7.4 Cost Estimation

Financial cost and Economic cost of the first priority project are shown in Table 7.5, 7.6, 7.7, 7.8.

Table-7.5 Financial Cost of the 1st Priority Project

(Based on the price level of fiscal year 1982)

Item	Foreign Currency 10^6 Yen	Local Currency 10^6 Rp	Total 10^6 Yen
1. Construction equipment	1,825	-	1,825
2. Spare parts and consumable materials	389	-	389
3. Civil works	411	9,745	4,020
4. Land acquisition	-	370	137
5. Engineering services	932	909	1,269
6. Government administration	-	584	216
7. Contingency	549	4,881	2,357
Total	4,106	16,489	10,213

Yen Evaluation: 1US$ = ¥240 = Rp650

Table- 7.6 Annual Financial Cost of The 1st Priofity Project

(Based on the Price level of fiscal year 1987

Item	1		2		3		4		5		6		Total		Grand Total
	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	10^6Yen
1. Construction equipment	1,825	-	-	-	-	-	-	-	-	-	-	-	1,825	-	1,825
2. Spare parts and consumable materials	149	-	60	-	60	-	60	-	60	-	-	-	389	-	389
3. Civil works	-	280	-	1,550	150	2,270	150	1,781	111	1,908	-	1,956	411	9,745	4,020
4. Land acquisition	-	250	-	110	-	0	-	10	-	0	-	0	-	370	137
5. Engineering services	266	184	169	145	137	145	131	145	112	145	117	145	932	909	1,269
6. Government administration	-	134	-	90	-	90	-	90	-	90	-	90	-	584	216
7. Contingency	224	84	34	380	70	777	88	875	89	1,204	44	1,557	549	4,881	2,357
Total	2,464	932	263	2,275	417	3,282	429	2,901	372	3,351	161	3,748	4,106	16,489	10,213
Japanese Yen	2,464	345	263	843	417	1,216	429	1,074	372	1,241	161	1,388	4,106	6,107	
Equivalent x 10^6YEN	2,809		1,106		1,633		1,503		1,613		1,549		10,213		

Yen Evaluation 1US$ = ¥240 = Rp650 (1982)

Table-7.7 Economic Cost of the 1st Priority Project

(Based on the price level of fiscal year 1982)

Item	Foreign Currency 10^6 Yen	Local Currency 10^6 Rp	Total 10^6Yen
1. Construction equipment hire cost	1,930	-	1,930
2. Civil works	411	7,855	3,320
3. Land acquisition	-	370	137
4. Engineering services	767	765	1,050
5. Government administration	-	575	213
6. Contingency	753	3,959	2,219
Total	3,861	13,524	8,869

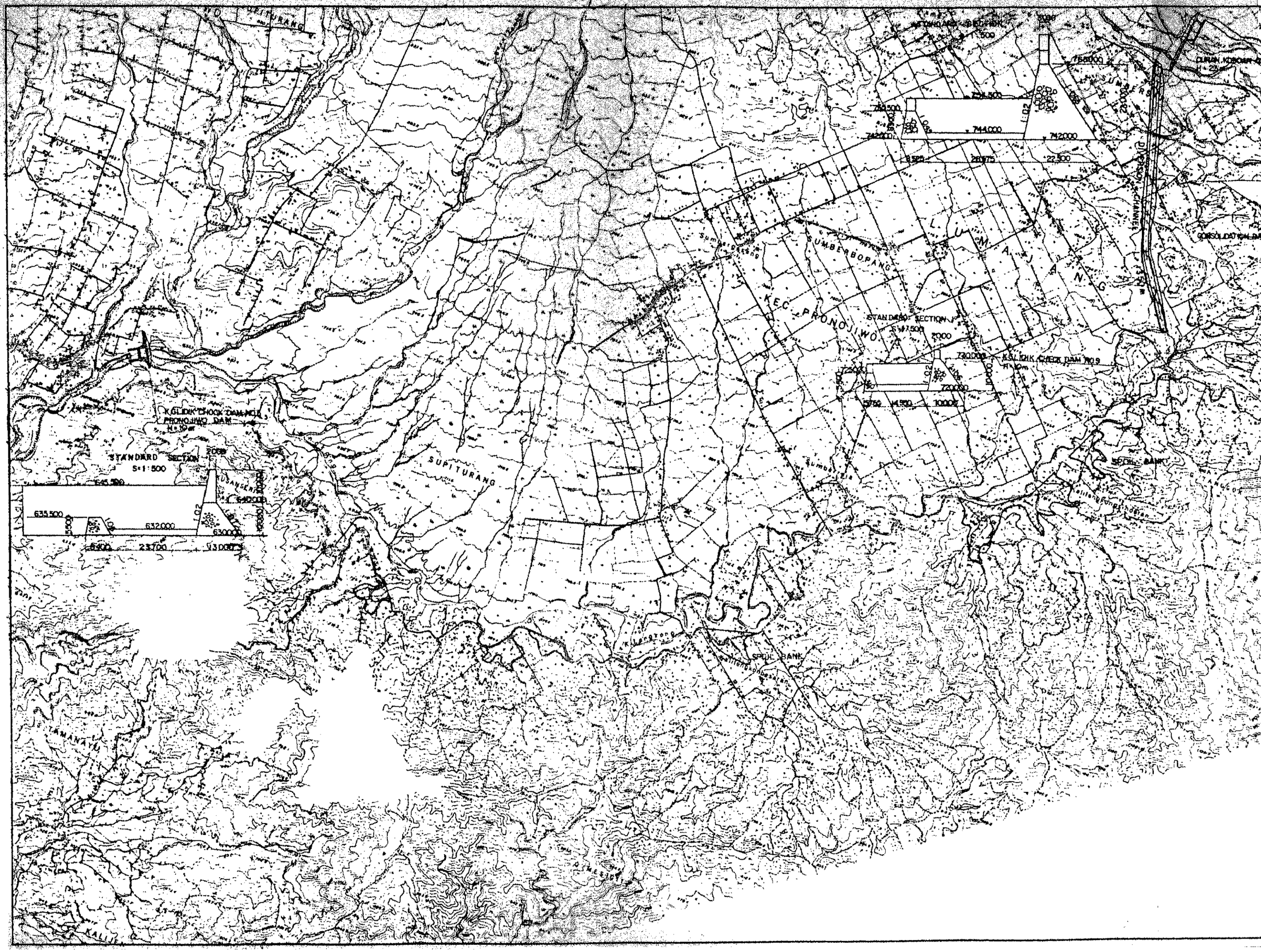
Yen Evaluation: 1US$ = ¥240 = Rp650

Table-7.8 Annual Economic Cost of The 1st Priofity Project

(Based on the Price level of fiscal year 1982)

Item	1		2		3		4		5		6		Total		Grand Total
	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	F.C. 10^6Yen	L.C. 10^6Rp	10^6Yen
1. Construction equipment hire cost	0	-	300	-	599	-	403	-	290	-	338	-	1,930	-	1,930
2. Civil works	-	260	-	1,290	148	1,825	148	1,433	115	1,504	-	1,543	411	7,855	3,320
3. Land acquisition	-	250	-	110	-	0	-	10	-	0	-	0	-	370	137
4. Engineering services	219	165	137	120	111	120	107	120	93	120	100	120	767	765	1,050
5. Government administration	-	125	-	90	-	90	-	90	-	90	-	90	-	575	213
6. Contingency	22	81	66	322	174	631	170	713	156	968	165	1,244	753	3,959	2,219
Total	241	881	503	1,932	1,032	2,666	828	2,366	654	2,682	603	2,997	3,861	13,524	8,869
Japanese Yen	241	326	503	716	1,032	987	828	876	654	993	603	1,110	3,861	5,008	
Equivalent x 10^6YEN	567		1,219		2,019		1,704		1,647		1,713		8,869		

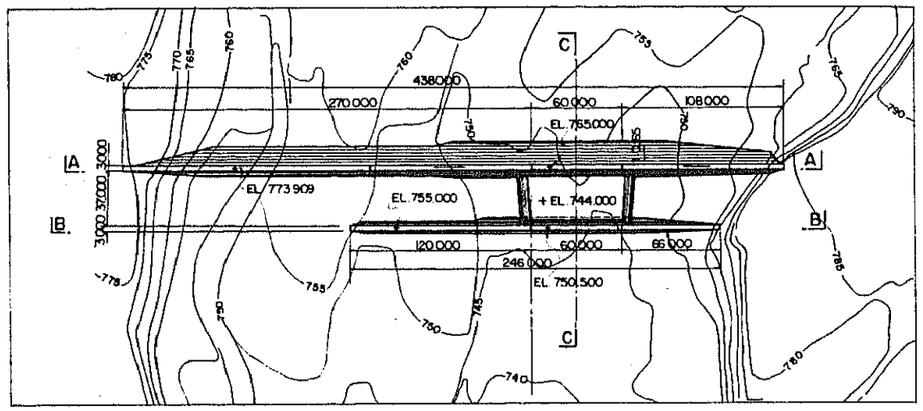
Yen Evaluation 1US$ = ¥240 = Rp650 (1982)


KEC. PRONOJIWO
SUMBERBOPANG
SUPITURANG
LUMAJANG
KALIMANAYU
STANDARD SECTION
S=1:500
K.GLIDIK CHECK DAM NO.19
PRONOJIWO DAM
H=10m
SPOIL BANK
DIVERSION CHANNEL


LUMAJANG
KEC. PRONOJIWO
KEC. CANDIPURO
SUMBERBOPANG
SUMBERWULUH
KEBUNDELI
DIVERSION CHANNEL
STANDARD SECTION
GABION WORK
CONSOLIDATION DAM
H=8m
K.LEPRAK SAND POCKET
K.SELOKIK CHECK DAM NO.9
SP-3
L=300m
L=250m
L=400m
L=550m
REPUBLIC OF INDONESIA
THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH EASTERN SLOPE OF MT SEMERU
SCALE
1:10,000
MAP OF SEDIMENT CONTROL FACILITY LOCATION OF THE FIRST PRIORITY PROJECT
SMF
101
JAPAN INTERNATIONAL COOPERATION AGENCY
DRAWN
CHECKED
APPROVED

CURAH KOBOAN CHECK DAM-6

PLAN S=1:2000



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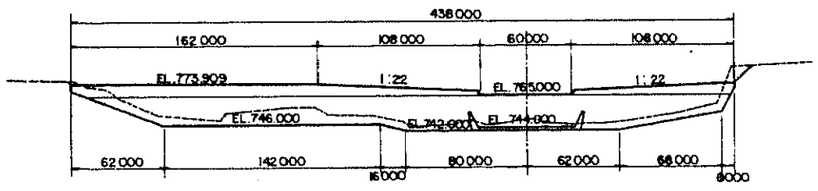

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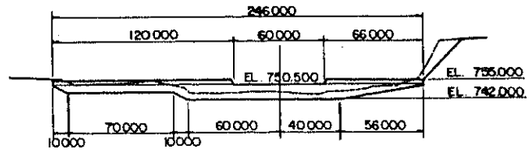

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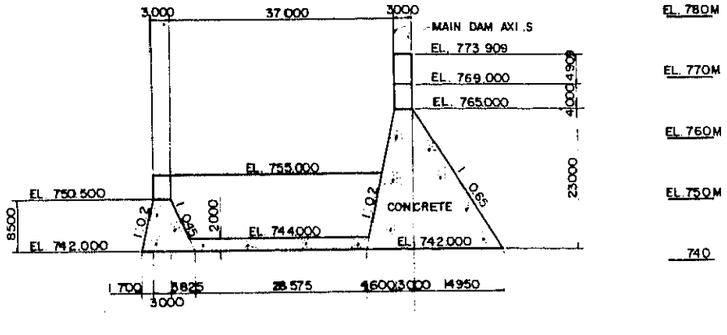
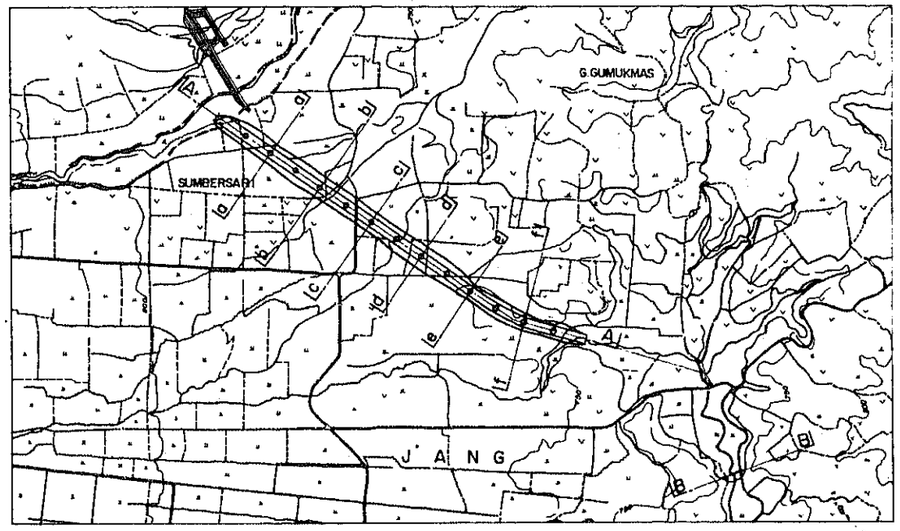


DIVERSION CHANNEL

PLAN S=1:10000



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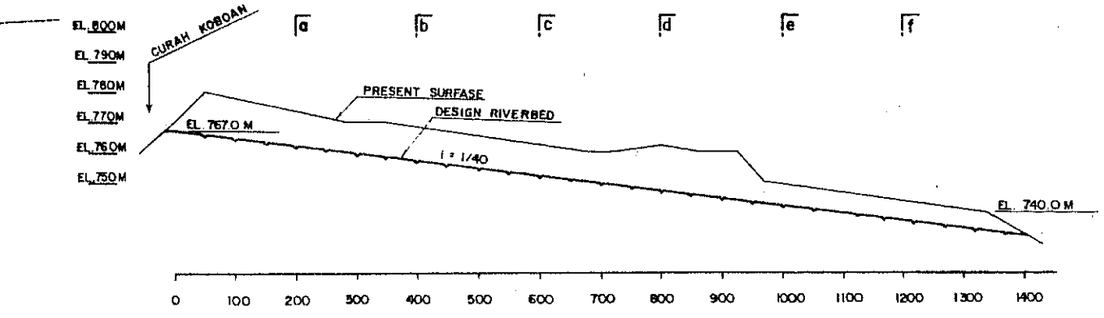
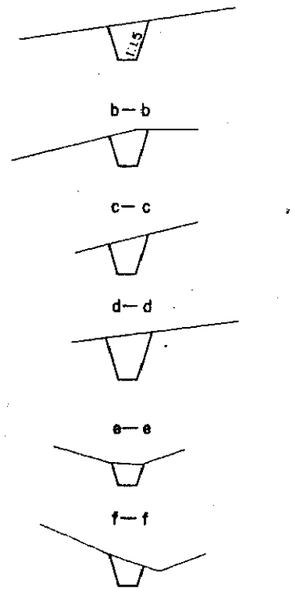


CROSS SECTION

H = 1 : 5.000
a — a V = 1 : 10.000



STANDARD SECTION OF DIVERSION CHANNEL

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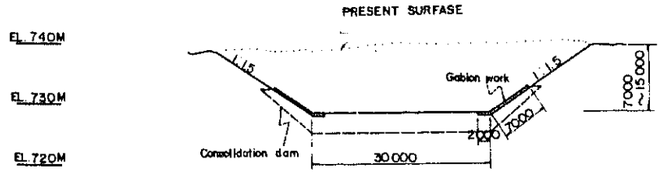

REPUBLIC OF INDONESIA THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH EASTERN SLOPE OF MT. SEMERU		SCALE 1 : 10 000 1 : 2 000 1 : 500
CURAH KOBOAN CHECK DAM-6 DIVERSION CHANNEL GENERAL DAM DESIGN		SMF 1 102
JAPAN INTERNATIONAL COOPERATION ABENCY		
DRAWN	CHECKED	APPROVED

K.LENGKONG CHECK DAM NO.3 (PRONOJIWO DAM)

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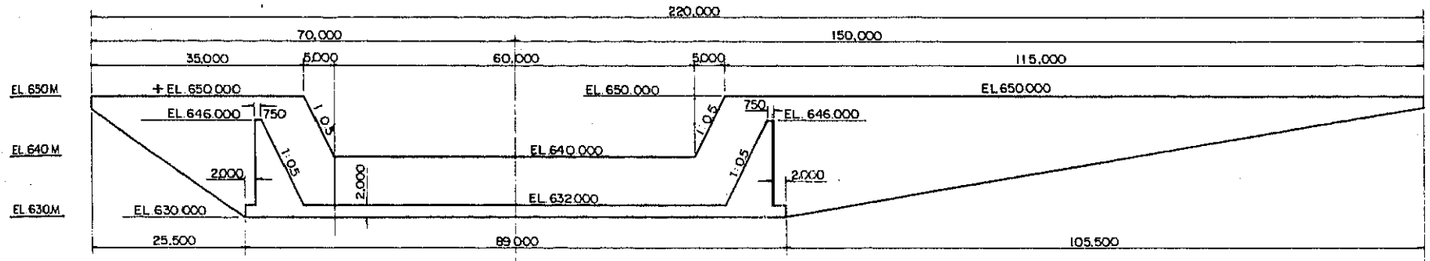

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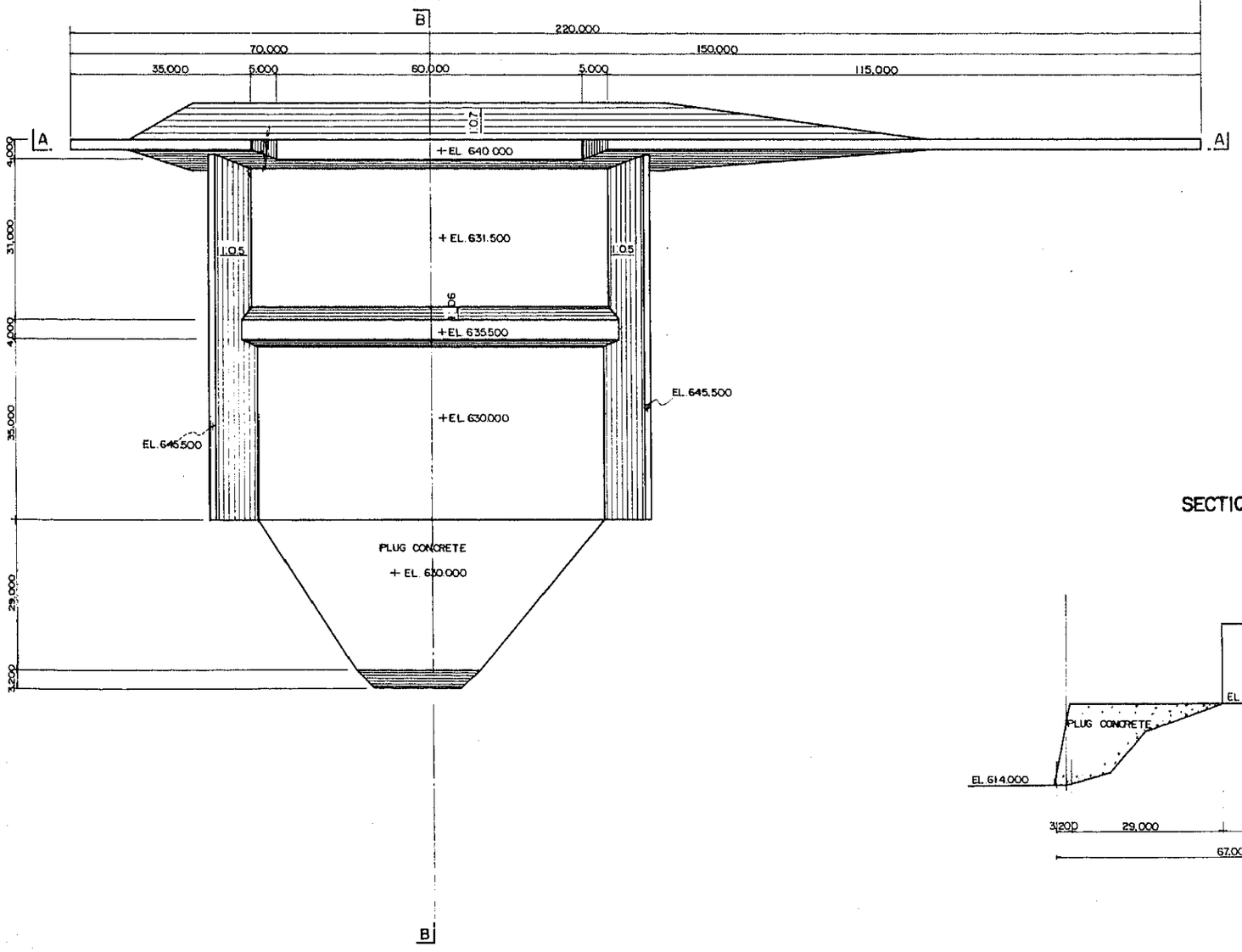
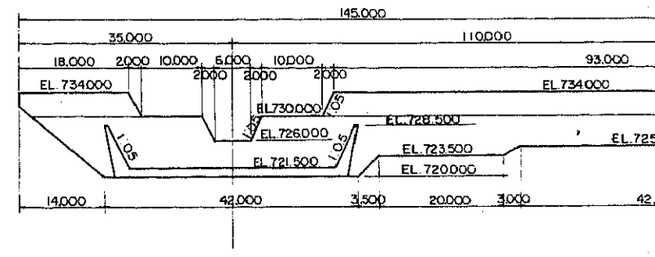


