

2.3 Existing Urban Trend

As shown in Fig. 2.10 urban area in the Study area is rapidly spreading in rather uncontrolled and disorderly manner. Due to absence of any proper land - use policy, the urban area is very difficult to be classified into residential, commercial, industrial area and so on. This is further difficult in newly developed area in the urban fringes. Mixed land - use with housings, business and commercial buildings and agriculture land is very commonly seen in the urban fringes.

As to spatial distribution of urban-poor or slumming in the urban area, it is rather difficult to designate particular places as most of the cities in Asia. Rent-free or low-rent houses and working places are available all over the urban area, the urban-poor can settle in all areas of the city. Nearness to the working place and availability of free or low rent housings are basically two determining factors for the settlement of people in the Study Area. This fact has been deteriorating the living condition of the urban area further. Population pressure in city centers has lead to outward expansion of urban area with no sufficient provision of urban infrastructure such as water supply, sewage system and transportation system.

KVUDPP Study describes the above situation as below:

- The prevailing pattern of urban development is dictated by distance from Greater Kathmandu (Kathmandu and Lalitpur),
- Agricultural land close to Greater Kathmandu is being converted to urban use at a rapid rate with little regard to efficient provision of infrastructure or the loss of prime agricultural land,
- Other urban settlements in the Valley are experiencing much lower growth rates than Greater Kathmandu, indeed many of the smaller settlements close to the Valley rim would appear stationary in so far as additional development is not occurring in a cluster form but instead as depressed buildings closely associated with the primary economic activity of agriculture, and
- Recent urban development is highly individualistic and pays little attention to the collective benefits of planning.

In this situation, the KVUDPP Study further describe the nature of urban trend as below:

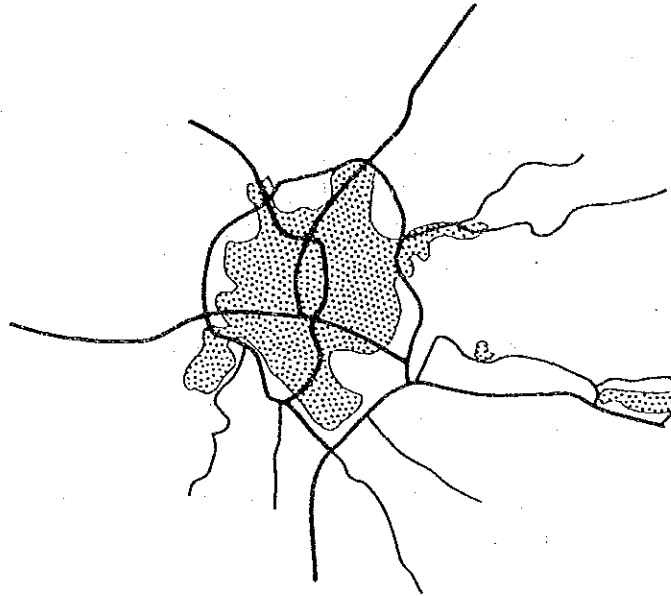
(the latter is reproduction of statement made in the KVUDPP Study)

The dominance of Greater Kathmandu as the stimulator of urban development is a clearly recognizable trend, and is unlikely to change within the foreseeable future. This is reinforced by the economic role of the city, in particular its creation of urban based economic activity. In large measure, this is dependent on a complex set of interrelated economic linkages which develop and snowball in established urban settlements. Once established, the forces that underpin this trend take on an inertia

which is difficult (if not impossible) to change. Indeed to do so may frustrate the impetus and thereby jeopardise the economic benefits which are vital to diversifying the national economy.

The trend of urban expansion is illustrated in Fig. 2.10.

1984



1991

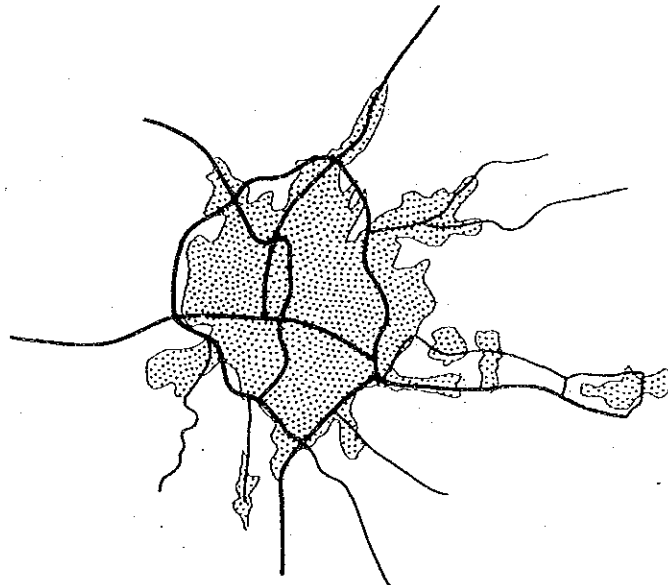


FIG. 2.10 TREND OF URBAN EXPANSION

CHAPTER 3

**PRESENT TRANSPORTATION SYSTEM
IN THE VALLEY**



3 PRESENT TRANSPORTATION SYSTEM IN THE VALLEY

3.1 Outline of the Transportation System

The transportation in the Valley is mainly done by roads. There is no railway system in the Valley at all. The roads in the Valley have been upgraded and renovated into motorable roads and extended with the initiation of bus services by such companies as Nav Durga Company and Sajha Yatayat in the beginning of 1960's.

At present, the total road length in the three (3) districts of the Valley is 740 km of which 250 km of roads is located within the three cities. The Valley is linked to other parts of the country as well as neighbouring countries by such roads as Tribhuvan Highway, Prithwi Highway, Arniko Highway and Trisuli Road.

The road network in the Greater Kathmandu is composed of ten radial roads extending from the central area of Kathmandu and functioning as arterial road in the Valley. The Ring Road is working as bypass and peripheral road. The city of Bhaktapur also has some radial roads which connect surrounding areas but most of these roads are either unpaved or single lane roads.

Apart from the standard of each of the roads, the Study area is provided with minimal density of road network. However, in spite of these provision of roads and roads as a network, efficiency of road transportation is at extremely low level. This fact, among other things, seems to come from following reasons:

- The road network is not always provided keeping balance with actual pattern of population distribution and location of economic activities. Recent population increase in the Valley induced the expansion of urban areas along the most of the radial roads. However, due to lack of the connector roads which link these areas, vehicles are forced to pass through the city center which has resulted in *unnecessary through-traffic in the central areas*,
- The standard of individual road, by and large, is substandard and actual service level is quite low due to poor maintenance, substandard road geometry and sporadic transportation management measures being undertaken,
- Mixing of different types of traffic, especially intrusion of pedestrians in carriageways, is lowering the efficiency in transportation, and
- Due to lack of road links and bridges in critical points, urban traffic, especially, in the central area is not moving smoothly.

In such circumstances, some of the piece-meal type of measures to enhance the road service level are being undertaken by different agencies, however, no satisfactory effect has been attained so far.

Mass transport has long been playing dominant role throughout the history of road transportation development in the Valley. Sajha Yatayat first began to operate bus service between Kathmandu and Bhaktapur in the beginning of 1960's although it was taken over by trolley bus service in the 1970's.

At present, mass transit service in the Valley is far below the satisfactory level in the following senses :

- Shortage in absolute number of fleets to meet growing demand,
- Lack in punctuality of service mainly due to congestion of roads and malfunction of fleets, and
- Inadequate bus services in the changing pattern of demand.

Sharp increase in demand for urban transportation system has induced a great number of small and medium-sized private companies to engage in this field of service in these days. At present, the private sector plays a substantial role in transportation in the Valley, especially in urban area through such public transportation services as minibus, tempo, and auto-rickshaw. However, in spite of these diversification of modes, public transportation in the Valley is rather disorderly operated and is far below the satisfactory level.

At present, most of the cargoes to and from the Valley are transported by truck via Tribhuvan Highway, Prithwi Highway, Arniko Highway and Trisuli Road. However, due to bad surface condition and poor geometry in certain sections of roads, transportation by truck on trunk roads is not efficient and transportation cost is much more higher than what it should be.

Most of the trucks are owned by private truck companies and used for long distance transportation services between the Valley and other parts of Nepal. However, heavy trucks are restricted to enter the area within the Ring Road during the day time which has resulted in idle waiting time along the road. This is another reason for higher transportation cost.

Transportation of cargoes in urban area is being done by smaller vehicles viz. light truck, tractor, power tiller and hand carts. However, increasing number of slow vehicles, especially power tiller and tractor on roads, is one of the reasons for congestion on urban roads.

There exists no reliable data about road traffic and number of vehicles in use in Nepal. The road traffic data collected by DOR and foreign consultants on irregular basis have shown great inconsistency among the methods of the surveys and compilation of statistics. The data of registered vehicle number is available in Department of Transport Management. However, these data are of little value to mention about the actual number of vehicles in use because no adjustment has been

done about the annual scrappings of vehicles. Therefore, the Study team has estimated the number of registered vehicles using a variety of data sources as shown in Tables 3.1 and 3.2. Total number of vehicles in Bagmati zone, which is slightly larger in area than the Valley, is estimated at about 55,000 in 1990/91.

Tribhuvan International Airport is located in the east of Kathmandu city. Number of passengers is about 816 thousand in 1990 and on the increase at 3.6% annually during the last ten years as shown in Table 3.3. It is expected that the existing capacity of the airport reaches saturation and expansion work of runway and facilities is awaited. The transport between the airport and the city is being done through Arniko Highway on which mixing of traffic is commonly seen.

Most of the consumer and industrial goods produced outside the Valley are transported through National Highway and the Ring Road which connect to the places of production outside the Valley. These goods are distributed to market areas located in densely populated areas mainly by heavy vehicles. However, passage of these vehicles and on/off loading along the narrow road in urban area are becoming one of the major causes of lowering the road capacities and deterioration of urban amenity. Creation of on/off loading yards outside the densely populated area and reorganization of distribution system would greatly contribute to streamline the urban traffic and would enhance the urban amenity in a long term.

TABLE 3.1 TOTAL NUMBER OF REGISTERED VEHICLES IN NEPAL

SN.	VEHICLE	85/86	87/88	90/91
1.	Bus / Minibus / Truck	7,362	9,015	13,522
2.	Car / Jeep	12,042	15,740	26,338
3.	Tempo	809	NA	2,932
4.	Power tiller / Tractor	2,724	1,528	5,817
5.	Motorcycle / Scooter	13,041	18,383	33,266
6.	Rickshaw	NA	NA	12,944
7.	Hand Cart	NA	NA	1,341
8.	CD/UN Vehicles			
	Total			96,160

N.B.: Vehicle number data was gathered from different sources.
Analysed and estimated by the Study Team.

TABLE 3.2 TOTAL NUMBER OF REGISTERED VEHICLES IN BAGMATI ZONE

SN.	VEHICLE	PUBLIC	PRIVATE	GOVERN- MENT	CORPORA- TION	TOTAL		
		90/91	90/91	90/91	90/91	73/74	80/81	90/91
1.	Bus, Minibus, Truck	3,217	2,378	1,134	340	1,952	3,658	7,069
2.	Car, Jeep	2,140	11,719	3,379	762	6,012	10,979	18,000
3.	Tempo, Autorickshaw	1,770	644	-	-	-	NA	2,414
4.	Power tiller, Tractor	1,026	703	-	-	NA	632	1,729
5.	Motorcycle, Scooter	-	21,219	2,193	799	NA	11,100	24,211
6.	Rickshaw	470				NA	464	470
7.	Hand Cart	NA				NA	600	NA
8.	CD/UN Vehicles					NA	NA	883
	Total					7,964	26,750	54,776

Remarks : 1. NA - Data not available for the corresponding year.
2. Vehicle number data was gathered from different available sources.
Analysed and estimated by the Study Team.

TABLE 3.3 AIRCRAFT AND PASSENGER MOVEMENT AT TRIBHUVAN INTERNATIONAL AIRPORT KATHMANDU

Year	Type	Aircraft Mvment			Passenger Movement		
		Arrival	Departure	Total	Embarked	Disembarked	Total
1981	Int'l	3,165	3,202	6,367	200,727	200,189	400,916
	Dom'st	7,223	7,234	14,457	94,438	96,494	190,932
	Total	10,388	10,436	20,824	295,165	296,683	591,848
1982	Int'l	3,116	3,113	6,229	208,061	199,762	407,823
	Dom'st	6,423	6,466	12,889	73,038	79,573	152,611
	Total	9,539	9,579	19,118	281,099	279,335	560,434
1983	Int'l	2,869	2,866	5,735	210,462	204,379	414,841
	Dom'st	6,990	7,004	13,994	76,463	76,167	152,630
	Total	9,859	9,870	19,729	286,925	280,546	567,471
1984	Int'l	2,812	2,800	5,612	235,784	229,556	465,340
	Dom'st	7,611	7,508	15,119	86,400	86,756	173,156
	Total	10,423	10,308	20,731	322,184	316,312	638,496
1985	Int'l	3,031	3,028	6,059	256,044	226,814	482,858
	Dom'st	6,986	6,988	13,974	94,575	92,453	187,028
	Total	10,017	10,016	20,033	350,619	319,267	669,886
1986	Int'l	3,161	3,153	6,314	267,460	255,785	523,245
	Dom'st	5,117	5,730	10,847	101,259	107,200	208,459
	Total	8,278	8,883	17,161	368,719	362,985	731,704
1987	Int'l	3,277	3,290	6,567	278,909	294,235	573,144
	Dom'st	6,210	6,290	12,500	109,585	108,953	218,538
	Total	9,487	9,580	19,067	388,494	403,188	791,682
1988	Int'l	3,348	3,351	6,699	312,791	315,627	628,418
	Dom'st	6,825	6,859	13,684	133,692	130,735	264,427
	Total	10,173	10,210	20,383	446,483	446,362	892,845
1989	Int'l	3,527	3,520	7,047	313,445	300,134	613,579
	Dom'st	5,885	5,934	11,819	102,339	101,963	204,302
	Total	9,412	9,454	18,866	415,784	402,097	817,881
1990	Int'l	3,458	3,508	6,966	283,083	316,325	599,408
	Dom'st	5,281	5,405	10,686	122,501	94,373	216,874
	Total	8,739	8,913	17,652	405,584	410,698	816,282

Source : Civil Aviation Report, 1990

3.2 Road Classification and Network in the Valley

Kathmandu Valley is served with the Ring Road and radial pattern of road network as shown in Fig. 3.1 with a total length of 740 km according to the DOR Statistics of 1990.

The roads are classified into four(4) categories of the roads as given in Table 3.4.

TABLE 3.4 CLASSIFICATION OF ROADS IN KATHMANDU VALLEY

	<u>Road Length(km)</u>	<u>Remarks</u>
- Highway	34	Tribhuvan and Arniko HW
- Feeder Road	25	Thimi and Trisuli FR
- District Road	342	Primary/Secondary DR
- Urban Road	339	Ring Road (28km) and City Roads with Class A, B, C and D
Total	740 km	

3.2.1 Highways and Feeder Roads

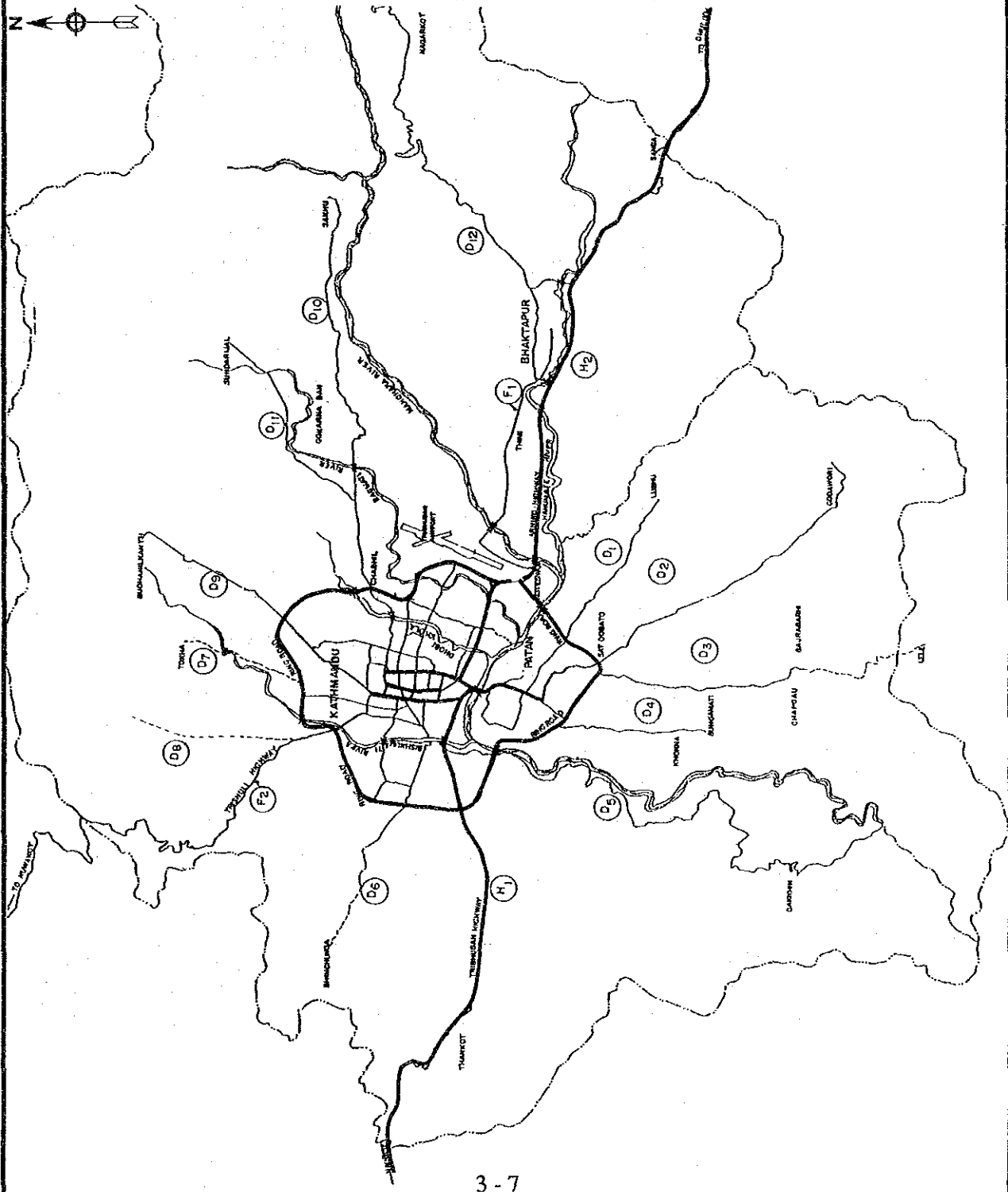
Tribhuvan and Arniko Highways are designated as national highways which basically are continuous throughout the country. They are the major connection between the capital, Kathmandu, with the areas outside Kathmandu Valley.

Thimi and Trisuli Roads are categorized as Feeder Roads which generally lead from the national highway to the district headquarters. Thimi Road connects District headquarter of Bhaktapur to Arniko Highway, while Trisuli Road connects headquarter of Nuwakot District with the Ring Road.

Although Trisuli Road was not included in the list of roads in Kathmandu District in the DOR Statistics in 1990, a part of Trisuli Road from Balaju on the Ring Road up to the boundary of Kathmandu District (17.0 km approx. from the Ring Road) was included in this Study since it is under the jurisdiction of DOR in Kathmandu District.

3.2.2 District Roads

District road consists of all roads not defined as national highway or feeder and city roads and serves as primarily access to the towns and villages and abutting land. There is no sub-categories in the district road according to the present DOR Statistics, however, the district roads given in Table 3.5 are to be deemed as primary roads since they are vital local roads constituting radial network in the Valley.



LEGEND

- Highway
 - H1 Tribhuvan Highway
 - H2 Amiko Highway
- Feeder Road
 - F1 Trimi Road
 - F2 Trisuli Road
- District Road (Primary)
 - D1 Lubhu Road
 - D2 Godawari Road
 - D3 Chapagaun Road
 - D4 Bungmati Road
 - D5 Dakshinkali Road
 - D6 Bhimdhunga Road
 - D7 Tokha Road
 - D8 Phutung Road
 - D9 Buchanlikantha Road
 - D10 Sankhu Road
 - D11 Sundarjal Road
 - D12 Nagarkot Road
- Urban Road
 - R Ring Road
 - A Class A Primary
 - B Class B Secondary
 - C Class C Access
 - D Class D Access

0 50 100 200 400m
SCALE=1:50,000

HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G.)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
FUNCTIONAL CLASSIFICATION OF
ROAD NETWORK
FIG. 3.1
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

TABLE 3.5 PRIMARY DISTRICT ROADS DEFINED BY THE STUDY TEAM

<u>S.N.</u>	<u>Name of Road</u>	<u>Length(km)</u>	<u>Connection</u>
1.	Lubhu Road	5 km	Ring Road - Lubhu
2.	Godawari Road	18 km	Ring Road - Godawari
3.	Chapagaun Road	7 km	Ring Road - Chapagaun
4.	Bungamati Road	5 km	Ring Road - Bungamati
5.	Dakshinkali Road	18 km	Ring Road - Dakshinkali
6.	Bhimdhunga Road	7 km	Ring Road - Bhimdhunga
7.	Tokha Road	4 km	Ring Road - Tokha
8.	Phutung Road	7 km	Balaju - Phutung
9.	Budhanilkantha Road	8 km	Ring Road - Budhanilkantha
10.	Sunkhu Road	16 km	Ring Road - Sankhu
11.	Sundarijal Road	9 km	Baralgau - Sundarijal
12.	Nagarkot Road	20 km	Bhaktapur - Nagarkot
	Total	124 km	

The other district roads are considered to be the secondary road serving primarily as access carrying traffic to abutting villages, lands, markets and to higher type of roads.

3.2.3 Urban Roads

Urban roads in the Valley consist of the Ring Road and city roads with sub-classification of four (4) grades from Class A to D as shown in Table 3.6.

TABLE 3.6 CLASSIFICATION OF URBAN ROADS

	<u>Kathmandu District</u>	<u>Lalitpur District</u>	<u>Bhaktapur District</u>	<u>Total (km)</u>
Ring Road	21.0	7.0	0.0	28.0
Class A	24.3	5.0	0.0	29.3
Class B	71.9	13.5	7.8	93.2
Class C	39.0	13.5	8.2	60.7
Class D	86.8	41.0	0.0	127.8
Total	<u>243.0</u>	<u>80.0</u>	<u>16.0</u>	<u>339.0</u>

The Ring Road as well as Class A and B roads are vital city roads constituting primary road network in the city and serve greater portion of the vehicular traffic passing through the city, while Class C and D roads are providing access to abutting residential and business areas.

3.2.4 Summary of Road Network and Road Classification in Kathmandu Valley

The summary of road network in Kathmandu Valley under the Study is given in Table 3.7

TABLE 3.7 ROAD NETWORK UNDER THE STUDY

	Study Network Road Length(km)	Other Minor Road Length(km)	DOR Network Road Length(km)
- Highway	34	0	4
4 lanes	5	0	5
2 lanes	29	0	29
- Feeder Road	25	0	25
2 lanes	5	0	5
1 lane	20	0	20
- District Road	124	218	342
2 lanes	14	0	14
1 lane	110	218	328
- Urban Road	157	182	339
4 lanes	7	0	7
2 lanes	71	20	91
1 lane	79	162	241
Total	340 km	400	740

TABLE 3.8 NEPAL DESIGN STANDARDS (2027)
(FIRST REVISION - 2045)

Classification Terrain	Trunk Road			Feeder Roads			District Roads		
	Mount- ainous	Rolling	Level	Mount- ainous	Rolling	Level	Mount- ainous	Rolling	Level
Design Speed (Km/hr)	50/40	80	120	40/30	60	100	30/25	40	60
Maximum Average Gradient	5%	4%	3%	7%	6%	5%	7%	6%	5%
Maximum Gradient	8%	6%	5%	10%	8%	7%	12%	10%	7%
Maximum Length of Grade in Excess of Average Grade	150m	210m	250m	120m	180m	210m	100m	120m	100m
Maximum Length of Recovery at Grade Specified	210m @ 3%	300m @ 2%	600m @ 2%	150m @ 3%	150m @ 3%	300m @ 2%	150m @ 4%	150m @ 3%	150m @ 3%

3.3 Existing Road Condition

Road Inventory Survey was conducted by the Study team in December, 1991 to identify the existing problems and issues on the traffic and road network in Kathmandu Valley. Data collected by the Study team are as follows:

Road Inventory Survey:

Length, Width of Carriageway, Shoulder, Sidewalk and Right-of-Way,
Pavement Condition, Roadside Clearance and Condition, Parking Space and
Bridge Type, Width, Length and Condition

The roads under the Study are Highways, Feeder Roads, Primary District Roads and Urban Road including the Ring Road and Class A and B City Roads. Fig.3.2 and 3.3 show the existing road network by lane number and by road surface condition respectively.

3.3.1 Present Road Conditions




The characteristics and issues on the road network in Kathmandu Valley identified by the Study team through the survey are described briefly hereunder:

(1) Highways

Tribhuvan Highway is the important national highway which connects Kathmandu and the regions in the southern Nepal as well as India. The road is heavily trafficked and congested since towns located along the road and new settlements are continuously developing. To cope with the increasing traffic demand to and from the areas outside Kathmandu Valley, improvement of the existing road might be necessary in the near future. However, the widening of the existing carriageway might be difficult due to the location of numbers of houses and buildings encroaching on the right-of-way.

