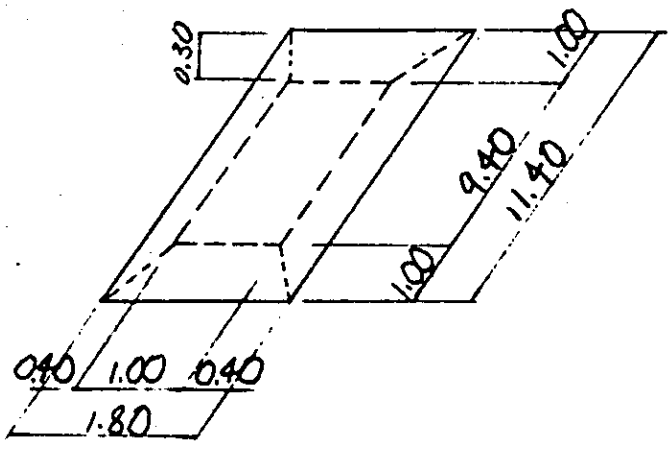
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^3	195.1	
FOUNDATION MORTAR	m^3	0.1	F_{cu} = 400 kg/cm²
PILE	m x NUMBER	7 x 35 8 x 35	φ500-A φ500-B

1) CONCRETE VOLUME

(1) BEAM



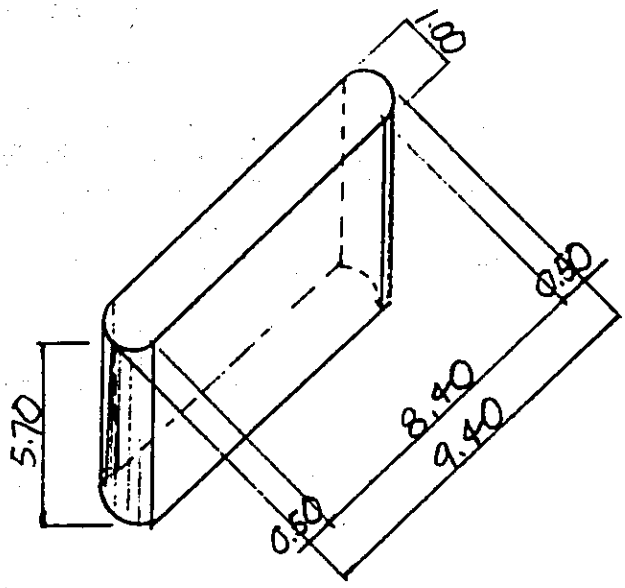
$Va = 1.80 \times 0.70 \times 11.40$ = 14.364 m³



$Vb = \frac{0.30}{6} \times \{ 1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40) \}$ = 4.408 "

BEAM TOTAL = 18.772 m³

(2) COLUMN

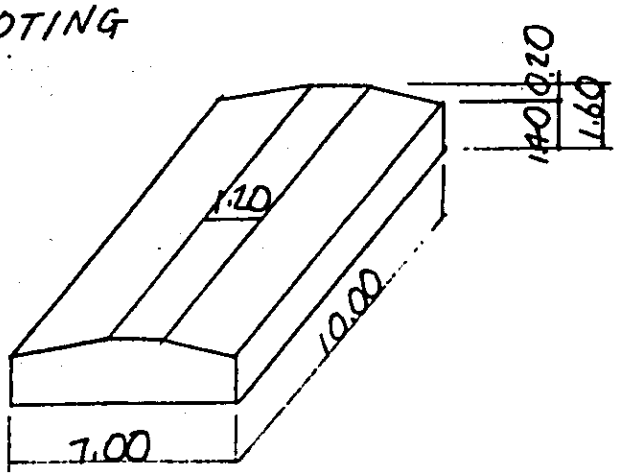


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 5.70$ ..... = 4.477 m^3

$V_b = 1.00 \times 8.40 \times 5.70$ ..... = 47.880 "

COLUMN TOTAL = 52.357 m^3

(3) FOOTING



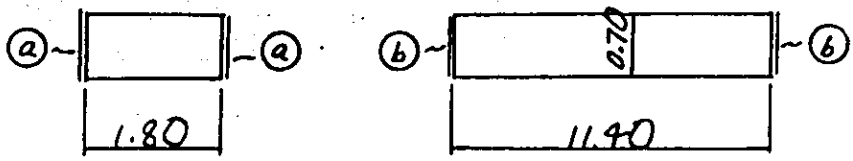
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

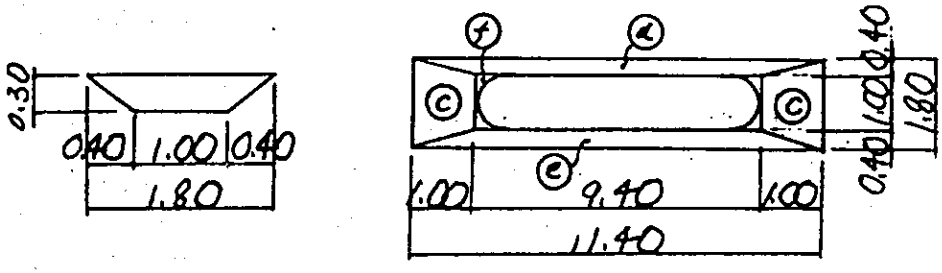
FOOTING TOTAL = 106.200 m^3

2) FORM AREA

1) BEAM

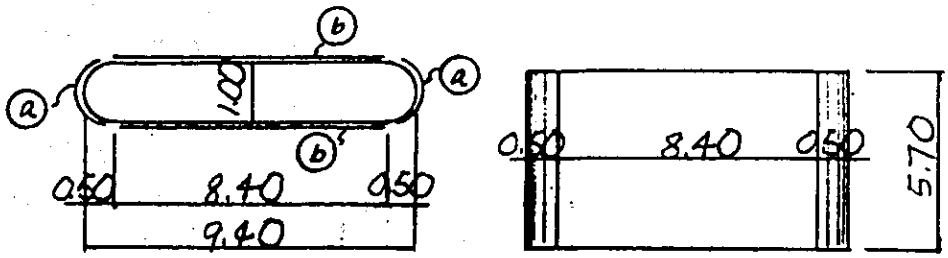


A_a = 0.70 × 11.40 × 2	=	15.960 m^2
A_b = 0.70 × 1.80 × 2	=	2.520 "



A_c = ½ × (1.00 + 1.80) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2	=	2.923 "
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.40^2 + 0.30^2}$ (0.500)	=	5.200 "
A_e = "	=	5.200 "
A_f = (1 − π/4) × 1.00^2	=	0.215 "
BEAM TOTAL	=	32.018 m^2

(2) COLUMN

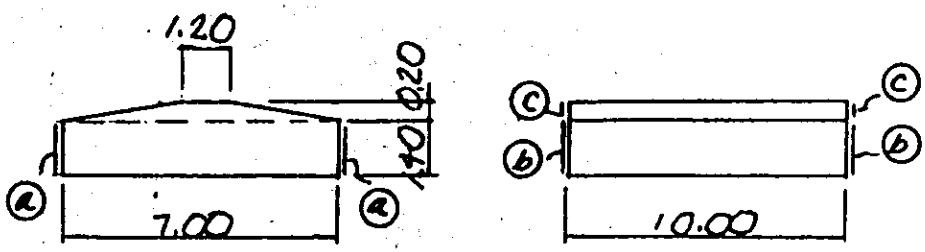


$A_a = \pi \times 1.00 \times 5.70$ = 17.907 m^2

$A_b = 8.40 \times 5.70 \times 2$ = 95.760 "

COLUMN TOTAL = 113.667 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$ = 28.000 m^2

$A_b = 1.40 \times 7.00 \times 2$ = 19.600 "

$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$ = 1.640 "

FOOTING TOTAL = 49.240 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	18.8	72.601	1364.9
COLUMN	52.4	137.749	7218.0
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 279.2 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

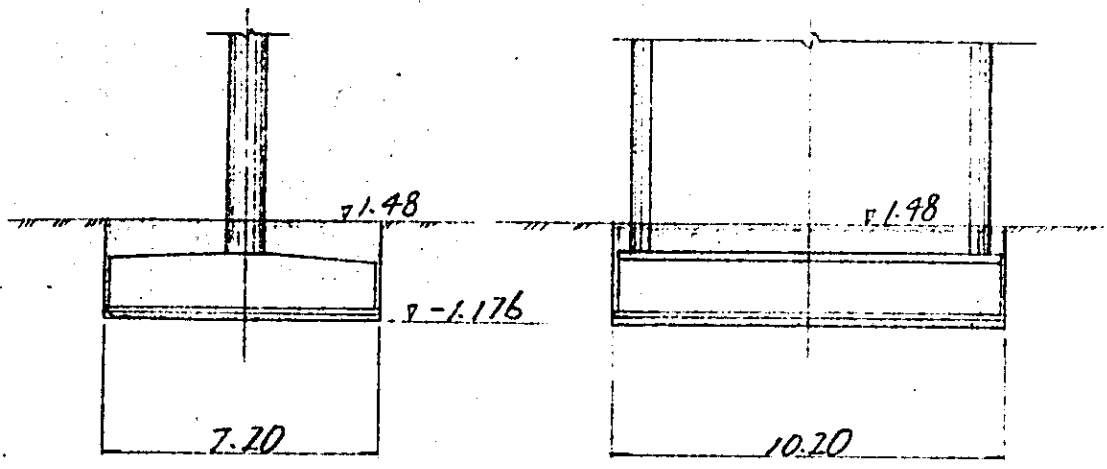
$$R = \frac{\text{REINFORCING BAR OF Fo6}}{\text{CONCRETE VOLUME OF Fo6}}$$

$$R_B = \frac{1328.6}{18.3} = 72.601$$

$$R_C = \frac{10882.2}{79.0} = 137.749$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

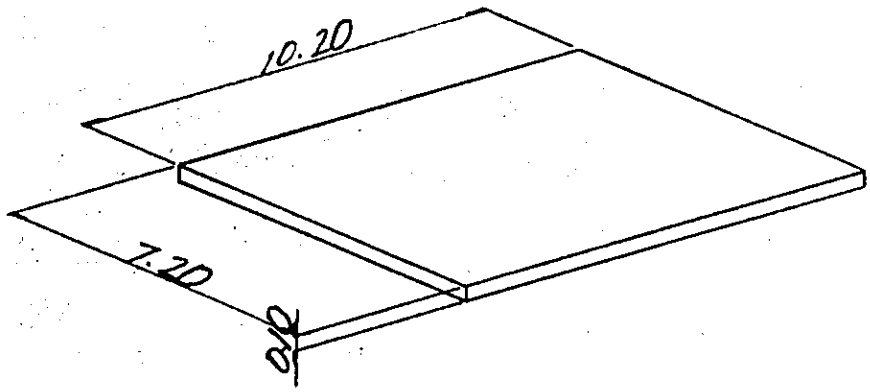


$$Va = 7.20 \times 10.20 \times (1.48 + 1.176) = 175.057\ m^3$$

5) FOUNDATION MORTAR

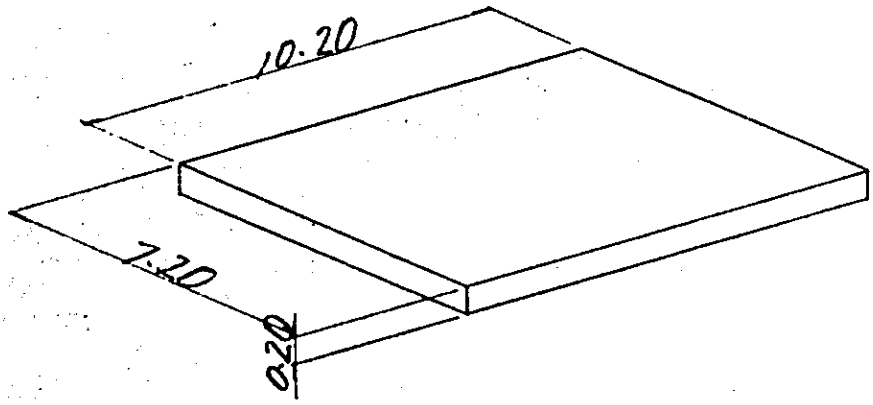
$$Va = \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 8 = 0.069\ m^3$$

6) LEVELING CONCRETE



$Va = 7.20 \times 10.20 \times 0.10 = 7.344\ m^3$

7) AGGREGATE SUBBASE



$Va = 7.20 \times 10.20 \times 0.20 = 14.688\ m^3$

8) PILE

$\phi = 500$

TYPE-A 7 m × 35

TYPE-B 8 m × 35

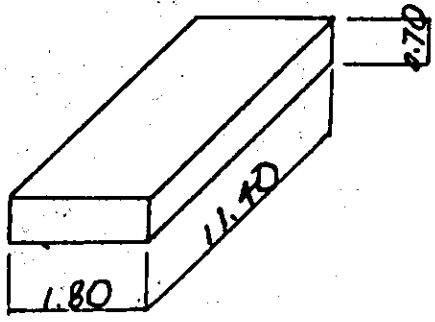
43 PIER 39

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	18.8	32.0	1644.1	87.5
COLUMN	52.4	113.7	7218.0	137.7
TOTAL	71.2	145.7	8862.1	124.5
FOOTING	106.2	49.2	6784.5	63.9

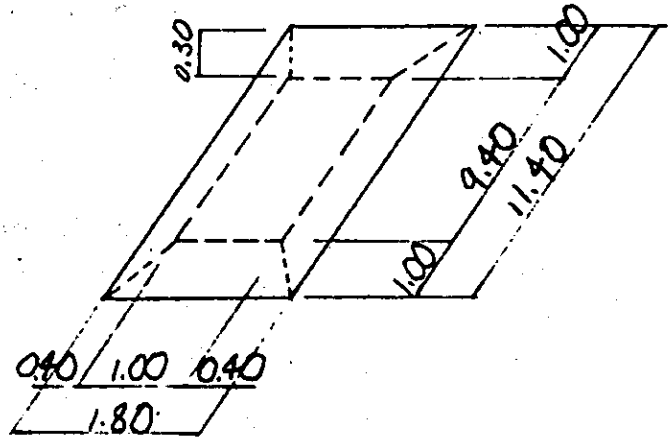
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	7.3	CLASS F
AGGREGATE SUBBASE	m^3	14.7	A.S.B.-3
EXCAVATION	m^3	195.1	
FOUNDATION MORTAR	m^3	0.1	f_{ck} = 400 kg/cm²
PILE	m x NUMBER	7 x 35 8 x 35	φ500-A φ500-B

