4. Canal Abierto

Open Channel

- Quantity Calculation of Open channel

Calculation paper is devided as follows.

1. Oi : Open channel & inspection road
2. Tr : Transition
3. Si : Siphon
4. Cr : Cross drainage
5. Ai : Additional inspection road
6. Dt : Ditch
7. Pb : Pedestrian bridge

Item No.	Description of Works	Unit	Quantity	Breakdown	
6	**SEVERINO OPEN CHANNEL**				
6.1	CARE OF RIVER AND CONTROL AND REMOVAL OF WATER				
/01	Construction and removal of temporary coffering	L.S.			
/02	Care of water during construction in open air construction site	L.S.			
Subtotal of Item 6.1					
6.2	EARTH WORKS				
/01	Clearing the site along open channel	m2	177,435		
				1) Oi,Tr	157,489
				2) Si	7,115
				3) Ai	12,830
/02	Open-cut excavation, in common, for open channel	m3	211,937		
				1) Oi,Tr	211,937
/03	Open-cut excavation, in common, for structures	m3	22,252		
				1) Si	5,667
				2) Cr	1,683
				3) Ai	13,219
/04	Open-cut excavation, in weathered rock, for open channel	m3	2,190,846		
				1) Oi,Tr	2,190,846

Item No.	Description of Works	Unit	Quantity	Breakdown	
/05	Open-cut excavation, in weathered rock, for structures	m3	23,622		
				1) Si	22,669
				2) Cr	1,683
/06	Open-cut excavation, in rock, for open channel	m3	6,776		
				1) Oi,Tr	6,776
/07	Open-cut excavation, in rock, for structures	m3	730.564		
				1) Si	
				2) Cr	
				3) Ai	
/08	Trench excavation, all classes, for underdrain	m3	565		
				1) Oi	558
				2) Tr	7
/09	Trench excavation, all classes, for drain ditch, catch basin and foundation of wire net fence	m3	5,783		
				1) Tr	3,539
				2) Ai	1,042
				3) Si	521
				4) Cr	681
/10	Embankment for open channel	m3	209,922		
				1) Oi,Tr	209,922
/11	Backfilling for structures	m3	9,792		
				1) Tr	1,420
				2) Si	8,372
/12	Sand and gravel bedding for open channel lining	m3	1,959		
				1) Oi	1,959

Item No.	Description of Works	Unit	Quantity	Breakdown	
/13	Gravel bedding for structures	m3	766		
				1) Dt (Si)	68
				2) Dt (Cr)	89
				3) Dt (Pb)	21
				4) Dt (Oi)	452
				5) Dt (Ai)	136
/14	Gabion mattress (t= 500 mm)	m3	7,187		
				1) Si	6,725
				2) Cr	462
/15	Sod facing	m2	76,153		
				1) Oi,Tr	69,932
				2) Ai	6,221
	Subtotal of Item 6.2				
	6.3 CONCRETE WORKS				
/01	Concrete, class A, for pedestrian bridge slab and girders	m3	68		
				1) Pb	68
/02	Concrete, class A, for blockout	m3	7		
				1) Tr	7
/03	Concrete, class B, for syphon structure	m3	6,130		
				1) Si	6,130
/04	Concrete, class B, for valve box of syphon	m3	38		
				1) Si	38

Item No.	Description of Works	Unit	Quantity	Breakdown	
/05	Concrete, class E, for open and closed transition structure	m3	860		
				1) Tr	860
/06	Concrete, class E, for drainage culvert and wing walls	m3	1,462		
				1) Cr	1,462
/07	Concrete, class E, for pedestrian bridge abutment walls	m3	70		
				1) Pb	70
/08	Concrete, class F, for lining concrete of open channel	m3	9,386		
				1) Oi	9,386
/09	Concrete, class F, for drain ditch and catch basin	m3	1,872		
				1) Dt (Oi,Tr)	1,135
				2) Dt (Ai)	350
				3) Dt (Si)	163
				4) Dt (Cr)	224
/10	Concrete, class G, for foundation of wire net fence	m3	13		
				1) Pb	13
/11	Concrete, class H, for levelling concrete	m3	627		
				1) Tr	48
				2) Si	311
				3) Cr	262
				4) Pb	6
/12	Formwork, F1 finish, for concrete of Items /03,/04 /05, /06 anc /07	m2	10,848		
				1) Si	6,334
				2) Tr	1,333
				3) Cr	3,152
				4) Pb	29

Item No.	Description of Works	Unit	Quantity	Breakdown	
/13	Formwork, F1 finish, for concrete of Item /08	m2	1,650	1) Oi	1,650
/14	Formwork, F1 finish, for concrete of Items /09 and /10	m2	9,538	1) Dt (Oi,Tr)	5,656
				3) Dt (Pb)	209
				4) Dt (Si)	806
				5) Dt (Cr)	1,118
				6) Dt (Ai)	1,750
/15	Formwork, F2 finish, for concrete of Items /01, /04 and /07	m2	1,048	1) Pb	837
				2) Si	211
/16	Formwork, F3 finish, for concrete of Items /02, /03, /05 and /0	m2	11,019	1) Si	6,948
				2) Tr	1,206
				3) Cr	2,865
/17	Formwork, F3 finish, for concrete of Item /08	m2	48,243	1) Oi	48,243
/18	Formwork, F3 finish, for concrete of Item /09	m2	6,295	1) Dt (Oi,Tr)	3,818
				3) Dt (Ai)	1,166
				4) Dt (Si)	558
				5) Dt (Cr)	753
/19	Reinforcing bars for open channel lining	ton	154	1) Oi	154

Item No.	Description of Works	Unit	Quantity	Breakdown	
/20	Reinforcing bars for structures	ton	222		
				1) Tr	57
				2) Si	39
				3) Cr	120
				4) Pb	5
/21	Dowel bars, D.16 mm (round bar) for open channel	ton	2,495		
				1) Oi	2,495
/22	Dowel bars, D.22 mm (round bar) for structures	ton	6		
				1) Tr	0
				2) Si	5
				3) Cr	1
/23	P.V.C. waterstop, type B (W = 200 mm) for structures	m	1,540		
				1) Si	1,268
				2) Cr	271
/24	P.V.C. waterstop, type C (W = 150 mm) for open channel	m	10,528		
				1) Oi	10,528
/25	Bituminous coating for contraction joints of open channel and structures	m2	2,350		
				1) Oi	1,579
				2) Tr	54
				3) Si	717
/26	Joint filler for pedestrian bridge (t= 20 mm)	m2	6		
				1) Pb	6
/27	Joint filler for culvert and wall (t= 10 mm)	m2	85		
				1) Cr	85

Item No.	Description of Works	Unit	Quantity	Breakdown	
Subtotal of Item 6.3					
6.4	DRAINAGE				
/01	P.V.C. perforated pipes, D.100 mm for underdrain	m	5,779	1) Oi 2) Tr	5,588 191
/02	Pre-cast concrete pipe, D.800 mm	m	281	1) Cr	281
/03	Pre-cast concrete pipe, D.1,000 mm	m	351	1) Cr	351
Subtotal of Item 6.4					
6.5	ROAD WORKS				
/01	Compacting of original ground	m3	17,394	1) Oi 2) Ai	11,562 5,832
/02	Improved subgrade material, not less than corrected CBR 12	m3	1,077	1) Oi	1,077
/03	Graded crushed stone subbase, not less than corrected CBR 60	m3	3,417	1) Oi 2) Ai	2,542 875
Subtotal of Item 6.5					

Item No.	Description of Works	Unit	Quantity	Breakdown	
6.6	MISCELLANEOUS METAL WORKS				
/01	Steel drain pipe, D.200 with valve	kg	5,365	1) Si	5,365
/02	Trash rack	kg	8,676	1) Tr	8,676
/03	Steel handrail for pedestrian bridge, open transition structure	kg	8,310	1) Pb 2) Tr	3,496 4,814
/04	Wire net fence with gate	kg	9,867	1) Pb	9,867
/05	Elastmeric bearing pad for pedestrian bridge 300mmx200mmx	nos.	44	1) Pb	44
/06	Anchor rods with steel pies, D.32 mm for pedestrian bridge	kg	315	1) Pb	315
	Subtotal of Item 6.6				
	TOTAL OF ITEM 6				

No.

Oi;

OPEN CHANNEL

x

INSPECTION ROAD.

Civil works

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
1	0.000	18.000	474.300	1,134.000	1,004.400	0.000	157.500	141.300	0.000	495.000
2	18.000	15.000	405.000	930.000	876.000	0.000	140.250	117.750	0.000	420.000
3	33.000	14.000	352.800	806.400	641.200	0.000	123.200	62.300	0.000	401.800
4	47.000	22.900	563.340	1,296.140	1,135.840	0.000	176.330	77.860	0.000	648.070
5	69.900	10.100	241.895	551.460	484.800	0.000	69.690	40.400	0.000	281.285
6	80.000	20.000	470.000	1,112.000	732.000	0.000	145.000	66.000	0.000	547.000
7	100.000	20.000	509.000	1,204.000	1,160.000	0.000	154.000	125.000	0.000	581.000
8	120.000	12.610	341.101	781.820	890.266	0.000	108.446	107.185	0.000	382.083
9	132.610	19.390	483.780	1,066.450	907.452	0.000	145.425	128.943	0.000	548.737
10	152.000	13.000	321.100	587.600	353.600	0.000	99.450	61.750	0.000	356.850
11	165.000	10.750	270.363	414.950	301.000	6.450	82.238	56.438	0.000	294.550
12	175.750	10.750	270.363	382.700	187.050	51.600	108.575	41.925	0.540	298.313
13	186.500	13.500	288.225	432.540	133.650	56.700	124.875	10.125	0.810	328.725
14	200.000								0.000	
15	245.000	13.500	243.000	270.540	10.125	51.300	67.500	0.000	1.710	289.575
16	258.500	5.500	122.375	86.900	0.000	74.800	56.925	0.000	1.290	140.525
17	264.000	16.000	364.800	547.200	252.800	156.800	143.200	36.000	2.160	421.600
18	280.000	25.000	608.750	1,420.000	1,255.000	0.000	190.000	172.500	0.000	701.250
19	305.000	13.000	347.750	806.000	982.800	0.000	102.700	131.300	0.000	395.850
20	318.000	10.900	297.570	682.340	915.600	0.000	82.295	125.350	0.000	338.445
21	328.900	16.100	437.920	988.540	1,432.900	0.000	116.725	196.420	0.000	501.515
22	345.000	20.000	467.000	1,008.000	1,014.000	0.000	135.000	128.000	0.000	597.000
23	365.000	16.000	314.400	620.800	140.800	0.000	94.400	16.000	0.000	413.600
24	381.000	6.840	145.350	320.112	156.636	0.000	44.118	20.178	0.000	171.684
25	387.840	28.420	622.398	1,460.788	898.072	0.000	211.729	90.944	0.000	731.815
26	416.260	22.811	456.220	958.062	394.630	0.000	153.974	22.811	0.000	544.042
27	439.071	13.500	212.625	400.950	98.550	0.000	60.750	0.000	0.000	266.625
28	452.571								0.000	
29	658.339	13.500	176.175	326.700	90.585	0.000	29.700	0.000	0.000	228.825
30	671.839	13.171	288.445	603.232	458.351	0.000	76.392	61.904	0.000	339.153
31	685.010	10.800	286.740	663.120	756.000	0.000	77.220	115.560	0.000	328.320
32	695.810	23.680	621.600	1,401.856	1,686.016	0.000	162.208	265.216	0.000	713.952
33	719.490	25.510	571.424	1,224.480	1,020.400	0.000	170.917	132.652	0.000	674.739

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
34	745.000	25.000	501.250	490.000	175.000	235.000	185.000	0.000	5.700	598.750
35	770.000	9.270	209.965	0.000	0.000	335.574	96.408	0.000	9.089	244.264
36	779.270	9.640	348.968	0.000	0.000	1,258.984	242.446	0.000	13.618	384.636
37	788.910	8.460	426.384	0.000	0.000	2,167.452	326.556	0.000	13.618	453.033
38	797.370	27.630	985.009	93.942	0.000	4,348.962	631.346	0.000	23.022	1,080.333
39	825.000	18.270	376.362	69.426	0.000	394.632	151.641	0.000	13.800	450.355
40	843.270	16.730	480.151	6.692	0.000	1,244.712	286.083	0.000	16.963	540.379
41	860.000	25.000	797.500	0.000	0.000	2,370.000	497.500	0.000	34.044	875.000
42	885.000	15.000	375.750	339.000	147.000	555.000	177.750	20.250	10.213	426.000
43	900.000	30.000	774.000	870.000	294.000	510.000	379.500	40.500	4.950	873.000
44	930.000	20.000	529.000	576.000	278.000	340.000	246.000	38.000	3.960	594.000
45	950.000	17.080	397.964	867.664	647.332	0.000	123.830	88.816	0.000	463.722
46	967.080	12.920	317.186	739.024	614.992	0.000	98.838	89.148	0.000	366.282
47	980.000	16.220	362.517	856.416	489.844	0.000	124.083	58.392	0.000	424.964
48	996.220	5.780	107.508	219.640	57.800	0.000	33.813	0.000	0.000	130.628
49	1,002.000	12.660	391.827	177.240	43.044	1,992.684	236.742	0.000	10.213	432.972
50	1,014.660	18.790	851.187	0.000	0.000	5,745.982	638.860	0.000	27.235	907.557
51	1,033.450	9.350	365.117	0.000	0.000	2,217.820	215.050	0.000	13.618	394.570
52	1,042.800	10.310	262.389	175.270	41.240	915.528	91.243	0.000	6.809	298.990
53	1,053.110	31.890	746.226	1,575.366	1,492.452	0.000	231.203	169.017	0.000	875.381
54	1,085.000	25.000	611.250	1,425.000	1,405.000	0.000	192.500	163.750	0.000	711.250
55	1,110.000	10.750	202.100	387.000	148.350	2.150	61.813	13.438	0.000	245.638
56	1,120.750	20.000	538.000	228.000	8.000	1,840.000	308.000	0.000	13.618	617.000
57	1,140.750	19.250	876.838	0.000	0.000	5,574.800	692.038	0.000	27.235	922.075
58	1,160.000	20.000	1,144.000	0.000	0.000	8,556.000	990.000	0.000	27.235	1,176.000
59	1,180.000	15.990	909.032	0.000	0.000	5,938.686	791.505	0.000	20.426	944.210
60	1,195.990	24.010	1,204.101	0.000	0.000	5,968.886	1,001.217	0.000	34.044	1,258.124
61	1,220.000	17.160	761.046	0.000	0.000	2,896.608	596.310	0.000	20.426	804.804
62	1,237.160	22.900	1,041.950	0.000	0.000	3,751.020	828.980	0.000	27.235	1,112.940
63	1,260.060	9.940	494.018	0.000	0.000	2,651.992	414.995	0.000	13.618	529.802
64	1,270.000	18.000	680.400	0.000	0.000	3,481.200	524.700	0.000	20.426	747.900
65	1,288.000	12.000	256.800	136.800	40.800	350.400	127.200	0.000	6.809	303.600
66	1,300.000	20.000	453.000	264.000	68.000	384.000	220.000	0.000	6.840	524.000

A-12

Civil works

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
67	1,320.000	35.660	1,078.715	64.188	0.000	2,203.788	682.889	0.000	30.686	1,180.346
68	1,355.660	2.740	98.914	0.000	0.000	466.348	70.007	0.000	6.809	106.175
69	1,358.400	19.100	536.710	240.660	45.840	2,429.520	313.240	0.000	13.618	604.515
70	1,377.500	20.360	360.372	618.944	179.168	0.000	101.800	0.000	0.000	444.866
71	1,397.860	24.140	662.643	429.692	154.496	1,713.940	512.975	0.000	17.022	757.996
72	1,422.000	18.000	715.500	0.000	0.000	3,675.600	644.400	0.000	20.426	783.000
73	1,440.000	20.000	955.000	0.000	0.000	6,248.000	809.000	0.000	27.235	1,026.000
74	1,460.000	16.000	836.800	0.000	0.000	5,043.200	725.600	0.000	20.426	888.000
75	1,476.000	17.000	588.200	258.400	98.600	2,312.000	414.800	0.000	10.213	646.000
76	1,493.000	22.000	745.800	334.400	127.600	2,367.200	514.800	0.000	13.618	495.000
77	1,515.000	15.480	552.636	325.080	133.128	1,665.648	386.226	17.028	10.213	375.390
78	1,530.480	27.020	586.334	864.640	243.180	124.292	241.829	29.722	2.250	680.904
79	1,557.500	12.500	336.875	167.500	5.000	295.000	194.375	0.000	6.030	374.375
80	1,570.000	20.000	492.000	92.000	0.000	532.000	271.000	0.000	12.480	561.000
81	1,590.000	20.000	348.000	264.000	24.000	160.000	117.000	0.000	6.240	429.000
82	1,610.000	17.830	348.576	231.790	21.396	206.828	139.965	0.000	3.960	414.547
83	1,627.830	17.170	409.505	82.416	0.000	370.872	215.484	0.000	7.560	466.166
84	1,645.000	25.000	572.500	150.000	0.000	460.000	283.750	0.000	11.700	655.000
85	1,670.000	23.230	459.954	167.256	0.000	325.220	191.648	0.000	8.640	547.067
86	1,693.230	24.220	707.224	96.880	0.000	3,042.032	448.070	0.000	22.122	790.783
87	1,717.450	5.550	219.502	0.000	0.000	1,216.560	168.165	0.000	6.809	238.372
88	1,723.000	22.000	778.800	0.000	0.000	3,115.200	584.100	0.000	27.235	864.600
89	1,745.000	21.000	847.350	0.000	0.000	3,855.600	667.800	0.000	27.235	915.600
90	1,766.000	24.000	1,158.000	0.000	0.000	5,160.000	962.400	0.000	27.235	1,220.400
91	1,790.000	22.000	902.000	0.000	0.000	3,185.600	710.600	0.000	27.235	971.300
92	1,812.000	9.270	253.071	14.832	0.000	763.848	158.980	0.000	10.109	287.833
93	1,821.270	11.390	238.621	52.394	0.000	223.244	109.914	0.000	5.880	280.764
94	1,832.660	11.390	304.682	34.170	0.000	637.840	185.657	0.000	9.389	346.256
95	1,844.050	15.950	576.593	0.000	0.000	2,389.310	433.840	0.000	20.426	631.620
96	1,860.000	23.170	1,155.025	0.000	0.000	8,039.990	983.567	0.000	27.235	1,224.535
97	1,883.170	31.830	1,866.829	0.000	0.000	14,896.440	1,667.892	0.000	40.853	1,965.502
98	1,915.000	44.580	1,589.277	784.608	329.892	9,959.172	1,286.133	0.000	27.235	1,870.131
99	1,959.580	25.420	366.048	716.844	244.032	0.000	88.970	0.000	0.000	532.549

