2.8 ACCESS ROAD

2.8.1 Summary

Earth Works

Road	Length (m)	Excavation (m2)	Embankment			Stripping (m)	Base (m2)	Subbase (m2)	Hot Asphalt Surface (m2)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)				
Left Bank Access Road	858.0	18,900	100	180	160	10,700	430	1,500	3,600
Access Road to Hydropower Station	656.5	57,400	10	200	1,000	17,700	350	1,200	2,800
Access Road to Intake Structure	207.1	12,300	0	0	0	3,600	90	300	900
Right Bank Access Road	1,688.1	56,600	280	1,600	1,500	29,500	830	2,900	7,100
Maintenance Road to Reservoir	397.5	6,100	10	10	40	5,700	0	300	
Dam Crest Road		0	0	970	0	0	280	1,100	2,600
Total	3,807.2	151,300	400	2,960	2,700	67,200	1,980	7,300	17,000

Drainage Ditch Type 3-1

Road	Length (m)	Drainage Ditch					
		Type 1-1	Type 1-2	Type 2-1	Type 2-2	Type 3-1	Type 3-2
Left Bank Access Road	858.0	410	280	60	10		
Access Road to Hydropower Station	656.5	460	290				
Access Road to Intake Structure	207.1	0	160				
Right Bank Access Road	1,688.1	1,750	220				
Maintenance Road to Reservoir	397.5					420	
Total	3,807.2	2,620	950	60	10	420	0

Excavated Slope

Sta	1:0.5 (m2)	1:0.8 (m2)	1:1.5 (m2)	Level (m2)	1:0.8 (m2)
Left Bank Access Road	0	2,170	390	0	
Access Road to Hydropower Station	3,970	7,260	20	1,110	
Access Road to Intake Structure	0	1,350	0	80	
Right Bank Access Road	520	9,560	2,780	560	
Maintenance Road to Reservoir			70		1,360
Total	4,490	18,170	2,870	1,750	1,360

Item	Area (m2)
Sodding	22,790
Shotcrete	5,850
Total	28,640

2.8.2 Left Bank Access Road

1. Cross Sectional Area

Sta	Distance (m)	Excavation (m2)	Embankment			Stripping (m)	Base (m2)	Subbase (m2)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)			
0+00		260.01				45.81	0.46	1.51
0+50	50.000	33.29				16.64	0.46	1.51
BC1	38.057	4.14	0.21	3.18	3.19	14.22	0.47	1.87
1+00	11.943	6.38	0.21	2.62	2.94	15.11	0.47	1.81
EC1/BC2	29.843	13.10				9.90	0.47	1.50
1+50	20.157	21.63				13.18	0.47	1.50
2+00	50.000	36.93				16.13	0.47	1.50
EC2	32.206	33.23				14.14	0.47	1.05
2+50	17.794	28.85				13.47	0.48	1.51
2+80	30.000	41.04				16.06	0.48	1.51
BC3	22.049	37.74				15.57	0.48	1.50
3+50	47.951	20.19				10.92	0.48	1.50
EC3	18.982	22.53				11.59	0.46	1.51
3+90	21.018	15.46				13.99	0.46	1.50
BC4	11.284	10.19				9.80	0.48	1.50
4+50	48.716	3.37	0.21			7.98	0.48	1.50
EC4	37.678	5.67				8.63	0.48	1.50
5+00	12.322	5.18				7.66	0.48	1.50
BC5	11.570	4.33	0.07			7.70	0.48	1.50
5+50	38.430	2.17	0.15			7.37	0.48	1.50
EC5	26.008	0.51	0.43			7.15	0.49	2.22
6+00	23.992	2.36				5.18	0.48	1.51
6+50	50.000	1.15	0.11			6.48	0.48	1.51
7+00	50.000	1.52	0.28			6.40	0.48	2.15
7+50	50.000	0.12	0.29	0.67		7.31	0.48	2.21
8+00	50.000	0.00	0.50			7.26	0.50	2.24
8+50	50.000	0.04				6.63	0.46	1.51
8+58	8.000	0.00				6.63	0.46	1.50

2. Calculated Volume

Sta	Distance (m)	Excavation (m3)	Embankment			Stripping (m2)	Base (m3)	Subbase (m3)
			Subshoulder (m3)	Subgrade (m3)	Common (m3)			
0+00								
0+50	50.000	7,332.5	0.0	0.0	0.0	1,561.3	23.1	75.7
BC1	38.057	712.2	4.1	60.5	60.8	587.2	17.7	64.4
1+00	11.943	62.8	2.5	34.6	36.6	175.1	5.6	22.0
EC1/BC2	29.843	290.7	3.2	39.1	43.9	373.2	14.0	49.4
1+50	20.157	350.1	0.0	0.0	0.0	232.6	9.5	30.2
2+00	50.000	1,464.1	0.0	0.0	0.0	732.8	23.7	74.9
EC2	32.206	1,129.9	0.0	0.0	0.0	487.4	15.2	41.0
2+50	17.794	552.3	0.0	0.0	0.0	245.6	8.5	22.7
2+80	30.000	1,048.2	0.0	0.0	0.0	443.0	14.3	45.2
BC3	22.049	868.5	0.0	0.0	0.0	348.7	10.5	33.2
3+50	47.951	1,388.9	0.0	0.0	0.0	635.1	23.0	71.9
EC3	18.982	405.5	0.0	0.0	0.0	213.6	8.9	28.5
3+90	21.018	399.3	0.0	0.0	0.0	268.8	9.6	31.6
BC4	11.284	144.7	0.0	0.0	0.0	134.2	5.3	17.0
4+50	48.716	330.3	5.1	0.0	0.0	433.1	23.4	73.1
EC4	37.678	170.3	4.0	0.0	0.0	312.9	18.1	56.5
5+00	12.322	66.8	0.0	0.0	0.0	100.4	5.9	18.5
BC5	11.570	55.0	0.4	0.0	0.0	88.9	5.6	17.4
5+50	38.430	124.9	4.2	0.0	0.0	289.6	18.4	57.6
EC5	26.008	34.9	7.5	0.0	0.0	188.8	12.6	48.4
6+00	23.992	34.4	5.2	0.0	0.0	147.9	11.6	44.7
6+50	50.000	87.8	2.8	0.0	0.0	291.5	23.9	75.4
7+00	50.000	66.8	9.8	0.0	0.0	322.0	23.9	91.4
7+50	50.000	41.0	14.3	16.8	0.0	342.8	24.0	108.9
8+00	50.000	3.0	19.8	16.8	0.0	364.3	24.5	111.1
8+50	50.000	1.0	12.5	0.0	0.0	347.3	24.0	93.7
8+58	8.000	0.2	0.0	0.0	0.0	53.0	3.7	12.1
Total	858.0	17,166.0	95.2	167.7	141.3	9,721.0	408.7	1,416.6
		x 1.1	x 1.1	x 1.1	x 1.1	x 1.1	x 1.05	x 1.05
Total with Allowance		18,900.0	100.0	180.0	160.0	10,700.0	430.0	1,500.0

3. Drainage Ditch

Drainage Ditch Type 1-1	STA. 0+00 to STA. 3+68.982	368.982 x 1.05 =	390 m
	STA.0+18.0	19.000 x 1.05 =	20 m
Drainage Ditch Type 1-2	STA. 3+5.767 to STA. 5+70	264.233 x 1.05 =	280 m
Drainage Ditch Type 2-1		55.500 x 1.05 =	60 m
Drainage Ditch Type 2-2		14.000 x 1.05 =	10 m

4. Excavated Slope

	1:0.5 (m2)	1:0.8 (m2)	1:1.5 (m2)	Level (m2)
		10.52	76.33	
		198.37	10.90	
		1,023.05	206.70	
Total	0	1,231.94	293.93	0
x slope	0	1,972	353	0
Total (x 1.1)	0	2,170	390	0

2.8.3 Access Road to Hydropower Station

1. Cross Sectinal Area

Sta	Distance (m)	Excavation (m2)	Embankment			Stripping (m)	Base (m2)	Subbase (m2)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)			
BC1								
EC1/BC2	31.416	78.19				27.19	1.18	3.61
0+50	18.584	25.95	0.30	8.82	35.93	27.50	0.94	3.73
EC2/BC3	22.257	26.80				14.14	0.47	1.50
0+90	17.743	20.39				10.77	0.47	1.51
EC3/BC4	13.149	11.60	0.26	0.09		9.80	0.47	1.57
EC4/BC5	25.307	19.57				11.58	0.47	1.50
1+50	21.544	36.29				15.70	0.43	1.36
EC5/BC6	40.852	30.17				15.10	0.47	1.51
2+10	19.148	25.42				14.25	0.47	1.51
EC6/BC7	27.714	40.30			0.78	19.14	0.47	1.62
2+50	12.286	12.81			4.89	14.22	0.48	1.84
EC7/BC8	26.809	34.10				15.77	0.47	1.50
EC8	20.726	34.87				16.77	0.47	1.50
3+20	22.465	15.97			3.83	13.81	0.48	1.79
3+50	30	77.95				22.74	0.46	1.51
BC9	46.705	118.98				23.36	0.46	1.51
4+10	13.295	64.17				18.60	0.46	1.51
EC9	8.696	44.71				17.76	0.47	1.53
BC10	0.913	43.44				17.54	0.46	1.51
4+50	30.391	60.10				23.29	0.46	1.51
EC10/BC11	12.675	95.31				24.40	0.46	1.51
EC11/BC12	21.991	103.01				26.02	0.47	1.50
5+05	20.334	61.42				22.35	0.47	1.50
EC12	29.408	87.16				30.93	0.47	1.50
5+50	15.592	77.60				30.01	0.48	1.51
BC13	25.492	197.65				39.69	0.46	1.51
EC13/BC14	21.467	133.11				29.86	0.47	1.50
6+10	13.041	134.13				32.65	0.47	1.51
EC14	18.113	271.57				38.70	0.47	1.51
6+50	21.887	245.09				49.64	0.47	1.51
6+67.564	17.564	91.33				50.66	0.47	1.51
6+80	12.436	222.70				60.12		
6+98.5	18.5	0.00				0.00		

2. Calculated Volume

Sta	Distance (m)	Excavation (m3)	Embankment			Stripping (m2)	Base (m3)	Subbase (m3)
			Subshoulder (m3)	Subgrade (m3)	Common (m3)			
BC1								
EC1/BC2	31.416	1,228.2	0.0	0.0	0.0	427.1	18.5	56.7
0+50	18.584	967.7	2.8	82.0	333.9	508.2	19.7	68.2
EC2/BC3	22.257	587.0	3.3	98.2	399.8	463.4	15.7	58.2
0+90	17.743	418.6	0.0	0.0	0.0	221.0	8.3	26.7
EC3/BC4	13.149	210.3	1.7	0.6	0.0	135.2	6.2	20.3
EC4/BC5	25.307	394.3	3.3	1.2	0.0	270.5	12.0	38.9
1+50	21.544	601.7	0.0	0.0	0.0	293.9	9.7	30.8
EC5/BC6	40.852	1,357.5	0.0	0.0	0.0	629.1	18.4	58.6
2+10	19.148	532.2	0.0	0.0	0.0	281.0	9.0	29.0
EC6/BC7	27.714	910.6	0.0	0.0	10.8	462.7	13.0	43.4
2+50	12.286	326.3	0.0	0.0	34.8	204.9	5.8	21.3
EC7/BC8	26.809	628.7	0.0	0.0	65.5	402.0	12.8	44.8
EC8	20.726	714.7	0.0	0.0	0.0	337.2	9.8	31.1
3+20	22.465	571.1	0.0	0.0	43.0	343.5	10.7	37.0
3+50	30.000	1,408.8	0.0	0.0	57.5	548.3	14.1	49.6
BC9	46.705	4,598.8	0.0	0.0	0.0	1,076.6	21.5	70.7
4+10	13.295	1,217.5	0.0	0.0	0.0	278.9	6.1	20.1
EC9	8.696	473.4	0.0	0.0	0.0	158.1	4.0	13.2
BC10	0.913	40.2	0.0	0.0	0.0	16.1	0.4	1.4
4+50	30.391	1,573.3	0.0	0.0	0.0	620.4	13.9	45.8
EC10/BC11	12.675	984.9	0.0	0.0	0.0	302.2	5.8	19.1
EC11/BC12	21.991	2,180.6	0.0	0.0	0.0	554.4	10.2	33.1
5+05	20.334	1,671.8	0.0	0.0	0.0	491.8	9.6	30.5
EC12	29.408	2,184.7	0.0	0.0	0.0	783.4	13.9	44.1
5+50	15.592	1,284.5	0.0	0.0	0.0	475.1	7.4	23.4
BC13	25.492	3,508.3	0.0	0.0	0.0	888.4	11.9	38.4
EC13/BC14	21.467	3,550.2	0.0	0.0	0.0	746.5	10.0	32.3
6+10	13.041	1,742.5	0.0	0.0	0.0	407.6	6.1	19.7
EC14	18.113	3,674.2	0.0	0.0	0.0	646.2	8.5	27.4
6+50	21.887	5,654.1	0.0	0.0	0.0	966.7	10.2	33.1
6+67.564	17.564	2,954.4	0.0	0.0	0.0	880.8	8.2	26.6
6+80	12.436	1,952.6	0.0	0.0	0.0	688.8	2.9	9.4
6+98.5	18.500	2,060.0	0.0	0.0	0.0	556.1	0.0	0.0
Total	698.5	52,163.9	11.2	181.9	945.4	16,066.2	334.4	1,102.6
		x 1.1	x 1.1	x 1.1	x 1.1	x 1.1	x 1.05	x 1.05
Total with Allowance		57,400.0	10.0	200.0	1,000.0	17,700.0	350.0	1,200.0

3. Drainage Ditch

Drainage Ditch Type 1-1	STA. 0+00 to STA. 0+72.257	63.000 x 1.05 =	70 m
	STA. 0+72.257 to STA. 4+45	372.743 x 1.05 =	390 m
Drainage Ditch Type 1-2	STA. 3+90 to STA. 6+67.564	277.564 x 1.05 =	290 m

4. Excavated Slope

	1:0.5 (m2)	1:0.8 (m2)	1:1.5 (m2)	Level (m2)
	56.25	47.21	15.54	24.57
	150.00	151.24		12.35
	118.83	78.40		23.05
	35.83	51.34		25.50
	36.91	286.66		108.06
	90.45	185.84		135.27
	159.13	17.70		105.37
	21.68	33.62		6.06
	6.31	106.22		64.45
	2.51	51.54		122.16
	79.99	86.18		137.82
	313.21	5.87		105.74
	297.63	243.65		94.08
	172.72	13.77		41.80
	74.02	319.52		
		298.02		
		272.11		
		262.87		
		251.08		
		66.36		
		99.95		
		56.82		
		59.74		
		110.59		
		91.66		
		52.93		
		314.64		
		60.88		
		224.18		
		131.32		
		92.15		
Total	1,615.47	4,124.06	15.54	1,006.28
x slope	3,612	6,603	19	1,006
Total(x 1.1)	3,970	7,260	20	1,110

2.8.4 Access Road to Intake Structure

1. Cross Sectional Area

Sta	Distance (m)	Excavation (m2)	Embankment			Stripping (m)	Base (m2)	Subbase (m2)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)			
BC1								
EC1	39.794	42.49				19.11	0.57	1.71
0+50	10.206	14.96				8.30	0.62	1.88
BC2	7.926	18.63				9.04	0.47	1.51
EC2/BC3	40.142	32.16				13.02	0.47	1.50
1+20	21.932	49.00				17.52	0.46	1.50
EC3	31.824	31.68				16.72	0.47	1.50
1+80	28.176	222.93				36.58	0.46	1.51
2+07.110	27.11	7.51				7.76	0.26	0.99
2+08.780	1.67							

2. Calculated Volume

Sta	Distance (m)	Excavation (m3)	Embankment			Stripping (m2)	Base (m3)	Subbase (m3)
			Subshoulder (m3)	Subgrade (m3)	Common (m3)			
BC1								
EC1	39.794	845.4	0.0	0.0	0.0	380.2	11.3	34.0
0+50	10.206	293.2	0.0	0.0	0.0	139.9	6.1	18.3
BC2	7.926	133.1	0.0	0.0	0.0	68.7	4.3	13.4
EC2/BC3	40.142	1,019.4	0.0	0.0	0.0	442.8	18.9	60.4
1+20	21.932	890.0	0.0	0.0	0.0	334.9	10.2	33.0
EC3	31.824	1,283.8	0.0	0.0	0.0	544.8	14.8	47.8
1+80	28.176	3,586.9	0.0	0.0	0.0	750.9	13.2	42.4
2+07.110	27.11	3,123.6	0.0	0.0	0.0	601.0	9.8	33.9
2+07.110	1.67	6.3	0.0	0.0	0.0	6.5	0.2	0.8
Total	208.78	11,181.7	0.0	0.0	0.0	3,269.7	88.7	284.2
		x 1.1	x 1.1	x 1.1	x 1.1	x 1.1	x 1.05	x 1.05
Total with Allowance		12,300.0	0.0	0.0	0.0	3,600.0	90.0	300.0

3. Drainage Ditch

Drainage Ditch Type 1-1		0.000 x 1.05 =	0 m
		0.000 x 1.05 =	0 m
Drainage Ditch Type 1-2	STA. 0+57.926 to STA.2+8.3	150.374 x 1.05 =	160 m

4. Excavated Slope

	1:0.5 (m2)	1:0.8 (m2)	1:1.5 (m2)	Level (m2)
		617.42 150.69		75.34
Total	0.00	768.11	0.00	75.34
x slope	0	1,230	0	75
Total (x 1.1)	0	1,350	0	80

