

4.2 URBAN SERVICE

4.2.1 Administrative System

The administrative system for public passenger transport service in Lahore is shown in Figure 4.1.1. The Regional Transport Authority (RTA) of Lahore administers permits of buses, minibuses, and Suzuki-wagons.

Figures 4.2.1 and 4.2.2 and Table 4.2.1 show main routes of public passenger transport service in the Lahore Metropolitan Area.

Non-motorized vehicles, tongas (horse-drawn carts of passengers) are administered by Taxation Office, Metropolitan Corporation of Lahore. The permit is fixed, no new entry is allowed, but replacement of the cart without changing the registration number has been accepted for more than a decade.

4.2.2 Operators of Stage Carriages (common service by bus and others)

(1) Private operators

Most public transport service in the Lahore Metropolitan Area is supplied by private operators. The service system is organized as in the following way :

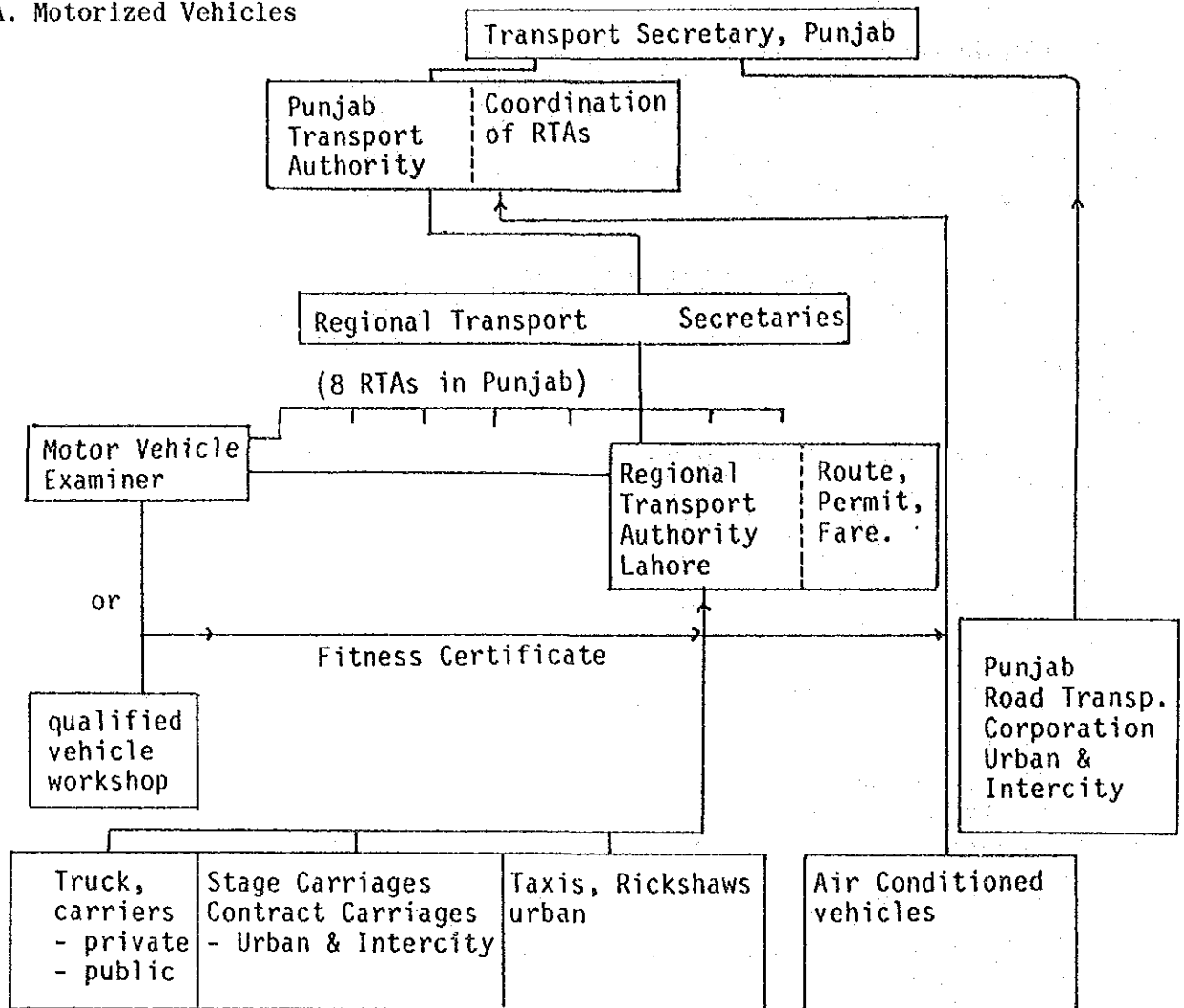
- 1 Regional Transport Authority of Lahore (RTA) and Punjab Transport Authority determine the route to be served by operators.
- 2 Private persons and enterprises who are willing to participate in the public passenger service should report to the RTA to get a permit for the intended route by paying an annual fee.
- 3 The report should have an attached fitness certificate by Motor Vehicle Examiner, a subordinated agency of PTA, or by a qualified vehicle workshop, and the vehicle should be less than 2 years old, based on the model year.
- 4 Insurance is compulsory for all vehicles and the driver should have a public service vehicle driving license.
- 5 It is said no maximum number of permits is defined for the route by RTA. Entrance is free if pre-requisite conditions are fulfilled, and exit is free. Hours for operation and frequency of trips is dependent on the drivers.

Vehicle type and normal capacity by private operators are shown below:

- | | |
|--|--------------------|
| - Standard buses (Bedford, Hino, etc.) | : 50-60 passengers |
| - Toyota Hiace | : 18-24 passengers |
| - Ford Transits | : 16-20 passengers |
| - Mazda | : 30-40 passengers |
| - Suzuki | : 8-10 passengers |

Figure 4.1.1 Administrative System for Public Passenger and Cargo Transport Service.

A. Motorized Vehicles



B. Non-Motorized

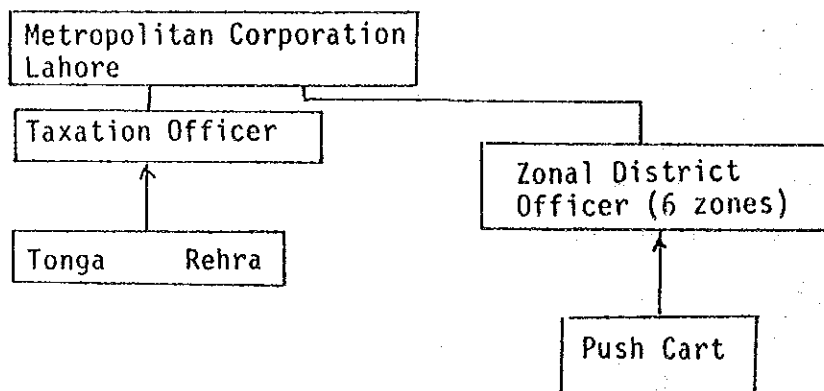
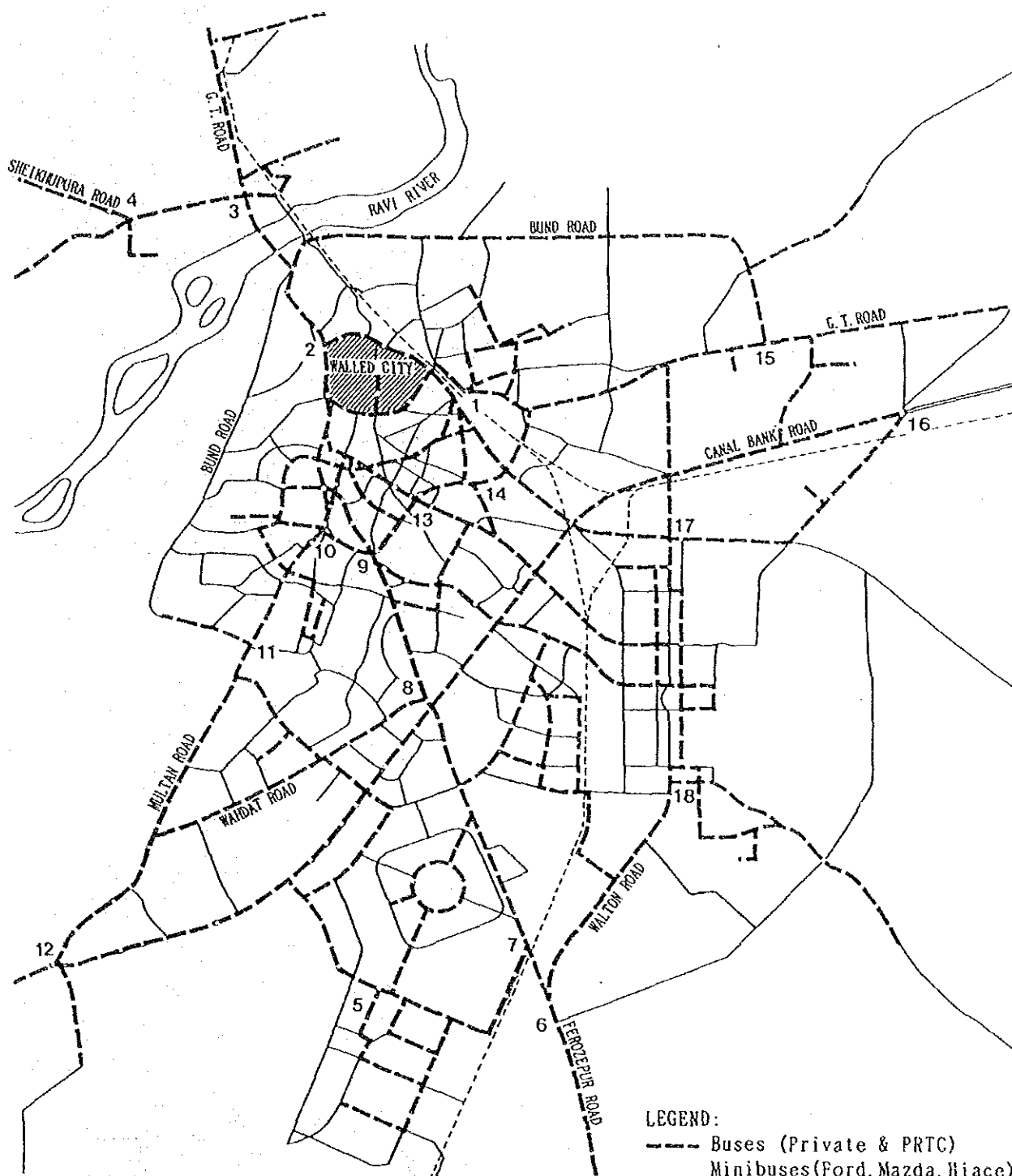


Figure 4.2.1 Bus Routes in 1990



- | | |
|----------------------|-----------------------|
| 1. Railway Station | 10. Chauburji |
| 2. Azadi Chowk | 11. Yatim Khana Chowk |
| 3. Shadara Chowk | 12. Thokar Niaz Baig |
| 4. Begum Kot Chowk | 13. Charing Cross |
| 5. Township Centre | 14. Simla Hill Chowk |
| 6. General Hospital | 15. Darogawala Chowk |
| 7. Lahore Bridge | 16. Harbanspura |
| 8. Muslim Town Chowk | 17. Sadar Bazar |
| 9. Mozang Chungi | 18. R. A. Bazar |

LEGEND:
 - - - Buses (Private & PRTC)
 - - - Minibuses (Ford, Mazda, Hiace)
 - - - Suzuki Wagon
 ——— Road
 - - - Railway

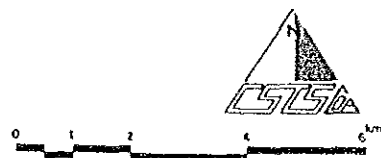


Figure 4.2.2 Bus Route Structure

Urban Service				Intercity Service	
PRTC	Private Bus	Minibus	Suzuki	Regular Bus	Minibus
<p>Routes emanate from the Ferozepur Corridor mostly. The average length of the routes is the largest in the four types in LMA.</p> <p>*No. of Routes = 33</p> <p>*Average Route Length = 23.5 km</p> <p>*Daily Trips = 770</p> <p>*Daily No. of Seats = 53,900</p>	<p>Routes cover the east and the south-east area of LMA where PRTC routes cannot extend.</p> <p>*No. of Routes = 12</p> <p>*Average Route Length = 23.0 km</p> <p>*Daily Trips = 1,368</p> <p>*Daily No. of Seats = 68,400</p>	<p>Routes from the periphery of Walled City and from the Railway Station Area.</p> <p>Route lengths are not large as PRTC or Private Bus, But the number of the service routes is the largest and cover most of the public service network.</p> <p>Currently, about 60% of the public transport users are served by minibus.</p> <p>*No. of Routes = 50</p> <p>*Average Route Length = 17.0 km</p> <p>*Daily Trips = 8,456</p> <p>*Daily No. of Seats = 169,120</p>	<p>Routes are among Walled city, Krishan Nagar, & Shad Bagh.</p> <p>Penetrate in narrow streets of those densely located areas. Although not authorized, some of this type serve as feeder service in the developed housing areas, such as Model Town, Township, Iqbal Town, etc.</p> <p>*No. of Routes = 4</p> <p>*Average Route Length = 11.0 km</p> <p>*Daily Trips = 869</p> <p>*Daily No. of Seats = 8,690</p>	<p>All intercity buses of PRTC from GTS in Railway Sta. Area, and majority of private buses from Badami Bagh Gen Bus Stands, partly with airconditioned.</p> <p>*Daily Trips = 2,679</p> <p>*Daily No. of Seats = 133,950</p>	<p>Mostly serve for the same directions as the intercity buses. A larger concentration in Railway Sta. Area. Some are airconditioned.</p> <p>*Daily Trips = 3,954</p> <p>*Daily No. of Seats = 79,080</p>

*From Tables 4.2.1-2, Table 4.4.1, Appendix Tables 4.2.1-4.2.4. and other detail data.

Owners of vehicles on each route organize an association and the association is grouped into four federations. The association is an autonomous body having the following activities:

- At the terminal point of each route in the central area departures are regulated by an on-site manager. His job is to ensure a schedule of uniformly timed departures between the hours of 5 A.M. and 10 P.M.
- Order and cleaning of the parking and queuing places.
- Accounting record of miscellaneous expenses and the receipt of departure fee.
- Minimize violation of route operation.

There is no official limit to the number of vehicle permits, however it is likely that the federations are tightly organized in a manner which prevents free entry into the transit market.

(2) Public operator

Punjab Road Transport Corporation is the only public bus service corporation, belonging to Punjab Province. In Lahore, it has 7 depots for urban service and 34 scheduled routes. Its road worthy fleet is listed as 212 vehicles, however only about 60 % of them are not operating due to mechanical troubles and difficulty in procuring parts. The routes and fleet are summarized in Table 4.2.1. Volvo buses are in use by the PRTC in Lahore.

(3) Others

The Model Town Community owns 10 buses, 5 for a route to Railway Station and the other to Mayo Hospital using the same route as PRTC buses. They are given permits by RTA and charge the fare in the same manner as the PRTC.

Universities, colleges, and schools have their own buses or minibuses for their staff and students. Route fare and frequency are determined by each institutes. They are not required to obtain route permits from the RTA. Private factories also have their own buses for transport of employees. These buses are not administered by RTA.

(4) Overall demands and services

Trips and seat capacities of those services are summarized in Table 4.2.2 by using the route data in Appendix Tables 4.2.1 through 4.2.4.

It is calculated from the Table 4.2.2 that the available seat capacities per day in 1990 are $300,110 \times 2$ (Round trip) = 600,220 in LMA and $213,030 \times 2$ (Round trip) = 426,060 for intercity buses. If the average turns of passengers per trip is 2.0, the gross total seats available are $600,200 \times 2 = 1,200,000$ for the bus service within LMA. Intercity service have a turn rate of 1.0. Accordingly, $1,200,000 + 426,000 = 1,626,000$ seats are available for the LMA as a whole.

The result of the person trip survey shows persons using the public buses are 1,481,000 trips per day. Person trips and available seats are not equal but are close each other. The summarized trips and seats in Table 4.2.2 is considered to show the existing service of all public buses in LMA.

(5) Trips of Buses and Mini-buses

Service trips of buses and mini-buses were aggregated on the main routes in Figure 4.2.3 by using Table 4.4.1, Appendix Tables 4.2.1 through 4.2.4 and data of each route. Fig. 4.2.3 indicates trips or service frequency of both directions in 1990. (Duplicated from Figure 13.4.1)

4.2.3 Operators of Contract Carriages (Taxis and Rickshaws)

All taxis and rickshaws in Lahore are private operators. They register at RTA Lahore and receive permit of a taxis or a rickshaw. A Vehicle fitness certificate must be obtained every 6 month and an insurance coverage is compulsory.

Table 4.2.1 Urban Buses : Routes and Permits

1. Private Operators with Permits¹⁾

	(1984)	(1985)	(1990) ***	(1990) (Routes) ***
Mini Bus	996	1238		
Mazda	34	80	2189	(47)
Private Bus	143	179	260	(13)
Suzuki Wagon	191	362	213	(4)
Total	1364	1859	2571	(66)

2. PRTC Buses

	(1979) ²⁾	(1989) ²⁾	(1990) ³⁾	(1990) (Routes)
Schedules	321	275	212	(34)
On roads	145	167	85*	(30)**

Notes: * Of the scheduled buses, 40% are assumed on roads.

Source: ** The Study Team's estimate.

*** Routes with only a few permit vehicles are not included.

1) Regional Transport Authority Lahore, 1990.

