Table II.6.1 Construction Schedule for the Short-term Development Plan

Main Items	1985	1986	1987	1988	1989	1990
1. Mobilization and Demobilization						
2. Breakwater						
3. Revetment						
4. Dredging/Reclamation						
5. Container Berth						
6. Breakbulk Berth						
7. Domestic Wharf						
8. Tapioca Terminal						
9. Sugar/Molasses Wharf						
10. Ship Repair Yard						
11. Building						
12. Utility						
13. Road, Railway etc.						
14. Engineering Study						

COST ESTIMATE BREAKDOWN

Table II.6.2 CONSTRUCTION COST OF PORT/HARBOR FACILITIES (SHORT TERM DEVELOPMENT PLAN: REFER TO THE ATTACHED FIG.II.6.6) (Revised on Dec 15)

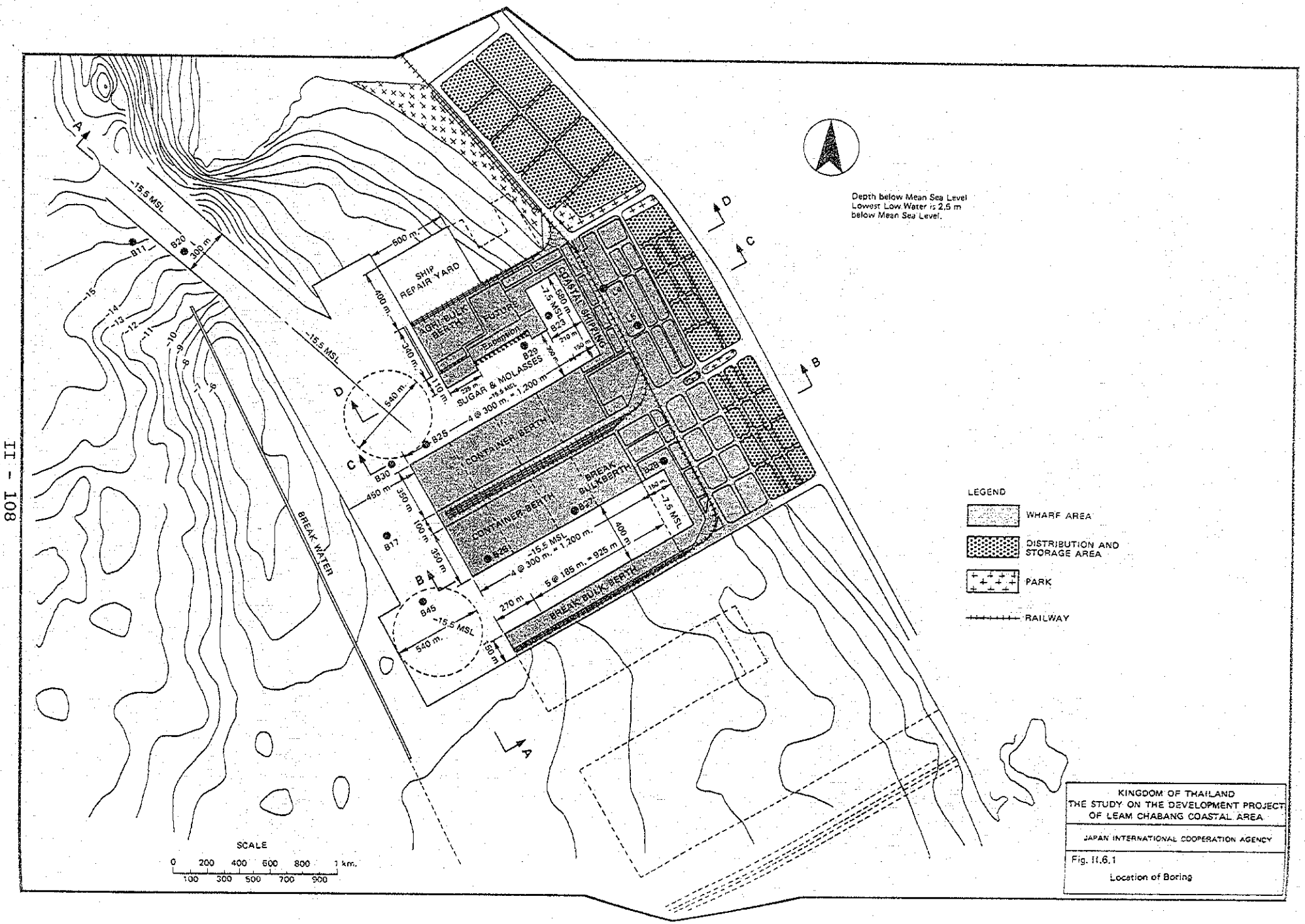
Items	Unit	Unit Cost (Baht) Total	Unit Cost (Baht) Foreign Currency	Unit Cost (Baht) Local Currency	Quantity	Cost (1,000 Baht) Total	Cost (1,000 Baht) Foreign Currency	Cost (1,000 Baht) Local Currency	Remarks
PUBLIC FACILITIES AND WHARVES									
1. Dredging & Reclamation	m^3	55	38	17	8,465,000	465,575	321,670	143,905	
2. Earthwork (Filling)	m^3	46	21	25	1,342,000	61,732	28,182	33,550	
3. Protective Facilities						751,000	334,225	416,775	
1) Breakwater	m	183,000	83,000	100,000	2,400	439,200	199,200	240,000	average depth -7^m
2) Revetment						311,800	135,025	176,775	
(1) R-9	m	39,000	18,000	21,000	210	8,190	3,780	4,410	
(2) R-10	m	137,000	62,000	75,000	1,200	164,400	74,400	90,000	
(3) R-11	m	221,000	86,500	134,500	450	99,450	38,925	60,525	
(4) R-12	m	71,000	32,000	39,000	560	39,760	17,920	21,840	
4. Mooring Facilities						1,055,210	527,370	527,840	
1) QW-2	m	792,000	396,000	396,000	900	712,800	356,400	356,400	3 container wharves
2) QW-2	m	792,000	396,000	396,000	300	237,600	118,800	118,800	1 break bulk wharf
3) LW-1	m	223,000	111,000	112,000	470	104,810	52,170	52,640	domestic wharf
5. Road	m	517.5	180	337.5	181,000	93,667	32,580	61,087	
6. Pavement						250,590	87,420	163,170	
1) Container Terminals	m^2	630	220	410	297,000	187,110	65,340	121,770	
2) Other Public Terminals	m^2	460	160	300	138,000	63,480	22,080	41,400	
7. Rail Track						90,000	30,000	60,000	
1) L_1	m	9,000	3,000	6,000	6,100	54,900	18,300	36,600	Container Terminal-Junction
2) L_2	m	9,000	3,000	6,000	3,900	35,100	11,700	23,400	Junction-Marshalling Yard
8. Building						509,040	75,720	433,320	
1) Port Administration Office	m^2	8,600	1,300	7,300	25,000	215,000	32,500	182,500	
2) Terminal Office						63,640	9,620	54,020	
a) Container Terminal	m^2	8,600	1,300	7,300	4,200	36,120	5,460	30,660	
b) Break Bulk Terminal	m^2	8,600	1,300	7,300	800	6,880	1,040	5,840	
c) Domestic Wharf	m^2	8,600	1,300	7,300	2,400	20,640	3,120	17,520	
3) Warehouse						72,000	10,500	61,500	
a) Domestic Wharf	m^2	4,800	700	4,100	10,000	48,000	7,000	41,000	
b) Wharf Area	m^2								
c) Inspection Warehouse	m^2	4,800	700	4,100	5,000	24,000	3,500	20,500	
4) Container Freight Station	m^2	4,800	700	4,100	15,000	72,000	10,500	61,500	
5) Transit Shed						86,400	12,600	73,800	
a) Break Bulk	m^2	4,800	700	4,100	8,000	38,400	5,600	32,800	
b) Domestic Wharf	m^2	4,800	700	4,100	10,000	48,000	7,000	41,000	
6) Maintenance Shop	m^2								Container Terminals
9. Lighting Installation	L.S				1	45,000	36,000	9,000	Container Terminals
10. Cargo Handling Equipment						312,440	292,440	20,000	
1) Container Terminals						300,000	280,000	20,000	
a) Gantry Crane	unit	75,000,000	70,000,000	5,000,000	4	300,000	280,000	20,000	3 Terminals
b) Transfer Crane	unit	-	-	-					(b)(c),(d): Future preparation
c) Forklift	unit	-	-	-					by private operators
d) Tractor and Chassis	unit	-	-	-					
2) Break Bulk Terminal	L.S	-	-	-	1	5,160	5,160	0	
3) Domestic Terminal	L.S	-	-	-	1	7,280	7,280	0	
11. Navigation Aids	L.S	-	-	-	1	12,000	10,800	1,200	Harbor radar not included
12. Tug Boat etc.	L.S	-	-	-	1	100,000	100,000	0	3,000HP x 2, 2,000HP x 1
13. Water Supply and Sewerage	L.S	-	-	-	1	7,800	4,100	3,700	2-Pilot boat
14. Sub-total		-	-	-		3,754,054	1,880,507	1,873,543	Including 2 pumping stations
15. Engineering Service		-	-	-		375,405	188,051	187,354	10%
16. Physical Contingency		-	-	-		825,541	414,442	411,099	20%
17. Total		-	-	-		4,955,000	2,483,000	2,472,000	

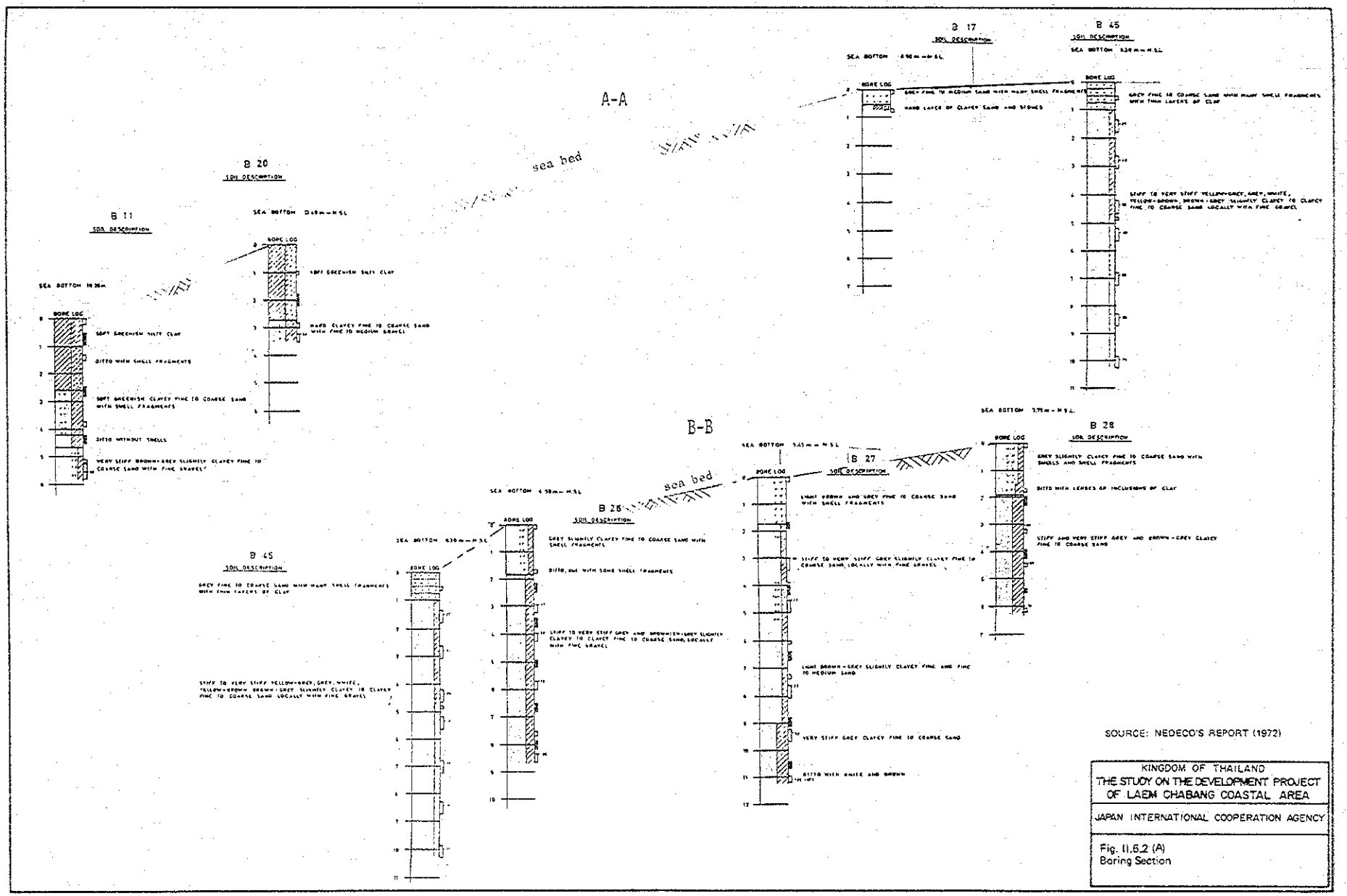
Table II.6.3 CONSTRUCTION COST OF PORT/HARBOR FACILITIES (SHORT TERM DEVELOPMENT PLAN)

Items	Unit	Unit Cost (Baht) Total	Foreign Currency	Local Currency	Quantity	Cost (1,000 Baht) Total	Foreign Currency	Local Currency	Remarks
PRIVATE FACILITIES AND WHARVES									
A. AGRIBULK WHARF									
1. Dredging & Reclamation	m^3	55	38	17	916,000	50,380	34,808	15,572	
2. Earthwork (Filling)	m^3	46	21	25	69,000	3,174	1,449	1,725	
3. Protective Facilities						94,440	38,063	56,377	Supplied by the Government
1) Breakwater						-	-	-	
2) Revetment						94,440	38,063	56,377	
(1) R-1	m	54,000	24,000	30,000	170	9,180	4,080	5,100	
(2) R-5	m	222,200	87,000	135,200	340	75,548	29,580	45,968	
(3) R-7'	m	39,000	18,000	21,000	70	2,730	1,260	1,470	
(4) R-0"	m	23,750	10,700	13,050	127	3,016	1,359	1,657	
(5) R-5"		32,250	14,500	17,750	123	3,966	1,784	2,182	
4. Mooring Facility						142,800	85,680	57,120	
Detached Pier (p-1)	m	420,000	252,000	168,000	340	142,800	85,680	57,120	
5. Road	m^2	-	-	-	7,800	4,036	1,404	2,632	Future preparation access road
6. Pavement	m^2	-	-	-	-	-	-	-	prepared by a private operator
7. Rail Track	m	-	-	-	-	-	-	-	- do -
8. Building	m	-	-	-	-	-	-	-	- do -
1) Terminal Office	m^2	-	-	-	-	-	-	-	- do -
2) Transit Shed	m^2	-	-	-	-	-	-	-	- do -
9. Cargo Handling Equipment	L.S	-	-	-	-	-	-	-	- do -
10. Planting	m^2	-	-	-	-	-	-	-	
11. Water Supply and Sewerage	L.S					3,400	1,700	1,700	Including one pumping station(33%)
12. Sub-total		-	-	-	-	298,230	163,104	135,126	
13. Engineering Service		-	-	-	-	29,823	16,310	13,513	10%
14. Physical Contingency		-	-	-	-	64,947	35,586	29,361	20%
15. Total		-	-	-	-	393,000	215,000	178,000	
B. SUGAR AND MOLASSES WHARF									
1. Dredging & Reclamation	m^3	55	38	17	405,000	22,275	15,390	6,885	
2. Earthwork (Filling)	m^3	46	21	25	33,000	1,518	693	825	
3. Protective Facilities		-	-	-	-	43,850	18,553	25,297	
1) Breakwater		-	-	-	-	-	-	-	Suppling by the Government
2) Revetment		-	-	-	-	43,850	18,553	25,297	
(1) R-1	m	54,000	24,000	30,000	170	9,180	4,080	5,100	
(2) R-8'	m	124,000	56,000	68,000	40	4,960	2,240	2,720	
(3) R-6	m	222,200	87,000	135,200	90	19,998	7,830	12,168	
(4)	m	39,000	18,000	21,000	70	2,730	1,260	1,470	
(5) R-0"	m	23,750	10,700	13,050	127	3,016	1,359	1,657	
(6) R-5"	m	32,250	14,500	17,750	123	3,966	1,784	2,182	
4. Mooring Facility									
QW-1	m	764,000	382,000	382,000	225	171,900	85,950	85,950	
5. Road	m^2	-	-	-	20,000	10,350	3,600	6,750	Access road prepared by a private
6. Pavement	m^2	-	-	-	-	-	-	-	operator - do -
7. Rail Track		-	-	-	-	-	-	-	- do -
8. Building		-	-	-	-	-	-	-	- do -
1) Terminal Office	m^2	-	-	-	-	-	-	-	
2) Warehouse	m^2	-	-	-	-	-	-	-	
3) Molasses Tank	unit	-	-	-	-	-	-	-	
9. Cargo Handling Equipment	L.S	-	-	-	-	-	-	-	- do -
10. Water Supply and Sewerage	L.S	-	-	-	-	3,400	1,700	1,700	Including one pumping station(33%)
11. Sub-total		-	-	-	-	253,293	125,886	127,407	
12. Engineering Service		-	-	-	-	25,329	12,589	12,740	10%
13. Physical Contingency		-	-	-	-	55,378	27,525	27,453	20%
14. Total		-	-	-	-	334,000	166,000	168,000	
C. SHIP REPAIR YARD									
1. Dredging & Reclamation	m^3	55	38	17	94,000	5,170	3,572	1,598	
2. Earthwork (Filling)	m^3	46	21	25	126,000	5,796	2,646	3,150	
3. Protective Facilities						183,392	82,683	100,709	
1) Breakwater		-	-	-	-	-	-	-	supplied by the Government

Table II.6.3 CONSTRUCTION COST OF PORT/HARBOR FACILITIES (SHORT TERM DEVELOPMENT PLAN)

Items	Unit	Unit Cost (Baht) Total	Foreign Currency	Local Currency	Quantity	Cost (1,000) Baht) Total	Foreign Currency	Local Currency	Remarks
2) Revetment		-	-	-	-	183,392	82,683	100,709	
(1) R-1 -		54,000	24,000	30,000	170	9,180	4,080	5,100	
(2) R-2 -		62,000	28,000	34,000	400	24,800	11,200	13,600	
(3) R-0" -		23,750	10,700	13,050	127	3,016	1,359	1,657	
(4) R-3 -		137,000	62,000	75,000	500	68,500	31,000	37,500	
(5) R-4 -	m	178,000	80,000	98,000	400	71,200	32,000	39,200	
(6) R-7'	m	39,000	18,000	21,000	70	2,730	1,260	1,470	
(7) R-5"		32,250	14,500	17,750	123	3,966	1,784	2,182	
4. Mooring Facility									
5. Road	m^2	517.5	180	337.5	7,800	4,036	1,404	2,632	Access Road
6. Pavement	m^2	-	-	-	-	-	-	-	prepared by a private operator
7. Rail Track	m	-	-	-	-	-	-	-	- do -
8. Building	m^2	-	-	-	-	-	-	-	- do -
9. Cargo Handling Equipment		-	-	-	-	-	-	-	- do -
10. Water Supply and Sewerage	L.S	-	-	-	-	3,600	1,700	1,900	Including one pumping station (33%)
11. Sub-total		-	-	-	-	201,994	92,005	109,989	
12. Engineering Service		-	-	-	-	20,199	9,200	10,999	10%
13. Physical Contingency		-	-	-	-	43,807	19,795	24,012	20%
14. Total						266,000	121,000	145,000	


Depth below Mean Sea Level
Lowest Low Water is 2.5 m
below Mean Sea Level.
LEGEND
WHARF AREA
DISTRIBUTION AND STORAGE AREA
PARK
RAILWAY
SHIP REPAIR YARD
AGRI. BULK BERTH
FUEL DEPOT
EXPORTION
COASTAL SHIPPING
SUGAR & MOLASSES
CONTAINER BERTH
BREAK BULK BERTH
BREAK WATER
-15.5 MSL
-7.5 MSL
SCALE
0 200 400 600 800 1 km.
100 300 500 700 900
KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LEAM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. II.6.1
Location of Boring



SOURCE: NEDECO'S REPORT (1972)

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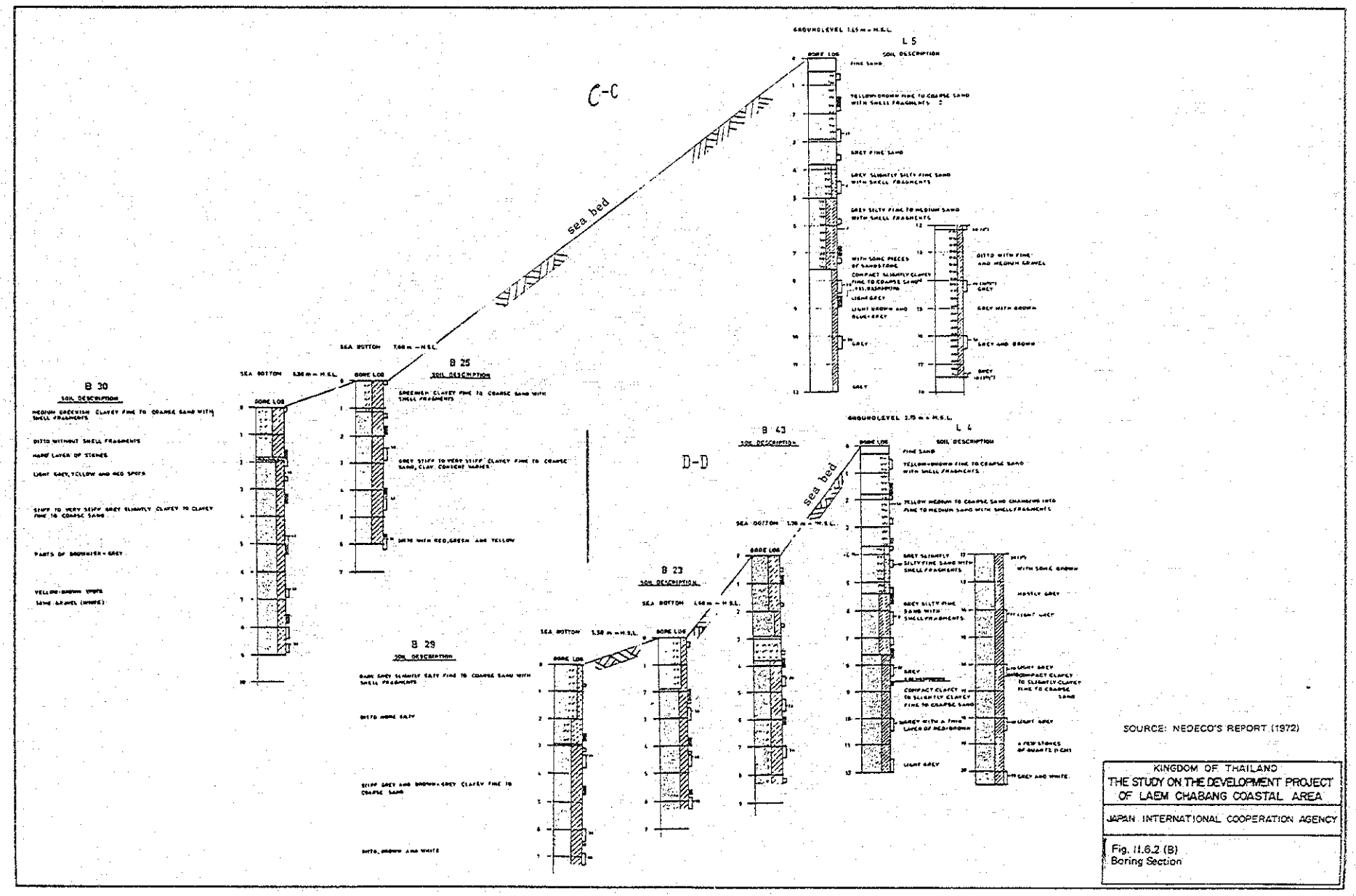
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. II.6.2 (A)
Boring Section



SOURCE: NEDECO'S REPORT (1972)

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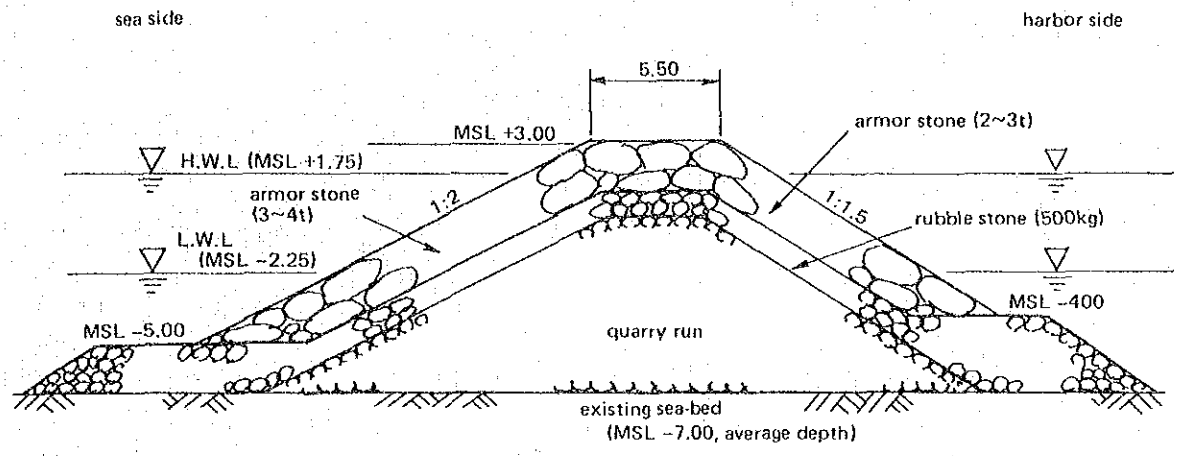
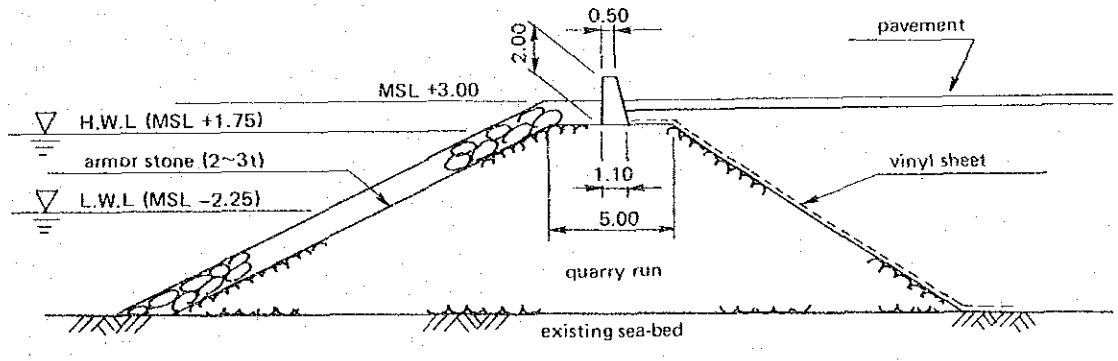
Fig. II.6.2 (B)
Boring Section





LEGEND

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THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA

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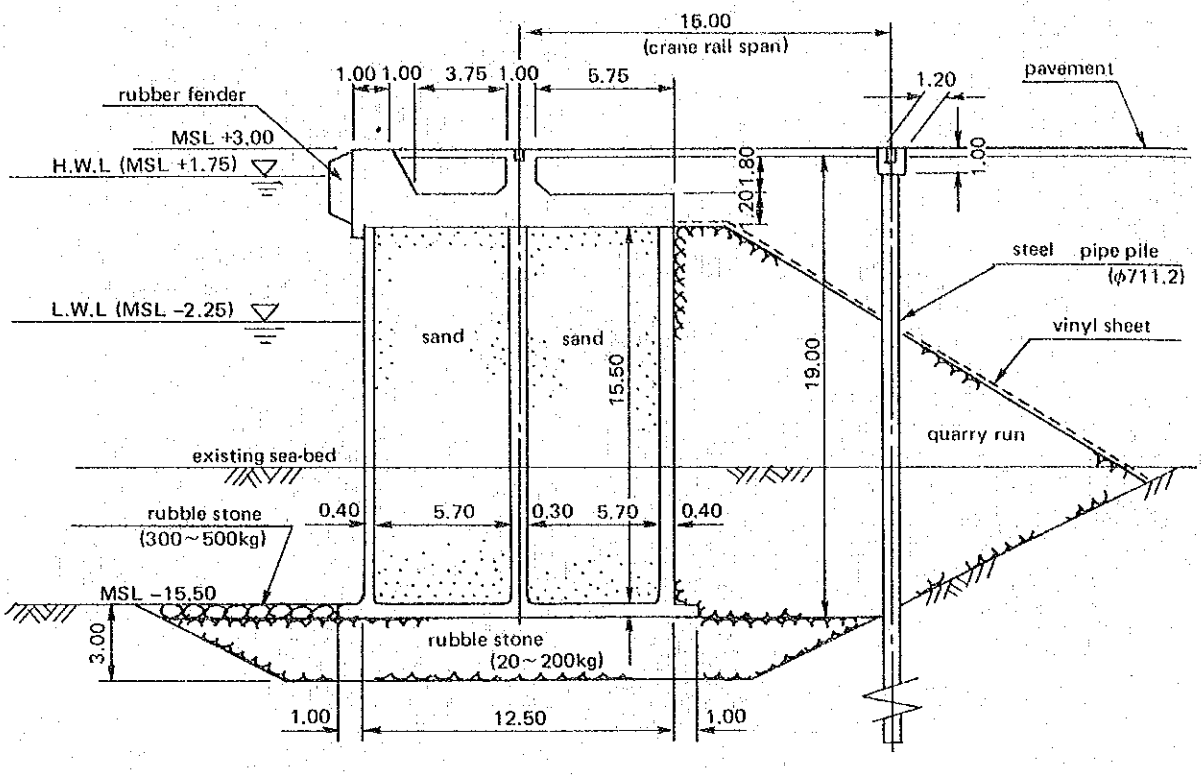
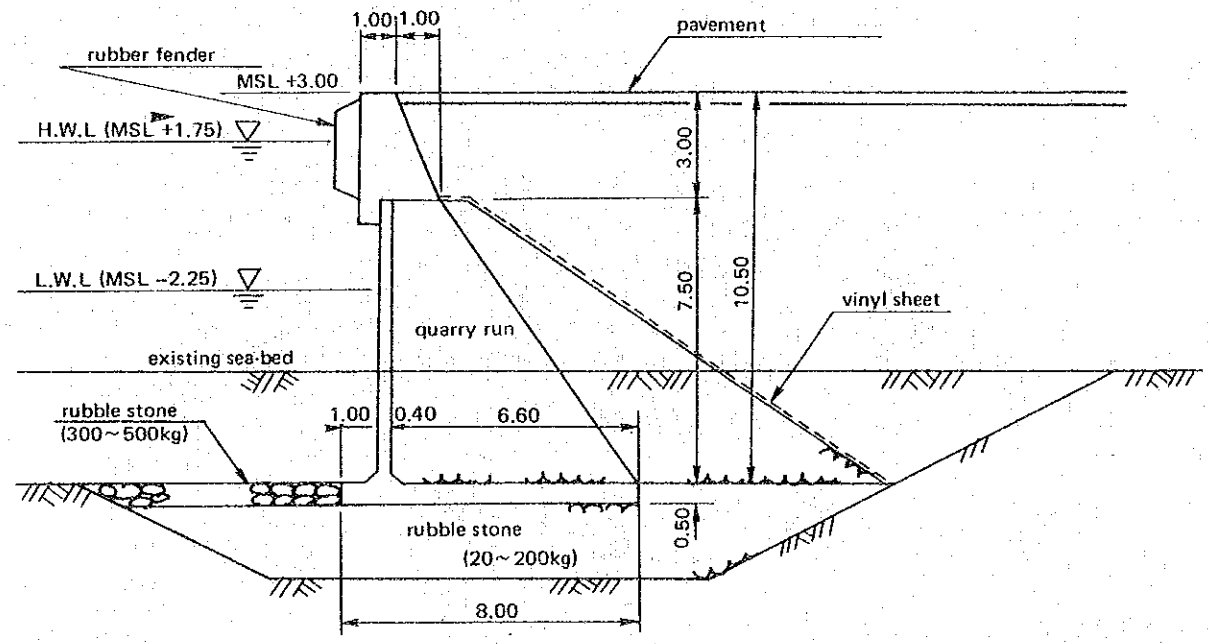
Fig. II.6.3
Breakwater Revetment

S = 1/300





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OF LAEM CHABANG COASTAL AREA

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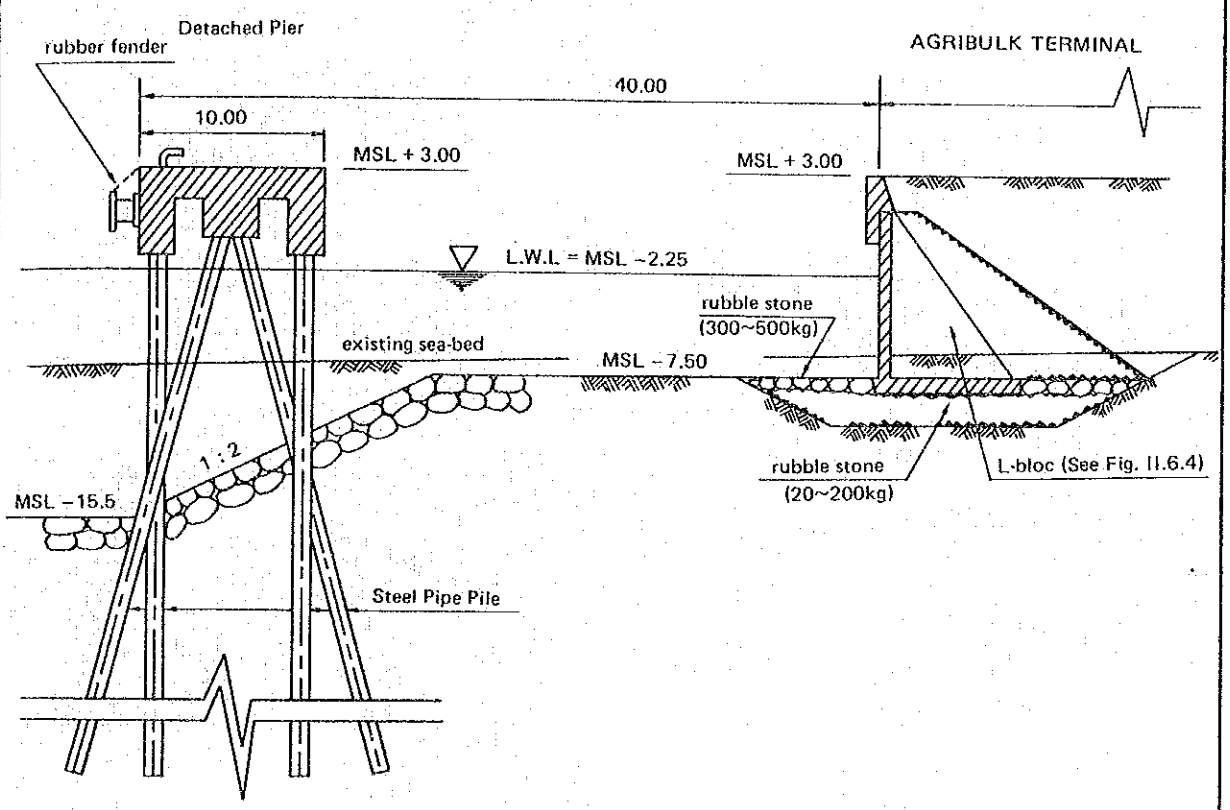
Fig. II.6.4
Quaywall (Caisson & L-bloc) S = 1/200



LEGEND

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OF LAEM CHABANG COASTAL AREA

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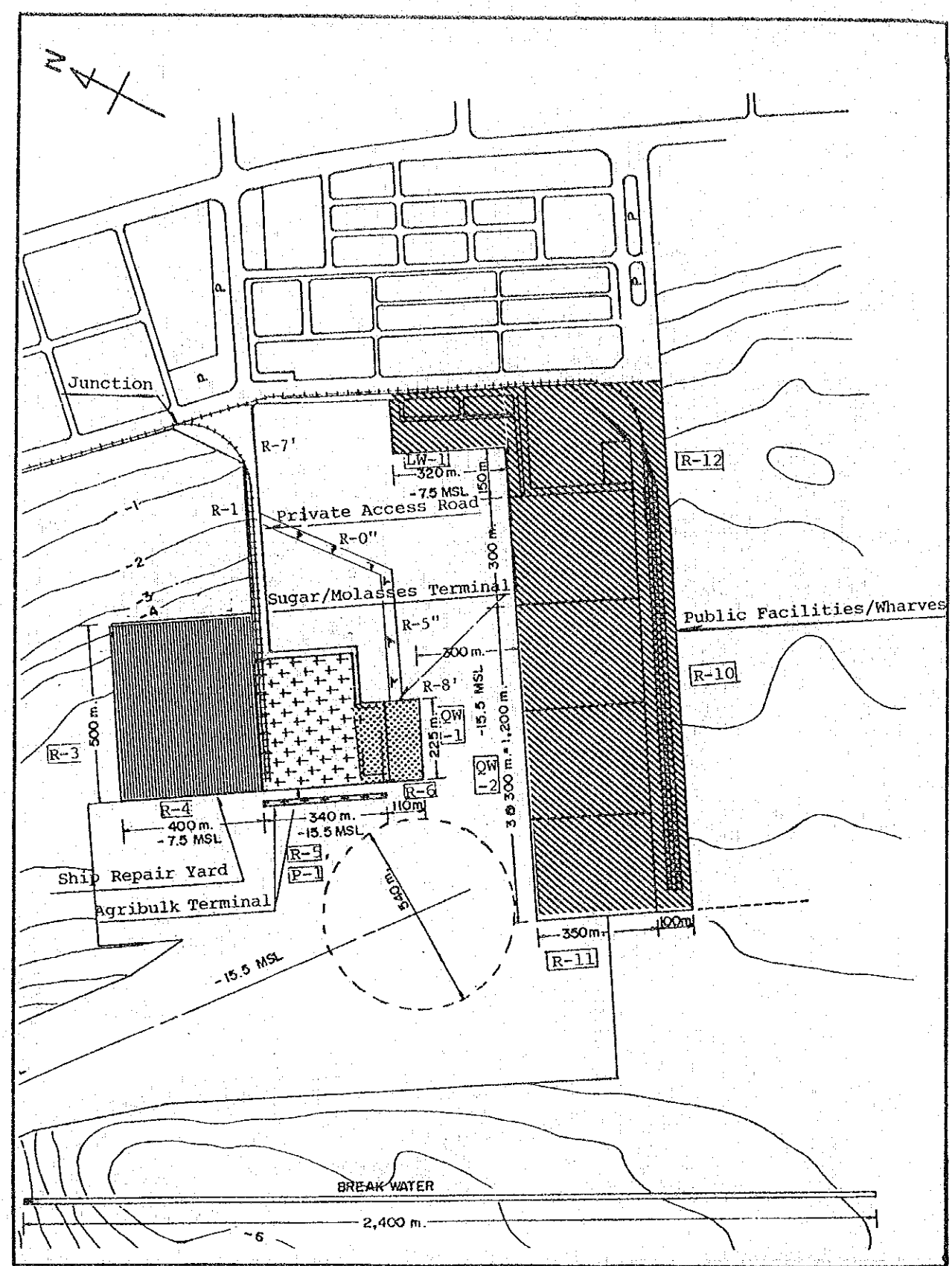
Fig. II.6.5
Detached Pier for Agribulk Terminal S = 1/400



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KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. II.6.6
Port Facilities Plan (Short Term Development)

A P P E N D I X

II-1 Facility and Utilization of Bangkok Port

1. Berthing Facilities at Port of Bangkok — Table II-1-1

2. Activities

(1) Ocean-going Vessels by Berthing Facility in 1982 — Table II-1-2

(2) Vessels Waiting for Berth of Bangkok Port

a. Waiting for Klong Toei Berth (P.A.T. Wharves) at the Bangkok Bar — Table II-1-3

b. Waiting for Berth of Bangkok Port at the Bangkok Bar — Table II-1-4

(3) Details of Foreign-going Vessels Berthed at Klong Toei P.A.T. Wharf in 1982

a. Net Registered Tons — Table II-1-5

b. Length — Table II-1-6

c. Draught — Table II-1-7

(4) Import Cargo Classified by Kind of Goods at Klong Toei Wharf — Table II-1-8

(5) Export Cargo Classified by Kind of Goods at Khlong Toei Wharf — Table II-1-9

(6) Import Cargo Discharged at Klong Toei P.A.T. Wharf — Table II-1-10, Fig. II-1-1

(7) Inbound and Outbound Container Passed through Klong Toei Wharf — Table II-1-11

(8) Stevedores — Table II-1-12

Table II-1-1 BERTHING FACILITIES AT PORT OF BANGKOK (EAST BANK)

1982

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Maximum of Vessel Draught (Ft)	Maximum of Vessel N.R.T (Ton)	Vessel No. of Berth (Berth)	Vessel No. per Year	Type of Cargo Import	Type of Cargo Export	Facilities	Size of Warehouse	Capacity of Warehouse (Metric Ton/ Year
	EAST BANK													
2	JALAPRATHAN CEMENT Co. LTD	1970	3, 72	54	300	15	1,650	1	(160)	Pack Cement	Bulk Cement	Pipe for Cement	Silo 4 Tanks Height 30 m Radius 5 m	304,000
4	THAI PLASTIC & CHEMICALS Co. LTD.	1972	6, 12	72	350	20	2,500	1	24	Requid Inflam-mable Chemicals	-	Pipe 2 Pipe	Tank 2,000 MT/Tank 3 Tank	36,000
8C	UNITED SILO Co. LTD.	1970	54, 230	40	565	27	14,000	1	80	Fertilizer Wheat	Maize Tapioca	2 lines of Conveyers 2 lines long 2 lines short	Warehouse 7 unit Size 100,000 m^2 Silo 20 unit	600,000
8A 8B	UNITED FLOUR MIU Co. LTD (Wharf 8B T.M.N for rent)	1967	54, 315	30	565	27	14,000	2	170	"	"	Crane 3 ton 1 Unit Folklift 3 ton 1 Unit	Warehouse 17 unit Size 110,000 m^2	500,000
10	SIAM CEMENT Co. LTD (SAM RONG TAI)	1968	50, 160	20	565	25	12,000	1	100	Plant	Cement Scrap Iron	Pipe for Cement	Warehouse 4 unit Size 10,000 m^2 Cement Tank 6 unit Total Capacity 36,000 Ton	480,000
12	G.S. STEEL CO. LTD	1969	10, 124	24	490	27	10,000	1	24	Steel, Scrap Iron L.P.G Gas		Magnetic Crane 5 Ton 2 Unit	Storage Open Warehouse Size 1,476 m^2	240,000
14A	CHAOCHOMG WAREHOUSE CO. LTD	1981	10, 75	20	330	27	10,000	1	70	Sawn Timber Steel Fertilizer Paper	Rice Sugar Maize Canned Food	Crane 20 Ton 1 Unit (being to buy now)	Warehouse 1 unit Size 1,920 m^2 being construction 3 unit	160,000
14	POONPIPAT CO. LED	1970	30, 130	18	565	27	14,000	1	100	Steel Fertilizer	Rice Flour of Tapioca	[1]Shovel loader 3 Unit [2]Conveyer line	Warehouse 10 unit Size 33,800 m^2 Capacity 100,000 Ton Silo 1 unit Capacity 20,000 Ton	450,000

1982

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Maximum of Vessel Draught (Ft)	Maximum of Vessel N.R.T (Ton)	Vessel No. of Berth (Berth)	Vessel No. per Year	Type of Cargo Import	Type of Cargo Export	Facilities	Size of Warehouse	Capacity of Warehouse (Metric Ton/ Year)
16A 16C	THAI SUGAR TERMINAL	1965	8.3, 388	40	565	27	14,000	2	250	Fertilizer Wheat Wood (Timber)	Rice Sugar Molas-ses Fluorite	Conveyer line Pipe for Molasses	Warehouse 33 unit Capacity 280,000 Ton Tank for Molasses 4 Tank Capacity 10,000 Ton/ Tank	800,000
16D	COOPERATIVE OF AGRICULTURE	1968 (Operation 1975)	20, 100	40	523	27	8,000	1	100		Rice Fertilizer Maize Bean Cake		Warehouse 1 unit Size 4,000 m^2 Capacity 25,000 Ton Silo 6 unit Total Capacity 30,000 Ton	200,000
16E	THANAKIT WAREHOUSE	1980	30, 260	50	565	26	14,000	1	120	Wood (Timber)	Rice Maize Tapioca		Warehouse 8 unit Size 55,200 m^2	500,000
18 A C D F	MILITARY OIL REFINARY(Bangkok) (Original, rent from SUMIT OIL)	1969 (Rebuild)	18A 6, 20 18C 8, 20 18D 8, 49 18F 8, 20	15	565	27	15,000	3	15	Feul		Pipe for Oil	Oil Tank 93 unit Total Capacity 698.923 kl	3,000,000
					for Big Ship from foreign Country 1 Ship 5,000 NRT 2 Ships 1,000 NRT 1 Ship						Ship Contain Oil for foreign Country 15 Ship/Year Receive Oil from Sri Racha to Bangkok about 700 Ship/Year			
18C B	PETROLEUM AUTHORITY OF THAILAND (PTT)	1976	40.8, 80	10	560	27	12,000	1	100	Product of Oil		Crane Pipe	Oil Tank 19 unit Size of Capacity 71,000 Ton	700,000 (18B — 150,000)
					Berth 18B for Oil Ship from Sri Racha to Bangkok 300 Ships/Year									
20A 22A	PORT AUTHORITY OF THAILAND (PAT)	1939	30, 2,900	-	600	27	14,000	16	1,700	Scrap Iron Machinary Vehicle Chemical Product Bathing Goods	Product mode from wood, Steel Canned Food Live Caw Baffalow Mineral Other	[1]Crane 5, 30 ton, 32 unit [2]Folklift 5,000-7,000 pond 286 unit [3]Trailer 2,600-12,000 pond 37 unit [4]Trailer Lift for Container Capacity 10-35 Ton 6 unit	Warehouse 42 unit Total Size 226,757 m^2 Open Storage 404,140 m^2	5,000,000

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Maximum of Vessel Draught (Ft)	Maximum of Vessel N.R.T (Ton)	Vessel No. of Berth (Berth)	Vessel No. per Year	Type of Cargo Import	Type of Cargo Export	Facilities	Size of Warehouse	Capacity of Warehouse (Metric Ton/ Year)
24 A B C D	THE SHELL Co., OF THAILAND LTD	More than 30 year	24A 9, 15 B 11.5, 15 C 6, 36 D 2, 15	35	565 565 350 350	26 (For oil ship from Sri Rocha to Bangkok)	14,000 14,000	1 1 1 1	42 300 400	Oil Product		Pipe for Oil	Tank for Oil 35 unit Capacity 260 Million litre	190,000 Only Ship Oil from foreign Country
26 A B	ESSO STANDARD (THAILAND)Co., LTD	1964	5, 10	26	565 (26B Berth is length 330 ft for Oil Ship from Sri Racha to Bangkok)	26	10,000	1	50	Oil Product Chemical goods		Pipe for Oil	Tank for Oil 67 unit Capacity 140 Million Litre	120,000 Only Ship Oil from Foreign Country
28	SUMMIT OIL WARE-HOUSE Co., LTD	1963	6.5, 16.5	60	300 (from Sri Racha to Bangkok)	16	1,500	1	-	Oil Product		Pipe for Oil	Oil Tank 5 unit Capacity 1.1 Million Litre	(Receive from Sri Racha 170,000 Ton/Year)
30	CALTEX OIL (THAILAND) LTD	1955	6.4, 15.5	90.5	565 (for Domestic Oil Ship about 370 Ship/Year)	27	14,000	1	24	Oil Product		Pipe for Oil	Oil Tank 26 unit Capacity 142 Million Litre	383,000 (Receive from Sri Racha 1 Million Ton/Year)
30A	SAIM CEMENT (SA THU PRADIT)	1981	10, 30.4	45	300	20	1,000	1	15	L.P.G		Gas Pipe from Ship to Tank		Can't estimate because it's just open
32	THAI DUMRONG DEVELOPMENT	1959	13, 14 (2 Berth)	32	400	20	5,000	1	240		Rice		Warehouse 1 unit Size 6,384 m^2 Capacity 45,000 Ton	120,000
34	THAI RUANG PANICH Co.	1957	8, 20 (2 Berth)	25	400	20	5,000	1	-		Rice (Most of them handled by lighter) Go to the Big Ship at the Midstream		Warehouse 1 unit Size 3,000 m^2	36,000
36	TAPE PANICH Co.	1965	5, 12 (3 Berth)	26.5	400	20	5,000	1	48		Rice		Warehouse 1 unit Size 3,420 m^2	120,000
38	THAI SONBOON WAREHOUSE	1963	8.5, 15 (3 Berth)	32	433	27	8,000	1	120		Rice Maize		Warehouse 2 unit Size 2,720 m^2	120,000
40	KITTI RICE Co.	1963	7.5, B (4 Berth)	25	400	23	5,000	1	36		Rice Maize		Warehouse 2 unit Total Size 30,744 m^2	72,000
56	THAI MARITIME NAVIGATION Co. (T.M.N) YANAWA	1935 Original name (Wang Lee Berth)	15, 83	15	365	26	2,500	1	120	Timber Chemical Goods Other Goods	Other Goods	Folklift 2 ton 6 unit Folklift 3 ton 2 unit	Warehouse 2 unit Total Size 3,115 m^2	25,000

BERTHING FACILITIES AT THE PORT OF BANGKOK (WEST BANK)

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Draught (Ft)	N.R.T	No. of Berth (Berth)	No. per Year	Type of Cargo Facilities Import	Export		Size of Warehouse	Capacity of Warehouse (Metric Ton/Year)
	WEST BANK													
1	COOPERATIVE SALT WHARF (LEAM FAR PER)	1943	10, 80	52	565	27	14,000	1	20	Fertilizer	Rice Maize Nonglutinous rice		Warehouse 3 unit Total Capacity 5,080 m^2	50,000
1A	THAI RUAM TOON WAREHOUSE	1977	70, 182	12	565	27	14,000	1	36-60	General Cargo	Sugar Molasses	Pipe for Molasses	1)Wharehouse 2 unit Total Size 9,450 m^2 2)Molasses Tank 4 unit Total Size 20,000Ton	500,000
1B	PACIFFIC PLASTIC	1982	6, 12	75	500	25	10,000	1	12	Liquid Chemical,		Pipe For Recieve Cargo	Tank 3 unit Total Size 1,500 Ton	33,000
3	MITPON WAREHOUSE	1973	48, 237	48	565	27	14,000	2	60	Fertili-zer, Dangerous Cargo	.Rice Molasses Row Sugar	1)Spiller 400Ton/h 1 unit 2)Vocum 250Ton/h 2 unit	1)Warehouse 10 unit Total Size 28,000 m^2 2)Molasses Tank 60 Ton 4 unit	300,000
5	LEAM THONG WAREHOUSE	1973	20, 270	20	565	27	14,000	2	100	Fertili-zer Wheat Bean Coke	Rice Maize Sugar	1)Spiller 1 unit 250Ton/h 2)Vacum 2 unit Size of capacity 100Ton/h	1)Warehouse Size 35,000 m^2 12 unit 2)Silo 300 Ton 20 unit 3) Silo, 1,100 Ton 36 unit	330,000

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Draught (Ft)	N.R.T	No. of Berth (Berth)	No. per Year	Type of Cargo Import	Export	Facilities	Size of Warehouse	Capacity of Warehouse (Metric Ton/Year)
5B	SIAM CHEMICAL	1978	80, 180	20	500	22	10,000	1	60	Timber Sulphuric acid, Sulphur Powder Plumenagan Ammonium Gas	Re-frige-ated Cargo, Sulphuric Cargo acid	1)Crane 20 Ton 1 unit 2)Folklift 2 Ton 4 unit	1)Warehouse 2unit Total Size 2,400 m^2 2)Tank 36 unit 80 Ton/Tank	380,000
5A	THAI CENTRAL CHEMICAL	1975	20.6, 310.7	30	565	27	13,000	2	6	Fertilizer, Raw Material for Product Fertilizer		1)Crane 5 Ton 1 unit 2)Folklift 1 Ton 3 unit	Warehouse Size 3.798 m^2 Total 12 unit	500,000
5B	THAI SAILO & INDUSTRY	1975	17, 120	17	565	27	14,000	1	150	Ferti-lizer Timber Machinary Chemical Product Wheat	Maize, Non-gluti-nous rice	1)Spiller 200 Ton/h 2 unit 2)Vacum 80 Ton/h 2 unit 3)Shavel loader 2 unit	1)Warehouse Size 2,000 m^2 2 unit 2)Steel Tank Capacity 1,500 Ton 12 unit 3)Cement Tank Capacity 1,500 Ton 18 unit	400,000
7	BANGKOK DRYING SILD	1964	17, 120	27	556	27	12,000	1	170		Maize	Conveyer Line 2 unit Total 480 Ton/h	1)Warehouse Size 2,000 m^2 Capacity 5,000 Ton 2)Silo 1,000 Ton 46 unit	400,000
9	RUAM THON THAI AND LITDANG	1967	8, 164 (2 Berth)	29	475	27	10,000	1	24		Rice Maize Bean		Warehouse 6 unit Total Capacity 8,640 m^2	60,000
11	MITSUBISHI	1972	5, 10	35	367	27	5,500	1	36	Chamical Product		Pipe for Receive Chemical	Stock Tank 21 unit Total Capacity 5,000 Ton	40,000
13	BANGKOK MOLASSES	1970	20, 22	39	500	27	10,000	1	12		Mo-lasses	Folklift 2.5 Ton 1 unit	Tank for Molasses 4 unit Total Capacity 11,000 Ton	200,000
15	THONBURI WAREHOUSE	1969	10, 22	25	315	27	4,500	1	30	Soda Bicar-bonate	Rice Raw Suger	Folklift 1 Ton 1 unit	1)Tank 1 unit 2)Warehouse 3 unit Total Capacity 5,958 m^2	500,000

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Draught (Ft)	N.R.T	No. of Berth (Berth)	No. per Year	Type of Cargo Import	Export	Facilities	Size of Warehouse	Capacity of Warehouse (Metric Ton/Year)
17	MARUBENI	1966	25, 30	30.5	365	27	7,000	1	12		Mo-lasses	Pipe	Molasses Tank 3 unit Total 5,800 Ton	55,000
19	ASIA MOLASSES	1972	14.5, 19	31	320	25	7,000	1	12		Mo-lasses Raw Sugar Maize	Pipe	1) Molasses Tank 2 unit Total Capacity 34 m^3 2)Warehouse 3 unit Total Capacity 15,858 m^2	130,000
19A	THAI FAI (1968)	1974	20, 150	50	565	27	10,000	1	50		Rice		Warehouse 1 unit Capacity 2,000 Ton	60,000
21A	NANAPAN ENTERPRISE	1975	17, 134	25	500	23	10,000	1	50		Rice		1)Warehouse Bord Capacity 50,000 Ton 2)Warehouse 4 unit Total Capacity 14,850 m^2	50,000
21C	CHEMICAL BOND	1976	12, 5	70	400	27	10,000	1	12	Chemical Feul	Alcohol 95% and 88%	Pipe for Sending and Receiving	Tank 10 unit Total Capacity 5,300 Ton	24,000
21E	LEAM THONG BOND (CHAIYA POhn Co. Rent to operate)	1981	17.25. 197.4	15	500	27	10,000	1	20		Rice		Warehouse 7 unit Total Capacity 5,500 Ton	100,000
21D	P.S. DEVELOPMENT	1983	11, 270	23	500	27	10,000	2	36		Rice Maize Sugar	Big Conveyer 3 Line Small Conveyer 2 Line Folklift 11 Ton 3 unit	Warehouse 10 unit Total Capacity 2,310 m^2	300,000
21B	SUP SATHAPORN	1975	20, 90	20	500	27	10,000	1	2		Maize Tapioca (Chips, Peller)	1)Conveyer 1 Line 2)Folklift 1.7 Ton 1 unit	Warehouse 10 unit Total Capacity 6,300 m^2	
21	MITSUI CO.	1973	6, 3	30	340	25	6,900	1	12	Liquid Chemical Product		Pipe for Receive	Stock Tank 10 unit Total Capacity 5,500 m^2	6,000

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Draught (Ft)	N.R.T	No. of Berth (Berth)	No. per Year	Type of Cargo Import	Export	Facilities	Size of Warehouse	Capacity of Warehouse (Metric Ton/Year)
23	TANAPORN CHAI (HORN HEAR SENG)	1967	20, 260	28	365	27	8,000	2	100		Rice Maize		Warehouse 4 unit Total Capacity 31,200 m^2	150,000
23A	SUPANAWA	1971	10, 138.4	15	450	22	6,000	2	69	Fertilizer Timber Sawn Timber	Fertilizer Rice Maize	1)Mobil Crane 20 Ton 1 unit 2)Folklift 1 Ton 2 unit 3)Crane 15 Ton 1 unit	Warehouse 5 unit Total Capacity 5,396 m^2	60,000
23B	MOBIL OIL	1976	4.5, 10	26	450	27	6,000	1	8	Machine Oil, Chemical Product		Pipe for Receive Cargo from Ships 7 unit	1)Warehouse 1 unit Size 3,200 m^2 2)Tank 5 unit Total Capacity 4.8 Million Litre	20,000
25	KENSEN (JU FUA)	1967	7, 17	45	350	23	5,000	1	12		Maize		Warehouse 4 unit Total Capacity 7,840 m^2	36,000
27	KRUNG THAI BANK WAREHOUSE	1968	30, 100	35	400	24	6,000	1	120		Rice, Bean Maize		Warehouse 12 unit Total Capacity 3,096 m^2	120,000
29 A B C	SANTONGCACAO (SUNG HENG LEE)	1972	20, 289	20	450	23	6,000	1	20		Rice		Warehouse 20 unit Total Capacity 41,905 m^2	200,000
31	TAH CAU THAI	1965 (New Repair)	12, 190	20	400	24	6,000	1	20		Rice		Warehouse 12 unit Total Capacity 22,200 m^2	24,000
33 A B	THAI MARITIME NAVIGATION (T.M.N) (Bang Pa kok)	1967	13, 208	13	450	24	5,000	2	200	Sawn Timber Other	Rice Bean Maize	Folklift 2-3 Ton 20 unit	Warehouse 4 unit Total Capacity 7,020 m^2 Krung Tep Band 4 unit, Capacity 17,380 m^2	120,000

