A-10-2-4 Fishing

(1) The present state of fishing in and around the Lingayen Gulf Table A-10-12 shows the fishing production in Region I where the Lingayen Gulf is situated as compared with the total production in the Republic of the Philippines.

Table A-10-12 : Fishing Quantity and Volume in over-all Philippines and Region I

Fishing area / Devision	Over-all Philippines		Region I		Region-I / Over-all Philippines (Ratio)
	Quantity	Value	Quantity	Value	
Fish pond	107	809	13	(99)	12%
Mu.incipal fishing	732	2,561	18	(63)	2.5%
Commercial fishing	499	2,549	5	(26)	1.0%
Total	1,338	5,919	36	(188)	

Unit: Quantity - 1,000 metric ton
Value - million peso

As seen from the above table, the fish production in the fish ponds in Region I accounts for 12% of the nation's total (5% according to another source of information) but only 1 to 2.5% in the municipal fishing and commercial fishing.

Of the seven provinces which comprise Region I, the fishing industry flourishes in four provinces, that is, Pangasinan, Ilocos Norte, Ilocos Sur and La Union. Of these provinces, Pangasinan and La Union face the Lingayen Gulf. The present state of fishing in these four provinces is shown in Table A-10-13.

As seen from Table A-10-12 and A-10-13, the fishing in the provinces of La Union and Pangasinan which face the Lingayen Gulf accounts for 100% of the total fishing production in Region I for commercial fishing, almost 100% also for pond fishing and 60 to 70% in municipal fishing.

From this, fishing can be said to be an important industry, along with farming, in these two provinces.

(2) Fishing Production

Fig. A-10-8 shows the fishing production in the Philippines over the past 30 years.

Table A-10-14 shows fishing production, income, and income per unit quantity. As seen from the table, the income per unit quantity was ₱5,100/ton for commercial fishing, ₱7,600/ton for fish pond and ₱3,500/ton for municipal fishing in 1975(nationwide average).

Table A-10-13 : Fishing in Region I

Division	Area	Panga-sinan	La Union	Ilocos Norte	Ilocos Sur	Total
Fish pond	Developped	Ha 11,023	547	45	272	11,887
	Un-developed	4,337	90	-	-	4,427
	Total	15,360	637	45	272	16,314
	Distribution	94%	4%	0.2%	1.8%	100%
Municipal fishing	Numbers of fisherman	11,251	4,000	5,362	4,550	25,163
	Distribution	45%	16%	21%	18%	100%
	Numbers of Banca	2,630	1,450	518	1,248	5,846
	Numbers of Banca (Non-motorized)	4,255	330	101	2,077	6,763
	Total of banca	6,885	1,780	619	3,325	12,609
	(Distribution)	55%	14%	5%	26%	
Commercial fishing	Numbers of Marine-barriers	127	70	67	130	394
	Distribution	32%	18%	17%	33%	100%
	Numbers of fishing boat	19	15	-	-	34
	Aggregate tonnage	317 G.T.	560 G.T.	-	-	877
	Numbers of fishing (distribution)	56%	44%	-	-	100%

Table A-10-14 : Fishing Quantity and Value in the Philippines

Year	Commercial fishing			Fishing pond			Municipal fishing		
——	Quantity	Value	V/Q	Quantity	Value	V/Q	Quantity	Value	V/Q
1971	382	879	2.3	98	328	3.3	543	1,124	2.1
1972	425	1,106	2.6	99	332	3.4	599	1,389	2.3
1973	465	1,262	2.7	100	434	4.3	640	1,600	2.5
1974	471	2,390	5.1	113	784	6.9	685	2,396	3.5
1975	499	2,549	5.1	107	809	7.9	732	2,561	3.5

Remarks: Quantity : 1,000 metric tons
Value : million Peso
V/Q : Ratio of value in production against quantity (the unit : x 1,000 Pesos/M.T.)

The following is the total income from fishing in Region I estimated from the nationwide average.

Table A-10-15 : Fishing Value in Region I (1975)

Value / Division	Production	Value/M.Ton	Value
Fishing Pond	12,939	₱.7,600/M.T.	₱. 98,336,400
Municipal Fishing	18,039	3,500/M.T.	63,136,500
Commercial Fishing	4,944	5,100/M.T.	25,214,400
Total	35,922		₱.186,687,300

(a) Estimated income from fishing in the provinces of La Union and Pangasinan

As shown in Table A-10-13 and discussed above, the income from fishing in these two provinces can be estimated as follows, 100% of the total in Region I for fish pond and commercial fishing and 60% for municipal fishing.

(98,336,400 x 1.0) + (25,214,400 x 1.0) + (63,136,500 x 0.6)

= ₱161,432,700

(b) Income per day per person

i) Municipal fishing (La Union and Pangasinan average)

$$\frac{₱63,136,500}{172,976 \times 365 \text{ days}} = ₱6.9/\text{day.person}$$

Income per person per day is ₱10 - 15/day, according to the information from the Bureau of Fisheries and the Agoo City Hall and it is estimated to be ₱10/person.day on the average.

ii) Pond fishing

$$\frac{₱98,336,400}{11,887 \text{ ha}} = ₱8,273/\text{ha.year}$$

iii) Commercial boat

$$\frac{₱25,214,400}{34 \text{ vessels} \times 365} = ₱2,032/\text{day.vessel}$$

(3) Fishing Methods

i) Municipal Fishing

Trawl, Beach Seine, Troll Line, Gill Net, Fish Cerral, Fish Pot, Hook & Line, Long Line, Fish Traps, Lift Net Spear, Cover Net

ii) Commercial Fishing

Trawl, Gill Net

(Note) Municipal fishing is the coastal fishing using bancas less than 3 tons mainly operating in the waters not deeper than 12 to 13 meters. Commercial fishing uses much larger boats over 3 tons manned by several employed fishermen operating in the waters deeper than 13 meters.

(4) Principal kinds of fish

i) Municipal Fishing

Slipmouth, Lizard, Nemipterid, Sugpo Shrimps, Flatfish, Groupers, Awordfish, Sardines, Mackerel, Skipjack, Flying-Fish

ii) Commercial Fishing

Bangus, Mullets, Tilopia, Gobies, Siganid, Sugpo, Mackerel, Pampane Tuna

(5) Fishing in the vicinity of Rabon

According to the information from the Bureau of Fisheries, there are 326 fishermen in the vicinity of the proposed land reclamation site at Rabon, 326 in Sto Tomas and 1,672 in Dagupan.

The number of the fishermen living in the coastal area directly adjacent to the land reclamation site is estimated to be less than 100 (100 families). The number of fishermen who have been fishing in the area to be reclaimed (2.5km x 5km) is estimated at about 150 to 200 persons.

The fishermen operating in this area are most engaged in municipal fishing (coastal fishing). There are several large commercial fishing boats(20 - 30-ton) at the pier of Damortis.

