Northern Region Agricultural Extension Office

Under Director and Deputy Director, there are;

1) 16 subject matter specialists
2) 4 trainers
3) 4 office clerks
4) 19 permanent employees and
5) 6 temporary employees

Total 49 personnels

Kaset Changwat

See description 3.6.5.b)

Kaset Amphoe

1) Assistant chief is now vacant in 1981 August, in Amphoe Doi Saket. Home Economist, Youth activity and office clerk are posted under chief of Kaset Amphoe office.
About 500 young people participate in youth activity is in the case of Doi Saket.

2) In the case of office of Kaset Amphoe San Sai, under Kaset Amphoe, there are Deputy chief, Home economist and Youth activity and office clerk are posted.

3) Youth activity is almost equivalent to 4H activity of U.S.A. and called 4K is Thailand which means Ket (Head), Kamon (Heart), Korn (Hand) and Kai (Health).

Kaset Tambol

1) It is general rule that Kaset Tambol is trained about 2 months at Regional Agricultural Extension Office, just after assigned.

2) Kaset Tambol visits Contact Farmers at least once every two weeks for giving advices and training.

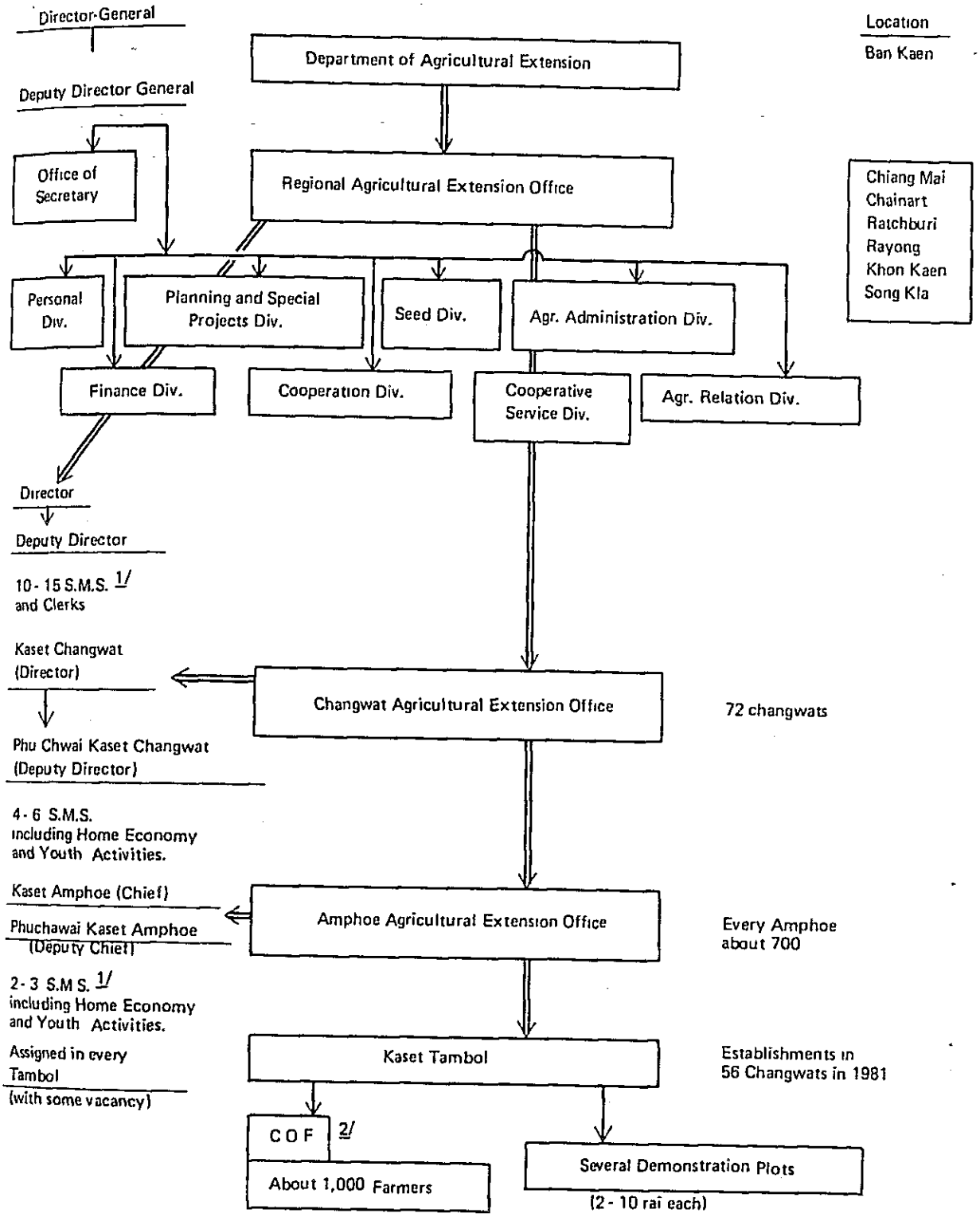
3) Kaset Tambol has a meeting every two weeks at office of Kaset Amphoe.

4) Officer of Kaset Changwat joins the second meeting of the month at Kaset Amphoe, and also farmers themselves can participate in the second meeting in the case of Changwat Chiang Mai. Second meeting is held jointly Amphoe San Sai, Mae Rim and Doi Saket. Meeting office is rotated Amphoe by Amphoe. Last Tuesday, Home economy and Youth activity meeting is held at Amphoe office.

5) Very few of Kaset Tambols have their own office, and then right now almost all Kaset Tambols are carrying out their office business at their own home. In case of Amphoe San Sai with 12 Tambol, only two Kaset Tambols have their own offices out of 11 assigned Kaset Tambols, and also in case of Doi Saket with 13 Tambols, only two Kaset Tambols here as well as Amphoe San Sai have their own offices out of 12 assigned Kaset Tambols.

6) Performance of works of Kaset Tambol is training and visiting system, transportation facility is necessarily needed. In the case of Amphoe San Sai, Moter-Cycle is available for Kaset Tambol with loan with 30 months repayment.

FIGURE F 4-1 AGRICULTURAL EXTENSION SYSTEM IN THAILAND



Remarks: 1/ Subject matter specialists.

2/ Contact Farmers: about 10% of farmers is settled from farmers under Jurisdiction of Kaset Tambol.

Agricultural Cooperative in Thailand

Cooperative movement in Thailand can be dated back to 1916 when the first cooperative was formed in rural area as village credit co-operative adopted along the German style, Raiffaisan line by the initiation of the Section of Statistics and Commerce in the Ministry of Commerce under the Government of King Rama VI. From that time onward, even after the change from monarchy to the constitution system, the promotion of the cooperative movement has been the task of the government of every era during which it passed through several phases of expansion, stagration, consolidation and revival. Under the reorganization taken place in 1972 finally merged together into a unified Department which is the present Cooperative Promotion Department under the Ministry of Agriculture and Cooperatives.

The Cooperatives Promotion Department is responsible for publishing and diseminating the principles and methods of cooperatives among the people by encouraging the establishment of cooperatives of all types with the objective to increase income and improve the standard of living their members.

i) Types of Cooperarives

At present, there are six types of registered cooperatives.

1. Agricultural Cooperatives
2. Fisheries Cooperatives
3. Land settlement Cooperatives
4. Consumers' Cooperatives
5. Services Cooperatives
6. Thrift and Credit Cooperarives

ii) Structure of Cooperatives

The Cooperatives in Thailand are now vertically organized at three levels; primary Cooperatives at local level, secondary Cooperatives at Changwat level and the apex Cooperatives at the national level.

1. Primary Agricultural Cooperatives

It is consists of individual farmers, usually divided into various groups of village or tambol level for training purpose, business activities or determination of proposals for forwarding to the board of directors. At the end of December 1978, those are 1,464 cooperatives of all types in the country.

2. Secondary Cooperatives

Three or more primaries can together form a secondary federation at Changwat level. These secondary cooperarives undertake joint activities on behalf of their primary affiliates including processing of agricultural produce. At present, there are 30 agricultural cooperative federations functioning at Changwat level. In upper Northern region, only two Changwats viz. Chiang Mai and Chiang Rai have federations out of eight (8) changwats.

3. Agricultrual Cooperative Federation of Thailand (ACFT)

At the national level the ACFT is the apex cooperative of Agricultural Cooperatives, while the Consumers' Cooperative Federation of Thailand and the Thrift and Credit Cooperative Federation of Thailand are other apex organizations respectively for their affiliates.

4. The Cooperarive League of Thailand

It is established and the Cooperatives Act 1968 which is regarded as apex organization of cooperative movement to function as promotional and educational cooperative body at national level.

FIGURE F 5-1 GOVERNMENT STRUCTURE FOR COOPERATIVE ADMINISTRATION

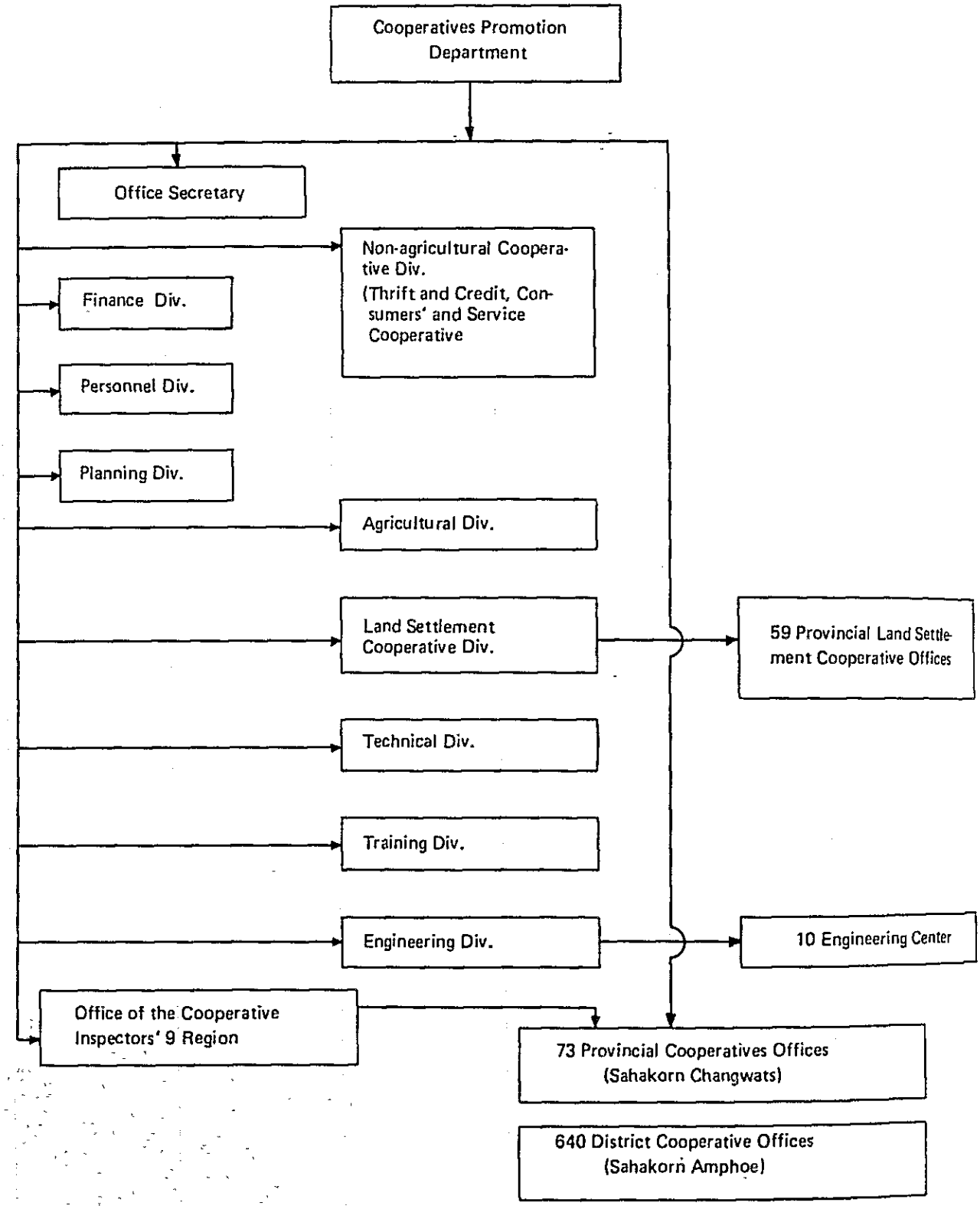
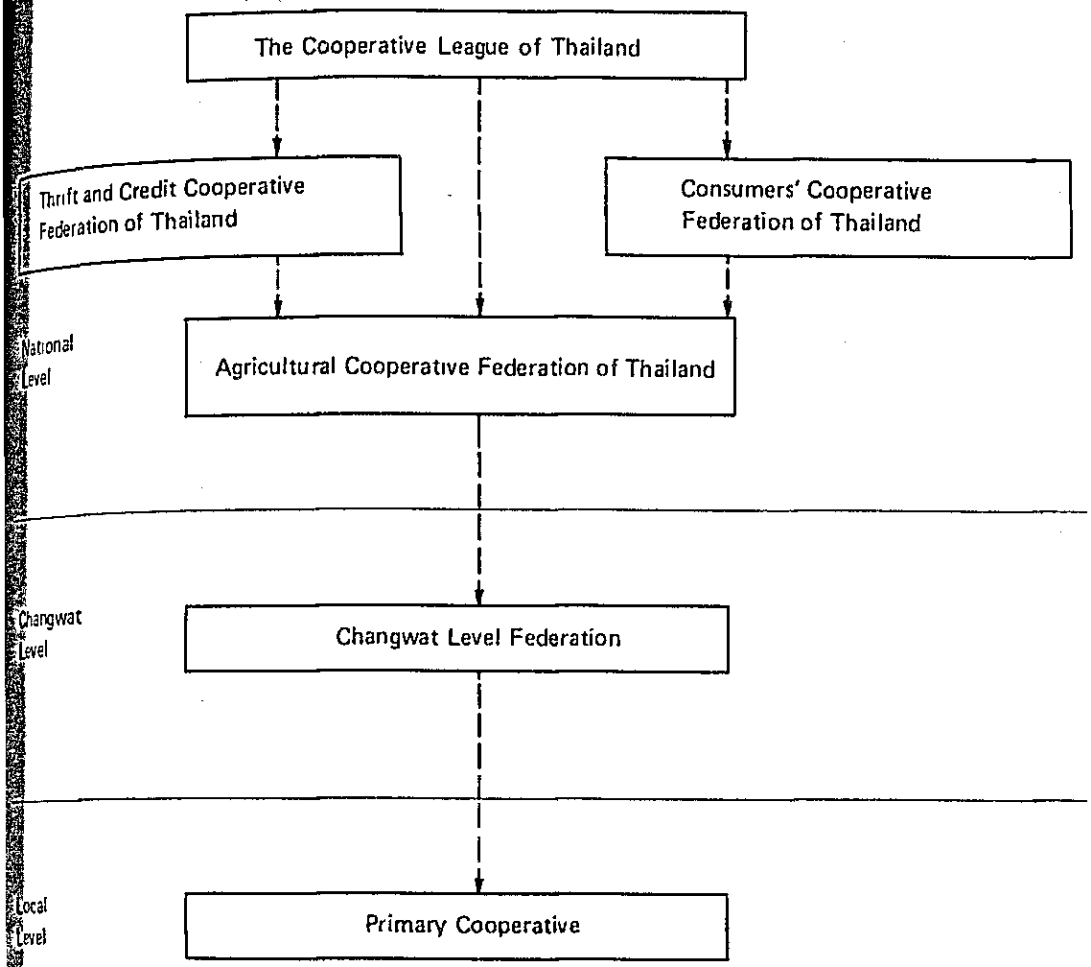


FIGURE F 5 - 2 STRUCTURAL RELATIONSHIP COOPERATIVE MOVEMENT



Remark: According to the policy of the Government, at least one agricultural Cooperative should be establish within the boundary of one Amphoe.

Table F 6-1 Money Lenders to Farmers before Establishment of BAAC

(Unit: %)

Item	Whole Kingdom		North		Central Plain	
	No.	Amount	No.	Amount	No.	Amount
1. Institutional Loans	7.9	5.0	10.3	7.8	2.3	3.0
Credit Cooperative	7.5		10.3	9.8	1.4	2.0
Government Agency	0.4		0.0	0.0	0.9	1.0
Commercial Bank	0.0		0.0	0.0	0.0	0.0
2. Relatives	39.9	32.0	44.8	47.0	17.8	22.6
3. Neighbourers	15.7	15.0	24.1	19.9	14.0	16.7
4. Other Non-Institutional Loans	36.5	46.0	20.6	23.3	65.9	57.8
Local Shops	16.5		4.1	3.0	39.2	13.9
Crops Buyers	8.6		5.2	10.1	8.2	7.9
Land lords	2.1		0.0	0.0	6.6	10.7
Money Lenders	5.4		7.8	8.9	8.0	14.3
Others	3.9		3.5	1.3	3.9	11.0

Source: Agricultural Credit in Thailand, Theory, Data, Policy 1765

Kasesart University 1965

Table F 6-2 Interest Rate by Region and by Money Lender before Establishment of BAAC

(Unit: %/month)

Item	Whole Kingdom	Center	North	North East	South
1. Institutional loans	0.8	0.8	0.8	0.8	0.8
Credit Cooperatives	0.8	0.8	0.8	0.8	0.8
Government Agency	0.8	0.8	0.8	0.8	0.8
Commercial Bank	-	-	-	-	0.8
2. Relatives	1.8	1.7	2.6	1.8	1.1
3. Neighbourers	2.6	2.4	3.3	3.3	2.3
4. Other Non-Institutional Loans	2.9	2.3	4.8	4.3	2.0
Local shops	3.5	2.7	5.4	6.2	2.7
Crops Buyers	2.9	2.4	4.7	3.9	1.3
Land lords	3.5	3.8	-	1.8	-
Money Lenders	3.3	2.1	5.0	7.3	3.7
Others	2.5	1.6	3.4	7.0	2.2
Weighted average	2.4	2.2	3.3	2.7	1.5

Source: Ibid.

Table F 7-1 Yield of Rice Varieties by Water Use and Cropping Season

Variety		Treatment T1	T2	T3	T4
1. Wet season					
RD1	Production (kg/rai)	869.0	844.0	805.5	824.5
	Water use (m^3/rai)	1,672.2	1,320.5	1,291.8	1,220.2
RD5	Production (kg/rai)	801.3	801.7	780.7	791.7
	Water use (m^3/rai)	1,643.7	1,345.6	1,355.7	1,314.1

T1: Water depth of 5cm receded to soil surface
T2: " and dried up 3 day
T3: " 5 "
T4: " 7 "

2. Dry season

RD1	Production (kg/rai)	653.2	590.3	506.3	459.0
	Water use (m^3/rai)	4,311.4	2,128.2	1,329.9	1,587.0
RD2	Production (kg/rai)	646.6	618.5	577.2	540.2
	Water use (m^3/rai)	411.4	2,346.2	1,562.4	1,284.2

T1: Water depth 5cm continually
T2: " and receded to soil surface
T3: " dried up for 4 days
T4: " 7 "

3. Dry season

	Treatment T1	T2	T3	T4	T5	T6	T7	T8
Production (kg/rai)	672.4	700.4	657.5	649.1	638.6	620.8	663.9	616.6
Water use (m^3/rai)	2,673.6	2,742.1	2,225.9	2,141.4	1,955.8	4,133.8	2,684.5	809.8

T1: Water depth 15cm continually
T2: " 7.5cm "
T3: " 2.5cm "
T4: " 1.25cm " to the panicle formation stage and then increase to 15cm.
T5: " 1.25cm continually
T6: " 15cm twice a week (monday and thurseday)
T7: " 7.5cm twice a week (")
T8: Land soaking to saturation stage

Source: Mae Tang Irrigation Agricultural Experimental Station (1975 - 1977)

Vegetables;

Crops	Planting time	Harvesting time	Yield
Tomato	Same as garlic	60 - 90 days after trans-planting nursery 45 days	800 kg/rai
Cabbage	Same as garlic	70 - 100 days after trans-planting nursery 45 days	1,000 kg/rai
Shallot	Same as garlic	45 days after planting	1,500 kg/rai (fresh)

Fruits;

Crops	Beginning of harvest after planting	Harvesting season	Yield/rai	Spacing
Longan	4 - 5 years	Jul. - Aug.	1,400 - 1,750kg	8-10 x 8-10m
Lychee	4 - 5 years	Apr. - May	1,000 - 1,250kg	8-10 x 8-10m

Note: Irrigation to Longan
2 times; 1 time before flower (May - Jun.)
1 time after flower

Institutional Finance

The Bank for Agriculture and Agricultural Cooperative aimes eventually to expand it services into every Amphoe of the country and to this end new Branch and Field Office are gradually being opened in upcountry areas. During 1981 the Bank plans to open other 8 new Branch Offices located in the furtherest corners of the country. (Now, at end of March, 1981, 61 Branches out of 72 Changwats and number of Amphoes served by Branches 613 out of the total 710 Amphoes.)

Pattern of loan to farmers is, however, 5,950 million Baht directly channeled through BAAC Branches and 2,245 million Baht through Cooperatives. Further more most of these loans are for agricultural production usage. There is hardly found out any room for cooperatives to get loan in order to lift up their running fund of marketing business from BAAC.

The BAAC continues to seek low-cost funds from various domestic and foreign sources, to support its rapid expanding lending operations. Analysis of operation fund is reviewed below:

Operation fund classified by sources (Apr. 1980 - Mar. 1981)

	Amount (million Baht)	%	Interest Rate (%)
1. Own (Capital Funds[1/]	2,037[2/]	11	
2. Deposit from the general public	2,301	13	8 per annum for saving deposit 10-12 per annum for time deposit
3. Deposits from Commercial Banks	7,187	37	10-12 per annum on average
4. Borrowings	2,035	11	
5. Note Payable	4,500	24	lowest rediscount rate
6. Others	279	2	
Total	18,339	100	

1/ BAAC has an authorized capital of 4,000 million Baht.

2/ Paid up share capital is 1,540 million Baht.

The weak points of operational funds of BAAC are found out in the facts of smaller share of deposit from the general public at low cost, the largest share of deposit from commercial banks at high cost and rediscounting the BAAC's notes at low rediscount rates from Central Bank, the Bank of Thailand.

Borrowings amounts amounted to 2,035 million Baht as of 31 March, 1981. BAAC's most important source of Borrowings at the present time is Japan (OECF). BAAC had principal outstanding to the OECF totaling 1,615 million Baht or approximately 80% of the Bank's total borrowings. The next funding source is the U.S.A. which has braned funds amounting to 208 million Baht or 10% of the total borrowing.

Under such circumstances, individual cooperatives are feeling shortage of running fund to collect or marketing agricultural products, even when they bend up warehouses by long-term loans from BAAC. Even if BAAC expands, individual cooperaitves cannot service without any low cost running funds as well as BAAC itself.

It is true that institution finance to farmers has been remedied as well as possible after establishment of BAAC. Shortage of running funds of individual cooperatives should be the next obstacle to be cleared away for building up intensified agricultural practices, because cooperatives would be main channel through which intensified agricultural inputs are to reach individual farmers in good cooperation of Kaset Tambol system, especially in small land-size farming area as the Project Area.

APPENDIX G. DAM AND CANAL

APPENDIX G DAM AND CANAL

Appendix G-1 Stability Analyses and Earth Work Quantity

Appendix G-2

Stability Analyses of Dams

The dambody shall be safe against sliding failure under the following conditions

i) At end of construction there is residual construction pore pressure
ii) Reservoir is at normal full water level and seepage is steady
iii) Reservoir is at inermediate water level and seepage is steady
iv) Reservoir at rapid drawdown from normal full water level to low water level
v) Reservoir at surcharge or high water level

For conditions iii) and iv), safety analysises are conducted on the upstream slope only.

The stability against sliding failure shall be examined, as a rule by applying the slice method to the slip circle surface. The factor of safety for these conditions is obtained by the following formula;

$$SF = \frac{\Sigma[c.l + (N-U-Ne)\ \tan\phi]}{\Sigma\ (T + Te)}$$

Where

SF: factor of safety
N : normal force acting on slip circle of each slice
T : tangential force acting on slip circle of each slice
U : pore pressure acting on slip circle of each slice
Ne: normal force of earthquake load acting on slip circle of each slice
Te: tangential force of earthquake load acting on slip circle of each slice
ϕ : angle of internal friclion of materials on slip circle of each slice

c : cohesion of materials on slip circle of each slice

l : arc length of slip circle of each slice

The safety factor shall be more than 1.2. Design values to be used for stability analyses of three dams were determined on the basis of the results of tests made on the materials and on foundation conditions as mentioned in Appendix II and are summarized in Table G 1-1.

Table G 1-1 Design Values

(Left Saddle Dam and Right Saddle Dam)

Zone	Unit Weight $\rho t(t/m^3)$	Unit Weight $\rho sat(t/m^3)$	Cohesion $c\ (t/m^2)$	Friction Angle ϕ (deg)
Core	1.9	2.0	4.3	23
Random	1.9	2.0	2.0	27
Filter	2.0	2.1	0	35
Rock	2.0	2.1	0	38
Foundation	1.9	2.0	9.0	22°

(Main Dam)

Zone	Unit Weight $\rho t(t/m^3)$	Unit Weight $\rho sat(t/m^3)$	Cohesion $c\ (t/m^2)$	Friction Angle ϕ (deg)
Core	1.9	2.0	4.3	23
Transition	2.0	2.1	0	35
Filter	2.0	2.1	0	35
Rock	2.0	2.1	0	38
Foundation	1.9	2.0	0	35°

The results of safety analyses are shown in Table G 1-2 to Table G 1-4.

Table G 1-2 Summary of Stability Analysis for Left Saddle Dam

	Conditions	Earthquake Force	Water Level	Slope	Safety Factor	Remarks
I	At end of construction of dam	100 % (K=0.10)	-	Upstream	1.539	1
				Downstream	1.406	2
II	Reservoir at normal full water level and seepage is steady. (N.W.L.)	100 %	N.W.L. 390m	Upstream	2.212	3
				Downstream	1.608	4
III	Reservoir at intermediate water level and seepage is steady. (M.W.L.)	100 %	M.W.L. 380m	Upstream	1.962	5
			M.W.L. 365m	"	1.702	6
IV	Reservoir at rapid draw-down from nomal water level to low water level. (N.W.L. to L.W.L.)	100 %	L.W.L. 357.5m	Upstream	1.664	7
V	Reservoir at surcharge or high water level. (H.W.L.)	100 %	H.W.L. 392.8m	Upstream	2.192	8
				Downstream	1.616	9

Notes: The safety factor is computed by the formula: $SF = \Sigma [c.l + (N-U-Ne) \tan\phi] / \Sigma(T + Te)$

Table G 1-3 Summary of Stability Analysis for Main Dam

	Conditions	Earthquake Force	Water Level	Slope	Safety Factor	Remarks
I	At end of construction of dam		-	Upstream	1.621	1
				Downstream	1.400	2
II	Reservoir at normal full water level and seepage is steady (N.W.L.)		N.W.L. 390m	Upstream	1.289	3
				Downstream	1.459	4
III	Reservoir at intermediate water level and seepage is steady. (M.W.L.)		M.W.L. 380m	Upstream	1.262	5
			M.W.L. 370m	"	1.233	6
			M.W.L. 360m	"	1.227	7
			M.W.L. 350m	"	1.243	8
IV	Reservoir at rapid drawdown from normal water level to low water level. (N.W.L. to L.W.L.)		L.W.L. 350m	Upstream	1.237	9
V	Reservoir at surcharge or high water level. (H.W.L.)		H.W.L. 392.8m	Upstream	1.362	10
				Downstream	1.402	11

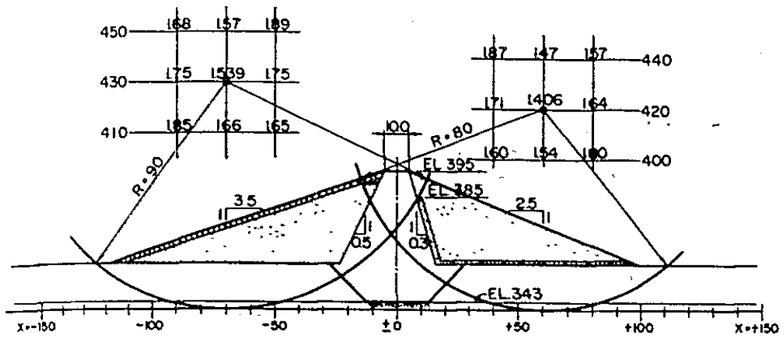
Notes: The safety factor is computed by the formula: $SF = \Sigma [c.l + (N-U-Ne) \tan\phi] / \Sigma(T + Te)$

Table G 1-4 Summary of Stability Analysis for Right Saddle Dam

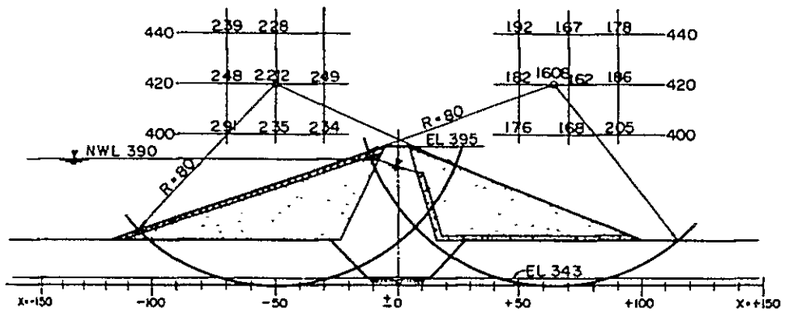
	Conditions	Earthquake Force	Water Level	Slope	Safety Factor	Remarks
I	At end of construction of dam	100 % (K=0.10)	-	Upstream	1.397	1
				Downstream	1.390	2
II	Reservoir at normal full water level and seepage is steady (N.W.L.)	100 %	N.W.L. 390m	Upstream	1.358	3
				Downstream	1.374	4
III	Reservoir at intermediate water level and seepage is steady (M.W.L.)	100 %	M.W.L. 380m	Upstream	1.339	5
			M.W.L. 370m	"	1.441	6
			M.W.L. 363m	"	1.566	7
IV	Reservoir at rapid drawdown from normal water level to low water level (N.W.L. to L.W.L)	100 %	L.W.L. 363m	Upstream	1.540	8
V	Reservoir at surcharge or high water level (H.W.L.)	100 %	H.W.L. 392.8m	Upstream	1.381	9
				Downstream	1.599	10

Notes: The safety factor is computed by the formula: $SF = \Sigma [c.l + (N-U-Ne) \tan\phi] / \Sigma(T + Te)$

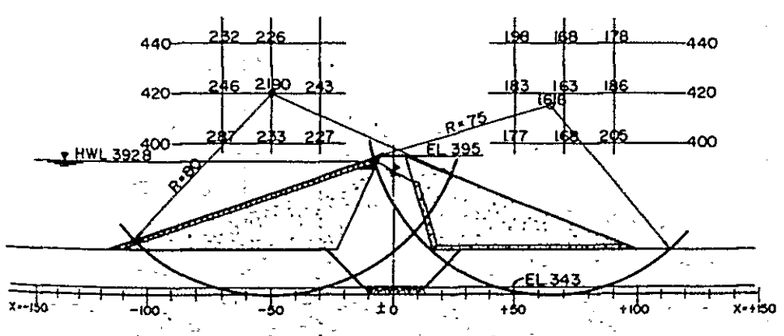
CASE-1-



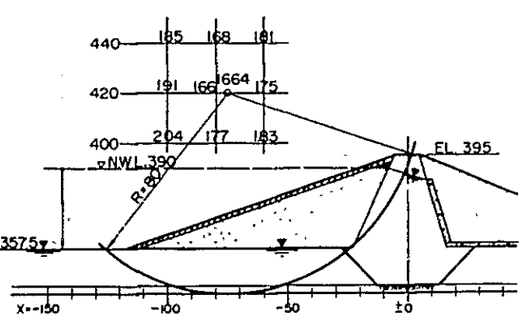
CASE-2-



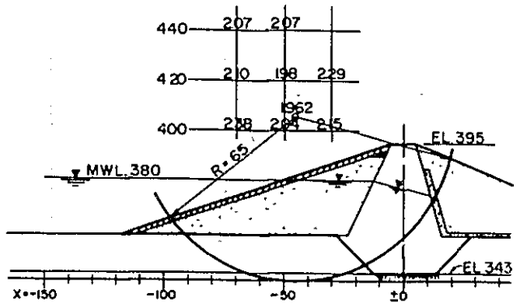
CASE-3-



CASE-4-



CASE-5-



CASE-6-

CASE-7-

CASE-8-

CASE-9-

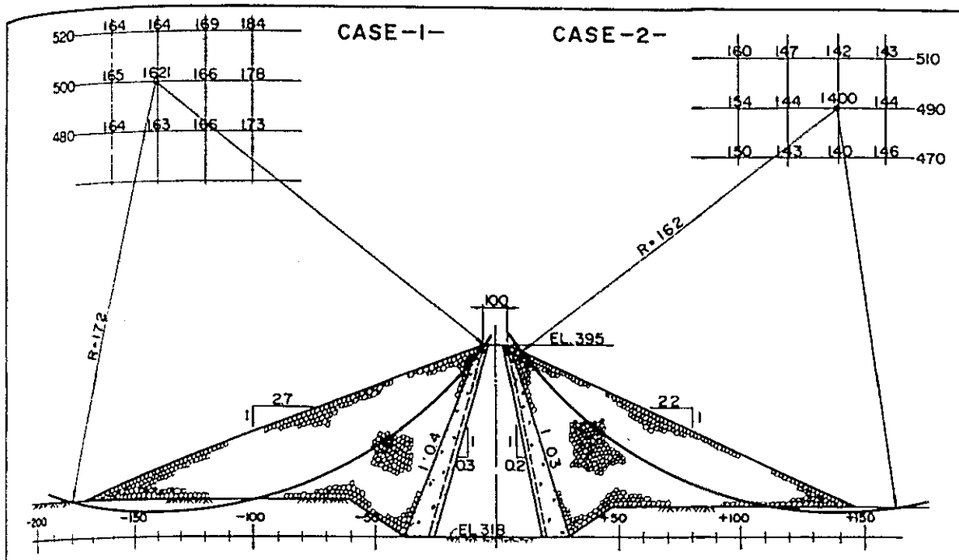
DESIGN VALUES

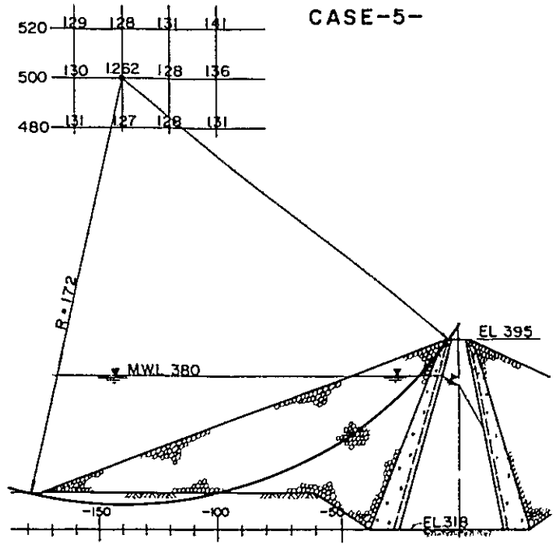
ZONE	UNIT WEIGHT γ_t (t/m³)	UNIT WEIGHT γ_{sat} (t/m³)	COHESION C (t/m²)	FRICT ANGLE ϕ (deg)
Core	19	20	43	23
Random	19	20	20	27
Filter	20	21	0	35
Rock	20	21	0	38
Foundation	19	20	90	22°