1) CONCRETE VOLUME

(1) BEAM



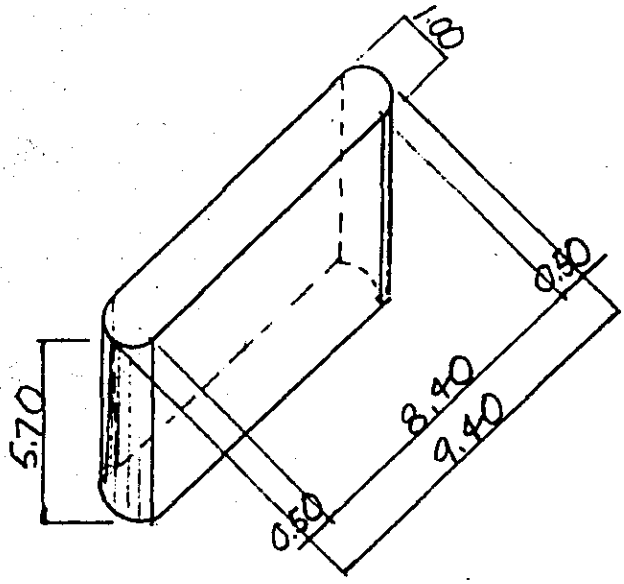
$V_a = 1.80 \times 0.70 \times 11.40$ = 14.364 m³



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m³

(2) COLUMN

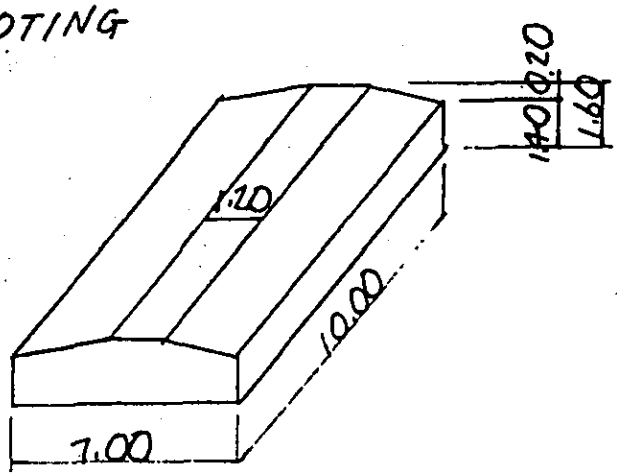


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 5.70$ ..... = 4.477 m^3

$V_b = 1.00 \times 8.40 \times 5.70$ ..... = 47.880 "

COLUMN TOTAL = 52.357 m^3

(3) FOOTING



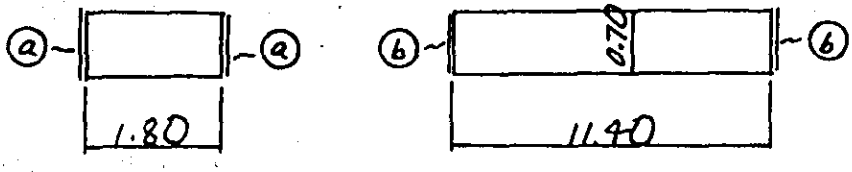
$V_a = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 10.00$ = 8.200 m^3

$V_b = 7.00 \times 1.40 \times 10.00$ = 98.000 "

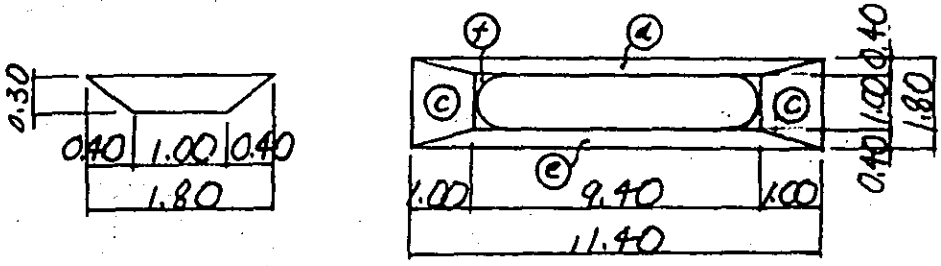
FOOTING TOTAL = 106.200 m^3

2) FORM AREA

(1) BEAM

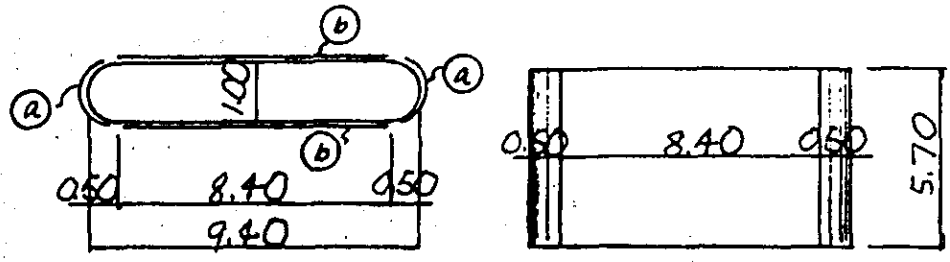


		m²
A_a = 0.70 × 11.40 × 2	=	15.960
A_b = 0.70 × 1.80 × 2	=	2.520 "



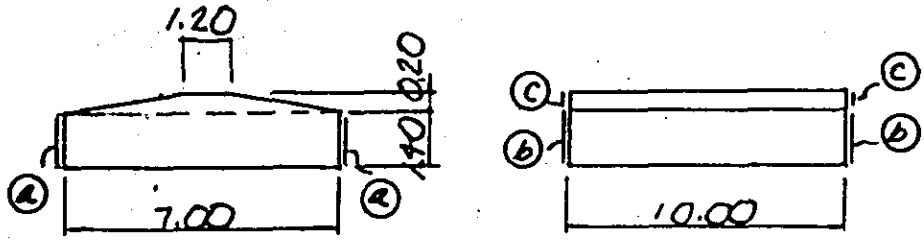
A_c = ½ × (1.00 + 1.80) × $\sqrt{1.00^2 + 0.30^2}$ (1.044) × 2	=	2.923 "
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.40^2 + 0.30^2}$ (0.500)	=	5.200 "
A_e = "	=	5.200 "
A_f = (1 − π/4) × 1.00²	=	0.215 "
BEAM TOTAL	=	32.018 m²

(2) COLUMN



$A_a = \pi \times 1.00 \times 5.70$	=	17.907 m^2
$A_b = 8.40 \times 5.70 \times 2$	=	95.760 "
COLUMN TOTAL	=	113.667 m^2

(3) FOOTING



$A_a = 1.40 \times 10.00 \times 2$	=	28.000 m^2
$A_b = 1.40 \times 7.00 \times 2$	=	19.600 "
$A_c = \frac{1}{2} \times (1.20 + 7.00) \times 0.20 \times 2$	=	1.640 "
FOOTING TOTAL	=	49.240 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	18.8	72.601	1364.9
COLUMN	52.4	137.749	7218.0
FOOTING	106.2	63.884	6784.5

BEARING BASE D16 279.2 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

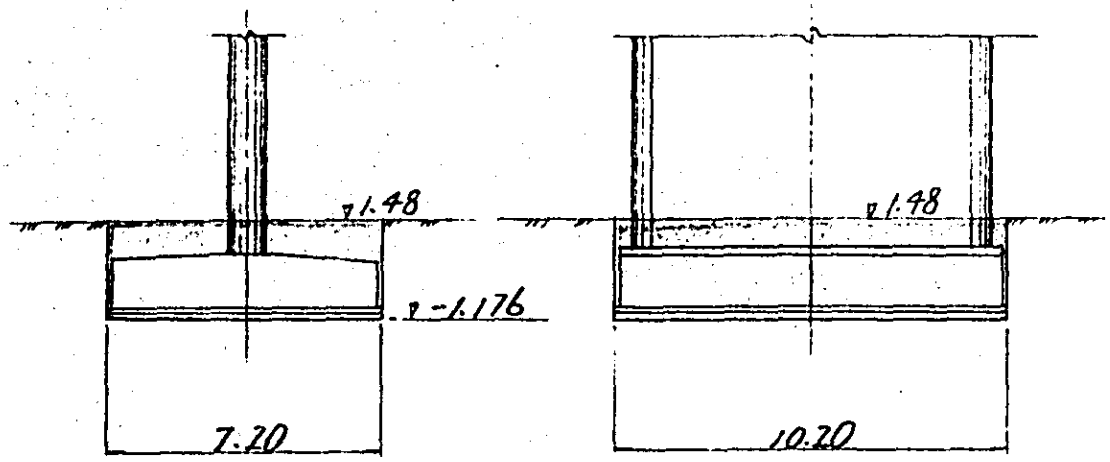
$$R = \frac{\text{REINFORCING BAR OF Po6}}{\text{CONCRETE VOLUME OF Po6}}$$

$$R_B = \frac{1328.6}{18.3} = 72.601$$

$$R_C = \frac{10882.2}{79.0} = 137.749$$

$$R_F = \frac{6784.5}{106.2} = 63.884$$

4) EXCAVATION

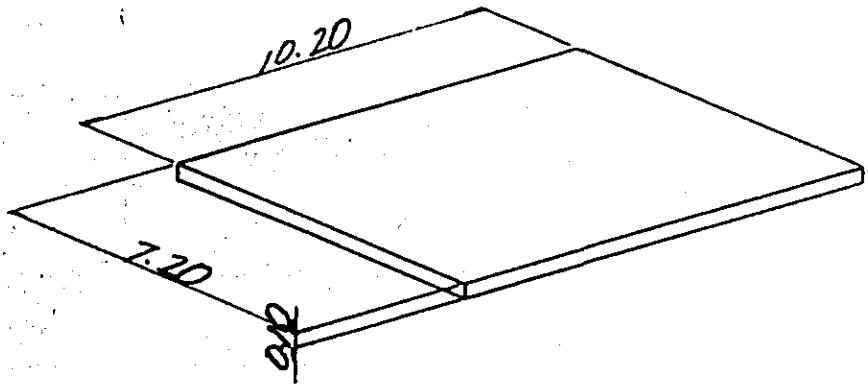


$$Va = 7.20 \times 10.20 \times (1.48 + 1.176) = 195.057\ m^3$$

5) FOUNDATION MORTAR

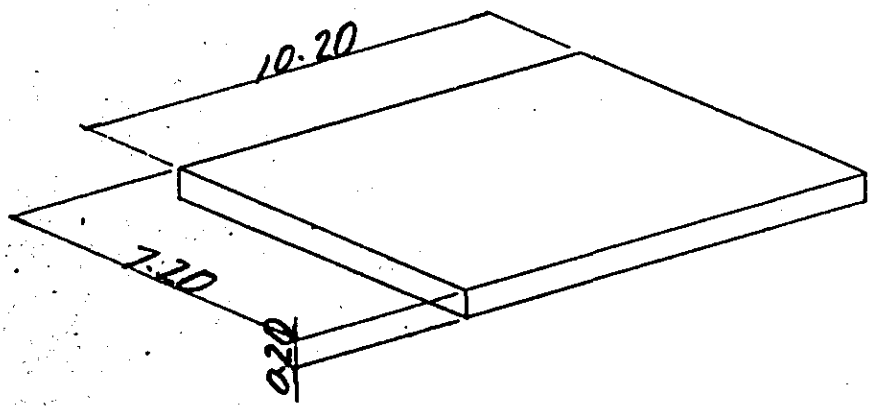
$$Va = \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 8 = 0.069\ m^3$$

6) LEVELING CONCRETE



Va = 7.20 × 10.20 × 0.10 = 7.344 m^3

7) AGGREGATE SUBBASE



Va = 7.20 × 10.20 × 0.20 = 14.688 m^3

8) PILE

ϕ - 500

TYPE-A 7 m × 35

TYPE-B 8 m × 35

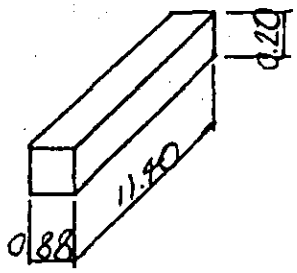
44 PIER NO.1

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	20.8	37.0	2110.2	101.5
COLUMN	62.5	135.6	9852.1	157.6
TOTAL	83.3	172.6	11962.3	143.6
FOOTING	185.5	73.6	12128.5	65.4

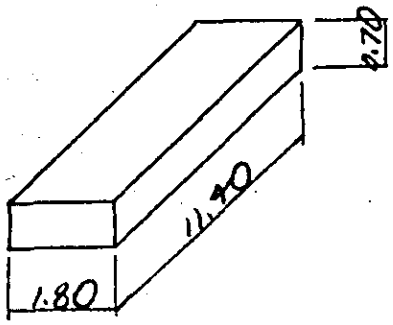
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B.-3
EXCAVATION	m^3	441.6	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm²
PILE	m x NUMBER	14 x 42	φ500-B

