CHAPTER 6 MAINTENANCE AND AMENITY FACILITIES

6.1 Mooring Facility

TYPE OF WORK : MOORING FACILITIES
LOCATION :
:

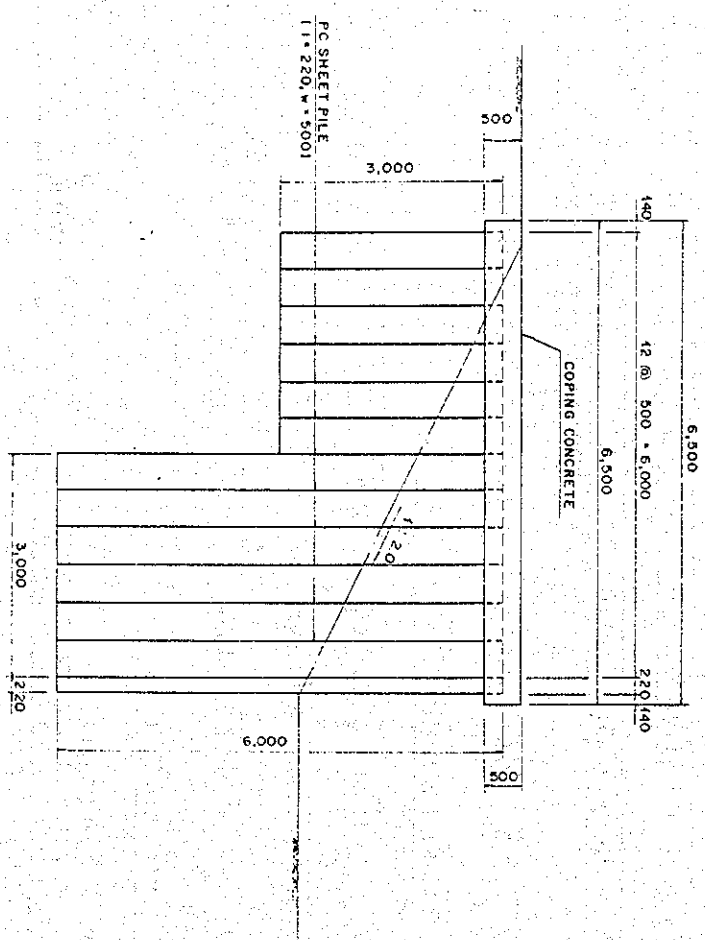
PER 1 PLACE

CALCULATION			RESULT
STRUCTURAL EXCAVATION			
A = (6.28 + 7.78) x ½ x 3.00	=	21.090 m^2	
V_1 = 21.09 x 10.00	=	210.900	
V_2 = ½ x 6.00 x 3.00 x 6.00	=	54.000	
V_3 = (1.50 + 0.90) x ½ x 0.60 x (5.00 + 1.414 x 6.00) x 2	=	19.416	
V_4 = 1.118 x 6.00 x 1.00 x (5.00 + 1.414 x 6.00) x 2	=	180.901	
V_5 = 0.60 x 1.00 x 5.00 x 2	=	6.000	
V_6 = (1.20 + 2.80) x ½ x 0.60 x 10.00	=	12.000	
V_7 = (4.80 + 6.10) x ½ x 0.50 x 10.00	=	27.250	
V_8 = 1.202 x 4.50 x 0.50 x 10.00	=	27.045	
TOTAL V	=	537.510	537.510 m^3
BACKFILL WITH SELECTED SOIL			
A_1 = (0.50 + 1.10) x ½ x 0.60	=	0.480	
A_2 = (0.50 + 1.00) x ½ x 0.50	=	0.375	
A_1 = (0.50 + 0.80) x ½ x 0.30	=	0.195	
TOTAL A	=	1.050 m^2	
V = 1.05 x 10.00	=	10.500	10.500 m^3
GRAVEL BEDDING			
V = (6.31 x 0.25 + 0.50 x 0.25) x 10.00	=	17.025	17.025 m^3
RUBBLE STONE FILLING			
V = ½ x 0.50 x 0.75 x 10.00	=	1.875	1.875 m^3
GABION MATTRESS			
A = 0.50 x 3.00	=	1.50 m^2	
V = 1.50 x 10.00	=	15.000	15.000 m^3

MOORING FACILITIES

PER 1 PLACE

TYPE OF WORK :	PC SHEET PILE
LOCATION :	



CALCULATION	RESULT
- PC SHEET PILE	
L_1 = 6.00 m/pile L_2 = 4.00 m/pile	
L = (6.00 m/pile × 18 piles + 4.00 m/pile × 6 piles) × 2	
= 264.000	264.000 m
• DRIVING	
L_1 = 4.50 m/pile × 12 piles × 2 = 108.000	
L_2 = 3.00 m/pile × 3 piles × 2 = 18.000	
L_3 = 3.50 m/pile × 3 piles × 2 = 21.000	
L_4 = 3.00 m/pile × 6 piles × 2 = 36.000	
TOTAL = 183.000	183.000 m

TYPE OF WORK : MOORING FACILITIES
LOCATION :
:

PER 1 PLACE

CALCULATION			RESULT
PC SHEET PILE			
PC SHEET PILE			
L_1 = 6.00 m / pile L_2 = 4.00 m /pile			
L = (6.00 m / pile x 18 piles + 4.00 m / pile x 6 piles) x 2		= 264.000	264.000 m
DRIVING			
L_1 = 4.50 m / pile x 12 piles x 2		= 108.000	
L_2 = 3.00 m / pile x 3 piles x 2		= 18.000	
L_3 = 3.50 m / pile x 3 piles x 2		= 21.000	
L_4 = 3.00 m / pile x 6 piles x 2		= 36.000	
	TOTAL L	= 183.000	183.000 m
COPING CONCRETE			
CONCRETE TYPE C1			
V = (0.50 + 0.50 – 0.22 x 0.25) x (6.50 + 6.00) x 2		= 4.875	4.875 m^3
GRAVEL BEDDING			
V = (6.50 + 6.00) x 2 x 0.10 x 0.24		= 0.600	0.600 m^3
FORM (H < 4.0 m)			
A_1 = (0.50 x 2 + 0.14) x (6.50 + 6.00) x 2		= 28.500	
A_2 = 0.50 x 0.50 x 2 x 2		= 1.000	
	TOTAL A	= 29.500	29.500 m^2
REINFORCING BAR			
D13 (W = 1.04 kg.f / m)			
n_1 = 7 bars			
W_1 = (6.50 + 6.00 – 0.05 x 2) x 7 bars x 1.04		= 90.272	

TYPE OF WORK : MOORING FACILITIES
LOCATION :
:

PER 1 PLACE

CALCULATION			RESULT
D10 (W = 0.617 kg.f / m)			
n_2 = (6.50 + 6.00 - 0.05 x 2) : 0.30 + 1	÷	42 bars	
L = 0.40 x 3	=	1.200 m / bar	
W_2 = 42 x 1.20 x 0.617 x 2	=	62.194	
TOTAL W	=	152.466 kg.f	0.152 tf
BASE CONCRETE			
CONCRETE TYPE C1			
V = 3.15 m^3/ 10.00 m x 10.00 m	=	3.150	3.150 m^3
GRAVEL BEDDING			
V = 0.80 m^3/ 10.00 m x 10.00 m	=	0.800	0.800 m^3
FORM (H < 4.0 m)			
A = 13.45 m^2/ 10.00 m x 10.00 m	=	13.450	13.450 m^2
REINFORCING BAR			
W = 0.039 tf / 10.00 m x 10.00 m	=	0.039	0.039 tf
LOG PILE (Dia 150, L = 2.0 m / pile)			
L = 10.00 m / 10.00 m x 10.00 m	=	10.000	10.000 m
CONCRETE STEPS			
CONCRETE TYPE D			
V = {(6.31 + 1.00) x 0.50 – ½ x 0.30 x 0.45 x 10} x 10.00	=	29.800	29.800 m^3
FORM (H < 4.0 m)			
A_1 = 0.30 x 10.00 x 10	=	30.000	
A_2 = 0.25 x 10.00	=	2.500	
TOTAL A	=	32.500	32.500 m^2
REINFORCING BAR			
D13 (W = 1.04 kg.f / m)			
n_1 = (6.31 + 0.45 – 0.05 x 2) : 0.30 + 1	=	24 bars	
L = (10.00 – 0.05 x 2)	=	9.90 m / bar	
W_1 = 24 x 9.90 x 1.04	=	247.104	

