2.4 Automobile Ownership

The number of vehicles registered with the Road Transport Department is inconsistent with the actual number of vehicles in terms of regional distribution. The number of registered vehicles by type in the whole Malaysia is shown in Table 2.4.1. Car ownership information obtained from the HIS in this study is shown in Table 2.4.2.

Table 2.4.1 Number of Vehicles Registered in Malaysia

Unit: 000

Year	M.cycle	Car	Bus	Taxi	Hire Car	Lorry	Others	Total
1986	1,850.8	1,301.0	18.6	23.8	3.6	223.5	102.3	3,523.7
1987	1,930.0	1,356.7	19.4	24.9	3.7	233.1	106.7	3,674.5
1988	2,030.4	1,427.3	20.5	26.2	3.9	245.2	112.2	3,865.7
1989	2,182.5	1,534.2	22.0	28.1	4.2	263.6	120.6	4,155.2
1990	2,388.5	1,679.0	24.1	30.8	4.6	288.5	132.0	4,547.4
1991	2,595.7	1,824.7	26.1	33.4	5.0	313.5	143.5	4,942.0
1992	2,762.7	1,942.0	27.8	35.6	5.4	333.7	152.7	5,259.8
1993	2,970.8	2,088.3	29.9	38.3	5.8	358.8	164.2	5,656.0
1994	3,297.5	2,302.5	33.5	42.2	5.3	393.8	178.4	6,253.3
1995	3,608.5	2,553.6	36.0	46.8	8.2	440.7	203.7	6,897.4
1996	3,951.9	2,886.5	39.0	49.5	10.0	512.2	237.6	7,686.7
1997	4,316.3	3,204.4	41.9	54.1	12.5	569.0	329.4	8,527.6

Source : Road Transport Department
Note: Federal Territory of Labuan is included in Sabah

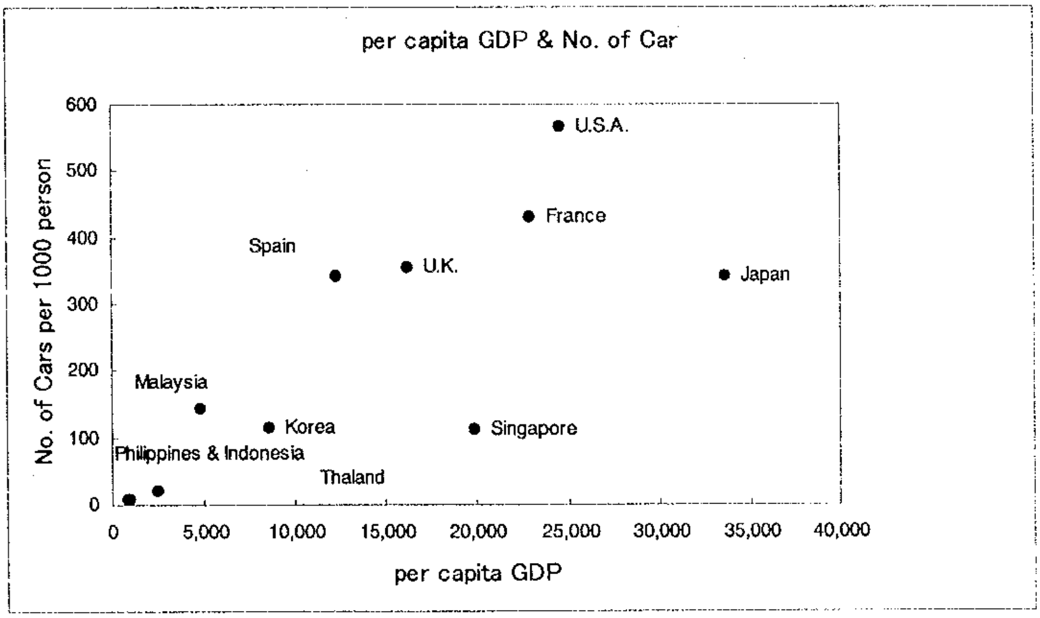


Figure 2.4.1 International Comparison of Car Ownership

Table 2.4.2 Vehicle Ownership in Klang Valley

	Number of Automobile			Ownership per 1000 person		
District	Motorcycle	Car	Total	Motorcycle	Car	Total
Kuala Lumpur	225,031	289,521	514,552	164	211	375
Gombak	83,143	88,818	171,961	174	186	360
Hulu Langat	110,466	109,829	220,295	194	193	388
Petaling	140,891	192,222	333,113	169	231	400
Klang	99,056	107,356	206,412	190	206	396
Total	658,587	787,746	1,446,333	175	209	383

Source: Home Interview Survey by SMURT-KL (1997)

According to the Home Interview Survey results, car ownership in the Klang Valley region was estimated at 209 vehicles per 1,000 person, which is approximately 50 % higher than the average national level. The Petaling District shows the highest ownership in the area followed by the City of Kuala Lumpur.

2.5 Land Use

Figure 2.5.1 shows the present land use of KL. The land use shows another aspect in explaining the traffic congestion problem of KL.

As shown in the figure, business and commercial functions, which are the red coloured areas, centre in the CPA, while most parts outside of the CPA is residential areas. There are a few business and commercial areas outside the CPA, but their scales are not so large.

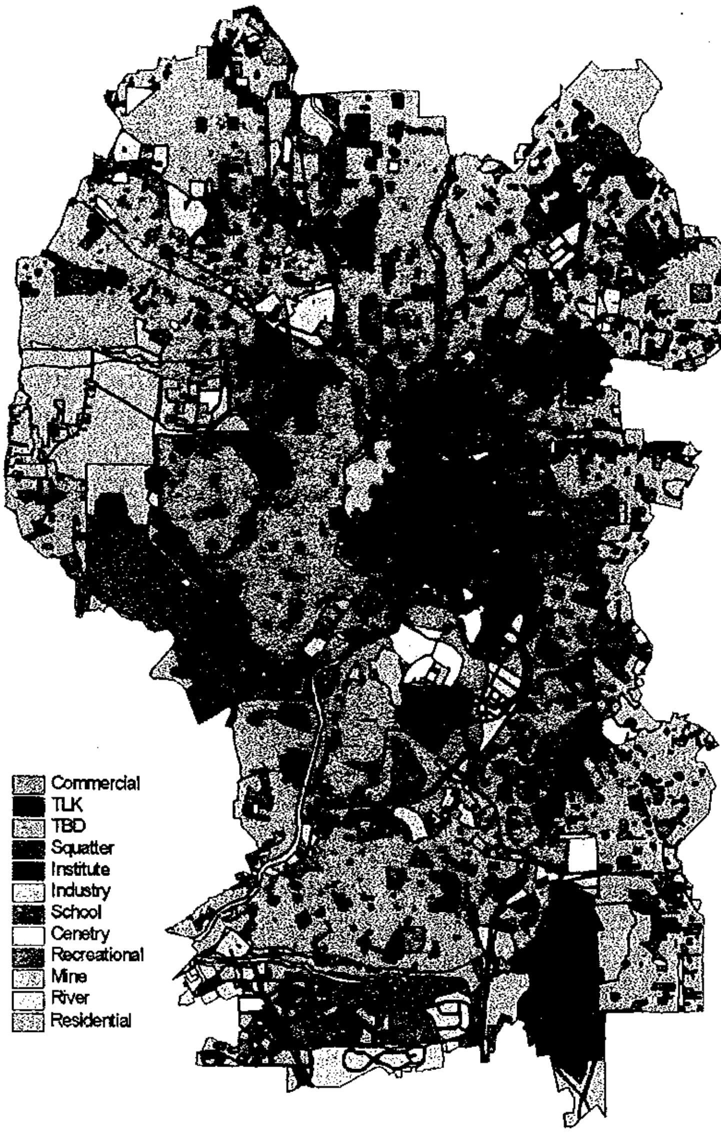


Figure 2.5.1 Present Land Use of KL

2.6 Identification of Kuala Lumpur Metropolitan Area

According to the Home Interview Survey, work places are concentrated in the CPA of Kuala Lumpur, Petaling Jaya, Shah Alam, and Klang. As shown in Figure 2.6.1, the CPA attracts many workers form the surrounding areas including Petaling Jaya, and its coverage is wider than other three centres. The CPA is the most significant urban centre in the region. Petaling Jaya also attracts workers from the surrounding areas, in particular, form the south of Petaling Jaya. Some commute to Petaling Jaya from Kuala Lumpur as well. Shah Alam and Klang are also urban centres attracting workers from the surrounding areas, these areas, however, are more independent compared to the other two centres, and they have relatively small influential areas.

The Klang Valley region has four urban centres at present. Among the four centres, the CPA and Petaling Jaya have mutual relations due to proximity of their locations. The Kuala Lumpur metropolitan area is defined as the area covering the Federal Territory of Kuala Lumpur and its conurbation area within 10 km from the boundary. The metropolitan area has two major urban centres, the CPA as the core urban centre and Petaling Jaya as a sub-centre.

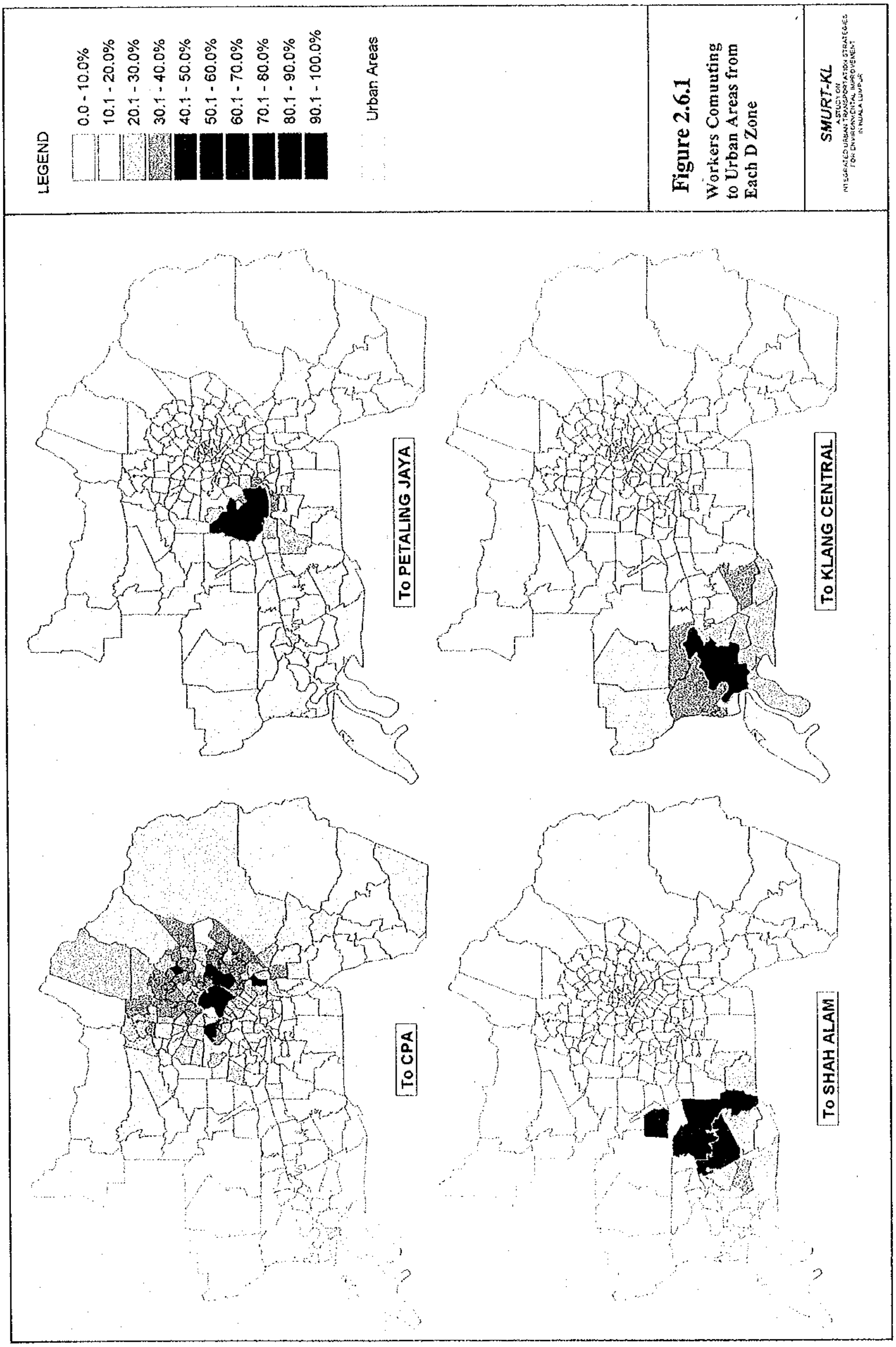


Figure 2.6.1
Workers Comuting to Urban Areas from Each D Zone

Chapter 3

Current Traffic Characteristics

Chapter 3 Current Traffic Characteristics

3.1 Road and Traffic System

3.1.1 Road Network

(1) Current Road Network Configuration

The Current road network configuration is simple, consisting of several radial roads connecting to other cities and regions, one major ring road made up of by Jln. Tun Razak, Jln. Damansara and Jln. Duta, and a minor ring road around CBD, Jln. Sultan Ismail and Jln. Imbi. In terms of radial roads, the following are the major inter-city arterial roads. The detailed hierarchy of road network will be discussed in a later section.

- Jln. Ipoh (for the north)
- Karak Highway (for the north)
- Jln. Ampang (for the east)
- Jln. Cheras (for the south-east)
- Kuala Lumpur Seremban Highway and Jln. Sungai Besi (for the south)
- Federal Highway and Shah Alam Highway (for the east)
- Jln. Kuching (for the north-west)

Some of the above are expressways or highways with full access control, while others are ordinary roads with partial access control. The ordinary roads, Jln. Cheras and Sungai Besi are under improvement by a BOT scheme at present and will be expected to open to the public in the near future as toll roads.

Many minor arterial roads are arranged to complement these major arterial roads to form a comprehensive present road network.

(2) Number of Lanes and Carriageway

Almost all of the highways and expressways, having the major arterial road function mentioned above, are dual carriageways with six lanes in total, and users are able to access existing roads through well constructed interchanges. They are constructed under the BOT scheme by the government except for the Federal highway, and a small toll is imposed for road maintenance purpose only at the east end of the Highway.

Meanwhile, the Ampang Elevated Highway is under construction as a divided four-lane road and buses and large vehicles are prohibited from using this road due to physical limitations.

A part of Jln. Sungai Besi, is opened to the public as a dual carriageway with six lanes in total. Jln. Cheras is expected to be open to the public with six lanes and its front roads will be constructed parallel to the main roads.

On the other hand, the Ampang Elevated Highway is under construction at present and the current function of Jln. Ampang will be replaced by this new highway in the near future. In addition, Jln. Cheras and Jln. Sungai Besi are also under road widening exercises at present by the BOT scheme, and they will be changed to toll roads after the completion of the improvements. This means that all of the major radial arterial roads will become toll roads in the future and users will have to pay tolls to use the roads.

Most of the minor arterial roads consist of four lanes, while some are dual single carriageways. Sidewalks are provided on most major parts of the minor arterial roads but their width is not enough to meet pedestrian demand.

(3) Network Hierarchy

1) Classification

In terms of road network hierarchy, there are several typical classifications of urban road network in this field but each city or urban area has different conditions depending on their historical land use pattern and road network configuration. The road network in the Study Area seems a little bit complicated from the view point of road hierarchy due to the variety of road classifications. The key point, however, is whether the classification fits the current and future road function or not.

Figure 3.1.1 shows one of the typical classifications by two indicators i.e., traffic volume and average trip length obtained by traffic assignment applied for some sample links of the road network.

