FIG. 4.23 PRESENT TRAFFIC DESIRE LINE (PERSON)
- ALL PURPOSES, ALL MODES -

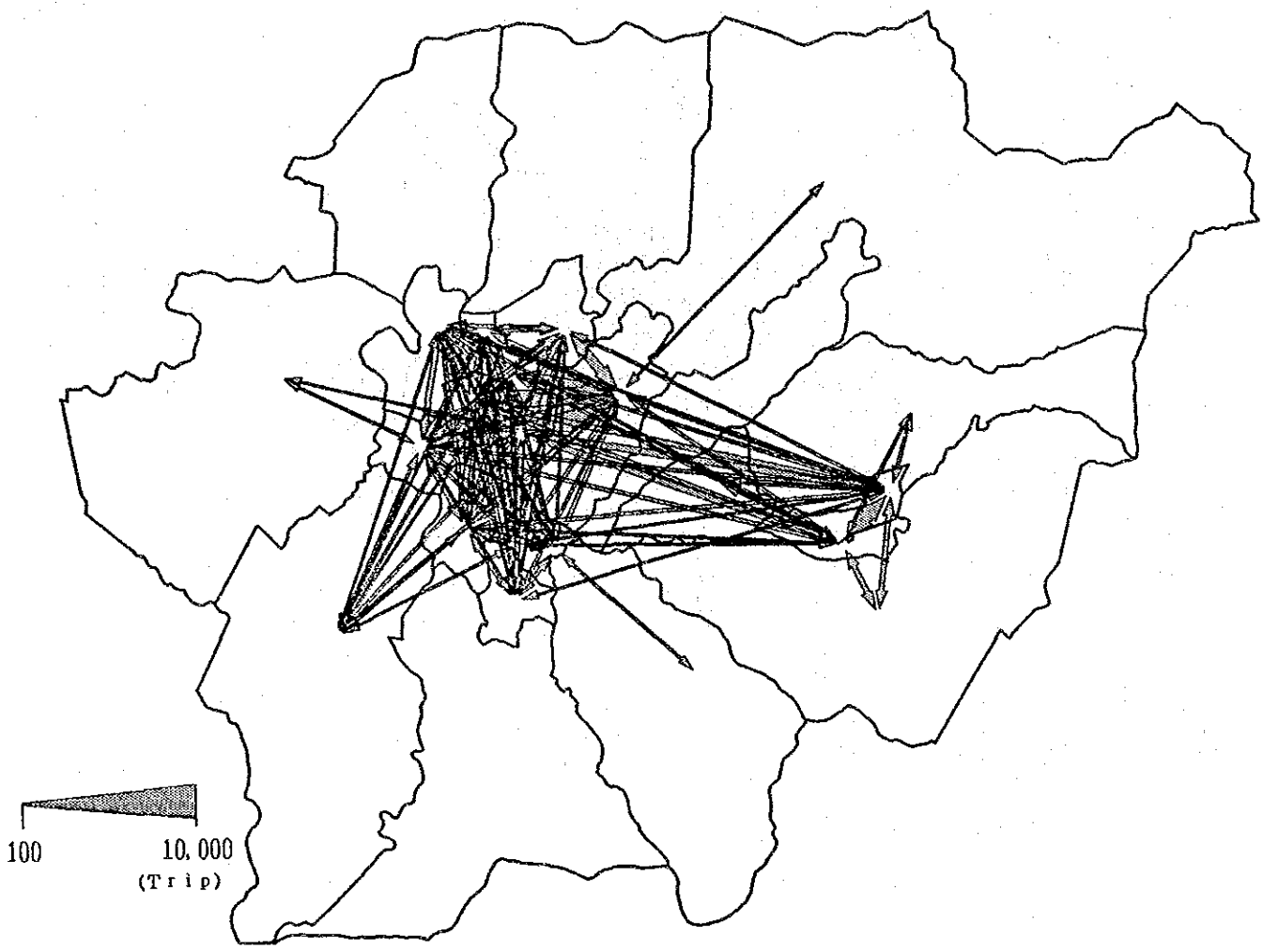


FIG. 4.24 PRESENT TRAFFIC