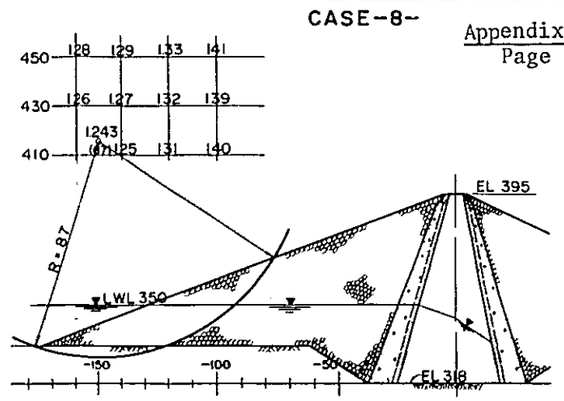
SUMMARY OF STABILITY ANALYSIS FOR LEFT SADDLE DAM

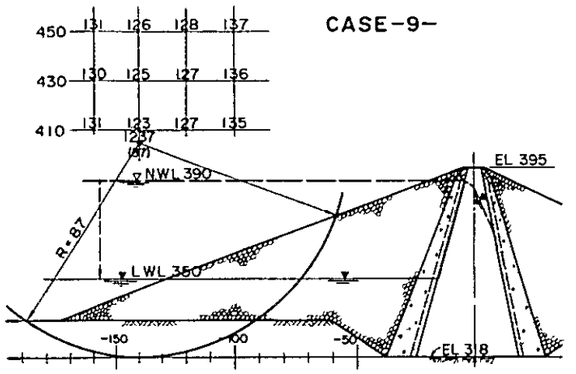
	CONDITIONS	EARTHQUAKE FORCE	WATER LEVEL	SLOPE	SAFETY FACTOR	CASE
I	At end of construction of dam	100% (K=010)	——	Upstream	1539	1
				Downstream	1406	2
II	Reservoir at normal full water level and seepage is steady	100%	NWL 390	Upstream	2212	3
				Downstream	1608	4
III	Reservoir at intermediate water level and seepage is steady	100%	MWL 380	Upstream	1962	5
			365	"	1702	6
IV	Reservoir at rapid drawdown from normal water level	100%	LWL 3575	Upstream	1664	7
V	Reservoir at high water level	100%	HWL 392.8	Upstream	2.192	8
				Downstream	1.616	9

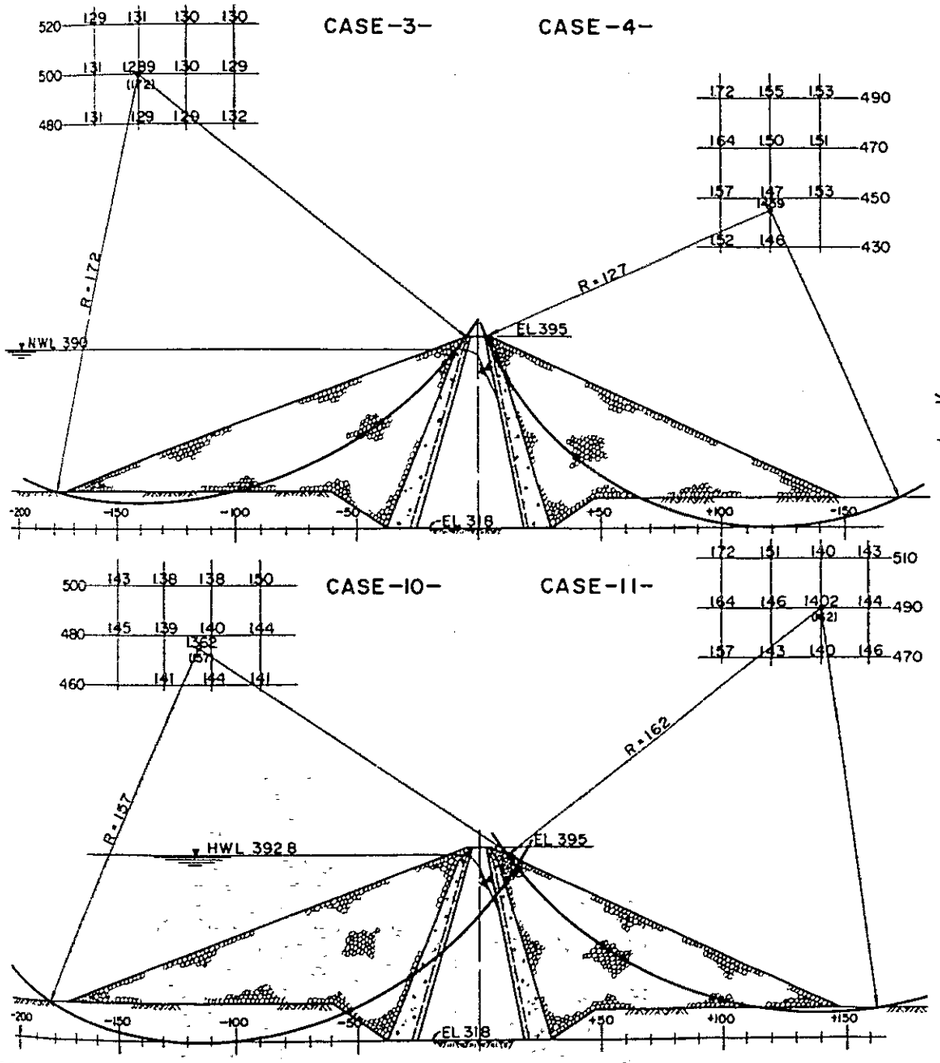
FIGURE G1-1
STABILITY ANALYSIS FOR LEFT SADDLE DAM
(AUGUST 1981)

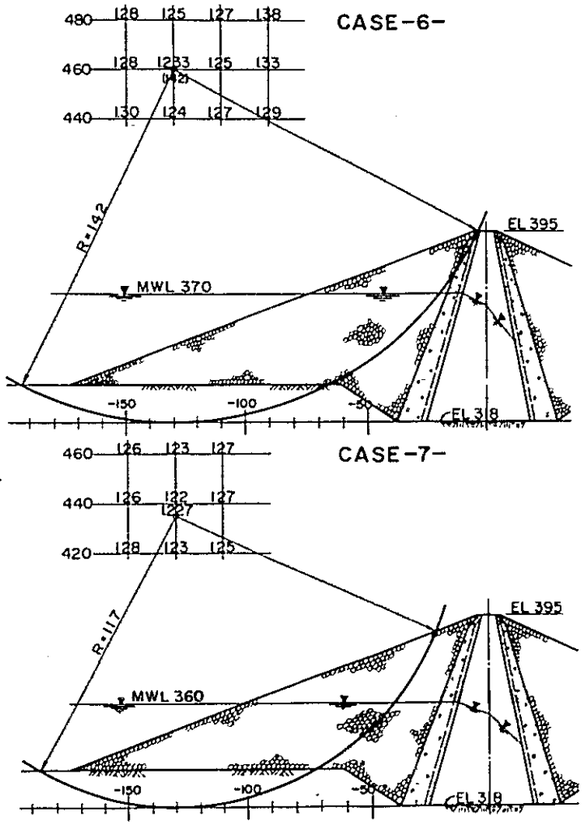












SUMMARY OF STABILITY ANALYSIS FOR MAIN DAM

	CONDITIONS	EARTHQUAKE FORCE	WATER LEVEL	SLOPE	SAFETY FACTOR	CASE
I	At end of construction of dam	100% (K = 010)	——	Upstream	1621	1
				Downstream	1400	2
II	Reservoir at normal full water level and seepage is steady	100%	NWL 390	Upstream	1289	3
				Downstream	1459	4
III	Reservoir at intermediate water level and seepage is steady	100%	MWL 380	Upstream	1262	5
			370	"	1233	6
			360	"	1227	7
			350	"	1243	8
IV	Reservoir at rapid drawdown from normal water level	100%	LWL 350	Upstream	1237	9
V	Reservoir at high water level	100%	HWL 3928	Upstream	1362	10
				Downstream	1402	11

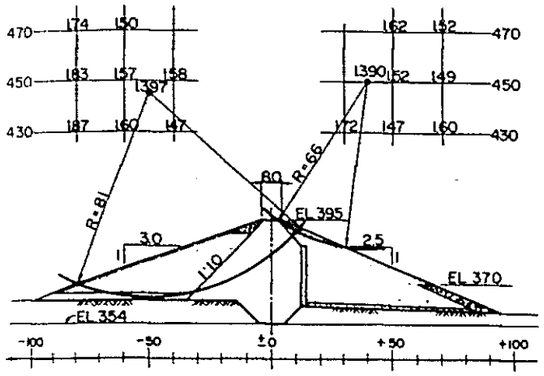
DESIGN VALUES

ZONE	UNIT WEIGHT γ_t (t/m³)	UNIT WEIGHT γ_{sat} (t/m³)	COHESION C (t/m²)	FRICT ANGLE ϕ (deg)
Core	1.9	20	43	23
Transition	20	2.1	0	35
Filter	20	21	0	35
Rock	20	21	0	38
Foundation	19	20	0	35°

FIGURE G1-2
STABILITY ANALYSIS FOR MAIN DAM

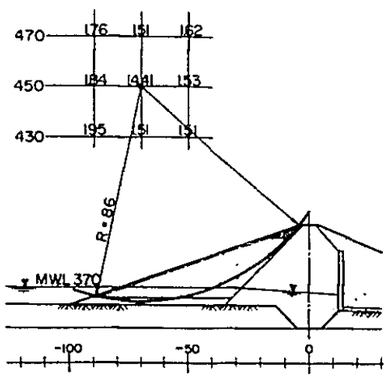
(AUGUST 1981)

CASE -1-



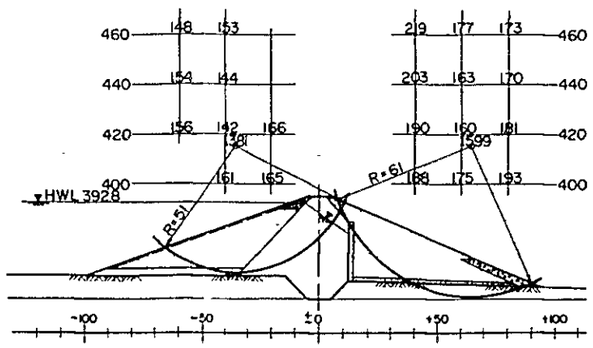
CASE -2-

CASE -6-



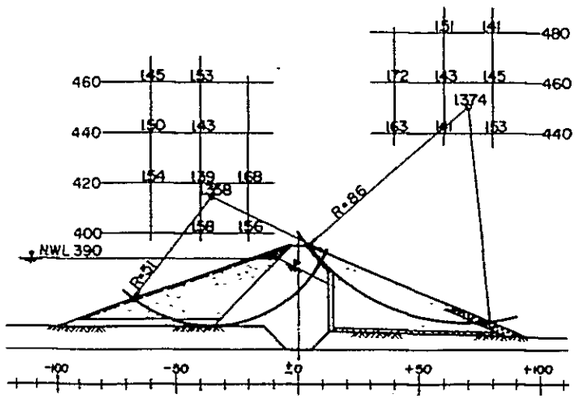
CASE -9-

CASE -10-

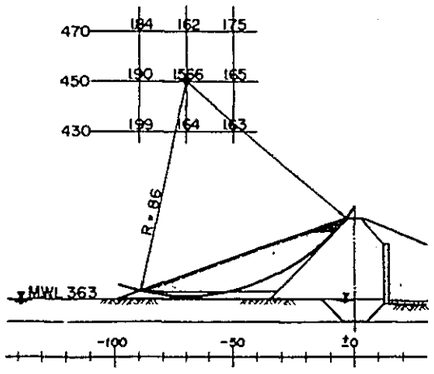


CASE -3-

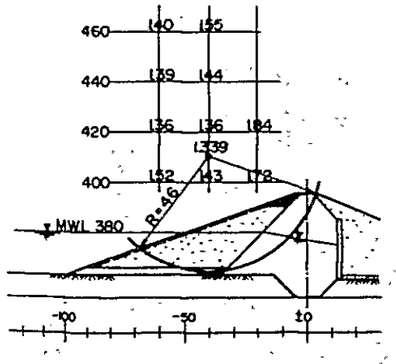
CASE -4-



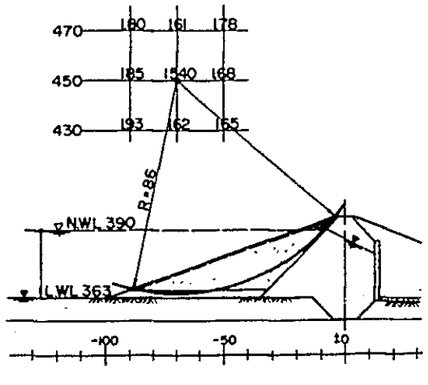
CASE -7-



CASE -5-



CASE -8-



DESIGN VALUES

ZONE	UNIT WEIGHT γ (t/m³)	UNIT WEIGHT γ_{sat} (t/m³)	COHESION C (t/m²)	FRICT ANGLE ϕ (deg)
Core	19	20	43	23
Random	19	20	20	27
Filter	20	21	0	35
Rock	20	21	0	38
Foundation	19	20	90	22°

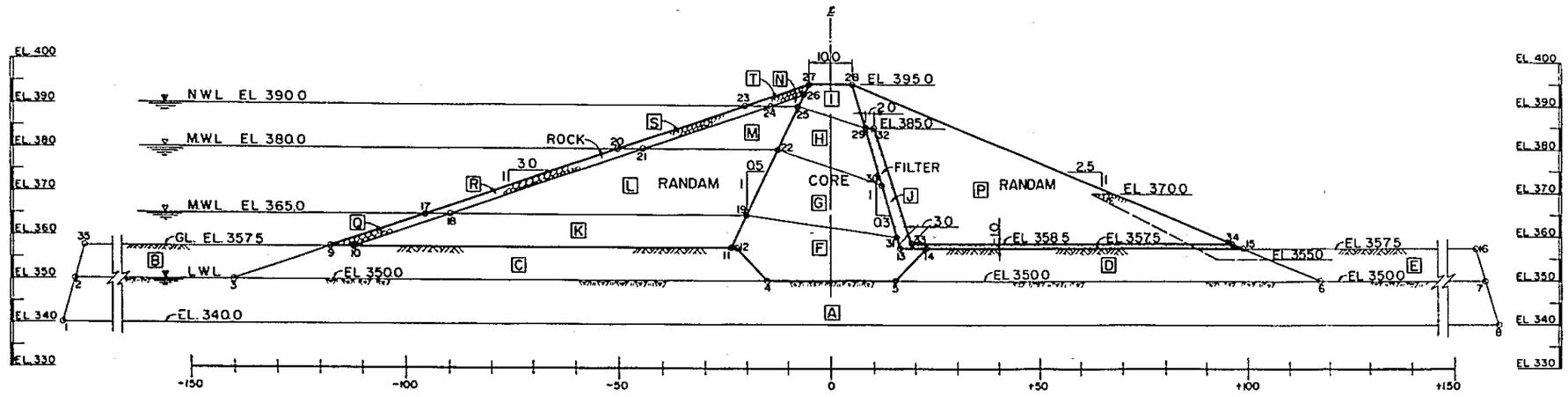
SUMMARY OF STABILITY ANALYSIS FOR RIGHT SADDLE DAM

	CONDITIONS	EARTHQUAKE FORCE	WATER LEVEL	SLOPE	SAFETY FACTOR	CASE
I	At end of construction of dam	100% (K=0.10)	——	Upstream	1.397	1
				Downstream	1.390	2
II	Reservoir at normal full water level and seepage is steady	100%	NWL 390	Upstream	1.358	3
				Downstream	1.374	4
III	Reservoir at intermediate water level and seepage is steady	100%	MWL 380	Upstream	1.339	5
			370	〃	1.441	6
			363	〃	1.566	7
IV	Reservoir at rapid drawdown from normal water level	100%	LWL 363	Upstream	1.540	8
V	Reservoir at high water level	100%	HWL 392.8	Upstream	1.381	9
				Downstream	1.599	10

FIGURE G1-3

STABILITY ANALYSIS FOR RIGHT SADDLE DAM

(AUGUST 1981)

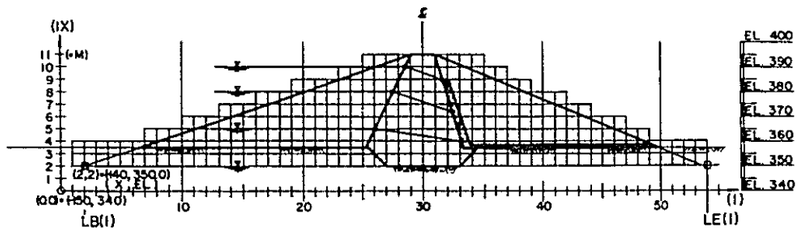


LEFT SADDLE DAM SCALE 1 : 500

(1) COORDINATE OF GRID POINTS

NO.	X	Y	NO.	X	Y	NO.	X	Y	NO.	X	Y
1	-300	340.0	11	-24	357.5	21	-45.0	380.0	31	+15.5	360.0
2	-300	350.0	12	-22.5	〃	22	-12.5	〃	32	+10.0	385.0
3	-140	〃	13	+16.3	〃	23	-20.0	390.0	33	+19.0	358.5
4	-15	〃	14	+22.5	〃	24	-15.0	〃	34	+96.3	〃
5	+15	〃	15	+99	〃	25	-7.5	〃	35	-300	357.5
6	+117.5	〃	16	+300	〃	26	-6.0	393.0			
7	+300	〃	17	-9.5	365.0	27	-5.0	395.0			
8	+300	340.0	18	-9.0	〃	28	+5.0	〃			
9	-117.5	357.5	19	-2.0	〃	29	+8.0	385.0			
10	-112.5	〃	20	-5.0	380.0	30	+11.9	372.0			

(3) GRID FOR SEEPAGE LINE



(5) DESIGN VALUES

ZONE		UNIT WEIGHT ρ_t (t/m³)	UNIT WEIGHT ρ_{sat} (t/m³)	COHESION C (t/m²)	FRICT ANGLE ϕ (deg)	NO. OF ZONE
Core	Ⅳ	1.9	2.0	2.2	23	F, G, H, I
Random	Ⅳ	1.9	2.0	1.9	28	K, L, M, N & P
Filter	Ⅳ	2.0	2.0	0	30	J
Rock	Ⅳ	2.0	2.0	0	35	Q, R, S, T
Foundation	Ⅳ	1.9	1.9	2.8	28	A, B, C, D
〃	②	〃	〃	3.0	22°	
〃	③	〃	〃	10.0	15°	

REMARKS;

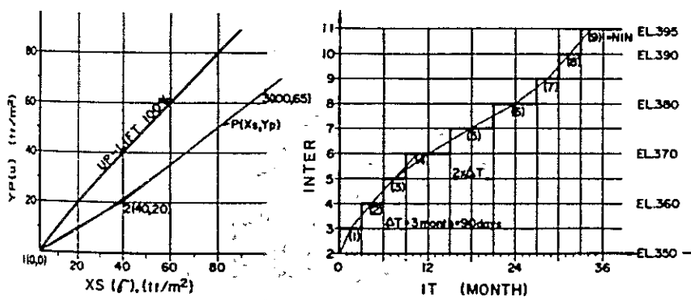
1) Design values based on R I D 's data except Foundation-②③
2) Design values of Foundation-②,③ come from ZAO-DAM, JAPAN March 1980
3) Earthquake force is K=0.10
4) Safety against sliding failure are examined by appling the slice mithod to slip circle surface

(6) SUMMARY OF STABILITY ANALYSIS

	CASE	WATER LEVEL	EARTH QUAKE	SLOPE	SAFETY FACTOR
1	Just after completion of dam with construction pore pressure	—	100% (K=0.10)	Up Stream	1.440
2				Down 〃	1.300
3	After completion of dam and seepage is steady at normal full water level	NWL 390	100%	Up Stream	2.241
4				Down 〃	1.462
5	After completion of dam and seepage is water level intermediate water level	MWL 380	100%	Up Stream	1.938
6		MWL 365		Up 〃	1.599
7	Rapid drawdown	NWL — LWL	100%	Up Stream	1.530
8	Case 1 with foud design value -②	—	100%	Up Stream	1.500
9	Case 1 with found design value -③			Up 〃	1.232

(2) ESTIMATION OF PORE PRESSURE DURING CONSTRUCTION

(A) BANK LOAD(δ) VS. PORE PRESSURE(u) (B) BANKING SPEED

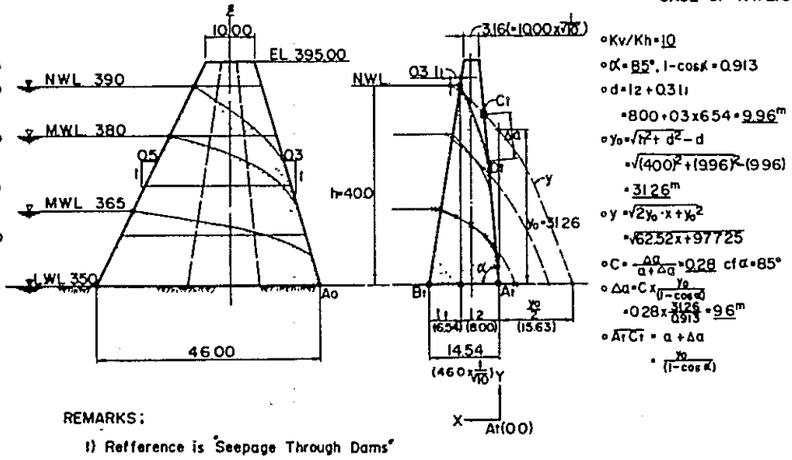


REMARKS:

1) Bank load (δ) is ρ_t (1.9t/m³)xh(m)
2) PWP.(u) is assumed by Hilf's equation
3) Cv = 0.01 cm²/sec

(4) ESTIMATION OF SEEPAGE LINE

(A) NORMAL SECTION (B) TRNSFORMED CECTION (C) EXAMPLE CASE OF NWL.390.0



- Kv/Kh=1.0
- α=85°, 1-cosα=0.913
- d=12+0.3l
  =8.00+0.3×65.4=9.96m
- $y_0=\sqrt{h^2+d^2}-d$
  $=\sqrt{(40.0)^2+(19.96)^2}-(19.96)$
  =31.26m
- $y=\sqrt{2y_0\cdot x+y_0^2}$
  $=\sqrt{62.52x+977.25}$
- $C=\frac{\Delta a}{a+\Delta a}=0.28$ cfα=85°
- $\Delta a=C\times\frac{y_0}{(1-\cos\alpha)}$
  $=0.28\times\frac{31.26}{0.913}=9.6$m
- $\overline{AtCt}=a+\Delta a$
  $=\frac{y_0}{(1-\cos\alpha)}$

REMARKS:

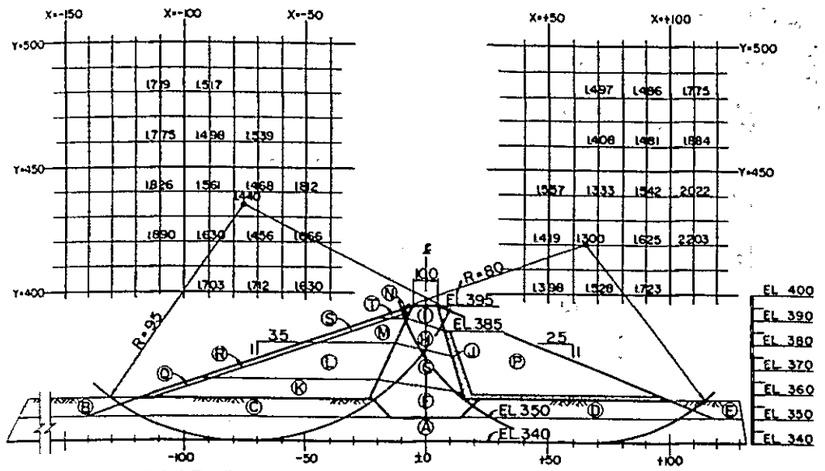
1) Refference is 'Seepage Through Dams' by A. CASAGRANDE

FIGURE G1-4

STABILITY ANALYSIS FOR LEFT SADDLE DAM

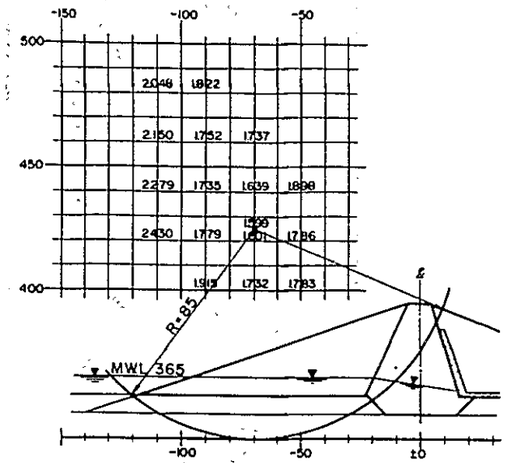
(APRIL 1981)-1/2

CASE-1-

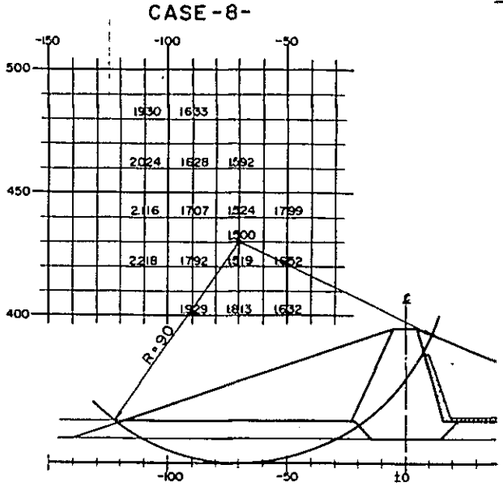


CASE-2-

CASE-6-



CASE-8-



CASE-3-

CASE-4-

CASE-7-

CASE-9-

CASE-5-

SUMMARY OF STABILITY ANALYSIS

	CASE	WATER LEVEL	EARTHQUAKE	SLOPE	SAFETY FACTOR
1	Just after completion of dam with construction pore pressure	—	100% (K=0.10)	Up Stream	1.440
2				Down 〃	1.300
3	After completion of dam and seepage is steady at normal full water level	N.W.L. 390	100%	Up Stream	2.241
4				Down 〃	1.462
5	After completion of dam and seepage is steady at intermediate water level	M.W.L. 380	100%	Up Stream	1.938
6		M.W.L. 365		Up 〃	1.599
7	Rapid drawdown	N.W.L → L.W.L	100%	Up Stream	1.530
8	Case, 1	—	100%	Up Stream	1.500
9				Up 〃	1.232

DESIGN VALUES

ZONE	UNIT WEIGHT γ_t (t/m³)	UNIT WEIGHT γ_{sat} (t/m³)	COHESION C (t/m²)	FRICT. ANGLE ϕ (deg)	NO OF ZONE
Core	1.9	2.0	2.2	23	F, G, H, I
Random	1.9	2.0	1.9	28	K, L, M, N, P
Filter	2.0	2.0	0	30	J
Rock	2.0	2.0	0	35	Q, R, S, T
Foundation	1.9	1.9	1.9	28	A, B, C, D, E
Found — 2	〃	〃	9.0	22°	Case-8-
Found — 3	〃	〃	10.0	15°	Case-9-

REMARKS;

1) In Case 1 to 7, design values based on R.D.'s original plan.
2) In Case 8 to 9, foundation design value changed into Found-2 and Found-3 Case.
3) Safety factor is obtained by the following formula; Design Criteria For Dams in Japan;

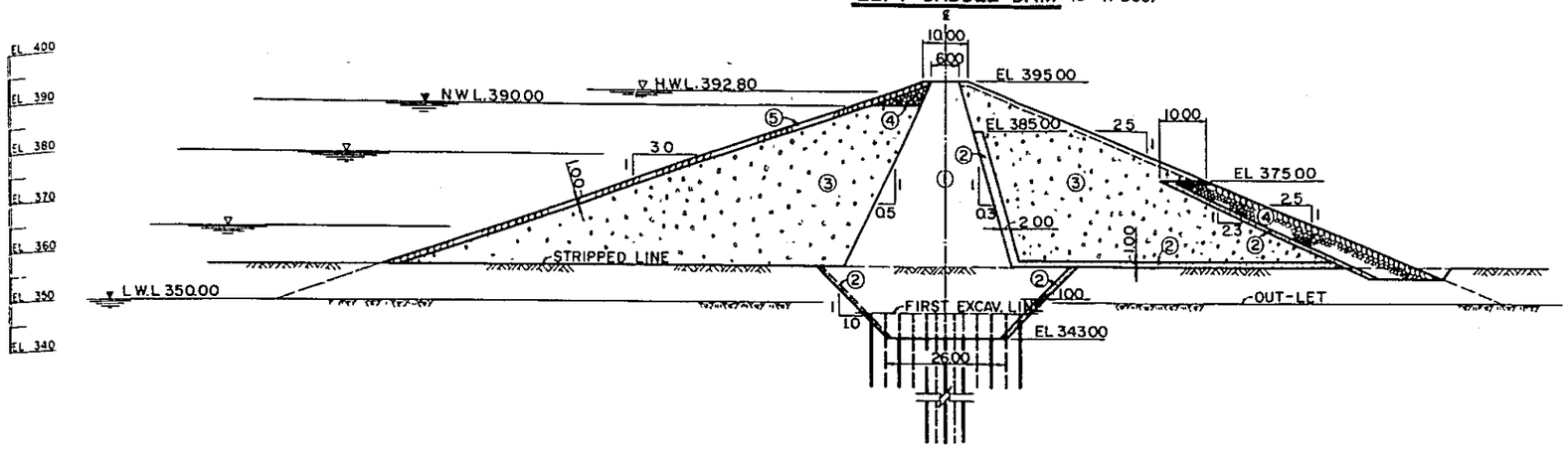
$$Fs = \frac{\Sigma \{C \cdot l + (N - U - Ne) \tan \phi\}}{\Sigma (T + Te)}$$

FIGURE G1-5

STABILITY ANALYSIS FOR LEFT SADDLE DAM

(APRIL 1981) - 2/2

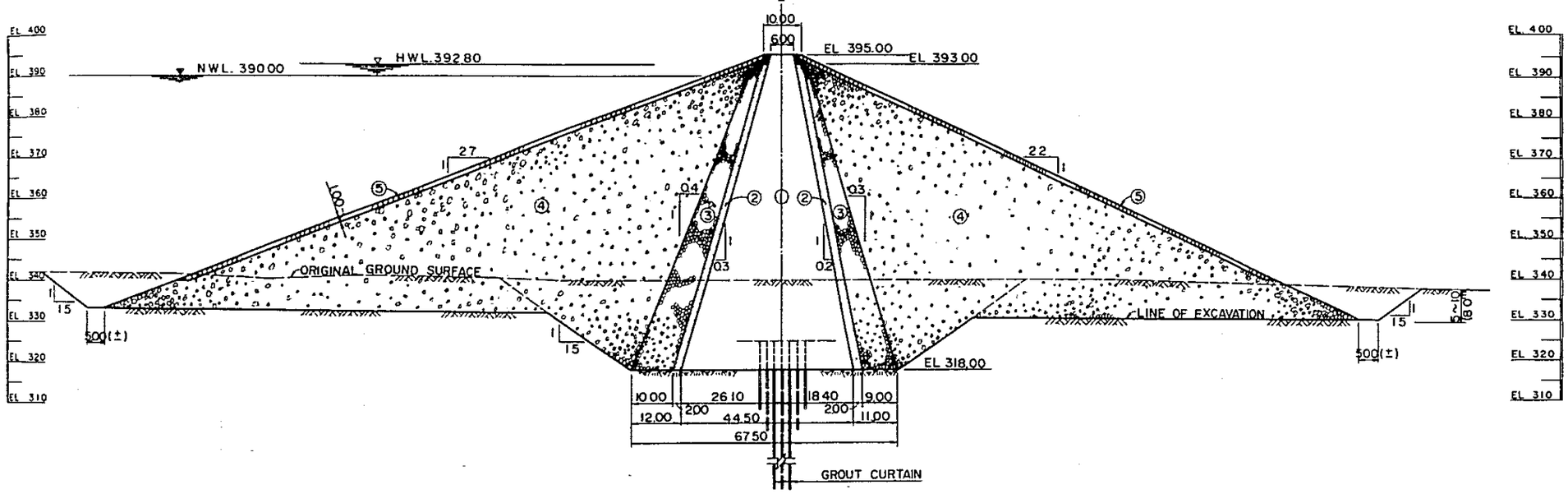
LEFT SADDLE DAM (S = 1/500)



LEFT SADDLE DAM

	ZONE	VOLUME (m³)
①	Core	628,000
②	Filter	97,000
③	Random	1,388,000
④	Rock	79,000
⑤	Rip-rap	67,000
(TOTAL BANK)		(2,259,000)
STRIPPED		134,000
CORE TRENCH		227,000
(TOTAL EXCAV.)		361,000