(6) Calculation of compensation payments to the fishermen

The compensation to be paid to the fishermen who will be affected by the proposed land reclamation may be calculated as follows. The necessity, amount and kinds of compensation to be paid to the fishermen are the problems to be studied on the Philippine side in the future. Here, tentative calculation is made here on the basis of the method which is commonly used in Japan.

Method of calculation: Compensation for the loss of fishing rights (Japanese method)

Average net profit (R): ₱3,000/year.person (₱10/day.person 300 work days a year)

Annual interest(r): 8%

Number of recipients: 100

Total sum of compensation: $\frac{3,000}{0.08} \times 100 = 3,750,000$(pesos)

Fig. A-10-8 **FISHING: QUANTITY OF PRODUCTION, CY 1947-74**

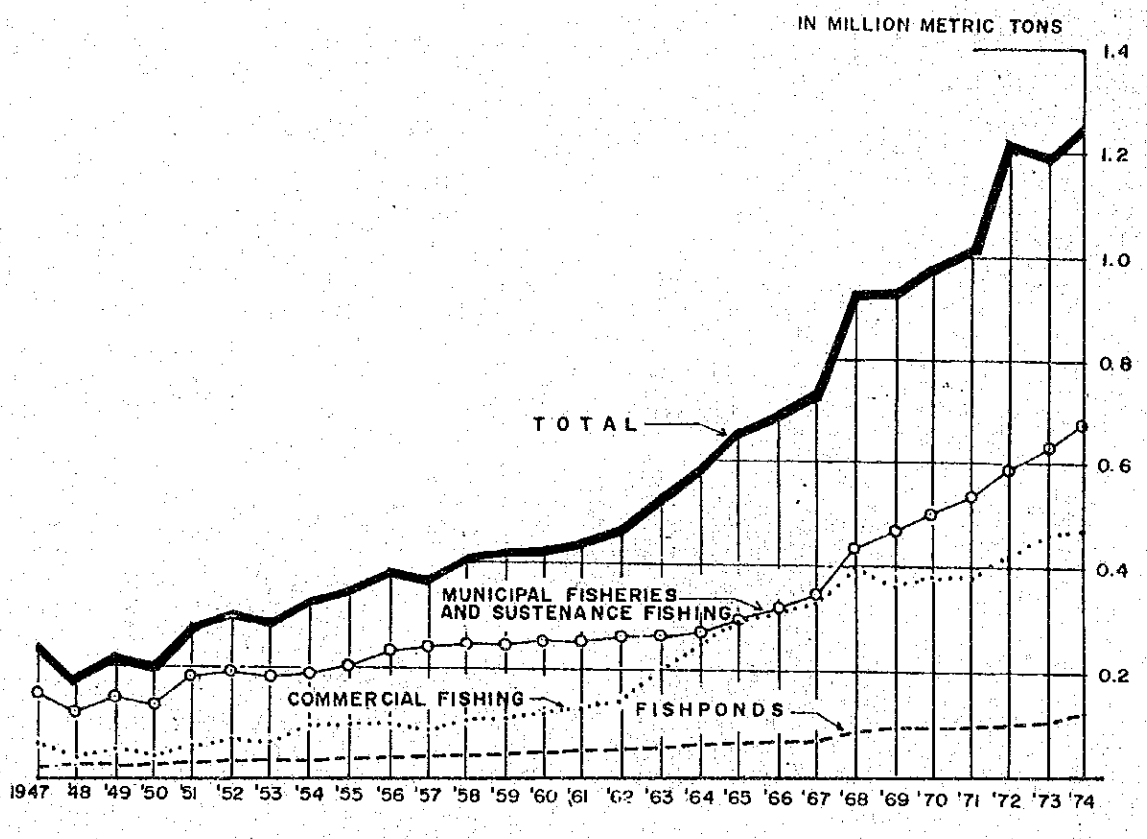


Fig. A-10-9

OVER-ALL CROP PRODUCTION: CROP YEAR 1946-75

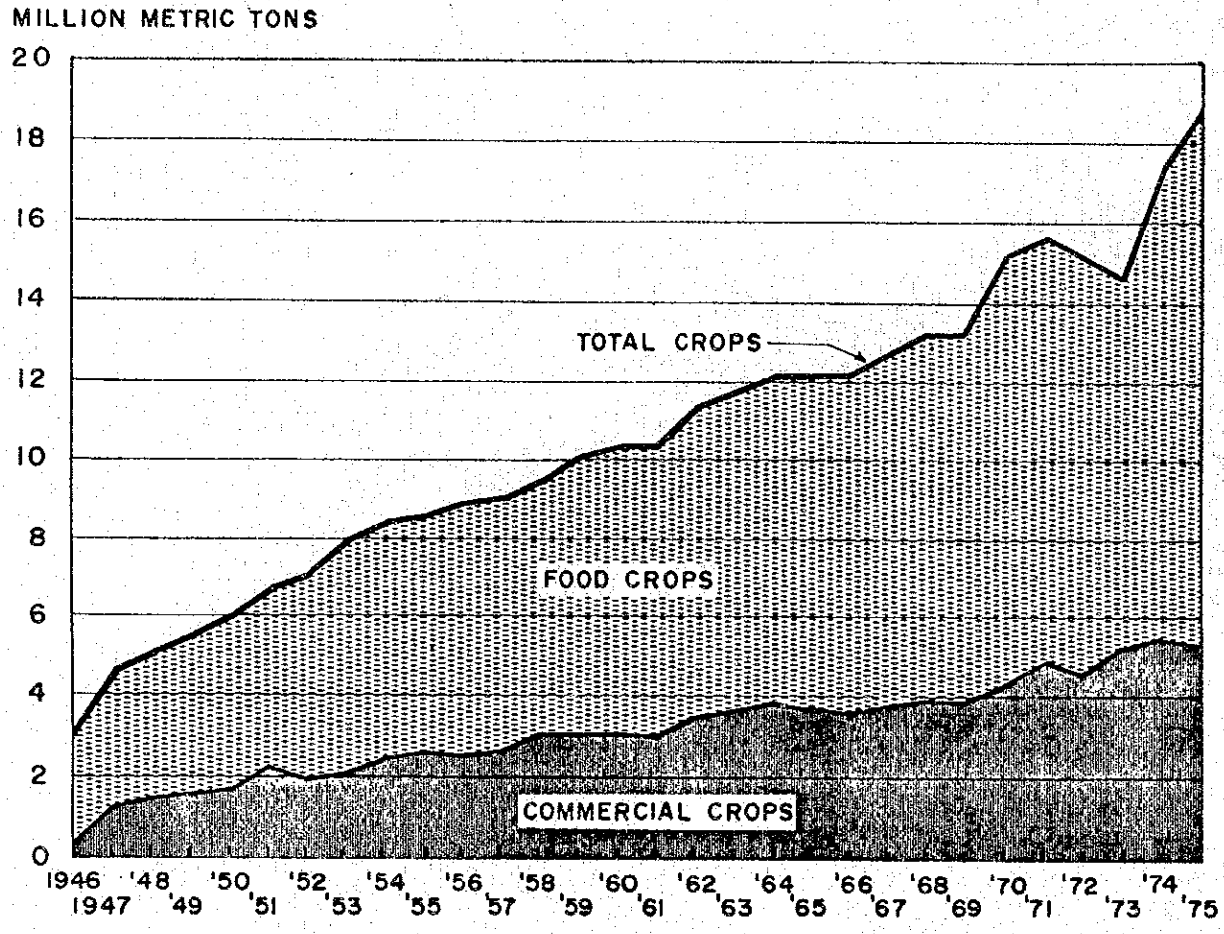