A more simplified figure is shown in Figure 3.1.2 as the classification criteria. Considering the road network characteristics in KL, ideally the roads should ideally be divided into five categories as follows:

1 Highway/Expressway

2 Major arterial road

3 Arterial road

4 Minor arterial road

5 Local road

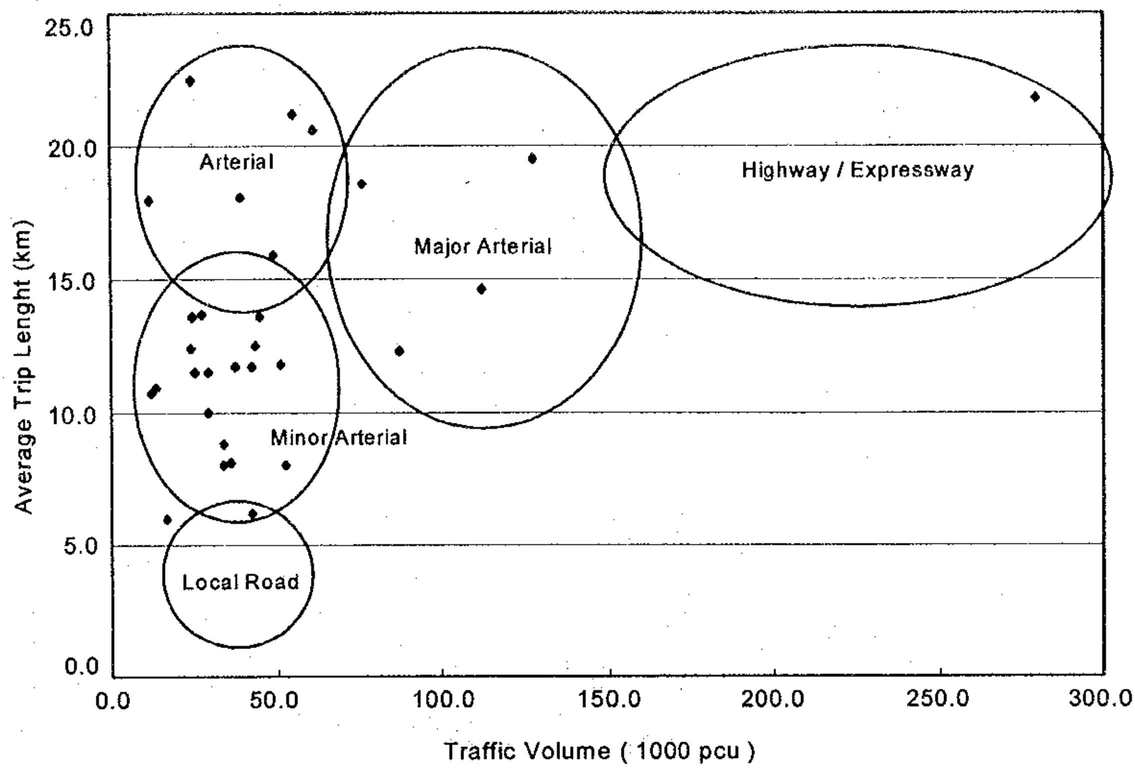


Figure 3.1.1 Classification of Road Functions

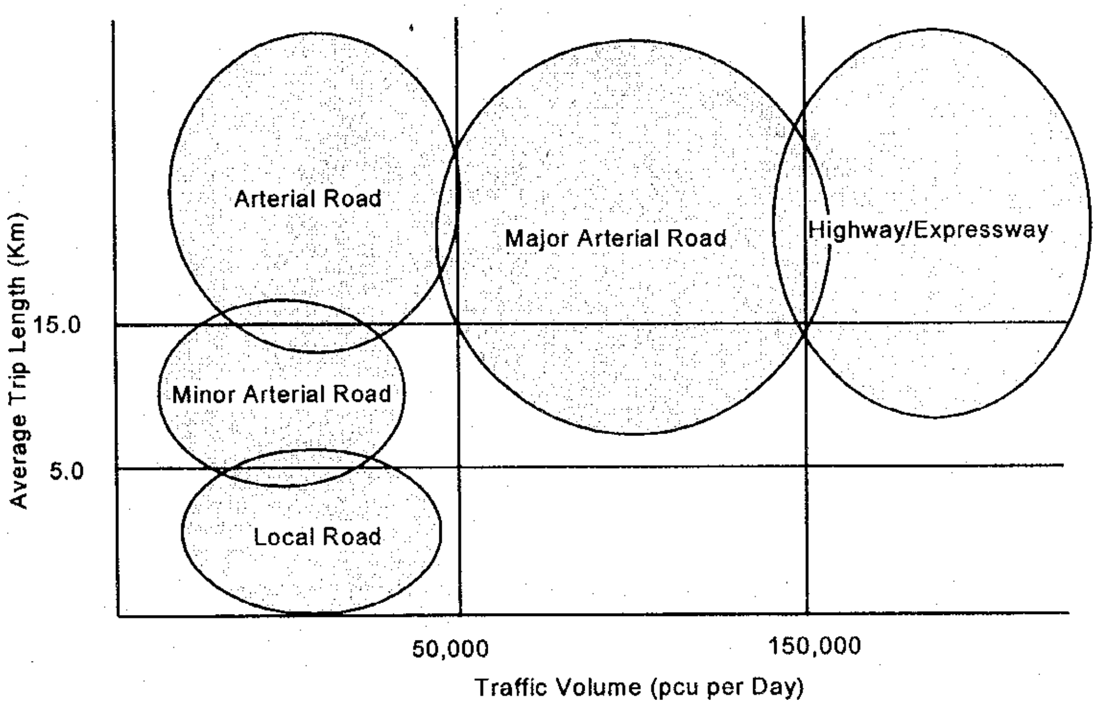


Figure 3.1.2 Criteria of Road Function

The road network hierarchy is decided not only by the traffic volume and average trip length but also by its physical conditions and other geometric factors including design speed. This classification is, however, used to decide road functions as the first stage and the road network is eventually classified by taking into consideration other factors mentioned above and continuity of the road sections as the second stage. Following these steps, Figure 3.1.3 shows the highway/expressway and major arterial roads, which are combined as a group, and arterial roads.

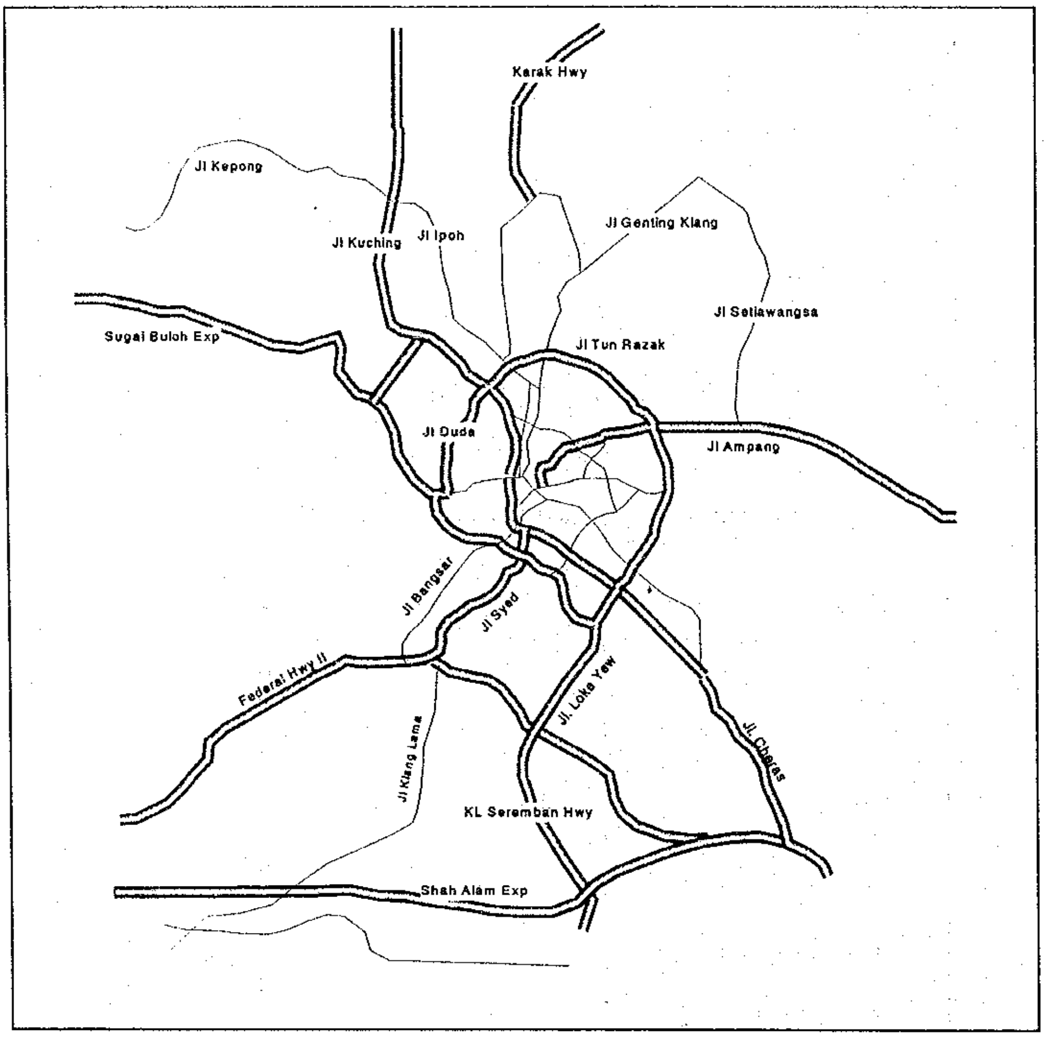


Figure 3.1.3 Hierarchy of Existing Road Network

3.1.2 Traffic Characteristics

(1) Traffic Volume

1) Traffic Volume in Kuala Lumpur Urban Area

Table 3.1.1 and Figure 3.1.4. depicts the two-way 24-hour traffic volumes on the major roads in the Kuala Lumpur urban area. This is based on the Pavement Management System project of DBKL and the JICA Study. The traffic volume is in the range of 10,400 and 223,400 passenger car unit (PCU). The highest volume of 223,400 was observed on the Federal Highway 2 (Lebuhraya Persekutuan), which runs from the east to the west of the city. Other large traffic volumes were observed on the arterial streets in the city as follows; Kuala Lumpur Seremban Highway, Lebuhraya Mahmeru, Jalan Syed Putra, Jalan Tun Razak, Jalan Istana, Jalan Kuching, Jalan Ipoh, Jalan Yew, Jalan Loke Yew, Jalan Duta Jalan Sungai Besi Jalan Cheras, Jalan Kinabalu, Jalan Bangsar, Jalan Bukit Bintang Jalan Sultan Ismail, and Jalan Kepong at 100,300 - 244,500 PCU/day two way.

Table 3.1.1 Traffic Volume on Major Roads (1997)

Unit: PCU per Day. 2 Way

Road	Range of Traffic Volume	Road	Range of Traffic Volume
Federal Highway 2 (Persekutuan)	223,400 - 78,300	Jalan Bangsar	115,400 - 114,700
KL-Seremban Highway	244,500 -	Jalan Bukit Bintang	105,800 - 26,500
Lebuhraya Mahmeru	205,200 -	Jalan Sultan Ismail	105,600 - 73,000
Jalan Damansara	206,400 - 95,100	Jalan Kepong	100,300 -
Jalan Syed Putra	164,200 -	Jalan Ampang	96,900 - 69,600
Jalan Tun Razak	189,700 - 132,700	Jalan Tuanku Abdul Rahman	94,600 - 45,600
Jalan Istana	140,900 -	Jalan Segambut	93,500 - 34,200
Jalan Kuching	136,800 - 100,300	Jalan Dang Wangi	71,800 - 69,500
Jalan Ipoh	136,800 - 52,400	Jalan Cheng Lock	65,200 -
Jalan Yew	136,300 - 132,700	Jalan Raja Chulan	63,400 - 55,900
Jalan Loke Yew	138,900 - 117,600	Jalan Tun Perak	62,900 -
Jalan Duta	123,000 - 102,600	Jalan Raja Lout	61,900 - 41,000
Jalan Sungai Besi	120,800 -	Jalan Gombak	58,800 -
Jalan Cheras	117,600 -	Jalan Pahang	46,700 - 46,300
Jalan Kinabalu	115,900 -	Jalan Pudu	45,600 -

Source: Pavement Management System. DBKL. August 1996.
SMURT-KL, JICA Study Team. Traffic Count on Screen Survey 1997.
Note : Growth rate 1.14 between 1996 and 1997 based on JICA traffic count survey.

2) Screen Line Traffic Volume

The 16 hour vehicle traffic volume on the Screen lines is shown in Table A 3.1.1. The two-way traffic volume at each point ranged between 217,100 and 19,800 PCU/16 hour. The total two-way traffic volume for screen line across Sungai Gombak and Sungai Klang was 1,287,500 PCU/16 hour, while the total screen line traffic volumes in the area bounded by Sungai Gombak, Sungai Klang, Sungai Kerayong and City boundary was 2,016,600 PCU/16 hour. High traffic volumes were recorded at the North-South Expressway (S-33), Jalan Damansara (S-14), Federal Highway 2 (S-16), Jalan Tun Razak (S-4), Jalan Cheras (S-29), Jalan Loke Yew (S-30) and Jalan Kinabalu (S-12).

3) Cordon Line Traffic Volume

The 16 hour and peak hour vehicle traffic volumes on the Cordon line is shown in Table A 3.1.2. The highest two-way volume of 64,000 PCU/16 hour was observed on the North-South Expressway (South) (C-8), the followed by the traffic volume on the Federal Road 5 (South) (C-12), Federal Road 1 (North) (C-4), North-South Expressway (North) (C-3) and State Road B 11 (C-10). The recorded volumes are at 35,800, 29,000, 21,000 and 20,200 respectively. Figure 3.1.5 shows the traffic volume passing the cordon line classified into seven (7) traffic corridors (North-western part, Western part, Northern part, Eastern part, Southern part, South-eastern part and South-western part). The south-bound traffic volume showed the highest figure, equivalent to 32.5% of the total cordon line traffic volume. The volume at the other parts were as follows: Northern part, 21.9%, South-western part, 14.8%, Eastern South-eastern part, 12.2%, Eastern part, 7.3%, North-western and Western part with 5.8 and 5.4% respectively.

4) Hourly Fluctuation

The hourly fluctuation of traffic volume on representative stations of the screen line survey in the Study Area is shown in Figure A 3.1.1. The fluctuation patterns were observed in the three peak periods; during 7:00-9:00 in the morning, 11:00-14:00 in the day, and 17:00-19:00 in the evening. Especially large fluctuations were seen in the midday hour due to changes in traffic congestion that occured during business hours.

Table 3.1.2 shows the peak ratio of hourly traffic to 16-hour traffic. The morning and evening peak rates on the major station of the screen line and the cordon line were as follows: the peak rate at the area outside the Middle Ring Road varies from 5.8 % to 9.6 % and average at 7.0 %, while the rate of the area inside the Middle Ring Road on the screen line varies from 5.0 to 8.7 %, and average at 6.8 %. The rate of evening peak hour ranges between 6.3-10.4%, with average of 8.2% for the area outside of the Middle Ring Road, and 5.0-11.6%, with average at 7.9% for the inside the MRR.

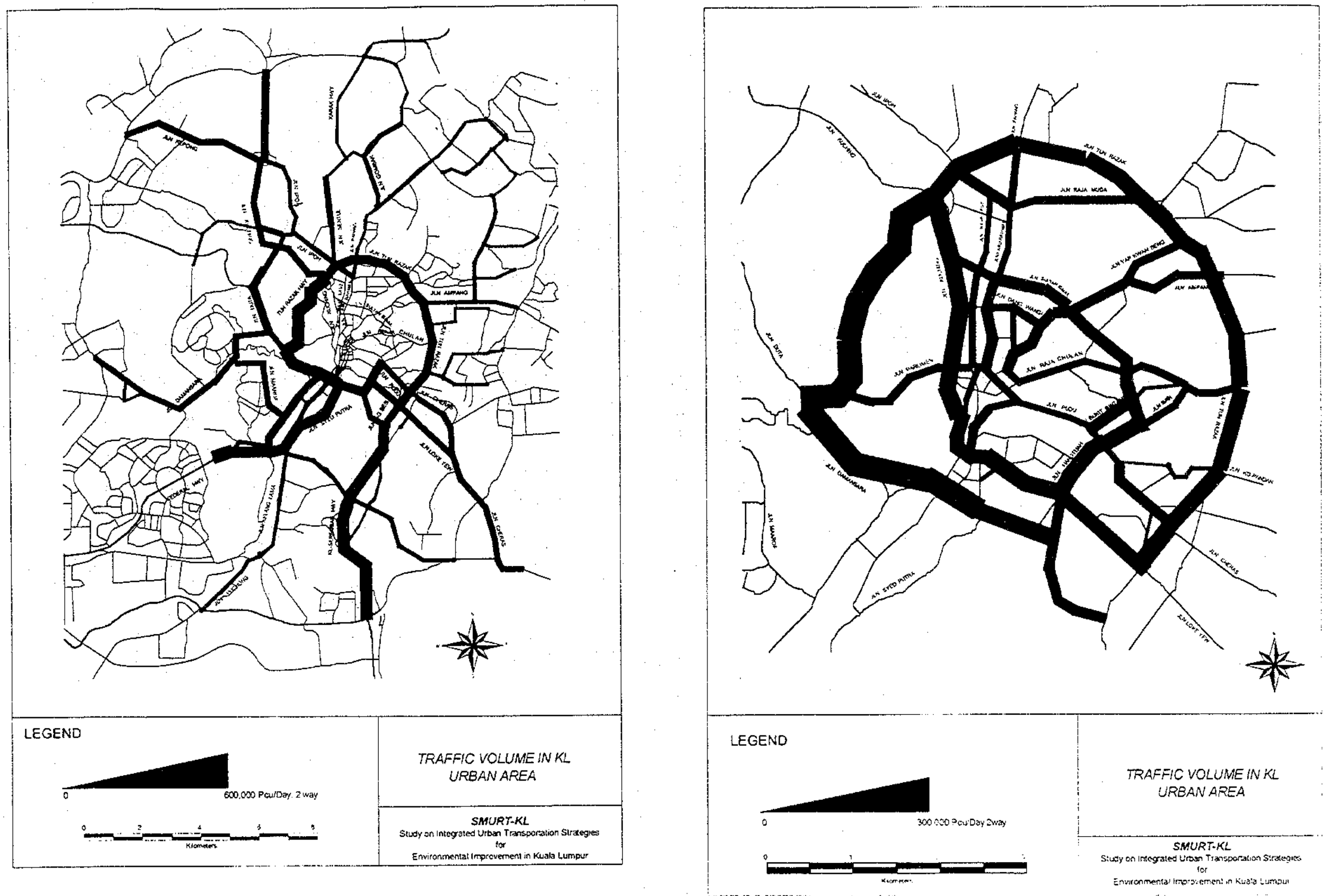


Figure 3.1.4 Traffic Volume in Kuala Lumpur Urban Area

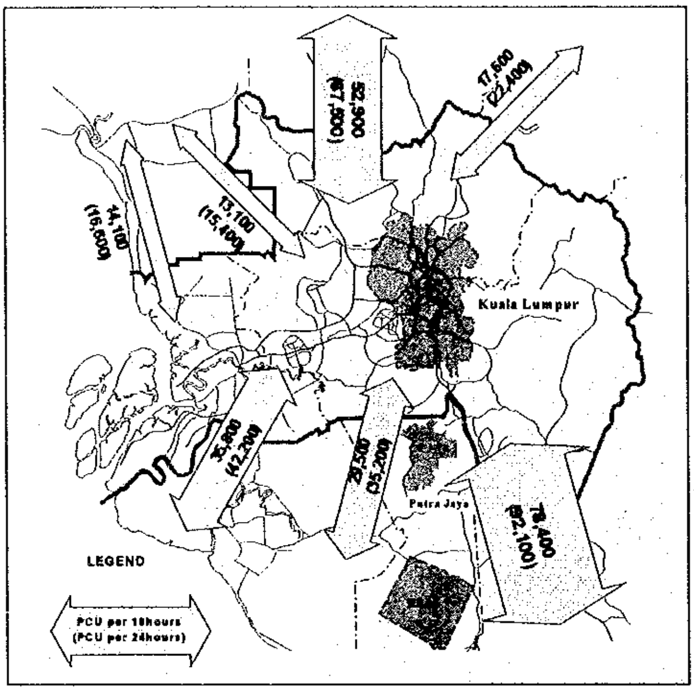


Figure 3.1.5 Traffic Volume on Cordon Line

Table 3.1.2 Peak Rate of Hourly Traffic to 16-Hour Traffic

Type	Area	Peak Rate			
		AM		PM	
		Range	Average	Range	Average
Screen Line	1. Outside Middle Ring Road	5.8-9.6	7.0	6.3-10.4	8.2
	2. Inside Middle Ring Road	5.0-8.7	6.8	5.0-11.6	7.9
Cordon Line	1. North Western Part	7.1	7.1	8.0	8.0
	2. Western Part	9.5	9.5	7.3	7.3
	3. Northern Part	6.4-8.7	7.5	7.4-9.7	8.4
	4. Eastern Part	8.6	8.6	8.3	8.3
	5. Southern Part	7.6-9.9	8.8	7.4-8.3	7.9
	6. South Eastern Part	7.6-9.3	8.5	7.8-9.6	8.7
	7. South Western Part	8.1	8.1	7.5	7.5

Source : SMURT-KL, Screen Line Survey and Cordon Line Survey, 1997

The ratio of 16 hour traffic volume to 24 hour volume on the screen line and the cordon line are shown in Table 3.1.3. The ratios on the screen line varied from 1.09 to 1.20, and 1.13 on average, while the ratios on the cordon line were observed in the ranged between 1.09 and 1.28, and 1.19 on average.

