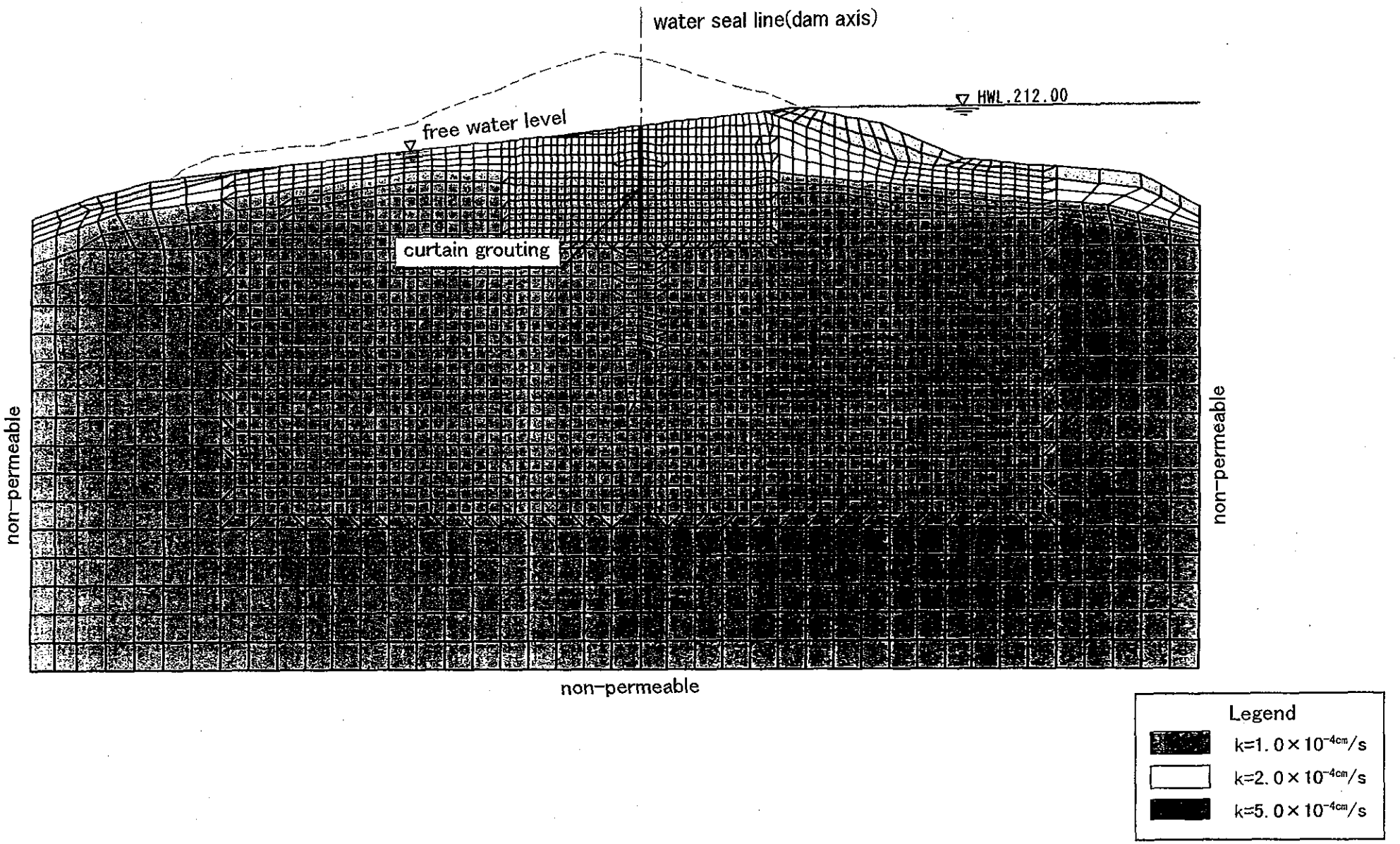


Fig.5 (1) Analysis model (section 1)

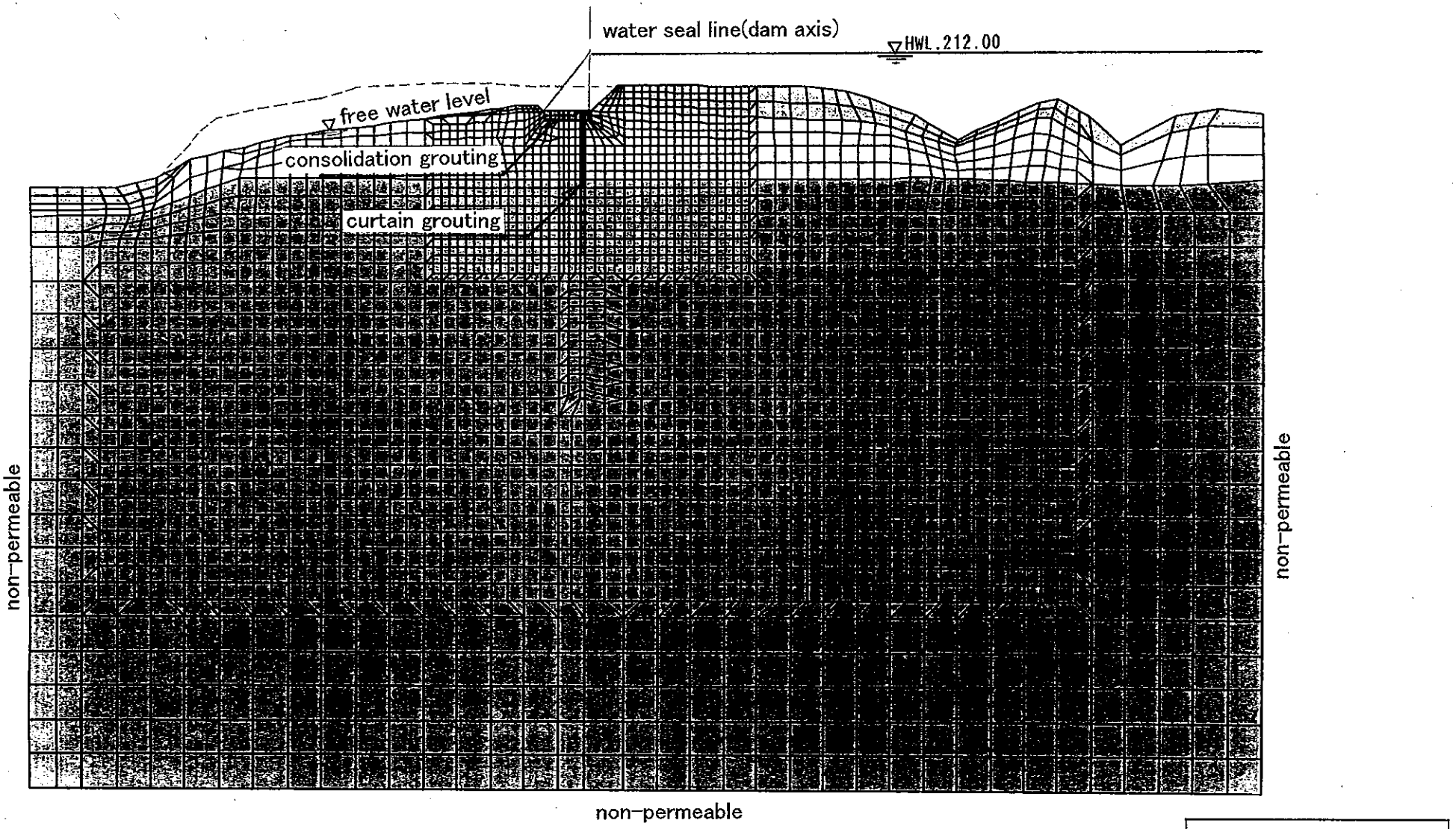


Fig.5 (2) Analysis model (section 2)

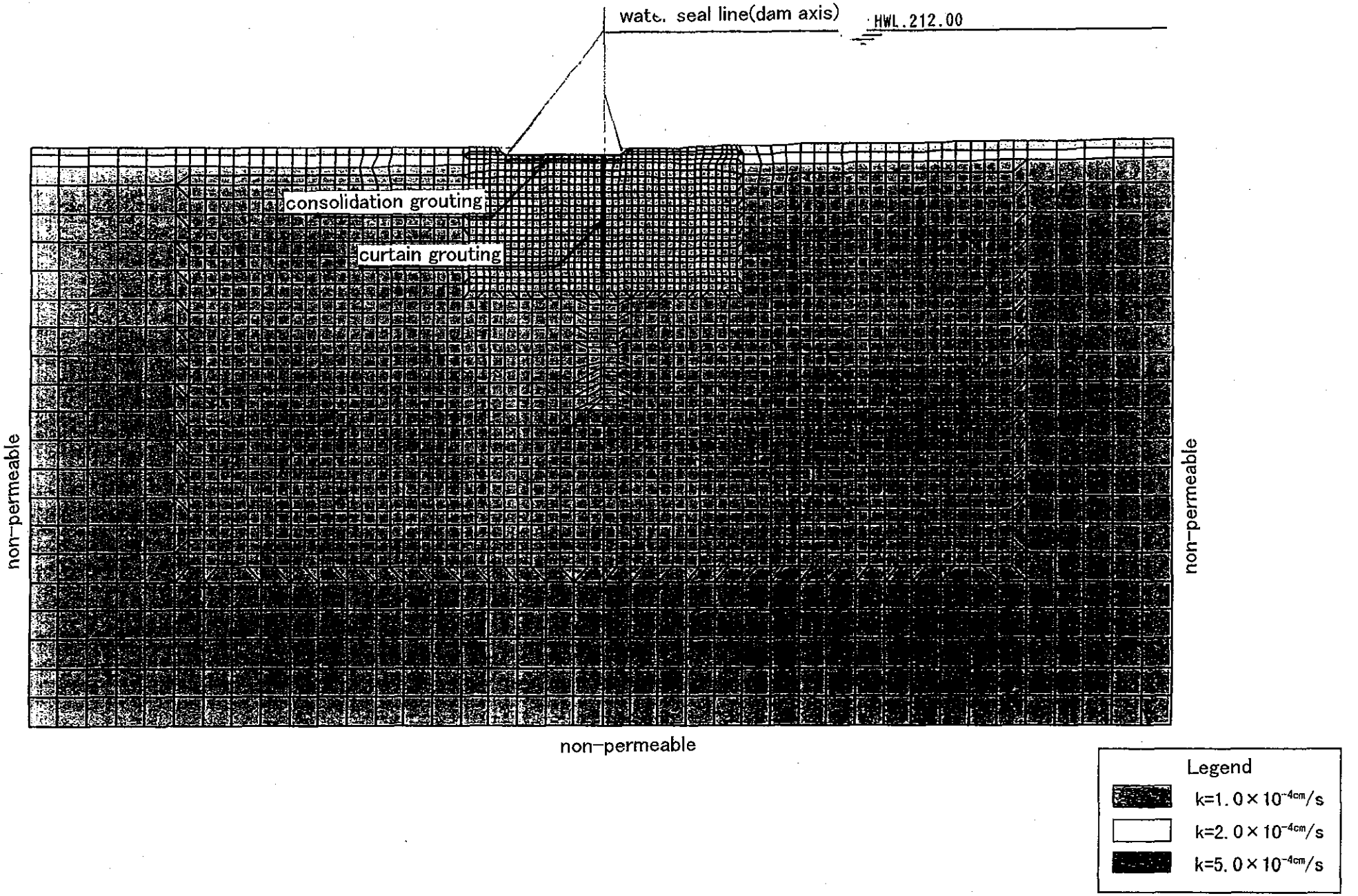


Fig.5 (3) Analysis model (section 3)

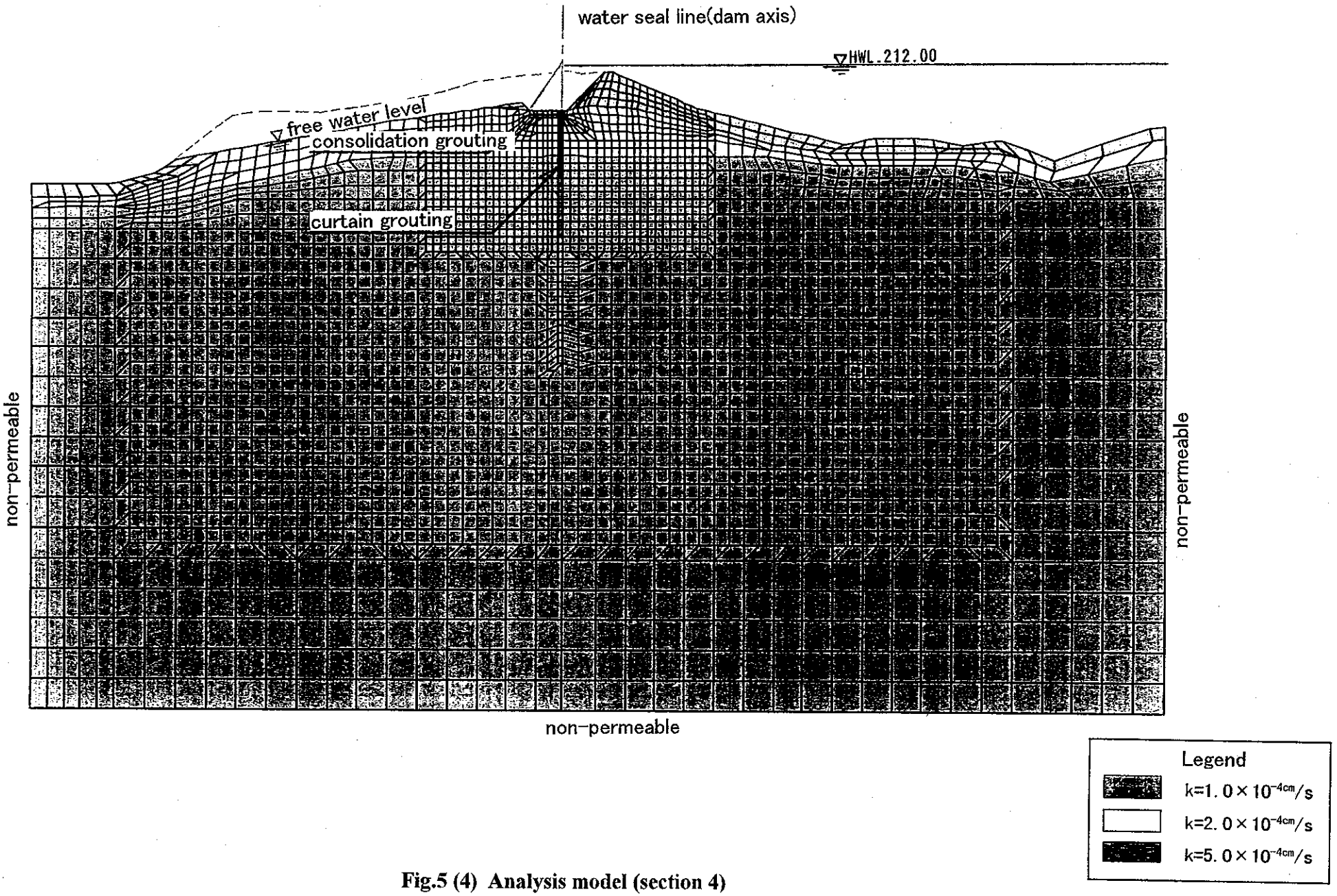


Fig.5 (4) Analysis model (section 4)

