Appendix 3.2.3 (12) Frequency of Typhoons*1

Year \ Radius	Within 200 Km	Within 300 Km
1974	3	7
1975	1	3
1976	0	3
1977	2	2
1978	6	6
1979	5	5
1980	3	4
1981	3	6
1982	2	6
1983	2	4
Total	27	46
Mean	3	5

Note: *1 The number of typhoons which passed within circular areas with radius of 200 km and 300 km from Batangas are shown above.

Source: Study Team (1985)

Appendix 3.2.3 (13) Frequency of Wave Height by Wave Direction*1

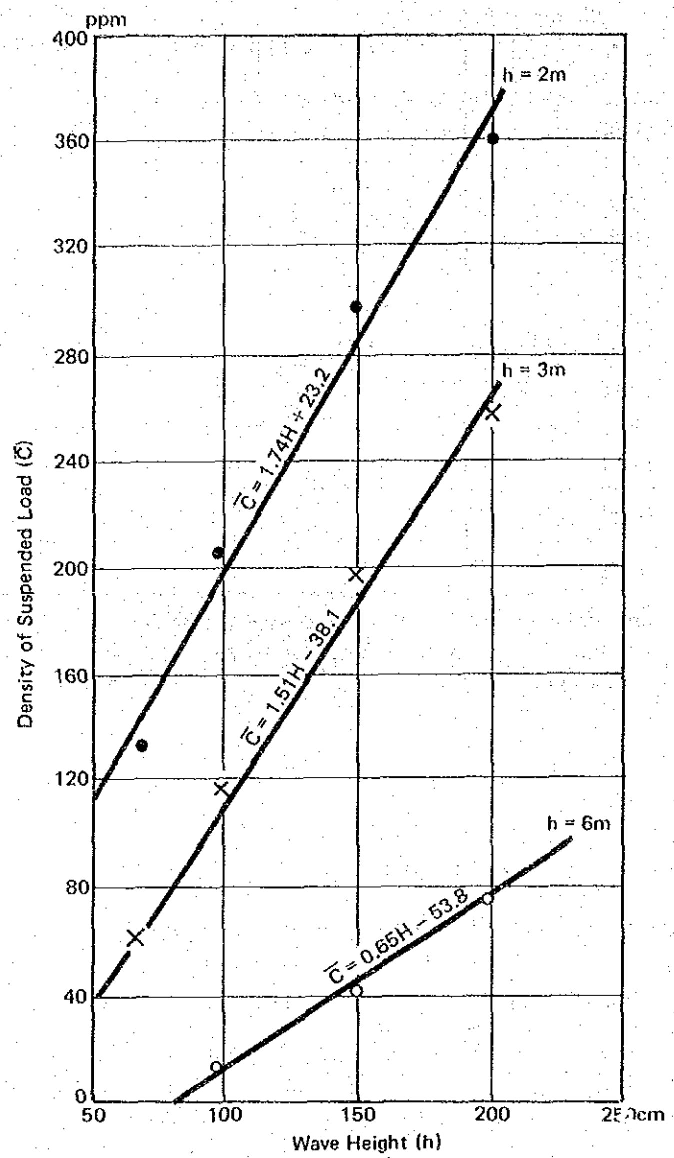
Wave Height (m) \ Wave Direction	WNW	W	WSW	SW	SSW	Total
0.11 ~ 0.40	8	17	27	57	9	118
0.41 ~ 0.70	3	7	36	29	6	81
0.71 ~ 1.00		2	10	10	1	23
1.01 ~ 1.30		2	2	2		6
1.31 ≤				2		
Total	11	28	75	100	16	230

Note: *1 Annual wave height distribution by wave direction is assumed based on the wave observations made by the Study Team (Oct. 3 to Nov. 1, 1984) and the Siltation Study Team (July 1, 1982 to June 30, 1983), as well as on the wave hindcasting results from two typhoons (T8214 and T8217) conducted by the Study Team. In the above table, only waves of WNW, W, WSW, SW and SSW are selected in consideration of effects on littoral drfft.

Sources: 1) Final Report on the Siltation Study

2) Study Team

Appendix 3.2.3 (14) Relation between Mean Suspended Load Volume, $\bar{c}$ and Wave Height, H[1]



*1 The above figure shows calculated relation of $\bar{c}$ and H at the wave period of four (4) sec..
$\bar{c}$ is calculated using the following formula;

$$c = \frac{10^3}{h - 0.05h} \left(\frac{1}{A} Z^A\right)_{0.05h}^{h} \text{ (p.p.m.)}$$

$$A = \frac{2 - U^*}{1 - U^*} \quad (U^* > 2)$$

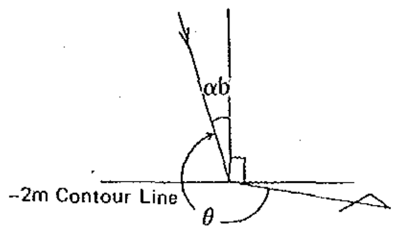
where,
- c : Mean suspended load volume from sea bottom to sea surface
- h : Depth
- Z : Height on sea bottom
- U*: Maximum friction velocity

Source: Study Team (1985)

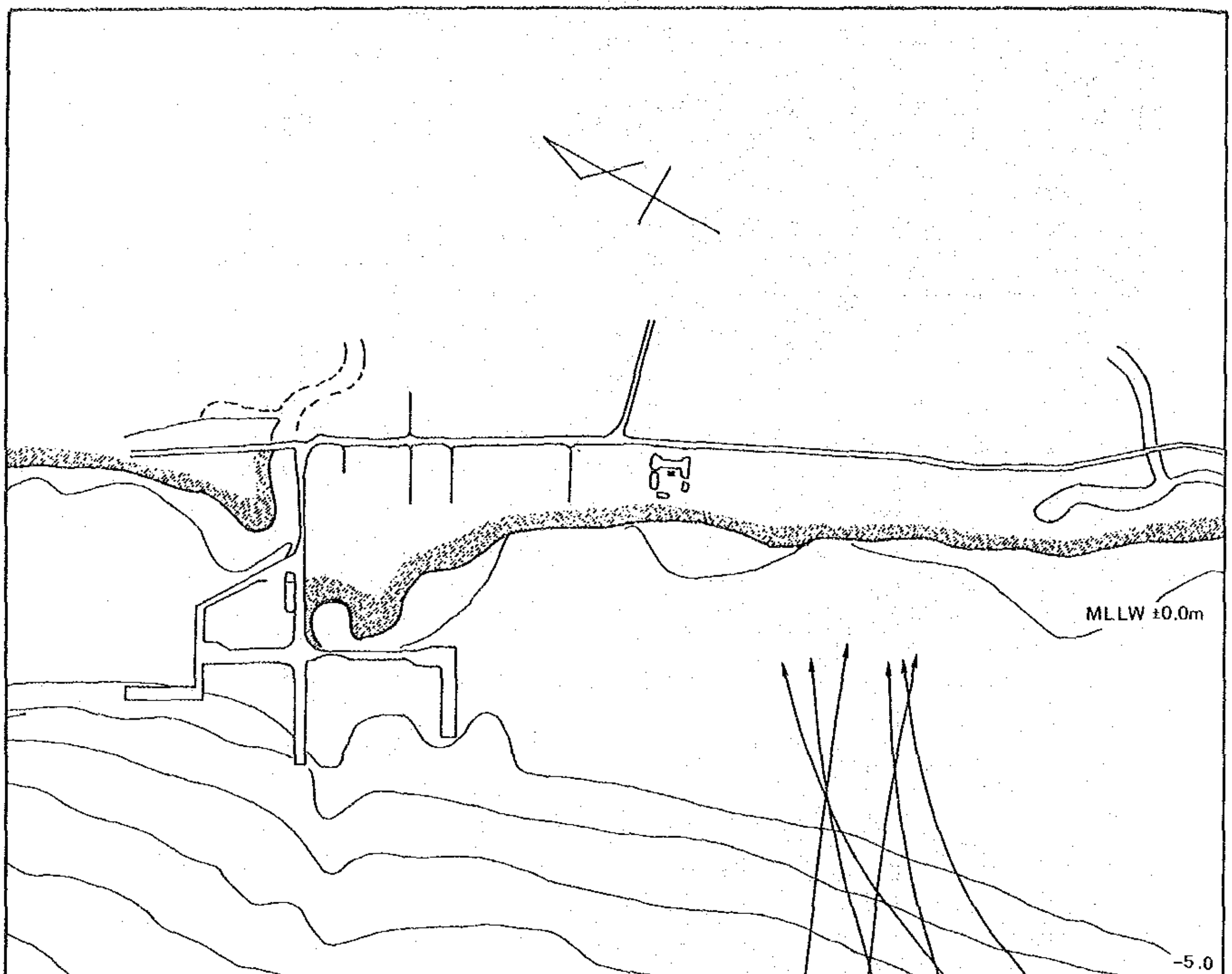
Appendix 3.2.3 (15) Refraction Coefficient, Kr

Item / Wave Direction	Kr	θ	αb
WSW	0.99	N 251°	6°
SW	0.95	N 236°	21°
SSW	0.78	N 227°	30°

Relation between θ and αb



Appendix 3.2.3 (16) Chart of Refraction Diagram



Appendix 3.2.3 (17) Calculation of Wave Height in Shallow Water Area

WSW		SW		SSW	
Wave Height (m)	Number of Waves	Wave Height (m)	Number of Waves	Wave Height (m)	Number of Waves
0.24	27	0.23	57	0.19	9
0.52	36	0.50	29	0.41	6
0.81	10	0.77	10	0.64	1
1.09	2	1.05	2	0.86	0
1.38	0	1.32	2	1.09	0

*1 Wave height in shallow water area is calculated using the following formula:

$$H = Ho \times Kr \times Ks$$

where, H : Wave height in shallow water area (m) (in significant waves)

Ho : Offshore wave height (in significant waves) (See Appendix 3.2.3 (13))

Kr : Refraction coefficient (See Appendix 3.2.3 (15))

Ks : Shoaling coefficient

$$Ks = \sqrt{\frac{1}{2n} \cdot \frac{Co}{C}}, \quad n = \frac{1}{2}\left(1 + \frac{4\pi h/L}{\mathrm{Sinh}\,(4\pi h/L)}\right)$$

L : Wave length

h : Depth

C : Wave velocity

Co : Wave velocity in deep sea

Source: Study Team (1985)

Appendix 3.2.3 (18) Appearance Ratio by Wave Height*1

Wave Direction / Wave Height (m)	NW	WNW	W	WSW	SW	SSW	S	SSE	SE	Unknown Direction	Total
≤ 0.10										444	444 (76%)
0.11 0.40		5	13	24	14	9		1	1		67 (12%)
0.41 0.70	1	3	5	13	23	5	1	3	1		55 (10%)
0.71 1.00				3	8	2			1		14 (2%)
1.01 1.30					1						1
1.31 ≤					1						1
Total	1	8	18	40	47	16	1	4	3	444	582 (100%)

*1 Wave observations were carried out from July 1, 1982 to June 30, 1983.

Source: Final Report on The Siltation Study

Appendix 3.2.4 Volume of Littoral Drift

Appendix 3.2.4 (1) Volume of Littoral Drift (Qs) by Suspended Load*1

WSW					
H	$\overline{C}$	U	h.B.t	N	Qs x 10^6
0.24	65	0.101	4,320 x 10^6	27	766
0.52	114	0.106	"	36	1,879
0.81	164	0.113	"	10	801
1.09	213	0.124	"	2	228
1.38				0	
ΣQs					3,674

SW					
H	$\overline{C}$	U	h.B.T	N	Qs x 10^6
0.23	63	0.104	4,320 x 10^6	57	1,613
0.50	110	0.118	"	29	1,626
0.77	157	0.142	"	10	963
1.05	206	0.177	"	2	315
1.32	253	0.222	"	2	485
ΣQs					5,002

SSW					
H	$\overline{C}$	U	h.B.t	N	Qs x 10^6
0.19	56	0.104	4,320 x 10^6	9	226
0.41	95	0.116	"	6	286
0.64	135	0.140	"	1	82
0.86				0	
1.09				0	
ΣQs					594

N: Frequency

h.B.t = 2 x 100 x (6 x 3600) = 4,320 x 10^6

ΣQs = 9,270 x 1.41*1 x 10^6 gr/year

$= 13{,}071 \times 10^6 \times \frac{1.5}{2.65}^{*2} \times 0.27^{*3} \times 10^{-6}$

$= 1{,}998\ m^3/year$

*1: revised coefficient by difference of particle diameter.

*2: conversion number from gram to cube meter.

*3: coefficient by vertical distribution of suspended density.

*1 Suspended content is given by the formula:

$$Qs = \overline{C}\, h\, B\, U\, t,$$

where, $\overline{C}$: Concentration of suspended soil

h : Depth

B : Width of the objective area from the shoreline

U : Current velocity

t : Duration time of wave

Current velocity U is indicated as the sum of the two components along the coastline, velocity of sediment transport by waves and tidal current. The formula is shown below.

$$U = \overline{V} \sin\alpha b + Vt,$$

where, $\overline{V}$: Velocity of sediment transported by waves

αb : Angle between wave crest line and underwater contour

Vt : Velocity tidal current (10 m/sec is used as the mean velocity).

Source: Study Team (1985)

Appendix 3.2.4 (2) Volume of Littoral Draft (Qx) by Bed Load*1

Wave Energy from South to North

Height (m) \ Direction	WSW	SW	SSW	Total
0.25	1,486	9,294	1,280	12,060
0.55	9,587	22,886	4,131	36,604
0.85	7,558	18,849	1,645	28,052
1.15	2,045	6,900		8,945
1.45		10,970		10,970
Total	20,676	68,899	7,056	96,631

Qx = 0.45 x 96.631 x 0.22 x 0.89 = 8,514 m^3/year

Wave Energy from North to South

Height (m) \ Direction	WNW	W	WSW	Total
0.25	2,113	3,893	1,486	7,492
0.55	3,835	7,758	9,587	21,180
0.85		5,294	7,558	12,852
1.15		9,690	2,045	11,735
Total	5,948	26,635	20,676	53,259

*1 Component of wave energy along the coastline is indicated by the following equation:

$$Ex = \frac{naWaKr^2 Ho^2 La}{8\ To} Sin\alpha b Cos\alpha b$$

where: Ex : Component of wave energy transported along the coastline with unit width and unit time near the breaker line.

αb : Angle between wave crest and shoreline at the breaker line

Na : Ratio of wave velocity and group velocity in the deep sea (1/2)

Wa : 1.03 ton/m^3

Ho, La, To : Wave height, wave length and period in the deep sea.

Source: Study Team (1985)

Appendix 3.2.5 Results of Wave Hindcasting

Appendix 3.2.5 (1) Results of Wave Hindcasting (Typhoon 7025)*1

Upper: Wave Height
Lower: Wave Period

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SSW	WSW	W	WNW	NW	NNW
L1	5.33	4.26	0.90	3.72	5.10	4.79	4.50	4.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	7.40	6.70	3.30	6.30	7.30	7.10	7.00	7.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L2	1.31	0.71	0.63	0.0	0.0	0.0	1.80	2.33	6.12	6.93	5.40	0.0	0.0	5.31	6.17	4.79
	4.40	3.10	2.70	0.0	0.0	0.0	4.50	5.50	9.70	10.00	9.20	0.0	0.0	8.90	9.00	7.90
L3	0.55	0.52	0.0	0.0	0.0	1.35	1.14	1.87	1.05	3.70	5.02	5.28	4.21	3.83	3.66	3.23
	2.70	2.50	0.0	0.0	0.0	3.70	3.20	5.00	3.00	7.50	8.50	8.60	7.90	7.50	7.20	6.70
L4	0.0	0.0	0.0	0.0	0.0	1.25	1.51	1.65	2.07	0.0	4.08	4.23	4.16	2.48	2.24	2.02
	0.0	0.0	0.0	0.0	0.0	4.40	4.90	5.00	4.90	0.0	6.60	6.70	6.70	5.30	5.10	4.80
M1	0.63	0.50	0.0	0.0	0.0	0.0	0.58	5.22	3.86	3.91	0.0	4.75	5.58	5.61	6.63	5.45
	3.00	2.30	0.0	0.0	0.0	0.0	2.40	7.10	6.10	6.00	0.0	6.90	8.00	7.90	8.50	7.70
M2	0.51	0.51	0.0	0.0	0.0	0.0	1.64	3.19	6.70	7.69	7.70	6.28	6.56	7.20	7.28	5.30
	2.50	2.20	0.0	0.0	0.0	0.0	4.40	6.80	9.70	10.20	10.20	9.40	9.40	9.70	9.70	8.30
M3	0.62	0.0	0.0	0.0	0.0	0.39	0.38	0.45	2.91	3.04	4.37	6.04	6.55	5.50	4.58	3.82
	2.80	0.0	0.0	0.0	0.0	2.10	2.10	2.10	4.80	4.80	5.90	7.70	8.30	7.50	6.90	6.30
M4	0.59	0.0	0.0	0.0	0.0	0.83	1.03	1.16	2.89	3.52	5.30	5.38	4.96	4.32	4.20	1.86
	2.50	0.0	0.0	0.0	0.0	3.10	3.50	3.80	5.30	5.60	6.90	7.10	7.00	6.30	6.20	4.50
S1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.48	2.55	4.57	6.59	6.60	5.87	4.32	3.33
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.60	4.70	6.20	8.00	8.00	7.60	6.40	5.50
S2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.10	2.32	4.88	7.01	7.02	3.41	2.52	2.52
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.10	4.20	6.30	8.30	8.30	5.20	4.50	4.50
S3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.44	2.68	2.95	2.99	2.45	2.18	2.48	1.90
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.80	4.90	4.90	4.90	4.30	4.10	4.40	4.00
S4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.34	3.52	3.42	2.85	2.62	2.62	1.95	1.75	1.78
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.50	5.80	5.50	4.90	4.60	4.60	3.90	3.50	3.50
S5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.88	3.94	2.93	1.98	1.66	1.72	1.29	1.07	1.11
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.30	6.10	5.00	4.00	3.40	3.40	2.90	2.40	2.40
S6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.35	3.64	3.41	2.54	2.20	2.21	1.46	1.12	1.14
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.40	5.90	5.50	4.60	4.10	4.10	3.10	2.60	2.50
S7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.76	3.27	3.50	3.24	2.97	2.96	1.89	1.40	1.30
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.50	5.20	5.40	5.20	5.00	5.00	3.70	2.90	2.70

*1 L, M and S stand for calculation points in the grids of large, middle and small areas. (Refer to Appendix 3.2.5 (7) and Fig. 3.2.8.)
Source: Study Team (1985)

Appendix 3.2.5 (2) Results of Wave Hindcasting (Typhoon 8217)*1

Upper: Wave Height
Lower: Wave Period

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SSW	WSW	W	WNW	NW	NNW
L1	0.0	1.15	2.07	4.01	4.56	5.88	5.82	6.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	3.80	4.90	6.50	6.90	7.80	7.90	8.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L2	3.26	4.65	4.66	5.01	5.82	5.46	0.0	6.12	8.57	6.38	0.0	0.0	0.0	0.0	0.0	0.0
	6.40	7.30	7.20	7.30	7.80	7.70	0.0	8.50	11.20	10.40	0.0	0.0	0.0	0.0	0.0	0.0
L3	0.51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.08	7.86	6.74	6.26	6.00	4.99	3.81
	2.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.70	10.30	9.70	9.40	9.20	8.20	7.10
L4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.43	2.13	3.66	0.0	0.0	0.0	3.86	5.41
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.40	5.40	6.50	0.0	0.0	0.0	6.40	7.40
M1	1.59	3.13	3.13	3.38	3.37	3.63	4.82	5.61	3.21	1.88	0.0	0.0	0.0	0.0	0.0	0.0
	4.30	5.30	5.20	5.10	5.10	5.40	6.40	7.20	5.70	4.50	0.0	0.0	0.0	0.0	0.0	0.0
M2	5.81	5.05	3.94	0.0	3.57	0.0	3.67	5.82	9.17	9.40	6.73	0.0	0.0	0.0	0.0	1.26
	7.90	7.20	6.10	0.0	5.80	0.0	6.10	9.30	11.30	11.50	10.00	0.0	0.0	0.0	0.0	4.10
M3	3.33	4.21	3.67	3.76	4.10	3.80	3.54	3.47	3.46	1.05	0.0	0.0	0.0	0.0	0.0	0.0
	5.80	6.30	5.80	6.00	6.40	6.00	5.40	5.20	5.20	3.10	0.0	0.0	0.0	0.0	0.0	0.0
M4	4.18	4.16	4.04	4.10	4.76	4.77	4.96	5.23	3.26	1.47	0.0	0.0	0.0	0.0	0.0	0.0
	6.40	6.40	6.30	6.40	6.80	6.80	6.90	7.10	5.80	3.90	0.0	0.0	0.0	0.0	0.0	0.0
S1	0.0	0.0	0.0	0.0	0.0	3.81	3.83	2.80	2.87	0.92	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	5.80	5.80	4.70	4.80	3.10	0.0	0.0	0.0	0.0	0.0	0.0
S2	0.0	0.0	0.0	0.0	0.0	0.0	3.80	3.57	3.09	0.80	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	5.50	5.40	5.00	2.80	0.0	0.0	0.0	0.0	0.0	0.0
S3	0.0	0.0	0.0	0.0	0.0	0.0	4.15	3.77	2.99	1.14	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	5.80	5.50	5.10	3.40	0.0	0.0	0.0	0.0	0.0	0.0
S4	0.0	0.0	0.0	0.0	0.0	0.85	2.12	3.20	3.33	1.81	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	2.30	3.90	5.00	5.20	4.20	0.0	0.0	0.0	0.0	0.0	0.0
S5	0.0	0.0	0.0	0.0	0.0	1.83	2.59	4.23	4.33	1.77	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	3.60	4.40	6.00	6.20	4.20	0.0	0.0	0.0	0.0	0.0	0.0
S6	0.0	0.0	0.0	0.0	0.0	1.16	1.71	3.08	3.09	1.89	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	2.60	3.20	4.80	4.80	4.30	0.0	0.0	0.0	0.0	0.0	0.0
S7	0.0	0.0	0.0	0.0	0.0	0.0	1.34	1.99	2.04	1.20	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	2.80	3.60	3.70	3.60	0.0	0.0	0.0	0.0	0.0	0.0

*1 L, M and S stand for calculation points in the grids of large, middle and small areas. (Refer to Appendix 3.2.5 (7) and Fig. 3.2.8.)
Source: Study Team (1985)

Appendix 3.2.5 (3) Results of Wave Hindcasting (Typhoon 8214)*1

Upper: Wave Height
Lower: Wave Period

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
L1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.97 7.20	6.42 8.20	7.98 9.60	8.23 10.40	7.61 11.30	7.03 10.90	6.29 10.20	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
L2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	5.69 7.80	8.06 9.70	9.42 11.50	7.77 11.10	6.47 10.30	4.75 9.00	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
L3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	6.20 8.50	7.86 10.10	7.90 10.40	7.15 10.20	3.94 8.00	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
L4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.01 5.40	1.94 5.20	1.67 4.60	0.55 2.70	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
M1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.55 2.40	0.88 3.10	5.58 7.30	5.93 7.60	3.07 5.50	2.48 4.90	2.75 5.30	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
M2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	7.66 8.70	10.94 12.20	9.68 12.00	8.16 11.20	5.31 9.30	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
M3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.50 4.60	2.56 4.60	1.85 3.90	1.32 3.40	1.66 3.80	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
M4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.56 2.60	1.24 3.90	2.12 4.70	1.59 4.10	1.35 3.80	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.90 4.10	2.07 4.30	1.27 3.50	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.74 4.00	1.74 4.00	1.00 3.00	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.75 4.20	1.67 4.10	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.54 3.80	2.77 5.40	1.80 4.40	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S5	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.01 4.40	2.90 5.40	1.69 4.20	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S6	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.43 3.50	2.88 5.50	1.88 4.50	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
S7	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.99 2.80	1.99 4.30	1.57 4.00	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0

*1 L, M and S stand for calculation points in the grids of large, middle and small areas. (Refer to Appendix 3.2.5 (7) and Fig. 3.2.8.)
Source: Study Team (1985)

Appendix 3.2.5 (4) HMax of Every Grid by Computer (Typhoon 8217)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	---GRID NUMBER
1	4.8	4.8	3.6	2.4	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	--WAVE HEIGHT
	6.3	6.3	5.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---WAVE PERIOD
	8	8	8	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	---WAVE DIRECTION
2	4.8	4.8	3.6	2.4	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	
	6.3	6.3	5.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
3	4.9	4.9	3.8	2.6	****	****	****	****	5.6	5.3	4.8	3.9	****	****	****	****	****	****	****	****	****	****	****	****	****	
	6.5	6.5	5.3	4.0	0.0	0.0	0.0	0.0	7.3	7.0	6.6	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	5	10	10	10	10	8	8	8	8	10	10	10	10	10	10	10	10	10	10	10	10	10	
4	5.1	5.1	4.0	2.7	****	****	****	3.8	5.6	5.2	4.8	4.4	4.2	3.8	3.0	****	****	****	****	****	****	****	****	****	****	
	6.7	6.7	5.5	4.2	0.0	0.0	0.0	5.8	7.3	7.0	6.6	6.3	6.1	5.7	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	5	10	10	10	6	8	8	8	8	8	8	8	10	10	10	10	10	10	10	10	10	10	
5	5.2	5.2	4.3	2.9	****	****	****	3.4	5.5	5.2	4.7	4.3	4.0	3.8	3.3	2.4	****	****	****	****	****	****	****	****	****	
	6.8	6.8	5.8	4.4	0.0	0.0	0.0	5.2	7.2	6.9	6.6	6.2	6.0	5.7	5.2	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	5	10	10	10	6	8	8	8	8	8	8	8	8	10	10	10	10	10	10	10	10	10	
6	5.3	5.3	4.5	3.0	****	****	****	****	5.5	5.2	4.7	4.2	3.8	3.6	3.2	2.4	1.5	****	****	****	****	****	****	****	****	
	6.9	6.9	6.1	4.7	0.0	0.0	0.0	0.0	7.2	6.9	6.5	6.1	5.8	5.6	5.1	4.2	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	5	10	10	10	10	8	8	8	8	8	8	8	8	8	10	10	10	10	10	10	10	10	
7	5.3	5.3	4.8	3.2	****	4.2	5.5	5.5	5.4	5.1	4.6	4.0	3.6	3.5	3.0	2.3	1.0	****	****	****	****	****	****	****	****	
	7.0	7.0	6.4	4.4	0.0	6.2	7.3	7.2	7.1	6.9	6.4	5.9	5.6	5.4	4.9	4.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	8	10	6	8	8	8	8	8	8	8	8	8	8	8	10	10	10	10	10	10	10	10	
8	5.2	5.2	4.9	3.7	****	3.8	5.4	5.4	5.3	5.1	4.6	3.9	3.4	3.3	2.9	2.1	****	****	****	****	****	****	****	****	****	
	7.0	7.0	6.6	5.1	0.0	5.6	7.1	7.1	7.1	6.8	6.4	5.8	5.3	5.2	4.8	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	8	10	5	8	8	8	8	8	8	8	8	8	8	10	10	10	10	10	10	10	10	10	
9	5.1	5.1	5.0	4.4	****	****	5.2	5.2	5.2	5.0	4.6	3.8	3.1	3.1	2.7	2.0	1.5	****	****	****	****	****	****	****	****	
	6.9	6.9	6.8	5.9	0.0	0.0	7.0	7.0	7.0	6.8	6.4	5.6	5.0	5.0	4.5	3.8	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	8	8	8	8	10	10	8	8	8	8	8	8	8	8	8	8	8	10	10	10	10	10	10	10	10	
10	5.0	5.0	4.9	4.8	4.3	****	5.1	5.0	5.0	4.9	4.5	3.7	2.8	2.8	2.4	1.6	1.2	****	****	4.8	4.3	3.1	****	****	****	
	6.8	6.8	6.8	6.7	5.9	0.0	6.9	6.9	6.9	6.7	6.3	5.5	4.7	4.8	4.2	3.2	2.1	0.0	0.0	6.6	6.2	4.8	0.0	0.0	0.0	
	8	8	8	8	8	10	8	8	8	8	9	9	8	8	8	8	6	10	10	9	9	9	10	10	10	
11	4.8	4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.8	4.5	3.6	2.6	2.6	2.2	1.6	****	****	4.7	4.7	4.4	3.3	2.0	****	****	
	6.7	6.7	6.7	6.7	6.7	6.8	6.8	6.7	6.7	6.7	6.3	5.4	4.3	4.4	3.9	2.6	0.0	0.0	6.5	6.6	6.2	5.2	3.7	0.0	0.0	
	8	8	8	8	8	8	8	8	9	9	9	9	6	9	9	6	10	10	8	9	9	9	9	10	10	
12	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.7	4.5	3.6	2.6	2.3	2.0	****	****	4.0	4.5	4.6	4.3	3.3	1.9	****	****	
	6.6	6.6	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.5	6.3	5.4	4.3	3.8	3.3	0.0	0.0	5.7	6.4	6.5	6.2	5.1	3.6	0.0	0.0	
	6	6	8	8	8	8	8	8	9	9	9	9	6	6	6	10	10	8	8	9	9	9	9	10	10	
13	4.8	4.8	4.6	4.5	4.4	4.5	4.5	4.5	4.5	4.5	4.4	3.7	2.7	2.5	2.2	****	****	3.6	4.4	4.4	4.3	3.3	1.7	****	****	
	6.7	6.7	6.6	6.4	6.4	6.4	6.4	6.5	6.4	6.4	6.3	5.4	4.3	4.0	3.6	0.0	0.0	5.4	6.2	6.3	6.2	5.1	3.4	0.0	0.0	
	6	6	6	6	8	8	8	8	8	9	9	9	6	6	6	10	10	8	8	9	9	9	9	10	10	
14	4.9	4.9	4.8	4.6	4.5	4.3	4.3	4.3	4.3	4.3	4.3	3.9	****	2.6	2.4	2.5	2.8	3.3	4.2	4.3	4.3	3.3	1.4	****	****	
	6.8	6.8	6.7	6.6	6.4	6.3	6.2	6.3	6.3	6.2	6.2	5.7	0.0	4.2	3.8	4.1	4.4	5.0	6.1	6.1	6.1	5.1	3.0	0.0	0.0	
	6	6	6	6	6	6	8	8	8	9	9	9	10	6	6	7	7	7	8	8	9	9	9	10	10	
15	4.9	4.9	4.8	4.8	4.7	4.6	4.4	4.3	4.1	4.1	4.1	4.0	3.7	****	****	2.4	2.3	2.5	4.0	4.1	4.2	3.4	1.6	****	****	
	6.9	6.9	6.8	6.7	6.6	6.5	6.4	6.2	6.1	6.1	6.0	6.0	5.5	0.0	0.0	3.8	3.5	3.8	5.9	6.0	6.1	5.1	2.5	0.0	0.0	
	6	6	6	6	6	6	6	6	8	8	9	9	9	10	10	6	6	7	8	8	9	9	7	10	10	

Source: Study Team (1985)