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
100	1,985.000	25.190	445.863	755.700	272.052	0.000	94.463	15.114	0.000	545.364
101	2,010.190	12.340	273.948	579.980	468.920	0.000	80.827	56.147	0.000	322.074
102	2,022.530	17.470	467.323	1,044.706	1,582.782	0.000	132.772	198.285	0.000	531.962
103	2,040.000	20.000	572.000	1,360.000	2,516.000	0.000	141.000	324.000	0.000	647.000
104	2,060.000	20.000	553.000	1,340.000	1,940.000	0.000	139.000	281.000	0.000	632.000
105	2,080.000	19.380	420.546	841.092	670.548	0.000	105.621	101.745	0.000	497.097
106	2,099.380	29.760	614.544	366.048	65.472	571.392	263.376	0.000	17.022	733.584
107	2,129.140	13.860	481.635	1.386	0.000	1,169.784	335.412	0.000	20.426	517.671
108	2,143.000	15.000	664.500	33.000	0.000	1,491.000	503.250	0.000	14.353	684.000
109	2,158.000	15.000	557.250	33.000	0.000	1,110.000	396.750	0.000	14.353	588.750
110	2,173.000	17.000	396.950	180.200	47.600	676.600	191.250	0.000	10.213	454.750
111	2,190.000	23.560	432.326	777.480	334.552	0.000	117.800	24.738	0.000	526.566
112	2,213.560	16.440	337.020	716.784	341.952	0.000	128.232	29.592	0.000	401.958
113	2,230.000	25.000	475.000	925.000	345.000	0.000	157.500	18.750	0.000	573.750
114	2,255.000	25.560	521.424	439.632	112.464	383.400	214.704	0.000	8.250	621.108
115	2,280.560	17.310	541.803	24.234	0.000	2,052.966	373.896	0.000	15.163	607.581
116	2,297.870	22.130	1,286.860	22.130	0.000	2,350.206	470.263	0.000	14.818	767.911
117	2,320.000	23.000	1,196.000	340.400	59.800	262.200	317.400	0.000	2.880	640.550
118	2,343.000	22.000	644.600	484.000	57.200	602.800	400.400	0.000	5.520	699.600
119	2,365.000	17.350	571.682	145.740	0.000	1,044.470	377.362	0.000	13.093	613.322
120	2,382.350	16.350	557.535	3.270	0.000	1,428.990	373.597	0.000	20.426	594.322
121	2,398.700	20.000	671.000	60.000	0.000	1,330.000	448.000	0.000	18.898	718.000
122	2,418.700	20.000	539.000	208.000	2.000	498.000	307.000	0.000	7.080	598.000
123	2,438.700	20.000	742.000	148.000	2.000	3,616.000	542.000	0.000	15.418	805.000
124	2,458.700	20.000	694.000	156.000	12.000	3,544.000	477.000	0.000	13.618	763.000
125	2,478.700	20.000	391.000	688.000	332.000	12.000	113.000	35.000	0.000	472.000
126	2,498.700	12.640	302.096	685.088	505.600	0.000	113.128	59.408	0.000	352.024
127	2,511.340	18.660	454.371	1,026.300	865.824	0.000	152.079	125.955	0.000	523.413
128	2,530.000	20.000	476.000	1,056.000	796.000	0.000	167.000	126.000	0.000	546.000
129	2,550.000	20.000	480.000	1,080.000	820.000	0.000	168.000	117.000	0.000	552.000
130	2,570.000	20.000	482.000	956.000	594.000	16.000	163.000	102.000	0.000	549.000
131	2,590.000	20.000	449.000	788.000	278.000	17.000	157.000	67.000	0.000	513.000
132	2,610.000	20.000	423.000	852.000	336.000	1.000	141.000	54.000	0.000	494.000

Civil works

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
133	2,630.000	20.000	398.000	836.000	328.000	0.000	126.000	27.000	0.000	472.000
134	2,650.000	9.530	182.023	381.200	148.668	0.000	60.039	7.148	0.000	218.237
135	2,659.530	20.470	422.705	925.244	532.220	0.000	141.243	48.104	0.000	502.538
136	2,680.000	20.630	460.049	1,014.996	771.562	0.000	142.347	83.552	0.000	540.506
137	2,700.630	24.370	481.307	1,067.406	594.628	0.000	126.724	53.614	0.000	575.132
138	2,725.000	25.000	478.750	725.000	170.000	140.000	158.750	0.000	1.200	566.250
139	2,750.000	24.965	459.356	431.895	71.774	153.909	127.322	0.000	1.200	547.982
140	2,774.965	13.500	186.975	219.375	53.055	11.003	6.750	0.000	0.000	239.625
141	2,788.465	299.130							0.000	
142	3,087.595	13.500	216.675	415.125	183.600	7.425	55.350	0.000	0.000	270.000
143	3,101.095	10.855	244.780	542.479	459.167	0.000	92.810	35.822	0.000	286.029
144	3,111.950	18.050	466.593	1,050.510	1,454.830	0.000	159.743	159.743	0.000	535.183
145	3,130.000	20.000	543.000	1,264.000	988.000	0.000	179.000	235.000	0.000	619.000
146	3,150.000	20.000	570.000	1,360.000	1,544.000	0.000	181.000	294.000	0.000	646.000
147	3,170.000	20.000	607.000	1,452.000	3,392.000	0.000	168.000	382.000	0.000	682.000
148	3,190.000	20.000	617.000	1,440.000	3,472.000	0.000	160.000	401.000	0.000	692.000
149	3,210.000	20.000	586.000	1,360.000	2,544.000	0.000	172.000	318.000	0.000	661.000
150	3,230.000	25.460	668.325	1,334.104	1,481.772	40.736	220.229	216.410	0.000	761.254
151	3,255.460	26.340	608.454	1,248.516	321.348	42.144	194.916	53.997	0.000	654.549
152	3,281.800	16.460	382.695	464.172	0.000	678.152	144.025	0.000	10.213	390.925
153	3,298.260	16.740	572.508	3.348	0.000	1,627.128	360.747	0.000	20.426	585.063
154	3,315.000	20.000	652.000	404.000	116.000	1,120.000	371.000	25.000	13.618	691.000
155	3,335.000	20.000	481.000	1,008.000	880.000	0.000	124.000	133.000	0.000	554.000
156	3,355.000	20.000	519.000	1,136.000	1,348.000	0.000	149.000	189.000	0.000	595.000
157	3,375.000	20.000	510.000	800.000	636.000	116.000	202.000	99.000	2.400	572.000
158	3,395.000	20.000	442.000	576.000	140.000	116.000	176.000	18.000	2.400	502.000
159	3,415.000	13.450	292.537	613.320	435.780	0.000	92.132	45.730	0.000	342.975
160	3,428.450	27.410	690.732	1,595.262	1,617.190	0.000	220.651	211.057	0.000	796.261
161	3,455.860	22.140	479.331	991.872	814.752	0.000	136.161	95.202	0.000	561.249
162	3,478.000	21.000	567.000	357.000	121.800	1,852.200	319.200	0.000	13.618	627.900
163	3,499.000	21.000	597.450	483.000	273.000	1,852.200	339.150	24.150	13.618	660.450
164	3,520.000	25.000	603.750	1,330.000	1,555.000	0.000	185.000	185.000	0.000	698.750
165	3,545.000	20.000	556.000	1,220.000	2,084.000	0.000	208.000	253.000	0.000	632.000

A-17

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
166	3,565.000	20.000	559.000	1,256.000	1,984.000	0.000	212.000	247.000	0.000	632.000
167	3,585.000	17.990	494.725	1,129.772	1,496.768	0.000	151.116	205.985	0.000	559.489
168	3,602.990	17.010	449.915	1,030.806	932.148	0.000	146.286	148.838	0.000	510.300
169	3,620.000	10.190	244.051	529.880	334.232	0.000	72.349	59.612	0.000	276.149
170	3,630.190	19.810	450.677	855.792	471.478	0.000	140.651	83.202	0.000	512.088
171	3,650.000	20.000	458.000	420.000	136.000	512.000	196.000	32.000	13.618	522.000
172	3,670.000	20.000	449.000	456.000	260.000	512.000	168.000	48.000	13.618	515.000
173	3,690.000	20.000	465.000	976.000	600.000	0.000	117.000	112.000	0.000	528.000
174	3,710.000	22.830	525.090	1,086.708	567.325	1.142	134.697	113.008	0.000	593.580
175	3,732.830	17.170	379.457	772.650	388.901	0.859	98.728	70.397	0.000	433.543
176	3,750.000	20.000	468.000	1,016.000	844.000	0.000	127.000	130.000	0.000	538.000
177	3,770.000	20.000	441.000	988.000	680.000	0.000	147.000	83.000	0.000	519.000
178	3,790.000	20.000	440.000	445.000	132.000	448.000	190.000	0.000	1.080	504.000
179	3,810.000	20.000	477.000	533.000	372.000	448.000	188.000	58.000	1.080	540.000
180	3,830.000	20.000	507.000	1,176.000	1,216.000	0.000	157.000	152.000	0.000	581.000
181	3,850.000	20.000	553.000	1,288.000	1,796.000	0.000	171.000	215.000	0.000	626.000
182	3,870.000	10.900	303.565	701.960	1,031.140	0.000	94.830	134.070	0.000	344.440
183	3,880.900	19.100	531.935	1,207.120	1,745.740	0.000	165.215	229.200	0.000	603.560
184	3,900.000	9.000	230.400	495.000	499.050	0.000	69.750	68.850	0.000	263.250
185	3,909.000	27.390	683.380	1,500.972	1,244.875	0.000	190.360	186.252	0.000	776.506
186	3,936.390	13.610	355.902	819.322	865.596	0.000	97.312	119.088	0.000	398.773
187	3,950.000	20.000	458.000	780.000	604.000	64.000	158.000	77.000	1.200	525.000
188	3,970.000	21.000	422.100	289.800	67.200	138.600	162.750	0.000	5.280	486.150
189	3,991.000	21.000	465.150	705.600	487.200	71.400	173.250	45.150	4.080	534.450
190	4,012.000	18.000	462.600	1,098.000	1,155.600	0.000	175.500	132.300	0.000	534.600
191	4,030.000	19.000	503.500	1,166.600	1,459.200	0.000	171.000	189.050	0.000	577.600
192	4,049.000	21.000	623.700	840.000	911.400	390.600	289.800	117.600	2.400	676.200
193	4,070.000	10.000	369.000	254.000	958.000	186.000	141.000	137.500	1.200	368.500
194	4,080.000	10.000	286.500	250.000	861.000	0.000	60.500	129.000	0.000	299.500
195	4,090.000	20.000	415.000	736.000	510.000	0.000	110.000	74.000	0.000	488.000
196	4,110.000	25.750	663.063	1,462.600	1,663.450	0.000	190.550	227.888	0.000	750.613
197	4,135.750	23.520	583.296	1,274.784	1,157.184	0.000	158.760	176.400	0.000	662.088
198	4,159.270	20.730	497.520	1,152.588	597.024	0.000	146.146	109.869	0.000	564.892

4-16

Civil works

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
199	4,180.000	20.000	529.000	1,272.000	1,160.000	0.000	162.000	167.000	0.000	596.000
200	4,200.000	20.000	522.000	1,176.000	1,316.000	0.000	150.000	186.000	0.000	592.000
201	4,220.000	20.000	483.000	1,036.000	788.000	0.000	132.000	126.000	0.000	546.000
202	4,240.000	20.000	632.000	848.000	364.000	308.000	334.000	66.000	1.680	670.000
203	4,260.000	20.000	611.000	808.000	448.000	308.000	343.000	46.000	1.680	658.000
204	4,280.000	12.490	281.649	579.536	512.090	0.000	81.809	52.458	0.000	327.862
205	4,292.490	17.510	434.248	924.528	1,148.656	0.000	126.948	127.823	0.000	498.160
206	4,310.000	25.000	666.250	1,545.000	2,055.000	0.000	211.250	250.000	0.000	761.250
207	4,335.000	28.000	841.400	1,926.400	3,903.200	0.000	233.800	457.800	0.000	943.600
208	4,363.000	13.880	496.210	1,046.552	2,942.560	0.000	116.592	253.310	0.000	505.926
209	4,376.880	13.120	463.792	989.248	2,807.680	0.000	110.864	238.128	0.000	470.352
210	4,390.000	15.330	469.098	1,057.770	2,394.546	0.000	136.437	272.874	0.000	520.453
211	4,405.330	17.670	467.372	1,017.792	1,293.444	0.000	144.894	173.166	0.000	532.751
212	4,423.000	22.000	555.500	679.800	391.600	246.400	253.000	60.500	4.680	624.800
213	4,445.000	20.000	761.000	114.000	0.000	1,752.000	585.000	0.000	18.298	790.000
214	4,465.000	20.000	722.000	0.000	0.000	2,104.000	502.000	0.000	27.235	737.000
215	4,485.000	9.000	264.150	0.000	0.000	1,098.000	126.450	0.000	13.618	270.450
216	4,494.000	11.000	352.550	20.900	0.000	1,284.800	214.500	0.000	9.029	372.350
217	4,505.000	19.820	540.095	382.526	95.136	574.780	292.345	36.667	6.720	595.591
218	4,524.820	28.570	682.823	1,148.514	571.400	154.278	239.988	102.852	2.850	755.677
219	4,553.390	21.610	511.076	907.620	475.420	60.508	181.524	77.796	0.840	568.343
220	4,575.000	22.380	576.285	653.496	152.184	268.560	287.583	41.403	3.960	633.354
221	4,597.380	28.140	1,007.412	416.472	0.000	1,632.120	688.023	0.000	9.300	1,055.250
222	4,625.520	19.480	864.912	225.968	0.000	1,745.408	476.286	0.000	9.000	883.418
223	4,645.000	20.000	790.000	532.000	180.000	928.000	350.000	47.000	5.400	810.000
224	4,665.000	20.000	634.000	784.000	272.000	180.000	322.000	86.000	1.680	666.000
225	4,685.000	20.000	501.000	832.000	320.000	68.000	178.000	81.000	0.960	558.000
226	4,705.000	12.700	328.930	708.660	889.000	0.000	85.725	114.300	0.000	372.110
227	4,717.700	22.300	545.235	1,195.280	1,494.100	0.000	138.260	170.595	0.000	626.630
228	4,740.000	21.470	393.975	738.568	253.346	0.000	107.350	16.103	0.000	475.561
229	4,761.470	20.620	493.849	400.028	70.108	317.548	156.712	0.000	3.000	557.771
230	4,782.090	24.430	625.408	356.678	0.000	449.512	228.421	0.000	6.150	698.698
231	4,806.520	17.480	366.206	583.832	185.288	52.440	123.234	34.960	1.440	426.512

A-17

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
232	4,824.000	13.690	308.709	643.430	399.748	0.000	79.402	67.081	0.000	353.202
233	4,837.690	22.310	555.519	1,133.348	1,182.430	0.000	142.784	174.018	0.000	626.911
234	4,860.000	20.080	519.068	1,132.512	1,353.392	0.000	137.548	188.752	0.000	586.336
235	4,880.080	9.580	241.416	549.892	523.068	0.000	71.371	68.976	0.000	276.383
236	4,889.660	13.500	309.150	725.288	494.100	0.000	96.525	60.075	0.000	353.700
237	4,903.160	49.290							0.000	
238	4,952.450	13.500	282.150	644.625	534.600	0.000	120.825	40.500	0.000	365.850
239	4,965.950	3.840	93.120	218.880	244.224	0.000	26.688	30.144	0.000	115.584
240	4,969.790	19.840	524.768	1,202.304	1,368.960	0.000	152.768	185.504	0.000	585.280
241	4,989.630	25.370	767.442	1,583.088	1,588.162	0.000	214.376	308.245	0.000	819.451
242	5,015.000	15.000	500.250	1,017.000	1,200.000	0.000	152.250	234.750	0.000	525.750
243	5,030.000	18.160	651.036	1,383.792	1,983.072	0.000	166.164	331.420	0.000	687.356
244	5,048.160	21.840	696.696	1,515.696	1,943.760	0.000	157.248	324.324	0.000	756.756
245	5,070.000	25.000	620.000	880.000	730.000	175.000	240.000	115.000	16.950	698.750
246	5,095.000	15.970	376.094	332.176	31.940	166.088	182.058	11.978	11.070	421.608
247	5,110.970	9.910	335.949	164.506	19.820	505.410	223.966	7.432	5.520	357.751
248	5,120.880	8.000	261.200	124.800	0.000	388.800	174.000	0.000	5.220	279.600
249	5,128.880	11.120	248.532	262.432	0.000	80.064	120.096	0.000	1.380	283.560
250	5,140.000	20.000	656.000	176.000	0.000	2,056.000	443.000	0.000	15.778	710.000
251	5,160.000	16.040	655.234	2,040.288	0.000	1,549.464	494.834	0.000	20.426	688.116
252	5,176.040	23.960	900.896	3,047.712	0.000	1,883.256	649.316	0.000	27.235	952.410
253	5,200.000	20.000	529.000	292.000	72.000	1,572.000	287.000	0.000	13.618	593.000
254	5,220.000	20.000	443.000	908.000	912.000	0.000	119.000	114.000	0.000	519.000
255	5,240.000	26.230	744.932	1,652.490	2,769.888	0.000	222.955	352.793	0.000	839.360
256	5,266.230	23.770	685.765	1,464.232	2,020.450	0.000	215.119	287.617	0.000	757.075
257	5,290.000	23.000	665.850	1,421.400	1,304.100	0.000	209.300	240.350	0.000	723.350
258	5,313.000	19.060	561.317	1,204.592	1,399.004	0.000	163.916	230.626	0.000	610.873
259	5,332.060	22.940	559.736	1,069.004	892.366	4.588	191.549	137.640	0.000	630.850
260	5,355.000	25.000	492.500	515.000	20.000	120.000	203.750	0.000	2.850	583.750
261	5,380.000	14.180	277.219	153.144	0.000	119.112	109.186	0.000	3.330	329.685
262	5,394.180	20.800	420.160	561.600	139.360	79.040	132.080	31.200	2.160	497.120
263	5,414.980	20.790	457.380	910.602	434.511	0.000	125.780	83.160	0.000	533.264
264	5,435.770	24.230	573.039	1,148.502	741.438	0.000	173.244	117.515	0.000	652.998

