serious attention must be given to the degradation of the primary capital urban center of the existing CBD mainly due to the difficult access to it on the congested road network. As a result of the lowering socio-economic position of the existing CBD, Bangkok Capital threatens become merely a vast built-up area without the focus point of the prime CBD or urban center, and just one of the local urban centers scattered over the urban area. It is undeniable that an advanced and prestigious prime urban center district is of great significance for Bangkok's becoming an international center through the 21st century.

To this end, locational advantages of the existing CBD should be strengthened through the mass transport system, especially the improvement of the railway system connecting the CBD with the rest of the country in place of the road network which is no longer a reliable transportation means in the urban area of Bangkok.

In this context a significant question must be raised: Is the existing CBD of Bangkok large enough to be decentralized?

It may be so as long as Bangkok depends on a road based transport system with a limited capacity of transport to/from the CBD. The appropriate size of the CBD should be estimated by taking into consideration first the transport system applied and, secondly, the expected future functions and roles in the integrated urban structure for providing for the future growth of Bangkok capital through the 21st century.

SPURT predicts the further development of the existing CBD in the wake of MRT development. A recent research study was made on MRT systems in the developing world. It concluded that in the absence of MRT, city center size was limited by the capacity of the bus system. It is generally recognized that buses cannot, except in exceptional circumstances, carry more than 20,000 passenger/hour down a major corridor, whatever is done. As this level is approached, the growth of the City Center must slow down.

An MRT system will typically provide a quantum leap in capacity, of up to 60,000 passenger/hour/direction and such a system allows the Center to continue to grow (except that it does not, of course, make it grow). Bangkok, in some corridors, has approached this threshold and the MRT system can be expected to support the continuing identification of the city center. The evidence indicates that this will happen. This is assumed to be desirable.

In the Study of Mass Rapid Transit in Developing Countries (TRRL Contractor Report 188, Halcrow Fox and Associates, 1990), the effects of railway improvement on CBD development are foreseen to be greater than those of MRT because of the larger service areas and capacity of the improved railway. MRTs are designed to serve limited urban areas such as those of the CBD and neighboring commercial areas, while the improved railway is to serve the vast area of the suburbs up to a distance of 50 km range from the center of Bangkok. The volume of population served by the railways is not comparably as large as those of MRTs.

It is noteworthy that as the capital city grows, the CBD must also grow accordingly to serve as the primary urban center for governing and leading the capital city development as a whole. The improved railways are supposed to help develop the CBD further in this manner. It may be concluded that the advancement of the existing CBD is one of the essential conditions for establishing the integrated urban structure of the capital city, which will be supported by the railway improvement.

(3) Rail-Urban Corridors as a Key Element of the Integrated Urban Structure

1) Urbanization Mechanism

Intensive land use zones with high density along the improved railways from the CBD toward suburban areas will be emerging and play important roles as urban corridors, which are to systematize the socio-economic activities and traffic movements.

The urbanization mechanism particular to the rail urban corridors is shown as follows;

a) Interactive development between urban area and railway

As the railway system becomes more and more convenient, the railway passengers will increase in volume. Accordingly the potential for commercial development targeting the increased passengers as clientele will be raised around the stations. The commercial developments are again expected to further increase the railway passengers for shopping. This process of interactive development will be repeated so that the urban corridors, which are very convenient not only in terms of transport service but for commercial and other urban services which will emerge along the railways. This is also a process of densification along the railways.

b) Interactive development between CBD and Suburbs through the improved railway

As the existing CBD further grows, along with the railway improvement, a massive housing demand from those employed in the CBD will take place. The massive housing sites for them, but not limited to them will be developed in the suburbs along the suburban rail line directly connecting with the CBD. As the population increases in accordance with the urban and housing development in the suburbs along the railway, the great market of the CBD along the railway with the high accessibility from the suburbs will be shaped. This, in turn, will enhance the commercial development along the railway in the CBD. This is expected to raise the reputation of the suburbs along the railways for housing sites because of the high accessibility to the very convenient commercial centers by means of a single ride the railway to them. The high reputation will help boost further urban and housing development along the railway. These interactive and simultaneous developments of the CBD and suburbs are vital to the successful development of the rail urban corridors.

2) Urban Land Management Through Urban Corridors

New urban areas will be developed through the improved railway, a suburban commuter line, which should reduce the commuting time from two to three hours by car to one hour.

One phenomenon of Bangkok urbanization is that the urban areas have still been expanding into the suburban areas in pursuit of residential areas for people, in such particular form as "housing estate sprawl" or new satellite towns, as referred to in the MRSP study. The study recommends that such disorderly real estate development as satellite towns should be stopped. In this situation, the railway can take the lead in suburbanization.

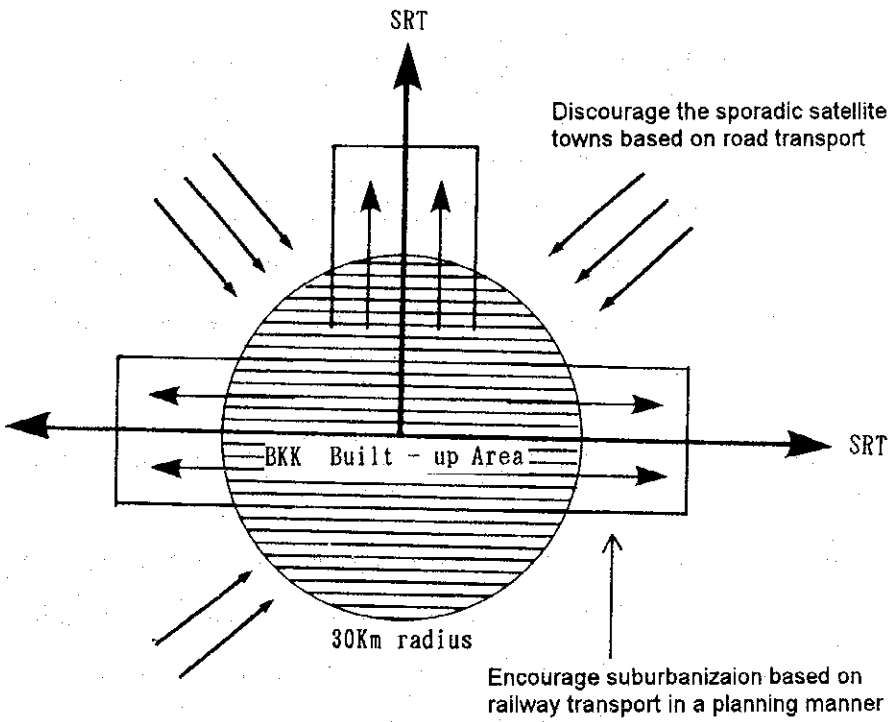
An orderly urban development along the suburban railways should be encouraged in a planned manner while the sprawling real estate developments relying on road transport should be discouraged or restricted, with the built-up areas being contained within the range of 30 km radius. In this case, the advantages of urban corridor system are listed as follows:

a) The urban and housing developments depending on road transport beyond the 30 km radius will force intolerable long commuting travel time on the people. This also tends to put additional car traffic in/around the worsening traffic situation in the built-up areas of Bangkok. The urban developments based on the railway will reduce the travel time as well as the dependency on road transport.

b) The urban and housing developments based on road transport are likely to lead to scattered land use with low density, thus resulting in the waste of precious land resources and inefficiency of land use and infrastructure development. Conversely, with the popularity of the railway, land use would become high, dense and compact, which would result in highly efficient land use and infrastructure development in the railway service areas.

Based on the above discussions, it is recommended that new urban lands which will be needed for the next generation or for the further growth of Bangkok should be provided in urban corridors while land transport-based urban/housing developments should be banned at the fringe of the built-up areas within a 30 km radius as shown in Fig. 3.4.10.

Fig. 3.4.10 Urban Land Development Control



3.4.3.2 Basic Features of Urban Area Growth

(1) Classification and Geographical Urbanization Characteristics

Urban areas on which the urban structure is to be forged are classified into four areas according to the distance from the center of Bangkok, taking into consideration the current urbanization trends/characteristics and future growth, as shown in the Fig. 3.4.10 and discussed below:

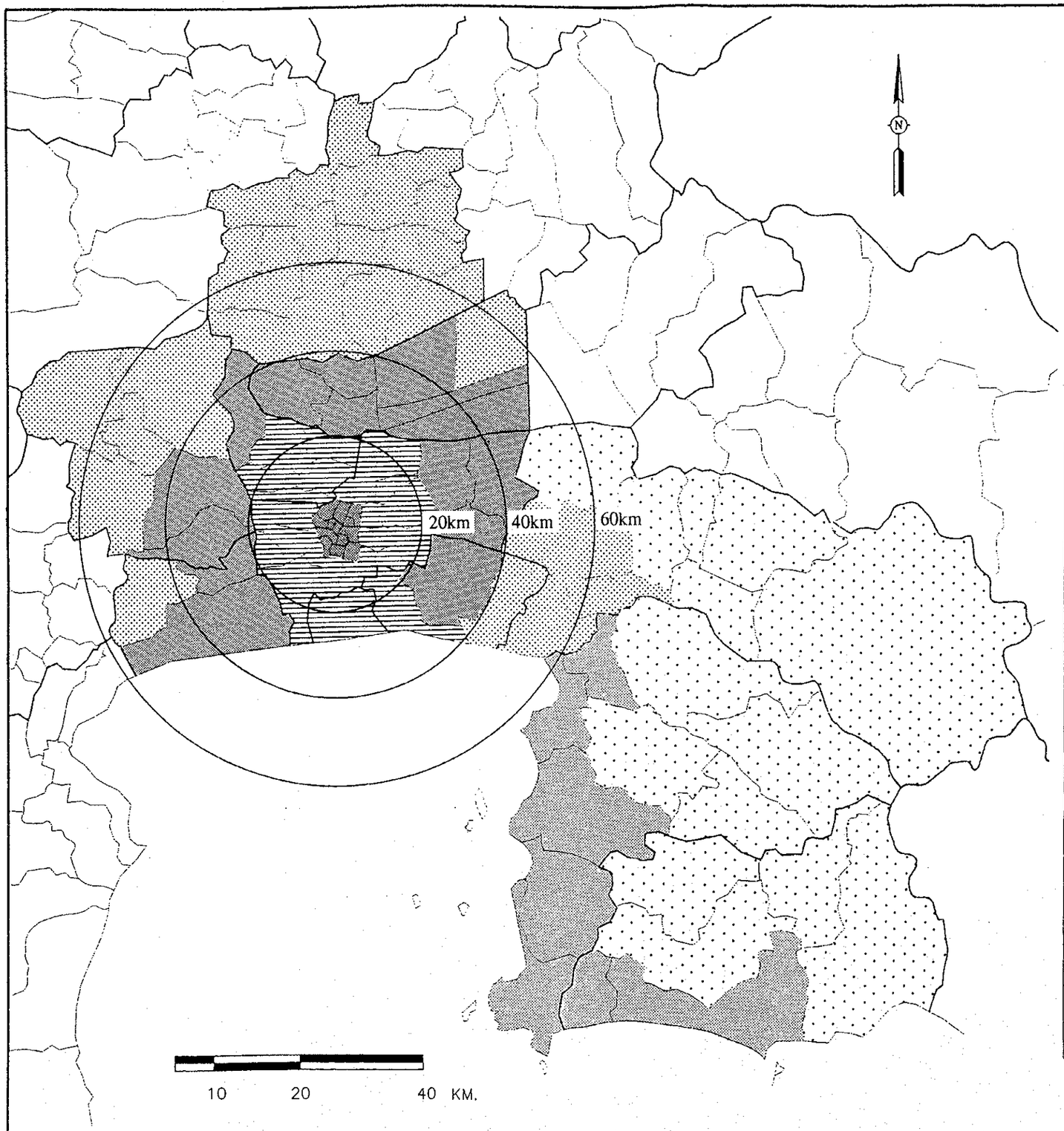
1) Central Urban Area including the existing CBD and its adjoining high density populated ampors (total 17 ampors)

Some of the districts in this area have shown a declining population trend. This trend is anticipated to cover all the districts in this area due to the increase of employment generated in the process of a change in land use from residential to commercial and offices and others, accelerated by the renewal/redevelopment projects.

2) Middle Urban Area within the range of the 20 km radius from the center of Bangkok

Surrounding the Central Urban Area, this classified area, represented typically by such districts as Bangkapi, Taling Chan, Nonthaburi and others, has been experiencing a massive immigration in line with the expansion of built-up areas from Bangkok in pursuit of housing sites for those who commute to work in the CBD of Bangkok. It is foreseeable that this trend will continue until the area reaches the population saturation point, resulting in a high density populated area.

Fig. 3.4.11 Classification of Urban Area



AMPHUR / CHANGWAT ALIGNED IN LINE WITH REGIONAL / URBAN STRUCTURE

	50 KM RADIUS AREA				BSB AREA	
	CENTRAL	MIDDLE Area	Inner Suburb	Outter Suburb	BSB (Coastal)	BSB (Inland)
1.BMA (BKK)	Phra Nakhon Pom Prap Sat Pathum Wan Bang Rak Sam Phan Thaw Sathon Bankholae Yan Nawa Dusit Bang Sue Phaya Thai Ratchatevee	Eastern Corridor (M-1) Huai Kwang Khlong Toei (M-2) Bang Kapi Bang Kum Pravet Phra Khanong (Other) Bangkhen Don Muang Chatuchak Lat Phrao	Lat Krabang Min Buri Nong Chok			
(Tonburi)	Khlong San Thon Buri Bangkok Yai Bangkok Noi Bang Phlad	(Other) Taling chan Phasi charee Nong khaem Chom Tong Bang Khun Th Rat Burana				
2. Samut Phrakran		Phra Pradaeng Muang S/P Phra Samus chedi	Bang Phli	Bang Bo		
3. Chachoengsao				Muang Chachoengsao Ban Pha Bang Pakong	BSB (Coastal)	BSB (Inland) Bang Nam Prico Bang Khla Phanom Sarakham Plaeng Yao Ratchasan Sanam Chai Khet Tha Takeab
4. Chonburi					Phan Thong Muang Chon Buri Si Racha Bang Lamung Satthip	Phanat Nikhom Ban Bung Ho Thong Nong Yai
5. Rayong					Ban Chang Muang Rayong	Ban Khai Pluak Daeng Wang Chan Klaeng
6. Nonthaburi		Non Thaburi Bang Kruai Bang Yai Pak Kret Bang Bua Thong	Sai Noi			
7.Pathum Thani			Muang Pathum Lam Lukka Thanyaburi Khlong Luang Lat Lum Kaeo Sam Khok	Nong Sua		
8. Samut Sakhon			(Muang Samut Krathum Baen	Ban Phaeo		
9.Nakhon Pathom			Nakhon chaisi Sao Phran	Muang Nakon Kam Phaeng Saen Bang Len(Donum)		
10.Ayutthaya				Muang Ayutthaya Bang Pa-in other Amphor		

c) Inner Suburban Area outside of the middle urban area, between a 20 km and 40 km radius

The built-up area from Bangkok is on the verge of expanding outward beyond the boundary of the middle urban area (20 km distance from the center of Bangkok) and estimated to reach the 40 km distance away from Bangkok. It seems that this urbanization is taking place in such manner as spilling over from the densely populated middle urban area. This inner suburban area is predicted to skill over to the outer urban area of Bangkok in future.

d) Outer Suburban Area between the range of 40 and 60 km radius centering on the regional urban centers such as Chachoengsao, Ayutthaya and Nakhon Pathom

Urbanization due to the influence of Bangkok is not dominant, with a few exceptions including those in Bang Pakong on highway No. 34 leading to ESB and Bang Pa-in on route No. 1 highway. The area remains mostly rural in character with urban growth centering on the regional urban centers.

2) General Urbanization Trends and Perspectives

Summarizing the population changes as outlined above, the population distribution of Bangkok seems to be changing like a wave going outward (ripples) with population (or density) decreasing in the central urban area, population (density) increasing in the middle urban area, and the population spilling over to the inner suburban area (Fig. 3.4.12).

The area with the highest population density is likely to form a ring (or circle) around the center of Bangkok and move outward as time passes.

The zones of the highest population density form the shape of a "doughnut" expanding outward (Fig. 3.4.13).

Fig. 3.4.12 Population Distribution Change

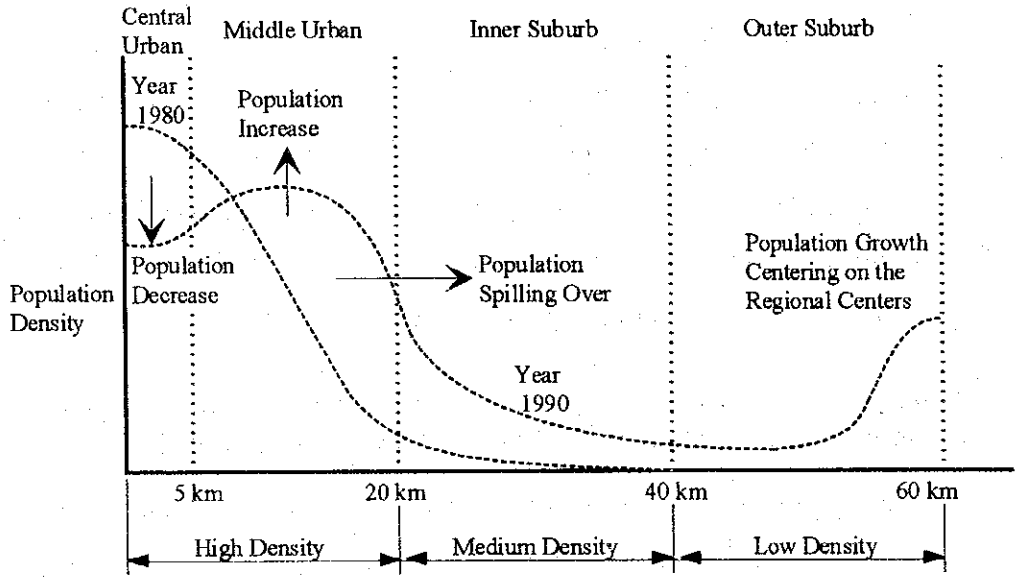
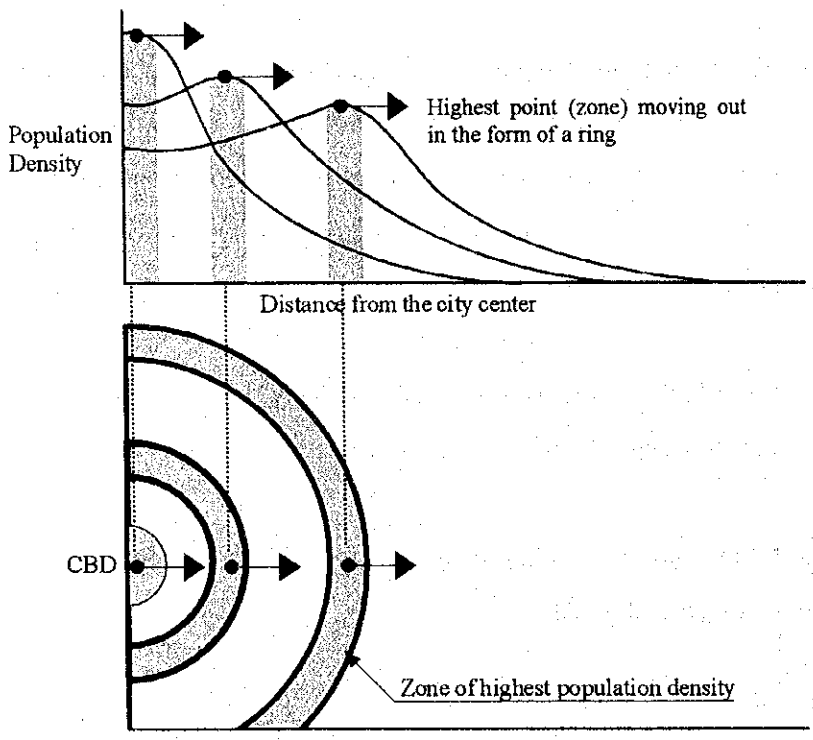


Fig. 3.4.13 Doughnut Phenomenon of Population



3.4.3.3 Proposed General System of Regional/Urban Mass Transport

1) Future Transport Situation of Bangkok

The Study on Ground Access to the Second Bangkok International Airport (AAT) pictures the future transportation situation of Bangkok as follows:

a) Worsening Traffic Condition on the Streets and Highway

i. Congestion on the streets of Bangkok is not expected to improve in the foreseeable future. In fact, it is probable that congestion will worsen appreciably for, although a number of expressway projects are under way, vehicle ownership is forecast to increase dramatically in the next decade and Bangkok does not have the road network to accommodate this growth. The city has a very low roadway area to land area ratio and the distributor/collector road network is unlikely to see much expansion in the future, constrained as it is by high land costs, among other things.

ii. The downtown area will be particularly affected by congestion. Even the many expressway projects planned for the city may not greatly relieve traffic on the streets themselves; in fact, they may just attract more traffic to the city center. The three planned MRT projects will limit congestion by providing an alternative to private car use when they are implemented, yet even an optimistic forecast of the traffic situation in the city center in the year 2000 would not foresee any major improvement over the situation today.

iii. The conclusion of the analysis is that much of the major road network, existing and planned, between SBIA and the City of Bangkok will be operating at or close to capacity in the year 2000, and that there is insufficient spare capacity to serve the substantial traffic demand arising from SBIA. Beyond 2010, the City's streets and the regional highway network will be operating at or near saturation.

b) MRT Link Use

i. It is unrealistic to expect significantly more road capacity within the urbanized area and the only practical way of accommodating traffic growth beyond 2010 is by developing a good widespread MRT network.

ii. It is also essential for those days when traffic comes to a virtual standstill on Bangkok's streets, when an MRT would be the only means of traveling to/from the airport. These are the basic reasons why the MRT link to SBIA was recommended in the study.