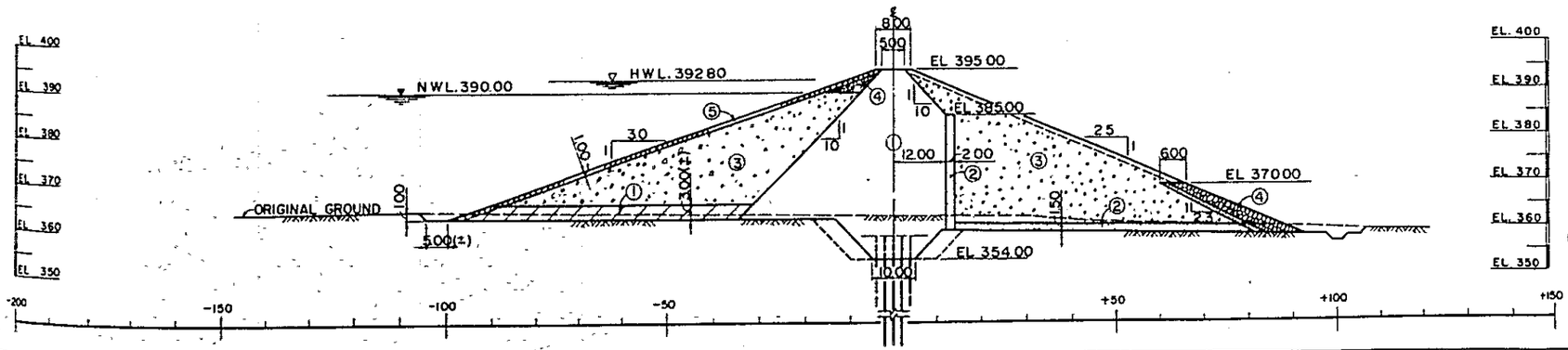
MAIN DAM (S = 1/500)



MAIN DAM

	ZONE	VOLUME (m³)
①	Core	954,000
②	Filter	164,000
③	Toransition	406,000
④	Rock	3,882,000
⑤	Rip-rip	170,000
(TOTAL BANK)		(5,576,000)
STRIPPED		537,000
CORE TRENCH		679,000
(TOTAL EXCAV.)		(1,216,000)

RIGHT SADDLE DAM (S = 1/500)



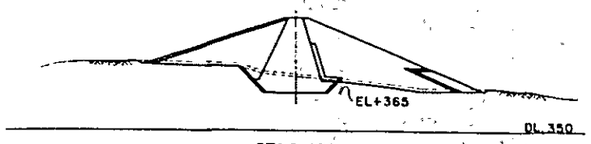
RIGHT SADDLE DAM

	ZONE	VOLUME (m³)
①	Core	644,000
②	Filter	68,000
③	Random	649,000
④	Rock	26,000
⑤	Rip-rap	52,000
(TOTAL BANK)		(1,439,000)
STRIPPED		109,000
CORE TRENCH		165,000
(TOTAL EXCAV.)		(274,000)

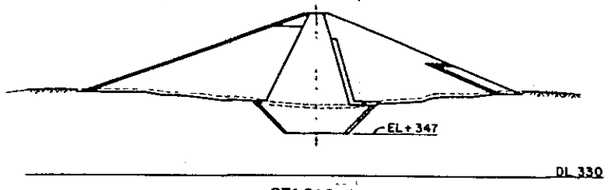
FIGURE G1-6

QUANTITY OF EARTH WORK FOR MAE KUANG DAMS-1

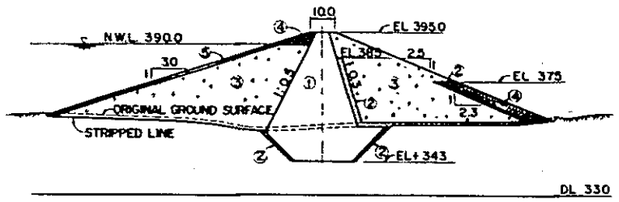
LEFT SADDLE DAM (S=1/1,000)



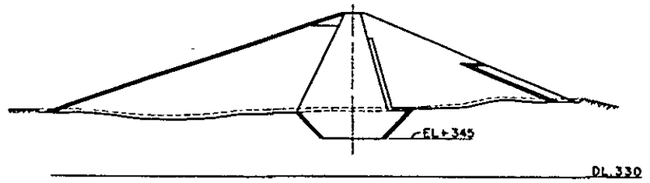
STA 0+100



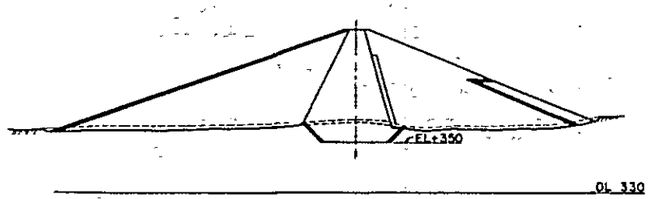
STA 0+200



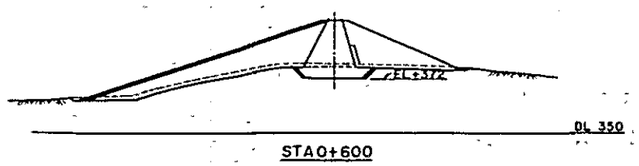
STA 0+300



STA 0+400

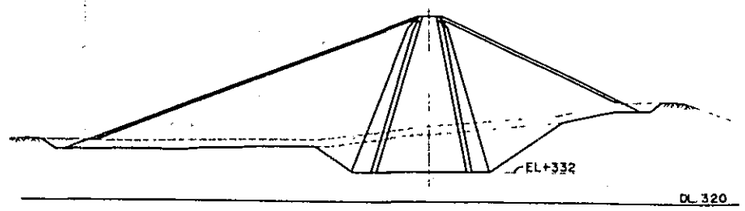


STA 0+500



STA 0+600

MAIN DAM (S=1/1,000)



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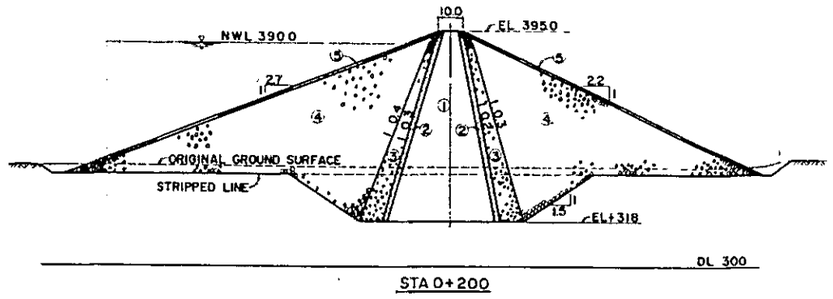
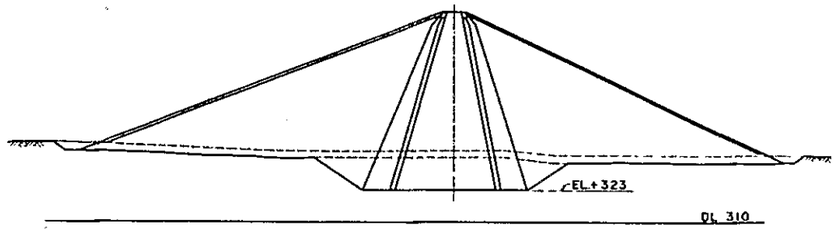
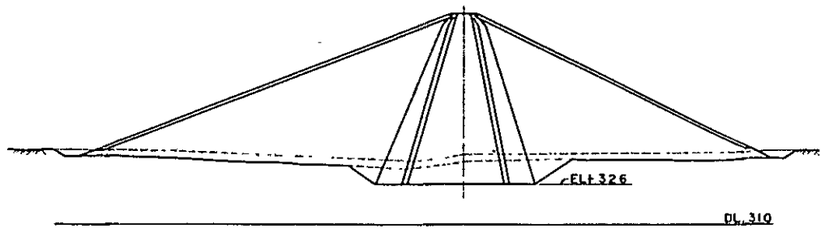


STA 0+200



STA 0+300



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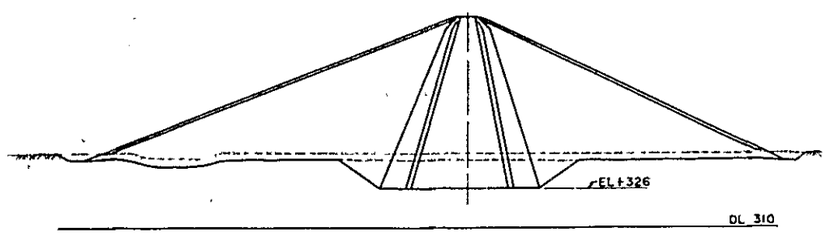
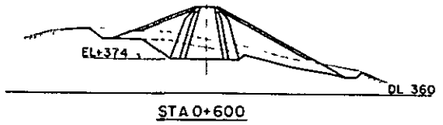
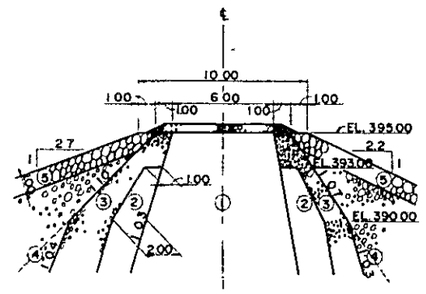


STA 0+500



STA 0+600



LEFT SADDLE DAM	
①	CORE
②	FILTER
③	RANDOM
④	ROCK
⑤	RIP-RAP

MAIN DAM	
①	CORE
②	FILTER
③	TRANSITION
④	ROCK
⑤	RIP-RAP

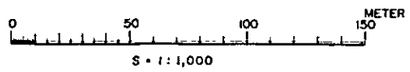
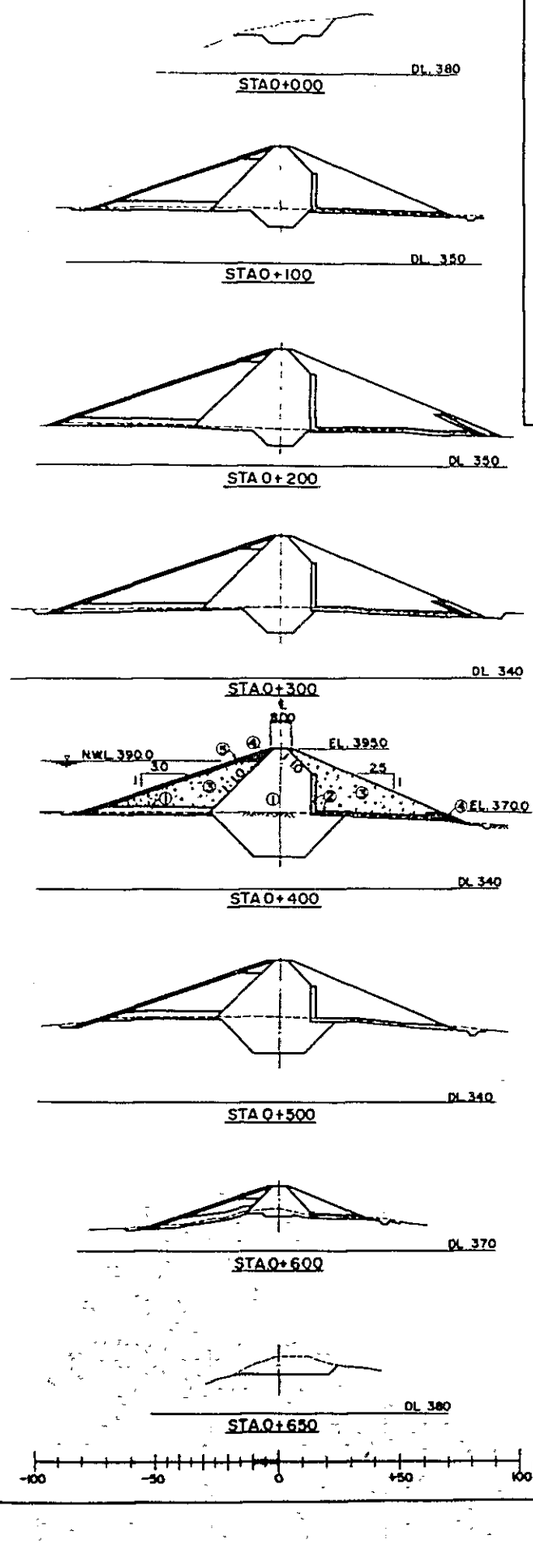


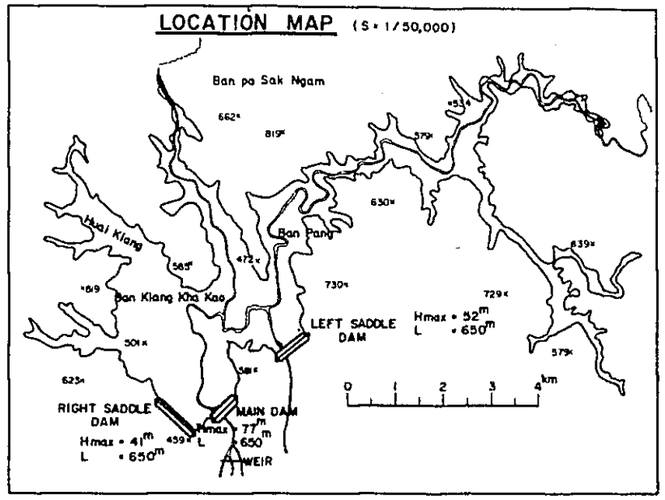
FIGURE G1-7

QUANTITY OF EARTH WORK FOR MAE KUANG DAMS-2

RIGHT SADDLE DAM (S = 1/1,000)



LOCATION MAP (S = 1/50,000)



NO	ZONE
①	CORE
②	FILTER
③	RANDOM
④	ROCK
⑤	RIP-RAP

QUANTITY OF EARTH WORK FOR MAE KUANG DAMS

(1) LEFT SADDLE DAM

Station NO.	DAM Height H(m)	Dist L(m)	EMBANKMENT Core A_1 m²	Core V_1 m³	Filter A_2 m²	Filter V_2 m³	Random A_3 m²	Random V_3 m³	Rock A_4 m²	Rock V_4 m³	Rip-rap A_5 m²	Rip-rap V_5 m³	EXCAVATION Stripped C_1 m²	Stripped D_1 m³	Core Trench C_2 m²	Core Trench D_2 m³
0+000	0	60	0	–	0	–	0	–	0	–	0	–				
		(160)2/														
0+100	30	100	630	42,000 1/	124	8,300 1/	1090	72,700 1/	100	6,700 1/	62	4,100 1/	142	13,100 2/	260	27,700 2/
0+200	48	100	1230	93,000	172	14,800	2520	180,500	116	10,800	98	8,000	186	16,400	400	33,000
0+300	52	100	1380	130,500	186	17,900	3150	283,500	170	14,300	116	10,700	214	20,000	520	46,000
0+400	50	100	1290	133,500	180	18,300	2990	307,000	148	15,900	130	12,300	226	22,000	410	46,500
0+500	45	100	1030	116,000	184	18,200	2500	274,500	172	16,000	130	13,000	234	23,000	250	33,000
0+600	23	100	380	70,500	72	12,800	940	172,000	30	10,100	106	11,800	164	19,900	150	20,000
0+650	0	50	0	12,700 1/	0	2,400 1/	0	31,300 1/	0	1,000 1/	0	3,500 1/		10,900 3/		10,000 3/
		(100)3/														
Net Total				598,200		92,700		1,321,500		74,800		63,400		127,300		216,200
(Net x105%)				(628,000)		(97,000)		(1,388,000)		(79,000)		(67,000)		(134,000)		(227,000)

Note 1/ $V_n = \frac{2}{3} \times L \times (A_n + A_{n-1})$, L = 100m, 2/ L = 160m, 3/ L = 100m

(2) MAIN DAM

Station NO.	DAM Height H(m)	Dist L(m)	EMBANKMENT Core A_1 m²	Core V_1 m³	Filter A_2 m²	Filter V_2 m³	Transition A_3 m²	Transition V_3 m³	Rock A_4 m²	Rock V_4 m³	Rip-rap A_5 m²	Rip-rap V_5 m³	EXCAVATION Stripped C_1 m²	Stripped D_1 m³	Core Trench C_2 m²	Core Trench D_2 m³
0+000	0	0	–	–	–	–	–	–	–	–	–	–				
0+100	63	100	1370	91,300 1/	248	16,500 1/	584	38,900 1/	4804	320,200 1/	239	15,900 1/	770	51,300 1/	1200	80,000 1/
0+200	77	100	3944	165,700	306	27,700	822	70,300	7261	603,300	297	26,800	920	84,500	1900	155,000
0+300	72	100	1728	183,600	285	29,600	733	77,800	7252	725,700	297	29,700	930	92,500	1170	153,500
0+400	69	100	3604	166,600	273	27,900	682	70,800	7487	737,000	302	30,000	920	92,500	640	90,500
0+500	69	100	3604	160,400	273	27,300	682	68,200	7009	724,800	292	29,700	925	92,300	910	77,500
0+600	21	100	236	92,000	75	17,400	106	39,400	812	391,100	90	19,100	350	63,800	180	54,500
0+650	0	50	0	7,900 1/	0	2,500 1/	0	3,500 1/	0	27,000 1/	0	3,000 1/	0	11,700 1/	0	6,000 1/
Net Total				867,500		148,900		368,900		3,529,100		154,200		488,600		617,000
(Net x110%)				(954,000)		(164,000)		(406,000)		(3,882,000)		(170,000)		(537,000)		(679,000)

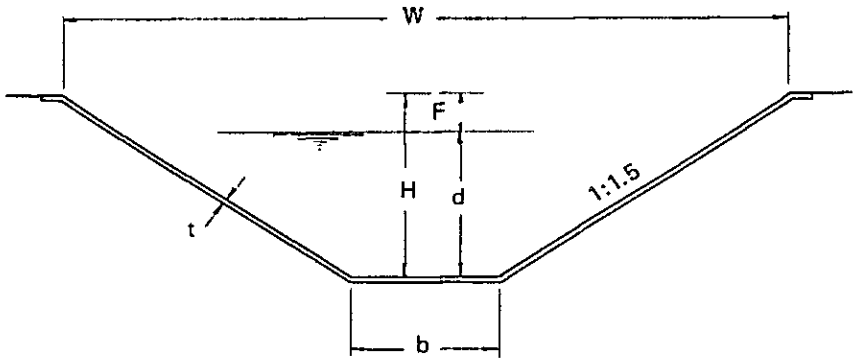
(3) RIGHT SADDLE DAM

Station NO.	DAM Height H(m)	Dist L(m)	EMBANKMENT Core A_1 m²	Core V_1 m³	Filter A_2 m²	Filter V_2 m³	Random A_3 m²	Random V_3 m³	Rock A_4 m²	Rock V_4 m³	Rip-rap A_5 m²	Rip-rap V_5 m³	EXCAVATION Stripped C_1 m²	Stripped D_1 m³	Core Trench C_2 m²	Core Trench D_2 m³
0+000	0	60	0	–	0	–	0	–	0	–	0	–	37	1,500 1/	142	5,700 1/
0+100	31	100	873	58,200 1/	113	7,500 1/	965	64,300 1/	19	1,300	78	5,200	165	10,100	96	11,900
0+200	37	100	1236	105,500	140	12,700	1580	127,300	82	5,100	95	8,700	200	18,300	85	9,100
0+300	37	100	1116	117,600	125	13,300	1420	150,000	62	7,200	94	9,500	194	19,700	171	12,800
0+400	41	100	1418	126,700	115	12,000	1030	122,500	39	5,100	82	8,800	178	18,600	602	38,700
0+500	36	100	1097	125,800	104	11,000	860	94,500	28	3,400	83	8,300	171	17,500	406	50,400
0+600	13	100	290	69,400	34	6,900	200	53,000	19	2,400	53	6,800	108	14,000	17	21,200
0+650	0	50	0	9,700 1/	0	1,100 1/	0	6,700 1/	0	600 1/	0	1,800 1/	40	3,700	164	4,500
0+675	0	25	0	–	0	–	0	–	0	–	0	–	0	700 1/	0	2,700 1/
Net Total				812,900		64,500		618,300		25,100		49,100		104,100		157,000
(Net x105%)				(644,000)		(68,000)		(649,000)		(26,000)		(52,000)		(109,000)		(165,000)

FIGURE G1-8

QUANTITY OF EARTH WORK FOR MAE KUANG DAMS-3

Canal	Section	Type, Design Discharge (cu.m/sec)	b (m)	d (m)	A (sq.km)	R (m)	I	n	V (m/sec)	Calculated Discharge (cu.m/sec)	F (m)	H (m)	W (m)
Left Main Canal	No.0 - No.34+900	1 10.800	2.600	2.100	12.075	1.187	1/8,000	0.014	0.895	10.807	0.55	2.65	10.55
	No.34+900- No.44+800	2 8.019	1.900	2.000	9.800	1.075	o/8,000	0.014	0.839	8.222	0.50	2.40	9.10
	No.44+800- No.55+200	3 5.758	1.700	1.750	7.569	0.945	1/8,000	0.014	0.769	5.821	0.50	2.25	8.45
	No.55+200- No.72	4 2.780	1.400	1.300	4.355	0.715	1/8,000	0.014	0.639	2.783	0.45	1.75	6.65
Right Main Canal	No.0- No.15+400	1 1.540	1.600	1.000	3.100	0.595	1/10,000	0.014	0.505	1.566	0.35	1.35	5.65



Remarks:

1/ t is decided as follows:
t = 0.05m, for Q = 2.5 cu.m/sec
t = 0.06m, for Q = 2.5-5.0 cu.m/sec
t = 0.07m, for Q = 5.0-10 cu.m/sec

(RID Concrete Lined Canal Section & Details)

Table G 2-2 Flow Capacity of Major Rivers

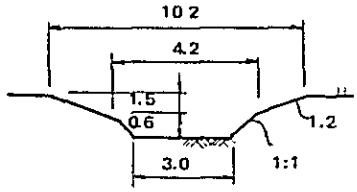
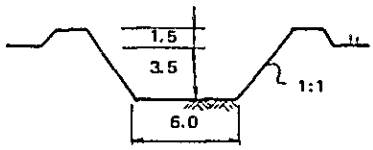
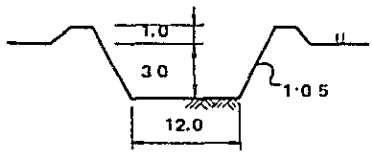
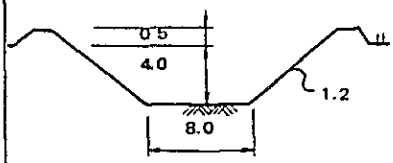
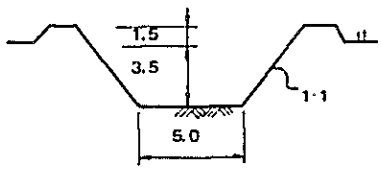
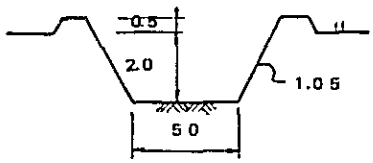
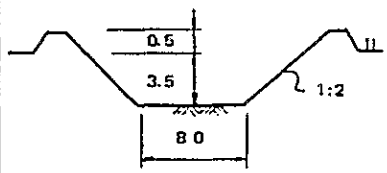
Name of River	Drainage Area: Mountains (sq.km)	Drainage Area: Paddy Field (sq.km)	Drainage Area: Total (sq.km)	Flow Capacity[1] of River (cu.m/sec)	Run-off[2] (1/5): Mountains (cu.m/sec)	Run-off[2] (1/5): Paddy Field (cu.m/sec)	Run-off[2] (1/5): Total (cu.m/sec)	Necessity of Improvement	Note
Huai Hong Hok	14	-	14	32.5	34.58	-	34.58	No	
Muang Mai	21	-	21	99.9	47.50	-	47.50	No	
Huai Bon	47	-	47	113.4	100.95	-	100.95	No	
Muang Mae Ka	40	36	76	128.0	95.08	32.53	127.61	No	
Muang Mae Tak	19	-	19	110.0	45.86	-	45.86	No	
Huai Nam Ngam	7	-	7	38.4	15.60	-	15.60	No	
Nam Mae Pu	26	44	70	94.5(126.1)[3]	61.57	39.27	100.84	No	
Muang Mae On	174	18	192	316.2(528.2)	316.68	17.45	334.13	No	
Huai Hat	21	48	60	Not Clear	50.28	42.85	93.13	No	It seems that the runoff is drained through uncountable creeks in the down-stream area
Nam Mae Thi	39	19	58	126.2	84.08	18.43	102.51	No	
Nam Mae Tip	46.5	-	48	97.5(113.7)	101.12	-	101.12	No	
Mae Yak	74	49	123	216.0	148.15	43.20	191.35	No	
Huai Che	19	1	20	336.0	43.47	1.10	44.57	No	

Note: 1/ See Table G -2-3

2/ Mountains: 2.60 cu.m/sec/sq.km x area (sq.km) x reduction factor
Paddy Field 1.10 cu.m/sec/sq.km x area (sq.km) x reduction factor

3/ Figures in parenthesis show the flow capacity of river with full cross sectional area including freeboard

Table G 2 - 3 Estimation of Flow Capacity of Major Rivers

Name	Cross Section	Capacity
Haui Hong Hok		A = 13.0 sq.m, P = 11.4 m, R = 1.1 m I = 1/150, n = 0.035, V = 2.5 m/s Q = 32.5 cu.m/s
Muang Mai		A = 33.3 sq.m, P = 15.9 m, R = 2.1 m I = 1/250, n = 0 035, V = 3.0 m/s Q = 99.9 cu.m/s
Huai Bon		A = 40.5 sq.m, P = 18.7 m, R = 2.2 m I = 1/300, n = 0.035, V = 2.8 m/s Q = 113 4 cu.m/s
Muang Mae Ka		A = 64.0 sq m, P = 25.9 m, R = 2.5 m I = 1/700, n = 0.035, V = 2.0 m/s Q = 128 0 cu.m/s
Muang Mae Tak		A = 29.8 sq m, P = 14.9 m, R = 2.0 m I = 1/150, n = 0.035, V = 3.7 m/s Q = 110.3 cu.m/s
Huai Nam Ngam		A = 12.0 sq.m, P = 9.5 m, R = 1.2 m I = 1/100, n = 0.035, V = 3.2 m/s Q = 38.4 cu.m/s
Nam Mae Pu		A = 52.5 sq.m, P = 23.7 m, R = 2.2 m I = 1/700, n = 0.035, V = 1.8 m/s Q = 94.5 cu m/s

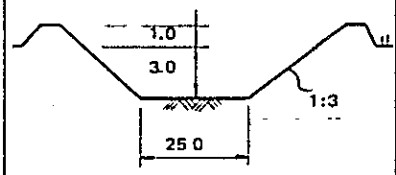
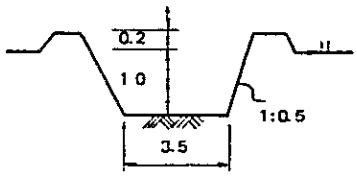
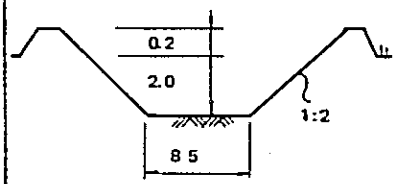
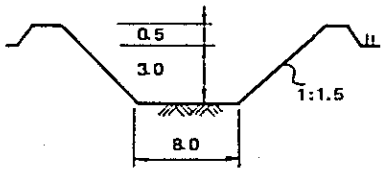
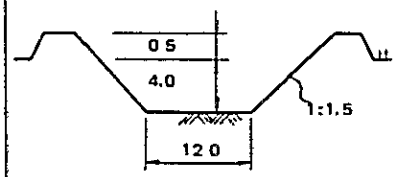
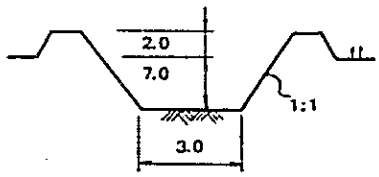
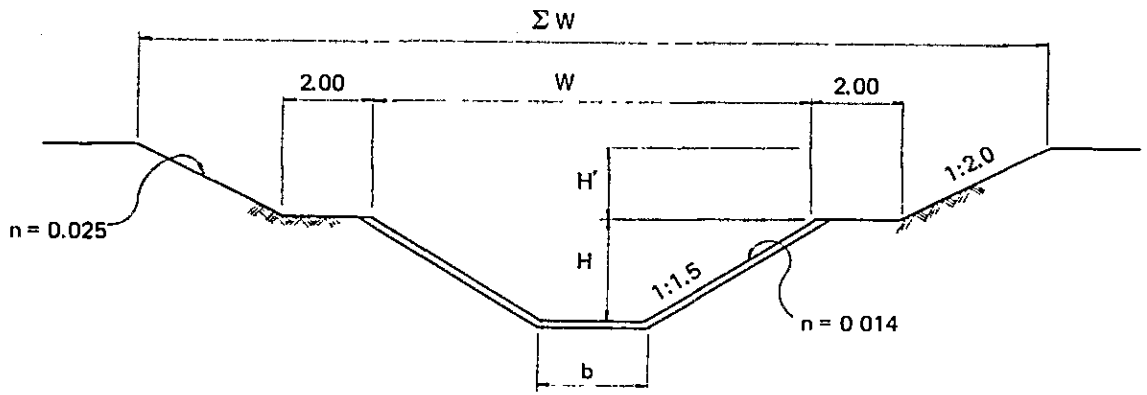
Name	Cross Section	Capacity
Muang Mae On		A = 102.0 sq.m, P = 44.0 m, R = 2.3 m I = 1/250, n = 0.035, V = 3.1 m/s Q = 316.2 cu.m/s
Huai Hat		A = 4.0 sq.m, P = 5.7 m, R = 0.7 m I = 1/500, n = 0.035, V = 1.0 m/s Q = 4.0 cu.m/s
Nam Mae Thi		A = 43.5 sq.m, P = 21.9 m, R = 2.0 m I = 1/250, n = 0.035, V = 2.9 m/s Q = 126.2 cu.m/s
Nam Mae Tip		A = 37.5 sq.m, P = 18.8 m, R = 2.0 m I = 1/400, n = 0.035, V = 2.6 m/s Q = 97.5 cu.m/s
Mae Yak		A = 72.0 sq.m, P = 26.4 m, R = 2.7 m I = 1/350, n = 0.035, V = 3.0 m/s Q = 216.0 cu.m/s
Huai Che		A = 70.0 sq.m, P = 22.8 m, R = 3.1 m I = 1/70, n = 0.035, V = 4.8 m/s Q = 336.0 cu.m/s

Table G 2 - 4 Hydraulic Calculation of Main Canal for Drainage

Canal	Section	b (m)	W (m)	ΣW (m)	H (m)	H' (m)	A (sq.km)	R (m)	I	n	V (m/sec)	Q Capacity (cu.m/sec)	Maximum Drainage Area (ha)	Q Run-off (cu.m/sec)	Q 1/ Irrigation Water (cu.m/sec)	ΣQ (cu.m/sec)	Remarks
Left Main Canal	No.0 – No.34+900	2.60	10.55	17.75	2.65	0.80	30.344	1.538	1/8,000	0.018	0.828	25.12	800	19.55	3.74	23.29	Q>ΣQ
	No.34+900– No.44+800	1.90	9.10	26.30	2.40	0.80	24.960	1.377	1/8,000	0.018	0.769	19.19	600	15.13	2.78	17.91	Q>ΣQ
	No.44+800– No.55+200	1.70	8.45	15.25	2.25	0.70	21.114	1.249	1/8,000	0.019	0.682	14.40	450	11.58	1.99	13.57	Q>ΣQ
	No.55+200– No.72	1.40	6.65	13.05	1.75	0.60	14.154	0.983	1/8,000	0.019	0.582	8.24	250	6.50	0.53	7.03	Q>ΣQ
Right Main Canal	No.0 – No.15+400	1.60	5.65	12.05	1.35	0.60	11.404	0.867	1/10,000	0.020	0.455	5.19	150	3.90	0.43	4.33	Q>ΣQ

Note: 1/ The average of the irrigation discharge in the wet season.



APPENDIX II. CONSTRUCTION MATERIALS

Appendix II CONSTRUCTION MATERIALS

Appendix II-1 Construction Materials

1) Borrow Area

The location of the borrow areas are shown on Figure H 1-1.

Borrow area investigations and material studies being conducted concurrently should be continued furthermore.

The following areas shall be strongly recommendable;

i) Reservoir areas

ii) Downstream areas within the 5 km limit far from the damsite

iii) Another downstream areas

iv) The use of materials from excavation for dam, spillways and other appurtenant structures shall also be taken into account.

2) Quality and Available Quantity of Materials

The quality of materials and quantity economically available at or near the damsite are important factors in selecting the type of dams. Subsequent material investigation should be conducted.

Conservative estimates of the available amount of materials are required twice of the necessary amount of designing a balanced fill.

Available amount of soil materials at each borrow areas is shown in Table H 1-1, which are estimated by RID.

Geologica reconnaisance for quarry sites finds out a lot of sandstone and shale in the reservoir area. Selecting the quarry in reservoir will have the several merits. Material investigation shall be initiated to determine the quarry and to study materials.

3) Material

Embankment materials for Mae Kuang Dam are soil for impervious zone, sand and gravel for filter zone and concrete aggregate and rock for pervious and semi-pervious zone.

a) Soil Materials

Soil consists of mostly silt and clay with variety of colour of greyish white, yellowish brown, reddish brown and red.

Field water content of these soils are dry side against optimum water content and watering to the materials shall be required to get the impervious soil. Matrices of soil are sandstone, shale, clay-slate and laterite.

The following criteria can be proposed to select the core material;

i) Plasticity index should be more than 6 per cent

ii) Gravel content (minus No.4) should be less than 65 per cent

iii) Silt and clay content (minus No.200) should be more than 10 per cent

iv) Coefficient of permeability should be less than 3×10^{-5} cm/sec

b) Filter materials and concrete aggregate

Sand and gravel from the Mae Kuang river shall be mostly available for filter and concrete aggregate. Crushed rock of limestone shall be also usable as construction materials.

c) Rock Materials

Types of rock for the dams are limestone, sandstone, shale and clay-slate.

Limestone and fresh sandstone shall be desirable for pervious and semi-pervious materials. Soft rock of weathered sandstone, shale and clay-slate shall be liable to crushed into small size during the consturction and/or by weathering. These rock should be used with care for pervious zone or random zone.

4) Material Testing

Material testing were executed by the following organizations:

i) RID ; Research & Laboratory Sect., January 1979
Report of Soil Test (Memo 209/2521)

ii) RID : Technical Division, 1980
Report of Soil Test (Memo 175/2522)

iii) RID : Field Laboratory, January 1978 to October 1980
Report on Earth Work Control of Left Saddle Dam

iv) JICA (contracted by K.E.C.) ; May 1981
Factual Report on Soil Engineering Properties of Embankment Materials

v) RID ; Research & Laboratory Sect., September 1981
Report of Soil Test (Memo 145/2524)
Report of Rock Test (Memo M-394CA)

Results of material tests are shown in Table II 1-2, Table II 1-3 and on Figure II 1-2.

5) Recommendation on Embankment Materials

Laboratory test shall be performed on samples from the test pits and drilling holes.

The physical property tests are required for promising sampled materials. The mechanical property tests are recommended for typical

samples. Detail test programs will be established during the progress of investigations and designs. Conservative quantity of material tests in shown in Table H 1-4.

Material testing shall be done mostly based on the standard of ASTM, unless the Engineer will require.