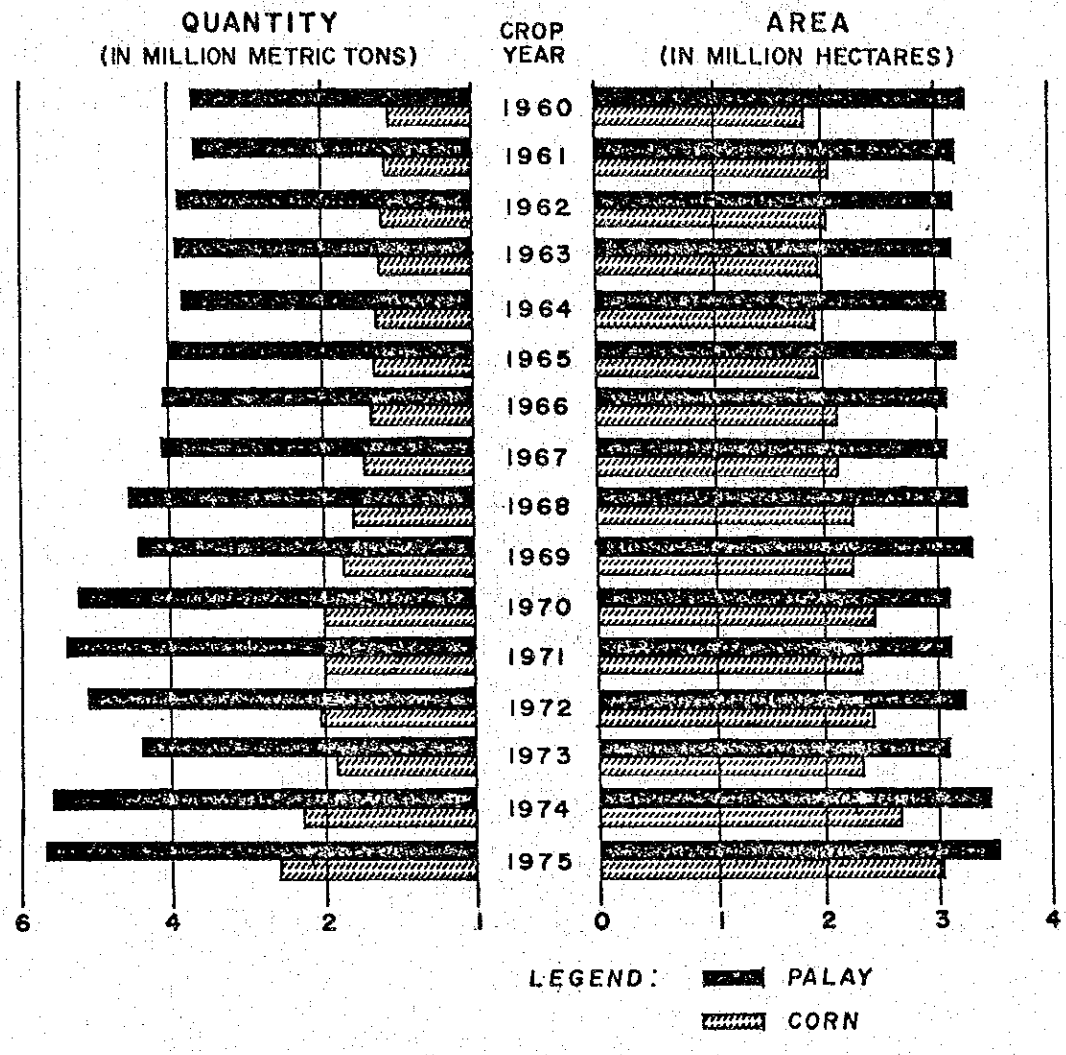


Fig. A-10-10

PALAY AND CORN PRODUCTION AND AREA HARVESTED: CROP YEAR 1960-75



A-10-2-5 Agriculture

(1) Present State of Agriculture in the Philippines

About 70% of the farm produce in the Philippines is for domestic consumption (food crops), of which 30% are commercial crops. Of the food crops, palay (rough rice) accounts for about 40%; corn, 16%; bananas, 12% and vegetables, 8%.

The principal commercial crops are sugar cane (47%) and coconut (40%).

Fig. A-10-9 shows the agricultural production in recent years and Fig. A-10-10 shows the palay and corn production and area harvested.

Palay and corn are also the main farm products in the Ilocos Region and the state of Pangasinan. Table A-10-16 shows the palay and corn production in quantity and value and cultivated land areas in the Ilocos Region and the province of Pangasinan compared with the nationwide totals.

