3. Tanque de Carga
Head Tank

3. Tanque de Carga

Head Tank

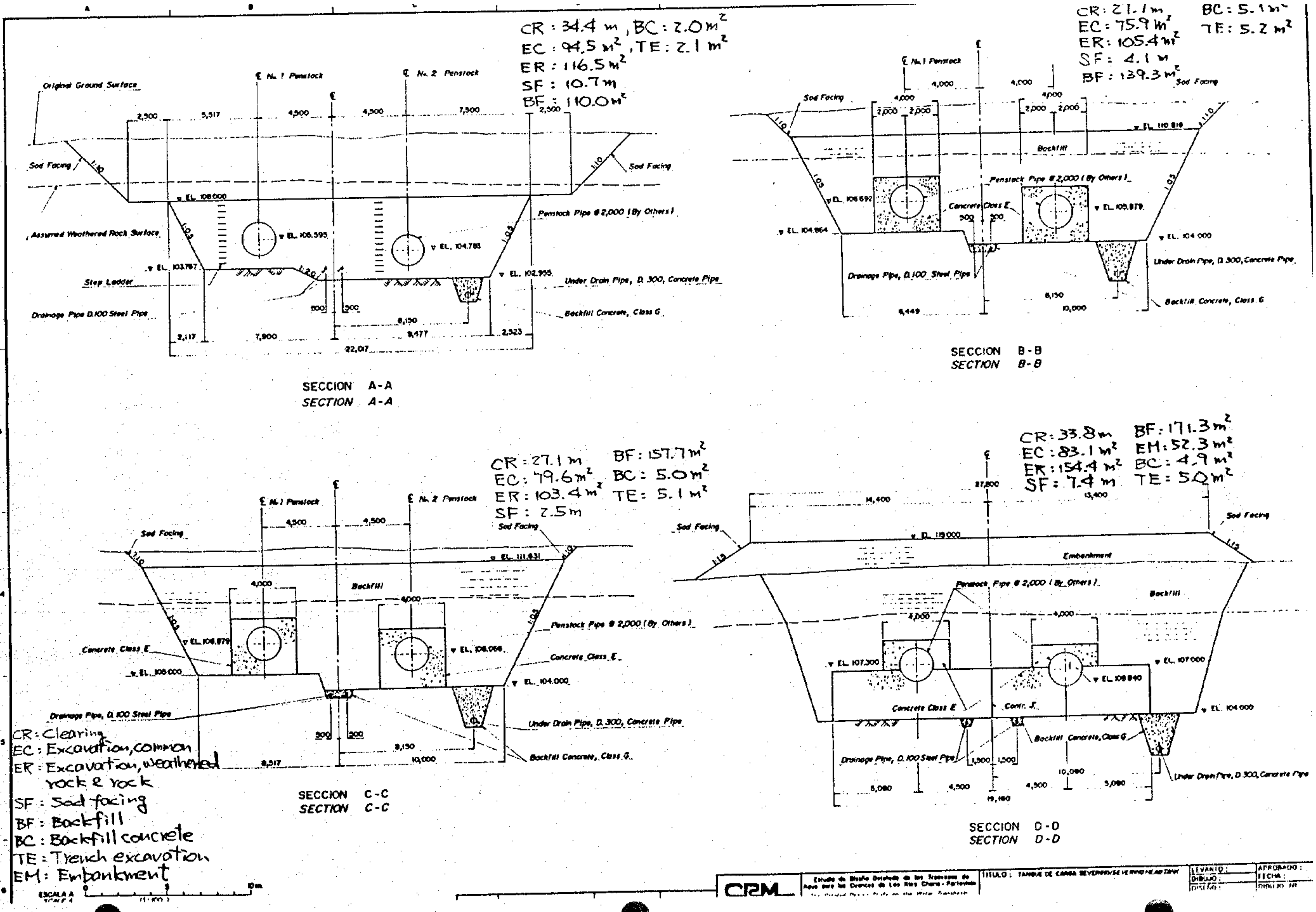
Working Division: 4. Severino Head Tank

Description	Calculation Details	Unit	Quantity	Remarks
4.2	EARTHWORK			
101	clearing the site			
	2,410 m²			
102	Open-cut excavation, in common, for head tank			
	6,128 m³			
103	Open-cut excavation, in weathered rock, for head tank			
	weathered rock & rock 10,292 m³			
	90% weathered rock 10,292 × 0.9			
	= 9,263 m³			
104	Open-cut excavation, in rock, for head tank			
	10% for rock 10,292 × 0.1 = 1,029 m³			
106	Free drainning backfill 463 m³			
107	Backfill			
	4,351 m³			
108	Embankment			
	780 m³			
110	Sod Facing 552 m²			

W-12

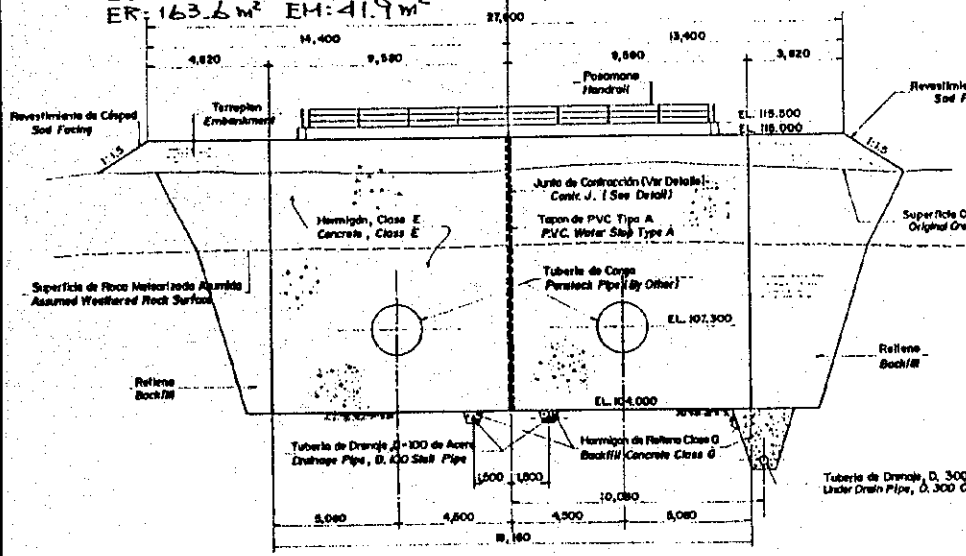
Head Tank Earth Work

		Site Clearance		Excavation, common		Excavation, w. rock		Free Draining Backfill		Back Fill		Sod Facing		Embankment	
Sec. No.	Distance (m)	L (m)	A (m2)	A (m2)	V (m3)	A (m2)	V (m3)	A (m2)	V (m3)	A (m2)	V (m3)	L (m)	A (m2)	A (m2)	V (m3)
A		34.4		94.5		116.5		0.0		110.0		10.7		0.0	
B	6.819	27.7	211.7	75.9	581.0	105.4	756.6	0.0	0.0	139.3	850.0	4.1	50.5	0.0	0.0
C	1.219	27.1	33.4	79.6	94.8	103.4	127.3	0.0	0.0	157.7	181.0	2.5	4.0	0.0	0.0
D	5.386	33.8	164.0	83.1	438.2	154.4	694.3	0.0	0.0	171.3	886.0	7.4	26.7	52.3	140.8
E	4.000	32.1	131.8	87.9	342.0	163.6	636.0	0.0	0.0	40.9	424.4	5.2	25.2	41.9	188.4
F	2.000	32.7	64.8	84.8	172.7	200.4	364.0	12.4	0.0	65.0	105.9	6.0	11.2	19.4	61.3
G	19.200	32.1	622.1	84.9	1,629.1	244.3	4,269.1	12.4	238.1	71.7	1,312.3	5.5	110.4	5.3	237.1
H	10.000	34.9	335.0	77.4	811.5	57.8	1,510.5	4.3	83.5	14.1	429.0	9.1	73.0	11.6	84.5
I	5.000	35.0	174.8	80.4	394.5	77.0	337.0	4.3	21.5	15.6	74.3	9.5	46.5	7.7	48.3
J	22.500	24.5	669.4	67.5	1,663.9	65.0	1,597.5	6.4	120.4	0.0	87.8	8.7	204.8	0.0	19.3
Total of 2			2,407		6,128		10,292		463		4,351		552		780



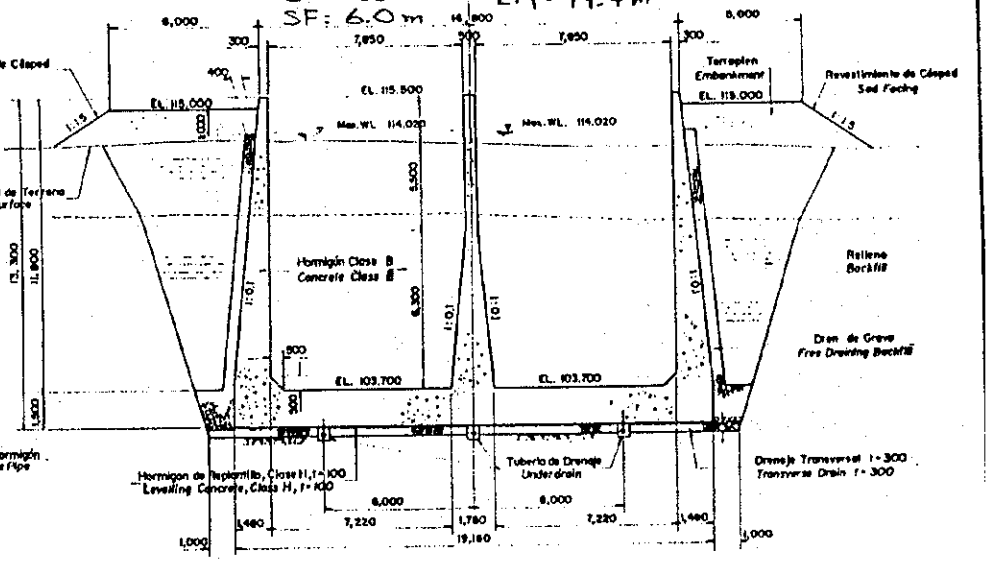
CR : 34.4 m , BC : 2.0 m²
EC : 94.5 m² , TE : 2.1 m²
ER : 116.5 m²
SF : 10.7 m
BF : 110.0 m²
Original Ground Surface
Sod Facing
Assumed Weathered Rock Surface
Step Ladder
Drainage Pipe D.100 Steel Pipe
℄ No. 1 Penstock
℄ No. 2 Penstock
EL. 108.000
EL. 106.595
EL. 104.783
EL. 103.787
EL. 102.955
Penstock Pipe Ø 2,000 (By Others)
Under Drain Pipe, D. 300, Concrete Pipe
Backfill Concrete, Class G
2,500
5,517
4,500
7,500
2,117
7,900
8,150
9,477
2,523
22,017
SECCION A-A
SECTION A-A
CR : 21.1 m, BC : 5.1 m²
EC : 75.9 m², TE : 5.2 m²
ER : 105.4 m²
SF : 4.1 m
BF : 139.3 m²
℄ No. 1 Penstock
Backfill
Penstock Pipe Ø 2,000 (By Others)
Concrete Class E
EL. 110.819
EL. 106.692
EL. 105.879
EL. 104.864
EL. 104.000
Drainage Pipe, D.100 Steel Pipe
Under Drain Pipe, D. 300, Concrete Pipe
Backfill Concrete, Class G
8,449
8,150
10,000
SECCION B-B
SECTION B-B
CR : 27.1 m BF : 157.7 m²
EC : 79.6 m² BC : 5.0 m²
ER : 103.4 m² TE : 5.1 m²
SF : 2.5 m
℄ No. 1 Penstock
℄ No. 2 Penstock
Sod Facing
Backfill
EL. 111.831
EL. 106.879
EL. 106.066
EL. 105.000
EL. 104.000
Penstock Pipe Ø 2,000 (By Others)
Concrete Class E
Drainage Pipe, D.100 Steel Pipe
Under Drain Pipe, D. 300, Concrete Pipe
Backfill Concrete, Class G
8,517
8,150
10,000
SECCION C-C
SECTION C-C
CR : 33.8 m BF : 171.3 m²
EC : 83.1 m² EM : 52.3 m²
ER : 154.4 m² BC : 4.9 m²
SF : 7.4 m TE : 5.0 m²
Sod Facing
Embankment
Backfill
EL. 119.000
EL. 107.300
EL. 106.840
EL. 107.000
EL. 104.000
Penstock Pipe Ø 2,000 (By Others)
Concrete Class E
Backfill Concrete, Class G
Drainage Pipe, D. 100 Steel Pipe
Under Drain Pipe, D. 300, Concrete Pipe
14,400
13,400
27,800
5,080
4,500
1,500
19,160
10,080
SECCION D-D
SECTION D-D
CR : Clearing
EC : Excavation, common
ER : Excavation, weathered rock & rock
SF : Sod facing
BF : Backfill
BC : Backfill concrete
TE : Trench excavation
EM : Embankment
ESCALA A
10 m
CRM
LEVANTO:
DIBUJO:
DISEÑO:
APROBADO:
FECHA:

