SECTORAL REPORT IV

TRANSPORTATION DEVELOPMENT PLAN

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX

1. EXISTING INFRASTRUCTURE CONDITIONS AND PLANS

1.1 Introduction

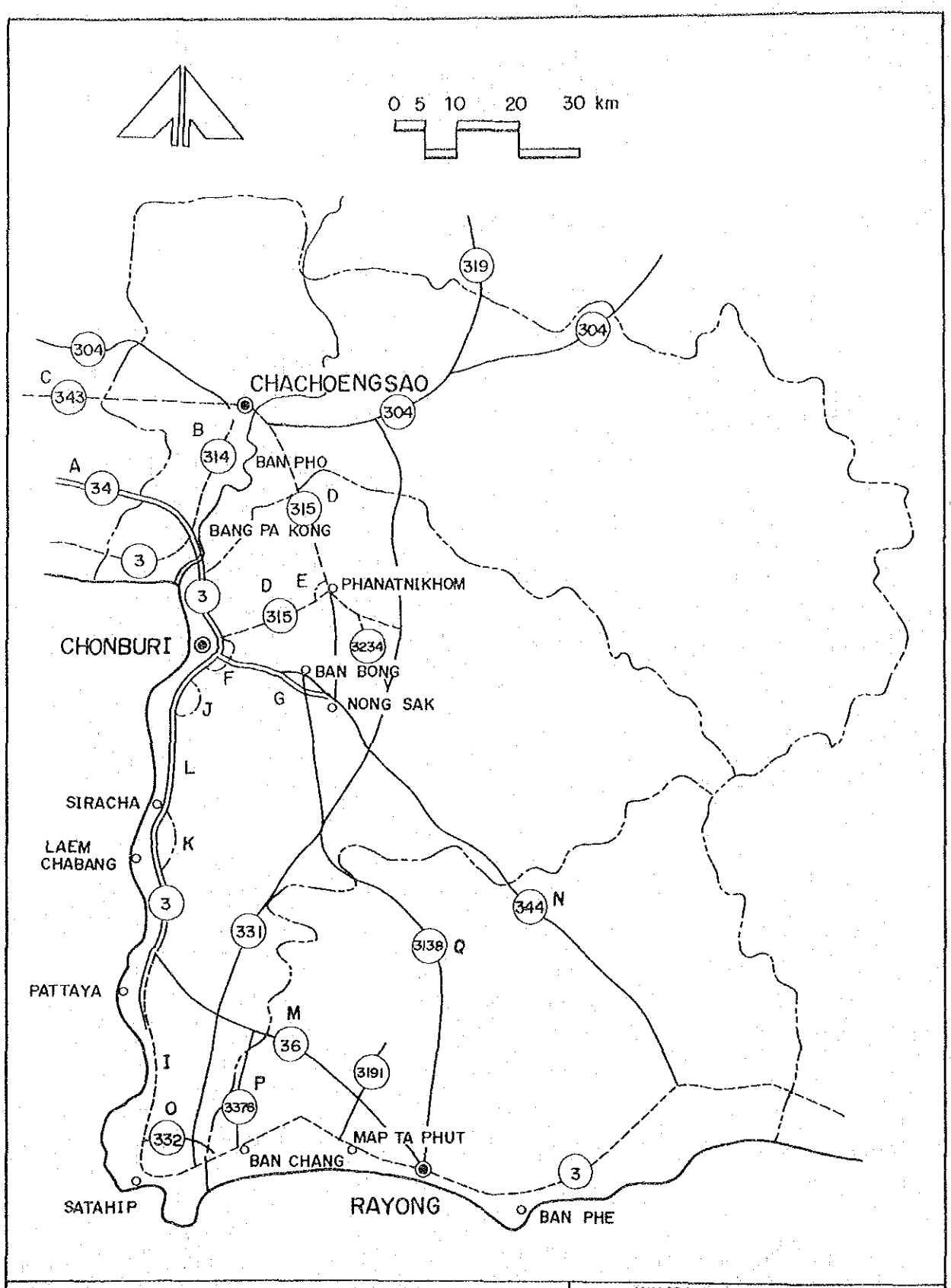
The Eastern Seaborad is rapidly becoming an area in Thailand where transport infrastructure is well provided. Spearheaded by the provision of a good highway network, the Government's past and on-going efforts to upgrade the area's transport infrastructure, by and large, will be conductive for the development of this region.

In this section current conditions of existing transport infrastructure and plans for future improvements are described from the regional view point, except for ports which are dealt with in Chapter II.

1.2 Road Network

In the past decade the highway network covering the Changwats of Chachoengsao, Chonburi and Rayong has been greatly improved. So much so that the Highway Department (DOH) intends to include only a few new highway construction of improvement projects during the remainder of the Fifth Five Year Plan period which runs until 1986. The following briefly describes recent additions or improvements to the network and status of the projects including those identified by the ESS Figure VI-1-1 shows locations of these projects as well as the existing network. Capital letters in the Figure indicate corresponding descriptions below.

A. Route 34, the main artery between Bangkok and the Eastern Seaboard, is being upgraded to have reinforced concrete pavement for selected portions of its dual carriageway vulnerable to flooding. This will not add any capacity in geometric terms, but will greatly improve its reliability by reducing the extent of damages by flooding.



LEGEND

CLASSIFICATION

- (3) Primary national highway
- (34) Inter-regional highway
- (331) Secondary national highway
- (3138) Provintial highway

PAVEMENT STANDARD

- Dual carriageway
- Asphaltic concrete
- Nonstandard penetration macadum with overlay
- Planned

A,B,C,D--See text

KINGDOM OF THAILAND

THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

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Fig. IV.1.1
Road Network Classification and Pavement Standards 1984

B. The upgrading of Route 314, connecting Chachoengsao with Route 34 has been designed and is to be included in the 1986 budget for construction.

C. Route 343, the so far non-existent direct link between Bangkok (Klangton) and Latkrabang, is being contemplated by the Department but no action has been taken.

D. The detailed design of upgraded Route 315 connecting Chachoengsao and Chonburi via Phanatnikhom has been completed under the funds provided by ADB and IBRD, and its construction will start shortly.

E. No plan exists as to the construction of Phanatnikhom Bypass, which was recommended by ESS.

F. Since last year the Police Department has started to direct all heavy trucks to the Chonburi Bypass. However, most of the other types of vehicles continue to use the old route due to the substantially longer distance of the Bypass.

G. The Chonburi - Nong Sak Road, the northern part of Route 314, has been constructed with the standards of dual carriageway of reinforced concrete pavement to withstand extremely heavy loading conditions of sugarcane trucks covering onto this road.

H. An F3 standard road is under construction connecting Nong Sak and Phanatnikhom.

I. No major improvement projects are scheduled for Route 3 south of Chonburi up to Rayong. Beside routine maintenance work, only special maintenance activities are considered for this road such as damage restoration and major patching works. The widening of this portion is considered economically unjustifiable due to the low traffic volume.

J. & K. However, the DOH initiated preliminary alignment surveys for two short bypass roads at Nong Mong and Si Racha. Depending upon the progress of the Eastern Seaborad projects, these bypass roads may be included in the next five year plan.

L. No action has been taken by the DOH concerning the upgrading of Route 3 to the expressway standard in the Chonburi - Pattaya Carridor. This would involve reconstruction of hundreds of intersections for access control purposes, and would be very costly together with the problem of right-of-way constraints.

M. & N. Route 36 and Route 344 have been constructed at S1 standards (the highest for two lane roads). Route 36 has the right-of-way width of 80 meters and can be upgraded to a dual carriageway without much difficulty.

O. Route 332 connecting Ban Chang with Route 3 north of Sattahip has been completed and serves as a bypass road around Sattahip.

P. The construction of Route 3376 connecting Ban Chang and Route 36 is included in the 1984 budget.

Q. The construction of Route 3138 linking directly Rayong and Ban Bung has already been completed at F2 standards except in the middle where standards are F3.

1.3 Railways

The new Chachoengsao - Sattahip Line is under construction. The line is connected with the Eastern Line at Chachoengsao enabling for the first time, upon completion, for the Eastern Seaboard region to have links by railway with Bangkok and the rest of the country. Although a single track line, relatively high standards were adopted for this line, low grade (maximum 1%) and axle loading higher than other lines in Thailand in anticipation of heavy usage derived from the development of this region.

Grade separations are provided at intersections with all major roads. The construction of track is expected to be completed by April 1985. Prequalification of contractors has been made for the installation of signalling and other supporting facilities. Seven sets, fourteen cars of diesel coaches were already purchased for this line. The State Railway of Thailand has initiated tentative passenger services between Bangkok and Pattaya in October 1984 well before the completion of all facilities in 1987. A station will be constructed east of Sri Racha near the Project area.

Four other projects at various stages of planning and implementation are of great importance to the Laem Chabang Project, the Bang Sue Container Yard, the Eastern-North Eastern Link Line, the Sattahip - Map Ta Phut Extension, and the Laem Chabang Spur.

The access rail link from the Laem Chabang Port and Industrial Estate to the Chachoengsao - Sattahip Line, i.e. the Laem Chabang Spur, has been designed by the staff of SRT except for the portion within the Industrial Estate and the Port and the marshallying yard. SRT has already acquired the land for its right-of-way from the main line to Route 3, and the design of this portion is considered complete. Facilities to the placed in the west of Route 3 shall be the subject of this Study. The spur line has been designed to cross Route 3 by underpassing.

The Bang Sue Container Yard is intended to capture the container cargo traffic through the new deep sea port by railway. Its operation, therefore, will have a profound effect on the operation of the Laem Chabang Port and, to a less extent, of the Laem Chabang Industrial Estate. Its detailed design has largely been completed by a team of Canadian consultants and their draft final report has been turned in. To compensate for the longer land transport distance than the Klong Toey Port, SRT plans to transport containers between Laem Chabang and Bangkok under the "bonded" condition, i.e. customs inspection to be carried out in Bang Sue for import and export containers. SRT contends that this practice would offer a better security to shippers over the transport by trucks. The implementation process was

already started and the whole facilities are expected to be completed in 1987. A feasibility study on a domestic container rail transport system is as also carried out by the same consultants.

The detailed design of the Sattanhip - Map Ta Phut Extension has been started. Funding of its construction, however, has not been determined at the moment. Since the Soda Ash Plant Project was suspended by a Cabinet decision in February this year, the actual implementation schedule of this line is uncertain at this time.

The direct connection of the Eastern Line and the North Eastern Line, bypassing Bangkok with a distance saving of some 50 km, will be the last project among the major infrastructure projects related to the Eastern Seaboard Program. The line is intended to facilitate the supply of raw materials from the North East to the Map Ta Phut industrial estate. The Government has recently asked the Italian government to provide technical assistance for the study and design of this link.

1.4 Airports

The existing international airport at Don Muang, 25 km north of Bangkok is the only airport of significance at the moment. It is currently under an expansion program. The extension of the second runway has been completed and the terminal facilities are being expanded.

The second Bangkok International Airport has been proposed to be located at Bang Ngu Hao, approximately 25 km east of Bangkok between Route 34 and Route 304. A feasibility study and detailed design project has been initiated in May 1983. The Government has been considering an option of expanding the Don Muang Airport instead. No decision has been made to date.

The U Ta Pao airfield lies 60 km south of Laem Chabang. It is directly connected with Laem Chabang by Route 3. The airfield was originally built for military purposes but lately turned over to the Aviation Department for civilian use. The Department designated it as an alternate airport to the Don Muang Airport for emergency landing.

Actual management of the airfield, however, is still under the control of the Navy. So far actual civilian use of the airfield has been minimal except for occasional use by small crafts. The Ministry of Communication has invested in this airfield sufficient to make it an emergency landing airstrip for international alights but no more.

2. REGIONAL TRANSPORT OPERATIONS

2.1 Road Transport

1) Traffic Volumes and Trends

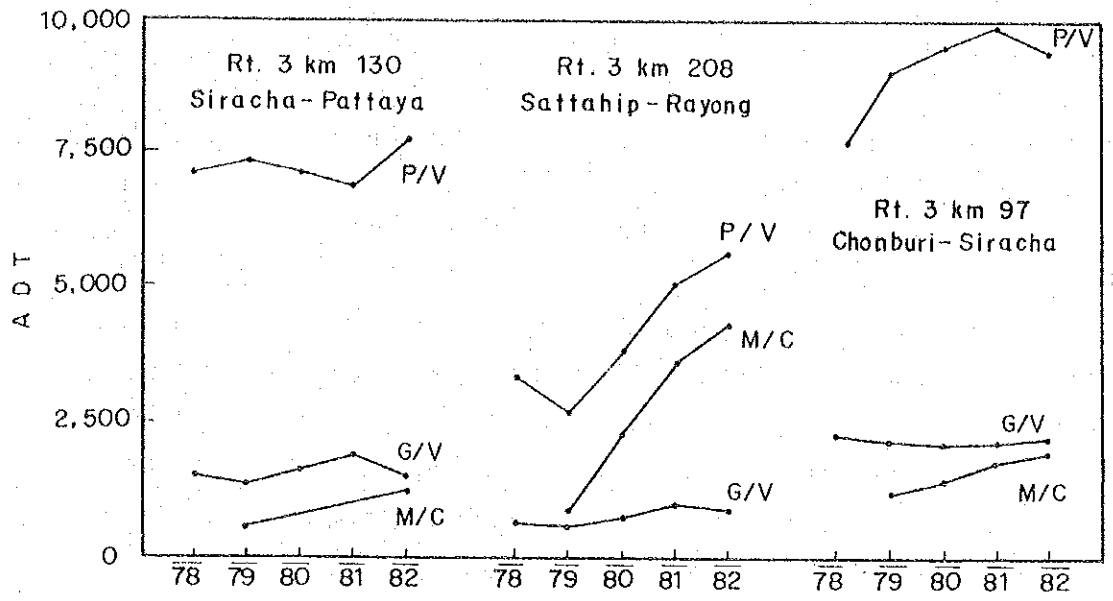
The Department of Highways has been taking classified traffic counts throughout the country for some time, and it publishes summary reports showing averages adjusted by expansion and seasonal adjustment factors. Figure IV.2.1 shows past traffic counts figures published by the DOH since 1978 for selected locations in the Eastern Seaboard. Absolute numbers, however, should be taken with caution since the margin of error from the true annual average figures could be quite significant due to limited samples. Changes of large proportions and long term trends could be observed by examining these data.

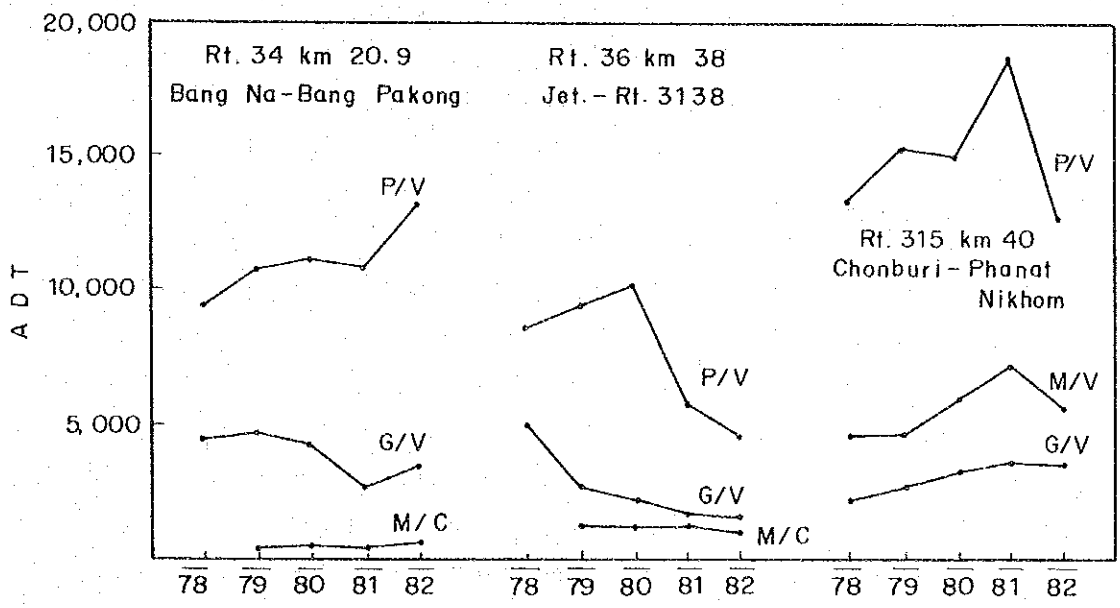
Traffic on the section between Si Racha and Pattaya on Route 3 seems to be growing slowly, whereas traffic between Sattahip and Rayong has been glowing rapidly reflecting the rapid economic expansion induced directly and indirectly by the gas pipeline and possibly by the Thai Petrochemical Company.

Passenger vehicle traffic in sections immediately outside of the City of Chonburi has been steadily growing whereas goods vehicles traffic level has been stable.

The remarkable drop in passenger vehicle traffic on Route 36 after 1980 indicates the diversion of traffic to and from Prachinburi and Trat to the newly completed Route 344.

The noticeable drop in traffic on route 315 after 1981 is probably the reflection of poor security on this road and the completion of the high standard carriageway of Route 344 from Chonburi to Nong Sak.





LEGEND

P/V : Passenger vehecle (including passenger car, truks, buses and light trucks.)

G/V : Goods vehecle (including medium and heavy trucks).

M/C : Motorcycle.

KINGDOM OF THAILAND

THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

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Fig. IV.2.1
Changes in Traffic Level in Eastern Seabord

2) Truck Terminal

The long discussed truck terminals in and around Bangkok finally seem to be taking shape. In 1983 the Government decided to implement the truck terminal project entirely on the private business basis. Private companies are to be given concession to construct and operate truck terminals at sites chosen by the companies under conditions negotiated with the Government. Three truck terminals were indentified, the Western, the Northern, and the Eastern terminals. For the Western and the Northern terminals, companies were already selected, contracts signed, and detailed designs started. The Western terminal will be located along Route 4 at the border of Changwat Nakhon Pathom, occupying 74 rai of land. The Northern erminal will be located along Route 1 at the kilopost of 30 km, occupying 93 rai of land. Both of them are expected to be opened by May 1986. Initial facilities will be modest, minimum design traffic of 100 trucks a day for the Western terminal and 200 trucks a day for the Northern terminal.

The Eastern terminal will have the most direct impact on the Laem Chabang Port and the Industrial Estate. Proposals from private companies have been submitted and the contract will be signed shortly. The terminal will be located in the Bang Na area with the minimum area of 62 rai and with the initial facilities sufficient for 100 trucks a day. The construction is supposed to be completed by the end of 1986.

In order to induce truckers to use the truck terminals the Land Transport Department is considering a tighter truck traffic control within the Bangkok area such as designation of truck routes and tighter restrictions on truck movements in the inner area. The direct impact of the operation of truck terminals would certainly be the more use of larger vehicles. Short-run road transport costs may increase due to double handling, but long-run costs would decrease. For a well defined cargo source and receiving area such as the Laem Chabang complex and the Bangkok truck terminals, in particular the Eastern terminal, could be beneficial to develop an efficient road transport system. However, if the negative consequences of tighter traffic control and double handling are perceived excessive, traffic may shift to other modes such as rail and coastal shipping.

3) Road Passenger Traffic

At present passenger transport in the Eastern Seaboard south of Chachoengsao is borne by private cars and light trucks, buses of various sizes, and some by trucks. Reliance on buses is high, the total number of small and heavy buses in the traffic stream is about one half of the combined number of passenger cars, taxis and light trucks. In other words more than 80% of passengers currently rely on bus services which are being provided by the government run Transport Company and private operators. From the Bangkok Eastern Bus Terminal at Sukhumvit Soi 63 buses to the cities and towns in the region depart at every hour on the hour. Fares are Baht 25 to Chonburi, Baht 44 to Si Racha, Baht 50 to Pattaya, Baht 62 to Sattahip, and Baht 69 to Rayong. These fare levels are roughly at the same level as the current second class passenger fares of the state Railway of Thailand. Not much is known at the moment about the long distance bus services. The forthcoming intercity bus study, being planned by the Land Transport Department will shed more light on such services.

2.2 Rail Transport

No rail services have been provided in this region except the very recent passenger service between Bangkok and Pattaya on a trial basis. It is however worth mentioning that the rail transport as a whole, once the dominant mode of transport in Thailand, has been steadily loosing its share in Thailand despite diverse efforts by the State Railway of Thailand.

The number of passengers has been increasing. Between 1977 and 1981 the total number of passengers served by SRT had been increased at rate of 8.0% per annum. In terms of passenger kilometers the growth rate was 14% per annum. Passenger traffic by road transport, however, had grown slightly more than those by rail transport, and consequently, the share of rail transport in the total passenger traffic declined.

Freight traffic by the rail mode had declined even in absolute terms. Between 1977 and 1981 the total net ton-kilometers decreased by more than 10%. In terms of ton-kilometer, petroleum products account for one third

of the total, and rice and cement one sixth each, and maize one nineth. More than three quarters are for these four commodities. Currently the shares of rail mode in transporting rice is 5% and in transporting maize 10%.

2.3 Coastal Shipping

The distance between Laem Chabang and Bangkok is 120 km by road and 90 km by waterway. Although the distance is relatively short for waterway transportation (average distance of domestic shipping in Japan is 110 kilometers for sand and gravel and 350 - 550 km for other commodities), practically all products and residual crude of oil refinery facilities in Si Racha, 9.4 million tons a year, are currently transported to Bangkok by barges. Tapioca is transported by lighters mostly from Bang Pakong and some from Bangkok area, totalling 2.5 million tons a year to Ko Si Chang where transshipment to ocean going vessels takes place. A small percentage of export rice is also transshipped at Ko Si Chang from barges. No ther shipping activities of significance exist in the Eastern Seaboard to date.

3. TRANSPORT POLICIES AND TRAFFIC PROJECTIONS

3.1 Introduction

The development for the Eastern Seaboard region provides a particularly interesting situation for transport planners. Unlike many underdeveloped areas there is no obvious lack of transport infrastructure. On the contrary, basic infrastructure for all modes of transportation is or to be available, highways, railways, coastal shipping, airport, and even pipelines. It is not sufficient to look at each mode of transport separately as they are deeply interrelated, sometimes competing and sometimes complimenting each other. It is, therefore, necessary to view the whole transport sector as an integrated whole, and to try to optimize the use of the entire system rather than the optimization of individual modes.

The optimization of the transport system should be viewed in the context of regional and national development strategies. Past experience in other countries suggests that transport system can be an effective tool in guiding the development, particularly spatial distribution and types of development.

As often the case in the transport sector, when a complex set of regulations and institutional arrangements distorts the market mechanism, a modification of such non-physical matters may be as effective as the provision of major infrastructure, or conversely, without such institutional changes a system may not be operated efficiently as designed.

The consumption of a kind of goods or a service depends on the cost perceived by the consumer relative to the costs of other goods of services perceived by the consumer. Real costs of providing such goods or services may be very different from the costs perceived by the consumer.

Transport services are of no exception. Passengers or shippers choose a transport service based largely on the cost, monetary or otherwise, perceived by them. If the real cost of providing such service to the economy, the economic cost, differs significantly from the cost perceived by passengers or shippers, the perceived cost, a condition of economically inefficient resource allocation may result.

In this chapter are described perceived and economic costs of transport between Laem Chabang and Bangkok by each of the three modes from the origin to the final destination including transshipment, pickup and delivery operations. A comparison is made among perceived and economic costs of the three modes and policy implications are discussed.

During many of formal and informal meetings with the concerned government officials, it was generally agreed that the answer to the question of cargo modal split would largely depend on government policies which are yet to be formulated and that the tentative distribution percentages among various modes of transport presented in this report be accepted for the planning purposes.

As for the passenger transport an attempt was made to determine the amount and characteristics of passenger transport demand for this area taking into account the particularities of this entirely new development, i.e. the first entirely newly made city of commercial port and industry in Thailand. Origins and destinations of residents were determined, vehicle ownership levels and travel characteristics were estimated by income groups. Road network and roadway designs were determined so as to satisfy such demand patterns.

3.2 Cargo Transport Demand

3.2.1 Import and Export Cargo Through the Port

The proposed deep sea port at Laem Chabang is expected to become the major commercial port of Thailand. The degree and the speed to realize this goal depends much on how shipping companies are to be persuaded to move their main operations from the existing Bangkok Port to Laem Chabang. For estimating the import and export cargo throughput of the Laem Chabang Port the following steps were taken.

- For the combined total import/export tonnages of containerized and break bulk cargoes a time series analysis was made an a growth trend line was determined to extrapolate the line to the year 2001. At the same time the elasticity of total combined tonnage of containerized and break bulk cargoes was established and the growth rate up to the year 2001 was determined for the assumed GDP growth rate of 6% per annum. The averages of the two estimates developed by the above two methods was adopted. The estimates for the year 1991 was established in a similar manner.

- The above import and export cargo transport demand was re-examined against two additional sets of assumptions concerning the GDP growth.

- The percentage of containerized cargo, currently 33%, was assumed to become 50% in 1991 and 70% in 2001.

- The total export tonnage was assumed to be the same as the total containerized import tonnage, as is the case at present.

- The capacity of the Bangkok Port was assumed to increase from the existing throughput of 2.2 million tons of containers and 3.41 million tons of break bulk to 3 million tons of containers and 4.5 million tons of break bulk. These Bangkok port throughputs were deducted from the total tonnages and the remainder was assigned to the Laem Chabang Port.

- The export tonnages of sugar, molasses and tapioca were estimated individually and the tonnages to be shipped out of the Laem Chabang Port were determined heavily taking into account the expressed policies of the RTG.

- No other agricultural export commodities were considered to have chances of using the Laem Chabang Port.

Chapter II of this report, Port Development Plan, presents details of the above process.

The following table summarizes the results.

Table IV.3.1 IMPORT AND EXPORT CARGO THROUGH THE PORT

(Unit: million tons)

Type of Cargo		Annual Tonnage 1991	Annual Tonnage 2001
Container	Import	1.41	3.80
	Export	1.41	3.80
Break Bulk	Import	0.36	1.80
	Export	0.04	0.20
Agri-Bulk	Export		
	Sugar	0.50	1.40
	Molasses	0.20	0.50
	Tapioca	4.50	4.50

3.2.2 Cargo Traffic to and from GIE and EPZ

Types and sizes of industries likely to be located in the Laem Chabang General Industrial Estate and the Export Processing Zone were stipulated and their resource requirements estimated. Chapter I of the report, Industrial Development Plan, presents details of the analysis and the results.

Fifteen industries with further division into 43 sub-types were identified considering the comparative advantages and restrictions of Laem Chabang GIE and EPZ and characteristics of other industrial estates in Asia. For each of the 15 industry types resource requirements such as area, manpower, input material tonnage, and water, were estimated and output tonnage and value were calculated by means of applying the industry averages in Japan with appropriate modifications considering the conditions in Thailand.