Appendix 3.2.5 (5) HMax of Every Grid by Computer (Typhoon 7025)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	- - GRID NUMBER
1	6.4	6.4	6.0	5.6	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	- - WAVE HEIGHT
	8.1	8.1	7.7	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	- - WAVE PERIOD
	15	15	14	14	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	- - WAVE DIRECTION
2	6.4	6.4	6.0	5.6	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	
	8.1	8.1	7.7	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	15	15	14	14	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
3	6.3	6.3	6.3	6.1	****	****	****	****	5.4	5.4	5.5	5.4	****	****	****	****	****	****	****	****	****	****	****	****	****	
	8.1	8.1	8.0	7.8	0.0	0.0	0.0	0.0	7.2	7.2	7.2	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	15	15	14	14	8	8	8	8	8	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	
4	6.2	6.2	6.3	6.3	****	****	****	2.5	5.3	5.3	5.4	5.5	5.3	5.0	4.8	****	****	****	****	****	****	****	****	****	****	
	7.9	7.9	8.0	8.0	0.0	0.0	0.0	4.0	7.1	7.1	7.2	7.2	7.0	6.7	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	14	14	14	14	8	8	8	8	9	9	9	9	9	9	9	8	8	8	8	8	8	8	8	8	8	
5	6.0	6.0	6.2	6.3	****	****	****	1.5	5.2	5.2	5.3	5.4	5.3	5.0	4.7	4.4	****	****	****	****	****	****	****	****	****	
	7.7	7.7	7.9	8.0	0.0	0.0	0.0	2.7	7.0	7.0	7.1	7.2	7.0	6.7	6.5	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	14	14	14	14	8	8	8	8	9	9	9	9	9	9	9	10	8	8	8	8	8	8	8	8	8	
6	5.8	5.8	6.0	6.2	****	****	****	****	5.1	5.2	5.3	5.4	5.3	5.0	4.7	4.4	3.6	****	****	****	****	****	****	****	****	
	7.5	7.5	7.7	7.9	0.0	0.0	0.0	0.0	6.9	7.0	7.0	7.1	6.9	6.7	6.4	6.1	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	14	14	14	14	9	9	8	8	9	9	9	9	9	10	10	10	13	8	8	8	8	8	8	8	8	
7	5.6	5.6	5.8	6.0	****	2.3	4.9	4.9	5.0	5.2	5.3	5.4	5.3	5.0	4.7	4.4	3.9	****	****	****	****	****	****	****	****	
	7.2	7.2	7.5	7.7	0.0	3.9	6.9	6.8	6.8	6.9	7.0	7.1	6.9	6.6	6.4	6.1	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	14	14	14	14	9	9	9	9	9	9	9	9	10	10	10	10	13	8	8	8	8	8	8	8	8	
8	5.4	5.4	5.6	5.9	****	1.4	4.7	4.8	5.0	5.2	5.3	5.4	5.3	4.9	4.6	4.3	****	****	****	****	****	****	****	****	****	
	7.0	7.0	7.3	7.5	0.0	2.6	6.8	6.7	6.8	6.9	7.0	7.1	6.9	6.6	6.3	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	14	14	14	14	9	9	9	9	9	9	9	10	10	10	10	11	8	8	8	8	8	8	8	8	8	
9	5.2	5.2	5.4	5.7	****	****	4.6	4.8	5.0	5.2	5.3	5.5	5.3	4.9	4.6	4.3	4.1	****	****	****	****	****	****	****	****	
	6.8	6.8	7.1	7.3	0.0	0.0	6.5	6.6	6.8	6.9	7.1	7.2	6.9	6.5	6.3	6.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	14	14	14	14	9	9	9	9	9	10	10	10	10	10	11	11	13	8	8	8	8	8	8	8	8	
10	5.0	5.0	5.3	5.5	4.6	****	4.5	4.9	5.1	5.3	5.4	5.5	5.2	4.9	4.8	4.3	4.3	****	****	4.0	3.9	3.6	****	****	****	
	6.6	6.6	6.9	7.1	6.5	0.0	6.4	6.7	6.9	7.0	7.1	7.2	6.8	6.5	6.4	5.9	6.3	0.0	0.0	6.2	6.1	5.9	0.0	0.0	0.0	
	14	14	14	14	9	9	9	9	10	10	10	10	10	11	11	12	13	8	8	9	9	9	8	8	8	
11	4.8	4.8	5.1	5.3	5.2	4.7	4.9	5.0	5.2	5.3	5.5	5.6	5.3	5.2	5.0	4.3	****	****	3.8	3.8	3.8	3.5	3.5	****	****	
	6.3	6.3	6.7	6.9	6.7	6.5	6.7	6.8	7.0	7.1	7.2	7.3	6.9	6.8	6.6	6.3	0.0	0.0	5.9	6.0	6.0	5.8	5.4	0.0	0.0	
	14	14	14	14	14	10	10	10	10	10	10	10	12	12	12	13	9	8	9	9	9	9	10	8	8	
12	4.8	4.8	5.0	5.2	5.3	5.3	5.2	5.2	5.3	5.4	5.6	5.7	5.5	5.3	5.1	****	****	2.5	3.5	3.6	3.6	3.4	3.5	****	****	
	6.3	6.3	6.6	6.8	6.9	6.8	6.7	6.8	6.9	7.2	7.3	7.4	7.0	6.8	6.7	0.0	0.0	4.5	5.7	5.8	5.9	5.3	5.3	0.0	0.0	
	14	14	14	14	14	14	13	13	13	10	11	11	12	12	12	9	9	9	9	9	9	10	10	8	8	
13	4.9	4.9	5.0	5.2	5.3	5.4	5.5	5.5	5.6	5.6	5.7	5.8	5.5	5.4	5.3	****	****	2.1	3.3	3.4	3.5	3.6	3.6	****	****	
	6.4	6.4	6.6	6.7	6.9	7.0	7.0	7.0	7.1	7.2	7.2	7.4	6.9	6.9	6.9	0.0	0.0	4.0	5.5	5.6	5.7	5.3	5.2	0.0	0.0	
	14	14	14	14	14	14	14	13	13	13	13	11	13	13	13	9	9	9	9	9	9	10	11	8	8	
14	5.0	5.0	5.1	5.2	5.3	5.5	5.6	5.7	5.8	5.8	5.9	6.0	****	2.7	3.6	2.4	2.7	3.0	3.2	3.4	3.6	4.0	3.8	****	****	
	6.6	6.6	6.7	6.8	6.9	7.1	7.2	7.2	7.3	7.3	7.4	7.5	0.0	4.3	5.6	4.1	4.6	4.9	5.1	5.4	5.5	5.6	5.7	0.0	0.0	
	14	14	14	14	14	14	14	13	13	13	13	13	9	16	15	13	13	13	13	13	13	11	12	8	8	
15	5.1	5.1	5.2	5.3	5.4	5.5	5.7	5.8	5.9	6.0	6.0	6.1	6.2	****	****	1.6	1.8	2.2	2.8	3.0	3.9	4.6	3.3	****	****	
	6.7	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.5	7.6	7.7	0.0	0.0	3.0	3.4	4.1	5.0	4.4	5.3	6.0	5.3	0.0	0.0	
	14	14	14	13	14	14	13	13	13	13	13	13	13	9	9	15	14	13	9	11	11	11	13	9	9	

Source: Study Team (1985)

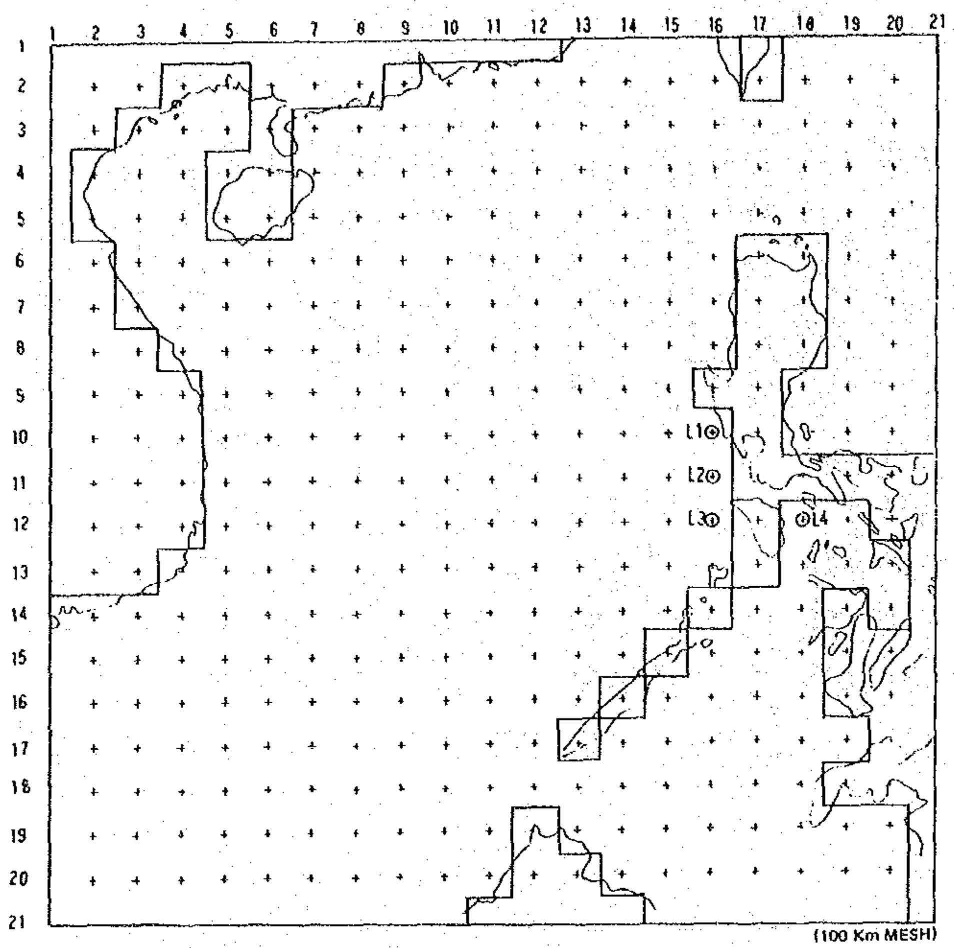
Appendix 3.2.5 (6) HMax of Every Grid by Computer (Typhoon 8214)

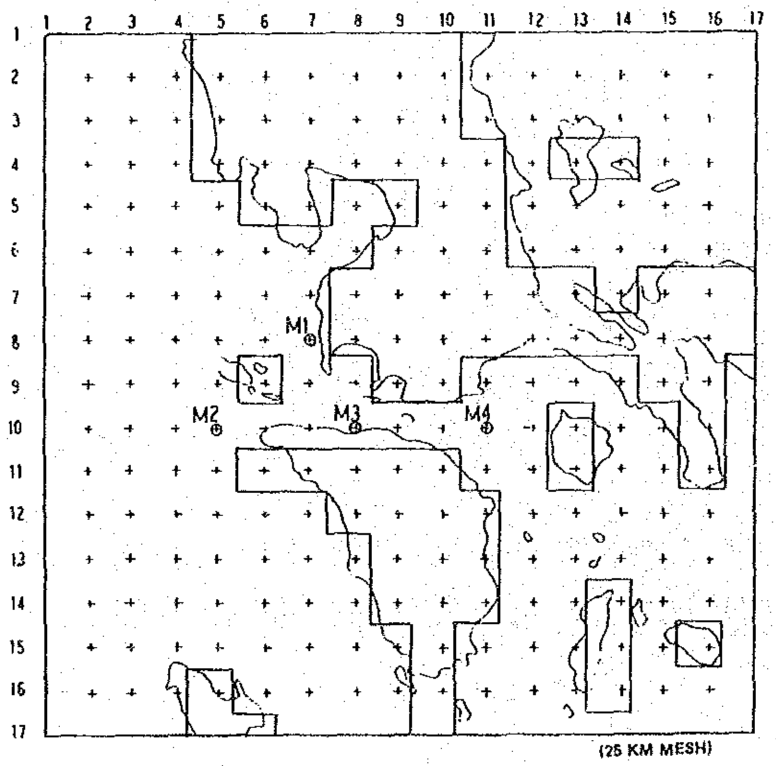
25 --GRID NUMBER
**** --WAVE HEIGHT
0.0 --WAVE PERIOD
10 --WAVE DIRECTION

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	5.6 7.4 9	5.6 7.4 9	5.3 7.1 9	4.6 6.7 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
2	5.6 7.4 9	5.6 7.4 9	5.3 7.1 9	4.6 6.7 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
3	5.5 7.3 9	5.5 7.3 9	5.2 7.1 9	4.6 6.7 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	5.1 7.1 9	5.0 7.1 9	4.7 6.9 9	4.3 6.6 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
4	5.4 7.2 9	5.4 7.2 9	5.2 7.1 9	4.5 6.7 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	2.3 4.1 8	5.0 7.1 9	4.9 7.0 9	4.6 6.8 9	4.3 6.6 9	3.1 5.5 9	3.2 5.6 9	3.1 5.5 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
5	5.3 7.2 9	5.3 7.2 9	5.1 7.0 9	4.5 6.6 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	1.4 2.7 8	4.9 7.0 9	4.8 6.9 9	4.5 6.7 9	4.2 6.5 9	3.0 5.3 9	3.0 5.4 9	3.0 5.4 9	2.5 4.8 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
6	5.1 7.1 9	5.1 7.1 9	5.0 7.0 9	4.5 6.5 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	4.7 6.9 9	4.7 6.8 9	4.4 6.6 9	4.1 6.5 9	2.9 5.2 9	2.9 5.2 9	2.8 5.2 9	2.3 4.6 9	1.2 3.0 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
7	5.0 6.9 9	5.0 6.9 9	4.9 6.9 9	4.5 6.4 9	**** 0.0 10	2.5 4.2 8	4.6 6.7 9	4.6 6.7 9	4.6 6.7 9	4.5 6.7 9	4.3 6.6 9	4.0 6.4 9	2.7 5.0 9	2.7 5.1 9	2.7 5.0 9	2.1 4.3 9	0.8 2.1 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
8	4.9 6.8 9	4.9 6.8 9	4.8 6.8 9	4.5 6.5 9	**** 0.0 10	1.6 3.8 8	4.5 6.6 9	4.4 6.6 9	4.5 6.6 9	4.4 6.6 9	4.2 6.4 9	3.9 6.3 9	2.5 4.8 9	2.6 4.8 9	2.5 4.8 9	1.9 4.0 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
9	4.8 6.7 9	4.8 6.7 9	4.6 6.6 9	4.5 6.5 9	**** 0.0 10	**** 0.0 10	4.3 6.5 9	4.3 6.5 9	4.3 6.5 9	4.3 6.5 9	4.1 6.3 9	3.8 6.2 9	2.3 4.5 9	2.4 4.6 9	2.3 4.6 9	1.6 3.6 9	1.2 3.0 9	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10	**** 0.0 10
10	4.6 6.6 9	4.6 6.6 9	4.4 6.5 9	4.4 6.5 9	4.2 6.3 9	**** 0.0 10	4.2 6.3 9	4.1 6.3 9	4.2 6.4 9	4.1 6.3 9	3.9 6.2 9	3.7 6.1 9	2.1 4.2 9	2.1 4.3 9	2.1 4.3 9	1.3 3.0 9	0.8 2.1 9	**** 0.0 10	**** 0.0 10	2.9 5.4 9	2.9 5.4 9	2.9 5.5 9	**** 0.0 10	**** 0.0 10	**** 0.0 10
11	4.5 6.5 9	4.5 6.5 9	4.3 6.4 8	4.2 6.3 8	4.2 6.3 8	4.1 6.3 8	4.1 6.2 9	4.0 6.2 9	4.0 6.2 9	4.0 6.2 9	3.8 6.1 9	3.6 5.9 9	1.8 3.7 9	1.9 4.0 9	1.9 4.0 9	0.8 2.1 9	**** 0.0 10	**** 0.0 10	2.7 5.2 9	2.8 5.3 9	2.8 5.4 9	2.8 5.4 9	2.0 4.3 9	**** 0.0 10	**** 0.0 10
12	4.3 6.3 9	4.3 6.3 9	4.1 6.2 8	4.0 6.2 8	4.0 6.1 8	3.9 6.1 8	3.9 6.1 8	3.8 6.1 9	3.9 6.1 9	3.8 6.1 9	3.6 5.9 9	3.4 5.8 9	1.4 3.1 9	1.6 3.5 9	1.6 3.5 9	**** 0.0 10	**** 0.0 10	2.1 4.3 9	2.6 5.1 9	2.7 5.2 9	2.7 5.2 9	2.7 5.2 9	1.8 4.0 9	**** 0.0 10	**** 0.0 10
13	4.1 6.1 9	4.1 6.1 9	3.9 6.0 8	3.9 6.0 8	3.8 6.0 8	3.8 6.0 8	3.7 5.9 8	3.7 5.9 9	3.7 5.9 9	3.7 5.9 9	3.5 5.8 9	3.3 5.6 9	1.1 3.1 8	1.2 3.0 9	1.2 3.0 9	**** 0.0 10	**** 0.0 10	1.8 3.9 8	2.5 4.9 9	2.5 5.0 9	2.6 5.1 9	2.6 5.1 9	1.5 3.5 9	**** 0.0 10	**** 0.0 10
14	3.9 5.9 9	3.9 5.9 9	3.7 5.8 8	3.7 5.8 8	3.6 5.8 8	3.6 5.8 8	3.6 5.8 8	3.5 5.8 8	3.5 5.7 9	3.5 5.7 9	3.3 5.6 9	3.1 5.5 9	**** 0.0 10	1.0 2.9 8	0.9 2.6 8	1.2 2.9 9	1.2 2.9 9	1.4 3.2 8	2.3 4.8 9	2.4 4.9 9	2.5 5.0 9	2.4 5.0 9	1.2 2.9 9	**** 0.0 10	**** 0.0 10
15	3.7 5.7 9	3.7 5.7 9	3.5 5.6 8	3.4 5.6 8	3.4 5.6 8	3.4 5.6 8	3.4 5.6 8	3.3 5.6 8	3.3 5.5 9	3.3 5.5 9	3.1 5.4 9	2.9 5.3 9	2.9 5.2 9	**** 0.0 10	**** 0.0 10	0.8 2.4 8	0.8 2.1 9	0.9 2.2 8	2.2 4.5 9	2.3 4.7 9	2.4 4.9 9	2.3 4.8 9	0.7 2.0 9	**** 0.0 10	**** 0.0 10

Source: Study Team (1985)

Appendix 3.2.5 (7) Calculation Grid (100 Km, 25 Km)





Appendix 3.2.6 Analysis of Tidal Harmonic Constants

Area	Philippines
Station	Batangas
Time Zone	-8.00
Latitude	13 45 24 N
Longitude	121 2 24 E
Duration	Oct. 5 ~ Nov. 5, 1984
Method of Analysis	T.1 Method for one month

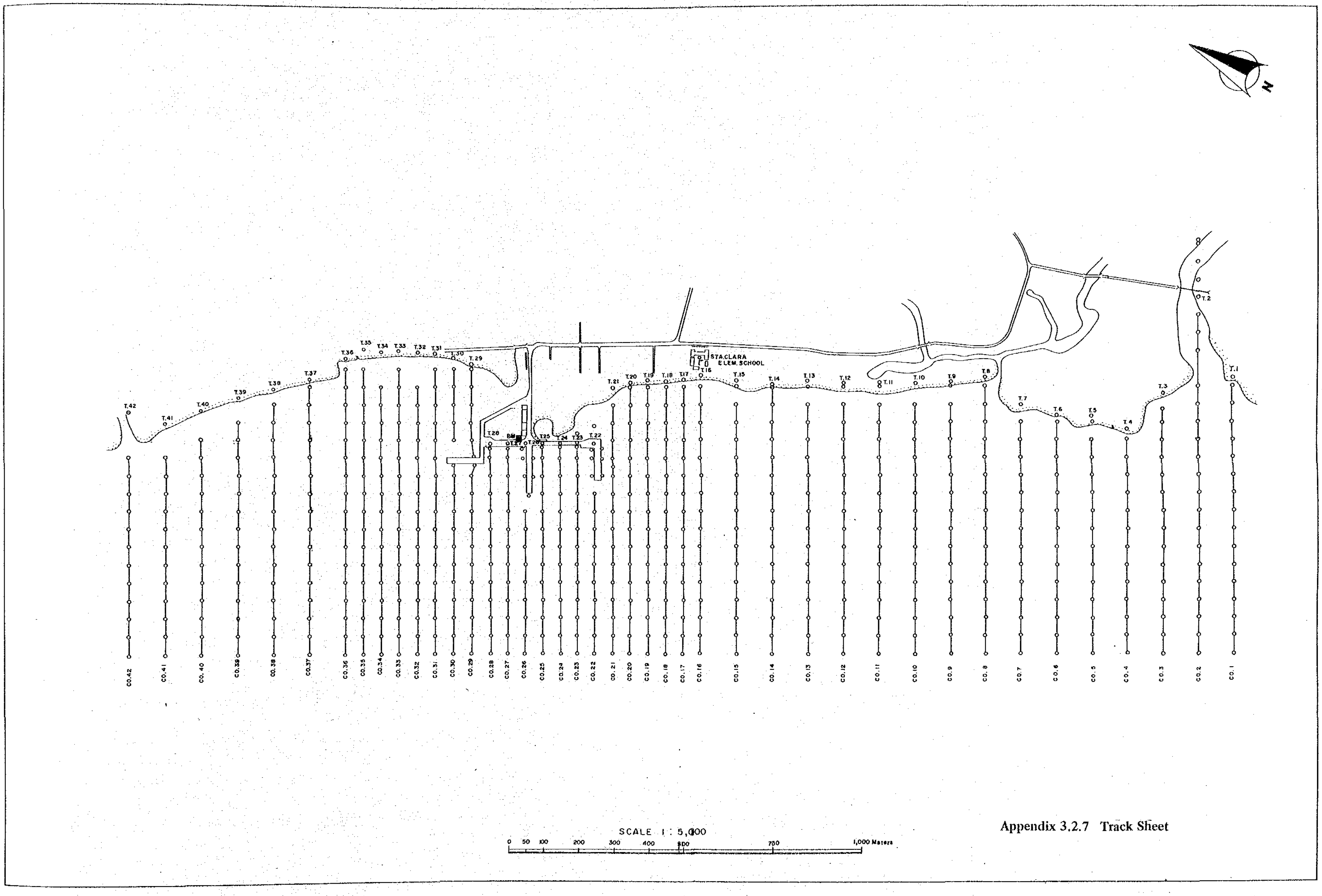
Symbols*1	H (cm)	K (deg.)	G (deg.)
MM	7.13	39.4	43.7
MSF	4.23	65.2	73.3
Q_1	4.32	281.5	267.6
O_1	24.52	281.2	271.8
M_1	2.45	306.5	301.4
K_1	30.63	324.8	324.1
J_1	1.16	41.2	44.9
OO_1	1.24	73.5	81.6
P_1	10.14	324.6	323.4
MU_2	2.37	335.1	316.7
N_2	5.16	314.6	300.1
NU_2	0.99	314.6	300.7
M_2	22.09	312.8	302.5
L_2	5.74	331.1	325.2
S_2	10.61	341.0	338.9

Source: Study Team (1985)

Symbols*1	H (cm)	K (deg.)	G (deg.)
K_2	2.89	341.0	339.5
$2SM_2$	0.69	238.3	244.3
MO_3	0.56	155.6	135.9
M_3	1.39	334.4	319.1
MK_3	1.90	112.7	101.8
MN_4	0.15	201.6	176.8
M_4	0.58	253.1	232.7
SN_4	0.60	232.3	215.7
MS_4	0.96	300.0	287.7
$2MN_6$	0.16	264.6	229.6
M_6	0.28	296.0	265.3
MSN_6	0.27	24.5	357.7
$2MS_6$	0.41	123.8	101.3
$2SM_6$	0.27	160.2	145.8

AO

*1 H : Amplitude
K : Phase (by Local Time)
G : Phase (by GMT)



Appendix 3.2.7 Track Sheet

Appendix 3.3.1 *Geology of Batangas Bay*

In general, the geology of the area surrounding Batangas Bay is characterized by younger geological formations distributed within the central-western part of the area and older geological formations which are distributed in the eastern section.

The older geological formations are composed mainly of rock units from the upper Miocene in the Tertiary age to Plio-Pleistocene in the Quarternary age. These will be described from lower to upper formations in order.

The oldest rock in this area is upper Miocene andesite which mainly constitutes Mt. Liguayen. The andesite is composed of amphibole andesite and associated with some tuffbrecciated thin layers. A limestone formation is found in the vicinity of Mapulo, which is at the eastern part of the Bay. The limestone is colored white to buff and is massive and moderately compacted.

Conglomerate formations which are correlated with Pinamucan formation named by Avila et.al. (1980) are found around the southern foot of Mt. Liguayen. These rocks are composed of alternated beds of conglomerate, sandstone and shale. The conglomerate is well sorted. It is made up of unconsolidated pebbles in a sandy to tuffaceous matrix.

Agglomerate formation of generally andesitic composition is scattered throughout the southern part of the Mt. Liguayen area. These formations are composed of tuffite and tuff breccia alternatively. These alternate formations sometimes show reverse grading, with tuffite, lapilli-tuff and tuff breccia from the surface downwards. This phenomena suggestes that these agglomerate formations originated from the water-laid pyroclastic flow of the Mt. Liguayen volcano.

Andesite (II) and Dacite are found in the eastern part of Batangas Bay and constitute the Calumpan Peninsula and the area around the Taal Lake high mountains.

The volcanic rock is composed of two pyroxene andesite and horn-blend dacite with some minor pyroclastic beds. Especially, dacite rock mass is predominant in the highland of Mainaga and the Bougui-lava area and is outcropping.

A tuff formation which is called Taal tuff (Wolfe et.al., 1980), (BMG, 1981), or Tayasan tuff (Avila et.al., 1980) covers the Batangas plain. It is composed of thick tuff and lapilli tuff with pisolites. It is light gray to brownish in color, and lapilli tuff is composed of sub-angular – sub-roundness andesite in pebble size. Pea-size concretions (called pisolite) and characteristics of this sequence suggest a sub-aerial deposition. These rock units spread widely and thickly constitute the underground basement rock of the Batangas plain and bay.

Reef limestone is confined along the present shoreline, extending from Matoco point on the east to the San Andres and Santa Maria area on the west. It is white to buff colored and contains shells of foramniferas. Porous and coralline in nature, it is generally flat-bedded but in some places dips gently towards the sea.

Coastal terrace deposits constitute the flat plains of the Pinamucan area. They are composed of coarse grained coral sand on the upper part and boulder gravel bed on the lower part. Due to the very loose sediments, subsurface failures sometimes occur at the cliffs of these coastal terrace deposits.

Alluvium sediments are distributed along the coastal areas and at the mouth of large rivers as shown on the flood plain of the Calumpan area. They consist of poor and unconsolidated materials of clay, sand and gravel which were distinctively confirmed by the drilling of this project.

The data on geomorphology and geology surrounding Batangas Bay are shown in Fig. A as a geological map (1:200,000) and Fig. B a geomorphological classification map (1:200,000).

Fig. C and Fig. D show the schematic geological profiles based on the above-mentioned geological data.

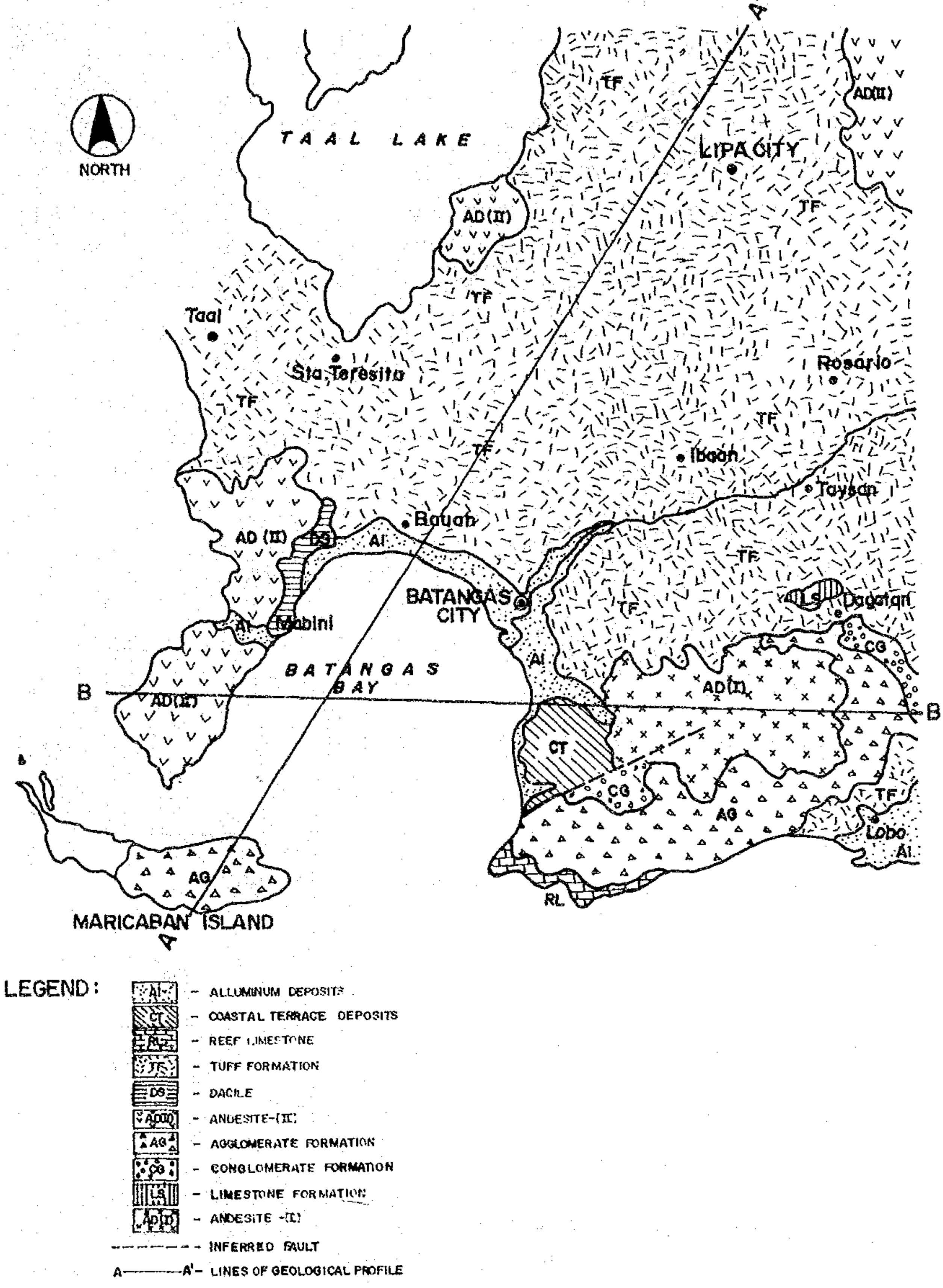


Fig. A General Geological Map of The Area Surrounding Batangas Bay (1:200,000)

