

3.3 Existing Conditions of Urban/Regional Development and Railway

3.3.1 The 200 km Radius Area

3.3.1.1 Regional Structure

(1) Regional Development Context

Based on the Seventh National Economic and Social Development Plan (Seventh Plan) the growth path and development direction in the 200 km radius area are shown in Fig. 3.3.1 The region can be generally structured in accordance with the distance from the City Center of Bangkok as follows (This shows the trend of regional development and expansion with the focus point in Bangkok):

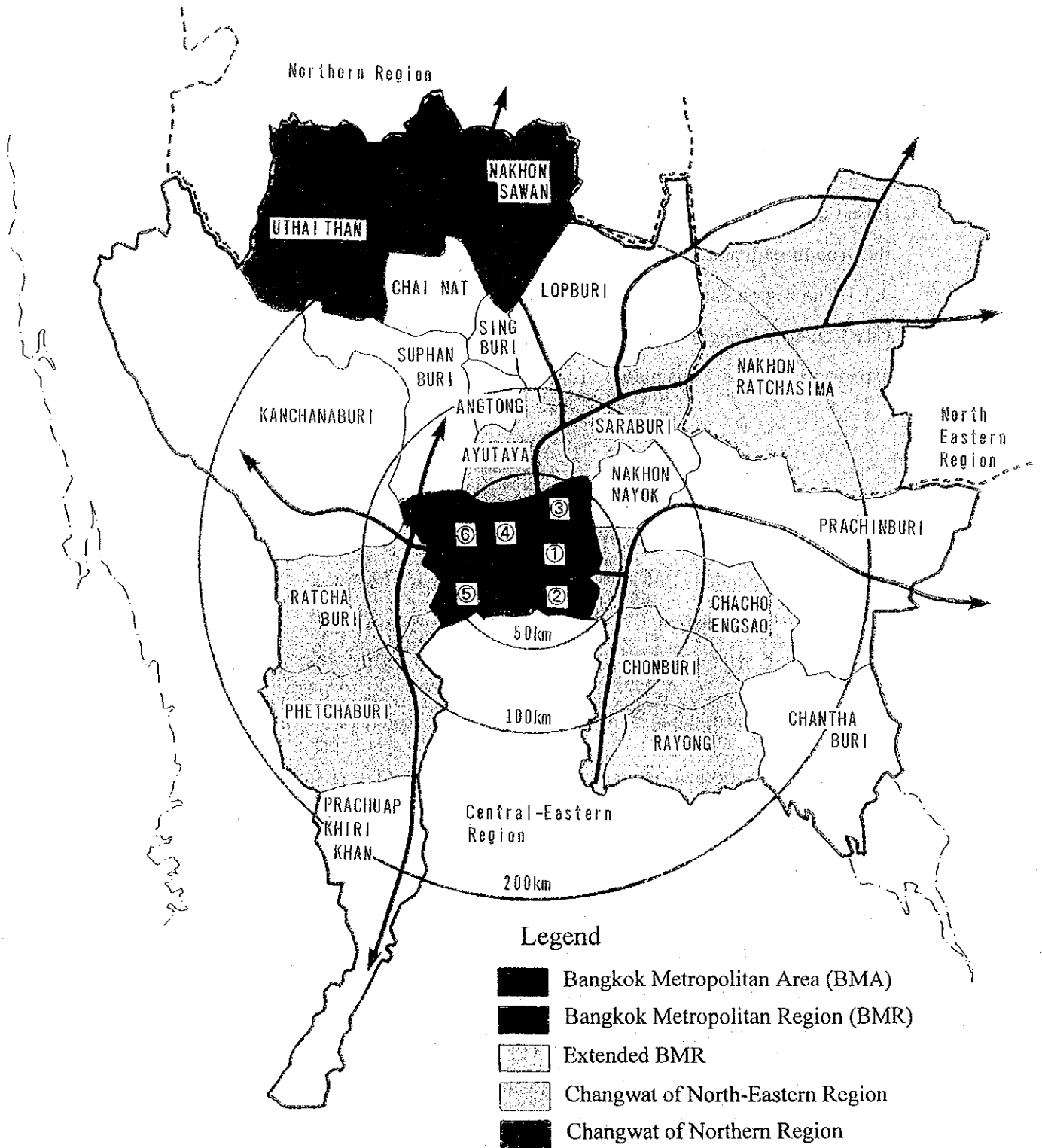
<u>Area</u>	<u>Length of Radius (Distance)</u>
BMA Built-up Area	Approx. 30 km
BMR (6 provinces)	Approx. 50 km
Extended BMR	Approx. 100 km
Local Region (Northern and Northeastern Region)	Approx. 200 km

1) Bangkok Metropolitan Built-up Area within the Range of 30 km Radius

The urbanization has expanded outward to reach as far as 30 km from the center of Bangkok. The basic characteristics of urbanization of Bangkok are summarized as follows:

- High density urbanization
A rush of construction of high-rise building (offices, condominiums and hotels) since the latter part of 1980's increased the density of built-up area to create the concentrated high density urban area.
- Expansion of ribbon-type urban area
Another prominent feature of the Bangkok urban area are narrow strips of built-up area along the arterial roads radiating from the central area of Bangkok, with vacant tracts being left between the strips within the city.

Fig. 3.3.1 Regional Structure



- Sporadic urban development in the surrounding suburbs
On the other hand in the suburbs sporadic urban development led by factories, industrial estates, housing estates and others are rampant.

2) Bangkok Metropolitan Region

Bangkok Metropolitan Region (BMR) including BMA and the neighboring 5 provinces constitutes the substantial economic/industrial hub of the Thai capital region as it achieved more than half of the GDP of Thailand. As the total population of BMR reached as large as 8.8 million person in 1990, the population density of the surrounding 5 provinces is still as low as 600 person/km² on the average as compared to 3,600 person/km² of BMA. This shows that agricultural land use is prominent in the surrounding the provinces, which are potential areas for urban and housing developments enhanced by the three improved railways.

3) Extended BMR

The Ext. BMR was designated out of the BMR so as to be the leading center for the next stage of development of Thailand and the capital region (New Economic Zone). In the Ext. BMR, local urban centers such as SARABURI, CHONBURI, NAKHON PATHOM and others are strategically located so that it will grow, with these local cities working as centers for regional development.

More specifically the Eastern Sea Board Development has been making intensive progress in the area ranging from Chonburi to Rayon, and the area covering Ayutthaya, Saraburi and Lopburi are planned to grow as an inland center for distribution of natural resources and manufactured products and for industrial development.

It is anticipated that the Ext. BMR will grow centering on the 2 pivotal development areas.

- ## 4) Nakhon Sawan and Nakhon Ratchasima belonging to the North region and North Eastern Region of Thailand respectively are the gateways from Bangkok to the regions.

The forthcoming intensive development of Ext. BMR (New Economic Zone)

which are designed to be new economic/industrial centers of Thailand (the coastal and inland center) is to give rise to the locational shift of the manufacturing and distribution industries from Bangkok to the Ext. BMR with the changing role of Bangkok toward the more administrative and managerial business center of a region extending to Vietnam, Laos, Cambodia and other neighboring countries.

It is apparent that the Bangkok capital region is about to change its area-size and subsequent regional structure. In response to this situation, the Thai government launched the study for restructuring the capital region, that is the Metropolitan Regional Structure planning study, the outline of which is given in a later section.

(2) Physical Conditions

The Bangkok plain stretches far and wide in the middle of the Study area with highlands having an altitude of 200 to 500 m at the fringe of the study area as shown in the topographical map of Fig. 3.3.2.

The agricultural land uses are predominant with rice-paddy fields in the plains area and rubber, sugarcane and corn plantations toward the highlands (Fig. 3.3.3).

(3) Socio-Economic Conditions

1) Population Distribution

< Population Size >

The total population in the study area amounted to 23.5 million in 1990 (Table 3.3.1), accounting for 42.0% of the total population of Thailand. While the principal capital economic area including Ext. BMR has a population size of about 13.0 million, the remaining 10.5 million of population is distributed in areas other than the above-mentioned area in the study area.

Fig. 3.3.2 Topography of the Study Area

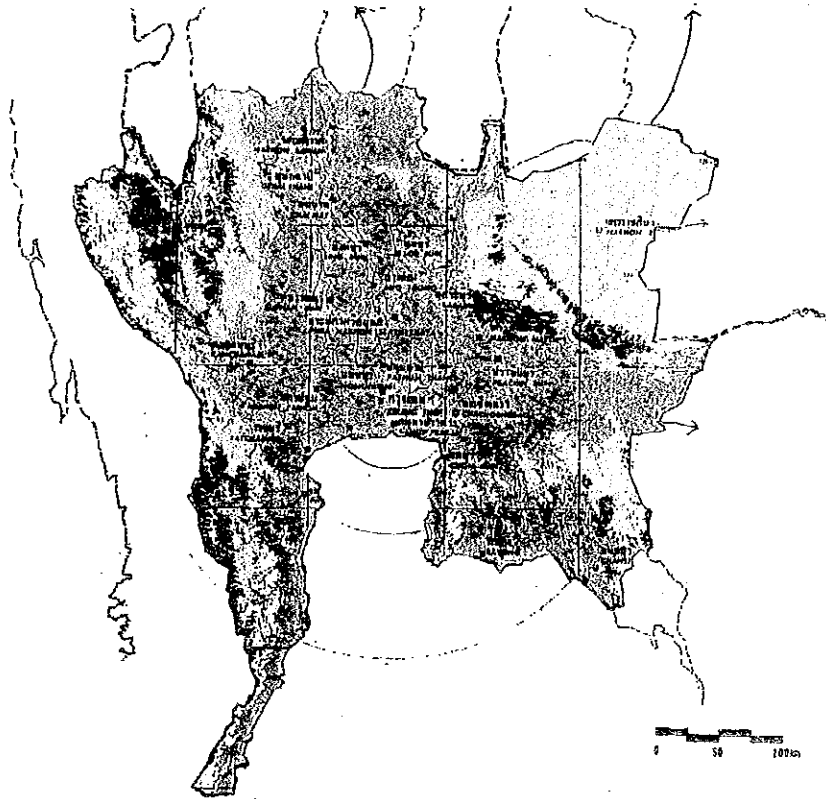


Fig. 3.3.3 Land Use in the Study Area

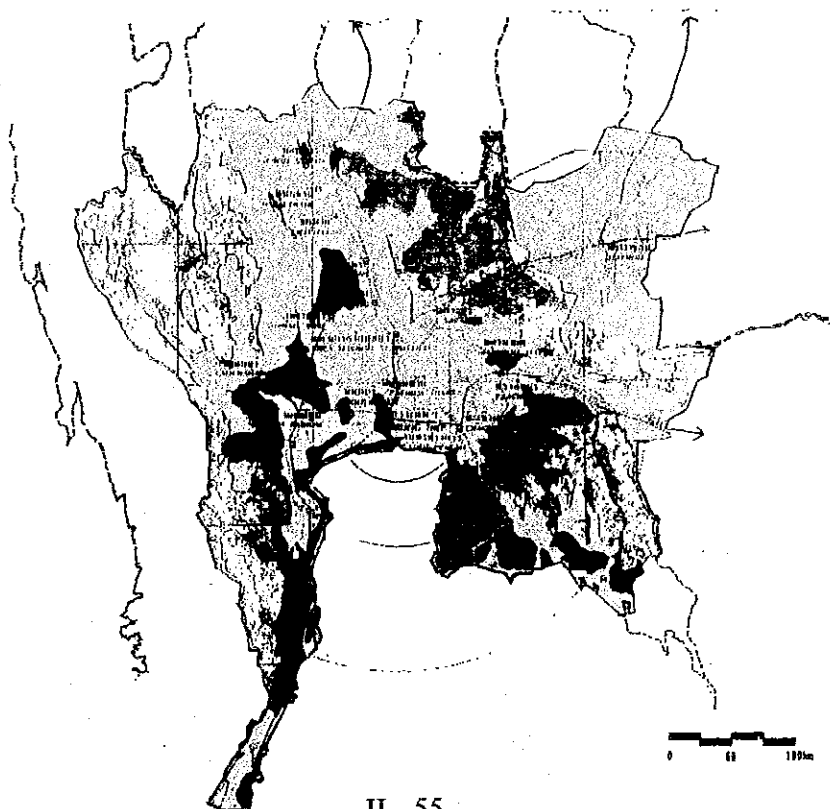


Fig. 3.3.4 Year 1990 Population Density(person/sq.km)

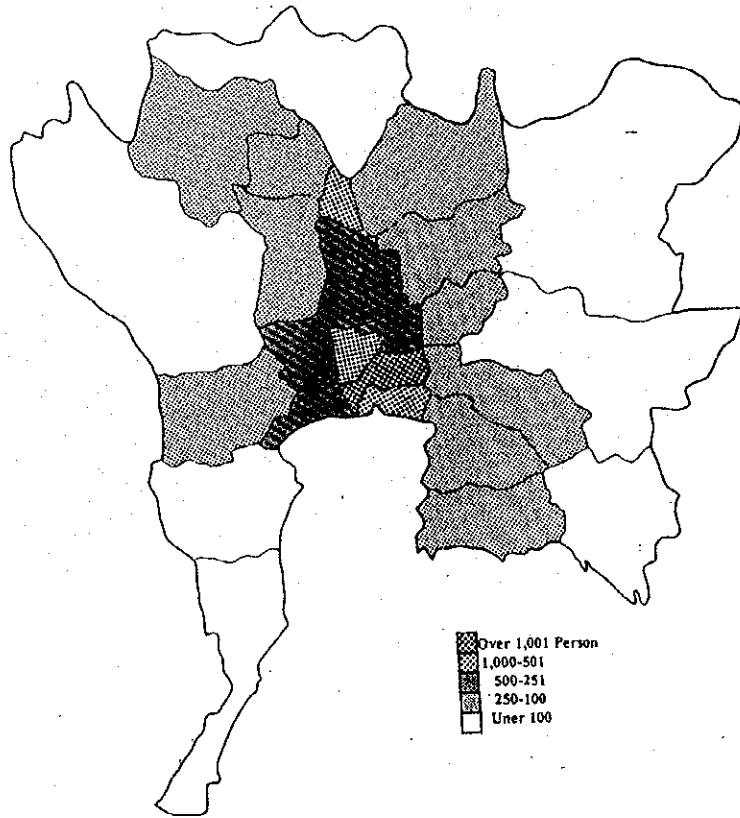
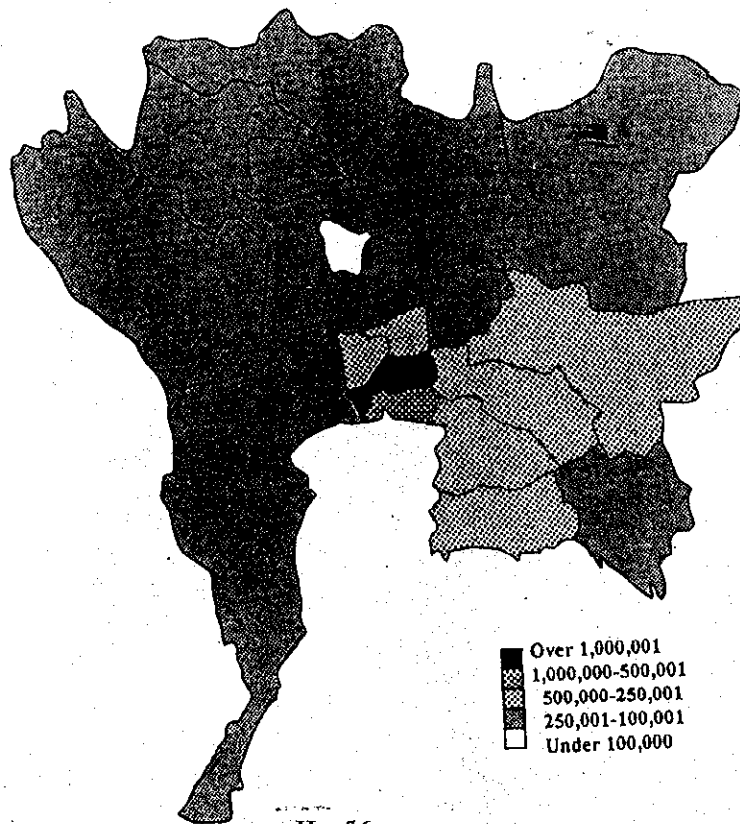


Fig. 3.3.5 Population Increase 2010-1990 (person)



<Population Density>

The Population Density in 1990 in the study area as shown in Figure 3.3.4. suggests the tendency of population distribution spreading over the neighboring provinces, and in the North-south direction of Bangkok.

Table 3.3.1 Population Distribution

	Forecast by NESDB (in 000)		
	1980	1990	2010
BMA	4,870 (25.0)	6,162 (26.2)	7,977 (24.8)
5 Prov. in BMR	2,025 (10.4)	2,808 (11.9)	4,575 (14.2)
Extended BMR	3,579 (18.4)	4,389 (18.6)	6,138 (19.1)
Total of Ext. BMR	10,474 (53.9)	13,359 (56.7)	18,690 (58.1)
Other	8,972 (46.1)	10,184 (43.3)	13,495 (41.9)
Total of 200 km area	19,446 (100.0)	23,543 (100.0)	32,185 (100.0)

Figures in parenthesis: Population share in the study area

<Population Growth>

The regional population share of BMA, BMR and Ext. BMR has been increasing in the past decade (1980 to 1990) as shown in Table 3.3.1 The forecasted trend of the population distribution seen a faster growth of population in areas outside the BMA.

<Population Size to be Accommodated up to the Year 2010>

The population size to be accommodated by the area up to the year 2010 is shown in Table 3.3.1.

Table 3.3.2 The population Size to be Accommodated up to Year 2010

Area	Increment of Population (million persons)
BMA	1.81
5 provinces in BMR	1.78
Extended BMR	1.75
Other Areas	3.31
Total of Study Area	8.45

The increase of population in BMR (BMA + 5 provinces) is estimated to be as large

as 3.5 million which is equivalent to 40% of the existing population of BMR. It may be roughly said that an additional urban area which is equivalent in size to about 40% of the existing built-up area must be developed to accommodate the population increment in BMR.

What would happen if the number of vehicles and traffic volume on the road network increases in proportion to the growth rate of BMR population? This just emphasizes the importance of railway development in the BMR.

2) Economic/Industrial Structure

The basic features of the economic/industrial structure are summarized as follows:

- The share of BMR in the country's GDP has been steadily increasing (regional development projects like the ESB Development and others have not yet taken effect in decreasing the BMR share)
- The GDP share of the 5 provinces in the BMR has increased (The driving force of Thai economic development in 1980's).
- Manufacturing industry accounted for the largest share among industries of BMA with its percentage of the total higher than the average of all industries in BMA.
- The manufacturing industry which shared 40% of GDP in the neighboring 5 provinces, took the leading role for regional economic development.

In spite of the fact that high economic achievement was realized as shown above, there is still disparity in the study area as shown in the distribution of per capita GRP in Fig. 3.3.6

3) Locational Structure of Urban Centers

According to the National Urban Development Policy Framework of NESDB, the hierarchical regional system of urban centers is shown in the Fig. 3.3.7 and 3.3.8

The basic characteristics of this system are summarized as follows:

- The existing urban centers like Bangkok, Nonthaburi, Samut Prakan and others in the Bangkok built-up area within a range of 30 km radius are designated as core city level. These centers work collectively to fulfill the role of Bangkok as a national/regional urban center.
- The urban centers with core city level 1 in the Ext. BMR such as Nakhon Pathom, Saraburi and Chonburi are the prime cities followed by the core cities at level 2 such as Rachaburi, Ayutthaya, Chachonsao and Rayon in their respective regions.
- Core cities at level 2 like Nakhon Sawan and Nakhon Ratchasima serve the regions as regional urban centers.