1) CONCRETE VOLUME

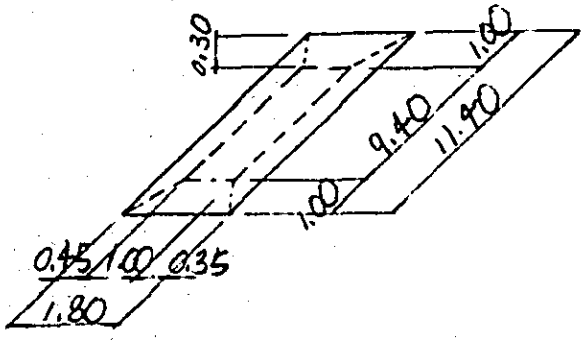
(1) BEAM



$Va = 0.88 \times 0.20 \times 11.40$ = 2.006 m³



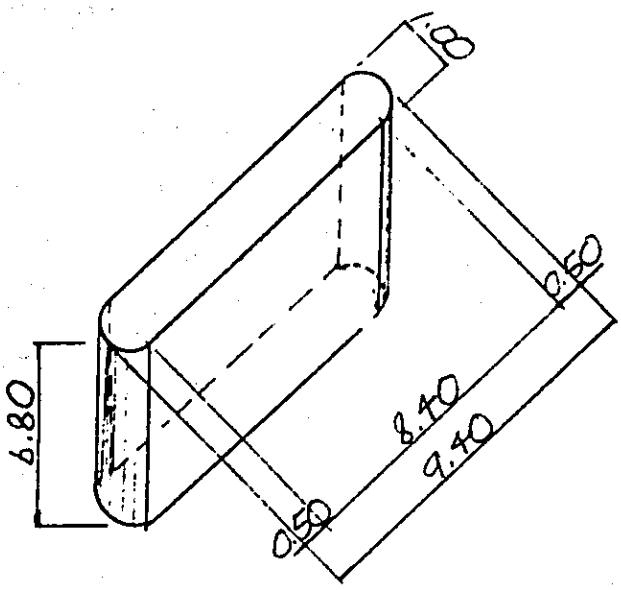
$Vb = 1.80 \times 0.70 \times 11.40$ = 14.364 "



$Vc = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 20.778 m³

(2) COLUMN

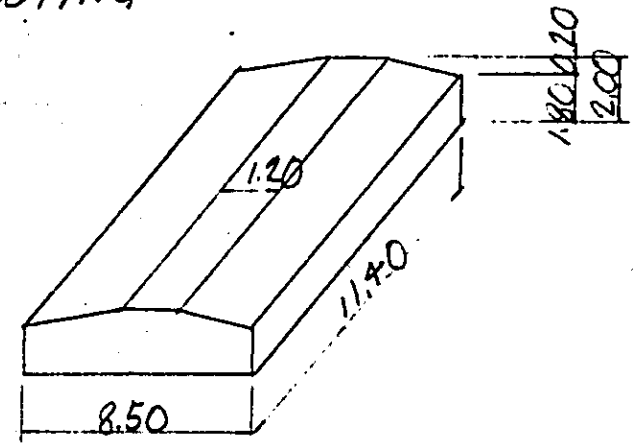


$V_a = \frac{1}{4} \times \pi \times 1.00 \times 6.80$ = 5.341 m³

$V_b = 1.00 \times 8.40 \times 6.80$ = 57.120 "

COLUMN TOTAL = 62.461 m³

(3) FOOTING



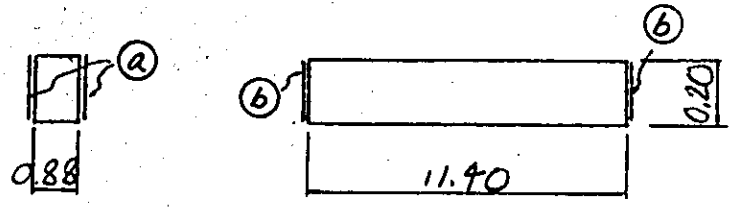
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m³

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420 "

FOOTING TOTAL = 185.478 m³

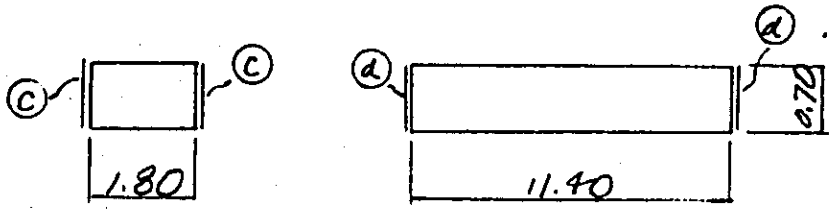
2) FORM AREA

(1) BEAM



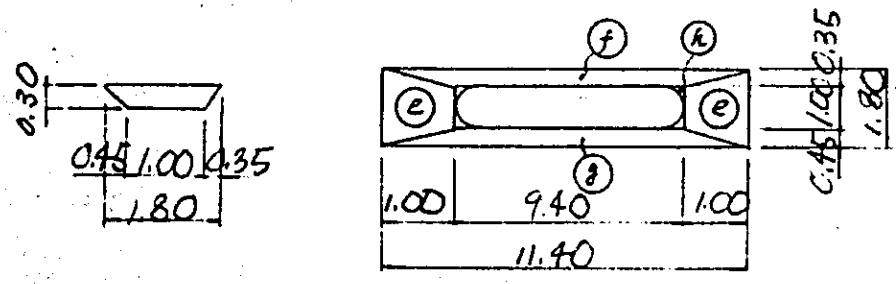
$Ae = 0.20 \times 11.40 \times 2$ = 4.560 m^2

$Ab = 0.20 \times 0.88 \times 2$ = 0.352 "



$Ac = 0.70 \times 11.40 \times 2$ = 15.960 "

$Ad = 0.70 \times 1.80 \times 2$ = 2.520 "



$Ae = \frac{1}{2} \times (1.00 + 1.80) \times \sqrt{1.00^2 + 0.30^2} \times 2$ = 2.923 "

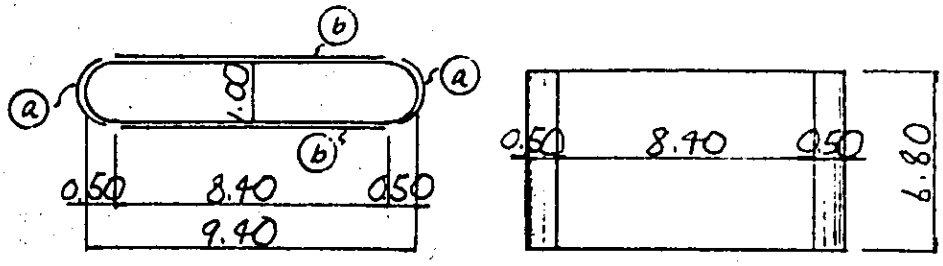
$Af = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.35^2 + 0.30^2}$ = 4.797 "

$Ag = \frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.45^2 + 0.30^2}$ = 5.626 "

$Ah = (1 - \pi/4) \times 1.00^2$ = 0.215 "

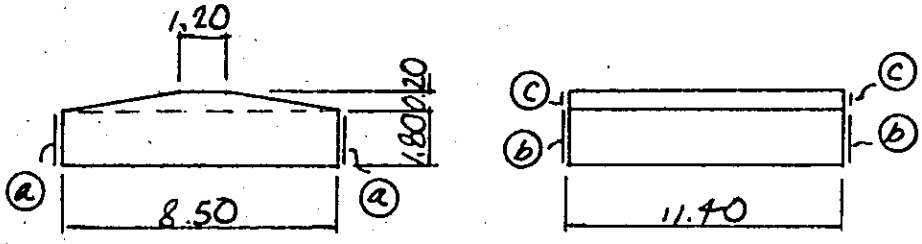
BEAM TOTAL = 36.950 m^2

(2) COLUMN



$Aa = \pi \times 1.00 \times 6.80$	=	21.363 m^2
$Ab = 8.40 \times 6.80 \times 2$	=	114.240 "
COLUMN TOTAL	=	135.603 m^2

(3) FOOTING



$Aa = 1.80 \times 11.40 \times 2$	=	41.040 m^2
$Ab = 1.80 \times 8.50 \times 2$	=	30.600 "
$Ac = 1/2 \times (1.20 + 8.50) \times 0.20 \times 2$	=	1.940 "
FOOTING TOTAL	=	73.580 m^2

3) REINFORCING BAR

	V (m³)	R (kg/m³)	W=V·R (kg)
BEAM	20.8	82.971	1725.8
COLUMN	62.5	157.633	9852.1
FOOTING	185.5	65.383	12128.5

BEARING BASE D16 384.9 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

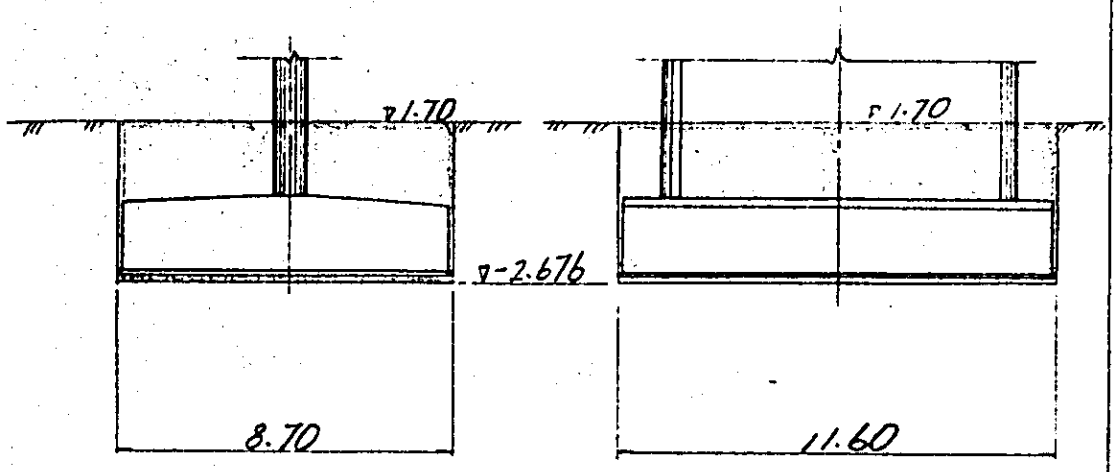
$$R = \frac{\text{REINFORCING BAR OF } P_{40}}{\text{CONCRETE VOLUME OF } P_{40}}$$

$$R_B = \frac{1725.8}{20.8} = 82.971$$

$$R_C = \frac{9694.4}{61.5} = 157.633$$

$$R_F = \frac{12128.5}{185.6} = 65.383$$

4) EXCAVATION

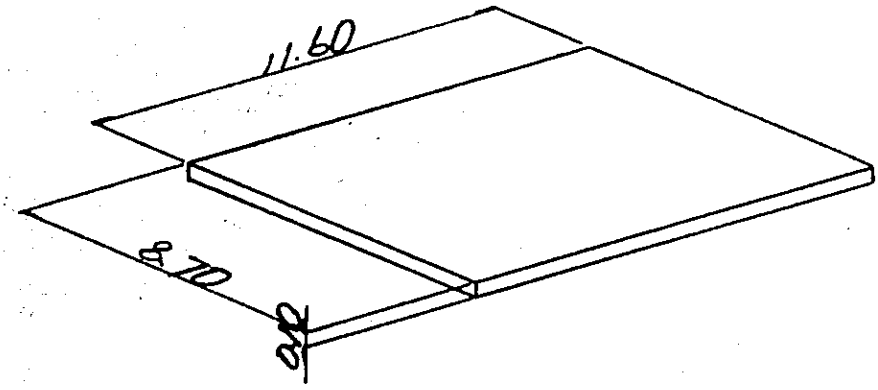


$$Va = 8.70 \times 11.60 \times (2.676 + 1.70) = 441.626 \ m^3$$

5) FOUNDATION MORTAR

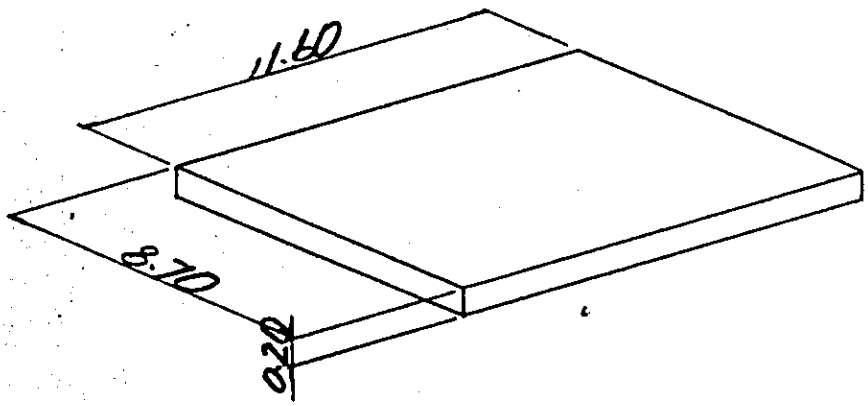
$$Va = \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8$$
$$+ \tfrac{1}{2} \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4 = 0.088 \ m^3$$

6) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

7) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

8) PILE

ϕ = 500

TYPE - B 14 m × 42

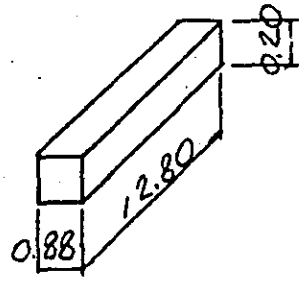
45 PIER 42

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	24.1	40.6	2003.1	83.1
COLUMN	80.5	158.1	11 953.5	148.5
TOTAL	104.6	198.7	13 956.6	133.4
FOOTING	134.3	62.3	7 660.9	57.0

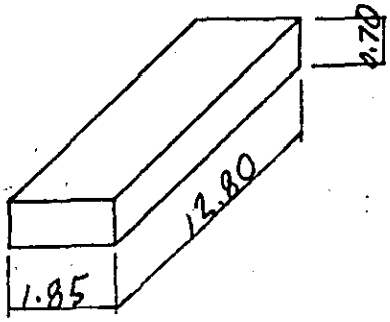
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	8.2	CLASS F
AGGREGATE SUBBASE	m^3	16.4	A.S.E.-3
EXCAVATION	m^3	355.7	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 420 kg/cm^2
PILE	m × NUMBER	14 × 45	φ500-B