2.8.5 Right Bank Access Road

1. Cross Sectional Area

Sta	Distance (m)	Excavation (m2)	Embankment			Stripping (m)	Base (m2)	Subbase (m2)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)			
BC1								
EC1	29.147	191.52				41.24	0.46	1.51
0+50	20.853	68.68				16.62	0.46	1.51
1+00	50	92.00				28.15	0.46	1.51
BC2	35.318	67.47				23.70	0.48	1.49
1+50	14.682	40.92				19.85	0.48	1.49
EC2/BC3	10.45	50.97				21.66	0.46	1.50
1+80	19.55	112.70				24.43	0.46	1.51
EC3/BC4	21.989	155.96				33.67	0.46	1.50
2+40	38.011	49.08	0.35	1.61	3.97	27.14	0.48	1.61
EC4	18.014	102.94				26.56	0.46	1.51
BC5	19.301	104.65				27.24	0.46	1.51
3+00	22.685	77.28				22.26	0.46	1.51
EC5/BC6	15.799	68.19				22.41	0.46	1.50
EC6/BC7	25.133	35.81				14.76	0.47	1.50
3+50	9.068	43.79				15.64	0.47	1.51
3+90	40	43.23				22.07	0.46	1.51
EC7	24.759	44.85				19.63	0.47	1.52
4+50	35.241	65.74				23.66	0.46	1.51
BC8	24.873	53.15				20.64	0.47	1.51
5+00	25.127	48.52				19.29	0.47	1.51
EC8	16.412	51.66				21.04	0.47	1.51
BC9	24.336	35.18				21.62	0.48	1.49
5+50	9.252	24.82				14.35	0.48	1.49
EC9	21.379	17.29				12.15	0.48	1.49
BC10	16.206	22.99				12.76	0.47	1.51
6+10	22.415	34.29				14.36	0.47	1.51
EC10	25.232	32.34				14.02	0.47	1.51
6+50	14.768	26.08	0.10			14.86	0.48	1.51
7+00	50	5.82	0.29	2.25	0.97	13.87	0.48	1.58
7+50	50	1.55	0.29	3.85	1.56	12.44	0.50	2.03
8+00	50	7.27				9.07	0.50	1.51
8+50	50	8.21				8.73	0.50	1.51
BC11	18.133	27.61				18.74	0.50	1.51
9+00	31.867	36.91				29.00	0.50	1.51
EC11/BC12	18.617	16.03				11.66	0.50	1.51
9+50	31.383	29.14				15.87	0.50	1.51
EC12	11.726	21.60				14.38	0.50	1.51
10+00	38.274	7.13	0.29		0.08	10.21	0.48	1.58
10+50	50	8.36	0.22			10.03	0.48	1.58
11+00	50	1.70	0.29	0.16		8.74	0.48	1.71
11+50	50	3.16	0.29	1.61		10.72	0.48	1.80
12+00	50	1.74	0.29	2.81	0.28	11.13	0.48	1.93
BC13	41.501	2.54	0.26			8.84	0.48	1.58
12+50	8.499	0.18	0.29	4.04		10.51	0.49	2.22
EC13	31.643	0.18	0.29	0.92	0.46	10.14	0.49	2.22
13+00	18.357	0.86	0.66			10.92	0.46	2.22
13+50	50	1.34	0.58	3.20		12.06	0.46	2.24
13+80	30	1.17	0.58	9.02	2.65	14.65	0.46	2.24
14+10	30	1.79	0.58	0.58		17.95	0.46	2.13
14+50	40	1.53	0.58			13.31	0.46	2.13
15+00	50	6.72				8.93	0.46	1.51
BC14	13.225	4.14				9.64	0.46	1.51
15+50	36.775	18.20				10.89	0.46	1.51
16+00	50	32.59				12.77	0.46	1.51
EC14/BC15	13.407	12.28				11.35	0.46	1.51
16+50	36.593	2.42	0.58	8.79	26.42	20.77	0.46	2.22
EC15	38.107					6.00	0.46	2.22

2. Calculated Volume

Sta	Distance (m)	Excavation (m3)	Embankment			Stripping (m2)	Base (m3)	Subbase (m3)
			Subshoulder (m3)	Subgrade (m3)	Common (m3)			
BC1								
EC1	29.147	2,791.1	0.0	0.0	0.0	601.0	6.7	22.1
0+50	20.853	2,713.0	0.0	0.0	0.0	603.3	9.6	31.6
1+00	50	4,017.0	0.0	0.0	0.0	1,119.3	23.1	75.7
BC2	35.318	2,816.1	0.0	0.0	0.0	915.6	16.5	53.1
1+50	14.682	795.7	0.0	0.0	0.0	319.7	7.0	21.9
EC2/BC3	10.45	480.1	0.0	0.0	0.0	216.9	4.9	15.7
1+80	19.55	1,599.9	0.0	0.0	0.0	450.5	8.9	29.4
EC3/BC4	21.989	2,953.8	0.0	0.0	0.0	638.8	10.1	33.1
2+40	38.011	3,896.9	6.6	30.6	75.5	1,155.7	17.9	59.2
EC4	18.014	1,369.2	3.1	14.5	35.8	483.7	8.5	28.0
BC5	19.301	2,003.3	0.0	0.0	0.0	519.2	8.8	29.1
3+00	22.685	2,063.5	0.0	0.0	0.0	561.5	10.4	34.2
EC5/BC6	15.799	1,149.1	0.0	0.0	0.0	352.9	7.2	23.8
EC6/BC7	25.133	1,306.9	0.0	0.0	0.0	467.1	11.7	37.8
3+50	9.068	360.9	0.0	0.0	0.0	137.8	4.3	13.7
3+90	40	1,740.4	0.0	0.0	0.0	754.2	18.5	60.4
EC7	24.759	1,090.4	0.0	0.0	0.0	516.2	11.4	37.4
4+50	35.241	1,948.7	0.0	0.0	0.0	762.8	16.4	53.4
BC8	24.873	1,478.6	0.0	0.0	0.0	550.9	11.6	37.6
5+00	25.127	1,277.3	0.0	0.0	0.0	501.7	11.8	37.9
EC8	16.412	822.1	0.0	0.0	0.0	330.9	7.7	24.8
BC9	24.336	1,056.7	0.0	0.0	0.0	519.1	11.5	36.5
5+50	9.252	277.6	0.0	0.0	0.0	166.4	4.4	13.8
EC9	21.379	450.1	0.0	0.0	0.0	283.3	10.2	31.9
BC10	16.206	326.4	0.0	0.0	0.0	201.8	7.6	24.3
6+10	22.415	642.0	0.0	0.0	0.0	304.0	10.5	33.8
EC10	25.232	840.6	0.0	0.0	0.0	358.1	11.8	38.1
6+50	14.768	431.4	0.7	0.0	0.0	213.3	7.0	22.3
7+00	50	797.6	9.8	56.3	24.3	718.3	23.9	77.2
7+50	50	184.3	14.5	152.5	63.3	657.8	24.5	90.2
8+00	50	220.5	7.3	96.3	39.0	537.8	25.0	88.4
8+50	50	387.0	0.0	0.0	0.0	445.0	25.0	75.4
BC11	18.133	324.8	0.0	0.0	0.0	249.1	9.1	27.3
9+00	31.867	1,028.0	0.0	0.0	0.0	760.7	15.9	48.0
EC11/BC12	18.617	492.8	0.0	0.0	0.0	378.5	9.3	28.1
9+50	31.383	708.8	0.0	0.0	0.0	432.0	15.7	47.3
EC12	11.726	297.5	0.0	0.0	0.0	177.3	5.9	17.7
10+00	38.274	549.8	5.5	0.0	1.5	470.4	18.8	59.2
10+50	50	387.3	12.7	0.0	2.0	506.0	24.0	79.1
11+00	50	251.6	12.8	4.1	0.0	469.5	24.0	82.2
11+50	50	121.7	14.5	44.4	0.0	486.6	24.0	87.7
12+00	50	122.6	14.5	110.7	6.9	546.3	24.0	93.3
BC13	41.501	88.9	11.4	58.4	5.7	414.5	19.9	72.8
12+50	8.499	11.6	2.3	17.2	0.0	82.2	4.1	16.1
EC13	31.643	5.7	9.2	78.5	7.3	326.7	15.5	70.1
13+00	18.357	9.5	8.7	8.4	4.2	193.3	8.7	40.7
13+50	50	55.0	31.0	80.0	0.0	574.5	22.9	111.4
13+80	30	37.7	17.4	183.3	39.8	400.7	13.7	67.2
14+10	30	44.4	17.4	144.0	39.8	489.0	13.7	65.6
14+50	40	66.4	23.2	11.6	0.0	625.2	18.3	85.2
15+00	50	206.3	14.5	0.0	0.0	556.0	22.9	91.0
BC14	13.225	71.8	0.0	0.0	0.0	122.8	6.1	20.0
15+50	36.775	410.8	0.0	0.0	0.0	377.5	16.8	55.5
16+00	50	1,269.8	0.0	0.0	0.0	591.5	22.9	75.3
EC14/BC15	13.407	300.8	0.0	0.0	0.0	161.7	6.1	20.2
16+50	36.593	269.0	10.6	160.8	483.4	587.7	16.8	68.2
EC15	38.107	46.1	11.1	167.5	503.4	510.1	17.5	84.6
Total	1688.107	51,466.6	258.9	1,418.9	1,331.7	26,854.0	791.0	2,805.2
		x 1.1	x 1.1	x 1.1	x 1.1	x 1.1	x 1.05	x 1.05
Total with Allowance		56,600.0	280.0	1,600.0	1,500.0	29,500.0	830.0	2,900.0

3. Drainage Ditch

Drainage Ditch Type 1-1	STA. 0+00 to STA. 0+50	38.000 x 1.05 =	40 m
	STA. 0+50 to STA. 13+90	1340.00 x 1.05 =	1410 m
	STA. 14+00 to STA. 16+88.107	288.107 x 1.05 =	300 m
Drainage Ditch Type 1-2	STA. 14+00 to STA. 16+13.407	213.407 x 1.05 =	220 m

4. Excavated Slope

	1:0.5 (m2)	1:0.8 (m2)	1:1.5 (m2)	Level (m2)
	97.94	159.37	47.16	46.74
	112.50	629.93	451.05	232.26
		81.65	87.70	44.78
		420.98	176.29	45.01
		202.50	285.68	6.29
		90.67	115.11	90.17
		177.91	113.72	43.90
		179.64	69.45	
		283.76	58.40	
		173.18	47.44	
		17.50	112.59	
		149.61	537.86	
		7.05		
		135.15		
		80.91		
		132.09		
		360.68		
		58.68		
		235.88		
		83.41		
		313.77		
		184.36		
		459.77		
		127.60		
		296.98		
		30.44		
		61.53		
		93.67		
		198.17		
Total	210.44	5,426.84	2,102.45	509.15
x slope	471	8,688	2,527	509
Total(x 1.1)	520	9,560	2,780	560

2.8.6 Maintenance Road to Reservoir

1. Cross Sectional Area

Sta	Distance (m)	Excavation (m2)	Embankment			Subbase (m2)	Stripping (m)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)		
0+00		1.72				0.75	0.00
0+15	15	1.26	0.17	0.45	0.10	0.88	4.10
BC1	30.481	2.47	0.17	0.10	0.10	0.80	7.43
0+60	14.519	5.33			0.10	0.72	7.61
EC1	15.326	9.29			0.10	0.75	9.24
0+90	14.674	9.79			0.10	0.75	9.30
BC2	17.255	9.49			0.10	0.74	10.37
1+25	17.745	7.93			0.10	0.74	9.96
EC2	31.037	10.92			0.10	0.74	9.83
2+00	43.963	15.73			0.10	0.75	16.65
BC3	46.42	24.82			0.10	0.75	14.28
2+60	13.58	16.34			0.10	0.75	11.38
EC3/BC4	16.266	17.68			0.10	0.75	14.09
3+00	23.734	18.39			0.10	0.74	14.58
EC4/BC5	12.394	20.31			0.10	0.75	16.26
3+40	27.606	16.29			0.10	0.75	15.50
EC5	31.037	21.89			0.10	0.75	26.04
3+97.5	26.463	32.17			0.10	0.75	22.46

2. Calculated Volume

Sta	Distance (m)	Excavation (m2)	Embankment			Subbase (m2)	Stripping (m)
			Subshoulder (m2)	Subgrade (m2)	Common (m2)		
0+00							
0+15	15	22.4	1.3	3.4	0.8	12.2	30.8
BC1	30.481	56.8	5.2	8.4	3.0	25.6	175.8
0+60	14.519	56.6	1.2	0.7	1.5	11.0	109.2
EC1	15.326	112.0	0.0	0.0	1.5	11.3	129.2
0+90	14.674	140.0	0.0	0.0	1.5	11.0	136.1
BC2	17.255	166.3	0.0	0.0	1.7	12.9	169.7
1+25	17.745	154.6	0.0	0.0	1.8	13.2	180.4
EC2	31.037	292.5	0.0	0.0	3.1	23.1	307.2
2+00	43.963	585.8	0.0	0.0	4.4	32.8	582.1
BC3	46.42	941.2	0.0	0.0	4.6	34.9	717.9
2+60	13.58	279.5	0.0	0.0	1.4	10.2	174.2
EC3/BC4	16.266	276.7	0.0	0.0	1.6	12.2	207.1
3+00	23.734	428.0	0.0	0.0	2.4	17.7	340.1
EC4/BC5	12.394	239.8	0.0	0.0	1.2	9.2	191.1
3+40	27.606	505.2	0.0	0.0	2.8	20.7	438.4
EC5	31.037	592.5	0.0	0.0	3.1	23.3	644.7
3+97.5	26.463	715.3	0.0	0.0	2.6	19.9	641.7
Total	397.5	5,565.2	7.7	12.5	39.0	301.2	5,175.8
		x 1.10	x 1.10	x 1.10	x 1.10	x 1.10	x 1.10
Total with Allowance		6,100	10	10	40	300	5,700

3. Drainage Ditch

Drainage Ditch Type 3-1 STA. 0+00 to STA. 3+97.5 397.500 x 1.05 = 420 m

4. Excavated Slope

Sta	1:0.5 (m2)	1:0.8 (m2)	1:1.5 (m2)	Level (m2)
		261.10	49.98	
		65.27		
		12.19		
		3.48		
		4.22		
		19.27		
		135.31		
		271.24		
Total	0	772.08	49.98	0.00
x slope	0	1,236	60	0
Total(x 1.1)	0	1,360	70	0

2.9 Grouting

2.9.1 Summary

Driiling and grouting	Unit	Total	Curtain (Dam)	Blanket (Dam)	Consolidation (Dam)	Consolidation (Spillway)	Curtain Consolidation (Tunnel)
Core Drilling (66 mm dia) :							
from within Gallery	m	1,200	1,200				
from Surface	m	4,900	4,900				
Rotary Drilling Holes for Grouting (46 mm dia) :							
from within Gallery	m	5,200	4,000		1,200		
from Surface	m	14,400	11,700	2,200		500	
from Tunnels	m	1,050					1,050
Drill set-up for drilling grout hole	No.	4,050	3,200	390	200	80	180
Wash and Water Pressure Testing	No.	4,050	3,200	390	200	80	180
Cement used in Pressure Grouting	tonne	409	324	39	20	8	18

2.9.2 Curtain (Dam)

1. Drilling from within Gallery

(m)

Zone No.	Pilot (66mm dia.)	Primary (46mm dia.)	Secondary (46mm dia.)		Tertiary (46mm dia.)				Check (66mm dia.)
			1	2	1	2	3	4	
L1									
L2									
L3									
L4									
L5									
L6									
L7									
L8									
L9									
L10									
L11									
L12									
L13									
L14									
L15									
L16									
L17									
L18									
L19									
L20									
L21									
L22									
L23									
C1									
C2									
C3									
C4									
C5									
C6									
C7									
C8									
C9									
C10									
C11									
C12	31.3	22.6	22.4	22.8	22.0	22.5	22.7	22.9	21.0
C13	33.0	23.5	23.3	23.7	23.2	23.4	23.6	23.8	21.4
C14	33.8	26.1	25.0	27.3	24.4	25.5	26.7	27.9	16.9
C15	38.5	30.8	29.6	34.0	29.0	30.2	32.1	34.5	21.9
C16	45.1	37.5	36.3	38.6	35.7	36.9	38.0	39.2	25.9
C17	49.8	33.8	36.8	30.8	38.3	35.3	32.3	29.3	30.1
C18	37.8	26.5	26.5	26.5	26.5	26.5	26.5	26.5	29.2
C19	36.5	26.5	26.5	26.5	26.5	26.5	26.5	27.8	29.2
C20	39.3	35.3	32.3	38.3	30.8	33.8	36.8	39.8	31.5
C21	51.3	41.0	41.2	40.9	41.2	41.1	41.0	40.9	31.0
C22	50.8	38.5	39.4	38.4	40.7	38.6	38.5	38.4	30.6
C23	48.3	38.0	38.2	37.9	38.2	38.1	38.0	37.9	28.3
C24	47.8	36.8	37.7	35.5	37.7	37.4	36.1	34.9	27.8
C25	44.2	36.2	35.2	37.2	34.7	35.7	36.7	37.6	32.9
C26	48.1	40.1	39.1	41.1	38.6	39.6	40.6	41.6	36.6
C27	52.1	44.0	43.0	43.7	42.6	43.5	44.2	43.3	40.3
C28									
R1									
R2									
R3									
R4									
R5									
R6									
R7									
R8									
Total	687.7	537.3	532.4	543.2	530.3	534.7	540.3	546.2	454.7

