APPENDIX 15 EXPLANATION OF THE PROPOSED CARGO HANDLING SYSTEM

APPENDIX 15 EXPLANATION OF THE PROPOSED CARGO HANDLING SYSTEM

The general cargo handled at the public wharf is of many types and various weights, therefore it is difficult to increase efficiency due to the limits on the mechanization of such work.

However, high efficiency is considered to be indispensable and it leads to the following results.

1) Shortening the ship stay in the port and the turn-around time.

2) Improving the labour environment and the safety of cargo work.

3) Making it possible to use port facilities efficiently and to decrease the required number of berths.

4) Combining points 1 to 3 lead to reduced cargo handling cost

In this section we describe the optimum cargo handling system, which is a prerequisit for ship sailing and port development plans.

(1) Cargo handling system

The cargo flow in the port area is shown in the model described in Chapter 9 and the cargo handling is generally routed through basic facilities such as aprons, transit sheds and open storages. The following course of action is adopted in order to increase efficiency.

a) The general cargo handled at public wharves should be palletized as much as possible. Not only does the palletization make cargo easy to handle, but it helps prevent damage.

b) The re-handling between aprons and storage facilities (i.e. T/Shed & O/Storage) should be carried out by means of fork lifts. This is made easier when the cargo is palletized.

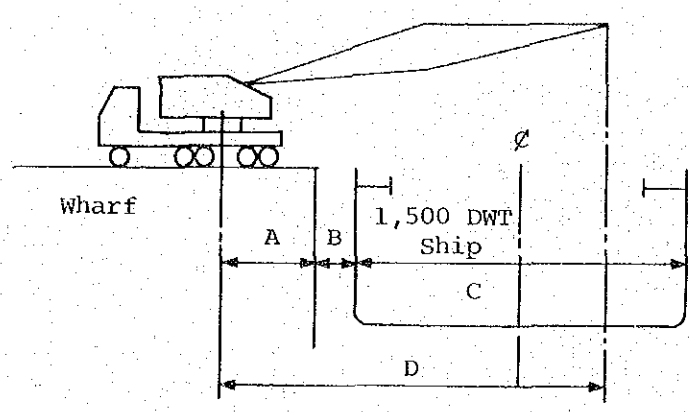
(2) Cargo handling machines

a) Cranes

As described in Chapter 9, the mobile crane is generally employed for cargo handling on public wharves dealing with the domestic trade. In this study, the truck crane rather than the mobile crane is selected for the following reasons.

- The Cargo handling efficiency of wharf cranes is not necessarily high, furthermore, it is expected that wharf cranes cause handling cost increases due to the extremely high cost of the equipment. In addition, there is no need to provide wharf cranes for their reach. Considering these factors, the wharf crane was eliminated.
- The mobility of the truck crane is far superior to that of others, and the charges for using these cranes will be competitive due to the low depreciation and operation costs.

Selection of the Cranes Lifting Capacity



reach

$$D = A + B + \frac{3}{4} C$$

Fig. A.15-1 Crane Lifting Capacity

Where, $D = 3\ m + 0.5\ m + \frac{3}{4} \times 11.5\ m = 12.125\ (m)$

Turning moment:

$$2t \times 12.125\ m = 24.25\ (t\text{-}m)$$

Required resisting moment:

$$24.25\ (t\text{-}m) \times \frac{100}{100 - 50} = 48.5\ (t\text{-}m)$$

Where, 50 stands for the percentage reduction in proportion to the reach.

Therefore, the optimum capacity is

20 t Crane [max, resisting moment = 20 t × 3 m = 60 (t-m)]

Net Crane Handling Efficiency

A crane's full cycle time is generally 1.3 2.3 min. If we assume 1.5 min. as the effective cycle time, the net handling efficiency is estimated as follows.

40 cycles/hr × 2 t = 80 t/hr

Where, 2 t shows the typical weight of cargo per cycle.

b) Fork-Lift

As described above, the fork-lift is adopted in order to make effective use of the storage facilities and achieve quick re-handling.

Selection of the Fork-Lift Capacity

Typical combinations of cranes and fork-lifts are as follows.

20 t Crane and 2 t Fork-Lifts
35 t Crane and 3.5 t Fork-Lifts

Therefore, the capacity of fork-lifts should be 2.0 t.

Net Fork Lift Handling Efficiency

The designated distance from aprons to storage facilities is generally around 150 m.

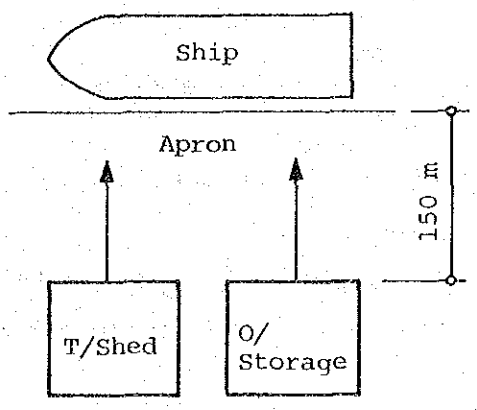


Fig. A.15-2 Movement of Fork-Lifts

The travel time per round-trip is computed as follows.

300 m ÷ 83 m/min. = 4 min.

where, the average fork-lift speed is assumed to be

5 km/hr = 83 m/min.

Therefore, it is possible for a fork-lift to make 15 roundtrips per hour, and the efficiency is 2.0 t × 15 = 30 t/hr.

(3) General cargo palletization

The types of packaging described in 9.2 (2) are classified in detail in order to select those suitable for palletization.

Table A.15-1 Packaging Types and Weights

Commodity	Type	Weight (kg/pc)	(Ave.)
General Cargo	Box (Small)*	5 ∿ 20	(10)
	Carton*	2 ∿ 500	(20)
	Case (Wooden)	20 ∿ 20,000	(500)
	Crate/Skeleton Case	10 ∿ 30,000	(1,500)
	Drum*	20 ∿ 300	(70)
	Skid	200 ∿ 5,000	(500)
Fertilizer	Bag*	10 ∿ 200	(50)
Construction Materials	Bundle	20 ∿ 3,000	(300)
	Coil	100 ∿ 4,000	(2,000)
	Unpacked	Var.	
Rice & Maize	Bag*	10 ∿ 200	(50)
	Bale*	90 ∿ 2,000	(200)
Vegetable & Fruits	Box (Small)*	5 ∿ 20	(10)
Fish Products	Do*	Do	

The cargo marked with an (*) can be palletized taking into consideration its packaging and weight, say less than 1 t/pc.

Therefore, it is estimated that half of the general cargo, fertilizer, rice & maize, fish products and vegetables & fruits are suitable for palletization.

Furthermore, in considering future cargo volumes it is assumed that palletized cargo and loose cargo will each account for 50 percent.

(4) Cargo handling efficiency

In this section, the target for cargo handling efficiency shall be set up on the basis of the above described system and equipment.

In general, the efficiencies of workers, fork-lifts and cranes are in a one-two-six ratio.

Accordingly, the net handling efficiencies are:

Worker : 15 t/hr
Fork-Lift: 30 t/hr
Crane : 80 t/hr

Furthermore, the efficiency is affected by the type of cargo, and palletized and loose cargo are in a ratio of two to one.

From the above-mentioned efficiencies, the net capacity is determined by the efficiency of the crane, as follows:

Palletized Cargo: 80 t/hr
Loose Cargo : 40 t/hr

Meanwhile, the actual cargo work includes all kinds of lost time, waiting due to various reasons, rigging, rests and so on.

Table A.15-2 Net Working Time and Lost Time

Kind of Work	Net Working Time	Lost Time
Loading	60 ∿ 70%	40 ∿ 30%
Discharging	50 ∿ 60%	50 ∿ 40%
Re-handling	60 ∿ 70%	40 ∿ 30%
Average	60%	40%

And therefore, the actual efficiency can be computed as follows.

Palletized Cargo: 80 t/hr × 0.6 = 50 t/hr
Loose Cargo : 40 t/hr × 0.6 = 20 t/hr
Average : (50 t/hr + 20 t/hr) ÷ 2 = 35 t/hr

The typical composition of a gang for cargo handling is decided in proportion to the various efficiencies, as following.

20 t Truck Crane	1	(with operator)
2 t Fork-Lift	3	(with operator)
Worker	6	

In the case of stevedoring (i.e. cargo handling on the ship), the gang will generally be 12 ∿ 15 men as it includes hold-men and deck-men, etc.

