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SUMMARY

THE FEASIBILITY STUDY ON MEASURES TO PROMOTE THE CONTAINER HANDLING SYSTEM THROUGH LAEM CHABANG PORT IN THE KINGDOM OF THAILAND

FINAL REPORT

JULY 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Japanese Government decided to conduct a feasibility study on Measures to Promote Container Handling System through the Laem Chabang Port and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a survey team headed by Mr. Keiichi Miyota, composed of members from the Overseas Coastal Area Development Institute of Japan and Pacific Consultant International Co., Ltd. on three occasions : during the period from April 1988 to October 1988, in January 1989 and again in March 1989.

The team held discussions with concerned officials of the Government of the Kingdom of Thailand, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincerest appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

July, 1989

Kensuke Yanagiya

President

Japan International Cooperation Agency

LETTER OF TRANSMITTAL

July 1989

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency

Dear Mr. Yanagiya:

It is my great pleasure to submit herewith a report for the Feasibility Study on Measures to Promote the Container Handling System through Laem Chabang Port in the Kingdom of Thailand.

This report is the result of studies carried out by the Overseas Coastal Area Development Institute of Japan (OCDI) and Pacific Consultants International (PCI) at the request of the Japan International Cooperation Agency (JICA). The study team conducted the first field survey from April to July 1988 to collect a variety of data. The survey was followed by three other field surveys.

This findings of these surveys were discussed to formulate an efficient container transport system for Laem Chabang Port and to study the feasibility of the project, and were then compiled into this report. The study shows that the formulation of an effective management and operation system at Laem Chabang Port and the construction of the Inland Container Depot (ICD) are extremely important for the national economy of Thailand and the implementation of the ICD project is feasible both economically and financially. We, therefore, earnestly hope that measures will be taken to implement this project as soon as possible.

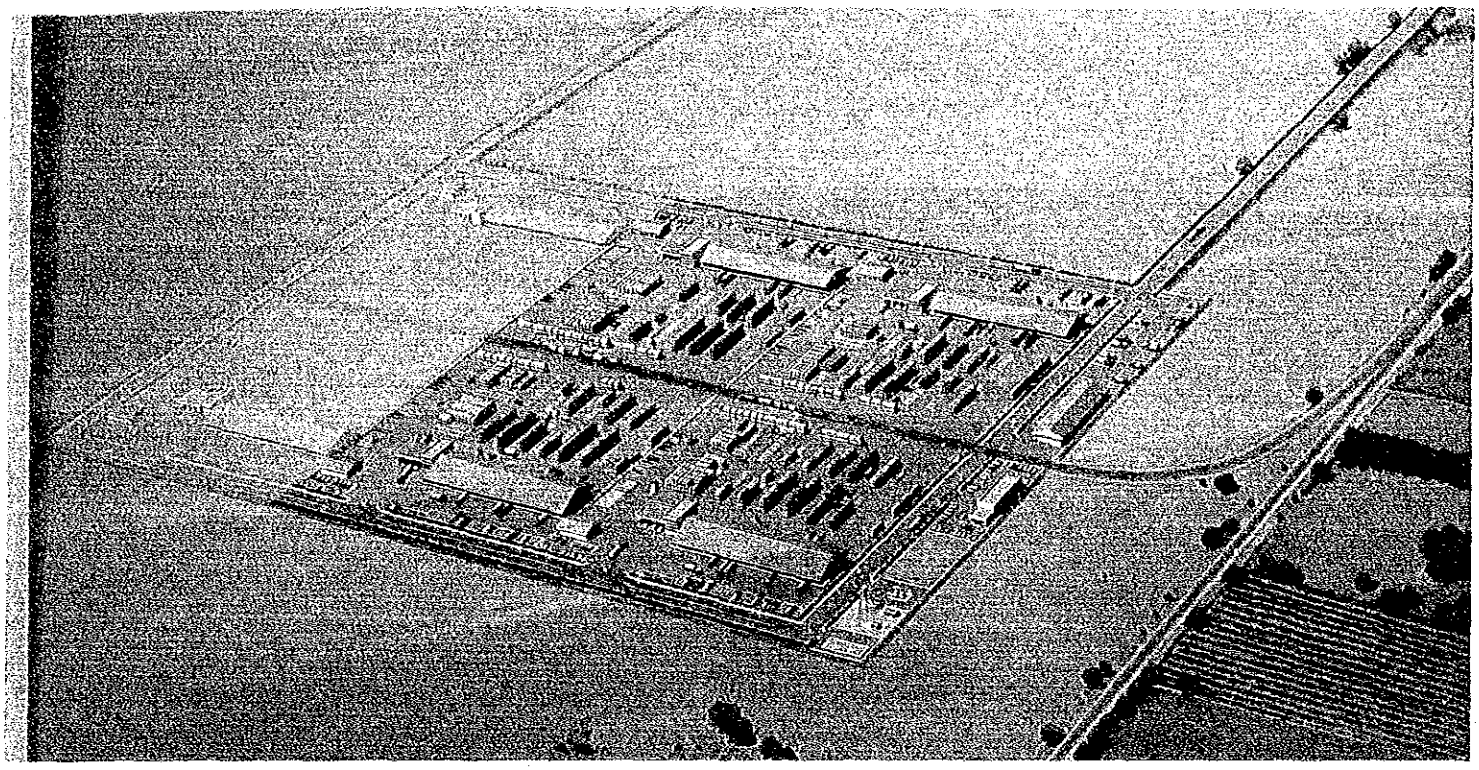
On behalf of the study team, let me express my heartfelt thanks to the Government of the Kingdom of Thailand and to the various organizations concerned with the Study for the generous cooperation, assistance and warm hospitality which were extended to the study team during their stay in Thailand.

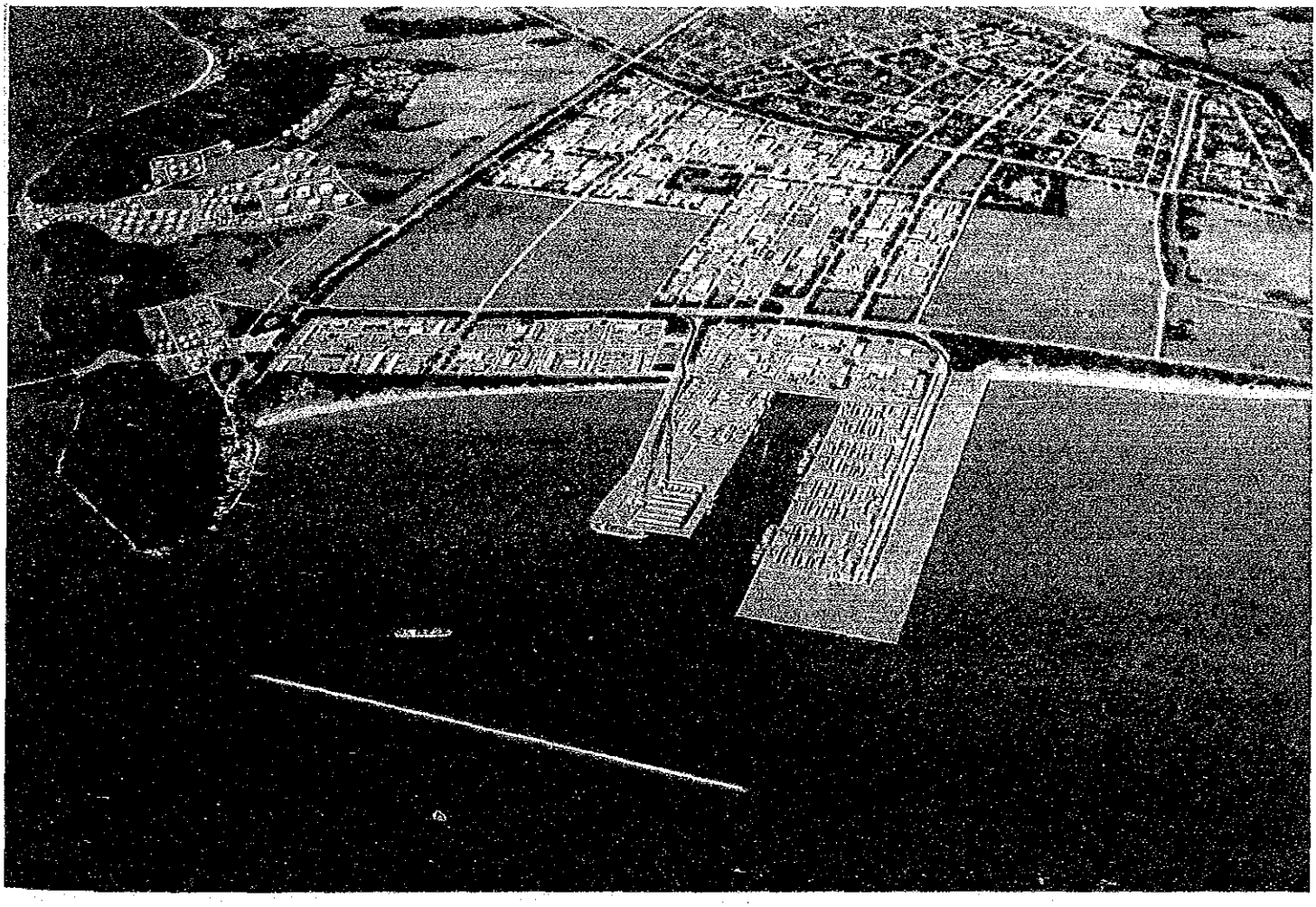
Our thanks are also due to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Transport and the Japanese Embassy in Thailand for their valuable advice and support during the field survey and the preparation of this report.

Yours Faithfully,

Keiichi Miyota
Head
Japanese Study Team for the Feasibility Study on Measures to Promote the Container Handling System through Laem Chabang Port in the Kingdom of Thailand
(Senior Adviser, the Overseas Coastal Area Development Institute of Japan)

Laem Chabang Port
GULF OF
TONGKING
HANOI
HAINAN DAO
INDO-
CHINA
THAILAND
CAMBODIA
KAMPUCHEA
Chiang Mai
Da Nang
Nha Trang
BANGKOK
MERGUI
ARCHIPELAGO
GULF
OF
THAILAND
HO CHI MINH (SAIGON)
MALAYSIA
PENINSULAR
MALAYSIA
KEDAH
KELANTAN
TERENGGANU
MALAYA
George Town
KUALA LUMPUR
SINGAPORE





Foreign Exchange Rate

US$ 1 = 25.6 Baht = ¥ 133

(As of August, 1988)

ABBREVIATIONS

A/N	Arrival Notice
BEA	Bangkok Metropolitan Electricity Authority
BKK	Bangkok
B/L	Bill of Lading
BMA	Bangkok Metropolitan Area
B/N	Boat Note
BOI	The Board of Investment
CFS	Container Freight Station
CIF	Cost, Insurance and Freight
CLP	Container Load Plan
CY	Container Yard
DBT	Declaration of Bonded Transportation
D/O	Delivery Order
D/R	Dock Reciept
E/D	Export Declaration
EDO	Equipment Despatch Order
E/E	Export Entry
EIRR	Economic Internal Rate of Return
EPMOS	Study on the Effective Port Management and Operation System in the Kingdom of Thailand, JICA
E/R	Equipment Receipt
ETO	The Express Transport Organization of Thailand
FCL	Full Container Load
FIRR	Financial Internal Rate of Return
FOB	Free on Board
GDP	Gross Domestic Product
GNP	Gross National Product
HD	The Harbour Department of the Ministry of Transport and Communications
ICD	Inland Container Depot
I/D	Import Declaration
I.E.	Industrial Estate
I/E	Import Entry
IEAT	The Industrial Estate Authority of Thailand

JICA	The Japan International Cooperation Agency
LCB	Laem Chabang
LCL	Less than Container Load
M/F	Manifest
MOAC	The Ministry of Agriculture & Co-operations
MOTC	The Ministry of Transport and Communications
MSL	Mean Sea Level
NESDB	The National Economic and Social Development Board
NRT	Net Registered Tonnage
O/D	Origin and Destination
OECF	The Overseas Economic Cooperation Fund
PAT	The Port Authority of Thailand
P.M.B.	The Port Management Body of Laem Chabang Port
SRT	The State Railway of Thailand
TEU	Twenty-foot Equivalent Unit
TOT	The Telephone Organization of Thailand

CONTENTS

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

1. Necessity of a New Management and Operation System

(1) New Management System

When we consider the management and operation of Laem Chabang Port, we should clearly distinguish between port management and port operation.

As for port management, we basically hope to establish a new Port Management Body (P.M.B.) as a public sector entity. But whatever the decision will be, the importance of separate management from Klong Toei should be recognized and given top priority.

To make up for the lack of management expertise in Thailand, it will probably be necessary to employ foreign experts, in particular during the early stage of operation.

(2) New Operation System

As for the terminal operation, the most important factor is the introduction of competition in the terminal operation market. This may result in higher efficiency than under relatively monopolistic conditions. Therefore, we recommend one operator for each terminal. Thus the terminals should be separately leased out to the private sector. And the most appropriate candidates for terminal operators are shipping companies. Direct operation by the P.M.B. workers should be avoided.

(3) ICD Management and Operation

It is desirable that both the marine terminals and the ICDs be owned and managed by the P.M.B. and leased out to terminal operators on a unified basis. Thus the operation of the ICDs should be carried out by integrated operators who also operate the marine terminals and inland transportation.

(4) New Port Management Body

It is important to maximize the efficiency and productivity of the administration and management of the P.M.B. by minimizing the cost. For this purpose, the organization of the P.M.B. should be as simple as possible and the staff members of the P.M.B. should be appointed based on the principle of the able minority. The proposed number of officers is 70.

2. Necessity of the Lat Krabang ICD

Laem Chabang Port is located about 130kms southeast of Bangkok, which is the main center of economic activities in Thailand. If there were no ICD around the Bangkok area, the shippers/consignees with LCL cargoes and those whose plants can not accommodate stuffing/unstuffing works would have to bring and pick up their cargoes to and from Laem Chabang Port CFS under their own arrangement and pay for the inland transportation to and from the port.

The basic function of the ICD for Laem Chabang Port must be as a stuffing and unstuffing station in which customs clearance is conducted to complete all procedures by shippers/consignees. This is the same basic function as at other ICDs throughout the would. After the ICD begins operations, various social benefits can be expected in addition to the benefits to consignees/shippers, such as an increase in the container handling capacity at the marine terminal and a decrease in the total traffic volume on the roads between the Bangkok area and Laem Chabang Port.

It is necessary to construct the ICD at the Lat Krabang Area considering the locations of Laem Chabang Port and of the major origins/ destinations of the container cargo through the ICD, the transportation network, traffic conditions and the land use. And the ICD and Laem Chabang Port should begin operations simultaneously.

3. Container Cargo in the Future

The target year of this study is 1996 as a first stage, and 2001 as a final stage.

The future container cargo volume is estimated based on the cargo volume by commodity and the containerized ratio of each commodity. The Study Team estimates that the future container cargo volume in Thailand will be 10.6 million tons in 1991, 15.5 million tons in 1996 and 19.8 million tons in 2001, which is equivalent to 1.09 million TEUs, 1.49 million TEUs and 1.82 million TEUs in each year. Of the above volume, the cargo which would be handled at the ports in the Bangkok Zone would be 0.99 million TEUs, 1.36 million TEUs and 1.67 million TEUs in each corresponding year.

According to the Origin/Destination (O/D) survey, the share of the

exported cargo from BMA will decrease in the future, but the major destination of imported cargo will still be BMA in the future.

The container cargo volume through Laem Chabang Port is estimated at 6.8 million tons in 1996 and 10.6 million tons in 2001 and in terms of TEUs, 638 thousand TEUs and 953 thousand TEUs, respectively. Of the above volume, the container cargo through the ICD is estimated at 1.3 million tons in 1996 and 2.1 million tons in 2001, and more than 80% of this cargo would move to or from BMA.

4. Master Plan

The master plan is formulated with a target year of 2001. In order to secure efficient port operations, ICDs corresponding to each marine terminal at Laem Chabang Port will be located at the Lat Krabang ICD. From the cargo forecast and the container handling capacity per berth with the ICD, the required number of berths and ICDs will be 6 under the master plan in 2001. The ICDs should be connected to the Eastern Line of SRT with a spur line and to the existing and future road networks to secure effective container transportation between the ICD and Laem Chabang Port. The branch offices of the P.M.B., the Customs, SRT and other related agencies should be set in a main office building to operate the ICD effectively.

The total required land area is about 300 rai (48ha) for the master plan with 6 ICDs of 36 rai each and the construction cost is estimated at about 1,215 million baht (in August 1988 prices).

5. The First Stage Plan

The first stage plan is aimed at the year 1996, and covers the urgent development plan of the ICD. The first stage plan includes 4 ICDs and common facilities such as the spur line of the railway and the main office building. The required land area is about 200 rai (32ha), and the construction cost is estimated at about 831 million baht. About 256 million baht, approximately 30%, will come from foreign loans. The construction should be finished by the middle of 1991 when Laem Chabang Port begins full operations.

6. Economic and Financial Analysis of the First Stage Plan of the Lat Krabang ICD

(1) Economic Analysis

The First Stage Plan is evaluated using the Economic Internal Rate of Return (EIRR) which is calculated based on cost-benefit analysis from the viewpoint of the national economy. Benefits considered are the savings in land transportation costs and Customs procedures costs while costs are the construction, maintenance and administration and operation costs. The internal rate of return, using 31 years as the period of economic calculation, is 17.0%.

This shows that the First Stage Plan is feasible from the viewpoint of the national economy.

(2) Financial Analysis

The new P.M.B. maintains its financial viability throughout the entire project life including the construction period. It will be able to pay all expenditures and have some surplus even after appropriating funds for the repayment of foreign loans including interest.

As for the profitability of the project itself, the FIRR is estimated to be 6.5%, which exceeds the weighted average interest rate of capital (5.7%) during the project life.

And the financial soundness of the terminal operators will also be maintained during the lease period of the marine terminals and ICDs while maintaining the handling charges at a competitive level with Bangkok Port.

(3) Evaluation

Judging from the above, we conclude that the First Stage Plan with the target year of 1996 is feasible both economically and financially.

RECOMMENDATIONS

The container cargo volume in Thailand has increased rapidly in the recent past, and this increase is expected to continue. But the existing port, Bangkok Port, has become congested because of the lack of container handling capacity, and the operation of Laem Chabang Port is expected to solve the above problem. The ICD is expected to carry out an important role for the use of Laem Chabang Port.

The recommendations below concern various matters we noticed while conducting this survey and drafting the plans.

1) The ICD project should be implemented as soon as possible because the implementation schedule is very tight to cope with the scheduled commencement of operations at Laem Chabang Port.

2) The port management body (P.M.B.) should be a public sector organization because the port exclusively occupies waterfront areas which are regarded as public assets by nature, and the port is an indispensable infrastructure for the community. Services offered using port facilities should be available to all parties on a free and equal basis.

3) Operations at the marine terminals and ICDs should be privatized under lease contracts with the P.M.B. because private firms are superior to the public sector in terms of business efficiency in general. A monopoly should be strictly avoided. In other words, competition should be introduced in the terminal operation.

4) The planned highway network connecting the Bangkok area and Laem Chabang should be constructed as soon as possible and the existing roads connecting Bangkok and Laem Chabang should also be improved. As traffic volume on Route 34, which is almost the only existing route connecting the Bangkok area and Laem Chabang, has increased up to almost its full capacity, the traffic congestion is expected to be severe in the future, and the congestion will grow worse along with the progress of the Eastern Seaboard Development Program.

5) The Thai Government should stipulate a land use plan for the area around the ICD. This would stimulate the development of various industries to support effective container handling, including export processing industries, manufacturing of container vans, warehouses, distribution of imported goods, wholesale markets, and trucking carrier services. To avoid uncontrolled sprawl, it is preferable that the public sector acquires the land and leases (or sells) it to users following an appropriate land use plan.

6) Bonded transport between the ICD and Laem Chabang Port should be allowed by the Customs Department for both exported and imported cargoes. Bonded transport for both imported and exported cargoes is absolutely necessary to realize the full merits of container transport using the ICD. Such bonded transport is commonly adopted at other ICDs throughout the world.