Arniko Highway is the main road running east from Kathmandu to the eastern Nepal up to Tibetan border. It is also the major connector between Kathmandu and Bhaktapur City. The section of this road inside the Ring Road is well engineered with sufficient width of carriageway(4 lanes), shoulder and sidewalk on both sides. It has 2-lane carriageway with 6.5 m width outside the Ring Road. The section between the Ring Road and Bhaktapur is heavily trafficked due to the rapid expansion of the urbanized areas in and around Thimi and Bhaktapur. The widening of the road might not be difficult because the sufficient width of right-of-way is being reserved.

LEGEND

-  4 lanes
-  2 lanes
-  1 lane

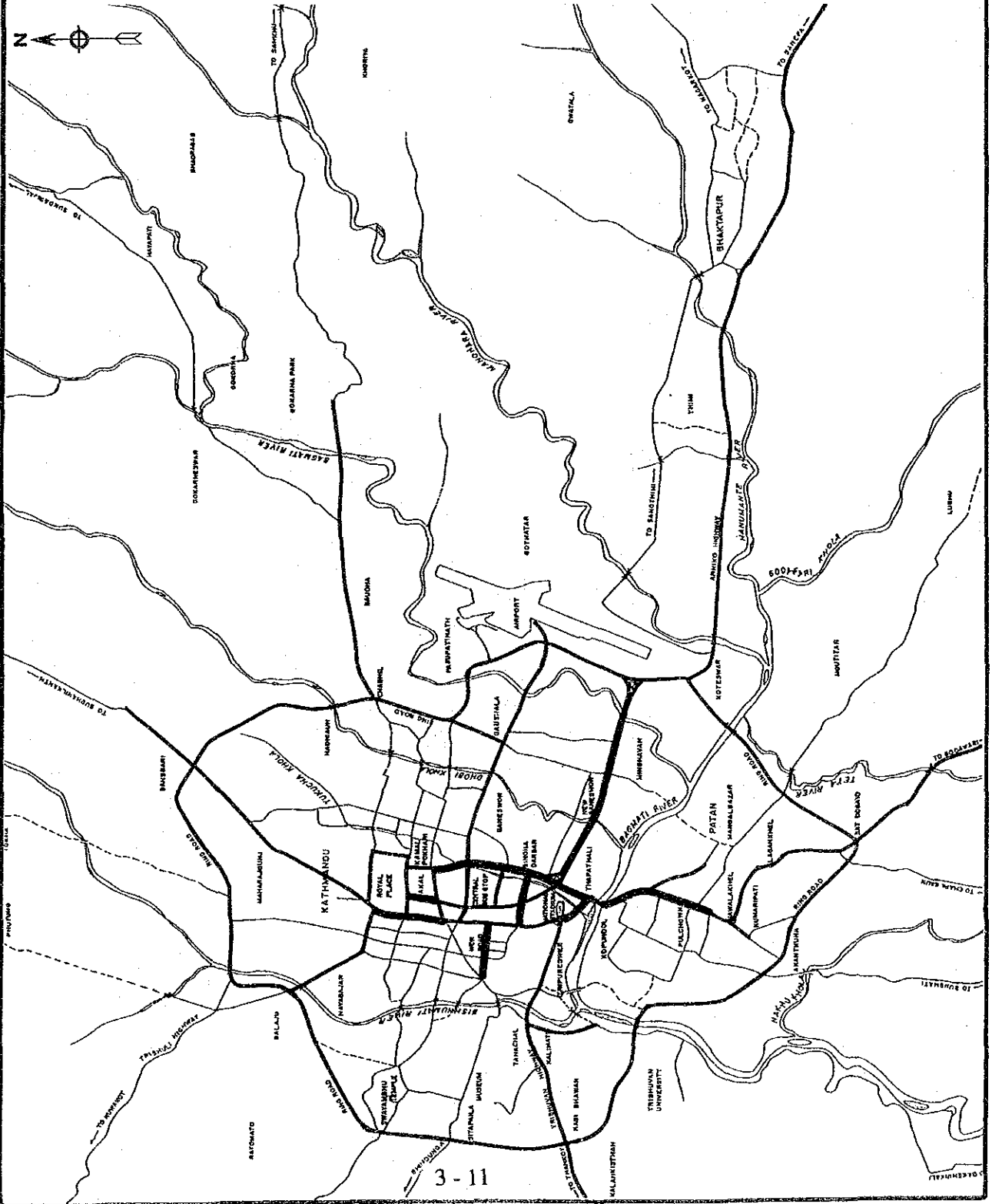
0 250 500 1000 2000m
 SCALE = 1 : 25,000

HIS MAJESTYS GOVERNMENT OF NEPAL
 (H.M.G)

KATHMANDU VALLEY
 URBAN ROAD DEVELOPMENT
 ROAD CLASSIFICATION BY
 LANE NUMBER

FIG.3.2

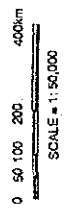
JAPAN INTERNATIONAL COOPERATION
 AGENCY (JICA)





LEGEND

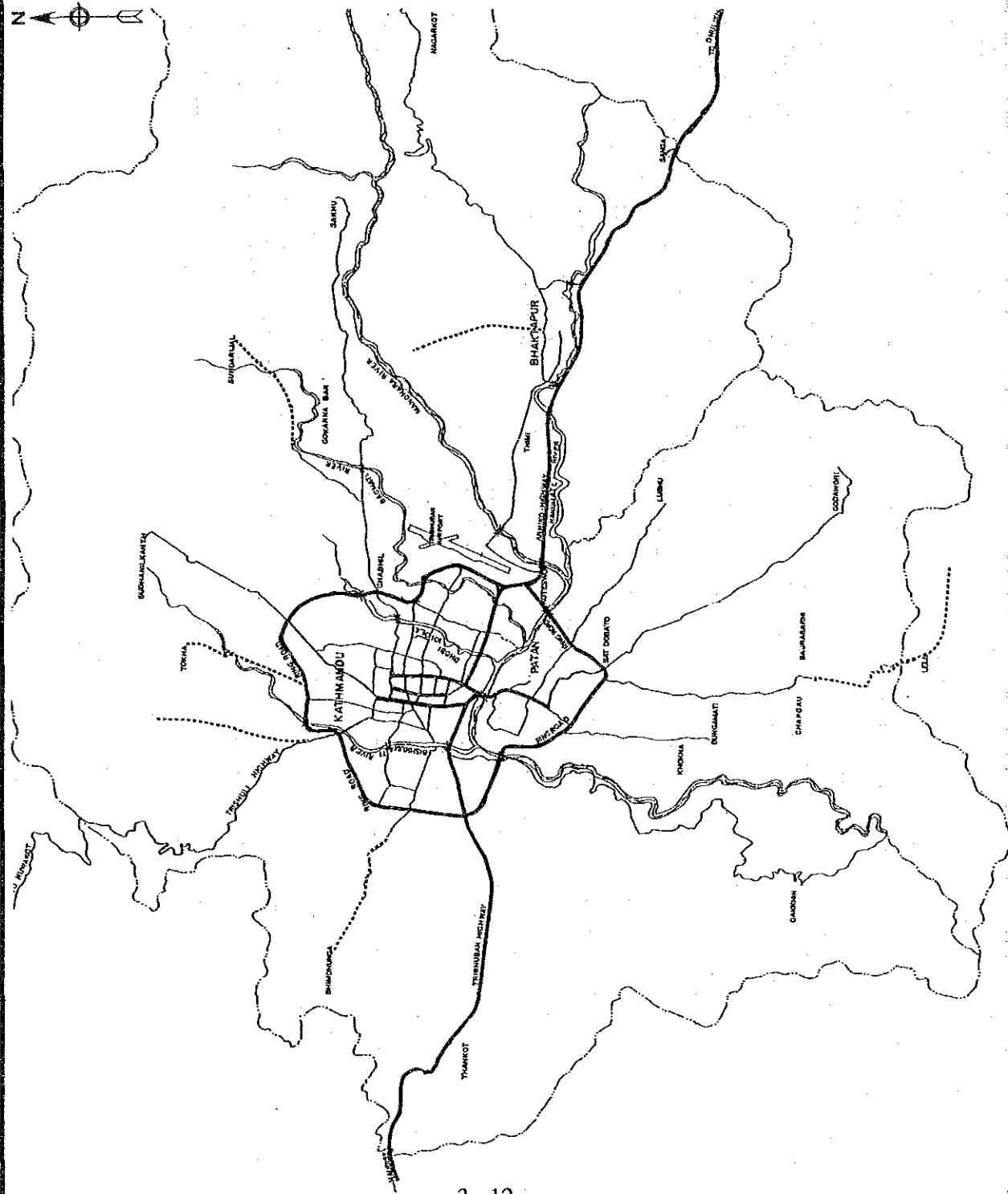
- Black topped
- Gravel and Earth



HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G.)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
ROAD CLASSIFICATION BY
SURFACE CONDITION

FIG. 3.3

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



(2) Feeder Roads

Thimi Road is a 4.0 m wide road with a single lane and a low grade design standards. Thimi is going to become a vital intermediate town in between Kathmandu and Bhaktapur and rapid urbanization is expected to be taken place in this area. The road, therefore, should be upgraded to a higher design standard with two-lane carriageway at least taking into consideration anticipated future traffic increase in the areas along the feeder roads.

Trisuli Road is a connector between Kathmandu with Nuwakot and Rasuwa District. It is a 3.5 m single lane road with poor geometric condition, however, the road standard is generally acceptable for traffic volume for the moment.

(3) District Roads

A number of towns and villages are developed along the primary district roads and new settlement are continuously developing along those roads. As shown in Fig.3.1, these primary district roads are mostly radiating from the Ring Road. Their function is important in the transportation of cargoes as well as commuters from the areas outside the Ring Road. Although these primary district roads are mostly narrow and in poor condition, the standard of road is generally acceptable for the present traffic volume.

It was observed that certain sections of primary district roads in the rural area are still gravelled and earthen roads. Dust pollution caused by these roads in the dry season makes the damage to the roadside crops and result in an inconvenience and health hazard to the people living near the roads and commuters.

In addition, as a result of road inventory survey, it was observed that one third of the pavement on the primary district roads have been deteriorated to the level that requires reconstruction due to the passage of heavy buses and trucks. Since the primary district roads are useful roads with localized nature, they should be maintained properly by patching, pot-hole repairs and preventive maintenance to provide all-weather access to the public transport vehicles.

(4) Urban Roads

Road conditions were inspected only for the primary and secondary roads in the urban area since other roads are less important and serve as access to the abutting buildings. The following are the summary of road conditions identified by the Study Team (See Fig. 3.4).

LEGEND

Historical Core Area

Preferred Road Link

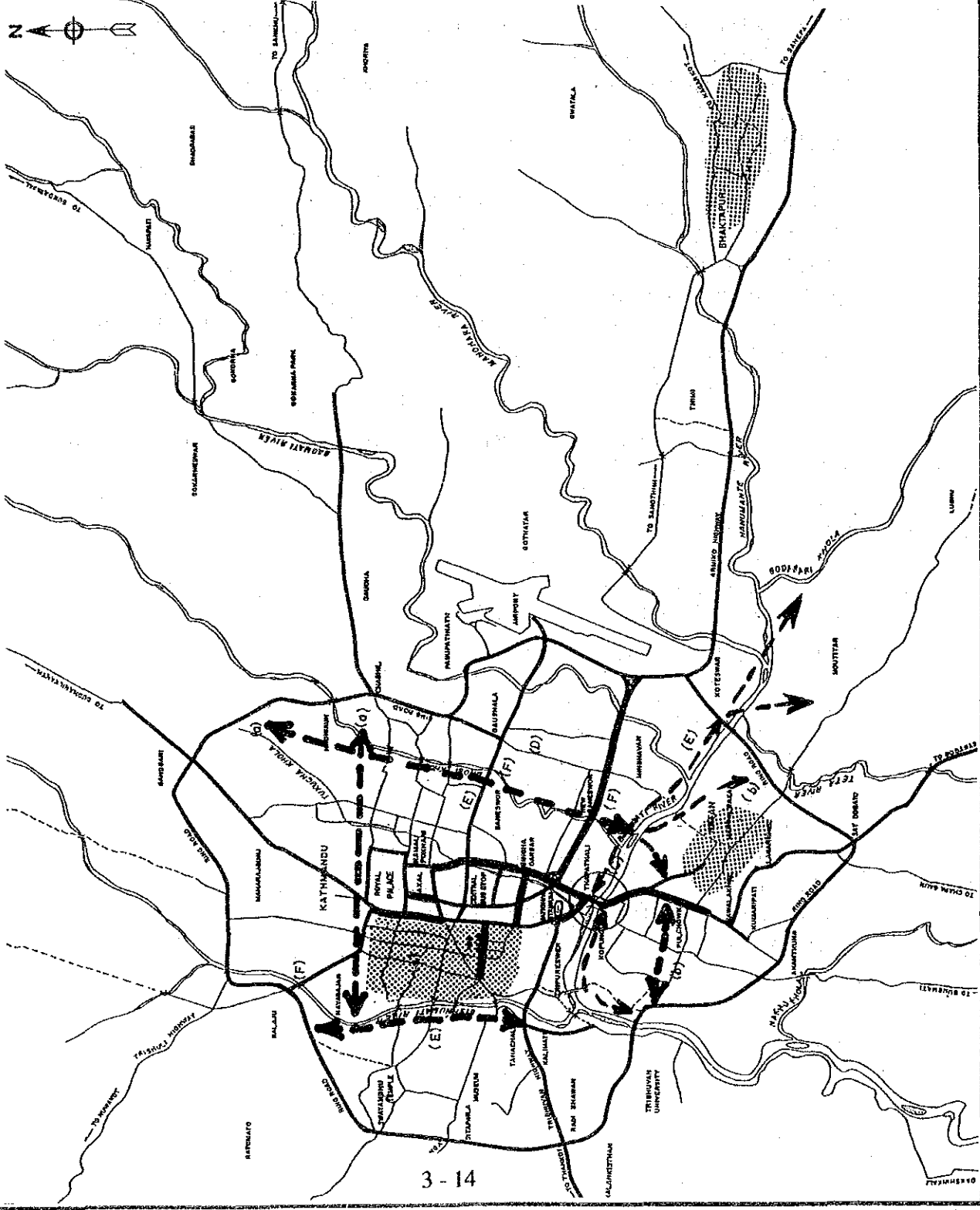


0 250 500 1000 2000m
SCALE=1 : 25, 000

HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G.)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
MAJOR FINDINGS ON PRESENT
ROAD NETWORK

FIG. 3.4

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



Ring Road

The Ring Road is one of the vital arterial roads in Kathmandu Valley with a function of dispersing the through traffic in the central area. It is well engineered with 10 m wide double carriageway road. The right-of-way being reserved along the road is 30 m to 50 m wide which is sufficient for expansion from existing 2-lane to 4-lane in future.

Heavy traffic congestion were observed at the major intersections with highways, feeder roads and primary district roads due to lack of bus bays and loading/unloading places. In addition, a number of large trucks and buses are being parked on the shoulders of the road nearby the major intersections due to restriction of entrance to the city during the day time. These vehicles interfere with the smooth traffic flow on the Ring Road, therefore, adequate parking lots should be provided urgently.

City Roads

(a) Kathmandu city is served with parallel street system with one east-west arterial road (Arniko Highway to Tribhuvan Highway) and one north-south arterial road from the Ring Road at Maharajganj up to Bagmati Bridge at Thapathali. As shown in Fig.3.4, there is no major road connecting east to west in the northern part of the city, and also no arterial road in the direction of north to south in the western and eastern parts of the city. These missing links might be indispensable to build up well-balanced and efficient road network in the city, which would result in the reduction of traffic congestion on the roads in the central area.

The areas around Durbar Square, Hanuman Dhoka and Ason Tole could be defined as historic core areas in Kathmandu. Neither extension nor improvement of the existing roads in the core areas is recommended and intrusion of traffic into the core areas should be restricted to minimize the impact on the environment of historic areas.

(b) Lalitpur city has so far only one arterial road connecting the north to south-east namely the road connecting Bagmati Bridge to the Ring Road at Sat Dobato from where the road leads to Godawari. The road network and its conditions in Lalitpur are inadequate in the rapid urbanization of the city. (See Fig. 3.4) The road network in the east-west direction is extremely insufficient. Extension of the Pulchok-Jhamsikhel Road up to the Ring Road would stimulate urban land development in western part of Lalitpur. Extension of Jawalakhel - Ekantakuna Road up to the Ring Road would also serve as a vital arterial road to disperse through-traffic in the area outside the Ring Road. Northern part of Lalitpur city near Shankahmol is also designated as historic core area. Master Plan study on this core area is undergoing with a technical assistance from GTZ.

(c) River crossing capacity of Bagmati River is too small to meet the existing traffic demand between Kathmandu and Lalitpur. The integration of Kathmandu and Lalitpur are inevitable process in the rapid urbanization of the area. Bagmati Bridge,

which is only the vehicular bridge other than the Ring road connecting cities of Kathmandu and Lalitpur, collapsed on August 1991 and was recovered in May 1992. However, enhancement of river crossing capacity over Bagmati River is the most urgent issue. (See Fig. 3.4) The expansion of river crossing capacity requires new Bagmati Bridge with 4 lanes as well as new Shankhamol Bridge to cope with the anticipated increase in traffic over Bagmati River.

(d) The city roads, especially low grade roads classified into Class B to D, have encountered problems of encroachment in the right-of-way and uncontrolled development adjacent thereto. Encroachment of buildings on the shoulders of the road sometimes interferes with smooth traffic flow and causes damages to drainage system, resulting in deterioration of road function and reduction in capacity. It is imperative for the Department of Roads to tackle this problem to prevent further encroachment. DOR should be empowered to control all the illegal activities within the right -of-way.

(e) To cope with the rapid motorization resulted from urbanization of Kathmandu, expansion of road network is indispensable. Rapid urbanization and chaotic development, however, make it difficult to construct road infrastructure due to high land acquisition and compensation costs resulted from it. It is recommended for the government to consider the maximum utilization of riverbed near the bank of Bagmati and Bishnumati rivers and Dhobi Khola for road construction.

(f) There are a number of small bridges in the urban area, which are mostly old and narrow and become bottlenecks to the traffic. However, these bridges are under the program of reconstruction with the financial assistance from Japanese Government and IDA.

(g) Most of the existing bridges in the city are suffering the scouring of bridge foundations. Adequate counter measures should be taken as soon as possible to protect the further deterioration on the foundation of the following bridges:

- Dhobi Khola Bridge, Arniko Highway
- Dhobi Khola Bridge, Dilli Bazar-Old Banewar Road
- Bagmati Bridge, Old Banewar Road
- Bishnumati Bridge, Trisuli Road

3.3.2 Capacity of the Existing Roads

Traffic capacity of the existing roads has been calculated based on the result of the road inventory survey. There are several factors that affect the road capacity as given below:

Lane Number, Carriageway and Shoulder Width, Roadside Condition, Sidewalk, Composition of Traffic, Mixing Ratio of Motorcycles and Bicycles

Road capacity has been calculated based on the carriageway width with appropriate reductions taking into account of roadside conditions and traffic component. Result of calculation on each road is illustrated in Fig. 3.5.

Different types of traffic take up differing amount of road space and impose differing loads on the road structures. It is necessary, therefore, to adopt a standard traffic unit, namely "Passenger Car Unit (PCU)". The traffic coefficients to be adopted are developed for the purpose of the Study by the Study team on the basis of DOR Standards (2027) as shown Table 3.9.

TABLE 3.9 PASSENGER CAR UNIT FOR URBAN ROADS

Passenger car, Taxi, Tempo, Autorickshaw	1.0
Light truck	1.5
Heavy truck	4.0
Minibus	3.0
Trolley Bus and Bus	4.0
Motorcycle	0.5
Bicycle, Rickshaw	0.5
Others (Hand-cart, Pack animal)	1.0

In Kathmandu, most of the roads inside the Ring Road are deemed to be operated under urban conditions, while the roads outside the Ring Road are mostly categorized as the rural ones.

For the capacity analysis, the following traffic components (Table 3.10) have been adopted for obtaining the adjustment factor for mixing of motorcycles and bicycles on the basis of the traffic survey.

TABLE 3.10 TRAFFIC COMPONENTS OBSERVED BY THE STUDY TEAM

	Motor- cycle	Bicycle Others	Passenger car and taxi	Minibus Bus/Truck	Total
Roads outside Ring Road	<u>16</u>	<u>57</u>	18	9	100%
Roads inside Ring Road	<u>30</u>	<u>24</u>	42	4	100%

The passage of large volumes of motor cycles and bicycle (non-motorized traffic) on the city roads as seen above leads to reduction in capacity. The roadside conditions along the city roads also lead to the reduction in capacity due to encroachment of numbers of buildings on right-of-way and sometimes up to road shoulders.

LEGEND

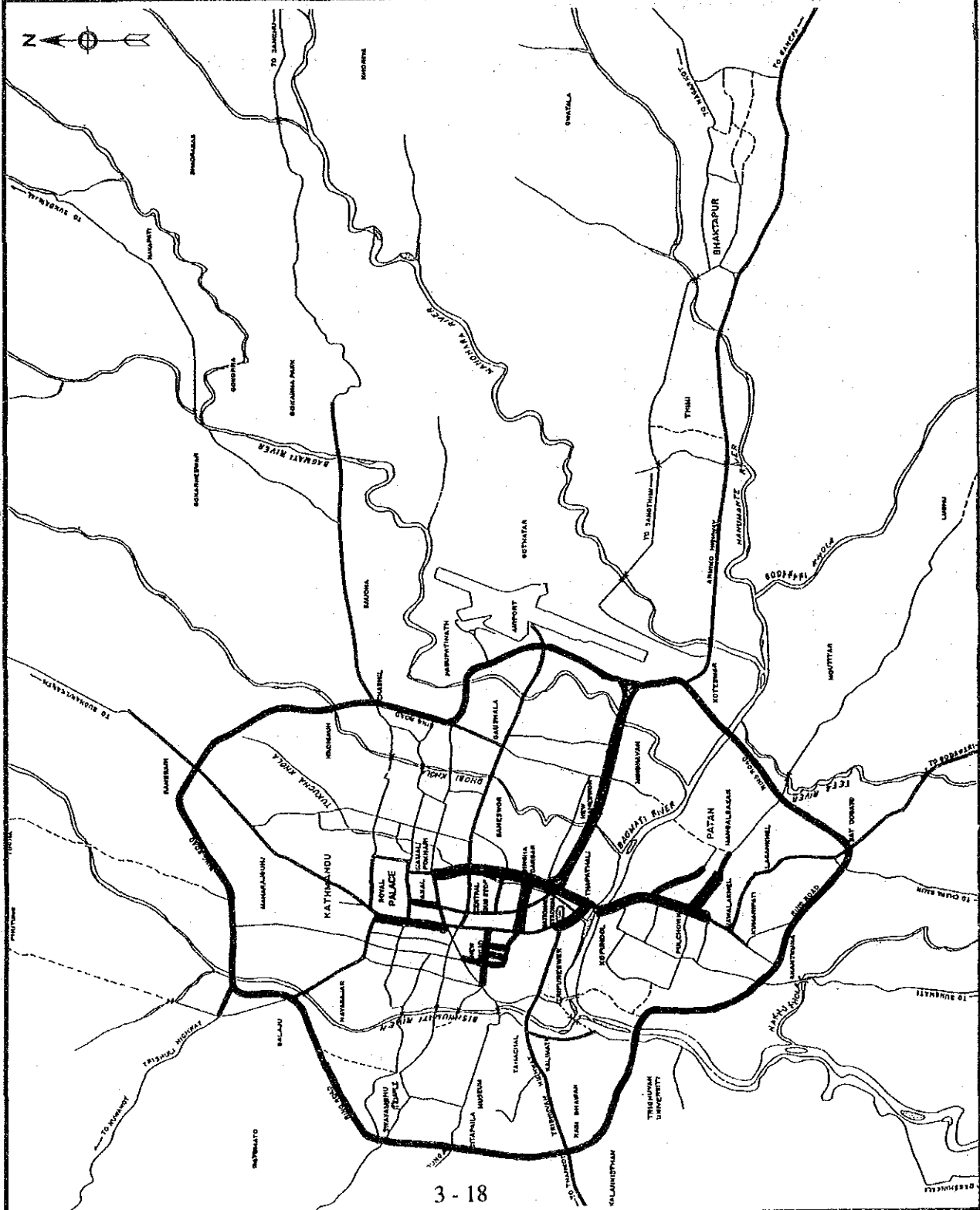
6000 4000 2000
(pcu/hr)

0 250 500 1000 2000m
SCALE=1:25,000

HIS MAJESTYS GOVERNMENT OF NEPAL
(H.M.G.)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
TRAFFIC CAPACITY OF EXISTING
ROADS

FIG. 3.5

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



3.3.3 Road Density by Traffic Zone

Road density per population has been analyzed by each traffic zone established by the Study team. The classes of roads subject to the analysis are as follows:

Highways,
Feeder Roads,
Primary District Roads (Blacktopped road only), and
Primary City Roads (Class A only).

The road density by traffic zone has been given in Table 3.11 and categorized into five (5) levels viz. Level 1 to Level 5 as shown in Fig. 3.6.