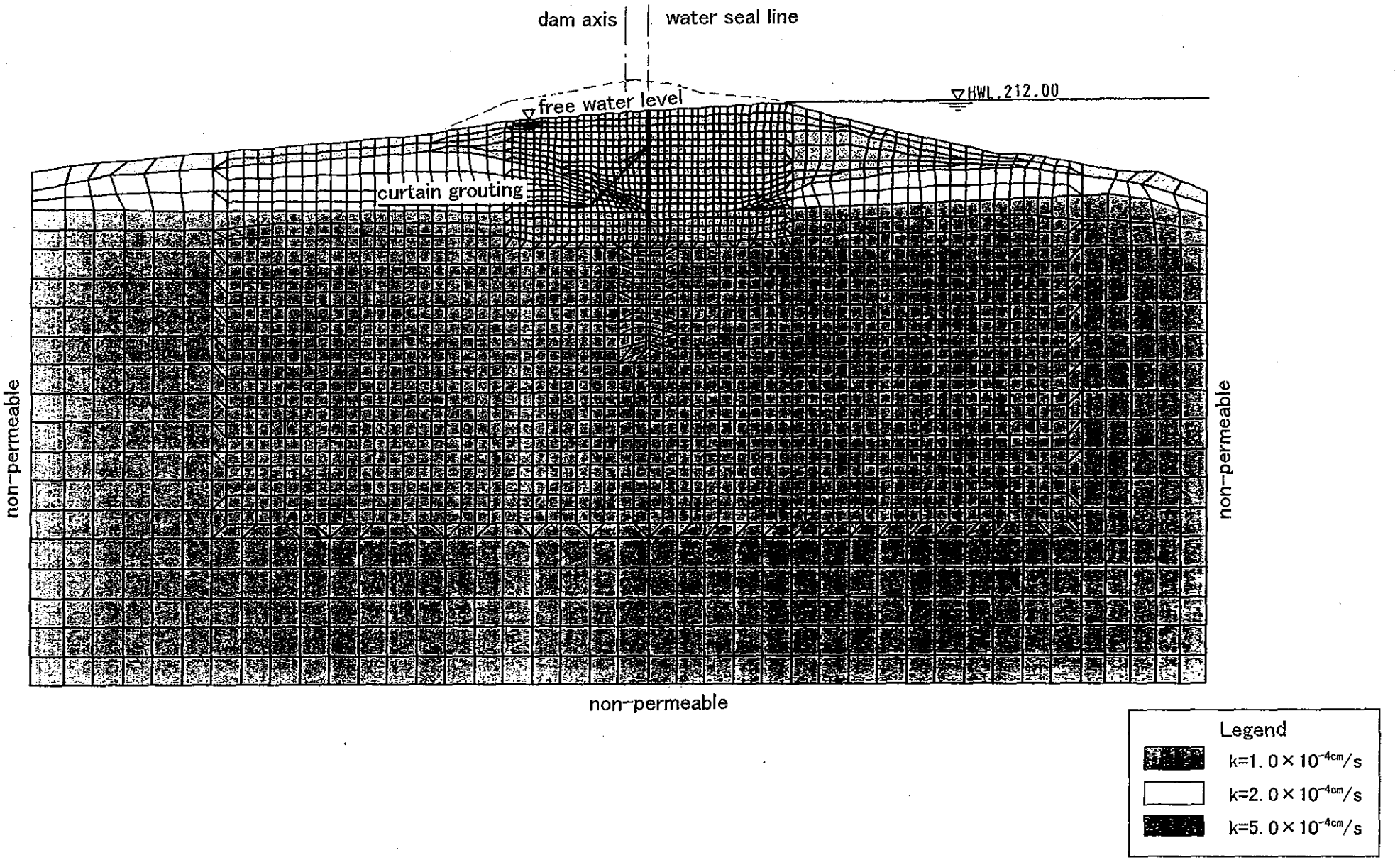


Fig.5 (5) Analysis model (section 5)

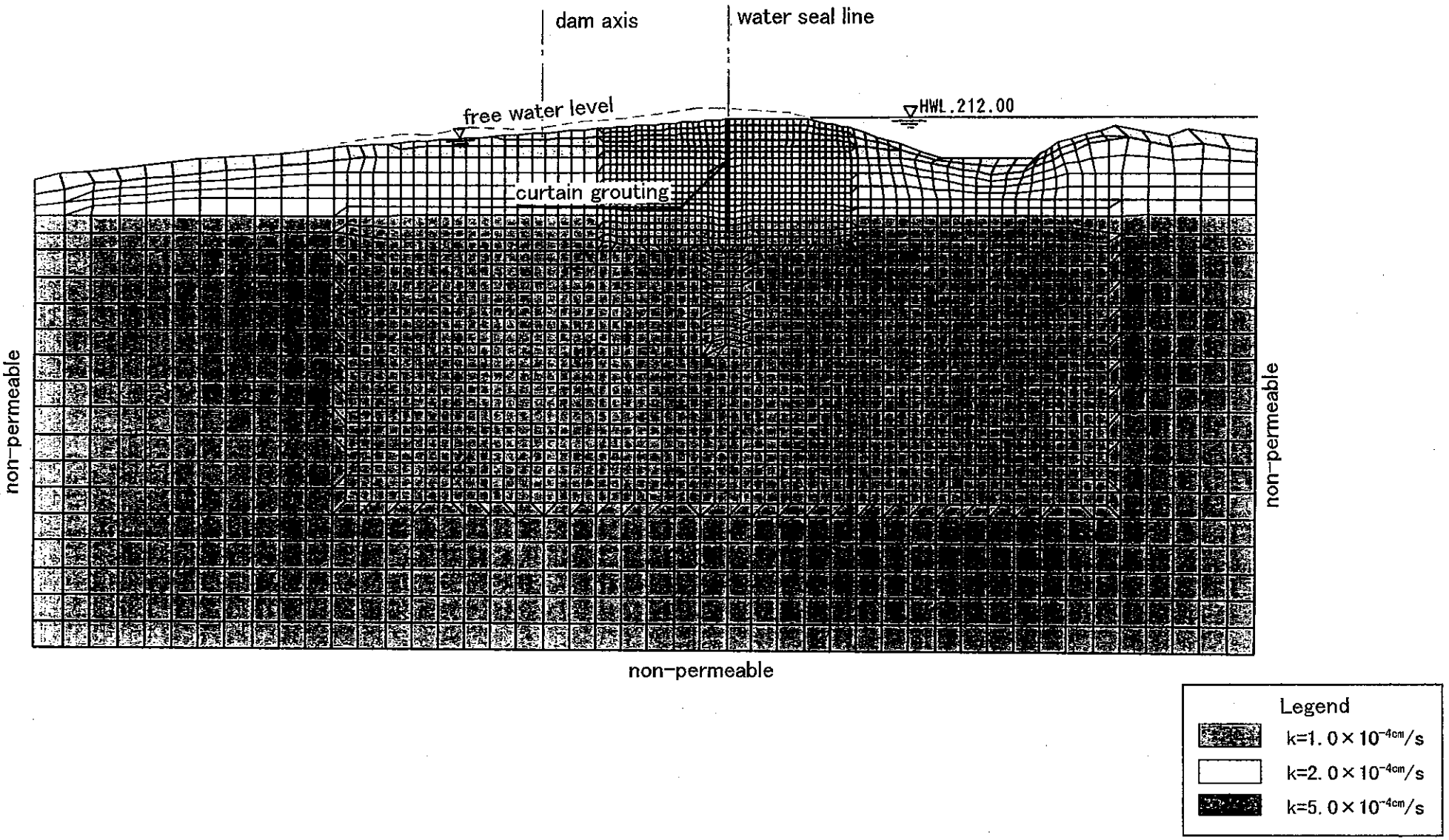


Fig.5 (6) Analysis model (section 6)

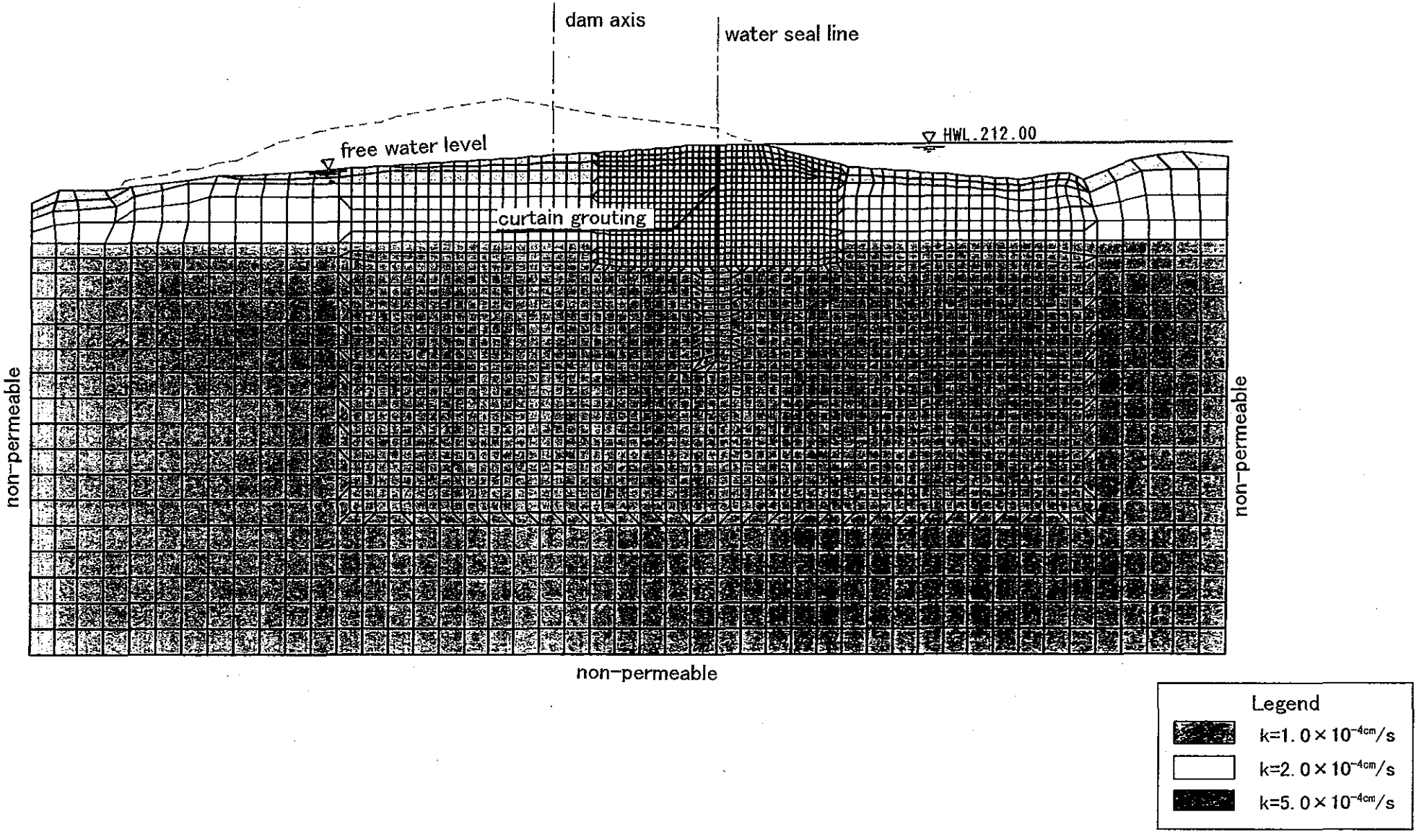


Fig.5 (7) Analysis model (section 7)

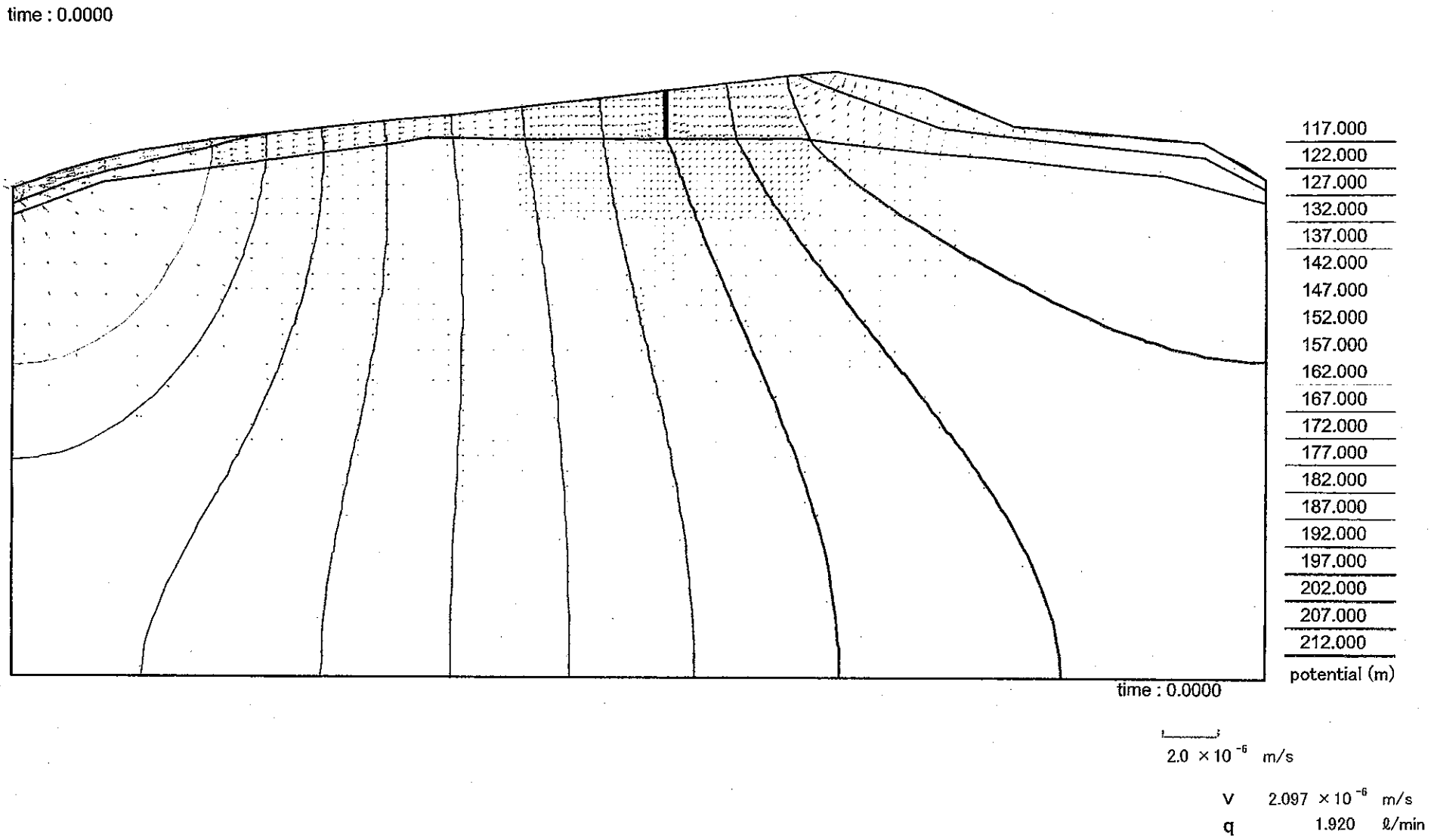


Fig.6 (1) Hydraulic potential line & veloeity vector (section 1 : curtain grouting 0.5H)