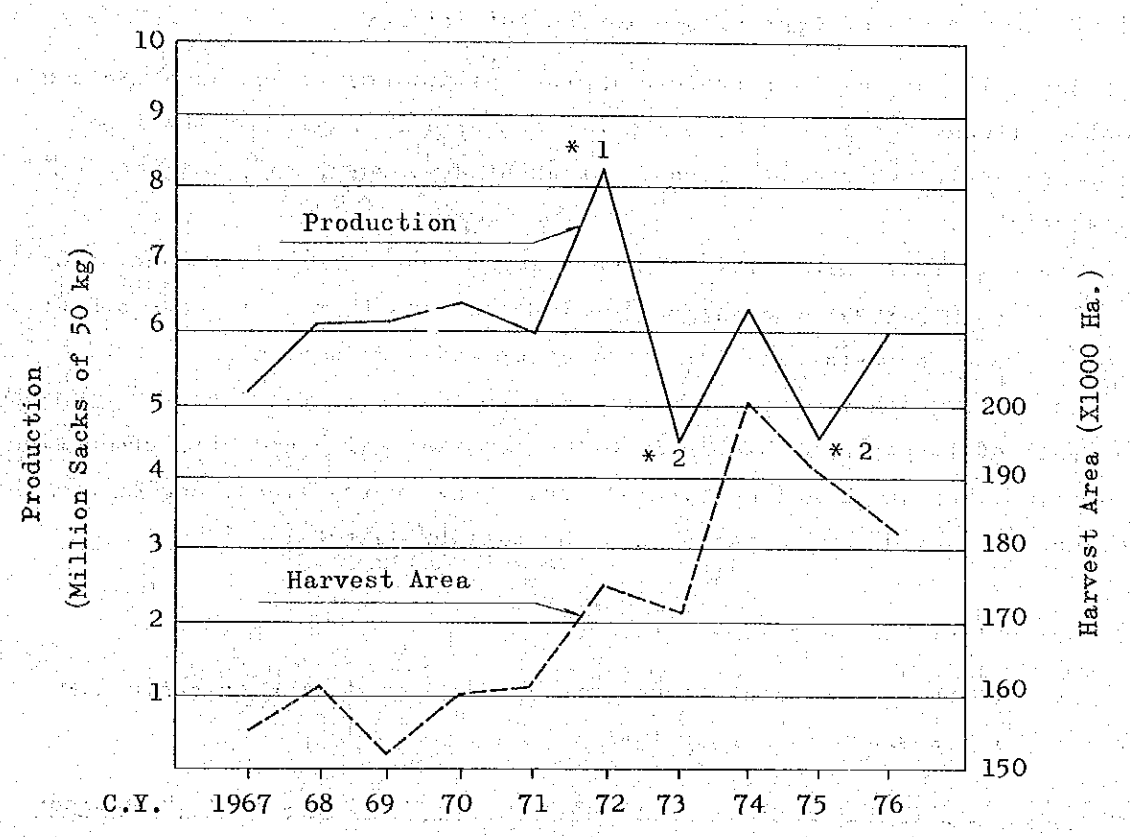
(2) Agriculture in Pangasinan Province

The production of palay (rough rice) and harvest area in Pangasinan Province are as shown in Fig. A-10-11.

Table A-10-16 : Paray and Corn Production in Ilocos Region & Pangasinan

Area, proportion / Area Production	Over-all Philippines	Ilocos region	Ilocos / O.A.P.	Pangasinan	Pangasinan / Ilocos
Palay(rough rice)					
Area (Ha.)	3,538,840	338,500	9.6%	190,770	56%
Production (M.T.)	5,660,045	422,000	7.5%	225,950	53%
Value (x 1000 Pesos)	5,345,477	432,888	8.1%	231,780	53%
Corn (Shelled)					
Area (Ha.)	3,062,450	63,070	2.0%	40,320	64%
Production (M.T.)	2,568,380	31,475	1.2%	18,255	58%
Value (x 1000 Pesos)	2,153,234	27,676	1.3%	16,052	58%

Fig. A-10-11 Palay of Production and Harvest Area



Remarks:

*1 The year 1972 saw a marked rise in the palay production owing to the advent of a new variety (IR-No.4).

*2 The production dropped due to typhoon damage in 1973 and 1975.

The palay production in Pangasinan Province at present is around 5 million sacks and the harvet area is about 200,000 ha.

(3) Damage to Farming (1976) - Based on the data obtained from the D.A.B.S. on February 20, 1978.

The rice paddies along the Agno River and the Bued River in the province of Pangasinan have been damaged from the tailings since 1966 and the crop has decreased since 1960.

a. Damage caused by tailings

(a) The tailings siltation has solidified the surface of rice paddies, thus making fertilization ineffective.

(b) Sand has sedimented on the bottom of the irrigation channels, thus reducing the amount of water supply. The water channels were designed to have a capacity of 28 m^3/sec, and now it had been reduced to 7.5 m^3/sec.

(c) The tilling of the rice plant is inhibited.

b. Area of the damaged rice paddies

Bracketed are the areas of rice paddies which have been recovered.

Pangasinan	Bautista	37 ha (9)
	Bayanban	100 ha (22)
	Alcala	60 ha (15)
	Sta Barbara	7 ha (7)
	San Jacinto	37 ha
	San Fabian	8 ha
	San Manuel	100 ha
	Tayug	80 ha
La Union	Rosario	*70 ha
		500 ha

c. Farming population who suffered damages

Of the farming population in Pangasinan Province totaling 157,000, about 400 have suffered damage from siltation.

d. Damages

(i) Rice crop 50 canvas/1 ha was reduced to half

(ii) The price of 1 cavan of unhulled rice ₱55.

(iii) Double-harvests

50 cavans x 55 pesos x $\frac{1}{2}$ x 500 ha x 2 harvests

≒ 1,400,000 pesos/year

e. Method of restoration

The farmland could be improved by over turning the surface soid. The rice paddies which have suffered damage from siltation needs nitrogen fertilizer at a rate of 20 kg/ha.

A-10-2-6 Design Calculations for Rubble Bulkhead

1. Calculation of rubble weight

$$W = \frac{\gamma_r H^3}{K (S_r - 1)^3 \cot \alpha}$$

where γ_r : density of rubble

S_r : specific gravity of rubble to sea water

K : shape factor of rubble

H : wave height (m) as progressive wave on the slope

α : gradient (^{o})

Assuming $\alpha = 34^o$ (1 : 1.50)

$$W = \frac{2.7 \times (2.7)3}{4.3 \times (2.7 - 1)^3 \cot} = \frac{2.7^4}{4.3 \times 1.7^3 \times 1.483} = 1.7 \text{ t}$$

Therefore, rubble stones heavier than 1.7 ton will be needed for armoring the bulkhead. This is to be applied to the portion of bulkhead submerged in shallow waters and is susceptible to the influence of the waves.

o Thickness of armor layer

$$e = 3.3 \sqrt{w/r}$$

e : thickness of armor layer (m)

w : weight of armor stone (t)

r : density of armor stone (t/m^3)

$$e = 3.3\sqrt{\frac{1.7}{2.7}} = 2.6 \text{ m}$$

2. Top Height of the Bulkhead

The height of the rubble bulkhead is generally made over 0.6 H 1/3 from the design tidal level height. (H.H.W.L.)

Hence Design tidal level height: DL + 1.2 m (H.H.W.L.)

Wave height: H 1/3 = 2.7 m

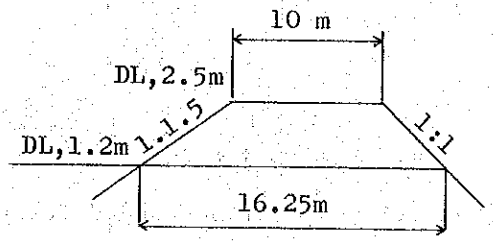
Bulkhead height: 1.2 + 0.6 x 2.7 = 2.8 m

However, since it is necessary to make a embankment by tailing to DL + 4m, considering the height to the tailings as the bulkhead height, the height of the top of the rubble bulkhead is to be DL + 2.5 m to permit the waves to flow over the bulkhead.