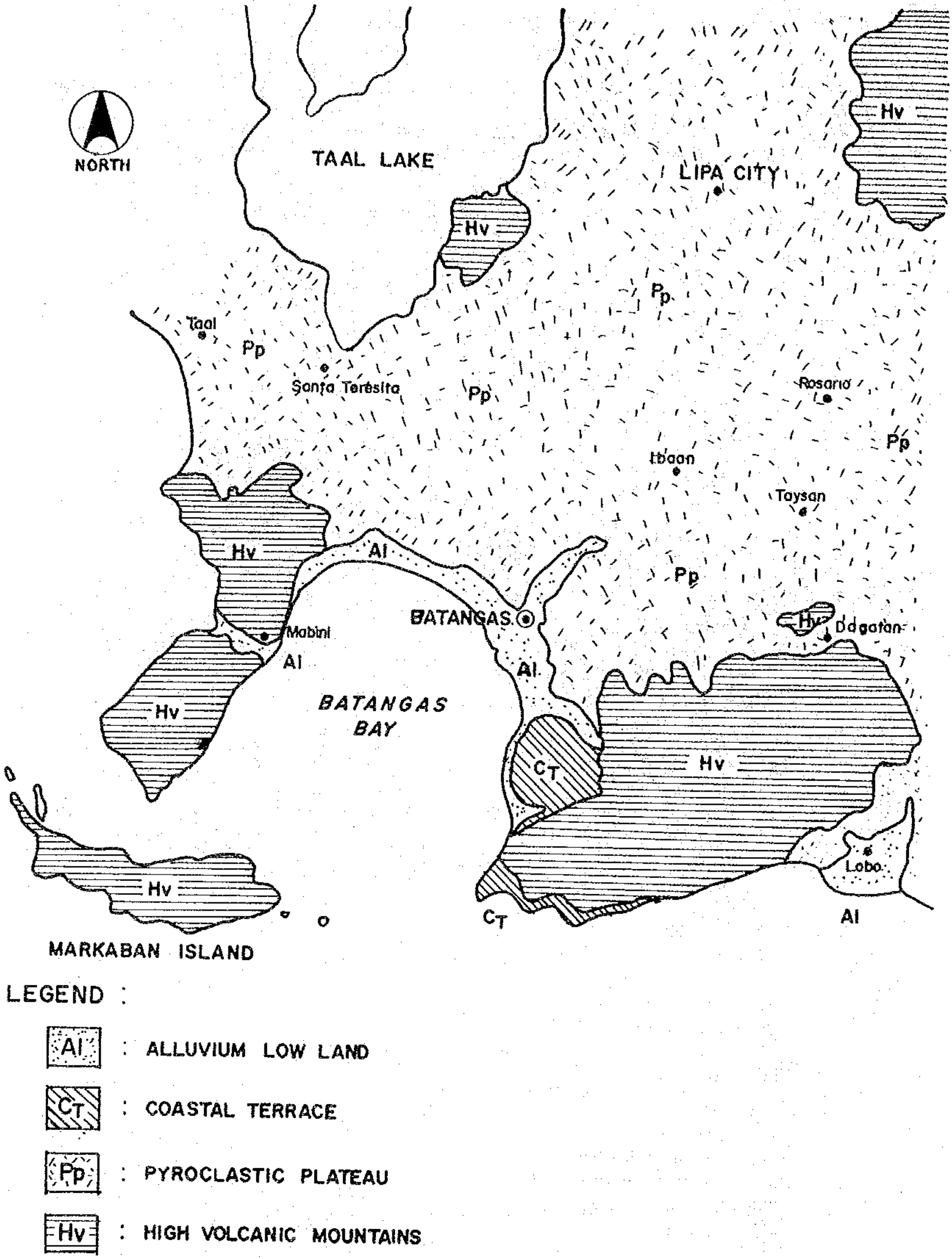
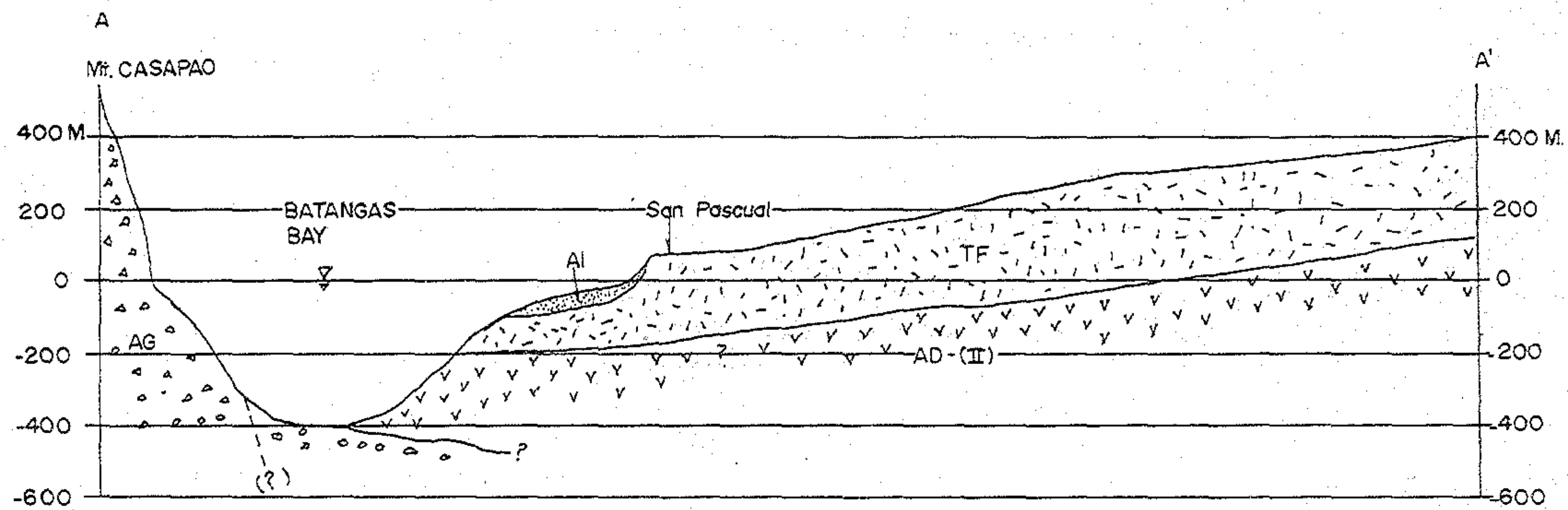


Fig. B General Geomorphological Classification Map (1:200,000)

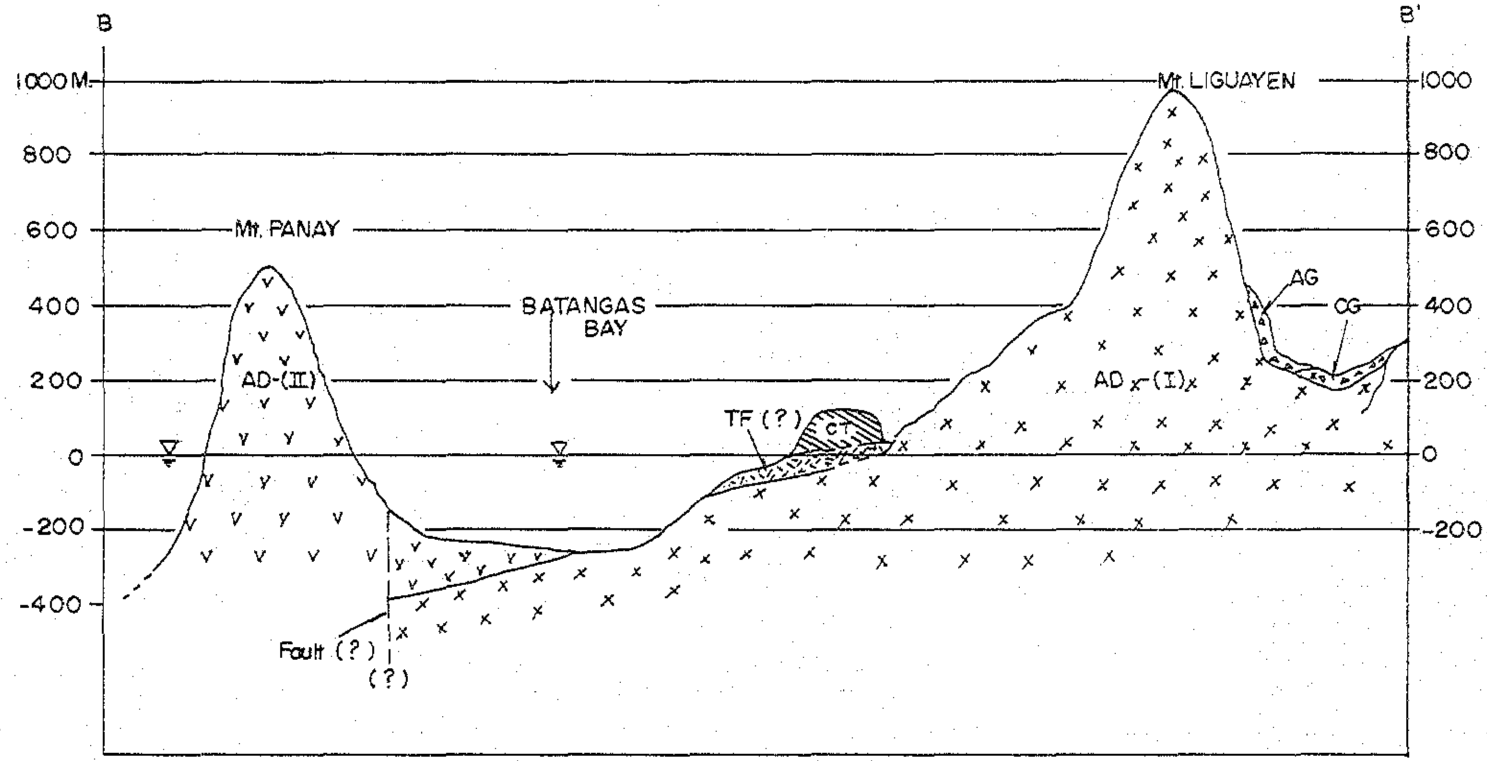


Horizontal Scale 1: 200,000
Vertical Scale 1: 200,000

Abbreviations are as follows:

- Al : Alluvium Sediments
- TF : Tuff Formation
- AD(II) : Andesite-(II)
- AG : Agglomerate Formation
- (?) : Inferred fault

Fig. C Schematic Geological Profile along Batangas Bay



Horizontal Scale 1: 200000
Vertical Scale 1: 200000

Abbreviations are as follows:

CT : Coastal Terrace Deposits
TF : Tuff Formation
AD(II) : Andesite-(II)
AG : Agglomerate Formation
CG : Conglomerate Formation
AD(I) : Andesite-(I)
(?) : Inferred Fault

Fig. D Schematic Geological Profile along Batangas Bay

Appendix 3.3.2 (1) Results of Soil Test (B.H. No. 1)

Elevation M.L.L.W (m)	Character of Grain-Size						Specific Gravity (Gs)	Moisture Content W (%)	Unit Weight γt (g/cm3)	Unconfined Compressive Strength qu (kgf/cm2)
	Gravel (%)	Sand (%)	Fine Grained (%)	D20 (mm)	D50 (mm)	Coefficient of Uniformity (Uc)				
- 1	4.6	91.9	3.5	0.19	0.31	2.5	2.73	34.6	1.690	
- 2										
- 3										
- 4	7.7	85.8	6.5	0.19	0.41	4.17	2.65	31.2	1.634	
- 5										
- 6										
- 7	21.9	68.3	9.8	0.25	0.77	11.11	2.56	27.6	1.575	
- 8										
- 9	11.8	76.6	11.6	0.17	0.55	12.2	2.56	24.1	1.594	
-10										
-11										
-12	36.4	51.9	11.7	0.17	0.82	20.0	2.48	22.1	1.543	
-13										
-14										
-15	22.3	63.9	13.8	0.13	0.66	18.2	2.45	28.5	1.657	
-16										
-17	13.2	29.6	52.9	0.026	0.057	4.7	2.37	55.9	1.671	
-18	1.6	80.7	15.6	0.072	0.142	3.0	2.45	42.2	1.730	
-19										
-20	14.3	75.2	10.5	0.132	0.24	4.62	2.52	44.3	1.748	
-21										

Appendix 3.3.2 (2) Results of Soil Test (B.H. No. 2)

Elevation M.L.L.W (m)	Character of Grain-Size						Specific Gravity (Gs)	Moisture Content W (%)	Unit Weight γ_t (g/cm^3)	Unconfined Comprssive Strength qu (kgf/cm^2)
	Gravel (%)	Sand (%)	Fine Grained (%)	D20 (mm)	D50 (mm)	Coefficient of Uniformity (Uc)				
- 2	1.0	41.8	57.2	0.037	0.072	4.44	2.49	56.9	1.541	
- 3										
- 4										
- 5	1.3	23.3	75.4	0.057	0.072	1.78	2.58	72.3	1.493	0.161
- 6										
- 7	1.0	42.0	57.0	0.033	0.067	8.89	2.38	64.5	1.573	
- 8	18.7	53.2	28.1	0.043	0.22	28.6	2.44	42.7	1.690	
- 9										
-10	7.9	69.8	22.3	0.065	0.24	14.4	2.50	44.3	1.716	
-11										
-12	7.7	78.9	13.4	0.11	0.28	5.54	2.60	34.3	1.730	
-13										
-14										
-15	7.9	78.9	13.2	0.12	0.39	8.72	2.47	38.1	1.690	
-16										
-17	4.4	71.4	24.2	0.065	0.15	4.40	2.49	45.8	1.703	
-18										
-19										
-20	5.4	76.6	18.0	0.09	0.18	3.79	2.68	45.4	1.748	
-21										
-22	15.7	64.7	19.6	0.08	0.19	6.36	2.51	43.5	1.675	
-23	10.1	78.9	11.0	0.1	0.24	4.31	2.59	38.9	1.735	
-24										
-25										
-26	23.2	63.7	13.1	0.13	0.57	14.7	2.52	47.7	1.586	
-27	23.7	65.2	11.1	0.28	1.1	21.7	2.50	37.1	1.565	
-28										
-29										
-30	21.4	63.2	15.4	0.105	0.64	26.3	2.52	42.5	1.597	
-31										
-32										
-33	16.6	69.9	13.5	0.12	0.21	7.8	2.54	40.9	1.613	

Appendix 3.3.2 (3) Results of Soil Test (B.H. No. 3)

Elevation M.L.L.W (m)	Character of Grain-Size: Gravel (%)	Sand (%)	Fine Grained (%)	D20 (mm)	D50 (mm)	Coefficient of Uniformity (Uc)	Specific Gravity (Gs)	Moisture Content W (%)	Unit Weight γ_t (g/cm^3)	Unconfined Compressive Strength qu (kgf/cm^2)
-10	1.2	36.6	62.2	0.029	0.057	5.5	2.42	72.3	1.471	
-11										
-12										
-13	0	1.7	98.3	0.017	0.05	9.0	2.47	75.8	1.46	0.181
-14	0.3	4.0	95.7	0.015	0.052	6.2	2.51	85.4	1.487	
-15										
-16	0	4.4	95.6	0.011	0.041	9.1	2.56	74.1	1.50	0.234
-17										
-18										
-19	0	11.1	88.9	0.016	0.05	6.2	2.50	71.3	1.49	0.222
-20										
-21	3.0	29.4	67.6	0.028	0.054	4.8	2.52	63.3	1.451	
-22										
-23	3.0	26.2	70.8	0.032	0.056	2.8	2.56	75.8	1.534	
-24	1.8	84.1	14.1	0.097	0.155	17.5	2.60	60.1	1.549	
-25										
-26	32.2	55.1	12.7	0.11	0.3	10.7	2.44	51.4	1.587	
-27										
-28										
-29	33.0	53.8	13.2	0.17	0.9	14.8	2.46	48.9	1.635	
-30										
-31	41.9	40.4	17.7	0.14	1.35	37.5	2.41	36.0	1.595	
-32	29.1	48.8	20.1	0.065	0.40	26.1	2.44	40.3	1.499	
-33										
-34	12.5	82.5	5.0	0.16	0.325	3.60	2.44	46.4	1.691	

Appendix 3,3.2 (4) Results of Soil Test (B.H. No. 4)

Elevation M.L.L.W (m)	Character of Grain-Size: Gravel (%)	Sand (%)	Fine Grained (%)	D20 (mm)	D50 (mm)	Coef-ficient of Uni-formity (Uc)	Specific Gravity (Gs)	Moisture Content W (%)	Unit Weight γt (g/cm³)	Uncon-fined Compres-sive Strength qu (kgf/cm²)
0	0.6	83.6	15.8	0.085	0.155	3.1	2.47	32.7	1.693	
- 1										
- 2										
- 3	5.6	66.3	28.1	0.06	0.12	6.9	2.40	39.6	1.667	
- 4										
- 5										
- 6	0.4	59.6	40.0	0.044	0.09	3.8	2.37	48.9	1.590	
- 7										
- 8										
- 9	5.4	82.7	11.9	0.13	0.35	6.1	2.38	33.3	1.694	
-10										
-11	5.6	74.9	14.5	0.076	0.19	7.4	2.51	49.2	1.711	
-12										
-13	9.5	72.7	17.8	0.09	0.19	7.1	2.53	36.7	1.730	
-14										
-15	15.3	57.1	27.6	0.058	0.16	6.2	2.43	42.5	1.564	
-16	8.7	79.8	11.5	0.12	0.23	4.7	2.40	44.8	1.612	
-17										
-18	20.6	61.1	18.3	0.09	0.28	16.0	2.36	47.0	1.598	
-19										
-20	16.5	77.5	6.0	0.14	0.28	4.0	2.35	42.3	1.703	
-21										
-22										
-23	19.4	41.0	39.6	0.033	0.25	26.3	2.42	31.6	1.503	
-24	14.4	62.2	23.4	0.062	0.2	11.6	2.37	33.4	1.590	
-25										
-26	42.1	35.1	22.8	0.058	1.30	115	2.40	38.3	1.514	
-27	33.9	45.0	21.1	0.070	0.78	45.4	2.38	40.3	1.497	
-28	32.9	46.0	21.1	0.065	0.80	53.8	2.37	31.4	1.651	
-29										
-30										

Appendix 3.3.2 (5) Results of Soil Test (B.H. No. 5)

Elevation M.L.L.W (m)	Character of Grain-Size Gravel (%)	Sand (%)	Fine Grained (%)	D20 (mm)	D50 (mm)	Coefficient of Uniformity (Uc)	Specific Gravity (Gs)	Moisture Content W (%)	Unit Weight γt (g/cm³)	Unconfined Compressive Strength qu (kgf/cm²)
0	0.4	81.4	18.2	0.078	0.125	2.6	2.48	43.1	1.461	
~ 1										
~ 2										
~ 3	5.8	65.6	28.6	0.067	0.14	3.6	2.51	40.2	1.487	
~ 4										
~ 5	18.5	69.3	12.2	0.095	0.25	5.4	2.50	33.4	1.578	
~ 6										
~ 7										
~ 8	4.4	82.0	13.6	0.12	0.25	5.0	2.51	35.6	1.712	
~ 9										
~10										
~11	12.9	76.5	10.6	0.13	0.35	6.5	2.52	41.3	1.732	
~12										
~13	10.6	75.3	14.1	0.098	0.22	6.1	2.48	41.9	1.748	
~14										
~15										
~16	13.0	77.0	10.0	0.14	0.28	5.0	2.42	41.5	1.749	
~17	2.8	35.5	61.7	0.032	0.063	3.4	2.45	42.5	1.503	
~18										
~19	4.7	79.5	15.8	0.084	0.25	3.8	2.50	38.0	1.674	
~20										
~21	15.1	67.1	17.8	0.082	0.18	7.6	2.46	35.4	1.672	
~22										
~23	13.4	53.3	33.3	0.047	0.13	7.7	2.46	31.0	1.657	
~24	0.9	64.8	34.3	0.052	0.105	3.7	2.44	36.9	1.626	
~25										
~26										
~27	38.1	50.0	11.9	0.12	0.53	22.9	2.42	50.3	1.695	
~28										
~29										
~30										

Appendix 3.3.2 (6) Results of Soil Test (B.H. No. 6)

Elevation M.L.L.W (m)	Character of Grain-Size Gravel (%)	Sand (%)	Fine Grained (%)	D20 (mm)	D50 (mm)	Coef-ficient of Uni-formity (Uc)	Specific Gravity (Gs)	Moisture Content W (%)	Unit Weight γ_t (g/cm^3)	Uncon-fined Compres-sive Strength qu (kgf/cm^2)
- 8										
- 9	1.8	25.1	73.1	0.016	0.05	8.8	2.47	98.9	1.476	
-10										
-11	0.2	13.6	86.2	0.02	0.046	4.50	2.53	74.5	1.426	0.095
-12										
-13										
-14	0	7.9	92.1	0.018	0.041	14.5	2.49	86.0	1.42	0.175
-15										
-16										
-17	0	4.2	95.8	0.0095	0.25	3.4	2.51	71.1	1.50	0.0178
-18	0	4.5	95.5	0.015	0.05	27.0	2.56	86.8	1.494	
-19										
-20	0.2	12.8	87.0	0.017	0.056	9.2	2.54	68.1	1.490	0.168
-21										
-22										
-23	6.8	61.0	32.2	0.043	0.16	4.5	2.53	51.6	1.587	
-24	20.9	64.0	15.1	0.086	0.27	7.2	2.50	45.4	1.702	
-25										
-26	13.1	45.9	41.0	0.05	0.13	8.6	2.59	34.5	1.583	
-27										
-28	29.0	53.4	17.6	0.09	0.35	21.7	2.50	55.0	1.730	
-29										
-30										
-31	24.7	65.2	10.1	0.17	0.82	15.7	2.55	36.2	1.690	
-32										
-33	22.4	64.9	12.7	0.16	0.68	16.7	2.57	43.8	1.719	

Appendix 3.3.3 Possibility of Liquefaction

There are various criteria to judge the possibility of liquefaction of sandy layers. The judgement of the sandy layers investigated at Batangas follows the standards proposed in the technical note of the Port and Harbour Research Institute (Ministry of Transport in Japan), No. 336 of June 1980. The flow chart to estimate the possibility of liquefaction of sandy layers is shown in Fig. A. Grain size distribution, N-Value by the standard penetration test, and expected horizontal acceleration from earthquakes are principal factors used in the above standards.

Fig. C presents the calculated relationship between horizontal distance from an epicenter and the maximum horizontal acceleration on bedrock at the objective site by magnitude of earthquakes. For convenience, in the estimate of critical N-value, the maximum horizontal acceleration obtained from Fig. C is used instead of that on the ground surface of the objective site.

Based on the standards, the following results are obtained:

1) By grain size distribution curves, about 60 percent of the sandy soils sampled at Batangas are classified as Zone (A), and the remaining 40 percent as Zone (B).

2) The maximum horizontal acceleration on bedrock at Batangas is estimated as 100 gals from the earthquake records for the last thirty-two years.

3) According to Fig. D, the critical N-value for the sandy soils which are classified as Zone (A) is estimated as seven (7), and that for the sandy soils in Zone (B) is estimated as two (2).

4) Judging from actual N-value distribution, about 50 percent of the sandy soils in Zone (A) have N-values smaller than the critical figure, and about 20 percent of the sandy soil in Zone (B) have N-values smaller than the critical figure.

Judging from the results, the sandy soils investigated at Batangas seem to have a possibility of liquefaction.

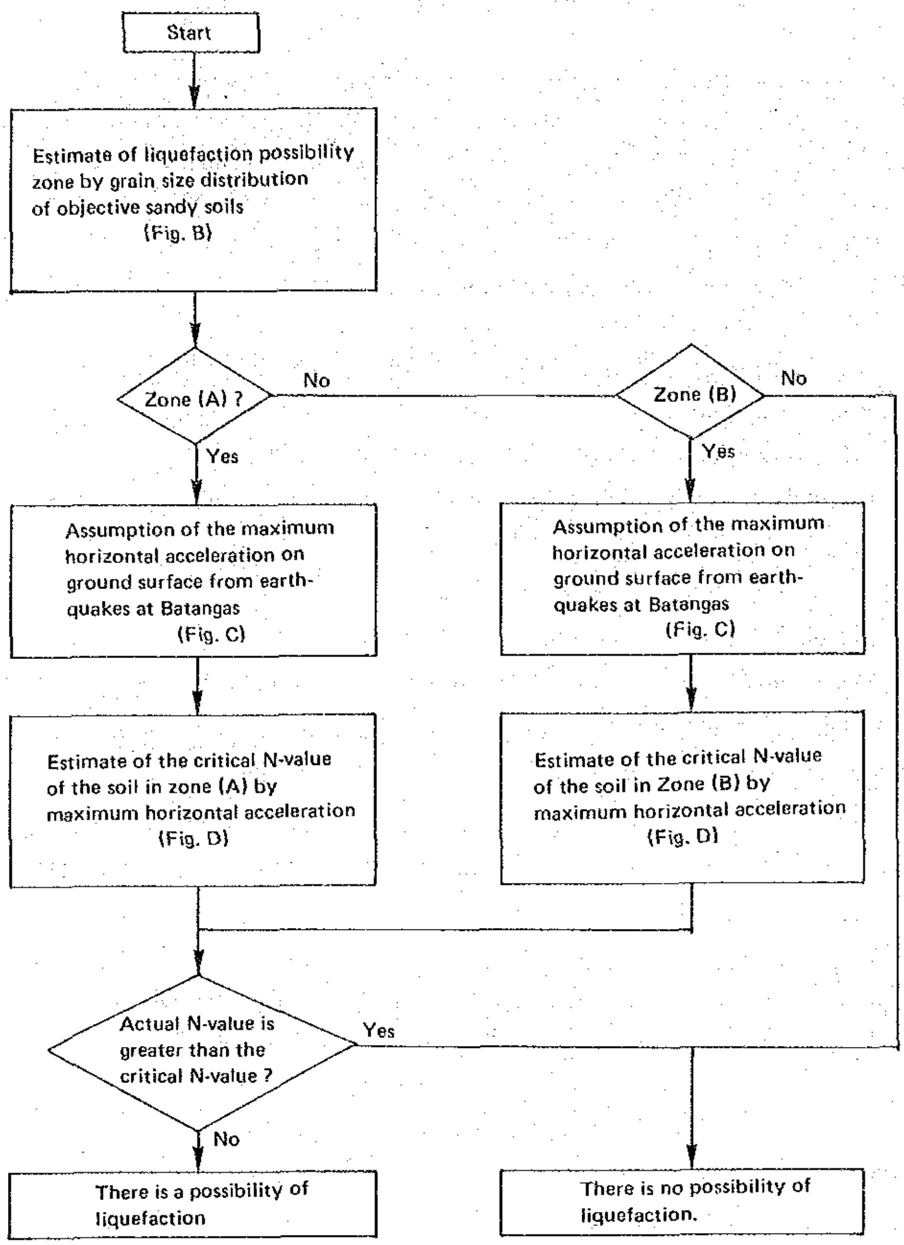


Fig. A Flow Chart for Estimating Possibility of Liquefaction

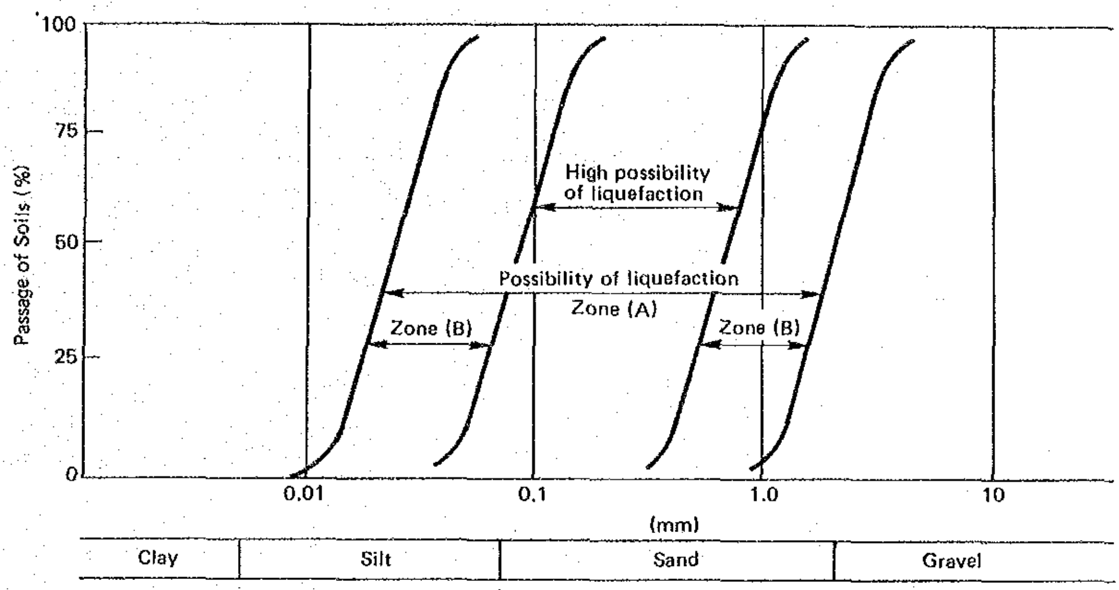


Fig. B Grain Size Distribution Curve of Soil for Possibility of Liquefaction

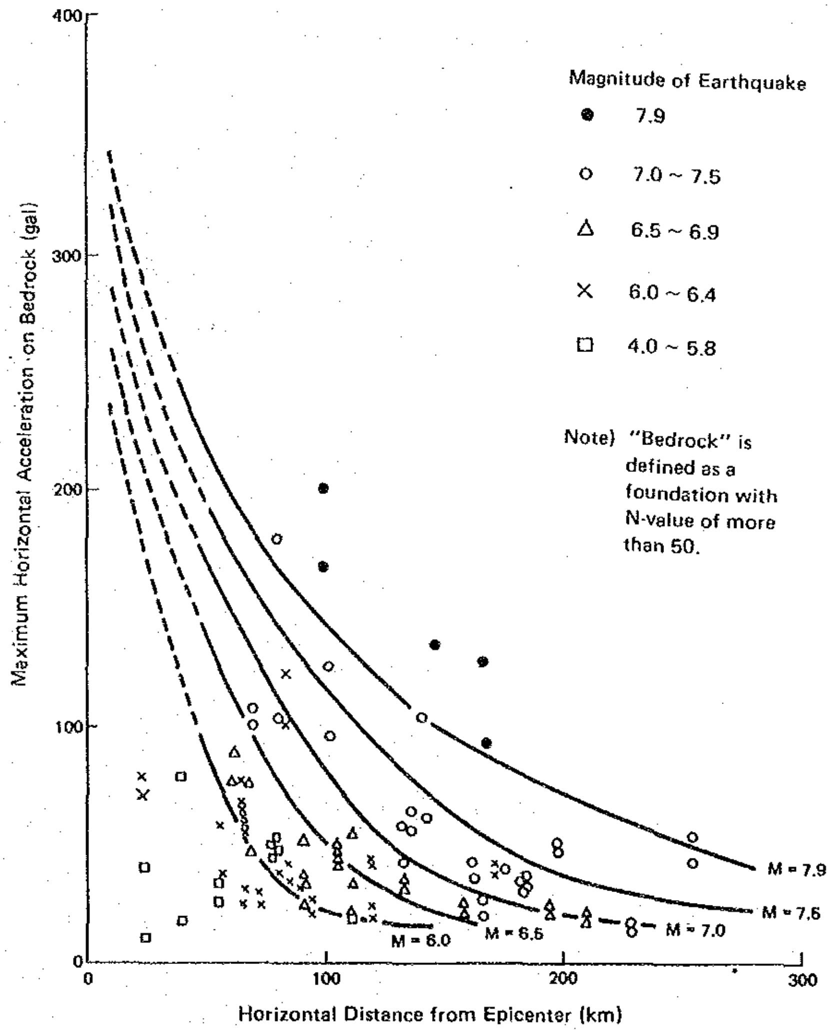


Fig. C Maximum Horizontal Acceleration of Foundation and Active Distance

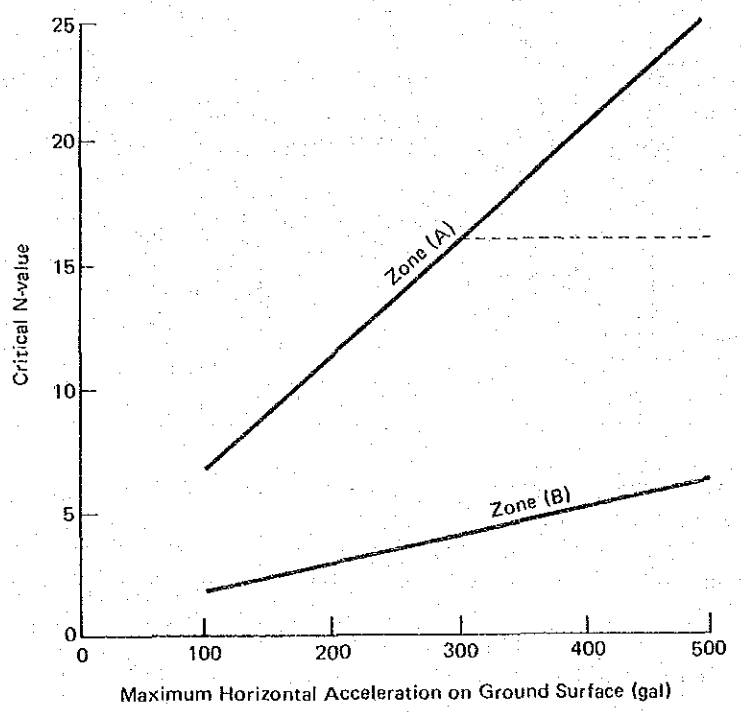


Fig. D Critical N-value Estimate

Appendix 3.3.4 (1) Earthquakes

Date	Lat	Long	Location	m (ml)	Places felt
1949					
Feb. 14	13.28′	120.45′	Northern Mindoro		Manila-V, Tanauan-IV, Cabanatuan-III, Culion-II
Mar. 28	13.58′	120.00′	Vicinity of Lubang Island		Manila-V, Ambulong-III, Lucena-III
May 5	13.15′	121.15′	Mindoro		
1950					
Apr. 4	13.30′	120.35′	Northern Mindoro		Calapan-III
1951					
Apr. 23	14.50′	119.25′	Southwest of Zambales		Iba-III
July 5	13.54′	120.18′	Lubang Island		Manila-II, Calapan-II
Sep. 6	15.36′	120.52′	Nueva Ecija		Cabanatuan-IV, Dagupan-III, Baguio, Manila-II
Oct. 12	15.18′	120.18′	Southwestern Tarlac		Iba, Manila-III, Baguio, Dagupan-II
1952					
Jan. 9	15.30′	121.50′	Near E Coast of Quezon		Baler, Infanta-III, Baguio, Manila-II, Casiguran-I
16	14.20′	119.40′	China Sea		Manila, Calapan-III
Jun. 3	14.30′	122.00′	Lamon Bay		Infanta-III
Aug. 3	13.55′	120.06′	Lubang Island		Manila-II
1953					
Aug. 3	13.25′	122.50′	Ragay Gulf		Aurora-V, Daet-IV
1954					
Feb. 23	14.30′	122.10′	Lamon Bay		Infanta-III, Burdeos-II
May 20	14.35′	119.18′	China Sea		Manila-I
1955					
Apr. 5	15.05′	119.55′	Near W Coast of Zambales		Iba-III
May 16	13.20′	122.40′	Ragay Gulf		Aurora-IV, Daet-IV
Dec. 18	13.50′	121.10′	Batangas Province		Batangas-III, Calapan-III
1956					
Oct. 23	14.05′	120.25′	Off W Coast of Batangas (Distance from Batangas city 65 Km)		Manila, Cavite-V, Calapan, Romblon-IV, Lucena, Ambulong, Cabanatuan-III
1957					
Dec. 23	13.00′	121.00′	Mindoro (Distance from Batangas city 75Km)		Calapan-V, Romblon-II
1958					
Jan. 20	14.05′	120.12′	Near W Coast of Batangas		Manila-V, Quezon-IV, Ambulong-III, Calapan-II
Feb. 11	15.10′	119.45′	Near W Coast of Zambales		Iba-III