Table 3.1.3 Ratios of 16 Hour Traffic Volume to 24 Hour Volume

Type	No.	Station	Ratio of 24 Hour/16Hour Traffic Volume
On Screen Line	4	Jalan Tun Razak	1.125
	9	Jalan Raja	1.097
	15	Jalan Tun Sambantan	1.085
	25	Jalan Ampang	1.196
Total			1.126
On Cordon Line	1	Federal Road 5(North)	1.178
	3	North-South Expressway(North	1.275
	7	Federal Road 1(South)	1.092
Total			1.194

Source: SMURT-KL, JICA Study, 1997.

5) Vehicular Type Composition

The vehicular type composition on the screen and cordon lines is shown in Figure A3.1.2 and Figure A3.1.3. The characteristics of the vehicular type composition on the screen and cordon lines are shown below.

a. Screen Line

The share of each vehicular type on the screen line during the 16-hour period were as follows: motorcycle, 8.8-47.1%, cars, 44.6-74.6%, taxis, 1.9-12.8%, buses, 0.5-11.9% and lorries, 1.1-21.6%. At the screen line stations of Jalan Damansara (S-14) and North-South Expressway (S-33), cars showed a high share of 74.6% and 69.7% respectively. Motorcycles had a high share at the stations at Jalan Tun Sambanthan (S-15), 47.1%, Jalan Sultan Sulaiman (S-13), 39.2% and Jalan 37/56 (S-23), 38.6%. The share of lorries on the Karak Highway (S-1) was as high as 21.6%.

b. Cordon Line

Of the total volume on the cordon line, the share of cars in the Southern part was high at 62.8%. The South-eastern and Western parts each had a high share of lorries at 26.5%, while the share of motorcycles in the Western and the South-eastern parts were about 22%, which was higher than that of other parts of the Study Area.

(2) Travel Speed

Information on the travel time of cars running on major roads and highways of the Study Area was obtained by the travel time survey. This survey was carried out along twenty (20) major roads. The surveyors recorded the elapsing time at the major intersections, the stopping time as well as the reasons of congestion (9 items). Three round trips of each survey route were made, and the information was recorded during the morning, midday, and evening peak hours. The check points were generally set at the centre of the major intersections. The reasons for the stops are shown as below:

- Waiting for the traffic light to change

- Traffic accident
- Crossing of pedestrians
- Congestion by buses near bus stop
- Traffic congestion caused by traffic spill-back from upstream
- Merging from side roads without a signal light
- Diverging to side roads without a signal light
- Affected by the cars turning to left/right
- Others (Parking on street, Poor pavement maintenance, Construction work, etc.)

1) Status of Travel Speed

a. General Characteristics of Vehicular Travel Speed by Periods

Figure 3.1.6, Figure A 3.1.4, and Figure A 3.1.5 show the current vehicular travel speed by sections on the major roads during the morning peak hours, the midday hours, and the evening peak hours. This figure shows the distribution of average travel speeds that was classified by speed rank. The general characteristics of vehicular travel speed by periods are described below.

i. Morning Peak Hour

Segments with a travel speed of 10 km/h or less, indicating heavy congestion, were concentrated on the major radial roads in the city centre bordered by Jalan Tun Razak, Jalan Ipoh, Jalan Duta, Jalan Damansara, and Jalan Loke Yew. These heavily congested roads are:

- Jalan Tun Razak (Section Jalan U Thant- Jalan Pahang),
- Jalan Sultan Ismail (Section Loke Yew - Ampang, Raja Lout - Kuching),
- Jalan Ampang (Section Dang Wangi - Hulu Klang),
- Jalan Tuanku Abdul Rahman (Section Ipoh - Tun Perak),
- Jalan Pahang (Section Toll gate - Ipoh),
- Jalan Raja Lout (Section Ipoh - Sultan Ismail),
- Jalan Kuching (Section Tun Razak - Sultan Ismail)
- Jalan Tun Perak (Section Tuanku Abdul Rahman - Raja Chulan),
- Jalan Pudu (Section Bukit Bintang - Tun Razak),
- Jalan Sungai Besi (Section Pudu - Lapangan Terbang),
- Jalan Cheng Lock (Section Pudu - Nirwana),
- Jalan Nirwana (Section Cheng Lock - Kinabalu),
- Jalan Syed Putra (Section Damansara - Kinabalu),
- Jalan Parlimen (Section Kuching - Mahameru), and
- Jalan Duta (Section Mahameru - Pesiaran. Kuching - Ipoh).

In the morning peak hour, the reversible lanes on Jalan Loke Yew has shown the effectiveness of the change in lane direction according to the traffic demand.

Congested road segments with the same travel speed as those above were seen in separate areas such as Jalan Pahang, Jalan Syed Putra and Jalan Maarof. The traffic congestion in the business/commercial area surrounded by Jalan Tun Razak, Jalan Loke Yew and Jalan Duta was therefore affected. Overall, the area with a low travel speed of below 20 km/h covered approximately 37.9 sq.-km.

ii. Midday Hour

In the area surrounded by Jalan Tun Razak, Jalan Loke Yew, Jalan Kinabalu and Jalan Kuching which has a travel speed of 10 km/h or below, traffic for business purposes is concentrated in the city's business and commercial centre. The highly congested segments are as follows:

- Jalan Tun Razak (Section Pahang - Raja Muda Abdullah Aziz),
- Jalan Sultan Ismail (Section Kuching - Raja Lout, Raja Aboudlah - Ampang, Bukit Bintang - Loke Yew),
- Jalan Ampang (Section Tun Razak - Dang Wangi),
- Jalan Pahang (Section Tun Razak - Ipoh),
- Jalan Raja Lout (Section Ipoh - Dang Wangi, Tun Perak - Kinabalu),
- Jalan Cheng Lock (Section Pudu - Nirwana),
- Jalan Nirwana (Section Cheng Lock - Kinabalu),
- Jalan Tun Perak (Section Tuank Abdul Rahman - Cheng Lock),
- Jalan Pudu (Section Bukit Bintang - Tun Razak), and
- Jalan Raja Chulan (Section Bukit Bintang - Tun Razak).

In addition, low travel speeds were observed in the vicinity of the intersections Jalan Persekutuan - Jalan Pantai Baharu, Jalan Ampang - Jalan Setiawangsa, and Jalan Ulu Kelang. The area with a low travel speed of under 20 km/h covered approximately 16.7 sq.-km.

iii. Evening Peak Hour

The segments with low travel speeds in the evening peak hours were almost the same as those in the morning peak hours. However the congested area with travel speeds of below 10 km/hour, concentrated more on the inside of the Middle Ring Road than in the morning.

Thus, the highly congested segments were located mostly on the major roads in the areas surrounded by Jalan Tun Razak, Jalan Kuching and Jalan Loke Yew. The area with a travel speed of below 20 km/hour covered approximately 24.3 sq. km.

iv. Comparison of Travel Speed in the Past Decade

Table 3.1.4 shows the comparison of average travel speeds between 1986 and 1997. The changes in travel speeds are shown in Figure 3.1.8 by period and by direction. The travel speeds in 1986 were obtained from the Klang Valley Transportation Study, JICA 1987.

As seen in Table 3.1.4, the average travel speeds have decreased significantly on the Inner Ring Road (Route No.1), the Middle Ring Road (Route No.2), Jalan Ampang (Route No.7), Jalan Cheras-Jalan Pudu (Route No.8), Seremban Highway (Route No.9), Federal Highway 2 (Route No.10) and Jalan Pantai (Route No.11). The deterioration rates of travel speeds in the peak hours are as follows: Inner Ring Road, 18-67 %, Middle Ring Road, 28-65 %, Jalan Ampang, 22-47 %, Jalan Cheras-Jalan Pudu, 6-51 %, Seremban Highway, 2-48 %, Federal Highway 2, 13-46 %, and Jalan Pantai, 37-52 %.

In particular the major roads in the eastern and southern parts show a serious deterioration, in travel speeds. In contrast, the travel speeds on Jalan Ipoh-Jalan Kuching (Route No.3) and Karak Highway - Jalan Sentul (Route No.5) increased compared with those in 1986 due to the construction of highways.

Figure 3.1.6

AVERAGE VEHECULAR TRAVELS SPEED

(MORNING PEAK HOUR)

LEGEND

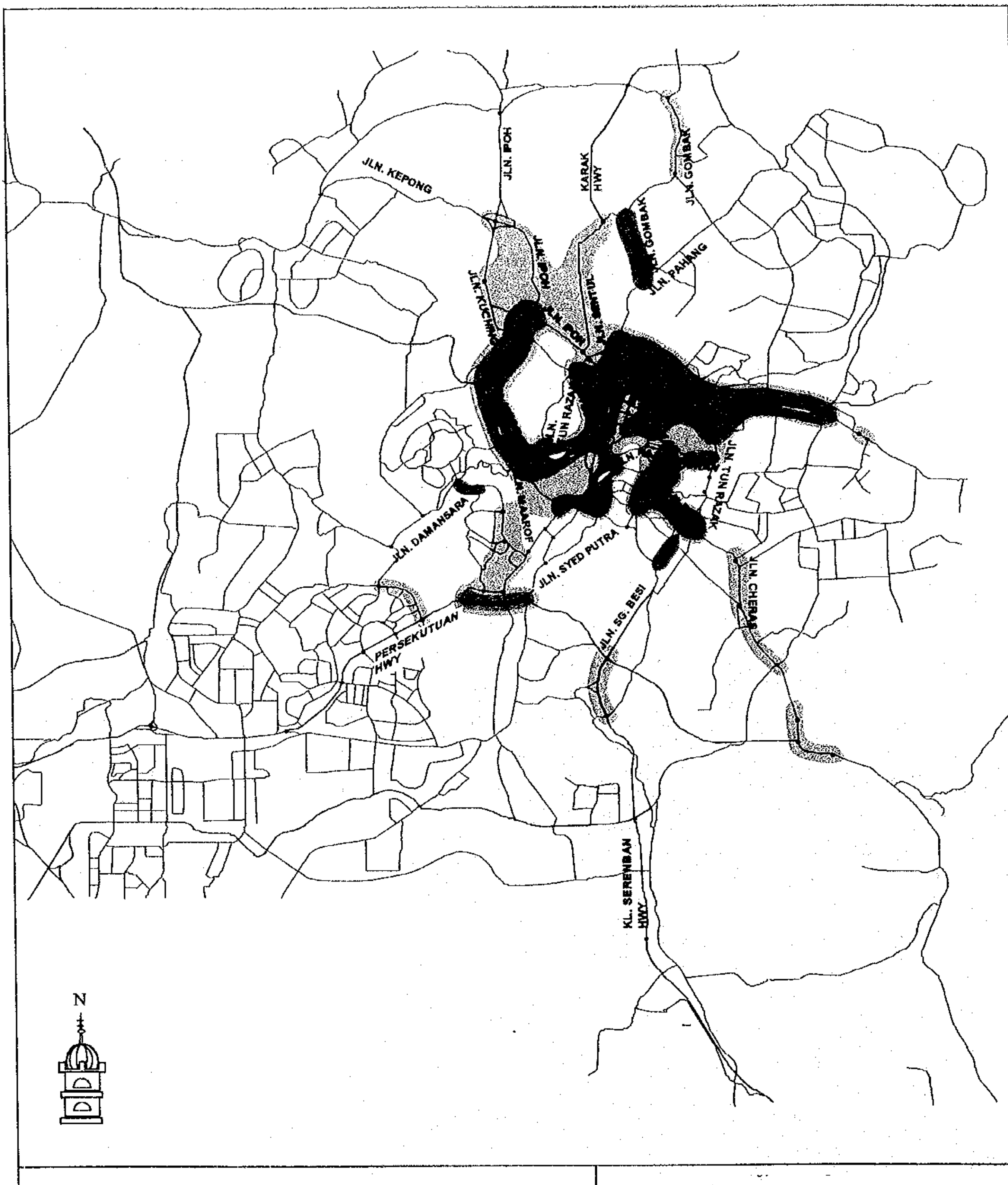
- Under 10 km/h
- 10-20 km/h
- 20-30 km/h
- 30-40 km/h
- 40-50 km/h
- Above 50 km/h

2 0 2 4

KILOMETERS

SMURT-KL

Study on Integrated Urban Transportation Strategies for Environmental Improvement in Kuala Lumpur



LEGEND

Under 10 km/h

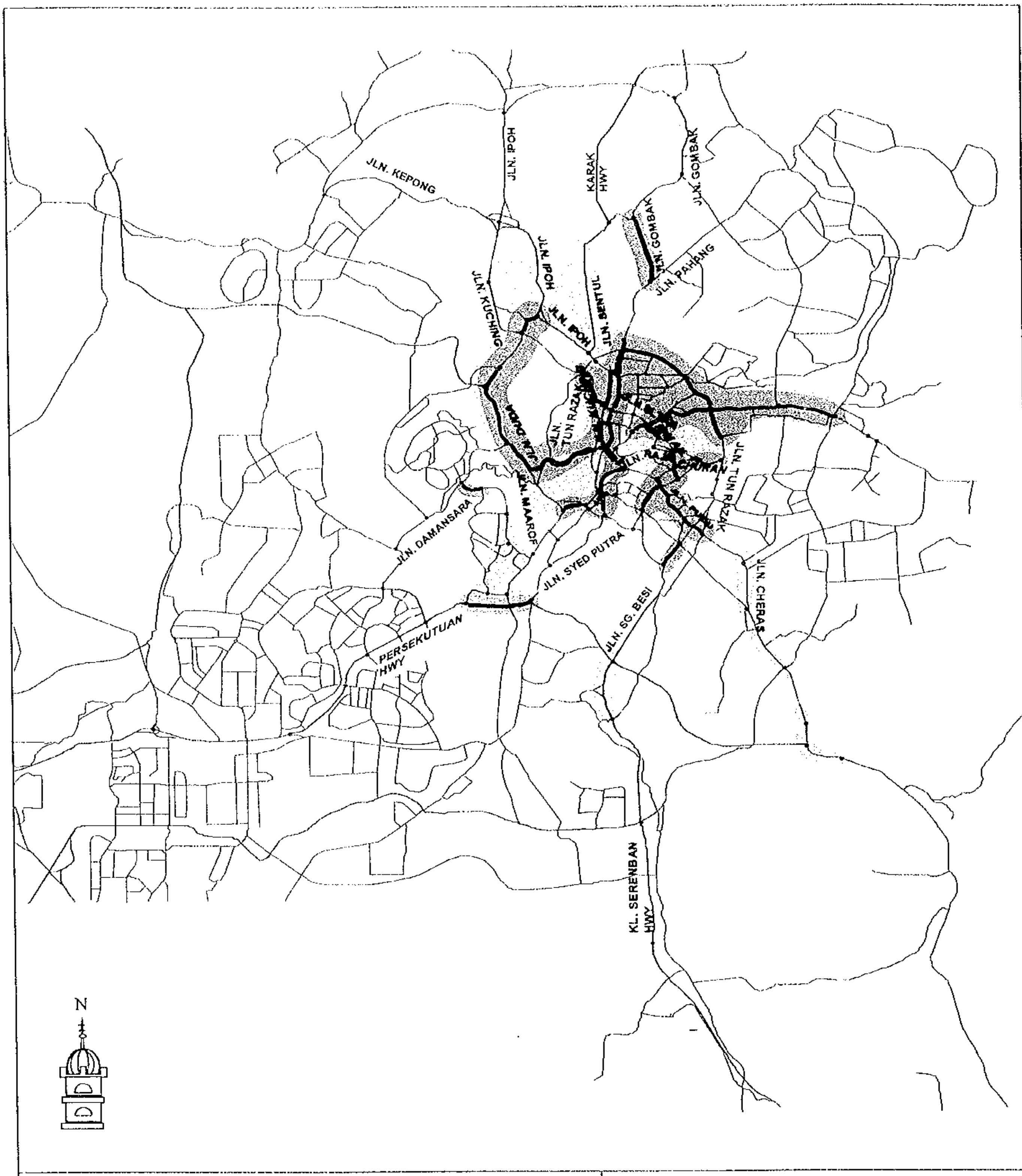
10-20 km/h

2 0 2 4

KILOMETERS

Figure 3.1.7
Area with Low Travel Speed
(Morning Peak Hour)

SMURT-KL
INTEGRATED URBAN TRANSPORT STRATEGIES
FOR
ENVIRONMENTAL IMPROVEMENT
IN
KUALA LUMPUR
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