Unlike the breakwater, the rubble bulkhead is backfilled, and therefore its inside slope shall have a gradient of 1 : 1.

Considering the construction from the landward side, the top of bulkhead shall have a width of 10 m to allow the passage of two dump trucks running side by side.

3. Calculation of the Stability of Rubble Bulkhead



$fW \geqq np$

f: coefficient of friction between the rubble stone surface; 0.8

W: unit weight of rubble in the water; 1.0 t/m^3

n: safety factor ; over 1.2

P : wave force (wave breaking pressure on the high tide level)

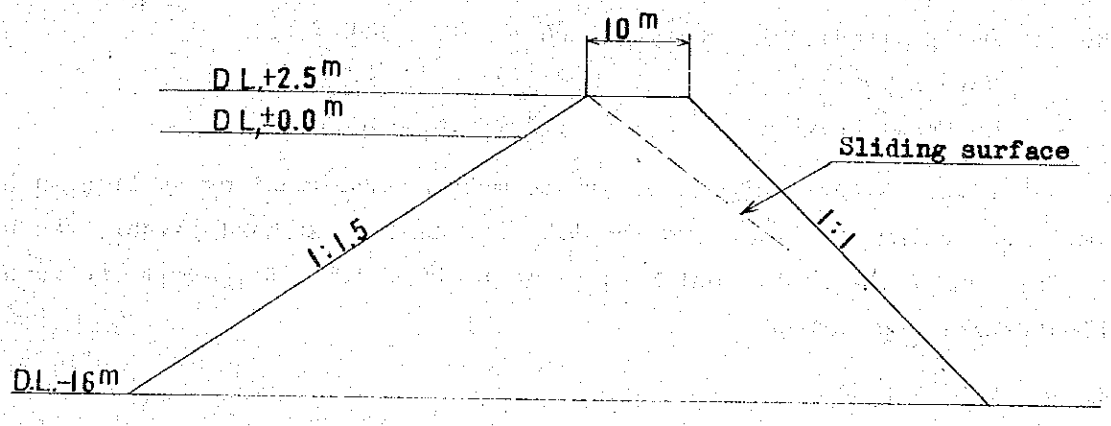
$$P = \frac{3}{2} WH \times h = \frac{3}{2} \times 1.03 \times 2.7 \times (2.5 - 1.2) = 5.42 \text{ t/m}$$

$$W = \frac{10.0 + 16.25 \text{ m}}{2} \times 1.3 \text{ m} \times 1.0 \text{ t/m}^3 = 17.1 \text{ t/m}$$

$$n = \frac{0.8 \times 17.1}{5.42} = 2.5 > 1.2$$

4. Study on Sliding Stability

In general, rectilinear sliding is assumed for gravel slope in many cases. Here, calcualtions will be made in accordance with the figure below, assuming the water depth to be 16 m.



$$F = \frac{\sum (C\ell + W \cos\alpha \tan\Phi)}{\sin\alpha W + \cos\alpha \sum Q}$$

C : cohesion of rubble (C = 0)

ℓ : sliding surface (m)

W : weight of rubble on the sliding surface (t)

α : angle formed by the sliding surface and the horizontal

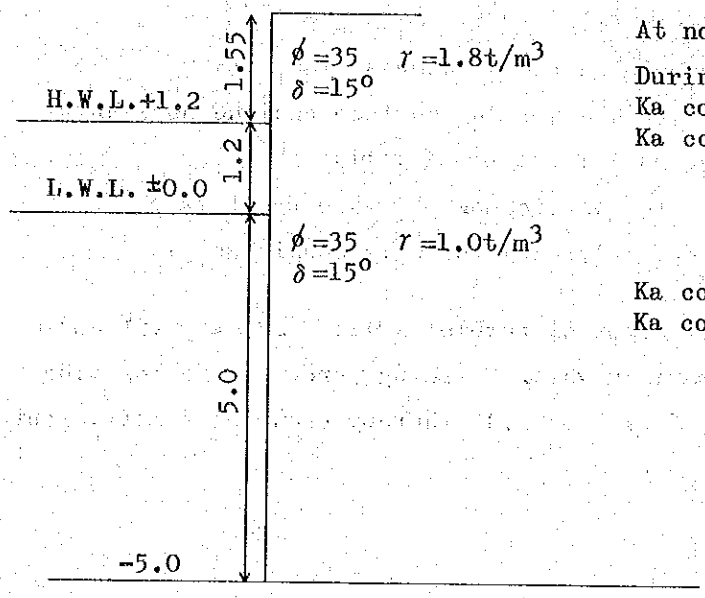
ϕ : angle of internal friction of rubble

Q : horizontal force working on the sliding surface
(In this case, only wave force is considered.)

Assuming that the unit weight of rubble is 1.8 t/m^3, $\phi = 45^\circ$ and C = 0 and considering the maximum water breaking force at the low tide level as an external force, F will be 1.4, thereby ensuring a sufficient stability.

A-10-2-7 Design Calculations for corrugated Cell Bulkhead

1. Earth pressure and residual water pressure



At normal time w=1.0t/m2

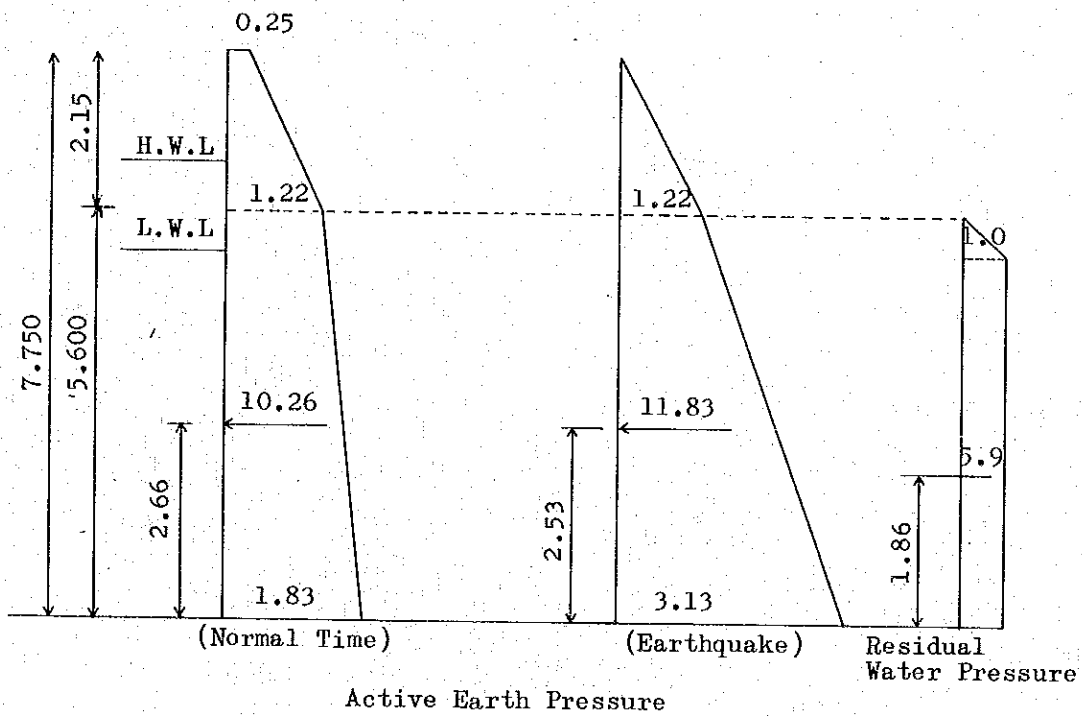
During earthquake w=0

Ka cos δ =0.25 (K=0)