Certain amounts of input and output of EPZ were assumed to be obtained or marketed domestically and to be transported by trucks. The result, by definition of EPZ, was assumed to be entirely imported or exported through the Port.

For cargo to and form GIE industry averages of percentages of input or output transported by water-borne transport in Japan were taken to estimate the portion of input or output to be borne by the waterway transport. Adjustments were made downward considering the prospect that the development of private wharves and the like in the Bangkok side would not be fast enough.

Table IV.3.2 summarizes the results.

Table IV.3.2 CARGO TRANSPORT REQUIREMENTS OF GIE AND EPZ (2001)

	Input	Output	Total
EPZ			
Annual total tonnage (000)	194	176	370
Modal split (%)			
Road	7	6	7
Rail	-	-	-
Oceangoing vessel	93	94	94
CIE			
Annual total tonnage (000)	1,432	1,264	2,696
Modal split (%)			
Road	43	67	54
Rail	24	-	13
Coastal shipping	33	33	33

3.2.3 Cargo Transport Demand Generated by New Town and Surroundings

The total population of the Laem Chabang complex in its full development has been estimated at 117,680 in the new town and 37,950 in the surrounding areas. Assuming 4.1 persons per household, the above figures can be translated into 28,700 and 9,300 households in the new town and in the surrounding areas respectively.

The results of the 1976 detailed household expenditure surveys were published by the National Statistics Office. Retail prices in 1976 were

also found in a NSO publication. Using the data for the Bangkok Metropolitan Area, average household monthly consumption in weight was estimated as shown in Table IV.3.3. The estimated monthly consumption per household was 162 kg. Including the weight of boxes and baskets are containers the total weight to be transported would be 180 kg per month or 2.16 tons per year per household. Therefore, in the year at their full development 62,000 tons of consumer items to the new town and 20,000 tons of consumer items to the surrounding areas would have to be brought in. If all of these are to be transported by 6 wheel trucks, 49 trips and 16 trips respectively would be required every working day. However, a significant percentage of trips to deliver consumer items is likely to be made by pickups and actual heavy truck traffic for the purpose of serving the new town and the surrounding area would be somewhat less than the above estimates. Pickup traffic is accounted for in the passenger vehicle traffic estimates.

Table IV.3.3 MONTHLY HOUSEHOLD CONSUMPTION ESTIMATES

Rice consumed at home	54 kg
Rice & grain products consumed else	16
Pouletry and meat	10
Fish and marine food	10
Eggs	3
Oil and fats	2
Vegetables	10
Beverages	13
Fuel	20
All others	20
Total	162 kg

Source: Based on Socio-economic survey of 1975 - 1976, NSO, and Statistical Yearbook 1983, NSO

3.3 Cargo Transport Modal Split

3.3.1 Introduction

While trucks can basically transport cargo from the point of origin to the point of destination in one hauling operation, the transport by rail or waterway involve short-haul and transshipment operations to reach origin or final destination unless private sidings or wharves are provided. Figure IV.3.1 illustrates the required minimum operations for cargo transport between Laem Chabang and Bangkok by the three modes of road, rail and waterway. Cases are shown for import/export cargoes and cargoes to and from GIE and EPZ.

Perceived and economic costs of each of transport operations are examined and the total costs for each mode to transport from the point of origin to the point of final destination are compared. Economic costs include the cost of providing infrastructure when the expansion of capacity or strengthening is needed to accommodated additional traffic. Details are shown in Appendix VI-A.

3.3.2 Modal Comparison

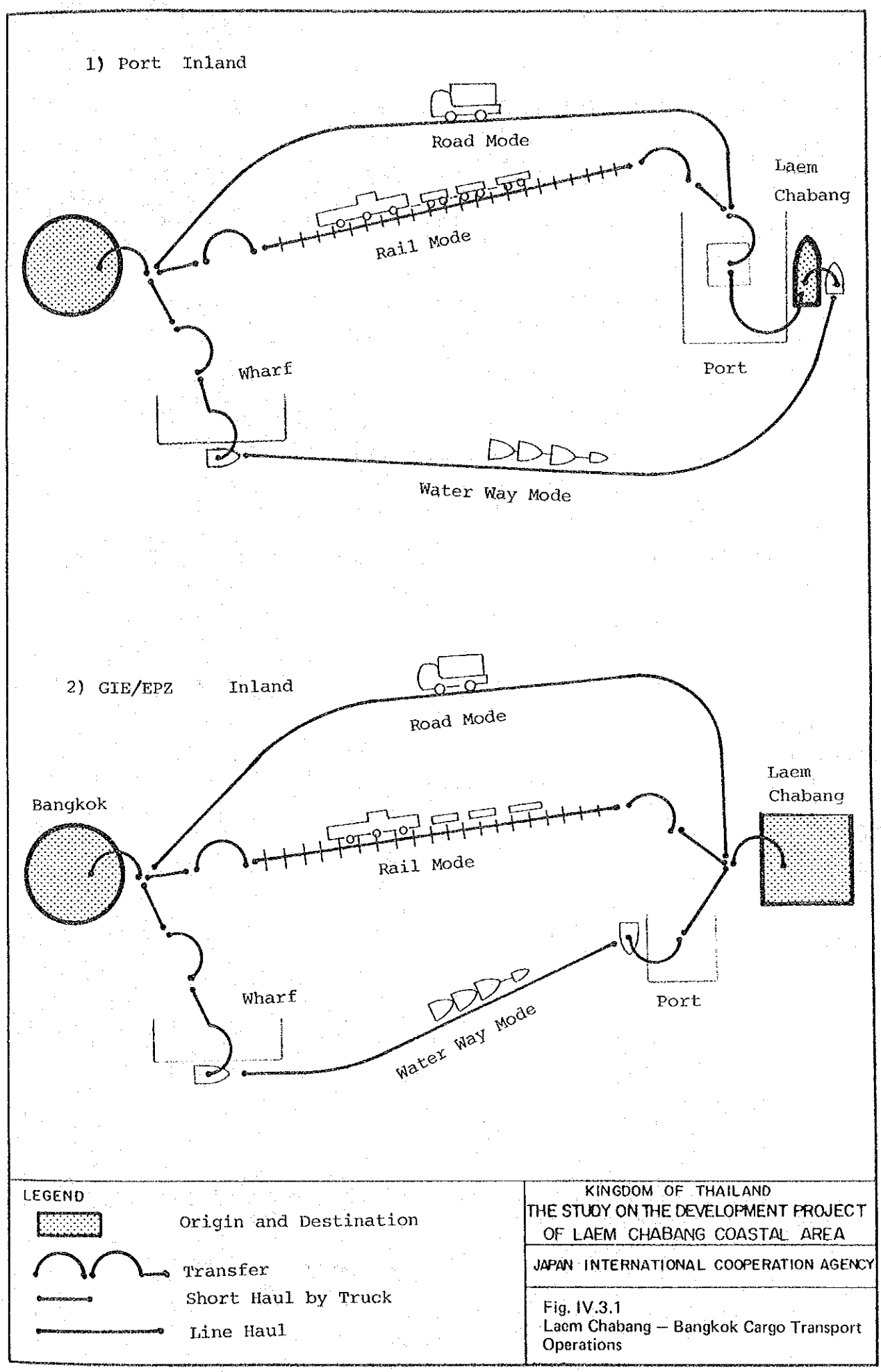
Table IV.3.4 shows perceived and economic costs of linehaul (main line operation with no transshipment or transfer) transport by truck, rail train, and coastal shipping vessel. It is apparent that the waterway vessel is the least costly and then comes the rail train. This tendency is more pronounced in terms of economic cost. The ton-km economic cost of convoy of large barges is less than one tenth of that of trucks and one fifth of that of rail train.

The picture, however, is quite different when the overall transport cost from the origin to the final destination including transshipments and transfers as shown in Table IV.3.5

In terms of perceived cost the rail mode is the most expensive and the difference between the road mode and the waterway mode is no longer large. High perceived costs of the rail mode is primarily due to the proposed cargo handling charges in the Bangkok Terminal at Bang Sue. If it is intended for the railway to take a significant part of cargo transport between Laem Chabang and Bangkok, cargo handling charges in the Bangkok Terminal should be set at competitive levels in comparison with other modes. Prevailing freight rates charged by 10 wheel trucks at present are extremely low as shown in Appendix VI-A. They will have to be increased to keep the fleet in operational order. However, even allowing certain amount of freight rate increases in the road mode, trucks will be preferred by the majority of shippers.

Even in terms of economic cost the rail mode has little advantage over the road mode for export/import cargo through the Laem Chabang Port. For this type of cargo the waterway mode has a clear cost advantage over the other two. It should be noted that the overall economic cost of waterway mode includes the economic costs of providing additional wharves in the side of Bangkok area. For cargo to and from the Industrial Estate and Export Processing Zone the waterway mode does not have a clear advantage over the other modes, unless an efficient handling system is established in Laem Chabang specifically for barge convoys and intra-area delivery pickup system. For this type of cargo the rail mode is economically the least expensive.

Except the road mode the percentage of transshipment and transfer costs are quite high. Emphasis should be placed for improving the efficiency of inter-modal transfers.


1) Port Inland
Road Mode
Rail Mode
Laem
Chabang
Wharf
Port
Water Way Mode
2) GIE/EPZ Inland
Road Mode
Bangkok
Laem
Chabang
Rail Mode
Wharf
Port
Water Way Mode
LEGEND
Origin and Destination
Transfer
Short Haul by Truck
Line Haul
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THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. IV.3.1
Laem Chabang – Bangkok Cargo Transport Operations

Table IV.3.4 LAEM CHAGANG - BANGKOK LINEHAUL COSTS BY MODE

(Unit: Baht/ton)

Perceived Cost

Road		Rail		Waterway	
6 Wheel 6.5t	185	Class 3	70	Lighter	43
10 Wheel 8.4t	151	Class 4	61	Small Barge	27
13t	98	Container	61	Large Barge	17
18t	71				
Semi-trailer Container	203				

Economic Cost

Road		Rail		Waterway	
6 Wheel 6.5t	151	Class 3	53	Lighter	24
10 Wheel 8.4t	157	Class 4	53	Samll Barge	16
13t	101	Container	53	Large Barge	9
18t	81				
Semi-trailer Container	154				

Table IV.3.5 LAEM CHABANG - BANGKOK OVERALL TRANSPORT COST BY MODE

(Unit: Baht/ton)

	Road			Rail		Waterway		
Perceived Cost								
Port - BKK	6 Wheel	6.5t	245	Class 3	293	Lighter		144
	10 Wheel	13t	158	Class 4	284	Samll Barge		128
		18t	131	Container	276	Large Barge		118
	Semi-trailer							
	Container		263					
GIE/EPZ-BKK	6 Wheel	6.5t	185	Class 3	243	Lighter	(83)	185
	10 Wheel	8.4t	151	Class 4	234	Small Barge	(67)	169
		13t	98			Large Barge	(57)	159
		18t	71					
Economic Cost								
Port - BKK	6 Wheel	6.5t	208	Class 3	167	Lighter	(101)	111
	10 Wheel	13t	162	Class 4	167	Small Barge	(93)	103
		18t	147	Container	145	Large Barge	(81)	96
	Semitrailer							
	Container		154					
GIE/EPZ-BKK	6 Wheel	6.5t	160	Class 3	120	Lighter	(105)	149
	10 Wheel	8.4t	167	Class 4	120	Small Barge	(97)	141
		13t	114			Large Barge	(91)	135
		18t	99					

Note: 1. Figures in parenthesis for perceived costs under Waterway include perceived costs of final delivery/pickup by truck and include 10 Baht/ton of port operation charge in Laem Chabang for domestic cargo instead of 50 Baht/ton applied to export/import cargo.

2. Figures in parenthesis for economic costs under Waterway indicate cases with labor intensive cargo handling.

3.3.3 Prospects by Type of Cargo

1) Cargo to and from GIE and EPZ

Distribution of cargo to and from GIE and EPZ was estimated based on data among Japanese industries as described in Section 3.2.2. Near entirety of cargo to and from the EPZ will go through the Laem Chabang Port by definition of EPZ. For cargo to and from the GIE it would be difficult to achieve the level of waterway transport share as shown in the initial stage in Japan as the perceived cost differential is not large. However, as the volume becomes larger, firms would construct private wharves and try to internalize the system as much as possible including transfers and delivery/pickup operations.

For certain input materials which do not go through the Bangkok rail terminal and come from points much further, the rail mode would have a clear advantage.

2) Export and Import Cargo

Container

If left under the free competition, there would be little chance for the SRT to capture a significant share of container transport between Laem Chabang and Bangkok. The proposed charges in the Bang Sue Terminal make the total perceived cost to shippers more expensive than the private trucker charges even without storage charges. And the time factor heavily favors the road mode.

Although not large, there would certainly be economic cost savings by using the already constructed railway instead of the road and truck system. It is assumed that the government will make every effort to attract container traffic to the rail mode including the pricing and the streamlining of handling procedures. It is also likely that the government would take certain mandatory measures to ensure a minimum level of container traffic on the railway system. As is the case at present, direct transshipment of container to barges or lighters would not be allowed.

It was assumed that container traffic would be split 50 - 50 between the road and the rail systems.

Break Bulk

At present 90% of break bulk cargo are directly transshipped to lighters in the Klong Toey Port or in the mid-stream and are transported to private wharves. Export in break bulk, although small amount, is being done in the same manner. When the port of call of a regular batch of cargo is changed to Laem Chabang, the consignee with easy access to a private wharf and lighters or barges would simply extend the journey of lighters to Laem Chabang.

However, for consignees or shippers who do not have prior experience with receiving or sending by lighters or barges, transport by trucks would appear overwhelmingly simpler with only a minor cost disadvantage.

The rail system would capture only a minor portion of the total for which conditions such as distance, location of final consignee, cargo form, etc., are particularly suitable for the rail mode.

The modal split for the break bulk cargo was tentatively determined as 75% to the road mode, 15% to the rail mode, and 10% to the waterway mode.

Sugar and Molasses

Sugar and molasses produced in areas closer to Laem Chabang than to the Bangkok area would be exported from the Laem Chabang Port. It is expected that the road mode would take 100% of this transport.

Tapioca

Existing tapioca loading facilities at Ko Si Chang and in Ao Udom have sufficient capacity to handle tapioca export for sometime to come. However, the government has expressed its intention of adding another tapioca loading

facility within the Laem Chabang Port so that small shippers would have a choice in selecting a facility. Considering the widely scattered production areas, the modal split ratios were assumed to be 50% for the road, 20% for the rail and 30% for the waterway system.

Maize

Maize is produced almost entirely for export. It is estimated that 30% of the total are transported by trucks, 10% by rail, and 60% by inland waterways before reaching silos and storages in private loading facilities. The Marketing Organization of Farmers was reported to have installed maize storage silos and loading equipment of sufficient capacity in the Sattahip Port. It was decided that no amount of maize export would be handled in the Laem Chabang Port.

Rice

Rice has traditionally been transported by barges from numerous mills located alongside rivers in the Central and Northern regions to Bangkok. Export of rice is being done by loading feeder vessels or lighters at private wharves along the Chao Phraya river around Bangkok in relatively small quantities at a time. Lighters transship rice to feeder vessels offshore for topping off. The system is well developed. It was assumed that no rice export would be handled in the Laem Chabang Port.

3.3.4 Modal Split Ratios

Table IV.3.6 summarizes the assumed model split ratios for cargo transport.

Table IV.3.6 MODEL SPLIT RATIOS FOR CARGO TRAFFIC

Type of Cargo		Annual Tonnage (10^6 tons)		Modal Split (%)					
				1991			2001		
		1991	2001	Road	Rail	Barge	Road	Rail	Barge
Container	Import	1.4	3.8	50	50	-	50	50	-
	Export	1.4	3.8	50	50	-	50	50	-
Break Bulk	Import	0.36	1.8	75	15	10	75	15	10
	Export	0.04	0.2	75	15	10	75	10	10
Agri-bulk	Sugar	0.5	1.4	100	-	-	100	-	-
	Molasses	0.2	0.5	100	-	-	100	-	-
	Tapioca	4.5	4.5	50	20	30	50	20	30
EPZ	Input	0.11	0.19	7	-	93	7	-	93
	Output	0.10	0.18	6	-	94	6	-	94
GIE	Input	0.57	1.43	43	24	33	43	24	33
	Output	0.50	1.26	67	-	33	67	-	33

3.4 Passenger Traffic Demand and Modal Split

3.4.1 Introduction

It is evident that the planned development of the Laem Chabang Area, if materialized, will be an area dominated by workers. There has not been a single town or city of this nature in Thailand yet. The Area will have distinctive characteristics not only in the physical appearance of the dominant port and factories but also in the characteristics of its residents and people coming regularly to the Area. Travel behavior of its residents will be no exception. Simple application of average travel characteristics of other urban areas such as Bangkok to the Area may lead to erroneous projections.

It was attempted in this study to develop a set of assumptions on the travel characteristics specifically for the Area.

3.4.2 Population Characteristics

Classification of residents in the New Town was made and presented in Chapter III in accordance with the employment structure in the Area. Workers and subsequently dwelling units were classified into low, middle, and high income groups in accordance with the current NHA's classification. The average monthly income levels were assumed to be Baht 4,000, Baht 7,000 and Baht 11,000 for low, middle, and high income groups respectively in 1984. It was assumed that these average income levels of the three groups would grow at a rate of 3.6% per annum in real terms. Table IV.3.7 summarizes the resulting distribution in the New Town. It was further assumed that the income distribution in among workers living in the other areas would be the same as in the New Town.

During the initial stages of the development it is expected that a large portion of the Area's work force would be in the single status, in other words many migrant workers would start working in the Area without their family. However, many of these single workers would probably live together sharing housing either voluntarily or by arrangement provided by the employer. It is likely that many of them would also share the means of transport particularly when commuting. Under such circumstances it is appropriate to regard each dwelling unit as household when assessing their travel behavior.

Passenger transport demand is area-dependent. Residents of a large metropolitan area would have different life-style and would spend differently than those living in a compact city. Demand for transport is an item for which the difference is expected to be large. In order to assess the transport demand by the residents of the Area a comparative analysis was carried out.

Patterns of personal expenditure on transport, public and private, were analyzed separately for residents of Bangkok, municipal areas in the Central region, and sanitary districts in the Central Region. Details are presented in Appendix VI-B.

Table IV.3.7 INCOME DISTRIBUTION IN NEW TOWN

Household (Dwelling Unit) Income Level	1991			2001		
	Average Monthly Income (฿/No.)	No. of DU (No.)	% of Total DU (%)	Average Monthly Income (฿/No.)	No. of DU (No.)	% of Total DU (%)
High	14,000	510	9.9	20,100	2,610	10.0
Middle	9,000	3,363	65.5	12,800	16,770	65.0
Low	5,100	1,260	24.6	7,300	6,520	25.0
Total	-	5,133	100.0	-	26,100	100.0

Note: Average household (dwelling unit) monthly income levels were assumed to be Baht 4,000, Baht 7,000 and Baht 11,000 for low, middle and high income groups in 1984 respectively. The growth of income in real terms was assumed to be 3.6% per annum.

Source: Table

It was found that people in the Greater Bangkok Area spend a higher percentage of their income on transport than people in the other areas, particularly on the local public transport, indicating the higher need to travel and the availability of public transport in the former.

It was also found that people with high income in the latter two areas outside of Bangkok had a higher propencity to own private vehicles than those in Bangkok. This could be explained by three factors; the generally higher cost of living, a wider range of spending opportunities, and the provision of well-developed public transport network in Bangkok. People outside of Bangkok seem to spend less money on public transport. This is probably more a result of the compact size of the range of their daily activities than the lack of good public transport means.

A good public transport network is planned for the Laem Chabang Area. It was decided to assume that travel characteristics of people for this Area be at the midway between those of Bangkokians and those of people in municipal areas in the Central Region. Vehicle ownership, modal split, and other travel characteristics for this Area were determined on the basis of this assumption.

3.4.3 Passenger Traffic Demand

The clear separation of workplace and residencial area planned for this area will surely contribute to creating a good environment but it will also create a large flow of workers commuting back and forth twice daily. In addition the highly concentrated employment in the Area, as oppose to the situation in other traditional cities in Thailand where self-employed workers occupy a large segment of workforce, would make this commuter flow more pronounced. Therefore, commuter movements in the critical period of the morning peak hour were examined in detail.

The spetial distribution of employment was presented in Chapter III of this report. Except for the port and the EPZ all workers were assumed to be in the one-shift schedule. For the Port 71.5% of workers would be on a two-shift basis, and for the EPZ one third each of the all workers would be in one-shift, two-shift, and three-shift schedules respectively.

For the short term plan it was assumed that 11,000 workers would be commuting to this Area from the existing communities of Si Racha, Chonburi, and Pattaya. It was determined that these locally available workers would be attracted to the Area in proportion to the size of the respective city and in reverse proportion to the distance to the Area powered to 1.2. The formula is a familiar gravity model. The power of 1.2 was chosen on the basis of experience elsewhere.

It was also assumed that 1,000 workers for the short term plan and 4,000 workers for the long term plan working in the business and commercial area would live in the same area.

In order to determine the commuter flows in sufficient detail the entire area including Si Racha was divided into 16 zones. Three zones, Chonburi, Pattaya, and Si Racha Industrial Park, were added, aming the total number of zones 19. The New Town was divided into 5 zones, block A through block E, and the EPZ and the GIE were divided into 5 zones on the basis of the locations of entrance gates.

It was generally assumed that workplaces of workers living in a zone would evenly spread over other zones where employment opportunities exist, except for a few cases such as those living in the business and commercial area and those from Chonburi, Pattaya and existing Si Racha from where no additional workers after 1991 were assumed.

Origins and destinations of morning commuters were estimated and summarized in Table IV.3.8. Figure IV.3.2 illustrates these flows.

3.4.4 Vehicle Ownership

At present vehicle registration data in Thailand can be obtained only down to the level of Changwat. Difference by type of area, e.g. urban and rural, can not be known by official registration statistics. It was also found that the vehicle registration statistics for the Changwat of Chonburi were unreliable for the purpose of estimating the level of vehicle ownership due to the incomplete changes in vehicle resistration procedures in this Changwat.

Table IV.3.8 ORIGINS AND DESTINATIONS OF MORNING COMMUTERS
(LONG TERM PLAN)

Origin	Destination 1 Port	2 EPZ West	3 EPZ South	4 EPZ East	5 GIE North	6 GIE South	7 Oil & Gas	8 SR IP	9 Commu-nity Center	10 Busi-ness Area	11 New Si Racha	12 Old Si Racha	13 Chonburi	14 Pattaya	15 New Town Block A	16 New Town Block B	17 New Town Block C	18 New Town Block D	19 New Town Block E	Total
10 Busniess Area	-	-	-	-	-	-	-	-	-	4,000	-	-	-	-	-	-	-	-	-	4,000
11 New Si Racha	1,116	551	546	546	1,005	1,005	244	4,323	863	1,998	-	-	-	-	543	428	359	184	260	13,980
12 Old Si Racha	465	220	220	220	402	402	156	1,547	-	1,229	-	-	-	-	944	-	-	-	-	5,805
13 Chonburi	263	125	125	125	228	228	-	-	-	696	-	-	-	-	418	-	-	-	-	2,208
14 Pattaya	265	120	120	120	217	219	-	-	-	668	-	-	-	-	403	-	-	-	-	2,134
15 New Town Block A	1,243	601	603	603	1,297	2,297	-	480	901	3,292	-	-	-	-	1,192	-	-	-	-	11,509
16 New Town Block B	1,350	652	654	654	1,190	1,190	-	428	1,038	3,576	-	-	-	-	-	1,772	-	-	-	12,504
17 New Town Block C	1,218	575	577	577	1,447	1,447	-	377	820	3,323	-	-	-	-	-	-	641	-	-	11,002
18 New Town Block D	810	398	398	398	725	725	-	257	838	2,145	-	-	-	-	-	-	-	806	-	7,501
19 New Town Block E	594	281	281	281	512	512	-	188	540	1,573	-	-	-	-	-	-	-	-	740	5,502
Total	7,324	3,503	3,524	3,524	7,025	7,025	400	7,600	5,000	22,500	-	-	-	-	3,500	2,200	1,000	1,000	1,000	76,145

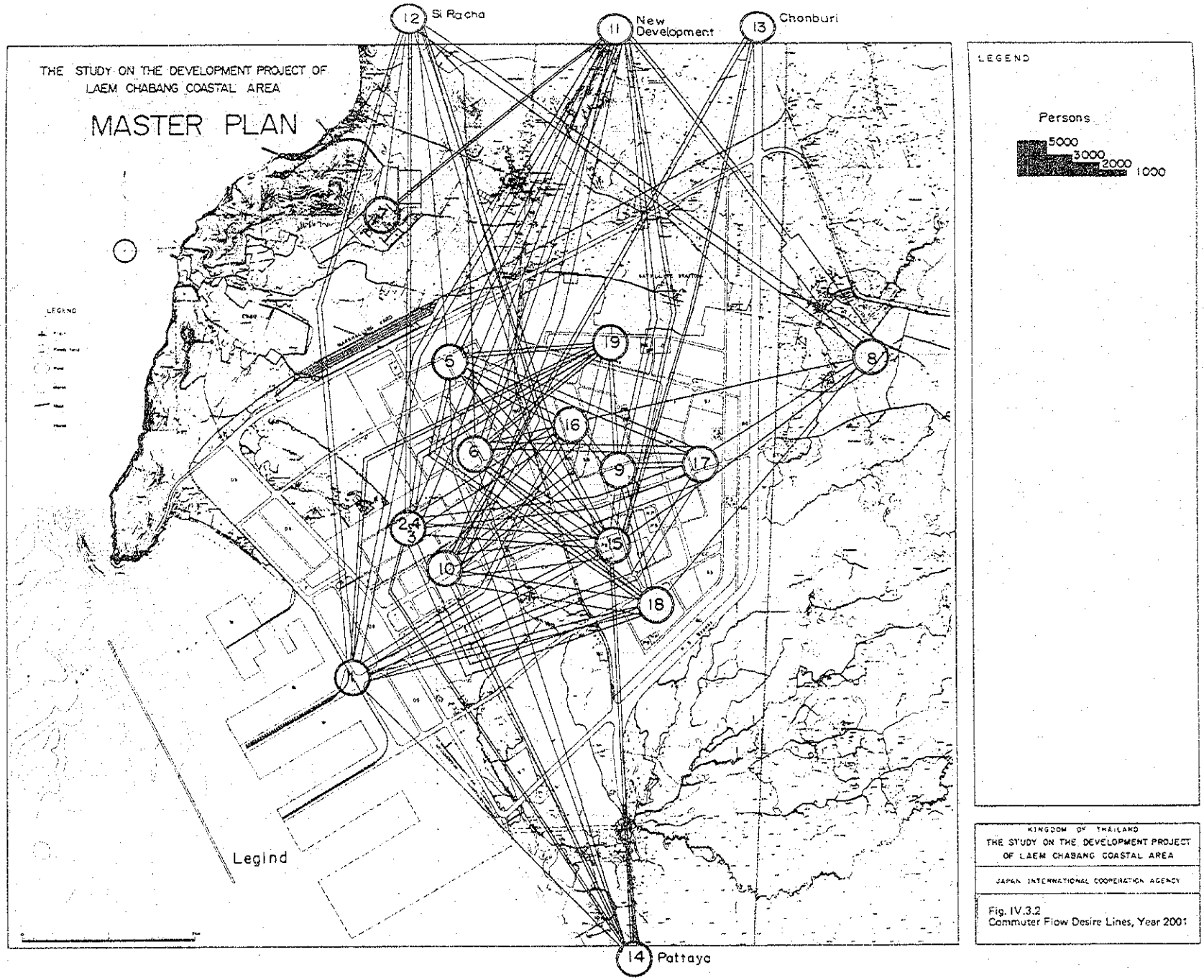

THE STUDY ON THE DEVELOPMENT PROJECT OF
LAEM CHABANG COASTAL AREA
MASTER PLAN
12 Si Racha
11 New Development
13 Chonburi
14 Pattaya
Legind
LEGEND
Persons
5000
3000
2000
1000
KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. IV.3.2
Commuter Flow Desire Lines, Year 2001

Table IV.3.9 shows vehicle registration statistics and the number of household for Bangkok from 1978 to 1981. It can be seen that about 40% of households in Bangkok own at least one passenger car in 1981. Prices of new cars in Thailand are extremely high relative to income level. It was also shown in Appendix IV-B that only the highest income decile group showed sufficiently high expenditure on vehicle purchase. The relatively large figure of car resistration in Bangkok indicates the existance of a large used car market allowing used cars cascading down progressively less affluent households.