APPENDIX 16 RESULTS OF ANALYSIS FOR PORT FACILITIES

Table A.16-1 (1) Result of Analysis for Berth

BANGKOK

Year	Annual Cargo Volume Ⓐ (1,000 t)	Ⓑ (t/day)	Ⓒ (day)	Ⓓ (t)	Ⓔ = Ⓐ/Ⓓ (Nos)	Ⓓ/Ⓑ + Ⓒ (day)	Ⓕ (day)	Ⓖ	Ⓗ	Ⓘ = Ⓕ/ⒼⒽ
1987	Case 1 854	900	0.5	600	1,423	1	1,423	0.7	310	7
				950	899	1.5	1,349			6
				1,450	589	2	1,178			5
	Case 2 984	900	0.5	600	1,640	1	1,640	0.7	310	8
				950	1,036	1.5	1,554			7
				1,450	679	2	1,358			6
1992	Case 1 1,112	900	0.5	600	1,853	1	1,853	0.7	310	9
				950	1,171	1.5	1,757			8
				1,450	767	2	1,534			7
	Case 2 1,332	900	0.5	600	2,220	1	2,220	0.7	310	10
				950	1,402	1.5	2,103			10
				1,450	919	2	1,838			8
2000	Case 1 1,599	900	0.5	600	2,598	1	2,598	0.7	310	12
				950	1,641	1.5	2,462			11
				1,450	1,075	2	2,150			10
	Case 2 2,038	900	0.5	600	3,397	1	3,397	0.7	310	16
				950	2,145	1.5	3,218			15
				1,450	1,406	2	2,812			13

Table A.16-1 (2) Result of Analysis for Berth

SURAT THANI

Year	Annual Cargo Volume Ⓐ (1,000 t)	Ⓑ (t/day)	Ⓒ (day)	Ⓓ (t)	Ⓔ = Ⓐ/Ⓓ (Nos)	Ⓓ/Ⓑ + Ⓒ (day)	Ⓕ (day)	Ⓖ	Ⓗ	Ⓘ = Ⓕ/ⓁⒽ
1987	Case 1 138	900	0.5	600	230	1	230	0.7	310	1
				950	145	1.5	218			1
				1,450	95	2	190			1
	Case 2 152	900	0.5	600	253	1	253	0.7	310	1
				950	160	1.5	240			1
				1,450	105	2	210			1
1992	Case 1 191	900	0.5	600	318	1	318	0.7	310	1
				950	201	1.5	302			1
				1,450	132	2	264			1
	Case 2 216	900	0.5	600	360	1	360	0.7	310	2
				950	227	1.5	341			2
				1,450	149	2	298			1
2000	Case 1 288	900	0.5	600	480	1	480	0.7	310	2
				950	303	1.5	455			2
				1,450	199	2	398			2
	Case 2 338	900	0.5	600	563	1	563	0.7	310	3
				950	356	1.5	534			2
				1,450	233	2	466			2

Table A.16-1 (3) Result of Analysis for Berth

PAK PHANANG

Year	Annual Cargo Volume Ⓐ (1,000 t)	Ⓑ (t/day)	Ⓒ (day)	Ⓓ (t)	Ⓔ = Ⓐ/Ⓓ (Nos)	Ⓓ/Ⓑ + Ⓒ (day)	Ⓕ (day)	Ⓖ	Ⓗ	Ⓘ = Ⓕ/ⒼⒽ
1987	Case 1 161	900	0.5	600	268	1	268	0.7	310	1
				950	169	1.5	254			1
				1,450	111	2	222			1
	Case 2 199	900	0.5	600	332	1	332	0.7	310	2
				950	209	1.5	314			1
				1,450	137	2	274			1
1992	Case 1 200	900	0.5	600	333	1	333	0.7	310	2
				950	211	1.5	317			1
				1,450	138	2	276			1
	Case 2 260	900	0.5	600	433	1	433	0.7	310	2
				950	274	1.5	411			2
				1,450	179	2	358			2
2000	Case 1 295	900	0.5	600	492	1	492	0.7	310	2
				950	311	1.5	467			2
				1,450	203	2	406			2
	Case 2 411	900	0.5	600	685	1	685	0.7	310	3
				950	433	1.5	650			3
				1,450	283	2	566			3

Table A.16-1 (4) Result of Analysis for Berth

SONGKHLA

Year	Annual Cargo Volume Ⓐ (1,000 t)	Ⓑ (t/day)	Ⓒ (day)	Ⓓ (t)	Ⓔ = Ⓐ/Ⓓ (Nos)	Ⓓ/Ⓑ + Ⓒ (day)	Ⓕ (day)	Ⓖ	Ⓗ	Ⓘ = Ⓕ/ⒼⒽ
1987	Case 1 404	900	0.5	600	673	1	673	0.7	310	3
				950	425	1.5	638			3
				1,450	279	2	558			3
	Case 2 455	900	0.5	600	758	1	758	0.7	310	4
				950	479	1.5	719			3
				1,450	314	2	628			3
1992	Case 1 515	900	0.5	600	858	1	858	0.7	310	4
				950	542	1.5	813			4
				1,450	355	2	710			3
	Case 2 601	900	0.5	600	1,002	1	1,002	0.7	310	5
				950	633	1.5	950			4
				1,450	414	2	838			4
2000	Case 1 722	900	0.5	600	1,203	1	1,203	0.7	310	6
				950	760	1.5	1,140			5
				1,450	498	2	996			5
	Case 2 892	900	0.5	600	1,487	1	1,487	0.7	310	7
				950	939	1.5	1,409			7
				1,450	615	2	1,230			6

Table A.16-1 (5) Result of Analysis for Berth

PATTANI

Year	Annual Cargo Volume Ⓐ (1,000 t)	Ⓑ (t/day)	Ⓒ (day)	Ⓓ (t)	Ⓔ = Ⓐ/Ⓓ (Nos)	Ⓓ/Ⓑ + Ⓒ (day)	Ⓕ (day)	Ⓖ	Ⓗ	Ⓘ = Ⓕ/ⓂⓃ
1987	Case 1 104	900	0.5	600	173	1	173	0.7	310	1
				950	109	1.5	164			1
				1,450	72	2	144			1
	Case 2 119	900	0.5	600	198	1	198	0.7	310	1
				950	125	1.5	188			1
				1,450	82	2	164			1
1992	Case 1 147	900	0.5	600	245	1	245	0.7	310	1
				950	155	1.5	233			1
				1,450	101	2	202			1
	Case 2 174	900	0.5	600	290	1	290	0.7	310	1
				950	183	1.5	275			1
				1,450	120	2	240			1
2000	Case 1 207	900	0.5	600	345	1	345	0.7	310	2
				950	218	1.5	327			2
				1,450	143	2	286			1
	Case 2 264	900	0.5	600	440	1	440	0.7	310	2
				950	278	1.5	417			2
				1,450	182	2	364			2

Table A.16-2 (1) Result of Analysis
Open Storage Area

Port	Year	Cargo Volume	N (1,000 t)	R α W	A (m^2)
Bangkok	1992	Case 1 × 25%	278	20×0.5×2.5 25	11,100
	2000	Case 1 × 25%	400	"	16,000
Surat Thani (Ban Don)	1992	Case 1 × 25%	48	"	1,900
	2000	Case 1 × 25%	72	"	2,900
Pak Phanang	1992	Case 1 × 25%	50	"	2,000
	2000	Case 1 × 25%	74	"	3,000
Songkhla	1992	Case 1 × 25%	129	"	5,200
	2000	Case 1 × 25%	181	"	7,200
Pattani	1992	Case 1 × 25%	37	"	1,500
	2000	Case 1 × 25%	52	"	2,100