TYPE OF WORK : MOORING FACILITIES
LOCATION :
:

PER 1 PLACE

CALCULATION			RESULT
n_2 = (10.00 - 0.05 x 2) : 0.30 + 1	=	34 bars	
L = (6.31 + 0.45 – 0.05 x 2)	=	6.660 m / bar	
W_2 = 6.66 x 34 x 1.04	=	235.498	
TOTAL W	=	482.602 kg.f	0.483 tf
RUBBLE STONE BEDDING			
A_1 = 1.118 x 6.00 x 0.40 + ½ x 0.40 x 0.80	=	4.283 m^2	
V_1 = 4.283 x 5.00 x 2	=	42.830	
A_2 = ½ x $(1.118 \times 6.00)^2$	=	22.499 m^2	
V_2 = 22.499 x 0.40 x 2	=	17.999	
TOTAL V	=	60.829	60.829 m^3
STONE FACING			
A_1 = (1.50 + 0.90) x ½ x 0.60	=	0.720 m^2	
A_2 = 1.118 x 6.00 x 0.60	=	4.025 m^2	
A_3 = 1.00 x 0.60	=	0.600 m^2	
TOTAL A	=	5.345 m^2	
V_1 = 5.345 x 5.00 x 2	=	53.450	
V_2 = { ½ x $(1.118 \times 6.00)^2$ x 0.60 + 0.720 x 1.118 x 6.00} x 2	=	36.658	
TOTAL V	=	90.108 m^3	90.108 m^3

6.2 Riverside Approach Steps

TYPE OF WORK :
LOCATION : APPROACH STEPS TYPE – WA (RIVER SIDE)

CALCULATION				RESULT
STRUCTURAL EXCAVATION				
A_1 = (1.4 + 2.0) x 0.6 : 2		=	1.02	
V_1 = 1.02 x 3.40		=	3.468	
A_2 = (1.4 + 2.0) x 0.6 : 2		=	1.02	
V_2 = 1.02 x 0.8		=	0.816	
	TOTAL	=	4.284	4.284 m^3
BACKFILL WITH SELECTED SOIL				
A_1 = (0.6 + 1.2) x 0.6 : 2		=	0.54	
V_1 = 0.54 x 3.4		=	1.836	
A_2 = (0.6 + 1.2) x 0.6 : 2		=	0.54	
V_2 = 0.54 X 0.8 X 2		=	0.864	
	TOTAL	=	2.700	2.700 m^3

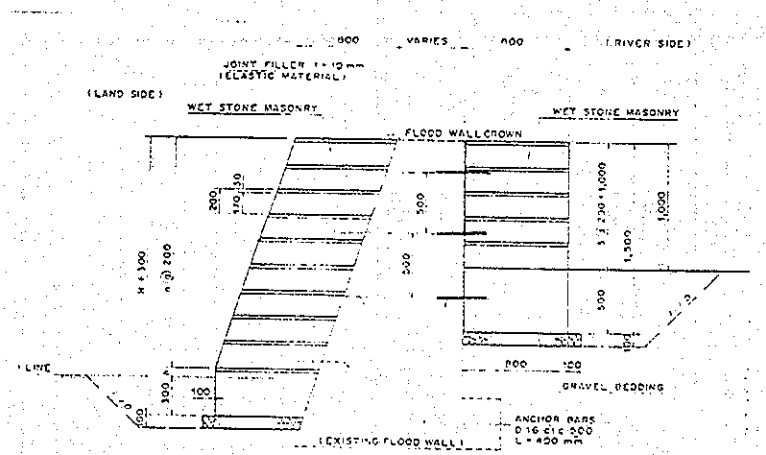
TYPE OF WORK :
LOCATION : APPROACH STEPS TYPE – WA (RIVER SIDE)

CALCULATION				RESULT
WET STONE MASONRY				
1. 0.8 x 0.2 x 1.0		=	0.16	
2. 0.8 x 0.2 x 1.6		=	0.256	
3. 0.8 x 0.2 x 2.2		=	0.352	
4. 0.8 x 0.2 x 2.8		=	0.448	
5. 0.8 x 0.7 x 3.4		=	0.544	
	V	=	1.76	1.760 m^3
GRAVEL BEDDING				
V = 0.1 x 0.9 x 3.6		=	0.324	0.324 m^3
CEMENT MORTAR POINTING				
• SIDE				
0.2 x 1.0		=	0.2	
0.2 x 1.6		=	0.32	
0.2 x 2.2		=	0.44	
0.2 x 2.8		=	0.56	
0.2 x 3.4		=	0.68	
	TOTAL:	=	2.200	
• FRONT				
0.8 x 1.0 x 2		=	1.600	
• TOP				
3.4 x 0.8		=	2.720	
	TOTAL	=	6.52	6.520 m^2
JOINT FILTER				
A = 0.2 x 1.0 + 0.2 x 1.6 + 0.2 x 2.2 + 0.2 x 2.8 + 0.7 x 3.4				
		=	2.2	2.200 m^2

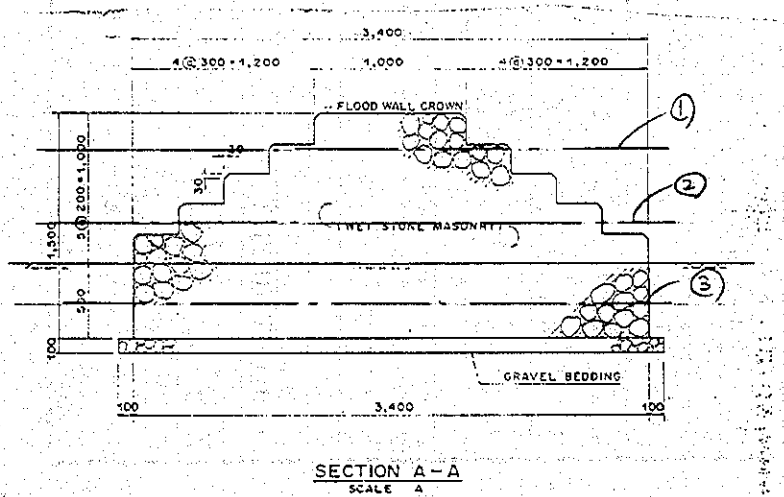
APPROACH STEPS TYPE W.A (RIVER SIDE)

TYPE OF WORK :	ANCHOR BARS
LOCATION :	

(RIVER SIDE)



SECTION B–B
SCALE A



SECTION A–A
SCALE A

CALCULATION	RESULT
· D 16 (1.580 kgf/m)	
①	
$L_1 = 0.4 \times 2 = 0.8$	
②	
$L_2 = 0.4 \times 3 = 1.2$	
③	
$L_3 = 0.4 \times 3 = 1.2$	
TOTAL = 3.2	
$W = 3.2 \times 1.580 = 5.056$	5.056 kgf

TYPE OF WORK :
LOCATION : APPROACH STEPS TYPE – WA (LAND SIDE)

CALCULATION				RESULT
STRUCTURAL EXCAVATION				
A_1 =	(1.750 + 1.250) x 0.4 : 2	=	0.6	
V_1 =	0.6 x 5.8	=	3.48	
A_2 =	(0.6 + 1.0) x 0.4 : 2	=	0.32	
V_2 =	0.32 x 1.250 x	=	0.800	
	TOTAL = V_1 + V_2	=	4.28	4.280 m^3
BACKFILL WITH SELECTED SOIL				
A_1 =	(1.0 + 0.6) x 0.4 : 2	=	0.32	
V_1 =	0.32 x 6.00	=	1.92	
A_2 =	(0.6 + 1.0) x 0.4 : 2	=	0.32	
V_2 =	0.32 x 0.6 x 2	=	0.384	
	TOTAL = V_1 + V_2	=	2.304	2.304 m^3