LEGEND

Under 10 km/h

10-20 km/h

2 0 2 4

KILOMETERS

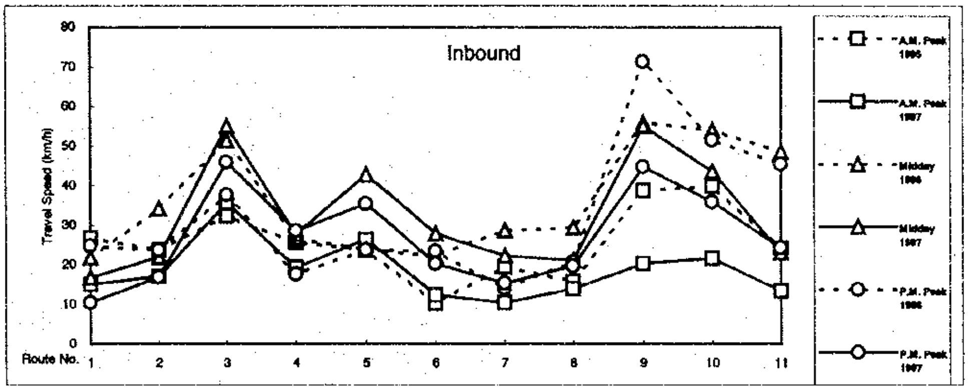
Figure 3.1.7
Area with Low Travel Speed
(Morning Peak Hour)

SMURT-KL
INTEGRATED URBAN TRANSPORT STRATEGIES
FOR
ENVIRONMENTAL IMPROVEMENT
IN
KUALA LUMPUR
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Table 3.1.4 Comparison of Average Route Travel Speed Past Decade

No.	Route	Average Route Travel Speed (km/h)											
		Inbound						Outbound					
		A.M. Peak		Midday		P.M. Peak		A.M. Peak		Midday		P.M. Peak	
		1986	1997	1986	1997	1986	1997	1986	1997	1986	1997	1986	1997
1	Inner Rig Road	26.7	15.0	21.8	16.8	24.8	10.4	21.2	17.3	20.1	13.0	15.7	5.3
2	Middle Ring Road	23.6	17.1	34.1	21.9	23.6	16.9	33.4	13.6	37.5	38.4	45.2	16.1
3	Jln Ipoh, Jln Kuching	32.3	35.6	51.4	55.0	37.7	45.9	25.5	67.3	20.4	62.2	69.9	41.4
4	Jln Kepong, Jln Ipoh	25.6	19.3	26.7	27.7	17.6	28.5	17.2	28.2	34.0	25.6	32.0	18.1
5	Karak Highway, Jln Sentul	23.7	26.4	23.7	42.7	23.7	35.4	37.0	45.0	33.9	52.8	18.2	39.2
6	Jln Gombak, Jln Pahang	10.3	12.4	22.3	27.9	23.4	20.2	36.6	27.0	32.7	35.5	14.5	21.0
7	Jln Ampang	19.5	10.4	28.6	22.2	14.0	15.3	24.9	19.5	26.3	18.1	15.1	10.6
8	Jln Cheras, Jln Pudu	15.8	14.0	29.4	21.2	20.8	19.7	34.8	22.8	35.5	25.5	36.9	18.0
9	Seremban Highway	38.8	20.3	55.9	55.0	71.3	44.8	68.7	60.6	64.8	58.8	18.8	58.8
10	Federal Highway II	39.9	21.7	54.0	43.6	51.5	35.9	45.7	26.9	54.3	47.1	36.2	37.4
11	Jln Pantai	24.3	13.4	48.5	23.1	45.5	24.3	32.7	19.6	34.8	20.9	26.2	16.4

Source: Klang Valley Transportation. JICA Study 1986. SMURT-KL. JICA Study 1987.



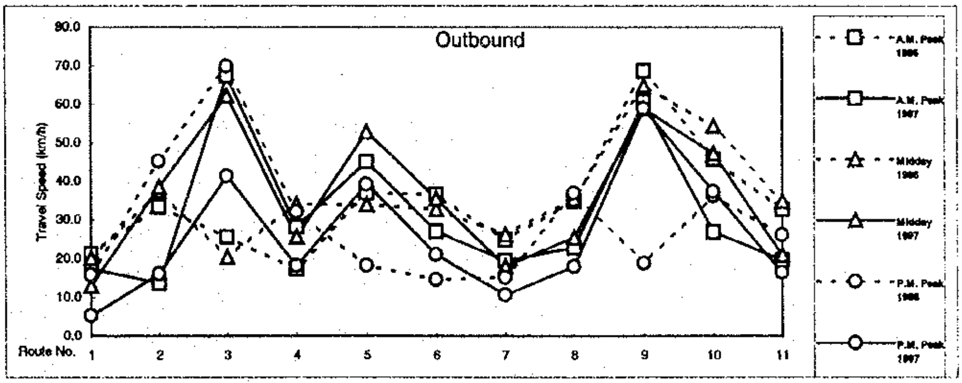


Figure 3.1.8 Comparison of Average Travel Speed in the Past Decade

v. Characteristics of Vehicular Travel Speed By Routes

A sample of the travel time and distance diagram for various routes are shown in Figure A 3.1.6 (1), (2), (3). This figure shows the running time and the stopping time in relation to the distance.

(Inner Ring Road - Route No.1)

Segments with a low travel speed in the peak hours were at Jalan Raja Laut , Jalan Ampang, Jalan Ramlee, Jalan Bukit Bintang, Jalan Imbi and Jalan Pudu. The average travel speeds on these segments were between 1.4 km/h and 10.0 km/h.

The travel speeds in the counter-clockwise direction were low compared to that in the clockwise direction due to severe congestion, especially in the 2.7 km section between Jalan T.A. Rahman and Jalan Imbi where the travel speed in the evening peak hours was as low as 1.3 km/hour.

In the peak hours, drastic changes in travel time in the congested segments were not observed. A chronic traffic congestion caused by mixed purpose traffic was observed between Jalan, Sultan and Jalan Loke Yew.

The main cause for the congested segments with a travel speed of below 10 km/hour during the peak hours were the bottle necks and narrowing of roads caused by construction works. As a result, the traffic was over-saturated due to a spill-back effect.

(Middle Ring Road -Route No.2)

Segments with a low travel speed in the peak hours were on Jalan Raja Muda, Jalan Ampang and Jalan U Thant, and especially the Jalan Ampang intersection, which is a key bottleneck causing heavy chronic traffic congestion. The average travel speeds on these segments were between 4.5 km/h and 9.9 km/h. The low travel speed was also observed on Jalan Ipoh, Jalan Bukit Bintang in the morning and evening peak hours.

(The traffic congestion of clockwise and counter-clockwise direction are more or less the same except during off-peak hours).

In the morning peak hours, the travel speeds in the clockwise direction changed by the hour band. Serious traffic congestion was mitigated within two hours. In the evening peak hours, the travel time in the counter-clockwise direction continued to increase for more than 2 hours. The serious traffic congestion was caused by substantial trips “going to home” and “other private purposes”.

The main cause for the congested segments with a travel speed of below 10 km/hour during the peak hours were the bottle necks and narrowing of roads caused by construction works. As a result, the traffic was over-saturated due to a spill-back effect.

In addition, the traffic to and from local streets between Jalan Pahang and Jalan Ampang disturbed the main traffic flows.

(Jalan Kuching and Jalan Ipoh -Route No.3)

Serious traffic congestion with a travel speed below 10 km/hour was not seen during the peak hour. In the evening peak hours, travel speeds of below 20 km/h were seen between Jalan Sultan Ismail and Jalan Parlimen in the inbound direction.

The main causes for the congested segments mentioned above were due to the waiting for traffic lights, the spill-back from upstream, and the friction to and from the local streets.

b. Main Causes for Traffic Congestion on Major Roads

The travel time of each segment, the frequency of stops and their causes were recorded in the travel time survey to find out what causes traffic congestion on major roads. The major causes of traffic congestion were classified into the 7 types shown below.

- Waiting for traffic light change
- Congestion of buses near bus stops
- Traffic spill-back due to bottlenecks
- Traffic merging from side roads without a traffic light
- Influence of cars turning to the left
- Road narrowing due to construction.
- Interchange/Roundabout without a traffic light

Figure 3.1.9 shows the main causes for traffic congestion on the major roads. The main causes for the congested segments with a travel speed of below 20 km/h during the peak hours are shown below.

On the major roads surrounded by Jalan Tun Razak, Jalan Kuching and Jalan Loke Yew, serious traffic congestion was caused by over-saturated congestion with spill-back due to bottlenecks, the wait for traffic signal lights to change, congestion of buses near bus stops and road narrowing of roads due to construction works. Countermeasures to achieve a smooth traffic flow and mitigate traffic congestion at the bottlenecks are required.

i. Waiting for traffic light change

The congested segments, caused by the wait for traffic lights to change, were seen at the main intersections of the major roads. The intersections were on Jalan Tun Razak, Jalan Sultan Ismail, Jalan Pudu, Jalan Raja Laut, Jalan Tuank Abdul Rahman, Jalan Ampang, Jalan Tun Perak, Jalan Raja Chulan, Jalan Tun Sambanthan, Jalan Bangsar and Jalan Maarof. The actual causes for the long wait at signalised intersections might be the long cycle of a multi-phasing traffic signal. Manual control by police, however, helping to avoid the traffic spill-back problem.

LEGEND

- Waiting for traffic light to change
- Congestion of buses near the bus stop
- Spill back condition
- Merging/diverging to/from minor roads
- Influence of the cars turning to right/left
- Under construction
- Interchanger/roundabout without traffic light

0 1 2 3 4 5 6
Kilometers

Figure 3.1.9
Main Causes for Traffic Congestion with Low Speed

SMURT-KL
Study on Integrated Urban Transportation Strategies for Environmental Improvement in Kuala Lumpur

ii. Congestion of buses near bus stops

The congested segments, caused by buses near bus stops, were seen on some major roads. Buses, especially the pink mini-buses, occupy 2 lanes to load and unload passengers. This practice is commonly seen on the minor arterial roads such as Jalan Ampang, Jalan Pudu, Jalan Sultan Ismail, Jalan Raja Laut and Jalan Pantai Baharu.

iii. Traffic spill-back due to bottlenecks

The bottlenecks causing over-saturated congestion with traffic spill-back were seen on many intersections of Jalan Tun Razak, Jalan Sultan Ismail, Jalan Ampang, Jalan Pahang, Jalan Kuching, Jalan Raja Laut, Jalan Tuanku Abdul Rahman, Jalan Raja Chulan, Jalan Pudu, Jalan Tun Perak, Jalan Sentul Jalan Ipoh, Jalan Parlimen, Jalan Damansara, Jalan Bangsar, Jalan Tun Sambanthan and Jalan Maarof.

iv. Friction from local streets without a traffic light

The traffic to and from local streets without traffic lights disturbs the main traffic flow at the section between Jalan Ipoh and Jalan Ampang on Jalan Tun Razak.

v. Influence of cars turning to the left

The influence of cars turning to the left is seen on the 4-lane roads in the business/commercial area. A typical road is Jalan Ampang, and the affected sections are; Jalan Setiawangsa - Jalan Ulu Kelang, Jalan Dang Wangi - Jalan Yap Kwan Seng.

vi. Reduction of road width by construction works

The congested segments caused by the narrow road due to construction works, were seen on many major roads. The locations which suffered from a reduced road capacity were the section between Jalan Raja Muda Abdul Aziz and Jalan U Thant on Jalan Tun Razak, the sections between Jalan Ampang and Jalan Raja Abdullah, Jalan Hang Tuah and Jalan Raja Chulan on Jalan Sultan Ismail, and the section between Jalan Maarof and Jalan Pantai Baharu on Jalan Bangsar.

vii. Interchange/roundabout without traffic light

The congested segments caused by interchanges/roundabouts without a traffic light, were also seen on the major roads. The seriously congested locations, due to the insufficient capacity of roundabouts, were Jalan Pudu - Jalan Cheng lock, Jalan Pudu - Jalan Tun Razak, Jalan Loke Yew - Jalan Cheras, Jalan Stn Hishamuddin - Jalan Perdana. On the other hand, seriously congested locations due to the insufficient capacity of the junctions were Jalan Cheras - Jalan Persekutuan, Jalan Cheras - Jalan Loke Yew, Jalan Loke Yew - Jalan Sungai Besi, Jalan Sungai Besi - Lapangan Terbang, Jalan Damansara - Jalan Stn Hishamddin, Jalan Damansara - Jalan Travers, Mahameru - Jalan Kuching, Jalan Duta - Sri Hartamas and Jalan Duta/Semantan.

c. The changes of travel time by time on the congested segments

Figure 3.1.10 (1) (2) shows the time duration that was taken to mitigate serious congestion. This figure was drawn based on the changes in travel time on congested segments with a low speed (travel time and distance diagram). The time duration was classified into three categories; (1) within one hour, (2) between one and two hours, and (3) over 2 hours. The information obtained is useful in determining the operation hours for traffic control measures; i.e., whether it should be employed for a limited number of hours or for 24 hours. The status of such time duration is shown below;

i. Morning peak hour

The main ring roads show that it takes more than two hours to mitigate a serious congestion, excluding the clockwise direction of Jalan Tun Razak between Jalan Ipoh and Jalan Raja Chulan.

The congested segment between Jalan Ipoh and Karak on Jalan Kampung was observed to be less than one hour.

For the inbound direction, the morning peak hours on most major radial roads were between one and two hours, such as on Jalan Ampang, Jalan Ipoh, Jalan Raja Chulan, Jalan Pudu, Jalan Sungai Besi - North South Expressway, Jalan Syed Putra and Jalan Tun Sambanthan.

The morning peak duration, along Jalan Raja Lout and Jalan Tuanku Abdul Rahman, however, was more than two hours.

ii. Evening peak hour

The outbound directions on the two ring roads and the major radial roads took more than two hours to mitigate a serious congestion.

The evening peak duration for the inbound directions of Jalan Ampang between Jalan Dang Wangi and Jalan Setiawangsa, and Jalan Tuanku Abdul Rahman, however, was observed to be less than two hours.

d. Comparison of Bus Travel Speed and Car Travel Speed

Table A 3.1.3 shows the comparison between bus travel speeds and car travel speeds on the surveyed routes. The routes were classified by the provision of a bus exclusive lane. The average bus travel speeds on most routes were lower than the average car travel speeds, but the bus speeds varied from route to route and on the hour of day. The differences between cars and buses can be attributed to the loading and unloading time of passengers. The average bus travel speed was observed to be in the range of 4.0 and 15 km per hour.

(3) Traffic Accident

1) Number of Accident

Table 3.1.5 shows the number of road accidents that occurred in Kuala Lumpur and Selangor during the past 10 years (1987-1996). Figure 3.1.11 shows the number of accidents in Kuala Lumpur and Selangor during the past 10 years. Figure 3.1.12 shows the number of accidents and deaths per 10,000 registered vehicles in Kuala Lumpur during the past 9 years (1988-1996). As shown in Table 3.1.5, the number of accidents both in KL and Selangor declined up to 1989, but it has however increased gradually since then, especially in recent years. Although the number of accidents in Kuala Lumpur increased by about 1.4 times during the past decade, the number of accidents and deaths per 10,000 registered vehicles declined by approximately 50 percent over the same period, indicating the effectiveness of traffic safety measures.