7) Songkhla and Phuket deep seaports should be used effectively. The two ports were recently constructed with sufficient facilities for large vessels, but they are not yet being operated fully. There are sufficient cargoes for containerization, such as raw rubber, in the hinterland of these ports. So effective usage of these ports will greatly contribute to reducing the congestion at Bangkok Port and will also contribute to the economic and social development of this region.

8) A review of the present development plan for Laem Chabang Port should be carried out on the basis of the ICD plan.

INTRODUCTION

INTRODUCTION

1. Background

The Royal Thai Government (hereinafter referred to as "the RTG") is aggressively proceeding with the implementation of the Eastern Seaboard Development Program which is expected to contribute significantly to the economic growth of the country; encouraging industrialization of the district and decentralization of industry and population away from the Bangkok metropolitan area.

Laem Chabang Port is an integral part of the Eastern Seaboard Development Program. The Port will support and promote the industrial activities of this area through offering economical international transportation. At the same time, due to the physical restrictions at Bangkok Port, Laem Chabang Port is also expected to serve as a gateway for international standard container vessels.

At present, container cargoes are handled mostly at Klong Toei Wharves in Bangkok Port. The volume of container cargoes has increased sharply in recent years because of the growth of trade with foreign countries and the wide development of containerization for many commodities.

From the national economic viewpoint, it is crucial to minimize the total transportation costs as a whole. In this sense, an appropriate container transportation system can play an important role in Thailand as in many other countries.

Even though development of new General Industrial Estates/Parks are planned outside of Bangkok, Bangkok will remain the leading international trade center and center for containerized cargo. Therefore, it is very important to ensure smooth connections between Laem Chabang Port and Bangkok as well as efficient terminal operation at Laem Chabang Port.

2. Objective of the Study

The objective of the study is to formulate an efficient container transport system for Laem Chabang Port including recommendations on an appropriate container transportation system between Bangkok and Laem Chabang Port focusing especially on formulation of a layout plan of the

Inland Container Depot and recommendations for an efficient management and operation system.

3. Circumstances

The Government of the Kingdom of Thailand requested the Government of Japan to carry out a feasibility study on measures to promote the container handling system through Laem Chabang Port. In response to the request, the Government of Japan decided to undertake the study and dispatched the Japanese Preliminary Study Team headed by Mr. Tadahiko Yagyu to the Kingdom of Thailand from 1 December to 11 December 1987.

The team had a series of discussions about the project with the authorities of the Government of Thailand. The Scope of Work for the Study was agreed upon on 8 December 1987 by Mr. Tadahiko Yagyu, Leader of the Japanese Preliminary Study Team, and Dr. Savit Bhotiwihok, Director of the Office of the Eastern Seaboard Development Committee.

Based on the Scope of Work, JICA organized a study team headed by Mr. Keiichi Miyota, Executive Director, OCDI. The study team executed the study including four field surveys from April of 1988 to March of 1989.

4. Scope of the Study

In order to achieve the objectives, the study tasks include the following items.

1) Review of Related Reports, Information and Data
2) Future Demand Forecast
3) Formulation of an Inland Container Depot (ICD) Plan
4) Formulation of a Management and Operation System
5) Evaluation of the ICD Plan and Preparation of an Implementation Schedule

5. Study Schedule

The study was conducted as follows.

1) Preparation in Japan	: Mar. - Apr. 1988
2) First Field Survey and Presentation of Inception Report	: Apr. - Jul. 1988
3) Second Field Survey and Presentation of Interim Report-I	: Jul. - Oct. 1988
4) Third Field Survey and Presentation of Interim Report-II	: Jan. 1989
5) Fourth Field Survey and Presentation of Draft Final Report	: Mar. 1989
6) Submission of Final Report	: Jul. 1989

6. Organization of the Study Team

The study team is comprised of twelve experts from OCDI and PCI, and a JICA representative. Their names and responsibilities are as follows.

Mr. Keiich Miyota	Overall Management	(OCDI)
Mr. Yutaka Sunohara	Port & Facility Planning	(OCDI)
Mr. Seiichi Kuroda	Facility Planning for Access	(OCDI)
Mr. Tetsuji Hashimoto	Demand Forecast, Economic Analysis	(OCDI)
Mr. Iwao Toyoda	Financial Analysis	(OCDI)
Mr. Hiroshi Fuseya	Port Management and Operation (I)	(OCDI)
Mr. Hideaki Mine	Port Management and Operation (II)	(OCDI)
Mr. Yukito Kida	Shipping	(OCDI)
Mr. Ryuji Sakaguchi	Structural Design	(PCI)
Mr. Toshiaki Kudo	Computer System Design	(PCI)
Mr. Shozo Kawasaki	Construction Planning, Cost Estimation	(PCI)
Mr. Osamu Nogoshi	Natural Conditions	(PCI)
Mr. Yuuichi Sasaoka	Coordinator	(JICA)

7. Members of the Steering Committee and Counterpart Personnel

The members of the steering committee and the Thai counterpart personnel are listed below.

(1) Steering Committee Members

Dr. Savit	Bhotiwihok	Director, Office of the Eastern Seaboard Development Committee (OESB)
Mr. Pathai	Metharom	Deputy Director, Office of the Eastern Seaboard Development Committee (OESB)
Mr. Prasert	Kmonwatananisa	Policy & Planning Analyst, National Economic and Social Development Board (NESDB)
Mr. Kamrob	Warachat	Director of Planning Division, Ministry of Transport Communications (MOTC)
Ms. Krishnee	Varanusupakul	Director of Economic Division, Ministry of Transport Communications (MOTC)
Mr. Pyoongkich	Chivamit	Deputy Director General, Port Authority of Thailand (PAT)
Mr. Ihhipol	Sucaromn	Marketing Manager, State Railway of Thailand (SRT)
Mr. Sanong	Jotikasthira	Chief Engineer, State Railway of Thailand (SRT)
Mr. Prakob	Tantiyapong	Director of Vehicle & Cargo Division, Customs Department
Mr. Bancha	Vadhanasindhu	Civil Engineer, Department of Highways (DOH)
Mr. J.T. Schmidt		Bangkok Shipowners and Agents Association (BSAA)
Mr. Nivat	Changariyavong	Bangkok Shipowners and Agnets Association (BSAA)
Mr. Mana	Patram	Bangkok Shipowners and Agents Association (BSAA)

(2) Counterpart Members

Mr. Kriangkrai Boonyayothin	Senior Policy & Planning Analyst, Office of the Eastern Seaboard Development Committee (OESB)
Ms. Kanchana Ubolcholket	Deputy Director of Technical Department, Port Authority of Thailand (PAT)
Mr. Surajit Retyim	Director of Project & Planning Division, Techinical Department, Port Authority of Thailand (PAT)
Ms. Rapeepan Kongdis	Chief of Project Analysis Section, Project & Planning Division, Technical Department, Port Authority of Thailand (PAT)
Mr. Chalermkeat Salakham	Chief of Project Analysis Section, Project & Planning Division, Technical Department, Port Authority of Thailand (PAT)
Mr. Voravuth Mala	Chief of Container Cargo Section, State Railway of Thailand (SRT)
Mr. Preecha Chavalittumrong	Director of Personnel Division, Customs Department
Ms. Jitjumnong Changpet	Valuation Division, Customs Department
Mr. Vanich Prachasri	Director of Policy Planning & Project Development Department, Express Transportaion Orgainization of Thailand (ETO)

SUMMARY

PART I CONTAINER TRANSPORTATION IN THAILAND

CHAPTER 1 PRESENT SITUATION OF PORTS

1.1 Present Situation of Existing Ports

1. In Thailand there are four major ports: the Ports of Bangkok, Sattahip, Songkhla and Phuket. Foreign trade is mainly carried out at Bangkok and Sattahip under the management and operation of PAT, one of the state enterprises under MOTC.

2. As for cargo volume, total exports increased steadily from 15 million tons in 1978 to 23 million tons in 1987, but total imports fluctuated between 15 million tons and 23 million tons during this period.

3. The throughput of container cargoes has increased sharply in recent years, and almost all these cargoes are handled at Bangkok Port. The total volume of containers loaded or unloaded at Bangkok Port reached 650 thousand TEUs in 1987 and 790 thousand TEUs in 1988.

4. Liner service on the major trading routes is rapidly being containerized, using larger size ships. To cope with the larger size container ships, deeper facilities are being constructed in other Asian countries as well as in Europe and the United States. However in Thailand, container berths at Bangkok Port are not sufficiently deep and the shallow channel to Klong Toei Wharves limits the navigation of larger size container ships. The port is located on the left side of the Chao Phraya River, 26 to 29 kms from the river mouth. And the rapid increase of container cargo in the past couple of years has caused severe congestion at Bangkok Port.

Table I.1.1 Container Cargo at Bangkok Port (1981-1988)

Year	Export		Import		Total	
	Tons	TEUs	Tons	TEUs	Tons	TEUs
1981	1,058,775	121,594	1,126,407	119,902	2,185,182	241,496
1982	1,155,565	127,591	1,107,361	131,833	2,262,926	259,424
1983	1,330,444	152,334	1,495,795	152,190	2,826,239	304,524
1984	1,825,065	169,967	1,537,103	171,054	3,362,168	341,021
1985	2,332,221	201,096	1,549,312	199,323	3,881,533	400,419
1986	3,069,538	254,702	1,724,265	256,562	4,793,803	511,264
1987	3,898,636	322,695	2,318,720	326,835	6,217,356	649,530
1988	4,895,519	393,850	3,019,564	397,734	7,915,083	791,584

Source: Statistical Sect. Technical Department, PAT

1.2 Laem Chabang Port Development

5. The Laem Chabang Port Project is one of the projects of the Eastern Seaboard Development Program. Laem Chabang is situated about 125 kms southeast of Bangkok and the Laem Chabang complex will have a commercial containerized deep seaport, an industrial estate and an export processing zone backed up by a completely new urban community and essential infrastructure.

6. Laem Chabang Port will be a primary gateway for containerized cargo, which has been increasing sharply in recent years and is now handled mainly at only Bangkok Port (Klong Toei Wharves). The new port will be able to handle up to 3,000 TEU container vessels and 120,000 DWT agricarriers. The first stage development includes two container berths, one break-bulk berth and agri-bulk loading facilities.

7. The construction program was started at the end of 1987 and the first vessel is expected to call at the end of 1990, followed by full operation in the middle of 1991.

CHAPTER 2 CONTAINER TRANSPORTATION

2.1 The Development of Container Transportation

1. International foreign trade using marine containers started in the 1960s. In April 1966, Sea-Land Service, Inc. started full container vessel service for trans-Atlantic trade. Since then, almost all shipping companies in the world hastened to deploy container vessels on main liner service routes.

2. The essential characteristics of containerization are:

(1) Shape of boxes, (2) standardization of box size, and (3) handling as unit loads. These make it possible to adopt a module system of handling equipment and to reduce the risk of damage.

3. Containers also permit handling and transportation in all weather, and consequently the stability of transportation schedules can increase. The simplification of preparing and exchanging documents is also considered as an important effect of containerization. The reefer container is another factor allowing low-cost food transportation in small lots, etc. Confirmation of cargo flow is easier by using container numbers, and shipping companies can offer such information to consignees and shippers.

4. For shipping companies, containerization contributes to savings and rationalization of cargo handling charges in ports, and easier land transport.

5. For customers the main merits are cost saving, reduced cargo damage, simpler customs procedures and shorter transit time.

6. As for container vessels, at the end of 1987, more than 800 full container vessels with a total capacity of 1,600 thousand TEUs are navigating all over the world. Major shipping companies are mainly using third generation vessels on trunk routes.

2.2 Container Transportation and Documentation

(1) Present System at Bangkok Port

7. Though all the shoreside cargo operations in the port area are in principle executed by the equipment and laborers owned or employed by PAT in Bangkok Port, shipping agents (yard operators) sometimes have to procure equipment and laborers by themselves with PAT's permission due to the lack of resources at PAT. The present flow of container cargoes and documents is shown in Figs. I.2.1 and I.2.2.

8. The primary missions of the Thai Customs Department are the collection of import and export duties as well as various customs fees, the prevention and suppression of duty evasion and contraband and the promotion of export trade. The system of customs procedures itself in Thailand is the same as in other countries. But, the bonded transportation system has not yet become popular due to the necessity of cargo inspection for preventing smuggling.

(2) Popular Container Transportation in the World

9. The optimum flow of containerized cargoes and documents has been established and pushed forward mainly by shipping companies and their affiliated container terminals and this flow seems to be popular at major ports in the world except for some countries where peculiar circumstances exist.

10. Though the customs clearance of containerized cargo is almost the same as that of ordinary cargo, containerized cargo is generally allowed to pass through import/export customs clearance without a strict actual inspection in the marine container terminal in order to promote door to door transportation.

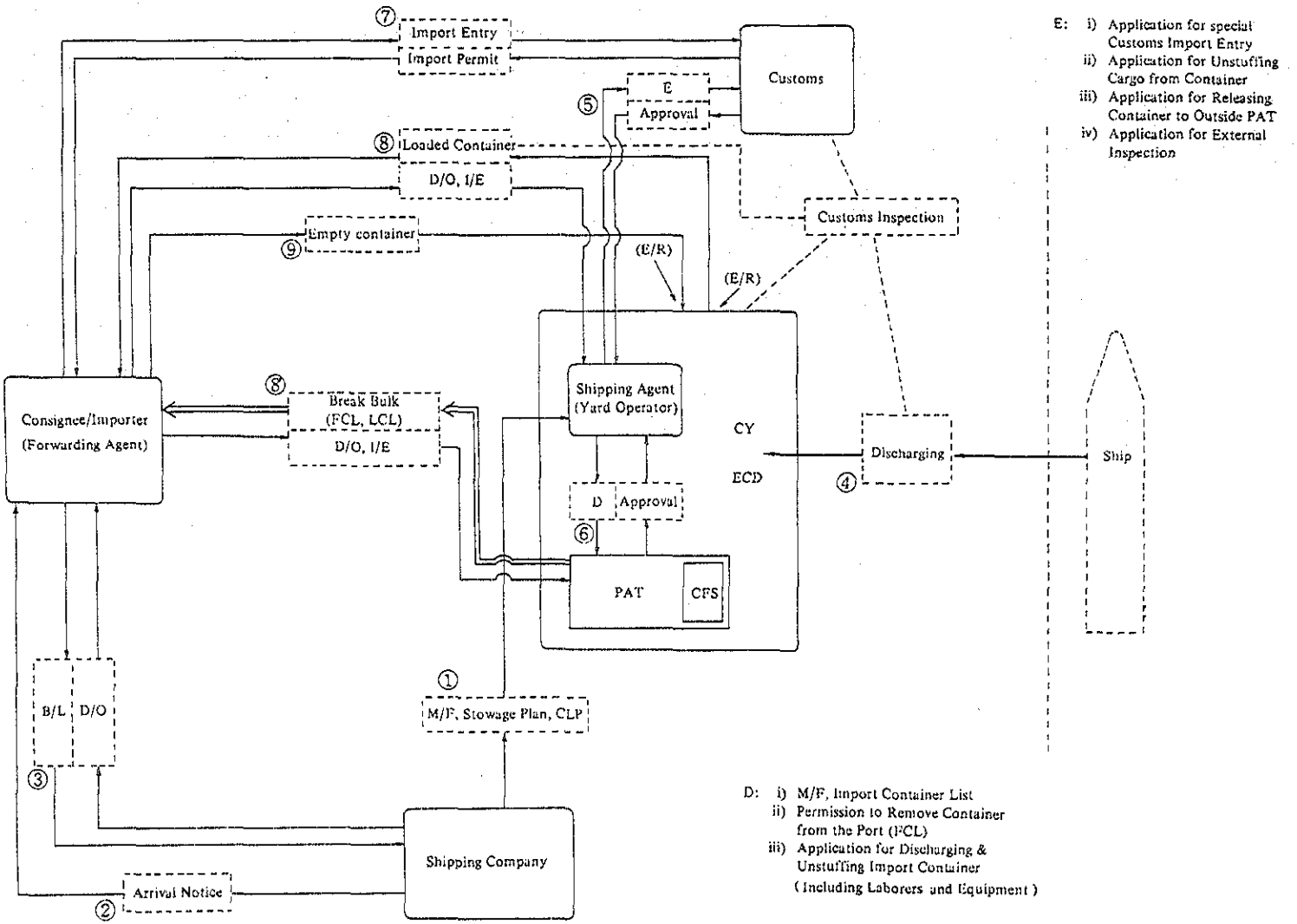


Fig. I.2.1 Present Flow of Container Cargoes and Documents (Import)

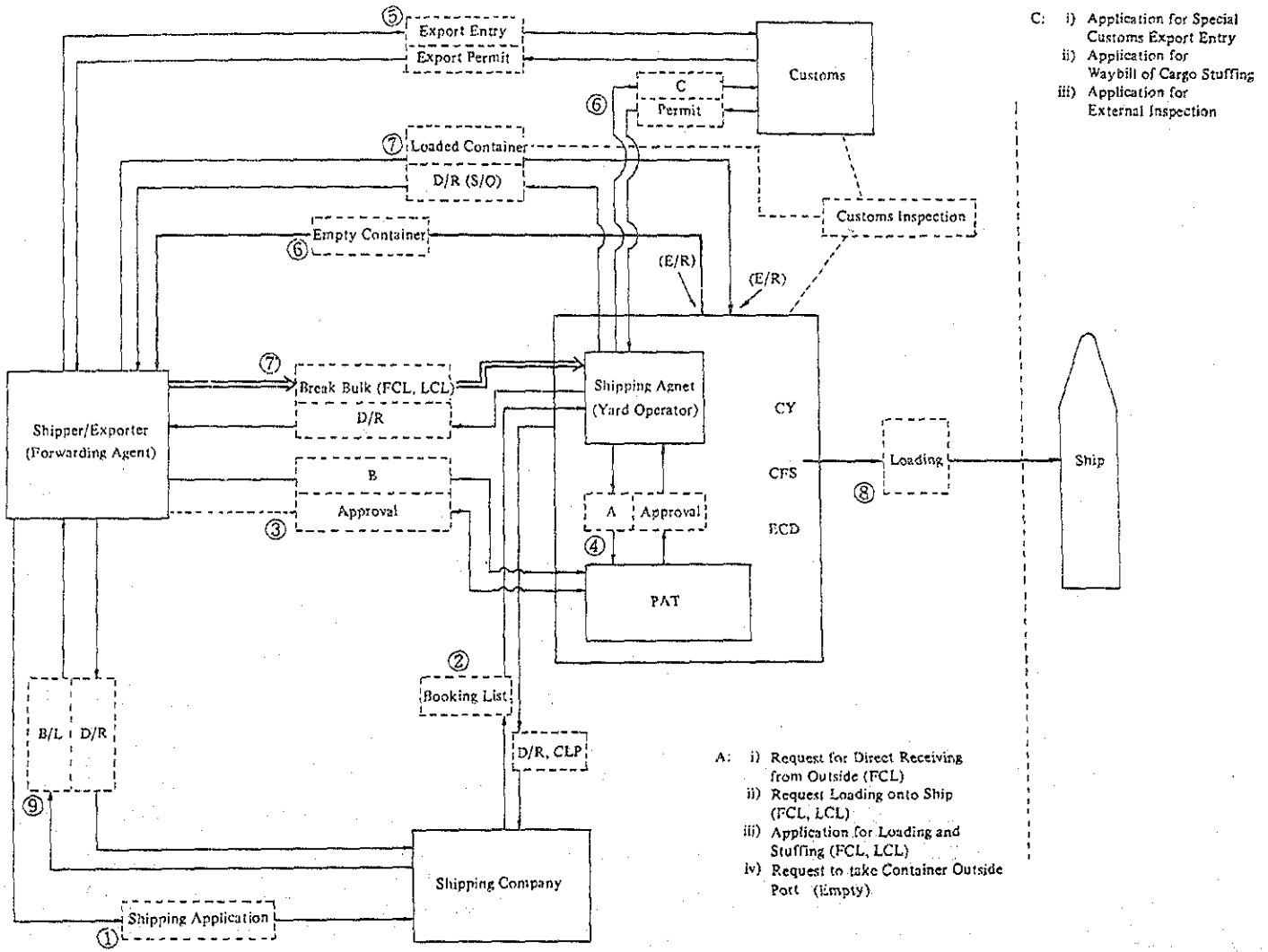


Fig. I.2.2 Present Flow of Container Cargoes and Documents (Export)

CHAPTER 3 INLAND CONTAINER DEPOT

3.1 Inland Container Depots in the World

1. Almost every shipping freight conference or agreement regulates the rules on so-called "Inland Container Depots (ICDs)." The precise meaning of an ICD is an "Inland Empty Container Depot" or an "Inland Clearance Depot." Non-conference shipping companies establish their depots more freely.