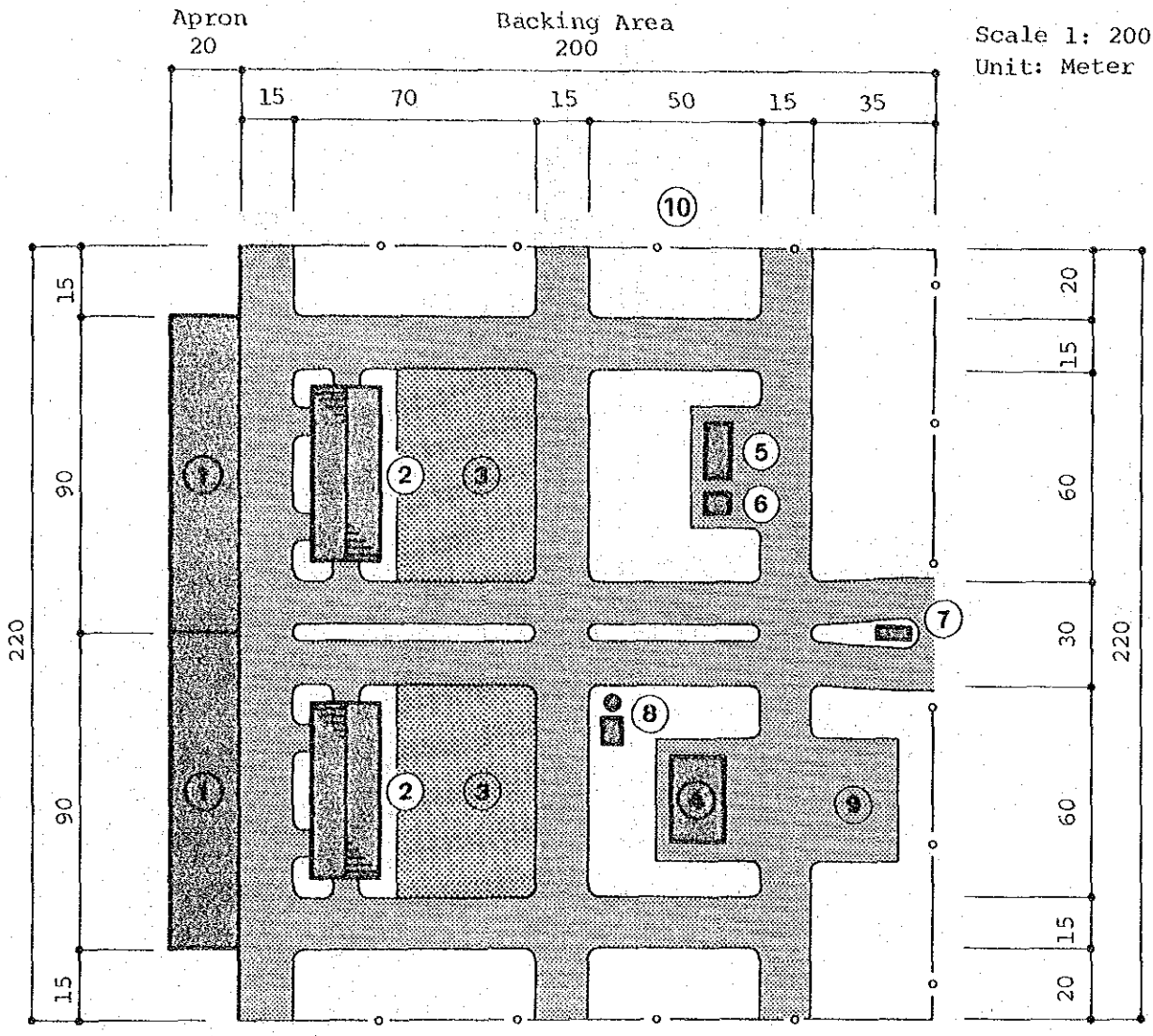
Case 1 only

Table A.16-2 (2) Result of Analysis
Transit Shed

Port	Year	Cargo Volume	N (1,000 t)	R α ω	A (m^2)	n
Bangkok	1992	Case 1 × 25%	278	35 ×0.5 ×2.5 = 43.75	6,400	7
	2000	Case 1 × 25%	400	"	9,100	9
Surat Thani (Ban Don)	1992	Case 1 × 25%	48	"	1,100	1
	2000	Case 1 × 25%	72	"	1,700	2
Pak Phanang	1992	Case 1 × 25%	50	"	1,100	1
	2000	Case 1 × 25%	74	"	1,700	2
Songkhla	1992	Case 1 × 25%	129	"	3,000	3
	2000	Case 1 × 25%	181	"	4,100	4
Pattani	1992	Case 1 × 25%	37	"	800	1
	2000	Case 1 × 25%	52	"	1,200	1

Case 1 only

APPENDIX 17 PORT FACILITIES PLAN AND CONSTRUCTION COSTS



①	RC Wharf & Bulkhead	2 Nos × 90M × 20M = 3,600 M^2
②	Transit Shed	2 Nos × 50M × 20M = 2,000 M^2
③	Open Storage	2 Nos × 60M × 40M = 4,800 M^2
④	Port Office	400 M^2
⑤	Work Shop	150 M^2
⑥	Custom House	50 M^2
⑦	Gate House	30 M^2
⑧	Pump House & Water Tower	1 Unit including 80 M^3 Tank
⑨	Paved Road & Parking Area	18,000 M^2
⑩	Fence & Gate	590 M