Civil works

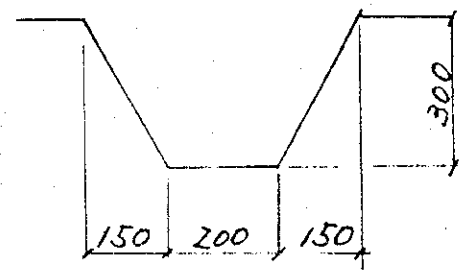
No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
265	5,460.000	25.000	630.000	1,300.000	1,140.000	0.000	180.000	158.750	0.000	701.250
266	5,485.000	25.000	632.500	1,315.000	1,140.000	0.000	172.500	175.000	0.000	702.500
267	5,510.000	17.170	451.571	992.426	985.558	0.000	127.917	147.662	0.000	504.798
268	5,527.170	17.830	517.070	1,173.214	1,843.622	0.000	147.989	240.705	0.000	578.583
269	5,545.000	20.000	570.000	1,264.000	1,744.000	0.000	178.000	246.000	0.000	640.000
270	5,565.000	21.570	579.154	1,289.886	1,104.384	0.000	186.580	182.266	0.000	644.943
271	5,586.570	23.430	599.808	1,340.196	1,447.974	0.000	180.411	202.670	0.000	674.784
272	5,610.000	30.000	738.000	1,590.000	1,062.000	6.000	312.000	138.000	6.000	841.500
273	5,640.000	4.500	126.000	264.600	152.100	0.900	53.100	26.325	1.200	139.275
274	5,644.500	10.500	271.950	348.600	441.000	0.000	91.875	61.425	6.809	297.675
275	5,655.000	10.000	227.500	274.000	472.000	0.000	75.500	41.000	6.809	256.000
276	5,665.000	25.000	633.750	1,375.000	1,955.000	0.000	193.750	205.000	0.000	716.250
277	5,690.000	22.200	684.870	1,411.920	4,071.480	0.000	160.950	411.810	0.000	742.590
278	5,712.200	17.800	720.900	1,185.480	6,603.800	0.000	106.800	606.980	0.000	740.480
279	5,730.000	20.000	839.000	1,396.000	8,136.000	0.000	122.000	725.000	0.000	857.000
280	5,750.000	10.000	394.000	802.000	3,670.000	0.000	62.500	350.000	0.000	415.500
281	5,760.000	19.230	683.626	1,499.940	5,315.172	0.000	124.033	559.593	0.000	744.201
282	5,779.230	19.230	575.939	1,315.332	2,780.658	0.000	168.263	326.910	0.000	647.090
283	5,798.460	16.400	419.840	938.080	1,177.520	0.000	144.320	134.480	0.000	481.340
284	5,814.860	13.500	236.250	464.738	257.850	7.425	60.750	25.650	0.000	286.875
285	5,828.360								0.000	
286	5,975.690	13.500	280.800	622.013	423.900	0.000	92.475	43.875	0.000	332.775
287	5,989.190	9.610	246.977	568.912	534.316	0.000	83.607	75.919	0.000	283.976
288	5,998.800	16.200	424.440	965.520	1,091.880	0.000	137.700	148.230	0.000	486.000
289	6,015.000	15.000	385.500	891.000	891.000	0.000	126.000	123.000	0.000	442.500
290	6,030.000	17.000	408.000	924.800	673.200	0.000	126.650	98.600	0.000	470.050
291	6,047.000	23.000	543.950	874.000	331.200	101.200	231.150	48.300	1.920	619.850
292	6,070.000	25.000	611.250	875.000	215.000	112.500	281.250	50.000	3.000	696.250
293	6,095.000	16.000	399.200	672.000	364.800	11.200	152.000	70.400	2.160	445.600
294	6,111.000	12.430	310.750	474.826	233.684	27.346	134.244	39.155	2.160	341.825
295	6,123.430	31.570	770.308	1,155.462	246.246	88.396	314.121	99.445	1.800	861.861
296	6,155.000	25.000	636.250	1,095.000	635.000	30.000	187.500	173.750	0.900	697.500
297	6,180.000	25.000	663.750	1,395.000	1,435.000	0.000	165.000	238.750	0.000	726.250

No.	STA.	Distance	Clearing	C. common	C. weatherd	Embank.	Sod face	Shotcrete	Dowel bar	Land acqusi.
298	6,205.000	19.000	467.400	672.600	725.800	193.800	157.700	95.000	2.520	517.750
299	6,224.000	2.000	46.600	13.200	4.800	46.000	20.800	0.000	4.034	50.700
300	6,226.000	6.000	153.600	135.600	46.800	90.000	63.300	17.100	3.524	165.600
301	6,232.000	23.000	711.850	998.200	354.200	248.400	299.000	150.650	2.520	726.800
302	6,255.000	25.000	751.250	845.000	317.500	360.000	316.250	173.750	5.100	763.750
303	6,280.000	26.000	783.900	1,320.800	2,795.000	150.800	226.200	384.800	2.550	842.400
304	6,306.000	26.640	956.376	2,157.840	6,350.976	0.000	193.140	732.600	0.000	1,028.304
305	6,332.640	19.310	679.712	1,235.840	4,356.336	0.000	112.963	413.234	0.000	704.815
306	6,351.950	13.120	474.288	663.872	2,889.024	0.000	70.192	244.688	0.000	461.824
307	6,365.070	13.110	484.415	718.428	3,033.654	0.000	70.139	319.229	0.000	471.960
308	6,378.180	4.740	154.761	285.348	951.792	0.000	27.966	96.459	0.000	160.923
309	6,382.920	12.000	409.200	1,012.800	2,829.600	0.000	80.400	301.200	0.000	432.000
310	6,394.920									
	Total		157,489.265	211,936.775	225,862.109	209,922.462	69,931.753	28,652.586	1,579.241	173,837.608

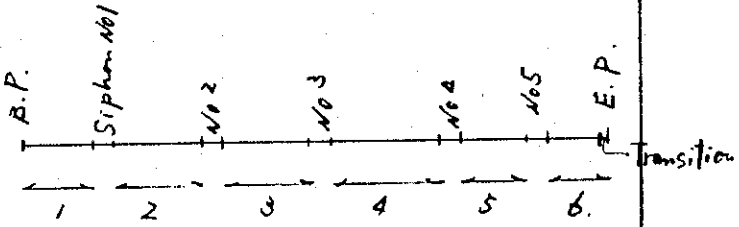
4-26

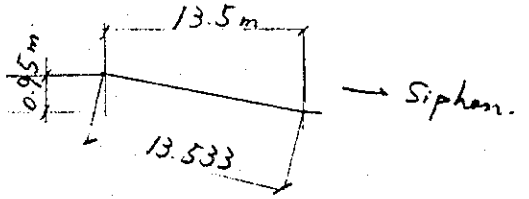
Working Division: 6. SEVERINO OPEN CHANNEL

Description	Calculation Details	Unit	Quantity	Remarks
6.2 108	Trench excavation, all classes, for underdrain	m^3	569.753	
1)	Oi	m^3	557.648	
	1. 186.500 m			
	2. 180.571 m			
	3. 2103.126 m			
	4. 1788.574 m			
	5. 848.907 m			
	6. 393.731 m			
	$5501.409_m \times 0.105\ m^3 = 577.648\ m^3$			
2)	Tr	m^3	7.105	
	13.533 m × 5 nos. = 67.665			
	$67.665_m \times 0.105\ m^2 = 7105\ m^3$			



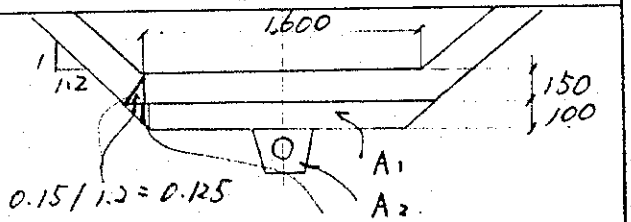
$A = (0.2 + 0.5) \times 0.3 / 2$
$= 0.105\ m^2$

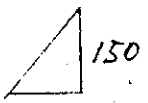


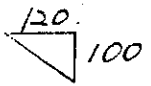


Working Division: 6.

Description	Calculation Details	Unit	Quantity	Remarks
6.2 112	Sand and gravel bedding for open channel	m^3		
1) Oi		m^3	1958.502	
	Length : 5501.409 m			
	Area : 0.356 m^2			
	Volume : 1958.502 m^3			







$A_1 = (1.6 + 1.6 + 0.125 \times 2) \times 0.15 / 2$
$= 0.259 \ m^2$

$A_2 = 0.105 - 0.05^2 \Pi = 0.097 \ m^2$

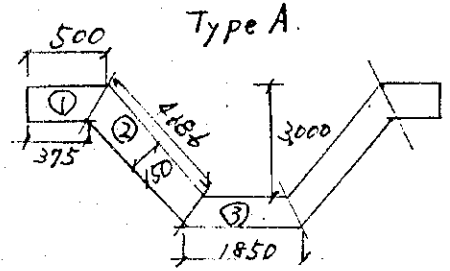
$A = A_1 + A_2 = 0.259 + 0.097 = 0.356 \ m^2$

A-12

Working Division: 6.

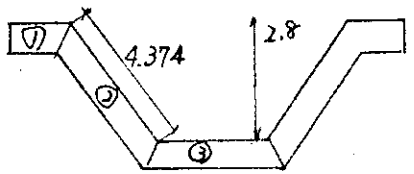
Description	Calculation Details	Unit	Quantity	Remarks
6.3 108	Concrete class F. for lining concrete of open channel	m^3	9,386.431	
	i) Type A L = 186.500 m (c/f 6.2 101) (until Siphon No. 1).			
	V = 1.797 m^2 × 186.500 m = 335.141 m^3			
	ii) Type B L = 5,314.909 m			
	V = 1.703 m^2 × 5314.909 m = 9051.290 m^3			
	i) + ii) = 9,386.431			

Type A.



① (0.5 + 0.375) × 0.15/2 = 0.066
② 4.686 × 0.15 × 0.703
× 2 = 1.538
③ (1.6 + 1.85) × 0.15/2 = 0.259
A_A = 1.797 m^2

Type B.

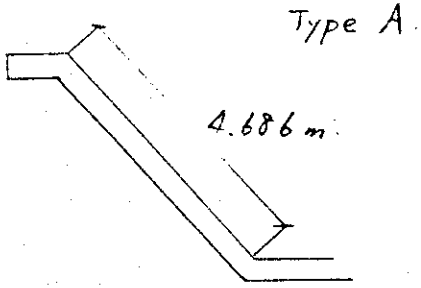


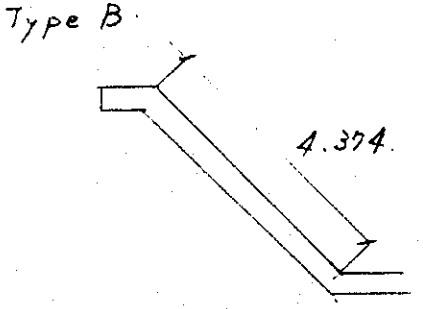
① same as above = 0.066
② 0.15 × 4.374 × 0.656
× 2 = 1.444
③ same as above 0.259
A_B = 1.703.

A-23

Working Division: 6.

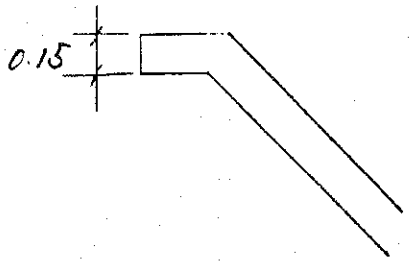
Description	Calculation Details	Unit	Quantity	Remarks
6.3 /17	Formwork, F3 finish for concrete item 108	m^2	48,292.702	
	i) Type A L = 186.500 x 2 = 373.000			
	A = 4.686 m x 373.000 m = 1747.878 m^2			
	ii) Type B L = 5314.909 x 2 = 10,629.818			
	A = 4.374 m x 10629.818 m = 46,494.824 m^2			
	i) + ii) = 48,242.702 m^2			





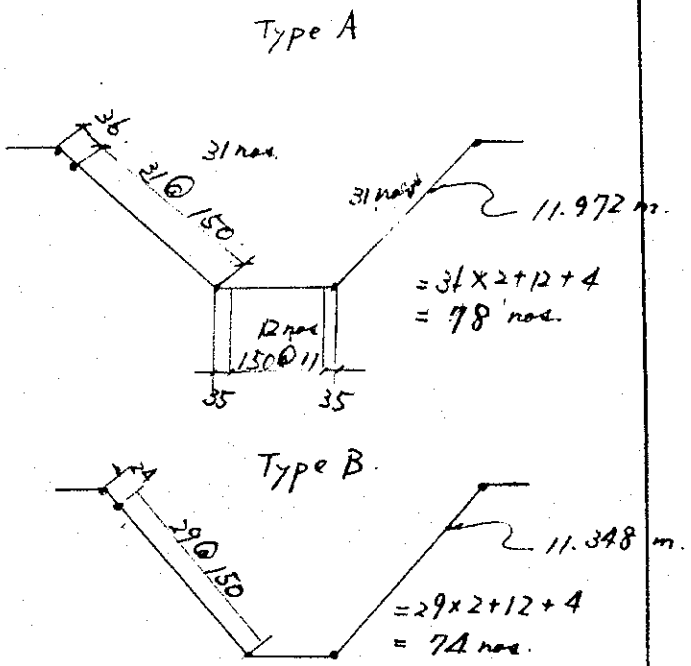
A-2K

Working Division: 6

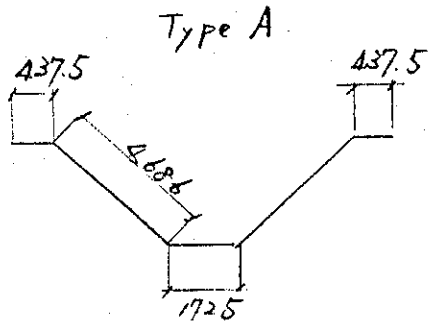
Description	Calculation Details	Unit	Quantity	Remarks
6.3 1.3	Formwork. FI finish. for concrete item 108	m^2	1,650.423	
	0.15m × 5501.409m = 825.211			
	(both side) ×2 = 1,650.423			

Working Division: 6.

Description	Calculation Details	Unit	Quantity	Remarks
6.3 1 19	Reinforcing bars for open channel lining	ton	154.242	
	#5.5 — 0.187 kg/m			
	i) Type A per(m) in longitud			
	78 m + 11.972 m × 1m/0.15m			
	= 157.813 m			
	w = 157.813 × 0.187 = 29.511 kg			
	W = 29.511 kg/m × 186.500 m			
	= 5.503 802 kg = 5.504 ton			
	ii) Type B			
	74 m + 11.348 × 1m/0.15m = 149.653 m			
	w = 149.653 × 0.187 = 27.985 kg			
	W = 27.985 kg/m × 5314.909 m			
	= 148737.728 kg = 148.738 Ton			
	i) + ii) = 5.504 + 148.738			
	= 154.242 Ton			



Working Division: 6

Description	Calculation Details	Unit	Quantity	Remarks
6.3 / 24	P.V.C. waterstop, type C (W = 150 mm) for open channel	m	10,528.216	Type A  L = (437.5 + 4,686) x 2 + 1,725 = 11,972 = 11.972 m Type B L = (437.5 + 4,374) x 2 + 1,725 = 11,348 = 11.348 m.
	per 6m. longitude			
	i) Type A 186.5 m / 6m = 31.083 = 32 nos 11.972 m x 32 nos = 383.104 m			
	ii) Type B 180.571 m / 6 = 30.095 → 32 nos 2103.126 / 6 = 350.521 → 352 nos 1788.574 / 6 = 298.096 → 300 nos 848.907 / 6 = 141.485 → 143 nos 393.731 / 6 = 65.622 → 67 nos 894 nos 11.348 x 894 nos = 10,145.112			
	i) + ii) = 10,528.216 m.			

Working Division: 6.

Description	Calculation Details	Unit	Quantity	Remarks
6.3 125	Bituminous sealing for contraction joints of main channel and structures	m^2	1579.06	
1) 0i	i) Type A (cf. 6.3 124)			
	$L = 11.972\ m$			
	$a = 11.972\ m \times 0.15\ m = 1.796\ m^2$			
	$A = 1.796\ m^2 \times 32$ nos $= 57.472\ m^2$			
	ii) Type B			
	$L = 11.348\ m$			
	$a = 11.348\ m \times 0.15\ m = 1.702\ m^2$			
	$A = 1.702\ m^2 \times 894$ nos			
	$= 1521.588\ m^2$			
	i) + ii) = $1579.06\ m^2$			

A-128

Working Division: 6.