LEGEND

Time Duration

- 0 - 1.0 hours
- 1.0- 2.0 hours
- over 2.0 hours

0 1 2 3 4 5 6
Kilometers

Figure 3.1.10 (1)
Time Duration to Improve Traffic Congestion

AM Peak Hours

SMURT-KL
Study on Integrated Urban Transportation Strategies for Environmental Improvement in Kuala Lumpur

LEGEND

Time Duration

0 - 1.0 hours

1.0- 2.0 hours

over 2.0 hours

0 1 2 3 4 5 6

Kilometers

Figure 3.1.10 (2)
Time Duration to Improve Traffic Congestion
PM Peak Hours

SMURT-KL
Study on Integrated Urban Transportation Strategies for Environmental Improvement in Kuala Lumpur

Table 3.1.5 General Traffic Accidents Data in Kuala Lumpur and Selangor (Year 1987-1996)

		Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number of Registered Vehicles		K L		395,402	443,802	514,322	596,705	668,967	739,878	848,749	1,293,558	1,502,890
		Selangor		824,047	864,014	919,491	980,951	1,039,948	1,087,429	1,281,100	955,356	1,036,624
		total		1,219,449	1,307,816	1,433,813	1,577,656	1,708,915	1,827,307	2,129,849	2,248,914	2,539,514
Vehicles Involve In Accidents		K L		35,334	37,535	43,829	46,424	47,260	50,198	51,391	51,389	59,021
		Ditricts		27,741	31,976	34,320	38,152	43,124	51,649	63,632	72,163	87,816
		total		63,075	69,511	78,149	84,576	90,384	101,847	115,023	123,552	146,837
Total Number of Accidents		K L	20,104	18,728	16,068	19,365	22,800	24,697	27,000	27,439	27,939	33,375
		Districts		11,140	10,477	14,173	16,574	23,772	33,051	36,955	41,737	48,049
		total		29,868	26,545	33,538	39,374	48,469	60,051	64,394	69,676	81,424
Casualties	Death	K L		203	210	249	265	298	287	350	323	396
		Districts		468	539	552	655	791	777	887	948	1,125
		total		671	749	801	920	1,089	1,064	1,237	1,271	1,521
	Injuries	K L		2,958	2,699	3,192	3,712	3,876	4,473	4,444	4,697	4,350
		Districts		3,257	4,351	3,614	4,268	4,441	5,645	7,490	7,946	8,523
		total		6,215	7,050	6,806	7,980	8,316	10,118	11,934	12,643	12,873

Source: Laporan Perangkaan Kemalangan Jalan Raya MALAYSIA 1995. POLIS DIRAJA MALAYSIA
Law Traffic Bukit Aman.
Districts: Klang, Gombak, Petaling and Hulu Langat

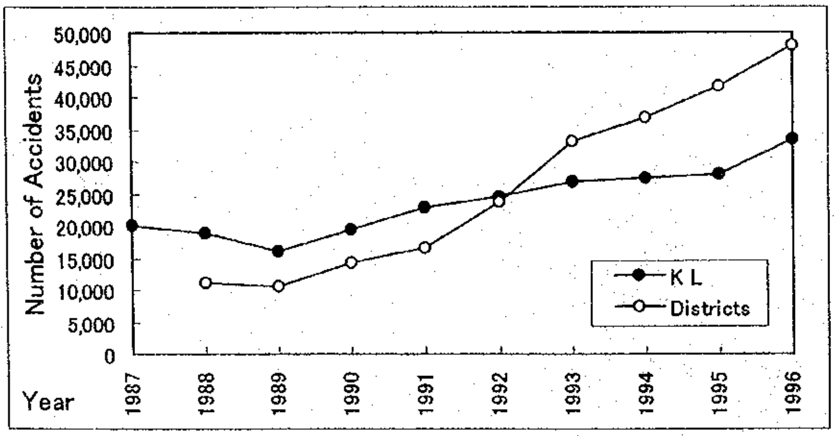


Figure 3.1.11 Accidents in Kuala Lumpur and Districts (1987-1986)

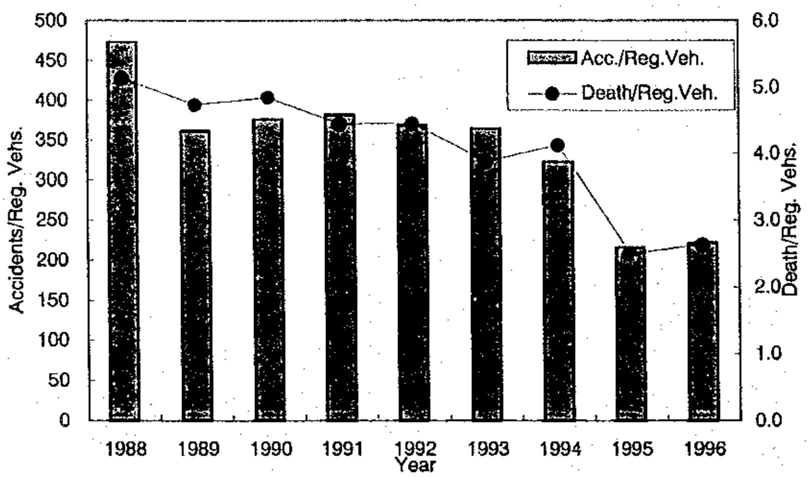


Figure 3.1.12 Number of Accidents and Death Per 10,000 Registered Vehicles in Kuala Lumpur (1988 -1996)

2) Accidents by Vehicle Type

Figure 3.1.13 shows the number of accidents involving fatal / serious accidents by vehicle type in Kuala Lumpur and the four Districts (Klang, Gombak, Petaling and Hulu Langat) in 1996.

In Kuala Lumpur, 52% of the total number of fatal/serious accidents caused by vehicles (including two-wheeled vehicles) were caused by motorcycles, 30% by private cars, 10% by lorries/vans, 3% by buses and 2% by taxies. In the four Districts, accidents related to motorcycles accounted for 46%, private cars 24%, lorries/vans 19%, buses 4% and taxies 1%. The high involvement of motorcycles in traffic accidents has resulted in a high accident rate for Kuala Lumpur.

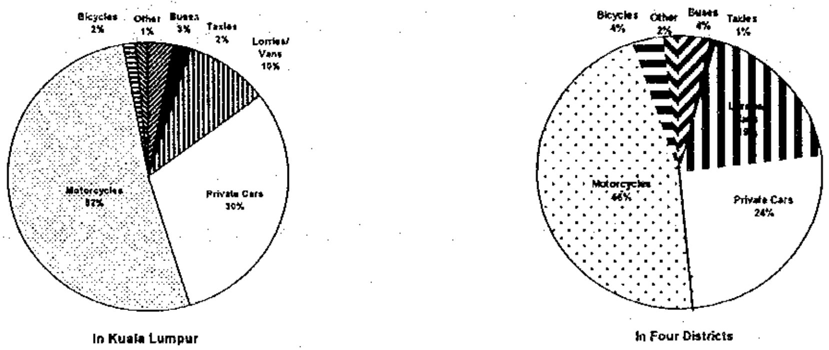


Figure 3.1.13 Number of Accidents by Type of Vehicles (Fatal/serious accidents)

3) Traffic Accident Types

Figure 3.1.14 shows the number of first collision accidents in Kuala Lumpur and the surrounding four Districts in 1996.

In Kuala Lumpur, 19% of the total number of fatal/serious accidents caused by vehicles (including two-wheeled vehicles) were by rear end collision, 18% by hitting pedestrians, 17% by angular collision, 14% from being out of control and 13% by side swipe. Such accidents in the four Districts showed angular collision to be 22%, head-on collision 17%, rear end collision 14%, being out of control 13%, and hitting pedestrians 12%.

The percentage of rear end collision and accidents involving pedestrians is high in Kuala Lumpur. The high rear end collision rate is seen in the urban area due to traffic congestion. Since drivers are frustrated by traffic congestion, in order to jump queue, they tend to make a sudden lane change without indicationg, and result in blocked intersections.

The pedestrian involved accidents are high due to their ignorance of the signal light when crossing the street. Good countermeasures to mitigate traffic congestion and educate the road users should be emphasized.

In contrast, a high number of angular collision and head-on collision are observed in the rural area. The need to install signal lights and safety traffic signs should be considered.

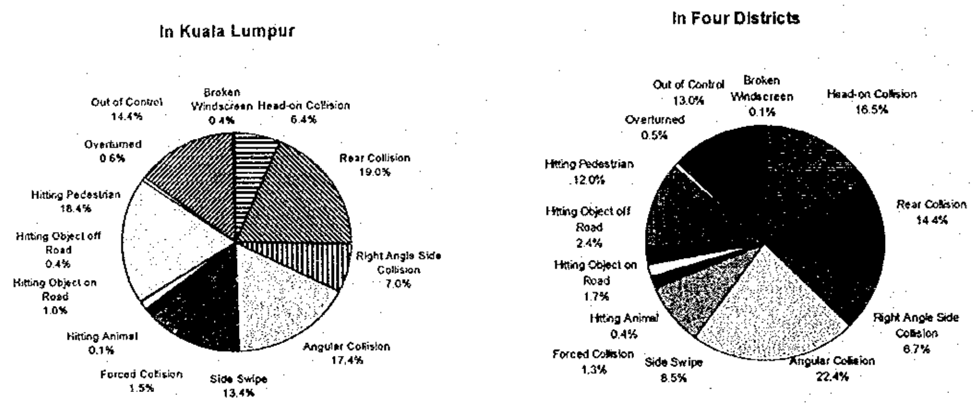


Figure 3.1.14 Number of Accidents by Type of First Collision

4) Casualties by Types of Road User

Figure 3.1.15 shows the number of casualties by types of road user that occurred in Kuala Lumpur during the past 10 years (1987-1996). It is remarkable that the number of casualties by motorcyclists has increased sharply over the years up till 1995. The number of casualties by motorcyclists has increased about 1.5 times during the past decade. In contrast, casualties caused by other types of road users have not increased since 1987. Safety measures to reduce motorcycle-involved accidents is essential.

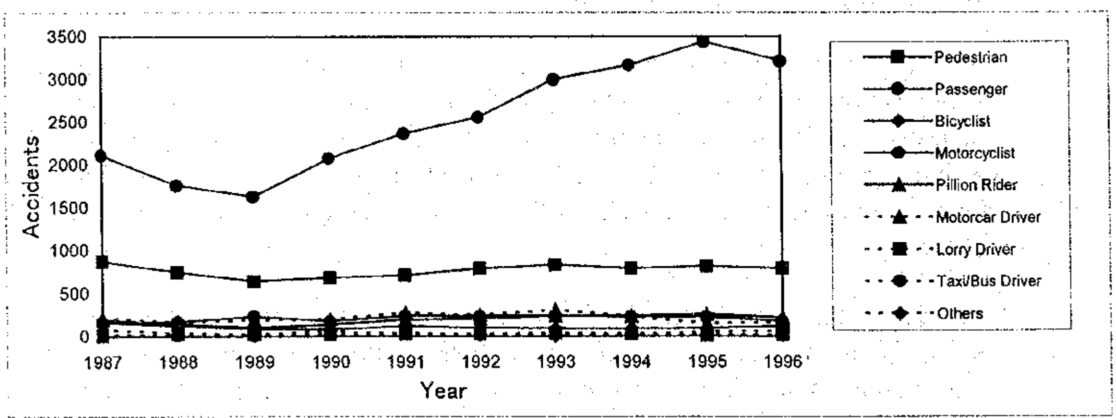


Figure 3.1.15 Number of Casualties by Type of User (1987-1996)

6) Pedestrians Involved Accidents

The current condition of accidents involving pedestrians (fatal and serious accidents) in Kuala Lumpur in 1996 are shown as follows:

- 32 % of the pedestrian accidents occurred in residential areas and 23 % in shopping areas.
- 64 % of the pedestrian accidents occurred because of carelessness when crossing, followed by 26 % from working/playing on roads.
- 53 % of the pedestrian accidents occurred on the driveway, 5 % within 50m from pedestrian crossings, and 5 % on footpaths.

According to the characteristics mentioned above and visual observations on the road, pedestrian accidents are caused mainly by the people's ignorance when crossing the street (jay-walking) between intersections.

7) Motorcycle Accidents

The current condition of accidents involving motorcycles (fatal and serious accidents) in Kuala Lumpur in 1996 are shown as follows:

- 62 % of the motorcycle accidents occurred on straight roads, 19 % at T/Y junctions, and 7 % at cross-junctions.
- 28 % of the motorcycle accidents occurred in residential areas, 14 % in shopping areas, and 11% in office areas.
- 19 % of the motorcycle accidents occurred because of dangerous driving, 6 % from dangerous turning, and 5 % from driving too closely.

According to the characteristics mentioned above and visual observations on roads, the motorcycle accidents are caused mainly by rough driving practices such as zigzagging and driving too closely between vehicles.

3.1.3 Road Traffic Control and Management

(1) Traffic Control and Management Conditions

1) Traffic Signal Control System

a. Signal Light Facilities

i. Signalised Intersections

As of August 1997, there were over 250 signalised intersections in KL as shown in Figure 3.1.16. The intersections were mainly divided into two zones for control purposes, the SCATS (Sydney Co-ordinated Adaptive Traffic System) system zone covering 95 intersections inside the Middle Ring Roads and the isolated/vehicle actuated system zone covering 100 intersections outside the Middle Ring Road.

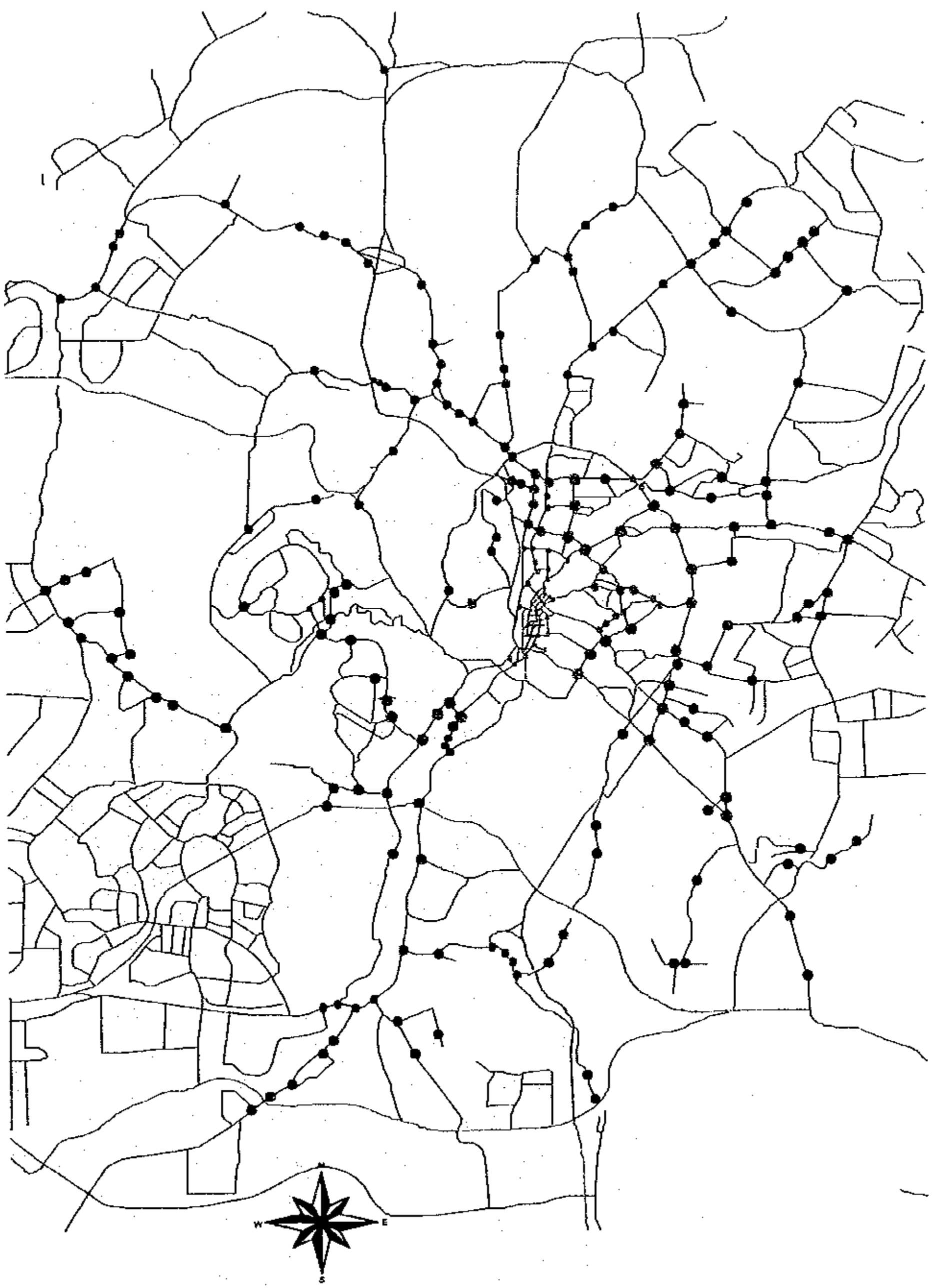
ii. Traffic Control Facilities

The traffic signals installed at major intersections are mostly vertical-type signal heads. Signals with a hand push button for pedestrians were employed in the urban area.

At some intersections, traffic lights were not visible because of low poles which were frequently blocked when large vehicles were in front.

Loop-type vehicle detectors were installed for traffic control at signalised intersections. Traffic data at the intersections was directly transmitted to the control centre via underground cables.

The traffic control centre is located in the City Hall building. Major items of equipment have been installed in this control centre and local controllers within central KL are directly managed here. The control centre comprises of a control room and a machine room. The control room contains equipment units such as consoles, CRT display units, CCTV monitors, and a wall map with co-ordinate signal points. The machine room consist of central processing units (CPUs) and their peripherals, communication control equipment, and other major items of equipment for the traffic control system.



LEGEND

- ISOLATED AND VEHICLE-ACTUATED SYSTEM
- COMPUTERIZED DYNAMIC SYSTEM (SCATS)

0 2 4 6 8

KILOMETERS

Figure 3.1.16
Location of Signalised Intersections

SMURT-KL
Study on Integrated Urban Transrtation Strategies
for
Environmental Improvement in Kuala Lumpur

b. Signal Control System

i. SCATS System

The signal phasing inside the Middle Ring Road follows the SCATS system. Cycle patterns respond to the changes in traffic volume information sent by the detectors. The key intersection serves as a base point for determining control cycle, split, and offset. At all intersections under the SCATS control, loop-typed detectors are required on all the approach lanes. The detectors are installed at a distance of 1.5 meter from the stop lines, except on exclusive right turn lanes (See Figure 3.1.17). In the SCATS system, the whole area is divided into smaller sub-areas comprised of one to ten signalised intersections which share a common cycle time. The common cycle time is updated following every cycle in steps of up to 6 seconds according to the degree of saturation in the sub-areas. Each sub-area has five offset plans in which four plans are pre-determined by past input database and one by the current traffic volume information sent by the detectors. It should be noted that SCATS is applicable to under-saturated traffic conditions. The of the SCATS detectors at stop lines are good for measuring the degree of saturation only if the intersection is not saturated.

Currently, during peak hours, most major signalised intersections are manually controlled by traffic policemen, because the current traffic congestion in KL is difficult to control using the existing system due to over-saturation. With the manual control by the traffic police, it is however difficult to keep co-ordination with the signals, and it tends to result in longer cycle times. Manual operations are made based on visual assessment of the traffic congestion at limited intersections by the traffic policemen and /or by information received via transceivers.

ii. Signal Phasing

The majority of traffic signals installed are of the multiphase system which sets one phase for each direction. Such a system, with four phases per cycle, results in long cycle time. The cycle time under manual control is observed to be over 120 seconds. Therefore, countermeasures to improve the traffic phase should be considered.

c. Planned Signalised Control System

The SCATS system was implemented in two stages of Phase I and II. Phase I, implemented in 1994, covered about 40 intersections located inside the Inner Ring Road. Phase II, implemented in 1995, covered about 100 intersections located inside the Middle Ring Road. Phase III, which is currently under bidding, will cover about 100 intersections outside the Middle Ring Road. Completion of Phase III is expected around the end of 1998.