Total (66mm dia)		1,142.5
Total (46mm dia)		3,764.4
Total (66mm dia)	x 1.05 =	1,200.0
Total (46mm dia)	x 1.05 =	4,000.0
Total		5,200.0

2. Drilling from Surface

(m)

Zone No.	Pilot (66mm dia.)	Primary (46mm dia.)	Secondary (46mm dia.)		Tertiary (46mm dia.)				Check (66mm dia.)
			1	2	1	2	3	4	
L1	51.1	42.4	41.8	43.0	0.0	0.0	0.0	0.0	62.7
L2	53.6	44.9	44.2	45.5	0.0	0.0	0.0	0.0	58.7
L3	50.0	47.4	46.7	48.0	0.0	0.0	0.0	0.0	57.1
L4	56.4	49.8	49.2	50.5	0.0	0.0	0.0	0.0	56.9
L5	61.8	52.2	51.6	52.7	0.0	0.0	0.0	0.0	57.2
L6	63.3	54.4	53.8	54.9	0.0	0.0	0.0	0.0	57.5
L7	65.4	56.3	55.9	56.8	0.0	0.0	0.0	0.0	57.0
L8	67.2	57.1	57.2	57.2	0.0	0.0	0.0	0.0	57.5
L9	67.3	57.7	57.5	58.0	0.0	0.0	0.0	0.0	59.9
L10	68.5	60.0	59.1	60.8	0.0	0.0	0.0	0.0	62.6
L11	71.6	63.1	62.4	63.9	0.0	0.0	0.0	0.0	64.8
L12	74.7	64.5	64.6	64.4	64.6	64.5	64.5	64.4	66.8
L13	74.3	64.1	64.2	63.8	64.3	64.2	63.9	63.6	65.3
L14	73.5	62.7	63.2	61.2	63.4	63.0	62.4	59.7	57.6
L15	68.2	53.7	56.7	51.7	57.7	55.2	52.2	51.7	54.0
L16	61.7	53.2	51.7	53.2	51.7	51.8	53.2	53.2	55.5
L17	63.2	53.2	53.2	51.7	53.2	53.2	51.8	51.7	54.0
L18	61.7	52.2	51.7	52.2	51.7	52.2	52.2	52.2	54.5
L19	62.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	54.5
L20	62.2	52.2	52.2	52.1	52.2	52.2	52.2	50.9	50.3
L21	59.6	48.2	48.2	48.2	48.3	48.2	48.2	48.2	50.3
L22	58.2	48.2	48.2	48.2	48.2	48.2	48.2	47.7	47.2
L23	56.5	45.2	45.2	45.2	45.2	45.2	45.2	45.2	47.2
C1	55.2	45.2	45.2	42.8	45.2	45.2	44.3	39.8	40.7
C2	49.8	35.3	36.8	33.8	36.8	36.8	35.3	33.8	30.9
C3	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C4	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C5	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C6	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C7	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C8	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C9	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C10	37.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	30.9
C11	37.8	26.8	27.8	26.8	27.8	26.8	26.8	26.8	24.7
C12									
C13									
C14									
C15									
C16									
C17									
C18									
C19									
C20									
C21									
C22									
C23									
C24									
C25									
C26									
C27									
C28	56.4	47.3	45.2	51.4	46.1	45.2	49.9	51.6	45.0
R1	63.1	57.7	55.9	57.6	54.5	57.4	57.7	57.5	48.7
R2	67.4	57.5	57.4	57.4	57.4	57.5	57.5	57.3	55.0
R3	67.2	56.8	57.0	56.6	57.1	56.9	56.7	56.5	55.6
R4	66.4	55.9	56.1	55.7	56.2	56.0	55.8	55.6	56.0
R5	65.5	55.0	55.2	54.8	0.0	0.0	0.0	0.0	56.2
R6	64.5	53.5	54.0	53.0	0.0	0.0	0.0	0.0	57.0
R7	62.5	51.3	51.9	50.8	0.0	0.0	0.0	0.0	59.3
R8	60.2	48.9	49.6	48.0	0.0	0.0	0.0	0.0	64.4
	57.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2,527.4	2,048.6	2,045.4	2,046.5	1,256.3	1,254.3	1,252.5	1,242.0	2,149.6
Total (66mm dia)									4,677.0
Total (46mm dia)									11,145.5
Total (66mm dia)								x 1.05 =	4,900.0
Total (46mm dia)								x 1.05 =	11,700.0
Total									16,600.0

3. Drilling (only)

(m)

Zone No.	Pilot (66mm dia.)	Primary (46mm dia.)	Secondary (46mm dia.)		Tertiary (46mm dia.)				Check (66mm dia.)
			1	2	1	2	3	4	
L1	31.1	31.0	31.1	31.0					47.1
L2	30.9	30.8	30.8	30.7					41.2
L3	24.5	30.5	30.6	30.5					37.6
L4	28.2	30.3	30.4	30.2					35.1
L5	30.9	29.9	30.0	29.8					33.1
L6	29.6	29.4	29.5	29.2					31.0
L7	29.0	28.6	28.8	28.4					28.1
L8	28.1	26.7	27.4	26.0					26.1
L9	25.5	24.6	25.0	24.2					25.9
L10	23.9	24.1	23.9	24.2					26.0
L11	24.3	24.5	24.4	24.6					25.7
L12	24.7	24.5	24.6	24.4	24.6	24.5	24.5	24.4	25.0
L13	24.3	24.1	24.2	23.8	24.3	24.2	23.9	23.6	23.5
L14	23.5	22.7	23.2	21.2	23.4	23.0	22.4	19.7	15.8
L15	18.2	13.7	16.7	11.7	17.7	15.2	12.2	11.7	12.2
L16	11.7	13.2	11.7	13.2	11.7	11.8	13.2	13.2	13.8
L17	13.2	13.2	13.2	11.7	13.2	13.2	11.8	11.7	12.2
L18	11.7	12.2	11.7	12.2	11.7	12.2	12.2	12.2	12.7
L19	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.7
L20	12.2	12.2	12.2	12.1	12.2	12.2	12.2	10.9	8.6
L21	9.6	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.6
L22	8.2	8.2	8.2	8.2	8.2	8.2	8.2	7.7	5.4
L23	6.5	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.4
C1	5.2	5.2	5.2	4.0	5.2	5.2	4.3	2.9	3.7
C2	4.7	3.0	3.6	7.5	3.6	3.6	6.0	9.0	3.3
C3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C4	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C6	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C7	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C8	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C10	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.3
C11	3.0	2.0	3.0	2.8	3.0	2.0	2.0	6.3	0.9
C12	0.8	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.8
C13	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8
C14	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.8
C15	1.1	1.1	1.1	1.1	1.1	1.1	0.8	1.1	0.8
C16	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.8
C17	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9
C18	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9
C19	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.1	0.9
C20	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9
C21	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9
C22	1.1	1.1	0.8	1.1	1.1	1.1	1.1	1.1	0.9
C23	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.8
C24	1.1	0.9	1.1	0.9	1.1	0.9	0.9	0.9	0.8
C25	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8
C26	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8
C27	0.9	0.9	0.9	1.5	0.9	0.9	1.5	1.5	0.8
C28	5.0	7.7	4.7	12.7	5.2	5.2	10.7	13.3	5.2
R1	15.2	21.6	19.0	22.3	17.1	20.8	22.0	22.7	12.3
R2	23.0	24.8	23.9	25.7	23.5	24.4	25.3	26.0	21.8
R3	26.3	27.6	27.0	28.3	26.7	27.3	28.0	28.6	25.7
R4	28.9	30.2	29.6	30.9	29.3	29.9	30.6	31.2	29.2
R5	31.5	32.8	32.2	33.5					32.4
R6	34.0	34.8	34.4	35.1					36.3
R7	35.5	36.1	35.8	36.4					41.2
R8	36.7	37.2	37.0	37.1					48.8
	37.1								
Total	809.0	783.2	778.6	790.0	326.4	328.6	335.4	341.7	813.7
Total									5,306.6
Total								x 1.05 =	5,600.0

4. Grouting (m)

Zone No.	Pilot (66mm dia.)	Primary (46mm dia.)	Secondary (46mm dia.)		Tertiary (46mm dia.)				Check (66mm dia.)
			1	2	1	2	3	4	
L1	20.0	11.4	10.7	12.0					15.6
L2	22.7	14.1	13.4	14.8					17.5
L3	25.5	16.8	16.1	17.5					19.6
L4	28.2	19.5	18.9	20.2					21.8
L5	30.9	22.3	21.6	23.0					24.1
L6	33.6	25.0	24.3	25.7					26.5
L7	36.4	27.7	27.0	28.4					29.0
L8	39.1	30.5	29.8	31.1					31.5
L9	41.8	33.2	32.5	33.9					34.0
L10	44.5	35.9	35.2	36.6					36.6
L11	47.3	38.6	38.0	39.3					39.2
L12	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L13	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L14	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L15	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L16	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L17	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L18	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L19	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L20	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L21	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L22	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
L23	50.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8
C1	50.0	40.0	40.0	38.8	40.0	40.0	40.0	36.9	37.1
C2	45.1	32.3	33.2	26.3	33.2	33.2	29.3	24.8	27.6
C3	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C4	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C5	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C6	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C7	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C8	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C9	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C10	34.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	27.6
C11	34.8	24.8	24.8	24.0	24.8	24.8	24.8	20.5	23.8
C12	30.5	21.7	21.5	22.0	21.2	21.6	21.8	22.1	20.2
C13	32.2	22.6	22.4	22.8	22.3	22.5	22.7	23.0	20.6
C14	32.7	25.0	23.8	26.2	23.3	24.4	25.6	26.8	16.1
C15	37.3	29.7	28.5	32.8	27.9	29.1	31.3	33.4	21.1
C16	44.0	36.3	35.2	37.5	34.6	35.8	36.9	38.1	25.1
C17	48.7	32.7	35.7	29.7	37.2	34.2	31.2	28.2	29.2
C18	36.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	28.4
C19	35.7	25.7	25.7	25.7	25.7	25.7	25.7	26.7	28.4
C20	38.2	34.2	31.2	37.2	29.7	32.7	35.7	38.7	30.6
C21	50.2	39.9	40.0	39.8	40.1	40.0	39.9	39.7	30.2
C22	49.7	37.4	38.6	37.3	39.6	37.5	37.4	37.2	29.7
C23	47.2	36.9	37.0	36.8	37.1	37.0	36.9	36.7	27.4
C24	46.7	35.8	36.5	34.5	36.6	36.5	35.2	33.9	27.0
C25	43.3	35.2	34.3	36.2	33.8	34.7	35.7	36.7	32.1
C26	47.2	39.2	38.2	40.1	37.7	38.7	39.7	40.6	35.8
C27	51.1	43.1	42.1	42.2	41.6	42.6	42.7	41.8	39.5
C28	51.4	39.6	40.5	38.7	40.9	40.0	39.2	38.3	39.7
R1	47.9	36.1	37.0	35.3	37.4	36.6	35.7	34.8	36.4
R2	44.4	32.6	33.5	31.8	33.9	33.1	32.2	31.3	33.1
R3	40.9	29.2	30.0	28.3	30.5	29.6	28.7	27.9	29.9
R4	37.4	25.7	26.5	24.8	27.0	26.1	25.2	24.4	26.8
R5	33.9	22.2	23.1	21.3					23.7
R6	30.5	18.7	19.6	17.8					20.8
R7	27.0	15.2	16.1	14.4					18.0
R8	23.5	11.7	12.6	10.9					15.6
	20.0								
Total	2,406.2	1,802.7	1,799.2	1,799.8	1,460.1	1,460.3	1,457.4	1,446.5	1,790.6
Total									15,422.8
Total								x 1.05 =	16,200.0
Total								x 20kg/m=	324,000.0

5. Water Pressure Test

(times)

Zone No.	Pilot (66mm dia.)	Primary (46mm dia.)	Secondary (46mm dia.)		Tertiary (46mm dia.)				Check (66mm dia.)
			1	2	1	2	3	4	
L1	4.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	3.0
L2	5.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	3.0
L3	5.0	3.0	3.0	4.0	0.0	0.0	0.0	0.0	4.0
L4	6.0	4.0	4.0	4.0	0.0	0.0	0.0	0.0	4.0
L5	6.0	4.0	4.0	5.0	0.0	0.0	0.0	0.0	5.0
L6	7.0	5.0	5.0	5.0	0.0	0.0	0.0	0.0	5.0
L7	7.0	6.0	5.0	6.0	0.0	0.0	0.0	0.0	6.0
L8	8.0	6.0	6.0	6.0	0.0	0.0	0.0	0.0	6.0
L9	8.0	7.0	7.0	7.0	0.0	0.0	0.0	0.0	7.0
L10	9.0	7.0	7.0	7.0	0.0	0.0	0.0	0.0	7.0
L11	9.0	8.0	8.0	8.0	0.0	0.0	0.0	0.0	8.0
L12	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L13	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L14	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L15	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L16	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L17	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L18	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L19	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L20	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L21	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L22	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
L23	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
C1	10.0	8.0	8.0	8.0	8.0	8.0	8.0	7.0	7.0
C2	9.0	6.0	7.0	5.0	7.0	7.0	6.0	5.0	6.0
C3	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C4	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C5	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C6	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C7	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C8	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C9	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C10	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C11	7.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	5.0
C12	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
C13	6.0	5.0	4.0	5.0	4.0	5.0	5.0	5.0	4.0
C14	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0
C15	7.0	6.0	6.0	7.0	6.0	6.0	6.0	7.0	4.0
C16	9.0	7.0	7.0	8.0	7.0	7.0	7.0	8.0	5.0
C17	10.0	7.0	7.0	6.0	7.0	7.0	6.0	6.0	6.0
C18	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C19	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0
C20	8.0	7.0	6.0	7.0	6.0	7.0	7.0	8.0	6.0
C21	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	6.0
C22	10.0	7.0	8.0	7.0	8.0	7.0	7.0	7.0	6.0
C23	9.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0
C24	9.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0
C25	9.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.0
C26	9.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.0
C27	10.0	9.0	8.0	8.0	8.0	9.0	9.0	8.0	8.0
C28	10.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
R1	10.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
R2	9.0	7.0	7.0	6.0	7.0	7.0	6.0	6.0	7.0
R3	8.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
R4	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
R5	7.0	4.0	5.0	4.0	0.0	0.0	0.0	0.0	5.0
R6	6.0	4.0	4.0	4.0	0.0	0.0	0.0	0.0	4.0
R7	5.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	4.0
R8	5.0	2.0	3.0	2.0	0.0	0.0	0.0	0.0	3.0
	4.0								
Total	480.0	360.0	360.0	360.0	291.0	293.0	290.0	289.0	356.0
Total									3,079.0
Total								x 1.05 =	3,200.0

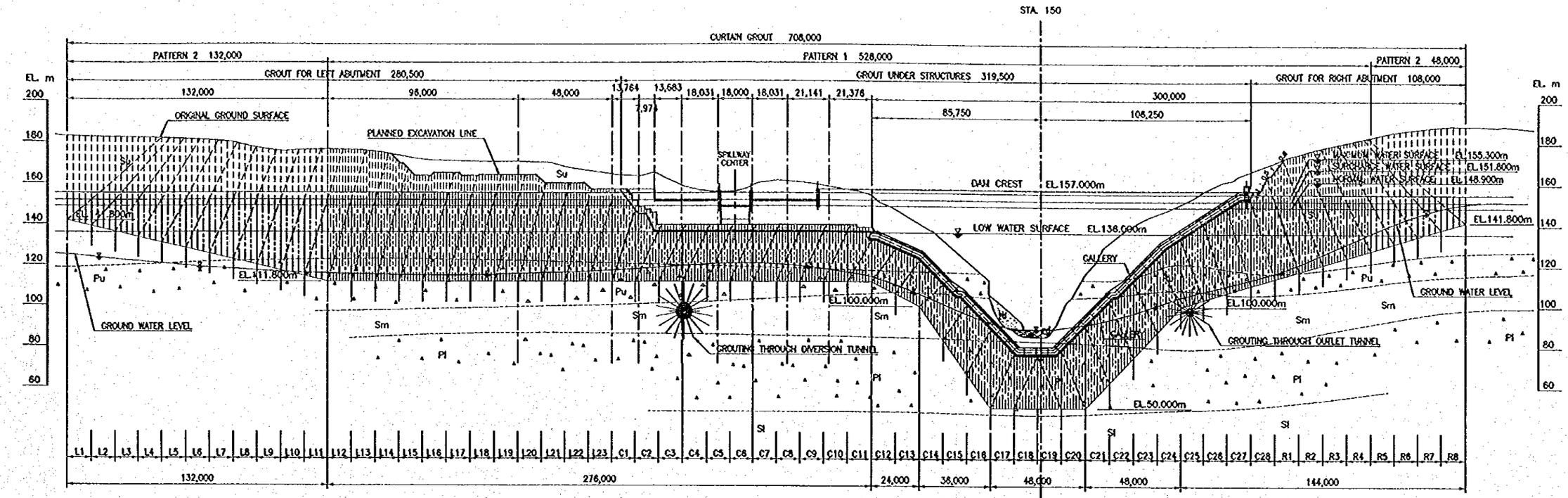
2.9.3 Consolidation and Blanket Grouting (46 mm dia.)