The last point was proved in an home interview survey conducted in the course of the Feasibility Study on the Second Stage Expressway System in the Greater Bangkok by JICA in 1982. Although the number of samples was rather small, this survey nevertheless is the only source of data in recent years concerning transport demand characteristics in Bangkok.

Table IV.3.10 shows vehicle ownership levels by income level. A sizable portion of even the lowest income group owns passenger vehicles, even though the initial purchasing prices of which are clearly beyond the reach of this group. Taking the fact into account that a non-negligible portion of households own more than one car (see Table IV.3.11), the average passenger car ownership level shown in Table IV.3.10 compares well with the vehicle registration data shown in Table IV.3.9.

As stated earlier, car ownership level for a given household income level for this Area was assumed to be at the average of ownership levels for that household income level for residents of Bangkok and for residents of municipalities in the Central Region. The ratio of vehicle purchase expenditures for Bangkok and for municipalities developed from Table IV-B.5 were applied to vehicle ownership levels by income level in Bangkok as shown in Table IV.3.10 to arrive at the vehicle ownership projections for the Area taking into account the growth in household income in the future. Table IV.3.12 summarizes the results.

Table IV.3.9 NUMBERS OF HOUSEHOLDS AND REGISTERED VEHICLES

Item	1978	1979	1980	1981
1) No. of Households (in thousands)	726	774	821	851
2) Average Household Size	6.7	6.5	6.3	6.3
3) Registered Vehicles (in thousands)				
Cars	249	269	298	332
Taxis and Samlors	21	21	21	21
Total Cars	270	290	319	353
Motorcycles	149	146	172	290
4) Total Cars/No. of Households	0.372	0.374	0.388	0.415

Source: 1) & 2): BMA 1982
3): Police Dept. 1982

Table IV.3.10 MONTHLY FAMILY INCOME AND VEHICLE OWNERSHIP BY INCOME LEVEL

Monthly Family Income (in thousand Baht)	1.0-3.0	3.1-5.0	5.1-7.0	7.1-9.0	9.1-11.0	11.1-16.0	16.1-21.0	21.1-31.0	31.1-51.0	51.1-	Total	Average Baht
No. of Households												
With C	28	38	38	42	46	64	46	33	16	8	359	13,724
With C & MC	4	12	6	12	11	9	11	7	5	5	82	15,951
Sub-total	32	50	44	54	57	73	57	40	21	13	441	14,138
With MC	37	41	32	22	13	15	-	2	-	1	163	6,331
None	176	140	100	64	39	35	11	4	2	-	571	5,583
Total	245	231	176	140	109	123	68	46	23	14	1,175	8,898
Percentage of Families Owning Vehicles												
With C	11	16	22	30	42	52	68	72	70	57	30	
With C & MC	2	5	3	9	10	7	16	15	22	36	7	
Sub-total	13	21	25	39	52	59	84	87	92	93	37	
With MC	15	18	18	15	12	12	-	4	-	7	14	
None	72	61	57	46	36	28	16	9	8	-	49	
Total	100	100	100	100	100	100	100	100	100	100	100	

Note: C: Car
MC: Motorcycle

Source: Feasibility Study on the Second Stage Expressway System in Greater Bangkok, 1983

Table IV.3.11 MULTIPLE VEHICLE OWNERSHIP, BANGKOK 1982

Item	No.	%
Number of Households		
Owning one car	461	26.6
More than one car (Ave. 2.4)	187	10.8
Sub-total	648	37.4
Non-car-owing Households	1,083	62.6
Total	1,731	100.0

Source: Feasibility Study on the Second Stage Expressway, 1983

Table IV.3.12 VEHICLE OWNERSHIP PROJECTIONS

(in percent of households)

Vehicle Ownership	1991 Income Group			2001 Income Group		
	Low	Middle	High	Low	Middle	High
Car and Motorcycle	23	54	66	34	65	87
Motorcycle only	18	17	14	16	14	4
None	59	29	20	50	21	9
Total	100	100	100	100	100	100

Source: JICA Study Team

3.4.5 Public Transport Use and Modal Split

The aforementioned home interview survey by JICA resulted in a Table of trip mode by trip purpose as shown in Table IV.3.13. If limited to work trips, 35% were by private means and the rest by public transport. When compared with Table IV.3.13 adjusted by the average occupancy of 1.58 passengers per car, roughly 80% of available cars were used for the commuting purpose.

The aforementioned JICA study also included interview surveys for bus passengers. It was found that 41% of all air-conditioned bus passengers and 25% of regular bus passengers had access to private cars in their respective households. There is clearly a case for attracting passengers to public transport by means of a good service.

Nevertheless, the modal split of commuters work trips would heavily depend on the availability of cars for the purpose.

For each of the three household income groups availability of cars and motorcycles for work trips were estimated for the years 1991 and 2001. For 1991 80% of all cars were assumed to be available for the purpose and 90% of all motorcycles available to work trips. For 2001 two cases were stipulated, one with the same 80% availability of cars and the other with 60% of all cars for the commuting purposes. The latter case was adopted considering the compact size of the Area and the likelihood of provision of a good bus transport service network in the Area. Table IV.3.14 shows the results together with other characteristics propoerties. For the short term plan 20% of workers would use private passenger cars, 7% by motorcycle, and the rest by public transport. For the long term plan 25% would be on cars, 7% on motorcycles, and the rest (68%) would take public transport system.

3.4.6 Vehicular Traffic Demand

On the basis of characteristics presented in Table IV.3.14 person trip demand as presented in the subsection 3.4.2 was converted into vehiclar transport demand estimates. Table IV.3.15 shows simplified conversion factors expressed in per commuter basis.

Table IV.3.16 summarizes the interzonal movements of commuters during the morning peak hour for the long-term plan in terms of combined Passenger Car Unit (PCU) for cars and motorcycles and the number of large buses required for each zonal pair.

3.4.7 Rail Passenger Traffic

No matter what the Government policies are, it would be very difficult for the railway to capture a significant portion of passengers in this region. Difference in monetary terms with the road transport can not be large because of short distances. Being a single track line, travel time can not be at a competitive level with the road transport. However, for a limited number of longer trips such as to and from Chonburi, and in particular to and from Bangkok, a sizable portion of such trips may be on the railway, especially when a railway station is provided adjacent to the New Town. However, such railway passenger traffic would be unlikely to be large enough to affect the design requirements of roadways.

3.5 Through Traffic

Changes in vehicular traffic levels as measured by DOH from 1978 to 1982 at points around Laem Chabang on Route 3 are shown in Table IV.3.17. The patterns of changes do not follow those indicated by a previous regional study. This of course is inevitable as micro-phenomena individually do not necessarily conform with macro-trends with which regional studies can only deal.

The combined traffic counts of passenger vehicles at the three stations shown in the Table grew at an annual rate of 4.4% and that of goods vehicles at -0.8% during the period shown. For the same time period population of Chonburi and Rayong Changwats grew at 2.4% per annum. Per capita income during the same time period grew at 0.6% p.a. in Rayong and 3.4% p.a. in Chonburi in real terms. (The very low rate for Rayong is due to the sever setback in the agricultural sector in 1979 and 1980. Since 1980 per capita income in Rayong grew at 14.9% p.a.) The per capita income growth rate for combined population of Chonburi and Rayong for the time period was 2.5% p.a.

Table IV.3.13 TRIP MODE BY TRIP PURPOSE

(Percentages in parentheses)

Item	To Work	To School	To Business	To Private	To Go Home	Total	
Private Transport							
Car	464	242	178	282	687	1,853 (65.8)	(21.7)
Motorcycle	149	30	94	82	198	553 (19.6)	(6.4)
Samlor	7	13	10	20	26	76 (2.7)	(0.9)
Taxi	10	4	11	20	26	71 (2.5)	(0.8)
School Bus	6	100	1	1	93	201 (7.1)	(2.3)
Truck	5	1	26	8	25	65 (2.3)	(0.8)
Sub-total	641	390	320	413	1,055	2,819	
	(22.7)	(13.8)	(11.4)	(14.7)	(37.4)	(100.0)	
	(34.8)	(24.9)	(61.8)	(38.9)	(29.5)		(32.9)
Public Transport							
Small Bus	148	108	22	66	188	532 (9.3)	(6.2)
Large Bus	1,033	1,057	176	577	2,299	5,142 (89.6)	(60.1)
Train	7	5	0	3	10	25 (0.0)	(0.3)
Boat	15	9	0	3	15	42 (0.1)	(0.5)
Sub-total	1,203	1,179	198	649	2,512	5,741	
	(21.9)	(20.5)	(3.4)	(11.3)	(43.8)	(100.0)	
	(65.2)	(75.1)	(38.2)	(61.1)	(70.5)		(67.1)
Total	1,844	1,569	518	1,062	3,567	8,560	
	(21.5)	(18.3)	(6.1)	(12.4)	(41.7)	(100.0)	(100.0)
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	

Source: Feasibility Study on the Second Stage Expressway System in Greater Bangkok, 1983

Table IV.3.14 WORK TRIP MODAL SPLIT PROJECTIONS

Household Income Group	Base Case				High Public Transport Case			
	Low	Middle	High	Ave.	Low	Middle	High	Ave.
1991								
-Household (Dwelling Unit) Distribution (%)	25	65	10	-	-	-	-	-
-Workers/Household	3.0	2.29	2.1	2.45				
-Vehicle Availability for Work Trip (% of Household)								
Car (80% for work)	18	43	53	38				
Motorcycle (90% for work)	16	15	13	15				
-Vehicle Occupancy								
Car	1.58	1.58	1.58	1.58				
Motorcycle	1.24	1.24	1.24	1.24				
-Person Work Trip Modal Split in %								
Car	10	24	32	20				
Motorcycle	7	7	7	7				
Public	83	69	61	73				
2001								
-Household Distribution	25	65	10	-	25	65	10	-
-Workers/Household	2.33	2.12	2.0	2.16	2.33	2.12	2.0	2.16
-Vehicle Availability for Work Trip (% of Household)								
Car/1 (x% for work)	27	52	70	48	20	39	52	36
Motorcycle (90% for work)	14	13	4	12	14	13	4	12
-Vehicle Occupancy								
Car	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Motorcycle	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
-Person Work Trip Modal Split in %								
Car	17	37	53	33	14	28	39	25
Motorcycle	7	7	2	7	7	7	2	7
Public	76	56	45	60	79	65	59	68

Note: /1: x = 80 for base case, x = 60 for high public transport case

Source: JICA Study Team

Table IV.3.15 AVERAGE VEHICULAR DEMAND PER COMMUTER

Item	1991	2001	
		Base	High Public Transp.
Passenger Cars & Motorcycles (PCU)	0.145	0.239	0.186
Buses (Numbers)	0.010	0.0086	0.0097

Note: Bus occupancy is assumed to be 70 passengers for peak hour.

Table IV.3.16 ORIGINS AND DESTINATIONS OF MORNING COMMUTER VEHICLES
(LONG TERM PLAN)

Origin	Destination 1 Port	2 EPZ West	3 EPZ South	4 EPZ East	5 GIE North	6 GIE South	7 Oil & Gas	8 SR IP	9 Connu-nity Center	10 Business Area	11 New Si Racha	12 Old Si Racha	13 Chon-buri	14 Pattaya	15 New Town Block A	16 New Town Block B	17 New Town Block C	18 New Town Block D	19 New Town Block E	Total
10 Business Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
11 New Sri Racha	208/11	102/6	102/5	102/5	187/10	187/10	45/2	804/43	161/9	372/20	-	-	-	-	101/5	80/4	67/4	36/2	48/3	2600/140
12 Old Sri Racha	86/5	41/2	41/2	41/2	75/4	75/4	29/2	288/15	-	229/12	-	-	-	-	176/9	-	-	-	-	1080/58
13 Chonburi	49/3	23/1	23/1	23/1	42/2	42/2	-	-	-	129/7	-	-	-	-	78/4	-	-	-	-	411/22
14 Pattaya	49/3	22/1	22/1	22/1	41/2	41/2	-	-	-	124/7	-	-	-	-	75/4	-	-	-	-	397/21
15 New Town Block A	231/12	112/6	112/6	112/6	241/13	241/13	-	89/5	166/9	612/33	-	-	-	-	222/12	-	-	-	-	2141/115
16 New Town Block B	251/14	121/7	122/7	122/7	221/12	221/12	-	80/4	193/10	665/36	-	-	-	-	-	330/18	-	-	-	2326/125
17 New Town Block C	227/12	107/6	107/6	107/6	269/14	2691/14	-	70/4	153/8	618/33	-	-	-	-	-	-	119/6	-	-	2046/110
18 New Town Block D	151/8	74/4	74/4	74/4	135/7	135/7	-	48/3	156/8	399/21	-	-	-	-	-	-	-	150/2	-	1395/75
19 New Town Block E	110/6	52/3	52/3	52/3	95/5	95/5	-	35/2	100/5	293/16	-	-	-	-	-	-	-	-	138/7	1023/55
Total	1362/73	652/35	655/35	655/35	1307/70	1307/70	744/4	1414/76	930/50	3441/185	-	-	-	-	651/35	410/22	186/10	186/10	186/10	13419/721

Note: Left figures and right figures indicate passenger cars and motorcycles in PCU and buses in number respectively.

It was decided that the growth rate of through traffic of passenger vehicles be determined by the following formula:

Traffic growth rate = population growth rate + 0.72
x per capita income growth rate

Assuming the accelerated growth per capita income growth rate of 3.6% p.a. for the two Changwats, through passenger vehicle traffic would grow at 4.5% p.a.

Goods vehicles had hardly grown in number on Route 3 as shown in Table IV.3.17. Considering the already started changes in cropping pattern in this region, it was assumed that the traffic level of normal goods vehicle traffic would remain unchanged for the planning purposes for the year 1991.

According to the Feasibility Study Report for the Map Ta Phut Complex, the first stage operation of the planned fertilizer, the petrochemical, and the downstream plants would generate 658 thousand tons of outbound and 149 thousand tons of inbound cargoes on road vehicles. Practically all of them will be bulk cargo and will go through the Laem Chabang area. In terms of the number of trucks the above can be translated as 120 to 170 trucks per day.

When these plants are operated at full capacity as planned by the year 2001, they will generate 1.3 million tons of output on trucks toward Bangkok and 320 thousand tons of input on trucks, requiring 330 to 410 truck trips per day.

Estimates on rail traffic generated by the Map Ta Phut Complex are presented in the next subsection on railway.

For the first stage development of the Map Ta Phut Complex, the National Housing Authority has estimated 5,362 migrant workers would be attracted to the area. Including dependents the total population corresponding to these migrant workers would be 10,300 persons. The trip rate for long distance vehiclar trips in this region was estimated by ESS at

850 vehicles per 100,000 population. Therefore, in the order of 110 vehicles per day, both ways, due to the Map Ta Phut development would go through the Laem Chabang area by 1991.

If the development at Map Ta Phut is limited to the above three types of industry, the long distance road passenger vehicle traffic would be around 200 vehicles per day by 2001.

Foregoing analysis is summarized in Table IV.3.18 showing daily volume of through traffic on Route 3.

Table IV.3.17 CHANGES IN TRAFFIC ON ROUTE 3

Section	Type	Year				
		78	79	80	81	82
Chonburi - Siracha	P/V	15,361	18,114	NA	19,911	18,794
	M/C	NA	2,572	NA	3,761	4,010
	G/V	4,617	4,564	NA	4,350	4,409
Siracha - Pattaya	P/V	7,193	7,371	NA	6,907	7,819
	M/C	NA	599	NA	1,097	1,245
	G/V	1,572	1,432	NA	1,988	1,561
Pattaya - Sattahip	P/V	2,309	1,972	NA	2,518	2,895
	M/C	NA	16	NA	1,086	1,222
	G/V	339	239	NA	361	362

Note: P/V: passenger vehicles
M/C: motorcycles
G/V: goods vehicles

Source: DOH, Traffic Division

Table IV.3.18 DAILY ROAD THROUGH TRAFFIC, 1991 & 2001

	Item	Passenger Vehicles	Motor-cycles	Goods Vehicles	Total (PCU)
1991	Normal Traffic	11,900	1,900	1,550	15,570
	Map Ta Phut Cargo	-	-	280	560
	Map Ta Phut Passenger	110	-	-	110
	Total				16,240
2001	Normal Traffic	18,480	2,950	1,550	22,470
	Map Ta Phut Cargo	-	-	740	1,480
	Map Ta Phut Passenger	200	-	-	200
	Total				24,150

3.6 Transport Facility Design Volumes

3.6.1 Vehicle/Vessel Loading Conditions

Loading conditions of vehicles determine the number of vehicles required to transport the given amount of cargo of passengers, and the number of vehicles in turn determines the size of infrastructure. Loading conditions were determined in this study on the basis of prevailing conditions in Thailand with due consideration to likely future improvements. They are summarized below.

Table IV.3.19 VEHICLE LOADING CONDITIONS

(Unit: tons)

	Cargo Type				
	Container		Industrial	Tapioca &	Other
	20'	40'	Products	Constr. M.	Bulk
Trailer	20.4	20.4(30)	12(10)	-	-
10 Wheeler	10.2	-(70)	8.3(40)	18(90)	13(70)
6 Wheeler	-	-	4.2(50)	6.5(10)	6.5(30)
Train	1,000	1,000	-	600	450
Barge					
4x300 tons	-	-	-	1,120	1,120
4x700 tons	-	-	-	2,500	2,500
Selfpropeled	-	-	-	900	900

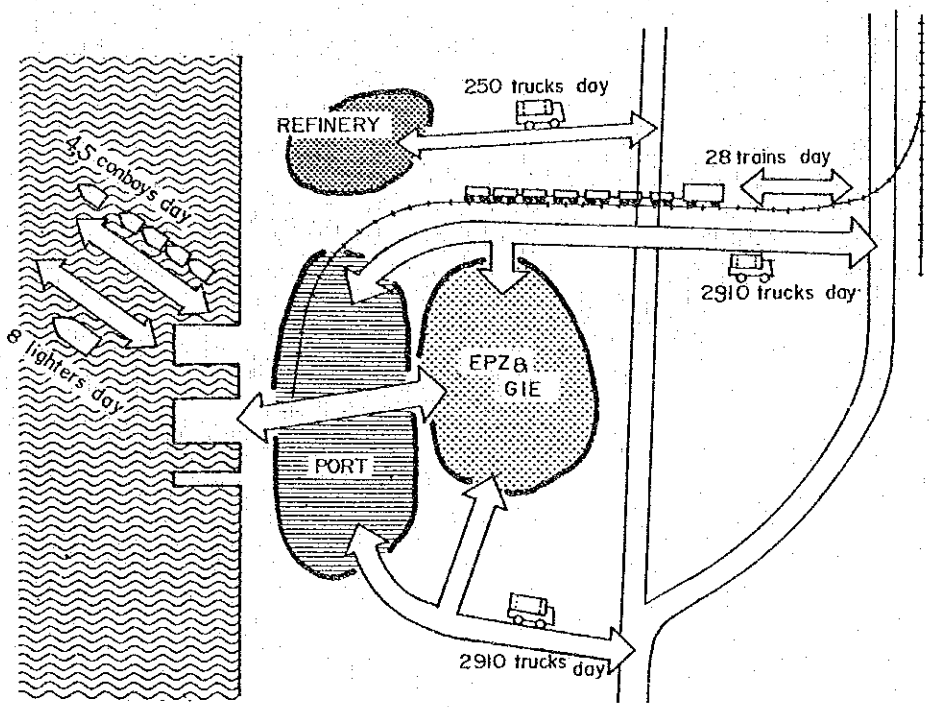
	1971	2001	(in passengers)
Passenger car	1.50	1.50	
Motorcycle	1.21	1.21	
Bus (overall/peak)	45/70	45/70	

Note: Figures in parenthesis indicate shares of each truck type.

A present a large majority of trucks return empty. It was assumed that the operation of the eastern truck terminal would improve the back haul utilization and that 50% of trucks would find the back haul cargo.

3.6.2 Facility Design Volumes

The schematic diagrams shown in Figure IV.3.3 and Figure IV.3.4 show design traffic volumes for transport infrastructure facilities in the Area. For road passenger transport volumes are shown in terms of the peak hour vehicular volumes, and for others in terms of daily volumes for the year 2001.



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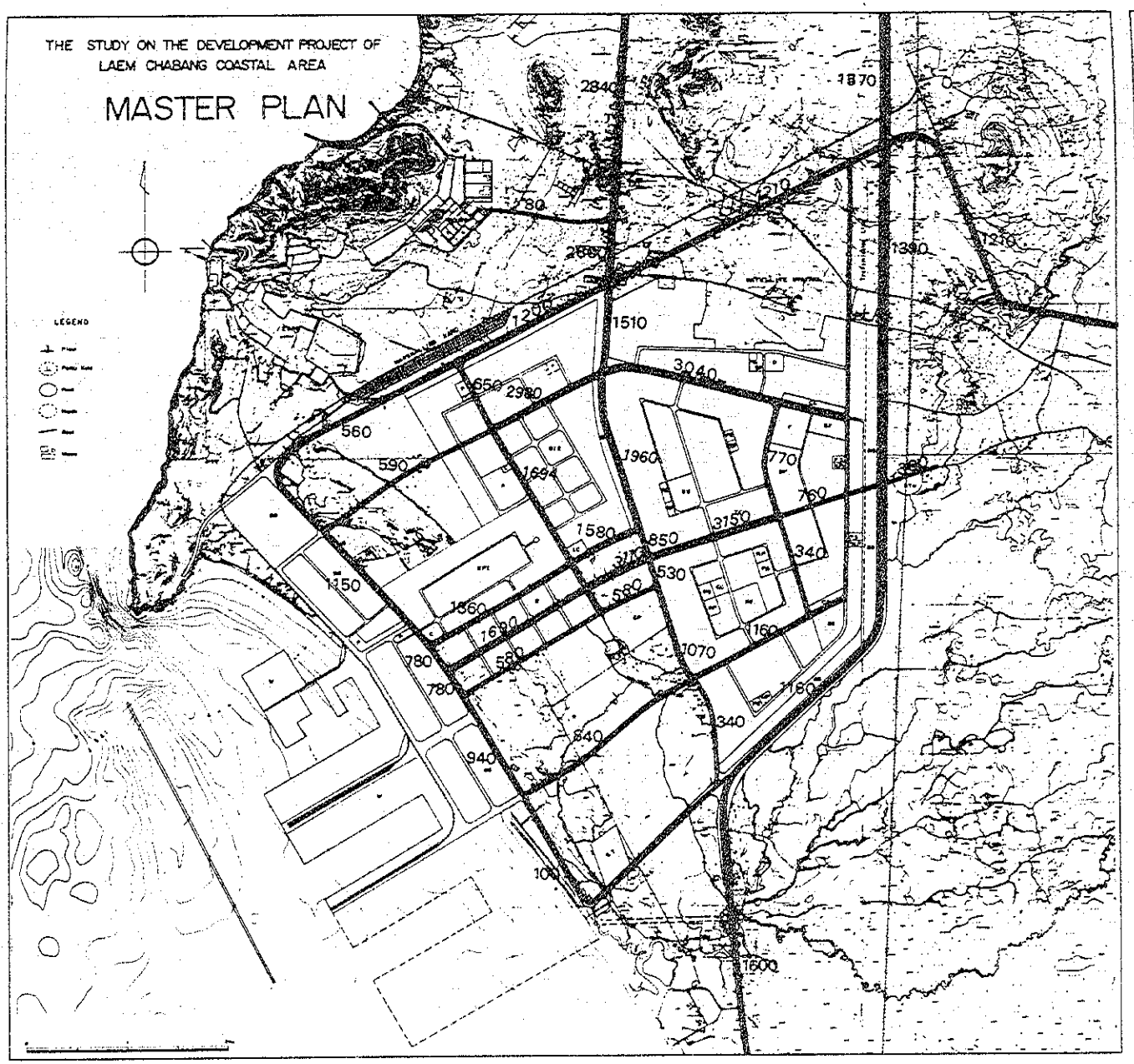
(Twoway, Daily Traffic
During Peak Season, Year 2001)

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.3.3
Domestic Cargo Flows



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KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.3.4
Peak Hour Oneway Traffic Flows,
Year 2001 (In PCU)

3.7 Regional Transport Network Prospects

3.7.1 Road Network

Investigations on road traffic demand, existing highway network and its improvement plans revealed that the highway network in the Eastern Seaboard region would generally by adequate to accommodate road traffic demand upto the year 2001 without major additions or improvements except the strengthening of pavement by means of periodic overlay to withstand greatly increased heavy vehicle traffic. Several localized improvements, however, would be required before the target year of 2001.

An obvious case is Route 3191 connecting the Map Ta Phut heavy industry development area with Route 36. If the Map Ta Phut Project is implemented and developed as planned, a large majority of heavy truck movement would be on Route 36. At least route 3191 will have to be strengthened to withstand heavy axle loads of bulk carrying heavy trucks. Depending upon the level of urban development in the Map Ta Phut area it may become necessary to make this road a 4-lane road along with Route 36. Route 36 can readily be widened, but the widening of Route 3191 would require careful planning before land acquisition because of pipelines laid along the road.