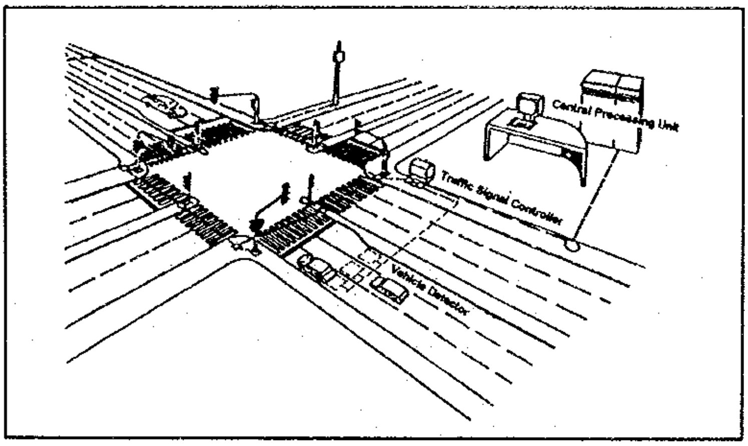


Figure 3.1.17 Layout of Existing Traffic Detectors

2) Traffic Control Regulations

The major traffic control regulations in KL are as follows:

- One-way traffic regulation
- Reversible lane regulation
- Bus/taxi exclusive lane regulation
- Curb parking regulation
- Heavy vehicle regulation

a. One-way Traffic Regulation

There are numerous one-way roads, consisting mainly of the major roads in the central part of the old city. The major one-way trunk roads are Jalan Raja Laut, Jalan Tuanku Abdul Rahman, and Jalan Bukit Bintang, which is located in one of the major shopping areas. At present, temporary one-way roads, such as Jalan Sultan Ismail, Jalan Raja Chulan, and Jalan P. Ramlee. are increasing because of the road constructions for the Light Rail Transit and the Monorail projects. The one-way system on narrow streets has been basically maintained.

b. Reversible Lane Regulation

The reversible lane roads are located on the major radial roads with a high traffic volume. They are: Jalan Loke Yew (4 lanes and 2 lanes) during the morning peak hours of 6:30-9:00 between Sri Sabah Flat House - Loke Yew Flat House; Jalan Kampung Pandan (3 lanes and 1 lane) during the morning peak hours of 6:30-9:30 between Jalan Kampung Pandan roundabout - Jalan Perkasa junction; Jalan Sentul (3 lanes and 1 lane) during the morning hours of 7:00-9-00 between Jalan Bandar Baru to Jalan Ipoh-Jalan Tun Razak; and Jalan Ampang (one-way from two way of 4 lanes) during the morning peak hours of 7:00-9:00 between Jalan Tun Razak - Jalan Setiawangsa.

c. Bus/Taxi Exclusive Lane Regulation

The bus and taxi exclusive lanes were introduced on several major roads. The major bus and taxi exclusive lane roads are Jalan Raja Laut, Jalan Tuanku Abdul Rahman, Jalan Ipoh, Jalan Pudu, Jalan Cheng Lock, Jalan Syed Putra, Jalan Nirwana, Jalan Bangsar, and Jalan Semantan. During rush hour, however, bus and taxi exclusive lanes are congested with buses at the main signalised intersections. Therefore, the effect of bus lanes is not evident.

d. Curb Parking Regulation

Curb parking is prohibited on most of major roads in the built-up areas of KL except for the roads with toll parking meters. Strict and thorough control by the traffic police has reduced the number of vehicles violating the regulation. Roadside parking is prohibited all day.

e. Heavy Vehicles Regulation

Due to KL's regulation, slow moving vehicles are not allowed to come into the city centre and specified roads during rush hours. The main points of the regulation are as follows:

- "Slow moving vehicles" mean any vehicles except for trade tricycle and trishaw, which are not allowed to run on public roads in excess of ten(10) miles per hour. They include oil or water tankers, timber lorries, lorries laden with over three (3) tonnes, tractors, trailers, earth moving excavators, bulldozers, and bullock carts.
- "City centre"means the area bounded by Jalan Tun Razak, Jalan Yew, Jalan Sungai Besi, Jalan Lapangan Terbang Lama, Jalan Istana, and Lebuhraya Mahameru.

- The hour specified for prohibition is as follows:

Morning:	7:00 a.m. to 9:30 a.m.
Afternoon:	4:00 p.m. to 6:00 p.m.

- Roads to which the prohibition applies during the hours specified in the morning and afternoon are the following: All roads within the city centre, Jalan Tun Razak, Jalan Yew, Jalan Sungai Besi, Jalan Lapangan Terbang Lama, Jalan Istana, Mahameru Expressway, Jalan Segambut, Jalan Kuching, Jalan Ipoh, Jalan Sentul, Jalan Pahang, Jalan Semarak, Jalan Datuk Keramat, Jalan Ampang, Jalan Loke Yew, Jalan Kuchai Lama, Jalan Pantai Bahru, Jalan Bangsar, Jalan Damansara, Jalan Semantan, Jalan Maarof, Jalan Tenteram, KL-Seremban Expressway, Jalan Kampung Pandan, Jalan Syed Putra and Jalan Klang Lama.

- Roads to which the prohibition applies, on the way to the city centre during the hours specified in the morning and on the opposite way during the hours specified in the afternoon are the following: Jalan Kepong, Jalan Ipoh, Karak highway, Jalan Gombak, Jalan Genting Klang, Jalan Cheras, Jalan Sungai Besi, and Jalan Klang lama.

3) Traffic Safety Facilities

The present condition of the traffic safety facilities in the urbanised area of KL is summarised as follows:

a. Pedestrian Bridges

Pedestrian bridges generally need to be installed on wide streets with many urban facilities attracting many people, i.e., schools, hospitals, large bus stops, etc. In KL, there is a standard manual for the installation of pedestrian bridges based on road traffic volume. Pedestrian bridges are installed at several points along major roads such as the ring roads of Jalan Tun Razak and Jalan Sultan Ismail, as well as at major radial roads such as Jalan Tuanku Abdul Rahman, Jalan Bangsar and Jalan Pudu. However, they are not sufficient in number. The number of pedestrian bridges inside the Middle Ring Road which has a high density of pedestrians is 22, and the average distance between pedestrian bridges is observed to be about 800 - 1,000 meters.

b. Guard Fence and Guard Pipe

Very few streets in KL have a guard fence, rope, or rail except on highways. Guard facilities dividing sidewalks and carriageway are necessary along arterial roads, especially before and after intersections and at pedestrian bridges, in order to protect pedestrians, to keep vehicles within the carriageway, and, to regulate disorders jay-walkers.

c. Traffic Signs

Traffic signs for guidance, regulation, and caution are comparatively well arranged in KL. As for the regulatory signs, stop signs and no-parking signs are properly installed. However, the road guidance signs are generally small, and they are sometime not visible. Furthermore, some regulation signs are badly installed in terms of poor visibility due to low poles, although they are sufficient in number.

d. Traffic and Road Marking

On the road surface in the urban areas, stop lines, lane marks, pedestrian crossings, and bus lanes are painted. Their maintenance is generally good. On the secondary roads with heavy traffic, however, most crossing marks have faded. In addition, pedestrian crossing marking is insufficient in number.

e. Sidewalk

Sidewalks are generally available on roads where there are many pedestrians. However, most sidewalks are not friendly to pedestrians due to their narrow width and their excessive height. Such conditions was especially observed at sidewalks along the major roads inside the Inner Ring Road.

4) Traffic Education and Campaign System

a. Drivers' Behaviour

Malaysian drivers have been described as being comparatively lawful and disciplined. Their driving habits are considered to be better than those of other Asian countries. However, some drivers are ignorant of the traffic laws on the roads. For instance, they sometimes ignore the red signal light, make sudden and frequent lane changes without indicating, ignore speed limits, squeeze in queues, and block intersections. As for the mini-bus drivers, they would rather stop outside of the bus stop lanes instead of following the queue, and change lanes hastily in order to pick up extra passengers. Motorcycle drivers also often run too close between vehicles without maintaining their lane (zigzag driving).

Therefore, effective traffic education programs and campaigns should be promoted to improve the drivers' compliance with traffic laws and regulations.

b. Pedestrians' Behaviour

The pedestrians' behaviour in KL is seen as being lawless in some cases and well behaved in others. Pedestrians certainly become irritated at major intersections when they have to wait for a long time to cross the road in a bad environmental filled with heavy vehicle exhaust and noise. For instance, they cross the streets by ignoring the signal lights. They might wander into vehicle lanes to shorten their journey, while at bus stops, pedestrians and passengers overflow onto the vehicle lanes. Such behaviour by the pedestrians is generally regarded as being one of the causes for traffic congestion in KL, particularly from the viewpoint of motorists. However, from visual observation, pedestrians in KL behave well at intersections where there are appropriate pedestrian facilities available.

Appropriate pedestrian facilities are, therefore, necessary to improve the pedestrians' behaviour.

3.2 Parking System

3.2.1 Current Off-street Parking Conditions

(1) Parking Duration and Turnover

The average parking duration for various purposes in the Survey Area was 2.0 hours, with the duration for going "to work" and "to home" are longest at 3.7 and 4.2 hours respectively (see Table 3.2.1). Accordingly, the average turnover by purpose are: "to work" at 2.2 times, "to school" at 3.0 times, "to home" at 1.9 times, "business" at 5.3 times, "private activity" at 5.0 times and "others" at 4.2 times. The approximate average turnover for all purposes is 4.0 times. Please refer to the off-street parking survey results in the CBD found in the technical report.

Table 3.2.1 Parking Duration and Turnover in CBD

No.	Trip Purpose	Av. Parking Duration (Hrs)	Av. Turnover (Time)
1	To work	3.7	2.2
2	To school	2.7	3.0
3	To home	4.2	1.9
4	Business	1.5	5.3
5	Private activity	1.6	5.0
6	Others	1.9	4.2
	Total	2.0	4.0

Source: SMURT-KL, JICA STUDY, Parking survey 1997

(2) Parking Capacity and Demand

1) Office Parking Capacity

The Total office parking capacity in the CPA was about 87,000 pcu. lot in the year 1997. Table 3.2.2 shows the office parking capacity by zone in 1997, where the capacity was estimated from the total floor area by zone and pcu. lot per floor area.

Table 3.2.2 Parking Capacity of Office by C Zone in CPA

C Zone No.	1997	
	Floor Area (sqm)	Capacity (pcu.lot)
1	446,766	9,506
2	972,517	20,692
3	497,148	10,578
4	403,840	8,592
5	1,178,125	25,066
6	134,444	2,861
7	337,626	7,184
8	121,209	2,579
CPA. Total	4,091,675	87,057

Note: office floor area per 1 pcu.lot =1 pcu. lot/47 sqm
Source: SMURT-KL JICA Studt, parking survey, 1997

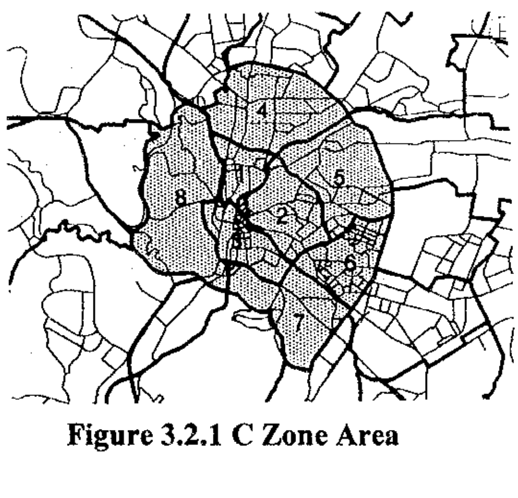


Figure 3.2.1 C Zone Area

2) Parking Demand of office

The Parking demand in the CPA for the year 1997 was estimated from the attraction volume of the 1997 OD table. The parking demand was calculated based on the turnover by trip purposes. The parking demand of office by zone for the year 1997 is shown in Table 3.2.3. The total demand in the CPA in 1997 was forecasted to be approximately 76,500 pcu. lot per day.

Table 3.2.3 Parking Demand of Office by Zone in CPA

C Zone No.	1997 PCU Attraction			1997 Total Demand
	HBW	HBB	NHBB	
1	1,871	23	4,881	1,776
2	42,289	1,141	78,246	34,201
3	13,159	183	20,196	9,826
4	11,471	473	14,714	8,080
5	19,832	415	28,229	14,419
6	5,318	206	6,660	3,713
7	3,917	133	4,707	2,694
8	2,941	24	2,200	1,756
CPA. Total	100,798	2,598	159,833	76,465

Source: SMURT-KL JICA, Study Team, Person trip survey.
Note: HBW(Home to work place),HBB(Home to business), NHBB(None Home to busine

3.2.2 Comparison of Parking Capacity and Demand

The balance of parking capacity and demand in the year 1997 are shown in Table 3.2.4. The volume of parking demand and that of capacity in the year 1997 were almost equivalent. However, the supply of parking spaces in Zone No.2 and No.6 fell short of demand by about 13,500 pcu. lot and 800 pcu. lot respectively, which is around 135 hectares and 9 hectares respectively.

Table 3.2.4 Comparison of Parking Capacity and Demand of Office

C Zone No.	1997 Parking Demand	1997 Parking Capacity	1997 Development needs of parking spaces	
			Pcu. Lot	Area (ha)
1	1,776	9,506	7,730	0
2	34,201	20,692	-13,509	-135
3	9,826	10,578	751	8
4	8,080	8,592	513	5
5	14,419	25,066	10,647	106
6	3,713	2,861	-852	-9
7	2,694	7,184	4,490	0
8	1,756	2,579	822	8
CPA. Total	76,465	87,057	10,592	106

Source: SMURT-KL JICA, Study Team

3.3 Bus Operation System and Taxi Transport

3.3.1 Current Bus Operation

(1) Bus Operation

The total number of bus operations which serve Kuala Lumpur and its conurbation area was observed to be around 15,000 bus trips per day. The streets which were heavily used for bus transport were Jln. Tuanku Abdul Rahman, Jln. Raja Laut, Jln. Cheng Lock, Jln. Pudu, Lebuh Pasar Besar, Jln. Raja, Jln. Ipoh and Jln. Bukit Bintang. On all the streets listed above, more than one thousand buses operated on a weekday as illustrated in Figures A 3.3.1 and A 3.3.2(see Appendix).

(2) Bus Frequency

The observed bus frequencies by bus route are listed in Tables A 3.3.1 through A 3.3.3. The observed frequency of Intrakota buses in the morning peak period was generally similar to the scheduled frequency on average. Most buses operated at a 15 to 20 minute interval in the peak period.

However buses were often bumper to bumper due to traffic congestion on the streets. Figure A 3.3.3 illustrates the interval of bus operation by bus route at the survey station 2 on Jln. Tuanku Abdul Rahman. Bus frequency varied according to the scheduled frequency of each bus route. It was observed that two or more buses came in a short period, but then the interval until the appearance of the next bus was considerably long, sometimes exceeding an hour. This irregular frequency of bus operation irritates the bus passengers. The distribution of bus waiting time by route is summarised in Figure 3.3.1.

(3) Effect of Bus and Taxi Priority Lanes

When streets are not congested the speed of buses are almost the same as that of cars, excluding the time spent for passengers to board and alight, which can be seen as the gradient in the Time - Distance Chart.

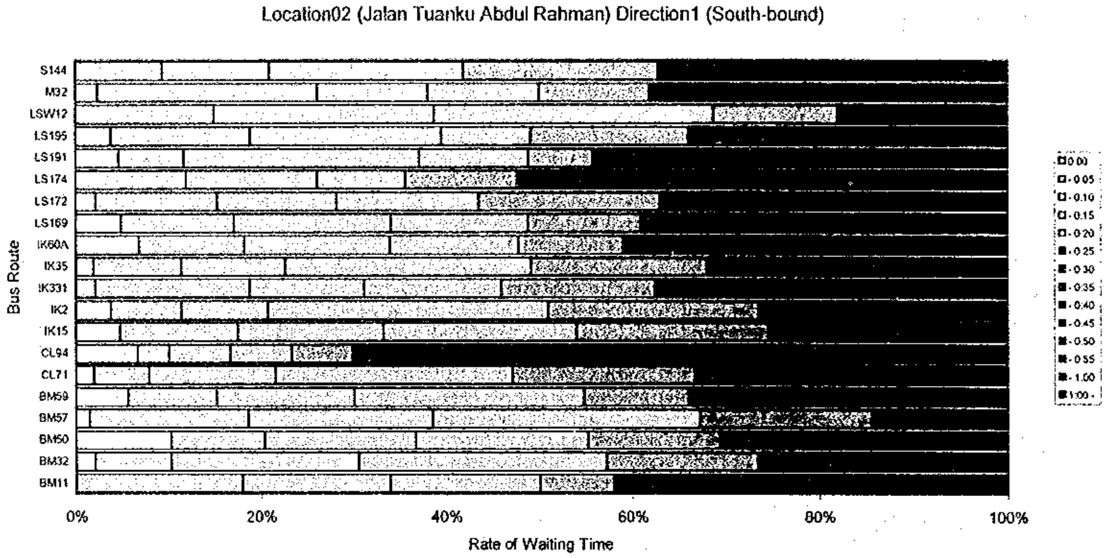


Figure 3.3.1 Bus Frequency Distribution

3.3.2 Problems of Bus Transport System

(1) Bus Priority Lanes

Although smooth bus operation had been expected with the implementation of the bus priority lanes, hardly any effect was hardly observed on the surveyed routes for the following reasons:

1) Lack of Enforcement

When heavy rain brought about a serious congestion on Jln. Cheras during the afternoon peak period of the survey day, many cars plunged into the bus priority lane and buses were dragged into the traffic congestion as depicted in Figure 3.3.5. Since the bus priority lane is not physically separated from the ordinary lanes for cars, bus operation can be easily disturbed by cars without strong enforcement.

2) Inadequate Allocation of Bus Priority Lanes

Most of the sections with the bus priority lane on Jln. Syed Putra were not congested as shown in Figure 3.3.6. The congested section started at the intersection with Jln. Kinabalu towards the south for the inbound direction. A bus priority lane, however, is not provided in this most congested section. As a result, buses plunge into the traffic congestion at the end. In order for the designated bus priority lane to contribute to a smoother bus operation, the bus lane should be extended to the north.