CR: 32.1 m SF: 5.2m BC: 4.9 m²
EC: 87.9 m² BF: 40.9 m² TE: 5.0 m²
ER: 163.6 m² EM: 41.9 m²



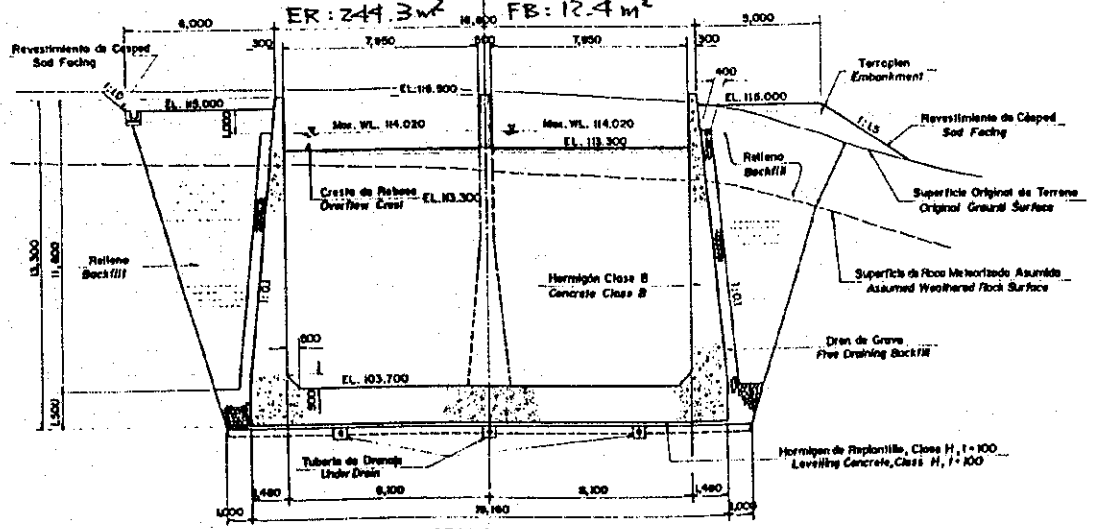
SECCION E - E ESCALA A
SECTION E - E SCALE A

CR: 32.7 m BF: 65.0 m²
EC: 84.8 m² FB: 12.4 m²
ER: 200.4 m² EM: 19.4 m²
SF: 6.0 m



SECCION F - F ESCALA A
SECTION F - F SCALE A

CR: 32.1 m SF: 5.5 m EM: 5.3 m²
EC: 84.9 m² BF: 71.7 m²
ER: 244.3 m² FB: 12.4 m²



SECCION G - G ESCALA A
SECTION G - G SCALE A

CR: clearing
EC: Excavation, common
ER: Excavation, weathered rock & rock
SF: Sod facing
BF: Backfill
FB: Free draining backfill
EM: Embankment
TE: Trench excavation

ESCALA A
SCALE A
(1:100)
0 5 10m

CRM

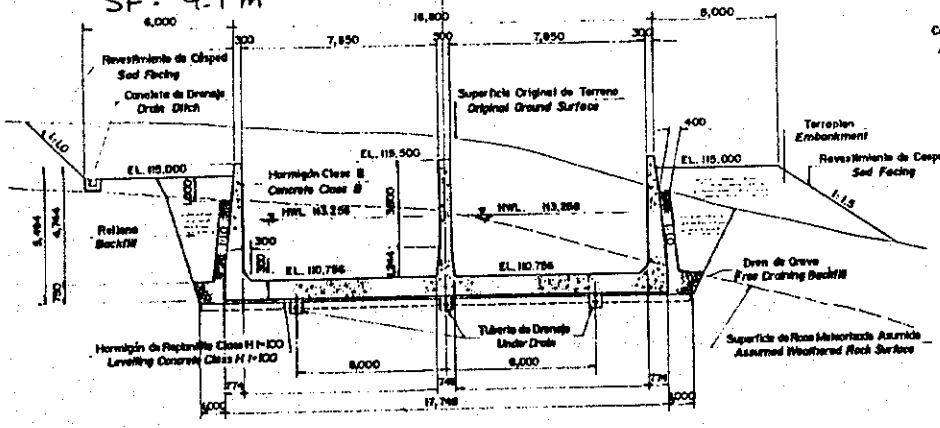
Estudio de Diseño Definitivo de los Trasvases de Agua para los Cauces de Los Ríos Cruces - Pamahue
The Detailed Design Study on the Water Transfers

TITULO : TANQUE DE CAMARA DE VERTIDO - SPILLWAY HEADTANK

DETALLE ESTRUCTURAL (3/4)

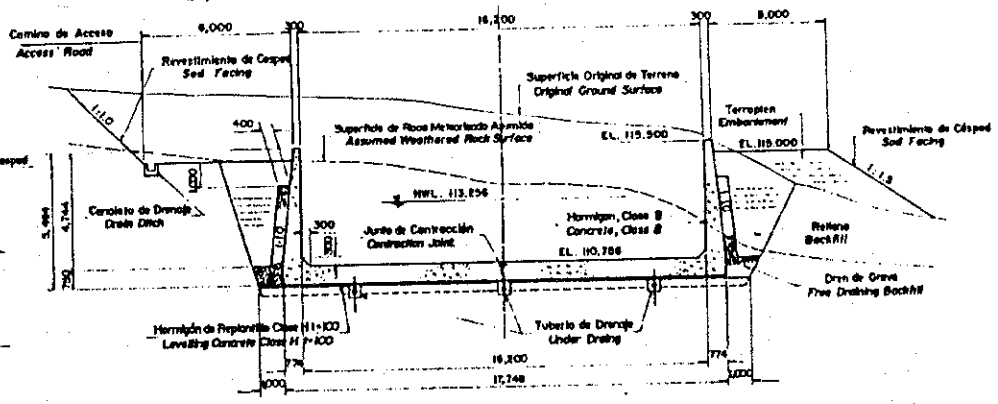
LEVANTÓ :
DIBUJÓ :
DISEÑÓ :
APROBADO :
FECHA :
DIBUJO Nº

CR: 34.9 m
EC: 77.4 m²
ER: 57.8 m²
SF: 9.1 m
BF: 14.1 m²
FB: 4.3 m²
EM: 11.6 m²

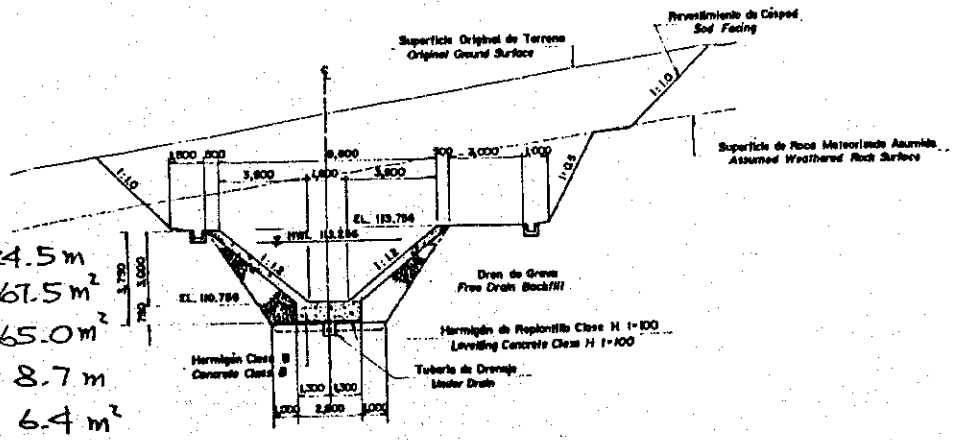


SECCION H - H ESCALA A
SECTION H - H SCALE A

CR: 35.0m
EC: 80.4 m²
ER: 77.0 m²
SF: 9.5 m
BF: 15.6 m²
FB: 4.3 m²
EM: 7.7 m²



SECCION I - I ESCALA A
SECTION I - I SCALE A



CR: 24.5 m
EC: 67.5 m²
ER: 65.0 m²
SF: 8.7 m
FB: 6.4 m²

SECCION J - J ESCALA A
SECTION J - J SCALE A

CR: Clearing
EC: Excavation, common
ER: Excavation, weathered rock & rock
SF: Sod facing
BF: Backfill
FB: Free draining backfill
EM: Embankment

ESCALA A
SCALE A
1:100

CRM

Estudio de Diseño Detallado de los Trasvases de Aguas de las Cuencas de Los Ríos Chone - Portoviejo
The Detailed Design Study on the Water Transfers

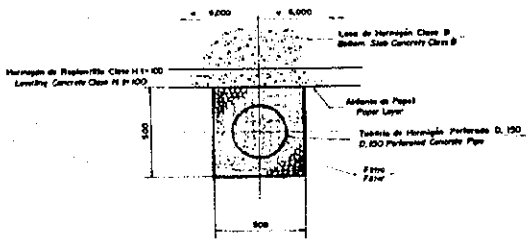
TITULO: TANQUE DE CABEZA SEVERINO / SEVERINO HEAD TANK

DETALLE ESTRUCTURAL (4/4)