The introduction of a bypass road seems inevitable if the development of the Laem Chabang port and urban complex is to be developed as planned. Future traffic requirements can not be accommodated by the construction of a series of grade separated intersections. The expected traffic volumes at full development would simply too large for such a scheme.

Provided that the planned development of the Laem Chabang and Map Ta Phut areas will progress, a new short road bypassing the existing extensive road side development in Nong Mong would become a necessity. This bypass would be economically justified by vehicle operating cost savings alone.

3.7.2 Rail Transport

The brand new Chachoengsao - Sattahip line is nearing completion and the construction of the Bangkok Rail Container Terminal at Bang Sue has been decided. The underutilization of these facilities constructed with a considerable sum of resources would result in a net loss to the national economy as shown in Section 3.3.2. Measures should be taken to achieve an adequate level of utilization of these facilities.

Relying entirely on regulatory measures is not recommendable as such environment would certainly lead to an inefficient state in the long run. Pricing and level of services should be determined considering the conditions offered by the other competing modes.

With all the effort, however, it would be rather difficult for the railway to capture a majority of cargo flow to and from the Laem Chabang complex.

It has been estimated for the short-term plan that by 1991 0.7 million tons of import containers, 0.7 million tons of export containers, 54 thousand tons of import breakbulk cargo, 6 thousand tons of export breakbulk cargo, and 900 thousand tons of tapioca for export would be transported by the railway. The railway system basically consists of a single track facility from Bangkok to Sattahip via Chachoengsao with a single track spur leading to the Laem Chabang port and the possible extension to the Map Ta Phut complex. The system will have to accommodate the above cargo volumes and some passenger traffic mainly between Bangkok and Chachoengsao, and, assuming the Map Ta Phut Complex will be in operation on time, cargoes to and from the complex.

It was estimated in the Feasibility study of the Map Ta Phut complex that railway would transport for the planned fertilizer, petrochemical, and downstream plants in their first stage 217 thousand tons of output and 406 thousand tons of input annually. This amount can be translated into 3 to 5 trains per day.

Because of the relatively high standards of this line (maximum grade 1%) existing locomotives can pull up to 1,000 tons of cargo on this line. The average loading under the current SRT operations is 450 tons per train. Assuming 750 tons per train of loading, the Chachoengsao - Laem Chabang section of the railway will have to accommodate 20 to 25 trains per day during the peak season of tapioca export (10 trains per day). The capacity of single track railway depends on several factors among which the number of sidings and the signalling are important. The level of traffic described above can be accommodated without much difficulty.

3.7.3 Waterway Transport

Among industrialized countries where domestic shipping is possible, coastal or inland waterway shipping takes a prominent role in goods transportation. More than half in Japan and more than 40% in the U.S. of all goods transportation are borne by domestic shipping in terms of ton-kilometers. Table IV.3.20 shows shares of domestic shipping for principal items in Japan in 1977. It is apparent bulk and heavy commodities are primarily transported by coastal shipping, indicating the concentration of industries in coastal areas.

The construction of the Laem Chabang deep seaport and the adjoining industrial estate should induce the emergence of coastal shipping between the Laem Chabang port and other parts of the country. If the close proximity to the port is fully taken advantage of, then the logical consequence is the growth of water-borne transportation. In other words the degree of success of the Laem Chabang industrial estate as a industrial estate with a direct access to port facilities should be judged, at least partially, by the degree of its usage of water-borne transportation. The growth of water-borne transportation in the Gulf of Thailand would induce industries to be located along its shoreline. The potential of the Gulf of Thailand as a source of inexpensive industrial transportation would be gradually taken advantage of.

Table IV.3.20 SHARES OF COASTAL SHIPPING BY ITEM IN JAPAN, 1977

(In percent)

Item	In Total Tonnage	In Total Ton-kilometers
Coal	39	95
Non-metal mineral	33	82
Oil products	48	90
Cement	38	86
Coaks & other coal products	27	29
Metal	25	75
Metal ore	17	66
Paper & pulp	11	53
Chemicals	28	60
Grain	10	43
Fertilizer	6	32
Sand gravel and stones	4	23
Pint and other chemical products	4	20
Metal products	1	17

Source: Kowan Keikaku Soran, Nihon Kowan Kyokai, 1982

The selection of mode, however, is not determined solely on the basis of monetary costs. Time and institutional problems sometimes are decisive factors. Currently coastal shipping in Thailand is heavily penalized by governmental permit procedures. A streamling of institutional structure concerning coastal shipping is needed.

The majority of industrial enterprises own their fleet of trucks for which capital costs are slready sunk costs to them. Therefore, the use of coastal shipping would occur among the newly established industries at first, followed by the switches from truck transport by existing companies. In any case by the year 2001 a substantial portion of goods traffic between Laem Chabang and Bangkok and elsewhere should be carried by coastal shipping. For the planning purposes it was assumed that 33% of all input and output of the GIE be carried by coastal shipping as described in Section 3.3.4.

3.7.4 Air Transport

The Civil Aviation Board has designated a subcommittee entrusted to study the possibility of establishing an aircraft maintenance industry in the U Tapo airfield, but no specific recommendations have yet emerged. There has also been repeated calls by some representatives of the tourism industry to promote the airfield as a destination for chartered flights to directly serve the Pattaya resort located 36 km north. The Aviation Department has welcome the idea but no specific action has yet been taken.

It has been discussed within certain government circles that the availability of U Ta Bao airfield could be attractive enough to investers to set up high-tech industries in this region, in particular Laem Chabang. At present, half a dozen international "high-tech" electronics companies operate manufacturing plants almost exclusively for export. Their plants are located at periphery of the Bangkok Metropolitan Area, in Bang Na, Nonthaburi, Rangsit, Ayuttaya, etc. Some of the plants are not particularly close to the Don Muang Airport. In terms of travel time from the airport, Laem Chabang is definitely closer to airport than some of the existing "high-tech" plants.

It appears that if the travel time from the airport is in the order of one hour, it is acceptable to "high-tech" industries. Experience elsewhere such as the Silicon valley and Kyushu seems to confirm this. As far as the proximity to the airport is concerned, Laem Chabang can be said to be no less advantageous than, say, Bang Na, or Ayuttaya.

However, a crutial matter is the kind and the quality of air-service provided at the airport. A possible, and probably only, way for the U Tapo airfield to compete with Don Muang in this regard would be to use feeder service from Singapore by special cargo aircraft. In fact an international high-tech company which has operations in Singapore is said to launch exactly such a private air-freight operation linking the Changi and the Don Muang airports to form an integrated operation. If government incentives are perceived right to such multinational cooperations, and the services provided and customs procedures imposed in U Ta Pao (these non-monetary factors are usually quite significant to private investers) are also considered better, the establishment of high-tech industries in Laem Chabang may materialize.

4. ROAD NETWORK PLANNING

4.1 Road Network Planning

4.1.1 Basic Considerations for the Road Network Planning

Road network planning be conducted in consideration of various angles such as traffic perspective, transportation perspective, open space perspective and utility perspective. The primary function may defer depending upon characteristics of the road.

The planning of a road network should be carried out on the basis of the characteristics and functions of the roads. The most important aspect is the definition of the road criteria in weighing characteristics and functions.

The main items to be considered for road network planning in this study area are as follows:

- To separate the traffic flow of passengers and the cargo
- To define the road standards.
- To classify functions and characteristics of the road.
- To connect various roads organically.
- To ensure the safety to minimize traffic accidents.
- To perserve a good environment.

4.1.2 Functional Classification of Roads

In this study, all roads are to be classified into several categories considering their functions. The criteria of each category are described as follows.

1) Inter Urban Primary Roads (V_1)

These roads form the primary network for the country. All long distance traffic movements travelling from major cities to other major cities should be included in this category.

2) Intra Urban Primary Roads (V_2)

These roads form the primary network for a town as a whole. All long-distance traffic movements to, from and within the town should be canalized on the intra urban primary roads.

3) District Roads (V_3)

These roads distribute traffic within the residential, industrial and principal business districts of the town. They form the link between the primary network and the roads within community areas.

4) Local Roads (V_4)

These roads distribute traffic between community areas. They form the link between district roads and collector roads.

5) Collector Road (V_5)

These roads distribute traffic within community area. They form the link between local roads and access roads.

6) Access Roads (V_6, V_7)

These roads give direct access to buildings and land within community areas.

4.1.3 Design Standards

The basic design standards for rural area highways are prepared by DOH and the principal design standards for industrial and residential area are prepared by IEAT and DTCP respectively. In the standards mentioned above, however, the detailed elements are not stated, so standard of AASHO (American Highway Design Standards) and other countries are referred to for detailed element.

4.1.4 Typical Cross-Section

In principle, the DOH standards are adopted for the cross-section of major roads such as inter-urban primary roads, intra-urban primary roads and district roads.

Taking into account the IEAT's and DTCP's design standards, the detailed cross-section elements of the other minor roads are examined. The typical cross-sections are illustrated in Fig. IV.4.1 to Fig. IV.4.5.

1) Lane Width

A lane width of 3.5 meters is adopted for major roads considering the DOH standards, the expected high truck percentage and the high running speed.

A lane width of 3.0 meters is adopted for the minor roads such as the local and collector roads on the basis of the IEAT and DTCP standards, except minor roads in the industrial and port areas, for which a lane width of 3.5 m is adopted due to the expected high truck percentage with much traffic volume.

2) Shoulder Width

Basically, it is not necessary to establish a wide shoulder on the dual carriage way road in urban area.

Taking into account various functions of the shoulder in urban area and the width of the vehicles, the shoulder width of 1.50 meters is adopted. The shoulder will be used for emergency park, the short time parking and other motives.

The shoulder width of 0.5 meters is adopted for minor roads in view of its few traffic volume.

3) Sidewalk Width

It is desirable to have sidewalks as wide as possible for keeping the better environment of streets. The sidewalks width of 4.0 - 5.0 meters is basically adopted including a width for tree plantation on the sidewalk. The minimum sidewalk width is 1.5 meters considering the width of person's shoulder.

4.1.5 Future Road Network

Future road network is illustrated in Fig. IV.4.6. The plans are prepared analyzing such aspects as basic considerations of the road network briefly explained in the Sub-section 4.1.1, function and characteristics of each road and the existing road network.

4.1.6 Intersection Plan

1) General

An intersection is a cross point of roads at which traffic changes its direction. An intersection plan should be carefully prepared so as to minimize traffic accidents which often occurs at intersections.

Type of intersection in this study is planned as below on the basis of a traffic volume at the intersection and the function of the road.

(1) Inter Urban Primary Road (V_1) — Grade Separated Intersection.
(2) Other Dual Carriage way — Signalized At-grade Intersection.
(3) 2 Lane Road — Non Signalized At-grade Intersection.

Road Class	V_1	V_2	V_3	V_4	V_5	V_6
V_1	◎	◎	-	-	-	-
V_2	◎	o	o	-	-	-
V_3	-	o	o	o	-	-
V_4	-	-	o	Δ	Δ	-
V_5	-	-	-	Δ	Δ	Δ
V_6	-	-	-	-	Δ	Δ

Note: ◎ : Grade Separation
o : Signalized At-grade
Δ : Non Signalized At-grade
- : Non Access

2) Location of the Intersection Type

Type of intersection are planned taking into account the future traffic volume, basic consideration of the type of intersection, function of the individual road and the road network.

Location of grade separated and signalized intersections are illustrated in Fig. IV.4.7. The type of intersection of each intersection that is intersection A to H are illustrated in Fig. IV 4.8.

4.1.7 Public Transportation Requirement

1) Public Transportation Requirement

The number of commuters in the study area and the surrounding areas in the year 2001 are estimated to be 76,145. Within these commuters, the number of commuter from New Town Development area to the Industrial Estate, Port area and Business areas in year 2001 are estimated to be 24,090.

If these commuters will use only passenger car for commuting, traffic volume will be estimated to be about 50,000 vehicles per hour (V/H). As a result, 50 traffic lanes and large parking spaces will be required to control above mentioned traffic volume.

Therefore, a good public transportation system is required in this study area and surrounding area not only due to the lack of private means but also to reduce the construction cost of streets and other public utilities substantially.

2) Introduction of Bus Exclusive Lanes

According to the result of the traffic projection from new town to the work place, where the industrial estate, port area and business area, during peak hour, it is estimated that 373 buses per hour will have to be operated. Since the new town and above development areas are connected by 5 roads, therefore, 75 buses per road per hour should be operated.

Introduction of bus exclusive lanes will be required in order to secure that good environment along the roads, to decrease the traffic accidents and the construction cost, and to increase the availability of the public transportation services.

3) Bus Route

By the traffic projection, the number of bus between each traffic zone are forecasted. The main items to be considered for the allocation of bus routes are as follows;

- to define the passenger demand.
- to select the minimum distance route.
- to connect the main activities of the development.
- to ensure the higher availability of buses.
- to conform to the road network.

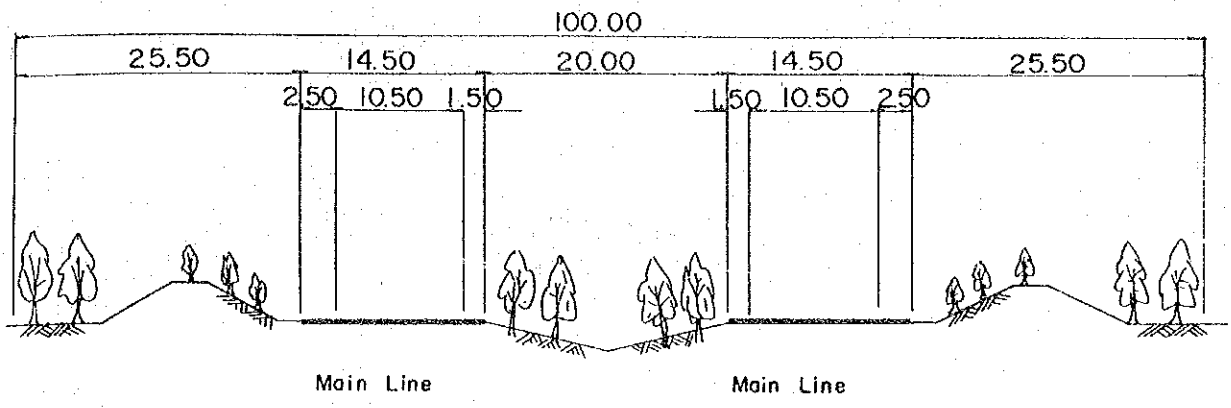
Additionaly, long distance trip bus route such as Bangkok to Pattaya will be operated on the route 3 by-pass and middle distance trip bus route such as Siracha to Pattaya will be operated on the existing route 3.

4) Allocation of Main Bus Terminals and Bus Stops

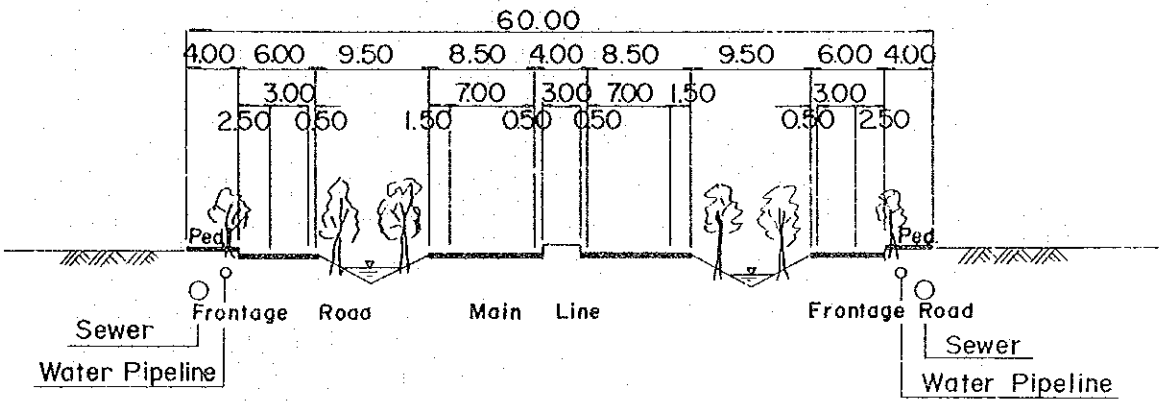
Allocation of main bus terminals should be determined in consideration of the bus route location, the activities of the development, and demand of the commuters. There are two areas with major activities, that are new town center and the business center, in this development area. Therefore, the main bus terminals should be located in the above mentioned two areas.

Allocation of bus stops should also be determined in consideration of the development pattern of the city, bus routes and the maximum allowable walking distance. Since bus routes are located along the district roads surrounding each block, bus stop would be placed at both side of the block. Under this plan, the maximum walking distance for passenger will become 500 - 600 meters. Bus stops will be constructed by cutting a part of the side walk as bus bays.

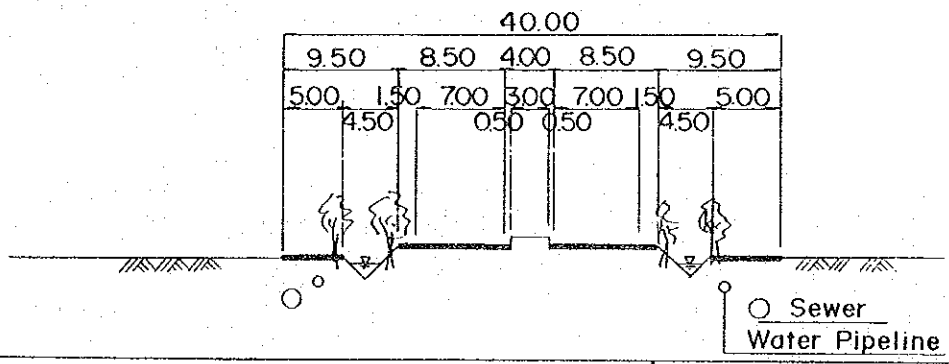
1) Inter Urban Primary Road (V1)



2) Intra Urban Primary Road (V2)



3) District Distributor (V3)



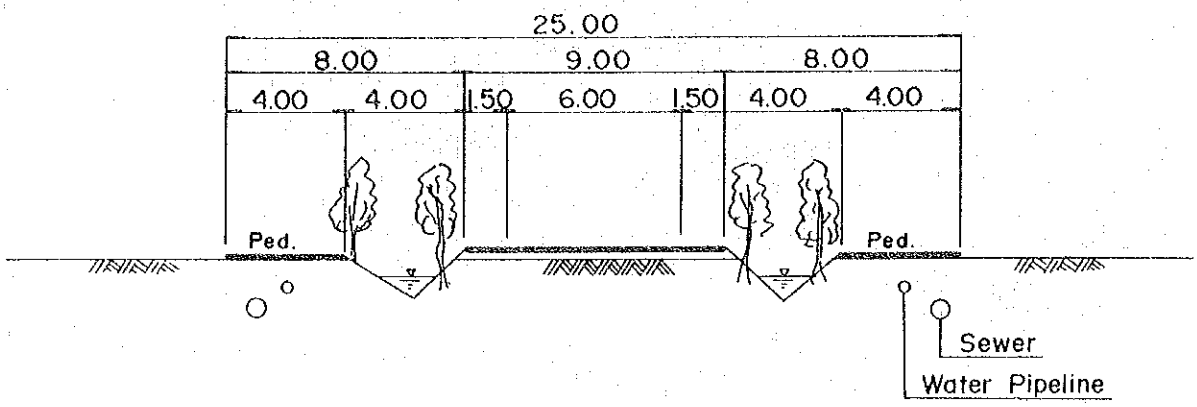
LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

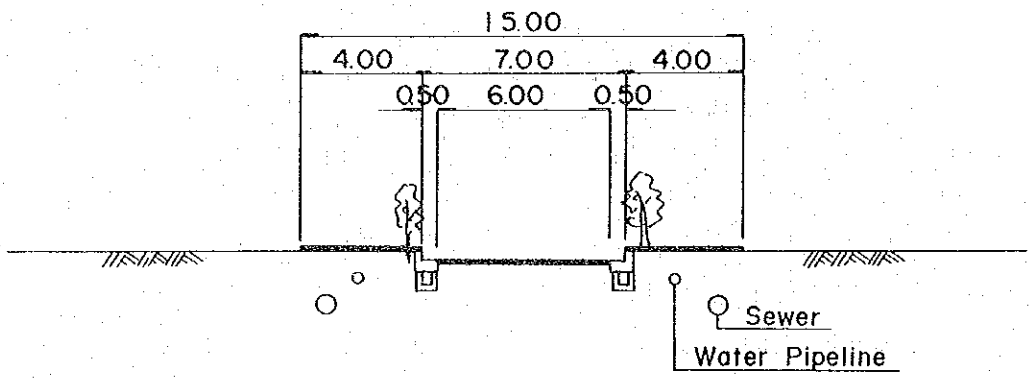
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.4.1
Typical Cross-Section (Master-Plan)

4) Local Road (∇_4) (For New Town Area)

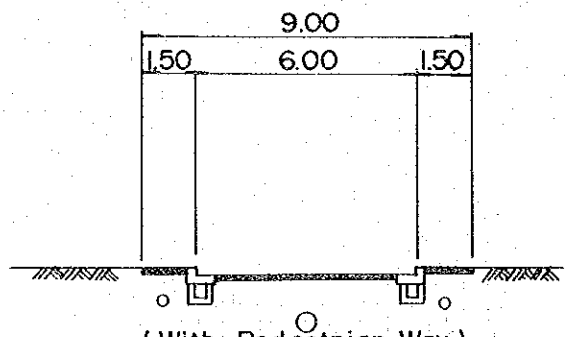


5) Collector (∇_5) (For New Town Area)

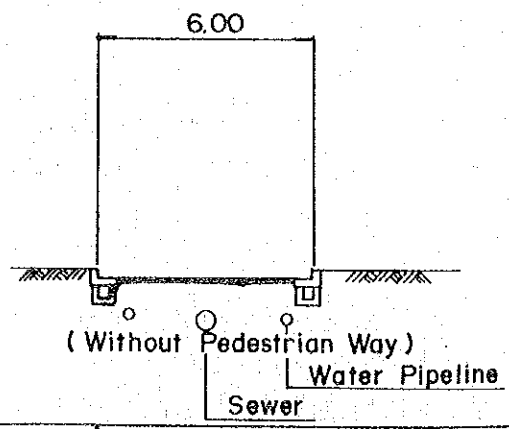


6) Access Road (∇_6) (For New Town Area)

(∇_{6-1})



(∇_{6-2})



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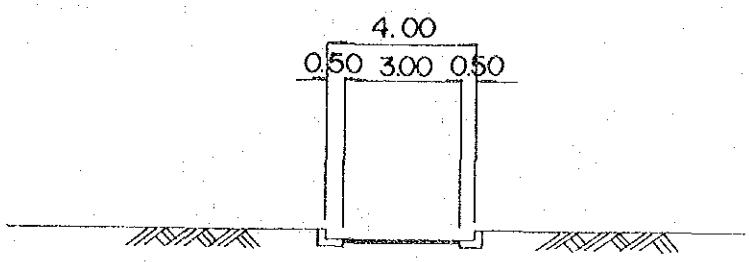
KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

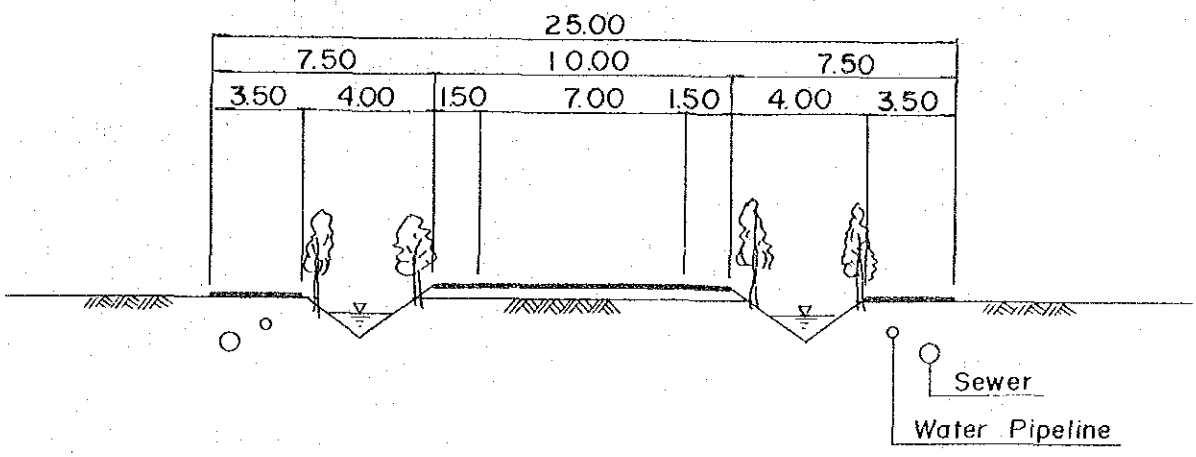
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.4.2
Typical Cross-Section (Master-Plan)

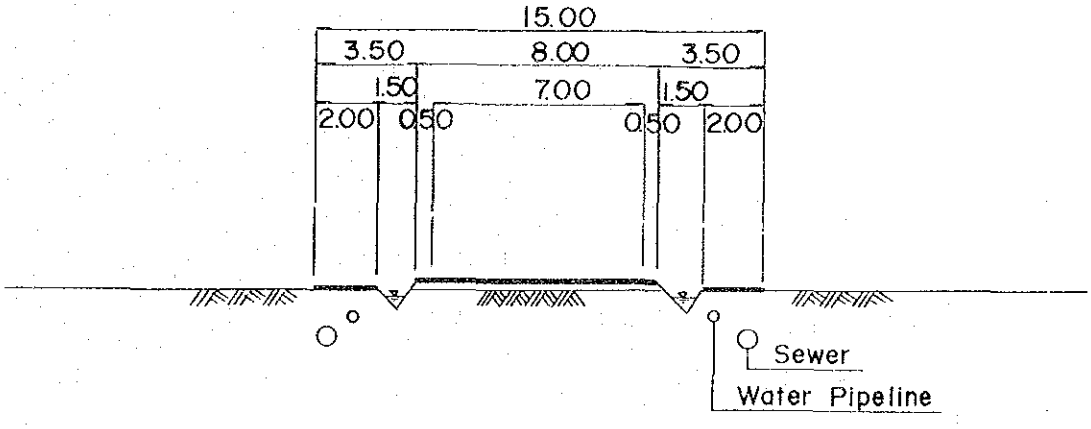
7) Access Road (V7) (For New Town Area)



8) Local Road (V4) (For Industrial Estate Area)



9) Collector (V5) (For Industrial Estate Area)



