3.2 Road Network

1) General

In Bangkok, continuous population growth associated with sharp increases in income and economic activities has led to an extraordinary rise in the number of vehicles. Among the many causes of Bangkok's chronic traffic congestion are too many vehicles using too few roads. The road system has been poorly developed; it lacks structural coherence and serves traffic needs inefficiently. Traffic congestion takes place not only during rush hours but also during off-peak hours in many locations. People traveling by vehicles (either private or public transport) not only have to spend a long time but also must be prepared for uncertainty in travel time. Oversaturated situation spoils the effectiveness of many existing traffic measures such as bus-lanes, one-way streets, etc.

The deficiency of the road system has been a repeatedly raised issue in transportation planning in Bangkok.

(a) The network is coarse and poor in both quantity and quality. The road density is only about 4% even in the area within the Middle Ring Road. Hierarchical structure of roads is unclearly and improperly defined. In particular, the deficiencies of secondary and distributor roads are critical.

(b) There are many "missing links" in the road network. The origin of the problem probably lies in the use of canals as the traditional means of transportation in the last few decades.

(c) The roads are few outside the Middle Ring Road where urban development is actively taking place. The development of a proper road system in these areas determines the quality of transportation service and urban development.

2) Regional Structure

The Road network of Bangkok, the single strong vehicle of socio-economic activities of the country, has been structured not only to meet the requirements of intracity transportation but also the large intercity transportation needs between Bangkok and the rest of the country. As Bangkok has grown, the intercity transportation demand has also increased. Present intercity access to/from Bangkok is shown in Figure 3.2.1 and outlined as follows:

- to/from north and northeast via Route 1 and Route 32
- to/from east via Route 305 and Route 304
- to/from southeast via Route 3 and Route 34
- to/from southwest via Route 35
- to/from northwest via Route 340

The heavily trafficked directions are to/from the north, southeast and southwest. It is seen that the planning concept of the First Stage Expressway complies with these intercity movements.

Railways (SRT) are operated to/from Bangkok in radial shape; north line towards Chiang Mai, northeast line towards Nong Khai and Ubon Ratcha Thani, east line towards Aranya Prathet and south line towards Sungai Kolok. They mostly serve inter-city goods and passenger transport. The role in urban transportation is limited to the Don Muang, Haulampong and Hua Takhe areas. The system, being mostly single track except north line and part of east line, is constructed at-grade therefore intersects with many major roads.

Chao Phraya River also functions mainly as a regional transportation system. Without tributaries, which have been converted mostly to urban roads, its role for intracity transport is limited to the immediate adjoining areas alongside the river.

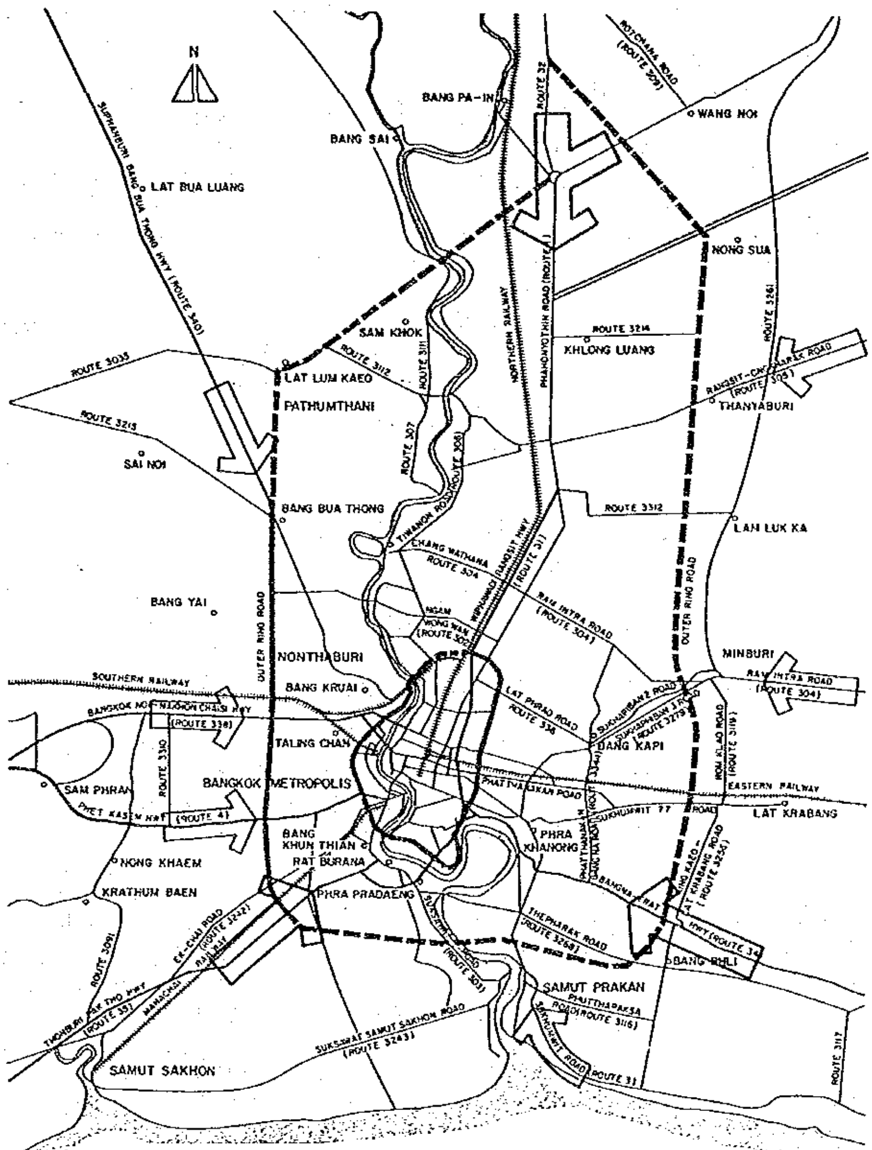


Figure 3.2.1 Road Network of Bangkok within the Regional Structure

3) Study Area Road Inventory

Existing roads inventory was reviewed and updated. The existing roads inventory is as follows:

a) Bangkok Road Registration; BMA
b) Computer Output of Road Inventory Database; DOH

Based on the above, the inventory form was prepared to facilitate managing the necessary data. Information included in the inventory is as shown in Table 3.2.1.

Table 3.2.1 Information included in SIMR Road Inventory

1) Name of road
2) Node No.: start, end
3) Zone No.: traffic zone number a road is located in
4) Right of Way Width (m)
5) No. of Lanes: for bus and other traffic by direction
6) Total No. of Lanes
7) Carriageway Width (m): right, left, median and total
8) Sidewalk Width (m): right and left
9) Total Road Width (m)
10) Pavement Type: 1. Concrete, 2. Asphalt Concrete, 3. Others
11) Pavement Conditions: 1. Good, 2. Fair
12) Administration: 1. BMA, 2. PWD, 3. DOH

The above road inventory, however, does not cover all existing roads in the study area. Most of small sois are omitted. Limited information on the sois is available from the "Land Use Map of Bangkok" prepared by the Town Planning Division of BMA.

At present, it is estimated that the total road length in the study area is approximately 3,800 km of which 978 km are the roads identified in the study that will function either as primary, secondary, or distributor roads. The remaining 2,800 km are sois (or access roads) distributed over the study area. (See Table 3.2.2 and Figure 3.2.2)

The availability of the roads significantly varies between the areas inside and outside the Middle Ring Road. Inside the Middle Ring Road there is an average of 8.1 km of roads per sqkm, while there is only 1.9 km in the area outside the Middle Ring Road. The roads occupy 10.7% in the former area, while only 2.7% in the latter area. However, it is noted that the road area when expressed in terms of right of way will considerably increase in the areas outside the Middle Ring Road from 21.6 Km^2 to 32 Km^2, while that of the area inside the Middle Ring Road does not change much. This means that the room for widening carriageways of the roads in suburban areas is considerable.

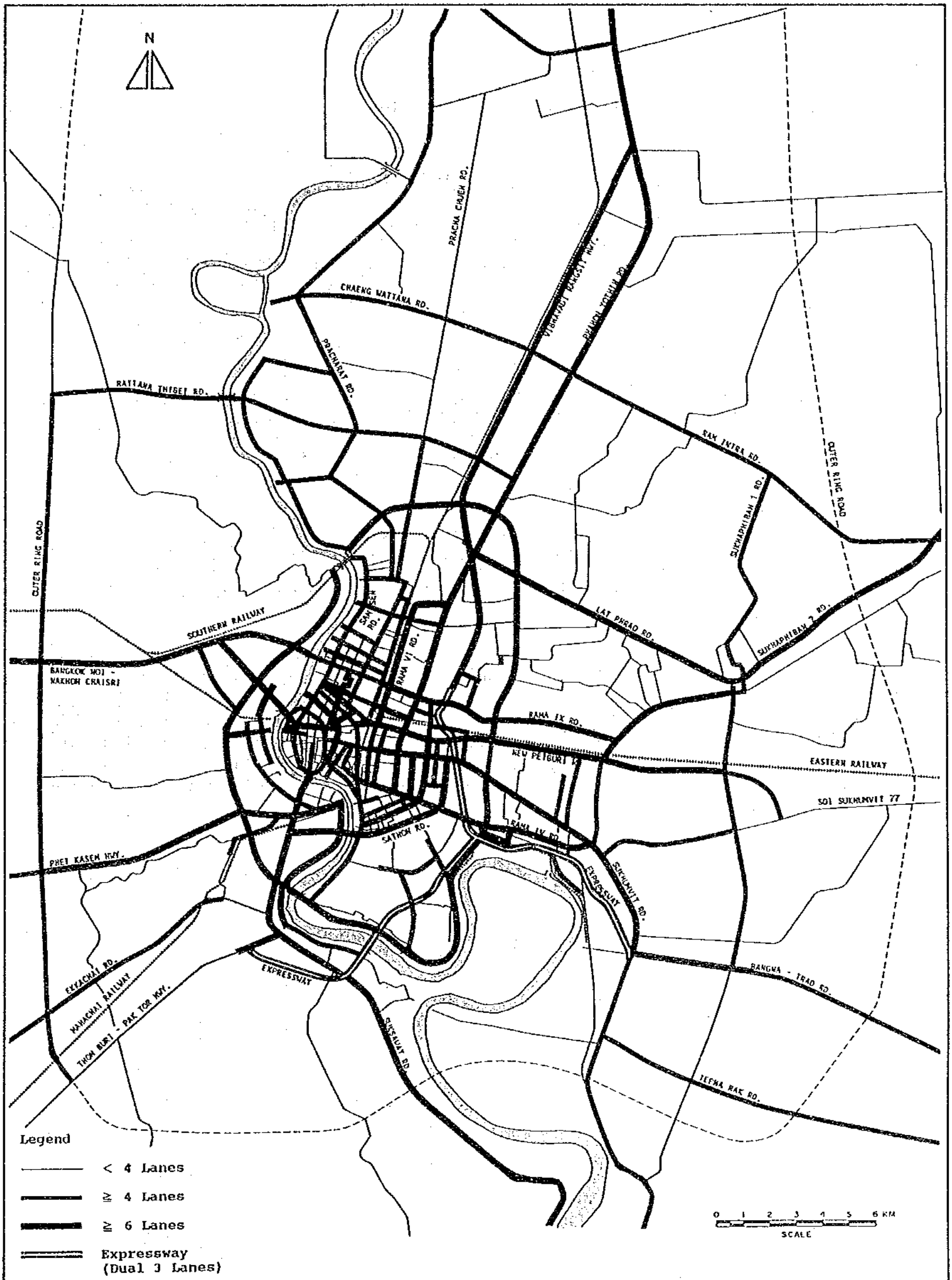


Figure 3.2.2 Existing Roads by No. of Lanes in the Study Area

Table 3.2.2 Existing Roads in the Study Area

Item	Area	Major Roads1/	Soi	Total	Area Km^2	Road Availability Total/Area
Road Length (km)	Inside Middle Ring Road	304	825 2/	1,129	140	8.1
	Outside Middle Ring Road	674	2,000 2/	2,674	1,390	1.9
	Total	978	2,825	3,803	1,530	2.5
Road (km2)	Inside Middle Ring Road	8.4 (8.6) 3/	6.6 4/	15.0	140	0.107
	Outside Middle Ring Road	21.6 (32.0) 3/	16.0 4/	37.6	1,390	0.027
	Total	30.0 (40.6)	22.6	52.6	1,530	0.034

Source: SIMR Road Inventory and TPD/BMA information
1/ include primary, secondary and part of distributors
2/ estimated based on BMA data and other available data
3/ figures in the parenthesis indicate the road area calculated based on Right-of-way width rather than carriageway width
4/ the road area of Soi was estimated by assuming the average width of Soi is 8 meter

The major roads of the study area are composed of those constructed, maintained and administered by different agencies such as BMA, DOH, PWD, ETA and other municipalities. The total length of the major roads is approximately 978 km of which BMA and DOH contribute 68% and 28% of the total network length, respectively. However, DOH shares nearly 40% of the road area in terms of right of way. 31% of the roads are distributed inside the Middle Ring Road.

Table 3.2.3 Identified Major Roads in the Study Area3/

Item 1/ \ Agency	BMA	DOH	ETA	OTHERS 2/	TOTAL (%)
1) Road Length (km)					
- Inside Middle Ring Road	269	19	14	2	304 (31.1)
- Outside Middle Ring Road	394	259	13	7	674 (68.9)
Total	664 (67.9)	278 (28.4)	27 (2.8)	9 (0.9)	978 (100.0)
2) Road Area (sq kms)					
- Inside Middle Ring Road	7.2	0.7	0.6	-	8.5 (26.6)
- Outside Middle Ring Road	10.6	12.0	0.5	0.3	23.4 (73.4)
Total	17.8 (55.8)	12.7 (39.8)	1.1 (3.4)	0.3 (0.3)	31.9 (100.0)

Source: SIMR Road Inventory
1/ Middle Ring Road is included in Inside Middle Ring Road
2/ Others include roads of PWD and other municipalities than BMA.
3/ Excluding Sois.

The roads with six lanes and over and those with four to five lanes are 31% (304 Km) and 35% (338 Km) of the total, respectively. Approximately a half of the former roads and 35% of the latter roads are distributed inside the Middle Ring Road.

Table 3.2.4 Identified Roads by No. of Lanes in the Study Area[1/]

(Km)

Road Type	Inside Middle Ring Road	Outside Middle Ring Road	Total
Expressway	13.9 (4.6)	13.2 (2.0)	27.1 (2.8)
6 lanes and more	137.7 (45.3)	139.0 (20.6)	276.7 (28.3)
4 lanes and more	117.0 (38.5)	220.5 (32.7)	337.5 (34.5)
Less than 4 lanes	35.2 (11.6)	301.4 (44.7)	336.6 (34.4)
Total	303.8 (100.0)	674.1(100.0)	977.9 (100.0)

Source: SIMR Road Inventory
1/ Sois are not included

Availability of the roads varies significantly by area as shown in Table 3.2.5. Although all the roads are not covered but limited to those from the existing road inventories, the overall percentage is extremely low. It is also clear that there is a large difference in roads availability between the areas inside and outside the Middle Ring Road. However, the roads outside the Middle Ring Road have considerable room for widening because of the wide right-of-way, which is not the case for those inside the Middle Ring Road.

Table 3.2.5 Identified Roads by Area[1/]

Area	sqKm	Road Length (Km)	Road Area(sqKm)		Road Availability		
			Carriage Way	Right of Way	Km/sqKm	cy/sqKm	Row/sqKm
Within MRR	141	304	8.4	8.6	2.2	6.0	6.1
North	585	252	4.8	8.4	0.4	0.8	1.4
Northwest	403	127	2.4	5.4	0.3	0.6	1.3
Southeast	213	161	3.4	4.6	0.8	1.6	2.2
Southwest	189	134	2.6	5.0	0.7	1.4	2.6
Total	1531	978	21.6	32.0	0.6	1.4	2.1

Source: SIMR Road Inventory
1/ Sois are not included

4) Network Characteristics

At present, there are no officially determined classification nor commonly applicable standards for the roads in the metropolitan Bangkok area. The DOH standards only apply to rural roads. Accordingly, the standards currently applied for various projects in the study area differ from each other.

The recent attempt of defining road types is done in STTR and partly in the JICA Study. The former classifies the roads at four hierarchical levels of function:

Primary roads: These are intended to concentrate flows of traffic as economically as possible; most of the traffic along primary roads is of long distance nature.

Secondary roads: The role of the secondary roads is to act as the main feeders within the areas bounded by primary roads and to provide minor connections between primary roads. Typically, in a city, it is found desirable to space secondary roads at intervals of about 2-4 km, which means that the area bounded by secondary (or primary) roads is in the range of 4-16 sq. km, and this area is "drained" by distributor roads at about 1 km spacing. If the intervals are greater than this, vehicles have to travel longer distances on distributors, which are designed for only moderate speeds. They provide major feeders to the primary roads; some of the traffic on secondary roads will be generated along the roads themselves but mostly from the tertiary/distributor roads of lower hierarchy.

Distributor roads: These serve as access roads and also as spine roads for other access roads; they lead into secondary or primary roads.

Access roads: These provide direct connections at the locations of most origins and destinations.

(1) Primary Roads

The primary network of a city is normally dominated by the city center that attracts traffic fairly uniformly from all parts of the city and beyond. Some of the primary roads are therefore radials catering to this city center traffic. Other primary roads include city center primary roads that cope with movements across the city center. STTR defines the primary roads as shown in Figure 3.2.3. The system is composed of nine existing radials, two rings and four routes across the city center; two north-south and two east-west.

The existing First Stage Expressway provides the arterial function by linking three major intercity traffic movements with 27.1 Km elevated system which consists of three sections; Din Daeng-port section (8.9Km), Bang Na Port section (7.9Km) and Dao Khanong-Port section (10.3 Km).

Figure 3.2.3 Primary and Secondary Road Network of the Study Area

The overall pattern of the Bangkok road network is a mixture of radial/circumferential system and grid system. Of the two circumferentials, the Middle Ring Road has been completed, but the Outer Ring Road is only partially completed. Nine radials include Pracha Chun, Vibahavadi Rangsit/Pahon Yothin, Phetburi/New Phetburi, Sukhumvit, Rama IV, Suksawat, Thonburi-Pak Tho, Phet Kasem and Bangkok Noi-Nakhon Chaisi. The radials are lacking in the northwest, and northeast which makes it difficult to provide these areas with an adequate road system. These primary roads form a rather grid pattern in the city center (more or less the area within the Middle Ring Road).

Another apparent weakness in the primary network is the lack of radial forks in the suburban areas. As the radials extend outwards, the distance between them naturally increases, and bifurcation is required to maintain good coverage of the outer area.

(2) Secondary Roads

One of the weakness of the Bangkok road system is the lack of secondary and below roads. Their characteristics by area are briefly as follows:

Area Within Middle Ring Road: The secondary network in this area is relatively well provided. However the following weaknesses are observed:

(a) Lack of east-west connection in the north.
(b) Lack of river crossings across Chao Phraya River.
(c) Low quality of some secondary roads, especially those from the south across Sathorn Road through to Rama IV.
(d) Lack of links in Makkasan area.

Northwest Area: There are no secondary roads on the west side of the River. The areas are too large to be developed properly without secondary roads.

North: This area is similarly lacking in secondary roads. Large areas enclosed by Pahon Yothin, Ram Intra, and Lat Phrao roads are only served by sois.

East and Southeast: These areas are relatively better served. However, there are still many areas where secondary road are connections are considerably lacking.

Southwest: The area similarly lacks secondary roads.

(3) Distributor Roads

Aside from the insufficient secondary roads, there is also a considerable lack in distributor roads. Large-scale commercial/urban developments are forced to be located only along the main road network, having no exit or alternative access from another side. The consequences of this lack of distributor roads are as follows; 1) excessive traffic is forced to access roads, causing congestion and environmental nuisance, and 2) traffic is forced to travel longer distances on the main roads, which creates additional traffic, much of it on the main roads and also much turning traffic at junctions. Thus, the lack of distributor roads contributes to the congestion problem on the main roads.

Many pocket areas lacking in proper distributors can be easily found in the study area not only in the area outside the Middle Ring Road but also in the inner area. Figure 3.2.4 shows super-size blocks without proper distribution roads, while Figure 3.2.5 shows more detailed characteristics of the problems of the following classical areas as examples:

(a) The Sukhumvit-Asok-Pet Buri-Ekkamai block. Exit from the north is blocked - though not insuperably - by a Khlong. Few residents have a feasible exit from the block on more than one side.

(b) The Tak Sin-Dao Kanong-Wutthakat-Thoet Thai block, recently divided by the construction of the Middle Ring Road. Three klongs run right across the block but they have been bridged in places.

(c) The Lat Phrao-Middle Ring Road-Inthramara-Vibahavadi Rangsit block. A klong also runs across this block. There is one through-road.

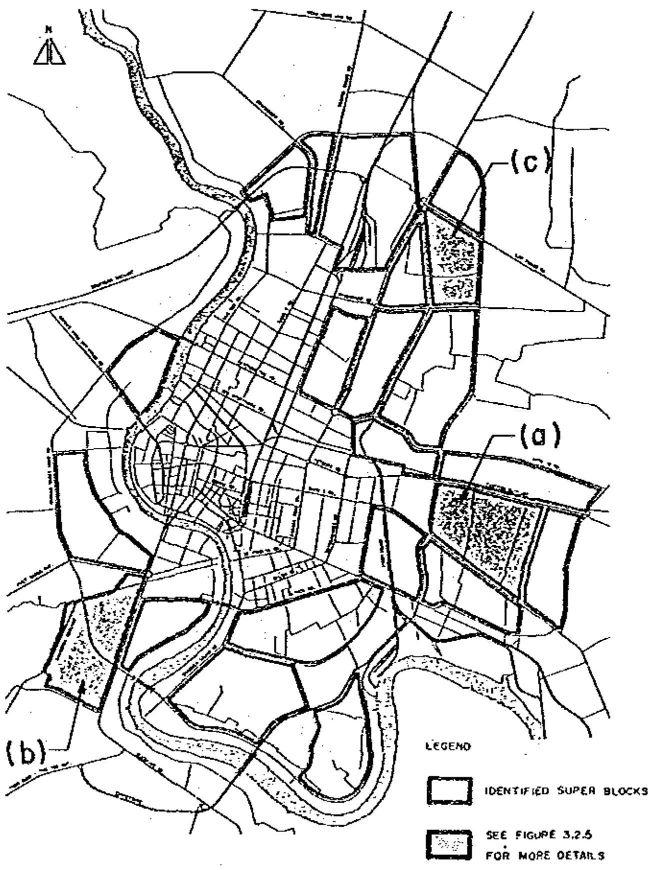
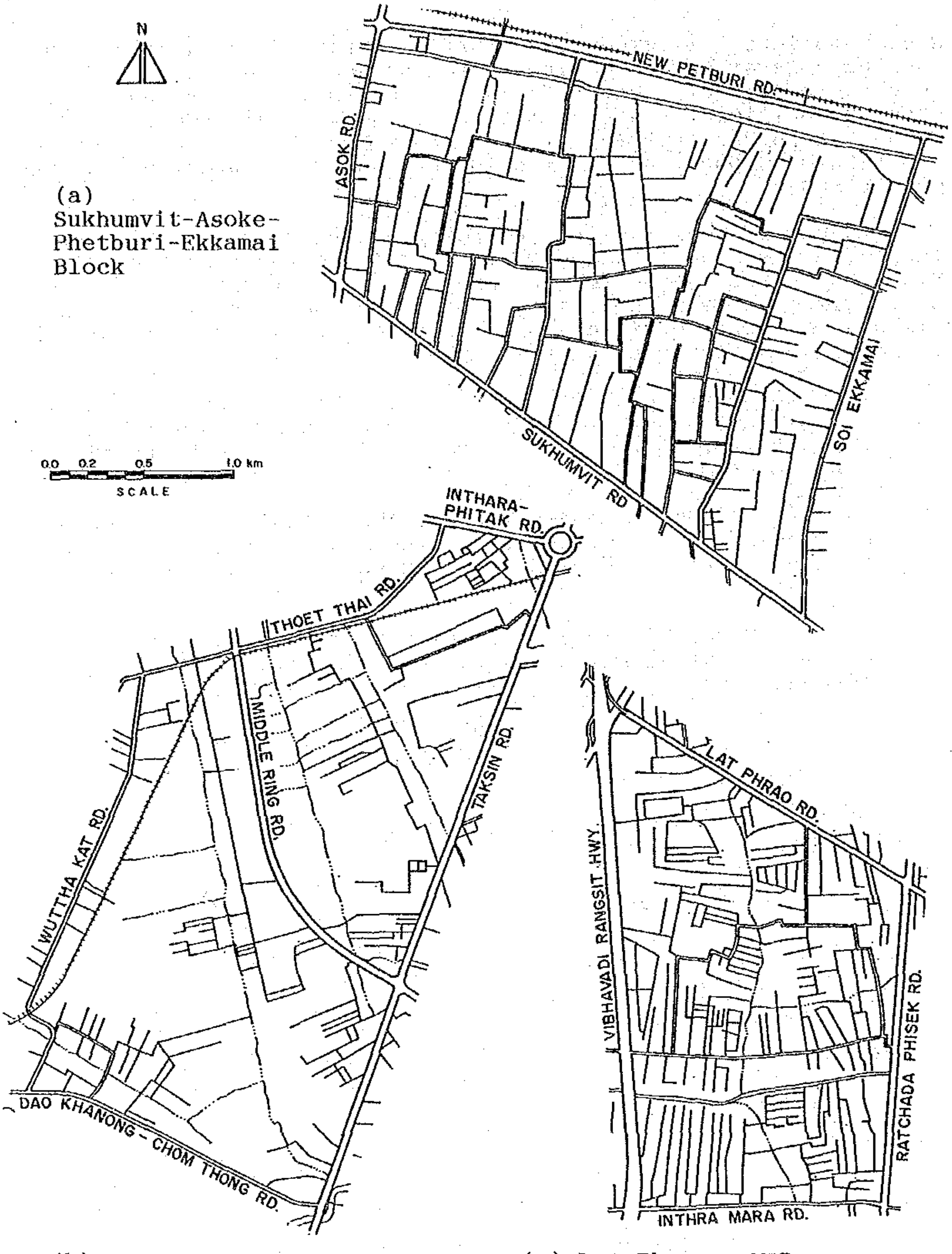


Figure 3.2.4
Indentified Superblocks without Proper Distributors



(a)
Sukhumvit-Asoke-
Phetburi-Ekkamai
Block

(b)
Taksin-Don Kanong-
Wuthakhat - Thoet Thai Block

(c) Lat Phrao - MRR -
Inthra Mara - Vibhavadi
Rangsit Block

Figure 3.2.5 Characteristics of Selected Superblocks

3.3 Current Road Traffic

1) Traffic Volume Growth

Comparing the traffic volume of the 1985 JICA Study with the 1989 study result, the growth of vehicle traffic volume was calculated.

Growth factors on major roads in and around the study area are shown in Figure 3.3.1. Growth factors in Old Bangkok, which is bordered by Krung Kasem Rd and Chao Phraya River, and in the Thonburi district are roughly 0.9 each, indicating that traffic volumes have decreased. The congested area bordered by Chao Phraya River, Thahran Rd, Sutthisan Winit Chai Rd, Middle Ring Rd and Saton Rd shows an increase factor of roughly 1.1, indicating that traffic volume has grown by 10%. The highest increase factor, 1.50, is seen in the city's northern area near the Middle Ring Rd, while the western area on the outside of the Middle Ring Rd and the eastern area show increase factors of 1.2 and 1.3 respectively. *Thus, traffic volume in the area where congestion* is the most severe has not increased appreciably over the past four years.