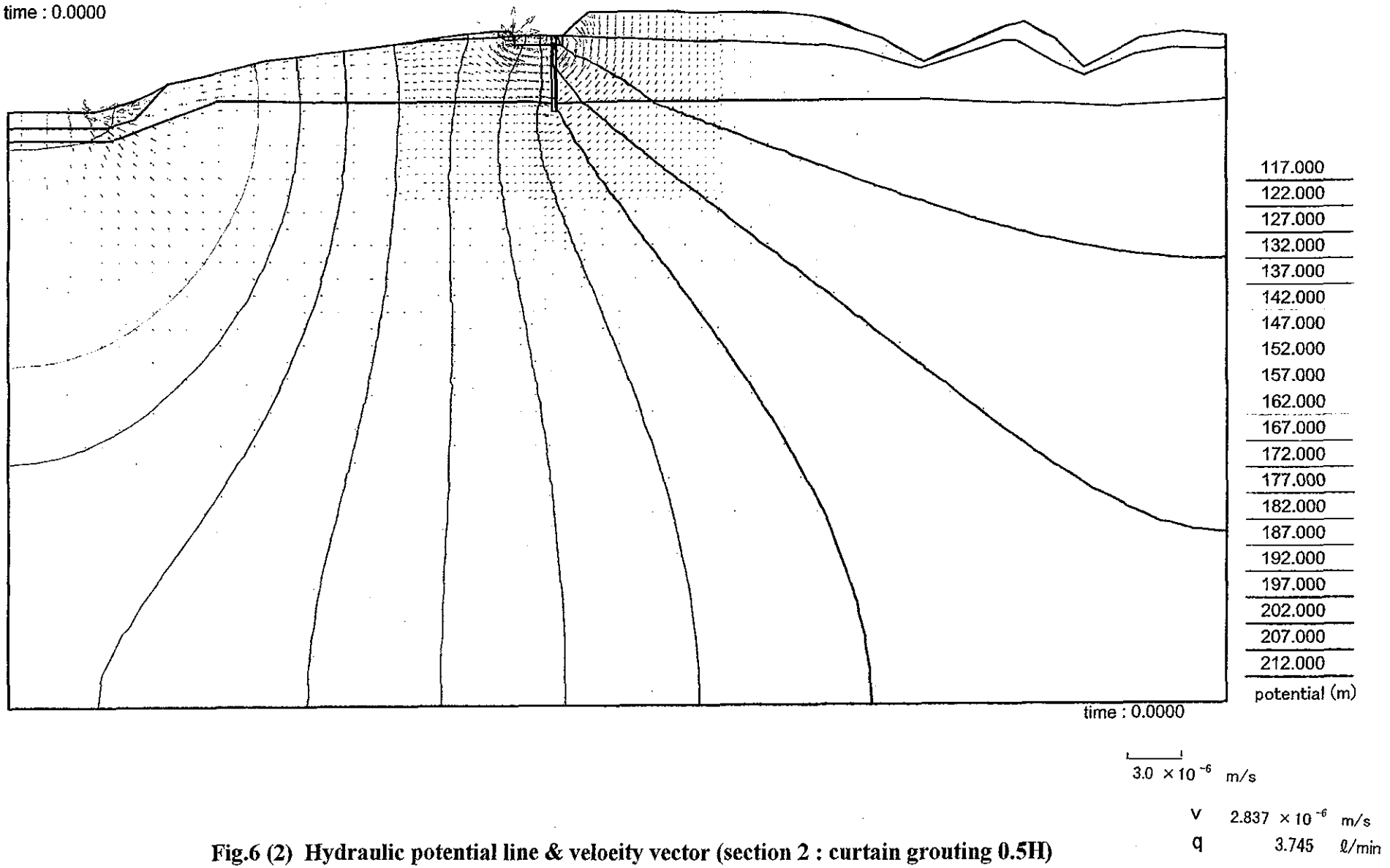


Fig.6 (2) Hydraulic potential line & veloeity vector (section 2 : curtain grouting 0.5H)

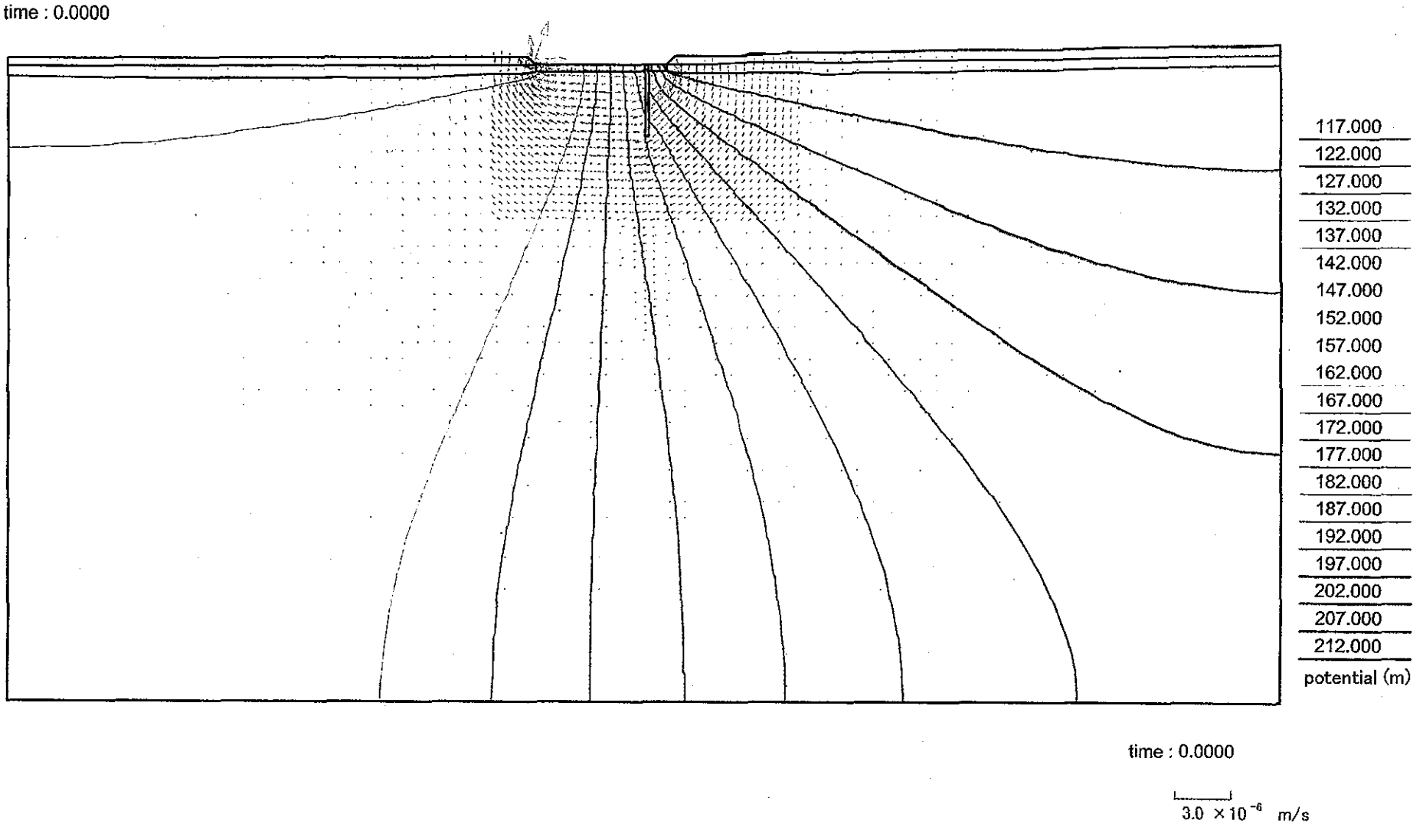


Fig.6 (3) Hydraulic potential line & veloeity vector (section 3 : curtain grouting 0.5H)

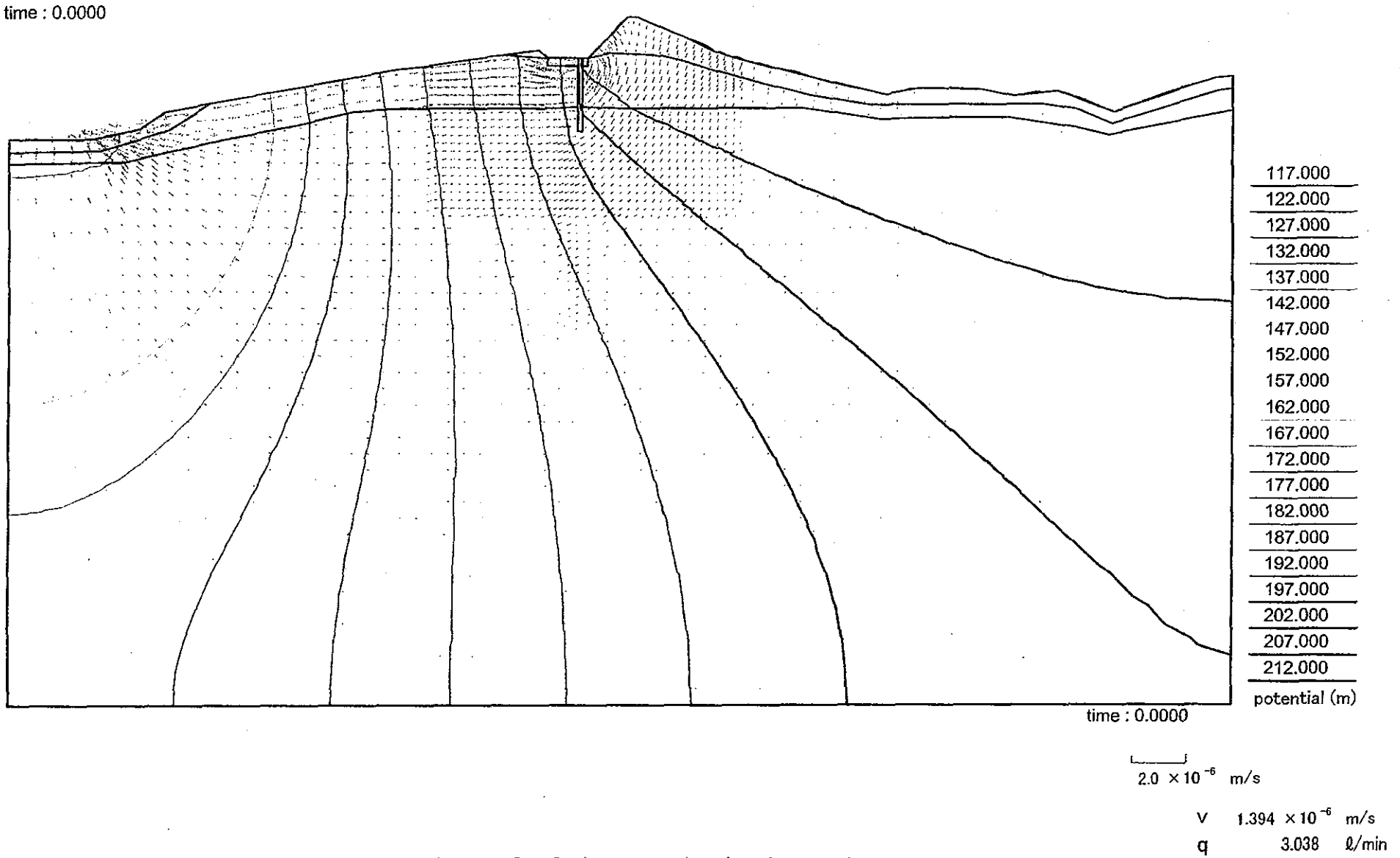
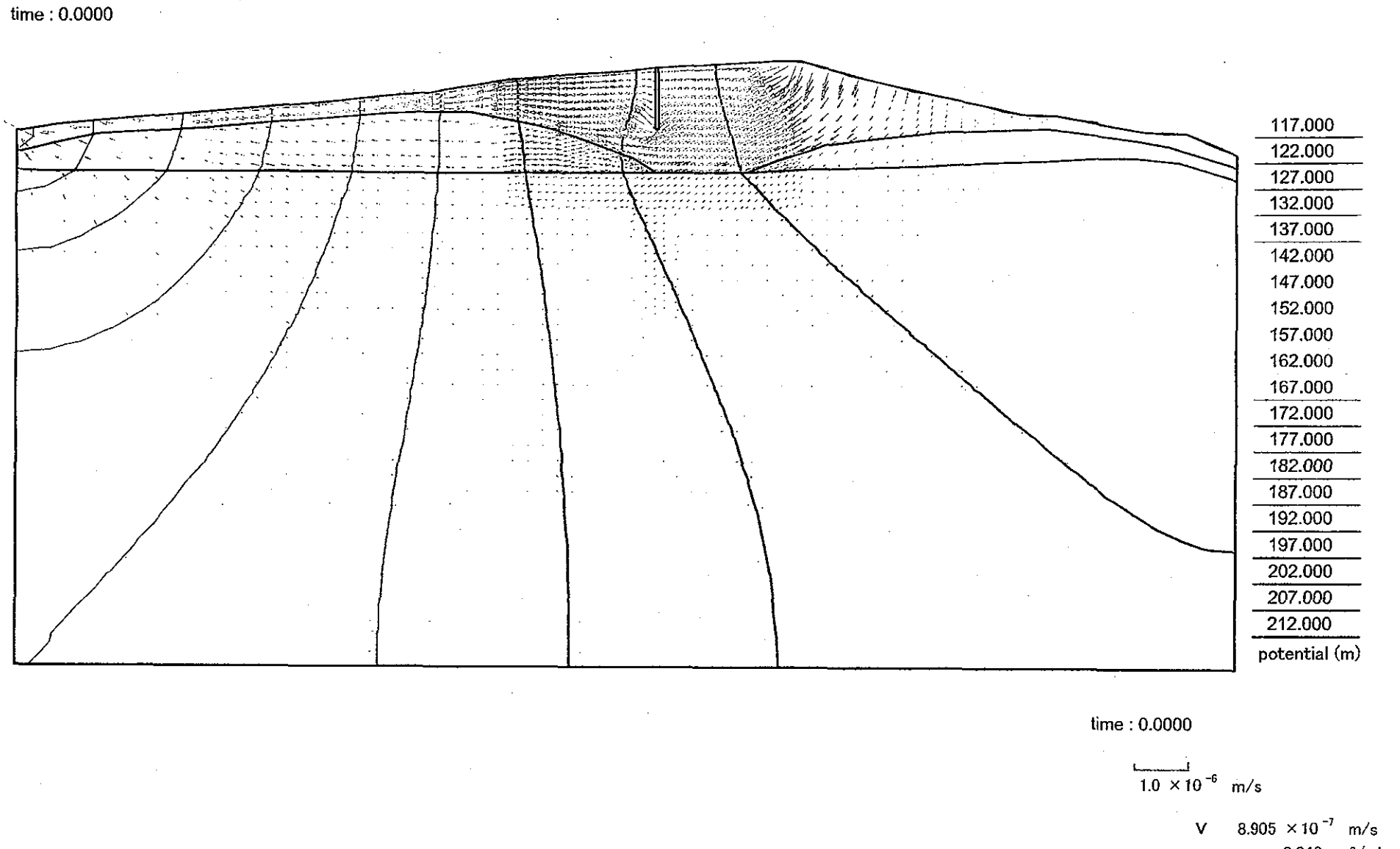


Fig.6 (4) Hydraulic potential line & veloeity vector (section 4 : curtain grouting 0.5H)



11-3-23

Fig.6 (5) Hydraulic potential line & veloeity vector (section 5 : curtain grouting 0.5H)