No. of Wharf	Name of Wharf	Year of Building & Operating	Size of Wharf (Apron Width, Length (m)	Bridge (Trestle) (m)	Maximum of Vessel L.O.A (Ft)	Draught (Ft)	N.R.T	No. of Berth (Berth)	No. per Year	Type of Cargo Facilities Import	Export	Size of Warehouse	Capacity of Warehouse (Metric Ton/Year)
37	RONG SRI CHRONG THAI	1956	30, 70	30	370	22	3,000	1	24		Rice	Warehouse 4 unit Total Capacity 22,000 m^2	36,000
39	KAOBING TONG	1947	8, 8	15	350	27	5,000	1	10		Rice Bean Maize	Warehouse 4 unit Total Capacity 3,800 m^2	72,000
41	RUAM TUN THAI	1960	8, 13	18	200	18	2,500	1	10		Rice	Warehouse 6 unit Total Capacity 5,557 m^2	72,000
43	THAISAY	1944	5, 100	30	375	22	5,000	1	36		Rice Maize	Warehouse 2 unit Total Capacity 5,444 m^2	72,000
45	UNHORN LAO MIHON	1907	4, 60	9	350	22	4,000	1	40		Rice Agriculture Goods	Warehouse 2 unit Total Capacity 7,597 m^2	288,000

Table II-1-2 Ocean-going Vessels by Berthing Facility in 1982

Location	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Klong Toei (Berth Alongside)	141	130	157	153	149	141	143	149	139	147	146	142	1,737
Klong Toei (Midstream)	32	30	38	33	32	31	38	32	35	32	26	26	385
Sathu Prodit	18	12	16	14	18	28	14	10	12	18	22	25	207
Bang Kho Leam	9	6	6	6	6	13	9	10	12	8	14	9	108
Rice Mill Wharves	28	29	23	21	24	14	21	14	19	9	23	23	248
Bang Pla Kot	4	3	6	6	1	6	4	3	2	7	1	-	43
Oil Jetties	290	289	282	284	290	268	291	296	277	298	278	296	3,439
Other Private Wharves	140	121	122	119	124	108	107	116	107	92	100	93	1,349
Bang Pa Kok	15	8	11	15	19	13	11	13	18	20	17	13	173
Wang Lee	7	2	3	2	2	-	5	-	-	-	1	-	22
Thai Maritime Navigation	5	2	1	-	-	-	-	-	-	-	-	-	8
Total	689	632	665	653	665	622	643	643	621	631	628	627	7,719

Table II-1-3 Waiting for Klong Toei Berth at the Bangkok Bar

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Average
Number of Ship Calls	46	38	57	61	62	57	70	59	52	51	61	45	659	54.92
Averaga hours per call	9.7	11.1	5.5	17.0	26.8	13.4	18.3	12.5	16.0	12.4	7.5	10.9	161.1	13.43

Table II-1-4 Waiting for Berth of Bangkok Port at the Bangkok Bar

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Average
Number of Ship Calls	141	124	152	181	146	141	135	137	122	118	149	127	1,670	139.17
Average hour per call	43.6	36.1	14.5	28.2	58.2	19.3	29.2	21.6	18.3	12.3	11.5	21.4	314.20	26.18

Table II-1-5 Details of Foreign-going Vessels Berthed at Klong Toei PAT Wharf

a. Net Registered Tons (NRT)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Under 1,000 NRT	6	6	12	9	9	10	8	10	11	13	9	9	112
1,001 ~ 2,000	20	25	24	22	23	15	16	22	14	19	19	14	233
2,001 ~ 3,000	41	45	48	57	49	45	59	44	50	53	51	56	598
3,001 ~ 4,000	20	14	21	20	17	15	14	16	15	16	18	16	202
4,001 ~ 5,000	9	12	10	10	10	16	10	14	15	15	13	13	147
5,001 ~ 6,000	18	11	17	18	22	24	15	23	15	14	15	18	210
6,001 ~ 7,000	18	11	21	14	16	13	16	12	15	12	19	14	181
7,001 ~ 8,000	7	4	4	2	2	-	3	1	1	3	-	-	27
8,001 ~ 9,000	1	1	-	1	1	3	-	5	1	1	1	1	16
9,001 ~ 10,000	1	1	-	-	-	-	2	1	2	-	1	-	8
10,001 ~ 11,000	-	-	-	-	-	-	-	-	-	-	-	-	-
Over 11,000	-	-	-	-	-	-	-	1	-	1	-	1	3
Total	141	130	157	153	149	141	143	149	139	147	146	142	1,737

Table II-1-6 Details of Foreign-going Vessels Berthed at Klong Toei PAT Wharf

b. Overall Length

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Under 76.25 m	5	5	9	7	6	9	7	6	6	10	8	8	89
76.25 ~ 91.50	6	5	9	8	4	5	3	5	3	5	6	2	61
91.50 ~ 106.75	20	26	28	24	40	23	31	33	25	33	25	31	339
106.75 ~ 122.00	29	34	35	40	29	30	35	28	30	33	35	29	387
122.00 ~ 137.25	19	21	22	23	22	21	23	24	24	25	24	30	278
137.25 ~ 152.50	31	20	27	24	21	23	20	25	22	24	21	22	280
152.50 ~ 167.68	26	16	25	24	25	28	20	24	21	14	23	16	262
167.68 ~ 182.93	5	3	2	3	2	2	4	4	5	3	4	4	41
Total	141	130	157	153	149	141	143	149	139	147	146	142	1,737

Table II-1-7 Details of Foreign-going Vessels Berthed at Klong Toei PAT Wharf

c. Draught

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Under 4.50 m	18	7	21	17	12	17	13	9	12	17	11	11	165
4.50 5.49	30	42	34	38	32	27	36	38	26	27	35	29	394
5.49 6.40	40	40	42	42	41	36	35	39	39	40	39	41	474
6.40 7.32	36	32	40	38	44	38	38	37	40	39	40	40	462
7.35 8.23	16	9	18	18	19	22	21	24	22	24	18	21	232
8.23 9.15	1	-	2	-	1	1	-	2	-	-	3	-	10
Total	141	130	157	153	149	141	143	149	139	147	146	142	1,737

Table II-1-8 IMPORT CARGO CLASSIFIED BY KIND OF GOODS AT KHLONG TOEI WHARF (DURING THE YEAR 1977 - 1983)

Item	Import Cargo (Metric Ton)						
	1977	1978	1979	1980	1981	1982	1983
All kinds of vehicles	53,265	39,712	26,694	20,921	16,491	13,473	18,638
Heavy lifts (over 3 tons)	66,304	106,692	125,221	114,892	114,693	96,386	124,594
Dangerous cargo	43,189	35,409	33,941	46,513	49,720	44,778	60,880
Valuable cargo	29,656	60,613	61,737	70,920	109,870	67,614	76,759
Refrigerated cargo	1,134	1,018	400	1,556	3,892	4,915	10,266
Damaged broken cargo	11,379	11,939	11,257	5,702	7,390	18,356	4,597
Mild steel bars, rails, pipes, Rods, etc.	182,838	176,086	206,451	197,027	235,358	183,613	264,166
Machinery	61,403	120,567	116,552	114,237	158,884	121,787	158,265
Provisions	51,931	62,124	71,458	96,258	128,989	87,172	78,815
Cargo in drums	95,070	95,485	112,283	137,535	131,776	102,426	127,519
Chemical products	104,342	117,865	158,566	145,194	159,926	166,952	271,814
Sheet glass	3,387	3,608	5,869	5,180	10,354	7,467	13,217
Sanitary ware	11,382	23,406	34,667	19,817	13,481	6,777	8,702
Dirty cargo	24,320	18,349	15,677	20,829	20,943	10,268	11,071
Miscellaneous	1,302,525	704,745	1,083,598	936,957	1,013,160	1,007,672	1,331,899
Total (Landside)	2,042,125	1,577,558	2,064,371	1,933,538	2,174,927	1,939,656	2,561,992
Overside	1,426,024	1,817,736	1,664,584	1,652,504	1,559,270	1,438,191	1,801,502
Total (Khlong Toei Wharf)	3,468,149	3,395,294	3,728,955	3,586,042	3,734,197	3,377,847	4,363,494

Source: Bangkok Port

Table II-1-9 EXPORT CARGO CLASSIFIED BY KIND OF GOODS AT KHLONG TOEI WHARF (DURING THE YEAR 1981 - 1982)

Year	Export (Metric Ton)										
	Personal Effects	Metal Product	Machinery	Manmade Fibre	Other Textile Article	Frozen Goods	Food Product	Leather	Minerals	Miscella-neous	Total
1981	12,393	85,963	23,083	33,327	102,439	107,235	470,233	25,016	63,804	307,387	1,230,880
1982	4,040	78,524	14,396	29,367	55,862	114,506	575,084	7,969	55,696	502,727	1,438,171

Source: Bangkok Port

Table II-1-10 Import Cargo discharged at Klong Toei P.A.T. Wharf

(Unit: Metric Ton)

Year	Landside (on wharf)	Overside (discharged directly by)				Total
			Truck	Train	Lighter	
1977	2,042,125	1,426,024				3,468,149
1978	1,577,558	1,817,736				3,395,294
1979	2,064,371	1,664,584				3,728,955
1980	1,933,538	1,652,504				3,586,042
1981	2,174,927	1,559,270	13,909	12,149	1,533,212	3,734,197
1982	1,939,656	1,438,191	17,726	6,157	1,414,308	3,377,847
1983	2,561,992	1,801,502	16,988	5,507	1,779,007	4,363,494

Table II-1-11 INBOUND AND OUTBOUND CONTAINERS PASSED THOUGH
(KHLONG TOEI WHARF)

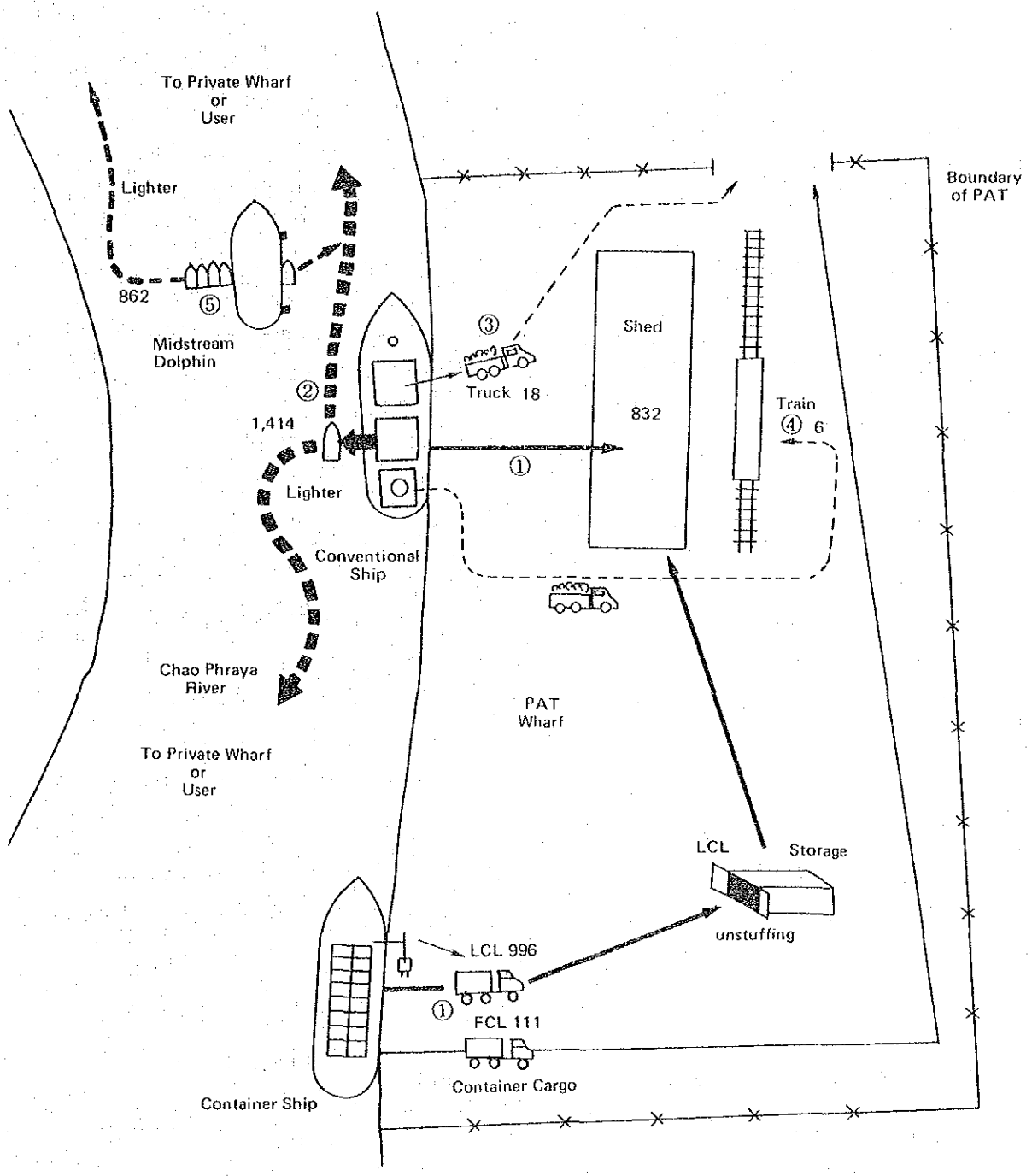
CALENDAR YEAR	CONTAINER	INBOUND												TOTAL			OUTBOUND												TOTAL		
		MTY			LOADED												MTY			LOADED											
					LCL			FCL			REEFER									LCL			FCL			REEFER					
		20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'	20'	35'	40'
1977	No.of Container	298	30	41	11769	4936	6100	1624	538	876	97	101	123	13788	5605	7140	2706	441	650	524	-	534	7983	5164	5724	62	-	48	11275	5605	6956
	T.E.U.	433			32,607			4,318			320			37,878			4,778			1,592			28,468			158			34,996		
1978	No.of Container	2654	287	710	23903	6132	9253	1752	591	934	139	51	92	28448	7061	10989	5154	507	1293	-	-	-	18170	6341	9201	440	172	173	23764	7020	10667
	T.E.U.	4,577			53,140			4,654			412			62,783			8,627			-			47,669			1,087			57,383		
1979	No.of Container	4633	-	917	29593	7758	12698	1983	1099	1975	47	-	11	36256	8857	15601	6415	1081	1520	-	-	-	28034	7309	13628	726	467	158	35175	8857	15306
	T.E.U.	6,467			68,566			7,856			69			82,958			11,347			-			68,081			1,859			81,287		
1980	No.of Container	8667	61	2919	33109	6532	13516	2916	1337	2376	-	-	-	44692	7930	18811	5615	543	1462	-	-	-	36870	6681	16707	723	524	65	43208	7748	18234
	T.E.U.	14,612			71,572			10,008			-			96,192			9,489			-			81,976			1,770			93,235		
1981	No.of Container	8327	109	2621	47607	4409	20201	3907	939	2376	13	55	3	59854	5512	25201	7205	777	4057	-	-	-	52409	4052	21550	1057	511	182	60671	5340	25789
	T.E.U.	13,760			95,725			10,302			115			119,902			16,679			-			102,600			2,315			121,594		
1982	No.of Container	14540	1101	6095	50250	2912	17888	5905	237	2867	-	-	-	70695	4250	26850	3747	144	2231	-	-	-	62287	3687	23052	1761	809	555	67795	4640	25838
	T.E.U.	28,657			91,122			12,054			-			131,833			8,461			-			114,843			4,287			127,591		
1983	No.of Container	10100	319	3454	60406	3926	23187	10135	436	4984	67	-	20	80708	4681	31645	5600	1064	4834	-	-	-	72926	3519	25672	1677	340	1252	80203	4923	31758
	T.E.U.	17,566			113,651			20,866			107			152,190			17,130			-			130,428			4,776			152,334		

Remarks 1. T.E.U. : Total number of containers in twenty equivalent unit.
2. MTY : Empty Container.
3. LCL : Less than Container Load.
4. FCL : Full Container Load.
5. SOURCE : Container Division, Bangkok Port.

Source:
STATISTICAL SECT.
TECHNICAL OFFICE

Table II-1-12 Stevedores

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Number of Stevedoring Contractors	193	194	194	195	195	198	199	201	203	203	204	206	198.7
Number of Stevedore Laboures (Registered)	10,577	10,577	10,581	10,581	10,581	10,581	10,581	10,581	10,581	10,586	10,586	10,589	10,581.8



LEGEND

Import Cargo	4,239 (Thousand Ton)
1. Landside Cargo	1,939
①, ①'	
2 Overside Cargo	2,300
②~④	1,438
⑤	862

KINGDOM OF THAILAND
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JAPAN INTERNATIONAL COOPERATION ANGENCY

Fig. II.1.1
Flow of Import Cargo at Klong Toei Port
(1982)

II-2 Correlation Analysis for Cargo Forecast

1) Coorelation analysis between GDP and general cargo volume.

The correlation between the gross domestic product and the port cargo volume handled at the P.A.T. wharves for 1974 through 1982 can be be expressed by following equations.

Cargo flow	Equation of least squares	Correlation factor
Import	V = - 64.0827 + 14.5551G	0.9038
Export	V = -1699.5951 + 9.3928G	0.9865
Total	V = -1763.6778 + 23.9479G	0.9635

V = Cargo volume in a given year (thousand metric ton)

G = Gross domestic product in the same given year (Billion Baht in 1972 price)

2) Correlation analysis between the calender year and general cargo volume.

The correlation between the calender year and general cargo volume passed through the P.A.T. wharves for 1974 through 1983 is summarized in following equations.

Cargo flow	Equation of least squares	Correlation factor
Import	V = - 514566.6727 + 262.0182Y	0.9234
Export	V = - 325333.2364 + 164.8424Y	0.9890
Total	V = - 839899.9091 + 426.8606Y	0.9682

V = Cargo volume in the given year (thousand metric ton)

Y = Calender year

3) Correlation analysis between GDP and container cargo volume.

The correlation between GDP and container cargo volume handled at the P.A.T. wharves for 1976 through 1982 obtained by the following equations.

Cargo flow	Equation of least squares	Correlation factor
Import	V = - 1986.2890 + 9.3832G	0.9905
Export	V = - 2215.7455 + 10.4669G	0.9948
Total	V = - 4085.0345 + 19.8501G	0.9965

V = Container cargo volume in the given year (thousand metric ton)

G = GDP (Billion Baht in 1972 price)

4) Correlation analysis between container cargo volume and calender year.

The correlation between container cargo volume and calender year for 1976 through 1983 is shown in the following equations.

Cargo flow	Equation of least squares	Correlation factor
Import	V = - 341053.9881 + 172.7024Y	0.9861
Export	V = - 347149.75 + 175.75Y	0.9934
Total	V = - 688203.7831 + 348.4524Y	0.9943

V = Container cargo volume in the given year (thousand metric ton)

Y = Calender year

II-3 Sensitivity Analysis for Cargo Forecast

The team was informed by the P.A.T. that the NESDB recently changed the GDP increase rate from 6.0 % to 5.5 /5.2 % and the effect of this change on the cargo forecast, especially for break bulk and container volume, was needed to be assessed. Furthermore, the GDP on 1983 was informed to adjust the correlation analysis. The cargo forecast was done based on this new GDP assumption and recent performance as shown in the following. The result showed that the estimate was indentical with the figures in the Interim Report with very maginal difference in 2001 AD, which can be neglected for determining the berth requirement.

1) Future GDP growth

The future annual growth rate of GDP and GDP estimates was shown as follows;

Year	Case I GDP (Billion Baht)	Case I Growth Rate (%)	Case II GDP (Billion Baht)	Case II Growth Rate (%)
1983	342	5.7	342	5.7
1984	361	5.6	361	5.6
1987	424	5.2	425	5.5
1991	519	5.2	527	5.5
2000	819	5.2	853	5.5

2) Correlation analysis between general cargo and GDP

(1) The correlations between the port volume handled at the P.A.T. wharves and the gross domestic product for 1974 through 1983 can be expressed by following equations.

Correlation between GDP and Cargo volume

- Import

$$V = -252.2646 + 15.3590G$$

$$r = 0.9299$$

- Export

$$V = -1748.5977 + 9.6022G$$

$$r = 0.9898$$

Total

$$V = -2000.8623 + 24.9612G$$
$$r = 0.9726$$

where, V = Cargo volume in a given year (thousand ton)

G = Gross domestic product in the same given year (Billion Baht in 1972 price)

r = Coefficient of correlation

(2) The formulas for the correlations between the container cargo volume and GDP, for the years 1976 through 1983 can be obtained by the following equations.

Correlation between container cargo volume and GDP

- Import

$$V = -2060.7666 + 10.1275G$$
$$r = 0.9888$$

- Export

$$V = -2174.1641 + 10.3053G$$
$$r = 0.9960$$

- Total

$$V = -4234.9307 + 20.4328G$$
$$r = 0.9969$$

where, V = Container cargo volume in the given year (thousand ton)

G = Gross domestic product in the given year (Billion Baht in 1972 price)

r = Coefficient of correlation

3) Forecast of container and break bulk cargoes

The results of general cargo forecast are summarized in Table III-3-1.

Table II.3.1

Unit : Million ton

Commodity		Total volume in Klong Toei and Laem Chabang Ports								Capacity of Klong Toei Port	Potential Demand of Laem Chabang Port			
		1991				2000					1991		2000	
Case		Time Trend	Case I	Case II	Average of Case I&II	Time Trend	Case I	Case II	Average of Case I&II		Time Trend	Average of Case I&II	Time Trend	Average of Case I&II
Container	Total	5.3	6.1	6.3	6.2	8.1	11.7	12.4	12.1	3.0	2.3	3.2 (2.8)	5.1	9.1 (7.1)
	Import	2.7	3.2	3.3	3.2	4.2	6.2	6.6	6.4					
	Export	2.6	2.9	3.0	3.0	3.9	5.5	5.8	5.7					
Break Bulk	Total	4.7	4.8	4.9	4.8	5.7	6.7	6.9	6.8	4.5	0.2	0.3 (0.3)	1.2	2.3 (1.8)
	Import	4.4	4.5	4.6	4.5	5.3	6.1	6.3	6.2					
	Export	0.3	0.3	0.3	0.3	0.4	0.6	0.6	0.6					
	Grand Total	10.0	10.9	11.2	11.0	13.8	18.4	19.3	18.9	7.5	2.5	3.5 (3.1)	6.3	11.4 (8.9)

II-4(A) Cargo Forecast by Previous Studies

1) Container handling at Bangkok Port.

The report was submitted by Mr. Kohei NAGAI, the ESCAP Senior Port Expert, as the report of advisory service for the PAT in May 1984. The results for the forecast of cargoes is shown in follows:

	1990
Container Cargo	
Inward	3.1
Outward	3.1
Sub-total	6.2
Break Bulk Cargo	
Inward	2.1
Outward	0.2
Sub-total	2.3
Total	8.5

Unit : Million ton

2) Forecast of container and break bulk cargoes via Klong Toei wharf

This cargo forecast was prepared by Statistical Section, Technical Office, P.A.T. in February 1984. The forecast general cargo traffic passed through the P.A.T. wharves was as follows:

	1990
Container Cargo	
Inward	3.32
Outward	2.96
Sub-total	6.28
Break Bulk Cargo	
Inward	2.30
Outward	0.32
Sub-total	2.62
Total	8.90

Unit : Million ton

3) BKKTERM (Bang Sue Container Freight Station Complex) Study and Design Phase (I) Final Report.

This report was submitted by CANAC consultants limited and published in January 1984. The following are the forecasts of total import and export cargo, including container cargo making use of Klong Toei and the Eastern Seaboard.

	1990	2000
Total import and export cargo	6.7 - 9.2	8.9 - 18.0
(Import and Export container cargo)	(4.5 - 5.8)	(6.3 - 11.0)

Unit : Million ton

4) The Feasibility Study of the Development of the Port of Laem Chabang.

This report was prepared in January 1983 by CIPO's in-house consultants (Louis Berger International U.S.A.). The forecast general cargo throughput for Klong Toei and Laem Chabang Ports was as follows:

	1991	2000
Containerized	5.49	7.93
Break Bulk	4.10	7.52
Total	9.59	15.45

Unit : Million ton

5) The Eastern Seaboard Study (Sector: Transport)

The draft of this report was published in mid. 1982: it was prepared by Coopers and Lybrand Associates.

The potential traffic for a new deepwater port was as follows;

	1991	2001
Container	1.0 - 1.4	4.2 - 6.7
Break-Bulk	0.6 - 0.7	1.1 - 1.6
Agri-Bulk	1.0 - 2.3	1.1 - 2.4
Mineral Bulk	2.1 - 5.3	4.1 - 7.6
Domestic	1.0	1.0
Total	5.9 - 10.9	11.5 - 19.3

Unit : Million ton

6) The final working paper on the selection of a port site.

This report is a revised addition to the Maunsell. Sindhu Maunsell Consultants report of 1981. The forecast of traffic using the new deep-seaport is as follows;

	1990	2000
General Cargo	2.3	6.5
Agri-Bulk	2.1	2.5
Mineral	3.98	5.1
Total	8.5	14.1

Unit : Million ton

7) The Deep-Seaport of Laem Chabang Review 1978.

This report was prepared by Netherlands Engineering Consultants (NEDECO). The forecasts of cargo traffic using Laem Chabang Port in this report were as follows;

	1990	2000
General Cargo	1.7	4.7
Agri-Bulk	3.5	4.5
Mineral-Bulk	0.9	1.3
Total	6.1	10.5

Unit : Million ton

ANNEX 1 BRUSSELS TARIFF NOMENCLATURE

Section I. Live animals; animal products

Chapter 1	Live animals
Chapter 2	Meat and edible meat offals
Chapter 3	Fish, crustaceans and molluscs
Chapter 4	Dairy products; birds' eggs; natural honey
Chapter 5	Products of animal origin, not elsewhere specified or included

Section II. Vegetable products

Chapter 6	Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental follage
Chapter 7	Edible vegetables and certain roots and tubers
Chapter 8	Edible fruit and nuts; peel of melone of citrus fruit
Chapter 9	Coffee, tea, mate and spices
Chapter 10	Cerrels
Chapter 11	Products of the milling industry; malt and starches; gluten; inulin
Chapter 12	Oil seeds and oleaginous fruit; miscellaneous grains, seeds and fruit; industrial and medical plants; straw and fodder
Chapter 13	Raw vegetable materials of a kind suitable for use in dyeing or in tanning; lacs; guns, resins and other vegetable saps and extracts
Chapter 14	Vegetable plaiting and carving materials; vegetable products not elsewhere specified or included

Section III. Animal and vegetable fats and oils and their cleavage products; prepared edible fats; animal and vegetable waxes

Chapter 15	Animal and vegetable fats and oils and their cleavage products; prepared edible fats; animal and vetetable waxes

Section IV. Prepared foodstuffs; beverages, spirits and vinegar; tabacco

Chapter 16	Preparations of meat, of fish, of crustaceans or molluscs
Chapter 17	Sugars and sugar confetionery
Chapter 18	Cocoa and cocoa preparations
Chapter 19	Preparations of cereals, flour or starch; pastrycooks' products
Chapter 20	Preparations of vegetables, fruit or other parts of plants
Chapter 21	Miscellaneous edible preparations
Chapter 22	Beverages, spirits and vinegar
Chapter 23	Residues and waste from the food industries; prepared animal fodder
Chapter 24	Tobacco

Section V. Mineral products

Chapter 25	Salt; sulphur; earths and stone; plastering materials, lime and cement
Chapter 26	Metallic ores, slag and ash
Chapter 27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes

Section VI. Products of the chemical and allied industries

Chapter 28	Inorganic chemicals; organic and inorganic compounds of precious metals, of rare earth metals, of radio-active elements and of isotopes
Chapter 29	Organic chemicals
Chapter 30	Pharmaceutical products
Chapter 31	Fertilisers
Chapter 32	Tanning and dyeing extracts; tannins and their derivatives; dyes, colours, paints and varnishes; putty, fillers and stoppings; inks
Chapter 33	Essential oils and resionoids; perfumery, cosmetics and toilet preparations

Chapter 34 Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes, prepared waxes, polishing and scouring preparations, candles and similar articles, modelling pastes and dental waxes.

Chapter 35 Albuminoidal substances; glues

Chapter 36 Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations

Chapter 37 Photographic and cinematographic goods

Chapter 38 Miscellanous chemical products

Section VII. Artificial resins and plastic materials, cellulose esters and ethers; and article thereof; rubber, synthetic rubbers, factice, and articles thereof

Chapter 39 Artificial resins and plastic materials, cellulose esters and ethers; articles thereof

Chapter 40 Rubber, synthetic rubbers, factice, and articles thereof

Section VIII. Raw hides and skins, leather, furskins and articles thereof; saddlery and harness; travel goods, handbags and the like; articles of gut (other than silk-worm gut)

Chapter 41 Raw hides and skins (other than furskins) and leather

Chapter 42 Articles of leather; saddlery and harness; travel goods, handbags and the like; articles of animal gut (other than silk-worm gut).