Fig. A.17-1 Typical Coastal Port (1500 DWT×2) General Plan

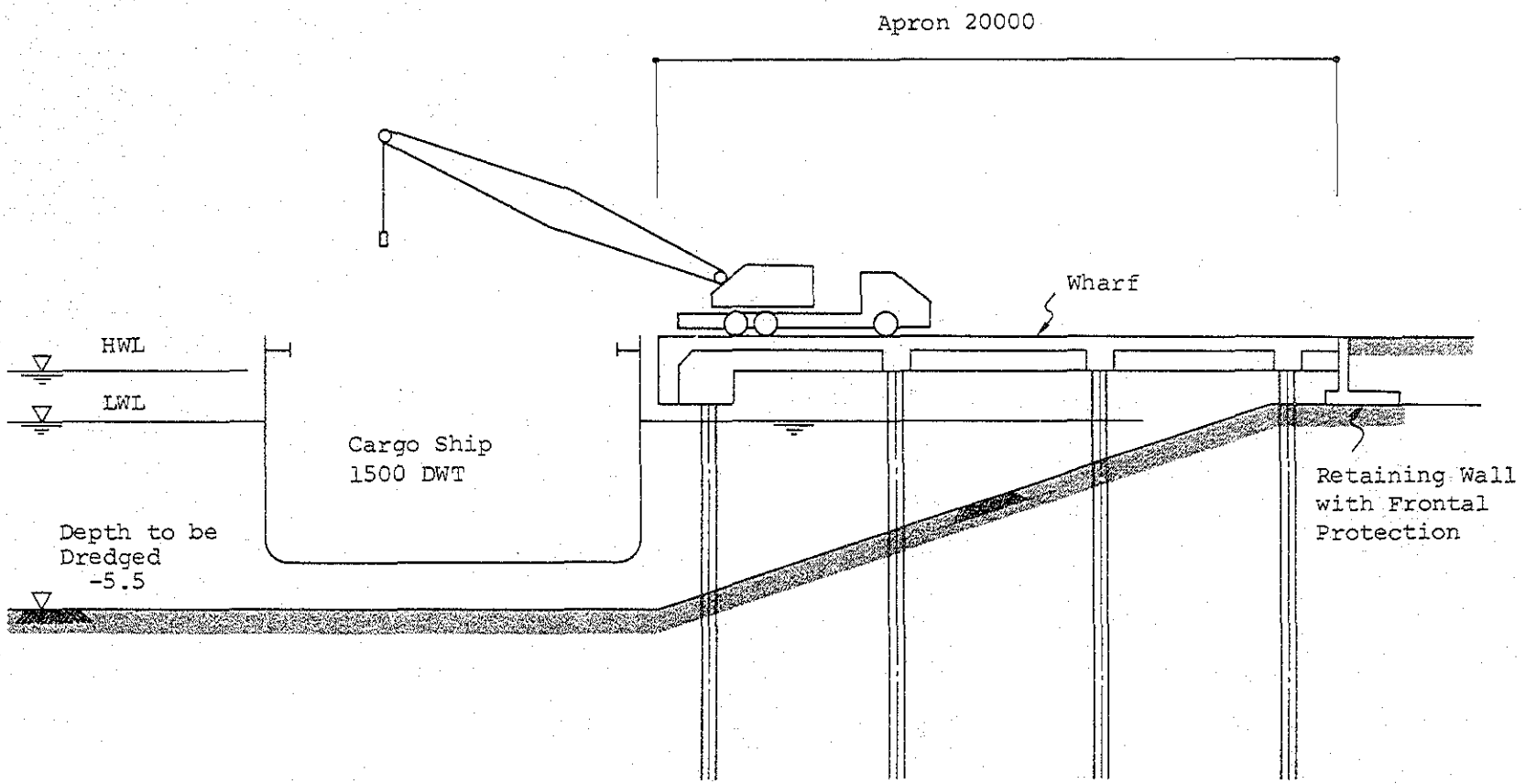


Fig. A.17-2 Typical Section of Wharf

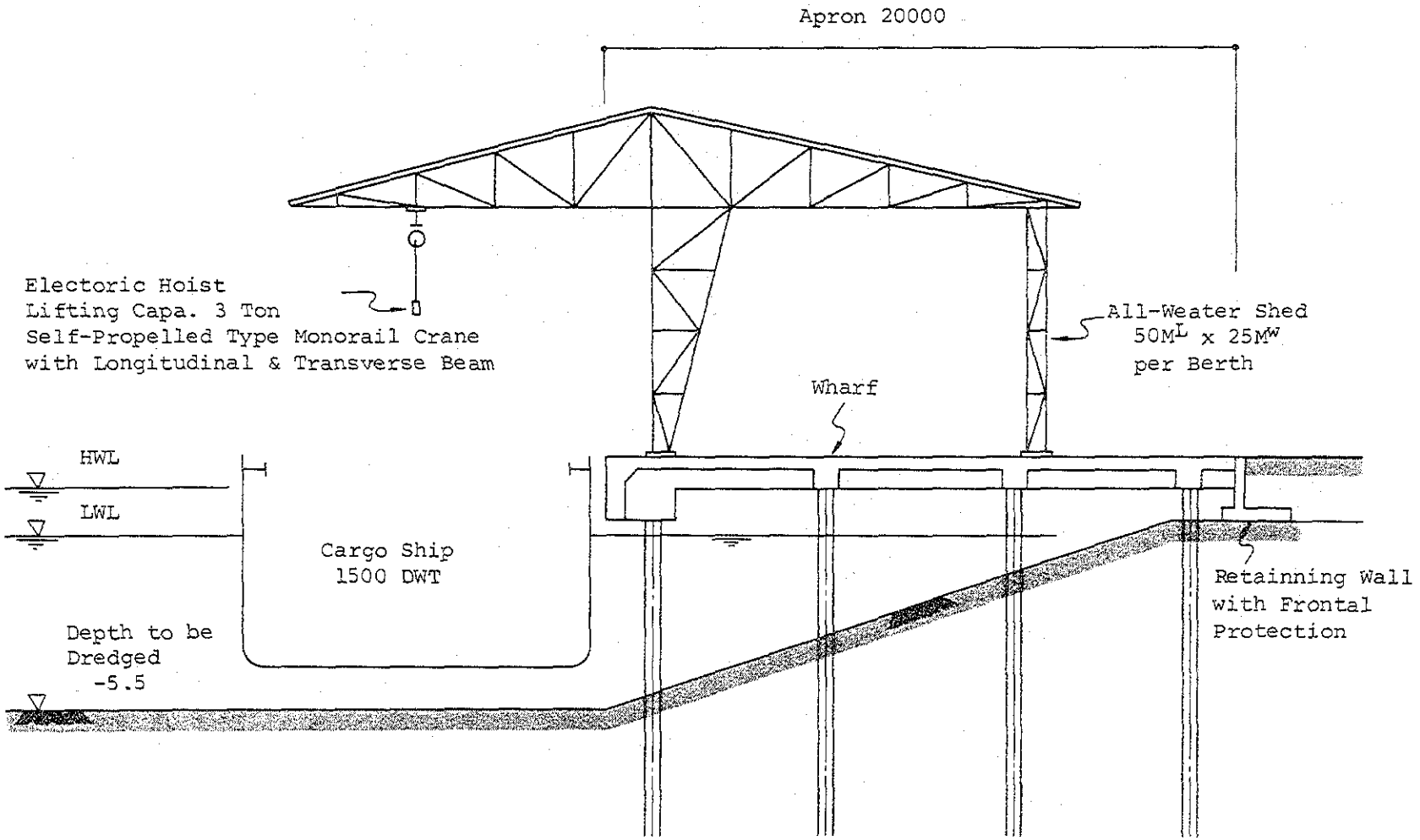


Fig. A.17-3 Typical Section of Wharf with All-Weather Shed

Table A.17-1 Construction Costs

Per 2 Berths

	Item	Unit	Q'ty	Rate (฿)	Amount (฿)
1.	Clearing & Site Preparation	m^2	44,000	3.5	154,000
2.	Excavation	m^3	-	-	-
3.	Filling 20 cm Thick	m^3	8,800	180	1,584,000
4.	Road including Sub Base	m^2	18,000	400	7,200,000
5.	Bank Protection				
	Bulkhead (Rc) 2.4 m^3/m	m^3	530	2,500	1,325,000
	Rock Protection 3 m^3/m	m^3	660	400	264,000
6.	Rc Wharf	m^2	3,600	4,500	16,200,000
7.	paved Open Storage	m^2	4,800	400	1,920,000
8.	Transit Shed	m^2	2,000	3,000	6,000,000
9.	Ancillary Buildings				
	Port Office (Rc)	m^2	400	4,500	1,800,000
	Work Shop (Rc)	m^2	150	5,500	825,000
	Custom House (Rc)	m^2	50	6,000	300,000
	Gate House (Rc)	m^2	30	6,000	180,000
10.	Water Supply System	LS			2,500,000
11.	Drainage System	LS			1,000,000
12.	Electricity & Lighting	LS			1,800,000
13.	Fence & Gate	m	590	1,000	590,000
	Sub Total				43,642,000
14.	Overhead & Profit	15%			6,546,300
	Total				50,188,300
15.	Engineering	10%			5,018,830
16.	Contingency	20%			10,037,660
	Grand Total				65,244,790

Table A.17-2 Alternative Construction Cost

Per 2 Berths

	Item	Unit	Q'ty	Rate (฿)	Amount (฿)
1. 13.	Sub Total	-	-	-	43,642,000
14.	All-weather Shed	m^2	2,500 1/	4,500	11,250,000
15.	Electric Hoist	No	5 2/	250,000	1,250,000
	Sub Total				56,142,000
16.	Overhead & Profit	15%			8,421,300
	Total				64,563,300
17.	Engineering	10%			6,456,330
18.	Contingency	20%			12,912,660
	Grand Total				83,932,290

Note: 1/ 50 m × 25 m × 2 nos = 2,500 m^2

2/ Required number of Hoist per berth shall be; -

2 nos + 0.5 no for spare = 2.5 nos/berth

Monorail beam shall be included in steal structures of the shed.

Maintenance Dredging Cost

(1) Unit Cost for Maintenance Dredging

As stated in Chapter 4, the operation cost for maintenance dredging is as follows.

7.5 ฿/m^3 for Cutter
10.0 ฿/m^3 for Hopper

These cost shows the direct cost excluding administration and overheads.

(2) Annual Required Volume

Annual required volume to be dredged of the following ports are assumed with regard to the depth for 1500 DWT vessels.

Surat Thani	V = 350,000 m^{3}p.a.
Pak Phanang	V = 200,000 m^{3}p.a. 1/
Pattani	V = 230,000 m^{3}p.a.

Note: 1/ Alternative port at Ban Pak Nakhon

These volume are assumed on the basis of silt rate estimated by AIT and past record of dredging.

(3) Maintenance Dredging Cost

Surat Thani	350,000 m^3	8.75 ฿/m^3	= 3.1 M฿	2/
Pak Phanang	200,000 m^3	7.5 ฿/m^3	= 1.5 M฿	3/
Pattani	230,000 m^3	7.5 ฿/m^3	= 1.7 M฿	3/
			Total 6.2 M฿	

Note: 2/ by Hopper & Cutter,
3/ by Cutter

APPENDIX 18 REDUCTION OF THE ROAD MAINTENANCE COST

APPENDIX 18 REDUCTION OF THE ROAD MAINTENANCE COST

The expected diversion of cargo from roads to ports due to the development of coastal shipping and the port improvement will bring various benefits to the country.

Particularly, considering that increases of heavy vehicle traffic and rampant overloading of trucks affects the pavement structure directly, the cargo diversion will, without doubt, help to prolong the pavement life. In this study, only the reduction of road maintenance cost is adopted as a countable benefit and indirect benefits such as the reduction of noise, vibration and air pollution are not taken into account.

It is needless to say that the cost reduction estimated in this section is not connected with DOH's budget reduction arising from the fact that the budget for road maintenance falls short of the required cost. Nevertheless, it is clear that the cargo diversion will contribute to restrain the prohibitive cost increases anticipated in the future.

(1) Affected roads

According to Thailand's Highway classification system, National Highways and Provincial Highways are under the responsibility of DOH.

Therefore, the above-mentioned Highways which are the main arterial roads are selected for consideration, and other roads (i.e. Rural Roads, Municipal Roads, Concession Roads, etc.) are excluded.

In the Southern Region, the roads are numbered as follows.

National Highways ..... Primary No. 4, 41 & 42
Secondary No. 401∿410

Provincial Highways ..... N. 4000s

However, since the National Highways play the leading role in long-distance truck transport, it is reasonable to confine our examination of the effect of cargo diversion to the National Highways between Bangkok and the South. The Provincial Highways are excluded for following two reasons.

1) Even though the feeder cargo using Provincial Highways will decrease as well, it may be counterballanced by new traffic originating at the major ports, as they are part of the road network between the ports and their hinterlands.

2) Provincial Roads are generally short in comparison with National Highways.

(2) Trip Length

Judging from the long-distance traffic using the foregoing routes, the trip length is simplified as follows.

Bangkok - Songkhla 950 km via Route 4 & 41

(3) Road Maintenance Unit Cost

DOH's budget and its allocation are shown in Tables A.14-1 & A.14-2. As per the above-mentioned record, the budget allocation for recent years has been roughly: -

Administration	20%
Construction	60%
Maintenance	20%

For example, the budget for road maintenance for FY 1982 is 1,863 MB, and this comprises only material and operation (labour) cost with associated overheads, that is, the direct cost excluding administration and equipment service cost (fuel).

Apart from DOH's budget, there are a few methods to compute the unit cost for road maintenance, but calculation based on only the budget is not suitable in the present circumstances, as was stated before.

Essencially, the road pavement maintenance cost will increase with time once it has begun to be used, in other words, the condition of paved roads will grow worse year by year independent of the traffic volume. Although the damage to pavement on aged roads will be accelerated by the traffic increases, this effect on deterioration is not considered in this study.

Therefore, the road maintenance unit cost is estimated by the following formula determined from the chart of annual maintenance costs.

$$M = 75{,}000 + 3.3\ ADT^{1/}$$

where, M: Road Maintenance Cost (₱/km/annum) for Asphalt Concrete Pavement in March 1981 prices

ADT: Average Daily Traffic

(4) Traffic Decrease due to Cargo Diversion

1) Cargo Diversion from Roads to Ports

A. Forecast of Road Cargo (Fig. A.14-1)

The results of the road cargo forecast are shown in Tables A.14-3 & A.14-4.

B. Forecast of Port Cargo (Fig. A.14-2)

The results of the port cargo forecast are described in Chapter 9, Development Plan for Coastal Ports.

C. Decrease in Road Cargo Volume

The decrease in road cargo volume is summarized in Fig. A.14-3. The cargo diversion is subject to the improvement of port facilities corresponding to the estimated port cargo volume.

2) Decrease in Highway Traffic

Firstly, the decrease in the daily volume of one-way trucks can be calculated from the decrease in road cargo volume due to cargo diversion.

Year	Decrease in truck numbers
1987	854,000 Ton ÷ 13 Ton ÷ 365 Days = 180 trucks
1992	1,112,000 Ton ÷ 13 Ton ÷ 365 Days = 234 trucks
2000	1,599,000 Ton ÷ 13 Ton ÷ 365 Days = 337 trucks

where, the number of trucks is for 10 wheel trucks.

Even though overload is a main factor affecting the pavement life, the calculation is carried out using the legal load because DOH's loading survey does not show a remarkable frequency.

3) ADT decrease

Finally, the decrease of daily traffic volume of one-way trucks is converted to the standard ADT for the following reasons.

A. The formula estimating road maintenance costs is lead as a function of ADT based upon the standard composition of vehicles.

B. Although heavy vehicles affect the pavement life directly, the cumulative stress from light vehicles such as passenger cars and light trucks cannot be ignored.

According to the data of the Traffic Volume & Flow Map prepared by DOH, the traffic constitution on Routes 4 and 41 is generally as follows.

The ratio of heavy vehicles: 30% of ADT
(including Heavy Bus, Medium Truck and Heavy Truck)
The ratio of heavy trucks: 10% of ADT

Therefore, the following standard ADT is obtained.