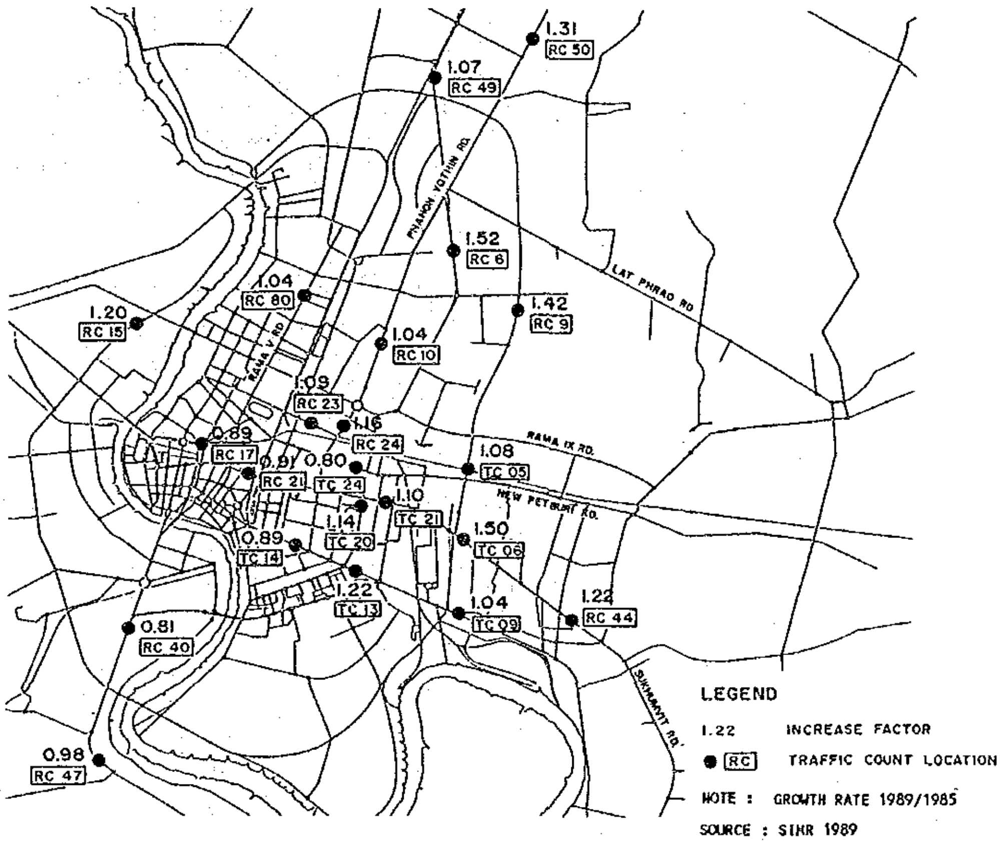


Figure 3.3.1 12-Hour Traffic Volume Growth Factor

2) Traffic Characteristics

Conditions pertaining to the flow of vehicular traffic within the study area in 1989 are discussed below.

(1) Vehicular Traffic

a. Traffic Volume in Bangkok Urban Area

As shown in Table 3.3.1 and in Figure 3.3.2, two-way traffic volumes during a 12-hour period on arterial roads in the study area range from 30,000 to 126,000 pcu. Vibhavadi Rangsit Rd has the highest volume, at about 126,000 pcu. The next highest volumes are seen on the roads that comprised the arterial road network in the city center-Ding Daeng Rd, Petburi Rd, Rama IV Rd, Sukhumvit Rd, Phaya Thai Rd, and Ratcha Damnoen Klang Rd--at 70,300-81,600. Ratchaprarop Rd has volumes ranging from 42,900 to 65,500. Two-way 12-hour volume on the Middle Ring Rd, which circumscribes the city center, is 25,000-60,500 -- which is relatively low owing to the existence of several sections that have not been built yet. Thus, it can be seen that a large volume of vehicular traffic converges on the area surrounded by Rama IV Rd, the Middle Ring Rd, Din Daeng Rd, Ratchawithi Rd, and Chao Phraya River.

Two-way traffic volumes during a morning peak hour on arterial roads in the study area vary between 2,500 and 12,000 pcu, as shown in Table 3.3.1. The highest volume (12,000) is observed on Vibhavadi Rangsit Rd, which is an expressway for exclusive motor vehicle use. Peak-hour volume per lane is roughly 1,500 pcu. Two-way peak-hour volumes on arterial roads serving the city center range between 3,300 and 7,700, with peak-hour volume per lane as high as 600-900 pcu, indicating conditions of saturation.

Table 3.3.1 Traffic Volume on Major Roads (1989)

PCU/12H for both directions

Road	Range of Volume 12 Hour	Range of Volume Peak Hour
Vibahavadi Rangsit	116,300 - 126,300	9,300 - 12,000
Petburi	23,400 - 81,600	2,200 - 7,200
Rama IV	43,600 - 80,900	3,900 - 6,800
Sukhumvit	38,500 - 79,100	3,200 - 7,700
Din Daeng	53,900 - 73,700	4,800 - 7,700
Phaya Thai	41,300 - 72,800	3,000 - 7,000
Ratchadamnoen Klang	70,300	6,700
Sathorn	65,500	4,600
Ratchadaphisek	49,200 - 60,500	2,900 - 3,900
Phahon Yothin	40,700 - 57,100	2,900 - 4,700
Somdet Phra Chao Taksin	- 54,500	4,700
Rama VI	37,900 - 54,000	3,200 - 4,100
Suksawat	- 55,000	4,900
Charan Sanitwongse	- 52,000	6,600
Ratchaprarop	42,400 - 50,200	3,300 - 3,700
Witthayu	32,000 - 49,500	2,400 - 4,600
Sukhumvit 21	31,700 - 48,200	2,400 - 3,200
Ratchawithi	31,400 - 43,200	2,600 - 3,300
Lat Phrao	- 42,900	3,300
Henri Dunant	33,900 - 38,900	3,000 - 3,100
Rama V	- 29,900	2,500

SOURCE: SIMR

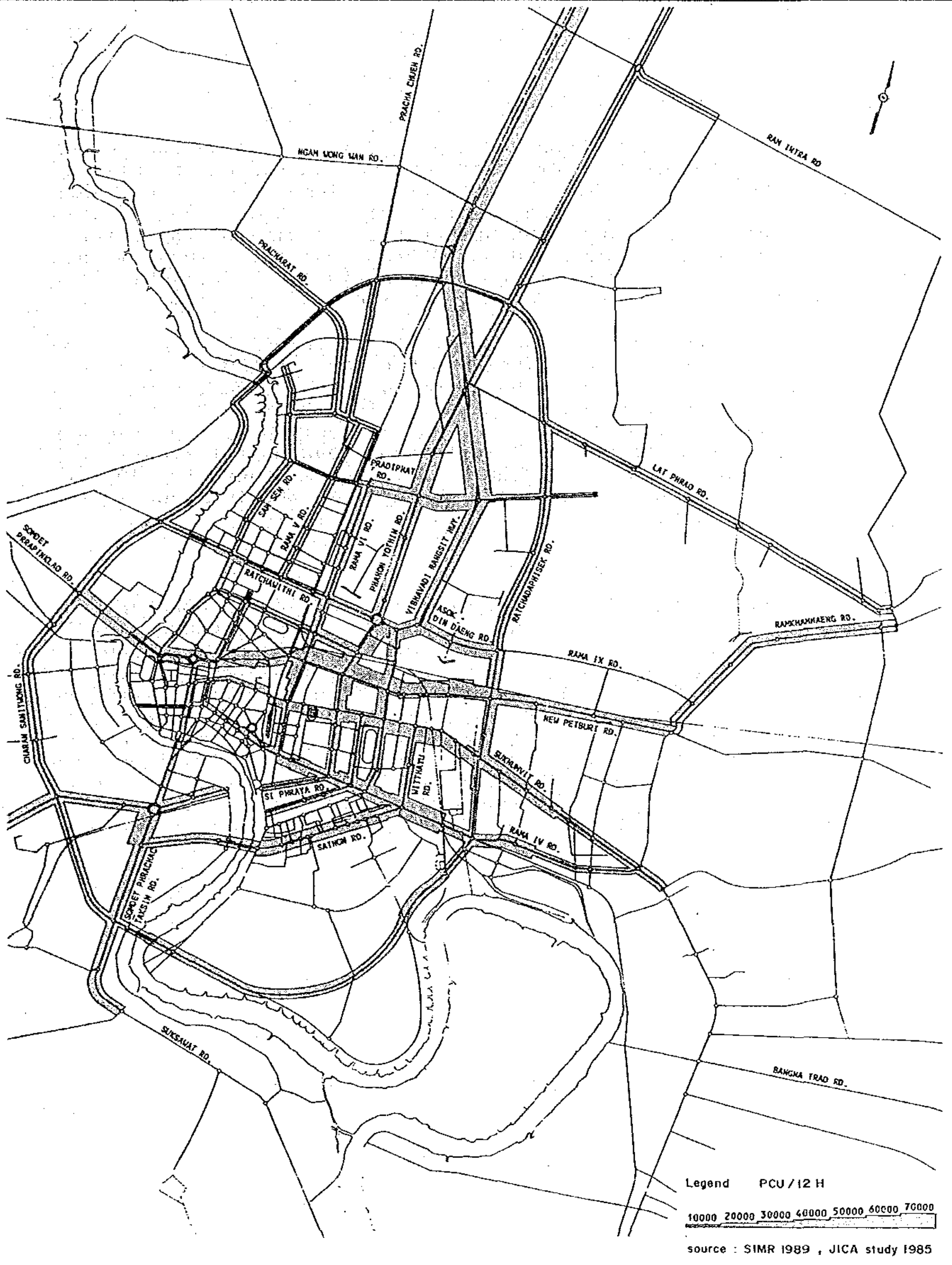


Figure 3.3.2 12-Hour Vehicular Traffic Flow on Arterials in 1989

b. Screen Line Traffic Volume

Table 3.3.2 show the 12-hour vehicle traffic volume on the screen line. The 12-hour two-way traffic volume at various points is about 9,000 to 69,000. High traffic volumes cross the Phra Pinklao Bridge (S-6), Phra Pokklao Bridge (S-8), and Taksin Bridge (S-9). The 12-hour two-way traffic volumes on these three bridges are 85,200, 68,200 and 68,800 respectively. The combined traffic volume of these three bridges is 222,200, which is equivalent to 44% of the total screen line traffic volume.

Table 3.3.2 shows the peak hour traffic volume on the screen line. The two-way traffic volumes per hour at the morning peak hour (8:00-9:00) range from 800 to 8,200, while the range is 500 to 2,800 in the outbound direction. The traffic volumes are between 300 to 5,400 in the inbound direction. The two-way traffic volumes per hour in the afternoon peak hour (17:00-18:00) range from 900 to 8,400. The traffic volume range is 400 to 2,900 in the inbound direction, while it is 500 to 6,300 in the outbound direction.

c. Cordon Line Traffic Volume

Table 3.3.3 shows the 12-hour vehicle traffic volume on the cordon line. The largest and smallest two-way 12-hour traffic volumes observed at the cordon line stations are about 3,600 and 55,800 respectively. Figure 3.3.3 shows the traffic volume passing the cordon line classified by five traffic corridors (northern part, northwestern part, western part, southern part, and eastern part). The traffic volume bound to the western part shows a high figure equivalent to about 40% of the total cordon line traffic volume. This is followed by the east-bound direction, about 25%, south-bound direction, 20%; and the northwest-bound direction and north-bound direction with 8 and 7% respectively.

Table 3.3.2 Traffic Volume on Screen Line

12 Hours (7-19h)

Location	IN			OUT			TOTAL		
	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU
S-1	923	2,996	4,301	901	3,051	4,626	1,824	6,047	8,927
S-2	1,261	4,660	7,129	1,212	5,017	7,651	2,473	9,677	14,781
S-3	1,676	9,563	13,523	1,688	10,331	14,744	3,364	19,894	28,266
S-4	4,511	12,653	14,293	4,957	13,663	15,398	9,468	26,316	29,691
S-5	6,351	18,871	22,519	7,436	21,303	25,184	13,787	40,174	47,703
S-6	12,001	35,756	41,856	11,713	36,916	43,363	23,714	72,672	85,219
S-7	9,991	19,596	22,309	8,024	14,084	15,592	18,015	33,680	37,901
S-8	18,065	20,673	26,764	23,294	34,129	41,452	41,359	54,802	68,216
S-9	20,731	27,889	35,188	15,864	27,884	33,624	36,595	55,773	68,813
S-10	11,046	18,735	23,724	8,674	16,026	20,735	19,720	34,761	44,459
S-11	0	18,836	24,461	0	16,050	22,207	0	34,886	46,668
TOTAL	86,556	190,228	236,067	83,763	198,454	244,577	170,319	388,682	480,644

Morning Peak (8-9h)

POINT	IN			OUT			TOTAL		
	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU
S-1	87	226	322	98	317	470	185	543	791
S-2	114	331	533	144	481	622	258	812	1,156
S-3	215	777	992	185	1,033	1,363	400	1,810	2,355
S-4	532	917	1,082	964	1,803	2,021	1,496	2,720	3,102
S-5	933	2,024	2,324	678	1,386	1,638	1,611	3,410	3,962
S-6	2,060	4,852	5,415	941	2,397	2,816	3,001	7,249	8,230
S-7	1,541	2,085	2,445	497	921	1,014	2,038	3,006	3,459
S-8	3,946	3,951	4,936	1,280	2,076	2,627	5,226	6,027	7,563
S-9	6,130	3,618	4,734	1,166	1,660	1,915	7,296	5,278	6,650
S-10	1,654	1,902	2,358	885	1,384	1,708	2,539	3,286	4,066
S-11	0	1,835	2,050	0	1,306	1,513	0	3,141	3,563
TOTAL	17,212	22,518	27,189	6,838	14,764	17,708	24,050	37,282	44,897

Evening Peak (17-18h)

POINT	IN			OUT			TOTAL		
	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU
S-1	84	276	397	126	298	495	210	574	892
S-2	149	417	628	121	377	589	270	794	1,218
S-3	171	1,027	1,411	241	927	1,204	412	1,954	2,615
S-4	452	1,235	1,395	404	986	1,156	856	2,221	2,551
S-5	485	1,554	1,762	1,105	3,215	3,548	1,590	4,769	5,311
S-6	966	2,557	2,907	1,360	4,980	5,447	2,326	7,537	8,353
S-7	687	1,285	1,463	838	1,490	1,646	1,525	2,775	3,108
S-8	1,106	1,256	1,673	3,114	5,489	6,310	4,220	6,745	7,983
S-9	1,171	1,504	1,759	1,665	3,666	4,008	2,836	5,170	5,767
S-10	1,071	1,569	1,923	952	1,475	1,846	2,023	3,044	3,769
S-11	0	1,581	1,856	0	1,490	1,710	0	3,071	3,566
TOTAL	6,342	14,261	17,173	9,926	24,393	27,959	16,268	38,654	45,132

Table 3.3.3 Traffic Volume on Cordon Line

12 Hours

DIRECTION	STATION	I N			OUT			TOTAL		
		Mtc	Vehicle	PCU	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU
WEST	R 01	3,352	21,338	25,758	3,154	21,613	26,627	6,506	42,951	52,385
	R 02	6,138	21,807	28,241	5,000	19,587	27,541	11,138	41,394	55,783
	R 03	1,286	6,498	9,706	1,328	5,041	7,331	2,614	11,539	17,037
	R 04-1	1,380	5,449	9,365	1,211	7,385	12,139	2,591	12,834	21,503
	S.Total	12,156	55,092	73,071	10,693	53,626	73,637	22,849	108,718	146,708
SOUTH	R 04-2	671	1,988	2,886	731	1,659	2,339	1,402	3,647	5,225
	R 05	1,837	6,327	10,789	2,046	6,934	11,437	3,883	13,261	22,225
	R 06	3,227	9,147	13,163	2,970	8,039	12,011	6,197	17,186	25,174
	R 07	972	3,372	5,448	973	3,461	5,474	1,945	6,833	10,921
	C 01	2,151	5,593	7,069	1,934	5,233	6,766	4,085	10,826	13,836
	S.Total	8,858	28,427	39,354	8,654	25,326	38,027	17,512	51,753	77,381
EAST	R 08	1,377	14,395	20,327	1,800	19,381	26,741	3,177	33,776	47,069
	R 09	908	3,246	4,560	1,000	3,351	4,673	1,908	6,597	9,233
	R 10	821	3,300	4,793	759	3,365	4,707	1,580	6,665	9,500
	R 11	1,304	6,068	9,026	1,258	5,779	8,419	2,562	11,847	17,445
	R 12	759	3,005	4,288	593	3,124	4,517	1,352	6,129	8,806
	C 02	1,172	3,029	4,229	940	2,687	3,872	2,112	5,716	8,101
	C 03	340	1,113	1,727	426	1,234	1,905	766	2,347	3,632
	S.Total	6,681	34,156	48,950	6,776	38,921	54,836	13,457	73,077	103,786
NORTH	R 13	981	10,952	18,669	856	10,016	16,915	1,837	20,968	35,584
	R 14	345	2,280	3,756	390	2,565	4,115	735	4,845	7,870
	S.Total	1,326	13,232	22,425	1,246	12,581	21,030	2,572	25,813	43,455
NORTH-WEST	R 15	361	1,684	2,673	338	1,802	2,858	699	3,486	5,531
	R 16	770	1,518	1,898	868	1,859	2,380	1,638	3,377	4,278
	R 17	990	6,522	8,514	887	6,073	7,784	1,877	12,595	16,298
	S.Total	2,121	9,724	13,085	2,093	9,734	13,023	4,214	19,458	26,107
TOTAL		31,142	138,631	196,885	29,462	140,188	200,552	60,604	278,819	397,437

Peak Hours

DIRECTION	STATION	I N			OUT			TOTAL		
		Mtc	Vehicle	PCU	Mtc	Vehicle	PCU	Mtc	Vehicle	PCU
WEST	R 01	515	1,804	2,046	245	1,477	1,718	760	3,281	3,765
	R 02	809	1,749	2,201	451	1,501	1,931	1,260	3,250	4,133
	R 03	112	350	478	128	326	415	240	676	893
	R 04-1	167	625	1,124	72	570	811	239	1,195	1,935
	S.Total	1,603	4,528	5,850	896	3,874	4,876	2,499	8,402	10,726
SOUTH	R 04-2	89	168	245	82	118	160	171	286	405
	R 05	274	504	832	205	572	926	479	1,076	1,758
	R 06	237	788	1,135	311	705	1,006	548	1,493	2,142
	R 07	104	262	409	78	295	431	182	557	840
	C 01	274	529	638	131	465	551	405	994	1,189
	S.Total	978	2,251	3,259	807	2,155	3,075	1,785	4,406	6,334
EAST	R 08	200	763	1,122	146	1,225	1,469	346	1,988	2,591
	R 09	137	397	537	113	382	530	250	779	1,067
	R 10	92	233	335	65	339	430	157	572	765
	R 11	124	452	601	133	531	711	257	983	1,312
	R 12	78	242	355	68	289	404	146	531	759
	C 02	105	251	339	83	216	293	188	467	632
	C 03	26	99	160	41	87	130	67	186	291
	S.Total	762	2,437	3,448	649	3,069	3,968	1,411	5,506	7,416
NORTH	R 13	72	814	1,532	83	601	935	155	1,415	2,467
	R 14	26	149	253	38	219	324	64	368	578
	S.Total	98	963	1,785	121	820	1,260	219	1,783	3,045
NORTH-WEST	R 15	31	125	199	29	147	229	60	272	428
	R 16	73	159	193	87	202	251	160	361	444
	R 17	118	526	629	91	611	733	209	1,137	1,362
	S.Total	222	810	1,021	207	960	1,213	429	1,770	2,234
TOTAL		3,663	10,989	15,362	2,680	10,878	14,392	6,343	21,867	29,754

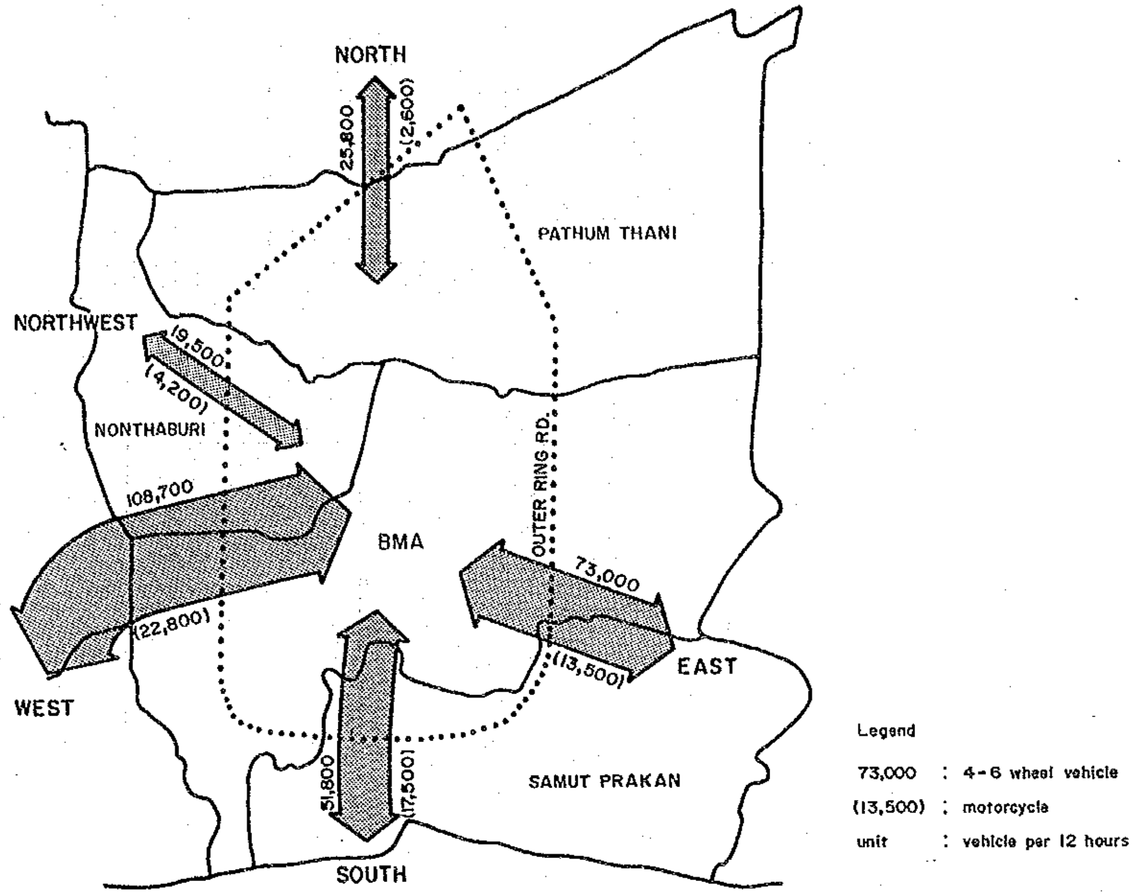
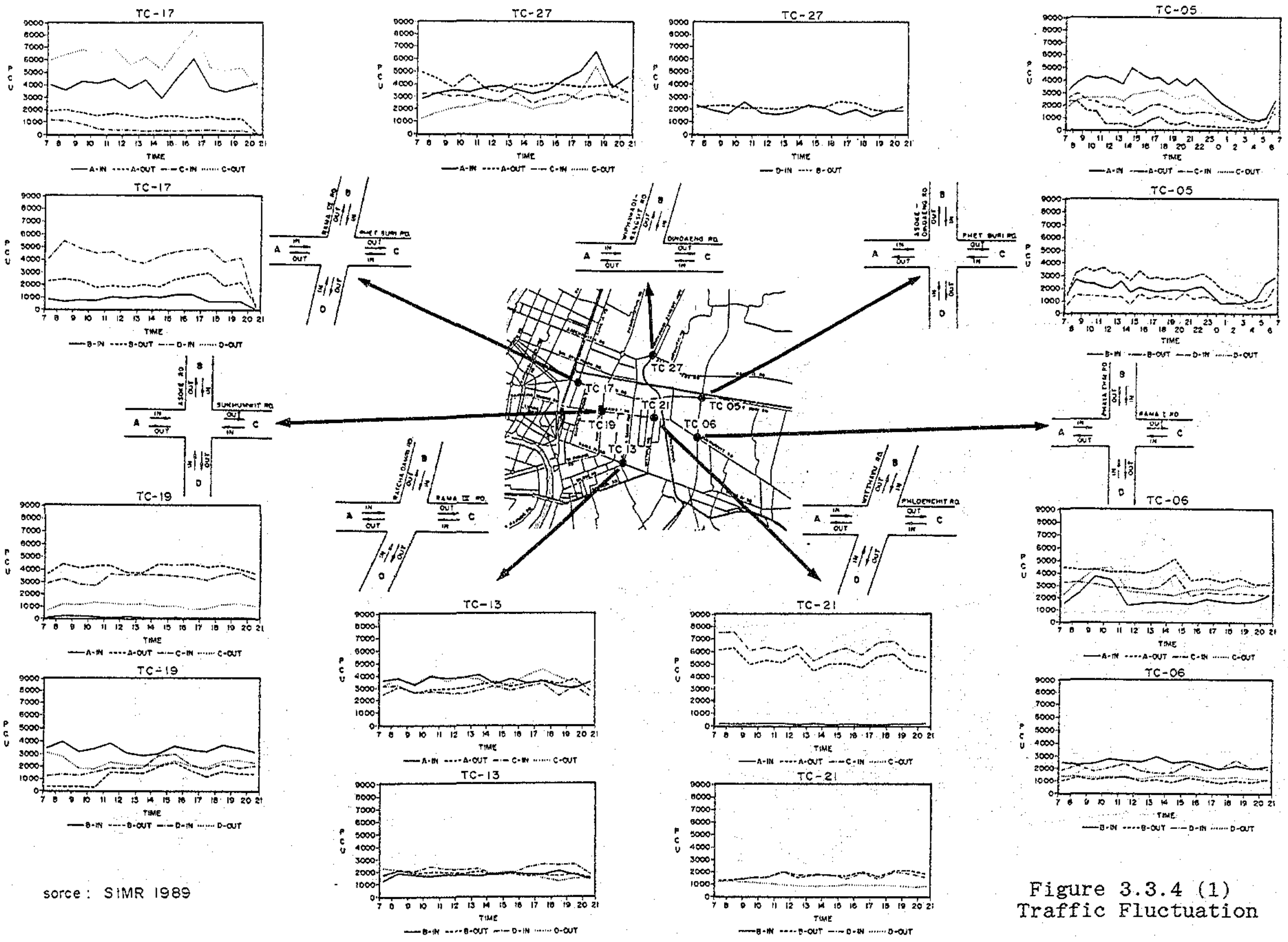


Figure 3.3.3 Traffic Volume on Cordon Line

d. Hourly Fluctuation

Figure 3.3.4 shows the hourly fluctuations of traffic volumes on major roads in the study area. The fluctuation patterns shown in the figure are complicated and vary widely. Peak hours generally occur during 7:00-9:00 in the morning, 13:00-14:00 in the afternoon, and 16:00-18:00 in the evening. Especially large fluctuations are seen from morning to afternoon due to changes in traffic congestion that occur during business hours.