Table II 1-1 Borrow Area Investigation

(Unit: cu.m)

Investigated Year	Borrow Area	CL	CL-SC	SC	ML	ML-CL	ML-SM	SM	SM-SP	SP	GP GM	Laterite With Clay	Laterite With Silt	Total (m^3)
1977 (2520)[1/]	No. 1	18,600			113,500			123,000			6,900			262,000
	2	-			-			-			-			-
	3	26,400			396,000			348,000			-			770,000
	4	1,400			154,000			69,000			-			224,900
	5	197,500			188,000			227,000			-			612,500
	Sub-total	243,900			851,500			767,500			6,900			1,869,800
1978 (2521)[1/]	No. 6	57,600	-	37,800	32,400	9,000	-	149,400	5,400	-	-	-	-	291,600
	7	85,800	-	6,600	77,000	11,000	37,400	99,000	-	19,800	-	13,200	15,400	365,200
	8	195,700	-	58,500	117,000	-	15,700	146,200	-	11,200	13,500	49,500	-	607,730
	9	966,000	28,000	168,000	938,000	-	70,000	546,000	-	28,000	-	392,000	196,000	3,332,000
	10	310,400	-	99,200	179,200	-	-	185,600	-	-	-	112,000	-	886,400
	11	255,000	-	110,000	97,500	-	-	185,000	-	-	-	-	-	647,500
	12	322,500	-	187,500	517,500	-	-	990,000	-	-	-	-	-	2,017,500
	13	79,800	-	190,200	100,800	-	-	604,800	-	-	-	-	-	975,600
	14	840,000	-	-	1,545,000	-	540,000	1,920,000	-	-	-	-	-	4,845,000
	15	63,000	-	109,500	120,000	-	-	246,000	-	-	-	-	-	538,500
	16	453,600	-	93,600	32,400	-	302,400	147,600	-	-	-	68,400	61,200	1,159,200
	17	43,200	-	16,800	8,000	-	33,600	23,200	-	26,400	-	16,800	17,600	185,600
	Sub-total	3,672,600	28,000	1,077,700	3,764,800	20,000	999,100	5,242,800	5,400	85,400	13,500	651,900	290,200	15,851,400

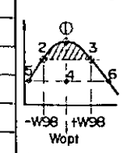
1/ Geotechnical Report, Borrow Area Investigation - MAE KUANG DAM -, Chiangmai, Thailand; Soil and Geology Division; March, 1979.

TABLE H1-2

SUMMARY OF SOIL TESTS

PROJECT: MAE KUANG
(Doi Saket, Chaign Mai, THAILAND)

SAMPLE NO	UNIFIED SOIL CLASSIFICATION	GRAIN-SIZE ANALYSIS: GRAVEL 4760μm (%)	SAND 74μm (%)	SILT 5μm (%)	CLAY (%)	MAX. PARTICLE SIZE (mm)	CONSISTENCY: LIQUID LIMIT WL (%)	PLASTIC LIMIT Wp (%)	PLASTICITY INDEX Ip	SPECIFIC GRAVITY OF SOIL Gs	FIELD MOISTURE CONTENT Wf (%)	COMPACTION TEST: METHOD ASTM STANDARD	OPTIMUM WATER CONTENT (Wopt %)	MAX DRY UNIT WT γdmax t/m³	(Wopt-Wf) (%)	SPECIMEN CONDITIONS: ① DENSITY DRY γd t/m³	DENSITY WET γt t/m³	WATER CONTENT W (%)	VOID RATIO e₀	DEGREE OF SATURATION Sr(%)	PERMEABILITY TEST: METHOD	COEFFICIENT OF PERMEABILITY K (cm/s)	CONSOLIDATION TEST: PRECONSOLIDATION STRESS Pc t/m²	COMPRESSION INDEX Cc	COEF. OF CONSOLI. Cv cm²/s	Δe / Δ log σ at 1.28 kg/cm² S (%)	DIRECT-SHEAR TEST: COHESION C (t/m²)	FRICTION ANGLE φ (degree)	TRIAXIAL-UU-TEST: COHESION Cu (t/m²)	FRICTION ANGLE φu (deg)	TRIAXIAL-CU-TEST: COHESION Ccu (t/m²)	FRICTION ANGLE φcu (deg)	UNCONFINED COMPRESSION TEST: qu (t/m²)	Fsa (t/m²)	REMARKS
(BAN PAN Borrow Area)																																				
BP-1	MH	1.6	39.2	18.2	41.0	9.52	55.60	33.13	22.47	2.655, 2.665, 2.658	14.16, 16.84, 16.45																											1) Mechanical Prop Testing Point
(Minus NO 4)										(2.660)	(15.81)																									
							Shring Kage Limit 26.25					Ⓐ	28.8	1.463	(+) 1.30	① 1.00	1.463	1.884	(Wopt) 28.8	0.818	93.6	Falling Head	2.1x10⁻⁶	28.0% (1.85)	0.04		1.03	5.0 (2.846%/1.466/1.883)	19.0	18 *	0 *	7.0	18.8°			
																② -98	1.433	1.803	(-W98) 25.8	0.856	80.1	"	2.1x10⁻⁶	26.1% 1.800	0.07		88			(Saturated Sample *					
																③ +98	"	1.887	(+W98) 31.7	"	98.5	"	1.2x10⁻⁷	30.9% 1.889	0.04		74								
																④ +95	1.389	1.789	(Wopt) 28.8	0.915	83.7	—	—													
(Brown)																⑤ -95	"	1.725	(-W95) 24.2	"	70.4	Fall	1.2x10⁻⁶													
												(RID)* -A-	29.5*	1.460*	(+) 1.37*	⑥ +95	"	1.858	(+W95) 33.8	"	98.3	"	2.9x10⁻⁷	32.7% 1.843	0.08		109	4.0 (2.848%/1.392/1.787)	20°	14 *	0 *	2.8	22°			
																															Saturated Sample *					
BP-2		Before Compaction 19.8	24.3	8.9	47.0	19.1				2.630																										
(Minus 3/4")	MH	After Compaction 12.9	28.2	11.9	47.0	12.7	—	—	—	2.654, 2.665																										
(Brown)										(2.650)																										
												Ⓐ	27.1	1.523		① 1.00	1.523	1.935	(Wopt) 27.1	0.740	97.0	Fall	4.1x10⁻⁷													
																② -98	1.492	1.853	(-W98) 24.2	0.776	82.6	"	1.1x10⁻⁷													
																③ +98	"	1.921	(+W98) 28.8	"	98.3	"	2.9x10⁻⁷													
												(RID)* -C-	22.0*	1.680*	(+) 6.2*																							
BP-3																① 1.00	1.502	1.900	26.5	0.871	85.5	Fall	2.0x10⁻⁷		0.11		10.7	2.0	26°	6.2	14°	2.5	24°			
(2.5~3.0m)	(MH)	—	—	—	—	—	—	—	—	2.81	29.7	Ⓐ	26.5	1.502	⊖ 3.2	② -98	1.472	1.805	22.6	0.909	70.0	"	2.3x10⁻⁷		0.21		13.0	1.5	23°	6.0	22.5°					
(Brown)																③ +98	"	1.912	29.9	"	92.4	"	2.0x10⁻⁷		0.13		9.9	2.9	24.5°	6.0	14.5°					
																④ +95	1.427	1.805	26.5	0.969	76.8	—	—							(Partial Satur. Sample)					
												(Site)* -A-	28.5*	1.465*	⊖ 1.2*																					
(Huai Hak Borrow Area)																																				
HH-1		3.4	2.4	1.4	2.8	12.7	37.00	20.61	16.39	2.632, 2.610	3.97, 3.85																									
(Brown)	SC						Shring Kage Limit: 26.20			(2.623)	(3.90)																											
from pit AD-3										2.626	3.89																									
												(RID)* -A-	11.8	1.965	(+) 7.9																					
HH-2							44.00	23.00	21.00	2.628, 2.618	9.75, 9.90																											
	SC	7.2	3.2	1.5	4.6	9.5	Shring Kage Limit: 25.64			2.630 (2.626)	9.44 (9.69)																											
(Grey)																																				
from pit AD-4												(RID)* -A-	16.2*	1.790*	(+) 6.5*																					
HH-3																① 1.00	1.998	2.218	11.0	0.336	87.5	Fall.	1.8x10⁻⁷		0.05		7.4	0.5	42°	7.5	25.5°	5.1	28°			
(0.5~1.5m)	SM	3.5	4.7	1.1	0.7	38.1	—	Non Plastic	—	2.67	14.3	Ⓐ	11.0	1.998	⊖ 3.3	② -98	1.958	2.134	9.0	0.364	66.0	"	1.6x10⁻⁶					2.0	31.5°	12.0	24°					
(Brown)																③ +98	"	2.209	12.8	"	94.0	"	1.3x10⁻⁶		0.06		6.5	2.0	35°	7.5	17°					
from pit AD-3																④ +95	1.898	2.107	11.0	0.407	72.2	—	—													
												(Site)* -A-	12.7*	1.930*	⊖ 1.6*																					
HH-4																① 1.00	1.652	1.976	19.6	0.628	83.9	Fall.	2.0x10⁻⁷		0.11		8.6	4.4	24°	7.2	13.5°	4.2	22°			
(3.0~4.0m)	CH	0.5	3.6	2.3	3.6	19.1	57	28	29	2.69	17.3	Ⓐ	19.6	1.652	(+) 2.3	② -98	1.619	1.891	16.8	0.662	68.3	"	1.0x10⁻⁶					1.2	26.5°	7.5	1.5°					
(Grey)																③ +98	"	1.977	22.1	"	89.7	"	5.8x10⁻⁸		0.11		7.5	2.8	25.5°	6.3	11.5°					
from pit AD-4																④ +95	1.569	1.877	19.6	0.714	73.8	—	—													
Pervious Materials											Absorption*																									1) Filter materials of SS-1,2,3 sampled from Sand Stock Area.
SS-1	SP	0	88.9	(11.1)		4.76				2.59	—											Const. Head	3.9x10⁻³													
(Fine Sand)																																				2) R-1 & R-2 were lime stone
SS-2	SP	13.5	8.6	(5.9)		9.5				2.585	—											Const. Head	4.6x10⁻³													
(Medium Sand)																																				3) SS-1,2,3 & R-1,2 tested by KEC.
SS-3 (Gravel)	GP	—	—	—	—	—				2.70	0.48*																									
R-1 (Rock)	GP									2.71	0.45*																									
R-2 (Rock)	GP									2.70	0.47*																									



2) BP-1,2 & HH-1,2 sampled at March, 1981 and tested by KEC, May 1981.

3) BP-3 & HH-3,4 sampled at June, 1981 and tested by RID, Sept 1981

4) BP-1, 2, 3 sampled from the same pit.

5) HH-1, 3 sampled from the pit of AD-3 and HH-2, 4 from the pit AD-4.

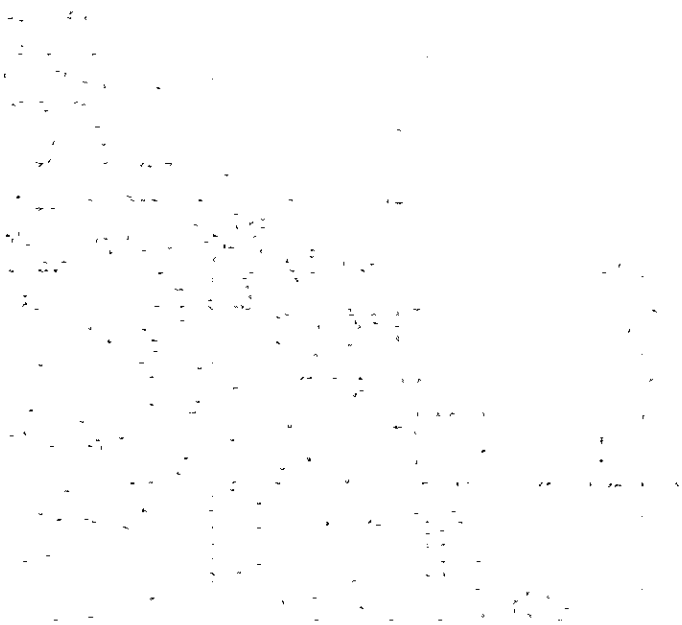


Table II 1-3 Summary of Rock Test[1/]

Sample	Source	Depth (m)	Apparent Specific Gravity	Absorption (%)	Compression Strength (kg/cm^2)	Soundness by Sodium Sulfate (% loss)
R-3	Ban Pasak Ngam		2.73	0.60		3.20
R-4	Cliff at upstream of left abutment of Main dam		2.60	2.50		9.40
DSP-1	DH-1 from Spillway	3.0 ~ 6.3	2.66	0.75	903 866	8.68
DSP 5-A	DH-5 from Spillway	6.2 ~ 7.0	2.63	2.25	137[1/] 224[1/]	7.64
DSP 5-B		13.8 ~ 14.0	2.71	0.74		1.82
MDA-2	MDA-2 from Main dam	21.0 ~ 22.3	2.81	0.20	175[2/] 481	7.36

Note) 1/ : tested by RID, July 1981
2/ : Specimen with hair crack

Table II 1-4 Laboratory Test for Embankment Materials

Item	Qantity	Remarks
a) Physical Property Test of Soil		
1. Water Content	50 x 2	
2. Specific Gravity	50	
3. Grain Size Analysis (Sieving Method)	50	
4. Grain Size Analysis (Hydrometer Method)	50	
5. Liquid Limit	50 x 2	
6. Plastic Limit	50 x 2	
7. Unit Weight of Soil	25	
b) Mechanical Property Test of Soil		
8. Compaction	20 x 2	Standard and Modified Method
9. Consolidation	20	e ~ logP, Cv,
10. Falling-head Permeability	20 x 2	
11. Direct Shear -cu-	20 x 2	
12. Triaxial -uu- 1/	10	1/ with pore pressure measurement.
13. Triaxial -cu -1/	20	
14. Static Penetration	20	
15. Peping Test 2/	5	2/ for fine and medium sand
c) Rock Material Test		
1. Absorption	30	
2. Sulphate Soundness	30	
3. Compressive Strength	30	
4. Sulphate Soundness	30	
5. Los Angeles Abrasion	30	
6. Slaking Test	10	
7. Direct Shear -cu- 3/	15	3/ large scale test
8. Compaction 3/	15	
9. Sieving 3/	15	
d) Filter Material Test		
1. Sieving	20	
2. Absorption	20	
3. Constant-head Permeability	10 x 2	
4. Relative Density	10	

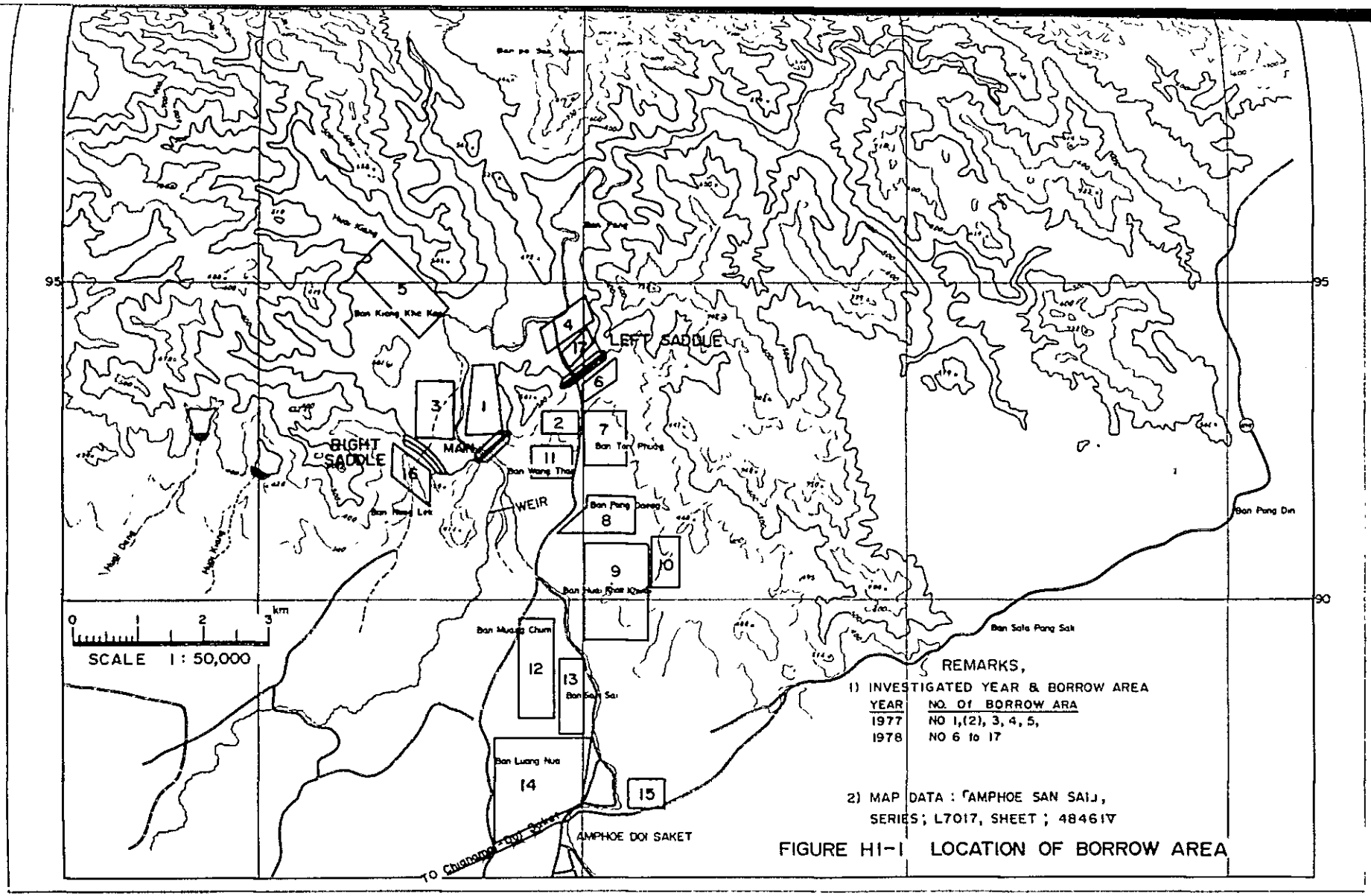
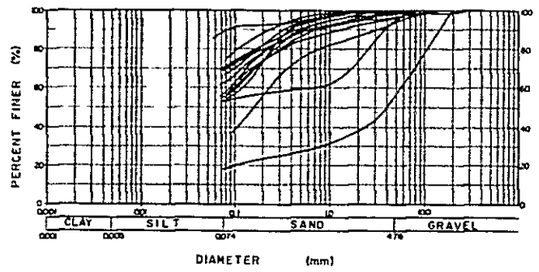
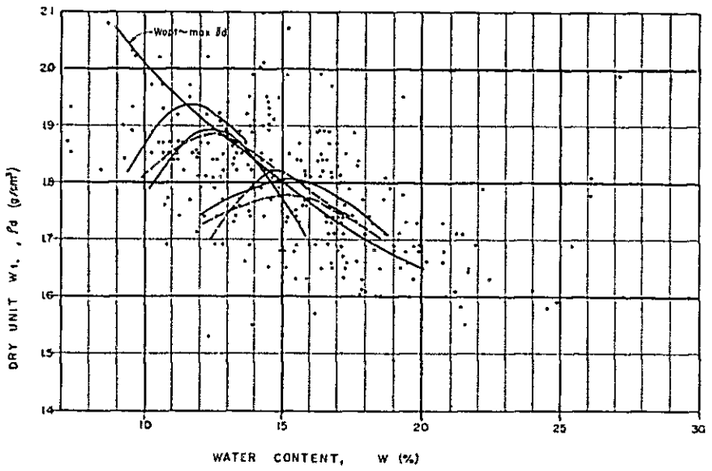


FIGURE H1-1 LOCATION OF BORROW AREA

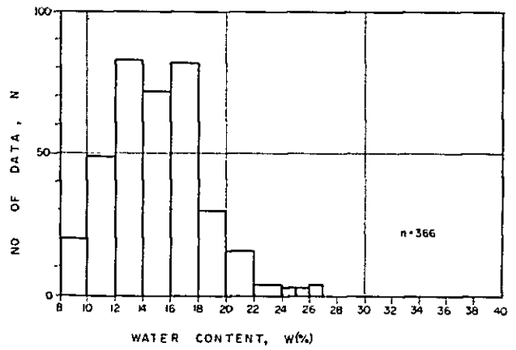
GRAIN-SIZE ANALYSIS



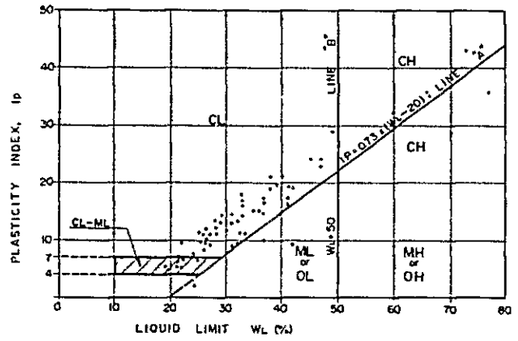
COMPACTION TEST & FILL-DENSITY



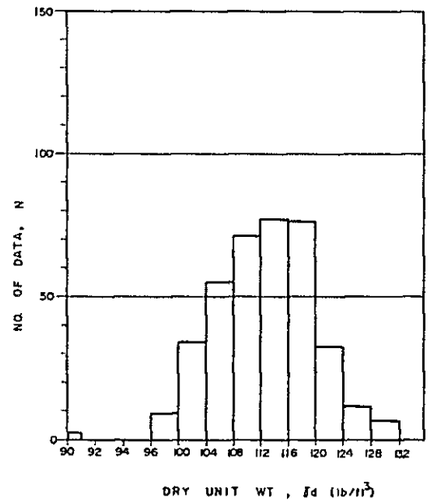
Wf ~ N



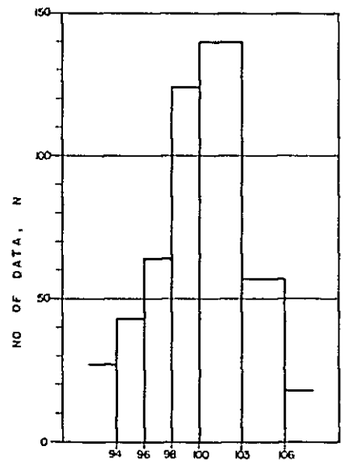
PLASTICITY CHART



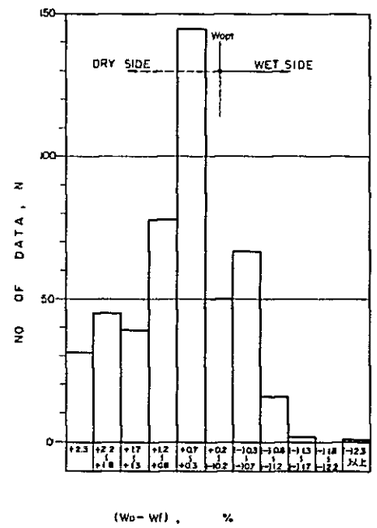
γd ~ N



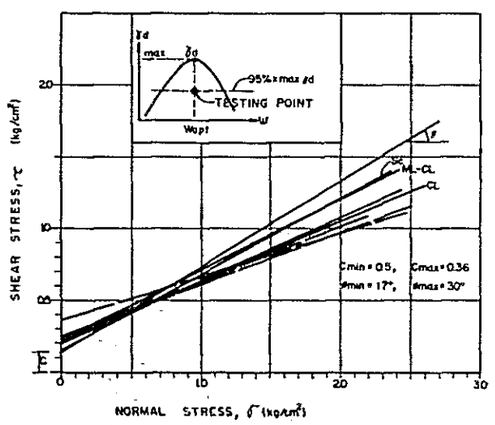
D-VALUE ~ N



(Wo-Wf) ~ N

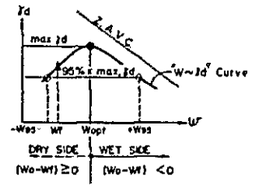


DIRECT-SHEER TEST



REMARKS:

1)



2) $\gamma d(t/m^3) = \gamma d\ (lb/ft^3) \times 001602$

3) $D\text{-Value}\ (\%) = \frac{\gamma d \times 100}{\max \gamma d}$

FIGURE H 1-2 SUMMARY OF SOIL TEST

APPENDIX I. COST ESTIMATES

APPENDIX I COST ESTIMATES

Appendix I-1 Cost Estimates under Force Account

Appendix I-2 Cost Estimate under Contract

Table I 1-2. Budget Schedule of the Project
(Force account base for Main Dam etc.)

	Total			2519 - 2525 - Sept.'82			2526 Oct.'82 - Sept.'83			2527 Oct.'83 - Sept.'84			2528 Oct.'84 - S	
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C
Civil Works (Sub-total)	887,245	1,100,695	1,987,938	0	130,610	130,610	186,080	199,095	385,175	251,051	277,734	528,785	229,890	258,2
1. Pre-Engineering	390	8,730	9,120	0	5,250	5,250	240	2,130	2,370	90	790	880	60	5
2. Preparation	3,290	1,670	4,960	0	260	260	3,290	1,410	4,700	0	0	0	0	
3. Main Dam	379,837	384,209	764,046	0	0	0	37,984	38,421	76,405	113,951	115,263	229,214	113,951	115,2
4. Left Saddle Dam	132,064	224,230	356,294	0	103,810	103,810	105,651	96,336	201,987	23,772	21,675	45,447	2,641	2,4
5. Right Saddle Dam	112,712	110,583	223,295	0	0	0	0	0	0	45,085	44,233	89,318	45,085	44,2
6. Spillway	52,853	52,238	105,091	0	0	0	0	0	0	15,856	15,671	31,527	15,856	15,6
7. Main Canal	93,751	172,972	266,723	0	15,440	15,440	18,750	31,507	50,257	28,126	47,259	75,385	28,126	47,2
8. Lateral Canal	49,764	67,614	117,379	0	0	0	9,953	15,523	23,476	14,929	20,285	35,214	14,929	20,2
9. Improvement Old Facilities	46,212	62,788	109,000	0	0	0	9,242	12,558	21,800	9,242	12,558	21,800	9,242	12,5
10. Others	16,370	15,660	32,030	0	5,850	5,850	970	3,210	4,180	0	0	0	0	
Land Acquisition & Compensation (Sub-total)	0	110,230	110,230	0	73,500	73,500	0	8,000	8,000	0	9,000	9,000	0	9,0
1. Land Acquisition	0	69,410	69,410	0	32,680	32,680	0	8,000	8,000	0	9,000	9,000	0	9,0
2. Compensation	0	40,820	40,820	0	40,820	40,820	0	0	0	0	0	0	0	
Construction Equipment (Sub-total)	203,000	64,760	267,760	0	22,230	22,230	100,750	8,850	109,600	100,750	12,400	113,150	0	10,6
1. Old Equipment	0	57,760	57,760	0	22,230	22,230	0	7,100	7,100	0	10,650	10,650	0	10,6
2. New Equipment	200,000	0	200,000	0	0	0	100,000	0	100,000	100,000	0	100,000	0	
3. Transportation	3,000	7,000	10,000	0	0	0	750	1,750	2,500	750	1,750	2,500	0	
Project Facilities	5,740	38,480	44,220	0	27,980	27,980	1,640	3,000	4,640	820	1,500	2,300	3,280	6,0
Project Administration	0	14,550	14,550	0	4,640	4,640	0	2,290	2,290	0	2,290	2,290	0	2,2
Consulting Services	90,638	55,554	146,192	0	0	0	22,206	13,611	35,817	11,149	6,833	17,982	14,411	8,8
On-Farm Development)	(100,691)	(136,809)	(237,500)	(0)	(0)	(0)	(20,138)	(27,362)	(47,500)	(20,138)	(27,362)	(47,500)	(20,128)	(27,3
Sub-total (1-6)	1,186,621	1,384,269	2,570,890	0	258,960	258,960	310,676	234,846	545,522	363,770	309,757	673,527	247,581	295,0
Contingency	120,997	158,341	279,338	0	38,844	38,844	36,664	24,180	60,844	47,705	40,450	88,155	26,664	36,0
Sub-total (1-6, 8)	1,307,618	1,542,610	2,850,228	0	297,804	297,804	347,340	259,026	606,366	411,475	350,207	761,682	274,245	331,0
Price Escalation	248,713	601,551	850,264	0	0	0	24,314	38,854	63,168	59,623	112,942	172,565	61,717	172,4
Total (1-6, 8, 9)	1,556,331	2,144,161	3,700,492	0	297,804	297,804	371,654	297,880	669,534	471,098	463,149	934,247	335,962	503,4
Sub-total (1-7)	(1,287,312)	(1,521,078)	(2,808,390)	(0)	(258,960)	(258,960)	(330,814)	(262,208)	(593,022)	(385,908)	(337,119)	(721,027)	(267,719)	(322,3
Contingency	(136,101)	(178,862)	(314,963)	(0)	(38,844)	(38,844)	(39,685)	(28,284)	(67,969)	(50,725)	(44,555)	(95,280)	(29,685)	(40,1
Sub-total (1-7, 8')	(1,423,413)	(1,699,940)	(3,123,353)	(0)	(297,804)	(297,804)	(370,499)	(290,492)	(660,991)	(434,633)	(381,674)	(816,307)	(297,404)	(362,5
Price Escalation	(274,928)	(686,447)	(961,375)	(0)	(0)	(0)	(25,935)	(43,574)	(69,509)	(62,978)	(123,090)	(186,068)	(66,929)	(188,8
Total (1-7, 8', 9')	(1,698,341)	(2,386,387)	(4,084,728)	(0)	(297,804)	(297,804)	(396,434)	(334,066)	(730,500)	(497,611)	(504,764)	(1,002,375)	(364,333)	(551,3

(Unit: ฿'000)

ept.'85		2527			2528			2529			2530			2531		
		Oct.'83 - Sept.'84			Oct.'84 - Sept.'85			Oct.'85 - Sept.'86			Oct.'86 - Sept.'87			Oct.'87 - Sept.'88		
-	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
95	385,175	251,051	277,734	528,785	229,890	258,238	488,128	120,177	136,721	256,898	55,219	60,438	115,657	44,826	37,859	82,685
30	2,370	90	790	880	60	560	620	0	0	0	0	0	0	0	0	0
10	4,700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	76,405	113,951	115,263	229,214	113,951	115,263	229,214	56,976	57,631	114,607	37,984	38,421	76,405	18,991	19,210	38,201
36	201,987	23,772	21,675	45,447	2,641	2,409	5,050	0	0	0	0	0	0	0	0	0
0	0	45,085	44,233	89,318	45,085	44,233	89,318	11,270	11,059	22,329	5,636	5,529	11,165	5,636	5,529	11,165
0	0	15,856	15,671	31,527	15,856	15,671	31,527	19,027	18,806	37,833	2,144	2,090	4,204	0	0	0
07	50,257	28,126	47,259	75,385	28,126	47,259	75,385	14,063	23,629	37,692	4,686	7,878	12,564	0	0	0
23	23,476	14,929	20,285	35,214	14,929	20,285	35,214	4,977	6,760	11,737	2,488	3,381	5,869	2,488	3,381	5,869
58	21,800	9,242	12,558	21,800	9,242	12,558	21,800	13,864	18,836	32,700	2,311	3,139	5,450	2,311	3,139	5,450
10	4,180	0	0	0	0	0	0	0	0	0	0	0	0	15,400	6,600	22,000
00	8,000	0	9,000	9,000	0	9,000	9,000	0	7,000	7,000	0	3,730	3,730	0	0	0
00	8,000	0	9,000	9,000	0	9,000	9,000	0	7,000	7,000	0	3,730	3,730	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	109,600	100,750	12,400	113,150	0	10,650	10,650	0	5,300	5,300	0	1,480	1,480	1,500	3,850	5,350
00	7,100	0	10,650	10,650	0	10,650	10,650	0	5,300	5,300	0	1,480	1,480	0	350	350
0	100,000	100,000	0	100,000	0	0	0	0	0	0	0	0	0	0	0	0
50	2,500	750	1,750	2,500	0	0	0	0	0	0	0	0	0	1,500	3,500	5,000
00	4,640	820	1,500	2,300	3,280	6,000	9,280	0	0	0	0	0	0	0	0	0
90	2,290	0	2,290	2,290	0	2,290	2,290	0	1,520	1,520	0	760	760	0	760	760
11	35,817	11,149	6,833	17,982	14,411	8,833	23,244	16,677	10,222	26,899	14,593	8,944	23,537	11,602	7,111	18,713
62)	(47,500)	(20,138)	(27,362)	(47,500)	(20,128)	(27,362)	(47,500)	(30,207)	(41,043)	(71,250)	(5,035)	(6,840)	(11,875)	(5,035)	(6,840)	(11,875)
46	545,522	363,770	309,757	673,527	247,581	295,011	542,592	136,854	160,763	297,617	69,812	75,352	145,164	57,928	49,580	107,508
80	60,844	47,705	40,450	88,155	26,664	36,042	62,706	8,572	14,638	23,210	- 565	2,866	2,301	1,957	1,321	3,278
26	606,366	411,475	350,207	761,682	274,245	331,053	605,298	145,426	175,401	320,827	69,247	78,218	147,465	59,885	50,901	110,786
54	63,168	59,623	112,942	172,565	61,717	172,437	234,154	45,198	131,376	176,574	27,875	79,106	106,981	29,986	66,836	96,822
80	669,534	471,098	463,149	934,247	335,962	503,490	839,452	190,624	306,777	497,401	97,122	157,324	254,446	89,871	117,737	207,608
08)	(593,022)	(383,908)	(337,119)	(721,027)	(267,719)	(322,373)	(590,092)	(167,061)	(201,806)	(368,867)	(74,847)	(82,192)	(157,039)	(62,963)	(56,420)	(119,383)
84)	(67,969)	(50,725)	(44,555)	(95,280)	(29,685)	(40,146)	(69,831)	(13,103)	(20,795)	(33,898)	(191)	(3,891)	(4,082)	(2,712)	(2,347)	(5,059)
92)	(660,991)	(434,633)	(381,674)	(816,307)	(297,404)	(362,519)	(659,923)	(180,164)	(222,601)	(402,765)	(75,038)	(86,083)	(161,121)	(65,675)	(58,767)	(124,442)
74)	(69,509)	(62,978)	(123,090)	(186,068)	(66,929)	(188,827)	(255,756)	(55,994)	(166,730)	(222,724)	(30,207)	(87,061)	(117,268)	(52,885)	(77,165)	(110,050)
66)	(730,500)	(497,611)	(504,764)	(1,002,375)	(364,333)	(551,346)	(915,679)	(236,158)	(389,331)	(625,489)	(105,245)	(173,144)	(278,389)	(98,560)	(135,932)	(234,492)