Table 3.3.3 GRP Growth of BMR, 1981 - 1987, at 1972 Constant Prices

(in million baht, %)

	GRP			Annual Growth Rate	
	1981	1986	1987	1981-1986	1986-1987
	BMA	126,702	159,012	178,062	4.65
5 Provinces	28,183	38,064	42,260	6.19	11.02
BMR	154,885	197,076	220,322	4.94	11.79
Whole Kingdom	318,439	412,608	441,894	5.32	7.10

Table 3.3.4 Growth Rate of GRP and Composition by Industrial Origin at 1972 Constant Prices

(in %)

	BMR			BMA			5 Provinces		
	Composition by Industrial Origin		Annual Growth Rate	Composition by Industrial Origin		Annual Growth Rate	Composition by Industrial Origin		Annual Growth Rate
	1981	1987	1981-87	1981	1987	1981-87	1981	1987	1981-87
Agriculture	3.9	3.5	4.2	1.8	1.8	6.2	13.2	10.4	2.9
Mining	0.3	0.3	7.4	0	0	0	1.5	1.5	7.4
Manufacturing	33.1	33.1	6.1	31.2	31.4	6.0	41.3	40.2	6.5
Construction	4.9	3.4	-0.4	5.7	3.7	-1.4	1.7	2.1	10.9
Electricity and water supply	2.4	2.8	8.6	1.8	2.0	8.1	5.2	5.9	9.3
Transportation and communication	7.2	9.1	10.4	8.2	10.4	10.1	2.4	3.4	14.0
Wholesales & Retail Trade	23.9	23.1	5.5	25.1	24.4	5.3	18.3	17.7	8.4
Banking, insurance and real estate	3.6	4.0	7.7	4.2	4.5	7.4	1.2	1.6	11.9
Ownership of dwelling	3.2	3.1	5.3	3.4	3.3	5.3	2.4	2.2	4.9
Public administration and defence	3.8	3.2	3.4	4.1	3.5	3.2	2.2	2.0	5.6
Services	13.8	14.5	6.9	14.5	14.8	6.2	10.6	13.0	10.7
Total	100	100	6.0	100	100	5.8	100	100	7.0

Source: National Account Division; NESDB

Fig. 3.3.6 Per Capita GRP

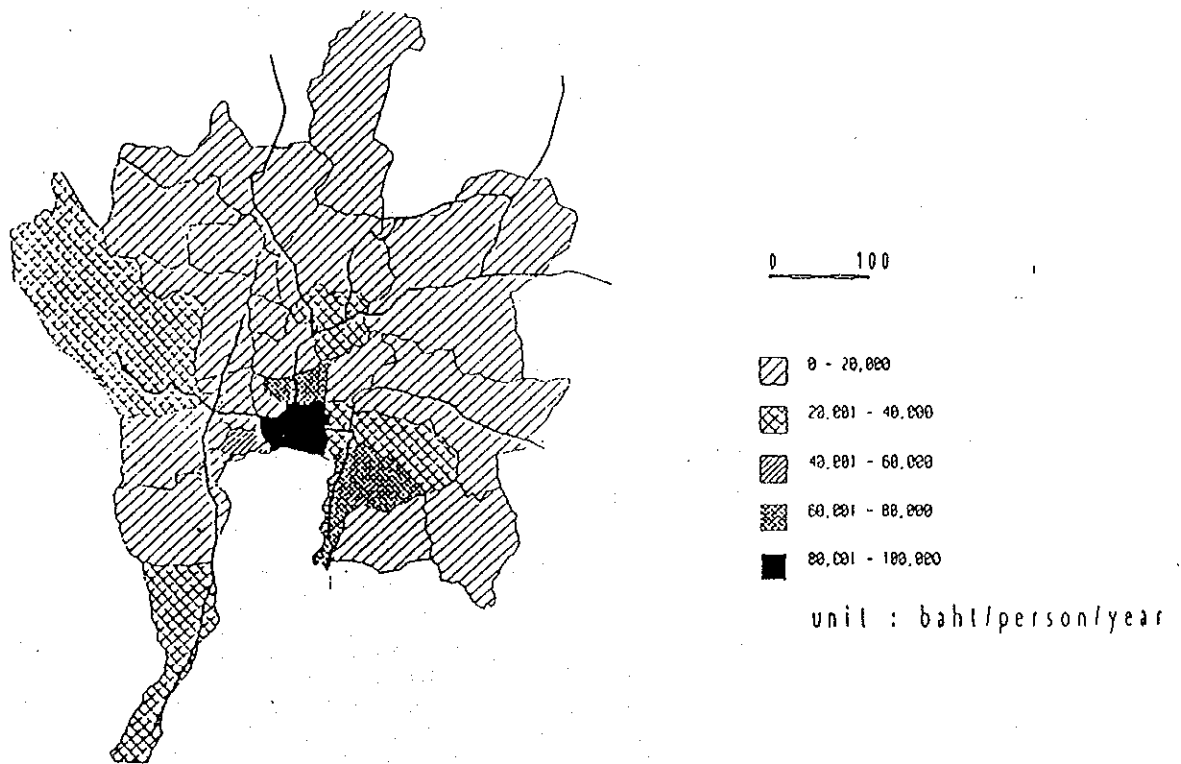


Fig. 3.3.7 Hierarchical Urban Structure

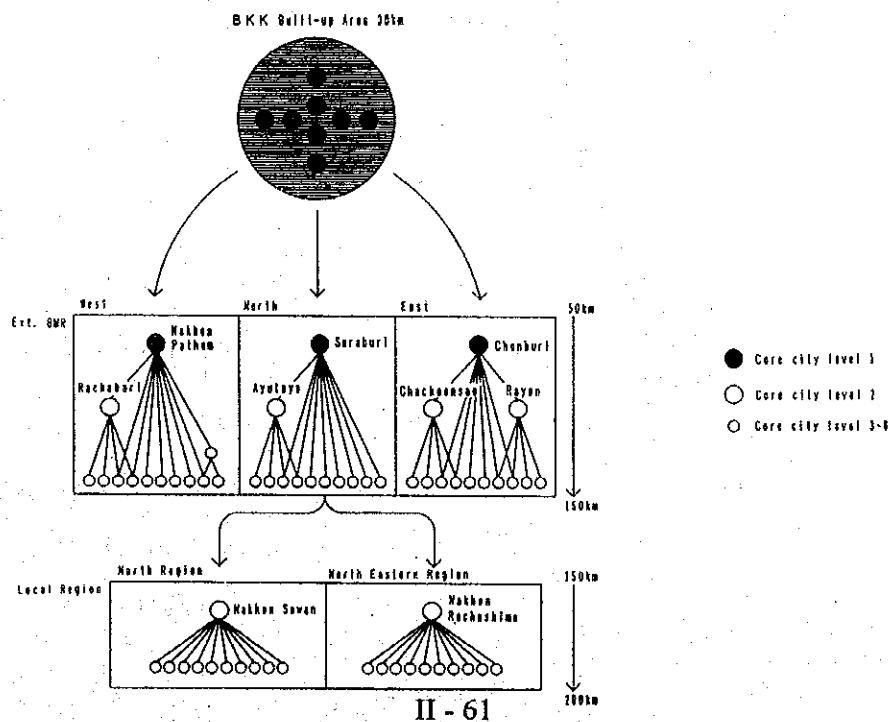
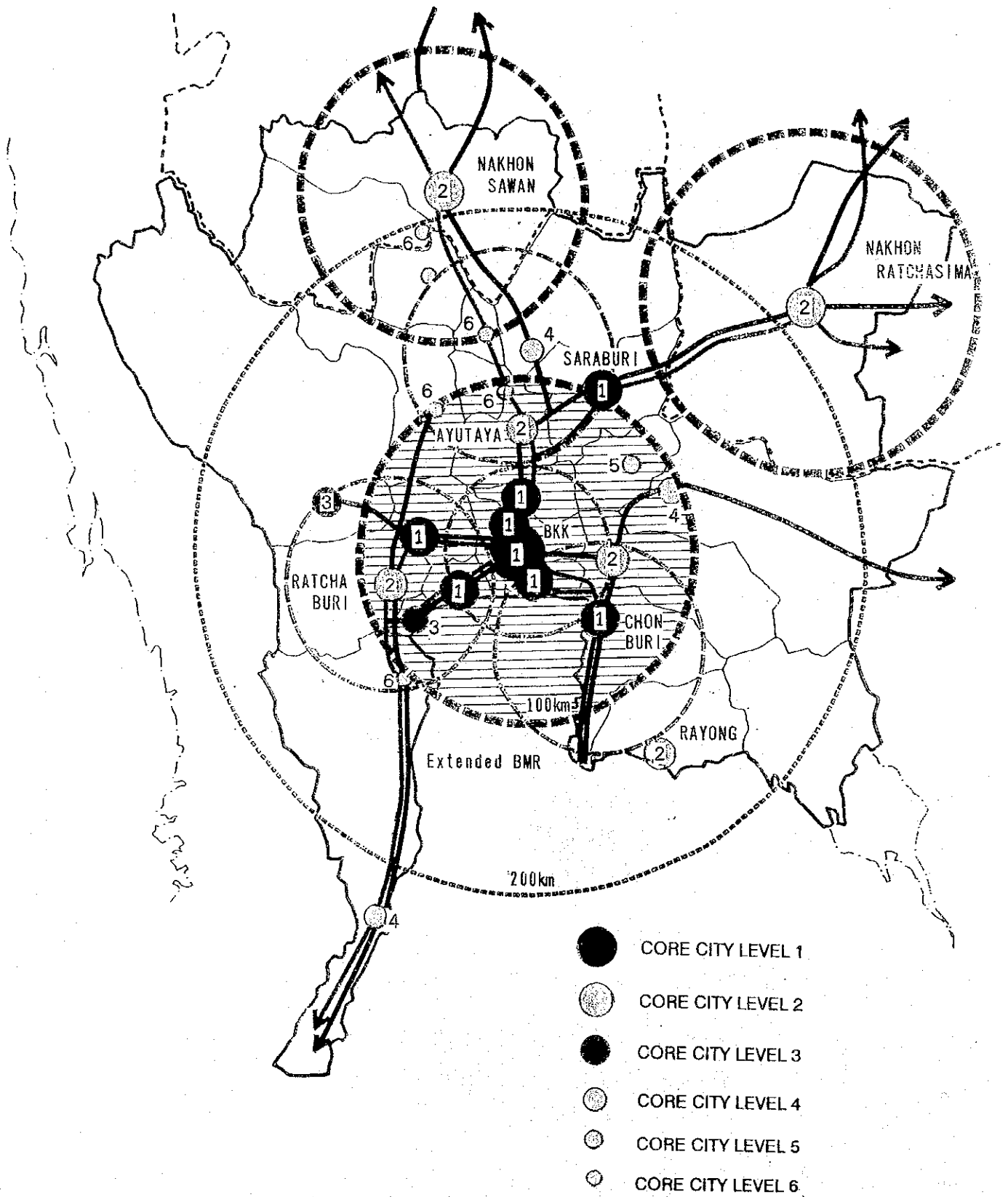


Fig. 3.3.8 Locational Structure of Urban Centers



3.3.1.2 Regional Transport Structure

(1) Existing Transport System

The existing transport system in the study area is composed of road transport (cars and buses, etc.), rail and water transport. Major components of the regional transport are cars, long distance bus and rail. Rail transport covers major transport corridors, however the utilization of rail is quite low. The role of rail transport in the public transport system in the Bangkok metropolis is also negligible with only 19 thousand passengers daily. On the other hand, urban transport in the Bangkok Metropolis is mainly composed of city buses, cars and motorcycles. Trip mode composition in Bangkok and along the transport corridors is shown in Fig. 3.3.9. The domination of bus transport is evident in the eastern and northern corridors at 75.5 % and 56.1 %, while the share of car, taxi and truck in Bangkok and southern/western corridor is high at 42.1 % and 47.1 % . The share of train in the northern and southern/western corridors is 4.2 % and 3.6 % (including Mae Kong Line), while the train in Bangkok and eastern corridor is almost nil (1.0% and 0.9%).

Fig. 3.3.9 Trip Mode Composition in Bangkok and along Transport Corridors

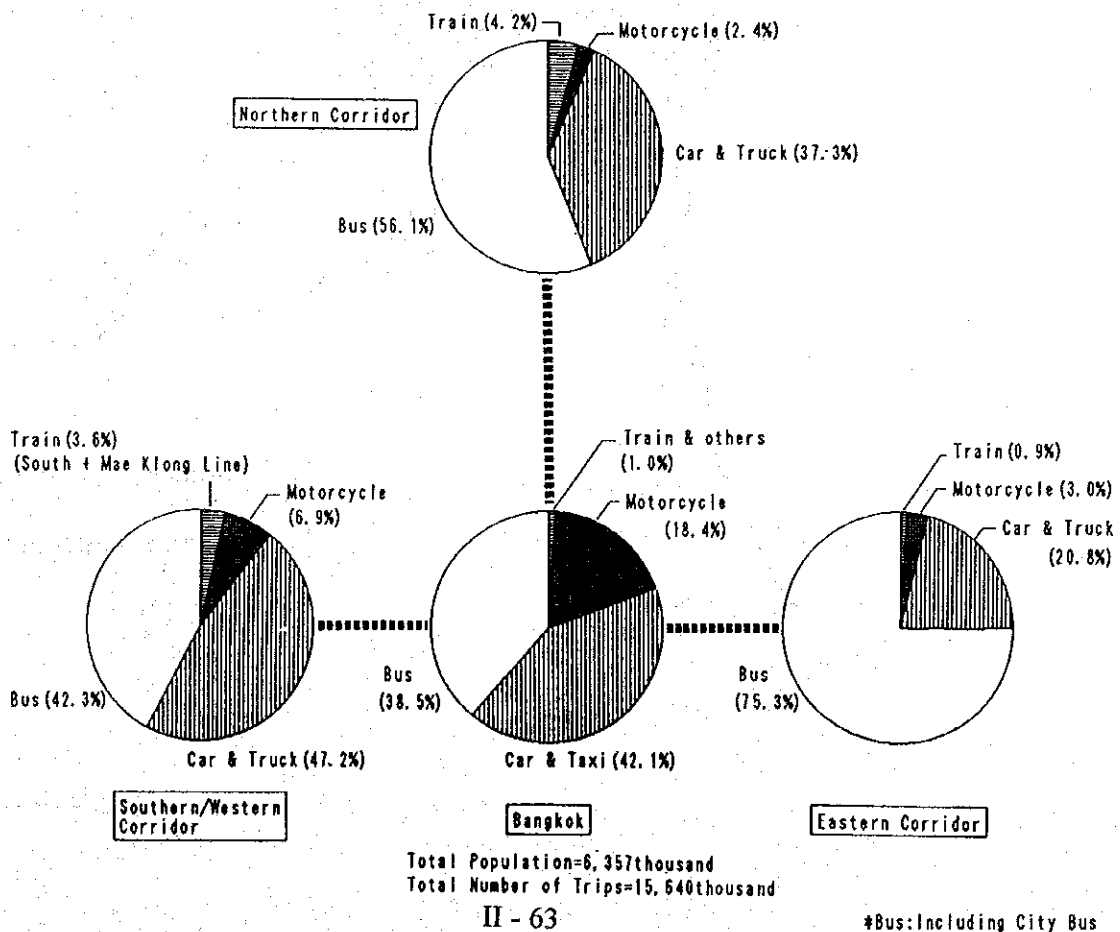
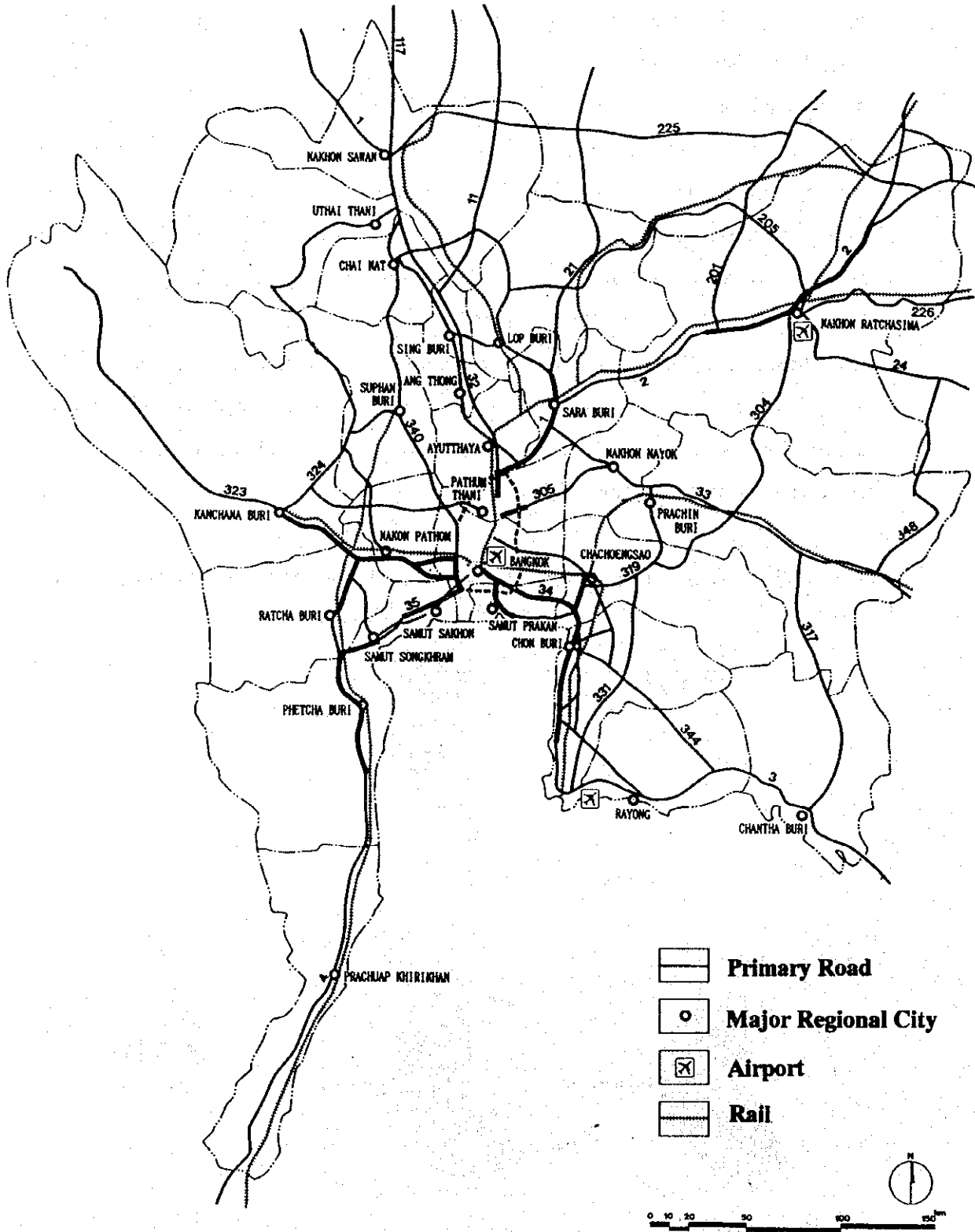


Fig. 3.3.10 Existing Road Network in the Study Area



(2) Road Transport

The existing road network in the study area is basically radial in the center of Bangkok Metropolis and each radial trunk road connects the major regional center as a transport corridor, as shown in Fig. 3.3.10. The inflow and outflow traffic to/from Bangkok is shown in Fig. 3.3.11. The major characteristics of road transport in the study area are as follows;

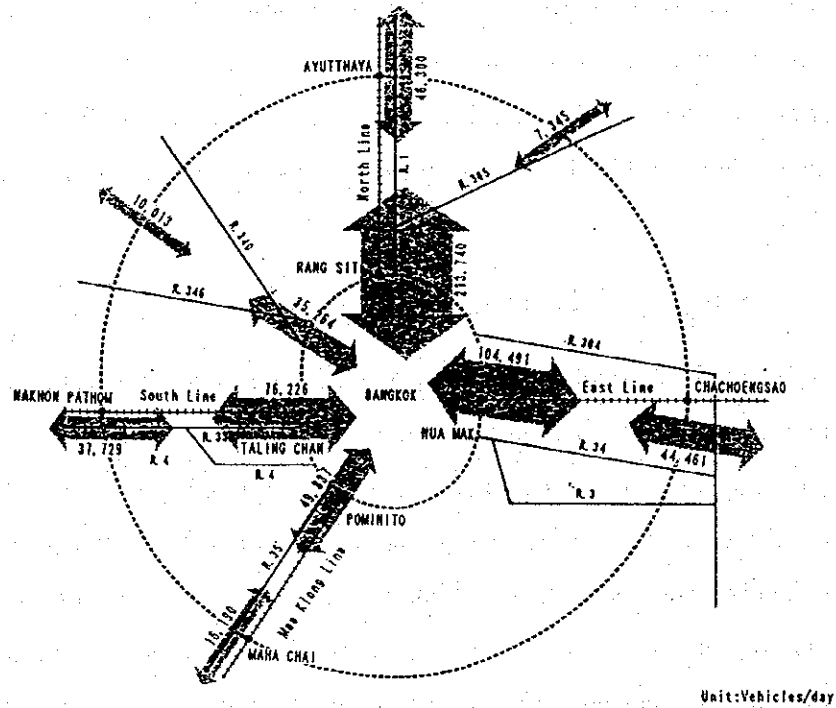
1) Extremely congested road traffic in the Bangkok built-up area

In Bangkok, continuous population growth associated with sharp increase in income, and economic activities has led to an extraordinary rise in the number of vehicles. Among many causes of Bangkok's chronic traffic congestion are too many vehicles using too few roads. The road system has been poorly developed; it lacks structural coherence and serves traffic needs inefficiently. Traffic congestion takes place not only during rush hours but also during off-peak hours in many locations. People traveling by vehicles (either private or public transport) not only have to contend with long travel time but also with uncertain travel time. The oversaturated situation spoils the effectiveness of many existing traffic measures such as bus lanes and one-way streets, etc., among other things. To cope with these conditions in Bangkok, the government has been studying the development of various urban rail transit systems.

2) Relatively high level of transport service of the intercity trunk roads

National roads, which provide relatively high level of transport service, spread all over the country aimed at improving road traffic, developing the access between regional cities, and vitalizing regional cities. And there is 4,300 km of motorway projects covering the whole country up to the year 2010 under the Department of Highways (DOH) to improve conditions.

Fig. 3.3.11 Inflow and Outflow Traffic To/From Bangkok



(3) Public Transport (Bus and Rail)

The major public transport system not only in Bangkok but also in regional cities is by buses. The bus system in Bangkok is being operated by the Bangkok Mass Transit Authority (BMTA) and partly by private companies. Transport Company is a private long distance bus company which serves long distance public transport between Bangkok and regional cities. There are three long distance bus terminals in Bangkok and mainly four long distance routes towards the north, northeast, south, and east along the transport corridors.

The rail network in the study area extend towards the north, east, and south, including Mae Klong Line, and mainly runs parallel to the transport corridors in each direction and competes with long distance bus and cars. The overall modal share of rail transport remains low -- less than 1%. However, in areas where the road network is still incomplete, the percentage of rail utilization is high, as can be seen in Table 3.3.5 for

Chachoengsao (eastern city 60 km from Bangkok) and Ayutthaya (northern city 70 km from Bangkok).

Table 3.3.5 Bus and Rail Passengers Between Bangkok and Major Regional Cities

Region	Province	The number of passengers			
		Bus Passengers		Rail Passengers	
		No.	(%)	No.	(%)
UCR	Lopburi	4018	77.3	1180	22.7
	Saraburi	2134	76.4	660	23.6
	Ayutthaya	2296	56.4	1773	43.6
WR	Ratchaburi	3519	95.6	163	4.4
	Suphanburi	1909	98.2	35	1.8
	Kanchanaburi	2006	79.3	524	20.7
	Phetchaburi	1676	95.3	83	4.7
ESB	Chachoengsao	1120	43.1	1476	56.9

Source: Study of Intercity and Rural Bus Transport Phase II, 1991 (SIRB)

The utilization of rail is low throughout the network, and in some cases extremely low, owing to the long distance between stations and the city center and poor accessibility such as Klong Rangsit, Suphan Buri, and Chonburi. (Refer to Table 3.3.6)

Fig. 3.3.13 presents a concept of the existing public transport system in the study area, from which it can be easily understood that the bus is the major public transport system throughout the study area, and that the low utilization of rail transport is primarily due to an incomplete network.