K.LENGKONG CHECK DAM NO

SECTION A — A S = 1 :



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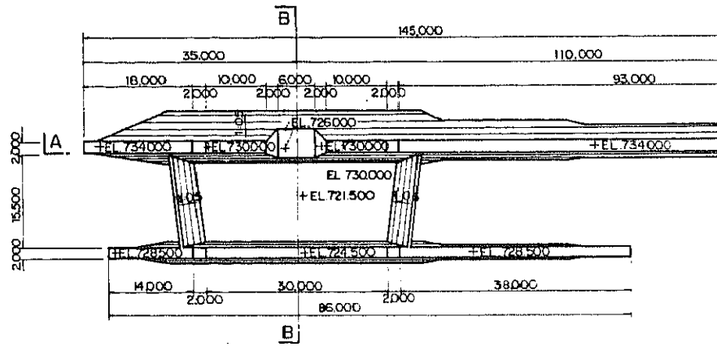

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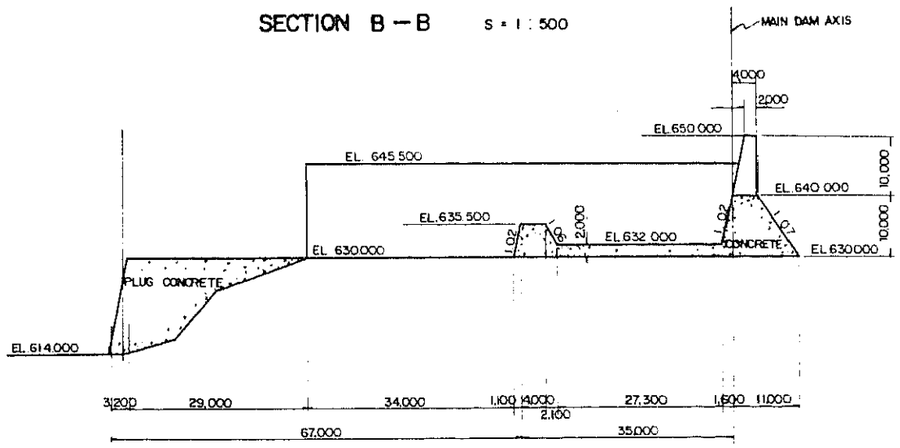

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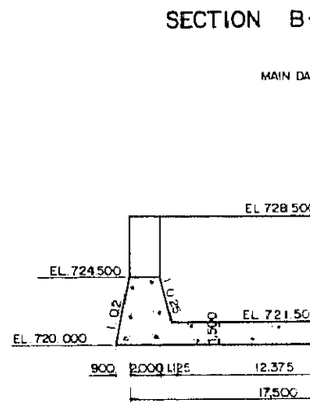
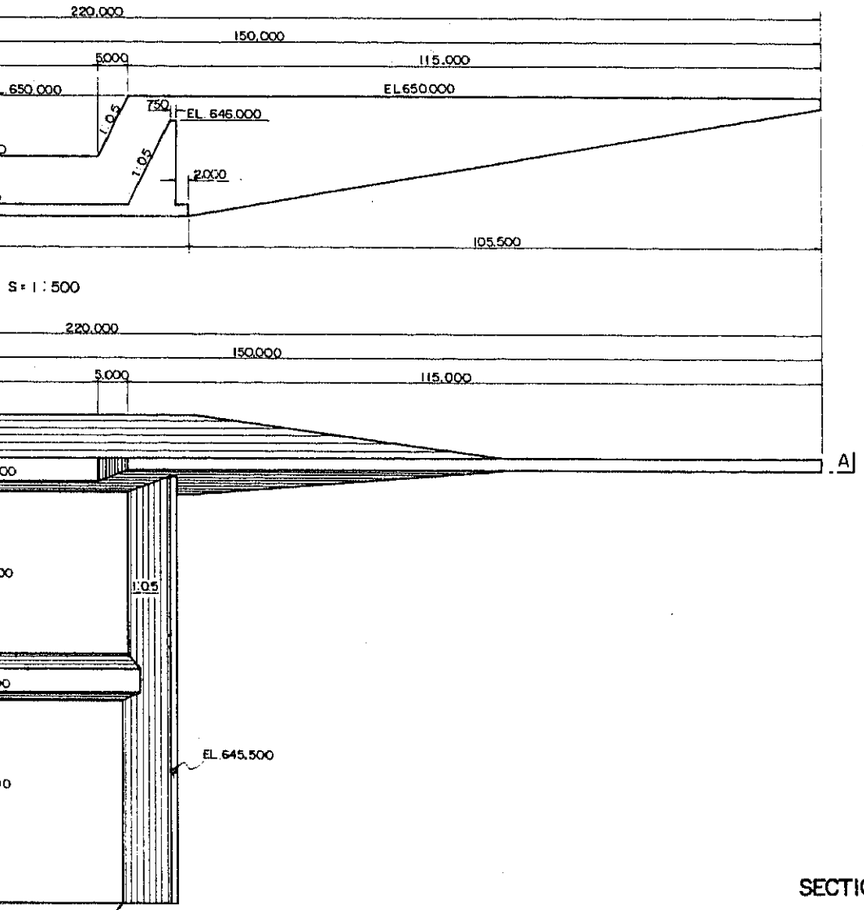


AM NO.3 (PRONOJIWO DAM)
CTION A — A S = 1 : 500



K.LENGKONG CHECK DAM NO.7

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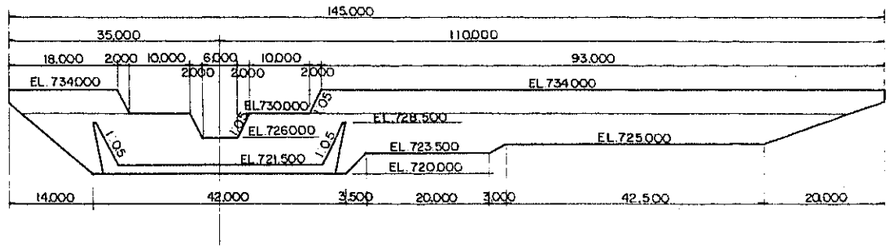

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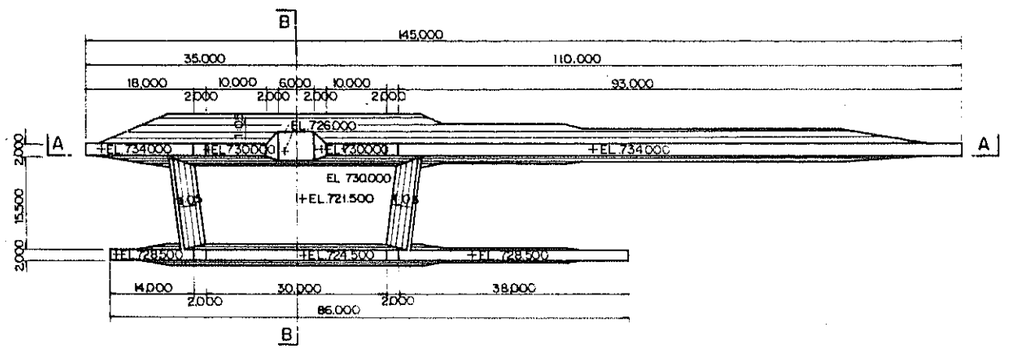

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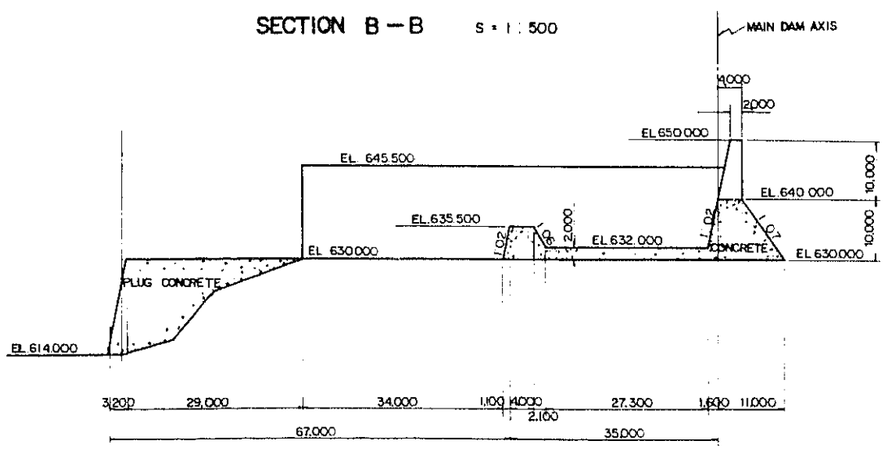

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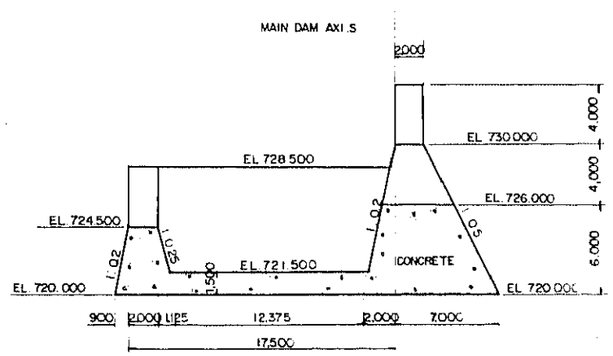


REPUBLIC OF INDONESIA	SCALE
THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH EASTERN SLOPE OF MT. SEMERU	1 : 500 1 : 200

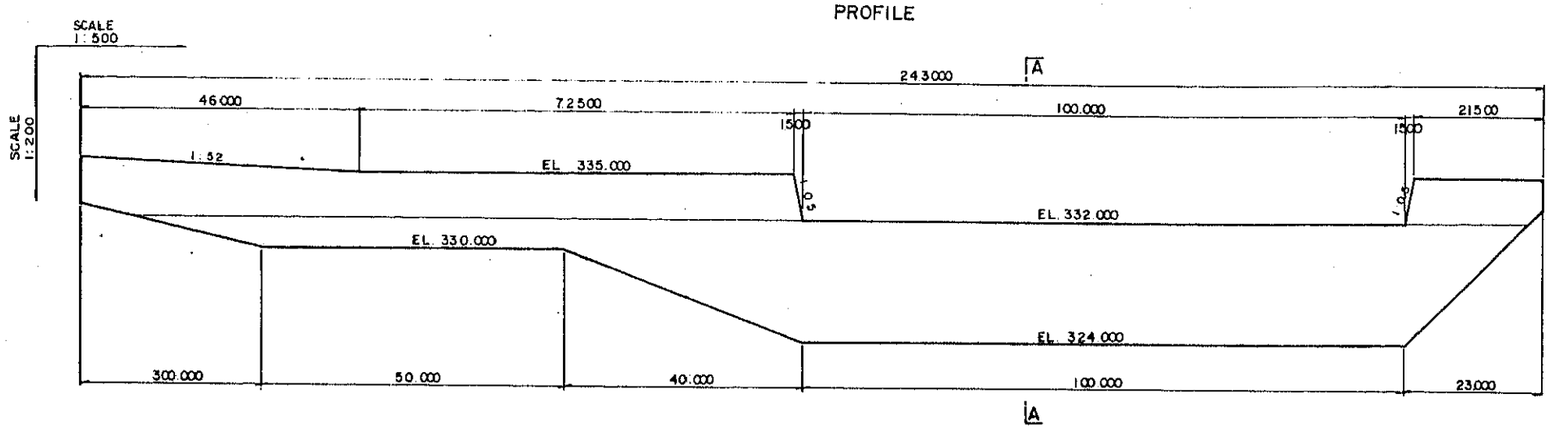
K. LENGKONG CHECK DAM — 3	SMF
K. LENGKONG CHECK DAM — 7	1
GENERAL DAM DESIGN	103

JAPAN INTERNATIONAL COOPERATION AGENCY

DRAWN	CHECKED	APPROVED

CONSOLIDATION DAM-1

PROFILE



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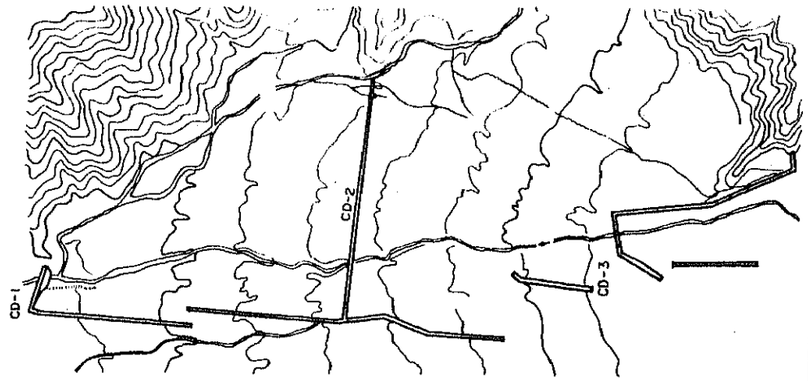
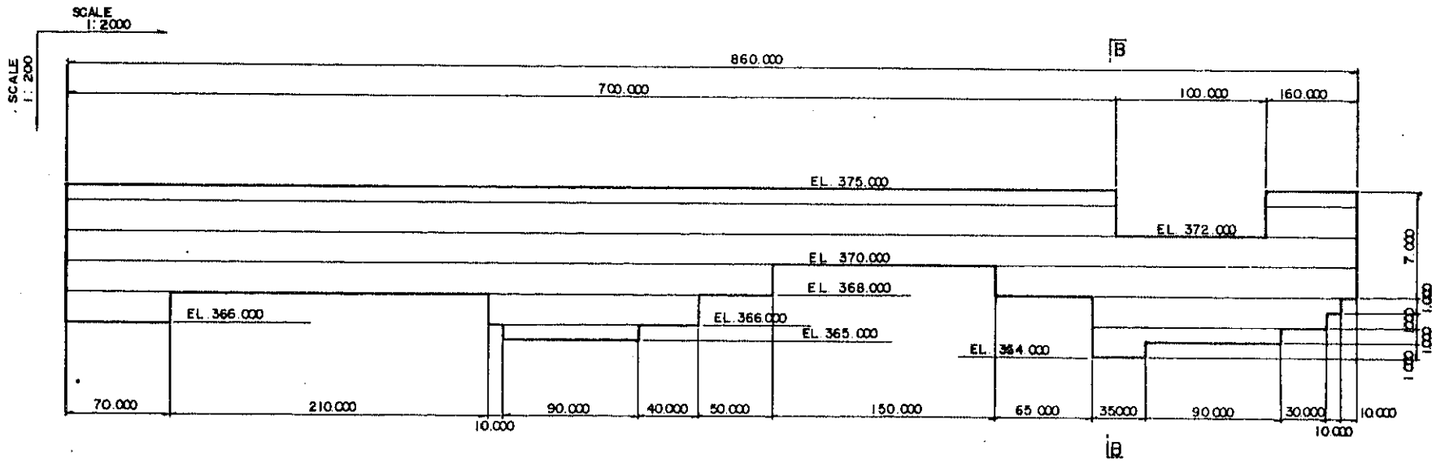


CONSOLIDATION DAM-2

PROFILE



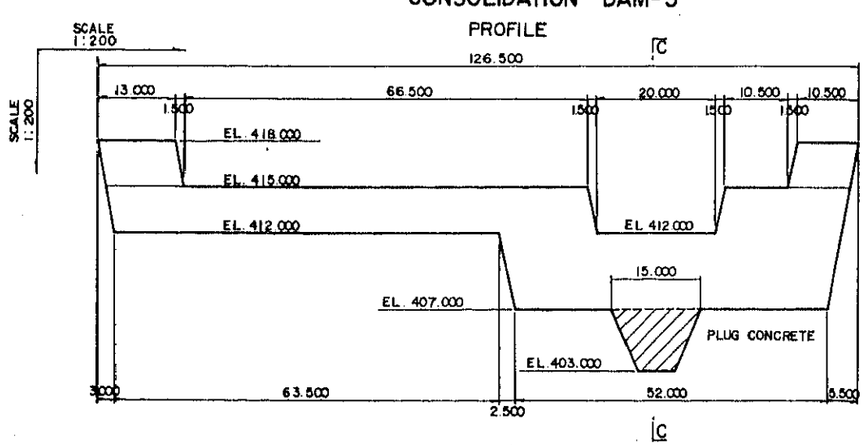
SECTION B-B

SCALE 1 : 200

SECTION A-A SCALE 1: 200

CONSOLIDATION DAM-3

PROFILE



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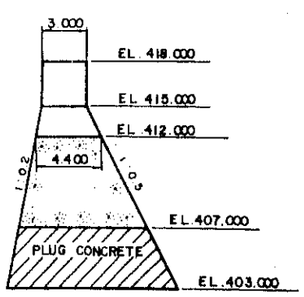


REPUBLIC OF INDONESIA THE FEASIBILITY STUDY ON THE VOLCANIC DEBRIS CONTROL AND WATER CONSERVATION PROJECT IN THE SOUTH EASTERN SLOPE OF MT. MERAPI	SCALE 1:10 000 1:2 000 1:500 1:200
K.LEPRAK SANDPOCKET GENERAL SANDPOCKET DESIGN	SMF 1 104
JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	

APPENDIX - 1

PRICE LIST OF CONSTRUCTION EQUIPMENT

Price List of Construction Equipment (General)

Equipment	Description Power (KW)	Weight (Ton)	Amount (10^3 Yen)	Remarks
1. Equipment				
(1) Aggregate Plant	2,107 PS 207.65 KW	354.1	274,622	
(2) Concrete Plant	1,417 PS 33.65 KW	530.9	149,278	
(3) Concrete Setting Plant	2,360 PS 930.2 KW	864	971,846	
(4) Paving Equipment	315 PS 109 KW	64.1	94,500	
(5) Earth Work Equipment		248	329,047	
(6) Laboratory Equipment			5,000	
Sub Total	6,199 PS	2,061.1	1,824,293	
2. Spare Parts				
(1) Aggregate Plant			47,223	
(2) Concrete Plant			43,943	
(3) Concrete Setting Plant			202,734	
(4) Paving Equipment Plant			32,790	
(5) Earth Work Equipment			59,600	
(6) Laboratory Equipment			2,000	
Sub Total			388,290	
Total			2,212,583	

Price List of Construction Equipment (Detail - 1/4)

Equipment	Description	Power (KW)	Unit Price CIF Surabaya (10^3 Yen)	Q'ty	Weight (ton)	Amount (10^3 Yen)	Remarks
1. AGGREGATE PLANT							
(1) Vibrating Feeder	130 t/h	0.85	1,189	3	1.7	3,567	
(2) Vibrating Screen	80mm/40, 1.2m x 3.0m	7.5	4,079	1	2.9	4,079	
(3) Vibrating Screen	20 mm/5, 1.5m x 3.0m	7.5	4,843	1	3.9	4,483	
(4) Classifier	ø 0.75m x 5.5m	3.7	5,776	1	3.5	5,776	
(5) Pump	ø 100mm, 1.5m^3/min	37.0	889	2	0.3	1,778	
(6) Submerged Pump	ø 125mm, 1.5m^3/min	37.0	1,566	2	0.1	3,132	
(7) Take off Gate		-	150	7	0.1	1,050	
(8) Vibrating Feeder	100 t/h	0.6	1,046	4	0.5	4,184	
(9) Belt Conveyor	750mm(W) x 70m(L)	11.0		L.S.	20.0	19,000	
(10) Belt Conveyor	600mm(W) x 120m(L)	13.0		L.S.	43.0	35,000	
(11) Belt Conveyor	450mm(W) x 120m(L)	12.0		L.S.	40.0	27,420	
(12) Screening Tower	7m(L)x6m(W)x14m(H)	-	12,000	1	32.0	12,000	
(13) Hopper, etc.		-		(6)	14.0	5,250	
(14) Pipe of Tunnel	ø 3m x 70m(L)	-		L.S.	57.0	17,830	
(15) Water Tunk	Capacity: 60 m^3	-	2,250	2	6.0	4,500	
(16) Water Pipe	ø 40mm - o 250mm	-		L.S.	12.0	1,057	
(17) Drainage Pipe	ø 100mm - o 250mm	-		L.S.	20.0	2,266	
(18) Crawler Type Loader	Bucket cap. 2.2 m^3	197 PS	25,390	1	21.4	25,390	
(19) Dump Truck	Loading Wt. 11 ton	312 PS	10,080	5	9.3	50,400	
(20) Diesel Generator	375 KVA	350 PS	37,400	1	15.0	37,400	
(21) Sub Station	Tr. 1 ø 30 KVA	-		1	0.3	300	
(22) Control Panel & Siwtchboard				L.S.	2.0	7,500	
(23) Distribution Board				L.S.		900	
Sub Total of Aggregate Plant		2,107 PS 207.65 KW			354.1	274,622	

Price List of Construction Equipment (Detail - 2/4)