2. Many ICDs are located near the major origins and destinations of the container cargo, especially when these are far from the port. One of the examples is the Hamamatsu Inland Container Terminal in Japan, which was built by the Shizuoka local government in 1971. It is located 100 kms west of Shimizu Port. The main export cargoes originating in the Hamamatsu region are stuffed into containers after obtaining customs clearance at the terminal, and are then transported via Shimizu Port and other neighboring ports.

3.2 Container Transportation System between the Marine Terminal and the ICD

3. The function of the ICD is basically the same as that of the CFS except that the location of the ICD is far from the port.

4. Considering this situation, customs procedures are to be completely executed at the ICD. Therefore, not only marine terminals but also the ICD should be designated as a bonded area, where customs clearance of both import and export cargoes can be executed. Then, containers should be transported in bond between the two places by reliable trucking companies and railway companies. The marine terminal operator or the ICD operator should declare the bonded transportation of containers to Customs on behalf of shippers and consignees, attaching a transportation manifest. When containers arrive at the marine terminal or the ICD, container seals are

checked and this declaration is verified by customs officers.

5. As for bonded transportation by trailers between the marine terminal and the ICD, the study team proposes the following measures considering the conditions in Thailand.

① First Step

i) To oblige the ICD operator or the marine terminal operator to affix an additional seal as well as a Customs seal.
ii) To designate reliable trucking companies as authorized transporters between the ICD and the marine terminal, and to oblige them to distinctly mark their road trailers.
iii) To designate a transport route between the ICD and the marine terminal.

② Seconod Step

After the First Step is ploperly executed, the following measures are to be adopted.

i) To check departure and arrival time for every road trailer at the ICD and the marine terminal.
ii) To adopt document inspection instead of physical inspection.

6. In order to realize efficient container operations, a comprehensive system for the smooth transmission of all necessary information must be established through the cooperation of all the related parties. Especially, the smooth flow of information between the marine terminal and the ICD must be maintained.

7. Since the Study Team recognizes that the unified management and operation of the marine terminal, the ICD and the transportation between the two places is to be implemented by a single entity, it should be understood that the above entity is responsible to shippers and consignees for this transportation.

3.3 Functions of the ICD for Laem Chabang Port

8. Laem Chabang Port is located about 130 kms southeast of Bangkok, which is the main center of economic activities in Thailand. If there were no ICD around the Bangkok area, the shippers/consignees with LCL cargoes or whose plants can not accommodate stuffing/unstuffing work would have to bring and pick up their cargoes to and from Laem Chabang Port CFS under their own arrangement and pay for the inland transportation. They will thus benefit greatly if an ICD is provided around the Bangkok area, because they will be released from travelling to Laem Chabang Port to request the loading/unloading operation and carry out the necessary procedures.

9. Then the basic function of the ICD for Laem Chabang Port must be as a stuffing and unstuffing station in which customs clearance is conducted to complete all procedures by shippers/consignees. Other ICDs throughout the world fulfill the same basic function.

10. After the ICD begins operations, various social benefits can be expected, in addition to the benefits to consignees/shippers:

(1) To increase the container handling capacity at the marine terminal

(2) To decrease the total traffic volume on the roads between the Bangkok area and Laem Chabang Port

11. An image of the cargo flow through the ICD and Laem Chabang Port is shown in Fig. I.3.1.

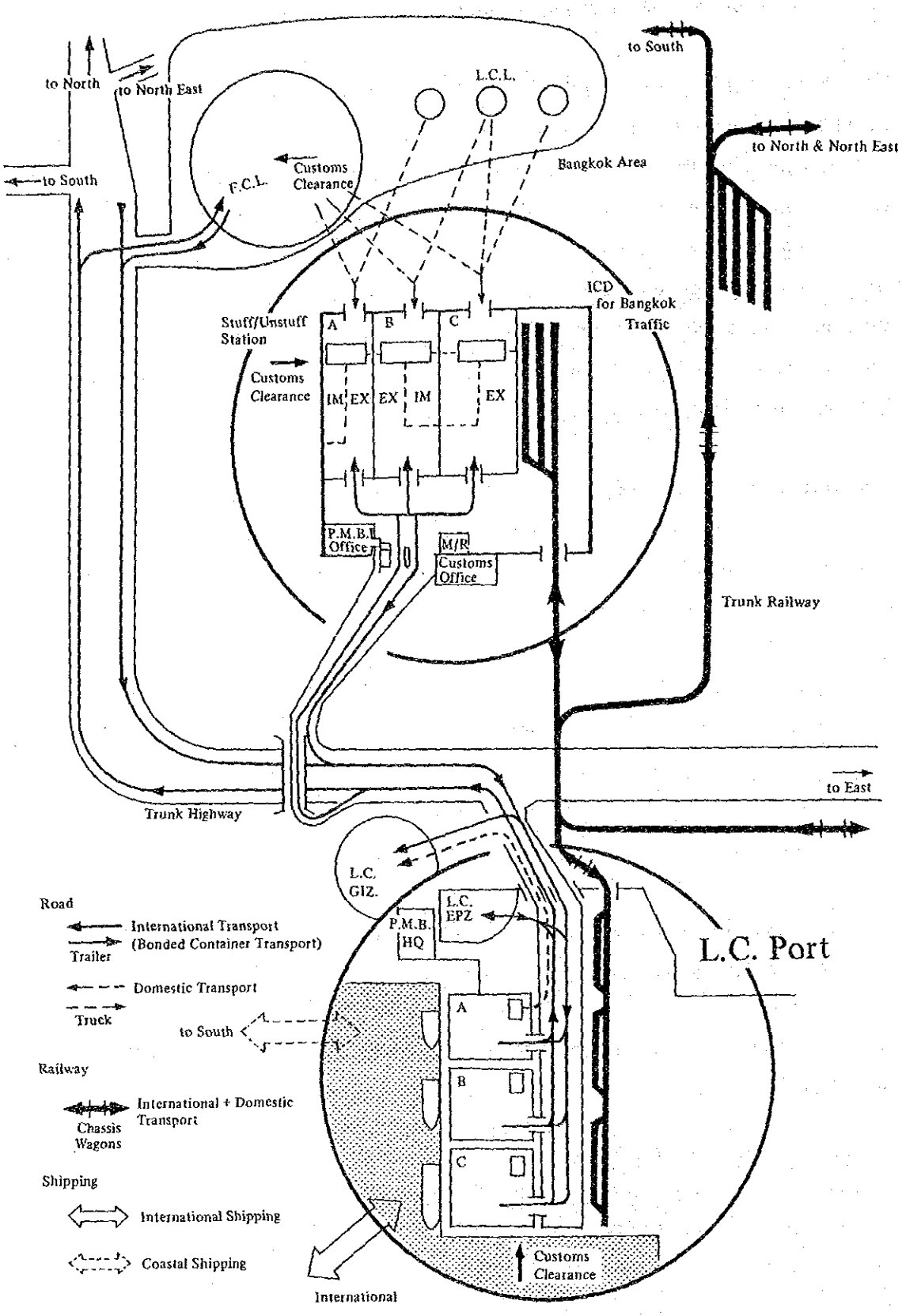


Fig. 1.3.1 Port, ICD and Inland Transportation (Model)

3.4 Facilities at the ICD

12. Based on the ICD functions and the facilities prepared at the marine terminals, the following facilities are required at the ICD:

(1) Gate Box
(2) Container Gate
(3) Weighbridge
(4) Parking
(5) Office Building
(6) Container Freight Station (CFS)
(7) Maintenance and Repair Shop
(8) Washing Facilities
(9) Container Yard (CY)
(10) Parking for Yard Equipment
(11) Cargo Handling Equipment
(12) Reefer Plug
(13) Bonded Fence
(14) Fuel Facilities
(15) Electricity Sub-station
(16) Rail Track

13. And if the scale of the ICD is large, the following common facilities are also required:

(17) Main Office Building
(18) Overtime Cargo Warehouse
(19) Water Drainage System
(20) Water Supply System
(21) Additional Parking

PART II MANAGEMENT AND OPERATION

CHAPTER 1 NEW MANAGEMENT AND OPERATION SYSTEM OF LAEM CHABANG PORT AND THE ICD

1.1 Framework of Total Management and Operation System

(1) Management and Operation System of Laem Chabang Port

1. When we consider the management and operation of Laem Chabang Port, we should clearly distinguish between port management and the port operation. One key issue is the division of work between the public and private sectors.

2. Privatization is not an almighty policy to solve problems in the public sector, and a careful examination is required case by case, because the situation of the public sector and the private sector is quite different field by field. The public sector is suitable as a port management body which owns assets and has the responsibility to maintain and prepare port services, but the public sector does not have sufficient ability and experience in modern container operation, and it may be best for the private sector to carry out this work.

3. We basically hope to establish a new Port Management Body (P.M.B.), but we must take into account the possibility of PAT's involvement in the Laem Chabang port management. Whatever the decision will be, the importance of separate management from Klong Toei should be recognized and given top priority.

4. The private sector will provide sufficient services to accommodate the container throughout. The P.M.B. must, however, continue to control to an adequate extent such services even after privatization, with a minimum number of staff.

5. To make up for the lack of management expertise in Thailand, it will probably be necessary to employ foreign experts, in particular during the early stage of the new ports. Necessary guidance could be provided by foreign experts who would work as advisors, for example, through bilateral cooperation from foreign governments. Experts can not only advise the management body, but can also transfer valuable knowledge to local staff.

6. It may be possible to find operators for each terminal. We assume in this report each terminal will be separately leased out to the private sector. A further examination is presented in the following section.

7. Our proposal for the framework of the management and operation system is summarized in Fig. II.1.1 below.

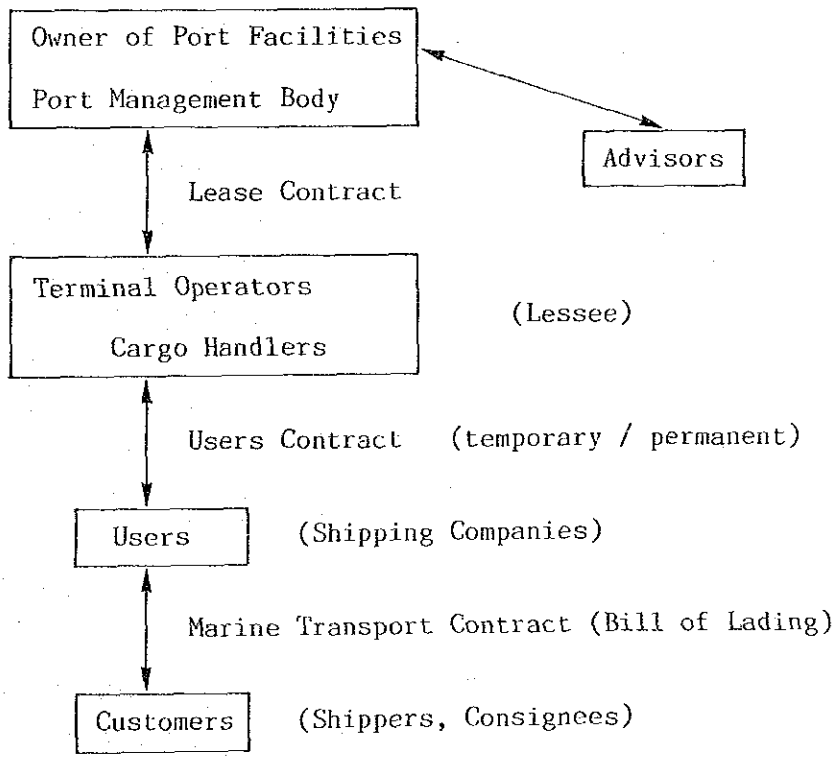


Fig. II.1.1 Management and Operation System for Laem Chabang Port (Framework)

(2) Container Terminal Operation System

1) Number of Terminal Operators

8. In case of one operator operating several berths, continuous berths may occasionally be occupied by more than four vessels at quays originally designed for three berths, but this would require repeatedly shifting already berthed vessels to make room for vessels coming later, and it would be difficult to actually realize a berth occupancy ratio as high as that which is theoretically possible.

9. The "first comes, first served" operation may contribute to equality of quay facility use among users and to effective use of quay walls. Inside the terminal, however, there will always be congestion through cross-transportation of containers between container yard and quay wall. In addition, shipping companies would not be able to predict waiting time for berthing and might disfavor the unstable schedule.

10. For preventing such disadvantages, a "preferential system" could be considered whether it is partial or total in which the terminal operator would enjoy smooth operation of loading and discharging containers through nearby quays and yards assigned in advance. At the same time, shipping companies would enjoy less waiting time for berths and a more stable schedule. The terminal operator, in turn, would gain a guarantee of substantial throughput from the shipping companies. The advantages of the "first comes, first served" system are, however, sharply reduced in accordance with the needs of the port and the requirement to provide better service.

11. Considering the total transportation cost, it is unrealistic and undesirable to expect a high occupancy ratio of the quay wall in spite of the congestion in the container yard, which may possibly cause increased expenditure in ship waiting and in yard operation itself.

12. Under a one-operator system, cost reduction in managerial and operational scale-merit can be expected, but this estimation is only meaningful provided the capacity is almost fully used. A certain effect

will also appear in increased yard capacity, but it may be within the range of lost capacity due to type of operation equipment, frequency and stability of calling schedules, progress in the operation level of new managers and workers, and, after all, the throughput volume which the operators can gather.

13. It should be stressed that the most important factor is the introduction of competition in the terminal operation market, which can result in higher efficiency than under relatively monopolistic conditions. We therefore recommend that one operator operate only one berth at the initial stage of the Laem Chabang Port operation when the number of container berths is limited.

2) Potential Terminal Operators

14. Terminal operators are required to have sufficient experience in terminal operation and efficient cargo handling in Thailand, the ability to attract sufficient cargo volume, and financial stability.

15. Possible forms of terminal operators are as follows:

① Port management body
  ①-a Direct operation by P.M.B. workers
  ①-b Handling operations entrusted to private companies
② Shipping companies (or their affiliated companies)
  ②-a One shipping company
  ②-b Consortium of shipping companies
  ②-c Joint Venture among shipping companies, container handling companies, inland transporters, etc.
③ Independent body

16. If an independent terminal operator seeks stable business prospects before starting operations, he would have to negotiate with some shipping companies and try to gain their decision to use his terminal.

17. We consider that shipping companies would be the most appropriate candidates if they find Thai partners who have some relation with the container transportation business. At present, the Thai flag shipping companies do not have enough experience, but foreign companies do.

18. Direct operation by the P.M.B. workers should be avoided, even if the P.M.B. would be responsible for operations at one of several terminals.

(3) ICD Management and Operation System

19. The main functions of the ICD are (1) Stuffing and unstuffing of container cargoes at the CFS and (2) Stacking of container boxes at the CY, with all customs procedures carried out at the ICD and with bonded transport between the ICD and Laem Chabang Port.

20. The ICD should be owned by a governmental agency, because (1) the implementation of Laem Chabang Port was already started by a governmental agency, PAT, and the ICD is a part of Laem Chabang Port, because the main functions of the ICD are the same as at the marine terminal at the port, and (2) after the lease period of a marine terminal terminates, the lessee may change as happens at many ports, and then the new lessee would have to prepare his own ICD if the ICD is owned by the private sector. So, it is desirable that both the marine terminals and the ICDs be owned by a governmental agency and leased out to terminal operators under a unified lease agreement for both facilities.

21. To evaluate the appropriate management system for the ICD the following items should be considered: (1) uniform management policy and control with Laem Chabang Port, (2) good coordination with other agencies, such as the Customs, (3) investment cost reduction, (4) scale merit of common operation, and (5) assurance to fairly offer equal opportunity to use the port.

22. The container transportation should be carried out by integrated

operators which lease facilities at both the marine terminal and the ICD. This would contribute to (1) cost reduction through procedure simplification, (2) time and cost reduction in the total administration, (3) ease to introduce an integrated computer system, (4) scale-merit in machinery and labor arrangement, and (5) supply of timely, accurate information on cargo movement.

23. Considering the flexibility in choosing time and origin/destination, road transportation should be recognized as one suitable mode for inland transportation of containers, and it is very important to assure fair competition within the private sector in inland transportation.

24. As for railway transportation, SRT's role will be important. SRT should be placed in charge of train operation and marshalling operation throughout, principally on a fixed schedule basis.

1.2 Administration and Management by the Port Management Body

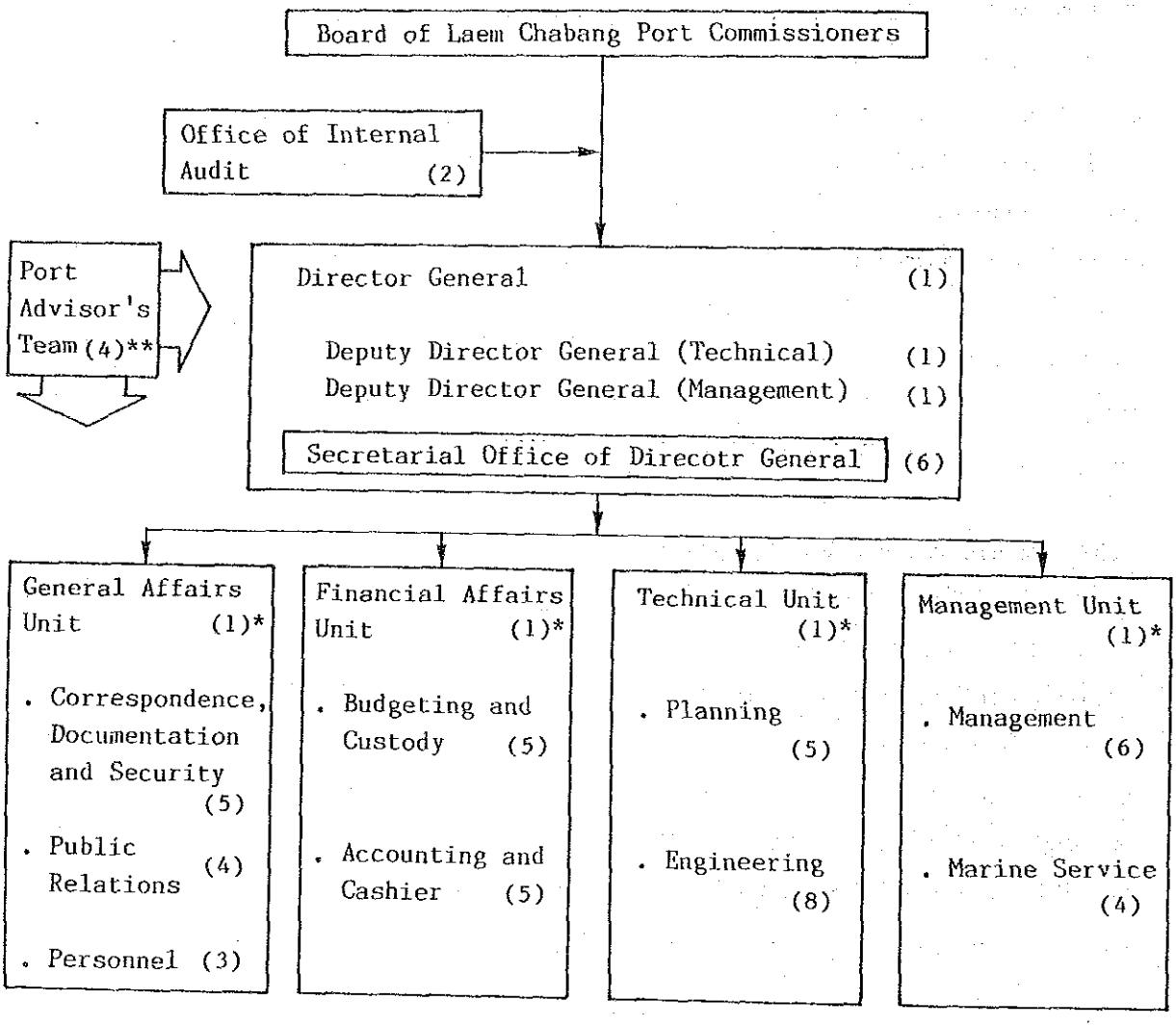
25. It is important to maximize the efficiency and productivity of the administration and management of the P.M.B. by minimizing the cost. In order to minimize the administration cost, the organization of the P.M.B. should be as simple as possible and the staff members of the P.M.B. should be appointed based on the principle of the able minority. Some works of the P.M.B. should be carried out by the private sector as far as possible through contracts under the supervision of the P.M.B.