Table 3.3.6 Annual Rail Passenger Volume in Major Stations and its Administrative Population in 1990

Route Name	Station Name	Distance from Bangkok (km)	Annual Passengers (000)	Administrative Population (000)	Annual Pass./Pop.	Route Name	Station Name	Distance from Bangkok (km)	Annual Passengers (000)	Administrative Population (000)	Annual Pass./Pop.
North Line	Hua Lamphong	0	14,392	345	14.72	South Line	Thon Buri	28	517	272	1.90
	Don Muang	22	2,145	200	10.73		Taling Chan	22	73	110	0.66
	Klong Rangsit	28	75	80	0.94		Sala Ya	35	156	110	1.42
	Bang Pa-In	58	317	65	4.88		Nakhon Chaisi	51	29	95	0.31
	Ayutthaya	71	1,237	122	10.14		Nakhon Pathom	64	316	217	1.46
	Ban Pachi	90	686	30	22.87		Suphan Buri	158	8	140	0.06
	Lop Buri	133	845	57	14.82		Kanchanaburi	133	140	60	2.33
	Nakhon Sawan	246	361	-	-		Ratchaburi	117	208	176	1.18
	Sara Buri	113	312	121	2.58		Fhetchaburi	167	154	100	1.54
	Kaeng Khoi	125	263	70	3.76		Hua Hin	229	192	20	9.60
North-east Line	Nakhon Rachasima	264	449	-	-	Prachuap Khiri Khan	318	127	24	5.29	
	Makkasan	5	557	251	2.22	Wongwian Yai	0	1,117	272	4.11	
East Line	Hua Mak	15	909	251	3.62	Maha Chai	31	784	155	5.06	
	Hua Thake	31	714	78	9.15						
	Chachoengsao	61	925	126	7.34						
	Chonburi	108	3	189	0.02						
	Sattahip	168	17	96	0.18						
	Prachin Buri	122	442	91	4.86						
	Aranyaprathet	255	89	63	1.41						

Source: SRT

Fig. 3.3.12 Existing Rail Network and Annual Passengers in Major Stations

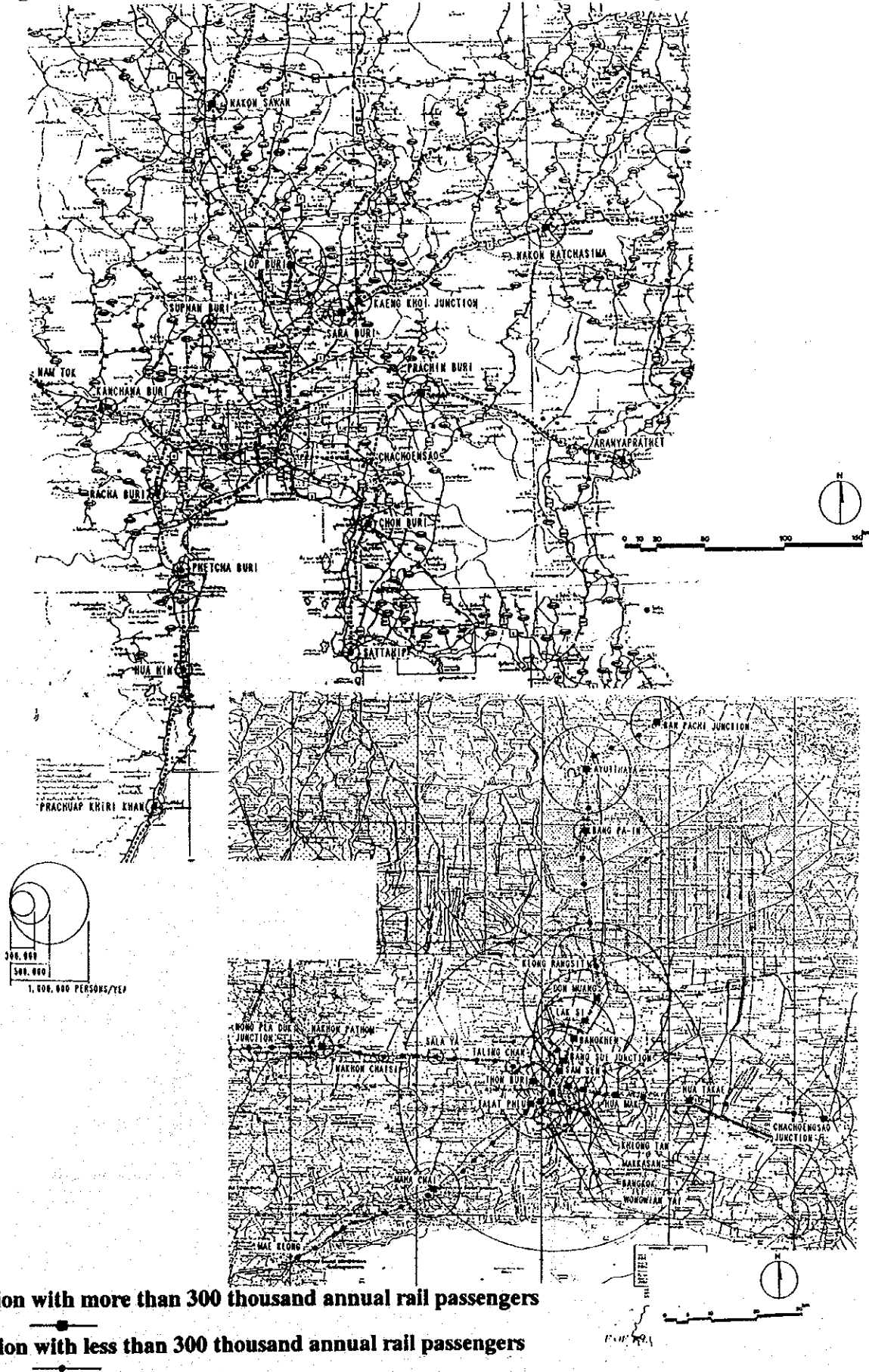
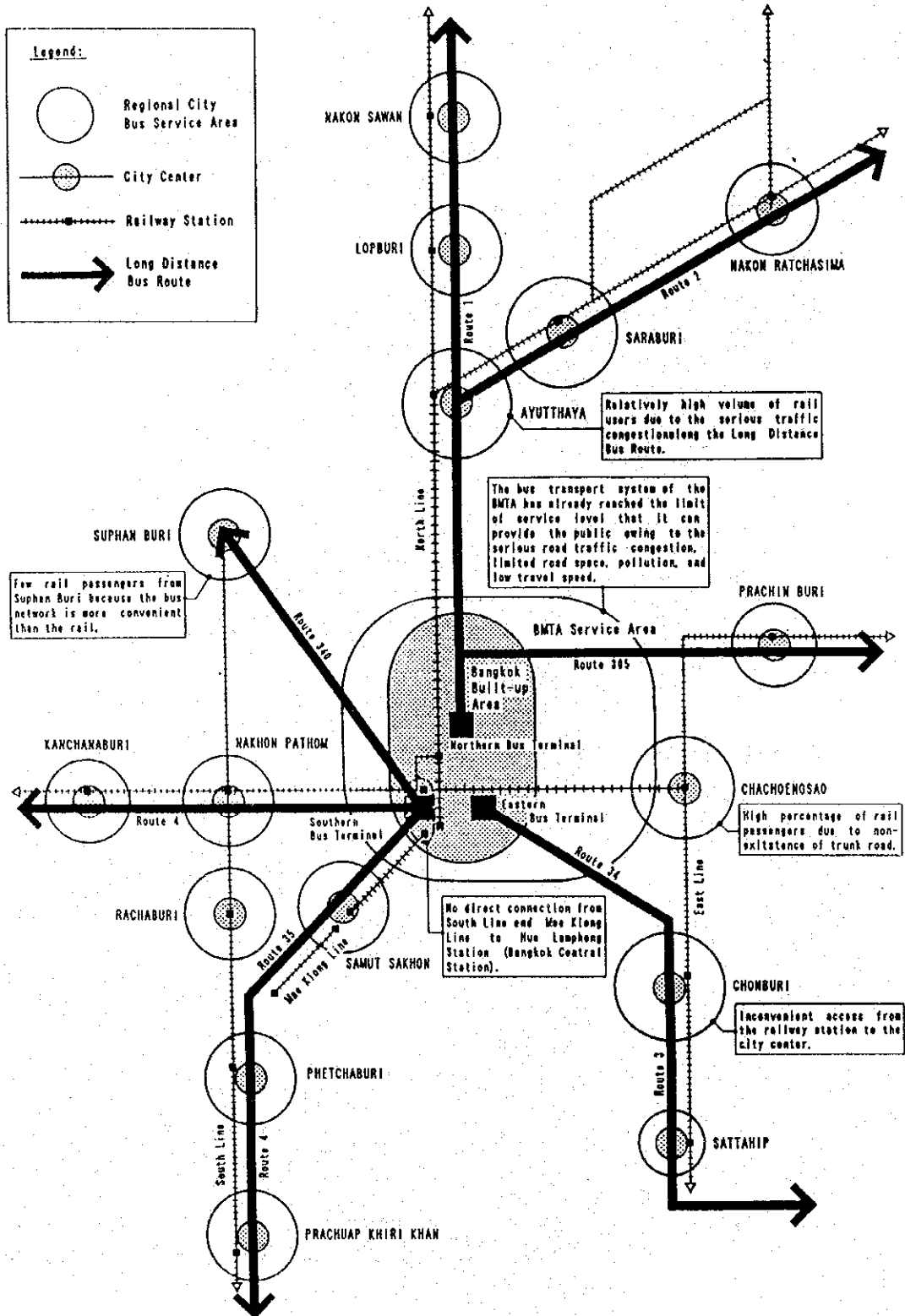


Fig. 3.3.13 Conceptual Existing Public Transport System in the Study Area



(4) Transport Plans and Projects

There are mainly three types of transport plans and projects to improve road traffic conditions

especially in the Bangkok metropolis, to develop the regional centers, and to improve the access between regional centers. They are as follows:

1) Road (Refer to Fig. 3.3.14.)

- Elevated Expressway System in Bangkok

Expressway projects are to be constructed in the Bangkok built-up area as a solution to improving the serious traffic congestion thereby paving the way for the growth of urban activities. One such project is the four-stage elevated expressway project of the Expressway Rapid Transit Authority (ETA) designed to make efficient use of limited road space in Bangkok. The first stage and part of the second stage are already completed. The other expressway projects are the Don Muang tollway, which is currently being constructed under a Build-Operate-Transfer (BOT) scheme and the Ramindra- Atnarong Expressway also by the ETA.

- 4,300 km Motorway Plan by DOH

There is a motorway plan covering 4,300 km spread all over the country up to the year 2010 under the Department of Highways (DOH) aimed at improving road traffic, developing the access between regional cities, and vitalizing the regional cities. The concept of these projects is to formulate the radial-circumferential expressway system including two radial and seven circumferential motorways in the center of Bangkok. Some road projects, such as 4 traffic lane highways and New Bangkok-Chonburi Highway are part of this project.

- By-pass Projects

The Ministry of Transport and Communications has proposed by-pass projects to relieve traffic congestion in the major nine provinces. Among these provinces, the following four provinces are located in the study area:

- Nakhon Ratchasima
- Lop Buri
- Saraburi
- Kanchanaburi

2) Public Transport (Refer to Fig. 3.3.15)

- 2,744 km Double Railway Tracks of SRT

The major objectives of this project are to meet the expected increase in rail passengers and cargoes, and to provide better service in terms of punctuality and safety. This project will also allow SRT to attract more passengers and cargoes which can relieve traffic congestion on roads.

- Urban Rail Transit Systems

Several rail transit systems have already been examined and proposed since the 1980's and preparations have been made to provide better public transport services to address the worsening traffic conditions in the city center of Bangkok. The projects that were proposed and have already been committed both by the government and the private sector are as follows:

Hopewell: 3-storey transport and commercial complex. The project includes commercial facilities (1F), urban rapid transit (2F) and toll way (3F) with 34-km of south-north line (from Don Muang to Ponimit in Mae Klong Line via Hua Lamphong Central Station and Wongwian Yai) and 26-km of east-west line (from Hua Make to Taling Chan via Thonburi). This is an 800 billion baht project to vitalize the SRT and strengthen its feeder system using the existing SRT property.

MRTA : elevated rapid transit system 20-km long with a capacity of 40 thousand passengers/hour connecting the eastern part of the Bangkok built-up area by a circumferential route, from Bang Sue to Hua Lamphong via the north bus terminal, Middle Ring Road, and Rama IV Road.

BTS: elevated light rail transit aimed to improve public transport service and to alleviate serious traffic congestion, using the existing trunk road space. The total route length is 19 km with 10.5 km of Victory Line (from Silom to the north bus terminal in Phahonyothin via Rachapralop) and 8.5 km of Sukhumvit Line (from Sukhumvit to Rama I Road via Prunchit) where the CBD in Bangkok cannot be covered by the Hopewell System and MRTA.

Subway : the introduction of this system in Bangkok would be difficult owing to geological conditions and the cost to be incurred. Nonetheless, it is being proposed anew by BMA in the hope that it would alleviate traffic congestion in Bangkok. Proposed four routes are basically of radial pattern, covering the CBD in Bangkok (not covered by other systems) with future extension towards the suburban area and circumferential route of the Bangkok built-up area.

- **BMA Guideway Bus**

There are many rail transit projects in the Bangkok built-up area. Before the completion of these transit systems, BMA will initiate the guideway bus project using articulated, air conditioned buses as alternative modes. And to provide better transport service, the park and ride system (P & R) will be introduced for road users who wish to travel to business areas. After completion of the BMA transit system (BTS), the guideway bus system will be adjusted to serve as feeder transport of BTS. Alignment in Phase I (before the service of BTS) consists of two routes:

- Phahonyothin Route: 26.6 km
- Sukhumvit Route: 32.8 km

3) Other Transport Facilities (Refer to Fig. 3.3.14)

- **Second Bangkok International Airport (SBIA)**

In order to cope with the increased international air passengers, the Second

Bangkok international Airport (SBIA) has been studied by the Airports Authority of Thailand (AAT). The proposed location of SBIA is in Bang Phli in Samut Prakan, between Bangkok and the Eastern Seaboard (ESB). It is expected that the generated traffic between Don Muang International Airport and SBIA would be small because these two airports would be functioning independently. Some important data projected for SBIA are as follows:

Runway : 3,700m x 4 (future expansion up to 4,000m, capacity = 112 flights/hour)

Annual air Passengers: 100 million

Annual air freight : 8.4 million tons

- Inland Container Depot (ICD)

An Inland Container Depot (ICD) is being planned at Lat Krabang, a suburb east of Bangkok, to be built on the 620 rai of SRT property. The ICD is expected to handle the increased container cargo between Bangkok and ESB.

- Truck Terminals

The study on truck terminals called "Feasibility Study of Truck Terminals in the Suburban Area of Bangkok" was funded by the Japanese Government. Its objectives were to provide efficient transport of cargoes and to relieve traffic congestion in the Bangkok Metropolitan Region. The study recommended the construction of truck terminals in the north (Rangsit), east (Bang Na), west (Bank Khan), and central area (Yannawa).

Fig. 3.3.14 Transport Plans and Projects (Road and Other Transport Facilities)

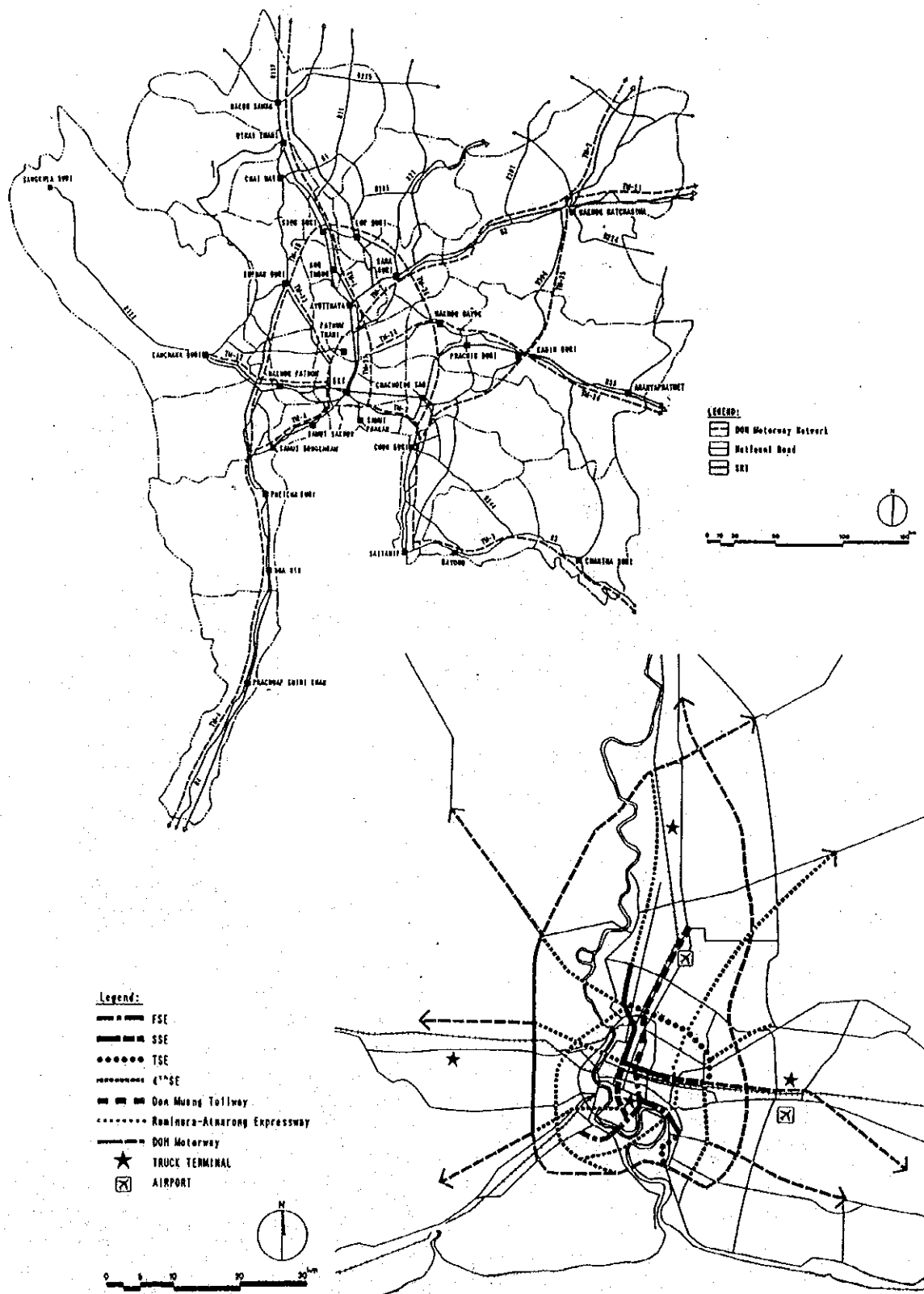
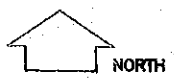
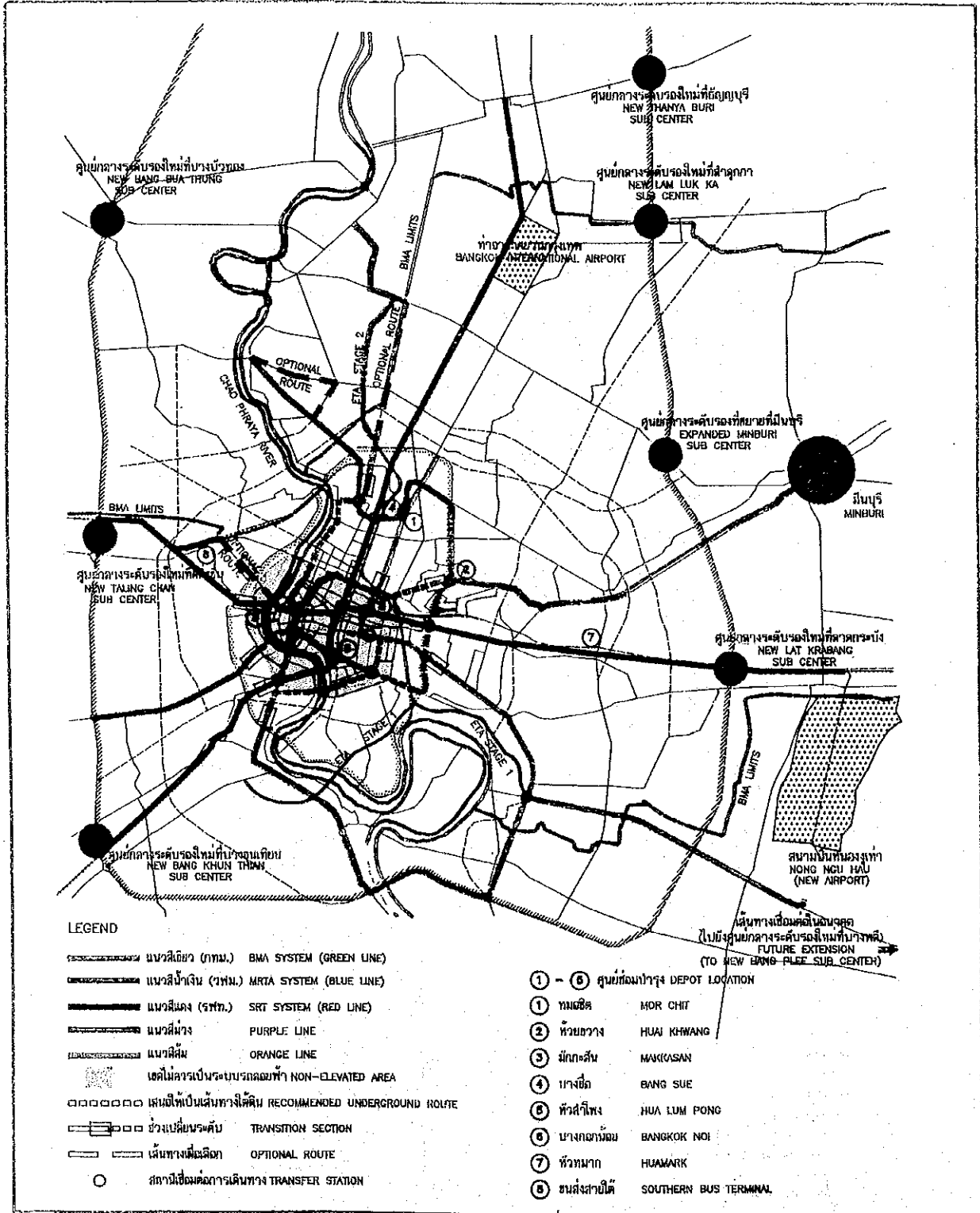


Fig. 3.3.15 Transport Plans and Projects (Public Transport)



MASTER PLAN FOR MASS RAPID TRANSIT SYSTEM

EXHIBIT 1

3.3.2 The SRT Railway

3.3.2.1 Railway Network

Railway lines all radiate from Bangkok, and extend out towards the north, east, and south, including Mae Klong Line, and partly run parallel to the transport corridors of each direction. However, the utilization of rail as an urban transport is low due to the indirect connection of the south line to the center of Bangkok and the low service level in terms of punctuality, speed, and comfort. Incidentally, the daily number of train passengers is approximately 50 thousand which is less than 1% of the total number of passengers using transport.

There are 182 stations in the study area distributed as follows: north line including northeast line has 77, east line 38, south line 60, and Mae Klong Line 7. However, the stations with annual passengers reaching more than 300 thousand number only 27, which constitute 15% of the total number of stations.

The density of railway routes is 7.3 km per 1,000 km² at present, and is far inferior to the road density (highways only), 93.4 km per 1,000 km².

3.3.2.2 Transportation Characteristics

(1) Passenger Transportation

Passenger traffic volume of SRT in 1990 was 77,203,000 persons, a decrease of 810,000 (1.0%) from 1985. The past trend of passenger transportation is shown in Table 3.3.7. As shown, the trend of increase in passenger slowed down and even posted a negative growth rate in 1990.