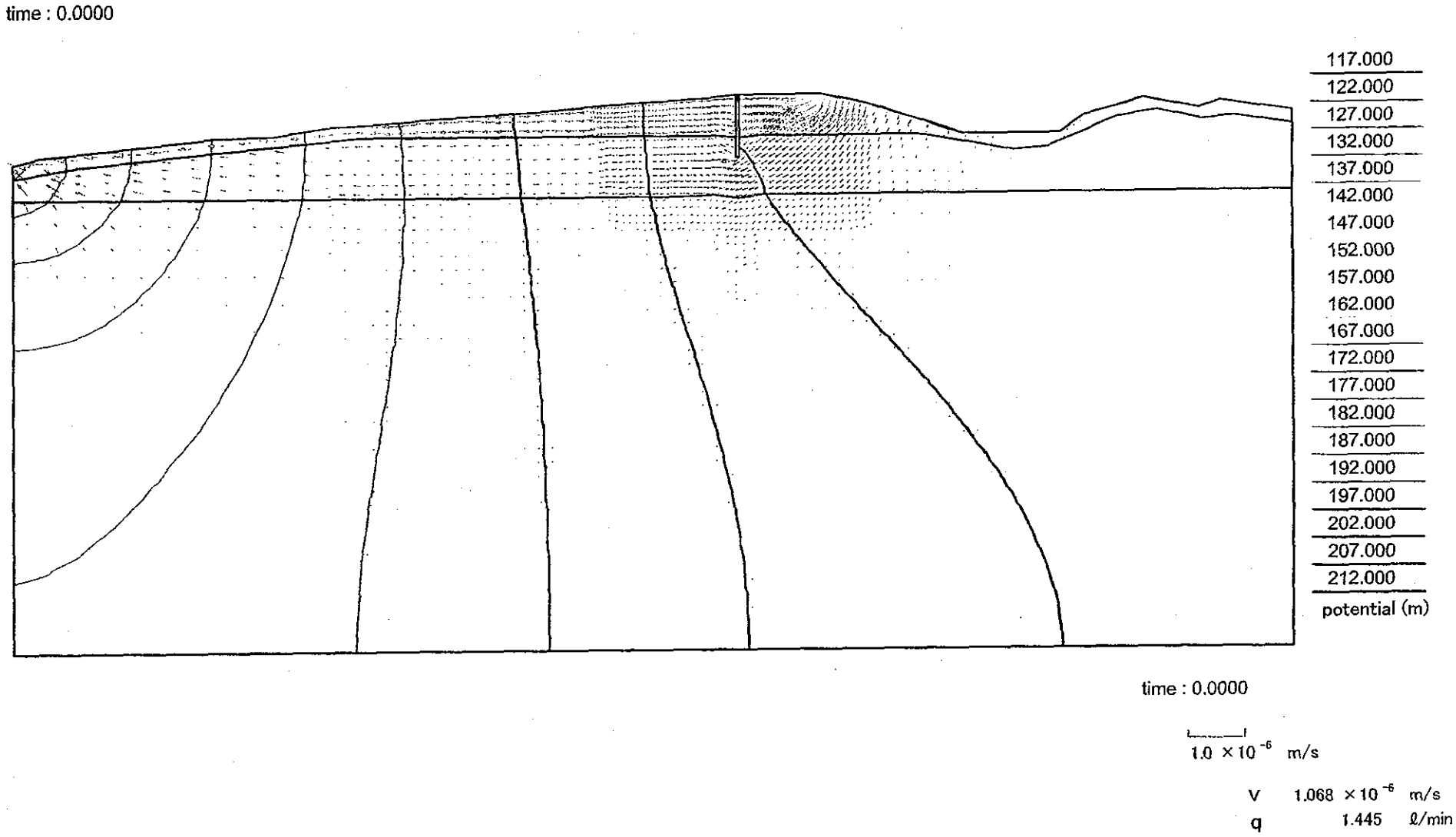
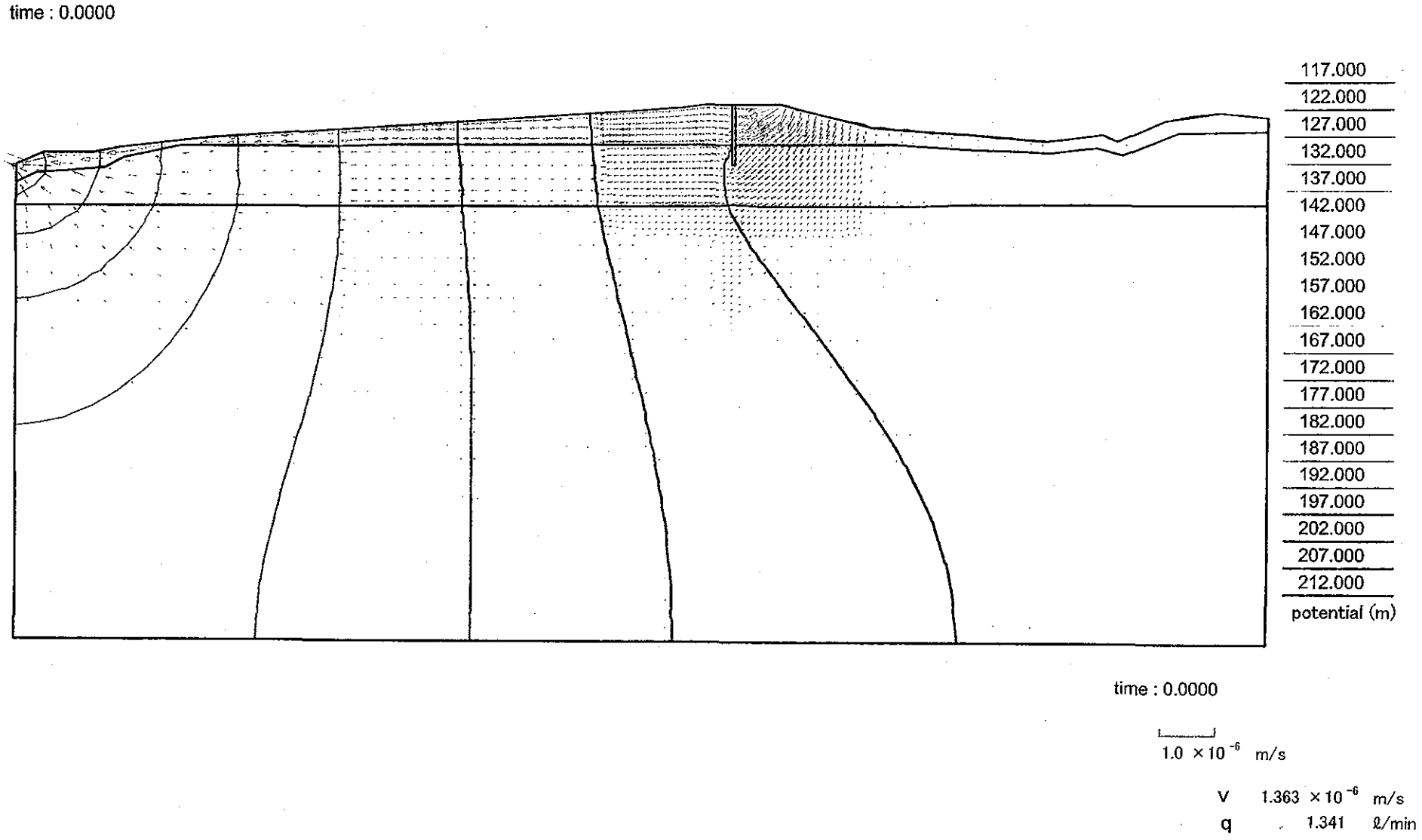


Fig.6 (6) Hydraulic potential line & veloeity vector (section 6 : curtain grouting 0.5H)



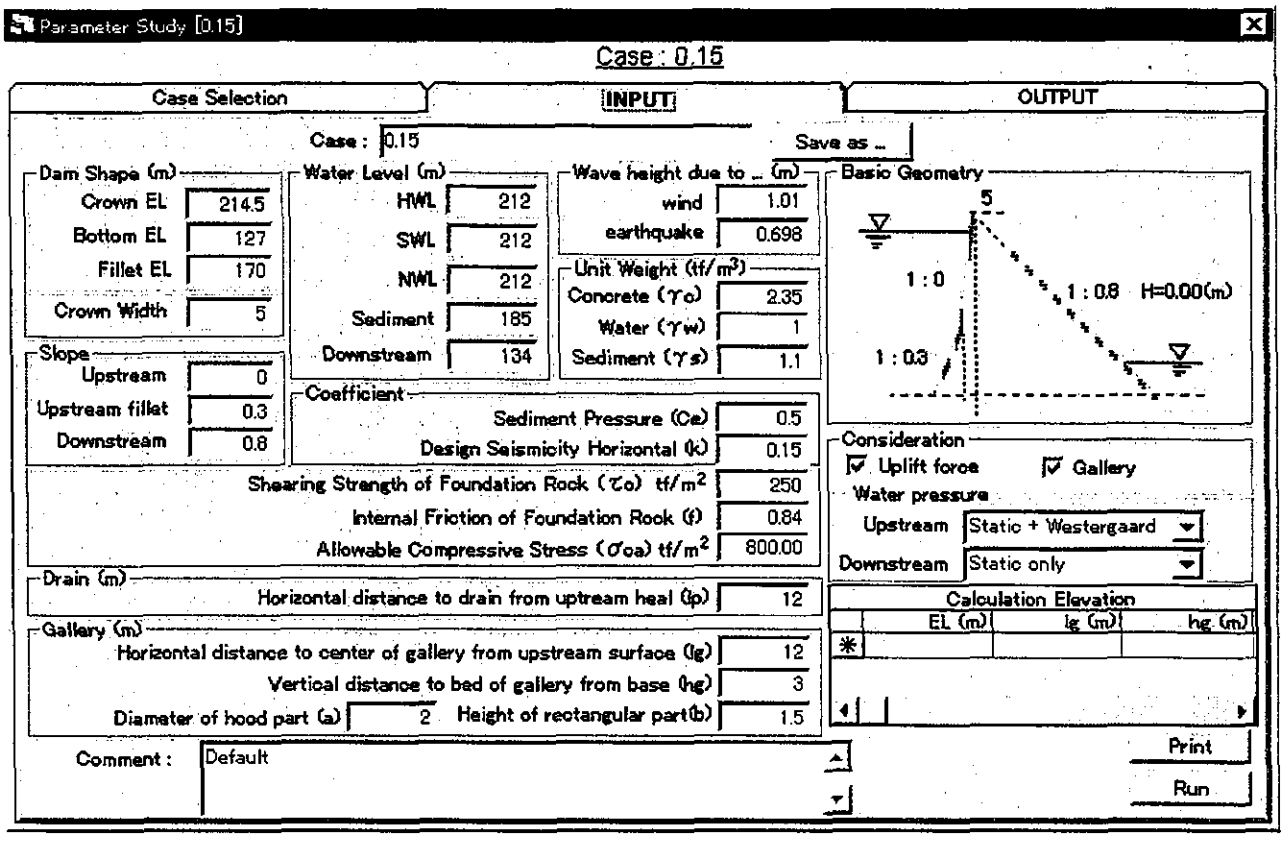
11-3-25

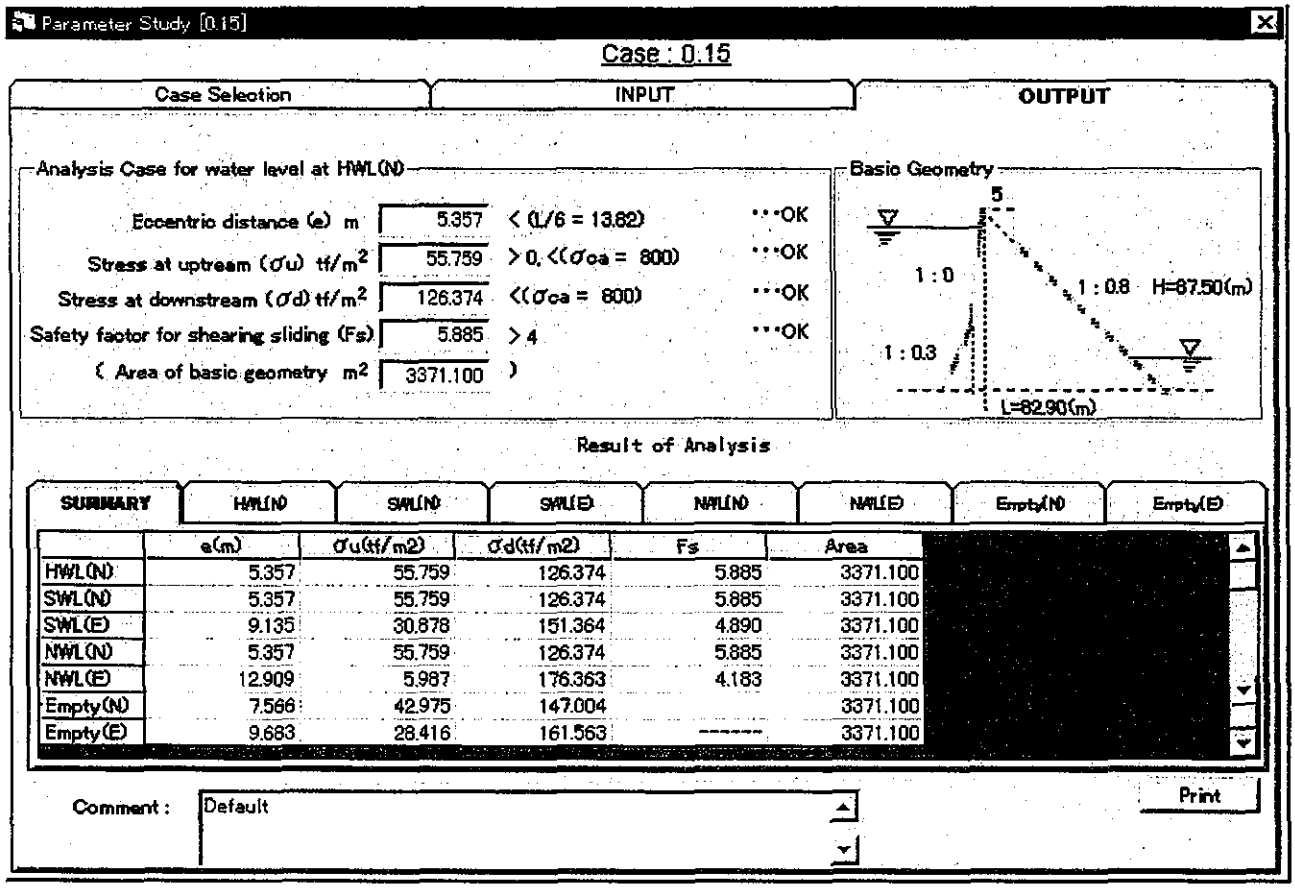
Fig.6 (7) Hydraulic potential line & veloeity vector (section 7 : curtain grouting 0.5H)

Appendix 11.4

Dam Stability Analysis

671
(672)