To see how traffic volumes fluctuate during a week, quarter-hourly fluctuations of traffic volume on ETA - Soi 3 section of Sukhumvit Rd during the morning peak hours were charted for each day of the week as shown in Figure 3.3.5. As the figure indicates, traffic volumes vary greatly depending on the day of the week.



sorce : SIMR 1989

Figure 3.3.4 (1)
Traffic Fluctuation

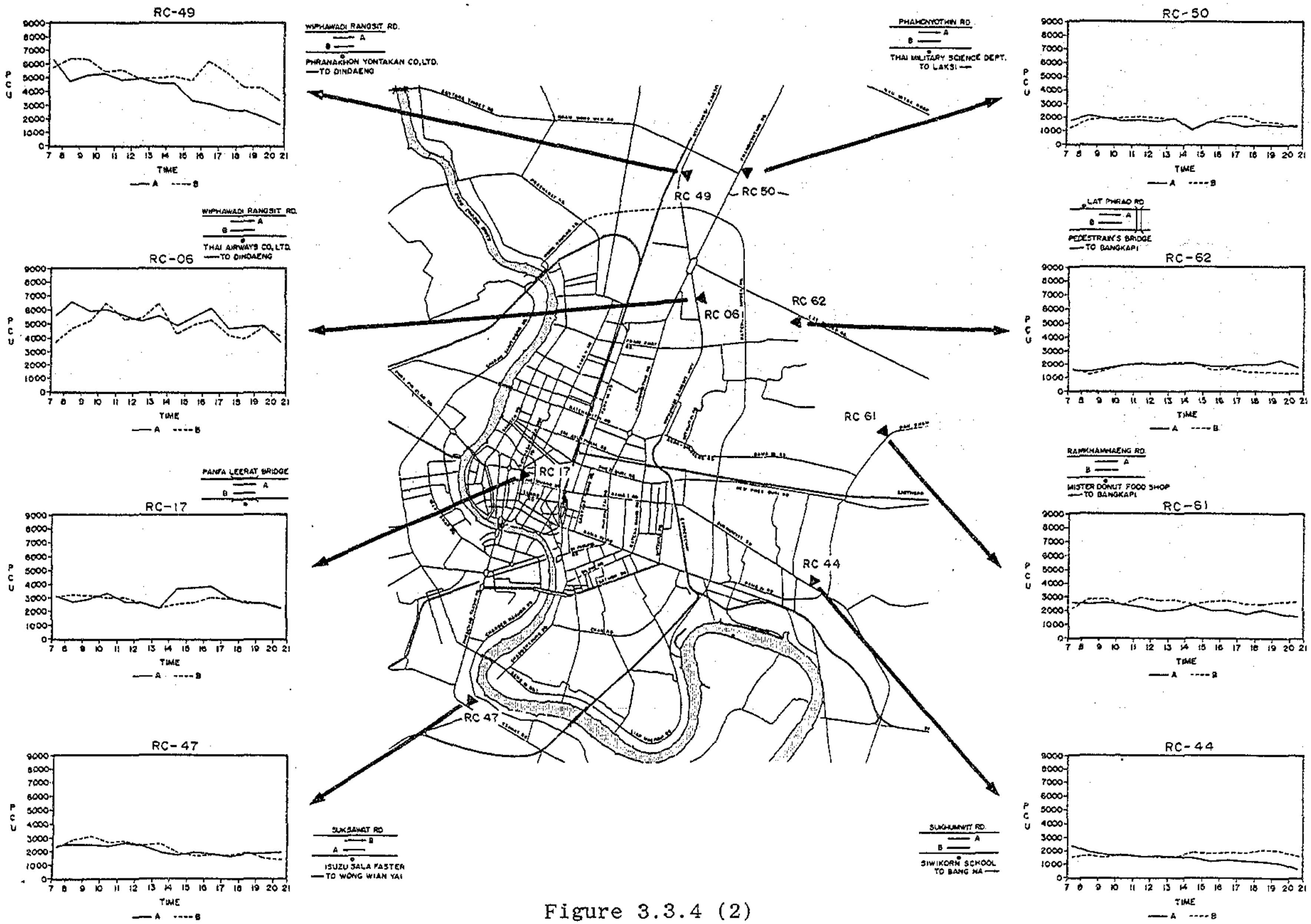
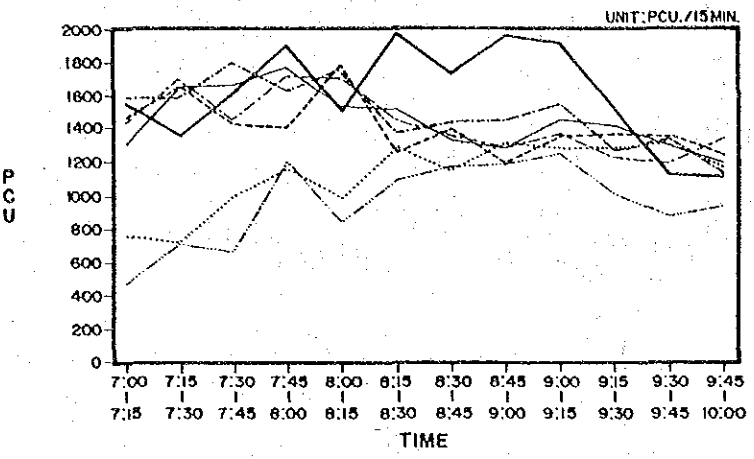


Figure 3.3.4 (2)
Traffic Fluctuation

source : SIMR 1989

(Section ETA-Soi3 on Sukhumvit Road, Inbound)



(Section ETA-Soi3 on Sukhumvit Road, Outbound)

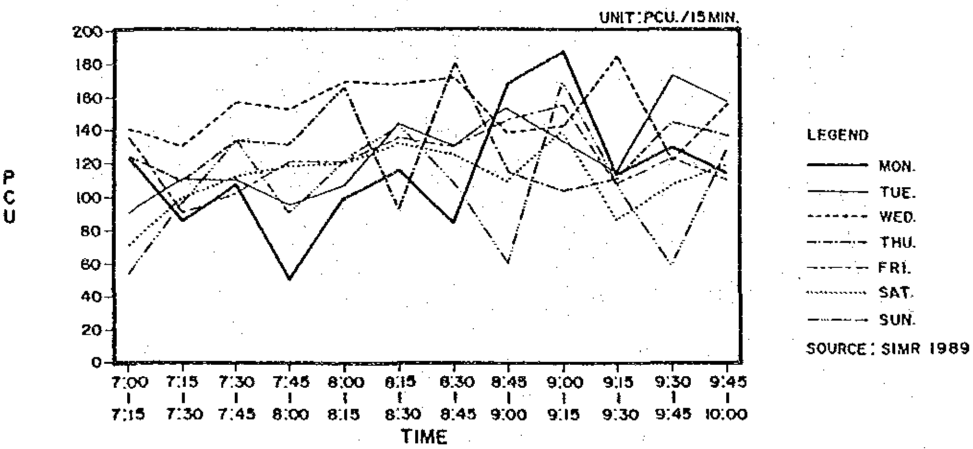


Figure 3.3.5 Traffic Fluctuation During A Week

The morning and evening peak rates of hourly traffic to 24-hour traffic on the main screen line are as shown hereafter.

Phra Nangklao Bridge: The peak hour traffic volume is approximately 1800 from 8:00 to 9:00, showing a peak rate of 6.8%. The traffic volume is about 2,000 from 17:00 to 18:00, showing a peak rate of 7.3%.

Phra Pinklao Bridge: The peak hour traffic volume is about 8,000 from 7:00 to 8:00, showing a peak rate of 7.6%. The traffic volume is about 7,500 from 17:00 to 18:00, with a peak rate of 7.1%.

Taksin Bridge: The peak hour traffic volume is about 5,300 from 7:00 to 8:00, showing a 6.8% peak rate. The traffic volume is about 5,500 from 17:00 to 18:00, showing a peak rate of 6.5%.

e. Vehicle Type Composition

The vehicle type composition on the major roads on the screen and cordon lines is shown in Figures 3.3.6 and 3.3.7. The characteristics of the vehicle type composition on the screen line are as stated below.

At the screen line stations S-4 to S-10, private passenger cars and motorcycles have the highest share at 70%, while business use vehicles (trucks) occupy about a 60% share at other points. This can be explained by the restriction on entry of large vehicles during the day into roads except expressways and Vibhavadi Rangsit Highway inside the Middle Ring Road.

In the vehicle type composition on the expressway at the Rama IX Bridge (S-11), business use vehicles have a 60% share. This shows that the expressway serves commercial and industrial activities.

At stations form S-4 to S-10, the share of private vehicles (passenger cars and motorcycles) is 80% or higher in the morning and afternoon peak hours. This is about 10% higher than the percentage of private vehicles on a 12-hour basis. On the expressway, the percentage of private vehicles is about 58%, which is about 15% higher than the percentage on a 12-hour basis.

The vehicle type composition characteristics on the cordon line are as stated below.

The percentage of north-bound business use vehicles is 75%, which is higher than that of other points (about 50%).

The percentage of private vehicles at the peak hour time in the morning and in the afternoon at this station maintains the same value as the corresponding percentage of private vehicles on the 12-hour basis. However, it is about 10% higher at other points.

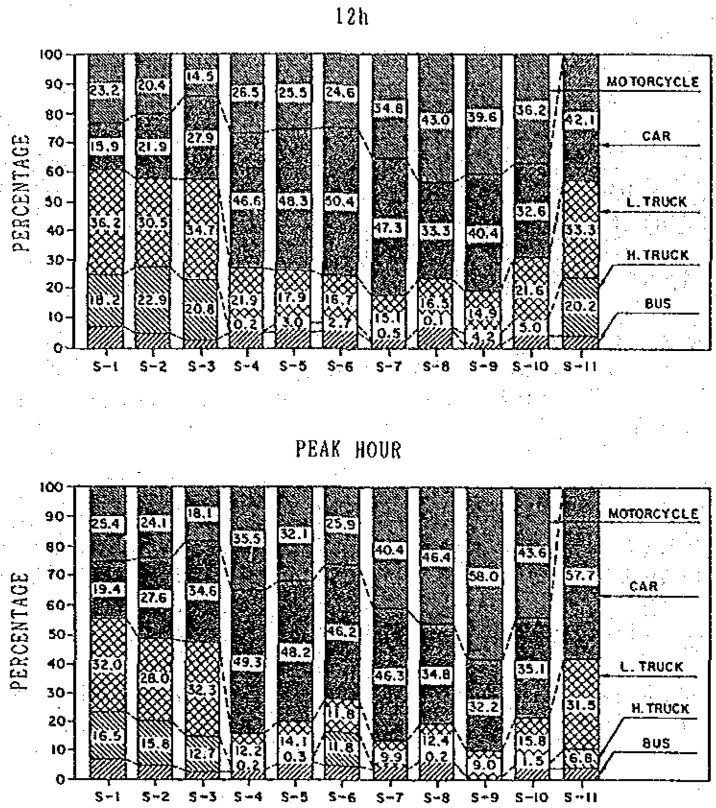


Figure 3.3.6 Vehicular Composition on Screen Line

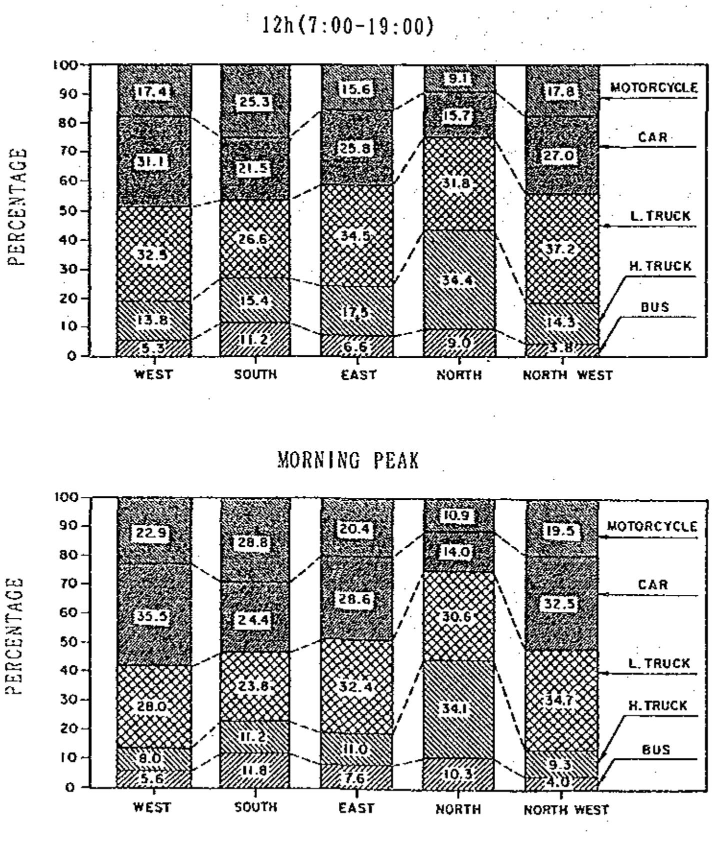


Figure 3.3.7 Vehicular Composition on Cordon Line

(2) Travel Speed

Figure 3.3.8 shows the distribution of travel speed by road section during the morning and evening peak hours.

a. Morning Peak Hours

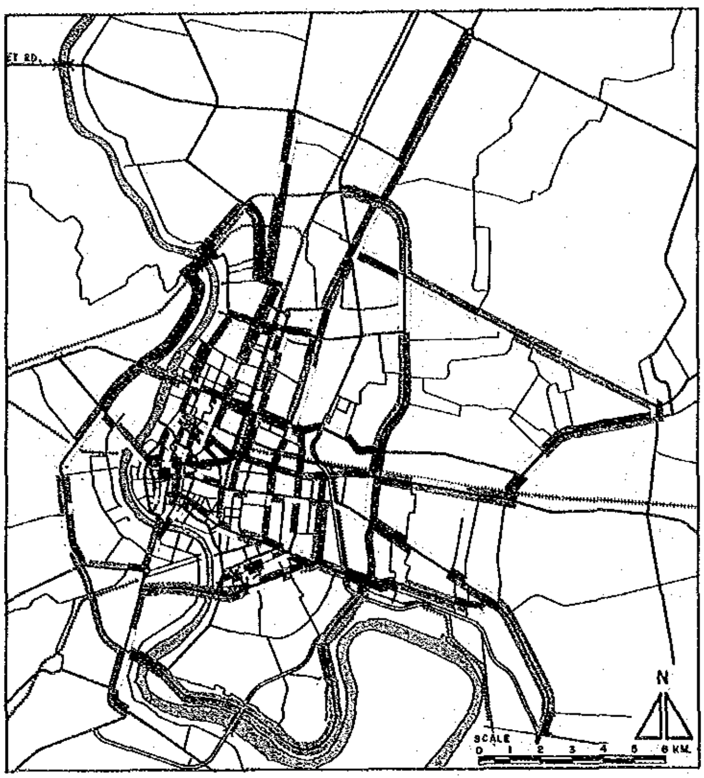
Sections with travel speeds of 10 km/h or less, indicating congestion, are heavily concentrated in the city center bordered by Charun Sanit Wong Rd, Thawarn Rd, Phahon Yothin Rd, Din Daeng Rd, Middle Ring Rd (Asok), Rama IV Rd, Phaya Thai Rd, and Bamrung Muang Rd. Separated from this major area of congestion, sections having the same travel speeds are seen in and around areas where a major road intersects the Middle Ring Rd. These sections are located on Mahai Sawan Rd, Suk Sawat Rd, Lat Phrao Rd, Phahon Yothin Rd, Prachachun Rd and Prachart Rd. In addition, low speeds were observed in the vicinity of the Rama IV - Sukhumvit intersection, the Sathorn - Charoen Krung intersection, the New Petburi - Ramkhamhaeng intersection and the Ramkhamhaeng - Lat Phrao intersection.

Thus, the area covering approximately 20 sq.km centering on Ratchawithi Rd, Din Daeng Rd, Phahon Yothin Rd, Phaya Thai Rd, Ratchaprarop Rd and Rama IV Rd is heavily congested.

b. Evening Peak Hours

Sections with low travel speeds in the evening peak hours are more or less the same as in the morning peak hours. However, the congested area extends further northward and southward than in the morning. The area covering approximately 30 sq.km centering on Ratchawithi Rd, Din Daeng Rd, Petburi Rd, Phahon Yothin Rd, Phaya Thai Rd, Ratchaprarop Rd, Rama IV Rd, Soi Asok Rd and Silom Rd is heavily congested.

Morning Peak Hour



Evening Peak Hour

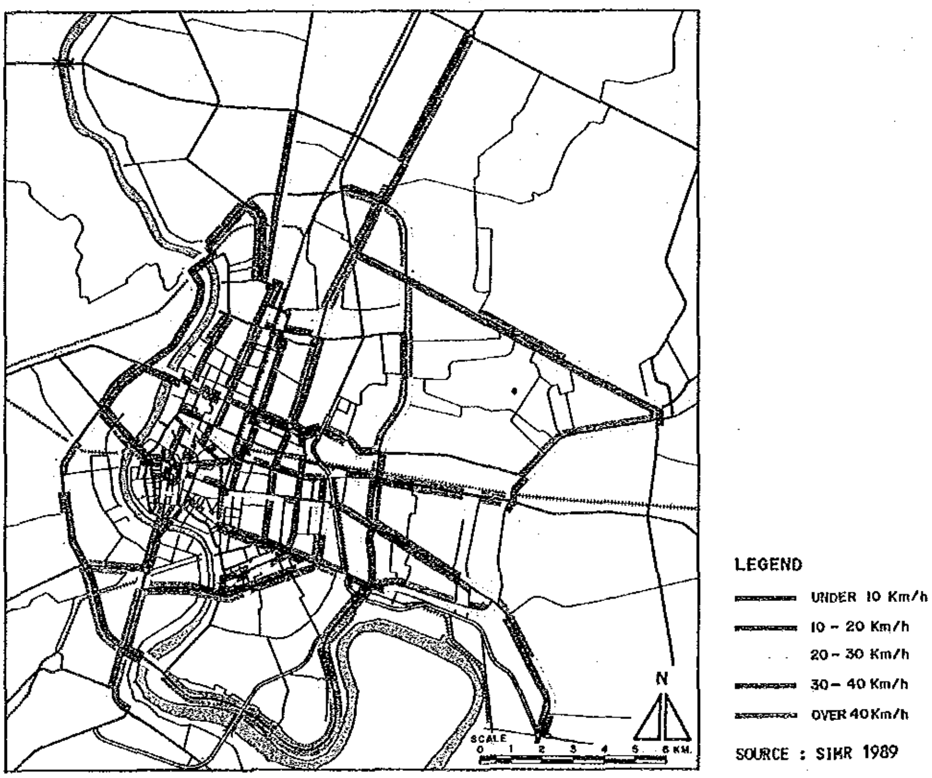


Figure 3.3.8 Average Travel Speed

(3) Traffic Accidents

a. Number of Accidents

Table 3.3.4 gives the number of traffic accidents that occurred in the Bangkok Metropolitan Area during the past 10 years (1979 - 1988). As shown in Figure 3.3.9, a downward trend was observed in 1982, but the number increased gradually over the following years and rose sharply in 1987 and 1988, resulting in a 2.6-fold increase in traffic accidents during the past decade. However, the number of accidents per 100 vehicles registered declined by close to 50% during the 10 year period, from 3.4 accidents to 1.9, apparently indicating the effectiveness of traffic safety measures.

Table 3.3.4 Traffic Accidents and Registered Vehicles

Year / Description	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Number of Accidents	12,045	11,190	11,802	9,794	13,674	14,092	14,295	16,069	19,745	31,175
Number of Registered Vehicles in Bangkok	350,970	438,128	490,988	563,543	606,806	694,101	760,257	-	-	1,050,033
Accident/100 Registered Vehicles in Bangkok	3.4	2.6	2.4	1.7	2.3	2.0	1.9	-	-	1.9

Source : Department of Land Transport
Dec. 1988

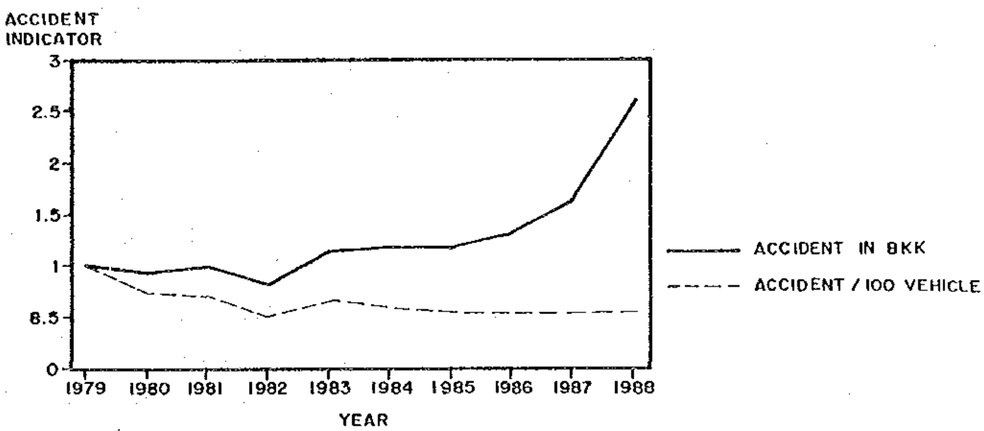


Figure 3.3.9 Traffic Accidents and Registered Vehicles

b. Accident Analysis

Figure 3.3.10 shows the locations where accidents occur at a high frequency within the area bordered by the Middle Ring Rd. There is a tendency toward high accident frequency in the city center, particularly on Rama IV Rd, Sukhumvit Rd, Petburi Rd, Phaya Thai Rd and Sri Ayutthaya Rd, where congestion is severe.

Of the total number of traffic accidents, a substantial 76% were vehicle-to-vehicle accidents (including motorcycles), while 20% involved pedestrians. Of the total number of vehicle-to-vehicle accidents, rear-end collisions represented 25%, side collisions during turning movements, 20%, and scraping, 17%. Of the total number of vehicle-to-pedestrian accidents, 11% occurred while the pedestrians were crossing a street where there is no pedestrian crossing.

By cause of accident, close to half (47%) the total number was caused by improper driving speed. This was followed by improper overtaking at 27% and improper turning movement at 24%.

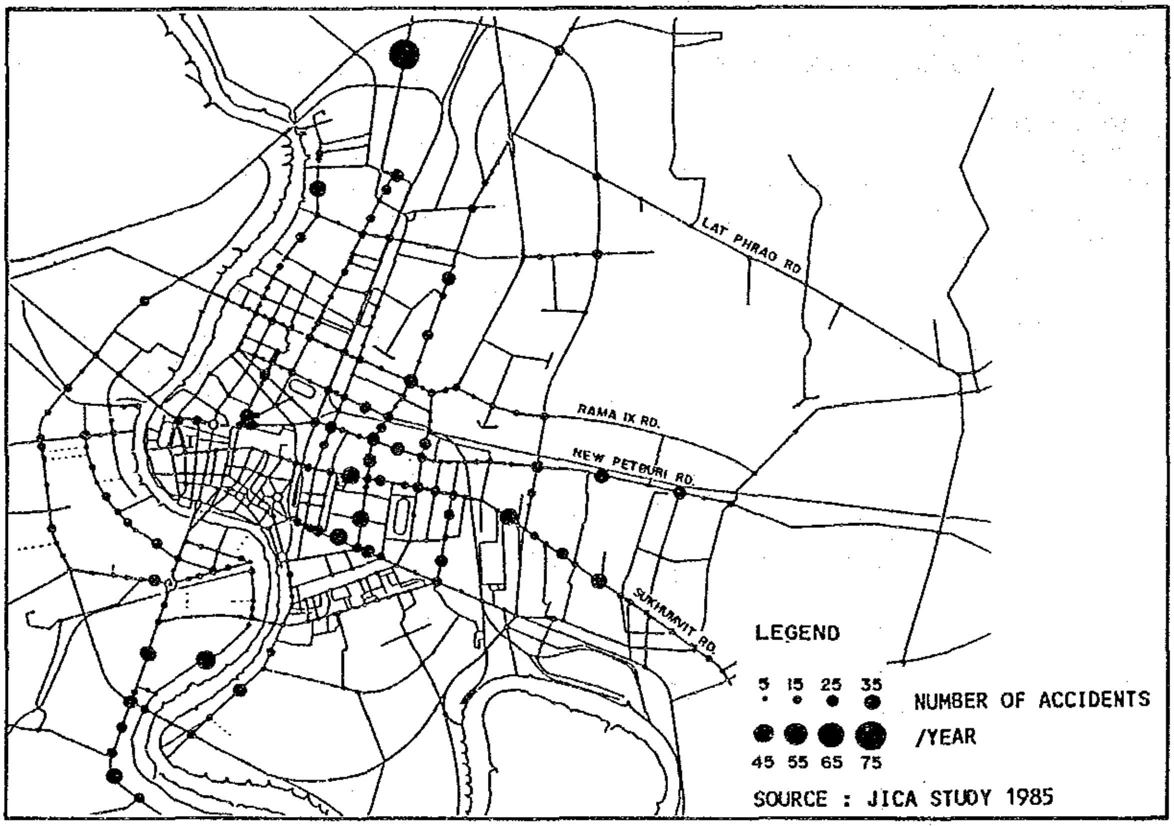


Figure 3.3.10 High Accident Frequency Points

3) Status of Parking

(1) On-Street Parking

Figure 3.3.11 shows the parking survey area. The survey area covers approximately 9 km^2 surrounded by the Chao Phraya River and the Krung Kasem Road. The on-street parking characteristics are described hereafter.

a. Parking Capacity

The on-street parking capacity in the survey area is as shown in Table 3.3.5. The on-street parking capacity of the total survey area is about 32,000 spaces (PCU). On-street parking capacity by P/T zone is 3,600 in zone 1, 4,700 in zone 2, 2,800 in zone 3, 11,700 in zone 4, 6,500 in zone 5, and 2,800 in zone 6.