Grouting	Drilling (m)	Holes	Total (m)	Grouting (m)	Holes	Total (m)	Pressure Test	Holes	Total
Consolidation									
from Gallery	6.0	192	1152.0	5.0	192	960.0	1.0	192	192.0
Dam		x 1.05 =	1,200.0		x 1.05 =	1,010.0		x 1.05 =	200.0
Total					x 20kg/m=	20,000.0			
from Surface	6.5	77	500.5	5.0	77	385.0	1.0	77	77.0
Spillway		x 1.05 =	500.0		x 1.05 =	400.0		x 1.05 =	80.0
Total					x 20kg/m=	8,000.0			

Grouting	Drilling (m)	Holes	Total (m)	Grouting (m)	Holes	Total (m)	Pressure Test	Holes	Total
Blanket									
from Surface	11.0	188	2068.0	10.0	188	1880.0	2.0	188	376.0
(Dam)		x 1.05 =	2,200.0		x 1.05 =	1,970.0		x 1.05 =	390.0
Total					x 20kg/m=	39,000.0			

2.9.4 Drilling and Grouting from Tunnels (46mm dia.)

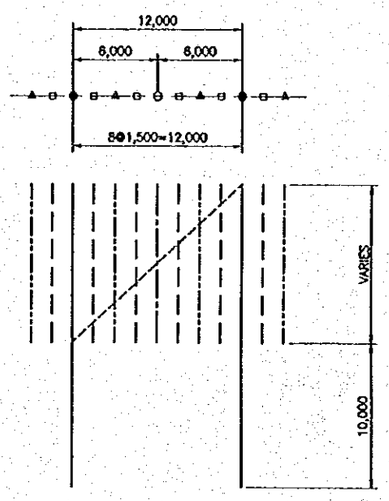
Grouting	No.	Drilling (m)	Holes	Total (m)	Grouting (m)	Holes	Total (m)	Pressure Test	Holes	Total
Diversion										
Curtain	1	13.0	1	13.0	10.0	1	10.0	2.0	1	2.0
	2	13.0	2	25.9	10.0	2	20.0	2.0	2	4.0
	3	13.0	2	25.9	10.0	2	20.0	2.0	2	4.0
	4	13.0	2	25.9	10.0	2	20.0	2.0	2	4.0
	5	13.0	2	25.9	10.0	2	20.0	2.0	2	4.0
	6	13.0	2	25.9	10.0	2	20.0	2.0	2	4.0
	7	13.1	2	26.2	10.0	2	20.0	2.0	2	4.0
	8	12.8	2	25.6	10.0	2	20.0	2.0	2	4.0
	9	12.3	2	24.7	10.0	2	20.0	2.0	2	4.0
	10	12.3	1	12.3	10.0	1	10.0	2.0	1	2.0
Consolidation-1	1	6.2	4.0	24.6	5.0	4.0	20.0	1.0	4.0	4.0
	2	6.2	8.0	49.2	5.0	8.0	40.0	1.0	8.0	8.0
	3	6.2	8.0	49.2	5.0	8.0	40.0	1.0	8.0	8.0
	4	6.1	8.0	48.5	5.0	8.0	40.0	1.0	8.0	8.0
	5	6.0	4.0	24.0	5.0	4.0	20.0	1.0	4.0	4.0
Consolidation-2	1	6.2	6.0	36.9	5.0	6.0	30.0	1.0	6.0	6.0
	2	6.2	6.0	36.9	5.0	6.0	30.0	1.0	6.0	6.0
	3	6.2	6.0	37.2	5.0	6.0	30.0	1.0	6.0	6.0
	4	6.1	6.0	36.3	5.0	6.0	30.0	1.0	6.0	6.0
Outlet Tunnel										
Curtain	1	10.1	1	10.1	10.0	1	10.0	2.0	1	2.0
	2	10.1	2	20.2	10.0	2	20.0	2.0	2	4.0
	3	10.1	2	20.2	10.0	2	20.0	2.0	2	4.0
	4	10.1	2	20.2	10.0	2	20.0	2.0	2	4.0
	5	10.1	2	20.2	10.0	2	20.0	2.0	2	4.0
	6	10.1	2	20.2	10.0	2	20.0	2.0	2	4.0
	7	10.1	2	20.2	10.0	2	20.0	2.0	2	4.0
	8	10.0	2	20.0	10.0	2	20.0	2.0	2	4.0
	9	10.0	2	20.0	10.0	2	20.0	2.0	2	4.0
	10	10.0	1	10.0	10.0	1	10.0	2.0	1	2.0
Consolidation-1	1	5.1	3.0	15.3	5.0	3.0	15.0	1.0	3.0	3.0
	2	5.1	6.0	30.6	5.0	6.0	30.0	1.0	6.0	6.0
	3	5.1	6.0	30.6	5.0	6.0	30.0	1.0	6.0	6.0
	4	5.0	6.0	30.0	5.0	6.0	30.0	1.0	6.0	6.0
	5	5.0	3.0	15.0	5.0	3.0	15.0	1.0	3.0	3.0
Consolidation-2	1	5.1	6.0	30.6	5.0	6.0	30.0	1.0	6.0	6.0
	2	5.1	6.0	30.6	5.0	6.0	30.0	1.0	6.0	6.0
	3	5.1	6.0	30.6	5.0	6.0	30.0	1.0	6.0	6.0
	4	5.0	6.0	30.0	5.0	6.0	30.0	1.0	6.0	6.0
Total				998.7			880.0			176.0
Total			x 1.05 =	1,050.0		x 1.05 =	920.0		x 1.05 =	180.0
Total						x 20kg/m=	18,000.0			



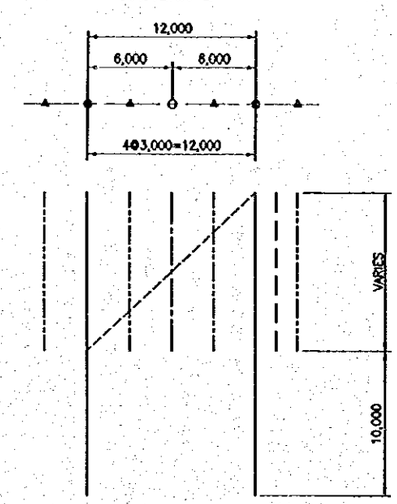
LONGITUDINAL PROFILE ALONG CUTAIN GROUT LINE

SCALE A

PATTERN 1



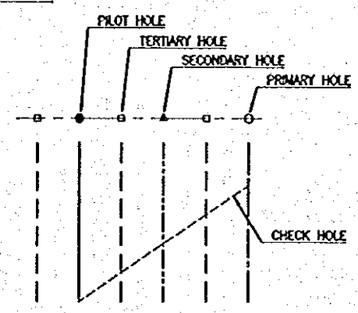
PATTERN 2



PATTERN OF CURTAIN GROUT HOLES

SCALE B

LEGEND



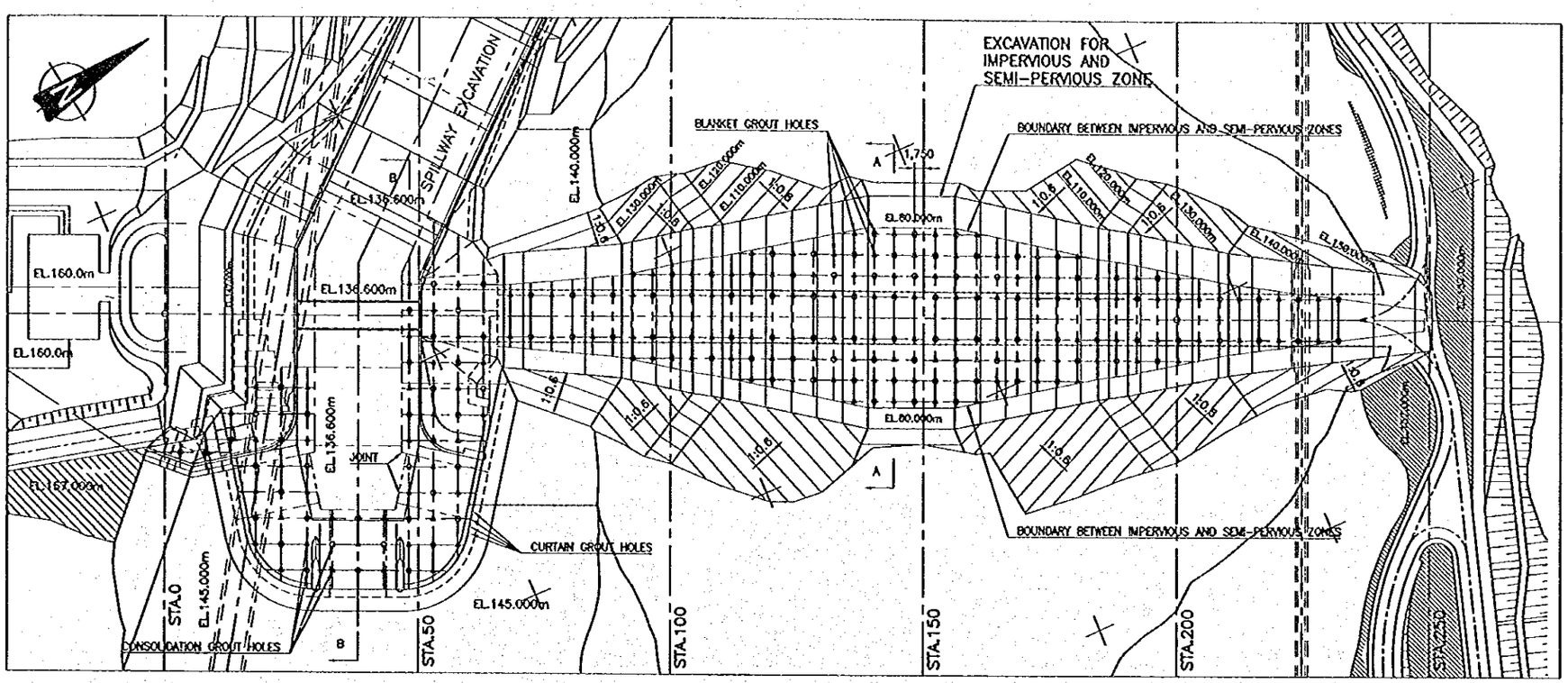
LEGEND

rd : RIVER DEPOSIT
td : TALUS DEPOSIT
Su : UPPER SEDIMENTARY ROCK UNIT
Pu : UPPER PYROCLASTIC ROCK UNIT
Sm : MIDDLE SEDIMENTARY ROCK UNIT
Pl : LOWER PYROCLASTIC ROCK UNIT

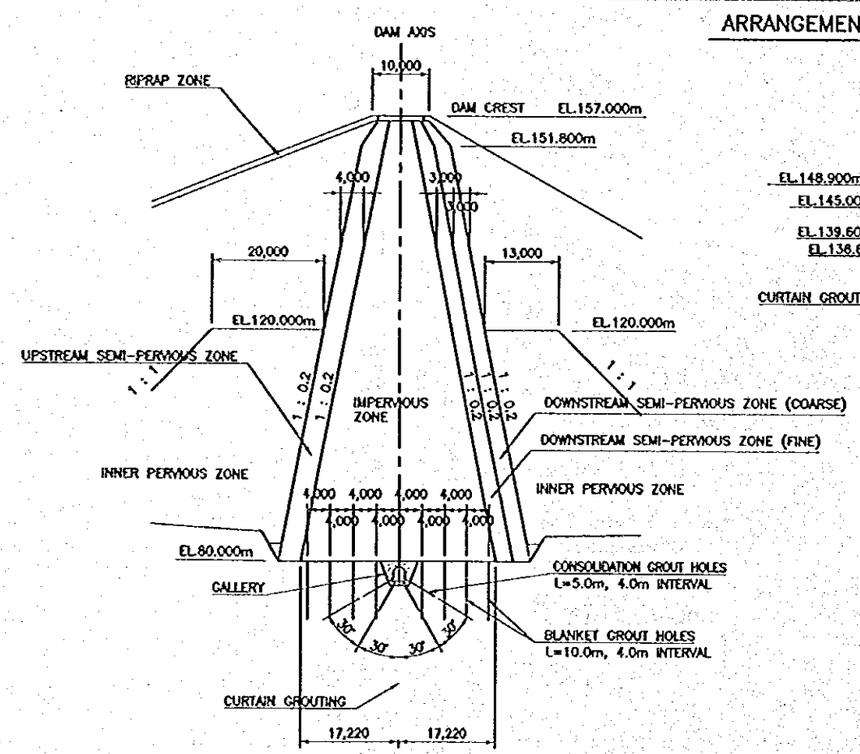
SCALE A 0 20 40 60 80 100m

SCALE B 0 4 8 12 16 20m

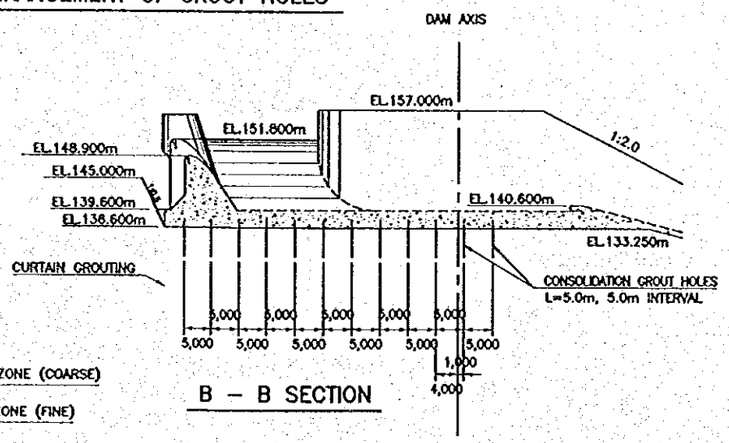
EMBANKMENT DAM
ARRANGEMENT OF FOUNDATION GROUTING (2/3)



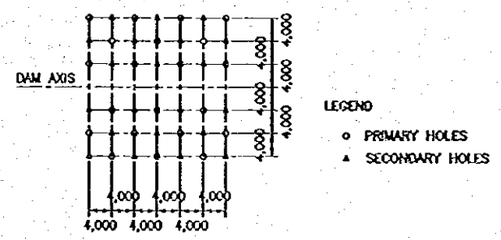
ARRANGEMENT OF GROUT HOLES



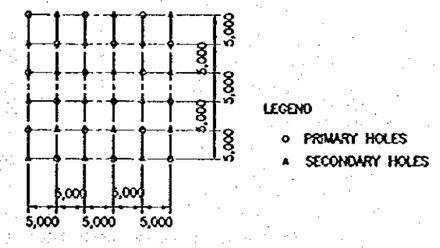
A – A SECTION



B – B SECTION



PATTERN OF BLANKET GROUT HOLES



PATTERN OF CONSOLIDATION GROUT HOLES

SCALE 0 10 20 30 40 50m

EMBANKMENT DAM
ARRANGEMENT OF FOUNDATION GROUTING (3/3)

Chapter 3

POWERHOUSE

POWERHOUSE

1. Excavation (Rock) EL. 77.700 ~ EL. 80.000 (Area is shown in other drawing sheet)

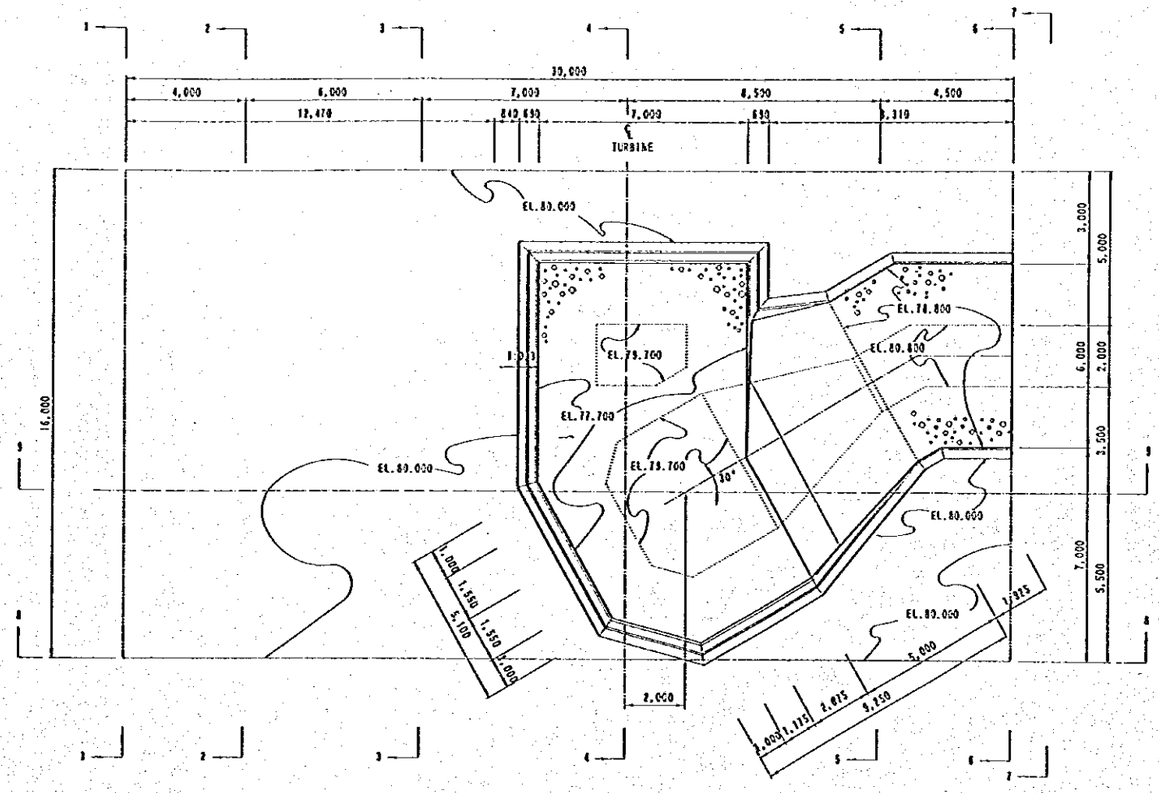
EL.	Area (Level) m^2	Average m^2	height m	Vol. m^3
77.700	83.417	—	—	—
78.000	93.731	88.574	0.30	26.57
78.800	126.959	110.345	0.80	88.28
78.800	156.442	—	—	—
79.000	159.333	157.888	0.20	31.58
80.000	173.942	166.638	1.00	166.64
			Total	313.07 m^3