Equipment	Description	Power (KW)	Unit Price CIF Surabaya (10^3 Yen)	Q'ty	Weight (ton)	Amount (10^3 Yen)	Remarks
2. CONCRETE PLANT							
(24) Concrete Plant	Mixer 0.75 m^3 x 2 set	20.0	63,600	1	82.0	63,600	
(25) Cement Silo	Capacity 200 ton	0.75	6,450	1	16.0	6,450	
(26) Screw Conveyor	10 t/h 15 m (L)	5.5	1,565	1	1.8	1,565	
(27) Screw Conveyor	10 t/h 10 m (L)	3.7	1,130	1	1.3	1,130	
(28) Bucket Conveyor	10 t/h 26 m (H)	3.7	4,404	1	6.8	4,404	
(29) Air Compressor	Portable type 5 m^3/min	52 PS	2,974	1	1.4	2,974	
(30) Truck Mixer	Capacity 3 m^3	195 PS	7,740	7	7.5	54,180	
(31) Generator House	5m (W) x 6m (L)	-	1,125	1	3.0	1,125	
(32) Cement Warehouse	8m (W) x 15m (L)	-	4,500	1	12.0	4,500	
(33) Electric Material (wire, pole, light)				L.S.	-	9,350	
Sub Total of Concrete Plant		1,417 PS 33.65 KW			530.9	149,278	

Price List of Construction Equipment (Detail - 3/4)

Equipment	Description	Power (KW)	Unit Price CIF Surabaya (10^3 Yen)	Q'ty	Weight (ton)	Amount (10^3 Yen)	Remarks
3. CONCRETE SETTING PLANT							
(34) Diesel Locomotive	Nominal wt. 6 ton	78 PS	12,040	4	12.0	48,160	
(35) Trolley Bucket	1.5 m^3 x 2 set	-	3,329	6	7.2	19,974	
(36) Cable Crane (second rail rope type)	Bucket Cap. 1.5 m^3	300.0	208,000	2	430	416,000	
(37) Pump	ø100mm 1.5m^3/min	37.0	889	4	0.6	3,556	
(38) Submerged Pump	ø125mm 1.5m^3/min	37.0	1,556	4	0.2	6,264	
(39) Water Tunk	Capacity 60 m^3	-	2,250	4	12.0	9,000	
(40) Pipe	ø100mm - 250mm	-		L.S.	80.0	9,066	
(41) Concrete Vibrator	ø60mm	1.2	197	6	0.088	1,182	
(42) Air Compressor	Portable Type 7m^3/min	74 PS	3,737	2	3.6	7,474	
(43) Rail	Type 30kg/m 35m(L)x2			L.S.	4.2	940	
(44) Crawler Crane	Lifting cap. 80t boom length 45m	250 PS	125,000	2	146.8	250,000	
(45) Concrete Bucket	Capacity 1.5 m^3	-	1,430	6	1.7	8,580	
(46) Diesel Generator	375 KVA	350 PS	36,700	4	30.0	146,800	
(47) Generator House	5m (W) x 12m (L)	-	2,250	2	12.0	4,500	
(48) Sub Station	Tr. 1 ø 50 KVA	-	400	2	0.8	800	
(49) Electric Material (wire, pole, light)				L.S.	-	20,800	
(50) Staging	5m (W) x 15m (L)			2	50.0	18,750	
Sub Total of Concrete Setting Plant		2,360 PS 930.2 KW			864	971,846	

Price List of Construction Equipment (Detail - 4/4)

Equipment	Description	Power (KW)	Unit Price CIF Surabaya (10^3 Yen)	Q'ty	Weight (ton)	Amount (10^3 Yen)	Remarks
4. PAVING EQUIPMENT							
(51) Asphalt Plant	Capacity 30 t/h	109.0	46,100	1	27.0	46,100	
(52) Asphalt Finisher	Paving width 3.6 m	35 PS	12,430	1	7.3	12,430	
(53) Asphalt Engine Sprayer	Capacity 200 liter	4 PS	300	2	0.15	600	
(54) Motor Grader	Blade length 3.7 m	126 PS	15,530	1	12.0	15,530	
(55) Road Roller	Weight 10 t	58 PS	8,050	1	8.0	8,050	
(56) Tire Roller	Weight 8 - 15 t	85 PS	9,740	1	8.5	9,740	
(57) Vibratory Roller	Weight 1 t	7 PS	2,050	1	1.1	2,050	
Sub Total of Paving Equipment		315 PS 109 KW			64.1	94,500	
5. EARTH WORK EQUIPMENT							
(58) Back-hoe	1.4 m^3		43,147.9	6	231	258,887	
(59) Dump Truck	8 t		7,016.0	10	17	70,160	
Sub Total of Earth Equipment		0			248	329,047	
6. LABORATORY EQUIPMENT							
(60) Concrete Laboratory				L.S.		5,000	
TOTAL		1,459.5 KW 6,199 PS			2,061.1	1,824,293	

PRICE LITS SPARE PART (DETAIL 1/2)

EQUIPMENT	DESCRIPTION	RATE	PRICE (10^3¥)
1. AGGRIGATE PLANT			
(1) Vibrating Feeder	130 t/h	0,2	713
(2) Vibrating Screen	1,2 m x 3,0 m	0,7	2,855
(3) Vibrating Screen	1,5 m x 3,0 m	0,7	3,390
(4) Classifier	ø 0,75m x 5,5m	0,5	2,888
(5) Pump	ø 100 mm	0,8	1,422
(6) Submerged Pump	ø 125 mm	0,8	2,506
(7) Take Of Gate		0,2	210
(8) Vibrating Feeder		0,2	837
(9) Belt Conve yor	750 mm (w)	0,05	950
(10) Belt Conveyor	600 mm (w)	0,05	1,750
(11) Belt Conveyor	450 mm (w)	0,05	1,371
(12) Hopper		0,2	1,050
(13) Drainage Pipe	ø 100 ø 250mm	0,5	1,133
(14) Crawler Type Loader	2,2 m^3	0,2	5,078
(15) Dump Truck	11 ton	0,2	10,080
(16) Diesel Generator	375 K V A	0,2	7,480
(17) Sub Station		0,5	150
(18) Control Panel		0,4	3,000
(19) Distribution Board		0,4	360
Sub Total Of Aggregate Plant			47,223
2. CONCRETE PLANT			
(20) Concrete Plant	0,75 m^3 x 2	0,4	25,440
(21) Cement Silo	200 ton	0,05	323
(22) Screw Conveyor	15 m (L)	0,1	157
(23) Screw Conveyor	10 m (L)	0,1	113
(24) Bucket Conveyor		0,2	881
(25) Air Comprissor	5 m^3 / min	0,2	595
(26) Truck Mixer	3 m^3	0,3	16,254
(27) Lighting		0,5	180
Sub Total Concrete Plant			43,943

PRICE LITS SPARE PART (DETAIL 2/2)

EQUIPMENT	DESCRIPTION	RATE	PRICE (10^3¥)
3. CONCRETE SETTING PLANT			
(28) Diesel Locomotive	6 ton	0,3	14,448
(29) Trolley		0,4	7,990
(30) Cable Crane	1,5 m^3	0,2	83,200
(31) Pump	ø 100 mm	0,8	2,844
(32) Submerged Pump	ø 125 mm	0,8	5,012
(33) Concrete Vibrator	ø 60 mm	0,2	2 36
(34) Air Compressor	7 m^3/min	0,2	1,494
(35) Crawler Crane	80 ton	0,2	50,000
(36) Concrete Bucket	1,5 m^3	0,3	2,574
(37) Diesel Generator	375 KVA	0,2	29,360
(38) Sub Station		0,5	400
(39) Lighting		0,5	3,300
(40) Staging		0,1	1,876
Sub Total of Concrete Setting Plant			202,734
4. PAVING EQUIPMENT			
(41) Asphalt Plant	30 t/n	0,5	23,050
(42) Asphalt Finisher	3,6 mm	0,2	2,486
(43) Asphalt Engine Sprayer		0,3	180
(44) Motor Grader	3,7 m	0,2	3,106
(45) Road Roller	10 ton	0,2	1,610
(46) Tire Roller	8-15 ton	0,2	1,948
(47) Vibratori Roller	1 ton	0,2	410
Sub Total of Paving Equipment			32,790
5. EARTH WORK EQUIPMENT			
(48) Back hoe		0,19	48,000
(49) Dump Truck		0,17	11,600
Sub Total of Earth Work Equipment			59,600
6. LABORATORY EQUIPMENT			
(50) Concrete Laboratory		0,4	2,000
T o t a l		0,21	388,290

APPENDIX - 2

UNIT PRICE OF LABORS AND MATERIALS

1. Unit price of labor during the past six years ($1978/_{79}$ - $1983/_{84}$)

From : Daftar harga bulanan

DATI - 1 Jawa Timur, Bidang Pengairan.

December

Labor	Unit price (Rp. / day)						
	1978/'79	1979/'80	1980/'81	1981/'82	1982/'83	1983/'84*	
Common labor	Rp. 400	Rp. 500	Rp. 600	Rp. 750	Rp. 800	Rp.1.250	
Fore man	Rp. 800	Rp.1.000	Rp.1750	Rp.2.250	Rp.2.250	Rp.2.750	
M a s o n	Rp. 700	Rp. 900	Rp.1.500	Rp.2.000	Rp.2.000	Rp.2.750	
Chief of mason	Rp. 800	Rp.1.000	Rp.1.750	Rp.2.250	Rp.2.250	Rp.3.000	
Carpenter	Rp. 700	Rp. 900	Rp.1.500	Rp.2.000	Rp.2.000	Rp.2.750	
Chief of carpenter	Rp. 800	Rp.1.000	Rp.1.750	Rp.2.250	Rp.2.250	Rp.3.000	
M e c h a n i c	Rp. 800	Rp.1.000	Rp.1.250	Rp.2.000	Rp.2.000	Rp.2.750	
O p e r a t o r	Rp. 700	Rp. 900	Rp.1.750	Rp.2.500	Rp.2.500	Rp.3.000	
Assistant operator	Rp. 650	Rp. 800	Rp.1 500	Rp.2.000	Rp.2.250	Rp.2.500	
Chief of operator	Rp.1.000	Rp.1.250	Rp.2.000	Rp.3.000	Rp.3.000	Rp.3.500	
Driver	Rp. 800	Rp.1.000	Rp.2.000	Rp.2.500	Rp.3.000	Rp.3.000	
Gabion net maker	Rp. 800	Rp.1.000	Rp.1.500	Rp.1.750	Rp.2.000	Rp.2.500	
Skilled reinforcing man	Rp. 700	Rp.1.000	Rp.1.500	Rp.1.750	Rp.2.000	Rp.2.750	

* May

2. Unit price of material during the past six year ($1978/_{79}$ - $1983/_{84}$)

From : Daftar Harga Bulanan,

DATI - I Jawa Timur, Bidang Pengairan. December :

Material	Unit	Unit Price						
		1978/'79	1979/'80	1980/'81	1981/'82	1982/'83	1983/'84 *	
Portlandcement	Rp/Bag	Rp.2.500	Rp.2.700	Rp.3.000	Rp.3.100	Rp.3.250	Rp.3.250	
Sand	Rp/m^3	Rp. 500	Rp. 500	Rp. 600	Rp. 750	Rp. 800	Rp. 800	
G r a v e l	"	Rp. 800	Rp.1.000	Rp.1.500	Rp.2.250	Rp.2.500	Rp.3.500	
River stone	"	Rp.1.250	Rp.1.350	Rp.1.750	Rp.3.000	Rp.3.100	Rp.3.200	
Plaster	Rp/m^2	Rp.1.100	Rp.1.120	Rp.1.240	Rp.1.250	Rp.1.320	Rp.1.700	
Wood for form work	"	Rp.4.000	Rp.4.250	Rp.4.250	Rp.4.500	Rp.4.500	Rp.5.000	
Shape steel	Rp/Kg	Rp. 400	Rp. 450	Rp. 500	Rp. 600	Rp 650	Rp.1.250	
Brick	1piece	Rp. 12	Rp. 13	Rp 14	Rp. 15	Rp. 17	Rp. 35	
G r e a s e	Rp/Kg	Rp. 900	Rp.1.000	Rp.1.000	Rp.1.025	Rp.1.025	Rp.1.050	
Fuel oil	Rp/Ltr	Rp. 30	Rp. 50	Rp. 52,50	Rp. 52,50	Rp. 85	Rp. 1 45	
Engine Oil SAE=10	"	Rp. 475	Rp. 500	Rp. 525	Rp.537,50	Rp.537,50	Rp. 700	
Engine Oil SAE=20	"	Rp. 485	Rp. 500	Rp. 525	Rp.537,50	Rp.537,50	Rp. 700	
Engine Oil SAE=30	"	Rp. 485	Rp. 510	Rp. 525	Rp.537,50	Rp.537,50	Rp. 630	
Engine Oil SAE special (20-40)	Rp/Ltr	Rp. 545	Rp. 550	Rp. 580	Rp.587,50	Rp.587,50	Rp. 625	
Dynamite	---	-	-	-	-	-	-	
Detonator	-	-	-	-	-	-	-	
Reinforcing bar	Rp/Kg	Rp 600	Rp. 600	Rp. 650	Rp. 700	Rp. 800	Rp. 850	
Gabion wire Ø2mm	Rp/Kg	Rp 400	Rp. 500	Rp. 500	Rp. 550	Rp. 600	Rp. 700	
Ø3mm	"	Rp. 300	Rp. 450	Rp. 450	Rp. 500	Rp. 550	Rp. 650	
Ø4mm	"	Rp. 250	Rp. 400	Rp. 400	Rp. 450	Rp. 500	Rp. 600	

* May

3. Manpower Allomeent.

	* Plain Concrete (1 m³)	Reinforced Concrete (1 m³)	Soil Excavation (1 m³)		3-mm Gabion Matress (1 m³)	4-mm Gabion Matresss (1 m³)	** masonry Concrete (1 m³)	Embank-ment (1 m³)	Planting Grass. (1 m²)	Backfill (1 m³)
			Keras	Biasa						
Common Laboror	6+2+4	6+2+4+6.75	1	0.75	1.6+4.50	1.8+4.5	3.6	0.25	0.15	0.125
Foreman	0.3+0.1	0.3+0.1	0.025	0.033	0.075	0.075	0.18	0.01	0.01	0.005
Mason	1	1	-		-	-	1.2	-	-	-
Chief Mason	0.1	0.1+2.25	-		-	-	0,12	-	-	-
Carpenter	5	5	-		-	-	-	-	-	-
Chief Carpenter	0.5	0.5	-		-	-	-	-	-	-
Mechanic	-	-	-		-	-	-	-	-	-
Driver	-	-	-		-	-	-	-	-	-
Operator	-	-	-		-	-	-	-	-	-
Asst. Operator	-	-	-		-	-	-	-	-	-
Skilled Laboror	-	6.75	-		2	2.20	-	-	-	-

* C : S : G = 1 : 2 : 3 ** Mortor ; C : S = 1 : 2

4. Material Quantity for Civil Works

14 June 1983

Material \ Mixed/m³	Plain Concrete 1pc:2 sand 3 gv/m³	Reinforced Concrete 1pc:2 sand : 3gv /m³	Gabion matress 4 mm/m³	Gabion matress 3 mm/m³	Masonry Concrete 1pc;2sand		
Portland Cement (zak)	6,8	6.80	-	-	2.37Tong		
Sand (m³)	0.54	0.54	-	-	0.4275		
Gravel (m³)	0.82	0.82	-	-	-		
River Stone (m³)	-	-	3	3	1.2		
Wire (Kg)	-	-	45	25	-		
Iron (Kg)	-	110	-	-	-		
Wire Iron (Kg)	-	2	-	-	-		
Wood (m³)	-	0.40	-	-	-		
Nail (Kg)	-	4	-	-	-		

1 Tong =70 Kg.
1 zak =40 Kg.

5. Land acquisition cost

From: Agraria Lumajang

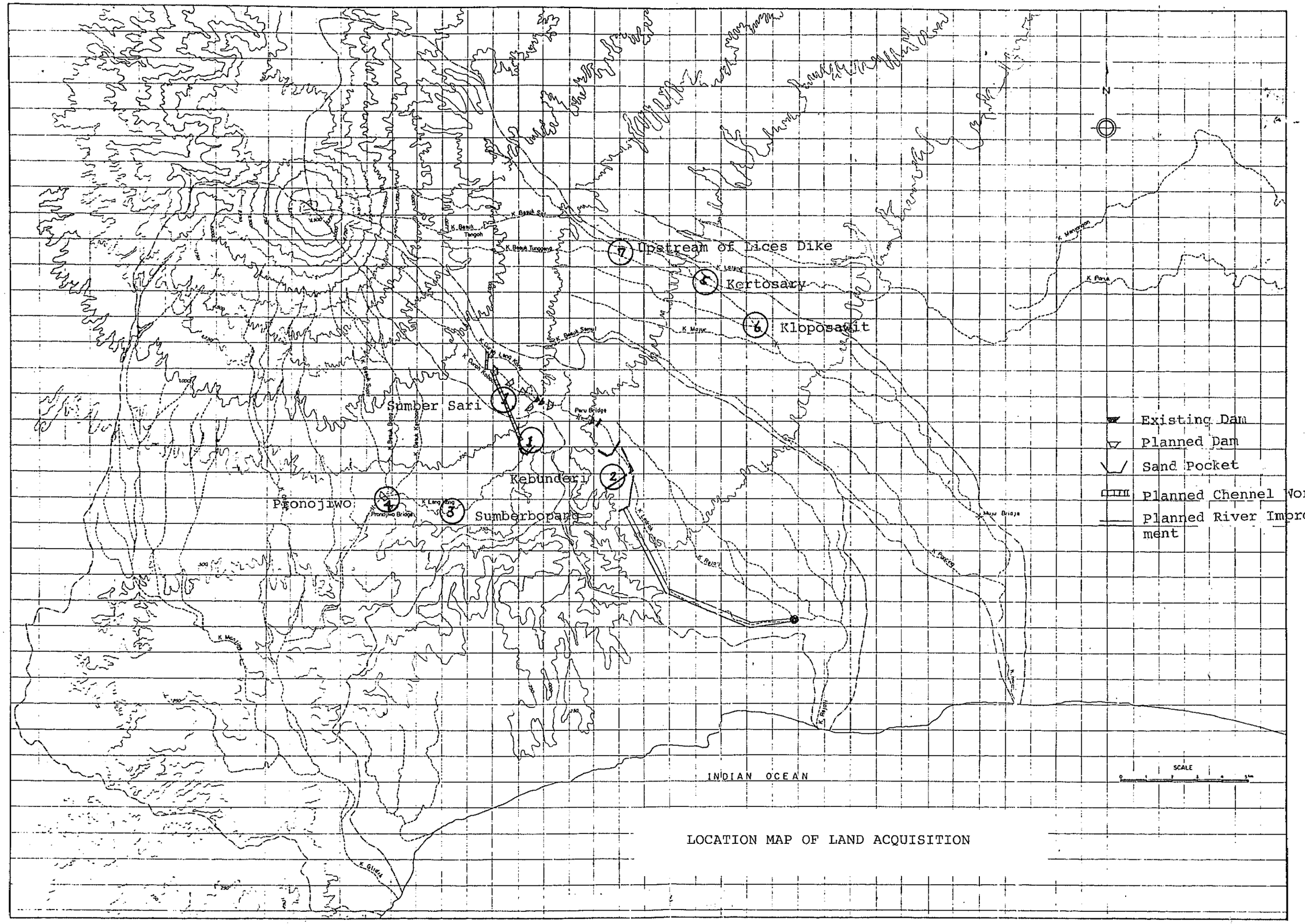
Location	Desa	Paddy	Coffe	Sugar Cone	Uncal-tivated Land	
1. Sumber Sari	500,- 50.000	300,- 90,-	150,- 10.000	300,- 90	75,- -	land Rp/m² house, plant "
2. Kebundeli	500,- 45.000	300,- 90,-	200,- 9.000	300,- 90	200,- -	
3. Sumberbopang	500,- 45.000	300,- 90,-	150,- 12.000	300,- 90	75,- -	
4. Pronojiwo	500 80.000	300 90,-	150 12.000	300 90	75 -	
5. Kertosari	500 50.000	200 12 0	150 9.000	300 90	100 -	
6. Kloposawit	600 75.000	200 12 0	500 9.000	600 90	200 -	
7. Upstream from Lices dike	500 30.000	200 90,-	150 10.000	300 90	75,- -	

Upper : land (Rp/m^2)
Lower : Cost of paddy, house and etc. (Rp/m^2)

6. Transportation Cost. = Rp.150 /ton /Km

7. Erection Cost of Contruction equiment =Rp.625.000 + Rp.156.200
= Rp.781.250, /ton

Manpower = Rp.40.000 /ton.



LOCATION MAP OF LAND ACQUISITION

8. Labor cost including overtime pay and compensation of injury

(1) Working time

Compulsory working hours/day	9 hours
Actual working hours	8 hours

(2) Base unit price of labor

Compulsory working time	07:00-14:00
From: Unit Price of Laborer Section 1	

(3) Overtime pay

Overtime hour	14:00-16:00 (2 hour)
Unit price/hour (14:00-15:00 o'clock 150%) (15:00-22:00 " 200%)	$\frac{\text{Unit price/day}}{7}$ x (150% x 1 + 200% x 1)
Overtime pay/day	(Unit price/day) x 0.5

(4) Meal allowance 0

(5) Compensation of an injury in harness

3 days x 5%/month

Pay for compensation of an injury

$$= \frac{\text{(Unit price/day)} \times 3 \times 0.05}{25} = 0.06 \times \text{(Unit price/day)}$$

(6) Total labor cost

(1 + 0.5 + 0.006) x (Unit price/day)

= 1.506 x (Unit price/day)*

Labor cost including a overtime pay and compensation

Labor	Labor cost including a overtime pay 07:00-16:00 (82/83 fiscal year)
Common labor	Rp 1,200
Foreman	Rp 3,390
Mason	Rp 3,010
Chief of mason	Rp 3,390
Carpenter	Rp 3,010
Chief of carpenter	Rp 3,390
Mechanic	Rp 3,010
Operator	Rp 3,770
Assistant operator	Rp 3,390
Chief of operator	Rp 4,520
Driver	Rp 4,520
Gabion net maker	Rp 3,010
Skilled reinforcing man	Rp 3,010

APPENDIX - 3

UNIT COST OF CIVIL WORKS

UNIT COST OF CIVIL WORKS

The result of calculation for unit price is shown on the next table.