26. Though being located far from Laem Chabang, the ICD will actually function as a part of the marine terminal. Then, the marine terminal and the ICD should be administered and managed as one body by the P.M.B.

27. The proposed structure and number of officers are shown in Fig. II.1.2.

28. The P.M.B., as a corporate body, should make the greatest effort to keep the balance of revenue and expenditure and to maintain its financial

soundness, cutting wasteful expenditures and obtaining revenue which covers necessary expenditure through its activity. On the other hand, port charges should be at a reasonable level for the port users.



Total Number of Officers: 70

Notes: * They are the Directors of the Unit
** Advisors will come from outside and are not included in the total number of officers.

Fig. II.1.2 Organization Chart of the P.M.B.

CHAPTER 2 LEASE CONTRACT OF CONTAINER TERMINAL AND ICD

2.1 Lease Conditions

1. Considering the stability of the lease contract, the life of gantry cranes and the amount of capital invested in facilities and equipment by the lessee, a period of ten years with further renewal periods of five years at the lessee's option would be appropriate.

2. The amount of rent can be fixed at the same amount throughout the entire period. The lessee pays the monthly rent.

3. The rent should be changed by notice of the lessor, under the following cases: (1) drastic change of the economic situation, (2) improvement or modification is made to the terminal facilities or equipment, and (3) need to change the rent to maintain an equitable balance with any other similar lease by the lessor. But, in order to maintain the stability of the lease contract by both the lessor and the lessee, changes of rent should be minimized, and should be conducted after at least half of the lease period has expired.

4. To maintain the terminal in good and tenantable condition, daily maintenance and minor repairs on the premises of not more than a certain amount per month should be the responsibility of the lessee during the lease period.

5. The marine terminals and the ICDs should be rented on a unified basis, but the lease contracts should be separated.

6. If the lessee desires to modify the construction specifications after the conclusion of the contract, the negotiable period should be limited to within three months after the signature of the contract. In this case, the burden of additional expenses, if any, should be negotiated by both parties.

7. In case the total cost of construction works can not be finally calculated before the bidding, the lessor may show only the minimum bidding

price to the candidates. In this case, the successful bidder might sign the contract temporarily subject to further negotiations on rent.

2.2 Criteria to Select the Successful Bidders

8. The criteria to select the successful bidders should include: (1) total rent for both facilities, (2) the ability to conduct excellent container terminal operations, (3) the likelihood of actually achieving the expected cargo volume by shipping companies based on past results, (4) the recruitment and training scheme of managers and workers, and (5) the program to prepare the required equipment.

CHAPTER 3 COMPUTER INFORMATION SYSTEM

3.1 Preconditions for Development of the Information System

1. Computerization in the port-related business is not so advanced in Thailand as a whole, while some shipping companies and agents have highly advanced computer systems connecting with their worldwide networks. The present conditions at each agency are as follows:

(1) PAT

2. PAT has been planning the introduction of a computer system focusing on 1) recording and reporting data on the movement of containers, 2) controlling the space (yard) utilization, 3) facilitating the printing of invoices, 4) providing data for management, and 5) producing the Port Management Information System (PORTMIS).

(2) Customs

3. Customs presently has a computer system with a database for trade statistics and accounting, and is planning to expand the system to connect it with other related bodies such as airports and seaports.

(3) SRT

4. SRT is employing a computer system for its internal work and plans to introduce and develop a new system including wagon control.

(4) Shipping Companies and Agents

5. The level of computer utilization of the shipping companies and agents ranges widely. But most of their plans to develop new or more advanced computer systems emphasize their operations at Bangkok Port. And the computer systems and advanced knowledge of the shipping companies are also expected to be utilized for the new container operations at Laem Chabang Port and the ICD.

3.2 Computer Information System

6. The Study Team has limited the scope to the basic design of the computer information system which focuses on the ICD's operation and communications among the ICD, the container terminal and the operators considering the present situation and the future plans. The proposed computer information system and organization are shown in Figs. II.3.1 and II.3.2.

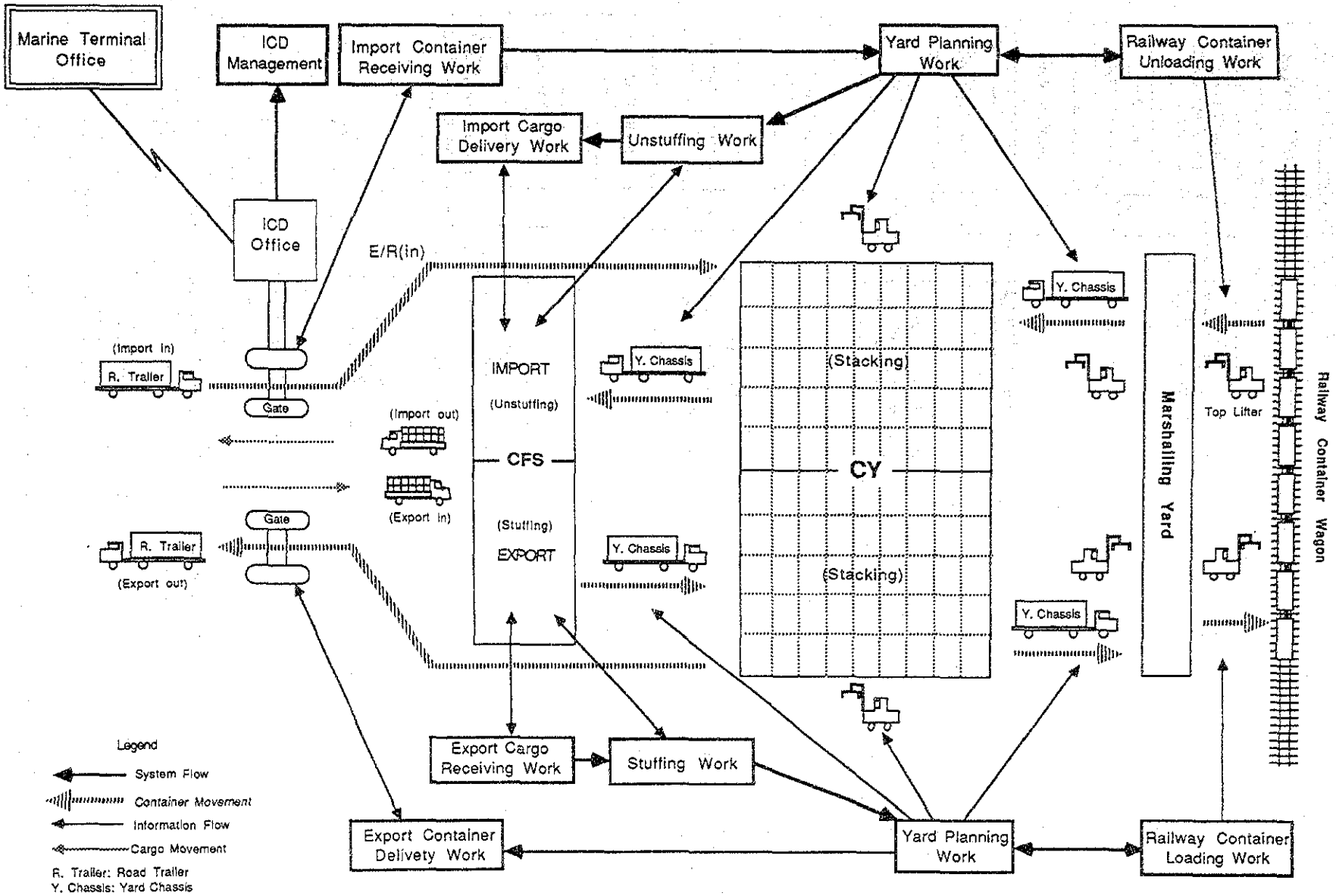


Fig. II.3.1 Computer Information System Image and Container/Cargo Movement in the ICD

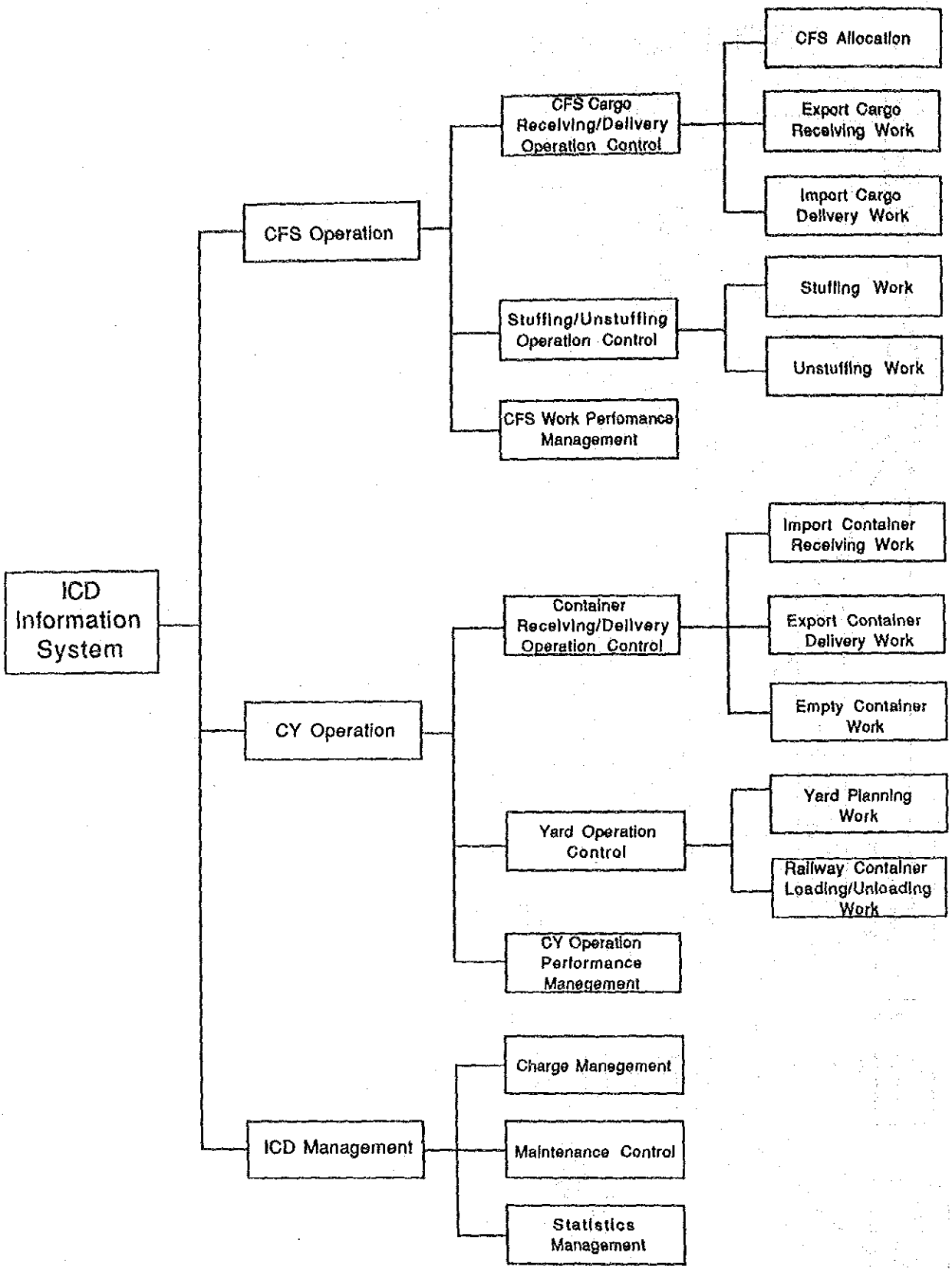


Fig. II.3.2 Computer Information System Organization

PART III INLAND CONTAINER DEPOT PLAN

CHAPTER 1 CARGO FORECAST

1.1 Socioeconomic Framework

1. It is necessary to estimate the future economic situation in the hinterland in order to forecast the future cargo volume.

2. Though the estimated annual growth rate of GDP in the Sixth National Economic and Social Development Plan (1986-1991) is set at 5%, the actual growth rate of GDP was 7% in 1987 and 10.5% (estimated) in 1988. Then the Study Team estimates the annual growth rate as 6.5% during the period of the Sixth Plan. And after 1991, the Study Team adopts an annual growth rate of 5%.

1.2 Cargo Volume Forecast

3. The target year of this study is 1996 as a first stage, and 2001 as a final stage. In the cargo forecast two methods are adopted. The one is a micro forecast in which the volume of major commodities is estimated based on the following factors:

(Export)

(1) National Development Plan
(2) Industrial Estates/Parks Development Plan
(3) International Trade Agreements
(4) Production Forecast by the Government
(5) Annual Trends in Recent 5-10 Years, etc.

(Import)

(1) Production Forecast in Thailand
(2) Future Economic Factors (Population, GDP, etc.)
(3) Consumption per Capita
(4) Relation between Import Volume and Export Volume
(5) Annual Trends in Recent 5-10 Years, etc.

4. On the other hand a macro forecast is conducted to estimate the total cargo volume based on the correlation between cargo volume and GDP for the purpose of checking the total import volume and export volume of industrial products estimated by the micro forecast.

5. One of the important factors affecting the cargo volume which could be handled at the ports in the Bangkok zone is the effective usage of the deep seaports at Songkhla and Phuket, which were recently opened.

6. The present and future containerized ratio of each commodity is estimated based on interviews with exporters, importers and shipping companies, and checked by the actual container volume and the annual trend of the total containerized ratio.

7. According to the above assumptions, the Study Team estimates the future container cargo volume in each port area as shown in Table III.1.1.

Table III.1.1 Container Cargo Volume in Thailand

Unit: 1,000 tons

		1991	1996	2001
Bangkok Zone	Export	6,108	8,568	10,455
	Import	3,617	5,910	8,185
	Total	9,725	14,478	18,640
Songkhla & Phuket	Export	855	1,062	1,192
	Import	-	-	-
	Total	855	1,062	1,192
Total	Export	6,963	9,630	11,647
	Import	3,617	5,910	8,185
	Total	10,580	15,540	19,832

Note: Import container cargo at Songkhla and Phuket would be negligible

8. At present about 40% of the imported container boxes are empty because of the imbalance of exported cargo and imported cargo. To solve the above problem an industry to manufacture new container boxes started in Thailand, and this is expected to help reduce the import of empty containers.

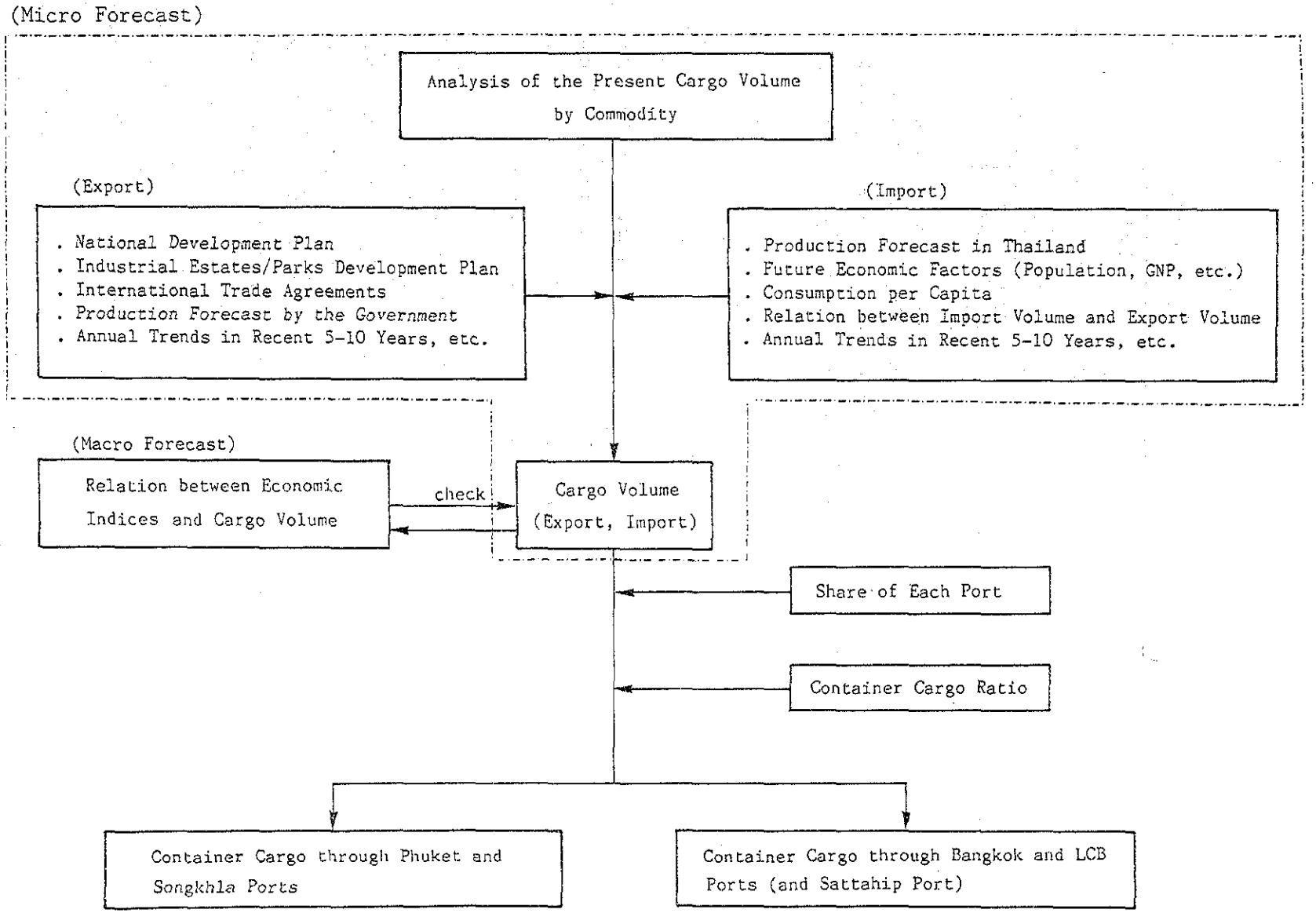


Fig. III.1.1 Flow Chart of the Cargo Forecast

9. Consequently, the container volume handled at ports in each year is estimated as shown in Table III.1.2.

Table III.1.2 Container Volume Handled at Ports

Unit: 1,000 TEUs

	1991	1996	2001
Bangkok Zone	988	1,358	1,673
Songkhla & Phuket	101	129	145
Total	1,089	1,487	1,818

Note: 1) Average weight per loaded container is set at 12 tons/TEU.
2) 17 tons/TEU is adopted for rubber at Songkhla and Phuket.
3) Newly manufactured container boxes in Thailand are assumed to total 30,000 TEUs in 1991, and 70,000 TEUs in 1996 and 2001.

1.3 Origin and Destination (O/D) Analysis

10. The O/D analysis of the present container cargo was carried out primarily based on the results of the interview survey with exporters and importers, and secondarily based on regional economic factors such as number of factories, main production areas, industrial estates/parks, etc.

11. The O/D of estimated future container cargo is calculated considering the development plans and other economic factors on the basis of the present O/D. The results of the estimates are shown in Table III.1.3. Due to the restrictions on industrial development in BMA, the share of the exported container cargo from BMA will decrease from 26% in 1987 to 16% in 2001. But as for imported cargo the share of BMA will still be more than 50% in 2001.