2) Punjab Road Transport Corporation and TEPA-LDA

3) Working of PRTC (Memorandum of PRTC, 1990)

Figure 4.2.3 Trips of Buses and Mini-buses

Legend: The total of PRTC, private, Suzuki and mini-bus. (Inter and intra city service)
 : Both directions per day, 1990

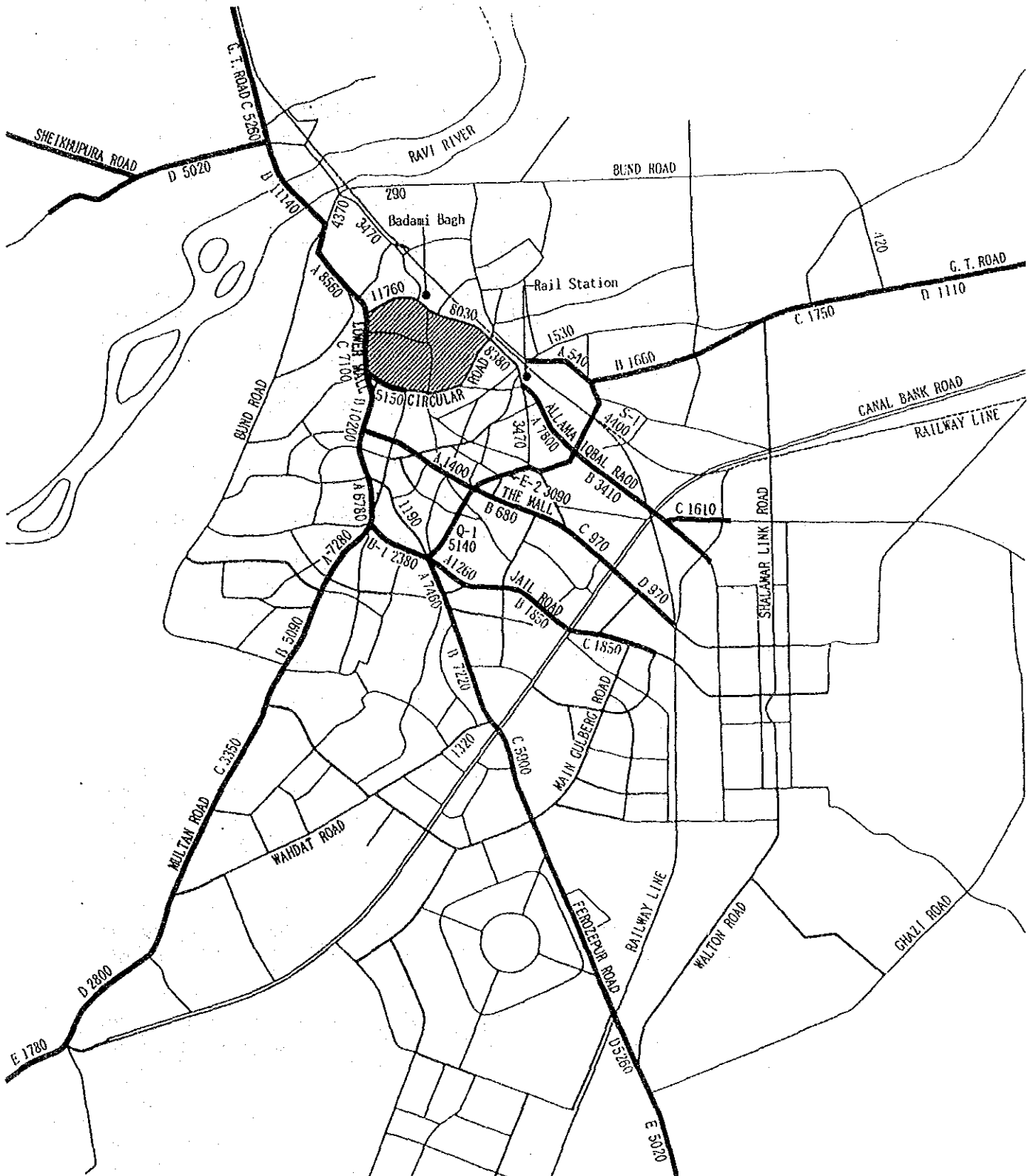


Table 4.2.2 Trips and Seat per Day

Group	Trips	(One-way) ²⁾	
		Seats ¹⁾ /Veh.	Seat Capacity
<u>In LMA</u>			
PRTC bus	1368	70	68400
Private bus	770	50	53900
Mini bus	8456	20	169120
Suzuki van	869	10	8690

S. Total	11463	-	300110
<u>Intercity service</u>			
Intercity bus	2679	50	133950
Intercity mini bus	3954	20	79080

S. Total	6633	-	213030

Total ³⁾	18096	-	513140

- Notes: 1) Seats include some standing spaces.
 2) One way service. Need to be doubled for the round trip service.
 3) Routes with a few permits are not included.

Currently 328 taxis hold taxi permit, while they were 450 in 1980. There is no limit in the maximum number of taxis to be determined by RTA, but the number of taxis have tended to decrease. The reasons are, it is said, strong competitive with rickshaws, other public service, and low revenues which do not attract new investors to the market.

Air-conditioned private taxis are operating in Lahore under a Special Punjab Government Project, and are given permit by Punjab Transport Authority. The number is 155 as of July 1990, short of the initial target of 300.

There are 7,000 rickshaws with permits in Lahore. This volume is said to be the maximum number under the current policy of RTA. This is an increase from 5,000 in 1980.

4.2.4 Animal Carts

(1) Tonga

Horse drawn carts for passenger service are used on narrow streets and wide roads as well. A cart can be registered at the Taxation Office, Lahore Metropolitan Corporation. The province has a rule not to increase the number of registered Tongas and Lahore has had constant number of 4040 for the past ten years.

It is common that Tongas wait for passengers at a stand adjacent to the terminal and stops of buses and minibuses. They then carry passengers to inner areas which are not served by buses. Each tonga has maximum six seat capacity for passengers.

(2) Rehra

An animal drawn cart for cargo transport service is called a "Rehra". These vehicles may be pulled by camels, horses, bulls or donkeys. Camel horse, and bull carts are also registered with an annual fee at the same office as Tonga registration. The maximum number of Rehras pulled by bulls, horses or camels is 5200 over the past ten years or so. Donkey carts are not authorized to serve for cargo transport, however an unknown number of donkey carts is used nevertheless for transport of various commodities.

(3) Push Cart

Human pulled carts are seen on roads quite often. They are said to be controlled by Zonal Districts of which there are 6 in the LMC. No number of carts is given by district. These slow moving carts are prohibited from running on VIP roads, such as Jail Road, Mall, Ferozepur Road, Canal Bank Road, and others. However, some are seen travelling on these roads.

4.3 Inter-city Service

4.3.1 Administrative System

The administrative organizations covering the intercity service are mostly the same as the case of urban service. They are shown also in Figure 4.1.1. Each RTA issues a permit of operation when it receives application by a private person or a company at its office. Accordingly, either of the two offices can issue permits for the same route since the route has two end points. For example, a permit for a route between Lahore and Multan can be applied for in the RTA office in either Lahore or Multan.

4.3.2 Operators

Intercity routes and permits filed in Lahore RTA are summarized in Table 4.4.1. There are scheduled PRTC buses of 366 on 54 routes. Private buses of standard size with a permit total of 1660 are registered over 98 routes, 528 minibuses have a permits on 43 routes, and 1,055 flying coaches are permitted on 55 routes.

In addition air-conditioned flying coaches which depart from Lahore represent approximately 440 permits out of the total of 510 permits in Punjab Province.

Table 4.3.1 Intercity Routes and Permits (September, 1990)

	Routes	Permits
1. PRTC ¹⁾	54	366
2. Private ²⁾		
Buses	98	1660
Mazda	43	528
3. Flying Coaches ²⁾	55	1055
4. Air Conditioned ³⁾		
Flying coaches and Buses	30	440

Notes: 1) Including "lease buses" from private owners.
2) Routes in operation include one route with one permit, and the same routes are counted separately if permit is issued in different timing by RTA, Lahore.

Source: 1) Punjab Road Transport Corporation, 1990.
2,3) Regional Transport Authority, Lahore, 1990.
4) Punjab Transport Authority, 1990.

4.4 Bus Terminals

4.4.1 General Bus Stand (Badami Bagh)

Badami Bagh Bus Stand, administered by Lahore Metropolitan Corporation (LMC), has an area of 15 ha approximately. It is a terminus for both intercity buses and minibuses excluding PRTC buses, with some transfer urban routes for buses and minibuses. A number of private shops of different types and some units of LMC and other agencies are found in the area. In addition the following facilities are located in association with the bus service.

- Bus bay areas : main 21 bays, east 13 bays
- Intercity wagon stands (20 stands)
- Local wagon stands (4 stands)
- GTS workshop
- Taxi & rickshaw stands
- Tonga/rehra stands
- Offices of administration, police stand, driver's rest house, waiting room for passengers, mosques, etc.

Average daily bus departures are given by the Commissioner of the General Bus Stands:

- East stands (Shorkot, Sargodha, etc.)	500
- Main stands (Rawalpindi, Multan, etc.)	1000
- Intercity wagon stands (Sargodha, Rawalpindi, etc.)	650
- Urban minibus stands (Model Town, etc.)	250
Total departures per day	2400

Every bus and wagon entering the General Bus Stand for passenger service pays a fee. A financial profile of the General Bus Stand is shown below:

July 1990 - June 1991

	Budget	
	<u>Revenue</u>	<u>Expenditure</u>
Fee & Rent	Rs.6.0 million	
Operation & Development		Rs.5.0 million
Surplus		Rs.1.0 million
Total	Rs.6.0 million	Rs.6.0 million

4.4.2 Railway Station Area (GTS)

The area in front of Lahore Railway Station is a complex of numerous bus terminals. The GTS Terminal has an area of 8 ha, covering parking spaces and busbays. All intercity buses of PRTC and NWFP depart and arrive here. Street sides adjacent to the GTS Terminal are de facto terminals of minibuses, flying coaches, A.C. coaches for intercity routes, and of PRTC urban buses, private buses, minibuses and Suzuki wagons for urban routes.

According to a survey conducted by HFA Consultants in March 1990, the departure of intercity buses are found as follows:

Intercity Routes	
GTS Bus (Punjab and NWFP)	340
Wagon/Minibus	1250
A.C. Flying Coaches	400
Total Departure per day	1990

Source : TEPA-LDA and HFA, 1990.

4.4.3 Others

There is no bus terminal facility beside the above two terminals in the Lahore Metropolitan Area. Private buses and minibuses for urban service have no terminal facilities, most routes has common roadside spaces for parking, such as Old Ravi Bridge, Bhatti Chowk and the Railway Station Area.

4.5 Trucks, Railways and Others

4.5.1 Trucks

All commodity carrier vehicles are required to register at RTA to receive a permit. If the truck owner intends to operate in two regions, he has to get a permit also in the other RTA. In RTA Lahore most permits are given to operate in the region, covering Lahore, Okara, Sheikhpura, and Kasur Districts.

Carriers are classified into two groups : public (general and commercial) carriers and private (non-commercial) carriers. The followings are the total number of permits issued by RTA Lahore :

	<u>Public carriers</u>	<u>Private carriers</u>	<u>Total</u>
Trucks	1723	960	2,683
Suzuki Pick-up	5496	9630	15,126
Total	7219	10590	17,809

Source : RTA Lahore, October, 1990.

Long body vehicles (trailers and truck-trailers) are mostly registered in Karachi, not in Lahore. Another group of the long body vehicles are National Logistic Cell (NLC) which belongs to the Federal Government and transport important commodities mostly to/from Karachi Port under guidance of the Federal Government.

4.5.2 Truck Terminal

There are no common use cargo terminals in Lahore. but, Minto Park Truck Complex, the north side to the Iqbal Park is a huge complex area clustered by a number of trucking company, warehouse, repair garage, spare-part shop, barbershop, restaurant, etc. The area is adjacent to the fruit/vegetable market, along the road between the old Ravi Bridge and the Badami Bagh General Bus Stand. heavy trucks, small trucks, tongas and rehras move on the road together with buses and mini-buses entering/departing Badami Bagh General Bus Stand. Streets in the complex are occupied by parking vehicles as well as those under repairing and loading/unloading.

There are adhoc road side truck stands, located near walled city on the Circular Road and Ravi Road and others. At these sites trucks occupy shoulders, road-side spaces for parking, loading/unloading and repairing. At the junction of Wahdat/Multan Roads, there is an Octroi office at which heavily loaded trucks have to report and pay local tax. The junction is always crowded by traffic because the road space is not enough for separating the stopping vehicles from the passing ones. Some trucks use the area for terminal points and transfer cargoes to small vehicles.

In the similar way, there is minor truck standing points at the southern

part of Ferozpur road, at the eastern part of G.T. Road, etc. They are mostly for a local market, not in a scale of whole sale markets of vegetables and fruits located at the northern part of Iqbal Park.

Large trucks are not allowed to travel roads in day time between 6.00 a.m. and 8.0 p.m., except Ravi Bridge, Bund Roads and the road of Ravi Bridge - markets - Truck Stands - Badami Bagh. Inside the city, particularly in the traditional old city areas, the cargo movement is conducted virtually through day and night by various types of vehicles including animal drawn carts.

4.5.3 Movement of Goods and Goods-Vehicles

In this transport system study of Lahore, main efforts were to estimate person trips in the future on which a transport service development plan will be established. Movement of good vehicles were surveyed only when the subject person drove the vehicle or he was transported by a kind of those vehicles. However, no details of cargo were studied in the person trip interview survey.

4.5.4 Development of Truck Terminals in the Future

In accordance with the growth of Lahore urbanization the volumes of cargo movement will increase. Whether those volumes increasing in the future can be handled by the existing trucking complex at the north side of Iqbal Park should a component of development studies of Lahore. It is felt that the existing truck service complex alone cannot handle the cargo movement which is forecast to increase accompanied by population growth, income level growth, urban spatial expansion, etc.

An improvement plan of the road capacity of the corridor Ravi Bridge - Markets - Truck Service Complex - Badami Bagh is worthy for study as discussed in elsewhere, together with a study to expand the existing trucking service complex.

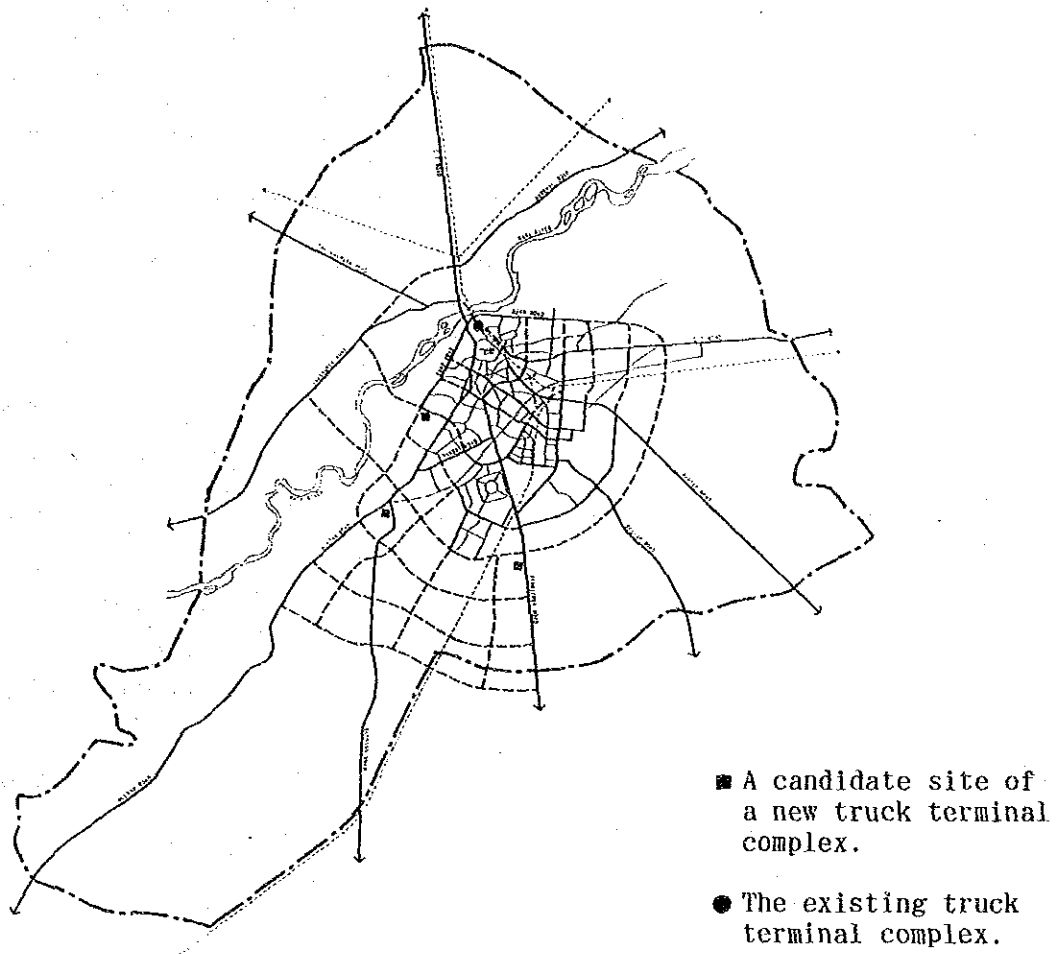
Locations of a new truck service complex with possibility of adjacent wholesale market development should be studied in a long range view points. Their locations would be along the radial truck roads and adjacent to Lahore Ring Road, subject for studies in the future. Lahore Traffic and Transport Component in PUDP, undertaken by HFA suggested a new location of Truck terminal at Babu Sabu at the junction of Bund Road and the proposed Lahore Ring road near Bakar Mandi (Discussion Paper 181, December 4, 1990) as a long term solution. However, its feasibility study is not likely included in the PUDP.

Figure 4.5.1 shows a candidate location of the new terminals subject for further studies: one on the Multan Road and the other on Ferozupur Road.

4.5.5 Railways

The railway network in Lahore Metropolitan Area is shown in Figure 4.5.2. The majority of passengers use the Lahore City Station and the result of one day passenger survey is shown in Table 4.5.1. According to the time table of Summer 1990, there are 59 trains departing Lahore Station daily.

Figure 4.5.1 Location of Truck Terminals



And one train goes to Amritsar, crossing daily the Indian border daily at Wagah.

Approximately, 15,300 passengers travel on trains daily at Lahore Station. The volume is divided into ticketed passengers (8300) and others (7000) which is composed of monthly ticket passengers plus student ticket passengers plus others including free riders. This is according to a survey conducted on 7th October 1990. Statistical data of sold tickets at each station, 1985-89, are in Appendix Table 4.5.3.

Passengers on other stations within the area are small in number. Some use the train for commuting and business but the time schedule and frequency of local trains does not seem to respond to demand. For example, at Lahore Cantonment Station, 15 trains in each direction stop at the station. Tickets sold in a day on 14th October, 1990 was 509 and monthly tickets of 21. Industrial plants surround the station, but an extensive commercial/business core is not yet developed near the station. Commuters to the centre of the city by railways are also few. It is found a number of passengers enter the train without buying a ticket and passengers exit the train go out at various directions neglecting the station exit. Pakistan Railways began terminating a few trains to and from the south at the Cantonment Station, instead of at Lahore Station in November, 1990.

Table 4.5.1 Railway Service and Passengers :
Lahore City Station (7th October 1990)

Departures	A	B	C	D	E
	Trains	Ticket Passengers	Total Passengers	Inter- viewed	C/D
1. To Sheikhpura/ Faisalabad	11	2,079	3,200	232	(14.00)
2. To Shorkot	5	437	650	144	(5.00)
3. To Narowal	9	1,071	1,600	188	(14.00)
4. To Karachi/Multan Kasur/Pakpattan	18	3,132	7,050	476	(15.00)
5. To Rawalpindi	11	1,406	2,800	235	(12.00)
6. To Wagah (Domestic)	5	150	-	-	-
TOTAL :	59	8,275	15,300	1,205	(13.00)

Note:

A: By the Time Table, September 1990, Information Centre, Lahore Station.