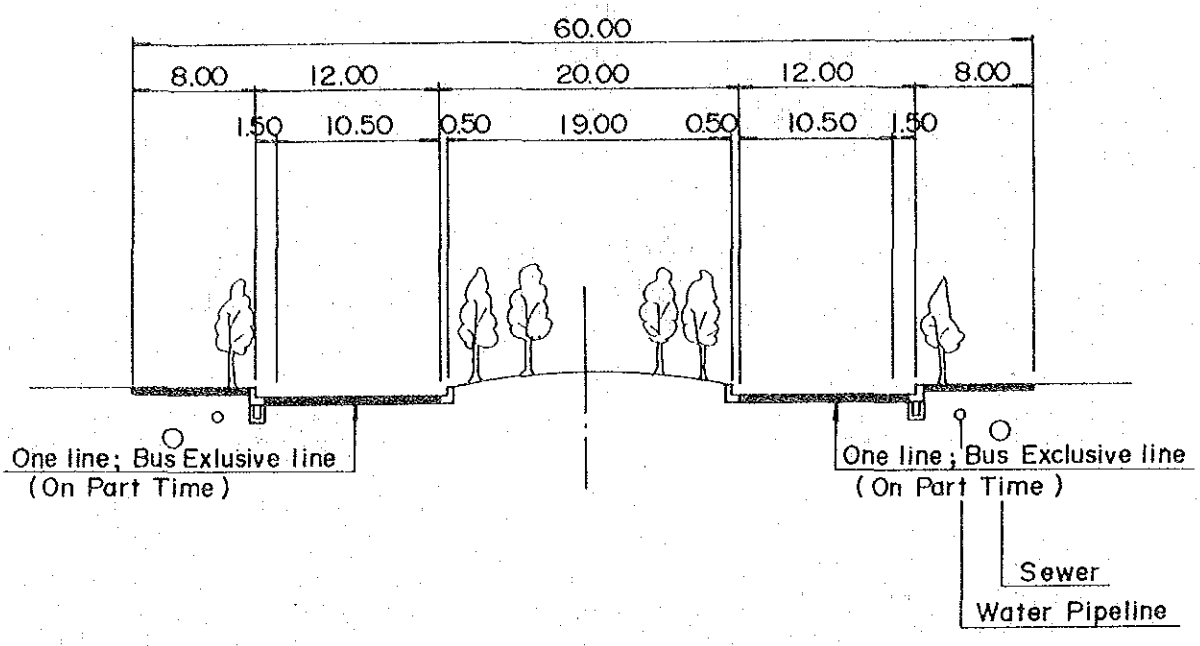
LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

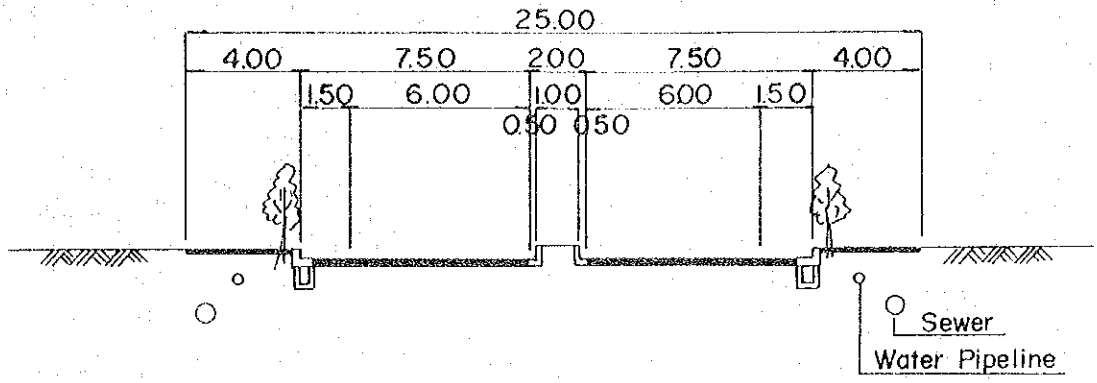
Fig. IV.4.3
Typical Cross-Section (Master-Plan)

10) District Distributor (V_3) (For Business & Commercial Area)

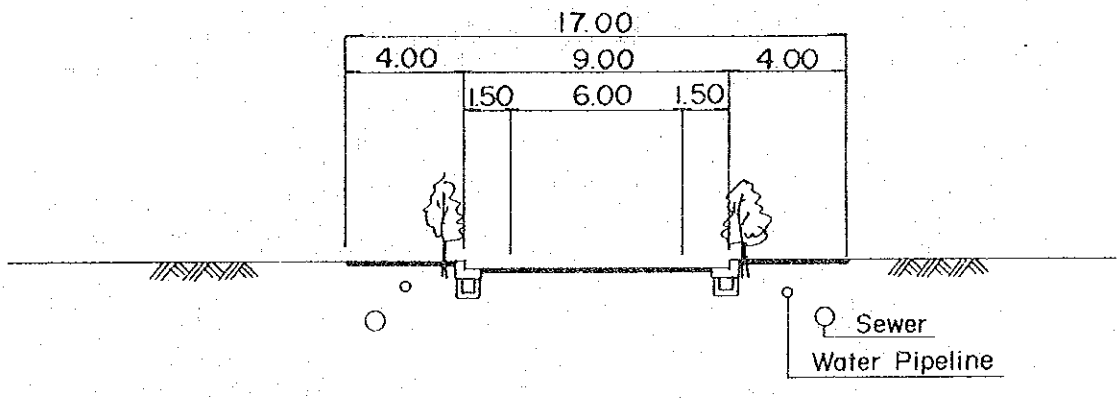


LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
	JAPAN INTERNATIONAL COOPERATION AGENCY
	Fig. IV.4.4 Typical Cross-Section (Master-Plan)

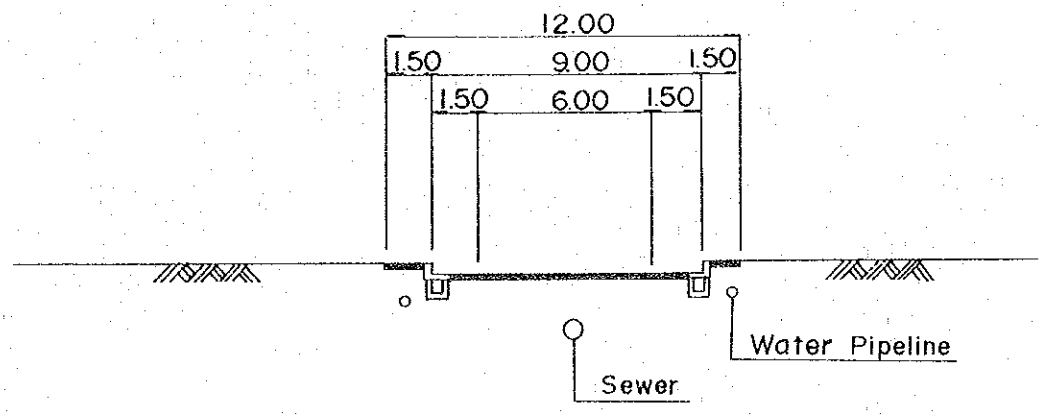
11) Local Road (▽4) (For Business & Commercial Area)



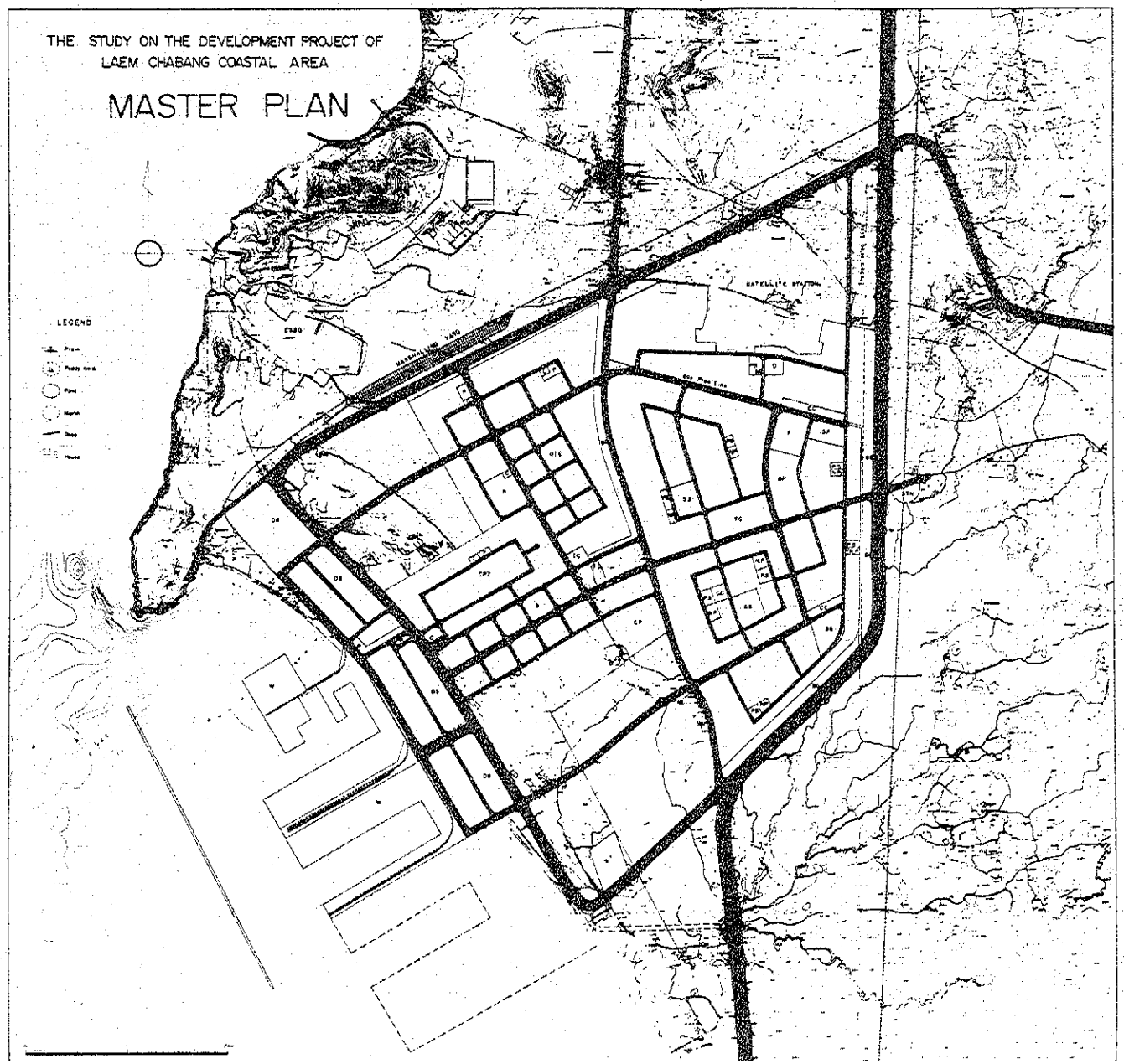
12) Collector (▽5) (For Business & Commercial Area)



13) Access Road (▽6) (For Business & Commercial Area)



LEGEND	KINGDOM OF THAILAND THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
	JAPAN INTERNATIONAL COOPERATION AGENCY
	Fig. IV.4.5 Typical Cross-Section (Master-Plan)



LEGEND

V.1 ROAD

V.2 ROAD

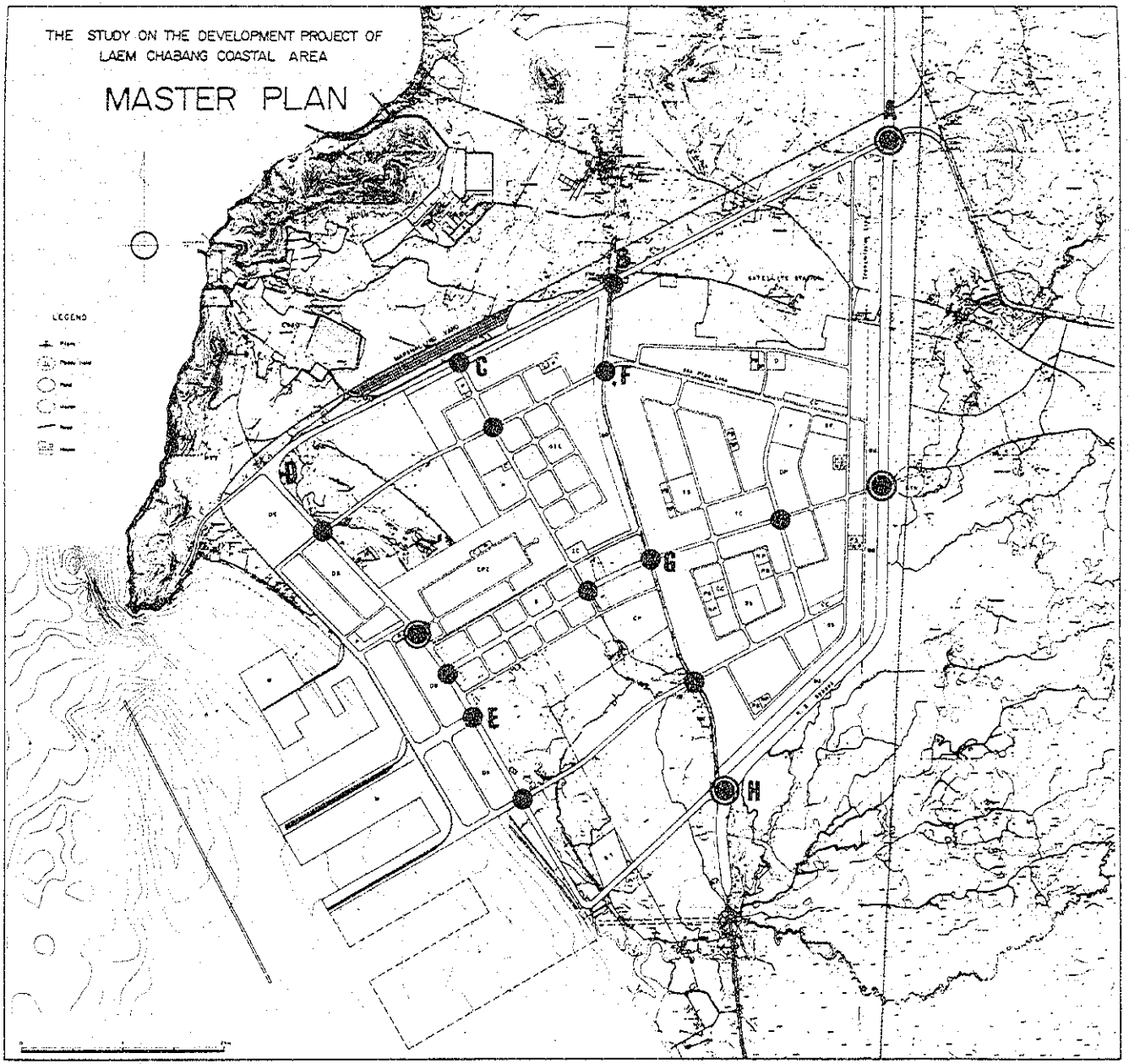
V.3 ROAD

V.4-V.7 ROAD

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.4.6
Road Network Configuration (Master Plan)



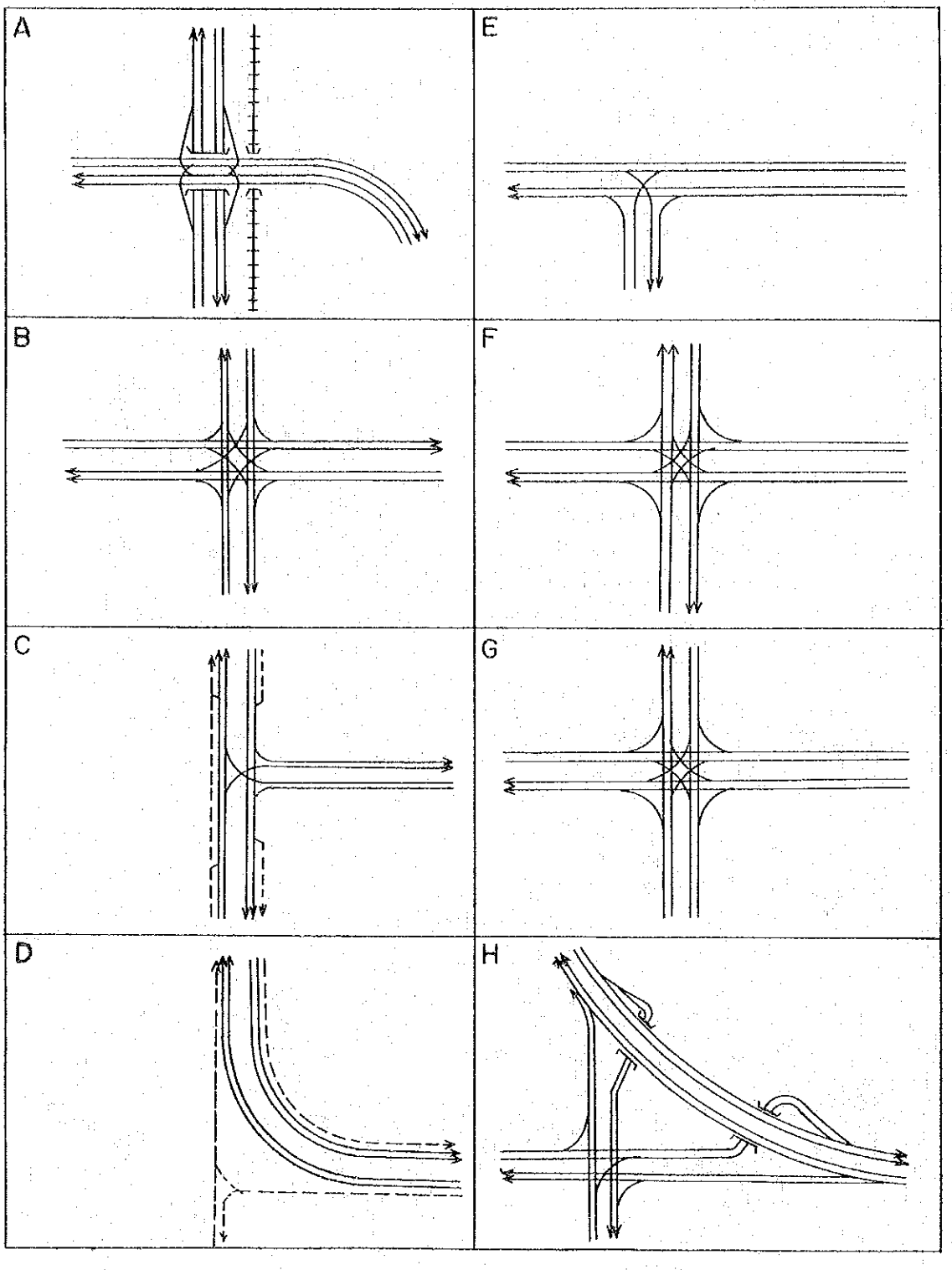
LEGEND

- Signalized Intersection
- Grade Separated Intersection

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.4.7
Location of Intersection (Master Plan)



LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
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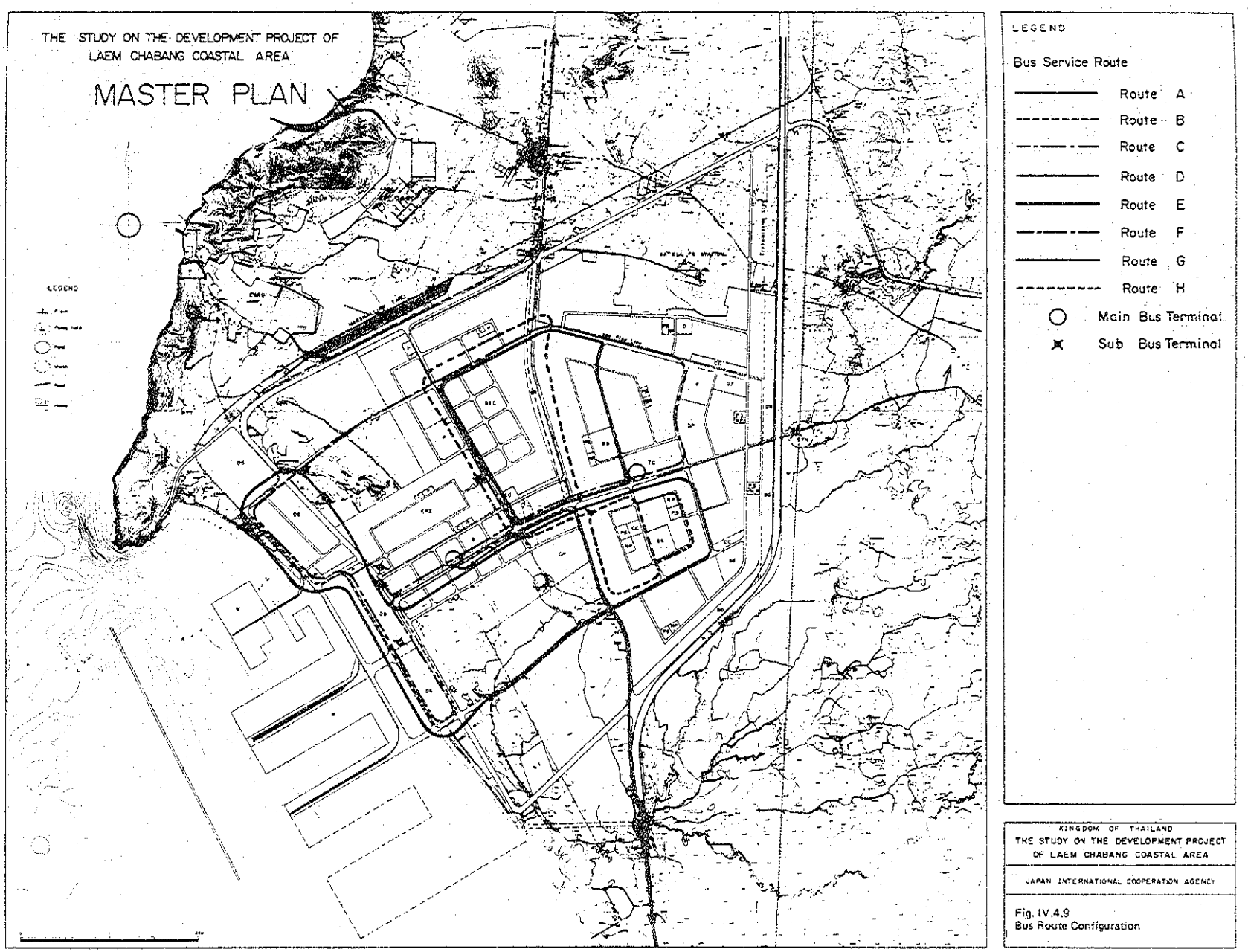
Fig. IV.4.8
Type of Intersection Plan


THE STUDY ON THE DEVELOPMENT PROJECT OF
LAEM CHABANG COASTAL AREA
MASTER PLAN
LEGEND
Bus Service Route
Route A
Route B
Route C
Route D
Route E
Route F
Route G
Route H
Main Bus Terminal
Sub Bus Terminal
KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. IV.4.9
Bus Route Configuration

5. CARGO AND PASSENGER TRANSPORT DEMAND FOR SHORT TERM DEVELOPMENT

Cargo transport demand for the short term plan has already been described in preceeding section on long term transport plan. Estimation methods and resulting volume estimates are presented in these sections.

Methods of passenger transport demand projections have been presented in preceeding sections on long term transport plan. Table IV.5.1 shows origins and destinations of peak hour passenger traffic flows, and Figure IV.5.1 illustrates peak hour passenger movements in the form of desire lines.

Table IV.5.2 shows origins and destinations of morning peak hour vehicular traffic of private vehicles (passenger cars and motorcycles), and public transport (buses). Figure IV.5.2 shows peak hour oneway traffic volumes in PCUs on the short term plan road network for the year 1991.