Appendix 3.3.4 (2) Earthquakes

Date	Lat	Long	Location	m (ml)	Places felt
1958					
Feb. 19	15.30′	121.00′	Nueva Ecija		Baler-IV, Baguio-II
Aug. 1	13.30′	120.30′	Northern Mindoro		Manila-II, Calapan-II, Romblon-I
24	13.50′	120.00′	10 Km East of Lubang Island		Manila-II, Calapan-III
Sep. 23	15.00′	119.50′	Near W coast of Zambales		Iba-IV
1959					
Feb. 21	14.20′	120.30′	Manila Bay		Manila-II
July 18	15.30′	120.20′	Zambales-Pamgasinan Border		Iba-VI, Dagupan-V, Baguio, Baler, Laoag-IV, Cabanatuan, Vigan-III, Aparri-II
1960					
Jan. 29	14.00′	120.00′	Off NW Coast of Mindoro		Manila-IV
29	13.45′	120.25′			Calapan-VI, Batangas-III, Cabite-II, Manila-I
Dec. 15	13.36′	120.42′	Central Mindoro		Calapan-III
15	13.36′	120.42′	(Distance from Batangas city 28 Km)		Calapan-IV
1961					
July 15	13.06′	120.24′	Off Western Coast of Mamburao, Occ. Mindoro		Manila-IV
1962					
Oct. 28	14.48′	119.42′	Near Western Coast of Zambales	5.0 (ml)	Iba-VI, Manila-IV, Baguio-II
Dec. 21	15.24′	121.48′	East Coast of Dinagalan Bay		Manila-II
1963					
Feb. 7	14.42′	119.36′	Off Coast of Zambales	4.5 (ml)	Iba-V
Feb. 25	15.30′	121.18′	Central Luzon	5.0	Baler-V, Manila-IV, Cabanatuan-II, Infanta, Dagupan-II
July 30	13.30′	122.55′	South of Daet, Camarines Norte		Daet-III
Oct. 22	14.10′	122.10′	Off Coast of Alabat Island		Lucena-IV
1964					
Mar. 10	13.30′	122.50′	Along Ragay Gulf, Camarines Sur		Daet-III
12	13.30′	122.55′	Ragay Gulf	5.3	Daet-IV, Aurora, Manila-III, Lagaspi-II, Alabat-I
24	14.10′	120.00′	Off NW Coast of Lubang Is.	5.5	Manila-II
Aug. 20	13.10′	121.00′	South of Mindoro (Distance from Batangas city 67 Km)		Dalapan-IV

Appendix 3.3.4 (3) Earthquakes

Date	Lat	Long	Location	m (ml)	Places felt
1965					
Apr. 3	13.36′	119.42′	Off Western Coast of Lubang Is.	5.2	Manila-III
Aug. 13	13.36′	120.06′	Off NW Coast of Mindoro		Manila-III
Oct. 2	14.50′	119.40′	Off SW Coast of Zambales		Iba-IV
1966					
Jan. 10	13.55′	120.06′	Northern Coast of Lubang Is. (Distance from Batangas city 90 Km)	5.5	Ambulong-V, Calapan-IV, Manila-IV
Feb. 17	15.36′	121.55′			Baler-IV
Aug. 15	13.25′	121.30′	Northeast of Mindoro (Distance from Batangas city 63 Km)	5.7	Calapan, Romblon-V, Manila-IV, Ambulong-II, Infanta, Alabat-II
Sep. 14	13.12′	121.06′	Northern Mindoro		Calapan-IV
Oct. 11	13.30′	120.18′	Northern Mindoro	5.2	Calapan-IV, Manila-III
27	13.25′	121.00′	Northern Mindoro	5.0	Calapan-IV
Dec. 21	14.18′	122.06′	North of Alabat Is.	5.4	Alabat-VI, Manila-V, Lucena, Daet, Batangas-IV, Aurora, Baler, Casiguran-II
1967					
Jan. 5	14.48′	119.30′	China Sea, 75 Km SW of Iba	5.4	Manila, Iba-IV
Mar. 31	13.25′	122.00′	Southern Marinduque	5.0	Marinduque-IV
May 6	15.18′	119.48′	Off West Coast of Iba	5.1	Ina-IV
Sep. 11	14.48′	121.24′	Norzagaray Bulacan		Manila, Quezon City-VI
1968					
Apr. 7	13.06′	120.42′	Mindoro (Distance from Batangas city 75 Km)	4.7	Batangas-IV
Aug. 9	15.42′	121.42′	Baler		Casiguran-IV
11	15.30′	121.36′	Baler	5.4	Manila, Baler-IV, Baguio-III, Quezon-II, Cabanatuan-II
14	15.06′	122.30′	NE of Polillo	5.4	Alabat-IV, Aurora-II, Cabanatuan, Jomalig-II
23	15.36′	121.30′	SW of Baler	5.2	Manila, Baler-IV, Tarlca, Iba-III, Alabat, Quezon City-II
28	15.12′	122.36′	ENE of Polillo		Manila, Alabat, Baler-V, Quezon-IV
Sep. 23	15.42′	121.54′	NNE of Polillo	5.3	Baler, Manila-IV, Quezon City-III, Cabanatuan-II
Nov. 22	13.06′	122.36′	Near Aurora		Aurora-VI, Manila, Legaspi, Masbâte, Alabat-III

Appendix 3.3.4 (4) Earthquakes

Date	Lat	Long	Location	m (ml)	Places felt
1969					
Mar. 6	15.48′	121.48′	Northeast of Baler	4.8	Baler-IV, Manila-II
Jun. 11	13.12′	121.24′	Northern Lake Maujan	5.4	Victoria, Or. Mindoro-VI, Marinduque-V, Gulod, Batangas, Calapan-III, Romblon, Manila-II
11	13.06′	121.00′	Mount Halcon	4.7	Victoria-IV, Marinduque-III Romblon-II
Oct. 6	15.06′	119.48′	Off SW Coast of Zambales (Distance from Batangas city 183 Km)	5.6	Iba-VI, Manila, Pasay, Dagupan, Gulod, Batangas,IV, Baguio, Quezon City-III
Dec. 23	13.48′	120.36′	Southwestern Batangas (Distance from Batangas city 37 Km)	5.3	Manila, Gulod, Batangas-IV, Iba-III, Quezon City-II
1970					
Jan. 29	15.00′	119.54′	Off West Coast of Iba	4.8	Iba-IV, Baler-III, Manila, Seb, Casiguran-II
Feb. 26	13.36′	120.36′	North of Mindoro	5.3	Talisai, Pasay, Manila-IV, Calapan, Panpanga-III, Quezon City, Baguio-I
Apr. 8	15.18′	121.36′	NW of Polillo Is.	5.2	Baler-IV, Quezon city, Infanta, Baguio-III, Alabat, Manila-II
9	15.24′	121.48′	North of Polillo	5.7	Baler, Aurora-V, Alabat, Baguio, Dagupan, Manila, Quezon city-IV, Lucena, Casiguran, Tarac, Daet-II
12	14.06′	122.00′	North of Polillo	5.5	Pasay, Manila-IV, Cabanatuan-III, Gulod, Gulod, Lucena-II
15	15.06′	122.42′	ENE of Polillo	5.7	Luzon, Manila-V
Jul. 11	13.54′	120.24′	Lubang Is. (Distance from Batangas city 59 Km)	5.6	Talisay-IV, Manila-III, Infanta-II
Aug. 20	15.30′	121.30′	Baler		Manila, Quezon city-II
Nov. 21	15.00′	120.06′	Zambales		Iba-VI
1971					
Jul. 4	15.36′	121.54′	Off East Coast of Baler	5.5	Baler, Manila-V, Quezon, Dagupan, Infanta-IV
20	15.18′	120.81′	Near ESE of Iba	5.4	Iba-VI, Manila-II
1972					
Apr. 26	13.24′	120.18′	NW Coast of Mindoro (Distance from Batangas city 80 Km)	6.2	Manila, Cavite, Ambulong, Tayabas-V, Cabanatuan, Cuyo, Coron, Iba-IV

Appendix 3.3.4 (5) Earthquakes

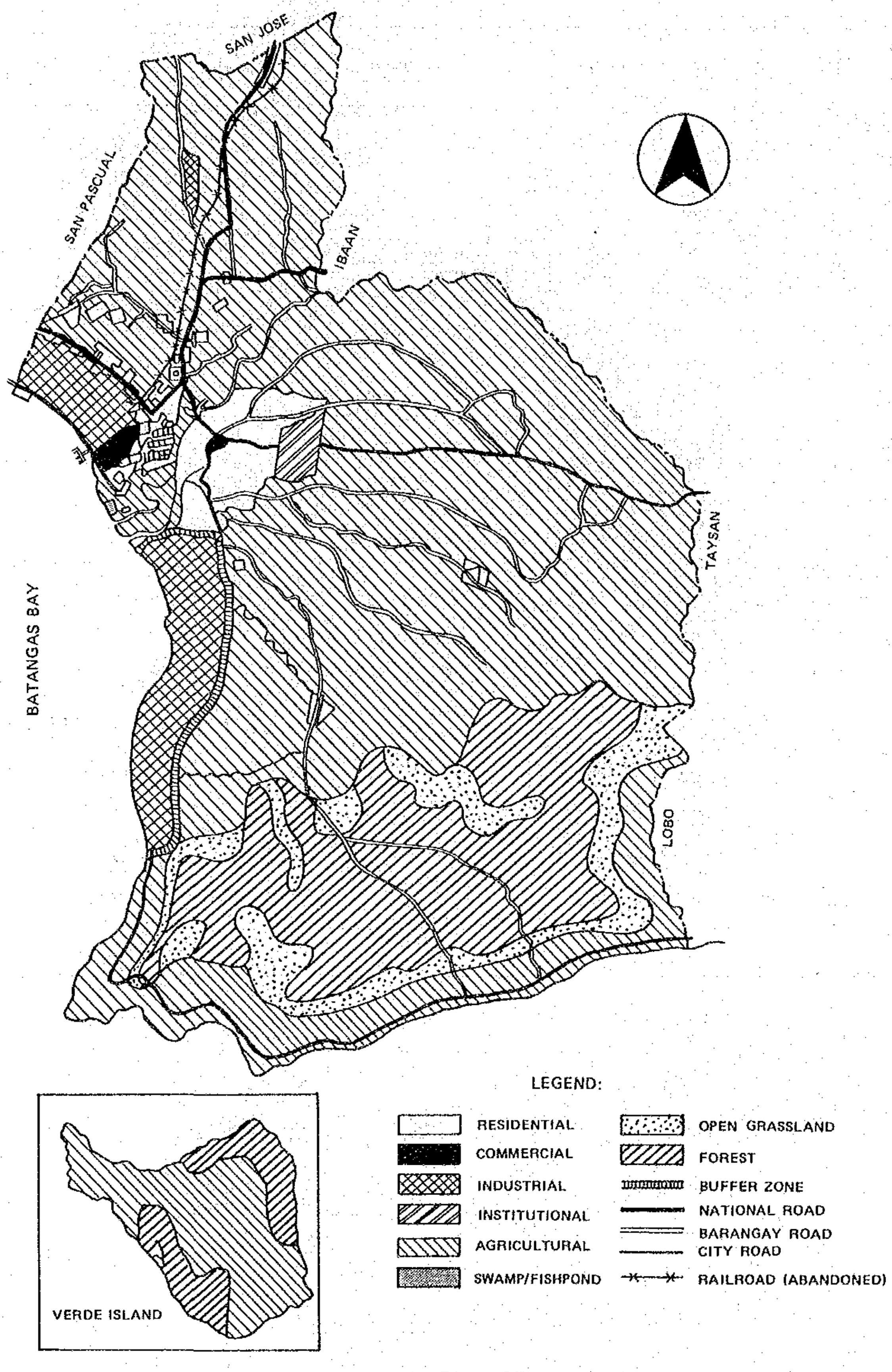
Date	Lat	Long	Location	m (ml)	Places felt
1972					
Apr. 27	13.30′	120.42′	Off NW Coast of Mindoro	5.4	Gr. Manila-IV
May 17	13.24′	119.54′	Mindoro Strait	5.7	Manila-IV, Quezon city-II, Calapan-I
1973					
Mar. 17	13.24′	122.48′	Ragay Gulf (Distance from Batangas city 185 Km)	7.0	Flat widely over Luzon and Northern Visayas Max Inten.-VII
May 13	13.36′	120.36′	Balayan Bay (Distance from Batangas city 70 Km)	5.2	Rizal, Batangas-IV, Manila-III, Ambulong-II
Oct. 25	13.36′	120.12′	Near Lubang Is.		Greater Manila, Arayat-IV, Baguio city-III
Nov. 21	13.30′	121.00′	Near Northern Coast of Mindoro (Distance from Batangas city 25 Km)		Baco, Or. Mindoro-VII, Calapan-IV
1974					
Feb. 19	13.54′	122.18′	Southern Quezon	5.7	Calauag-VIII, Alabat-VII, Manila-VI
Jul. 3	13.24′	120.48′	Northern Mindoro (Distance from Batangas city 40 Km)	4.3	Calapan-IV
Oct. 23	13.30′	120.36′	Northern Mindoro	5.2	Marinduque-IV, Ambulong, Manila-III, Tatabas, Calapan, Alabat-II, Quezon city-I
1975					
Apr. 29	13.36′	120.30′	Northern Mindoro		Puerto Galera-VI, Tayabas, Alabat, Daet, Calapan, Ambulong-III, Manila-II
Jun. 18	13.54′	120.36′	SW of Lubang Is. (Distance from Batangas city 42 Km)	5.4	Manila-V, Quezon-II, Calapan-IV
Oct. 5	14.12′	121.54′	Near Alabat Is.	5.0	Alabat-IV, San Francisco, Manila-II
1976					
Feb. 13	13.32′	120.04′	Near Lubang Is.	5.6	Manila-IV, Quezon city, Ambulong-III, Calapan-II
May 44	13.23′	120.13′	Near Lubang Is.	5.4	Manila-II
5	13.31′	120.04′	Near Lubang Is.	5.4	Manila-II, Quezon-I
Jul. 2	13.51′	120.42′	Balayan Bay		Manila-II, Quezon-I
Sep. 22	13.48′	119.48′	Balayan Bay	5.2	Manila-III, Pasay, Ambulong-II, Quezon-I

Appendix 3.3.4 (6) Earthquakes

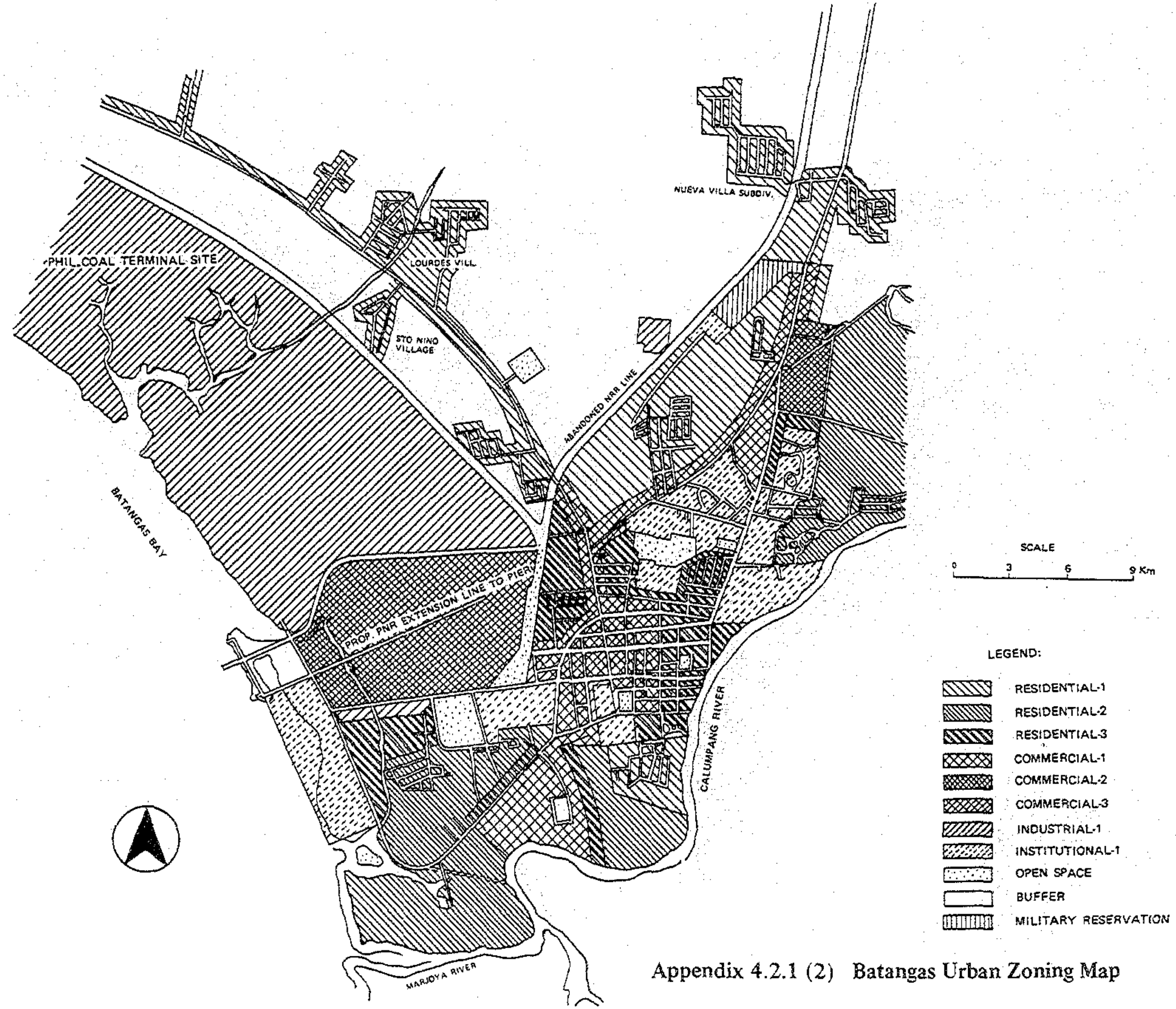
Date	Lat	Long	Location	m (ml)	Places felt
1977					
Feb. 3	13.18′	122.42′	Ragay Gulf		San Francisco-III
May 12	13.02′	121.49′	Off South Coast of Marinduque	4.7	Marinduque-VI, Manila, Calapan, Romblon-III
Jun. 1	13.43′	122.17′	Bondoc Peninsula	3.9	Marinduque-IV, San Francisco-II
1978					
Jan. 31	13.18′	120.54′	Northern Mindoro		Calapan-II
Jun. 25	13.37′	119.23′	Off West Coast of Batangas	5.1	Manila, Bagac-II
Aug. 28	13.54′	120.06′	Near Lubang Is.		Manila-II
1979					
May 25	13.40′	122.46′	Ragay Gulf	4.4	Daet, San Francisco-II
Aug. 11	13.40′	119.52′	Batangas Province	4.6	Subic-V, Manila-II, Tayabas, Ambulong-I
25	14.02′	120.41′	Batangas Prov.	3.8	Tuy-IV
Nov. 21	13.59′	122.00′	Near Alabat Is.	3.8	Alabat-II, Manila, Quezon-I
Dec. 11	14.12′	120.04′	Northern Mindoro	4.0	Puerto Galera-IV, Calapan-III
12	13.34′	120.58′	Northern Mindoro (Distance from Batangas city 17 Km)	4.2	Puerto Galera-V
14	13.36′	120.28′	Verde Is. Passage Mindoro (Distance from Batangas city 59 Km)	4.7	Puerto Galera, Tanauan-IV, Manila-III
16	13.41′	120.42′	Off Coast of Northern Mindoro		Puerto Galera-II
1980					
Mar. 22	13.29′	120.29′	Northern Mindoro (Distance from Batangas city 56 Km)	4.7	Calapan-IV, Manila, Puerto Galera-III
Jun. 18	13.25′	121.54′	Marinduque		Boac-I
Jul. 2	13.18′	120.48′	Northern Mindoro		Puerto Galera-II
Aug. 25	13.50′	120.37′	Southern Coast of Batangas (Distance from Batangas city 20 Km)	4.3	Puerto Galera-IV, Balayan Bay Area-III
Sep. 19	13.51′	120.52′	Verde Is. Passage	4.9	Calatan, Bagac, Tuy-IV, Manila-III
24	13.39′	120.47′	Northern Mindoro (Distance from Batangas city 15 Km)	3.2	Puerto Galera-IV
Nov. 25	13.33′	120.51′	Off Northern Coast of Mindoro		Puerto Galera-III

Appendix 3.3.4 (7) Earthquakes

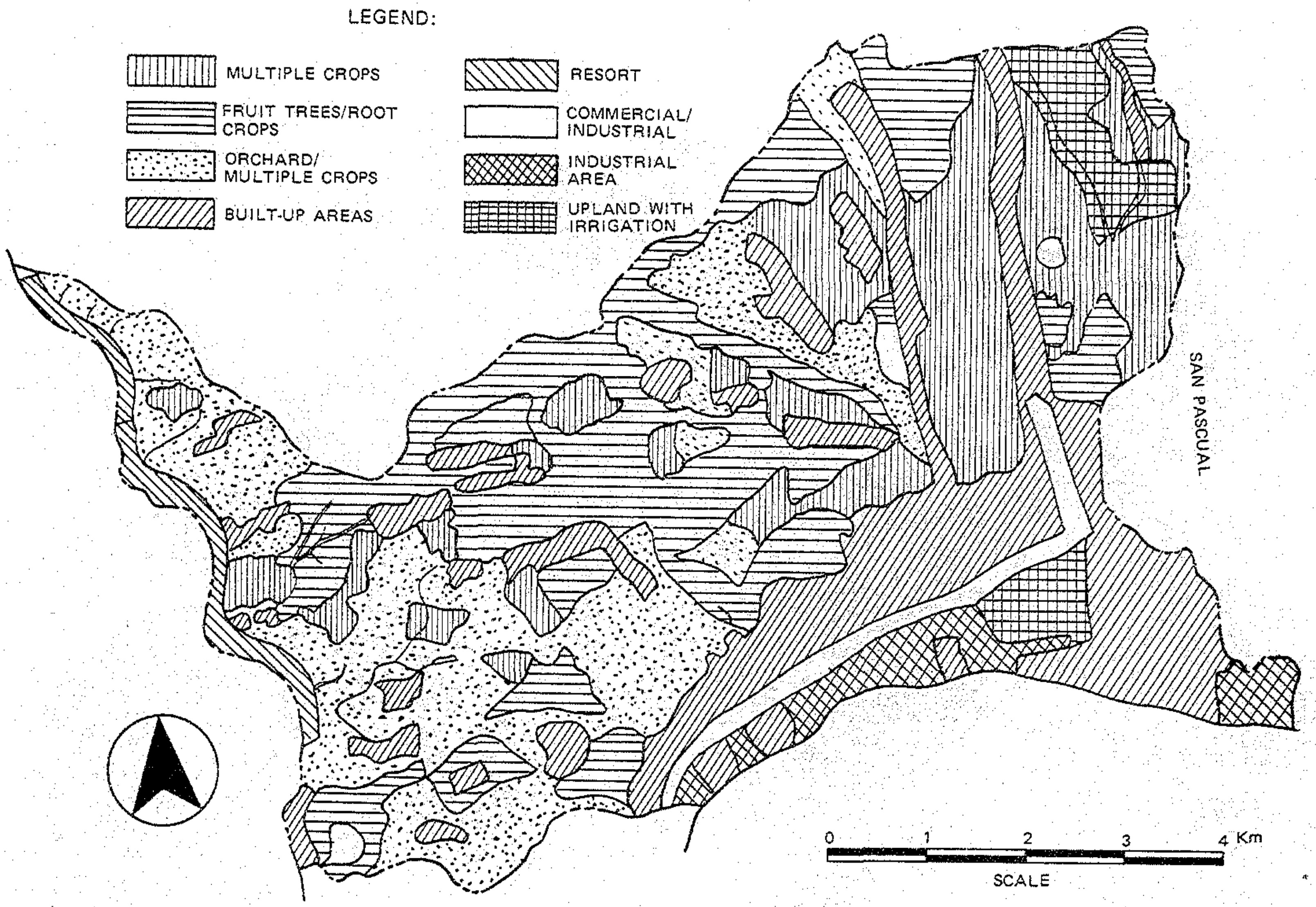
Date	Lat	Long	Location	m (ml)	Places felt
1981					
Jan. 7	13.25′	120.29′		3.4	Depth 50.0 Km
16	13.37′	122.45′		3.9	Depth 50.0 Km
Feb. 5	13.24′	119.59′		3.9	Depth 39.8 Km
6	13.14′	121.06′		3.7	Depth 39.3 Km
Mar. 13	13.54′	120.29′		4.9	Depth 183.3 Km Puerto Galera, Bagac-IV, Manila-III
15	13.03′	120.11′		3.9	Depth 4.6 Km
21	13.30′	121.13′			Puerto Galera-II
27	12.30′	119.52′		4.4	Depth 50 Km
Apr. 16	12.52′	120.24′		3.8	Depth 139.3 Km
23	13.42′	120.13′		4.0	Depth 61.6 Km
28	13.35′	120.13′		4.3	Depth 180.0 Km
May 1	13.15′	120.37′		4.3	Manila, Puerto Galera-II
Jul 29	13.58′	120.42′		4.5	Depth 316.0 Km
Aug. 1	14.58′	119.45′		4.6	Depth 120.0 Km
Sep. 8	13.32′	121.19′		3.6	Depth 65.9 Km Calapan-III
Oct. 5	13.38′	120.41′		3.8	Depth 178.9 Km Puerto Galera-I
26	13.24′	119.58′		4.6	Depth 50 Km Puerto Galera-II
27	13.14′	120.51′		3.3	Depth 65.3 Km Puerto Galera-II
Dec. 20	13.07′	120.38′		4.7	Depth 50 Km Calapan-IV, Manila, Pasay-III Quezon City-I



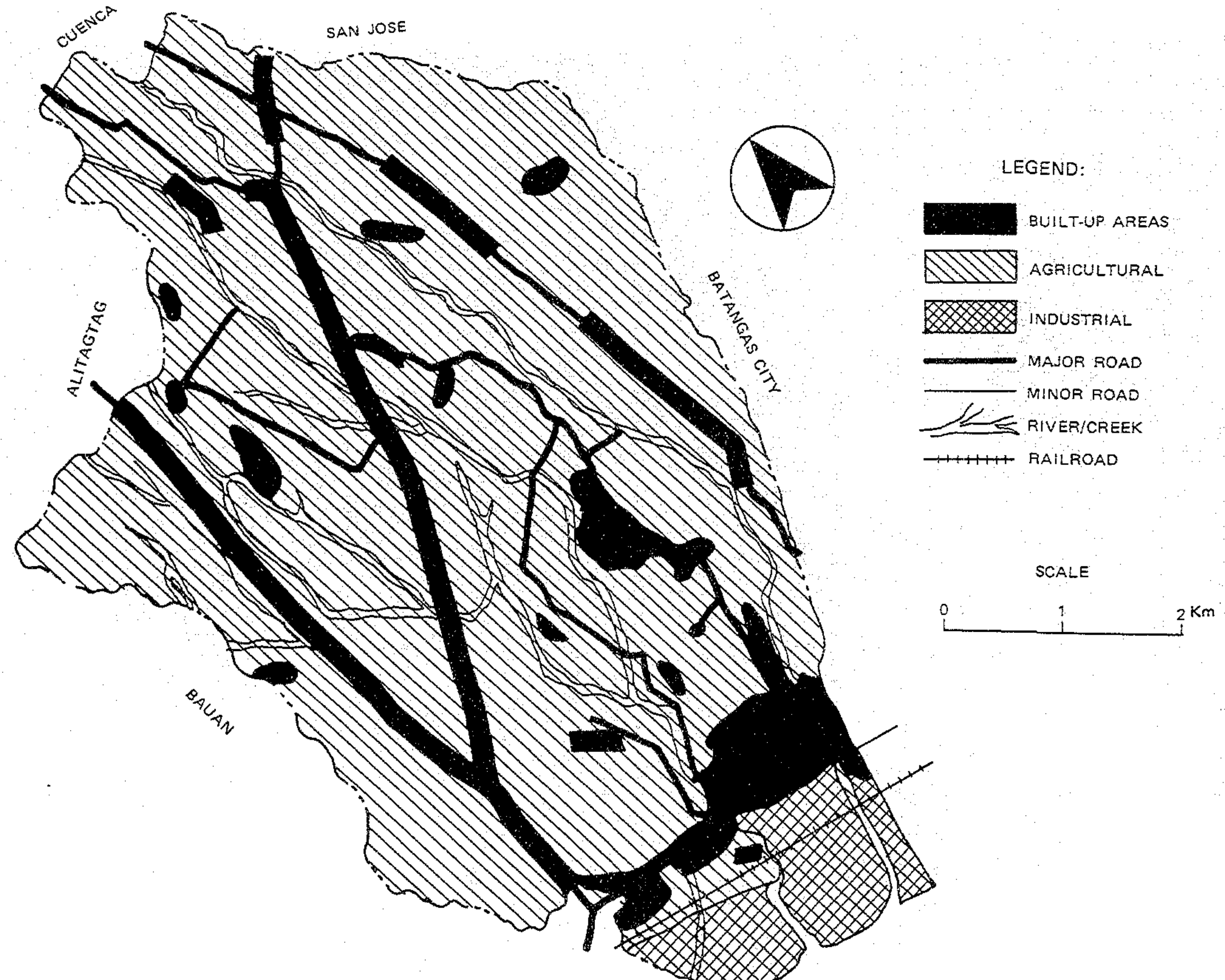
Appendix 4.2.1 (1) Land Use Plan of Batangas City



Appendix 4.2.1 (2) Batangas Urban Zoning Map



Appendix 4.2.1 (3) Land Use Plan of Municipality of Bauan



Appendix 4.2.1 (4) Land Use Plan of Municipality of San Pascual

Appendix 5.1 Study on Steel Products Distribution Center at Batangas

1. Preferable Physical Distribution in Metropolitan Areas

1.1 Priority of "Flow" within Major Urban Areas

Generally, "flow" in major cities is divided into the flow of "physical goods" and of "commercial trade information". Considering the main objects that flow in urban areas, "flow" can also be classified into four categories: physical objects, money, persons and information.