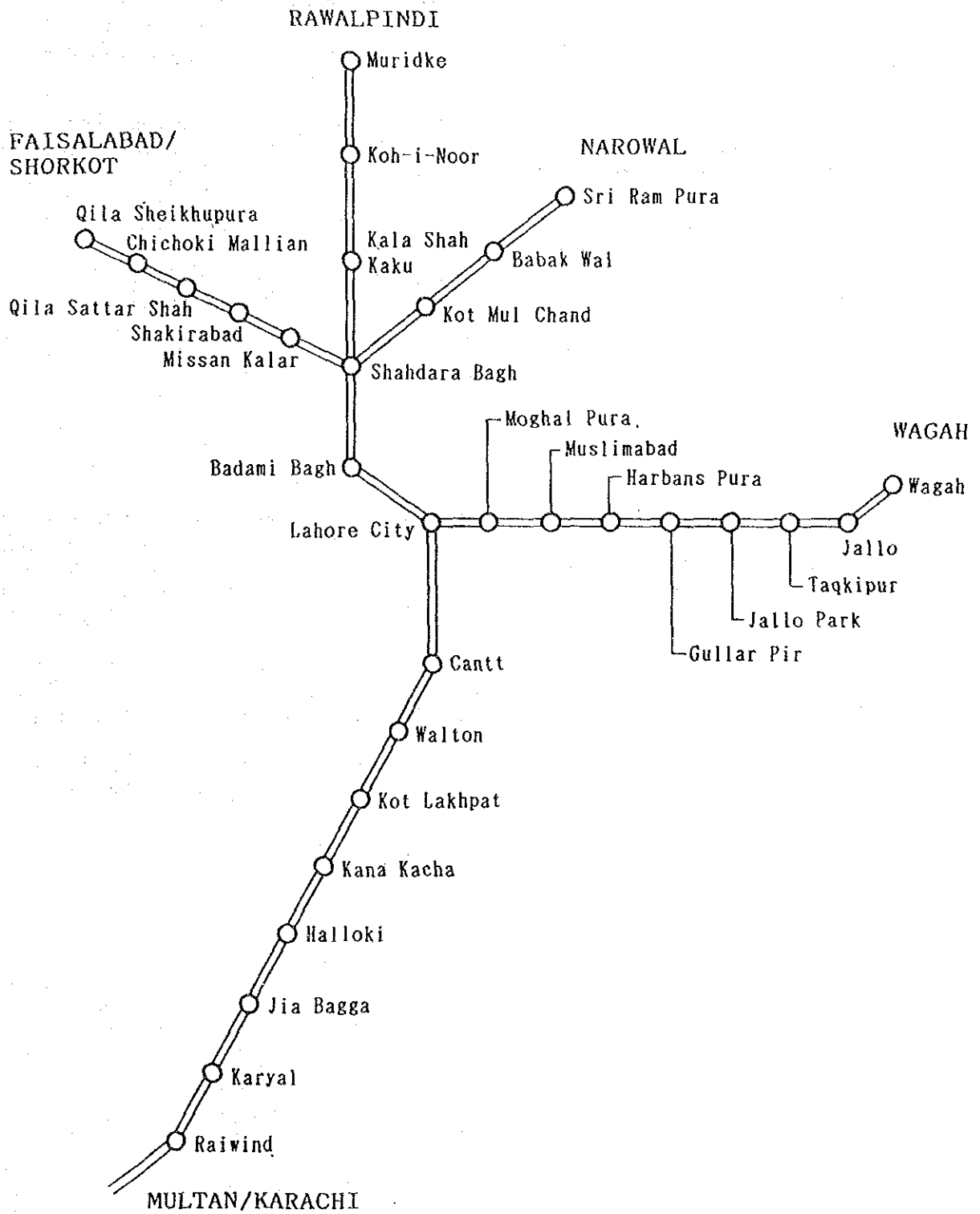
B: By Commercial Superintendent, Booking, Lahore Station.

C: Quick & crude counting 7th October, 1990.

D: Interviewed Passengers.

- Remarks :
- 1) There is a train to India and from India respectively via Wagah each day. The interview was not possible because the platform is fenced by Customs Department.
 - 2) C. Total Passengers include monthly ticket users, students, those who would buy ticket on the train and free riders. The counting was for a few coaches and multiplied to the total coaches of the train; it was a crude counting by the surveyors.
 - 3) According to the Ticket Collection Office of the Station the total tickets collected at the Station were 9,582 on the same day.
 - 4) Wagah line has a schedule of 5 trains departing every day, with the ticket passengers of 150.

Figure 4.5.2 Railway Lines in L.M.A.



4.5.6 Airport

The civil Aviation Authority, its headquarters located in Karachi, administers civil airports and flights throughout the country. The Lahore airport is located on the eastern side of the Cantonment, a distance of 8 km from the Assembly Hall. It has a runway of 2740 m with 46 m wide, bitumen surface. With radar and navigation aids facilities, the airport can operate for night time departures and landings.

Large aircraft such as DC-10 and A-300 are used at the airport in regular flight together other types including F-27.

The regular flight service at the airport is shown below, through which it is found the airport has a daily schedule of 22-30 departures for domestic lines and 2-3 departures for international lines.

	<u>Week</u>	<u>Daily average</u>
Domestic	304	43.4
International	38	5.4
Total	342	48.8

The number of passengers using the airport is shown in Appendix Table 4.5.1. The total number of arrivals and departures has increased from 0.83 million in 1981/82 to 1.36 million in 1986/87, an increase of 10% per annum. Cargo and mail handled are shown in Appendix Table 4.5.2. Cargo totalled was 12,007 tons in 1981/82 and 18,240 tons in 1986/87, an increase of 9% per annum. Mail showed an increase from 731 tons in total of 1981/82 to 792 tons of 1984/85, however it decreased after that year. It is said the decrease was caused by the liberalization policy to admit private operators, such as TCS which are classified as cargo in CAA's statistics.

Minibus and PRTC buses provide service to the centre of Lahore and taxis are available at the airport. No shuttle bus service between the airport and the city centre is in operation.

4.6 USER'S CHARACTERISTICS

4.6.1 Buses and Railways

(1) Shares

Modal split between the bus and rail was studied by using the person trip OD tables (B zones). It was found that the total person trips using bus and rail in 1990 is as follows (refer to Chapter 2)

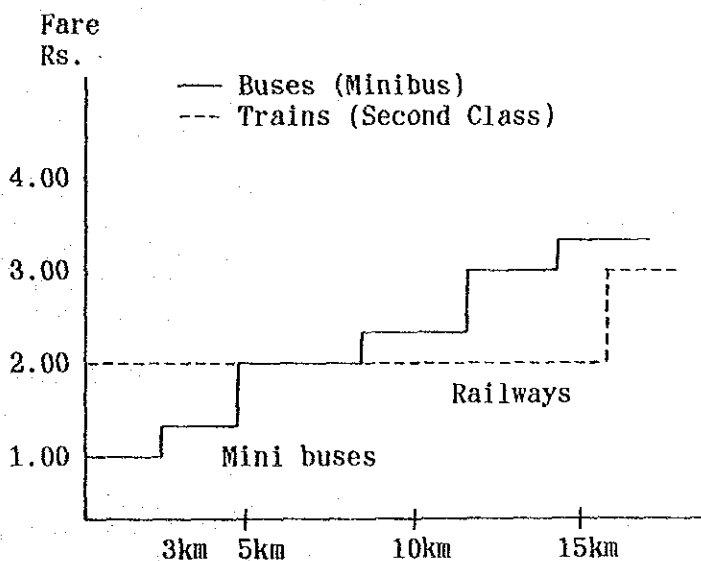
		(In per cents)	
1) Public buses (bus, minibus, suzuki)	1,481,500	(96.1)	(80.2)
2) PR's trains	60,900	(3.9)	(3.3)
3) Total of 1) and 2)	1,542,400	(100.0)	(83.5)
4) Total public modes including others	1,848,000	-	(100.0)

Only 3.3% of public transit riders use the train service provided by Pakistan Railways in the LMA, excluding through passengers. This corresponds to 1.2% of all vehicle users including bicycles and motorcycles.

(2) Fare Rates

Bus fares vary according to bus types, but differences are negligible within the LMA. They are listed in Appendix Table 4.6.1. Fares of minibus service was taken to represent the buses and compared with the fares of the second class on trains. Train fares in LMA are a flat rate of Rs.2.00 upto 15km and Rs.3.00 upto 30km. They are shown in Fig. 4.6.1.

Figure 4.6.1 Public Transport Fares



(3) Modal Split between the Existing Buses and Railway Service

Currently Pakistan Railways provides long distance inter-regional service and of which some stop at stations in LMA. Frequencies are low and not competitive with buses and minibuses. Data, particularly with railway users, were not sufficient to develop a reliable model formula for modal split.

Recognizing these disadvantages, the following analysis was conducted by studying the data:

Trips : Zonal trip in B zones are used to find public service users and rail service users. The total of one day's trips are used and the percent of rail users among the public service users are calculated for selected zone pairs.

Travel time : 1) by buses & minibuses

- . Approach section to/from the zone : 5 minutes per access
- . Waiting time 5 minutes
- . i.e. 15 minutes of access time from the zone i to j.
- . Bus travel time : 20 km/hr (in City)
24 km/hr (outside City)

2) by train

- . Approach section between the station and the road node:
5 minutes
To and from the zone center, if there is a bus route, bus time plus 5 minutes walk time and 5 minutes wait are added. If there is a direct link from the node to the zone center, a walk of 5 minutes is assumed.
- . Waiting time : Trains are not frequent, therefore an average of 30 minutes is used. Bus wait time: 5 minutes.
- . i.e. 40 minutes of access time from the zone i to j. If a bus route is used, the time on the bus plus bus wait 5 minutes are added.

Fares : As shown in Figure 4.6.1, the fares of buses and rails are very close and it is assumed no difference in fare rate.

Route : The shortest route between the zone i to j is selected by looking at the bus and railway route map, and the bus travel time is calculated by 20 km/hr on the in-city roads and 24 km/hr in the suburban roads. The travel time by train is calculated at 35 km/hr.

The zone pair data showing the percentage of rail users are related to the time factors.

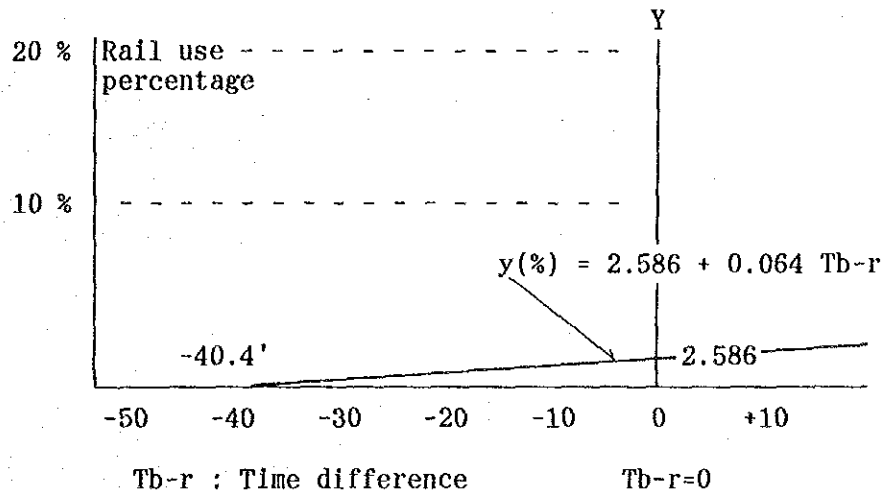
- . Pr is quite small mostly around 1%.
- . Time ratio factor is not showing a tendency of modal split.
- . Time difference factor is selected to find a tendency of linear relationship through regression analysis, but the value of "r" is low.

Figure 4.6.2 Modal Split : Buses and Railways

$$Pr = 2.586 + 0.064 \cdot (Tb-r), \quad r^2 = 0.587$$

where Between the zone i and j

Pr : Percent of rail users
 Tb-r : Travel time difference in minutes
 Tr : via railways
 Tb : via buses



The model through selected data shows the railway users have the maximum percent of 2.6% when the travel time via bus and that via railways are equal. If the travel time via railways is larger than buses more than 40.4 minutes, there are no railway users and all use the bus service. Percentages of rail users change along the line; as the travel time by rail becomes larger than buses, the modal split share of railways will decrease linearly.

(4) Application of the Model

The model in Figure 4.6.2 was applied to the person trips in 1990 using the c-zone matrix of public service users. Modal split between bus versus rail showed assigned person trips on each link of the network. The traffic count data on the screen line roads in LMA are compared with the assigned trip volume on the same link as in the following Table 4.6.1.

Table 4.6.1 Screen Line Check : Public Service Users

Screen	A	B	C
	Traffic count in vehicles and persons	Trip assignment on the network	A/B
Screen Line A (Canal Bank Crossing)	56222 veh ¹⁾ 579294 prs ²⁾	558269	1.04
Screen Line B (Railway Crossing)	53742 veh ¹⁾ 395918 prs ²⁾	391224	1.01
Screen Line C (New Ravi Bridge)	16054 veh ¹⁾ 274905 prs ²⁾	3215953	0.85

Notes : 1) Taxi, Rickshaw, Suzuki, Minibus, Bus, Insti. bus, and Tonga
 2) Persons are tabulated by using the average occupants observed.

Passengers using each railway station are given by PR as in Appendix Table 4.5.3. They are compared in terms of passengers per day as follows:

A	B	C
PR's ticket sales data	Trip assignment on the network	A/B
18,940	12,269	1.54

Notes : A from Appendix Table 4.6.2.

Since the persons using railways are relatively small and train frequency is very small, it is difficult to develop a diversion model. However, the time difference model after changing the parameters is used for the estimate of LRT and Rail users.

4.6.2 Bus Passenger Interview

(1) Objective and Composition of Survey

The Bus Passenger Interview Survey was to collect information on typical travel characteristics of bus passengers who use urban bus services and their comments on new services in Lahore.

(2) Survey Method and Survey Period

Among the existing bus stops in LMA, the ten (10) major bus stops shown in Figure 4.6.3 were selected as the survey stations. The Bus Passenger Interview Survey was conducted at the bus stops from 7:00 to 18:00 on October 6, 1990. The interview was made only with passengers who were waiting to use buses at the bus stops.

The survey form for the bus passenger interview survey is shown in Appendix Table 4.6.1 and includes the following survey items.

- Sex
- Place of Residence
- Address of Origin and Destination
- Trip Purpose
- Modes of Travel (Modes to come here)
- Travel Time
- Bus Route No. The passenger intends to get on)
- Occupation
- Age
- Monthly Income
- Comment on the Current Bus Services
- Others

(3) Survey Results

The results of the survey are enumerated and the summary is shown below. The survey was conducted on the inward direction on selected points (Fig. 3.4.4) of Ferozpur and other roads during the morning time of 7:00 - 11:00 a.m. and the outward direction during the afternoon 2:00 - 6:00 p.m.

a. Interviewed passengers

	Men	Women	Total
Morning (To center)	433	2	435
Afternoon (From center)	412	61	473
Total	845	63	908

b. Trip purposes

The distribution of trip purposes in percentages.

	To Work	To School	To Home	On Business	Others	Total
						(%)
Morning	57	8	9	12	14	100
Afternoon	24	3	45	6	22	100
Total	40	5	27	9	19	100

c. Travel Time

Travel time is composed of 1) origin to the bus stop, 2) waiting time, and 3) the time to arrive at the destination. The total time becomes larger when the survey stations are away from the central area to the

south. Buses are frequent on main roads, but people have to wait 15 minutes in average because crowded buses do not stop and riders must wait for a bus on a specific route.

	Access	Waiting	Time on board	Total	Fare paying
Morning (To center)	19.2	16.2	33.6	68.9	2.80
Afternoon (From center)	20.4	15.5	40.8	76.7	3.30
Total	19.8	15.8	37.4	73.0	3.10

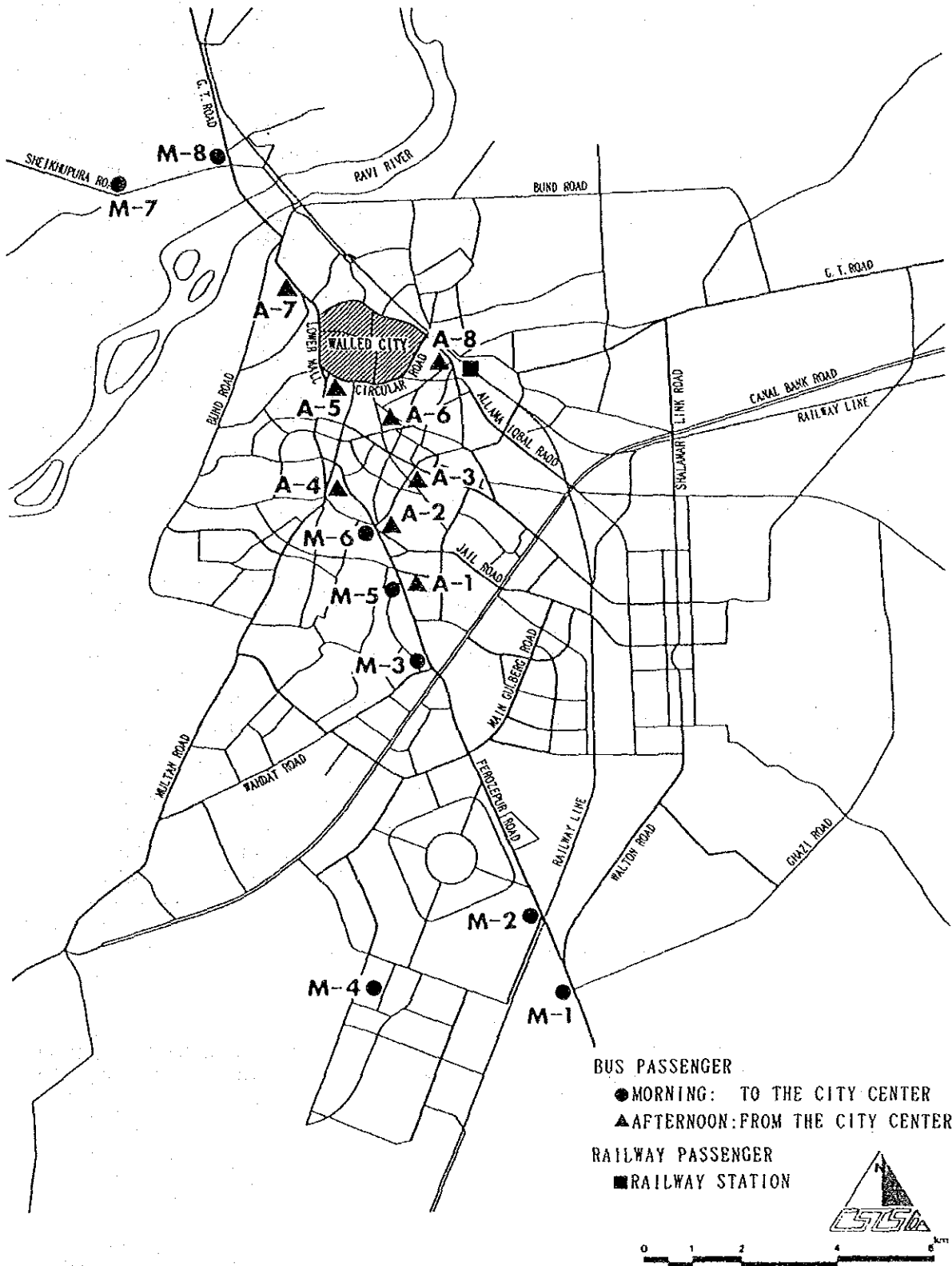
d. Perceived Modal Choice of Public Transport

In order to determine the tendency of passengers to use a new form of transit service, a question was included in the interview asking about their preference for a new service with a higher fare. In the survey, questions were raised to know how much they would pay additionally to use a faster service:

No express bus service exist currently in the LMA. The questions were their preference for a hypothetical faster service. Answered are classified in the following Table.