Parameter Study [0.15]
Case : 0.15
Case Selection
INPUT
OUTPUT
Case : 0.15
Save as ..
Dam Shape (m)
Crown EL 214.5
Bottom EL 127
Fillet EL 170
Crown Width 5
Water Level (m)
HWL 212
SWL 212
NWL 212
Sediment 185
Downstream 134
Wave height due to .. (m)
wind 1.01
earthquake 0.698
Unit Weight (tf/m3)
Concrete (γc) 2.35
Water (γw) 1
Sediment (γs) 1.1
Basic Geometry
5
1 : 0
1 : 0.8
H=0.00(m)
1 : 0.3
Slope
Upstream 0
Upstream fillet 0.3
Downstream 0.8
Coefficient
Sediment Pressure (Ce) 0.5
Design Seismicity Horizontal (k) 0.15
Shearing Strength of Foundation Rock (τo) tf/m2 250
Internal Friction of Foundation Rock (f) 0.84
Allowable Compressive Stress (σca) tf/m2 800.00
Consideration
Uplift force
Gallery
Water pressure
Upstream Static + Westergaard
Downstream Static only
Drain (m)
Horizontal distance to drain from uptream heal (lp) 12
Calculation Elevation
EL (m)
lg (m)
hg (m)
Gallery (m)
Horizontal distance to center of gallery from upstream surface (lg) 12
Vertical distance to bed of gallery from base (hg) 3
Diameter of hood part (a) 2
Height of rectangular part(b) 1.5
Comment : Default
Print
Run


Parameter Study [0.15]
Case : 0.15
Case Selection
INPUT
OUTPUT
Analysis Case for water level at HWL(N)
Eccentric distance (e) m 5.357 < (L/6 = 13.82) ···OK
Stress at uptream (σu) tf/m2 55.759 > 0, <(σca = 800) ···OK
Stress at downstream (σd) tf/m2 126.374 <(σca = 800) ···OK
Safety factor for shearing sliding (Fs) 5.885 > 4 ···OK
(Area of basic geometry m2 3371.100)
Basic Geometry
5
1 : 0
1 : 0.8
H=87.50(m)
1 : 0.3
L=82.90(m)
Result of Analysis
SUMMARY
HWL(N)
SWL(N)
SWL(E)
NWL(N)
NWL(E)
Empty(N)
Empty(E)
e(m) σu(tf/m2) σd(tf/m2) Fs Area
HWL(N) 5.357 55.759 126.374 5.885 3371.100
SWL(N) 5.357 55.759 126.374 5.885 3371.100
SWL(E) 9.135 30.878 151.364 4.890 3371.100
NWL(N) 5.357 55.759 126.374 5.885 3371.100
NWL(E) 12.909 5.987 176.363 4.183 3371.100
Empty(N) 7.566 42.975 147.004 3371.100
Empty(E) 9.683 28.416 161.563 ------ 3371.100
Comment : Default
Print

CHAPARRAL STABILITY

CASE		1	2	check	3	4	5	6	7	8	check
Dam Shape(m)											
Crown EL	m	214.5	214.5		214.5	214.5	214.5	214.5	214.5	214.5	
Bottom EL	m	127.0	127.0		127.0	127.0	127.0	127.0	127.0	127.0	
Fillet EL	m	127.0	170.0		170.0	170.0	150.0	170.0	127.0	170.0	
Crown Width	m	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	
Slope											
Upstream		0	0		0	0	0	0	0	0	
Upstream Fillet		0	0.3		0.2	0.1	0.3	0.2	0	0.3	
Downstream		0.8	0.8		0.8	0.8	0.8	0.8	0.8	0.8	
Water Level (m)											
HWL	m	212.0	212.0		212.0	212.0	212.0	212.0	212.0	212.0	
SWL(サーチャージ)	m	212.0	212.0		212.0	212.0	212.0	212.0	212.0	212.0	
NWL	m	212.0	212.0		212.0	212.0	212.0	212.0	212.0	212.0	
Sediment	m	185.0	185.0		185.0	185.0	185.0	185.0	185.0	185.0	
Downstream	m	134.0	134.0		134.0	134.0	134.0	134.0	134.0	134.0	
Wave height due to (m)											
wind	m	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	
earthquake	m	0.7	0.7		0.7	0.7	0.7	0.7	0.7	0.7	
Unit Weight (tf/m3)											
Concrete(γc)	tf/m3	2.35	2.35		2.35	2.35	2.35	2.35	2.35	2.35	
Water(γw)	tf/m3	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	
sediment(γs)	tf/m3	1.1	1.1		1.1	1.1	1.1	1.1	1.1	1.1	
Coefficient											
Sediment Pressure(Ce)		0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	
Seismic Horizontal (k)		0.12	0.12		0.12	0.12	0.15	0.15	0.15	0.15	
Strength characteristic											
Shearing Strength of Foundation Rock (τo)	tf/m2	250	250		250	250	250	250	250	250	
Internal Friction of Foundation Rock (f)		0.84	0.84		0.84	0.84	0.84	0.84	0.84	0.84	
Allowable Compressive Stress (σca)	tf/m2	800	800		800	800	800	800	800	800	
Drain											
Horizontal distance to drain from upstream heal (lp)	m	10	12		8	4	12	8	10	12	
Gallery											
Horizontal distance to center of gallery from upstream surface (lg)	m	10	12		8	4	12	8	10	12	
Vertical distance to bed of gallery from base (hg)	m	3	3		3	3	3	3	3	3	

Output			NG	OK	OK	OK	NG	NG	NG	NG	OK	OK
	Eccentric distance(e)	m	9.725	5.357		5.927	6.612	7.362	5.927	9.725	5.357	
HWL	Stress at uptream(σu)	tf/m^2	13.828	55.759	54.513	49.471	41.74	37.023	49.471	13.828	55.759	54.513
(N)	Stress at downstream(σd)	tf/m^2	152.357	126.374	126.77	131.236	137.375	136.966	131.236	152.357	126.374	126.77
	Safety factor for shearing sliding(Fs)		4.867	5.885	5.879	5.569	5.254	5.402	5.569	4.867	5.885	5.879
	Eccentric distance(e)	m	9.725	5.357		5.927	6.612	7.362	5.927	9.725	5.357	
SWL	Stress at uptream(σu)	tf/m^2	13.828	55.759	53.571	49.471	41.74	37.023	49.471	13.828	55.759	53.571
(N)	Stress at downstream(σd)	tf/m^2	152.357	126.374	127.821	131.236	137.375	136.966	131.236	152.357	126.374	127.821
	Safety factor for shearing sliding(Fs)		4.867	5.885	5.842	5.569	5.254	5.402	5.569	4.867	5.885	5.842
	Eccentric distance(e)	m	13.623	8.409		9.154	10.037	11.55	9.919	14.542	9.135	
SWL	Stress at uptream(σu)	tf/m^2	-13.936	35.666	34.418	27.227	16.971	8.603	21.946	-20.481	30.878	29.629
(E)	Stress at downstream(σd)	tf/m^2	180.121	146.575	146.975	153.556	162.184	165.448	158.837	186.665	151.364	151.763
	Safety factor for shearing sliding(Fs)		4.211	5.055	5.05	4.796	4.535	4.516	4.641	4.08	4.89	4.885
	Eccentric distance(e)	m	9.725	5.357		5.927	6.612	7.362	5.927	9.725	5.357	
NWL	Stress at uptream(σu)	tf/m^2	13.828	55.757	52.62	49.471	41.74	37.023	49.471	13.828	55.759	52.62
(N)	Stress at downstream(σd)	tf/m^2	152.357	126.374	128.882	131.236	137.375	136.966	131.236	152.357	126.374	128.882
	Safety factor for shearing sliding(Fs)		4.867	5.885	5.805	5.569	5.254	5.402	5.569	4.867	5.885	5.805
	Eccentric distance(e)	m	17.523	11.458		12.38	13.463	15.736	13.91	19.361	12.909	
NWL	Stress at uptream(σu)	tf/m^2	-41.713	15.564	14.313	4.973	-7.81	-19.827	-5.589	-54.802	5.987	4.736
(E)	Stress at downstream(σd)	tf/m^2	207.898	166.786	167.188	175.886	187.005	193.941	186.448	220.986	176.363	176.765
	Safety factor for shearing sliding(Fs)		3.711	4.431	4.426	4.211	3.989	3.881	3.978	3.511	4.183	4.178
	Eccentric distance(e)	m	11.749	7.566		8.917	10.305	8.936	8.917	11.749	7.566	
Emp	Stress at uptream(σu)	tf/m^2	-0.724	147.004	145.288	31.109	16.806	29.171	31.109	-0.724	147.007	145.288
ty(N)	Stress at downstream(σd)	tf/m^2	207.091	42.975	39.845	163.735	183.466	163.529	163.735	207.091	42.975	39.845
	Safety factor for shearing sliding(Fs)		—	—		—	—	—	—	—	—	—
	Eccentric distance(e)	m	13.518	9.26		10.635	12.048	11.107	11.064	13.96	9.683	
Emp	Stress at uptream(σu)	tf/m^2	-16.373	158.651	153.551	18.334	2.712	12.854	15.141	-20.285	161.563	159.847
ty(E)	Stress at downstream(σd)	tf/m^2	222.74	31.328	27.534	176.51	197.56	179.846	179.703	226.652	28.416	25.286
	Safety factor for shearing sliding(Fs)		—	—	—	—	—	—	—	—	—	—

Appendix 11.5

Transportation Route to Project Site

675
(676)

A Turning Point from
American High Way located
El Triunfo

Longest Bridge

of River

Smallest Curve of an Unpaved Road

Concrete Bridge

(need to detailed inspection)

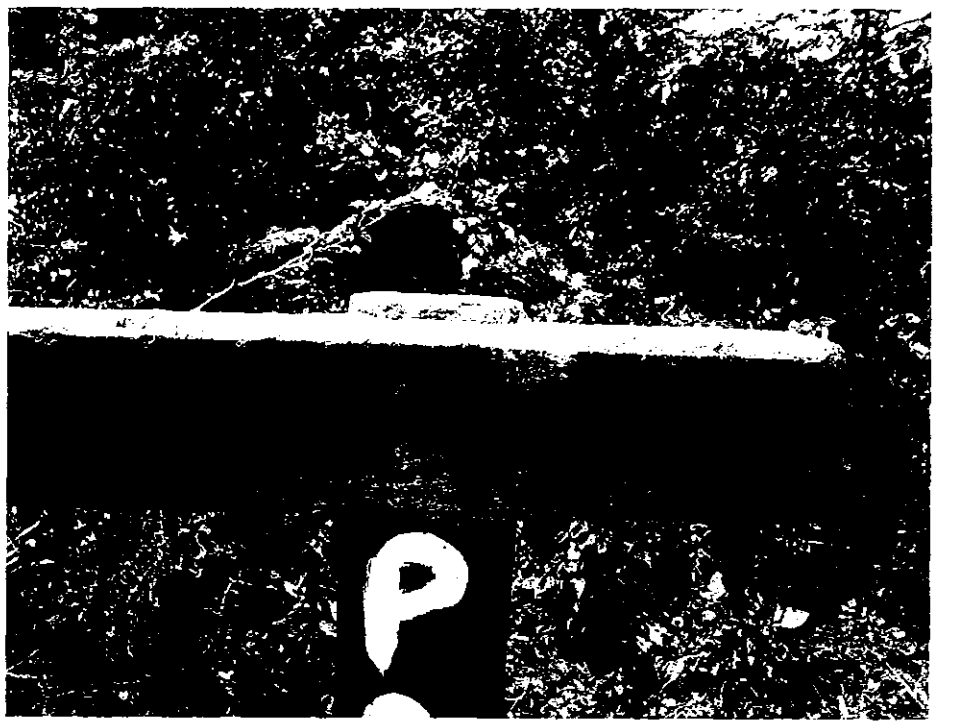
Concrete Bridge

(need to reinforcement work)

Concrete Bridge

(need to detailed inspection)

A Turning Point to SESORI



26.207 km from American Highway

Narrow Road near Project Site
(need to expansion work)

Torola River near Project Site

Chapter 12: Construction Plan and Cost of Construction

Appendix 12.1: Construction Plan

Appendix 12.2: Cost of Construction

- Appendix 12.2.1: Summary of El Chaparral Project Cost
- Appendix 12.2.2: Details of Project Cost (Civil)
- Appendix 12.2.3: Details of Project Cost (Electric)
- Appendix 12.2.4: Disbursement Schedule

Appendix 12.3: Calculated Quantity

- Appendix 12.3.1: Summary of Quantity
- Appendix 12.3.2: Civil Works
- Appendix 12.3.3: Hydromechanical Equipment

Appendix 12.1

Construction Plan

Table 12.1 EL Chaparral Project Construction Schedule

item		unit	quantity	1st year	2nd year	3rd year	4th year	remarks
				A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	
1 Preparatory works								
construction road 1 (B=6m)	existing road improvement	km	6					
construction road 2 (B=6m)	new road (permanent)	km	3					
construction road 3 (B=11m)	new road (temporary)	km	2					
camp & office facility		LS	1					
temporary yard development		LS	1					
temporary construction facility	water supply, electric supply	LS	1					
	aggregate/concrete plant	LS	1					
	cable crane & others	LS	1					
2 Main civil works								
Care of river					diversion			
upstream coffer dam	excavation	m^3	5,400					
	dam concrete	m^3	14,400					15,360 m^3/month (24day/month×20h/day×20 times/h×2.0m^3×0.8)
downstream coffer dam	excavation	m^3	5,000					
	dam embankment	m^3	3,000					
diversion tunnel	excavation	m^3	8,200					
	tunnel excavation(L=380m)	m^3	24,000					144 m/month (24day/month×1.5m/cycle×4cycle/day)
	lining concrete(L=80m)	m^3	2,100					120 m/month (24day/month÷2day/1cycle×10m/1cycle)
	closing (plug concrete)	LS	1					
Dam								
Dam								
excavation		m^3	311,200					50,000 m^3/month (20day/month×2,500m^3/day)
RCC dam concrete	inner concrete	m^3	247,600					57,600 m^3/month (20day/month×20h/day×20 times/h×6.0m^3×0.8×1.5)
conventional dam concrete	outer concrete	m^3	121,600					
curtain grouting	boring (cement injection)	m	46,800					
consolidation grouting	boring (cement injection)	m	4,400					
Spillway								
structural concrete	pier, guide wall and others	m^3	23,000					
gate installation	gate	LS	1					

Table 12.1 EL Chaparral Project Construction Schedule

item		unit	quantity	1st year	2nd year	3rd year	4th year	remarks
				A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	
Water way								
Intake								
structural concrete	pier and others	m^3	1,200					
gate installation	gate and screen	LS	1					
Penstock								
incline schaft excavation		m^3	2,400					L=91m、60m/month (20day/month×1.5m/cycle×2cycle/day)
penstock tube installation		m	145					L=89m、30m/month (20day/month÷12day/cycle×18m/cycle)
filling concrete		m^3	800					
Power house								～EL145m 166,100m^3、EL145m～ 31,100m^3
Power house								
excavation		m^3	179,400					50,000m^3/month (20day/month×2,500m^3/day)、
structural concrete	foundation, slab and others	m^3	11,700					2,400m^3/month(120m^3/day×20day/month)
Control building								
Control building	35×27×13	LS	1					
Outlet								
excavation		m^3	16,200					
Switch yard								
foundation concrete		m^3	100					
3. Electric equipment	equipment installation	LS	1			inundation		
main draft and overhead traveling crane								
main turbine & it's auxiliary equipment								
main generator & it's auxiliary equipment								
sub turbine & generator & it's auxiliary equipment								
power plant equipment								
switchyard equipment and main transformer								
dry and wet test							operation	
transmission line		km	43					

Appendix 12.2

Cost of Construction

Appendix 12.2.1: Summary of El Chaparral Project Cost

Appendix 12.2.2: Details of Project Cost (Civil)