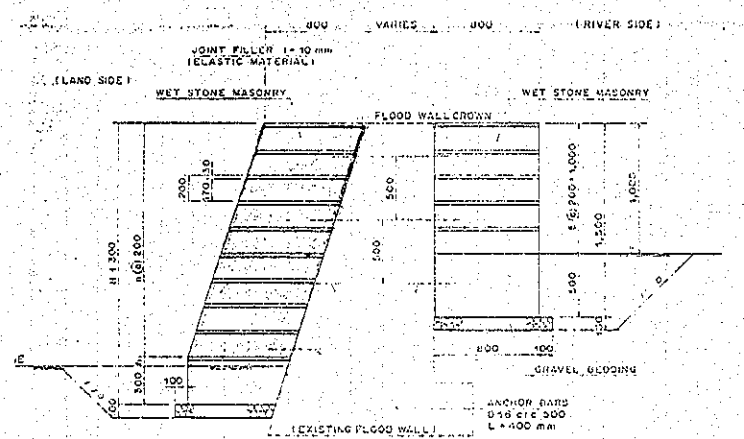
TYPE OF WORK :
LOCATION : APPROACH STEPS TYPE – WA (LAND SIDE)

CALCULATION			RESULT
WET STONE MASONRY			
BLOCK			
1. 0.8 x 0.2 x 1.0	=	0.16	
2. 0.8 x 0.2 x 1.6	=	0.256	
3. 0.8 x 0.2 x 2.2	=	0.352	
4. 0.8 x 0.2 x 2.8	=	0.448	
5. 0.8 x 0.2 x 3.4	=	0.544	
6. 0.8 x 0.2 x 4.0	=	0.640	
7. 0.8 x 0.2 x 4.6	=	0.736	
8. 0.8 x 0.2 x 5.2	=	0.832	
9. (0.8 x 0.67) x 0.367 : 2 x 5.8	=	1.565	
TOTAL:	=	5.533	5.533 m^3
GRAVEL BEDDING			
V = (0.76 + 0.73) x 0.1 : 2 x 6.0	=	0.447	0.447 m^3

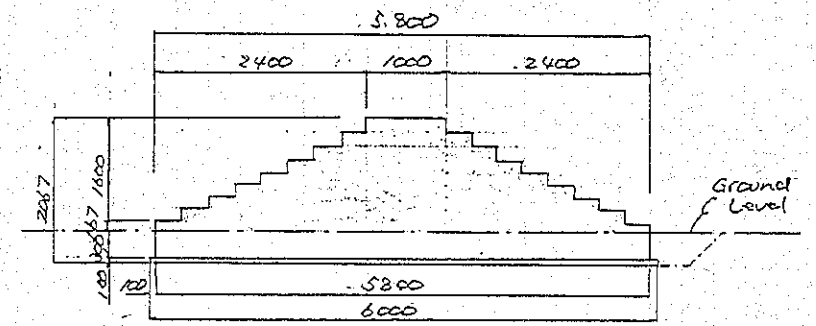
APPROACH STEPS TYPE -W.A. (LAND SIDE)

TYPE OF WORK :	CEMENT MORTAR PLASTERING
LOCATION :	

(LAND SIDE)



SECTION B–B
SCALE A



CALCULATION		RESULT
· SIDES		
0.2 x 1.0	= 0.2	
0.2 x 1.6	= 0.32	
0.2 x 2.2	= 0.44	
0.2 x 2.8	= 0.56	
0.2 x 3.4	= 0.68	
0.2 x 4.0	= 0.80	
0.2 x 4.6	= 0.92	
0.2 x 5.2	= 1.04	
0.067 x 5.8	= 0.389	
TOTAL	= 5.349	
· FRONT		
A = (1.6 + 0.067) x 0.8	= 1.334	
· TOP		
A = 5.8 x 0.8	= 4.640	
TOTAL	= 11.323	11.323 m²

TYPE OF WORK :
LOCATION : APPROACH STEPS TYPE – WA (LAND SIDE)

CALCULATION				RESULT
JOINT FILTER				
0.2 x 1.0		=	0.2	
0.2 x 1.6		=	0.32	
0.2 x 2.2		=	0.44	
0.2 x 2.8		=	0.56	
0.2 x 3.4		=	0.68	
0.2 x 4.0		=	0.80	
0.2 x 4.6		=	0.92	
0.2 x 5.2		=	1.04	
0.367 x 5.8		=	2.129	
	TOTAL:	=	7.089	7.089 m^2
ANCHOR BARS				
• D 16 (1.580 kgf/m)				
1. L_1 = 0.4 x 2		=	0.8	
2. L_2 = 0.4 x 5		=	2.0	
3. L_3 = 0.4 x 9		=	3.6	
L = $L_1 + L_2 + L_3$		=	6.4	
N = 6.4 x 1.580		=	10.112	10.112 kgf

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WA-2)
:
:

PER 1 PLACE

CALCULATION			RESULT
STRUCTURAL EXCAVATION			
A_1 = (1.20 + 4.30) x ½ x 1.20	=	3.300	
A_2 = (1.118 x 6.30 +0.70) x 0.60	=	4.646	
A_3 = (0.80 + 1.80) x ½ x 0.80	=	1.040	
TOTAL A	=	8.986 m^2	
V = 8.986 x 1.80	=	16.175	16.175 m^3
BACKFILL WITH SELECTED SOIL			
A_1 = (0.50 + 1.20) x ½ x 0.70	=	0.595	
A_2 = (1.50 + 1.90) x ½ x 0.30	=	0.510	
A_1 = (0.50 + 1.10) x ½ x 0.60	=	0.480	
TOTAL A	=	1.585 m^2	
V = 1.585 x 1.80	=	2.853	2.853 m^3
GRAVEL BEDDING			
Average Height : h = 2.650 m			
A = (1.118 x 6.30 + 0.70) x 0.25	=	1.936	
V = 1.936 x 1.20	=	2.323	2.323 m^3
CONCRETE TYPE D			
Average Height : h = 2.650 m			
CONCRETE TYPE D			
V = {(1.118 x 6.30 + 0.70) x 0.35 – ½ x 0.40 x 0.20 x14}	=	2.580	2.580 m^3
FORM (H < 4.0 m)			
A = 0.20 x 1.20 x 14	=	3.360	3.360 m^2

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WA-2)
:
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PER 1 PLACE

CALCULATION			RESULT
REINFORCING BAR (D13, W = 1.04 kg.f / m			
n_1 = (1.118 x 6.30 + 0.70 – 0.05 x 2) : 0.30 + 1	≒	27 bars	
L_1 = (1.20 – 0.05 x 2)	=	1.10 m / bar	
W_1 = 27 x 1.10 x 1.04	=	30.888	
n_2 = (1.20 – 0.05 x 2) : 0.30 + 1	≒	6 bars	
L_2 = 1.118 x 6.30 + 0.70 – 0.05 x 2	=	7.643 m / bar	
W_2 = 7.643 x 6 x 1.04	=	47.692	
TOTAL W	=	78.580 kg.f	0.079 tf
SIDE WALL			
CONCRETE TYPE C1			
V = 1.233 m^3/ 2.936 m x 7.743	=	3.252	3.252 m^3
GRAVEL BEDDING			
V = 1.089 m^3/ 2.936 m x 7.743	=	2.872	2.872 m^3
FORM (H < 4.0 m)			
A = 11.782 m^2/ 2.936 m x 7.743	=	31.072	31.072 m^2
REINFORCING BAR			
W = 0.059 tf / 2.936 m x 7.743	=	0.156	0.156 tf
JOINT FILLER			
A = 2.055 m^2/ 2.936 m x 7.743	=	5.420	5.420 m^2
BASE CONCRETE			
CONCRETE TYPE C1			
V = 3.150 m^3/ 10.00 m x 1.80	=	0.567	0.567 m^3
GRAVEL BEDDING			
V = 0.80 m^3/ 10.00 m x 1.80	=	0.144	0.144 m^3
FORM (H < 4.0 m)			
A = 13.240 m^2/ 10.00 m x 1.80	=	2.383	2.383 m^2