3) Excessive Bus Operation

Bus operations were not disturbed by cars on Jln. Raja Laut and Jln. Tuanku Abdul Rahman. It was observed that bus speeds were comparable to car speeds on some occasions even when the boarding and alighting periods were included as shown in Figure 3.3.4. However, as described earlier, the total number of buses operating on Jln. Raja Laut accounts for as many as 2600 bus trips per day. Sometimes a platoon of buses were held up for some hundred meters on the single lane reserved for buses, and this resulted in a low bus operating speed.

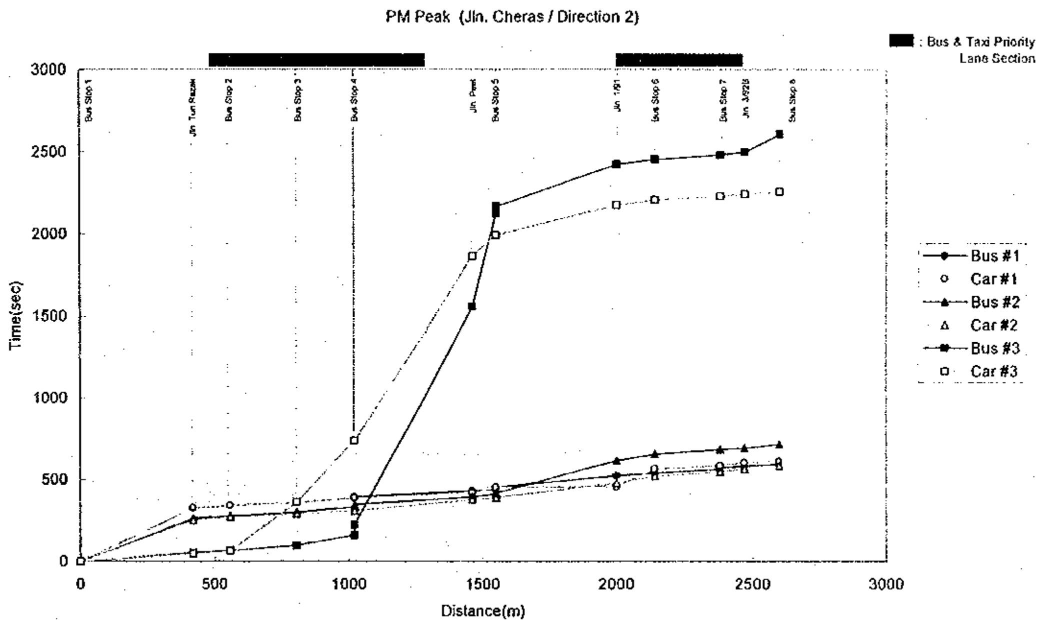


Figure 3.3.2 Bus Speed and Car Speed on Bus Priority Lane (1)

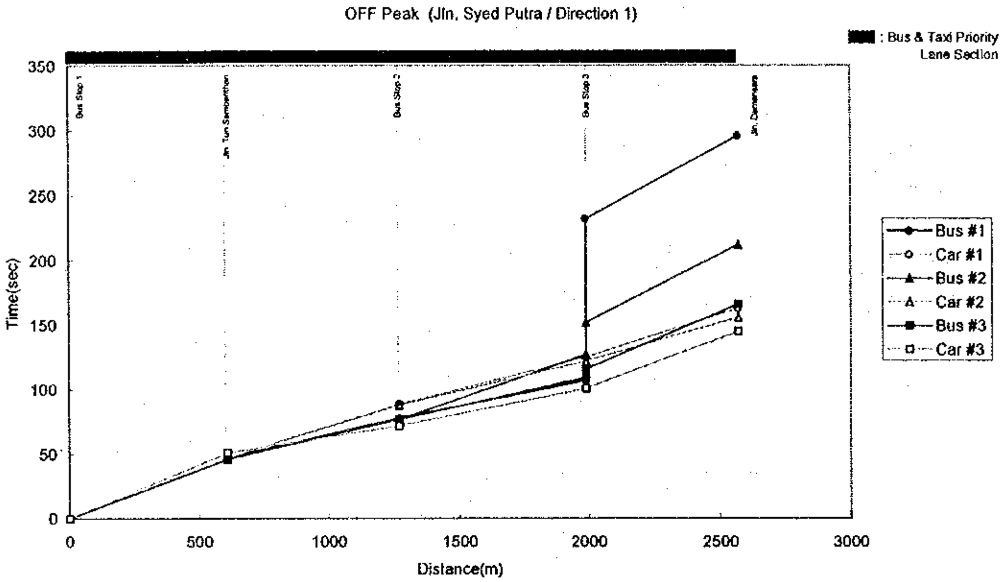


Figure 3.3.3 Bus Speed and Car Speed on Bus Priority Lane (2)

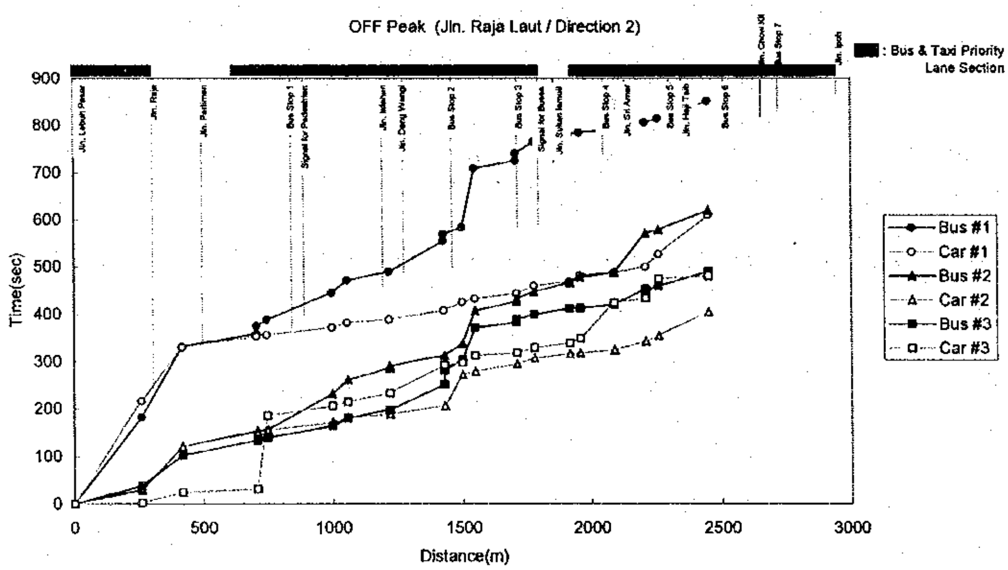


Figure 3.3.4 Bus Speed and Car Speed on Bus Priority Lane (3)

(2) Insufficient Coverage of Bus Service Area

Obviously bus operation is subject to the availability of road space; large size buses cannot operate on narrow streets. The lack of arterial streets limits the supply of large bus services. Suburban areas and newly developed areas suffer from poor bus services.

(3) Lack of Direct Bus Services

In large metropolitan areas like KL, people travel from places to places. Although most trips are attracted in the central area, trips from one part of the metropolitan area to another part outside the central area might be required. As most existing bus services concentrate their destinations to the city centre, many trips cannot be completed with just one bus ride. Thus there is some discrepancy between the demand and supply of bus services. With regard to this matter, further quantitative analysis will be conducted after the present passenger OD matrices are developed by compiling the Person Trip survey data.

(4) Duplication of Bus Routes

In KL, almost all bus routes run in a radial direction from/to CBD and some of them have similar route structures. Some buses serve almost the same corridor with little difference in terms of their final destination in the suburbs. This results in an excessive number of similar bus routes being operated in the central area. For instance, stage bus No.41 and mini bus No. 32 operate on Jln. Raja Laut. Similarly, stage bus No. 42 and mini bus N0.10 runs on Jln. Pudu.

(5) Low Frequency of Bus Service

Bus operations of Intrakota are scheduled at a frequency of 15 minutes to one hour, partly due to the excessive number of bus routes. A 30 minutes to one hour frequency is simply too long for wait. In addition, buses are often delayed due to poor road conditions, and force the passengers to wait for a long time.

(6) Overloading of Bus Passengers

Most buses exceed its capacity during the peak hours. The observed average occupancy of buses is about 50 passengers for stage buses and about 40 passengers for mini buses in the morning peak period.

(7) Long Bus Travel Time and Unreliability on Bus Operation

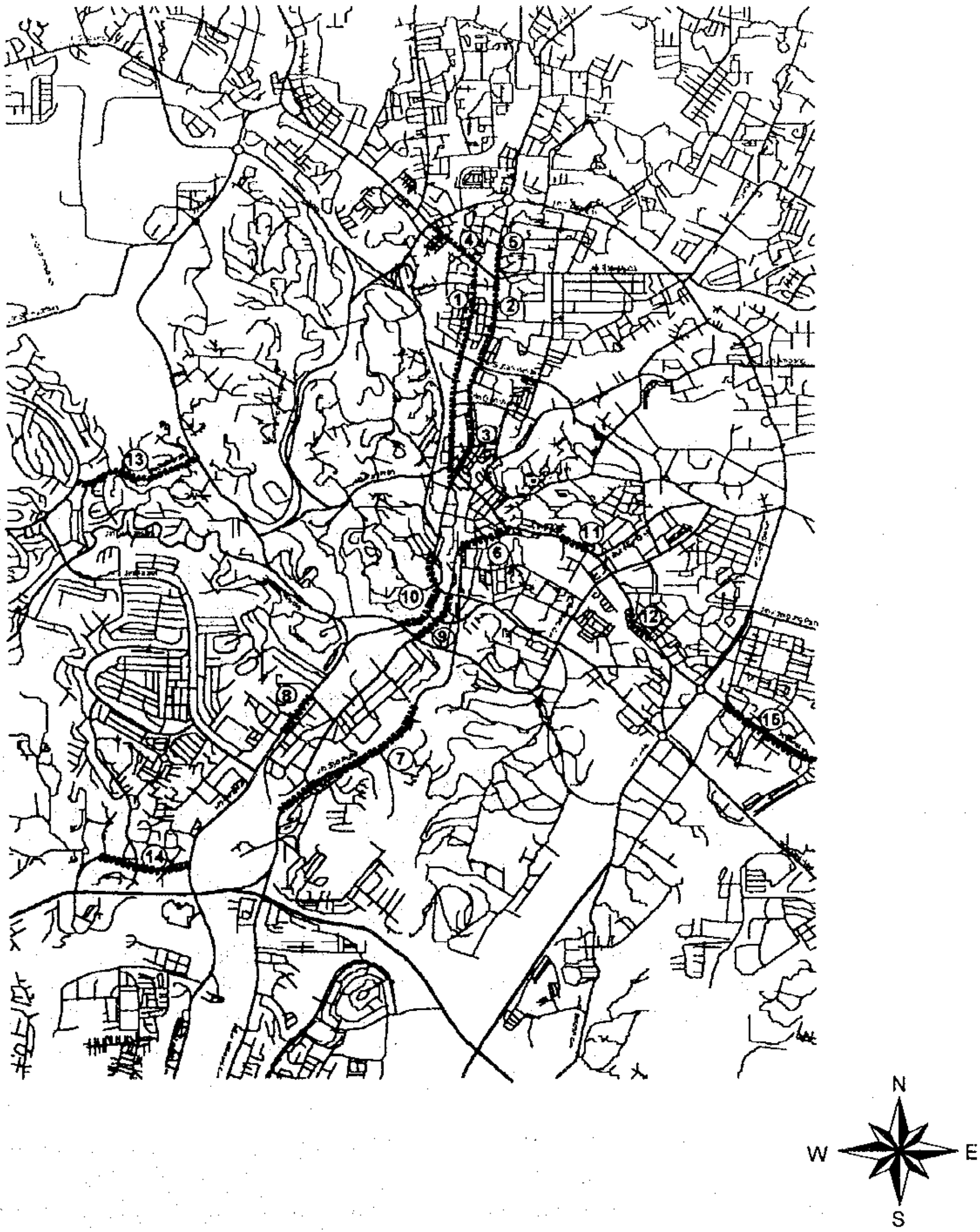
Severe traffic congestion prevails on many road sections in KL and its surrounding areas as discussed in Section 3.1.2. The observed average bus speed inbound to the city centre in the morning peak period was as low as 7 to 15 km per hour. Compared with private passenger cars, the average speed of buses on ordinary streets were observed to be about 20 to 40 percent lower due to the additional time required for loading and unloading passengers. In contrast, on some bus priority lanes, the speed of buses were observed to be almost the same as that of private cars. Although it is recognised that bus priority lanes contribute to bus operation efficiency, the current length of bus priority lanes is still too limited and it lacks continuity as shown in Figure 3.3.5. As a result, buses are still forced to plunge into the road congestion, thus affecting their operation.

(8) Poor Bus Terminal Facility

The existing bus terminal facilities are not well designed for the existing level of demand. In particular, the Puduraya bus terminal is always overcrowded with bus passengers and the interior of the terminal is dark and dirty. The sidewalks and pedestrian crossings around the terminal are also poor, thus causing inconvenience to the bus passengers.

(9) Inadequate Location of Inter-city Bus Terminal

Inter-city bus terminals are located in the city centre. This brings about more congestion in the central area since all the inter-city buses enter the city centre.



LEGEND

- Main Roads
- Alternative Roads
- Tollway
- Bus and Taxi Priority Lanes

0 0.5 1 1.5 2 3 4
Kilometers

Figure 3.3.5

Bus and Taxi Priority Lanes
in July 1997

SMURT-KL
Study on Integrated Urban Transrtation Strategies
for
Environmental Improvement in Kuala Lumpur

3.3.3 Taxi Transport

The average number of taxis per population in Kuala Lumpur is higher than those in major cities in Japan as indicated in Table 3.3.1. This implies that the availability of taxis in Kuala Lumpur is sufficient.

Table 3.3.1 Average Number of Taxis per Population

City	Population 1995 (persons)	Number of Taxis 1994 (vehicles)	Average Number of Taxis per Population
Sapporo	1,733,133	5,328	3.1
Sendai	936,733	2,633	2.8
Tokyo – Special Wards	7,836,665	48,116	6.1
Yokohama	3,273,609	5,550	1.7
Nagoya	2,086,745	8,158	3.9
Kyoto	1,389,342	8,384	6.0
Osaka	2,478,628	11,283	4.6
Kobe	1,456,780	5,099	3.5
Hiroshima	1,082,222	3,440	3.2
Kitakyushu	1,015,117	3,714	3.7
Hukuoka	1,225,745	4,625	3.8
Kuala Lumpur 1)	1,375,000	11,275	8.2

Source : Annual Urban Transport Statistics 1997[*Toshikoutsuunennpou*], Japan Transport Economics Research Center
Note : 1) as of August 1997

Taxis are one of public mode of transport, and it supplement the mass transit by providing door to door services to meet more personal needs of travel. At present the share of person trips made by taxis accounts for merely 1 percent in all the motorised modes of transport, so that a role of taxi transport is limited in terms of volume.

Taxi is used more in the CPA than in suburban areas, 18.1 percent of taxi trips are related to the CPA, while 14.8 percent of car trips is made departed from or attracted to the CPA. Consequently average trip length of taxi (6.1 km) is shorter than that of cars (8.7 km) and motorcycles (7.0km).

3.4 Railway Operation System

3.4.1 Current Railway Operation

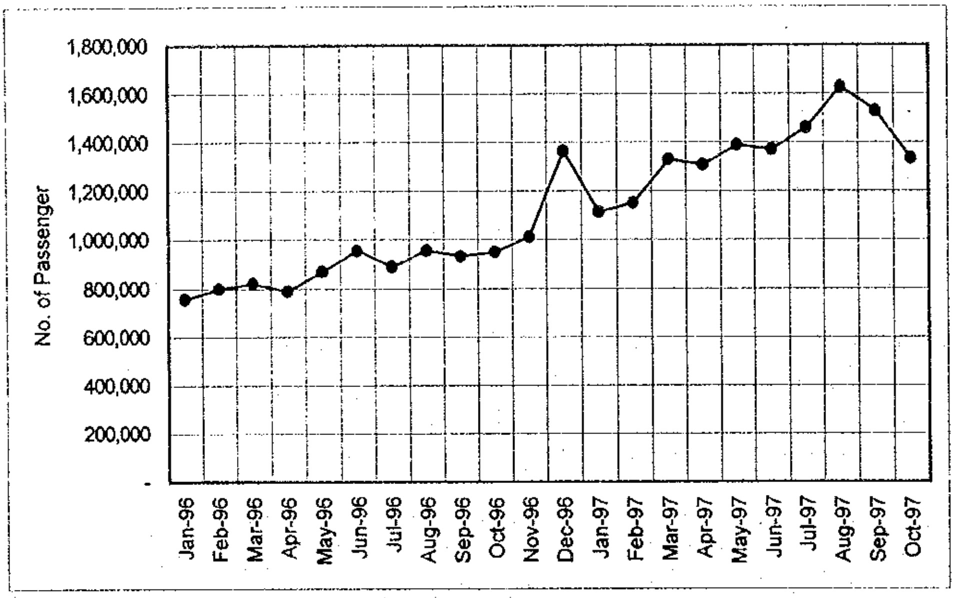
(1) KTM Commuter

1) Ridership

Since the completion of the double tracking / electrification project in late 1995, the KTM commuter train has been performing very well. During the first year of full operation of the 153km railway, KTM commuter recorded 11 million passengers, which was approximately an average of 30,000 passengers daily.

Viewing the available 1997 figures, the number of passengers continued to increase constantly (Figure 3.4.1). Efforts made to improve the level of services during this year are reflected in these favourable figures. The average growth rate of monthly passengers against the same month of the previous year was between 140% and 170%. It was sure to be a success that such a performance could be driven even though the current headway operation is in between 15 and 20 minutes in peak hour periods. However, it must be pointed out that the number of passengers on weekdays (most of them are commuters) is usually less than that on holidays. This indicates that there is room for further improvement to attract more people to KTM. Since only KTM has an extended network in the Klang Valley region, it is expected to play a more vital role in the urban transportation of the region.

