3.3.7 Railway

1) Cargo Volume and Traffic Intensity

Based on the modal split discussed in the Sectoral Report II "Port Development Pan", the railway cargo and the train traffic were estimated as follows.

Item	Origin	Destination	2001		1991	
			Cargo Volume	Trains per day	Cargo Volume	Trains per day
Container	Laem Chabang	Bangkok	1.9(MT)	6.2	0.7(MT)	2.4*
	Bangkok	Laem Chabang	1.9	6.2	0.7	2.4**
Break Bulk	Laem Chabang	Bangkok	0.27	1.5	0.05	0.27
Tapioca	North East	Laem Chabang	0.90	5.0	0.9	5.0
Total	Northbound		5.0	7.7	2.35	2.7
	Southbound			11.2		7.7

* 1,000t payload unit train 640 m.
** 600t payload non unit train 380 m.

2) Railway Alignment

The spur line from the Chachoengso-Sattahip line to the port is aligned according to the study by the SRT.

3.3.8 Cost Estimate

Following is the cost estimate for the long-term development plan indlucing direct/indirect cost, engineering service fee and physical contingency.

Cost Estimate for the Long-Term Development

(Unit: ₱ 10^6)

Item	Total
1. Public Facilities and Wharves	11,725
2. Private Facilities and Wharves	1,325
a. Agribulk Wharf	725
b. Sugar and Molasses Wharf	334
c. Ship Repair Yard	266

Note: This cost estimate has been made under the same way of dividing construction items as that in the cost estimate for the short term development plan. (Refer to Table II.6.2 and II-6-3 in the Sectoral Report II.)

Table 3.3.1 ESTIMATED NUMBER OF CONTAINERS HANDLED AT PORTS IN ASIA IN 1983 (1)

(in thousand TEU)

Country	Port	Import		Export		Total	Total Loaded	Percent of	Ranking by Total	No. of Shipping Routes Calling			
		Loaded	Empty	Loaded	Empty	Handled	Handled	Loaded to Total	Loaded Handled	USWC Route	Europe Route	Total	Ranking
Bangladesh													
	Chittagong	3.6	2.5	4.7	1.2	12.0	8.3	69	32	2	1	3	21
Brunei													
	Muara	4.0	0.	0.	4.0	8.0	4.0	50	35				
People's Republic of China													
	Dalian (1981)	1.4	1.6	2.3	0.2	5.5	3.7	67	34	1		1	27
	Huangpu	4.0	0.8	2.2	2.0	9.0	6.2	69	33		1	1	27
	Tiangin	NA	NA	NA	NA	56.0	38.1*		22		1	1	27
	Shanghai (1982)	NA	NA	NA	NA	66.0	44.9*		21		2	2	26
Hong Kong													
	All Terminals (1982)	603*		615*		1,660.0	1,406.9*		1	22	12	34	1
India													
	Bombay	61.0	24.0	72.0	14.0	171.0	133.0	78	13	3	3	6	15
	Calcutta/Haldia	NA	NA	NA	NA	36.2	28.1*		25	2	1	3	21
	Cochin	2.0	17.0	18.0	0.8	37.8	20.0	53	26	3		3	21
	Madras	9.8	3.3	9.0	3.0	25.0	18.8	75	27	2	1	3	21
	Tuticorin	0.	0.	0.4	0.	0.4	0.4	100	38				
	Visakhapatnam	0.1	0.2	0.2	0.1	0.5	0.3	60	39	1		1	27
Indonesia													
	Tanjung Perak (Surabaya)	12.6	0.8	4.8	8.8	26.8	17.4	65	28		7	7	14
	Tanjung Priok (Jakarta)	57.4	8.5	10.0	55.3	131.0	67.4	80	20	2	7	9	12
	Belawan (Sumatra)	5.9	1.9	5.6	2.4	15.8	11.5	73	29				

Note: * excluding transshipment
- estimated

Table 3.3.1 ESTIMATED NUMBER OF CONTAINERS HANDLED AT PORTS IN ASIA IN 1983 (2)

Country	Port	Import		Export		Total	Total Loaded	Percent of	Ranking by Total	No. of Shipping Routes Calling			
		Loaded	Empty	Loaded	Empty	Handled	Handled	Loaded to Total	Loaded Handled	USWC Route	Europe Route	Total	Ranking
Japan													
	Kitakushu	240	31.0	46.0	4.0	105.0	70.0	67	18				
	Kobe (1982)	547.4	185.4	713.8	57.9	1,504.4	1,261.2	84	2	21	5	26	3
	Naha (1982)	7.5	-	1.0	-	8.4	8.4	100	31	1		1	27
	Nagoya (1982)	83.8	40.6	112.2	7.6	244.3	196.0	80	12	11	3	14	8
	Osaka	147.0	32.0	167.0	12.0	358.0	314.0	88	10	8	3	11	11
	Shimizu	16.5	29.0	53.0	1.7	100.2	69.5	69	19	3		3	21
	Tokyo	256.0	68.0	284.0	37.0	625.0	520.0	83	8	9	5	14	8
	Yokkaichi	8.9	0.2	1.1	0.1	10.2	10.0	98	30				
	Yokohama	279.6	141.2	400.2	47.8	868.8	679.8	78	6	21	3	24	4
Malasia													
	Penang	11.1	4.8	13.6	2.9	32.3	24.7	76	24	3	6	9	12
	Port Kelang	79.0	7.0	48.0	36.0	170.0	127.0	75	14	4	10	14	8
	Kuching	0.7	0	0.1	0.6	1.3	0.8	62	37				
Pakistan													
	Karachi	55.8	11.8	45.1	11.5	124.2	100.9	81	17	1	4	5	18
Philippines													
	Cebu	48.2	5.7	55.0	6.3	115.1	103.2	90	16	1		1	27
	Manila	264.0	32.1	216.7	55.5	568.3	480.7	85	9	5	1	6	15
Singapore													
	Singapore	523.3	82.8	460.5	143.5	1,210.1	983.8	81	4	9	21	30	2
South Korea													
	Busan	288.0	98.0	431.0	54.0	871.0	719.0	83	5	16	4	20	6
	Inchon (1981)	11.9		17.4		29.3	24.2	83	25	5	1	6	15
Srilanka													
	Colombo	59.1	11.0	60.5	7.0	137.6	119.6	87	15	3	2	5	18
Taiwan													
	Kaohsiung	400.3	239.6	649.7	44.3	1,333.9	1,050.0	79	3	17	4	21	5
	Keelung	184.0	194.0	347.0	12.0	737.0	531.0	72	7	16	3	19	7
	Taichung	0.9	2.8	3.3	0.	7.1	4..	39	54				
Thailand													
	Bangkok	121.6	22.9	134.0	10.2	288.7	255.6	89	11	3	3	6	18

Table 3.3.2 TOTAL ANNUAL CAPACITY PROVIDED BY CONTAINER SHIPPING SERVICES FOR HONG KONG AND SINGAPORE IN 1982

(In thousand TEU)

Route	Hong Kong	Singapore
Far East - US West Coast	965.6	229.9
Far East - Europe	549.5	604.5
Far East Regional	370.0	365.8
Total	1,885.1	1,200.2

Source: Calculated by the JICA Team from shipping schedules shown in the NYK report.

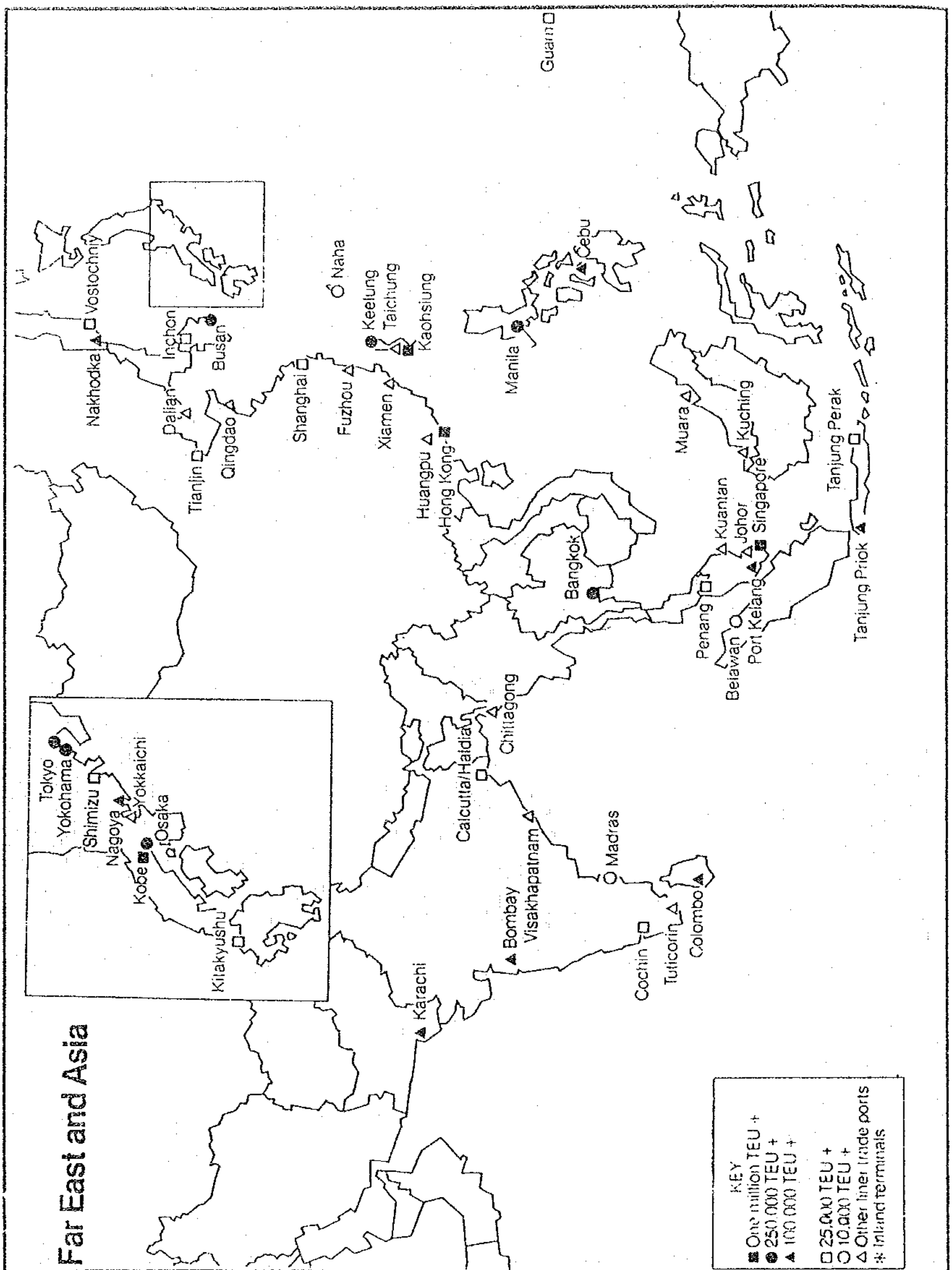

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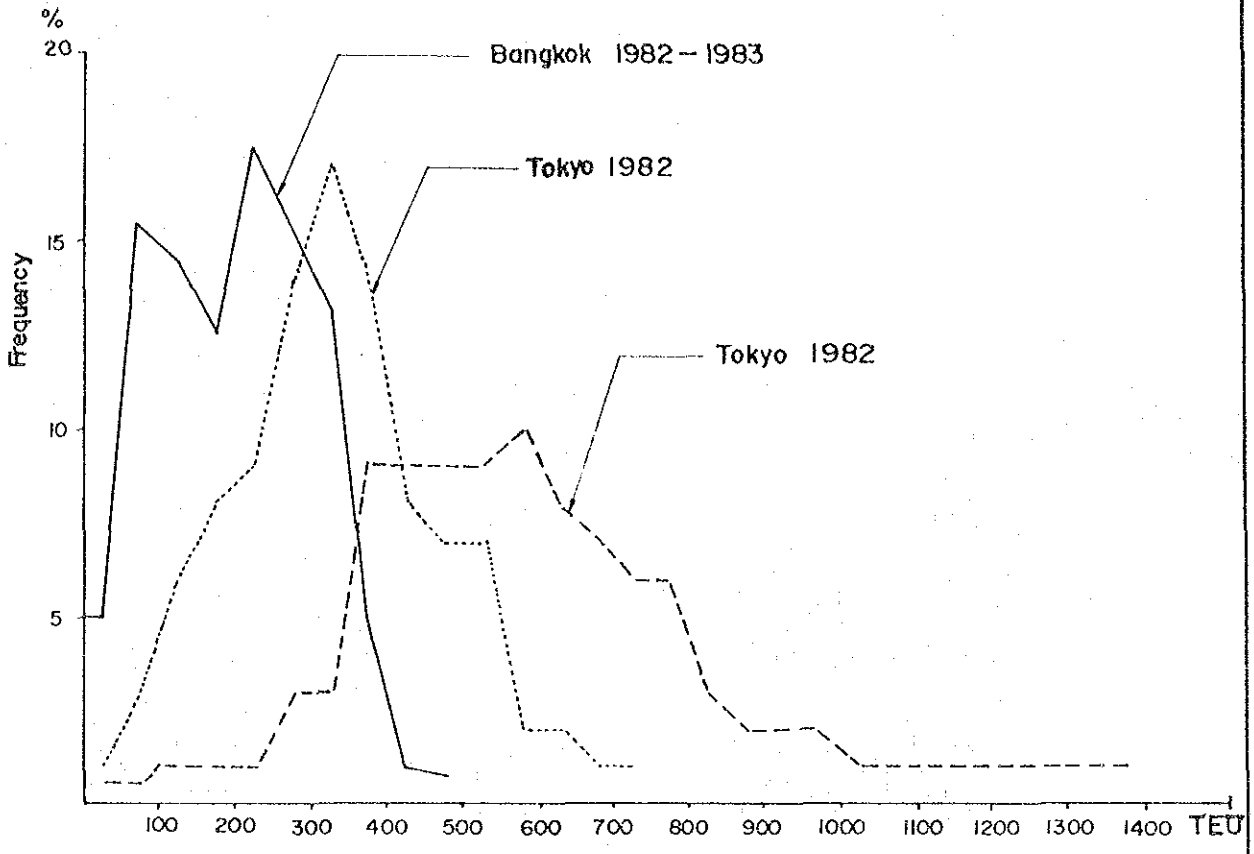
Fig. 3.3.1
Container Throughputs in Asian Ports



NOTE : Percentage figures indicate proportion for each of 50 TEU increase.

SOURCE : Bangkok, K. Nagai, ESCAP report "Container Handling at Bangkok Port", May 1984

Tokyo, Study on berth equipment and function, Keihin Gaibokodan Feb. 1982

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	Fig. 3.3.2 Distribution of Outbound Containers per Ship Tokyo and Bangkok

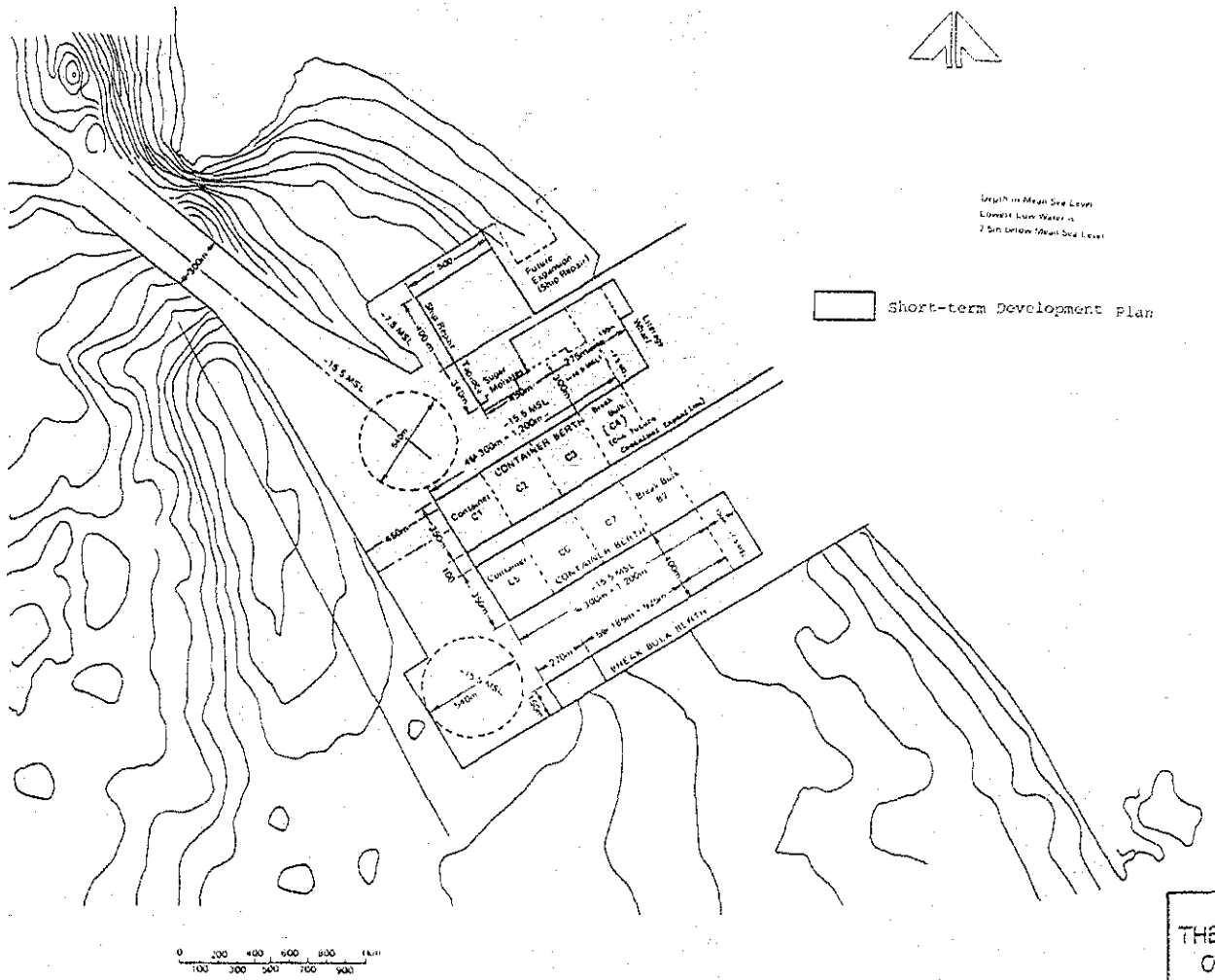

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Fig. 3.3.3
Master Plan (Pier Type)