Work Item		Specification	Unit	Unit Cost (Rp)		
				Financial Cost	Economic Cost	
					Total	Foreign Currency Portion
Excavation by man-power	Common soil	Depth is less than 1 m.	m^3	1,420	770	0
	Hard soil	Transportation is within 30 m.		1,740	940	0
	Rock			4,900	3,930	0
Excavation by machine	Hard soil	Back hoe 1.4 m^3 Bulldozer 25 t	m^3	*310	860	550
Embankment by manpower		Transportation is within 30 m	m^3	760	410	0
Embankment by machine		Bulldozer 16 t	m^3	*170	430	260
Concrete	Plain concrete	C:S:G = 1:2:3	m^3	64,230	57,030	0
	Reinforced concrete	C:S:G = 1:2:3 Steel = 110 kg/m^3		171,420	160,170	0
	Masonry concrete	C:S = 1:2		22,780	20,400	0
Gabion matress		ø3 mm	m^2	3,660	3,300	0
		d = 0.3 m	m^3	12,210	11,000	0
Rock cleaning		With portable compressor	m^2	*3,041	2,480	320
Steel basket		Shaped steel = 0.06 t/m^3	m^2	31,890	30,700	25,800
Form work			m^2	10,700	8,880	0

* excluding the equipment hire cost.

Breakdowns of unit costs (Fiscal year 1982/1983) are as follows.

1. Excavation by manpower (1 m^3)

Conditions for calculation of unit cost

Excavation with depth less than 1 m + Transportation with distance 30 m

Work Item		Labor	Labor Allotment (man.day)	Unit Price Rp/man.day ( ): Economic Unit Price	Unit Price (Rp/m^3) Financial Cost Rp/m^3	Economic Cost Rp/m^3
Common soil	Excavation	Labor	0.75	1,200 (600)	900	450
		Foreman	0.025	3,390	85	85
	Transportation	Labor	0.33	1,200 (600)	396	198
		Foreman	0.01	3,390	34	34
		Total			1,415	770
Hard soil	Excavation	Labor	1.0	1,200 (600)	1,200	600
		Foreman	0.033	3,390	112	112
	Transportation	Labor	0.33	1,200 (600)	396	198
		Foreman	0.01	3,390	34	34
		Total			1,742	940
Rock	Excavation	Common labor	1.28	1,200 (600)	1,536	768
		Skilled labor	0.84	3,010	2,528	2,528
		Foreman	0.12	3,390	407	407
	Transportation	Common labor	0.33	1,200 (600)	396	198
		Foreman	0.01	3,390	34	34
		Total			4,901	3,930

2. Embankment by Manpower (1 m^3)

Conditions for calculation of unit cost

Embankment with transportation at location
(distance=30 m)

Work Item	Labor	Labor Allotment (man.day)	Unit Price Rp/man.day ( ): Economic Unit Price	Unit Price (Rp/m^3)	
				Financial Cost Rp/m^3	Economic Cost Rp/m^3
Embankment	Labor	0.25	1,200 (600)	300	150
	Foreman	0.01	3,390	34	34
Transportation	Labor	0.33	1,200 (600)	396	198
	Foreman	0.01	3,390	34	34
Total				764	410

3. Plain Concrete

Conditions for calculation of unit cost

Mix porportion C:S:G = 1:2:3

Item		Allotment				Unit Price Rp ( ): Economic Unit Price	Unit Price Rp/m^3	
		Concrete Mixing & Setting	Form Making	Form Removal	Total		Financial Cost	Economic Cost
Labor (man.day)	Common labor	6	2	4	12	1,200 (600) man.day	14,400	7,200
	Foreman	0.3		0.1	0.4	3,390 "	1,356	1,356
	Mason	1			1	3,010 "	3,010	3,010
	Chief mason	0.1			0.1	3,390 "	339	339
	Carpenter		5		5	3,010 "	15,050	15,050
	Chief carpenter		0.5		0.5	3,390 "	1,695	1,695
	Sub Total						35,850	28,650
Material	Portland cement (bag)	6.8			6.8	3,250 /bag	22,100	22,100
	Sand (m^3)	0.54			0.54	800 /m^3	430	430
	Gravel (")	0.82			0.82	2,500 /m^3	2,050	2,050
	Wood (")		0.4		0.4	4,500 /m^3	1,800	1,800
	Nail (kg)		4		4	500 /kg	2,000	2,000
	Sub Total						28,380	28,380
	Total						64,230	57,030

4. Reinforced Concrete by Manpower (m^3)

Conditions for calculation of unit cost
Mix proportion C:S:G = 1:2:3

Item		Allotment					Unit Price Rp ( ): Economic Unit Price	Unit Price Rp/m^3	
		Concrete Mixing & Setting	Form Making	Form Removal	Rein-forcing	Total		Financial Cost	Economic Cost
Labor (man.day)	Common labor	6	2	4	6.75	18.75	1,200 (600)/man day	22,500	11,250
	Foreman	0.3		0.1		0.4	3,390	1,356	1,356
	Mason	1				1	3,010	3,010	3,010
	Chief mason	1				0.1	3,390	339	339
	Carpenter		5			5	3,010	15,050	15,050
	Chief carpenter		0.5			0.5	3,390	1,695	1,695
	Reinforcing man				6.75	6.75	3,010	2,258	2,258
	Chief reinforcing man				2.25	2.25	3,390	7,628	7,628
	Sub Total							53,836	42,586
Mate-rial	Portland cement (bag)	6.8				6.8	3,250 /bag	22,100	22,100
	Sand (m^3)	0.54				0.54	800 /m^3	430	430
	Gravel (")	0.82				0.82	2,500 /m^3	2,050	2,050
	Wood (")		0.4			0.4	4,500 /m^3	1,800	1,800
	Nail (kg)		4			4	500 /kg	2,000	2,000
	Reinforcing bar (kg)				110	110	800 /kg	88,000	88,000
	Wire (kg)				2	2.0	600 /kg	1,200	1,200
	Sub Total							117,580	117,580
	Total							171,416	160,170

5. Masonry Concrete by Manpower

Conditions for calculation of unit cost

Mix proportion of mortar C:S = 1:2

	Work Item	Allot-ment man.day	Unit Price ( ): Economic Unit Price Rp/man.day	Unit Price (Rp^3) Financial Cost	Unit Price (Rp^3) Economic Cost
Labor	Common labor	3.6	1,200 (600)	4,320	2,160
	Foreman	0.18	3,390	610	610
	Mason	1.2	3,010	3,612	3,612
	Chief mason	0.12	3,390	407	407
	Sub Total			8,949	6,790
Material	Portland cement	bag 2.37	Rp/bag 3,250	7,700	7,700
	Sand	m^3 0.4275	Rp/m^3 800	340	340
	River stone	1.2	3,100	3,720	3,720
	Sub Total			11,760	11,760
Joint concrete (Labor + Material) x 0.1				2,071	1,855
Total				22,780	20,405

6. Gabion Matress

Conditions for calculation of unit cost
3 m^3 Gabion-matress with ø3 mm wire

	Work Item	Allot-ment man.day	Unit Price Rp ( ): Economic Unit Price	Unit Price (Rp) Financial Cost	Economic Cost
Labor	Common labor	6.1	1,200 (600)	7,320	3,660
	Foreman	0.075	3,390	254	254
	Gabion net maker	2.0	3,010	6,020	6,020
	Sub Total			13,594	9,930
Material	River stone (m^3)	3	3,100	9,300	9,300
	Wire (kg)	25	550	13,750	13,750
	Sub Total			23,050	23,050
	Total			36,644	32,980
	Unit cost per 1 m^3			12,214	10,993
	Unit cost per 1 m^2			3,664	3,298

7. Rock Cleaning

Work Item		Allot-ment man.day	Unit Price Rp/man.day ( ): Economic Unit Price	Unit Price (Rp/m^3)	
				Financial Cost	Economic Cost
Labor	Common labor	1.46	1,200 (600)	1,752	876
	Skilled labor	0.30	3,010	903	903
	Foreman	0.04	3,390	136	136
	Sub Total			2,791	1,910
Operator	Operator	0.00871	3,770	33	33
	Asst. Operator	0.00871	3,390	30	30
	Chief Operator	0.00156	4,520	7	7
	Sub Total			70	70
Equipment hire cost (Refer to next page)				180	500
Total				3,041	2,480
Foreign currency portion in equipment hire cost					320

Table

Breakdown of equipment cost

Equipment			
Item			
① Depreciation cost per hour	① =d+T	5,083	Rp/hour
ⓐ Economic life		6	year
ⓑ Operation time/year		1,000	hour/year
Ⓐ Perchase cost		19,060,000	Rp
Ⓑ Tire&pipe cost		0	Rp
Ⓡ Residual cost	R=0.1(A-B)	1,906,000	Rp
Ⓓ Depreciation cost	D=A-(B+R)	17,154,000	Rp
ⓓ Depreciation cost/hour	$d=\frac{D}{a \cdot b}$	2,859	Rp /hour
Ⓣ Tax cost	$T=0.2\ \frac{a+1}{2a}\ \frac{A}{b}$	2,224	Rp /hour
② Operation cost	② = $\sum$ (e~j)	428	Rp/hour
ⓔ Fuel oil	4.21 l/hour Rp 85=	357	Rp/hour
ⓕ Lubricant oil	l/hour Rp 800=		Rp/hour
ⓖ Hydrolic oil	l/hour Rp 1500=		Rp/hour
ⓗ Grease	kg/hour Rp 2500=	71	Rp/hour
ⓘ Transmissin oil	l/hour Rp 800=		Rp/hour
ⓙ Final drive oil	l/hour Rp 800=		Rp/hour
③ Repair cost	③ =0.12 $\frac{(A-B)}{b}$	= 2,287	Rp/hour
④ Direct cost	④ = ① + ② + ③	7,798	Rp/hour
⑤ Indirect cost	⑤ = 0.15 × ④	1,170	Rp/hour
⑥ Total	⑥ = ④ + ⑤	8,968	Rp/hour
⑦ Production/hour	Performance = 16m^2/hr Economic hire cost =(8,968-2,224)x1.19=8,027Rp/hr Foreign currency portion =(2,287x0.6+2,859)x1.19=5,035Rp/hr Unit cost per 1m^2 = $\frac{8,027}{16}$ = 500Rp/m^2 = $\frac{5,035}{16}$ = 320Rp/m^2		

100yen=270Rp

8. Steel Basket

Item			Allotment man.day	Unit Price Rp/man.day ( ): Economic Unit Price	Unit Price (Rp/m^3)	
					Financial Cost	Economic Cost
Labor	Stone arrangement	Common labor	2.0	1,200 (600)	2,400	1,200
		Foreman	0.07	3,390	237	237
	Steel construction	Skilled labor	0.11	3,010	331	331
		Foreman	0.005	3,390	17	17
		Sub Total			2,985	1,785
Material	River stone		1 m^3	3,100	3,100	3,100
	Shape steel		0.06 t	430,000	25,800	25,800
	Sub Total				28,900	28,900
Total					31,885	30,700

9. Form Work

Item		Allotment			Unit Price	Unit Price (Rp/m^2)	
		Form Making	Form Removal	Total	( ): Economic Unit Price Rp/man.day	Financial Cost	Economic Cost
		man.day					
Labor	Carpenter	1.25	0.625	1.875	3,010	5,644	5,644
	Chief carpenter	0.125	0.0625	0.1875	3,390	636	636
	Common labor	1.5	1.5	3	12,00 (600)	3,600	1,800
	Foreman	0.05	0.05	0.1	3,390	339	339
	Sub Total					10,219	8,419
Material	Wood	m^3 0.0825	-	-	Rp/m^3 4,500	371	371
	Nail	kg 0.188	-	-	Rp/kg 500	94	94
	Sub Total					465	465
Total						10,684	8,884

10. Embankment and Backfill by Machine Power

Conditions for calculation of embankment and backfill

Spreading soil Bulldozer (16t) Performance = 91 m^3/hr

Compaction Bulldozer (16t) Performance = 115 m^3/hr

Item		Allot-ment man.day	Unit Price Rp/man.day	Unit Price (Rp/m^2)	
				Financial Cost	Economic Cost
Labor	Operator	0.00246	3,770	9.3	9.3
	Asst. Operator	0.00246	3,390	8.3	8.3
	Sub Total			17.6	17.6
Equip-ment hire cost	Spreading	0.00137	189,360	87	230
	Compaction	0.00109	189,360	69	182
	Sub Total			156	412
Total				174	430
Foreign currency portion in equipment hire cost		(13,030/91 + 13,030/115)			256

11. Excavation by Back Hoe

Conditions for calculation of excavation

(1) Characteristics of soil .... Hard soil

(2) Excavation : Back hoe (1.4m^3) Performance = 71 m^3/hr

Dozing, Collecting soil : Bulldozer (25t) Performance = 102 m^3/hr

Item		Allotment	Unit Price ( ): Economic Unit Price Rp/man.day	Unit Price (Rp/m^3)	
				Financial Cost	Economic Cost
Labor	Operator	0.00299	3,770	11.3	11.3
	Asst. Operator	0.00299	3,390	10.1	10.1
	Sub Total			21.4	21.4
Equipment hire cost	Excavation	0.001761	411,344	162	508
	Dozing, Collecting	0.001225	393,744	130	332
	Sub Total			292	840
Total				313	861
Foreign currency portion in equipment hire cost		24,550/71 + 20,690/102		-	548

APPENDIX - 4

Government Administration Cost

(1) Total Salary (10^3 Rp)		31,370	51,670	60,540	89,910	89,910
Number of staff (person)	(2) Total person	40	86	96	110	110
	(3) Person for logistic, job site and driver	21	25	30	31	31
	(4) Person for administration (4) = (2)-(3)	19	61	66	79	79
(5) Salary for administration (5) = (1)x(4)/(2) (10^3 Rp)		14,900	36,650	41,620	64,570	64,570
(6) Salary for logistic, job site and driver (6) = (1)x(3)/(2) (10^3 Rp)		16,470	15,020	18,920	25,340	25,340
(7) Construction cost		399,000	524,500	598,500	778,000	778,000 +747,000* =1,525,000
(8) Proportion of administration cost and construction cost (8) = (5)/(7)		4%	7%	7%	8%	4%

* Budget for urgent improvement project

Item (1)(2)(3) and (7) were inquired by Mt. Semeru Project office in August, 1983.

Urgent Improvement Project will be executed by the same number of staffs with the help of a consultant company.

APPENDIX - 5

CONSTRUCTION PLAN AND COST ESTIMATION

OF

DIVERSION CHANNEL

CONSTRUCTION PLAN AND COST ESTIMATE OF THE DIVERSION CHANNEL

1. OUTLINE OF THE CONSTRUCTION

Excavation of the diversion channel will start at the lower stream side and move up to the upper stream side. The excavated soil will be moved to the lower stream area and, then, transported to the spoil bank at the K. Lengkong fan.

Spoil banks will be planned for places where a rise of the road surface has been necessitated due to the accumulation of discharged sediment. The excavated soil from the diversion channel will be used for this purpose. The transportation plan of the excavated soil is shown in Fig.-2.1.

The revetment work for both banks of the channel and the concrete placing of a consolidation dam, which is to be built across the channel, will be carried out simultaneously following the completion of the excavation work for the diversion channel.

The construction schedule is as follows:

Excavation for the Diversion Channel ... 2 years
Revetment Work and Concrete Placing
for the Consolidation Dam ..... 1 year

2. TRANSPORTATION OF EXCAVATED SOIL

Mean transportation distance of the excavated earth for the diversion channel is calculated by next formula.

$$\bar{L} = \frac{\Sigma VexL}{\Sigma Ve}$$

(1) Excavation volume

$Vn = 566{,}000\ m^3$

(2) Exchange coefficient of earth volume $L = 1.34$

$C = 0.95$

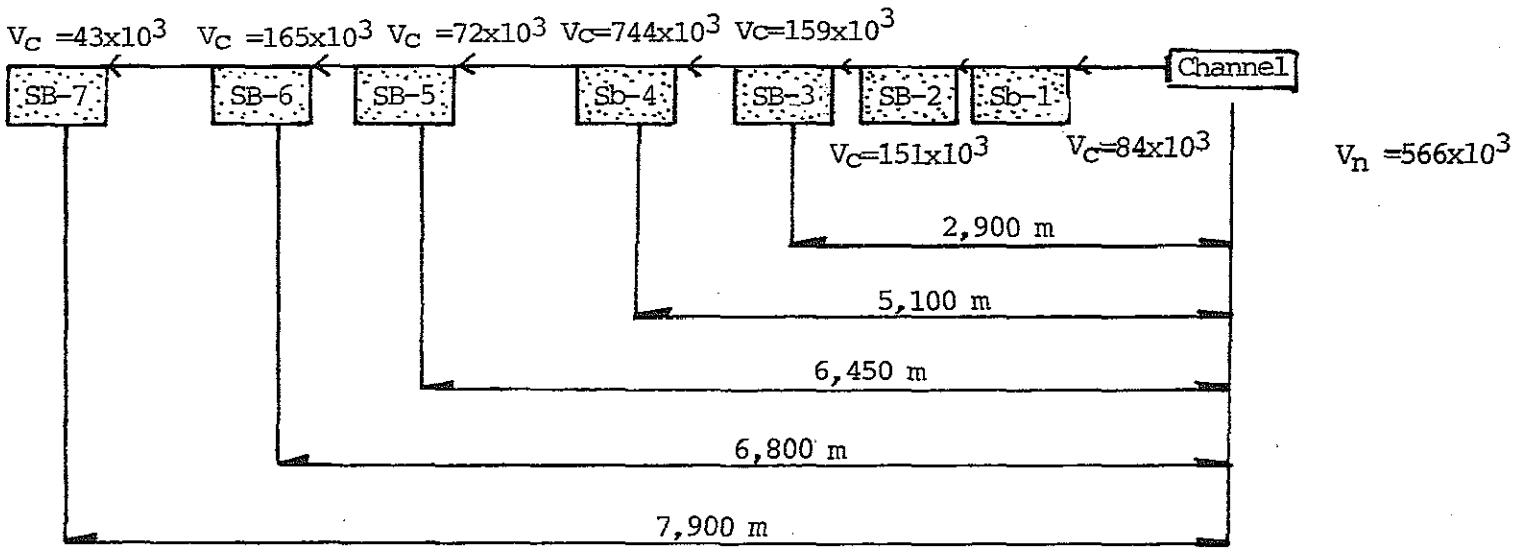
(3) Spoil bank and transportation distance

No. of Spoil Bank	Distance L (m)	Earth Volume ($10^3\ m^3$)			Ve.L ($10^6 m^3$.m)
		Compacted Vc	Natural Vn	Loose Ve	
SB-3	2.900	159	167.4	234.3	679.5
SB-4	5.100	99	104.2	145.3	744.1
SB-5	6.450	71.5	75.3	105.4	679.6
SB-6	6.800	165	173.7	243.2	1,653.5
SB-7	7.900	43.1	45.4	63.6	502.1
Total				792.4	792.4

Mean transportation distance ($\bar{L}$)

$$\bar{L} = \frac{\Sigma V_1 \times L}{\Sigma V_1} = \frac{4258.8 \times 10^6}{792.4 \times 10^3} = 5370\ m$$

$$V_1 = 792.4 \times 10^3\ m^3$$



Channel excavation

Spoil bank

Earth work of diversion works

V_c : Compacted

V_n : Natural

VL : Lose

3. NUMBER OF WORK DAYS PER YEAR

(1) Dry season (May - November, 7 months)

A day with daily rainfall = 7 mm/day is workable.

Workable days/month	= 25 days
Number of days in dry season	= 175 days

(2) Rainy seaons (December - April, 5 months)

Work hours/day	= 4 hours
Equivalent work days in rainy season	= $25 \times \frac{4}{8} \times 5 = 63$

(3) Total number of work days per year = 238 days = 240 days

4. EXISTING CONSTRUCTION EQUIPMENT

Existing construction equipment of this Mt. Semeru Project are shown in Table-4.1. These equipment firstly should be used for construction. But, if the quantity and the function of these equipment are not enough, new equipments are imported.

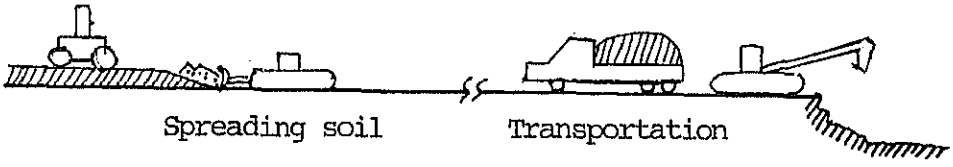
Table - 4 .1 Equipment of Mt. Semeru Project

including equipment for U.I.P.