Description	Calculation Details	Unit	Quantity	Remarks
6.4 101	P.V.C. Perforated pipes. D100mm for underdrain	m	5656.074	
1)	Oi (cf 6.3 101) L = 5501.409	m	5,501.409 87.000 5588.409	
2)	Tr			
	$13.533_{m} \times 5_{m} = 67.665$ m	m	67.665	
	Fall into crossing culvert		87.000	

Working Division: 6.

Description	Calculation Details	Unit	Quantity	Remarks
64 103	Graded crushed stone subbase, not less than corrected CBR 60	m^3		
1)	Oi	m^3	2541 784	
	t = 150 mm			
	Total Length = 5501.409 + 13.5 × 10			
	+ 12.0			
	= 5648.409 m			
	t B L			
	V = 0.15 × 3.0 × 5648.409			
	= 2541.784 m^3			
2)	Ai			

A1 C3

Working Division: 6.

Description	Calculation Details	Unit	Quantity	Remarks
6.5 101	Compacting of original ground.			
1)	Oi			
	Length = Total drain dital length (left side)			
	= 3.854 m			
	L W			
	3.854 m × 3.0 m = 11,562 m²			

A-31

Working Division: 6

Description	Calculation Details	Unit	Quantity	Remarks
6.5 102	Improved subgrade material, not less than corrected CBR 12			
1)	Oi			
	Located at embankment area			
	Length = (Total inspection road length) − (Compacting area length)			
	= 5648.409 − 3854			
	= 1794.409 m			
	t = 200 mm			
	t B L			
	V = 0.2m × 3.0m × 1794.409			
	= 1076.645 m³			

A.W.2

No.

Tr.:

TRANSITION

No.

〈Transition〉

1. concrete

(3.54 + 4.95) /2 × 13.5 m = 57.308 m^3

57.308 × 11 set = 630.383 m^3

2. Leveling concrete.

(0.26 + 0.39) /2 × 13.5 = 4.388 m^3

4.388 × 11 set = 48.263 m^3

3. Reinforcement

concrete $1m^3$ —— 90 kg

630.383 × 90 = 56734.47 kg.

4 Formwork

F3 : (8.748 + 7.5) /2 × 13.5 = 109.674 m^2

109.674 m^2 × 11 set = 1206.414 m^2

F1 : (9.444 + 8.51) /2 × 13.5 = 121.190

121.190 × 11 set = 1333.084 m^2

5. Backfilling.

(4.562 + 14.562)/2 × 13.5 = 129.087

129.087 × 11 set = 1,419.957 m^3

6. Bituminous

4.95 × 11 set = 54.45 m^2

7. Dowel bar

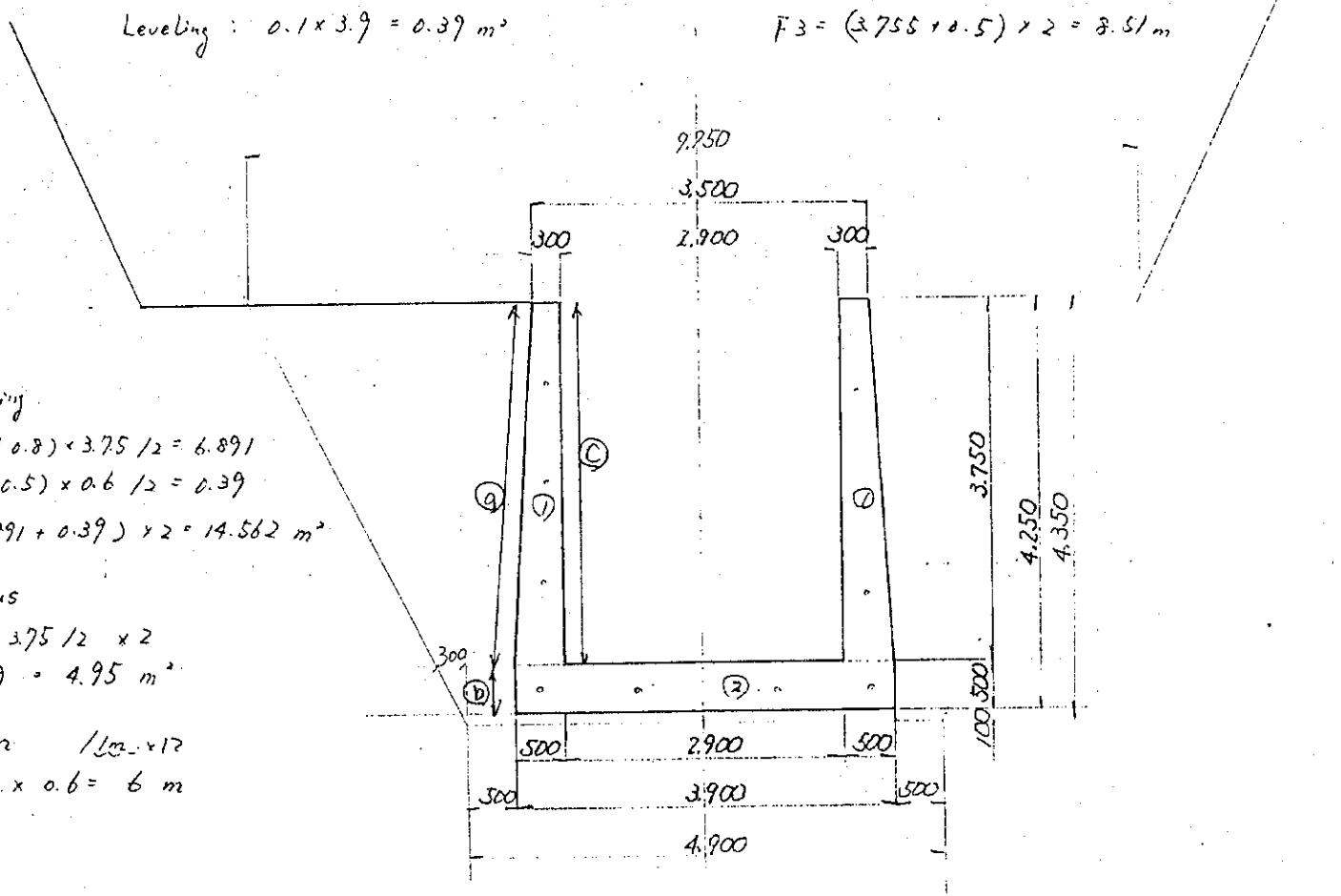
6m × 11 set = 66 m.

66m × 2.98 kg = 196.68 kg.

Concrete : ① = (0.3+0.5) × 3.75 / 2
= 1.5
② = 0.5 × 3.9 = 1.95
∴ 1.5 × 2 + 1.95 = 4.95 m³

Leveling : 0.1 × 3.9 = 0.39 m³

Formwork : ⓐ = $\sqrt{0.3^2 + 3.75^2}$ = 3.755 m
ⓑ = 0.5
ⓒ = 3.75
F1 = 3.75 × 2 = 7.5 m
F3 = (3.755 + 0.5) × 2 = 8.51 m



Back filling
(2.875 + 0.8) × 3.75 / 2 = 6.891
(0.8 + 0.5) × 0.6 / 2 = 0.39
∴ (6.891 + 0.39) × 2 = 14.562 m³

Bituminous
(0.3+0.5) × 3.75 / 2 × 2
+ 0.5 × 3.9 = 4.95 m²

Dowel bar @ 1m. × 12
10 ϕ × 0.6 = 6 m

A-54

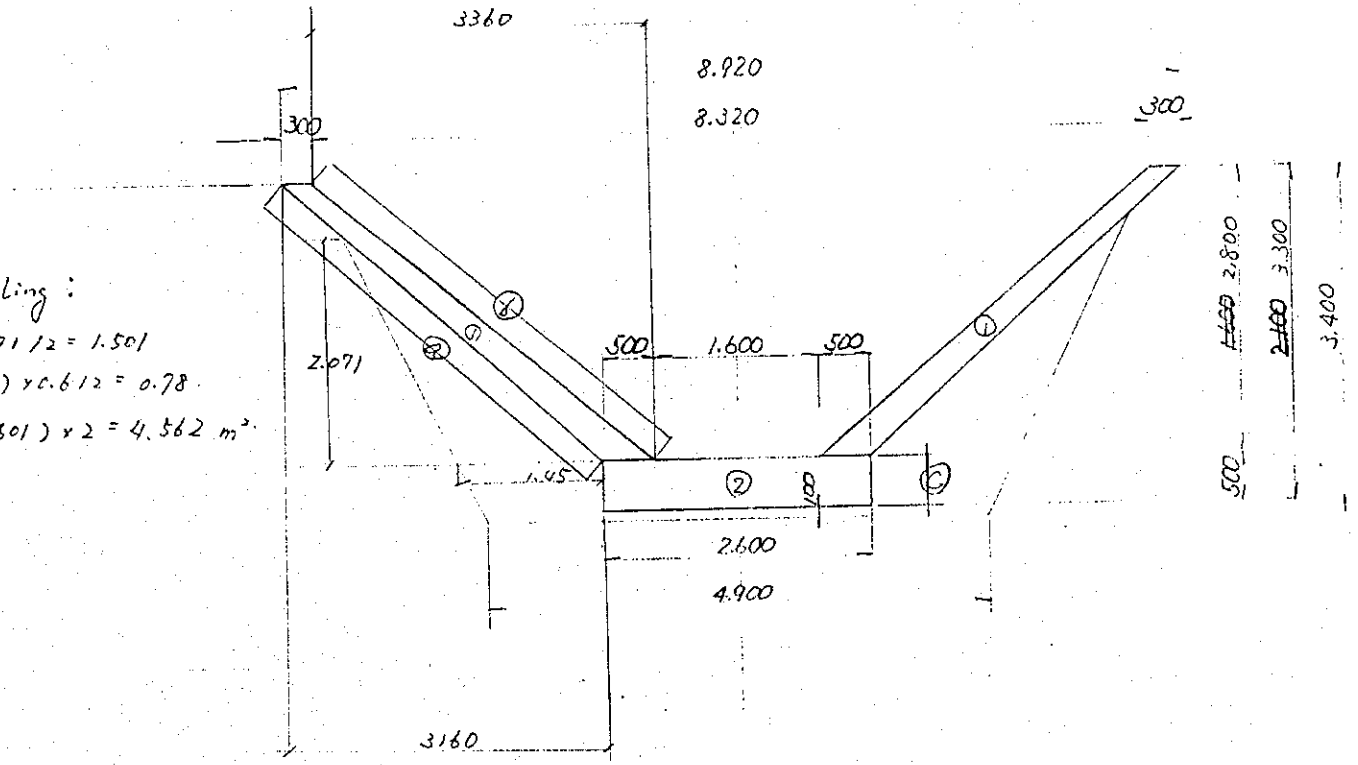
concrete : ① = (0.3 + 0.5) × 2.8 / 2
= 1.12.
② = 0.5 × 2.6 = 1.3
∴ 1.12 × 2 + 1.3 = 3.54 m³

Leveling : A = 0.1 × 2.6 = 0.26 m²

formwork : ⓐ = $\sqrt{3.16^2 + 2.8^2}$
= 4.222
ⓑ = $\sqrt{3.36^2 + 3.8^2}$
= 4.374
ⓒ = 0.5.

F1 = ⓑ × 2 = 8.748 m

F3 : ⓐ × 2 + ⓒ × 2
= 9.444 m

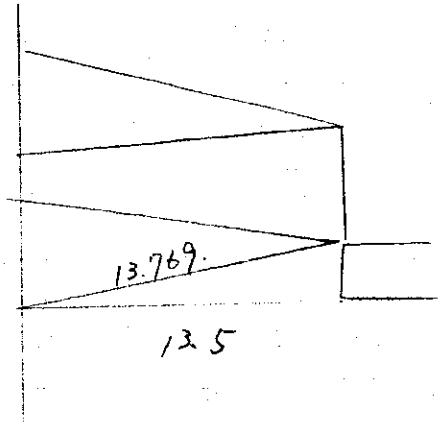


Backfiling :
1.45 × 2.071 / 2 = 1.501
(1.45 + 1.15) × 0.6 / 2 = 0.78
(0.78 + 1.501) × 2 = 4.562 m³

A-36

No.

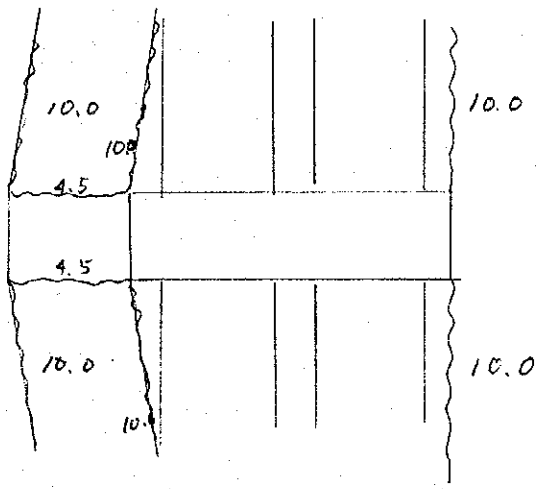
〈Handrail for Transition〉



13.769 m × 2 × 11 set = 302.918 m

31.784 kg/m × 302.918 = 9,627.946

Fence.



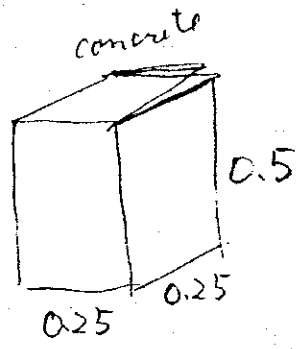
Total 69.0 m.

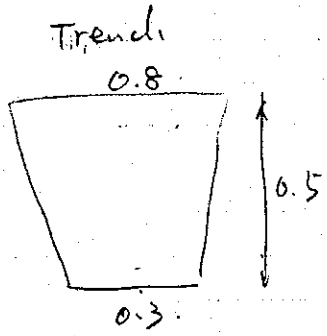
13 kg/m × 69.0 m × 11 set = 9867 kg

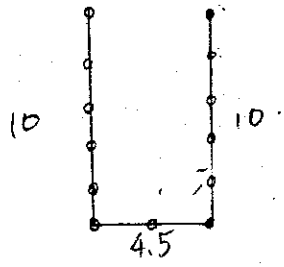
concrete of fence.

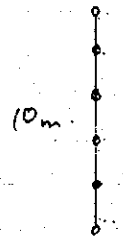
No.

〈concrete of fence〉









1 bridge ——— 38 nos.

concrete

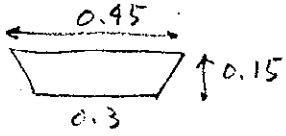
$0.25 \times 0.25 \times 0.5 \times 38\ \text{nos} \times 11\ \text{nos} = 13.063$

Trench excavation.

$(0.8^2 + 0.3^2) / 2 \times 0.5 = 0.183\ m^3$

$0.183 \times 38 \times 11 = 76.494\ m^3$

Gravel.



$(0.45^2 + 0.3^2) / 2 \times 0.15 = 0.022$

$0.022 \times 38 \times 11 = 9.196\ m^3$

Formwork. $0.25 \times 0.5 \times 4 = 0.5$

$0.5 \times 38\ \text{nos} \times 11\ \text{nos} = 209\ m^2$

No.

〈 Block out. for Trench 〉

Width = 3.5 m.

$0.25 \times 0.4 \times 3.5 = 0.35$
$0.45 \times 0.5 \times 3.5 = 0.788$
$0.25^2/2 \times 3.5 = 0.109$
1.247

$1.247 \times 6\text{ 基} = 7.482\ m^3$

formwork.

$(0.25 \times 2 + 0.25 \times 2 + 0.4) \times 3.5 = 4.9$

$4.9 \times 6 = 29.4\ m^2$

No.....

POZA HONDA INLET

TRASHRACK

(1) Bar Element

10 × 110 × 4,280 m × ~~56~~ 52 pcs

8.6 kg/m × 4,280 m × 56 pcs = 2,061.25 kg

(2) Supporting Beam

H 500 × 200 × 10 × 16

89.7 kg/m

89.7 kg/m × 4.6 m = 412.62 kg

(3) Bottom Embedded Parts

L 150 × 100 × 12

22.4 kg/m

22.4 kg/m × 4.3 m = 96.32 kg

(4) Top Embedded Parts

≒ 150 × 100 × 12 4.0 m wide

22.4 kg/m 0.8 t/m

22.4 kg/m × 4.3 m = 96.32 kg

(5) Spacer (Pipe φ20)

1.68 kg/m × 4 m × 12 pcs = 80.64 kg

(6) Tie Bar (φ19)

2.25 kg/m × 4 m × 12 pcs = 108 kg

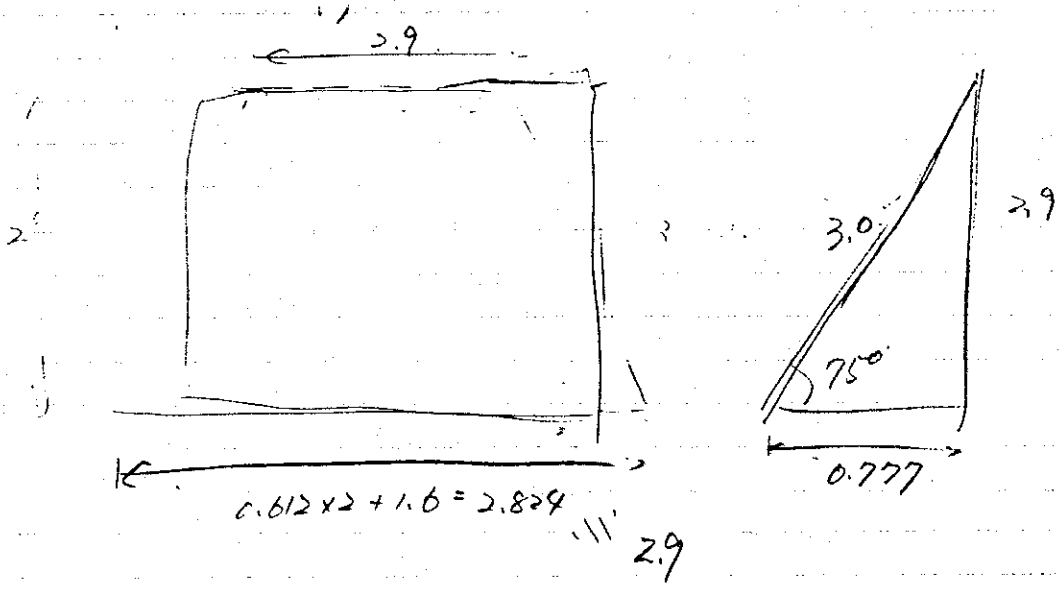
SUM (1)~(6) 2,855.15 kg → 2,900 kg

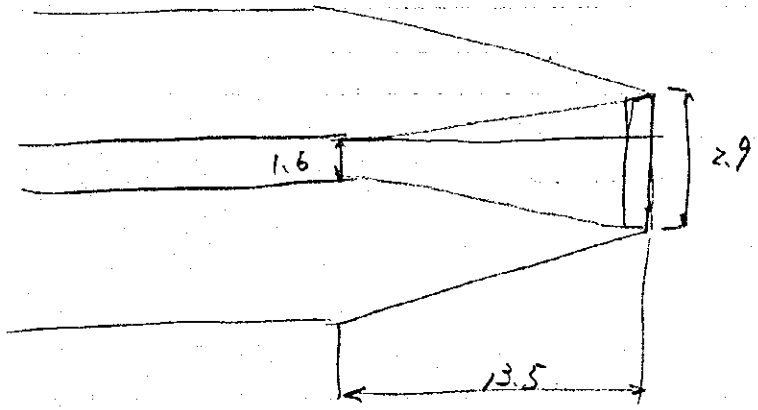
A049

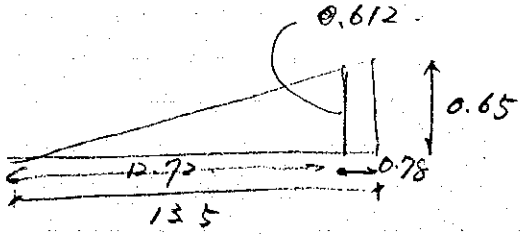
→ 3.17 t → 3.2 50×500 t/m

No.