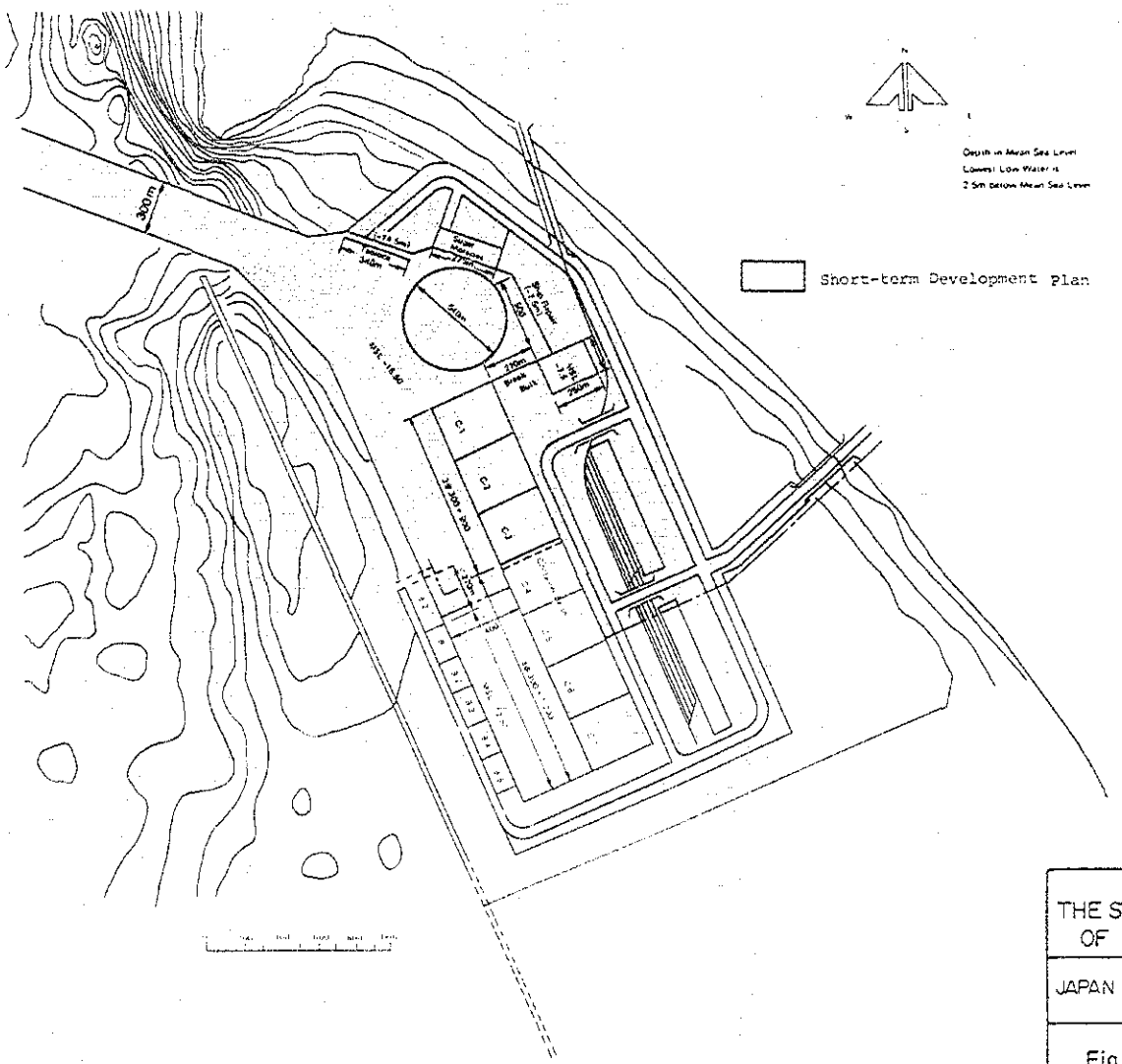

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Fig. 3.3.4
Master Plan (Island Type)

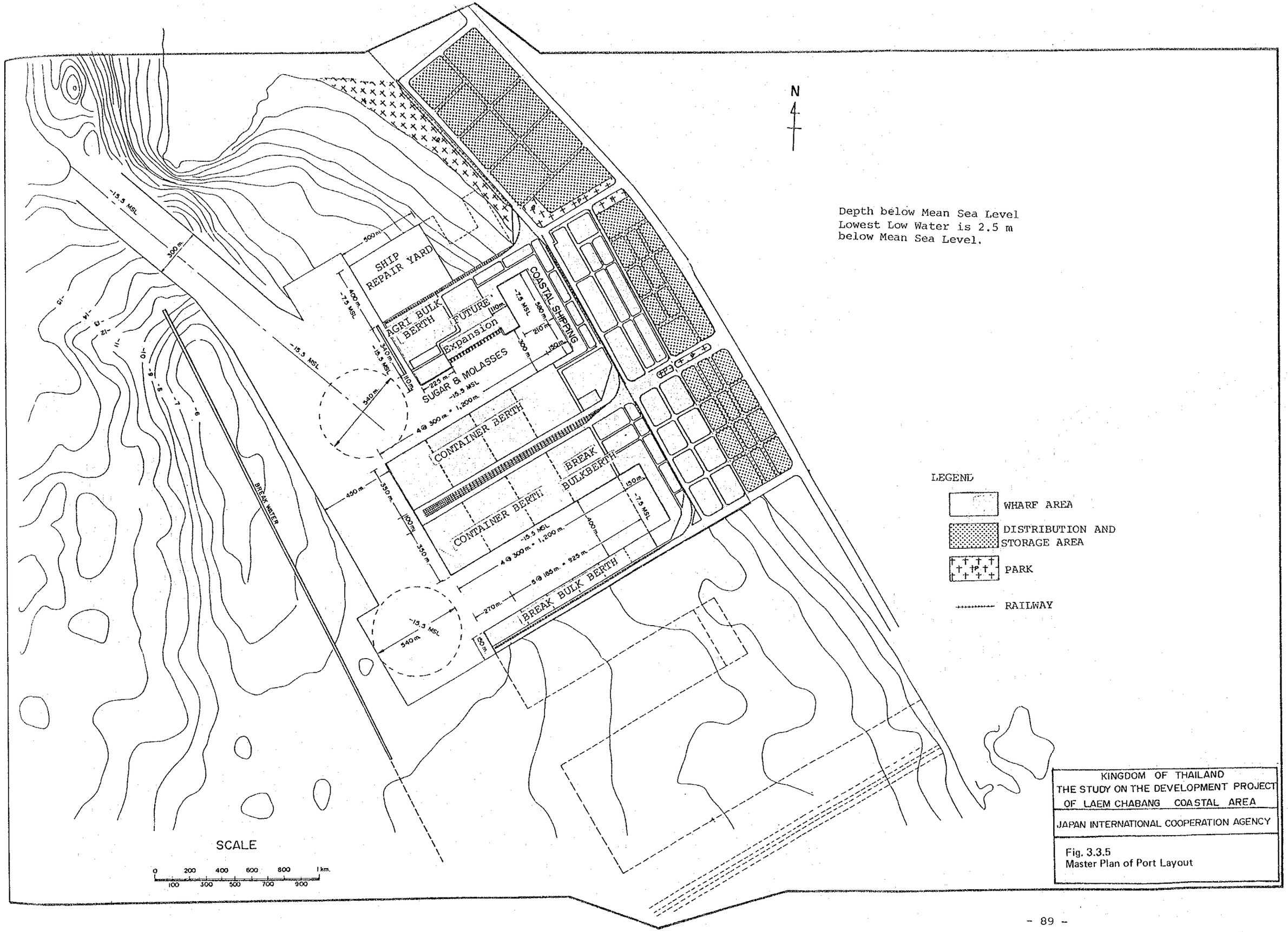

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Fig. 3.3.5
Master Plan of Port Layout

3.4 URBAN DEVELOPMENT PLAN

3.4.1 Policy for the Urban Development and Premises for the New Town

1) National Policy

The RTG's national policy for economic and social development intends to reduce the population flow into the Bangkok and decentralize growth away from the Bangkok Metropolis.

In this respect, the Eastern Seaboard region is expected to become the new center for the industrialization and new urban development.

A relatively high level of urbanization in the Laem Chabang Area is one of the major targets of the Eastern Seaboard to relieve the pressure on Bangkok for industry and urban growth. Urban growth at Laem Chabang is expected to offer an attractive basis for the new migrants at a relatively low cost.

2) Policy for the Urban Development

Basic policies of the urban development are described below.

(1) The urban development should proceed to support the industrial and port activities in the adjacent areas. The new town will be developed in an optimum scale to accomodate the industrial workers and induced workers with the provision of full range of facilities aiming at creation of a balanced and successful town.

(2) New town will be developed in a good balance with port and industrial development.

(3) The planning must be flexible enough to cope with possible changes in social, industrial and commercial requirements in a long-term perspective so that structure will function efficiently at all development phases.

(4) There should be a satisfaction of population in relation to age group, family structure and employment to provide a sound basis for the development of the new town at all phases of its growth.

(5) The new town development should be carefully related to the existing areas and a part of established urban functions would be utilized by the new town residents.

(6) Infrastructure such as road network and sewerage system will be provided linking to the urban and regional networks.

(7) The housing program will provide low and middle (medium) and upper income workers with appropriate support facilities including educational and common facilities. It is important to provide housing to low and middle income families at an afforadable prices.

(8) Development phasing of the new town should be able to keep pace with the industrial and port development program.

3) Site Selection for the Urban Development Area

Refering to the existing land use and projected new development area for the port and the industry, and also the topography and the physical constraints in the Siracha - Laem Chabang area, the available land for the new urban development area will be defined as follows:

- The south of the existing Siracha built-up area
- The north of the Huai Yai river swamp area
- The east of the route 3
- The west of the Chachoengsao - Sattahip railway
  (the east of the railway will be preserved as the farm and forestry land)

Among those areas, three alternative locations for the urban development and the New Town, which accomodate the target population of around 120,000 in 2001, are proposed as explained below.

(1) Alternative Site A

The area is located adjacent to the area for the industrial estate and the port on the east, where the Eastern Seaboard Study recommended as the Urban Development Area.

The reasons for selecting this location for establishing a New Town are as follows:

- Immediate proximity to the deep water port
- Proximity to a number of other centers of employment
- Availability of land already in government ownership
- Easy access from the Route 3 and, subsequently, from the new railway
- Suitability of the topography for servicing, with access to the sea for a marine sewerage outlet
- Ease of establishment of new drainage and flood control system
- Potential for long term expansion

(2) Alternative Site B

The Area is located between Chachoengsao - Sattahip railway track on the east and the foot of a hill on the west. The northern part of the area will be adjacent to the existing Siracha built up area.

The reasons for proposing this alternative location for a new town are as follows:

- Immediate proximity to the existing built up area of Siracha (Tambon) and continuity of the communities
- Easy access for the residents of the new town to the existing urban services, such as medical, higher educational, commercial and etc.
- Availability of existing infrastructure, especially streets
- Generation of higher urban activities as a result of combination of the existing Siracha Town and the new town

(3) Alternative Site C

The characteristic features of area are combinations of Alternative Site A and Alternatives Site B.

Site of the three alternatives are presented in Fig. 3.4.1. Principal features of each alternative is explained in Table 3.4.1. Three alternatives are comparatively analyzed from every aspect of development potential.

As a result, the Department of Town and Country Planning has chosen Alternative A Site for the new town development and Alternative B Site for a large scale residential development to accomodate housing for the induced and the natural growth of population.

3.4.2 Present Conditions

1) Settlement and Population

In the Eastern Seaboard, there are four major urban centers that are Conburi, Siracha - Laem Chabang, Pattaya, Sattahip - Map Ta Phut - Rayong where urban development are expected.

Chonburi would remain as the main urban centre of the Estern Seaboard, with its role as the sub-regional centre providing administrative services and transportation facilities, and marketing link to Bangkok.

The town of Siracha is a focus of this coastal area with relatively small population living within its municipal boundaries, in 1982. The town is situated at a narrow apron of coastal plain and its capacity for expansion is limited.

Laem Chabang development area according to ESS covers a string of coastal towns and villages and inland of the Sukhumvit Highway, and scattered rural settlements. The existing urban pouplation was 48,300 in 1981, is found in three main locations, from north to south, Bang Phra, Siracha and Bang Lamung. Population of Ao Udom Sanitary district is about 64,000 and most population is concentrated in the seaside village of Ban Ao Udom and in the nearby settlement along the Suknumvit Highway.

2) Topography and Physical Constrains

There are coastal hills in the south of Siracha with an average height of 200 m terminating at the coast of the headland of Laem Chabang. To the south of Laem Chabang stretched the broad sweep of flat hinterland drained by the Huai Yai river.

The urban development area is an elevated plain with good drainage conditions. The natural drainage flows toward the west of the Route 3 and from there the water flows into two directions to the north and south into the ocean.

3) Other Existing Conditions

Location of existing schools (1984), existing common facilities, assessed land value (1983-1984) and publicly owned lnad are presented in Fig. 3.4.2 to 3.4.5.

3.4.3 Previous Studies

As a previous study on the urban development at Siracha - Laem Chabang Area, the Eastern Seaboard Study for the National Economic & Social Development Board, September 1982, conducted by the Coopers & Lybrand Associates (ESS) shows various facts and estimates as follows.

1) Growth of Employment

The Eastern Seaboard Study did not include the growth of employment generated by the port development, consequently, the growth of employment in this study is larger than that of ESS.

2) Population Projections

ESS proposed a new town, which accommodates all in-migrant population related to the industrial development at Laem Chabang area, with the

population of some 100,000. The proposal by the Study Team shows relatively larger number of population in the new town.

ESS also assumed that additional increase of population caused by increasing employments which would require residential developments beside the new town development. These are also taken into consideration in the present study.

3) Land Requirements for the New Town

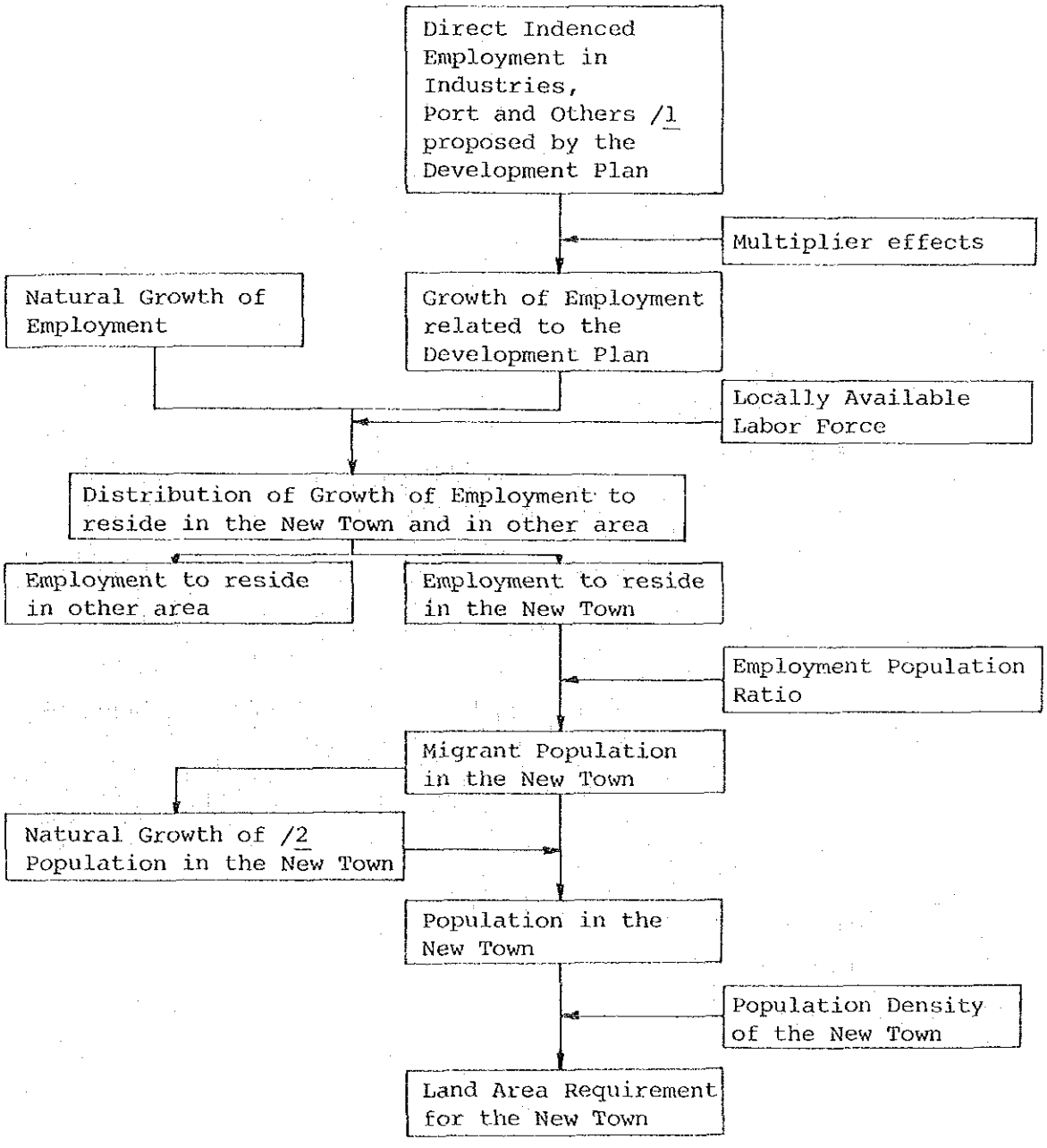
ESS assumed 20 persons per rai (125 persons/hectare) for the population density of the new town, which resulted in the land requirement for the new town to be around 4,700 rai (750 ha). The proposal by the Study Team shows relatively larger area requirement for the new town.

4) Phasing of Development

According to the ESS scenario, the early phases (up to 1991) of developments will take place around in the area of one fifth of the total development area. In comparison with ESS, relatively larger area is proposed to be developed at the early phase in the present study.

3.4.4 Population Projection

The target population and the land area requirement for the New Town in the years of 1991 and 2001 are projected by the procedures as shown in the following chart.



/1 : Higher Education and Research & Development, Offices, and Construction

/2 : For the population in the New Town, 1991, the natural growth of population are not counted.

1) Direct Induced Employment

For the direct induced employment by the development plan, following factors of the employment gorwth are counted.

(1) Grwoth of employment induced by the port development
(Refer to the port development plan for detail.)

(2) Growth of employment induced by the industrial development
(Refer to the industrial development plan for detail.)

(3) Growth of employment induced by vocational and training schools and research & development institutions.

(4) Employment growth induced by office relocation

Office relocation from Bangkok metropolitan area to this development area is proposed to decentralize office function and its engaged population.

(5) Growth of employment induced by construction activities beside local building programme construction workers.

The figures for induced employment growth related to the development are shown Table 3.4.2.

2) Multiplier Effects

In addition to the direct induced employment, there will be some indirect employment generation resulting from forward and backward linkages, and from the consumption requirements of the employment. These indirect employment effects are collectively defined as the employment multiplier.