The following are the major findings and issues identified through the analysis of road density:

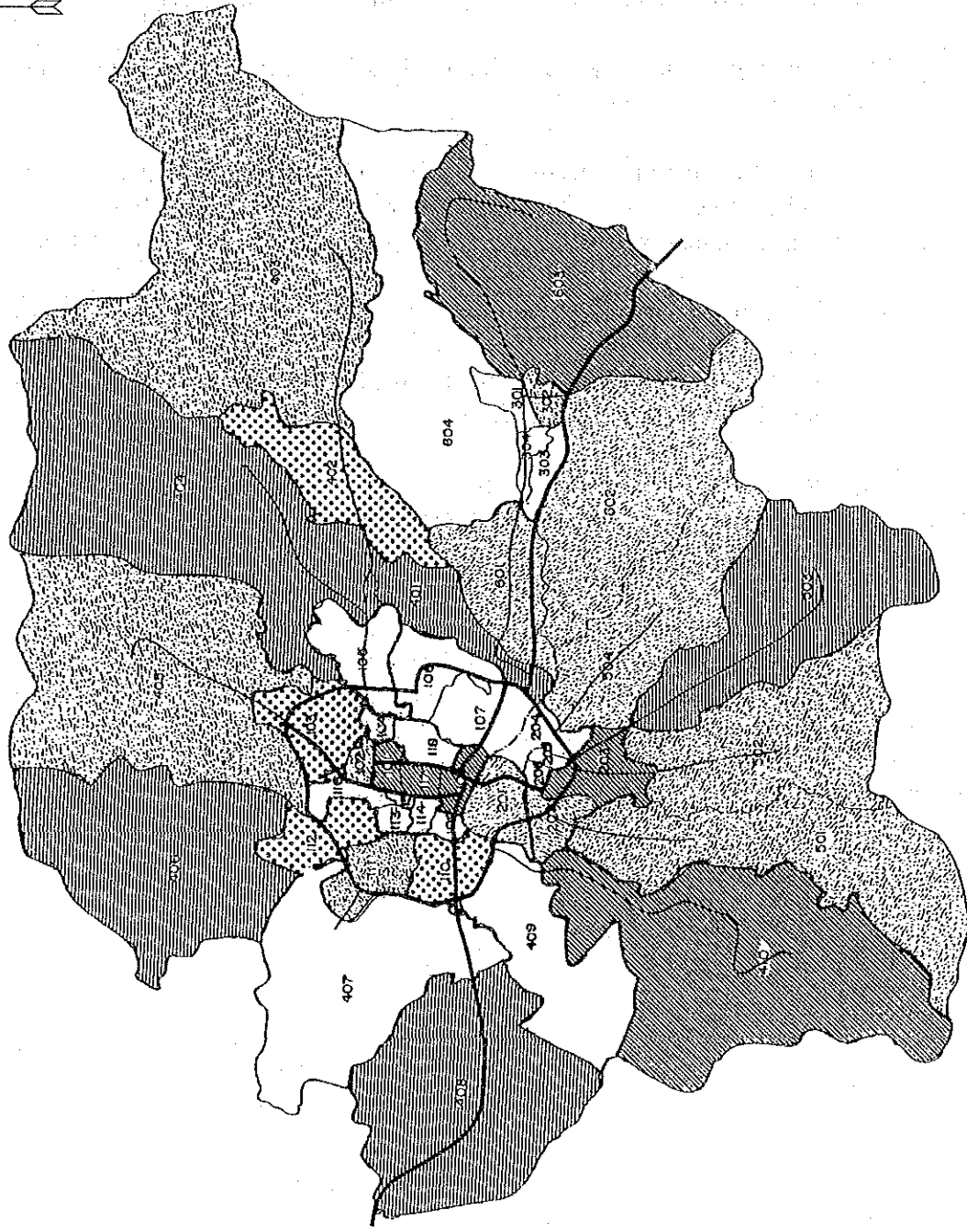
- (1) Road densities in the historic core areas in Kathmandu, Lalitpur and Bhaktapur cities (Zone No. 113, 114, 115, 116, 205, 206, 301, 303, 304) are extremely sparse from the reason that these core areas are very densely populated.
- (2) Necessity of new road facilities in the areas along Dhobi Khola including Baneswar in Kathmandu city (Zone No. 104, 105, 106, 107, 118) and northern areas of Lalitpur along Bagmati River (Zone No. 201, 204) could be justified in terms of road density.
- (3) Road densities in traffic zone No. 407 and 604 are extremely sparse due to lack of primary district roads, while Zone No.403, 405, 501, 502, 504, 601 and 602 have lower road density compared with other zones.

There is a primary secondary district road in each zone, however, the road surface is mostly poorly blacktopped or gravelled or earthen road. Necessity of extension or upgrading of the existing primary and secondary district roads could also be justified from the view point of basic human needs.

LEGEND

(Unit : m/thousand persons)

- ~ 100 (Level 1)
- 101 ~ 200 (Level 2)
- 201 ~ 300 (Level 3)
- 301 ~ 400 (Level 4)
- 400 ~ (Level 5)



HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G.)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
ROAD DENSITY BY TRAFFIC ZONE

FIG. 3.6

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

Table 3.11 ROAD DENSITY BY TRAFFIC ZONE

	Highway	Feeder Road	Primary Distr. Rd.	City Road Class A	Total Road Length (km)	Population	Road Density (m/1,000 person)
101				3.30	3.30	6,691	493
102				0.90	0.90	8,288	109
103			1.40	6.50	7.90	29,746	266
104				0.00	0.00	8,592	0
105			2.50		2.50	37,380	67
106				1.10	1.10	24,831	44
107	2.20			1.80	4.00	41,213	97
108	1.70			3.50	5.20	9,983	521
109	0.70				0.70	20,329	34
110	2.40			3.90	6.30	30,074	209
111				2.60	2.60	19,431	134
112		1.80		3.00	4.80	20,281	237
113				0.20	0.20	28,813	7
114				0.90	0.90	45,330	20
115				0.50	0.50	19,190	26
116				1.20	1.20	19,208	62
117				6.90	6.90	12,753	541
118				1.10	1.10	32,068	34
201				3.00	3.00	25,925	116
202			0.70	1.90	2.60	11,757	221
203			2.40	4.40	6.80	15,300	444
204				1.90	1.90	28,019	68
205				0.60	0.60	15,856	38
206				0.70	0.70	20,346	34
301			0.80		0.80	16,099	50
302	1.10				1.10	9,794	112
303		1.50			1.50	18,752	80
304		0.30			0.30	16,477	18
401	0.80	2.10		0.50	3.40	10,985	310
402			3.60		3.60	15,015	240
403			3.40		3.40	26,878	126
404			9.00		9.00	29,291	307
405			6.90		6.90	36,807	187
406		9.00			9.00	25,886	348
407			1.00		1.00	24,868	40
408	10.50				10.50	31,633	332
409			1.80	3.20	5.00	33,674	148
410			13.80		13.80	19,304	715
501			3.50		3.50	21,273	165
502			4.80		4.80	32,270	149
503			8.00		8.00	21,148	378
504			5.50		5.50	29,626	186
601	4.50			4.60	9.10	31,919	285
602	4.20				4.20	29,991	140
603			13.40		13.40	24,282	552
604		0.30			0.30	25,783	12
Total	28.1	15.00	82.50	58.20	183.80	1,063,162	173

3.4 Public Transport

Public transport service in the Valley is composed of mass transportation services mainly by buses and minibuses on major roads and services by tempos and autorickshaws on secondary roads. Major bus route service at present, is being operated by Sajha Yatayat, Nepal Transport Corporation and many other private bus companies. Trolley bus is operated between Kathmandu and Bhaktapur by Nepal Transport Corporation since early 1970's.

The role of private sector in the public transportation services is dominant and about 80% of services are being undertaken by private sector. The dominance of private sector in public transportation services comes from the following reasons:

- Government is taking liberal policy in providing license and other related support to private sector,
- The involvement of many private companies in this field of service induced the competition among the companies which has resulted in better services, compared with those of public sector.

Major bus network and number of bus service on each route are illustrated in Fig. 3.7, 3.8, 3.9 and 3.10. The service level, in general, is quite low as against growing demand by users in the following senses :

- Absolute shortage in fleet number,
- Fleets in use, by and large, are obsolete and prone to malfunction during the services,
- The service routes are not always provided with sufficient number of buses, keeping balance with the size of demand. There are some townships which have no bus service system at all,
- Bus stops are not located systematically by different companies and there is no coordination among companies,
- The locations of bus stops are usually not marked clearly and most of the bus stops are not provided with even minimal facilities such as shelters and bus bays, and
- No time-table, route-map and fare-rate has been made in public for the convenience of users.

Due to insufficient service in mass transportation by public sector in the Valley, private sector has launched mass transportation service rather in disordered manner (Ref. Table 3.12). Most of the tempos have began their services on the routes where

the services by bus cannot be provided, whereas minibuses are being operated where the services by buses are insufficient. Services by small tempos are mainly provided on the roads in the central area and/or narrow feeder roads where large vehicles cannot enter.

The nature of issues in public transport in the Study area, lies in shortage of "capacities" in terms of road capacity and fleet capacity. Lack of proper management, say functional dislinkage between bus service on arterial road and minibus/auto-rickshaw/tempo services on feeder roads, are another reason behind the inefficient public transportation services.

The operation of heavy buses on the streets in the urban area is one of the other aspects of urban traffic. At present, bus terminal which is located near the downtown of Kathmandu, is used both for long distant and city buses. Passage of heavy buses in urban area is a major cause of deterioration of urban amenities and traffic accidents as well as congestion of urban roads and pollution.

There is a plan of relocation of the bus terminal to Balaju, suburban area located near the north-west corner of the Ring Road. Although this site is controversial among the decision-makers and users, this kind of policy of dispersing the places of traffic congestion to other parts of the city would promote more streamlined traffic in the urban roads.

The Study area is now on the early stage of motorization and it is expected that the number of vehicles will increase in the near future and road traffic situation will become more serious one. In these circumstances, the role of public transport would become more vital in the urban transportation.

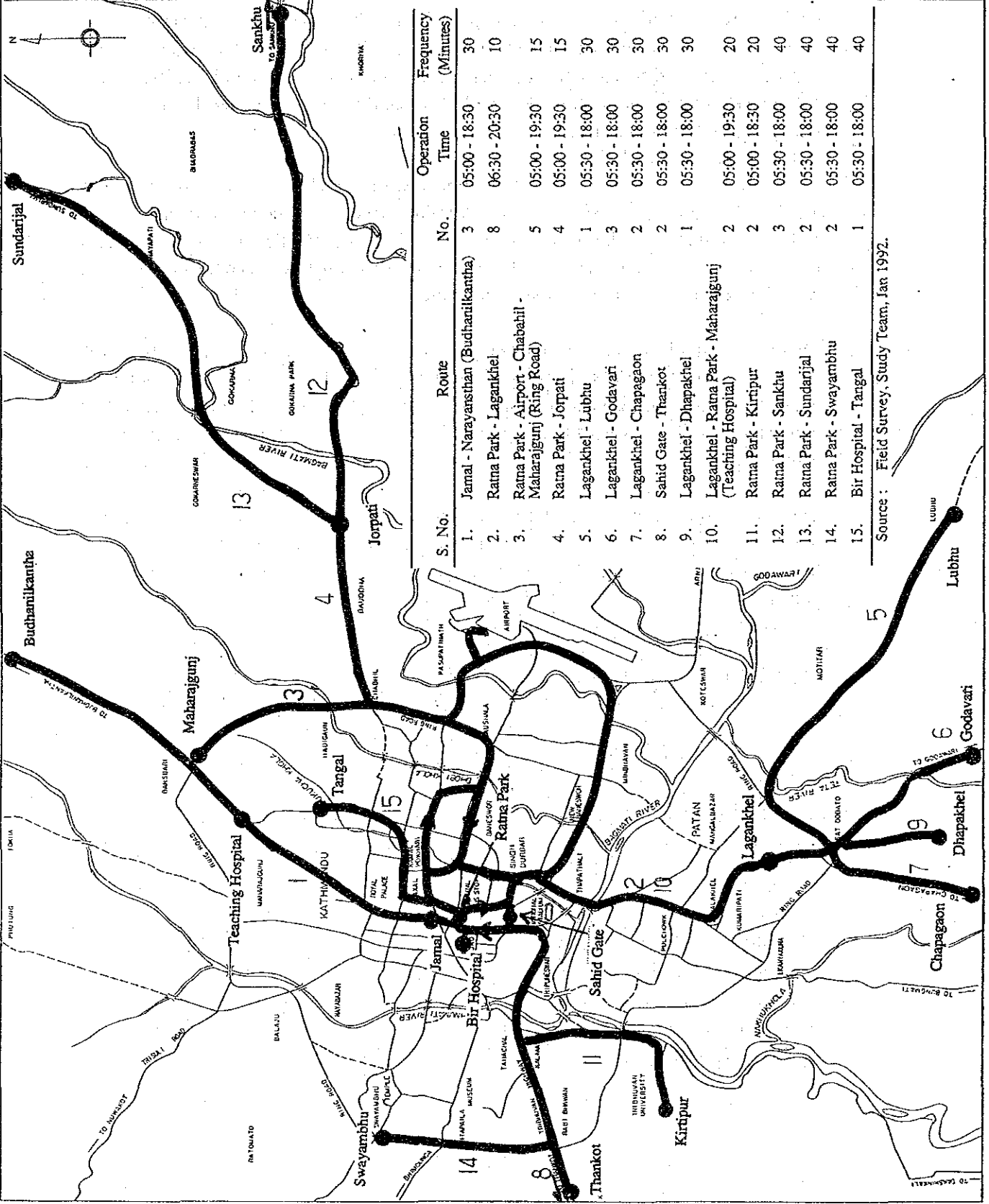
TABLE 3.12 VEHICLE PERMIT ISSUED BY ZONAL TRANSPORT MANAGEMENT OFFICE (OPERATION WITHIN THE VALLEY)

Sl. No.	Vehicle Type	Permit issued in No.		Increase in 4 years (86/87 - 90/91)	Annual average growth %	Remarks
		1986/87	1990/91			
1	2	3	4	5	6	
1.	Taxi	1,510	1,857	347	6	After getting the permit, owner can put his vehicle in any desired route with route operation committees concurrence.
2.	Tempo*	621	1,805	1,184	48	
3.	Bus (Private)	17	69	52	76	
4.	Bus (Sajha)	46	59	13	7	
5.	Minibus	420	630	210	13	

*Including tempo (three-wheeler) operating with meter.

Source : Environmental Impact Study of Kathmandu Valley Urban Road, NEPECON, December 1991.

LEGEND :-



S. No.	Route	No.	Operation Time	Frequency (Minutes)
1.	Jamal - Narayansthan (Budhanikantha)	3	05:00 - 18:30	30
2.	Ratna Park - Lagankhel	8	06:30 - 20:30	10
3.	Ratna Park - Airport - Chabahil - Maharajgunj (Ring Road)	5	05:00 - 19:30	15
4.	Ratna Park - Jorpati	4	05:00 - 19:30	15
5.	Lagankhel - Lubhu	1	05:30 - 18:00	30
6.	Lagankhel - Godavari	3	05:30 - 18:00	30
7.	Lagankhel - Chapagaon	2	05:30 - 18:00	30
8.	Sahid Gate - Thakot	2	05:30 - 18:00	30
9.	Lagankhel - Dhapakhel	1	05:30 - 18:00	30
10.	Lagankhel - Ratna Park - Maharajgunj (Teaching Hospital)	2	05:00 - 19:30	20
11.	Ratna Park - Kirtipur	2	05:00 - 18:30	20
12.	Ratna Park - Sankhu	3	05:30 - 18:00	40
13.	Ratna Park - Sundarjal	2	05:30 - 18:00	40
14.	Ratna Park - Swayambhu	2	05:30 - 18:00	40
15.	Bir Hospital - Tangal	1	05:30 - 18:00	40

Source : Field Survey, Study Team, Jan 1992.

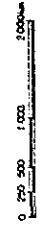
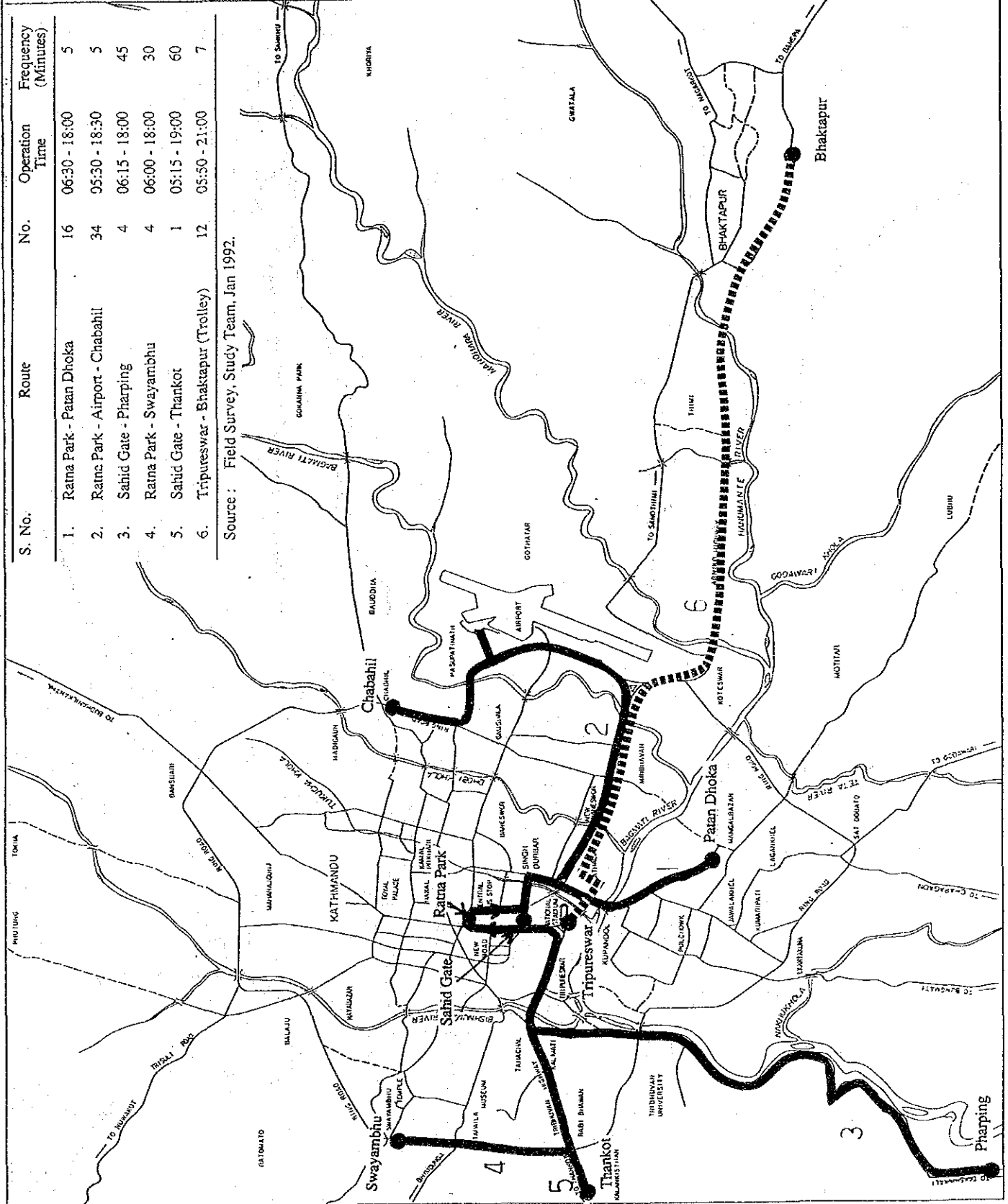
HIS MAJESTY'S GOVERNMENT OF NEPAL
(HMG)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
**SAJHA YATAYAT
BUS ROUTE
NETWORK**

FIG NO. 3.7
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

LEGEND: -

S. No.	Route	No.	Operation Time	Frequency (Minutes)
1.	Ratna Park - Patan Dhoka	16	06:30 - 18:00	5
2.	Ratna Park - Airport - Chababil	34	05:30 - 18:30	5
3.	Sahid Gate - Pharping	4	06:15 - 18:00	45
4.	Ratna Park - Swayambhu	4	06:00 - 18:00	30
5.	Sahid Gate - Thankot	1	05:15 - 19:00	60
6.	Tripureswar - Bhaktapur (Trolley)	12	05:50 - 21:00	7

Source: Field Survey, Study Team, Jan 1992.



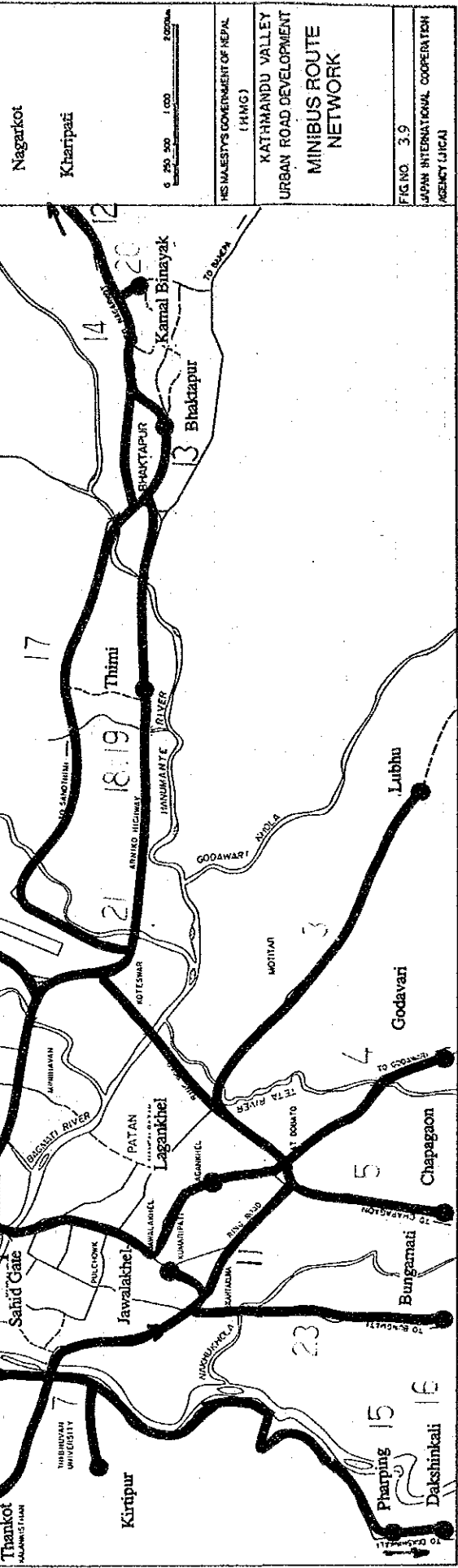
HERMAJESTY'S GOVERNMENT OF NEPAL
(HMGI)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
**BUS ROUTE
NETWORK
(EXCEPT SAJHA)**
FIG. NO. 3.8
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

LEGEND :-



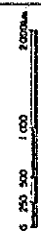
S. No.	Route	No.	Operation Time (Minutes)
1.	Raina Park - Laganckhel	60	05:30 - 20:00
2.	Raina Park - Jorpati	60	05:30 - 20:00
3.	Laganckhel - Lubhu	3	07:15 - 18:30
4.	Laganckhel - Godavari	10	06:00 - 18:30
5.	Laganckhel - Chapagaon	7	06:00 - 18:30
6.	Sahid Gate - Thakor	35	05:10 - 19:00
7.	Raina Park - Kiripur	35	06:00 - 19:30
8.	Raina Park - Sankhu	32	07:00 - 18:00
9.	Raina Park - Sundarijal	10	07:00 - 18:00
10.	Jamal - Bulaju	24	06:00 - 18:00
11.	Laganckhel - Ring Road - Laganckhel	7	06:00 - 16:50
12.	Bhaktapur - Nagarkot	5	06:00 - 15:00
13.	Kathmandu - Bhaktapur (Express)	41	06:45 - 19:15
14.	Kathmandu - Bhaktapur (Kamal Binayak)	20	07:00 - 18:50
15.	Sahid Gate - Pharping	20	06:00 - 17:50
16.	Sahid Gate - Dakshinkali	10	05:30 - 18:30
17.	Raina Park - Bhaktapur (via Thimi North)	38	07:00 - 19:15
18.	Bhaktapur - Laganckhel (via Arniko Highway)	4	06:00 - 17:00
19.	Kamal Binayak (Bhaktapur) - Kharipati	26	06:00 - 19:30
20.	Raina Park - Thimi (Arniko Highway)	22	05:30 - 19:00
21.	Jamal - Naryanasthan (Budhanikanta)	3	06:00 - 18:30
22.	Jawalakhel - Bungamati	15	05:30 - 20:00
23.	Raina Park - Thali	5	05:30 - 20:00
24.	Raina Park - Gokarna	15	05:30 - 20:00

Source : Field Survey, Study Team, Jan 1992.