Year	Decrease in ADT
1987	1,800
1992	2,340
2000	3,370

(5) Reduction of Road Maintenance Cost

The individual cost reductions are calculated as follows.

$$M\ 1987 = 3.3 \times 1{,}800 \times 960\ km \times (1.05)^2 = 6{,}286{,}896\ ¥$$
$$M\ 1992 = 3.3 \times 2{,}340 \times 960\ km \times (1.05)^2 = 8{,}172{,}965\ ¥$$
$$M\ 2000 = 3.3 \times 3{,}370 \times 960\ km \times (1.05)^2 = 11{,}770{,}466\ ¥$$

where, M is in March 1983 Price including cost escallation (i.e. price index 1.05)

Therefore,

Year	Cost Decrease (M฿/year)
1987	6.3
1988	6.7
1989	7.1
1990	7.4
1991	7.8
1992	8.2
1993	8.7
1994	9.1
1995	9.6
1996	10.0
1997	10.5
1998	10.9
1999	11.4
2000	11.8

(6) Verification of Cost Reduction

As stated before, the reduction of road maintenance cost is calculated by an equation based on the relationship between ADT and the annual maintenance cost.

The cost reduction should be checked by different methods to ensure the reliability of this value.

This is done by using the Standard DOH Method for Maintenance Budgeting (the "Ka-factor" method), and this method is used for estimating the routine maintenance cost. 2/

$$M = (Na \cdot Ka \cdot Km + FE) \cdot L$$

where, M: Maintenance cost for the project road
Na: Maintenance cost/km for a standard road
Ka: Road characteristics factor
Km: Factor for material prices and delivery charges
FE: Equipment and fuel cost/km for the project road
L: Length of the road

And Na = 8,800 ฿/km for bitumen surfaced roads in 1982 prices

Km = 1.0 for the southern region (Average)

$$Ka = 1 + 0.5 \left(\sum_{i=1}^{6} Xi + \sum Yi \right)$$

When this method is applied, there are many factors to be taken into account as mentioned above, but the only factor relating to ADT is X_3.

Therefore, the annual cost decreases in 1983 price are:-

M 1987 = 8,800 B/km ×0.5 ×0.53 ×960 km ×1.05 = 2,350,656 ฿

M 1992 = 8,800 B/km ×0.5 ×0.78 ×960 km ×1.05 = 3,459,456 ฿

M 2000 = 8,800 B/km ×0.5 ×1.27 ×960 km ×1.05 = 5,632,704 ฿

where, X_3 (0.53 - 1.27) are obtained from decreases in ADT. 1.05 is the price index.

Meanwhile, the budget for all maintenance expenditures excluding administration, overhead expenditures and equipment service costs (fuel) is broken down into the following items.

Routine Maintenance	ex. 674 M฿ (FY1982)
Periodic Maintenance	484
Special Maintenance	169
Betterments	82
Emergency	54
Equipment Revolving Funds	400
	ex. 1,863 M฿ (FY1982)

Therefore, the routine maintenance cost is a half of all maintenance expenditures excluding equipment revolving funds.

Consequently, the reduction of road maintenance cost due to cargo diversion is obtained by multiplying the above value by a factor 2 as follows.

M 1987 ≒ 4.7 M฿

M 1992 ≒ 6.9 M฿

M 2000 ≒ 11.3 M฿

These results are similar to the previously calculated cost decrease.

Moreover, to compare these values with the DOH budget, the following percentages are roughly estimated.

The maintenance expenditure (FY1982) is

1863 M₱ ÷ 44,000 km × 960 km ≒ 40.6 M₱

Therefore,

M 1987	6.3 M₱ by method 1	16%
	4.7 M₱ by method 2	12%
M 1992	8.2 M₱ by method 1	20%
	6.9 M₱ by method 2	17%
M 2000	11.8 M₱ by method 1	29%
	11.3 M₱ by method 2	28%

In short, the cost decrease for the year 2000 (ie; after the completion of the port improvements) will reach approx. 30 percent of the present maintenance cost.

Considering the fact that the traffic decrease due to cargo diversion is all heavy trucks, this estimated cost decrease is considered to be reasonable.

1/ Feasibility Study and Detailed Engineering Design for Provincial Road Improvement
Phase I Technical Report Oct. 1982