Chapter 43 Furskins and artificial fur; manufactures thereof

Section IX. Wood and articles of wood; wood charcoal; cork and articles of cork; manufactures of straw, of esparto and of other plaiting materials; basketware and wickerwork

Chapter 44 Wood and articles of wood; wood charcoal

Chapter 45 Cork and articles of cork

Chapter 46 Manufactures of straw, of esparto and of other plaiting materials; basketware and wickerwork

Section X. Paper-making material; paper and paperboard and articles thereof

Chapter 47	Paper-making material
Chapter 48	Paper and paperboard; articles of paper pulp, of paper or of paperboard
Chapter 49	Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans

Section XI. Textiles and textile articles

Chapter 50	Silk and waste silk
Chapter 51	Man-made fibres (continuous)
Chapter 52	Metallised textiles
Chapter 53	Wool and other animal hair
Chapter 54	Flax and ramie
Chapter 55	Cotton
Chapter 56	Man-made fibres (discontinous)
Chapter 57	Other vegetable textile materials; yarn and woven fabric of paper yarn
Chapter 58	Carpets, mats, matting and tapestries; pile and chenille fabrics; narrow fabrics; trimmings; tulle and other net fabrics; lace; embroidery
Chapter 59	Wadding and felt; twine, cordage, ropes and cables; special fabrics; impregnated and coated fabrics; textile articles of a kind suitable for industrial use
Chapter 60	Knitted and crocheted goods
Chapter 61	Articles of apparel and clothing accessories of textile fabric, other than knitted or crocheted goods
Chapter 62	Other made up textile articles
Chapter 63	Old clothing and other textile articles; rags

Section XII. Footwear, headgear, umbrellas, sunshades, whips, riding-crops and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair; fans

Chapter 64	Footwear, gaiters and the like; parts of such articles

Chapter 65	Headgear and parts thereof
Chapter 66	Umbrellas, sunshades, walking-sticks, whips, riding-crops and parts thereof
Chapter 67	Prepared feathers and down and articles made of feathers or of down; artificial flowers; articles of human hair; fans

Section XIII. Articles of stone, of plaster, of cement, of asbestos, of mica and of similar materials; ceramic products; glass and glassware

Chapter 68	Articles of stone, of plaster, of cement, of asbestos, of mica and of similar materials
Chapter 69	Ceramic products
Chapter 70	Glass and glassware

Section XIV. Pearls, precious and semi-precious stones, precious metals, rolled precious metals, and articles thereof; imitation jewellery; coin

Chapter 71	Pearls, precious and semi-precious stones, precious metals, rolled precious metals, and articles thereof; imitation jewellery
Chapter 72	Coin

Section XV. Base metals and articles of base metal

Chapter 73	Iron and steel and articles thereof
Chapter 74	Copper and articles thereof
Chapter 75	Nickel and articles thereof
Chapter 76	Aluminium and articles thereof
Chapter 77	Magnesium and beryllium and articles thereof
Chapter 78	Lead and articles thereof
Chapter 79	Zinc and articles thereof
Chapter 80	Tin and articles thereof
Chapter 81	Other base metals employed in metallurgy and articles thereof
Chapter 82	Tools, implements, cutlery, spoons and forks, of base metal; parts thereof
Chapter 83	Miscellaneous articles of base metal

Section XVI. Machinery and mechanical appliances; electrical equipment; parts thereof

Chapter 84 Boilers, machinery and mechanical applicances; parts thereof

Chapter 85 Electrical machinery and equipment; parts thereof

Section XVII. Vehicles, aircraft, and parts thereof; vessels and certain associated transport equipment

Chapter 86 Railway and tramway locomotives, rolling-stock and parts thereof; railway and tramway track fixtures and fittings; traffic signalling equipment of all kinds (not electrically powered)

Chapter 87 Vehicles, other than railway or tramway rolling-stock, and parts thereof

Chapter 88 Aircraft and parts thereof; parachutes; catapults and similar aircraft launching gear; ground flying trainers

Chapter 89 Ships, boats and floating structures

Section XVIII. Optical, photographic, cinematographic, measuring, checking, precision, medical and surgical instruments and apparatus; clocks and watches; musical instruments, sound recorders and reproducers; parts thereof

Chapter 90 Optical, photographic, cinematographic, measuring, checking, precision, medical and surgical instruments and apparatus; parts thereof

Chapter 91 Clocks and watches and parts thereof

Chapter 92 Musical instruments; sound recorders and reproducers; parts and accessories of such articles

Section XIX. Arms and ammunition; parts thereof

Chapter 93 Arms and ammunition; parts thereof

Section XX. Miscellaneous manufactured articles

Chapter 94 Furniture and parts thereof; bedding, mattresses, mattress support, cusions and similar stuffed furnishings

Chapter 95 Articles and manufactures of carving or moulding material

Chapter 96 Brooms, brushes, feather dusters, powder-puffs and sieves

Chapter 97 Toys, games and sports requisites; parts thereof

Chapter 98 Miscellaneous manufactured articles

Section XXI. Works of art, collectors' pieces, and antiques

Chapter 99 Works of art, collectors' pieces, and antiques

(Goods exempted from payment of duty - classified in Thai Customs Tariff Act).

Table II-4 (B) Container Box by Distance

Distance	10 km. L	10 km. R	20 km. L	20 km. R	30 km. L	30 km. R	40 km. R	100 km	180 km	750 km	Unknown	Total
Load	745	24	421.75	81	89	106.25	64	-	-	-	106	1,652
Empty	334	-	139	5	8.75	-	2	8	5	2	25	513.75
Total	1,079	24	560.75	86	97.75	106.25	66	8	5	2	131	2,165.75

Remark L: Left Side at the Lower Section at the Chao Phraya River

R: Right Side at the Lower Section at the Chao Phraya River

Note: See the attached Fig. II-4(B).1

Table II-2 Container Box by Commodity

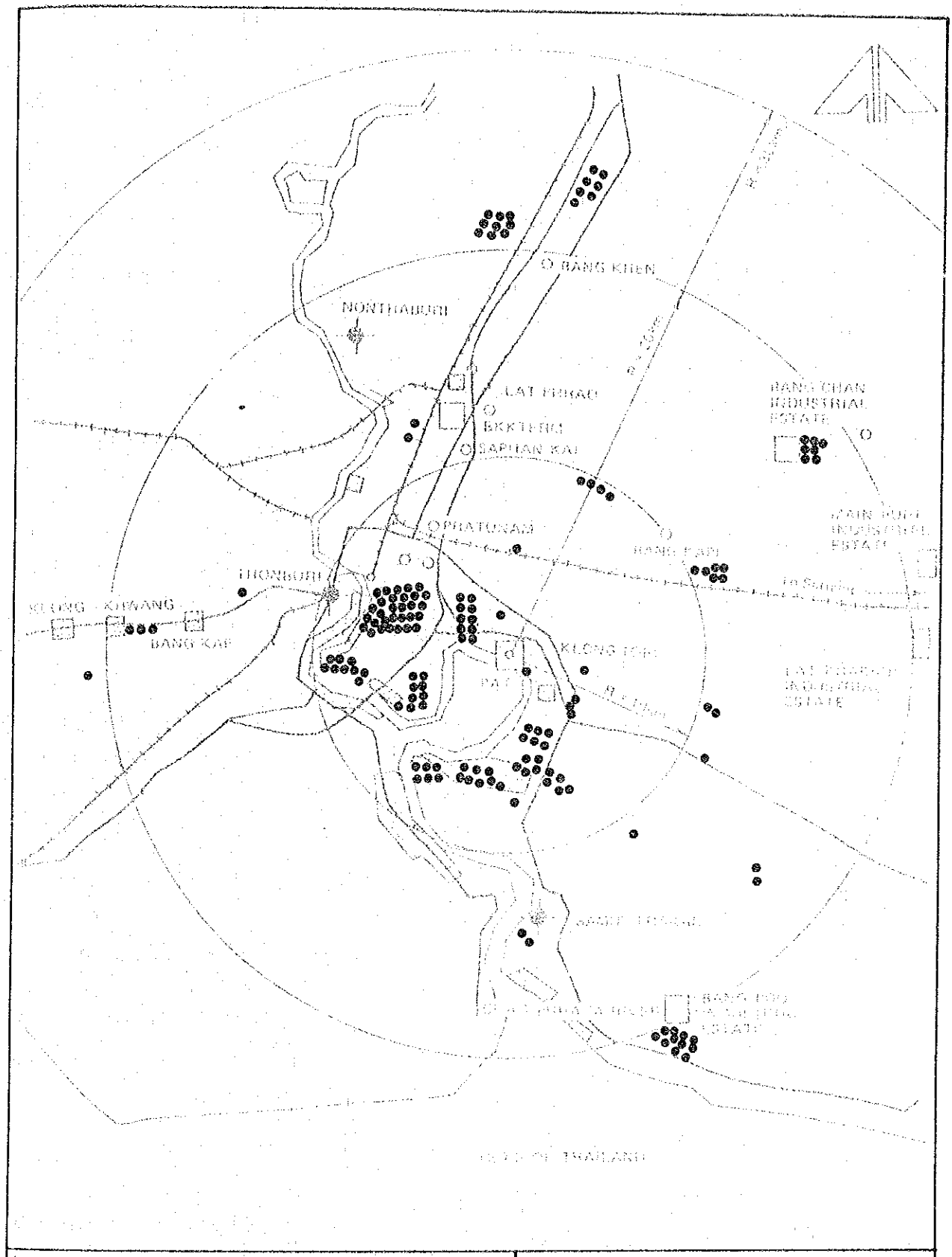
Commodity	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XVI	XVII	XIII	XX	XXI	Unknown	Total	%
(TEU)																						
Load	59	2	74	94.25	210	165	169	19	36	17	145	15	35	10	234.75	114	3	64	8	178	1,652	76
Empty	0	20	0	14	5	32	11	0	88	0	58.75	0	0	0	73	47	2	64	4	95	513.75	24
Total	59	22	74	108.25	215	197	180	19	124	17	203.75	15	35	10	307.75	161	5	128	12	273	2,165.75	
Percentage(%)																						
Load	4	-	4	6	13	10	10	1	2	1	9	1	2	1	14	7	-	4	-	11		100
Empty	0	4	0	3	1	6	2	0	17	0	11	0	0	0	14	9	-	13	1	19		100
Total	3	1	3	5	10	9	8	1	6	1	9	1	2	-	14	7	-	6	1	13		100

(See Annex 1)

Table II-3 Container Box by Company

Load	TEU	%
A	1,021	62
B	18	1
C	47	3
D	388	23
E	0	-
F	0	-
Unknown	178	11
Total	1,652	100
Empty		
A	152.75	30
B	95	18
C	26	5
D	157	31
E	0	-
F	0	-
Unknown	83	16
Total	513.75	100
Total		
A	1,173.75	54
B	113	5
C	73	4
D	545	25
E	0	-
F	0	-
Unknown	261	12
Total	2,165.75	100

Remarks: A = Private Company Factory
B = Private Company Shipping Agent
C = Private Company Air Line
D = Private Company Others
E = Government Authority
F = Others



LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
INDUSTRIAL ESTATE COMMERCIAL AREA MAJOR CENTER MINOR SUB CENTER 10 CONTAINER BOX (TEU)	JAPAN INTERNATIONAL COOPERATION ANGENCY
	Fig. 1 Distribution of Container Box

Source: IEAT PLANNED INDUSTRIAL ESTATES IN BANGKOK METROPOLITAN

II-5 Number of Workers in Port and its Related Business

Workers include people who engage in all necessary works and businesses to operate the port and also those in businesses which have direct connection with port activities. Workers engaging themselves in heavy chemical industries of which factories were located along the waterfront were excluded from this estimation because those were not essential for commercial port activities. The statistics concerning such workers was very limited in Japanese ports and almost nil in Thailand. For the purpose of our study number of workers is very essential to estimate the magnitude of the development. So the statistics of ports in Japan, especially Kobe Port was used for estimation. According to the study done by Kobe Municipality, the number of workers related to port activities is summerized as follows. (See the attached table)

It was assumed that the number of port workers and the total volume of cargo handled at the public berth are equal at the Port of Kobe and the future Laem Chabang Port. Using the number of workers listed above and the total throughput at Kobe in 1979, 0.88 person was required to handle 1,000 tons of cargo.

It was also attempted to calibrate this estimate with the corresponding value in Klong Toei. But because of the lack of statistics, any reliable comparison was infeasible. From limited information obtained, it seemed that two or three times of number of workers was required to handle a 1,000 tons port cargoes in Klong Toei. The figure in Kobe Port was adopted only because this gives the smaller population and conservative estimate for frastructure demand.

The mutiplier effect was also estimated to be 0.7 from a study in Japan which shows the amount of employment generated by the port related/dependent business employee.

Table Port related/dependent Worker

	(person)
1. Port Related Business	
Transport Communication	43,385
shipping, pilot, news agent for ship related information, towage, private buoy and wharf, longshore, warehouse stevedore, inland transport related for port etc.	
Manufacturing	4,695
ship repair, container van repair	
Commerce	3,296
ship chandler, bunker oil supply	
Port related Construction	3,279
Public Service	4,738
port authority, other public organization related to port	
Other port related service	1,111
Subtotal	60,504
2. Port Dependent Business	
Bank Insurance	653
foreign exchange, maritime insurance	
Commerce	11,987
foreign trade business, petroleum wholesale	
Construction business relying on port	405
Subtotal	13,636
Grand total	74,140

1979 : Municipal Economy and Port Kobe, Kobe Minicipality

II-6 Analysis on the calmness in the harbour

The calmness in the harbour was estimated using the mathematical computer model which simulated an irregular wave disturbance phenomena.

The layout of the port facilities in this report was slightly different from the one used for the calmness analysis. So strictly speaking, the result cannot be reliable in the neighborhood of the private wharves where revision of the water front layout was made, but this gives a piece of information on the general view of wave disturbance in the harbour.

The calculation corresponding to the revised layout was intended, but it was finally concluded that such scale of configuration revision will not significantly influence the result. Because the change is almost negligible compared with the unit mesh length based on which the disturbance is calculated in the model.

The three incident wave direction, NW, W and S were assumed. The wave height was assumed to be 1.5 m for W and S and 1.0 m for NW. The wave height was exceeded only 3 days in one year according to the Nedeco report and the reduction of height for NW direction was done by taking into consideration the effect of Ko Shichan Island as a barrier for wave energy propagation.

The result of calculation for pier type was summarized in Fig. III-6-1 3. The contour in the drawings show a height of wave in meter generated by a incident wave.

The most critical case is the NW direction for the container berths basin but the wave height is higher than 75 cm only at limited area (77 cm).

It was concluded that the breakwater and berth alignment was acceptable from the wave disturbance aspects.

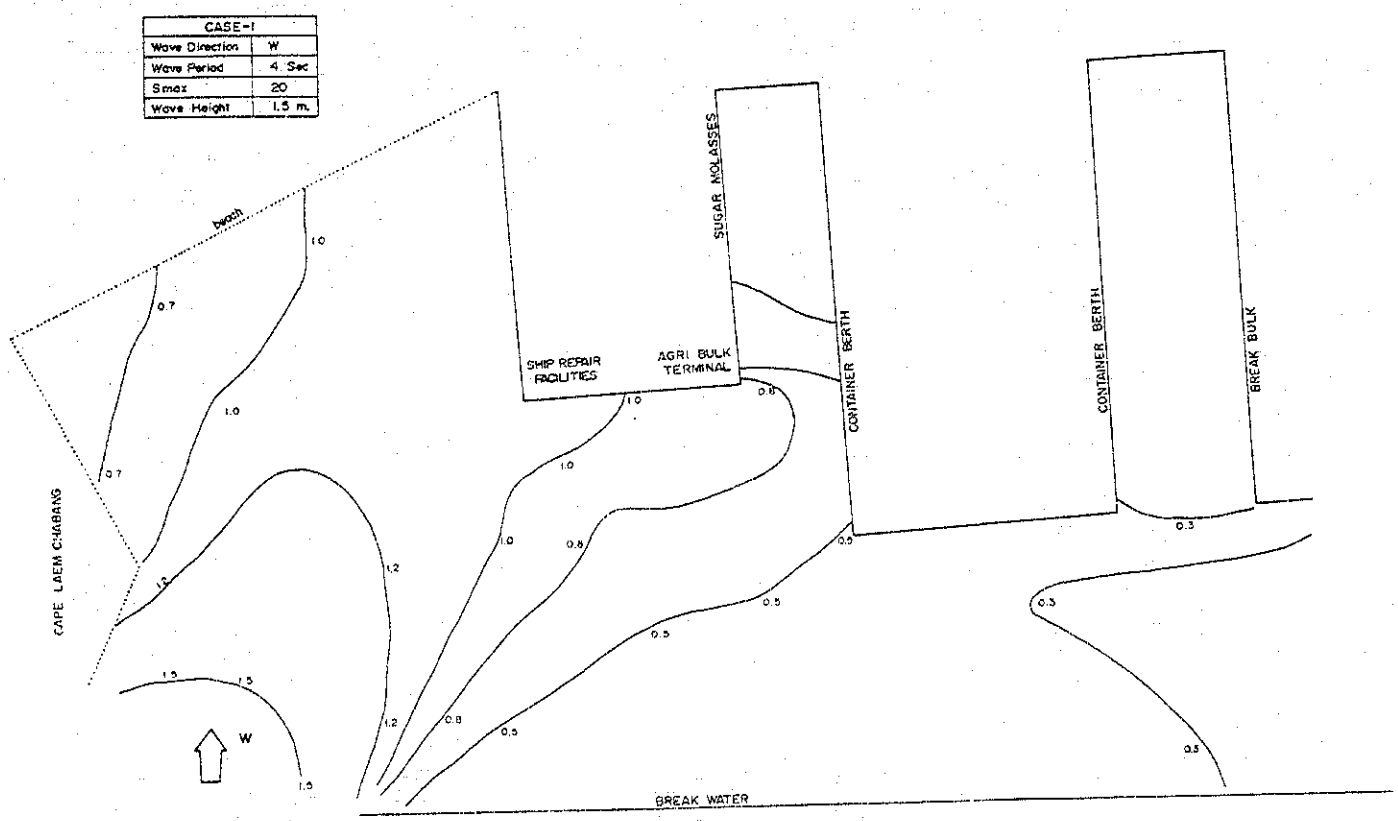


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Fig. II.6.1
Wave Disturbance West

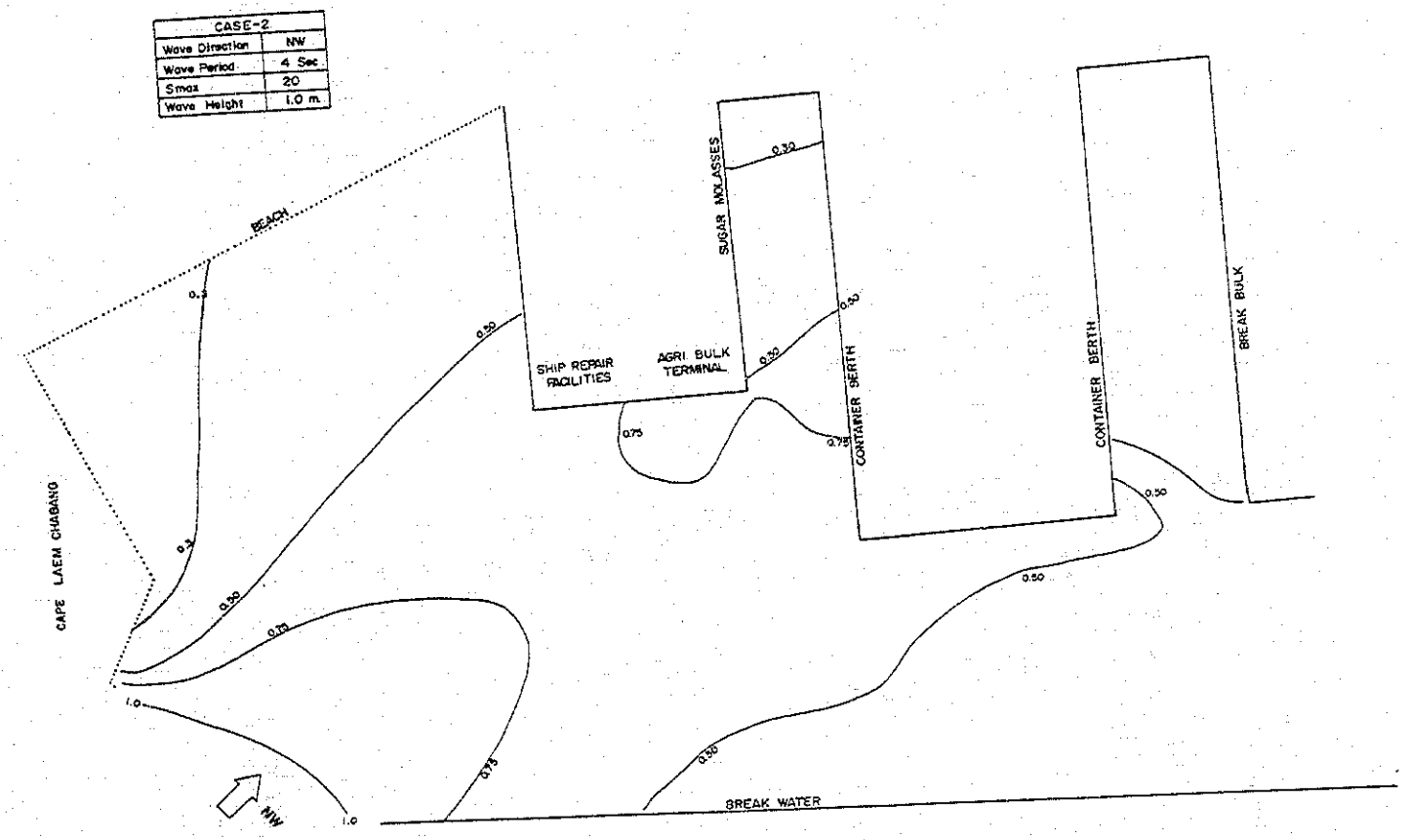

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Fig. II.6.2
Wave Disturbance North West

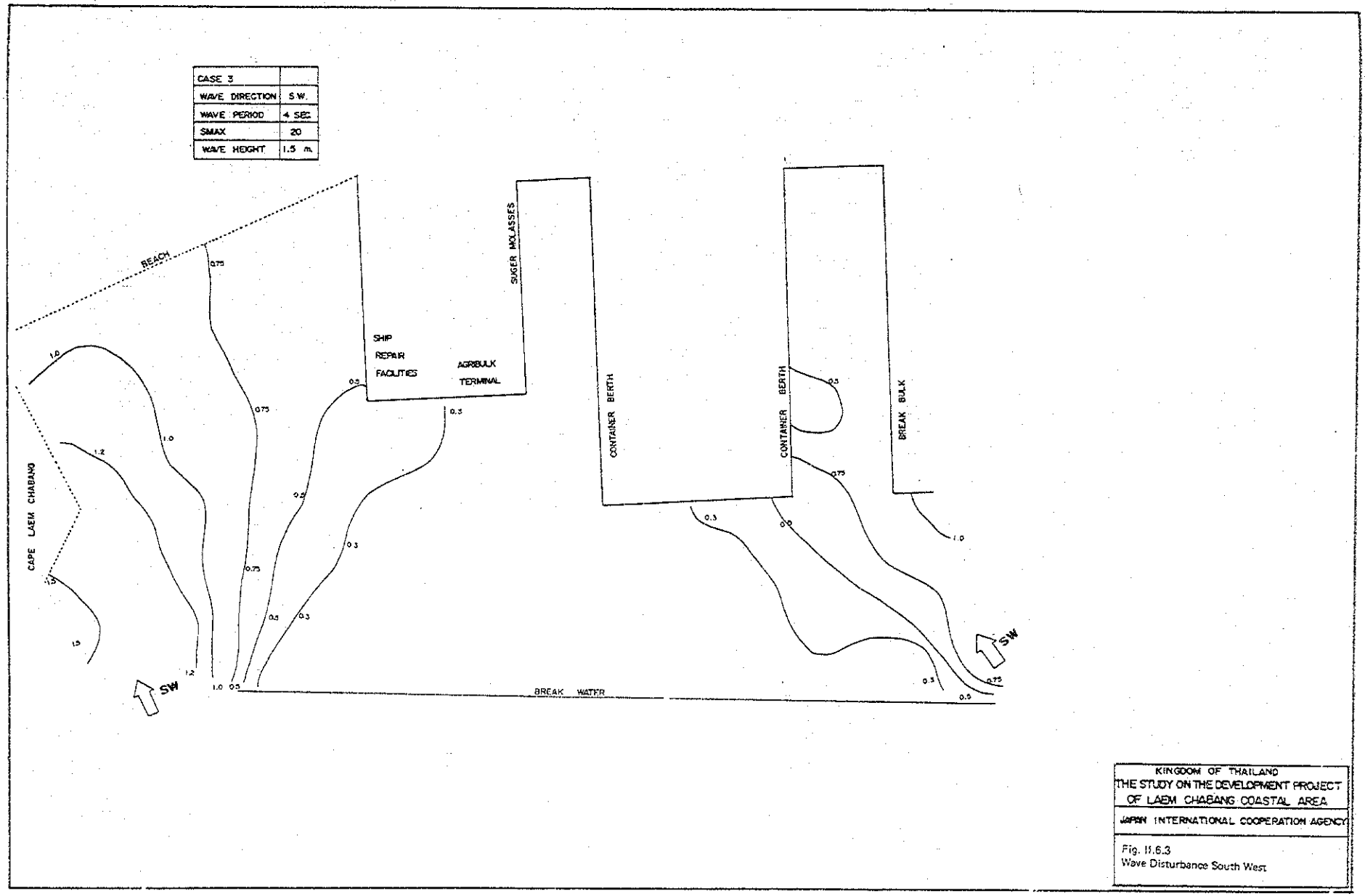
CASE 3
WAVE DIRECTION S.W.
WAVE PERIOD 4 SEC
SMAX 20
WAVE HEIGHT 1.5 m
BEACH
CAPE LAEM CHABANG
SHIP REPAIR FACILITIES
AGRIBULK TERMINAL
SUGER MOLASSES
CONTAINER BERTH
CONTAINER BERTH
BREAK BULK
BREAK WATER
SW
SW
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Fig. II.6.3
Wave Disturbance South West

II-7 Dustproof measures for Tapioca Terminal

During the study, many people seemed to worry about the possible trouble of the tapioca dust if the agribulk terminal be located near to either a container terminal or ship repair facilities. On the other hand, a compact port layout which integrates organically different kinds of terminal and facilities was essential in order to build an effective and economic port. It means that an isolated tapioca agribulk terminal preserving the huge space within a port is undersirable.

From the example of a bulk terminal in Japan, it was concluded a dust problem can be well prevented if a proper caution is paid for selecting the handling equipments. The following is the outline of the bulk terminal where the study team visited.

Name : Kokusai Futo Company (International Wharf Company)

Location: Yokohama Honmoku, Japan

Function: unloading, transhipment, storage, sorting and primary process of some commodities.

Facilities:

quaywall -17.5m depth. 348m length.
max. ship size 170,000 D/W.

crane 1000 t/h 3 unit. conveyer 3000 t/h.

The amount of import of main commodities in 1982 fiscal year
230,000 t

Main commodities handled

Salt for industrial use and edible salt, maize, kaoliang, barley, wheat, edible soybean, soybean meal, various kinds of grain pellet, glass sand, ore, fertilizer.

Dust Problem caused by the original equipment: The unloading is done by a 14 cubic meters grab and the material is dumped to a hopper of 70 cubic meters. Then it is transported by conveyer system to a storage area.

The dust was ejected into the air when the material dropped into the hopper colliding with the bottom of the hopper. The material is also dispersed during the free fall to the hopper.

The dust is drifted and scattered causing the serious nuisance to neighborhood terminals. The complaint of the dust from a surrounding area has foreced this company to devise a dust preventive method.

The method: Improvement was attained by combining two devices. One was a absorption of dust by vacuum at a top fringe of hopper. This was done through slit and dust was collected in a bug filter. Another device is a vertically hunged net installed around the hopper which prevents the scatter of the dust during the free fall of material from a grab to hopper. At the same time an air flow turning down at the top of the net to circulate within the hopper was generated, which prevents dust from being drifted beyond hopper edge.

It was proved that an amount of dust drifting outside of hopper was reduced to less than 5% of the amount of dust which would be dispersed in the original handling method. The increase of the initial cost was 15 - 20%. A staff in the terminal stated he would not find any difficulty to handle tapioca without causing dust nuisance whether it was loading or unloading operation.