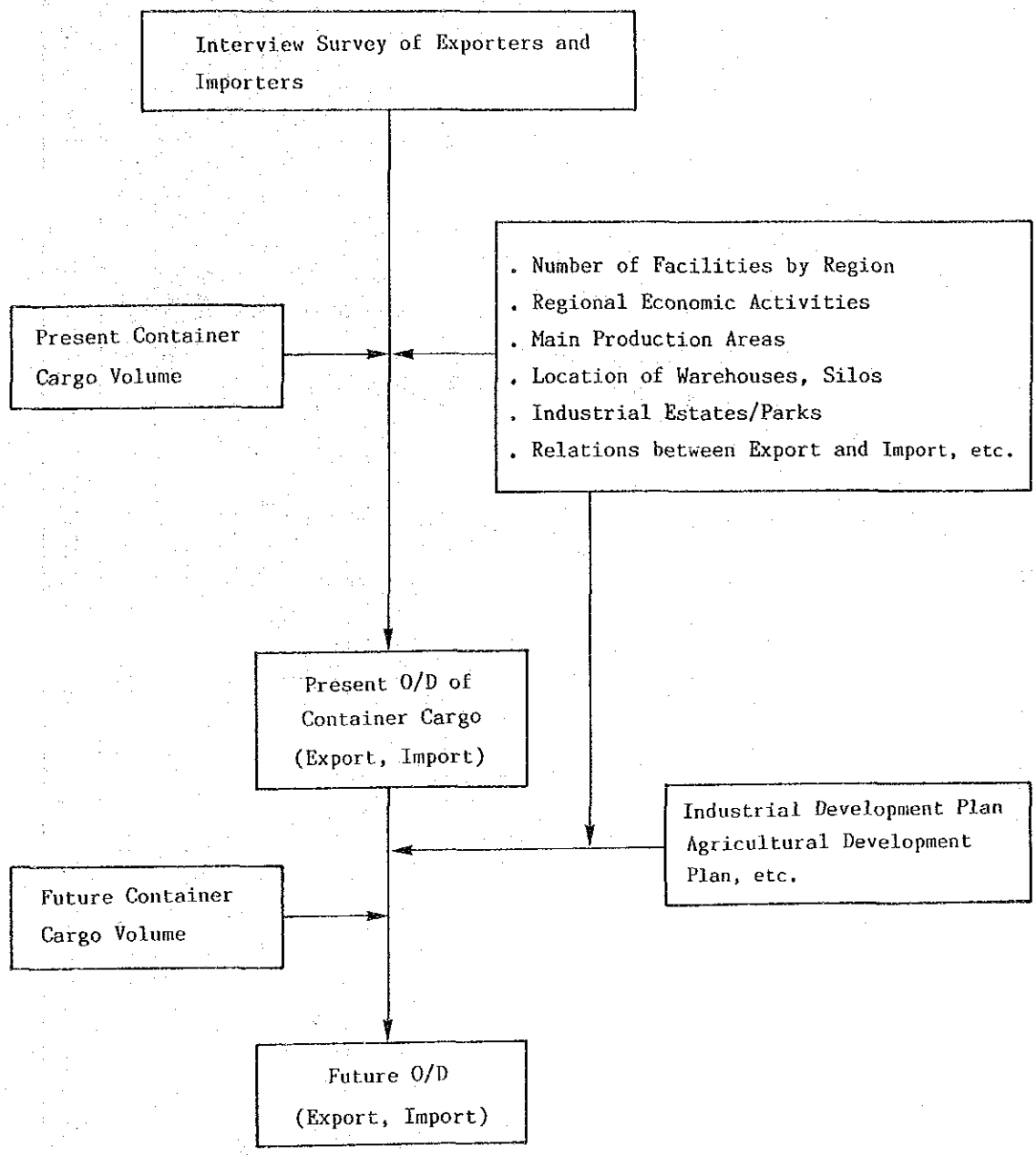


Fig. III.1.2 Flow Chart of the O/D Analysis

Table III.1.3 O/D of Container Cargo Handled at Bangkok Zone
(Bangkok Zone = Bangkok + Laem Chabang + Sattahip)

Unit : 1,000 tons, (%)

Area	1987						1996						2001					
	Export	%	Import	%	Total	%	Export	%	Import	%	Total	%	Export	%	Import	%	Total	%
BMA																		
Bangkok West	400	(11)	353	(15)	753	(12)	464	(5)	677	(11)	1141	(8)	491	(5)	933	(11)	1424	(8)
Bangkok East	170	(4)	147	(6)	317	(5)	491	(6)	418	(7)	909	(6)	575	(5)	586	(7)	1161	(6)
Bangkok North	133	(3)	81	(3)	214	(3)	235	(3)	242	(4)	477	(3)	266	(3)	345	(4)	611	(3)
Bangkok Central	300	(8)	691	(30)	991	(17)	349	(4)	2047	(35)	2396	(17)	364	(3)	2836	(35)	3200	(17)
Sub-Total	1003	(26)	1272	(54)	2275	(37)	1539	(18)	3384	(57)	4923	(34)	1696	(16)	4700	(57)	6396	(34)
Central																		
Samutprakan	480	(12)	192	(8)	672	(11)	1335	(16)	722	(12)	2057	(14)	1681	(16)	1038	(13)	2719	(15)
Nonthaburi & Pathumthani	152	(4)	104	(4)	256	(4)	1041	(12)	232	(4)	1273	(9)	1226	(12)	331	(4)	1557	(8)
Samut Sakhon	136	(3)	72	(3)	208	(3)	580	(7)	145	(2)	727	(5)	743	(7)	182	(2)	925	(5)
Central North	235	(6)	51	(2)	286	(5)	754	(9)	158	(3)	912	(6)	924	(9)	240	(3)	1164	(6)
Central West	169	(4)	88	(4)	257	(4)	206	(2)	198	(3)	404	(3)	263	(3)	270	(3)	533	(3)
Central East	177	(6)	15	(2)	192	(3)	435	(5)	27	(0)	462	(3)	554	(5)	34	(0)	588	(3)
Sub-Total	1349	(35)	522	(23)	1871	(30)	4351	(51)	1482	(24)	5833	(40)	5391	(52)	2095	(25)	7486	(40)
Eastern	313	(8)	58	(3)	371	(6)	1190	(14)	119	(2)	1309	(9)	1559	(15)	159	(2)	1718	(9)
Northern	365	(9)	135	(6)	500	(8)	721	(8)	266	(5)	987	(7)	866	(8)	356	(5)	1222	(7)
Northeastern	253	(6)	239	(10)	492	(8)	354	(4)	451	(8)	805	(6)	439	(4)	600	(7)	1039	(6)
Southern	616	(16)	93	(4)	709	(11)	413	(5)	208	(4)	621	(4)	504	(5)	275	(4)	779	(4)
Total	3899	(100)	2319	(100)	6218	(100)	8568	(100)	5910	(100)	14478	(100)	10455	(100)	8185	(100)	18640	(100)

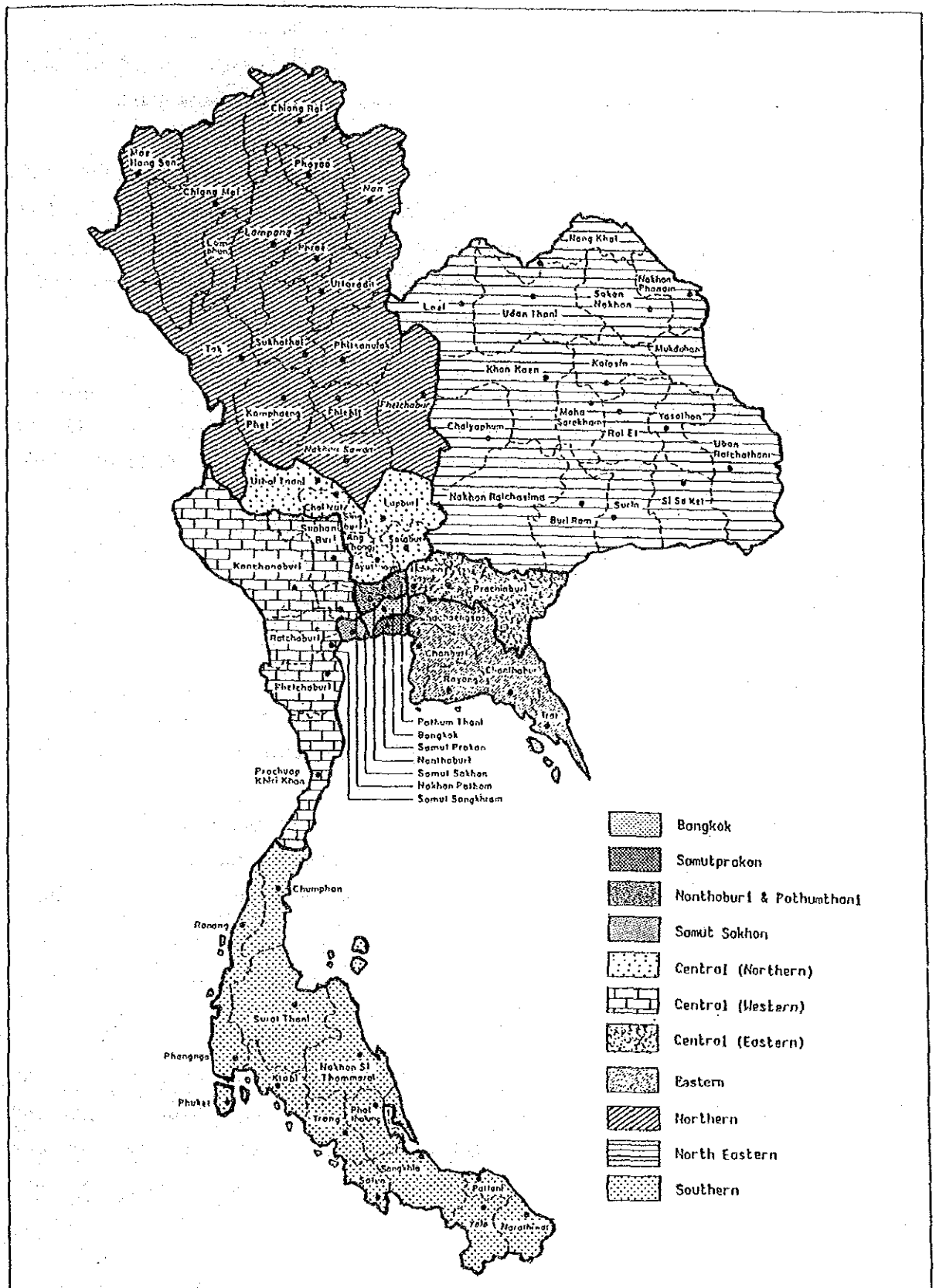


Fig. III.1.3 Zone Area Map

1.4 Cargo Volume of Bangkok Port and Laem Chabang Port

(1) Evaluation of the Container Handling Capacity at Bangkok Port

12. The evaluation criteria to determine the container handling capacity at Bangkok Port consist of two fields, 1) the yard capacity and 2) the berth occupancy which mainly depends on the handling capacity of the gantry cranes. Within the yard capacity, outside container yards to be set up by the private sector are taken into consideration.

13. And the capacity is evaluated at two levels, 1) the normal capacity which will occur after the Laem Chabang Port operation starts, and 2) an exceptional capacity which will serve as a temporary countermeasure before the Laem Chabang Port operation starts.

14. The results of the calculation are as follows:

Exceptional capacity:	840,000 TEUs/year
Normal capacity:	720,000 "

15. But to handle the above volume the following items should be achieved.

1) Sufficient space and equipment for container handling
2) Well arranged operation system for container handling
3) Smooth transportation of containers between the port area and the hinterland.

(2) Cargo Volume at Laem Chabang Port

16. The volume of cargo other than container cargo is also estimated on the basis of the O/D analysis of such cargoes as break bulk, tapioca, sugar and molasses. The results of the estimates are almost the same as the estimates in the detailed design of Laem Chabang Port except for container cargo.

17. Container cargo volume handled at Laem Chabang Port, which is calculated by deducting the capacity of Bangkok Port from the total container volume of Bangkok Zone, is 6.8 million tons in 1996 and 10.6

million tons in 2001 and in terms of TEUs, 638 thousand TEUs and 953 thousand TEUs, respectively.

Table III.1.4 Future Cargo Volume at Laem Chabang Port

Unit: 1,000 tons
(1,000 TEUs)

	1996			2001		
	Export	Import	Total	Export	Import	Total
Containers	4,030	2,780	6,810 (638)	5,950	4,660	10,610 (953)
Break Bulk	50	280	330	70	330	400
Tapioca	1,270	-	1,270	1,270	-	1,270
Sugar	590	-	590	590	-	590
Molasses	230	-	230	230	-	230
Total	6,170	3,060	9,230	8,110	4,990	13,100

1.5 Container Cargo through the ICD

(1) Container Cargo Volume through the ICD

18. The container cargo volume through the ICD is estimated based on the analysis of the O/D of the future container cargo, both LCL and FCL, which would be handled at Laem Chabang Port. The major cargoes through the ICD will have their origins and destinations in BMA and its surrounding areas, because the cargoes near Laem Chabang Port are expected to be transported directly to and from the port.

19. Consequently the Study Team estimates the container cargo which would be handled at the ICD to be 1,287 thousand tons in 1996 and 2,104 thousand tons in 2001 as shown in Table III.1.5. According to the O/D analysis, more than 80% of the container cargo through the ICD would move to or from BMA.

20. The number of container boxes corresponding to the above volume would be 107 thousand TEUs in 1996 and 175 thousand TEUs in 2001, which would

represent 17% in 1996 and 18% in 2001 of all container boxes handled at Laem Chabang Port.

Table III.1.5 O/D of the Container Cargo Through the ICD

Unit: 1,000 tons (%)

	BMA					Other Areas	Total
	West	East	North	Central	Sub-Total		
1996	251 (19.5)	157 (12.2)	92 (7.1)	539 (41.9)	1,039 (80.7)	248 (19.3)	1,287 (100)
2001	397 (18.9)	258 (12.3)	152 (7.2)	893 (42.4)	1,700 (80.8)	404 (19.2)	2,104 (100)

(2) Traffic Volume by Mode

21. The traffic volume between the ICD and the O/D is estimated based on the container cargo volume through the ICD, the average tonnage per vehicle, fluctuation and related vehicles. The daily traffic volume is estimated as 1,790 vehicles in 1996 and 2,890 vehicles in 2001.

22. The transportation between the ICD and Laem Chabang Port is expected to be carried out by both road and railway. As for railway transportation, the cutoff time would be earlier than for trailers due to the longer handling time.

23. Then the container volume by each transportation mode is estimated as shown in Table III.1.6. According to the results, the share of railway transportation would be 25% of the total container movement. Consequently, the corresponding daily traffic volume by roads would be 420 vehicles in 1996 and 710 vehicles in 2001. And the required number of trains is 2 round trips per day.

Table III.1.6 Container Volume by Each Transportation Mode Between the ICD and Laem Chabang Port

Unit: TEUs

	1996			2001		
	Export	Import	Total	Export	Import	Total
Road	25,000	55,500	80,500	38,200	95,900	134,100
Railway	13,400	13,400	26,800	20,600	20,600	41,200
Total	38,400	68,900	107,300	58,800	116,500	175,300

1.6 Influence on the Present Development Plan of Laem Chabang Port

24. Assuming that the estimated cargo handling capacity at each container terminal would increase up to 160,000 TEUs using the ICD, the required number of berths at Laem Chabang Port is 4 in 1996, and 6 in 2001 considering the estimated container cargo in both years.

25. The necessary number of berths for container handling and related facilities at Laem Chabang Port should be calculated assuming the use of the ICD.

CHAPTER 2 SELECTION OF THE APPROPRIATE AREA FOR THE ICD

2.1 Examined Areas

1. It is commonly recognized that one of the main objects of container transport is door to door service, which means that the most ideal point for stuffing and unstuffing is the factory or warehouse of the shipper or consignee. But it is impossible to realize door to door service for all container cargo. Then it is desirable to locate the stuffing and unstuffing point as close to the main O/D of the cargo as possible.

2. From the O/D analysis of the container cargo through the ICD, it is estimated that more than 80% of the cargo moves from or to BMA. Therefore the Study Team examines BMA and its surrounding areas for an appropriate ICD site, and divides the area into four areas, namely, the Bangkok Central Area, the Bangkok Eastern Area, the Bangkok Western Area and the Bangkok Northern Area.

2.2 Main Criteria

3. The main criteria to evaluate each area as a possible ICD site are as follows:

(1) Relation between ICD Site and O/D of the Container Cargo.
The main factors are as follows:

1) Distribution of the O/D of container cargo
2) Location of the Industrial Estates and Parks
3) Sufficient cargo volume to operate the ICD

(2) Accessibility to the Transportation Network

The transportation network to be considered includes the present and future road network and the railway line.

1) Road network
(a) Present roads: Route 34, Route 304, Route 3119 and Route 3256

(b) Future roads: Outer-ring road, Extension of the Dindang Road to Lat Krabang and New Highway between Lat Krabang and Bang Pakong

2) Railway line: Eastern line

(3) Traffic Conditions

The main factors of the traffic conditions are as follows:

1) Traffic congestion
2) Regulations on the traffic of heavy vehicles
3) The need to pass through the Bangkok Central Area

(4) Land Use

Concerning the land use, the main factors to be considered are as follows:

1) Present land use
2) Ease of future expansion
3) Regulations on land use
4) Land price

2.3 Evaluation of the Examined Areas

4. The Study Team evaluates each area by each of the criteria mentioned above. Each of the criteria is weighted equally, as they are all important;

Good condition: ◎ --- Point: 1
Normal condition: ○ --- Point: 0
Poor condition: △ --- Point: -1

5. According to the above assumptions, each area is evaluated as shown in Table III.2.1. Consequently the Study Team recommends that the Bangkok Eastern Area would be the most appropriate location for the ICD.