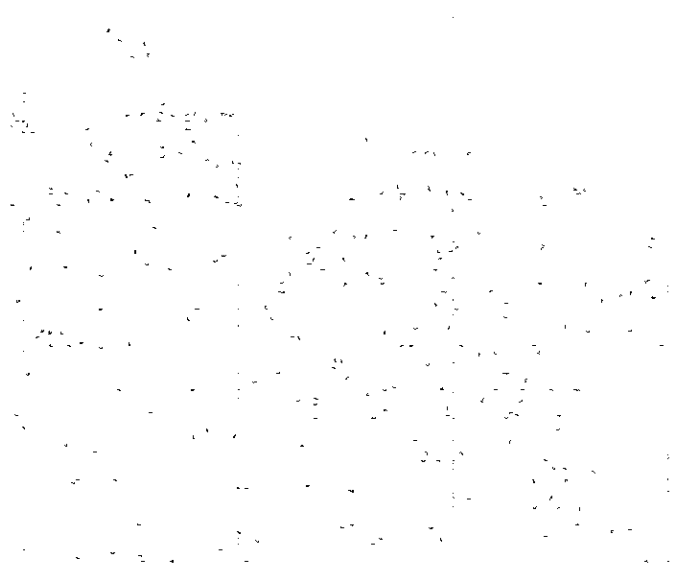


Table I 1-3. Estimate of the Project Cost

Item	Description		Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency			Local Currency		
							Depreciation (฿'000)	Material (฿'000)	Total (฿'000)	Material (฿'000)	Labor (฿'000)	Total (฿'000)
1. Civil Works												
1-1.	Pre-Engineering	(1)		R.I.D's item	A	5,250	-	-	-	525	4,725	5,250
	"	(2)		"		3,870	-	390	390	-	3,480	3,480
1-2.	Preparation	(1)		"	B-10	260	-	-	-	-	260	260
	"	(2)		"	B-8	4,700	-	3,290	3,290	-	1,410	1,410
1-3.	Main Dam	(1)		"	C-2	-	-	-	-	-	-	-
	"	(2)		"	"	764,046	-	379,837	379,837	150,094	234,115	384,209
1-4.	Left Saddle Dam	(1)		"	C-3	103,810	-	-	-	59,130	44,680	103,810
	"	(2)		"	"	252,484	-	132,064	132,064	55,146	65,274	120,420
1-5.	Right Saddle Dam	(1)		"	C-4	-	-	-	-	-	-	-
	"	(2)		"	"	223,295	-	112,712	112,712	48,985	61,598	110,583
1-6.	Spill Way	(1)		"	C-6	-	-	-	-	-	-	-
	"	(2)		"	"	105,091	-	52,853	52,853	20,444	31,794	52,238
1-7.	Main Canal	(1)		"	D	15,440	-	-	-	93,354	6,086	15,440
	"	(2)		"	"	251,283	-	93,751	93,751	73,761	83,771	157,532
1-8.	Lateral Canal	(1)		"	"	-	-	-	-	-	-	-
	"	(2)		"	"	117,379	-	49,764	49,764	26,101	41,514	67,615
1-9.	Improvement Old Facilities	(1)		"	E	-	-	-	-	-	-	-
	"	(2)		"	"	109,000	-	46,212	46,212	23,928	38,860	62,788
1-10.	Others	(1)		"	C-1, 5, 7	5,850	-	-	-	2,925	2,925	5,850
	"	(2)		"	"	26,180	-	16,370	16,370	4,905	4,905	9,810
	Total	(1)				130,610	-	-	-	71,934	58,676	130,610
	Total	(2)				1,857,328	-	887,243	887,243	403,365	566,720	970,085
	Total (1) + (2)					1,987,938	-	887,243	887,243	475,299	625,396	1,100,695
2. Land Acquisition & Compensation												
2-1.	Land Acquisition	(1)		R.I.D's item	H	32,680	-	-	-	32,680	-	32,680
	"	(2)		"	"	36,730	-	-	-	36,730	-	36,730
2-2.	Compensation	(1)		"	B-9	40,820	-	-	-	20,410	20,410	40,820
		(2)		"	"	-	-	-	-	-	-	-
	Total	(1)				73,500	-	-	-	53,090	20,410	73,500
	Total	(2)				36,730	-	-	-	36,730	-	36,730
	Total (1) + (2)					110,230	-	-	-	89,820	20,410	110,230

Item	Description	Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency			Local Currency		
						Depreciation (฿'000)	Material (฿'000)	Total (฿'000)	Material (฿'000)	Labor (฿'000)	Total (฿'000)
3.	Construction Equipment										
3-1.	Old Equipment (1)		R.I.D's item F-2		22,230	-	-	-	22,230	-	22,230
	" (2)		" "		35,530	-	-	-	35,530	-	35,530
3-2.	New Equipment (1)		New item		-	-	-	-	-	-	-
	" (2)		"		200,000	200,000	-	200,000	-	-	-
3-3.	Transportation (1)		R.I.D's item F-3		-	-	-	-	-	-	-
	" (2)		" "		10,000	-	3,000	3,000	3,500	3,500	7,000
	Total (1)				22,230	-	-	-	22,230	-	22,230
	Total (2)				245,530	200,000	3,000	203,000	39,030	3,500	42,530
	Total (1) + (2)				267,760	200,000	3,000	203,000	61,260	3,500	64,760
4.	Project Facilities										
	" (1)		R.I.D's item B-1-7		27,980	-	-	-	13,990	13,990	27,980
	" (2)		"		16,240	-	5,740	5,740	5,250	5,250	10,500
	" (1) + (2)				44,220	-	5,740	5,740	19,240	19,240	38,480
5.	Project Administration										
	" (1)		R.I.D's item F-1		4,640	-	-	-	460	4,180	4,640
	" (2)		"		9,910	-	-	-	990	8,920	9,910
	" (1) + (2)				14,550	-	-	-	1,450	13,100	14,550
6.	Consulting Services										
	" (1)										
	" (2)				146,192	-	90,638	90,638	-	55,554	55,554
	" (1) + (2)				146,192	-	90,638	90,638	-	55,554	55,554
7.	On-Farm Development										
	(1)				-	-	-	-	-	-	-
	(2)				237,500	-	100,691	100,691	52,136	84,673	136,809
	(1) + (2)				237,500	-	100,691	100,691	52,136	84,673	136,809
	Sub-Total (1-6)										
	" (1)				258,960	-	-	-	161,704	97,256	258,960
	" (2)				2,311,930	200,000	986,621	1,186,621	485,365	639,944	1,125,309
	" (1) + (2)				2,570,890	200,000	986,621	1,186,621	647,069	737,200	1,384,269
	Sub-Total (1-7)										
	" (1)				258,960	-	-	-	161,704	97,256	258,960
	" (2)				2,549,430	200,000	1,087,312	1,287,312	532,501	724,617	1,262,118
	" (1) + (2)				2,808,390	200,000	1,087,312	1,287,312	699,205	821,873	1,521,078

Item	Description	Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency			Local Currency		
						Depreciation (฿'000)	Material (฿'000)	Total (฿'000)	Material (฿'000)	Labor (฿'000)	Total (฿'000)
1-3.	Main Dam (2)										
1-3-1.	Clearing Construction & Borrow Area	400	rai	300	120	-	12	12	24	84	108
1-3-2.	River Diversion		L.S.		10,000	-	5,000	5,000	2,000	3,000	5,000
1-3-3.	Earth Works										
	Stripping Dam Foundation & Borrow	537,000	cu.m	12	6,444	-	3,222	3,222	1,289	1,933	3,222
	Cut Off Trench (Soil)	407,000	"	24	9,768	-	4,884	4,884	1,954	2,930	4,884
	" (Soft Rock)	272,000	"	31	8,432	-	5,481	5,481	1,475	1,476	2,951
	Embankment (Core)	954,000	"	40	38,160	-	17,172	17,172	6,678	14,310	20,988
	" (Transition)	406,000	"	60	24,360	-	12,180	12,180	3,654	8,526	12,180
	(Rock)	3,882,000	"	80	310,560	-	170,808	170,808	46,584	93,168	139,752
	Dam Slope Furnishing	170,000	sq.m	10	1,700	-	170	170	170	1,360	1,530
	Sub-total (1-3-3)				399,424	-	213,917	213,917	61,804	123,703	185,507
1-3-4.	Drain & Slope Protection										
	Filter Drain	164,000	cu.m	125	20,500	-	9,225	9,225	3,588	7,687	11,275
	Riprap with Bedding	170,000	"	540	91,800	-	9,180	9,180	36,720	45,900	82,620
	Sub-total (1-3-4)				112,300	-	18,405	18,405	40,308	53,587	93,895
1-3-5.	Foundation Treatment										
	Fault Treatment	3	zone	3,500,000	10,500	-	5,250	5,250	2,625	2,625	5,250
	Core Drilling with P.Test	2,000	m	2,300	4,600	-	3,680	3,680	460	460	920
	Drilling for Contact G.	2,000	"	600	1,200	-	960	960	120	120	240
	Contact Grouting	200	ton	4,400	880	-	528	528	308	44	352
	Drilling for Curtain G.	3,300	m	1,500	49,500	-	39,600	39,600	4,950	4,950	9,900
	Curtain Grouting	4,950	ton	4,400	21,780	-	13,068	13,068	7,623	1,089	8,712
	Drilling for Blanket Grouting	17,000	m	600	10,200	-	8,160	8,160	1,020	1,020	2,040
	Blanket Grouting	2,550	ton	4,400	11,220	-	6,732	6,732	3,927	561	4,488
	Sub-total (1-3-5)				109,880	-	77,978	77,978	21,033	10,869	31,902
1-3-6.	Instrument Guage		L.S.		5,000	-	4,000	4,000	-	1,000	1,000
1-3-7.	Furnishing Road Way	0.7	km	950,000	665	-	266	266	133	266	399
1-3-8.	Pole with Guardrail	1.4	"	375,000	525	-	367	367	53	105	158
1-3-9.	Electrical Installing		L.S.		880	-	440	440	132	308	440
1-3-10.	River Outlet Construction										
	Excavation (Rock, mp)	5,000	cu.m	100	500	-	175	175	50	275	325
	" (machine)	40,000	"	30	1,200	-	600	600	240	360	600
	Backfill (manpower)	10,000	"	60	600	-	30	30	60	510	570
	" (machine)	20,000	"	33	660	-	330	330	132	198	330
	Reinforced Concrete	3,200	"	3,700	11,840	-	2,368	2,368	2,368	7,104	9,472
	Water Stop	1,000	m	700	700	-	70	70	560	70	630
	Mass Concrete	3,900	cu.m	1,600	6,240	-	1,872	1,872	2,496	1,872	4,368
	Trashrack		L.S.		2,000	-	1,400	1,400	100	500	600
	Steel Liner ø2.2 m x 300 m		L.S.		6,000	-	4,200	4,200	300	1,500	1,800
	High Pressure Gate		L.S.		6,000	-	4,200	4,200	300	1,500	1,800
	Drainage Work		L.S.		3,000	-	1,500	1,500	600	900	1,500
	Control House etc.		L.S.		4,650	-	2,010	2,010	1,320	1,320	2,640
	Sub-Total (1-3-10)				43,390	-	18,755	18,755	8,526	16,109	24,635
	Construction Sub-Total				682,184	-	339,140	339,140	134,013	209,031	343,044
1-3-11.	Miscellaneous				81,862	-	40,697	40,697	16,081	25,084	41,165
	Total				764,046	-	379,837	379,837	150,094	234,115	384,209

Item	Description		Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency Depreciation (฿'000)	Foreign Currency Material (฿'000)	Foreign Currency Total (฿'000)	Local Currency Material (฿'000)	Local Currency Labor (฿'000)	Local Currency Total (฿'000)
1-4.	Left Saddle Dam											
1-4-1.	Clearing Construction & Borrow Area	(1)	650	rai	240	156	-	-	-	47	109	156
1-4-2.	Earth Works											
	Stripping Dam Foundation & Borrow	(1)	221,000	cu.m	8.60	1,900	-	-	-	950	950	1,900
	"	(2)	39,000	"	12	468	-	234	234	94	140	234
	Cut Off Trench	(1)	100,000	"	11.8	1,180	-	-	-	590	590	1,180
	"	(2)	127,000	"	24	3,048	-	1,524	1,524	610	914	1,524
	Embankment Core	(2)	628,000	"	40	25,120	-	11,304	11,304	4,396	9,420	13,816
	" Randam	(1)	455,700	"	25.7	11,714	-	-	-	5,857	5,857	11,714
	" "	(2)	932,000	"	40	37,280	-	16,776	16,776	6,524	13,980	20,504
	" Rock	(2)	79,000	"	80	6,320	-	3,476	3,476	948	1,896	2,844
	Dam Slope Furnishing	(2)	67,000	sq.m	10	670	-	67	67	67	536	603
	Sub-Total (1-4-2)	(1)				14,794	-	-	-	7,397	7,397	14,794
	"	(2)				72,906	-	33,381	33,381	12,638	26,887	39,525
	" (1) + (2)					87,700	-	33,381	33,381	20,035	34,284	54,319
1-4-3.	Drain & Slope Protection											
	Filter Dain	(1)	61,700	cu.m	87.5	5,400	-	-	-	2,700	2,700	5,400
	"	(2)	35,300	"	125	4,413	-	1,986	1,986	772	1,655	2,427
	Sodding	(2)	35,000	sq.m	20	700	-	70	70	210	420	630
	Riprap with Bedding	(1)	2,400	cu.m	435	1,044	-	-	-	522	522	1,044
	"	(2)	64,600	"	540	34,884	-	3,488	3,488	13,954	17,442	31,396
	Sub-Total (1-4-3)	(1)				6,444	-	-	-	3,222	3,222	6,444
	"	(2)				39,997	-	5,544	5,544	14,936	19,517	34,453
	" (1) + (2)					46,441	-	5,544	5,544	18,158	22,739	40,897
1-4-4.	Foundation Treatment											
	Fault Treatment	(1)		L.S.		583	-	-	-	292	291	583
	Drilling for Contact G.	(1)	789	m	600	473	-	-	-	378	95	473
	Contact Grouting	(1)	281	"	2,100	590	-	-	-	472	118	590
	Core Drilling with P.Test	(2)	2,000	"	2,300	4,600	-	3,680	3,680	460	460	920
	Drilling for Consolid. G.	(2)	21,000	"	600	12,600	-	7,560	7,560	2,520	2,520	5,040
	Consolidation G.	(2)	3,150	ton	4,400	13,860	-	8,316	8,316	4,851	693	5,544
	Drilling for Curtain G.	(1)	3,341	m	2,000	6,682	-	-	-	5,346	1,336	6,682
	"	(2)	35,000	"	1,500	52,500	-	42,000	5,240	5,250	-	10,500
	Curtain Grouting	(1)	690	stg.	4,700	3,243	-	-	-	2,594	649	3,243
	"	(2)	5,250	ton	4,400	23,100	-	13,860	13,860	8,085	1,155	9,240
	Drilling for Blanket G.	(1)	680	m	2,000	1,360	-	-	-	1,088	272	1,360
	Blanket Grouting	(1)	188	stg.	4,700	884	-	-	-	707	177	884
	Relief Well	(2)	300	m	6,000	1,800	-	900	900	180	720	900
	Sub-Total (1-4-4)	(1)				13,815	-	-	-	10,877	2,938	13,815
	"	(2)				108,460	-	76,316	76,316	21,346	10,798	32,144

Item	Description	Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency			Local Currency		
						Depreciation (฿'000)	Material (฿'000)	Total (฿'000)	Material (฿'000)	Labor (฿'000)	Total (฿'000)
1-4-5.	Instrument Guage (2)		L.S.		2,000	-	1,600	1,600	-	400	400
1-4-6.	Furnishing Road Way (2)	0.7	km	950,000	665	-	266	266	133	266	399
1-4-7.	Pole with Guardrail (2)	1.4	"	375,000	525	-	368	368	53	104	157
1-4-8.	Electrical Installing(2)		L.S.		880	-	440	440	132	308	440
1-4-9.	Left Canal Outlet (1)										
	Excavation (manpower)	10,000	cu.m	23.52	235	-	-	-	118	117	235
	" (machine)	65,000	"	13.54	880	-	-	-	440	440	880
	Backfill (manpower)	10,000	"	48	480	-	-	-	240	240	480
	" (machine)	30,000	"	26	780	-	-	-	390	390	780
	Reinforced Concrete	4,500	"	2,920.7	13,143	-	-	-	5,257	7,886	13,143
	Water Stop	1,320	m	569.7	752	-	-	-	677	75	752
	Mass Concrete	6,200	cu.m	1,180.5	7,319	-	-	-	5,123	2,196	7,319
	Trashrack		L.S.		2,358	-	-	-	1,651	707	2,358
	Steel Liner ø3.0 m		L.S.		5,820	-	-	-	4,074	1,746	5,820
	High Pressure Gate		L.S.		6,000	-	-	-	4,200	1,800	6,000
	Drainage Works		L.S.		570	-	-	-	285	285	570
	Control House etc.		L.S.		4,600	-	-	-	2,300	2,300	4,600
	Sub-Total (1-4-9)(1)				42,937	-	-	-	24,755	18,182	42,937
	Construction Sub-Total(1)				78,146	-	-	-	46,298	31,848	78,146
	" (2)				225,433	-	117,915	117,915	49,238	58,280	107,518
	" (1) + (2)				303,579	-	117,915	117,195	95,536	90,128	185,664
1-4-10.	Miscellaneous (1)				25,664	-	-	-	12,832	12,832	25,664
	(2)				27,051	-	14,149	14,149	5,908	6,994	12,902
	Total (1)				103,810	-	-	-	59,130	44,680	103,810
	" (2)				252,484	-	132,064	132,064	55,146	65,274	120,420
	" (1) + (2)				356,294	-	132,064	132,064	114,276	109,954	224,230
1-5.	Right Saddle Dam (2)										
1-5-1.	Clearing Construction & Borrow Area	550	rai	300	165	-	17	17	33	115	148
1-5-2.	Earth Works										
	Stripping Dam Foundation & Borrow	109,000	cu.m	12	1,308	-	654	654	262	392	654
	Cut Off Trench (Soil)	116,000	"	24	2,784	-	1,392	1,392	557	835	1,392
	" (Rock)	49,000	"	31	1,519	-	987	987	266	266	532
	Embankment (Core)	644,000	"	40	27,760	-	11,592	11,592	4,508	9,660	14,168
	" (Random)	649,000	"	40	25,960	-	11,682	11,682	4,543	9,735	14,278
	" (Rock)	26,000	"	80	2,080	-	1,144	1,144	312	624	936
	Dam Slope Furnishing	52,000	sq.m	10	520	-	52	52	52	416	468
	Sub-Total (1-5-2)				59,931	-	27,503	27,503	10,500	21,928	32,428
1-5-3.	Drain & Slope Protection										
	Filter Drain	68,000	cu.m	125	8,500	-	3,825	3,825	1,488	3,187	4,675
	Sodding	31,000	sq.m	20	620	-	62	62	186	372	558
	Riprap with Bedding	52,000	cu.m	540	28,080	-	2,808	2,808	11,232	14,040	25,272
	Sub-Total (1-5-3)				37,200	-	6,695	6,695	12,906	17,599	30,505

Item	Description	Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency: Depreciation (฿'000)	Foreign Currency: Material (฿'000)	Foreign Currency: Total (฿'000)	Local Currency: Material (฿'000)	Local Currency: Labor (฿'000)	Local Currency: Total (฿'000)
1-5-4.	Foundation Treatment										
	Fault Treatment	2	zone	3,500,000	7,000	-	3,500	3,500	1,750	1,750	3,500
	Core Drilling with P.Test	1,000	m	2,300	2,300	-	1,840	1,840	230	230	460
	Drilling for Contact G.	2,000	"	600	1,200	-	960	960	120	120	240
	Contact Grouting	200	ton	4,400	880	-	528	528	308	44	352
	Drilling for Curtain G.	26,000	m	1,500	39,000	-	31,200	31,200	3,900	3,900	7,800
	Curtain Grouting	3,900	ton	4,400	17,160	-	10,296	10,296	6,006	858	6,864
	Drilling for Blaket G.	10,000	m	600	6,000	-	4,800	4,800	600	600	1,200
	Blanket Grouting	1,500	ton	4,400	6,600	-	3,960	3,960	2,310	330	2,640
	Sub-Total (1-5-4)				80,140	-	57,084	57,084	15,224	7,832	23,056
1-5-5.	Instrument Guage		L.S.		2,000	-	1,600	1,600	0	400	400
1-5-6.	Furnishing Road Way	0.7	km	950,000	665	-	266	266	133	266	399
1-5-7.	Pole with Guardrail	1.4	"	375,000	525	-	367	367	53	105	158
1-5-8.	Electrical Installing		L.S.		880	-	440	440	132	308	440
1-5-9.	Right Canal Outlet										
	Excavation (Rock)	1,500	cu.m	100	150	-	53	53	15	82	97
	" (machine)	13,000	"	30	390	-	195	195	78	117	195
	Backfill (manpower)	4,000	"	60	240	-	12	12	24	204	228
	" (machine)	7,000	"	33	231	-	116	116	47	68	115
	Reinforced Concrete	1,200	"	3,700	4,440	-	888	888	888	2,664	3,552
	Water Stop	400	m	700	280	-	56	56	196	28	224
	Mass Concrete	1,500	cu.m	1,600	2,400	-	720	720	960	720	1,680
	Trashrack		L.S.		950	-	475	475	237	238	475
	Steel Liner ø1 m		L.S.		3,000	-	1,500	1,500	750	750	1,500
	High Pressure Gate		L.S.		3,750	-	1,875	1,875	937	938	1,875
	Drainage Work		L.S.		120	-	60	60	24	36	60
	Control House etc.		L.S.		1,914	-	714	714	600	600	1,200
	Sub-Total (1-5-9)				17,865	-	6,664	6,664	4,756	6,445	11,201
	Construction Sub-Total				199,371	-	100,636	100,636	43,737	54,998	98,735
1-5-10.	Miscellaneous				23,924	-	12,076	12,076	5,248	6,600	11,848
	Total				223,295	-	112,712	112,712	48,985	61,598	110,583
1-6.	Spillway (2)										
	Excavation (Rock)	740,000	cu.m	50	37,000	-	24,050	24,050	6,475	6,475	12,950
	" (Soil)	130,000	"	24	3,120	-	1,560	1,560	624	936	1,560
	Backfill (manpower)	4,000	"	60	240	-	12	12	24	204	228
	" (machine)	7,000	"	33	231	-	116	116	46	69	115
	Mass Concrete	700	"	1,600	1,120	-	336	336	448	336	784
	Reinforced Concrete	8,100	"	3,700	29,970	-	5,994	5,994	5,994	17,982	23,976
	Water Stop	1,000	m	700	700	-	140	140	490	70	560
	Concrete Pipe ø1 m	200	"	1,700	340	-	170	170	68	102	170
	Riprap	2,000	cu.m	540	1,080	-	108	108	432	540	972
	Drilling for Curtain G	10,000	m	(1,343)	(13,430)		10,744	10,744	1,343	1,343	2,686
	Curtain Grouting	1,500	ton	4,400	6,600	-	3,960	3,960	2,310	330	2,640
	[illegible]				[illegible]		47,100	47,100	18,251	28,387	[illegible]

Item	Description	Quantity	Unit	Rate (B)	Total Cost (B'000)	Foreign Currency			Local Currency		
						Depreciation (B'000)	Material (B'000)	Total (B'000)	Material (B'000)	Labor (B'000)	Total (B'000)
1-7.	Main Canal										
1-7-1.	Left Main Canal by RID (1)										
	Excavation (machine)	162,024	cu.m	8	1,296	-	-	-	648	648	1,296
	Excavation (manpower)	18,212	"	20	364	-	-	-	18	346	364
	Embankment	110,528	"	21	2,321	-	-	-	1,160	1,161	2,321
	Sodding	50,240	sq.m	8	401	-	-	-	160	241	401
	Lining Concrete	5,526	cu.m	1,190	6,576	-	-	-	4,603	1,973	6,576
	Syhon Works	2	Place	250,000	500	-	-	-	350	150	500
	Diversion Facilities	1	"	30,000	30	-	-	-	21	9	30
	Sub-Total				11,488	-	-	-	6,960	4,528	11,488
	Other Structures				2,297	-	-	-	1,392	905	2,297
	Sub-Total				13,785	-	-	-	8,352	5,433	13,785
	Miscellaneous				1,655	-	-	-	1,002	653	1,655
	Sub-Total				15,440	-	-	-	9,354	6,086	15,440
1-7-2.	Left Main Canal by Contractor	(2)									
	Clearing	1,742	Rai	375	653	-	65	65	131	457	588
	Excavation (machine)	1,102,710	cu.m	24	26,465	-	13,233	12,233	5,293	7,939	13,232
	Excavation (manpower)	122,476	"	30	3,674	-	184	184	367	3,123	3,490
	Embankment	651,180	"	49	31,908	-	15,954	15,954	4,786	11,168	15,954
	Road Construction	92,008	"	50	4,600	-	1,840	1,840	920	1,840	2,760
	Sodding	262,880	sq.m	13	3,418	-	342	342	1,025	2,051	3,076
	Lining Concrete	48,257	cu.m	1,840	88,793	-	26,638	26,638	35,517	26,638	62,155
	Syhon Works	13	Place	390,000	5,070	-	2,535	2,535	1,014	1,521	2,535
	Diversion Facilities	19	"	48,000	912	-	456	456	182	274	456
	Sub-Total				165,493	-	61,247	61,247	49,235	55,011	104,246
	Other Structures				33,099	-	12,249	12,249	9,847	11,003	20,850
	Sub-Total				198,592	-	73,496	73,496	59,082	66,014	125,096
	Miscellaneous				23,831	-	8,819	8,819	7,090	7,922	15,012
	Sub-Total				222,423	-	82,315	82,315	66,172	73,936	140,108
1-7-3.	Right Main Canal by RID	(2)									
	Clearing	226	Rai	375	85	-	9	9	17	59	76
	Excavation (machine)	77,900	cu.m	12	935	-	467	467	187	281	468
	Excavation (manpower)	8,550	"	30	257	-	13	13	26	218	244
	Embankment	76,950	"	33	2,539	-	1,269	1,269	381	889	1,270
	Road Construction	13,300	"	50	665	-	266	266	133	266	399
	Sodding	38,000	sq.m	13	494	-	49	49	148	297	445
	Lining Concrete	3,230	cu.m	1,840	5,943	-	1,783	1,783	2,377	1,783	4,160
	Syhon Works	3	Place	390,000	1,170	-	585	585	234	351	585
	Diversion Facilities	7	"	48,000	336	-	168	168	67	101	168
	Sub-Total				12,424	-	4,609	4,609	3,570	4,245	7,815
	Other Structures				2,484	-	922	922	714	848	1,562
	Sub-Total				14,908	-	5,531	5,531	4,284	5,093	9,377
	Miscellaneous				1,789	-	664	664	514	611	1,125
	Sub-Total				16,697	-	6,195	6,195	4,798	5,704	10,502

Item	Description	Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency			Local Currency		
						Depreciation (฿'000)	Material (฿'000)	Total (฿'000)	Material (฿'000)	Labor (฿'000)	Total (฿'000)
1-7-4.	Right Main Canal by Contractor (2)										
	Clearing	140	Rai	375	53	-	5	5	11	37	48
	Excavation (machine)	48,380	cu.m	24	1,161	-	581	581	232	348	580
	Excavation (manpower)	5,310	"	30	159	-	8	8	16	135	151
	Embankment	47,790	"	49	2,342	-	1,171	1,171	351	820	1,171
	Road Construction	8,260	"	50	413	-	165	165	83	165	248
	Sodding	23,600	sq.m	13	307	-	31	31	92	184	276
	Lining Concrete	2,006	cu.m	1,840	3,691	-	1,477	1,477	1,107	1,107	2,214
	Syhon Works	2	Place	390,000	780	-	390	390	156	234	390
	Diversion Facilities	3	"	48,000	144	-	72	72	29	43	72
	Sub-Total				9,050	-	3,900	3,900	2,077	3,073	5,150
	Other Structures				1,810	-	780	780	415	615	1,030
	Sub-Total				10,860	-	4,680	4,680	2,492	3,688	6,180
	Miscellaneous				1,303	-	561	561	299	443	742
	Sub-Total				12,163	-	5,241	5,241	2,791	4,131	6,922
	Total (1)				15,440	-	-	-	9,354	6,086	15,440
	Total (2)				251,283	-	93,751	93,751	73,761	83,771	157,532
	(1) + (2)				266,723	-	93,751	93,751	83,115	89,857	172,972
1-8.	Lateral Canal (2)										
1-8-1.	Left Bank Area (2)										
	Excavation (machine)	72,996	cu.m	24	1,752	-	876	876	350	526	876
	Excavation (manpower)	72,996	"	30	2,190	-	110	110	219	1,861	2,080
	Embankment	425,810	"	49	20,865	-	10,432	10,432	3,130	7,303	10,433
	Excavation onto Dump-truck	352,814	"	30	10,584	-	5,292	5,292	2,117	3,175	5,292
	Soil Hauling (5 km)	352,814	"	8	2,823	-	1,976	1,976	282	565	847
	Road Construction	109,494	"	50	5,475	-	2,190	2,190	1,095	2,190	3,285
	Sodding	364,980	sq.m	13	4,745	-	475	475	1,423	2,847	4,270
	Lining Concrete	6,205	cu.m	1,840	11,417	-	3,425	3,425	4,567	3,425	7,992
	Diversion Facilities	229	Place	48,000	10,992	-	5,496	5,496	2,198	3,298	5,496
	Sub-Total				70,843	-	30,272	30,272	15,381	25,190	40,571
	Other Structures				14,168	-	6,054	6,054	3,076	5,038	8,114
	Sub-Total				85,011	-	36,326	36,326	18,457	30,228	48,685
	Miscellaneous				10,201	-	4,359	4,359	2,215	3,627	5,842
	Sub-Total				95,212	-	40,685	40,685	20,672	33,855	54,527
1-8-2.	Right Bank Area (2)										
	Excavation (manpower)	9,948	cu.m	30	298	-	15	15	30	253	283
	Embankment	87,045	"	49	4,265	-	2,132	2,132	640	1,493	2,133
	Excavation onto Dump-truck	96,993	"	30	2,910	-	1,455	1,455	582	873	1,455
	Soil Hauling (2 km)	96,993	"	3	291	-	204	204	29	58	87
	Road Construction	22,383	"	50	1,119	-	448	448	224	447	671
	Sodding	74,610	sq.m	13	970	-	97	97	291	582	873
	Lining Concrete	2,487	cu.m	1,840	1,576	-	1,373	1,373	1,830	1,373	3,203
	Diversion Facilities	43	Place	48,000	2,064	-	1,032	1,032	413	619	1,032
	Sub-Total				16,193	-	6,756	6,756	4,039	5,098	9,737
	Other Structures				3,200	-	1,351	1,351	808	1,140	1,948
	Sub-Total				19,393	-	8,107	8,107	4,847	6,238	11,085

Item	Description	Quantity	Unit	Rate (฿)	Total Cost (฿'000)	Foreign Currency			Local Currency		
						Depreciation (฿'000)	Material (฿'000)	Total (฿'000)	Material (฿'000)	Labor (฿'000)	Total (฿'000)
1-9.	Improvement Old Facilities (2)				109,000	-	46,212	46,212	23,928	38,860	62,788

Note; (1): Cost in the years 2519 (1976) - 2525 (1982). See Table I 1-12.
(2): Cost in the years 2526 (1983) - 2531 (1988)

Construction Equipment

1. Cost of Construction Equipment

   a) Old Equipment; see Table I 1-12
   List of Old Equipment, see Table I 1-4, I 1-5 & I 1-6

   b) New Equipment

   ° for earth work; see Table I 1-7
   two sets x @US$2,156,700 = 4,313,400

   ° for quarrying; see Table I 1-8
   US$3,489,000

   ° for foundation work; see Table I 1-9
   US$1,606,000

   Total US$9,408,400

   ≒ ฿200,000,000

Table I 1-4. List of Old Equipment (1)

No.	Description	Year	RID No.	Price in Thailand (Bath)
a)	Heavy Equipment			
1.	Scraper Cat.621 21 cuyd	1968	554	1,239,540.39
2.	"	1968	557	1,239,540.39
3.	"	1968	561	1,239,540.39
4.	"	1969	616	1,479,500.00
5.	Scraper F/A 260 B 21 cuyd	1978	902	2,448,000.00
6.	"	1978	903	2,448,000.00
7.	"	1978	904	2,448,000.00
8.	"	1979	1199	2,663,000.00
9.	"	1979	1200	2,663,000.00
10.	Tractor Bulldozer Komatsu D 155 A 320 HP	1976	159	1,848,000.00
11.	"	1978	1088	2,105,300.00
12.	"	1978	1093	2,444,500.00
13.	Tractor Bulldozer Komatsu D 85 A 180 HP	1978	1095	1,315,800.00
14.	Tractor Bulldozer Cat.D 8 H 320 HP	1974	549	1,181,495.32
15.	Tractor Bulldozer Cat.D 7 E 180 HP	1968	543	753,295.18
16.	"	1968	544	888,848.12
17.	Tractor Bulldozer F/A 21 C 270 HP	1979	881	1,895,000.00
18.	"	1977	888	2,098,000.00
19.	Motor Grader Champion D 740 160 HP	1977	843	1,027,000.00
20.	"	1977	845	1,027,000.00
21.	"	1979	1284	1,109,000.00
22.	"	1979	1286	1,108,000.00
23.	Motor Grader Wabco 555 160 HP	1976	76	1,089,000.00
24.	Front End Loader JH 60 130 HP	1978	957	600,000.00
25.	Front End Loader W-20 Case	1979	1263	674,000.00
26.	Front End Loader Furukawa LL-170	1977	822	641,717.87

No.	Description	Year	RID No.	Price in Thailand (Bath)
27.	Backhoe JD450-C	1977	420	633,000.00
28.	Pay Hauler IH	1968	565	1,064,665.10
29.	"	1968	566	1,064,665.10
30.	Farm Tractor Leyland 272 70 HP	1977	869	192,000.00
31.	Dump Truck International F 230 D 10 cuyd	1967	476	547,977.87
	Total			25,308,264.56

b) Excavators

Drag Lines

1.	Bucyrus 38 B Size 1 1/2 cuyd Model D-333-C	1971	297	1,846,900.00
2.	Hitachi U 112 L Size 1 1/2 cuyd	1978	347	3,375,000.00
3.	P & H Truckcrane 25 Tons, Dragline 3/4 cuyd	1980	432	2,000,000.00
4.	P & H Truckcrane 25 Tons, Dragline 3/4 cuyd	1980	422	2,000,000.00
	Total			9,221,900.00

c) Car

Truck 23,000 Ibs.