Ka cos δ =0.29 (K=0.1)

Ka cos δ =0.25 (K=0)

Ka cos δ =0.33 (K=0.1)



Active Earth Pressure

2. Cell Sliding

The safety factor for the sliding of the cells is calculated for its lower surface.

$$P = \begin{matrix}\text{Earth}\\ \text{pressure}\end{matrix} + \begin{matrix}\text{Water}\\ \text{pressure}\end{matrix} = 10.^{26} + 5.0 = 15.^{3}\ \text{t/m}$$

$$\text{Cell weight} = \frac{\pi}{4} D^2 (\sum rh) = \frac{\pi}{4} \times (7.72)^2 \times (1.8 \times 2.15 + 1.0 \times 5.6)$$

$$= 443.3\ \text{t}$$

The effective width of a cell is 9.72 m, taking the joints into consideration, and therefore the effective weight of the cell per meter, w, is

$$W = 443.^{28} \div 9.72 \doteq 45.6\ \text{t/m}$$

The safety factor at normal time is

$$\text{S.F.} = \frac{W \tan\phi}{P} = \frac{45.6 \times \tan 35^\circ}{15.3} = 2.1 > 1.5$$

At earthquake time

$$Pe = \begin{matrix}\text{Earth}\\ \text{pressure}\end{matrix} + \begin{matrix}\text{Water}\\ \text{pressure}\end{matrix} + \begin{matrix}\text{Seismic}\\ \text{force}\end{matrix} = 11.8 + 5.0 + 45.^{6} \times 0.1 = 21.4$$

The safety factor is

$$\text{S.F.} = \frac{W \tan \phi}{Pe} = \frac{45.6 \times \tan 35^\circ}{21.4} = 1.5 > 1.0$$

3. Effective shape due to the cell arrangement

Effective width : $B = \sqrt{3}\, R = \sqrt{3} \times 3.86 = 6.7$ m

Effective length: $2L = \frac{\pi}{\sqrt{3}} R = \frac{\pi}{\sqrt{3}} \times 3.86 = 7.0$ m

4. Study on the Overturn of Cell

A study on the overturn of the cell is made for the overall height of the cell and at earthquake time.

$$\nu\, tm = \frac{B}{Ht'} = \frac{6.7}{9.47} = 0.71$$

$$Ht' = Hw' + \frac{w + r(Ht - Hw')}{r'} = 5.6 + \frac{1.8 \times (7.75 - 5.6)}{1.0} = 9.47$$

R_{tm} is obtained from Fig. A-10-12, assumimg $\phi = 35^{o}$.

$R_{tm} = 1.02$

The moment of overturn resistance, M_{rt}, is

$$M_{rt} = \frac{1}{6}\, r' H_t'^{3}\, R_{tm} = \frac{1}{6} \times 1.0 \times 9.47^{3} \times 1.02 = 144.4 \ t\text{-m}$$

Next, the overturn moment is calculated as follows.

Earth pressure: $11.8 \times 2.53 \times \frac{9.72}{7.0} = 41.45$

Water pressure: $5.9 \times 1.86 \times \frac{9.72}{7.0} = 15.24$

Seismic force: $Me = \frac{1}{2} r H^{2} K_h B$

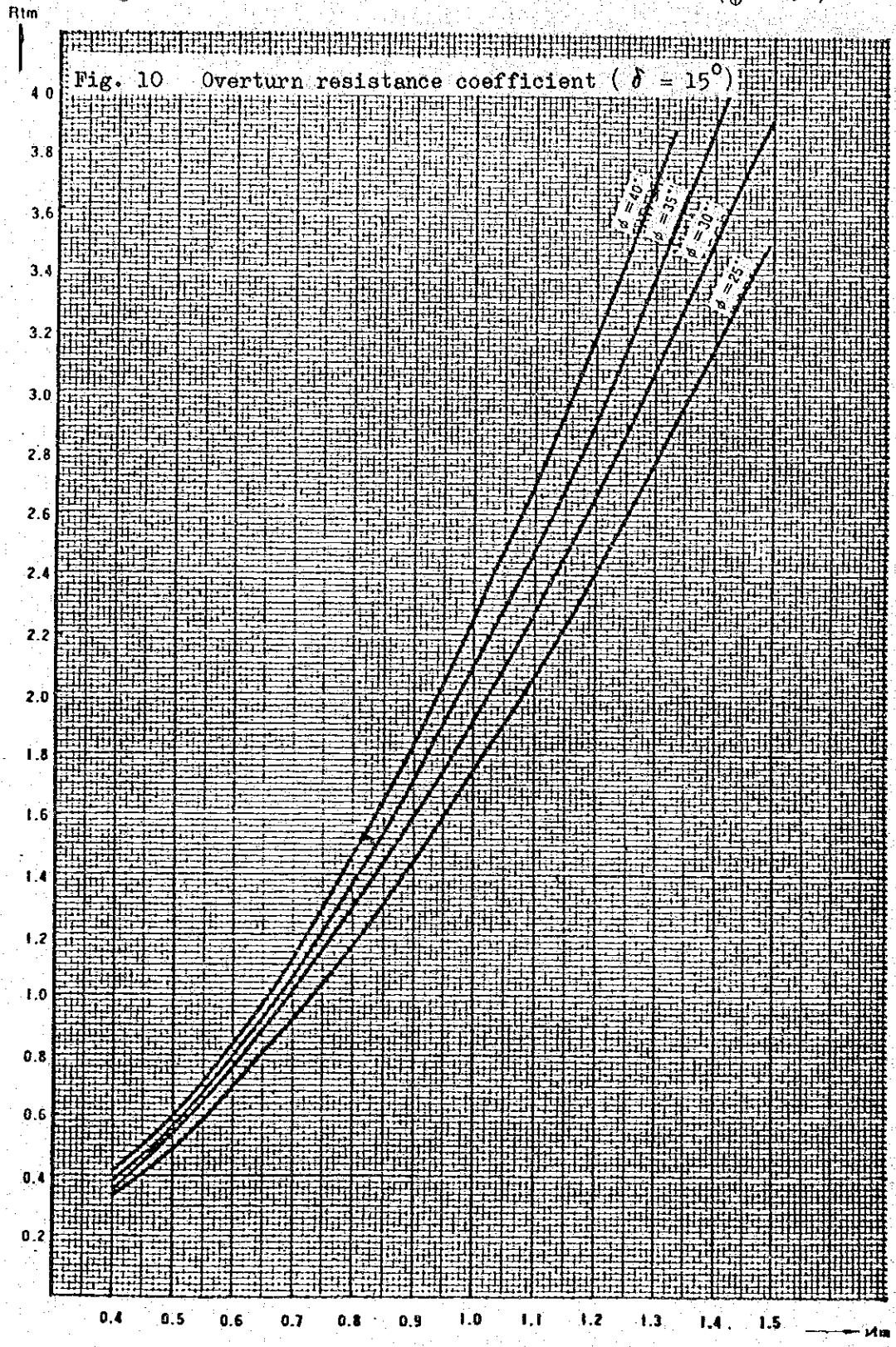
$$= (1.8 \times 2.15 \times 6.55 + 5.6 \times 1.0 \times \frac{5.6}{2}) \times 0.1 \times 6.7 = 27.4$$