Item	Exsisting equipment at 1983			Equipment of U.I.P.		
	Specification	Performance	Quantity	Specification	Total resudal hour	Quantity
Bulldozer	15 t	33 m^3/hr	2	25 t	48,483	8
	15 t	30 m^3/hr	2	16 t	3,270	3
				18 t	1,090	1
Back-hoe	0.5 m^3	8 m^3/hr	3	1.4 m^3	9,520	2
	0.4 m^3	7 m^3/hr	1	0.7 m^3	9,592	2
Dozer shovel				1.8 m^3	33,326	7
Track shove	0.8 m^3		2			
Dumptruck	3 ton		5	8 ton	152,267	30
	6 ton		2			
	6 ton		8			
Truckcrane	10 ton		1	25 t		1
Lag-hammer				ys23LD	5,450	10
Portable Compressor				10^5 m^3PDS	4,080	3
Vibration Roller				BW210	7,546	2
Motor Grader				3.7 m	9,648	2
Concrete Mixer				0.6 m^3		1

5. CONSTRUCTION METHOD AND EQUIPMENT OF DIVERSION CHANNEL

Work item	Equipment	Specification of equipment	Quantity
Excavation and loading	Back hoe	1.4 m^3	4
	Doser	25 ton	1
↓ Transportation	Dump Truck	8 ton	24
↓ Spreading Soil	Bull dozer	25 ton	2
↓ Compaction	Vibration Roller	3 ton	2
	Bull dozer	16 ton	



Assist for excavation ripping dozer.

Fig.-5.1 Construction method for excavation of diversion channel

6. PERFORMANCE AND HIRE COST

The breakdown of the performance and the hire cost for each equipment are shown on the following tables.

Table-6.1 Performance and hire cost

Equipment	Specification	Work Item	Performance	Economic Cost of Equipment Rp/hour
Back hoe	1.4 m^3	Excavation	43 m^3/hr	36,050
Dump Truck	8 ton	Transpor-tation	8.3 m^3/hr	6,810
Bulldozer	25 t	Spreading	127 m^3/hr	33,830
Vibration Roller	3 t	Compaction	144 m^3/hr	17,690
Bulldozer	16 t	Compaction	138 m^3/hr	20,960
Bulldozer	25 t	Ripping	133 m^3/hr	33,830

Table

Breakdown of equipment cost

Equipment	Back hoe 1.4 m^3		
Item			
① Depreciation cost per hour	① =d+T	28,660	Rp/hour
ⓐ Economic life		5	year
ⓑ Operation time/year		1,300	hour/year
Ⓐ Perchase cost		124,191,000	Rp
Ⓑ Tire&pipe cost		0	Rp
Ⓡ Residual cost	R=0.1(A-B)	12,419,000	Rp
Ⓓ Depreciation cost	D=A-(B+R)	111,772,000	Rp
ⓓ Depreciation cost/hour	$d=\frac{D}{a \cdot b}$	17,196	Rp /hour
Ⓣ Tax cost	$T=0.2\ \frac{a+1}{2a}\ \frac{A}{b}$	11,464	Rp /hour
② Operation cost	② = $\sum$ (e~j)	1,918	Rp/hour
ⓔ Fuel oil	18.8l/hour Rp 85=	1,598	Rp/hour
ⓕ Lubricant oil	l/hour Rp 800=		Rp/hour
ⓖ Hydrolic oil	l/hour Rp 1500=		Rp/hour
ⓗ Grease	kg/hour Rp 2500=	320	Rp/hour
ⓘ Transmissin oil	l/hour Rp 800=		Rp/hour
ⓙ Final drive oil	l/hour Rp 800=		Rp/hour
③ Repair cost	③ =0.12 $\frac{(A-B)}{b}$	= 5,730	Rp/hour
④ Direct cost	④ = ① + ② + ③	36,308	Rp/hour
⑤ Indirect cost	⑤ = 0.15 × ④	5,446	Rp/hour
⑥ Total	⑥ = ④ + ⑤	41,754	Rp/hour
⑦ Production/hour	g = 1.37 m^3 Cs=45 (Swing angle=180°) E = 0,4 Q = $\frac{3,600 \times 1.37 \times 0.4}{45}$ = 43 m^3/hour Foreign currency = (5,730x0.6+17,196) x1.19=24,550 Hire cost = (41,754-11,464)x1.19 = 36,050		

Transportation Cost
= 38.5t x 270km x 740Rp/t km
= 7,692 x 10^3 Rp

Table

Breakdown of equipment cost

Equipment	Dump Truck 8 t		
Item			
① Depreciation cost per hour	① =d+T	4,020	Rp/hour
ⓐ Economic life		4	year
ⓑ Operation time/year		1,600	hour/year
Ⓐ Perchase cost		18,943,000	Rp
Ⓑ Tire&pipe cost		883,000	Rp
Ⓡ Residual cost	$R=0.1(A-B)$	1,806,000	Rp
Ⓓ Depreciation cost	$D=A-(B+R)$	16,254,000	Rp
ⓓ Depreciation cost/hour	$d=\frac{D}{a \cdot b}$	2,540	Rp./hour
Ⓣ Tax cost	$T=0.2\ \frac{a+1}{2a}\ \frac{A}{b}$	1,480	Rp./hour
② Operation cost	② = $\sum$ (e~j)	888	Rp/hour
ⓔ Fuel oil	8.7 l/hour Rp 85=	740	Rp/hour
ⓕ Lubricant oil	l/hour Rp 800=		Rp/hour
ⓖ Hydrolic oil	l/hour Rp 1500=		Rp/hour
ⓗ Grease	kg/hour Rp 2500=	148	Rp/hour
ⓘ Transmissin oil	l/hour Rp 800=		Rp/hour
ⓙ Final drive oil	l/hour Rp 800=		Rp/hour
③ Repair cost	③ $=0.12\ \frac{(A-B)}{b}$	= 1,355	Rp/hour
④ Direct cost	④ = ① + ② + ③	6,263	Rp/hour
⑤ Indirect cost	⑤ = 0.15 × ④	939	Rp/hour
⑥ Total	⑥ = ④ + ⑤	7,202	Rp/hour
⑦ Production/hour $Q=\frac{60.C\ .f.E}{Cn}$, $C=\frac{W}{r}$ $Cm = te + td + \frac{\ell}{v_1}\ \frac{\ell_2}{v_2}$ f=0.8 E=0.9 r=1.36 t/m³ $V_1=V_2$=25k m /h =410m/min te =3.1 td = 1.5 Cm=30.8 min Q=8.3m³/hr	Diversion - 1 L = 5,370m Q = 8.3 m³/hour Foreign Currency = (1,355x0.6+2,540)x1.19=3,990 Hire cost = (7,202-1,480)x1.19=6,810		

Table

Breakdown of equipment cost

Equipment	Bull dozer 25 t for spreading so; /for ripping		
Item			
① Depreciation cost per hour	① =d+T	20,882	Rp/hour
ⓐ Economic life		6	year
ⓑ Operation time/year		1,300	hour/year
Ⓐ Perchase cost		101,801,000	Rp
Ⓑ Tire&pipe cost		0	Rp
Ⓡ Residual cost	R=0.1(A-B)	10,180,000	Rp
Ⓓ Depreciation cost	D=A-(B+R)	91,621,000	Rp
ⓓ Depreciation cost/hour	$d=\frac{D}{a \cdot b}$	11,746	Rp /hour
Ⓣ Tax cost	$T=0.2\ \frac{a+1}{2a}\ \frac{A}{b}$	9,136	Rp /hour
② Operation cost	② = $\sum$ (e~j)	2,389	Rp/hour
ⓔ Fuel oil	23.4 l/hour Rp 85=	1,989	Rp/hour
ⓕ Lubricant oil	l/hour Rp 800=	400	Rp/hour
ⓖ Hydrolic oil	l/hour Rp 1500=	400	Rp/hour
ⓗ Grease	kg/hour Rp 2500=	400	Rp/hour
ⓘ Transmissin oil	l/hour Rp 800=	400	Rp/hour
ⓙ Final drive oil	l/hour Rp 800=	400	Rp/hour
③ Repair cost	$③ = 0.12\ \frac{(A-B)}{b}$	= 9,397	Rp/hour
④ Direct cost	④ = ① + ② + ③	32,668	Rp/hour
⑤ Indirect cost	⑤ = 0.15 × ④	4,900	Rp/hour
⑥ Total	⑥ = ④ + ⑤	37,568	Rp/hour
⑦ Production/hour $Q = \frac{69.g.E}{Cm}$ For ripping $Q = \frac{60\ An.L.E}{Cm}$ $Cm = \frac{1}{24}\ L+0.25$	For spreading soil $g = 2.8 m^3$ E = 0.75 L = 20m Cm = 0.99 min $Q = \frac{60x2.8x0.75}{0.9g} = 127\ m^3/hour$ For ripping L = 20m An = $0.4 m^2$ L = 20m Cm = 1.08 min E = 0.3 $Q = \frac{60x0.4x20x0.3}{1,08} = 133\ m^3/hour$		

Transportation cost

Surabaya - Job site

$(25.8 \times 1.2)t \times 270km \times 740Rp/t.km = 6.186 \times 10^3$ Rp

Foreign currency = (91,397x0.6+11,746)x1.19 = 20,690

Hire cost = (37,568-9,136)x1.19 = 33,830

Table

Breakdown of equipment cost

Equipment	Vibration roller 3t		
Item			
① Depreciation cost per hour	① =d+T	15,221	Rp/hour
ⓐ Economic life		7	year
ⓑ Operation time/year		800	hour/year
Ⓐ Perchase cost		49,971,000	Rp
Ⓑ Tire&pipe cost		0	Rp
Ⓡ Residual cost	R=0.1(A-B)	4,997,000	Rp
Ⓓ Depreciation cost	D=A-(B+R)	44,974,000	Rp
ⓓ Depreciation cost/hour	$d=\frac{D}{a \cdot b}$	8,031	Rp /hour
Ⓣ Tax cost	$T=0.2\ \frac{a+1}{2a}\ \frac{A}{b}$	7,140	Rp /hour
② Operation cost	② = $\sum$ (e~j)	163	Rp/hour
ⓔ Fuel oil	1.6 l/hour Rp 85=	136	Rp/hour
ⓕ Lubricant oil	l/hour Rp 800=		Rp/hour
ⓖ Hydrolic oil	l/hour Rp 1500=		Rp/hour
ⓗ Grease	kg/hour Rp 2500=	27	Rp/hour
ⓘ Transmissin oil	l/hour Rp 800=		Rp/hour
ⓙ Final drive oil	l/hour Rp 800=		Rp/hour
③ Repair cost	③ =0.12 $\frac{(A-B)}{b}$	= 3,748	Rp/hour
④ Direct cost	④ = ① + ② + ③	19,132	Rp/hour
⑤ Indirect cost	⑤ = 0.15 × ④	2,870	Rp/hour
⑥ Total	⑥ = ④ + ⑤	22,002	Rp/hour
⑦ Production/hour $Q = \frac{1,000V.W.H.f.E}{N}$ V=2.0km/hr, W=1.5m, H=0.3m, N=4, F=0.9, f=0.71 $Q=\frac{1,000x3x1.5x0.3x0.71x0.9}{4}$	Foreign currency = (3,748x0.6+8,031)x1.19=12,233 Hire cost = (22,002-7,140)x1.19=17,686 Q = 144m^3/hr		

Transportation = $(3.1x1.2)^t$ x 270km x 740Rp/t.km
= 743 x 10^3Rp

Table

Breakdown of equipment cost

Equipment	Bulldozer (16t) for Spreading		
Item			
① Depreciation cost per hour	① =d+T	13,032	Rp/hour
ⓐ Economic life		5	year
ⓑ Operation time/year		1,300	hour/year
Ⓐ Perchase cost		56,469,000	Rp
Ⓑ Tire&pipe cost		0	Rp
Ⓡ Residual cost	R=0.1(A-B)	5,647,000	Rp
Ⓓ Depreciation cost	D=A-(B+R)	50,822,000	Rp
ⓓ Depreciation cost/hour	$d=\frac{D}{a \cdot b}$	7,819	Rp /hour
Ⓣ Tax cost	$T=0.2\ \frac{a+1}{2a}\ \frac{A}{b}$	5,213	Rp /hour
② Operation cost	② = $\sum$ (e~j)	1,602	Rp/hour
ⓔ Fuel oil	15.7 l/hour Rp	85= 1,330	Rp/hour
ⓕ Lubricant oil	l/hour Rp	800=	Rp/hour
ⓖ Hydrolic oil	l/hour Rp	1500= 267	Rp/hour
ⓗ Grease	kg/hour Rp	2500=	Rp/hour
ⓘ Transmissin oil	l/hour Rp	800=	Rp/hour
ⓙ Final drive oil	l/hour Rp	800=	Rp/hour
③ Repair cost	③ =0.12 $\frac{(A-B)}{b}$	= 5,213	Rp/hour
④ Direct cost	④ = ① + ② + ③	= 19,847	Rp/hour
⑤ Indirect cost	⑤ = 0.15 × ④	= 2,977	Rp/hour
⑥ Total	⑥ = ④ + ⑤	= 22,824	Rp/hour
⑦ Production/hour $Q = \frac{60.8.E}{Cm}$ $q=2m^3$, E=0.75, ℓ=20m Cm=0.99 min. $Q=\frac{60x2x0.75}{0.99} = 91m^3/hr$	Foreign currency =(5,213x0.6+7,819)x1.19=13,030 Hire cost = (22,824-5,213)x1.19=20,960 $Q = 91m^3/hr$		

Transportation

(15.73x1.2) x 270km x 740Rp/t.km

$= 3,771x10^3$Rp

7. QUANTITY OF EQUIPMENT

(1) Average work hours/day = 7 hours
Workable days/year for excavation = 240 days
(daily rainfall is less than 7 mm)

(2) Construction volume

Work Item	Diversion Channel - 1
Excavation	566,000 m^3 (N)
Transportation Distance	792,000 m^3 (L) 5,370 m
Compacting	537,000 m^3 (C) 792,000 m^3 (L)

(3) Construction volume/day
Construction term of excavation = 2 years

	Total Construction Volume	Construction Volume per Day
Excavator	566,000	1,180 m^3 (N)
Transportation	792,000	1,650 m^3 (L)
Compacting	792,00	1,650 m^3 (L)

(4) Quantity of equipment

Work item	Equipment	Performance (m^3/hour)	Construction volume per day (m^3)	Quantity of equipment
Excavation	Back hoe (1.4 m^3)	43	1,180 (N)	3.9 = 4
	Bulldozer	133	* 590 (W)	0.6 = 1
Transportation	Dumptruck (8 t)	9.8	1,650 (L)	24.0 = 24
Spreading	Bulldozer (25 t)	127	1,650 (L)	1.8 = 2
Compaction	Vibration Roller (3 t)	144	2,016 (L)	2.0 = 2
	Bulldozer (16 t)	138	464 (L)	0.5 = 1

Work time per day = 7 hour

* 1,180 x 50 % = 590

8. COST ESTIMATION FOR DIVERSION CHANNEL

The direct construction cost for diversion channel are shown in Table-8.1.

Table-8.1 Direct Construction Cost

Work Item		Quantity (m^3)	Economic Cost (10^6Rp)	Financial Cost (10^6Rp)
Excavation	Civil work	566,000	713	719
	Hire cost of equipment	-	966	-
Rivetment 7,290		80	89	
Concrete work		2,370	135	152
Total			1,894	960

Conditions for estimation

(1) Excavation by back hoe with the help of bulldozer

(2) Including transportation cost of equipment

8.1 Equipment Hire Cost

Work Item	Equipment	Unit Hire Cost (Foreign Curency) Rp/hour	Performance (m^3/hour)	Construction Volume (m^3)	Actual Working (hour)	Total Hire (10^6)	Foreign Currency (10^6)
Excavation	Back hoe	36,050 (24,550)	43	566,000	13,163	475	323
	Bulldozer	33,830 (20,690)	133	283,000	2,128	650	44
Transpor-tation	Dump Truck	6,810 (3,990)	8.3	792,000	95,422	650	381
Spreading	Bulldozer	33,830 (20,690)	127	792,000	6,240	211	129
Compaction	Vibrating Roller	17,690 (12,230)	144	792,000	5,500	97	67
	Bulldozer	20,960 (13,030)	138	222,320	1,611	35	22
Total						1,540	966

8.2 Operator Cost

( ) Economic cost

Labor	Allotment of Manpower (man.day)	Unit Price (Rp/man.day)	Cost (10^6Rp)	Total (10^6Rp)
Operator	4,320	3,770	16	
Assistant	4,320	3,390	15	
Driver	11,520	4,520	52	145
Assistant	5,760	4,520	26	(138.5)
Common labor	9,600	1,200 (600)	11.5(5.8)	
Chief operator	3,600	4,520	17	
Foreman	1,920	3,390	7	

Total work days = 240 x 2 = 480 days

Financial civil work = 1,540 x 10^6Rp + 145 x 10^6 Rp - 966 x 10^6 Rp = 719 x 10^6Rp

Economic cost
- Civil work = (1,540 - 966 + 138.5) x 10^6 Rp = 713 x 10^6 Rp
- Equipment hire cost = Foreign currency = 966 x 10^6 Rp

8.3 Cost of Gabion Work and Concrete Work

( ): Economic cost

Work Item	Quantity	Unit Price	Cost 10^6Rp
Gabion work	7,290 m^3	(Rp 11,000/m^3)	89
		Rp 12,210/m^3	(80)
Concrete work	2,370 m^3	Rp 64,230/m^3 (Rp 57,030/m^3)	152 (135)
Total			241 (215)

APPENDIX - 6

CONSTRUCTION PLAN AND COST ESTIMATE
OF
B. CURAH KOBO'AN AND PRONOJIWO DAM

CONSTRUCTION PLAN AND COST ESTIMATE OF
B. CURAH KOBO'AN AND PRONOJIWO DAM

CONSTRUCTION PLAN OF
B. KOBO'AN CHECK DAM NO. 6 AND PRONOJIWO DAM

1. SPECIFICATIONS AND CONSTRUCTION QUANTITY

		Check Dam No.6	Pronojiwo Dam
Crown Altitude	(m)	EL 775.7	EL 650.0
Dam Height	(m)	31.7	10
Crown Length	(m)	438	230
Concrete Volume	(m^3)	120,800	42,700
Main Dam		101,000	17,600
Sub Dam		5,400	1,200
Apron		13,000	7,200
Plug		-	7,100
Side Wall (*)		1,400	9,600

* Plain concrete. Masonry concrete is used for other places.

Here, the construction quantity is shown by the plain concrete volume equivalent, based on the following convertion result.

Masonry Concrete (m^3)	119,400	33,100
x 0.55 (Convertion Factor)	65,600	18,200
Side Wall	1,400	9,600
Miscellaneous	6,000 (other than dam)	-
Plain Concrete Total (m^3)	73,000	27,800

2. CONCRETE PLACING

2.1 Calculation of Concrete Placing Capacity

(1) Work Conditions

Work days per year 240 days
Average work days per month 20 days
Average work hours per day 10 hours (double shift)
One shift: 7 hours (Concrete placing ..... 5 hours)
(Miscellaneous work ..... 2 hours)

Construction of the check dam will be completed first and then the construction of Pronojiwo dam will start. The average construction volume per day shall be 200 m^3 by masonry concrete. Therefore, after conversion to the plain concrete volume equivalent, it would be 110 m^3/day.

(2) Construction Volume

a) Average Volume

The construction volume per concrete placing hour (Qc), common to each dam, is determined as follows:

$$QC = \frac{Vc}{Hr} = \frac{200\ m^3}{10\ hrs} = 20\ m^3/hr \quad (11\ m^3/hr \text{ for plain concrete})$$

Vc: Average daily placing volume 200 m^3
Hr: Average daily placing volume 10 hours

b) Maximum Volume

Where the placing can be done efficiently, the daily work volume will be increased by 50% to the maximum volume at 30 m^3/hr (17 m^3/hr in plain concrete equivalent).

2.2 Concrete Placing Equipment

(1) Selection of Equipment

The study will be carried out on the following types of equipment based on the site conditions for both dams.

One end travelling cable crane
Travelling jib crane
Crawler crane
Concrete pump

a) One End Travelling Cable Crane

Since both sides of the check dam site are flat, only the one end travelling type of cable crane proves to be practicable. Even if the one end travelling cable crane is used, it will be necessary for the steel towers on both banks to have respective heights of 40 m on the right bank and 30 m on the left bank. It is still possible to use a cable despite the expected span between the steel towers being 540 m.

The merit of using a cable crane lies in the fact that the installation of any machinery/equipment on the riverbed is unnecessary as the conveyance of concrete buckets will be done by the aerial transport system and that the crane system will not be directly affected by harmful lahar effects.

When it is diverted for the Pronojiwo dam work, it could prove quite useful as the span at the dam site will be 400 m and both banks form gentle slopes.

b) Travelling Jib Crane

Although there is a fixed type of jib crane, three of the biggest models available in Japan, with the longest work radius of 75 m, would be required to cover the prospective crown length of the check dam at 438 m.

If the travelling type is used, only one crane will be sufficient. In addition, the topography of the dam site is favourable for the use of the travelling jib crane in that the height of the trestle gutter, which is indispensable for moving the crane, is sufficient at 5 m. However, only 180 m of the original 400 m long gutter, used for the check dam, will be converted for use at the Pronojiwo dam site.