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WA-2)
:
:

PER 1 PLACE

CALCULATION		RESULT
REINFORCING BAR		
W = 0.101 tf / 10.00 m x 1.80	= 0.018	0.018 tf
TOP CONCRETE		
CONCRETE TYPE C1		
V = 2.10 m^3/ 10.00 m x 1.80	= 0.378	0.378 m^3
GRAVEL BEDDING		
V = 0.80 m^3/ 10.00 m x 1.80	= 0.144	0.144 m^3
FORM (H < 4.0 m)		
A = 14.210 m^2/ 10.00 m x 1.80	= 2.558	2.558 m^2
REINFORCING BAR		
W = 0.098 tf / 10.00 m x 1.80	= 0.018	0.018 tf
JOINT FILLER		
A = 3.120 m^2/ 10.00 m x 1.80	= 0.562	0.562 m^2

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WB)
:
:

PER 1 PLACE

CALCULATION			RESULT
STRUCTURAL EXCAVATION			
A_1 = ½ x 1.80 x 0.90		= 0.810	
A_2 = (1.118 x 2.00 + 0.70) x 0.60		= 1.762	
A_3 = (0.80 + 1.80) x ½ x 0.80		= 1.040	
	TOTAL A	= 3.612 m^2	
V_1 = 3.612 x 3.60		= 13.003	
V_2 = {½ x 0.60 x 1.20 + (2.795 + 1.00) x 0.50} x 2.00 x 2		= 9.030	
	TOTAL V	= 22.033	22.033 m^3
BACKFILL WITH SELECTED SOIL			
A_1 = (0.50 + 1.10) x ½ x 0.60		= 0.480	
A_2 = (0.50 + 0.80) x ½ x 0.30		= 0.195	
V_1 = 0.480 x 3.60		= 1.728	
V_2 = 0.195 x 2.00 x 2		= 0.780	
	TOTAL V	= 2.508	2.508 m^3
GRAVEL BEDDING			
A = (1.118 x 2.00 + 0.70) x 0.25		= 0.734	
V = 0.734 x 3.00		= 2.202	2.202 m^3
RUBBLE STONE FILLING			
V = ½ x 0.60 x 1.20 x 7.60		= 2.736	2.736 m^3
GABION CYLINDER ø 500			
V = $\pi/4$ x 0.50^2 x (2.795 + 1.00) x 4.00 x 2		= 5.961	5.961 m^3
SOIL FILLING			
V = (2.795 + 1.00) x 2.00 x 2 – 5.961		= 1.629	1.629 m^3

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WB)
:
:

PER 1 PLACE

CALCULATION			RESULT
CONCRETE TYPE D			
CONCRETE TYPE D			
V = {(1.118 x 2.00 + 0.70) x 0.35 – ½ x 0.40			
x 0.20 x 5} x 3.00	=	2.483	2.483 m^3
FORM (H < 4.0 m)			
A = 0.20 x 3.00 x 5	=	3.000	3.000 m^2
REINFORCING BAR (D13, W = 1.04 kg.f / m			
n_1 = (1.118 x 2.00 + 0.70 – 0.05 x 2) : 0.30 + 1	≒	11 bars	
L_1 = (3.00 – 0.05 x 2)	=	2.90 m / bar	
W_1 = 11 x 2.90 x 1.04	=	33.176	
n_2 = (3.00 – 0.05 x 2) : 0.30 + 1	≒	11 bars	
L_2 = 1.118 x 2.00 + 0.70 – 0.05 x 2	=	2.836 m / bar	
W_2 = 2.836 x 11 x 1.04	=	32.444	
TOTAL W	=	65.620 kg.f	0.066 tf
SIDE WALL			
CONCRETE TYPE C1			
V = (2.236 + 0.70) x 0.70 x 0.30 x 2	=	1.233	1.233 m^3
GRAVEL BEDDING			
V = {(0.10 x 0.30) + (0.10 + 0.211) x ½ } x			
(2.236 + 0.70) x 2	=	1.089	1.089 m^3
FORM (H < 4.0 m)			
A = {(2.236 + 2.420) x ½ + (0.70 + 0.535) x			
½ } x 2 x 2	=	11.782	11.782 m^2
REINFORCING BAR			
D13 (W = 1.04 kg.f / m)			
n_1 = 6 bars			
L_1 = (2.236 + 0.70 - 0.05 x 2)	=	2.836 m / bar	
W_1 = 6 x 2.836 x 1.04 x 2	=	35.393	

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WB)
:
:

PER 1 PLACE

CALCULATION			RESULT
D10 (W = 0.617 kg.f / m)			
n_2 = (2.236 + 0.70 x 2) : 0.30 + 1	≒	11 bars	
L_2 = (0.20 x 2 + 0.60 x 2 + 15 x 0.01)	=	1.750 m / bar	
W_2 = 11 x 1.75 x 0.617 x 2	=	23.755	
TOTAL W	=	59.148 kg.f	0.059 tf
JOINT FILLER			
A = (1.118 x 2.00 + 0.70) x 0.35 x 2	=	2.055	2.055 m^2
BASE CONCRETE			
CONCRETE TYPE C1			
V = (0.50 + 0.75) x ½ x 0.50 x 3.00	=	0.938	0.938 m^3
GRAVEL BEDDING			
V = (3.00 + 0.10 x 2) x 0.10 x 0.70	=	0.224	0.224 m^3
FORM (H < 4.0 m)			
A = (0.50 + 0.75) x 3.00 + (0.50 + 0.75) x ½			
x 0.50 x 2	=	4.375	4.375 m^2
REINFORCING BAR			
D13 (W = 1.04 kg.f / m)			
n_1 = 6 bars			
L_1 = (3.00 - 0.05 x 2)	=	2.900 m / bar	
W_1 = 6 x 2.900 x 1.04	=	18.096	
D10 (W = 0.617 kg.f / m)			
n_2 = (3.00 - 0.05 x 2) : 0.30 + 1	≒	11 bars	
L_2 = (0.40 + 0.43 + 0.63 + 0.447 + 15 x 0.01)	=	2.057 m / bar	
W_2 = 11 x 2.057 x 0.617	=	13.961	
TOTAL W	=	32.057 kg.f	0.032 tf

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WB)
:
:

PER 1 PLACE

CALCULATION		RESULT
LOG PILE		
L = 2.00 m / pile x 3 piles	= 6.000	6.000 m
TOP CONCRETE		
CONCRETE TYPE C1		
V = 2.10 m^3/ 10.00 m x 3.60	= 0.756	0.756 m^3
GRAVEL BEDDING		
V = 0.80 m^3/ 10.00 m x 3.60	= 0.288	0.288 m^3
FORM (H < 4.0 m)		
A = 14.210 m^2/ 10.00 m x 3.60	= 5.116	5.116 m^2
REINFORCING BAR		
W = 0.098 tf / 10.00 m x 3.60	= 0.035	0.035 tf
JOINT FILLER		
A = 3.120 m^2/ 10.00 m x 3.60	= 1.123	1.123 m^2

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-WB)
:
:

PER 1 PLACE

CALCULATION			RESULT
STRUCTURAL EXCAVATION			
A_1 = ½ x 1.80 x 0.90		= 0.810	
A_2 = (1.118 x 2.00 + 0.70) x 0.60		= 1.762	
A_3 = (0.80 + 1.80) x ½ x 0.80		= 1.040	
	TOTAL A	= 3.612 m^2	
V_1 = 3.612 x 3.60		= 13.003	
V_2 = {½ x 0.60 x 1.20 + (2.795 + 1.00) x 0.50} x 2.00 x 2		= 9.030	
	TOTAL V	= 22.033	22.033 m^3
BACKFILL WITH SELECTED SOIL			
A_1 = (0.50 + 1.10) x ½ x 0.60		= 0.480	
A_2 = (0.50 + 0.80) x ½ x 0.30		= 0.195	
V_1 = 0.480 x 3.60		= 1.728	
V_2 = 0.195 x 2.00 x 2		= 0.780	
	TOTAL V	= 2.508	2.508 m^3
GRAVEL BEDDING			
A = (1.118 x 2.00 + 0.70) x 0.25		= 0.734	
V = 0.734 x 3.00		= 2.202	2.202 m^3
RUBBLE STONE FILLING			
V = ½ x 0.60 x 1.20 x 7.60		= 2.736	2.736 m^3
GABION CYLINDER ø 500			
V = $\pi/4$ x 0.50^2 x (2.795 + 1.00) x 4.00 x 2		= 5.961	5.961 m^3
SOIL FILLING			
V = (2.795 + 1.00) x 2.00 x 2 – 5.961		= 1.629	1.629 m^3