2. LEAN CONCRETE (EL. 80.000 ~ EL. 82.800)

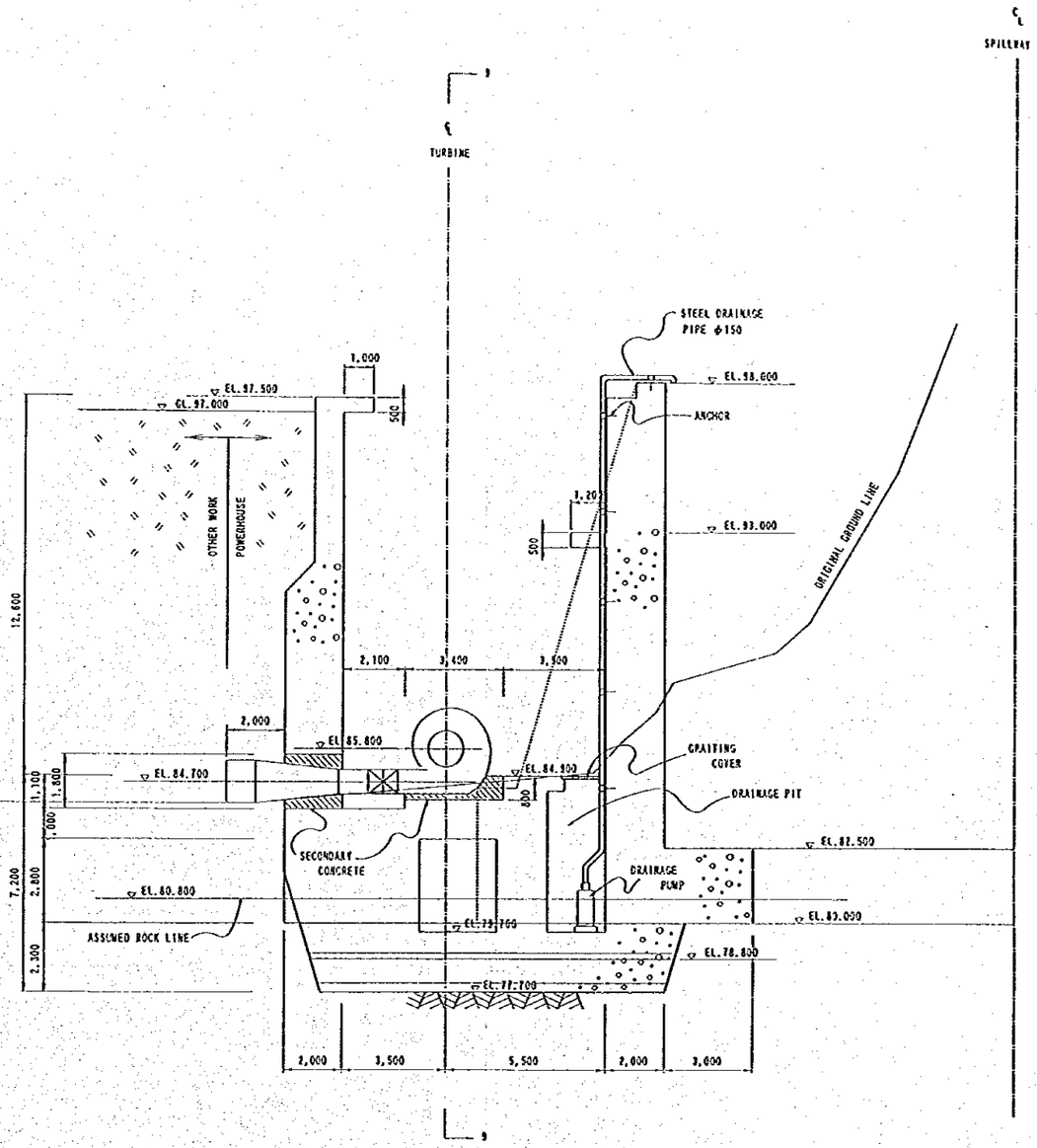
EL.	Area (Level) m^2	Average m^2	height m	Vol. m^3
80.000	194.139	—	—	—
81.000	182.964	188,302	1.00	188,30
82.000	171.386	176.925	1.00	176.93
82.800	162.954	169.170	0.80	133.74
			Sub total	498.97 m^3

Add Volume for open Area

1.0 × 6.1 × 2.4	=	14.64 m^3
	Total	504.61 m^3



EL. 77.700 - EL. 80.000 FLOOR

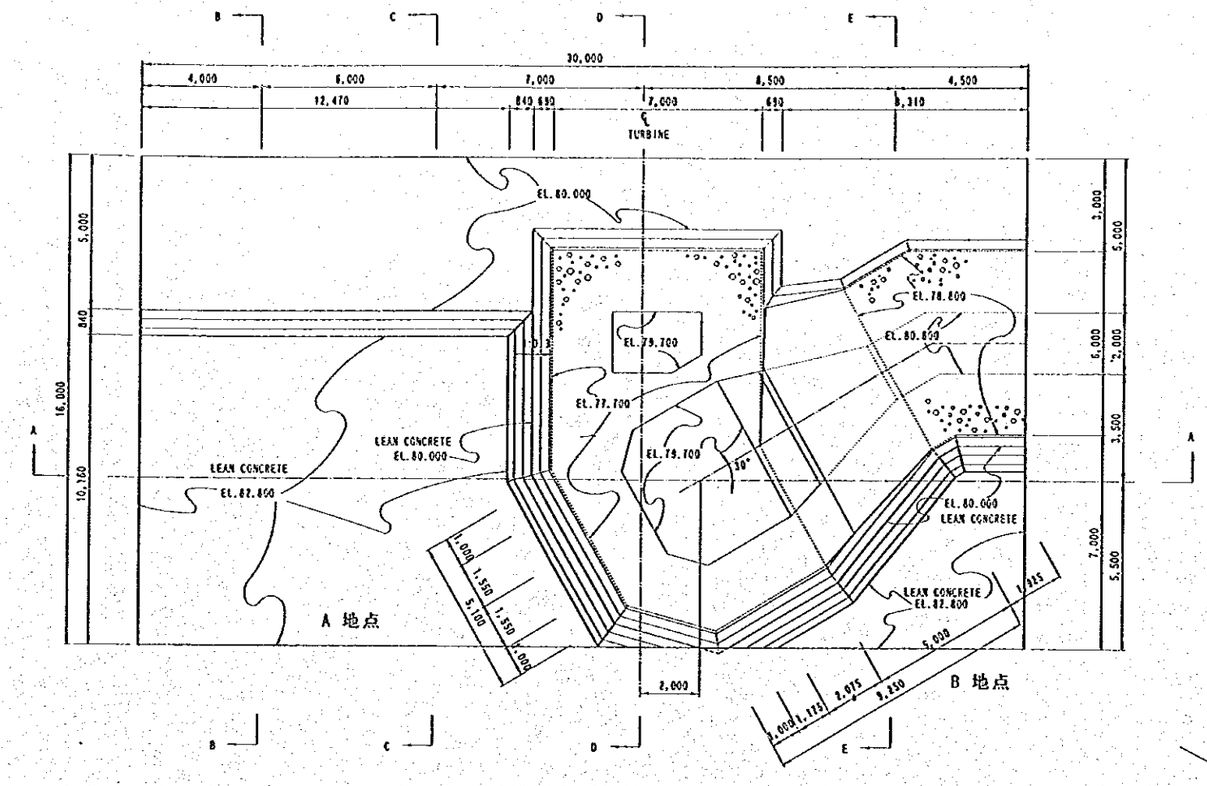


SECTION 4-4

SCALE 0 5 10 m

掘削平面面積算定 (ROCK)

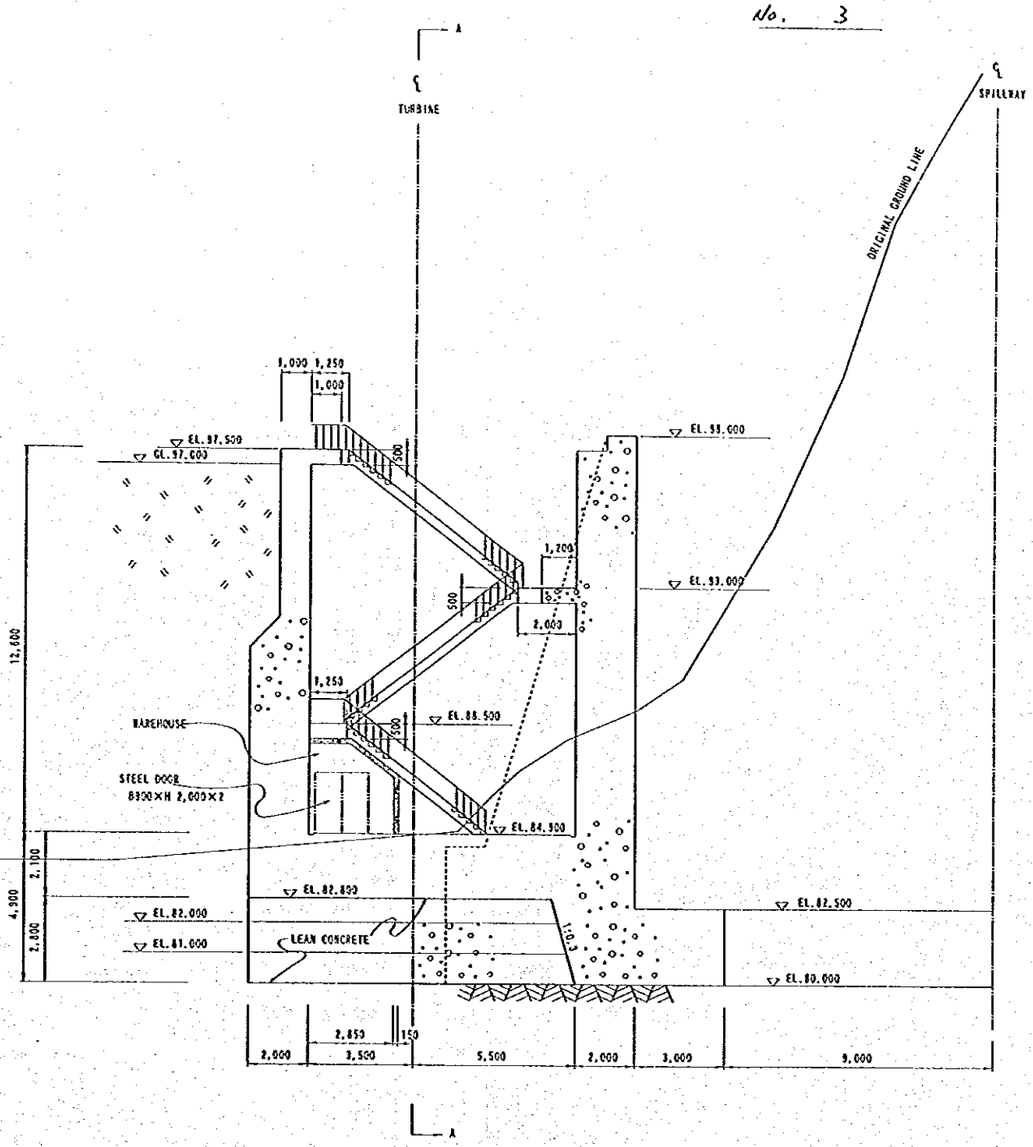
EL.	面積(JWCAD) 単位:m2
	面 積
77.700	83.417
78.000	93.731
78.800	126.959
78.800	156.442
79.000	159.333
80.000	173.942



EL. 80.000 ~ EL. 82.800 FLOOR

LEAN CONCRETE 面積算定

EL.	面積(JWCAD)		単位:m2
	A 地点	B 地点	合 計
80.000	156.457	37.682	194.139
81.000	148.481	33.983	182.464
82.000	140.899	30.487	171.386
82.800	135.116	27.838	162.954



SECTION C-C

SCALE 0 5 10 m

3. CONCRETE STRUCTURE

1) EL. 77.900 ~ EL. 82.800 (Area is shown in other drawing sheet)

EL.	Area (Level) m^2	Average m^2	height m	Vol. m^3
77.900	83.417	—	—	—
78.000	93.731	88.574	0.30	26.57
78.800	126.959	110.345	0.80	88.28
78.800	156.442	—	—	—
79.000	159.333	159.888	0.20	31.58
80.000	193.942	166.638	1.00	166.64
80.000	285.952	—	—	—
81.000	297.536	291.744	1.00	291.74
82.000	308.613	303.074	1.00	303.07
82.500	313.928	311.271	0.50	155.64
82.500	223.928	—	—	—
82.800	227.045	225.487	0.30	67.65

Sub total 1,131.17 m^3

Subtraction

Tailrace $V = \{(3.10+5.10) \times 1/2 \times 1.00 + 5.10 \times 3.25\} \times 3.10 + (2.00 \times 2.00 + 5.10 \times 3.10) \times 1/2 \times 5.00 + 2.00^2 \times (1.925 + 3.206)$ $= -134.14\ m^3$

Drain Pit $V = (3.00 \times 2.00 - 1.00 \times 0.60 \times 1/2) \times 3.10$ $= -17.67$ "

Subtraction Total. 999.36 m^3

2) EL. 82.800 ~ EL. 98.000

- Section Ⓐ

$V_1 = 2.00 \times 11.60 \times 13.00 + 2.00 \times 11.60 \times 5.00 = 417.60\ m^3$

$V_2 = 7.00 \times 2.10 \times 13.00 = 191.10$ "

$V_3 = 7.00 \times 1.00 \times 13.00 + 7.00 \times 0.50 \times 1.00 = 94.50$ "

$V_4 = 2.00 \times 2.00 \times (11.00 + 3.00) = 56.00$ "

$V_5 = 1.00 \times 0.80 \times 3.00 \times 2 = 4.80$ "

$V_6 = 2.00 \times 2.00 \times 10.10 + 1.00^2 \times 1/2 \times 2.00 \times 2 = 42.40$ "

Total of Section Ⓐ = 806.40 m^3

• Section Ⓑ

V_7 = 15.00 × 2.10 × 13.00 = 409.50 m³

V_8 = (2.00 × 12.60 + 1.00 × 0.50) × 15.00 = 308.50 "

V_9 = (1.00 × 6.50 + 1.00² × 1/2 + 2.00 × 6.10) × 15.00 = 288.00 "

V_{10} = (1.00 × 15.00 + 1.00 × 0.25 + 1.00 × 1.00) × 0.50 = 81.25 "

V_{11} = (1.20 × 15.00 + 2.00 × 0.80 + 0.80² × 1/2 × 2
+ 2.00 × 4.80 + 0.50 × 1.00 × 1/2 + 1.00 × 1.00) × 0.50 = 15.545 "

V_{12} = 2.20 × 1.25 × 0.50 = 1.375 "

Landing

V_{13} = (0.1875 × 5.95 + 0.29 × 0.1875 × 1/2 × 23) × 1.00 × 2 pcs
Stairs + (0.18 × 4.50 + 0.29 × 0.18 × 1/2 × 19 + 0.25 × 0.18 × 1/2) × 1.00 = 4.61 "

Subtotal = 1,108.98 m³

Subtraction

Penstock (Extract of water) V = 3.20 × 2.10 × 1.10 = − 7.39 m³

Penstock V = 1.80² × π/4 × 2.00 = − 5.09 "

Draft V = 3.00 × 2.10 × 2.80 = − 17.64 "

" V = 1.00 × 0.80 × 3.40 = − 2.72 "

ROTOR V = (1.40 × 2.00 + 1.50 × 3.00 + 1.50 × 1.20)
× 0.50 = − 4.55 "

DRAIN PIT V = (3.00 × 2.00 − 1.00 × 0.60 × 1/2) × 2.10
− 2.00 × 1.40 × 0.50 = − 10.57 "

Open Area V = 0.80 × 1.00 × 0.50 = − 0.40 "

AIR DUCT V = 1.50 × 1.00 × (1.50 + 3.50) = − 7.50 "

CABLE DUCT

W500×D400 V = 0.50 × 0.40 × (1.90 + 2.00 + 2.90) = − 1.36 "

W700×D400 V = 0.70 × 0.40 × 4.50 = − 1.26 "

W300×D300 V = 0.30 × 0.30 × (3.50 + 0.90 + 0.50 × 2) = − 0.49 "

DRAINAGE

W150 x D50 $V = 0.15 \times 0.05 \times (9.00 + 12.70 + 9.00 + 3.05 + 6.45)$ $= -0.30\ m^3$

PIPE φ150 $V = 0.15^2 \times \pi/4 \times 0.50$

" φ100 $V = 0.10^2 \times \pi/4 \times 0.50$ } $= -0.01$ "

Total of Subtraction $= -59.26\ m^3$

Total of Section Ⓑ $= 1,049.52\ m^3$

• Section Ⓒ

$V_{14} = 8.00 \times 2.10 \times 13.00$ $= 218.40\ m^3$

$V_{15} = 1.00 \times 11.90 \times 9.00$ $= 107.10$ "

$V_{16} = 2.00 \times 11.90 \times 8.00$ $= 190.40$ "

$V_{17} = (1.00 \times 5.80 + 1.00^2 \times 1/2 + 2.00 \times 6.10) \times 8.00$ $= 148.00$ "

$V_{18} = \{9.00 \times 11.90 - (3.00 \times 2.50 - 0.50^2) - (4.00 \times 3.00 - 0.50^2)\} \times 2.00$ $= 176.20$ "

$V_{19} = (12.00 \times 0.70 + 1.00 \times 0.50) \times 8.00$ $= 71.20$ "

$V_{20} = 9.00 \times 1.00 \times 5.00$ $= 45.00$ "

$V_{21} = (0.30 + 0.80) \times 1/2 \times 0.50 \times 9.00 \times 2$ $= 4.95$ "

Subtotal $= 961.25\ m^3$

Subtraction

Open Area $V = (1.00 \times 1.30 + 0.80 \times 1.40) \times 2.00$ $= -4.84\ m^3$

" $V = 0.50 \times 0.50 \times 0.70 \times 2$ $= -0.35$ "

" $V = 1.40 \times 0.80 \times 1.00$ $= -1.12$ "

" $V = 1.00 \times 1.50 \times 1.00$ $= -1.50$ "

STEEL
PIPE φ800, φ150
φ400, φ250

$V = (1.00^2 + 0.85^2 + 0.60^2 + 0.45^2) \times \pi/4$

$\times 2.00 \quad = -3.59\ m^3$

DRAINAGE
W150×D50 $V = 0.15 \times 0.05 \times (5.00 + 5.00$

$+ 8.70 + 2.50 + 2.50 + 2.00 + 2.00) = -0.21\ m^3$

Foundation
SECONDARY
CONCRETE $V = (0.80 \times 0.80 + 0.40 \times 0.40) \times 0.60 \times 2 = -0.80\ m^3$

Sub total $= -12.41\ m^3$

Total of Section ©

$961.25 - 12.41 = 948.84\ m^3$

3) AIR DUCT

$V = 1.60 \times 2.10 \times 2.70 - 1.00 \times 1.50 \times 2.20$

$- 1.00 \times 0.30 \times 1.50 - 0.20 \times 0.20 \times (1.90 \times 2 + 1.00 \times 2) = 5.09\ m^3$

↑ SECONDARY CON.