The MRT link to SBIA and the High Speed Train were proposed in that study on the following important assumptions of the Bangkok MRT network:

- "It is, however, not sufficient to provide an MRT/rail link between Bangkok and SBIA. The link must be an integral part of a city-wide MRT (rail) network, otherwise passengers, and employees, would spend so much time accessing the downtown terminal that they might as well drive direct to the airport."

- "One of the assumptions for the ridership forecast of High Speed Train is to provide a high quality rail mass transit system within Bangkok to provide easy access to HSR terminal locations. It is assumed that the distribution system, whether it be the Hopewell, the MRTA, Tanayong, or any other system or combination of systems, will exist by the time the HSR line is built.

These studies suggest that in the serious traffic congestion on the streets of Bangkok, MRT systems are indispensable. However, in order that the MRT system works efficiently, it must be integrated. The MRT integration in and around Bangkok is discussed in this chapter.

2) General Classification of Mass Transit Systems

In a mega city like Bangkok, different types of mass transit systems are built to respond to the various transport demands stretching all-over the metropolitan area, and interconnected with one another to develop into an integrated regional/urban mass transport network and system.

The individual mass transit systems vary in transport function and service, ranging from guided bus system, mono-rail, light rail transit, sky train to subway, heavy rail transit and high speed train, dependent upon such factors as transport distance, speed, frequency, accessibility, capacities and so on.

Generally the individual mass transit systems are likely to be classified into the following three (3) types, to cope with the transport problems and difficulties:

- Intra-Urban MTS
- Suburban MTS
- Inter-Urban MTS

The 3 types of MTS can be characterized by distance of main haul, schedule speed, accessibility to the system, frequency of train operation as shown in Fig. 3.4.14 and outlined as follows :

a) Distance : Speed

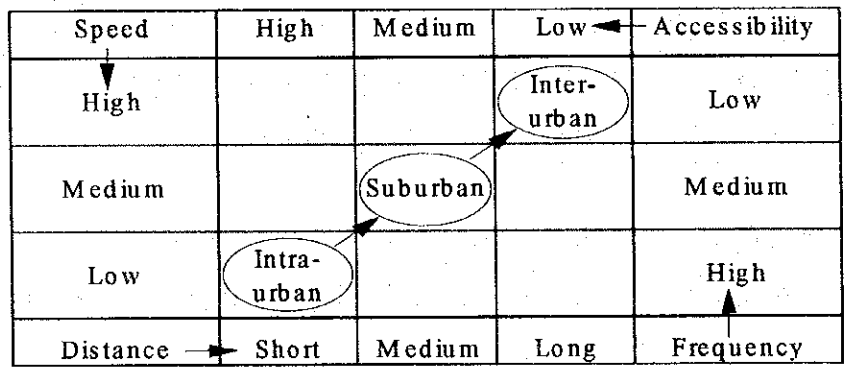
It is obvious that the longer the travel distance is, the higher the required speed is.

b) Speed : Accessibility

Accessibility to the system is higher when trains make brief stops at many stations. In other words the interval (distance) between station is shorter. However, the train speed is forced to be lower due to the many stations reducing the speed and consuming time for brief stops. Because of this trade-off relationship between speed and accessibility, Inter-urban MTS should pursue higher speed with lower accessibility, and Intra-Urban MTS should pursue higher accessibility with relatively lower speed.

Historically, MTS improvement has been geared toward addressing the two kinds of transportation difficulties: one (Intra-Urban) is overcoming the volume (efficient/effective large capacity of transport, especially for the massive volume of traffic in the central area of Mega cities); the other (Inter-urban) is overcoming the distance (efficient/effective long distance transport, especially for the long haul traffic essential to the national/regional economic/social development)

Fig. 3.4.14 General Characteristics of Mass Transit System



3) Proposed General System of Regional/Urban Mass Transport

The three types of MTS as classified in the preceding section, each with its own targeted area and traffic demand, are to be applied in parallel with the city planning and development based on the general urbanization trend and perspectives as described in the preceding section, so as to establish the basic system of integrated regional/urban mass transport (see Fig. 3.4.15).

a) Classification of MTS in 50 km Radius Region of Bangkok

The existing and planned MTS are classified and listed in the table below:

Classification	MTS
Intra-urban	Hopewell MRTA Tanayon Subway
Suburban	SRT suburban commuter line
Inter-urban	SRT national/regional trunk line

b) Targeted Areas and Trips to be Served by MTS

The MTS should be applied mainly to serve the transport demands, which are deemed to be of great importance from the view points of solution of urban transport problems (especially the elimination of road traffic congestion) and urban social/economic development, as summarized below :

i. Intra-Urban: Congested urban traffic in the city

ii. Suburban: Prolonged urban traffic from suburbs

iii. Inter-Urban: Long distance traffic with either origin or destination within the city

Accordingly, the targeted area and trips of each MTS are listed in Table 3.4.10.

Table 3.4.10 Targeted Areas and Trips of MTS

Types of MTS applied	Targeted Area	Targeted Trip
Intra-Urban MTS (consisting of the planned MRT including Hopewell, Tanayon, MRTA, subway and others)	Densely populated area and CBD within 20 km radius area	High-density short- distance trips
Suburban MTS (SRT suburban line)	Expanded urban area beyond 20 km radius up to 40 km	Medium-density medium-distance trips
Inter-Urban/ Regional MTS (SRT Regional/National Trunk Line)	Regional urban centers and their hinterlands (changwat)	Low-density long-distance trips

c) General Specification of MTS Applied

Practical specification of MTS is set forth in Table 3.4.11, taking into consideration their transport function and services.

i. Intra-Urban MTS

Since the Intra-Urban MTSs are to target the massive short distance trips in the built-up area, the convenience of riding the system is the first criteria.

- Station interval - size of service area

To this end, station interval (distance between stations) should be as low as the train operation can allow so as to place stations closest to the potential clientele. This is meant to include as many people as possible within the direct service area (walking distance) of the MTS system. Thus the service areas (or catchment area) of Intra-urban MTS tend to be smaller for the sake of passengers' convenience. Since the Intra-urban system is designed to pass through high-density population/employment areas, a considerable number of passengers are assumed to take the system.

Fig. 3.4.15 Basic System of Integrated Regional/Urban Mass Transport

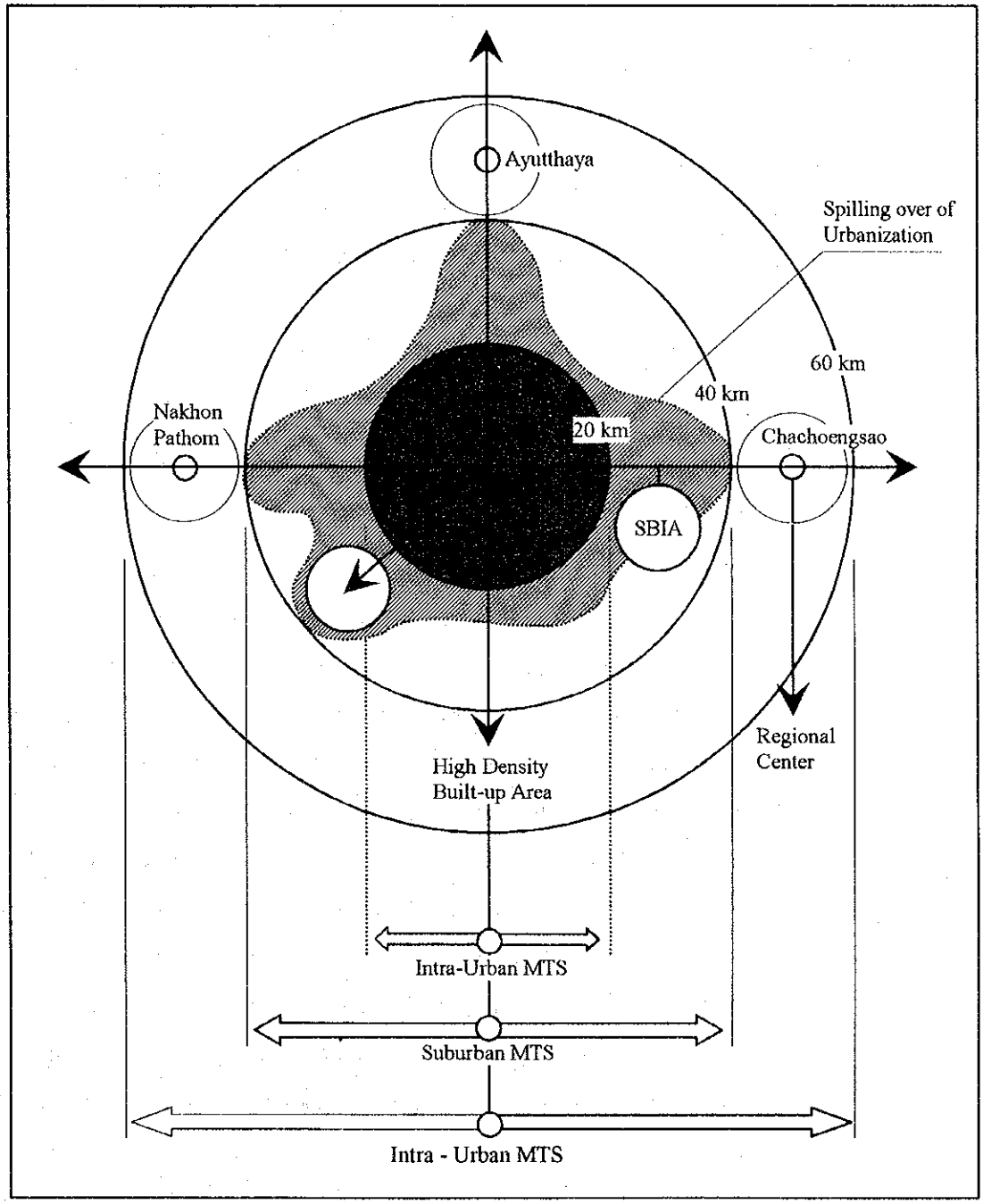


Table 3.4.11 Practical Specification of MTS

	Length of Main Haul	Schedule Speed	Station Interval	Frequency
Intra-Urban	15-20 km (Extendible to 30 km)	30km/h	0.5 - 1.0km	2 - 5 minutes
Suburban	30 km (Extendible to 60 km)	60km/h	2.0 - 3.0km	10 - 20 minutes
Inter-Urban	50km and beyond	100km/h	20 - 30km	60 minutes

- Speed and Frequency

"Do not let passengers wait for the train too long" or "passengers can take a train in a few minutes anytime they arrive at the stations" are important promotional slogans for the intra-urban system. In this regard, frequency of train operation should be as high as possible depending on the volume of passenger demand. On the other hand, "high speed" of trains will not be of to great importance because of the short-distance of the train ride within the city. Moreover, taking into consideration the worst situation of vehicle traffic on the road — a couple of hours delay is not exceptional as is an unpredictable travel time — reliability of travel schedule with even a slower speed will be much more appreciated. Consequently the reliability , accessibility, frequency of transport are more significant criteria for the Intra-urban system rather than speed.

- Length of Main Haul

It is not unusual that the Intra-urban system is limited in its length of main haul. If the line length exceeds a practical size, travel time on the main haul — especially between one end (ex-fringe of city) and the other end (ex-CBD) — becomes extremely long due to the slower speed of the system by its nature.

In addition, overload on the system, is threatened that especially at the points/sections in the CBD at the morning peak-hour caused by trains converging from the longer main haul.

ii. Inter-Urban MTS

Since the Inter-urban MTS will target the longer distance trips and a relatively smaller volume of passengers than the Intra-urban region, time saving is the first concern of the passengers.

- Station Interval

The stations will reduce the schedule speed by consuming time through deceleration/acceleration of train and stopping at the stations. Although as small a number of stations as possible, or longer station intervals are desirable from the standpoint of increasing the schedule speed, a balance must be made between the speed and accessibility from the regions.

Regional express trains are recommended to stop at one station in every changwat — approx. 50 km station interval.

iii. Suburban MTS

- Necessity of Suburban MTS

The suburban MTS becomes necessary as the city grows beyond the boundary of the 20 km radius. Expanded built-up areas beyond that boundary can neither be serviced fully by Intra-urban or Inter-urban. If the Inter-urban MST line is to be extended to serve the expanded built up area, it does not work well because of the limitation of the service line in terms of length and capacity as stated before. If additional stations on the Inter-urban MTS are constructed in order to serve the suburban areas, the high speed services of the Inter-urban MTS are hampered. It cannot also fully serve the area due to the relatively low frequency and accessibility designed for Inter-urban services.

In this regard, special measures are needed to provide transportation services to the growing suburban area. Since the suburban lines are to serve longer distance travels from the suburbs than the Intra-urban MRT, the schedule speed will be around 60 km/h, which is higher than the 30 km/h, of Intra-urban but lower than the 100 km/h of the Inter-urban. Limitation also is imposed on the suburban lines in length of main haul. Practically around 30 km from the center of Bangkok is recommendable. However, it is extendible up to 60 km (commuting time is around 1.5 hour). In order to keep the scheduled speed of 60 km/h, the number of stations must be limited.

d) Inter-Connection of the 3 Types of MTS

While the individual mass transport line is designed to serve its own territory (service area), they must be interconnected to one another as follows:

i. City-wide MRT Network

The individual lines of Intra-urban mass rapid transit systems such as Hopewell, Tanayon, MRTA and others must be interconnected to develop into an integrated city-wide mass rapid transit network so that the passengers can fully travel on public transport alone from origin to destination using one or more MRT lines. Otherwise, MRT systems will turn out to be inconvenient to the city dwellers, resulting in unpopularity of public transport.

ii. Hierarchical Network of Intra-Urban, Suburban Line and Inter-Urban

The city-wide network of the Intra-urban mass transit system, as stated above, must be interconnected with the public transport trunk lines such as Suburban lines and Inter-urban lines to serve as a distribution/collection system for the trunk lines. Otherwise, if passengers would spend so much time accessing the trunk lines, they might give up public transport and drive directly to their destinations. It must be stated that completion of and interconnection with the city wide MRT network is considered the most

important assumption of the proposed ground access system to SBIA as well as High Speed Train connecting Bangkok and ESB.

e) Direction of Railway Transport Systematization in the 50 km Radius Area

SRT rail lines will be an integral part of the Regional/Urban Mass Transport System. An SRT railway will be viable only if such an integrated mass transport network is established. More specifically the city-wide integrated MRT network consisting of the Hopewell, MRTA and others is one of the most important prerequisites for systematization of railway transport because it cannot work effectively without a distribution/collection system in the urban area of Bangkok. It must be noted that the establishment and operation of the city-wide MRT network is an assumption for the proposed access system to SBIA and High Speed Train.

4) Proposed Urban Public Transport System and Network with the SRT Suburban Line being the Backbone

The urban public transport system and network as shown in Fig. 3.4.16 is presented through the application of the proposed general system of regional/urban mass transport, taking into consideration the following factors:

a) Important Roles of SRT Suburban Lines

i. Necessity of New Urban Public Transport for Suburbanization - SRT Commuter Line

As repeatedly stated, it is almost impossible to develop urban areas on a large scale, to absorb the increasing demand for housing and others, within the reach of a reasonable time distance of commuting as far as it is based on road transport. Bangkok may be plunged into the situation where urban development cannot be implemented without construction of a mass transit system.

This holds all the more true for suburbanization, as discussed below:

- Private Transport

  It takes 2 to 3 hours, and maybe more in the future, to reach the CBD and major access points in Bangkok from the suburbs, based on private transport. In addition, this would lead to worsening traffic congestion by putting additional private traffic on the existing roads. In this condition it is apparent that the suburban private traffic cannot play the important role as defined above.

- Bus transport

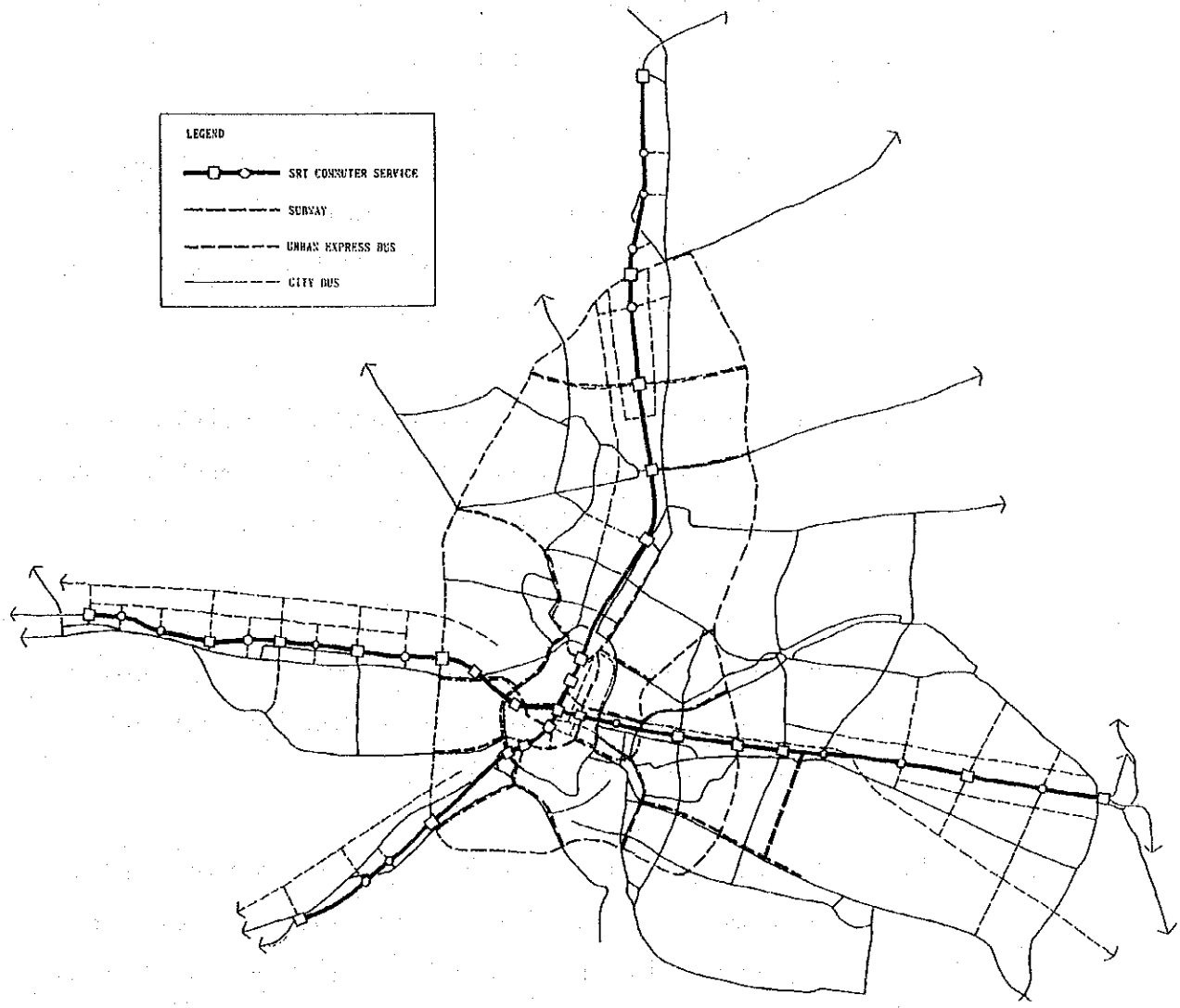
  The suburban area is classified as a public transport deficient area out of reach of line and area of bus service, which is discussed in the succeeding section. It is concluded that the bus system cannot provide efficient and effective public transport service, especially to the suburban area due to its the limitation in terms of distance (Local bus line) and transport capacity of the bus line service (Long distance bus line).