The flow of physical objects requires means of transportation such as automobiles and railways. So, physical flow can be dealt with as a problem of the traffic of cars, trucks, trains and other conveyances. Physical objects which flow include water, sewage and industrial and daily waste materials along with products and commercial goods. As for products, the physical flow in urban areas is defined as "physical distribution".

To stimulate proper urban development, the most important items which flow into major cities are consumer goods, and information related to consumption, production and distribution. The flow of these two major items should be given top priority in large urban areas. When production and physical distribution facilities locate in central urban areas, they tend to cause congestion and to interfere with the flow of the two priority items, that is consumer goods and information.

Furthermore, when production and distribution facilities locate in central urban areas, the overall efficiency of production and distribution decreases. This is due to relatively slow transportation caused by over-crowing, and other problems from excessive demand on limited goods and services in a small, centralized area.

One method to improve the flow of consumer goods and information is to relocate production and distribution facilities to outlying suburban areas. This policy should be pursued not only to improve the environment of the inner city, but also to stimulate the proper development of the entire urban area.

Table 5.1 shows the results of a survey on the location inclination of middle and large industries which are established in urban areas of Japan. According to the table, only 15% of the industries answer that all the facilities related to production and physical distribution should be secured in central urban areas.

The industries which handle such heavy commodities as soils, cement, glass and metals answer that some portion or all of the facilities can be located outside of urban areas. The survey indicates that the production plants and physical distribution facilities related to storage, transportation and packing can be relocated outside of urban areas.

Table 5.1 Location Inclination of Middle and Large Japanese Industrial Firms

Commodity Group \ Activities	Suitable location	Stock	Transport	Manufacturing	Structuring	Processing	Printing	Whole sale trade	Retail trade	Repairs and painting	Package	Construction work	Cultivation	Others	Overall
Soil Stone Cement Glass	A	-	0.0	0.0	0.0	-	-	0.0	-	-	-	0.0	0.0	-	0.0
	B	-	0.0	25.0	0.0	-	-	71.0	-	-	-	0.0	50.0	-	28.5
	C	-	100.0	75.0	100.0	-	-	29.0	-	-	-	100.0	50.0	-	71.5
	Total	-	2	8	1	-	-	7	-	-	-	9	2	-	28
Logs and Lumber	A	-	0.0	14.2	0.0	-	-	12.5	50.0	50.0	-	0.0	-	-	14.5
	B		100.0	28.4	0.0	-	-	25.0	0.0	50.0	-	0.0	-	-	26.1
	C	-	0.0	57.4	100.0	-	-	62.5	50.0	0.0	-	100.0	-	-	59.4
	Total	-	1	53	1	-	-	8	2	2	-	2	-	-	69
Cloth Paper	A	0.0	-	11.8	-	27.3	40.0	17.3	42.0	100.0	-	0.0	-	-	18.6
	B	100.0	-	29.0	-	9.1	0.0	31.4	37.8	0.0	-	100.0	-	-	28.8
	C	0.0	-	69.2	-	63.6	60.0	51.3	20.2	0.0	-	0.0	-	-	52.6
	Total	1	-	83	-	11	5	35	19	1	-	1	-	-	156
Metals	A	0.0	0.0	8.8	18.2	0.0	-	22.2	18.2	13.3	0.0	10.0	-	-	11.6
	B	0.0	20.0	30.2	9.1	25.0	-	25.0	62.6	20.0	0.0	30.0	-	-	29.4
	C	100.0	80.0	61.0	72.7	75.0	-	52.8	18.2	66.7	100.0	60.0	-	-	59.0
	Total	1	5	159	11	4	-	36	16	15	2	10	-	-	259
Oil & Chemical Products Chemicals Synthetic Resins	A	-	0.0	8.0	100.0	-	-	27.2	6.7	0.0	-	0.0	-	-	15.2
	B	-	0.0	28.0	0.0	-	-	45.5	53.3	100.0	-	0.0	-	-	39.4
	C	-	100.0	64.0	0.0	-	-	27.3	40.0	0.0	-	100.0	-	-	45.4
	Total	-	1	25	1	-	-	22	15	1	-	1	-	-	66
Foods Animals Others	A	0.0	0.0	10.0	-	-	-	10.7	39.0	-	0.0	-	33.3	33.3	21.2
	B	100.0	40.0	50.0	-	-	-	43.0	41.6	-	0.0	-	-	33.3	42.4
	C	0.0	60.0	40.0	-	-	-	46.3	19.4	-	100.0	-	66.7	33.3	36.4
	Total	2	5	20	-	-	-	28	36	-	2	-	3	3	99
Overall	A	0.0	0.0	9.8	7.2	20.0	40.0	17.6	30.4	19.5	0.0	4.4	20.0	33.3	14.8
	B	75.0	30.8	30.2	21.3	13.3	0.0	36.0	45.5	26.8	25.0	17.4	20.0	33.3	32.0
	C	25.0	69.2	60.0	71.5	66.7	60.0	46.4	24.1	53.7	75.0	78.2	60.0	33.3	53.2
	Total	4	13	348	14	15	5	136	88	19	4	23	5	3	677

A: All the functions of the firm are required to remain within urban areas.

B: Some portion of the functions of the firm can be relocated outside of urban areas.

C: *All the firms's functions can be relocated outside of urban areas.*

Source: "Social System in Urban Area", Shunsuke Ishihara, 1973

1.2 Traffic Problems in Urban Areas and Countermeasures

Although traffic in urban areas can be classified by purpose into commuter traffic, business traffic and recreational traffic, business trips are considered to be the most essential to support the fundamental economic and political activities of the city.

In capital cities, administrative organs, financial agencies and commercial districts have a tendency to concentrate. Though the concentration and integration of the three facilitate rapid development of motorization, they also generate heavy traffic in central urban areas, and come to hinder not only business trips but also other transportation. Good traffic regulation as well as proper road planning and construction can help to minimize this congestion.

As motorization increases, traffic congestion can not be alleviated only by construction of new roads or improvement of existing roads. Traffic controls and regulations such as prohibiting large trucks from central urban areas, become necessary. Traffic controls and regulations are considered preferable to construction and improvement of roads. This is partially because when additional roads are constructed, idle cars which are seldom used due to heavy traffic soon take advantage of the new roads until they too become seriously congested.

Table 5.2 shows the comparison of road length between Metro Manila and Tokyo in 1983. Judging from the ratio of land area to total road length, (a)/(b) in the table, Metro Manila seems to have more room for future road construction or improvement than Metro Tokyo. However, in the near future, Metro Manila will also face the same problems Metro Tokyo has had; that is, construction of new roads and improvement of existing roads alone can not adequately reduce traffic congestion in the city. Additionally, Metro Manila will also have difficulties in acquisition of land necessary for future road construction and improvement due to the concentration of population, administrative organs, financial agencies and commercial districts.

In this sense as well, traffic regulation is considered to be the most effective remedy for the traffic congestion in Metro Manila, and proper regulation will contribute to improvement of the efficiency of physical distribution in the urban area.

Table 5.2 Comparison of Road Length between Metro Manila and Tokyo in 1983

	Metro Manila	Metro Tokyo
Land Area (a)	636 km^2	2,141 km^2
Road Length (b)	2,647 km	22,435 km
Road Area (c)	–	142.123 km^2
(c)/(a) %	–	6.6 %
(a)/(b) (km^2/km)	0.240 km^2/km	0.095 km^2/km

When traffic regulation is put into practice, the object of the control or regulation should be to minimize all traffic which can be excluded from the urban area in terms of proper city development. As mentioned above, production plants and physical distribution facilities related to storage, transportation and packing can be relocated outside of urban areas. Especially, the traffic of large trucks related to such enterprises causes more congestion than conventional business traffic and such traffic should be controlled by pursuing a relocation policy. Heavy traffic also reduces the efficiency of necessary physical distribution within urban areas. Therefore, the relocation policy also seems to have the additional advantage of economizing transportation costs for those enterprises which are engaged in the physical distribution of consumer goods within the urban area.

2. Introduction of a Steel Products Distribution Center in Batangas Port

As explained in section 1, in Metro Manila, the production plants and physical distribution facilities related to storage, transportation and packing should be positively relocated outside of the urban area in order not only to reduce traffic congestion but also to stimulate the proper development of Metro Manila. The industries which are established in Metro Manila and which handle such heavy commodities as soils, cement, glass and metals should be the objects of the relocation policy.

As far as cargoes presently passing through Manila Port are concerned, steel products are the largest in cargo volume among the heavy commodities mentioned above. Additionally, most of the shearing and manufacturing plants which use the steel products as raw materials are located in and around Metro Manila. The traffic transporting the steel products from Manila Port to the users through Metro Manila seems to be one of the main causes of traffic congestion in the city. Considering that Batangas Port is located close to Metro Manila and that, behind Batangas Port, there remain vast areas which could be used for future development, Batangas seems to provide one of the most suitable locations to establish a steel products distribution center which is comprised of steel products unloading facilities, storage facilities and related secondary firms.

The construction of a steel products distribution center would surely contribute to reducing the traffic congestion in the central city, and to stimulating the proper development of the urban area. Such a distribution center would reduce transportation costs for the related secondary fabricating firms which would be relocated to the new distribution center in accordance with the decentralization policy.

As raw materials would be carried to the distribution center by ship, there would be virtually no need for land transportation to carry these materials to the fabricating firms. Further, by reducing the traffic congestion which is currently caused by the land transportation of raw materials, these firms would also save transportation costs when shipping finished products, as the delivery trucks would travel over less crowded roads and consequent move faster.

3. "Economic Boundary" between Manila Port and Batangas Port, and Feasibility of a Steel Products Distribution Center in Batangas

In order to determine the feasibility of a steel products distribution center in Batangas, we must consider the following items:

i) The location of the economic boundary between Manila Port and Batangas Port;

ii) The number of firms already located on the Batangas side of this boundary;

iii) The number of firms willing to relocate to the Batangas side of this boundary; and

iv) The number of new firms which locate on the Batangas side of this boundary.

The economic boundary, that is the line which divides the areas where it is less expensive to receive raw materials from one port or the other, is determined below considering the transportation costs via Manila North Harbour versus the transportation costs via the Port of Batangas.

3.1 Location of the Economic Boundary

The economic boundary for steel products is determined by comparing the overall transportation costs via Manila North Harbour with those via Batangas Port. Specifically, the boundary is determined as the point where the transportation costs via Manila equal the costs via Batangas.

For the estimate, steel products are assumed to be supplied from Iligan, Mindanao Island by sea.

The following cost elements are taken into consideration in the estimate:

a) Marine transportation cost of vessels
(The difference of the marine transportation costs between the two modes, i.e. the marine transportation cost between Batangas and Manila)

b) Inventory cost of steel products
(The inventory cost of steel products is usually added to transportation cost. When the transport distance is shortened, the volume of the stock can be reduced. In the estimate, reductions of the inventory cost are regarded as savings of interest on the steel products due to time-savings of the marine transportation between Batangas and Manila.)

c) Land transportation cost of trucks

In the estimate, port charges and handling cost are excluded assuming that these costs at Manila and Batangas are the same.

The preconditions to estimate each cost element are shown below:

i) Marine transportation cost of vessels

Marine transportation distance between Batangas and Manila . . . . 155 km (83.6 nautical miles)

Ship size . . . . 5,000 DWT

Average load of steel products per ship . . . . 4,000 tons

Charter rate . . . . 7 $/month/DWT

Average ship speed . . . . 14 knots

Difference of the marine transportation costs between the two modes . . . . –2.63 P/ton

ii) Inventory cost of steel products

Wholesale price of steel products . . . . 11,500 P/ton

Annual interest rate 7%

Time-savings of marine transportation between the two modes . . . . 6 hrs

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Reduction of inventory cost of steel products . . . . 0.55 P/ton

iii) Land transportation cost

Distance between Manila North harbour and Batangas . . . . 105 km

Distance between Manila North harbour and entrance of expressway . . . . 15 km

Distance of expressway from Manila to Batangas (the expressway is assumed to be extended to Batangas City.) . . . . 88 km

Distance between Batangas Port and entrance of expressway . . . . 2 km

Hauling trucks (the trucks are assumed to be owned by users of steel products) . . . . 15 ton trucks

Average load of steel products per truck . . . . 10 tons

Average trucking speed in Manila . . . . 13 km/hr

Average trucking speed on the expressway . . . . 80 km/hr

Average trucking speed in Batangas . . . . 40 km/hr

Expressway toll rate for 15-ton trucks (the toll rate applied to the estimate is the same as the present rate shown in the Table 5.3.) . . . . 0.481 ₱/km

Running cost of trucks . . . . 2.9398 ₱/km

Basic fixed cost of trucks . . . . 27.5182 ₱/hr

Daily working hours of trucks . . . . 8 hrs.

Table 5.3 Toll Rate on the South Luzon Expressway

Class 3 3-axle (pesos)

		Distance*		1	2	3	4	5	6
1	Nicols	(Km)		–					
2	Bicutan	5.00		3.00	–				
3	Sukat	–		5.00	2.00	–			
4	Alabang	6.00	11.0	6.25	3.50	1.50	–		
5	Susans Hts.	–	–	8.75	6.00	4.00	2.50	–	–
6	Carmona	10.50	21.5	12.25	9.00	7.25	5.75	3.25	–
7	Calamba	16.50	38.0	20.50	17.50	15.50	14.25	11.75	8.25

Note: * Distance is estimated from the geographical map.
Source: Toll Regulatory Board.

When comparing only land transportation cost of trucks from Manila North Harbour with that from Batangas Port by using the preconditions shown above, the economically balanced point is found at the point 43 km south of Manila North Harbour. (See Table 5.4.) When adding the marine transportation cost of the vessels and the inventory cost for the steel products while they are being transported over land, the economically balanced point is located 40 km south of Manila North Harbour (see Fig. 5.1).

Therefore, this point, that is 40 km south from Manila North Harbour, is estimated as the economic boundary for the transportation cost of steel products.

3.2 Trends in Relocation and Establishment of New Firms, and Feasibility of a Steel Products Distribution Center in Batangas

There are already 5 firms located on the Batangas side of the economic boundary. We expect that the relocation of firms from the central urban area to, and the establishment of new firms within, the Batangas side of the economic boundary will be accelerated for the following reasons:

1) A large demand for steel products in the Metro Manila Area is expected in the future. According to our cargo forecast, 1,880 thousand tons of steel products are estimated to be consumed in the Metro Manila Area in 1990, and 3,440 thousand tons in 2000. In terms of growth, the consumption of steel products in 1990 is expected to become 1.23 times as large as that in 1980, and the consumption in 2000, 2.26 times as large as that in 1980. Even if the present firms have a capacity to meet the demand in the year 1990, new firms will have to be established or present firms expanded by the year 2000 to increase capacity to supply the increased steel products demand between 1990 and 2000, i.e. 1,560 thousand tons.

2) 60 percent of the present firms are located in the center of Metro Manila which is defined as the area within a radius of 20 km from Manila North Harbour. Although the increased demand will drive the present firms to expand their capacity, they will face difficulties in acquiring new land in the center of the city for the expansion.

Many firms will choose to locate or relocate some or all of their plants outside the central urban area.

3) At present, the government has a policy prohibiting the establishment of new industries within a 50 km radius of Manila City. This policy will force new establishments to locate outside of the 50 km area centering on Manila City.

4) The five new firms which were established over the last five years outside of the 40 km area centering on Manila North Harbour are all located south of Metro Manila, and are all within the Batangas side of the economic boundary. Considering that there is already an expressway between Manila and Calamba, and that there are plans to expand this expressway from Calamba to Batangas by the year 2000, this tendency to locate south of Manila will be accelerated in the future.

All of the factors mentioned above indicate that it will be economical for a considerable portion of both new and relocating firms to set up operations on the Batangas side of the economic boundary. The development of the South Luzon Expressway will be an especially important factor influencing the location of these firms, and several firms are likely to locate in areas adjacent to Expressway.

Of course, the development of Batangas Port will also induce firms to locate south of Manila. In fact, improved facilities for handling bulk steel at Batangas may also reduce handling charges and handling time at Batangas. Improved efficiency at Batangas Port will act as an additional incentive for firms to locate, or relocate on the Batangas side of the economic boundary.

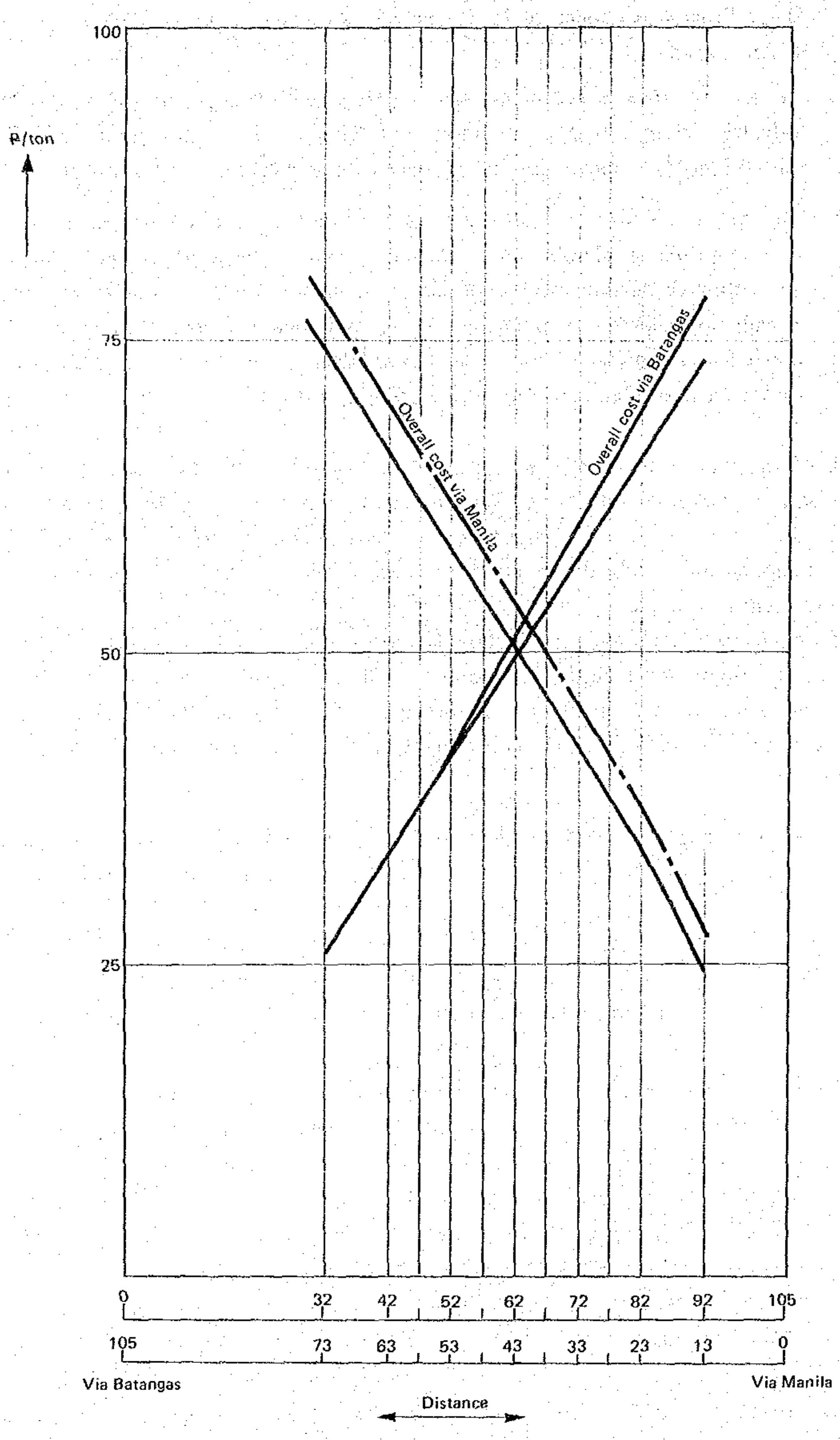


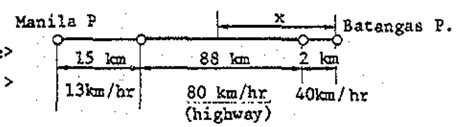
Fig. 5.1 Comparison of Overall Transportation Costs of Steel Products via Manila North Harbour and via Batangas Port

Table 5.4 Comparison of Trucking Costs

(Via Batangas)										(Via Manila)									
Distance from Batangas	Travel-ing time	Number of trips	Cargo volume	Using privately owned trucks			Official tariff rate	Days neces-sary for transporting 100 tons		Distance from Manila	Travel-ing time	Number of trips	Cargo volume	Using privately owned trucks			Official tariff rate	Days neces-sary for transporting 100 tons
				Running cost	Fixed cost	Total								Running cost	Fixed cost	Total		
(x) km	(hour)	(times/day)	(ton)	(₱)	(₱)	(₱)	(₱/100 tons)	(day)	(105-x)	(hour)	(times/day)	(ton)	(₱)	(₱)	(₱) (₱/ton)	(₱/100 tons)	(day)
32	0.425	9.412	94.11	1,770.8	660.4	2,431.2 (25.83)	7,424	1.0625	73	1.879	2.129	21.29	913.8	660.4	1,574.2 (73.9)	16,936	4.697
42	0.550	7.273	72.73	1,796.0	660.4	2,456.4 (33.77)	9,744	1.375	63	1.754	2.280	22.80	844.6	660.4	1,504.9 (66.0)	14,616	4.386
47	0.613	6.531	65.31	1,804.8	660.4	2,465.2 (37.75)	10,904	1.531	58	1.91	2.365	23.65	806.5	660.4	1,466.9 (62.0)	13,456	4.228
52	0.675	5.926	59.26	1,811.8	660.4	2,472.2 (41.72)	12,064	1.687	53	1.629	2.455	24.55	765.0	660.4	1,425.4 (58.1)	12,296	4.073
57	0.7375	5.434	54.24	1,817.8	660.4	2,478.2 (45.69)	13,240	1.8436	48	1.566	2.554	25.54	720.8	660.4	1,381.2 (54.1)	11,136	3.915
62	0.800	5.000	50.00	1,822.7	660.4	2,483.1 (49.66)	14,384	2.000	43	1.504	2.659	26.59	672.3	660.4	1,332.7 (50.1)	9,976	3.761
67	0.8625	4.638	46.38	1,827.1	660.4	2,487.5 (53.63)	15,544	2.1575	38	1.441	2.776	27.76	620.2	660.4	1,280.6 (46.1)	8,816	3.602
72	0.925	4.324	43.24	1,830.5	660.4	2,490.9 (57.60)	16,704	2.3126	33	1.379	2.901	29.01	562.9	660.4	1,223.3 (42.1)	7,656	3.447
77	0.963	4.051	40.51	1,834.0	660.4	2,494.4 (61.57)	17,864	2.4685	28	1.316	3.040	30.40	500.5	660.4	1,160.9 (38.2)	6,496	3.290
82	1.050	3.809	38.09	1,836.4	660.4	2,496.8 (65.55)	19,024	2.6254	23	1.254	3.190	31.90	431.4	660.4	1,091.8 (34.2)	5,336	3.135
92	1.175	3.404	34.04	1,841.3	660.4	2,501.7 (73.49)	21,344	2.9070	13	1.000	4.000	40.00	305.7	660.4	996.1 (24.2)	3,016	2.500

Note: * ( ) Indicates unit cost (₱/ton/day)

*



* Assuming that three-axis trucks are used, and the average load per truck is 10 tons.

* Working hours/day : 8 hours

* Running cost : 2.9398 ₱/km

* Basic Fixed cost : 27.5182 ₱/hour

* Official tariff : 2.32 ₱/ton.km

Appendix 6.2.1 Origin and Destination Survey

Our Origin and Destination Survey was conducted at Batangas Port in cooperation with PMU Batangas. The results of the survey are described below:

(1) Ports concerned with survey: Base Port and Sub-ports under PMU Batangas

(2) Survey period: January 1983 for 1 year

(3) Survey Items: Port cargo traffic volume by O/D; port by commodity

(4) Basic data: Monthly cumulative documents held by PMU Batangas

(5) Results of Survey: Summarized below and detailed in Tables 1 & 2

Inbound Cargoes:

By route: Region IV's share is 83% (of which 77.4% from Calapan and 1% from San Jose) and likewise 8.1% for Regions VI ~ VIII (minerals, logs, lumber), 4.7% for Regions IX ~ XII (logs, lumber), 2.8% for Regions I ~ III (minerals), 0.8% for Region V (minerals) and 0.7% for NCR (minerals, logs, lumber).

By item: Palay/rice is 90% from Calapan and 10% from San Jose; minerals are 54% from Regions VI ~ VIII, 24% from Regions I ~ III and 9% from Region IV; Calamansi is 99% from Calapan; Copra is 90% from Calapan (99.8% from Region IV); logs/lumber are 56% from Region IX ~ XII, 24% from Region VI ~ VIII, and 13% from Calapan (16% Region IV); bananas are 98% from Calapan.

Outbound Cargoes:

By route: 86% of the cargo goes to Calapan, 5.3% to San Jose, and 6.2% to other ports in Region IV. (Total share to Region IV comes to 97%, and to Regions IX ~ XII the total equals 1.5%)

By item: 55% of cement goes to Calapan and 27% to San Jose (97% to Region IV). Bottled cargoes are 81% for Calapan and 3.2% for San Jose (100% for Region IV). Fertilizer is 99% to Calapan.

Conclusions:

- The counter-port of Batangas Port is mainly Calapan, sub-port in Mindoro, and few items (mineral, logs and lumber) are transported to and from areas outside of Region IV.
- Vehicle weight is included in the cargo volume of "other general cargoes" of the Calapan Ro-Ro statistics.