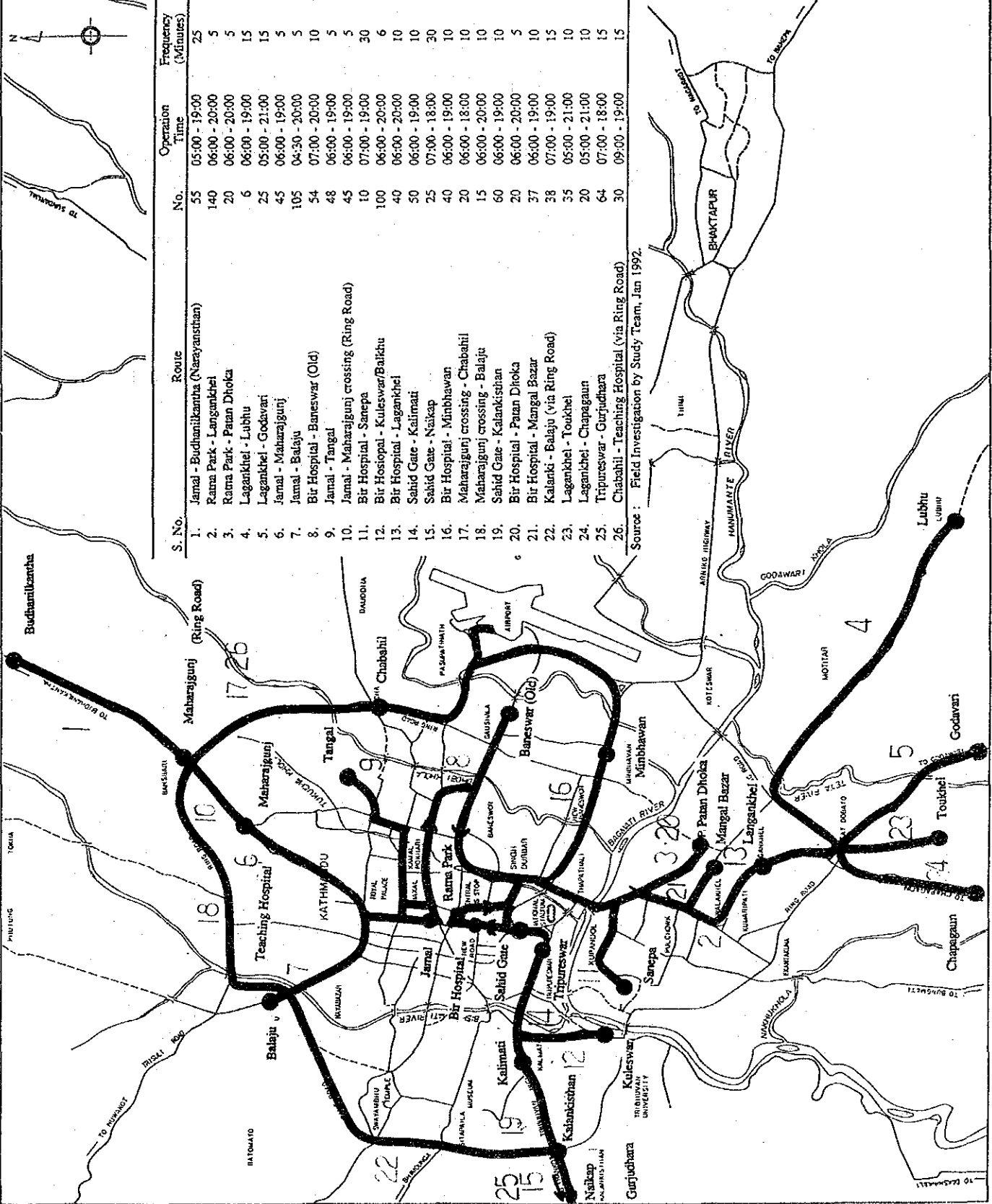
Nagarkot

Kharipati



MINISTRY'S GOVERNMENT OF NEPAL
(HMG)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
MINIBUS ROUTE
NETWORK
FIG. NO. 3.9
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

LEGEND :-



S. No.	Route	No.	Operation Time	Frequency (Minutes)
1.	Jamal - Budhanilkantha (Naxayanshan)	55	05:00 - 19:00	25
2.	Rama Park - Langankhel	140	06:00 - 20:00	5
3.	Rama Park - Patan Dhoka	20	06:00 - 20:00	5
4.	Laganckhel - Lubhu	6	06:00 - 19:00	15
5.	Laganckhel - Godavari	25	05:00 - 21:00	15
6.	Jamal - Maharajgunj	45	06:00 - 19:00	5
7.	Jamal - Balaju	105	04:30 - 20:00	5
8.	Bir Hospital - Baneswar (Old)	54	07:00 - 20:00	10
9.	Jamal - Tangal	48	06:00 - 19:00	5
10.	Jamal - Maharajgunj crossing (Ring Road)	45	06:00 - 19:00	5
11.	Bir Hospital - Sanepa	10	07:00 - 19:00	30
12.	Bir Hospital - Kuleswar/Balkhu	100	06:00 - 20:00	6
13.	Bir Hospital - Laganckhel	40	06:00 - 20:00	10
14.	Sahid Gate - Kalimati	50	06:00 - 19:00	10
15.	Sahid Gate - Naikap	25	07:00 - 18:00	30
16.	Bir Hospital - Minbhawan	40	06:00 - 19:00	10
17.	Maharajgunj crossing - Chabahl	20	06:00 - 18:00	10
18.	Maharajgunj crossing - Balaju	15	06:00 - 20:00	10
19.	Sahid Gate - Kalankishan	60	06:00 - 19:00	10
20.	Bir Hospital - Patan Dhoka	20	06:00 - 20:00	5
21.	Bir Hospital - Mangal Bazar	37	06:00 - 19:00	10
22.	Kalanki - Balaju (via Ring Road)	38	07:00 - 19:00	15
23.	Laganckhel - Toukhel	35	05:00 - 21:00	10
24.	Laganckhel - Chapagaun	20	05:00 - 21:00	10
25.	Tripureswar - Gurjadhara	64	07:00 - 18:00	15
26.	Chabahl - Teaching Hospital (via Ring Road)	30	09:00 - 19:00	15

Source : Field Investigation by Study Team, Jan 1992.



HER MAJESTY'S GOVERNMENT OF NEPAL
(HMGN)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
TEMPO ROUTE
NETWORK
FIG. NO. 3.10
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

3.5 On-going Traffic Management

At present, a variety of traffic management measures are being undertaken in the Study area. Some of the measures being undertaken are as follows:

- One-way operation
To enhance the capacities in the urban road, one way traffic regulation is undertaken on the streets in the central areas of Kathmandu and Lalitpur as shown in Fig. 3.12.
- Prohibition of on-street parking and provision of parking spaces on designated road sections as shown Fig. 3.13.
- For the efficient use of road sections of high congestion level, on-street parking is prohibited, while road sections with wider spaces are utilized as authorized parking space,
- Route restriction on three-wheelers
For the smooth traffic flow especially for light vehicles, minibuses and buses, new permission of tempo route is suspended since late 1991,
- Heavy trucks are restricted to enter the area within the Ring Road during the day time to reduce the congestion there,
- Restriction on the registration of three-wheelers and auto-rickshaws in Kathmandu and Lalitpur districts,
- For the promotion of efficient road use and improvement of traffic safety, new registration of three-wheelers including auto-rickshaws is being suspended since December 1991,
- Restriction on operation of slow-vehicles on major roads during peak hours (9:00 A.M. - 11:00 A.M., 4:00 P.M. - 6:00 P.M.) on week days,
- For the purpose of smooth traffic flow and resultant reduction of traffic accidents, slow vehicles including rickshaws, tractors, hand carts, and power tillers are banned on major roads in the central area during peak hours, and
- Channelization of long-distance bus movements on the roads within the Ring Road.

The history of traffic management in the Study area began with the legislation of Traffic Acts during 1960s and afterwards. Major Acts noteworthy are as follows:

- Vehicle Condition Act (1963)
Regulation on vehicle standard/introduction of vehicle inspection system,

- Motor Vehicle Act (1963)
Restriction of vehicle weight on bridges and so on. Limitation on loading, tonnage and number of passengers,
- Public Road Act (1974)
Regulation on usage of road space and right-of-way.

However, in spite of these legislative regulations and controls, actual traffic condition, especially in the urban area, has little been improved and rather getting worse in these days. As a matter of fact, rules attached to the above Acts are not strictly enforced and observed. Violators have not been penalized in case of violation of the law.

Lack of traffic management related to pedestrians is another issue. Intrusion of pedestrians into the carriageway and crossing of roads where there is no zebra crossings are daily events and becoming one of the prime causes of fatal accidents. Provision of fenced side-walks and that of more zebra crossings with signals are effective measures to channelize the pedestrian movement. In fact due to poor traffic behavior by pedestrians, such facilities as pedestrian crossing bridges and subway located in the city center of Kathmandu are not functioning well at present. At the same time, pedestrian sidewalks are insufficiently provided. For example, existing footpath width in Dillibazar area is less than one meter whereas the flow of pedestrian traffic is very large.

Intrusion of vehicles is legally banned in the historical monument areas such as Durbar Square and Dattatraya of Bhaktapur town.

Widening and renovation of existing roads are very limited mainly due to high land acquisition cost and financial constraints. The traffic management is to become a vital measure for the improvement of urban traffic condition as far as immediate future is concerned.

TABLE 3.13 ROAD ACCIDENT BY LOCATION, TIME AND MONTH
IN GREATER KATHMANDU* 15th JULY 1990 TO 14th DEC 1991

Month	Accident Location		Accident Time	
	Intersection	Midblock	Day	Night
Apr / May	5	10	9	6
May / June	11	24	29	6
June / July	13	15	23	5
July / Aug	5	11	11	5
Aug / Sep	8	17	21	4
Sep / Oct	12	20	23	9
Oct / Nov	7	8	12	3
Nov / Dec	7	19	19	7
Dec / Jan	7	12	12	7
Jan / Feb	9	14	18	5
Feb / Mar	8	13	20	1
Mar / Apr	10	19	23	6

Source : Central Traffic Police, Dec 1991

*Municipality Area of Kathmandu and Lalitpur

TABLE 3.14 AVERAGE ROAD ACCIDENT BETWEEN DIFFERENT MODES BY
MONTH IN GREATER KATHMANDU 15th JULY 1990 TO 14th DEC. 1991

Accident type	A/M	M/J	J/J	J/A	A/S	S/O	O/N	N/D	D/J	J/F	F/M	M/A	Total
Vehicle-Vehicle	12	21	21	11	16	26	13	18	10	20	16	22	206
Vehicle-Pedestrian	2	5	4	1	3	-	-	1	1	-	2	1	20
Vehicle/Bicycle/ Motor cycle	1	7	3	3	5	3	2	7	8	3	2	6	50
Bicycle/Motor cycle-Pedestrian	-	2	-	1	1	-	-	-	-	-	-	-	4
Total	15	35	28	16	25	29	15	26	19	23	20	29	280

Source : Central Traffic Police, Dec. 1991

TABLE 3.15 ROAD ACCIDENT: VEHICLE INVOLVEMENT BY TYPE
IN GREATER KATHMANDU* 15th DEC 1990 TO 14th DEC 1991

Month	Heavy Vehicle			Light Vehicle		Tempo Three -wheeler	Motor- cycle	Tractor Power Tiller	Total	Remarks
	Truck	Bus	Minibus	Car	Jeep/Van					
Dec / Jan	4	3	4	20	1	3	10	-	45	
Jan / Feb	2	11	7	15	3	2	3	1	44	
Feb / Mar	4	5	3	19	6	6	4	-	47	
Mar / Apr	2	5	4	20	10	5	2	-	48	
Apr / May	5	5	3	7	8	5	-	1	34	
May / Jun	7	1	8	23	7	8	7	3	64	
Jun / Jul	6	6	2	21	6	5	2	2	50	
Jul / Aug	5	4	7	29	5	9	7	1	67	
Aug / Sep	8	9	5	16	-	8	8	1	55	
Sep / Oct	5	10	4	24	5	4	3	2	57	
Oct / Nov	5	8	4	13	2	7	1	-	40	
Nov / Dec	8	5	4	13	4	2	5	-	41	
Total	61	72	55	220	57	64	52	11		
Total No. of Vehicle	188			277		64	52	11	592	
No. of Vehicles as per 15th Apr. 1991	7,362			18,638		2,723	25,405	1,793	55,921	

Source : Central Traffic Police, Dec. 1991

*Municipality Area of Kathmandu and Lalitpur

TABLE 3.16 VEHICLE FLEET AND VEHICLE INVOLVEMENT
IN ACCIDENT 1990/91

	Heavy Vehicle	Light Vehicle	Three-wheeler	Motorcycle	Tractor/ Power-tiller
Number of Vehicles as per 15th Apr. 1991	7,362	18,638	2,723	25,405	1,793
Percentage (%)	13.17%	33.33%	4.87%	45.43%	3.20%
Vehicle Number involved in Accident 15th Dec. 1990 to 14th Dec. 1991	188	277	64	52	11
Percentage (%)	31.76%	46.79%	10.81%	8.78%	1.86%

Source : Study Team Analysis, Dec. 1991.

LEGEND

- Bus stop
- Car Parking Area
- Pedestrian Bridge
- Pedestrian Subway
- Signal Controlled Roundabout
- Signal Controlled Intersection
- Truck Parking Area
- ▨ Propose Central Bus Park

0 250 500 1000 2000m
SCALE=1 : 25, 000

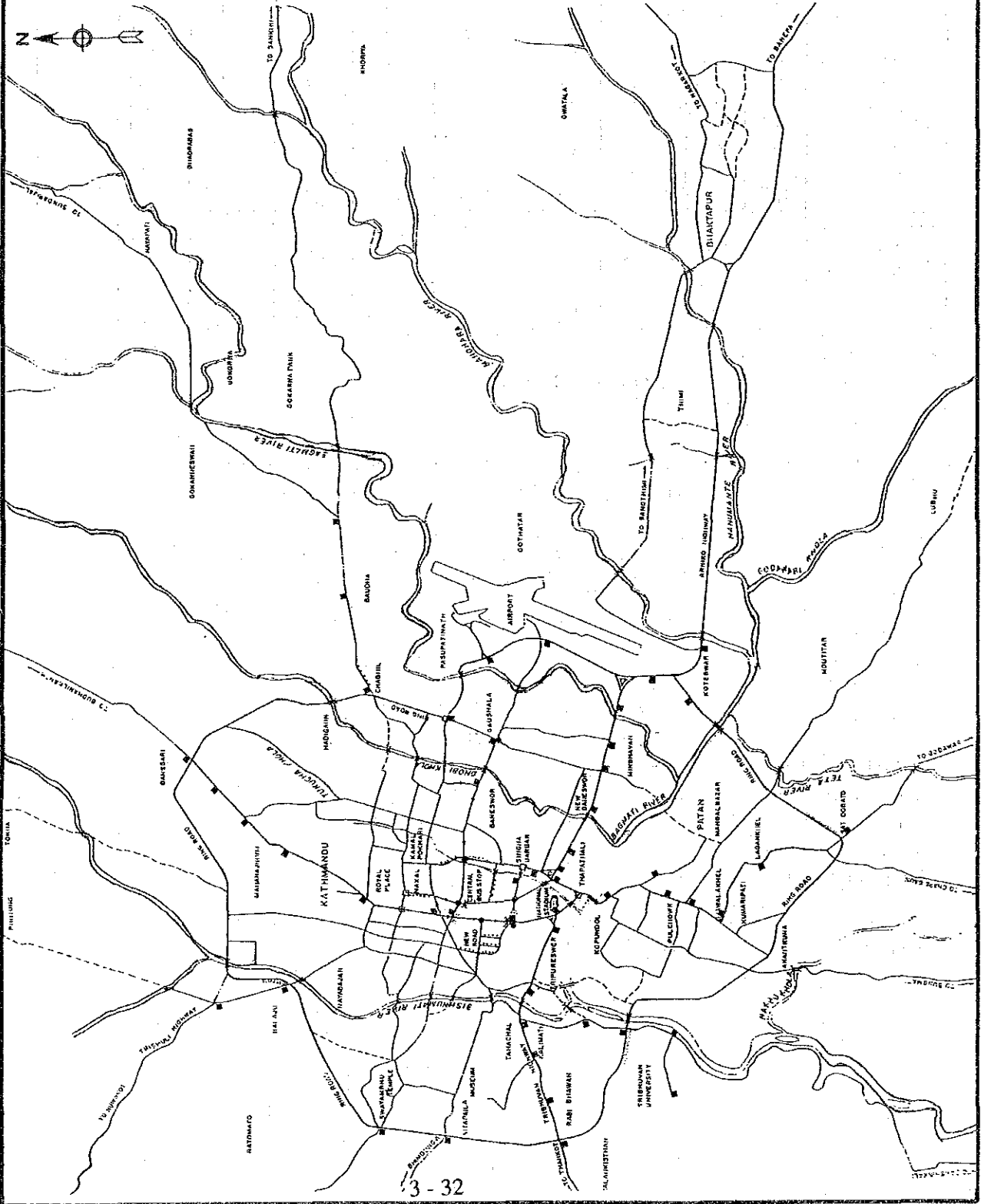
HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G)

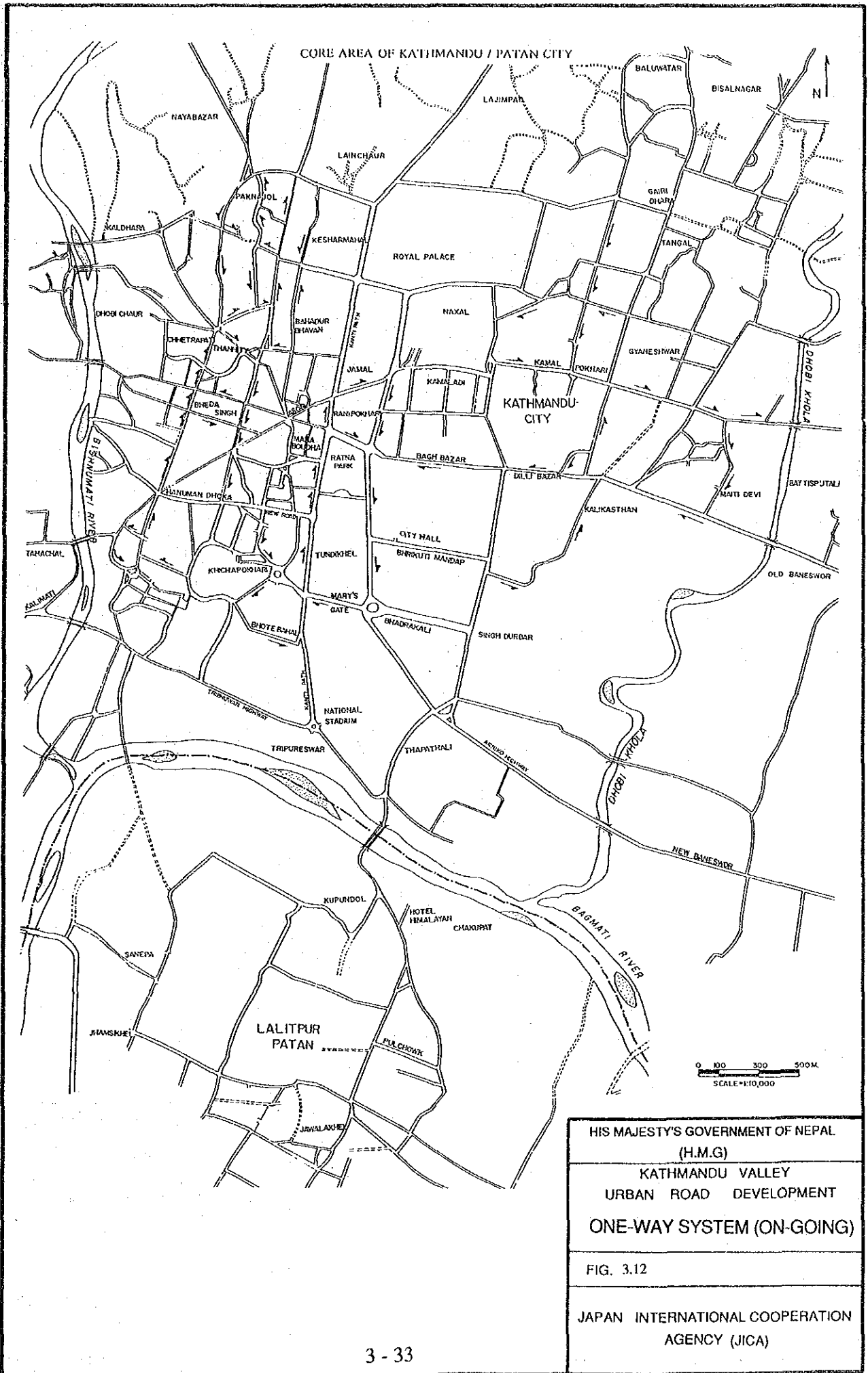
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT

ON-GOING TRAFFIC MANAGEMENT

FIG. 3.11

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



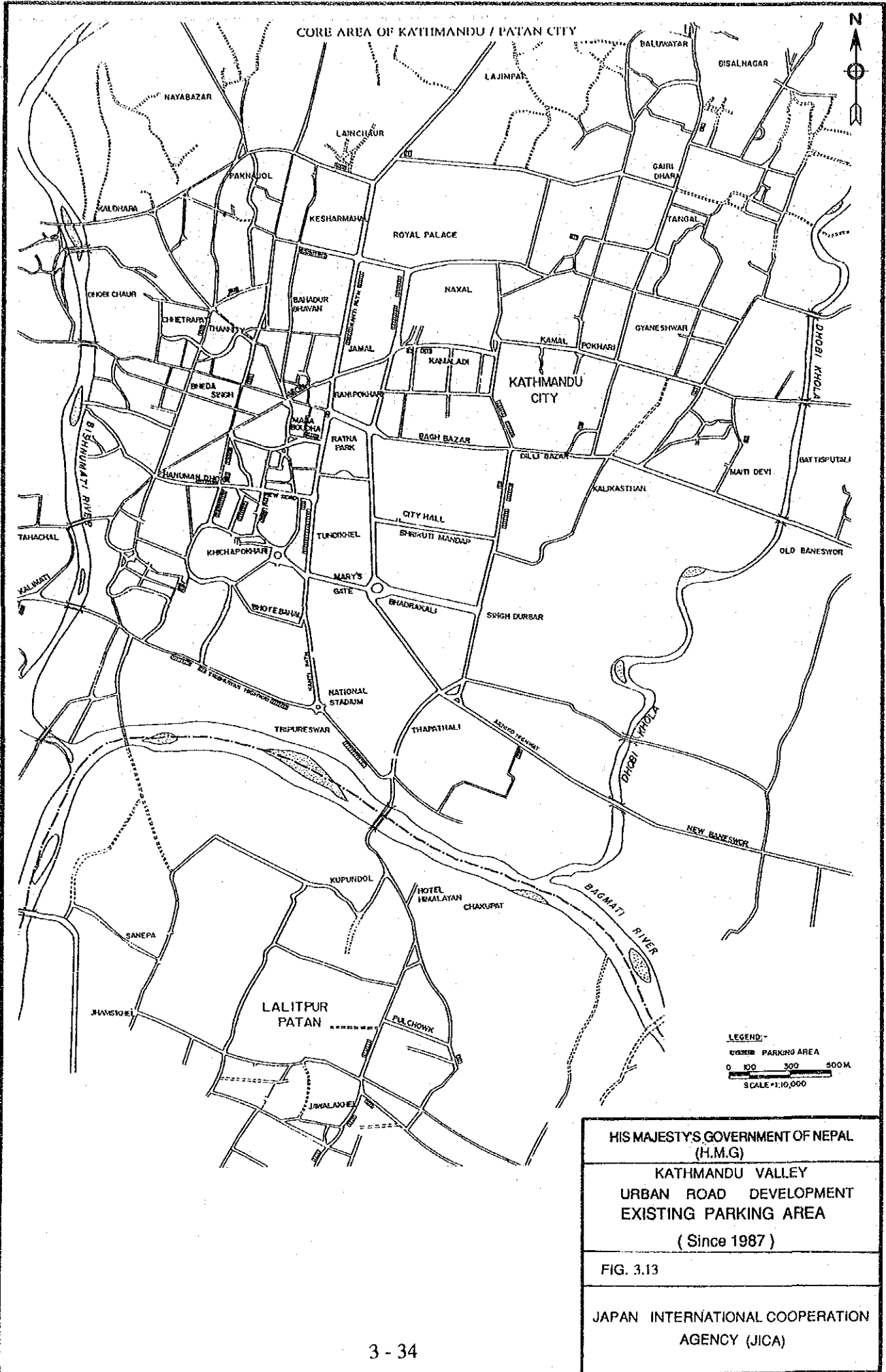


HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G.)