2/ Road Feasibility Study Project Vol. I Oct. 1982

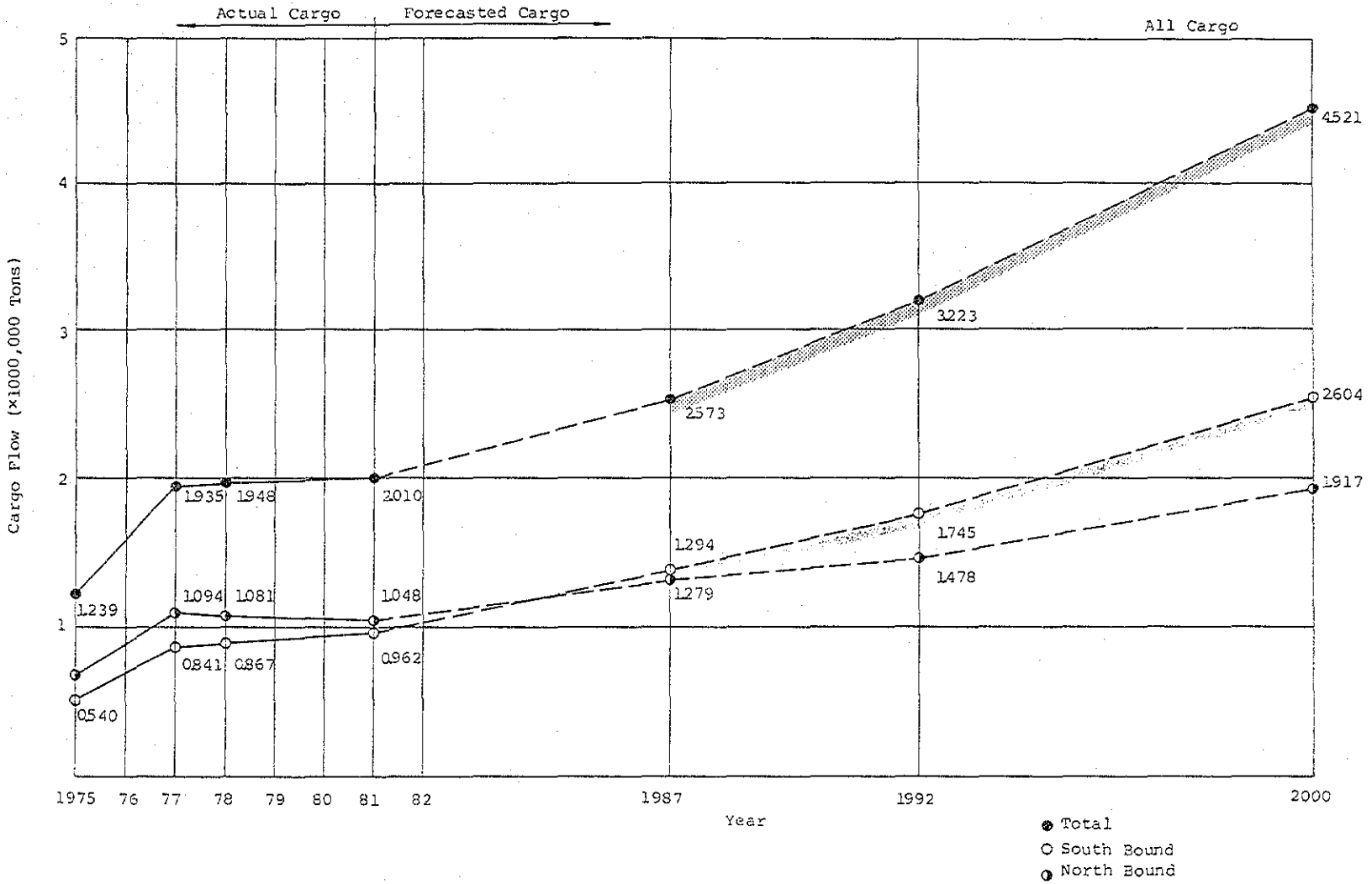


Fig. A.18-1 Cargo Flows by Road

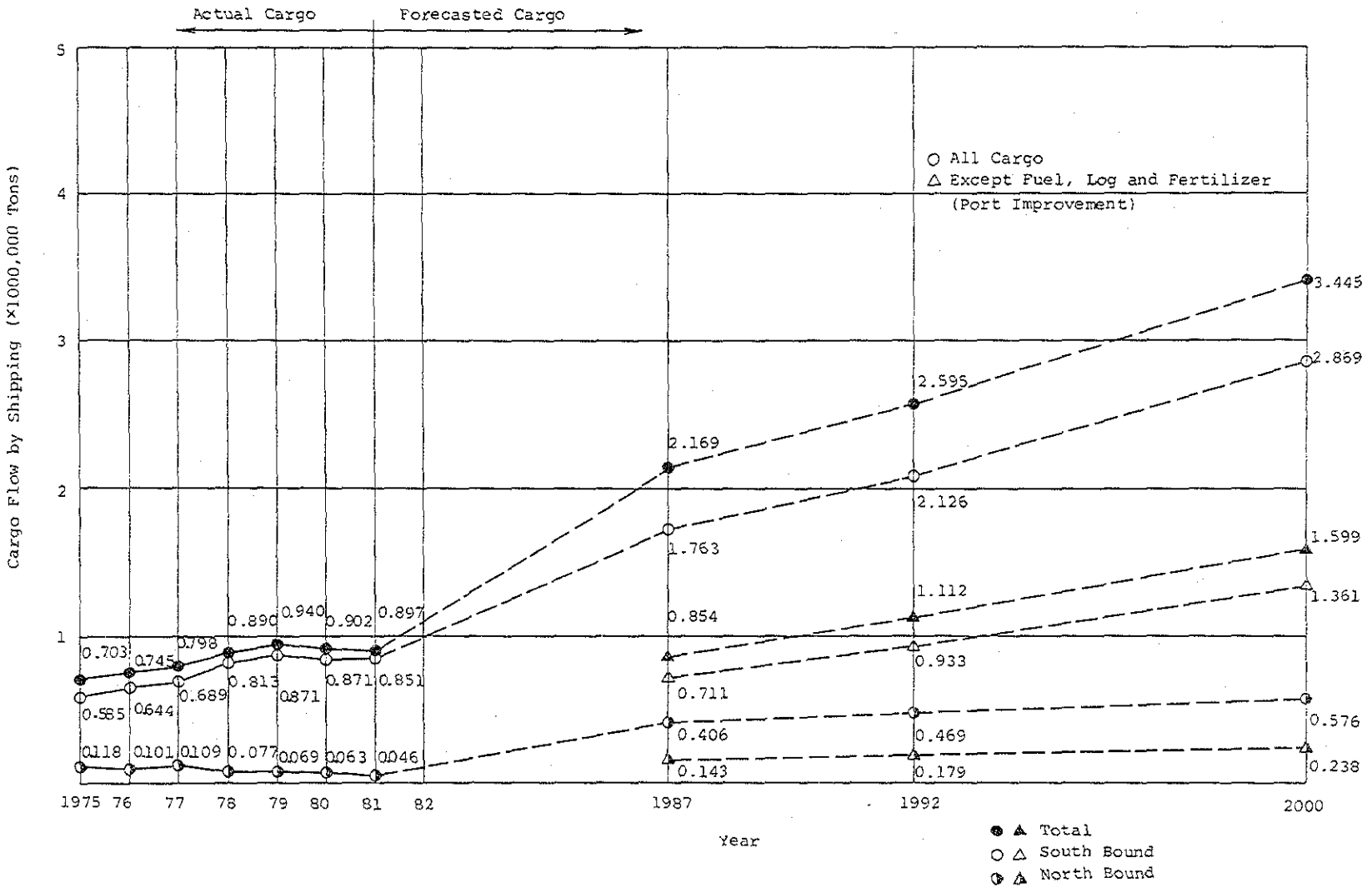


Fig. A.18-2 Cargo Flow by Shipping

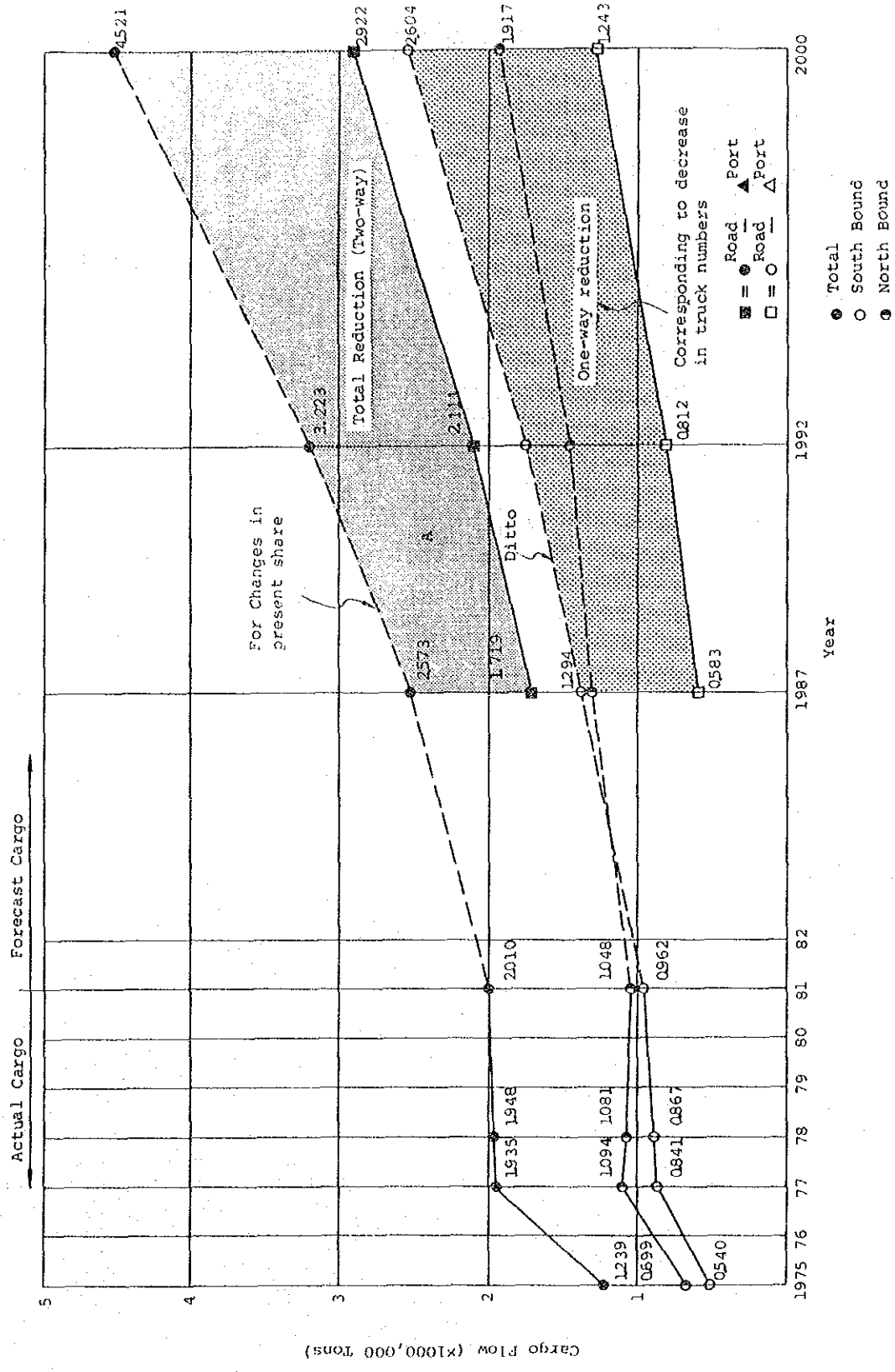


Fig. A.18-3 Cargo Flows by Road after Diversion

Target of Cargo Distribution (Road/Rail)

General Cargo	:	Y = 0.172 -86.4
Fertilizer	:	Y = 0.187 -86.3
Construction Material	:	Y = 0.109 -66.4
Rice	:	Y = 0.188 -90.5
Maize	:	Same as Fertilizer
Fuel	:	Y = 0.238 -63.5

Table A.18-1 (1) The Rate of Distribution by Road (Southbound)

Unit: %

Distance / Commodity	Chumphon 460 km	Ban Don 670 km	Pak Phanang 790 km	Songkhla 950 km	Pattani 1,010 km	Narathiwat 1,130 km
General Cargo	100	71.2	50.5	23.0	12.7	0
Fertilizer	100	61.0	38.6	8.7	0	0
Const. M.	100	93.4	80.3	62.9	56.3	43.2
Rice	100	64.5	42.0	11.9	0.6	0
Maize	100	61.0	38.6	8.7	0	0
Fuel	54.0	4.0	0	0	0	0

100-Y

Target of Cargo Distribution (Road/Rail)

General Cargo : (Assumed) similar to Fish Products

Wood Products : Y = 0.164 -69.8

Fish Products : Y = 0.0621 -40.1

Vegetable & Fruit : (Assumed) similar to Fish Products

Rice : Same as Rice (Southbound)

Rubber : (Assumed) by rail

Table A.18-1 (2) The Rate of Distribution by Road (Northbound)

Unit: %

Distance / Commodity	Chumphon 460 km	Ban Don 670 km	Pak Phanang 790 km	Songkhla 950 km	Pattani 1,010 km	Narathiwat 1,130 km
General Cargo	100	100	90 (100)	80 (100)	80 (100)	70 (100)
Wood Products	94.4	59.9	40.2	14.0	0.4	0
Fish Products	100	98.5	91.0	81.1	77.4	69.9
Veg. & Fruits	100	100	90 (100)	80 (100)	80 (100)	70 (100)
Rice	100	64.5	42.0	11.9	0.6	0
Rubber	0	0	0	0	0	0

100-Y

Table A.18-2 (1) Estimated Cargo Volume by Roads, 1987

Unit: Thousand Tons

	Commodity	Chumphon	Ban Don	Pak Phanang	Songkhla	Pattani	Narathiwat	Total
South-bound	General Cargo	242	281	117	109	14	0	763
	Fertilizer	8	14	17	5	0	0	44
	Construction Material	52	100	31	144	30	5	362
	Rice	20	4	6	1	0	0	31
	Maize	5	5	4	1	0	0	15
	Dry Total	327	404	175	260	44	5	1,215
	Fuel	67	12	0	0	0	0	79
	Southbound Total	394	416	175	260	44	5	1,294
North-bound	General Cargo	25	37	22	62	6	4	156
	Wood Products	277	73	24	4	0	0	378
	Fish Products	212	203	43	117	29	8	612
	Vegetable & Fruits	34	53	15	7	6	2	117
	Rice	0	0	13	3	0	0	16
	Rubber	0	0	0	0	0	0	0
	Northbound Total	548	366	117	193	41	14	1,279
Total	Total	942	782	292	453	85	19	2,573