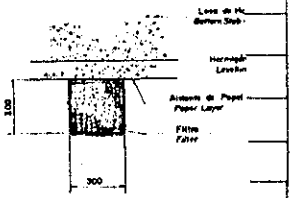
LEVANTO:
DIBUJO:
DISEÑO:
APROBADO:
FECHA:
DIBUJO Nº

Working Division:

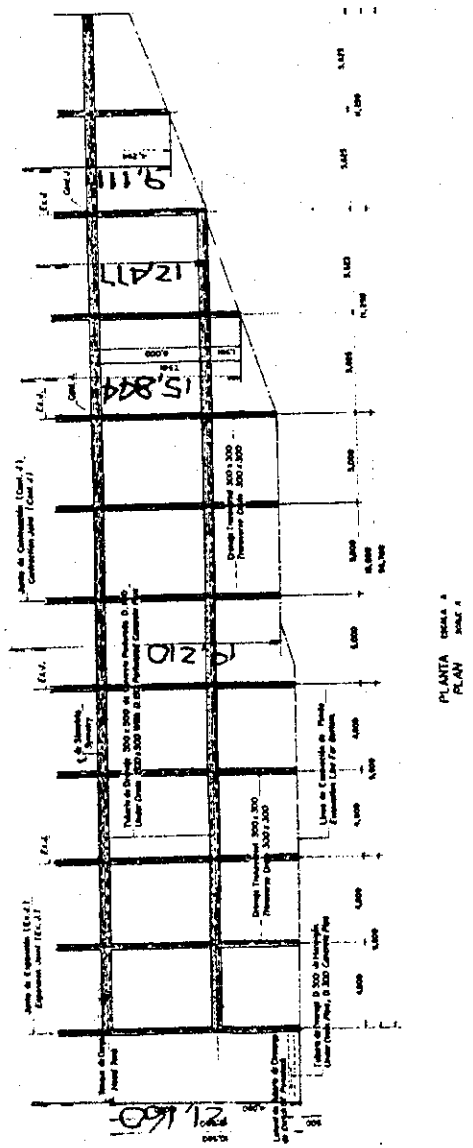
Description	Calculation Details	Unit	Quantity	Remarks
105	Trench excavation, all classes, for underdrain, transverse drain, drainage pipe, underdrain pipe, draindich and foundation of fence			
–	for underdrain $l = 56.7 + 2 \times 45.709 = 148.118$ m			
	$V = 0.5 \times 0.5 \times 148.118 = 37.03\ m^3$			
–	for transverse drain $l = 21.16 \times 5 + 19.749 \times 2 + 19.210 + 15.844 + 12.477 + 9.111 = 201.940$ m			
	$V = 0.3 \times 0.3 \times 201.940 = 18.17\ m^3$			
	sub total $55.20\ m^3$			



DETALLE DE TUBERIA DE DRENAJE
UNDER DRAIN DETAIL



DETALLE DE DREN TRANSVERSAL
TRANSVERSE DRAIN DETAIL

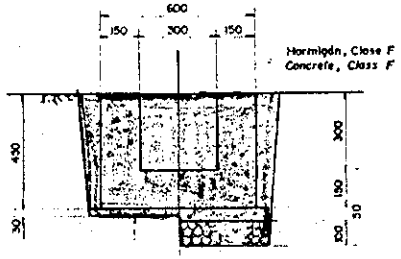


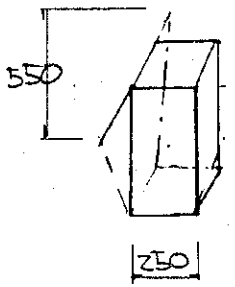
Working Division: _____

Description	Calculation Details	Unit	Quantity	Remarks
–	for underdrain pipe			
	$A = 4.4\ m^2$ (Sec. D-D, E-E)			
	$\ell = 7.494 + 2.729 = 10.223\ m$			
	$A = 4.4\ m^2 \sim 2.1\ m^2$			
	$\ell = 10\ m$			
	$V = 4.4 \times 10.223 + \frac{4.4+2.1}{2} \times 10$			
	$= 77.5\ m^3$			
–	for drainage pipe			
	$A = 0.625\ m^2$ (Sec D-D, E-E)			
	$\ell = 9.5 + 1.414 = 10.914\ m$			
	$A = 0.825\ m^2$ (Sec B-B, C-C)			
	$\ell = 8.924 - 6.819/2 = 5.515\ m$			
	$V = 0.625 \times 10.914 + 0.825 \times 5.515$			
	$= 11.4\ m^3$			

Working Division:

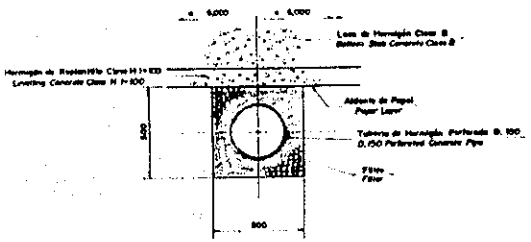
Description	Calculation Details	Unit	Quantity	Remarks
–	for drain ditch			
	$l = 22.7 + 23.2 + 16.0 = 61.9 \approx 62m$			
	$V = 62 \times 0.7 \times 0.6 = 26.0\ m^3$			
–	for foundation of fence			
	11 nos			
	$\frac{0.25^2 + 0.55^2}{2} \times 0.5 \times 11 = 1.0 m^3$			
	Total $35.2 + 77.5 + 11.4 + 26.0 + 1.0$			
	$= 171.1\ m^3$			



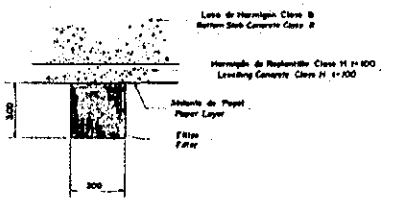


Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
109	Sand and gravel fill, for underdrain and transverse drain			
-	for underdrain			
	$l = 148.118$ m			
	$V = (0.5 \times 0.5 - \pi/4 \times 0.15^2) \times 148.118$			
	$= 34.41$ m^3			
-	for transverse drain			
	$l = 201.940$ m			
	$V = 0.3 \times 0.3 \times 201.940 = 18.17$ m^3			
	Total $34.41 + 18.17$			
	$= 52.58$ m^3			
	$= 53$ m^3			



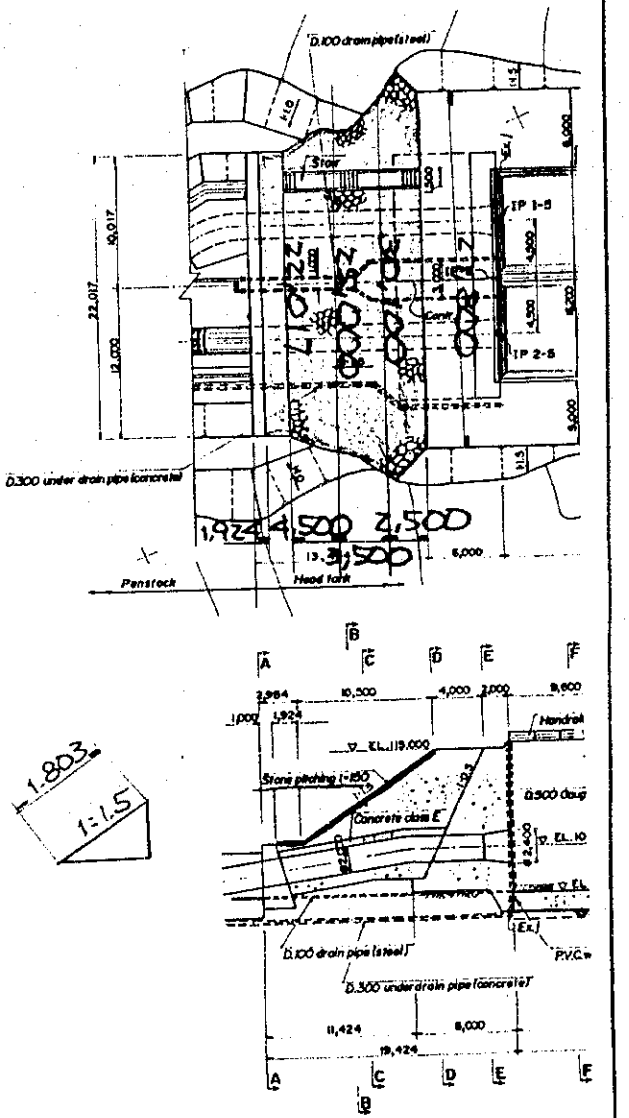
DETALLE DE TUBERIA DE DRENAJE
UNDER DRAIN DETAIL



DETALLE DE DREN TRANSVERSAL
TRANSVERSE DRAIN DETAIL

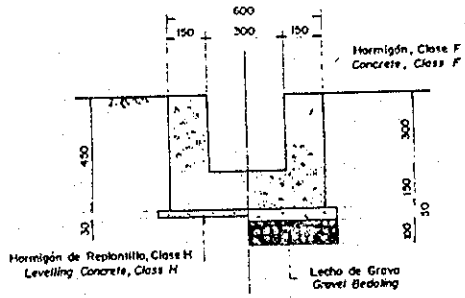
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/11	Stone pitching, for embankment slope protection			
	$t = 150$ mm			
	$A_1 = \frac{27.8+30.1}{2} \times 2.5 + \frac{30.1+25.0}{2} \times 3.5$			
	$+ \frac{25.0+27.017}{2} \times 4.5 = 286\ m^2$			
	$A_2 = 1.924 \times 22.017 = 42.4\ m^2$			
	$A = 286 \times 1.803 + 42.4 = 558\ m^2$			



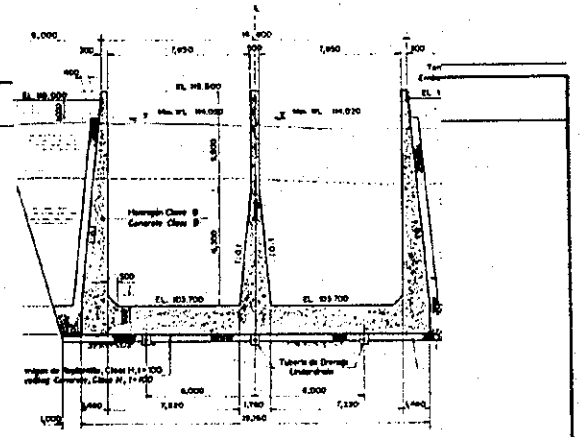
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/12	Gravel bedding for drain ditch			
	t= 100mm. l= 62 m			
	V= 0.1 × 0.6 × 62 = 3.7 m^3			

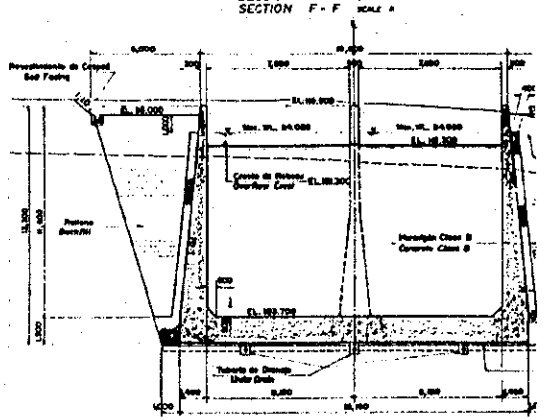


Working Division:

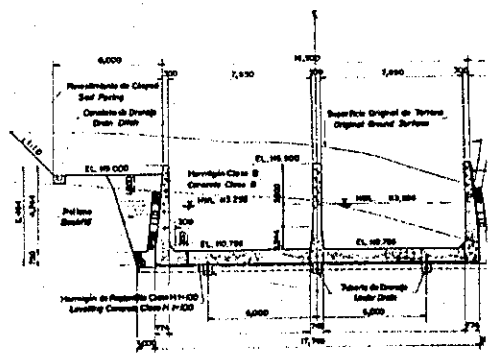
Description	Calculation Details	Unit	Quantity
4.3	Concrete Work		
101	Concrete, class B, for head tank structure		
-	Sec. F-F ~ G-G $\ell = 19.20\,m$		
	$A = \frac{0.3+1.48}{2} \times 11.80 \times 2 + 0.5 \times 5.5$		
	$+ \frac{0.5+1.760}{2} \times 6.3 + 1.5 \times 19.16$		
	$+ \frac{1}{2} \times 0.5^2 \times 2$		
	$= 59.86\,m^2$		
	$\nabla = 59.86 \times 19.20 =$ 1,149	m^3	
-	Sec. G ~ G $\ell = 1.0\,m$ (side wall)		
	$A_G = \frac{0.3+1.48}{2} \times 11.80 \times 2 = 21.00\,m^2$		
	$\nabla = 1.0 \times 21.00 =$ 21	m^3	
-	Sec. G-G ~ H-H $\ell = 2.342\,m$ (side wall)		
	$A_{H} = \frac{0.3+0.774}{2} \times 4.744 \times 2 = 5.10\,m^2$		
	$\nabla = \frac{21.00+5.10}{2} \times 2.342 =$ 31	m^3	



SECCION F - F ESCALA A
SECTION F - F SCALE A



SECCION G - G ESCALA A
SECTION G - G SCALE A

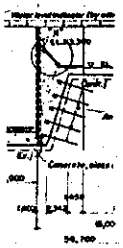


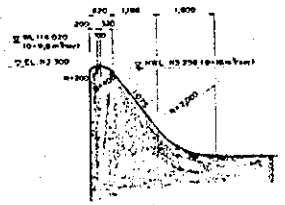
SECCION H - H ESCALA A
SECTION H - H SCALE A

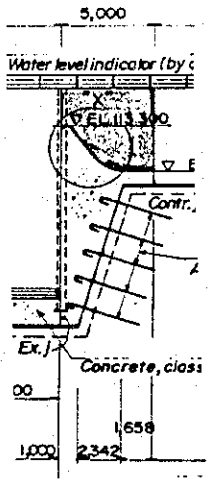
313

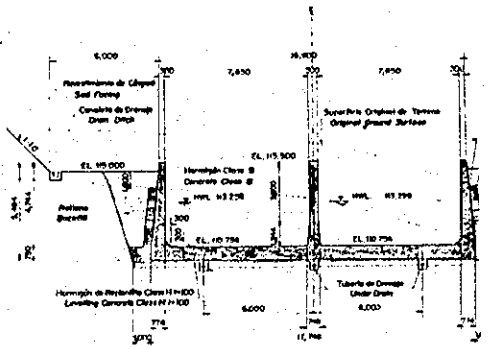
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
–	Sec. G-G ~ H-H			
	(overflow weir)			
	$A = \left\{ \frac{1.0 + 3.408}{2} \times 7.806 + 0.75 \times 3.408 \right.$			
	$\left. + \frac{0.5 + 2.408}{2} \times 2.544 \right\} = 23.46\ m^2$			
	$V = 23.46 \times 16.2 = 380$	m^3		
–	Sec. G-G ~ H-H			
	(center wall)			
	$(4.744 \times 3.408 - \frac{0.5+2.408}{2} \times 2.544) \times 0.5$			
	$= 6$	m^3		
–	Sec H-H $\quad l = 11.592\ m$			
	$A_H = \frac{0.3+0.774}{2} \times 4.744 \times 2 + 0.75 \times 17.749$			
	$+ 0.5 \times 3.5 + \frac{0.5+0.749}{2} \times 1.244$			
	$+ \frac{1}{2} \times 0.3^2 \times 2$			
	$= 21.02\ m^2$			
	$V = 11.592 \times 21.02 = 244$	m^3		





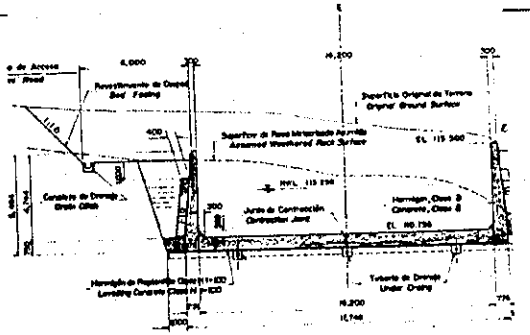




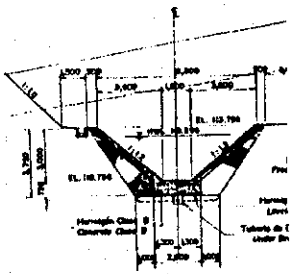
SECCION H - H ESCALA 1
SECTION H - H SCALE 1

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
	Sec I-I ~ Sec J-J $l = 22.500$ m			
	$A_I = \frac{0.3+0.774}{2} \times 4.744 \times 2 + 0.75 \times 17.748 + \frac{1}{2} \times 0.3^2 \times 2$			
	$= 18.50 m^2$			
	$A_J = 0.5 \times 3.0 \times 2 + 2.6 \times 0.75$			
	$= 4.95 m^2$			
	$V = \frac{18.50+4.95}{2} \times 22.5 =$ 264	m^3		
	Total 1,149 + 21 + 31 + 380 + 6 + 244 + 264			
	$= 2,095 m^3$			



SECCION I - I ESCALA A
SECTION I - I SCALE A

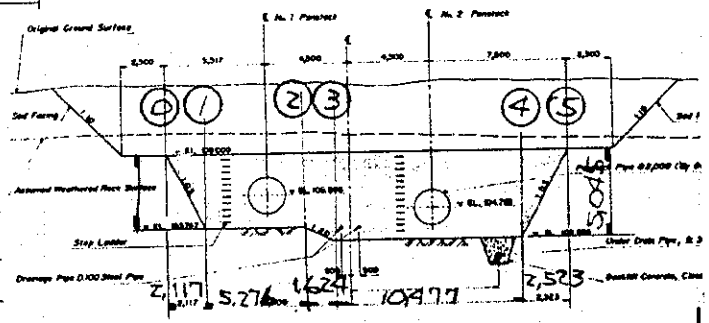


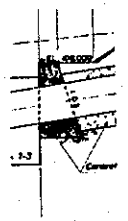
SECCION J - J ESCALA A
SECTION J - J SCALE A

3-12

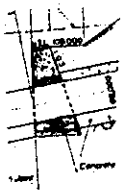
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
102	Concrete, class E, for gravity walls			
-	retaining wall at beginning of head tank			
	A_1 ($h = 4.233$)			
	$\frac{1.0 + 3.117}{2} \times 4.233 = 8.71\ m^2$			
	A_2 ($h = 5.045$)			
	$\frac{1.0 + 3.523}{2} \times 5.045 = 11.41\ m^2$			
	②~①			
	$8.71/2 \times 2.117$ = 9.22	m^3		
	①~②			
	$8.71 \times 5.276 - \pi/4 \times 2.0^2 \times 2.203 = 39.03$			
	②~③			
	$\frac{8.71 + 11.41}{2} \times 1.624$ = 16.34			
	③~④			
	$11.41 \times 10.477 - \pi/4 \times 2.0^2 \times 2.609 = 111.35$			
	④~⑤			
	$11.41/2 \times 2.523$ = 14.39			
	subtotal 190	m^3		





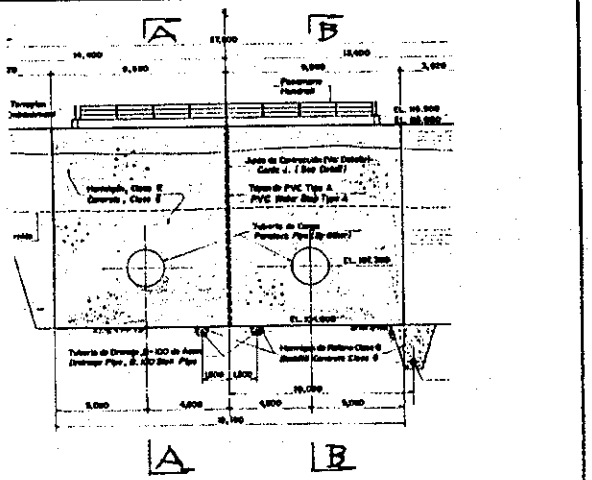
Sec. ①~②

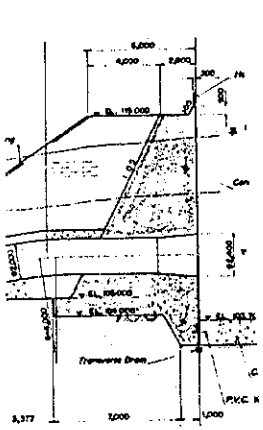


Sec. ③~④

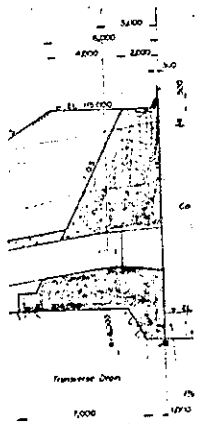
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
–	at outlet of penstock pipe			
	$\left\{\frac{0.3+0.55}{2}\times 0.5+\frac{2.0+7.5}{2}\times 11.0\right.$			
	$+\frac{1}{2}\times 1.0\times 1.0+\frac{1}{2}\times(1.0+1.9)\times 1.8\}\times 19.16$			
	$-\pi/4\times 2.0^2\times 5.85\times 2$			
	$=1,028\ m^3$			
	Total $190+1,028=1,218\ m^3$			