It is expected that a market mechanism works in the modal choice; when a passenger prefers a faster mode or a better quality service the service is charging a high fare and he has to pay a higher price. The interview resulted in a tendency that approximately 75% of the interviewed persons would pay Rs.1.88 in addition to the current payment of Rs.3.00 if the service of a 30% faster transport are supplied. They would pay Rs.2.32 if the new bus can supply a service of 50% reduction in travel time.

Figure 4.6.3 Public Transport Survey Stations



Preference for New Service

Interview time	Average travel time from orig. to Desti.		Average fare paid	Services		Faster by 30%	Willing to pay additionally	Faster by 50%	Willing to pay additionally
	Min.			Faster by 15%	Willing to pay additionally				
Morning	50	Min.	2.80 Rs	42'	+ 1.38 Rs	35'	+ 1.86	25'	+ 2.37
persons (%)			435 (100)		338 (78)		329 (76)		331 (76)
Afternoon	56	Min.	3.21 Rs	47'	+ 1.23 Rs	39'	+ 1.90	28'	+ 2.29
persons (%)			473 (100)		354 (75)		341 (72)		357 (76)
Total	53.18	Min.	3.00 Rs	45'	+ 1.31 Rs	37'	+ 1.88	27'	+ 2.32
persons (%)			908 (100)		692 (76)		670 (74)		688 (76)

e. Vehicle Ownership

The bus passengers asked if their family has a private vehicle are classified as in the following figures.

	M/C	Car, Jeep	Others	Total	Not Owned	G.Total
Morning (To center)	73 (17)	33 (7)	0 (0)	106 (24)	329 (76)	435 (100)
Afternoon (From center)	84 (18)	25 (5)	0 (0)	109 (23)	364 (77)	473 (100)
Total	157 (17)	58 (7)	0 (0)	215 (24)	693 (76)	908 (100)

Remarks : Number in persons
() in percent

The above figures show 24% of passengers have a motorcycle or car/jeep in his family. The reason of not using the private vehicle are tabulated as in the following way.

	a) Others in family use the vehicle	b) In mechanical troubles	c) Congested roads or difficult in parking	d) Others	Total
Morning (To center)	80	10	11	5	106
Afternoon (From center)	77	14	9	9	109
Total	157 (73%)	24 (11%)	20 (9%)	14 (7%)	215 (100%)

Of those answered there is a motor vehicle in his family, 73% of the respondents said the vehicle was used by an other member of the family.

**CHAPTER 5. URBAN GROWTH AND SOCIOECONOMIC
FRAMEWORK**

CHAPTER 5 URBAN GROWTH AND SOCIOECONOMIC FRAMEWORK

5.1 Socioeconomic Perspectives for 2000/2010

This section aims to describe the outline of perspective on some socio-economic indicators related to the basic factors for transport demand forecasting. First, the socioeconomic frame of the LMA as a whole is estimated based on the official national and provincial plans. In the next stage, the distribution of population, employment, and other factors by area is then predicted.

5.1.1. Population

(1) Population in the LMA

The total population in the LMA is estimated as 5.43 million in 1990. Thus, the average annual growth rate between 1970 and 1990 was 3.4%. It is believed that this figure is higher than the 3.1% which is the average of all Pakistan, due to migration into the LMA.

People in 4.17 million, or 77% of the total in the LMA, live in the inner area. This concentration of population to the inner area has declined in the 80s. Urban growth, in terms of population distribution is spreading toward outskirts of the inner area of the LMA.

Based on the growth trends of population and the following factors, the population in the years of 2000 and 2010 was forecasted as shown in Table 5.1.1 and Figure 5.1.1.

- a) It was assumed that the natural growth rate of the LMA was equal to the growth rate of Pakistan. To this was added the increase due to migration.
- b) The future natural growth rate in LMA is based on the estimated population growth rate of the Seventh Five Year Plan.
- c) Considering the past trend of migration to LMA, 2 cases of future growth are proposed:
 - Case 1: It is assumed that the future growth rate of migration will gradually decline in proportion to the natural increase.
 - Case 2: It is assumed that the future growth rate of migration will maintain the recent high growth.

The past trend of population growth and the results of alternative forecasts are summarized in Table 5.1.1.

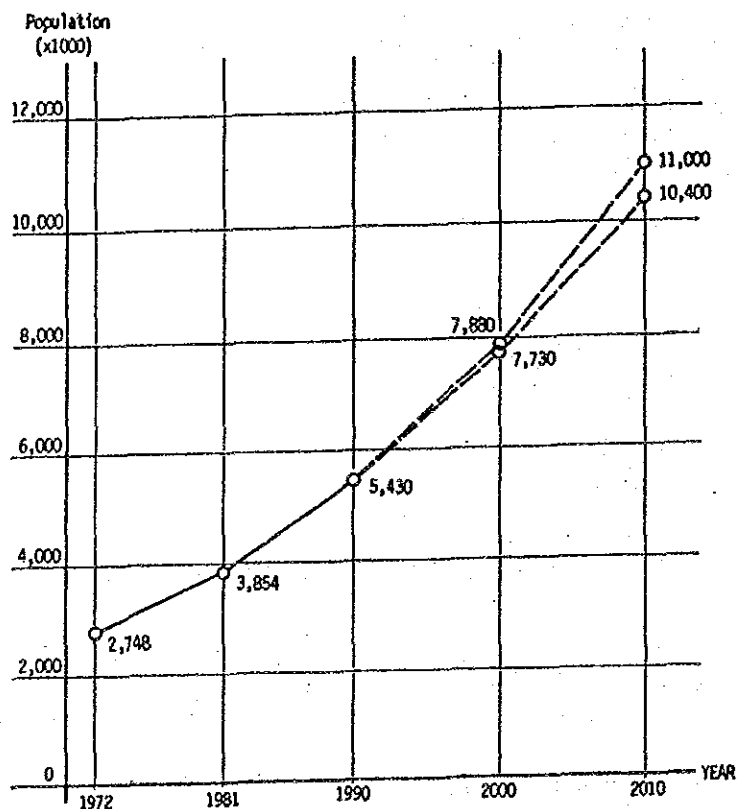
Table 5.1.1 Population Forecast of LMA, 2000 and 2010

YEAR	POPULATION (× 1000)		ANNUAL GROWTH RATE(%)				
	CASE 1	CASE 2	NATURAL	MIGRATION		TOTAL	
				CASE 1	CASE 2	CASE 1	CASE 2
1972	2,748						
1981	3,854		3.1	0.7		3.8	
1990	5,430		3.1	0.8		3.9	
2000	7,730	7,880	3.0 ^{1/}	0.6	0.8	3.6	3.8
2010	10,400	11,000	2.6 ^{1/}	0.4	0.8	3.0	3.4

^{1/} 7th 5-Year Plan, i.e., 3.0% is growth rate of 1992/1993 and 2.6% is 2002/2003.

The estimated figure in case 1 was chosen as a fundamental framework for the planning of urban transport system in the LMA.

Figure 5.1.1 Population Forecast of LMA, 2000 and 2010



(2) Population by Gender and by Age Group

Based on the data in 1981, the population by gender and by age group (5 years) is forecasted for the year 2000 and 2010 respectively, applying "Cohort" method.

For the model, followings are assumed:

Crude Birth Rate(CBR) : 32/000 (cf. 43.3 in Pakistan, 1990)

Infant Mortality Rate(IMR):70/000 (cf. 113 in Pakistan, 1990)

Crude Death Rate(CDR) : 8.9/000 (cf. 10.5 in Pakistan, 1990)

Migration Rate : 0.7% (from 1972 to 1981 in LMA)

The results of forecast are summarized in Table 5.1.2 and 5.1.3.

Table 5.1.2 Population Indicators by Gender and Age Group

Items	1981	1990 ^{1/}	2000	2010
Sex rate (male/100 female)	115	112	110	108
Below 5 years old (%)	14.8	14.4	14.8	14.7
Below 15 years (%)	42.8	40.2	40.8	41.1
15 to 64 years (%)	53.6	55.5	54.5	54.1
Above 65 years (%)	3.6	4.3	4.7	4.8
Females of 15-49 yr. (Baby-bearing age) (%)	45.7	47.5	46.9	46.7
Dependency rate (%) (below 15 & above 64)	86.6	80.2	83.5	84.8

^{1/} Data in 1990 were derived from 1990 HIS

Table 5.1.3 Population by Gender and by Age Group, 2000 and 2010

AGE	2000-LMA			2010-LAM		
	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE
00-04	1,140,415	579,563	560,852	1,525,121	775,071	750,050
05-09	1,081,773	560,818	520,955	1,466,471	760,254	706,217
10-14	931,016	487,899	443,117	1,282,867	672,286	610,581
15-19	754,427	397,937	356,490	1,058,772	558,470	500,302
20-24	690,494	365,320	325,174	1,058,772	474,213	424,838
25-29	603,249	319,451	283,798	899,051	389,998	349,248
30-34	524,838	274,029	250,809	739,246	336,801	316,111
35-39	446,091	231,526	214,565	652,912	300,651	286,564
40-44	354,317	186,778	167,539	587,215	266,915	253,793
45-49	277,872	144,533	133,339	520,708	221,029	208,485
50-54	209,930	106,944	102,986	429,514	158,134	148,614
55-59	185,040	91,515	93,525	306,748	116,378	115,377
60-64	165,037	89,185	75,852	231,755	103,797	96,717
65-69	110,240	58,849	51,391	200,514	76,280	75,761
70-74	167,447	97,973	69,474	152,041	106,383	93,204
75-	87,814	48,097	39,717	147,478	78,232	69,246
TOTAL	7,730,000	4,040,417	3,689,583	10,400,000	5,394,892	5,005,108

(3) Population by Occupation

Population, which was estimated by age group in the previous section, is broken down by occupation.

The following were the preconditions for this estimate:

- a) Ratio of school enrollment is assumed to increase in accordance with development of educational facilities, such as primary, middle schools and higher degree, professional, within LMA.

Table 5.1.4. School Enrollment Rate

	1990 2000 2010		
	1990 2000 2010		
	1990 2000 2010		
Primary School	86	93	100
Middle/High School	58	59	61

- b) The ratios of "Looking for work" and "Others" against to the total work force are stable even in future.
- c) Female workers will continue to increase following the past trend, and comparison with other Islamic countries is also considered.

Table 5.1.5 Female Workers against Male Workers

	1981 1990 2000 2010			
	1981 1990 2000 2010			
Lahore Dist. (LMA)	4.5	6.8	13.0	19.2

(reference)

Pakistan	10.4% (1984)
Morocco	24.5 (1982)
Egypt	26.5 (1984)
Indonesia	64.9 (1986)

The result is shown in Table 5.1.6.

Table 5.1.6 Estimated Population by Occupation, 2000 and 2010

(000)

	2000			2010		
	Total	Male	Female	Total	Male	Female
Total Pop.	7,730	4,040	3,690	10,400	5,395	5,005
Total Work Force	5,508	2,900	2,608	7,408	3,860	3,548
-Working	1,824	1,613	211	2,472	2,074	398
-Looking for	165	152	13	222	204	18
-Housekeeping	1,561	-	1,561	2,027	-	2,027
-Student	1,539	880	659	2,124	1,242	882
-Others	419	255	164	563	340	223

(4) Work force by Employment Sector

Number of employment by industry sector was also estimated, considering the following factors:

- a) Number of employment in primary sector will increase slightly in future, while its share in all the sector will decrease.
- b) Number of employment in secondary sector will increase with 160 thousand from 1990 to 2010, and its share will decline to small extent. The industrial estate for this sector will be developed within the existing areas and along the arterial road in outer area of LMA.
- c) Employment in tertiary sector will largely increase both in number and in share.
The tertiary sector is also developed in the LMA, in accordance with the concentration of business/commerce function at the both city centers existing and southern newly-developed.

The result of forecast is summarized in the following tables:

Table 5.1.7 Workers by Employment Sector, 2000 and 2010

SECTOR	PROJECTION-2000		PROJECTION-2000	
	NO. (000)	(%)	NO. (000)	(%)
AGRICULTURE	128	7.0	148	6.0
MINING & QUARRYING	3	0.2	3	0.1
MANUFACTURING	268	14.7	344	13.9
CONSTRUCTION	93	5.1	124	5.0
ELECTRIC, GAS & WATER	47	2.6	69	2.8
COMMERCE	434	23.8	606	24.5
TRANSPORT	88	4.8	129	5.2
FINANCE & INSURANCE	60	3.3	91	3.7
COMMUNITY & SOCIAL SERVICE	703	38.5	958	38.8
OTHERS	0	0.0	0	0.0
ALL INDUSTRIES	1824	100.0	2472	100.0

Table 5.1.8 Percentage Composition by Sector

Industry Sector	1981 ^{1/}	1990 ^{2/}	2000	2010
Primary	11.4	7.8	7	6
Secondary	26.2	20.4	20	19
Tertiary	59.4	71.8	73	75
	100.0	100.0	100	100

^{1/} National Census
^{2/} Estimated by HIS

5.1.2 GNP per Capita

Per capita Gross National Product (GNP) was estimated based on the following data.

- a) Trends of GNP per capita, 1960 to 1988.
- b) Perspectives in the Seventh Five Year Plan and National Transport Study (JICA, 1988).

The estimated GNP per capita is Rs. 16,440 in 2010 (at 1990 price), and this is 1.83 times bigger than that in 1990, at an annual growth rate of 3.1%.

Table 5.1.9 GNP per Capita, 2000 and 2010

Items	1987	1990	2000	2010
GNP per Capita				
at 1987 Price (Rs.)	6,906	7,590	10,340	13,900
at 1990 Price (Rs.)		8,977	12,230	16,440
Annual Growth Rate (%)		3.21	3.12	3.00

5.1.3 Household Income Level

At first, the correlation between GNP per capita and average household income of the national level was examined, and this correlation was applied to the future GNP per capita already estimated in the previous stage.

$$Y = 0.4712 * X - 250.19$$

wherein, Y: Household Income (Rs. per month)

X: GNP per capita (Rs.)

r= 0.999

	GNP per capita (at 1987/88 price)	Average House- hold Income
1977/78	Rs.5,071	Rs.2,160/month
1982/83	6,055	2,560
1987/88	6,906	3,026
1992/93*	8,088	3,562

* Seventh Five Year Plan

The regional difference between the income level in Pakistan and that in LMA was also considered by the available data, and the same tendency was applied even for the future. The average household income level in LMA was finally obtained.

Table 5.1.10 Average Household Income, 2000 and 2010

Items	Year	1990	2000	2010
GNP per Capita (Rs.)		7,592	10,340	13,900
Family Income (Rs./Month)		3,338	4,622	6,300
Pakistan (Rs./Month)		3,750	5,190	7,080
Lahore (Rs./Month)		3,906	5,410	7,370

Note: 1990 value

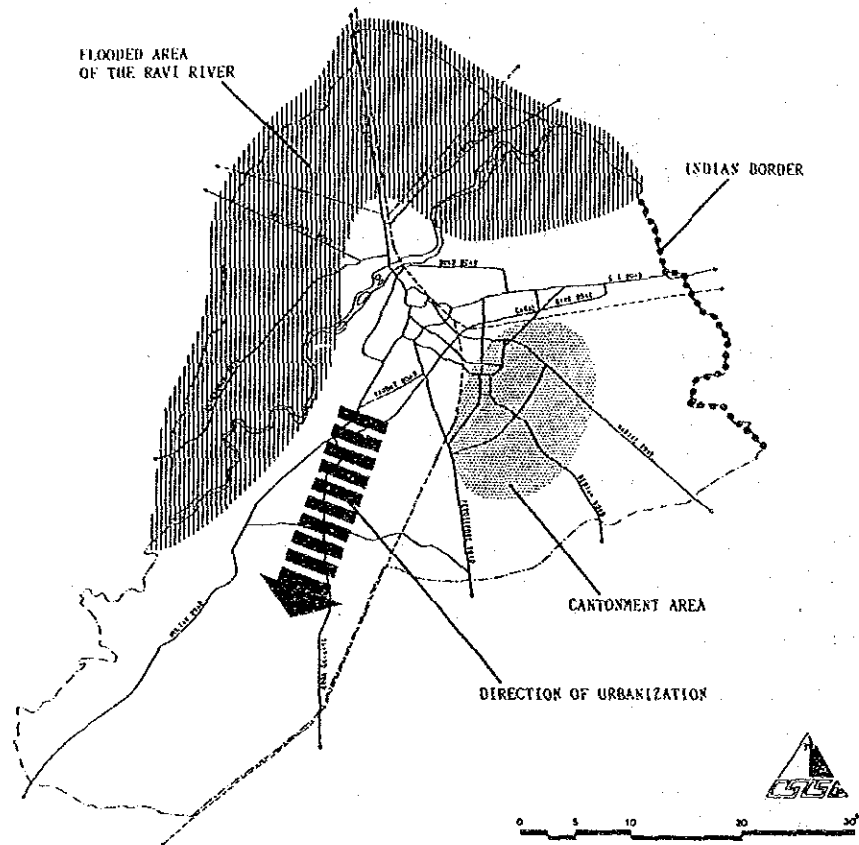
5.2 CONCEPTUAL LAND USE PLAN

Following the socioeconomic framework discussed in the previous section, a conceptual land use pattern was developed to cope with that framework. Although this conceptual land use pattern had a very close mutual relationship to transport network configuration, the land use pattern was formulated prior to planning the transport network system.

5.2.1. Direction of Future Urbanization

Historically, Lahore developed from the Walled City, which originated in the Moghul Era. It has expanded as shown in Chapter 1 (Figure 1.3.3), but there are some topographical and social limitations in its future urban growth, which has been considered to be toward the south/south-west direction as shown in Figure 5.2.1.

Figure 5.2.1 Direction of Future Urbanization



In addition, renewal development in the existing urbanized area must be done to cope with future development pressure, since some portions of the area have inadequate land use and rather low density. Presently, there are a few high-rise office buildings under construction and redevelopment projects in the central area of Lahore.