1.	Hino KE 101	1968	1698	150,000.00
2.	Nissan UD 3	1967	1518	149,000.00
3.	Magirus Deutz	1976	2492	240,000.00
4.	Hino KR 320	1977	2658	253,750.00
5.	"	1977	2659	253,750.00
6.	Isuzu TXD 50	1977	2780	258,000.00
7.	"	1977	2781	258,000.00
8.	"	1977	2782	258,000.00
9.	"	1980	5-4019	298,000.00
	Sub-Total			2,118,500.00

No.	Description	Year	RID. No.	Price in Thailand (Bath)
	Dump Truck 4 cuyd			
1.	Nissan UD 4	1978	548	189,000.00
2.	Hino KR 300	1977	766	325,000.00
3.	"	1977	767	325,000.00
4.	"	1980	958	307,900.00
5.	"	1980	969	307,900.00
6.	"	1978	970	307,900.00
7.	"	1978	971	307,900.00
8.	"	1978	972	307,900.00
9.	Isuzu TXD 40	1977	825	324,000.00
10.	"	1978	869	322,000.00
11.	"	1978	870	322,000.00
	Sub-Total			3,346,500.00
	Dump Truck 6 cuyd			
1.	Hino KB 302		548	
2.	"	1980	1317	649,000.00
3.	Nissan UD 6	1980	1310	679,000.00
	Sub-Total			1,328,000.00
	Water Truck 6 cum.			
1.	Hino TE 11	1967	1495	120,000.00
2.	Isuzu TXD 40	1977	2777	293,000.00
3.	"	1977	2823	298,000.00
4.	"	1980	001	320,000.00
5.	"	1980	002	320,000.00
6.	"	1980	003	320,000.00
7.	"	1980	004	320,000.00
8.	"	1980	005	320,000.00
9.	"	1980	006	320,000.00
10.	"	1980	007	320,000.00

No.	Description	Year	RID. No.	Price in Thailand (Bath)
11.	Isuzu TXD 40	1980	008	320,000.00
12.	Magirus Deutz		2960	240,000.00
			2961	240,000.00
	Sub-Total			3,751,000.00
	Field Jeep			
1.	Nissan Patrol Model G 60	1968	1716	42,360.00
2.	"	1978	2926	222,000.00
3.	"	1978	3018	197,000.00
4.	"	1978	3287	209,000.00
5.	"	1978	3288	209,000.00
6.	Land Rover	1977	2300	172,000.00
7.	Scout (IH)	1967	1309	60,420.00
8.	"	1971	2201	69,270.00
9.	"	1971	2203	69,270.00
10.	"	1971	2206	69,270.00
	Sub-Total			1,319,590.00
	Micro Bus			
1.	Ford Thames	1964	263	59,600.00
2.	Volkswagen	1978	118	68,000.00
	Sub-Total			127,600.00
	Station Wagon			
1.	Peugeot 404	1963	25	96,000.00
	Sub-Total			96,000.00

No.	Description	Year	RID. No.	Price in Thailand (Bath)
	Pick - Up			
1.	Datsun Model B 20	1977	2824	78,000.00
2.	"	1977	2827	77,750.00
3.	"	1977	2828	77,750.00
4.	Toyota Hilux RN 20	1977	2768	66,450.00
5.	"	1977	2769	66,450.00
6.	"	1977	2770	66,450.00
7.	"	1979	2-4029	89,300.00
8.	"	1979	2-4030	89,300.00
	Sub-Total			611,450.00
	Total			12,698,640.00

No.	Description	Year	Unit	Price in Thailand (Bath)
	d) Miselenous Equipment, Concrete Mixer			
1.	"Gilson" Model 65 Crt Size 6 Cuft	1977	1	91,401.23
2.	Loro-De Parisini Model 18 N Size 1/2 m^3	1966	2	86,425.00
3.	"Center" Size 7/8 Cuft	1978	5	16,900.00
4.	Benfovod Model 16 S 10/7 Cuft	1979	7	139,950.00
5.	Batching Plant Model 100 Unit Plant Capacity 100 CU yds/hour	1970	1	2,336,846.57
6.	"Liner" Complow	1961	1	111,408.00
	Sub-Total			3,776,655.80
	Vibrator Roller			
1.	"Vibro Plus" Model DD-18	1971	1	73,968.00
	Sub-Total			73,968.00
	Vibrator Compactor			
1.	Kurita Model BSR-5	1978	20	8,300.00
2.	Mikaza Model MVC 70 F	1978	2	12,750.00
	Sub-Total			191,500.00
	Water Pump			
1.	Kirlaskar Type RV_3 ø6"	1980	1	64,900.00
2.	Steyr Model 213 S ø6"	1968	2	64,159.00
3.	Kirlaskar Type RB 2 ø 6"	1980	2	64,900.00
4.	Submersible Model M-4 D ø4"	1980	2	39,700.00
5.	Ford Model 200x150-135 ø6"	1980	1	160,000.00
6.	Osna Model S 65 ø2"	1980	2	15,080.00
7.	Awamura Model CSH 125/80 ø3"	1979	2	20,990.00
8.	Torishima-KSB Type ETA 80-40/2 ø4"	1978	4	40,680.00
9.	Stork Type ST 1501 ø4"	1978	2	35,400.00
10.	Wisconcin Model A 20 FB ø1 1/2"	1978	1	30,000.00
11.	Briggo ø2"	1978	2	4,050.00
	Sub-Total			312,240.00

No.	Description	Year	Unit	Price in Thailand (Bath)
	Electric Generator			
1.	Ruston Model LDC 50 KW.	1969	1	115,540.00
2.	Markon Model B 600 B 200 KW.	1971	1	365,450.00
3.	CMC Model AC 145 15 KW.	1979	2	66,400.00
4.	CMC Model 4 AL-64 30 KW.	1978	1	90,880.00
5.	BUB Model 2 YPA 5 KW.	1968	1	24,500.00
	Sub-Total			729,170.00
	Air Conpressor			
1.	"Leroi" Model 60 C RD 2 SER. Size 60 CFM	1970	1	11,000.00
2.	Air Man Type AMP Size 600 CFM	1966	1	276,000.00
3.	"Komatsu" Model EV 170 U 600 CFM 370 CFM	1978	2	449,500.00
4.	Gaener Model 365 Roto Air Pluy Size 365 CFM	1965	1	177,400.00
	Sub-Total			1,363,400.00
	Concrete Vibrator			
1.	Mikasa Model MVI-CE	1978	19	8,250.00
2.	Dynapac Type AP 56 ϕ2"	1980	5	11,290.00
3.	Dynapac Type AP 78 ϕ2 1/2"	1980	5	14,350.00
	Sub-Total			284,950.00
	Total			6,731,883.80
	Grand Total			53,960,688.36

Table I 1-5. List of Old Equipment (2)
(Equipment for Foundation Treatment)

No.	Equipment Detailed	Amount	Age of Machine Use (Years)	Remark
1.	Grouting Pump belonging to (TONE.) with Mixer Tank and Agitator Tank	1	4	are executing
2.	Grouting Pump belonging to (TOHO) with Mixer Tank and Agitator Tank	1	5	are executing
3.	Grouting Pump belonging to (YAMATO) with Mixer Tank and Agitator Tank	1	4	"
4.	Air-Compressor belonging to (JOY) Driven by Commine engine	1	5	"
5.	Air-Compressor belonging to (MISUI SEIKI) Driven by Commine engine	1	5	Repairing
6.	Electric generator (CMC) Model 4135 G.1		2	are executing
7.	Rotary Drilling machine, belonging to (ACKER), Driven by DIESEL engine PETTER. Model PJ 2 W, 20 HP	1	8	"
8.	Rotary Drilling machine, belonging to (ACKER) Driven by WISCONSIN engine, 14.5 HP	2	8	"
9.	Rotary Drilling machine, belonging to (JOY), Driven by PERGEN engine	1	6	Repairing
10.	Rotary Drilling machine, belonging to (TONE) Model TDC-1, Driven by electric.	1	2	are executing
11.	Rotary Drilling machine, belonging to (LONG YEAR) Driven by AIR MOTOR, 23 HP.	1	3	are executing
12.	Air-Driller machine, belonging to (SECO) Model B 20 V.	1	2	"
13.	Air-Driller machine, belonging to (BOYLES) del L 16-6	2	8	"
14.	Percussion drilling machine (Air Track), belonging to WORTHINGTON, Model D.W.L. 7 RR	1	10	Repairing

No.	Equipment Detailed	Amount	Age of Machine Use (Years)	Remark
15.	Percussion drilling machine, (Air Track) belonging to ATLAS COPCO, Model ROC 601	1	4	are executing
16.	The Standard Soil Penetration Blow machine, belonging to (ACKER), Driven by WISCONSIN engine, Model T.H.D. 14.5 HP.	3	8	are executing
17.	High power Water-Pump, belonging to (WANNER), Driven by WISCONSIN engine, Model A.G.N.D., 11.5 HP	5	5	"
18.	High power Water-Pump, belonging to (WANNER), Driven by DIESEL engine KIRLORKEAR, Model A.V2.7 HP	1	2	Repairing
19.	Water - Pump (DEMING), Driven by WISCONSIN engine, Model A.G.N.D., 11.5 HP	2	8	Repairing
20.	Water - Pump (BEEM LOYEN), Driven by WISCONSIN engine, Model A.G.N.C., 11.5 HP	2	10	one executing, and one Repairing
21.	High Power Water - Pump (AJAC), Driven by BRIGGZ engine, 3 HP.	1	2	are executing
22.	Water Pump, belonging to (WIKING), Driven by electric motor, Model L 124 V, 15 HP	1	2	"

Table I 1-6. List of Old Equipment (3)
(Testing Equipment)

No.		Number	Per Unit Price in Thailand	Remark (Year)
1.	Slump Test Set (Made in Thailand)	2	1,638	1980
2.	Concrete Cylinder Mold ø6" (Made in Thailand)	19	1,290	1980
3.	Compression Testing Machine (U.S.A.) (Soil Test Model (T-710 M 120,000 kgs.))	1	77,700	1980
4.	Air Entrainment Meter (U.S.A.) (Soil Test Model CT 126, 1/4 Cubic foot)	1	18,540	1979
5.	Laboratory Warming Pot (U.S.A.) (Soil Test Model L-114A)	1	9,500	1979
6.	Vertical Cylinder Copper (U.S.A.) (Soil Test Model CT 53)	1	6,030	1979
7.	Motorized Sieve Shaker (U.S.A.) (Soil Test Model CL-305B-8, CL-30JA-1)	1	10,225	1978
8.	Motorized Dynamic Sieve Shaker (Endecott Model 2 Mark England)	1	18,000	1979
9.	Laboratory Oven, Double Wall Type (Lab-Line Model 3605-1 U.S.A.)	1	22,500	1979
10.	Basic Field Density Set	3	7,400	1979
11.	ASTM Liquid Limit Set (Hogentogler U.S.A.)	1	4,000	1979
12.	Sample Ejector (Humboldt Model H 4155 U.S.A.)	1	4,590	1979
13.	Triple Beam Balance [OHAUS, U.S.A.] (Capacity 311 grams Sensitivity 0.01 gram)	1	2,159	1979
14.	Triple Beam Balance [OHAUS, U.S.A.] (Capacity 1610 grams Sensitivity 0.01 gram)	1	1,820	1979
15.	Solution Balance [OHAUS, U.S.A.] (Capacity 20 kilogram Sensitivity 1.0 gram)	1	9,210	1979
			219,460	

16. Sieves

U.S. Standard Sieves

Sieve Size	Number	Per Unit Price in Thailand	Remark (Year)
2"	1	1,100	1981
1 1/2"	1	1,100	1981
1"	1	1,100	1981
3/4"	3	1,100	1981
1/2"	1	1,100	1981
3/8"	1	1,100	1981
# 4	3	1,100	1981
# 8	1	1,100	1981
# 10	1	1,100	1981
# 16	1	1,100	1981
# 18	1	1,100	1981
# 20	1	1,100	1981
# 30	2	1,100	1981
# 40	1	1,100	1981
# 50	1	1,100	1981
#100	1	1,100	1981
#200	1	1,100	1981
Wet Washing Sieves #200	2	2,455	1978
		29,110	

Table I 1-7. List of New Equipment (1)
(Typical RID 21 cu.yd. Scraper Fleet Arrangement)

Example of a typical motor scraper (21 cu.yd.size) fleet used in earth-moving jobs that comprise excavation haul and compaction of earth works (such as earth dam and road construction). Approximate outturn of such a fleet is 700,000 m^3 per year assuming a typical job with borrow area within 1.5 km distance (Actual requirements for type and quantity of equipment may vary according to job conditions).

Type and Size of Machine	Quantity	Unit CIF Bangkok Price (US$)	Total Price CIF BKK US$	Remark
21 cu.yd. Motor Scraper	5	180,000	900,000	for excavating and hauling
300 HP Bulldozer	5	160,000	800,000	1 unit for pushing scraper
				2 units for polling sheeps foot rollers
				2 units for land clearing and stripping
160 HP Motor Grader	2	70,000	140,000	1 unit for grading on dam
				1 unit for grading bad road and general grading jobs
15 Tons Double Drum Sheep's foot Rooler	2 pairs	7,000	14,000	for compacting earth
100 HP Front end loader with bachhoe attachment	1	80,000	80,000	for ditching loading, laying pipe and odd jobs
75 HP Farm Tractor with Front dozer blade and disc tiller	1	19,000	19,000	for ploughing
100 HP Front end loader	1	50,000	50,000	for loading materials on to dump truck
6000 Litre Water Tank Truck	2	17,000	34,000	for providing water for earth compaction and for wetting haul road
10 Ton Truck Crane	1	60,700	60,700	for general crane works
6 Ton Flat Bed Truck	3	15,000	45,000	2 units to be used as fuel and oiltruck, 1 unit for missellaneous jobs
1 Ton Pick-up Truck	2	4,000	8,000	
	Sub-Total		2,143,700	
Repair Shop Equipments				
350A. Welding Machine Diesel Engine Drive	1	10,000	10,000	
Oxy-Acetelyne Welding	1	200	200	
6" Electric Grinder	1	400	400	
Hi-Pressure Water Pump	1	1,000	1,000	
Hydraulic Tire Remover	1	1,400	1,400	

Table I 1-8. List of New Equipment (2)
(Quarrying and Rock Embankment)

Type and Size of Machine	Quantity	Unit Price C.I.F. BKK (US$)	Total Price
Air Compressor 34 m^3/min.	3	67,000	201,000
Crawler Drill 15 m^3/min.	6	40,000	240,000
Dump Truck 32t	6	194,000	1,164,000
Bulldozer 21t with ripper	6	130,000	780,000
Bozershovel 4.0 m^3	2	186,000	372,000
Vibrating Roller 15t	4	90,000	360,000
Truck Crane 30t	2	186,000	372,000
Total			3,489,000

Table I 1-9. List of New Equipment (3)
(Foundation Treatment)

Type and Size of Machine	Quantity	Unit Price C.I.F. BKK (US$)	Total Price
Boring Machine (rotary)	8	12,000	96,000
Crawler Drill (percussion)	4	277,000	1,108,000
Boring Tool Set	8	17,000	136,000
Grouting Machine Set	6	27,000	162,000
Compressor (for C. Drill)	4	26,000	104,000
Total			1,606,000

Table I 1-10. Consulting Services and Training

Item	Description	Quantity	Unit	Rate (฿)	Total Cost: Foreign Currency (฿'000)	Total Cost: Local Currency (฿'000)
6-1.	Consulting Services					
6-1-1.	Final Design					
	(a) Foreign Currency					
	Consultants remuneration	127	month	160,000	20,320	
	Out-of-pocket expenses					
	International travel expense	24	trip	27,000	648	
	Reimbursable cost item and others		L.S.		4,194	
	Miscellaneous		L.S.		2,516	
	Sub-total				27,678	
	(b) Local Currency					
	Consultants remuneration	45	month	70,000		3,150
	Consultants per diem					
	Foreign	3,810	day	700		2,667
	Local	1,350	day	700		945
	Living allowance and quarter					
	Foreign	127	month	7,000		889
	Local	45	month	7,000		315
	Local communication and transportation	344	trip	2,200		757
	Printing of reports		L.S.			800
	Miscellaneous		L.S.			952
	Sub-total					10,475
6-1-2.	Construction Supervision					
	(a) Foreign Currency					
	Consultans remuneration	238	month	160,000	38,080	
	Out-of-pocket expenses					
	International travel expense	40	trip	27,000	1,080	
	Reimbursable cost item and others		L.S.		7,832	
	Miscellaneous		L.S.		4,699	
	Sub-total				51,691	
	(b) Local Currency					
	Consultants remuneration	243	month	70,000		17,010
	Consultants per diem					
	Foreign	7,140	day	700		4,998
	Local	7,290	day	700		5,103
	Living allowance and quarter					
	Foreign	238	month	7,000		1,666
	Local	243	month	7,000		1,701
	Local communication and transportation	246	trip	2,200		541
	Printing of report		L.S.			800
	Miscellaneous		L.S.			3,182
	Sub-total					35,001

Item	Description	Quantity	Unit	Rate (฿)	Total Cost: Foreign Currency (฿'000)	Total Cost: Local Currency (฿'000)
6-1-3.	Supporting Services and Maintenance					
	(a) Foreign Currency					
	Consultants remuneration	45	month	160,000	7,200	
	Out-of-pocket expenses					
	International travel expense	7	trip	27,000	189	
	Reimbursable cost item and others		L.S.		1,478	
	Miscellaneous				887	
	Sub-total				9,754	
	(b) Local Currency					
	Consultants remuneration	74	month	70,000		5,180
	Consultants per diem					
	Foreign	1,350	day	700		945
	Local	2,220	day	700		1,554
	Living allowance and quarter					
	Foreign	45	month	7,000		315
	Local	74	month	7,000		518
	Local communication and transportation	60	trip	2,200		132
	Miscellaneous		L.S.			864
	Sub-total					9,508
6-2.	Training					
	(a) Foreign Currency					
	International travel expenses	10	person	27,000	270	
	per diem, 5 persons x 60 days	300	day	1,200	360	
	5 persons x 120 days	600	day	1,200	720	
	Other cost		L.S.		500	
	Miscellaneous		L.S.		185	
	Sub-total				2,035	
	(b) Local Currency					
	Preparation expense		L.S.			50
	Sub-total					50
	Total				91,158 (62%)	55,034 (38%)
					146,192	

Table I 1-11. On-farm Development Cost

Following two available data which have been studied in the north Thailand, are referred to decide the on-farm development cost in the Project. In this estimation, it is assumed that the on-farm development will be conducted in accordance with an extensive method (ditch and dike method) under the force account basis.

Data-1: On-farm Development Cost

Item	Fiscal Year				
	1978	1979	1980	1981	1982
Cost per rai (฿/rai)	800	1,155	1,500	1,523*	1,932*
Developed area (rai)	2,331	5,618	756	9,939	16,350

Note: *: estimated cost

Source: "Terminal Report on Nongwai Pioneer Agriculture Report" prepared by Sanyu Consualtant under ADB loan, July 1981.

Data-2: On-farm Development Cost (as of 1981)

Item	Sample Area			
	Area E-1	Area E-2	Area E-3	Average
Cost per rai (฿/rai)1/	2,654	1,782	2,026	2,154
Developed area	1,312	2,451	2,474	6,237

Note: 1/; cost is revised with the price escalation of 10 percent for the estimated cost on the basis of price at the physical year 1980.

Topographical slope;

Area E-1: over 1/100

Area E-2: Kew Lom

Area E-3: 1/100 - 1/200

Source: "Feasibility Report on the Mae Wang-Kew Lom Irrigated Agriculture Development Project" prepared by JICA, March 1980.

Based upon the above data, the required on-farm cost is estimated at about 1,900 baht per rai (11,875 Baht per hectare) as of physical year 1981, which is equivalent to an average of the both costs in 1981.

Item		Quantity	Unit	Total Cost	2519 (1976) Quantity	2519 (1976) Cost	2520 (1977) Quantity	2520 (1977) Cost	2521 (1978) Quantity	2521 (1978) Cost	2522 (1979) Quantity	2522 (1979) Cost
A.	Survey			8,341,500	-	-	-	496,000	-	854,000	-	481,500
1.	Topographical Survey			6,141,500				296,000		854,000	-	481,500
2.	Engineering Soil Survey			2,200,000				200,000		-	-	-
B.	General Works			85,807,700		1,580,000		9,398,000		12,289,200	-	19,545,000
1.	Camp Site Clearing	1,200	rai	288,000	335	80,000	625	150,000	240	58,000	-	-
2.	Fence and Fort	4.5	km	810,000	-		15	225,000	3	585,000	-	-
3.	Roads in Camp	14.45	km	13,939,600	-	400,000	4.45	1,018,000	2	882,000	6	4,480,000
4.	Electrical and Water Supply System			4,530,600	-	200,000	-	1,611,000	-	892,600	-	700,000
5.	Communication System			1,500,000	-	-	-	-	-	347,600	-	-
6.	Temporary Grade House	95	unit	14,219,000	12	900,000	22	3,468,000	36	6,216,000	25	3,635,000
7.	Permanent Grade House	22	unit	5,638,600	-	-	1	117,000	-	-	4	750,000
8.	Clearing Reservoir Area	9,400	rai	3,760,000	-	-	-	-	-	-	-	-
9.	Resettlement			40,817,400	-	-	-	2,809,000	-	3,308,000	-	9,860,000
10.	Road Maintenance	12	km	264,500	-	-	-	-	-	-	-	120,000
C.	Construction Dam Saddles and Appurtemant Sturcture			835,280,000	-	-	-	-	-	11,902,000	-	29,115,900
1.	Geological and Soil Mechanical Survey			1,404,000	-	-	-	-	-	1,154,000	-	250,000
2.	Main Dam and Appurtenant Structure			336,480,000	-	-	-	-	-	-	-	-
3.	Left Saddle and Appurtenant Structure			248,048,000	-	-	-	-	-	10,748,000	-	24,669,900
4.	Right Saddle and Appurtenant Structure			171,400,000	-	-	-	-	-	-	-	-
5.	Dam Access Road			2,000,000	-	-	-	-	-	-	-	900,000
6.	Spillway			54,750,000	-	-	-	-	-	-	-	-
7.	Access Bridge			3,548,000	-	-	-	-	-	-	-	3,296,000
8.	Hydro-electric Power Plant			17,650,000	-	-	-	-	-	-	-	-
D.	Water Distribution System	100,000	rai	600,000,000	-	-	-	-	-	-	-	-
E.	Improvement Old Facilities	60,000	rai	120,000,000	-	-	-	-	-	-	-	-
	Sub-Total (A - E)			1,649,429,200	-	1,580,000	-	9,894,000	-	25,045,200	-	49,142,400
F.	Administration			55,570,800	-	-	-	10,690,600	-	3,728,900	-	3,300,600
1.	Administration and Engineering Control			12,570,800	-	-	-	319,900	-	685,000	-	788,600
2.	Construction Equipment			40,000,000	-	-	-	10,370,700	-	3,043,900	-	2,522,000
3.	Transportation			3,000,000	-	-	-	-	-	-	-	-
G.	Contingency			105,000,000	-	-	-	-	-	-	-	-
H.	Purchase Land			50,000,000	-	1,776,000	-	7,348,000	-	2,552,000	-	5,783,000
	Grand Total (A - H)			1,860,000,000	-	3,356,000	-	27,932,600	-	31,326,100	-	58,226,000

Table I 1-12. Original Budget Schedule of the Project, 2519 - 2530 (4 June 1981, Mae Kuang Project Office)

2522 (1979)		2523 (1980)		2524 (1981)		2525 (1982)		Sub-Total (1)		2526 (1983)		2527 (1984)		2528 (198	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	
-	481,500	-	666,000	-	500,000	-	2,250,000	-	5,247,500	-	1,894,000	-	700,000	-	
-	481,500	-	462,000	-	300,000	-	1,444,000	-	3,837,500	-	1,104,000	-	700,000	-	
-	-	-	204,000	-	200,000	-	806,000	-	1,410,000	-	790,000	-	-	-	
-	19,545,000	-	9,179,400	-	11,064,500	-	6,000,000	-	69,056,100	-	11,399,600	-	3,397,600	-	1,
-	-	-	-	-	-	-	-	1,200	288,000	-	-	-	-	-	
-	-	-	-	-	-	-	-	4.5	810,000	-	-	-	-	-	
6	4,480,000	-	-	-	-	-	-	12.45	6,780,000	-	7,199,600	-	-	-	
-	700,000	-	753,000	-	374,000	-	-	-	4,530,600	-27,974,200	-	-	-	-	
-	-	-	-	-	132,000	-	-	-	479,600	-	440,000	-	-	-	
25	3,635,000	-	-	-	-	-	-	95	14,219,000	-	-	-	-	-	
4	750,000	-	-	-	-	-	-	5	867,000	-	-	12	3,397,600	-	1,
-	-	-	-	-	-	-	-	-	-	9,400	3,760,000	-	-	-	
-	9,860,000	-	8,426,400	-	10,414,000	-	6,000,000	-	40,817,400	-	-	-	-	-	
-	120,000	-	-	-	144,500	-	-	-	264,500	-	-	-	-	-	
-	29,115,900	-	27,536,475	-	21,142,850	-	19,961,700	-	109,658,925	-	284,391,075	-	404,750,000	-	36,
-	250,000	-	-	-	-	-	-	-	1,404,000	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	5,852,000	-	-	300,000,000	-	36
-	24,669,900	-	27,284,475	-	21,142,850	-	19,961,700	-	103,806,925	-	144,241,075	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	121,400,000	-	50,000,000	-	
-	900,000	-	-	-	-	-	-	-	900,000	-	1,100,000	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	54,750,000	-	
-	3,296,000	-	252,000	-	-	-	-	-	3,548,000	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	17,650,000	-	-	-	
-	-	-	-	-	-	-	15,435,000	-	15,435,000	-	64,565,000	30,000	230,000,000	30,000	230
-	-	-	-	-	-	-	-	-	-	-	-	10,000	20,000,000	20,000	40
-	49,142,400	-	37,381,875	-	32,707,350	-	43,646,700	-	199,397,525	-	362,249,675	-	658,847,600	-	308
-	3,300,600	-	3,852,230	-	4,423,450	-	877,100	-	26,872,880	-	9,616,100	-	7,300,000	-	5
-	788,600	-	947,000	-	1,031,800	-	877,100	-	4,639,400	-	2,716,100	-	3,000,000	-	1
-	2,522,000	-	2,905,230	-	3,391,650	-	-	-	22,233,480	-	6,900,000	-	4,300,000	-	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	5,783,000	-	3,387,000	-	7,500,000	-	4,330,000	-	32,676,000	-	5,000,000	-	5,000,000	-	5
-	58,226,000	-	44,621,105	-	44,630,800	-	48,853,800	-	258,946,405	-	376,865,775	-	671,147,600	-	319

Note:

June 1981, Mae Kuang Project Office)

tal (1)	2526 (1983)		2527 (1984)		2528 (1985)		2529 (1986)		2530 (1987)		Sub-Total (2)		Revision of (2)	
Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Rate	Cost
5,247,500	-	1,894,000	-	700,000	-	500,000	-	-	-	-	-	3,094,000	1.25	3,870,000
3,837,500	-	1,104,000	-	700,000	-	500,000	-	-	-	-	-	2,304,000	-	-
1,410,000	-	790,000	-	-	-	-	-	-	-	-	-	790,000	-	-
69,056,100	-	11,399,600	-	3,397,600	-	1,954,400	-	-	-	-	-	16,751,600	-	-
288,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
810,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6,780,000	-	7,199,600	-	-	-	-	-	-	-	-	-	7,199,600	-	-
4,530,600	27,974,200	-	-	-	-	-	-	-	-	-	-	-	1.25	16,240,000
479,600	-	440,000	-	-	-	580,400	-	-	-	-	-	1,020,400	-	-
14,219,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
867,000	-	-	12	3,397,600	-	1,374,000	-	-	-	-	-	4,771,600	-	-
-	9,400	3,760,000	-	-	-	-	-	-	-	-	-	3,760,000	1.25	4,700,000
40,817,400	-	-	-	-	-	-	-	-	-	-	-	-	-	-
264,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
109,658,925	-	284,391,075	-	404,750,000	-	36,480,000	-	-	-	-	-	725,621,075	-	-
1,404,000	-	-	-	-	-	-	-	-	-	-	-	-	1.25	26,180,000
-	5,852,000	-	-	300,000,000	-	36,480,000	-	-	-	-	-	336,480,000	1/	764,046,000
103,806,925	-	144,241,075	-	-	-	-	-	-	-	-	-	144,241,075	1/	252,484,000
-	-	121,400,000	-	50,000,000	-	-	-	-	-	-	-	171,400,000	1/	233,295,000
900,000	-	1,100,000	-	-	-	-	-	-	-	-	-	1,100,000	-	-
-	-	-	-	54,750,000	-	-	-	-	-	-	-	54,000,000	1/	105,091,000
3,548,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	17,650,000	-	-	-	-	-	-	-	-	-	17,650,000	-	-
15,435,000	-	64,565,000	30,000	230,000,000	30,000	230,000,000	-	60,000,000	-	-	-	584,565,000	1/	368,662,000
-	-	-	10,000	20,000,000	20,000	40,000,000	20,000	40,000,000	10,000	20,000,000	-	120,000,000	1/	109,000,000
199,397,525	-	362,249,675	-	658,847,600	-	308,934,400	-	100,000,000	-	20,000,000	-	1,450,031,675	-	-
26,872,880	-	9,616,100	-	7,300,000	-	5,600,000	-	2,000,000	-	4,181,820	-	28,697,920	-	-
4,639,400	-	2,716,100	-	3,000,000	-	1,000,000	-	644,500	-	570,800	-	7,931,400	1.25	9,910,000
22,233,480	-	6,900,000	-	4,300,000	-	4,600,000	-	1,355,500	-	611,020	-	17,766,520	2.00	35,530,000
-	-	-	-	-	-	-	-	-	-	3,000,000	-	3,000,000	1/	10,000,000
-	-	-	-	-	-	-	-	-	-	105,000,000	-	105,000,000	1/	407,394,000
32,676,000	-	5,000,000	-	5,000,000	-	5,000,000	-	2,324,000	-	-	-	17,324,000	1/	36,730,000
258,946,405	-	376,865,775	-	671,147,600	-	319,534,400	-	104,324,000	-	129,181,820	-	1,601,053,595		

Note: 1/ Costs of these items were estimated anew. (See Table I 1-3)

Table I 4-18 Investment Cost of the Project (Main Dam, Spillway and Right Saddle Under Contract by International Tender)

Description	Total		Foreign Currency		Local Currency	
	฿'000	US$'000	฿'000	US$'000	฿'000	US$'000
1. Civil Works (Sub-total)	2,206,424	110,321	887,243	44,362	1,319,181	65,959
1-1. Pre-Engineering	9,120	456	390	20	8,730	436
1-2. Preparation	4,960	248	3,290	164	1,670	84
1-3. Main Dam	916,855	45,843	379,837	18,992	537,018	26,851
1-4. Left Saddle Dam	356,294	17,815	132,064	6,603	224,230	11,212
1-5. Right Saddle Dam	267,954	13,398	112,712	5,636	155,242	7,762
1-6. Spillway	126,109	6,305	52,853	2,642	73,256	3,663
1-7. Main Canal	266,723	13,336	93,751	4,688	172,972	8,648
1-8. Lateral Canal	117,379	5,869	49,764	2,488	67,615	3,381
1-9. Improvement of Old Facilities	109,000	5,450	46,212	2,311	62,788	3,139
1-10. Others	32,030	1,601	16,370	818	15,660	783
2. Land Acquisition & Compensation (Sub-total)	110,230	5,512	0	0	110,230	5,512
2-1. Land Acquisition	69,410	3,471	0	0	69,410	3,471
2-2. Compensation	40,820	2,041	0	0	40,820	2,041
3. Construction Equipment (Sub-total)	267,760	13,388	203,000	10,150	64,760	3,238
3-1. Old Equipment	57,760	2,888	0	0	57,760	2,888
3-2. New Equipment	200,000	10,000	200,000	10,000	0	0
3-3. Transportation	10,000	500	3,000	150	7,000	350
4. Project Facilities	44,220	2,211	5,740	287	38,480	1,924
5. Project Administration	14,550	728	0	0	14,550	728
6. Consulting Services	146,192	7,310	90,638	4,532	55,554	2,778
(7. On-Farm Development)	(237,500)	(11,375)	(100,691)	(5,035)	(136,809)	(6,840)
Sub-total (1 - 6)	2,789,376	139,469	1,186,621	59,332	1,602,755	80,137
8. Contingency	312,110	15,605	120,997	6,049	191,113	9,556
Sub-total (1 - 6, 8)	3,101,486	155,074	1,307,618	65,381	1,793,868	89,693
9. Price Escalation	987,168	49,359	248,713	12,436	738,455	36,923
Total (1 - 6, 8, 9)	4,088,654	204,433	1,556,331	77,817	2,532,323	126,616
Sub-total (1 - 7)	(3,026,876)	(151,344)	(1,287,312)	(64,366)	(1,739,564)	(86,978)
8'.Contingency	(347,735)	(17,387)	(136,101)	(6,805)	(211,634)	(10,582)
Sub-total (1 - 7, 8')	(3,374,611)	(168,731)	(1,423,413)	(71,171)	(1,951,198)	(97,560)
9'.Price Escalation	(1,098,276)	(54,913)	(274,928)	(13,746)	(823,348)	(41,167)
Total (1 - 7, 8', 9')	(4,472,887)	(223,644)	(1,698,341)	(84,917)	(2,774,546)	(138,727)

Table I 2-2. Budget Schedule of the Project (Alternative)
(Contract Base for Main Dame etc. by International Tender)