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-GB-1)
:

PER 1 PLACE

CALCULATION			RESULT
STRUCTURAL EXCAVATION			
A_1 = ½ x 1.80 x 0.90		= 0.810	
A_2 = (1.118 x 4.800 + 0.70) x 0.60		= 3.640	
A_3 = (0.80 + 1.80) x ½ x 0.80		= 1.040	
	TOTAL A	= 5.490 m^2	
V_1 = 5.490 x 3.60		= 19.764	
V_2 = {½ x 0.60 x 1.20 + (5.925 + 1.00) x 0.50}			
x 2.00 x 2		= 15.290	
	TOTAL V	= 35.054	35.054 m^3
BACKFILL WITH SELECTED SOIL			
A_1 = (0.50 + 1.10) x ½ x 0.60		= 0.480	
A_2 = (0.50 + 0.80) x ½ x 0.30		= 0.195	
V_1 = 0.480 x 3.60		= 1.728	
V_2 = 0.195 x 2.00 x 2		= 0.780	
	TOTAL V	= 2.508	2.508 m^3
GRAVEL BEDDING			
A = (1.118 x 4.80 + 0.75) x 0.25		= 1.517	
V = 1.517 x 3.00		= 4.551	4.551 m^3
BASE CONCRETE			
CONCRETE TYPE C1			
V = 0.938			0.938 m^3
GRAVEL BEDDING			
V = 0.224			0.224 m^3
FORM (H < 4.0 m)			
A = 4.375			4.375 m^2

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-GB-1)
:

PER 1 PLACE

CALCULATION		RESULT
REINFORCING BAR		
W = 0.032		0.032 tf
LOG PILE		
L = 6.000		6.000 m
TOP CONCRETE		
CONCRETE TYPE C1		
V = 0.756		0.756 m^3
GRAVEL BEDDING		
V = 0.288		0.288 m^3
FORM (H < 4.0 m)		
A = 5.116		5.116 m^2
REINFORCING BAR		
W = 0.035		0.035 tf
JOINT FILLER		
A = 1.123		1.123 m^2
SIDE WALL		
CONCRETE TYPE C1		
V = 1.233 m^3/ 2.936 m x 6.066	= 2.547	2.547 m^3
GRAVEL BEDDING		
V = 1.089 m^3/ 2.936 m x 6.066	= 2.250	2.250 m^3
FORM (H < 4.0 m)		
A = 11.782 m^2/ 2.936 m x 6.066	= 24.343	24.343 m^2
REINFORCING BAR		
W = 0.059 tf / 2.936 m x 6.066	= 0.122	0.122 tf
JOINT FILLER		
A = 2.055 m^2/ 2.936 m x 6.066	= 4.246	4.246 m^2

TYPE OF WORK : CONCRETE STEPS
LOCATION : APPROACH STEPS (TYPE-GB-1)
:

PER 1 PLACE

CALCULATION			RESULT
CONCRETE TYPE D			
V = {(1.118 x 4.80 + 0.70) x 0.35 – ½ x 0.40 x 0.20 x 12	=	4.930	
FORM (H < 4.0 m)			
A = 0.20 x 3.00 x 12	=	7.200	7.200 m^2
REINFORCING BAR (D13, W = 1.04 kg.f / m)			
n_1 = (1.118 x 4.80 + 0.70 – 0.05 x 2) / 0.30 + 1	=	21 bars	
L_1 = (3.00 – 0.05 x 2)	=	2.90 m/ bar	
W_1 = 21 x 2.90 x 1.04	=	63.336	
n_2 = (3.00 – 0.05 x 2) / 0.30 + 1	=	11 bars	
L_2 = 1.118 x 4.80 + 0.70 – 0.05 x 2	=	5.966 m/ bar	
W_2 = 11 x 5.966 x 1.04	=	68.251	
TOTAL W	=	131.587 kg.f	0.132 tf
RUBBLE STONE FILLING			
V = ½ x 0.60 x 1.20 x 7.60	=	2.736	2.736 m^3
GABION CYLINDER ø 500			
V = ¾ x 0.50^2 x (5.925 + 1.00) x 4.00 x 2	=	10.878	10.878 m^3
SOIL FILLING			
V = (5.925 + 1.00) x 0.50 x 2 – 10.878	=	2.972	2.972 m^3

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE – G2

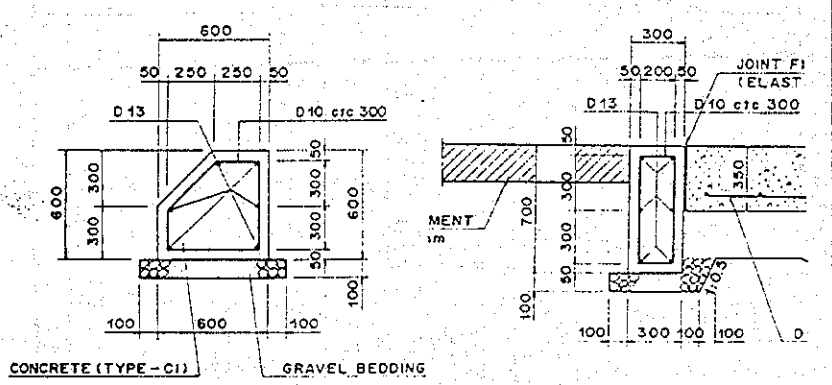
CALCULATION			RESULT
STRUCTURAL EXCAVATION			
A = (2.3 + 2.7) x 0.6 : 2	=	1.500	
A = 1.3 x 2.9	=	3.770	
A = (6.3 + 3.25) x 1.0 : 2	=	4.775	
A = (2.8 + 1.2) x 0.7 : 2	=	1.400	
TOTAL	=	11.445	
V = 11.445 x 3.6	=	41.202	41.202 m^3
BACKFILL WITH SELECTED SOIL			
(0.5 + 1.3) x 0.8 : 2	=	0.720	
(0.5 + 1.2) x 0.7 : 2	=	0.595	
(0.4 + 1.4) x 1.0 : 2 - 0.5 x 1.0	=	0.400	
TOTAL	=	1.715	
V = 1.715 x 3.6	=	6.174	6.174 m^3

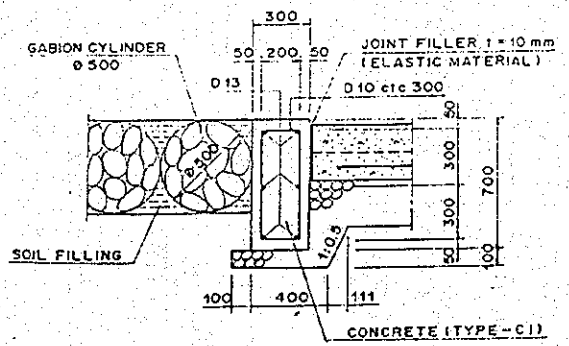
TYPE OF WORK :
LOCATION : APPROACH STEP TYPE – G2