1) CONCRETE VOLUME

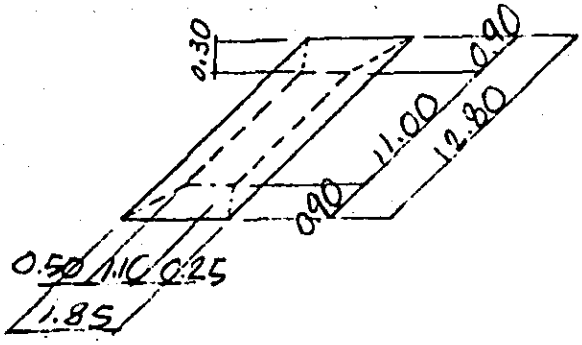
(1) BEAM



$Va = 0.88 \times 0.20 \times 12.80$ = 2.253 m³



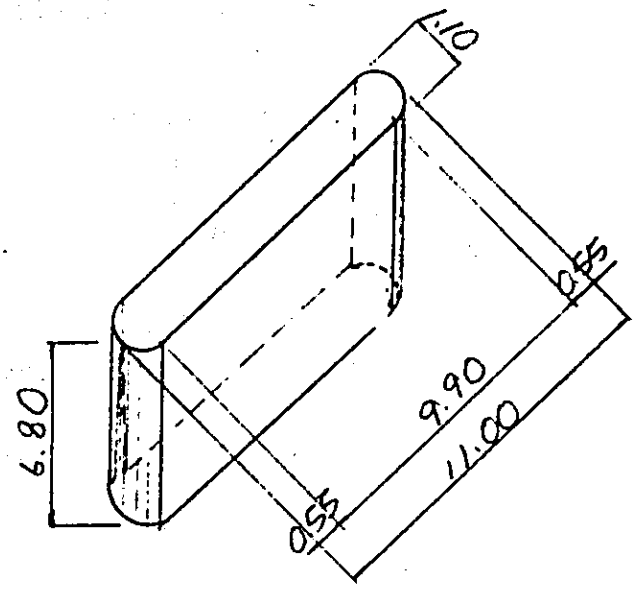
$Vb = 1.85 \times 0.70 \times 12.80$ = 16.576 "



$$Vc = \frac{0.30}{6} \times \{1.10 \times 11.00 + 1.85 \times 12.80 + (1.10 + 1.85) \cdot (11.00 + 12.80)\} = 5.300 \text{ "}$$

BEAM TOTAL = 24.129 m³

(2) COLUMN

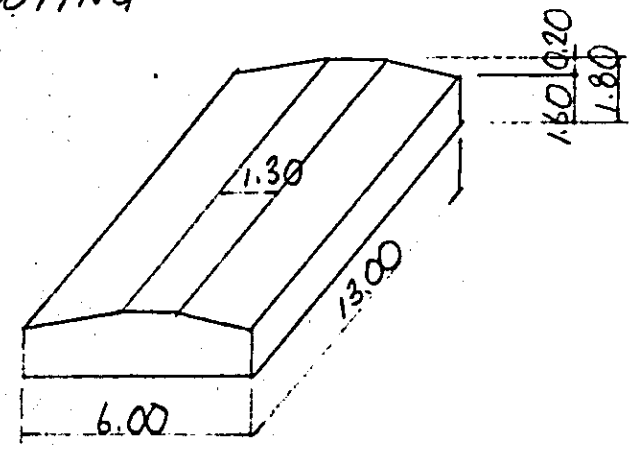


$Va = \frac{1}{4} \times \pi \times 1.10^2 \times 6.80$ = 6.462 m^3

$Vb = 1.10 \times 9.90 \times 6.80$ = 74.052 "

COLUMN TOTAL = 80.514 m^3

(3) FOOTING



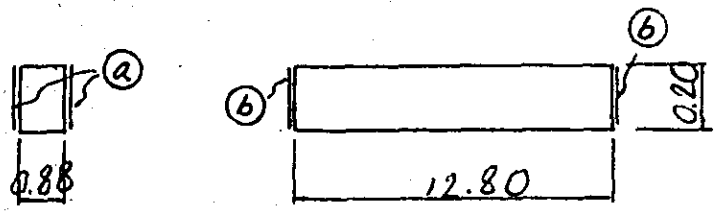
$Va = \frac{1}{2} \times (1.30 + 6.00) \times 0.20 \times 13.00$ = 9.490 m^3

$Vb = 6.00 \times 1.60 \times 13.00$ = 124.800 "

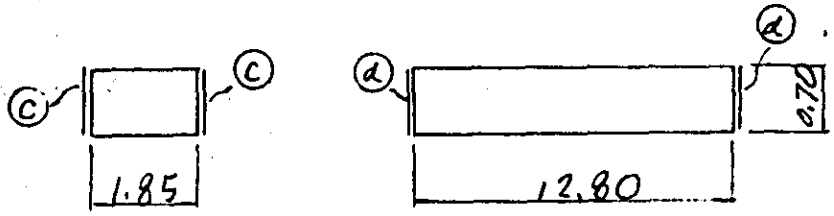
FOOTING TOTAL = 134.290 m^3

2) FORM AREA

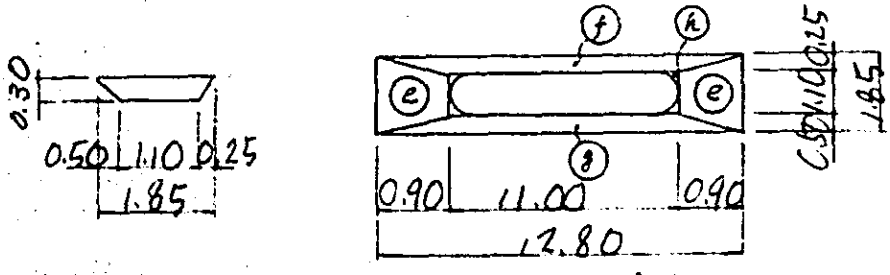
(1) BEAM



$Ae = 0.20 \times 12.80 \times 2$	=	5.120 m²
$Ab = 0.20 \times 0.88 \times 2$	=	0.352 "

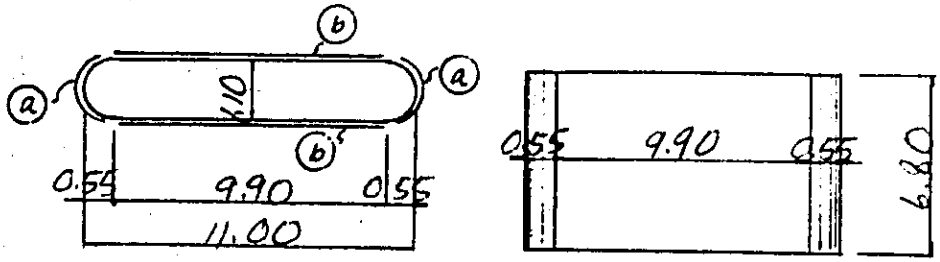


$Ac = 0.70 \times 1.85 \times 2$	=	2.590 "
$Ad = 0.70 \times 12.80 \times 2$	=	17.920 "



$Ae = \frac{1}{2} \times (1.10 + 1.85) \times \sqrt{0.90^2 + 0.30^2} \times 2$ (0.949)	=	2.800 "
$Af = \frac{1}{2} \times (11.00 + 12.80) \times \sqrt{0.25^2 + 0.30^2}$ (0.391)	=	4.653 "
$Ag = \frac{1}{2} \times (11.00 + 12.80) \times \sqrt{0.50^2 + 0.30^2}$ (0.583)	=	6.938 "
$Ah = (1 - \pi/4) \times 1.10^2$	=	0.210 "
BEAM TOTAL	=	40.633 m²

(2) COLUMN

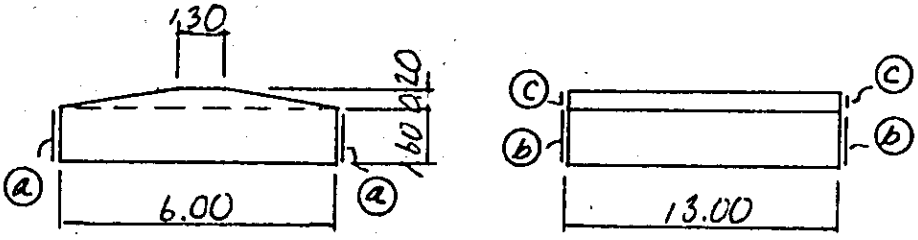


$A_a = \pi \times 1.10 \times 6.80$ = 23.499 m^2

$A_b = 9.90 \times 6.80 \times 2$ = 134.640 "

COLUMN TOTAL = 158.139 m^2

(3) FOOTING



$A_a = 1.60 \times 13.00 \times 2$ = 41.600 m^2

$A_b = 1.60 \times 6.00 \times 2$ = 19.200 "

$A_c = \frac{1}{2} \times (1.30 + 6.00) \times 0.20 \times 2$ = 1.460 "

FOOTING TOTAL = 62.260 m^2

3) REINFORCING BAR

	$V\ (m^3)$	$R\ (kg/m^3)$	$W = V \cdot R\ (kg)$
BEAM	24.1	67.165	1618.7
COLUMN	80.5	148.491	11 953.5
FOOTING	134.3	57.043	7 660.9

BEARING BASE D16 3384 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

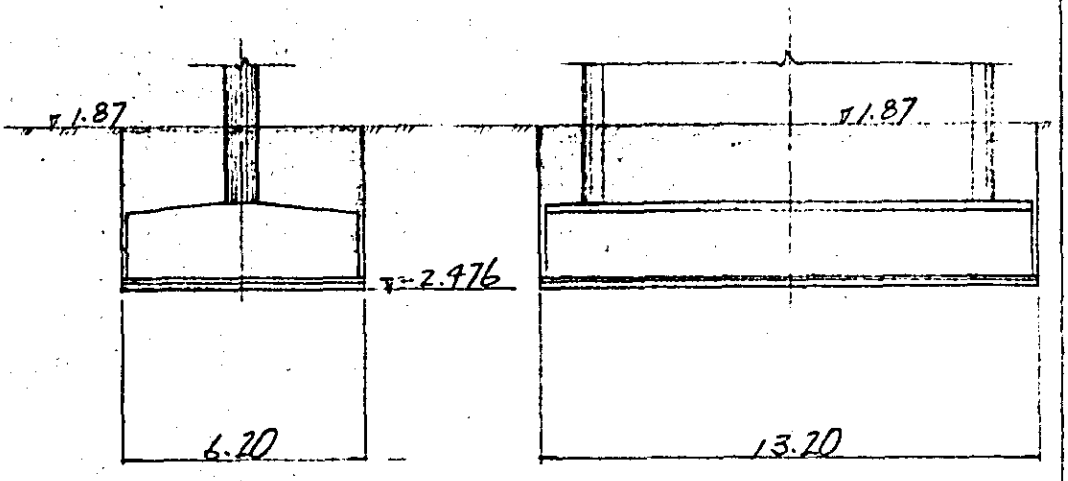
$$R = \frac{\text{REINFORCING BAR OF } F_{48}}{\text{CONCRETE VOLUME OF } P_{48}}$$

$$R_B = \frac{1591.8}{23.7} = 67.165$$

$$R_C = \frac{11\,775.3}{79.3} = 148.491$$

$$R_F = \frac{7660.9}{134.3} = 57.043$$

4) EXCAVATION



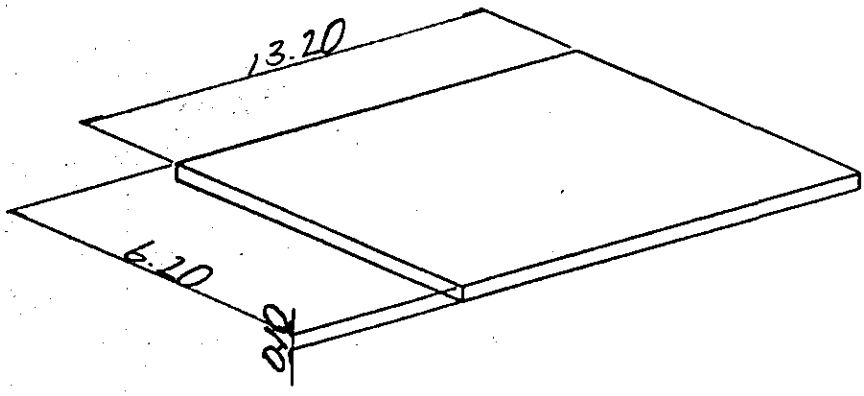
1 Va = 6.20 × 13.20 × (1.87 + 2.476) = 355.677 m^3

5) FOUNDATION MORTAR

$Va = 1/2 \times (0.736 \times 0.688 + 0.70 \times 0.65) \times 0.018 \times 4$

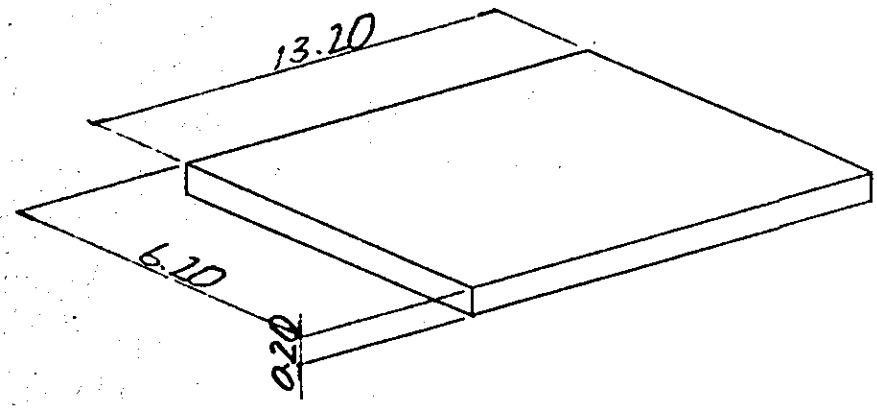
$+ 1/2 \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 8 = 0.088\ m^3$