Appendix 12.2.3: Details of Project Cost (Electric)

Appendix 12.2.4: Disbursement Schedule

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(692)

Appendix 12.2.1

Summary of El Chaparral Project Cost

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(694)

Table 12.2 EL CHAPARRAL PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Quantity	Unit	Unit Price	Total Cost	Foreign Currency	Local Currency	Subtotal
PROJECT COST							
1 Preparatory Works							$ 4,471,800
Construction road 1 (Improved existing road , B=6m)	6.0	km	$ 15,400	$ 92,400	$ 9,240	$ 83,160	
Construction road 2 (new permanent paved road , B=6m)	3.0	km	$ 185,000	$ 555,000	$ 55,500	$ 499,500	
Construction road 3 (new temporary road , B=11m)	2.0	km	$ 37,200	$ 74,400	$ 7,440	$ 66,960	
Camp & office facility	1	ls	$ 1,800,000	$ 1,800,000	$ 180,000	$ 1,620,000	
Temporary constructon facility	1	ls	$ 1,100,000	$ 1,100,000	$ 110,000	$ 990,000	
Temporary constructon yard development	1	ls	$ 850,000	$ 850,000	$ 85,000	$ 765,000	
2 Civil Works							$ 57,114,110
Care of River							$ 6,210,450
Upstream Cofferdam							
Common Excavation	3,800	m^3	$ 4	$ 15,200	$ 7,600	$ 7,600	
Rock Excavation	1,600	m^3	$ 10	$ 16,000	$ 9,600	$ 6,400	
Roller Compacted Concrete	14,400	m^3	$ 55	$ 792,000	$ 316,800	$ 475,200	
Others	1	ls	40000	$ 40,000	$ 20,000	$ 20,000	
Downstream Cofferdam							
Common Excavation	3,500	m^3	$ 4	$ 14,000	$ 7,000	$ 7,000	
Rock Excavation	1,500	m^3	$ 10	$ 15,000	$ 9,000	$ 6,000	
Embankment	3,000	m^3	$ 7	$ 21,000	$ 16,800	$ 4,200	
Others	1	ls	40000	$ 40,000	$ 20,000	$ 20,000	
Diversion Tunnel							
Common Excavation	8,200	m^3	$ 4	$ 32,800	$ 16,400	$ 16,400	
Tunnel Excavation	24,000	m^3	$ 150	$ 3,600,000	$ 2,880,000	$ 720,000	
Tunnel Lining Concrete	2,100	m^3	$ 230	$ 483,000	$ 241,500	$ 241,500	
Reinforced Bar	60	t	$ 1,500	$ 90,000	$ 54,000	$ 36,000	
Others	1	ls	25%	$ 1,051,450	$ 630,870	$ 420,580	
Dam							$ 44,048,400
Dam							
Common Excavation	124,500	m^3	$ 4	$ 498,000	$ 249,000	$ 249,000	
Rock Excavation	186,700	m^3	$ 10	$ 1,867,000	$ 1,120,200	$ 746,800	
Roller Compacted Concrete(Inner Concrete)	247,600	m^3	$ 55	$ 13,618,000	$ 5,447,200	$ 8,170,800	
Conventional Concrete(Dam Crest Con + Outer Con)	121,600	m^3	$ 100	$ 12,160,000	$ 4,864,000	$ 7,296,000	
Consolidation Grouting Drilling	4,400	m	$ 60	$ 264,000	$ 52,800	$ 211,200	
Consolidation Grouting Cement	90	t	$ 700	$ 63,000	$ 12,600	$ 50,400	
Curtain Grouting Drilling	46,800	m	$ 130	$ 6,084,000	$ 1,216,800	$ 4,867,200	
Curtain Grouting Cement	2,200	t	$ 700	$ 1,540,000	$ 308,000	$ 1,232,000	
Others	1	ls	10%	$ 3,609,400	$ 180,470	$ 3,428,930	
Spillway							
Structural Concrete(Piers,Chute,Walls,etc)	23,000	m^3	$ 130	$ 2,990,000	$ 897,000	$ 2,093,000	
Reinforced Bar	640	t	$ 1,500	$ 960,000	$ 576,000	$ 384,000	
Others	1	ls	10%	$ 395,000	$ 19,750	$ 375,250	

Table 12.2 EL CHAPARRAL PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Quantity	Unit	Unit Price	Total Cost	Foreign Currency	Local Currency	Subtotal
Water way							$ 1,070,300
Intake							
Structural Concrete(Piers,etc)	1,200	m^3	$ 130	$ 156,000	$ 46,800	$ 109,200	
Reinforced Bar	60	t	$ 1,500	$ 90,000	$ 54,000	$ 36,000	
Others	1	ls	10%	$ 24,600	$ 7,380	$ 17,220	
Penstock							
Incline Shaft Excavation	2,400	m^3	$ 200	$ 480,000	$ 384,000	$ 96,000	
Filling Concrete	800	m^3	$ 190	$ 152,000	$ 60,800	$ 91,200	
Structural Concrete(Anchor Block)	500	m^3	$ 130	$ 65,000	$ 19,500	$ 45,500	
Rainforced Bar	20	t	$ 1,500	$ 30,000	$ 18,000	$ 12,000	
Others	1	ls	10%	$ 72,700	$ 21,810	$ 50,890	
Powerhouse							$ 5,784,960
Powerhouse							
Common Excavation	35,900	m^3	$ 4	$ 143,600	$ 71,800	$ 71,800	
Rock Excavation	143,500	m^3	$ 10	$ 1,435,000	$ 861,000	$ 574,000	
Structural Concrete(Slab, Barrel)	11,700	m^3	$ 130	$ 1,521,000	$ 456,300	$ 1,064,700	
Reinfored Bar	740	t	$ 1,500	$ 1,110,000	$ 666,000	$ 444,000	
Others	1	ls	20%	$ 841,920	$ 336,770	$ 505,150	
Control Building							
Control Building	12,300	inner m^3	$ 40	$ 492,000	$ -	$ 492,000	
Outlet							
Common Excavation	4,900	m^3	$ 4	$ 19,600	$ 9,800	$ 9,800	
Rock Excavation	11,300	m^3	$ 10	$ 113,000	$ 67,800	$ 45,200	
Others	1	ls	20%	$ 26,520	$ 10,610	$ 15,910	
Switchyard							
Common Excavation	13,900	m^3	$ 4	$ 55,600	$ 27,800	$ 27,800	
Structural Concrete(Faundation)	100	m^3	$ 130	$ 13,000	$ 3,900	$ 9,100	
Others	1	ls	20%	$ 13,720	$ 5,490	$ 8,230	
3 Hydromechanical Equipment							$ 11,720,000
Spillway Gate	1,130	t	$ 7,000	$ 7,910,000	$ 7,119,000	$ 791,000	
Intake Gate	90	t	$ 6,000	$ 540,000	$ 486,000	$ 54,000	
Intake Screen	20	t	$ 3,000	$ 60,000	$ 54,000	$ 6,000	
Penstock Tube	350	t	$ 5,000	$ 1,750,000	$ 1,575,000	$ 175,000	
Outlet Gate	70	t	$ 6,000	$ 420,000	$ 378,000	$ 42,000	
Sluiceway Gate & Steel liner	1	ls	$ 1,040,000	$ 1,040,000	$ 936,000	$ 104,000	

Table 12.2 EL CHAPARRAL PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Quantity	Unit	Unit Price	Total Cost	Foreign Currency	Local Currency	Subtotal
4 Electric equipment							$ 17,786,000
Main Turbine and Speed Governing System	1	ls	$ 5,466,000	$ 5,466,000	$ 4,700,760	$ 765,240	
Main Generator and Excitation System	1	ls	$ 4,328,000	$ 4,328,000	$ 3,722,080	$ 605,920	
Main Power Transformer	1	ls	$ 1,043,000	$ 1,043,000	$ 896,980	$ 146,020	
Small Turbine and Speed Governing System	1	ls	$ 425,000	$ 425,000	$ 365,500	$ 59,500	
Small Generator and Excitation System	1	ls	$ 387,000	$ 387,000	$ 332,820	$ 54,180	
Overhead Travel Crane	1	ls	$ 857,000	$ 857,000	$ 737,020	$ 119,980	
Swichyard Equipment	1	ls	$ 502,000	$ 502,000	$ 431,720	$ 70,280	
Powerplant Equipment	1	ls	$ 4,778,000	$ 4,778,000	$ 4,109,080	$ 668,920	
5 Transmission Equipment							$ 2,597,000
Receiving Switch	1	ls	$ 177,000	$ 177,000	$ 152,220	$ 24,780	
Transmission Line	1	ls	$ 2,420,000	$ 2,420,000	$ 1,742,400	$ 677,600	
6 Environmental Cost							$ 7,420,000
Infrastructure							
New Public Road	11	km	$ 25,000	$ 275,000	$ 27,500	$ 247,500	
Improved Public Road	33	km	$ 15,000	$ 495,000	$ 49,500	$ 445,500	
New Bridge (two bridges)	2	ls	$ 2,000,000	$ 4,000,000	$ 3,600,000	$ 400,000	
Environmental Mitigation							
Environmental Mitigation	1	ls	$ 192,000	$ 192,000	$ 19,200	$ 172,800	
Environmental Mitigation inherent to project	1	ls	$ 2,458,000	$ 2,458,000	$ 245,800	$ 2,212,200	
7 Land Acquisition and Resettlement							$ 9,823,700
Land Acquisition for Reservoir (suitable for agriculture)	234	ha	$ 8,000	$ 1,872,000	$ -	$ 1,872,000	
Land Acquisition for Reservoir (not suitable for agriculture)	645	ha	$ 5,900	$ 3,805,500	$ -	$ 3,805,500	
Land Acquisition for Reservoir (steep land)	81	ha	$ 4,200	$ 340,200	$ -	$ 340,200	
Land Acquisition for Access Road	23	ha	$ 5,000	$ 115,000	$ -	$ 115,000	
Land Acquisition for Camp, Temporary Land	7	ha	$ 5,000	$ 35,000	$ -	$ 35,000	
Land Acquisition for Dam, Powerhouse and Switch yard	6	ha	$ 5,000	$ 30,000	$ -	$ 30,000	
Right of way for Transmission line	43	km	$ 32,000	$ 1,376,000	$ -	$ 1,376,000	
Relocation and Resettlement Cost	75	family	$ 30,000	$ 2,250,000	$ -	$ 2,250,000	
TOTAL DIRECT COST				**$ 110,932,610**	**$ 54,430,710**	**$ 56,501,900**	
8 Contingency							$ 7,763,750
Preparatory Works + Civil Works			10%	$ 6,158,600	2,275,020	$ 3,883,580	
Hydromechanical Equipment			5%	$ 586,000	527,400	$ 58,600	
Electric Equipment + Transmission Equipment			5%	$ 1,019,150	859,530	$ 159,620	
9 Administration & Engineering Cost							$ 16,639,900
Administration & Engineering Cost	1	ls	15%	$ 16,639,900	$ 11,370,600	$ 5,269,300	
TOTAL INDIRECT COST				**$ 24,403,650**	**$ 15,032,550**	**$ 9,371,100**	
TOTAL PROJECT CONSTRUCTION COST				**$ 135,336,260**	**$ 69,463,260**	**$ 65,873,000**	

Appendix 12.2.2

Details of Project Cost (Civil)

699
(900)

1. Preparatory Works

(1) Construction road 1 (B= 6m)

Improvement of existing road (expanding width of existing road to 6 m)
gravel road, L=6 km
15,400 US$/km X 6 km = 92,400 US$

(2) Construction road 2 (B= 6m)

New construction road
asphalt road, L=3 km
185,000 US$/km X 3 km = 555,000 US$

(3) Construction road 3 (B= 11m)

New construction road
gravel road, L=2 km
37,200 US$/km X 2 km = 74,400 US$

(4) Camp & office facility

	adopted	A project	C project	remarks
camp facility	3	3	2 4	civil works x %
		4,098,000	4,900,000	US$

El Chaparral Civil Works Cost = 57,114,110 US$ X 3% = 1,713,423 = 1,800,000 US$

(5) Temporary construction facility

1) Power supply

Power supply facility

dam concrete volume = 370,000 m3 2,600 kVA
power house Installed capacity = 64,400 kW 800 kVA
US$ 300,000

2) Water supply

	adopted	A project	C project	remarks
water supply	0 5	0 4	0 5	civil works x %
		544,000	1,041,000	US$

El Chaparral Civil Works Cost = 57,114,110 US$ X 0 5% =285,571 = 300,000 US$

3) Temporary bridge

Temporary bridge 500,000 US$ based on J-Power's past records

Temporary construction facility = 1) + 2) + 3) = 300,000 + 300,000 + 500,000 = 1,100,000 US$

(6) Temporary yard development

Yard 1 (land area that is located 2 km upstream from dam site,
land area for aggregate plant, motor pool, assembly yard, stock yard and power supply yard)
Yard 2 (land area at the left side of dam
land area for concrete plant)
Yard 3 includes in the area for Switch yard
Yard 4 (land area at the left side of dam,
land area for camp & office facility)
Total land area for Yard 1, 2, 4 = 72,300 + 12,500 + 57,500 = 142,300 m2
Excavation volume = 72,300 m2 X 1m + 70,000 m2 X 2m = 212,300 m3
Excavation cost = 212,300 m3 X 4 US$/m3 = 849,200 US$ = 850,000 US$

2. unit price for civil works, hydromechanical equipment

(price in Jan. 2003)

(Civil Works)

item	unit	adopted			A project in Peru			B project in Costa Rica			C project in Suri Lanca			D project in Vietnum		
		unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)
common excavation	US$/m^3	4	50	50	4.3	63	37	3.6	47	53	4	75	25	2.3	78	22
rock excavation	US$/m^3	10	60	40	14.1	64	36	8.4	62	38	14.6	82	18	3.3	67	33
earthfill embankment	US$/m^3	7	80	20	–	–	–	–	–	–	6.5	75	25	2.7	81	19
tunnel excavation	US$/m^3	150	80	20	159.8	80	20	–	–	–	84	82	18	42.6	77	23
shaft excavation	US$/m^3	200	80	20	201.6	86	14	–	–	–	–	–	–	119.2	95	5
incline shaft excavation	US$/m^3	200	80	20	–	–	–	–	–	–	106	82	18	122.6	93	7
care of river for diversion work	LS	40000	50	50	–	–	–	–	–	–	37854	54	46	–	–	–
RCC dam concrete *1	US$/m^3	55	40	60	–	–	–	51.7	38	62	–	–	–	–	–	–
conventional dam concrete	US$/m^3	100	40	60	114.5	18	82	101	38	62	102	78	22	–	–	–
structural concrete	US$/m^3	130	30	70	134.1	17	83	120.6	35	65	132.3	79	21	–	–	–
tunnel lining concrete	US$/m^3	230	50	50	237.8	54	46	–	–	–	131.4	84	16	133.9	67	33
tunnel filling concrete	US$/m^3	190	40	60	192.5	36	64	–	–	–	179.4	78	22	114.8	60	40
shaft lining concrete	US$/m^3	230	50	50	231.7	44	56									
control building	US$/m^3	40	0	100	–	–	–	–	–	–	–	–	–	36.3	0	100
reinforcement	US$/t	1500	60	40	1437	35	65	1519.3	64	36	1285.8	71	29	470.9	4	96
spillway gate	US$/t	7000	90	10	7261	91	9	–	–	–	7186	88	12	–	–	–
intake gate	US$/t	6000	90	10	6684	91	9	–	–	–	6873	88	12	–	–	–
intake screen	US$/t	3000	90	10	3388	93	7	–	–	–	–	–	–	–	–	–
penstock tube	US$/t	5000	90	10	3799	81	19	–	–	–	5000	88	12	–	–	–
consolidation grouting drilling	US$/m	60	20	80	69.8	15	85	–	–	–	196.1	92	8	48.8	92	8
curtain grouting drilling	US$/m	130	20	80	139.5	15	85	–	–	–	196.1	92	8	48.8	92	8
cement grouting (consoli/curtain	US$/t	700	20	80	708.7	15	85	–	–	–	1478.3	72	28	491	81	19