Figure 3.4.2 suggests one of the ideas for further improvement. As clearly depicted in the figure, the density of passengers decreases in proportion to the distance from Kuala Lumpur, which suggests that more frequent service between busy sections is preferable instead of providing full line operations between the terminals.



	Num of Passenger	Length in Operation	Average Passenger (per length)	Commencement of Operation
Aug-95	162,086	61.6	2,631	KL - Rawang and Sentul - Shah Alam
Sep-95	452,913	82.5	5,490	Shah Alam - Klang and KL - Salak Selatan
Oct-95	547,509	91.5	5,984	Klang - Port Klang
Nov-95	784,848	106.6	7,363	Salak - Selatan - Kajang
Dec-95	870,087	153.4	5,672	Kajang - Seremban
Jan-96	756,945	153.4	4,934	
Feb-96	798,083	153.4	5,203	
Mar-96	821,276	153.4	5,354	
Apr-96	789,058	153.4	5,144	
May-96	870,827	153.4	5,677	
Jun-96	955,114	153.4	6,226	
Jul-96	888,608	153.4	5,793	
Aug-96	956,497	153.4	6,235	
Sep-96	932,350	153.4	6,078	
Oct-96	950,125	153.4	6,194	
Nov-96	1,010,689	153.4	6,589	
Dec-96	1,364,979	153.4	8,898	Growth againt the same month of the last year
Jan-97	1,114,892	153.4	7,268	147%
Feb-97	1,150,593	153.4	7,501	144%
Mar-97	1,330,365	153.4	8,673	162%
Apr-97	1,307,621	153.4	8,524	166%
May-97	1,388,870	153.4	9,054	159%
Jun-97	1,371,088	153.4	8,938	144%
Jul-97	1,461,174	153.4	9,525	164%
Aug-97	1,629,016	153.4	10,619	170%
Sep-97	1,530,052	153.4	9,974	164%
Oct-97	1,332,964	153.4	8,689	140%
Total 1996	11,094,551			Average = 156%

Figure 3.4.1 Monthly Passenger of KTM Commuter

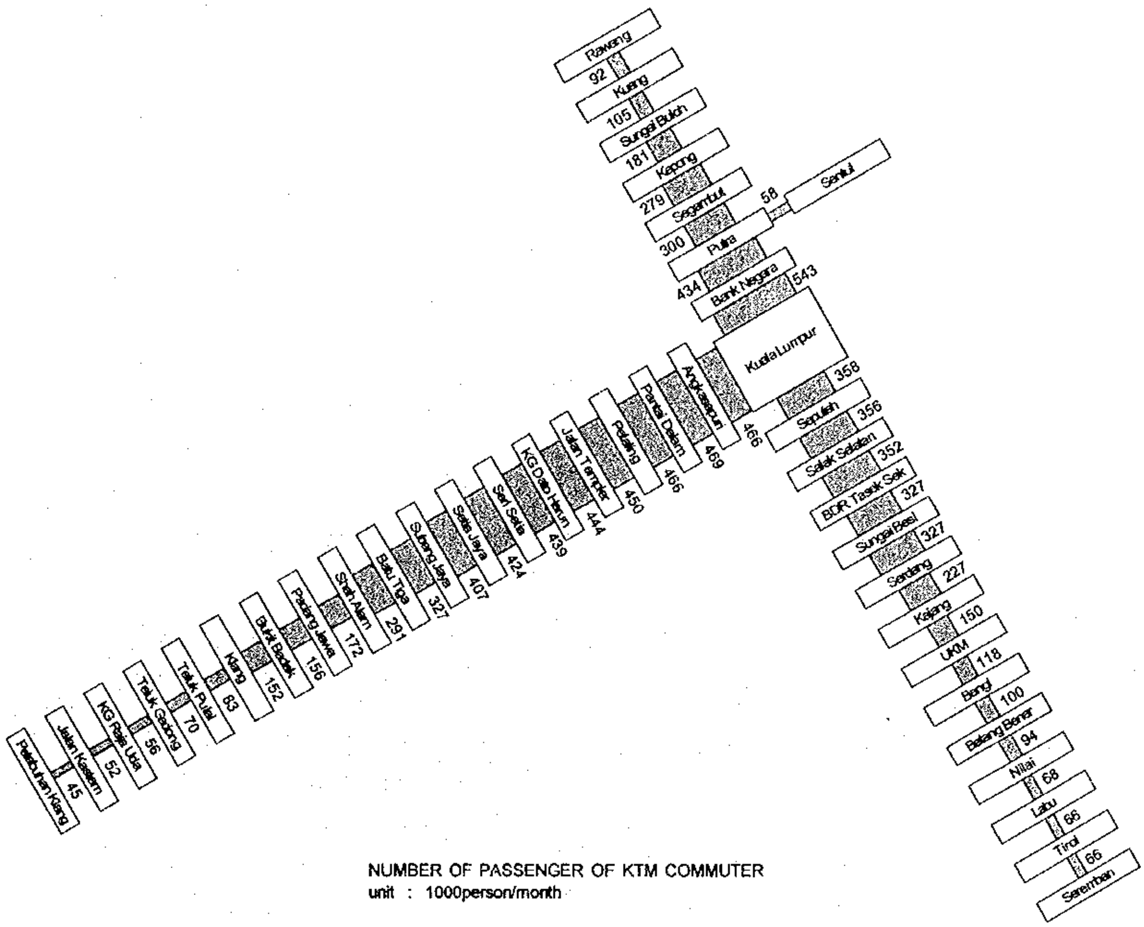


Figure 3.4.2 Number of Passenger of KTM Commuter

(2) LRT SYSTEM I (Phase 1)

1) Rider-ship

The number of passengers using the LRT Phase 1 system, which starts from Ampang and ends at Sultan Ismail with a length of 12km, has been increasing constantly since the beginning of its operation as shown in Figure 3.4.3. However, the absolute figure itself has not been successful enough yet in financial terms. At present the system carries about 63,000 passengers on weekdays, and 23,000 passengers on holidays, or 54,000 passengers on average. According to the financial analysis discussed in Chapter 13, more than 100,000 passengers are necessary to make this business viable.

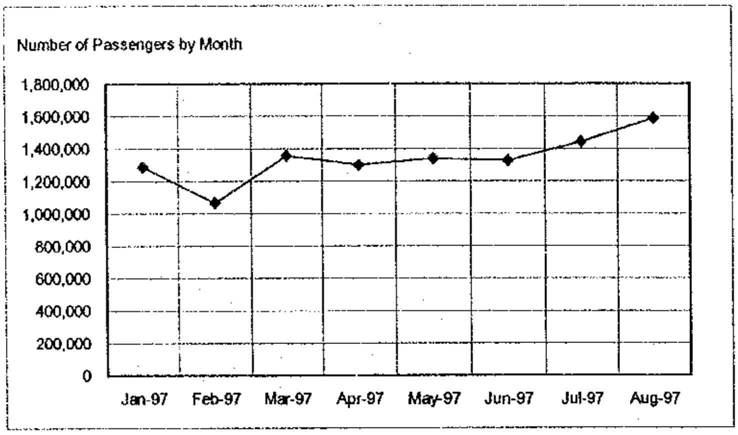


Figure 3.4.3 Monthly Passenger of LRT Phase 1 System

Figures 3.4.4 and 3.4.5 explain one of the reasons for the shortage of passengers. There was a very sharp peak period in the morning and a rather moderate peak period in the evening, but there was almost no demand in the hours between. This implies that the use of the system is limited to commuting, and does not extend to other uses such as business, shopping, and going to school, etc. The other fact, that is, less passengers on holidays, also suggests the limitations of the LRT.

2) Number of Passengers by Station

The number of passengers by the stations also showed some interesting facts as depicted in Figure 3.4.6. The highest figure was observed at the Masjid Jamek station, followed by Plaza Rakyat, Ampang, and Bandaraya. Except for the Ampang station, the other three are located in areas with many business and commercial establishments, which are usually the destinations of so-called "white collar" people. At the less attractive stations such as Cahaya, Pandan Indah, and Miharja, there are no place of attraction like office buildings, shopping complexes, amusement facilities, large schools, and mosque. For example, the distance from the Pandan Indah station to the closest shopping complex named Pandan Kapital exceeds 1 km. In the case of the Miharja station, there is a huge shopping complex named UE3 within a 500m distance, but unfortunately it appears that most customers used their own cars or buses (27 routes including Intrakota, City Liner, and Bus Mini Wilayah are available) to get there.

As discussed above, there are very limited seeds to generate more passengers to use the system at present. One of the ways to attract more passengers to the current system is to provide the services at a lower fee during the off peak-hours, which could be introduced by STAR themselves. This way, shopping trips, school trips, and some business trips may be generated. However, it must not be a fundamental solution for the future. An integrated use of the land through the re-development of the areas surrounding the stations is necessary to create an environment suitable for the system. Another solution could be an institutional change. For example, some tax exemption scheme could be proposed by allowing full transportation cost to their employees. This way, the public would be more willing to use the system as it is more punctual, reliable and faster than buses in most cases.

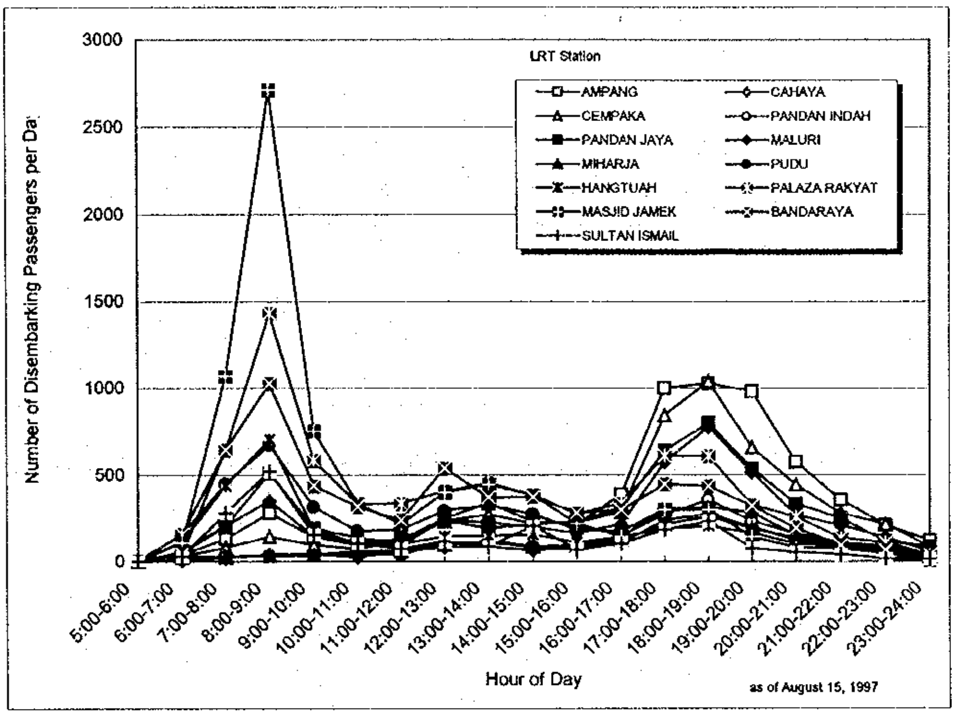


Figure 3.4.4 Hourly Fluctuation of LRT STAR Passenger (Disembarking)

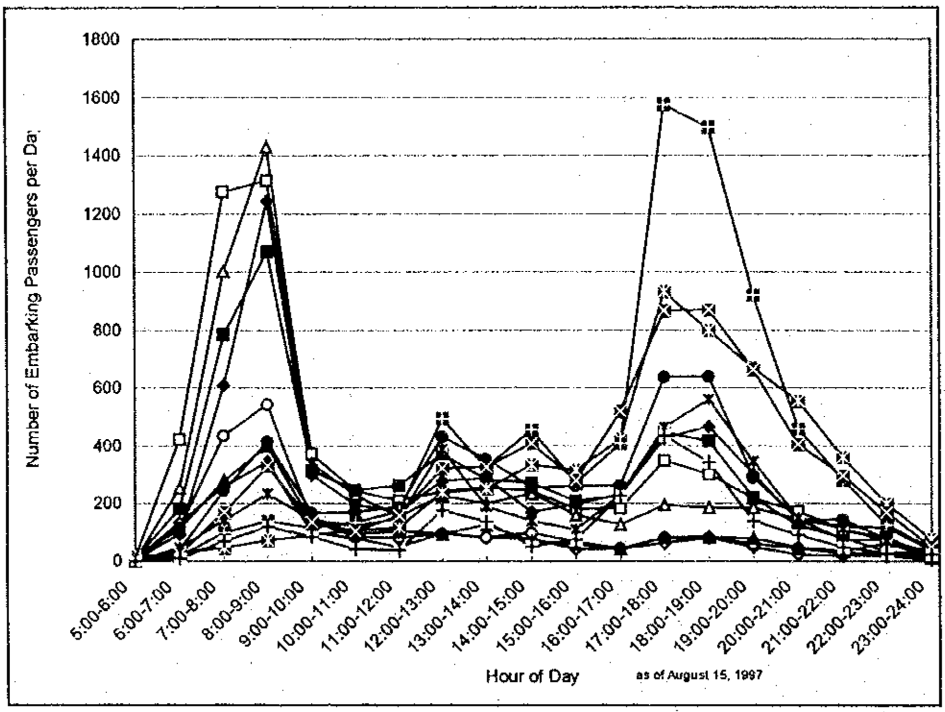


Figure 3.4.5 Hourly Fluctuation of LRT STAR Passenger (Embarking)

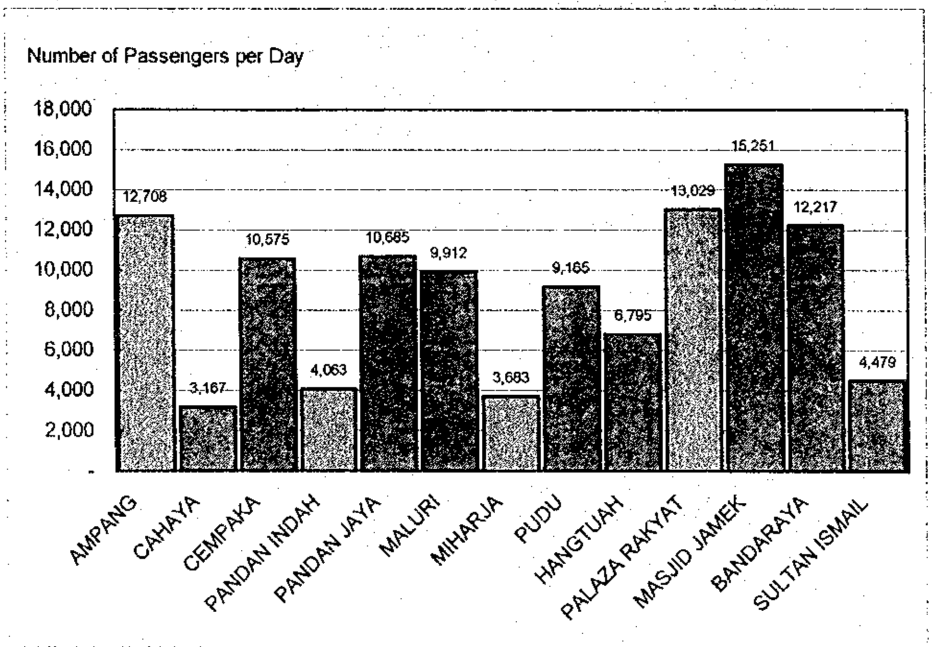


Figure 3.4.6 Number of Passengers by LRT Station

3.4.2 Problems of Railway Transport System

(1) Limited Service Area

At present only KTM Komuter and LRT System I (STAR) have started their services, i.e., the coverage of the rail-based transport is still limited. Furthermore, land use around the stations is not attractive to the railway passengers except at some stations in the city centre.

(2) Low Frequency of Rail Service

Although KTM Komuter has been increasing the number of train cars gradually, the frequency of service is not sufficient as shown in Table 3.4.1. On the other hand, the LRT System I provides a reasonably frequent service of 3 to 5 minutes headway during peak hours.

Table 3.4.1 Frequency of KTM Komuter and LRT

Railway/LRT Line	Peak	Off-Peak
KTM Komuter		
- Sentul – Pelabuhan Klang Line	30 min.	30 min.
- Seremban – Rawang Line	30 min.	30 min.
LRT System I (STAR)	3 to 5 min.	7 to 15 min.

Note: Frequency of the KTM Komuter service is as of June, 1997. From August 1997, KTMB installed additional trains and have increased frequency to 15 min. for Sentul – Pelabuhan Klan line and 20 min. for Seremban – Rawang line in peak hours.

(3) Expensive Fare

Compared to bus transport, the fare level of the LRT is considerably high. For instance, the fare between Ampang and Bandaraya costs RM 2.95. If the passenger needs to use the feeder bus service to get to the LRT station, it costs additional RM 0.50. Meanwhile, buses with air conditioning, cost merely RM 0.90 per trip. Thus, many public transport users feel that the LRT system far is expensive.

(4) Insufficient Feeder Services

In principle the feeder service to the LRT stations are provided by Intrakota and those to the KTM Komuter stations are by the Park May bus company. Feeder bus services are provided at six LRT stations out of 13 stations. Compared with the frequent LRT service of 3 to 5 minutes during peak hours, the frequency of the feeder service at 15 minutes is much lower. At present, even though Park May provides the feeder services at Shah Alam and Sungai Buloh, the company plans to cease operations at Sungai Buloh due to insufficient ridership.

(5) Inconvenient Access Roads to the Stations

Access roads to the Railway and LRT stations are not well planned for the pedestrians. Sidewalks are generally narrow and some parts are damaged. In addition, pedestrian crossings are insufficient in the areas surrounding the railway/LRT stations and passengers have difficulties in getting to their destinations. The environment is not suitable for walking from the viewpoint of amenity as well as safety.