Table 1

Port of BATANGAS
Month JAN. - DEC. Year 1983
(Unit: Tons)

Commodity \ Origin	Region - IV									National Capital Region (Manila)	Regions I-III ( )	Region V ( )	Regions VI-VIII ( )	Regions IX-XII ( )	Total
	Batangas	Calapan	Sta. Cruz	Balanacan	San Jose	Pto. Galera	Pto. Princesa	Bauan	Others						
1. PALAY & RICE		30,577		49	1,437	233			1,519						33,817
2. MINERALS		2,001				37			140	953	5,798	1621	13,023	360	23,936
3. CALAMANSI		19,876				153			20						20,051
4. COPRA		18,029	12			1,212			649	10			39		19,953
5. LOGS & LUMBER		2,248				516			81	530			4,254	9,821	17,452
6. BANANAS		13,711				74			174						13,960
7. ANIMALS		2,630			681	30			1,306	10		18	7		4,684
8. CORN		3,396		.60	190	84			637	26					4,336
9. ANIMAL FEEDS		2,604			88	5			98						2,797
10. OTHERS		80,701	.59		630	896			1,730	26	480	177	1,103	388	86,136
TOTAL		175,778	13	50	3,027	3,245			6,359	1,557	6,278	1,817	18,427	10,571	227,126

Table 2

Port of BATANGAS

Month JAN. - DEC. Year 1983

(Unit: Tons)

Destination / Commodity	Region - IV									National Capital Region (Manila)	Regions I-III ( )	Region V ( )	Regions VI-VIII ( )	Regions IX-XII ( )	Total
	Batangas	Calapan	St. Cruz	Balanacan	San Jose	Pto. Galera	Pto. Princesa	Bauan	Others						
1. CEMENT		10,316			5,097	221			2,700	459			8		18,803
2. BOTTLED CARGO		12,586			504	465			1,990		4		3		15,555
3. OTHER CONS. GOODS		5,656			654	172			65						6,549
4. FERTILIZER		4,673			21	15			2						4,712
5. SUGAR		2,330			2	149			141	8					2,631
6. OTHER CEREALS		1,167			80	61			59						1,368
7. FRUITS & VEGETABLES		1,283				48			16						1,348
8. CHEMICALS		387			2										390
9. OTHERS		73,443			472	869			1,179	209	2		531	2,049	78,756
TOTAL		111,844			6,834	2,004			6,155	676	6		542	2,049	130,114

Appendix 6.2.2 Production and Consumption of Palay (1983)

Philippines ('000 tons)

	Population ('000 persons)	Production ('000 MT)	Consumption ('000 MT)	Surplus/ (Deficit)
Region I	3,754	853.7	634.4	219.3
II	2,399	932.4	405.4	527.0
III	5,196	1,688.0	878.1	809.9
IV	6,703	796.4	1,132.8	(336.4)
V	3,744	546.9	632.7	(85.8)
VI	4,866	948.6	822.3	126.3
VII	4,032	121.6	197.6	(76.0)
VIII	2,963	288.2	500.7	(212.5)
IX	2,734	263.0	462.0	(199.0)
X	3,012	278.0	509.0	(231.0)
XI	3,645	458.6	616.0	(157.4)
XII	2,467	555.4	416.9	138.5
NCR	6,540	–	1,105.2	(1,105.2)
Total	52,055	7,731	8,313.1	(582.1)

Note: National per capita consumption outside of Region VII on a palay base = 110 kg ÷ 0.65 = 169 kg/year; for Region VII = 49 kg/year

Region IV ('000 tons)

	Population*1 ('000 persons)	Production*2 ('000 MT)	Consumption ('000 MT)	Surplus/ (Deficit)
Batangas	1,284	94.6	217.0	(122.4)
Cavite	843	44.7	142.5	(97.8)
Laguna	1,064	137.8	179.8	(42.0)
Quezon	1,235	176.7	208.7	(32.0)
Rizal	607	27.3	102.6	(75.3)
Aurora	117	24.5	19.8	4.7
Marinduque	190	21.2	32.1	(10.9)
Mindoro Occ.	243	73.7	41.1	32.6
Mindoro Or.	489	95.6	82.6	13.0
Palawan	407	68.4	68.8	(0.4)
Romblon	211	32.1	35.7	(3.6)
Total	6,690	796.6	1,130.7	(334.1)

*1 Estimate by Study Team
*2 Estimate by Study Team (Basic data from BAEx)

Appendix 6.2.3 Irrigation Plan in Region IV

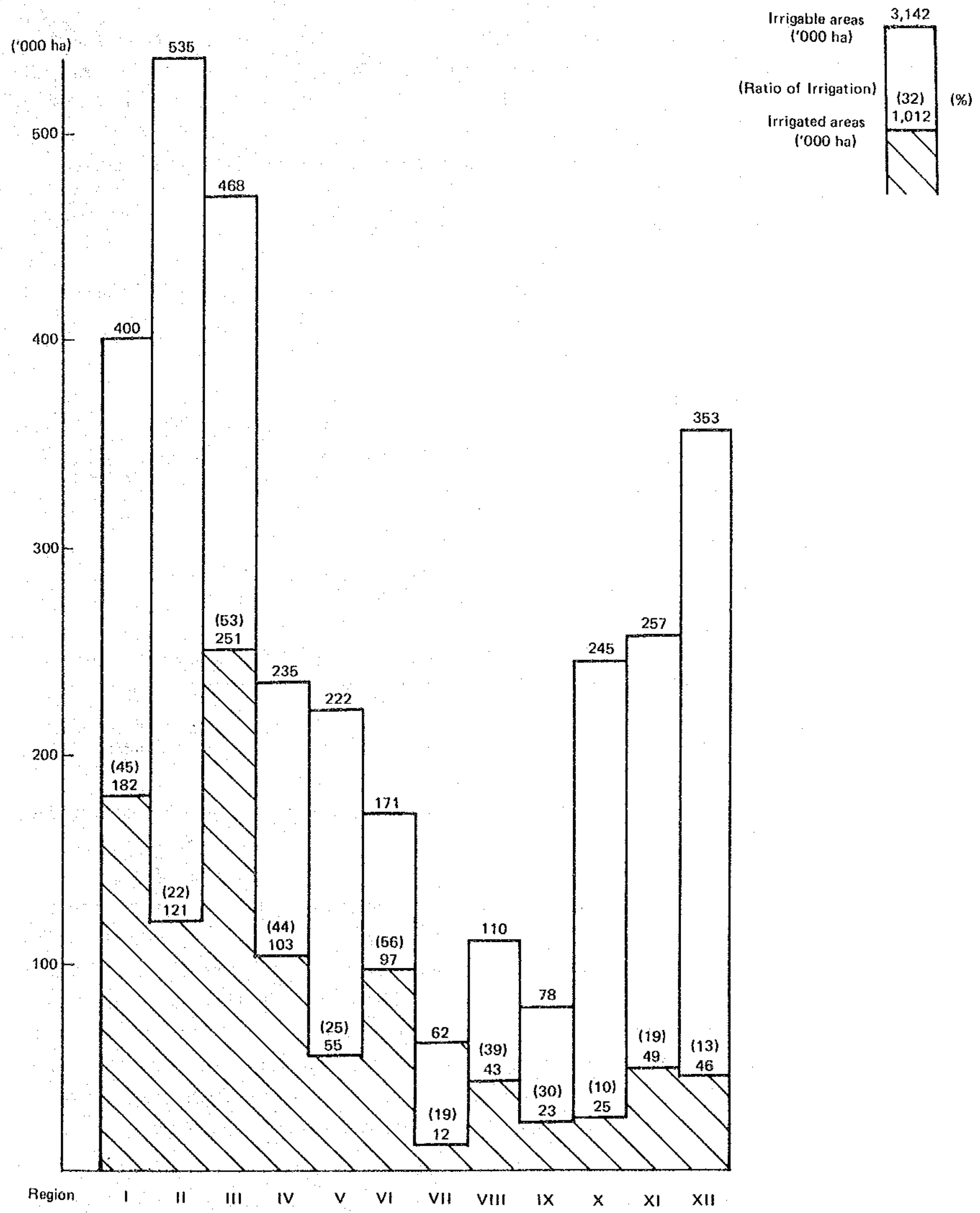
(hectares)

Province	1985 ~ 1990		1991 ~ 1995		1995 ~ 2000	
	N	R	N	R	N	R
I. Aurora	1,890	1,376	2,180	586	700	1,286
II. Batangas	350	1,516	235	–	–	848
III. Cavite	620	–	900	–	–	–
IV. Laguna	1,174	8,575	–	14,972	–	14,857
V. Marinduque	296	419	25	211	–	54
VI. Mindoro Occ.	9,407	7,950	–	17,850	1,180	8,668
VII. Mindoro Ori	15,079	25,324	1,120	19,671	2,208	38,410
VIII. Palawan	9,788	6,983	1,350	5,060	1,700	7,000
IX. Quezon	1,271	6,990	973	2,472	880	4,526
X. Rizal	147	551	186	234	85	165
XI. Romblon	438	893	201	344	77	–
Total	40,460	60,577	7,170	61,400	6,830	75,814

Note: N: New
R: Rehabilitated

Source: NIA

Appendix 6. 2.4. Existing Irrigable Areas and Irrigated Areas in 1980



Source: MPWH, INFRASTRUCTURE ATLAS, 1983

Appendix 6.2.5 Assumed Distribution Ratio of Palay and Rice from Mindoro Island, and Assumed Ratio of Rice to Palay in Shipments to Batangas Bay

The present distribution ratio of palay and rice from Mindoro Island and the ratio of rice to palay in the shipments to Batangas Bay are assumed primarily based on interviews with NFA Officials, "Inter-Modal Route Network Analysis of the West Mindoro-Luzon Corridor (NTPP)" (hereinafter referred to as "Network Analysis"), and the origin-destination survey of port cargoes at PMU Batangas conducted by the Study Team (hereinafter referred as the "O/D Survey").

1. Distribution Ratio of Palay and Rice on Mindoro Island

The percentage of surplus palay and rice handled by different ports in East (Oriental) and West (Occidental) Mindoro Provinces is assumed here.

A. East Mindoro

According to interviews with NFA officials as well as the O/D Survey of port cargoes in 1983, Calapan Port handles almost one hundred percent of the surplus. Therefore, all of the surplus is assumed to go through Calapan Port.

B. West Mindoro

In West Mindoro, the surplus in the north area is shipped from Mamburao Port, that in the middle area, from Sablayan Port, and that in the south area from San Jose Port.

Judging from the present road network and location of the above ports in West Mindoro, the north area is presumed to consist of the four municiparities of Abra de Ilog, Paluan, Mamburao and Sta. Cruz.

Similarly, the middle area is presumed to consist of Sablayan Municipality, and the south part of the four municipalities of Calintaan, Rizal, San Jose and Magsaysay.

The present percents of surplus shipments from these three ports could not be obtained from the survey. The figures are estimated from the harvest area of palay by municipality in West Mindoro, 1980 (NFA), which is shown in Table A. Since the surplus of palay is the difference between local production and local consumption, and the local consumption is supposed to be proportionate to the population in the area, the area population should be taken into consideration in the estimate. However, according to the 1980 Census Population and Housing (NCSO), the area population is almost proportionate to the harvest area, so the surplus is supposed to be proportionate to the harvest area (see note). Thus in this study, the surplus shipments are assumed proportionate to both harvest area and population.

According to Table A, the present percents of surplus shipments from Mambulao, Sablayan and San Jose are estimated on a palay basis as about 15%, 25% and 60% respectively.

Table A. Distribution Ratio of the Surplus from West Mindoro (Palay Basis)

Area	Municipality	Cultivated Area (has)	Percent
North	Abra de Ilog	1,856	15%
	Paluan	1,169	
	Mamburao	2,742	
	Sta. Cruz	2,887	
	Sub-Total	8,654	
Middle	Sablayan	14,135	25%
South	Calintaan	6,542	60%
	Rizal	10,071	
	San Jose	13,651	
	Magsaysay	4,844	
	Sub-Total	35,108	
Total		57,897	100%

Note: When the cultivated area in certain localities is proportionate to the population of the corresponding areas, the surplus of palay is proportionate to the harvest area, as expressed by the following formula:
Source: National Food Authority (NFA)

$$Si = Ai \times \text{Constant}$$

where, Si : Surplus of palay in area i
Ai : Cultivated area of palay in area i

Generally speaking, the surplus of palay in a certain area i, Si is expressed by the following formula:

$$Si = Ai \times m - (Pi \times C)$$

where, Ai : Cultivated area of palay in area i (has)
m : Mean crop of palay (ton/ha/year)
Pi : Population in area i (persons)
C : Per capita consumption on a palay basis (ton/person/year)

The formula can be developed as follows:

$$\frac{1}{C} \cdot \frac{Si}{Ai} = \frac{m}{C} - \frac{Pi}{Ai}$$

When the mean crop of palay, m, and the per capita consumption, C, are assumed to be constant in West Mindoro and the harvested area, Ai is proportionate to the population, Pi, the formula can be developed further as follows:

$$\frac{1}{C} \cdot \frac{Si}{Ai} = K - J$$

$$\frac{Si}{Ai} = (K - J)\,C = \text{constant}$$

$$Si = Ai \times \text{Constant}$$

where, K : m/c
J : Pi/Ai

2. Destination Distribution Ratio of Palay and Rice from Mindoro Island

The percentage of the surplus of palay and rice from Mindoro Island shipped to various ports is assumed here.

A. East Mindoro

According to the O/D Survey, 96 percent of the palay and rice outgoing from Calapan Port was shipped to the Port of Batangas, and the remaining 4 percent was shipped to other area such as Manila and Marinduque. All the surplus from East Mindoro is assumed to pass through Calapan. Therefore 96 percent of the surplus of East Mindoro is supposed to go from Calapan to the Port of Batangas, and 4 percent to other areas (on a palay basis).

B. West Mindoro

1) North Area

According to the Network Analysis, the surplus in the north area is purchased by NFA and private millers, and is transported to Mamburao Port by trucks. Almost 100 percent of the surplus is shipped from Mamburao to Batangas Bay. About 70 percent of the surplus is purchased by NFA, and goes to the NFA terminal or to Bauan Port. The rest of the surplus is bought by private millers, and is supposed to go to Batangas Port and Bauan Port.

Unfortunately, the distribution ratio in Batangas Bay could not be obtained in the survey. For the cargo projections, the portion purchased by NFA is assumed to be shipped to the NFA terminal and Bauan Port equally, and that purchased by private millers to Batangas Port and Bauan Port equally on a palay basis. (See Table B)

2) Middle Area

As in the north area, NFA is also supposed to buy about 70 percent of the surplus in the middle area and transport it to the NFA terminal and Bauan Port in Batangas Bay. The remaining 30 percent of the surplus is also assumed to be purchased by private millers and transported to Batangas Port and Bauan Port equally.

Thus, the distribution ratio of the middle area is assumed to be the same as that of the north area. (See Table B)

3) South Area

The Network Analysis shows that the surplus of palay in the south area is purchased

by NFA and private millers and is transported to San Jose by jeepneys and trucks.
According to interviews with NFA officials, about 80 percent of the surplus is purchased by the NFA on a palay basis. Half of it, i.e. 40 percent of the surplus, is shipped to the NFA terminal and Bauan Port. The rest, i.e. 40 percent of the surplus, is transported to other areas such as Palawan, Romblon, Manila and Marinduque.
20 percent of the surplus is supposed to be bought by private millers and transported to the Manila Area.
Since the distribution ratio of the palay and rice in Batangas Bay could not be obtained, NFA is assumed to ship their palay and rice to the NFA terminal and Bauan Port equally on a palay basis.

Table B. Distribution Ratio of the Surplus from Mindoro to Batangas Bay (Palay Basis)

Harvest Area		Purchaser of the Surplus	Percentage of the Purchase	Destination			
				Batangas Bay			Others
				Batangas Port	NFA Terminal	Bauan Port	
East Mindoro		-	100%	96%	-	-	4%
West Mindoro	North and Middle Area	NFA	70%	-	35%	35%	-
		Private Millers	30%	15%	15%	-	-
		Total	100%	15%	50%	35%	-
	South Area	NFA	80%		20%	20%	40%
		Private Millers	20%	-	-	-	20%
		Total	100%	-	20%	20%	60%

3. Ratio of Rice to Palay in Shipments from Mindoro to Batangas Bay

The present mixture ratio of rice to palay in the distribution from Mindoro to Batangas Bay could not be determined in the survey. It is assumed for the projections as follows:

A. West Mindoro

According to interviews with NFA officials, 17 to 18 percent of the rice and palay transported from West Mindoro to Batangas Bay by NFA is in a rice form (on a palay volume basis).

When considering that as a whole NFA purchases about 80 percent of the surplus from West Mindoro, the present mixture ratio of rice to palay transported from West Mindoro to Batangas Bay can be assumed roughly as one to four on a palay volume basis.

Mean while, as for commercial purchase, the mixture ratio of rice to palay transported from San Jose to other places in 1984 is roughly four to one on a palay volume basis.

B. East Mindoro

Since no data is available, the present mixture ratio of rice to palay in the distribution from East Mindoro to Batangas Bay is assumed as four to one on a palay basis, the same as the commercial flow in west Mindoro.

Appendix 6.2.6 Annual Coconut Production (1968 ~ 1982)

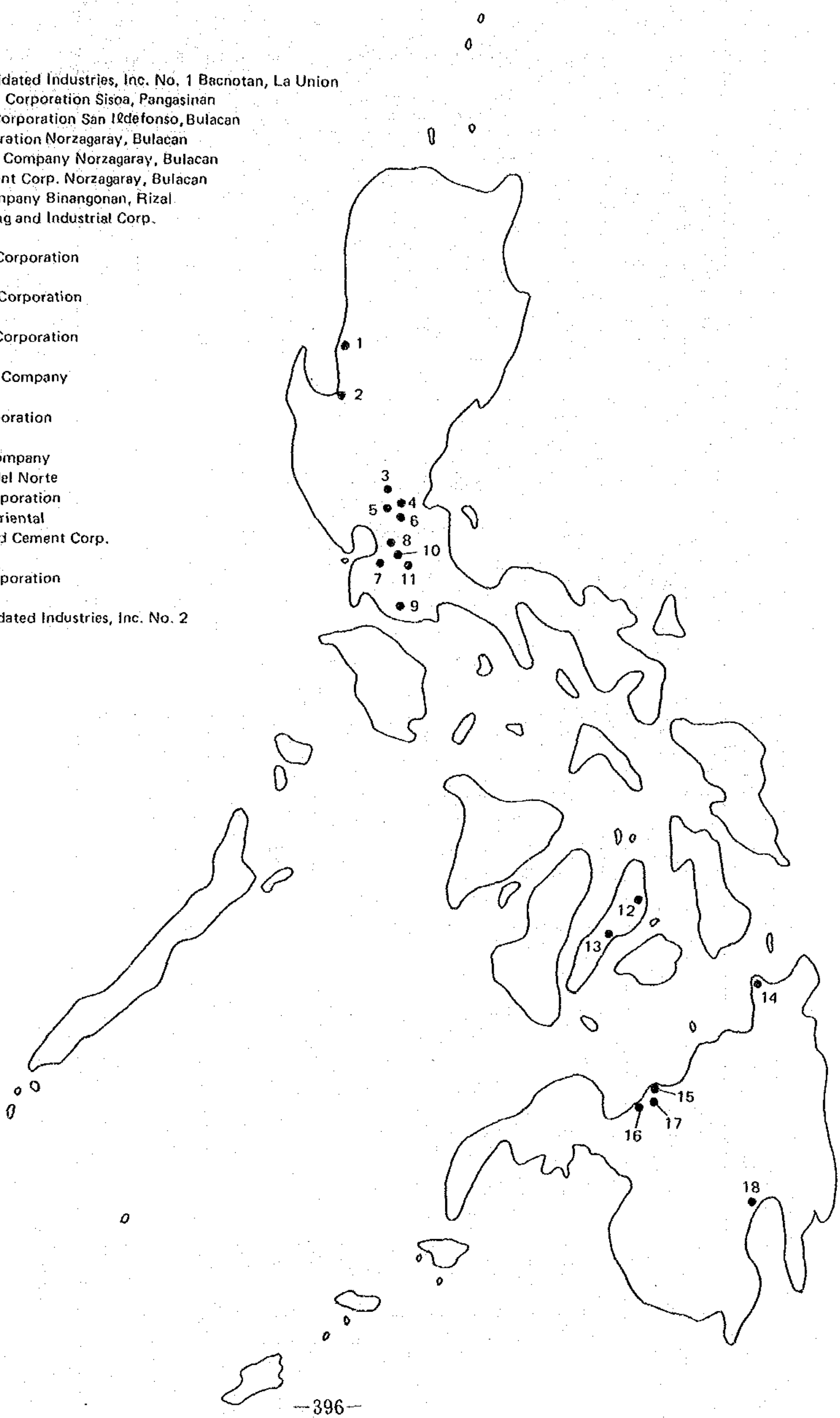
('000 MT)

Year	Total Coconut Production	Export				Locally consumed			
		Total	Copra	Coconut Oil	Desiccated Coconut	Total	Manufactured Oil	Home-Made Oil	Foodnuts
1968	1,462	1,206	681	436	88	256	213	13	29
1969	1,259	960	553	344	62	298	259	12	26
1970	1,356	1,036	423	539	73	319	263	6	50
1971	1,755	1,455	710	653	91	300	255	6	38
1972	2,173	1,820	968	756	95	353	307	6	40
1973	1,871	1,514	727	691	95	356	300	18	37
1974	1,424	1,085	309	698	77	338	281	14	42
1975	2,198	1,866	832	954	79	332	266	21	43
1976	2,742	2,338	867	1,373	98	404	322	27	54
1977	2,439	1,954	559	1,275	118	485	412	24	48
1978	2,516	2,086	379	1,595	110	430	355	25	50
1979	1,902	1,526	144	1,281	100	375	295	30	50
1980	2,068	1,709	123	1,450	135	358	278	30	50
1981	2,306	1,903	106	1,661	135	403	323	30	50
1982	2,157	1,835	191	1,506	137	321	241	30	50

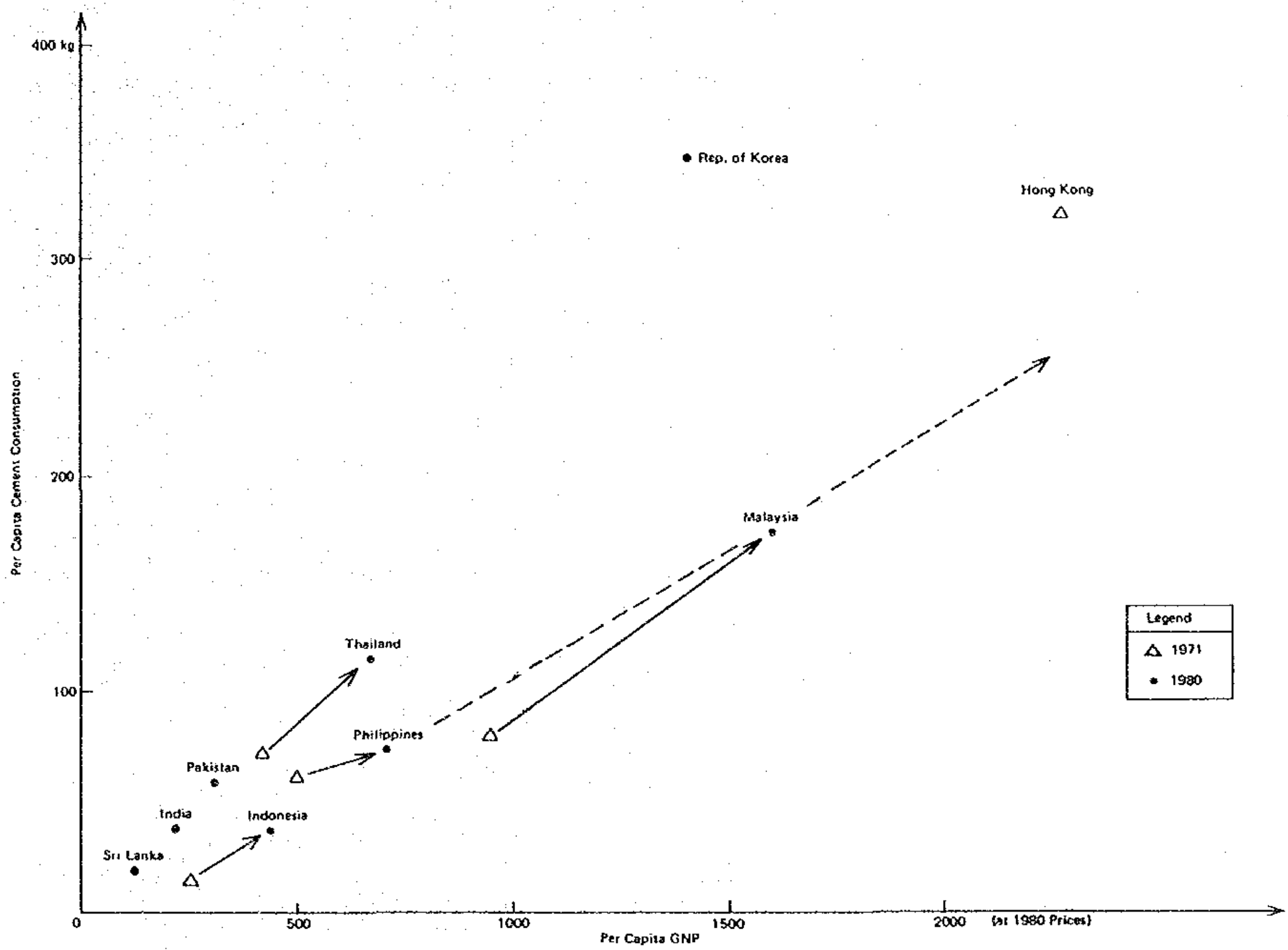
Source: Coconut Statistics 1982 Vol. VI No. 16, United Coconut Association of the Philippines, Inc. June 1983.

Appendix 6.2.7 Location of Cement Plants

1. Bacnotan Consolidated Industries, Inc. No. 1 Bacnotan, La Union
2. Northern Cement Corporation Sisoa, Pangasinan
3. Central Cement Corporation San Ildefonso, Bulacan
4. Hi-Cement Corporation Norzagaray, Bulacan
5. Republic Cement Company Norzagaray, Bulacan
6. Continental Cement Corp. Norzagaray, Bulacan
7. Rizal Cement Company Binangonan, Rizal
8. Marinduque Mining and Industrial Corp. Ancipolo, Rizal
9. Fortune Cement Corporation Taysan, Batangas
10. Filipinas Cement Corporation Teresa, Rizal
11. Midland Cement Corporation Tanay, Rizal
12. Universal Cement Company Danao City, Cebu
13. Apo Cement Corporation Naga City, Cebu
14. Pacific Cement Company Surigao, Surigao del Norte
15. Floro Cement Corporation Lugait, Misamis Oriental
16. Mindanao Portland Cement Corp. Iligan City
17. Iligan Cement Corporation Iligan City
18. Bacnotan Consolidated Industries, Inc. No. 2 Davao City



Appendix 6.2.8 Per Capita GNP and Per Capita Cement Consumption (1971, 1980)



Appendix 6.2.9 Cement: Domestic and Export Sales 1974 ~ 1983 and Market Share of Fortune Cement

	Total Sales			Domestic Sales			Export		
	National	Fortune		National	Fortune		National	Fortune	
	('000 MT)	('000 MT)	%	('000 MT)	('000 MT)	%	('000 MT)	('000 MT)	(%)
1974	3,479	224	6.4	2,715	168	6.2	764	56	7.3
1975	4,327	287	6.6	3,525	194	5.5	802	93	11.6
1976	4,085	290	7.1	3,379	169	5.0	707	121	17.1
1977	4,099	307	7.5	3,277	190	5.8	822	117	14.2
1978	4,215	340	8.1	3,391	191	5.6	823	149	18.1
1979	3,813	267	7.0	3,535	224	6.3	278	43	15.5
1980	4,441	354	8.0	3,646	184	5.0	794	170	21.4
1981	3,986	310	7.8	3,515	179	5.1	471	131	27.8
1982	4,374	346	7.9	3,782	170	4.5	592	176	29.7
1983	4,530	323	7.1	4,400	292	6.6	130	31	23.8
Avg.			7.25			5.56			18.66

Source: PHILCEMCOR

Appendix 6.2.10 Cement Exports from the Philippines by Destination

	1974 ~ 1978 (total)		1979 ~ 1983 (total)	
Destination	('000 MT)	%	('000 MT)	%
Asia	2,592	66	2,215	98
Middle East	1,244	32	35	1.5
Others	84	2	15	0.5
Total	3,920	100	2,265	100

Source: PHILCEMCOR

Appendix 6.2.11 Cement Imports of the Four Major Countries

('000 MT)

Year	*** Hong Kong	*** Singapore	** India	Indonesia	Total	Exports of the Philippines	Market Share of the Philippines (%)
1972	931.4	1,031.3	–	1,200.4	3,163.1	300.0	9.5
1973	1,211.3	1,182.3	–	1,427.0	3,820.6	920.0	23.5
1974	1,336.6	1,186.7	–	1,737.7	4,261.0	764.5	17.9
1975	1,152.6	1,390.3	–	1,609.2	4,152.1	802.2	19.3
1976	1,625.0	1,598.9	–	1,430.5	4,654.4	706.6	15.2
1977	2,101.9	1,449.2	–	590.8	4,141.9	822.3	19.9
1978	2,352.2	1,635.6	1,320.0	420.1*	5,727.9	823.5	14.4
1979	2,574.9	1,682.5	1,420.0	148.1*	5,825.5	277.8	4.8****
1980	3,219.9	1,831.2	2,290.0	327.2*	7,668.3	794.4	10.4
1981	3,397	1,930	1,451	242	7,020	470.6	6.7
1982	3,552	2,685	1,508	500	8,245	591.6	7.2
1983	3,037	3,606	2,500	610	9,753	129.7	1.3****
Avg.	–	–	–	–	–	–	14.4%

Note: * Statistical Yearbook of Indonesia
** Japan Cement Yearbook
*** UN Yearbook of Intn'l Trade Statistics
**** Excluded as an exception in calculating the average

Appendix 6.2.12 Cement Exports to Asian Countries from Japan by Kind of Cement

('000 tons)

Year	1980	1981	1982	1983	1984	Total	(%)
Bagged	499	461	720	1,800	618	4,098	21
Bulk	446	484	684	990	1,431	4,035	20
Clinker	2,037	2,016	2,453	2,781	2,436	11,723	59
Total	2,982	2,961	3,857	5,571	4,485	19,856	100

Source: Japan Cement Exporters Association

Appendix 6.2.13 Annual Production, Imports and Demand of Fertilizer (1979 ~ 1983)

	Production ('000 MT)	Imports ('000 MT)	Total Supply	Demand for Finished Fertilizer ('000 MT)
1979	233.7 (24%)	734.6 (76%)	968.3	848.9
1980	230.0 (24%)	745.3 (76%)	982.0	819.6
1981	264.3 (38%)	428.9 (62%)	691.2	785.4
1982	125.8 (14%)	765.3 (86%)	891.2	845.9
1983	163.4 (21%)	613.4 (79%)	776.8	878.3

Source: Fertilizer and Pesticides Authority (FPA)

Appendix 6.2.14 Production and Export of Sugar in the Philippines

(Thousand MT)

	Production of Sugar	Export Volume of Sugar	Domestic Consumption
1979	2,275	1,146	1,129
1980	2,726	1,722	1,004
1981	2,362	1,224	1,138
1982	2,329	1,246	1,083
1983	2,130	963	1,167

Source: PHILSUCOM

Appendix 6.2.15 Ratio of Land Used to Produce Palay and Sugar Cane and Land Used to Produce Other Crops in the Philippines and in the Provinces of Region IV in 1980

	Total Area ('000 ha)	Rice and Sugar Cane		Other Crops*1	
		('000 ha)	(%)	('000 ha)	(%)
Philippines	8,446	4,060	48	4,386	52
Region IV	770	396	51	374	49
Laguna	99	52	53	47	47
Batangas	240	74	31	166	69
Cavite	83	30	36	53	64
Quezon	65	26	40	39	60
Rizal	13	7	54	6	46
Anrora	23	20	87	3	13
Marinduque	12	8	67	4	33
Occ. Mindoro	38	29	76	9	24
Ori. Mindoro	129	101	78	28	22
Palawan	51	40	80	11	20
Romblon	16	8	50	8	50

Source: Basic data from BAECON
Note: *1 Other Crops except Coconut

Appendix 6.2.16 Saw Timber Harvest by Region

('000 m^3)

	1979	1981	1982
Philippines	6,578	5,400	4,514
I	108	71	66
II	940	1,101	844
III	18	37	32
IV	241	197	221
V	68	78	35
VI	176	192	112
VII	105	–	–
VIII	308	204	169
IX	634	589	476
X	1,298	1,083	1,007
XI	1,951	1,456	1,065
XII	731	392	487

Source: Forestry Statistics (BOFD)

Appendix 6.2.17 Active Sawmills in Region IV (m^3) 1982

	With Timber Concessions			Without Timber Concessions		
	Number	Daily Rated Capacity	Annual Log Requirements	Number	Daily Rated Capacity	Annual Log Requirements
Region IV	5	365	312,948	20	1,042	416,983
Batangas	-	-	-	1	35	14,151
Metro Manila	-	-	-	14	837	334,907
Palawan	3	259	270,495	-	-	-
Quezon	2	106	42,453	5	170	67,925

Source: Forestry Statistics (BOFD)

Appendix 6.2.18 Local Scrap-Melting Plants

Name of Firm	Location	Start of Operation	No. of Melting Units	Holding Capacity (MT)	Annual Rated Capacity (MT)
1. Allenco Steel Corp.	Bo. Pampiona, Las Pinas Metro Manila	1972	2 Electric Arc	12 each	43,000
2. Apollo Steel Mills Corporation	818 E. Pantaleon St. Mandaluyong, Metro Manila	1970	1 Electric Arc	15	25,000
3. Armco-Marsteel Alloy Corporation	Napindan, Taguig Metro Manila	1977	1 Electric Arc	20	47,250
4. Armstrong Industries, Inc.	Arkong Bato Bo, Polo Valenzueia, Metro Manila	1972	2 Electric Arc	8.5	30,000
5. Cathay Pacific Steel Smelting Corp.	Atlas Road, Bo. San Bartolome Km. 16, Quirino Highway Novaliches, Quezon City	1975	1 Electric Arc	10	24,000
6. Globe Steel Corp.	Guijo Street, St. Anthony Subd, Cainta, Rizal	1971	2 Electric Arc	10;15	58,500
7. Marcela Steel Corp.	Punta, Sta. Ana, Manila	1953	3 Electric Arc	8;10;12	60,000
8. Marsteel Corp.	555 Tandang Sora, Baesa Quezon City	1970	2 Electric Arc	5	13,500
9. Master Steel Products, Inc.	89 Kaingin St. Quezon City	1969	2 Electric Induction	3 each	9,000
10. National Steel Corp.	Iligan City	1960	1 Electric Arc	25	44,000
11. Philippine Blooming Mills Co., Inc.	Bo, Manggahan, Pasig Metro Manila	1957	1 Electric Arc 2 Open Hearth	45 45	175,500 270,000
12. Union Steel Manufacturing Co., Inc.	28 8th St., 9th Avenue Grace Park, Caloocan City	1964	1 Electric Arc	5	6,000

Source: Primary Iron and Steel Industry of the Philippines. 1980 Metals Industry Research and Development Center.