*2 excavation unit price includes the cost for excavation, shotcrete and rockbolt

*3 concrete unit price includes the cost for concrete placement and frame work except RCC

(rate of other works) % for total cost	adopted			A project			remark
	FC (%)	LC (%)	total	FC (%)	LC (%)	total	
diversion tunnel	60	40	25	58.3	41.7	25.6	D project (plug concrete, consolidation grout and others)
dam	5	95	10	3.3	96.7	11	A project (water stop, bridge and others)
intake	30	70	10	31.1	68.9	7.7	A project (water stio, staff gauge and others)
penstock tunnel	30	70	10	28.4	71.6	5.9	A project (mortal injection and others)
power house	40	60	20	37.3	62.7	21.1	D project (shotcrete, drain work and others)

*4 % is the rate for total cost

(Inflation rate)

(USA)

1995	1996	1997	1998	1999	2000	2001	2002
	3.3%	1.7%	1.6%	2.7%	3.4%	1.6%	2.4%

(El Salvador)

1995	1996	1997	1998	1999	2000	2001	2002
	7.4%	1.9%	4.2%	−1.0%	4.3%	1.4%	2.8%

(Labor cost : US$/day)

	El Salvado	A project	B project
Foreman	50	49	45
Skilled labor	18	42	19
Common labor	15	38	17
Machine operator	60	39	25
Mechanic	30	39	25
Electrician	30	39	25

(Material cost)

	El Salvado	A project	B project
cement	108	129	103
reinforcing bar	250	532	–

(A project/Detailed Design in Peru)

inflation rate (1996--2002)

inflation of FC part used the rate in USA = 14%

inflation of LC part used the rate in El Salvador = 14%

(Civil Works)

(1) unit price

% for total unit price

item	unit	unit price (US$ in Jan. 2003 base)				
		FC	%	LC	%	total
common excavation	US$/$m^3$	2.7	63	1.6	37	4.3
rock excavation	US$/$m^3$	9	64	5.1	36	14.1
tunnel excavation	US$/$m^3$	127.3	80	32.5	20	159.8
shaft excavation	US$/$m^3$	173.4	86	28.2	14	201.6
conventional dam concrete	US$/$m^3$	20.3	18	94.2	82	114.5
structural concrete	US$/$m^3$	22.7	17	111.4	83	134.1
tunnel lining concrete	US$/$m^3$	127.6	54	110.2	46	237.8
tunnel filling concrete	US$/$m^3$	69.8	36	122.7	64	192.5
shaft lining concrete	US$/$m^3$	103.1	44	128.6	56	231.7
reinforcement	US$/t	497.4	35	939.6	65	1437
spillway gate(radial gate)	US$/t	6627	91	634	9	7261
intake gate	US$/t	6050	91	634	9	6684
intake screen	US$/t	3143	93	245	7	3388
penstock	US$/t	3092	81	707	19	3799
drilling for consolidation grouting (L=470m)	US$/m	10.7	15	59.1	85	69.8
drilling for curtain grouting (L=1520m)	US$/m	21.4	15	118.1	85	139.5
cement grouting (W=300t)	US$/t	108.6	15	600.1	85	708.7

(rate of other works) % for total cost	FC (%)	LC (%)	total *5	remark
dam	3.3	96.7	11	water stop, bridge and others
intake	31.1	68.9	7.7	water stio, staff gauge and others
pemstock tunnel	28.4	71.6	5.9	mortal injection and others

(B project Detailed Design in Costa Rica)

inflation rate (1996-2002)

inflation of FC part was used the rate in USA = 14%

inflation of LC part was used the rate in El Salvador = 14%

(Civil Works)

% for total unit price

item	unit	unit price (US$ in Jan. 2003 base)				
		FC	%	LC	%	total
common excavation	US$/$m^3$	1.7	47	1.9	53	3.6
rock excavation	US$/$m^3$	5.2	62	3.2	38	8.4
RCC dam concrete	US$/$m^3$	19.6	38	32.1	62	51.7
conventional dam concrete	US$/$m^3$	38.6	38	62.4	62	101
structural concrete	US$/$m^3$	42.5	35	78.1	65	120.6
reinforcement	US$/t	969.4	64	549.9	36	1519.3

(C project Deatailed Design in Sri Lanca)

inflation rate (1995-2002)

inflation of FC part was used the rate in USA = 18%

inflation of LC part was used the rate in El Salvador = 22%

(Civil Works)

% for total unit price

item	unit	unit price (US$ in Jan. 2003 base)				
		FC	%	LC	%	total
common excavation	US$/$m^3$	3	75	1	25	4
rock excavation	US$/$m^3$	11.9	82	2.7	18	14.6
embankment	US$/$m^3$	4.9	75	1.6	25	6.5
tunnel excavation	US$/$m^3$	68.9	82	15.1	18	84
inclined shaft excavation	US$/$m^3$	86.5	82	19.5	18	106
care of river for diversion work	LS	20390	54	17464	46	37854
conventional dam concrete	US$/$m^3$	79.2	78	22.8	22	102
structural concrete	US$/$m^3$	104.4	79	27.9	21	132.3
tunnel lining concrete	US$/$m^3$	109.8	84	21.6	16	131.4
tunnel filling concrete	US$/$m^3$	140.4	78	39	22	179.4
reinforcement	US$/t	914.6	71	371.2	29	1285.8
spillway gate	US$/t	6351	88	835	12	7186
intake gate	US$/t	6015	88	858	12	6873
penstock	US$/t	4400	88	600	12	5000
drilling for consolidation grouting (L=2360m)	US$/m	179.9	92	16.2	8	196.1
drilling for curtain grouting (L=4000m)	US$/m	179.9	92	16.2	8	196.1
cement grouting (60t)	US$/t	1060.1	72	418.2	28	1478.3

(D project Contract Cost in Vietnum)

inflation rate (1997–2002)

inflation of FC part was used the rate in USA = 12%

inflation of LC part was used the rate in El Salvador = 12%

(Civil Works)

% for total unit price

item	unit	unit price (US$ in Jan 2003 base)				
		FC	%	LC	%	total
common excavation	US$/m^3	1 8	78	0 5	22	2 3
rock excavation	US$/m^3	2 2	67	1 1	33	3 3
tunnel excavation	US$/m^3	32 9	77	9 7	23	42 6
shaft excavation	US$/m^3	112 9	95	6 3	5	119 2
inclined shaft excavation	US$/m^3	114 5	93	8 1	7	122 6
embankment	US$/m^3	2 2	81	0 5	19	2 7
tunnel lining concrete	US$/m^3	89 6	67	44 3	33	133 9
tunnel filling concrete	US$/m^3	69 4	60	45 4	40	114 8
slab concrete	US$/m^3	36 9	52	33 9	48	70 8
barrel, casing concrete	US$/m^3	34 6	50	35 1	50	69 7
asphalt facing	US$/m^2	0	0	6 5	100	6 5
control building	US$/m^3	0	0	36 3	100	36 3
reinforcement	US$/t	17 7	4	453 2	96	470 9
drilling for consolidation grouting (L=8040m)	US$/m	44 8	92	4	8	48 8
drilling for curtain grouting (L=5600m)	US$/m	44 8	92	4	8	48 8
cement grouting (W=1040t)	US$/t	397	81	94	19	491

(rate of other works) % for total cost	FC (%)	LC (%)	total	remark
diversion tunnel	58 3	41 7	25 6	plug concrete, consolidation grout and others
power house	37 3	62 7	21 1	shotcrete, drain work and others

(RCC concrete *1)

B project in Costarica

concrete volume = 552 000 m3 =727000 yd3

RCC concrete unit price = 51 7 US$/m3

RCC concret unit price in USA (1989 base)

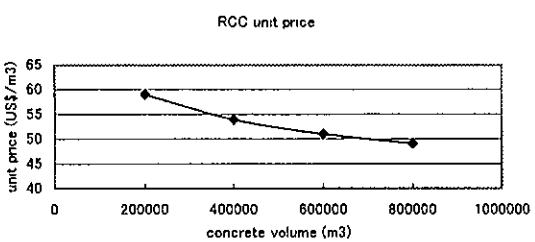
unit price = 127 1 / (concrete volume)$^{0\,1318}$

concrete volume in yard

El Chaparral Project

concrete volume = 262000 m3 (inner concrete) =345000 yd3

RCC concrete unit price = 51 7 × (727000/345000)$^{0\,1318}$ = 55 US$/m3



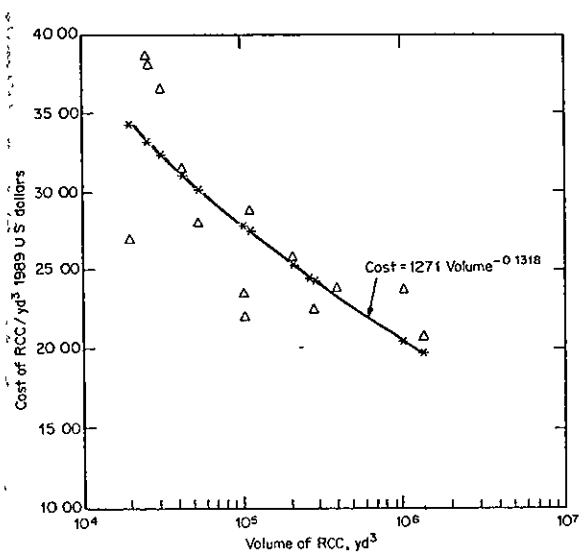


Figure 10 5 Costs of RCC per cubic yard (*Note.* 1 yd^3 = 0 76 m^3)

4. Administration & Engineering Cost

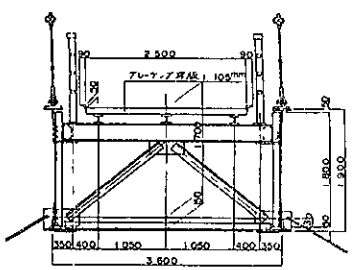
	adopted	A project	C project	remarks
Administration Cos	2	2 2	1.2	direct cost X%
		4,340,000	3,030,000	US$

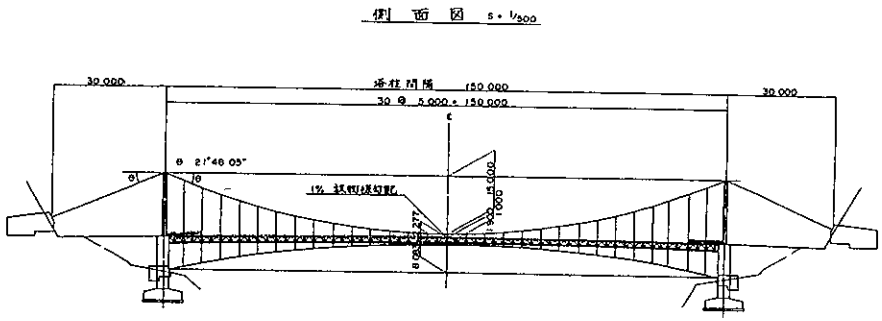
El Chaparral Civil Works Cost = directcost × 2%

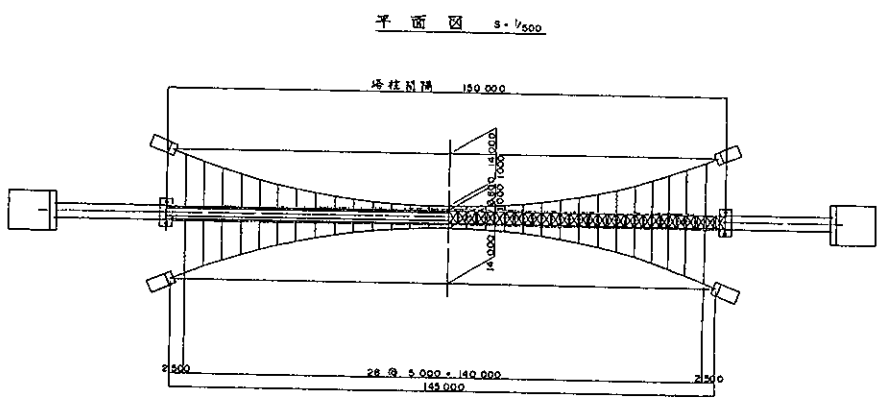
5. Environmental Cost

(1) Infrastructure

New Public Road 11 km X 25,000 US$/km = 275,000 US$
Improved Public Road 33 km x 15,000 US$/km = 495,000 US$
New Bridge (1 line, B=4m, L=150m x 2 bridges) = 4,000,000 US$
(cost estimate from contractor in Guatemala)
Total = 4,770,000 US$







(2) Enviromental Mitigation

Environmental Mitigation . 1 ls 192,000 US$
Environmental Mitigation inherent to project . 1 ls 2,458,000 US$

6 Land Acquisition & Resettlement (unit prices are from CEL)

1) Land Acquisition for Reservoir (suitable for agriculture) 234 ha x 8,000 US$/ha = 1,872,000 US$
2) Land Acquisition for Reservoir (not suitable for agriculture) 645 ha x 5,900 US$/ha = 3,805,500 US$
3) Land Acquisition for Reservoir (steep land) 81 ha x 4,200 US$/ha = 340,200 US$
4) Land Acquisition for Access Road 23 ha x 5,000 US$/ha = 115,000 US$
5) Land Acquisition for Camp, Temporary Land 7 ha x 5,000 US$/ha = 35,000 US$
6) Land Acquisition for Dam, Powerhouse & Switch yard 6 ha x 5,000 US$/ha = 30,000 US$
7) Right way for Transmission Line 43 km x 32,000 US$/km = 1,376,000 US$
8) Relocation and Resettlement Cost 75 family × 30,000 US$/family =2,250,000 US$
Total = 9,823,700 US$

Appendix 12.2.3

Details of Project Cost (Electric)

El Chaparral Hydroelectric Power Station
Cost Estimation of Electro-mechanical Equipment

January, 2004

J-Power,(EPDC)

About the calculation of Electro-mechanical equipment cost, It carried out by price assumption of a level which is FS Design. A price will be confirmed a cost of construction at the 2003 and a reserve fund is 5%.

1. **Electro-mechanical Equipment Cost**

   A transportation cost, installation expense, and insurance are as follows at an installation adjustment delivery price.

   - Inland transportation etc. CIF x 1 %

   (with customs clearance expense, inland transportation insurance, various taxes)

   - Installation construction CIF x 15 % (Total : 16 %)

   Therefore, an installation adjustment delivery price is CIF price x 1.16.