Table III.2.1 Comparison of the Four Areas

Evaluation Criteria	BKK Cent.	BKK East	BKK West	BKK North
ICD Site and O/D of Cargo				
(1) O/D of the Container Cargo	◎	○	○	△
(2) Location of Industrial Estates/Parks	△	◎	△	○
(3) Sufficient Cargo Volume	○	◎	△	△
Accessibility to Transportation Network				
(1) Road				
1) Present Network (Rt. 34, Rt. 304, Rt. 3119, Rt. 3256)	○	◎	△	○
2) Future Network (Outer-ring Rd., Dindang Rd. New Highway (Lat Krabang-Bang Pakong))	△	◎	○	○
(2) Railway: Eastern Line	○	◎	△	○
Traffic Conditions				
(1) Traffic Congestion	△	◎	◎	○
(2) Regulations on the Traffic of Heavy Vehicles	△	◎	◎	◎
(3) Problems to Pass through the Center of the BMA	△	◎	△	○
Land Use				
(1) Present Land Use	△	◎	◎	◎
(2) Ease of Future Expansion	△	◎	◎	◎
(3) Regulations on Land Use	△	○	○	○
(4) Land Price	△	○	◎	○
Evaluation	-8	10	0	1

Note 1) ◎: Good Condition ------ Point: 1
○: Nomal Condition ------ Point: 0
△: Poor Condition ------ Point: -1

Note 2) BKK: Bangkok

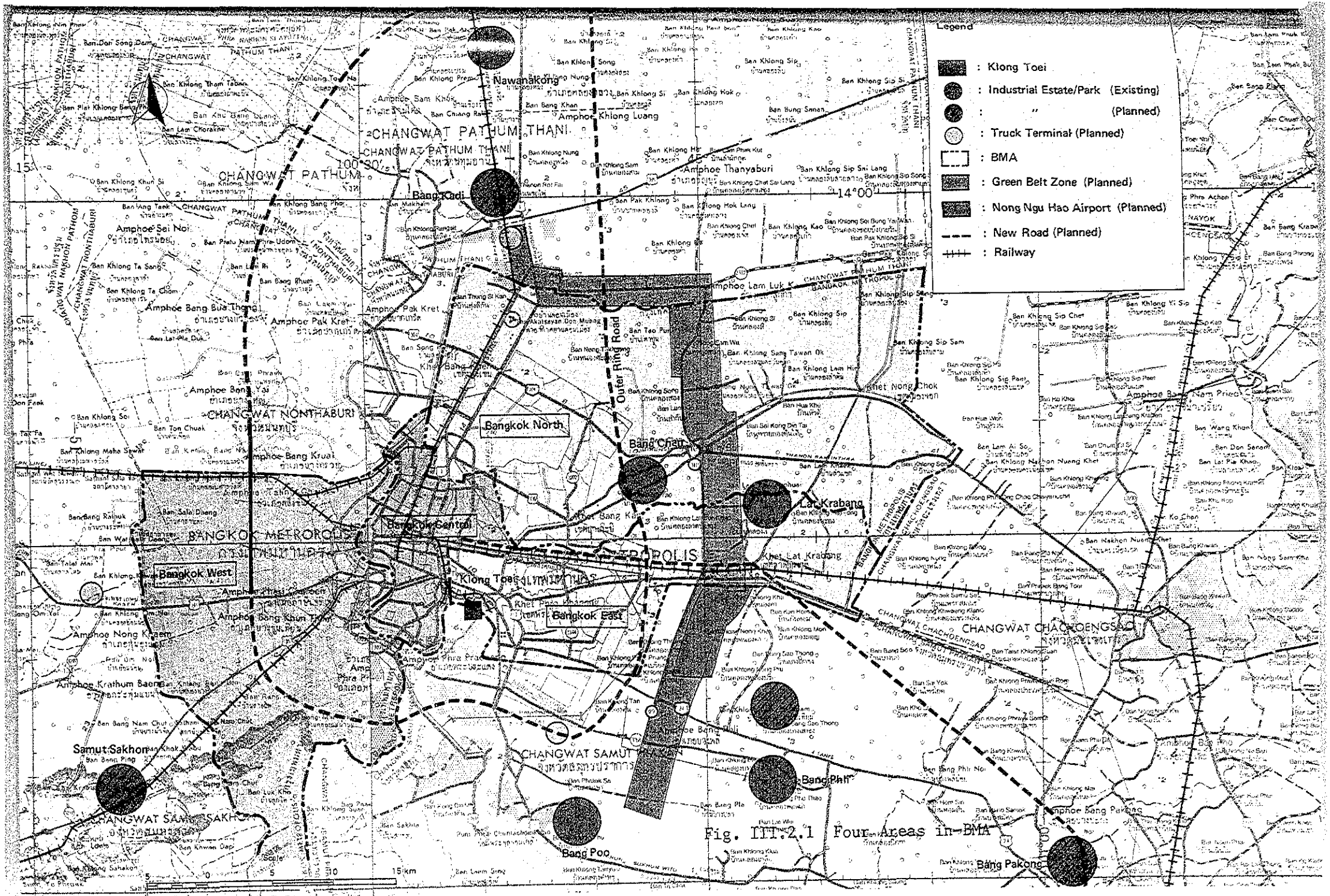


Fig. III.2.1 Four Areas in BMA

CHAPTER 3 NATURAL CONDITIONS

3.1 Natural Conditions of the Proposed Area

1. The natural ground level in the proposed area is on the order of 0.2 meters to 1.5 meters above mean sea level. At the end of the rainy season, the rainfall and the high water of the Chao Phraya River cause floods frequently about 50 cm above the surface of the land. The inside Green Belt and the Khlongs Song Tong Nun are designed to help prevent flooding.

2. Big earthquakes have never been recorded around the Bangkok Area. Due to this, the load of earthquakes is not a major consideration in the design of structures.

3.2 Soil Conditions

3. The following four types of soil were observed by the boring survey carried out at Lat Krabang as shown in Figs. III.3.1 and III.3.2.

(1) Weathered Clay Top Stratum

4. The uppermost stratum of 0.5 to 1.5 meters is gray-brown clay, organic soil including humus and forming a weathered "dry crust". The underground water levels in bore holes are 0.5 m (east area) and 0.2-0.4 meters (west area).

(2) Soft Bangkok Clay

5. Very soft to medium dark gray silty clays reachs depths between 15.0 to 20.0 meters.

(3) Stiff to Hard Bangkok Clay

6. Stiff to hard gray and brown clay lies underneath the soft Bangkok clay. The depth of this formation is generally between 15.0 to 29.0 meters with a thickness of 4.0 to 10.0 meters.

(4) Dense Sand and Gravel

7. The dense sand stratum is dark gray to light brown silty and very fine sand. The depth of this formation is 21 meters in the east area and 23 meters in the west area. The N-values range from 25 to 40 in the west area and to more than 50 in the east area.

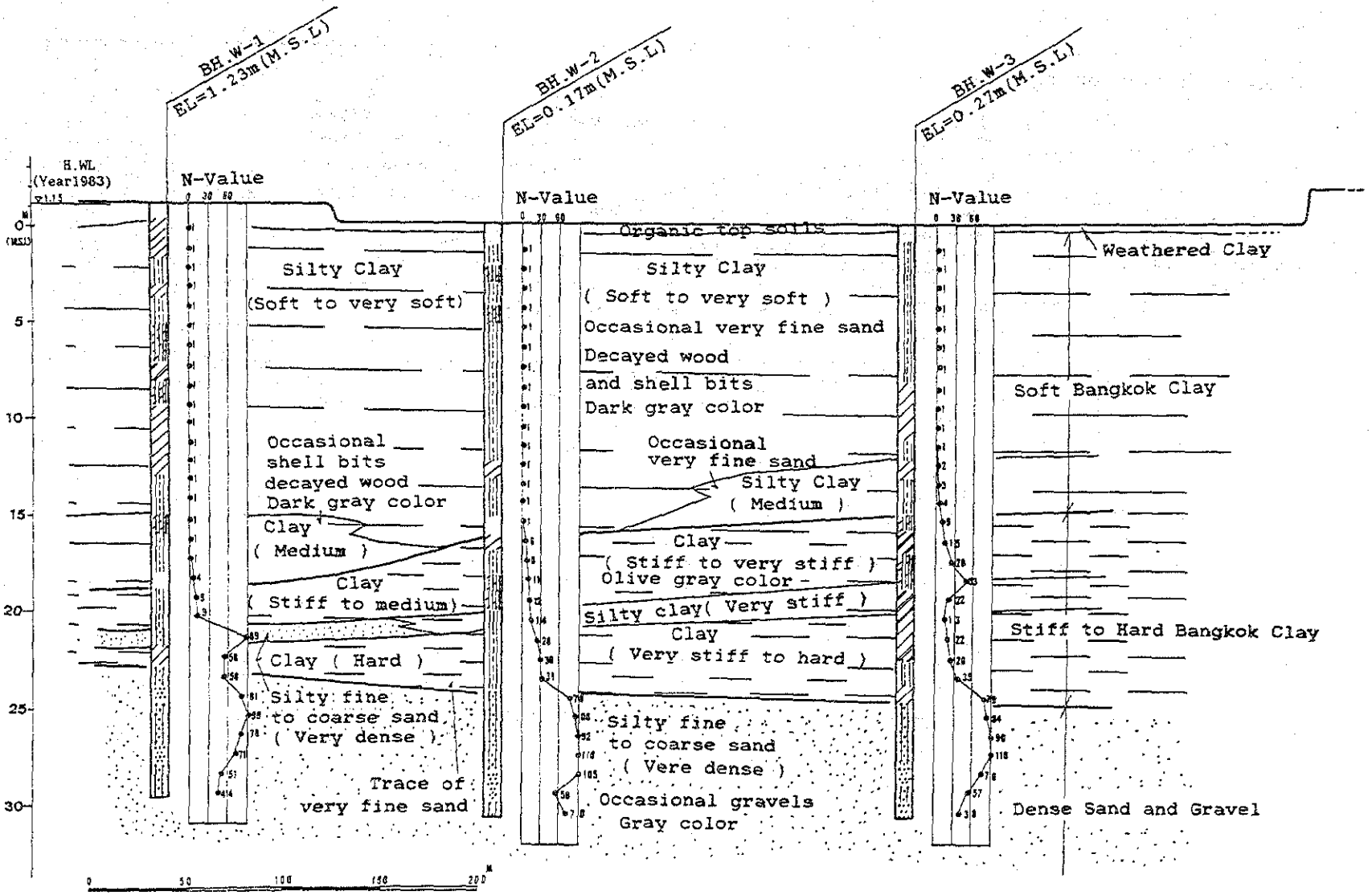


Fig. III.3.1 Longitudinal Soil Profile (West Area)

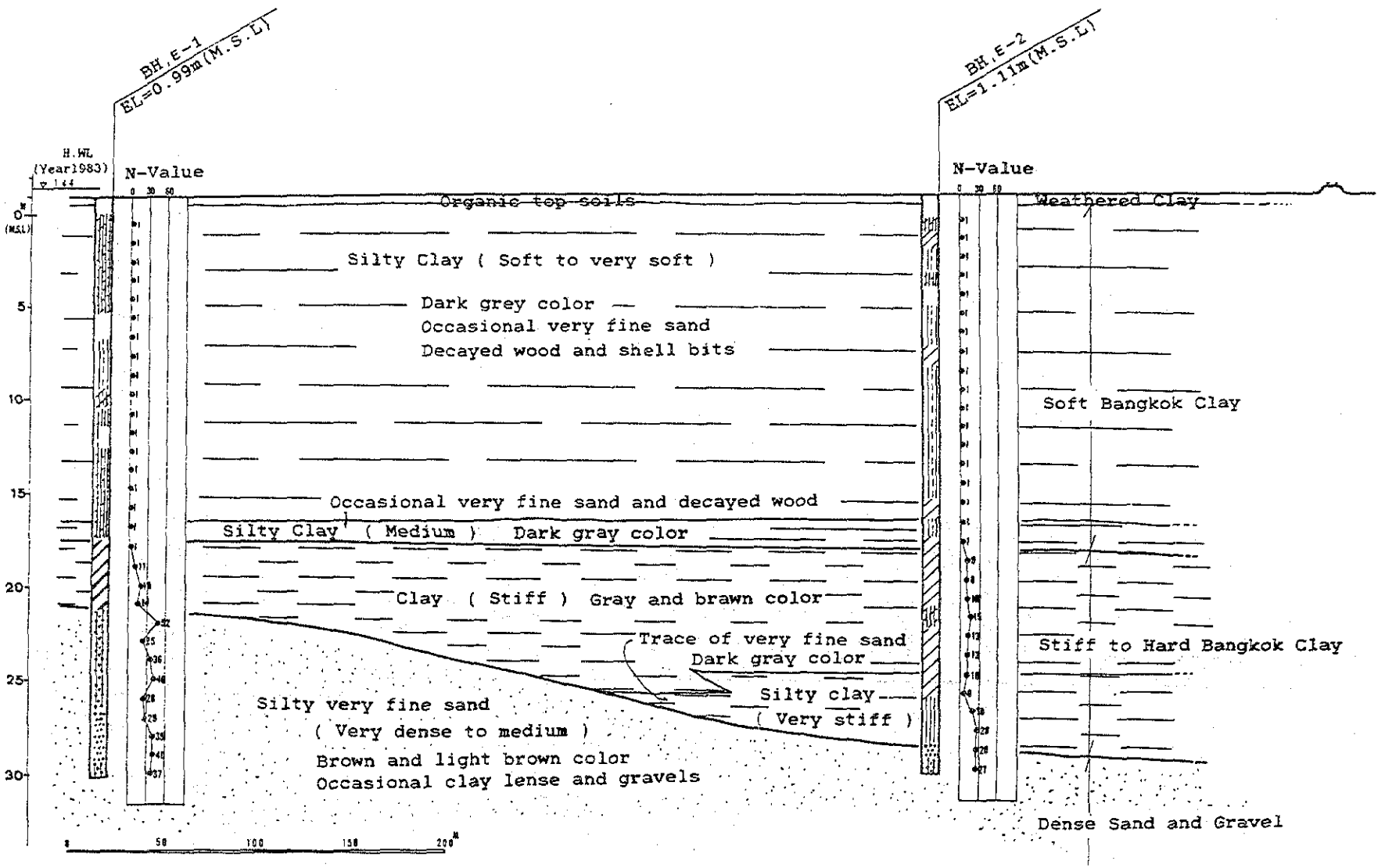


Fig. III.3.2 Longitudinal Soil Profile (East Area)

CHAPTER 4 OPERATION IN THE ICD

4.1 Operation

1. Container handling systems are classified by the handling equipment used such as the chassis system, the straddle carrier system, the transtainer system and the top lifter system. A general comparison of the above four systems is shown in Table III.4.1. Considering the cargo volume, initial cost, manpower and the experience in Thailand, we recommend that the top lifter system in combination with a chassis feed is the most appropriate system for the ICD operation.

Table III.4.1 Comparison of Container Handling Systems

Area of Comparison	Chassis	Straddle Carrier	Tire-Mounted Transtainer	Top Lifter
1.Land Utilization	Very Poor	Good	Very Good	Good
2.Initial Investment including Equipment	Large	Medium	Large	Small
3.Heavy Pavement	Not Required	Required	Required (partial)	Required
4.Mobility and Flexibility	Very Large	Large	Small	Large
5.Container Shifting	No	Medium	Large	Medium
6.Number of Skilled Laborers	Small	Large	Medium	Small
7.Maintenance Cost	Low	High	Low	Medium
8.Container Damage	Low	High	Low	Low
9.Safety of Operation	High	Low	Medium	Medium

4.2 Organization and Personnel

2. For the operation of an ICD, the following four sections would be required:

(1) Administration Section

(2) Business Section

(3) Operational Section

(4) Maintenance Section

3. The numbers and functions of personnel which will be required to effectively carry out the ICD operations depend on various factors. A sample organization chart and the number of personnel for an ICD in 1996 is shown in Fig. III.4.1.

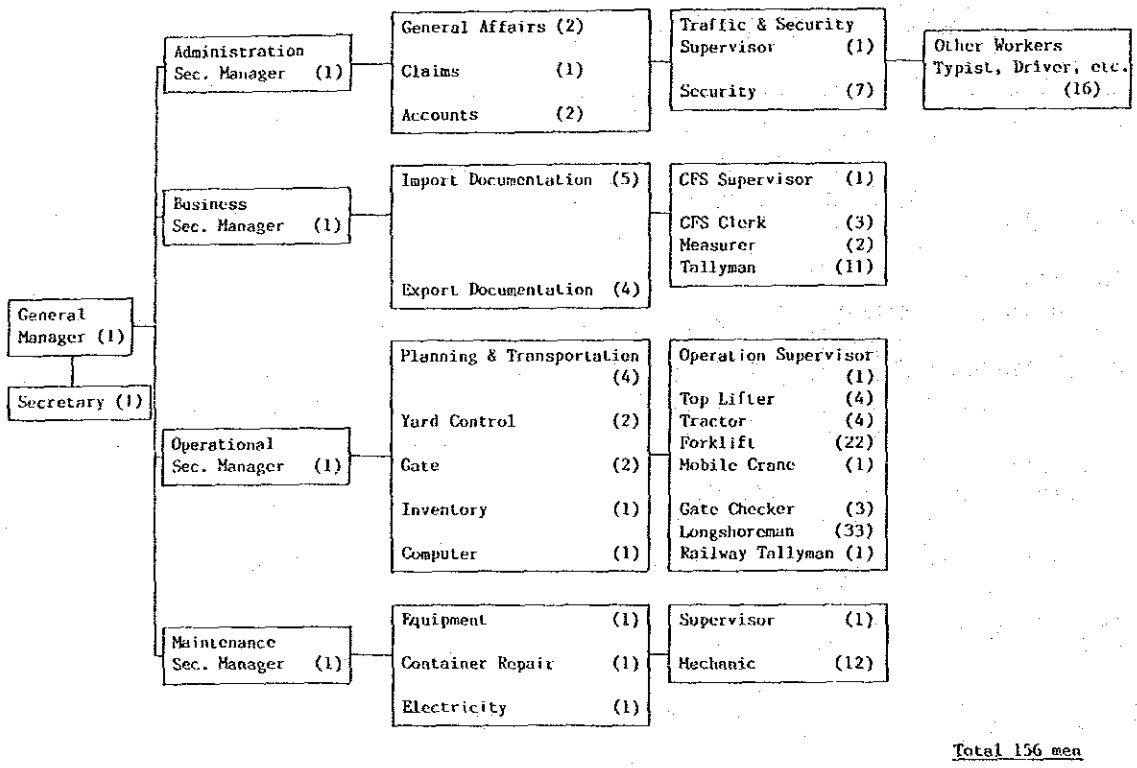


Fig. III.4.1 Organization Chart of each ICD

4.3 Necessary Equipment for the ICD Operation

4. The type and quantity of equipment are estimated considering the top lifter system. An example of the required equipment for each ICD is listed in Table III.4.2.

Table III.4.2 Equipment Necessary for each ICD

Item		Number
Top Lifter	(35-ton)	4
"	(10-ton)	1
Yard Tractor		5
Yard Chassis		36
Mobile Crane	(20-ton)	1
Forklift	(6-ton)	2
"	(3-ton)	14
"	(2-ton)	13
Weighbridge	(50-ton)	2
Wireless Phone (VHF)		15
Small Equipment (Sling, Pallet, etc., -- Set)		1
Mini Truck	(2-ton)	1
Messenger Car		1

CHAPTER 5 LAYOUT PLAN OF THE LAT KRABANG INLAND CONTAINER DEPOT

5.1 The Scale of the ICD

(1) Number of ICDs

1. In this study we suppose that an ICD corresponding to each marine terminal at Laem Chabang Port will be located at the Lat Krabang ICD. Considering the container cargo volume thorough Laem Chabang Port and the container handling capacity per berth with the ICD, the required number of container handling berths will be 4 in 1996 and 6 in 2001 as analyzed in Chapter 1-6 of this part. Consequently the Lat Krabang ICD will require 6 ICDs under the master plan in 2001 and 4 ICDs under the first stage plan in 1996.

(2) Facilities in Each ICD

1) Container Freight Station (CFS)

2. The required space of the CFS is calculated based on the container cargo volume, storage capacity, average dwell time and other factors. And the dimensions of each CFS are decided considering the existing CFSs.

2) Container Yard (CY)

3. The required space of the CY is calculated based on the number of containers, average dwell time, stacking height and other factors assuming the use of the top lifter system.

3) Space for Railway Transportation

4. The required yard space for container handling by railway transportation is calculated based on the required space of the cargo handling equipment.

4) Other Facilities

5. The scales and dimensions of other required facilities such as parking area, container gate, office building and maintenance and repair shop are estimated considering the cargo volume, the capacity of each facility and the dimensions of the existing facilities.

6. The required facilities and their scales are shown in Table III.5.1.

Table III.5.1 Facilities in Each ICD

Facility	Scale
Container Freight Station (CFS)	5,200 m^2 (130 m x 40 m)
Container Yard (CY)	22,000 m^2 (with 20 reefer plugs)
Parking Area for Yard Chassis	1,400 m^2
Marshalling Yard for Railway Transportation	Depth: 25 m
Container Gate	3 lanes with 2 weighbridges
Office	1,000 m^2
Maintenance & Repair Shop	640 m^2 (32 m x 20 m)
Parking Space	Trucks, cars, motorcycles
Other Facilities	Container washing area, fuel station

(3) Administration Zone

7. The required facilities in the administration zone are a main office, an overtime cargo warehouse, an electric substation, water supply facilities, septic tank and other facilities.

8. The scales of the main office and the overtime cargo warehouse are as follows:

1) Main office : 1,200 m^2

The following agencies will use the main office:

The Port Management Body, Customs Department, the State Railway of Thailand, terminal operators' association and others.

2) Overtime cargo warehouse : 3,200 m^2 (in the master plan)
2,100 m^2 (in the first stage plan)

(4) Spur Line

9. The Lat Krabang ICD will be connected to the Eastern Line of SRT. The dimensions of the spur line are calculated considering the capacity of locomotives, the effective length of railroad stations, the weight of wagons and the weight of container boxes. The required dimensions of the spur line are as follows:

Radius = 300 meters or more
Length = 500 meters

5.2 Layout Plan

10. The following concepts are considered in preparing the layout plan:

1) Smooth connection of the spur line to the Eastern Line
2) Smooth cargo handling at each ICD
3) Smooth connections between each ICD and the main office
4) Some reserved area

11. Based on the above concepts each ICD requires 36 rai (230 m x 250 m) as shown in Fig. III.5.1. The ICDs, administration zone, access road and spur line are allotted as shown in Fig. III.5.2 as a master plan and as shown in Fig. III.5.3 as a first stage plan. The required land area is 296 rai (47.4 ha) for the master plan and 200 rai (32.0 ha) for the first stage plan.