	Total			2519 - 2525 - Sept.'82			2526 Oct.'82 - Sept.'83			2527 Oct.'83 - Sept.'84			Oct.'8
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.
Civil Works (Sub-total)	887,243	1,319,181	2,206,424	0	130,610	130,610	186,080	214,376	400,456	251,051	347,746	598,797	22,890
1-1. Pre-Engineering	390	8,730	9,120	0	5,250	5,250	240	2,130	2,370	90	790	880	60
1-2. Preparation	3,290	1,670	4,960	0	260	260	3,290	1,410	4,700	0	0	0	0
1-3. Main Dam	379,837	537,018	916,855	0	0	0	37,984	53,702	91,686	113,951	161,105	275,056	113,951
1-4. Left Saddle Dam	132,064	224,230	356,294	0	103,810	103,810	105,651	96,336	201,987	23,772	21,675	45,447	2,641
1-5. Right Saddle Dam	112,712	155,242	267,954	0	0	0	0	0	0	45,085	62,097	107,182	45,085
1-6. Spillway	52,853	73,256	126,109	0	0	0	0	0	0	15,856	21,977	37,833	15,856
1-7. Main Canal	93,751	172,972	266,723	0	15,440	15,440	18,750	31,507	50.257	28,126	47,259	75,385	28,126
1-8. Lateral Canal	49,764	67,615	117,379	0	0	0	9,953	13,523	23,476	14,929	20,285	35,214	14,929
1-9. Improvement Old Facilities	46,212	62,788	109,000	0	0	0	9,242	12,558	21,800	9,242	12,558	21,800	9,242
1-10. Others	16,370	15,660	32,030	0	5,850	5,850	970	3,210	4,180	0	0	0	0
2. Land Acqusition & Compensation (Sub-total)	0	110,230	110,230	0	73,500	73,500	0	8,000	8,000	0	9,000	9,000	0
2-1. Land Acquisition	0	69,410	69,410	0	32,680	32,680	0	8,000	8,000	0	9,000	9,000	0
2-2. Compensation	0	40,820	40,820	0	40,820	40,820	0	0	0	0	0	0	0
3. Construction Equipment (Sub-total)	203,000	64,760	267,760	0	22,230	22,230	100,750	8,850	109,600	100,750	12,400	113,150	0
3-1. Old Equipment	0	57,760	57,760	0	22,230	22,230	0	7,100	7,100	0	10,650	10,650	0
3-2. New Equipment	200,000	0	200,000	0	0	0	100,000	0	100,000	100,000	0	100,000	0
3-3. Transportation	3,000	7,000	10,000	0	0	0	750	1,750	2,500	750	1,750	2,500	0
4. Project Facilities	5,740	38,480	44,220	0	27,980	27,980	1,640	3,000	4,640	820	1,500	2,320	3,280
5. Project Administration	0	14,550	14,550	0	4,640	4,640	0	2,290	2,290	0	2,290	2,290	0
6. Consulting Services	90,638	55,554	146,192	0	0	0	22,206	13,611	35,817	11,149	6,833	17,982	14,411
7. On-Farm Development)	(100,691)	(136,809)	(237,500)	(0)	(0)	(0)	(20,138)	(27,362)	(47,500)	(20,138)	(27,362)	(47,500)	(20,138)
Sub-total (1-6)	1,186,621	1,602,275	2,789,376	0	258,960	258,960	310,676	250,127	560,803	363,770	379,769	743,539	247,581
8. Contingency	120,997	191,113	312,110	0	38,844	38,844	36,664	26,472	63,136	47,705	50,952	98.657	26,664
Sub-total (1-6, 8)	1,307,618	1,793,868	3,101,486	0	297,804	297,804	347,340	276,599	623,939	411,475	430,721	842,196	274,245
9. Price Escalation	248,713	738,455	987,168	0	0	0	24,314	41,490	65,804	59,623	138,908	198,531	61,717
Total (1-6, 8, 9)	1,556,331	2,532,323	4,088,654	0	297,804	297,804	371,654	318,089	689,743	471,098	569,629	1,040,727	335,962
Sub-total (1-7)	(1,287,312)	(1,739,564)	(3,026,876)	(0)	(258,960)	(258,960)	(330,814)	(277,489)	(608,303)	(383,908)	(407,131)	(791,039)	(267,719)
Contingency	(136,101)	(211,634)	(347,735)	(0)	(38,844)	(38,844)	(39,685)	(30,576)	(70,261)	(50,725)	(55,056)	(105,781)	(29,685)
Sub-total (1-7, 8')	(1,423,413)	(1,951,198)	(3,374,611)	(0)	(297,804)	(297,804)	(370,499)	(308,065)	(678,564)	(434,633)	(462,187)	(896,820)	(297,404)
Price Escalation	(274,928)	(823,348)	(1,098,276)	(0)	(0)	(0)	(25,935)	(46,210)	(72,145)	(62,978)	(149,055)	(212,033)	(69,929)
Total (1-7, 8', 9')	(1,698,341)	(2,774,546)	(4,472,887)	(0)	(297,804)	(297,804)	(396,434)	(354,275)	(750,709)	(497,611)	(611,242)	(1,108,853)	(364,333)

(Unit: ฿'000)

Tender)

.'83	2527			2528			2529			2530			2531		
	Oct.'83 - Sept.'84			Oct.'84 - Sept.'85			Oct.'85 - Sept.'86			Oct.'86 - Sept.'87			Oct.'87 - Sept.'88		
Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
400,456	251,051	347,746	598,797	22,890	328,250	558,140	120,177	171,674	291,851	55,219	78,792	134,011	44,826	47,733	92,559
2,370	90	790	880	60	560	620	0	0	0	0	0	0	0	0	0
4,700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91,686	113,951	161,105	275,056	113,951	161,105	275,056	56,976	80,553	137,529	37,984	53,702	91,686	18,991	26,851	45,842
201,987	23,772	21,675	45,447	2,641	2,409	5,050	0	0	0	0	0	0	0	0	0
0	45,085	62,097	107,182	45,085	62,097	107,182	11,270	15,524	26,794	5,636	7,762	13,398	5,636	7,762	13,398
0	15,856	21,977	37,833	15,856	21,977	37,833	19,027	26,372	45,399	2,114	2,930	5,044	0	0	0
50.257	28,126	47,259	75,385	28,126	47,259	75,385	14,063	23,629	37,692	4,686	7,878	12,564	0	0	0
23,476	14,929	20,285	35,214	14,929	20,285	35,214	4,977	6,760	11,737	2,488	3,381	5,869	2,488	3,381	5,869
21,800	9,242	12,558	21,800	9,242	12,558	21,800	13,864	18,836	32,700	2,311	3,139	5,450	2,311	3,139	5,450
4,180	0	0	0	0	0	0	0	0	0	0	0	0	15,400	6,600	22,000
8,000	0	9,000	9,000	0	9,000	9,000	0	7,000	7,000	0	3,730	3,730	0	0	0
8,000	0	9,000	9,000	0	9,000	9,000	0	7,000	7,000	0	3,730	3,730	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109,600	100,750	12,400	113,150	0	10,650	10,650	0	5,300	5,300	0	1,480	1,480	1,500	3,850	5,350
7,100	0	10,650	10,650	0	10,650	10,650	0	5,300	5,300	0	1,480	1,480	0	350	350
100,000	100,000	0	100,000	0	0	0	0	0	0	0	0	0	0	0	0
2,500	750	1,750	2,500	0	0	0	0	0	0	0	0	0	1,500	3,500	5,000
4,640	820	1,500	2,320	3,280	6,000	9,280	0	0	0	0	0	0	0	0	0
2,290	0	2,290	2,290	0	2,290	2,290	0	1,520	1,520	0	760	760	0	760	760
35,817	11,149	6,833	17,982	14,411	8,833	23,244	16,677	10,222	26,899	14,593	8,944	23,537	11,602	7,111	18,713
(47,500)	(20,138)	(27,362)	(47,500)	(20,138)	(27,362)	(47,500)	(30,207)	(41,043)	(71,250)	(5,035)	(6,840)	(11,875)	(5,035)	(6,480)	(11,875)
560,803	363,770	379,769	743,539	247,581	365,023	612,604	136,854	195,716	332,570	69,812	93,706	163,518	57,928	59,454	117,382
63,136	47,705	50,952	98.657	26,664	46,544	73,208	8,572	19,881	28,453	- 565	5,618	5,053	1,957	2,802	4,759
623,939	411,475	430,721	842,196	274,245	411,567	685,812	145,426	215,597	361,023	69,247	99,324	168,571	59,885	62,256	122,141
65,804	59,623	138,908	198,531	61,717	214,375	276,092	45,198	161,484	206,682	27,875	100,452	128,327	29,986	81,746	111,732
689,743	471,098	569,629	1,040,727	335,962	625,942	961,904	190,624	377,081	567,705	97,122	199,776	296,898	89,871	144,002	233,873
) (608,303)	(383,908)	(407,131)	(791,039)	(267,719)	(392,385)	(660,104)	(167,061)	(236,759)	(403,820)	(74,847)	(100,546)	(175,393)	(62,963)	(66,294)	(129,257)
) (70,261)	(50,725)	(55,056)	(105,781)	(29,685)	(50,648)	(80,333)	(13,103)	(26,038)	(39,141)	(191)	(6,644)	(6,835)	(2,712)	(3,828)	(6,540)
) (678,564)	(434,633)	(462,187)	(896,820)	(297,404)	(443,033)	(740,437)	(180,164)	(262,797)	(442,961)	(75,038)	(107,190)	(182,228)	(65,675)	(70,122)	(135,797)
) (72,145)	(62,978)	(149,055)	(212,033)	(69,929)	(230,765)	(297,694)	(55,994)	(196,837)	(252,831)	(30,207)	(108,407)	(138,614)	(32,885)	(92,074)	(124,959)
) (750,709)	(497,611)	(611,242)	(1,108,853)	(364,333)	(673,798)	(1,038,131)	(236,158)	(459,634)	(695,792)	(105,245)	(215,597)	(320,842)	(98,560)	(162,196)	(260,756)

APPENDIX J. PROJECT IMPLEMENTATION

APPENDIX J PROJECT IMPLEMENTATION

Appendix J-1 Operation and Maintenance Cost

Appendix J-2 Term of Reference for the Consultant's Services

Figure J 2-1 Proposed Schedule for Consultant's Services

Operation and Maintenance Cost

1. Salaries and Wages

Item	Description	No. of Personnel	Salary per Annum (฿)	Total Salary per Annum (฿ '000)
a)	Main Project Office			
	Manager	1	72,000	72.0
	Assistant manager	1	64,800	64.8
	Agriculturist	2	57,600	115.2
	Administrative officer	2	57,600	115.2
	Irrigation inspector	2	57,600	115.2
	Irrigation supervisor	4	54,000	216.0
	Gateman	60	36,000	2,160.0
	Instrument man	1	36,000	36.0
	Casher	1	43,200	43.2
	Accounting clerk	1	43,200	43.2
	Store keeper	1	27,000	27.0
	Clerk/typist	5	43,200	216.0
	Bill collector	4	43,200	172.8
	Billing clerk	4	43,200	172.8
	Securing gurd	2	27,000	54.0
	Driver	4	36,000	144.0
	Heavy equipment operator	3	36,000	108.0
	Auto mechanician	2	36,000	72.0
	Survey aid	2	28,800	57.6
	Grass cutter	80	12,600	1,008.0
	Janitor	2	12,600	25.2
	Sub-total	245		5,038.2
	Incentive allowance 1/12 x 5,038.2 =			419.9

Casual employees for repair works
(60 days per year)

Construction foreman	1 day x ฿150 =	฿150
Skilled labor	1 day x ฿120 =	฿120
Labor	1 day x ฿ 60 =	฿ 60
	Total	฿330

Item	Description	No. of Personnel	Salary per Annum (฿)	Total Salary per Annum (฿ '000)
		฿330 x 60 days = 19,800		19.8
b)	Dam Operation Office (3 offices)			
	Mechanical engineer	3	36,000	108.0
	Gate operator	3	36,000	108.0
	Electrical engineer	3	36,000	108.0
	Janitor	3	12,600	37.8
	Watchman	3	12,600	37.8
	Sub-total			399.6
c)	Blanch Office (8 offices)			
	Irrigation supervisor	8	57,600	460.8
	Gateman	8	36,000	288.0
	Driver	8	36,000	288.0
	Sub-total			1,036.8
	Total			6,914.3

2. Equipment Operations

a) Depreciation Cost

Machineries	Quantity	Unit Cost (฿'000)	Total Cost (฿'000)	Depreciation Cost (฿ '000)
Main Project Office				
Backhoe excavator, 1.2 m^3	2	4,800	9,600	960
Dump truck, 8 ton	3	540	1,620	162
Track flated, 6 ton	2	340	680	68
Crawler type loader, 6-8 ton	1	640	640	68
Motor grader, 2.5 m	1	830	830	83
Crawler type tractor, 6 ton	1	590	590	59
Crawler type tractor, 11 ton	1	1,090	1,090	109
Station wagon, 4 x 4	3	440	1,320	132
Jeep, utility vehicle, 4 x 4	6	310	1,860	186
Saloon car	2	400	800	80

Machineries	Quantity	Unit Cost (฿'000)	Total Cost (฿'000)	Depreciation Cost (฿ '000)
Motorcycle, 90cc	70	40	2,800	560
Concrete mixer, 0.3 m^3	2	80	160	16
Water pump, 2" - 4"	2	20	40	4
Radio transciever	13	230	2,990	299
Meteorological station	1	50	50	5
Surveying instlement	2	90	180	18
Miscellaneous tools and equipment	L.S.	520	520	52
Spare part (15%)				429
Sub-total				3,290
Dam Operation Office				
Jeep, utility vehicle, 4 x 4	3	310	930	93
Motorcycle, 90cc	6	40	240	24
Sub-total				117
Blanch Office				
Jeep, utility vehicle, 4 x 4	8	310	2,480	248
Motorcycle, 90cc	8	40	320	32
Sub-total				280
b) Fuel and Oil				
20,000ha x 150฿/ha = ฿3,000 x 10^3				3,000
Total				6,687

3. Materials and Supplies

a) Irrigation Canals and Roads;

Maintenance of irrigation canal;

Main canal; 2.0m x 0.1m x 148,000m x 1/5 x 40฿/m^3
= ฿236,800 237

Lateral canal; 1.0m x 0.1m x 357,000m x 1/5 x 40฿/m^3
= ฿285,600 287

Maintenance of road;		
Main canal; 4.5m x 115,200m x 1/5 x 60฿/m^2		
	= ฿6,220,800	6,221
Sub-total		6,745
b) Building		
Main office; 35m x 10m x 2 x 1,500฿/m^2 x 0.04 = 42,000		42
Dam operation office; 10m x 5m x 3 x 1,000฿/m^2 x 0.04 = 6,000		6
Blanch office; 10m x 5m x 13 x 1,000฿/^{2} x 0.04 = 26,000		26
Sub-total		74
Total		6,819
4. Administration and General Expenditure		
฿6,914,300 x 30% = ฿2,074,290		2,074

Term of Reference for the Consultant's Services

A. Objectives

The purpose of the Consultant's services is to assist the Government in the effective implementation of the project.

The Consultant's services are divided into three phases as shown below;

i) Final detail design of the Project and preparation of tender document

ii) Tendering, construction supervision and training of local counterpart personnel.

iii) Supporting services and managements

B. Specific Term of Reference

The Consultants will provide a team to undertake the following Consultant's services.

1) To assist the preparation of detailed design, cost estimates, specifications and tender documents for civil works and for procurement of operation and maintenance equipments, construction machineries, consturction materials and other goods and instruments necessary for the project

2) To assist Mae Kuang Irrigated Agriculture Development Project in the supervision of construction works under the project

3) To assist and advise the Project Manager in preparing monthly construction schedule and work records

4) To assist the relevant Government agencies to prepare irrigated agricultural training program which will include the provision for:

i) effective education of farmers in the Project Area through intensive demonstration and other means to enable them to adopt

new cropping systems, diversified crops, use improved varieties of crops and improve cultivation practices;

ii) strengthening of existing farmer's organizations and establishment of new organizations, of local farmers for the effective channelling of agricultural services;

iii) adequate supply of agricultural credit and production requisites to these farmers as required for the recommended system of intensive cropping; and

5) To train local counterpart personnel in all phases of project activities.

C. Expertise

1) Senior Irrigation Engineer with sufficient experience in the planning, design and operation and maintenance of irrigation and drainage system and with sufficient seniority to function as team leader.

2) Hydrologist with sufficient experience in evaluating the climatical and hydrological data and also analysing run-off discharge, water balance, and sedimentation.

3) Irrigation Engineer with sufficient experience to set-up for applied research on several upland crops prefered by the farmer, to be used in the proposed multiple cropping scheme.

4) Engineering Geologist with sufficient experience in the geological investigation for the major structures such as dam, canal structures, bridge and etc.

5) Soil Mechanical Engineer with sufficient experience for soil mechanical investigation, test and stability analysis of dam and foundation by applying computer.

6) Design Engineer with sufficient experience in the planning, design and construction of dam, canal, strucutres and power plant.

7) Mechanical Engineer with experience in management and organization of operation and maintenance of construction equipment and power plant.

8) Construction planner with sufficient experience in planning and designing of project construction.

9) Cost Estimator to estimate the project costs in the both manners of force account and contract bases.

10) Tender documents specialist and specification writer with sufficient experience for the preparation of tender documents and specifications of the project.

11) Agronomist with sufficient experience in the crop and soil management under paddy irrigation and upland crops at the farm level as well as in agricultural supporting services for irrigated agriculture.

12) Economist with sufficient experience in the establishment of farm budgets, marketing and credit services and in the evaluation of economic and financial viability of the project.

D. Services to be provided by the Government

The Government will provide the followings for carrying out the Consultant's services.

1) All available documents, drawing, maps, statistics, data and other information related to the irrigation development Project in the area.

2) Suitable full-time counterparts personnel, including engineers, technicians and professionals, as required for the project; and

3) To excempt the Consultants from (or bear the cost of) any taxes, duties, fees, levies and other impositions imposed under its laws and regulations in the respect of;

i) any payment made to the Consultants in connection with the carrying out their services;

ii) any equipment, materials and supplies brought into the territories of the Government for the purpose of carrying out the services; and

iii) any property brought by the members of the Consultants for their personnel use and consumption.

Figure J 2-1 shows the proposed schedule for the Consultant's services.

FIGURE J2-1 PROPOSED SCHEDULE FOR CONSULTANTS SERVICE

Foreign Consultants
Local Consultants

Description \ Year	1982			1983			1984			1985			1986			1987			1988			Man-Month	
	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	Foreign	Local
I. Final Design																							
1. Leader																						I-1 12	
2. Hydrologist																						I-2 4	
3. Irrigation Engineer																						I-3 6	
4. Engineering Geologist																						I-4 7	
5. Soil Mechanical Engineer																						I-5 7	
6. Design Engineer (Dam) (A)																						I-6 12	
7. -do- (Dam) (B)																						I-7 12	
8. -do- (Canal) (A)																						I-8 12	
9. -do- (Canal) (B)																						I-9	11
10. -do- (Struture) (A)																						I-10 10	
11. -do- (Struture) (B)																						I-11	10
12. -do- (Power Plant)																						I-12 5	
13 -do- (Architecture)																						I-13 5	
14. Mechanical Engineer (Equipment)																						I-14 4	
15. -do- (Power Plant)																						I-15 3	
16. Construction Planner																						I-16 5	
17. Cost Estimator																						I-17 5	
18 Specialist for Tender Documents																						I-18 4	
19 Spesifications Writer (A)																						I-19 4	
20 -do- (B)																						I-20 4	
21. Agronomist																						I-21 4	
22. Economist																						I-22 2	
23 Surveyor (A)																						I-23	12
24 -do- (B)																						I-24	12
Sub-Total																						127	45
II Costrution Supervision																							
II-1 Tendering																							
1 Project Engineer (Leader)																						II-1 2	
2. Mechanical Engineer (Equipment)																						II-2 2	
3 -do- (Power Plant)																						II-3 1	
4 Cost Estimator																						II-4 1	
Sub-Total																						6	
II-2 Costrution Supervision																							
5 Project Engineer (Leader)																						II-5 57	
6. Project Engineer (Site Supervisor)																						II-6	57
7 Dam Engineer (A)																						II-7 48	
8. -do- (B) (Site Supervisor)																						II-8	57
9 Canal Engineer (A)																						II-9 48	
10. -do- (B) (Site Supervisor)																						II-10	48
11. Engineering Geologist																						II-11 36	
12. Soil Mechanical Engineer																						II-12 26	
13. Mechanical Engineer (Equipment)																						II-13 9	
14. -do- (Power Plant)																						II-14 6	
15. Economist																						II-15 2	
16 Surveyor (A)																						II-16	48
17. -do- (B)																						II-17	33
Sub-Total																						232	243
III Supporing Services and Management																							
1 Agronomist (A)																						III-1 26	
2. -do- (B)																						III-2	37
3 Extension Service Expert																						III-3	18
4. Water and Farm Management Expert (A)																						III-4 19	
5 -do- (B)																						III-5	19
Sub-Total																						45	74
Total																						410	363

APPENDIX K. AGRO-ECONOMY

APPENDIX K AGRO-ECONOMY

Appendix K-1

Appendix K-2

Appendix K-3 Economic Internal Rate of Return (EIRR)-With On-farm Cost (Force Account Basis)

Table K 1-1. Gross National Product at Constant 1972 Prices

(Unit: ฿ million)

Whole Kingdom

Industrial Origin	1975	1976	1977	1978	1979[E/]
Agriculture	62,081	65,898	65,537	75,059	73,612
Crops	45,639	49,013	46,794	55,524	54,038
Livestock	7,377	7,622	8,102	8,203	8,585
Fisheries	5,734	5,898	7,499	8,395	8,102
Forestry	3,331	3,365	3,142	2,937	2,887
Mining and quarrying	2,485	2,906	3,526	4,101	4,627
Manufacturing	36,787	42,529	48,071	52,756	58,036
Construction	8,514	10,022	11,996	14,141	15,367
Electricity and water supply	3,181	3,642	4,144	4,500	5,060
Transportation and communication	13,445	14,650	16,142	18,434	20,831
Wholesale and retail trade	35,774	38,821	41,213	43,452	47,009
Banking, insurance and real estate	9,629	10,208	11,574	13,833	15,319
Ownership of dwellings	3,555	3,664	3,823	4,081	4,379
Public administration and defence	8,359	8,893	9,555	10,166	11,417
Services	19,704	21,276	23,260	26,317	29,090
Gross Domestic Product, (GDP)	203,514	222,509	238,841	266,840	284,747
Plus: Net Factor Income Payment from the Rest of the World	- 175	- 1,018	- 1,571	- 2,785	- 5,406
Gross National Product, (GNP)	203,339	221,491	237,270	264,055	279,341
Per Capita GNP (Baht)	4,856	5,156	5,388	5,855	6,054

E/: Estimated

Table K 1-2. Gross Regional Product at Constant 1972 Prices

(Unit: ฿ million)

Northern Region

Industrial Origin	1975	1976	1977	1978	1979 E/
Agriculture	15,174	15,685	14,378	16,888	17,440
Crops	12,371	12,701	11,427	14,102	14,579
Livestock	1,642	1,698	2,159	2,020	2,109
Fisheries	268	212	198	211	206
Forestry	893	1,074	594	555	546
Mining and quarrying	401	422	493	622	731
Manufacturing	2,811	3,236	3,451	3,667	3,941
Construction	1,031	1,424	1,674	2,322	2,244
Electricity and water supply	1,358	1,459	1,768	1,482	1,693
Transportation and communication	2,195	2,373	2,622	2,992	3,356
Wholesale and retail trade	5,828	6,100	5,791	6,173	6,578
Banking, insurance and real estate	446	520	681	867	961
Ownership of dwellings	297	308	308	326	346
Public administration and defence	838	848	921	1,105	1,326
Services	2,440	2,906	2,954	3,496	3,886
Gross Regional Product, (GRP)	32,819	35,281	35,041	39,940	42,502
Per Capita GRP (Baht)	3,686	3,900	3,808	4,270	4,477

E/: Estimated

Table K 1-3. Gross Provincial Product at Constant 1972 Prices

(Unit: ฿ million)

Chiang Mai Province

Industrial Origin	1975	1976	1977	1978	1979 E/
Agriculture	2,041.4	1,921.1	2,051.8	2,397.9	2,496.8
Crops	1,658.9	1,610.1	1,698.3	2,070.8	2,155.7
Livestock	243.8	235.9	279.7	273.3	288.3
Fisheries	29.3	21.8	19.1	18.6	18.2
Forestry	109.4	53.3	54.7	35.2	34.6
Mining and quarrying	114.9	102.5	104.4	135.5	132.9
Manufacturing	467.5	523.2	542.8	579.8	615.1
Construction	146.3	219.6	242.2	544.7	444.8
Electricity and water supply	25.9	30.1	34.5	36.6	43.1
Transportation and communication	428.7	443.4	540.7	588.8	660.5
Wholesale and retail trade	825.3	827.7	881.3	962.5	1,003.6
Banking, insurance and real estate	117.8	128.5	157.1	209.5	232.3
Ownership of dwellings	39.5	40.4	41.0	43.7	46.2
Public administration and defence	159.4	163.1	177.1	204.5	241.1
Services	589.3	808.6	716.7	913.0	1,030.6
Gross Provincial Product, (GPP)	4,956.0	5,208.2	5,489.6	6,616.5	6,947.0
Per Capita GPP (Baht)	4,521	4,733	4,909	5,806	6,041

E/: Estimated

Table K 1-4. Gross Provincial Product at Constant 1972 Prices

(Unit: ฿ million)

Lamohun Province

Industrial Origin	1975	1976	1977	1978	1979 E/
Agriculture	734.0	725.2	724.5	715.0	739.1
Crops	591.0	652.3	662.1	563.0	583.2
Livestock	69.1	60.3	43.2	116.0	120.5
Fisheries	0.7	0.9	0.6	0.1	0.1
Forestry	73.2	11.7	18.6	35.9	35.3
Mining and quarrying	54.2	64.3	74.3	68.1	59.0
Manufacturing	115.0	117.5	123.9	131.6	135.6
Construction	29.5	31.1	34.5	17.6	30.1
Electricity and water supply	2.2	3.8	5.1	4.4	5.8
Transportation and communication	170.4	193.1	209.5	276.7	306.0
Wholesale and retail trade	294.8	288.0	287.7	268.0	273.1
Banking, insurance and real estate	6.6	7.5	9.5	12.7	14.0
Ownership of dwellings	11.5	11.8	12.0	12.6	13.5
Public administration and defence	25.6	26.0	28.3	33.3	40.7
Services	73.5	76.9	85.1	94.6	103.3
Gross Provincial Product, (GPP)	1,517.3	1,545.2	1,594.4	1,634.6	1,720.2
Per Capita GPP (Baht)	4,482	4,549	4,673	4,766	4,977

E/: Estimated

Table K 1-5. Gross National Product at Current Market Prices

(Unit: ฿ million)

Whole Kingdom

Industrial Origin	1975	1976	1977	1978	1979 E/
Agriculture	94,063	104,657	110,929	131,167	145,616
Crops	69,666	77,509	79,069	99,342	109,082
Livestock	11,473	12,354	14,409	12,724	16,860
Fisheries	8,454	9,792	12,456	14,103	14,584
Forestry	4,470	5,002	4,995	4,998	5,090
Mining and quarrying	4,062	5,174	8,139	10,604	13,798
Manufacturing	53,910	63,025	74,676	87,657	108,865
Construction	12,873	15,784	20,251	25,863	31,471
Electricity and water supply	3,290	3,745	4,384	5,168	5,730
Transportation and communication	18,764	21,828	24,706	29,793	35,312
Wholesale and retail trade	54,681	59,391	74,931	94,631	112,964
Banking, insurance and real estate	14,559	16,075	19,537	25,300	31,372
Ownership of dwellings	4,415	4,840	5,272	5,868	6,875
Public administration and defence	12,321	13,571	14,810	17,943	21,292
Services	25,878	29,545	35,395	43,347	51,136
Gross Domestic Product, (GDP)	298,816	337,635	393,030	477,341	564,431
Plus: Net Factor Income Payment from the Rest of the World	- 219	- 1,261	- 2,014	- 3,712	- 7,652
Gross National Product, (GNP)	298,597	336,374	391,016	473,629	556,779
Per Capita GNP (Baht)	7,132	7,830	8,879	10,502	12,067

E/: Estimated

Source: National Statistical Office, Office of Prime Minister,

Table K 1-6. Gross Regional Product at Current Market Prices

(Unit: ฿ million)

Northern Region

Industrial Origin	1975	1976	1977	1978	1979 E/
Agriculture	25,208	26,673	25,653	31,873	35,689
Crops	20,738	21,609	20,408	27,112	29,948
Livestock	2,683	2,966	3,778	3,186	4,138
Fisheries	411	374	398	436	443
Forestry	1,376	1,724	1,069	1,139	1,160
Mining and quarrying	544	668	880	1,128	1,338
Manufacturing	4,518	5,244	5,668	6,399	7,120
Construction	1,561	2,245	2,826	4,249	4,597
Electricity and water supply	1,389	1,502	1,754	1,500	1,685
Transportation and communication	2,828	3,152	3,645	4,340	5,128
Wholesale and retail trade	9,346	9,732	10,673	13,821	15,756
Banking, insurance and real estate	737	890	1,215	1,668	2,078
Ownership of dwellings	391	419	448	522	593
Public administration and defence	1,283	1,329	1,482	2,024	2,525
Services	3,297	3,801	4,439	5,821	6,847
Gross Regional Product, (GRP)	51,102	55,655	58.683	73,345	83,356
Per Capita GRP (Baht)	5,740	6,151	6,377	7,842	8,781

E/: Estimated

Table K 1-7. Gross Provincial Product at Current Market Prices

(Unit: ฿ million)

Chiang Mai Province

Industiral Origin	1975	1976	1977	1978	1979E/
Agriculture	3,201.6	3,178.0	3,667.0	4,734.4	5,205.4
Crops	2,624.9	2,653.0	3,022.5	4,202.4	4,501.4
Livestock	395.1	394.2	510.7	428.4	598.5
Fisheries	44.9	38.4	38.4	38.5	39.1
Forestry	136.7	92.4	95.4	65.1	66.4
Mining and quarrying	126.8	150.2	186.5	262.0	301.8
Manufacturing	736.5	855.3	891.2	1,010.5	1,094.0
Construction	221.7	345.7	408.9	997.0	910.6
Electricity and water supply	27.2	30.5	36.4	45.9	55.5
Transportation and communication	553.3	586.8	753.3	849.0	1,004.8
Wholesale and retail trade	1,326.9	1,326.5	1,641.4	2,167.5	2,422.9
Banking, insurance and real estate	174.1	200.3	262.2	373.1	463.4
Ownership of dwellings	52.0	55.0	59.7	69.9	79.2
Public administration and defence	244.1	255.4	284.9	374.7	459.2
Services	797.2	1,015.9	1,108.7	1,569.3	1,864.1
Gross Provincial Product, (GPP)	7,461.4	7,999.6	9,300.2	12,453.3	13,860.9
Per Capita GPP (Baht)	6,806	7,270	8,317	10,928	12,053

E/: Estimated

Table K 1-8. Gross Provincial Product at Current Market Prices

(Unit: ฿ million)

Lamphun Province

Industrial Origin	1975	1976	1977	1978	1979 E/
Agriculture	1,272.6	1,244.1	1,289.8	1,297.5	1,411.9
Crops	1,041.3	1,104.3	1,165.9	1,054.6	1,122.5
Livestock	114.3	104.0	87.9	179.2	224.5
Fisheries	1.0	1.6	1.2	0.2	0.2
Forestry	116.0	34.2	34.8	63.5	64.7
Mining and quarrying	63.2	71.2	80.4	75.0	63.9
Manufacturing	177.1	189.8	203.4	228.4	239.2
Construction	44.8	49.1	58.4	82.4	61.7
Electricity and water supply	2.2	3.8	5.5	5.3	7.4
Transportation and communication	223.2	262.9	300.0	414.3	489.2
Wholesale and retail trade	473.0	460.4	532.9	610.2	670.0
Banking, insurance and real estate	13.9	16.1	20.3	28.9	36.3
Ownership of dwellings	15.2	16.0	17.4	20.3	23.1
Public administration and defence	39.1	40.5	45.5	60.9	77.5
Services	98.7	104.0	124.0	153.5	178.4
Gross Provincial Product, (GPP)	2,423.0	2,457.9	2,677.6	2,976.7	3,258.6
Per Capita GPP (Baht)	7,158	7,236	7,848	8,680	9,429

E/: Estimated

Table K 2-1. Population in the Northern Region

(Unit: Person)

		1971	1972	1973	1974	1975	1976	1977	1978	1979	Percentage in 1979 (%)
1.	Chian Rai	1,121,574	1,140,530	1,159,710	1,273,049	1,294,201	1,312,064	889,143	900,619	912,909	9.6
2.	Phayao							439,663	454,163	458,338	4.8
3.	Mae Hong Son	92,129	95,169	96,900	104,255	106,534	119,422	125,399	127,146	129,458	1.4
4.	Chiang Mai	1,023,223	1,049,802	1,072,855	1,086,205	1,096,243	1,100,325	1,118,271	1,139,537	1,150,043	12.1
5.	Nan	330,444	329,654	335,107	339,181	343,825	359,845	365,442	369,283	374,200	3.9
6.	Lamphun	308,266	313,598	334,296	336,802	338,521	339,689	341,194	343,917	345,608	3.6
7.	Lampang	598,964	610,323	625,185	636,580	643,001	645,260	648,639	652,528	655,993	6.9
8.	Phrae	394,688	394,420	399,389	415,239	417,428	418,548	425,235	436,234	441,725	4.7
9.	Uttaradit	344,349	351,323	381,907	386,312	394,715	405,008	410,117	415,434	426,080	4.5
10.	Sukhothai	443,490	462,373	470,396	488,182	497,824	505,168	513,843	521,361	527,168	5.6
11.	Tak	214,768	228,547	236,424	243,610	248,387	254,304	260,361	266,562	271,581	2.9
12.	Phitsanulok	559,509	575,900	634,652	649,373	655,216	675,146	683,315	690,818	703,000	7.4
13.	Kamphaeng Phet	337,451	406,139	432,276	481,992	497,840	498,658	516,948	529,975	545,379	5.7
14.	Phichit	497,928	500,899	511,523	508,109	515,782	534,798	541,911	549,398	562,658	5.9
15.	Phetchabun	566,415	608,481	631,395	657,213	680,143	716,286	733,583	753,865	766,617	8.1
16.	Nakhon Sawan	832,127	846,489	931,119	952,961	965,790	955,176	949,658	957,195	967,958	10.2
17.	Uthai Thani	192,582	202,882	206,979	212,338	217,744	232,031	241,218	246,236	254,449	2.7
	Total	7,857,905	8,114,509	8,458,087	8,769,377	8,903,194	9,047,528	9,201,920	9,353,389	9,493,164	100.0

Table K 2-2. Land, Population, Farm Family and Income

District	Whole Area (rai)	Cultivated Area (rai)	Population	Number of Farm Family	Total Income (฿'000)	Farm Income per Rai (฿/rai)	Average Farm Size (rai)	Persons Per Farm Family	Average Farm Income Per Family (฿)
Doi Saket	465,625	59,809	53,092	10,600	107,232	1,443.50	7.008	5.01	11,265.02
San Sai	198,763	82,033	66,291	11,962	239,775	2,004.53	9.999	5.54	20,044.75
San Kampheng	519,438	135,461	76,768	14,968	194,895	1,004.33	10.303	5.13	10,348.38
Whole Chiang Mai Province	14,492,567	1,395,273	1,131,974	201,133	2,841,776	1,337.08	10.452	5.23	11,935.49