For multiplier effects, the figures estimated and allocated to urban area by ESS are applied as follows:

Category	Ratio
Export-processing	1.4
Resource-based	1.8
Downstream industry	2.0
Light industry	2.3
Construction	1.8
Offices	1.3
Higher education	1.4
Port	1.6*

* Data from Map Ta Phut Study, and based on the dates of the Port of Kobe.

3) Natural Growth of Employment

According to ESS analysis, the natural growth of employment in the Siracha-Laemchabang development area, during years of 1981-2001 is estimated 23,700, which shows relatively high growth among other urban area in the Eastern Seaboard Corridor. Major portion of the growth is expected to be derived from the existing Siracha Industrial Park and oil refineries. For the employment to live in the new town, a part of the growth of the employment of the Siracha Industrial Park and oil refineries are counted.

4) Locally Available Labor Force

To some portions of the induced employment, non-migrant labor forces would be attracted. As such a locally available labor force, following sources of labor force could be counted.

- the natural growth of labor force
- unemployed labor force
- transfered labor force from presently engaged occupations

11,000 persons, which is around 7.5% of 1990 economically active persons or around 70% of the growth of economically active persons from 1985 to 1990 are counted for the locally available labor force for the short term development. But after the short term development, most of the induced employment are assumed to be filled by migrant workers, because the natural growth of the labor force is not much expected and the demand for the labor force in the area is projected high.

5) Distribution of Growth of Employment to reside in the New Town and in Other Area

Assumptions of the distributions of the growth employment are set as follows:

(1) 90 per cent of the growth of employment directly induced by this development programme will go to the new town, and residual 10 per cent will go to or come from other urban area.

(2) 60 percent of the growth of employment by multiplier effects of induced employment will go to the new town, and residual 40 per cent will go to or come from other urban area.

(3) Out of the natural growth of employment, some 8,000 employment are assumed for Siracha Industrial Park and oil refineries. 25 per cent of these will go to the new town and the rest will go to or come from other area.

6) Population/Employment Ratio

The conversion ratio of employment to population is figured out from the labor force participation ratio and the labor force population ratio. According to ESS analysis, employment/population ratios of in-migrant varies from 0.53 (1986-1991) to 0.52 (1996-2001).

The population/Employment Ratio is set 1.92 and the ratio is confirmed by the sex and age structure of the population and the economically active rated in the minicipal area of Chongwat Chonburi, 1980.

7) Natural Growth of Population

The changes in the population in the new town are figures out by using the cohort analysis.

(1) Projection of the Fertility Rates

(i) Total Fertility Rates

The data of the total fertility rates from the years of 1970 to 1979 in Thailand are analyzed and the rates are set as follows.

2.37 (1991), 2.02 (1996), 1.73 (2001)

(ii) Fertility Rates by Age Group and Sex Distribution

The changes in the fertility rates by age groups are shown in Sectral Report. The 1979 pattern of the fertility rates by age group are applied to the total fertility rates for the projection of that in the years of 1991, 1996 and 2001.

The sex distribution for the births is set, Male 106: Female 100, analizing 1970-1979 data.

(2) Mortality Rates

The changes in the mortality rates by sex and age group are shown in Sectrl Report, analizing the data of the mortality rates from the years of 1972 to 1981 in Thailand.

(3) Sex and Age Distribution of the Migrant Population

The projection of the sex age structure is based on the sex and age distribution for migrant population to the new town of which the method of the projection is described in the Short Term Development Plan and in the Secoral Report III more in detail.

(4) Natural Growth of Population in the New Town

The result of calculation of the natural growth of the population is as follows.

1991 - 1996	:	2,770
1885 - 2001	:	6,930
Total	:	9,700

The number of births and the mortality in the new town is shown in Sectoral Report.

8) Population in the New Town

As a result, the new town population in 2001 would be around 120,000 (117,680) and the land area required for the new town would be 960 ha (6,000 Rai)/1. The population density for the new town is taken from ESS and set to be 125 persons per hectare (20 persons per rai). The detailed information on the population is given in Table 3.4.2 and Sectoral Report.

/1: In case of the NHA's housing area for the new town, the density would be higher than 125 persons per hecter and the net land area requirement for the new town would be smaller than this figure.

3.4.5 Land Use Plan

1) Basic Principles for Planning

Land use plan is formulated in accordance with the following principles.

- The residential area in the new town will accomodate the estimated number of housing classified into several income groups.

- The common facilities, to support the daily lives of the new town residents, will be provided to meet the demands caused by the growth of population

- The commercial center (New Town center) will be a new core to serve for the new town and the surrounding area with easy access from all residential areas in the Laem chabang Development Planning Area.

- The communication system (Road Network will be designed to integrate all forms of transport and must be based on a clearly defined hiearchy of roads, and public transport routes.

- The development should be based upon a series of neighborhood areas from which extraneous traffic is excluded. These should be based on a maximum walking distance of about 500 - 800 m to primary schools, shops, public transport (Ex. bus stop) and other facilities.

- Pedestrians and vehicles should basically be separated. Well-defined pedestrian networks is to be achieved throughout the new town, linking the housing quarters with other various facilities.

- The buffer zones will be placed along the Inter and Intra Urban Primary Roads to protect residential environment from noises and air pollutions.

2) Land Use Plan in the New Town

Land will be allocated for each function seeking the most suitable zoning to embody the development policies. Area allotment is as estimated in Table 3.4.3. The land use plan is shown in Fig. 3.1.4.

3.4.6 Community Facilities

The institutional, educational, medical, welfare and recreational facilities for the new town will be provided by the public sector, while commercial facilities would be basically developed by the private sector.

1) Neighborhood Community Facilities

There will be eight neighborhood units in the residential area in the new town in 2001 with the population of around 120,000 and two neighborhood units with a population of about 24,000 in 1991. In addition to the population in the new town, some 1,000 population is expected in the Business and Commercial Area of this development complex in 1991.

A basic neighborhood unit in the new town will accomodate 12,000 to 15,000 people, which corresponds to a primary school district. In the Study, each neighborhood unit is assumed to have an average population of about 14,500 in formulating the development plan of community facilities such as schoools, shopping area, parks and open space for the dwellers.

(1) Educational Facilities

In the Study, educational facilities required in the new town are planned according to the NHA's upper-ceiling standard. Basic assumptions and major factors of facilities plan are as summarized below.

Item	Kindergarden	Primary School	Secondary School
Population	3,600	14,500	29,000
Ratio (pupil/student per population	0.07	0.14 /1	0.1
No. of pupil/student per facility	250	2,000 /2	2,900
Area of facility (ha)	0.32	2.4	5.6 - 8.0
Total number of facilities	24 - 32	8	4
Total area in NT (ha)	7.68 - 10.24	19.2	22.4 - 32
Area allocated in the study (ha)	10	20	32

/1: 0.11 in the Amphoe Siracha

/2: Average figure of the Amphoe Siracha is 500

Our study on the age structure of the population in the new town (Table 3.4.4) shows less number of population in school aged group at the early stage of immigration than at the later stage. However, there is a remarkable tendency of the growing population in school aged group caused by the fact that the majority of the immigrant would be younger generation who would have high fertility rates.

At the early stage of the new town development, all of the planned educational facilities would not be required, but it would be necessary to reserve the land for the planned educational facilities for the later stage of the development.

With reference to higher education, the existing technical colleges and vocational schools in the region will serve for the rising demand for the higher education. However, since the port and industrial developments will require well trained personnels, higher educational facilities for these purpose would be essentially necessary in this complex. In the business and commercial area of this development complex, a vacational school for industry and a training school for port are proposed. Those higher education institutions will hopefully grow as a core of regional higher education facilities when the development sucessfully matures.

(2) Community Center Facilities

Based on the discussions with the NHA, it will be necessary for every two neighborhood units to have a community center to function as core of the community.

These facilities in the community center includes the following.

- Health center
- Post office
- Police sub-station
- Telephone booth
- Car parking lot
- Shopping facilities

(3) Community facilities for a neighborhood unit

Community facilities of a neighborhood unit comprises the following.

- A primary school
- Kindergardents and day-care centers (3 - 4)
- Children's playground (4)
- Police box
- Mail box, Telephone booth
- Bus stops
- Laundry (private)
- Pharmacy (private)
- Local health clinic (private)
- Several shops (private)
- Neighborhood Park

2) Commercial Center (New Town Center)

The commercial center is expected to play a role of a nucleus of economic activities in the Laem Chabang Complex. The commercial center should have the easy access both by cars and people from residential areas.

The commercial center has the multi-functional zones comprising the following facilities with the total area of 37 - 40 ha.

- Commercial and Business Zones (14 - 15 ha)
- Public, Civic and Governmental Zone
- Cultural Zone (2.5 - 3 ha)
- Health Zone
- Other Area

Some parts of the commercial and business functions would be performed by providing shophouses along local roads and collectors which would encourage the residents to be involved with the commercial and business activities and would reinforce the human activities along the streets in

the new town. In this case, the area for the commercial center would be reduced to around 20 ha.

The detailed information on the community facilities is shown in the Appendix of Sectoral Report.

3.4.7 Parks and Open Space

Parks and open spaces would be planned to provide a good living environment for the inhabitants. They comprise the district park, neighborhood parks, playgrounds, malls and tot lots etc.

1) District Parks

District park is a spot with amenity and rest provided with benches, pergolas, ponds, trees and botanical gardens for recreational activities and various sports facilities. The total area would be about 22 ha (138 rai) or 2.4% of the new town area, and recreational spaces and sports fields.

2) Neighborhood parks and Playgrounds

One neighborhood park will be provided for each neighborhood unit, with land area of 2 ha with outdoor sports fields. For community open space, the field of secondary school could be utilized.

In addition to the neighborhood parks, four playgrounds will be provided in a neighborhood unit within a walking distance of about 250 to 300 meters and about 0.25 ha of each area to be used by children in a kindergarden area.

Total neighborhood parks' area is assumed at 16 ha. Total area for playgrounds is about 8 ha for the new town.

Playlots (tot lots) will be provided for each 40 - 50 dwelling units and will have around 400 m^2 area per lot.

3) Malls and Pedestrian Ways

Malls and pedestrian ways would be planned in addition to roads and streets in the new town.

4) Buffer zones

Along the inter urban and intra urban primary roads, buffer zones will be provided in order to protect a healthy and comfortable living environment kept apart from traffic nuisance.

3.4.8 Housing Development Plan

1) Housing Development

(1) Housing planned in the New Town

Based on the assumptions on the employment and population for the new town, around 26,100 dwelling units are estimated. (Table 3.4.5) For the immigrant workers, the number of dwelling units are figured out applying the NHA's methods, and the natural growth of households /1 are added to the 1996 and 2001 planned dwelling units.

/1: Excluded one-person households and unrelated individuals which are supposed to share houses by plural occupancy.

(2) Income Structure of Households /1

Considering income structure of workers in transportation and industries and others who will be directly employed by such industries and the NHA's methods of classifing income level of induced employment, following classification of income structure of households are estimated.

Category	Income Level	NHA's Standard	Pattaya	Laem Chabang %	Laem Chabang No. of D.U. /2
Group A	3,000-5,000 B/mo.	35%	25%	25	6,520
Group B	5,001-9,000 B/mo.	50%	54%	65	16,970
Group C	Over 9,001 B/mo.	15%	21%	10	2,610

Note: Income includes basic salary, bonus and pension etc.

/1: In this case, a household represents a person or a group of persons who live in a housing unit.

/2: Dwelling units in the new town.

2) Types and Number of Housing Units

(1) Types of Housing Units

It was clarified through discussions with NHA, that there are five basic different housing types with different plot sizes and family types as below.

	Type of Housing	Average Plot Size (m^2)*	family Types
A	A-1: Dormitory - Flat	80 - 100	For Single
	- do - - 2 to 3 storey		- do -
B	B-1: Row House - Single storey	100 - 120	- do - for Family
	- do - - Double storey		- do - with children
C	C-1: Semi-Detached	180 - 200	- do -
D	D-1: Detached House	240 - 400	- do -
E	E-1: Shop House - 2 storey	56 - 64	- do -
	E-2: - do - - 3 storey		- do -

* For long term plan the average plot size will vary being related to the future social and economic conditions.

Employment and population distribution over these categories of housing type is assumed as follows.

Income Groups		Types of Housing		
Low Income Group	25%	A	A-1	Domitory - Flat
			A-2	- do - - 2 to 3 storey
		B	B-1	Row house - Single storey
Middle Income	65%		B-2	- do - - Double storey
		C	C-1	Semi-detached - Single storey
			C-2	- do - - Double storey
High Income Group	10%	D	D-1	Detached House
		E	E-1	Shop House - 2 storey
			E-2	- do - - 3 storey

(2) Types and Number of Housing Units and Land Requirement

Types and number of housing units are figured out applying the NHA's method. The natural growth of households are grouped into each type following the same pattern as dwelling units distribution of direct induced employment. The result of the calculation of the types and number of housing units and the land area requirement for the net residential use are worked out based on the NHA standard as shown below.

Type of Housing	Average * Plot Size (m^2)	No. of Houses	Net Res. Area (ha)
B-1 or 2	100 - 140	20,140	201.4 - 282.0
C-1	180 - 200	3,340	60.1 - 66.8
C-2	180 - 200	1,150	20.7 - 23.0
E-1 or 2	56 - 64	940	5.3 - 6.0
D-1 or 2	240 - 400	530	12.7 - 21.2
Total	-	26,100	300.2 - 399.0

* For the long term plan the average plot size will vary related to the future social and economic conditions.

Some parts of the new town would be developed by private developers and the average plot size may be larger than NHA standard. In

this case the net residential are requirement would be larger than these figure.

3) Density Distribution

It will be essential to keep a balance among the low, middle and high density areas with the mixture of all types of housing in the residential area of the new town.

With reference to the density distribution of housing in the new town, high density areas will usually concentrate on around the commercial center area and the density will decrease gradually toward the outer areas of the new town.

Table 3.4.1 COMPARISON OF ALTERNATIVE SITES FOR URBAN DEVELOPMENT (1/2)

Factors to be Compared		Alternative A : The Site proposed by Eastern Seaboard Study	Alternative B : The Southern Area Adjacent to the existing Siracha build-up District	Alternative C : Combination of Alt. A and B	Remarks
Factors Related to Development Cost (by phasing)	Land Acquisition	Relatively costly.	Same as Alt. A	May be less expensive than Alt. A and Alt. B.	
	Infra-structure utilities	Water supply, drainage and sewerage system can be one system respectively.	Two (or three) systems for water sypply, drainage and sewerage may be required. Early construction of R = 3 bypass or service road is necessary.	Same as Alt. B (with more complication)	
	Earth work etc.	Minimum earth works are required for land formation .	More earth works than Alt. A are required for land formation.	Combination of Alt. A and Alt. B	
Availability of Land for Future Expansion (after year of 2000)	Industrial Area and (Port Area)	Industrial area can be expanded toward the south of the complex.	Industrial area can be expanded toward the south and east (Alt. A urban development area)	Combination of Alt. A and Alt. B.	
	Urban Area	Urban area can be expanded toward the north, eventually the urban area and the natural growth of Siracha Town will be combined.	Urban area can be expanded toward the south (Alt. A area etc.)	Combination of Alt. A and Alt. B.	
	Siracha Town (Natural growth)	Existing Siracha Town can be extended to the south, east and north.	Siracha Town can be extended to the east and north, southward extension will be limited by proposed new town (Alt. B site)	Same as Alt. B.	Extension toward the north and east are limited by a hill and railway truck.
Environmental Factors	Pollution from the oil refineries	Judging prevailing wind direction and the location of the plants, the area will not be affected heavily by the polluted exhaust from the existing oil refineries.	The area might be affected by polluted exhaust from the existing oil refinery plants.	Combination of Alt. A and Alt. B.	The new Industrial Development will not produce major hazard of poli pollution (Mostly light Industry)
	View from the Urban Development Area	The area is gradual sloping down to the coast, wide variety of views can be provided.	A hill located between the coast and the area will block the view to the sea from the area.	Combination of Alt. A and Alt. B.	
Others			Induced population of the new town will require and result upgrading urban functions of Siracha Town.		

Table 3.4.1 COMPARISON OF ALTERNATIVE SITES FOR URBAN DEVELOPMENT (2/2)

	Factors to be Compared	Alternative A : The Site proposed by Eastern Seaboard Study	Alternative B : The Southern Area Adjacent to the existing Siracha build-up District	Alternative C : Combination of Alt. A and B	Remarks
Availability of Land for Urban Development	Existing Land Use and Land Land Tenure	The area mostly used for agriculture with some local settlements. Parts of public owned land can be utilized for the development (IEAT, Ministry of Welfare)	The area mostly used for agriculture with some local settlements.	Combination of Alt. A and Alt. B.	
	Existing Facilities	A satelite station is located within the area. Transmission lines along railway truck.	Transmission lines running across the area. Large scale development may require re-alignment of the lines.	Combination of Alt. A and Alt. B.	Railway Stations are planed near to both Alt. A and Alt. B.
Suitability for Urban Development	Topography Drainage (Water supply)	The area is low lying coastal plain, the heig heights ranging from approx. 15 m. to 35 m.above sealevel. Slope grade 2.5 3% approx.	The area is mostly low lying plain defined by a coastal hill on the west. The heights ranging from approx. 50 m. to 65 m. slope grades 2.5 5%. The areas is divided to be two separate basins.	Combination of Alt. A and Alt. B.	For Alt. B and C, at least two separate drainage and sewerage systems are required.
	Soil Conditions	Sound soil conditions for Medium-rise Buildings.	Same as Alt. A.	Same as Alt. A	
Relationships Urban Development Area Industrial Complex and Siracha Town	Urban Development area - Industrial Complex.	Distance = approx. 0.2 8 km. along the boundary of these two area, buffer zone will be required.	Distance = approx. 2 12 km. more commuting services are required than Alt. A.	Combination of Alt. A and Alt. B.	
	Urban Development area- Siracha Town.	Distance : approx. 4 11.5 km. common facilities for the residents will be required from the early stage of the development. (or busing service to Siracha Town)	The urban development area can be considered as a extension of busing Siracha Town, Positively utilizing existing common facilities, especially at the early stage of development.	Combination of Alt. A and Alt. B.	