Appendix 6.2.19 Vehicle Weight vs. Maximum Weight of Cargo for Japanese Trucks

Kinds of Trucks		Vehicle Weight (kg)	Max Weight of Cargo (kg)	Total Weight of Loaded Vehicles (kg)
Isuzu	10.75 t	8,840	10,750	19,755
	10.5 t	8,995	10,500	19,660
	11.25 t	8,430	11,250	19,845
	11.5 t	8,165	11,500	19,830
Mitsubishi	10.75 t	8,800	10,750	19,715
	11.25 t	8,380	11,250	19,795
	11.75 t	7,865	11,750	19,780

Source: Japanese Motor Vehicles Guide Book, 1983 ~ 84, Japan Motor Industry Federation.

Appendix 6.2.20 Population in Mindoro (1980)

Occidental Mindoro Province

Municipality	Population		
	Total	Male	Female
Total	222,431	115,984	106,447
1. Abra de Ilog	12,917	6,763	6,154
2. Calintaan	14,416	7,580	6,836
3. Looc	6,801	3,505	3,296
4. Lubang	15,293	7,888	7,405
5. Magsaysay	17,560	9,147	8,413
6. Mamburao	15,533	8,041	7,492
7. Paluan	7,438	3,800	3,638
8. Rizal	18,609	9,735	8,874
9. Sablayan	36,699	19,892	16,807
10. San Jose	66,262	33,840	32,422
11. Sta. Cruz	10,903	5,793	5,110

Oriental Mindoro Province

Municipality	Population		
	Total	Male	Female
Total	446,938	228,390	218,548
1. Baco	18,607	9,612	8,995
2. Bansud	22,614	11,628	10,986
3. Bongabong	41,719	21,289	20,430
4. Bulalacao	16,926	8,765	8,161
5. Calapan	67,370	33,865	33,505
6. Gloria	25,291	12,932	12,359
7. Naujan	61,216	31,731	29,485
8. Pinamalayan	48,431	24,589	23,842
9. Pola	23,188	11,875	11,313
10. Puerto Galera	12,306	6,319	5,987
11. Roxas	25,458	12,845	12,613
12. San Teodoro	9,707	4,934	4,773
13. Socorro	24,332	12,496	11,836
14. Mansalay	23,548	12,059	11,489
15. Victoria	26,225	13,451	12,774

Source: 1980 census of population and housing, NCSO

Appendix 6.2.21 Passenger Arrivals and Departures at Region IV Airports, 1979 and 1980

Airport	1979		1980		Per Cent Increase/Decrease	
	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
Baler, Aurora	164	217	72	81	(56)	(63)
Gasan, Marinduque	10,388	9,910	7,557	7,549	(27)	(24)
Occidental Mindoro:						
Lubang	3,245	3,831	2,384	2,971	(26)	(22)
Mamburao	14,102	13,956	10,522	10,980	(25)	(21)
San Jose	27,634	26,277	22,780	21,822	(18)	(17)
Oriental Mindoro:						
Calapan	1,571	1,617	409	378	(74)	(77)
Wasig	201	301	154	187	(23)	(38)
Palawan:						
Busuanga	821	1,033	508	569	(38)	(45)
Cuyo	714	504	104	168	(85)	(67)
Puerto Princesa	38,948	36,123	37,940	37,356	(2)	(3)
Quezon:						
Alabat	NA	NA	NA	NA		
Lucena	83	35	14	14	(83)	(60)
Jomalig	197	235	77	110	(61)	(53)
Corregidor, Cavite	NA	NA	NA	NA		
Romblon, Romblon	7,057	8,357	6,889	6,798	(2)	(19)

Note: NA is data not available

Source: 5 year Regional Development Plan in Region IV (NEDA)

Appendix 6.3.1 Assumption of National Petroleum Product Consumption in 1990 and 2000

	1985	1990	1995	2000
Consumption (Thousand barrels)	47,920	54,150	62,500	70,220*1
Consumption*2 (Thousand M.T.)	6,955	7,859	9,071	10,191

*1 National Petroleum product consumption in 2000 is calculated from that in 1985 by using the average annual growth for the period 1985 ~ 1995, which is estimated to be 2.58 percent per annum.

*2 *Conversion from barrel to metric ton = 6.89 barrels/ton*

Source: Bureau of Energy Utilization (Refer to Appendix 6.3.2.)

Appendix 6.3.2 Energy Demand Projections*1

	1985	1990	1995
Energy Sources:			
Oil	47.92	54.15	62.50
Coal	9.77	15.40	26.12
Hydro	11.29	15.32	18.55
Geothermal	9.16	11.45	12.35
Bagasse	5.63	6.54	7.58
Agriwastes	8.96	11.08	13.48
Other Non-conventional	0.21	0.81	1.77
Nuclear	3.17	6.34	6.34
Total	96.11	121.09	148.73

*1 Volume in million barrels of fuel oil equivalent at 18,600 BTU/lb.

Sources: 1) Oil, Bagasse – Bureau of Energy Utilization
2) Hydro, Geothermal, Nuclear – National Power Corporation
3) Coal – PNOC Coal
4) Other Non-conventional – Ministry of Energy.

Appendix 6.3.3 Percent of National Oil Products Consumption Supplied by Production at the Batangas Oil Refineries

	1990	2000
Assumed Share*1	0.592	0.592

*1 1) According to the Ministry of Energy Report for 1982, Petrophil, the government-owned petroleum marketing company (linked to the Bataan Refinery Corporation) had the biggest market share with 40.8% followed by Caltex with 24.6%, Shell/Blecor with 21.7%, and Mobil with 12.9%.

This indicated that the refineries located at Batangas, that is Clatex and Shell/Blecor, had a total domestic market share of 46.3% in 1982 (Refer to Appendix 6.3.4).

2) Caltex took over Mobil's 12.9% share in 1983, so Caltex's market share is assumed to have risen to 37.5%. Thus, the total market share of the "Batangas Oil Refineries" is supposed to be 59.2% in 1983. This assumes that Caltex did not lose any of Mobil's former market share when it took over Mobil's operations, and that the market share of Shell/Blecor remained constant.

3) PPA's Annual Statistical Report for 1982 indicates that a few companies imported 275,298 tons of petroleum products directly. Among these companies, MMIC-SNR in Surigao imported about three fourths of this total. Judging from the recent energy transfer to coal use, it is supposed that MMIC-SNR will not import petroleum products in the future. Thus the portion of direct importation is assumed to sharply decrease and to become negligibly small.

4) PPA's Annual Statistical Report for 1982 also shows that, in ports other than Bataan and Batangas, Shell and Mobil directly imported petroleum products which supplied only 0.4 percent of domestic petroleum demand.

5) The future share of "Batangas Oil Refineries" in the national petroleum product consumption is assumed to be the same as their present market share of 59.2%.

Appendix 6.3.4 Batangas Oil Refineries' Actual Share of National Petroleum Product Consumption*1

Unit: Thousand Tons

		1979	1980	1981	1982
Petroleum Product Domestic Movement (Inward)	(A)	492	804	704	611
Crude Oil Domestic Movement (Inward)	(B)	94	57	1	185
Petroleum Product Imports	(C)	1,518	1,591	1,895	682
Crude Oil Imports	(D)	4,661	3,683	2,573	3,472
Total of Incoming Cargo (E = A + B + C + D)	(E)	6,765	6,135	5,174	4,950
Petroleum Product Exports	(F)	68	96	97	347
Petroleum Product Supply for Domestic Use (G = E – F)	(G)	6,697	6,039	5,077	4,603
National Petroleum Product Consumption*2*3	(H)	12,415	11,605	10,917	10,843
Share (G/H)		0.539	0.520	0.465	0.425

*1 "Batangas Oil Refineries" stands for CALTEX and SHELL.

*2 The figures are converted from the original figures described in barrels (Ministry of Energy Report 1982) to those in metric tons, by using the conversion rate of 6.89 barrels/ton.

*3 The figures include refinery fuel and loss.

Sources: 1) PPA Annual Statistical Reports 1979 ~ 1982.

2) Ministry of Energy Report 1982.

Appendix 6.3.5 Estimate of Batangas Oil Refineries Petroleum Product Supply Volume for Domestic Use in 1990 and 2000

	1990	2000
Petroleum Product Supply Volume*1 (Thousand M.T.)	4,653	6,033

*1 The petroleum product supply volume for domestic use by the Batangas Oil refineries is calculated using the following formula:

Petroleum Product Supply Volume for Domestic Use by Batangas Oil Refineries	=	National Petroleum Product Consumption	x	Share of Batangas Oil Refineries to National Petroleum Product Consumption

Appendix 6.3.6 Assumed Ratio of Petroleum Product Exports to Petroleum Product Supply for Domestic Use at the Batangas Oil Refineries.

	1979	1980	1981	1982	1990	2000
Ratio*1	0.010	0.016	0.019	0.075	0.030*2	0.030*2

*1 The petroleum product supply volume for domestic use = 1.0 (refer to Appendix 6.3.4.)

*2 The ratios in 1990 and 2000 are assumed by taking an average of the actual ratios for the period 1979 ~ 1982.

Appendix 6.3.7 Estimate of Petroleum Products Export Volume from Batangas Oil Refineries in 1990 and 2000*1

		1990	2000
Foreign (Export)	Petroleum Products (Thousand MT)	140	181

*1 The petroleum product export from the Batangas Oil refineries in 1990 and 2000 is calculated by the following formula:

Petroleum Product Exports from Batangas	=	Petroleum Product Supply Volume for Domestic Use in Batangas	x	Ratio of Petroleum Product Exports to Petroleum Product Supply for Domestic Use in Batangas

Appendix 6.3.8 Total Incoming Cargo Volume of Batangas Oil Refineries in 1990 and 2000

	1990	2000
Total Incoming Cargo Volume*1 (Thousand M.T.)	4,973	6,214

*1 The total incoming cargo volumes in 1990 and 2000 are calculated using the following formula:

Total Incoming Cargo Volume in Batangas	=	Batangas Oil Refineries' Petroleum Product Supply for Domestic Use	+	Petroleum Product Exports from Batangas

Appendix 6.3.9 Assumption of Future Distribution of Crude Oil and Petroleum Products in Incoming Cargo at the Batangas Oil Refineries

Unit: %

		1979	1980	1981	1982	1990*1	2000*1
Domestic Trade (Inward)	Petroleum Products	7.3	13.1	13.6	12.3	11.6	11.6
	Crude Oil	1.4	0.9	–	3.7	1.5	1.5
Foreign Trade (Import)	Petroleum Products	22.4	25.9	36.6	13.8	24.7	24.7
	Crude Oil	68.9	60.1	49.8	70.2	62.2	62.2
Total		100.0	100.0	100.0	100.0	100.0	100.0

*1 The future distribution of crude oil and petroleum products in the incoming cargo in 1990 and 2000 is assumed by taking an average of the corresponding figures for the period 1979 ~ 1982.

Source: PPA Annual Statistical Reports 1979 ~ 1982.

Appendix 6.3.10 Estimate of the Incoming Volume of Crude Oil and Petroleum Products in Domestic/Foreign Trade in 1990 and 2000.

Unit: Thousand tons

		1990	2000
Domestic*1 (Inward)	Petroleum Products	577	721
	Crude Oil	75	93
Foriegn*1 (Import)	Petroleum Products	1,228	1,535
	Crude Oil	3,093	3,865
Total of Incoming Cargo*2		4,973	6,214

*1 The future distribution of crude oil and petroleum products in the incoming cargo of Batangas is assumed in Appendix 6.3.9.

*2 Refer to Appendix 6.3.8.

Appendix 6.3.11 Assumption of Ratio of Outgoing Petroleum Products for Domestic Use (Products transported to other parts of the country by sea) to Total Petroleum Product Supply for Domestic Use.

	1979	1980	1981	1982	1990	2000
Ratio*1	0.330	0.280	0.276	0.288	0.294*2	0.294*2

*1 The petroleum product supply volume for domestic use = 1.00

*2 The ratio in 1990 and 2000 is assumed by taking an average of the figures for the period 1979 ~ 1982.

Source: PPA Annual Statistical Reports 1979 ~ 1982.

Appendix 6.3.12 Estimate of the Volume of Outgoing Petroleum Products for Domestic Use (Products transported by sea to other parts of the country) in Batangas*1

Unit: Thousand tons

		1990	2000
Domestic (Outward)	Petroleum Products	1,368	1,774

*1 The outgoing petroleum product volume for domestic use is calculated by the following formula:

Outgoing Petroleum Products Volume for Domestic Use	=	Petroleum Products Supply Volume for Domestic Use	x	Ratio of Outgoing Petroleum Volume for Domestic Use to Total Petroleum Product Supply Volume for Domestic Use

Appendix 6.3.13 Cargo Volume Projection of Crude Oil and Petroleum Products Related to Oil Refining

Unit: Thousand tons

	1990	2000
TOTAL CARGO THROUGHPUT	6,481	8,169
TOTAL DOMESTIC TRADE	2,020	2,588
Inward	652	814
Petroleum Products	577	721
Crude Oil	75	93
Outward	1,368	1,774
Petroleum Products	1,368	1,774
TOTAL FOREIGN TRADE	4,461	5,581
Import	4,321	5,400
Petroleum Products	1,228	1,535
Crude Oil	3,093	3,865
Export	140	181
Petroleum Products	140	181

Appendix 6.3.14 Projections of Wheat Imports (from PFM)

	Philippines (MT)	Pacific Flour Mills (PFM) (MT)	PFM's Share (%)
1974	478,226		
1975	463,949		
1976	721,512		
1977	628,064		
1978	765,977		
1979	790,577	3,476	0.44
1980	835,198	55,080	6.59
1981	840,948	66,967	7.96
1982	917,632	70,999	7.74
1983	796,122	55,672	6.99
1990	1,231,216*1	90,125	7.32*2
2000	1,672,430*1	122,422	7.32*2

*1 The wheat imports of the Philippines in 1990 and 2000 are assumed on the basis of historical trends.

$$V = -86,570,321 + 44,121Y$$

Where, V : Volume of wheat imports of the Philippines in year Y
Y : Year

*2 The future share of Pacific Flour Mills wheat imports to the total national wheat imports is assumed by taking an average of PFM's shares during the period 1980 ~ 1983.

Sources: 1) NFA
2) PPA Annual Statistical Reports 1979 ~ 1983.

Appendix 6.3.15 Projections of Soybean Meal Importation

	Philippines (MT)	Batangas (MT)	Batangas' Share (%)
1974	62,390		
1975	49,615		
1976	76,025		
1977	95,656		
1978	44,227		
1979	123,594		
1980	214,696		
1981	217,809	16,001	7.35
1982	387,488	0	0
1983	260,954	30,555	11.71
1990	522,472*1	49,792	9.53*2
2000	843,538*1	80,389	9.53*2

*1 The soybean meal imports of the Philippines in 1990 and 2000 are assumed on the basis of historical trends.

$$V = -63{,}369{,}723 + 32{,}107Y$$

Where, V : Volume of soybean meal imports of the Philippines in year Y
Y : Year

*2 The percent of soybean imports that will come through Batangas is assumed by taking an average of the two figures for 1981 and 1983.

Source: 1) NFA
2) PPA Annual Statistical Reports 1981 ~ 1983

Appendix 6.3.16 Projections of Outgoing Flour Volume (from PFM's Pier)

	Wheat Import Volume (MT)	Outgoing Flour Volume (MT)	Ratio*1
1980	55,080	1,940	0.0352
1981	66,967	11,627	0.1736
1982	70,999	900	0.0127
1983	55,672	0	0
1990	90,125*2	4,993	0.0554*3
2000	122,422*2	6,782	0.0554*3

*1 "Ratio" stands for the ratio of outgoing flour volume transported by sea to wheat import volume at Pacific Flour Mills.
Wheat Import Volume at PFM = 1.00

*2 Refer to Appendix 6.3.14.

*3 The future ratios in 1990 and 2000 are assumed by taking an average of the figures during the period 1980 ~ 1983.

Source: PPA Annual Statistical Reports 1980 ~ 1983.

Appendix 6.3.17 Assumption of the Ratio of the Volume of Other Cereals to that of Palay/Rice, and Projection of the Volume of the Other Cereals*1

	1982	1983	1990	2000
Palay/Rice A*2	14,478	23,033	22,000*3	31,000*3
Other Cereals B*2	5,042	13,503	10,274	14,477
Ratio B/A	0.348	0.586	0.467*4	0.467*4

*1 "Other cereals" are defined as all cereals other than palay/rice in the incoming grain cargoes.

*2 Unit: metric tons

*3 Refer to Table 6.2.6.

*4 The ratio of the volume of other cereals to that of palay/rice is assumed by taking an average of the figures for the period 1982 ~ 1983.

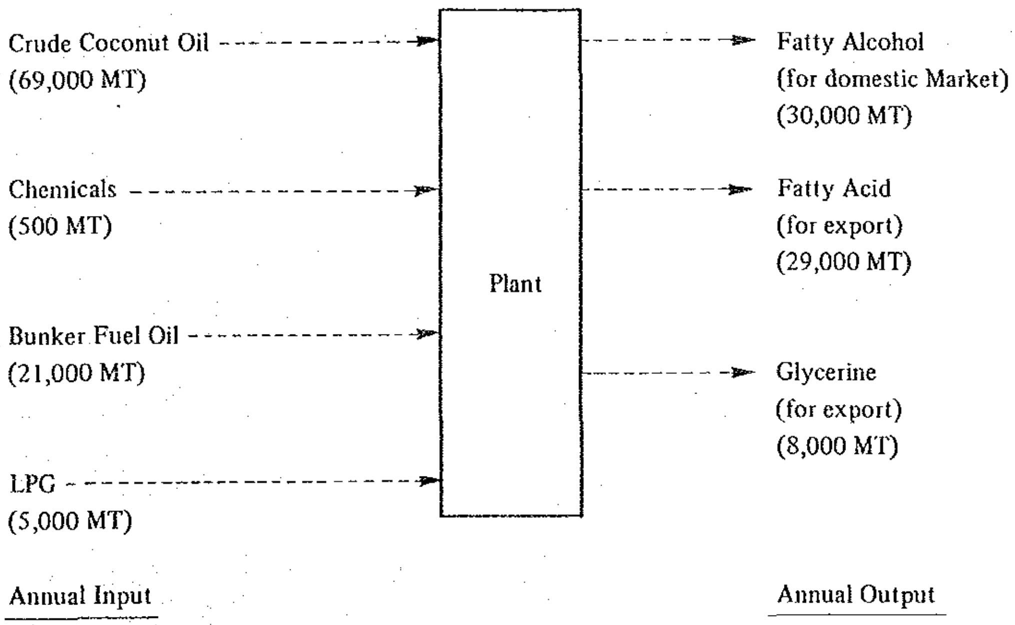
Source: PPA Annual Statistical Reports 1982 ~ 1983

Appendix 6.3.18 Cargo Volume Projections of Grain and Grain Products

Unit: tons

	1990	2000
Total Cargo Throughput	177,184	255,070
Total Domestic Trade	37,267	52,259
Inward	32,274	45,477
Palay/Rice	22,000	31,000
Other Cereals	10,274	14,477
Outward	4,993	6,782
Flour	4,993	6,782
Total Foreign Trade	139,917	202,811
Inward	139,917	202,811
Wheat	90,125	122,422
Soybeans	49,792	80,389
Export	0	0

Appendix 6.3.19 Assumption of Annual Input/Output at Full Operation of Present Facilities (UNICHEM)*1



*1 Material transportation mode (assumption):
- All of the coconut oil, chemicals, fatty, alcohol, fatty acid and glycerine
  – transported by sea
- All of the bunker fuel oil and LPG
  – transported by land (from CALTEX)

Appendix 6.3.20 Cargo Volume Projections of Coconut Oil and Coconut Chemicals Related to Production at UNICHEM*1 *2

	1990	2000
TOTAL CARGO THROUGHPUT	136,000	136,000
TOTAL DOMESTIC TRADE	99,000	99,000
Inward	69,000	69,000
Coconut Oil	69,000	69,000
Outward	30,000	30,000
Coconut Chemicals (fatty alcohol)	30,000	30,000
TOTAL FOREIGN TRADE	37,000	37,000
Import	0	0
Export	37,000	37,000
Coconut Chemicals (fatty acid and glycerine)	37,000	37,000

*1 Assumptions:
1) The plant will operate at full capacity.
2) There will be no increase in the production capacity up to 2000.

*2 The volume of input chemicals is neglected in the above cargo projections.

Appendix 6.3.21 Projection of Coal Demand of Philippine Cement Industry (In '000 MT at 9,500 BTU/LB)

Year	Cement Production*1	Total Demand*2	Domestic Purchases	Imports*3
1990	4,698	1,048	566	482
2000 Case I	6,437	1,436	1,034	402
Case II	7,678	1,713	1,311	402
Case III	9,119	2,034	1,632	402

*1 See Appendix 6.3.22.

*2 The coal demand of the cement industry is calculated using the following formula:

Coal Demand = Cement Clinker Production x Average Coal Rate

Where, Cement Clinker Production = 0.97 x Cement Production

Average Coal Rate = 0.23 ton/ton clinker

*3 Coal Imports for the Cement Industry = 0.80 x National Coal Imports

National Coal Imports: See Appendix 6.3.24.

Appendix 6.3.22 Projection of National Cement Production Volume

Year		Domestic Consumption	Export	Total
1974		2,715	764	3,479
1975		3,525	802	4,327
1976		3,379	707	4,085
1977		3,277	822	4,099
1978		3,391	823	4,215
1979		3,535	278	3,813
1980		3,646	794	4,441
1981		3,515	471	3,986
1982		3,782	592	4,374
1983		4,400	130	4,530
1990		4,138*1	560*2	4,698
2000	Case I	5,737*1	700*2	6,437
	Case II	6,978	700*2	7,678
	Case III	8,419	700*2	9,119

*1 See Appendix 6.3.23.

*2 The volume of cement exports in 1990 and 2000 is assumed based on an interview with PCIA.

Source: Philcemcor, Philippine Cement Authority

Appendix 6.3.23 Projection of Domestic Cement Consumption

Year	GDP			Per Capita GDP at 1980 Prices		Per Capital Domestic Cement Consumption (kg/year)	National Domestic Cement Consumption ('000 tons)
	At 1972 Prices (Billion Pesos)	At 1980*1 Prices (Billion Pesos)	Population (Million Persons)	(Pesos)	($*2)		
1990	114.2	327.6	61.48	5,329	687	67.3	4,138
2000							
Case I	153.5	440.4	71.35	6,172	796	97.8	6,978
Case II	181.6	521.0	71.35	7,302	942	97.8	6,978
Case III	214.4	615.1	71.35	8,621	1,112	118.0	8,419

*1 (GDP in pesos at 1980 Prices) = 2.869 x (GDP in pesos at 1972 Prices)

*2 (GDP in U.S. Dollars at 1980 Prices) = 0.129 x (GDP in Pesos at 1980 Prices)

*3 Per capita domestic cement consumption volumes in 1990 and 2000 are estimated by the following formula:

$$y = 0.1193x - 14.6$$

Where, y : per capita domestic cement consumption volume (kg/year)
x : per capita GDP in U.S.$ at 1980 Prices

Appendix 6.3.24 Estimated National Coal Imports

	1985	1990	1995	2000
Total Demand*1	9.77	15.40	26.12	42.64*3
Domestic Supply*1	7.29	13.38	22.98	40.86*3
Imports*1	2.48	2.02	3.14	1.78
Imports*2	0.739	0.602	0.936	0.530

*1 Volume in million barrels of fuel oil equivalent at 18,600 BTU/lb.

*2 Volume in million tonnes of imported coal at 10,000 BTU/lb.
The conversion rate from barrels of fuel oil equivalent at 18,600 BTU/lb to tons of imported coal at 10,000 BTU/lb is assumed as follows:

$$\text{Conversion Rate} = \frac{1}{3.53} \times \frac{10000}{9500} = 0.298$$

*3 The total demand and local supply of coal in 2000 are calculated from those in 1985 by using the average annual growth rates for the period 1985 ~ 1995, which are 10.3 and 12.2 percent per annum respectively.

Source: PNOC Coal

Appendix 6.3.25 Assumed Shares of Cement Production for the Philippine Cement Plants*1

		Estimated Cement Production Capacity*2 ('000 MT)	Share (%)
Luzon Based Plants	Bacnotan and Northern	863	14.7
	Others	3,229	55.0
	Sub-total	4,092	69.7
Visayas-Mindanao Based Plants		1,782	30.3
Total		5,874	100

*1 The shares of cement production in the Philippine cement plants are assumed to be in proportion to those of cement production capacities when coal volume is projected. Though the cement production capacities are estimated to change in the future in accordance with the expansion of domestic sales, the shares shown in the above table are assumed to be applicable for the projection.

*2 As of 1984, April

Source: Philippine Cement Authority

Appendix 6.3.26 Cargo Volume Projection of Coal through NCA's Permanent Coal Terminal

	1990	2000 Case I	2000 Case II	2000 Case III
Total Cargo Throughput	885	1,212	1,446	1,717
Total Domestic Trade	549	932	1,166	1,437
Inward (Coal)*1	395	721	914	1,138
Outward (Coal)*2	154	211	252	299
Total Foreign Trade	336	280	280	280
Import (Coal)*3	336	280	280	280
Export (Coal)	0	0	0	0

*1 [Incoming Coal Volume at NCA's Permanent Coal Terminal] = [Domestically Purchased Volume of the Coal Demand of the Philippine Cement Industry] x [Share of Cement Production of Luzon-Based Plants to Total Cement Production Capacity]

(Appendix 6.3.21) (Appendix 6.3.25)

*2 [Outgoing Coal Volume of NCA's Permanent Coal Terminal] = [Total Coal Demand of the Philippine Cement Industry] x [Share of Cement Production of Bacnotan and Northern Cement to Total Cement Production Capacity]

(Appendix 6.3.21) (Appendix 6.3.25)

*3 [Imported-Coal Volume at NCA's Permanent Coal Terminal] = [Imported Volume of the Coal Demand of the Philippine Cement Industry] x [Share of Cement Production of Luzon Based Plants to Total Cement Production Capacity]

(Appendix 6.3.21) (Appendix 6.3.25)

Appendix 6.3.27 Projected Chemical Imports (for BBTI and Himmel)

	GDP*1 (Billion Pesos)	Philippines (MT)	BBTI & Himmel (MT)	Share (%)
1976	73.6	107,249		
1977	78.0	153,583		
1978	82.6	199,315		
1979	88.3	194,707	10,599	5.44
1980	92.7	158,668	6,784	4.28
1981	96.2	179,326	13,680	7.63
1982	99.1	166,755	30,645	18.38
1983	100.1	183,179	46,753	25.52
1990	114.2	207,486*2	51,042	24.60*3
2000 Case I	153.5	268,873*2	66,143	24.60*3
Case II	181.6	312,766*2	76,940	24.60*3
Case III	214.4	363,999*2	89,544	24.60*3

*1 GDP is in billion pesos at constant 1972 prices.

*2 The national import volume of chemicals in 1990 and 2000 is estimated on the basis of the historical correlation between GDP and the country's importation.

$$V = 29{,}105 + 1{,}562G$$

Where, V : Chemicals import volume of the Philippines in year Y (MT)
G : GDP in year Y (billion pesos)

*3 The future percent of national chemical imports which will come through Batangas Bay is estimated on the following basis:

a) Himmel's present share for 1983 (assumption) = 0.6%
(Himmel started its operations in 1983).

b) BBTI's present share = 17.0%
(Assumed by taking an average of the figures for 1981 ~ 1983. Himmel's share in 1983 is excluded).

c) Himmel's future share increase (assumption) = 4.0%
(the total import of Himmel in 1984 is believed to be approximately 8,000 MT)

d) BBTI's future share increase (assumption) = 3.0%
(the two leaseholders of BBTI have a future extention plan, which is believed to increase BBTI's cargo handling volume by about 7,000 MT)

Source: 1) NEDA Statistical Yearbook 1984
2) BOC Foreign Trade Statistics 1976 ~ 1983.
3) PPA Annual Statistical Reports 1979 ~ 1983.

Appendix 6.3.28 Projected Coconut Oil Export Volume of BBTI

	Philippines (MT)	BBTI (MT)	BBTI's Share (%)
1976	851,272		
1977	790,882		
1978	989,516		
1979	794,631		
1980	914,008	15,684	1.7
1981	1,046,623	22,644	2.2
1982	948,942	5,932	0.6
1983	1,019,676	82,517	8.1
1990	1,201,922*1	38,462	3.2*2
2000	1,470,949*1	47,070	3.2*2

*1 The coconut oil export volume of the Philippines in 1990 and 2000 is estimated on the basis of the eight-year historical trend.

$$V = -52{,}334{,}432 + 26{,}903\,Y$$

Where, V : Coconut oil export volume of the Philippines in year Y
Y : Year

*2 BBTI's share of national coconut oil exports in 1990 and 2000 is assumed by taking an average of the corresponding figures for the period 1980 ~ 1983.

Sources: 1) Coconut Statistics 1982 (UCAP) and Coconut Today (Vol. 2, No. 2)
2) PPA Annual Statistical Reports 1980 ~ 1983.

Appendix 6.3.29 Projected Copra Cake/Pellets Export Volume of BBTI

	Philippines (MT)	BBTI (MT)	BBTI's Share (%)
1976	504,575		
1977	419,951		
1978	511,528		
1979	501,204	26,162	5.2
1980	530,597	6,500	1.2
1981	633,110	20,500	3.2
1982	589,572	20,500	3.5
1983	616,712	27,750	4.5
1990	791,807*1	27,713	3.5*2
2000	1,033,140*1	36,160	3.5*2

*1 The copra cake/pellets export volume of the Philippines in 1990 and 2000 is estimated on the basis of the eight-year historical trend.

$$V = -47{,}233{,}598 + 24{,}133Y$$

Where, V : Copra cake/pellets export volume of the Philippines in year Y
Y : Year

*2 BBTI's share of the national figure in 1990 and 2000 in terms of copra cake/pellets export is assumed by taking an average of the corresponding figures for the period 1979 ~ 1983.

Sources: 1) Coconut Statistics 1982 (UCAP) and Coconut Today (Vol. 2, No. 2)
2) PPA Annual Statistical Reports 1979 ~ 1983

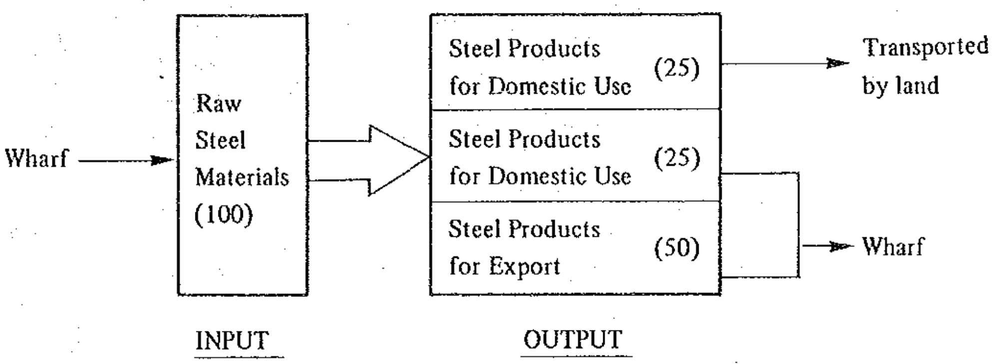
Appendix 6.3.30 Cargo Volume Projections of Steel and Steel Products (from AG&P – BMFY)*1

	1990	200
TOTAL CARGO THROUGHPUT	78,750	87,500
TOTAL DOMESTIC TRADE	56,250	62,500
Inward (Steel)	45,000	50,000
Outward (Steel Products)	11,250	12,500
TOTAL FOREIGN TRADE	22,500	25,000
Import	0	0
Export (Steel Products)	22,500	25,000

*1 Assumptions:

1) The total steel product volumes of AG&P – BMFY in 1990 and 2000 are assumed to be 45,000 MT and 50,000 MT respectively.
2) The assumption of the movement of raw steel materials and steel products and of their distribution is shown in Appendix 6.3.31.