Table 3.3.7 Rail Passenger Transportation

Fiscal Year	Number of Passenger (Thousand)	Growth Rate (%)	By Class (Thousand)		
			1st Class	2nd Class	3rd Class
1975	61,567		128	923	60,516 (5,961)
1980	74,286	20.7	78	1,605	72,603 (10,177)
1985	78,013	5.0	69	1,757	76,187
1990	77,203	-1.0	39	9,655	67,509 (7,846)

Note: Parenthesized figures represent commuters

Source: SRT Information Booklet

(2) Freight Transportation

The freight traffic volume has been basically stagnant from 1975 to 1985. However, the freight volume has drastically increased from 1985 to 1990 due to the economic boom in Thailand, as shown in Table 3.3.8. Looking at railway freight transportation by commodity, it is observed that 2.52 million tons of bulk cargo such as petroleum and cement (50% of total freight transportation) in 1975 was carried by railway, and 5.44 million tons (68% of total freight) in 1990. These figures indicate that the railway has an important role in moving bulk cargo.

Table 3.3.8 Freight Traffic Volume by Commodity

Fiscal Year	Petroleum	Cement	Agricultural Products	Others	Total Tonnage
1975	968	1,553	661	1,870	5,052 (100)
1980	1,353	2,529	830	1,521	6,233 (123)
1985	2,560	1,527	824	737	5,648 (112)
1990	2,968	2,470	588	1,969	7,995 (158)

Unit: Thousand tons, Million ton kilometers

Source: SRT Information Booklet

3.3.2.3 Railway Operation System

The existing number of trains is 336. The breakdown of trains by type and by line is given in Table 3.3.9.

Table 3.3.9 Number of Trains by Line(1985)

Line Type	Northern	North-eastern	Eastern	Southern	Total
Passenger					
Express	2	4	-	6	12
Rapid	6	8	-	10	24
Ordinary	28	43	10	30	111
Commuter	19	8	16	8	51
Total	55	63	26	54	198
Mixed	6	2	2	16	26
Freight	36	42	-	34	112
Total	97	107	28	104	336

Among these trains, the greater part of passenger trains (119 trains per day) is to/from Bangkok (Hua Lamphong) Station which is the largest terminal station in the study area, as shown in Table 3.3.10.

Table 3.3.10 Number of Trains at Hua Lamphong Station in 1985

Line Type	Northern	North-eastern	Eastern	Southern	Total
Express	2	4	-	4	10
Rapid	6	8	-	8	22
Ordinary	20	16	8	7	51
Commuter	16	6	12	-	34
Mixed	-	-	2	-	2
Total	44	34	22	19	119

From such a situation, the following problems are noted.

- As almost all trains depart from or arrive at Hua Lamphong Station, the Bangkok - Ban Pachi section has as many as 142 inbound and outbound trains, including a concentration of freight trains in a day; therefore, track capacity is limited.
- The eastern and southern lines branch from the northern line at a level crossing; thus, there is the problem of crossing both main tracks. Therefore, a speed limit is provided, resulting in difficulties in both transportation and operation. Also, care is required to ensure safety.

3.3.2.4 General Evaluation of the Existing Railway System

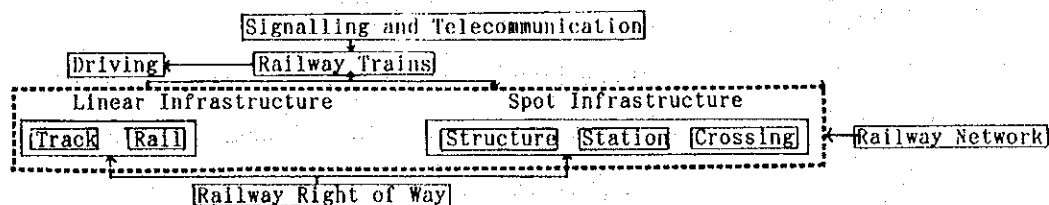
The general evaluation of the existing railway infrastructure and functions (refer to Table 3.3.11 and Table 3.3.12) are summarized as follows:

- The original functional system of Thai railway can be rated high as shown by the design speed of as high as 120 km/h.
- However maintenance problems, deterioration resulting from a shortage of re-investment and other bottleneck problems such as at-grade crossing, subsidence, degraded the original high functional system, lowering the train speed and the transport capacity.
- Nonetheless the existing SRT operating in this situation has been playing a certain role, as shown in the functional evaluation in Table 3.3.11.

Table 3.3.11 Summary of Functional Evaluation of the Existing Railway

Items	Evaluation
Safety	<ul style="list-style-type: none"> • Fair level by and large <p>(The brief stoppage and/or slowing down of trains near grade crossings to avoid traffic accidents sacrifices on-time operation and high-speed operation)</p>
On-time Operation (Time Reliability)	<ul style="list-style-type: none"> • High level among the developing countries <p>(Habitually a little delayed due to the grade crossing)</p>
Capacity	<ul style="list-style-type: none"> • Lowered Capacity <p>Due to;</p> <ol style="list-style-type: none"> 1. Low speed of train with large number of cars 2. Low speed of freight trains (vacuum brake 40 km/ h) 3. Brief stop and slow down at the grade crossing
Speed	<ul style="list-style-type: none"> • Possible speed of 120 km/h by diesel express trains on the existing tracks. <p>However in practice, speed is reduced due to the problems such as those of grade crossing and others.</p> <ul style="list-style-type: none"> • 90 km/h for passenger train with diesel locomotive • 25-45 km/h in built-up areas (grade crossing and squatter) • 40 km/h for freight trains (due to the vacuum brake)

Table 3.3.12 General Evaluation of the Existing Railway Infrastructure/Rolling Stocks and Counter Measures



Items	The Existing conditions and Problems	Necessary Counter Measures	
Right of way	<ul style="list-style-type: none"> Width of ROW: as wide as 40-80m (14-20m of Mae Klong line) Squatter in ROW in the built-up area 	<ul style="list-style-type: none"> Capable to accommodate a quadruple track (But Additional land acquisition necessary at the stations) Clearance of squatter (To be cleared by Hopewell project) 	
Linear Infra.	Track	<ul style="list-style-type: none"> North line: Double track, others: Single (Section of Hopewell: 3 track line planned) 	<ul style="list-style-type: none"> 2 and 4 tracking (Planned double tracking of 234km length)
	Rail	<ul style="list-style-type: none"> Road bed: stable at least Subsidence of bed before and after structures like bridges and others. 	<ul style="list-style-type: none"> Strengthening needed in the section of high speed and large volume of traffic (Heave rail, Increase of sleepers, Thickening bed, Improvement of turnout, etc.)
Spot Infra.	Structure	<ul style="list-style-type: none"> Superannuated bridges 	<ul style="list-style-type: none"> Strengthening load bearing capacity of bridges (Bearing pressure 14t -> 20t) (On going in the section from Lat Kraban to Chachonsao)
	Station	<ul style="list-style-type: none"> Low floor platform Bottle neck for increasing capacity and speed 	<ul style="list-style-type: none"> High floor platform in the section of high speed and large volume of traffic, over bridge Sufficient siding tracks
	Crossing	<ul style="list-style-type: none"> Stop or slow-down through the railway crossing 	<ul style="list-style-type: none"> Perfect shut off of road traffic in advance -> Grade separation -> Elevated railway. Strict traffic rules
Rolling stocks	<ul style="list-style-type: none"> Dilapidated train cars (aged and obsolete) Trains, 22 car long at maximum - slow speed, weak traction capacity and braking power. 8,000 freight cars mostly obsolete (vacuum brake), maximum speed at 40km/h, braking distance 1000km, which lowers capacity. 	<ul style="list-style-type: none"> High-powered and performance train cars. - Electric, Diesel car. (accelerating/braking power, high speed) Electrification (in the section of high speed and large volume of traffic) 	
Signaling/Telecommunication	<ul style="list-style-type: none"> Fair in a way. (OECF signaling modernization project) (Automatic signaling in the section of double track) Telecommunication rated fair in a way (OECF Telecommunication improvement project) 	<ul style="list-style-type: none"> Up-grade (in the section of high speed and large volume of traffic) (Unnecessitating tablet and reducing the interval between signals). 	
Railway network	<ul style="list-style-type: none"> Good coverage of the existing railway network of more than 3000km line length over the major regions of Thailand. Possibility of international railway network through the expansion of the existing lines. Networks centering on Bangkok 	<ul style="list-style-type: none"> Basically no need of new lines. Freight transport system centering on the emerging ESB over the country. Mitigation of congestion in Bangkok (especially diversion of freight transport). 	

3.4 Bangkok Centered Regional Development

3.4.1 Regional Development Structure - Multipolitan Structure -

3.4.1.1 Transport System as a Key Factor to Determine Regional Development Structure and Relationship between Them

In the past, when any kind of regional or urban structures were proposed in Thailand, no explicit mention was made of the transport systems to support them. Implicitly, road transport was taken for granted. However, as road transport has been declining reliability and the confidence regional/urban structure can be proposed without the explicit mention of the transport system needed support to them.

In MRSP study purposes a regional structure such as the Chao Phraya Multipolitan Structure on condition that the Inter-Urban Fast/Comfortable Train (FCT) is to be developed as one of the regional infrastructure networks attained in the preceding section. In this situation the relationship between the regional structure and transport system is quite important as follows:

- a) The regional/urban structure is to be determined by the transport systems applied to support it. (e.g., the urban structure based on road or public transport system is quite different).
- b) The feasibility of the applied transport system development is dependent on the urban structure which is designed to be best suited for the transport system so that best use can be made of it.

Thus the relationship between the urban structure (typically land use) and the transport system is defined in such a manner that the urban structure will determine the best applied transport system while the transport system will determine the urban structure best suited for it.

Actually a very important part of this study on integrated urban and railway development is the relationship between the urban structure (urban development) and transport system of railway.

3.4.1.2 Skeleton of the Proposed Regional Development Structure

Regional development structure is examined and proposed with special attention given to the effect of railway improvement and the interacting relationship between the regional/urban structure and railway transport.

Metropolitan Regional Structure Planning Study (MRSP Study) set forth the CHAOPHRAYA MULTIPOLIS, restructuring Bangkok region.

It has been determined that this JICA study follows the recommendations made in the MRSP study mainly for the following reasons:

- a) It is intended that MRSP acts as a guideline for regional/urban development in this region.
- b) Decentralization of the regional structure with the multinodal, polycentric system of settlement proposed in the MRSP study has been one of the government's development policies.
- c) In principle MRSP is the rail transport based regional development study which seems in harmony line with the basic concept of this JICA study.

As a matter of fact MRSP proposes Inter-Urban Fast/Comfortable Train (FCT) as one of the preconditions for developing urban districts such as the Eastern Seaboard, upper central region (especially Saraburi) and others, thus leading to restructuring Chao Phraya Multipolis.

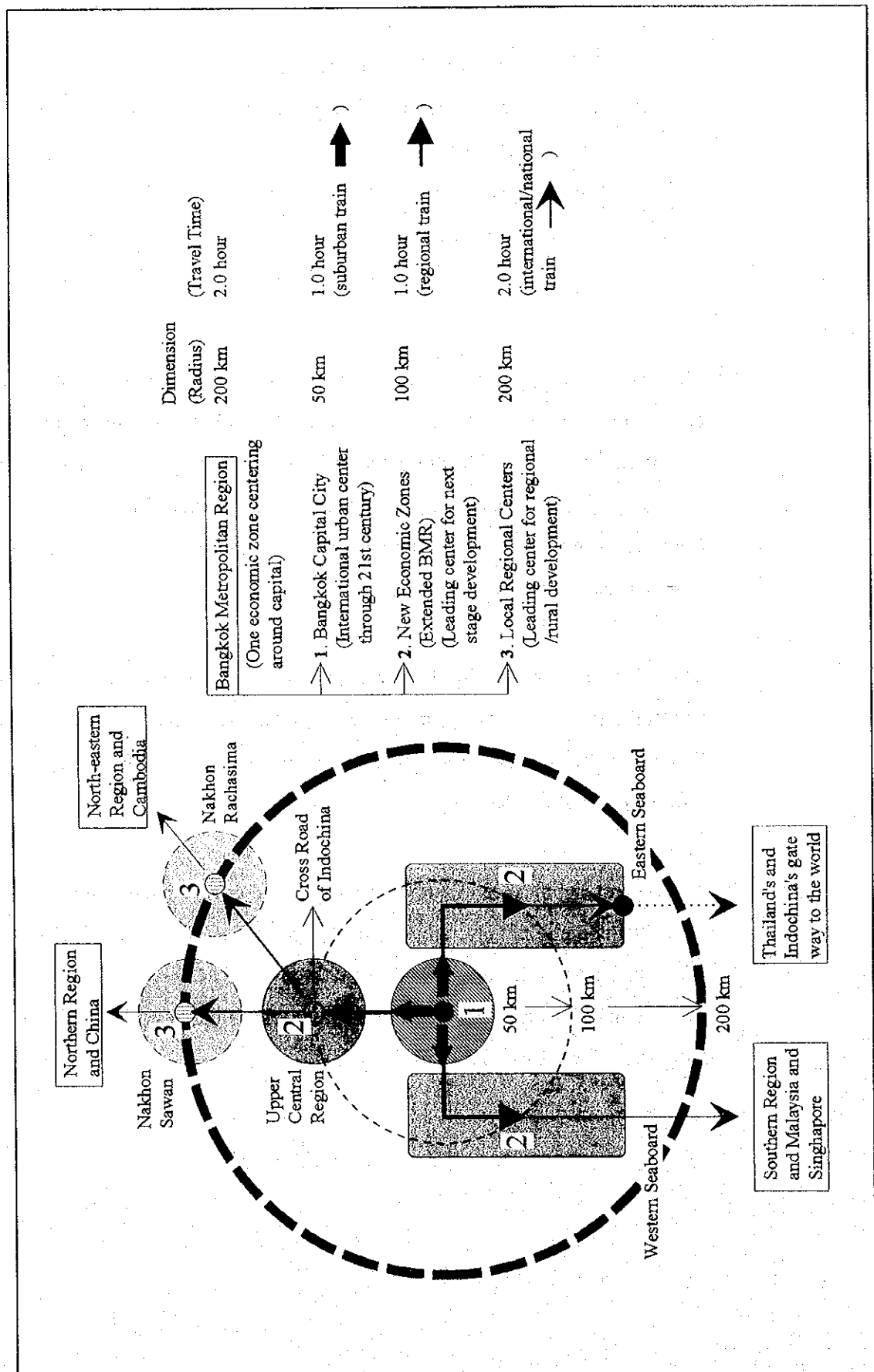
Based on the MRSP study and with more attention being paid to the positive interacting relationship between the regional development and the railway system, the regional structure is worked out as outlined below and shown in Figure 3.4.1.

(1) Composition and Development Policy of the Proposed Regional Structure

- 1) Bangkok Metropolitan Region equivalent to the Bangkok centered 200 km radius area, consists of the following sub-regions (almost similar to the district urban sub-systems of the MRSP study except the local regional centers)

- Bangkok Capital City (Bangkok Centered 50 km Radius Area)
 - Extended BMR (New Economic Zones) Consisting of the following
 - Eastern Seaboard
 - Western Seaboard
 - Upper central Region
 - Local Regional Center Area (Nakhon Sawan, Nakhon Rachasima)
- 2) The basic policy of development, which is in line with those of MRSP study, is to accelerate the socio-economic and industrial growth of the sub-regions based on their own resources and locational advantages, so as to create a multinodal, poly-centric system of settlement. However, it must be kept in mind that Bangkok Capital City must remain the prime city of the region as well as of Thailand in spite of the decentralization policy.
- 3) The sub-regions, especially Bangkok Capital City, New Economic Zones and the Local Regional Centers must be firmly linked with one another so that the Bangkok metropolitan region can work as one economic body leading the socio-economic growth of Thailand.
- 4) It is of great significance to note that the regional development structure as set out above is conditional on railway improvement (as discussed in detail in the following section). In the case of MRSP study, the FCT is proposed. Conversely the regional structure described in this study offers the best chance for maximum utilization of the existing railways.

Fig. 3.4.1 Regional Development Structure Integrated with Railway Improvement



(2) Main Development Features of Sub-Region

The main development features of the sub-regions are elaborated in consistency with the recommendations of the MRSP study as follows:

1) Bangkok Capital City

The area of the city is mostly equivalent to Greater Bangkok as defined in the MRSP study, which includes Bangkok and those areas directly dominated by Bangkok.

The changing of role of Bangkok capital city.

It is recognized that the economic growth of the capital has been generated mainly by the development of manufacturing industries in/around Bangkok. However Bangkok has reached the turning point where its role changes from manufacturing and distribution industries towards a more administrative and managerial business center.

International capital

As the MRSP study stresses, the future development of Bangkok Capital will be more an international finance/trade and development hub of Southeast Asia, and one of the key financial centers of Pacific Rim.

Upgraded and highly advanced business center

The major industries and activities to be fostered are trade/financial, information/communication oriented industries, research, knowledge related industries, which are all categorized as high value added industries.

2) Extended BMR

Extended BMR will be developed so as to be the leading center for the next stage development of Thailand and the capital region.

In parallel with the changing role of Bangkok as stated above, the manufacturing and distribution industries in Bangkok will shift their locations to the extended BMR area and will boost the industrial growth in that area.

Eastern Seaboard - Thailand's and Indochina's gateway to the world

The Eastern Seaboard Development is in progress with the focus on manufacturing (Laem Chabang, Maptaput Industrial Estate development) and port development. Further development is envisioned to make the Eastern Seaboard a metropolitan area (A study on the second phase of the Eastern Seaboard is due to be made). The MRSP study indicated that the region has two principal nodes as follows;

Chachoengsao : Aside from being a major agricultural/industrial center, Chachoengsao will also assume the role as Thailand's administrative sub-center and become the technical, management, and industrial support center for the Nong Ngu Hao International Airport. Through Chachoengsao, government services can be brought much closer to the rapidly-growing Eastern Seaboard and Saraburi industrial complexes.

Rayong - Mab Ta Phut - U Taphao : This closely-related, high-tech industrial and global trading complex will not only be Thailand's gateway to the world, but will also play a similar role for Indochina and Yunnan Province in South China.

Western Seaboard

Agriculture, natural resources and tourism are the backbones of economic activity in this region. The new steel mill and port development at Ban Saphan and destination tourism complexes between Cha-Am, Hua Hin and beyond will also play major roles in economic development.

Samut Songkhram - Petchaburi - Hua Hin - Controlled, agri/seafood and tourism development and conservation region.

Nakhon Pathom - Future Government administrative sub-centre, with particular focus on industrial and regional administrative services.

Upper Central Region - Crossroads of Indochina

In cooperation with the coastal center in ESB, the inland center for distribution of

natural resources/manufactured products and industrial development is planned to grow in the upper central region, anchored by the city of Saraburi, which is a resource rich region with great potential for further industrial development.

Saraburi will be developed as a future government construction technology and research center with particular focus on industrial and international export administrative services.

3) Local Regional Center - Nakhon Sawan and Nakhon Ratchasima

Nakhon Sawan and Nakhon Ratchasima are the development centers for the north and the northeast regions respectively.

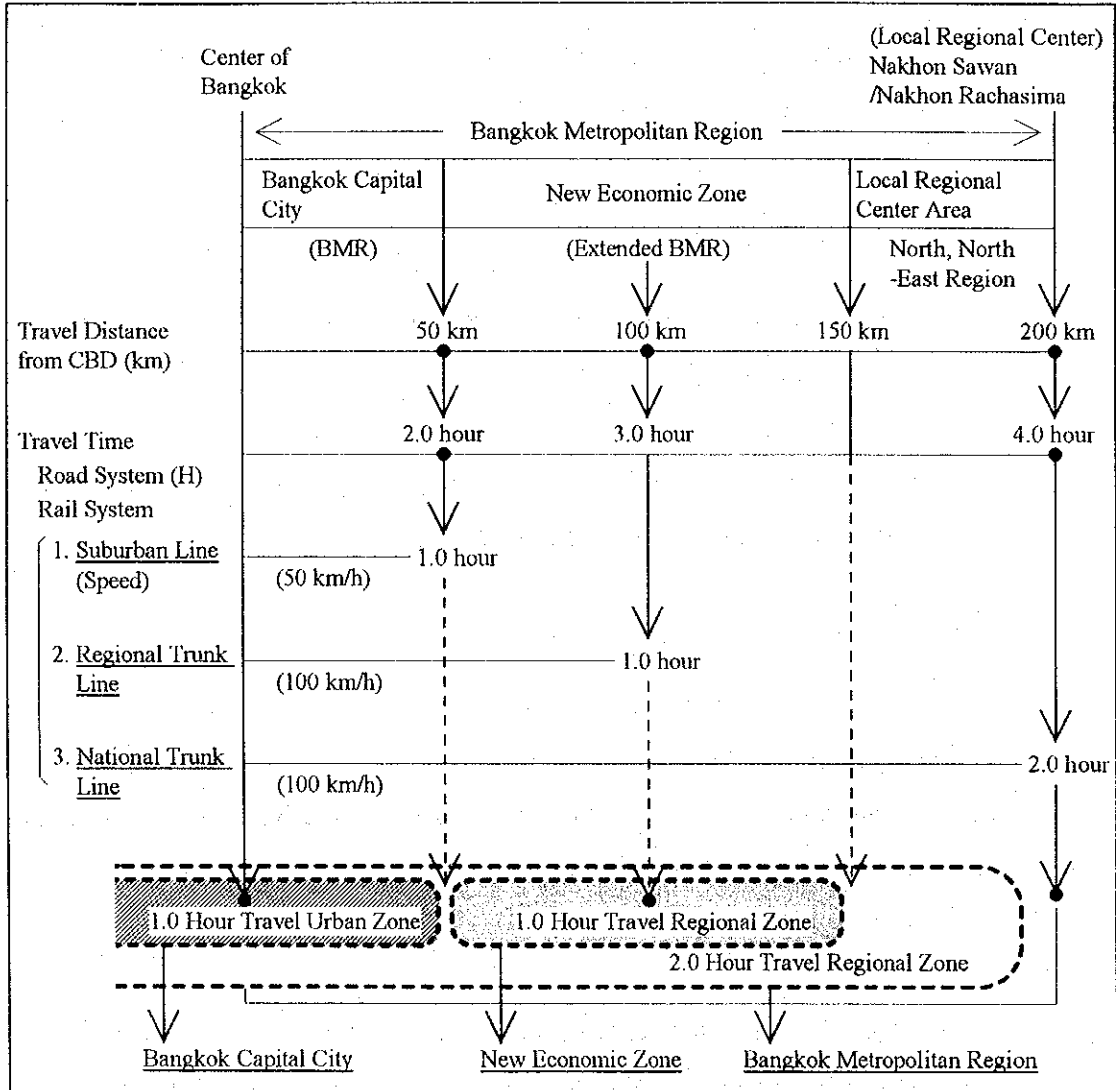
The regional centers in direct economic linkage with the Bangkok Capital and the new economic zones of the Extended BMR are to play an important role in boosting natural resource development in the region.