5.3 Development around the ICD

12. The ICD itself is originally considered to function as a part of smooth container box and cargo circulation, and should be separated from cargo storage operation. Nevertheless, without a sufficient storage

capacity trade and production can not work effectively, and warehouses should be prepared to support the expected economic growth. Then, such facilities are located around existing ICDs in the world to utilize the ICDs effectively. Consequently, ICDs and their allied facilities formulate a center of cargo circulation.

13. So it is desirable to develop the area around the ICDs for this purpose.

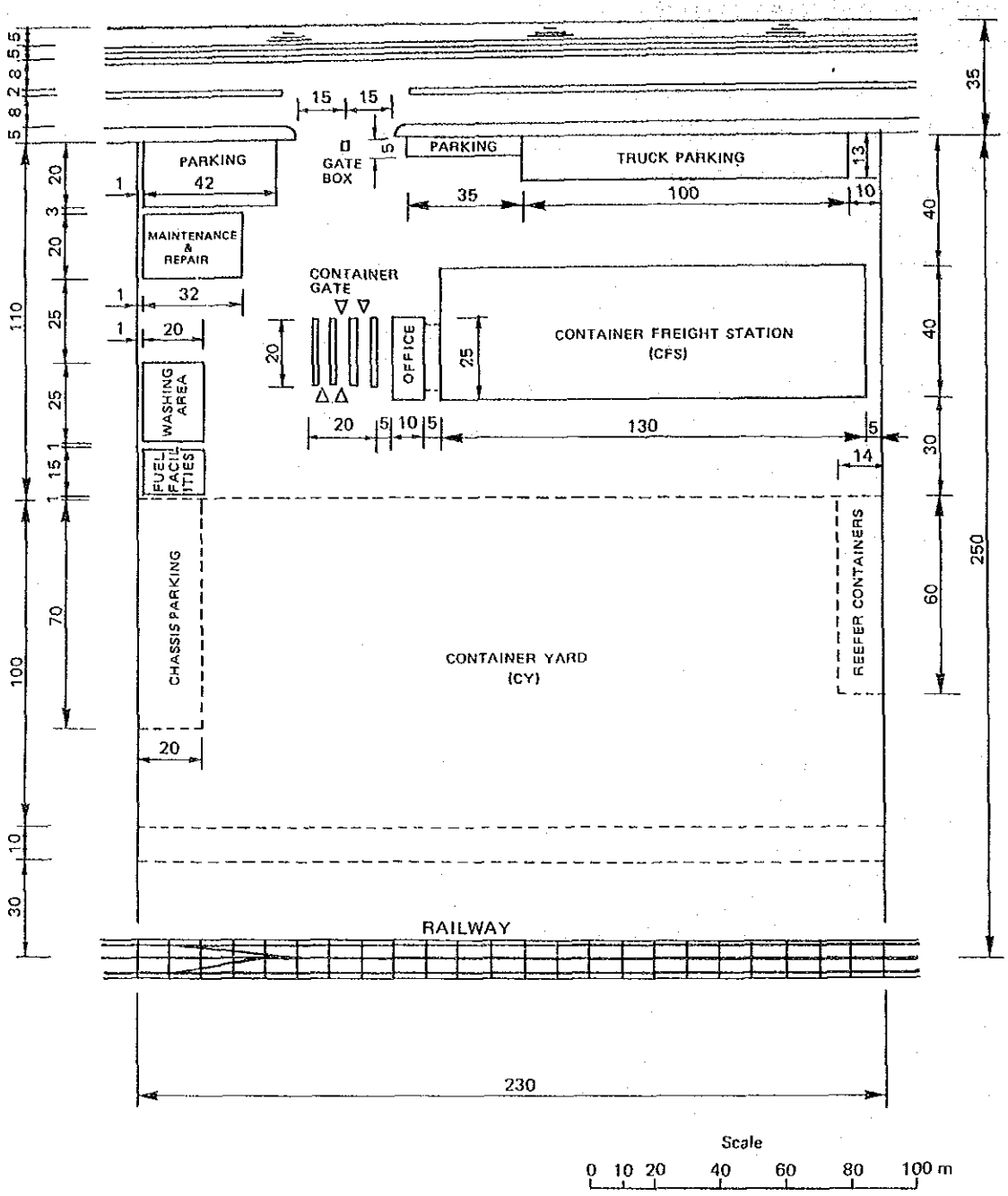
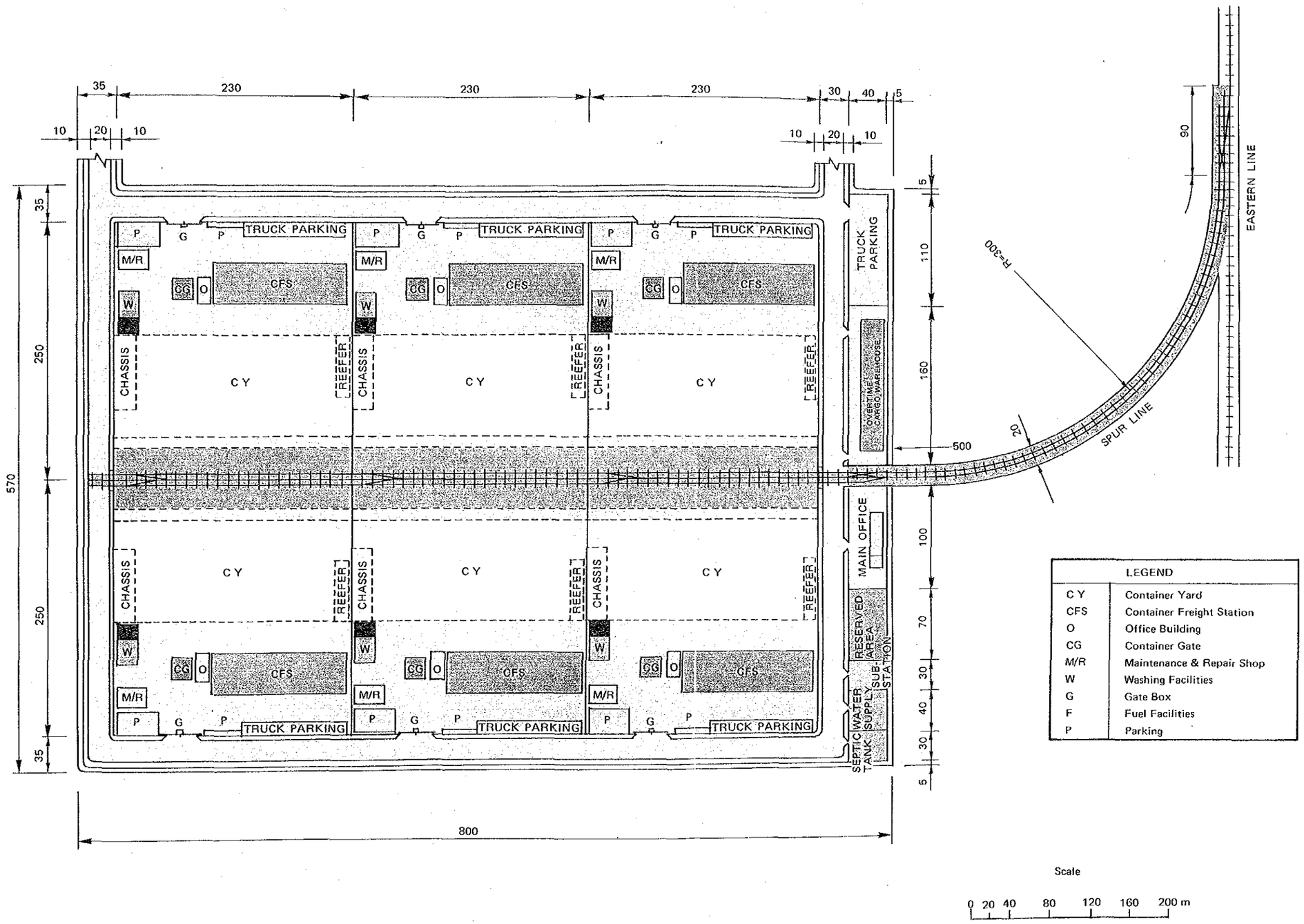


Fig. III.5.1 Layout of Each ICD at the Lat Krabang Inland Container Depot



LEGEND	
C Y	Container Yard
CFS	Container Freight Station
O	Office Building
CG	Container Gate
M/R	Maintenance & Repair Shop
W	Washing Facilities
G	Gate Box
F	Fuel Facilities
P	Parking

Scale

0 20 40 80 120 160 200 m

Fig. III.5.2 Layout of the Lat Krabang Inland Container Depot (2001)

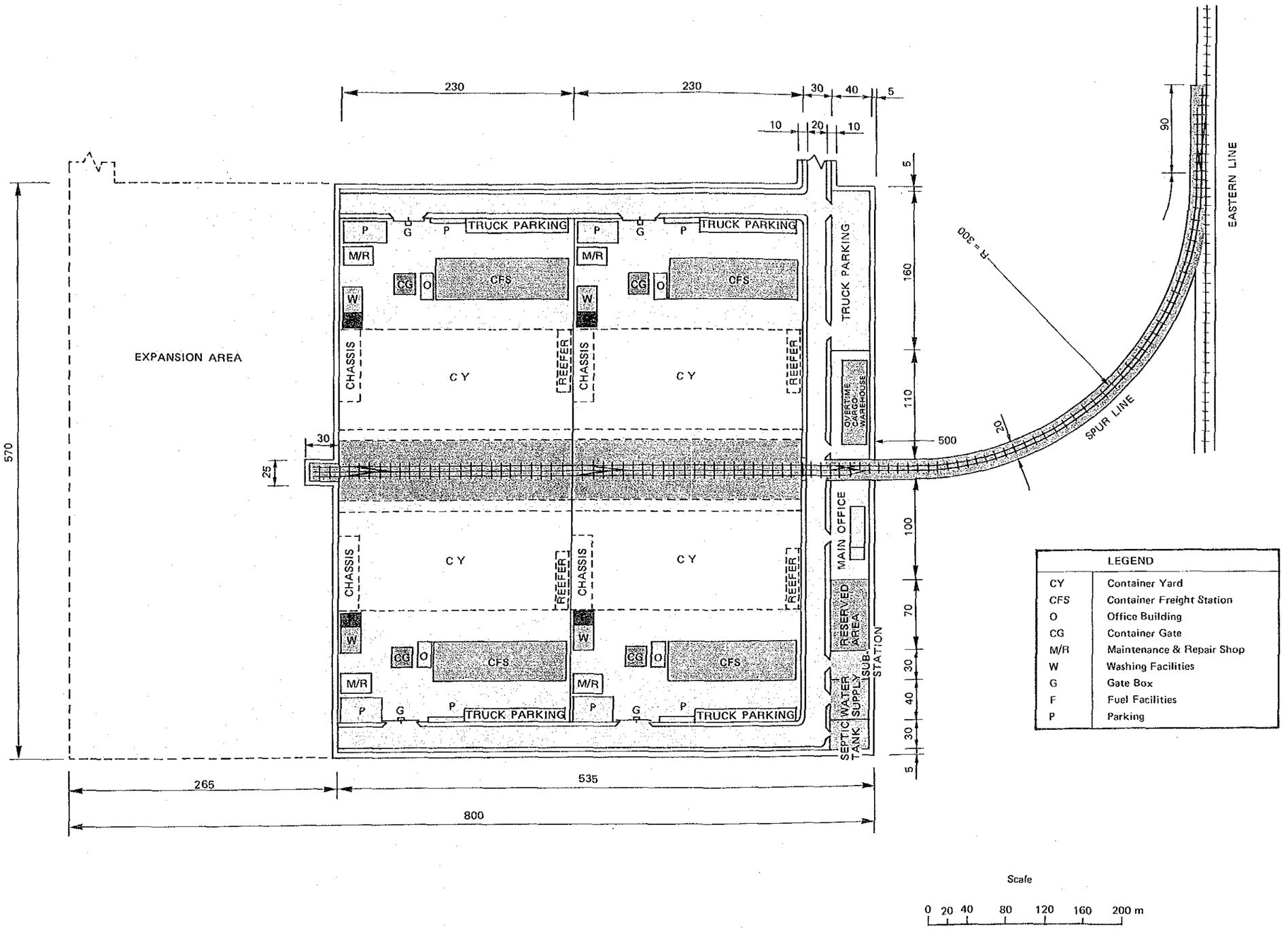


Fig. III.5.3 Layout of the Lat Krabang Inland Container Depot First Stage Plan (1996)

CHAPTER 6 PRELIMINARY ENGINEERING DESIGN

6.1 Presuppositions for Preliminary Design

(1) Site Constraints

1. The proposed area is cultivated field with no significant structures. Therefore, the area and configuration of the site required by the site planning of the ICD can be sufficiently secured. It should be noted that the existing site level is lower than the flood protection level.

(2) Existing Utilities

2. Existing facilities for water supply, sewage discharge and electric power supply are as follows:

1) Water Supply : Klongs are a possible water source.
2) Sewage discharge : A septic tank system is available.
3) Electric power supply : Electric power supply from BEA is available.

6.2 Preliminary Design of Facilities

3. Preliminary design is carried out for the following facilities:

Each ICD : CFS, Office Building, Container Gate, Maintenance and Repair Shop, Fuel Station and Container Yard

Administration Zone: Main Office Building, Overtime Cargo Warehouse

Utility Planning : Pumping Work, Electric Power Supply

Related Civil Work : Road and Pavement, Railway

4. General views of the CFS and the office building in each ICD and a view of the main office building are shown in Figs. III.6.1 through III.6.3.