- Planned Mass Transit System

  The Planned Mass Transit Systems such as Hopewell, MRTA, BTS and Subway are designed to serve the built-up areas within a 30 km radius at most, thus resulting in failure to serve the suburban area. Even their expansion cannot serve the suburban area because of the limitation in capacity and speed of transport.

  All of these factors seem to simply indicate the necessity of establishing a new public transport system for the suburbanization. Based on the discussion on the potential use of SRT in the preceding chapter, the suburban line on the existing SRT is qualified as the new public transport system for the suburbanization of Bangkok due to its possible speed and capacity of transport, especially making the best of the existing resources of the SRT.

Fig. 3.4.16 Urban Public transport Network with the SRT Suburban Line being the Backbone of the System



ii. Substitute of Urban Bus Service Reaching its Limitation

It is recognized that the bus system will no longer be the major system of urban public transport service in the face of the growing public transport demand in terms of the volume and expanding service areas, although the deficient function of bus services for urban transport should be attributed largely to traffic congestion on the roads. The planned MRT systems are to substitute for bus services in the built-up area of Bangkok only.

In the existing bus transport system there are an excessive number of bus lines radiating from the center of Bangkok stretching out toward the suburban area to serve and collect bus passengers in their own service areas. The following are the major problems inherent in this bus system.

- Extended bus lines toward the suburbs, following the outward expansion of built-up areas, have lengthened the travel time for bus passengers to reach the main access points in the Bangkok area. It can no longer be said to be a convenient means of public transport.

- So many buses are converging on the arterial roads in/around the center of Bangkok, which is becoming an other cause of traffic congestion on the roads, especially in the peak hours of commuting, thus resulting in loss of transport efficiency of bus services.

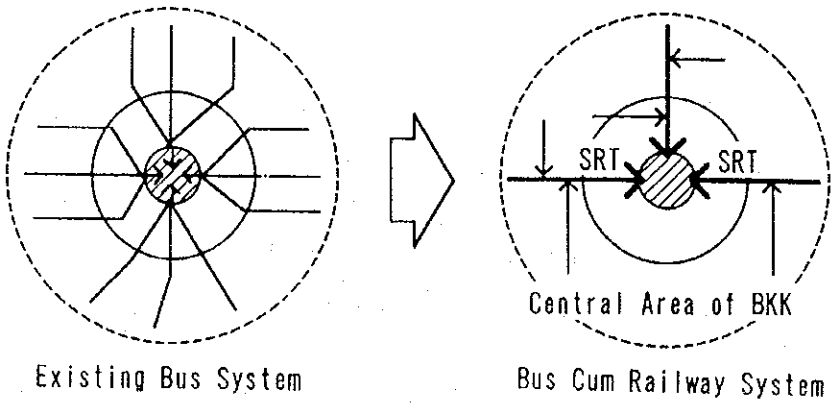
To overcome these constraints of bus services, the SRT suburban commuter lines connecting the central and suburban areas of Bangkok can play a role of trunk public transport line to the bus services.

The buses will no longer head directly to final individual destinations in the central area of Bangkok, instead they will terminate in stations of the commuter lines of SRT. The high speed of the commuter lines, say 50 to 70 km/hour is considered to make up for time lost due to access travel to the stations and transferring to rail transport including the waiting time.

The advantage of this system is to be found in increasing the public transport capacity entering into the central area by means of rail transport, rather than by converging bus lines on the roads in/around the central area.

Thus, the SRT suburban line offers a great opportunity to reorganize and systematize the existing problem-ridden bus services in Bangkok.

Fig. 3.4.17 Transformation of Urban Public Transportation from the Bus System to the Bus Cum Rail Transportation



It has been said that the Bangkok urbanization pattern features ribbon development or an urban corridor along the arterial roads radiating from the center of Bangkok mainly due to the road transport system. However it should not be neglected that bus services converging on the arterial roads due to lack of alternative routes of bus lines made a great contribution to the development of urban corridors along the arterial roads.

In this regard, it can be anticipated that the urban corridors may shift in accordance with the emerging public transport trunk line of the SRT commuter service instead of the bus lines on the arterial roads.

iii. Opportunity of Integrating the Planned Urban Mass Transit Systems Centering on the SRT Suburban Lines

As listed before, there are several planned mass transit systems. However, it must be pointed out that each system is designed only to serve its own service area, neglecting coordination with other systems to provide a more systematized public transport service.

It would be very unfortunate for millions of Bangkok people to lose the opportunity to enjoy the convenient transport services which can be offered if the individual MRT systems are inter-connected and integrated.

In this situation there is a possibility for the SRT commuter line to be a mainline of urban public transportation, through the individually planned MRTs which can be integrated and totally systematized to provide effective public transportation services, leading to the creation of a public transport-oriented city of Bangkok.

b) Combination of the Area-Wise and Linear Public Transport Service

An urban public transport system is composed of functionally different public transport systems - that is area-wise which is to serve closely within the city just like a city bus, and linear public transport which is to serve speedily between cities, just like the long distance bus line. As such the Bangkok public transport system should be established based on a combination of the area-wise service within the 30 km radius urban area, represented by bus, subway and other MRT, and the linear public transport on urban corridors represented by the suburban railway commuter lines.

c) Hierarchical System of Public Transport

In the hierarchical system of public transport, the lower ranked system is used as a feeder system of the higher ranked system, as shown in Table 3.4.12. For instance, the subway and other subsystems should be designed to work as a feeder system for the railway.

d) Basic Pattern of Public Transport

The basic pattern of public transport is shown in the Fig. 3.4.18, consisting of the SRT suburban line and the following systems.

i. Urban Express Bus

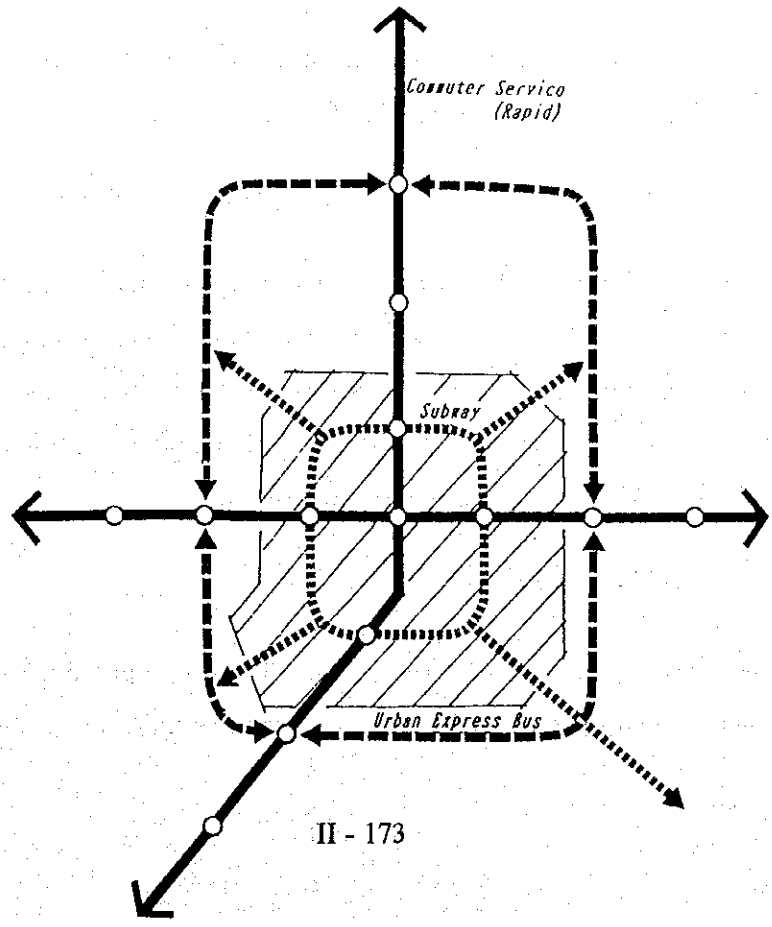
SPMB (Strategic Planning for Metropolitan Bangkok, 1994 MIT) proposes a

trunk bus system which provides public service among subcentral districts along the outer ring road and between BMA and these districts. It is recommended that SRT should utilize this trunk bus system as feeder service for commuter trains in the BMA bounded area.

Table 3.4.12 Feeder System of Main Lines of Public Transport

Main and Sub Lines	Built - up Area (30km)	Suburban Area (50km)
Railway (Suburban Commuter Lines)	1. Subway 2. Other Subsystems 3. Local Buses 4. Taxi and Samlor 5. Car 6. Walk	1. Local Buses 2. Taxi and Samlor 3. Car 4. Walk
Urban Express Bus Lines		1. Local Buses 2. Taxi and Samlor 3. Car 4. Walk
Subway	1. Other Sub Systems 2. Local Buses 3. Taxi and Samlor 4. Car 5. Walk	
Other Sub Systems	1. Local Buses 2. Taxi and Samlor 3. Car 4. Walk	

Fig. 3.4.18 Basic Pattern of Public Transport



ii. Subway

Present proposed subway system can be utilized as a feeder service of SRT inside the Bangkok built-up area. As the city grows, the further extension of subway line into suburban areas especially areas which the SRT cannot serve, should be recommended.

iii. Other Mass Transit

The planned mass transit systems other than the subway are designed to serve particular parts of built-up areas, for instance a part of the existing CBD. These mass transit systems should also be linked to the mainlines of public transport to serve as a subsystem or feeder to them.

3.4.3.4 Railway Transport System and Plan

The railway transport system is proposed and detailed in Volume II, Part III of the report. In this section , only the basic ideas and concepts of the rail system are discussed.

1) Network and System.

The proposed network and system of railway transport is shown in the Fig. 3.4.19. The basic features are summarized as follows:

a) Direct Connection to the central district, or the central station.

Direct connection to the central district is vital to the full scale operation of the suburban lines. Otherwise they can not work as planned in the study both in public transport and urban development. In this regard, the extension of Mae Khlong line to connect to the central station, and the direct connection of the southern line to the central station, are proposed.

b) Crisscrossing Network.

The crisscrossing shaped network (Fig. 3.4.20) is proposed not only to achieve of efficient train operation allowing the commuter trains to go through the central

district from one side to the other without having to stop and return, but also to meet the urban development needs to connect the East and West of Bangkok, in order to relieve the currently congested traffic over the Chao Phraya river and to spread the effect/impact of SBIA, ESB. development over the western side of Bangkok. This is illustrated in Fig. 3.4.21.

Fig. 3.4.19 Railway Transport System

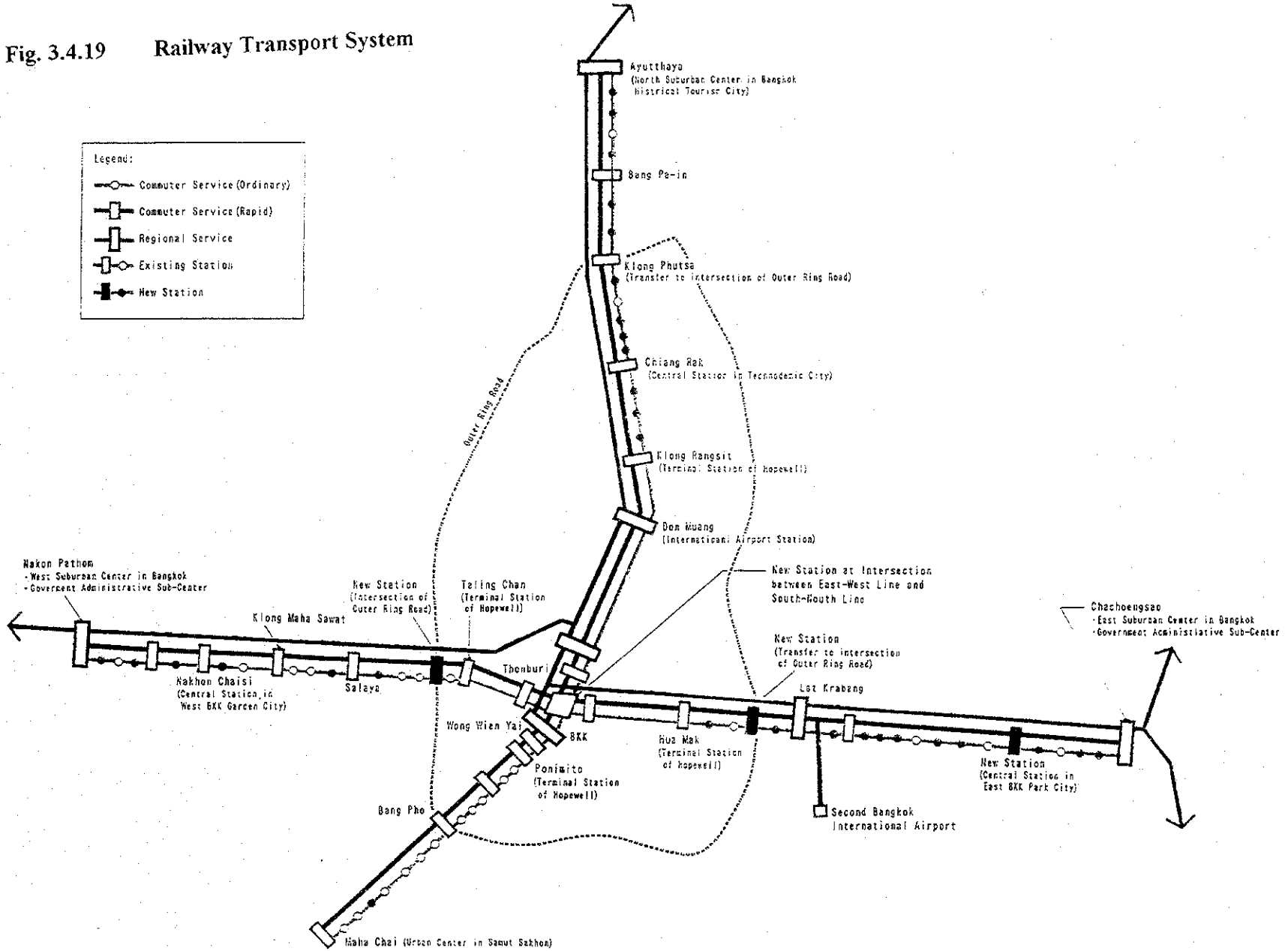


Fig. 3.4.20 Crisscrossing Railway Network

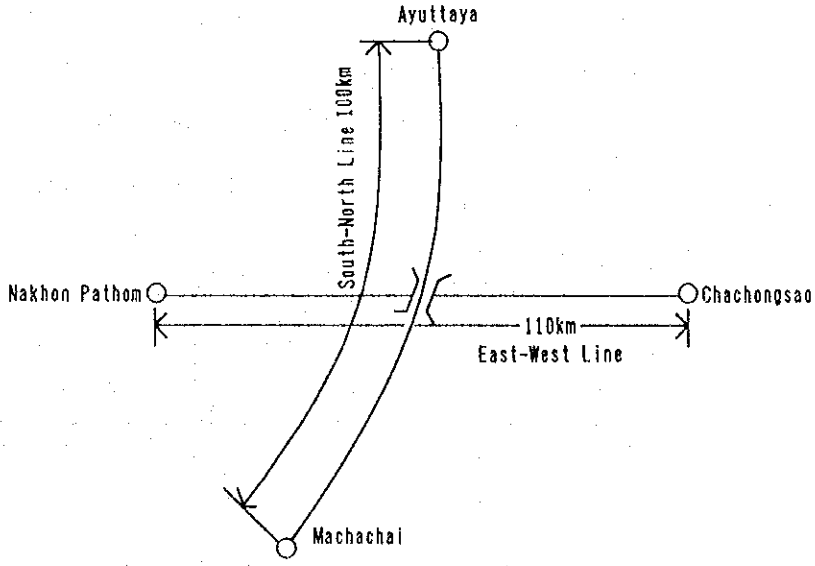
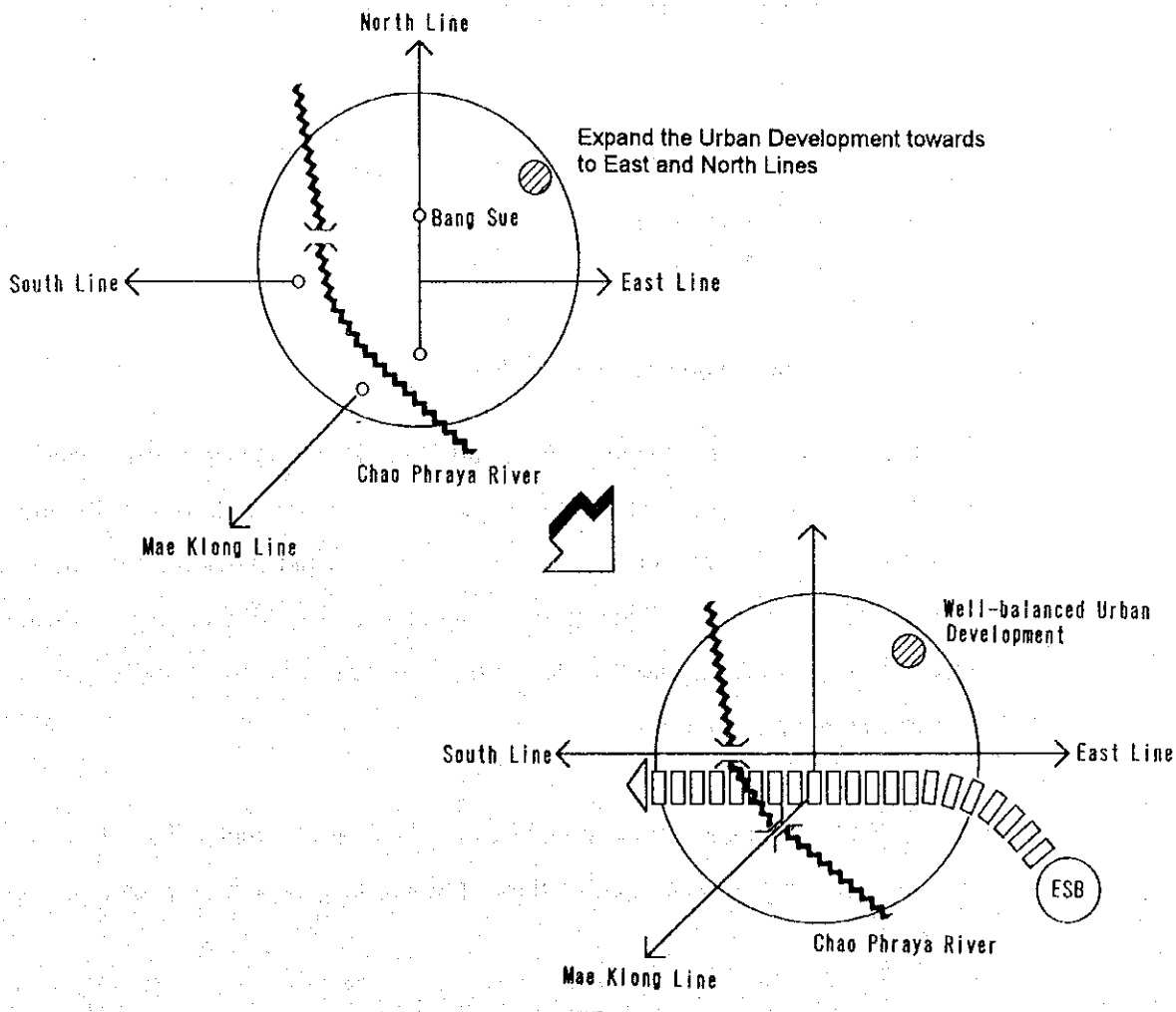


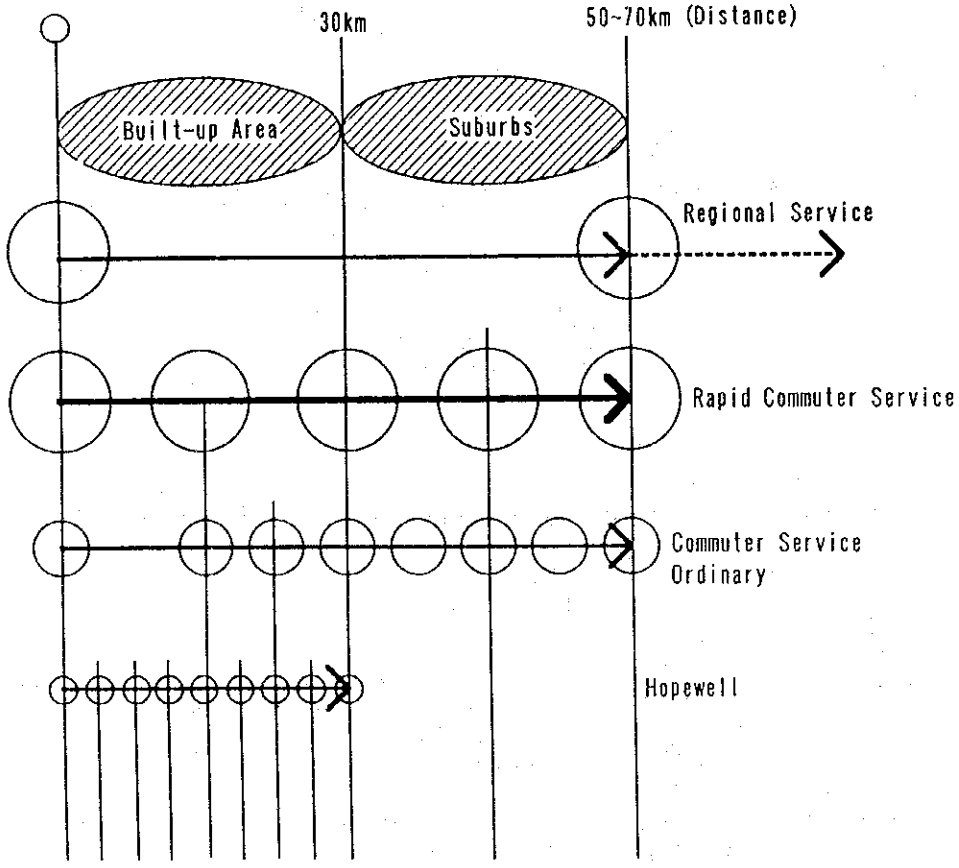
Fig. 3.4.21 Railway System Connecting the West and East Side of Bangkok



2) Operation System

The operation system is proposed in detail in Volume III of the report. Basically it consists of three types of train operation, as shown in Figure 3.46.