DESIRE LINE (PERSON)
- TO OFFICE, ALL MODES -

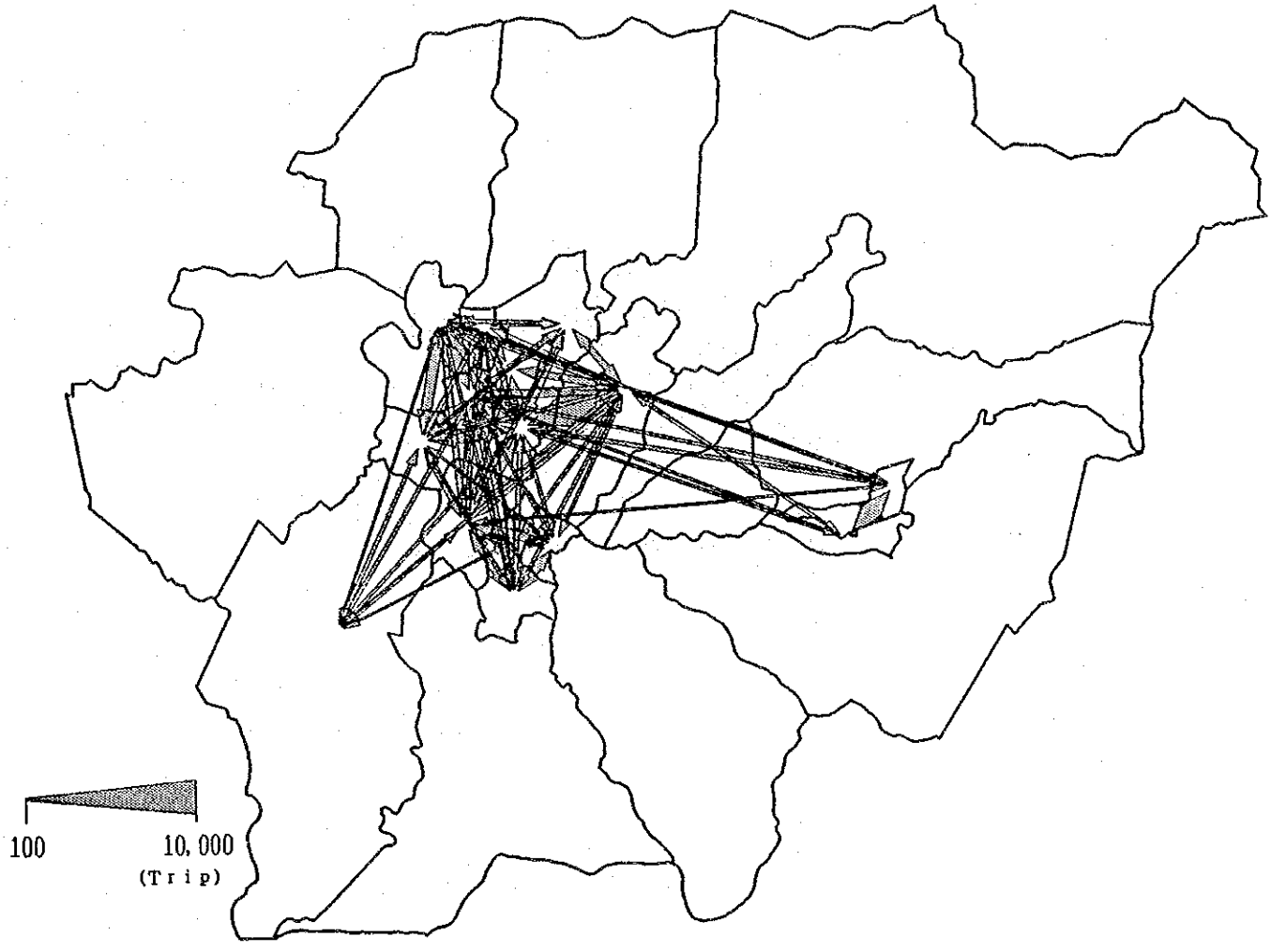


FIG. 4.25 PRESENT TRAFFIC DESIRE LINE (PERSON)