(3) Dimension of Regional Structure

It is natural that Bangkok Capital region has been and will be expanding its area and regional structure in the course of socio-economic growth. In fact, Bangkok was economically and socially quite limited to the area around Bangkok several decades ago and at present is about to expand its area of influence to the Extended BMR and some of the local regional centers above.

In this study the dimensions of the proposed regional structure as shown in the Figure 3.4.2. is determined in the light of the expected improvement of transport conditions (especially accessibility or reduction of travel time to the CBD of Bangkok) by the planned railway improvement, as well as standard transport conditions represented by standard travel time, set up for the socio-economic activities in the Bangkok centered region as follows.

Fig. 3.4.2 Dimension of Regional Structure Supported by Improved Railway Transport



1) Transport system and Regional structure

[Improvement of Regional/urban Transport Conditions by the Improved Railway System]

The improvement of the existing SRT lines connecting Bangkok capital city, New Economic zones and the local regional centers in the 4 radiating directions from the center of Bangkok is to improve the regional/urban transport conditions in terms of accessibility or travel time reduction to the center of Bangkok as compared to those of road transport systems. The transport improvement is to be respectively

made by three types of train services, suburban line, regional trunk line and national trunk line which are proposed to be provided in each direction from Bangkok, in the railway improvement plan, as follows.

Table 3.4.1 Transport Condition Improvements by Railway as compared to those by Road System

Distance from the center of BKK	50 km	100 km	200 km
Travel time by car	2.0 hours	3.0 hours	4.0 hours
Travel time by rail			
• Suburban line (50 km/h)	1.0 hours		
• Regional trunk line (100 km/h)		1.0 hours	
• National trunk line (100 km/h)			2.0 hours

[Standard transport service for regional/urban activities]

Taking into consideration the possible improvement of transport conditions by the railway, the standard transport service in terms of travel time for the regional/urban activities are set up as follows.

Table 3.4.2 Standard Transport Service (Travel Time - Accessibility)

The Bangkok Capital City	Access to the center of BKK within one hour travel time by suburban line
Extended BMR (New economic Zone)	Access to the center of BKK from the central part of the new economic zones within one hour travel time by regional trunk line
Bangkok Metropolitan Region	Access to the center of BKK within 2.0 hour travel time by the national/regional trunk line.

[Dimension of Regional structure]

Summarizing the above-discussions, the regional dimension of the proposed regional structure is worked out as follows.

Table 3.4.3 Regional Dimension of the Proposed Regional Structure

Bangkok Capital City	1.0 Hour Travel Urban Zone
New Economic Zone	1.0 Hour Travel Regional Zone
Bangkok Metropolitan Region	2.0 Hour Travel Regional Zone

In this table 1.0 Hour Travel Zone means that the center of Bangkok is accessible from any point place in the zone within one hour travel time, and the daily travel and activities can be completed within the area of one hour travel time.

One hour of travel time for Bangkok capital city and 2 hours of travel time for Bangkok Metropolitan Region are respectively set forth as reasonable times for commuting in the capital city and business/industrial travel in the regional development.

2) Dimension of Bangkok Metropolitan Region

The dimension of Bangkok Metropolitan Region including the sub-regions which should be integrated into one economic region as Bangkok capital region is determined with the emphasize on the following 3 aspects.

- Necessity of inclusion of the local regional centers (Nakhon Sawan and Nakhon Rachasima).

It is a natural tendency that the area of influence of the capital expands outward in accordance with the increase of socio-economic power of the capital in such a manner that it absorbs adjoining areas under its economic influence.

At present Bangkok Capital Region usually consists of BMR and Extended BMR, excluding the local regional centers.

In this study they are to be included in the Bangkok centered region, or the Bangkok economic zone, especially the development of the local regional centers are designed to be accelerated by means of strengthening the socio-economic and industrial linkage with the BMR and Extended BMR. For instance linkages between north and northeast region, and ESB will be of great significance for Thai National development. Nakhon Sawan and Nakhon Rachasima are expected to act as gateways for these regions.

Consequently the local regional centers are to be included in the Bangkok Metropolitan Region with a view to establishing firm linkage lines from the Bangkok capital city through the new economic zone to the local regional

centers within a 2 hour travel time.

- 2 hours of time distance for developing and sustaining the socio-economic linkage with Bangkok.

Any regional/urban developments should be placed within a certain travel time from the center of Bangkok, so that they can be successfully executed in direct socio-economic/industrial linkage and interaction with Bangkok.

2.0 hours of time distance from the center of Bangkok, within which the linkage with Bangkok will be developed and sustained is set for determining the area and dimension of Bangkok Metropolitan Region for the following reasons.

Travel time by road at present

Industrial developments including the Industrial Estate developments have been taking place around Bangkok. They are mostly located within more or less 2 hours travel time by the congested road transport system, depending on highway development. It may be suggested that 2 hours of travel time to Bangkok would be the desired limit for maintaining linkage with Bangkok on average. In reality the travel time has been lengthening due to worsening traffic congestion on the road network.

Travel time by the improved railway

The improvement of railway (national/regional trunk line with the scheduled speed of 100 km/H) can put the 200 km radius area including the local regional centers within 2 hours time distance from the center of Bangkok.

The railway will further expand the Bangkok centered economic zone, which has been limited to BMR and Extended BMR due to the constraints of road traffic.

Competition of railway with airplane

The purpose of this study is to make maximum use of the existing railway as

stated earlier. However it must be admitted that naturally there is a limit to this. It is widely known that as the travel distance gets longer the railway is likely to lose competitiveness to the airplane. It may be safely said that the railway can be competitive within the 200 km radius area from Bangkok.

3) Dimension of Bangkok Capital City

The area of Bangkok Capital City is mostly equivalent to Greater Bangkok as defined in the MRSP study, which includes Bangkok and those areas it directly dominates. It is interesting to know that at present there seems to be two (2) contradictory influences to outward urbanization dominated by Bangkok.

On the one hand it seems apparent that the urban area has been expanding outward in accordance with the socio-economic growth of Bangkok. In such a manner, the area dominated by Bangkok has been expanding outward. On the other hand it also seems true that urban communities in the suburbs of Bangkok tend to be less dependent on Bangkok, especially the existing CBD for their daily lives and activities, in such a manner as to avoid long travel times due to road traffic congestion. In this manner the dominance of Bangkok over the suburban areas appears to lessen, especially in accordance with the increasing travel time to Bangkok. It is still recognized that they rely to a concentration on Bangkok in terms of provision of goods and services. However, it is said that their contact with the existing CBD has been becoming less frequent than before in their daily lives, and that they increasingly depend on shopping centers, and workplaces located close to their home.

In this particular situation, it is quite hard to define dominance in the areas directly dominated by Bangkok. In line with this urbanization, taking into consideration inaccessibility to the CBD from the suburbs due to traffic congestion on the road network, such development schemes as those of the self-contained new towns and the job-housing balance development for the Bangkok metropolitan sub-center (MBA - MIT) where most daily activities of people including working, shopping, attending school and others are to be achieved in their localities have recently been

proposed so that they will be no longer totally dependent upon Bangkok. Are these developments categorized as dominated or not dominated by Bangkok?

The railway improvement is designed to drastically increase accessibility to the existing CBD and Bangkok from the suburbs in the situation of heavy traffic congestion on the road network (reduction of travel time from 2 hours by car to 1 hour by train - speed of 50 km/H between the center of Bangkok and a point or place 50 km distant from the center). Increasing accessibility to the CBD of Bangkok is a way to expand the areas influenced and dominated by Bangkok

One of the planning issues will be how far it should be expanded by means of improvement of the transport system such as the railway.

In this study it is recommended that it should be limited to a reasonable travel time for people commuting to the CBD of Bangkok, which is set at one hour, a standard commuting time in the major capital cities in the world. This is the basic reason for determining the dimension of the Bangkok Capital City within the range of a 50 km radius from Bangkok, which is equivalent to 1.0 hour travel time by the improved railway (the suburban commuter line).

3.4.2 Metropolitan Regional Development (200 km Radius Area)

3.4.2.1 Regional Development/Improvement of Railway

(1) Necessity and Goals of Railway Improvement

1) Necessity and Role of Railway Transport in the Context of National and Regional Development

It is evident that the SRT has not been fully utilized by the people especially in the urban area. This may be attributed to many factors including the precedence of road construction over railway, the low level of existing railway services, the size of the Thai economy which is not large enough to make optimum use of the railway transport, and so on. Nevertheless, this study aims at railway promotion notwithstanding this disadvantageous situation.

However, special attention must be paid to the development stage of Thailand. The country has achieved the first and second stages of socioeconomic development and is at the threshold of becoming a newly industrialized country (NIC).

The necessity and roles of railway must be defined in the light of Thailand's socioeconomic development in the 21st century. They are as follows:

General Public Transport System throughout the Nation and International Railway Lines Covering Indochina

The following goals of railway system improvement are set forth here to utilize the existing railway network covering major parts of Thailand including all the regional centers.

- **General Transport System Accessible to the Public Throughout Thailand:**
In response to the broader needs of Thai society, the SRT should serve as the backbone of public transport services, available to all brackets of society, the

rich and the poor, the old and the young, the rural and urban.

- National Freight Transportation System in Association with the Natural Resource and Manufacturing Developments Nationwide:

It is anticipated that natural resource and manufacturing developments in the countryside will be accelerated with industrial linkaging and the ESB will become national industrial and freight distribution center. In this regard, the establishment of a national freight transport system centering on the ESB and extending all over the country is vital for the socio-economic development of Thailand.

- International Railway Transport System:

The existing railway network stretching toward the boundaries with neighboring countries can be expanded to link Thailand with Indochina so as to establish an international railway transport system (including an existing railway link with Malaysia and Singapore). The system will be instrumental in making Thailand (especially Bangkok and ESB) become a regional center in the Indochina peninsula.

Backbone of the Capital's Regional Transport System

Thailand's development centers on the primate city of Bangkok and extends into the Bangkok Metropolitan Region (BMR) including its five neighboring provinces. Now, it is extending further beyond of the BMR (Extended BMR includes Eastern and Western Seaboard and Upper Central Region). As discussed in the preceding section, the Chao Phraya Multipolitan Area consists mainly of the BMR and Extended BMR.

The capital region has developed and expanded transitionally up to now and is coming close to the final development stage where it will be possible to predict its final, structure, shape and size. In other words, the Chao Phraya Multipolis

portends the future of the Thai Capital in terms of area and size, basic framework and regional system. In this regard the railway system is expected to fulfill the following roles and functions.

- To respond to the increasing needs for improvement in the quality of transportation services (safety, punctuality, frequency, high-speed and mass transport) with the increasing intensity and density of socio-economic activities in the future capital region.
- To form the backbone of the capital's regional transport through the combined Inter-Urban Railway and Inter-Urban Motorway system.

In spite of the fact that the existing railways are not popular, they are, by coincidence, oriented in the same directions as the regional/urban development towards the east, north, and west, within a 200 km. radius. This is likely to prove advantageous to the railway promotion as follows:

- No new railway line with its concomitant large amount of capital investment would be needed for railway promotion. Instead, improvement and strengthening of the existing railway networks would suffice.
- It is anticipated that high convenience would be attained by merely improving access to the existing railway stations from the developed area (or corridor) along the railway lines which would then attract a considerable number of passengers.

In addition, the width of 40-80 m of the existing right of way of the SRT line would be propitious for accommodating future development of the railway.

Energy/Environment Policies

It has been reported that railway transport can achieve the highest economic efficiency, especially in mass and/or long distance transport. However, emphasis

should also be placed on its effects on the environment as well as its energy efficiency.

Reports also suggest that railway promotion should be included as one of the country's policies and programs for environmental protection and rationalization of energy consumption.

2) Stages of Railway Improvement

The goals of railway improvement/development, with its role defined, are drawn up in stages taking into consideration the national/regional development context of the study area as shown in Table 3.4.4.

As previously stated, the original functional system of Thai railway can be rated high. However, maintenance problems, deterioration resulting from past scarce re-investment and the problems of at-grade crossings, and so on, prevented the railway from operating at full capacity.

Table 3.4.4 Staged Goals and Measures for Railway Improvement

Stage	Measures	Goals
First Stage (urgent)	1. Improvement of the existing operational system	1. Reliable urban public transport routes
Second Stage	2. Functional improvement and strengthening of the existing railway system.	2. Maintain the original speed (100-200 km/h) 3. Maintain the original capacity
Third Stage	3. More advanced improvement of the original system	4. Mass Capacity 5. High Speed

First Stage of Railway Improvement

At this stage, there is an urgent need that the operation of the existing railway system should be maximized in response to the worsening urban traffic problems.

In Bangkok, transport conditions are characterized by lengthy and unpredictable travel time by road. It is, therefore, most important to establish a reliable transport system and routes which would make possible scheduled trips for socio-economic activities.

Reliability of SRT trains is reasonably high, although trains may be delayed due to stops or slowdown at railway crossings. Therefore, the SRT can provide reliable urban transport services with improvements in the feeder system, which at present is one of the major deterrents to the choice of the rail as a popular alternative mode.

Second Stage of Railway Improvement

The goal of the second stage improvement is to regain the original operational capacity the SRT. For instance, the SRT trains were designed to run as fast as 120 km/h on the trunk rail lines. However, the trains are forced to run slow due to many factors such as outdated engines and brakes, stops and slow downs at the crossings, subsidence of rail bed, deterioration of rail bridges and so on. If and when the original functions of the SRT can be restored (operating at 100-120 km/h), the railway can reduce the travel time by car, the popular mode at present, and then bring about great impact on the regional/urban development of the study area.

Table 3.4.5 Reduction of Travel Time

Distance (km)		Travel Time (hr.)	
		Improved Railway	Car
30	(BMR)	1	2
100	(Extended BMR)	1	3
200	(Regional Center)	2	4

Third Stage of Railway Improvement

It is expected that a considerable size of passenger and cargo demand will be covered by the improved railway as presented above. However, the advancement

of railway system, especially for mass capacity and high speed (e.g., 200 km/h) would be required in special areas where there would be a larger volume of traffic demand and special needs for high speed train.

(2) Functional and Service Improvement of Railway to be attained

Railway improvement to the extent described above would change the regional structure and land use in the study area. Improvements in the second stage will constitute the basic parts of the total regional transport system in the study area in as much as the third stage improvement shall be limited to specific areas with expected higher/larger transportation demand not covering the total area. In this respect, focus would be placed on regional development based on the second stage railway improvement.

1) Functional Classification of Railway Lines

Railway lines can be functionally classified taking into account the regional structure in which they operate, distances which they run, and so on. In other words, there are three types of trains as shown in Table 3.4.6, with different levels of service and transport role, required to respond to the railway traffic demand.

Table 3.4.6 Functional Classification of Railway Lines

Train Service/Line	Speed (km/hr)	Distance (km)	Time (hr)
International/National Trunk Train Service	100	200 and over	2
Regional Trunk Train Service	100	100	1
Sub-urban Train Service (Commuter)	50	50	1

2) Reduction of Travel Time (Time-Distance)

The improved railway at the second stage is expected to reduce the time-distance to a great extent as shown in the comparison of travel time between the railway and car in Table 3.4.7.

Table 3.4.7 Comparison of Travel Time

Zone	Distance (km)	By Train (hr)	By Car (hr)
BMR	50	1 (Suburban Line)	2
Ext. BMR	100	1 (Regional Line)	3
Regional Center	200 (National Line)	2	4

Impacts due to the reduction of time distance are summarized as follows;

- 50 km radius area could be reached within one hour by train as compared to 2 hours or more by car at present. It implies that those who are forced into long time-distance commuting can commute within one hour.
- The emerging economic zone within the range of 50 to 100 km, would come closer to Bangkok in terms of travel time of one hour.
- The north and northeastern regional urban centers which have been isolated from Bangkok would be within 2 hours reach.

(3) Proposed Railway Improvement

1) Basic Policies of Railway Network Development

Railway trunk line network development is set forth on the following basic policies:

- The railway network is based on the second stage railway improvement as defined in the preceding chapter. This implies that the future railway network should be based on the existing railway lines, which are to be improved in the second stage. However, it should allow for additional new lines necessary to systematize the existing railway to operate effectively and efficiently.

The improvement projects for railways at the third stage shall be individually analyzed on the proposed network.

- Traffic assignments are to be carried out at two levels: one in the area within 200 km radius focusing on the trunk lines, the other in the 50 km radius area with the focus on suburban commuter lines. (Details are shown in Report of Volume II, Part III)

2) Basic Pattern of Railway Network

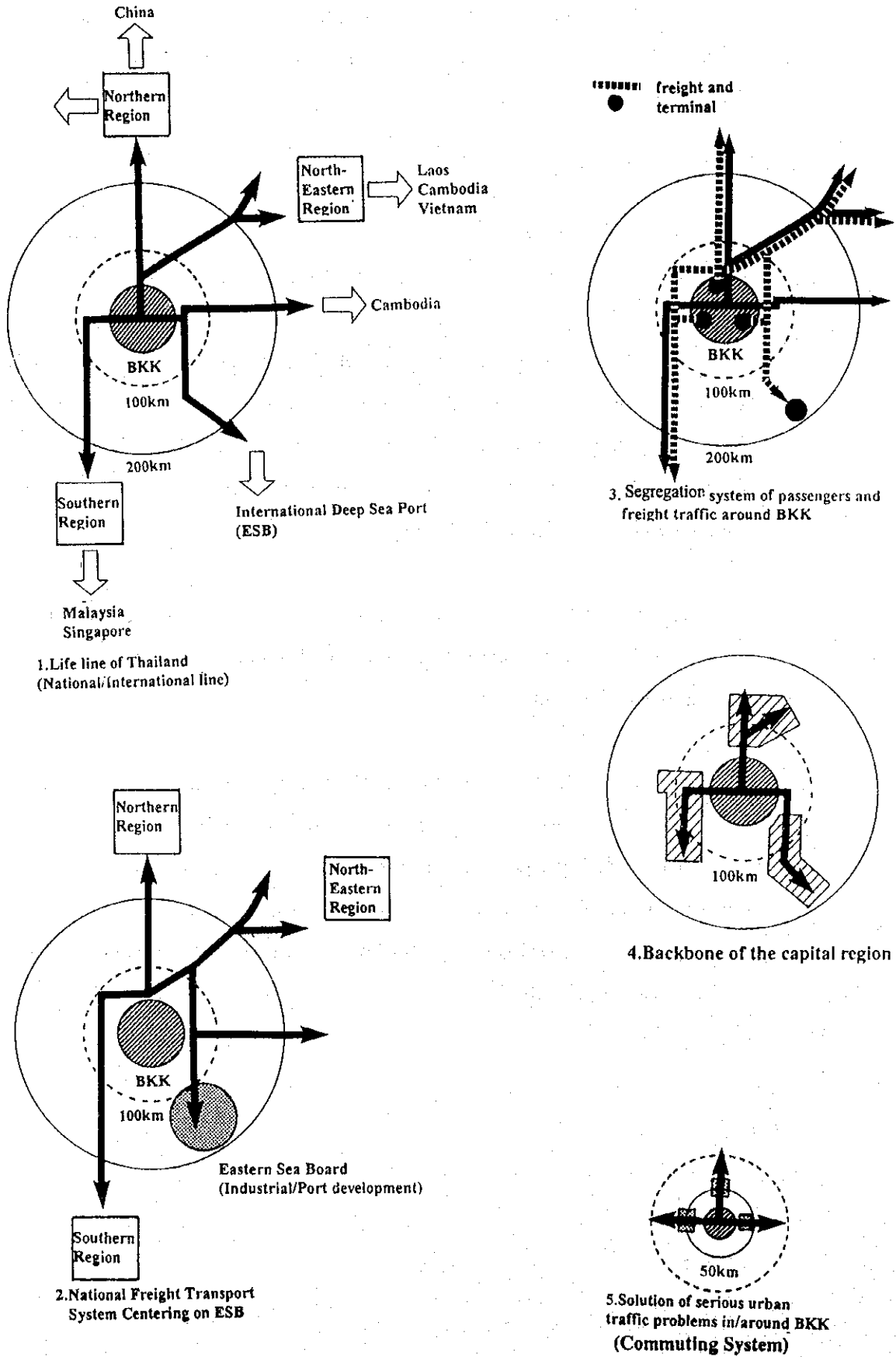
The basic pattern of the railway system in association with the roles and goals of railway improvement is summarized as follows: (Refer to Fig. 3.4.3)

- International/national railway transport, which is the lifeline of Thailand. It is of utmost importance to secure international lines including the existing and future expanded lines for Thailand's international development. The international lines of its neighboring countries should be linked with the following pivotal nodes in the country:

- Regional Center of Bangkok: Especially the international tourism trains covering Indochina and China, with Bangkok as one of the international terminals, are in prospect.

- Eastern Seaboard (ESB), the Gateway to the world: As stated in the MRSP Study, the ESB, especially Rayong-Map Ta Phut - U Taphao, will not only be Thailand's export gateway to the world, but will also play a similar role for Indochina and Yunnan Province in South China. In this regard, an international cargo transportation system should be developed centering on the ESB.

Fig. 3.4.3 Basic Pattern of Railway Network in the 200 km Radius Area



- Sara Buri Metropolis at the Crossroads of Indochina: According to the MRSP Study Saraburi Metropolis is poised to serve the next generation's construction and urban development industries of Indochina. There does not seem to be much difficulty to connect the SRT railway with Indochina and Yunnan Province in South China, in addition to Malaysia and Singapore, which are linked with Thailand through international train service at present, with only extension of the existing SRT Lines coming close to the national boundaries.
- National Freight Transport System Centering on ESB. Development of natural resources and industry in the countryside is one of the great concerns of the Thai Government with a view to enhancing the rural area's economic development and growth. For this purpose the national freight transport system, shipping natural resources and manufactured products throughout the country must be established centering on the ESB which is Thailand's export gateway to the world and the manufacturing/industrial center of Thailand.

Regarding the national freight transport system, special attention should be paid to the potential freight line directly connecting the Andaman Sea and Saraburi/ ESB. This line may benefit Thailand in terms of transportation cost and time and, more importantly, may provide a shorter route by by-passing in the very congested strait of Malacca.