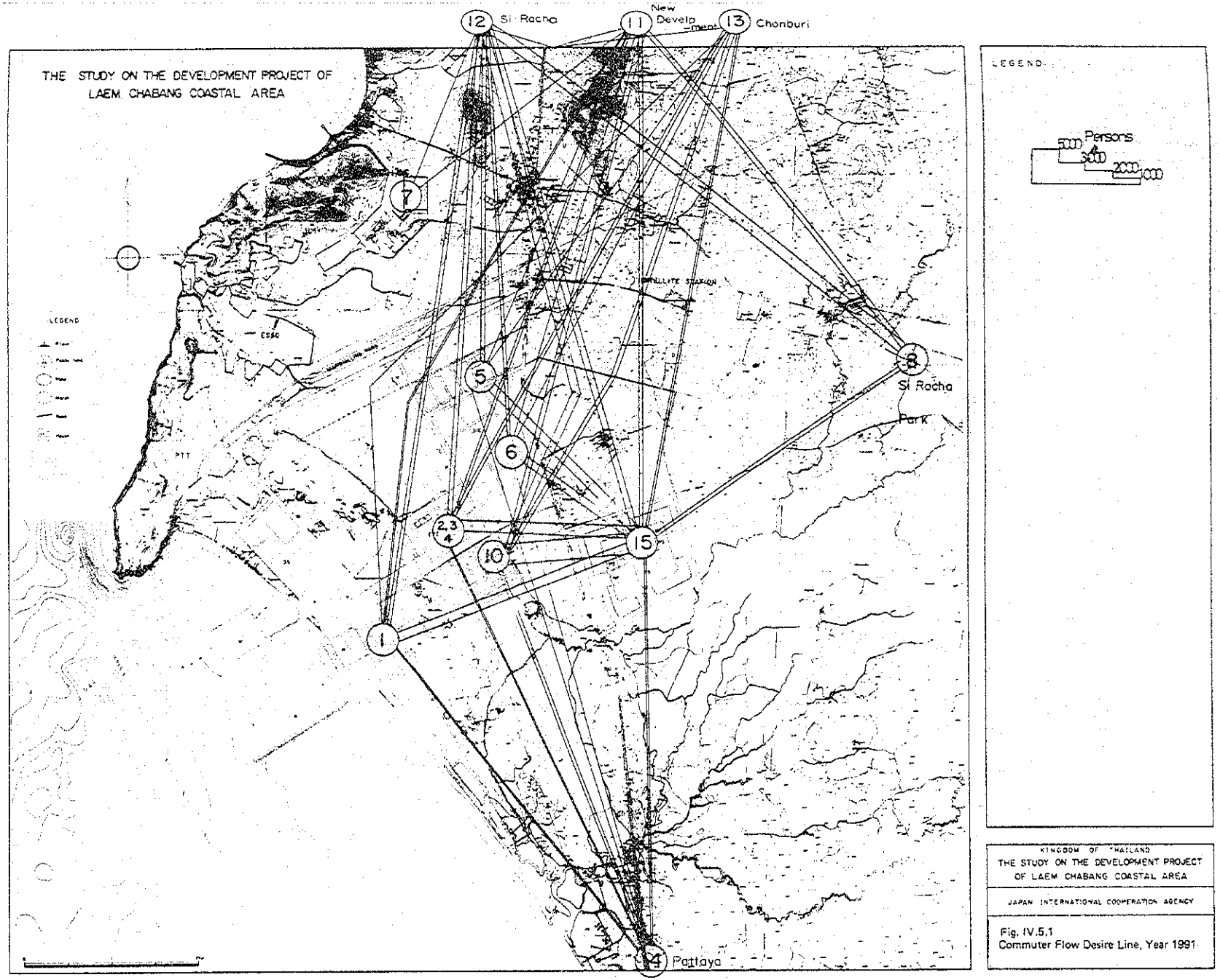
Table IV.5.1 ORIGINS AND DESTINATIONS OF MORNING COMMUTERS
(SHORT TERM PLAN)

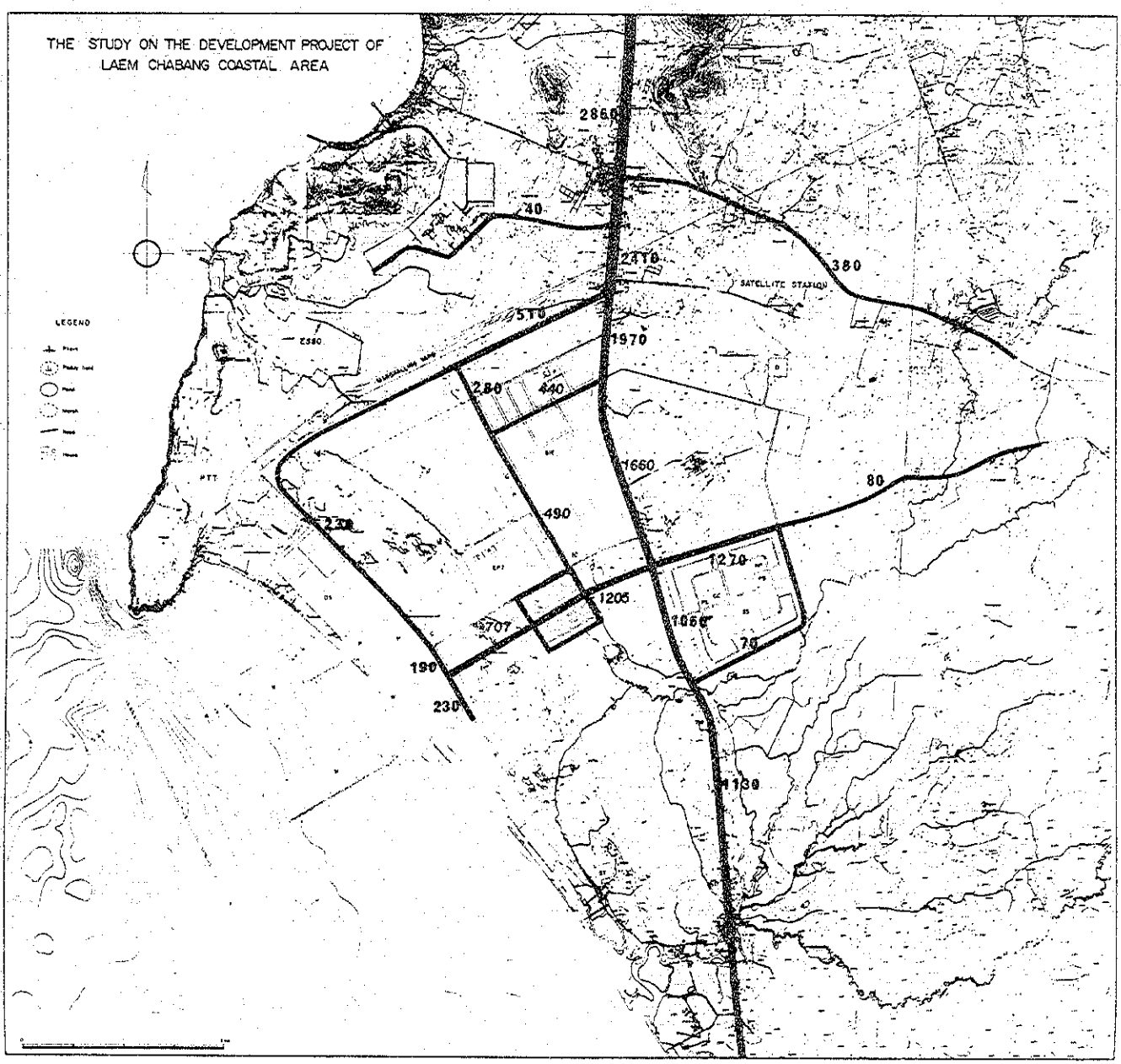
Origin	Destination																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
															New Town					
	Port	EPZ West	EPZ South	EPZ East	GIE North	GIE South	Oil & Gas	SR IP	Commu-nity Center	Busi-ness Area	New Si Racha	Old Si Racha	Chonburi	Pattaya	Block A	Block B	Block C	Block D	Block E	Total
10 Business Area	-	-	-	-	-	-	-	-	-	-	-	1,000	-	-	-	-	-	-	-	1,000
11 New Si Racha	223	106	105	105	193	193	75	742	-	599	-	-	-	-	452	-	-	-	-	2,793
12 Old Si Racha	465	220	220	220	402	402	156	1,547	-	1,229	-	-	-	-	944	-	-	-	-	5,805
13 Chonburi	263	125	125	125	228	228	-	-	-	696	-	-	-	-	418	-	-	-	-	2,208
14 Pattaya	265	120	120	120	219	219	-	-	-	668	-	-	-	-	403	-	-	-	-	2,134
15 New Town Block A	1,130	536	536	536	978	978	-	480	-	2,989	-	-	-	-	2,300	-	-	-	-	10,463
16 New Town Block B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 New Tosl Block C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 New Town Block D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19 New Town Block E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2,336	1,106	1,106	1,106	2,020	2,020	231	2,769	-	7,177	-	-	-	-	4,517	-	-	-	-	24,403

Table IV.5.2 ORIGINS AND DESTINATIONS OF MORNING COMMUTER VEHICLES
(SHORT TERM PLAN)

Origin	Destination																			
	1 Port	2 EPZ West	3 EPZ South	4 EPZ East	5 GIE North	6 GIE South	7 Oil & Gas	8 SR IR	9 Community Center	10 Business Area	11 New Si Racha	12 Old Si Racha	13 Chonburi	14 Pattaya	15 New Town Block A	16 New Town Block B	17 New Town Block C	18 New Town Block D	19 New Town Block E	Total
10 Business Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 New Si Racha	32/2	15/1	15/1	15/1	28/2	28/2	11/1	108/7	-	87/6	-	-	-	-	66/5	-	-	-	-	405/28
12 Old Si Racha	67/5	32/2	32/2	32/2	58/4	58/4	23/2	224/15	-	178/12	-	-	-	-	137/9	-	-	-	-	842/58
13 Chonburi	38/3	18/1	18/1	18/1	33/2	33/2	-	-	-	101/7	-	-	-	-	61/4	-	-	-	-	320/22
14 Pattaya	38/3	17/1	17/1	17/1	32/2	32/2	-	-	-	97/7	-	-	-	-	58/4	-	-	-	-	309/21
15 New Town Block A	164/11	78/5	78/5	78/5	142/10	142/10	-	70/5	-	433/30	-	-	-	-	334/23	-	-	-	-	1517/105
16 New Town Block B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 New Town Block C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 New Town Block D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19 New Town Block E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	339/23	160/11	160/11	160/11	293/20	293/20	33/2	402/28	-	896/62	-	-	-	-	655/45	-	-	-	-	3393/234

Note: PCU/Bus Figures in left corner are passenger cars and motorcycles in PCU.
Figures in right corner are number of buses.


THE STUDY ON THE DEVELOPMENT PROJECT OF
LAEM CHABANG COASTAL AREA
12 Si Racha
11 New Development
13 Chonburi
7
5
6
8 Si Racha Park
23 4
10
15
1
14 Pattaya
ESSO
PTT
SATELLITE STATION
LEGEND
LEGEND
5000 Persons
3000
2000
1000
KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. IV.5.1
Commuter Flow Desire Line, Year 1991



LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.5.2
Peak Hour Oneway Traffic Flow, Year 1991
(In PCU)

6. ROAD PLANNING FOR SHORT TERM DEVELOPMENT

6.1 Traffic Capacity

The traffic capacity on the planned roads are forecasted on the base of the characteristics of the road, the condition along the road and the element of the road cross-section due to examin the number of the lane on the individual planned roads. The traffic capacity of the general section and intersection are calculated as shown in Table IV.6.1.

Table IV.6.1 TRAFFIC CAPACITY

(Unit: V/H)

Road Class	General Section	Inter-section	No. of Lanes
Inter Urban Primary (V_1)	5,200	4,300	4
Intra Urban Primary (V_2)	5,200	4,300	4
District Road (V_3)	4,700	4,300	4
Local Road (V_4)	1,300	900	2
Collector Road (V_5)	1,000	900	2
Access Road (V_6)	700	600	1

6.2 Number of Lane

The number of lane on the road is examined on the base of the comparison between traffic capacity and forecasted future traffic volume, the possibility of the stage construction, and economic perspectives.

1) V_3 Road within New Town

Future traffic volume in year 1991 on this road are forcasted to be about 1,270 vehicles per hour (one direction) and the traffic capacity on this road per one lane is estimated to be about 1,070 vehicles per hour. Therefore, 2 lane dual carriageway is required in this stage (short term).

Taking into account the future traffic volume in year 2001, 2 lane dual carriageway be able to control the future traffic volume. After in year 2001, the traffic volume will be exceed the traffic capacity. In this case, the 3 lane dual carriageway will be required after in year 2001.

2) V_3 Road within Business Area

As a result of the traffic projection of the future traffic demand in year 1991, the 2 lanes dual carriageway be able to control the future traffic volume from new town to this area. So 2 lane dual carriageway is adopted in short term stage. However, in year 2001, 3 lanes dual carriageway will be required taking into account the future traffic volume from the new town to this area and traffic volume within area.

3) V_2 Inter Urban Primary Road

The future traffic volume in year 1991 on this road is foracsted to be about 500 vehicles per hour. From viewpoint of the traffic volume, 2 lane road on both direction be able to control the future traffic volume. But, taking into account the function and characteristics of the road, and traffic flow characteristics, 2 lane dual carriageway is adopted in this stage.

Considering the land use along the V_2 road in short term stage, the frontage roads are not constructed. The frontage roads will be constructed depending upon the industrial development program.

The typical cross-section of short term development stage are illustrated in Fig. IV.6.1 to Fig. IV.6.5.

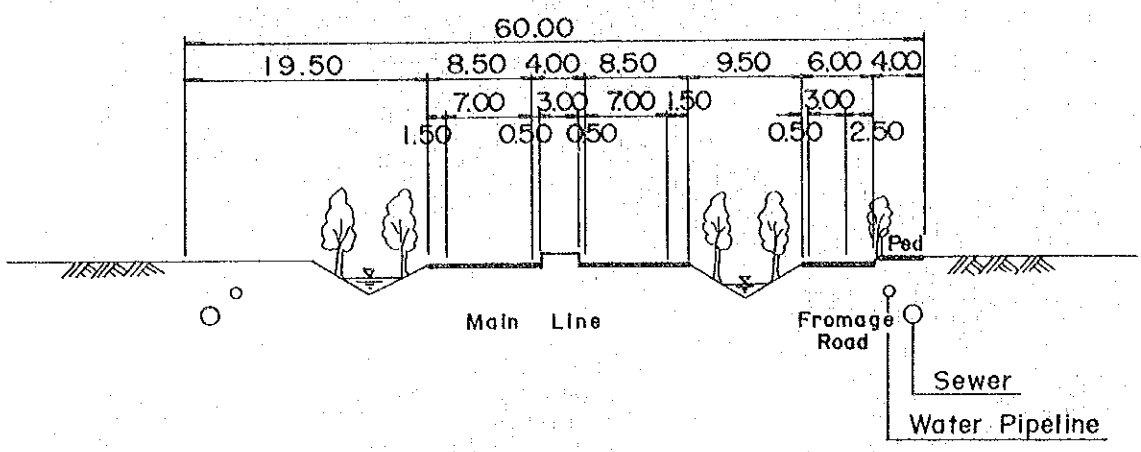
6.3 Road Network

The road network configuration in short term stage development is examined on the base of the road network in the long term development, additionally, taking into account the development program of the industrial estate and port development area. The road network configuration in short term is illustrated in Fig. IV. 6.6.

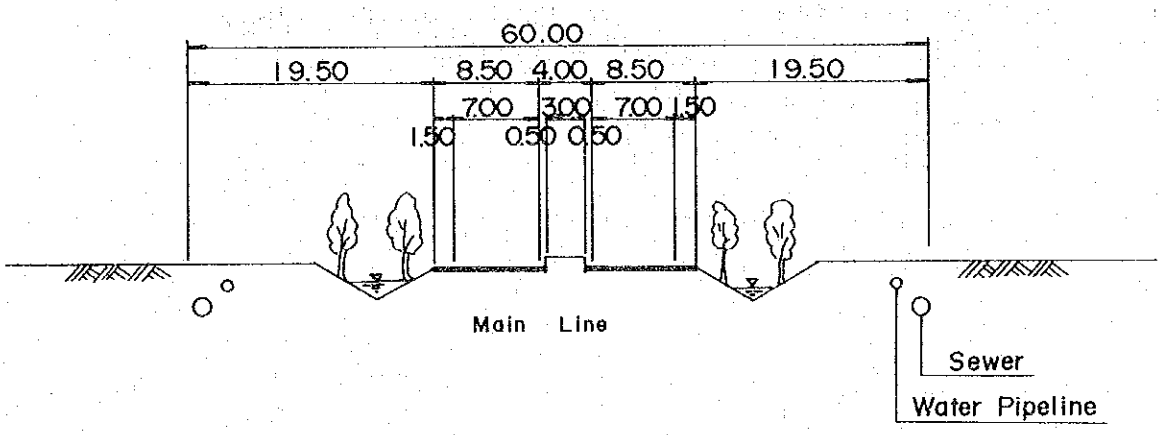
6.4 Intersection Design

Intersection design is carried out considering traffic flow, traffic volume, stage construction and economic perspectires. The pilot plan of the main intersections are illustrated in Fig IV.6.7 to Fig. IV.6.10. Main traffic flow of the main intersection on the existing Route 3 are presented from Chonburi to the industrial and port development area. So, these intersections are prepared two (2) turning right lanes for the turn right movent traffic flows.

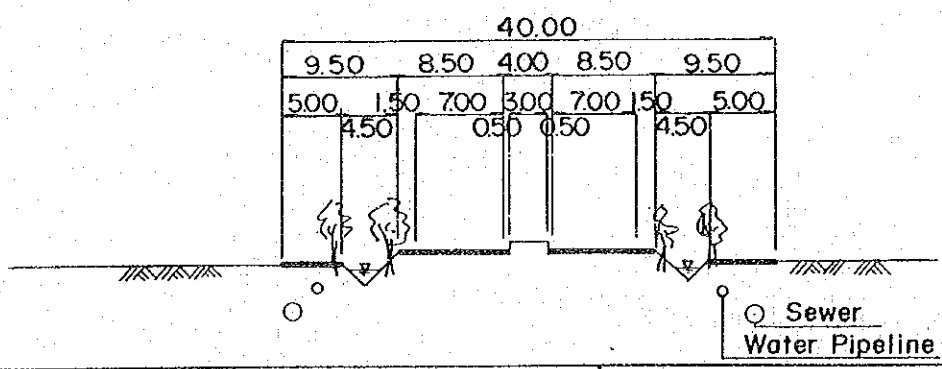
1) Intra Urban Primary Road (V_{2-1})



2) Intra Urban Primary Road (V_{2-2})



3) District Distributor (V_{3-1})



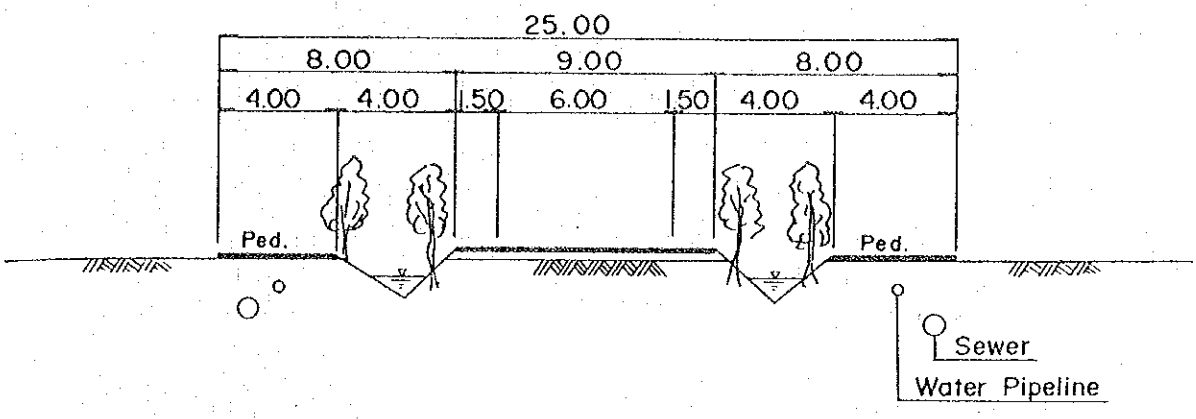
LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

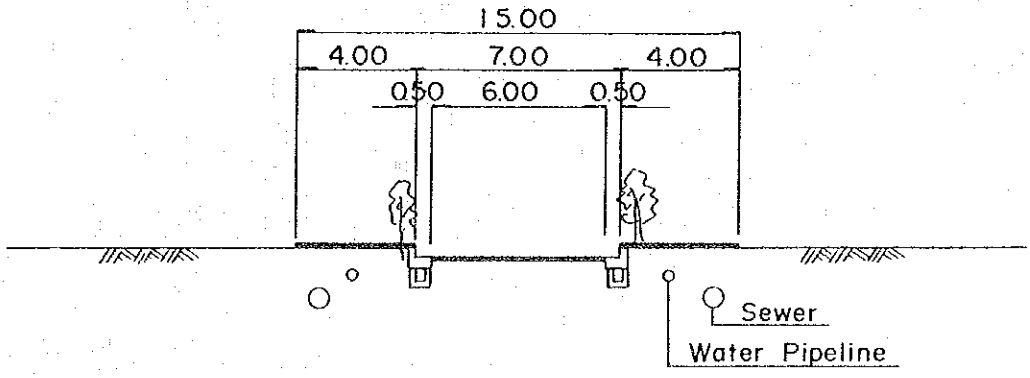
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.6.1
Typical Cross-Section (Short Term)

4) Local Road (∇_{4-1}) (For New Town Area)

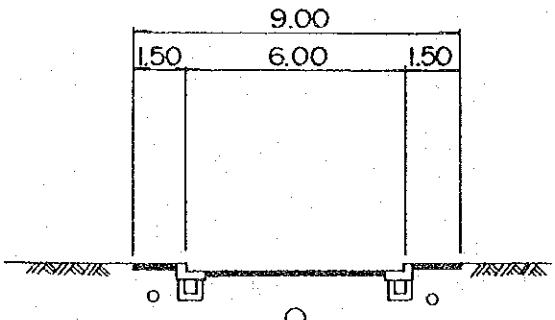


5) Collector (∇_{5-1}) (For New Town Area)

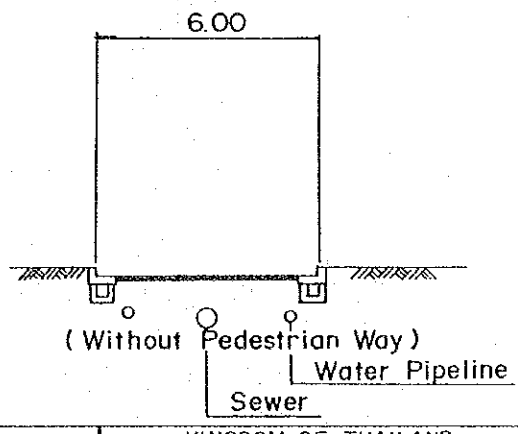


6) Access Road (∇_6) (For New Town Area)

(∇_{6-1})



(∇_{6-2})



LEGEND

KINGDOM OF THAILAND

THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

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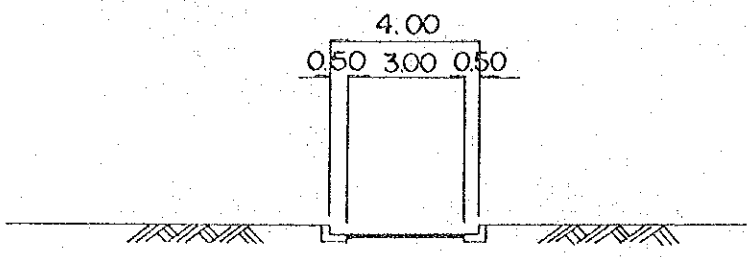
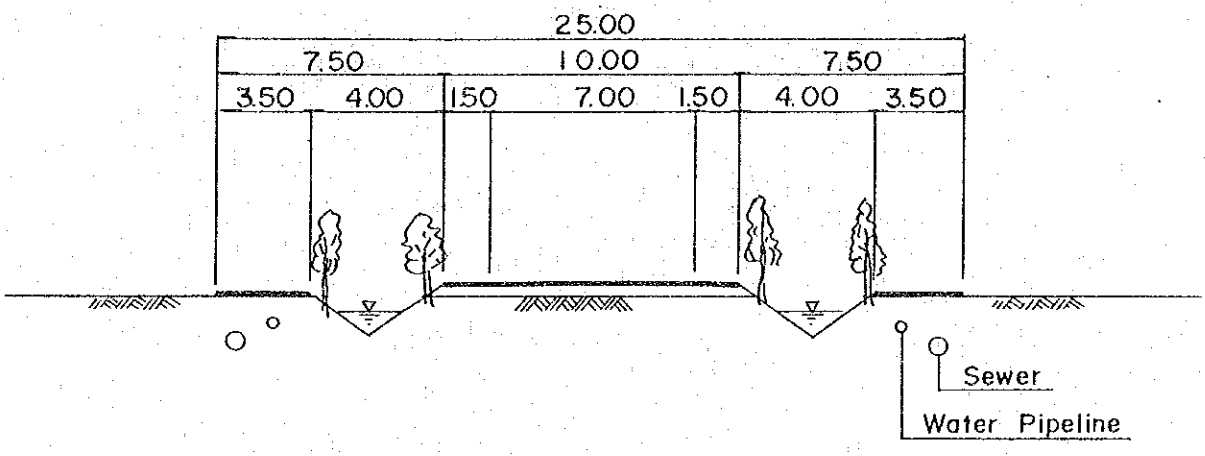
Fig. IV.6.2
Typical Cross-Section (Short Term)

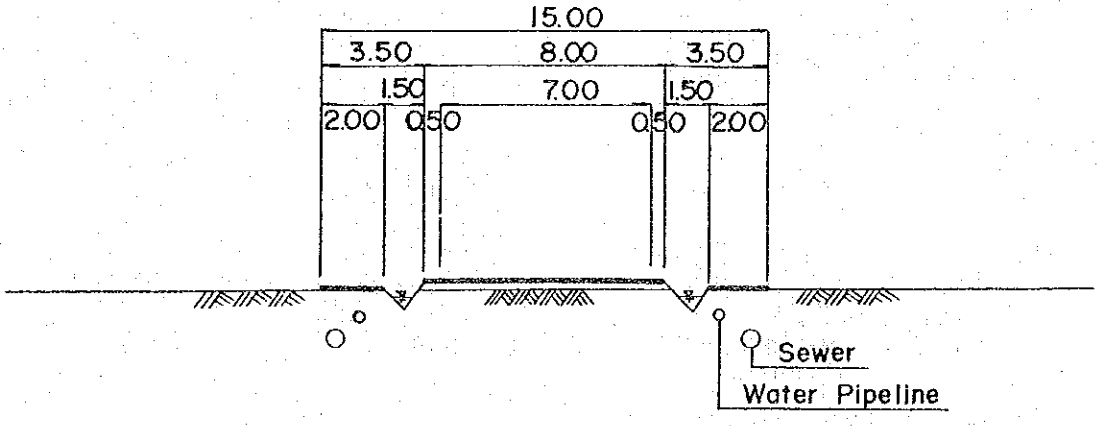
7) Access Road (∇_7) (For New Town Area)



8) Local Road (∇_4) (For Industrial Estate Area)



9) Collector (∇_5) (For Industrial Estate Area)



LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

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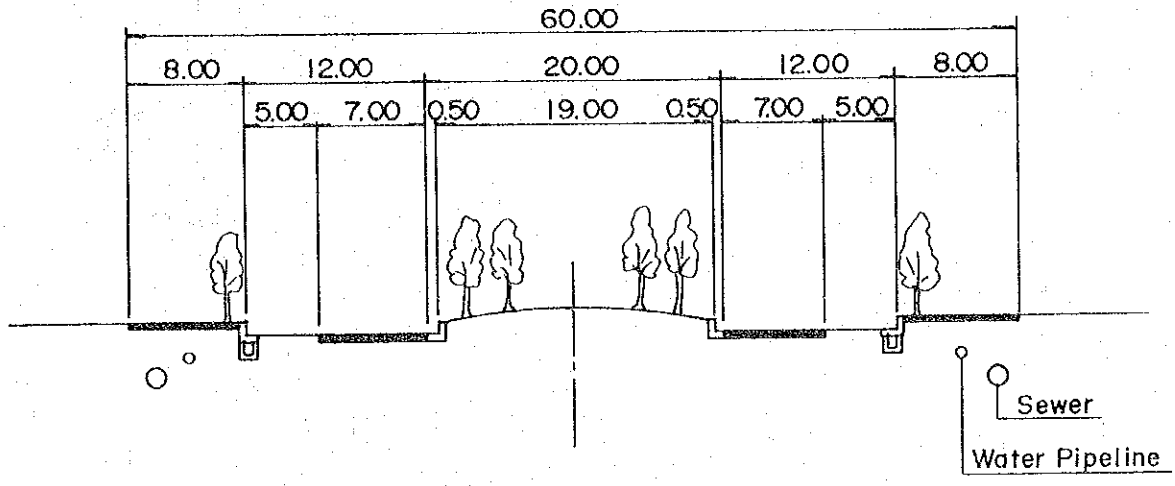
Fig. IV.6.3
Typical Cross-Section (Short Term)

10) District Distributor (V_{3-2}) (For Business & Commercial Area)