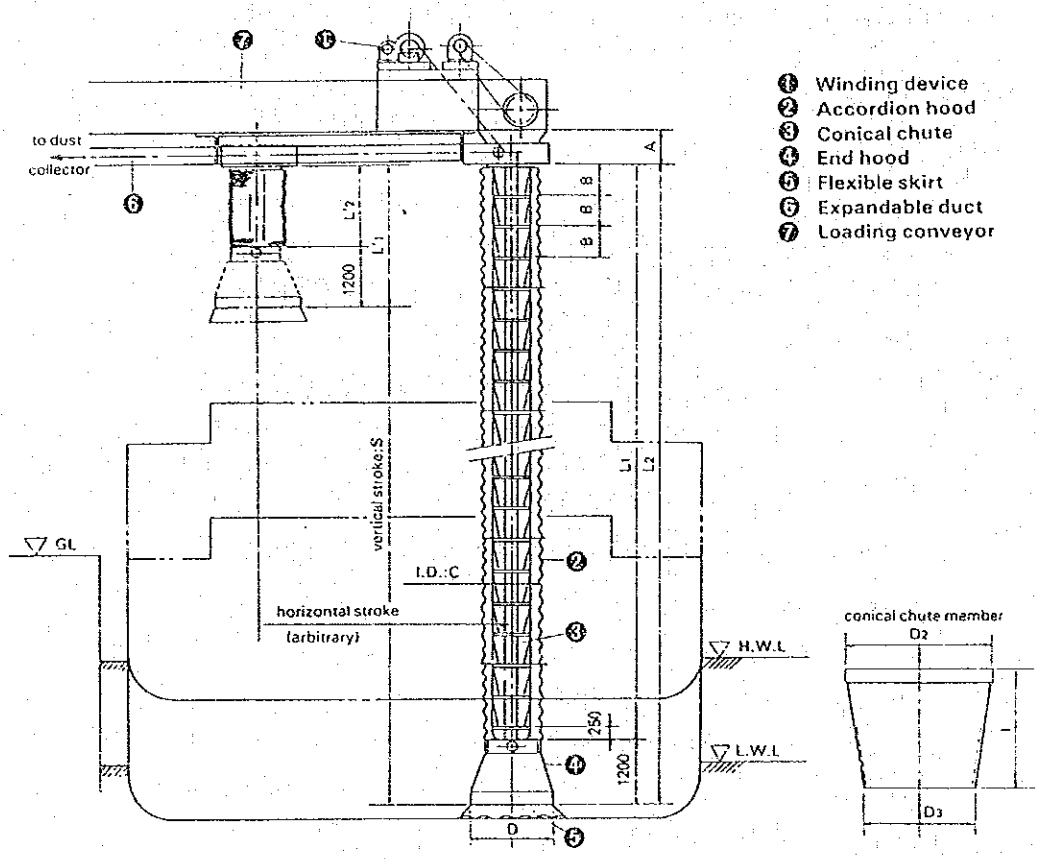
Following is an example of dustproof appratus.

Loading of granular or powderly materials such as grains, pellets, ores, etc. into cars, ship holds, bulk trucks, storage bins etc. often poses a problem of dust emission into the air.

This apparatus allows perfectly no dust emission or leakage and also very light/flexible and automatic operation.

1. Dimensions

The whole system, the dimensions of the characteristic parts and the capacity of the system are shown below. The chute can be expanded/retracted vertically as well as can be moved horizontally.
In the figure below, the chute as in its expanded and also retracted form is shown respectively.



(unit in mm)

capacity t/h \ dimensions	A	B	C	D	L_1	L_2	L'_1	L'_2	S	D_2	D_3	l
200	570	500	750	1500	L_2+1200	$B\times n+250$	L'_2+1200	$50\times n+400$	$L_1-L'_1$	510	300	600
300	630	600	880	1600	L_2+1200	$B\times n+250$	L'_2+1200	$65\times n+400$	$L_1-L'_1$	590	390	700
400	670	600	950	1600	L_2+1200	$B\times n+250$	L'_2+250	$65\times n+400$	$L_1-L'_1$	660	460	700
500	670	600	1000	1700	L_2+1200	$B\times n+250$	L'_2+1200	$65\times n+400$	$L_1-L'_1$	700	500	700

Remarks: 1. Capacity of 600T/H, 700T/H and over are also available.
2. Vertical stroke can be chosen freely depending on the situation.

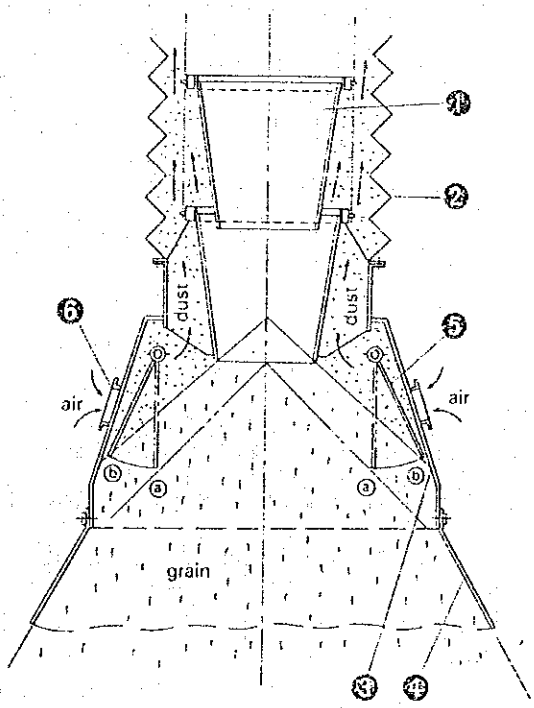
2. Structual Description of Dustproof Chute

This loading chute has been developed so as to overcome all the limitations of the conventional methods.

Instead of the telescopic straight pipe chute, the main chute consists of a series of many conical chute members.
1 this chute is held inside a flexible, air-tight, accordion hood
2 at the lower end of the chute, an end hood 3 and flexible skirt
4 are attached.

When dusty bulk materials fall through the conical chute, minute powders and dusts whirl up in the end hood. But these powers and dusts are absorbed by a blower equipped at the upper part of the chute (not shown in the figure), and fed into a dust collector through the annular space between the conical chute and the accordion hood.

As the pile of material in the end hood gradually grows up, the limit-switch actuator 5 is spontaneously pushed outside and finally actuates the limit-switch at the position b , which turns on the winding device for the chute. The winding device raises up the chute till the limit-switch turns off. This on-off system automatically maintains the hood position to any given optimum level relative to the pile.



1 Conical chute
2 Accordion hood
3 End hood
4 Flexible skirt
5 Limit-switch actuator
6 Air intake ports

II-8 Layout of Tapioca and Sugar/Molasses Terminal

1) Tapioca terminal.

Assumption

- The terminal area has a storage capacity of one twelfth of annual throughput.
- A certain portion of tapioca (30%) which is carried by barge is loaded from barges to an occean going vessel without any storage in the terminal.
- The bulk density is 0.6 t/m³.
- Embankment and afforestation zones are planned near the boundary to minimize a tapioca dust dispersion.
- Only minimum parking space for incoming trucks was secured within the terminal area. The additional parking spaces should be reserved in the distribution and storage area where the land cost is far cheaper. After observing the actual arrival of trucks for different transport, the parking area might be designed and operated by a private sector if necessary.
- The rest angle of tapioca is approximately 30 degrees.

Dimension of facilities

- transit shed : 200m x 120m. Height 32m at center. 3m at the edge along longer sides.

  storage capacity : 209,400 m³, (125,640 t)

  parking area : 200m x 75m. capacity : 150 trucks

2) Sugar and Molasses terminal

Assumption

- The terminal has a storage capacity of one twelfth of annual throughput in a shorterm development and a master plan stage.
- The bulk density of sugar is 0.84 t/m³ and that of molasses is 1.0 t/m³.

- The rest angle is 30 degrees.

Dimension of facilities

- transit shed for sugar

  70m x 80m height 21m at center 2m at edge

  storage capacity: 67,760 m^3, 56,900 t.

  nos of unit; 1 unit at 1991, additional 1 unit at 2001 AD

  molasses tank ϕ = 40m, height 20m

  storage capacity: 25,000 m^3

  nos of unit; 1 unit at 1991 additional 1 unit at 2001 AD

  (See Fig. II-8-1)

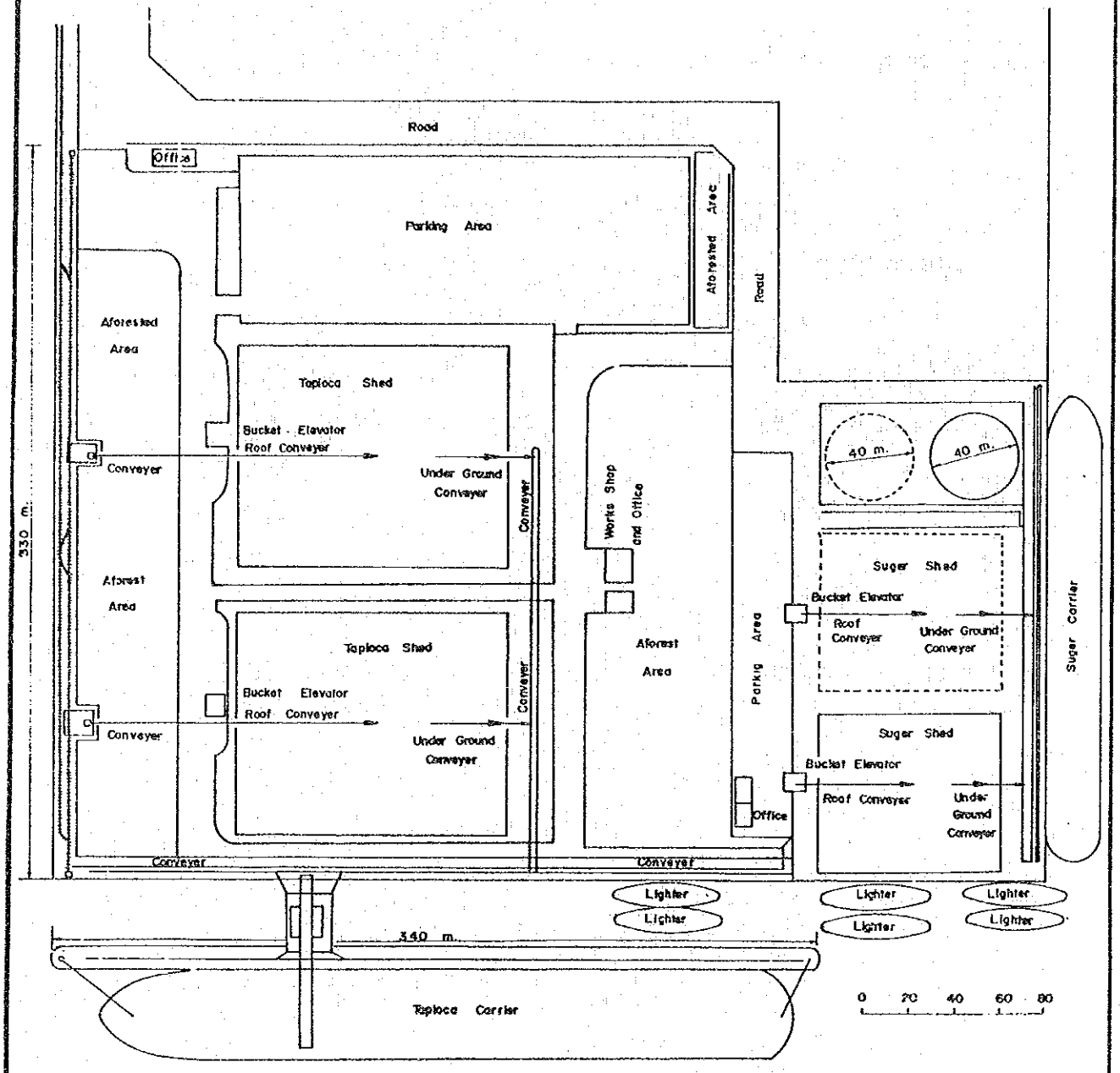


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Fig. II.8.1
Detailed Layout of Agribulk Terminal

II-9 Port Facilities Plan

1. The Road Traffic Volume in the Port Area

1) Premises for the calculation

- 50% of container cargoes to be handled at Laem Chabang will be carried by a railway laid along the road in front of the terminal and the remainder will be carried by road.
- Of the Break Bulk cargoes (other than containers) to be handled at Laem Chabang 75% will be carried by road 15% by railway, and 10% by barge.
- Among agri bulk cargoes, 50% of the tapioca will be carried by road, 20% by railway and 30% by barge.
- All the sugar and molasses will be carried by road.

2) The road traffic volume

The peak volume for port related road traffic can, in general, be calculated according to the following equation.

$$N = \frac{V \times \alpha}{\omega} \times \frac{\beta}{12} \times \frac{\gamma}{30} \times \frac{1+\delta}{\varepsilon} \times \sigma$$

Where:

N = Number of vehicles at peak hour
V = Annual volume of cargoes handled (tons)
α = Share of vehicles
ω = Load on a truck (tons)
β = Monthly variation
γ = Daily variation
ε = Percentage of loaded vehicles
δ = Percentage of vehicles related with port service
σ = Hourly variation

According to data used in port plans in Japan, values of these coefficient's are shown below.

$\beta = 1.2$ $\gamma = 1.5$ $\varepsilon = 0.50$ $\delta = 0.5$ $\sigma = 0.12$

* For the value of ω, the planned value in Japan and the actual result in Thailand are taken into account to determine the value. For container trailers, the value ω is set at 10.0.

The results of these calculation are shown in Table

		V (th. ton)	α	ω	N
Container	Truck	3,803	0.5	8.3	433
	Trailer	3,802	0.5	10.0	342
Break-Bulk		2,015	0.75	8.3	328
Tapioca		4,500	0.70	18	315
Sugar		1,360	1.0	18	136
Molasses		478	1.0	13	66

The road sections are designed using these figures as shown in Fig. II-9-1～III-9-3.

2. The area for transit shed, warehouses, sorting yards and open storage yards.

The required storage area can be determined using the following equation:

$$S = \frac{1}{\alpha} \times \frac{1}{W} \times \frac{N}{R}$$

Where, S = Storage area (or floor area) of the storage facilities (m^2)

α = Effective floor rate

W = Storing density (ton/m^2)

R = Turnover rate

N = Volume of cargoes using transit sheds, warehouse, sorting yards and open storage yards (tons/year).

According to the Japanese Technical Standard for port facilities, the values of Q and R are as follows.

The Values of α and R

	Transit Sheds	Warehouses	Sorting Yard	Open Storage Yards
α	0.5	0.7	0.5	0.7
R	20 - 25	8 - 12	20 - 25	8 - 12

The values of W are enumerated in the following table.

The Values of W

	Transit Sheds	Warehouses	Sorting Yard	Open Storage Yards
Row Cotton and Wool	1.0-2.0	1.0-2.0	-	-
Row Silk and Thread	1.0-2.0	1.0-2.0	-	-
Can food	1.5-3.0	1.0-3.0	-	-
Textile	1.0-2.0	1.0-2.5	-	-
Steel and Steel goods	1.0-3.5	2.0-3.5	2.0-3.0	2.0-3.0
Machinery and Miscellaneous	1.0-2.0	0.5-1.5	2.0-3.0	2.0-3.0

Source: The Technical Standard for Port and Harbor Facilities and actual performance in the typical Japanese ports.

These values can be applied in planning the development of the Laem Chabang port, and the values of α, W and R are as follows.

	Transit Sheds	Warehouses	Sorting Yard	Open Storage Yards
α	0.5	0.7	0.5	0.7
R	20	8	20	8
W	1.5	1.5	2.5	2.0

The values of N are forecasted from the cargo statistics at Bangkok Port and the actual performance in the typical Japanese ports.

The Volume of cargo stored in various facilities.

Unit : tons/year

		Transit Sheds	Warehouses	Sorting yard	Open storage yard
Cargo Volume	Foreign	145,600	655,200	254,400	1,145,000
	Domestic	146,000	79,000	70,000	36,000

From the above coefficients, the required storage areas are calculated as follows.

	Transit sheds	Warehouses	Sorting yard	Open storage yard
Storage area	10,000	78,000	13,000	103,000

From the above storage area, the gross area for storage facilities is determined as follows allowing for area for parking and load/unload work spaces.

Gross area of the storage facilities

Unit : m²

	Tansit sheds	Warehouses	Open storage area (including sorting yard)	Empty van pool
Site area	35,200	171,000	133,000	410,000

The gross area of empty van pool is determined from the actual performance in the typical Japanese ports.

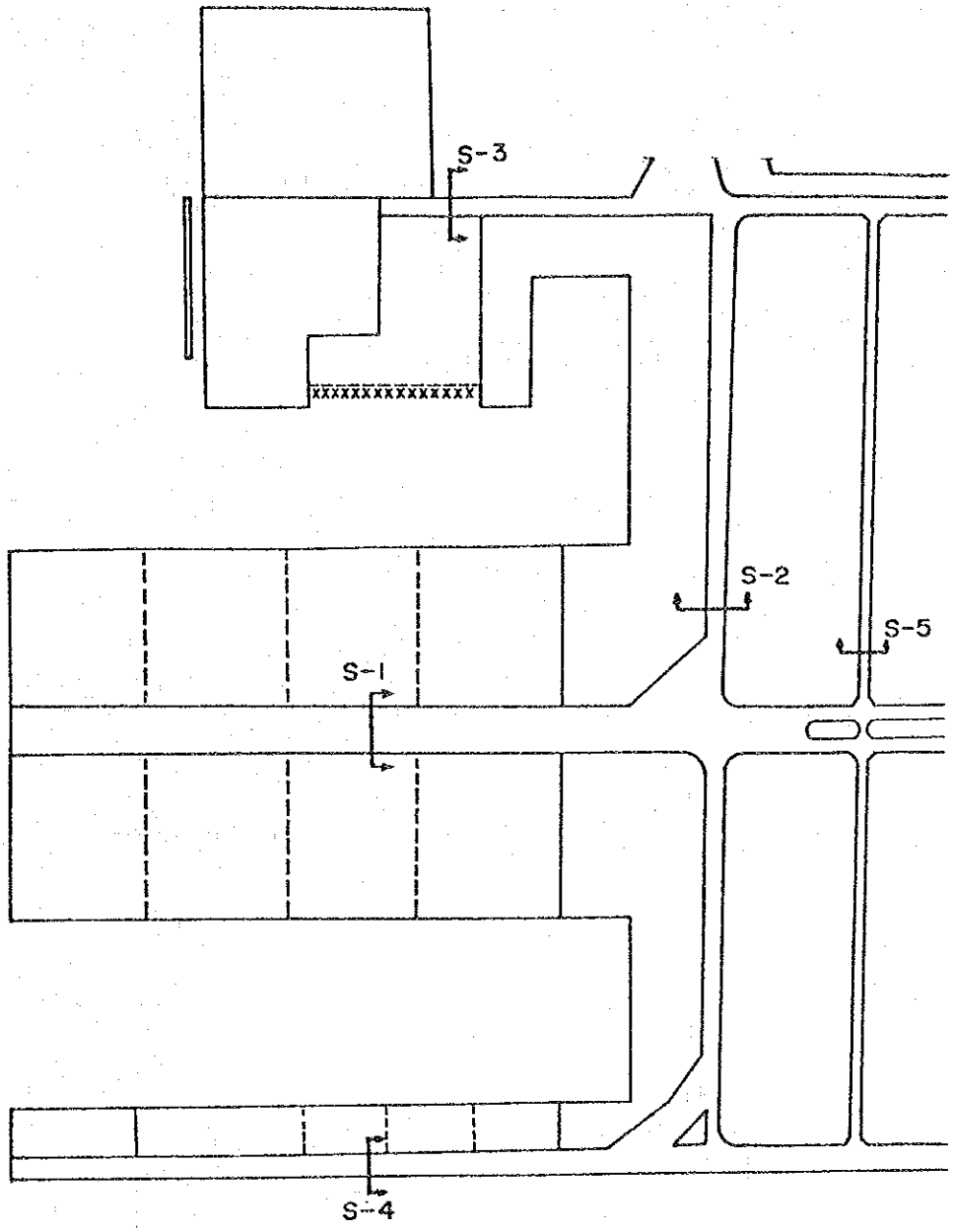

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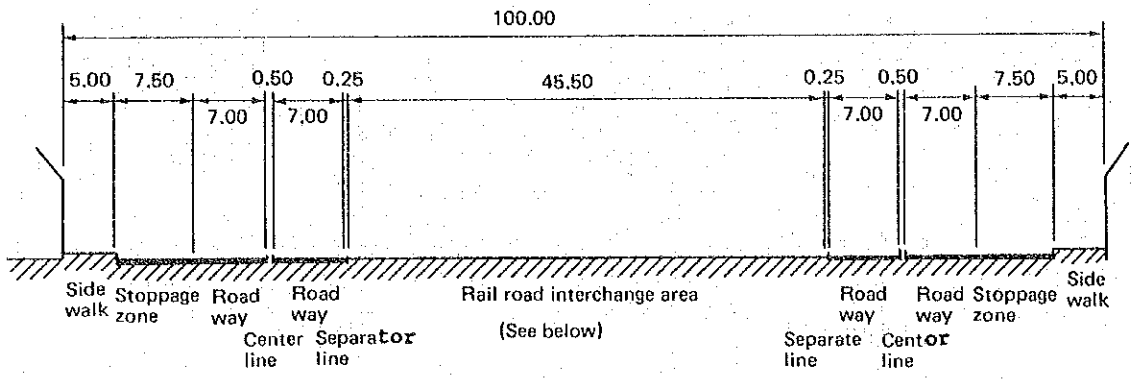
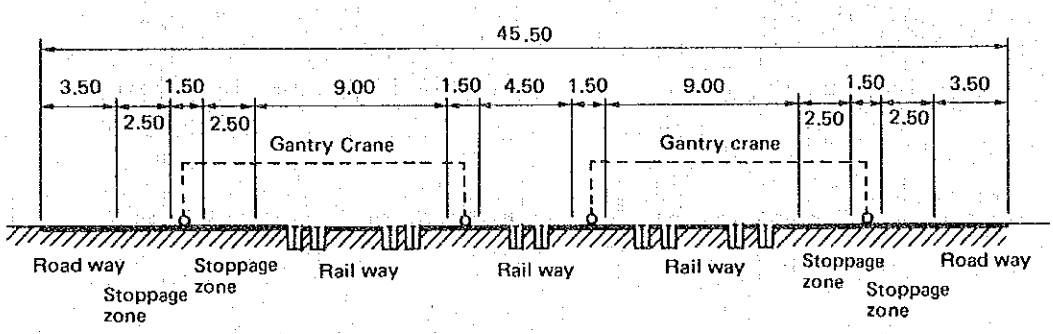
Fig. II.9.1
Road Network Plan

1) Cross Section S-1



"Section of Rail road interchange area"



2) Cross Section S-2

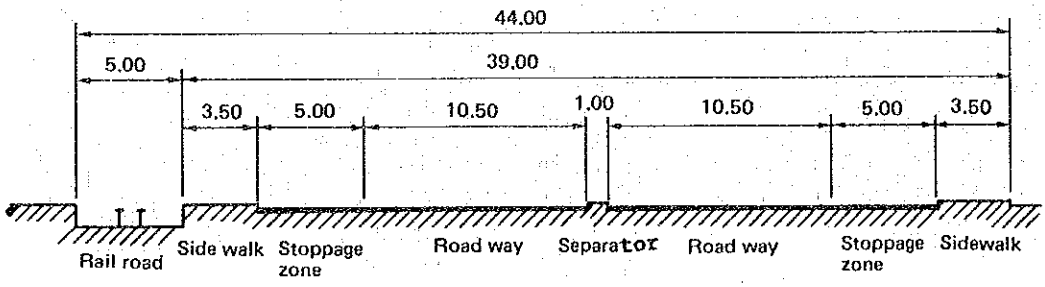


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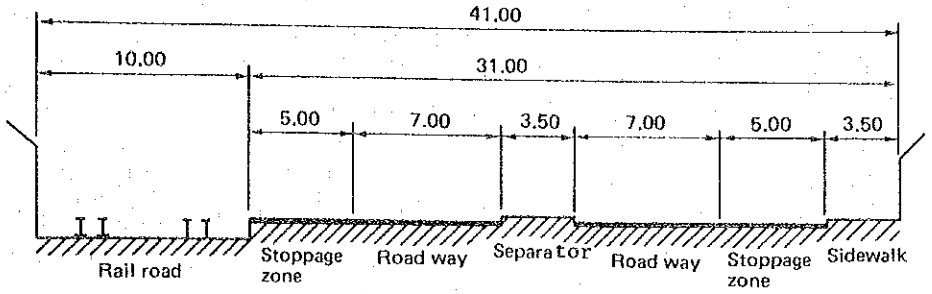
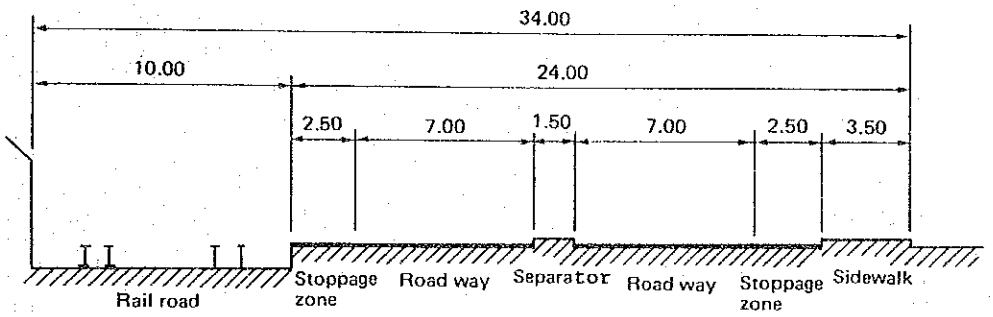
	Fig. II.9.2 Road Cross Section

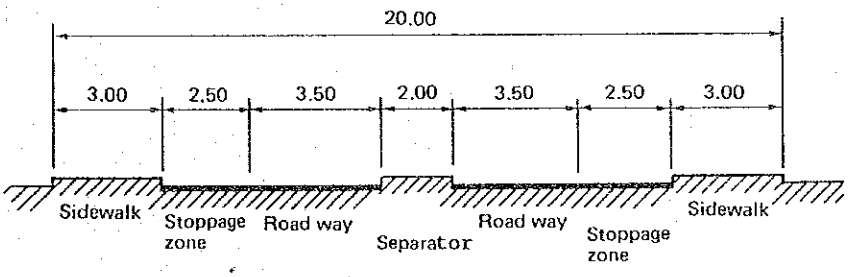
3) Cross Section S-3



4) Cross Section S-4



5) Cross Section S-5



LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
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	Fig. II.9.3 Road Cross Section

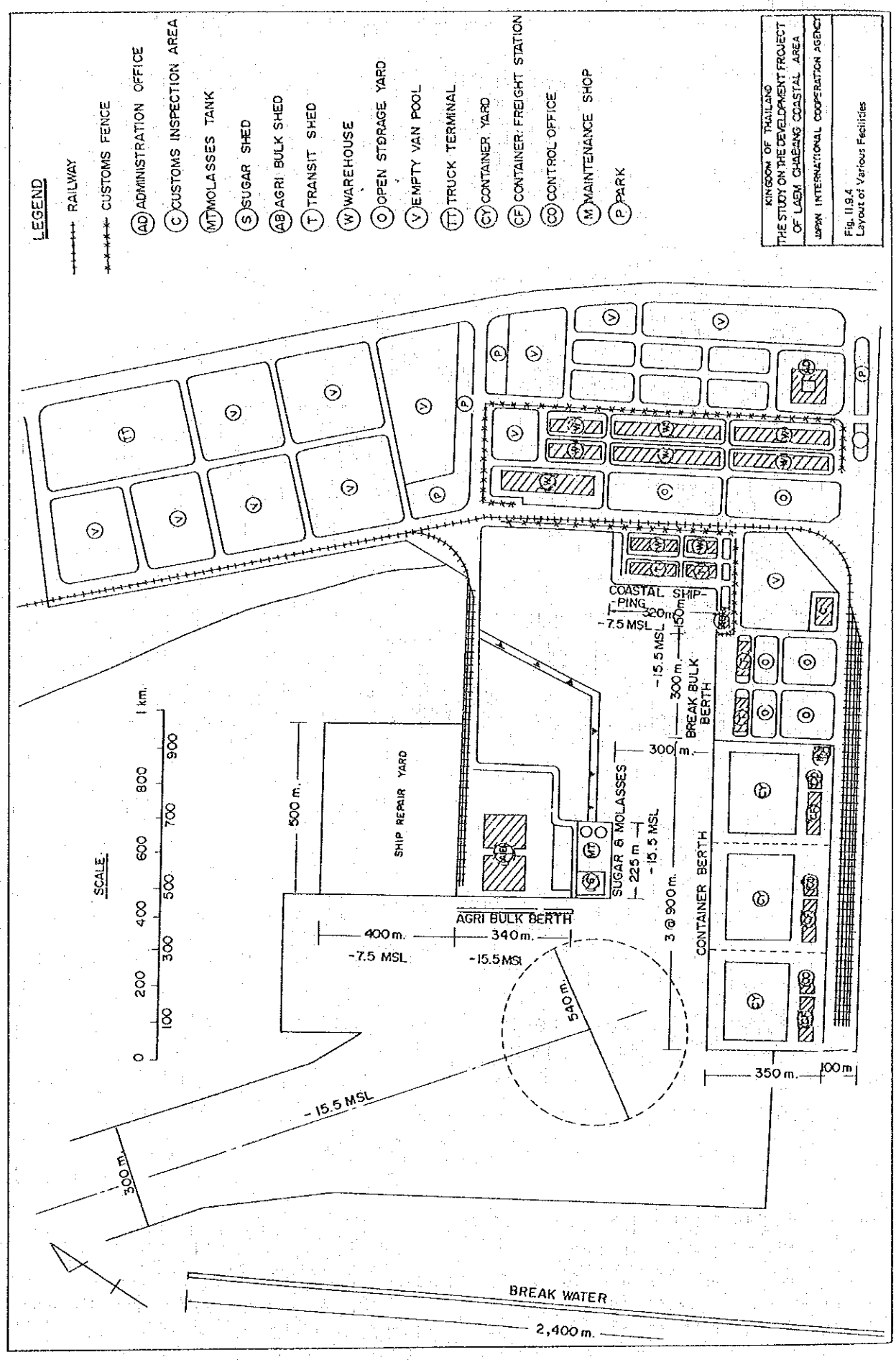
LEGEND
RAILWAY
CUSTOMS FENCE
AD ADMINISTRATION OFFICE
C CUSTOMS INSPECTION AREA
MT MOLASSES TANK
S SUGAR SHED
AB AGRI BULK SHED
T TRANSIT SHED
W WAREHOUSE
O OPEN STORAGE YARD
V EMPTY VAN POOL
TT TRUCK TERMINAL
CY CONTAINER YARD
CF CONTAINER FREIGHT STATION
CO CONTROL OFFICE
M MAINTENANCE SHOP
P PARK
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Fig. II.9.4
Layout of Various Facilities
SCALE
0
100
200
300
400
500
600
700
800
900
1 km.
SHIP REPAIR YARD
500 m.
COASTAL SHIPPING
320 m.
150 m.
-7.5 MSL
-15.5 MSL
300 m.
BREAK BULK BERTH
300 m.
SUGAR & MOLASSES
225 m.
-15.5 MSL
3 @ 900 m.
CONTAINER BERTH
AGRI BULK BERTH
400 m.
340 m.
-7.5 MSL
-15.5 MSL
540 m.
350 m.
100 m.
-15.5 MSL
300 m.
BREAK WATER
2,400 m.