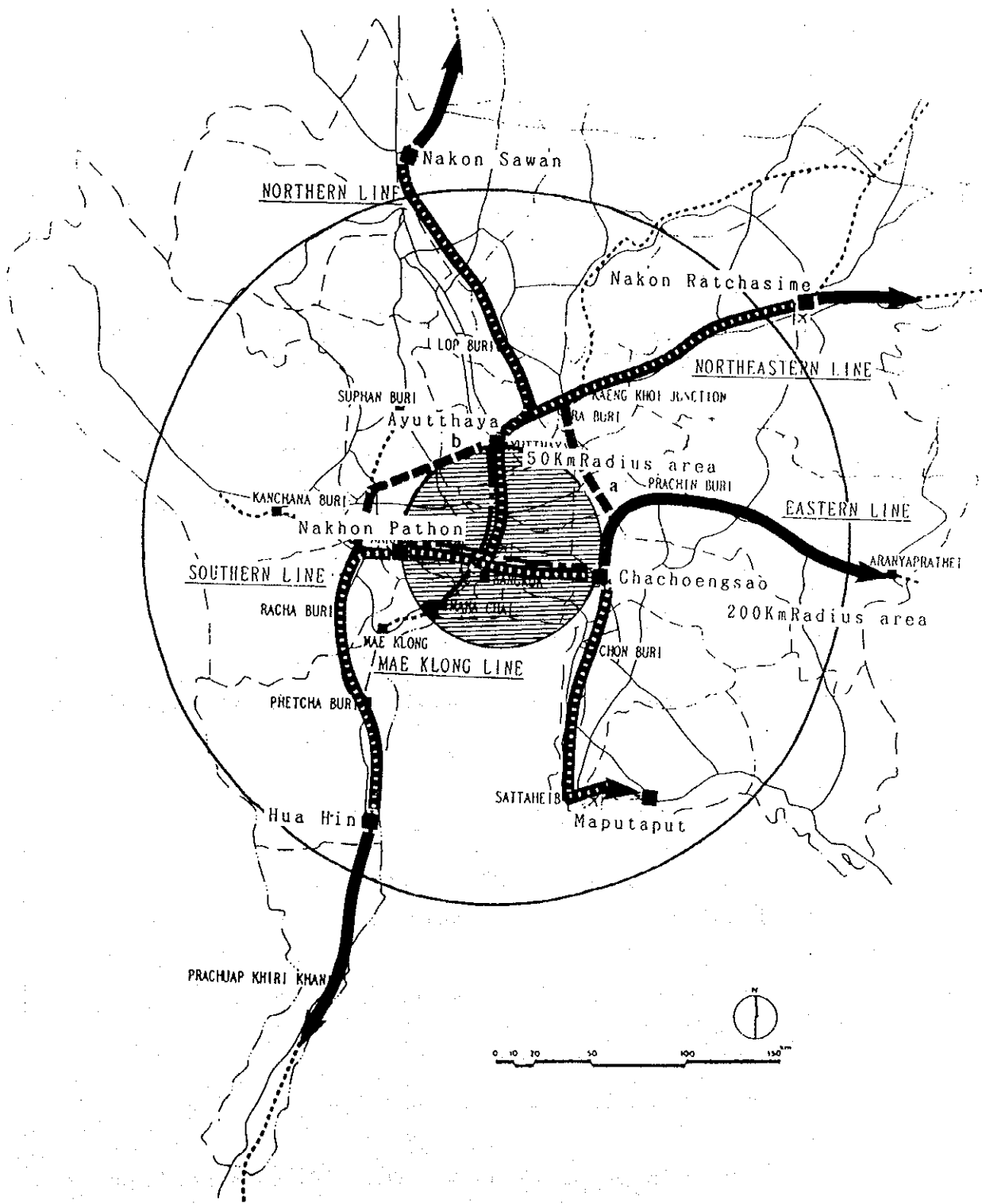
- Segregation System of Passenger and Freight Traffic Around Bangkok. It is desirable to divert heavy freight traffic from the most congested sections in Bangkok through the circumferential freight line from Nakhon Pathom to Chachoengsao through Saraburi, thus establishing a segregated system of passenger and freight traffic around Bangkok. All the more so when the existing trunk lines become congested with suburban commuter passenger cars.

- **Backbone of the Capital Regional Transport System.** One of the major purposes of the railway improvement is to further develop and restructure the capital region (transformation towards a multipolitan system in the MRSP study). The regional trunk rail line as referred to in this study, or the inter-urban Fast/Comfortable Train (FCT) so called in the MRSP Study, is designed to be the backbone of the capital region's transport system in cooperation with the inter-urban road system to take the lead in developing and changing the structure of the region.
- **Suburban Commuting System Changing the Urban Transportation Structure (Modal Shift).** The rationalization of modal share (shift to public transport, especially railway) is the one and only solution to the serious urban traffic problems in Bangkok.

3) Proposed Railway Network and System

The basic patterns of railway network as presented above are merged into a railway development system in the 200 km radius area as shown in the Fig. 3.4.4. The railway system is to consist of approx. 50 km radius area commuter system and approx. 200 km radius area regional trunk system. This railway development system is supposed to establish the regional urban system proposed in the succeeding section.

Fig. 3.4.4 Railway Transport System in the 200 km Radius Area



- National/International Line (passenger and freight)
- Diversion Line of Freight Traffic
-** Regional Trunk Line
- - - - -** commuter Line

4) Proposed Railway Development/Improvement Plan

The railway improvement plan is proposed as presented in the Report of Volume II, Part III. The outline is shown in the Table 3.4.8.

Table 3.4.8 Outline of the Proposed Railway Improvement

<p>Stage 1</p>	<p>Urgent Improvement</p> <p>1. Railway Grade Crossing Improvement</p> <ul style="list-style-type: none"> - To enforce the principle of First priority to the railway so that trains can pass without reducing speed. - Perfect shut-off and strict enforcement of traffic rules (prohibit the crossing of cars and pedestrians just before train passing) and so on. <p>2. Access Improvement</p> <ul style="list-style-type: none"> - Connection of the existing bus lines to the stations and establishment of preferential and/or guided bus lanes with this terminals at stations. - Improvement of Station plazas providing space for public transport (buses, taxis and others) and passenger cars. <p>3. Model Projects</p> <ul style="list-style-type: none"> - To attract peoples' attention to the railway.
<p>Stage 2</p>	<p>System Improvement</p> <p>1. Establishment of Urban commuter system within the range of 50 km radius.</p> <p>Examples;</p> <ul style="list-style-type: none"> - Completion of double tracking and track strengthening. - Completion of electrification - Automatic signaling, CTC, ATS-P train radio <p>2. Establishment of Regional trunk line system</p> <p>Examples;</p> <ul style="list-style-type: none"> - Completion of double tracking and track strengthening - Introduction of modern train cars
<p>Stage 3</p>	<p>Advanced System Development</p> <p>1. Four-lane tracking or new line construction</p> <p>Examples:</p> <ul style="list-style-type: none"> - New commuter line either inside or outside of the existing right of way of the SRT <p>2. Elevated Railway System</p>

(4) Local Transport System and Access to Railway

As stressed earlier, the establishment and improvement of a feeder system for the railway is one of the important prerequisites for railway promotion in Thailand. It must be emphasized that the improved railway, even with the highest level of transport services, would not be able to attract passengers and cargoes without a good feeder system. Also, the current stagnant utilization of the railway may be partly attributed to the poor access system, especially in Bangkok.

Feeder systems are indispensable to the railway and they must be established by the local transport system and network. Because the station is only one of the major access points in the multi-urban center area and the regional urban center area, the local transportation network is designed to serve not only the station but many other important access points.

It is also true that the feeder system is not simply a single direct access road to the station since the system must collect passengers coming from a broader area to the station. In this regard the feeder system should be a part of the local transport network.

In addition, it must be noted that since the multi-urban center area and the regional urban center area as well are planned to be self-contained communities, the railway, especially the trunk line connecting these areas with other areas such as Bangkok, will not be used daily, perhaps at most two to three times a week for special purposes such as business, social, and shopping.

It is advisable that the local transport system should be reviewed and modified because serious attention has not been paid to the impacts of the railway on land use, and to the necessary access to stations in the course of local transportation planning and implementation.

The basic policies for establishing the access system in the local transportation systems are summarized as follows:

- 1) Bangkok built-up area within a range of 30 km radius: Bangkok urban mass transit system.

Maximum use must be made of the planned mass transit systems (Hopewell system, Sky-train, Tanayong System and subway) and the guided bus system as the feeder system distributing and collecting passengers to the railway stations.

While the railways are developed to serve as main lines of urban transport, the planned mass transit systems are designed to serve as feeders to the main lines.

It is recommended that from this point of view, the planned mass transit systems and networks should be reviewed and modified, if necessary, to facilitate the connections among them, including transfer stations, joint stations, station plazas and others.

- 2) Bangkok suburbanization area in the range of 30 km to 50 km: Access road and branch railway.

It is anticipated that the railway, especially the suburban commuter lines, will be a main transport system for daily trips in coordination with the arterial roads running parallel with the railway. There is a possibility, then, that the railway stations will become the focal points in the peoples' daily life. On these premises, roads centering on the station should be constructed so as to establish the feeder system of the railway. In this area, access roads directly connecting the major urban development areas and the stations should be constructed. When and where the urban developments are quite large in scale and size, construction of new railway line (as branch or feeder line) should be proposed to connect them with the stations on the main railway line.

- 3) Multi-urban center area in the range of 50 km to 150 km radius

In this area, the railway stations must be linked with arterial roads connecting the major urban centers in order to collect and distribute railway passengers over a broader area.

There are two alternatives for developing central stations in this area as follows.

- Development of central stations at strategic points in the arterial road network and the railway network.
- Development of central stations at the existing stations in or close to the existing prime cities and towns in the area.

From the point of view of urban development potential, the latter is advisable. Transportation mode facilities such as bus terminals, station plazas and the like should be developed in the location selected for central stations.

4) The regional urban center area: Urban arterial roads

The national/regional arterial roads are converging into the regional urban centers (Nakhon Rachasima comprising National Roads Nos. 2, 24, 205, 226 and 304 and Nakhon Sawan comprising National Roads Nos. 1, 117, 225 and others).

There is a need to connect the stations with the urban arterial roads linking the national/regional arterial roads converging in the regional urban center.

3.4.2.2. Regional Urban Development System

(1) Development Potential and Effects of the Improved Railway

As proposed in the railway improvement plan, the three (3) types of train services effective in reducing travel time are respectively expected to increase the development potential of each of the sub-regions in line with the development features defined in the regional development structure in the preceding section of 3.4.1.

1) Bangkok Capital Region — 50 km Radius

Outstanding development potentials can be found in the following areas:

a) Revitalization of the existing CBD and built-up area of Bangkok.

It may be observed that the socio-economic position of the existing CBD in the Bangkok urban area has been diminishing and the centrality of the CBD as a primary urban center has been reduced mainly due to inaccessibility to the CBD from all other areas of Bangkok Capital, caused by the road traffic congestion. The relocation and dispersment of offices, hotels, and commercial facilities because of this contributes to these unfavorable conditions in the existing CBD. In this situation it is certain that railway improvement will drastically increase accessibility to the CBD from the major corridors of Bangkok through the reduction of travel time, thus, restoring the central position of the CBD in the capital region. This can be expected to work toward revitalization and re-development of the existing CBD which is quite vital so that the Bangkok capital becomes an international trade, financial managerial and technological center as anticipated in the regional development structure shown in the preceding section of 3.4.1.

b) Suburban Development

At present urban activities and urban development are restrained due to road traffic congestion (ex. within a 30 km radius of the existing built-up area). In this situation, the improved railway is designed to allow development activities to proceed to at least the 50 km radius area. Consequently, the railway will bring forth great urban development potential in the 30 to 50 km radius area which has been underdeveloped because of poor transportation service. As stated earlier, the suburban areas can be placed within one hour travel time from the CBD.

2) Extended BMR — New Economic Zones — 100 km Radius

By means of time distance reduction between the center of Bangkok and areas 100 km away, from 3 hours by car to one hour by train, the new economic zone centering on the 100 km radius, which is expected to grow in full swing in the 1990's, can develop a strong economic and industrial linkage with the international trade, financial, managerial, and technological functions of the existing CBD in Bangkok.

3) Local Regional Urban Center Area — 200 km Radius

These areas are to be placed within a time distance of 2 hours by railway. Regional centers for natural resource development would also be fostered in direct economic linkage with Bangkok and the new economic zones.

(2) Establishment of Regional Urban Development System

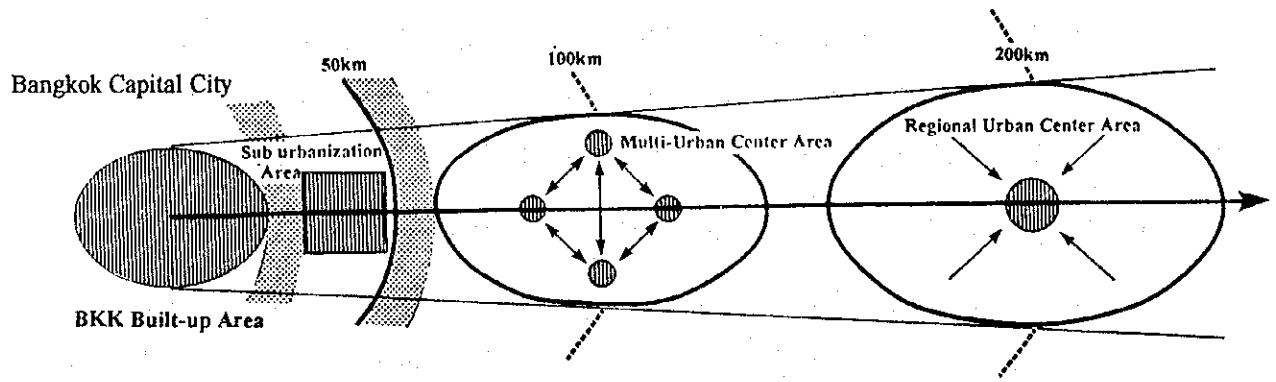
One of the important purposes of the integrated regional urban and railway development is to establish a regional urban development system based on the development potential and effects of the improved railway as summarized above. The basic concept of the integrated regional urban and railway development is elaborated as shown in the Fig. 3.4.5.

The following three (3) Regional urban development systems can be established with the socio-economic linkages between them strengthened by railway improvement as follows.

	Regional urban development system	Railway service	Accessibility to the CBD
Bangkok Capital City	Integrated capital city development system	The suburban lines (50 km/H)	1.0 hour
Extended BMR (New Economic Zone)	Multi-urban center development system	The Regional trunk line (100 km/H)	1.0 hour
Local Regional Center Area	Regional urban center development system	The national/regional trunk line (100 km/H)	2.0 hours

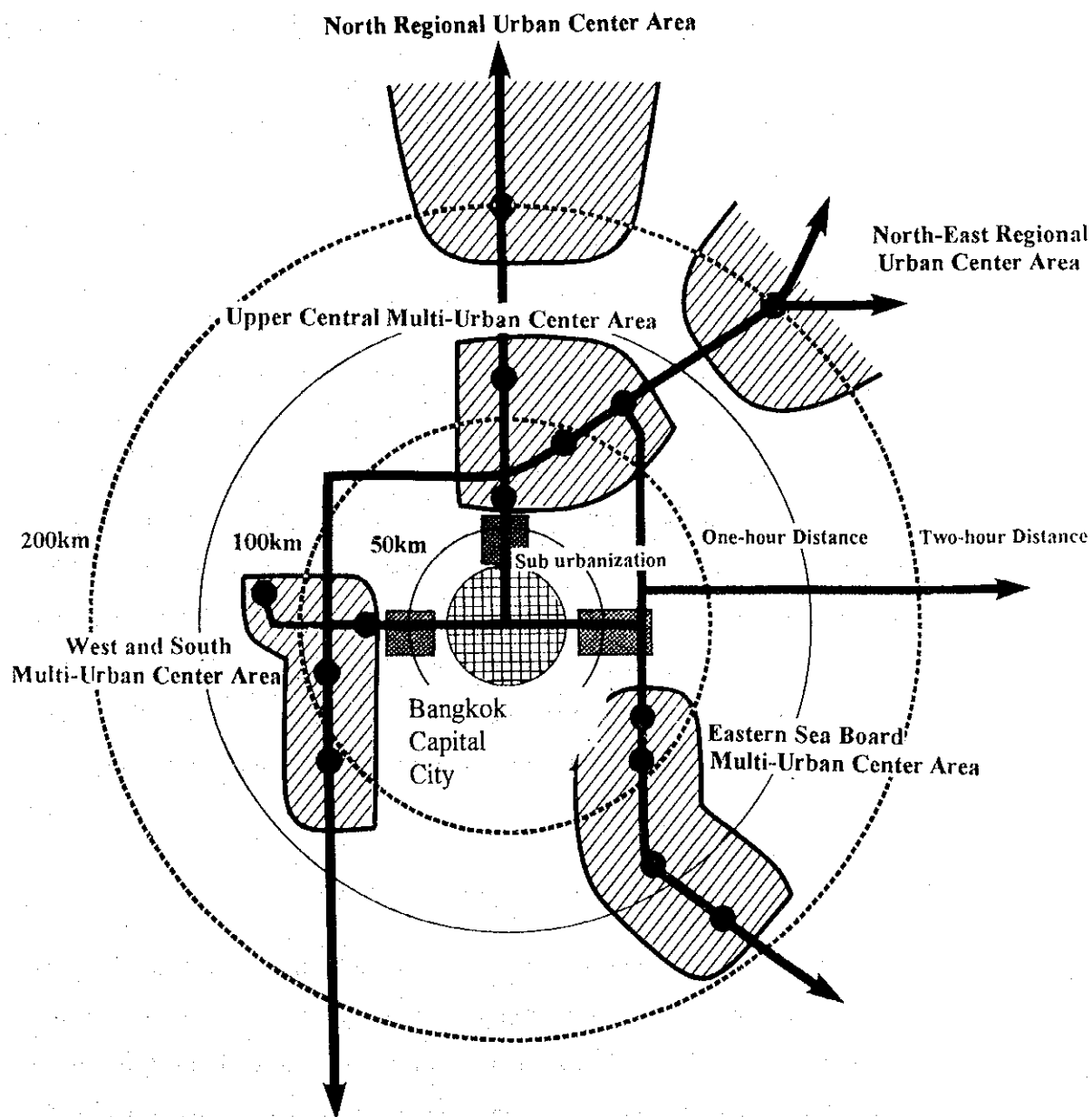
In line with the basic concepts proposed above, the regional urban development system is presented as shown in Fig. 3.4.6 and summarized as follows;

Fig. 3.4.5 Integrated Regional Urban and Railway Development



	0-30km	30-50km	50-100km	100-200km	200km+
Railway System	BMR(6prov.)		Ext. BMR		Local Region
		1.0 hour distance from CBD (2.0 hours by Car)	1.0 hour distance from CBD (3.0 hours by Car)		2.0 hour Distance (4.0 hours by Car)
Suburban Line	Commuter train(Short Distance 50km/h)				
Trunk Line	Regional train(Medium Distance 100km/h)			National/International Train(Long Distance 100km/h)	
Urban System	BKK Conurbated urban area of the capital		Regional Urban Center Area		
North	Pathom Thani	Saraburi Ayuttaya	Ban Phachi	Nakhon Sawan	
East	Chachoensao	Chon Buri Rayon	Lean Chabang	North-East Nakhon ratchasima	
South		Petcha buri	Ratchaburi	Nakhon Pathom	
Local transport system and Feeder system	BKK built-up Area	Sub-urbanization Area	Regional Arterial Road Network Collecting Passengers in the multi-urban Center Area		Connection to the national arterial road converging in the regional center
	Urban Mass Transport System (Hopewell Sky train Subway and Bus) Transfer Station Station Plaza	Access Road to the Station	Station Plaza, Bus terminal		Station plaza, Bus terminal

Fig. 3.4.6 Regional Urban Development System in the 200 km Radius Area



1) Bangkok Integrated Capital City Development System

In parallel with the regional growth out of Bangkok, Bangkok also has to grow with the changing of urban structure. While activities and industries “non-essential to Bangkok” should be relocated outside of Bangkok, those “essential to Bangkok” should be developed within the Bangkok capital city. On this premise urban areas must be developed in direct linkage — daily life travel time — with the center of Bangkok.

The areas within 50 km radius should be unified with Bangkok urban center as the focal point. In other words, the Bangkok capital city is defined as an urban area directly dominated by the center of Bangkok and within a time distance of one hour by rail transport. This area consists of the existing built-up area within a 30 km radius and new urban areas or suburbanized areas in the range of 30 km to 50 km from the center of Bangkok. The integrated city of Bangkok within the 50 km radius area should be developed with the revitalized CBD being the primary urban center, and the suburban area being developed in linkage with the CBD. The Bangkok integrated capital city development is examined in detail in the preceding section of 3.4.3.

2) Extended BMR Multi-Urban Center Development System

This area will not be dominated by one urban center alone. Unlike the Bangkok conurbation area described above, multiple urban centers will serve the area in a cooperative manner. This urban system is almost the same with the multipolitan system defined in the Metropolitan Regional Structure Planning Study. They are to share the developmental functions and be interconnected with each other by economic/industrial and social linkages.

The major urban centers included in the multi-urban center areas are listed as follows;

North: Saraburi, Ayuthaya, Banpachi, Kan Koi, Lop-buri, etc.
East: Chonburi, Laemchaban, Map Ta Phut, Rayong, etc.
South: Nakhon-Panthom, Ratchaburi, Phetchaburi

3) Regional Urban Center Development System

Nakhon Ratchasima and Nakhon Sawan, located at the fringe of the 200 km radius, belong to the northeastern region and northern region, respectively, which are served by the regional urban centers.

(3) Strategic Urban Development Project Integrated with the Railway Improvement

It is obvious that in order to achieve an integrated urban and railway development, it is necessary to expand the regional development activities covering a wider area such as those of the sub-regions specified in this study and not limited to urban development projects in particular areas along the improved railway.

The following are the examples.

The international/national and regional trunk lines are to spread the development effects and benefits all over the country and regions. In order to realize the effects of development and increase the transport demand of trunk lines, regional development efforts will be needed over a broad area along the railway.

However, in addition to the broad area regional developments such as the new economic zone - ESB, WEB and upper central regional development, strategic urban development projects can be identified in areas with quite high development potential being realized by, or as a result of the railway improvement. They are quite effective for increasing the ridership of railway and helping accelerate regional developments proposed in the regional structure.

They are listed as follows and shown in the Fig. 3.4.7.