CALCULATION			RESULT
GRAVEL BEDDING			
1) REVETMENT			
V = (0.7 + 9.890) x 0.25 x 3.0	=	7.943	
2) BASE CONCRETE			
V = 0.800 m^3/ 10.0 m x 3.6 m	=	0.288	
3) TOP CONCRETE			
V = 0.625 m^3/ 10.0 m x 3.6 m	=	0.225	
4) END WALL			
V = 0.810 m^3/10.0 m x (0.535 + 9.994) x 2	=	17.056	
V	=	25.512	25.512 m^3
CONCRETE TYPE - D			
• CONCRETE			
A_1 = (10.872 + 0.7) x 0.329	=	3.807	
A_2 = 0.4 x 0.2 : 2 x 19	=	0.760	
A = A_1 - A_2	=	3.047	
V = 3.047 x 3.0 m	=	9.141	9.141 m^3
• FORM			
A = 0.2 x 3.0 x 19	=	11.4	11.400 m^2

APPROACH STEP TYPE G2

TYPE OF WORK :	CONCRETE TYPE C , FORM
LOCATION :	



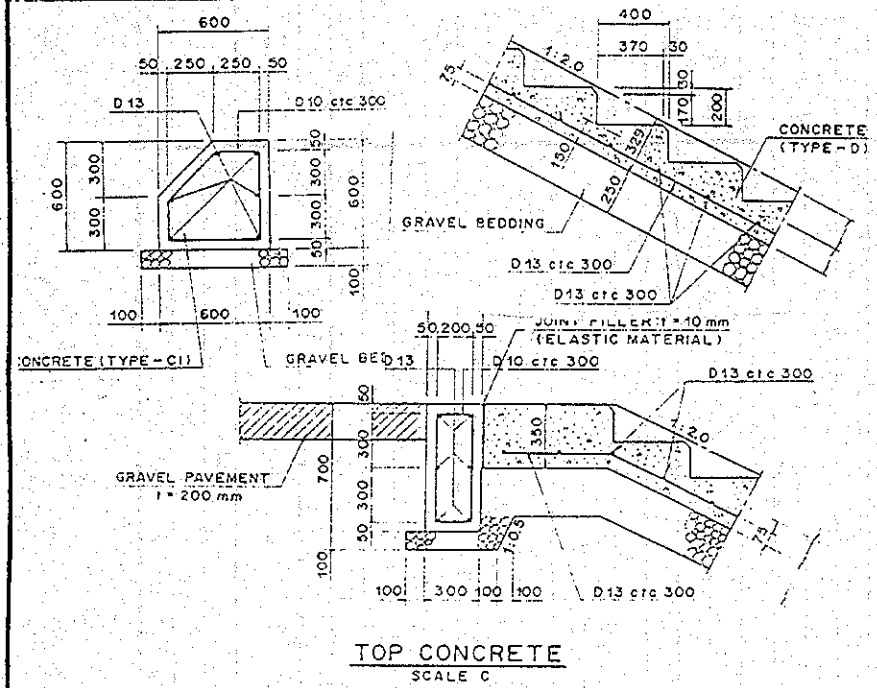


SIDE WALL

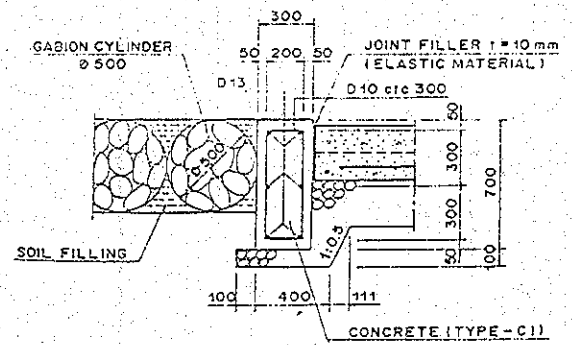
CALCULATION	RESULT
① BASE CONCRETE	
· CONCRETE	
V = 3.150 m³/10.0m x 3.6m = 1.134	1.134m³
· FORM	
V = 13.240m²/10.0 m x 3.6m = 4.766	4.766m²
② TOP CONCRETE	
· CONCRETE	
V = 2.100m³/10.0m x 3.6m = 0.756	0.756m³
· FORM	
A = 14.400m²/10.0m x 3.6m = 5.184	5.184m²
③ END WALL	
· CONCRETE	
A = (0.7+0.535)x0.7÷2 +	
(10.062+9.994)x0.7÷2 = 3.942	
V = 3.942x 0.3x2 = 2.365	2.365m³
· FORM	
3.942x2 = 7.884	7.884m²

APPROACH STEP TYPE G2

TYPE OF WORK :	DEFORMED REINFORCING BAR
LOCATION :	



TOP CONCRETE
SCALE C



CALCULATION	RESULT
① BASE CONCRETE	
0.101 tf/10.0m x 3.60m = 0.036	0.036tf
② TOP CONCRETE	
0.095 tf/10.0m x 3.60m = 0.034	0.034tf
③ END WALL	
0.101 tf/place x 2 = 0.202 tf	0.202tf
④ STEP	
D13 (1.04 kgf/m)	
• HOLIZONTAL	
ℓ = 3.0 - 0.05x2 = 2.900	
n = (10.872 + 0.7 - 0.05x2) ÷ 0.3 + 1 = 39	
W = 2.9x39 x 1.04 = 117.624 kgf	
• VERTICAL	
ℓ = 10.872 + 0.7 - 0.05x2 = 11.472	
n = (3.0 - 0.05x2) ÷ 0.3 + 1 = 11	
W = 11.472 x 11 x 1.04 = 131.239	
TOTAL = 248.863	0.249tf

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE – G2

CALCULATION			RESULT
JOINT FILTER			
1) TOP CONCRETE			
A = 0.35 x 3.0	=	1.05 m^2	1.050 m^2
2) SIDE WALL			
L = 0.7 + 10.062	=	10.762	
A = 10.762 x 0.35 x 2	=	7.533	7.533 m^3
GABION CYLINDER			
Ø = 500 mm			
a = π /4 x 0.5^2	=	0.196	
V = 0.196 x 8 x (1.0 + 7.826 + 3.0)	=	18.543	
SOIL FILLING			
V_1 = 0.5 x (1.0 + 7.826 + 3.0) x 4.0	=	23.652	
V_2 = 18.543			
V = V_1 - V_2	=	5.109	5.109 m^3

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE – G2

CALCULATION			RESULT
GABION MATTRESS			
A = 3.0 x 0.5 + 1.5 x 0.5	=	2.25	
V = 2.25 x 3.0 m	=	6.75	6.750 m^3
RUBBLE STONE FILLING			
A = 1.0 x 0.5 : 2 x 2	=	0.5	
V = 0.5 x 3.0 m	=	1.5	1.500 m^3

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE GA-3

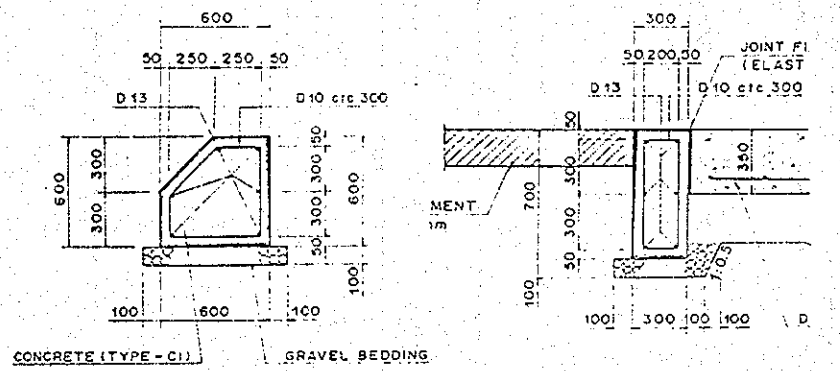
CALCULATION			RESULT
STRUCTURAL EXCAVATION			
1) (2.9 + 2.2) x 0.6 : 2	=	1.53	
2) 8.6 x 1.3	=	11.18	
3) (2.7 + 4.3) x 0.5 : 2	=	1.75	
4) (1.2 + 2.7) x 0.7 : 2	=	1.365	
A	=	15.825	
V = 15.825 x 1.800	=	28.485	28.485 m^3
BACKFILL WITH SELECTED SOIL			
1) (0.5 + 1.3) x 0.8 : 2	=	0.72	
2) (0.5 + 1.2) x 0.7 : 2	=	0.595	
3) (1.2 + 1.7) x 0.5 : 2	=	0.725	
A	=	2.040	
V = 2.040 x 1.800	=	3.672	3.672 m^3