Trash rack.







No.

(1) Bar element.

8.6 kg/m × 39 mm × 3.0 = 1006.2 kg.

(2) Supporting beam

89.7 kg/m × 3.5 m = 313.95 kg.

(3) bottom embeded parts

22.4 kg/m × 3.2 = 71.68 kg.

(4) Top embedded parts.

22.4 × 3.2 = 71.68.

(5) spacer. (pipe φ20).

1.68 kg/m × 2.9m × 10pcs = 48.72 kg

(6) Tie bar (φ19)

2.25 kg/m × 2.9 × 10 = 65.25.

Σ (1) ~ (6) = 1577.48.

T 10% = 1735.228
= 1.8 ton.

8676.14

1/12 1.8 ton × 5 nos = 9.0.

No.....

Si : SIPHON

1. Concrete
$4.2 \times 4.3 - 1.6^2\pi = 10.018\ m^3$

2. Leveling concrete
$0.1 \times 4.2 = 0.42\ m^3$

3. Steel bar
$10.018 \times 60\ kg/m^3 = 601.08\ kg$

4. Formwork
F1 : $4.3 \times 2 = 8.6\ m^2$
F3 : $3.2 \times \pi = 10.053\ m^2$

5. Bituminous coating
$10.018\ m^2/(9m)$

6. Waterstop
$3.7 \times 2 + 3.75 \times 2 = 14.9\ m/(9m)$

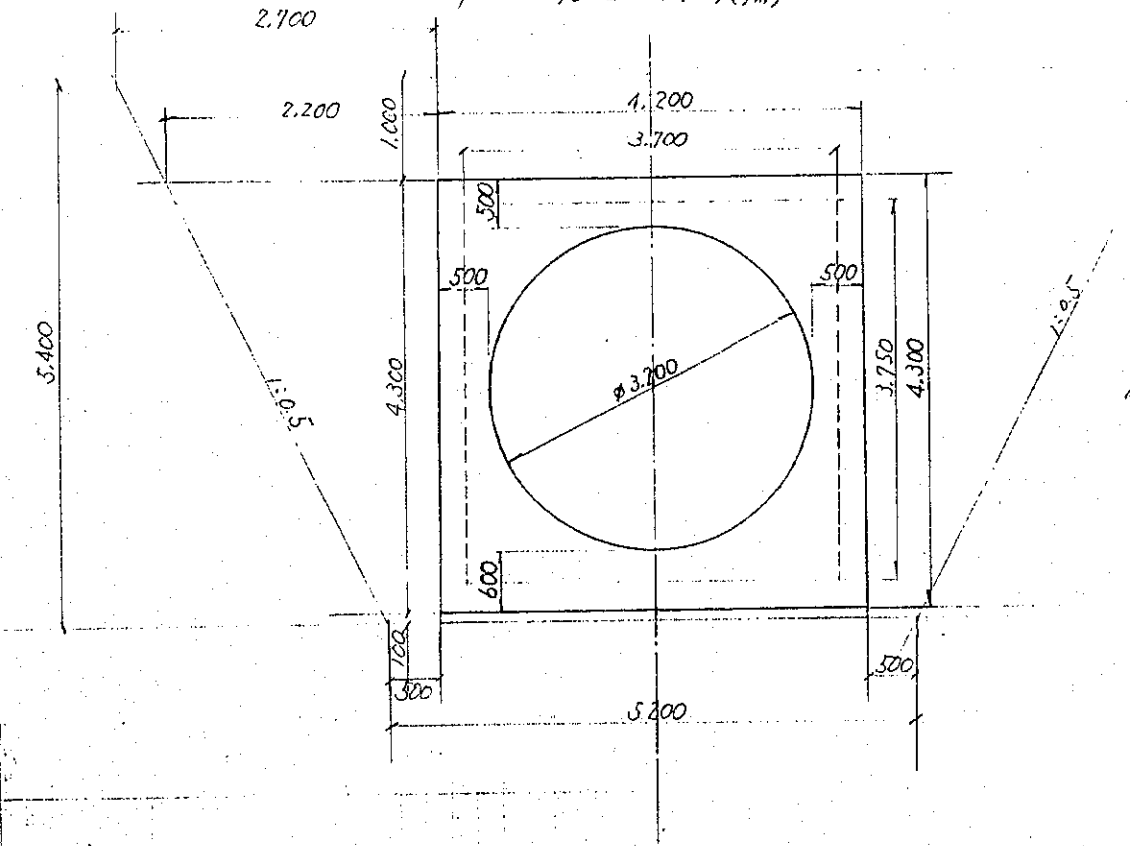
7. Dowel bar
$0.6 \times 32 = 19.2\ m$
$2.98\ kg/m \times 19.2m = 57.216\ kg/(9m)$

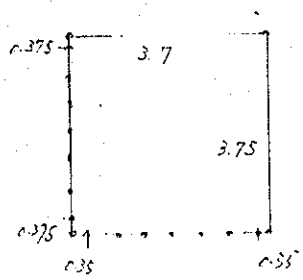
8. Backfill
$(2.2 + 0.5) \times 4.4 / 2 \times 2 = 11.88\ m^3$

9. Gabion
$(9.6 + 8.6) \times 1.0 / 2 = 9.1\ m^3$

10 Excavation
$(5.2 + 9.6) \times 5.4 / 2 = 39.96\ m^3$

11. c.c 9.6





$7 \times 4 \times 4 = 32\ t$

A-4

D 16 20 c/c.

D16 . 20 p/c.

1. concrete:
$3.9 \times 4.0 - 2.9 \times 2.9 + 0.2^2 \times 4 = 7.35\ m^3$

2. levering concrete
$0.1 \times 3.9 = 0.39\ m^3$

3. Steel bar
60 kg/ $1m^3$ (concrete) = 17
$7.35 \times 60 = 441$ kg

4. Formwork
F1: $4.0 \times 2 = 8.0\ m^2$
F3: $2.5 \times 3 + 0.283 \times 4 = 8.632\ m^2$

5. Bituminous coating
$7.35\ m^2$ /(9m)

6. Waterstop
$3.4 \times 2 + 3.45 \times 2 = 13.7$ m/(9m)

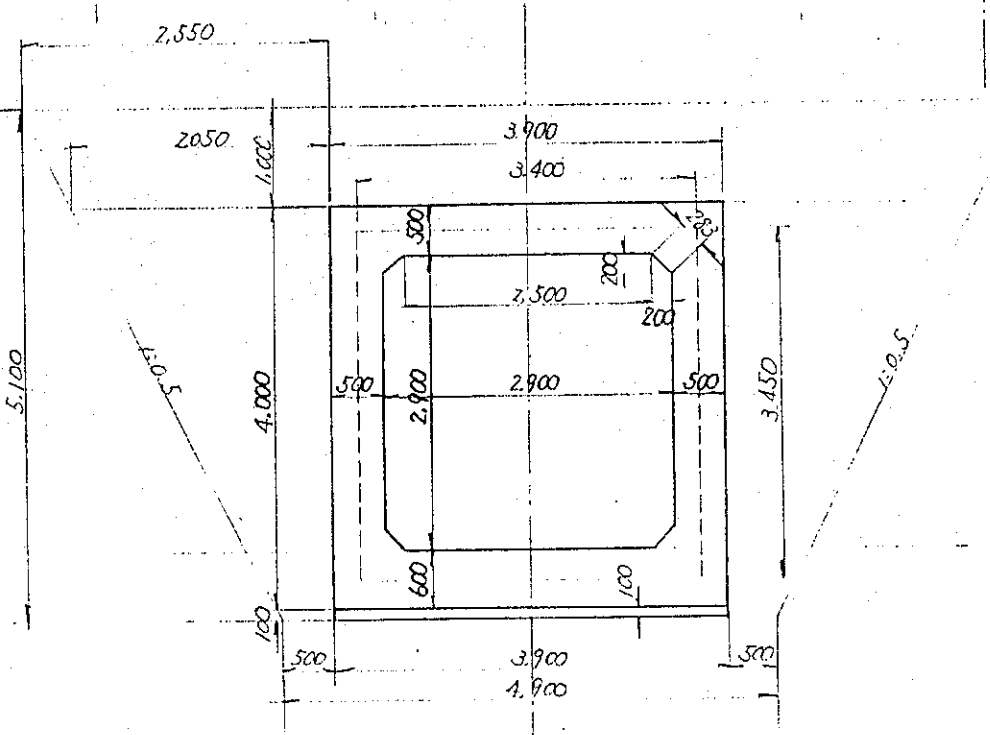
7. Dowel bar
$0.6 \times 32 = 19.2$ m
2.98 kg/m $\times 19.2$m $= 57.216$ kg/(9m)

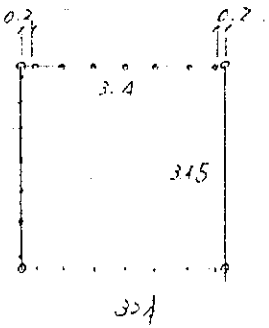
8. Back fill
$(2.05 + 0.5) \times 4.1\ 1/2 \times 2 = 10.455\ m^3$

9. Gabion
$(9.0 + 8.0) \times 1.0\ 1/2 = 8.5\ m^3$

10. Cl
9.0

Excavation
$(9 + 4.9) \times 5.1\ 1/2 = 35.445\ m^3$



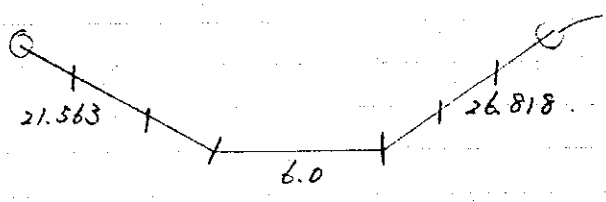


A-54

No.

Siphon B/Q

1) Siphon No.1.



CL = 9.0 × 48.705
= 438.345

Total Length = 48.705 m

i) Excavation
35.445 × 48.705 = 1,726.349 m³

ii) Concrete
7.35 × 48.705 = 357.982 m³

iii) Leveling concrete.
0.39 × 48.705 = 18.995 m³

iv) Steel bar
441 × 48.705 = 21,478.905 m³

v) Formwork.
F1: 8.0 × 48.705 = 389.64 m²
F3: 8.63 × 48.705 = 420.422 m²

vi) Backfill
10.455 × 48.705 = 509.211 m³

vii) Gabion
8.5 × 48.705 = 413.993.

* i = 1 m.
(Cc 345.270 (20%)
Cw 1,381.079 (80%)

- Bituminous coating

7.35 × 6 = 44.1 m²

- Water stop

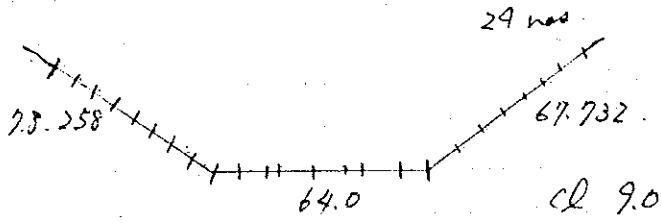
13.7m × 6 = 82.2 m

- Dowel bar

57.216 kg × 6 = 343.296 kg.

No.

Siphon No. 2.



Cl 9.0 × 209.99 = 1889.91

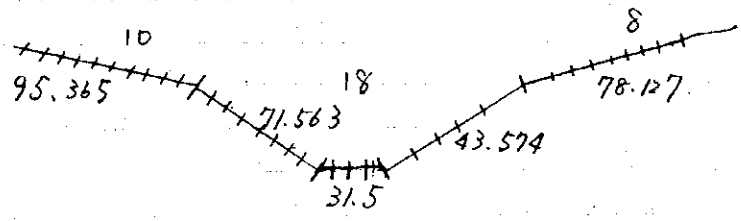
Total length = 209.99 m.

- Excavation
  35.445 × 209.99 = 7443.096. (Cc = 1488.619, Cw = 5954.477.)
- Concrete
  7.35 × 209.99 = 1543.427
- Leveling concrete
  0.39 × 209.99 = 81.896.
- Steel bar
  441 × 209.99 = 92605.59
- Formwork
  F1: 8.0 × 209.99 = 1679.92
  F3: 8.632 × 209.99 = 1812.634
- Back fill
  10.455 × 209.99 = 2195.445
- Gabion
  8.5 × 209.99 = 1,784.915
- B. coat
  7.35 × 24 = 176.4
- waterstop
  13.7 × 24 = 328.8
- Dowel bar
  57.216 × 24 = 1373.184.

No.

Siphon No. 3

cl. 9.0 × 173.492
9.6 × 146.637
= 2969.143



18
18.

Total length = 320.129 m { 173.492 (Rec)
146.637 (Cir)

- Excavation:

35.445 × 173.492 = 6149.424
39.96 × 146.637 = 5859.615
12009.039

(Cc = 2401.808
Cw = 9607.231

- Concrete

7.35 × 173.492 = 1275.166
10.018 × 146.637 = 1469.009
2744.175

- Leveling concrete

0.39 × 173.492 = 67.662
0.42 × 146.637 = 61.588
129.250

- Steel bar

441 × 173.492 = 76509.972
601.08 × 146.637 = 88140.570
164650.542

- Formwork

F1: 8.0 × 173.492 = 1,387.936
8.6 × 146.637 = 1261.078
2649.014

F3: 8.632 × 173.492 = 1497.583
10.053 × 146.637 = 1474.142
2971.725

No.

- Back fill.

10.455 × 173.492 = 1813.859
11.88 × 146.637 = 1742.048
3555.907

- Gabion.

8.5 × 173.492 = 1474.682
9.1 × 146.637 = 1334.400
2809.082

- B coat.

7.35 × 18 = 132.3
10.018 × 18 = 180.324
312.624

- Waterstop

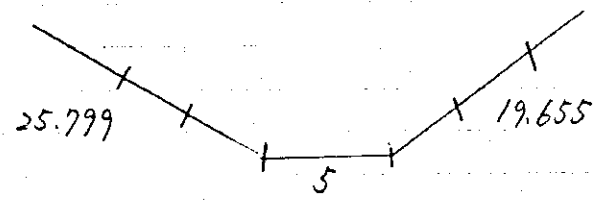
13.7 × 18 = 246.6
14.9 × 18 = 268.2
514.8

- Dowel bar

57.216 × 36 = 2059.776

No.

Siphon No. 4



CL
9.0 × 49.799
= 448.191

Total length = 49.799 m.

- Excavation
  35.445 × 49.799 = 1765.126. (C_c = 353.025, C_w = 1412.101

- Concrete
  7.35 × 49.799 = 366.022

- Leveling concrete
  0.39 × 49.799 = 19.422.

- Steel bar.
  441 × 49.799 = 21961.359

- Formwork
  F1: 8.0 × 49.799 = 398.392
  F3: 8.632 × 49.799 = 429.865

- Backfill
  10.455 × 49.799 = 520.649

- Gabion
  8.5 × 49.799 = 423.292

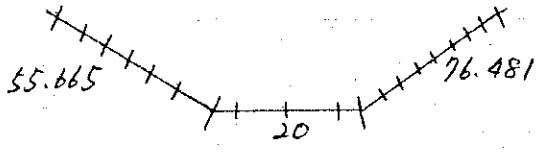
- B. coal.
  7.35 × 6 = 44.1

- Water stop 82.2 m

- Dowel bar 343.296 kg

No.

Siphon. No. 5



19 nov.

9.0 × 152.146 = 1369.314

Total length = 152.146

- Excavation
  35.445 × 152.146 = 5392.815 (Cc = 1078.563 / Cw = 4314.252.
- concrete
  7.35 × 152.146 = 1118.273.
- Leveling.
  0.39 × 152.146 = 59.337
- steel bar.
  441 × 152.146 = 67096.386
- Form work
  F1: 8.0 × 152.146 = 1217.168
  F3: 8.632 × 152.146 = 1313.324.
- Backfill
  10.455 × 152.146 = 1590.686.
- Gabion
  8.5 × 152.146 = 1293.241
- B. coat
  7.35 × .19 = 139.65
- Waterstop
  13.7 × 19 = 260.3
- Dowel bar
  57.216 × 19 = 1087.104

No.