Table 3.4.2 PROJECTION OF EMPLOYMENT AND POPULATION IN NEW TOWN

	1991				1996 /A			2001 /B		
	EMPLOYMENT	LOCALLY AVAILABLE LABOR FORCE	NEW TOWN	OTHER AREA	EMPLOYM'T	N.T.	OTHER AREA	EMPLOYM'T	N.T.	OTHER AREA
EPZ	5,430	9,470	3,450	5,420	7,210	6,490 (90%)	720 (10%)	4,660	4,190 (90%)	470 (10%)
GIE	4,040			600	6,230	5,610	620	3,780	3,400	380
PORT	7,200		2,620	4,120	3,400	3,060 (90%)	340 (10%)	3,400	3,060 (90%)	340 (10%)
HIGHER ED., RESEARCH & D.	-		-	-	500	450 (90%)	50 (10%)	500	450 (90%)	50 (10%)
CONSTRUCTION	-		-	-	900	810 (90%)	90 (10%)	500	450 (90%)	50 (10%)
OFFICES	-		-	-	1,000	900 (90%)	100 (10%)	1,000	900 (90%)	100 (10%)
MULTIPLIER EFFECT	8,130		3,840	2,580	1,710	2,400 /1	1,440 (60%)	960 (40%)	3,090 /3	1,850 (60%)
						9,280 /2	5,570	3,710	6,440 /4	3,860
TORC, ESSO SRI	3,000		1,090	480	1,430	3,000	750 (25%)	2,250 (75%)	2,000	500 (25%)
TOTAL	27,800		11,000	12,600	4,200	33,920	25,080	8,840	25,370	18,660
POPULATION				24,000 (1)	8,100		48,150 (2)	16,970		35,830 (3)

(1) REDISUAL MULTIPLIER EFFECT GENERATED BY 1991 INDUCED EMPLOYMENT
(2) 75% OF MULTIPLIER EFFECT GENERATED BY 1996 INDUCED EMPLOYMENT
(3) 25% - DO -
(4) 75% OF MULTIPLIER EFFECT GENERATED BY 2001 INDUCED EMPLOYMENT
/A MOST OF THE NATURAL GROWTH OF LABOR FORCE WILL BE ABSORBED BY THE NATURAL GROWTH OF EMPLOYMENT, IN CHONBURI-SIRACHA-PATAYA AREA, THE INDUCED EMPLOYMENT IN 1996 AND 2001 WILL BE FILLED BY MIGRANT.

NEW TOWN POPULATION (2001)

(1)+(2)+(3)	107,980
NATURAL GROWTH	9,700
TOTAL	117,680

≒ around 120,000

OTHER NATURAL GROWTH OF EMPLOYMENT IN SIRACHA LAEMCHABANG D.P.A. (SOURCE: ESS)

	1991	1996	2001	TOTAL
NATURAL GROWTH OF EMPLOYMENT	9,800	2,100	3,800	15,700

Table 3.4.3 LAND USE OF NEW TOWN (MASTER PLAN)

			(ha)	(Rai)	(%)
1.	Residential Use		(484)	(3,025)	52.0
2.	Community Use		(33)	(206)	3.5
	1) Town Centre		20	125	
	2) Community Centre (4.3 x 3)		13	81	
3.	Schools		(62)	(387)	6.7
	1) Secondary School	(8ha x 4)	32	200	
	2) Primary School	(2.5ha x 8)	20	125	
	3) Kindergarden	(0.32hax32)	10	62	
4.	Parks		(56)	(350)	6.0
	1) District Park	(22ha x 1)	22	138	
	2) Neighborhood park	(2ha x 8)	16	100	
	3) Playground	(0.25hax32)	8	50	
	4) Play lot	(0.04hax240)	10	62	
5.	Buffer Green	(4,700ha x 100m)	(47)	(293)	5.1
6.	Roads		(205)	(1,280)	22.0
	1) District Distribution	40m x 6,600m	26	162	
	2) Local Road	25m x 13,400m	34	212	
	3) Collector	15m x 7,700	12	75	
	4) Access & Pedestrian way	4-9mx221,700	133	831	
7.	River & Canal		(9)	(56)	1.0
8.	Water Filtration Plant		(12)	(75)	1.3
9.	Water Distribution Basin		(4)	(25)	0.4
10.	Power line & Gas pipeline		(18)	(113)	2.0
Total:			930.0	5,810	100.0

Table 3.4.4 PROJECTION OF POPULATION IN NEW TOWN, SEX AND AGE DISTRIBUTION, 1991, 1996, 2001

AGE	1991			1996			2001				
	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	%	FEMALE	%
0- 4	1,830	920	910	6,880	3,490	3,390	11,010	5,630	8.93	5,380	9.85
5- 9	1,930	970	960	5,710	2,870	2,840	9,730	4,930	7.81	4,800	8.79
10-14	1,890	960	930	5,700	2,880	2,820	8,490	4,280	6.79	4,210	7.70
15-19	3,540	1,770	1,770	9,000	4,510	4,490	10,960	5,510	8.74	5,450	9.98
20-24	6,780	4,060	2,720	17,090	9,880	7,210	19,030	10,510	16.67	8,520	15.59
25-29	2,950	1,530	1,420	12,630	7,070	5,560	21,320	12,020	19.07	9,300	17.02
30-34	1,440	780	660	5,810	3,070	2,740	14,640	8,130	12.89	6,510	11.92
35-39	1,260	690	570	3,930	2,150	1,780	7,590	4,040	6.41	3,550	6.51
40-44	710	400	310	2,660	1,480	1,180	4,890	2,680	4.25	2,210	4.05
45-49	580	320	260	1,860	1,030	830	3,450	1,900	3.00	1,550	2.84
50-54	360	200	160	1,250	690	560	2,310	1,270	2.01	1,040	1.90
55-59	260	150	110	870	500	370	1,590	880	1.39	710	1.30
60-64	170	80	90	580	300	280	1,050	570	0.90	480	0.88
65-70	110	50	60	370	170	200	680	330	0.53	350	0.64
70 OVER	190	80	110	580	230	350	940	380	0.60	560	1.02
TOTAL	24,000	12,960	11,040	74,920	40,320	34,600	117,680	63,060	100	54,620	100

NATURAL GROWTH OF POPULATION IN THE NEW TOWN

	1991-1996	1996-2001	TOTAL
NATURAL GROWTH OF POPULATION IN THE NEW TOWN	2,770	6,930	9,700

Table 3.4.5 DWELLING UNITS IN NEW TOWN

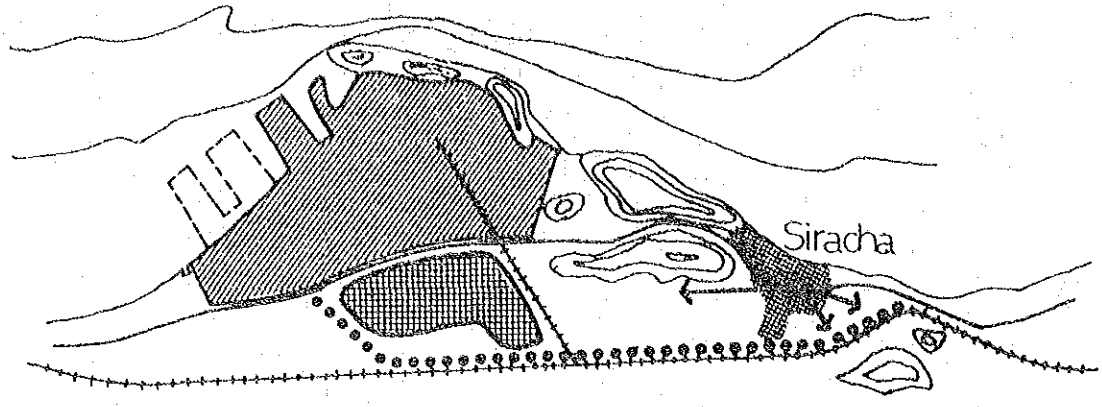
	1991	1996	2001	TOTAL
1991 MIGRANT GROUP	5,133 /1	384 /2	1,719 /2	7,236
1996 DO.	-	10,335 /1	764 /2	11,099
2001 DO.	-	-	7,803 /1	7,803
TOTAL	5,133	10,719	10,286	26,138

/1 DWELLING UNITS WERE FIGURED OUT BY N.H.A. METHOD;
EMPLOYMENTS IN NEW TOWN ⟶ D.U. IN NEW TOWN

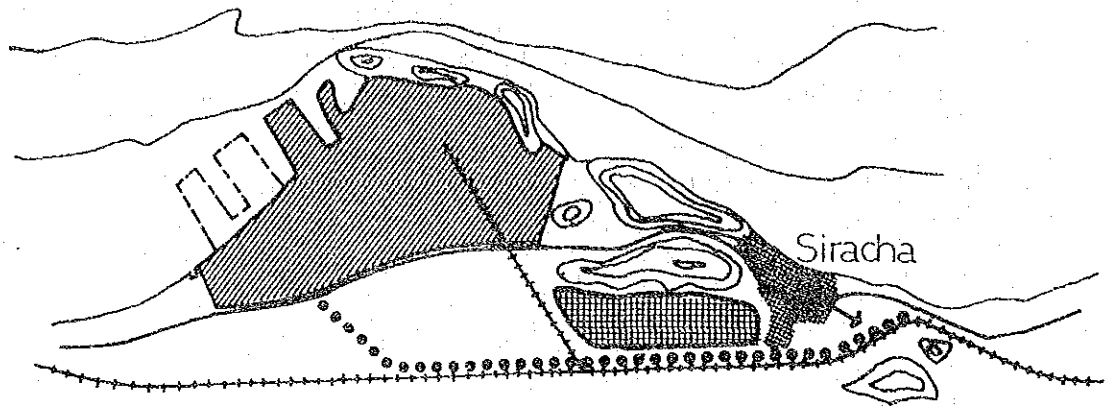
/2 NATURAL GROWTH OF HOUSEHOLDS, EXCLUDING ONE-PERSON HOUSEHOLDS AND UNRELATED INDIVIDUALS

INCOME STRUCTURE OF HOUSEHOLDS (2001)

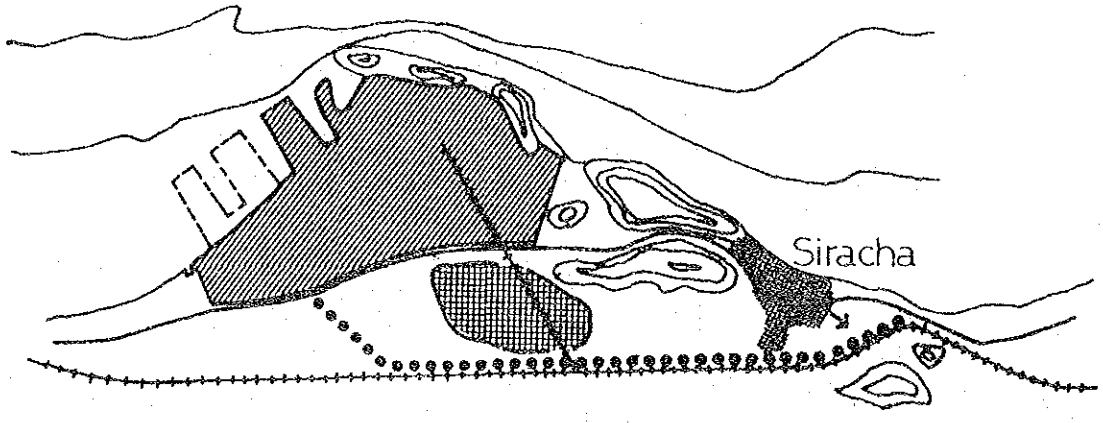
HIGH INCOME GROUP	2,610	(10%)
MIDDLE INCOME GROUP	16,970	(65%)
LOW INCOME GROUP	6,520	(25%)
	26,100	



ALTERNATIVE A



ALTERNATIVE B



ALTERNATIVE C

LEGEND

URBAN DEVELOPMENT

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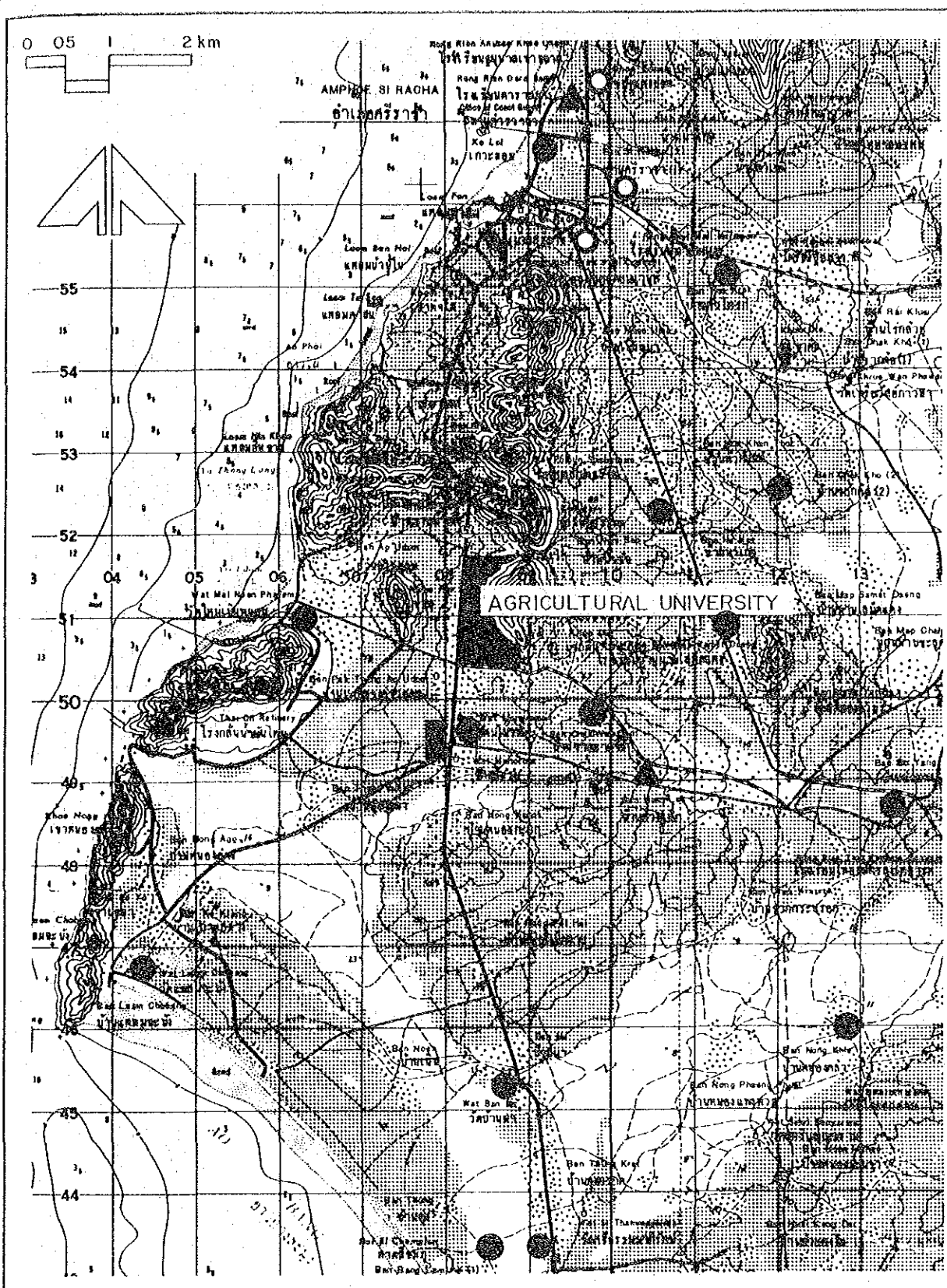
Fig. 3.4.1
Three Alternative Sites for Urban Development



LEGEND (Refer to Sectoral Report Appendix III-7 for detail)

- Primary school (public)
- Secondary school (public)
- Private school (kindergarden, primary school, secondary school)
- Vocational school (private)

Note : Agricultural university is the training center.

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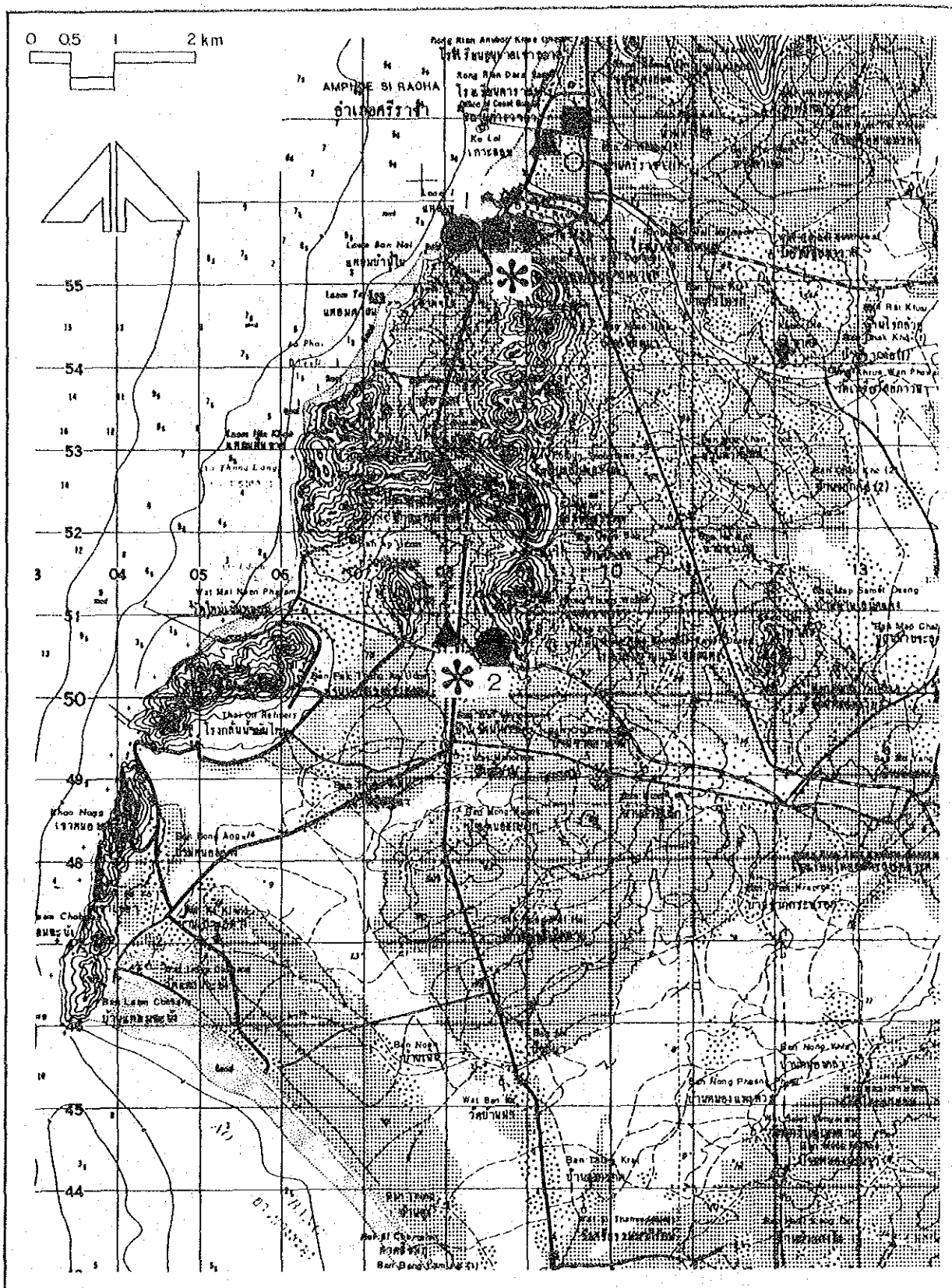
Fig. 3.4.2
Location of Existing Schools (1984)