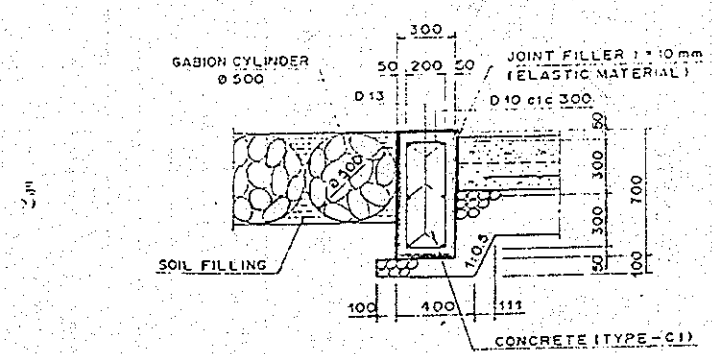
TYPE OF WORK :
LOCATION : APPROACH STEP TYPE GA-3

CALCULATION			RESULT
GRAVEL BEDDING			
1) BASE CONCRETE			
0.800 m^3/10.0 m x 1.8 m	=	0.144	0.144 m^3
2) TOP CONCRETE			
2.100 m^3/10.0 m x 1.8 m	=	0.378	0.378 m^3
3) SIDE WALL			
0.810 m^3/10.0 m x (10.9 + 0.7) x 2	=	1.879	1.879 m^3
4) STEP			
10.9 x 0.25 x 1.2	=	3.27	3.27 m^3
CONCRETE TYPE – D			
• CONCRETE			
V_1 = (10.9 + 0.7) x 0.329 x 1.2	=	4.580	
V_2 = 0.4 x 0.2 x 23 x 1.2	=	2.208	
V = V_1 - V_2	=	2.372	2.372 m^3
• FORM			
A = 0.2 x 1.2 x 23	=	5.52	5.52 m^3

APPROACH STEPS TYPE GA-3

TYPE OF WORK :	CONCRETE TYPE c1
LOCATION :	



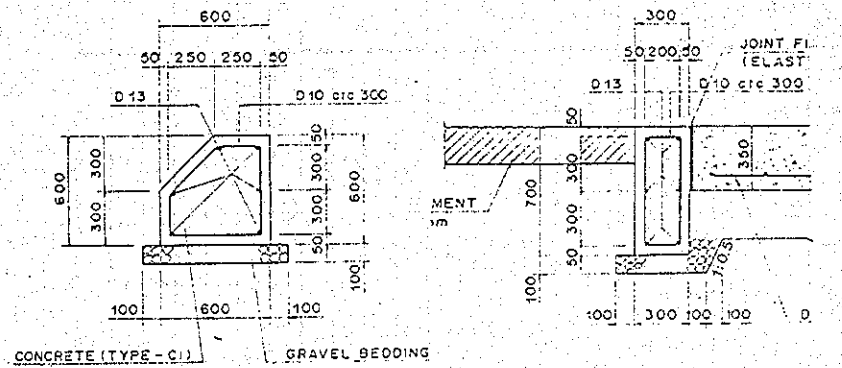


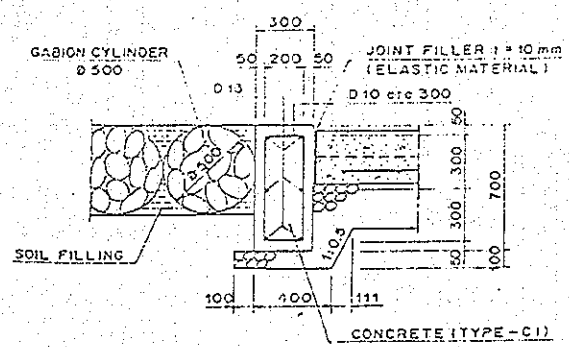
SIDE WALL

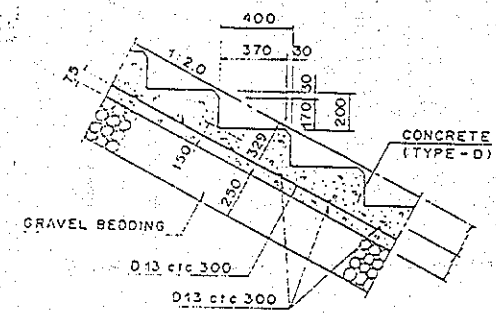
CALCULATION	RESULT
① BASE CONCRETE	
• CONCRETE	
V = 3.150 m³/10.0m x 1.8m = 0.567	0.567m³
• FORM	
A = 13.240 m²/10.0m x 1.8m = 2.383	2.383 m²
② TOP CONCRETE	
• CONCRETE	
V = 2.100 m²/10.0m x 1.8m = 0.378	0.378 m³
• FORM	
A = 14.000 m³/10.0m x 1.8m = 2.520	2.520 m²
③ SIDE WALL	
• CONCRETE	
V = (10.9+0.7) x 0.7 x 0.3 = 2.436	2.436m³
• FORM	
A = (10.9+0.7) x 0.7 x 2 = 16.24	16.240m²

APPROACH STEPS TYPE GA-3

TYPE OF WORK :	DEFORMED REINFORCING BAR
LOCATION :	







CALCULATION	RESULT
① BASE CONCRETE	
0.101 tf /10.0m x 1.8 m = 0.018	0.018tf.
② TOP CONCRETE	
0.095 tf /10.0m x 1.8m = 0.017	0.017tf
③ SIDE WALL	
0.095 tf /10.0m x (10.9+0.7)x2 = 0.110	0.110 tf
③ STEP	
· D13 (1.04 kgf/m)	
· HOLIZONTAL	
$\ell = 1.2 - 0.05 \times 2$ = 1.100	
$n = (10.9+0.7-0.05\times2) \div 0.371$ = 39	
$W = 1.1 \times 39 \times 1.04$ = 44.616	
· VERTICAL	
$\ell = 10.9+0.7-0.05\times2$ = 11.5	
$n = (1.2 - 0.05\times2) \div 0.371$ = 4	
$W = 11.5 \times 4 \times 1.04$ = 47.84	
TOTAL = 92.456	0.092 tf

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE GA-3

CALCULATION			RESULT
JOINT FILTER			
t = 10.0 mm ELASTIC MATERIAL			
1) TOP CONCRETE			
0.710 m^2/10.0 m x 1.200 m	=	0.445	0.445 m^2
2) SIDE WALL			
L = 10.9 + 0.7	=	11.600	
A = 11.60 x 0.35 x 2	=	8.120	8.120 m^2
GABION CYLINDER			
• Ø 500 mm			
A = π /4 x 0.5^2	=	0.196 m^2	
V = 0.196 x 8 x (3.0 + 5.4)	=	13.171	13.171 m^3
SOIL FILLING			
V_1 = 0.5 x (3.0 + 5.4) x 4.0	=	16.800 m^3	
V_2 = 13.171 m^3			
V = V_1 - V_2	=	3.629	3.629 m^3

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE GA-4

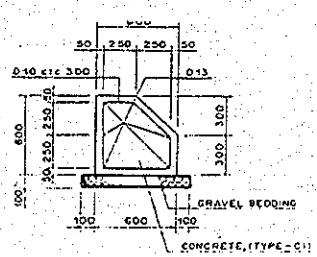
CALCULATION			RESULT
STRUCTURAL EXCAVATION			
1) (2.0 + 2.7) x 0.7 : 2	=	1.645	
2) (1.2 + 0.9) x 0.2 : 2	=	0.210	
3) 1.0 x 2.1	=	2.100	
4) (3.9 + 1.9) x 0.7 : 2	=	2.030	
5) (1.9 + 1.3) x 0.4 : 2	=	0.640	
TOTAL	=	6.625	
V = 6.625 x 1.8	=	11.925	11.925 m^3
BACKFILL WITH SELECTED SOIL			
1) (0.5 + 1.0) x 0.9 : 2	=	0.675	
2) (2.8 + 1.6) x 0.5 : 2	=	1.100	
3) (1.3 + 0.6) x 0.7 : 2	=	0.665	
TOTAL A	=	2.440	
V = 2.440 x 1.8	=	4.392	4.392 m^3