Fig. 3.4.22 Basics of Train Operation



3) Station and Transport Node System and Plan

The development of the transport node (station plaza) and feeder system, which is the direct connecting point between urban and railway system, is one of the most important factors for the integration of the urban and rail transport system. The functional transport node, which generates much transfer traffic and gathers many people using various transport modes, is the key factor of urban development of the area adjoining of station.

Existing SRT stations are not supposed to establish an efficient railway transport system due to many problems about these stations, such as lack of access road or

only narrow and poor road access to the station, etc.

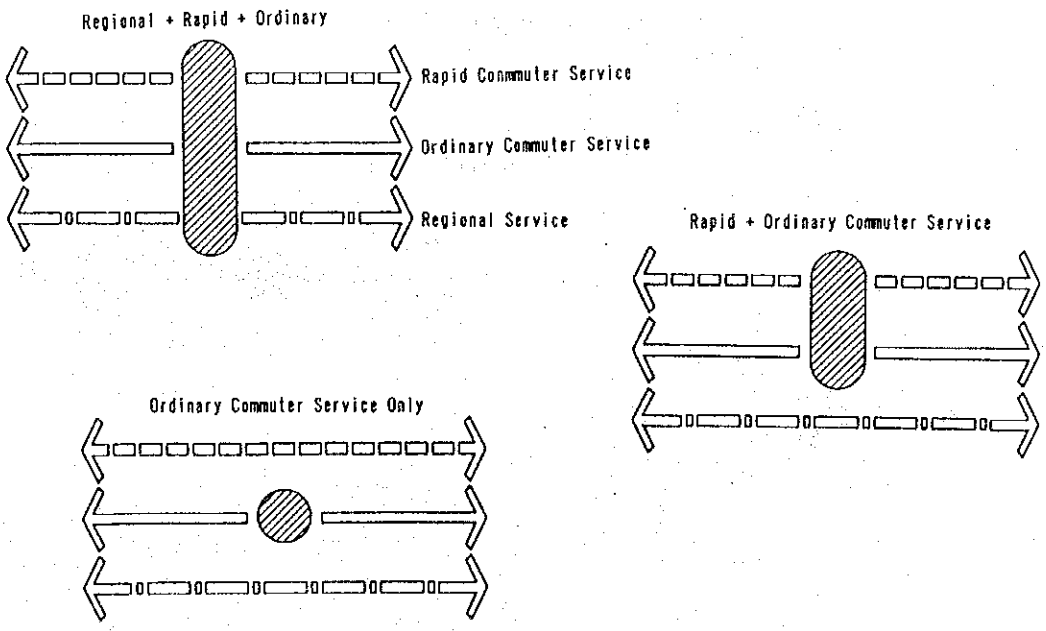
Considering these conditions, the planning direction of the development of SRT station and its station plaza are discussed in the following section. Generally, the station and its plaza are categorized as follows:

- Railway service type;
- Existing land use of adjoining area of station;
- Future development plan of the adjoining area;
- Future railway passengers and its characteristics;
- Access modes to the station;
- Configuration of access road to the station; and
- Location of the station plaza.

a) Railway Service Type

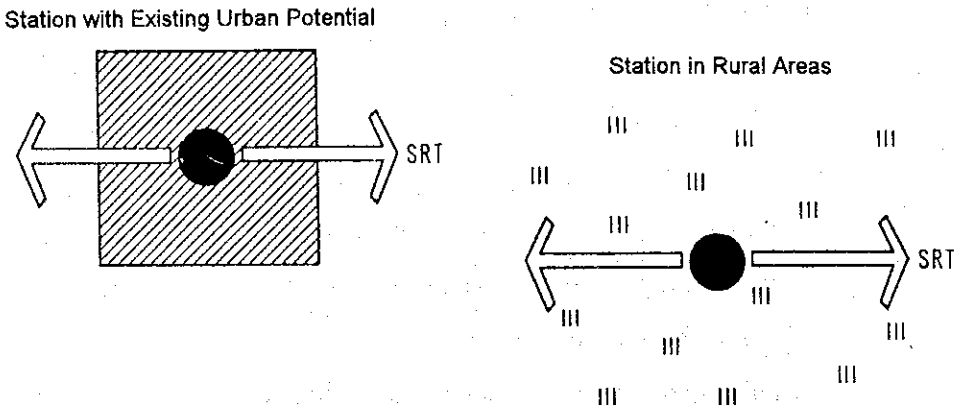
There are three railway service types, namely: regional service, rapid and ordinary commuter service based on the SRT improvement.

Fig. 3.4.23 Type of Railway Service



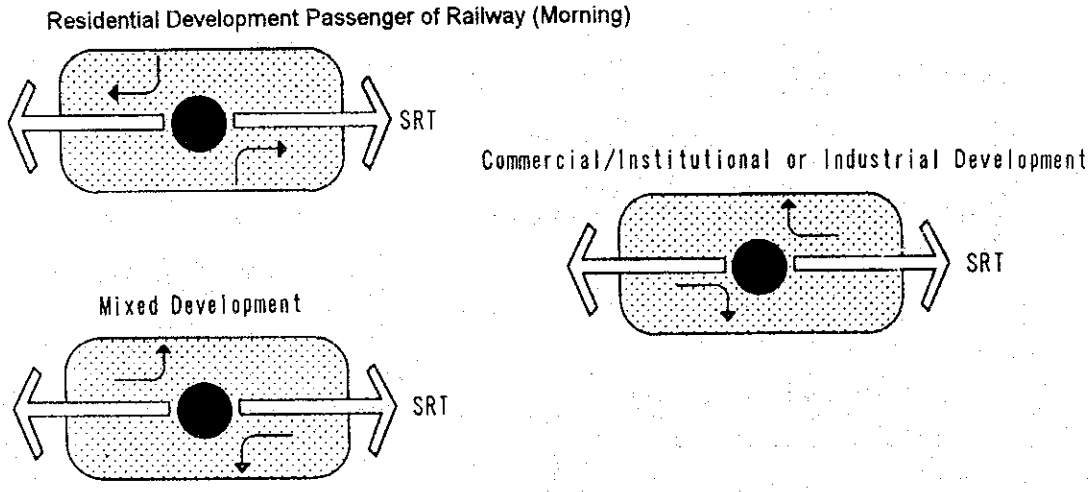
b) Existing Land Use of Adjoining Area of the Station

Fig. 3.4.24 Land Use of Adjoining Area



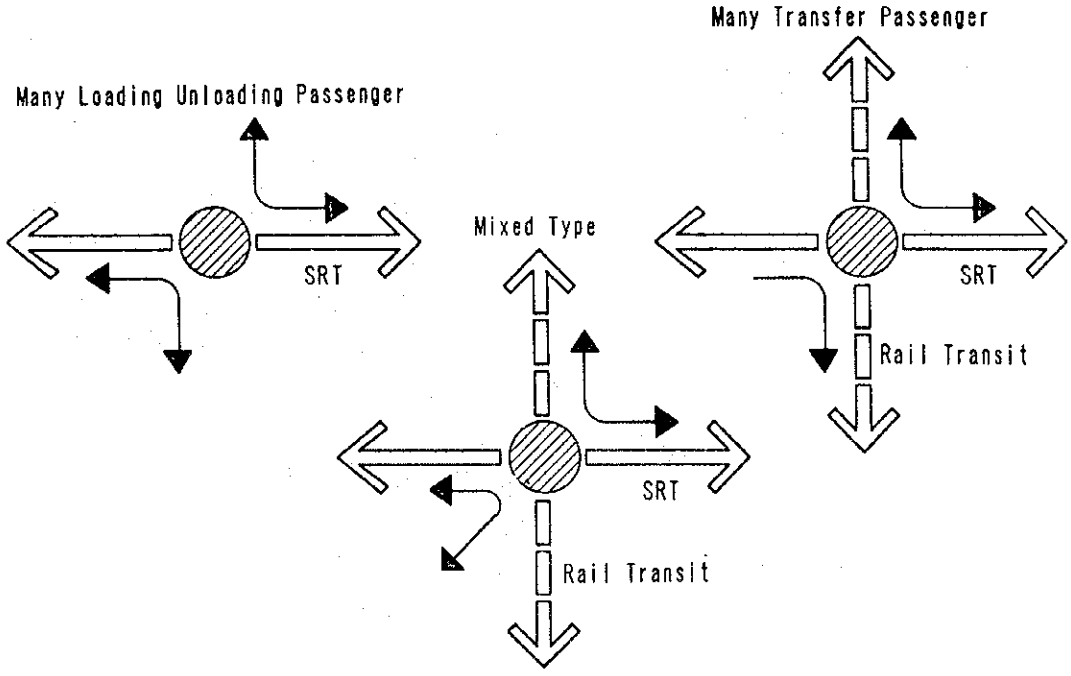
c) Future Development Plan of the Adjoining Area

Fig. 3.4.25 Future Development Plan



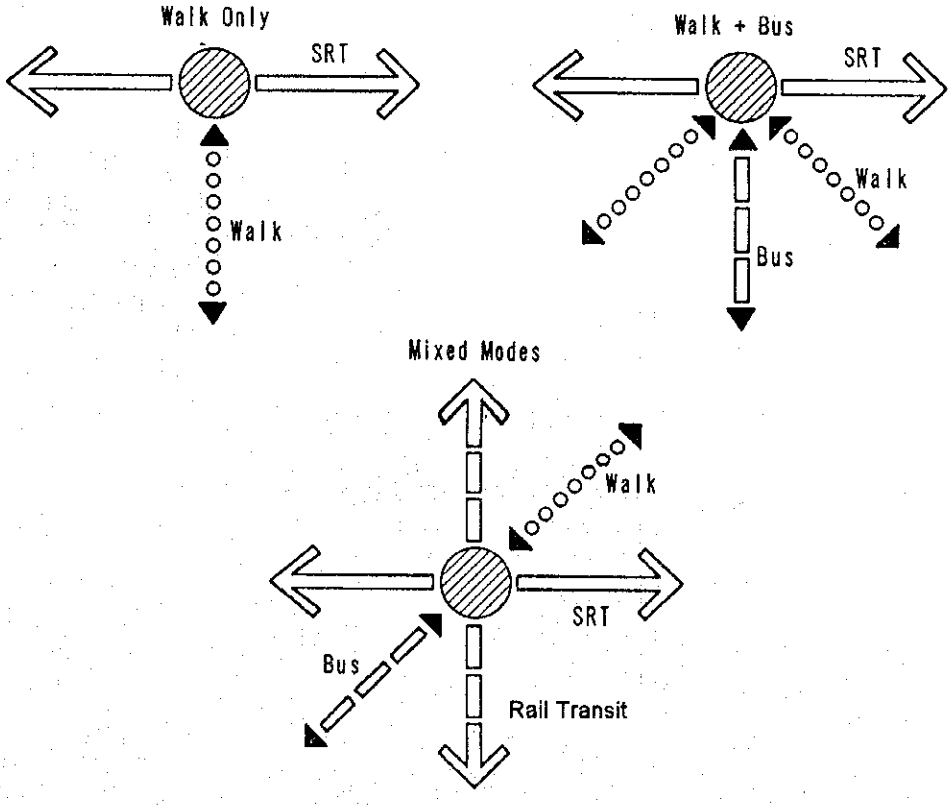
d) Future Railway Passengers and its Characteristics

Fig. 3.4.26 Passenger Volume and its Characteristics



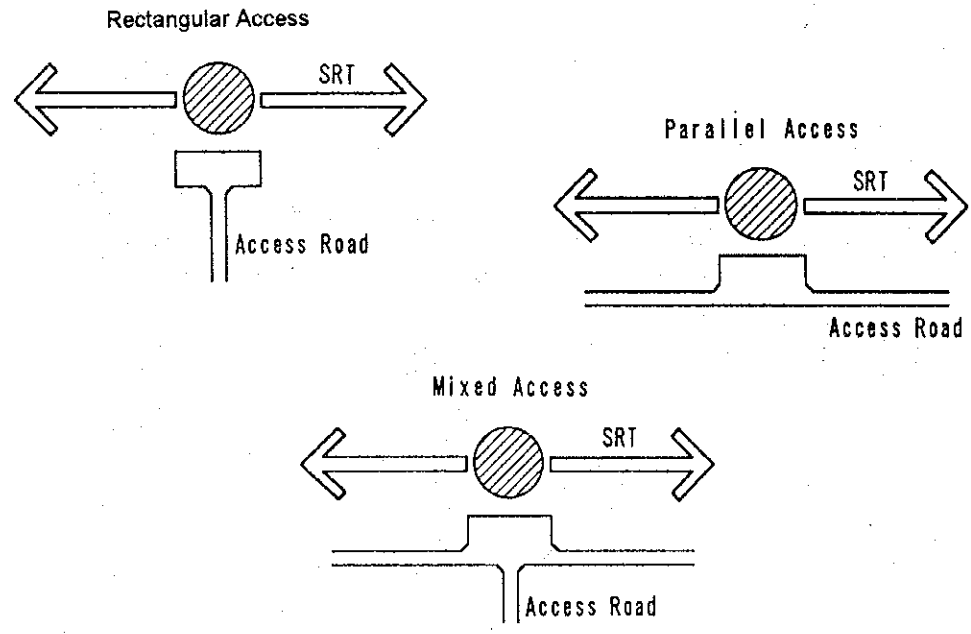
e) Access Mode to the Station

Fig. 3.4.27 Access Mode to the Station



f) Configuration of the Access Roads to the Station

Fig. 3.4.28 Access Road Pattern



g) Location of the Station Plazas

Fig. 3.4.29 Location of Station Plazas

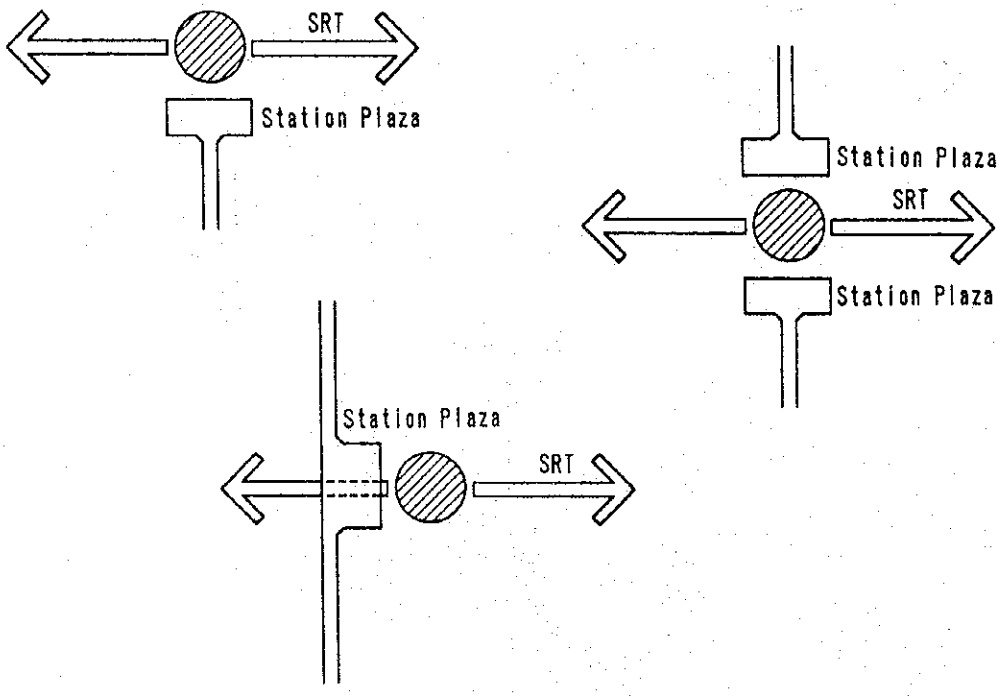


Table 3.4.13 Feeder Systems and Mode Interchange Development by Type of Station

Feeder and Transfer System	Development of Railway Station Adjoining Area	Development of New Town	Development of Multi-mode Intechange Area				
	Existing Urban Center	New Town Center	Subcenter along Outer Ring Road				Potential Point in Bangkok Built-up Area
			Lat Krabang	Bang Pa-In	Taling Chan	Bang Khun Chan	
1. Urban Express Bus	○/×	×	○	○	○	○	×
2. Hopewell	×	×	○	×	○	○	◎
3. Subway	×	×	○	×	○	×	◎
4. MRTS/BTS	×	×	×	×	×	×	◎
5. City Bus ·Busway ·Bus Priority/ Exclusive Lane ·Bus Priority Stop Light	◎	◎	○	○	○	○	◎
6. Long Distance Bus	○	×	×	○	×	×	×
7. Private Car ·Express Way	○/×	◎	○	○	○	○	○/×
·Ordinary Road	◎	◎	○	○	○	○	○
8. Walk	○	○	○	○	○	○	◎
Station Plaza	Mainly Considered Bus System	Preparation of Bus System and Introduction Car Parks for P&R and K&R	The Large Volume of Transfer Traffic between Many Different Modes, such as Rail Transit, Bus and Private Cars, etc.				Considered Pedestrian Space and Transfer System between Urban Rail Transits.