6) LEVELING CONCRETE



$Va = 6.20 \times 13.20 \times 0.10 = 8.187\ m^3$

7) AGGREGATE SUBBASE



$Va = 6.20 \times 13.20 \times 0.20 = 16.368\ m^3$

8) PILE

ϕ - 500

TYPE - B $14^{m} \times 45$

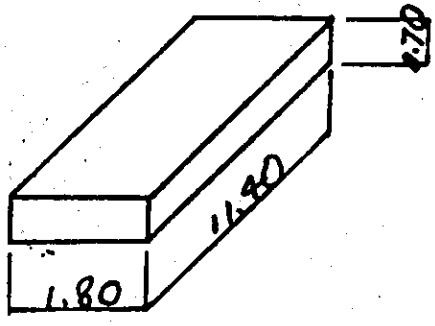
46 PIER C-43

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	18.8	32.0	2049.5	109.0
COLUMN	57.9	125.6	9127.0	157.6
TOTAL	76.7	157.6	11 176.5	145.7
FOOTING	185.5	73.6	12128.5	66.4

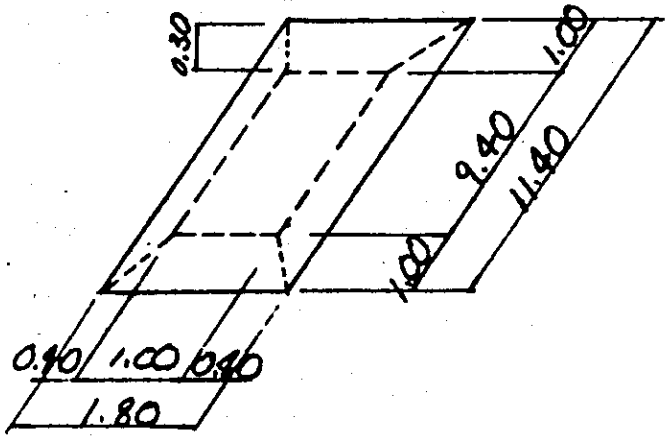
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B.-3
EXCAVATION	m^2	401.3	
FOUNDATION MORTAR	m^3	0.1	$\bar{J}_{cr}$ = 400
PILE	m x NUMBER	14 x 42	φ500-B

1) CONCRETE VOLUME

(1) BEAM



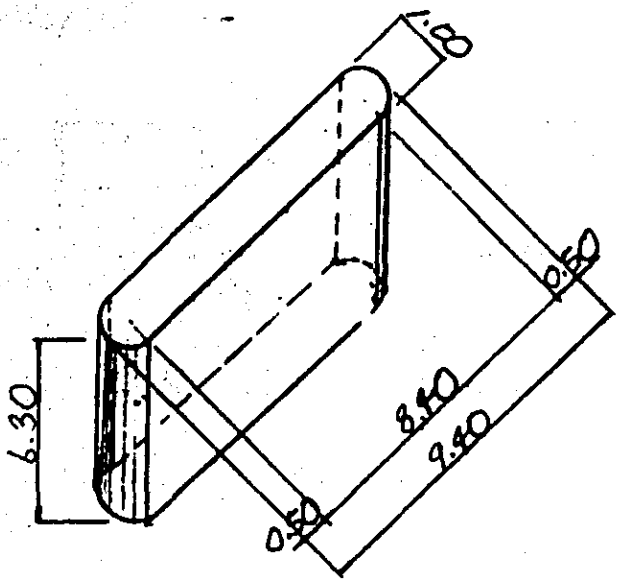
$V_a = 1.80 \times 0.70 \times 11.40$ = 14.364 m³



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m³

(2) COLUMN

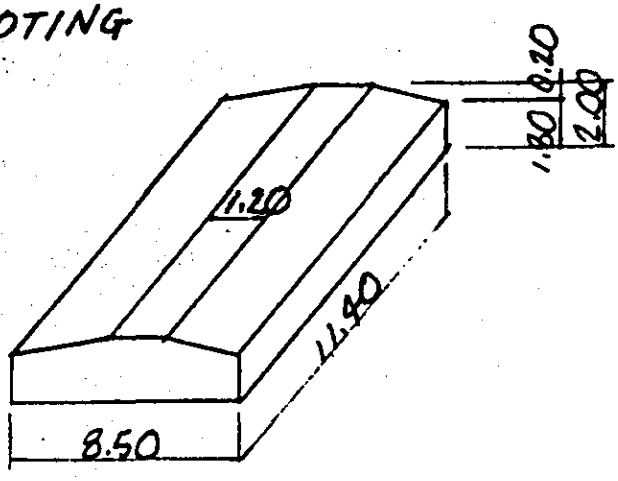


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 6.30$ = 4.948 m³

$V_b = 1.00 \times 8.40 \times 6.30$ = 52.920

COLUMN TOTAL = 57.868 m³

(3) FOOTING



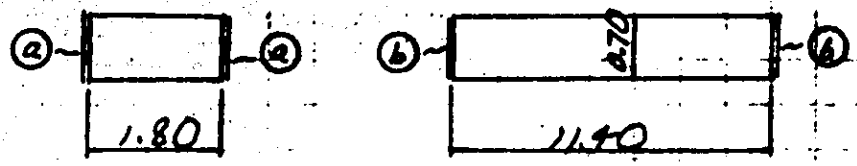
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m³

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420

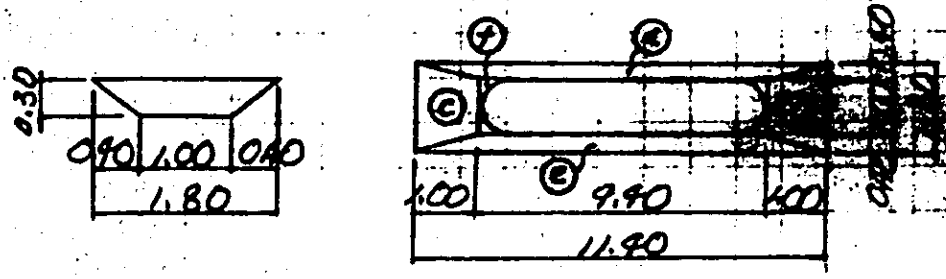
FOOTING TOTAL = 185.478 m³

2) FORM AREA

(1) BEAM

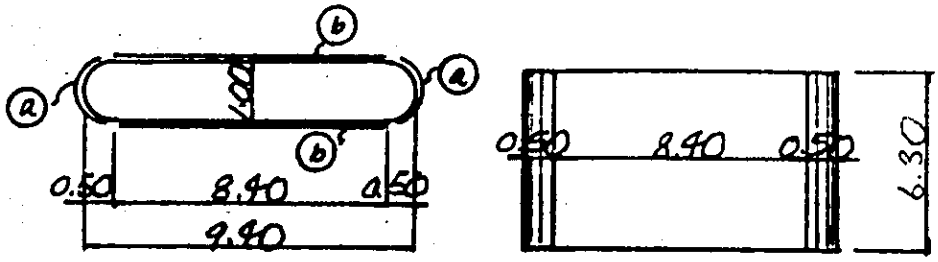


A_a = 0.70 × 11.40 × 2	=	15.960
A_b = 0.70 × 1.80 × 2	=	2.520



A_c = ½ × (1.00 + 1.80) · $\sqrt{1.00^2 + 0.30^2}$ × 2 (slope)	=	2.923
A_d = ½ × (9.40 + 11.40) · $\sqrt{0.40^2 + 0.30^2}$ (0.500)	=	5.200
A_e = 〃	=	5.200
A_f = (1 − π/4) × 1.00²	=	0.215
BEAM TOTAL	=	32.018 m²

(2) COLUMN

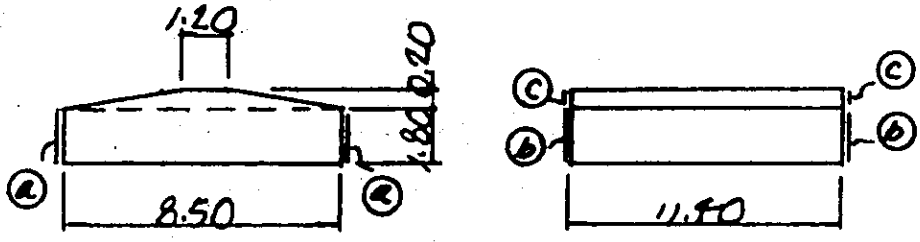


$A_a = \pi \times 1.00 \times 6.30$ = 19.792 m^2

$A_b = 8.40 \times 6.30 \times 2$ = 105.840 "

COLUMN TOTAL = 125.632 m^2

(3) FOOTING



$A_a = 1.80 \times 11.40 \times 2$ = 41.040 m^2

$A_b = 1.80 \times 8.50 \times 2$ = 30.600 "

$A_c = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$ = 1.940 "

FOOTING TOTAL = 73.580 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W=V·R (kg)
BEAM	18.8	82.971	1559.9
COLUMN	57.9	157.633	9127.0
FOOTING	185.5	65.383	12128.5

BEARING BASE D16 489.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

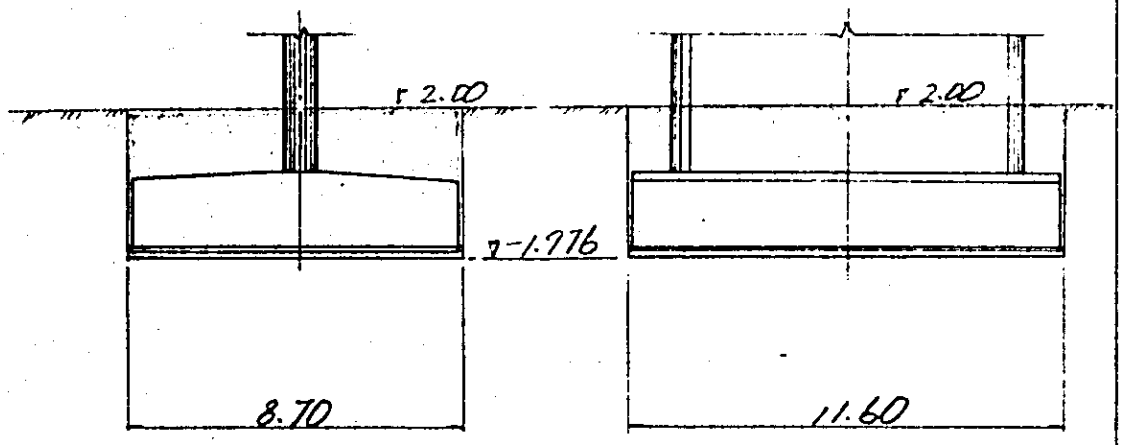
$$R = \frac{\text{REINFORCING BAR OF } P_{40}}{\text{CONCRETE VOLUME OF } P_{40}}$$

$$R_B = \frac{1725.8}{20.8} = 82.971$$

$$R_C = \frac{9694.4}{61.5} = 157.633$$

$$R_F = \frac{12128.5}{185.5} = 65.383$$

4) EXCAVATION

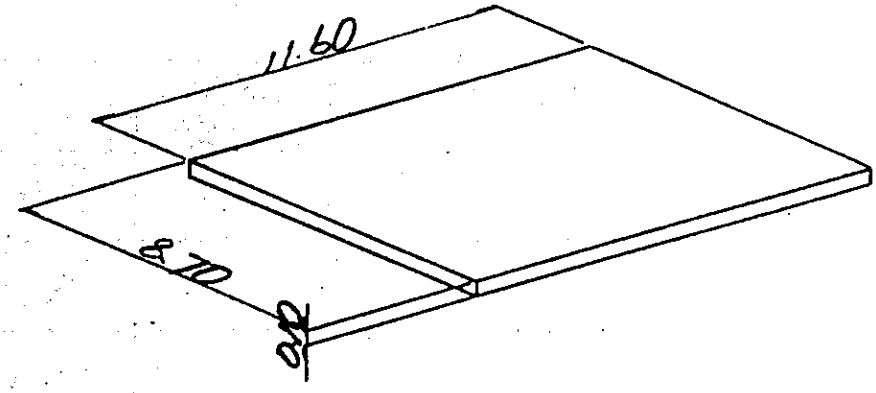


$$Va = 8.70 \times 11.60 \times (2.00 + 1.976) = 401.258 \ m^3$$

5) FOUNDATION MORTOR

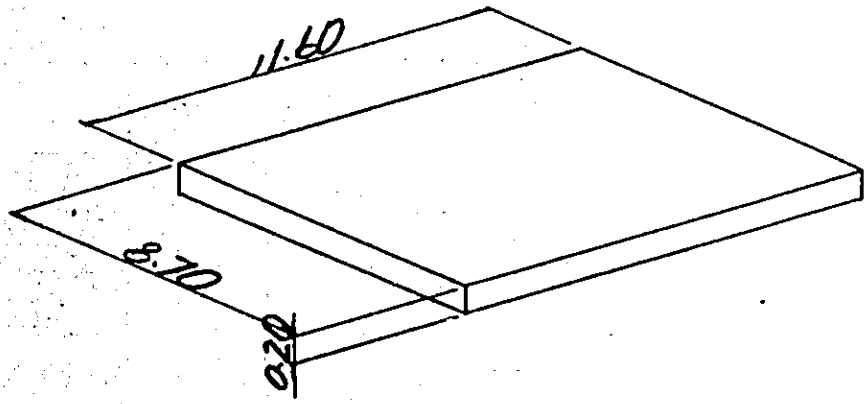
$$Va = \frac{1}{2} \times (0.136 \times 0.536 - 0.70 \times 0.50) \times 0.018 \times 16 = 0.107 \ m^3$$

6) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

7.) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

8) PILE

ϕ - 500

TYPE - B 14 m × 42

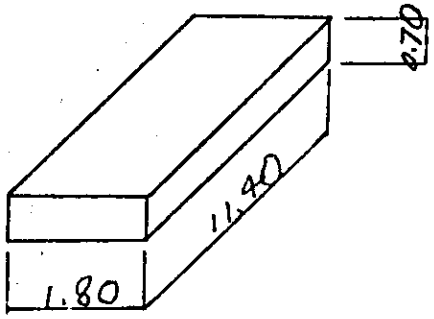
47 PIER 44

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (Kg)	RATIO (Kg/m^3)
BEAM	18.8	32.0	2049.5	109.0
COLUMN	61.5	133.6	9694.4	157.6
TOTAL	80.3	165.6	11743.9	146.3
FOOTING	185.5	73.6	12128.5	65.4

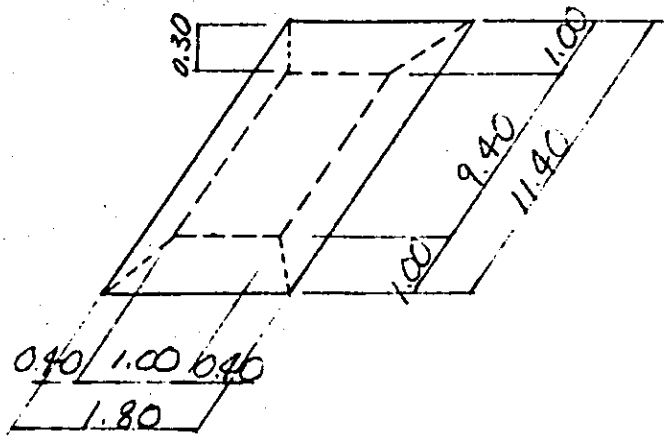
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B. - 3
EXCAVATION	m^3	380.1	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 Kg/cm^2
PILE	m x NUMBER	14 x 42	ϕ500 - B

1) CONCRETE VOLUME

11) BEAM



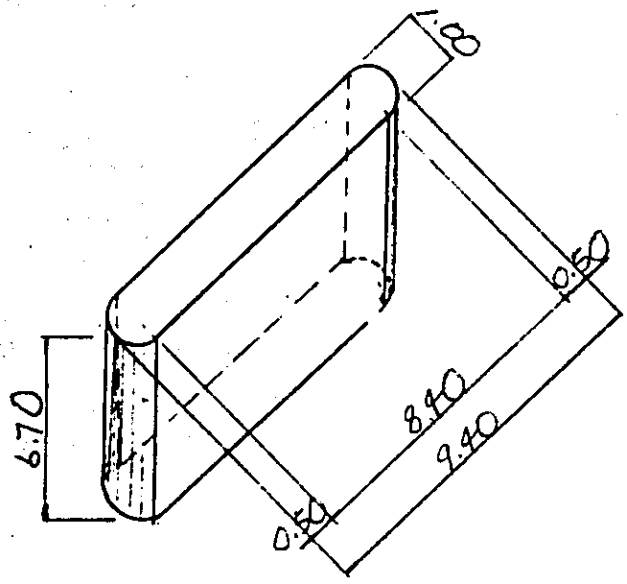
$V_a = 1.80 \times 0.10 \times 11.40$ = 14.364 m^3



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m^3

(2) COLUMN

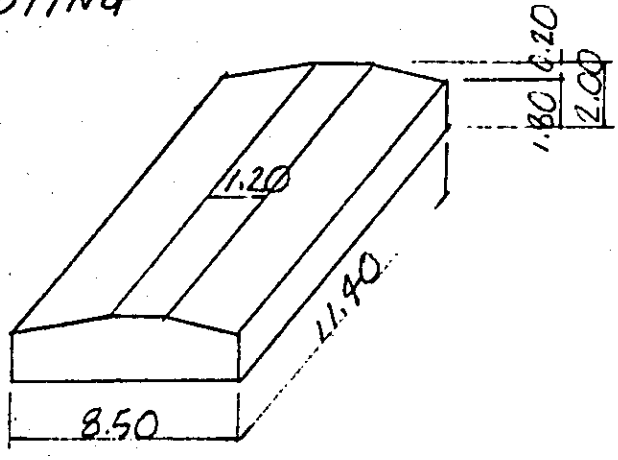


$Va = \frac{1}{4} \times \pi \times 1.00^2 \times 6.70$ = 5.262 m³

$Vb = 1.00 \times 8.40 \times 6.70$ = 56.280 "

COLUMN TOTAL = 61.542 m³

(3) FOOTING



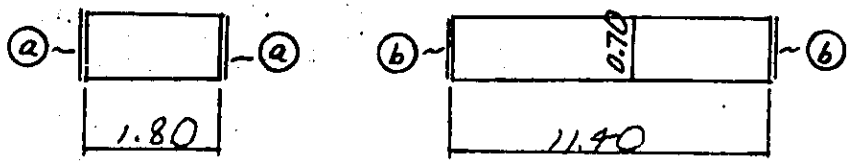
$Va = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m³

$Vb = 8.50 \times 1.80 \times 11.40$ = 174.420 "

FOOTING TOTAL = 185.478 m³

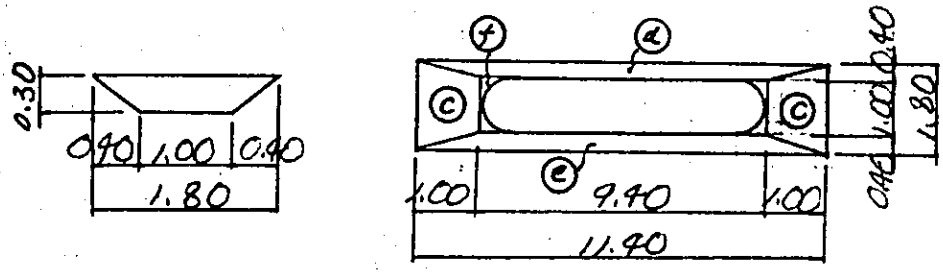
2) FORM AREA

(1) BEAM



A_a = 0.70 × 11.40 × 2 = 15.960 m²

A_b = 0.70 × 1.80 × 2 = 2.520 "



A_c = ½ × (1.00 + 1.80) × $\sqrt{1.00^2 + 0.30^2}$ × 2 = 2.923 "

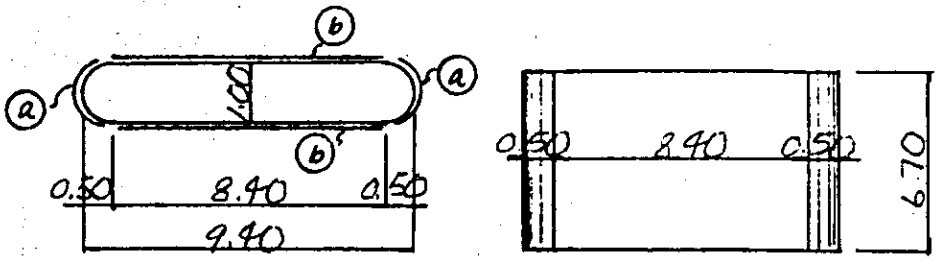
A_d = ½ × (9.40 + 11.40) × $\sqrt{0.40^2 + 0.30^2}$ = 5.200 "

A_e = 〃 = 5.200 "

A_f = (1 − π/4) × 1.00² = 0.215 "

BEAM TOTAL = 32.018 m²

(2) COLUMN

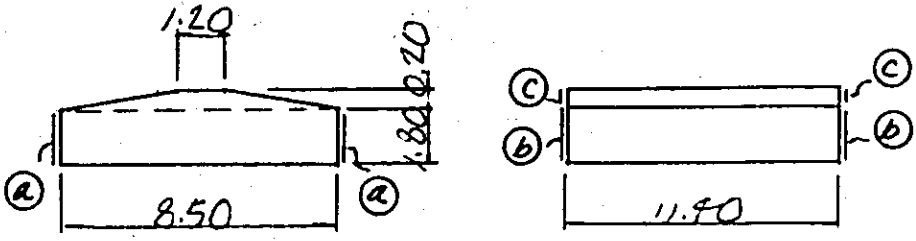


$Aa = \pi \times 1.00 \times 6.70$ = 21.049 m^2

$Ab = 8.40 \times 6.70 \times 2$ = 112.560 "

COLUMN TOTAL = 133.609 m^2

(3) FOOTING



$Aa = 1.80 \times 11.40 \times 2$ = 41.040 m^2

$Ab = 1.80 \times 8.50 \times 2$ = 30.600 "

$Ac = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$ = 1.940 "

FOOTING TOTAL = 73.580 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	18.8	82.971	1559.9
COLUMN	61.5	157.633	9694.4
FOOTING	185.5	65.383	12128.5

BEARING BASE D16 459.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

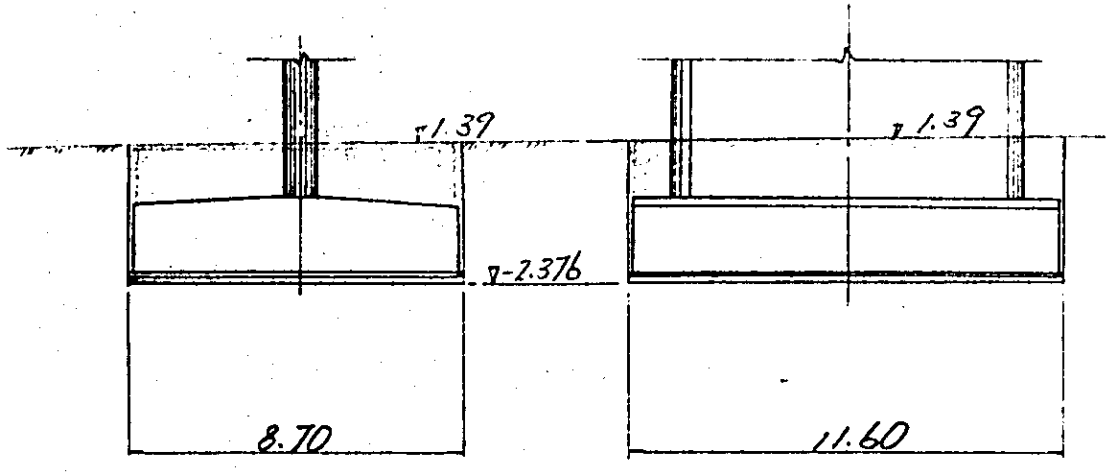
$$R = \frac{\text{REINFORCING BAR OF } P_{40}}{\text{CONCRETE VOLUME OF } P_{40}}$$

$$R_B = \frac{1725.8}{20.8} = 82.971$$

$$R_C = \frac{9694.4}{61.5} = 157.633$$

$$R_F = \frac{12128.5}{185.5} = 65.383$$

4) EXCAVATION

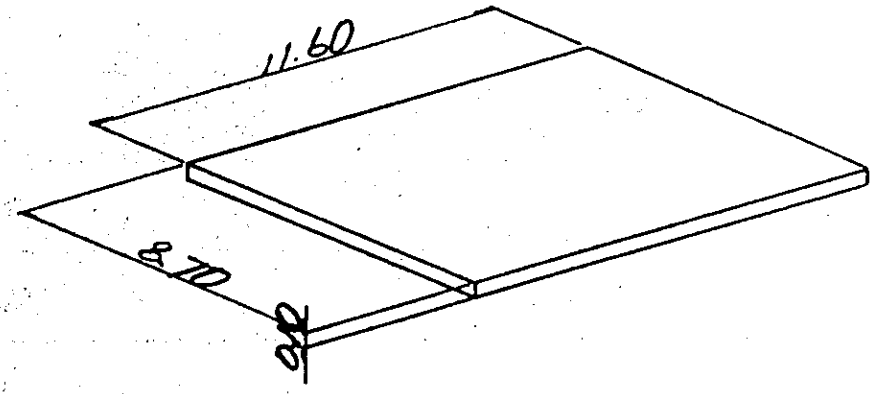


$$Va = 8.70 \times 11.60 \times (1.39 + 2.376) = 380.065\ m^3$$

5) FOUNDATION MORTAR

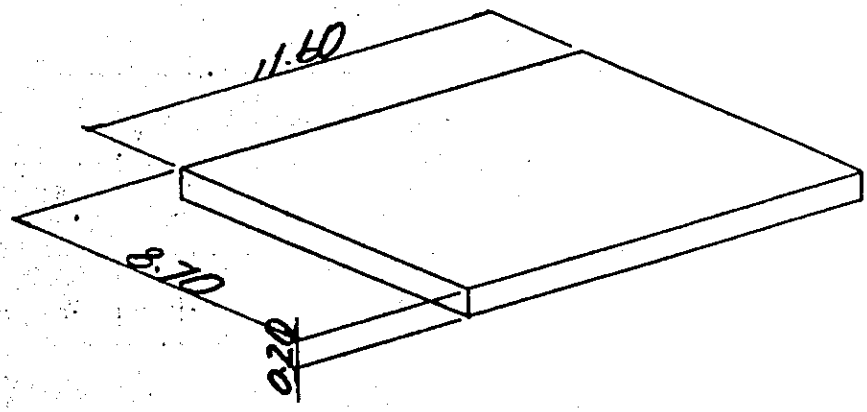
$$Va = \frac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 16 = 0.107\ m^3$$

6) LEVELING CONCRETE



$Va = 8.70 \times 11.60 \times 0.10 = 10.092\ m^3$

7) AGGREGATE SUBBASE



$Va = 8.70 \times 11.60 \times 0.20 = 20.184\ m^3$

8) PILE

$\phi = 500$

TYPE - B $14^{m} \times 42$

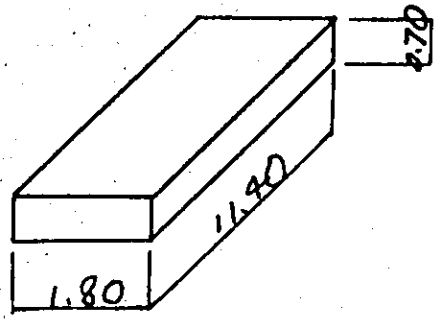
48 PIER 45

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	18.8	32.0	2049.5	109.0
COLUMN	61.5	133.6	9694.4	157.6
TOTAL	80.3	165.6	11743.9	146.3
FOOTING	185.5	73.6	12128.5	65.4