Table 3.3.5 On-Street Parking Density

Zone No.	Block No.	Length (m)	Capacity (PCU)
1	1-1	6,250	1,160
	1-2	5,140	1,000
	1-3	7,550	1,450
	TOTAL	18,940	3,610
2	2-1	11,220	2,020
	2-2	7,280	1,340
	2-3	7,520	1,390
	TOTAL	26,020	4,750
3	3-1	5,230	1,010
	3-2	4,740	930
	3-3	4,310	830
	TOTAL	14,280	2,770
4	4-1	13,450	2,460
	4-2	9,510	1,690
	4-3	7,600	1,340
	4-4	8,530	1,520
	4-5	5,800	1,100
	4-6	13,060	2,390
	4-7	6,070	1,160
	TOTAL	64,020	11,660
5	5-1	3,130	610
	5-2	9,550	1,830
	5-3	3,810	720
	5-4	8,070	1,520
	5-5	5,670	1,080
	5-6	3,880	740
	TOTAL	34,110	6,500
6	6-1	14,890	2,770
	TOTAL	14,890	2,770
Total		172,260	32,060

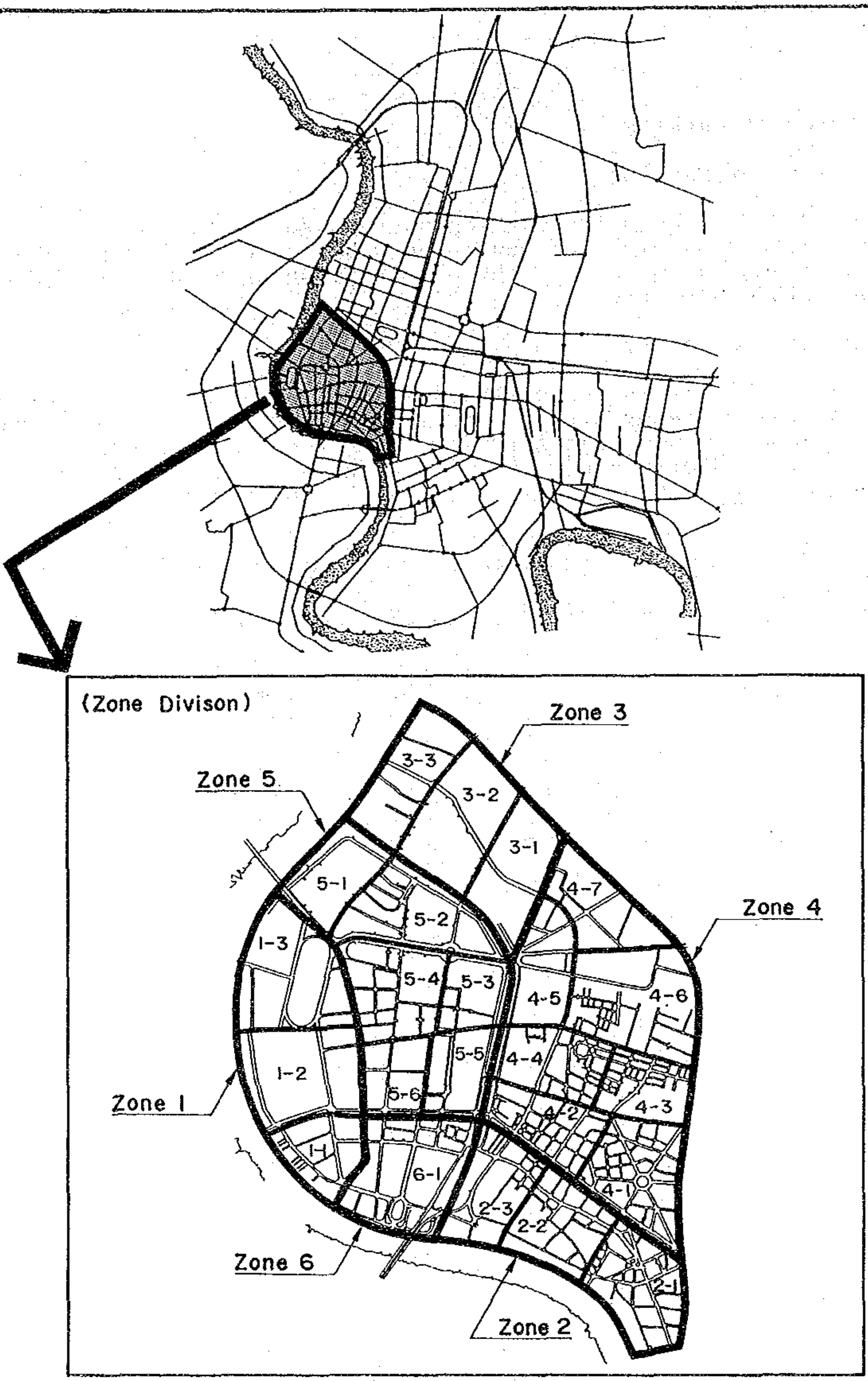


Figure 3.3.11 Parking Survey Area

b. Parking Density

Figure 3.3.12 and Table 3.3.6 show the parking density by hour and zone. The survey area for on-street parking density by hour and by road link is shown in Figure 3.3.13. The parking density is a ratio of the parking capacity and the number of parking vehicles by road link. The on-street parking capacity is calculated from the length of legal parking sections.

The parking density of each zone, except some zones of high density, is about 30-60%, which is not yet serious. The zones of comparatively high density are zones 2-1, 4-1, 4-3, and 4-4, surrounded by the Krung Kasem Road, Songwad Road, Jakkara Phet Road, and Bamrung Muang Road. In particular, the density is the highest in zone 4-3, with about 80% in the time period of 13:00-14:00. Other high density zones have densities as high as 50%.

Viewing the status of density distribution by time period, the density in the above mentioned zones 2-1, 4-1, and 4-3 is comparatively high throughout the total time period, and constantly maintains the level of 50-75%. In the morning peak hour, in zones 1-1, 2-1, 4-1 and 4-3 the density is 60-75%, while it is as low as 25% in zones 3-1, 3-2, 4-5, and 5-5. The parking density becomes higher at midday due to business purposes, etc., and its increase is particularly high in zone 4. At the evening peak hour, the density remains high in zone 4 from midday, while it decreases in other zones.

Figure 3.3.14 shows the hourly parking density fluctuation by hour and zone. In zone 1, the parking density increases in the day time, while it sharply decreases after 15:00. The parking purposes in this zone are considered to be mainly for work and business. In zone 2, the parking density stays nearly constant the whole day. People living around this area use roads as their garages. Besides, combined purposes such as work, shopping, business, and eating and drinking are considered. In zone 3, the fluctuation condition is the same as that of zone 1, but judging from the density increase in the evening, the purpose of eating and drinking seems to be the main motive. In zone 4, the fluctuation condition is similar to that of zone 2. In zone 5, the fluctuation condition is nearly the same as that of zone 1. Judging from the high density in the morning, however, many people in the area for work purpose, appear to park their vehicles on the road and use the road space as their garage. In zone 6, the fluctuation condition is nearly the same as that of zone 1.

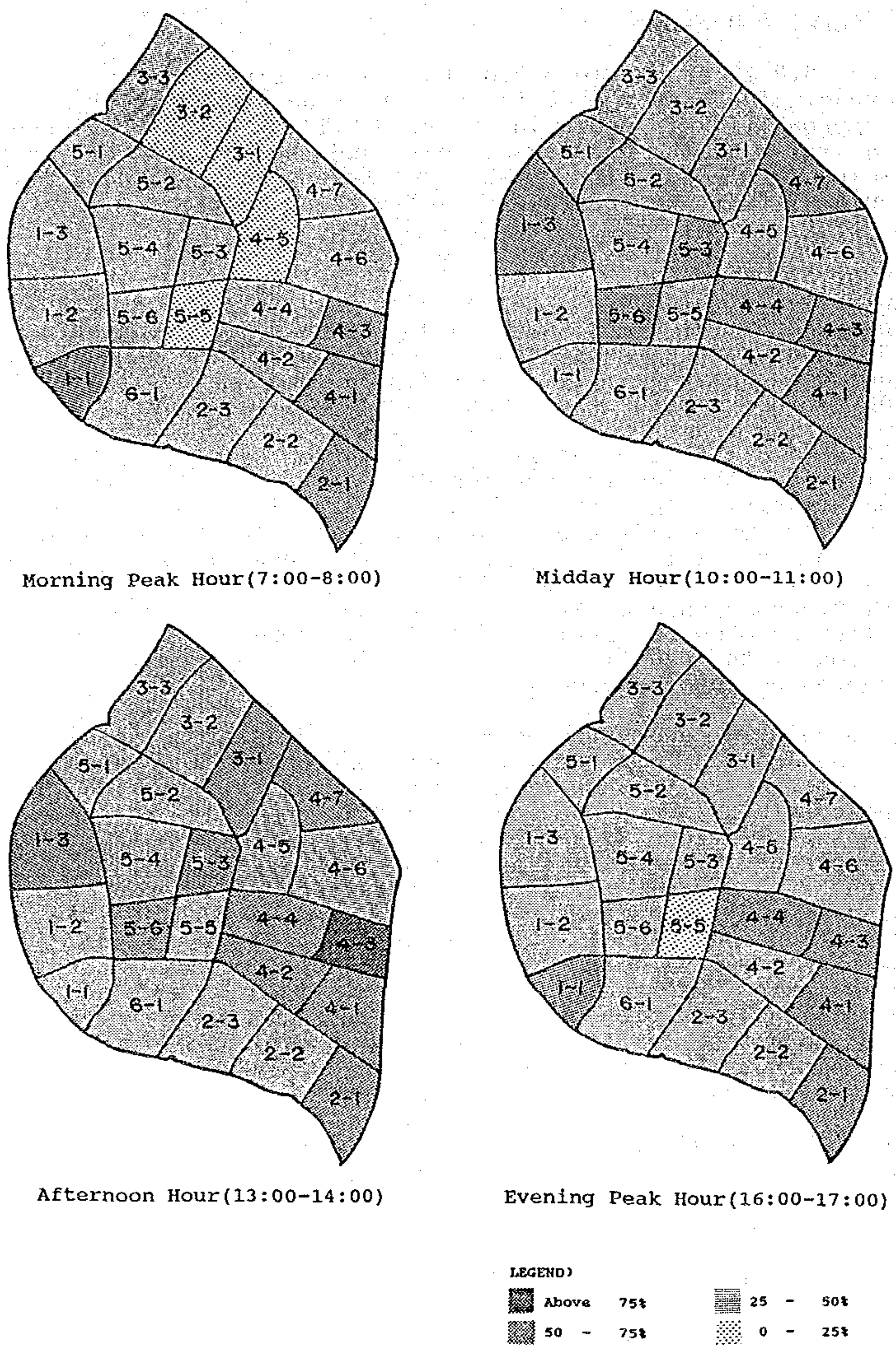


Figure 3.3.12 Parking Density by Zone

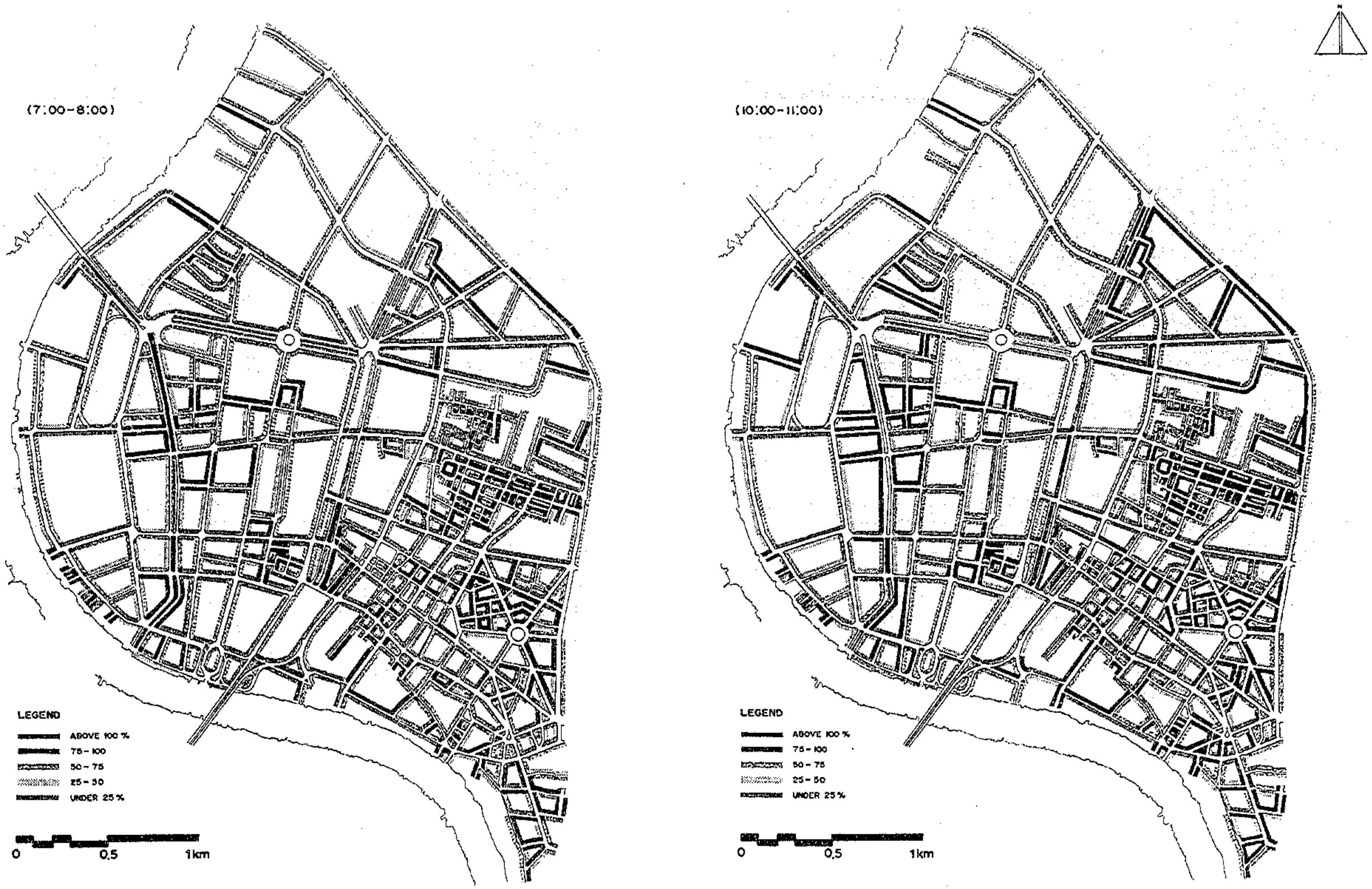


Figure 3.3.13 (1) Hourly Parking Density by Link

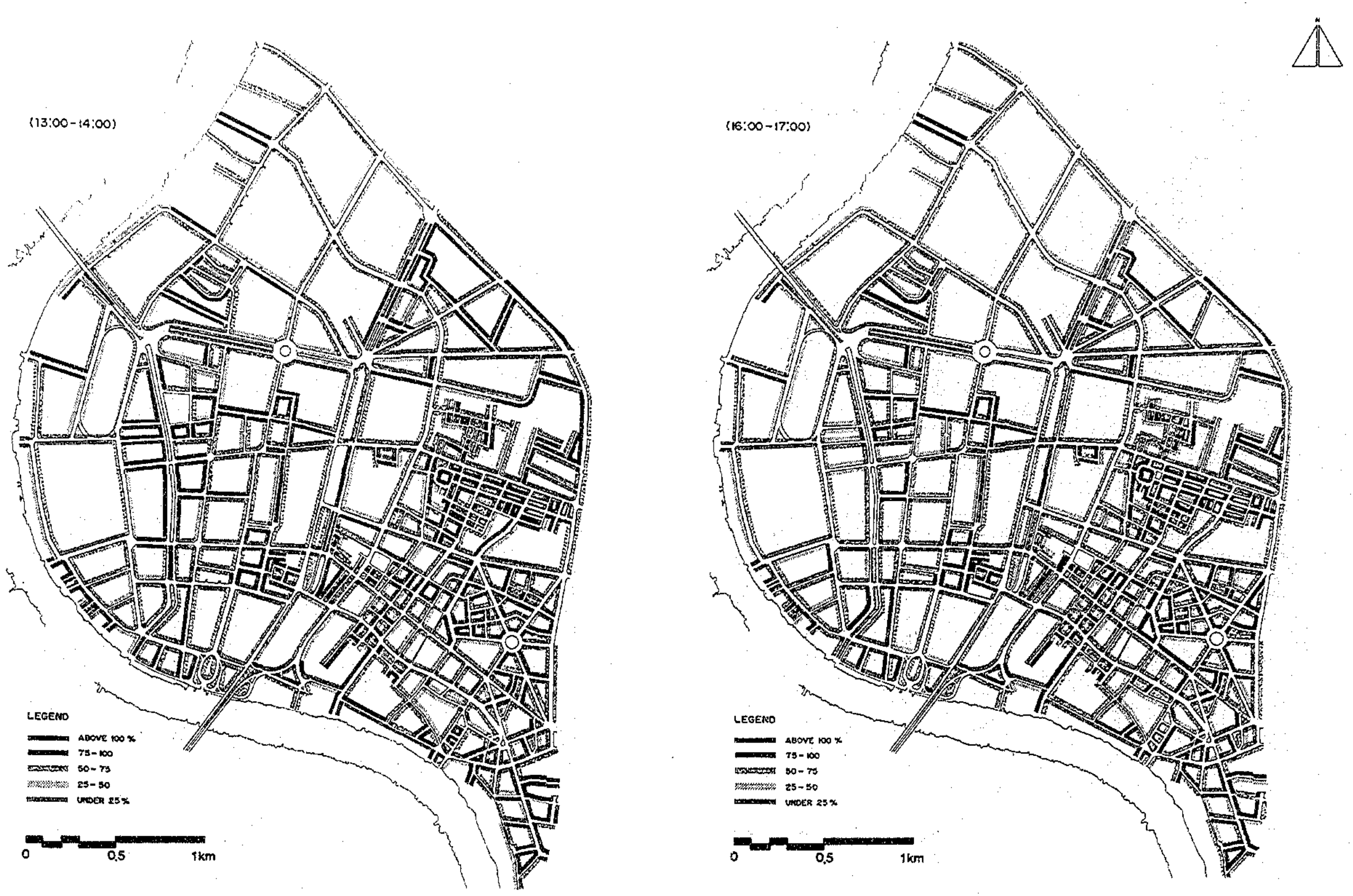


Figure 3.3.13 (2) Hourly Parking Density by Link

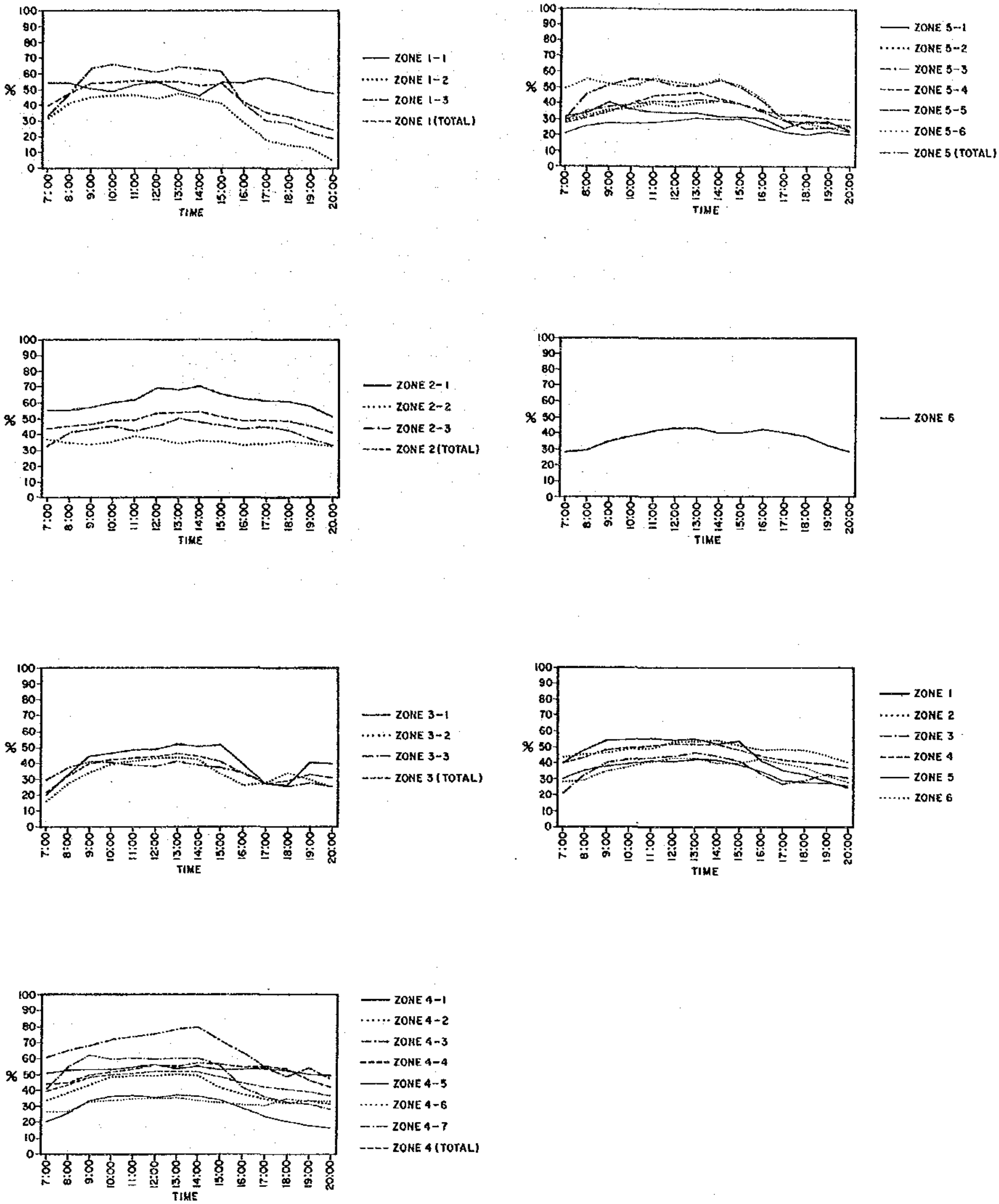


Figure 3.3.14 Hourly Parking Density Fluctuation

Table 3.3.6 On-Street Parking Demand and Density by Zone

(1) On-Street Parking Demand

ZONE	BLOCK	LENGTH (M)	CAPACITY	7:00 -8:00	8:00 -9:00	9:00 -10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00
1	1	6254	1156	628	628	580	561	608	637	527	528	629	624	663	630	572	550
	2	5144	997	318	412	453	461	464	439	471	439	408	268	178	148	129	51
	3	7546	1448	476	676	906	949	914	879	930	906	887	571	438	411	318	277
	TOTAL	18944	3601	1422	1717	1938	1971	1985	1955	1973	1872	1924	1483	1278	1189	1019	877
2	1	11220	2021	1107	1113	1148	1214	1242	1400	1380	1424	1322	1251	1236	1232	1155	1033
	2	7278	1338	487	466	449	476	511	500	462	480	474	446	452	474	456	441
	3	7524	1383	452	563	592	622	579	623	690	665	628	591	615	585	507	453
	TOTAL	26022	4742	2046	2142	2189	2312	2332	2523	2532	2569	2424	2288	2303	2291	2118	1927
3	1	5234	1010	197	329	445	466	492	497	529	515	523	399	269	266	408	404
	2	4744	932	144	247	319	365	384	404	406	395	311	242	254	318	275	229
	3	4312	831	243	307	341	337	323	316	341	321	311	282	221	212	227	214
	TOTAL	14290	2773	584	883	1105	1168	1199	1217	1276	1231	1145	923	744	797	910	847
4	1	13452	2462	1247	1290	1312	1313	1345	1392	1330	1361	1313	1320	1340	1289	1234	1213
	2	9506	1685	563	649	732	816	835	883	852	834	705	634	585	541	567	523
	3	7598	1335	810	869	911	961	986	1004	1051	969	954	850	727	659	718	623
	4	8526	1520	665	675	760	787	814	858	840	873	862	828	841	812	703	638
	5	5802	1104	225	283	371	401	407	394	413	402	376	319	260	224	197	181
	6	13059	2390	637	640	782	791	827	835	847	799	779	739	732	829	784	785
	7	6073	1161	471	628	720	690	696	688	696	696	646	485	419	382	367	328
	TOTAL	64016	11657	4617	5033	5588	5758	5911	6003	6027	5934	5635	5175	4905	4737	4572	4292
5	1	3128	608	190	205	244	217	210	205	204	191	188	185	146	170	170	137
	2	9552	1832	527	589	657	667	732	694	730	754	714	645	592	584	552	541
	3	3805	715	216	327	364	392	390	363	363	397	353	294	202	169	177	156
	4	8072	1518	418	472	524	595	672	691	714	649	593	541	490	490	459	447
	5	5673	1078	227	273	294	291	298	311	332	321	322	270	230	213	235	213
	6	3884	739	364	405	384	371	408	393	378	401	376	310	215	200	177	182
	TOTAL	34114	6490	1942	2271	2467	2533	2710	2657	2721	2713	2546	2245	1875	1827	1770	1676
5	1	14886	2772	773	813	961	1039	1140	1198	1199	1101	1104	1182	1104	1041	886	776
	TOTAL	14886	2772	773	813	961	1039	1140	1198	1199	1101	1104	1182	1104	1041	886	776
TOTAL		172272	32035	11384	12858	14247	14780	15276	15553	15727	15419	14777	13294	12209	11880	11273	10393

Source: SIMR 1989

(2) On-Street Parking Density

ZONE	BLOCK	LENGTH (M)	CAPACITY	7:00 -8:00	8:00 -9:00	9:00 -10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00
1	1	6254	1156	54	54	50	48	53	55	49	46	54	54	57	55	50	48
	2	5144	997	32	41	45	46	46	44	47	44	41	29	18	15	13	5
	3	7546	1448	33	47	63	66	63	61	64	63	61	39	30	28	22	19
	TOTAL	18944	3601	39	48	54	55	55	54	55	52	53	41	36	33	28	24
2	1	11220	2021	55	55	57	60	61	69	68	70	65	62	61	61	57	51
	2	7278	1338	36	35	34	36	38	37	35	36	35	33	34	35	34	33
	3	7524	1383	33	41	43	45	42	45	50	48	45	43	44	42	37	33
	TOTAL	26022	4742	43	45	46	49	49	53	53	54	51	48	49	48	45	41
3	1	5234	1010	19	33	44	46	49	49	52	51	52	40	27	26	40	40
	2	4744	932	15	26	34	39	41	43	44	42	33	26	27	34	29	25
	3	4312	831	29	37	41	41	39	38	41	39	37	34	27	26	27	26
	TOTAL	14290	2773	21	32	40	42	43	44	46	44	41	33	27	29	33	31
4	1	13452	2462	51	52	53	53	55	57	54	55	53	54	54	52	50	49
	2	9506	1685	33	38	43	48	50	49	51	50	42	38	35	32	34	31
	3	7598	1335	61	65	68	72	74	75	79	73	71	64	54	49	54	47
	4	8526	1520	44	44	50	52	54	56	55	57	57	54	55	53	46	42
	5	5802	1104	20	26	34	36	37	36	37	36	34	29	24	20	18	16
	6	13059	2390	27	27	33	33	35	35	35	33	33	31	31	35	33	33
	7	6073	1161	41	54	62	59	60	59	60	60	56	42	36	33	32	28
	TOTAL	64016	11657	40	43	48	49	51	51	52	51	48	44	42	41	39	37
5	1	3128	608	31	34	40	36	34	34	34	31	31	30	24	28	28	23
	2	9552	1832	29	32	36	36	40	38	40	41	39	35	32	32	30	40
	3	3805	715	30	46	51	55	55	51	51	56	49	41	28	24	25	22
	4	8072	1518	28	31	35	39	44	46	47	43	39	36	32	32	30	29
	5	5673	1078	21	25	27	27	28	29	31	30	30	25	21	20	22	20
	6	3884	739	49	55	52	50	55	53	51	54	51	42	29	27	24	25
	TOTAL	34114	6490	30	35	38	39	42	41	42	42	39	35	29	28	27	26
6	1	14886	2772	28	29	35	37	41	43	43	40	40	43	40	38	32	28
	TOTAL	14886	2772	28	29	35	37	41	43	43	40	40	43	40	38	32	28
TOTAL		172272	32035	36	40	44	46	48	49	49	48	46	42	38	37	35	32

Note: Parking Density(%) = Actual parking demand(PCU)/Legal parking capacity(PCU)

(2) Off-Street Parking

a. Off-Street Parking Capacity in Parking Survey Area

Table 3.3.7 shows the parking capacity by zone. The parking capacity is shown by type (open space, single-story parking building, multi-story parking building), and charged or free of charge.