		1'	2	3	4	5
Ex Cc	5667.285	345.270	1488.619	2401.808	353.025	1078.563
Cw	22669.14	1381.079	5954.477	9607.231	1412.101	4314.252
Concrete	6129.879	357.982	1543.427	2744.175	366.022	1118.273
leveling	308.9	18.995	81.896	129.250	19.422	59.337
Re-bar	367792.782	21478.905	92605.59	164650.542	21961.359	67096.386
Form F1	6334.134	389.64	1679.92	2649.014	398.392	1217.168
F3	6947.97	420.422	1812.634	2971.725	429.865	1313.324
Backfill	8371.898	509.211	2195.445	3555.907	520.649	1590.686
Gabion	6724.523	413.993	1784.915	2809.082	423.292	1293.241
Bit.coat	716.874	44.1	176.4	312.624	44.1	139.65
waterstop	1268.3	82.2	328.8	519.8	82.2	260.3
dowel bar	5206.656	343.296	1373.184	2059.776	343.296	1087.104
CQ	7114.963	438.345	1889.91	2969.143	448.191	1369.314

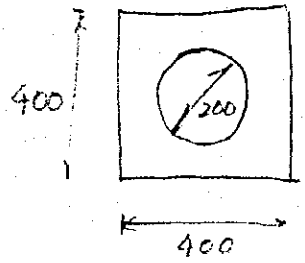
No.

〈 Valve box 〉

- Valve.

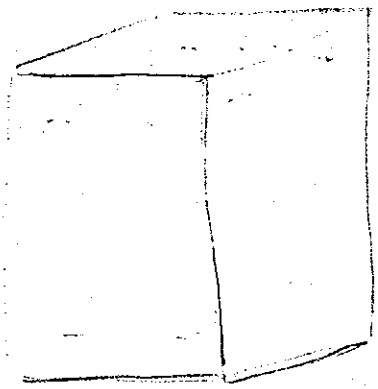
10 kgf/cm² ⟶ 1 unit 140 kg

- Steel pipe Φ200 mm. t = 6mm 31.1 kg/m.



Level 1.8 × 1.8 × 0.1 = 0.324 m³

- Valve box.



concrete

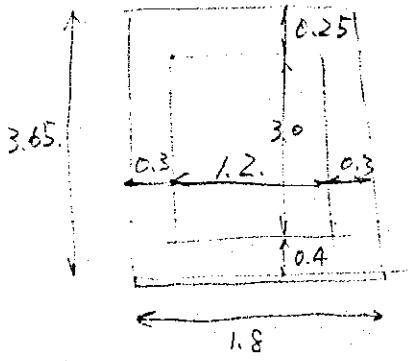
1.8 × 1.8 × 3.65
− 1.2 × 1.2 × 3.0
= 7.506 m³

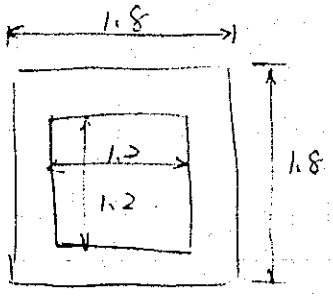
Re-bar.

7.506 × 60 = 450.36 kg

form

1.8 × 3.65 × 4 = 26.28
1.2 × 3.0 × 4 = 14.40
1.2 × 1.2 = 1.44
42.12 m².





No.

- Steel drain pipe , D200 with valve

valve 140 kg.

pipe 31.1 kg/m × 30 m = 933 kg.

1073 kg.

1073 kg × 5 nos = 5,365 kg.

- Valve box.

concrete : 7.506 × 5 nos = 37.53

Leveling : 0.324 × 5 = 1.62.

form : 42.12 × 5 = 210.6

Re bar : 450.36 × 5 = 2251.8

No.

CF:

CROSS DRAINAGE

No.	Quantity ø800	ø1,000	Cut	Concrete	Level	Gravel	Re-bar	F3 ~~F1~~	F1 ~~F3~~	Dwel	Joint	Waterstop
CD-1		47.094	0.000	0.000	16.530	13.186	0.000	0.000	35.791	0.000	0.000	0.000
CD-2	35.228		51.600	0.000	9.124	6.094	0.000	0.000	23.955	0.000	0.000	0.000
CD-3			0.000	142.791	6.490	0.000	11,949.187	275.012	265.801	38.400	9.060	29.000
CD-4			132.300	106.134	5.710	0.000	10,311.099	238.331	235.106	28.800	6.140	23.400
CD-5	49.238		0.000	0.000	12.753	8.518	0.000	0.000	33.482	0.000	0.000	0.000
CD-6			0.000	89.447	4.812	0.000	8,689.903	200.858	198.141	21.600	4.605	17.550
CD-7		63.246	0.000	0.000	22.199	17.709	0.000	0.000	48.067	0.000	0.000	0.000
CD-8			0.000	80.576	4.335	0.000	7,828.109	180.939	178.491	21.600	4.605	17.550
CD-9	38.290		0.000	0.000	9.917	6.624	0.000	0.000	0.000	0.000	0.000	0.000
CD-10			0.000	243.107	8.775	0.000	16,052.875	399.697	357.511	48.000	14.780	38.200
CD-11		32.818	170.625	0.000	11.519	9.189	0.000	0.000	24.942	0.000	0.000	0.000
CD-12			0.000	91.392	4.917	0.000	8,878.950	205.228	202.452	21.600	4.605	17.550
CD-13		60.299	0.000	0.000	21.165	16.884	0.000	0.000	45.827	0.000	0.000	0.000
CD-14		28.534	150.000	0.000	10.016	7.990	0.000	0.000	21.686	0.000	0.000	0.000
CD-15	55.965		0.000	0.000	14.495	9.682	0.000	0.000	38.056	0.000	0.000	0.000
CD-16		39.079	0.000	0.000	13.717	10.942	0.000	0.000	29.700	0.000	0.000	0.000
CD-17			144.000	55.174	2.968	0.000	5,360.228	123.896	122.220	14.400	3.070	11.700
CD-18	32.784		0.000	0.000	8.491	5.672	0.000	0.000	22.293	0.000	0.000	0.000
CD-19			960.000	90.588	4.012	0.000	7,171.884	189.788	169.757	24.000	5.780	18.600
CD-20			64.800	59.035	3.176	0.000	5,735.315	132.566	130.773	14.400	3.070	11.700
CD-21		47.694	132.750	0.000	16.741	13.354	0.000	0.000	36.248	0.000	0.000	0.000
CD-22			135.000	104.938	4.770	0.000	8,781.568	202.109	195.340	28.800	6.795	21.750
CD-23	36.944		134.400	0.000	9.569	6.391	0.000	0.000	25.122	0.000	0.000	0.000
CD-24	32.784		168.000	0.000	8.491	5.672	0.000	0.000	22.293	0.000	0.000	0.000
CD-25			0.000	254.630	9.191	0.000	16,813.751	418.642	374.456	48.000	14.780	38.200
CD-26			0.000	82.586	3.754	0.000	6,911.025	159.058	153.731	19.200	4.530	14.500
CD-27		32.191	552.500	0.000	11.299	9.013	0.000	0.000	24.465	0.000	0.000	0.000
CD-28			540.000	61.625	3.315	0.000	5,986.992	138.383	136.511	14.400	3.070	11.700
total	281.232	350.956	3,335.975	1,462.023	262.250	146.921	120,470.885	2,864.507	3,152.217	343.200	84.890	271.400

4-47

Cr. miscellaneous

No.	Pipe Length	Cut	Gab
CD-1	2.5		
CD-2	1	51.6	25
CD-3	6.8		
CD-4	6.9	132.3	
CD-5	5		
CD-6	6.1		
CD-7	9		
CD-8	2.7		
CD-9	2.4		
CD-10	6.1		
CD-11	1.5	170.625	
CD-12	3.9		
CD-13	4.8		
CD-14	1	150	30
CD-15	2		
CD-16	2.4		
CD-17	1.5	144	30
CD-18	1.2		
CD-19	0.5	960	60
CD-20	1.1	64.8	47
CD-21	1.8	132.75	40
CD-22	1.4	135	30
CD-23	1.2	134.4	50
CD-24	1.6	168	60
CD-25	10		
CD-26	1.2	30	30
CD-27	1.2	552.5	30
CD-28	0.2	540	30
TOTAL	87	3365.975	462

No.

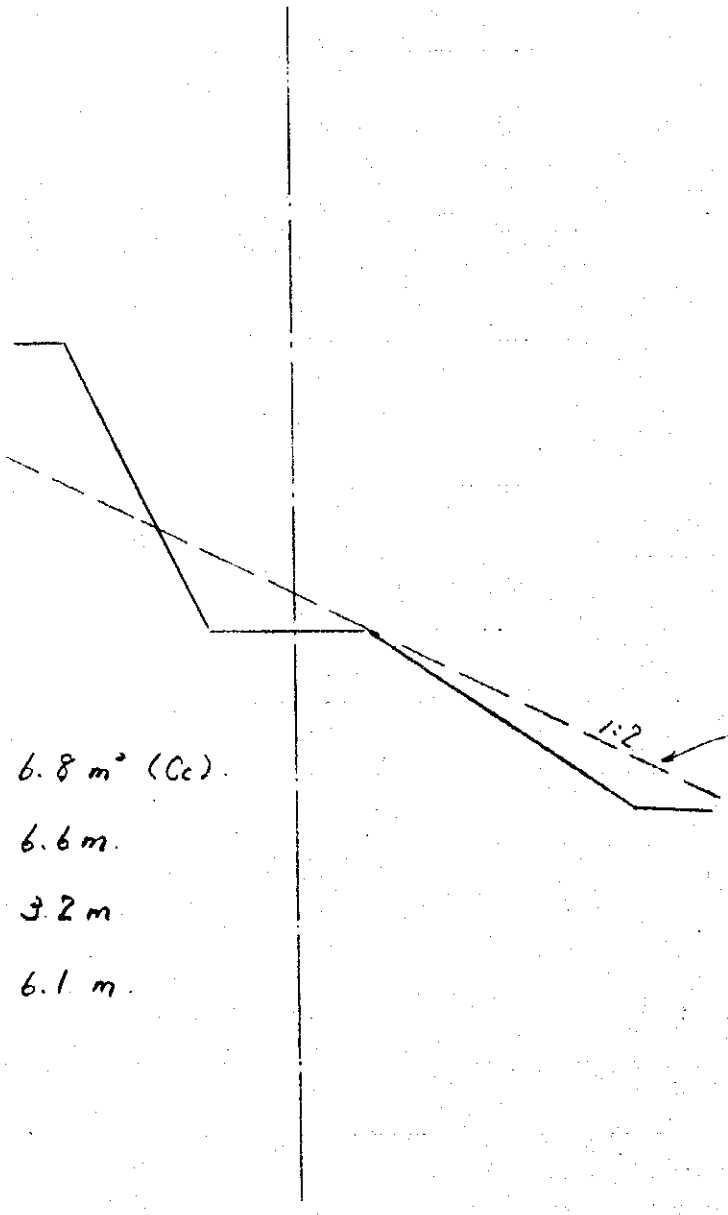
Ai :

ADDITIONAL

INSPECTION ROAD

Additional Inspection Road

TYPICAL CROSS SECTION



/1m	
Excavation	6.8 m³ (Cc).
Clearing	6.6 m.
Sod facing	3.2 m
Land acqusi	6.1 m.

No.

Additional inspection road

No.1	156 m.
No.2	984 m.
No.3	384 m.
No.4	300 m.
No.5	60 m.
No.6	60 m.
Total	1944 m.

Unit			
	Excavation	6.8 m^3 (Cc)	13219.2 m^3
	Clearing	6.6 m.	12830.4 m^2
	Sod facing	3.2 m.	6220.8 m^2
	Land acquisi	6.1 m	11,858.4 m^2

Compacting original ground

$3.0m \times 1.944 m = 5,832 m^2$

graded crushed stone

$3.0m \times 0.15m \times 1.944 m = 874.8 m^3$

No.

Dt :

DITCH

No.

Side ditch I = 1/3.000. n = 0.015

Type A 0.3 × 0.3 Qmax = 0.024 (100%)
= 0.018 (80%).

Qmax 1: ⟶ Area:

$Q = 0.5 \times 211 \times Area^{(km^2)} \times 100/360$

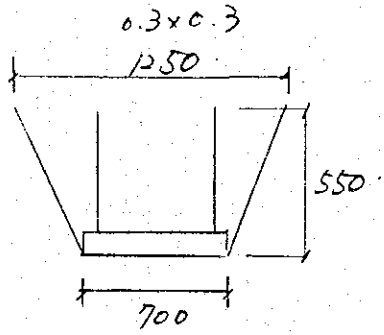
$A = \frac{Q}{0.5 \times 211} \times 360/100$

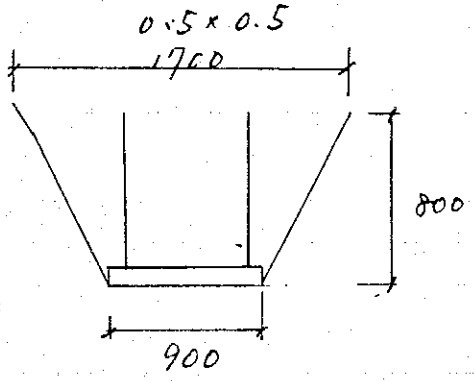
Amax = 0.0008 km²
= 819 m².

width of road = 4.5m

~182 m 0.3 × 0.3.
182m ~ 0.5 × 0.5

~150 m : 0.3 × 0.3.
0.5 × 0.5





Ex = (1.25+0.7) × 0.55 /2
= 2.536 m²

F1 = 0.6
F3 = 0.90

Ex = (1.7+0.9) × 0.8 /2
= 1.04 m².

F1 = 1.0
F3 = 1.3.

Drain Ditch

	B.P.	E.P.	Distance	0.3 X 0.3 Length	Ex.	Concrete	Gravel	F3	F1	0.5 X 0.5 Length	Ex	Conc.	Gravel	F3	F1
RIGHT SIDE															
	0	194	194	180	96.48	32.4	12.6	108	162	14	14.56	3.78	1.89	14	18.2
	269	362	93	93	49.848	16.74	6.51	55.8	83.7	0	0	0	0	0	0
	386	425	39	39	20.904	7.02	2.73	23.4	35.1	0	0	0	0	0	0
	658	750	92	92	49.312	16.56	6.44	55.2	82.8	0	0	0	0	0	0
	958	1,010	52	52	27.872	9.36	3.64	31.2	46.8	0	0	0	0	0	0
	1,058	1,120	62	62	33.232	11.16	4.34	37.2	55.8	0	0	0	0	0	0
	1,970	2,109	139	139	74.504	25.02	9.73	83.4	125.1	0	0	0	0	0	0
	2,186	2,279	93	93	49.848	16.74	6.51	55.8	83.7	0	0	0	0	0	0
	2,410	2,446	36	36	19.296	6.48	2.52	21.6	32.4	0	0	0	0	0	0
	2,487	2,588	101	101	54.136	18.18	7.07	60.6	90.9	0	0	0	0	0	0
	2,649	2,770	121	121	64.856	21.78	8.47	72.6	108.9	0	0	0	0	0	0
	3,088	3,264	176	176	94.336	31.68	12.32	105.6	158.4	0	0	0	0	0	0
	3,518	3,634	116	116	62.176	20.88	8.12	69.6	104.4	0	0	0	0	0	0
	3,753	3,786	33	33	17.688	5.94	2.31	19.8	29.7	0	0	0	0	0	0
	3,823	3,971	148	148	79.328	26.64	10.36	88.8	133.2	0	0	0	0	0	0
	4,002	4,057	55	55	29.48	9.9	3.85	33	49.5	0	0	0	0	0	0
	4,099	4,223	124	124	66.464	22.32	8.68	74.4	111.6	0	0	0	0	0	0
	4,292	4,425	133	133	71.288	23.94	9.31	79.8	119.7	0	0	0	0	0	0
	5,216	5,355	139	139	74.504	25.02	9.73	83.4	125.1	0	0	0	0	0	0
	5,681	5,828	147	147	78.792	26.46	10.29	88.2	132.3	0	0	0	0	0	0
	5,976	6,042	66	66	35.376	11.88	4.62	39.6	59.4	0	0	0	0	0	0
	6,281	6,395	114	114	61.104	20.52	7.98	68.4	102.6	0	0	0	0	0	0

Total 9981

0.3 X 0.3	3094.33	1039.14	404.11	3463.8	5195.7
0.5 X 0.5	368.16	95.58	47.79	354	460.2
Total	3462.49	1134.72	451.9	3817.8	5655.9