4) Around of Penstock

Add: $6.1 \times 4.6 \times 1.0 - 2.6 \times (3.2 + 0.9) \times 1.0 = 17.40\ m^3$

Subtraction: Upper $2.0 \times 0.4 \times 4.1 = -3.28\ m^3$

Lower $1.0 \times 0.4 \times 4.1 = -1.64\ m^3$

Total $12.48\ m^3$

5) Total

EL. 77.700 ~ EL. 82.800 の 計 $= 979.36\ m^3$

EL. 82.800 ~ EL. 98.000

Section Ⓐ $= 806.40\ m^3$

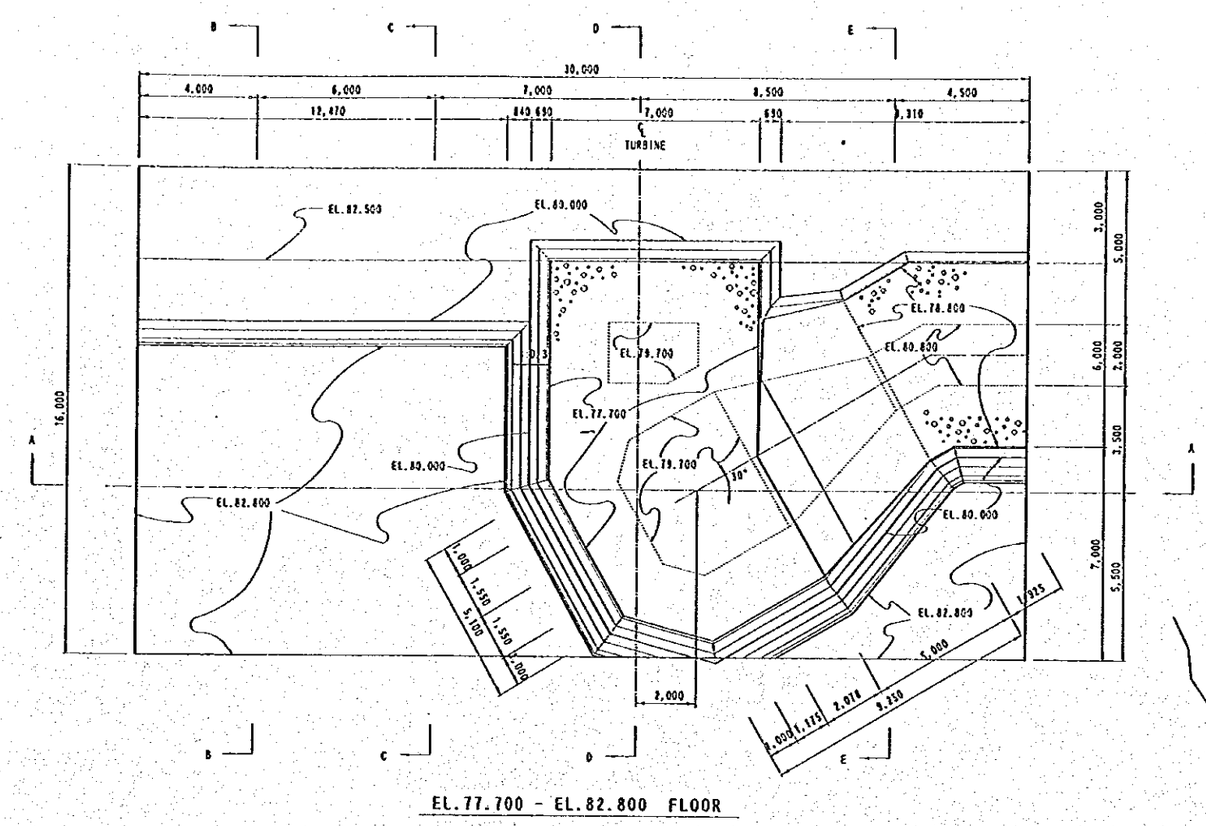
Section Ⓑ $= 1,049.52\ m^3$

Section Ⓒ $= 948.84\ m^3$

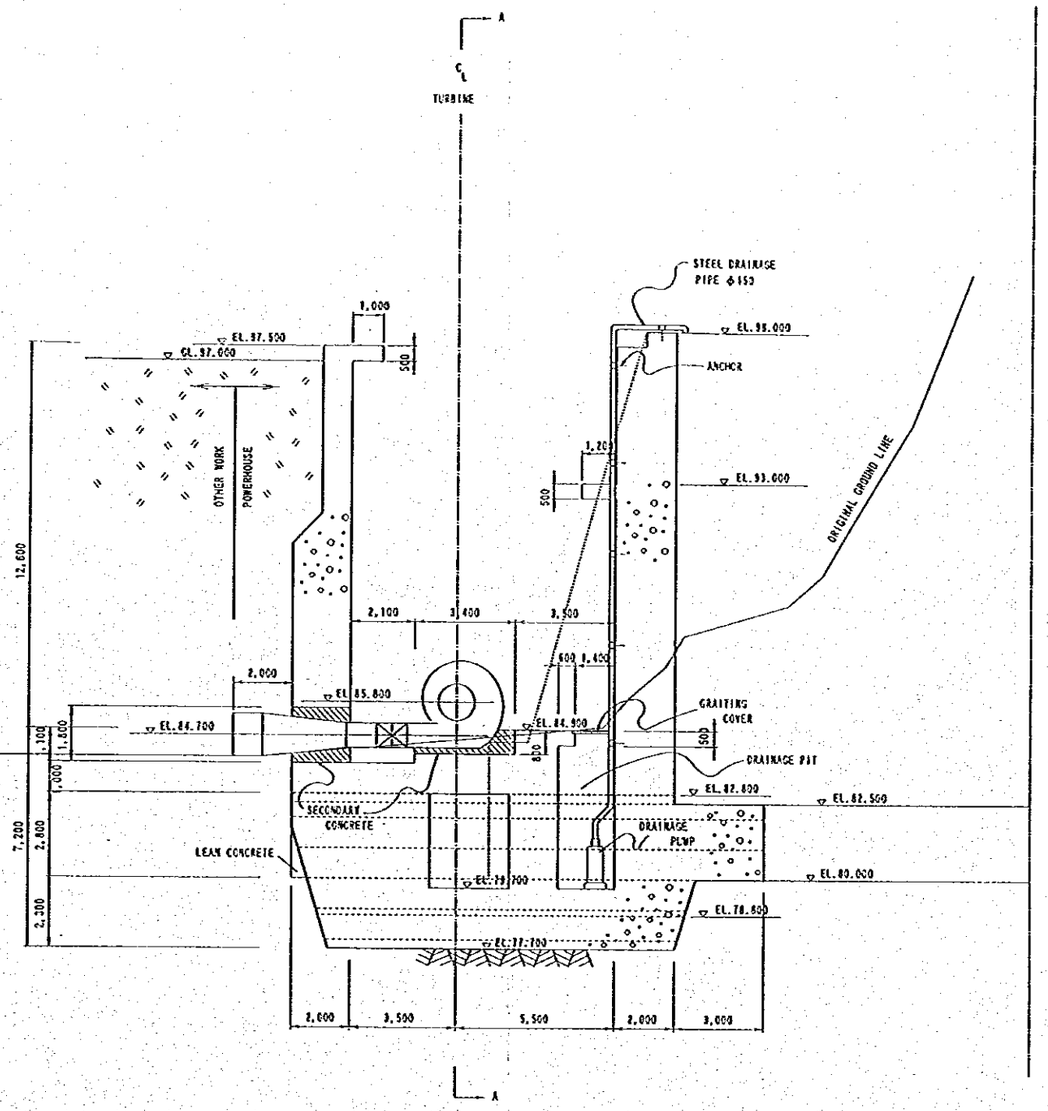
AIR DUCT $= 5.09\ m^3$

Around of Penstock $= 12.48\ m^3$

Total $3801.69\ m^3$

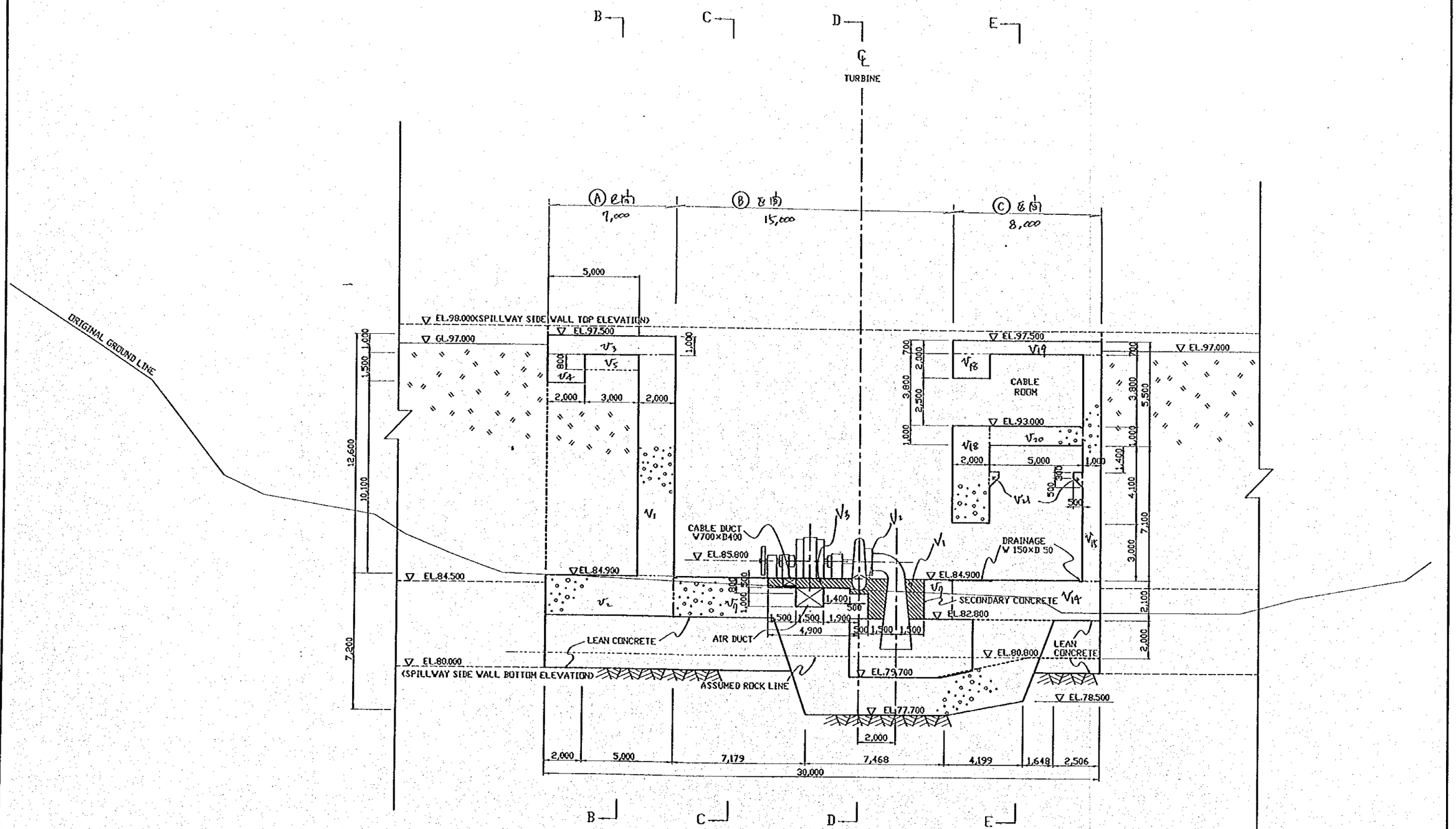


EL. 77.700 - EL. 82.800 FLOOR



CONCRETE 面積算定

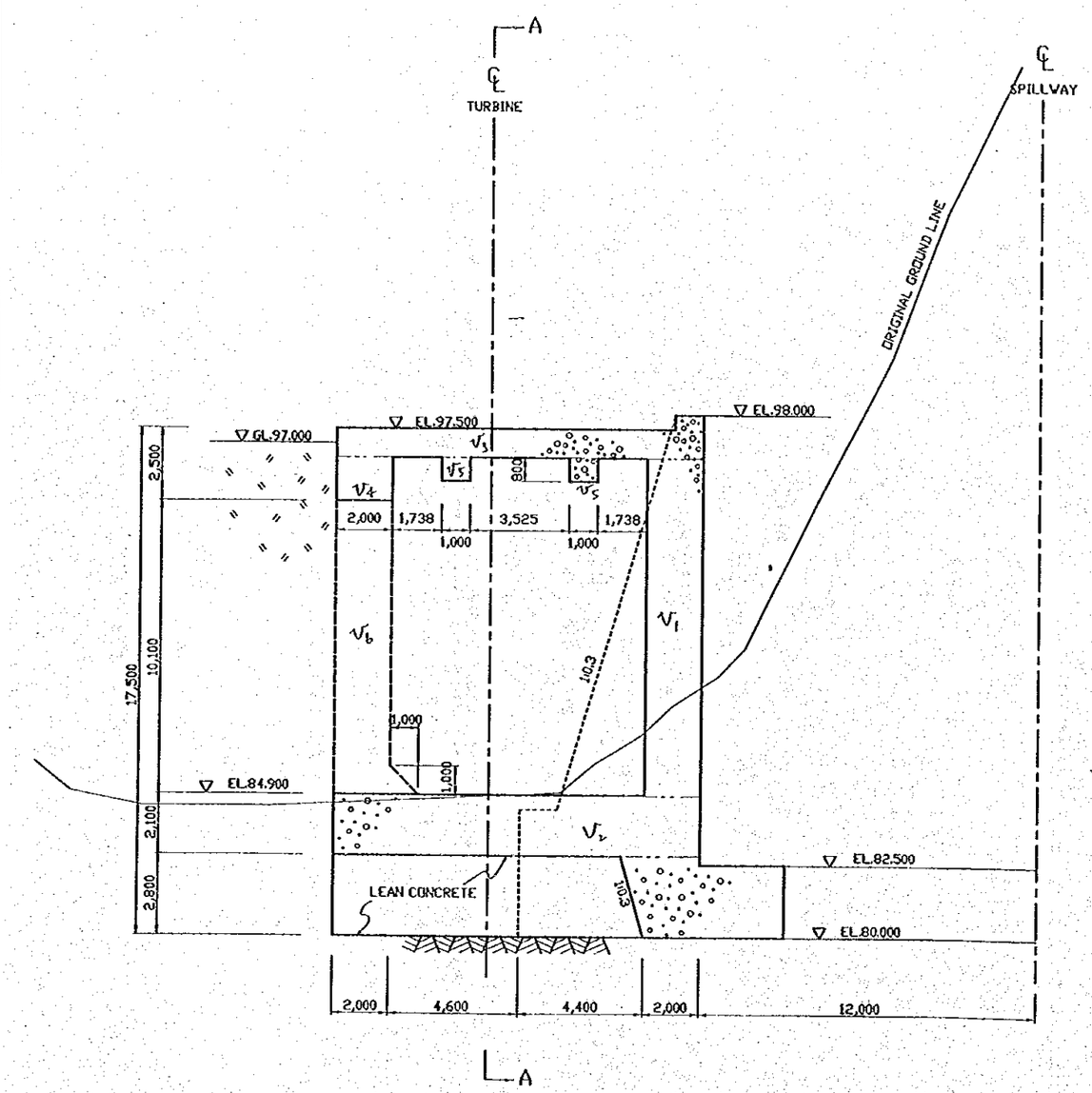
EL.	面積(JWCAD) 単位:m2
	面 積
77.700	83.417
78.000	93.731
78.800	126.959
78.800	156.442
79.000	159.333
80.000	173.942
80.000	285.952
81.000	297.536
82.000	308.613
82.500	313.928
82.500	223.928
82.800	227.045