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
ONE-WAY SYSTEM (ON-GOING)

FIG. 3.12

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



CORE AREA OF KATHMANDU / PATAN CITY



LEGEND:
 [Symbol] PARKING AREA
 0 100 200 300 400 500 M.
 SCALE = 1:10,000

HIS MAJESTY'S GOVERNMENT OF NEPAL
 (H.M.G.)
 KATHMANDU VALLEY
 URBAN ROAD DEVELOPMENT
 EXISTING PARKING AREA
 (Since 1987)
 FIG. 3.13
 JAPAN INTERNATIONAL COOPERATION
 AGENCY (JICA)

LEGEND

- Five Accident Locations
- Main Accident Locations

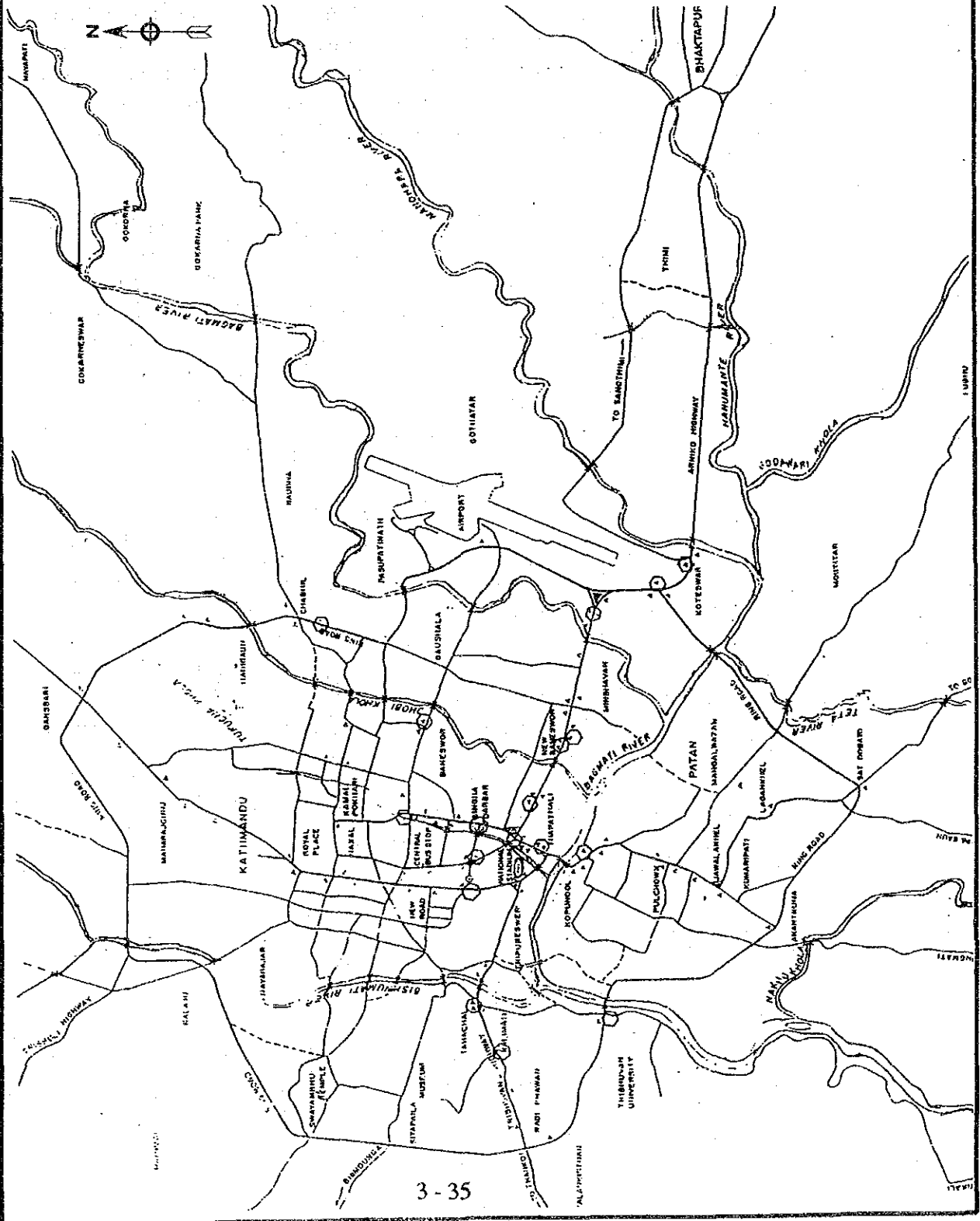
0 250 500 1000 2000m
 SCALE=1:25,000

HIS MAJESTY'S GOVERNMENT OF NEPAL
 (H.M.G)

KATHMANDU VALLEY
 URBAN ROAD DEVELOPMENT
 ACCIDENT LOCATIONS

FIG. 3.14

JAPAN INTERNATIONAL COOPERATION
 AGENCY (JICA)



3.6 Nature of Traffic Issue in the Study Area

As seen in the previous section, present traffic issues in the Study area has a variety of aspects in it and overall traffic situation is getting complicated in these days.

The factors behind the present traffic issues could be classified into two groups; one is external factors which come from national economy or structure of socio-economic condition of Nepal as a whole, and the other is internal factors related to the Study area itself. Population increase due to incessant inflow of migrators to the Study area, for instance, is a factor classified into the former group while heterogeneous distribution of urban facilities in the Study area might be one of the factors which could be classified into the latter. Transportation planning essentially should be carried out in view of the above two different natures of factors comprising the issues.

As to the former, traffic issues should be considered in nation wide scope and such policy as promotion of homogeneous development of nation as a whole might be introduced. For instance, dispersion of job opportunities or industries from the capital area is one of the measures to be undertaken in this context to prevent excessive traffic congestion in certain areas. On the other hand, in the latter, traffic issues should be considered in the combined factors which are attributed to both external and internal reasons. For the formulation of road development plan of Kathmandu Valley, study is to be carried out in the balance of the above natures of the issues.

As far as the Study area is concerned, the past trend of concentration of urban facility and urban expansion are expected to continue during the foreseeable future. With this consideration, as to the external factors, it is not unreasonable to assume that past trend will continue.

The nature of the traffic issues in the Study area lies in the fact that existing transportation infrastructure cannot provide sufficient services to the growing demand for traffic which has resulted in inefficiency in urban transportation as stated hereunder.

- Congestion of road and public transport,
- Decrease in vehicle speeds,
- Increase in traffic accidents, and
- Degradation of environment.

To cope with the above, a variety of measures including those of legislative and administrative measures have been undertaken by various Government and semi-

government agencies. However, no great achievement has been attained so far mainly due to the following reasons :

- Large scale improvement plans are not implementable due mainly to financial reasons which sometimes end up with easy execution of temporal works,
- Legislative measures ever applied are not strictly enforced and there is no effective penalty system in case of violation,
- The roads and road network in the Valley is not so made for vehicle users initially. It is a historical process that walkway in the Valley have been fragmentally widened/renovated into motorable roads in the wave of motorization and this process is still continuing. However, rapid urbanization/excessive concentration of urban facilities has begun to hinder this natural process of evolution, and
- People's concern toward road and traffic are still at low level. This could be seen in such behavior as intrusion of people into the right-of-way and illegal activities on road-side as well as sporadic traffic policies sometimes undertaken by Authorities.

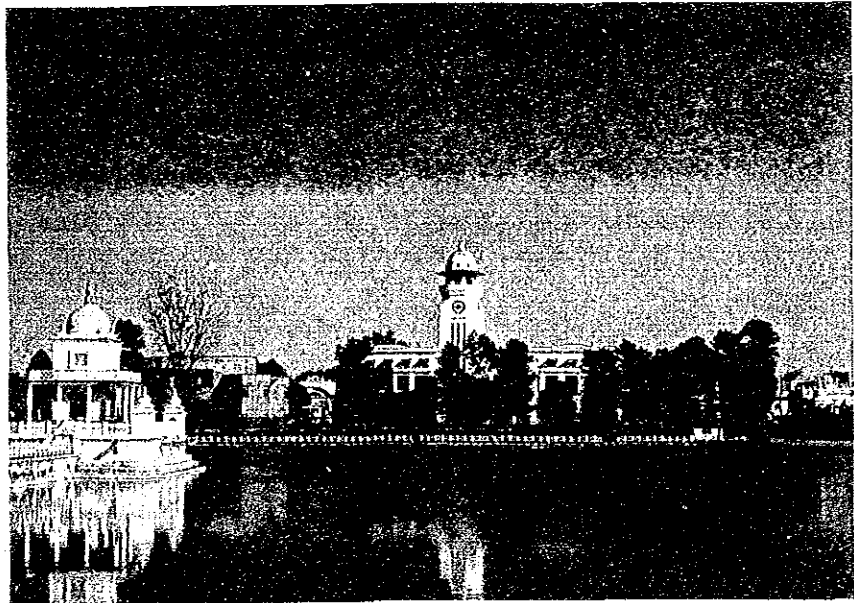
Factors behind the present traffic issues and probable policies to be undertaken are described in Table 3.17.

TABLE 3.17 FACTORS BEHIND PRESENT TRAFFIC ISSUES AND PROBABLE POLICIES

Present Traffic Issues	Factors behind Present Traffic Issues	Probable Policies
<p>* Inefficiency in Road Transport (Congestion and Slow vehicle speed)</p> <p>Increase in Traffic Accidents Degradation of Environment and Urban Amenities</p>	<p>A. Factors Related to Road and Transportation capacity</p> <p>1. Physical Factors (1) Shortage in absolute road length (2) Insufficient bridge capacity/carriageway width (3) Insufficient road linkage (4) Low geometric design (5) Insufficient intersection capacity (6) Lack of coordination among various government and semi-Government agencies</p> <p>2. Managemental Factors (1) Increase in roadside parking (2) Intrusion of pedestrian into carriageways (3) Increase in roadside loading and unloading (4) Mixing of slow-moving vehicles (5) Encroachment on roads and footpath</p> <p>3. Public Transport (1) Shortage of fleet number (2) Irregular operation of bus (3) Improper bus service system (4) Low frequency of buses service</p> <p>B. Factors Related to Increased Traffic Demand</p> <p>1. Population increase 2. Heterogeneous population increase 3. Extension of urban area 4. Increase in vehicle ownership 5. Diversification of urban activities 6. Uneven distribution of urban facilities</p> <p>C. Administrative / Legislative / Other Factors</p> <p>1. Lack of strict enforcement of regulation (through traffic, one-way, speed, heavy vehicle control, exhaust gas, etc) 2. Partial enactment of codes (building code, zoning code, parking code, functional classification of roads) 3. Poor traffic behavior (driver, pedestrians) 4. Lack of usage of traffic engineering principles in the solution of traffic problems</p>	<p>* Construction of roads, bridges and facilities * Upgrading, rehabilitation of existing roads, bridges and facilities * Improvement of intersection / round-about</p> <p>* Construction of public parking spaces, park yard, truck / bus terminals * Parking control (by meter and traffic police) * Provision of sidewalk, pedestrian walkways, footpath, and designation of pedestrian crossing points * Integration of bus stops * Functional classification of roads and regulation of traffic based on it * Junction management * Allocation of bus and establishment of operation schedule * Review of existing bus network and operation system * Introduction of ride-and-ride system (bus-minibus) * Redesign of traffic signals</p> <p>* Enforcement of zoning act * Creation of new commercial centers in suburbs</p> <p>* Enforcement / observation of codes * Introduction of penalty system * Review of permission system (bus, taxi, tempo) * Integration among agencies * Traffic education (driving school, pedestrian) * Integration among agencies, education * Introduction of vehicle inspection system</p>

CHAPTER 4

PRESENT TRAFFIC SITUATION



4 PRESENT TRAFFIC SITUATION

4.1 Traffic Survey

4.1.1 Outline of the Survey

In order to understand the characteristics of present traffic movement of the Valley and to prepare basic data for future traffic demand forecast, following traffic surveys have been carried out in December 1991:

- (a) Home Interview Survey (Person Trip Survey)
- (b) Roadside OD Survey
- (c) Traffic Flow Survey
 - Roadside Traffic Counts
 - Intersection Traffic Counts
 - Vehicle Speed Survey
- (d) Public Transportation Survey / Firm Interview Survey

4.1.2 Home Interview Survey (Person Trip Survey)

For the purpose of obtaining basic information about traffic behaviors in Kathmandu Valley, Person Trip Survey, through home interview, has been carried out during the period of Dec. 9 - 21, 1991.

The survey has been carried out in the following areas which are deemed vital parts of traffic activities and potential development areas in the Valley.

Three Cities : Kathmandu, Lalitpur and Bhaktapur
Nearby Area : Thimi, Kirtipur

About 6.2% of the households or one household out of every 16 households have been selected applying systematic sampling technique and interviewed. All the family members in the selected households who are "deemed responsible for their behavior" were interviewed. The wardwise number of households sampled and those of actually interviewed are listed in Table 4.1.

TABLE 4.1 COMPARATIVE CHART SHOWING TOTAL HOUSEHOLDS SAMPLED AND ACTUAL NUMBER OF HOUSEHOLDS SURVEYED

(Kathmandu)

MUNICIPALITY	MUNICIPALITY WARD	* NUMBER OF HOUSEHOLDS 1991	NUMBER OF HOUSEHOLDS SAMPLED	NUMBER OF HOUSEHOLDS SURVEYED
KATHMANDU	Ward No 1	720	45	56
	Ward No 2	1070	66	78
	Ward No 3	2116	131	133
	Ward No 4	2165	134	183
	Ward No 5	1074	67	101
	Ward No 6	2423	150	168
	Ward No 7	2618	162	200
	Ward No 8	1121	70	75
	Ward No 9	2386	148	145
	Ward No 10	5572	345	414
	Ward No 11	1531	95	95
	Ward No 12	1339	83	85
	Ward No 13	2156	134	146
	Ward No 14	2413	150	166
	Ward No 15	2312	143	163
	Ward No 16	2681	166	171
	Ward No 17	1419	88	95
	Ward No 18	930	58	68
	Ward No 19	973	60	65
	Ward No 20	1095	68	76
	Ward No 21	1277	79	90
	Ward No 22	919	57	59
	Ward No 23	1261	78	99
	Ward No 24	710	44	47
	Ward No 25	648	40	50
	Ward No 26	501	31	40
	Ward No 27	1031	64	65
	Ward No 28	613	38	41
	Ward No 29	2174	135	180
	Ward No 30	1316	82	76
	Ward No 31	1218	76	91
	Ward No 32	1576	98	99
	Ward No 33	1953	121	121
KATHMANDU TOTAL		53311	3306	3741

* Population Census, 1991

TABLE 4.1 COMPARATIVE CHART SHOWING TOTAL HOUSEHOLDS SAMPLED AND ACTUAL NUMBER OF HOUSEHOLDS SURVEYED (CONTINUED)

(Lalitpur)		* NUMBER OF HOUSEHOLDS 1991	NUMBER OF HOUSEHOLDS SAMPLED	NUMBER OF HOUSEHOLDS SURVEYED
MUNICIPALITY	MUNICIPALITY WARD			
LALITPUR	Ward No 1	1146	71	73
	Ward No 2	1065	66	67
	Ward No 3	1090	68	84
	Ward No 4	1535	95	103
	Ward No 5	2071	128	164
	Ward No 6	1105	69	89
	Ward No 7	735	46	54
	Ward No 8	578	36	47
	Ward No 9	821	51	51
	Ward No 10	333	21	21
	Ward No 11	568	35	53
	Ward No 12	549	34	45
	Ward No 13	285	18	22
	Ward No 14	397	25	24
	Ward No 15	377	23	29
	Ward No 16	379	23	25
	Ward No 17	324	20	24
	Ward No 18	219	14	16
	Ward No 19	337	21	23
	Ward No 20	498	31	38
	Ward No 21	506	31	47
	Ward No 22	683	42	54
PATAN TOTAL		15601	968	1153

* Population Census, 1991

(Bhaktapur)		* NUMBER OF HOUSEHOLDS 1991	NUMBER OF HOUSEHOLDS SAMPLED	NUMBER OF HOUSEHOLDS SURVEYED
MUNICIPALITY	MUNICIPALITY WARD			
BHAKTAPUR	Ward No 1	630	39	39
	Ward No 2	417	26	26
	Ward No 3	390	24	24
	Ward No 4	692	43	43
	Ward No 5	489	30	30
	Ward No 6	373	23	23
	Ward No 7	567	35	44
	Ward No 8	452	28	28
	Ward No 9	324	20	20
	Ward No 10	411	25	26
	Ward No 11	438	27	27
	Ward No 12	401	25	25
	Ward No 13	339	21	21
	Ward No 14	572	35	36
	Ward No 15	458	28	28
	Ward No 16	371	23	23
	Ward No 17	572	35	35
BHAKTAPUR TOTAL		7896	487	498
MUNICIPALLY TOTAL		76808	4761	5392
THIMI		-	-	71
KIRTIPUR		-	-	58

* Population Census, 1991

4.1.3 Roadside OD Survey

In order to understand the traffic movement by vehicle in the Study area, Roadside OD Survey has been carried out on major points of the roads as shown in Fig. 4.1. About one-third of the vehicles which passed each of the survey points were stopped by traffic police and inquired of their origin and destination, purpose of trip, kinds of commodity carrying with and so on.

The survey has been carried out for 16 hours (6:00-22:00) on certain weekdays which are regarded normal days of the week. Number of vehicles interviewed by survey point and total number of vehicles which passed each of the survey points are listed in Table 4.2.

4.1.4 Traffic Flow Survey

Traffic flow survey has been carried out to clarify actual road usage on the major roads in the Valley. Traffic flow survey in this study consists of following three surveys :

- Roadside Traffic Counts
- Intersection Traffic Counts
- Vehicle Speed Survey

(a) Roadside Traffic Counts

Traffic counts were carried out at 29 survey points on major roads and streets in the Valley as shown in Fig.4.2. The survey points are classified into the following two groups:

Group A : The survey points which coincide with those of Roadside OD survey.

Group B : The survey points where traffic count solely are carried out.

Number of vehicles which passed the survey points were counted by vehicle type, by time band and by direction. The duration of traffic count was 16 hours (6:00 - 22:00) for all the survey points except two of the survey points indicated B8 and B28, on which 24-hour traffic counts were conducted while one-week traffic counts were carried out at the survey point named B28 on which daily 16-hour traffic counts (6:00 - 22:00) have been carried out for one week.

Designation of direction for each survey point is given in Table 4.3.

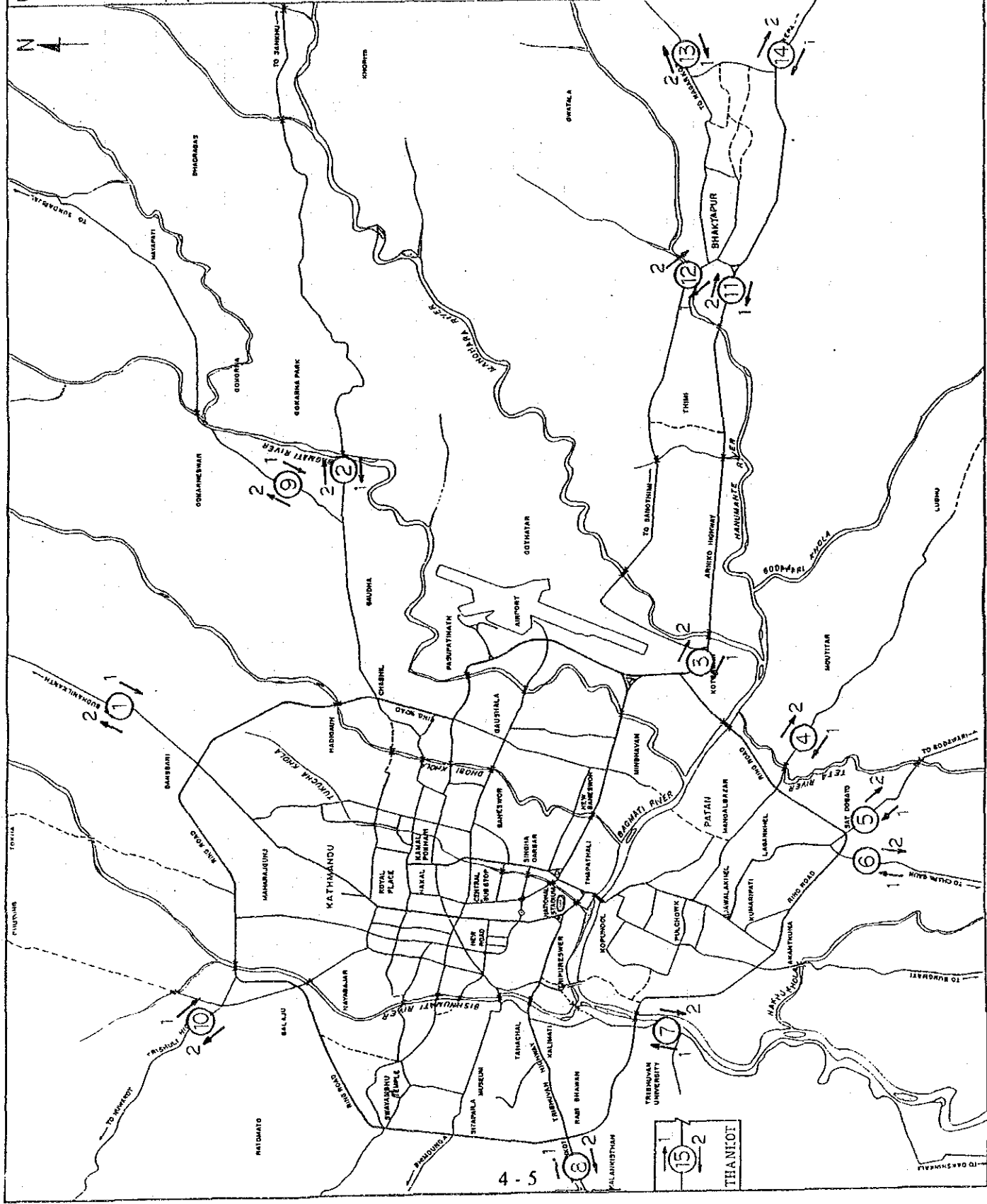
LEGEND :-
 ① SURVEY POINT NO. (A1- A15)
 1 DIRECTION NO.

POINT NO.	NAME OF THE PLACE
A.1	Tharbari
A.2	Jorpati Bagnoli Drainage
A.3	Kopsewar
A.4	Leaside
A.5	Khimatar
A.6	Sarabho
A.7	Tribhuvan University
A.8	Kalanastaban
A.9	Jorpati (Bhagan)
A.10	Bablu
A.11	SW of Bhaktapur (Tinkune)
A.12	NW of Bhaktapur (Trenment Place)
A.13	NE of Bhaktapur
A.14	SE of Bhaktapur
A.15	Thakot



HIS MAJESTY'S GOVERNMENT OF NEPAL
 (HMG)
 KATHMANDU VALLEY
 URBAN ROAD DEVELOPMENT
 LOCATION MAP OF
 ROADSIDE OD SURVEY

FIG. NO. - 4.1
 JAPAN INTERNATIONAL COOPERATION
 AGENCY (JICA)



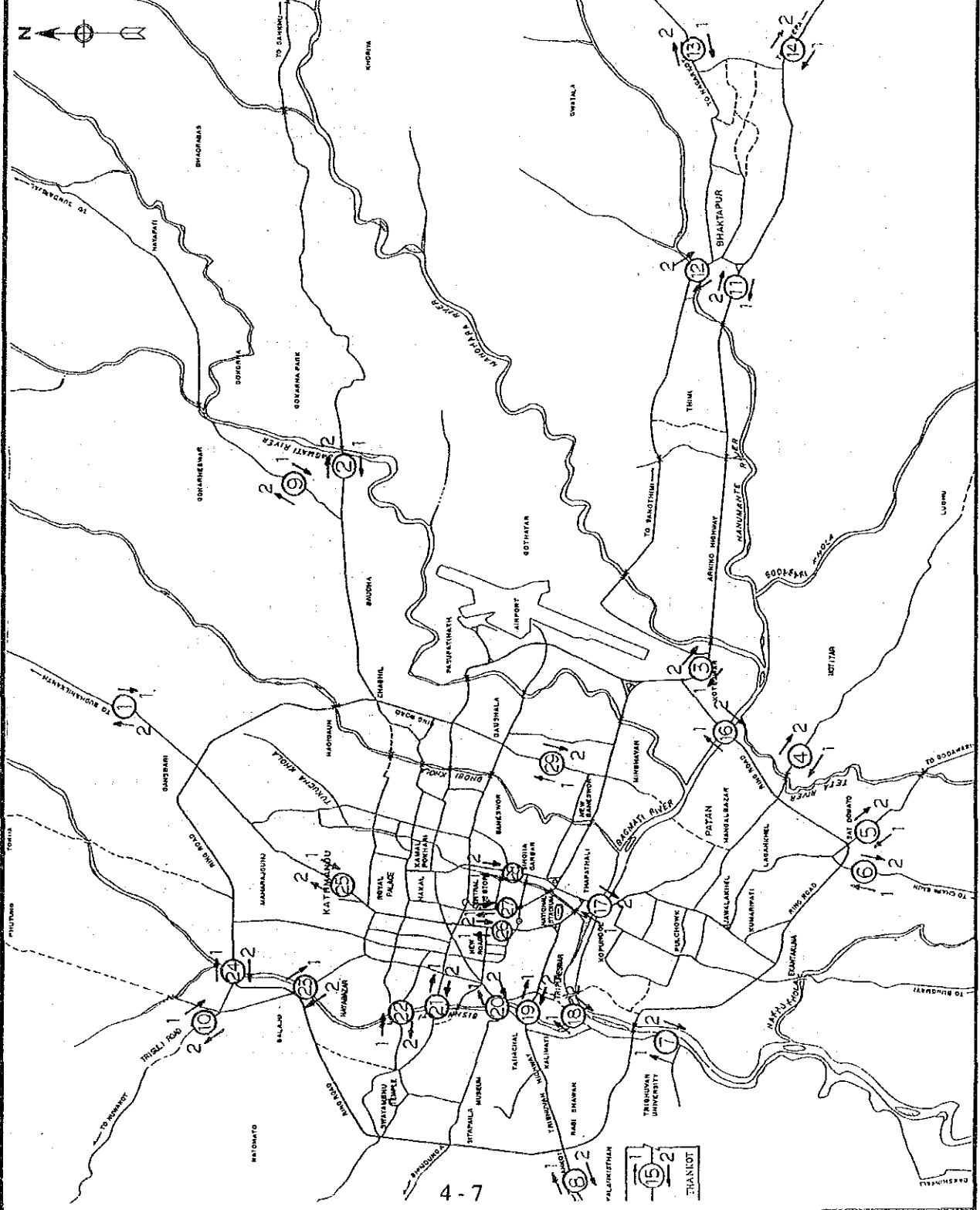
4-5

THAKOT

TABLE 4.2 TRAFFIC VOLUME AND NUMBER OF VEHICLES INTERVIEWED

No. of Survey Point	Name of Survey Point	Traffic Volume			Number of Vehicles Interviewed		
		Direction (1)	Direction (2)	Both Directions	Direction (1)	Direction (2)	Both Directions
1	Bansbari	1443	1495	2938	445	478	923
2	Jorpati Bagmati Bridge	1603	1595	3198	512	531	1043
3	Koteswar	4126	4673	8799	1289	1511	2800
4	Imadol	1802	1728	3530	596	555	1151
5	Khumaltar	2197	2112	4309	714	683	1397
6	Satdobato	1580	1669	3249	503	537	1040
7	TU*	2012	1998	4010	651	652	1303
8	Kalankisthan	2313	2445	4758	698	752	1450
9	Jorpati (Besigaon)	1098	1167	2265	348	373	721
10	Balaju	279	289	568	92	95	187
11	SW (Bhaktapur)	2333	2253	4586	730	679	1409
12	NW (Bhaktapur)	609	545	1154	188	176	364
13	NE (Bhaktapur)	770	782	1552	247	254	501
14	SE (Bhaktapur)	722	892	1614	247	299	546
15	Thankot	975	1244	2219	300	416	716
Total		23862	24887	48749	7560	7991	15551