2. **Turbine and Related Auxiliary Equipment**
   - Specification: Rated output: 65.9 MW, Effective head:72.8m, Francis type : 1 lot
   - $kW/H^{0.5} = 65,900 / 72.8^{0.5} = 7,724$
   - From a J^P price curve (CIF) of turbine: **4,712 k$**
3. **Generator and Related Auxiliary Equipment**
   - Specification: Rated capacity: 71.6MVA, Rated RPM: 200 rpm, Synchronous generator : 1 lot
   - kVA/rpm = 71,600 / 200 = 358
   - From a J^P price curve (CIF) of generator: **3,731 k$**
4. **Transformer and Related Auxiliary Equipment**
   - Specification: 3- phase type and BIL 550kV, Outdoor type transformer: 1 lot
   - Capacity : 73,000 kVA
   - From a J^P price curve (CIF) of transformer : 799 k$
   - Fire extinguisher equipment & line between transformer and switchyard : 100 (it calculates from the track record)
   - Sum total : 799 + 100 = **899**
5. **Sub Turbine and Related Auxiliary Equipment**
   - Specification: Rated output: 1.42 MW, Max. Effective head: 78.13m, Francis type : 1 lot
   - $kW/H^{0.5} = 1,420 / 78.13^{0.5} = 161$
   - From a J^P price curve (CIF) of turbine: **366 k$**

709

6. **Sub Generator and Related Auxiliary Equipment**

- Specification: Rated capacity: 1.51MVA, Rated RPM: 900 rpm,
  Synchronous generator : 1 lot
- kVA/rpm = 1,510 / 900 = 1.68
- From a J^P price curve (CIF) of generator : **334**

7. **Crane**

- Specification: Load rating T=200 tons, Span S= 22m : 1 lot
  Manufacturing weight: W ton ;
  W = 1/2.75(TS/20 + 2S + T)= 1/2.75 (200x22.0/20 + 2x22.0 + 200)
  = 169 tons
- From a J^P price curve (CIF) of crane : **739**

8. **Switching Station Equipment**

- Specification: 115kV Breaker and half scheme, 1-Bank, 1-tansmission l
  Number CB :3-sets
  (Voltage) x (CB number) = 115 x 3 = 345
- From a J^P price curve (CIF) of switching station equipment : **433 k$**

9. **Power plant Equipment**

a Insulated Phase Buses (IPB : 13.8 kV, 4 kA) 30 m: 1 lot
- From a J^P track record : **183**

b STR (transformer within a station) 13.8kV/480V and 1,410kVA Mold type, 1 set
- From a J^P track record : **169**

c Circuit Breaker (CB, 13.8kV, 4,000A) for parallel; 1set
- From a J^P Track record : **324**

d 13.8 kV Cub (VTSC & Arr, VT& cub.) : 1 lot;
- From a J^P track record : **126**

e 400V Cub. and NFB Cub. and CB for Sub Unit
- From a J^P track record for 400 kV Cub. and NFB Cub.: 165 k$ and
- From a J^P track record for CB (480V, 2,000A) for a sub unit: 12k$
  Subtotal : 165 + 12 = **177**

f A battery and rectifier (800 AH, 45kVA) 2 sets, and a in-butter (5kVA) 2 sets
- J^P from track record: **590**

g Switchboard and control device (with SCADA) : 1 lot
- J^P From a track record : **1,017k$**

h Line Protection Relay, 115kV Bus protection Relay, Line Fault Locator etc : 1 lot
- J^P from track record: **828 k$,**

i Information Transmission system : 1 lot
(Microwave Multiplex Radio Transmission System with a tower of a relay station)
- J^P from track record: **455 k$,**

j An electric wire, cables, communication system, lighting and others: 1 lot

- J^P from track record : **250k$**

Sub total = 183 + 169 + 324 + 126 + 177 + 590 + 1,017 + 828 + 455 + 250 = **4,119 k$**

10. Inclusive Sum (CIF)

= (4,712 + 3,731 + 899 + 366 + 334 + 739 + 433 + 4,119)

= **15,333**

11. The Total Cost of Construction (Full Turn Key Cost) = 15,333 X 1.16 = 17,786

(IC portion = 15,333k$, LC portion = 2,453 k$)

Appendix 12.2.4

Disbursement Schedule

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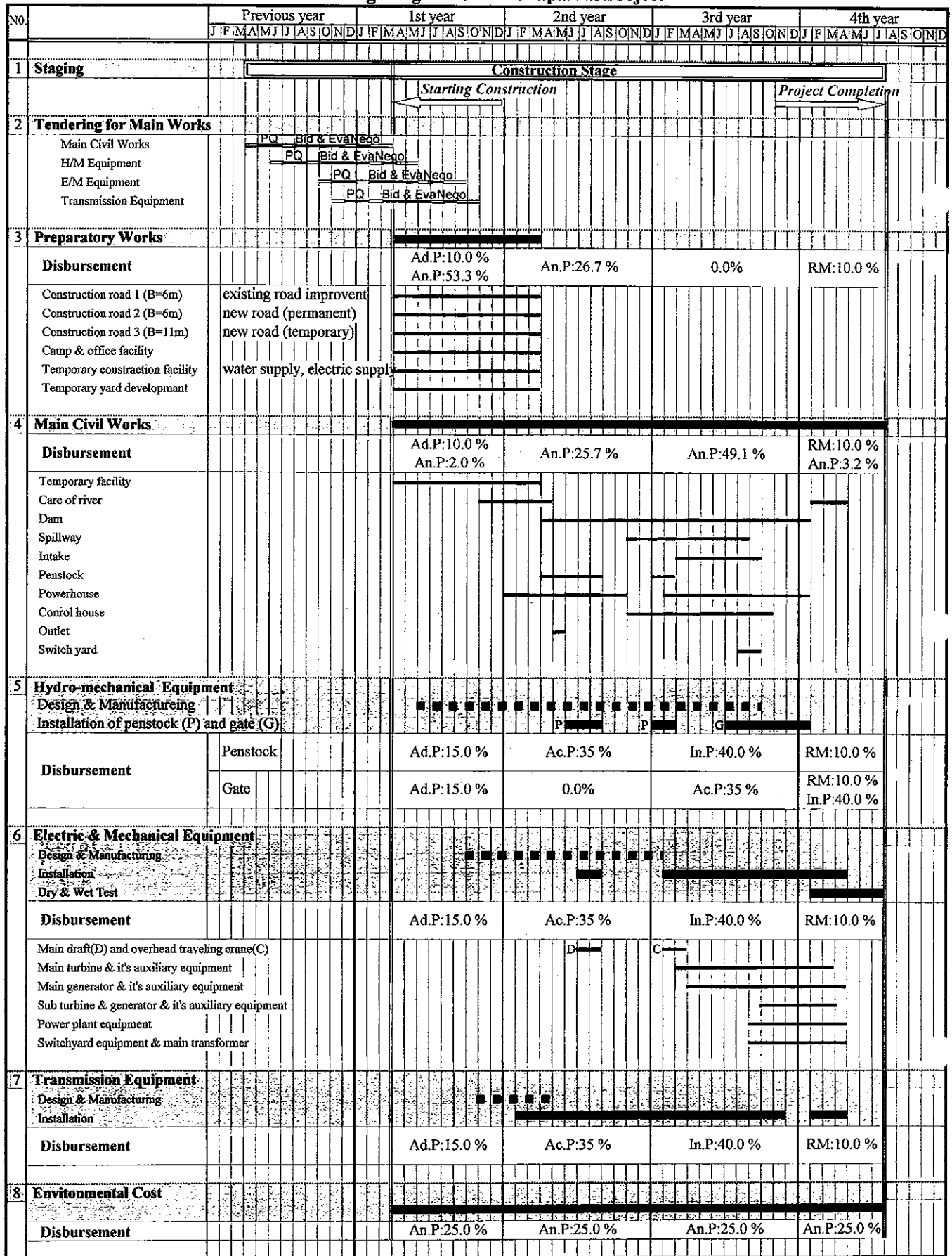
(7/14)

Table 12.3 Project Cost Disbursement Schedule

Unit:US$ thousand

Year	1	2	3	4	Total
Preparatory Works	3,130	894	0	447	4,472
FC	313	89	0	45	447
LC	2,817	805	0	402	4,025
Civil Works	6,815	14,676	28,072	7,551	57,114
FC	2,661	5,731	10,962	2,948	22,303
LC	4,154	8,945	17,110	4,602	34,811
Hydromechanical Equipment	1,758	613	4,190	5,160	11,720
FC	1,582	551	3,771	4,644	10,548
LC	176	61	419	516	1,172
Electromechanical Equipment	1,779	6,225	8,004	1,779	17,786
FC	1,530	5,354	6,883	1,530	15,296
LC	249	872	1,121	249	2,490
Transmission Line	390	909	1,039	260	2,597
FC	284	663	758	189	1,895
LC	105	246	281	70	702
Environmental Cost	1,855	1,855	1,855	1,855	7,420
FC	986	986	986	986	3,942
LC	870	870	870	870	3,478
Land Acquisition & Resettlement	9,824	0	0	0	9,824
FC	0	0	0	0	0
LC	9,824	0	0	0	9,824
Total Direct Cost	25,551	25,172	43,159	17,051	110,933
FC	7,356	13,374	23,359	10,342	54,431
LC	18,195	11,798	19,800	6,709	56,502
Contingency	1,191	1,944	3,469	1,160	7,764
FC	467	910	1,667	617	3,662
LC	724	1,034	1,802	542	4,102
Administration & Engineering Cost	3,833	3,776	6,474	2,558	16,640
FC	2,619	2,580	4,424	1,748	11,371
LC	1,214	1,196	2,050	810	5,269
Total Indirect Cost	5,024	5,720	9,943	3,717	24,404
FC	3,086	3,491	6,091	2,365	15,033
LC	1,937	2,230	3,852	1,352	9,371
Total Construction Cost	30,574	30,892	53,102	20,769	135,337
FC	10,442	16,864	29,450	12,707	69,463
LC	20,132	14,028	23,652	8,061	65,873

Disburing Program of EL Chaparral Project



Note : Ad.P : Advance payment, An.P : Annual paymant, RM : Retention money,
Ac.P : Payment when acceptance, In.P : Payment when installed,

1 (Condition of Disbursement)

(1) Civil Works	Advance payment	10%
	Retention money	10%
	Annual payment	
(2) Hydraulic Equiment	Advance payment	15%
	Payment when acceptec	35%
	Payment when installed	40%
	Retention money	10%
(3) Electric Equipment	same as (2)	

3 (Disbursement)

(10^3US$)

		1st year	2nd year	3rd year	4th year	total
(1) Preparatory Works		3130.2	894.4	0.0	447.2	4471.8
	10%	447 2	0 0	0 0	447.2	894.4
	AP	2683 1	894 4	0 0	0.0	3577.4
(2) Civil Works		6815.4	14676.0	28072.1	7550.6	57114.1
	10%	5711.4	0.0	0.0	5711.4	11422.8
	AP	1104.0	14676.0	28072.1	1839 2	45691.3
(3) Hydraulic Equipment	penstock	262.5	612.5	700.0	175.0	1750.0
	15%/10%	262.5	0.0	0.0	175.0	437 5
	35%/40%	0.0	612.5	700.0	0.0	1312.5
	gate	1495.5	0.0	3489.5	4985.0	9970.0
	15%/10%	1495 5	0.0	0 0	997.0	2492.5
	35%/40%	0 0	0 0	3489.5	3988.0	7477.5
(4) Electric Equipment		1778.6	6225.1	8003.7	1778.6	17786.0
	15%/10%	1778.6	0.0	0.0	1778.6	3557.2
	35%/40%	0.0	6225.1	8003.7	0.0	14228.8
(5) Transmission Line		389.6	909.0	1038.8	259.7	2597.0
	15%/10%	389.6	0.0	0 0	259.7	649.3
	35%/40%	0.0	909.0	1038 8	0.0	1947.8
(6) Environmental Cost		1855.0	1855.0	1855.0	1855.0	7420.0
(7) Land Acquisition		9823.7	0.0	0.0	0.0	9823.7
Total Direct Cost		25550.5	26171.9	43159.1	17051.1	110932.6
(8) Contingency		1190.9	1944.4	3468.8	1159.7	7763.7
(9) Administration & Engineering		3832.6	3775.8	6473.9	2557.7	16639.9
Total Indirect Cost		5023.4	5720.2	9942.7	3717.4	24403.6
Total Project Cost		30573.9	30892.1	53101.7	20768.4	135336.2

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(7/18)

Appendix 12.3

Calculated Quantity

Appendix 12.3.1: Summary of Quantity

Appendix 12.3.2: Civil Works

Appendix 12.3.3: Hydromechanical Equipment

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(720)

Appendix 12.3.1

Summary of Quantity

7>1
(7>2)

EL Chaparral Project Summary of Quantity

(1/2)

Item	Unit	Calculated Quantity	Adopted Quantity	note
12.3.1 Civil Works				
(1) Care of River				
a)Upstream Cofferdam				
Common Excavation	m^3	3,709	3,800	
Rock Excavation	m^3	1,590	1,600	
Dam Concrete (RCC)	m^3	14,344	14,400	
Others	LS	1	1	
b)Downstream Cofferdam				
Common Excavation	m^3	3,417	3,500	
Rock Excavation	m^3	1,465	1,500	
Embankment	m^3	2,906	3,000	
Others	LS	1	1	
c)Diversion Tunnel				
Common Excavation	m^3	8,186	8,200	
Tunnel Excavation	m^3	23,960	24,000	
Lining Concrete	m^3	2,062	2,100	
Reinforced Bar	ton	55	60	
Others	LS	1	1	
(2) Dam				
a)Dam				
Common Excavation	m^3	124,419	124,500	
Rock Excavation	m^3	186,628	186,700	
Dam Concrete (RCC)	m^3	247,507	247,600	inner concrete
Dam Concrete (conventional)	m^3	121,587	121,600	outer concrete
Consolidation Grouting Drilling	m	4,320	4,400	
Consolidation Grouting Cement	ton	81	90	
Curtain Grouting Drilling	m	46,713	46,800	
Curtain Grouting Cement	ton	2,180	2,200	
Others	LS	1	1	
b)Spillway				
Structural Concrete	m^3	22,972	23,000	
Reinforced Bar	ton	639	640	
Others	LS	1	1	

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EL Chaparral Project　Summary of Quantity

Item	Unit	Calculated Quantity	Adpted Quantity	note
(3) Water Way				
a)Intake				
Structural Concrete	m^3	1,151	1,200	
Reinforced Bar	ton	58	60	
Others	LS	1	1	
b)Penstock				
Tunnel Excavation	m^3	2,365	2,400	
Filling Concrete	m^3	723	800	
Structural Concrete	m^3	468	500	
Rainforced Bar	ton	14	20	
Others	LS	1	1	
(4) Powerhouse				
a)Powerhouse				
Common Excavation	m^3	35,860	35,900	
Rock Excavation	m^3	143,439	143,500	
Structural Concrete	m^3	11,668	11,700	
Reinforced Bar	ton	734	740	
Others	LS	1	1	
b)Control Building				
Contorol Building	LS	1	1	
c)Outlet				
Common Excavation	m^3	4,830	4,900	
Rock Excavation	m^3	11,269	11,300	
Others	Ls	1	1	
d)Switchyard				
Common Excavation	m^3	13,856	13,900	
Concrete (Foundation)	m^3	92	100	
Others	LS	1	1	
3 Hydromechanical Equipment				
Spillway Gate	ton	1,127	1,130	
Intake Gate	ton	84	90	
Intake Screen	ton	20	20	
Penstock Tube *)	ton	350	350	
Outlet Gate	ton	68	70	
Sluiceway and Steel Liner *)	LS	1	1	
*)It is not included in the Calculation Quantity				