Source: Northern Region Agricultural Development Center, Chiang Mai

Table K 2-3. Family Income by Provinces, Northern Region

Provinces	Gross Income: Farm Income (฿)	Gross Income: Non-farm Income (฿)	Total (฿)	Expense (฿)	Net Income (฿)	Number of Farm Family	Total Net Income by Provinces (฿ million)
Chiang Mai	7,337.64	5,693.62	13,031.26	10,258.18	2,773.08	150,311	416.82
Lamphun	5,946.45	6,734.35	12,680.80	9,251.59	3,429.21	47,233	161.97
Mae Hong Son	3,160.82	2,818.10	5,978.92	6,175.51	- 196.59	18,791	- 3.69
Chiang Rai	10,079.11	6,250.87	16,329.98	14,374.55	1,955.43	122,327	239.20
Phayao	10,747.63	9,974.45	20,721.48	19,858.07	863.41	52,024	44.92
Lampang	3,600.86	8,520.40	12,121.26	6,851.88	5,269.38	102,599	540.63
Phrae	4,914.75	7,512.89	12,427.64	10,758.12	1,669.52	52,543	87.72
Nan	3,526.84	1,691.47	5,018.31	6,156.73	- 1,138.42	58,244	- 66.31
Tak	5,857.37	6,538.31	12,375.68	8,999.09	3,376.59	31,244	105.50
Uttaradit	11,328.46	7,087.86	18,416.32	10,136.56	8,279.76	51,334	425.03
Sukhothai	12,755.92	5,858.58	18,614.50	11,607.43	7,007.07	72,104	505.24
Phisanulok	18,573.72	5,271.60	23,845.32	16,047.50	7,797.82	74,574	581.51
Phichit	17,958.05	4,274.37	22,232.42	17,712.89	4,519.53	53,209	240.48
Phetchabun	20,776.07	7,904.95	28,681.02	19,947.39	8,733.63	87,252	761.85
Kamphaseng Phet	27,222.20	5,629.54	32,851.74	18,030.69	14,821.65	53,809	797.54
Nakhon Sawan	13,942.05	4,170.95	18,113.00	14,993.92	3,119.08	86,049	268.39
Uthai Thani	11,588.60	3,991.49	15,580.09	13,184.11	2,395.98	33,505	80.27
Average or Total	11,285.64	6,079.60	17,365.24	12,843.45	4,521.79	1,147,130	5,187.08

Source: Agricultural Extension Office, Changwat Chiang Mai, Northern Region

Table K 2-4. Number of Holdings by Use of Hired Workers for Agricultural Work on the Holding and by Size of Holding

- Changwat Chiang Mai -

(Unit: rai)

Employment of Workers for Agricultural Work on the Holding	All Size	Size of Holding							
		Under 2	2-5.9	6-9.9	10-19.9	20-39.9	40-59.9	50-139.9	140 & over
Total Number of Holdings	113,285	2,741	48,005	31,161	25,882	5,063	288	110	35
Number of holdings reporting no employment	70,867	1,921	33,604	19,161	13,852	2,226	82	18	3
Number of holdings reporting employment	33,212	165	10,328	9,689	10,231	2,524	164	82	29
Number of hired permanent workers	7,414	60	1,480	1,343	2,366	1,297	224	266	378
Male	5,390	36	987	972	1,824	1,002	176	176	217
Female	2,024	24	493	371	542	295	48	90	161
Number of holdings whose employment not reported	9,206	655	4,073	2,311	1,799	313	42	10	3

Source: 1978 Agricultural Census Report - Changwat Chiang Mai -
Prepared by National Statistical Office, Office of the Prime Minister, 1979

Table K 2-5. Number of Holdings by Use of Hired Workers for Agricultural Work on the Holding and by Size of Holding

- Changwat Lamphun -

(Unit: rai)

Employment of Workers for Agricultural Work on the Holding	All Size	Under 2	2-5.9	6-9.9	10-19.9	20-39.9	40-59.9	50-159.9	140 & over
Total Number of Holdings	40,379	908	19,814	9,729	7,845	1,899	138	37	9
Number of holdings reporting no employment	22,046	499	11,283	5,105	4,231	879	43	6	0
Number of holdings reporting employment	12,043	128	5,429	3,151	2,476	746	77	27	9
Number of hired permanent workers	3,453	40	422	690	1,531	562	102	66	40
Male	1,667	24	181	271	681	363	68	48	31
Female	1,786	16	241	419	850	199	34	18	9
Number of holdings whose employment not reported	6,290	281	3,102	1,473	1,138	274	18	4	0

Source: 1978 Agricultural Census Report - Changwat Lamphun -
Prepared by National Statistical Office, Office of the Prime Minister, 1979

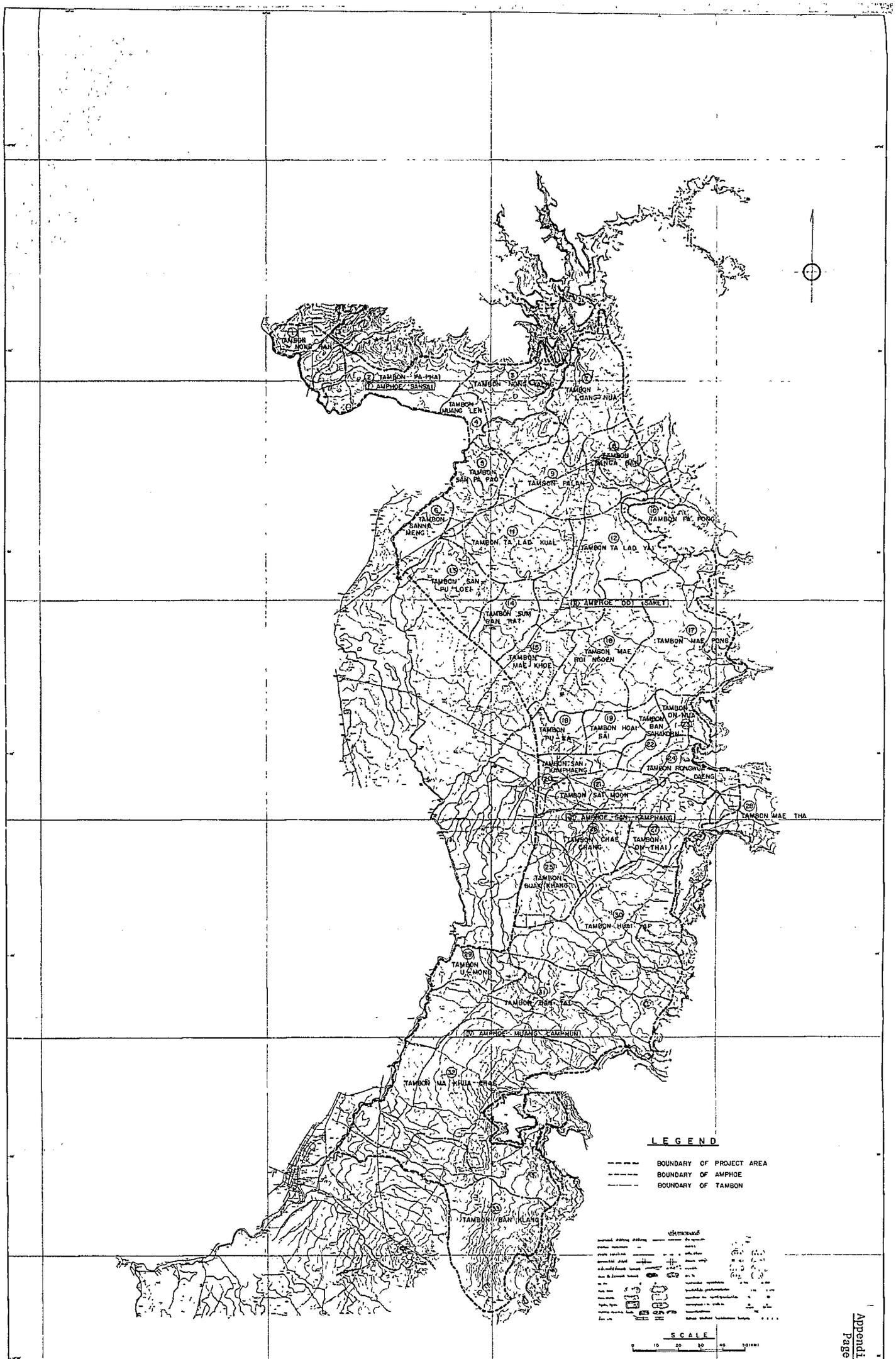


FIGURE K2-1 ADMINISTRATIVE MAP IN THE PROJECT AREA

Economic Internal Rate of Return (EIRR)

Basic Assumptions

The basic assumptions underlining the EIRR calculations are as follows:

(1) Prices: Farm gate prices of crops and physical inputs used in calculating the EIRR are derived from IBRD's projected world prices. Adjustments were dame for freight, quality, handling and processing. They are as follows:

Crops	Economic Prices (฿/ton in 1995)
Paddy	5,900
Groundnut	7,500
Soybeans	7,380
Tobacco	39,810
Longan	25,000
Inputs	
Urea	7,610
Muriate of potash	4,150
TSP	6,480
Pesticides	140 (฿/kg)
Animal labor	96 (฿/man/day)

(2) Paddy Yields: Paddy yields are assumed to increase gradually , reaching the full potential five years after implementation of the Project. Average yields of 4.6 ton/ha for improved varieties in the wet season, and 4.4 ton/ha for improved varieties in the dry season are expected in 1995/96 at full development of the Project excluding longan cultivation.

(3) Cost of Labor: All farm labor is valued at a seasonally adjusted opportunity cost. The economic cost per man-day is estimated at ฿22 which is about 50 percent of the peak rate.

(4) Agricultural Development Period: Some project benefits will commence in 1984/85, four years after construction is commenced. However, as it will take several years before the farmers adjust to the new cropping systems, it is assumed that full project benefits will not be achieved for five years after all project construction is completed. The benefits derivable from ordinary crops excluding longan would be 30, 55, 61, 82, 87, 92, 96 and 100 percent of total benefits for the Left Bank Area and the Right Bank Area, and 30, 55, 61, 82, 87, 92, 96 and 100 percent of total benefits for the Existing Area in years one to five after project completion.

(5) Economic Life of the Project: The economic life of the Project is assumed to be 50 years, taking into consideration the nature of the Project. This is in line with previous agricultural development project practices in Thailand.

Economic Costs

The economic costs of the Project consist of the following: i) capital cost including provision for on-farm development facilities (฿2,521,441,000), and ii) operation and maintenance (O & M) costs (฿17,420,000 per year from 1991/92 onwards). All costs are in constant prices as of 1980.

Economic Benefits

The economic benefits of the Project considered in the EIRR are the difference between the net production value "with" and "without" the Project. The economic benefits increase gradually in years one to five inclusive to about ฿631,344,000 in the 15th year when the

fully developed level will be reached including longan cultivation. The incremental annual economic benefits are estimated about ฿610 million after the 15th year through the whole project life.

Economic Internal Rate of Return (EIRR) and Sensitivity Tests

Based on the above assumptions, the EIRRs are calculated for the following cases.

Cases	EIRR (%)
Project base study	17.7
i) Reduction in respective unit prices of all crops by 10 percent	15.7
ii) Reduction in respective unit yields of all crops by 10 percent	15.7
iii) Two years delay in construction period	15.2
iv) Cost increase of 20 percent	15.3

Table K 3-1. Future Price Structure of Paddy and Rice

Item		1990 Price	
		Financial	Economic
Bangkok FOB price	US$/ton		
	Baht/ton	9,500	9,500
Rice premium		903	-
Export duty		380	-
Municipal tax		15	-
Exporter's margin		510	266
Wholesaler's margin		214	162
Transport and handling		560	447
Ex-mill price of rice		6,918	8,625
Ex-mill price of paddy		4,640	5,693
Milling cost		168	135
Miller's margin		337	135
Milling tax		85	-
Transport to mill		80	63
Input price of paddy at mill		3,970	5,360
Merchant's margin		470	-
Price of by-product		300	540
Farmgate price of paddy		3,800	5,900

Table K 3-2. Economic and Financial Costs

(Unit: ฿'000)

Item	Foreign Currency	Local Currency		Total Investment Cost	
		Financial Value	Economic Value	Financial Value	Economic Value
1. Civil Works	887,243	1,100,695	770,487	1,987,938	1,657,730
2. Land Acquisition and Compensation	0	110,230	0	110,230	0
3. Construction Equipment	203,000	64,760	20,076	267,760	223,076
4. Project Facilities	5,740	38,480	26,551	44,220	32,291
5. Project Administration	0	14,550	9,458	14,550	9,458
6. Consulting Services	90,638	55,554	43,332	146,192	133,970
7. On-Farm Development	100,691	136,809	95,766	237,500	196,457
8. Physical Contingency	136,101	178,862	132,358	314,963	268,459
Total	1,423,413	1,699,940	1,098,028	3,123,353	2,521,441

Table K 3-3. Economic and Financial Costs by Items

(Unit: ₦'000)

Item	Financial Cost								Economic Cost							
	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	Total	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	Total
1. Civil Works	130,610	385,175	528,785	488,128	256,898	115,657	82,685	1,987,938	91,427	325,446	445,465	410,657	215,882	97,526	71,327	1,657,730
2. Land Acquisition and Compensation	73,500	8,000	9,000	9,000	7,000	3,730	0	110,230	0	0	0	0	0	0	0	0
3. Construction Equipment	22,230	109,600	113,150	10,650	5,300	1,480	5,350	267,760	6,891	105,495	104,594	5,302	1,643	459	2,694	223,076
4. Project Facilities	27,960	4,640	2,320	9,280	0	0	0	44,220	19,506	3,710	1,855	7,420	0	0	0	32,291
5. Project Administration	4,640	2,290	2,290	2,290	1,520	760	760	14,550	3,016	1,488	1,489	1,489	988	494	494	9,458
6. Consulting Services	0	35,817	17,982	23,244	26,899	25,537	18,713	146,192	0	32,822	16,479	21,301	24,650	21,569	17,149	133,970
7. On-Farm Development	0	47,500	47,500	47,500	71,250	11,875	11,875	237,500	0	39,292	39,291	39,291	58,937	9,823	9,823	196,457
8. Physical Contingency	38,844	67,969	95,280	69,851	35,898	4,082	5,059	314,963	28,745	60,615	83,696	59,393	28,491	3,070	4,449	268,459
Total	297,804	654,885	816,307	659,923	403,765	161,121	124,442	3,123,353	119,385	566,866	692,869	542,853	330,591	132,941	105,936	2,521,441

Table K 3-4. Economic and Financial Crop Budget with Project

Economic

Crops	Unit Yield (ton/ha)	Unit Price (฿/ton)	Unit Gross Value (฿/ha)	Unit Production Cost (฿/ha)	Unit Net Value (฿/ha)
Rice (wet)	4.6	5,900	27,140	6,811	20,319
Rice (dry)	4.4	5,900	25,960	6,522	19,438
Groundnut	1.9	7,500	14,250	3,649	10,601
Sweet corn	1.2	2,200	2,640	874	1,766
Soybeans	1.8	7,380	13,824	3,594	10,230
Tobacco	1.3	39,810	51,753	13,947	37,806
Garlic	3.5	13,820	48,370	15,320	33,050
Vegetables	6.0	2,100	12,600	4,829	7,771
Longan	3.8	25,000	95,000	9,986	85,014

Financial

Crops	Unit Yield (ton/ha)	Unit Price (฿/ton)	Unit Gross Value (฿/ha)	Unit Production Cost (฿/ha)	Unit Net Value (฿ha)
Rice (wet)	4.6	3,800	17,480	7,653	9,827
Rice (dry)	4.4	3,800	16,720	7,329	9,391
Groundnut	1.9	5,700	10,830	5,093	5,737
Sweet corn	1.2	2,200	2,640	1,165	1,475
Soybeans	1.8	5,450	9,810	4,650	5,160
Tobacco	1.3	30,180	39,234	18,596	20,638
Garlic	3.5	10,500	36,750	20,426	16,324
Vegetables	6.0	2,100	12,600	6,439	6,161
Longan	3.8	19,000	72,200	13,315	58,885

Table K 3-5. Economic Budget by Cropping Systems

Cropping Systems	Unit Yield (ton/ha)	Unit Price (฿/ton)	Unit Gross Value (฿/ha)	Unit Production Cost (฿/ha)	Unit Net Value (฿/ha)
Rice (w)[1/] +	4.6	5,900	27,140	6,811	20,329
Rice (d)[2/]	4.4	5,900	25,960	6,522	19,438
Total					39,767
Rice (w) +	4.6	5,900	27,140	6,811	20,329
Groundnut (d)	1.9	7,500	14,250	3,649	10,601
Total					30,930
Rice (w) +	4.6	5,900	27,140	6,811	20,329
Soybeans (d)	1.8	7,380	13,824	3,594	10,230
Total					30,559
Rice (w) +	4.6	5,900	27,140	6,811	20,329
Sweet corn (d)	1.2	2,200	2,640	874	1,766
Total					22,095
Rice (w) +	4.6	5,900	27,140	6,811	20,329
Tobacco (d)	1.3	39,810	51,753	13,947	37,806
Total					58,135
Rice (w) +	4.6	5,900	27,140	6,811	20,329
Garlic (d)	3.5	13,820	48,370	15,320	33,050
Total					53,379
Rice (w) +	4.6	5,900	27,140	6,811	20,329
Vegetables (d)	6.0	2,100	12,600	4,829	7,771
Total					28,100
Soybeans (w) +	1.8	7,380	13,824	3,594	10,230
Tobacco (d)	1.3	39,810	51,753	13,947	37,806
Total					48,036
Soybeans (W) +	1.8	7,380	13,824	3,594	10,230
Groundnut (d)	1.9	7,500	14,250	3,649	10,601
Total					20,831
Longan (perennial)	3.8	25,000	95,000	9,986	85,014

Table K 3-6. Income with Project by Cropping Systems
(Economic)

Cropping Systems		Unit Net Value (฿/ha)	Ratio[1/]	Unit Net Return (฿/ha)	Acreage (ha)	Total Net Return Incl. Hired Labor Cost (฿'000/Project area)
Wet Season	Dry Season					
I. Rice	+ Groundnut	30,930	2/3	20,621		
Rice	+ Tobacco	58,135	1/3	19,376		
				39,997	2,442	97,673
II. Rice	+ Groundnut	30,930	2/3	20,621		
Rice	+ Garlic	53,379	1/3	17,791		
				38,412	1,130	43,406
III. Rice	+ Groundnut	30,930	2/3	20,621		
Rice	+ Vegetables	28,100	1/3	9,366		
				29,987	1,232	36,944
IV. Rice	+ Soybeans	30,559	1/2	15,280		
Rice	+ Sweet corn	22,095	1/2	11,048		
				26,328	4,325	113,869
V. Rice	+ Soybeans	30,559	2/3	20,374		
Rice	+ Garlic	53,379	1/3	17,791		
				38,165	1,836	70,071
VI. Rice	+ Rice	39,767	2/5	15,951		
Rice	+ Soybeans	30,559	3/5	18,335		
				34,286	6,380	218,745
VII. Soybeans	+ Groundnut	20,831	2/3	13,888		
Soybeans	+ Tobacco	48,036	1/3	16,010		
				29,898	1,323	39,555
VIII. Soybeans	+ Groundnut	20,831	1/2	10,416		
Longan		85,014	1/2	42,507		
				52,923	1,332	70,493

1/: Occupied by respective cropping systems

Table K 3-7. Financial Crop Production Cost with Project

Crops	Unit Yield (ton/ha)	Unit Price (฿/ton)	Unit Gross Value (฿/ha)	Production Cost						
				Seeds (฿/ha)	Fertilizer (฿/ha)	Agrochemicals (฿/ha)	Animal Labor (฿/ha)	Mechanical Labor (฿/ha)	Miscellaneous (฿/ha)	Total (฿/ha)
Rice (wet)	4.6	3,800	17,480	214	2,051	490	2,005	1,156	1,737	7,653
Rice (dry)	4.4	3,800	16,720	213	1,986	491	1,891	1,096	1,652	7,329
Groundnut	1.9	5,700	10,830	693	1,070	219	1,339	830	942	5,093
Sweet corn	1.2	2,200	2,640	146	242	130	260	125	262	1,165
Soybeans	1.8	5,450	9,810	618	958	237	1,232	767	838	4,650
Tobacco	1.3	30,180	39,234	2,566	3,961	4,110	2,659	1,395	3,905	18,596
Garlic	3.5	10,500	36,750	4,045	4,118	2,949	3,539	1,650	4,125	20,426
Vegetables	6.0	2,100	12,600	1,075	1,880	1,693	522	97	1,172	6,439
Longan	3.8	19,000	72,200		3,413	1,136			4,217	8,776

Table K 3-8. Economic Crop Production Cost with Project

Crops	Unit Yield (ton/ha)	Unit Price (฿/ton)	Gross Value (฿/ha)	Seeds (฿/ha)	Fertilizer (฿/ha)	Agro-chemicals (฿/ha)	Animal Labor (฿/ha)	Mechanical Labor (฿/ha)	Miscellaneous (฿/ha)	Total (฿/ha)
Rice (wet)	4.6	5,900	27,140	211	1,819	429	1,778	1,022	1,553	6,812
Rice (dry)	4.4	5,900	25,960	202	1,754	445	1,676	978	1,467	6,522
Groundnut	1.9	7,500	14,250	499	773	155	960	578	675	3,649
Sweet corn	1.2	2,200	2,640	110	181	99	281	94	109	874
Soybeans	1.8	7,380	13,824	485	744	180	952	586	647	3,594
Tobacco	1.3	39,810	51,753	1,939	2,985	3,068	2,120	1,478	2,357	13,947
Garlic	3.5	13,820	48,370	3,003	3,079	2,221	2,696	1,272	3,049	15,320
Vegetable	6.0	2,100	12,600	835	1,405	1,260	412	77	840	4,829
Logan	3.8	25,000	95,000		2,546	869			6,571	9,986

Table K 3-9. Economic and Financial Costs (Alternative-1)

(Unit: ฿ '000)

Items	Foreign Currency	Local Currency		Total Investment Cost	
		Financial Value	Economic Value	Financial Value	Economic Value
1. Civil Works	887,243	1,319,181	923,426	2,206,424	1,810,669
2. Land Acquisition and Compensation	0	110,230	0	110,230	0
3. Construction Equipment	203,000	64,760	20,077	267,760	223,077
4. Project Facilities	5,740	38,480	26,551	44,220	32,291
5. Project Administration	0	14,550	9,459	14,550	9,459
6. Consulting Services	90,638	55,554	43,333	146,192	133,971
7. On-Farm Development	100,691	136,809	95,765	237,500	196,456
8. Physical Contingency	136,101	211,634	156,610	347,735	292,711
Total	1,423,413	1,951,198	1,275,221	3,374,611	2,698,634

Table K 3-10. Economic and Financial Costs by Items (Alternative-1)

	Financial Cost								Economic Cost							
	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	Total	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	Total
1. Civil Works	130,610	400,456	598,797	558,140	291,851	134,011	92,559	2,206,424	91,427	336,143	494,473	459,665	240,349	110,373	78,239	1,810,669
2. Land Acquisition and Compensation	73,500	8,000	9,000	9,000	7,000	3,730	0	110,230	0	0	0	0	0	0	0	0
3. Construction Equipment	22,230	109,600	113,150	10,650	5,300	1,480	5,350	267,760	6,891	103,494	104,594	3,302	1,643	459	2,694	223,077
4. Project Facilities	27,980	4,640	2,320	9,280	0	0	0	44,220	19,306	3,710	1,855	7,420	0	0	0	32,291
5. Project Administration	4,640	2,290	2,290	2,290	1,520	760	760	14,550	3,016	1,489	1,489	1,489	988	494	494	9,459
6. Consulting Services	0	35,817	17,982	23,244	26,899	23,537	18,713	146,192	0	32,823	16,479	21,301	24,650	21,569	17,149	133,971
7. On-Farm Development	0	47,500	47,500	47,500	71,250	11,875	11,875	237,500	0	39,291	39,291	39,291	58,937	9,823	9,823	196,456
8. Physical Contingency	38,844	70,261	105,781	80,333	39,141	6,835	6,540	347,735	28,745	62,311	91,466	67,165	32,371	5,108	5,545	292,711
Total	297,804	678,564	896,820	740,437	442,961	182,228	135,797	3,374,611	149,385	579,261	749,647	599,633	358,938	147,826	113,944	2698,634

Table K 3-11. Summary of Economic Benefits and Costs of the Project[1/] (Alternative-1)

- Contract basis for main dam, etc. by international tender -

(Unit: ฿ '000)

No.	Year	Benefits	Investment Cost	O&M Cost	Total Cost	Net Flow (Incremental Cost)	Present Worth Discounted at 16%	Present Worth Discounted at 17%
1	1981/82		149,385		149,385	-149,385	-128,785	-127,679
2	1982/83	6,674	579,261		579,261	-572,587	-425,547	-418,275
3	1983/84	10,546	749,647		749,647	-739,101	-473,542	-461,495
4	1984/85	178,661	599,633		599,633	-420,972	-232,503	-224,631
5	1985/86	184,113	358,938		358,938	-174,825	-83,234	-79,738
6	1986/87	375,311	147,826		147,826	227,485	93,360	88,674
7	1987/88	413,626	113,944	13,501	127,445	286,181	101,251	95,356
8	1988/89	508,289	-34,281	15,957	-18,324	526,613	160,617	149,979
9	1989/90	540,425		17,194	17,194	523,231	137,610	127,354
10	1990/91	570,674		17,298	17,298	553,376	125,450	115,102
11	1991/92	586,803		17,420	17,420	569,383	111,257	101,236
12	1992/93	606,516		17,420	17,420	589,096	99,263	89,543
13	1993/94	608,510		17,420	17,420	591,090	85,826	76,783
14	1994/95	609,507		17,420	17,420	592,087	74,129	65,722
15	1995/96	610,504		17,420	17,420	593,084	64,053	56,284
|	|	|		|	|	|	|	|
50	2030/31	610,504		17,420	17,420	593,084	356	237
	Total						107,164	-17,928

$$E\ I\ R\ R = 16\% + \frac{107,164}{107,164 + 17,928} \times 1\% = 16.9\%$$

1/ All in constant prices in 1980.

Rent and Cost Recovery

a) General

In Thailand, project outlays will be collected by the Government from farmers beneficiaries. The extent of rent and recovery and the relationship between project charges and benefits are determined based on two indicies of rent recovery and cost recovery.

Rent recovery means the ratio of incremental project charges to project rent before repaying the charges. And cost recovery means the ratio of revenues from incremental project charges payable from all of project beneficiaries to project construction and incremental O & M costs.

b) Cost recovery

The project charges are divided into two, namely repayment costs for on-farm development facilities, and O & M costs of entire project facilities.

O & M costs are current expenditures including salaries and wages of staff, employees and others, depreciation costs and repair costs of project equipment and facilities, fuel and others. The repayment costs are calculated based on all of on-farm development costs with annual interest of 12 percent, repayment term of 12 years including 2-year grace perio after completion of the Project. The project charges are estimated as follows:

- Actual operation and maintenance costs of ฿1,435 per one unit farm of 1.4 ha for the main system and on-farm development facilities.
- An annual charge of possibly ฿5,368 per one unit farm of 1.4 ha for farmers with on-farm development over a 12-year period including a two year grace period, resulting to recover all of on-farm development costs at an annual rate of 12 percent interest.

Table K 5-1. Economic and Financial Costs (Alternative-2)[1/]

(Unit: ฿ '000)

Items	Foreign Currency	Local Currency		Total Investment Cost	
		Financial Value	Economic Value	Financial Value	Economic Value
1. Civil Works	887,243	1,319,181	423,426	2,206,424	1,810,669
2. Land Acquisition and Compensation	0	110,230	0	110,230	0
3. Construction Equipment	203,000	64,760	20,077	267,760	223,077
4. Project Facilities	5,740	38,480	26,551	44,220	32,291
5. Project Administration	0	14,550	9,459	14,550	9,459
6. Consulting Services	90,638	55,554	43,333	146,192	133,971
7. Physical Contingency	120,997	191,113	141,424	312,110	262,401
Total	1,307,618	1,793,388	1,164,270	3,101,486	2,471,868

1/ In case of contract basis without on-farm development.

Table K 5-2. Summary of Economic Benefits and Costs of the Project[1/] (Alternative-2)

(Unit: ฿ '000)

No.	Year	Benefits	Investment Cost	O&M Cost	Total Cost	Net Flow (Incremental Cost)	Present Worth Discounted at 16%	Present Worth Discounted at 17%
1	1981/82		149,385		149,385	-149,385	-128,785	-127,679
2	1982/83	6,674	521,516		521,516	-514,842	-382,631	-376,092
3	1983/84	10,546	647,520		647,520	-646,974	-408,109	-397,727
4	1984/85	153,837	497,504		497,504	-343,667	-189,807	-183,381
5	1985/86	158,681	262,567		262,567	-103,886	-49,460	-47,382
6	1986/87	321,912	121,604		121,604	200,308	82,206	78,080
7	1987/88	355,152	94,599	12,353	106,952	248,200	87,813	82,700
8	1988/89	437,114	-34,281	14,601	-19,680	456,794	139,322	130,095
9	1989/90	465,019		15,733	15,733	449,286	118,162	109,356
10	1990/91	491,446		15,828	15,828	475,618	107,823	98,929
11	1991/92	505,352		15,939	15,939	489,413	95,631	87,018
12	1992/93	522,507		15,939	15,939	506,568	85,357	76,998
13	1993/94	524,279		15,939	15,939	508,340	73,811	66,033
14	1994/95	525,164		15,939	15,939	509,225	63,755	56,524
15	1995/96	525,879		15,939	15,939	509,940	55,074	48,393
⋮	⋮	⋮		⋮	⋮	⋮	⋮	⋮
50	2030/31	525,879		15,939	15,939	509,940	306	204
	Total						92,331	-17,240

$$E\ I\ R\ R = 16\% + \frac{92,331}{92,331 + 17,240} \times 1\% = 16.8\%$$

1/ All in constant prices in 1980.
2/ In case of force account basis without on-farm development.

Table K 5-3. Economic and Financial Cost (Alternative-3)[1/]

(Unit: ฿ '000)

Items	Foreign Currency	Local Currency		Total Investment Cost	
		Financial Value	Economic Value	Financial Value	Economic Value
1. Civil Works	887,243	1,100,695		1,987,938	1,657,730
2. Land Acquisition and Compensation	0	110,230	770,487	110,230	0
3. Construction Equipment	203,000	64,760	0	267,760	223,076
4. Project Facilities	5,740	38,480	20,076	44,220	32,291
5. Project Administration	0	14,550	26,551	14,550	9,458
6. Consulting Services	90,638	55,554	9,458	146,192	133,970
7. Physical Contingency	120,997	158,341	117,173	279,338	238,170
Total	1,307,618	1,542,610	987,076	2,850,228	2,294,694

1/ In case of contract basis without on-farm development.

Table K 5-4. Summary of Economic Benefits and Costs of the Project[1/] (Alternative-3)[2/]

(Unit: ฿ '000)

Year	Benefits	Investment Cost	O&M Cost	Total Cost	Net Flow (Incremental Cost)	Present Worth Discounted at 15%	Present Worth Discounted at 16%
1981/82		149,385		149,385	-149,385	-129,905	-128,785
1982/83	6,674	533,892		533,892	-527,218	-398,630	-391,828
1983/84	10,546	704,299		704,299	-693,753	-456,143	-444,488
1984/85	153,837	554,284		554,284	-400,447	-228,976	-221,167
1985/86	158,681	290,914		290,914	-132,273	-65,766	-62,975
1986/87	321,912	136,487		136,487	185,425	80,159	76,098
1987/88	355,152	102,606	12,353	114,959	240,193	90,289	84,980
1988/89	437,114	-34,281	14,601	-19,680	456,794	149,326	139,322
1989/90	465,019		15,733	15,733	449,286	127,732	118,162
1990/91	491,446		15,828	15,828	475,618	117,668	107,823
1991/92	505,352		15,939	15,939	489,413	105,175	95,631
1992/93	522,507		15,939	15,939	506,568	94,678	85,357
1993/94	524,279		15,939	15,939	508,340	82,605	73,811
1994/95	525,164		15,939	15,939	509,225	71,953	63,755
1995/96	525,879		15,939	15,939	509,940	62,672	55,074
⋮	⋮		⋮	⋮	⋮	⋮	⋮
2030/31	525,879		15,939	15,939	509,940	459	306
Total						117,418	-7,031

$$EIRR = 15\% + \frac{117,418}{117,418 + 7,031} \times 1\% = 15.9\%$$

1/ All in constant prices in 1980.
2/ In case of contract basis without on-farm development.

Table K 5-5. Income With and Without the Project 3/

(Unit: ฿ '000)

No.	Year	Present	Without Project	With Project						
		Income from Crops	Income from Crops (A)	Left Bank Area (B)	Existing Area (C)	Bank Area (D)	Sub-total (E)=(B+C+D)	Resettlement Area 2/ (F)	Total (G)=(E+F)	Difference (H)=(G-A)
1	1981/82	19,660	19,660	2,163	6,881	10,616	19,660	0	19,660	0
2	1982/83	19,660	19,660	2,163	6,881	10,616	19,660	6,674	26,334	6,674
3	1983/84	19,660	19,660	2,163	6,881	10,616	19,660	10,546	30,206	10,546
4	1984/85	19,660	19,660	2,163	117,314	10,616	130,093	11,347	141,440	121,780
5	1985/86	19,660	19,660	2,163	124,317	10,616	137,096	12,548	149,644	129,684
6	1986/87	19,660	20,249	15,543	136,574	101,378	253,495	13,349	266,844	246,596
7	1987/88	19,660	20,249	24,098	150,582	132,681	307,369	13,349	320,718	300,468
8	1988/89	19,660	20,249	32,382	164,589	154,871	351,842	13,349	365,191	344,942
9	1989/90	19,660	20,249	40,706	175,095	185,987	401,488	13,349	414,837	394,588
10	1990/91	19,660	20,249	51,125	175,095	218,781	445,011	13,349	458,360	438,111
11	1991/92	19,660	20,840	56,973	175,095	247,848	479,916	13,349	493,265	472,425
12	1992/93	19,660	20,840	63,208	175,095	272,917	511,220	13,349	524,569	503,729
13	1993/94	19,660	20,840	64,139	175,095	273,663	512,897	13,349	526,246	505,406
14	1994/95	19,660	20,840	64,606	175,095	274,035	513,736	13,349	527,085	506,245
15	1995/96	19,660	20,840	65,072	175,095	274,408	514,575	13,349	527,924	507,084
		|	|	|	|	|	|	|	|	|
50	2030/31	19,660	20,840	65,072	175,095	274,408	514,575	13,349	527,924	507,084

1/ Incomes here represent value net from production costs.

2/ Net benefits obtainable from 450 ha of the proposed resettlement area located outside of the Project area.

3/ In case of Alternative 2 and 3.