[1. Bangkok Capital City]

- i. Urban redevelopment/renewal in the CBD and built-up area along the improved railway
- ii. Suburban development along the commuter line

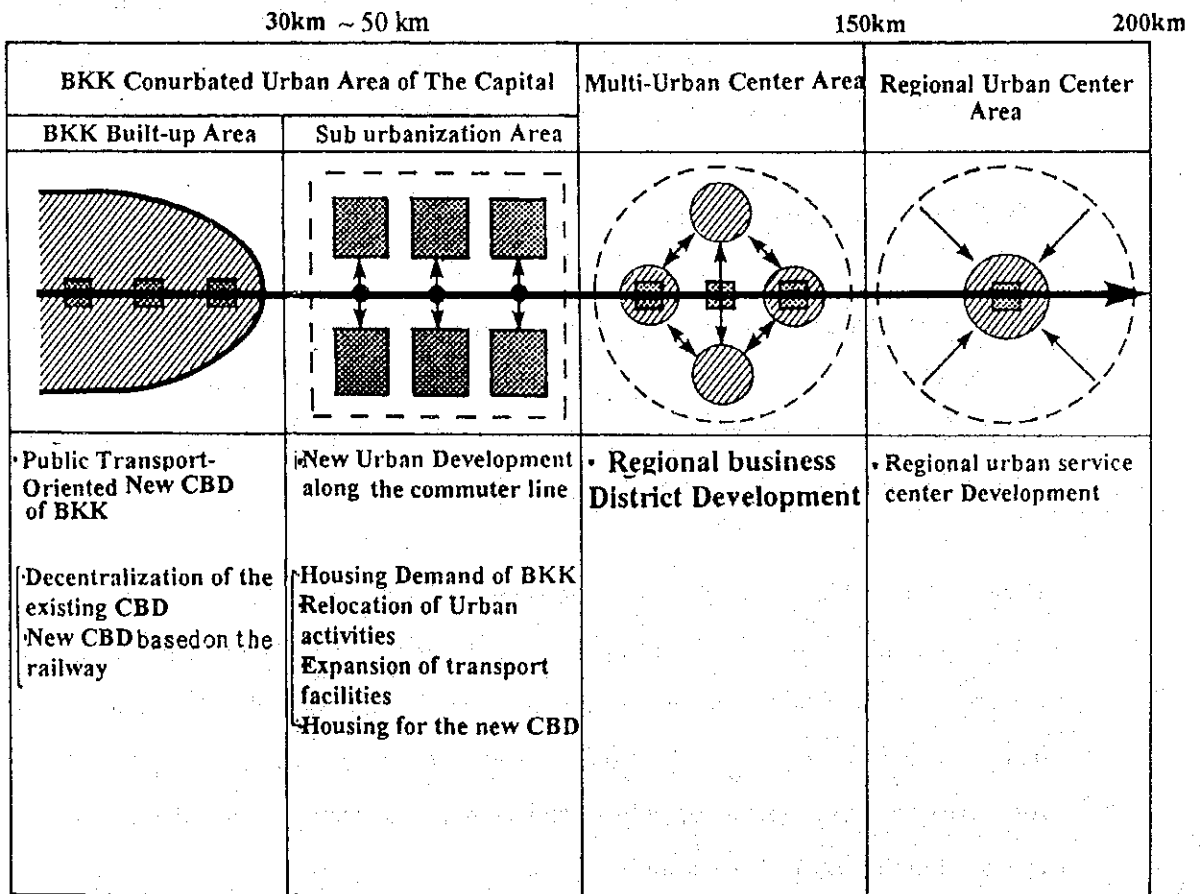
[2. Multi-Urban Center Area]

- iii. Regional business district development around the trunk line main stations

[3. Local Regional Center Area]

- iv. Regional urban service center development in front of the regional stations

Fig. 3.4.7 Strategic Urban Development Project Integrated with the Railway Improvement



- 1) Urban redevelopment/renewal in the CBD and built-up area along the improved railway.

The areas around the main stations in the built-up area will be important transport nodes and major gathering points of people coming from/to the massive urban development areas along the suburban commuter lines. The development potential will drastically increase in/around the stations in contrast with the existing conditions of idle and underutilized land. There is much opportunity for urban redevelopment /renewal there.

- 2) Suburban Development along the Commuter Line

Due to the greatly increased accessibility to the CBD and Bangkok (within one hour travel time) the need and potential for urban development is high in response to the needs and requirements of Bangkok City planning and development, provision for massive housing for Bangkok people, relocation of urban activities and so on.

- Remarks : Items (a) and (b) are the main topics of Integrated Capital City Development are fully discussed in the following section of 3.4.3.

- 3) Regional Business District Development around the Trunk Line Main Stations

It is anticipated that there will be special development opportunities in the districts around the key stations of the trunk lines serving the broad area of multi-urban centers because they are the collection and distribution points of railway passengers throughout the region. This may include regional business offices, hotels, shopping centers, recreational facilities in addition to the regional bus terminals.

The key stations will be located in such important cities as Saraburi, Chachoengsao, Nakhon Pathom, Chonburi, etc., so that the regional business districts in front of the key stations will take the lead in developing these socioeconomic zones.

4) **Regional Urban Service Center Development centered on the Regional Stations (Nakhon Sawan and Nakhon Rachasima)**

In accordance with the increase of the railway passengers at the regional stations of Nakhon Ratchasima and Nakhon Sawan, the districts in front of the stations become another facet of the regional urban centers. These "front " districts shall grow in cooperation with the existing central area of the cities.

3.4.3 Bangkok Integrated Capital City Development (50 km Radius Area)

3.4.3.1 Urban Structure for Integrated Capital City

(1) Transport System and Urban Structure

The subject of the desirable future urban structure of Bangkok and the Bangkok Capital Region has recently been extensively discussed. However, it is undeniable that some of the participants to these discussions seem to do it with a view to justify their own proposed development schemes.

The prospect of urban transport conditions, either as they are now or improved by new transport systems, is becoming a major factor in determining the future urban structure of the city. The urban structures projected and proposed, whether explicitly or implicitly, in the development study reports available to the JICA study are roughly classified in relation to the transport system applied, as shown in the Fig. 3.4.8. The excerpts of the studies regarding the urban structure and transport are shown in Table 3.4.9 and outlined as follows:

1) Existing and Future Structure (if things continue as they are).

The existing structure can be generally summed up by saying that as the built-up areas centering around the CBD have stretched to a range of 30 km radius at most, the following basic problems with regard to the urban structure are clear.

- a) It became almost impossible to develop housing sites within reach of reasonable commuting travel time, say one hour, from the center of Bangkok on the road transport network. Roads placed a limitation on expanding urbanization. In this difficult situation for the real estate business of the private sector, the advertisement of "new towns "or" self-contained towns" is rampant. These are not supposed to depend on the existing CBD and built-up areas for work, shopping and others.

Fig. 3.4.8 Generally Classified Bangkok Urban Structures Proposed in Studies

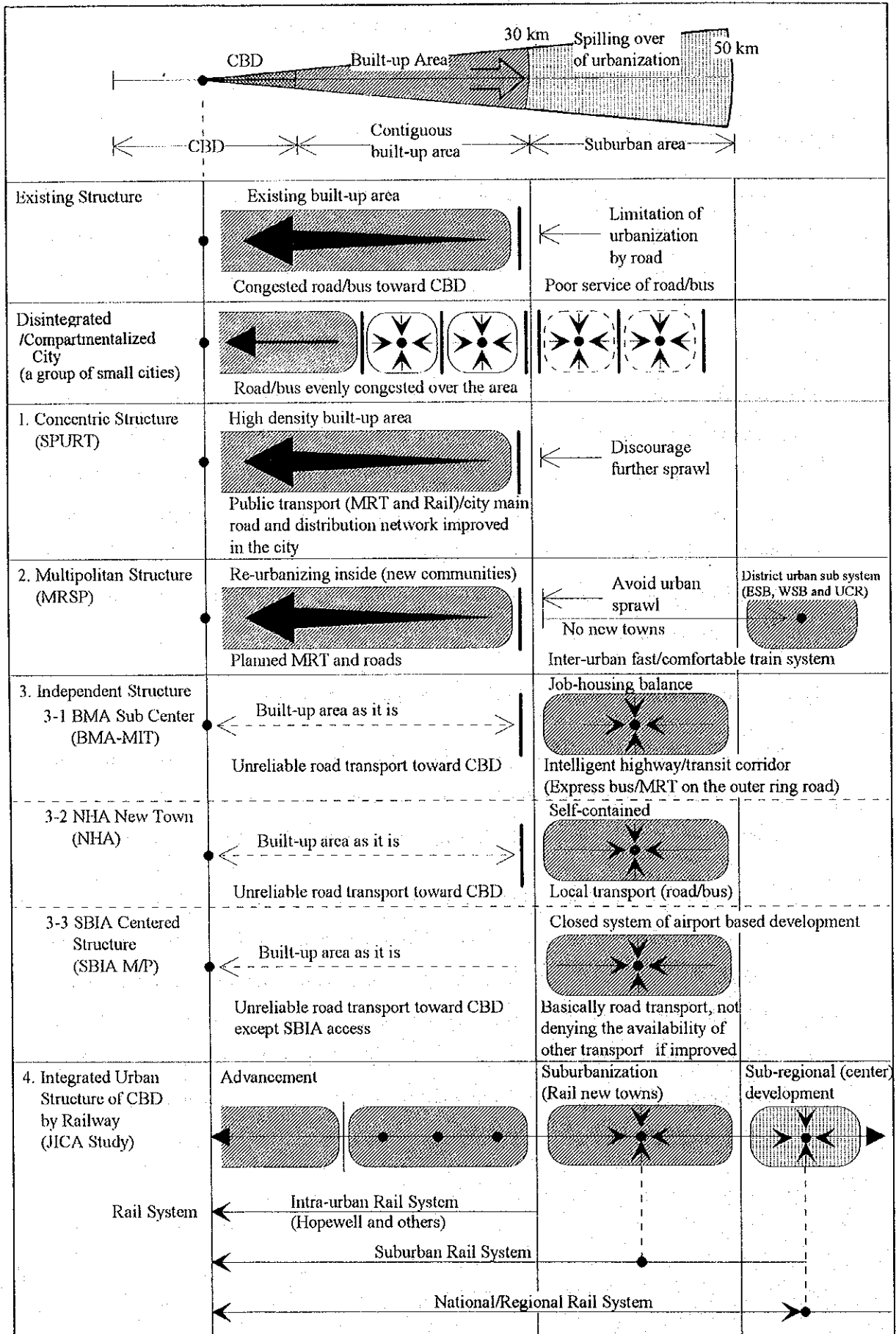


Table 3.4.9 Excerpts of Studies Regarding Urban Structures

I. Seventh Plan Urban and Regional Transport (SPURT)

[Compartmentalization in Future]

If the forecasts are correct and if congestion persists to an acute degree, people will increasingly take steps to avoid the congestion by taking jobs in the suburbs or building homes near their jobs in the inner city. This will have the effect of spreading congestion more evenly over a larger area.

Dispersal of this sort will produce (as has already happened) a contraction of labour markets; i.e., employers will find it difficult to recruit staff from outside their own locality. People will tend to transfer residences in order to be near their work, rather than take long trips. The city will become more compartmentalized; i.e., people will tend to confine their activities to one part of the city. Bangkok will cease to be an integrated city and will become a group of smaller cities, adjacent to each other but living-as much as possible-independently of each other.

[Concentric Structure]

Now that the city has spread its tentacles far and wide in all directions, it is necessary to discourage further sprawl and to consolidate within that area. In order to do this, the three strategies are:

- to use vacant and under-utilized land within the city;
- to develop relatively high density area within environmental limits, where accessibility is highest, i.e., the Central Area and at key transport nodes in the suburbs; and
- to prevent further undesirable development along main highways in the outskirts of the city, and in areas where it is costly in economic or environmental terms, by strengthening the planning system.

The SPURT transport strategy is, therefore, based on the goal of consolidating land use and concentrating development at points, and along corridors, of relatively high accessibility; while strongly supporting action to improve the planning system. This calls for:

- a) a selective program to improve the structure and density of the main road network in the city, rather than further expansion outwards;
- b) an extensive program to establish effective road distribution networks within urban blocks; and
- c) major improvement of public transport, particularly by the introduction of efficient rail transport, to enhance and create points and corridors of high accessibility.

II Metropolitan Regional Structure Planning Study (MRSP)

The Chao Phraya Multipolis : A Concept

- A vast and complex multipolitan urban system is emergent : the Chao Phraya Multipolis, a system which, in addition to the Bangkok Metropolis, includes three distinct, emergent, growing urban regions (ESB, WSB, and UCR), which increasingly have their own dynamics and their own "mission".

Multipolitan Settlement Structure, Inter-urban Transportation and Communication Network

- Most importantly, the settlements have significant (though sometimes subtle) differences in their functional or operational attributes. Thus, a multipolitan system is characterized by the complex transactional interrelationships of the various settlements within the hierarchy. A stable and well-functioning multipolis quickly generates and then maintains a type of comparative advantage among the settlements, allowing each center to build on its strengths (resources, skilled labour, location, institutional base, etc.).

- The emerging multipolis will be strengthened by inter-urban transportation infrastructure such as the fast, comfortable rail system and high-speed, controlled-access motorways.
- We propose that an inter-urban Fast/Comfortable Train System be given a high and urgent priority, in order to speed-up the inter-urban movement of people goods, services and ideas within the Chao Phraya Multipolis and beyond, to reduce inter-urban traffic, to strengthen the vitality of the cities (as opposed to the suburbs) within the multipolitan system, and to intensify the inter-urban economic, social and cultural transactions of all types.

Re-Urbanize Bangkok:

- To re-urbanize Bangkok, it is essential to avoid urban sprawl, to eliminate urban congestion and to create a setting which is urbane.
- Bangkok has enormous opportunities throughout its “footprint,” i.e. within the large pockets of un-urbanized areas located entirely within the Metropolis. Thus, rather than choosing the path of “New Towns in the Suburbs”, Bangkok should follow the path of building “New Communities in the Metropolis.”
- That means re-urbanizing huge tracts of unused urban land located inside the Metropolis, between major roads yet inaccessible due to unmanaged developments along its perimeter. Hundreds, if not thousands, of acres could be developed, accomplishing two major tasks in one stroke : gaining access through these “inaccessible lands” and, at the same time, building accommodation in the heart of the metropolis and reducing commuting. There can hardly be a better option for urban government anywhere.

III Strategic Planning For Metropolitan Bangkok (BMA-MIT)

[Job-housing Balance]

- Job-housing balance is one of the special emphasis of the metropolitan subcenter

program. Bangkok central city has a disproportionate numbers of the metropolitan area's jobs, while the suburbs contain large number of residences. The result is an unbalanced radial transportation pattern with heavily dominant flow in one direction in the morning, the other in the afternoon. This effect is becoming more pronounced over time. The intention of the metropolitan subcenters program is to create a larger number of jobs than houses in the peripheral area, tending to redress this unbalance. This goal requires careful land development control. Adequate land planning controls are a requisite of this program.

IV. New Town Development Study

[Self-contained]

- New Town development can minimize the housing shortage problem, alleviate traffic congestion in terms of job sources and housing locating in the same area, (p.1)
- The objectives of New Town in the eastern part to be developed to be self-contained Satellite Town Bangkok Metropolis (p.14)

V. Master Plan and Feasibility Studies for Area Around SBIA (SBIA M/P)

[SBIA Centered Structure]

There is no explicit description in the report on the urban regional structure the study is supposed to employ. However it can be considered that SBIA Area master plan implicitly assumes the SBIA centered structure, or closed community system where most airport related activities will be undertaken in the 5 km or the 30 km radius area center on the SBIA and the business zone in its vicinity, judging from the following projected employment distribution.

- The majority of jobs will be created both within and near the airport, contrary to the situation in many other airports in the world. For this reason, 70% of the employment is expected to be in the Bang Phli District and 30% in districts surrounding the Bang Phli area.

- b) In the past when the CBD worked as a primary center of Bangkok, there was a principle and orderly system of urbanization, though autonomous, that land use and urbanization hierarchically proposed and urban activities and traffic flows were systematized with the CBD as their center. As the CBD lost touch mainly due to difficult access to it, the city gradually disbanded.

In this situation, the Seventh Plan Urban and Regional Transport Study (SPURT-NESDB) predicted the future of Bangkok by saying that Bangkok will become a disintegrated city or a group of small cities because of “the compartmentalization” of urban areas as a result of worsened traffic congestion on the road network as explained in the excerpts in Table 3.4.9.

2) Proposed Urban Structure in Other Studies

With or without taking into consideration the future of Bangkok as predicted in SPURT, a variety of urban structures for the future of Bangkok have been presented in the other studies. These are outlined below with due attention paid to the transport system on which the proposed developments are based.

a) Concentric Structure (SPURT)

The high density urban area should be developed by means of utilizing the vacant and underutilized land with relatively high accessibility within the city (which may be equivalent to the 30 km radius area) while further outward sprawl should be discouraged. In this structure the emphasis shall be placed on the improvement of the transport system especially for serving the high density urban area, such as public transport (MRT) and distribution road networks.

b) Multipolitan Structure (MRSP)

Outside of Bangkok, the district urban sub-systems (ESB, WSB and UCR) should be developed so as to absorb the migration of people which otherwise would head for the Bangkok Capital, thus normalizing the rapid urbanization of Bangkok. For this structure, Inter-urban Fast/Comfortable Train System to be developed is a key condition so as to enhance the growth of the three (3) sub-districts in

transactional linkage with Bangkok. In Bangkok metropolis (30 km radius area) re-urbanization and rehabilitation will be needed in preparation for developing Bangkok into a future international (especially financial) center for Southeast Asia. The re-urbanization, which seems quite similar to the development policy of the above-mentioned concentric structure of SPURT, will take the path of building "new communities in the metropolis" utilizing the un-urbanized areas within it, rather than choosing the path of "new towns in the suburbs."

c) Independent Structure

This structure aims at sustainable urban development without relying on the road network leading to the CBD and built-up area, which have been and will be congested in the future. These development schemes also stem from the urban transport policy that additional car traffic generated by new urban developments should be designed so as not to be placed on the already congested roads in/around the CBD, by containing most of the car traffic within their localities or new towns through provision of employment opportunities close to residential areas.

The currently proposed, urban developments which fall into this category of urban structure are the following:

- BMA Sub Center (SPMB)

The outline of this development is shown in Section 3.1 Outline of Relevant Planning Studies and Table 3.4.9 of the excerpts on the proposed urban structure. The basic idea of this development appears to be to create job opportunities in proportion to the number of houses constructed in the sub centers with a view to correcting the lopsided traffic flows toward the CBD which is a major work place of Bangkok, and thus mitigate car traffic toward the center where there is no more room on the road network for additional car traffic.

Regarding the transport system it can be theoretically concluded that people

can enjoy the convenience of the traditional transport system, of passenger cars because traffic congestion would not take place on the roads due to the relatively short distances as compared to those for commuting to the CBD and the relatively smaller volume of car traffic concentration at the morning peak hour. In this regard, this urban structure seems to be one of the ways to continue car transport because traffic congestion in/around the CBD will disappear if/when the Bangkok urban area is subdivided into several job-housing balanced sub-centers which would evenly distribute car throughout the urban area. However, as the sub-centers grow, increasingly voluminous car traffic will be no longer manageable, and a public transport system will be needed. In this respect, the intelligent highway/transit corridor (the first stage of development of express bus and MRT system in expanding public transport system by bus) is proposed for the BMA Sub centers.

- NHA New Towns

The basic ideas of New Town Development are also outlined in Section 3.1 and Table 3.4.9. It must be admitted that the characteristics of the proposed new towns are vague judging from examination of the study reports prepared by NHA. Therefore the selection of new town sites and the criteria for selection are not straightforward. It is not clear whether they are aimed at reducing the housing backlogs of people who have jobs in Bangkok, or at providing housing for people who have to move according to the relocation of their factories, offices, or those who are pursuing employment opportunities in the next generation of society. The location of new towns to be developed varies depending upon their intended character. For instance, transportation to Bangkok would be the first criteria for new towns designed to accommodate people commuting to Bangkok. In this case, what types of transport systems should be developed—road transport or public transport? Do the new town development proposals include transport developments which are vital to their realization? These questions must be clearly answered when selecting a site for new towns. Also the industrial potential including locational advantages and development resources would be the first criteria

for a self-contained new town development where a large number of employment opportunities must be created.

Although the NHA study report does not explicitly mention the characteristics of the new towns to be developed, the hearing with NHA revealed the following development concepts. Basically they should be self-contained new towns with 70% of the workers living in the new town being employed in the vicinity and the remaining 30% being employed outside of the new town and commuting to Bangkok.

- SBIA Centered Structure (SBIA Master Plan and F/S)

In this JICA study, the SBIA is categorized as an independent development for the following basic reasons:

The SBIA should be the center in planning land use and zoning for the following areas:

Zone 1: airport property

Zone 2: area within 5 km of airport property

Zone 3: area at a distance of 5 to 15 km from airport property

Zone 4: area at a distance of 15 to 30 km from airport property

It may be good for measuring the development and environmental effects of the airport in accordance with the distance from the airport. However, it must be stressed that the SBIA should not be the center for planning land use and zoning because the SBIA is not the only factor to be considered for determining land use in the area around it even though it has the greatest development effects and influence over the area, as was recognized in the study report. Equal attention should be paid to other development factors such as the urbanization pressure and needs of Bangkok, like the housing demand and relocation requirement for the industries and urban activities of Bangkok, and the development potential of Chachoengsao, for instance, which will grow relying on its own indigenous development resources. The

effect of the SBIA is important, but it is not the only factor in determining the future of Chachoengsao. It seems that due attention has not been given to other factors for formulating the land use plan. Little attention has been given to the future urban structure of Bangkok whose development effects should be properly absorbed and accommodated. The SBIA M/P seems to attempt to establish an independent socio-economic zone dominated by the SBIA in the existing urban structure. Although the dominant areas including Chachoengsao, Bang Pli/Bang Pho are wider than the new town areas shown above, the basic concept of development is shared with them.

- Closed System of Airport Based Development

The basic development idea for the Master Plan for the area around SBIA is directly reflected in the projected distribution of SBIA related employment as follows:

Bang Phli District (International business zones adjacent to the airport)	70 %
Bang Bo	5 %
Lat Krabang	10 %
Chachoengsao	5 %
Samut Prakan	5 %
Pravet	5 %

These categories of SBIA related employment include not only tertiary industries such as airline offices, tourism, travel agencies, and hotels, but also warehousing and distribution/support industries. The following issues are raised for discussion.

Why as much as 70% of SBIA related employment must be located in the vicinity of the airport, even recognizing that some industries need to be located close to the airport to support the airport operation/business? Usually airport related industries, except those of distribution and logistics, are likely to locate at spots which are convenient to the airport itself as well

as the CBD and built-up areas. If/When the airport is conveniently connected with the CBD, some airport related industries would locate in the CBD, which is convenient to both of them.

However, the inaccessibility to the CBD because of traffic congestion on the road network seems to have caused the SBIA M/P study to propose the urban/business center close to the airport.

Why the SBIA related employment must be located at a distance from SBIA? It may be safe to locate all the employment within a certain area from the SBIA in terms of securing accessibility in the situation of congested road traffic. It must be noted that the effects of the airport seemed to be spread broadly all over the region and should be located in the urban structure which is aimed to emerge, not simply in accordance with physical distance. As it is, the SBIA related employment is contained in a 30 km radius area so as to create a somewhat independent economic zone of the SBIA.