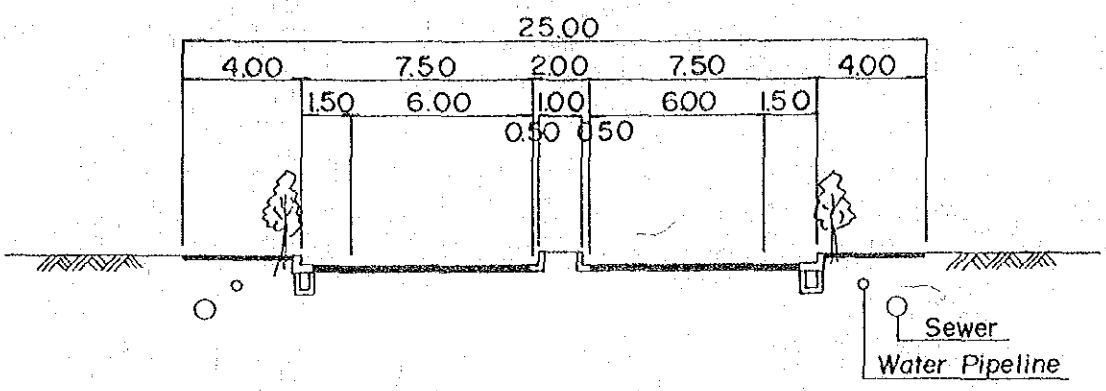
LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

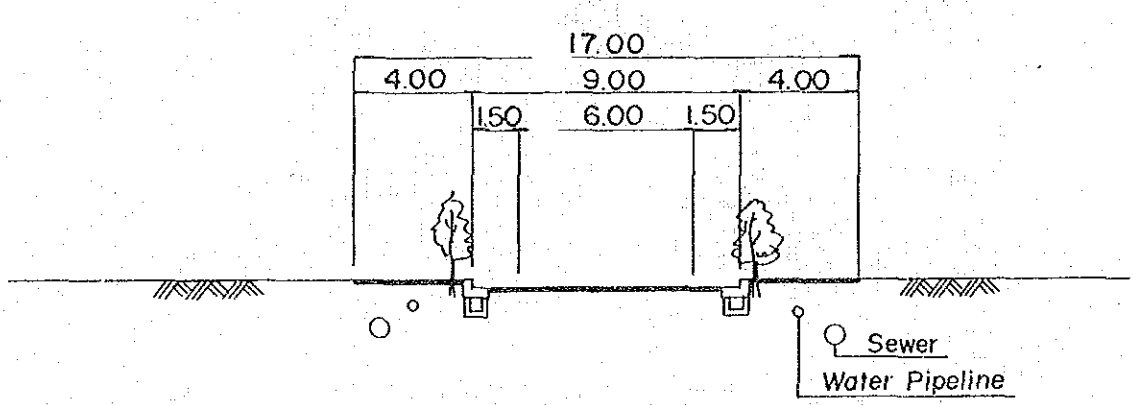
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.6.4
Typical Cross-Section (Short Term)

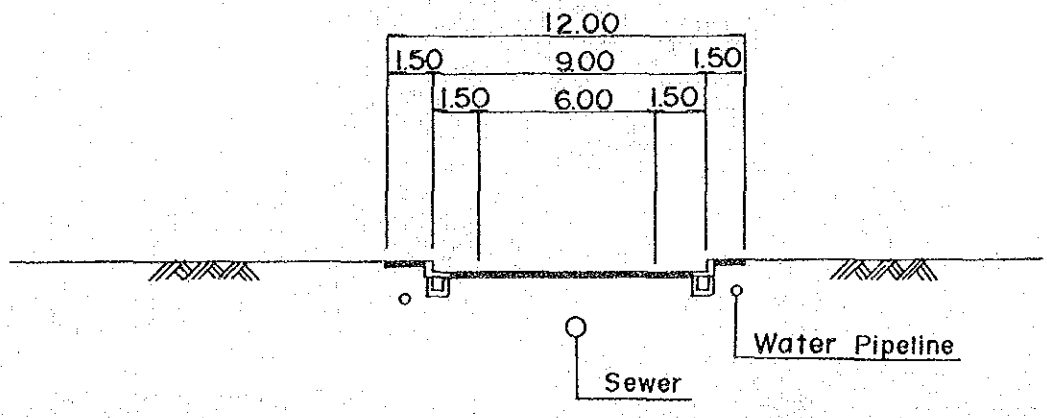
11) Local Road (V_{4-2}) (For Business & Commercial Area)



12) Collector (V_{5-3}) (For Business & Commercial Area)



13) Access Road (V_{6-3}) (For Business & Commercial Area)

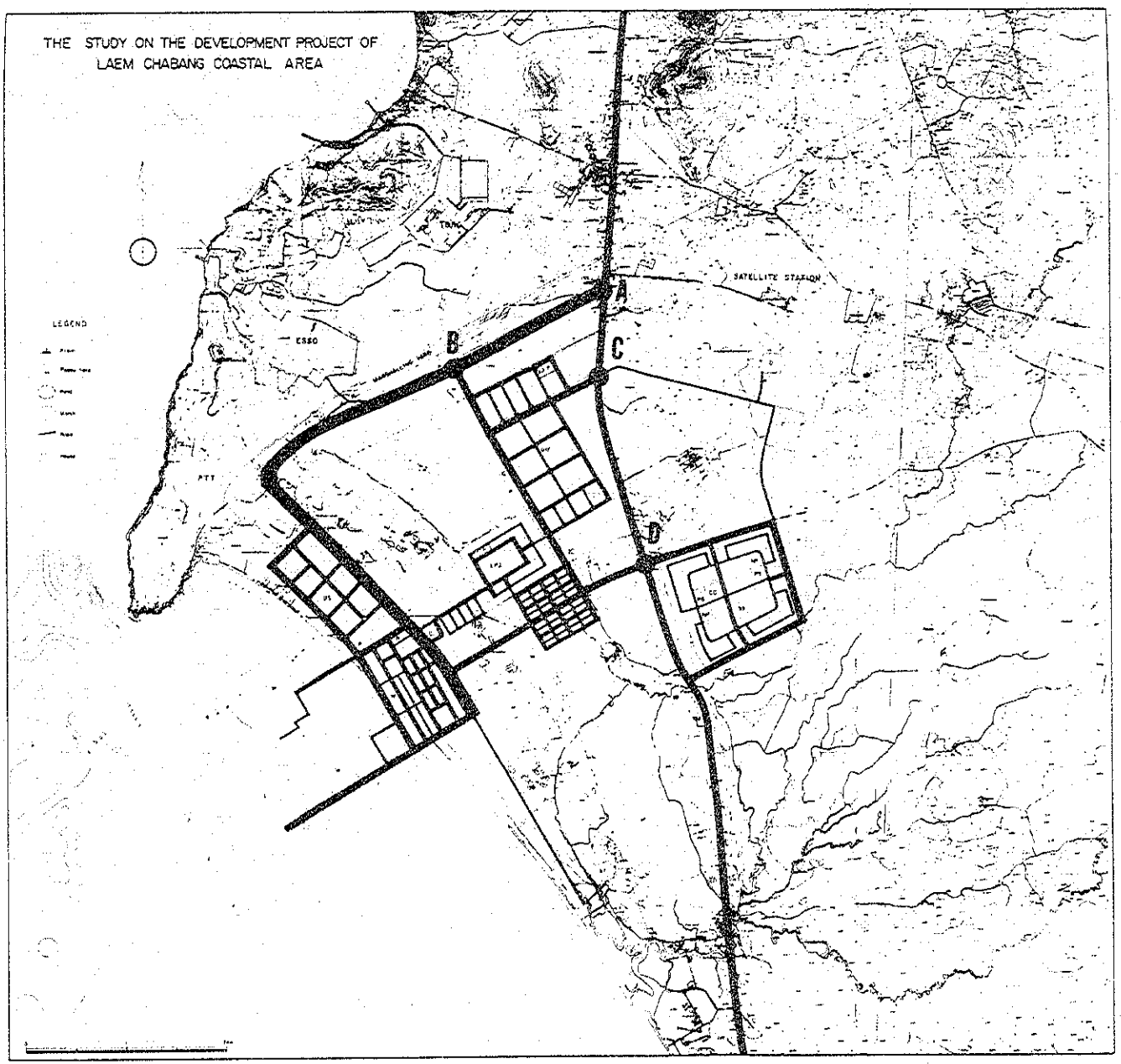


LEGEND

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.6.5
Typical Cross-Section (Short Term)



LEGEND

V-2 ROAD

V-3 ROAD

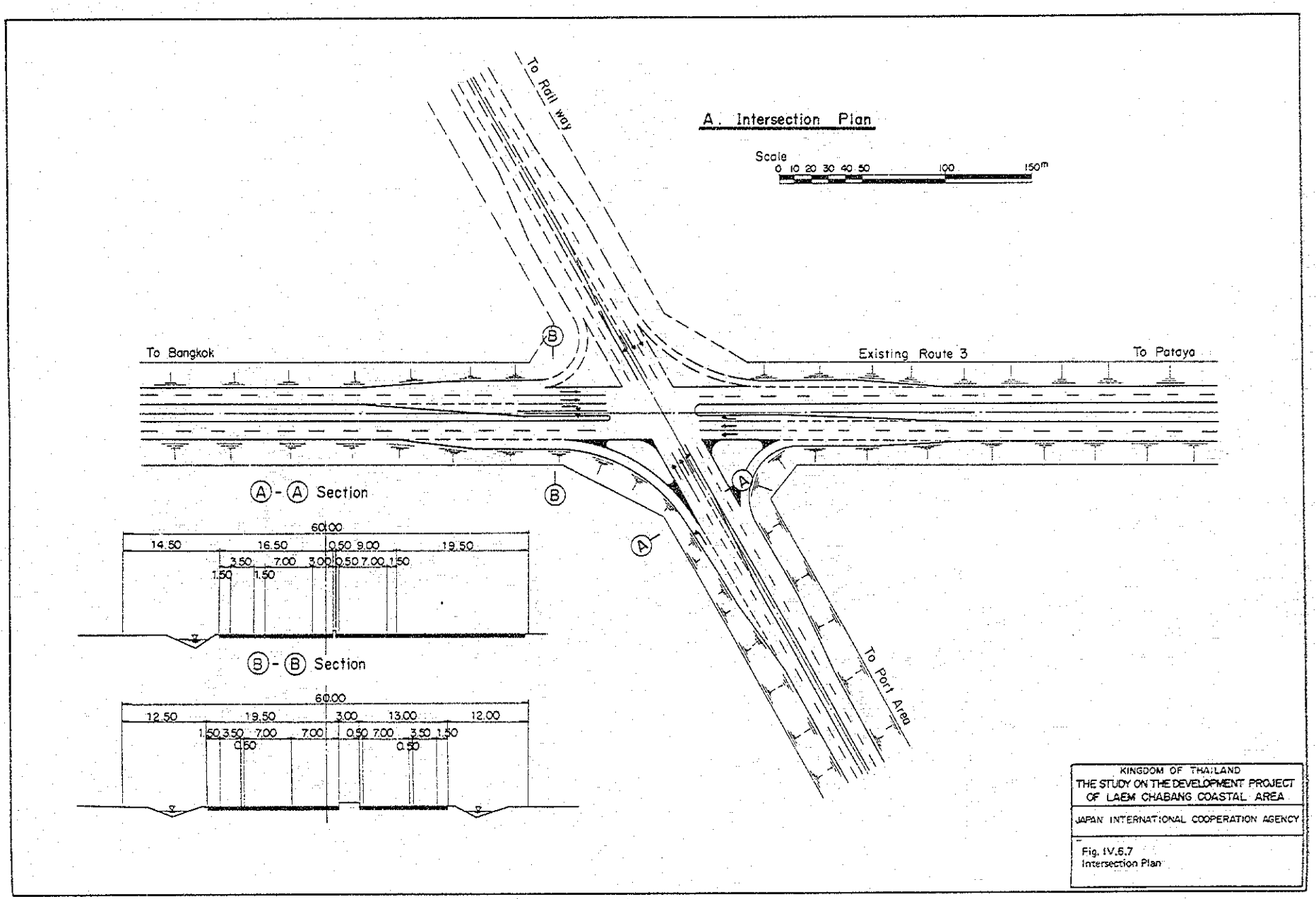
V-4 ROAD

V.5-V.7 ROAD

KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT
OF LAEM CHABANG COASTAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. IV.6.6
Road Network Configuration (Short-Term)


A. Intersection Plan
Scale
0 10 20 30 40 50 100 150m
To Rail way
To Bangkok
Existing Route 3
To Pataya
To Port Area
A
B
A - A Section
60.00
14.50 16.50 0.50 9.00 19.50
3.50 7.00 3.00 0.50 7.00 1.50
1.50 1.50
B - B Section
60.00
12.50 19.50 3.00 13.00 12.00
1.50 3.50 7.00 7.00 0.50 7.00 3.50 1.50
0.50 0.50
KINGDOM OF THAILAND
THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA
JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. IV.6.7
Intersection Plan

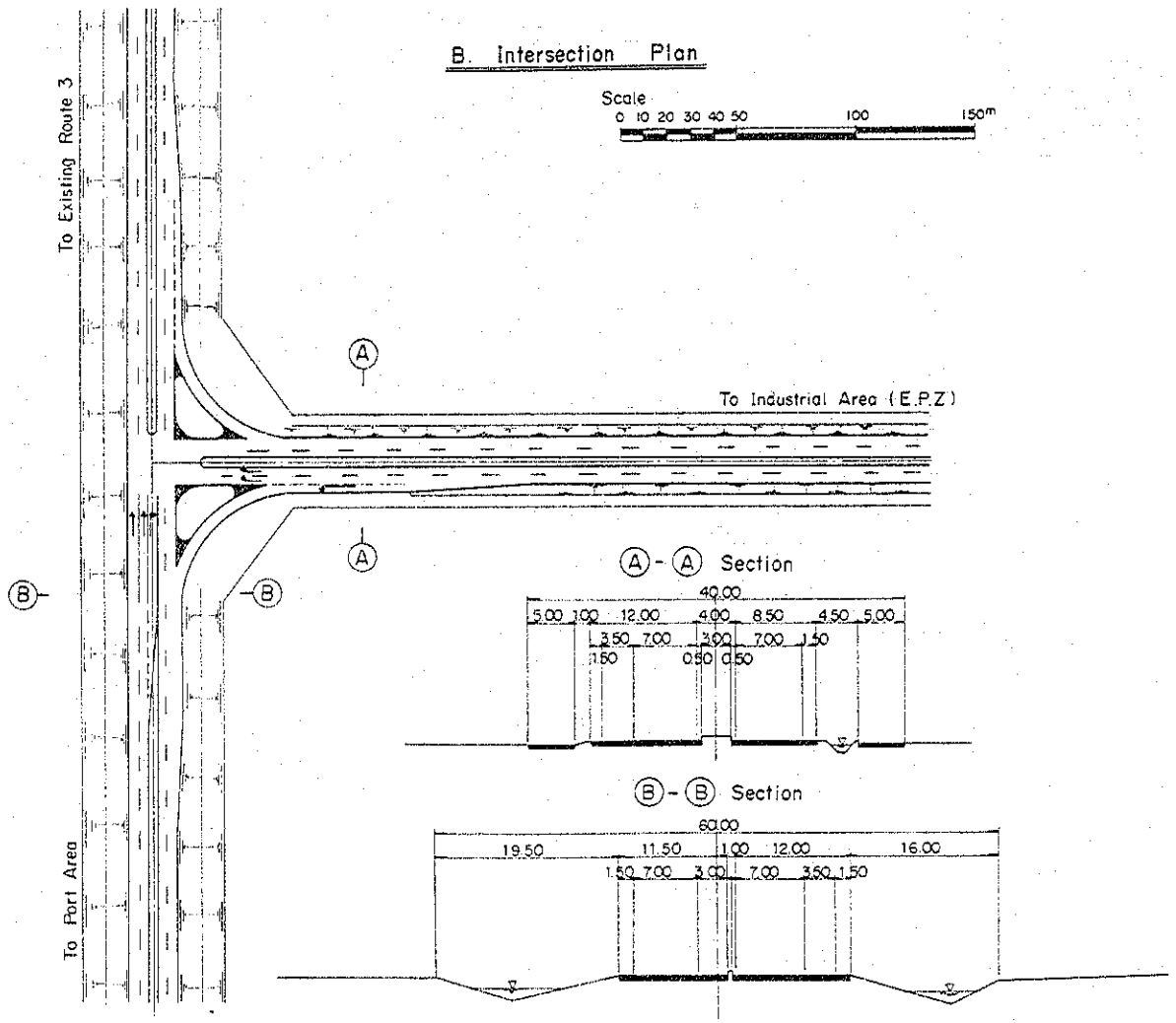


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Fig. IV.6.8
Intersection Plan

C. Intersection Plan

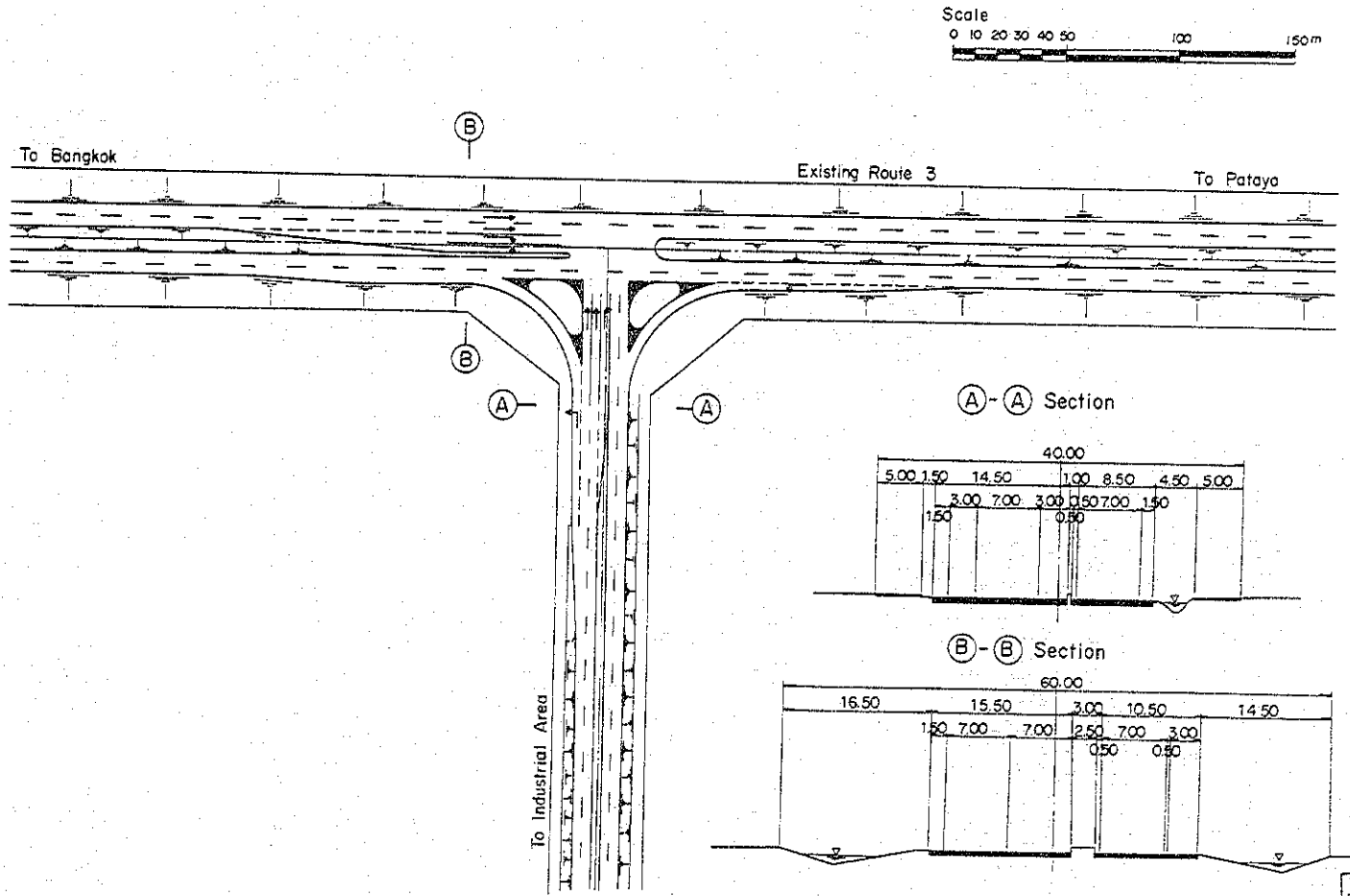

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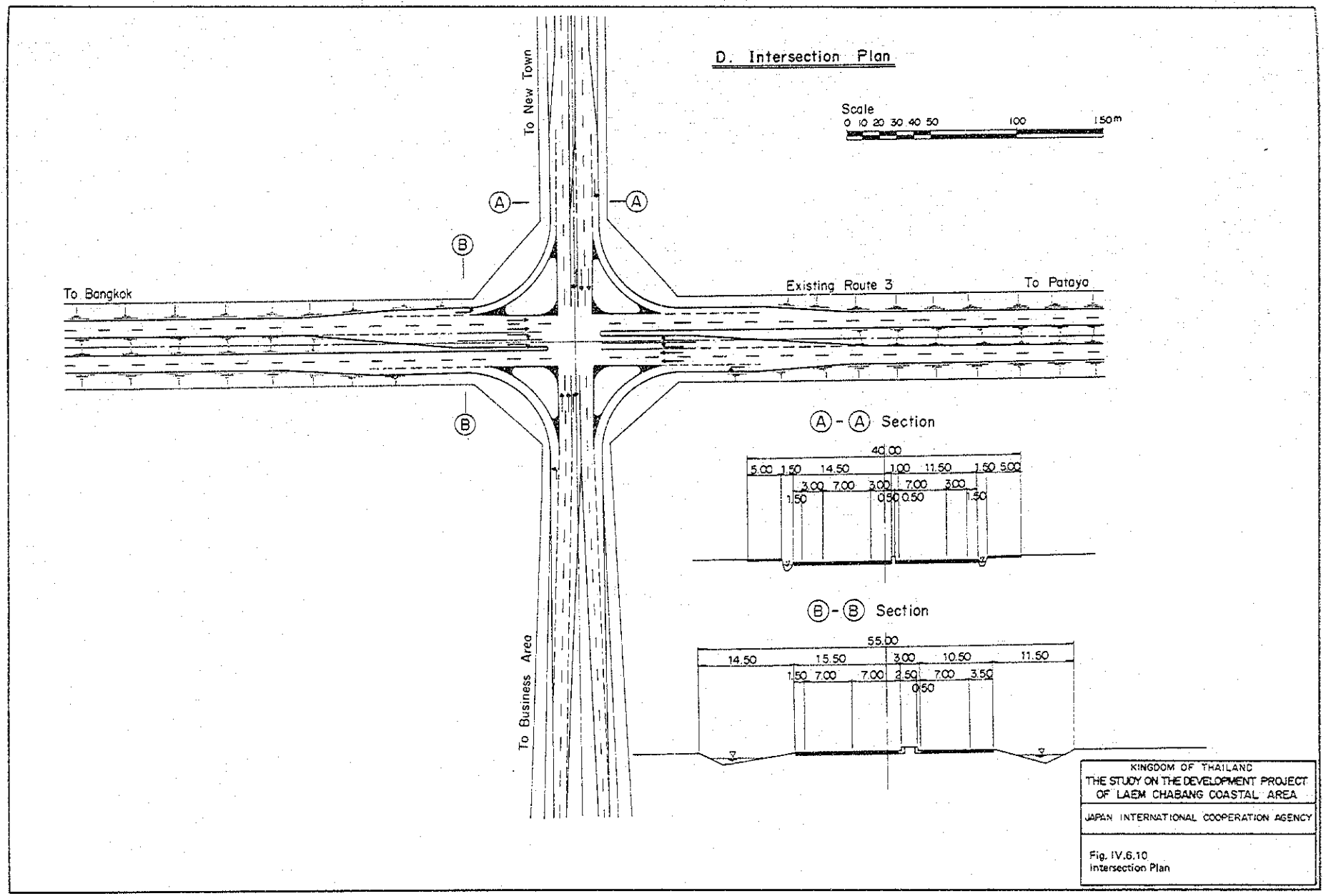
Fig. IV.6.9
Intersection Plan


D. Intersection Plan
Scale
0 10 20 30 40 50 100 150m
To New Town
To Bangkok
Existing Route 3
To Pataya
To Business Area
A
B
A - A Section
40.00
5.00 1.50 14.50 1.00 11.50 1.50 5.00
3.00 7.00 3.00 7.00 3.00
1.50 0.50 0.50 1.50
B - B Section
55.00
14.50 15.50 3.00 10.50 11.50
1.50 7.00 7.00 2.50 7.00 3.50
0.50
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JAPAN INTERNATIONAL COOPERATION AGENCY
Fig. IV.6.10
Intersection Plan

A P P E N D I X

APPENDIX IV-A

1. Road Mode Transport Costs

1) Perceived Costs

Prevailing private sector freight rates per truck are as follows:

Si Racha to Bangkok by 6-Wheeler	Baht 1,000
Bangkok to Si Racha by 6-Wheeler	Baht 850 (light load)
	Baht 1,000 (heavy load)

Rates for elsewhere indicate that rates for 10-wheelers are 5 to 6% higher than those for 6-wheelers. Private sector rates are about 30% lower than the official rates by ETO (Express Transport Organization).

The ETO's rate for transporting a 40' container by a semi-trailer from Bangkok to Si Racha at present is Baht 4,762. Private sector rate should be correspondingly lower. Per vehicle base freight rates for the linehaul operation between Laem Chabang and Bangkok are shown below.

Vehicle Type	6-wheel	10-wheel	Semi-trailer
Rate (Baht)	1,200	1,270	3,656

Tariff schedules of cargo handling in the Laem Chabang Port have not been determined. Considering the existing schedules in the Klong Toey Port and some streamlining of them, handling rates in Laem Chabang Port were assumed to be Baht 50 per ton for transfering cargo between the oceangoing vessel to the port storage and Baht 20 per ton for transfering between the storage and the truck. In cases when a cargo is directly loaded from the vessel to the truck deck, the latter rate would not apply. Therefore, an average truck loading/unloading rate of Baht 10 per ton was used.

2) Economic Costs

Economic vehicle operating costs are shown in Table 1 for speed levels of 20 km/h and 70 km/h respectively corresponding to congested and cruising conditions. For each of the three vehicle types three levels of loading were stipulated and ton-km costs were calculated. The results are shown in Table 2. The cost of empty return trips (assumed to be 50%) must be added in order to calculate real ton-km costs. Out of the total distance of 120 km, it was assumed the vehicles were operated at 20 km/h in 30 km length.

Economic costs of cargo handling in the Laem Chabang Port were estimated in the order-of-magnitude primarily based on the results of the analysis for the proposed Nakon Sawan Port presented in the Inland Waterways-Phase III Feasibility Study Report, Harbor Department, 1979. Adjustments were made to take into account inflation and larger but far higher throughput at Laem Chabang. It was estimated that economic costs of cargo handling were Baht 30 for the oceangoin vessel-port storage transfer and Baht 24 for the storage-truck transfer, including the depreciation of equipment.