LEGEND

- Administrative Office
- Hospital (No.1), Health Center (No.2)
- Fire Station
- Police Station
- Post Office
- Market

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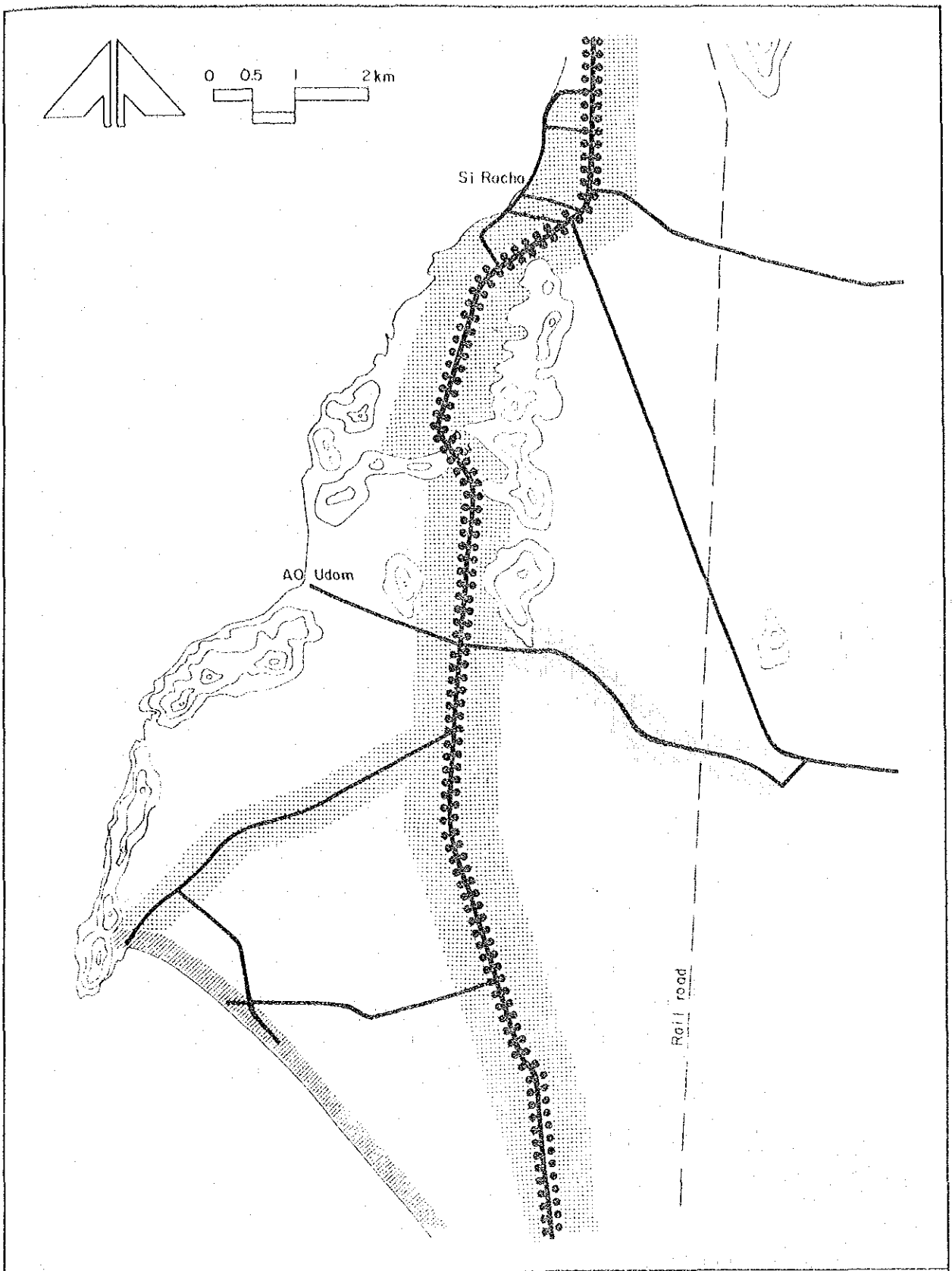
Fig. 3.4.3
Existing Common Facilities



LEGEND

- 300,000฿/ Rai (with 40m from R.3)
- 500,000฿/ Rai (with 200m from Coast line)
- 200,000฿/Rai (range from 40m to 200m from R.3 and/or within 200m from the road)
- 60,000฿/Rai (within 200m from the road)
- and 50,000฿ Rai (within 100m from the road)
- 25,000฿ Rai (the area except above mentioned)

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THE STUDY ON THE DEVELOPMENT PROJECT OF LAEM CHABANG COASTAL AREA

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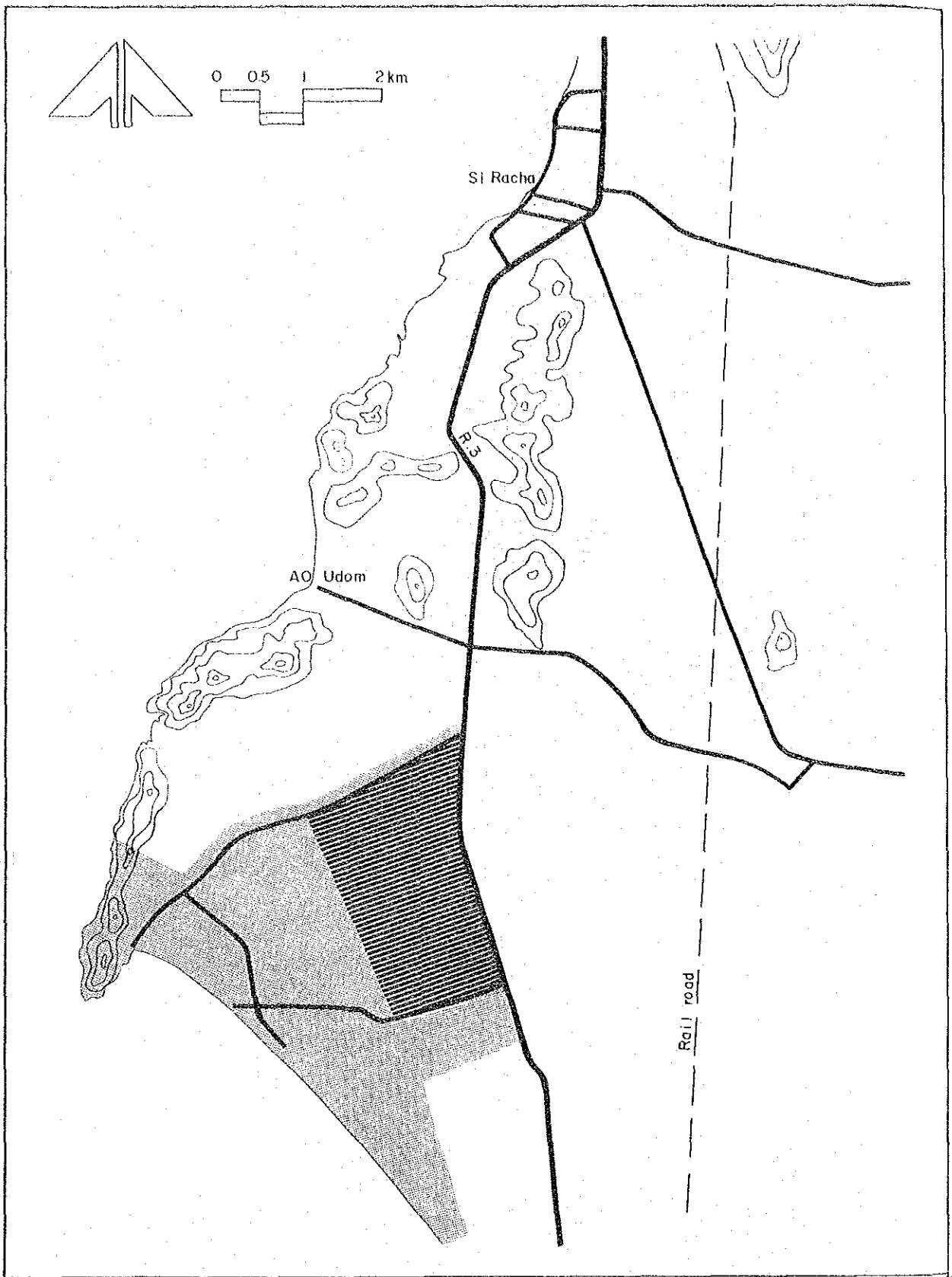
Fig. 3.4.4
Assessed Land Value 1983–84



LEGEND

Land for Industrial Development

Land for Port Development

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Fig. 3.4.5
Publicly Owned Land for Laem Chabang Development

3.5 Transportation Development Plan

3.5.1 General

The planning of transport systems for the Laem Chabang Coastal Area must distinguish the following types of traffic:

- Traffic generated by the residents of the Area
- Cargo traffic generated by the industrial estate and the export processing zone
- Traffic through the port, and
- Traffic generated in or attracted to the other areas in the region

An integrated system of transport facilities should be aimed to accommodate the above types of traffic with a minimum level of conflict at the least overall cost.

Conditions of existing transport facilities and immediate improvement plans in the Eastern Seaboard Region have been examined. In addition to the proposed deep sea port major components of transport facilities serving the Area will include a four-lane divided highway and a single track railway connecting with Bangkok, a railway container yard and a truck terminal in the outskirt of Bangkok, pipelines carrying natural gas products from Map Ta Phut and marine loading facilities, and an air-filed at U Tapao. All modes of transport will be available to the Area, and with a few improvement, each of them appears to have sufficient capacity up to the year 2001. It is apparent that achieving the optimum distribution of traffic among different modes within the limit of practically should be one of the most important aims of the transport planning for the Area in order to avoid the wasteful double investment or inefficient use of facilities.

Transport cost occupies only a minor fraction of the total cost of practically any goods. Shipper's choice of a transport mode can not be guided by a pricing policy alone. A package of transport policies, mostly institutional and covering all modes, will be required to obtain desirable distribution of traffic among modes in this region.

Within the bounds of the Laem Chabang Area, layout and design of transport facilities, e.g., avenues and streets, railway right-of-way and stations, parking lots, bus stopes, and so on, are not only decisive factors shaping the visual appearance of the Area but also one of the major factors influencing the siting of urban activities in the Area. Therefore, they should be considered as tools for shaping and guiding the urban development of the Area. The planning and designs of facilities and services described later in this chapter have been made with the above considerations in mind.

3.5.2 Cargo Transport Demand and Modal Split

1) Traffic Through the Port

The Laem Chabang Port is expected to become the main deep sea commercial port of Thailand. Estimates of volumes of cargo of various types and the methods used in deriving them have been presented in section 3.3. An analysis of perceived transport costs of each mode together with other non-quantifiable factors for the transport of goods between the Port and Bangkok has been made in order to determine the distribution of cargo among different modes (modal split).

It was found that the economic cost of transporting goods between the Port and the Bangkok area was at its least by the waterway mode, then comes the rail mode, and the road mode was the most expensive. Differences among modes were quite large when comparing the costs of linehaul operations. However, overall costs including those costs of intermodal transfers and additional construction such as additional private wharves and pavement overlay and final pickup/delivery show no longer marked differences among modes although the ranking remains the same. Under the prevailing rates the rail mode could well be the most expensive in terms of overall costs perceived by shippers.

Cargo transport modal split was determined type by type considering the existing actual practice and likely future scenarios.

2) Cargo Traffic to and from GIE and EPZ

Types and sizes of industries likely to be located in the GIE and the EPZ have been described in Section 3.2. For each of 15 industry types the amounts of input and output have been estimated by applying the industry average in Japan. For the EPZ certain amounts of input and output were assumed to be domestically transported by trucks depending on the type of industry, and the rest was assumed to be transported entirely through the Port. For the GIE industry average percentages of input or output transported by waterborne transport to the total input or output in Japan were applied industry by industry and then modified for Thailand to estimate the portion of input or output to be borne by waterway transport.

3) Cargo Transport Demand Generated by the New Town and Surroundings

The increase in the number of households attributable to the Laem Chabang Development Project has been estimated at about 38,000 by the year 2001. Using the household expenditure survey results, household consumption in weight was estimated. It was calculated that the above number of households would require 82,000 tons of consumer goods annually. However, a significant percentage of trips to deliver consumer goods is likely to be made by pickups and actual heavy truck traffic for the purpose of serving the Area would be insignificant relative to other types of traffic. Table 3.5.1 summarizes the estimates of cargo traffic volumes and their modal split ratios.

3.5.3 Passenger Transport Demand and Modal Split

1) Critical Passenger Transport Demand

Unlike other cities that followed natural uncontroled growth this area of planned development will have a clear separation of residence and work place. The distance between the residential areas and the main work places, i.e., the port, the EPZ, the GIE, the business area, and the community center, generally exceeds the limit of walking distance. The demand for motorized passenger traffic caused by workers commuting to the

above concentrations of work place, perticularly to the first three areas, would equal the number of workers in these areas.

The planned development, however, could minimize the demand for motorized transport by students by carefully placing the schools as suggested in the preceding section.

Except at a few locations where the truck traffic movements interfere with passenger vehicle movements, the amount of the latter would be the critical factor in determining the capacity of urban road network in the Area.

Factors that must be taken into account in estimating the peak hour demand include the shift schedule of workers. It was assumed that among workers in the Port 71.5% would be under the two-shift schedule, and among workers in the EPZ one third each would be under one-shift, two-shift, and three-shift respectively. In all other areas workers would be under ordinary working hour schedules with possible extra-hours in the evening.

From the existing communities of Si Racha, Chonburi and Pattaya, workers were assumed to be attracted to the new employment oppotunities in the Area in accordance with a gravity formula, i.e. in proportion to the respective city size and in reverse proportion to the distance powered to 1.2. It was further assumed that workers' destinations or workplaces are generally in proportion to the size of employment in each workplace.

Figure 3.5.1 illustrates amounts of commuter flows among various places in the Area for the year 2001.

2) Passenger Traffic Modal Split

The choice of travel mode by passengers is largely determined by their income level, type of their community, and availability of public transportation. Patterns of expenditure on transport by different income groups were examined for residents of Bangkok, municipal areas, sanitary districts, and villages in the Central Region. Significant differences

were observed. It was decided that residents in the Area would spend on transport in a fashion between Bangkokians and residents of municipalities in the Central Region.

Three income groups were differentiated and vehicle ownership and modal split ratios were estimated for each of the three groups.

Table 3.5.2 shows resulting vehicle ownership projections, and Table 3.5.3 modal split ratios for each income group. Table 3.5.4 shows origins and destinations of passenger vehicle traffic for passenger cars and motorcycles in passenger car units (PCU's) and for buses in number.

3.5.4 Transport Facility Design Volumes

1) Vehicle and Vessel Loading Conditions

Loading conditions of vehicles determine the number of vehicles required to transport the given amount of cargo or 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 considerations to likely future improvements.

2) Facility Design Volumes

Figures 3.5.2 and 3.5.3 illustrate design traffic volumes for transport infrastructure facilities in the Area.

3.5.5 Road Network Planning

1) Planning Policy

Considerations were given to the following factors in planning the road network of the Laem Chabang Complex.

- To separate the traffic flow of the passenger and cargo.

- To distinguich functions and characteristics of each road.
- To connect various roads to function as a whole.
- To ensure safety against traffic accidents.
- To maintain harmony and consistency with other facilities' development.
- To preserve a good environment.

2) Functions and Classifications of Roads

In this study, roads were classified into several categories considering their functions and characteristics.

(1) Inter-urban Primary Roads (V_1)

There roads form the primary road network within the whole country. A long distance traffic movements traveling between major cities are included in this type. Sometimes, these roads are planned outside of major cities to avoid the traffic congestion within cities.

(2) Intra-urban primary road (V_2)

These roads form the primary road network within a major city. A long and medium distance traffic movement to, from and within the city shoudl be canalized on the primary distributors.

(3) District roads (V_3)

These roads distributes the medium distance traffic movements within the residential, industral and principal business districts of the development areas. They form the link between the primary road network and a local roads within community areas.

(4) Local roads (V_4)

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

(5) Collector roads (V_5)

These roads distributes the traffic same as the local roads within a community area. They form the link between the local roads and access roads.

(6) Access roads (V_6, V_7)

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

3) Typical Cross-Sections

The typical cross-sections were examined taking into account the future traffic volume, traffic characteristics, the function of cross-section elements and the environmental perspectives. The typical cross-sections of the individual roads are illustrated in Fig. 3.5.4 to Fig. 3.5.8.

4) Fugure Road Network

The future road network was planned considering the road network planning policy, the functions and characteristics of the road, the future traffic demand, and the existing road network. Basically, the future road network pattern is formed as the ring roads and grid roads. The road network is illustrated in Fig. 3.5.9. Location of intersections is shown in Fig. 3.5.10.