SEC. A-A

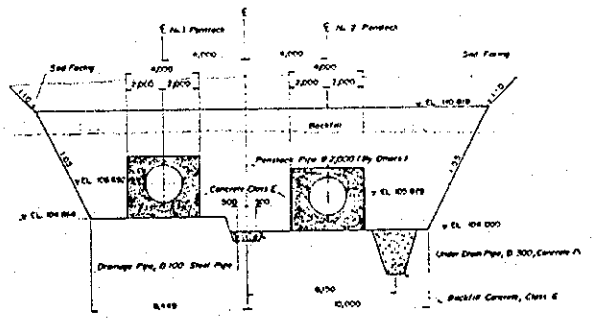


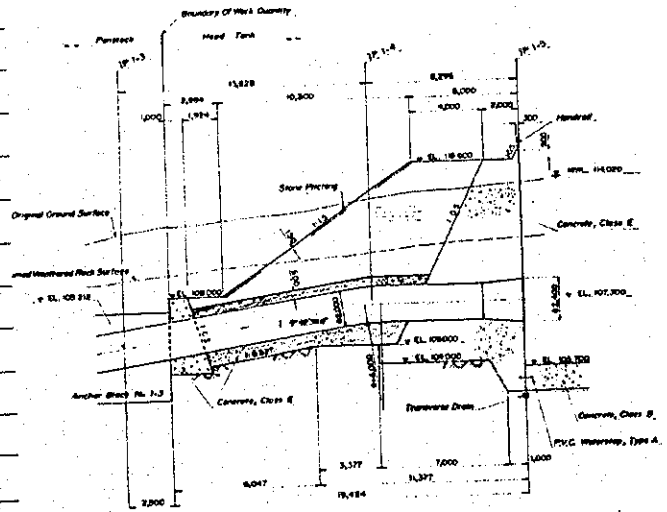
SEC. B-B

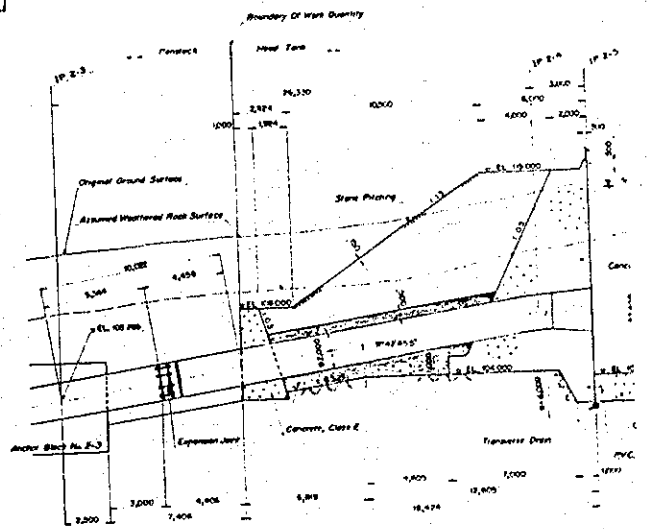
3-17

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
103	Concrete, class E, for encasing of penstock pipe			
	for NO.1 pipe			
	$40.1 \times 4 - \pi/4 \times 2.0^2 \times 11.5 = 125 m^3$			
	for NO.2 pipe			
	$39.0 \times 4 - \pi/4 \times 2.0^2 \times 11.0 = 122 m^3$			
	Total $125+122$			
	$= 247 m^3$			

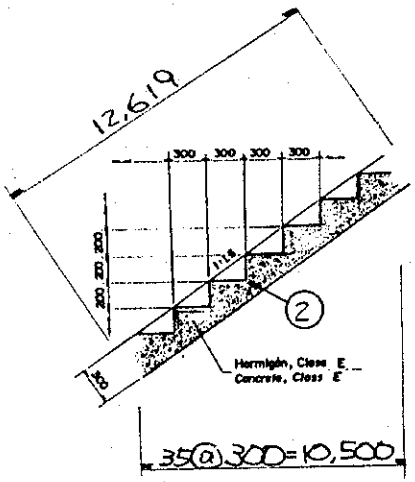


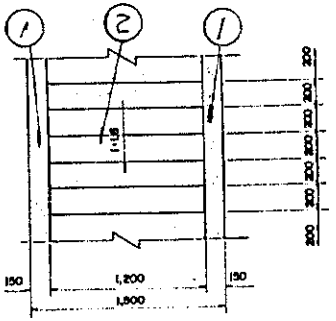




Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
104	Concrete, class E, for stair			
①	$0.15 \times 0.3 \times 12.619 \times 2 = 1.14 m^3$			
②	$0.3 \times 12.619 \times 1.2 - \frac{1}{2} \times 0.3 \times 0.2 \times 35$			
	$= 3.49 m^3$			
	Total $4.63 m^3$			

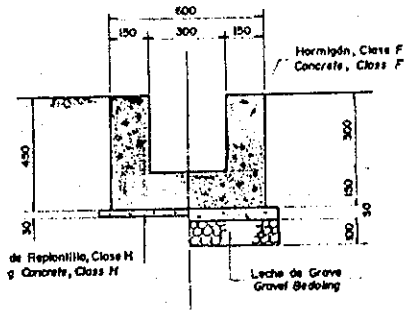




3-19

Working Division:

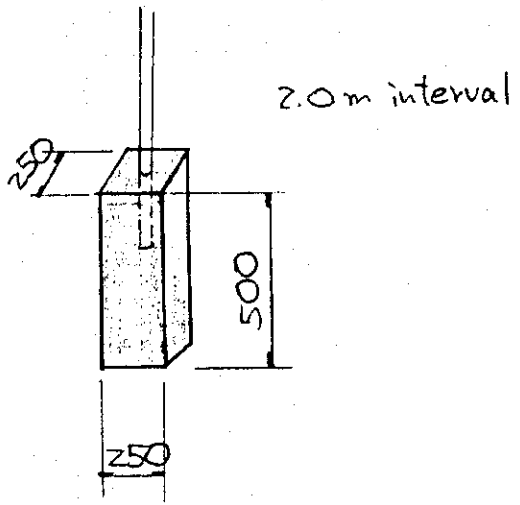
Description	Calculation Details	Unit	Quantity	Remarks
105	Concrete, class F, for drain ditch			
	l = 62m			
	(0.1×0.4×2 + 0.6×0.15) × 62			
	= 10.54 m³			
	≈ 11 m³			



C-2-5

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
106	Concrete, class G, for foundation concrete of wire net fence			
	l = 6 + 18 = 24 m			
	no. of foundation			
	1 + 18/2 + 1 = 11 nos			
	0.25×0.25×0.5×11 = 0.34 m³			
	= 0.4 m³			



Working Division: _____

Description	Calculation Details	Unit	Quantity	Remarks
107	Backfill concrete, class G, for underdrain and drainage pipes			
-	for underdrain pipe ϕ 300mm			
①	Sec. D-D, E-E $A = 4.4 - \pi/4 \times 0.3^2$			see figure of earth work
	$= 4.3\ m^2$			
	$l = 10.223\ m$			
	$V = 4.3 \times 10.223 = 44\ m^3$			
②	$A_1 = 4.4 - \pi/4 \cdot 0.3^2 = 4.3\ m^3$			
	$A_2 = 2.1 - \pi/4 \cdot 0.3^2 = 2.0\ m^3$			
	$l = 10\ m$			
	$V = \frac{4.3+2.0}{2} \times 10 = 32\ m^3$			
	sub total $76\ m^3$			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
–	for drainage pipe $\phi 100 \times 2$ lanes			
①	Sec. D-D, E-E $\ell = 10.914$ m			see figure of earth work
	$A = 0.625 - \pi/4 \times 0.1^2 \times 2$			
	$= 0.61\ m^2$			
	$V = 0.61 \times 10.914 =$ 6.7 m^3			
②	Sec. B-B, C-C $\ell = 5.515$ m			
	$A = 0.825 - \pi/4 \times 0.1^2 \times 2 = 0.81\ m^2$			
	$V = 0.81 \times 5.515 =$ 4.5 m^3			
	sub total 11.2 m^3			
	Total $76 + 11 =$ 87 m^3			

Working Division:

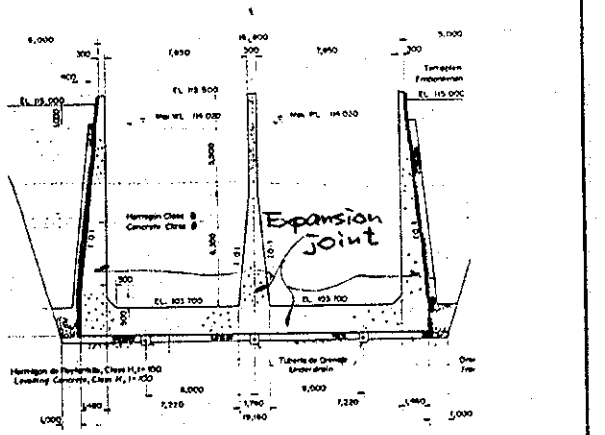
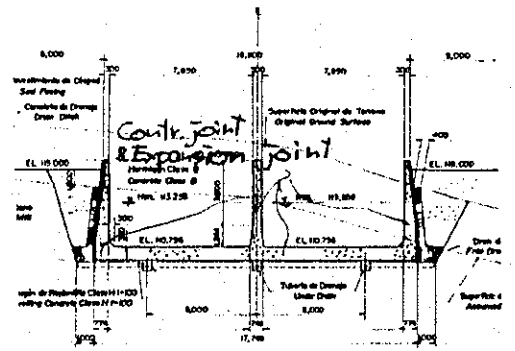
Description	Calculation Details	Unit	Quantity	Remarks
108	Concrete, class H, for levelling concrete for bottom slab of head tank structure and drain ditch			
-	for bottom slab of head tank			
	T=100			
①	Sec. F-F ~ G-G			see figure of concrete work 101
	$0.1 \times 19.16 \times (19.20+1.0) = 38.70m^3$			
②	Sec. G-G ~ H-H			
	$\frac{19.16+17.749}{2} \times 2.342 \times 0.1 = 4.32$			
③	Sec H-H			
	$0.1 \times 17.749 \times 11.592 = 20.57$			
④	Sec. I-I ~ J-J			
	$\frac{17.748+2.6}{2} \times 22.5 \times 0.1 = 22.89$			
	Subtotal $86.48m^3$			

3125

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
-	for drain ditch			
	$l = 62\,m$			
				see figure of concrete work /05
	$V = 0.05 \times 0.6 \times 62 = 1.86\,m^3$			
	Total $86.48 + 1.86$			
	$= 88.34$			
	$= 89\,m^3$			

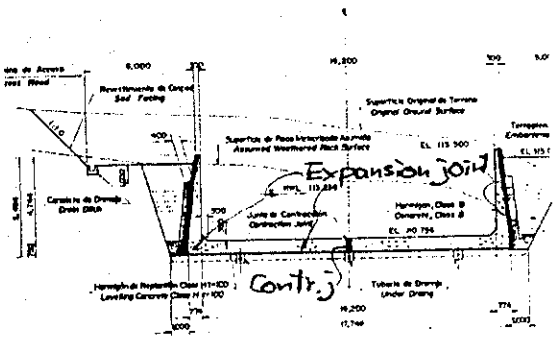
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
109	Formwork, FL finish, for concrete of items 101, 102, 103, 104, 105 and 106			
-	for 101			
①	Sec. F-F ~ G-G $l = (\sqrt{11.8^2 + 1.18^2} + 1.5) \times 2$ $= 26.718\ m$ $A = 26.718 \times 19.2 + 1.0 = 539.70\ m^2$			 SEC. F-F ~ G-G
	expansion joint 2 portions $\left\{2 \times \frac{0.3+1.48}{2} \times 1.8 + 1.5 \times 19.16 + 0.5 \times 5.5 + \frac{0.5+1.76}{2} \times 6.3 + \frac{1}{2} \times 0.5^2 \times 2\right\} \times 2$ $= 119.73\ m^2$			
②	Sec. G-G ~ H-H $l_1 = 26.718\ m$ $l_2 = (\sqrt{4.774^2 + 0.477^2} + 0.75) \times 2$ $= 11.096\ m$ $A = \frac{26.718 + 11.096}{2} \times 2.342 = 44.28\ m^2$			 SEC. G-G ~ H-H