3) General Evaluation of Proposed Urban Structure

The currently proposed urban structures which are designed to combat serious urban problems as well as accommodate the future urban growth of Bangkok, can be classified from the viewpoint of where further population growth and employment needs should be mainly accommodated, as follows:

- a) Regions out of Bangkok — MRSP
- b) Within the city (30 km radius) discouraging urban developments in the suburbs whether urban sprawl or new town — SPURT/MRSP
- c) Suburban area (30 to 50 km radius) independent from Bangkok

The proposed urban structures are generally evaluated as follows:

- a) It is very important to state that they are all commonly based on one condition that Bangkok transport problems, especially road traffic congestion will never be improved if things continue as they are not rather will worsen in the future.

Therefore, suburban developments independent from Bangkok are proposed.

b) They are contradictory and incompatible with one group (concentric and Multipolitan) denying the urbanization in the suburbs with a view to creating compact built-up areas in the city (30 km radius), the other group (independent) encouraging urbanization in the form of new towns in the suburbs, putting aside the built-up area (within 30 km radius). MRSP study is quoted as saying "The MIT Report advances many views and recommendations which are diametrically opposed to the views and recommendations developed under this study. We thoroughly disagree with the views emanating from the MIT Bangkok Study Team." The reasons for disagreement are given in the study MRSP. Some of them are as follows.

- Where Cities Thrive

Conversely, and very importantly, the New Towns can only thrive and grow when they are planned and built in locations where there are strong, pre-existing but-not-yet-readily-seen transactional needs or opportunities which in effect, call for a new settlement to be built. In parts of the world where the need is great and urbanization pressures are strong-such as parts of Asia-a set of new towns strung along a strong transportation system consisting of fast trains and fast, inter-urban freeways, could quite likely "survive the transplant" and grow.

- Satellite Towns Contribute to Urban Sprawl

We nevertheless still advise very strongly against such a strategy. New towns in the suburbs are typically located as shown in the Report prepared by the MIT Team. Experience shows that such New Towns are promptly swallowed up by the ever-expanding Metropolis, and for all practical purposes, disappear as distinct settlements. The main result of this strategy is therefore the continuation of urban sprawl, consumption of agricultural lands, costly extension of the related infrastructure, and a continuing aggravation of traffic congestion on the already-clogged roads

and streets of the Metropolis.

And, finally, the MRSP study stresses that the past several decades of these efforts clearly show that New Towns, Satellite Cities, radial, ring and orbital roads only lead to a continuing, ever-extending urban sprawl.

- c) An Independent Structure would be an antithesis to the Multipolitan structure. Nobody would deny that the Multipolitan structure proposed in the MRSP study, including the re-urbanization in the highly built-up area within 30 km radius area, not allowing undesirable outward urban sprawl, and the development of district urban sub-systems which are designed to absorb the urban pressures on the Bangkok Metropolis, would be the best solution.

However, even while recognizing its necessity and importance, it also cannot be denied that it is easier said than done, considering the following facts:

- In the past the necessity for decentralization by developing regions outside of Bangkok, most typically ESB and the rural developments have been emphasized. As a matter of fact, the government has made its best efforts in this direction of development. However, the reality is that the concentration remains in Bangkok, contrary to the desired effect of the policy. Although the potential for regional development outside Bangkok, especially new economic zones in the extended BMR, can be evaluated highly, it is doubtful that the regional developments can be implemented rapidly enough to absorb the current urbanization pressures in Bangkok, judging from past experience of the achievement of the Government policy of decentralization.
- Parallel with the regional development outside of Bangkok, the MRSP Study recommends re-urbanization within the city, and SPURT recommends the high density urban area within it. The conditions for these recommendations are the improvement of the transport system

within the city, especially the structure and density of the main road network and distribution roads in the blocks encompassed by the main roads. However, road construction in the built-up areas faces extreme difficulties because of the high land prices, necessity for removal of structures, the resistance to expropriation of land owners, social concerns on the environmental effects of road construction in urban areas, and so on.

In this situation of difficulties for urban development and transport improvement, what seems to be most practical and easiest is new town development, whether public or private, in the suburbs, where a large area of vacant land awaits development with no serious problems for land acquisition. No matter what justifications are given, the suburban developments including BMA sub-center, NHA new towns and SBIA master plan all fit into this line of pragmatism.

Summarizing the above it may be concluded that the contradiction comes from the clash between idealism represented by MRSP and the pragmatism represented by those who have to respond to the urgent urban development need, such as those of BMA, NHA and SBIA.

- d) Difficulty to develop employment opportunities large enough to sustain the concept of "self-contained" or "job-housing balance."

The development concepts of either self-contained or job-housing balance development sound very agreeable and praiseworthy and seem to be the only way left for Bangkok. However, as compared to the relatively lesser difficulties of physical development of new towns because of vacant land in the suburbs, they may face difficulties of attaining their purpose of self-contained or job-housing balance which is used to justify their development in the first place.

As far as they insist on "self-contained" or "job-housing" balance, they must show possibilities for industrial development to create sufficient employment. In the case of regional developments such as those of new economic zones,

development potential is based on natural resources, human resources and others. However, it remains to be seen what kinds of industrial/economic development can be envisioned in suburban areas, especially independently from, or in isolation from Bangkok.

(2) Urban Structure of Integrated Capital City

It would appear that all discussions on the future urban structure of Bangkok have been made on the supposition that Bangkok will continue to be a road transport based city. As far as the discussions carry this assumption, the major items for discussion are limited to decentralization, self-contained/job-housing balance, discouraging urban sprawl as the main evil of urban development, and so on, mainly from the viewpoint of managing road traffic. Nobody discusses the future urban structure if/when Bangkok becomes a public transport-based city.

As a matter of fact, all the current urban development features such as expanding outward urbanization, energetic development of hotels and offices here and there, and so on, are viewed negatively because of the adverse effects on road transport. It must be noted, however, that once comprehensive public transport systems are established in Bangkok, such urban activities will be viewed positively to help develop Bangkok as one of most prosperous international cities. In this regard, the most important issue is how to make Bangkok a public transport-based city, not be bogged down in discussions on the survival of Bangkok as a road transport based city.

If/When the Bangkok capital becomes a public transport based city, quite different horizons will be opened up to the Bangkok people. Taking into consideration the great possibilities for SRT railways to make Bangkok a public transport based city, time consuming discussions on what should be the urban structure of Bangkok based on road transport can be avoided, rather concentrating discussions on how a public transport based city can be made possible and what should be the urban structure based on public transport centering on the improvement of the SRT railway.

1) Basic Features of Railway-Based Urban Development

The basic features of railways in urban development, which distinguish the urban structure established on railway-based public transport from other urban structures such as those proposed in other studies, are summarized as follows:

a) Enlarging the accommodation capacity and employment of the population of the Metropolis

It is certain that the implementation of improved railways in Bangkok, especially the suburban lines, will work toward enlarging employment and accommodation capacity of the population of Bangkok by expanding the public transport service area accessible to the CBD as compared to those by road, which takes 2 to 3 hours from the suburbs. It will be possible for Bangkok and its suburbs to accommodate more population and employment in terms of transport capacity, especially to/from the CBD, and an environment free from the air pollution and noise caused by car traffic.

b) Strengthening the concentric pattern of urban structure and traffic movement

It is natural that the concentric pattern of land use and traffic flow centers around the CBD. In other words, a Bangkok centered urban structure will be strengthened due to greater accessibility to/from the CBD by the improved railway.

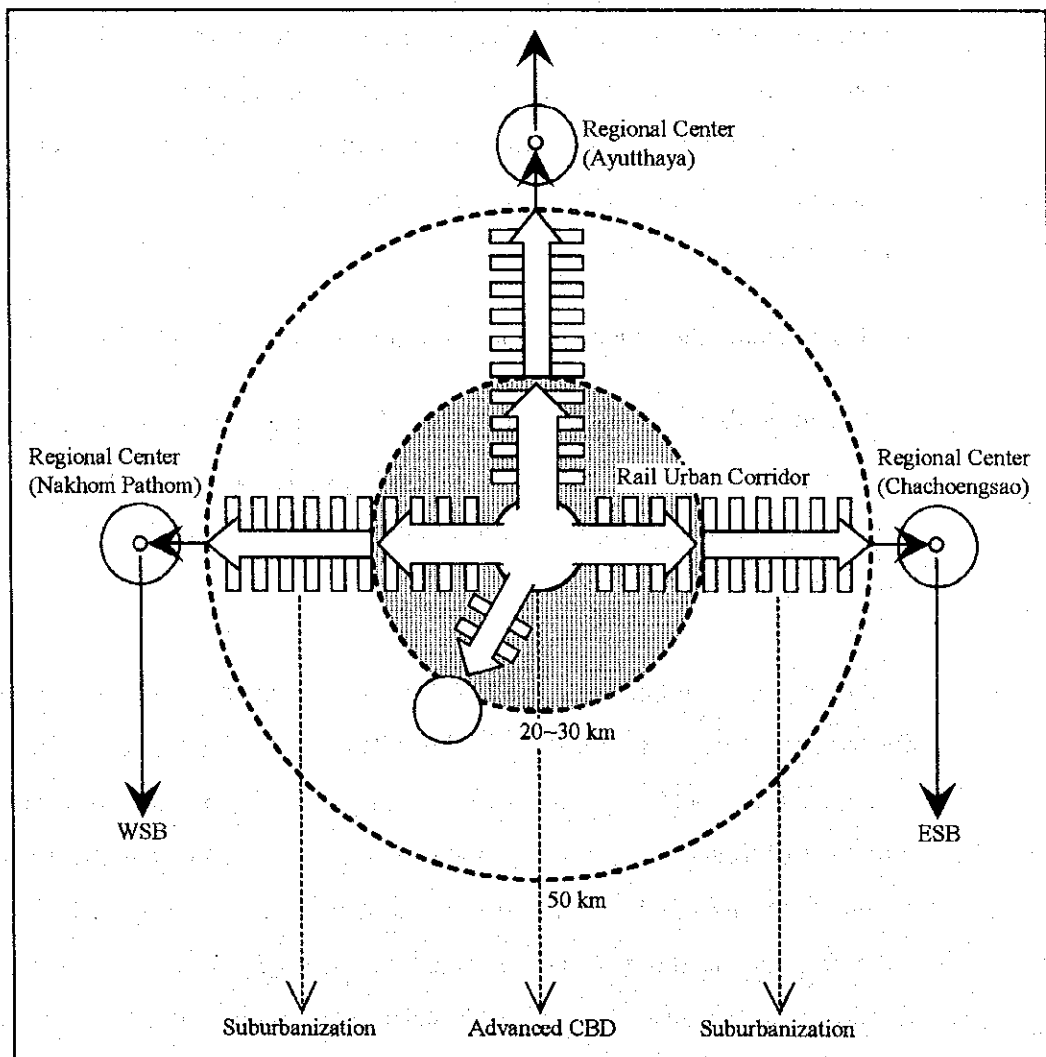
In this regard the urban structure based on the improved railway is quite different for the urban structures proposed in the SPURT and MRSP studies, which intend to limit the size and area of Bangkok Metropolis and to weaken the concentric structure of Bangkok mainly from the viewpoint of managing the road traffic centering on the CBD. It is also directly opposite to the proposed independent structures such as those of self-contained, job-housing balance and SBIA centered developments because the railway based urban structure develop the suburban areas in transactional linkage with the existing and improved CBD, bolstered by the increased accessibility which the improved railway is expected bring about.

In this context, it is advisable to state that the effects of the railway on urban structure as well as traffic movement are so great that serious consideration must be given to the future urban structure which the improved railway will lead to, and which appears quite different from those proposed in other studies of the government on the occasion of decision making for railway improvement.

2) Proposed Railway-Based Integrated Capital City

On these premises, the integrated capital city supported by the railway-based public transport is proposed, as shown in the Fig. 3.4.9. and outlined below.

Fig. 3.4.9 Urban Structure of Bangkok Integrated Capital City



a) "Integration" against "compartmentalization", "Independent development" and "Multipolis Structure"

First of all, it must be stressed that Bangkok can become an international and national urban center of the first grade only when all the areas belonging to it are brought together and integrated into one socio-economic body. The improved railway with the feeder systems such as those of Tanayong, MRTA, Hopewell System, buses and others will make this possible. It is fortunate for people in Bangkok that the existing railways running in the four directions from the center of Bangkok are in the best location to integrate the urban area of Bangkok. As far as Bangkok continues to depend on road transport, compartmentalization will be the inevitable result and this must be avoided for the future of the capital city.

The suburban areas (roughly at a range of distance from 30 km to 50 km) are no exception to this integration. As discussed in detail in the following sections, the suburban areas are envisaged to play important roles for renovating the functions and industries of Bangkok Capital, which is very necessary to develop Bangkok into an international advanced center. Why do they have to be developed independently, in isolation from the existing economic center of Bangkok as proposed in BMA sub-center, NHA new towns, and SBIA M/P? The concepts of self-contained, job-housing balance and independent SBIA dominated urban area can be viewed as compartmentalization of the Bangkok urban area on a large scale, which lead to disintegrating the sole of the capital. It is easy and understand that these may seen the best ways for urban development in so far as it depends on the plagued road transport system. It must also be admitted that the railway based urban structure is likely to accelerate the centripetal relationship between the metropolis and its satellites, which the MRSP Study strongly opposed as cited below.

The term "satellite" clearly defines a strong centripetal relationship between a metropolis and the satellite, a relationship of a superior (primate) city and a dependent, orbiting satellite, clearly in a subservient role, typically that of a "dormitory town." Most, if not, all of the transactions between the two, are

metropolis-centered, making the satellite even more subservient over time. Needless to say, that type of a relationship generates the strong and growing centripetal traffic movements only too familiar to anyone who lives in Bangkok. We do not place much hope in that type of spatial/operational arrangement and we strongly advise against it.

What the MRSP study mentions above may be true. However, this JICA Study still proposes railway improvement which may strengthen the centripetal relationship and subservient situation of the suburbs including new towns, because it places great importance for the advantages of railway for improving the present transport conditions and urban structure, and we believed these will offset the disadvantages that the MRSP study claims. The basic policies and concept which MRSP advocates have already been betrayed by the following facts :

- A strong centripetal relationship between a metropolis and suburbs as stressed in MRSP study cannot be strengthened mainly due to the transport problems represented by road traffic congestion. On the contrary, independent new towns or self-contained development which seems to weaken the centripetal relationship with the metropolis have been proposed for this reason.
- It is a reality that expanding outward urbanization, or urban sprawl has been taking place and even accelerated in spite of the MRSP recommendations to avoid and stop them. However, MRSP cannot be blamed for this since effective regulatory measures for controlling urban sprawl have not been established in Thailand. In this situation it is more practical though, not as idealistic as the MRSP intended to be, to accept the expanding urbanization as a reality in formulating the future urban structure of the Bangkok Capital region.
- In spite of the fact that the recommendations of the MRSP which strongly opposed urban development in any form of new towns or urban sprawl in

the suburbs of Bangkok-NHA new town development in the suburbs has already been approved by the then cabinet of government. It must also be stated that BMA sub-center development and SBIA centered M/P are under preparation for implementation.

Based on the above-mentioned trends rather than the too idealistic approach represented by the MRSP study and the too opportunistic and pragmatic/realistic approach of the self-contained or job-housing balance developments which are in reality quite difficult to implement, more reliable urban structures neither too idealistic nor too opportunistic, should be proposed. The terms of "integration" of capital city inevitably presume an hierarchical system where one (the suburbs) is dominated, while the other (CBD) dominates so that both of them become prosperous.

It may be said that the more prosperous the CBD of Bangkok becomes as an international center, the more benefits will be yielded to suburban areas, the subservient areas as defined in the MRSP study.

b) Total Urban Structure of Bangkok Integrated city (50 km Radius Area)

The improved railways aim at the establishment of a concentric urban structure for the integrated capital city with the classified urban areas of CBD-contiguous built-up area (up to 30 km from the CBD) - Suburbanization area - regional urban center (Chachoengsao, Nakhon Pathom, Ayutthaya) being aligned in order in accordance with the distance from the center of Bangkok, in the four (4) radiating directions within the 50 km radius area.

The above-stated classified urban areas are to be connected with one another by the improved railway so that every urban area will be prosperously developed and strong transactional linkage between them and the Bangkok Capital City will grow as a whole.

This type of concentric urban structure is made possible only by the improvement

of railway with no fears of transport problems such as those of traffic congestion in/around the CBD, and environmental problems. It must be stressed that this urban structure should be developed by means of solving the transport problems, more specifically the road traffic congestion. In this regard, it is quite distinguishable from urban structures proposed in other studies which are supposed to be established based on the hopelessly congested road network. The self-contained development is a typical example of this.

c) Necessity for the Suburban Areas to be Included in the Integrated Urban Structure

In the MRSP study, it is recommended to avoid urbanization, whether urban sprawl or new towns, in the suburban area of Bangkok. SPURT also advises to discourage further sprawl. On the other hand, the studies of NHA, SBIA M/P and BMA-MIT proposed a kind of independent new towns, urban centers and urban development in the suburbs.

In this study it is recommended that the suburban areas should be more positively developed and included in the integrated urban structure taking into consideration the great importance and magnitude of suburbanization for the further growth of Bangkok capital, not only from the realistic viewpoints that the urbanization of the suburbs is already a fact and will not be discouraged and that urban development will be somewhat easier due to the relatively low land prices and vacant lands in the suburbs. Faced with this reality, the basic policy of city planning and development in the suburbs must shift from discouraging urban sprawl to managing them in the best way. The improved railway will be very instrumental in managing urbanization because of its great influence on urbanization, which will be discussed in detail in the following chapters.

The importance of the suburban area from the viewpoint of city planning and development and future urban growth of Bangkok Capitals are summarized as follows :

- It is undeniable that Bangkok will keep on growing and increasing the volume of urban activities and population. It may be true that a good balance in population size between Bangkok and the local regions will be attained in the long run due to the implementation of the government policy of decentralization represented by the ESB development, upper central region development, and so on. However, it is also predictable that Bangkok's population will grow during that period of decentralization. Moreover, the urban activities and population essential to the advanced growth of Bangkok as a regional center among Asian countries must be positively located. In fact it is officially estimated that around 3 million people will be added to the existing size of BMR population according to NESDB's estimates. This also implies that the additional urban area to be developed is equivalent to 40% of the existing built up area, as discussed in Section 2.1.
- As represented by the current trend of outward expansion of the built-up area reaching the 30 km limit from the center of Bangkok, the incremental large volume of urban activities and population will be located mainly in suburban areas. As such, suburbanization has great implications on the existing urban structure of Bangkok, as follows:

The Magnitude and Dimension of Suburbanization

Suburbanization will outgrow the existing urban structure, which is at present contained within a range of 30 km radius, with the change in balance of volume of urban activities and population between the urban and suburban areas. This dictates a change of the existing urban structure to cover the broader area, but not continuous expansion of the existing one.

The Innovative Character of Suburbanization

The urban activities and urban population which are due to locate in the Bangkok capital from now on, are characterized by something like innovativeness and advancement, in line with the modernization and

upgrading of the Bangkok as a first class international urban center.

The suburban areas which are to accommodate such increasing urban activities and population will spearhead the urban innovation of Bangkok. The innovative urban and industrial development in connection with the construction of the Second Bangkok International Airport by the Thai Government of the example.

Suburbanization also includes the development of new life styles pursued by the emerging massive new urban citizens such as those of the middle class, who are the major harbingers for the advanced growth of Bangkok.

This all suggests that the suburban areas will no longer be marginal or subordinate parts of the urban structure. In this respect the new urban structure must be established so as to give equal importance with the existing CBD and built-up areas to the pivotal role of urban activities in suburban areas.

- Some specific types of urban development activities integrated with the railway improvement - suburban line which will be necessitated for the growth of Bangkok are as follows:

Provision of Housing in Response to the Growing Needs of Bangkok

Transport problems are becoming housing problems since the development sites for housing cannot be easily found within the travel time limit for commuting to work places. There is a growing demand for housing especially for massive medium income groups emerging with the development of tertiary industries in Bangkok i.e., trade, finance, managerial offices, accelerated by the internationalization and advanced hi-tech industries of Thailand.

This shows that traditional measures for providing housing are no longer

sufficient. Provision of housing with good transportation service will soon be one of the major tasks of Thai city planning and development.

In this regard, it is recommended to improve and develop suburban commuter trains for providing a large amount of housing with good transport services for commuting.

Enhancement of Relocation of the Existing Urban Activities and Facilities in Direct Linkage with Bangkok

The suburbanization area is designed to be one of the reception areas for the relocation of urban activities and facilities from the built-up areas of Bangkok. A good motivation for businesses to relocate their businesses out of Bangkok areas are the inefficiencies brought about by worsening traffic congestion.

The outward location changes are also facilitated by the scarcity or lack of accommodation for newcomers in Bangkok and the high land prices. The MRSP study advises relocation for all those who are non-essential to Bangkok. However, it depends upon their importance of socio-economic linkages with Bangkok and how far away they will be relocated from Bangkok.

The suburbanization area which will be within one hour by suburban lines should be developed to establish and relocate essential urban activities to Bangkok, such as universities, schools, government offices, urban light industries, etc.

Urban Development in Relation with Expansion of Transportation System

The strategic location of the suburbanization area has triggered transportation system development projects such as new international airport, inland depots and others as planned in response to the growth of Bangkok. The implication is that there are possibilities of urban

development correlated with the transport industry development in the suburbanization areas.

The Suburbanization Area Development in Conjunction with the Redevelopment and Renewal of the Existing CBD and Built-up Area of Bangkok

This type of urban redevelopment aims at the railway promotion and urban restructuring of the railway oriented city.

Urban redevelopment/renewal and slum-clearance/up-grading projects will be expedited in the course of modernizing the Bangkok urban area. However, alternative housing sites must be found for those who have to be relocated. The suburbanization area with improved railway service will be most suitable for alternative sites of housing due to the comparative low cost of land for housing and the reasonable transportation cost by railway to commute to the original workplaces.

Coupled with the railway-based new Bangkok CBD as stated above, the housing for workers in the CBD will be developed along the suburban lines to promote use of the railway for commuting and shopping.

d) Necessity of advancement of the existing CBD for the integrated urban structure

The other essential factor for establishing an integrated urban structure, in addition to the suburbanization of Bangkok as discussed above, is the strengthening and advancement of the existing CBD to serve as a control tower or leading center over the urbanization and urban development in the Bangkok capital.

It is well known that transport conditions affect land use. The chronic traffic congestion on the roads in Bangkok cannot stop changing the existing land use, represented by relocation of supermarkets, offices, hotels and the like toward the suburbs where the traffic conditions are relatively good. It may probably be desirable from the viewpoint of decentralization of urban activities. However,