The sum total of the above values is $M_r = 84.2$ t.m

The safety factor is

$$S.F. = \frac{M_{rt}}{M_v} = \frac{144.4}{84.2} = 1.72$$

Fig. A-10-12 Coefficient of Overturn Resistance ($\delta = 15^{o}$)



A-10-2-8 Design Calculations for Tailings Bulkhead

1. Determination of the weight of one armor stone

$$W = \frac{\gamma_r H^3}{K (Sr - 1)^3 \cot \alpha} = \frac{2.7 \times 2.7^3}{3.5 \times (2.7 - 1)^3 \cot 15^\circ}$$

$$\fallingdotseq 0.8 \text{ t}$$

2. Thickness of armor layer

$$e = 3 \times 3 \sqrt{\frac{W}{r}} = 3 \times 3 \sqrt{\frac{0.8}{2.7}} = 2.0 \text{ m}$$

0.8 - 1.0 t armor stone shall be used down to DL - 5 m and they may be smaller in size, 0.3 - 0.5 t at depths deeper than DL - 5 m because there will be less effect of the waves.

A-10-2-9 Study on Scouring

A study is made on the scouring in the vicinity of the reclaimed land.

1) Method of calculation of friction velocity

i) Friction velocity due to the tidal current

$$U/U_{*c} = h^{1/6}/n.\sqrt{g} \qquad \ldots\ldots\ldots (1)$$

U : average velocity of tidal current (m/sec)

U_{*c} : friction velocity on the sea bottom (m/sec)

h : water depth (m)

g : acceleration of gravity

n : Manning's coefficient of roughness of tidal current (0.02)

Assuming that h = 16 m, and U = 0.5 kt $\fallingdotseq$ 0.25 m, U_{*c} is calculated from the equation (1) as follows:

$$U_* = 0.01 \text{ m/sec}$$

2) Friction velocity due to the waves

$$U_{max}/U_{*w} = 8 \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (2)$$

$$U_{max} = \pi \cdot H/T \cdot 1/\sinh 2\pi h/L$$

U_{max} : maximum particle velocity on the sea bottom due to the waves (m/sec)

U_{*w} : friction velocity due to the waves (m/sec)

H : wave height (m)

T : wave cycle (sec)

h : water depth (m)

L : wave length (m) (calculated at $L = 1.56\ T^2$)

If H = 0.2 m, T = 5 sec, h = 16 m and L = 39 m are substituted in the equation, $U_{max} = 0.02$ m/sec and $U_{*w} = 0.002$ m/sec.

3) Composite friction velocity

$$U_* = \sqrt{U_{*c}^2 + U_{*w}^2}$$

$$= 0.01 \text{ m/sec}$$

4) Calculation of critical friction velocity

When $d \leq 6.5 \times 10^{-5}$m

$$U_* = \sqrt{2.26\ d} \qquad d: \text{grain size (m)}$$

The result of the calculation shows that the soil with the grain size smaller than 44 μ will be subject to scouring.

A-10-2-10 Study on Consolidation Settlement

$$S = \sum_{k=1}^{n} Hk \quad \frac{Cc}{1+e_o} \quad \log_{10} \frac{P}{Pc}$$

S : amount of settlement

H : layer thickness

Cc : compression index

e_o : initial voids ratio

P : deadweight

Pc : pre-load

(i) Dividing the total depth (H' = 22m) into 22 layers with one meter each and assuming that $\gamma t = 1.4\ t/m^3$, Gs = 2.7, $e_o = 3.25$, Cc = 0.30, and Pc = 0.03 kg/cm^2, the total amount of settlement will be

$S = 2.46$ m

If $C_v = 7.0 \times 10^{-3}\ cm^2/s$

$T_{90} = 4.6$ years

(ii) In case of H' = 12 m

$S = 1.12$ m

$T_{90} = 1.4$ years

APPENDIX B

THE RELATION WITH DEFINITE STUDY

APPENDIX B THE RELATION WITH DEFINITE STUDY

1. Preface

In this feasibility study, the plan of the TLP system was made by using a map on a scale of 1:50,000.

The following steps should be taken for the definite study.

The first step: Preparation of a map on a scale of 1:5,000 along the common line route and Recomfirmation of TLPS route plan.

The second step: Investigations to confirm the data required for the design.

The third step: Final design.

The contents of first and second steps will be described below.

2. The First Step

In this survey, a map on the scale of 1:50,000 (Aerial photos taken during 1947 through 1953 and prepared in 1956) was used. As the contour intervals is 20 m, another more detailed map is essential for the definite study and should first be prepared.

For the recomfirmation of TLPS route plan, it is necessary to use a map of a scale of 1:5,000, contour intervals of 5 m at the mountain and 2 m at the plain. The map contains the extent of about 26 km long from camp 4 to Rabon and the width of about 1 km.

The bench marks which are used for aerophotographic survey are put around the portals of tunnel and the important points on the common line route.

Recomfirmed common line route based on the survey with a map of a scale of 1:5,000 is the essential plan for the final design. However, there is some possibility of minor changes on the common line route plan when unexpected results are obtained from the surveys described below.

3. The Second Step

(1) Survey of the Land Part

a. Geological survey

Geological survey on rock conditions and faults at the tunnel route will be investigated in detail in order to determine the final route plan.

b. Survey by seismic wave

Seismic wave survey is conducted in order to get the data on the fissures and faults of rock formation at the necessary part, No. 7, No. 8, and No. 11 sections.

Contents: Measurement length: 3 km. Interval : 10 m

The required amount of gunpowder will be purchased from surrounding mines.

c. Survey by test boring

Boring survey is intended where visual check of rock or soil conditions is necessary. Boring cores obtained from boring work is utilized for the sample of strength test.