II-10 Container Yard Plan

Following are the main container handling systems. Leading shipping operators in the world are using some of those systems and they are making the best use of their system.

1. Chassis System
2. Straddle Carrier System
3. Yard Gantry Crane System
4. Fork lift Truck System

Fig. III-10-1 throug 4 show the typical layouts of container terminals for the above-mentioned systems.

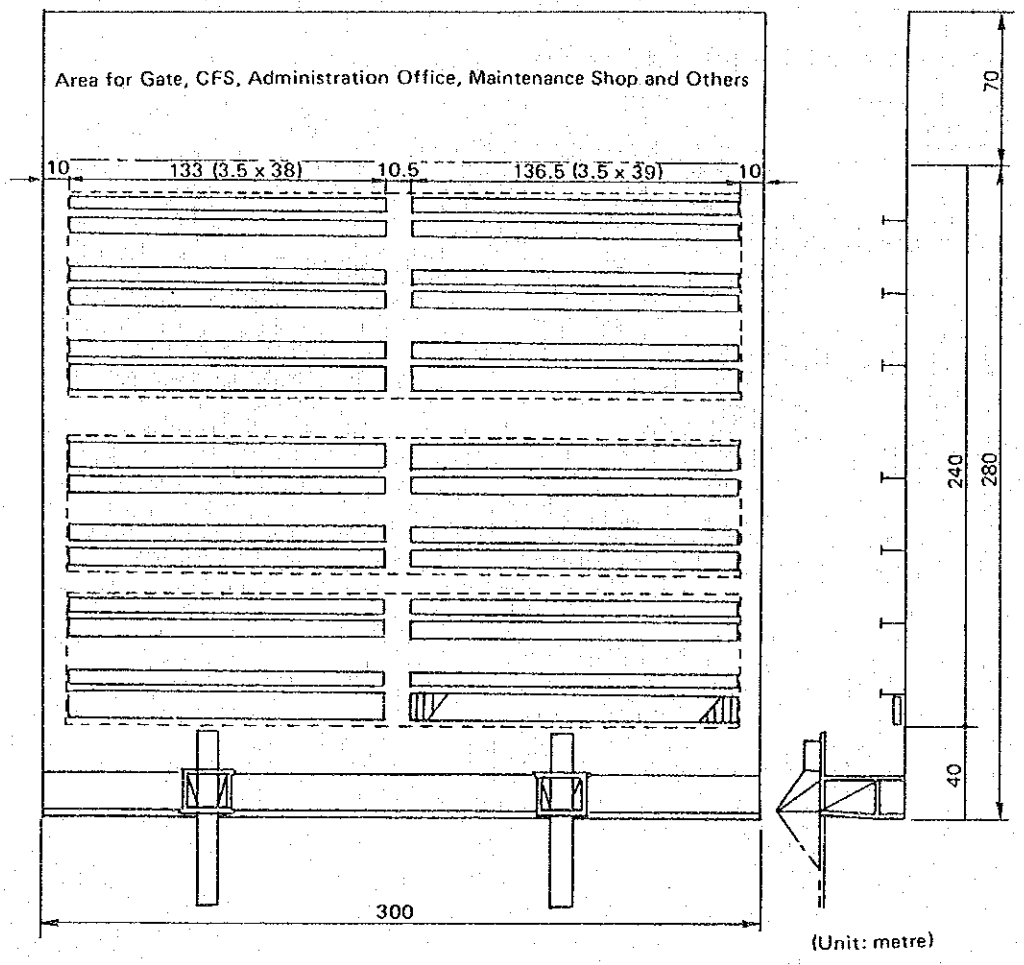

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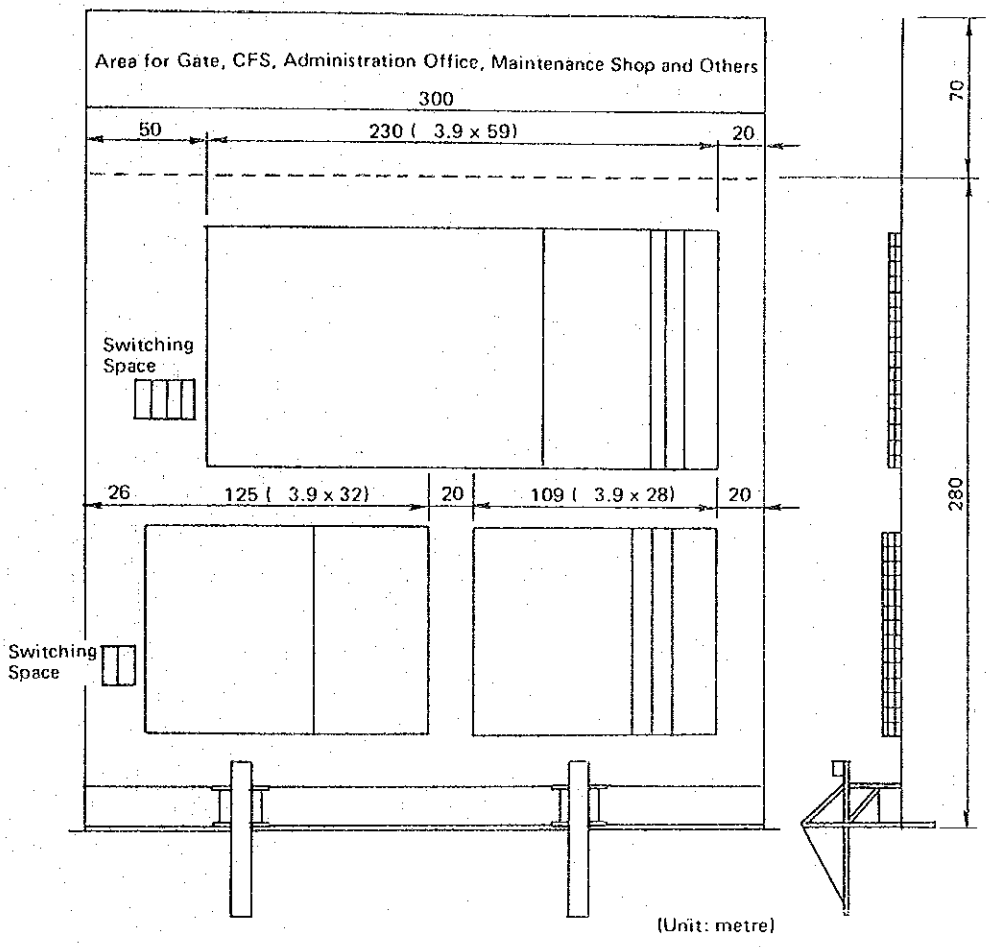
Fig. II.10.1
Layout of All Chassis System



LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
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	Fig. II.10.2 Layout of Straddle Carrier System

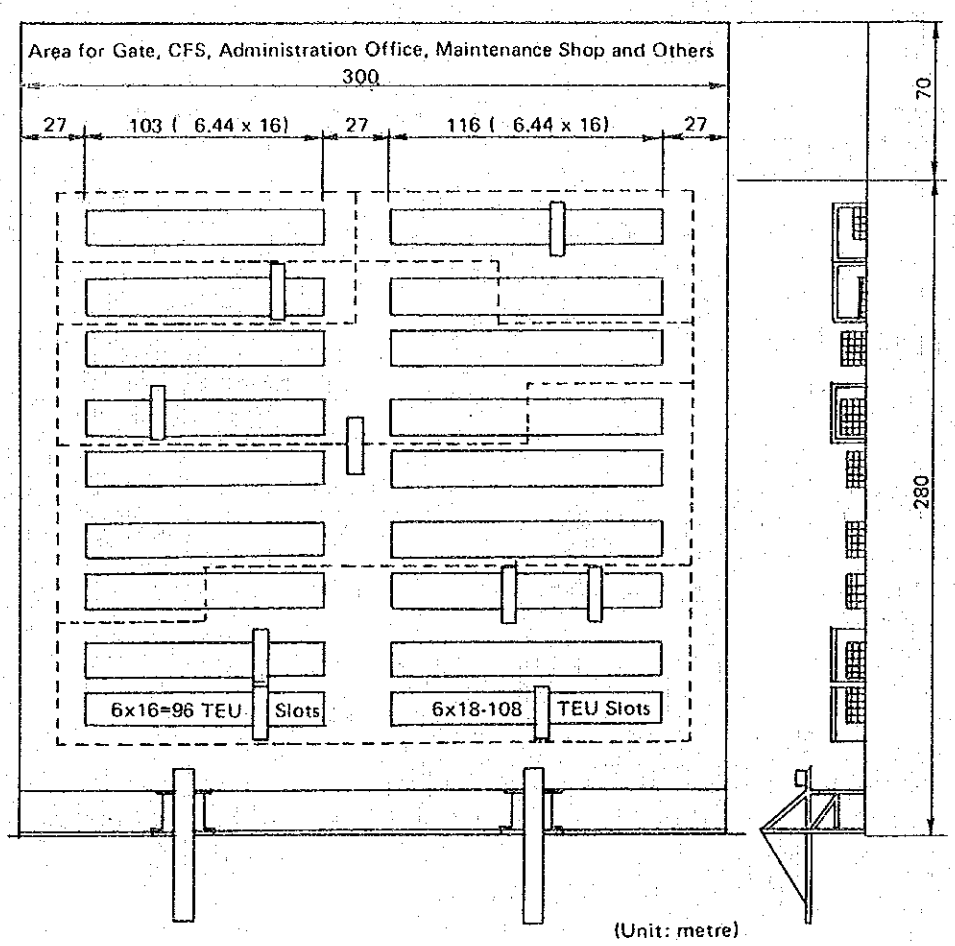

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Fig. II.10.3
Layout of Transfer Crane System

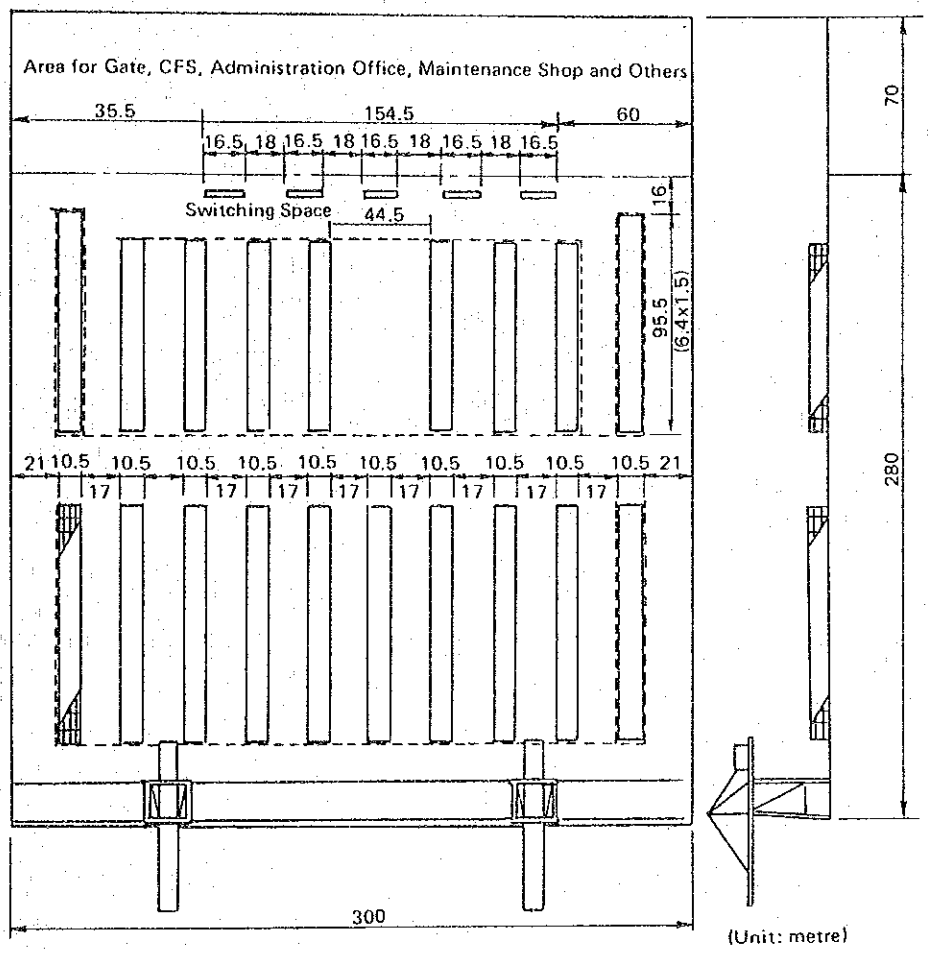

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Fig. II.10.4
Layout of Forklift Truck System

II-11 Containerization of Ocean Transport in the World

The mode of containerized cargo transport has proved to be highly beneficial to shippers and shipping companies alike. The former obtain more reliable, faster and less costly door-to-door services. The latter are able not only to reduce the internal cargo handling cost but to reduce the linehaul cost itself by means of utilizing ever larger vessels, which is made possible by the shorter handling, and therefore, berthing time.

From the late 1960's the containerization of ocean transport has progressed at a remakable rate. Figure II-11.1 shows the growth of full container fleet in the world. Between 1968 and 1980 the total capacity of full containers has grown by 29% per year. Rapid containerization is obvious. By the end of 1982, excluding those on very minor routes, there were 739 full container ships with the total capacity of 820,000 TEU and 1,435 semi-container ships with the total capacity of 500,000 TEU. The size of container ships has also increased greatly. Table II-11.1 shows the changes in full container fleet in the world from 1968 to 1982. The mean TEU per ship had increased from 450 in 1968 to 1,100 in 1973. During this period the mean DWT had increased from 13,146 tons to 22,745 tons. The seeming stabilization after 1973 does not mean that the increase in the ship size has stopped. This is due more to the fact that more minor routes has been containerized by smaller ships. Out of 51 new full container ships built in 1982 3 were of more than 40,000 DWT, 7 more than 30,000 DWT, and 16 more than 20,000 DWT. The average DWT of full container ships operated on the U.S.West Coast - Far East route in 1982 was 24,040 tons and the corresponding figure is 22,696 tons for semi-container ships. The average DWT figures for Far East - Europe route in 1982 were 32,129 tons for full container ships and 14,624 tons for semi-container ships. These main shipping routes have become dominated by large full or semi-container ships and general break bulk cargo ships have practically disappeared from main routes.

Container services on the main routes are dominated by a number of large shipping companies which are large enough to maintain world-wide network. Of the 280 shipping companies providing container services in 1982 the top 30 occupy 53% of the total TEU capacity. Table III-11.2 lists such companies.

A significant change has occurred in the container transport in the last two years. As shown in Figure II-11.1 the growth of the world container fleet has slowed considerably after 1980. This is a reflection of the slow growth of world trade due to the recession. In fact actual container transport demand in 1982 is considered lower than the year before and the supply of container transport capacity seemed to outstrip the demand in 1982. In all major shipping routes ship utilization rates declined. Some shipping lines added extra ports in order to offset the decline in cargo volumes at the ordinary ports of call. Even so a significant number of ships had to be laid idle. By the end of 1983 laid-up ships numbered 148 with the total TEU capacity of 53,457, almost 4% of the entire fleet.

This situation of over supply will probably not ease in the near future. At the end of 1982 there remain outstanding orders for 151 full container ships with a total capacity of 310,000 TEU. This alone would increase the total fleet capacity of full container ships by 38%, and there are outstanding orders for semi-container ships as well. It is unlikely that the world trade volume would increase by more than 8% per year for the coming 5 years. For shipping companies of world-wide operation short-term prospects are not bright. They would try to cut down the cost and at the same time would try to rearrange their shipping route in order to maximize the utilization of their ships.

TABLE II-11.1

(Full Container Fleets in the World 1968-1982)

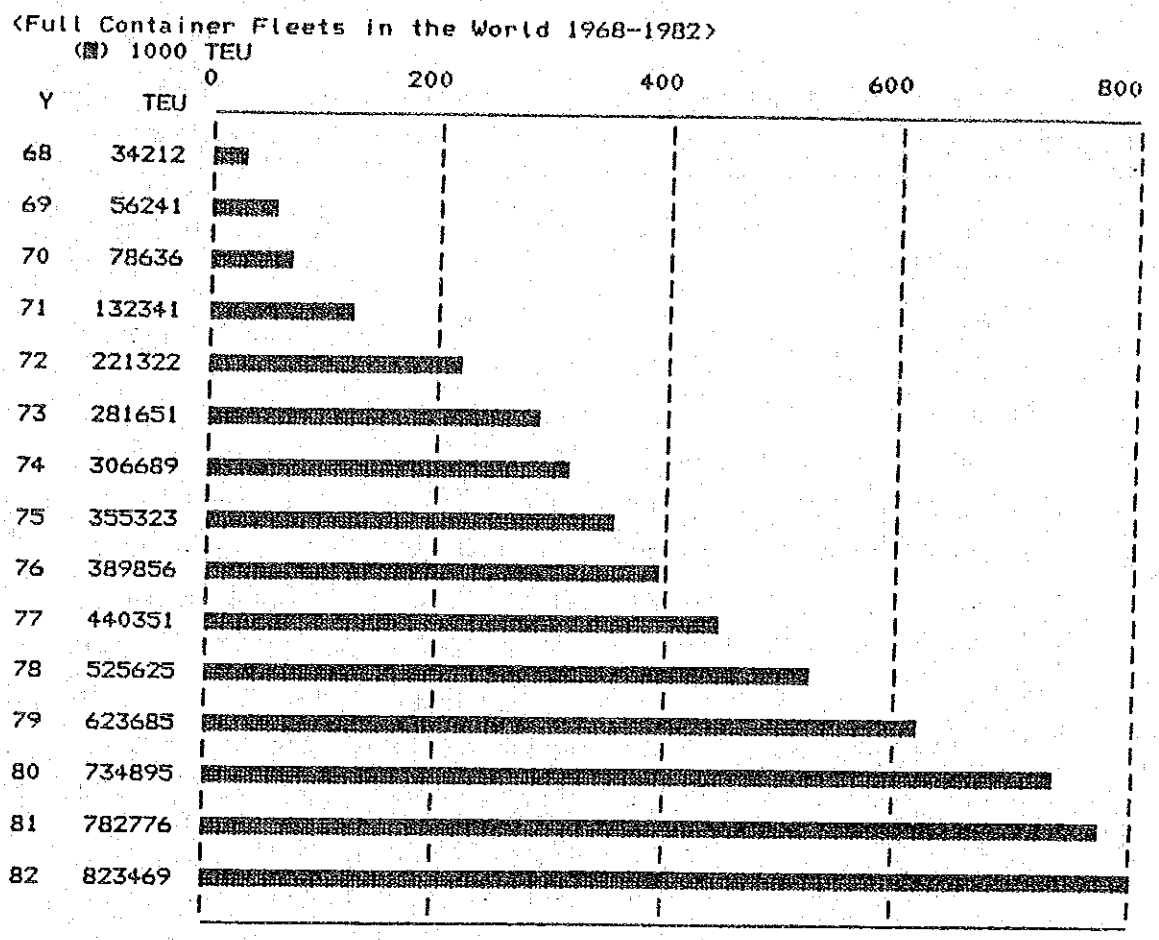
Year end	NO	GT	UP %	DW	UP %	TEU	UP %	TEU/GT	Mean TEU
1968	76	932888		999087		34212		0.0367	450
1968	109	1451212	55.6	1589918	59.1	56241	64.4	0.0388	516
1970	120	1805635	24.4	1808483	13.7	78636	39.8	0.0436	655
1971	151	2647941	46.6	2651541	46.6	132341	68.3	0.0500	876
1972	217	4621575	74.5	4497746	69.6	221322	67.2	0.0479	1020
1973	256	5905108	27.8	5822965	29.5	281651	27.3	0.0477	1100
1974	306	6383546	8.1	5952291	2.2	306689	8.9	0.0480	1002
1975	325	6833085	7.0	6573861	10.4	355323	15.9	0.0520	1093
1976	354	7459093	9.2	7136054	8.6	389856	9.7	0.0523	1101
1977	385	8553555	14.7	8186646	14.7	440351	13.0	0.0515	1144
1978	463	9914166	15.9	10039466	22.6	525625	19.4	0.0530	1135
1979	542	11552382	16.5	11693599	16.5	623685	18.7	0.0540	1151
1980	634	13253965	14.7	13876827	18.7	734895	17.8	0.0554	1159
1981	704	14006684	5.7	14842779	7.0	782776	6.5	0.0559	1112
1982	739	14471676	3.3	15444431	4.1	823469	5.2	0.0569	1114
mean UP% a year 68-81			21.6		21.6		25.5		

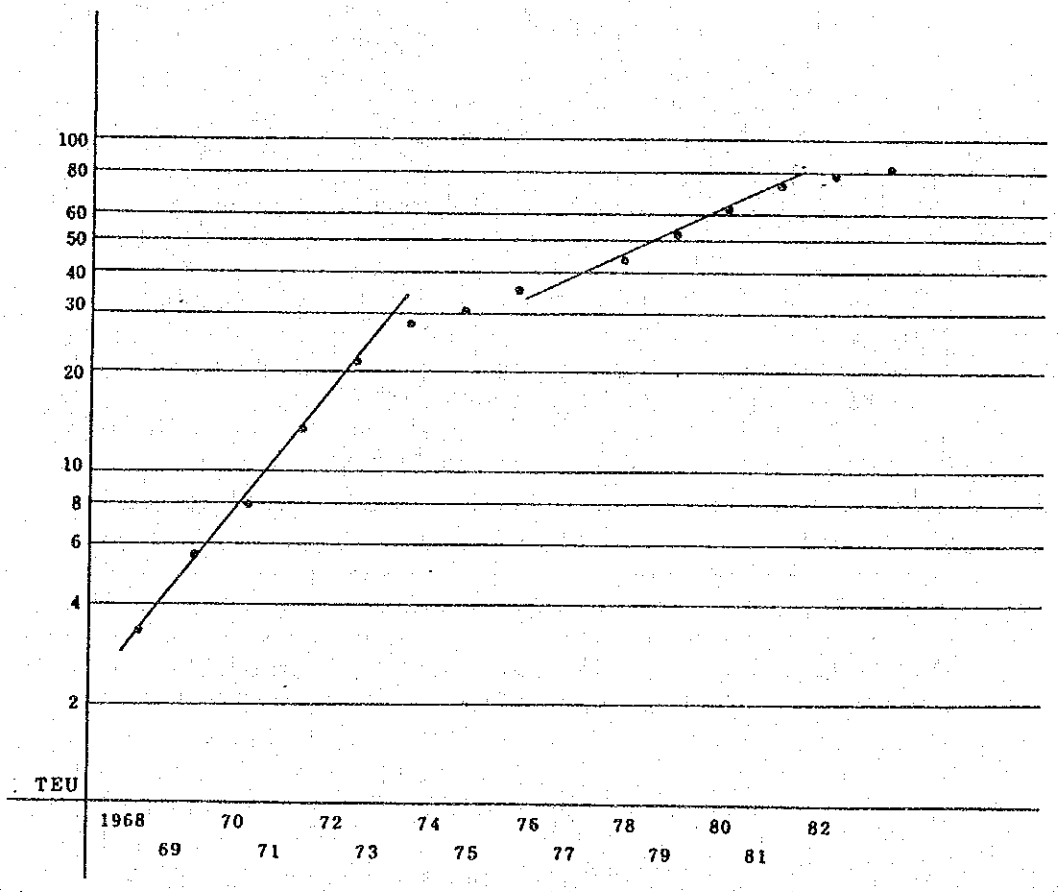
TABLE II-11.2

(Full Container Firms TOP 30)

Rank	81 R	Firms	Fg	82NO	82 GT	82 DW	82 TEU	TEU %
1.	(2)	Hapag	(Ge)	30	833911	830973	45748	5.56
2.	(1)	Sea-Land	(Am)	35	716271	692516	44985	5.46
3.	(3)	Maersk	(Da)	24	673339	719258	39342	4.78
4.	(5)	NYK	(Ja)	28	701988	662674	33513	4.07
5.	(4)	OCL	(Br)	16	643730	585493	31904	3.87
6.	(6)	OOCL	(HK)	18	459719	440671	27497	3.34
7.	(7)	CGM	(Fr)	18	407235	4462140	22499	2.73
8.	(9)	APL	(Am)	14	310082	316494	20724	2.52
9.	(10)	USL	(Am)	20	364772	381774	20416	2.48
19.	(13)	Ned	(Du)	12	384778	360548	20344	2.47
11.	(11)	MOL	(Ja)	14	458807	390596	20290	2.46
12.	(8)	Evergreen	(Tw)	15	249393	314515	19122	2.32
13.	(14)	Zim	(Is)	14	299092	327027	17426	2.12
14.	(15)	K Line	(Ja)	14	281837	287962	16237	1.97
15.	(-)	Baltic	(Ru)	18	275554	298167	16074	1.95
16.	(17)	Yangming	(Tw)	11	287730	291306	15410	1.87
17.	(12)	NOL	(Sg)	9	234657	290334	14067	1.71
18.	(18)	Safmarine	(SA)	6	271630	251270	12869	1.56
19.	(-)	UASC	(Ku)	10	193751	216422	11989	1.46
20.	(-)	Scan C	(No)	8	183190	207829	11608	1.41
21.	(20)	ACT	(Br)	8	204591	228988	11433	1.39
22.	(-)	EAC	(Da)	8	205205	181728	10608	1.29
23.	(-)	ANL	(Au)	8	174647	188976	10258	1.25
24.	(-)	Farrell	(Am)	7	177062	163139	10042	1.22
25.	(-)	Columbus	(Ge)	10	172391	192951	9975	1.21
26.	(-)	YS Line	(Ja)	7	209296	191688	9889	1.20
27.	(16)	W. Wilhelmsen	(No)	6	156128	185334	9787	1.19
28.	(-)	Triestino	(It)	11	175662	173952	9710	1.18
29.	(-)	KSC	(Ko)	6	153598	149326	9572	1.16
30.	(-)	Hellenic	(Gr)	10	134805	210279	9476	1.15
		TOP 30 TOTAL		415	9994851	10194330	562814	68.35
		OTHER 107		324	4476825	5250101	260655	31.65
		ALL TOTAL 137		739	14471676	15444431	823469	100.00

FIGURE II.11.1





APPENDIX II-12 RECORDS OF INTERVIEWS

Subject: Container Ship's Call on the Laem Chabang Container Terminal.

Dear Sir,

Thai government is going to carry out the detailed design of the proposed Laem Chabang Port, aming to construct following six berths by 1987 AD:

2 - container berth	-15^{m} below M.S.L
2 - break bulk berth	-13.5^{m} below M.S.L
1 - Sugar molasses berth	-15^{m} below M.S.L
1 - Agri-bulk berth	-15^{m} below M.S.L

JICA Study Team for the Laem Chabang Coastal Area Development Project has commenced a master planning and a feasibility study for the short development plan in the Laem Chabang area, which include a port study.

In order to confirm the feasibility of the port construction, especially the container terminal in Laem Chabang, the potential demand for this terminal needs to be assessed in the light of the relation to the existing container berths in Klong Toei Port. For this purpose we believe that the opinions of the ship line companies, of which ships are calling the Klong Toei Port, should be most important.

We would be much obliged if your esteemed company could answer the following questions in order to help us to propose the most suitable container terminal in Laem Chabang.

We promise you that your reply will be taken as confidential and every attention will be paid in the report not to refer to any opinion of any specific company.

Sincerely yours,

Kenjiro Kohriki,
Port Engineer of JICA Study Team.

Ambassador

QUESTIONNAIRE

Please answer the following question by putting circles on the selected item which fits you best, or otherwise specify your opinions as clearly as possible.

1. If the container terminal is built in Laem Chabang, will your container ships or semi container ships.

   (1) Visit Laem Chabang.

   (2) Remain at Klong Toei.

   (3) Other (please specify)

   A Company ..... (2)
   B Company ..... (2)
   C Company ..... (1)
   D Company ..... (2)
   E Company ..... (2)

2. If your answer in 1 is (2), please elaborate the reason.

   (1) You are quite satisfied with the container terminal in Klong Toei.

   (2) You don't want to enlarge the container ship size because the present size just fits the demand.

   (3) The additional inland transport cost is greater than the merit to use Laem Chabang.

   (4) Others (please specify)

   A Company ..... (3)
   B Company ..... (3)
   C Company ..... no comment
   D Company ..... no comment
   E Company ..... (3), larger container ships are not necessarily profitable at present in Thailand.

3. If your ship calls on Laem Chabang, what kind of operation and facilities do you think is the most suitable to the terminal in Laem Chabang ? Please answer the following questions.

3-1 Who will be the terminal operater ?

(1) The container terminal including the berth and back up facilities will be lent to one or serveral shipping lines and the cargo handling will be carried out by them.