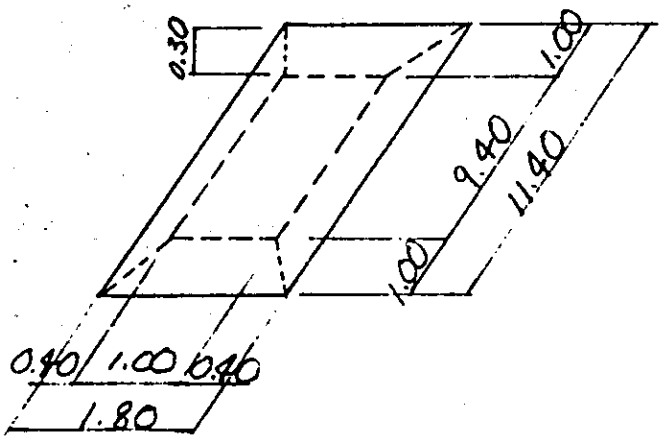
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B-3
EXCAVATION	m^3	360.9	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm^2
PILE	m × NUMBER	14 × 42	φ500-B

1) CONCRETE VOLUME

(1) BEAM



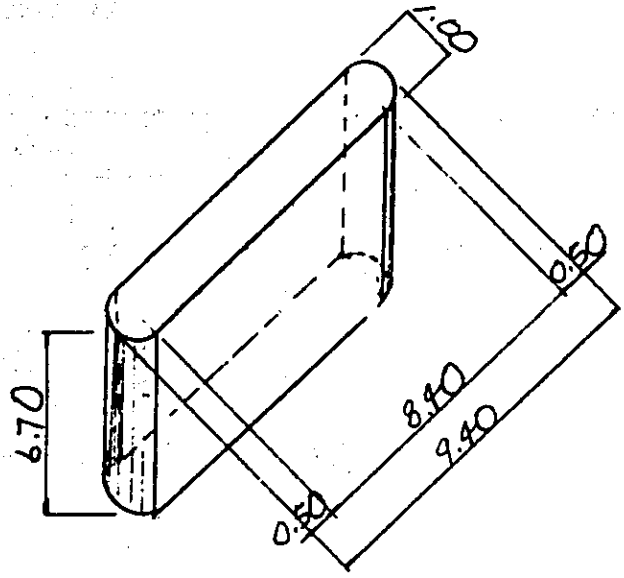
$V_a = 1.80 \times 0.70 \times 11.40$ = 14.364 m^3



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m^3

(2) COLUMN

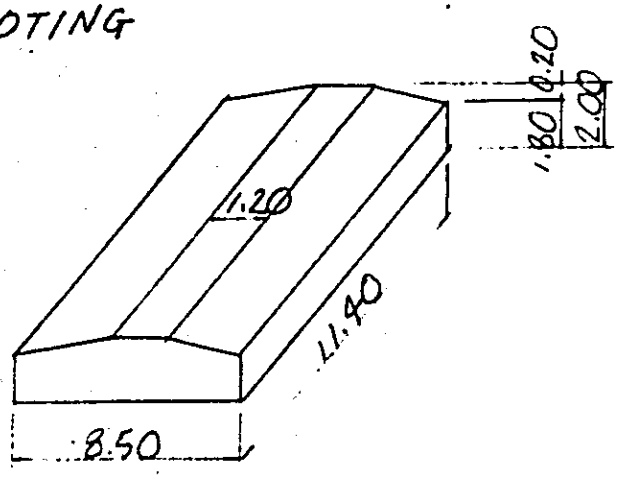


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 6.70$ = 5.262 m³

$V_b = 1.00 \times 8.40 \times 6.70$ = 56.280 "

COLUMN TOTAL = 61.542 m³

(3) FOOTING



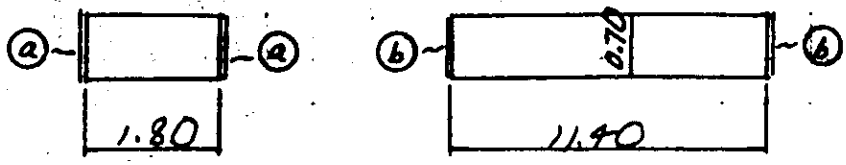
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m³

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420 "

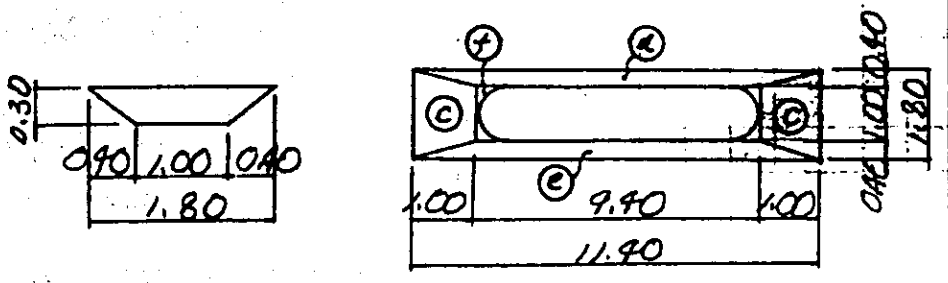
FOOTING TOTAL = 185.478 m³

2) FORM AREA

1) BEAM

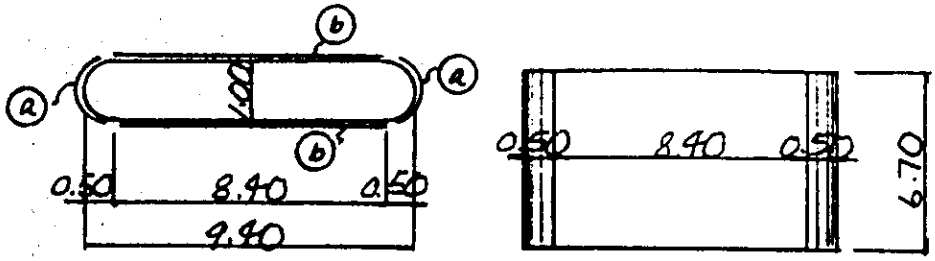


A_a =	0.70 × 11.40 × 2	=	15.960 m^2
A_b =	0.70 × 1.80 × 2	=	2.520 "



A_c =	$\frac{1}{2} \times (1.00 + 1.80) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (cdef)	=	2.923 "
A_d =	$\frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.40^2 + 0.30^2}$ (0.50)	=	5.200 "
A_e =	〃	=	5.200 "
A_f =	$(1 - \pi/4) \times 1.00^2$	=	0.215 "
	BEAM TOTAL	=	32.018 m^2

(2) COLUMN

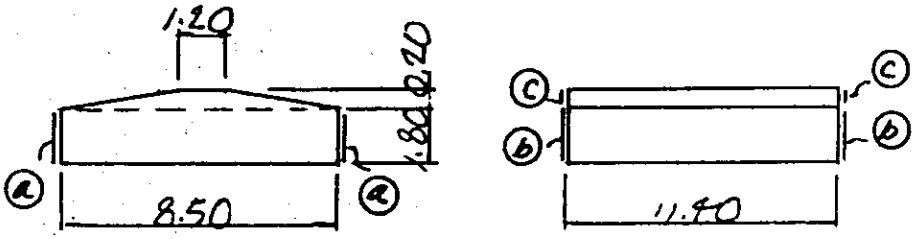


$A_a = \pi \times 1.00 \times 6.70$ = 21.049 m²

$A_b = 8.40 \times 6.70 \times 2$ = 112.560 "

COLUMN TOTAL = 133.609 m²

(3) FOOTING



$A_a = 1.80 \times 11.40 \times 2$ = 41.040 m²

$A_b = 1.80 \times 8.50 \times 2$ = 30.600 "

$A_c = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$ = 1.940 "

FOOTING TOTAL = 73.580 m²

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	18.8	82.971	1559.9
COLUMN	61.5	157.633	9694.4
FOOTING	185.5	66.383	12128.5

BEARING BASE D16 489.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

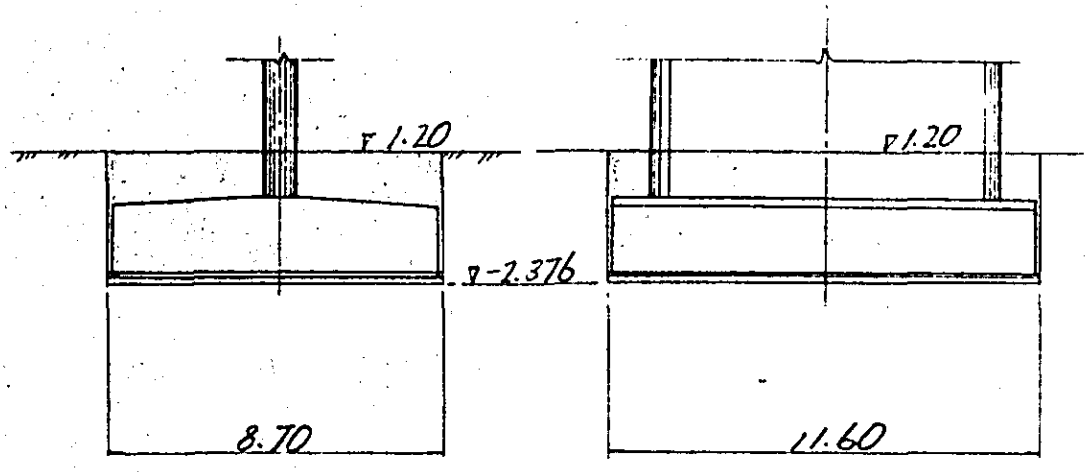
$$R = \frac{\text{REINFORCING BAR OF } P_{40}}{\text{CONCRETE VOLUME OF } P_{40}}$$

$$R_B = \frac{1725.8}{20.8} = 82.971$$

$$R_C = \frac{9694.4}{61.5} = 157.633$$

$$R_F = \frac{12128.5}{185.5} = 66.383$$

4) EXCAVATION

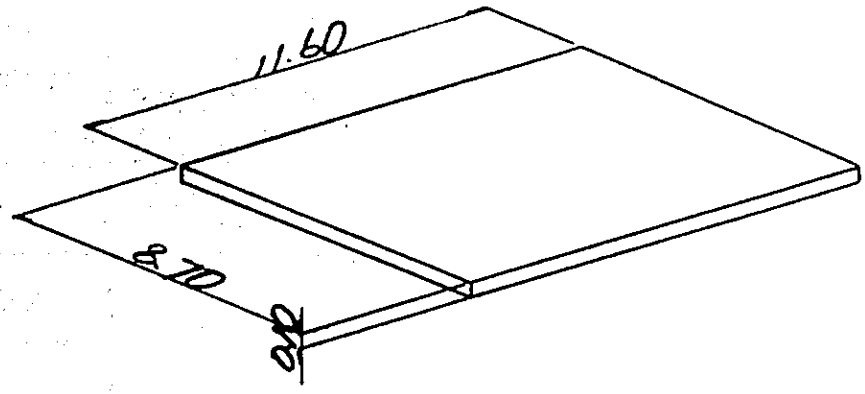


$$Va = 8.70 \times 11.60 \times (1.20 + 2.376) = 360.890\ m^3$$

5) FOUNDATION MORTAR

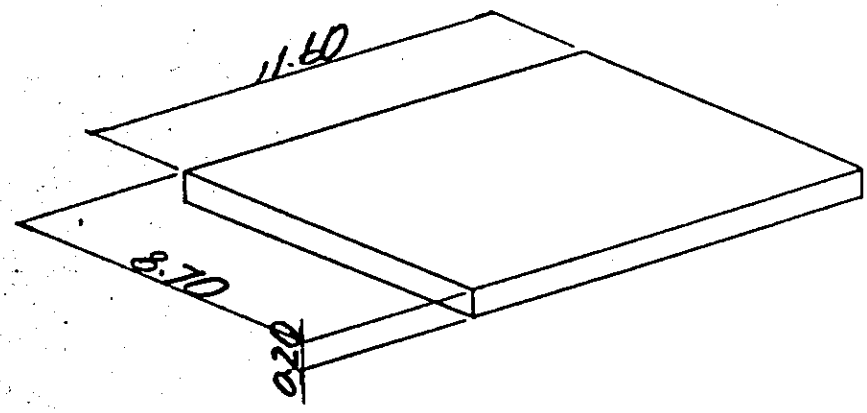
$$Va = \tfrac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 16 = 0.107\ m^3$$

6) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

7) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

8) PILE

ϕ = 500

TYPE - B 14 m × 42

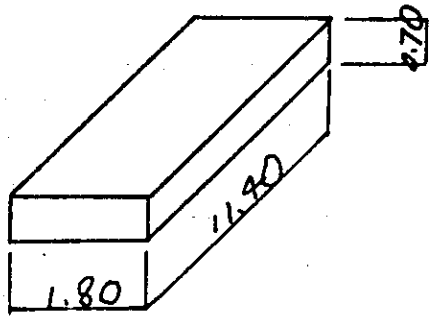
49 PIER 46

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	18.8	32.0	2049.5	109.0
COLUMN	61.5	133.6	9694.4	157.6
TOTAL	80.3	165.6	11743.9	146.3
FOOTING	185.5	73.6	12 128.5	65.4