Place of execution:

- 1 hole with a length of 250 m for the location of underground fall at the mountain area.
- 3 holes each with a length of 150 m around tunnel pit mouths (No. 7 and No. 8 section).
- 10 holes each with a length of 30 m at the No. 10 section.
- Total 14 holes with total length of 1,000 m

d. Tests on soil and rock

In order to get the data necessary for final design, tests of rock and soil are intended.

Contents:	Test on rock strength	8 pcs x 5 holes
	Tests on the nature of soil (specific gravity, water contents, grain size, liquid limit, elasticity limit and standard penetration test)	3 pcs x 10 holes
	Test on yield strength	5 pcs

(2) Survey at the sea area

Construction of the bulkhead for the recalimed land costs as much as that for land part. This feasibility study is based on a marine chart prepared in 1976 but it is desirable to improve precision of the estimated values as well as make a contribution to the utilization program of the reclaimed land through the detailed survey of the area where bulkhead will be constructed.

a. Survey of sea depth

Measuring range:	5 km x 3.5 km.
	Interval of measuring lines: 50 m
	Measuring line: 24 km in total length
Method:	Echo sounding.

b. Observation of tide (including surveys of tide level, wave height and drift sand)

Observation points:	17 (one point/1 km^2) x 3 points (upper, middle and lower layer)
Method:	Electric flow speed meter

c. Tests on sea bottom ground

Survey points:	17 (1 point/1 km^2)
Survey method:	test boring (10 m deep)
Test on the soil nature:	Physical test on 85 samples.
	Dynamic test on 24 samples.

d. Test on the nature of tailings

Physical and dynamic tests on each 10 samples.

(3) Field test on slurry trannsport

As usual, the launder is graded at 1 % for practical use. In this Project, 1.25% is recommended because the slurry will have a comparatively low pulp density, the possibility of coarsegrained particles being mixed and the fluctuation of both quantity and density.

The most suitable gradient for launder varies with the charasteristics of slurry to be transported and it has effect onthe abrasion and the dimension of launder. Therefore, field test on slurry transport with actual

size of launder should be conducted in order to decide the most suitable gradient for launder.

Field test will be conducted at the Philex dam site which has the tailing ratio of about 80 % of the six mines or a launder 300 m long.

It is desirable to commence field test preparation as fast as possible when the decision for planning the definite study is done because the results of field test affect the final design and rather longer time is necessary for the preparation of field test facilities.

Contents:
- Obervation of transportation conditions through a transparent launder in line and experiments in the room result.
- Data on relation between gradient of launder and flow speed, pulp density, sanding etc.
- Analysis of the result and decision of gradient of launder.

APPENDIX C

REFERENCE AND REPORT LIST

APPENDIX C REFERENCE AND REPORT LIST

C.1.1 BUREAU OF MINES, PHILIPPINES:

"PROJECT ON MINE TAILINGS DISPOSAL SYSTEM IN THE BAGUIO MINING DISTRICT", including THE APPENDIX I-VIII, and MAP showing THE PROPOSED TLP SYSTEM LINE

C.1.2 RAFAEL B. DAJAC:

"THE PROBLEMS OF THE PRESENT METHOD OF IMPOUNDING MILL TRAILINGS IN PHILEX" :
5TH SYMPOSIUM ON MINERAL RESOURCES DEVELOPMENT AND THE 24TH ANNUAL NATIONAL MINE CINFERENCE

C.1.3 LARRY P. MARTIN:

"BCI MILL TAILINGS DISPOSAL"

3RDSYMPOSIUM ON MINERAL RESOURCES DEVELOPMENT AND 18TH MINE SAFETY CONFERENCE, 1971

C.1.4 LAURENCE P. MARTIN:

"A STUDY OF THE RIVER POLLUTION BY MINE TAILINGS IN BENGUET PROVINCE, ITS EXTENT, CAUSES, EFFECTS, PRESENT METHODS OF CONTROL AND PROPOSED METHODS BEST SUITED FOR LOCAL CONDITIONS"
SAINT LOUIS UNIVERSITY, BAGUIO CITY,

C.1.5 ROGELIO C. SALAZAR, MEMETS, BSCHE:

"THE TAILING DISPOSAL SYSTEM OF ATLAS CONSOLIDATED MINING AND DEVELOPMENT CORPORATION"
5TH SYMPOSIUM ON MINERAL RESOURCES DEVELOPMENT AND THE 24TH ANNUAL NATIONAL MINE CONFERENCE

C.1.6 JOSE C. MAPALO, NAPOLEON A AVIA, FRED L FANGONON:

"ENVIRONMENTAL CONTROL MEASURES TO OFFSET ADVERSE EFFECTS OF PHILEX MINING OPERATIONS"

C.1.7 ROLAND E PENA AND MILAGROS V. REYES:

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THIRD GEOLOGICAL CONVENTION AND FIRST FIELD SYMPOSIUM ON ORE DEPOSIT OF THE PHILIPPINES AND THEIR EXPLORATION, February 3 - 6, 1971

C.1.9 VICTOR S. SERAFICA, RODOFO L. ENRIQUEZ, AND PETER L. DUNAN, PHILEX MINING CORPORATION:

" GEOLOGY OF SOUTHERN BAGUIO MINERAL DISTRICT"

5TH SYMPOSIUM ON MINERAL RESOURCE DEVELOPMENT AND 24TH ANNUAL NATIONAL MINE SAFETY CONFERENCE, November 24 - 26, 1977

C.1.10 JUNE ABRAJANO:

"STRATIGRAPHY AND GEOLOGIC HISTORY OF NEOGENE SEDIMENTARY ROCKS ALONG THE DAMORTIS-KENNON ROAD"

C.1.11 REFERENCE: SURVEY AND ANALYSIS COMMITTEE'S MATERIAL, ISSUANCE NO.1, November, 1970, METAL MINING AGENCY OF JAPAN, TOKYO

"THE AGE AND MODE OF ORGENIC MOVEMENT IN THE PHILIPPINES"

C.1.12 MUTSUMI MOTEGI D.Sc., METAL MINING AGENCY OF JAPAN, TOKYO

"PORPHYRY COPPER DEPOSIT IN THE PHILIPPINES
- THE STUCTURAL BACKGROUND AND THE PRESENT
CIRCUMSTANCES FOR THE ORE DEVELOPMENT - "

C.1.13 REFERENCE: NSDB RESEARCH PROJECT:

"A STUDY TO DETERMINE THE EFFECTS OF MINE TAILINGS ON MARINE LIFE" , 1973

C.2.1-23 DOCUMENTS, DRAWINGS AND ATA, obtaned from MINING COMPANIES, BUREAU OF MINES, AND GOVERNMENT AUTHORITY

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