Table 3.5.1 CARGO TRAFFIC VOLUMES AND MODAL SPLIT

Types 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	15	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	-	43	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

Table 3.5.2 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

Table 3.5.3 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

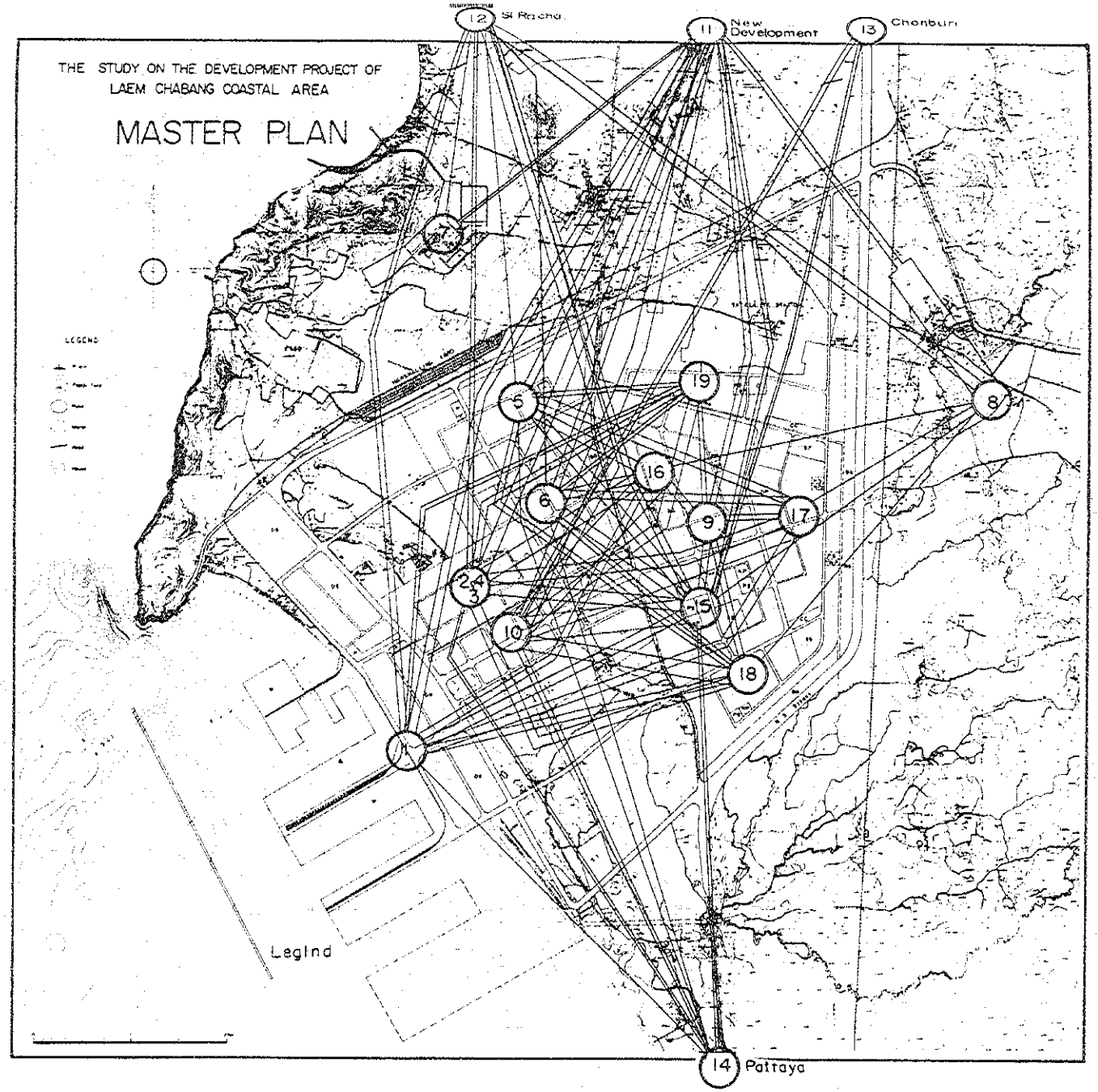
Note: /1: x = 80 for base case, x = 60 for high public transport case

Source: JICA Study Team

Table 3.5.4 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 Commu-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.



LEGEND

Persons

5000
3000
2000
1000

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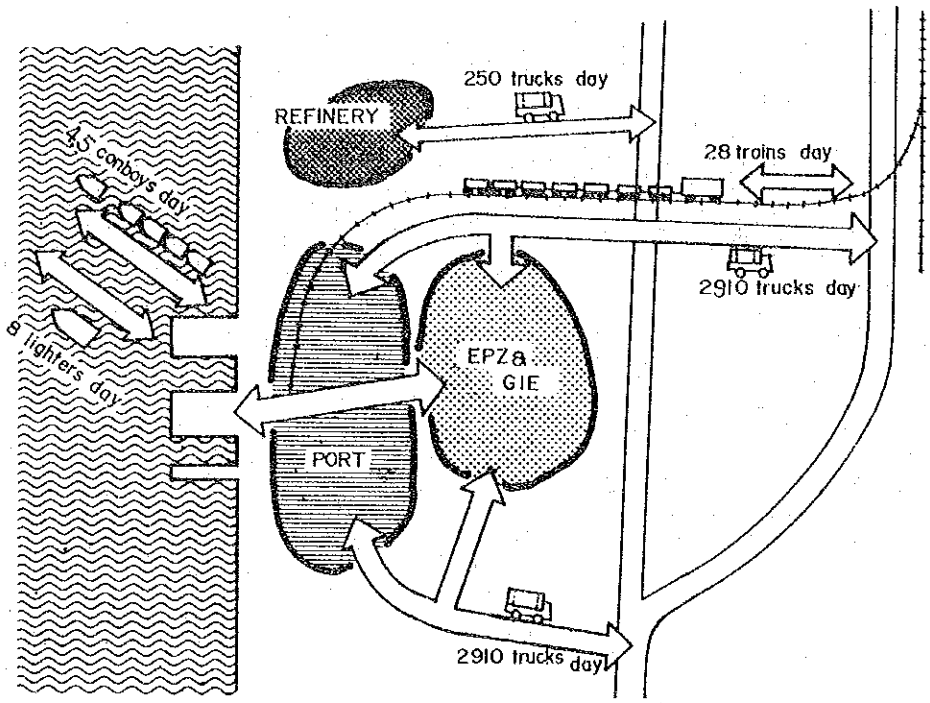
Fig. 3.5.1
Commuter Flow Desire Lines, Year 2001



LEGEND

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

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Fig. 3.5.2
Domestic Cargo Flows

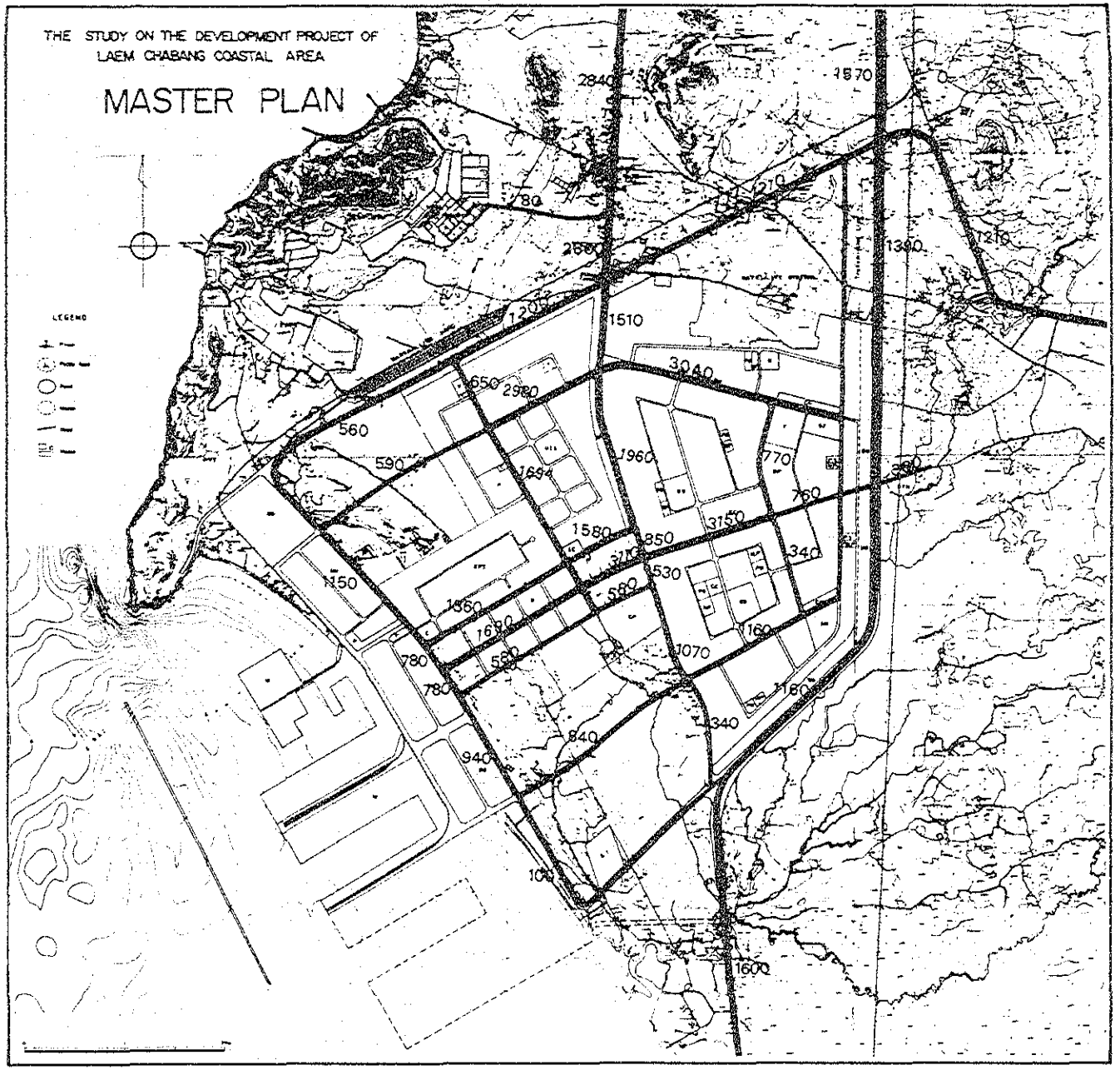

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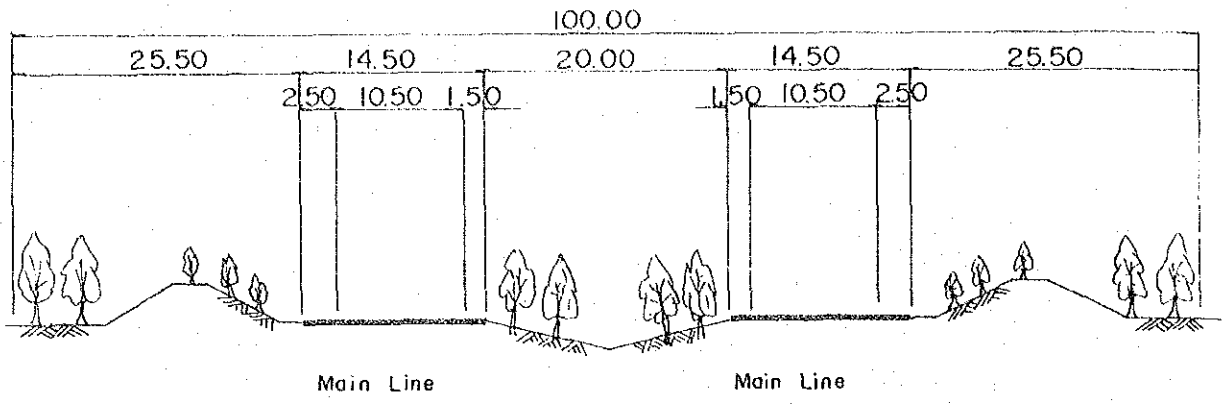
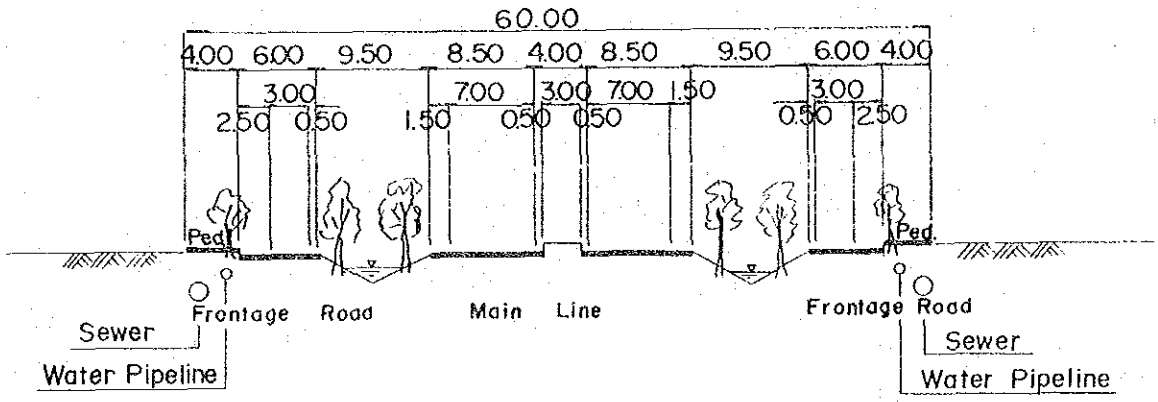
Fig. 3.5.3
Peak Hour Oneway Traffic Flows,
Year 2001 (In PCU)

1) Inter Urban Primary Road (V1)



2) Intra Urban Primary Road (V2)



3) District Distributor (V3)

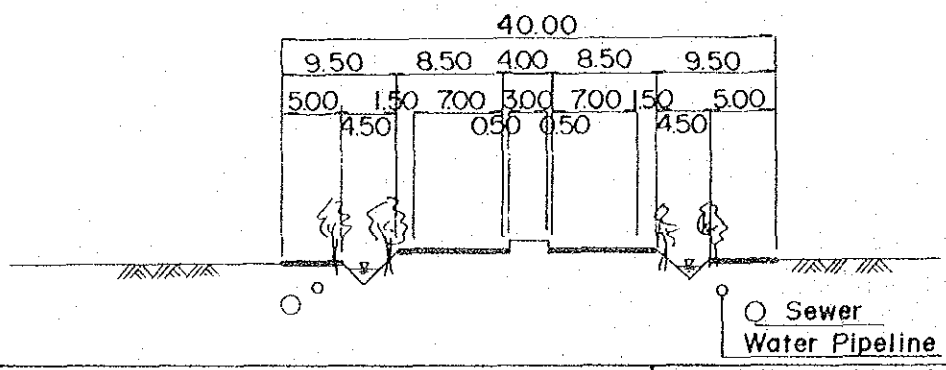


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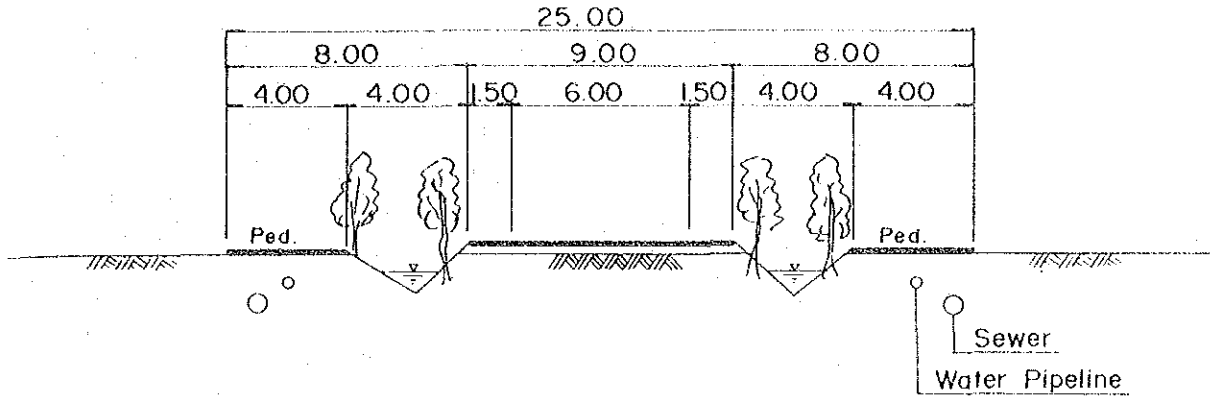
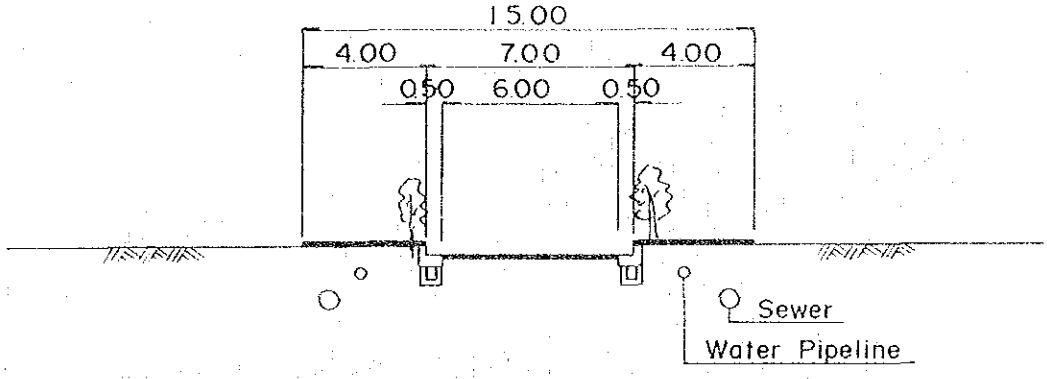
Fig. 3.5.4
Typical Cross-Section (Master-Plan)

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

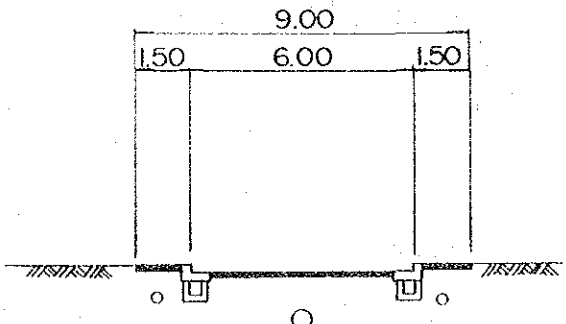


5) Collector (∇_5) (For New Town Area)



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

(∇_{6-1})



(∇_{6-2})

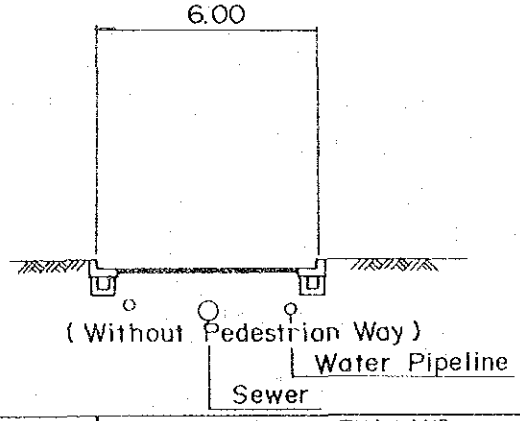


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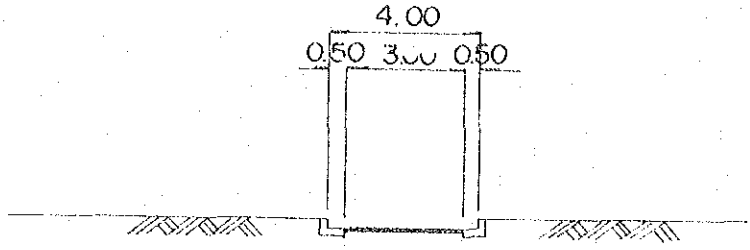
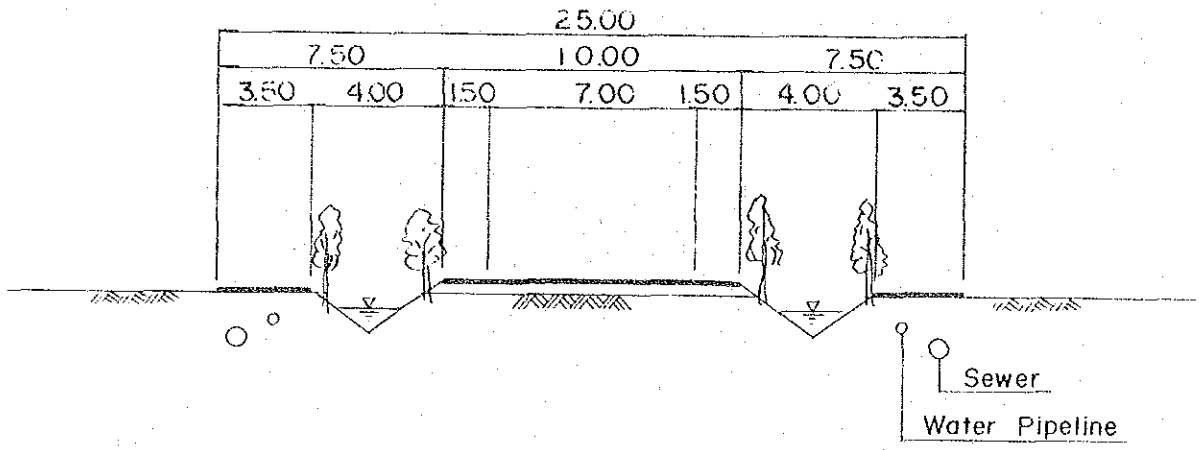
Fig. 3.5.5
Typical Cross-Section (Master-Plan)