Table 3.4.14 Information of Stations along East Line

LINE	STA NO.	NAME OF STATION	DISTANCE FROM BKK (km)	FEEDER SYSTEM (INCLUDING FUTURE SYSTEM)	ACCESS ROAD (EXISTING)	STATION PLAZA (EXISTING)	URBAN DEVELOPMENT	YEAR 2010 PASSENGER (PAX/DAY)	REMARKS
EASTERN	77	MAKKASAN (ORDINARY+EXPRESS)	5	HOPEWELL SUBWAY BUS TAXI, SAMLOR, BIKE	YES	NO			
	78	KHLONG TAN (ORDINARY)	10	HOPEWELL SUBWAY+WALK BUS TAXI, SAMLOR, BIKE BOAT	YES	YES			
	79	HUA MAK (ORDINARY+EXPRESS)	15	HOPEWELL BUS TAXI, SAMLOR, BIKE SILOR	YES	YES (LOADING AND UNLOADING SPACE OF FREIGHT)	·DEVELOPMENT OF STATION PLAZA ·DEVELOPMENT OF ADJOINING AREA		·TERMINAL OF HOPEWELL SYSTEM
	80	BAN THAP CHANG (OUTER RING ROAD) (ORDINARY+EXPRESS)	21	URBAN EXPRESS BUS BUS TAXI, SAMLOR, BIKE SILOR	YES (NARROW, LONG AND WINDING ROAD)	NO (DEAD END OF ACCESS ROAD)	·DEVELOPMENT OF URBAN SUB CENTER		·MODE INTERCHANGE BETWEEN SRT AND URBAN EXPRESS BUS ALONG ORR
	81	LAT KRABANG (ORDINARY)	27	BUS SONGTHEO, SAMLOR BIKE	YES	NO			·NEW SRT LINE TO SBIA ·URBAN DEVELOPMENT (BANG PLI & BANG PHO AND TANA CITY, ETC.)
	82	HUA TAKHE (ORDINARY+EXPRESS)	31	BUS SONGTHEO, SAMLOR BIKE	YES	NO	·DEVELOPMENT OF NEW URBAN CENTER		
	83	KHLONG LUANG PHAENG (ORDINARY)	40		NO	NO			
	84	PRENG (ORDINARY+EXPRESS)	47	BUS	YES	NO	·DEVELOPMENT OF NEW URBAN CENTER		
	85	(ORDINARY)			NO	NO			
	86	KHLONG BANG PHRA (ORDINARY)	54		NO	NO	·NHA LOW COST HOUSING PROJECT		
	87	CHACHOENGSAO (ORDINARY+EXPRESS)	61	BUS SONGTHEO, SAMLOR BIKE	YES	YES	·DEVELOPMENT OF STATION PLAZA ·DEVELOPMENT OF ADJOINING AREA		

Table 3.4.15 Information of Stations along North Line

LINE	STA NO.	NAME OF STATION	DISTANCE FROM BKK (km)	FEEDER SYSTEM (INCLUDING FUTURE SYSTEM)	ACCESS ROAD (EXISTING)	STATION PLAZA (EXISTING)	URBAN DEVELOPMENT	YEAR 2010 PASSENGER (PAX/DAY)	REMARKS
NORTHERN	1	BANGKOK (ORDINARY+EXPRESS)	0	HOPEWELL SUBWAY MRTS BUS TAXI, SAMLOR, BIKE	YES	YES			
	2	SAMSEN (ORDINARY+EXPRESS)	4	HOPEWELL SUBWAY BUS TAXI, SAMLOR, BIKE	YES	YES			
	3	BANG SUE JUNCTION (ORDINARY+EXPRESS)	7	HOPEWELL SUBWAY MRTS BUS TAXI, SAMLOR, BIKE	YES	YES			
	5	BANG KHEN (NO SRT STATION IN THE FUTURE)	13						
	6	LAK SI (NO SRT STATION IN THE FUTURE)	18						
	7	DON MUANG (ORDINARY+EXPRESS)	22	HOPEWELL SUBWAY(FUTURE EXT.) BUS TAXI, SAMLOR, BIKE	YES (WIPAWADHI RANGSIT)	YES (BUS BAY)			
	8	KHLONG RAGSIT (ORDINARY+EXPRESS)	28	HOPEWELL BUS TAXI, SAMLOR, BIKE SONGTHEO	YES (NEW SITE)	NO (SingleSPACE)	·REDEVELOPMENT OF ADJOINING AREA OF STATION		·TERMINAL OF HOPEWELL SYSTEM ·REMOVE OF SRT STATION TO THE NORTH
	9	CHIANG RAK (ORDINARY+EXPRESS)	37	BUS SONGTHEO, SAMLOR BIKE, BOAT	YES (NARROW ROAD FROM ROUTE 1)	YES (SMALL SPACE)	·CENTRAL STATION OF TECHNODEMIC CITY		·TAMASAT UNV., AIT & HI-TEC PARK
	10	CHIANG RAK NOI (ORDINARY+EXPRESS)	46	BUS SONGTHEO, SAMLOR BIKE, BOAT	YES (NARROW ROAD FROM ROUTE 1)	YES (SMALL SPACE)			
	11	KHLONG PHUTSA (ORDINARY)	52	URBAN EXPRESS BUS			·DEVELOPMENT OF STATION PLAZA		
	12	BANG PA-IN (ORDINARY+EXPRESS)	58	BUS TAXI, SAMLOR, BIKE SONGTHEO	YES	YES	·DEVELOPMENT OF STATION PLAZA		
	13	BAN PHO (ORDINARY)	63						
	14	AYUTTHAYA (ORDINARY+EXPRESS)	71	BUS TAXI, SAMLOR, BIKE SONGTHEO	YES	YES	·DEVELOPMENT OF STATION PLAZA ·DEVELOPMENT OF ADJOINING AREA		

Table 3.4.16 Information of Stations along South Line

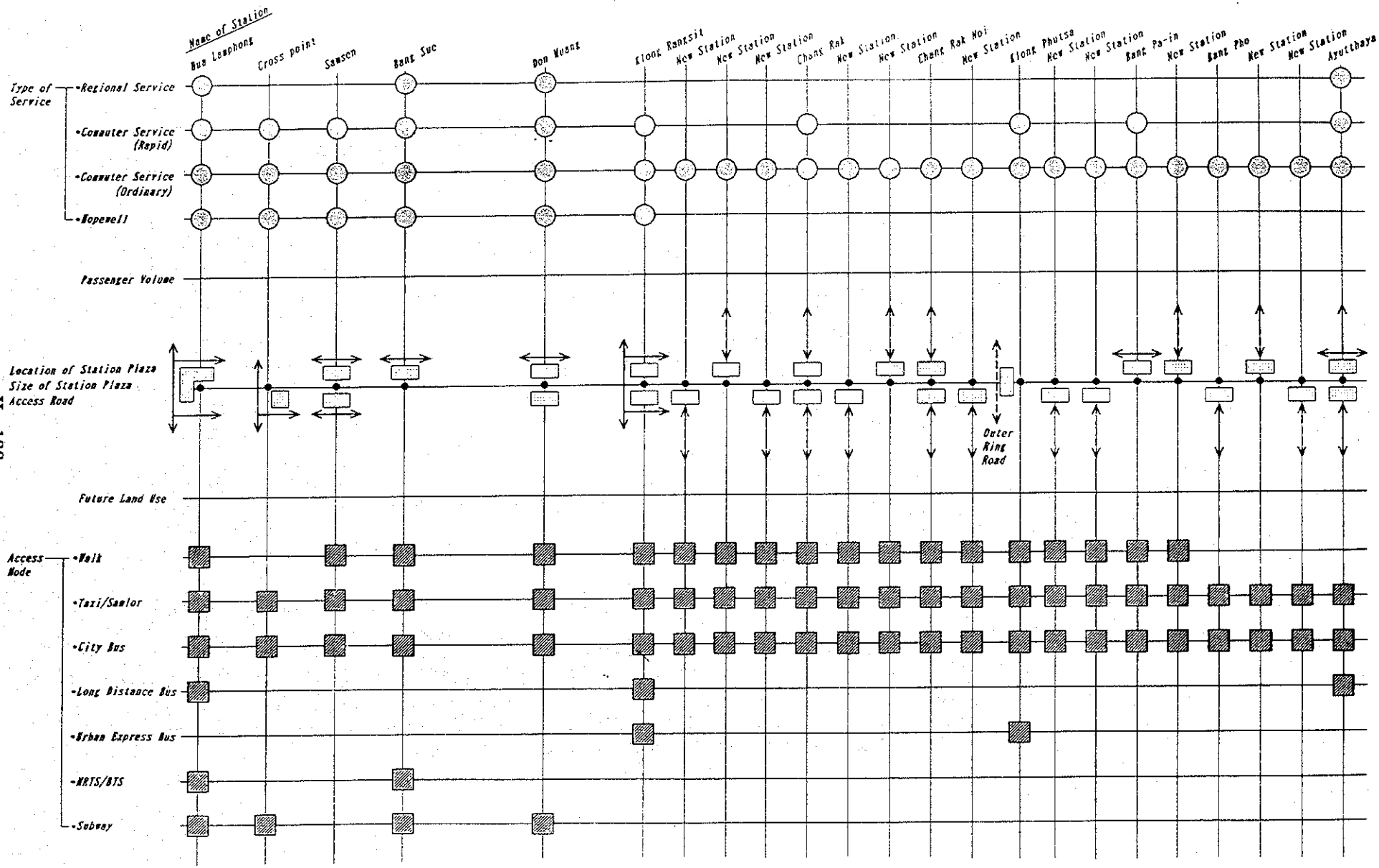
LINE	STA NO.	NAME OF STATION	DISTANCE FROM BKK (km)	FEEDER SYSTEM (INCLUDING FUTURE SYSTEM)	ACCESS ROAD (EXISTING)	STATION PLAZA (EXISTING)	URBAN DEVELOPMENT	YEAR 2010 PASSENGER (PAX/DAY)	REMARKS
SOUTHERN	114	THON BURI (ORDINARY+EXPRESS)	28	HOPEWELL BUS BOAT TAXI, SAMLOR, BIKE	YES (NARROW ROAD)	YES			
	115	TALING CHAN JUNCTION (ORDINARY)	22	HOPEWELL BUS TAXI, SAMLOR, BIKE					
	116	BANG BAMRU (ORDINARY)	18	BUS					
	117	BANG SON (ORDINARY)		BUS					
	118	BAN CHIMPHLI (OUTER RING ROAD) (ORDINARY+EXPRESS)	25	URBAN EXPRESS BUS BUS TAXI, SAMLOR, BIKE SONGTHEO	NO	NO	・DEVELOPMENT OF URBAN SUB CENTER		・MODE INTERCHANGE BETWEEN SRT AND URBAN EXPRESS BUS ALONG ORR
	119	SALA THAMMASOP (ORDINARY)	30	BUS	YES				
	120	SALA YA (ORDINARY+EXPRESS)	35	BUS, MINIBUS TAXI, SAMLOR, BIKE SONGTHEO, BOAT	YES	YES	・DEVELOPMENT OF STATION PLAZA ・NEW HOUSING DEVELOPMENT		・WESTERN BANKOK GARDEN CITY (PROPOSED)
	121	WAT SUWAN (ORDINARY)	40	BUS	YES	YES (SMALL SPACE)			
	122	KHLONG MAHA SAWAT (ORDINARY+EXPRESS)	43	BUS	YES	YES	・DEVELOPMENT OF STATION PLAZA ・NEW HOUSING DEVELOPMENT		
	123	WAT NGIU RAI (ORDINARY)	47	BUS	YES	YES			
	124	NAKHON CHAISI (ORDINARY-EXPRESS)	51	BUS	YES	NO (DEAD END OF ACCESS ROAD)	・DEVELOPMENT OF STATION PLAZA ・DEVELOPMENT OF ADJOINING AREA		
	125	THA CHALAEP (ORDINARY)	56	BUS	YES	NO			
	126	TON SAMRONG (ORDINARY)	60	BUS	YES	NO			
	127	NAKHON PATHOM (ORDINARY+EXPRESS)	64	BUS	YES	YES	・DEVELOPMENT OF STATION PLAZA ・DEVELOPMENT OF ADJOINING AREA ・HOUSING DEVELOPMENT		

Table 3.4.17 Information of Stations along Mae Klong Line

LINE	STA NO.	NAME OF STATION	DISTANCE FROM BKK (km)	FEEDER SYSTEM (INCLUDING FUTURE SYSTEM)	ACCESS ROAD (EXISTING)	STATION PLAZA (EXISTING)	URBAN DEVELOPMENT	YEAR 2010 PASSENGER (PAX/DAY)	REMARKS
MAE KLONG		WONGWIAN YAI (ORDINARY+EXPRESS)	0	HOPEWELL SUBWAY BUS	YES (NARROW ROAD)	NO			
		TALAT PHLU (ORDINARY)	2	HOPEWELL BUS					
		WAT SING (ORDINARY)	7	BUS					
		RANG PHO (ORDINARY+EXPRESS)	14	URBAN EXPRESS BUS BUS			・DEVELOPMENT OF URBAN SUB CENTER		・MODE INTERCHANGE BETWEEN SRT AND URBAN EXPRESS BUS ALONG ORR
		(ORDINARY+EXPRESS)					・NEW HOUSING DEVELOPMENT		
		MAHA CHAI (ORDINARY+EXPRESS)	31	BUS	YES	YES (SMALL SPACE)	・DEVELOPMENT OF STATION PLAZA ・DEVELOPMENT OF ADJOINING AREA		
		BAN LAEM	0						
		MAE KLONG	34						

NOTE : EXCLUDING STATIONS WITHIN BKK BUILT-UP AREA
EXCLUDING STATIONS LOCATED OUTSIDE 50 KM FROM BKK
(CHONBURI, SARABURI, NAKHON SAWAN, NAKHON RACHASIMA, KANCHANABURI, RATCHABURI)

Fig. 3.4.30 Station and its Plaza along North Line



3.4.3.5 Integrated Capital City Development

(1) General Development Plan of Bangkok Capital City

Based on the proposed future urban structure of Bangkok Capital City as discussed above, the general development plan is presented as shown in Fig. 3.4.30 and elaborated in this section.

1) Basic Development Concepts and Scenario

The basic concepts underlying the general development plan are summarized as follows;:

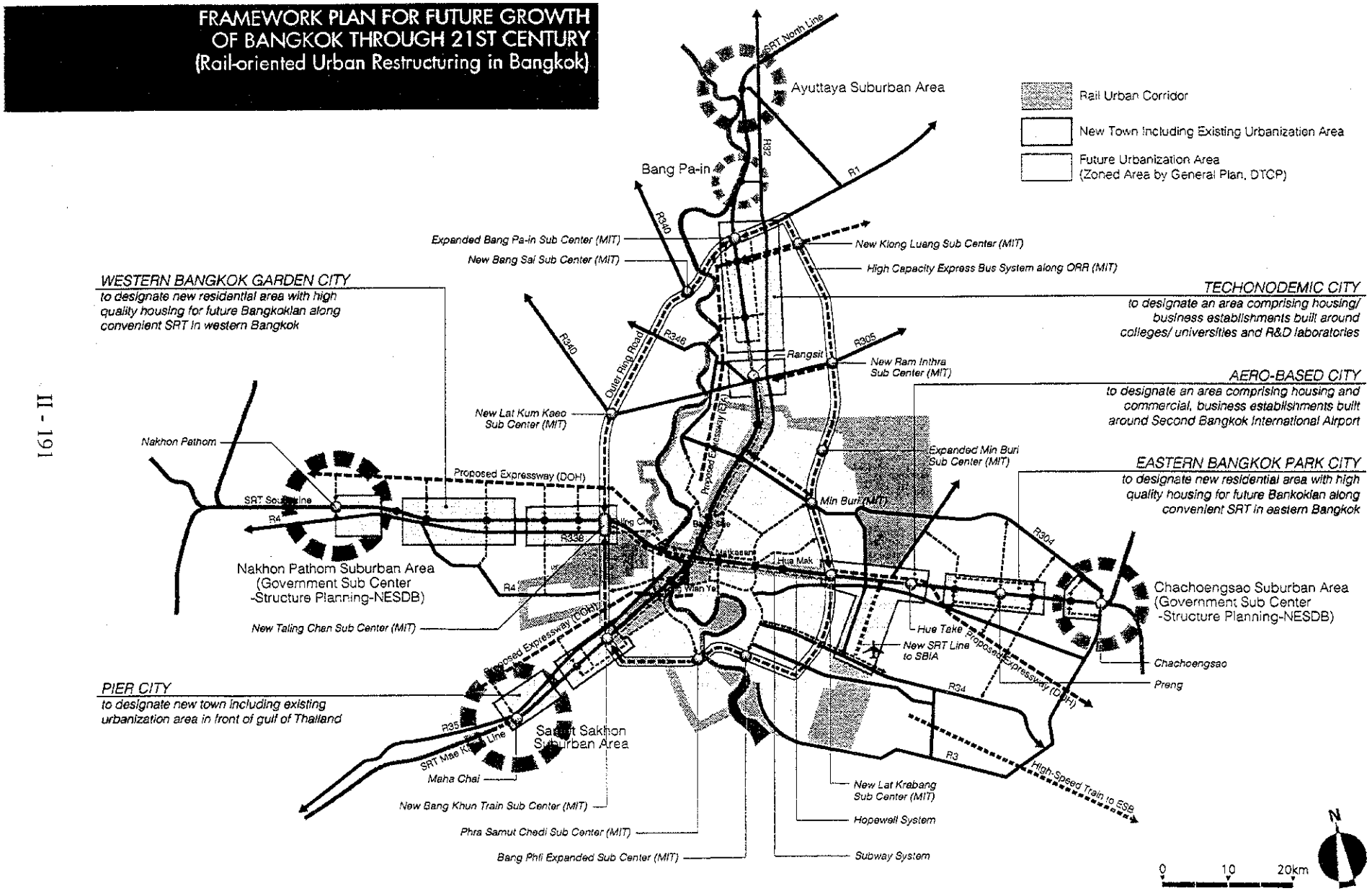
a) Bangkok Integrated Capital City will be composed of Bangkok central district, contiguous built-up area, suburban area and the local regional urban centers (Chachoengsao, Ayutthaya and Nakhon Pathom), located within approx. 50 km radius from the center of Bangkok.

b) Urban corridors radiating to the four (4) directions from the center of the city are designed to systematize and structure the urban areas, land uses, socioeconomic activities and traffic movements within the city.

c) Intensive land use urban zones along the corridors should be developed with the outward urban sprawl, including such urban development as new towns being discouraged in the areas other than the urban corridors from the viewpoint of city planning and development aiming at the efficient and effective urban land management. In this manner, the general built-up area centering on the existing CBD of Bangkok is to stretch within the range of 30 km radius, which is equivalent to the land area, the land uses (or zoning) of which are designated in the Bangkok general plan. It implies that the urban land development shall not be allowed to expand outward beyond the general built-up area designated above.

d) The classified urban areas constituting Bangkok Capital City must be mutually interacting through the urban corridors in developing the Capital City. The urban corridors shall be grow based on the development scenario presented in Fig. 3.4.31.

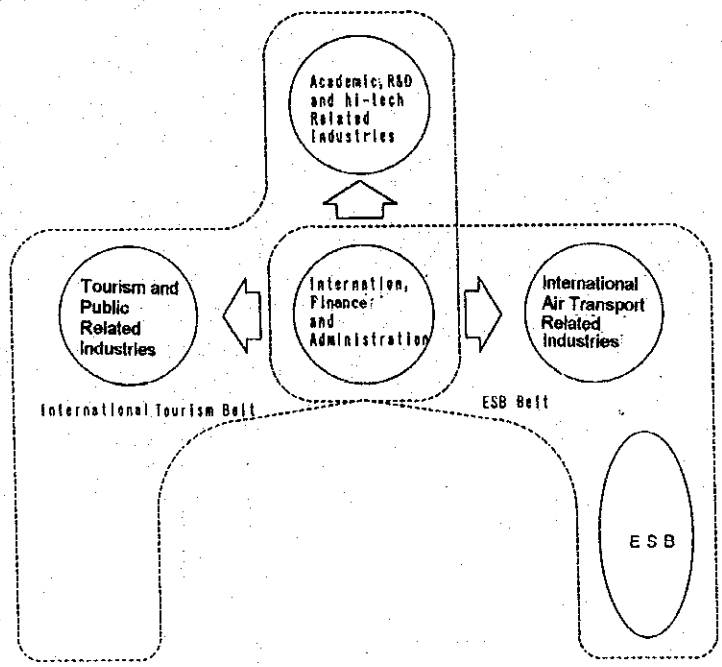
Fig. 3.4.31 General Development Plan of Bangkok Integrated Capital City



Taking into consideration the locational conditions and development potentials of each corridor, industrial development of new towns is envisioned with international aero-related industry in the eastern corridor, a combination of science and advanced (high tech) industries in the northern corridor, and a combination of tourism and social industries in the western corridor.

Parallel with the new town developments, knowledge and information-oriented industry, finance and managerial business will become predominant in the central part of Bangkok.

Fig. 3.4.32 Development Scenario



- Eastern Corridor

  On the eastern corridor leading to ESB, the aero-related city should be fostered centering on the SBIA and including the urban areas around it. It is due to accommodate service industries related to the operation of the airport, international exchange and trade as well as high-tech industry relying on the international air freight system. On the other hand, improvements should be made on the governmental administrative service through the construction of the government sub center planned to be realized in Chachoengsao. In the middle of the suburban area, new towns offering new lifestyle shall be built in order to accommodate the workers of the industries stated above, as well as the commuters to Bangkok and ESB.

- Northern Corridor

  This area is characterized by science technology and research represented by the universities, and pioneering/advanced industries represented by the Hi-Tech Industrial Estate. The new town, with its combination of industries and science research, will lead the advancement and high value added industries, especially manufacturing industries which will be further needed for Thailand.

- Western Corridor

  The western part of BMR is endowed with natural and tourism resources. The leading industry in this area is and will continue to be tourism. However, the quality of the existing tourism cannot be rated high from the viewpoint of international and national tourism in the 21st century and its innovation is vital for tourism promotion. It is recommended that a metropolitan tourism base should developed in association with the new town development so as to become a focal point for tourism which is will catalyze the innovation of the existing tourism facilities and network them. In particular, the accessibility to the international and national tourist trains on the south line will bring about greater development for the proposed tourism base.