Appendix 6.3.31 Assumption of Movement of Raw Steel Materials and Steel Products, and Their Distribution*1



*1 The production loss is disregarded in the output because it is considered to be only 1 ~ 2 percent of the input raw materials.

Appendix 6.3.32 Projections of Total Cargo Volume of Other Commodities

Year		GDP*1 (Billion Pesos)	Cargo Volume (MT)
1979		88.3	153,515
1980		92.7	205,963
1981		96.2	162,154
1982		99.1	98,201
1983		100.1	156,756
1990		114.2	165,064
2000	Case I	153.5	180,476
	Case II	181.6	191,496
	Case III	214.4	204,359

*1 GDP is in billion pesos at constant 1972 prices.

*2 The cargo volumes of other commodities in 1990 and 2000 are estimated on the basis of the historical correlation between GDP and the cargo volume of the other commodities. However, the figures in 1980 and 1982 are disregarded in the estimate.

$$V = 120{,}278 + 392G$$

Where, V : Cargo volume of other commodities in year Y (MT)
G : GDP in year Y (billion pesos)

Sources: 1) NEDA Statistical Yearbook 1984
2) PPA Annual Statistical Reports 1979 ~ 1983

Appendix 6.3.33 Projected Cargo Volumes of Other Commodities*1

Unit: tons

	1990	2000 Case I	2000 Case II	2000 Case III
Total Cargo Throughput	165,064	180,476	191,496	204,359
Total Domestic Trade	123,137	134,635	142,856	152,452
Inward	84,677	92,584	98,237	104,836
Outward	38,460	42,051	44,619	47,616
Total Foreign Trade	41,927	45,841	48,640	51,907
Import	32,353	35,373	37,533	40,054
Export	9,574	10,468	11,107	11,853

*1 The cargo volume distribution which is assumed in Appendix 6.3.34 is used in computation of the other commodities cargo volumes from the total volume obtained in Appendix 6.3.32.

Appendix 6.3.34 Assumed Cargo Volume Distribution of Other Commodities

		1979	1980	1981	1982	1983	1990	2000
Domestic Trade	Inward	60.5	60.3	64.8	39.6	30.7	51.3	51.3
	Outward	14.2	22.9	7.4	13.3	58.5	23.3	23.3
Foreign Trade	Import	21.6	9.3	13.5	44.6	9.9	19.6	19.6
	Export	3.7	7.5	14.3	2.5	0.9	5.8	5.8
Total		100	100	100	100	100	100	100

Source: PPA Annual Statistical Reports 1979 ~ 1983

Appendix 7.1 Relations between Ship Size and Overall Length, and Ship Size and Full-Load Draft

Figs. 7.1 (1) and 7.1 (2) show the relations between dead weight tonnage (DWT) and overall length (L), and DWT and full-load draft (d) for ships with age of less than 30 years from the Lloyd's Register of Ships, 1975 and the Register of Japanese Shipping, 1976. The dotted line indicates the estimated values of regression and the full line shows the value which covers 75% of the total number of data.

Tables 7.1 (1) and 7.1 (2) are the relation formula induced from Figs. 7.1 (1) and 7.1 (2).

Table 7.1 (1) Relation Between Ship Size and Length Overall

Tonnage category (DWT)	500 ~ 5,000	5,000 ~ 60,000
Number of data	1,786	6,501
75% regression formula	logL = 0.674 + 0.362 log (DWT)	logL = 0.970 + 0.297 log (DWT)
50% regression formula	logL = 0.654 + 0.362 log (DWT)	logL = 0.947 + 0.297 log (DWT)
Correlation coefficient	0.954	0.919

Table 7.1 (2) Relation Between Ship Size and Full-Load Draft

Tonnage category	500 ~ 5,000	5,000 ~ 60,000
Number of data	1,786	6,568
75% regression formula	logd = -0.279 + 0.301 log (DWT)	logd = -0.154 + 0.268 log (DWT)
50% regression formula	logd = -0.305 + 0.301 log (DWT)	logd = -0.173 + 0.268 log (DWT)
Correlation coefficient	0.895	0.929

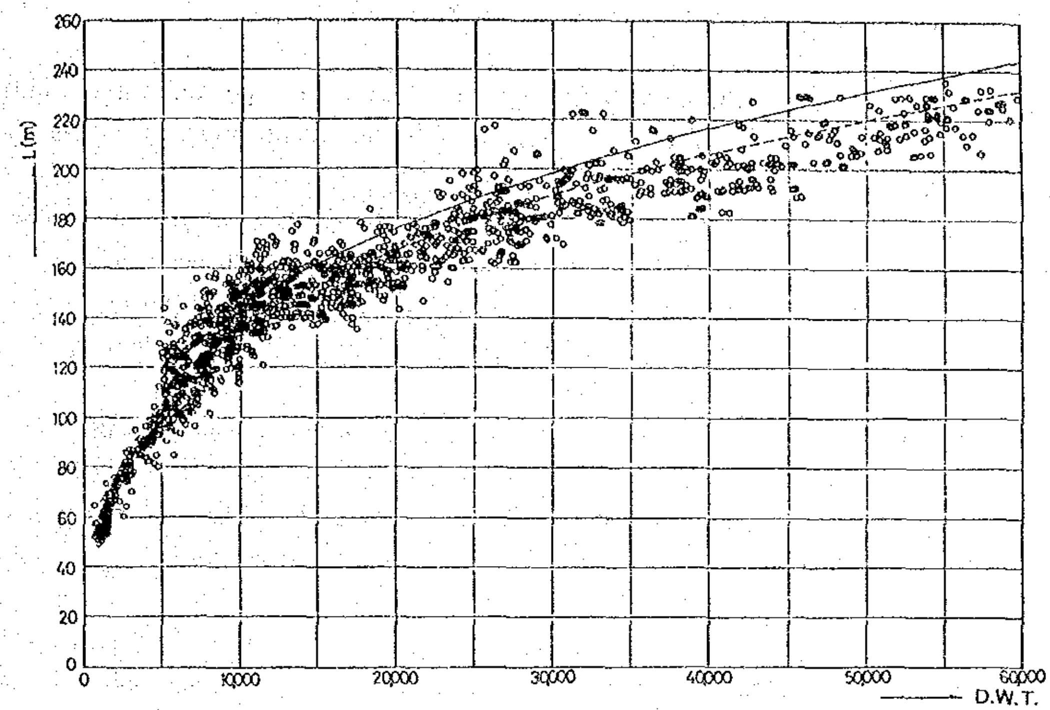


Fig. 7.1(1) Relation between Ship Size (DWT) and Overall Length (L)

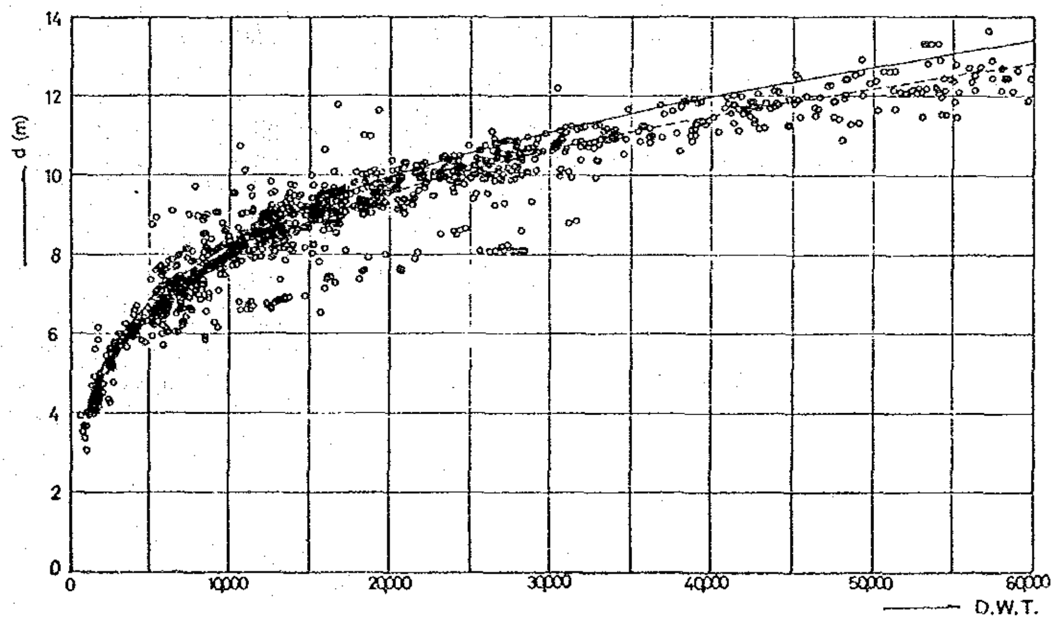


Fig. 7.1(2) Relation between Ship Size (DWT) and Full-Load Draft (d)

Appendix 7.2 Selection of Design Ship Size for the Ro-Ro Wharf

Roll on-Roll off vessels mainly carry trucks that are found on important cargo transport routes. The legal passenger limit of Ro-Ro vessels is restricted to no more than twelve (12) under the Japan Ship Safety Law.

All vessels which can accommodate more than twelve passengers are designated as passenger ships. Unlike Ro-Ro vessels, car ferry boats can generally transport both vehicles and a large number of passengers, and are designed to accommodate a variety of combinations of passengers and vehicles. Thus, selection of the design ship size for ferry and Ro-Ro berth planning is rather complicated.

The relationship between dead weight tonnage and gross tonnage is a useful way of determining the appropriate ship type for planning. Figure 7.2 (1) shows the relationship of these two factors for vessels which are currently used in Japan. In this figure, Ro-Ro type ships fall into Domain-I, while car ferrys which carry passengers as well as vehicles belong to Domain-II.

The ship type for designing the wharf should be selected from Domain-I. However, the number of such vessels is very small compared with the number of ferry-type ships. To be on the safe side, vessels like those on the border line between Domain I and Domain II have been selected as representing the appropriate design ship size for the Ro-Ro wharf, as summarized in the following table.

Table 7.2 (1) Design Ship Size for Ro-Ro Wharf Planning

Ship Class (GRT)	Maximum Loading Capacity (DWT)	Planned Load* (ton)
500	300	180
700	400	265
1,000	650	390
1,500	990	595

* Ratio of actual load to maximum loading capacity: 0.6

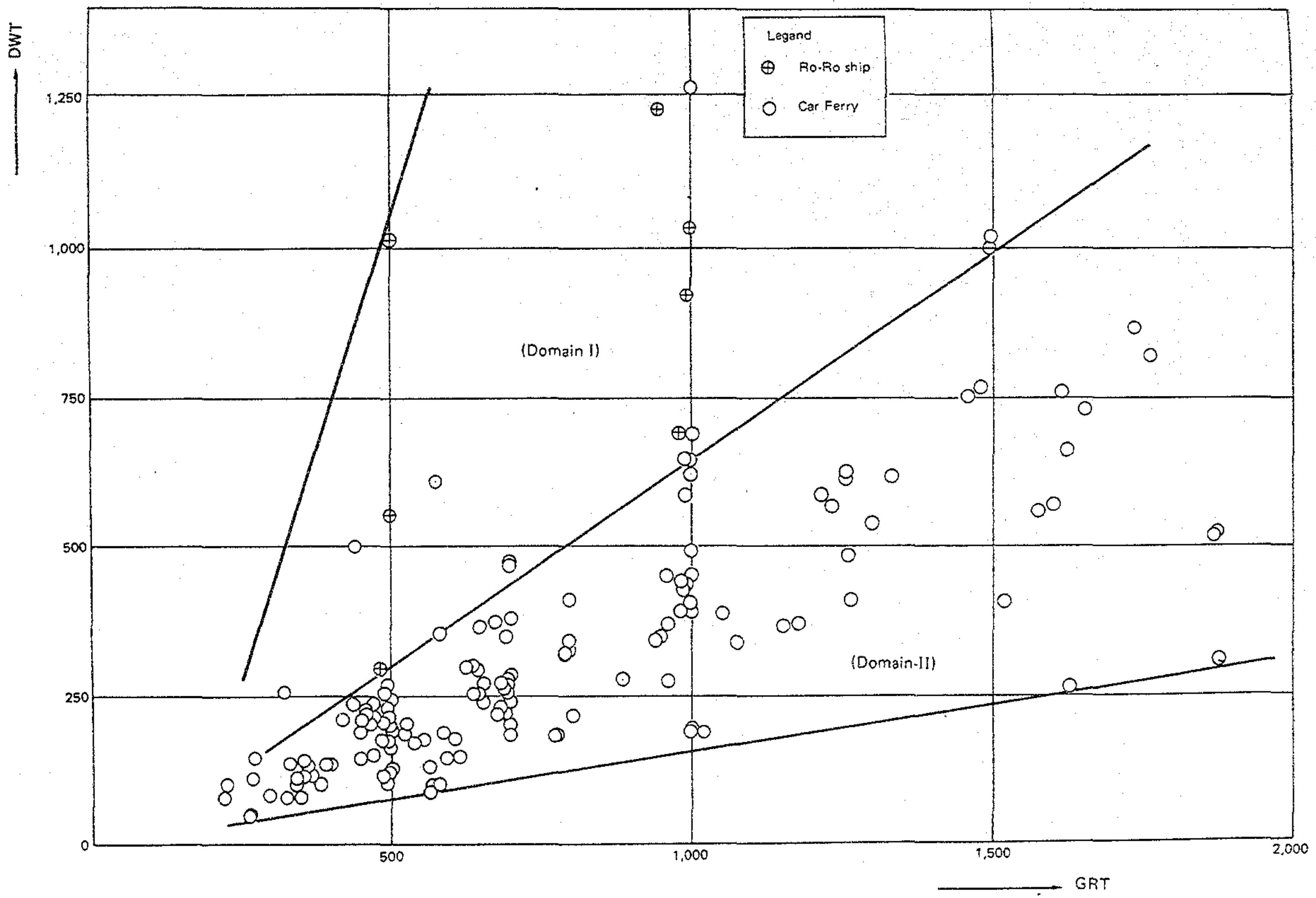


Fig. 7.2 (1) Distribution of the Ro-Ro and Ferry Ship in Terms of GRT and DWT

Appendix 7.3 Simulation Tests

1. Simulation Procedure

Simulation tests are conducted using a highspeed electronic computer and a program applying the event sequential method. Flow charts of simulation tests are presented in Figs. 7.3 (1), 7.3 (2) and 7.3 (3).

2. Input Data

General input data for simulations are shown in Table 7.3 (1)

In addition to the data on the forecast ship type and forecast cargo handling rate for each commodity, it is assumed that ship arrivals are randam and that the working time distribution pattern is a phase 2 Erlung Distribution pattern except for the great number of small boats less than 300 DWT. The distribution pattern of working time is determined on the basis of the actual distribution observed at Batangas Port in 1983. [Refer to Fig. 7.3 (4)]

3. Output Data

Output data on the number of ship calls, service time and waiting time by ship type by forecast major commodity are shown in Tables 7.3 (2), 7.3 (3) and 7.3 (4). Table 7.3 (2) shows the output data on the case of "Without the Short-term Development Plan (1990)", and Tables 7.3 (3) and 7.3 (4) show those on the cases of "With the Short Term Development Plans" in years 1990 and 1993, respectively.

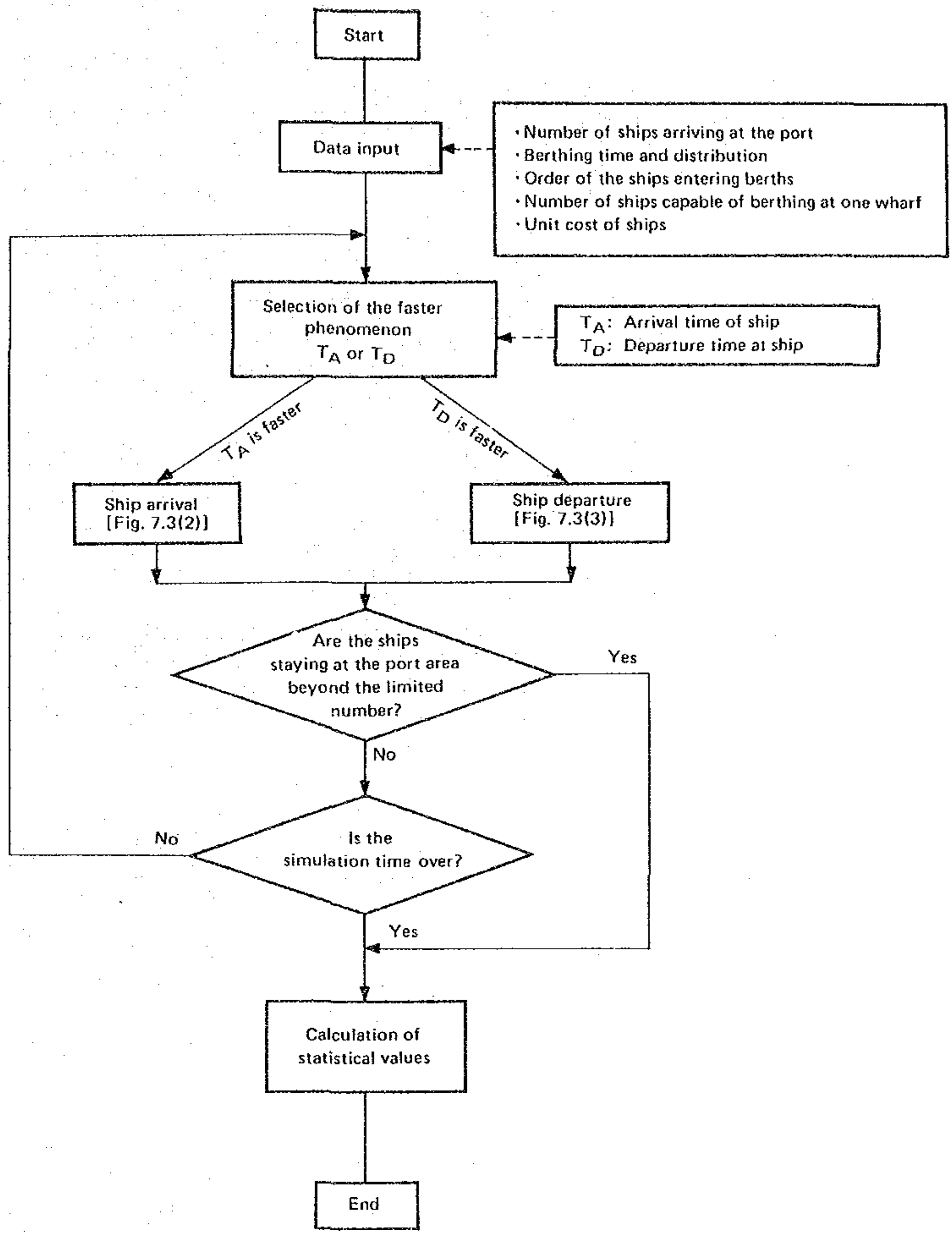


Fig. 7.3(1) Structure of Simulation Model

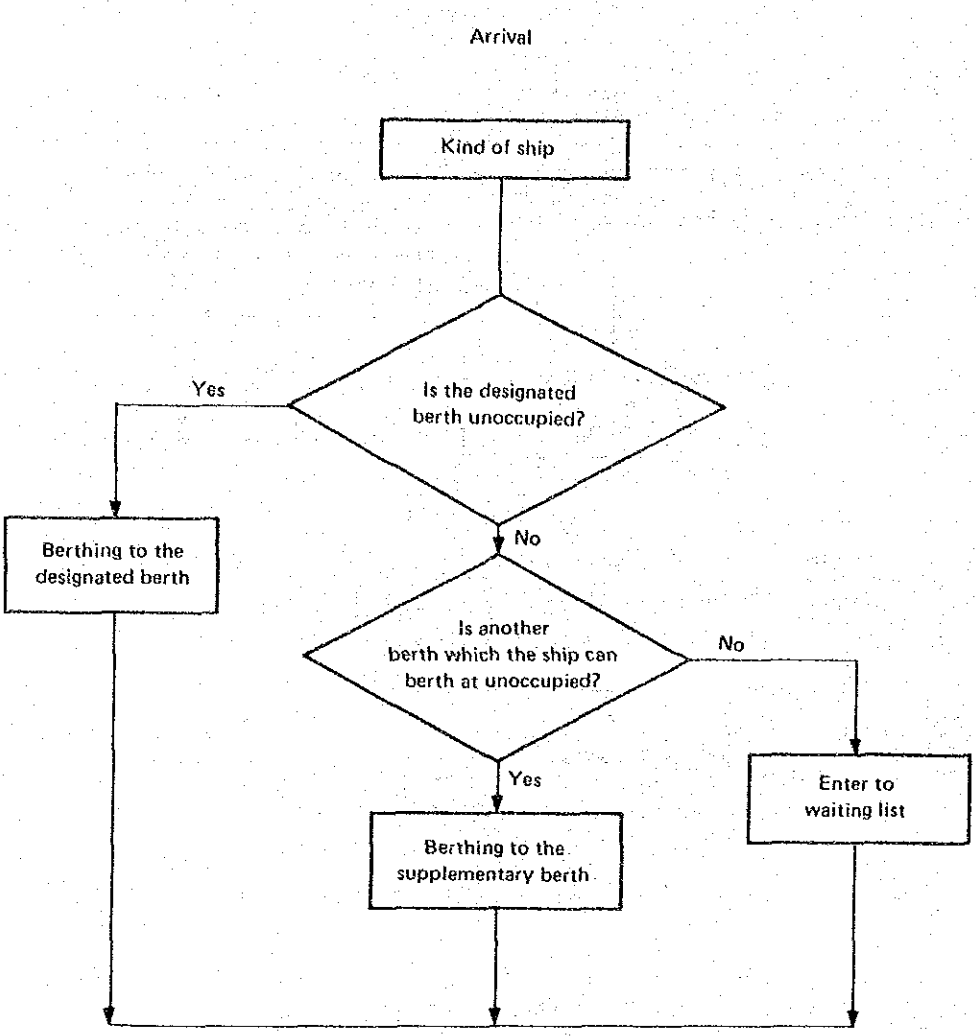


Fig. 7.3(2) Arrival

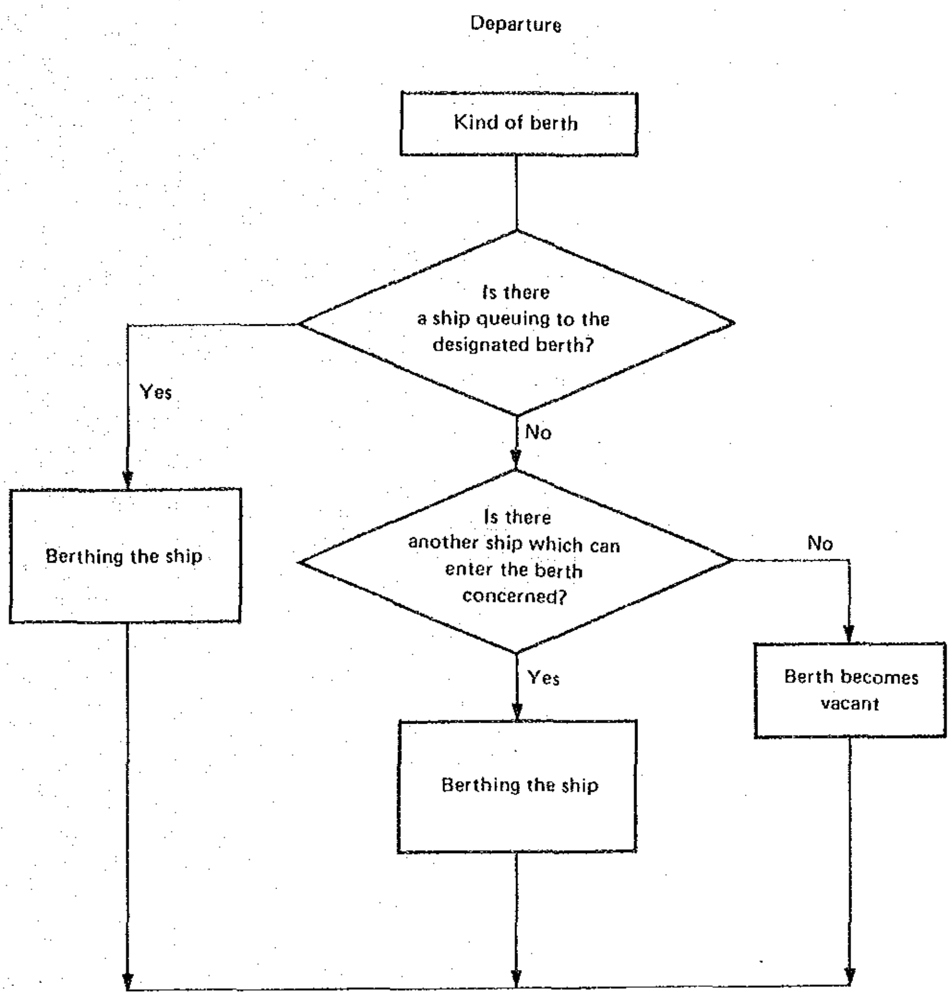


Fig. 7.3(3) Depature

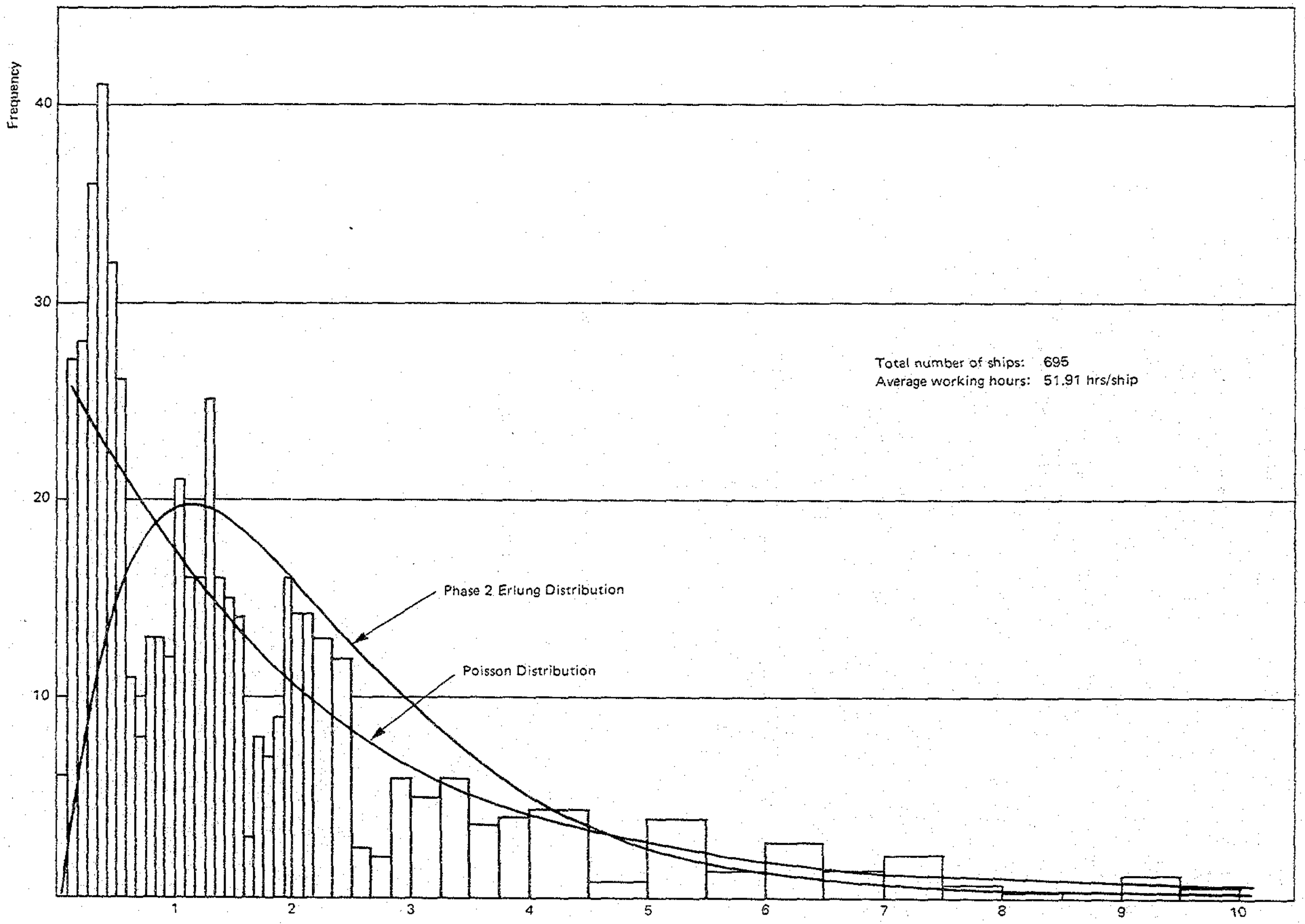


Fig. 7.3(4) Actual Distribution of Working Time at Batangas Port in 1983

Table 7.3 (1) Input Data for Simulation Tests

	Ship Group by Commodity	Average Ship size	Average Lot size	Cargo Handling Rate		1987		1988		1990		1993		1996		1999	
				Present facility	New wharf	Cargo Volume	Number of Ship calls	Cargo Volume	Number of Ship calls	Cargo Volume	Number of Ship calls	Cargo Volume	Number of Ship calls	Cargo Volume	Number of Ship calls	Cargo Volume	Number of Ship calls
	(Forein Trade)	(DWT)	(M. Ton)	A x B x C	A x B x C	(M.Ton)											
S_1	Cement	15,000	12,000	6 x 4 x 21*	20 x 3 x 21	12,000	1	12,000	1	24,000	2	24,000	2	24,000	2	24,000	2
S_2	Cement	10,000	6,000	6 x 4 x 21*	20 x 2 x 21	24,000	4	24,000	4	30,000	5	36,000	6	42,000	6	48,000	8
S_3	Cement	6,000	4,000	6 x 4 x 21*	20 x 2 x 21	28,000	7	32,000	8	36,000	9	36,000	10	40,000	10	40,000	10
S_4	Cement	3,500	2,000	6 x 4 x 14*	20 x 2 x 14	4,000	2	10,000	5	15,000	7	15,000	7	14,000	7	16,000	8
S_5	Minerals and Other Cargoes (Domestic Trade)	5000	3,000	15 x 2 x 21 6 x 4 x 21*	20 x 3 x 14	42,000	16	45,000	15	53,000	18	62,000	21	71,000	24	83,000	28
S_6	Logs and lumber	3,000	1,200	17 x 1 x 14	20 x 2 x 14	27,000	23	32,000	27	43,000	36	46,000	39	48,000	40	50,000	42
S_7	Minerals	2,000	700	15 x 1 x 14	15 x 1 x 14	8,000	12	8,000	12	7,000	10	7,000	12	8,000	12	9,000	13
S_8	Other Cargoes	150	15	5 ton/ship·hr	10 ton/ship·hr	6,000	400	6,500	434	8,000	534	8,500	567	9,000	600	9,500	633
S_9	Other Cargoes	500	300	7 x 2 x 14	12 x 2 x 14	38,000	127	47,500	159	59,000	197	73,000	242	93,000	310	115,500	385
	Total					191,000	592	217,000	665	275,000	818	308,000	906	347,000	1,011	394,000	1,129

Note: * Indicates the cargo handling rate at anchorage.

A x B x C: (cargo handling rate per gang per hour) x (number of hatches) x (working hours)