Table 3.3.7 Off-Street Parking Capacity

(Unit:PCU)

Zone No.	Block No.	Open Space	Type of Parking Lot Building			Free & Toll		
			1-Storey	Multi Stories	Total	Free	Toll	Total
1	1-1	530	0	0	530	530	0	530
	1-2	190	0	0	190	190	0	190
	1-3	530	0	0	530	530	0	530
	Total	1250	0	0	1250	1250	0	1250
2	2-1	478	100	400	978	578	400	978
	2-2	255	40	75	370	262	108	370
	2-3	334	50	0	384	234	150	384
	Total	1067	190	475	1732	1074	658	1732
3	3-1	1380	94	15	1489	1489	0	1489
	3-2	338	438	30	806	608	198	806
	3-3	648	173	0	821	821	0	821
	Total	2366	705	45	3116	2918	198	3116
4	4-1	427	58	41	526	526	0	526
	4-2	326	3	1230	1559	679	880	1559
	4-3	429	60	0	489	489	0	489
	4-4	274	43	200	517	517	0	517
	4-5	628	0	260	888	888	0	888
	4-6	930	45	1020	1995	1350	645	1995
	4-7	2144	50	35	2229	2229	0	2229
	Total	5158	259	2786	8203	6678	1525	8203
5	5-1	30	0	0	30	30	0	30
	5-2	248	95	360	703	414	289	703
	5-3	402	0	0	402	337	65	402
	5-4	683	50	0	733	733	0	733
	5-5	184	102	0	286	180	106	286
	5-6	20	50	0	70	70	0	70
	Total	1567	297	360	2224	1764	460	2224
6	6-1	688	195	1440	2323	823	1500	2323
	Total	688	195	1440	2323	823	1500	2323
Total		12096	1646	5160	18848	14507	4341	18848

The off-street parking capacity in the total area is about 18,800 spaces (PCU). The parking capacity by P/T zone is 1,300 spaces (PCU) in zone 1, 1,700 in zone 2, 3,100 in zone 3, 8,200 in zone 4, 2,200 in zone 5, and 2,300 in zone 6.

b. Status of Use of Charged Off-Street Parking Lots

As shown in Figure 3.3.15, survey was carried out at three off-street parking facilities located in the central part of the city as to the parking purpose, parking duration, and parking turnover rate. The parking characteristics are described below.

Fluctuation of Parking Vehicles

Figure 3.3.16 shows the fluctuation of parking vehicles at each parking lot. The peak hour is 15:00 to 16:00 at the Chidlom Central Department Store where vehicles are parked for shopping, and the maximum parking demand is about 13% of the total parking demand. At Sathorn Thani, where parking purposes are for work and business, the peak hour is from 10:00 to 11:00, and the peak rate is 12.2%. At the Wall Street Tower, where purposes are for work, business, shopping, and eating and drinking, the peak hour is from 9:00 to 10:00, and the peak rate is 9.1%. These peak rates are relatively lower than that of other major cities.

Average Parking Duration

Table 3.3.8 shows the parking duration by purpose and the average parking turnover at each parking facility. The status of the parking duration and parking turnover at each parking facility is as follows.

Table 3.3.8 Off-Street Parking Facility Situation

Location	Capacity (spaces)	Daily Parking Demand (PCU)	Maximum Parking Demand (PCU)	Peak Hour	Rate of Maximum to Daily Demand (%)	Average Parking Duration (Min)	Average Turn-over	Operating Hour
Central Chidlom Department Store	1500	6023	1067	15-16	13.0	S = 85	4.0	10-20
Sathorn Thani	750	2085	502	10-11	12.2	W = 265 B = 66 R = 42 O = 37	2.3	7-19
Wall Street Tower	500	1156	272	9-10	9.1	W = 277 B = 116 R = 109 O = 110	2.8	7-2

Note: Parking purpose
W : Work
B : Business
S : Shopping
R : Restaurant
O : Others

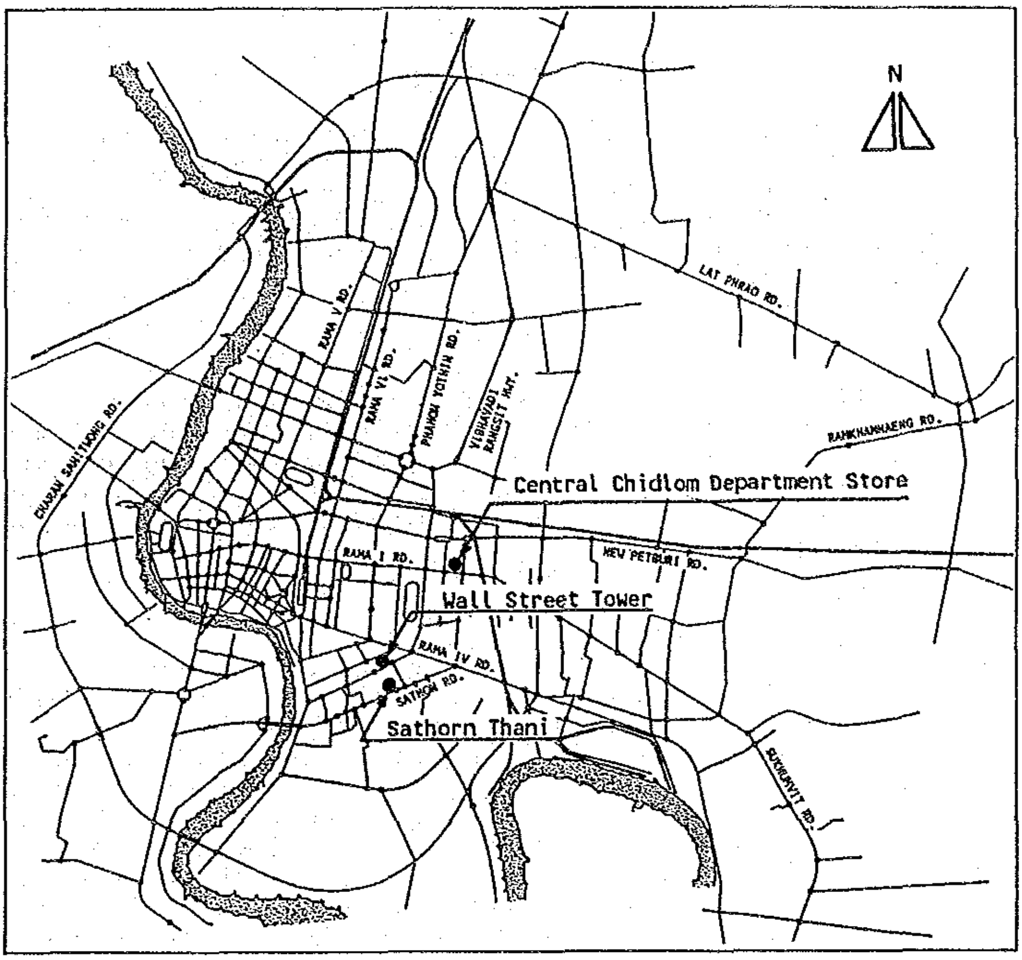


Figure 3.3.15 Locations of Off-Street Parking Survey

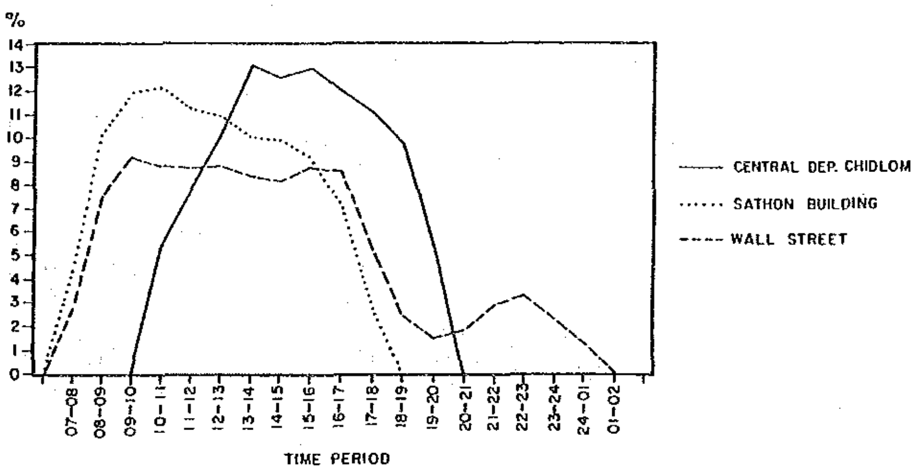


Figure 3.3.16 Fluctuation of Hourly Parking Vehicle by Location

i. Chidlom Central Department Store

The average parking duration for shopping is 85 minutes, and the average turnover rate is 5.5. The parking duration at this facility is a little longer compared with the parking duration for shopping in other major cities. One of the reasons may be attributed to the free parking offered by this department store.

ii Sathorn Thani

About 85% of the purposes of parking by the users of this parking facility are work and business, showing 265 minutes (4 hours 25 minutes) on the average for work and 66 minutes for business. Besides, 42 minutes parking duration on the average is for eating, and 37 minutes for other purposes. The parking turnover rate is 5.5.

iii Wall Street Tower

About 74% of the purposes of parking by the users at this parking facility are work and business, showing 277 minutes (4 hours 37 minutes) on the average for work and 116 minutes for business. Besides, 109 minutes parking duration on the average is for eating, and 110 minutes for other purposes. The parking turnover rate is 5.9. Compared with Sathorn Thani, the business purpose parking time and the eating purpose parking time are nearly doubled. The reason for the former is that there are many business facilities in this area, and the reason for the latter is that there are many facilities for pleasure and recreation.

3.4 Road Traffic Control and Management

1) Traffic Control and Management Facility

a. Status of Signalized Intersection

Figure 3.4.1 shows the locations of signalized intersections in Bangkok. About 200 major intersections in Bangkok are currently traffic-signal controlled. Out of these signalized intersections, 47 intersections in the old city area are computer controlled with the ATC system.

Nearly all signalized intersections are manually controlled at site by traffic policemen. According to observations, manual cycles are about 2.5-8 minutes. However, there is no concept on cycles owing to skipping and backtracking or phases. Manual operations are based on assessments of spot conditions as indicated by visual observations by traffic policemen and/or information received via transceivers.

Generally, the signal at each intersection is designed to indicate one phase to one direction of traffic flow at approach. Most of the traffic lights are mounted on low poles and have small lenses, resulting in poor visibility.

2) Traffic Control Regulations

The major traffic control regulations in Bangkok are as follows:

a. One-way traffic regulation
b. Unbalanced lane regulation
c. Bus lane regulation
d. Curb parking restriction
e. Large vehicle prohibition regulation

a. One-way Traffic Regulation

The one-way roads are shown in Figure 3.4.2. There are numerous one-way roads, mainly trunk roads, in the central part of the old city. The major one-way trunk roads are Sukhumvit Road, Ratcha Prarop Road, and Bamrung Muang Road. At present, contra-flow lane, reversible lanes and fixed unbalanced flow are used in combination with the one-way system on arterial roads. In principle, however, clockwise operation of one-way loops has basically been maintained.

b. Unbalanced Lane Regulation

Figure 3.4.2 shows unbalanced lane regulated roads. The unbalanced lane roads are located in the traffic congestion area in the center of the city. The main unbalanced lane roads are Petcha Buri Road (4 lanes and 2 lanes), Phayathai Road (6 lanes and 2 lanes), Rama VI Road (5 lanes and 2 lanes), Ratcha Prarop Road (4 lanes and 2 lanes), Sawan Kh-Alok Road (3 lanes and 1 lane), Soi Asok Road (3 lanes and 2 lanes), a part of Sukhumvit Road (5 lanes and 2 lanes), Din Daeng Road (3 lanes and 2 lanes), and a part of Thai Wang Road. The currently prepared number of unbalanced lane roads cannot cope with the rapid and perplexing changes in traffic demand, and they do not prove sufficiently effective.

c. Bus Lane Regulation

The bus lane regulated roads are shown in Figure 3.4.2. In principle, a bus lane is designed as a contra-flow lane when it is combined with a one-way road or an unbalanced lane road. Since the regulation is strictly applied by policemen to every bus lane during the rush hours, other types of vehicles are rejected. During the rush hours, however bus lanes are jammed with buses and the bus lane effect is therefore not evident.

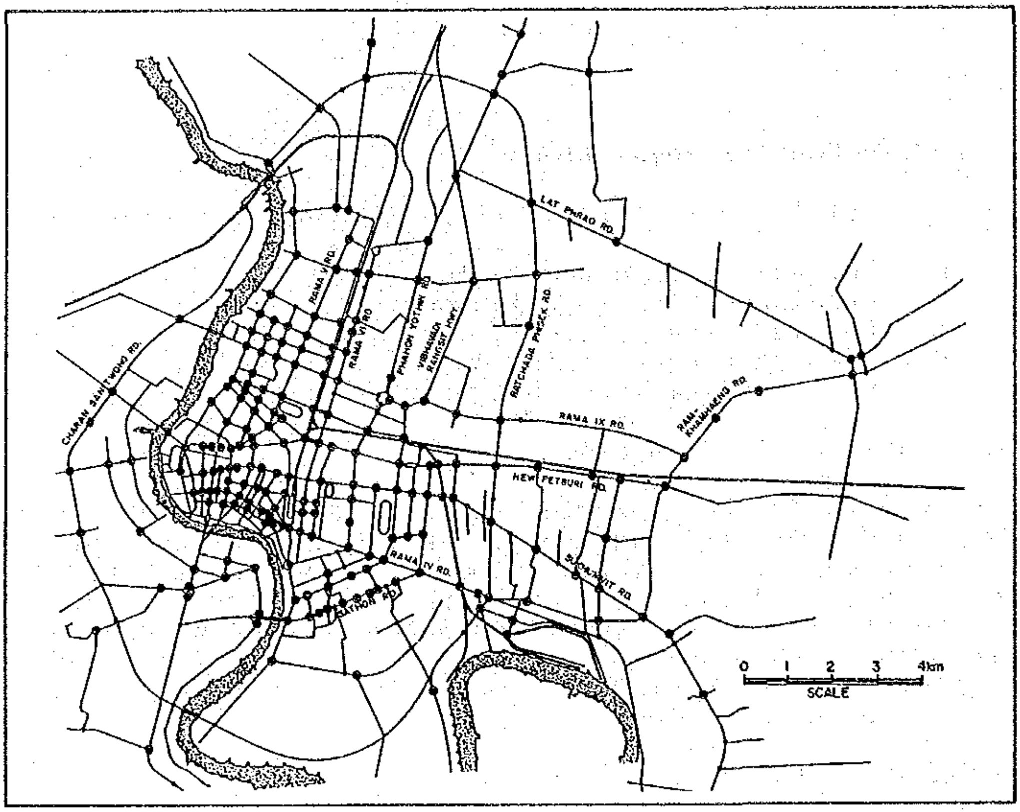


Figure 3.4.1 Locations of Signalized Intersections

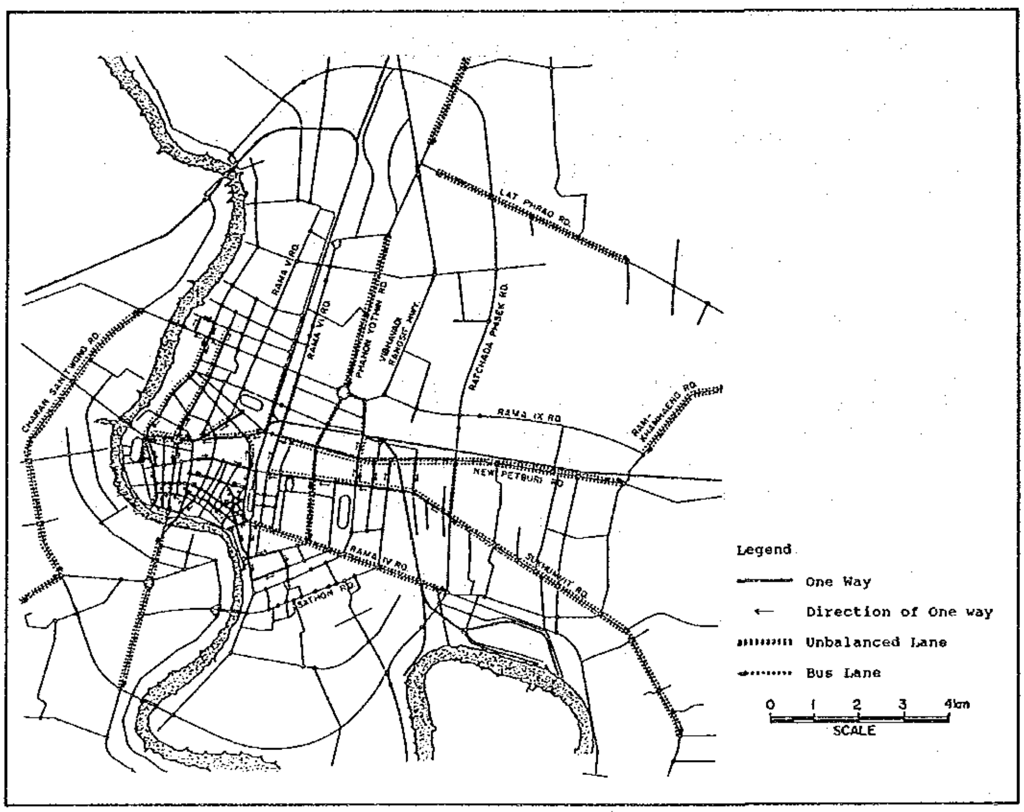


Figure 3.4.2 One Way Roads, Unbalanced Lanes and Bus Lanes

d. Curb Parking Restriction

Figure 3.4.3 shows the road parking restrictions on major roads. Parking is prohibited on most of the major roads in the built-up area of Bangkok, excepting the old city part. Strict and thorough control by police has reduced the number of cars violating the regulation. There are three types of road parking prohibition: whole day prohibition, prohibition for certain hours, and prohibition on certain days of the week (parking allowed only on Sunday, Tuesday and Thursday, or on Monday, Wednesday and Friday).

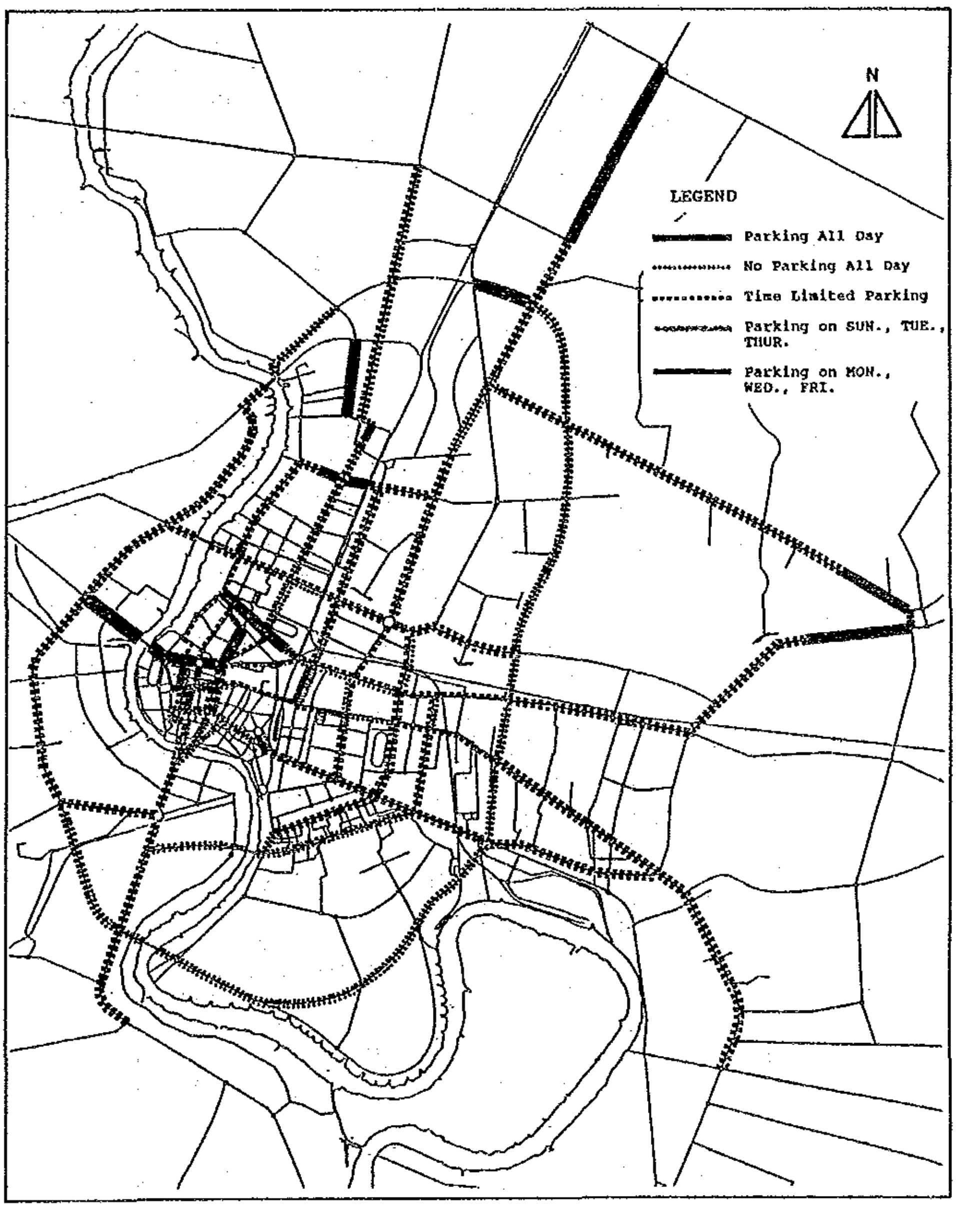


Figure 3.4.3 Curb Parking Restriction

e. Heavy Vehicle Restriction

By regulation, heavy vehicle are not allowed to come into the area inside the Middle Ring Road during the daytime on weekdays. The main points of the regulation are as follows:

i. Four to six wheeled large vehicles are prohibited from 6:30-9:00 and 16:30-19:00. This regulation, however, is not applicable on holidays (including Saturdays) nor to private vehicles.

ii. Large vehicles with 10 or more wheels are prohibited from 6:00-10:00 and 15:00-21:00. This regulation, however, is not applicable on holidays (including Saturdays) nor to certain designated roads (Figure 3.4.4).

iii. Heavy-long trucks are prohibited from 6:00-21:00. This regulation, however, is not applicable to holidays (including Saturdays).

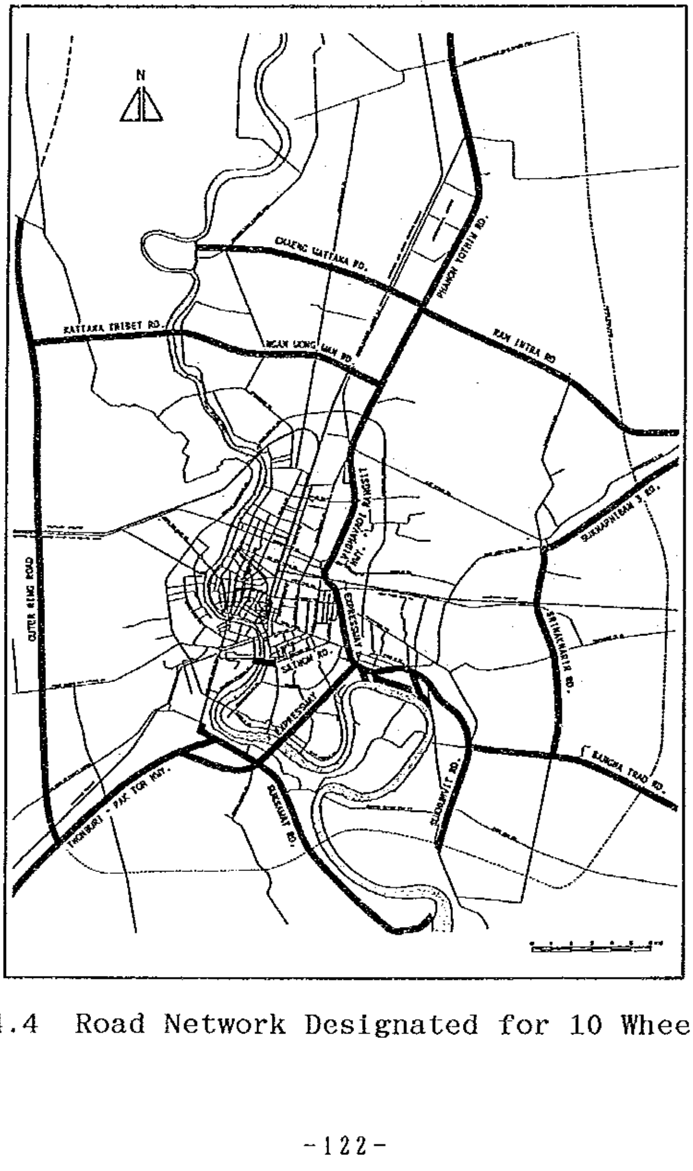


Figure 3.4.4 Road Network Designated for 10 Wheeled Trucks

CHAPTER 4

PUBLIC TRANSPORTATION

4. PUBLIC TRANSPORTATION

4.1 Public Transportation Modes in Bangkok

The public transportation system of Bangkok consists of different types of buses (such as regular bus, air-conditioned bus and minibus), taxi, samlor, silor-lek, hired motorcycle, railroad and water transport. The outline of the existing public transport modes is summarized in Table 4.1.1.

Table 4.1.1 The Outline of Public Transport in Bangkok

Mode		Operator	Capacity (Person)	Service Area	No. of Routes & Units	Passenger (Thousand Pass./Day)	Fare (Baht)
Bus	Regular Bus	BMTA/Private	80	Main Road	Route= 144 Unit= 5348	4683	*2 2.0
	Air-Con. Bus	BMTA/Private	38	Main Road	Route= 19 Unit= 683	290	*3 5.0
	Minibus	Private	30	Main Road	Route= 60 Unit= 2151	1120	*4 2.0
	Total	BMTA/Private		Main Road	Route= 223 Unit= 8182*1	6093	
Taxi		Private	4	Main Road/Soi	Unit= 13493	466 *2	*6 18.0
Silor-lek		Private 7 Associations	6	Main Road/Soi	Unit= 7874	351 *2	*6 7.0
Samlor		Private 4 Associations	3	Soi	Unit= 7406	323 *2	*6 10.0
Hired Motorcycle		Private	1	Service for 829 Soi	Unit= 16588	577 *2	*6 6.5
Railroad		SRT			Route= 4 Station= 16	19	*7 2.0
Ship/Boat		Private		Chao Phraya River/Khlong		262	*8 0.5

Note: *1 Excluding Song Theao (No. of units = 3.016)
*2 Based on the survey result. (Taxi=34.5 Pass./Unit/Day, Silor=44.6, Samlor=43.6, Hired Motorcycle=34.8)
*3 Flat fare of blue regular bus
*4 Fare of air-conditioned bus within first 8 kms
*5 Flat fare of minibus
*6 Based on the survey result (Fare/Person/Trip)
*7 Fare of first 10 kms
*8 Fare of Chao Phraya Ferry

1) Bus

Buses, which are the main land public transport, cover routes on almost all of the main thoroughfares in Bangkok, and are operated by BMTA (Bangkok Mass Transit Authority) and by semi-private sector.

The total number of bus routes, frequency and daily passengers are 223 routes, 66,554 trips and approximately 6.1 million passengers, respectively.