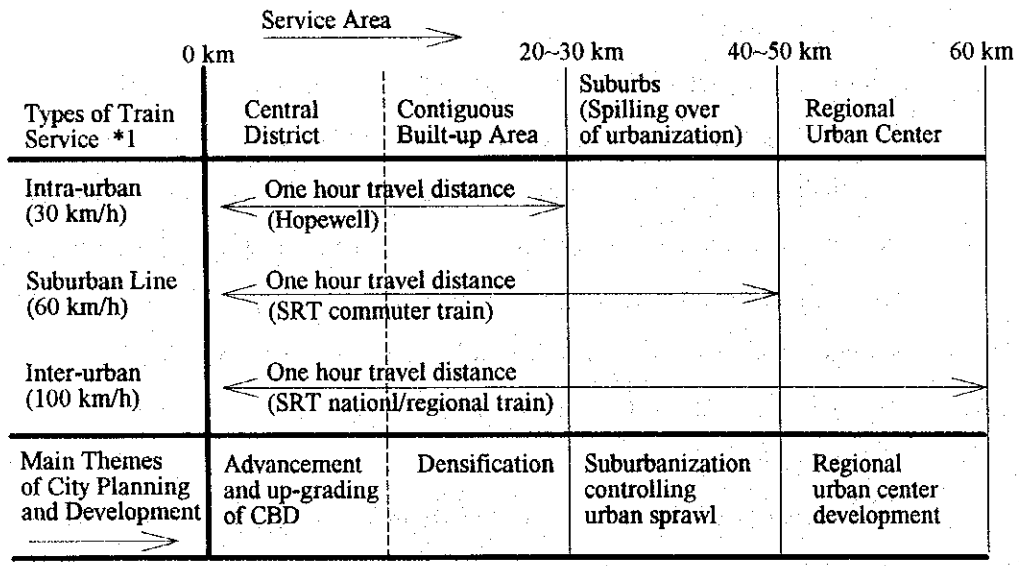
2) Integrated System of Rail-Transport-Based Urban Corridor

The integration of railway into urban structure or the integrated system of urban and railway development has been repeatedly discussed in the preceding chapters especially in the sections of the Proposed General System of Regional/Urban Mass Transport, Urban Structure for Integrated Capital City.

The railway improvement plan being integrated with urban development and the urban structure has in greater detail already been presented. This section will present the integrated urban and railway development on the proposed urban corridors.

The integrated system can be established through securing correspondence between the types of railway transport service provided, the service area (land use and size of the areas) and the main themes of city planning and development, as presented in Fig. 3.4.33 and summarized below.

Fig. 3.4.33 Correspondence Between Type of Train Service, Service Areas and Urban Development Themes



*1: Referred to the proposed general system of mass transport

- All the urban areas will mainly to be included within one hour travel time and

distance from the center of Bangkok by means of train transport of different types, in response to the different needs and requirements of the urban areas.

- Due to the transport improvement by railway, especially the reduction in travel time, the areas' development potential will be tremendously raised. This will make it possible to implement urban developments based on the areas' own needs and potential aiming at the following main themes of city planning and development.

  i. Advancement and upgrading of the CBD into a first grade international city;
  ii. Densification in/around the built-up area where the accessibility is highest due to the improved railway;
  iii. Suburbanization for accommodating urban activities and population in the process of innovation and growth of Bangkok; and
  iv. Regional urban center development in response to the regional growth.

(2) Integrated Urban and Railway Development Schemes

The integrated urban and railway development, that is, urban development integrated with the improved railway, is divided into two types of schemes, namely the urban redevelopment/renewal of CBD and the suburban development.

1) Urban Redevelopment/Renewal of CBD

a) Redevelopment for Intensification and Densification of Land Use Along the Railways

Admittedly, the present rail lines serve the governmental and official areas of Bangkok while most commercial, business and residential development has occurred in other areas such as Silom, Ratchadaphisek, etc. It is not unusual for commercial development potential along the rail line or around the stations to have remained quite low because the rail lines have not been used very much by

the people. It seems difficult to implement commercial development based on the existing conditions of the railway. However, it is anticipated that great urban development potentials will be realized around the stations once a large number of people start using the rail lines through the improvement of the railway especially in the wake of large scale suburban development.

In this respect, the commercial development should be progressively carried out in parallel with the railway improvement. Urban and commercial development would help improve the urban environment along the railway and bring about "positive image/feeling" of people for the railways, which up till now have been negative and poor. An urban complex with good amenities, well designed landscape, and comfortable environment around the stations will be one of the promotional measures for increasing railway ridership.

The area along the rail lines features the less intensive land use such as those of freight transport facilities, yards, factories, large scale vacant land, and so on. It is recommendable to redevelop the land in connection with the railway improvement where the facilities not essential to the CBD as well as to Bangkok, are relocated toward the suburbs. The sites of the existing government offices which are planned to relocate in the new government administrative centers of Chachoengsao and Nakhon Pathom will also be redeveloped in the direct service area of the railway.

The redevelopment of the sites around the stations in the central district should be planned and programmed as a process of densification and changing land use caused by the railway improvement and also as a necessary process of urban renovation and advancement for the central district of Bangkok toward a first grade international capital center.

Urban redevelopment along the railways can be viewed as a part of the densification of the city center, as suggested in the SPUR study stating that the objectives to discourage further sprawl and consolidate within the city are:

- to use vacant and under-utilized land within the city;
- to develop at relatively high density, 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 system of planing.

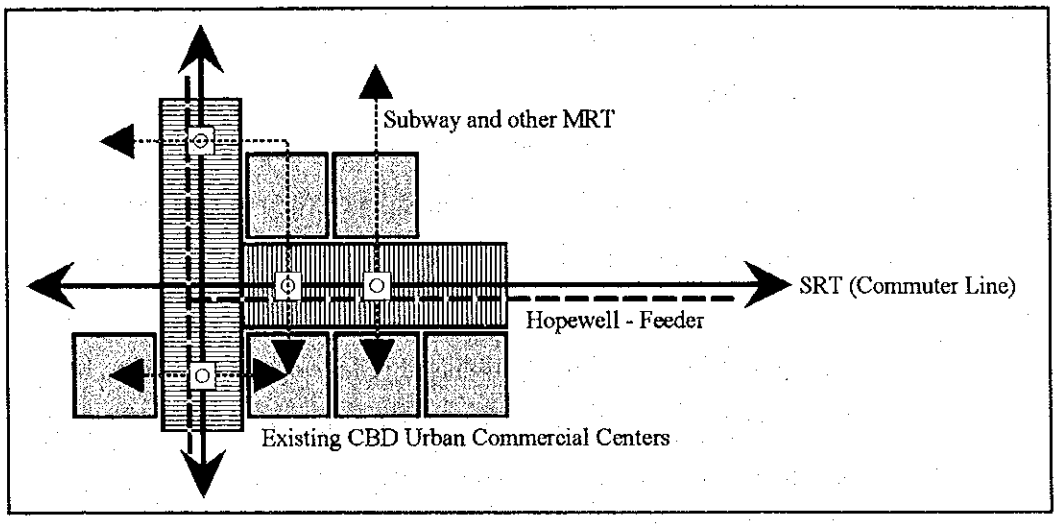
It must also be stated that rail-based redevelopment seems to be in line with the development policy of re-urbanizing Bangkok proposed in MRSP study which says that Bangkok has enormous opportunities within the large pockets of un-urbanized areas located entirely within the Metropolis. Bangkok should follow the path of building " New Communities in the Metropolis" (Excerpts are presented in Table 3.4.9). There are many non-urbanized tracts of lands along the railways since the railway itself became a physical barrier preventing urbanization in areas along it.

b) Rail Urban Corridors Restructuring CBD of Bangkok

The existing CBD and urban centers such as Silom, Siam Center, and others are at presently outside of the direct service area of the railways. As a high priority, they must be connected to the railway through the planned urban mass rapid transport systems such as Tanayon, MRTA, and buses and taxis.

As the rail urban corridors accompanied with the intensification and densification of land uses through urban redevelopment will emerge, the existing CBD and the urban corridors will be merged into one integrated CBD of Bangkok Capital City, with the development focus transferred to the urban corridors, as shown in Fig. 3.4.34. This implies that CBD restructuring will be correspondingly needed in order to transform Bangkok capital into a public transport based city.

Fig. 3.4.34 Future CBD Including the Rail Urban Corridor and the Existing CBD



The railway and the rail urban corridor are supposed to work in the direction of integrating the existing urban centers scattered within the central district of Bangkok.

c) Renovation of the Central District of Bangkok for the Next Generation

Urban development on the rail urban corridors in the central district, where the existing land use is less intensive and facilities such as those of transport /distribution industries and other to be relocated in the suburbs are dotted, must be well planned and implemented in order to accommodate the urban activities needed for the next generation. These include information/knowledge oriented industry, finance and trade industries, managerial business and so on, as defined in the development scenario in the preceding section. It may be concluded that urban redevelopment integrated with railway improvement seems to offer a great chance for the renovation of the central district of Bangkok.

2) Suburban Development

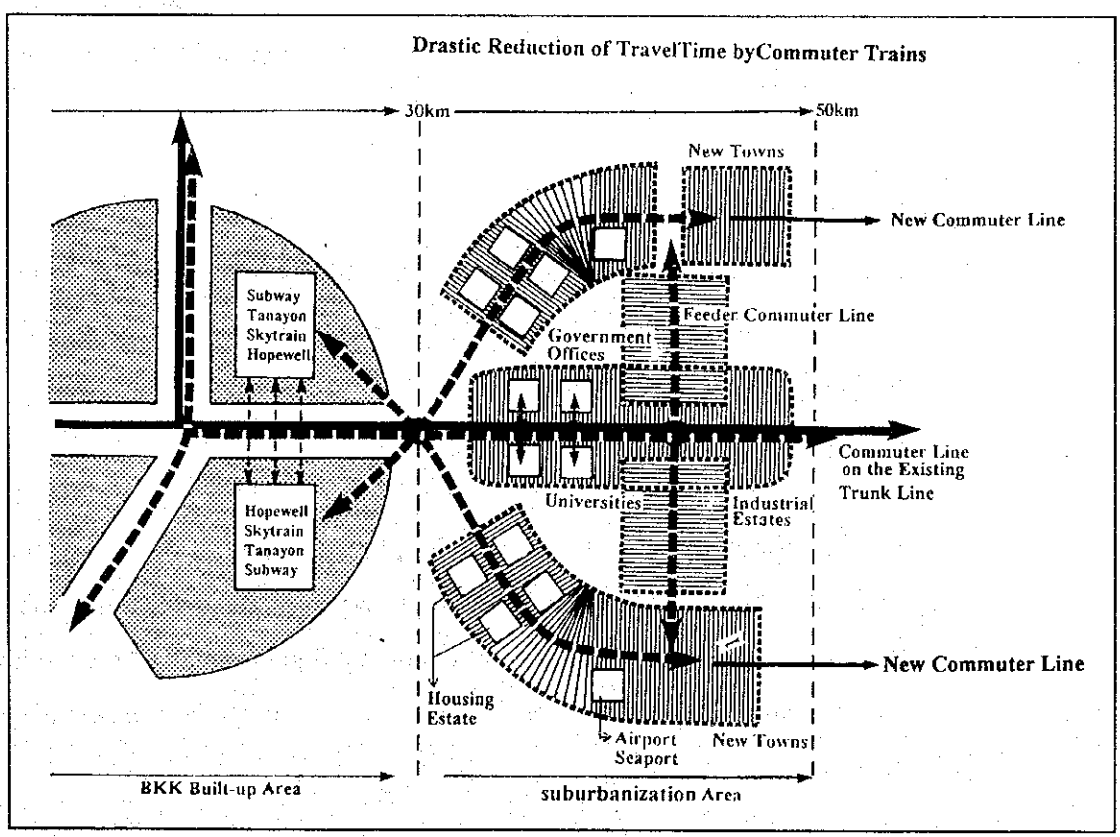
a) Typical Patterns of Integrated Urban and Railway Development for Suburban Development

The principal concept of integrated urban and railway development can be simply defined that the railway should be developed in non-urbanized areas with poor transport conditions, with a view to tapping the land resources, for accommodating the increasing demand for urban land.

In the planning process of the integrated development, the alignment of the commuter line must be planned with due consideration given to the constraints and potential of urban development, and an appropriate urban and land development plan based on rail-transport. In turn, an urban development plan must be set up with due consideration to the possible rail transport development plan.

This reciprocal planning approach will lead to some of the typical patterns of integrated urban and railway development as illustrated in Fig. 3.4.35.

Fig. 3.4.35 Typical Patterns of Integrated Urban and Railway Development in Suburbs



The integrated development plans, including railway development plan and urban development plan, must be worked out by direction or corridor, which differs depending on local conditions. Either of the basic patterns shown in Fig. 3.4.34 and outlined below will be applied to them.

The typical patterns show the three basic patterns of the improved existing line, the new main commuter line and the new branch commuter line with association of some urban development ideas, as shown in Table 3.4.18.

Table 3.4.18 The Typical Development Pattern

Railway development alternatives	Urban development ideas
1. The commuter line on the existing railway 2. New main commuter line 3. New branch commuter line	1. Provision of housing for employment in Bangkok 2. Relocation of urban activities and facilities 3. Transport related urban activities and industries 4. Urban development related to the redevelopment of the existing CBD

Commuter Line Development

- New main commuter line on the existing right of way of the improved railway;
- New main commuter line, which will be constructed to serve areas out of reach of the main commuter service; and
- The new branch commuter lines of the main line.

Feeder transport system of the trunk lines in the range of 30-50 km. radius, as described above, will use the road transport system (cars, taxis, buses and others). However, it could be feeder (branch) commuter line in areas where there is large feeder transport passenger demand, as in the case of urban housing developments.

Ideas of Urban Development Along the Improved Railway

- Development of the academic and science town which is expected to lead the high tech-industries in Thailand;
- Development of the airport-front-town to be fostered in association with international air transport industries;
- Development of the urban industrial town in which the existing light industries will be relocated and modernized; and
- Development of new towns on a large scale where the daily life needs are mostly met.

Necessity of New Town for the Integrated Urban and Rail Development

The main reasons for proposing new town development in the integrated urban and railway development are as follows:

- Necessity of urban development size large enough to make the railway operation feasible in terms of patronage. (A greater number of supportive population and employment must be accumulated along the railway);
- Necessity of development and implementation system which must be devised to make large scale urban developments like new towns possible, other than the conventional methods such as those of real estate development by private developers and spontaneous urbanization: and
- Necessity of creating organically unified urban areas, not the patchwork of the built-up areas, namely cities and towns, within which the basic needs of peoples' daily lives are mostly fulfilled.

As such "new town" suggests meeting the needs of a large population, development/ implementation system for materializing the large scaled development in a planned manner, and others for the urban and railway development.

General Definition of New Town Characters

The main factors influencing the basic characters of new towns to be developed along the improved railway are classified as follows:

- General outward urbanization trends continuing from the past — mainly housing mixed with some commercial and industrial activities;
- Prospects for local socioeconomic/industrial development, which are expected to bring and create employment in their localities, taking advantage of such developmental possibilities as:

  i. Relocation of urban activities and industries like those of universities, manufacturing/distribution industries, government offices and some kinds of business offices, commercial and recreational facilities, hotels and others into these localities; and
  ii. Development of innovative transport system and industries which are expected to raise the urban and industrial development potentials in their localities. The typical example is the SBIA and the development of the area around SBIA. The improved railway may fall into this category.

  As shown in the ideas of urban development in the preceding section, the proposed new towns such as academic and science town, airport based town and urban industrial town and the like seem to be in line with this development.

- Prospects of industrial development based on the indigenous resources in their localities. A typical example is found in Chachoengsao which is recommended to be developed based on its indigenous resources including natural and human resources and others.

Independent cities such as the self-contained, job-housing balance, SBIA centered metropolis and regional centers are designed to grow based on their industrial development potential which are presumed to create a large volume of employment in their localities, so as to achieve the goal of "Independence from Bangkok". In this

situation, special attention must be given to such factors as the effects of the improved railway in order to determine the future character of the proposed new towns.

Effects of Improved Railway on New Towns

- The improved railway will accelerate the present trend of outward expanding urbanization by means of strengthening the transport system in the radiating directions from Bangkok.

- The improved railway will enhance the massive housing site development for employees including those at present, and in future as well, working in the central district of Bangkok, mainly due to the highly improved accessibility by the railway (may be called "Bed town", "Dormitory town", "Town dominated by Bangkok" and the like). This will be more so, especially when the CBD further grows as a result of railway improvement because it needs more passengers or workers who find their housing sites along the railway because of its accessibility to the CBD.

- In addition to the effects of enhancing the housing development for commuters to Bangkok, the railway simultaneously expects to help promote the local socio-economic/industrial developments listed above, which will generate local employment opportunities for forming the base of independent cities, due to the interactive linkages between the local industrial developments with other major development centers such the CBD, Bangkok, ESB, being strengthened by the improved railway.

Objectives of New Towns

Taking into consideration, the current urbanization trends, potential for industrial/employment development, and the possible effects of railway as discussed above, it may be concluded that the proposed new towns must be double-tasked with the following main missions.

- Development of housing sites for employees working in Bangkok, in terms of responding to the massive housing backlog of the Metropolis; and

- Development of employment opportunities for building new communities.

The first task will likely intensify the concentric or centripetal structure and traffic movement - namely new towns more dominated by Bangkok, while the second task is geared toward self-contained/job-housing balanced new towns. Because of this nature, the new towns developed along the railway may be called "Hybrid New Town" or "Multi-Functional New Town" which will to be developed in a two-pronged way.

Advantages of Railway-Based New Towns

- Development potentials will be doubled to maximize the urbanization , which is important for the emerging urban corridor;

- The two different development approaches will complement each other so as to create an urban environment with higher urbanity/amenity and variety. Otherwise more homogeneous and monotonous urban environments like those represented by either local urban centers or housing estates in the suburbs would be the best result;

- The higher urban and public services to be provided need a larger volume of population to support them. The accumulated population living in the new towns and commuting whether inside or outside will help provide the higher level of public services;

- The hybrid new towns are more advantageous in management and operation of railway transport. The residential new town accommodating mainly the commuters to Bangkok is likely to impose difficulties of railway operation, resulting from the great fluctuation of passengers with the over concentrated one way traffic demand to Bangkok in the morning peak hours and from Bangkok in the evening peak

hours respectively, and very little traffic demand in the day time between peak hours. This forces the railway operator to purchase and operate a large number of rail cars to meet the excessive peak load of passengers traveling to and from work in Bangkok. This is a factor adversely affecting the financial condition of railway operators. The hybrid new towns work to normalize this fluctuating and lopsided commuter traffic by creating rail transport traffic.

The urban and industrial development in the hybrid new towns will increase the rail-commuting passengers in the opposite directions to/from Bangkok in peak hours, thus narrowing the gaps in the volume of passengers between the two directions, leading to a sound and efficient operation of rail transport.

As stated before, the urban and industrial developments in the hybrid new towns are viable only in close socioeconomic/industrial linkage and interactive relationship with Bangkok and the rest of Thailand, which are quite different from the case of the self-contained development constrained by the congested road traffic. Since high mobility is provided by the railway system to support the people's movement, the passenger traffic demand such as those of business trip, commercial/social trips and others, as in the business districts, is reasonably foreseeable in the daytime other than the peak hours of commuter traffic. This is quite helpful in normalizing traffic demand of the railway throughout the day, which also leads to an effective and efficient railway operation.

In the light of railway transport's basic feature or limitations that railway can provide excellent and efficient services only when supported by a large volume of passengers, people can enjoy the high level public transport service only when they cooperate to support them.

This shows the essence of the integrated urban and railway development that urban development, including housing and industrial development, must be deliberately planned with serious attention being paid to the sustainable and effective operation of railway transport while the railway transport improvement must be seriously planned to provide the best possible services to the regions so that it will be supported by people.

In conclusion, the hybrid new towns are recommended because they will be helpful in rectifying the operational problems inherent in commuter rail transport and in maximizing the utilization of the railway by the people.

Locationally Systematized and Structured New Town Development

It is a generally recommended that the new town development based on the improved railway be the type of hybrid new towns that reconcile and maximize the urbanization pressure from Bangkok and local development pressures for creating new communities being designed to make a contribution to developing a prosperous Bangkok capital city through the 21st century. However, it must be stated that these new town developments must be systematized and structured. Otherwise, new town development may be arbitrarily proposed and implemented with little regard to the desirable urban structure of Bangkok in the future and only concerned with specific aims such as providing housing or industrial sites, etc. It may be true that the new towns and satellite city developments are not the answer to Bangkok's urban problems because they still try to rely on road transport.

The suburban areas of Bangkok are strategically divided into the following three zones in which the urban development differs depending upon the locational conditions and development potential:

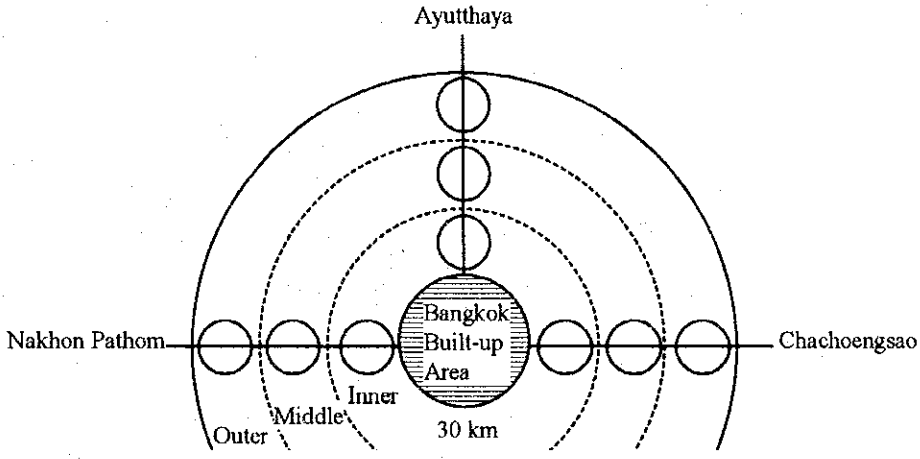
- Inner Suburbs, which are located about 30 km away from the center of Bangkok, closest to the built-up area. They work as a gateway to the Bangkok Urban Area.