Judging from the above-mentioned conditions, three (3) urban growth alternatives are proposed as the basis for forecasting future traffic

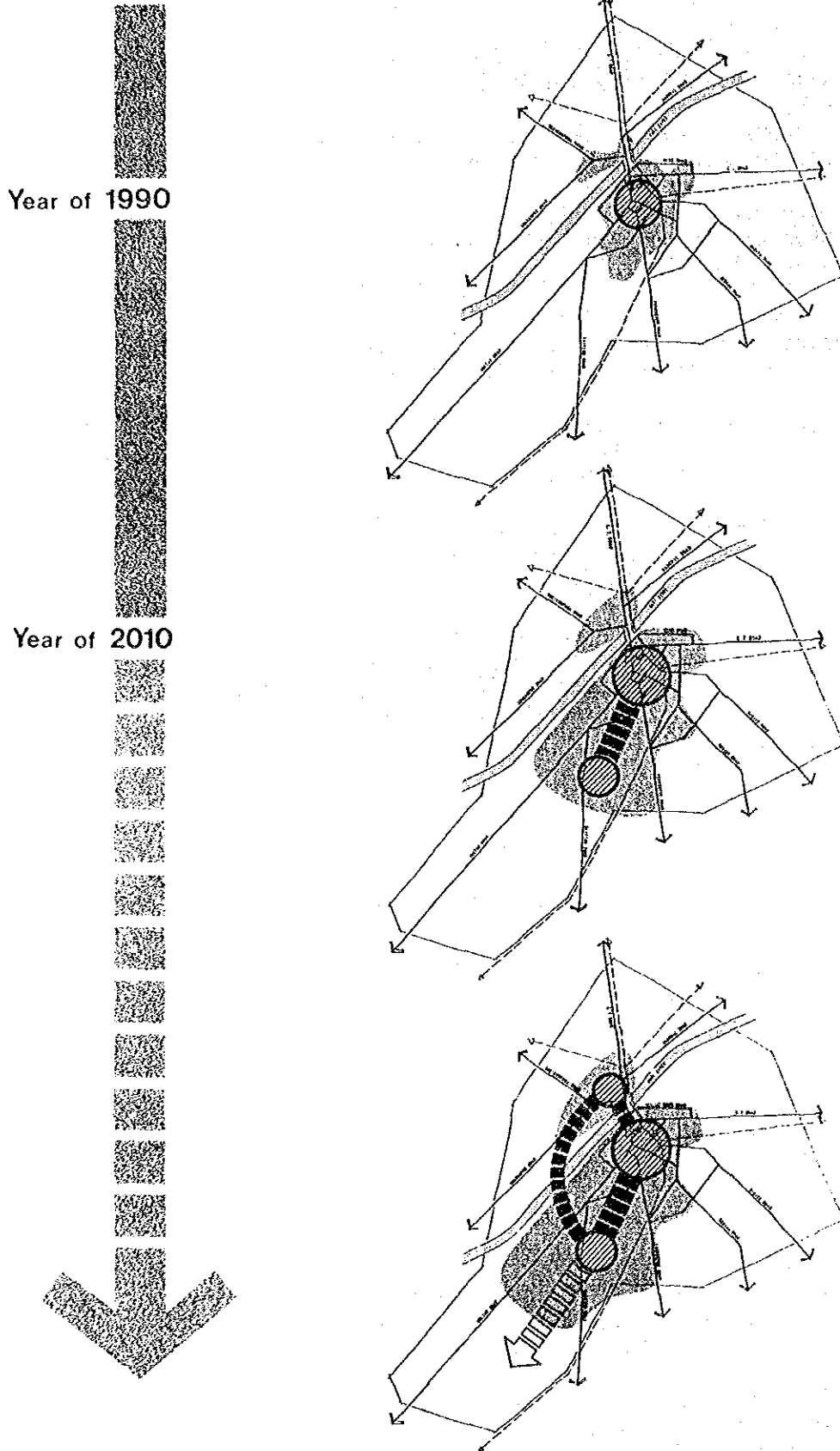
demand. These have been formulated after looking on the potentials, limitations, and historical background of urbanization and previous related studies.

- (a) Centralized Pattern: The existing urban activity center will continue into the future.
- (b) Decentralized Pattern (Twin-core Pattern): A new sub-center will develop in the southern/south-western suburbs of the LMA.
- (c) Dispersed Pattern (Triple-core Pattern): New sub-centers will develop not only in the south but also in the north, beyond Ravi River.

After careful examination, these three (3) alternatives are considered in accordance with a time stream as illustrated in Figure 5.2.2.

- In the 1990s: Urbanization will expand mainly in the southward direction based on the existing urban activity center.
- In the 2000s: The new sub-center will start to develop in the southern area in order to cope with the future population growth.
- After 2010: The population in the LMA after 2010 is expected to more than double compared with 1990; therefore, a third urban activity center will be necessary in the north, beyond the Ravi River.

Figure 5.2.2 Alternative Land Use Patterns
(with Time Sequence)



5.2.2. The Conceptual Land Use Plan

Based on the preceding discussion, the conceptual land use in 2010 has been drawn as shown in Figure 5.2.3. The concept is described as follows:

- (1) Urbanization will mainly extend to the south up to the old LMA boundary. It is expected that the urbanization in the northern area beyond the Ravi River will not extend much in 2010 due to the limitation of the flood control of Ravi River.
- (2) There are two business cores located in the existing city center and southern development area. The concept of the southern sub-core is shown in Figure 5.2.4. The sub-core is located at the intersection between the radial road and the circumferential road. The radial road is the main public transport corridor connecting with the existing city center. It would be effective to introduce traffic management measures, such as a transit mall along the public transport corridor, to create types of urban amenities with priority to pedestrians and public transport. For the surrounding residential area, it would be necessary to maintain good residential circumstances by providing adequate road network system, which excludes through-traffic.

Figure 5.2.3. Conceptual Land Use Pattern, 2010

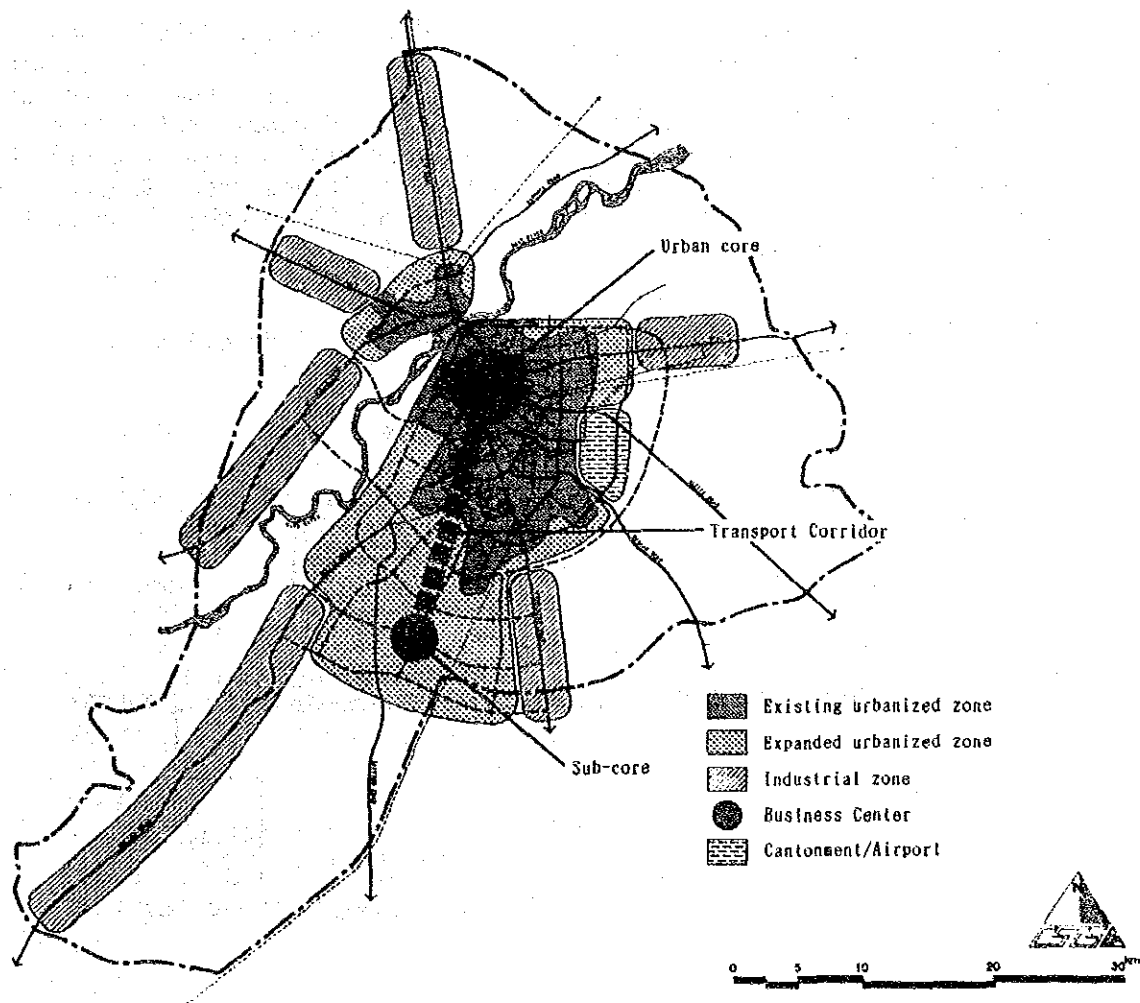
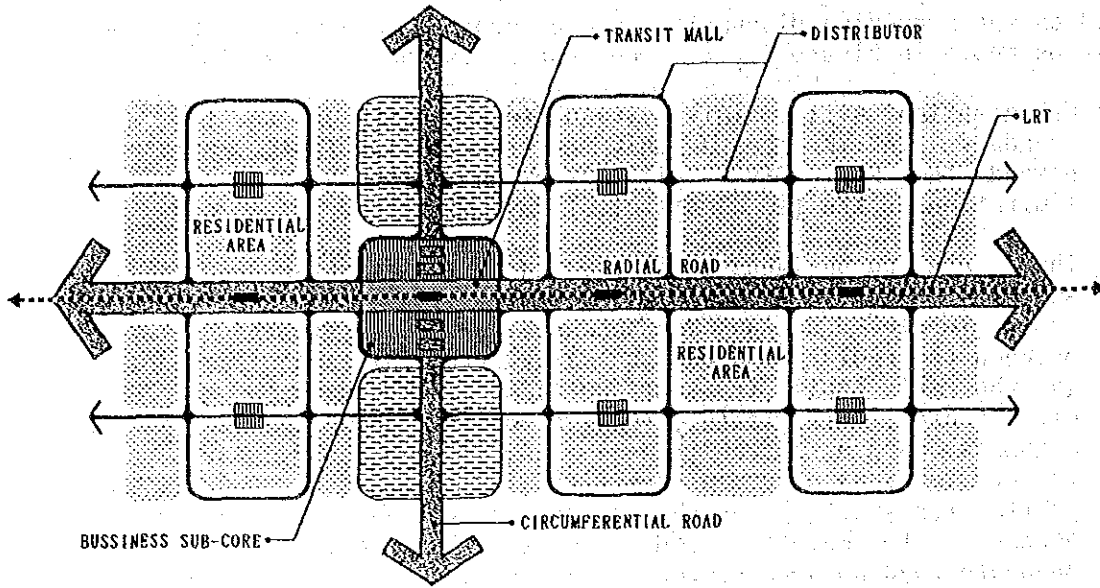
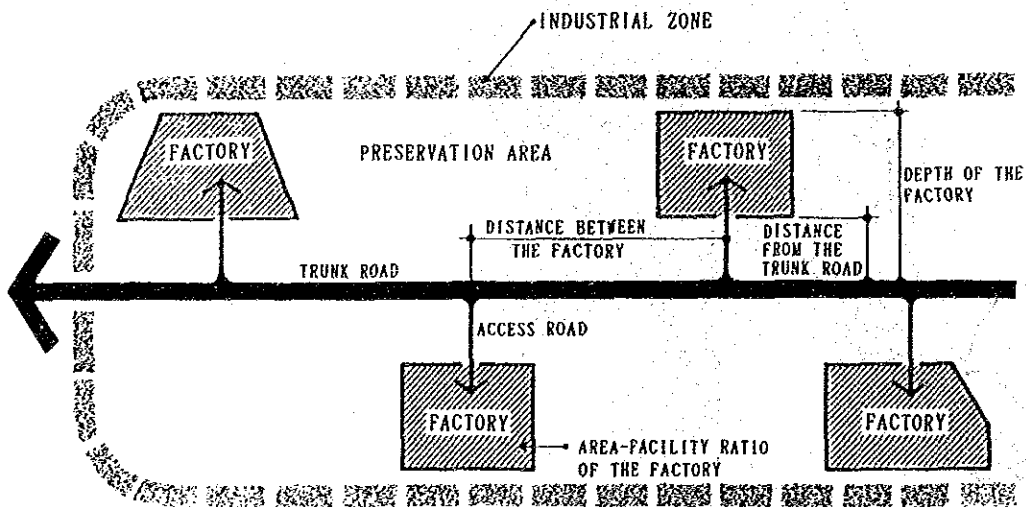


Figure 5.2.4 Conceptual Land Use for the Southern Sub-core



- (3) The new industrial zones along trunk roads in suburban area, such as Multan, Ferozpur, and G.T. Road-east, will be developed in addition to the existing industrial zones, such as G.T. Road-north and Sheikhpura road, due to the expected active economic activities in the future. For the development of new industrial zones, it would be necessary to create good industrial activity circumstances taking into account the distance between factories and the the preservation of the surrounding greenery, as shown in Figure 5.2.5.

Figure 5.2.5 Conceptual Land Use for Industrial development



5.3 DEMOGRAPHIC FRAMEWORK BY AREA

5.3.1. Population at Night

Future population by zone was estimated, considering the future land use pattern examined in the previous stage. The procedure of estimation is summarized as follows:

Each 84 zones in the LMA were classified into 7 categories according to the types of foreseeable land use/development in the future, and number of night population (residents) was projected. Table 5.3.1. explains the summary of this procedure and the result, and details are attached in Appendix 5. .

Table 5.3.1. Types of Land Use and Population Distribution

Land Use Type	Urbanization Characteristics	Population Density/Trend	Estimated Population (000)
Up-grading (2,571 ha)		Stable or	621(1990)
		Decrease	606(2000)
			592(2010)
Stable (6,214 ha)	Built-up area	Stable	720
			724
			729
Growing (7,706 ha)	Still urbanizing	Increase to the	1,244
		level of	1,427
		neighbours	1,611
Expansion (22,984 ha)	Developing	by scheme	1,584
			2,536
			3,499
New Center (25,165 ha)	Newly planned	100-150 person	186
		per hectare	1,173
			2,343
Suburban (167,550 ha)	Surrounding area	Natural increase	1,076
		only	1,283
			1,657

5.3.2. Daytime Population

(1) Workers in Working Place

The total number of workers was estimated to increase, from 1.45 million in 1990 to 2.47 million in 2010. The allocation of increasing amount of 1.02 million workers was assumed by their industry sector as follows:

- a) Primary sector: A slight increasing in the number of workers assigned to the suburban area where urbanization was not planned.
- b) Secondary sector: A addition of 160 thousand workers was estimated during the period. Of these, 90 thousand will be engaged within the existing industrial area. The rest will be distributed in the newly developed suburban areas along arterial roads.
- c) Tertiary sector: 760 thousand additional workers are expected. The distribution of working place is determined depending upon the characteristics of a given industry.

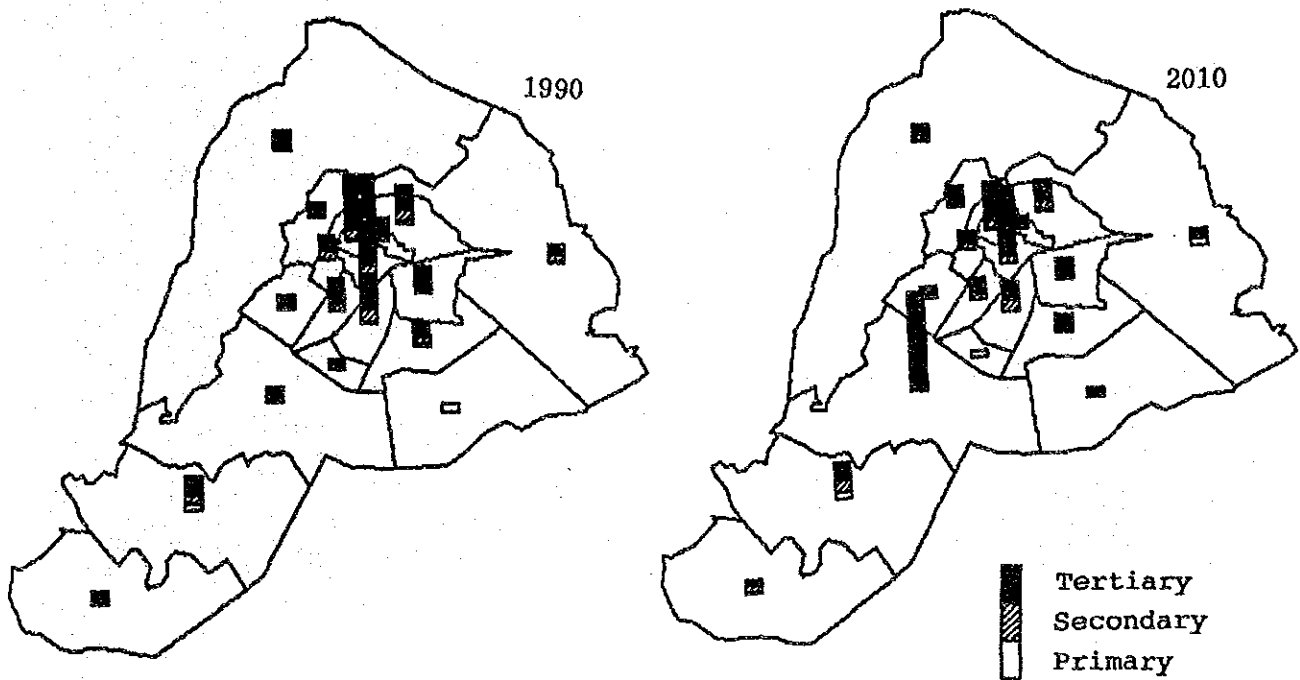
Table 5.3.2 Distribution of Workers in Tertiary Sector

Year	Night Pop./ No. of Workers	Areas to be Allocated		
		(1)	(2)	(3)
	(000)			
1990	Population	621	268	44
	Workers	415	28	6
2000	Population	606	1,288	464
	Workers	443	194	113
2010	Population	591	2,495	964
	Workers	531	462	294

- (1) Existing city center
- (2) Expanding southern area including new sub-center
- (3) New sub-center in south

The result of workers distribution is illustrated in Figure 5.3.1.

Figure 5.3.1 Distribution of Workers, 1990 and 2010



(2) School Enrollment and Others

Estimates of the number of students and others were made by assuming the following:

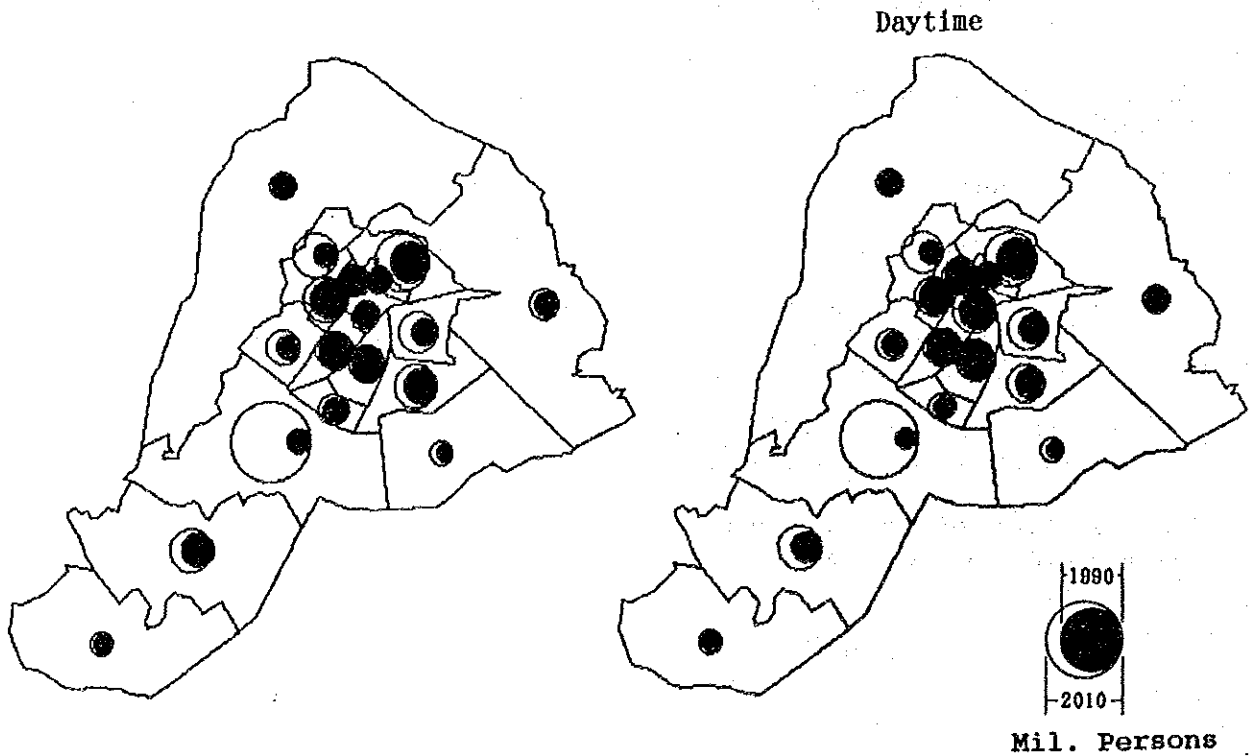
- a) Students of primary, middle, and high schools are distributed within the zones near their residence. Thus, students were estimated in accordance with the residential population increase.
- b) Students of higher education, college, university, professional schools are allocated at existing facilities and also in newly developing educational zones within the southern sub-center.
- c) Others such as housewives, jobless, and infants, are counted in their residential zones.