*Direction (1) To KTM
 *Direction (2) From KTM
 *TU : Tribhuvan University



LEGEND

① SURVEY POINT NO
(B1 - B29)

→ DIRECTION NO

POINT NAME OF THE PLACE

- B 1 Barsbari
- B 2 Jorpati Bagmati Bridge
- B 3 Koteswar
- B 4 Inradol
- B 5 Khumaltar
- B 6 Sadoobato
- B 7 Tribhuvan University
- B 8 Kalankishan
- B 9 Jorpati (Besigaun)
- B 10 Balaju
- B 11 SW of Bhaktapur (Tinkure)
- B 12 NW of Bhaktapur (Treatment Plant)
- B 13 NE of Bhaktapur
- B 14 SE of Bhaktapur
- B 15 Thankot
- B 16 Manohara Bridge
- B 17 Bagmati Bridge (Thapathali)
- B 18 Ropeway Terminal
- B 19 Teku
- B 20 Bhimsensthan
- B 21 Dattu Bridge
- B 22 Bageswari
- B 23 Bishnumati Bridge (Balaju)
- B 24 Bishnumati Bridge (Ring Road)
- B 25 Lazimpai
- B 26 General Post Office
- B 27 Exhibition Ground West
- B 28 Singh Durbar
- B 29 Baneshwar Mahadevsthan

HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G)

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
LOCATION MAP OF ROADSIDE
TRAFFIC COUNT

FIG. 4.2

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

TABLE 4.3 DESIGNATION OF DIRECTION BY SURVEY POINT

POINT NO	DIRECTION 1	DIRECTION 2
B1	To Kathmandu Central Area	To Budhanilkantha
B2	To Kathmandu Central Area	To Sankhu
B3	To Kathmandu Central Area	To Bhaktapur
B4	To Patan Central Area	To Lubhu
B5	To Patan Central Area	To Godawari
B6	To Patan Central Area	To Chapagaon
B7	To Kathmandu Central Area	To Kirtipur / Dakshinkali
B8	To Kathmandu Central Area	To Thankot
B9	To Kathmandu Central Area	To Sundarijal
B10	To Kathmandu Central Area	To Trisuli
B11	To Kathmandu	To Banepa
B12	To Thimi	To Bhaktapur
B13	To Bhaktapur	To Nagarkot
B14	To Kathmandu	To Banepa
B15	To Kathmandu	To Pokhara / Birgunj
B16	To Kathmandu	To Patan
B17	To Kathmandu	To Patan
B18	To Kathmandu Central Area	To Suburban Area
B19	To Kathmandu Central Area	To Suburban Area / Kalimati
B20	To Kathmandu Central Area	To Suburban Area
B21	To Kathmandu Central Area (motorcycle, bicycle and pedestrian)	To Suburban Area / Dally
B22	To Kathmandu Central Area	To Suburban Area / Swayambhu
B23	To Kathmandu Central Area	To Suburban Area / Balaju
B24	To Maharajgunj	To Balaju
B25	To Kathmandu Central Area	To Suburban Area / Maharajgunj
B26	To Tundikhel	To Tripureswar (pedestrian only)
B27	To Ratna Park (pedestrian only)	To Bhadrakali
B28	To Putali Sadak	To Maitighar
B29	To Old Baneswar	To New Baneswar

(b) Intersection Traffic Counts

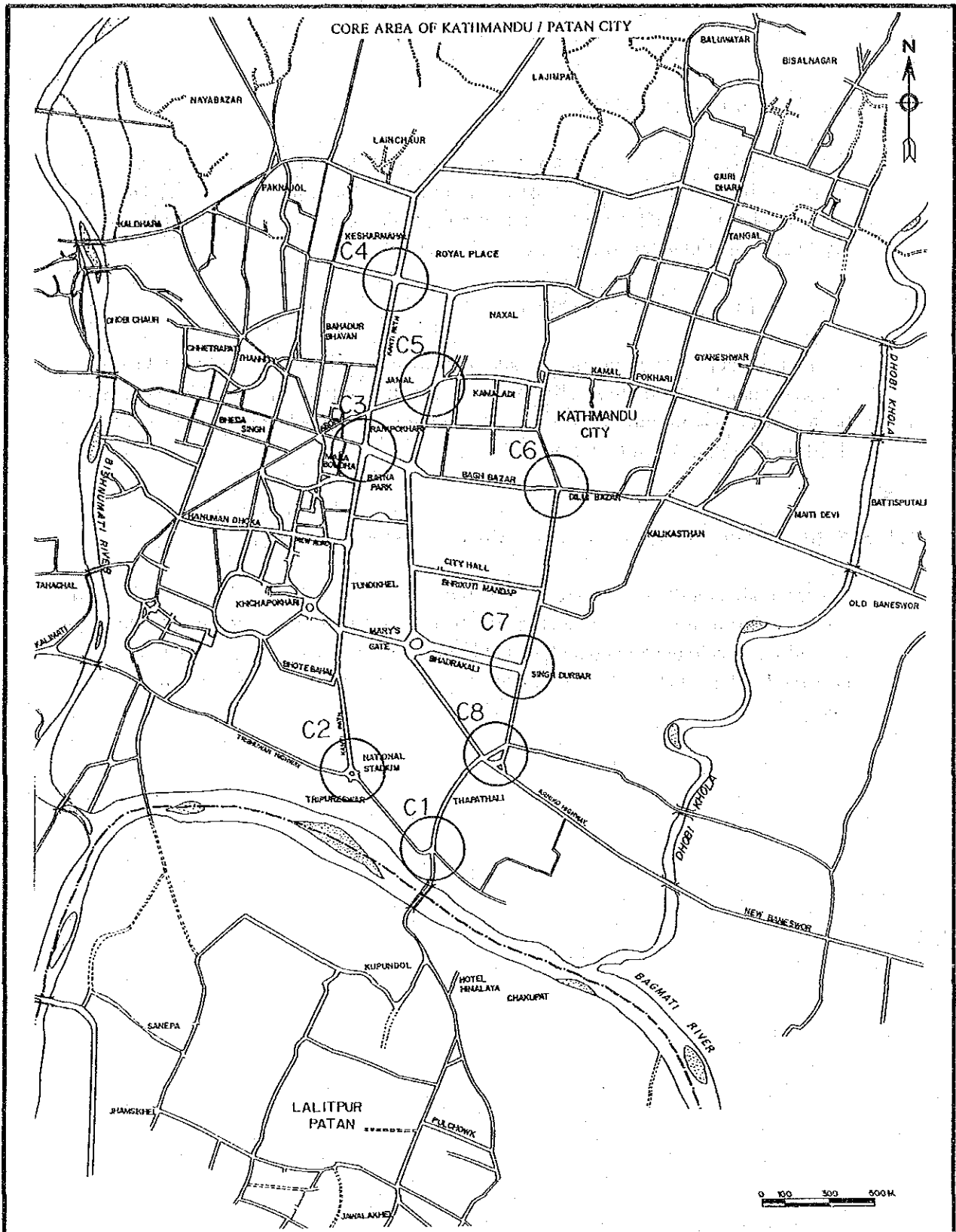
Direction-wise traffic flow at eight intersections located in central area have been measured for two hours both in the morning and evening peak-hours. Locations of intersections surveyed are given in Fig. 4.3 while the directions of traffic flow for each intersection is illustrated in Fig. 4.4.

(c) Vehicle Speed Survey

In order to obtain basic information about average vehicle speed by type and by grade of road, vehicle speed survey has been carried out on major roads. The survey has been carried out by moving observation method on designated section of roads as illustrated in Fig. 4.5, 4.6, 4.7 and 4.8.

4.1.5 Public Transportation Survey / Firm Interview Survey

For the understanding of service levels and characteristics of vehicle movements by public transportation sector and major firms, information about major routes for operation, vehicle ownership and related information about vehicle operation have been surveyed. The names of the firms interviewed in these surveys are listed in Table 4.4 and 4.5.



POINT NO	NAME OF THE PLACE
C 1	Thapathali
C 2	Tripureswar
C 3	Bhotahiti
C 4	Keshar Mahar
C 5	Durbar Marg
C 6	Putali Sadak
C 7	Singh Durbar
C 8	Maitighar

HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G.)

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
LOCATION MAP OF
INTERSECTION TRAFFIC COUNTS

FIG. 4.3

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

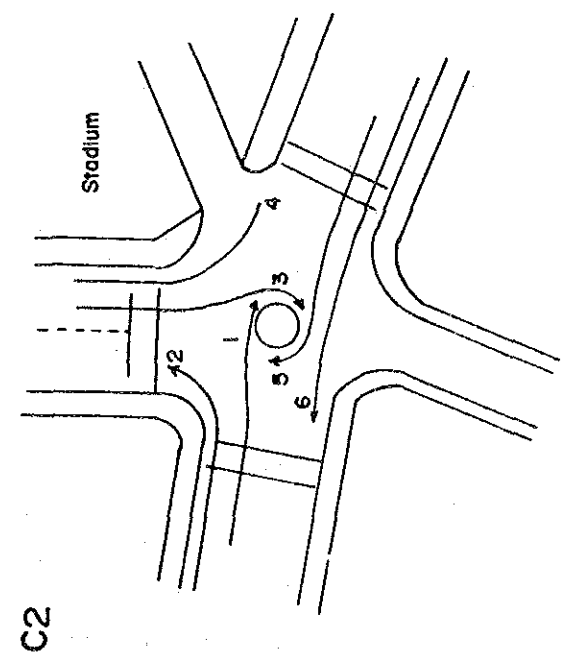
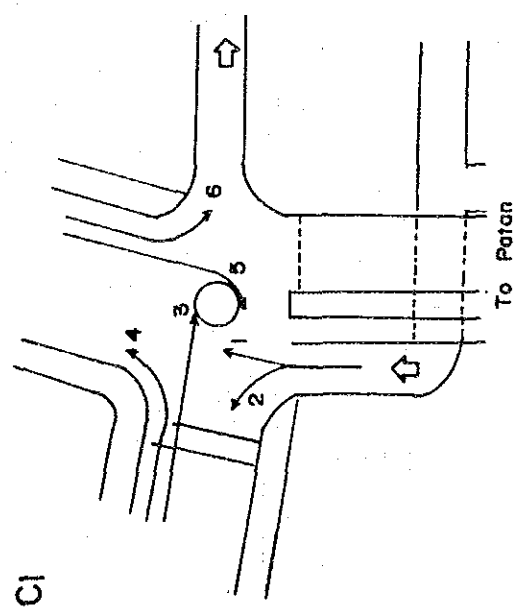
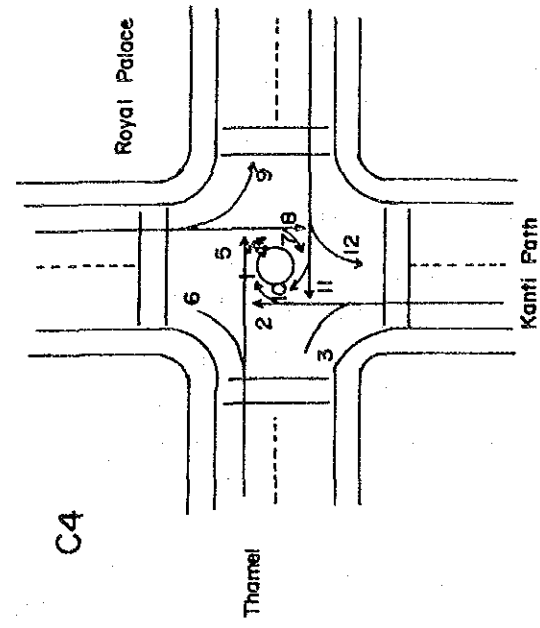
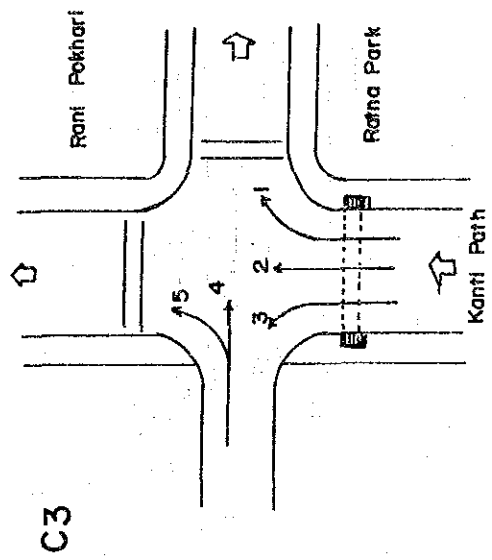
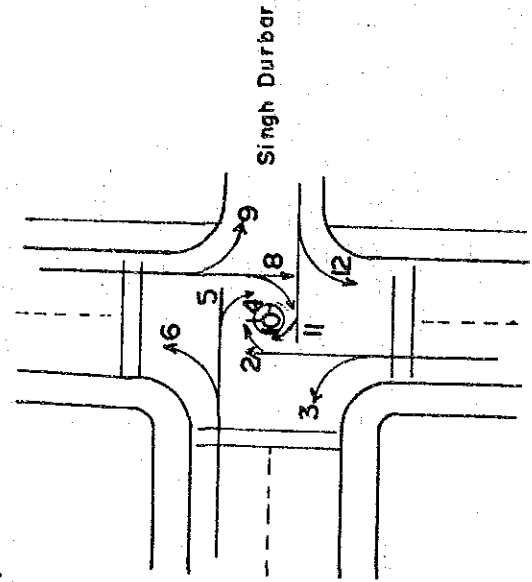


FIG.4.4 DIRECTION OF TRAFFIC FLOW IN INTERSECTION

C7



C8

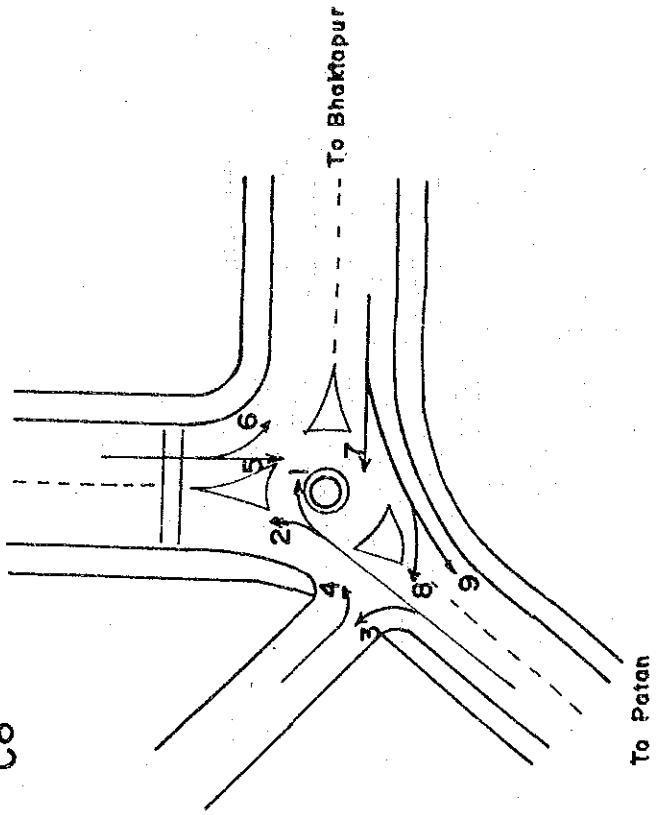
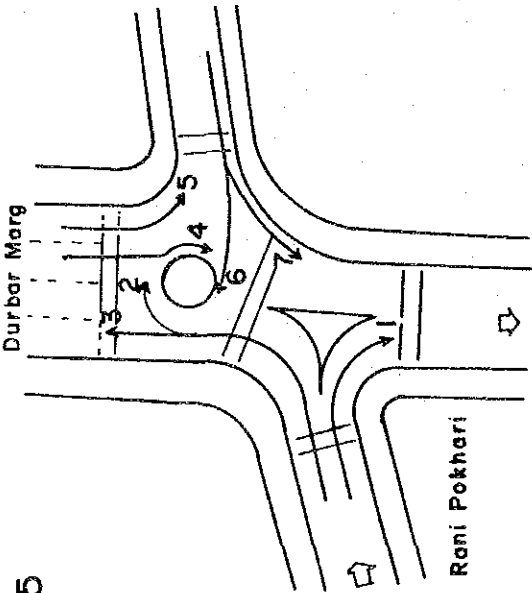
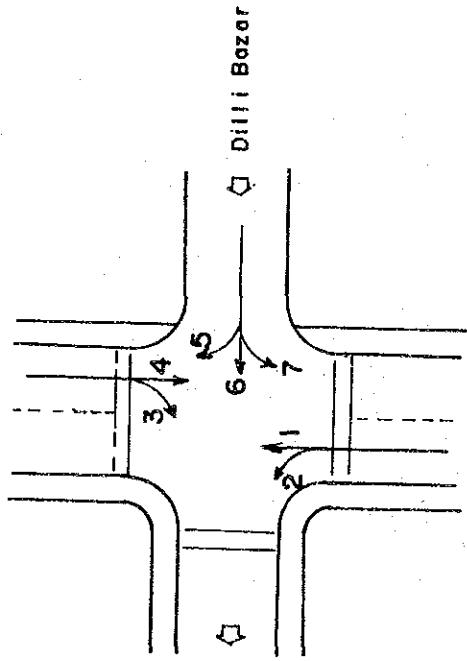


FIG.4 DIRECTION OF TRAFFIC FLOW IN INTERSECTION (CONTINUED)

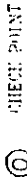
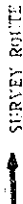
C5



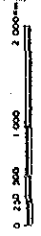
C6



LEGEND -

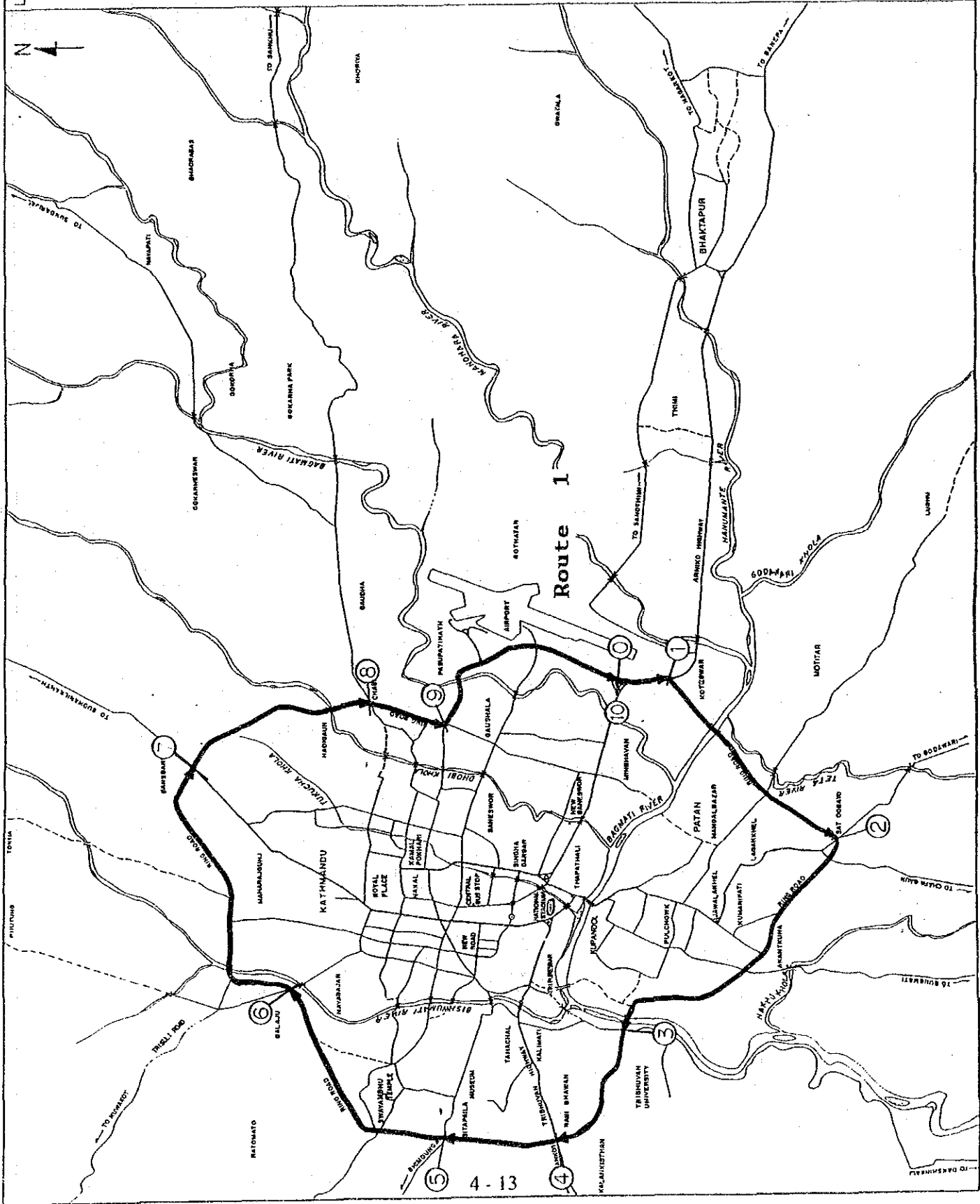


CHECK POINT	Route 1 (Ring Road)
0	To Manikgarh
1	To Bhaktapur
2	To Ghatwari
3	To Kirtipur
4	To Thamel
5	To Jhamsi
6	To Boudhanath
7	To Sankhu
8	To Ghatwari
9	TO POINT 0



HIS MAJESTY'S GOVERNMENT OF NEPAL
(HMG)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
VEHICLE SPEED
SURVEY ROUTE (I)

FIG. NO. - 4.5
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



LEGEND -

→ SURVEY ROUTE

○ CHECK POINT

CHECK POINT	Route 2
1	Enforcement (CS)
2	Enforcement (CS)
3	Enforcement (CS)
4	Enforcement (CS)
5	Enforcement (CS)
6	Enforcement (CS)
7	Enforcement (CS)
8	Enforcement (CS)

CHECK POINT	Route 1
0	Maharaj (CS)
1	Maharaj (CS)
2	Maharaj (CS)
3	Maharaj (CS)
4	Maharaj (CS)
5	Maharaj (CS)
6	Maharaj (CS)
7	Maharaj (CS)
8	Maharaj (CS)
9	Maharaj (CS)
10	Maharaj (CS)

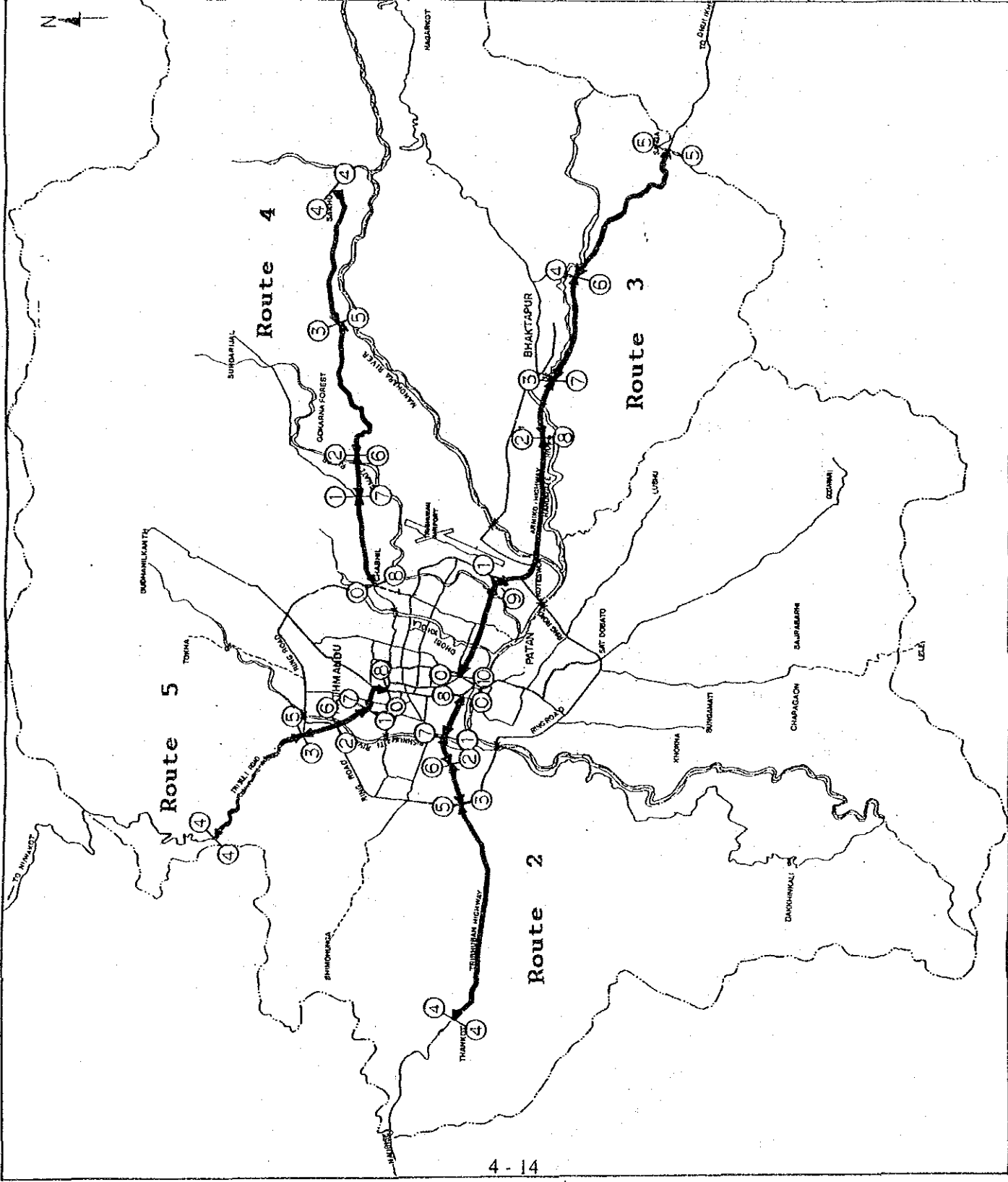
CHECK POINT	Route 4
0	Raja Road
1	Raja Road
2	Raja Road
3	Raja Road
4	Raja Road
5	Raja Road
6	Raja Road
7	Raja Road
8	Raja Road
9	Raja Road
10	Raja Road