- Middle Suburbs, which are located between the Inner Suburb and the Outer Suburbs.

- Outer Suburbs, which include the local urban centers such as Chachoengsao, Nakhon Phatom and Ayutthaya.

These urban centers are unique because they will be included in the Bangkok capital regions as well as local regions such as the Eastern Sea Board Development area, the Western Sea Board Development area and the upper central region, respectively.

Fig. 3.4.36 Suburban Area of Bangkok



New Town Development Integrated with the Railway Improvement

The following new town development which is an integral part of the Bangkok Capital City proposed in Section 3.4.3.5 is further elaborated, with attention being given specially to the development scenario by urban corridor and the classification of the suburban areas.

Table 3.4.19 New Town Development Schemes Along the Improved Railways

Corridors	Inner Suburbs	Middle Suburbs	Outer Suburbs
Eastern Corridor	Eastern New Town 1 (Aero based city)	Eastern New Town 2 (East Bangkok)	Eastern New Town 3 (Chachoengsao)
Northern Corridor	Northern New Town 1 (Rangsit Subcenter)	Northern New Town 2 (Technodomic City)	—
Western Corridor	Southern line N/T 1 (New Taling Chan s/c)	Southern line N/T 2 (West Bangkok Garden City)	Southern line N/T 3 (Nakhon Pathom Regional Center)
Southern Corridor	Mae Khlong line New Town 1	Mae Khlong line New Town 2	—

(3) Rail-based New Town Development Planning

1) Population Framework for New Town Development

a) Demographic Potential for New Towns

The serious concern of Thai City planning and development as well as this JICA study is how to accommodate or absorb the large increase of population of Bangkok foreseen up to the year 2010. It seems almost impossible to add the increasing population to the existing urban structure based on the road transport system, because this only contributes to further deterioration of urban transport, living conditions of people, urban environment and others. In this regard, a change of the existing road transport based city to a public transport based city is proposed so as to accommodate the unmanageably increasing population. In this context, the major planning item is how large a population can be planned to locate along the improved railway in order to substantially make the proposed systems work, or how large a population can be attracted to live in the proposed new towns.

Therefore, the rail based new town development planning focuses on the new development potential population to live along the railway and on the population growth in the proposed new towns as follows. (As a matter of course that this is crucially related to the viability and feasibility of the improved railway.)

New Development Potential Population

How large a volume of population will be able to be accumulated in the proposed new towns along the improved railway is the greatest concern of this study. To this end, the new development potential population is first estimated taking into consideration the following factors:

- Item 1: Potential growth of population of 50 km radius area, within which appropriate population distribution is discussed.; and

- Item 2: Size of population which cannot, and should not, be moved into the proposed new town because they are rooted in their localities at present and in the future.

The new development potential is calculated by means of subtracting the total number of item 2 from the total number of item 1, including families such as those looking for new homes to house an expanding number of family members, improving and changing their living conditions motivated by an the increase of family income, providing homes for newly married children; evacuating from the deteriorating living conditions in built-up areas and more specifically the individuals and families migrating to Bangkok, who all seem to be footloose coming in the hope of better employment opportunities, transport conditions, and living environment.

It is anticipated that the housing sites developed along the improved railway, with good living environment, utility services, and transport services, will increasingly attract the middle income group emerging massively in accordance with the modernization and internationalization of Bangkok, who are all attracted by the favorable characteristics of the new towns.

Total Potential Population Growth in the 50 km Radius Area of Bangkok

In this study, the total potential population growth in the 50 km radius area is set as the summation of populations estimated by province - changwat by NESDB in the year 2010. As such, the estimated population volume of NESDB is viewed as the potential growth of the area concerned. It should also be stated that the NESDB population projection summed for the 50 km radius area is supposed to be a control total population (14,000,000) for projecting population distribution in the area, including the new development potential population for new towns.

Estimated Regional Population Growth

The regional population growth which must be extracted from the total potential population growth in the 50 km radius area, as calculated above in order to estimate the new development potential population is forecasted as follows:

- Urbanization Characteristics and Population Growth

The areas in BMR or 50 km radius region can be classified in terms of population growth in accordance with urbanization characteristics.

The BMA central built-up area of Bangkok is characterized by population decrease from 1980 to 1990. This is mainly due to overcongestion, conversion of land use from residential to commercial, and traffic and environmental problems. On the other hand, the middle built-up area surrounding the central area experienced a rapid increase of population of as high as 5.14 % per annum in the 1980's.

The surrounding areas directly adjoining the BMA also experienced population increase due to the spill over of population from BMA as well as to industrial development. Thus, the built-up areas of BMA and surrounding areas have already joined together.

The population increases in such local urban center cities as Chachoengsao, Nakhon Pathom, and Ayutthaya were not high due to the stagnant economic growth of the local areas to which they belong.

- Future Prospect of Regional Population Growth

The population has been decreasing in the BMR central built-up area since 1980. It is anticipated that this trend will continue because of the acceleration of commercial and office building development in the area. In the middle built-up area which experienced a rapid population increase in 1980's, it is predicted that the population will continue to increase, not as high as the past average rate but at the average rate of BMA. In fact, the rate of increase of population will go down because of congestion of the built-up area.

In the condition of urbanization as stated above, the population of BMR amounts to 6.76 million. The difference with the NESDB population

estimation of 7.8 millions is expected to be accommodated in the new towns.

For the BMA surrounding area, there is a great possibility to allocate a considerably large population along the railway because of the large population increase in this area and the advantageous distance for railway transport to commute them to the center of Bangkok. In other words, it may be said that these areas are most suitable for the application of integrated urban and railway development. As such, it is advisable to encourage the location of population along the railway by limiting the growth of urbanization in the general built-up area outside of the railway service area.

However, since there are no railways in Nontaburi and Samut Prakhan, the population which is estimated to increase in these two provinces must be removed to other provinces having railway services. There maybe difficulties in locating all this population growth in the railway urban area. Taking this into consideration, half the volume of population estimated is targeted for allocation along the railway. In Patun Thai and Samut Sakhon where railway service is provided, all the estimated population is targeted for allocating along the railway.

According to the NESDB Estimation, a large population increase is supposed to take place in local urban center areas such as Chachoengsao. This seems to be mainly due to the government scheme to develop the Government Sub Center there. This is expected to result in a population increase as large as 140,000 persons (social increase- migration) in the NESDB estimation. In this study, half of that figure is targeted for allocating along the railway taking into consideration the government plan to place the sub-center along the railway.

On the other hand, since a very low increase of population is estimated for Nakhon Pathom in the NESDB forecast, none will be allotted along the railway if/when the population in the general urban area other than the railway service area increases at the regional average growth rate. This implies that

the railway service area will have a targeted population of 30 % of the population increase up to 2010.

Case Studies of Population Projection

The new town population will be estimated based on the possible cases of future population distribution in BMR as follows:

Case 1: Relocation of the present population plus location of the increment of population up to 2010 to the new towns. Some families may relocate themselves to the new towns on the occasion of marriage or in pursuit of new houses. In addition to this, an increment (social, natural) of population may be located in the new towns. This figure shows the maximum possible total of new town population.

Case 2: Increment of population up to 2010. The existing population will continue to be rooted in its present residential area. The possible part of the population which can be located in the new town is the increment of the population growth.

Case 3: Social increase of the population is likely to take place in the existing built-up area. The possible part of population which may be located in the new towns is only the social increase of population (migration) which seems to be footloose in selecting the location of their living places.

Case 4 Control of population growth rate in the general urban area at the regional average rate of increase. It is true that no population may be allotted into the new towns without limiting the population growth in the general urban area other than the railway service area. In this regard the possible population size of new town is estimated on the basis that the population growth in the general urban area is limited to the

regional average growth rate of population.

The calculations of the possible population volume for new towns are shown in the Table 3.4.20.

In conclusion, the possible estimated size of new town population ranges from 5.7 to 1.7 million, or a share of 40.5 % to 12.8 % in 2010 in the total population of BMR.

Conclusion of Setting Up the Population Framework for New Town Development

The preceding discussions of the case studies in population projection show great possibilities for railway improvement which may locate as much as 40.5 % of the future population of Bangkok within the railway service areas. However, it must be stated that this depends on the possibilities of implementation, more specifically the possibilities of enforcement of discouraging regional/urban development in the areas out of the reach of the improved railway service, and encouraging the housing and industrial development in the proposed new towns.

It must be stressed that future population distribution of Bangkok is less influenced by the railway improvement but greatly influenced by the government initiatives of urban and industrial development such as SBIA related development, NHA new towns development, BMA Metropolitan sub center development, and others. In this development context, this JICA study can say nothing about the future population distribution of Bangkok capital city, but only hopes that the government takes important initiatives to lead urban development and urbanization toward a rail transport based city. For this reason, this JICA study comes close to recommending the population distribution with general consideration to the balanced distribution of population in the capital city and with the serious attention given to the population distribution which makes the railway improvement reasonably viable and feasible.

Table 3.4.20 Potential Population Growth along Railways

	Population			Annual Growth Rate (%)		Case 1 Transfer + Natural & Social Increase			Case 2 Natural& Social Increase	Case 3 Social Increase Only			Case 4			Planning Figure	
						Transfer Population (A)*15% =(D)	2010-1990 (B)-(A) =(E)	Total (D)+(E)		Natural Growth Rate(%) (F)	Population (A)*(F)^20 =(G)	Social Increase (B)-(G) =(H)	Annual Growth Rate in (C) (I)	(A)*(I)^20 =(J)	(B)-(J) =(K)		
	1980	1990 (A)	2010 (B)	90/80	2010/90 (C)				(E)								
1 BMA Total	4,697,071	5,882,908	7,826,667	2.28	1.44	882,400	1,943,800	2,826,200	1,943,800		6,507,300	1,319,400		6,764,200	1,062,500	1,062,500	←(K)
·Center Built-up	2,734,509	2,631,403	-	-0.384	-	-	-	-	-	-0.384	2,436,500	-	-0.384	2,436,500	-		
·Middle Built-up	1,825,088	3,013,783	-	5.14	-	-	-	-	-	1.13	3,773,800	-	1.44	4,011,300	-		
·Outer Area	137,474	237,722	-	5.63	-	-	-	-	-	1.13	29,600	-	1.44	316,400	-		
2 BMA Adjoining Area Total		2,077,890	3,700,422		2.93	311,600	1,622,500	1,934,100	1,622,500		2,601,400	1,099,000		3,009,800	690,600		
·Nonthaburi	365,099	574,702	1,029,072	4.64	2.96	86,200	454,400	540,600	454,400	1.13	719,500	309,600	1.87	832,500	196,600	98,300	←(K)*50%
·Samut Prakhan	484,829	769,822	1,364,115	4.73	2.90	115,500	594,300	709,800	594,300	1.13	963,800	400,300	1.87	1,115,000	249,100	124,550	←(K)*50%
·Patum Thani		412,407	830,643		3.50	61,900	418,200	480,100	418,200	1.13	516,300	314,300	1.87	577,400	233,200	233,200	←(K)
·Samut Sakhon	256,000	320,959	476,592	2.29	2.00	48,100	155,600	203,700	155,600	1.13	401,800	74,800	1.87	464,900	11,700	44,800	←(H)*60%
1 + 2		7960798	11527089		1.87		3566300										
3 Local Urban Center Total		1,882,330	2,563,255		1.56	282,300	680,900	963,200	680,900		2,388,500	174,800		251,700	52,600		
·Chachoengsao		552,108	843,040		2.14	82,800	290,900	373,700	290,900	1.21	702,300	140,700	1.81	790,400	52,600	70,350	←(H)*50%
·Nakhon Pathom		629,573	834,856	1.45	1.42	94,400	205,300	29,299,700	205,300	1.21	800,800	34,100	1.81	834,900	0	61,590	←(E)*30%
·Ayutthaya		700,649	885,359		1.18	105,100	184,700	289,800	184,700	1.21	885,400	0	1.81	885,400	0	0	
1 + 2 + 3		9,843,128	14,090,344		1.81	1,476,500	4,247,200	5,723,700	4,247,200			2,593,200		12,284,700	1,805,700	1,700,000	

It must be reiterated that the population projection and population distribution are generally made in the hope of achieving the balanced development of Bangkok to which the improved railway can contribute, not heavily depending on the magnitude of the currently proposed urban developments. We are confident that the railway system as planned can accommodate an unexpected larger urban development, if successful, once the improved railway system is established based on the population distribution proposed in this study.

Based on the above discussions, the new development potential population is set at the minimum figure of 1.7 million, not permitting further growth depending on the urban development projects, which is designed to work as a control total for determining the population distribution among the proposed new towns as follows.

b) Population Distribution Among the Proposed New Towns

Main Factors to be Considered

The total estimated population of 1.7 million to be allocated to the new towns should be distributed taking the following factors into consideration:

- Optimal and Minimum Size of New Town Population

  There is no doubt that a city needs more than a certain size of population in order to functionally maintain itself. A large number of supportive population is required to provide a higher level of urban services. Cities with larger populations are more advantageous in terms of urban management, because of the economy of scale. However, it is also true that larger cities get plagued with urban problems such as the harmful influence of over-congestion, inefficiency and lowering level of urban services due to larger demand beyond the capacity of urban management.

- Administrative Capacity

  The population size of major cities in Thailand which are normally categorized

as major urban centers range from 50,000 to 200,000, except Bangkok. It is interesting to know that many of administrative units (khet) in Bangkok were subdivided during the period from 1980 to 1990. Judging from this, it may be concluded that the administrative units are likely to be subdivided when they reach a population size of 400,000 to 500,000. Accordingly no administrative unit with more than 400,000 population size can be found in 1990.

This suggests that the maximum population size of local government administration never exceeds 400,000 in terms of capability of administrative services. Thus, it may be said that the urban population size should range from 50,000 to 400,000 in Thailand.

- Employment Opportunities and Effective Transport Service for Commuting

The decisive factors of population distribution in BMR are employment distribution, and commuting manner.

For instance, the number of employment in the eastern corridor is supposed to increase largely because of the high possibility of industrial development stimulated by the construction and operation of the Second International Bangkok Airport, Eastern Sea Board Development, and others. In this situation where the railway has been improved sufficiently to allow commuting to this area from other districts, the number of population in the district will not increase correspondingly with the increase of employment.

Table 3.4.21 shows the disparity of employment per 1000 population by district, with the higher figure in inner Bangkok and the lower figure in the suburbs. This disparity simply indicates that the suburbs became the bed town for workers commuting to the inner city. However, employment per 1000 population in Pathun Thani is quite high. This is mainly because of the relatively large industrial development in the province.

Table 3.4.21 Population and Employment

	Population	Employment	Employment per 1,000 population
BMA	5,363	2,229	416
Inner	3,705	1,688	456
East	1,182	388	328
West	476	153	321
Samut Phrakan	321	118	368
Nonthaburi	454	152	335
Pathun Thani	216	90	417
Total	6,354	2,589	407

- Locational Potential of Population and Housing Development

The locational potential of population is high close to the center of Bangkok and decreases in accordance with the distance from Bangkok. However, the over congestion and high land price in the built-up area are likely to push housing development outward away from Bangkok. Based on these general trends of population distribution and housing development, the very large housing demand can be expected in the new towns because the railway provides convenient transport services and the new town can provide cheap housing due to the low land prices.

- Balance of Population Distribution Among the Corridors

In addition to employment distribution, another decisive factor of population distribution is the total balance of population distribution.

The lopsided population distribution in a specific corridor is not appropriate in terms of efficient infrastructure improvement. The excessive traffic demand on specific corridors is one example of problems in infrastructure improvement. It will be difficult to respond to an excessive demand. A balanced distribution of population among the four corridors is important. A concentration of population on a specific corridor results in excessive administrative and financial burdens on the specific provinces or municipalities. It also threatens to widen the gaps in the socioeconomic growth between municipalities.

- Strategic Population Distribution

  In spite of the necessity of a balanced distribution, there may be a case where the population should be strategically distributed in the four corridors. The following such a case. Instead of lowering the economic effects of population accumulation by dispersing it evenly over all of the corridors, strategically concentrating a large volume of population on a specific corridor may make it possible to provide the higher level of transport services.

  Considering the difficult conditions of developing the four corridors, the population may be strategically distributed . Urbanization is greater on the east side Bangkok than in the west side. Moreover, the west side has a disadvantage for urban development because of the necessity of constructing a bridge over the Chaophraya river.

  On the contrary, the east and north sides are advantageous for urban development at present (at least being connected with the existing urban center of Bangkok), and the higher urbanization pressure.

The difference between the corridors as stated above may lead to another option that a larger volume of population may be strategically allotted to the eastern corridor with the first priority placed on the implementation of integrated urban and railway development on the eastern corridor.

Population Distribution of New Towns

The planning of population distribution is quite vital to future railway improvement, which the planned urban development must rely on as follows:

- The population should be highly concentrated in limited areas which the railway can serve with high frequency, with a short time distance to the railway just like the convenience of bus ride, and others.

- The population should be distributed to promote the railway which serves the suburbs with higher priority on accessibility especially the travel time reduction to the center of Bangkok.

These examples show the necessity of population distribution in the consideration of the future desirable transport serving Bangkok 's urban growth.

In the hope of expanding the railway network to the extent that the railways become the backbone of public transport covering the 50 km radius of Bangkok Capital City, the future population is distributed more evenly to make all the rail-corridors radiating in the four (4) directions viable and feasible as much as possible. In this regard, the balanced population distribution policy is preferred over the strategically concentrated distribution since the population can be distributed to make the railway network lines in the 4 directions feasible.

More specifically, with the population size of new town targeted at 50, 000 to 400,000, the population is distributed to attain a balance among the four 4 corridors.

Table 3.4.22 Population Distribution among New Towns

East line New Town 1 (Aero City)	200,000
East line New Town 2 (East Bangkok)	200,000
East line New Town 3 (Chachoengsao)	98,800
North line New Town 1 (Rangsit Subcenter)	200,000
North line New Town 2 (Technodemic City)	436,000
South line New Town 1 (New Taling Chan S.C)	100,000
South line New Town 2 (West Bangkok G.C)	200,000
South line New Town 3 (Nakhon Pathom R.C)	63,600
Mae Khlong Line New Town 1	100,000
Mae Khlong Line New Town 2	96,800

2) Land Use Plan of Proposed New Towns

The land use plan is due for mapping, subject to the examination of existing conditions, coordination with other development projects and others. Major land use is shown in Table 3.4.23 and summarized below.

a) Residential Use

Housing sites are developed for the commuting and local employees in the new town. A variety of types of housing, including those for low, medium and high income groups, are provided and the population densities for housing development are set as follows:

- High density 200 person/ha
- Medium density 150 person/ha
- Low density 75 person/ha

b) Industrial Use

The industrial lands are developed for the aero-related industry, hi-tech industry, urban light industry, and others.

c) Institutional Use

The sites for institutional uses such as university, research center, governmental center and the like are developed in the new towns.

d) Commercial Use

The commercial lands are developed around the stations as either town centers or districts centers.