Although the low trestle height constitutes a merit for the travelling jib crane, it has a higher possibility of being affected by harmful lahar effects. It is, therefore, a vulnerable facility against the phenomena of lahar which characterizes the construction area.

c) Crawler Crane

The crawler crane is practicable in the sense that it does not require any temporary structure on the riverbed, however, its work performance is inferior to those cranes mentioned above. It is unsuitable for the entire construction of the dam since it will require staging to be operated in areas other than near the riverbed when the progress of the ground excavation work for the dam results in a larger working radius. Meanwhile, dam construction work always requires suspended transportation of materials

in regard to concrete placing. In the light of this, the highly mobile crawler crane is the most preferable for the suspended transportation of the gravel used for the masonry concrete and also for the concrete placing work in places not covered by the main crane.

d) Concrete Pump

The concrete placing performance of the concrete pump is better than any of the equipment mentioned so far, but it requires staging over the entire width of the river. It is not, therefore, an adequate equipment against lahar.

Based on the above study, the main equipment and sub equipment for concrete placing will be the one end travelling cable crane and the crawler crane respectively.

The location of the cable crane is shown in Fig.-2.1 and Fig.-2.2. The concrete volume, which the cable crane cannot cover, will be 8,200 m^3 for the check dam and 7,000 m^3 for the Pronojiwo dam, which will be dealt with by the crawler crane.

(2) Decision on the Capacity of the Placing Equipment

The capacity of the concrete bucket, which is to be used in connection with the one end travelling cable crane and the crawler crane, must be calculated.

a) Placing Work by Average Performance

As mentioned before, the average placing volume is 20 m^3/hr in masonry concrete equivalent, of which 11 m^3/hr will be transported by the bucket of the cable crane.

$$V_B = \frac{Qc.CM}{60.g} = \frac{11.5}{60 \times 0.8} = 1.15 \doteq 1.5 \text{ m}^3$$

Qc: Average placing volume 11 m^3/hr
Cm: Average cycle time 5 min
g : Coefficient of masonry concrete placing 0.8

b) Maximum Placing

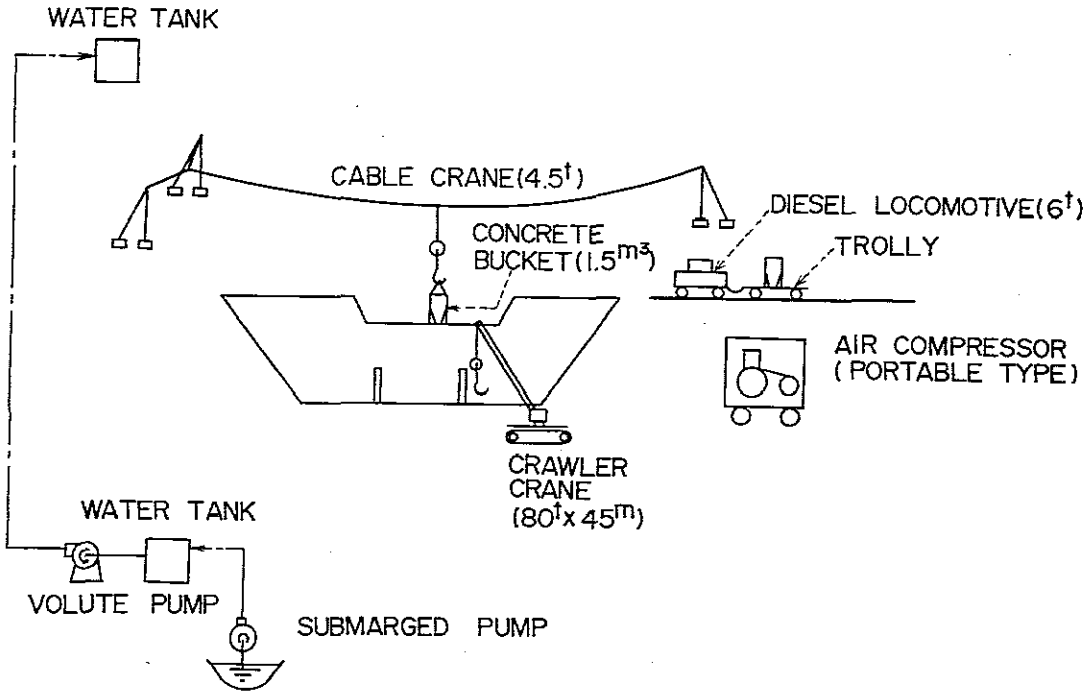
When the maximum placing volume is required, the value for Cm will be about 3.5 min. based on the above formula.

$$V_B = \frac{17 \times 3.5}{60 \times 0.8} = 1.24 \doteq 1.5 \text{ m}^3$$

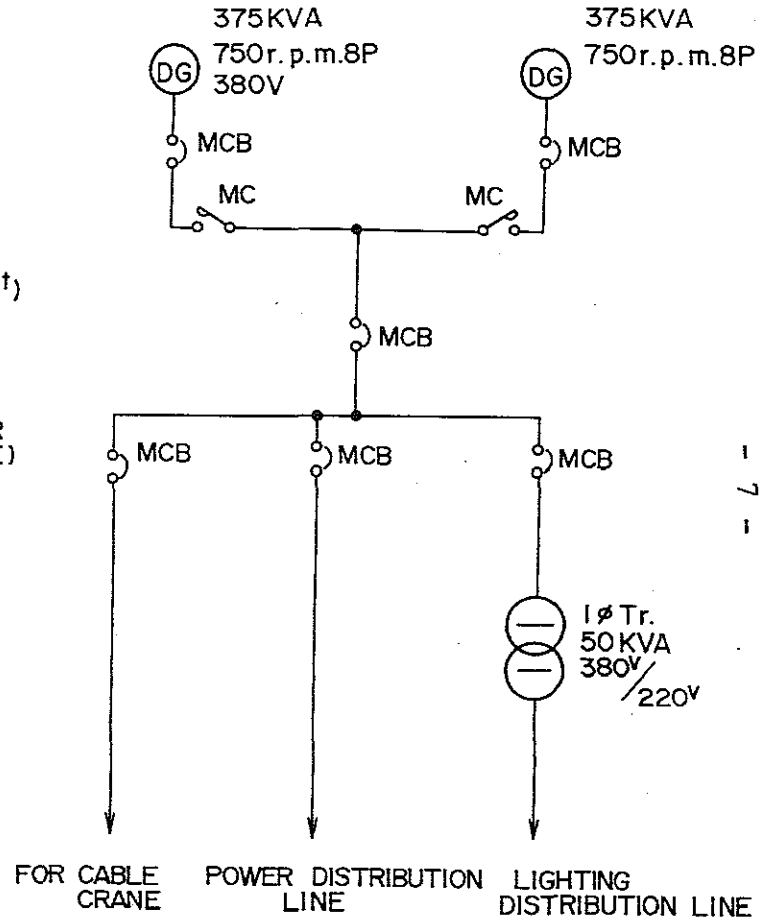
The capacity of the concrete bucket used for the cable crane will accordingly be 1.5 m^3, where the rated load of the crane will be of the 6t class.

When the crawler crane is used for the concrete placing, a bucket of the same size will be used. In addition, the suspended transportation of stones will employ a bucket of the same size (1.5 m^3) which will release the stones onto the placing location.

Fig.-2.3 shows the flow diagramme of the placing equipment.



FLOW DIAGRAM
FOR
DAM SITE



ONE-LINE DIAGRAM
FOR
DAM SITE

Fig-2 .3 Flow Diagram of Concrete Placing Equipment

2.3 Concrete Placing Schedule

The required number of months (M) is calculated according to the following formula based on the concrete placing performance.

$$M = \frac{Vp}{Qc.t.d}$$

	Check Dam No.6	Pronojiwo Dam
Plain concrete equivalent (Vp)	67,000 m^3	27,800
Average placing volume (Qc)	$^{3/hr}_{11\ m}$	11
Placing hours per day (t)	10 hrs	10
Placing days per month (d)	20 days	20
Required months	30.5 months	12.6

3. CONCRETE BATCHING FACILITIES

3.1 Concrete Plant

Two mixers, each with a capacity of 0.75 m^3, will be required as the capacity of the concrete bucket used for the cable crane is 1.5 m^3.

The margin of the concrete batching capacity (Qm) of the concrete plant by itself against the placing volume is examined below.

(1) Standard Capacity (Qm)

$$Qm = \frac{60.Vm}{Cm} = \frac{60.1.5}{3} = 30\ m^3/hr$$

Vm: Mixer capacity 1.5 m^3
Cm: Standard cycle time 3 min.

(2) The Margin of the Concrete Plant

The planned placing volume of the cable crane is as follows:

Average	11 m^3/hr
Maximum	17 m^3/hr

However, the maximum capacity of the cable crane is 30 m^3/hr. Therefore, the margin of the concrete plant is as follows:

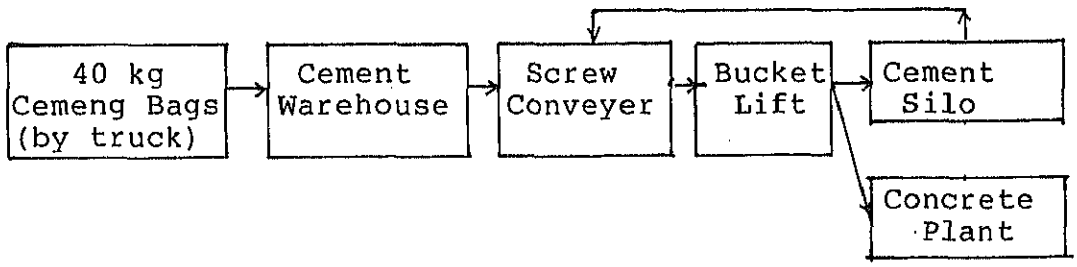
$$\text{Planned placing (average)} = \frac{30}{11} = 2.7$$

$$\text{Planned placing (maximum)} = \frac{30}{17} = 1.8$$

$$\text{Maximum crane capacity} = \frac{30}{30} = 1.0$$

3.2 Cement Supply and Storage Facilities

(1) Flow Diagramme for Cement



(2) Cement Supply Capacity (Qc)

$$Qc = \frac{Qm.}{g} = \frac{30 \times 0.225}{0.7} = 9.6 \doteq 10^t/hr$$

Qm:	Concrete batching capacity	30 m^3/hr
:	Unit cement volume used	0.225 t/m^3
g :	Performance coefficient	0.7

(3) Cement Silo Capacity

The storage volume of cement shall be 5 days equivalent for the planned maximum placing volume.

$$Vc = Qc.t.\ d = 17 \times 10 \times 0.225 \times 5 = 191.3^{t}$$

Qc: Concrete placing volume 17 m/hr
t : Placing hours per day 10 hrs
d : 5 days equivalent

Therefore, the storage capacity of the silo will be 200 t.

3.3 Sites of Concrete Batching Facilities

In view of the necessity to supply concrete to the check dam, Pronojiwo dam and others, the centralized plant system will be employed. The plant, therefore, along with the aggregate plant, will be built at the upper stream of the K. Liprak standpocket. The flow diagramme for the concrete batching facilities is shown in Fig.-3.1 and Fig.-3.2.

4. TRANSPORTATION OF CONCRETE

4.1 Transportation System

The concrete, which is manufactured by the concrete plant, will be transported to the banker line (or bucket yard) of the check dam, the Pronojiwo dam and others by truck mixers.

The capacity of the truck mixer will be of the 3 m^3 class to increase the efficiency of transportation although the capacity of the concrete bucket is 1.5 m^3.

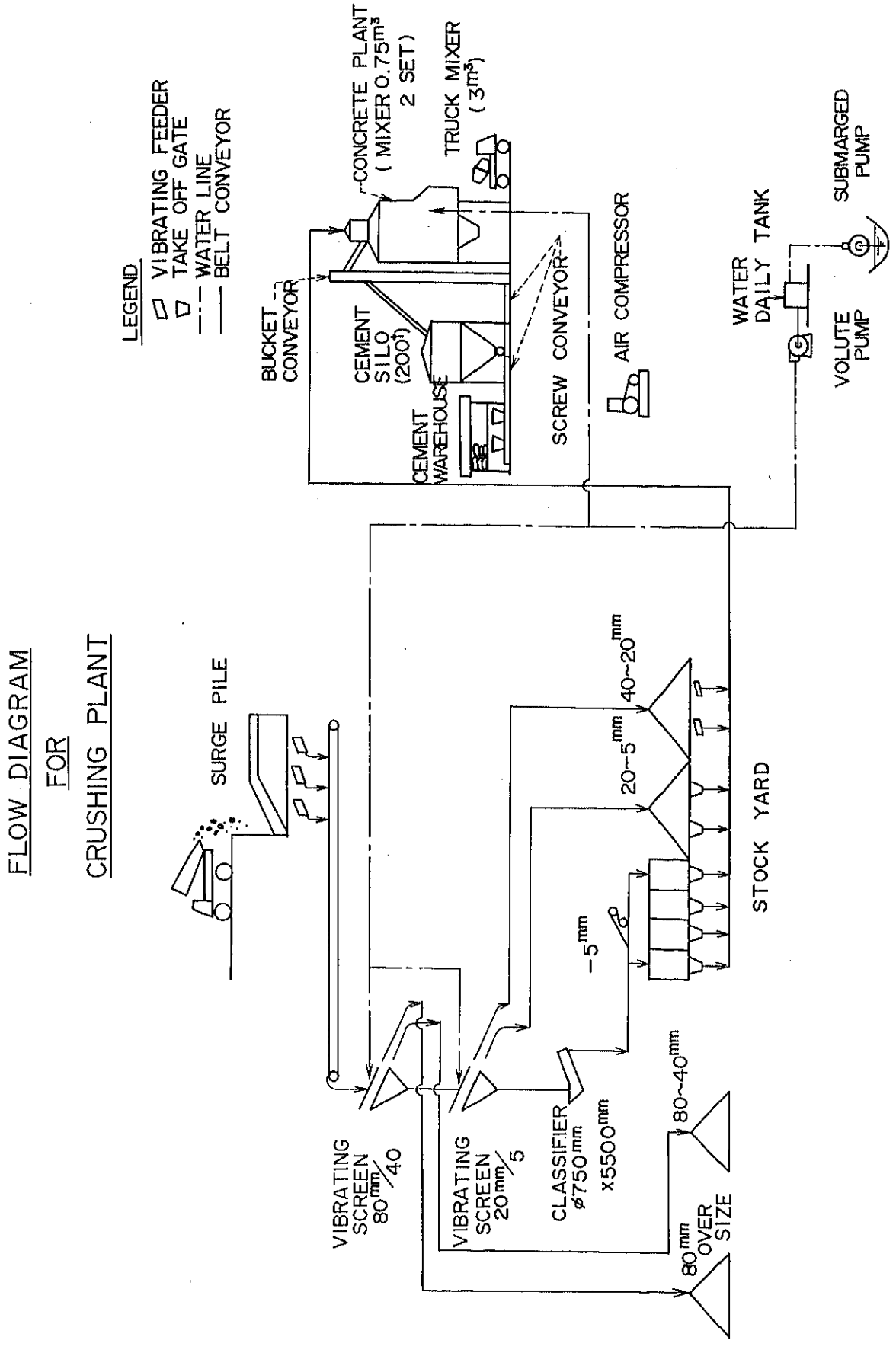


Fig-3.1 Flow Diagram of Concrete Batching Facilities

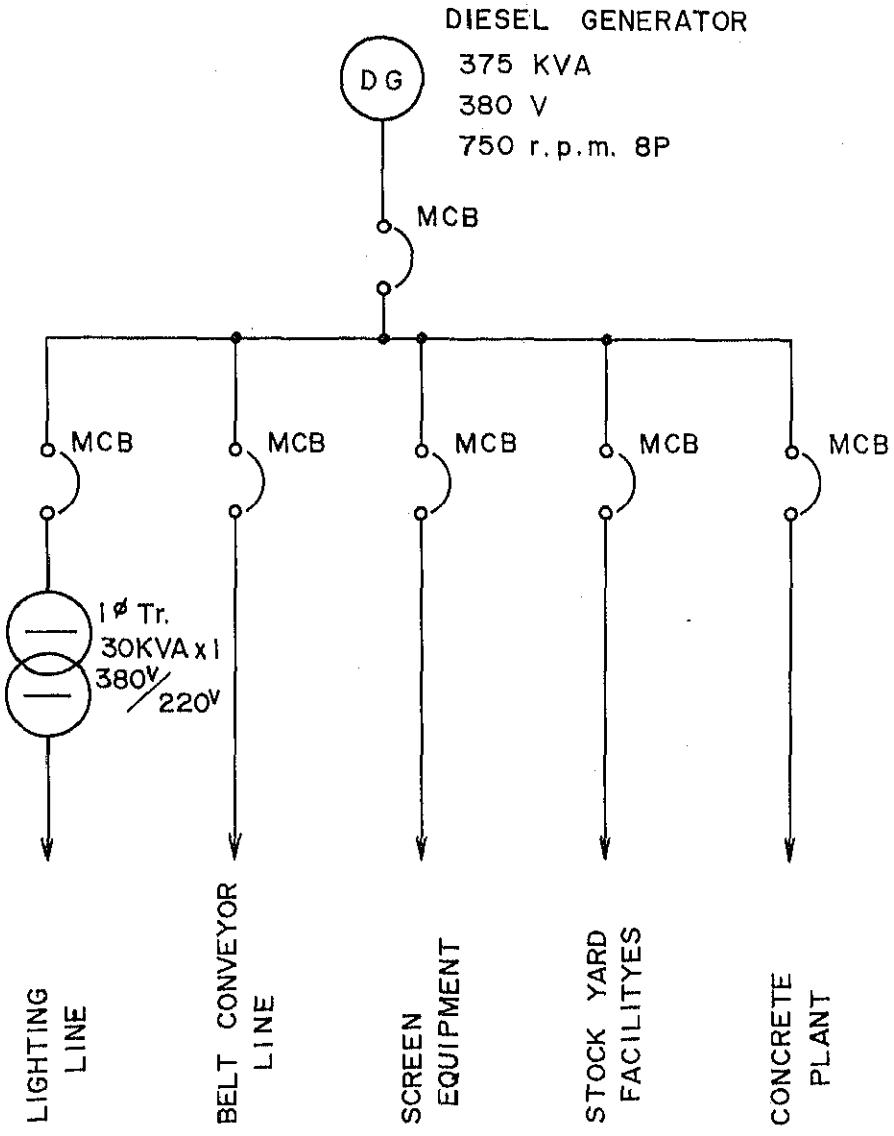


FIG.3.2 ONE-LINE DIAGRAM FOR CRUSHING PLANT

4.2 Required Number of Truck Mixers

There will be a difference in the required number of truck mixers as the transportation distance to the check dam is 13.3 Km while the distance to the Pronojiwo dam is 21 Km.

The required number of truck mixers will be given by the following formula:

$$N = \frac{Qc}{Qt}$$

$$Qt = \frac{60.g.E}{Cm}$$

Qc:	Maximum concrete placing volume	17 m/hr
Qt:	Truck mixer performance	(m^3/hr)
g :	Truck mixer capacity	3 m^3
E :	Coefficient of work	0.8
Cm:	Cycle time	(min.)

$$Cm = t_1 = t_2 = \frac{L}{V_2} = \frac{L}{V_2}$$

t_1:	Loading time	7 min.
t_2:	Unloading time for bucket	4 min.
L :	13.3 Km and 21 Km	
V_1:	Driving speed outward	0.5 Km/min.
V_2:	Driving speed inward	0.67 Km/min.

	Check Dam No.6	Pronojiwo Dam
Transportation distance (L)	13.3 Km	21.0
Cycle time (cm)	57.5 min.	84.3
Truck mixer performance (Qt)	2.5 m^3/hr	1.7
Required number of trucks (N)	6.8 - 7	10

As a result, three additional truck mixers will be required for the Pronojiwo dam construction.

The following are the countermeasures for this situation.

(1) The value of the concrete placing volume at 17 m^3/hr is the maximum value. It is used as there will be a large fluctuation of the actual placing performance as the length of the check dam is as long as 438 m.

(2) In comparison, the length of the Pronojiwo dam is relatively short at 230 m and the overall size of the dam is smaller than the check dam. Therefore, if the placing plan is based on the average placing volume of 11 m^3/hr, the required number of truck mixers will be 7.

(3) In the case of the Pronojiwo dam, three spare buckets will be provided at the bucket yard so that there will be no waiting for the truck mixers. In this way, the lower performance of the actual concrete placing work will not affect the transportation perofrmance of the truck mixers.

If these measures are taken, 7 truck mixers will suffice to carry out the required transportation work.

5. AGGREGATE QUARRYING, PRODUCTION AND STORAGE FACILITIES

5.1 Aggregate Production Schedule

(1) Conditions for Concrete Placing

Average placing volume per day	110 m^3
Maximum placing volume per day	170 m^3
Average placing days per month	20 days
Average placing volume per month	2,200 m^3
Concrete volume for check dam	73,000 m^3
Concrete volume for Pronojiwo dam	27,800 m^3

(2) Conditions for Aggregate Production

Total working days per year	240 days
Average working days per month	20 days
Average working hours per day	7 hours

When there is a necessity to meet the maximum placing requirement, the hours of operation of the aggregate stock yard will be extended on that day.

(3) Calculation of Production Capacity (Qa)

$$Qa = \frac{Qc.\gamma.\alpha}{t} = \frac{110 \times 2.2 \times 1.15}{7} = 40 \text{ t/hr}$$

Qc:	Average placing volume per day	110 m^3
γ :	Unit aggregate volume	2.2 t/m^3
α :	Supply fluctuation coefficient	1.15
t:	Average working hours per day	7 hrs.