CHECK POINT	Route 5
0	Sebar Mahal (CS)
1	Sebar Mahal (CS)
2	Sebar Mahal (CS)
3	Sebar Mahal (CS)
4	Sebar Mahal (CS)
5	Sebar Mahal (CS)
6	Sebar Mahal (CS)
7	Sebar Mahal (CS)
8	Sebar Mahal (CS)
9	Sebar Mahal (CS)
10	Sebar Mahal (CS)

HIS MAJESTY'S GOVERNMENT OF NEPAL
(HMG)

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
VEHICLE SPEED
SURVEY ROUTE (1)

FIG. NO. - 4.6
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)



LEGEND

→ SURVEY ROUTE

⊙ CHECK POINT

CHECK POINT	Route 6
0	Tharabaha (C.I.)
1	New Road
2	Veeshar Mahadev
3	Wahidpur
4	Route Road
5	Thughulka
6	POINT 4
7	POINT 3
8	POINT 2
9	Rains Park
10	POINT 0

CHECK POINT	Route 7
0	Hagaru Bridge
1	Jawalbari
2	Rain Road
3	Thaha
4	Garbari
5	POINT 3
6	POINT 2
7	POINT 1
8	POINT 0

0 100 200 400m

HIS MAJESTY'S GOVERNMENT OF NEPAL
(HMIS)

KATHMANDU VALLEY

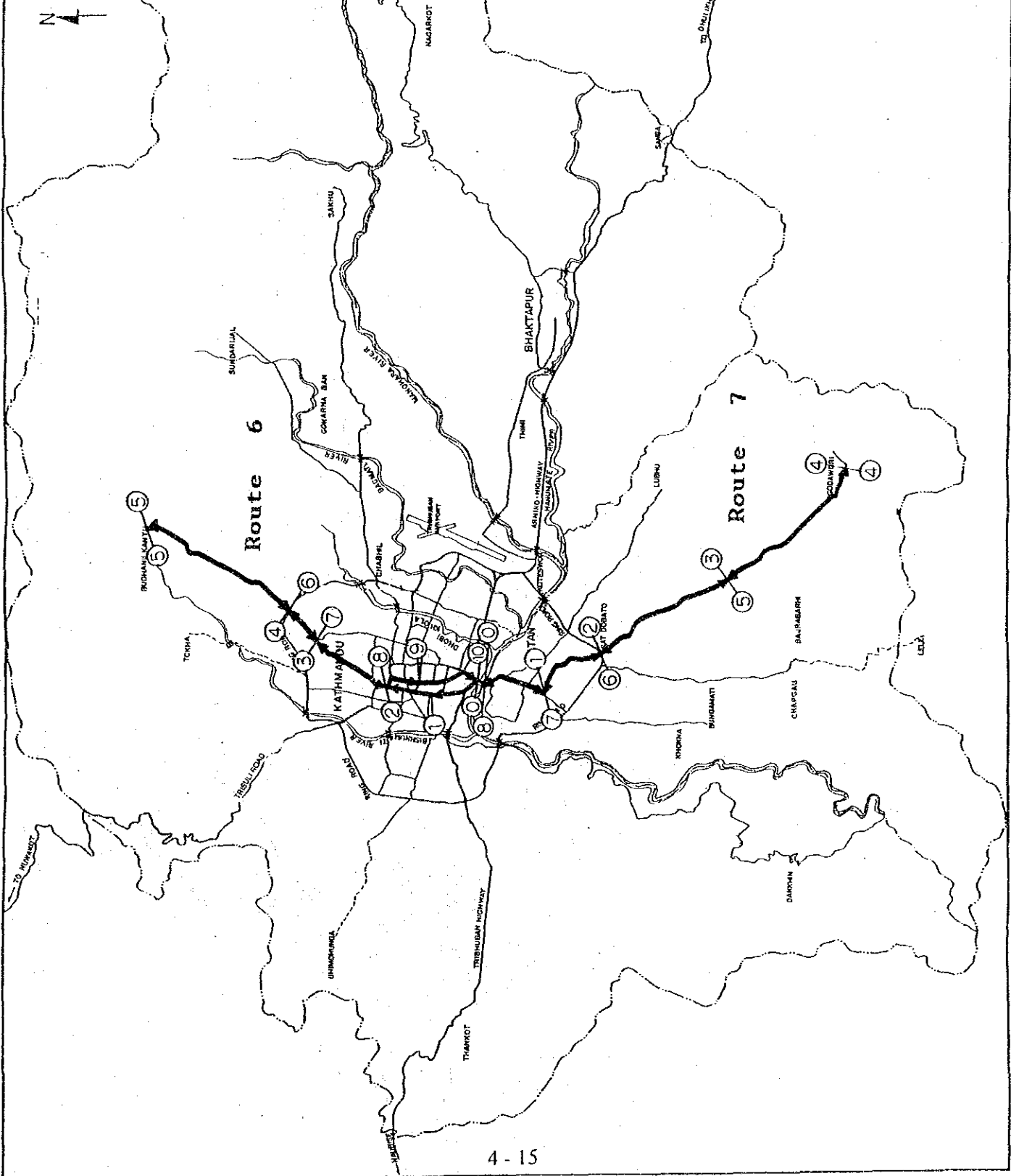
URBAN ROAD DEVELOPMENT



VEHICLE SPEED

SURVEY ROUTE (S)

FIG. NO. - 4.7

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

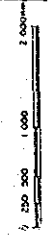


LEGEND :-
 SURVEY ROUTE
 CHECK POINT

CHECK POINT	Route 4
0	Tripureswar (GD)
1	Royal Nepal Airlines
2	Durvas Sauce
3	Chhetrapas
4	Vishnumati River
5	Road Road(Swamyabhu)
6	National Museum
7	Futbatal
8	Kailash
9	POINT 0

CHECK POINT	Route 9
0	Manaster (GN)
1	Punsi Sabin(GN)
2	Kamal Pothan
3	Road Road(Chhabib)
4	Airport
5	Old Bazaar
6	POINT 1
7	Rama Park
8	POINT 7

CHECK POINT	Route 10
0	Tharashali (GT)
1	Bayanai Bridge
2	Pulchow
3	Margal Bazar
4	Ring Road (To Jajhu)
5	Ring Road (To Bagramali)
6	POINT 2
7	Shanti Bazaar
8	POINT 1
9	POINT 0



HIS MAJESTY'S GOVERNMENT OF NEPAL
 (HMG)
 KATHMANDU VALLEY
 URBAN ROAD DEVELOPMENT
 VEHICLE SPEED
 SURVEY ROUTE (4)

FIG. NO - 4.8
 JAPAN INTERNATIONAL COOPERATION
 AGENCY (JICA)

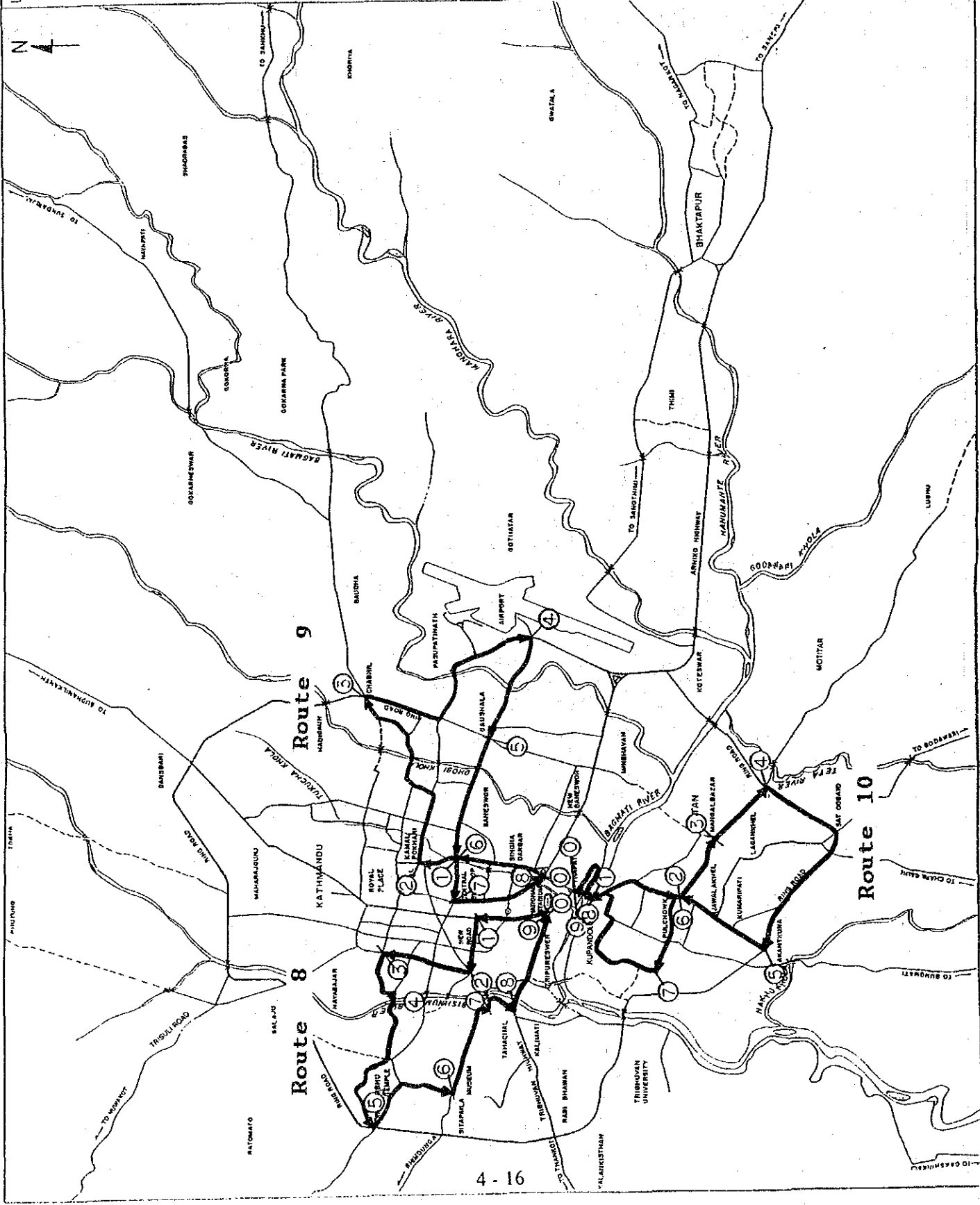


TABLE 4.4 LIST OF ORGANIZATION INTERVIEWED (PUBLIC TRANSPORTATION SURVEY)

Type of Public Transportation		Name of Organization	Name of Person Interviewed
Fixed Route	Trolley Bus	Trolley Bus Sansthan	Pasupati Sharma
	Bus	Sajha Yatayat	R. Shrestha
		Pachali Bhairab Bus Sewa	Prakash Shrestha
Swet Bhairab		Thulo Kanchha	
Seto Ganesh		Madan Mohan	
J.B. Travels		Badri Shrestha	
Minibus	Siddhi Ganesh	Shyam Ranjitkar	
	Kuranamaya Saran	Hirakaji Silpakar	
	Jaya Shiva	Rajan Bista	
	Shree Jaya Bhairab	Kasaman Shrestha	
	Kuleswar Mahadev	Madhu Bista	
	Dakshinkali Saran	Dabalman Manandhar	
Non-Fixed Route	Taxi	Private	Suman Thapa Magar
		Private	Rajan Rai
		Private	Basu
		Private	Rup N. Budhathoki
		Private	Govinda Subedi
		Private	Bir Bahadur Budhathoki
		Private	Harka Bahadur Gurung
		Private	Laxman Bista
		Private	Keshav Thapa
		Private	Harka Tamang
	Autorickshaw	Private	Norbu Sherpa
		Private	Keshar Shrestha
		Private	Hira Kumar Rai
		Private	Tempa Lama
	Private	Ram Kumar Bista	
	Private	Nirmal Raut	
	Private	Ram Bahadur	
	Private	Shiva Thapa	
	Private	Bir Bahadur Tamang	
	Private	Jit Bahadur Chakradhar	

TABLE 4.5 LIST OF ORGANIZATIONS INTERVIEWED
(FIRM INTERVIEW SURVEY)

Type	Name of Organization
HMG	Department of Tourism Ministry of Agriculture Department of Irrigation Chief District Office, Lalitpur Department of Forest Ministry of Home Election Commission Department of Roads District Road Office, Kathmandu District Road Office, Lalitpur
Embassy & International Organization	Indian Embassy CARE International Nepal
Construction	National Construction Company of Nepal Himal Cement Company Thankot Road Dhunga Udhyog Nippon Koei
Manufacturing (Food)	Nepal Food Corporation Nepal Dairy Development Corporation Ratna Feed Industry Nepal Biscuit Company
Manufacturing (Others)	Ombika Water Tank Harisiddhi Brick and Tile Factory Bansbari Leather and Shoe Factory Brighter Industries Janakpur Cigarette Factory Bottlers Nepal
Commerce	Bhaju Ratna Engineering and Sales
Finance	Nepal Rastra Bank Indo-Suez Bank Agriculture Development Bank
Transportation	Royal Nepal Airlines
Service (Education, Welfare)	Institute of Engineering St. Xaviers School Anandakuti Vidyapith Sano Thimi Campus Teaching Hospital Himalaya Nursing Home
Service (Hotel)	Hotel Yak & Yeti Kathmandu Guest House
Service (Others)	Silt Consultants Economic Services Centre
Project	Dhading District Development Project Pancheshwor Multi-Purpose Project Reconstruction and Rehabilitation Project

4.2 Characteristics of Person Trips

4.2.1 Introduction

The results of Person Trip Survey have been processed following the procedure described in Fig. 4.9 in which original data of Person Trip data has been processed into generalized data about traffic behaviors of residents on average day of the year. Characteristics of traffic behavior of the residents in the Study area are described in the following sections.

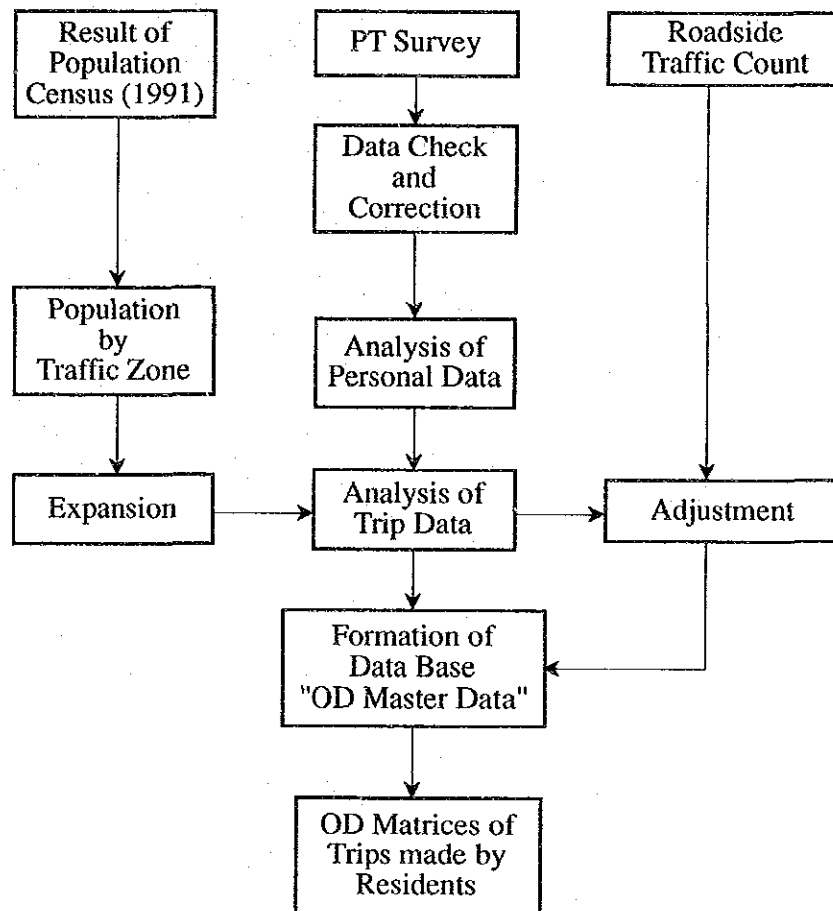


FIG. 4.9 PROCESSING PERSON TRIP (PT) DATA

4.2.2 Trip Characteristics

(1) Number of Person Trips

The total number of trips made by residents in the area of Person Trip Survey (Kathmandu, Lalitpur and Bhaktapur cities), is 1.02 million of which 97 percent (0.99 million trips) are trips which have both of the trip ends within the survey area.

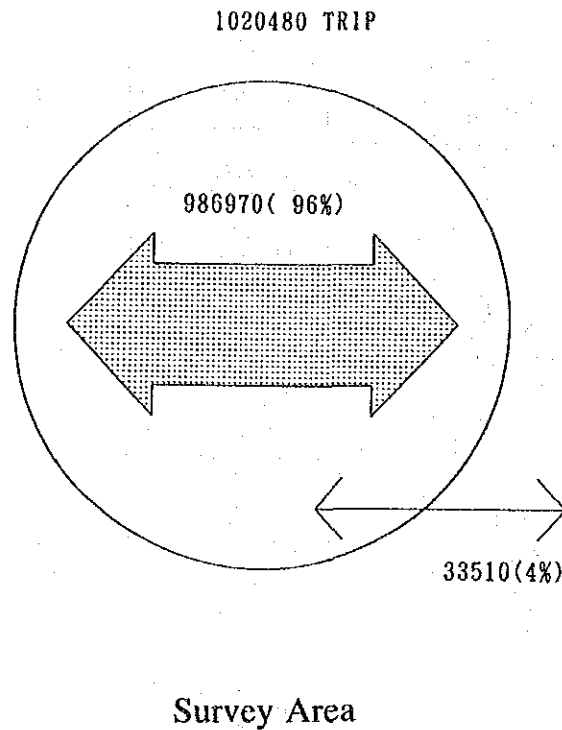


FIG. 4.10 NUMBER OF PERSON TRIPS

(2) Trip Composition by Purpose

Share of "to school" accounts for 17.6 percent of total trips while those of "to office" accounts for 14.5 percent. Those purposes occupy about one-third of total trips. The share of "home" occupies about one-half of the total trips. Trips relating to "business" is as small as 4.8 percent of all the trips.

PURPOSE	NUMBER OF TRIPS	PERCENTAGE
TO OFFICE	148321	14.5
TO SCHOOL	179744	17.6
BUSINESS	48901	4.8
SHOPPING	51826	5.1
HOME	483522	47.4
OTHERS	108166	10.6
TOTAL	1020480	100.0

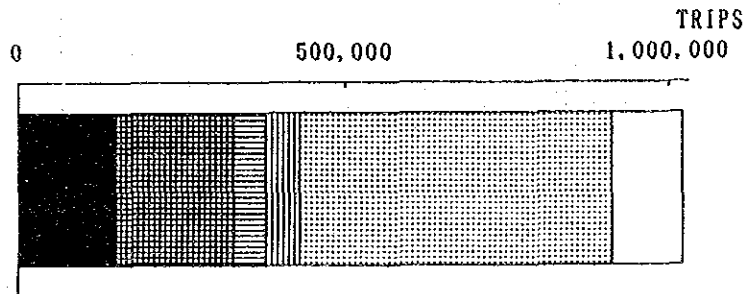


FIG. 4.11 TRIP COMPOSITION BY PURPOSE

(3) Trip Composition by Mode

Walking trips account for more than one-half of total trips. Share of bus trips is 17.6 percent while the shares of passenger cars and trucks are as small as 3.5 and 0.2 percent respectively. The above figures suggest premature nature of motorization in the area.

PURPOSE	NUMBER OF TRIPS	PERCENTAGE
WALK	541,768	53.1
BICYCLE	67,233	6.6
MOTORCYCLE	94,711	9.3
TEMPO	36,875	3.6
TAXI	21,170	2.1
MINIBUS	39,744	3.9
BUS	179,692	17.6
CAR	35,677	3.5
TRUCK	2,300	0.2
OTHERS	1,310	0.1
TOTAL	1,020,480	100.0

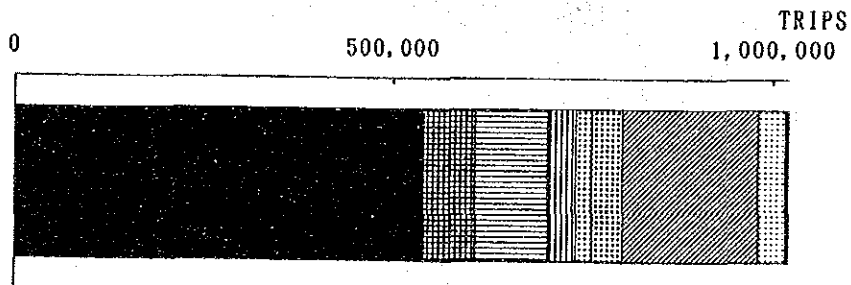


FIG. 4.12 TRIP COMPOSITION BY MODE

(4) Modal Split by Purpose of Trip

Shares of motorcycle and bus are high in the purpose of "to office". Walking constitutes about two-third of trips in the purpose of "to school" while the share of bus in the same purpose is 23 percent. Relative to business trip, shares of motorcycle and passenger car are higher than those in any other purposes while the share of walk is relatively lower. As to shopping, share of walk is higher (66.8 percent) than that of any other purposes while the share of bus is relatively lower accounting for 8.2 percent of the said purpose which is the second lowest figure among the corresponding shares by purpose of trips.

	Walk	Bicycle	Motor-cycle	Tempo	Taxi	Mini-bus	Bus	Passenger Car	Truck	Others	Total
To Office	36.4	8.9	15.7	4.6	1.7	5.4	20.5	6.1	0.3	0.2	100.0
To School	65.2	4.9	1.6	1.4	0.3	2.9	23.0	0.6	0.0	0.0	100.0
Business	39.6	7.2	24.9	3.0	3.6	5.6	7.7	7.2	0.8	0.4	100.0
Shopping	66.8	4.6	6.3	5.3	3.0	2.7	8.2	2.9	0.0	0.1	100.0
Home	54.3	6.5	8.5	3.3	2.0	3.9	18.0	3.1	0.2	0.1	100.0
Others	49.8	7.2	11.3	6.6	4.4	3.4	11.7	5.1	0.4	0.1	100.0

LEGEND

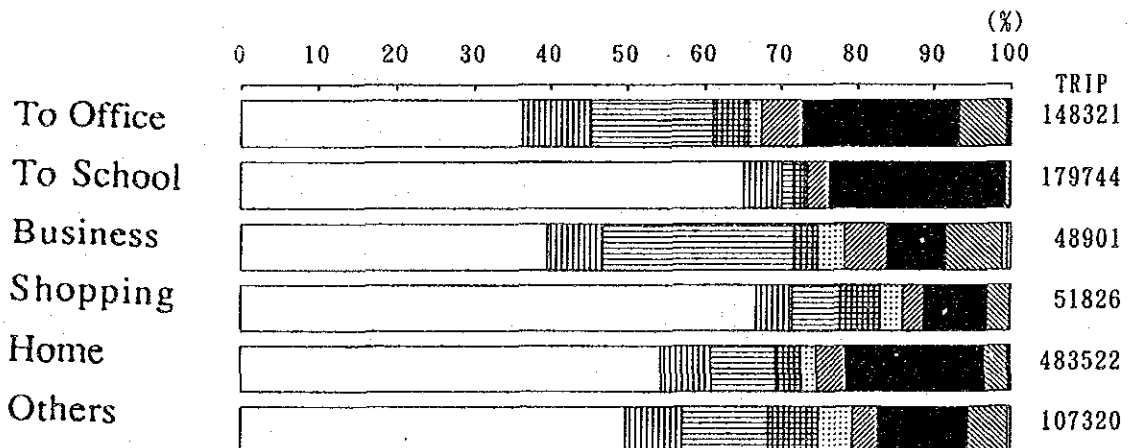
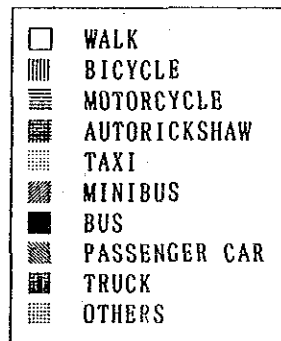


FIG. 4.13 MODAL SPLIT BY PURPOSE OF TRIP

(5) Modal Share by Travel Time

There exist distinct relation between the share of mode and travel time as shown in Fig. 4.14. Share of walk declines with the increase in travel time whilst the share of bus tends to increase with the increase in travel time. The share of bus in the total trips which takes 70 minutes and over is about 85 percent.