Basically, buses are divided into the following 3 categories:

(1) Regular bus

Regular bus, of 80 passengers capacity, is mainly operated by BMTA. The number of routes and fleet are 144 and 5,348 respectively. Fare is basically a 2 Baht flat fare. (Photo A)

(2) Air-conditioned bus

Air-conditioned bus, of 38 passengers capacity, is operated by BMTA and private companies with 19 routes and 683 fleet. For the first 8 kms the fare is 5 Baht and maximum fare is 15 Baht. (Photo B)

(3) Minibus

Minibus, with 30 seat capacity, is operated by the private sector. The number of routes and fleet are 60 and 2,150, respectively. The minibus fare is the same as that of the regular bus. (Photo C)

2) Taxi

Approximately 13,500 taxis are operated by the private sector in the urban area. There are no metered taxis or fixed fare system. (Photo D)

3) Silor

Silor is a 4-wheel vehicle of 6 passengers capacity and mainly serves in the suburban area. The number of units is 7,870. (Photo E)

4) Samlor

Samlor is a 3-wheel taxi of 3 passengers capacity and is operated by the private sector in the inner area. The number of units is 7,400. (Photo F)

5) Hired Motorcycle

Hired motorcycle, usually operated inside "Sois" which are normally narrow and dead-end roads, carries short trip passengers from soi to trunk road.

The number of hired motorcycles has increased significantly due to the structural features of the road system and the continuing urban development along the "Sois"

The number of hired motorcycles and the "Sois" where hired motorcycles service can be found are approximately 16,600 and 830, respectively. (Photo G)

6) Railway

The railway system in Bangkok is operated by SRT (State Railway of Thailand) along four lines (Northern Line, Eastern Line, Northeastern Line and Southern Line) which terminate at the three Bangkok terminal stations of Hua Lamphong, Thonburi, and Wong Wein Yai.

The number of daily rail passengers in the urban area is approximately 20,000 only. Bearing in mind the total public transport traffic demand in Bangkok, this figure is negligible. For the first 10 Kms of commuter train the fare is only 2 Baht. (Photo H)

7) Waterway Transport

Waterway transport was once the only transportation means of any significance in Bangkok. Then, as land transport developed, the Khlongs were filled and converted into roads, especially the eastern part of the Chao Phraya River. The utilization of waterway transport , however, in Thonburi area and along the Chao Phraya River is still notable. Daily passengers using waterway transport, such as the Chao Phraya ferries and express boats, etc., are approximately 260,000. The fare of the Chao Phraya ferry is 0.5 Baht. (Photo I)

Photo A　Regular Bus

Photo B　Air-conditioned Bus

Photo C　Minibus

Photo D　Taxi

Photo E　Silor

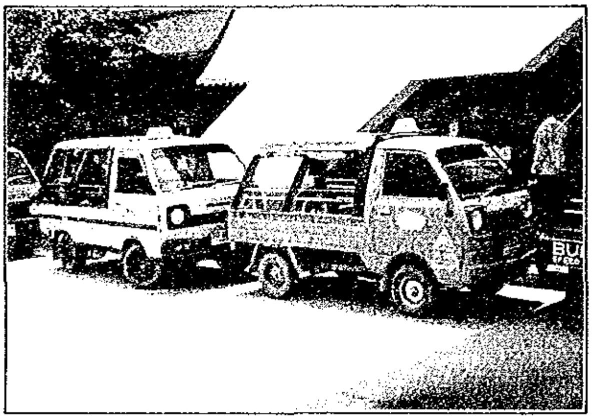


Photo F　Samlor

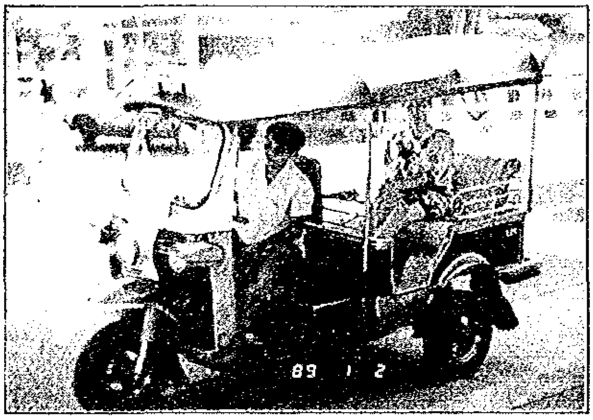


Photo G Soi Motorcycle

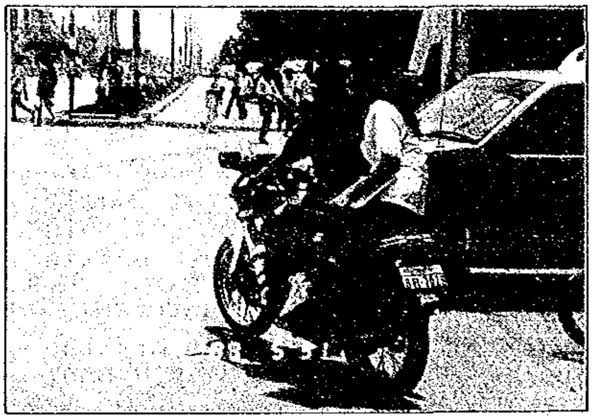


Photo H SRT

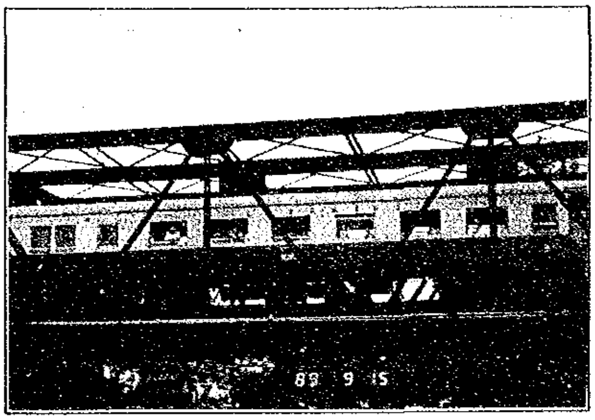
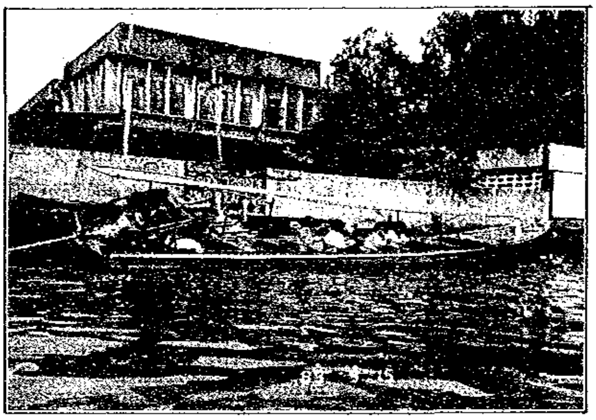


Photo I Water Transport



4.2 Demand for Public Transport

Based on the person trip survey and public transport survey results, demand characteristics for public transport are described below.

1) Number of passengers by mode

Number of passengers and the share of passengers by mode are shown in Figures 4.2.1 and 4.2.2, respectively. Total daily public transport passengers are 8.1 million in Bangkok. Of this total, 6.1 million passengers, or 76% of the total public transport users, are bus/minibus passengers.

Taxi, Samlor and Silor passengers are 1.1 million, 14% of the total and hired motorcycle passengers are 0.6 million, 7%. Boat passengers are 0.3 million, 3%.

On the other hand, rail passengers are only 19 thousand, and therefore, railway system does not play any significant role in the Bangkok public transport service.

Figure 4.2.1 Number of passengers by mode

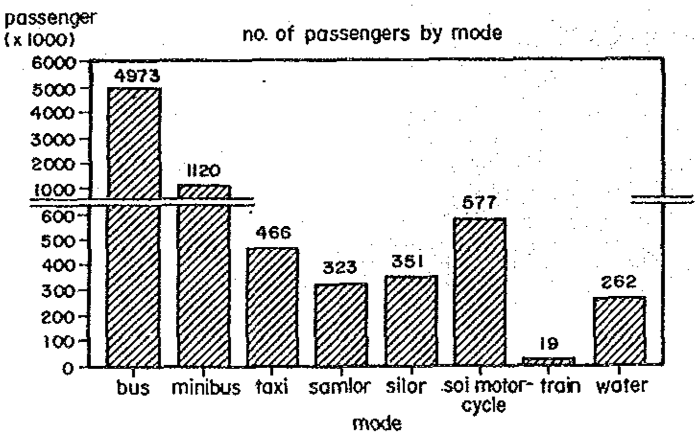
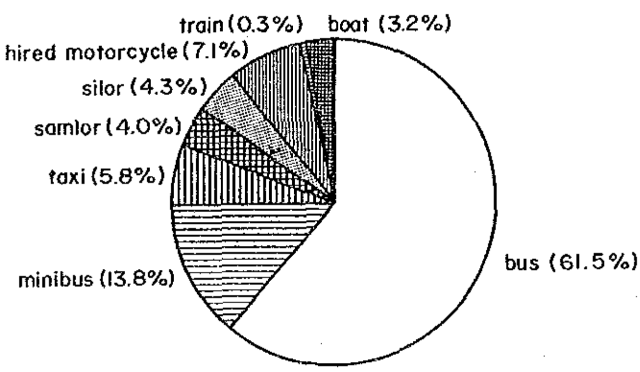


Figure 4.2.2 Share of passengers by Mode



2) Generated/attracted trips by Public transportation mode and zone (24 integrated zones)

Figure 4.2.3 (1) - (5) shows generated/attracted trips by mode and zone. Bus service is distributed from the inner area to the northeastern suburbs (Bang Kapi and Bang Khen districts). Minibus is heavily used in the suburbs (northern part, eastern part, and southern part) where bus service is poor.

Taxis usually serve the inner area, and therefore taxi users are concentrated in this area. The taxi utilization in the eastern area is also relatively high.

As a matter of course, train utilization along the railways is high. The Northern Line is used from the inner area to the suburbs, while the Eastern Line and the Southern Line are used by trips generated/attracted outside the Outer Ring Road and in the Bang Khun Tian area, respectively.

Generated/attracted trips by boat are distributed in the suburbs along the Chao Phraya River. A few generated/attracted trips by boat are found in the inner area.

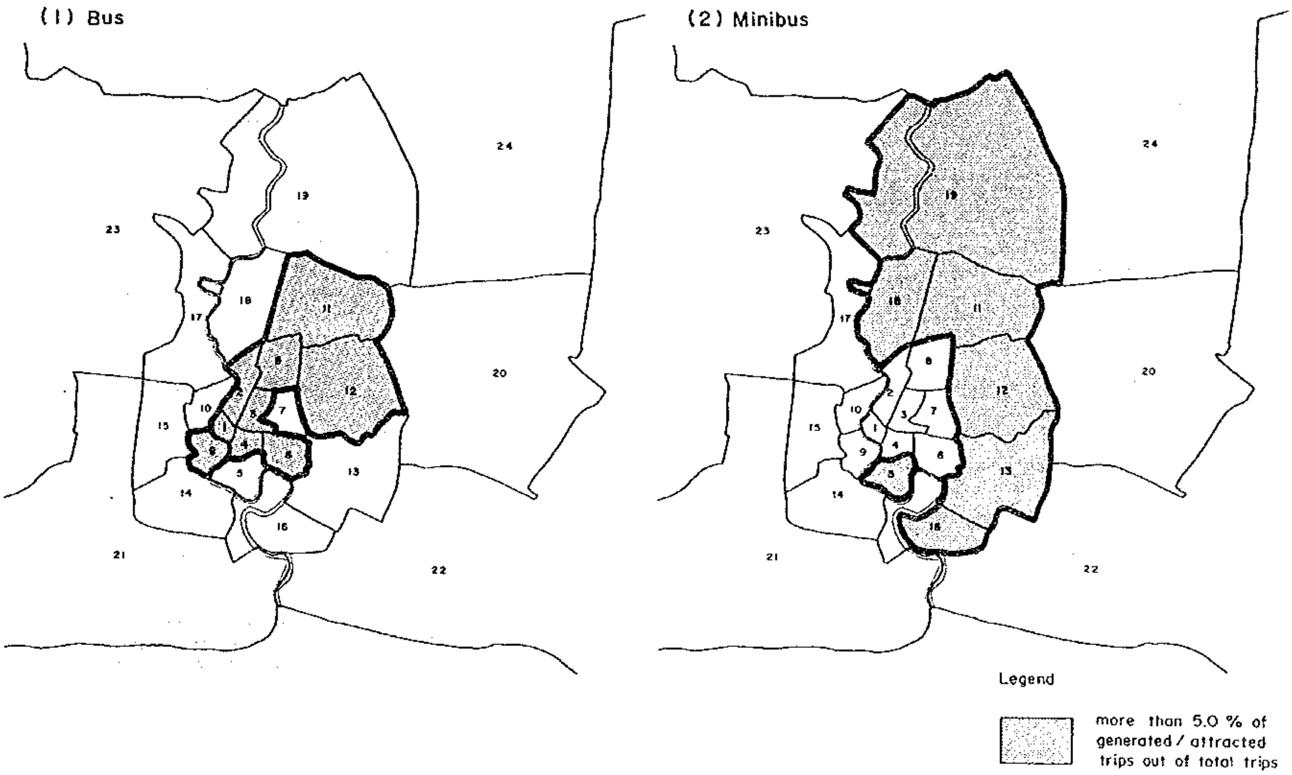


Figure 4.2.3 (1) Generated/Attracted Trips by Public Transportation Mode and Zone

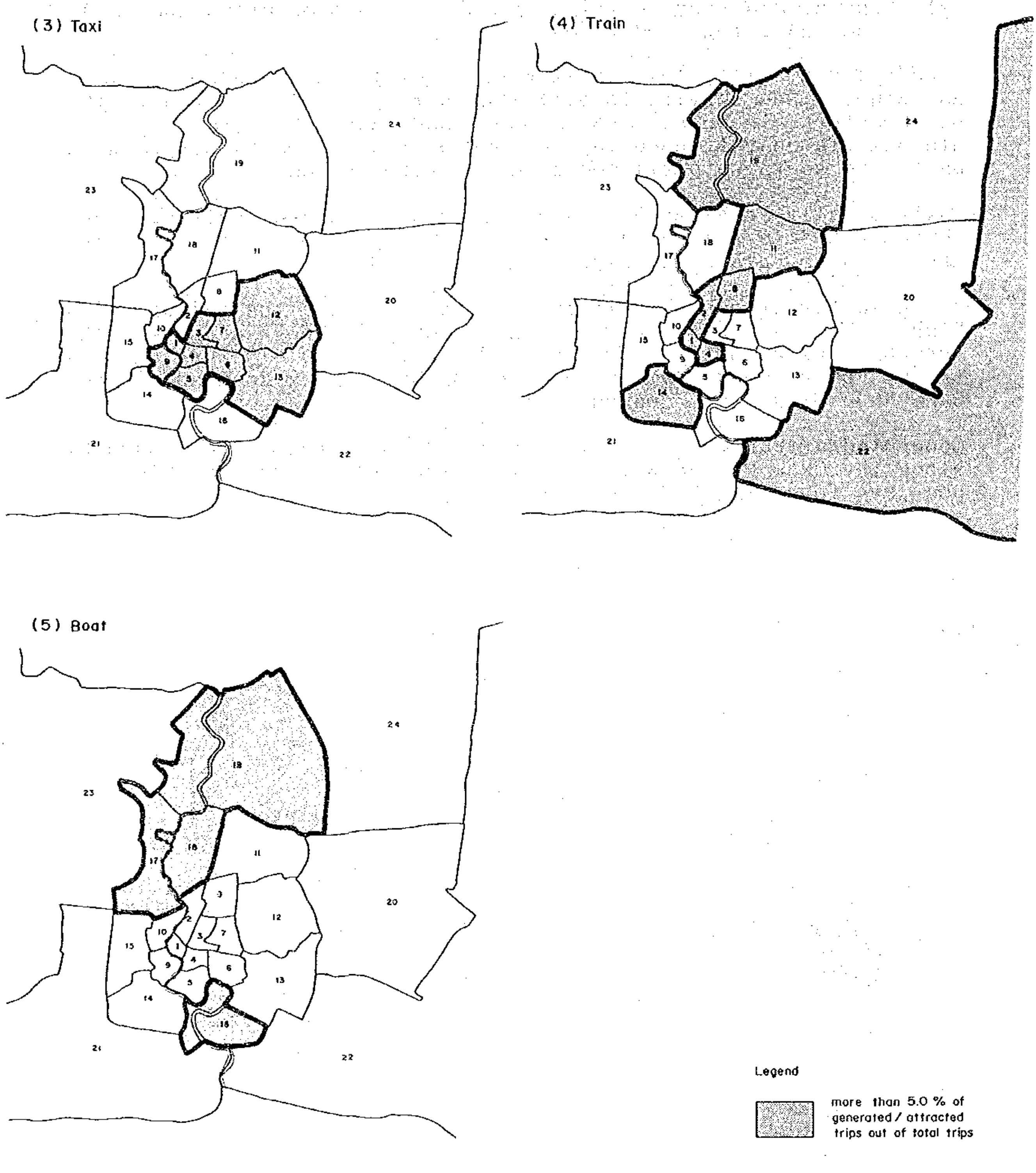


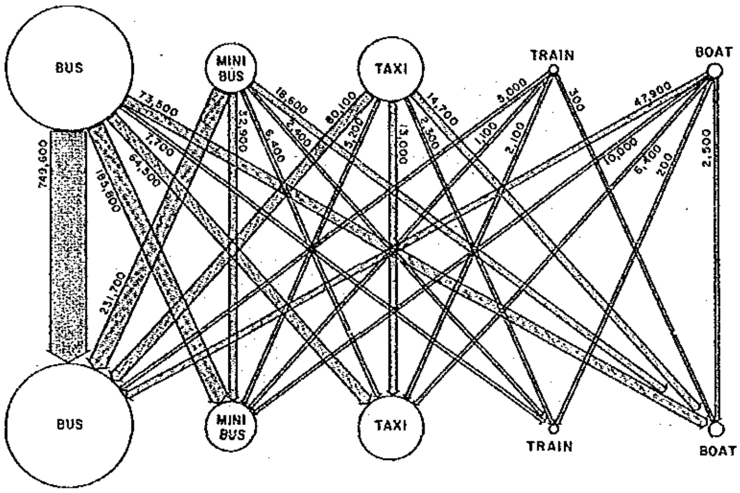
Figure 4.2.3 (2) Generated/Attracted Trips by Public Transportation Mode and Zone

3) Transfer characteristics by public transportation users

Figure 4.2.4 shows the number of passengers transferring from one public transportation mode to another.

According to the figure, 22% of bus users and 35% of minibus users transfer to other public transportation modes. Minibuses are often used as feeders of buses in the suburbs, therefore, transfer to buses has the largest portion.

Transfer passengers between buses are the largest accounting for 750,000 trips. Approximately 25% of the railway and waterway passengers transfer mainly to buses.



To / From	Bus	Mini-BUS	Taxi	Train	Water	Sub-Total (A)	Total (B)	Transfer Ratio (%) A/B * 100
Bus	749642	185840	64495	7739	73544	1081260	5247702	20.60
(%)	(69.3)	(17.2)	(6.0)	(6.8)	(6.8)	(100.0)		
Minibus	231705	32871	6382	2385	18634	291977	847232	34.46
(%)	(79.4)	(11.3)	(2.2)	(0.8)	(6.4)	(100.0)		
Taxi	80083	5232	12958	2284	14661	115218	1384604	8.32
(%)	(69.5)	(4.5)	(11.2)	(2.0)	(12.7)	(100.0)		
Train	4951	1092	2082	0	263	8388	32939	25.47
(%)	(59.0)	(13.0)	(24.8)	(0.0)	(3.1)	(100.0)		
Water	47866	10046	6432	156	2498	66998	258460	25.92
(%)	(71.4)	(15.0)	(9.6)	(0.2)	(3.7)	(100.0)		

Figure 4.2.4 Characteristics of Transfer between Modes of Public Transport

4) Average trip length

According to the Person Trip survey, the average trip length by public transportation mode is shown in Figure 4.2.5.

The average trip length of bus passengers is 6 km which is equivalent to the distance between Mahanakorn and Soi Asoke on Rama IV. For other public transportation modes the average trip lengths were as follows; 3.3 km (between Sukhumvit and New Phet Buri on the Phrakanong Khlong Ton Road) for minibus passengers, 5.2 km (between Hua Lampong Station and the Middle Ring Road on the Rama IV Road) for taxi passengers, 10.2 km (between Hua Lampong and Bang Sue) for train passengers, and 1.9 km (between Khlong Bangkok Noi and Bangkok Yai on the Chao Phraya River) for boat passengers.

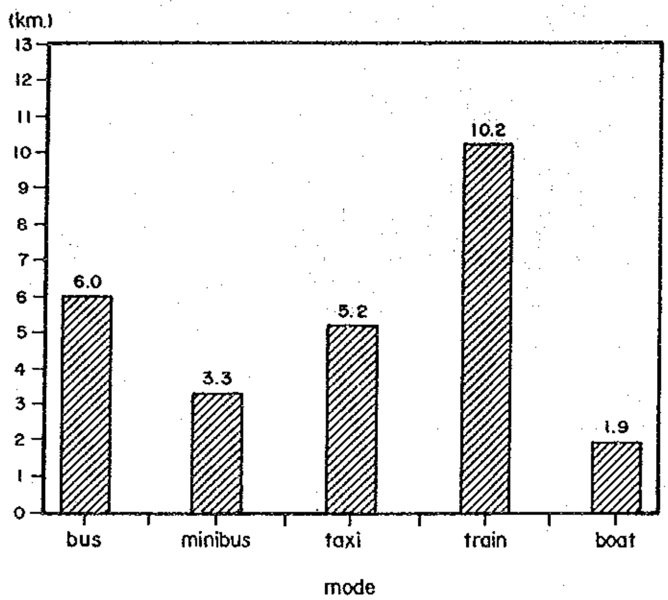


Figure 4.2.5 Average Trip Length by Public Transportation Mode

4.3 Bus/Minibus

1) Outline of Operational Characteristics

According to the Transport Act, public transport is supervised by the Department of Land Transport. Bus lines are classified into the following four categories which are conceptually shown in Figure 4.3.1:

- Category 1: Bus lines within BMA (mainly BMTA Bus) which is the primary concern of the discussion in this section.
- Category 2: Intercity bus lines between BMA and major cities of the country (long distance buses depart from 3 bus terminals. Refer to section 10 of 4.3 herein).
- Category 3: Bus lines outside BMA connecting between cities.
- Category 4: Bus lines within BMA, mainly feeder lines to bus lines of Category 1.

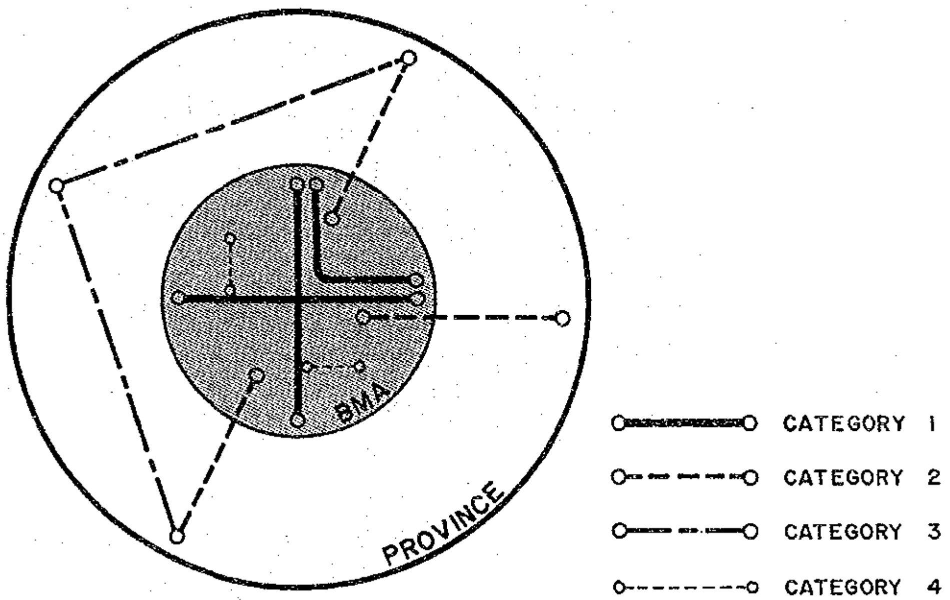


Figure 4.3.1 The Concept for Categories of Bus Lines

Outline of bus operational characteristics in Bangkok is shown in Table 4.3.1 and summarized as follows:

(a) Bus system in Bangkok is managed by BMTA and operated by BMTA and private bus companies.

(b) Operational conditions as of November 1988 are as follows:

No. of routes	223
Total length of routes (km)	5,163
No. of fleet (units)	8,182
Total daily bus trips	66,554
Total daily bus passengers	6,093,000

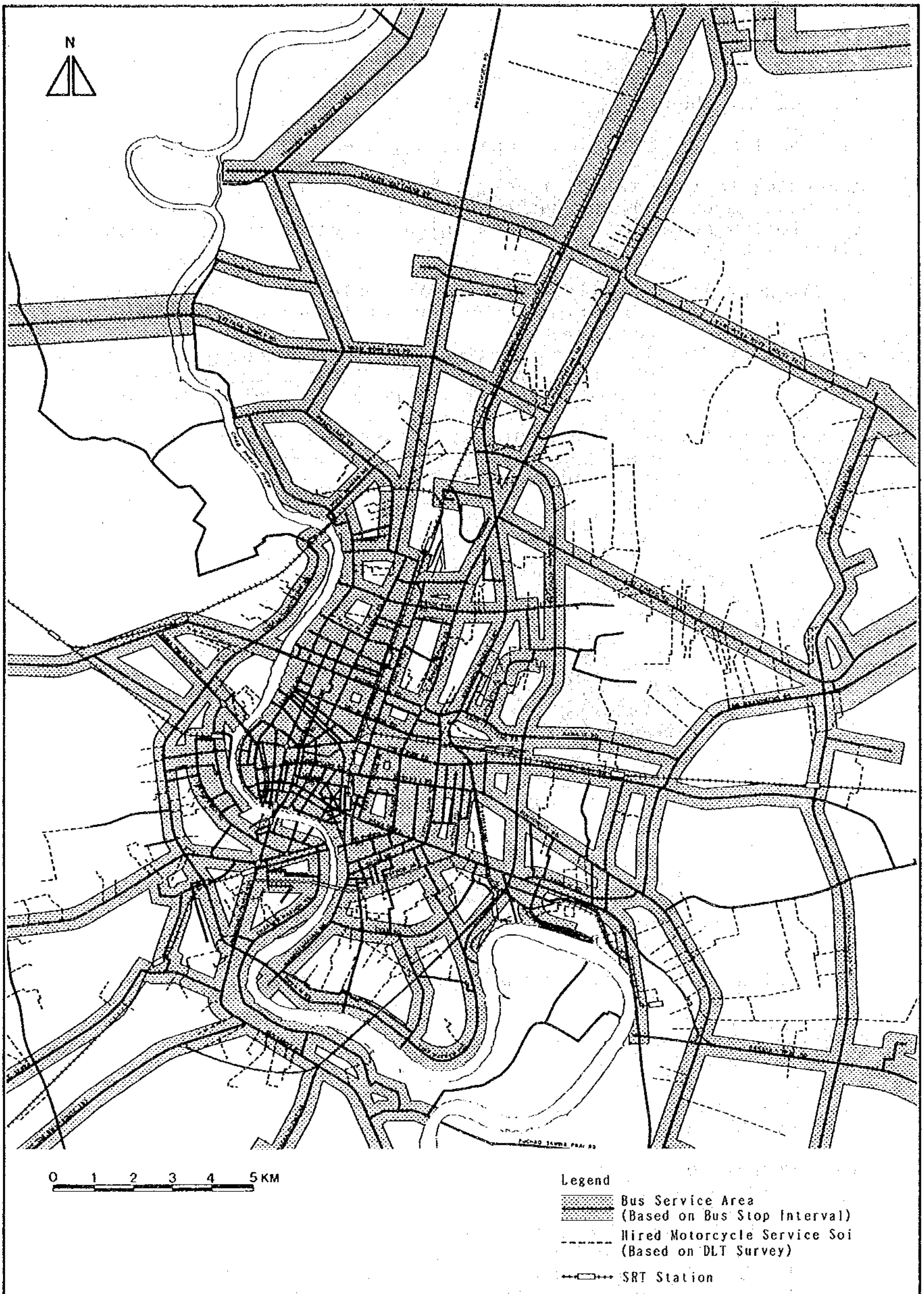


Figure 4.3.2 Coverage of Public Transport in Bangkok

(c) The regular bus operates on 65% (144 routes) of the total routes and serves 77% (4,683 thousand daily passengers) of the total daily passengers. All minibus routes (60) follow regular bus routes.