(1) Composition of Concrete

Concrete used most often is masonry concrete. However, all the figures used here are plain concrete equivalents. The composition of concrete will, therefore, be the one which is generally used for Sabo dams.

40 - 20 mm	20 - 5 mm	Under 5 mm	Total
33%	33%	34%	100%
726 Kg/m^3	726	748	2,200 Kg/m^3

5.2 Aggregate Quarrying Schedule

(1) Judgement Given by Study on Aggregate

The study on aggregate at 9 locations, including riverbed deposits of the K. Rejali and K. Mujur, showed that only the grain size of these two locations would meet the

aggregate requirements. The grain size distribution of the riverbed deposit is shown in Fig.-5.1. However, the K. Mujur was dropped due to the long transportation distance and it was decided that the riverbed deposits of the K. Rejali would be used.

(2) It apperas that the aggregate deposits at the K. Rejali can be used by simply removing oversize (more than 40 mm) gravel. If we are to ignore scattering large rocks, the crushing operation of oversize gravel may be unnecessary. However, a detailed study should be made before the actual work schedule is planned.

(a) Average Value of the Grain Size Test

Over 80mm	80 - 40mm	40 - 20mm	20 - 5mm	Under 5 mm
13.5%	22.0	18.0	15.2	31.3

(b) Grain Size for the Composition of Concrete

40 - 20mm	20 - 5mm	Under 5mm
33%	33%	34%

(c) The actual utilization plan is made based on these two tables shown in (a) and (b).

Gravel over 40 mm (35.5%) will be removed and counted as a loss.

Some 5% of the gravel under 5 mm is the size of under 0.15 mm (under silt size) and 2.5% will be counted as a loss as it will be washed away.

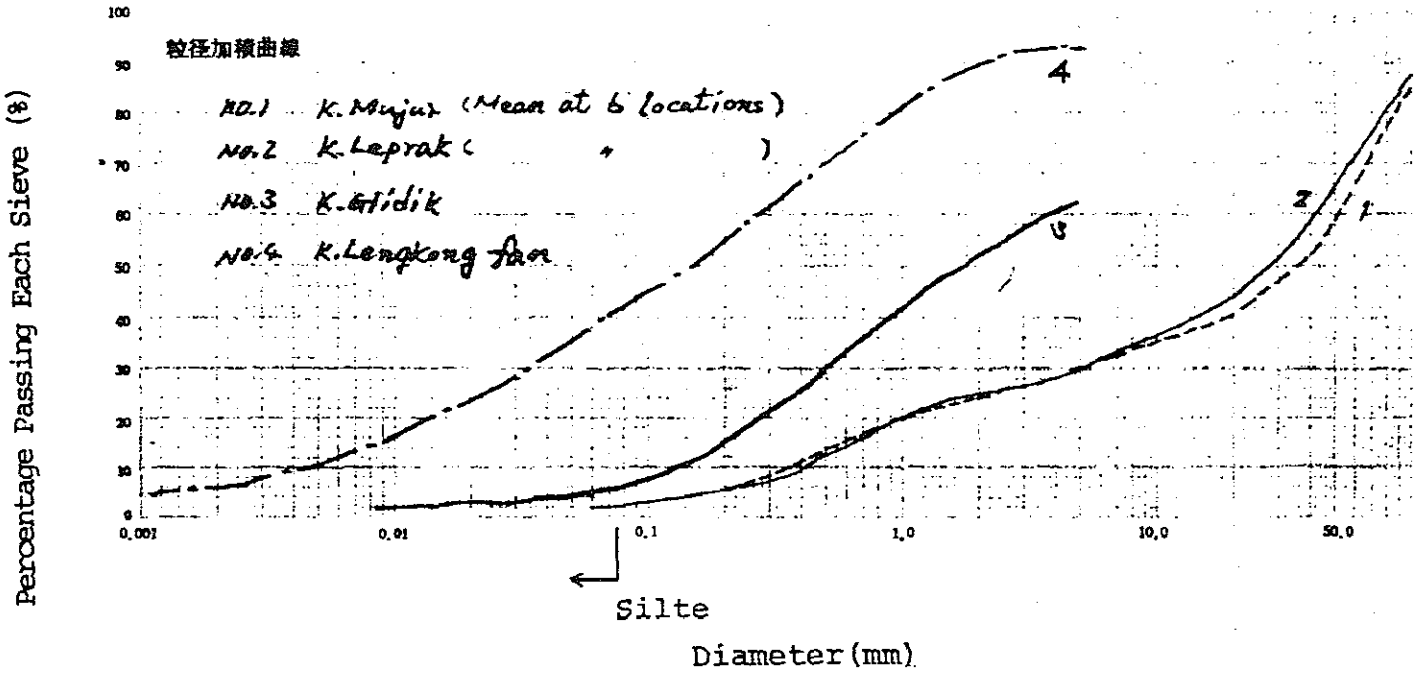


Fig-5.1 Grain Size Distribution Curve

The revised grain size distribution of the deposit after washing and screening is as follows:

40 - 20mm	20 - 5mm	Under 5mm	Total
18%	15.2%	28.8%	62.0%

Their respective percentages as a final product will be as follows:

40 - 20mm	20 - 5mm	Under 5mm	Total
29%	24.5%	46.5%	100%

Coarse Aggregate Only:

54.2%	45.8%

There is slightly more gravel at the size of 40-20 mm than of 20-5mm, but this deviation is within the standard requirement.

(3) Quarried Volume and Loss of Aggregate

(a) Quarried Volume

Over 40 mm	Under 5 mm	Total Loss
38.0%	35.5%	2.5%

The aggregate production volume, which will meet the average concrete placing volume per day at 110 m^3, is 40 t/hr and therefore, the necessary quarried volume (Qe) including the loss will be:

$$Qe = \frac{Qa}{(1 - 0.38)} = \frac{40}{0.62} = 64.5 \text{ t/hr}$$

Qa: Production Volume 40 t/hr

(b) Loss (Q_l)

$$Q_l = Qe - Qa = 64.5 - 40 = 24.5 \text{ t/hr}$$

(c) Table for the Aggregate Production

	Check Dam No.6	Pronojiwo Dam
Concrete volume	73,000 m^3	27,800
Aggregate volume used (Produced)	161,000 t	61,200
Aggregate volume quarried	260,000 t	99,000
Aggregate volume lost	99,000 t	37,800

(d) Utilization of Stones

Oversize stones at over 80 mm may be used as stones for masonry concrete. If this is the case, since stones at over 80 mm occupy 13.5% of all gravel, the utilized volume will be as follows:

Check Dam:	30,100 t
Pronojiwo Dam:	13,400 t
Total:	48,500 t

(4) Quarrying and Transportation Plan

Quarrying willbe around the sand pocket of the K. Liprak and will be done using a tractor shovel. The aggregate will then be loaded to dump trucks and transported to the stockyard of the aggregate plant at the upper stream.

(a) Tractor Shovel

The capacity of the tractor shovel (gm^3), which meets the required supply (Qe) at 64.5 t/hr for the aggregate plant, is as follows:

$$g = \frac{Qe.cm}{3,600.E} = \frac{64.5 \times 46}{3,600 \times 0.55} = 1.5\ m^3$$

cm: Cycle time 46 sec.
E : Work coefficient 0.55
g : Loading volume per cycle m^3

The size of the tractor shovel will, therefore, be one with a capacity of 2 m^3 class.

(b) Dump Truck

Although the places of quarrying extend over a wide area, the transportation distance is given as an average of 2.5 Km so that the required number of 11 ton capacity dump trucks can be calculated.

$$Qt = \frac{60.g.E}{cm} =$$

$$cm = \frac{6 \times 2{,}500}{1{,}000} + 13 = 28 \text{ min.}$$

g: 11 tons

E: Work coefficient 0.6

$$Qt = \frac{60 \times 11 \times 0.6}{28} = 14.1 \text{ t/hr}$$

$$N = \frac{Qe}{Qt} = \frac{64.5}{14.1} = 4.6 \fallingdotseq 5 \text{ (trucks)}$$

5.3 Aggregate Plant and Stockyard

(1) Aggregate Plant

At this stage, it is assumed that the required aggregate can be collected by only screening and washing the aggregate material. Therefore, crushing facilities and sand producing facilities are unnecessary.

The supply volume of aggregate material to the aggregate plant is 64.5 t/hr and the production volume is 40 t/hr.

The aggregate plant will consist of the following machinery.

(a)	Vibrating Screen (W Deck Type)	1
	1.2 m x 3.0 m (Sieve Opening 80 mm and 40 mm)	7.5 KW
(b)	Vibrating Screen (W Deck Type)	1
	1.5 m x 3.0 m (Sieve Opening 20 mm and 5 mm)	7.5 KW
(c)	Classifyer	1
	ø 0.75 m x 5.5 m	3.7 KW
(d)	Belt Conveyer	1 set
	750 mm x 70 m	11 KW
	600 mm x 120 m	13 KW
	450 mm x 120 m	12 KW

(2) Stockyard

The primary stockyard will be of a size to store five day's equivalent of quarried and transported aggregate. The product stockyard will also be of a size to store 5 day's equivalent of each of selected products, i.e. 40-20 mm, 20-5 mm and under 5 mm (sand).

Withdrawal from the stockyard will be done through the closed conduit and the aggregate will be transported to the screening plant and the concrete plant by conveyer belts.

With regard to the aggregate over 80 mm and 40-80 mm in size, it will be taken out by a loader and dump trucks whenever appropriate volumes have been stored.

6. VENTILATION AND WATER SUPPLY FACILITIES

6.1 Ventilation Facilities

(1) At the Centre Plant

Locations where ventilation facilities are required are the aggregate plant and the concrete plant. The actual location of the ventilation facility will be at the withdrawal gate of the aggregate product stockyard and the concrete plant. A mobile portable air-compressor will meet the requirement.

Air compressor (Portable type)	1
Ventilation capacity	5 m^3/min.

(2) At the Dam Sites

The excavation work is mostly done by the ripping operation using bulldozers. Therefore, ventilation will only be needed for cleaning of the base rock and for the concrete buckets.

A portable type of air compressor will be used in view of its use at two dam sites and will minimize piping at the construction sites.

Air compressor (Portable type)	1
Ventilation capacity	7 m^3/min.

6.2 Water Supply Facility

(1) At the Centre Plant

2.5 m^3/min. of water intake is planned to be stored at a reservoir, and will then be pumped upto the water tank to be used as washing water for the aggregate and mixing water for the concrete.

Water will be first stored at the reservoir to settle any elements of pollution so that the pollution of the river water can be avoided.

Water pump ø 125 mm 1.5 m^3/min.	2 37 KW
Centrifugal pump ø 100 mm 1.5 m^3/min.	37 KW
Water tank 60 m^3	2

(2) At the Dam Sites

Water supply facilities as the same at centre plant are planned to use as washing water and recuperation of the base rock.

Water pump ø 125 mm 1.5 m^3/min.	2 37 KW
Centrifugal pump ø 100 mm 1.5 m^3/min.	37 KW
Water tank 60 m^3	2

7. POWER FACILITY

The total requirement for power capacity at the centre plant area and the dam site is given as follows:

Centre plant area	380 V	240 KW
Dam site	380 V	450 KW

It appears to be inadequate to set up the power facility to receive this amount of power when the distance is considered and the power shall be independently generated by setting up generators at each location.

7.1 Centre Plant Area

(1) Diesel Generator 1

375 KVA 380 V

(2) Transformer 1

1ø 30 KVA

(3) Control Unit and Power Distribution Unit 1 set

7.2 Dam Site

(1) Diesel Generator 2

375 KVA 380 V

(2) Transformer 1

1ø 380 V

(3) Power Distribution Unit 1

7.3 Power Distribution Diagramme

The diagramme is shown in the attached paper.

The price list includes the facilities referred to in the above plan and the flow sheet indicates the flow of work.

8. COST ESTIMATE OF AGGREGATE PRODUCTION, CONCRETE BATCHING AND CONCRETE PLACING

The calculation of the direct construction cost for the B. Kobo'an check dam No.6 and the Pronojiwo dam is shown in Table-8.1, -8.2 and -8.3.

Equipment hire cost consists of depreciation cost, repair cost and administrative cost. The administrative cost consists of tax, insurance and stock cost and is excluded from the economic cost. The economic cost includes the result of the interest rate (19%) on the opportunity cost.

Depreciation cost = 0.9 x A
Repair cost = 0.5 x A
Administrative cost = 0.4 x A

A = Purchase cost

Therefore, the economic cost for equipment hire is shown in the following formula:

$$\text{(Equipment Hire Cost)} \times \frac{0.9 + 0.5}{0.9 + 0.5 + 0.4} \times 1.19$$

= (Equipment Hire Cost x 0.926

Table-8.1

Item	Volume	Direct Construction Cost (10^3 Rp)			Remarks
		Total	B. Kobo'an Check Dam	Pronojiwo Dam	
I. Aggregate plant related (Screening method)	Production volume	222,200t	161,000t	61,200t	Production capacity = 40 t/h
(1) Plant foundation excavation	500 m^3	870 (470)	650 (350)	220 (120)	
(2) Plant foundation concrete placing	400 m^3	25,692 (22,810)	19,193 (17,040)	6,499 (5,770)	
(3) Transportation and installation of equipments	420 t	588,000 (588,000)	439,271 (439,271)	148,729 (148,729)	
(4) Equipment hire cost	( )	0 (986,100)	0 (714,500)	0 (271,600)	Discount ratio 19%
(5) Quarrying and transportation of aggregate		64,216 (35,318)	46,529 (25,590)	17,687 (9,728)	$\frac{\text{Cost for common labor}}{\text{Cost for skilled labor}} = \frac{9}{1}$
(6) Plant operation		51,550 (43,820)	37,352 (31,750)	14,198 (12,070)	" $= \frac{3}{7}$
(7) Purchase of stones	1) 120,000 m^3 2) 33,000 m^3	474,300 (474,300)	372,000 (372,000)	102,300 (102,300)	Side wall is constructed with plain concrete
Sub-total		1,204,628 (2,150,818)	914,995 (1,600,501)	289,633 (550,317)	

Under: Financial cost for civil work
( ): Economic cost

Table-8.2

Item	Volume	Direct Construction Cost (10^3 Rp)			Remarks
		Total	B. Kobo'an Check Dam	Pronojiwo Dam	
II. Concrete related	Placing volume	100,800m	73,000m^3 (67,000 (6,000 (-8,200m^3: cable crane)	27,800m ^{3} (-7,000m^3 : cable crane)	Capacity of concrete placing = 11 m^3/h = 110 m^3/day
(1) Excavation for facilities and others	common 200m^3	348	252	96	
	1) 1,300m^3	(188)	(136)	(52)	
		2,262	2,262		
		(1,222)	(1,222)		
	2) 1,300m^3	2,262		2,262	
		(1,222)		(1,222)	
(2) Concrete placing for facilities	common 150m^3	9,635	6,978	2,657	
		(8,555)	(6,196)	(2,359)	
	1) 1,100m^3	70,625	70,653		
		(62,733)	(62,733)		
	2) 1,100m^3	70,625		70,653	
		(62,733)		(62,733)	
(3) Transportation and installation of equipments	common 130t	182,000	131,806	50,194	
		(182,000)	(131,806)	(50,194)	
	1) 420t	588,000	588,000		
		(588,000)	(588,000)		
	2) 420t	535,080		535,080	
		(535,080)		(535,080)	
(4) Equipment hire cost		0	0	0	
		(3,053,740)	(2,240,000)	(813,740)	

cont'd

Table-8.2 (cont'd)

Item	Volume	Direct Construction Cost (10^3 Rp)			Remarks
		Total	B. Kobo'an Check Dam	Pronojiwo Dam	
(5) Concrete mixing		78,725 (74,786)	57,013 (54,160)	21,712 (20,626)	$\frac{\text{Cost for common labor}}{\text{Cost for skilled labor}} = \frac{1}{9}$
(6) Concrete transportation		87,416 (86,542)	57,086 (56,515)	30,330 (30,027)	" $= \frac{1}{49}$
(7) Concrete placing		217,187 (211,760)	153,497 (149,660)	63,690 (62,100)	" $= \frac{1}{20}$
(8) Moulding boxes and recuperation	1) 27,200m^2 2) 10,800m^2	406,600 (337,467)	291,040 (241,563)	115,560 (95,904)	Unit price Rp 10,700/m^2 (7,870/m^2)
Sub-Total		2,250,821 (5,206,028)	1,358,587 (3,531,991)	892,234 (1,674,037)	

Upper: Financial cost for civil work
( ): Economic cost

Table-8.3

Item	Volume	Direct Construction Cost (10^3 Rp)			Remarks
		Total	B. Kobo'an Check Dam	Pronojiwo Dam	
III. Cement	1) 16,425t 2) 6,255t	1,842,750 (1,842,750)	1,334,531 (1,334,531)	508,219 (508,219)	Required cement = 0.225 t/m^3
Cost price for the concrete dam construction Total					
Financial cost for civil work		5,298,199	3,608,113	1,690,086	
Economic cost		9,199,596	6,467,023	2,732,573	
Foreign currency portion in economic cost		4,039,840	2,954,500	1,085,340	