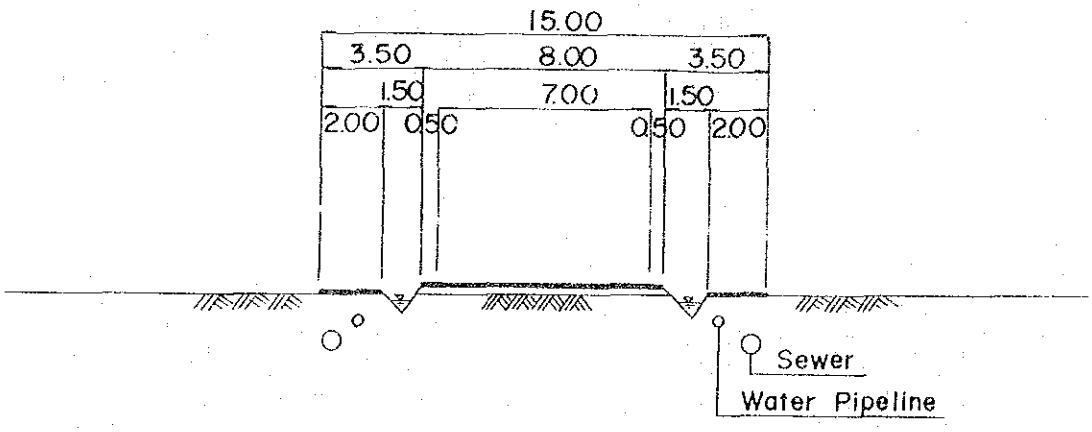
7) Access Road (∇_7) (For New Town Area)



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 JAPAN INTERNATIONAL COOPERATION AGENCY
	Fig. 3.5.6 Typical Cross-Section (Master-Plan)

10) District Distributor (∇_3) (For Business & Commercial Area)

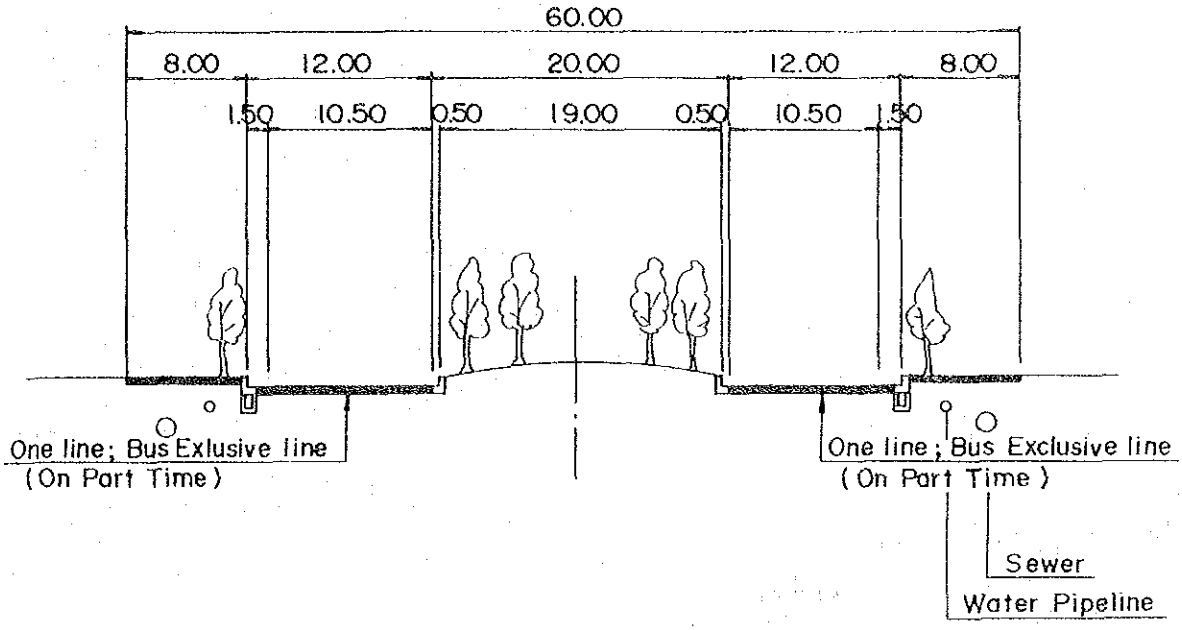


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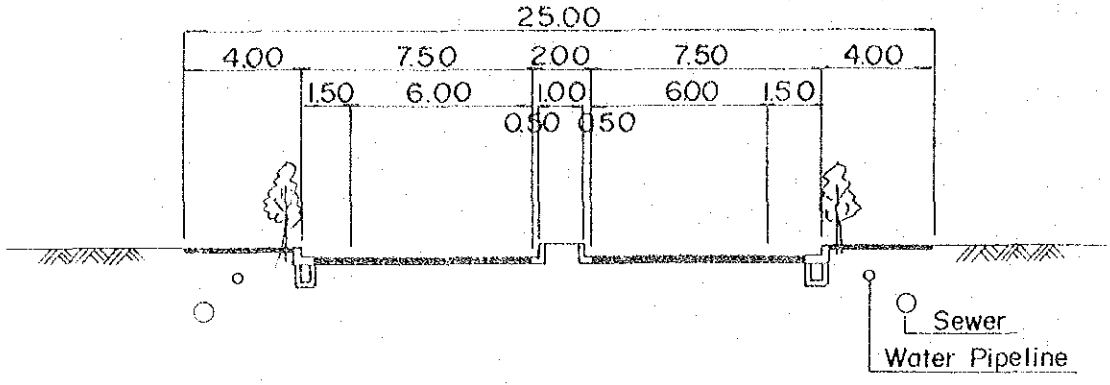
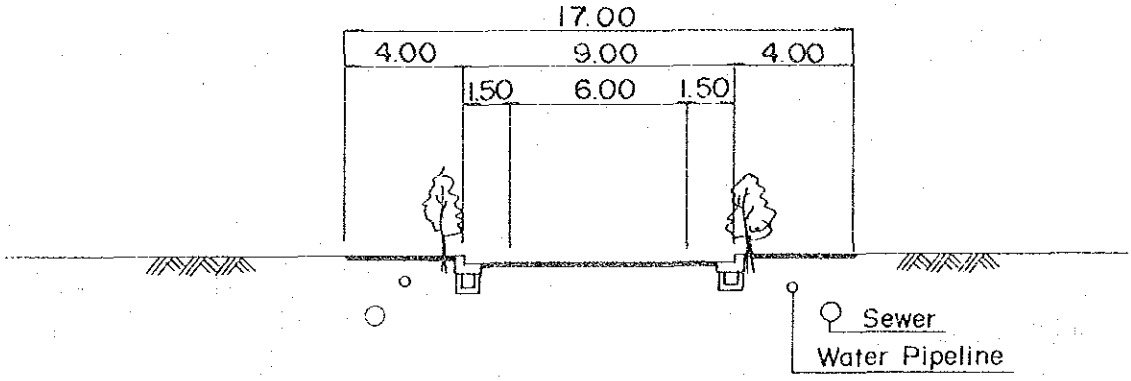
Fig. 3.5.7
Typical Cross-Section (Master-Plan)

11) Local Road (V4) (For Business & Commercial Area)



12) Collector (V5) (For Business & Commercial Area)



13) Access Road (V6) (For Business & Commercial Area)

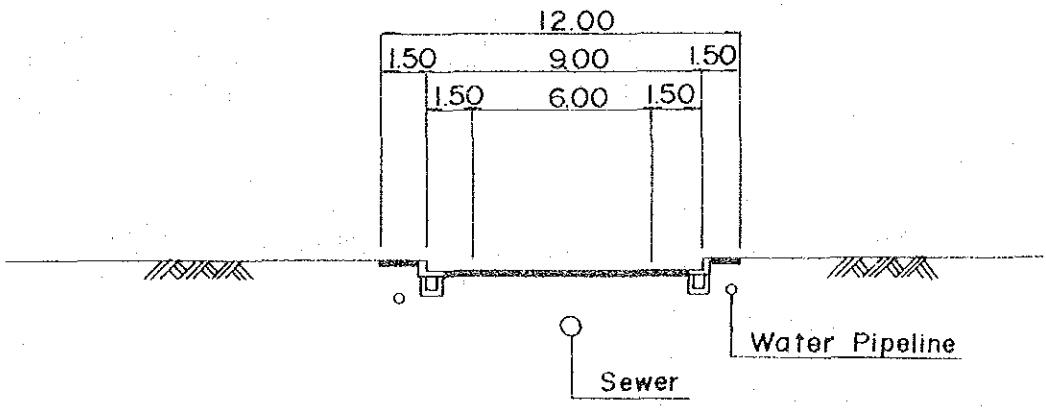


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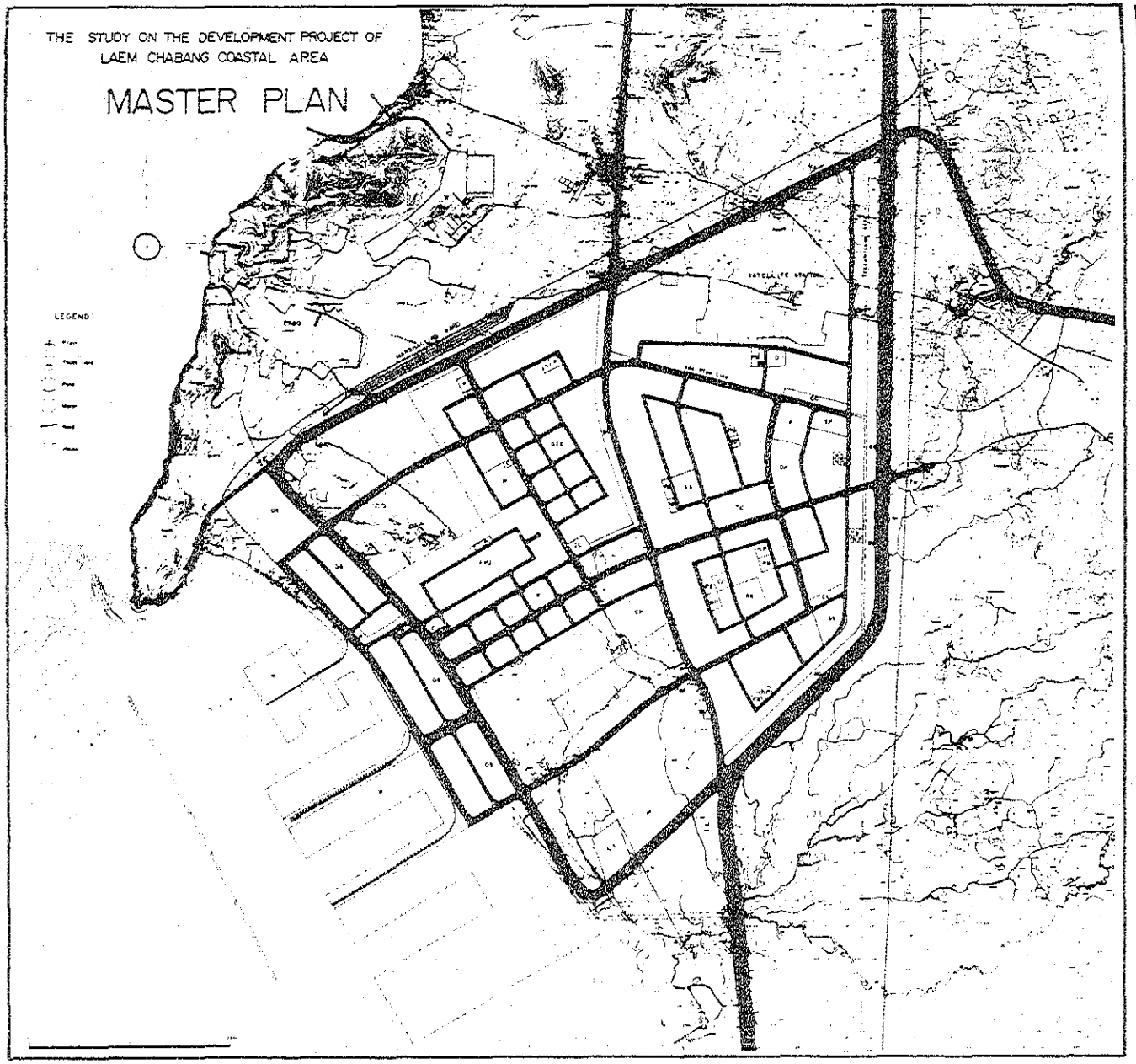
Fig. 3.5.8
Typical Cross-Section (Master-Plan)



LEGEND

V-1 ROAD

V-2 ROAD

V-3 ROAD

V.4-V.7 ROAD

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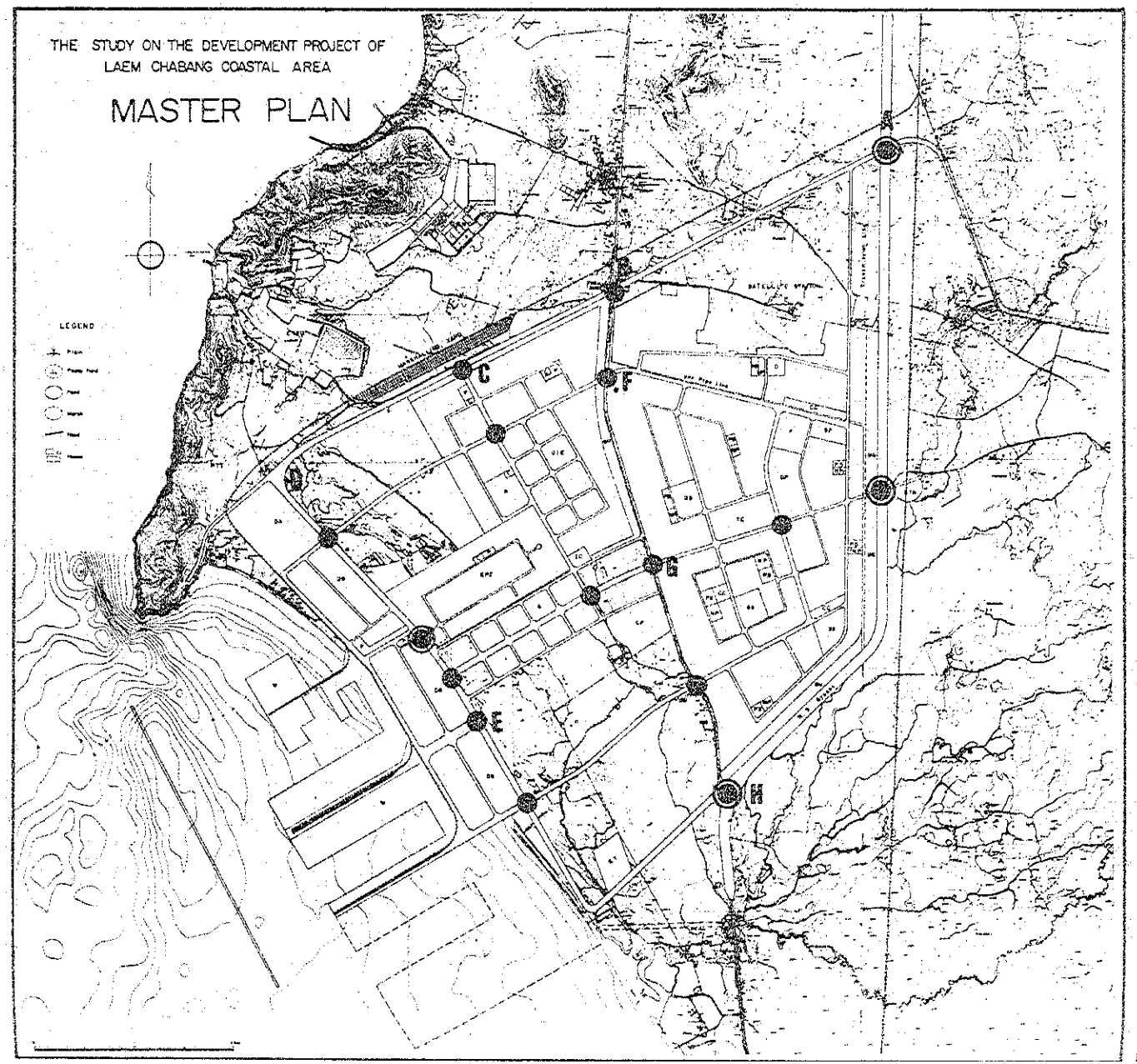
Fig. 3.5.9
Road Network Configuration (Master Plan)



LEGEND

Sig nalized Intersection

Grade Separated Intersection

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Fig. 3.5.10
Location of Intersection (Master Plan)

3.6 Utility Development Plan

3.6.1 Water Supply

1) General

Water supply plan of the Laem Chabang Complex was formulated incorporating the results of the previous study, "Feasibility Study on the Nong Kho - Laem Chabang Water Pipeline Project" by JICA in 1984 (hereafter referred to as the "Pilepline Study"). It proposes to construct raw water pipelines of gravity flow in two stages to cope with the increase of future water demand in the Laem Chabang Complex and Pattaya area until the target year of 2001.

Several factors clarified by the Pipeline Study are considered to be relevant to the present planning. They are,

(1) The location of the receiving well, and
(2) Future water demand

In the Pipeline Study, location of the receiving well was selected at the center of the residential area around 1 km away from the satelite station to the south, where the ground elevation is M.S.L. +35.0 m and the high water level of the receiving well is M.S.L. +36.7 m. It was planned in the study that the filtration plant is situated next to the receiving well.