(d) Average route length of air-conditioned bus (36 km) is relatively long compared with regular bus and minibus routes. On the other hand, regular bus figures for the average number of trips per route (311 trips/day) and average number of passengers per trip (102 passengers) are higher than those for the other categories.

(e) BMTA's share of the total passengers transported in Bangkok is approximately 62% (3,805,000 passengers/day).

Table 4.3.1 Public Transport Operational Statistics during November 1988

Items	Regular Bus				Air-conditioned Bus				Minibus		Total	
	BMTA		Private		BMTA		Private		Private			
	Figure	(%)	Figure	(%)	Figure	(%)	Figure	(%)	Figure	(%)	Figure	(%)
1 Total number of bus routes	115	51.6	26	13.0	11	4.9	8	3.6	60	26.9	223	100.0
2 Total length of routes in Km	2,450	47.5	662	12.8	395	7.6	284	5.5	1,372	26.6	5,163	100.0
3 Buses in operation (vehicles)	4,216	51.5	1,132	13.8	444	5.4	239	2.9	2,151	26.4	8,182	100.0
4 Number of bus trips (bus trip/day)	35,799	53.8	10,188	15.3	2,184	3.3	1,290	1.9	17,093	25.7	66,554	100.0
5 Number of bus passengers (person/day)	3,612,862	59.3	1,069,740	17.6	191,634	3.1	98,540	1.6	1,120,157	18.4	6,092,933	100.0
6 Average length of bus route (Km/route) (2)/(1)	21		23		36		36		23		23	
7 Average number of bus trips (bus trip per day) (4)/(1)	311		351		199		161		284		298	
8 Average number of passengers per route (passengers/day/route) (5)/(1)	31,416		36,887		17,421		12,318		18,669		26,302	
9 Average number of passengers per bus trip (person/bus trip) (5)/(4)	101		105		88		76		65		88	

SOURCE: BMTA

2) Bus Route Structure

The bus network covers most of the main thoroughfares in Bangkok as shown in Figure 4.3.2. Main characteristics of the bus routes are as follows:

(a) The basic bus route structure is a radial pattern with the old CBD at the center. Therefore, the number of radial routes amount to 176 (72.1% of the total) and the number of routes either having their origin or destination inside the old CBD or cross it is 124 (50.8%).

(b) The number of northbound routes is the largest at 93 (38.1% of the total).

(c) The basic bus route structure is classified into the following four (4) types, which are also shown in Figure 4.3.3.

Type A : Origin or destination of route is inside the old CBD (98 routes, 40.2%). Old CBD is located inside the area bounded by the Chao Phraya River and Khlong Phadung Krung Kasem.
Type B : Route crosses the old CBD (20 routes, 8.2%)
Type C : Route is outside the old CBD (100 routes, 41.0%)
Type D : Ring route (10 routes, 4.1%)

The bus routes are further classified as shown in Table 4.3.2.

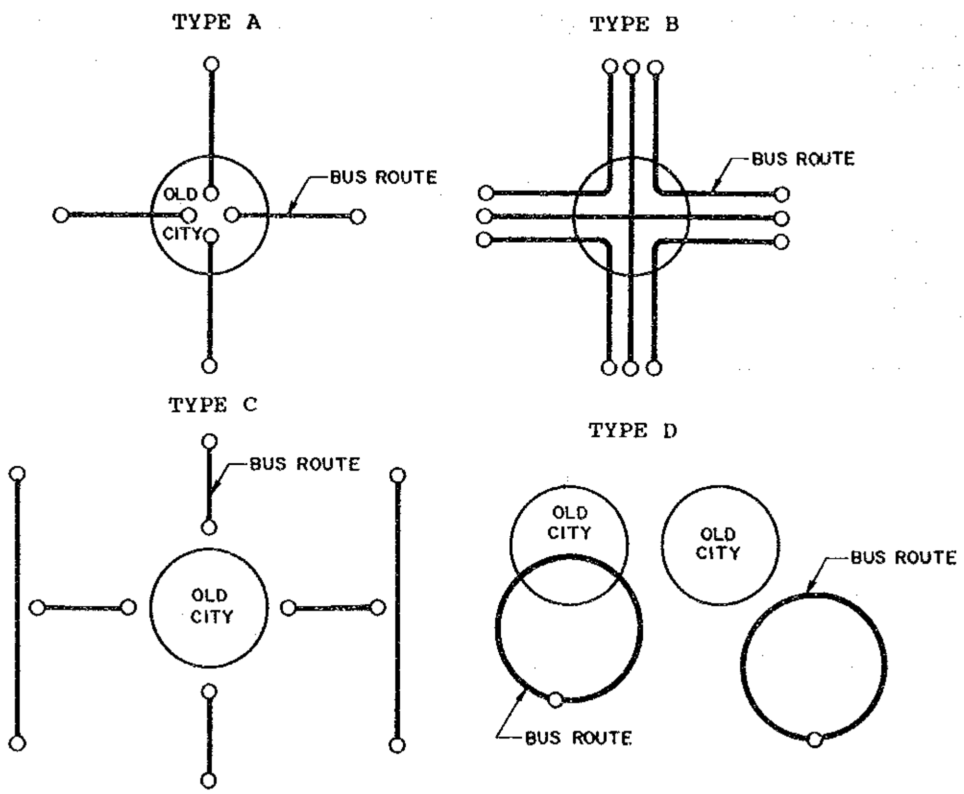


Figure 4.3.3 Bus Route by Type

Table 4.3.2 Bus Route Structure

BUS ROUTE STRUCTURE (MINIBUS)

TYPE		ROUTE NAME	NO. OF ROUTE
TYPE-A (ORIGIN OR DESTINATION IS INSIDE OLD CITY)	A-1(NORTHBOUND)	5, 8, 12, 18, 29, 30, 31, 34, 39, 44, 46, 70, 203	13
	A-2(SOUTHBOUND)	1, 6, 43, 68, 75, 82, 86, 89	8
	A-3(EASTBOUND)	2, 17, 48, 60	4
	A-4(WEASTBOUND)	80	1
TOTAL NO. OF ROUTE =26 (42.6%)			
TYPE-B (THE ROUTE CROSS OLD CITY)	B-1(NORTH-SOUTH)	3	1
	B-2(EAST-WEST)	40	1
	B-3(NORTH-EAST)		0
	B-4(NORTH-WEST)		0
	B-5(SOUTH-EAST)	4	1
TOTAL NO. OF ROUTE = 3 (4.9%)			
TYPE-C (ROUTE IS OUTSIDE OLD CITY)	C-1(RADIAL TYPE-NORTHBOUND)	11/1, 27, 29, 52, 97, 104	6
	C-2(RADIAL TYPE-SOUTHBOUND)	20, 88, 105, 120	4
	C-3(RADIAL TYPE-EASTBOUND)	102/1, 102/EX, 130	3
	C-4(RADIAL TYPE-WESTBOUND)	81	1
	C-5(CIRCUMFERENTIAL TYPE)	14, 22, 28, 38, 66, 71, 74, 77, 92, 98, 101, 107, 126, 129, 205, 207	16
TOTAL NO. OF ROUTE =30 (49.2%)			
TYPE-D (CIRCUMFERENTIAL ROUTE)	D-1(CROSS OLD CITY)	42, 56	2
	D-2(OUTSIDE OLD CITY)		0
TOTAL NO. OF ROUTE = 2 (3.3%)			
GRAND TOTAL			61

BUS ROUTE STRUCTURE (REGULAR BUS + AIR-CONDITIONED BUS)

TYPE		ROUTE NAME	NO. OF ROUTE
TYPE-A (ORIGIN OR DESTINATION IS INSIDE OLD CITY)	A-1(NORTHBOUND)	5,8,12,18,29,32,33,34,34/1,36, 39,39/3,44,44/1,44/2,46,49,51, 59,59/1,64,65,70,90,96, 96/2,110,112,201,203,204, A29,A39,A44	34
	A-2(SOUTHBOUND)	1, 6, 7, 7/1, 10, 35, 37, 43, 68, 75, 82, 85, 86, 89	14
	A-3(EASTBOUND)	2, 11, 15, 17, 25, 26, 45, 47, 48, 58/1, 60, 72, 73, 102, 109, 113, 119, 141, A1, A8, A12	21
	A-4(WEASTBOUND)	19, 80, 91	3
TOTAL NO. OF ROUTE =72 (39.3%)			
TYPE-B (THE ROUTE CROSS OLD CITY)	B-1(NORTH-SOUTH)	3, 9, 59, A6	4
	B-2(EAST-WEST)	40, 58, 58/2, 79, 121, A7, A11	7
	B-3(NORTH-EAST)	16, 67	2
	B-4(NORTH-WEST)	A3, A9	2
	B-5(SOUTH-EAST)	4, 21	2
TOTAL NO. OF ROUTE =17 (9.3%)			
TYPE-C (ROUTE IS OUTSIDE OLD CITY)	C-1(RADIAL TYPE-NORTHBOUND)	11/1, 24, 26, 27, 29/1, 29/2, 34/2, 39/1, 39/2, 52, 63, 69, 90/1, 97, 104, 114, 117, 127, 128, 134, A2	21
	C-2(RADIAL TYPE-SOUTHBOUND)	20, 84, 84/1, 88, 105, 120	6
	C-3(RADIAL TYPE-EASTBOUND)	23, 23/EX, 58/1, 60/1, 61, 93, 102/EX, 115, 116, 130, 132, 133, 1067, A14	14
	C-4(RADIAL TYPE-WESTBOUND)	81, 124, 125	3
	C-5(CIRCUMFERENTIAL TYPE)	13,14,22,28,38,62,66,71/1,71/2, 74,74/EX,76,77,92,95/1,95/2,98, 101,103,106,107,108,122,126, 129,131,136,138,140,142,145, 205,205/1,206,207,1122, A4,A5,A10,A13,A126,A138	42
TOTAL NO. OF ROUTE =86 (47.0%)			
TYPE-D (CIRCUMFERENTIAL ROUTE)	D-1(CROSS OLD CITY)	42, 53, 55, 56	4
	D-2(OUTSIDE OLD CITY)	54, 57, 111, 137	4
TOTAL NO. OF ROUTE = 8 (4.4%)			
GRAND TOTAL		(Regular Bus = 164) (Air-conditioned Bus = 19)	183

3) Bus Traffic

The present bus traffic on roads is more specifically shown in Figure 4.3.4 while major bus corridors are shown in Figure 4.3.5.

The heaviest bus traffic is observed along Phahon Yothin between Lat Phrao and Yan Phahon Yothin. This road section serves more than 50 bus routes and 18,000 bus trips (both directions) daily.

The second heavily used road by bus traffic is Rajdamnoen Klan between Atsadang and Tanao in old CBD, where 50 bus routes operate with 16,000 bus trips a day.

Corridors with heavy bus traffic (approximately more than 4,000 bus trips daily are as follows:

Northbound	:	Phayathai - Phahon Yothin Corridor, Samsen Corridor
Eastbound	:	Phet Buri - Ram Khamhaeng Corridor, Rama I - Sukhumvit Corridor, Rama IV Corridor
Southbound	:	Taksin - Suksawat Corridor
Westbound	:	Phet Kasem Corridor
Circumferential	:	Lat Phrao Corridor

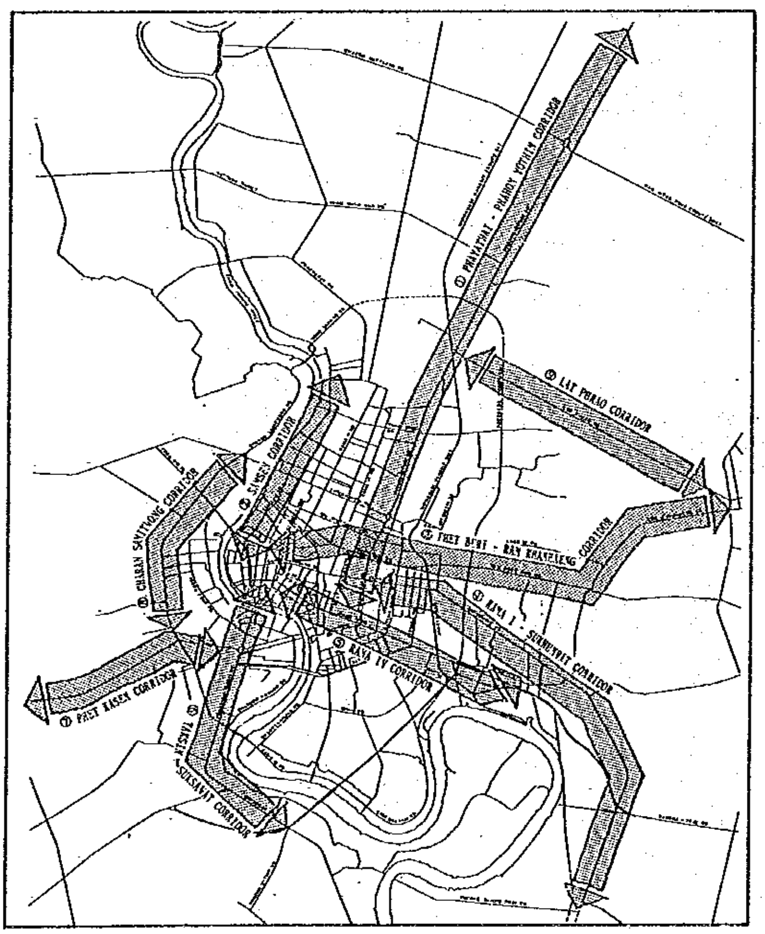


Figure 4.3.5 Main Bus Corridors

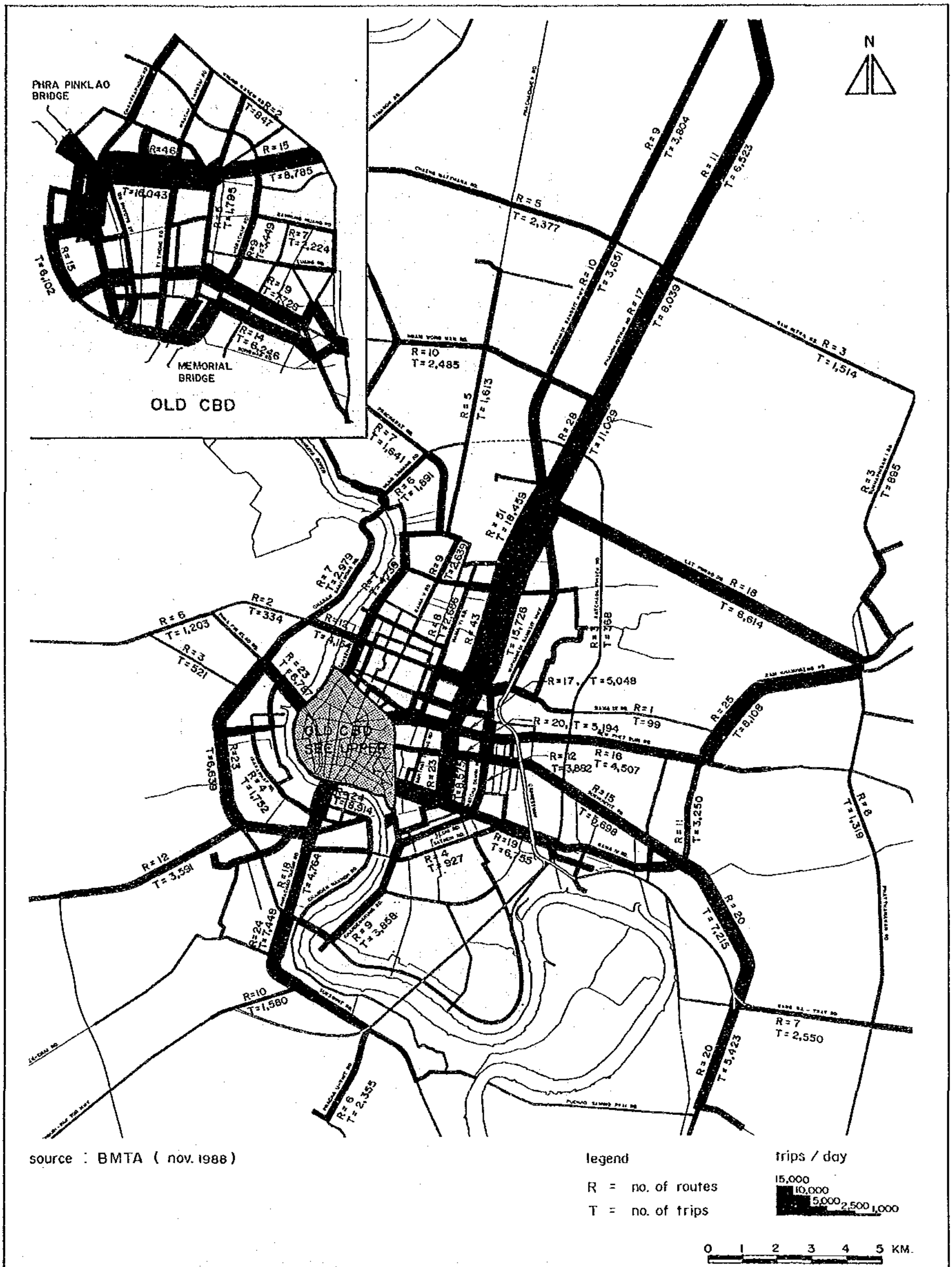


Figure 4.3.4 Bus Traffic

Based on the person trip survey, the result of demand assignment for bus trips is shown in Figure 4.3.6

It can generally be said that the demand for, and supply of bus service are almost balanced. Demand is greater along bus corridors with frequent bus service, such as Phahon Yothin, Phet Buri, Sukhumvit, Rama IV, Taksin, and Lat Phrao.

However, there is insufficient bus service in the circumferential corridor which connects the eastern suburbs of Bangkok with a loop composed by Ram Intra, Sukhapiban 1, Srinakharin, and Sukhumvit Soi 77 in the eastern suburbs, in spite of the increased demand due to the recent housing development.

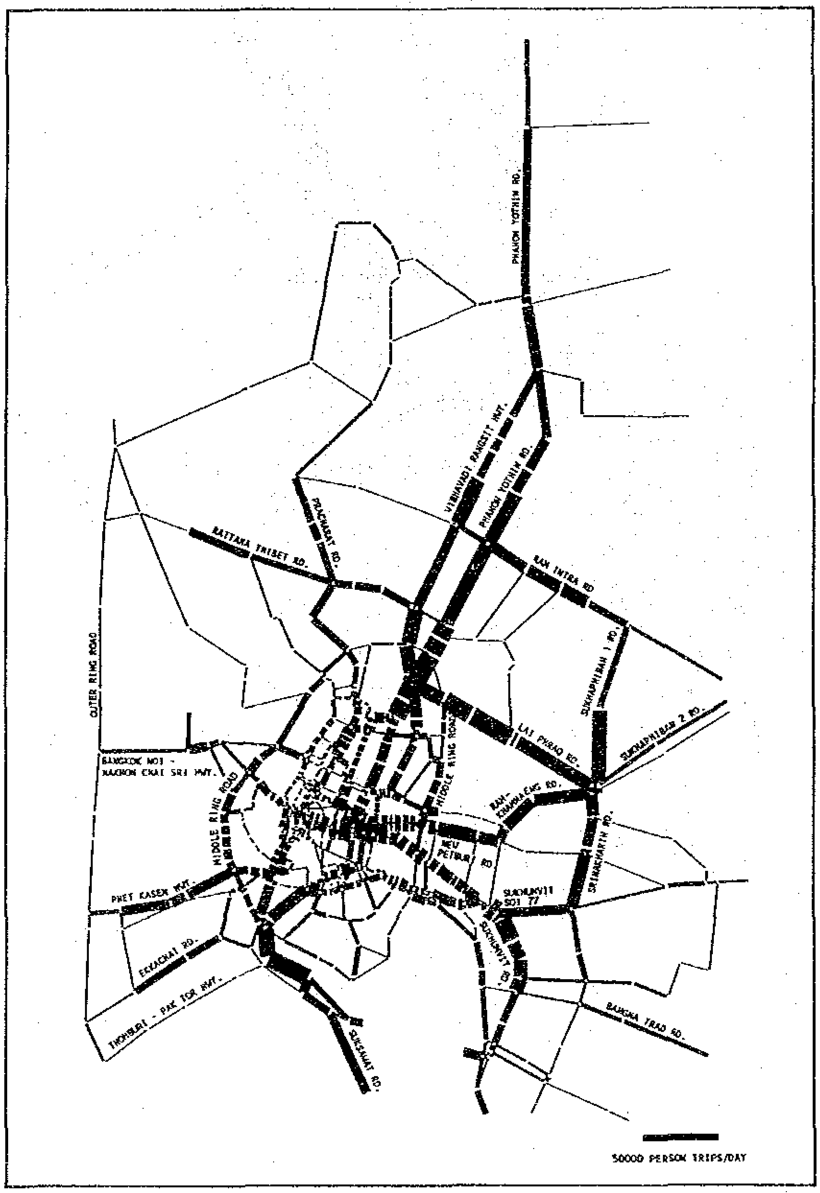


Figure 4.3.6 Present Public Transport Demand

4) Bus Travel Speed

Table 4.3.3 shows travel speed by bus type obtained by the bus on-board survey.

According to these results, the average travel speed at peak period of regular bus, air-conditioned bus, and minibus is 13.6 km/h, 17.3 km/h and 18.3 km/h, respectively. The regular bus travel speed is the lowest. The air-conditioned bus and the minibus survey routes were mainly concentrated in the Thonburi side.

The regular bus travel speed during the off-peak period is 18.6 km/h, which is 37% faster than at the peak period.

Looking at the bus travel speed by area, it can generally be said that the travel speed is lower on the east side of the Chao Phraya River (Bangkok area) than on the west side (Thonburi area). In the Bangkok central area, particularly inside the Middle Ring Road, the travel speed is as low as 11.4 km/h.

Table 4.3.3 Travel Speed by Type of Bus, Area and Time Period

Type of Bus	Area	Inside Middle Ring Road		Outside Middle Ring Road			Average
		Bangkok	Thonburi	North	East/South	West/South	
Regular Bus	AM Peak	11.4	18.1	15.8	15.7	20.4	13.1
	PM Peak	11.3	17.3	21.3	22.0	23.3	14.1
	Off-Peak	15.2	24.1	22.5	28.8	18.9	18.6
Air-conditioned Bus	AM Peak	13.1	20.8	25.1	18.1	28.1	16.6
	PM Peak	13.7	17.5	28.1	18.7	19.1	17.9
	Off-Peak	No Available Data					
Minibus	AM Peak	14.1	23.3		36.3	23.5	19.3
	PM Peak	10.6	13.5		14.1	26.0	17.3
	Off-Peak	No Available Data					

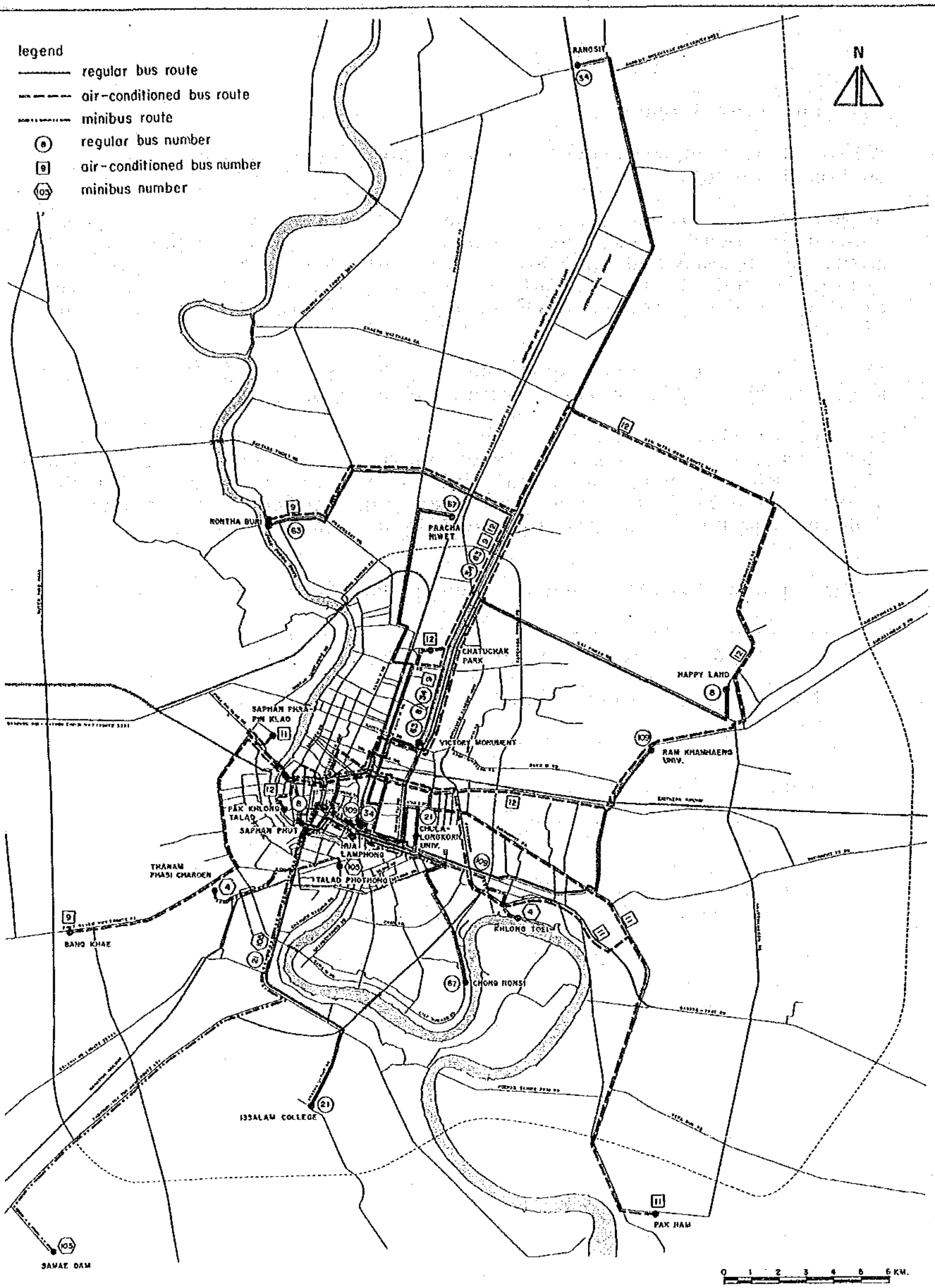


Figure 4.3.7 Bus On-board Survey Routes

5) Bus Stop/Terminal

According to the bus stop survey conducted by DLT in 1988, the total number of bus stops is more than 2,600. Major stops with heavy volume of boarding/alighting and transfer passengers are shown in Figure 4.3.8. They are located at interchange points, such as railway stations and long distance bus terminals, transfer points or near major commercial/institutional facilities.