The estimate of the daytime population is tabulated and illustrated in Table 5.3.3 and Figure 5.3.2.

Table 5.3.3. Daytime and Night Population, 1990 and 2010

NO.	ZONE NAME	1990			2010			DAY POP 2010/1990	NIGHT POP 2010/1990
		POPULATION IN DAYTIME	POPULATION AT NIGHT	DAY/NIGHT RATE	POPULATION IN DAYTIME	POPULATION AT NIGHT	DAY/NIGHT RATE		
1	WALLED CITY	434034	355515	1.22	516954	329690	1.57	1.19	0.93
2	GOVERNMENT HOUSE	532068	243959	2.18	749599	252511	2.97	1.41	1.04
3	IQBAL TOWN/NEW CAMPUS	421841	402357	1.05	536862	481410	1.12	1.27	1.20
4	SHAD BACH	262360	274813	0.95	290436	275210	1.06	1.11	1.00
5	KRISHAN NAGAR	390519	495474	0.79	518700	654280	0.79	1.33	1.32
6	NAZ BEG	192121	219758	0.87	357155	409452	0.87	1.86	1.86
7	BAGHBANPURA	606825	643328	0.94	1061589	1136240	0.93	1.75	1.77
8	SHAHARA	161341	196150	0.82	584798	728673	0.80	3.22	3.71
9	MAIN GULBERG/MODEL TOWN	455831	397300	1.15	568314	483053	1.18	1.25	1.22
10	TOWNSHIP	172932	214465	0.81	283928	340250	0.83	1.64	1.58
11	CANTONMENT-NORTH	318317	292956	1.09	640890	631917	1.01	2.01	2.16
12	CANTONMENT-SOUTH	334223	431925	0.77	537582	679556	0.79	1.61	1.57
13	WAHA	200477	226266	0.89	281981	298798	0.88	1.46	1.32
14	MOTA SINGHWALA	88159	124948	0.70	178011	208800	0.86	1.82	1.67
15	BHOPATTIAN(SOUTHERN SUB-CORE)	156888	186175	0.84	2084889	2341273	0.89	13.35	12.58
16	BHAIPHERU	138361	148611	0.93	211482	186248	1.08	1.63	1.32
17	SHEIKHUPURA	190304	202791	0.94	283962	267796	1.06	1.49	1.32
18	WAHGA/RAIWIND	343734	373545	0.92	691920	685285	1.01	2.01	1.83
TOTAL		5430336	5430336	1.00	10400242	10400242	1.00	1.92	1.92

Figure 5.3.2. Daytime Population, 1990 and 2010



CHAPTER 6. FUTURE TRAFFIC DEMAND

CHAPTER 6 FUTURE TRAFFIC DEMAND

6.1 FORECASTING METHOD

6.1.1. General

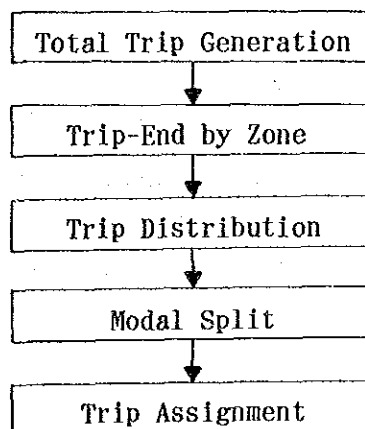
The overall flow of the traffic demand forecast, a quantitative benchmark in order to formulate the Master Plan for the year 2000/2010, is illustrated in Figure 6.1.1.

The traffic demand is estimated, in daily "person trips". It is based on the present trip characteristics obtained by analysis of the 1990 Person Trip Survey (HIS) results.

The items for demand forecast are summarized as follows:

- Number of zones : 84 zones for the LMA (C zone system)
18 zones for the LMA (B zone system)
- Categories of trip purpose : (5)
to work,
to school,
to home,
on business, and
private & others.
- Categories of transport mode : (4)
walk,
bicycle & motor-cycle,
car(four-wheelers), and
public transport.
- Time and Period : Weekday
Day base (24 hours)

Figure 6.1.1 General Flow Chart of Demand Forecast



6.1.2. Trip Generation Model

Since daily trip generation depends upon the persons' characteristics such as age, gender, occupation, car-ownership, it can be explained as "the number of trips generated per person". It is known as the trip generation rate, defined by the following formula:

$$R_i = G_i / P_i$$

wherein,

R_i : Trip generation rate of a person with characteristics i ,
 G_i : All trips generated by persons with characteristics i ,
 P_i : Population with characteristics i .

These trip generation rates are calculated by the results of the analysis of the 1990 HIS, and are also applied to the forecasted population for the future.

6.1.3. Trip-end Model

Transport demand by zone is presented in terms of trip generation and attraction. Trip generation refers to trips originating from a zone, while trip attraction to trips made towards a zone.

Since the model heavily relies on trip purpose, the factors used in the trip-end model differ by each trip purpose such as "to work", "to school", "to home", "on business", and "private & others".

The examination on which indicators have close relationships to the trip demand by trip purpose was conducted by analyzing the data of 1990 HIS, between the trip generation/attraction by all mode and some socioeconomic indicators, by zone.

6.1.4. Trip O-D Distribution Model

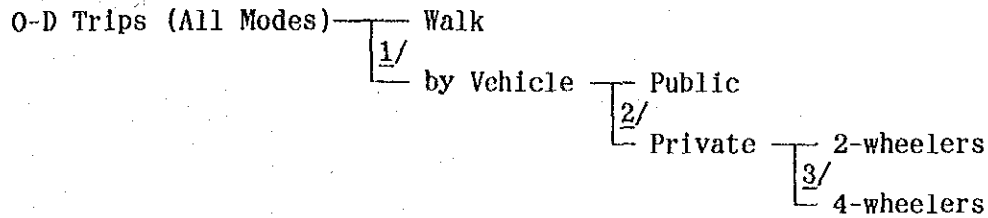
By using this model, the O-D trip distribution and trip volume by O-D pair are estimated, based on the trip generation and attraction determined at the previous stage.

Some applicable O-D distribution models for urban transport analysis and planning are "Present pattern method", "Gravity model", "Opportunity model", "Entropy model", and so on. The combination method, both of "present pattern method" and "gravity model", is adequate in this study.

6.1.5. Modal Split Model

The trip demand by transport mode is estimated after trip distribution is derived in the preceding stage, applying the 'three-steps binary choice model' as follows:

Figure 6.2.1 Modal Choice Steps



1/ Walk trip share = f (O-D distance)

2/ Public share = f (private vehicle ownership of O & D zone)

3/ 2-wheelers share = f (2-wheelers ownership of O & D zone)

6.1.6. Trip Assignment Model

Trip assignment models are used, as the final stage of traffic demand forecast, in order to estimate the assigned traffic volume along each road and/or public transport network.

There are four types of trip assignment in accordance with the level of planning purposes:

- Traffic demand assignment without capacity constraint on a spider network
- Traffic demand assignment without capacity constraint on the proposed network
- Capacity constrained trip assignment on the proposed network
- Public transport demand on public transport network/route

6.2 Total Number of Trips

The total number of trips made by the LMA residents, at the first step of demand forecast, is estimated as a "control total".

The "trip generation rate" is applied to the estimated population in the previous chapter, that is, the trip generation rate by occupation obtained by 1990 P.T. is multiplied by the estimated population by occupation.

$$T = \sum_i (R_i \times P_i)$$

where,

T : Total number of trips by the LMA residents

R_i : Trip generation rate by occupation i,

P_i : Number of population with occupation i.

Table 6.2.1 Trip Generation Rate by Occupation/Employment Sector

Occupation	Purpose	Work	School	Home	Business	Others	Total
Employment							
	in Primary Sec.	0.37	0.31	1.08	0.03	0.43	2.22
	in Secondary Sec.	0.48	0.25	1.08	0.07	0.44	2.34
	in Tertiary Sec.	0.52	0.25	1.15	0.07	0.49	2.47
Students		0.25	0.53	1.13	0.05	0.44	2.40
Housewives		0.22	0.21	0.78	0.03	0.41	1.65
Others		0.56	0.20	1.09	0.11	0.42	2.38
Total		0.32	0.32	1.00	0.05	0.44	2.14

Source: 1990 HIS

Table 6.2.2 Estimated Total Number of Trips

Trip purpose	No. of trips (000)	(%)	Trip rate
Work	3,027	15.2	0.34
School	3,115	15.7	0.35
Home	9,287	46.8	1.05
Business	499	2.5	0.06
Others	3,934	19.8	0.44
Total	19,863	100.0	2.24

Source: Study Team

Table 6.2.3 Comparison of Total Number of Trips

Items	1990	2010	2010/1990	AGR*
Population (5 yr. & above)	4,578	8,875	1.94	3.4%
No. of Trips	9,779	19,863	2.03	3.6%
Trip Generation Rate (Average)	2.14	2.24	1.05	-

* Annual growth rate
Source: Study Team

6.3 TRIP GENERATION/ATTRACTION BY ZONE

Trip generation/attraction by zone, following the beginning stage of demand forecast, were forecasted.

For this forecast, the following model formulas were applied after analyzing the correlations between the result of 1990 HIS and socioeconomic indicators by zone.

$$G_i \text{ or } A_i = f(x_i, y_i, z_i)$$

where,

G_i : Trip Generation from zone i,

A_i : Trip Attraction to zone i,

x_i, y_i, z_i : Factors in zone i.

These models were examined for both trip generation and attraction by each purpose of trip, and the results are summarized as follows:

Table 6.3.1 Trip Generation/Attraction Model

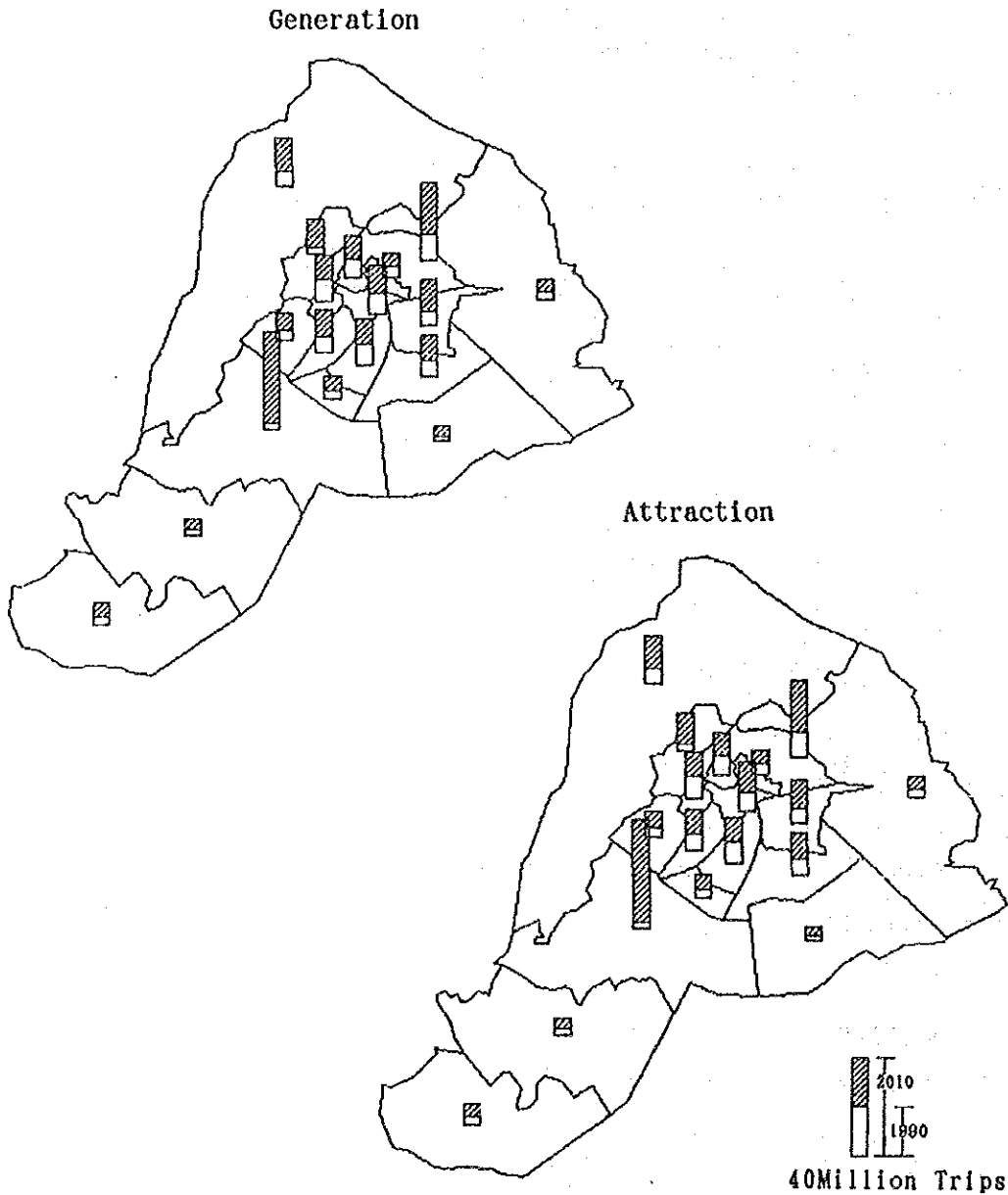
G/A by Trip purpose	Explanatory Factors	Correlation Coefficient
Trip Generation		
to Work	Employment at night Primary, Secondary & Tertiary	0.9782
to School	Student at night	0.9940
to Home	Student at daytime & Employment at daytime	0.9112
on Business	Employment at daytime Secondary & Tertiary	0.7505
Others	Population at night	0.8648
Trip Attraction		
to Work	Employment at daytime	0.9921
to School	Student at daytime	0.9899
to Home	Population at night	0.9578
on Business	Employment at daytime Secondary & Tertiary	0.8332
Others	Population at daytime	0.8332

Source: Study Team

The results of trip generation and attraction obtained by applying the above factors are adjusted to the total number of trips by trip generation model in the beginning stage of this demand forecast, and finalized as the trip generation/attraction by zone.

A summary of the results is shown in Figure 6.3.1, with a comparison of 1990 and 2010 (all purpose, all mode), in an 18-zone system.

Figure 6.3.1 Trip Generation by Zone, 1990 and 2010

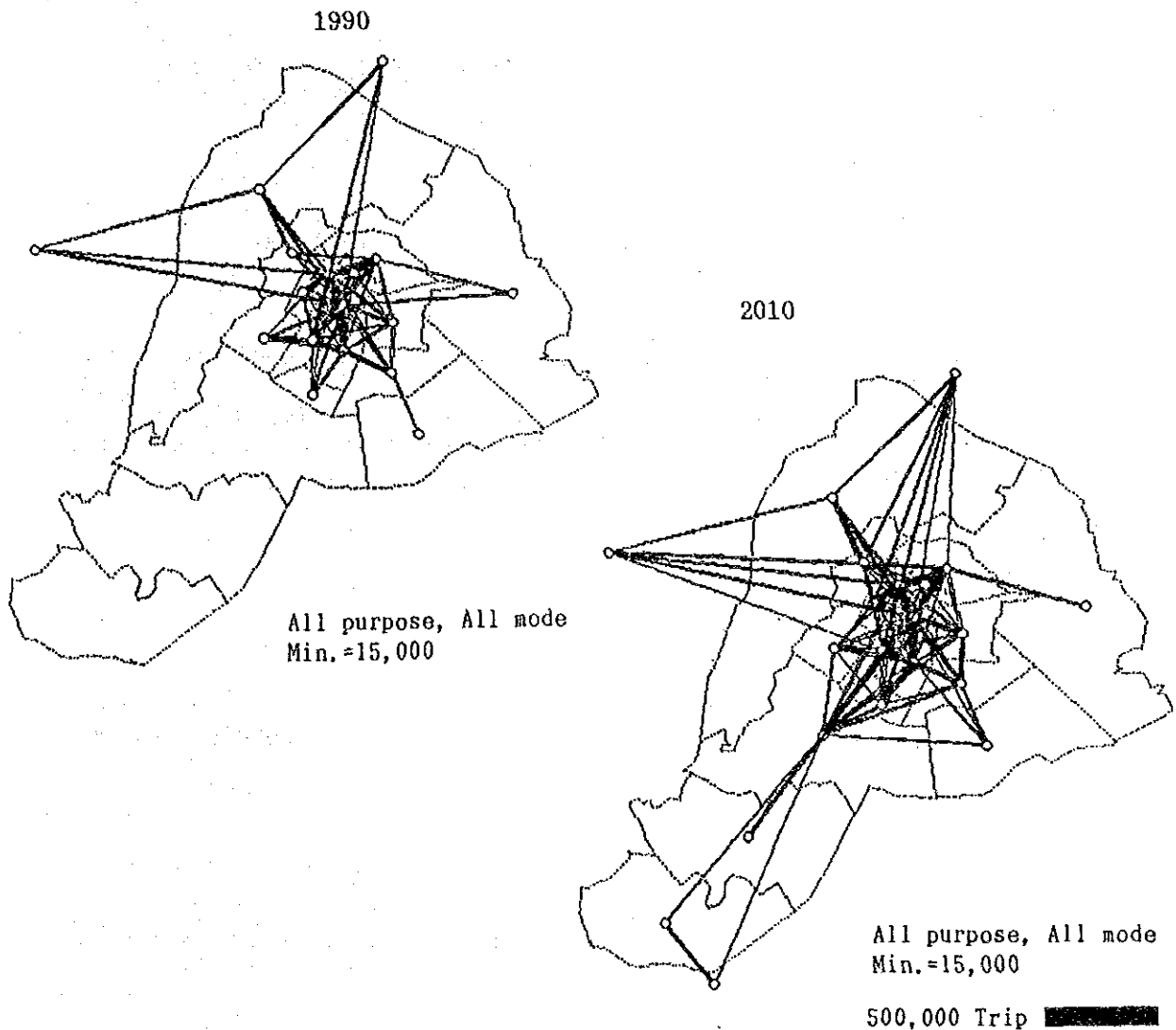


6.4 TRIP O-D DISTRIBUTION

Regarding to O-D distribution, a combination of "present pattern method" and "gravity model" was applied, after due comparison of the results by different methods with each other.