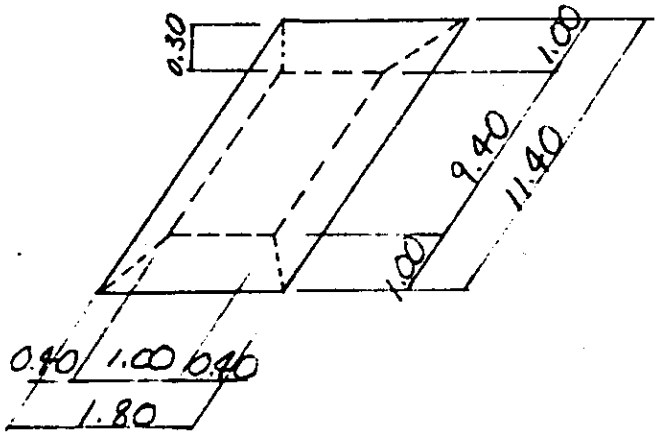
	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS F
AGGREGATE SUBBASE	m^3	20.2	A.S.B - 3
EXCAVATION	m^3	350.8	
FOUNDATION MORTAR	m^3	0.1	σ_{ck} = 400 kg/cm^2
PILE	m x NUMBER	14 x 42	φ500-B

1) CONCRETE VOLUME

11) BEAM



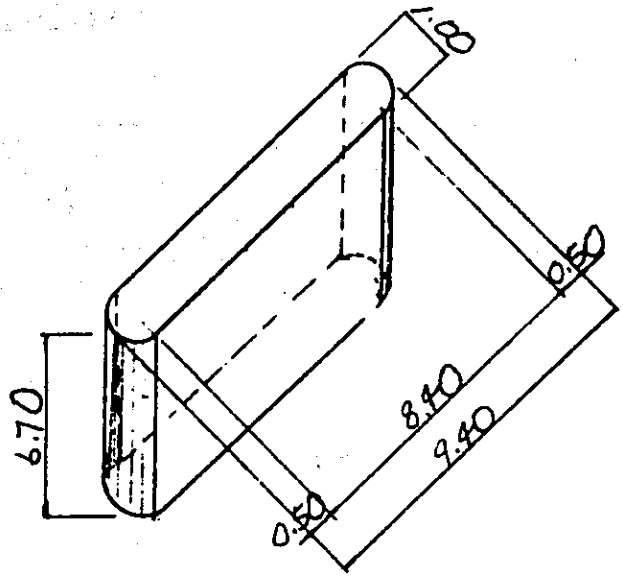
$V_a = 1.80 \times 0.70 \times 11.40$ = 14.364 m^3



$V_b = \frac{0.30}{6} \times \{1.00 \times 9.40 + 1.80 \times 11.40 + (1.00 + 1.80) \cdot (9.40 + 11.40)\}$ = 4.408 "

BEAM TOTAL = 18.772 m^3

(2) COLUMN

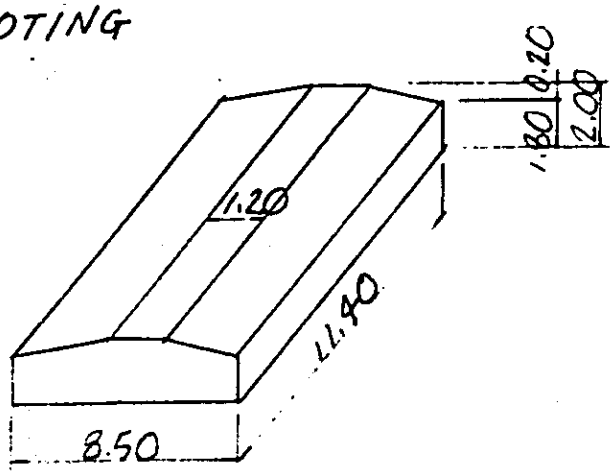


$V_a = \frac{1}{4} \times \pi \times 1.00^2 \times 6.70$ = 5.262 m^3

$V_b = 1.00 \times 8.40 \times 6.70$ = 56.280 "

COLUMN TOTAL = 61.542 m^3

(3) FOOTING



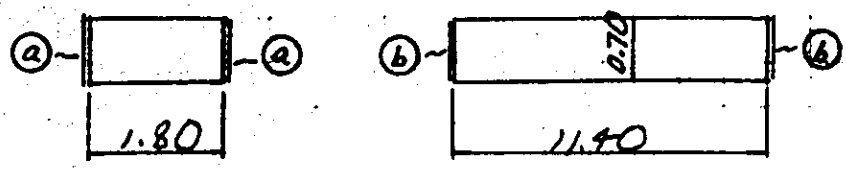
$V_a = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 11.40$ = 11.058 m^3

$V_b = 8.50 \times 1.80 \times 11.40$ = 174.420 "

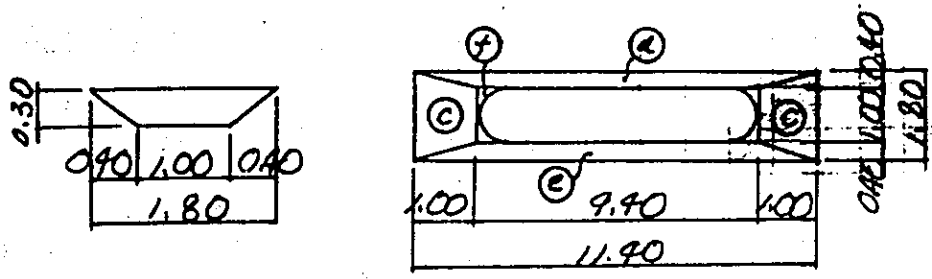
FOOTING TOTAL = 185.478 m^3

2) FORM AREA

1) BEAM

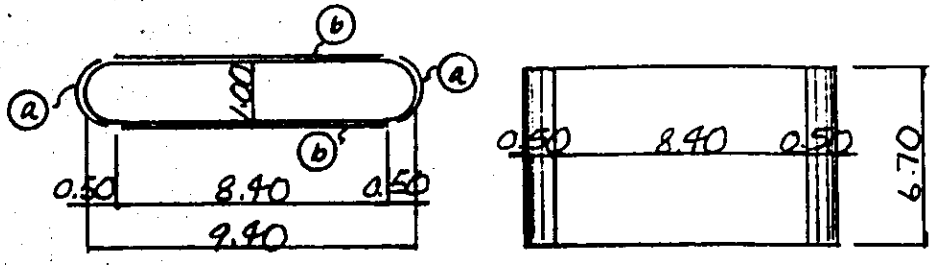


A_a =	0.70 × 11.40 × 2	=	15.960 m^2
A_b =	0.70 × 1.80 × 2	=	2.520 "



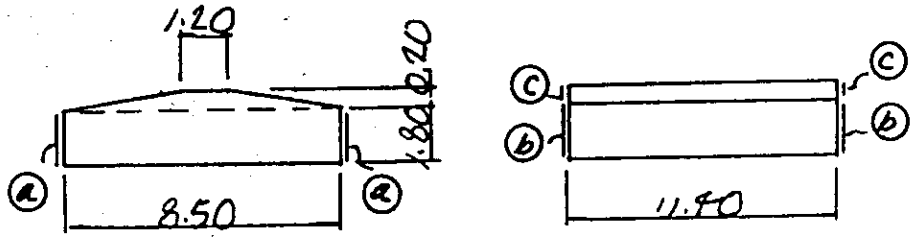
A_c =	$\frac{1}{2} \times (1.00 + 1.80) \times \sqrt{1.00^2 + 0.30^2} \times 2$ (four)	=	2.923 "
A_d =	$\frac{1}{2} \times (9.40 + 11.40) \times \sqrt{0.40^2 + 0.30^2}$ (c.sq)	=	5.200 "
A_e =	---------- "	=	5.200 "
A_f =	$(1 - \pi/4) \times 1.00^2$	=	0.215 "
	BEAM TOTAL	=	32.018 m^2

(2) COLUMN



$A_a = \pi \times 1.00 \times 6.70$	=	21.049 m^2
$A_b = 8.40 \times 6.70 \times 2$	=	112.560 "
COLUMN TOTAL	=	133.609 m^2

(3) FOOTING



$A_a = 1.80 \times 11.40 \times 2$	=	41.040 m^2
$A_b = 1.80 \times 8.50 \times 2$	=	30.600 "
$A_c = \frac{1}{2} \times (1.20 + 8.50) \times 0.20 \times 2$	=	1.940 "
FOOTING TOTAL	=	73.580 m^2

3) REINFORCING BAR

	V (m^3)	R (kg/m^3)	W = V · R (kg)
BEAM	18.8	82.971	1559.9
COLUMN	61.5	157.633	9694.4
FOOTING	185.5	65.383	12128.5

BEARING BASE D16 439.6 kg

V —— CONCRETE VOLUME

W —— REINFORCING BAR

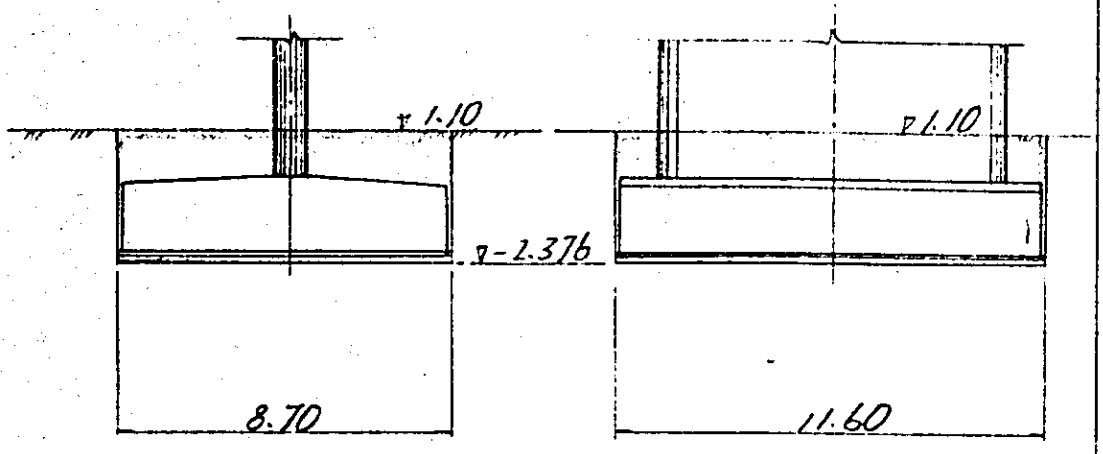
$$R = \frac{\text{REINFORCING BAR OF P40}}{\text{CONCRETE VOLUME OF P40}}$$

$$R_B = \frac{1725.8}{20.8} = 82.971$$

$$R_C = \frac{9694.4}{61.5} = 157.633$$

$$R_F = \frac{12128.5}{185.5} = 65.383$$

4). EXCAVATION

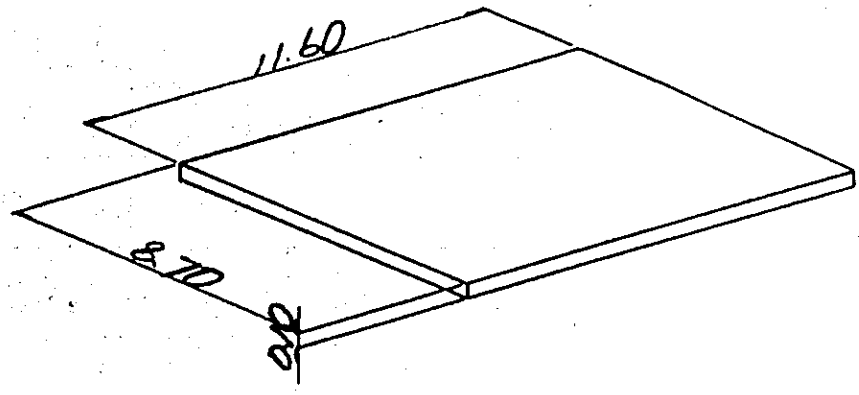


$Va = 8.70 \times 11.60 \times (1.10 + 2.376) = 350.798\ m^3$

5). FOUNDATION MORTAR

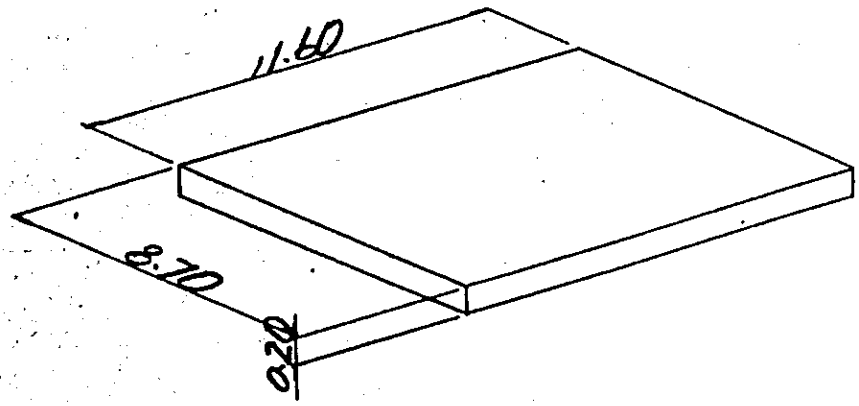
$Va = \frac{1}{2} \times (0.736 \times 0.536 + 0.70 \times 0.50) \times 0.018 \times 16 = 0.107\ m^3$

6) LEVELING CONCRETE



Va = 8.70 × 11.60 × 0.10 = 10.092 m^3

7) AGGREGATE SUBBASE



Va = 8.70 × 11.60 × 0.20 = 20.184 m^3

8) PILE

ϕ - 500

TYPE - B 14 m × 42

50 PIER 47

	CONCRETE VOLUME (m^3)	FORM AREA (m^2)	REINFORCING BAR (kg)	RATIO (kg/m^3)
BEAM	18.8	32.0	2049.5	109.0
COLUMN	61.5	133.6	9694.4	157.6
TOTAL	80.3	165.6	11743.9	146.3
FOOTING	185.5	73.6	12128.5	65.4

	UNIT	QUANTITY	REMARKS
LEVELING CONCRETE	m^3	10.1	CLASS B
AGGREGATE SUBBASE	m^3	20.2	A.S.B. - 3
EXCAVATION	m^3	340.7	
FOUNDATION MORTAR	m^3	0.1	
PILE	m x NUMBER	13 x 42	φ500 - B