Bus stops are provided every 340 meters on average in the CBD area, while the distance increases to 650 meters in the suburban area.

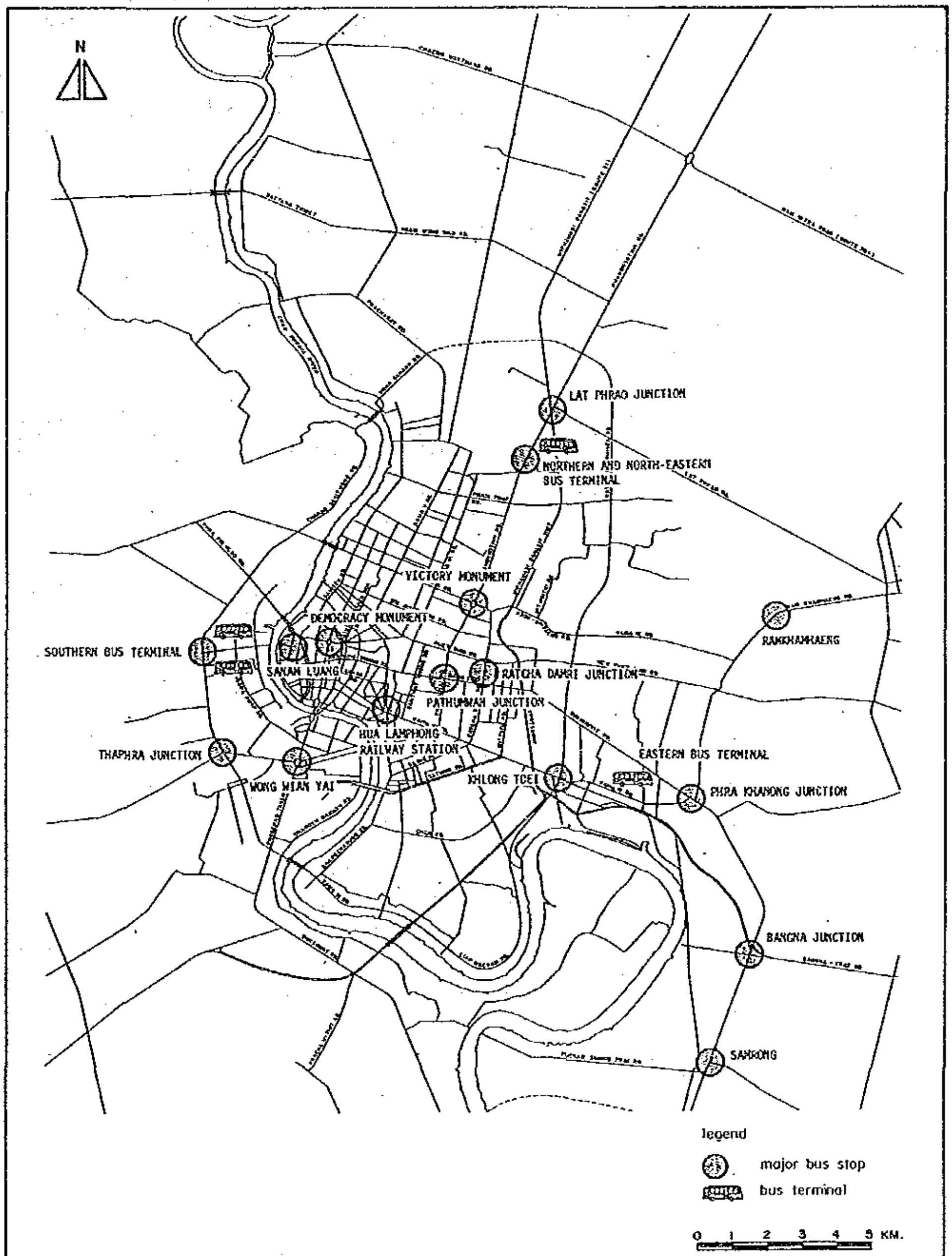


Figure 4.3.8 Location of Major Bus Stops and Terminals

6) Bus Service Management

As shown in Table 4.3.4 the total BMTA fleet is 4,850 of which approximately 90%, or 4,406 units, are regular buses, and 444 are air-conditioned buses. The number of units actually owned by BMTA is 3,761 (77.5%) while the remainder is rented from the private sector.

Due to the lack of a maintenance system only 11% (527 buses) of the total fleet is maintained by BMTA, while the rest is contracted out to the private sector with an average maintenance expense per bus of about 750 Baht/day.

There are 10 zone offices: 9 for regular buses and 1 for air-conditioned buses. Each zone has 3 depots and the average number of buses per depot is 163.

Locations of zone offices and depots are illustrated in Figure 4.3.9.

Table 4.3.4 Existing Condition of BMTA Bus Fleet (As of December, 1988)

Zone	BMTA Maintenance				Private Maintenance				Total
	BMTA Owned		Rental		BMTA Owned		Rental		
	Old Bus from Private Company	Regular Bus 10 m (2,300 Buses)	Regular Bus 10 m (40 Buses)	Volvo	Regular Bus 10 m (2,300 Buses)*3	Jumbo Bus 12 m (1,200 Buses)*4	Red Bus 10 m (500 Buses)*5	Daewoo 12 m (400 Buses)*6	
1	-	-	-	-	123	170	170	-	463
2	10	119	25	-	221	100	75	65	615
3	-	36	-	-	198	165	15	85	499
4	-	-	-	-	254	120	20	75	469
5	-	125	-	-	190	103	-	90	508
6 *1	-	-	-	-	260	130	-	85	475
8 *1	-	-	-	-	142	261	95	-	498
9	-	-	-	-	290	110	90	-	490
10	-	50	-	-	264	40	35	-	389
Subtotal	10	330	25	-	1942	1199	500	400	4,406
11 *2	-	-	-	164	-	280	-	-	444
Total	10	330	25	164	1942	1479	500	400	4,850

Note: *1 Zone 7 was absorbed within Zones 6 and 8.
*2 Zone 11 is an Air-Conditioned Bus Section.
Source: BMTA

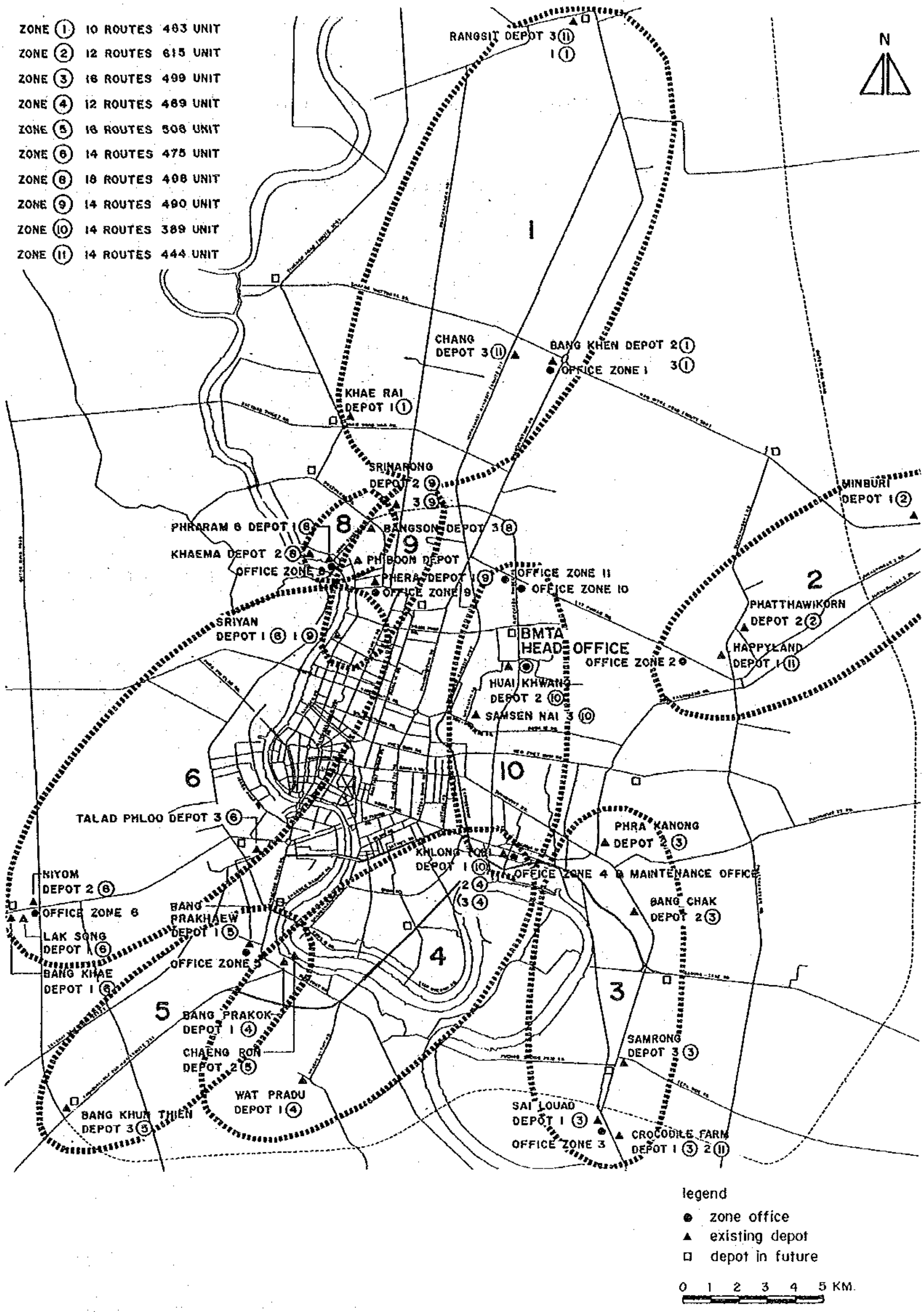


Figure 4.3.9 Location of Zone Offices and Depots

On the other hand, the capacity by type of bus is shown in Table 4.3.5.

Table 4.3.5 Bus Capacity by Type

Type of bus		Capacity (Person)		
		Seated	Standing	Total
Regular Bus	10m	30	43	73
	12m	38	54	92
Minibus		18	12	30
Air-conditioned Bus		38	-	38

Source: BMTA

7) BMTA Organization and Staff

BMTA is a state enterprise under the supervision of the Ministry of Communications. It is governed by an 11 member Board of Directors headed by a Managing Director, and supported by 3 Deputies with responsibilities covering: Operation, Administration, and Management.

The total number of BMTA staff is approximately 21,000. As shown in Table 4.3.6, 98% (20,400) of the total belong to the operation group, while 35.5% (7,400) are drivers and 38.0% (7,900) conductors. Number of staff per bus driver and per bus are 2.8 and 4.3, respectively.

Table 4.3.6 Summary of the Number of BMTA Staff for the Month of October 1988

Title	Director	Directorate	Admi.	Bus Ope.	Total
Director, Deputy director and Consultant	2	1	1	1	5
Organization, Section, Office and Division Staff	-	5	2	10	17
District manager and Deputy manager	-	-	-	19	19
Chief of the Office and Director of Division	7	9	20	209	225
Route Manager and Assistant manager	-	-	-	250	250
Chief of Unit, Chief of the Staff	-	71	-	166	237
Office Staff	56	-	132	836	1,024
Passenger Fare Staff	-	-	-	461	461
Bus Operation Personnels	-	-	-	186	186
Driver of Mechanical, Transport, Foreman	-	1	-	6/ 675	6/ 576
Radio Operators	-	-	-	133	133
Doctor, Nurse, Photographer, etc.	1	7	53	96	
Chief of Bus Technical and Garage	-	-	-	774	774
Inspector, Examiner	33	-	-	784	817
Office Driver, Janitor	-	17	3	128	148
Driver	-	-	-	7,398	7,398
Conductor	-	-	-	7,915	7,915
Cleaner, Watchman, etc.	-	16	1	499	516
TOTAL	99	129	194	20,357	20,777

Source : BMTA

8) Financial Status of BMTA

BMTA's financial status from 1985 to 1987 is summarized in Table 4.3.7. Revenue and expense in 1987 are 3,217.5 million Baht and 3,543.0 million Baht, respectively, showing a financial loss of 325.5 million Baht.

Of the total revenue, 95% is generated from ticket selling. On the other hand, 35 to 40% of the total expenses account for salaries and 25% for repair/maintenance.

Table 4.3.7 BMTA Revenue and Expense (1985-1987)

Unit : Thousand Baht

Item	1987	1986	1985
1. Primary Revenue			
1.1 BMTA ticket selling	3,059,937	3,017,362	3,018,212
1.2 received from monthly commuter pass	11,313	10,150	10,996
1.3 received from advertising	31,265	26,405	21,252
1.4 others	115,012	90,324	397,251
total	3,217,527	3,144,241	3,447,711
2. Primary Expense			
2.1 personal expense	1,451,329	1,425,423	1,413,505
2.2 fuel	732,668	759,161	800,925
2.3 bus rent	166,804	227,074	276,382
2.4 bus repairs	1,018,303	980,556	929,529
2.5 property rent	61,838	509,334	50,796
2.6 others	98,334	92,256	361,606
2.7 depreciation	11,749	48,126	132,707
total	3,543,025	3,592,530	3,965,450
3. Primary Benefit (Loss)	(325,498)	(438,315)	(517,739)
4. Paid Interest	582,904	598,433	500,287
5. Not Including Extra Expense Benefit (Loss)	(908,402)	(1,036,749)	(1,106,026)
6. Extra Expense	12,317	83,802	-
7. Net Benefit (Loss)	(920,719)	(1,120,551)	(1,106,206)
8. Not Including Depreciation	11,749	48,126	152,707
9. Not Including Paid Interest	582,904	598,433	588,287
10. Not Including Extra Expense	12,317	83,802	-
11. Operated Benefit (Loss)	(313,750)	(390,190)	(305,032)

Source: BMTA

9) Fare system of BMTA Bus

The fare system of BMTA bus is summarized in Table 4.3.8 below.

Table 4.3.8 Fare System of BMTA Bus

Type of Service		Fare System	Remarks
Ordinary Route	Blue Bus, Minibus Red Bus	Throughout 2.0 Baht 3.0	144 ordinary routes + 60 minibus rout
Via Express Way	Blue Bus Red Bus	Throughout 4.0 Baht 5.0	12 Routes
Express Bus	Blue Bus	Throughout 3.0 Baht	25 Routes
Night Shift	Blue Bus, Minibus	Throughout 3.5 Baht	10 Routes (23:00-5:00)
Charge Per Distance of Ordinary Type		1.0 - 5.5 Baht	6 Routes (Routes for Suburb Service)
Air-Conditioned Bus		The First 8 kms 5.0 Baht Every 4 kms. 2.0 Maximum 15.0	19 routes
Weekday Monthly Ticket		66 % Reduce 33 % Reduce	For primary and secondary student onl For High-school and University studen

Source: BMTA

10) Long Distance Bus

Long distance buses bound for other regions depart from 3 bus terminals.

- To Northern Region (Chiang Mai, Nakhon Sawan, Nakhon Ratchasima, etc.): From Northern Bus Terminal with 1,008 bus departure/day, located along Phahon Yothin Road.
- To Eastern Region (Chon Buri, etc.): From Eastern Terminal with 566 bus departure/day, located along Sukhumvit Road.
- To Southern Region (Songkla, etc.): From southern Bus Terminal with 1,026 bus departure/day, located along Middle Ring Road (Thonburi Side).

As shown in Table 4.3.9 the total volume of daily departure of passengers from Bangkok to the regions is 106,689 passengers, of which approximately 36% or 38,471 passengers depart from the Northern Bus Terminal, 24% (25,753 passengers) from Eastern Bus Terminal, and 40% (42,465 passengers) from Southern Bus Terminal.

Table 4.3.9 Number of Trips and Passengers for Long Distance Bus

Terminal	Number of trips/day			Number of Passenger/day		
	Normal	Aircon	Total	Normal	Aircon	Total
Northern bus terminal	505	503	1,008 (38.8%)	22,978	15,493	38,471 (36.1%)
Eastern bus terminal			566 (21.8%)			25,753 (24.1%)
Southern bus terminal	739	278	1,026 (39.4%)	33,625	8,840	42,465 (39.8%)
Total			2,600			106,689

Source : Transport Company Ltd.

11) Characteristics of Bus Users

Based on the public transport user opinion survey, the characteristics of bus users are summarized below.

(1) Characteristics of Bus Utilization

a. Generally, the bus service for the entire Bangkok area is good. However, more than 30% of interviewees who live in one part of the inner city (zone 5) and the suburbs in the eastern and northern areas (zones 11, 12, 13, 17, 18, 19) assess the bus service as inconvenient. Especially, more than 40% of interviewees in the northwestern area (zones 17, 18) respond that bus service is inconvenient. Therefore, it is assumed that the northwestern suburbs is an area with relatively poor bus service.

b. 75% of total interviewees use bus more than 5 times a week.

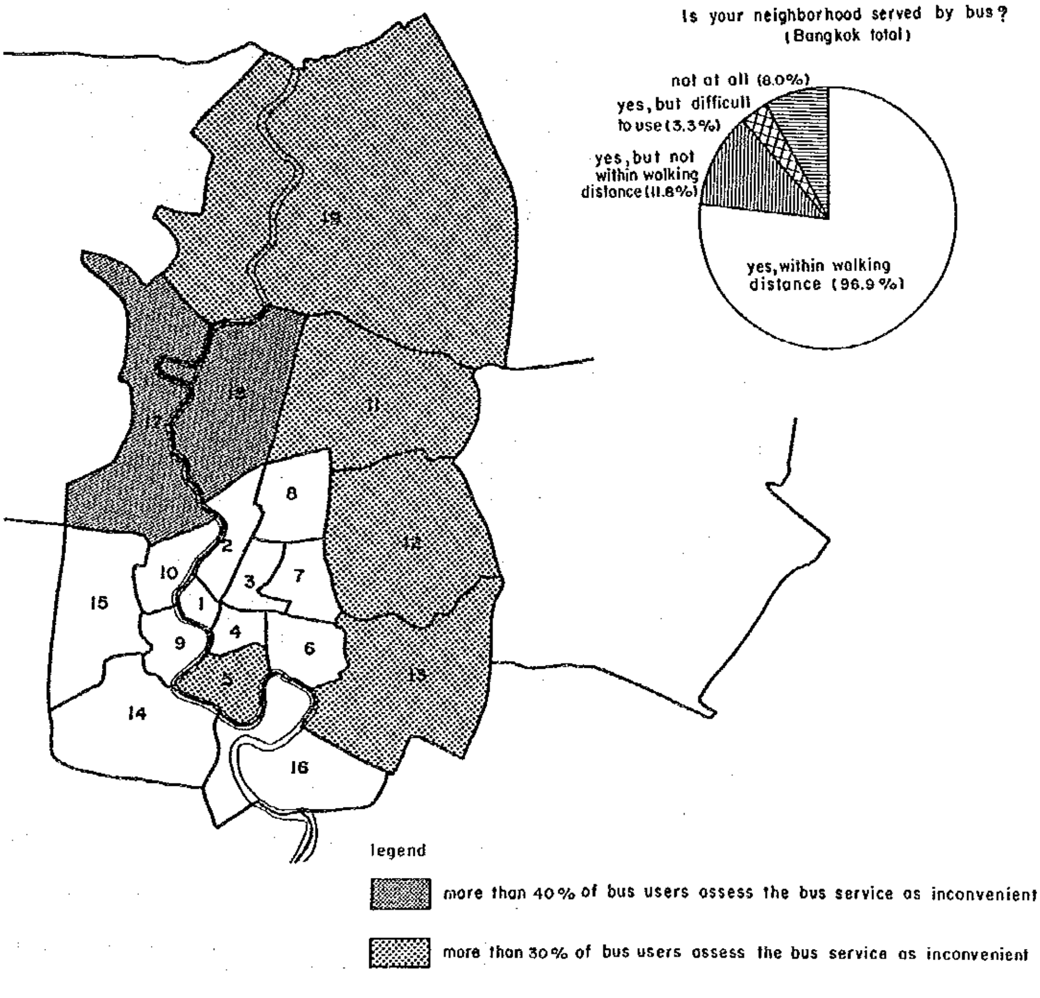


Figure 4.3.10 Poor Bus Service Area

c. Access mode to bus stop in the total Bangkok area is as follows:

Walk	85.9%
Hired Motorcycle	6.2%
Samlor/Silor	5.3%
Others	2.7%

The zones where the utilization percentage of hired motorcycle exceed 10% are zones 3, 5, 12 and 15 and the zones where the utilization percentage of samlor/silor exceed 10% are zones 11, 12, 13 and 18. Zone 12 shows the highest percentage of using transportation modes other than walking. (Refer to Figure 4.3.11).

Access time to bus stop by mode is as follows:

Walk	5 minutes
Hired Motorcycle	3 minutes
Samlor/Silor	9 minutes

On the other hand, access fares to bus stop by hired motorcycle and samlor/silor are 5 Baht and 16 Baht, respectively.

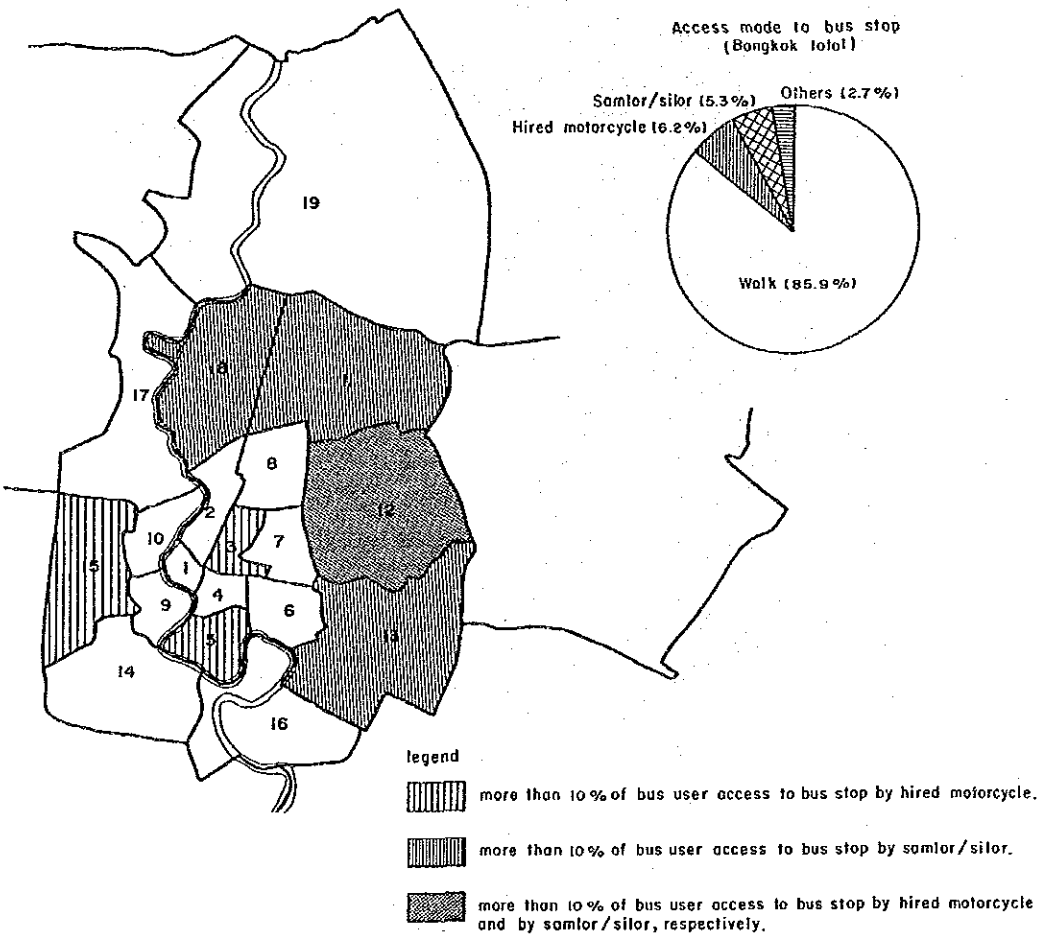


Figure 4.3.11 Access Mode to Bus Stop

d. Average waiting time at bus stop during peak period and off-peak period is 8 minutes and 10 minutes, respectively. There is no major difference between peak period and off-peak period.

(2) Assessment of Bus Service

On the whole, the bus service is highly valued by the interviewees. However, bus users consider the following two items unsatisfactory.

a. Service frequency during peak period (Regular bus + Air-conditioned bus)

b. Noise/Air Pollution and Heat/Temperature for regular bus users

(3) In the questionnaire addressed to Air-conditioned Bus Users, 82.3% of total interviewees answered that the reason for changing to air-conditioned bus is riding comfort.

Approximately 80.0% of total interviewees replied that the transport mode used before converting to air-conditioned bus was regular bus and minibus.

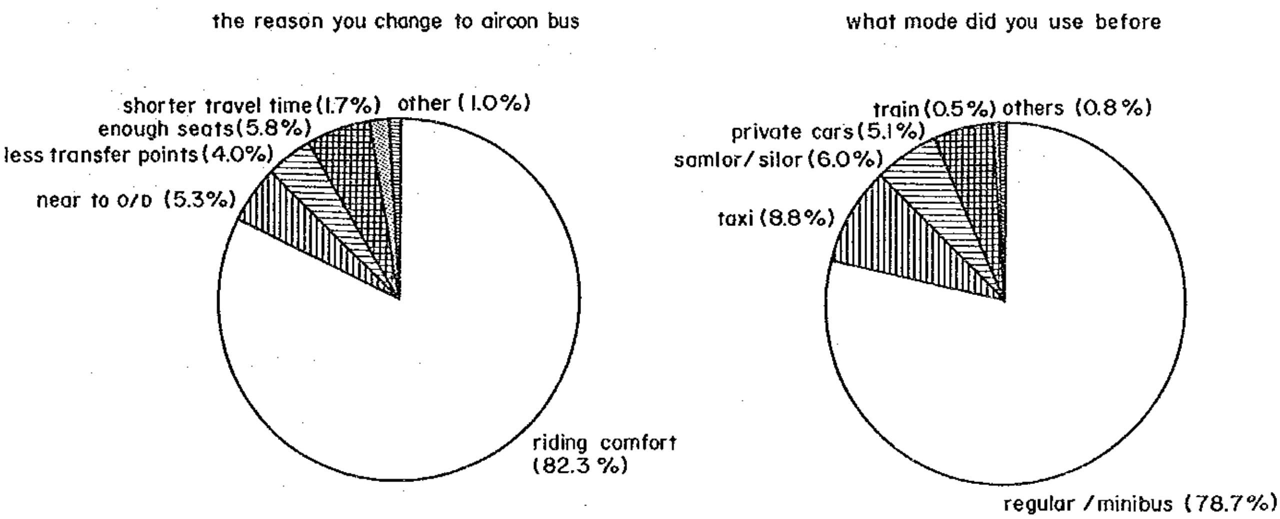


Figure 4.3.12 Questionnaire to Air-conditioned Bus Users