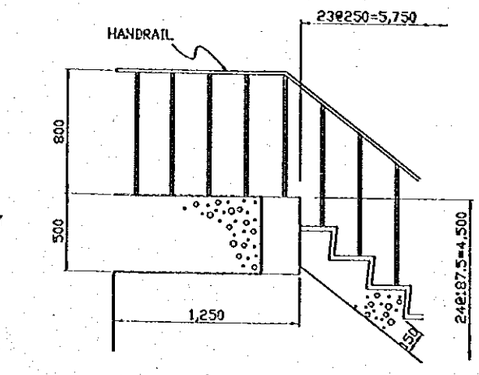
SECTION A-A

SCALE 0 5 10 m

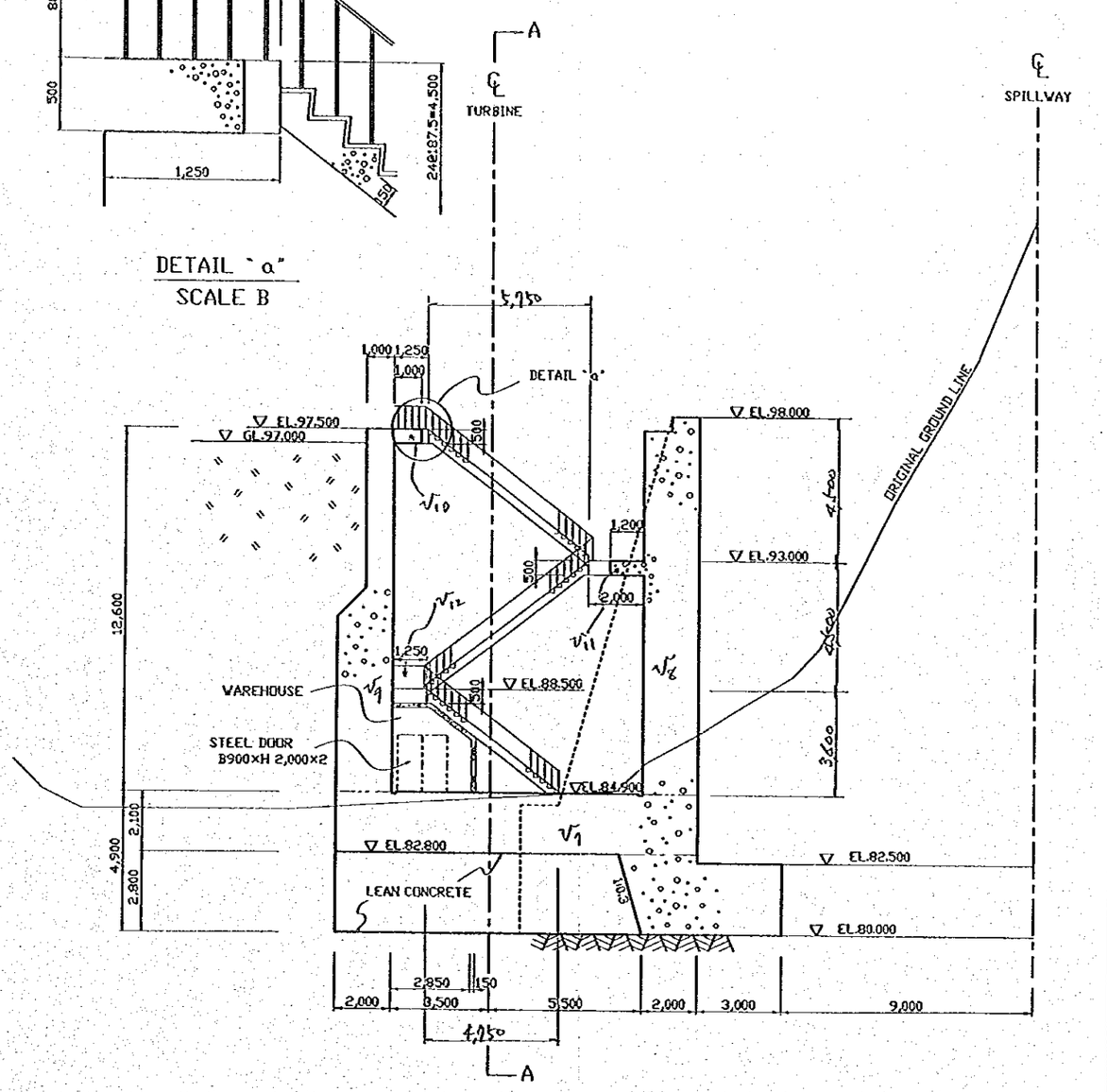
THE DETAILED DESIGN OF FLOOD CONTROL,URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 1-1 JATIBARANG DAM POWERHOUSE CONCRETE OUTLINE PROFILE
JAPAN INTERNATIONAL COOPERATION AGENCY	



SECTION B-B
SCALE A



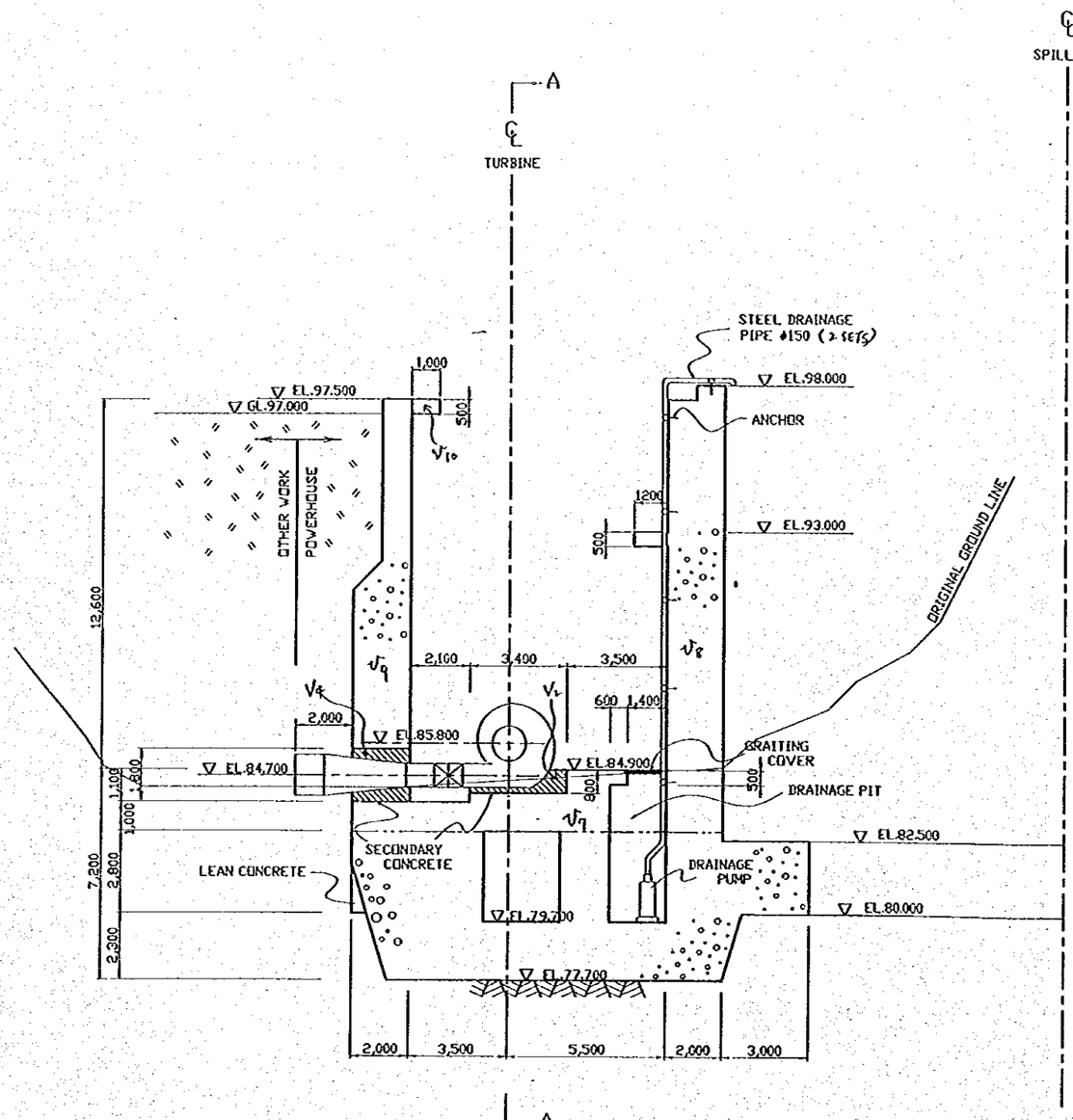
DETAIL "a"
SCALE B



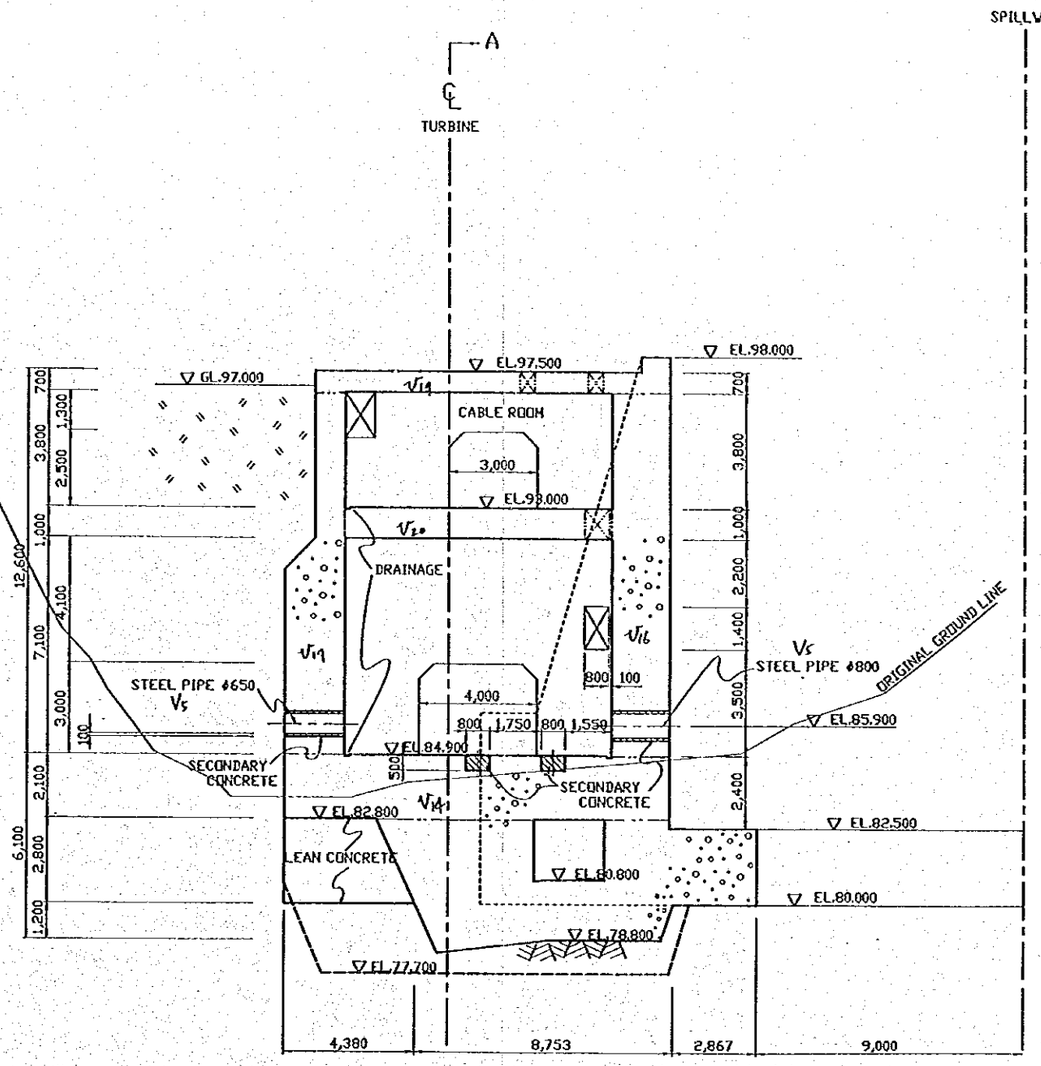
SECTION C-C
SCALE A

SCALE A 0 5 10 m
SCALE B 0 0.5 1 1.5 2 m

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 1-2 JATIBARANG DAM POWERHOUSE CONCRETE OUTLINE SECTION (SHEET 1 OF 2)
JAPAN INTERNATIONAL COOPERATION AGENCY	