It is anticipated that heavy traffic by heavy vehicles to and from Laem Chabang would require strengthening of the Route 3 at certain intervals. The economic cost of laying 5 cm thick asphalt overlay is estimated at Baht 114 per square meters. The total cost for the entire length of the 7m wide Route 3 from Laem Chabang to Bangkok is Baht 95.8 million. Under the prevailing conditions of the Route 3 it is estimated that a 5 cm thick asphalt overlay would extend the pavement life another 2.7 million applications of Equivalent Standard Axle (ESA). Therefore, the economic cost of pavement strengthening accountable to an additional ESA is Baht 35.5. ESA's per vehicle were calculated for different loading conditions of the three types of vehicles as shown in Table 3. Pavement strengthening costs accountable for one ton of freight were then calculated for various cases.

Table 4 and Table 5 summarizes the overall perceived and economic costs of the road mode transport between Bangkok and Laem Chabang. It should be noted that perceived linehaul costs of 10-wheel trucks, i.e. truckers' charges, are less than economic linehaul costs. In other words truckers

are loosing money. Prevailing rates seem to suggest a competition so severe that truckers are probably earning only to cover running costs but are unable to replace their vehicles.

2. Rail Mode Transport Costs

1) Perceived Costs

Under the current rate schedule of the State Railway of Thailand freight rates for the distance of 135 km between Bangkok and Laem Chabang are as follows:

Class 3 car load	Baht 69.95 per ton,
Class 4 car load	Baht 60.85 per ton, and
Petroleum	Baht 58.76 per ton.

Cargo handling charges in the Laem Chabang Port were determined based primarily on the existing rates by the Port Authority of Thailand as described in the preceeding section. Breakbulk handling charges assumed here are 50 Baht/ton for transfering between oceangoing vessels and the port storage and 23 Baht/ton between the storage and the rail car. For containers the charges are 43.9 Baht/ton and 20 Baht/ton respectively.

In the recently completed Feasibility Study of Bangkok Freight Terminal at Bang Sue it is proposed that all cargo handling operations and pickup and delivery operations to and from the Terminal be carried out by the SRT. The Report presents a tariff schedule for various operations. Proposed tarrifs are:

Transfer between a rail car and a truck	40.1 Baht/ton,
Pickup or delivery for breakbulk	110.3 Baht/ton, and
Pickup or delivery for container	111.1 Baht/ton.

2) Economic Costs

The construction of the Chachoengsao-Sattahip Line has largely been completed and its cost is irretreavable. It is a sunk cost. Therefore, the long-run variable cost of the SRT was taken as the economic resource cost of additional cargo on this line. In 1977 - 1978 the SRT estimated long-run economic variable costs and in 1979 the Inland waterway - Phase III Study updated them as follows:

Labor	0.1063 Bart/ton-km
Fuel	0.0694
Other	0.0348
Depreciation	0.0204
Interest	0.0368
Total	0.2677 Bart/ton-km

At 1983 prices the long-run variable cost was estimated at 0.3954 Baht/ton-km.

Economic costs of transshipment operations constituting parts of the rail mode transport including equipment depreciation are basically taken from the analysis results presented in the aforementioned inland waterway study with due modifications such as for inflation.

Pickup and delivery operations to and from the Terminal at Bang Sue were assumed to be done by 6-wheelers for an average distance of 10 km.

Perceived and economic costs of using the rail mode are presented in Table 6 and Table 7 respectively.

It should be noted that the proposed tariffs for cargo handling in the Bangkok Freight Terminal at Bang Sue are quite high relative to other costs.

3. Waterway Mode Transport Costs

Data on actual freight rates by waterway transport are hard to come by. Spot rates of coastal tankers in October 1983 are shown in Table 8. Lighters of 900 dead weight ton type transporting tapioca from Bang Pakong to Ko Si Chang in 8 hours charge 50 Baht/ton. The latter can be translated as about 1 Baht/ton-km.

Economic and financial operating costs of waterway vessels were estimated on a hourly basis in the Inland Waterways-Phase III, Feasibility Study in 1979. Resulting figures updated to 1983 prices are shown in Table 9. Three types of barges, wooden 50 DWT, steel 300 DWT, and steel 700 DWT were analyzed and three types of tow or pusher boats, towboat with 200 HP engine, towboat with 350 HP engine, and pusher boat with 500 HP engine, were dealt with. Forms of convoy considered are shown in Table 10 with respective operating speed. The operating cost of 900 DWT lighter was assumed to be the same as the sum of 85% of operating costs of three 300 DWT barges and 100% of operating cost of a towboat with a 200 HP engine.

Financial ton-kim costs were calculated using the above data for a comparison with the spot rates. The results are shown below:

- Barge convoy 4x300 DWT plus 200 HP towboat 0.20 Baht/ton-km
- Barge convoy 4x700 DWT plus 500 HP pusher 0.12 Baht/ton-km
- Lighter 900 DWT 0.30 Baht/ton-km

The financial cost of 2000 DWT tanker, therefore, would be in the order of 0.16 Baht/ton-km. Because return trips are always empty, the actual cost should be 1.75 times of this amount, 0.28 Baht/ton-km. An observed rate was 0.44 Baht/ton-km. This implies a gross markup of 57.1%. For the Bang Pakong-Ko Si Chang service the observed rate was 1 Baht/ton-km, whereas the calculated financial cost including an empty return trip was 0.53 Baht/ton-km, indicating a gross markup of 89%. However, the actual utilization of tapioca transporting lighters would be much less than 2,000 hours per year. The former gross markup was assumed for estimating perceived linehaul costs of waterway mode.

The risk of complete loss of cargo in the waterway transport mode is higher than any other mode. Insurance has always been an important art of the waterway transport system. It was assumed that the average insurance cost would be 1.2 Baht per Baht 1,000 cargo value per 100 km. It was also assumed that the average cargo value would be Baht 4,000 per ton.

The construction of the Laem Chabang Port was presumed in this analysis and its construction cost was excluded from the modal cost comparison as being common to all cases. The cost of providing loading and unloading facilities for waterway mode is another matter. If the existing barge wharves, mostly private, are inadequate to accommodate largely increased waterway mode cargo, the cost of additional wharves and related facilities must be taken into account. The annualized capital cost and the operating cost of the proposed Nakon Sawan Port are presented in the aforementioned Inaland Waterway Study report. Table 11 summarizes the results updated at 1983 prices. The unit cost of simple wharves along the Chao Phya river would be much less than that of the Nakon Sawan Port. Seventy percent of figures for the Nakon Sawan Port were adopted. Such wharves would be constructed mostly as private facility and their construction costs would not be preceived as out-of-pocket costs by their users. Only the economic costs, therefore, were considered for the additional wharves in the Bangkok side.

Transfer costs in the Laem Chabang Port and final delivery and pickup costs by trucks were already described in the preceeding sections.

Table 12 and Table 13 summarize overall perceived and economic costs of waterway transport mode including 90 km of linehaul, transshipment operations, and final delivery and pickup.

Table 1 ECONOMIC VEHICLE OPERATING COSTS

(Unit: Baht/km/vehicle)

Vehicle Type	6-Wheel		10-Wheel		Semi-Trailer	
Speed (km/h)						
Running Cost	2.02	2.28	3.41	3.88	5.02	5.70
Fixed Cost	4.79	2.75	5.27	2.99	9.19	5.25
Total	6.81	5.02	8.68	6.87	14.21	10.95

Source: Feasibility Study Report, Highway Sector Project Department of Highways, Dec. 1983 and JICA for Semi-trailer.

Table 2 ECONOMIC TON-KM COSTS BY TRUCKS

(Unit: Baht/ton-km)

Behicle Type	6-Wheel			10-Wheel			Semi-Trailer		
Payload (tons)	4.2	6.5	9.0	8.4	13.0	18.0	18.0	23.0	30.0
Speed 20 km/h	1.62	1.04	0.83	1.03	0.66	0.53	1.79	0.62	0.52
70 km/h	1.20	0.77	0.61	0.82	0.53	0.42	0.61	0.48	0.40

Source: Table 4, JICA

Table 3 PAVEMENT STRENGTHENING COST PER TON

Vehicle Type	6-Wheel			10-Wheel			Semi-Trailer		
Payload (tons)	4.2	6.5	9.0	8.4	13	18	18	23	30
Axle Load (tons)									
Axle 1	3	3.5	4	3.5	4.0	4.5	3	3.5	4.0
Axle 2	5.2	7	9	6.6	8.6	10.9	7.2	8.4	10
Axle 3	-	-	-	6.5	8.5	10.8	7.3	8.4	10
Axle 4	-	-	-	-	-	-	7.2	8.4	10
Axle 5	-	-	-	-	-	-	7.3	8.4	10
Per Vehicle ESA	0.176	0.564	2.02	0.847	2.48	6.22	2.46	4.44	8.90
Baht/ton	1.49	3.08	7.77	3.58	6.77	12.3	4.85	6.85	10.5

Table 4 ROAD MODE OVERALL PERCEIVED COSTS

(Unit: Baht/ton)

Vehicle Type	6-Wheel			10-Wheel			Semi-Trailer		
Payload (tons)	4.2	6.5	9.0	8.4	13.0	18.0	18.0	23.0	30.0
Port-Bangkok									
1) Ship-port storage	50	50	50	50	50	50	50	43.9	43.9
2) Port storage - truck	10	10	10	10	10	10	10	10	10
3) Linehaul	28.57	184.6	133.3	151.2	97.7	70.6	259.5	203.1	155.7
Total	345.7	244.6	173.3	211.2	157.7	130.6	319.5	263.1	215.7
GIE/EPZ - Bangkok									
3) Linehaul	285.7	L84.6	133.3	151.2	97.7	70.6	259.5	203.1	155.7

Note: Since the handling by shipper/consignee is involved in all modes associated costs are excluded from the analysis.

Table 5 ROAD MODE OVERALL ECONOMIC COSTS

(Unit: Baht/ton)

Vehicle Type	6-Wheel			10-Wheel			Semi-Trailer		
Payload (tons)	4.2	6.5	9.0	8.4	13	18	18	23	30
Port - Bangkok									
4) Ship-port storage	30	30	30	30	30	30	30	30	30
5) Storage - truck	24	24	24	24	24	24	24	24	24
6) Linehaul									
fast	108.0	60.3	54.9	73.8	47.7	37.8	54.9	43.2	36.0
slow	48.6	31.2	24.9	30.7	19.8	15.9	23.7	18.6	15.6
return trip 50%	78.3	50.3	39.9	52.4	33.8	26.9	39.3	30.9	25.8
Sub-total	234.9	150.8	119.7	157.1	101.3	80.6	117.9	92.7	72.4
7) Pavement strengthening	1.5	3.1	8.0	3.6	6.8	12.3	4.9	6.7	10.5
Total	290.4	207.9	181.7	214.7	162.1	146.9	176.8	153.6	141.9
GIE-EPZ - Bangkok									
8) Factory - truck	6	6	6	6	6	6	6	6	6
6) Linehaul	234.9	150.8	119.7	157.1	101.3	80.6	117.9	92.7	77.4
7) Pavement strengthening	1.5	3.1	8.0	3.6	6.8	12.3	4.7	6.9	10.5
Total	242.4	159.9	133.7	166.7	114.1	98.9	128.8	105.6	93.9

Table 6 RAIL MODE OVERALL PERCEIVED COSTS

(Unit: Baht/ton)

	Class 3	Class 4	Container
Port - Bangkok			
1) Ship-port storage	50	50	43.9
2) Storage - rail car	23	23	20
3) Rail linehaul	70.0	60.9	60.9
4) Rail car - truck	41.1	40.1	40.1
5) Truck delivery/pickup	100.3	110.3	111.1
Total	273.4	284.3	276.0
GIE/EPZ - Bangkok			
2,25) Operations only	243.4	234.3	-

Source: Inland Waterway Feasibility Study - Phase III

Table 7 RAIL MODE OVERALL ECONOMIC COSTS

(Unit: Baht/ton)

	Class 3	Class 4	Container
Port - Bangkok	17.0	17.0	17.0
1) Ship-port storage	30.0	30.0	20.0
2) Storage - rail car	28	28	19
3) Rail linehaul	53.4	53.4	53.4
4) Rail car - truck	28	28	28
5) Delivery/pickup	10.4	10.4	7.9
Total	166.8	166.8	145.3
CIE/EPZ - Bangkok			
2) Storage - rail car	28	28	-
3 - 5)	91.8	91.8	-
Total	119.8	119.8	-

Source: JICA Study Team

Table 8 COASTAL OIL TANKER SPOT RATE, OCT. 1983

From Si Racha To	Standard Vessel DWT	Sport Rate Satang/Litter	Baht/ Ton	Distance km	Baht per Ton-km
Bangkok	2,000	3	35.3	80	0.44
Ban Don	1,000	15	176.5	490	0.36
Pak Panang	500	16	188.2	550	0.34
Sougkhla	2,070	17	200.0	670	0.30

Source: Interim Report, Comprehensive Development Study of Coastal Shipping in the Kingdom of Thailand, JICA, 1984

Table 9 WATERWAY VESSELS OPERATING COSTS

Characteristics

	Barge		Barge		Barge		Towboat		Towboat		Pusher	
DWT or HP	50		300		700		200		350		500	
Construction	Wood		Steel		Steel		Wood		Steel		Steel	
Utilization hours/yr	2000		2000		4500		2500		3000		6000	
Financial/ Economic	F	E	F	E	F	E	F	E	F	E	F	E
Fixest Cost (Baht/hour)												
Vessel Depreciation & Interest	23.0	20.2	70.5	59.4	87.6	70.0	19.5	16.4	40.3	27.6	70.5	56.4
Other	23.2	22.1	76.8	74.3	29.7	26.1	112.6	97.1	144.5	130.9	171.3	153.5
Variable Cost												
All items	0.4	0.5	5.5	5.0	5.9	4.9	410.5	346.3	674.4	595.4	960.9	828.0
Total	46.6	42.8	152.7	138.7	123.2	101.0	542.5	459.8	659.2	753.9	1202.7	1023.1

Source: Updated from Inland Waterway - Phase III, Feasibility Study, Harvor Department, MOC, Dec. 1979.

Table 10 OPERATING SPEED OF WTERWAY TRANSPORT

(Unit: km/h)

Convey	Laden	Empty
12 x DWT 50 Barge	6	8
4 x DWT 300 Barge with TB 200 HP	6	8
4 x DWT 300 Barge with TB 350 HP	12	15
4 x DWT 700 Barge with PB 500 HO	10	13
900 DWT Lighter with 200 HP	6	8

Table 11 NAKON SAWAN PORT ECONOMIC COSTS

(Unit: Baht/ton)

Cost Item	Cargo Type			
	General Dry Cargo	General Dry Balk	Cement	Petroleum (Baht/m^3)
Capital	46.0	51.5	46.0	14.6
Operating	11.6	12.2	36.9	1.9
Total	57.6	63.7	82.9	16.5

Source: Based on data in Inland Waterways - Phase III Feasibility Study, Harbor Department, Dec. 1979.

Table 12 WATERWAY MODE OVERALL PERCEIVED COSTS

(Unit: Baht/ton)

Item	Lighter 900 DWT	Barge Convoy 4 x 300 + Tow	Barge Convoy 4 x 700 + Push
Port - Bangkok			
1) Ship-barge	50	50	50
2) Linehaul	42.7	27.1	16.9
3) Barge-whalf	10	10	10
4) Wharf-truck	6	6	6
5) Truck delivery/pickup	31	31	31
6) Insurance	4.3	4.3	4.3
Total	144.0	128.4	118.2
GIE/EPZ - Bangkok			
2)-6)	94.0	78.4	68.2
7) Barge-port	50	50	50
8) Port-truck	10	10	10
9) Truck delivery/pickup	31	31	31
Total	185.0	169.4	159.2

Table 13 WATERWAY MODE OVERALL ECONOMIC COSTS

(Unit: Baht/ton)

Item	Lighter 900 DWT	Barge Convey 4 x 300 + Ton	Barge Convey 4 x 700 + Push
Port - Bangkok			
1) Ship - barge	18	18	18
2) Linehaul	23.7	15.8	9.1
3) Barge - wharf			
Capital cost	36.1	36.1	36.1
Operating cost	8.5	1.5	8.5
4) Wharf - truck	14 (4)	14 (4)	14 (4)
5) Truck delivery/pickup	10.4	10.4	10.4
Total:	110.7(100.7)	102.8(92.8)	96.1(86.1)
GIE/EPZ - Bangkok			
2)-5)	92.7(82.7)	84.8(74.8)	78.1(68.1)
6) Barge - port	22 (8)	22 (8)	22 (8)
7) Port - truck	24 (4)	24 (4)	24 (4)
8) Truck delivery/pickup	10.4	10.4	10.4
Total:	149.1(105.1)	141.2(97.2)	134.5(90.5)

Note: Figures a parenthesis indicate costs under labor intensive methods.

APPENDIX IV-B PERSONAL EXPENDITURE ON TRANSPORT

In 1975 and 1976 the National Statistics Office conducted a large scale survey on income and expenditure of households throughout the country. The results of this remain to be the only source of data concerning transport expenditure differentiated by income level or occupation. Tables 14 through 16 show the average monthly per capita expenditure for transport by consumption expenditure level for the Greater Bangkok Metropolitan Area, the sanitary districts in the Central Region, and the municipal areas in the Central Region. The tables were compiled by the study team from originals in the NSO reports which were tabulated in slightly different classifications. The total consumption expenditure was adopted in lieu of income because of its higher consistency found in the original tables. Table V.4 shows a comparison of average figures among the three different types of areas.

It is interesting to note that people in the Greater Bangkok Area spend a higher percentage of their income on transport than people in the other areas, particularly on the local public transport, indicating the higher need to travel and the availability of public transport in the former. The lack of public transport is also reflected in the high percentage of expenditure on purchasing own vehicles in the latter areas.

Three classes of households are differentiated by this study as defined in consultation with NHA. The low income group is those with the household monthly income of less than 5,000 Baht, the middle income group with monthly income from 5,000 to 9,000 Baht and the high income group with the monthly income more than 9,000 Baht, all in middle 1984 prices.

Table 18 was prepared by applying a consumer price index for the period 1976 to 1984 to the figures in Tables 14 through 16 and reclassifying them in accordance with the income classes. This is a gross simplification since transport price increase has deviated considerably from the general consumer price increase. However, for the purpose of comparison of relative magnitude this method should be acceptable. A comparison of expenditure patterns by income class confirms the points made for the average figures. Clearly the ownership of passenger cars is limited to the high income group.

It was decided that the pattern of transport expenditure by the people working in the Laem Chabang Development Area would be at the average of those for the Greater Bangkok Metropolitan Area and the Central Region Municipal Areas. Rationals for this determination are; a. the Area is far smaller in size than Bangkok where cross town trips could be quite long, and b. the Area's intensive modern activities would make the residents and visitors more mobile than in traditional municipal areas.

Table 19 lists income elasticities of transport expenditure calculated for the three areas by means of regression analysis applied to the Tables 14 through 16. The regression equations were given the form of Cobb-Douglas function so that the regressed coefficient of power would directly indicate the respective elasticities. It should be cautioned that the elasticities shown in this table are not directly applicable to the high income groups since their data points are at the distant edge from the rest. The regressed elasticities should be applied to the middle and low income groups only.

Table 14 AVERAGE MONTHLY PER CAPITA EXPENDITURE FOR TRANSPORT BY DECILE GROUPS

Greater Bangkok Metropolitan Area

Item	Per Capita Consumptions Expenditure (Baht)										
	All Households	Less 265	265 - 335	336 - 396	397 - 457	458 - 517	518 - 589	590 - 708	709 - 844	845 - 1,159	1,160 and over
Percent of households	100	10.0	10.3	9.8	9.8	10.2	10.0	10.2	9.8	9.9	10.0
Average Household Size	5.7	7.6	7.2	6.5	6.0	5.6	5.7	5.3	4.8	4.3	3.4
Total Monthly Per Capita Expenditure	583	825	315	377	440	514	588	680	799	1023	1804
Local transport	18.1	7.4	9.3	13.4	14.5	18.8	20.3	22.5	27.5	30.7	38.2
Travel out of area	3.3	0.5	0.4	1.4	0.8	1.3	3.3	4.7	6.3	10.2	13.5
Vehicle operation	17.0	1.4	2.9	2.0	3.5	5.7	8.6	15.8	21.5	34.9	143.8
Vehicle purchase	9.8	0.4	1.0	2.0	1.5	2.9	5.4	5.7	11.0	15.1	98.5
All public transport	21.4	7.9	9.7	14.8	15.3	20.1	23.6	27.2	33.8	40.9	51.7
Corresponding 1984 Household Income	6214	3198	4241	4582	4937	5383	6267	6739	7172	8226	11470

Table 15 AVERAGE MONTHLY PER CAPITA EXPENDITURE FOR TRANSPORT BY DECILE GROUPS

Central Region, Municipal Areas

Item	Per Capita Consumptions Expenditure (Baht)										
	All Households	Less 292	292 - 375	376 - 433	434 - 503	504 - 570	571 - 652	653 - 746	747 - 915	916 - 1,216	1,216 and over
Percent of households	100	10.1	10.0	10.0	10.1	9.9	10.0	10.1	9.9	10.1	9.9
Average Household Size	5.2	6.2	6.7	6.0	6.6	5.4	4.7	5.2	4.2	4.0	3.1
Total Monthly Per Capita Expenditure	657	232	355	435	500	567	661	640	988	1157	1986
Local transport	7.7	1.8	3.9	3.8	7.4	8.0	5.7	10.6	13.3	11.8	19.4
Travel out of area	6.2	1.5	3.3	2.8	4.8	0.9	6.0	2.9	16.0	14.5	23.2
Vehicle operation	13.3	1.0	1.0	3.8	3.2	15.9	11.1	6.7	25.7	27.5	78.7
Vehicle purchase	22.9	0.2	1.0	0.5	5.8	9.4	9.6	19.8	6.2	66.5	212.6
All public transport	13.9	3.3	7.2	6.6	12.2	8.9	11.7	13.5	29.3	26.3	42.6
Corresponding 1984 Household Income	6389	2690	4448	4881	6171	5726	5810	6223	7760	8654	11513

Table 16 AVERAGE MONTHLY PER CAPITA EXPENDITURE FOR TRANSPORT BY DECILE GROUPS

Central Region, Sanitary District

Item	Per Capita Consumptions Expenditure (Baht)										
	All Households	Less 230	265 - 335	336 - 396	397 - 457	458 - 517	518 - 589	590 - 708	709 - 844	845 - 1,159	1,160 and over
Percent of households	100	10.0	10.0	10.4	9.6	10.0	10.4	9.6	10.0	10.0	10.0
Average Household Size	5.1	6.7	6.1	5.8	5.6	5.2	5.0	4.8	4.4	3.7	3.9
Total Monthly Per Capita Expenditure	533	190	276	325	384	409	498	543	696	932	1688
Local transport	8.6	1.0	3.8	4.5	4.5	9.2	13.0	13.5	11.8	14.6	19.2
Travel out of area	3.7	0.3	1.6	2.1	3.6	2.3	4.2	5.2	2.5	9.7	10.8
Vehicle operation	12.0	0.3	4.1	2.4	4.5	5.2	8.4	8.3	13.9	21.9	77.4
Vehicle purchase	17.5	-	0.3	0.2	1.6	0.4	0.4	2.3	4.8	20.3	213.8
All public transport	12.3	1.3	5.4	6.6	8.1	11.5	17.2	18.7	14.3	24.3	30.0
Corresponding 1984 Household Income	5083	2381	3148	3525	4021	3977	4656	4874	5727	6449	12311
Household Income	5083	2381	3148	3525	4021	3977	4656	4874	5727	6449	12311

Table 17 AVERAGE MONTHLY PER CAPITA EXPENDITURE ON TRANSPORT CENTRAL REGION (1975 - 1976)

Item	Greater Bangkok	Municipal Area	Sanitary District
Average Household Size	5.7	5.2	5.1
Total monthly expenditure (Baht)	583	657	533
Local transport (Baht)	18.1	7.7	8.6
(Percent to total expend.)	3.1	1.2	1.6
Travel out of area (Baht)	3.3	6.2	3.7
(Percent to total expend.)	0.6	0.9	0.7
Vehicle operation (Baht)	17.0	13.3	12.0
(Percent to total expend.)	2.9	2.0	2.3
Vehicle purchase (Baht)	9.8	22.9	17.5
(Percent to total expend.)	1.7	3.5	3.3
All public transport (Baht)	21.4	13.9	12.3
(Percent to total expend.)	3.7	2.1	2.3
All transport expenditure (Baht)	48.2	50.1	41.8
(Percent to total expend.)	8.3	7.6	7.8

Table 18 AVERAGE MONTHLY PER CAPITA EXPENDITURE FOR TRANSPORT BY HOUSEHOLD INCOME (CENTRAL REGION)

Income Class	Greater Bangkok			Municipal Area			Sanitary District		
	Low	Middle	High	Low	Middle	High	Low	Middle	High
Average Household Size	6.8	5.1	3.4	6.3	4.4	3.1	5.6	4.1	3.9
Household Income	3392	6757	11470	4006	6724	11573	3797	6088	12311
Total Per Capita Expenditure	508	1348	3373	637	1407	3714	701	1522	3157
Expenditure									
Local transport	20.9	44.8	71.4	5.9	17.7	36.3	13.2	24.7	35.9
%	4.1	3.3	2.1	0.9	1.3	1.0	1.9	1.6	1.1
Travel out of area	1.4	9.6	25.2	4.7	14.1	43.4	5.2	11.4	20.2
%	0.3	0.7	0.7	0.7	1.0	1.2	0.7	0.7	0.6
Vehicle operation	4.6	32.4	268.9	1.7	28.1	147.2	8.9	33.5	144.7
%	1.9	0.2	8.0	0.3	2.0	4.0	1.3	2.2	4.6
Vehicle purchase	2.3	15.0	184.2	1.1	36.6	397.6	1.4	23.5	399.8
%	0.5	1.1	5.5	0.2	2.6	10.7	0.2	1.5	12.7
All public transport	22.3	54.4	96.7	10.6	31.8	79.7	18.4	36.1	56.1
%	4.4	4.0	2.8	1.7	2.3	2.1	2.6	2.4	1.8

Note: Computed from Tables 2.2.1 - 2.2.3 by using a consumer price index of 1.87 for 1976-1984.

Table 19 INCOME ELASTICITY OF TRANSPORT EXPENDITURE

Item		Greater Bangkok Area	Central Region	
			Municipal Area	Sanitary District
Local transport	Elasticity	.841	1.07	1.24
	R^2	.943	.869	.754
Travel out of area	Elasticity	1.95	1.40	1.41
	R^2	.882	.665	.755
Vehicle operation	Elasticity	2.35	2.22	2.16
	R^2	.965	.900	.901
Vehicle purchase	Elasticity	2.57	3.19	3.86
	R^2	.982	.844	.907
All public transport	Elasticity	.987	1.22	1.29
	R^2	.956	.940	.788

Source: JICA Team, calculated from data in Socio-Economic Survey 1975-1976, NSO.