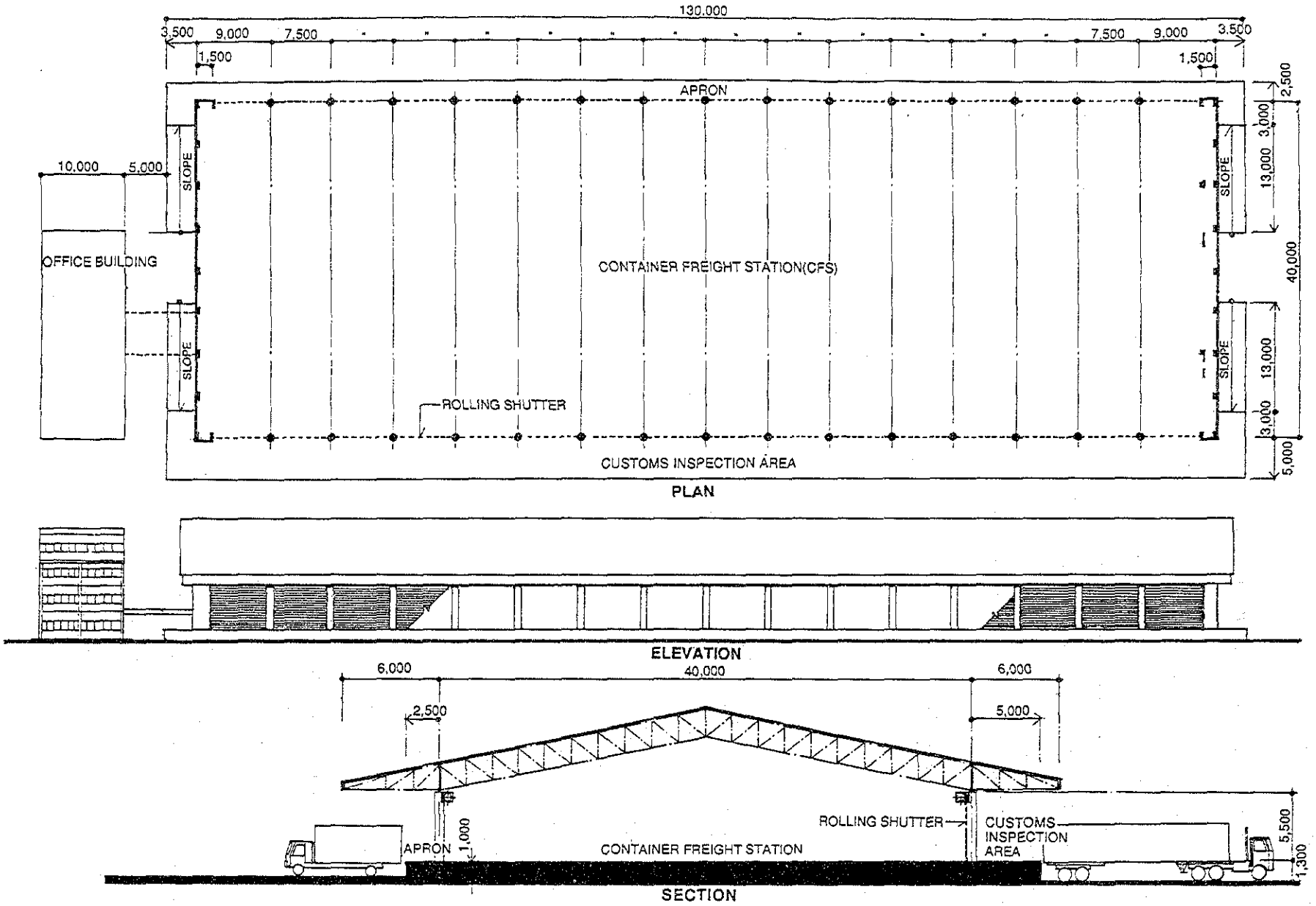


Fig. III.6.1 General View of the CFS

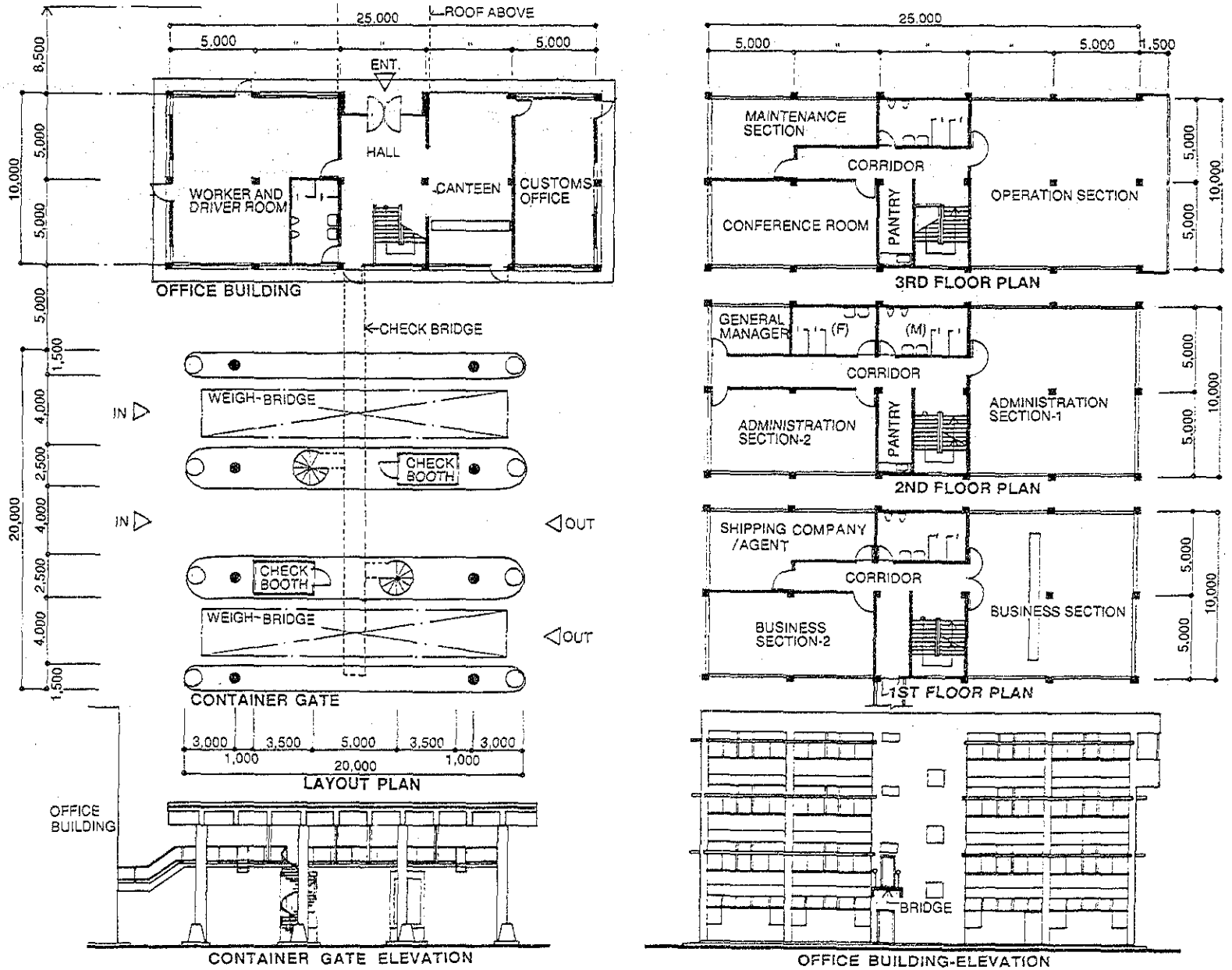


Fig. III.6.2 General View of the Office Building

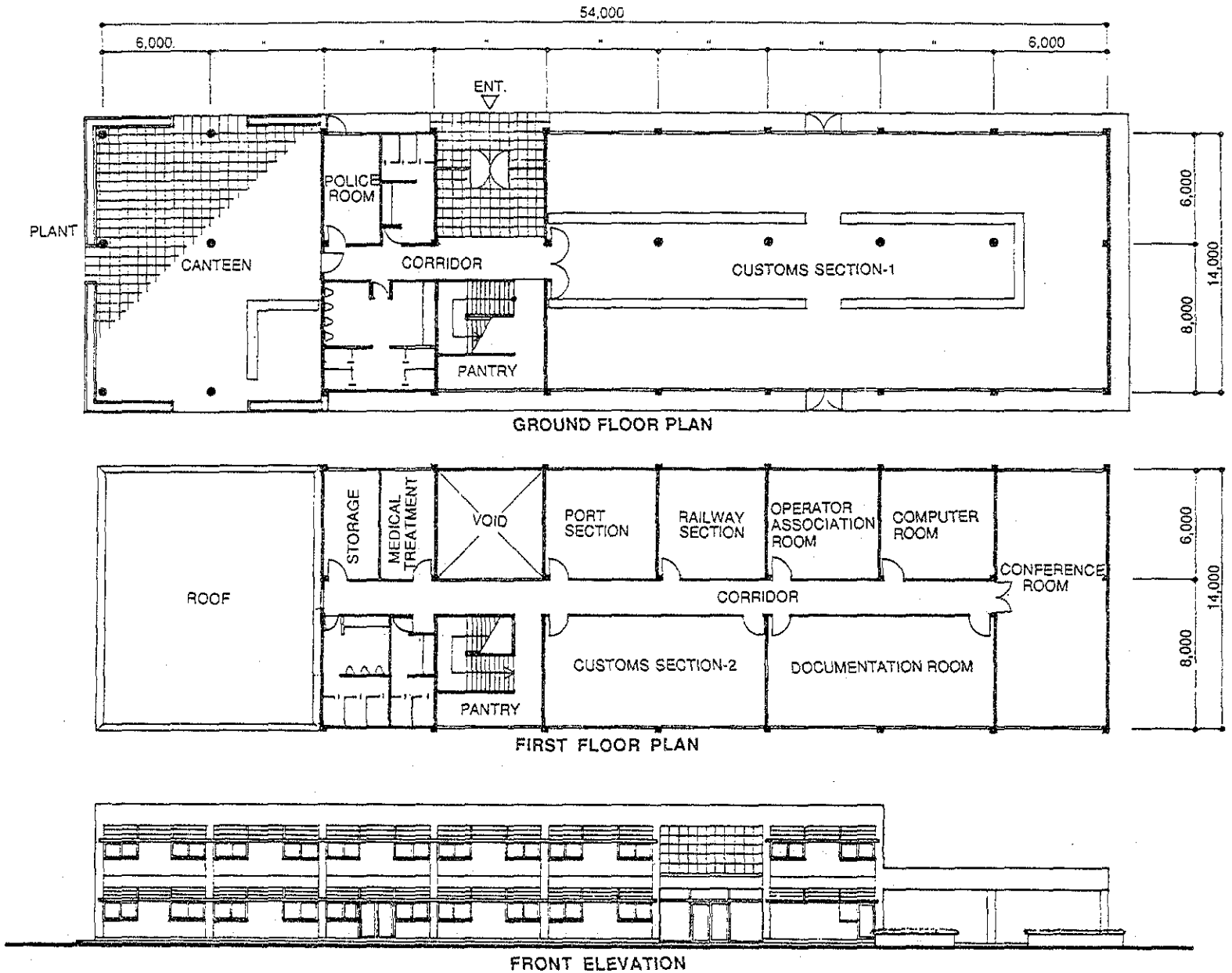


Fig. III.6.3 General View of the Main Office Building

CHAPTER 7 COST ESTIMATES AND IMPLEMENTATION PLAN

7.1 Cost Estimates

1. The cost estimation is based on the following assumptions:

   (1) Unit prices are divided into foreign currency and local currency.

   (2) The unit prices are determined based on the "Construction Material Prices in Central Region: Ministry of Commerce (Feb.-July 1988)", "Laem Chabang Industrial Complex Project (July 1988)", and "Laem Chabang Port Development Project (Sept. 1987)," and they are adjusted to the prices as of August 1988 considering inflation.

   (3) Land acquisition cost is estimated as one million baht per rai (1 rai = 1,600 m^2) considering both the official land price and the actual market price.

   (4) A physical contingency of 10% of direct construction cost, design/engineering cost and supervision cost is allowed.

   (5) Detailed engineering design cost and supervision cost are estimated at 7% of the direct construction cost.

2. Construction cost estimates are made for each section based on the quantities estimated in the preliminary design and on the unit prices for each work item.

3. The construction cost of common civil work includes the costs of land fill, pavement, railway, boundary fence and landscaping. The construction cost of the ICDs includes the costs of CFS, container gate, office building, repair shops, weighbridge, pavement, lighting, drainage and guard hut. The construction cost of common facilities includes the costs of the facilities in the administration zone such as main office building, overtime cargo warehouse and others.

4. The total construction cost of the project is 1,215 million baht, and the cost of the first stage plan is 831 million baht as shown in Table III.7.1.

Table III.7.1 Construction Cost

Unit: 1,000 Baht

Item	Construction Cost	
	Master Plan	First Stage
Construction Cost	780,234	535,798
Preparatory Work	1,422	960
Common Civil Work	256,554	177,622
ICDs	437,514	291,676
Common Facilities	47,590	40,026
Mobilization	37,154	25,514
Land Acquisition and Compensation	296,250	200,000
Detailed Engineering Design & Supervision	54,616	37,506
Physical Contingencies	83,480	57,330
Total	1,214,580	830,634
Local Cost	839,999	574,260
Foreign Cost	374,581	256,374

7.2 Implementation Plan

5. The implementation schedule is prepared on the condition that the entire construction of the Lat Krabang ICD would be completed by the end of August 1991 for the first stage and the end of 1996 for the second stage in consideration of the opening schedule of Laem Chabang Port and effective investment. The implementation schedule is shown in Figs. III.7.1 and III.7.2.

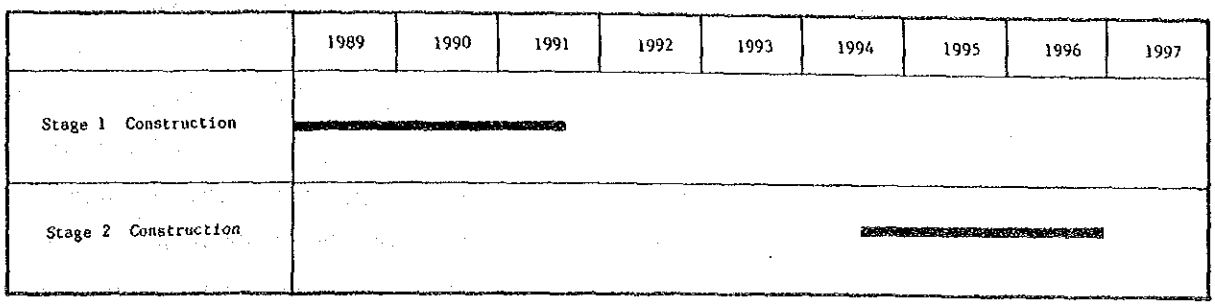


Fig. III.7.1 Implementation Schedule for Staged Construction

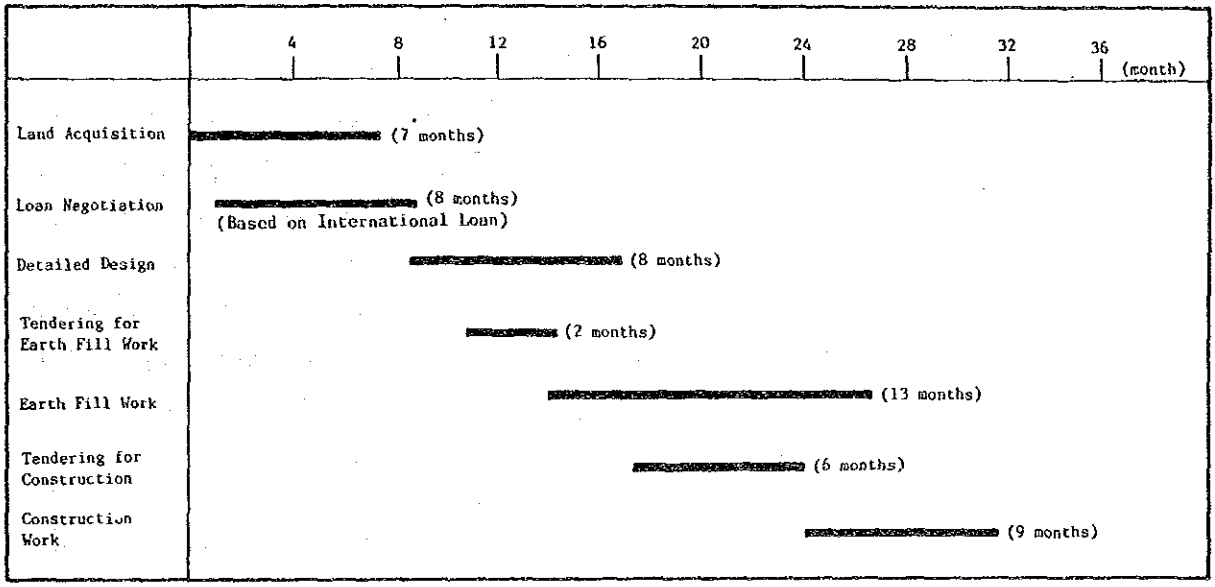


Fig. III.7.2 Implementation Schedule (Stage 1 Construction)

CHAPTER 8 ECONOMIC ANALYSIS

8.1 Purpose of the Economic Analysis

1. The purpose of the economic analysis is to appraise the economic feasibility of the First Stage Plan of the ICD from the viewpoint of the national economy. Therefore, the analysis investigates the economic benefits as well as the economic costs which will arise from the project, and evaluates whether the net benefits exceed those which could be derived from other investment opportunities (the opportunity cost of capital) in the Kingdom of Thailand.

8.2 Methodology of the Economic Analysis

2. The Economic Internal Rate of Return (EIRR) based on cost-benefit analysis is used in order to appraise the feasibility of the project. In estimating the costs and benefits of the Project, "economic pricing" is applied. Economic pricing here means the appraisal of costs and benefits in terms of international prices (border prices). The period of economic calculation (project life) is assumed as 31 years from the beginning of the construction (i.e. from 1989) considering the depreciation period of the main facilities and the construction period.

3. As a "without" case of the ICD project, the following conditions are assumed.

(1) The container cargo volume through Laem Chabang Port is the same as under the "with" case.

(2) The container cargoes which use the ICD under the "with" case are transported directly from/to Laem Chabang Port.

(3) Customs procedures are carried out at Laem Chabang Port.

(4) Additional facilities such as CY and CFS are required to cope with the same volume per berth as under the "with" case.

8.3 Costs

4. Under the "without" case, it will be necessary to construct a bigger CY and CFS at the marine terminal than under the "with" case. The costs are comprised of construction cost, maintenance and repair cost and administration and operation cost.

8.4 Benefits

5. Comparing the "with" and "without" cases, the following items are identified as benefits to the Thai Economy from the proposed project.

(1) Cost savings for land transportation

(2) Cost savings for Customs procedures

(3) Reducing the traffic volume between the ICD and Laem Chabang Port

(4) Promoting the national economic development through an efficient container transportation system

(5) Increasing employment opportunities

6. Of the above benefits, items (1) and (2) are adopted as tangible benefits for calculation.

8.5 Evaluation

7. The EIRR of the First Stage Plan, using 31 years as the period of economic calculation, is estimated to be 17.0%. Various sensitivity analyses are then performed as shown in Table III.8.1.

8. The First Stage Plan is judged to be feasible from the viewpoint of the national economy based upon the EIRR of the project as well as the uncountable benefits arising from the project.

Table III.8.1 EIRR of the First Stage Plan

Case	EIRR (%)
Base Case	17.0
Case A: Increase in Costs by 10%	15.2
Case B: Decrease in Benefits by 10%	15.0
Case C: Increase in Costs by 10% and Decrease in Benefits by 10%	13.4

CHAPTER 9 FINANCIAL ANALYSIS

9.1 Purpose and Procedure of the Analysis

1. The purposes of the study are to determine the charges of the P.M.B. and expected terminal operators, to analyze their projected financial situations, to examine the viability of the project and to examine the financial soundness of the P.M.B. and the terminal operators. The analysis is carried out for the first stage plan with a project life of 31 years. The procedure of the analysis is shown in Fig. III.9.1.

9.2 Methodology of the Financial Analysis

2. The viability of the project is analyzed based on the Financial Internal Rate of Return (FIRR) using the Discount Cash Flow Method, and the financial soundness of the P.M.B. is analyzed through financial statements. The financial soundness of the terminal operators is analyzed only through financial statements.

3. The required funds for the implementation of the project are divided into two categories: the foreign currency portion and the local currency portion.

9.3 *Financial Viability of the P.M.B.*

(1) Port Charges by the P.M.B.

4. Among the costs and expenditures, the costs of the common use facilities in the water area, that is, the costs of the breakwater, the basin, the channel, the navigation aids and the marine control system, are covered by the port dues. The other items are covered by the terminal rents from the terminal operators to whom the marine terminals and the ICDs are leased out.

(2) *Financial Soundness of the P.M.B.*

5. Based on the projected financial statements (balance sheet, profit and

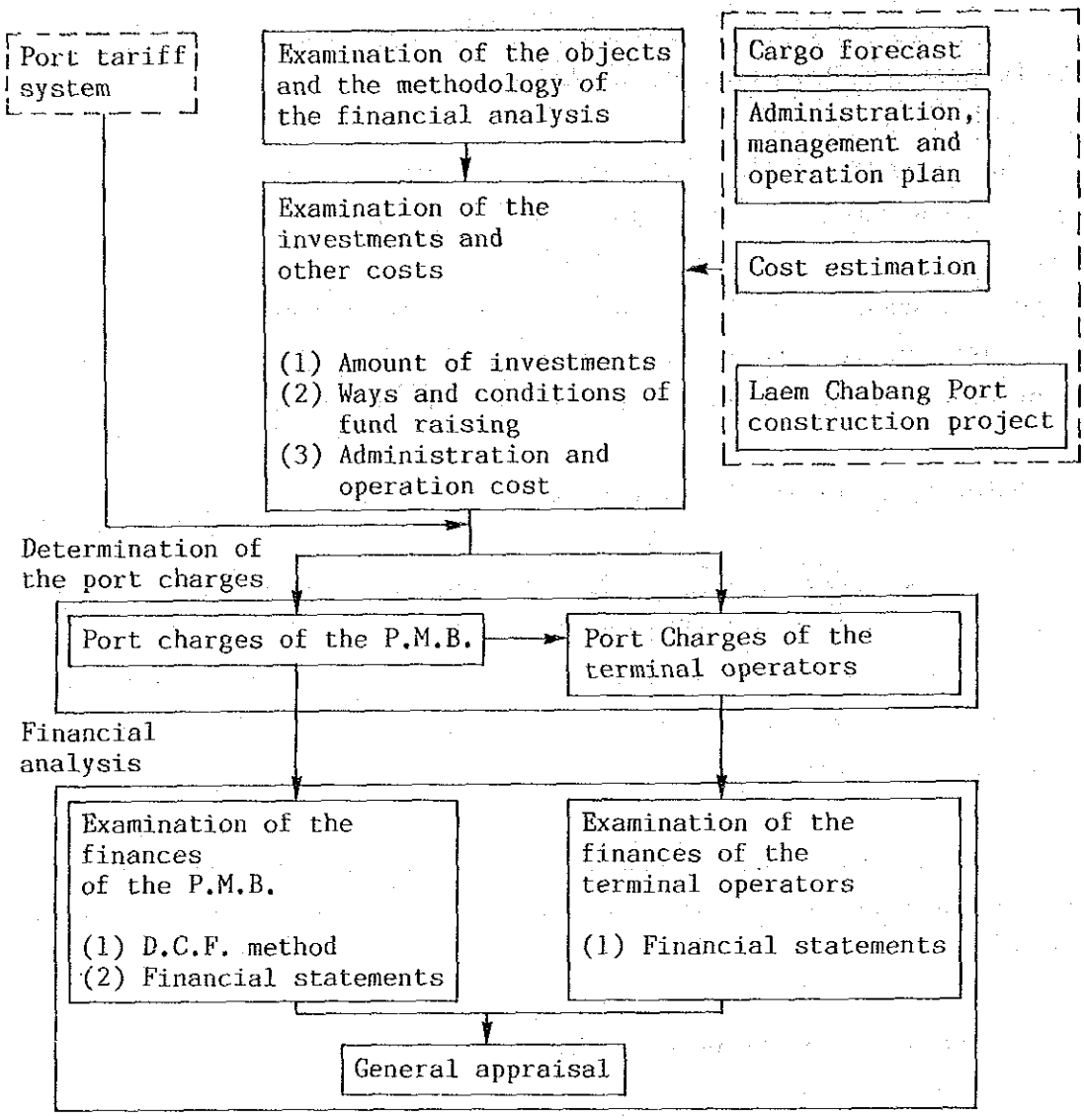


Fig. III.9.1 The Procedure of the Financial Analysis

loss statement and cash flow statement) and analysis of various financial ratios calculated from the financial statements, the projected financial condition of the P.M.B. is favorable. The revenue will be sufficient to cover the operating costs and loan repayment.

9.4 Financial Soundness of the Terminal Operators

6. The operation costs of the terminal operators should be covered by the charges on container handling at the marine terminal and the ICD and the charges at the CFS. Based on the proposed charges and the projected cargo volume, the projected financial statements show the projected financial condition of the terminal operators is favorable. And the expected tariff on container cargo would be at a competitive level compared with the present tariff at Bangkok Port.

9.5 Evaluation

7. The profitability of the project itself is appraised based on the FIRR. For the calculation of the FIRR, constant prices (August 1988) are used and revenues and costs reflect the comparison of the "with" and "without" cases.

8. The FIRR of this project is 6.5%, which exceeds the weighted average interest rate of capital (5.7%) during the project life.

9. The port charges of the P.M.B. are set to recover the total project cost within the project life in this study. Accordingly, when the total project cost changes, the port charges are also changed by the same rate in order to maintain the financial situation of the P.M.B. at the same level. When the total project cost increases by 10%, the port charges also increase by 10%.

10. Based on these results, the First Stage Plan can be judged feasible in terms of the viability of the P.M.B. and the terminal operators as well as the profitability of the project itself.