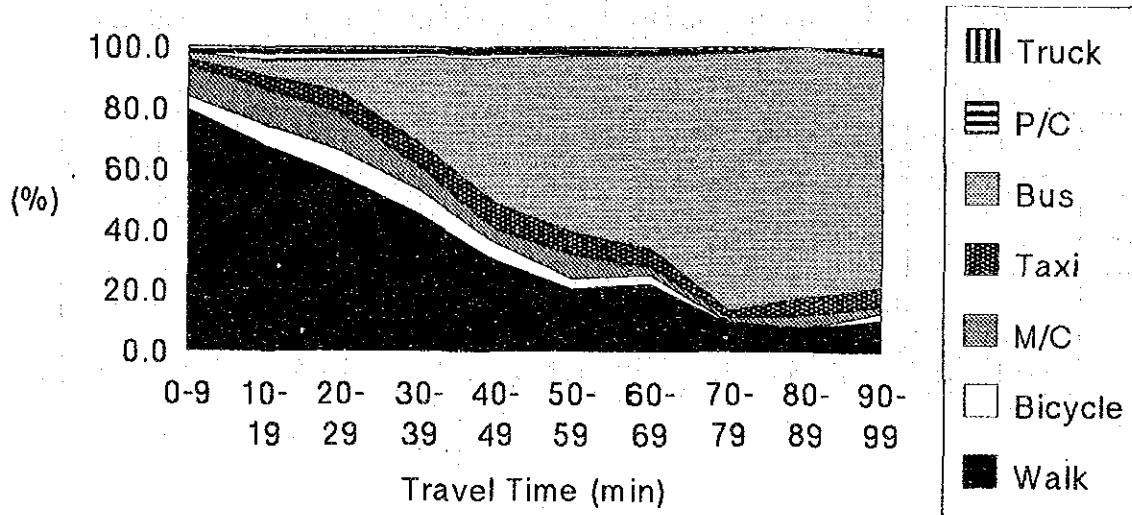


FIG. 4.14 MODAL SHARE BY TRAVEL TIME

(6) Trip Production Rate

There are the following 2 types of trip production rates. However, the gross trip production rate is called as the trip production rate in this study unless a special note is written.

- Gross trip production rate
Number of trips divided by the total number of population of 5 years and over.
- Net trip production rate
Number of trips divided by the total number of population of 5 years and over population that made trips on the survey day.

As to the trip production rates in the Survey area there exist following characteristics by different categories of population:

1) Trip Production Rate by Sex

Trip production rate is much higher by male as 2.187 compared with 1.779 by female. Average trip production rate is 2.039 as shown in Fig. 4.15. This fact suggests higher mobility of males than that of females.

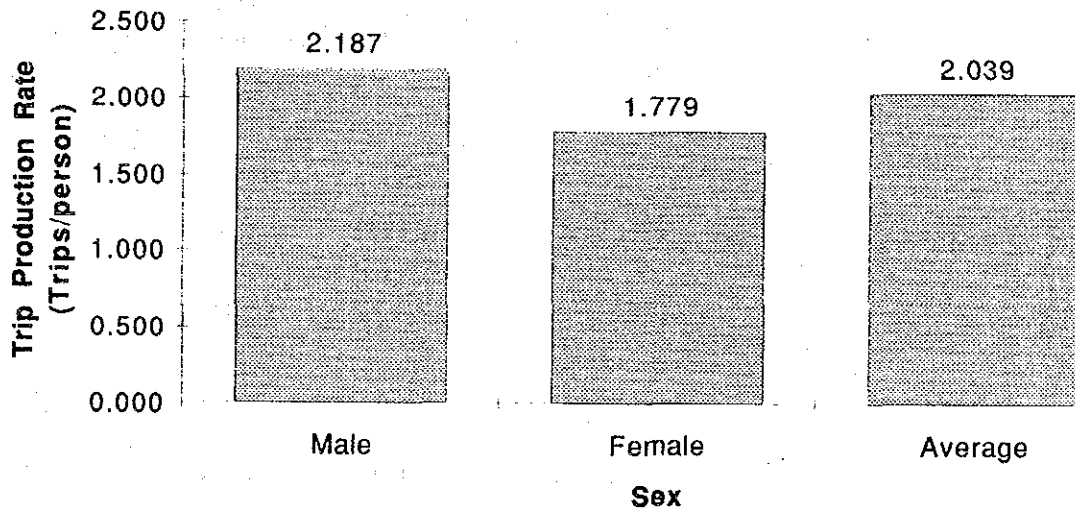


FIG. 4.15 TRIP PRODUCTION RATE BY SEX

2) Trip Production Rate by Age Group

Trip production rates by twenties and thirties are higher than those by other age groups. Production rates are apt to decrease as the age increases as shown in Fig. 4.16. This fact suggests higher mobility of people in their twenties and thirties.

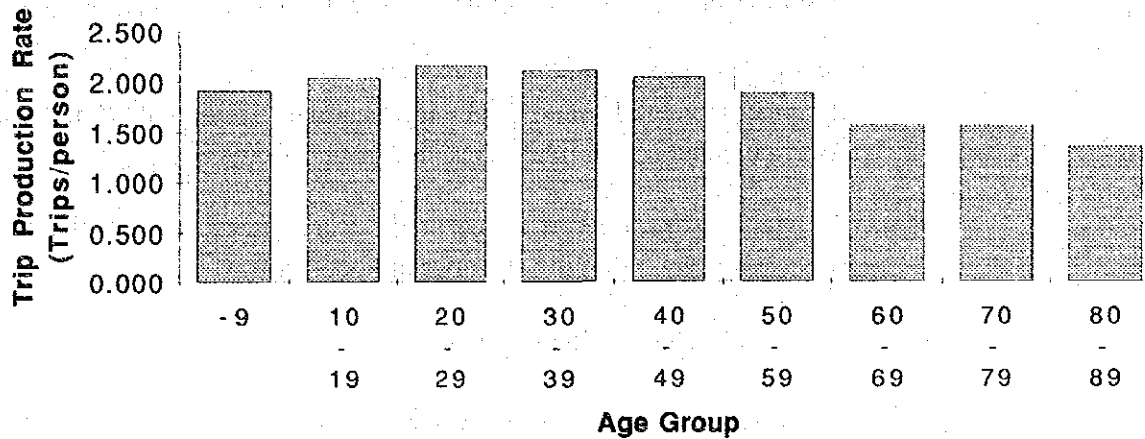


FIG. 4.16 TRIP PRODUCTION RATE BY AGE GROUP

3) Trip Production Rate by Profession

Trip production rates are a little higher for employer as 2.443 and for employee as 2.267, while that for housewife is quite low as 1.285 as shown in Fig. 4.17.

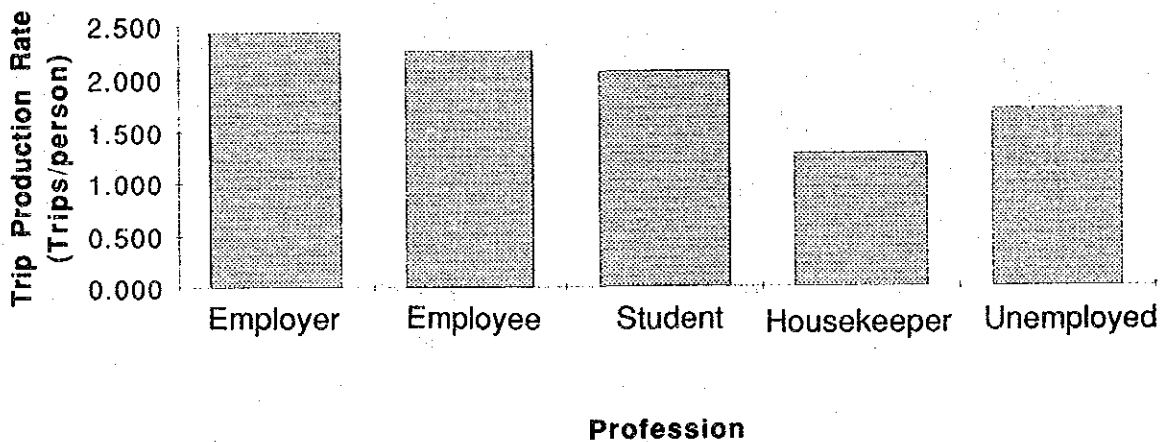


FIG. 4.17 TRIP PRODUCTION RATE BY PROFESSION

4) Trip Production Rate by Vehicle Ownership

Trip production rate for passenger car owning household is highest as 2.200 while that of motorcycle owning household is 2.137.

Trip production rate for household with no-car is as low as 1.990 as shown in Fig. 4.18.

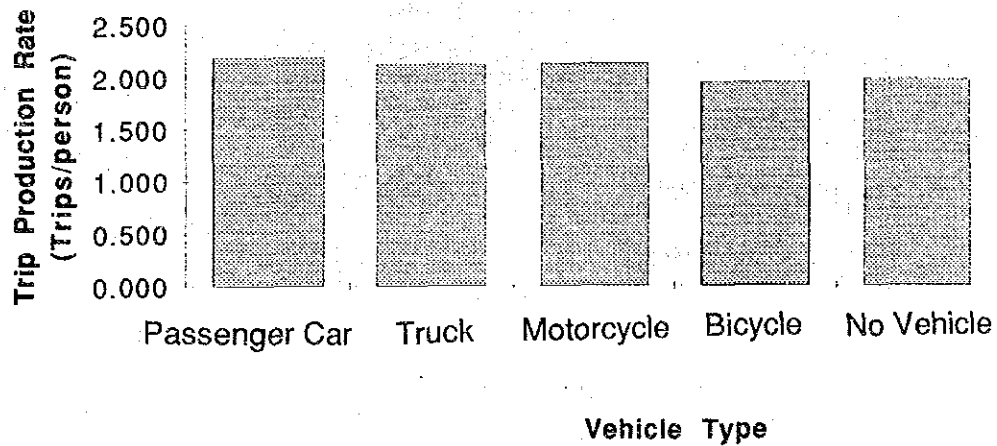


FIG. 4.18 TRIP PRODUCTION RATE BY VEHICLE OWNERSHIP

5) Trip Production Rate by Income Level

Higher income groups tend to show high trip rate as shown in Fig. 4.19. The relation between income level and ownership of vehicle by vehicle type justifies the above facts. (Ref. Fig. 4.20)

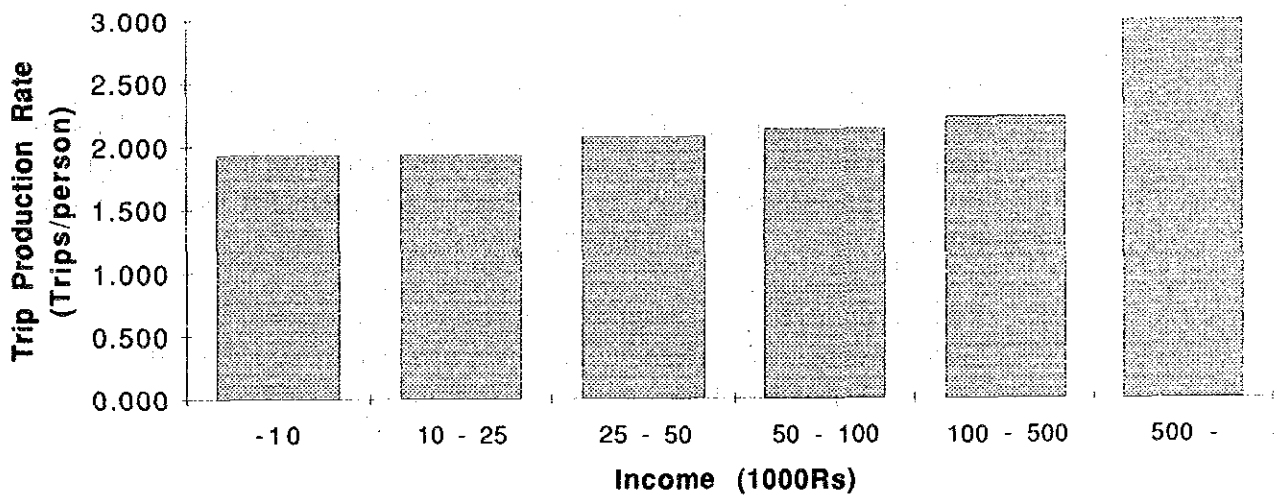


FIG. 4.19 TRIP PRODUCTION RATE BY INCOME LEVEL

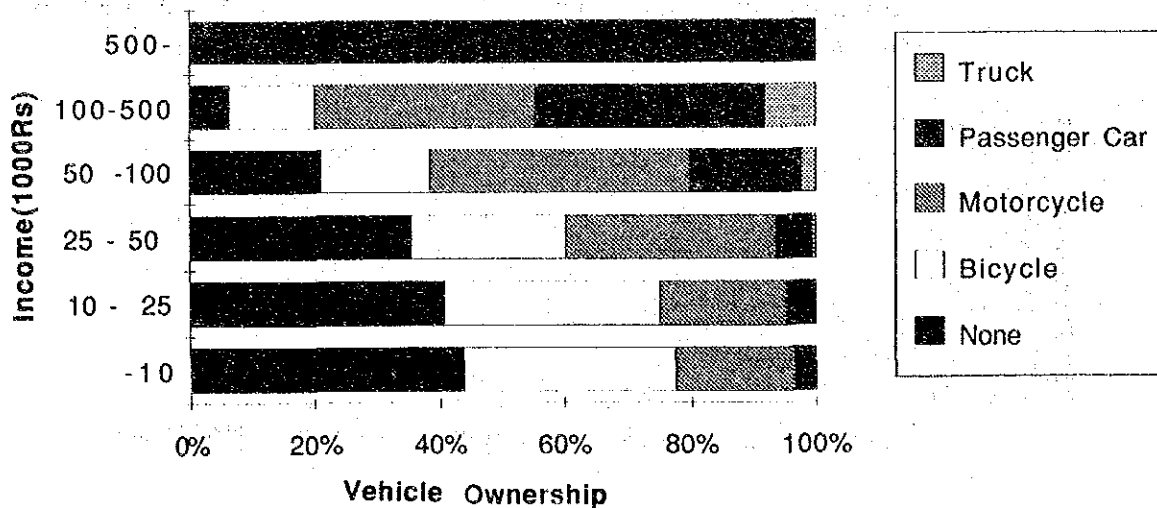


FIG. 4.20 RELATIONSHIP BETWEEN VEHICLE OWNERSHIP AND INCOME LEVEL

(7) Trip Generation and Attraction

Numbers of generated/attracted trips by purpose of trip by traffic zone are given in Fig. 4.21 and Table 4.6.

Largest number of trips of about 190 thousand has been recorded in Zone No. 1* which contains such commercial area as New Road and Thamel. Composition of trip purpose reflect regional characteristics in land-use pattern. Business areas located in the central area tend to show higher share of attracted trip of "business" and "shopping" purposes.

* Zone number under consolidated zones

Regarding zone corresponding between consolidated and original zones, refer Appendix 4-1.

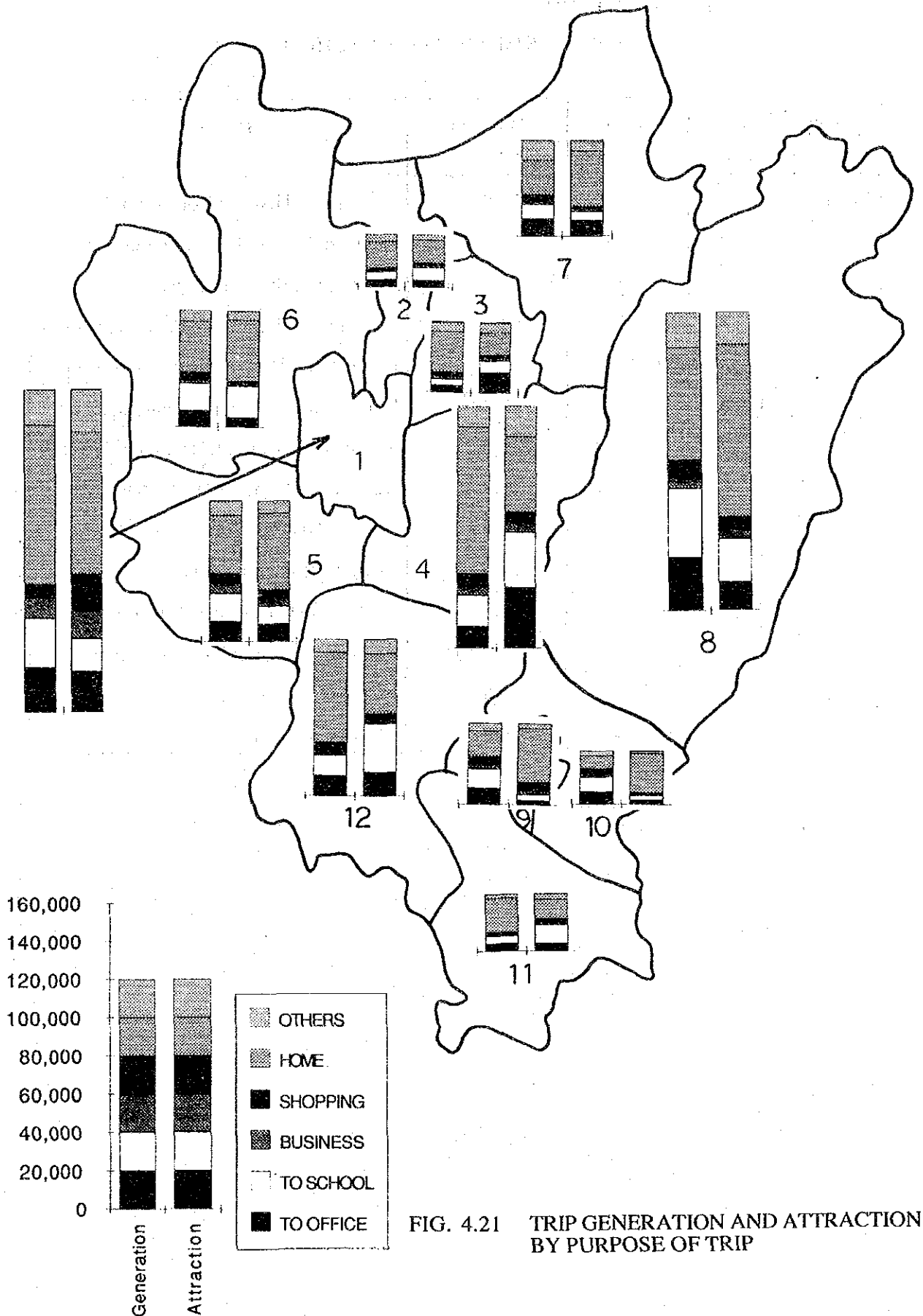


FIG. 4.21 TRIP GENERATION AND ATTRACTION BY PURPOSE OF TRIP

TABLE 4.6 CHARACTERISTICS IN TRIP GENERATION AND ATTRACTION
 - TRIP PURPOSE (TO OFFICE/SCHOOL) -

(percent)

City	Zone No.	Generation	Attraction	Remark
Kathmandu	1	29.2	22.8	Kathmandu Historic Core Area
	2	28.6	37.7	Kathmandu New Development Area
	3	19.3	*46.0 (17.2)	Kathmandu Business Area
	4	22.2	*47.9 (22.7)	Kathmandu Commercial/Business Area
	5	34.4	25.3	Kathmandu Western Residential Area
	6	37.5	35.4	Kathmandu Residential/Industrial Area
	7	33.1	26.2	Kathmandu Northern Residential Area
	8	*40.9	23.9	Kathmandu Eastern Residential Area
Lalitpur	9	*43.9	12.4	Lalitpur Historic Core Area
	10	*50.0	16.6	Lalitpur Residential Area
	11	26.1	*45.8 (33.0)	Lalitpur Southern Educational Area
	12	25.9	*46.0 (31.3)	Lalitpur Western Educational Area
Bhaktapur	13	*42.6	29.9	Bhaktapur Historic Area
	14	*43.6	27.7	Bhaktapur Historic Area

* : more than 40 percent
 () : School Trip only

(8) Trip Generation by Departure Time and Purpose of Trip

The peak hours in terms of departure lie in 9:00 - 10:00 in the morning and 16:00 - 17:00 in the evening. Major trip purposes in the morning peak are such daily traffic as "to school" and "to office" while the major purpose in evening peak is "home". Trips with other purposes distribute rather evenly throughout the period 6:00 - 18:00 as shown in Fig. 4.22.

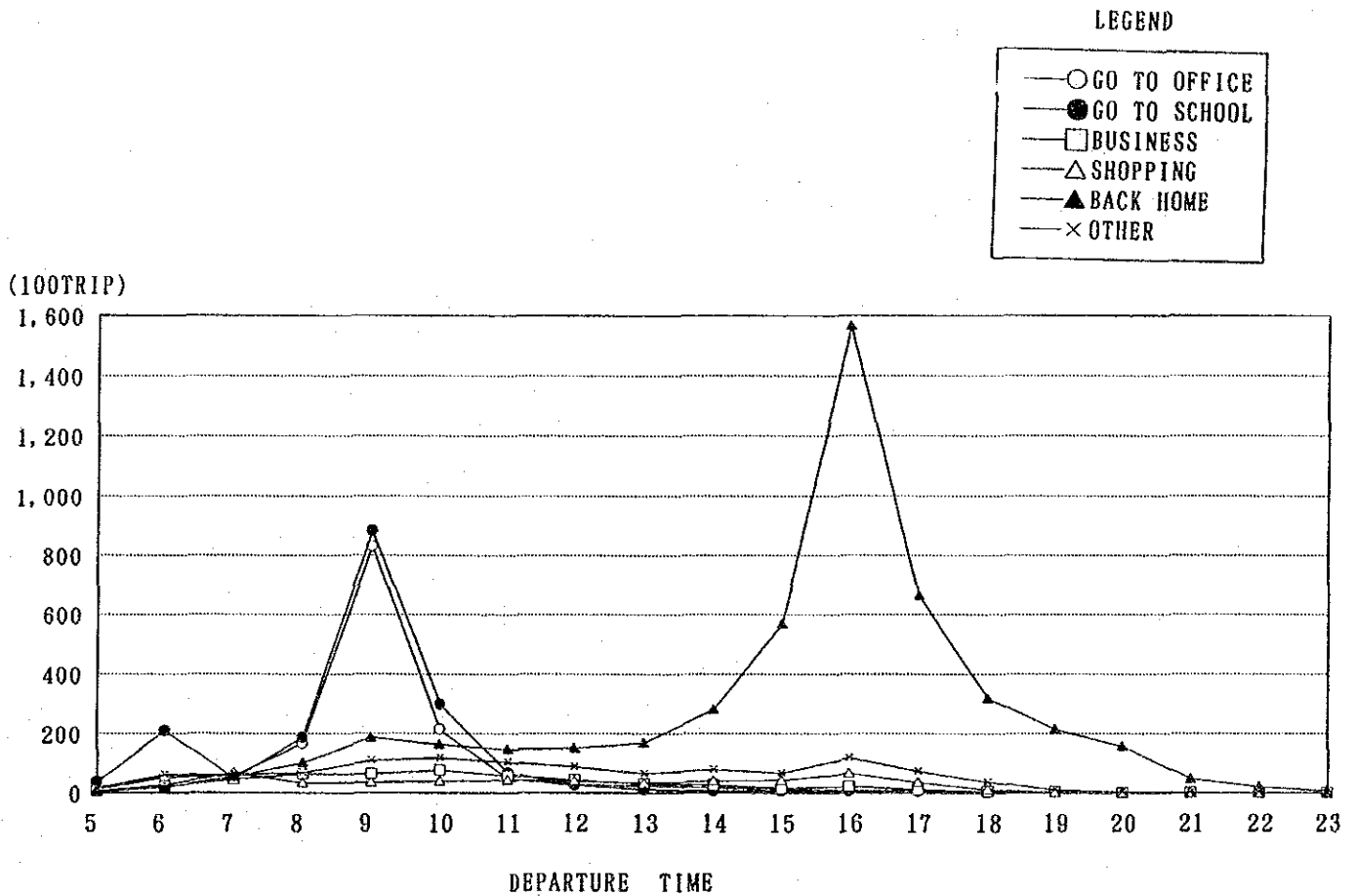


FIG. 4.22 TRIP GENERATION BY DEPARTURE TIME AND PURPOSE OF TRIP

(9) Trip Distribution

Traffic desire lines for major trip purposes are given in Fig. 4.23 to 4.27 from which following characteristics in trip distribution could be pointed out:

Trip Distribution by Purpose of Trip

- Concentration of trips of "to office" in the city centers of three cities, i.e. Kathmandu, Lalitpur and Bhaktapur.
- Relatively large concentration of trips of "to school" in the urban fringes.

Trip Distribution by Mode of Trip

- Taxi, including tempo, is used rather in short distant zone pairs, such as those among neighboring zones and so on.
- Trips by bus is rather distributed in wider areas. There exists strong consolidation of three cities in terms of bus desire line.