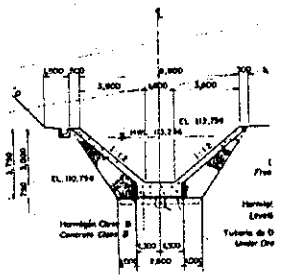
3-26

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
③	Sec. H-H			see Figure of ②
	$l_z = 11.096$			
	$A = 11.096 \times 11.592 = 128.62\,m^2$			
	Contr & ex. j 2 nos			
	$\left\{\frac{0.3+0.774}{2} \times 4.744 \times 2 + 0.75 \times 17.749 + 0.5 \times 3.5 + \frac{0.5+0.749}{2} \times 1.244\right\} \times 2$			
	$= 41.87\,m^2$			
④	Sec. I-I ~ J-J			
	$l_z = 11.096\,m$			
	$l_3 = 0.75 \times 2 = 1.5$			
	$A = \frac{11.096+1.5}{2} \times 22.5 = 141.70\,m^2$			
	Ex. joint			
	$(18.50 + 4.95)/2 = 11.73\,m^2$			
	Cont. j			
	$11.25 \times 0.75 = 8.44$			
	Total of for ② / ①			
	$1,036\,m^2$			



SEC. I-I

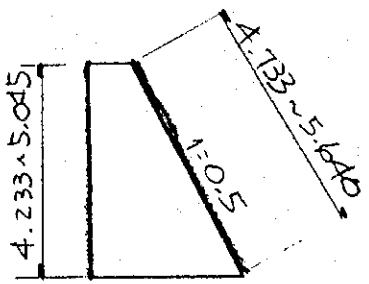


SEC. J-J

3-12

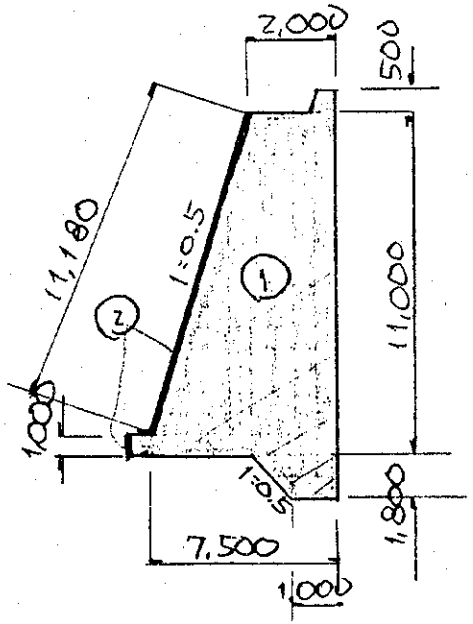
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
-	for 102			
	⓪ ~ ①			
	1/2 × 4.733 × 2.117 = 5.01 m²			
	① ~ ②			
	4.733 × 5.276 = 24.97 m²			
	② ~ ③			
	(4.733+5.640)/2 × 1.624 = 8.42			
	③ ~ ④			
	5.640 × 10.477 = 59.09			
	④ ~ ⑤			
	1/2 × 5.640 × 2.523 = 7.11			
	penstock pipe π/4 × 2.0² × 2 = − 6.28			
	sub total 98 m²			



Working Division:

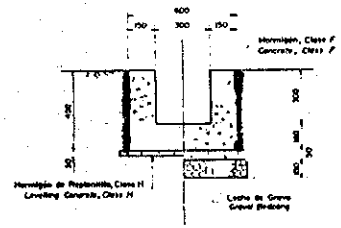
Description	Calculation Details	Unit	Quantity	Remarks
	at outlet of penstock pipe			
①	$\{\frac{0.3+0.55}{2} \times 0.5 + \frac{2.0+7.5}{2} \times 11.0 + \frac{1}{2} \times 1.0 \times 1.0$			
	$+ \frac{1}{2} \times (1.0+1.9) \times 1.8\} \times 3$ nos.			
	$= 166.72\ m^2$			
②	$(1.0+11.180) \times 19.16$			
	$= 233.37\ m^2$			
	sub total $400\ m^2$			
	Total of for 102 $498\ m^2$			



Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
-	for 103			
	No.1 Penstock			see figure of concrete work 103
	40.1 m^2			
	No.2 Penstock			
	39.0 m^2			
	Total of for 103			
	79 m^2			
-	for 104			see figure of concrete work 104
	0.3 × 12.619 × 2			
	= 8 m^2			

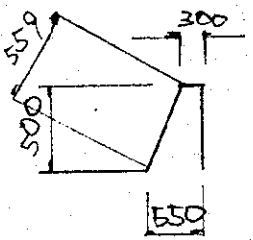
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
–	for 105			
	l = 62 m			
	0.55 × 2 × 62 = 68 m²			
–	for 106			see figure of concrete work 106
	11 nos.			
	0.25 × 0.5 × 4 × 11 = 6 m²			
	Total for			
	101 1,036			
	102 498			
	103 79			
	104 8			
	105 68			
	106 6			
	1,695 m³			

1-3-1

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/10	Formwork, F2 finish, for concrete of items of /02 and /04			
-	for /02			see figure of concrete work /02
	⓪~① 1/2 × 4.233 × 2.117 = 4.48m²			
	①~② 4.233 × 5.276 = 22.33m²			
	②~③ 1/2 × (4.233+5.045) × 1.624 = 7.53			
	③~④ 5.045 × 10.477 = 52.86			
	④~⑤ 1/2 × 5.045 × 2.523 = 6.36			
	Penstock pipe π/4 × 2.0² × 2 = - 6.28			
	0.559 × 16.8 = 9.39			
	Total of for /02 96.67m²			



W = 16.8m

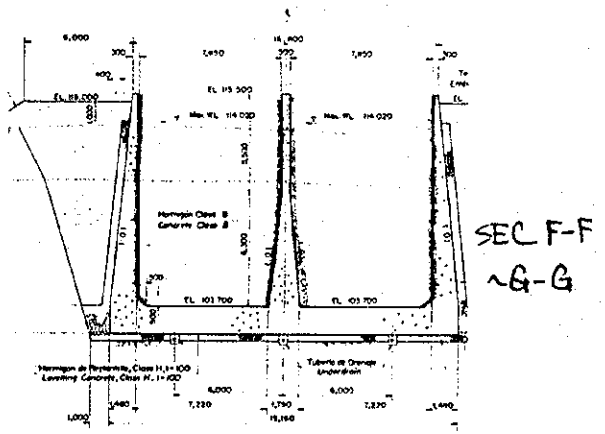
3-52

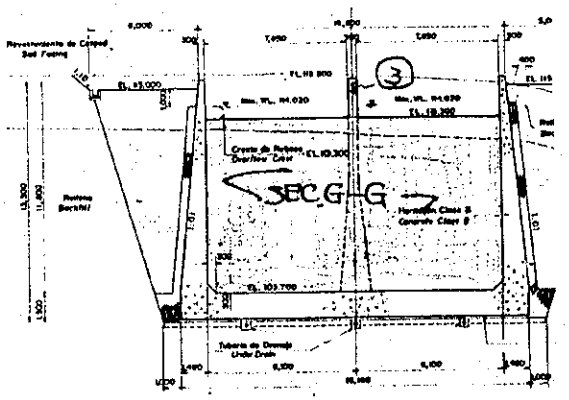
Working Division:

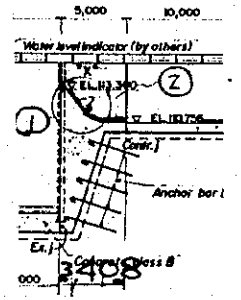
Description	Calculation Details	Unit	Quantity	Remarks
-	for /04			
	1/2 × 0.2 × 0.3 × 35 +			see figure of concrete work/04
	0.2 × 1.2 × 35 = 9.45 m^2			
	Total 96.67 + 9.45 = 106.12			
	= 106 m^2			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/11	Formwork, F3 finish, for concrete of items /01, /02 and /05			
-	for /01			
	Sec. F-F ~ G-G			
	$(11.3 + \sqrt{0.5^2+0.5^2} + \sqrt{6.3^2+0.63^2} + 5.5) \times 2 \times 19.2 = 915.40\ m^2$			
	Sec. G-G			
	$16.2 \times 9.6 - \frac{1}{2}\times 0.5^2 - 0.5\times 3.3 - \frac{0.5+1.760}{2}\times 6.3 = 146.63\ m^2$			
	Sec. G-G ~ H-H			
(1)	$(2\times\pi\times 0.2\times\frac{1}{4} + 0.1 + 2\times\pi\times 0.4\times\frac{53°7'48.37''}{360°} + \sqrt{1.584^2+1.188^2} + 2\times\pi\times 2.0\times\frac{53°7'48.37''}{360°}) \times 7.850\times 2 = 72.53\ m^2$			
(2)	$(4.744\times 3.408 - \frac{0.5+3.408}{2}\times 2.544)\times 4 = 44.79\ m^2$			
(3)	$\pi\times 0.5\times\frac{1}{2}\times 2.2 = 1.73\ m^2$			



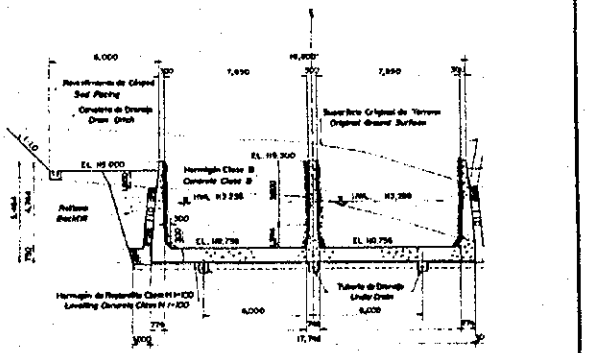




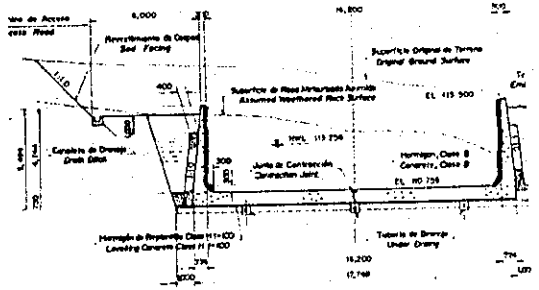
3-354

Working Division:

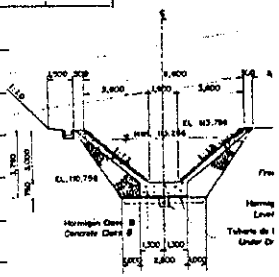
Description	Calculation Details	Unit	Quantity	Remarks
	Sec. H-H			
	$(4.744 + \sqrt{0.3^2+0.3^2} + 3.5 + \sqrt{1.244^2+0.124^2})$			
	$\times 2 \times 11.592$			
	$+ \pi \times 0.5 \times \frac{1}{2} \times 4.744 \quad = 233.67\ m^2$			
	Sec. I-I ~ J-J			
	$\frac{(4.744 + \sqrt{0.3^2+0.3^2}) \times 2 + \sqrt{3.0^2+3.6^2} \times 2}{2}$			
	$\times 22.5 \quad = 221.72\ m^2$			
	for 01 total $1,636\ m^2$			