Drain Ditch

	B.P.	E.P.	Distance	0.3 X 0.3 Length	Ex.	Concrete	Gravel	F3	F1	0.5 X 0.5 Length	Ex	Conc.	Gravel	F3	F1
LEFT SIDE															
a	0	194	194	180	96.48	32.4	12.6	108	162	14	14.56	3.78	1.89	14	18.2
b	269	453	184	180	96.48	32.4	12.6	108	162	4	4.16	1.08	0.54	4	5.2
c	658	752	94	94	50.384	16.92	6.58	56.4	84.6	0	0	0	0	0	0
d			0	0	0	0	0	0	0	0	0	0	0	0	0
e	891	1,011	120	120	64.32	21.6	8.4	72	108	0	0	0	0	0	0
f	1,048	1,130	82	82	43.952	14.76	5.74	49.2	73.8	0	0	0	0	0	0
g			0	0	0	0	0	0	0	0	0	0	0	0	0
h			0	0	0	0	0	0	0	0	0	0	0	0	0
i	1,375	1,409	34	34	18.224	6.12	2.38	20.4	30.6	0	0	0	0	0	0
j	1,500	1,689	189	180	96.48	32.4	12.6	108	162	9	9.36	2.43	1.215	9	11.7
k			0	0	0	0	0	0	0	0	0	0	0	0	0
l			0	0	0	0	0	0	0	0	0	0	0	0	0
m	1,957	2,114	157	157	84.152	28.26	10.99	94.2	141.3	0	0	0	0	0	0
n	2,181	2,275	94	94	50.384	16.92	6.58	56.4	84.6	0	0	0	0	0	0
o	2,309	2,445	136	136	72.896	24.48	9.52	81.6	122.4	0	0	0	0	0	0
p	2,466	2,608	142	142	76.112	25.56	9.94	85.2	127.8	0	0	0	0	0	0
q	3,310	3,475	165	165	88.44	29.7	11.55	99	148.5	0	0	0	0	0	0
r	3,502	3,653	151	151	80.936	27.18	10.57	90.6	135.9	0	0	0	0	0	0
s	3,681	3,791	110	110	58.96	19.8	7.7	66	99	0	0	0	0	0	0
t	3,825	3,975	150	150	80.4	27	10.5	90	135	0	0	0	0	0	0
u	3,987	4,065	78	78	41.808	14.04	5.46	46.8	70.2	0	0	0	0	0	0
v	4,083	4,262	179	179	95.944	32.22	12.53	107.4	161.1	0	0	0	0	0	0
w	4,278	4,440	162	162	86.832	29.16	11.34	97.2	145.8	0	0	0	0	0	0
x	4,525	4,614	89	89	47.704	16.02	6.23	53.4	80.1	0	0	0	0	0	0
y	4,650	4,903	253	180	96.48	32.4	12.6	108	162	73	75.92	19.71	9.855	73	94.9
z	4,952	5,108	156	156	83.616	28.08	10.92	93.6	140.4	0	0	0	0	0	0
A			0	0	0	0	0	0	0	0	0	0	0	0	0
B	5,208	5,628	420	180	96.48	32.4	12.6	108	162	240	249.6	64.8	32.4	240	312
C	5,676	5,828	152	152	81.472	27.36	10.64	91.2	136.8	0	0	0	0	0	0
D	5,976	6,050	74	74	39.664	13.32	5.18	44.4	66.6	0	0	0	0	0	0
E	6,081	6,250	169	169	90.584	30.42	11.83	101.4	152.1	0	0	0	0	0	0
F	6,275	6,395	120	120	64.32	21.6	8.4	72	108	0	0	0	0	0	0
		total	3854												

4-27

Drain Ditch for Ai

	Distance	0.3 X 0.3 Length	Excavatio	Concrete	Gravel	F3	F1
1	156	156	83.616	28.08	10.92	93.6	140.4
2	984	984	527.424	177.12	68.88	590.4	885.6
3	384	384	205.824	69.12	26.88	230.4	345.6
4	300	300	160.8	54	21	180	270
5	60	60	32.16	10.8	4.2	36	54
6	60	60	32.16	10.8	4.2	36	54
Total	1944		1041.98	349.92	136.08	1166.4	1749.6

99-4

Drain Ditch for Siphon

		0.3 X 0.3							0.5 X 0.5					
	Distance	Length	Excavatio	Concrete	Gravel	F3	F1		Length	Excavatio	Concrete	Gravel	F3	F1
1	25	50	26.8	9	3.5	30	45		25	26	6.75	3.375	25	32.5
2	102	104	55.744	18.72	7.28	62.4	93.6		102	106.08	27.54	13.77	102	132.6
3	346	346	185.456	62.28	24.22	207.6	311.4		0	0	0	0	0	0
4	28	56	30.016	10.08	3.92	33.6	50.4		28	29.12	7.56	3.78	28	36.4
5	116	116	62.176	20.88	8.12	69.6	104.4		0	0	0	0	0	0
617	Total		360.192	120.96	47.04	403.2	604.8							
			161.2	41.85	20.925	155	201.5							
	Total		521.392	162.81	67.965	558.2	806.3							

Drain Ditch to Cross drainage

				0.3 X 0.3							0.5 X 0.5					
	B.P.	E.P.	Distance	Length	Excavatio	Concrete	Gravel	F3	F1		Length	Excavatio	Concrete	Gravel	F3	F1
1			77	77	41.272	13.86	5.39	46.2	69.3		0	0	0	0	0	0
2			0	0	0	0	0	0	0		0	0	0	0	0	0
3			55	55	29.48	9.9	3.85	33	49.5		0	0	0	0	0	0
4			125	125	67	22.5	8.75	75	112.5		0	0	0	0	0	0
5			0	0	0	0	0	0	0		0	0	0	0	0	0
6			60	60	32.16	10.8	4.2	36	54		0	0	0	0	0	0
7			131	131	70.216	23.58	9.17	78.6	117.9		0	0	0	0	0	0
8			0	0	0	0	0	0	0		35	36.4	9.45	4.725	35	45.5
9			0	0	0	0	0	0	0		0	0	0	0	0	0
10			51	51	27.336	9.18	3.57	30.6	45.9		0	0	0	0	0	0
11			71	71	38.056	12.78	4.97	42.6	63.9		0	0	0	0	0	0
12			45	45	24.12	8.1	3.15	27	40.5		0	0	0	0	0	0
13			27	27	14.472	4.86	1.89	16.2	24.3		0	0	0	0	0	0
14			27	27	14.472	4.86	1.89	16.2	24.3		0	0	0	0	0	0
15			84	84	45.024	15.12	5.88	50.4	75.6		0	0	0	0	0	0
16			14	14	7.504	2.52	0.98	8.4	12.6		0	0	0	0	0	0
17			53	53	28.408	9.54	3.71	31.8	47.7		0	0	0	0	0	0
18			46	46	24.656	8.28	3.22	27.6	41.4		0	0	0	0	0	0
19			25	25	13.4	4.5	1.75	15	22.5		0	0	0	0	0	0
20			42	42	22.512	7.56	2.94	25.2	37.8		0	0	0	0	0	0
21			78	78	41.808	14.04	5.46	46.8	70.2		0	0	0	0	0	0
22			92	92	49.312	16.56	6.44	55.2	82.8		0	0	0	0	0	0
23			15	15	8.04	2.7	1.05	9	13.5		0	0	0	0	0	0
24			40	40	21.44	7.2	2.8	24	36		0	0	0	0	0	0
25			0	0	0	0	0	0	0		0	0	0	0	0	0
26			0	0	0	0	0	0	0		23	23.92	6.21	3.105	23	29.9
1158			1158	1158	620.688	208.44	81.06	694.8	1042.2							
				58	60.32	15.66	7.83	58	75.4							
TOTAL			1216	681.008	224.1	88.89	752.8	1117.6								

No.....

P6:

PEDESTRIAN

BRIDGE.

No.

Pedestrian Bridge.

1. Fence ..... 13 kg/m

2 bearing pad. 4 nos / 1 bridge. × 11 bridge = 44 nos.

3. handrail. 1087 kg / ~~34.2~~ 68.4 m = 31.784 = 15.892 kg/m.

both side of bridge = 20m.

∴ ~~635.68~~ 317.836 kg.

× 11 = ~~6992.48~~ 3496.199.

Fence.

No.....

Pedestrian bridge

1) concrete volume slab and girders

girder : $0.35 \times 0.4 \times 10.32 \times 2\text{nos} = 2.890$

slab : $0.1 \times 2.4 \times 10.32 = 2.477$

中バリ $0.85 \times 0.3 \times 0.2 \times 3\text{nos} = 0.153$

コウブン : $0.2 \times 0.15 \times 10.32 \times 2\text{nos} = 0.619$

$6.139\ m^3$

2) Reinforcement

concrete $1m^3$ につき 80 kg とする.

$80 \times 6.139 = 491.12\ kg$

3) Formwork

1. $0.25 \times 10.32 \times 2 = 5.16$
2. $0.425 \times 10.32 \times 2 = 8.772$
3. $0.4 \times 10.32 \times 2 = 8.256$
4. $0.3 \times 9.72 \times 2 = 5.832$
5. $0.85 \times 9.72 \times 2 = 16.524$
6. $0.85 \times 0.2 \times 3 = 0.51$
7. $0.15 \times 10.32 \times 2 = 3.096$
8. $0.85 \times 0.3 \times 6 = 1.53$
9. $0.35 \times 10.32 \times 2 = 7.224$

56.904

No.

4) Joint filler.

girder $0.35 \times 0.4 \times 2 = 0.28$

フィレ $0.85 \times 0.3 = 0.255$

$0.535 \ m^2$

5) concrete volume (abutment)

$0.2 \times 0.4 \times 2.4 \times 2$
$0.7 \times 1.3 \times 2.4 \times 2$
$0.3 \times 1.1 \times 2.4 \times 2$

$= 6.336 \ m^3$

6) Leveling concrete.

$0.1 \times 1.1 \times 2.4 \times 2 = 0.528 \ m^3$

7) Gravel bedding.

$0.2 \times 1.1 \times 2.4 \times 2 = 1.056 \ m^3$

8) form work.

$(1.7 + 0.4 + 1.3 + 0.3 \times 2) \times 2.4 \times 2 = 19.2 \ m^2$

9) Anchor bar.

6.31 kg/m

D32 × 900 mm × 4 nos × 11 set = 39.6 m → 249.876

steel pipe 60A × 450 mm × 4 × 11 set = 19.8 m → 65.34 kg.

3.3 kg/m

315.216 kg

5. Tunel

Tunnel

5.1 Tunel

Tunnel

Working Division: DAULE PERIPA ~ LA ESPERANZA DIVERSION TUNNEL

Description	Calculation Details	Unit	Quantity	Remarks
2.2	EARTHWORKS			
101	Clearing the site for the inlet and outlet structures			
	A = 3,447.2 + 3,697.3 = 7,144.5	m^2	7,145	
102	Open cut excavation, in common			
	V = 6,020.6 + 4,092.9 + 600 = 10,713.5 m^3	m^3	10,714	
103	Open cut excavation, in weathered rock			
	V = 18,866.5 + (3,975.1 × 0.9) = 22,444.1 m^3	m^3	22,444	
104	Open cut excavation, in rock			
	V = 3,975.1 × 0.1 = 397.5 m^3	m^3	398	

Daure Peripa - La Esperanza Diversion Tunnel(Conguillo Inlet)

Sec No	Dis.(m)	2.2/01 Clearing			2.2/02 Common		
		Length(m)	Mean(m)	Area(m2)	Sec.area(m2)	Mean(m2)	Volume(m3)
0		0			0		
	11.5		31	356.5		56.3	647.5
1		62			112.6		
	7.5		60.75	455.6		112.7	845.3
2		59.5			112.8		
	6.5		60.55	393.6		109.7	713.1
3		61.6			106.6		
	20		60.3	1206.0		107.9	2158.0
4		59			109.2		
	19		54.5	1035.5		87.2	1656.8
5		50			65.2		
			Total	3447.2		Total	6020.6

Sec No	Dis.(m)	2.2/03 Weathered rock			2.2/13 Sod facing		
		Sec.area(m2)	Mean(m2)	Volume(m3)	Length(m)	Mean(m)	Area(m2)
0		0			0		
	11.5		165.4	1902.1		2.15	24.7
1		330.8			4.3		
	7.5		396.3	2972.3		4.3	32.3
2		461.8			4.3		
	6.5		472.3	3070.0		4.35	28.3
3		482.8			4.4		
	20		396.2	7924.0		4.4	88.0
4		309.6			4.4		
	19		157.8	2998.2		21.2	402.8
5		6			38		
			Total	18866.5		Total	576.1

Sec No	Dis.(m)	2.3/20 Shotcrete		
		Length(m)	Mean(m)	Area(m2)
0		0		
	11.5		22.25	255.9
1		44.5		
	7.5		40.05	300.4
2		35.6		
	6.5		34.8	226.2
3		34		
	20		29.8	596.0
4		25.6		
	19		13.8	262.2
5		2		
			Total	1640.7

Daure Peripa - La Esperanza Diversion Tunnel(Membrillo Outlet)

Sec No	Dis.(m)	2.2/01 Clearing			2.2/02 Common		
		Length(m)	Mean(m)	Area(m2)	Sec.area(m2)	Mean(m2)	Volume(m3)
0		0			0		
	12.5		26.9	336.3		49.1	613.8
1		53.8			98.2		
	25		51.9	129.8		91.9	229.8
2		50			85.6		
	4.75		45	213.8		78.4	372.4
3		40			71.2		
	10		38	380.0		53.7	537.0
4		36			36.2		
	25		21.5	537.5		21.6	540.0
5		7			7		
	300		7	2100.0		6	1800.0
6		7			5		
			Total	3697.3		Total	4092.9

Sec No	Dis.(m)	2.2/03 Weathered rock			2.2/13 Sod facing		
		Sec.area(m2)	Mean(m2)	Volume(m3)	Length(m)	Mean(m)	Area(m2)
0		0			0		
	12.5		92	1150.0		2.65	33.1
1		184			5.3		
	2.5		163	407.5		5.55	13.9
2		142			5.8		
	4.75		167.55	795.9		6.55	31.1
3		193.1			7.3		
	10		115.3	1153.0		9.4	94.0
4		37.5			11.5		
	25		18.75	468.8		5.75	143.8
5		0			0		
	300		0	0.0		0	0.0
6		0			0		
			0	0.0		0	0.0
7		0			0		
			Total	3975.1		Total	315.9

Sec No	Dis.(m)	2.3/20 Shotcrete		
		Length(m)	Mean(m)	Area(m2)
0		0		
	12.5		9.55	119.4
1		19.1		
	2.5		18.6	46.5
2		18.1		
	4.75		25.1	119.2
3		32.1		
	10		23.8	238.0
4		15.5		
	25		7.75	193.8
5		0		
	300		0	0.0
6		0		
			Total	716.9

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
105	Under ground excavation, all classes, in tunnel and inlet structure			
	Inlet tunnel			
	$A_1 = 6.1^2 \times \pi \times 1/4 = 29.225 m^2$			
	$V_1 = 29.225 \times (14.98 - 1.0) = 408.6 m^3$			
	$A_2 = 6.5^2 \times \pi \times 1/4 = 33.183 m^2$			
	$V_2 = 33.183 \times 1.0 = 33.2 m^3$			
	Inlet shaft			
	$A_1 = (17.25^2 \times \pi \times 16.260205°/360° - \tan 16.260205° \times 8.0 \times 8.0 \times 1/2) \times 4 + (7.867^2 \times \pi \times 147.47959°/360°) \times 2$			
	$= 290.864 m^2$			
	$V_1 = 290.864 \times (EL.89.9 - EL.64.831) + 290.864/2 \times (EL.64.831 - EL.63.7)$			
	$= 7,456.2 m^3$			
	$V_2 = 7.7 \times 13.9 \times (EL.63.7 - EL.54.331) + 6.45 \times 13.9 \times (EL.64.831 - EL.63.7) + 2.7 \times 1.0 \times 3.7 = 1,114.2 m^3$			
	Tunnel transition part (L=10.0m)			
	$V_1 = 6.2 \times 6.05 \times 1.0 = 37.5 m^3$			
	$V_2 = \{5.8 \times 5.65 + (5.8^2 \times \pi/8 + 5.8 \times 2.75)\} \times 1/2 \times 9.0 = 278.7 m^3$			

4-14

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Tunnel type II (L=7.665.828m)			
	Excavation area : A= 18.617m²			
	V = 18.617 x 7.665.828 = 142.714.7m³			
	Tunnel type IV (L= 610.0m)			
	Excavation area : A= 18.651 m²			
	V = 18.651 x 610.0 = 11,377.1m³			
	Tunnel outlet part (L=10.0m)			
	V= (5.1²xπx 1/8 + 5.1x2.45) x10.0			
	= 227.1 m³			
	Total volume			
	V = 408.6+33.2+7,456.2+1,114.2			
	+ 37.5 + 278.7+ 142,714.7			
	+ 11,377.1+ 227.1 = 163,647.3m³	m³	163,647	
106	Trench excavation, all classes,			
	for drain ditch, catch basin			
	and foundation of wire net			
	fence			
	Drain ditch (Conguillo inlet)			
	v=(1.29+0.9)/2x0.65 x 105.0m			
	= 74.7 m³			
	Catch basin (Conguillo inlet)			
	v= 1.3x1.3x1.05 = 1.8m³			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Foundation of wire net fence			
	$V = (0.45 \times 0.45 + 0.75 \times 0.75)/2 \times 0.5$			
	$\times 6 = 1.1\ m^3$			
	Drain ditch (Membrillo outlet)			
	$V = (1.29 + 0.9)/2 \times 0.65 \times 60.0$			
	$= 42.7\ m^3$			
	Catch basin (Membrillo outlet)			
	$V = 1.3 \times 1.3 \times 1.05 = 1.8\ m^3$			
	Total volume			
	$V = 74.7 + 1.8 + 1.1 + 42.7 + 1.8$			
	$= 122.1\ m^3$	m^3		122
107	Permanent steel support,			
	H-125 x 125, in inlet structure			
	and tunnel			
	H-125 x 125 x 6.5 x 9 : 23.8 kg/m			
	PL-200 x 170 x 12 : 3.203 kg/no			
	PL-200 x 200 x 12 : 3.768 kg/no			
	Connection bolt D.19mm : 3.12 kg/no			
	Inlet tunnel			
	$W = (5.775 \times \pi \times 23.8 + 3.203 \times 4 + 3.12 \times 2) \times 12$			
	$= 5,410$ kg			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Tunnel			
	W = (11.36m x 23.8 + 3.203x2 + 3.768 x2 + 3.12x2) x (10 + 610 + 10)/1.2 = 152,539			
	Total weight			
	W = 5,410 + 152,539 = 157,949 kg	ton	158	
108	Permanent steel support in inlet shaft, H-300x300x10x15			
	H-300x300x10x15 : 94.0 kg/m			
	R-400x400x15 : 18.84 kg/no.			
	Connection bolt D25mm : 6.6 kg/no			
	W = {(17.0x2xπx16.260205°/360° x 4 + 8.667x2xπx147.47959°/360° x 2) x 94.0 + 18.84x12 + 6.6x10} x 13 = 81,902 kg	ton	82	
109	D.25 mm rock bolts			
	Inlet tunnel			
	l = 8x2.0x6 + 9x2.0x6 = 204.0m			
	Inlet shaft			
	l = 22x3.0x7 + 18x3.0x2 + 12x3.0 x3 = 678.0m			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Tunnel			
	$l = 9 \times 2.0 \times 3.456 + 8 \times 2.0 \times 3.456$			
	$= 117.504\,m$			
	Total length			
	$L = 204 + 678 + 117.504 = 118.386$	m	118.386	
110	Backfilling for inlet and outlet structures and anchor block of trash boom			
	Drain ditch and catch basin			
	$V_1 = \{(1.29+0.9)/2 \times 0.65 - 0.7 \times 0.65\}$			
	$\times 105.0 = 27.0\,m^3$			
	$V_2 = \{(1.29+0.9)/2 \times 0.65 - 0.7 \times 0.65\}$			
	$\times 60.0 = 15.4\,m^3$			
	Foundation of wire net fence			
	$V = \{(0.45 \times 0.45 + 0.75 \times 0.75)/2 \times 0.5$			
	$- 0.25 \times 0.25 \times 0.5\} \times 6 = 0.96$			
	Anchor block of trash boom			
	$V = \{(6.0 \times 6.0 + 10.0 \times 10.0)/2 \times 4.0$			
	$- 5.0 \times 5.0 \times 4.0\} \times 2 = 344\,m^3$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Total volume			
	$V = 27.0 + 15.4 + 0.96 + 344.0$			
	$= 387.4$	m^3	387	
111	Gravel surfacing for inlet structure			
	$V = (983 + 50) \times 0.1 = 103.3$	m^3	103	
112	Gravel bedding			
	Drain ditch & catch basin			
	$V = 0.8 \times 0.12 \times \{(105.0 + 60.0) \times 0.2\}$			
	$+ 1.2 \times 1.2 \times 0.15 = 3.4$	m^3	4	
113	Sod facing for inlet and outlet structure			
	$A = 576.1 + 315.9 = 892.0$	m^2	892	