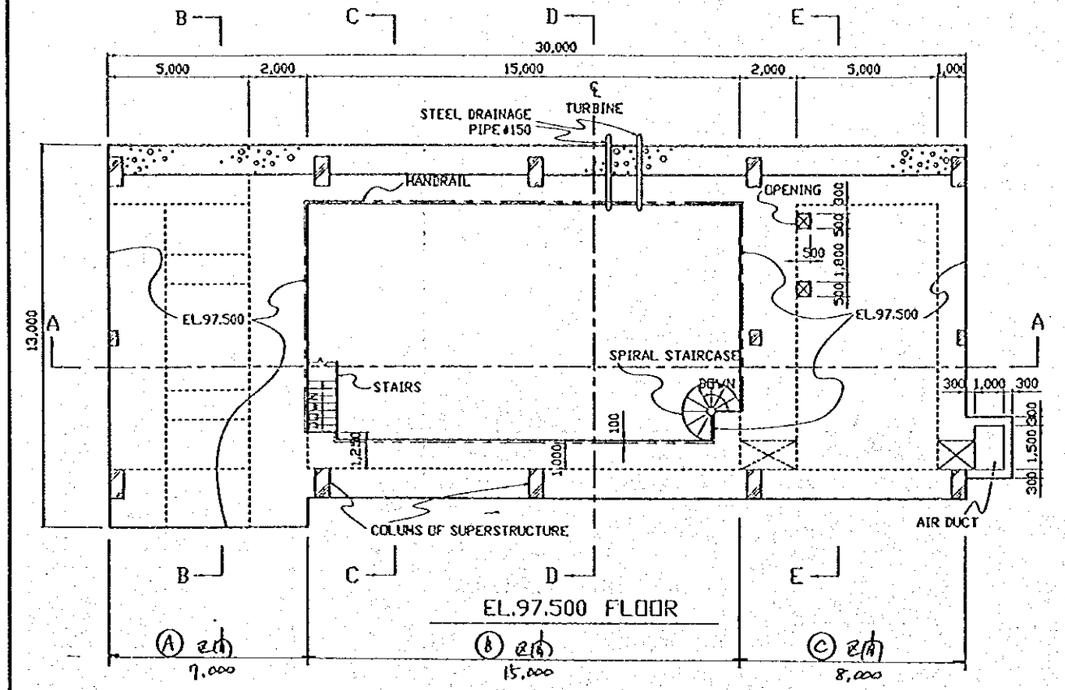
SECTION D-D

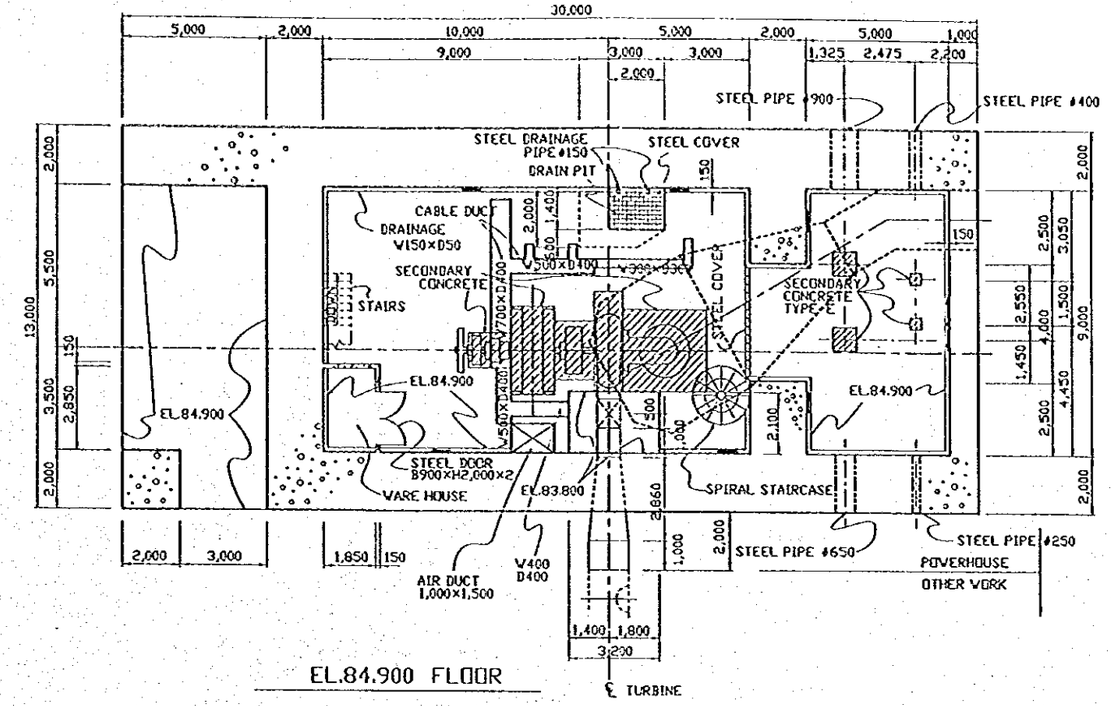


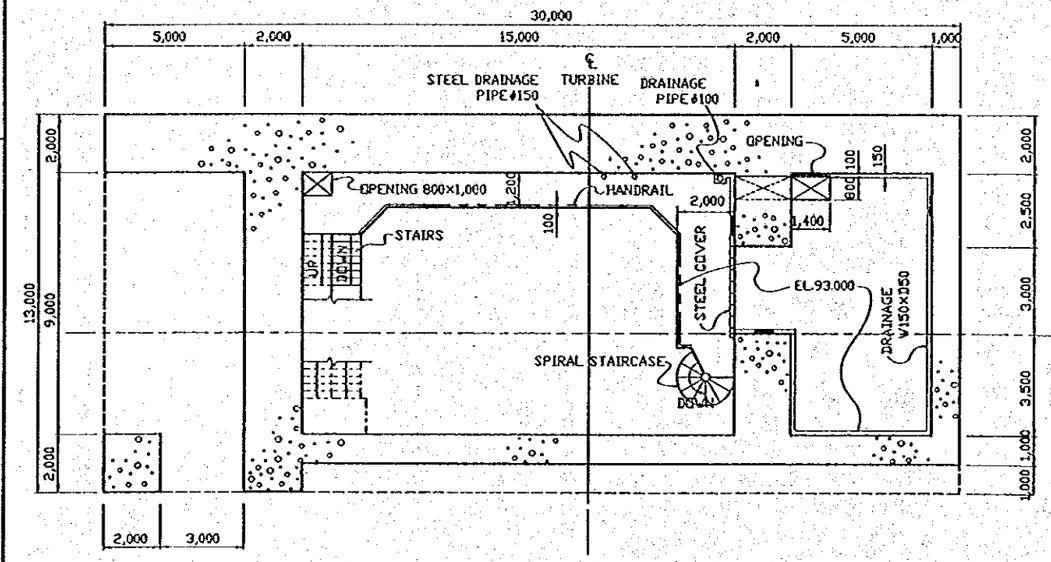
SECTION E-E

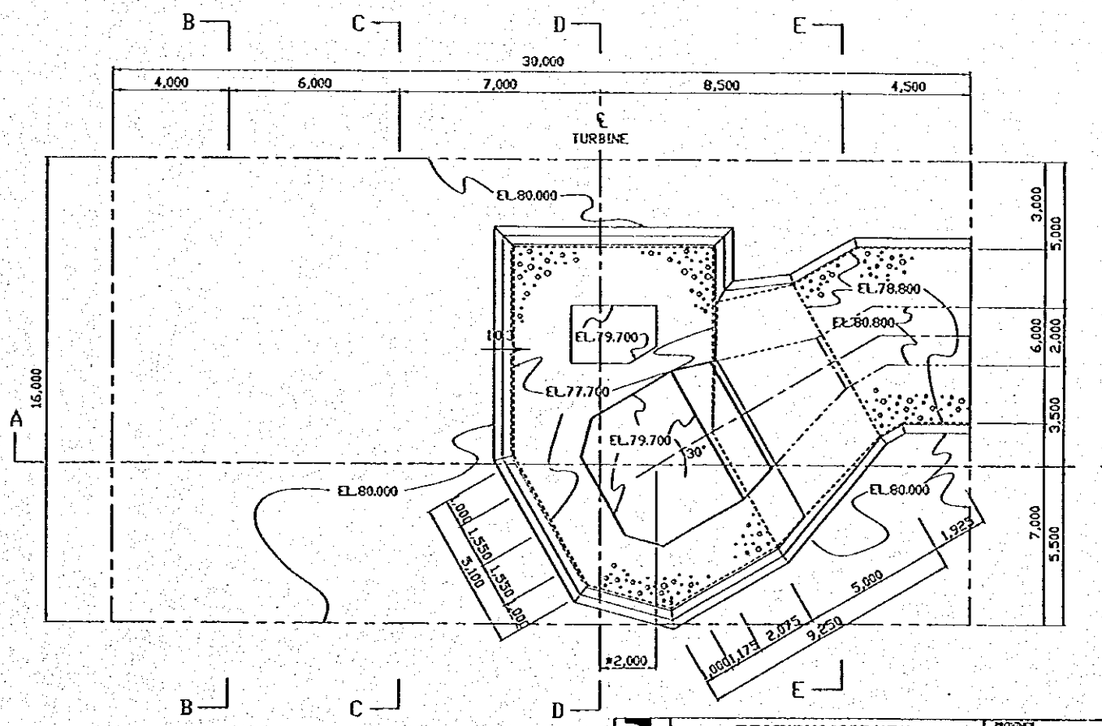
SCALE 0 5 10 m

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 1-3 JATIBARANG DAM POWERHOUSE CONCRETE OUTLINE SECTION (SHEET 2 OF 2)
JAPAN INTERNATIONAL COOPERATION AGENCY	









NOTES

1. THE DIMENSION MARKED WITH * AND RELATED DIMENSIONS MAY BE CHANGED DEPENDING ON THE SIZE OF A TURBINE.
2. THE STEEL PIPES SHOWN IN EL.84.900 FLOOR SHALL BE EMBEDED AT THE EL.85.900 WHICH ARE SUPPLIED BY OTHER CONTRACTOR.

REFERENCE DRAWINGS

JD-PI-HS-PI-1	GENERAL PLAN OF POVERHOUSE AREA
JD-PI-HS-St-2	POVERHOUSE-CONCRETE OUTLINE-PROFILE
JD-PI-HS-St-3	POVERHOUSE-CONCRETE OUTLINE-SECTIONS(1/2)
JD-PI-HS-St-4	POVERHOUSE-CONCRETE OUTLINE-SECTIONS(2/2)
JD-PI-HS-St-6	POVERHOUSE AND TAILRACE-GENERAL PLAN

SCALE 0 5 10 m

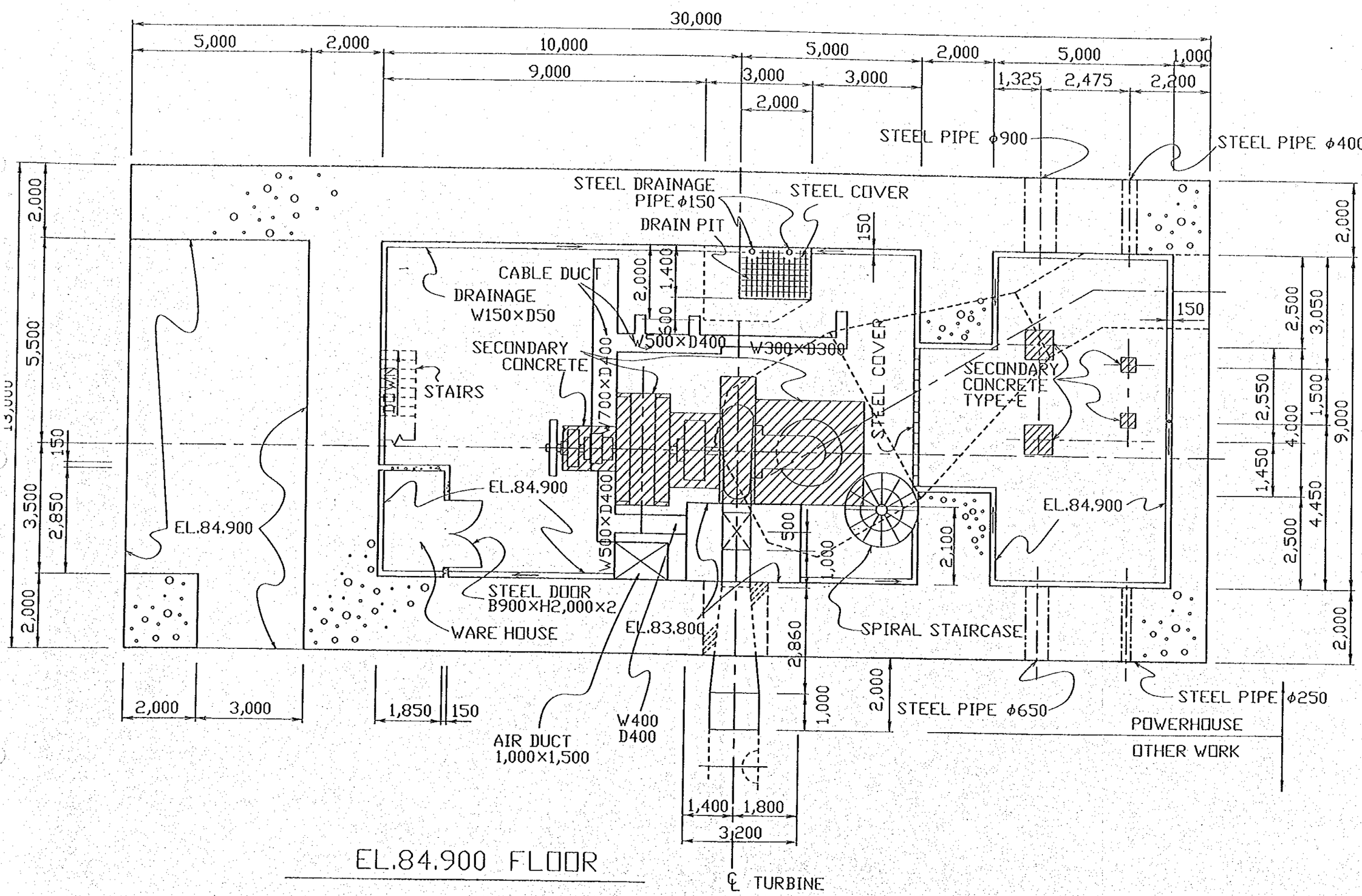
NO.	DATE	REVISIONS	ORIGINATED	DESIGNED	APPROVED

THE REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT AND DIRECTORATE GENERAL OF HUMAN SETTLEMENT

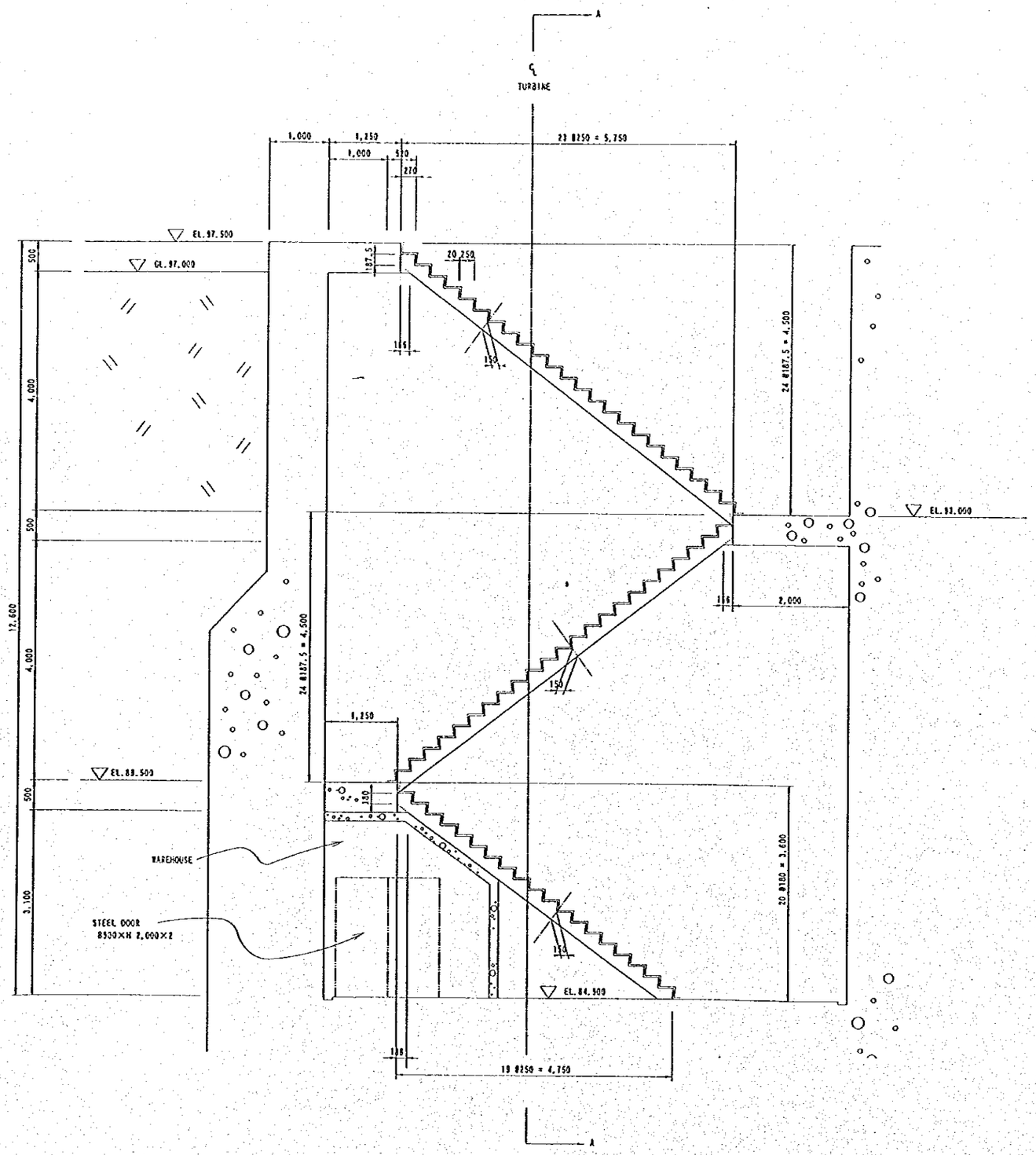
JRATUNSELUNA FLOOD CONTROL PROJECT
COMPONENT : JATIBARANG DAM CONSTRUCTION
JATIBARANG DAM MANAGEMENT COMPLEX
POWERHOUSE CONCRETE OUTLINE
PLAN

DESIGNED	
CHECKED	
APPROVED	CHIEF OF PLANNING AND DESIGN
	PROJECT MANAGER

PROVINCE: CENTRAL JAVA
PROJECT NAME: FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT OF SEMARANG IN THE REPUBLIC OF INDONESIA
DISTRICT: SEMARANG CITY
DRAWING NO. JD-PI-HS-St-5
SHEET NO.
DATE | CONTRACT NO.



EL.84.900 FLOOR



DETAIL OF STAIRS

4. SECONDARY CONCRETE

1) Around of Generator

Draft $V_1 = 3.00 \times 2.10 \times 2.80 - (0.90^2 + 1.40^2) \times 1/2 \times \pi/4 \times 2.10 = 17.64\ m^3$

" $V_2 = 1.00 \times 0.80 \times 3.40 - 0.404\ m^3 \times 2.50 = 1.91\ m^3$ (for JWCAD)

Rotor $V_3 = (1.40 \times 2.00 + 1.50 \times 3.00 + 1.50 \times 1.20) \times 0.50 - 0.70 \times 0.40 \times 1.20 = 4.21\ m^3$ (CABLE DUCT)

2) Penstock $V_4 = 1.80^2 \times \pi/4 \times 2.00 - (0.80^2 + 1.17^2) \times 1/2 \times \pi/4 \times 2.00 = 3.51\ m^3$

3) STEEL PIPE (Type C)

φ800, φ650
φ400, φ250 $V_5 = \{(1.00^2 + 0.85^2 + 0.60^2 + 0.45^2) \times \pi/4 - (0.80^2 + 0.65^2 + 0.40^2 \times 0.25^2) \times \pi/4\} \times 2.00 = 1.57\ m^3$

4) Foundation

$V_6 = (0.80 \times 0.80 + 0.40 \times 0.40) \times 0.50 \times 2 = 0.80\ m^3$

5) AIR DUCT

$V_7 = 0.20 \times 0.20 \times (1.90 \times 2 + 1.00 \times 2) = 0.23\ m^3$

Total 29.69 m^3

6) Total of Type E Concrete

Lean Concrete + Secondary Concrete (Type E)

$= 504.61 + (29.67 - 1.57) = 532.71\ m^3$

5. REINFORCEMENT (≤D30) (see pp. 16-21 ~ 16-28)

(S)

D13	D19	D22	D25	Subtotal
797.1	7225.1	607.0	0	8629.6 kg.

Wall (1-2)+(3-3)

D13	D19	D22	D25	Subtotal
1776.5	26955.1	3900.5	6749.4	39381.5 kg.

Wall (4-4)+(5-5)+(7-7)+(8-8)

D13	D19	D22	D25	Subtotal
815.3	8840.0	402.7	0	10058.0 kg.

Floor Board (FG)

D13	D19	D22	D25	D29	Subtotal
1051.6	25175.8	697.2	3456.0	13719.1	44099.7

(K)

D13	Subtotal
589.2	589.2

Total 102758 kg