A result in the form of O-D tables (in 18-zone system) is attached in Appendix Table 6.2, by mode: walk, private, public and all modes. Desired lines which indicate the O-D distribution pattern visually, are presented in Figure 6.4.1.

Figure 6.4.1 Desired Lines, 2010



6.5 MODAL SPLIT

The modal split, as mentioned earlier, employed the three-step binary choice model.

6.5.1. Modal Split between "Walk" and "by Vehicle"

The share of "walk" trips, at first, is determined from O-D table of all mode by applying the modal split model between "walk" and "by vehicle".

The "walk" trip, in general, depends on distance from origin to destination. It is clear, also in LMA, that the share of "walk" trips decreases proportionally as the trip length increases, and there are few trips exceeding 6 kilometres.

As a result of analysis of the 1990 HIS, the following relation was found between the share of "walk" trip to the total and the distance.

$$S_w = a * x^b$$

wherein,

S_w : Share of "walk" trip to the total(%),
 x : Distance(km),
 a, b : Parameter.

The application of this model to the future estimation was done, to inter-zonal trips (T_{ij}) excluding intra-zonal trips (T_{ii}). To the intra-zonal trips, the different shares which were separately estimated from the existing condition, and also taking the continuing motorization trend into consideration, were applied.

Thus, two O-D tables, "walk" and "by vehicle", were formulated.

6.5.2. Modal Split between "Public" and "Private"

A correlation between the share of by "private" and private vehicle ownership in origin/destination zones, was calibrated according to the following formula:

$$S_{prv} = a * Own_{i,j} + b$$

wherein,

S_{prv} : Share of "private" trip,
 $Own_{i,j}$: Average of Vehicle Ownership in zone i & j,
 a, b : Parameters

This formula was applied to the estimated future vehicle ownerships by zone and the shares of "private" were calculated by zone pair.

6.5.3. Modal Split between "two-wheeler" and "four-wheeler"

The same procedure as the modal share between "public" and "private", was carried out again for this modal split.

The ownerships of four-wheelers in zone i and j, are used for the same type of formula, in place of the private vehicle ownership, at this stage.

The O-D table of "private" was divided into "two-wheeler" and "four-wheeler", and four kinds of O-D tables by mode were finally completed.

6.5.4. Summary of the Result of Modal Split

The overall result of modal split in future, is tabulated in Table 6.5.1.

Table 6.5.1 Modal Share from O-D Tables

Mode	1990	2010	2010/1990
	(000)	(000)	
Walk	5,121	8,990	1.76
Private	3,280	7,269	2.22
Public	1,848	3,975	2.15
Total ₁	10,249	20,234	1.97
Total ₂	5,128	11,244	2.19

Total₂: Excluding walk

Table 6.5.2 Modal Share; Percentage Composition

Mode	Including walk		Excluding walk	
	1990	2010	1990	2010
Walk	50.0	44.4	-	-
Private	32.0	35.9	64.0	64.7
Public	18.0	19.7	36.0	35.4
Total	100.0	100.0	100.0	100.0

CHAPTER 7. MASTER PLAN STUDY

CHAPTER 7 MASTER PLAN STUDY

7.1 Planning Policy and Approach

7.1.1 Summary of the Existing Problems

Based on the analysis of existing transport system/facility, identified problems in LMA are summarized as follows:

(1) Road Network

- 1) Almost all traffic must pass through the CBD directly due to the lack of the adequate circumferential road network, except for the Circular Road around the Walled City.
- 2) The density of the arterial road network is relatively low in the southern suburban area.
- 3) There are insufficient distributors in the Krishan Nagar and Shad Bagh areas.
- 4) The daily traffic in 1990 on the Ravi Bridge is slightly over its capacity.

(2) Road Conditions

- 1) The deterioration of roads in the study area causes traffic congestion. The problems are particularly pronounced on Bund Road near Yatim Khana intersection, G.T. Road behind the Lahore City Station, and Sheikhpura Road between G.T. Road and Sharaqpur Road.
- 2) There are many roundabouts intersections in the CBD.
- 3) Illegal on-road parking and encroachment by commercial activities on the primary and secondary roads in the CBD make road space narrow and increase traffic "friction".

(3) Road Traffic

- 1) Motorcycles and bicycles, which combined a share of 50% of the total traffic, reduce eventual road capacity and increase traffic accidents.
- 2) Animal drawn vehicles near the Walled City area cause severe traffic jams and contribute to accidents in that area.

(4) Public Transportation

- 1) PRTC (Punjab Road Transport Corporation) is the only government corporation providing public transport services in the Lahore Metropolitan Area. It suffers from accumulated deficit due to

extremely low fares and large personnel costs. Consequently, the level of service on public transport is low because of the poor condition of the bus fleet and poor schedule adherence. Therefore, minibus and bus service conducted by the private sector has expanded rapidly in the LMA.

- 2) The use of inter-city bus terminal areas (Badami Bagh and GTS Bus Stand) is inefficient due to the inadequate access to these terminals.
- 3) Bus traffic sometimes causes traffic jams. This is due to the driving manner and minibus being provided by private Hi-Aces and the inconvenient service of PRTC conventional buses.
- 4) The use of the PR as urban transportation by LMA residents is low due to the poor service of shorter-trip operation, since the PR mainly concentrates on longer distance trains.

(5) Traffic Management and Transport Administration

- 1) Parking conditions in the city center are serious due to the increase in private cars. This is especially pronounced in the Anarkali area along the Mall.

Serious traffic jams also occur in front of schools along primary roads, such as Jail Road and Durand Road due to illegal on-street parking during school hours.

- 2) A well coordinated system among various agencies in urban traffic is not developed. A system should be developed in order to meet various demands of the rapidly increasing road traffic.

7.1.2 Planning Policy and Approach

Considering the analysis of existing transport conditions and expected future traffic demand, the planning policy for the urban transport master plan of LMA in the year of 2010 is settled as follows:

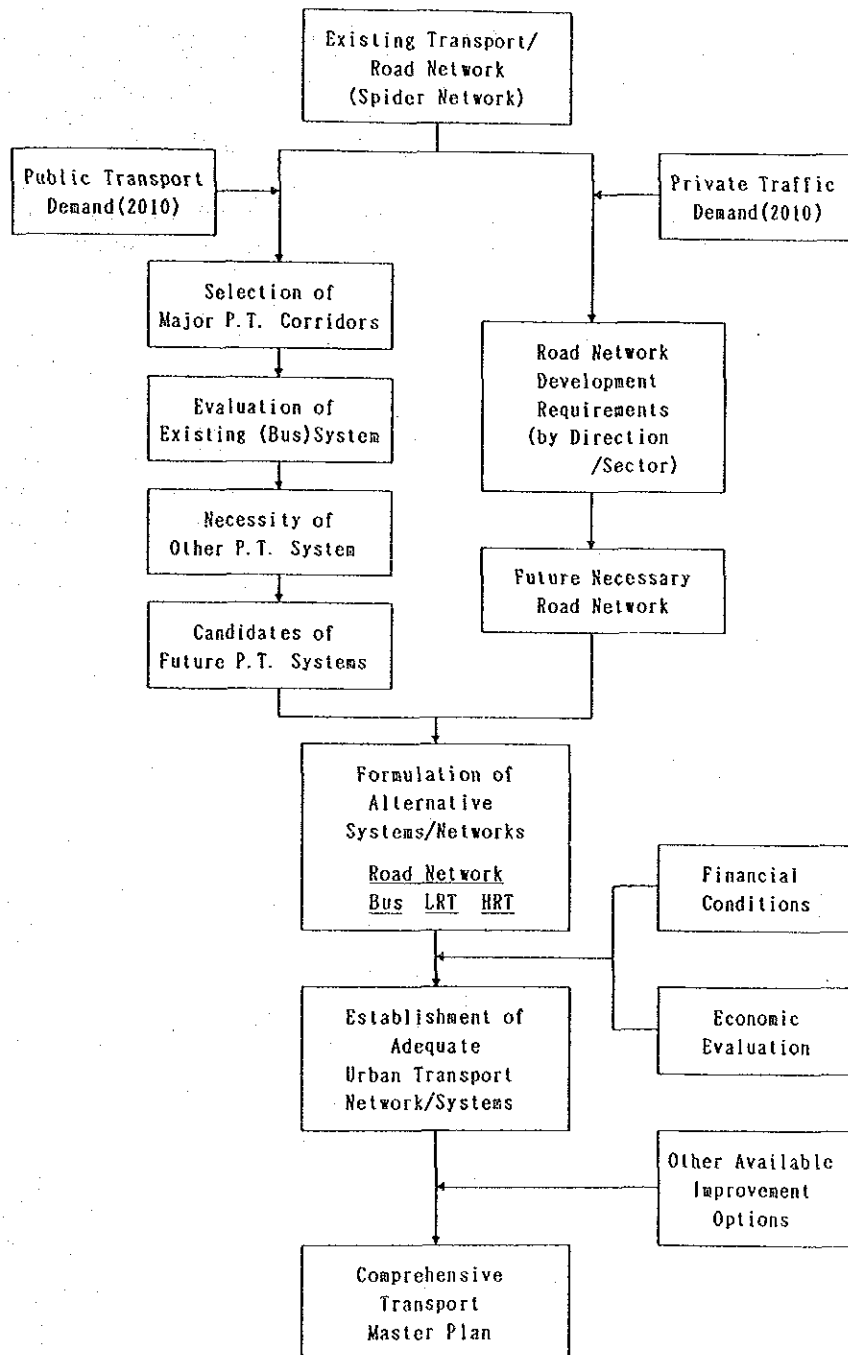
- Establishment of the comprehensive transport system that would accommodate the future traffic demand in LMA, while maintaining the individuality of the capital city in Punjab;
- Preservation of urban amenities in Lahore;
- Establishment of functional road network system, with radial and circumferential roads, to meet the future road traffic demand;
- Introduction of more effective public transport system with higher capacity, speed and comfort, to cope with the increasing public transportation demand;
- Consideration on the significant characteristics of transportation conditions in Lahore, such as high percentage share of 2-wheel vehicles to the total traffic and the very wide variety of transportation modes;

In addition, following viewpoints are considered especially for short-term planning.

- Effective use of the existing transport system/facility
- Improvement of existing bus service
- Efficient traffic management measures

Planning approach for the establishment of the transport master plan is summarized in Figure 7.1.1.

Figure 7.1.1 Planning Approach for Establishment of the Master Plan



7.2 Analysis on 'Do Nothing' Case

7.2.1 Examination on Spider Network

The result of the traffic assignment of the traffic demand in the forms of 1990 OD and 2010 OD tables to the spider network (Simplified network) is shown in Figure 7.2.2.

From this result, the traffic demand in LMA will increase approximately two times in the next 20 years and the increase of the traffic demand along the screen lines, such as Inner area, Canal, Railway, Ravi River and the southern sections are 1.5 to 3.6 times of 1990 demand, as summarized in Table 7.2.1.

The increase of traffic demand in the inner area is suppressed by the low increase of population growth. On the other hand, the increase in the outskirts of the urbanized area and the Ravi River, especially along the southern outskirts is expected to be 2.65 - 3.62 times in the next 20 years.

Table 7.2.1 Increase of Traffic Demand by Direction (Based on the Demand Assignment on the Spider Network)

('000 Person Trips/Day)

Screen/Section	1990	2010	2010/1990
Inner Area	2,616	4,520	1.73
Canal Bank	1,268	2,370	1.87
Railway	1,220	1,900	1.56
Ravi River	442	884	2.00
Southern Section-1	519	1,377	2.65
Southern Section-2	285	1,033	3.62

Figure 7.2.1 Location of Screen Lines and Sections

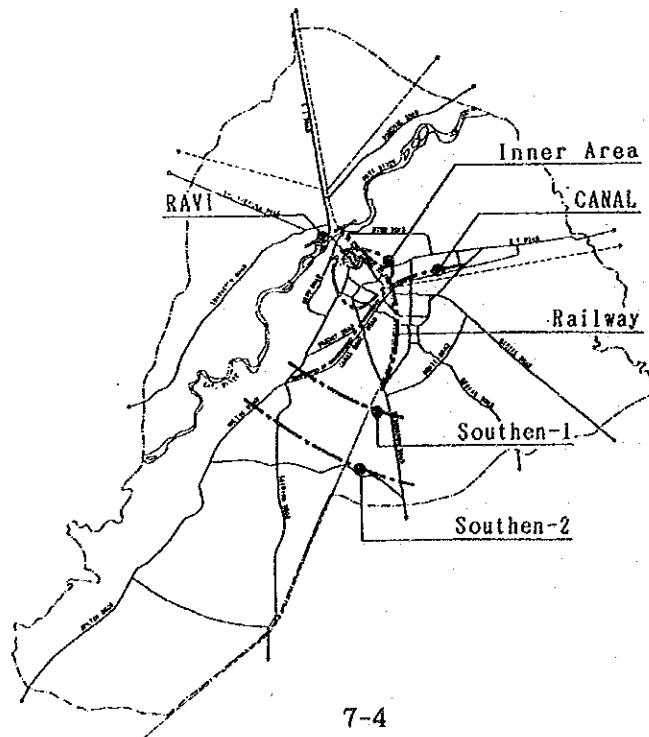
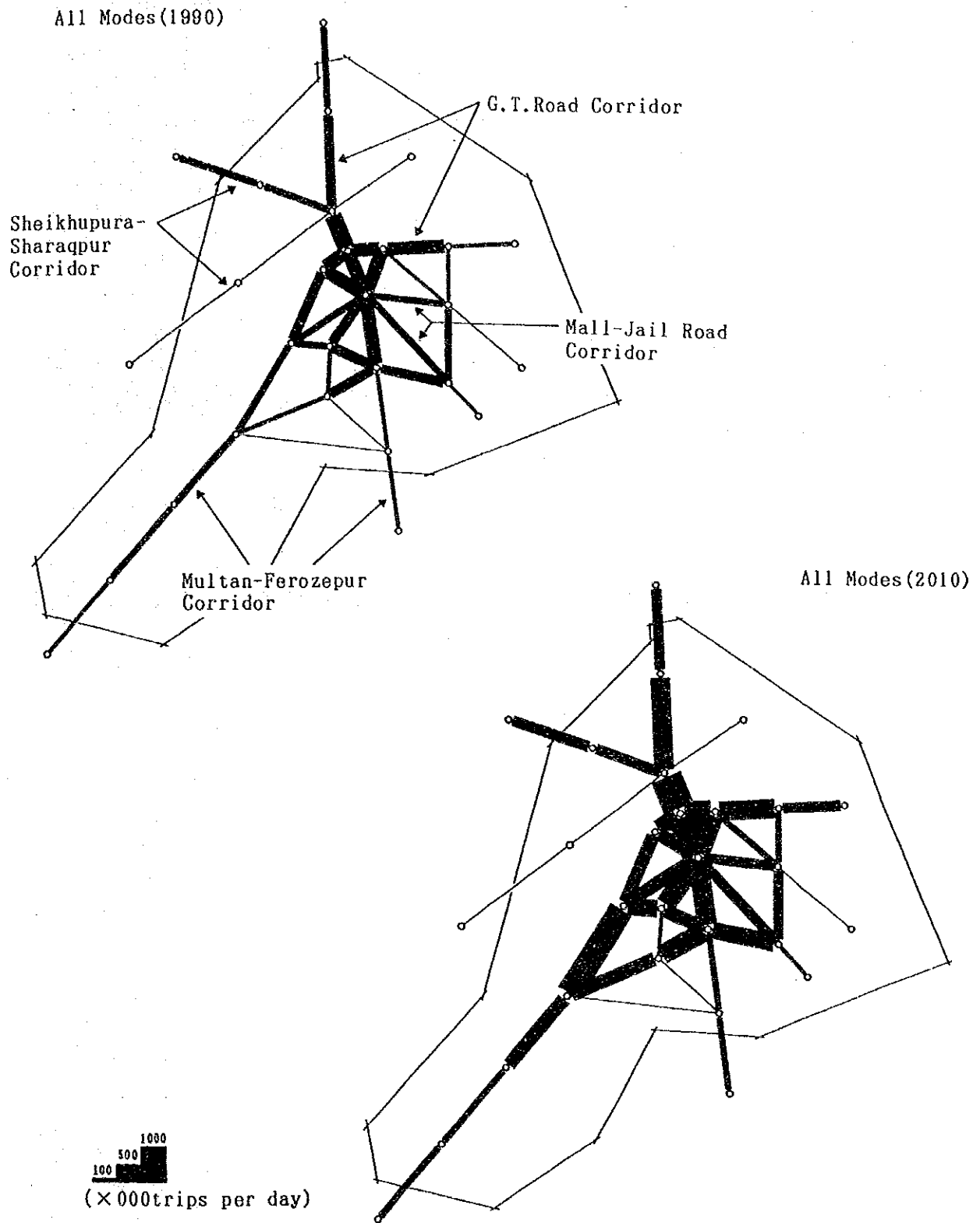


Figure 7.2.2 Demand Traffic Assignment on the Spider Network



7.2.2 Future Demand Assignment on Existing Network

Though overall feature of increasing traffic demand in 2010 has become clear in the previous paragraph, a simulation method is applied to make that forecast more in detail. The following two cases of traffic assignment are compared:

Case	OD Table	Network
1) Present Condition	1990	1990
2) Do Nothing	2010	1990

The result is summarized in Figure 7.2.3 and Table 7.2.2. The traffic condition of LMA will be deteriorated to a large extent, if no any improvements were done from now. For example, average travel speed will be from 28 km/hr to 11 km/hr and average congestion degree(V/C ratio) will be 0.9 to 1.7 respectively.

Table 7.2.2 Summary of Traffic Assignment, Do-Nothing

Network condition	OD Table	pcu*km (*1000)			pcu*hour (*1000)			Ave. velocity (km/h)			V-C ratio		
		Inner	Outer	Total	Inner	Outer	Total	Inner	Outer	Total	Inner	Outer	Total
Existing network	1990	8723.4	2296.4	11019.8	743.6	53.3	796.9	28.24	39.26	33.10	0.86	0.22	0.58
Do Nothing	2010	17432.0	6748.5	24180.5	2948.7	671.2	3619.9	11.47	26.40	18.06	1.74	0.80	1.32

Figure 7.2.3 Future Traffic Assignment on Present Network

Present Condition

Future Demand



Legend Volume/Capacity Ratio
less than 1.00
1.00 - 1.50
more than 1.50
150000 100000 50000



Legend Volume/Capacity Ratio
less than 1.00
1.00 - 1.50
more than 1.50
150000 100000 50000

7.3 Road Network Improvement

7.3.1 Required Number of Lanes by Sector

The required number of trunk roads by direction in 2010 is calculated by the comparison with future assigned traffic demand and the existing road network capacity, as shown in Table 7.3.1.