Table A.18-2 (2) Estimated Cargo Volume by Roads, 1992

Unit: Thousand Tons

	Commodity	Chumphon	Ban Don	Pak Phanang	Songkhla	Pattani	Narathiwat	Total
South-bound	General Cargo	347	375	141	141	19	0	1,023
	Fertilizer	12	24	27	8	0	0	71
	Construction Material	69	153	44	182	50	7	505
	Rice	21	5	6	1	0	0	33
	Maize	7	8	5	2	0	0	22
	Dry Total	456	565	223	334	69	7	1,654
	Fuel	78	13	0	0	0	0	91
	Southbound Total	534	578	223	334	69	7	1,745
North-bound	General Cargo	36	56	31	86	8	5	222
	Wood Products	306	81	27	4	0	0	418
	Fish Products	234	224	46	129	33	10	676
	Vegetable & Fruits	42	67	18	10	6	2	145
	Rice	0	0	14	3	0	0	17
	Rubber	0	0	0	0	0	0	0
	Northbound Total	618	428	136	232	47	17	1,478
Total	Total	1,152	1,006	359	566	116	24	3,223

Table A.18-2 (3) Estimated Cargo Volume by Roads, 2000

Unit: Thousand Tons

	Commodity	Chumphon	Ban Don	Pak Phanang	Songkhla	Pattani	Narathiwat	Total
South-bound	General Cargo	519	557	210	211	29	0	1,526
	Fertilizer	26	49	53	16	0	0	144
	Construction Material	116	259	84	216	68	14	757
	Rice	24	5	7	1	0	0	37
	Maize	15	12	10	4	0	0	41
	Dry Total	700	882	364	448	97	14	2,505
	Fuel	85	14	0	0	0	0	79
	Southbound Total	785	896	364	448	97	14	2,604
North-bound	General Cargo	66	112	50	151	12	8	399
	Wood Products	359	95	31	5	0	0	490
	Fish Products	274	270	54	151	39	11	799
	Vegetable & Fruits	59	95	26	13	10	4	207
	Rice	0	0	18	4	0	0	22
	Rubber	0	0	0	0	0	0	0
	Northbound Total	758	572	179	324	61	23	1,917
Total	Total	1,543	1,468	543	772	158	37	4,521

APPENDIX 19 OUT-LINE OF COASTAL PORTS IN SOUTHERN REGION

APPENDIX 19 OUTLINE OF COASTAL PORTS IN SOUTHERN REGION

The Outline of coastal ports in Southern region consists of I. Port Activity and II. Dredging, individually.

No.	Port Name
1	Ban Don including Tha Thong Port
2	Khanom
3	Pak Phanang
4	Songkhla
5	Pattani
6	Narathiwat
7	Phuket (for reference)
8	Tha-Sala (for reference)
9	Sichon (for reference)

Source: Technical Division, HD
Dredging & Maintenance Division, HD
Planning Division, DOH
Coastal Ports Study, Final Report by
Maunsell Consultants Limited. April 1980

Table A.19-1 (1) Out-line of Coastal Ports, Ban Don

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	Inner 40 Outer 60	IBRD Loan Dredging: Approach Channel to -4.5 m depth for 1,000 GRT (By Contract Dreding in 1984)
Length (m)	Do 10,000 Do 25,500	
Depth (m)	Do -2.0 Do -4.0	
(2) Tidal Conditions		———
HWS (m)	+2.50	
MSL (m)	+1.40	
LWS (m)	+0.30	
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Tha Thong Port 1,000 GRT (193.6 + 93.6)m × 14.18m × -6	
Municipal Jetty	Small passenger landing facility	
FMO Wharf	$99.5^m \times 20^m$	ADB loan fisheries wharf 100 or 150m long
CSO Plant	Nil	
Private Fish	Numerous Small wharves	
Oil	Oil wharves and depots	
Cargo	$25^m \times 8^m$ & $30^m \times 20^m$	
Others	Repair shipyard for fishing vessel	
(4) Seasonal Influence	The port is usable all the year round	———
(5) Shipping Company	Cho Vanakit Co., Ltd.	

Table A.19-1 (2) Out-line of Coastal Ports, Ban Don

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1971*	3.1	1,070,500	K 2&3
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance Dredging including Annual Budget, Volume & Dredger's Name for recent 5 years	1978	-	73,400+	K 3
	1979	-	155,700	K 1
	1980	1.2	1,003,000	K 1, 2 & 4
	1981	0.8	148,199	K 4
	1982	1.5	174,000	K 2
			190,600	K 1
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance Dredging Programme up to 1986	1983			K 6
	1984	As Contract Dredging		(K 1 & 3)
	1985			K 1, 3 & 8
	1986			K 1, 3 & 8
(4) Dredging Method including Disposal Area				
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume 174,000 M^3P.a. ii) Silt Rate 0.1 M p.a.			
(6) Remarks	* Capital dredging had been continued up to 1976 Total Budget 24.3 MB Total Volume 8,500,000 M3 + indicates Klong Tha Thong			

Table A.19-2 (1) Out-line of Coastal Ports, Khanom

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	40	
Length (m)	530	
Depth (m)	-3.0 (Inside)	
(2) Tidal Conditions		
HWS (m)		
MSL (m)	Unknown	
LWS (m)		
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Nil	
Municipal Jetty	Ferry Jetty (790 GRT)	
FMO Wharf	Nil	
CSO Plant	Nil	
Private Fish	Many small berths	
Oil	Seaberth (L/P, Dolphins) for 1,000 DWT Tanker	As the oil berth of Power Plant.
Cargo	Nil	
	Gypsum loading jetty - Private	Another loading jetty (Gypsum)
Others	Approx. 5 km from the Port	20,000 - 30,000 DWT
(4) Seasonal Influence		
(5) Shipping Company		

Table A.19-2 (2) Out-line of Coastal Ports, Khanom

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1978	0.4	114,700	K 3
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance Dredging including Annual Budget, Volume & Dredger's Name for recent 5 years	1978	a/m	a/m	a/m
	1979	Nil	Nil	Nil
	1980	Nil	Nil	Nil
	1981	Nil	Nil	Nil
	1982	1.3	97,000	K 4
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance Dredging Programme up to 1986	1983, 1984, 1985, 1986	Nil		
(4) Dredging Method including Disposal Area	Vessel engaged in M/Dredging is hopper dredger.			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume M^3 p.a. ii) Silt Rate M p.a.			
(6) Remarks	No dredging in fiscal year 1979-1981 * River training wall (at River Mouth)			

Table A.19-3 (1) Out-line of Coastal Ports, Pak Phanang

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	60	SEATEC's Proposal:
Length (m)	24,000	Alternative Navigation Channel
Depth (m)	-3.0	-3.0m × 11 km
(2) Tidal Conditions		
HWS (m)	+1.4	———
MSL (m)	+0.8	
LWS (m)	+0.2	
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Nil	SEATEC's Alternative Port: at Ban Pak Nakhon (F/S only)
Municipal Jetty	$10^m \times 6^m$	
FMO Wharf	Nil	FMO's Proposal: Construction of new facilities in 1984, 1985
CSO Plant	Nil	
Private Fish	24 Fishing Wharves $280^m \times 240^m$	
Oil	2 oil Wharves $2 \times (10^m \times 15^m)$	
Cargo	3 Cargo Wharves $3 \times (10^m \times 5^m)$	
Others	Nil	
(4) Seasonal Influence	The entrance to the port is protected from the NE Monsoon.	
(5) Shipping Company	Srithamaraj Transport Co. Ltd.	

Table A.19-3 (2) Out-line of Coastal Ports, Pak Phanang

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1981*	1.5	-	K 19 & 21
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance Dredging including Annual Budget. Volume & Dredger's Name for recent 5 years	1978			
	1979	Nil	Nil	Nil
	1980			
	1981*	a/m	a/m	a/m
	1982	7.3	1,255,000	K 19 & 21
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance Dredging Programme up to 1986	1983			K 21
	1984			K 21
	1985			K 19 & 29
	1986			K 21
(4) Dredging Method including Disposal Area	Disposal area is located along the channel. (Approx. 200 m. behind)			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume 250,000 M^3p.a. ii) Silt Rate 0.14 M p.a.			
(6) Remarks	* Capital dredging to be 1981 - 1984			

Table A.19-4 (1) Out-line of Coastal Ports, Songkhla

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel	Inner / Outer	
Width (m)	250 / 100	
Length (m)	4,000 / 3,000	
Depth (m)	-5.5 / -5.5	
(2) Tidal Conditions		
HWS (m)	(HAT) + 1.40	
MSL (m)	(LLW) + Varies - 0.00	
LWS (m)		
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Local government wharf is leased as private wharves. (ex. SEA Land Co., Ltd.)	Deep-sea Port plan by ADB loan
Municipal Jetty	Ferry Jetty	(*) Navy Pier (12m wide × -4.0)
FMO Wharf	90m long × -4.0	H/D Pier (85m long × -6.0)
CSO Plant	Nil	Marine Police Pier (-3.5)
Private Fish	Numerous Fishery Berths	State Railway Pier - Oil (50m × 15m × -6.0)
Oil	Nil	(Private wharves:)
Cargo	See (*)	1. TBH Pier (50m × 15m)
Others	See (*)	2. TMN Pier (90m×20m×-5.0)
		3. Harinsuit Co., Pier
		4. Hua Huphin Co., Pier
		5. Repair Yard (3 company Max 200 GT. Ave 30 GT
(4) Seasonal Influence	Port operated all year round	
(5) Shipping Company	Harinsuit Transport Co., Ltd. Tharoe Chakrwad Co., Ltd.	