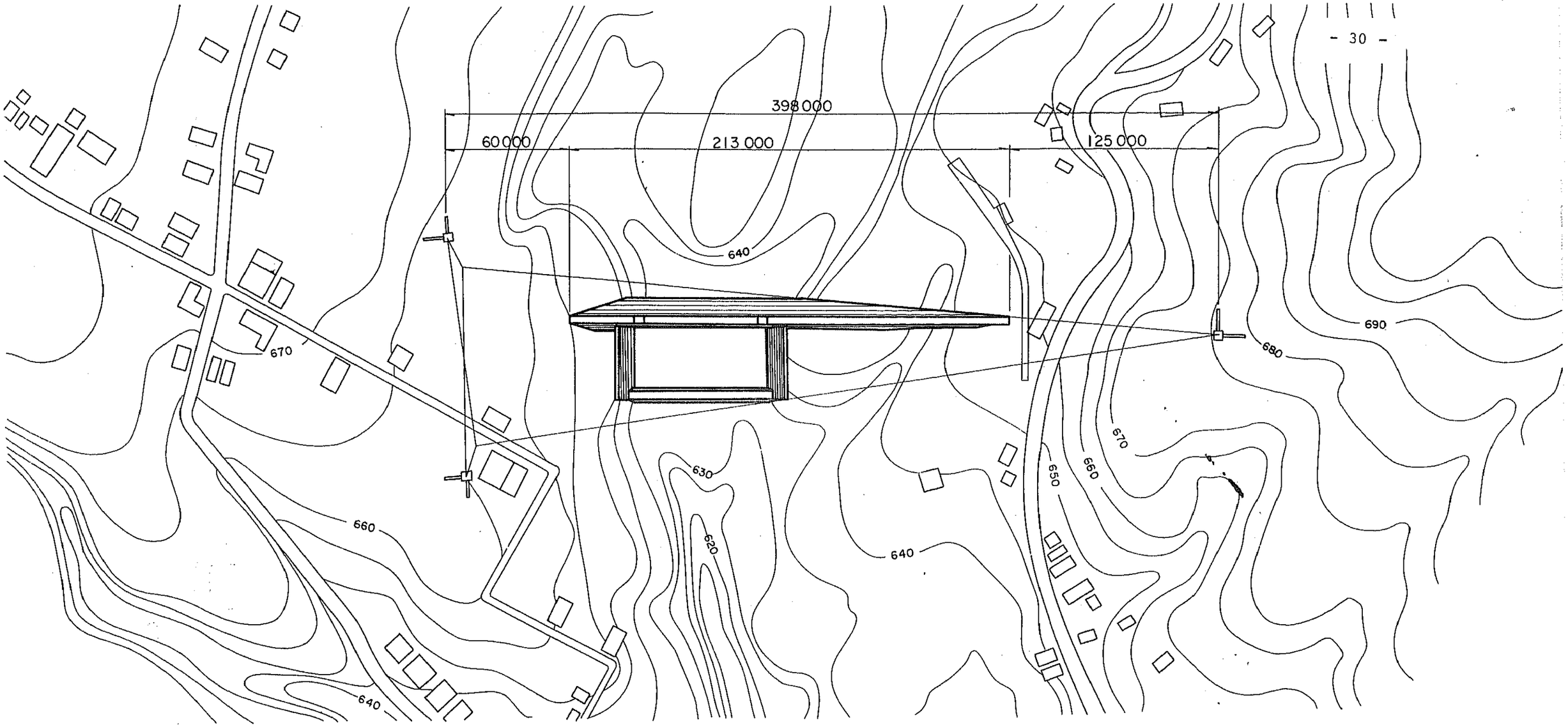


Fig – 2.1 Cable crane at the Pronojiwo dam site

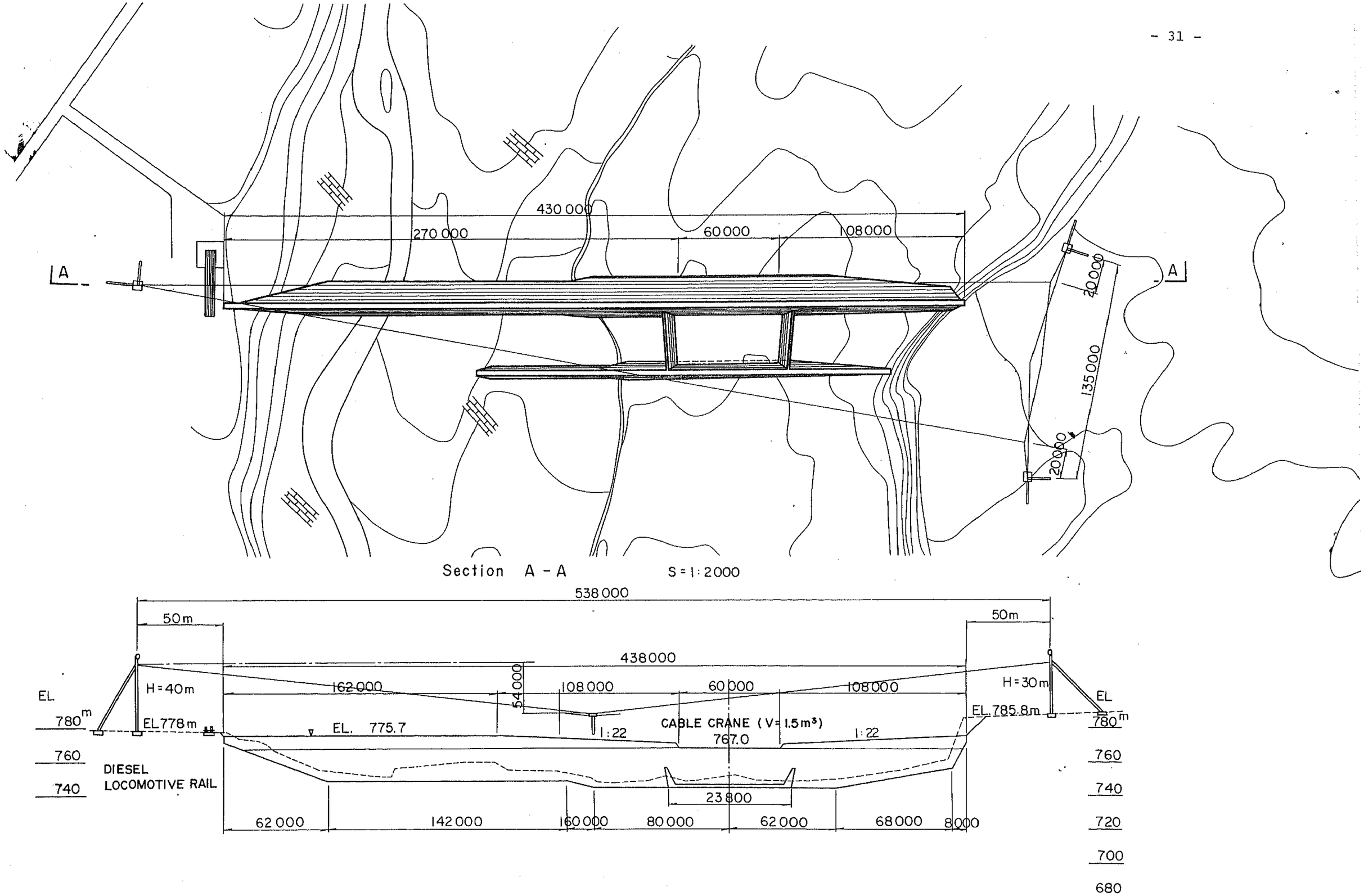


Fig - 2.2 Cable crane at the BS. Koboan check dam-6 site

APPENDIX - 7

Direct Construction Cost

Work Item		Quantity									Direct construction cost (10^6 Rp)		
		Excavation (m^3)		Embankment (m^3)		Concrete (m^3)	Masonry concrete (m^3)	Gabion work (m^3)	Rock cleaning (m^3)	Steel basket (m^3)	Financial cost (excluding equipment purchase cost)	Economic cost	
		By man-power	By machine	By man-power	By machine							Total	Foreign currency
Unit cost	Financial	Rp1,740	Rp310 (550)	Rp760	Rp170 (260)	Rp64,230	Rp22,780	Rp12,210	Rp3,041 (320)	Rp31,890 (25,800)			
	Economic	Rp 940	Rp860	Rp410	Rp430	Rp57,030	Rp20,400	Rp11,000	Rp2,480	Rp30,700			
Curah Kobo'an	CHD-7	2,300	20,600	2,300	20,600	40,200					2,598	2,322	17
"	CHD-6	6,900	61,800			121,100 1)					3,639	6,527	2,989
"	CHD-5	1,000	9,400				18,300				422	382	5
"	CHD-4	1,700	15,700		62,600	36,700					2,376	2,135	25
"	CHD-3	300	3,300				6,300				145	0	0
Diversion Channel			566,000 3)				2,400 3)	7,300 3)			960	1,894	966
K. Lengkong	CHD-7	400	3,300	1,900	17,700		6,500				154	144	8
"	CHD-8	2,400	21,900			42,700 2)			5,600		1,718	2,768	1,098
Curah Lengkong	CHD-1	200	1,500				3,100				71	65	1
"	CHD-2	600	5,100				10,000				230	209	3
Leprak Sandpocket			154,600		154,600		14,300	15,000		43,000	1,954	1,976	1,235

Remarks

( ): *Foreign currency* portion in economic cost

Total excavation quantity

Excavation quantity by manpower = 0.1 V
Excavation quantity by machine = 0.9 V

1), 2) Refer to "Cost estimation of Curah Kobo'an dam and Pronojiwo dam."

1) Financial cost = Rp 3,608 x 10^6
Economic cost = 6,467 x 10^6
Foreign currency portion = Rp 2,955 x 10^6

2) Financial cost = Rp 1,690 x 10^6
Economic cost = Rp 2,733 x 10^6
Foreign currency portion = Rp 1,085 x 10^6

3) Refer to "Cost estimation of diversion channel."

1) Financial cost = Rp 960 x 10^6
Economic cost = Rp 1,894 x 10^6
Foreign currency portion = Rp 966 x 10^6

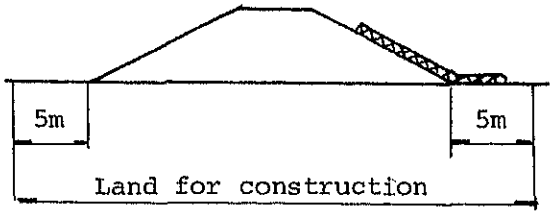
APPENDIX - 8

COST ESTIMATION OF LAND ACQUISITION

Cost Estimation of Land Acquisition Cost

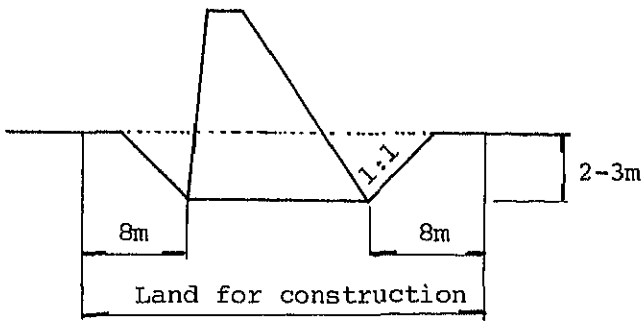
1. Definition of Land Acquisition

(1) For construction of dike



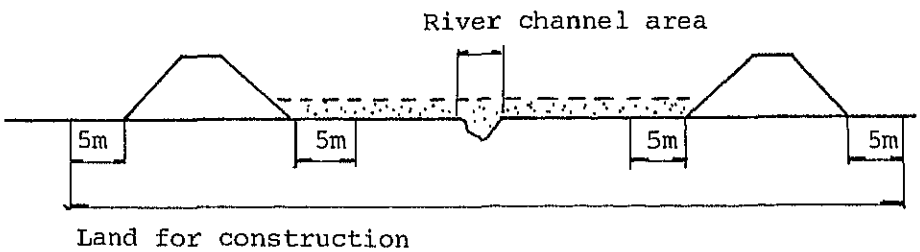
(2) For construction of dam

River channel area must be excluded.



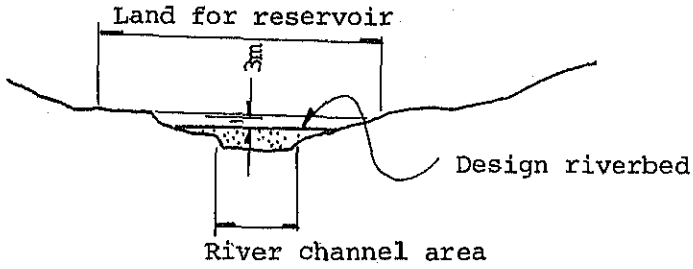
(3) For construction of sand pocket

River channel area must be excluded.

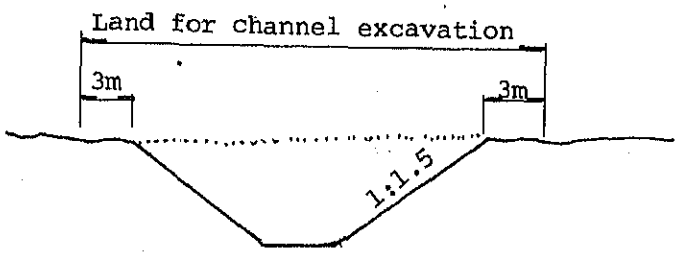


(4) For reservoir of dam

River channel area must be excluded.



(5) For channel excavation



2. Land Area for Construction

(1) Curah Kobo'an CHD-7

$$A_1 = \frac{1}{2} (39 + 19) \times 122 + 39 \times 58 - 58 \times 39 = 3,538 \text{ m}^2$$

(2) Curah Kobo'an CHD-6

$$A_2 = \frac{1}{2} (36 + 19) \times 298 + 36 \times 140 - 36 \times 176 = 6,899 \text{ m}^2$$

(3) Curah Kobo'an CHD-5

$$A_3 = \frac{1}{2} (29 + 19) \times 150 + 29 \times 86 - 29 \times 176 = 990 \text{ m}^2$$

(4) Curah Kobo'an CHD-4

$$A_4 = \frac{1}{2} (74 + 21) \times 23 + 74 \times 58 = 5,385 \text{ m}^2$$

(5) Curah Kobo'an CHD-3

$$A_5 = \frac{1}{2} (30 + 19) \times 21 + 37 \times 30 - 37 \times 30 = 515 \text{ m}^2$$

(6) Diversion Channel

$$A_6 = 6,000 + 6,500 + 2,500 + 217,000 = 232,000 \text{ m}^2$$

Breakdown of A_6

(6.1)	Pronojiwo dam	6,000 m^2
(6.2)	Glidik CHD-5	6,500 m^2
(6.3)	Glidik CHD-9	2,500 m^2
(6.4)	Channel and Reservoir	217,000 m^2

(7) Curah Lengkong CHD-1

$$A_7 = \frac{1}{2} (27 + 19) \times 31 + 20 \times 27 - 27 \times 15 = 848 \text{ m}^2$$

(8) Curah Lengkong CHD-2

$$A_8 = \frac{1}{2} (35 + 19) \times 40 + 18 \times 35 - 18 \times 35 = 1,080 \text{ m}^2$$

(9) Leprak sandpocket without right bank dike

$$A_9 = 24.6 \times 125 + 30 \times (700 + 60 + 100 + 170) - 10 \times (100 - 170) + 6.6 \times 870 + 50 \times (330 + 150 + 140) + 30 \times 746 + \frac{1}{2}(26 + 19) \times 143 + 30 \times (500 + 470 + 1,326)$$

$$= 157,534$$

Land acquisition cost for only construction area of dike

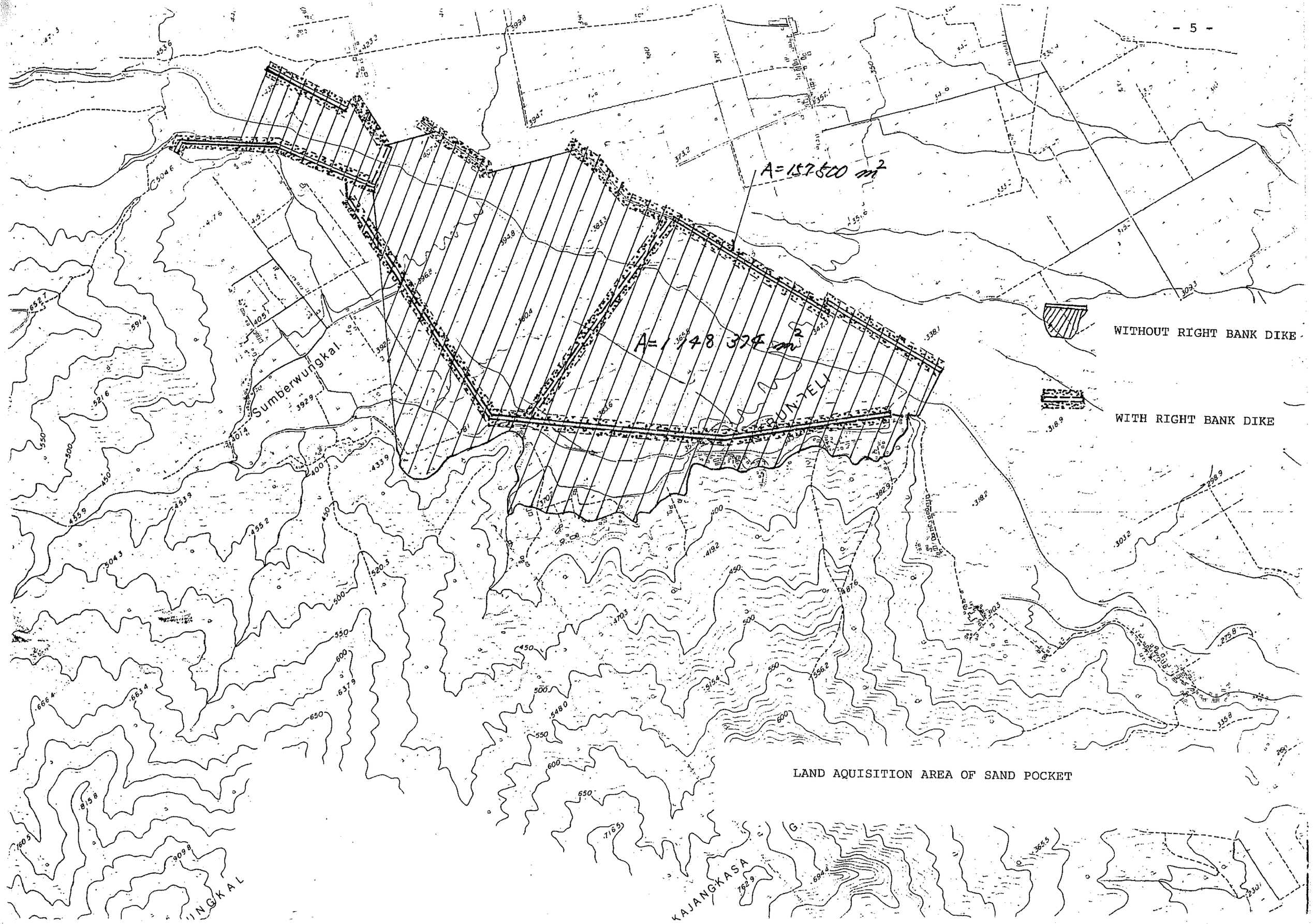
$$A_9 = 36.4 \times 300 + 38 \times 680 + 40.4 \times 200 + 35 \times 150 + 39 \times 400 + 34 \times 1,050 = 101,390 \text{ m}^2$$

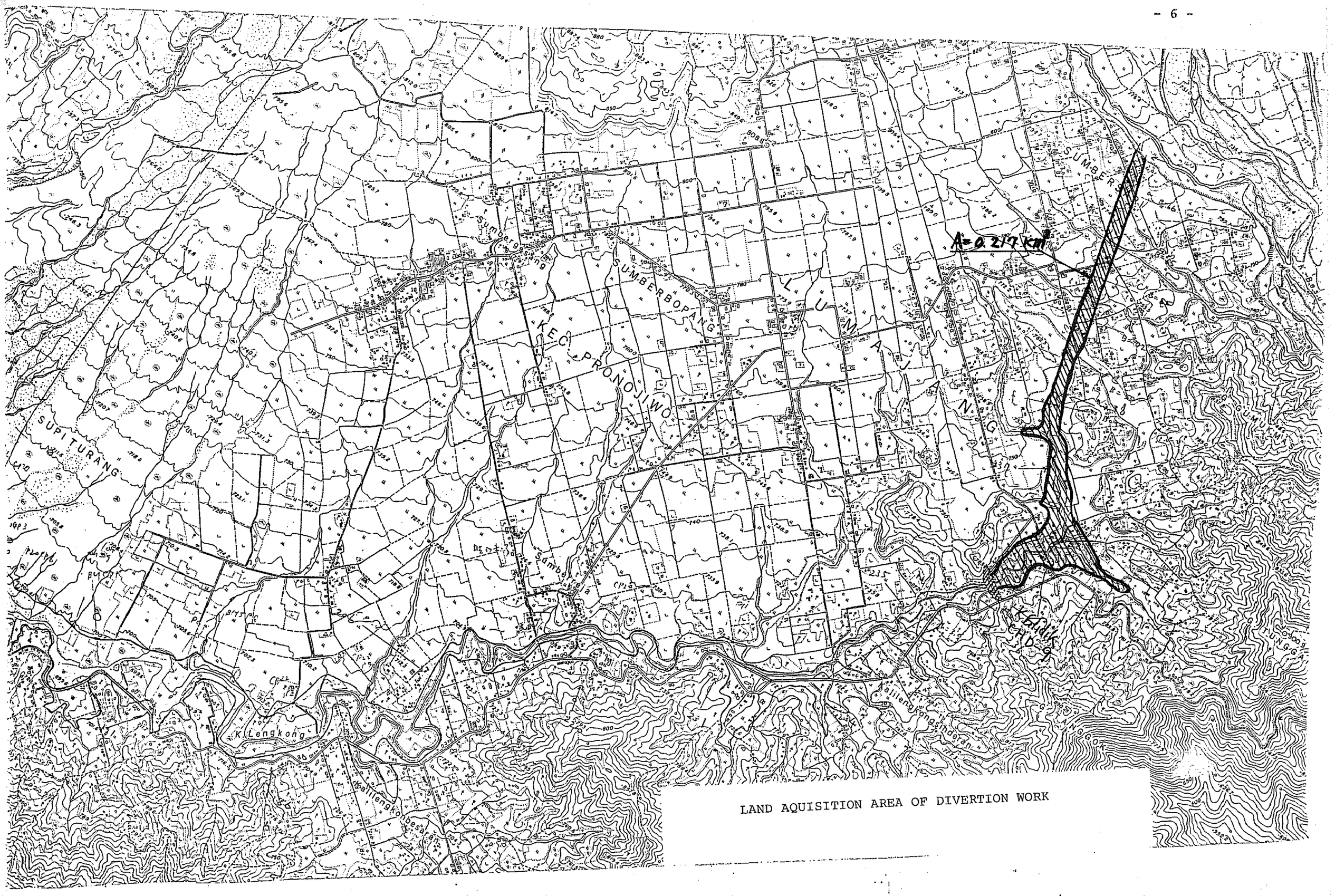
3. Land Acquisition Cost

Sabo Facilities	Item	Desa (m^2)	Paddy (m^2)	Coffee (m^2)	Sugar Cane (m^2)	Unculti-vated Land (m^2)	Total Cost
		Rp10,500	Rp390	Rp10,150	Rp390	Rp100	10^6Rp
1	3,500	200	2,200	100	100	900	4.10
2	6,900	400	4,400	200	200	1,800	8.20
3	1,000	60	640	20	30	250	1.12
4	5,400	300	3,500	100	200	1,300	5.74
5	500	30	320	10	20	120	0.56
6	1,340,000	77,700	857,600	26,800	40,200	337,700	1,471.78
6.1	6,000	350	3,840	120	180	1,510	6.61
6.2	6,500	380	4,160	130	200	1,630	7.07
6.3	2,500	140	1,600	50	80	630	2.70
6.4	217,000	12,890	138,880	4,340	6,510	54,380	241.54
7	800	50	500	20	20	210	0.95
8	1,100	60	700	20	30	290	1.15
9	101,390	5,880	64,890	2,030	3,050	25,540	111.40

Sabo facility No.1 Curah Kobo'an CHD-7
No.2 " CHD-6
No.3 " CHD-5
No.4 " CHD-4
No.5 " CHD-3
No.6 Diversion Channel
6.1 Pronojiwo dam
6.2 K. Lengkong CHD-6
6.3 K. Lengkong CHD-7
6.4 Channel and Reservoir
No.7 Curah Lengkong CHD-1
No.8 Curah Lengkong CHD-2
No.9 Leprak Sandpocket

*Desa Klopesawit: Desa = Rp 15,600/m^2
Sugar cane = Rp 690/m^2


A=157500 m²
A=1 148 374 m²
Sumberwungkal
KAJANGKASA
WITHOUT RIGHT BANK DIKE
WITH RIGHT BANK DIKE
LAND AQUISITION AREA OF SAND POCKET



LAND AQUISITION AREA OF DIVERTION WORK

APPENDIX - 9

Direct Cost for Irrigation

1. Work Item

Tunnel (ϕ = 2m) 430m

Cultivating is considered to be executed as the other project.

2. Direct Construction Cost

		Quantity	Direct Construction Cost (10^6 Rp)		
		Tunnel (m)	Financial Cost (excluding equipment purchase cost)	Economic Cost	
				Total	Foreign Portion
Unit Cost	Financial	541,600			
	Economic	446,000			
Intake and channel		430	233	192	25

Proportion of Economic Cost to Financial cost for intake and channel = Proportion of one for rock cleaning = 0.823