Table 7.3.1 Required Number of Road by Direction

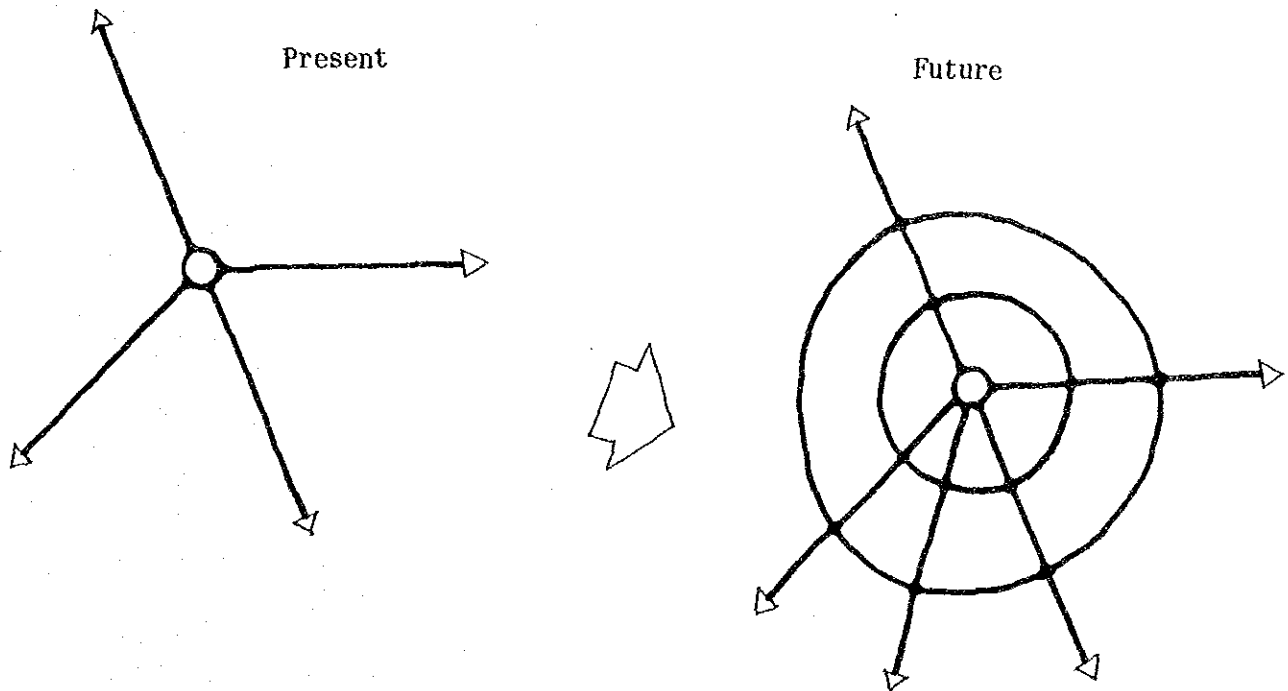
Screen/Section	A.Traffic Demand in 2010 (000 PCU/day)	B.Existing Road Capacity (000 PCU/day)	A - B	Required Additional No. of Road (4-lane Road)
Canal Bank	598	432	166	4
Railway	518	488	30	1
Ravi River	172	72	100	3
Southern Section-1	307	216	91	2
Southern Section-2	209	108	101	3

7.3.2 Network Configuration

(1) Basic Pattern

As mentioned in Chapter 1 and 3, the basic road network pattern of LMA is a radial network pattern centered the Walled City.

Figure 7.3.1 Conceptual Network Pattern



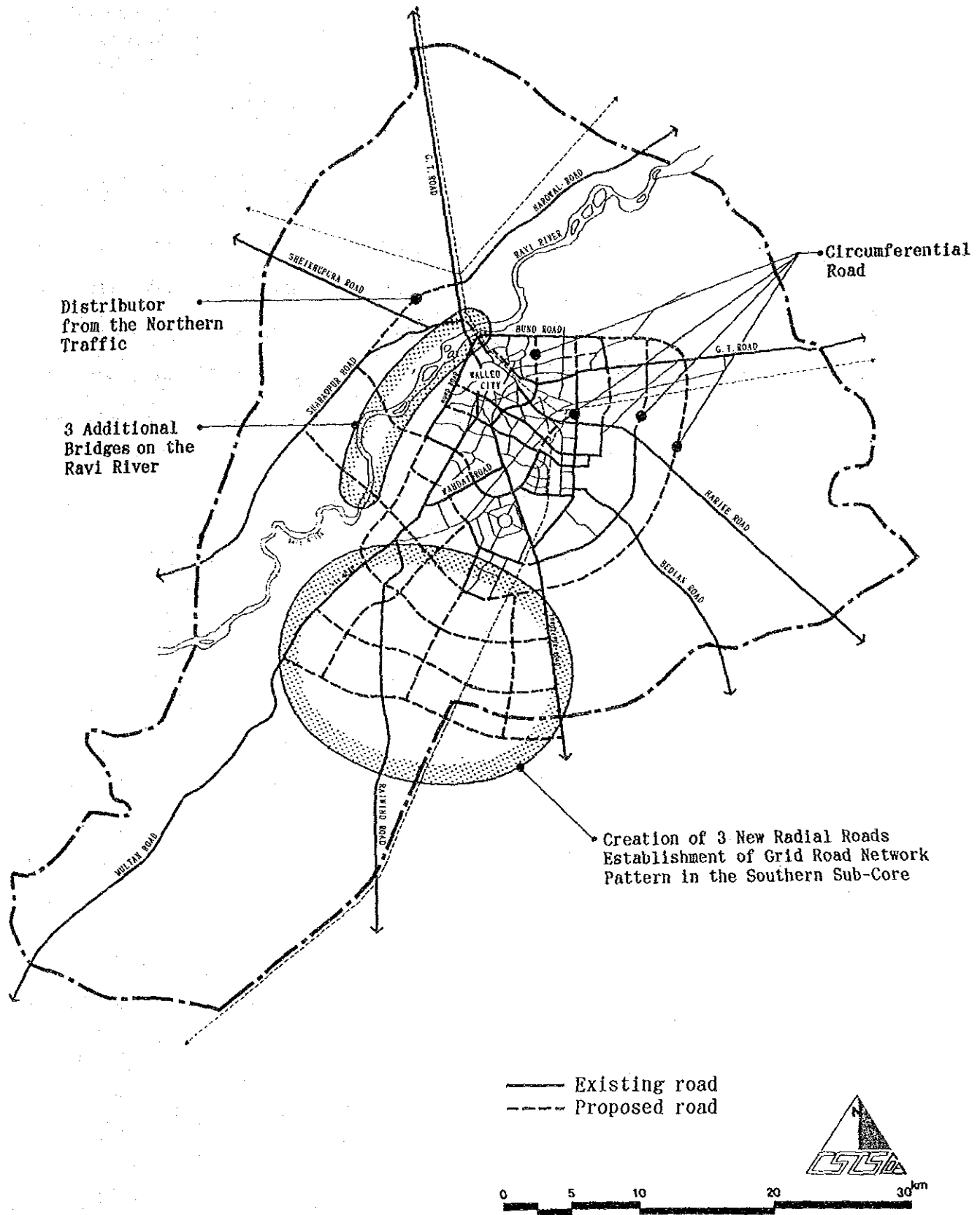
(2) Proposed Network Pattern

Based on the above Table, the existing identified problems, and the planning policy, road network to accommodate the future traffic demand is proposed in Figure 7.3.2. The basic configuration of this proposed network is summarized as follows:

- (1) Three radial roads are newly created between Multan Road and Ferozpur Road in the southern developed area. The grid road network pattern will consist of 6 radial roads i.e., new 3 roads and existing 3 roads and 3 circumferential roads proposed in the southern sub-core.
- (2) For the inner area, the creation of 4 circumferential roads is proposed to cope with the future traffic demand. New distributors are also proposed for the areas with poor road service such as Krishan Nagar and Shad Bagh.
- (3) Three more bridges are needed to accommodate future traffic crossing the Ravi River.

In order for the proposed network to effectively function, it will be necessary to widen existing narrow roads which connect to the new links and to construct flyovers at the major intersections, etc.

Figure 7.3.2 2010 Road Network to Accommodate the Future Traffic Demand



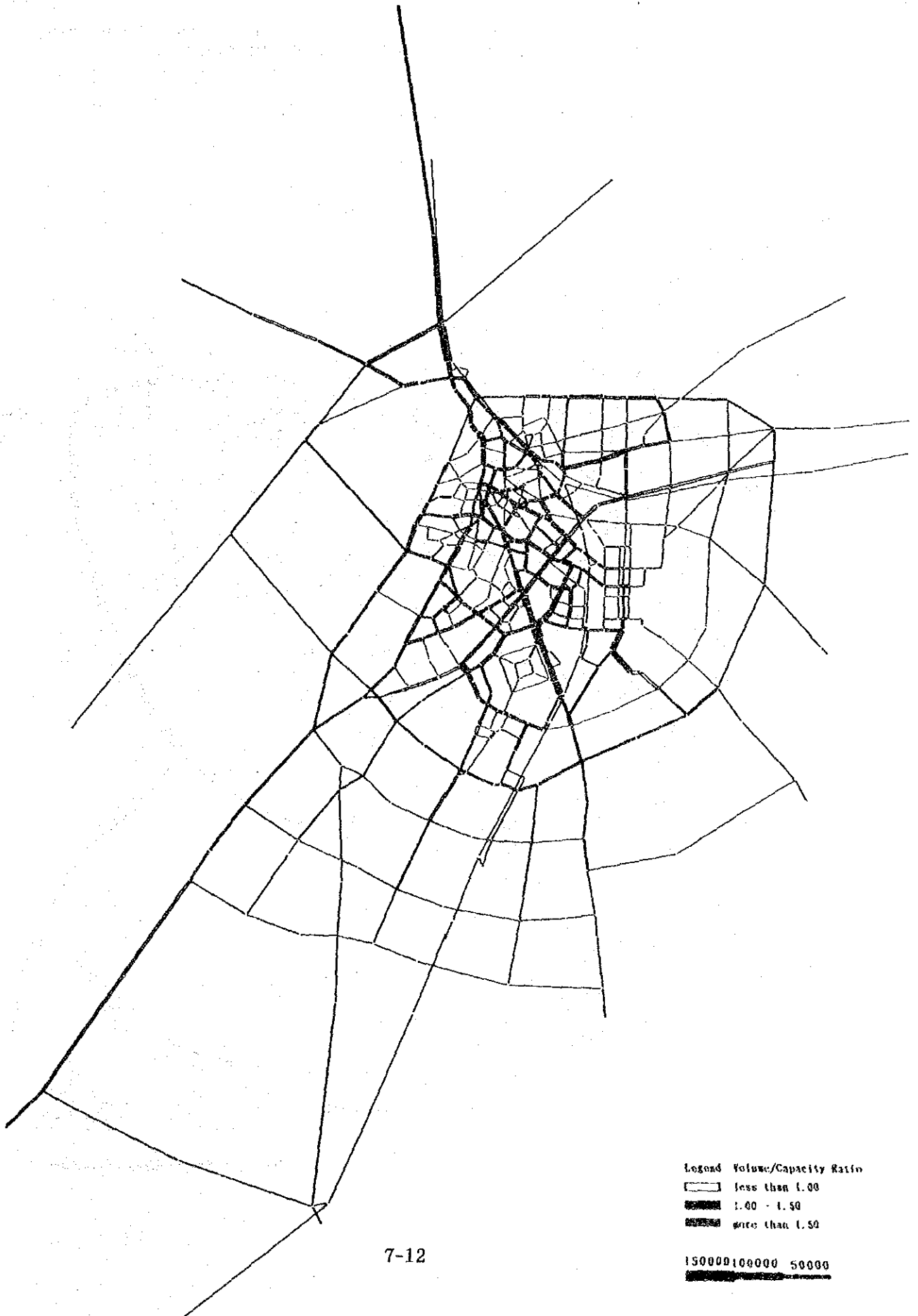
7.3.3 Traffic Demand Assessment

In order to assess the proposed road network plan, a quantitative examination was carried out. The results are summarized in the following table and figures, and the proposed network is justified from this aspect.

Table 7.3.2 Summary of Traffic Assignment, 2010

Network condition	OD Table	pcu*km (*1000)			pcu*hour (*1000)			Ave. velocity (km/h)			V-C ratio		
		Inner	Outer	Total	Inner	Outer	Total	Inner	Outer	Total	Inner	Outer	Total
Existing network	1990	8723.4	2296.4	11019.8	743.6	53.3	796.9	28.24	39.26	33.10	0.86	0.22	0.58
Existing network with road clean-up	1990	8686.6	2294.5	10981.1	717.8	53.2	771.0	29.16	39.26	33.62	0.83	0.22	0.56
Do Nothing	2010	17432.0	6748.5	24180.5	2948.7	671.2	3619.9	11.47	26.40	18.06	1.74	0.80	1.32
Do Nothing with road clean-up	2010	17385.9	6722.7	24108.6	2829.5	656.9	3486.4	12.26	26.76	18.66	1.68	0.80	1.29
Proposed Road Network without PT improvement	2010	16104.4	7147.2	23251.6	2118.4	357.8	2476.2	18.22	41.12	28.89	1.31	0.47	0.92

Figure 7.3.3 Result of Traffic Assignment, 2010



7.3.4 Characteristics of Major Proposed Roads

From the 2010 road network shown in Figure 7.3.2, the proposed roads and its function/characteristics are shown in Table 7.3.4 and Table 7.3.3.

Figure 7.3.4 Location of Proposed Roads

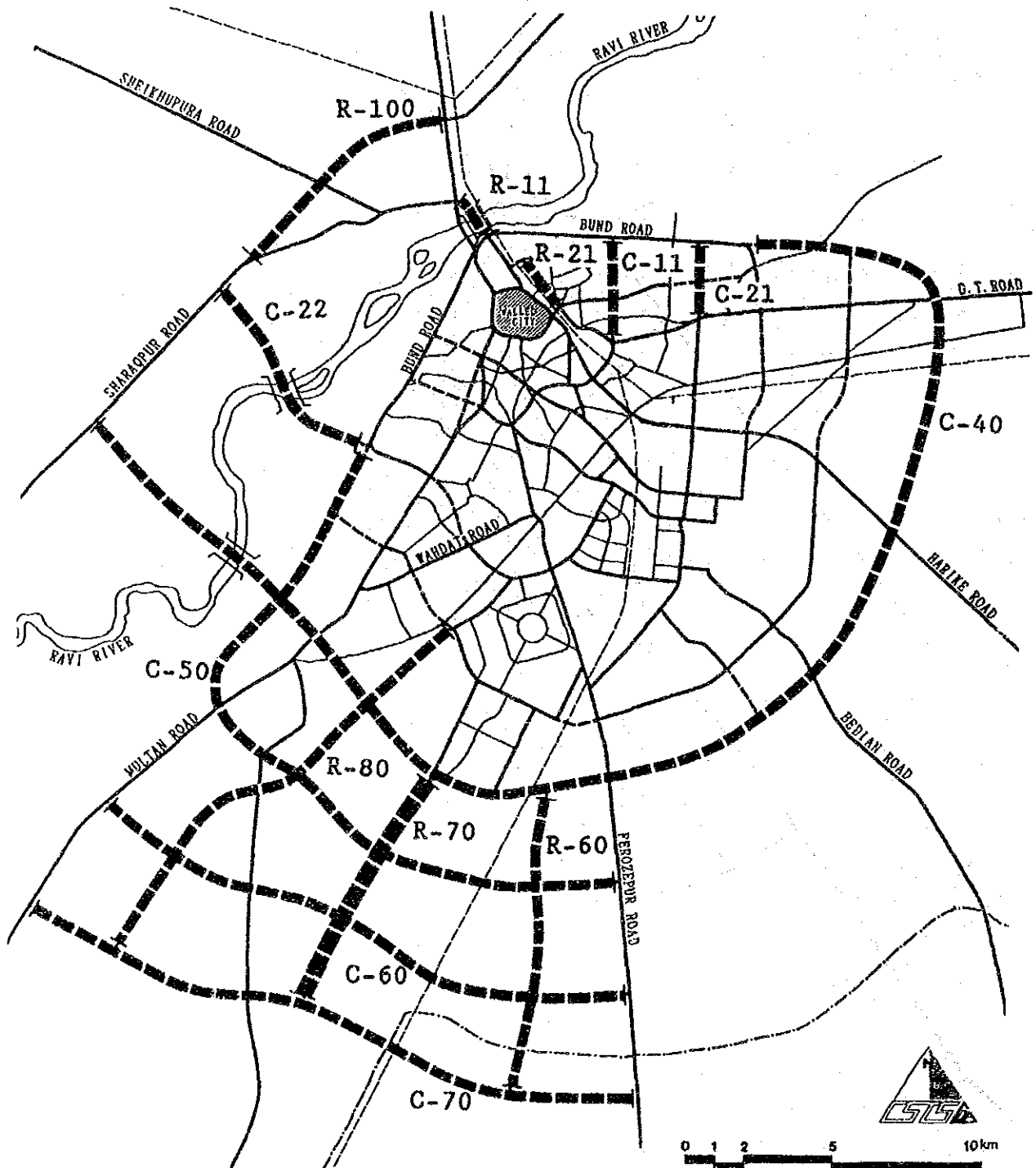


Table 7.3.3 Function and Characteristics of Proposed Roads

Name of Road	Location	Length (km)	No. of Lanes	Functions/Characteristics
R-11 G.T.Road Bypass	Sheikhpura Rd. - Bund Rd.	2.0	4	Distribute the north-east traffic along G.T.Road Compose the part of Radial Road No.1 (G.T.Road-North) Include new bridge construction
R-21 G.T.Road	Badaai Bagh - Lahore Station	2.1	4	Distribute the north-east traffic along G.T.Road Compose the part of Radial Road No.2 (G.T.Road-East)
R-60 Radial Rd. No.6	C-4 - C-7 Between Ferozpur Rd. and Railroad	10.2	4	Compose th part of trunk road network in the southern sub-core
R-70 Radial Rd. No.7	C-4 - C-7 Between R-6 and R-8	9.2	6	Not only trunk road but also major public transport corridor in the southern sub-core. Therefore, wide median is planned for the extension of new transit system.
R-80 Radial Rd. No.8	C-3 - C-7 Between R-7 and Multan Rd.	16.7	4	Compose the part of trunk road network in the southern sub-core
R-100 Sharaqpur Bypass	G.T.Road - C-2	9.0	4	Bypass of Sharaqpur Distribute the traffic into the city center
C-11 Circumferential Rd.No.1	Bund Road - G.T.Road	2.8	4	Compose the part of circumferential Rd. No.1 (Inner Ring Road) Distributor in the Shad Bagh area
C-21 Circumferential Rd.No.2	Bund Road - G.T.Road	2.8	4	Compose the part of circumferential Rd. No.2 (Middle Ring Road)
C-22	Shalimar Link Rd. - Min Gulberg	4.0		
C-23	Bund Road - Sharaqpur Rd.	8.4		Include new bridge construction
C-40 Circumferential Rd.No.4	Bund Rd. - Sharaqpur Rd.	45.5	4	Outer Ring Road Include new bridge construction
C-50 Circumferential Rd.No.5	Ferozpur Rd. - Bund Rd.	25.0	4	Bypass of Multan Road
C-60	Ferozpur Rd. - Multan Rd.	20.0	4	Compose the part of trunk road network in the southern sub-core.
C-70	Ferozpur Rd. - Multan Rd.	22.0	4	Compose the part of trunk road network in the southern sub-core.