Table 3.4.23 Land Use of New Towns

East Line	Total Area	Residential	Business	Commercial	Industry	R &D Academic	Parks and Greenery	Reserved Area	Leisures & Amusement	Public Facilities	Transport Facilities
East Line New Town 1 Air-based City	12,000	1,500	500	300	0	1,500	1,000	1,500	0	200	*1 4,500
East Line New Town 2 East Bangkok P.C.	5,600	2,000	400	300	0	400	1,000	500	0	200	800
East Line New Town 3 Chachoengsao H.P.	2,000	750	100	100	0	0	300	300	0	200	250
Total	19,600	4,250	1,000	700	0	1,900	2,300	2,300	0	600	5,550

North Line	Total Area	Residential	Business	Commercial	Industry	R &D Academic	Parks and Greenery	Reserved Area	Leisures & Amusement	Public Facilities	Transport Facilities
North Line New Town 1 Rangsit Subcenter	4,000	1,000	600	500	0	0	400	800	0	100	600
North Line New Town 2 Technodemic City	15,200	2,200	600	600	1,000	2,000	1,500	5,000	0	300	2,000
Total	19,200	3,200	1,200	1,100	1,000	2,000	1,900	5,800	0	400	2,600

South Line	Total Area	Residential	Business	Commercial	Industry	R &D Academic	Parks and Greenery	Reserved Area	Leisures & Amusement	Public Facilities	Transport Facilities
South Line New Town 1 New Taling Chan S.C.	6,500	800	500	500	0	1,600	500	1,500	0	100	1,000
South Line New Town 2 West Bangkok G.C.	9,000	2,000	500	300	0	500	1,500	1,500	1,000	200	1,500
South Line New Town 3 Nakhom Pathom R.C.	2,000	500	200	100	0	0	300	200	0	300	400
Total	17,500	3,300	1,200	900	0	2,100	2,300	3,200	1,000	600	2,900

Maha Chai Line	Total Area	Residential	Business	Commercial	Industry	R &D Academic	Parks and Greenery	Reserved Area	Leisures & Amusement	Public Facilities	Transport Facilities
Maha Chai Line N.T. 1 New Bang Kun Chan S.	5,000	1,000	300	200	0	900	500	1,000	200	100	800
Maha Chai Line N.T. 2 Pier City	3,500	800	300	300	0	0	350	650	400	200	500
Total	8,500	1,800	600	500	0	900	850	1,650	600	300	1,300

Note : *1 Including Second Bangkok International Airport

3) Infrastructure Development and Cost

a) Transport Facilities

- Roads

  Roads in the new towns are to be constructed in accordance with the road standards of Thailand as follows;

	Right of Way (lanes)
Urban Arterial Road	30-25 m (6-4)
Sub Arterial Road	20 m (4)
District Road	16 m (4-2)
Access Road	12 m (2)

- Station Plaza and Terminal

  Station plazas and terminals where the railway passengers get on and off the feeder systems such as bus, car and others should be constructed in front of the stations.

b) Water Supply

Water supply systems should be constructed based on the design standard of the Metropolitan Waterworks Authority of Thailand.

c) Drainage and Sewerage System

Drainage system development includes the improvement of the existing Khlong and construction of pipeline networks in the new towns. For flood control the rain water retention areas ,which are 5 % of the total development area , should be maintained. Sewerage systems including the sewer pipeline network and wastewater plant should be constructed in accordance with design standards of the Public Works Department of the Ministry of Interior.

d) Parks and Green Areas

According to the proposed standard in the Bangkok General Plan, the following park areas should be provided:

- Parks 2.0 m^2/person
- Green 4.1 m^2/person

e) Land Filling

Low level land in the new towns should be reclaimed up to an elevation of 1.0 m for flood protection.

f) Project Cost

The total urban development cost is estimated in Table 3.4.24. The total cost covering the 15 years from 1995 to 2010 amounts to 494.0 Billion Bhat.

Table 3.4.24 Urban Development Project Costs

	Development Area (ha)	Public Land Area (25 %)	Land Cost (MB)	Construction Cost (MB)	Total
East Line New Town 1 (Aero City)	6,500	1,625	36,660	48,100	84,760
East Line New Town 2 (East Bangkok P.C)	5,100	1,275	8,683	37,740	46,423
East Line New Town 3 (Chachoengsao)	1,700	425	1,169	12,580	13,749
North Line New Town 1 (Rangsit Sub-center)	3,200	800	13,400	23,680	37,080
North Line New Town 2 (Technodemic City)	10,200	2,550	23,435	75,480	98,915
South Line New Town 1 (New Taling Chan S.C)	5,000	1,250	20,937	37,000	57,937
South Line New Town 2 (West Bangkok G.C)	7,500	1,875	12,769	55,500	68,269
South Line New Town 3 (Nakhom Pathom R.C)	1,800	450	1,238	13,320	14,558
Mae Khlong Line New Town 1	4,000	1,000	16,750	29,600	46,350
Mae Khlong Line New Town 2 (Samut Sakhon)	2,850	713	4,856	21,090	25,946
	47,850	11,963	139,897	354,090	493,987

4) Development Program and Priority Corridor

The planning issues for setting forth the integrated urban and railway development programs with the priority projects and packages being identified are summarized below.

a) Development Program

The development programs of the integrated urban and railway development are presented in Fig. 3.4.37 and Fig. 3.4.38 and discussed below.

Different Characteristics of Corridors

Development programming must aim for establishing the corridors with the two (2) directions of East-West and North-South, which are designed to systematize the urbanization of BMR. In this regard, it is strategically important to accelerate urban development in such a manner as forging the urban corridors as planned. There seem to be differences in characteristics between the directions of corridors, which must be taken into consideration in formulating the development

programs.

- More progress of urbanization on the North-South

  It is observed that more progress of urban development has been more progressive in the North-South, especially the North line, than in the East-West.

  The considerably large volume of existing urban areas may be classified as those of urbanization in progress, with the one on the East-West direction being less developed as an urban development corridor.

- Greater importance of urbanization on the East-West

  It may be said that since urbanization has already been in progress on the North-South corridor, the urban development will continue on in line with this existing urbanization trend. In contrast there is a need to create a new urbanization trend in East-West direction. The East-West corridor seems more important from the viewpoint of changing the structure of Bangkok Capital City.

  Due to the hindrance of the of Chao Phraya river, urbanization has been stagnant on the Tonburi side of Bangkok as compared to the Bangkok side in spite of its direct proximity to the CBD of Bangkok. It can be anticipated that if/when the Tonburi side is directly connected with the Bangkok side by direct railway commuter service, urban and housing development will be accelerated, thus helping to accommodate the large volume of housing demand in Bangkok. More importantly, it will help ease traffic congestion on the road bridges over the Chao Phraya river.

  The establishment of an East-West transport line will be instrumental in spreading development effects of the SBIA and Eastern Seaboard Development to the west side, thus resulting in narrowing the disparity

between the east and west sides.

The East-West line will also be effective in supporting the Government sub-center developments in Chachoengsao and Nakhon Phatom located at both ends of the line, which are designed to alleviate the congestion in built-up areas of Bangkok through the relocation of government offices and will make a contribution to regional development in both the Eastern and Western Seaboard areas.

The SBIA new town will be advantageously developed in connection with the east-west corridor development instead of being developed independently.

Encouraging and Implementing Measures

The first step of railway promotion on the North-South line is to encourage people to use the train because of the existence of residential and urban areas developed in the areas along the line. The first step of railway promotion on the East-West line, on the other hand, is to locate people and urban activities in the service area of the line through urban development projects.

This indicates the different measures necessary depending in the corridor. One is an encouragement measure and the other is an implementation measure for railway promotion and urban development as well.

Time Sequence of Railway and Urban Development

The time schedule of railway and urban development is a case of chicken-and-egg because of their inter-dependency.

Implementation is dependent upon railway system in terms of transport service to the development. In this regard the railway must be developed before the start of urban development. All the more so for this project where the railway must attract people to locate in the service area by providing a high quality transport

service.

- Implementation of urban development before the railway development. From the viewpoint of railway management, especially financial feasibility, it is advisable to start providing railway transport services just when there is sufficient transport demand after the population increase brought about by urban development. Especially in a metropolis like Bangkok where the railway has not been designed to take the driving force of urbanization, urban development projects must be aggressively implemented with a view to increasing the volume of railway passengers, not merely depending on the market force of urbanization.

- Taking into account the conflicting aspects of urban and railway development, the basic policies of implementation scheduling are worked out as follows:

- Unlike urban areas to be newly opened by new railway construction, the railway lines exist in spite of the lower level of transport services, and people can use them and urban development can rely them. Due to the availability of existing railway lines, urban development can proceed prior to or in parallel with railway development. The existing railway with the transport efficiency increased must provide services until the railway development project will be accomplished. (However since the Mae Klong line is not connected with the CBD, the commencement of urban development must wait until the development of the Mae Klong line including connection over the Chao Phraya river will be finished).

- On the North-South line where the urban areas are already located and the railway transport passenger demand appears promising even without new urban development, the railway development project should go ahead. On the other hand, on the East-West line where railway passenger demand is not expected to be high, the urban development must be accelerated even

prior to the completion of the railway development.

By Line and By Section Railway Development

The railway network development may be implemented either by line or section. From the viewpoint of convenience and efficiency of project implementation, the network should be developed by line, for instance, first the Eastern line up to Chachoengsao, and second the Northern line, and so on. However, when one line is being constructed while other lines are neglected, urbanization may proceed along the radiating arterial roads in the traditional way in areas near the neglected lines, thus resulting in failure to increase the population along the railway.

In conclusion, it is advisable to start developing the railway sections closer to the urban center of Bangkok on all lines as far as possible. The railway development should be expanded outward to the next sections (inner to outer-suburb).

Implementation Speed and Time Duration of IURD

The implementation duration is set at 5 and 10 years for one railway section and one new town development, respectively. The railway and new town development should start simultaneously on all lines except the Mae Khlong line which has no connection to the CBD of Bangkok.

According to this schedule, the railway development of each section will be completed and it will start providing high quality transport services on completion of half of a new town. It is apparent that urban development will proceed with transport services being provided by the existing railway with the increased efficiency, up to the completion of the railway development.

Fig. 3.4.37 Development Program (1)

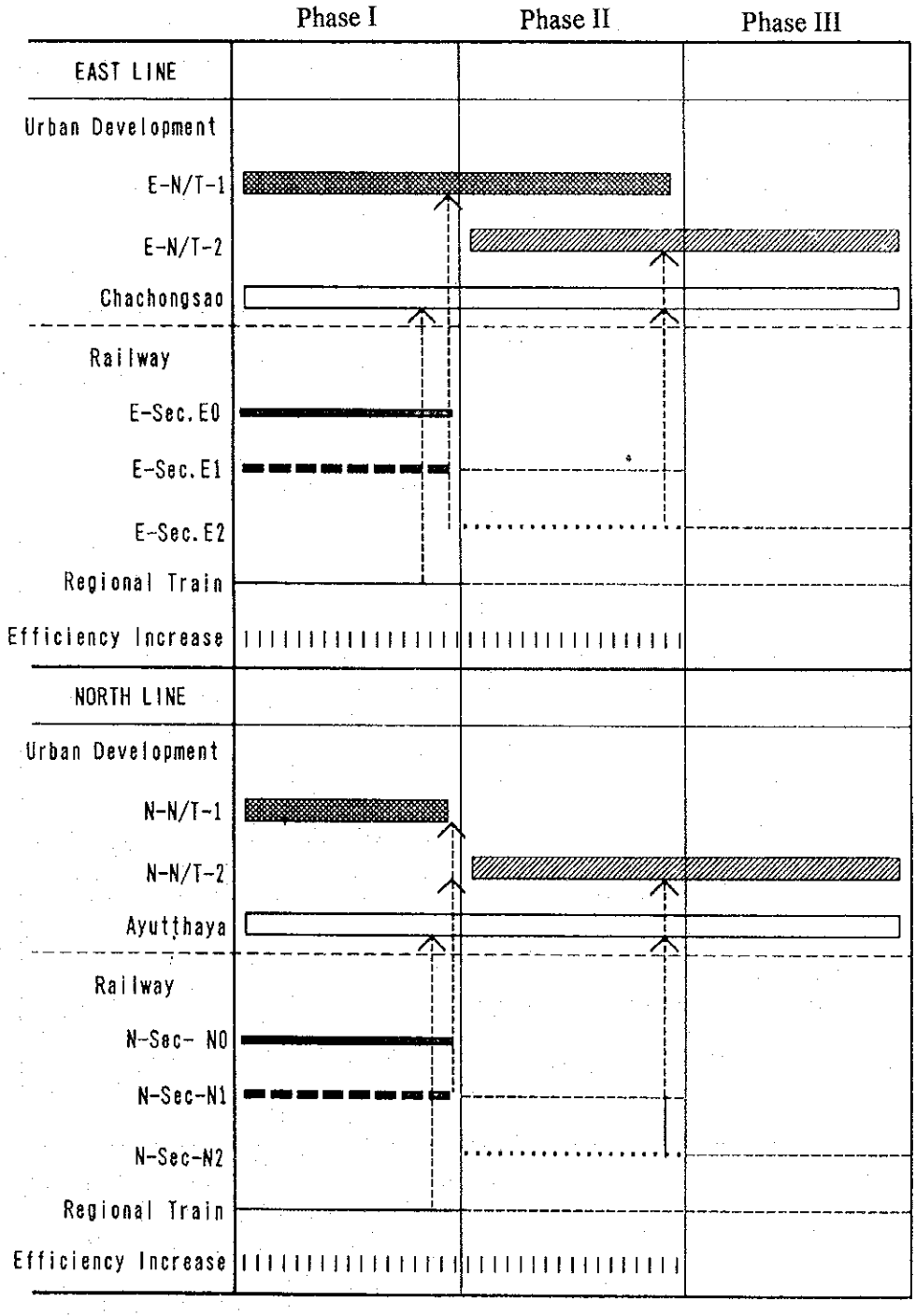


Fig. 3.4.38 Development Program (2)

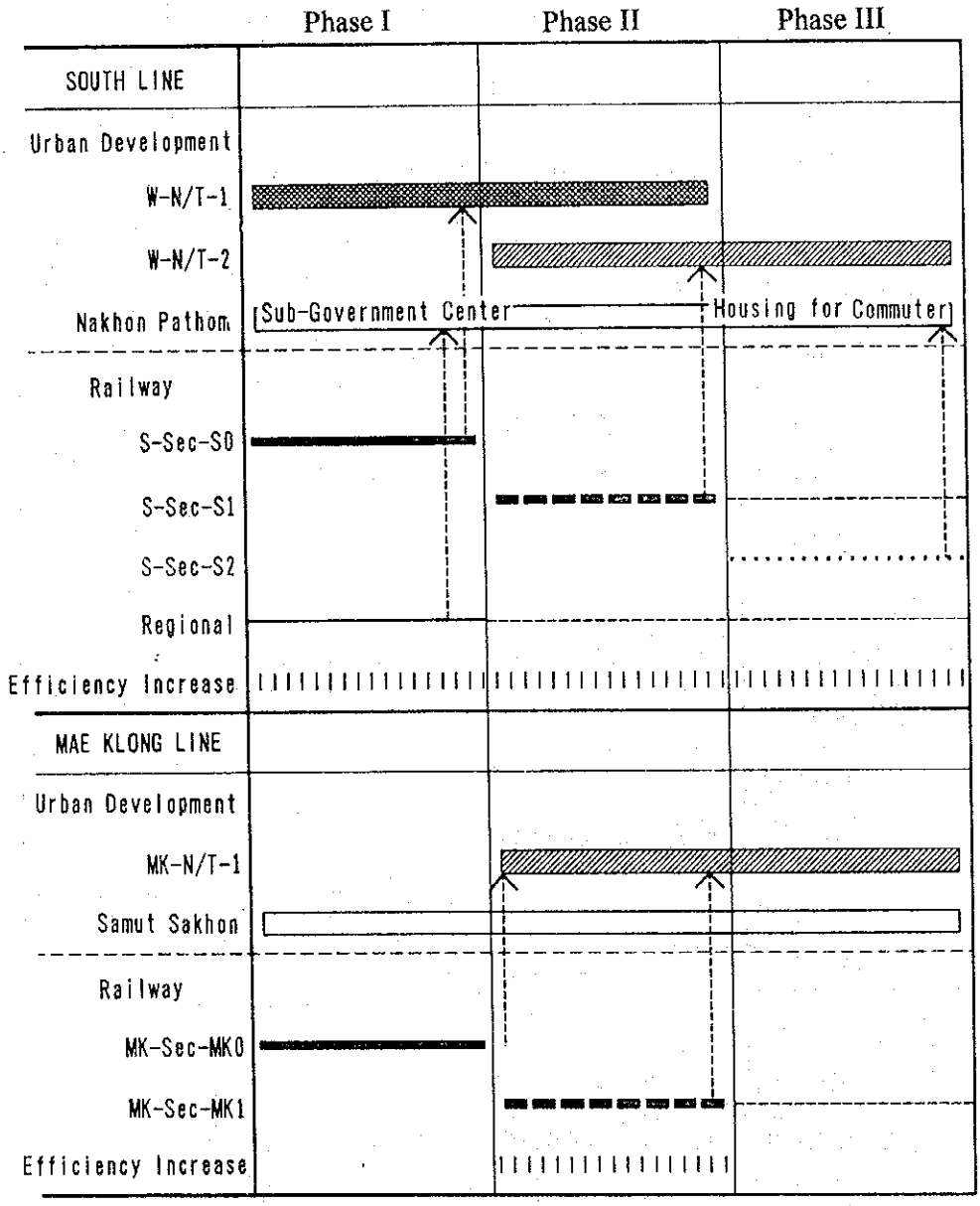
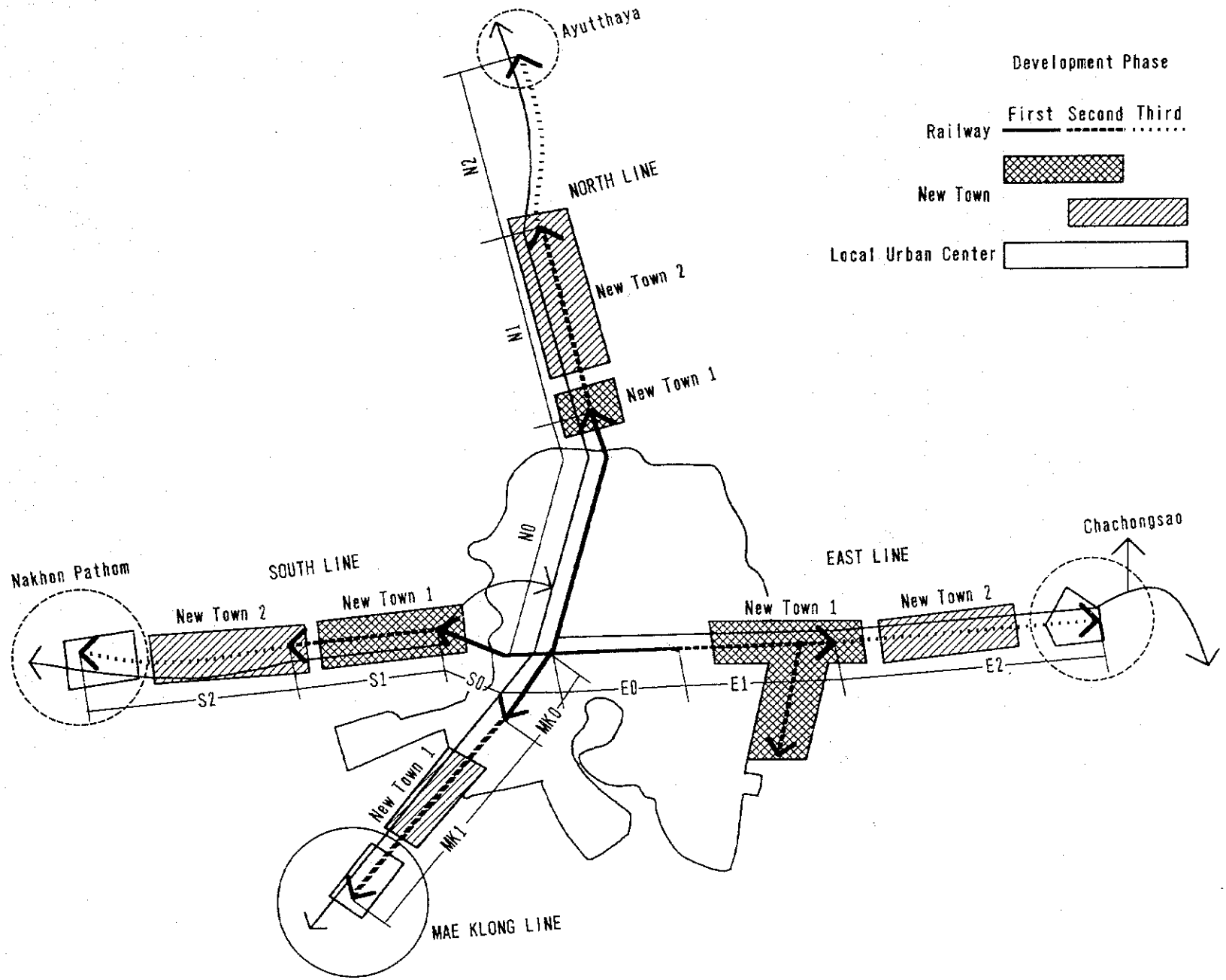


Fig. 3.4.39 Development Phases



b) Priority Corridor

The general evaluation, including economic and financial feasibility, on the four (4) rail lines of SRT radiating from the center of Bangkok, as discussed in Volume II, Part III of the report, places high priority on the SRT Eastern line improvement. However, it must be stressed that all of the four lines are of equal importance from a viewpoint of balanced development of Bangkok. The full scale improvement of SRT for urban transport, as well as integrated urban and railway development will be a first experience for Thailand. SRT Eastern line improvement is considered a model of development of this kind, which should be replicated in other corridors.