SECCION H - H ESCALA A
SECTION H - H SCALE A



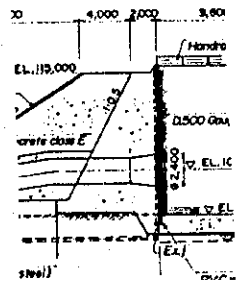
SECCION I - I ESCALA A
SECTION I - I SCALE A

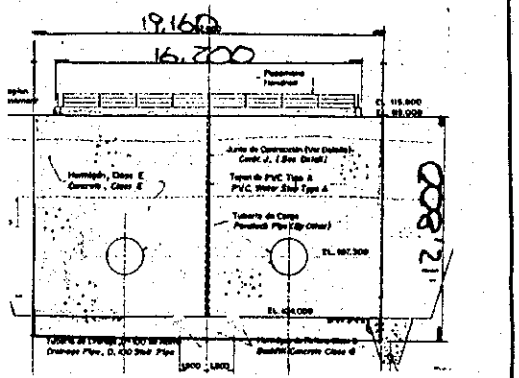


SECCION J - J ESCALA A
SECTION J - J SCALE A

Working Division:

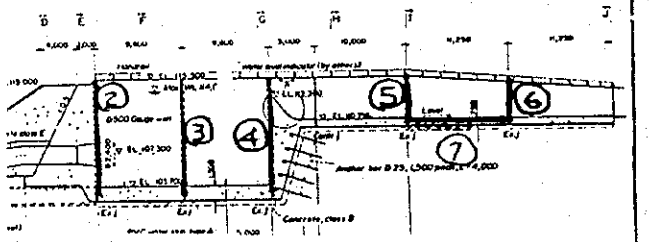
Description	Calculation Details	Unit	Quantity	Remarks
-	for 102			
	0.5 × 16.2 + 12.8 × 19.16			
	= 253.35 m²			
	= 253 m²			
-	for 105			
	l = 62 m			
	A = 0.4 × 2 × 62 = 49.60			
	= 50 m²			
	Total			
	for			
	101 1,636			
	102 253			
	105 50			
	1,939 m³			

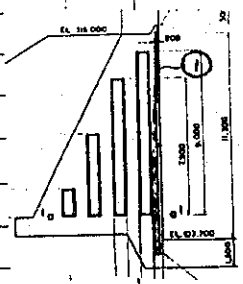


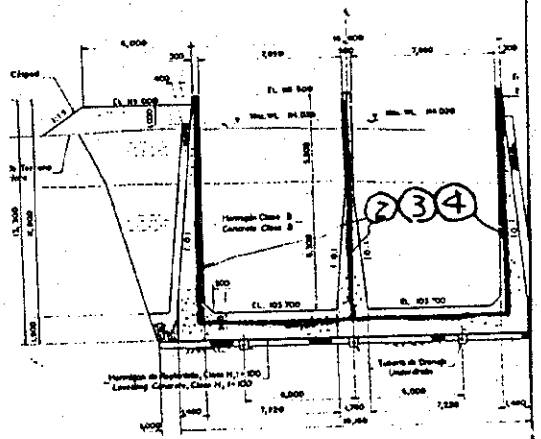


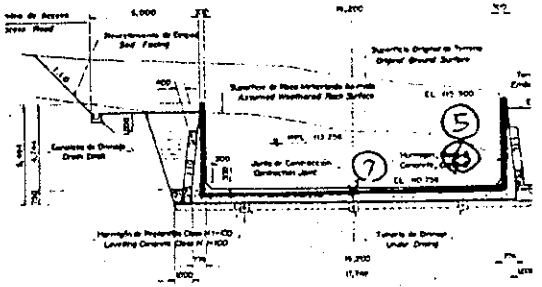
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/12	P.V.C Water stop, type A			
(1)	$L = \overset{EL}{115} - \overset{EL}{103.7} + 0.75$ = 12.05m			
(2)	$L = 3 \times (115 - 103.7 + 0.75)$ $(7.22 + 0.2) \times 2$ = 50.99m			
(3)	L = 50.99m			
(4)	L = 50.99m			
(5)	$L = (\overset{EL}{115} - \overset{EL}{110.756} + 0.375) \times 2$ $+ 16.2 + 0.2 \times 2$ = 25.84m			
(6)	$L = \sqrt{7.2^2 + (114.628 - 110.756 + 0.375)^2} \times 2$ $+ 8.9$ = 25.62m			
(7)	L = = 11.25m			
	Total 227.73 = 228m			









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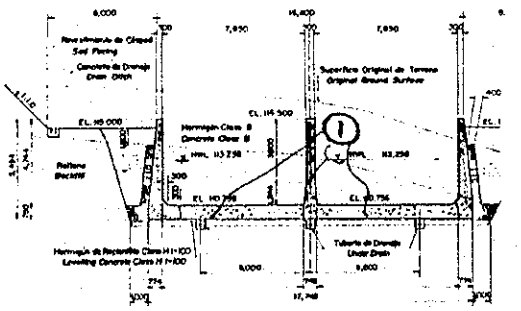
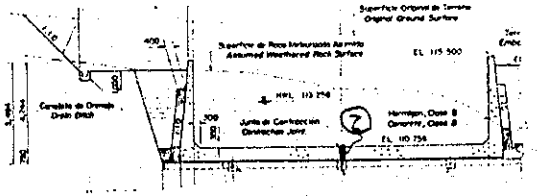
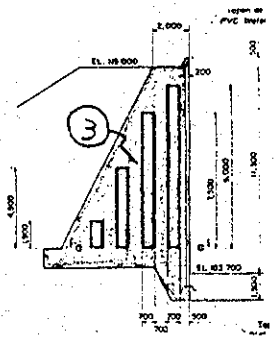
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/13	Bituminous coating for contraction joint			
①	$\left(\frac{0.3+0.774}{2}\times 4.744+\frac{1}{2}\times 0.3^2\right)\times 2$			
	$+\ 0.75\times 17.749+0.5\times 3.5+\frac{0.5+0.749}{2}\times 1.24$			
	$= 21.02\ m^2$			
②	$0.75\times 11.25 = 8.44\ m^2$			
③	$\frac{0.3+0.55}{2}\times 0.5$			
	$+\frac{2.0+7.5}{2}\times 11.0+\frac{1}{2}\times 1.0\times 1.0$			
	$+\frac{1.0+1.9}{2}\times 1.8$			
	$= 55.57\ m^2$			
	Total 85.03			
	$= 85\ m^2$			

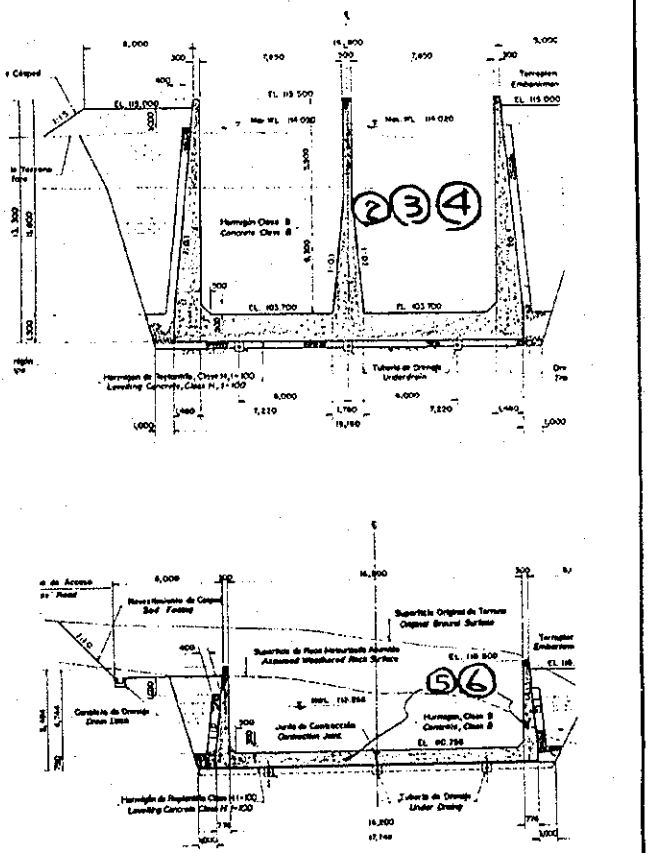






Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
114	Joint filler, for expansion joint (t=20 mm)			
	② $\left(\frac{0.3+1.486}{2}\times 11.80+\frac{1}{2}\times 0.5^2\right)\times 2$			
	$+ 1.5\times 19.16 + 0.5\times 5.5$			
	$+\frac{0.5+1.760}{2}\times 6.3$			
	$= 59.86\,m^2$			
	③ $59.86\,m^2$			
	④ $59.86\,m^2$			
	⑤ $\left(\frac{0.3+0.774}{2}\times 4.774+\frac{1}{2}\times 0.3^2\right)\times 2$			
	$+ 0.75\times 17.748$			
	$= 18.50\,m^2$			
	⑥ $0.4\times 3.872 + 9.9\times 0.75$			
	$= 8.97\,m^2$			
	Total $207.05\,m^2$			

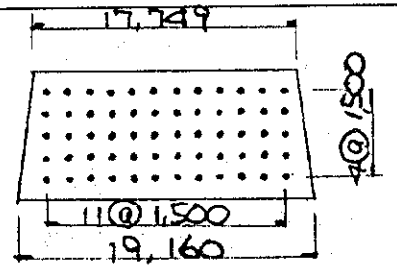


Working Division: _____

Description	Calculation Details	Unit	Quantity	Remarks
/15	Reinforcing bars for concrete works			
①	for head tank structure			
	Concrete 2,100 m^3			
	Re-bar 70 kg/m^3			
	W = 2,100×70 = 147,000kg			
②	Gravity wall			
	C 1,220 m^3			
	R 5 kg/m^3			
	W = 1,220×5 = 6,100kg			
③	encasing concrete			
	C 250 m^3			
	R 10 kg/m^3			
	W = 250×10 = 2,500kg			
④	stair			
	C 5 m^3			
	R 5 kg/m^3			
	W = 5×5 = 25kg			
⑤	Drain ditch			
	C 11 m^3			
	R 30 kg/m^3			
	W = 11×30 = 330kg			
	Total 155,955kg			
	= 156ton			

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
/16	Anchor bar, 22 mm			
	l = 4.0m / no.			
	no. = 5×12 = 60 nos			
	l = 4.0×60 = 240m			