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
2.3	DRILLING AND GROUTING WORKS			
101	D.45 mm drain holes in tunnel			
	(including drilling length of lining concrete and shotcrete)			
	Required number N = 8,296/5.0 x 2 = 3,320 nos			
	L = 3,320 x (1.5+0.3+0.1) = 6,308	m	6,308	
102	Backfill grouting			
	Inlet tunnel V_1 = 5.8 x π x 120°/360° x 0.03 x 14.98 = 2.73 m³			
	Inlet tunnel plug V2 = 4.6 x π x 120°/360° x 0.03 x (10.0 + 14.98 + 1.0) = 3.75 m³			
	Tunnel v = 4.5 x π x 120°/360° x 0.03 x 8,296 = 1,172.82 m³			
	Total volume V = 2.73 + 3.75 + 1,172.82 = 1,179.3	m³	1,180	

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
103	D.50mm steel pipes for backfill grouting			
	Inlet tunnel			
	$W_1 = 0.6m \times 5.31 kg/m \times 4 = 12.74 kg$			
	Plug			
	$W_2 = (10 + 14.98 + 1.0 + 1.0) \times 5.31 \times 3 = 429.79 kg$			
	Tunnel			
	$n = 8.296/5 \doteqdot 1660$			
	$W = 1,660 \times 0.4 \times 5.31 = 3,525.84$			
	Total weight			
	$W = 12.74 + 429.79 + 3,525.84 = 3,968.37 kg$	kg	3,968	
104	Contact grouting for concrete plug (Cement weight)			
	$W = 20 kg/m \times 26m = 520 kg$	kg	520	
105	D.40mm steel pipes for contact grouting			
	Supply and return pipe			
	Required length			
	$L = 26.0 \times 4 nos + 5.0 \times 4 = 124.0m$			

11-1-5

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Air vent pipe			
	Required length			
	$L = 26.0 + 2.0 + 0.3 \times 4 = 29.2\,m$			
	Weight			
	$W = (124.0 + 29.2) \times 3.89\,kg/m = 595.9\,kg$	kg	596	
106	D.25 mm steel pipes for contact grouting			
	Required length			
	$L = (9.5 + 0.3 \times 5) \times 4 \times 2.43\,kg/m$			
	$= 106.92\,kg$	kg	107	

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
2.4	CONCRETE WORKS			
101	Concrete, class A, for blockout concrete of inlet structure			
	Blockout concrete in partition wall (secondary concrete to be placed arround steel pipes)			
	$V_1 = 2.5 \times 2.5 \times 1.0 \times 2 + 1.4 \times 1.3 \times 1.0$			
	$= 14.32\ m^3$			
	Foundation concrete for valves			
	$V = 1.5 \times 0.6 \times 1.4 \times 4 = 5.04\ m^3$			
	Corner buffer $V = 1.267 \times 4 \times 2 = 10.14\ m^3$			
	Total volume			
	$V = 14.3 + 5.0 + 10.14 = 29.7$	m^3	30	
102	Concrete, class C, for floor slab, beam and stair of inlet structure			
	Floor slab and beam at EL.90.2m			
	$V_1 = (7.867^2 \times \pi \times 133.3168°/360° - 1.3 \times 2.977) \times 0.3 = 20.44\ m^3$ (Floor)			
	$V_2 = \{(15.1 + 16.4)/2 \times 4.1 \times 2 - 0.4 \times 4.1 \times -3.0 \times 3.0 \times 2 - 3.5 \times 3.5 \times 2\} \times 0.2$			
	$+ 0.15 \times 0.1 \times 3.15 \times 4 \times 2 + 0.15 \times 0.1 \times 3.65 \times 4 \times 2 = 15.52\ m^3$ (Floor)			

E1-1-13

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	$V3 = (7.867^2 \times \pi \times 133.3168°/360° - 1.0 \times 1.0 \times 2) \times 0.2 = 14.00\ m^3$ (Floor)			
	Beam			
	$V4 = 0.9 \times 1.2 \times 16.4 + 1/2 \times 0.6 \times 0.3 \times 1.0 \times 2$			
	$= 17.89\ m^3$			
	Beam			
	$V5 = (0.9 \times 1.2 \times 14.802 + 1/2 \times 0.6 \times 0.3 \times 1.0 \times 2) \times 2$			
	$= 32.33\ m^3$			
	Beam			
	$V6 = 0.4 \times 0.55 \times 4.1 \times 8 = 7.22\ m^3$			
	Subtotal			
	$V = 20.44 + 15.52 + 14.00 + 17.89 + 32.33 + 7.22 = 107.40\ m^3$			
	Floor slab and beam at EL. 82.0m			
	Floor			
	$V1 = (7.667^2 \times \pi \times 132.0237°/360° - 1.3 \times 2.713) \times 0.2 = 12.84\ m^3$			
	Floor			
	$V2 = 7.667^2 \times \pi \times 132.0237°/360° \times 0.2 = 13.55\ m^3$			
	Floor			
	$V3 = \{(16.4 + 14.68)/2 \times 4.1 \times 2 - 3.0 \times 3.0 \times 2 - 3.5 \times 3.5 \times 2\} \times 0.2 = 16.99\ m^3$			
	Beam			
	$V4 = 0.9 \times 1.2 \times 16.0 + 1/2 \times 0.6 \times 0.3 \times 1.0 \times 2$			
	$= 17.46\ m^3$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Beam			
	$V5 = (0.9 \times 1.2 \times 14.376 + 1/2 \times 0.6 \times 0.3 \times 1.0 \times 2)$			
	$\times 2 = 31.41 m^3$			
	Subtotal			
	$V = 12.84 + 13.55 + 16.99 + 17.46 + 31.41$			
	$= 92.25 m^3$			
	Floor slab and beam at EL.74.0m			
	Floor			
	$V1 = (7.667^2 \times \pi \times 132.0237°/360° - 1.3 \times 2.713)$			
	$\times 0.2 = 12.84 m^3$			
	Floor			
	$V2 = (7.667^2 \times \pi \times 132.8404°/360° - 1.0^2 \times \pi/8$			
	$- 0.3 \times 1.0) \times 0.2 = 13.49 m^3$			
	Floor			
	$V3 = \{(15.97 + 14.68)/2 \times 3.55 - 3.0 \times 3.0 \times 2\}$			
	$\times 0.2 = 7.28 m^3$			
	Floor			
	$V4 = \{0.85 \times 4.6 \times 0.55 + 0.9 \times 3.5 \times 0.2$			
	$+ 0.3 \times 3.5 \times 0.2 + (2.75 + 2.07)/2 \times 4.6 \times 0.2$			
	$- 0.8 \times 0.85 \times 0.2\} \times 2 = 10.14 m^3$			
	Ditch			
	$V5 = 0.2 \times 0.1 \times (56.062 - 1.0 \times 2 - 3.3)$			
	$= 1.02 m^3$			
	Beam			
	$V6 = 0.9 \times 14.376 \times 1.2 + 0.6 \times 0.3 + 0.8 \times 1.0 \times 13.376 +$	$0.4 \times$	$0.55 \times 4.6 \times 2$	$= 28.43 m^3$

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Subtotal			
	$v = 12.84 + 13.49 + 7.28 + 10.14 + 1.02$			
	$+ 28.43 = 73.2 m^3$			
	Stair			
	$V_1 = \{(0.15 + 0.35)/2 \times 0.25 + (0.15 + 0.35)/2$			
	$\times 0.295\} \times 1/2 \times 1.2 \times 40 + (1.0 + 1.180)/2$			
	$\times 1.2 \times 0.2 + 3.8 \times 0.2 \times 1.5 = 4.67 m^3$			
	$V_2 = \{(0.15 + 0.35)/2 \times 0.25 + (0.15 + 0.35)/2$			
	$\times 0.295\} \times 1/2 \times 1.2 \times 39 + (1.0 + 1.180)/2$			
	$\times 1.2 \times 0.2 + 3.8 \times 0.2 \times 1.5 = 4.59 m^3$			
	$V_3 = \{(0.15 + 0.35)/2 \times 0.25 + (0.15 + 0.35)/2$			
	$\times 0.295\} \times 1/2 \times 1.2 \times 18 = 1.47 m^3$			
	Subtotal			
	$v = 4.67 + 4.59 + 1.47 = 10.73 m^3$			
	Total volume of Item 2.4/02			
	$V = 107.40 + 92.25 + 73.20 + 10.73$			
	$= 283.58 m^3$	m^3		284
103	Concrete, class D, for inlet			
	structure			
	Inlet tunnel			
	$V = (5.8^2 \times \pi \times 1/4 - 4.6^2 \times \pi \times 1/4) \times 13.98$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	$+(6.0^2\times\pi\times1/4-4.6^2\times\pi\times1/4)\times1.0$			
	$=148.68m^3$			
	Inlet shaft			
	$V1=\{(17.1^2\times\pi\times16.2602°/360°-16.2^2\times\pi\times16.2602°$			
	$/360°)\times4+(8.767^2\times\pi\times147.4796°/360°-7.867^2$			
	$\times\pi\times147.4796°/360°)\times2\}\times(EL.90.2-EL.82.0)$			
	$=455.47m^3$			
	$V_2=\{(17.1^2\times\pi\times16.2602°/360°-16.0^2\times\pi\times16.2602°$			
	$/360°)\times4+(8.767^2\times\pi\times147.4796°/360°-7.667^2$			
	$\times\pi\times147.4796°/360°)\times2\}\times(EL.82.0-EL.66.031)$			
	$=1,073.07m^3$			
	$V3=\{(17.1^2\times\pi\times16.2602°/360°-16.0^2\times\pi\times16.2602°$			
	$/360°)\times2+(8.767^2\times\pi\times147.4796°/360°-7.667^2$			
	$\times\pi\times147.4796°/360°)\times1\}\times(EL.66.031-EL.64.9)$			
	$=38.00m^3$			
	$V4=\{(17.1^2\times\pi\times16.2602°/360°-1/2\times8.0\times2.333)$			
	$\times4+8.767^2\times\pi\times147.4796°/360°\times2\}$			
	$\times1.2-5.2\times5.2\times1.2\times2-1.5\times1.5\times1.0$			
	$=324.63m^3$			
	$V5=1.0\times16.0\times(74.0-64.9)+(1.0\times5.7$			
	$+0.5^2\times\pi\times1/2)\times(74.0-66.031)$			
	$=194.15m^3$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	$V6 = 1.0 \times 5.2 \times (64.831 - 55.631) \times 3$			
	$+ 1.0 \times 13.6 \times (64.831 - 55.631)$			
	$+ 1.0 \times 13.6 \times (63.7 - 55.631) + 13.6 \times 7.4$			
	$\times 1.3 + 2.6 \times 2.8 \times 1.0 = 516.49 m^3$			
	Tunnel			
	$V7 = 4.6^2 \times \pi \times 1/4 \times 1.1 + 3.7 \times 3.7 \times 1.1$			
	$= 33.34 m^3$			
	Total volume			
	$V = 148.68 + 455.47 + 1,073.07 + 38.00$			
	$+ 324.63 + 194.15 + 516.49 - 33.34$			
	$= 2,717.15$	m^3	2,717	
104	Concrete, class D, for tunnel lining			
	Transition part			
	$V = (5.9 \times 5.9 - 3.7 \times 3.7) \times 1.0 + \{(5.5$			
	$\times 5.5 - 3.7 \times 3.7) + (5.5^2 \times \pi \times 1/8 + 5.5 \times 2.75$			
	$- 3.3173 \times 1.85^2\} \times 1/2 \times 9.0 = 166.07 m^3$			
	Tunnel type II ($A = 6.086 m^2$)			
	$V = 6.086 \times 7.665.828 = 46,654.23$			
	Tunnel type IV ($A = 6.117 m^2$)			
	$V = 6.117 \times 610 = 3,731.37 m^3$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Tunnel outlet part			
	$V = (4.9^2 \times \pi \times 1/8 + 4.9 \times 2.45) \times 10.0$			
	$- (3.3173 \times 1.85^2 + 1.85^2 \times \pi \times 1/2 + 1.85$			
	$\times 3.7) \times 1/2 \times 10 = 96.46 m^3$			
	Total volume			
	$V = 166.07 + 46.654.23 + 3.731.37$			
	$+ 96.46 = 50,648.13$	m^3	50.648	
105	Concrete, class E, for concrete facing walls of inlet and outlet structures			
	Facing wall at Membrillo outlet			
	$V_1 = (9.871 + 4.371)/2 \times 5.5 \times 0.335$			
	$+ (20.871 + 14.871)/2 \times 4.0 \times 0.335$			
	$= 37.07 m^3$			
	$V_2 = (12.75 + 10.0)/2 \times 5.5 \times 0.335$			
	$+ (5.75 + 5.0)/2 \times 5.5 \times 0.335 + (6.149$			
	$+ 5.657)/2 \times 5.0 \times 0.3 = 39.72 m^3$			
	$V_3 = 3.7 \times 0.5 \times 10 = 18.5 m^3$			
	Total volume			
	$V = 37.07 + 39.72 + 18.5 = 95.29$	m^3	96	
106	Concrete, class F, for drain ditch and catch basin			

5-1-4

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Conguillo inlet, drain ditch			
	$V = (0.7 \times 0.62 - 0.5 \times 0.5) \times 105.0$			
	$+ 0.6 \times 0.1 \times 7.0 = 19.74\ m^3$			
	Conguillo inlet, catch basin			
	$V = (1.1 \times 1.1 \times 1.0 - 0.8 \times 0.8 \times 0.8) \times 1$			
	$= 0.70\ m^3$			
	Membrillo outlet, drain ditch			
	$V = (0.7 \times 0.62 - 0.5 \times 0.5) \times 60.0$			
	$+ 0.6 \times 0.1 \times 7.0 = 11.46\ m^3$			
	Membrillo outlet, catch basin			
	$V = (1.1 \times 1.1 \times 1.0 - 0.8 \times 0.8 \times 0.8) \times 1$			
	$= 0.70$			
	Total volume			
	$V = 19.74 + 0.7 + 11.46 + 0.7 = 32.6$	m^3		33
107	Concrete, class G, for plug			
	and secondary concrete			
	Plug			
	$V = (4.6^2 \times \pi \times 1/4 - 1.4^2 \times \pi \times 1/4 \times 2$			
	$- 0.8^2 \times \pi \times 1/4) \times (10 + 14.98 + 1.0)$			
	$= 338.72\ m^3$			
	Secondary concrete			
	$V_1 = \{(16.0^2 \times \pi \times 16.2602°/360° - 1/2 \times 8.0 \times 2.333)$			

←1-20

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	$\times 2 + (7.667^2 \times \pi \times 147.4796°/360°) \times 1$			
	$- 11.4 \times 4.3 - 1.4^2 \times \pi \times 1/4 \times 4.999 \times 2$			
	$- 0.8^2 \times \pi \times 1/4 \times 4.992 - 1.0 \times 16.0\}$			
	$\times (70.231 - 64.9) = 249.07\,m^3$			
	$V_2 = \{(16.0^2 \times \pi \times 16.2602°/360° - 1/2 \times 8.0$			
	$\times 2.333) \times 2 + (7.667^2 \times \pi \times 147.4796°/360°)$			
	$\times 1 - 6.2 \times 11.4 - (11.4 + 3.7)/2 \times 2.696$			
	$- 3.7 \times 1.104\} \times (70.231 - 66.031)$			
	$= 144.99\,m^3$			
	Total volume			
	$V = 338.72 + 249.07 + 144.99 = 732.78\,m^3$	m^3	733	
108	Concrete, class G, for anchor block of trash boom and foundation concrete of wire net fence			
	Anchor block			
	$V = 5.0 \times 5.0 \times 4.0 \times 2 = 200\,m^3$			
	Foundation concrete			
	$V = 0.25 \times 0.25 \times 0.5 \times 6 = 0.19$			
	Total volume			
	$V = 200 + 0.19 = 200.19$	m^3	201	