TBH Teck Bee Hang Co., Ltd.
TMN Thai Maritime Navigation Co., Ltd.

Table A.19-4 (2) Out-line of Coastal Ports, Songkhla

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1967	0.6	337,500	K 3
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance	1978		34,300	K 2
Dredging including	1979	Nil	Nil	Nil
Annual Budget, Volume	1980	Nil	Nil	Nil
& Dredger's Name for	1981	0.9	102,600	K 2
recent 5 years	1982	1.6	140,000	K 4
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance	1983			
Dredging Programme	1984	Inner Every 3 years		
up to 1986	1985	Outer Every 2 years (or Every year if necessary)		
	1986			
(4) Dredging Method including Disposal Area	Disposal area is located behind Ko Nu. (the distance from approach channel is approx. 3 km) Vessel engaged in M/Dredging is hopper dredger.			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume 500,000 M^3 p.a. ii) Silt Rate M p.a.			
(6) Remarks	Dredging had been carried out every year from 1967 to 1977 Total Budget. more than 23 MB Total Volume. approx. 9,500,000 M^3			

Table A.19-5 (1) Out-line of Coastal Ports, Pattani

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	60	
Length (m)	4,000	
Depth (m)	-3.0	
(2) Tidal Conditions		
HWS (m)	+1.1	
MSL (m)	+0.8	
LWS (m)	+0.6	
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Pattani Port Started in 1982 and will be finished in 1984 *	* for 1,000 GRT. (195m × 26m)
Municipal Jetty	Nil	
FMO Wharf	100m × 12m (1972) 75m × 3m	75m long timber wharf
CSO Plant	Cold store (1980)	
Private Fish		
Oil	7 Private wharves (84m × 49m)	
Cargo		
Others	Nil	
(4) Seasonal Influence	Operations restricted by NE Monsoon (Nov. - March)	
(5) Shipping Company		

Table A.19-5 (2) Out-line of Coastal Ports, Pattani

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1969	18.4	1,044,900	K 1
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance	1978		479,200	K 3
Dredging including	1979	Nil	Nil	Nil
Annual Budget, Volume	1980	1.0	232,700	K 3
& Dredger's Name for	1981	Nil	Nil	Nil
recent 5 years	1982	Nil	Nsl	Nil
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance	1983			
Dredging Programme	1984			
up to 1986	1985	IBRD loan	-	K 8
	1986			
(4) Dredging Method including Disposal Area	Disposal area is located adjacent to river bank, therefore the dredging is not effective becaused of backing into navigation channel.			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume 145,000 M^3 p.a. ii) Silt Rate 0.6 M p.a.			
(6) Remarks	* Capital dredging had been continued till 1970 Total Budget 3.1 MB Total Volume 1,650,000 M^3			

Table A.19-6 (1) Out-line of Coastal Ports, Narathiwat

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	40	
Length (m)	2,000	
Depth (m)	-3.0	
(2) Tidal Conditions		
HWS (m)	+1.0	
MSL (m)	+0.5	
LWS (m)	±0.0	
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Nil	
Municipal Jetty	Nil	
FMO Wharf	Nil	
CSO Plant	Nil	
Private Fish	Many small berths	
Oil	Nil	
Cargo	40m long wharf	
Others		
(4) Seasonal Influence	Port closed during NE Monsoon Season Lightering only possible March - Oct.	
(5) Shipping Company		

Table A.19-6 (2) Out-line of Coastal Ports, Narathiwat

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1969		97,800	K 15
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance	1978	Nil	Nil	Nil
Dredging including	1979	a/m	a/m	a/m
Annual Budget, Volume	1980	1.0	189,500	K 3
& Dredger's Name for	1981	1.0	164,500	K 1
recent 5 years	1982	Nil	Nil	
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance	1983			K 19
Dredging Programme	1984			
up to 1986	1985			K 1
	1986			
(4) Dredging Method including Disposal Area	Disposal area is located along the channel. (Approx. 200m behind)			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume 90,000 M^3 p.a. ii) Silt Rate 0.5 M p.a.			
(6) Remarks	* Capital dredging had been continurd until 1980. Total Budget 1.4 MB Total Volume 203,700 M^3			

Table A.19-7 (1) Out-line of Coastal Ports, Phuket

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel	Khlong-Thachin	
Width (m)	60	
Length (m)	4,000	
Depth (m)	-3.0	
(2) Tidal Conditions		
HWS (m)	+3.4	
MSL (m)	+1.9	
LWS (m)	+0.3	
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf		Deep-sea Port Plan under the assistance of ADB loan
Municipal Jetty		As well as Songkhla Port. The construction will be commenced in 1984.
FMO Wharf	with Cold Storage (121m × 17m)	
CSO Plant		The CSO propose to build a new plant adjacent to FMO wharf. (180m long)
Private Fish	Mani Fisher Berths	
Oil	Oil Berth & Depot	
Cargo	Timber wharf (50m long) : Lighter with container	
Others		
(4) Seasonal Influence	Port is usable all year round.	
(5) Shipping Company		

Table A.19-7 (2) Out-line of Coastal Ports, Phuket

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget M฿	Volume M^3	Dredger
	1970	1.4	404,600	K 7
(2) Maintenance Dredging	Year	Budget M฿	Volume M^3	Dredger
Record of Maintenance Dredging including Annual Budget, Volume & Dredger's Name for recent 5 years	1978	Nil	Nil	Nil
	1979	Nil	Nil	Nil
	1980	1.6	121,600	K 4 & 7
	1981	Nil	Nil	Nil
	1982	2.4	182,700	K 2 & 5
(3) Dredging Programme	Year	Budget M฿	Volume M^3	Dredger
Capital/Maintenance Dredging Programme up to 1986	1983			
	1984			
	1985			
	1986			
(4) Dredging Method including Disposal Area	M/Dredging is carried out by Cutter and Hopper.			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume M^3 p.a. ii) Silt Rate M p.a.			
(6) Remarks	M/Dredging had executed from 1971 to 1977 continuously Total Budget more than 7.60 M฿ Total Volume approx. 3,200,000 M^3			

Table A.19-8 (1) Out-line of Coastal Ports, Tha-Sala

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	40	
Length (m)	800	
Depth (m)	-2.0	
(2) Tidal Conditions		
HWS (m)		
MSL (m)	Unknown	
LWS (m)		
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Nil	
Municipal Jetty	Nil	
FMO Wharf	Nil	
CSO Plant	Nil	
Private Fish	Fisher boat berths only	
Oil	Nil	
Cargo	Nil	
Others		
(4) Seasonal Influence		
(5) Shipping Company		

Table A.19-8 (2) Out-line of Coastal Ports, Tha-Sala

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MK	Volume M^3	Dredger
	1969	0.5	97,000	K 3
(2) Maintenance Dredging	Year	Budget MK	Volume M^3	Dredger
Record of Maintenance	1978	Nil	Nil	Nil
Dredging including	1979	a/m	a/m	a/m
Annual Budget. Volume	1980	1.3	152,400	K 1 & 3
& Dredger's Name for	1981	Nil	Nil	Nil
recent 5 years	1982	Nil	Nil	Nil
(3) Dredging Programme	Year	Budget MK	Volume M^3	Dredger
Capital/Maintenance	1983			
Dredging Programme	1984			
up to 1986	1985			
	1986			
(4) Dredging Method including Disposal Area				
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume M^3 p.a. ii) Silt Rate M p.a			
(6) Remarks				

Table A.19-9 (1) Out-line of Coastal Ports, Sichon

I. Port Activity

Item	Existing Operations (including On-going Project)	Future Plan (Existing Development Proposal)
(1) Approach Channel		
Width (m)	40	
Length (m)	800	
Depth (m)	-2.0	
(2) Tidal Conditions		
HWS (m)		
MSL (m)	Unknown	
LWS (m)		
(3) Facilities	Dimensions (L × W × Depth)	Dimensions (L × W × Depth)
Government Wharf	Nil	
Municipal Jetty	Nil	
FMO Wharf	Nil	
CSO Plant	Nil	
Private Fish	Fisher boat berths only	
Oil	Nil	
Cargo	Nil	
Others		
(4) Seasonal Influence		
(5) Shipping Company		

Table A.19-9 (2) Out-line of Coastal Ports, Sichon

II. Dredging

Item	Record or Programme			
(1) Capital Dredging	Year	Budget MB	Volume M^3	Dredger
	1982	1.1	114,000	K 1
(2) Maintenance Dredging	Year	Budget MB	Volume M^3	Dredger
Record of Maintenance Dredging including Annual Budget. Volume & Dredger's Name for recent 5 years	1978 1979 1980 1981 1982	Nil a/m	a/m	a/m
(3) Dredging Programme	Year	Budget MB	Volume M^3	Dredger
Capital/Maintenance Dredging Programme up to 1986	1983 1984 1985 1986	Nil		
(4) Dredging Method including Disposal Area	Capital dredging in 1982 was carried out by mean of cutter suction dredger.			
(5) Siltation/Sedimentation ie. Littoral Driff affecting Navigation Channel	i) Estimated Maintenance Volume M^3 p.a. ii) Silt Rate M p.a.			
(6) Remarks