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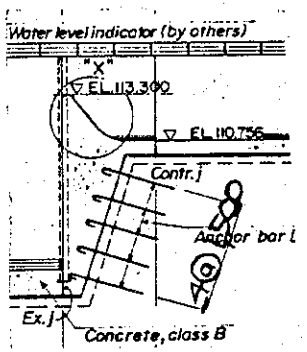
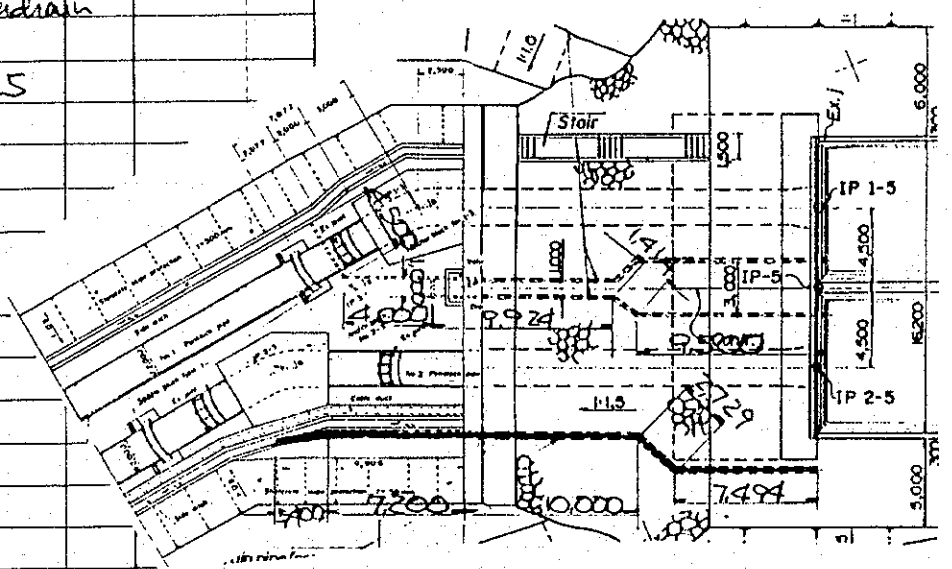


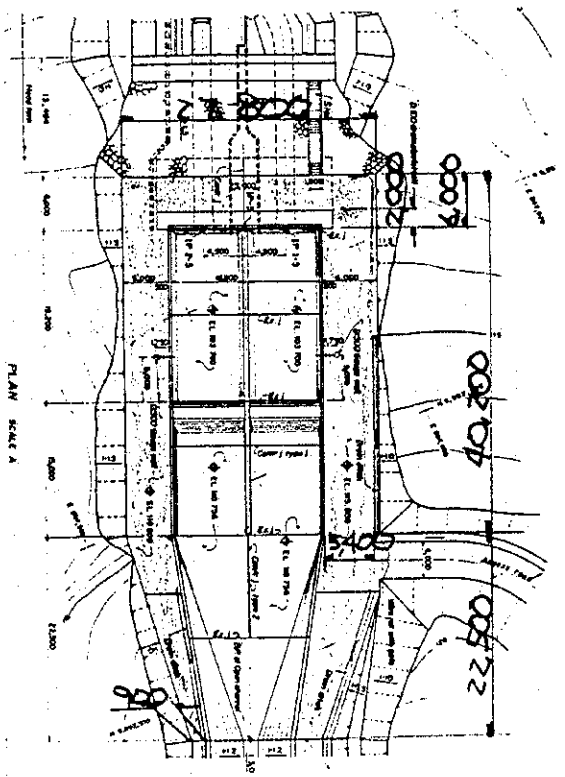
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
4.4	DRAINAGE			
101	Perforated concrete pipe, 150 mm diameter, for underdrain			see drawings of underdrain system
	$l = 56.7 + 2 \times 45.709 = 148.118$ m			
	$= 150$ m			
102	Concrete pipe, 300 mm dia, for underdrain			
	$L = 7.494 + 2.729 + 10.0 + 7.2 + 4.9 + 0.5$			
	$= 32.823$			
	$= 35$ m			



Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
4.5	ROAD WORK			
101	Graded crushed stone subbase			
	t = 150			
	$A = 24.0 \times 6.0 + 27.8 \times 6.0 + 34.2 \times 5.0 + \frac{4.4+0.9}{2} \times 22.5 + \frac{5.4+3.0}{2} \times 22.5 + 5.4 \times 16.2$			
	$= 723.405\ m^2$			
	$V = 0.15 \times 723.405 = 108.5 = 109\ m^3$			



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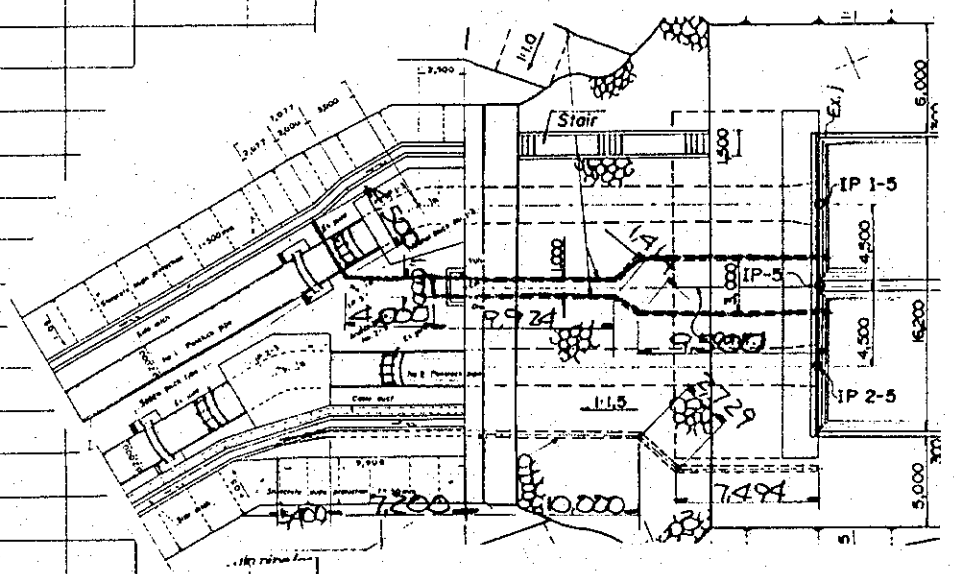
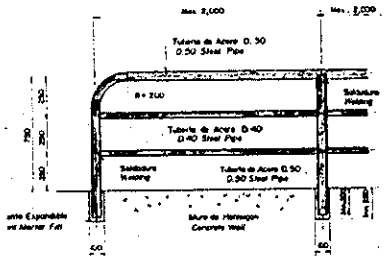
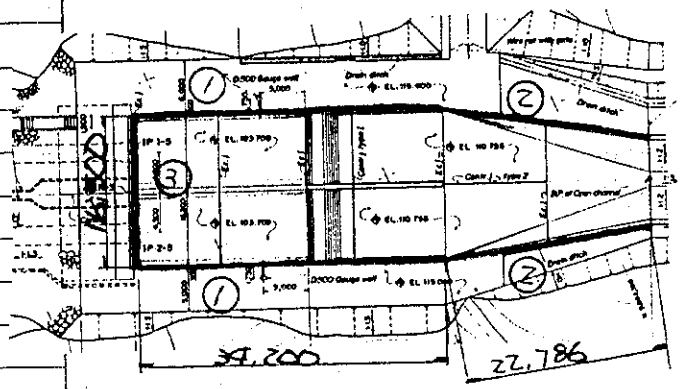
Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
4.6	MISCELLANEOUS METAL WORK			
101	Steel pipe with valve, 100 mm dia, for drainage of head tank			
	Pipe $l = (9.5 + 1.414 + 9.924) \times 2 + 1.0 + 4.0 + 4.5 = 51.176 = 51.2$ m			
	$W_P = 51.2 \times 12.2$ kg/m = 625 kg			
	valve 2 nos. 60kg/no.			
	$W_V = 60 \times 2 = 120$ kg			
	Total 745 kg			



Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
102	Steel handrail			
①	50mm pipe Vertical Nos. = 34.2/2.0 + 1 = 19 nos ℓ_V = 19 × 0.95 × 2 = 36.1 m horizontal ℓ_h = 34.2 × 2 = 68.4 m w = 5.31 kg/m 40 mm pipe ℓ = 34.2 × 2 × 2 = 136.8 m w = 3.89 kg/m W = (36.1 + 68.4) × 5.31 + 136.8 × 3.89 = 1,087 kg			
②	50mm pipe vertical Nos. = 22.786/2.0 + 1 = 13 nos ℓ_V = 13 × 0.95 × 2 = 24.7 m hor. ℓ = 22.786 × 2 = 45.572 m 40mm pipe ℓ = 22.786 × 2 × 2 = 91.144 m W = (24.7 + 45.572) × 5.31 + 91.144 × 3.89 = 728 kg			

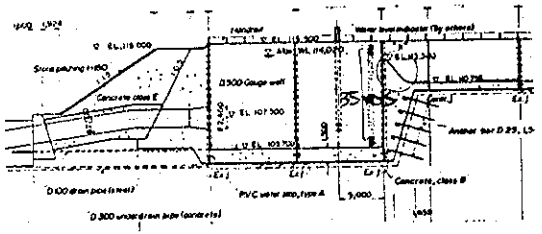
Working Division: _____

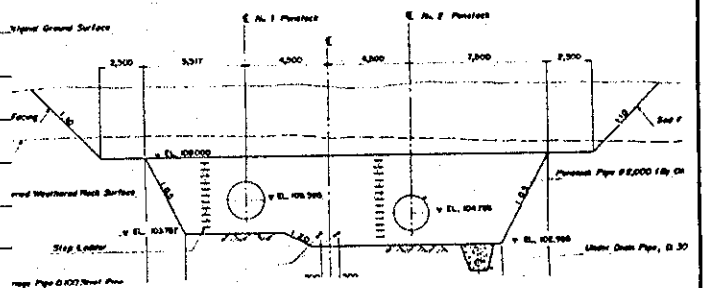
Description	Calculation Details	Unit	Quantity	Remarks
③	50 mm pipe			
	Vertical			
	Nos. = 16.5/2.0 + 1 = 10 nos			
	ℓ_v = 10 × 0.95 = 9.5 m			
	hor.			
	ℓ_h = 16.5			
	40 mm pipe			
	ℓ = 16.5 × 2 = 33.0 m			
	W = (9.5 + 16.5) × 5.31 + 33.0 × 3.89			
	= 266 kg			
	Total 2,081 kg			

97-5

Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
103	Round bar, for step ladder 350 interval $l = 1.26$ m / no. $w = 2.98$ kg/m			
-	for settling basin $H = 115.5 - 103.7 = 11.8$ m			
	nos. $= 11.8/0.35 + 1 = 35$ nos. / basin			
	$l = 1.26 \times 35 \times 2 = 88.2$ m			
	$W = 88.2 \times 2.98 = 263$ kg			
-	for retaining wall at the beginning of head tank $h_1 = 4.4$ m nos $= 4.4/0.35 + 1 = 14$ nos $h_2 = 5.2$ m nos $= 5.2/0.35 + 1 = 16$ nos 30 nos			
	$l = 1.26 \times 30 = 37.8$ m			
	$W = 37.8 \times 2.98 = 113$ kg			
	Total 376 kg			





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Working Division:

Description	Calculation Details	Unit	Quantity	Remarks
104	Wire net fence with gate			see drawing
	ℓ = 24 m w = 13 kg/m			
	W = 24 × 13 = 312 kg			
105	Staff gauge			
	h = 11.8 m			
	w = 200 mm			
106	Steel pipes for water level gauge			
	2 sets			
	ϕ500 h = 11.8 m / basin			
	ϕ200 ℓ = 2.0 m × 2 = 4.0 m / basin			
	W = 11.8 × 2 × 97.4 + 4.0 × 2 × 30.1			
	= 2,539 kg