TYPE OF WORK :
LOCATION : APPROACH STEP TYPE GA-4

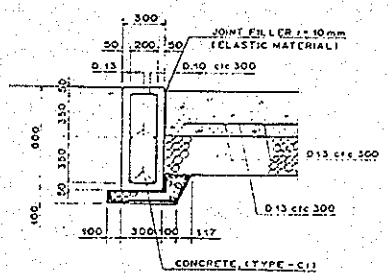
CALCULATION			RESULT
GRAVEL BEDDING			
1) STEP			
0.3 x (5.65 + 0.7) x 1.2 m	=	2.286	2.286 m^3
2) BASE CONCRETE			
0.800 m^3/10.0 m x 1.8 m	=	0.144	0.144 m^3
3) TOP CONCRETE			
0.700 m^3/10.0 m x 1.8 m	=	0.126	0.126 m^3
4) SIDE WALL			
0.700 m^3/10.0 m x (5.65 + 0.7) x 2	=	0.889	0.889 m^3
CONCRETE TYPE - D			
• CONCRETE			
V_1 = 0.366 x (6.0 + 0.7) x 1.2	=	2.943	
V_2 = 0.2 x 0.3 : 2 x 1.2 x 15	=	0.54	
V = V_1 - V_2	=	2.403	2.403 m^3
• FORM			
A = 0.2 x 1.2 x 15	=	3.600	3.600 m^2

APPROACH STEP TYPE GA-4

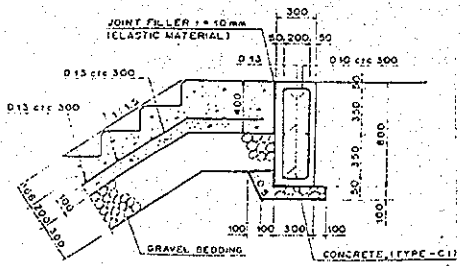
TYPE OF WORK :	CONCRETE TYPE C1
LOCATION :	



BASE CONCRETE
SCALE 0



SIDE WALL
SCALE 0

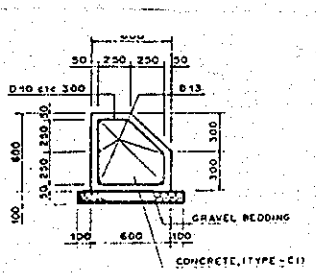


TOP CONCRETE
SCALE 0

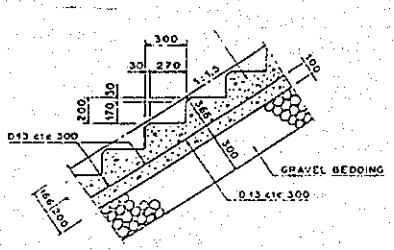
CALCULATION	RESULT
① BASE CONCRETE	
· CONCRETE	
V = 3.150 m³/10.0m x 1.80m = 0.567	0.567 m³
· FORM	
A = 13.240 m²/10.0m x 1.80m = 2.383	2.383m²
② TOP CONCRETE	
· CONCRETE	
V = 2.400 m³/10.0m x 1.80m = 0.432	0.432m³
· FORM	
A = 16.000 m²/10.0m x 1.80m = 2.88	2.880m²
③ SIDE WALL	
· CONCRETE	
V = (16.0+0.7) x 0.3 x 0.8 x 2 = 3.216	3.216m³
· FORM	
A = (16.0+0.7) x 0.8 x 4 = 21.44	21.440m²

APPROACH STEP TYPE GA-4

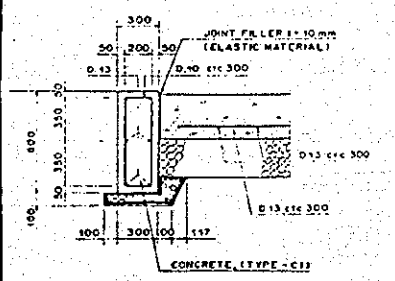
TYPE OF WORK :	DEFORMED REINFORCING BAR
LOCATION :	



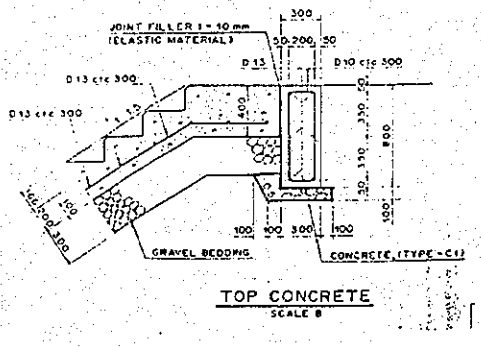
BASE CONCRETE
SCALE 0



DETAIL OF STEPS
SCALE 0



SIDE WALL
SCALE 0

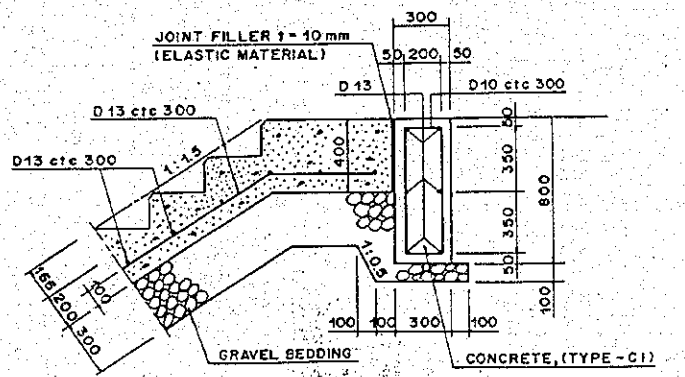


TOP CONCRETE
SCALE 0

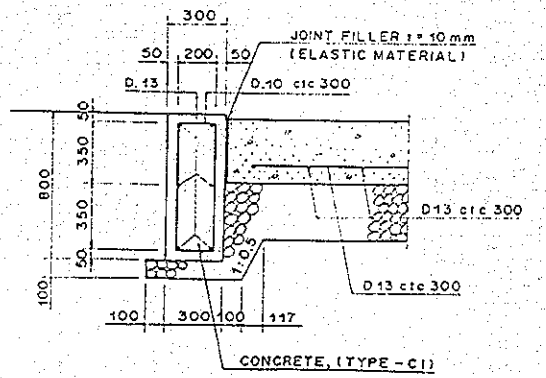
CALCULATION	RESULT
① BASE CONCRETE	
0.101 tf/10.0m x 1.8 m = 0.018	0.018tf
② TOP CONCRETE	
0.100 tf/10.0m x 1.8 m = 0.018	0.018tf.
③ SIDE WALL	
0.100 tf/10.0m x (6.0+0.7) x2 = 0.067	0.067tf
④ STEP	
D13 (1.04kgf/m)	
· HOLIZONTAL	
ℓ = 1.2 - 0.05x2 = 1.10 m	
n = (6.0+0.7 - 0.05x2) ÷ 0.3+1 = 23	
W = 1.1 x 23 x 1.04 = 26.312kgf	
· VERTICAL	
· ℓ = 6.0+0.7 - 0.05x2 = 6.60	
n = (1.2 - 0.05x2) ÷ 0.3+1 = 4	
W = 6.6 x 4 x 1.04 = 29.040 kgf	
TOTAL = 55.352	0.055 tf

APPROACH STEP TYPE GA-4

TYPE OF WORK :	JOINT FILLER
LOCATION :	



TOP CONCRETE
SCALE B



SIDE WALL
SCALE B

CALCULATION	RESULT
· 10mm , Elastic Material.	
① TOP CONCRETE	
A = 4.240 m²/10.0m x 1.2m = 0.509	0.509 m²
② SIDE WALL	
A = (6.0+0.7) x 0.4 x 2 = 5.36	5.360 m²