(2) The same way adopted in Klong Toei Port. PAT will become the terminal operator and the PAT staff will operate the container cranes and chassis or straddle carriers.

(3) Others (please specify)

A Company.....(1)

B Company.....(1) or to employ private contractors

C Company.....(3) operation by the third sector (30% government, 70% private)

D Company.....(1)

E Company.....(1)

3-2 Dimensions of the container terminal, such as water depth alongside the berth, the maximum and average ship size (DWT), width of the container yard in inland direction, container freight station etc.

(1) The similar size of the east quays in Klong Toei Port is sufficient except water depth. Then how deep should it be ?

(2) The size needs to be suitable for the operation described in the 3-1. Then please specify the dimension.

i) water depth (m)

ii) maximum and average ship size (D/W)

iii) marshalling yard area (m^2)

iv) container freight station area (m^2)

(3) Other (please specify)

A Company .....up to 1,000 TEU

B Company .....(2), water depth 40'

C Company .....Max 2,000 TEU (1,000-1,500 TEU at the initial state)

D Company .....less than 2,500 TEU (1,200-1,800 TEU)

E Company .....no comment

3-3 Is the terminal crane necessary ?

(1) Gantry crane is necessary.

(2) Mobile crane which is similar to one owned by the P.A.T. at Klong Toei is enough.

(3) Ships gear or ship-tainer is enough.

(4) Other (please specify)

A Company ..... (1)
B Company ..... (1)
C Company ..... (1)
D Company ..... (1)
E Company ..... (1) (ship crane should be made available)

3-4 The Equipment for the horizontal transport in the terminal:

(1) Transfer crane.

(2) Straddle carrier.

(3) Chassis.

(4) Other (please specify)

A Company ..... (1) and (2)
B Company ..... (2) and (3)
C Company ..... (3)
D Company ..... (1), (3), toploader and prime-mover
E Company ..... (3), (2) and toploader

4. Inland transportation between Laem Chabang and a Shipper/ consignee:

(1) The inland transportation will be done by your company or the private transportation company which relates to your company.

(2) The ETO will carry out this transportation as in Klong Toei Port.

(3) Others (please specify)

A Company ..... Shipper's arrangement preferable and also wants (1)

B Company ..... (1) (but not allowed today)

C Company ..... By rail (chartered container freight train between Laen Chabang and Bang Sue)

D Company ..... By rail (first alternative)
(1) (second alternative)

E Company ..... By truck and rail
- private truck company (not operated by Shipping lines)
- railway transportation is unreliable

5. Preferable time to shift your container operation to Laem Chabang from Klong Toei Port:

(1) 1988

(2) by 1991

(3) It is hard to decide the time since the depreciation period for the ships commissioned to Bangkok remains considerably.

(4) You will obey the order by Thai Government.

(5) Others (please specify)

A Company ..... (2)

B Company ..... (4)

C Company ..... At any time when communication facilities and other necessary equipment are available

D Company ..... Continue to use Klong Toei.
Along with the development of the Eastern Seaboard Industry, Laem Chabang will be used as well as Klong Toei.

E Company ..... Not mentioned the specific year of operation shift.
All the shipping companies have to stop completely container operation at Klong Toei simultaneously and move to Laem Chabang at the same time.

6. Proportion of the cargo handled by your company in Laem Chabang in case that you shift there:

(1) You will shift all operation from Klong Towi to Laem Chabang.

(2) You will devide the cargo according to the shiproute and the part of your cargo will be handled in Laem Chabang.

(3) You will obey the guideline shown by the government.

(4) Others (please specify)

A Company ..... (2)

B Company ..... (1)

C Company ..... (2) Necessary facilities and equipment (railway, telecommunication, etc.) have to be provided.

D Company ..... no answer

E Company ..... (1)

7. Port charge and tariff for container handling and the total charge per TEU:

(1) The same tariff system as the present one should be applied and the total charge per TEU should be equal to the present price.

(2) The new tariff system should be introduced based on the cost of the activities required.

(3) Others (please specify)

A Company ..... (2)

B Company ..... (1)

C Company ..... (2) Annual increase rate of tariff should not be high.

D Company ..... (2) (tariff for catainer)

E Company ..... no answer

8. The most favorable site of the unstuffing (stuffing) of the container in case of the import (export) via Laem Chabang Port:

8-1 Import Containerized Cargo; Unstuffing.

(1) Final consignee (factory, storehouse owned by wholesale company, etc.)

(2) Private godown near Klong Toei Port.

(3) Laem Chabang.

(4) Bang Sue railway container station proposed by the SRT.

(5) Others (please specify)

A Company ..... (1)
B Company ..... (1)
C Company ..... C.F.S at Klong Toei
D Company ..... (4)
E Company ..... (1)

8-2 Export Containerized Cargo; Stuffing.

(1) Shippers' storehouse.

(2) Private godown near Klong Toei Port.

(3) Laem Chabang.

(4) Bang Sue railway container station by SRT.

(5) Others (please specify)

A Company ..... (1)
B Company ..... (1) and (3)
C Company ..... no answer
D Company ..... no answer
E Company ..... (1)

9. At present more than 90% of the containerized cargo of in-and out-bound is either unstuffed or stuffed within the customs fence of PAT area. What do you think is the main reasons for this ? (you may choose more than one answer if any)

(1) The P.A.T's port tariff system makes it very expensive to transport the full container load outside of the P.A.T's area compared to less container cargo transport.

(2) The transport of the import cargo from the customs fence in Klong Towi port is now monopolized by the ETO who does not have enough number of trailer trucks.

(3) Tne ETO's tariff system makes it very expensive to transport the full container load outside of the P.A.T's area compared to the less container cargo.

(4) The customs clearance outside the customs fence is either extremly expensive or involves too complicated or inefficient procedures for the customs department.

(5) The full container transport in Bangkok is infeasible because of the physical restriction arising from the road structure (e.g., width, clearance height, allowable load, etc.) in Bangkok City or in the final destination (or origin in case of export).

(6) Other (please specify)

A Company ..... (1), (3) and (4) (major reasons)
B Company ..... (2) and (5) (minor reasons)
B Company ..... (2) and (3)

C Company ..... (1)

D Company ..... (1), (2), (3) and (4) As for (5),
a. right for imported container transportation
b. wrong no restriction for exporting container transportation because cargo comes from manufacturers from the outskirt of Bangkok.
c. traffic restriction for large truck in Bangkok City. (6 AM.-9 AM., 3 PM.-10 PM.)
d. risky unstuffing at the Port

E Company ..... (1), (2), (3) and (4)

. unreasonable habits (gate charge, tea money etc.)
. higher tariff system for FCL cargo
. insufficient number of vehicles owned by the ETO (The ETO subcontracts to private companies with 23% brokerage.)

APPENDIX II-13 COST COMPARISON OF LAEM CHABANG AND BANGKOK PORTS

1. The Object and Method of the Study

1) The Object

This study examines the benefits of the container terminal which will become the center of the new port being constructed at Laem Chabang, Thailand.

In order to examine the change in the container transportation cost which is caused by using the container terminal at the new port instead of the presently used facilities at Bangkok port, this study roughly compares the difference in transportation cost between the case of feeder service to Bangkok port, and the case in which a main route ship calls directly at the new Laem Chabang port.

2) The Method

The study team drew up 5 cases, using the North American and European routes as examples, these cases are listed below.

Case 1 (Extension of N. America - H.K.):

A main route from North America to Hong Kong is extended to include Laem Chabang port.

Case 2 (Deviation from N. America - Singapore):

Laem Chabang port is added as a new port of call on a main route from America to Singapore.

Case 3 (Deviation from Far East - Europe):

Laem Chabang is added as a new port of call on a main route from the Far East (Japan) to Europe.

Case 4 (Feeder from Hong Kong):

The cargoes are transhipped from Hong Kong to Bangkok using feeder ships.

Case 5 (Feeder from Singapore):

The cargoes are transhipped from Singapore to Bangkok using feeder ships.

The increment of the container transportation cost in Case 1, due to the primary route being extended to Laem Chabang port is compared with the total cost in case 4 which is currently incurred by the feeder transportation between Hong Kong and Bangkok.

Then the increase in the container transportation cost which results by adding Laem Chabang Port to the primary route as discussed in Case 2 and 3 is compared with the cost when the ship does not call at Laem Chabang Port (Case 5).

The outline of the cost comparison is shown in Fig. III-13-1 to III-13-3.

2) The premises for estimating the land transportation costs

(1) Entreport in the hinterland

In estimating the land transportation cost from Laem Chabang Port to the hinterland and vice versa the following distances are used.

Ransit area is located 30 km north of the PAT wharf in Bangkok and the distance between it and Laem Chabang is about 150 km.

Silom area is located 6 km northeast of the PAT wharf in B.K.K. and the distance between it and Laem Chabang is about 130 km.

(2) Modal split

The study team exammed 2 transport modes, road transportation and railway transportation.

In the case of road transportation, 50% of the cargoes handled at Laem Chabang port are FCL (C.L) cargoes and the other 50% LCL cargoes.

(3) Estimation of transportation costs

(i) Transportation by road

- All cargoes handled at Bangkok port are transported by 6-wheel trucks.
- All LCL cargoes handled at Laem Chabang port are transported by 10 wheel trucks.
- The average loads on a 6 wheel truck, a 10 wheel truck and a trailer are 4.2 ton, 8.3 ton and 10 ton respectively.
- All FCL cargoes handled at Laem Chabang Port are transported by trailer.

(ii) Transportation by railway

- The railway rate is based on the revised fares on March 1984
- The LCL cargoes are assumed to be 50% Class 3 and 50% Class 4, while all CL cargoes are Class 4.

3) The Premises for Estimating the Container Terminal Costs

At Bangkok Port, the Port Tariff charges are used for the terminal costs. At Laem Chabang Port, it is assumed that one container terminal with one berth is leased to a private sector.
The terminal cost is composed of three items; the depreciation cost for terminal facilities, the interest on the construction investment cost and the terminal operation cost.

Fig. II.13.1 The Study Flow Chart

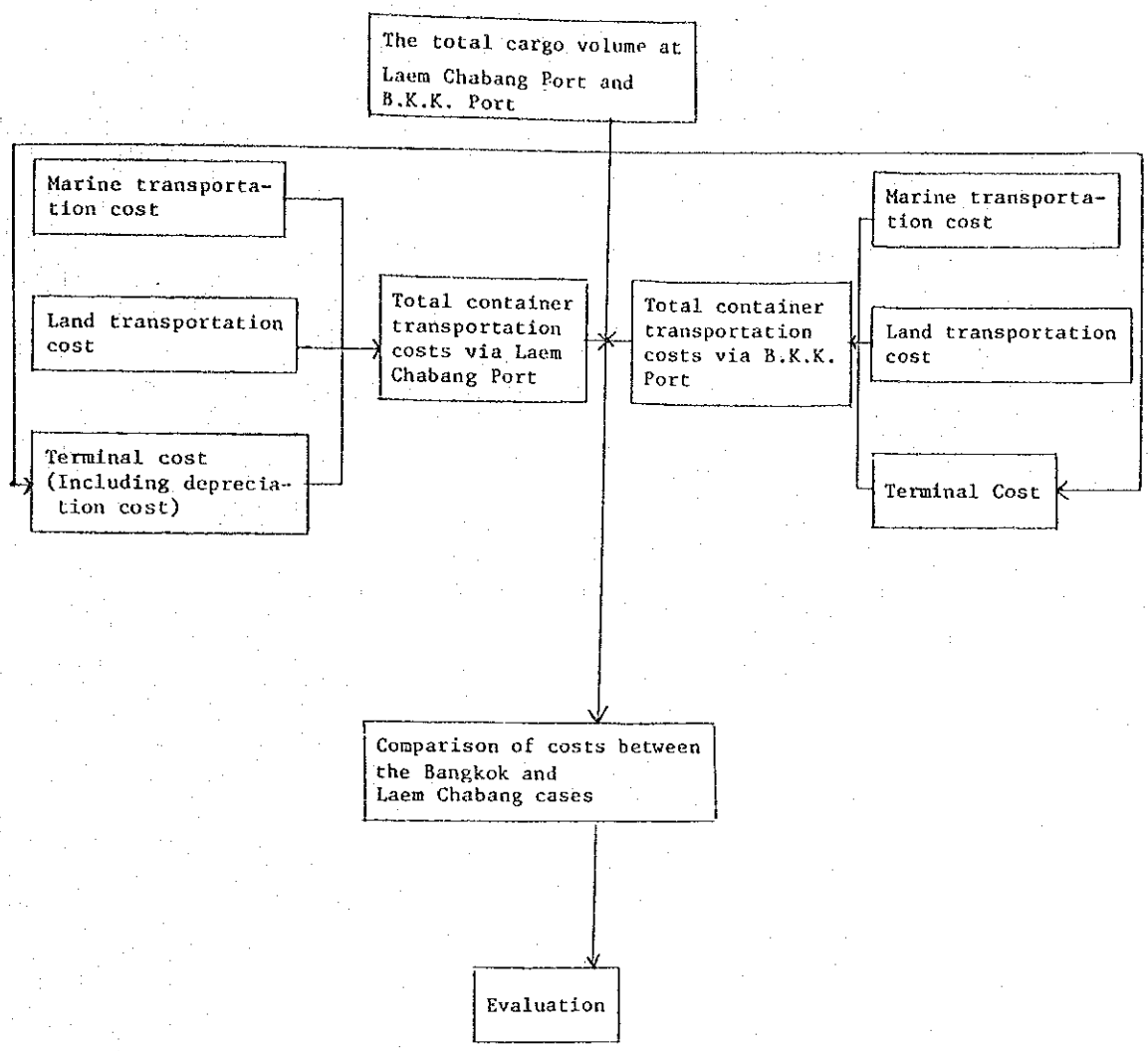
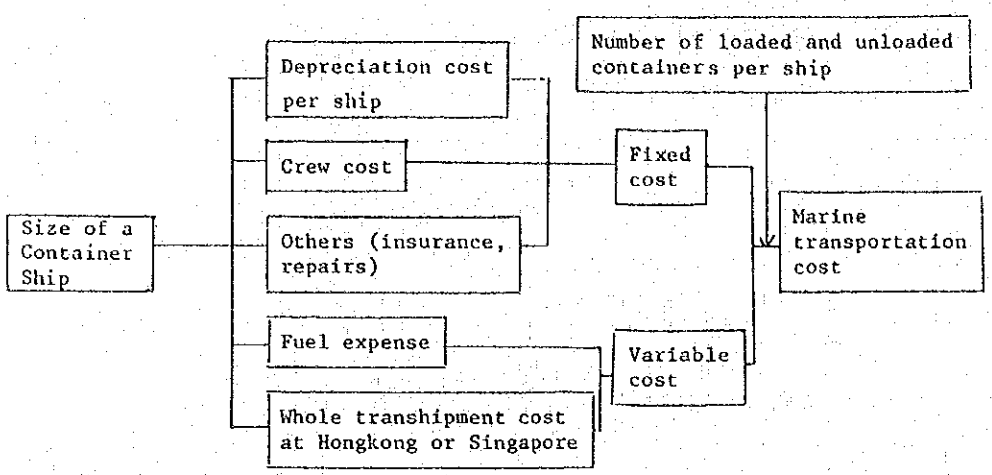


Fig. II.13.2 Method of Estimating the Marine Transportacion Cost



Method of Estimating the land transportation cost

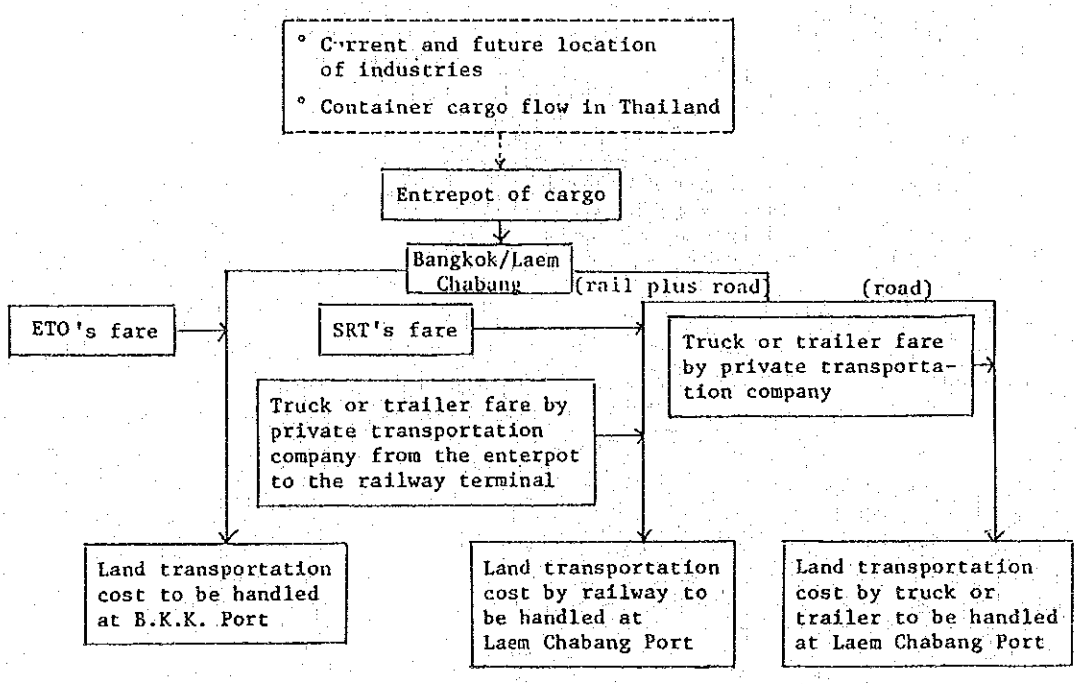
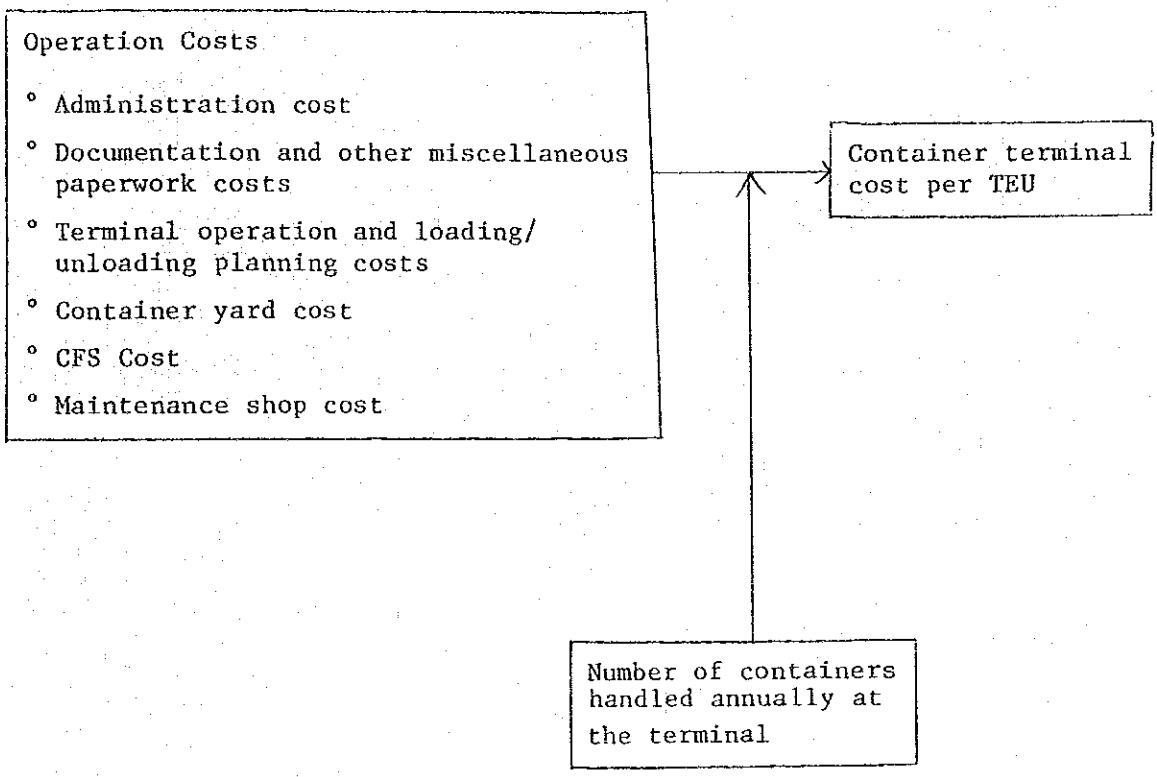


Fig. II.13.3 Method of Estimating the Terminal Cost (Terminal Cost of Laem Chabang)



2. The Conditions for Cost Comparison

1) The premises for the comparison of marine transportation costs

(1) The Routes North American Route and European Route

(2) The Ships

(i) North American Route	Capacity: 1,500 TEU Number of crew: 22 members Construction cost: ฿ 600 Million Number of containers loaded/unloaded at Laem Chabang Port: 600 TEU Age: 5 years
(ii) European Route	Capacity: 2,000 TEU Number of crew: 22 members Construction cost: ฿ 875 Million Number of containers loaded/unloaded at Laem Chabang Port: 800 TEU Age: 5 years
(iii) Feeder ship	Capacity: 400 TEU Number of crew: 22 members Construction cost: ฿ 160 Million Number of containers loaded/unloaded at Bangkok Port: 500 TEU Age: 10 years
(3) Method of ship deprecation	Residual value: 10% Straight line: 15 years

(4) Finance of ship construction

The financing method is assumed to be similar to the method used to finance the planned ship building in Japan, which is an ordinary procedure to subsidize the establishment of the mordern commercial fleet in Japan.

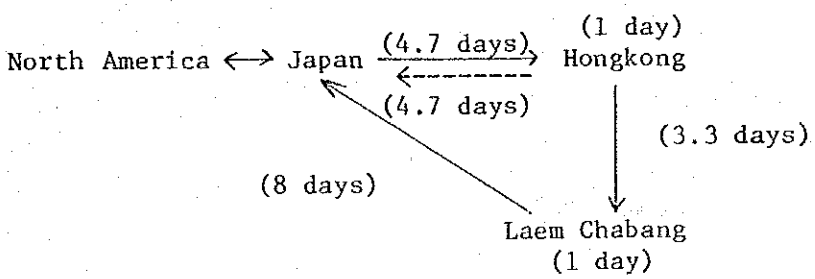
TABLE II-13-1 SHIP CONSTRUCTION FUNDS

	Source of Funds	Interest Rate	Term of Loan
Japan Development Bank	60 (%)	7.3 (%)	3 years grace, Repayment in the following 10 years
City Bank	30	8.4	Grace during the shipbuilding period, repayment over the following 8 years
Owned Fund	10		

Payment is to be made at the end of the year.

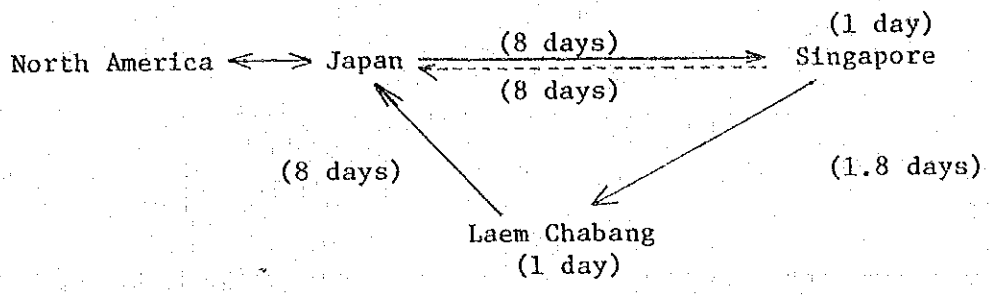
(5) Assumed Voyage Days

Case - 1



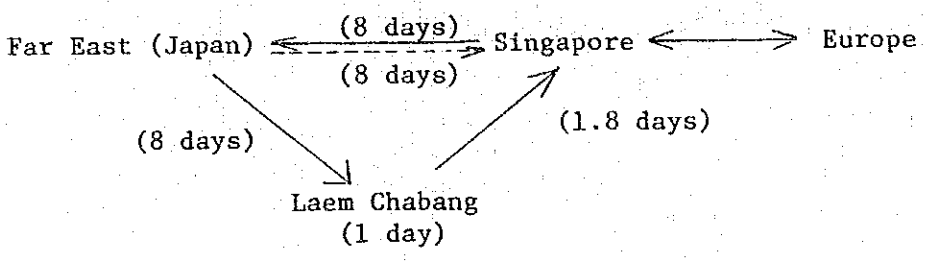
The increase in sailing days	6.6 days
The increase in mooring days	1 day
The increase in voyage days	7.6 days

Case - 2



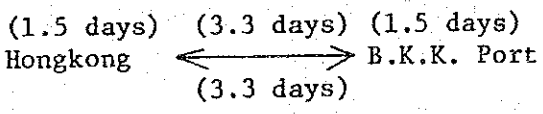
The increase in sailing days	1.8 days
The increase in mooring days	1 day
The increase in voyage days	2.8 days

Case - 3



The increase in sailing days	1.8 days
The increase in mooring days	1 day
The increase in voyage days	2.8 days

Case - 4 (Feeder service)



Sailing days	6.6 days
Mooring days	3.0 days
Voyage days	9.6 days

Case - 5 (Feeder service)

(1.5 days) Sincagapore $\xleftrightarrow[\text{(1.8 days)}]{\text{(1.8 days)}}$ (1.5 days) B.K.K. port

Sailing days	3.6 days
Mooring days	3.0 days
Voyage days	6.6 days

Note: The cargo handling speeds of a main route ship and on a feeder ship are 40 TEU/hour and 20 TEU/hour respectively.

3. Estimation of the Marine Transportation Costs

1) Marine Transportation Unit Costs

(1) Fixed costs

TABLE III-13-2 FIXED COSTS

(Unit: ฿ Million/year)

Ship Capacity	400 TEU	1,500 TEU	2,000 TEU
Depreciation cost & shipbilding interest	20.2	114.6	152.7
Crew cost	30.5	30.5	30.5
Others (insurance, repairs, etc.)	5.1	12.9	14.1
Total	55.8	158.0	197.3

(2) Variable costs

TABLE III-13-3 VARIABLE COSTS

Ship Capacity	400 TEU	1,500 TEU	2,000 TEU
Fuel expense*1			
sailing	213.9	299.0	361.6
mooring	8.5	12.7	14.5
Operation cost at Hongkong or Singapore*2	2.6 or 2.2	-	-

*1 (thousand bahts per day) *2 (thousand bahts per TEU)

Speed is assumed to be 18 knots.

2) Calculation of Differences

(1) Between case 1 and case 4

TABLE III-13-4 VOYAGE PERIOD

	Case 1	Case 4
	(Extension of N.America→ Hong Kong) net increase in Voyage days	(Feeder from Hong Kong) Total Voyage dyas
Sailing days	6.6 (days)	6.6 (days)
Mooring days	1.0	3.0
Total	7.6	9.6

TABLE III-13-5 MARINE TRANSPORTATION COST PER TEU

(Unit; ¥ thousand/TEU)

	Case 1 (Extension of N.America → Hong Kong) Net increase in cost	Case 4 (Feeder From Hong Kong) Total cost
Fixed Cost	5.483	2.963
Variable Cost	8.793	8.451
Total	14.276 ≒ 14.3	11.414 ≒ 11.4

(2) Between Case 2 and 5

TABLE III-13-6 VOYAGE PERIOD

	Case 2 (Deviation from N.America→Singapore) Net increase in Voyage days	Case 5 (Feeder from Singapore) Total Voyage days
Sailing days	1.8 (days)	3.6 (days)
Mooring days	1.0	3.0
Total	2.8	6.6

TABLE III-13-7 MARINE TRANSPORTATION COST PER TEU

(Unit; ¥ thousand/TEU)

	Case 2 (600 TEU/Ship) (Deviation from N.America→Singapore) Net increase in cost	Case 5 (500 TEU/Ship) (Feeder from Singapore) Total: cost
Fixed cost	2.020	2.019
Variable cost	0.918	3.831
Total	2.938 ≒ 2.9	5.850 ≒ 5.9

(3) Between Case 3 and 5

TABLE III-13-8 VOYAGE PERIOD

	Case 3 (Deviation from Far East→Europe) Net increase in Voyage days	Case 5 (Feeder from Singapore) Total Voyage day
Sailing days	1.8	3.6
Mooring days	1.0	3.0
Total	2.8	6.6

TABLE III-13-9 MARINE TRANSPORTATION COST PER TEU

(Unti; ¥thousand/TEU)

	Case 3 (800 TEU/Ship) (Deviation from Far East→Europe) Net increase in cost	Case 5 (500 TEU/Ship) (Feeder from Singapore) Total cost
Fixed cost	1.893	2.019
Variable cost	0.831	3.831
Total	2.724 ≒ 2.7	5.850 ≒ 5.9

4. Estimation of the Land transportation cost

1) Road Transportation Cost

The following table shows the road transportation cost from Bangkok Port and Laem Chabang Port to the Silom and Rang Site Area.

The road transportation costs are calculated by depreciation cost, personnel cost and fuel cost.

TABLE III-13-10 ROAD TRANSPORTATION COST (Unit: ฿/TEU)

		Silom Area	Rang Sit Area	Note
Bangkok Port	L.C.L	179	1,786	Truck
Laem Chabang Port	L.C.L	1,198	1,360	Truck
Laem Chabang Port	C.L.	1,255	1,432	Trailer

2) Railway Transportation Cost

The following table shows the transportation cost between Laem Chabang Port and the depots (the Silom and Rang Sit Areas), using the railway between Laem Chabang and Bang Sue and roads from Bang Sue to the depots.