The development plan of the raw water pipeline was formulated to cope with water demand tentatively projected until the year 2001. As the result of the industrial development plan and population projections in this Study, water demand projections as well as the development plan of the raw water pipeline were revised.

2) Water Demand

Future water demand was projected for the Laem Chabang development area. The area includes Laem Chabang Complex and other areas to be urbanized as affected by the government-oriented development in the

Complex. The regional water balance was reviewed comparing water resource availability and projected future water demand.

Total water demand at the consumer level (hereafter referred to "consumer water demand") in 2001 was projected as below. Methodology applied for water demand projection is explained in the Sectoral Report "Utility Development".

Area	Water Use	Per Day (m^3)	Per Year ($x10^6 m^3$)
Laem Chabang Complex	Domestic /1	26,400	9.6
	EPZ /2	8,400	2.5
	GIE /2	24,800	7.5
	Port /1	6,100	2.2
Others /3	Domestic /1	19,100	7.0
Total	-	84,800	28.8

/1: computed with 365 days per year

/2: computed with 300 working days per year

/3: Residential development areas except the Laem Chabang Complex.

Total consumer water demand was projected at 28.8 x $10^6 m^3$/year, which corresponds to 37.3 x $10^6 m^3$/year of the water to be supplied from the reservoir (hereafter called "Source Water Demand") assuming loss of 10% and 15% of the water produced at filtration plant between the reservoir and the receiving well and between the receiving well and consumer respectively.

The development plan of the raw water pipeline between the Nong Kho reservoir and the Laem Chabang Complex was formulated to cope with the source water demand of 32.1 x $10^6 m^3$/year in 2001. It is planned that the Nong Kho reservoir will be supplied with raw water from the Nong Pla Lai reservoir in the Rayong River basin (the capacity of Nong-Kho reservoir is only 10.2 x $10^6 m^3$/year). Considering that there is still abundant water resources in the Rayong River basin, it is proposed that the raw water supply plan be revised to meet an anticipated deficit of 5.2 x $10^6 m^3$/year.

3) Water Supply Planning

The water supply system comprises a distribution system and a filtration plant and is planned for the Laem Chabang Complex as the target area as shown in Fig. 3.6.1. In addition to this, however, Ao Udom town, which is currently receiving piped water supply from the Ao Udom Waterworks, is included in the target area considering its proximity to the Complex.

(1) Filtration Plant

Quantities of water for the plan is summarized as follows:

Unit: m^3day

Item	Daily Mean	Daily Maximum /1	Hourly Maximum /2
Domestic	26,400	37,000	55,500
Industrial	33,200	46,500	69,800
Port	6,100	8,500	12,800
Existing Ao Udom	4,000	5,600	8,400
Total	69,700	97,600	146,500

/1: Daily mean x 1.4

/2: Daily Max x 1.5

Capacity of filtration plant was determined applying the daily maximum volume of 97,600 m^3/day plus water to be used in the filtration plant.

Filtration process was determined analyzing water quality. According to the quality investigation performed at the Nong Kho Dam by the Pipeline Study, turbidity was 39 degree and Fe component was 1.7 mg/l as shown in detail in the Sectoral Report. Consequently, rapid filtration process with chemical sedimentation was considered to be appropriate for the project.

Since the filtration plant is to be designed based on the raw water quality, a detail study of water quality will be required,

prior to the detailed design. Therefore, an investigation of water quality at the Nong Kho Dam is recommended to be carried out for a duration of more than one year.

A plan for the filtration Plant is given in the Fig. 3.6.2. Flow Sheet and concepts for filtration plant facilities are shown in the Sectoral Report respectively.

(2) Water Distribution System

Purified water is conveyed to the distribution tower for water supply to high land area and to distribution basin for low land area, and further distributed to consumers by distribution pipes.

Capacity of the distribution tower and distribution basin is equivalent to 1 hour and 8 hours of planned daily maximum amount plus consumption for fire fighting respectively. Principal features of the distribution tower and the distribution basin are summarized as follows:

Item	Distribution Tower	Distribution Basin
Capacity	1,000 m^3	27,000 m^3
G.L.E.	M.S.L. + 55.0 m	M.S.L. + 50.0 m
H.W.L.	M.S.L. + 78.0 m	M.S.L. + 50.0 m
L.W.L.	M.S.L. + 75.0 m	M.S.L. + 47.0 m
Water Supply Population	57,600 /1	62,400 /1 + 33,900 /2

/1: Water supply population at residential area

/2: Workers at port

Note: Capacity of the distribution basin comprises the volume for the industrial estate and the port.

Computation of pipe network for distribution was carried out on the basis that poly vinyl chloride pipe be adopted for the range between 100 and 150 mm in diameter and ductile pipe for more than 200 mm in diameter. Layout of water supply system is shown in Fig. 3.6.3.

3.6.2 Sewarage System

1) Sewage Quantity and Quality

(1) Sewage Quantity

Quantity of sewage was assumed to be 90% of the amount of water supplied to consumers except water for ships. Infiltration of ground water into the sewer pipe was assumed at 20% of maximum dialy sewage. Planned sewage quantity was computed as follows:

Unit: m^3/day

Item	Mean Daily	Maximum Daily	Maximum Hourly	Ground Water
Domestic	23,800	33,300	50,000	6,700
E.P.Z.	7,600	10,600	15,900	2,100
G.I.E.	22,300	31,200	46,800	6,200
Port	4,600	6,400	9,600	1,300
Total	58,300	81,500	122,300	16,300

2) Sewage Quality

Quality of domestic sewage was assumed with reference to general figures in Japan. Industrial sewage quality was computed from weighted average of industries applying sewage flow rate in Japan. Assumed sewage quality is shown as follows:

Unit: mg/l

BOD	COD	SS	T-N	T-P
180	110	190	30	4

Note: Value of BOD, COD, SS are 20% higher than the results of computation.

3) Sewerage System Plan

(1) Sewers

In determing the cross section of sewer pipe, 50 to 100% of hourly maximum sewage plus ground water was considered for reserve. Here, the minimum velocity was set at 0.6 m/sec and the maximum velocity 3.0 m/sec.

Booster pump station is to be installed where the earth covering is more than 5.0 m.

Layout of sewarage system is shown in Fig. 3.6.4.

(2) Sewage Treatment Plant

Effluent quality of the three treatment processes of the standard biological treatment is summarized as follows based on the data in Japan:

(mg/l)

Item	Quality of Wastewater	Effluent Quality		
		Aerated Lagoon	Standard Activated Sludge	Oxdation Ditch
BOD	180	40	20	
COD	110	40	30	
SS	190	40	20	
T-N	30	25		15
T-P	4	3		

Diffusion densities at 5.0 km and 10.0 km offshore for COD, N, P as mentioned above were roughly computed by Joseph-Sendner formula as follows:

(Unit: mg/l)

	COD	T-N	T-P
5 km	1.2	0.4	0.03
10 km	1.1	0.3	0.02

According to the results of the computation, effluent water would be fully dilluted and typical biological treatment such as aerated logoon, oxidation ditch and standard activated sludge were all considered to be satisfactory.

Fig. 3.6.5 shows flow sheets of water treatment plan for aerated logoon, standard activated sludge and oxidation ditch.

The aerated lagoon method is the cheapest among the three and often adopted in the tropical areas. It, however, requires large plottage and its treatment stability is inferior to other two processes.

The standard activated sludge process is the most popular in Japan, but well trained engineers are necessary for the operation.

Oxidation ditch process has been in the spotlight in recent years as it removes N with easy operation. Though construction and operation cost of this process is higher than the aerated lagoon method, it would be a reasonable investment when taking into account the stability of N removal by this method. Furthermore, P is also able to be removed by chemical dosing. For these reasons, the oxidation ditch process is recommended in the Study. The plan of oxidation ditch is shown in Fig. 3.6.6. Concepts for the treatment plant facilities are shown in the Sectoral Report.

3.6.3 Drainage System

1) Present Condition

There exist two main open channels: Khlong Huai Bo Yai and Khlong Huai Bang Na which run through the Laem Chabang Complex as shown in Fig. 3.6.7. Features of the two channels are summarized as follows:

Name of Main Channels	Length (m)	Total Area of Basin (ha)	Contributing Area (ha)
K. Huai Bo Yai	5,800	2,700	1,500
K. Huai Bang Na	19,500	9,800	8,600

K. Huai Bo Yai branches off at the point 1300 m up-stream from the estuary and leads to K. Map Nong Rai and K. Map Nong stretching to the east and crossing the Route 3. As for the underpassing of the Route 3, box culvert of 7.5m-wide and 1.8m-high is installed for K. Map Nong Rai. Concrete pipe with 1.5 m in diameter is installed for K. Map Nong.

K. Huai Bang Na underpasses the Route 3 at the 4000 m upstream from the estuary and 30m-span bridge is installed there. Furthermore, it underpasses the railroad at 2600 m upstream from the Route 3 through box culvert with 7.5m-wide and 1.35m-high.

2) Design Consideration

Drainage facilities were determined as an open channel system except the points of underpassing the Route 3 and crossing point of roads. Major design criteria are as follows.

(1) 5-year return period is adopted as the storm reccurrence intervals. Rainfall intensity is as follows:

$$I = \frac{6000}{t + 35} \quad (mm/hr)$$

Where, I: Rainfall intensity (mm/hr)
t: time of concentration (minute)

(2) Outlet of stormwater was determined to locate at the estuary in the downstream of K. Huai Bo Yai and K. Bang Lamung. Design water elevation was also determined to be M.S.L. +1.75 m (H.H.L.). (Other design criteria are given in the Sectoral Report "Utility Development".)

Truck drains of stormwater is aligned basically in accordance with the existing drain routes. The plan for the trunk drain is shown in Fig. 3.6.8.

Since existing facilities at the four underpassing points of the Route 3 are unable to discharge the stormwater runoff according to the hydraulic computation of the existing drains, new facilities are required to be installed there.

Outlet of stormwater discharge is selected to be at the northern extremity and southern extremity of the Complex, taking into consideration the deposition of sand into the port area.

3.6.4 Solid Waste Disposal

1) Present Condition

Municipal and Amphoe office are responsible for the solid waste disposal respectively.

Solid waste tip of Siracha Municipality is located at approximately 2.5km east from the railroad with the area of 100ha. On the other hand, Amphoe Siracha office utilizes the land of PAT located in the north of ESSO, but is required to find out the new-solid waste tip in the near future. Service area and the location of the tip of Siracha Municiaplity and Amphoe Siracha is presented in Fig. 3.6.9. They serve for about 50,000 population that consist 45% of total Amphoe Siracha population with 109,000 in 1981. Collection of solid waste is carried out by means of three trucks in Siracha Municipality.

2) Solid Waste Quantities

Solid waste to be generated will be about 115,800 tons/year in the Laem Chabang Complex at full development and 32,000 tons/year for short-term development as shown below.

(Unit: tons/year)

Area	Short-term Development	At Full Development of Master Plan
Industrial Estate	19,000	67,800
Port Area (including Business Area)	5,800	13,000
New Town	7,200	35,000
Total	32,000	115,800

Accumulated tonnage of solid waste from 1987 to the full development year will be about 867,000 tons that will be 1,450,000 m^3 in volume with the specific gravity 0.3 tons/m^3 and the compaction factor of 50%, and during 1987-1991 for the short-term development the volume will be 210,000 m^3 which will require an area of 10 ha with 2 m depth.

The industrial estate will mainly generates sludge and mineral waste. Solid waste from the port is made of chip, paper and flour, and the new town will generate garbage, paper and plastics.

3) Disposal System

(1) Disposal Method

Landfiling is considered to be appropriate as the solid waste disposal method in the Laem Chabang Complex at least unit 2001 for the following reasons.

(i) A lot of farm land or forest with low land price can be utilized as the solid waste tip around the Laem Chabang Complex.

(ii) Incineration can not be introduced to the Complex becasue of the following reasons;

(a) Construction cost and maintenance cost would be high.

(b) Solid waste from the Complex would not have a suitable physical composition for the incineration. (Inflammable materials such as paper would be little).

(c) Air pollution would occur.

For the efficient disposal operation, industrial waste, port waste and the garbage from the new town must be disposed at one tip. Scrapped material with poisonous ingredient especially toxic heavy metals such as mercury, zinc, chrome, cadmium is not acceptable to the tip and must be disposed by each factory on their own responsibility.

(2) Location of Solid Waste Tip

There are two alternatives as the location of solid waste tip.

Pit A

The tip of Siracha Municipality with the area of 100ha at 10 km north from the Laem Chabang Complex can be utilized with joint work. Otherwise farm land can be purchased as the new tip next to Siracha municipality's tip.

Pit B

Reserved area near sewage treatment plant in the port area of the Laem Chabang Complex is the other alternative site. Tip site of landfilling can be utilized as a park or truck terminal in the future.

A comparison of the two alternative tips is shown in the following table.

	Item	Tip A	Tip B
(1)	Accessibility	10km from the north edge of Industrial Eastate by surface trip.	Located in the port area.
(2)	Down stream conditions	Located along upstream of Huai Yai river with many residences on down stream.	Located near the mouth of river without residences on down stream.
(3)	Land acquisition	About ฿7.3 x 10^6 (146 Rai x ฿50,000 Rai) is needed for tip area acquisition.	Already purchased by PAT.
(4)	Environmental impact	Smell or insect damages are regarded to be neglibible because of the low population density.	Some measures for the smell or insect are required because of its proximity to the business area.
(5)	Capacity	No limitation with additional land acquisition.	About 600,000m^3 in port area.

With some countermeasures (such as enough soil covering) to the offensive smell and insect damage, tip B would be attractive for the short-term development of the Laem Chabang Complex. However, tip A must be developed in the future after the filling up of tip B.

(3) Land Fill Plan

In case of a site where landfill is newly started, the preembankment landfill method should be adopted. In this method, the scheduled landfill area is enclosed by the previously-constructed embankment and solid waste is placed inside the embankment. For the purpose of preventing the environmental pollution, drainage pipes, leachate collection pit and impermeable layer are needed to be contructed.

(4) Collection system

Solid waste from the port area and the new town will be collected by the authority of Laem Chabang Complex development. Industrial solid waste, however, must be transported by each factory to the solid waste pit. Number of garbage trucks for collection of solid

waste will be 25 at full development and 7 for short-term development.

3.6.5 Power

For the Laem Chabang Complex, the Electricity Generating Authority of Thailand (EGAT) will be in charge of the generation and transmission of electricity and the Provincial Electricity Authority (PEA) will be responsible for the distribution of electricity to consumers.

One thermal power plant of the South Bangkok and two thermal power plants of Bang Pa Kong in Chachongsao province (with total expected output of 3,195MW in August, 1984) is scheduled for power supply to the Laem Chaban complex. Also 115KV and 230KV transmission line is at present installed from the said thermal plants to Ao Phai substation situated approximately 5 km north of the center of the development area. Power generation and transmission capacity is considered sufficient taking into account the future project of the Ao Phai thermal plant with 1,800MVA, even for further extension of the eastern seaboard development.

However, substations in the development area and transmission line from the Ao Phai substation will be required for connecting 22KV distribution lines installed by PEA, by which consumers in and around the development area can receive electricity for either at a high voltage of 22KV or at a low voltage of 220/380V.

Present situation of electric facilities in the Eastern Seaboard is as given in Fig. 3.6.10.

1) Power Demand

Total power demand in the Laem Chaban Complex was estimated to amount to 188.6MW judging from the number of dwelling units, production of each factory and volume of port activities.

Power demand of components of the complex is summarized below:

Power Demand Area	Power Demand (MW)
New Town	41.8
Industrial Estate	96.0
Port	50.8
Total	188.6

2) Power Supply Plan

As total power demand is quite large, two new substations are planned to be located within eastern end of the new town and northern end of the industrial estate. One (hereinafter referred to as Laem Chabang-1 substation) is mainly for power demand of the new town and port area, while other (hereinafter referred to as Laem Chabang-2 substation) for the industrial estate.

The power supply system from the said substations to each load center in the development area will be 22KV overhead distribution lines by PEA. All consumers in the residential area are provided with 220V low tension line to their house after stepping down with 22KV/220-380V by pole mounted transformers. However, other consumers such as factories and port will be provided with a 22KV incoming line to each private substation from any points of 22KV line above trunk road by owners expenses.

Proposed power supply system is shown on Fig. 3.6.11.

3.6.6 Telecommunication

In Thailand, demand for telephone and telex is strong especially among firms and factories. Telecommunication system with high quality and sufficient number is one of the effective incentives to attract investors to the Laem Chabang Complex.

At present, the Telephone Organization of Thailand (TOT) is in charge of a fully automatic telephone system provided about 900,000 local

telephone lines connected about 270 local exchanges. TOT is now implementing the Econimic and Social Development Project aiming at increasing Total number of telephone lines to approximatelly 1,800,000 by the year 1988.

Telephone network of Thailand is divided into five telephone areas (called the tertiary area) with each several secondary center areas. The Laem Chabang coastal area is belonged to the Chonbri secondary center area.

The present situation of telephone exchange in the Chonburi secondary center area is shown in Fig. 3.6.12.

Existing telex service operated by the Communications Authority of Thailand (CAT) has approximately 3,500 subscribers throughout the country. Telex network of Thailand is divided into four telex service parts, Central, North-Eastern, Northern and Southern parts.

Existing exchange within the Eastern Seaboard is the Pattaya zone exchange with 250 lines and Chachoengsao, Chonburi, Siracha, Rayong and Chanthaburi line concentrator.

Telex network in the Pattaya zone exchange is shown in Fig. 3.6.13.

1) Telephone and Telex Demand

(1) Telephone Demand

Telephone demand in the Laem Chabang Complex was calculated at 15,000 lines on the basis of number of dwelling units, shops in the town center, factories and employees of port area.

Telephone demand in each area is summarized as below;

Telephone Demand Area	Number of Telephone
New Town	8,740
Industrial Estate	1,364
Port Area	3,390
Public Booths	270
Total	13,764
Number of lines installed	15,000

(2) Telex Demand

Telex demand required in the industrial estate and the Port area was assumed to amount to 64 terminals in the minimum case as follows:

Telephone Demand Area	Number of Telephone
Industrial Estate	36
Port Area	28
Total	64

2) Telecommunication System Plan

(1) Telephone System Plan

As for the new telephone facilities in the Laem Chabang Complex, SPC degital type exchange with a capacity of 3,000 lines and 15,000 lines in 1991 and 2001 respectively will be installed by TOT at the local telephone exchange office established within the business and commercial area of this project.

And connection between the above exchange and the Chonbri secondary center exchange using pulse code modulation system (PCM) by aerial cable is planned for incorporating the existing long-distance telephone transmission system in Thailand. Within the development area, 100 P and 200 P cable will be installed along the trunk roads in accordance with established number of subscribers by block.