The railway transportation costs are estimated by SRT's tariff.

Table II-13-11 The Rail Transportation Cost

(Unit; ฿/TEU)

		Silom Area	Rang Sit Area	Note
LCL	Laem Chabang - Bang Sue	1,312	1,312	Railway
	Bang Sue - Silom Area	241		Truck
	Bang Sue - Rang Sit Area		311	
	Total	1,553	1,623	
CL	Laem Chabang - Bang Sue	*1,349	*1,349	Railway
	Bang Sue - Silom Area	224		Tractor & Chassis
	Bang Sue - Rang Sit Area		283	
	Total	1,573	1,632	

* Including handling cost at Bang Sue station.

3) Summary of the Transportation Costs

From Tables II-13-10 and II-13-11, the summary of container land transportation cost is as follows.

Table II-13-12 Container land transportation cost per TEU

(Unit: ฿/TEU)

	Road transportation cost		Railway transportation cost	
	Laem Chabang Port	Bangkok Port	Laem Chabang Port	
Silom Area	1,227	179	1,563	
Rang Sit Area	1,396	1,786	1,628	
Silom Area Ran Sit Area average	1,312	483	1,696	

NOTE: Ratio of CL/LCL=1.00

5. Estimated Container Terminal Cost

1) Composition of the Terminal Operations Cost

The composition of the terminal operation cost is as follows.

Table II-13-13 The Composition of the Terminal Operation Cost

Item	Content
Administration Costs	Personnel expenses for the general affairs and security staffs. Fuel and electrictly expenses for cargo handling activities, rent for a terminal with necessary facilities.
Documentation Cost	Personnel expenses for staff who prepair and process the various kinds of document necessary for loading/unloading and receipt/delivery of container cargo.
Planning for Operation Cost	Personnel expenses for staff who make the loading/unloading plans and the receipt/delivery plans for containers, and its yard controle, etc.
Container Yard (C.Y) Cost	Loading/unloading staff expenses, container handling equipment drivers expenses, other C.Y. labour expenses, depreciation, repair and fuel expenses for container handling equipment.
Container Freight Station (CFS)	C.F.S. labour expenses, depreciation, repair, and fuel expenses for cargo handling equipment.
Maintenance Shop, Work Cost	Expenses for the container and container handling equipments maintenance staff.

2) Terminal Personnel

The distribution of terminal personnel is planned based on the example of a terminal in Japan.

Table II-13-14 Terminal Personnel

	Officers	Workers	Total
Administration	10	4	14
Documentation	12		12
Operation and Planning	20		20
C.Y.Work		47	47
C.F.S. Work	6	14	20
M.S. Work	4	36	40
Total	52	101	153

3) The Number of Main Cargo Handling Machines in the Container Yard

Gantry Cranes; 2,
Transtainers; 3
Trailers; 9

4) The Number of Main Cargo Handling Machines in C.F.S.
3 ton Fork lifts 5

5) Other Expenses
Supplies and miscellaneous expenses.
฿ 765,000/terminal·month
(based on the actual figures at a terminal in Japan)

6) Depreciation Expenses and Prices of Handling Machines
The depreciation periods and the residual value ratios of the cargo handling machines are assumed to be the same as the legal rates in Japan.

Table II-13-15 The Depreciation Periods and the Residual Value Ratios

Cargi handling equipment	Price (¥ thousands)	Depreciation Period (years)	Residual Value Ratio
Transtainer	150,000	7	0.1
Tractor	9,000	5	0.1
Chassi	1,800	4	0.1
Forklift	3,600	4	0.1
Gantry Crane	700,000	15	0.1

7) Fuel and Repair Expenses for Cargo Handling Machines (Including miscellaneous expenses)

The calculations for fuel and repair expenses were made based on actual figures in Japan (Transtainer type)

Fuel	฿ 3,040,100/terminal·month
Repair	฿ 2,552,000/terminal·month
Total	฿ 5,592,100/terminal month
(Per TEU	฿ 55.9)

8) Terminal Rent

Interest on construction financing is 4.0% for 60% of the total construction cost and 14% for the rest.

Table II-13-16 Principal and Interest Installments

	Construction cost:C	Cx0.6	Cx0.4	Depreciation period	*A
	(M·฿)	(M·฿)	(M·฿)	(year)	(th ฿)
Boundaries and slope protection for reclaimed	31.0	15.5	15.5	50	2,895
Quay structure	247.5	123.8	123.7	50	23,106
Container yard pavement	61.3	30.7	30.6	10	9,651
Container freight station	75.0	37.5	37.5	35	7,313
Office and other building	26.0	13.0	13.0	35	2,563
Lighting installation	29.0	14.5	14.5	15	3,620
Utilities	19.3	9.7	9.6	10	3,036
Total	489.1	244.7	244.4		52,157

* A; The annual principal and interest installments are all the same

9) The Personnel Cost

The Personnel costs are calculated based on actual figures in Japan and the Report on wages (published by the Japanese chamber of commerce in Bangkok).

The average period of employment is 5 years for a labour and 10 years for an officer, and average education level for an officer is the completion of a vocational school course.

The personnel costs are calculated as follows;

Worker; ฿ 3,700/month

Officer; ฿ 5,600/month

10) Calculation of Terminal Cost

The terminal cost is calculated based on the factors in preceding Section I and preceding paragraphs 1) - 9).

Table II-13-17 Container Terminal Cost

(unit; ฿ thousand)

	Cost
Administration	5,182.2
Documentation	67.2
Operation and Planning	93.0
Container Yard	1,964.0
Container fright station	112.4
Maintenance shop	155.6
Total	7,574.4
Per TEU (loaded container)	*0.91

* Number of containers handled per month; 8330 TEU

2) Terminal Expenses at Bangkok Port

The terminal cost at Bangkok Port is calculated based on the Bangkok Port tariffs, excluding items such as channel dues, tug fee, pilotage, which can be treated as approximately common costs because they will be charged any way in both cases.

Table II-13-18 Port Charge per TEU

(Unit: ฿ TEU)

Item	
Charges against Shipowners	
a) Wharf Rate	16
b) Rent	80
Charges against Consignees or Importer	
Import Cargoes	
c) Landing Charges	777
d) Handling Charges	711
e) Rent for Import Cargoes	199
Export Cargoes	
f) Quay Dues	27
g) Handling Charges	356
h) Rent for Export Cargoes	68
i) Stuffing Charge	200

The result is as follows.

Expenses for import cargo; 1,700 ฿/TEU

Expenses for export cargo; 700 ฿/TEU

The average expenses for on even balance of import and export cargo is as follows.

(1,700 x 250 + 700 x 250) ÷ 500 TEU = ฿ 1,200/TEU

3) A Comparison of the Terminal costs at Bangkok Port and Laem Chabang port

The terminal costs per TEU at both ports can be sumerized as follows. (Based on the calculations shown in 1), 2))

Laem Chabang Port : ฿ 760/TEU

B.K.K. Port : ฿ 1,200/TEU

6. The Cost Comparisons

The costs were compared using the results obtained in Sections 3~5. The comparisons are presented as follows:

Table II-13-19 Cost comparison (case 1 and case 4)

(Unit; ฿thousand per TEU)

	(Case 1) (Extension of N.America → H.K) Net increase cost	(Case 4) (Feeder from Hong Kong)
Marine trnsportation cost	14.3	11.4
Land transportation cost	1.4 (1.7)	0.5
Terminal cost	0.9	1.2
Total	16.6 (16.9)	13.1

Table II-13-20 Cost Comparison (case 3 and 5)

(Unit; ฿thousand per TEU)

	(Case 2) (Deviation from N.America → Singapore)	(Case 5) (Feeder From Singapore)
Marine transportation cost	2.9	5.9
Land transportation cost	1.4 (1.7)	0.5
Terminal cost	0.9	1.2
Total	5.2 (5.5)	7.6

Table II-13-21 Cost Comparison (case 3 and 5)

(Unit; ฿thousand per TEU)

	(Case - 3) (Deviation from Far East→Europe)	(Case - 5) (Feeder From Singapore)
Marine transportation cost	2.7	5.9
Land transportation cost	1.4 (1.7)	0.5
Terminal cost	0.9	1.2
Total	5.0 (5.3)	7.6

( ); Rail transportation cost.

From the results of the comparisons the following conclusions are drawn.

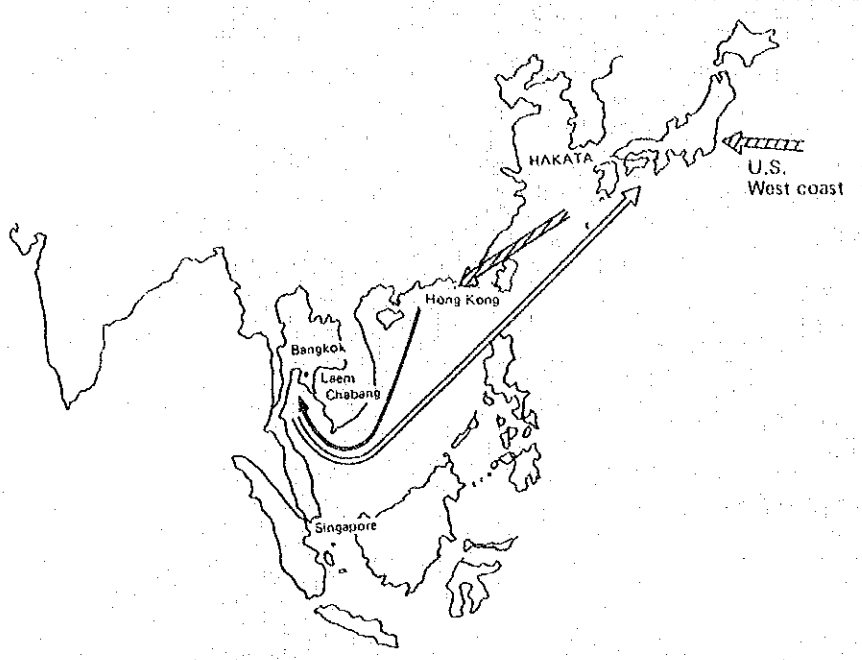
° As is predicted by some shipping industry, marine transportation, experts, if there are 500 or more TEU of containers to be loaded on or unloaded off a vessel, it is preferable to have 1,500 or more TEU capacity primary route sailing off the Gulf of Thailand call directly at Laem Chabang port rather than to transhipping the containers using feeder ships.

° Laem Chabang port could be equipped with sufficient facilities to handle the expected future increase in cargo volume, while Bangkok port has no space for expansion.

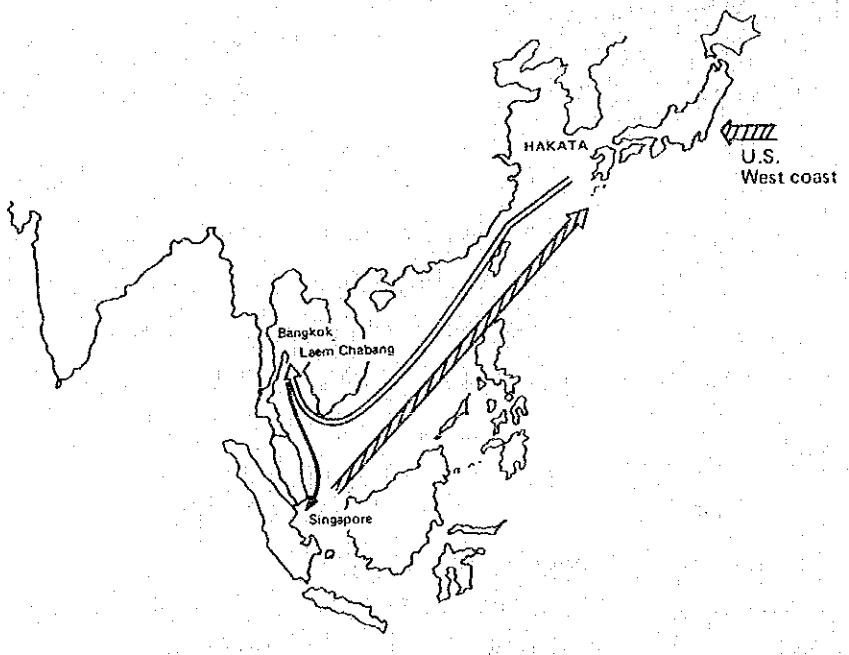
In this study, the costs of the waiting time which a ship has to endure due to congestion at Bangkok port are not included in the comperison one. Therefore, the actual cost of using Bangkok port will be higher than the figures estimated here. So that, it is necessary to study for waiting time of container ships at Bangkok port in the final report.

° In this study, only the North American route and European route are examined in the calculations. However, as the Australian route is similar in length to the North American route and as the Middle East route branch out from the European route, it would be easy to derive similar results for these routes as well, provided the capacity of the ships and other premises are kept the same.

° In this study, traffic congestion or the roads behind Bangkok port is not taken into account at all. As many industries in Thailand are affected by the traffic conditions in the city of Bangkok. But for the eastern area of Bangkok, where plants and offices are concentrated, the traffic cost will be much lower since the cargoes going to and from Laem Chabang port can avoid the traffic congestion inside Bangkok city.

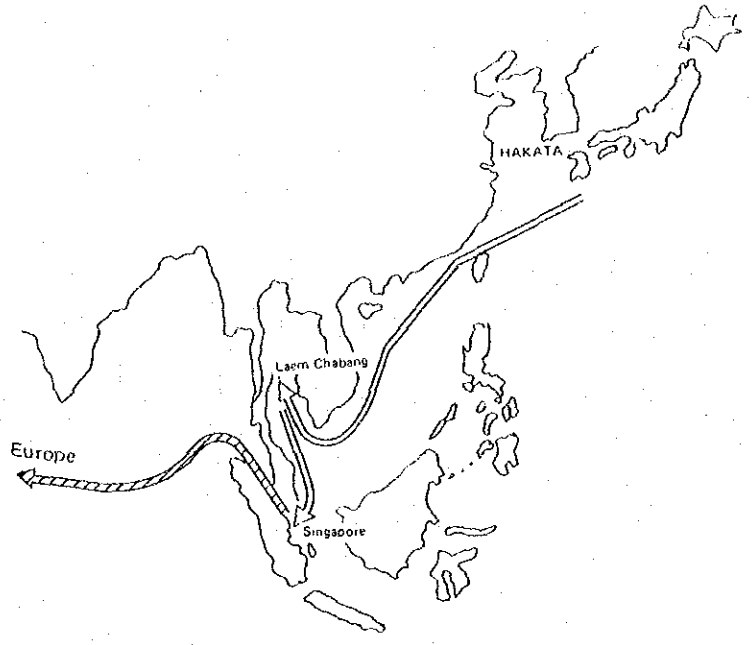


Case 1. Extension of West Coast/Hong Kong route
to Laem Chabang port

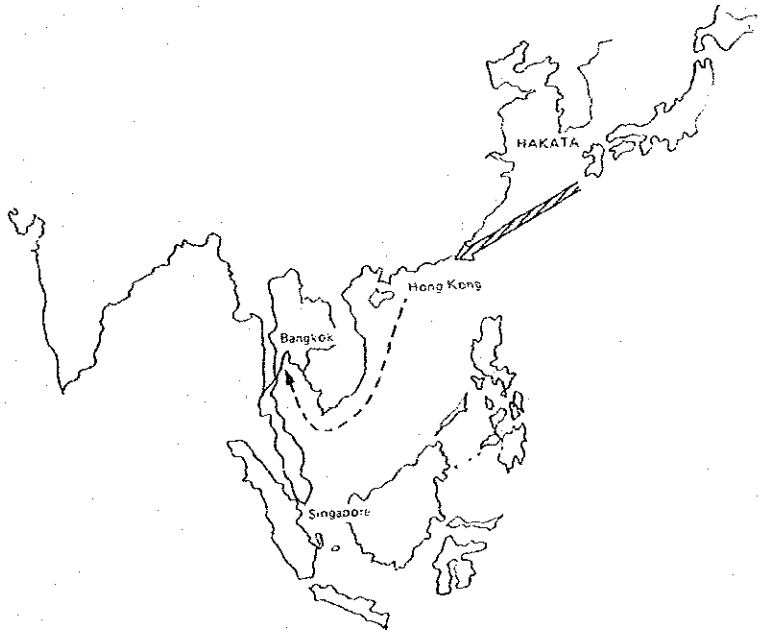


Case 2. Deviation from West Coast/Singapore route
to Laem Chabang port

LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
	JAPAN INTERNATIONAL COOPERATION ANGENCY
	Fig. II.13.4 Shipping Route (1)

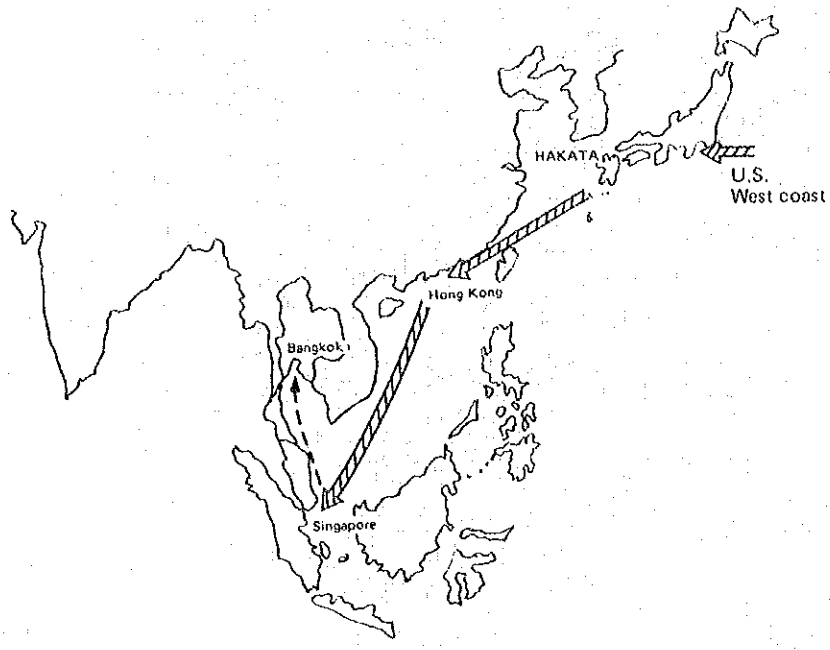


Case 3. Deviation from Far East/Europe to Laem Chabang port



Case 4. Feeder Service from Hong Kong to Bangkok port

LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
	JAPAN INTERNATIONAL COOPERATION ANGENCY
	Fig. II.13.5 Shipping Route (2)



Case 5. Feeder Service from Singapore to Bangkok port

LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
	JAPAN INTERNATIONAL COOPERATION ANGENCY
	Fig. II.13.6 Shipping Route (3)

II-14 Study Team's Opinions Concerning the Comments by Transportation and Port Working Group (7th November, 1984, Bangkok)

1. Comment:

Transportation considerations are accepted by the Port Working Group.

2. Comment:

Port Layout Plans (Short-term and MP) are acceptable to the Port Working Group.

3. Comments:

A number of preliminary design concepts have not been thoroughly analysed, these include:

(a) Breakwater sections
(b) Wharf sections (typical)
(c) Dredging problems and requirements
(d) Effect of subsurface conditions on offshore structural design
(e) Sources of materials

However, the cost estimate is quite conservative and since the above items will be optimised in the concurrent detailed design, there is no point to make modifications in the study.

Answer:

Please refer to the following sections in the Final Report for the above-mentioned comments in Item 3.

(a) Breakwater section (Fig. II.6.3)
(b) Wharf section (typical) (6.2.1 Berthing Structures)
(c) Dredging problems and requirements (6.3.2, 3) Dredging)
(d) Effect of subsurface conditions on offshore structural design (6.1.3 Subsoil Conditions)
(e) Sources of materials (6.3.1, 2) Construction Materials)

4. Comment:

The statement in the report that there are no significant storms in the Gulf of Thailand should be reviewed in light of the 30 year record of storm tracks.

Answer:

Please refer to 6.1.2, 3) Wind

5. Comments:

Probably the most important function of the study as related to port facilities is the analyses of throughputs. Tthe median projections used by JICA for Bangkok throughputs are not unreasonable, however, what is questionable are the following assumptions made in the report:-

(a) That the Laem Chabang function will be to seive the demand overflow from Klong Toei after the Klong Toei capacity is reached. This assumes a Klong Toei attraction priority which contradicts the report statements of Laem Chabang's attraction advantages over Klong Toei.

(b) That the maximum container handling capability/capacity at Klong Toei has already been reached (at 377,000 tons/berth per year). This is simply not so. It is obvious that the cargo handling capacity of the 6 berth Klong Toei container port can be drastically improved by:

(i) Providing adequate Container Gantry Cranes
(ii) Regarding the Container Yard + equipment
(iii) Allow for a more efficient handling and clearing of full containers.

Answer for (a)

We don't agree to the opinion by the review group that the cargo estimation method contradicts the result of the transport cost comparison. "Laem Chabang's attraction advantages over Klong Toei" are mainly derived from the following conclusions.

(i) The comparison of the container transportation cost in case of two ports described in Appendix II-3 shows that Laem Chabang port can be advantageous and attractive for such major container routes as Europe-EA and the U.S.-EA in which the cargo volume is large enough to assign or commission relatively larger vessels. It does not necessarily imply that Laem Chabang Port is advantageous for all routes.

(ii) Furthermore it was assumed in allocating the cargo to the two ports that the existing facilities in Klong Toei Pport should be utilized as they are in order to minimize the initial investment in Laem Chabang.

Answer for (b)

The study team agrees that it is necessary to make effort to improve the operation in Klong Toei Port because the present container operation is quite inefficient. But as described in the report there exist several fundamental factors which made this improvement difficult. For example, vessels larger than 15,000 DWT cannot enter the Chao Phraya River. The marshalling yard wide enough to enable the efficient container operation cannot be secured behind the container berth. The inbound container transportation is monopolized by the ETO and only a few steam lines have been traditionally allowed to occupy the most favorable yard for their container handling.

The increase of the handling capacity at the terminal aggravates the traffic congestion in Bangkok. Furthermore the increase of the handling capacity in Klong Toei influences against the decentralization of Bangkok which is one of the national policies. Therefore even if the improvement of Klong Toei may be attained to some extent, the drastic increase of handling capacity is neither plausible nor desirable. Based on the evaluation of Klong Toei capacity made by the several previous studies, the past throughput and the discussion with the staff of the P.A.T. and MOC as described in the sectoral report II-8 and II-9, the capacity was dicided.

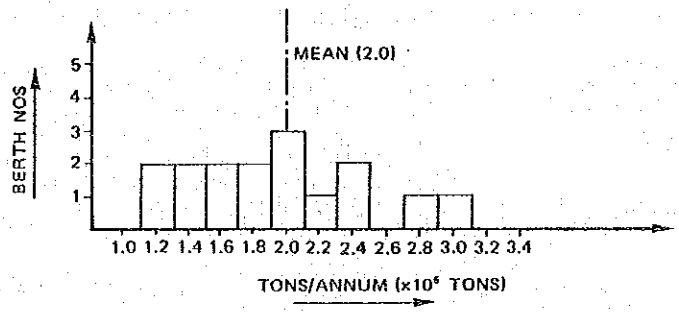
Although this method may not be rigorously accurate, the Study Team still maintains that this assumption is reasonable enough to estimate the cargo volume at Laem Chabang Port.

6. Comment:

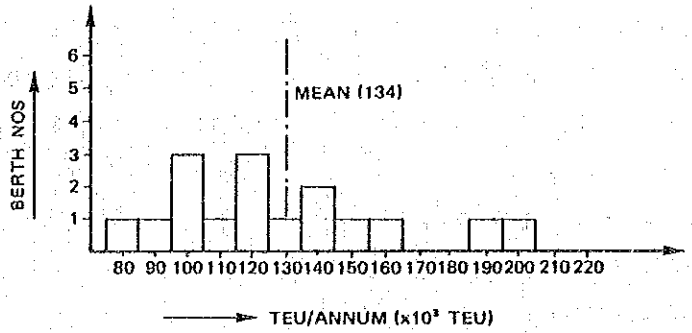
JICA has stated that 1.2 million tons/berth/annum can be achieved at Laem Chabang. This is on the high side - especially over the first several years of operation.

Answer:

As shown in the following figures, the assumed annual throughput per container berth is not a higher value at all. By planning efficient maintenance of handling equipment and training of the operators before the commencement of operation, this throughput can be easily attained in Thailand. Once the huge investment is decided for the breakwater, channel and container berths, the handling capacity of the gantry crane should not become the critical element for the total port throughput. If the Thai side is still skeptical about the handling capacity, two cranes for each berth should be equipped as originally proposed by the Study Team in the Interim Report and the Progress Report (II).



Annual Throughout per Berth
(Kobe Wharf Authority, 1982, 1983)



Annual Throughput Per Berth
(Kobe Wharf Authority 1982, 1983)

7. Comment:

The container traffic split between Klong Toei and Laem Chabang should be analysed based on relative economic attractions to shippers and the berth requirements at Laem Chabang as well as Klong Toei improvement programs should be adjusted accordingly to optimise benefits from expenditures.

Answer:

In general such theoretically rigorous approach as mentioned by Thai side is quite a reasonable method to decide the allotment of cargo to several ports. However, we have to clarify, for this purpose, the present and future container cargo flow in terms of commodities, routes and origin destination, of which information doesn't exist in Thailand for the time being. The survey for the container cargo flow itself will require an extraordinary amount of work which is not included within the scope of the present feasibility study.

The rehabilitation program in Klong Toei Port has also to be investigated especially for the new layout, its cost and the present privilege of the shipping and transport agencies. It is practically impossible to investigate these matters at this stage of the study, and it doesn't seem to be favorable from the viewpoint of the national interest as explained in 5(b).

8. Comment:

The breakdown between foreign and local currency portions of the port development costs is unbalanced and should reflect a higher foreign component.

Answer:

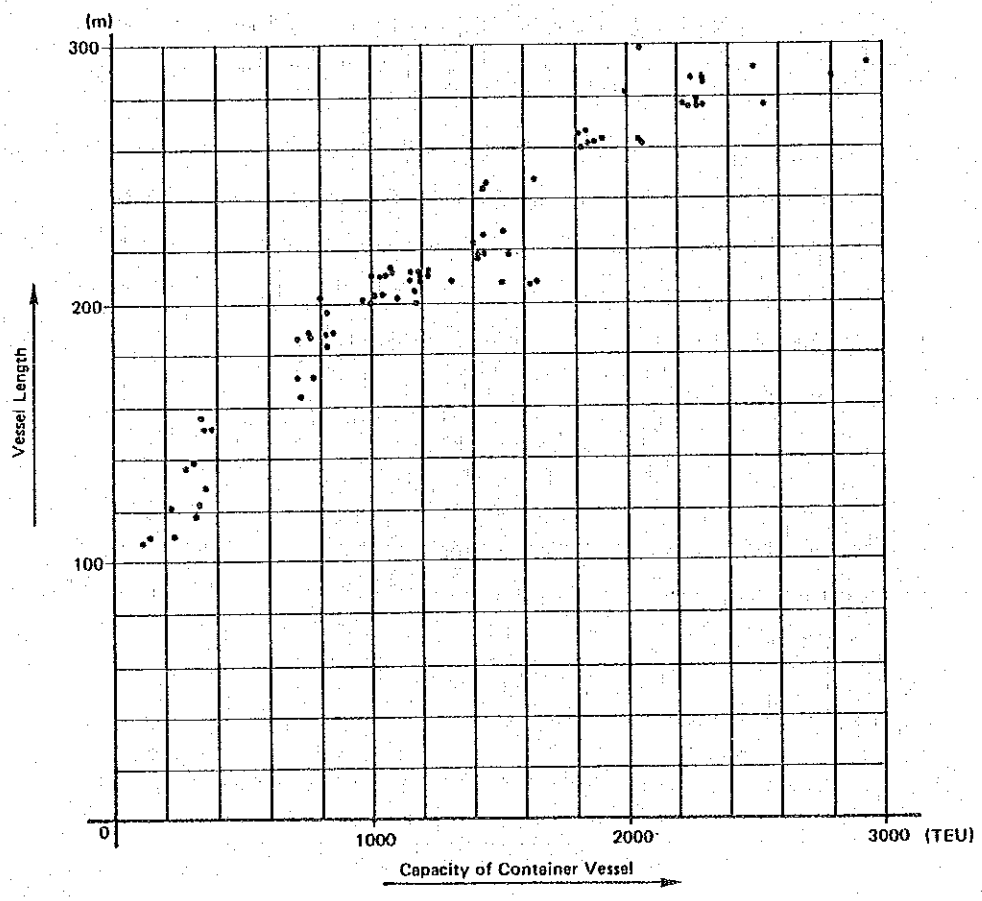
Please refer to 7. Investment Cost, Summary and Recommendation, Main Report.

9. Comment:

The assumed dimensions of the ships of the 2,000 TEU class are on the high side.

The Study Team's Comment:

The Study Team proposed the ship length based on the statistics on the ship dimension as shown in the following figure. According to this, the assumed length is not excessively big by any means. Furthermore, it should be avoided that the usage of the berth is limited simply because the berth is not wide enough to accommodate entering vessels.



10. Comment:

If voyage - length for the main line vessels is extended and schedules have to be kept, cost per day (or perslot) changes.

Answer:

Some two or three days increase in one voyage is not critical. Because container boxes are temporarily stocked more than averagely two or three days in a port and in case of transshipment at Hong Kong or Singapore the storage duration is also longer than three days in average.