- TO SCHOOL, ALL MODES -

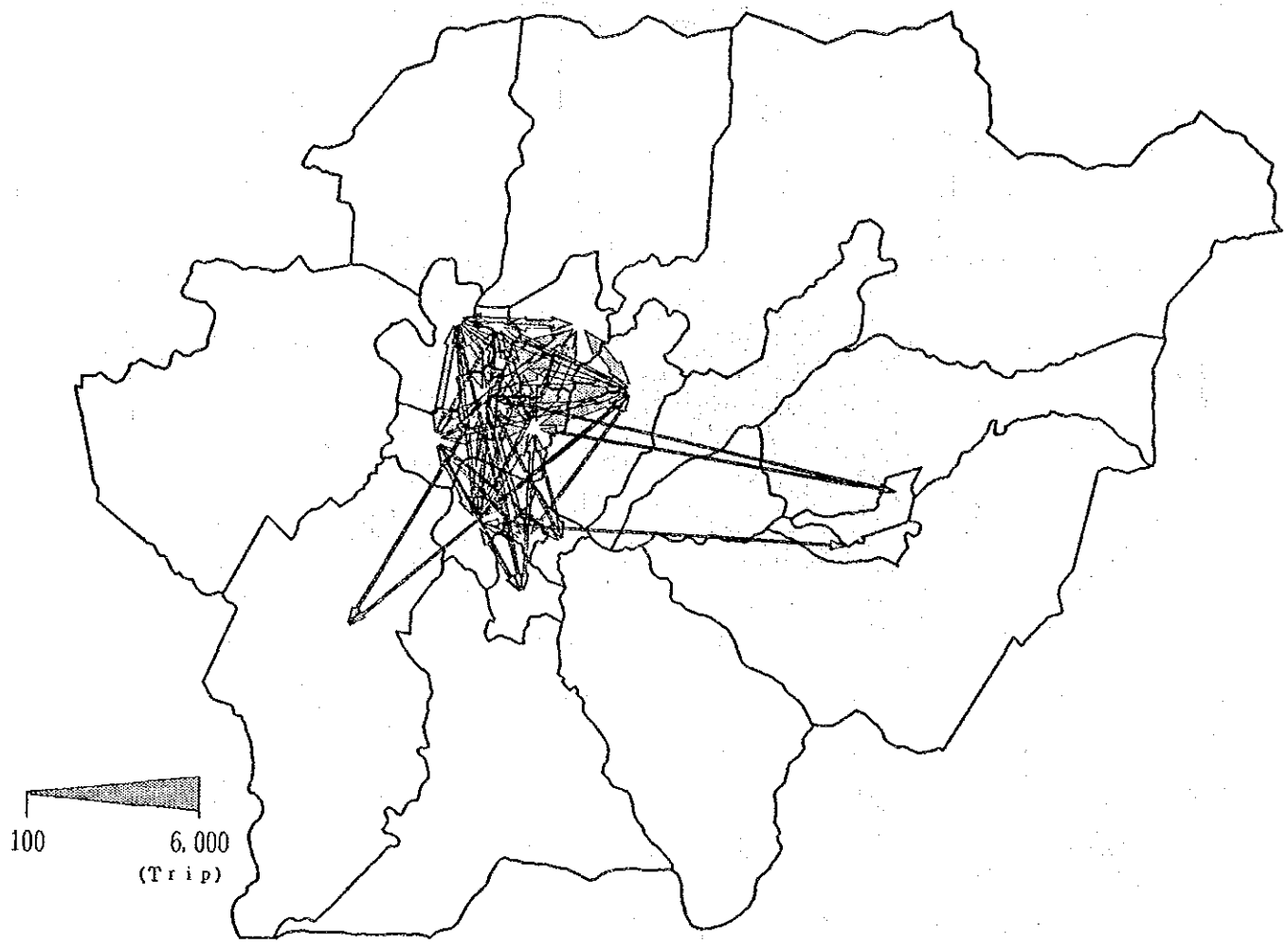


FIG. 4.26 PRESENT TRAFFIC DESIRE LINE (PERSON)
- ALL PURPOSES, BY TAXI -

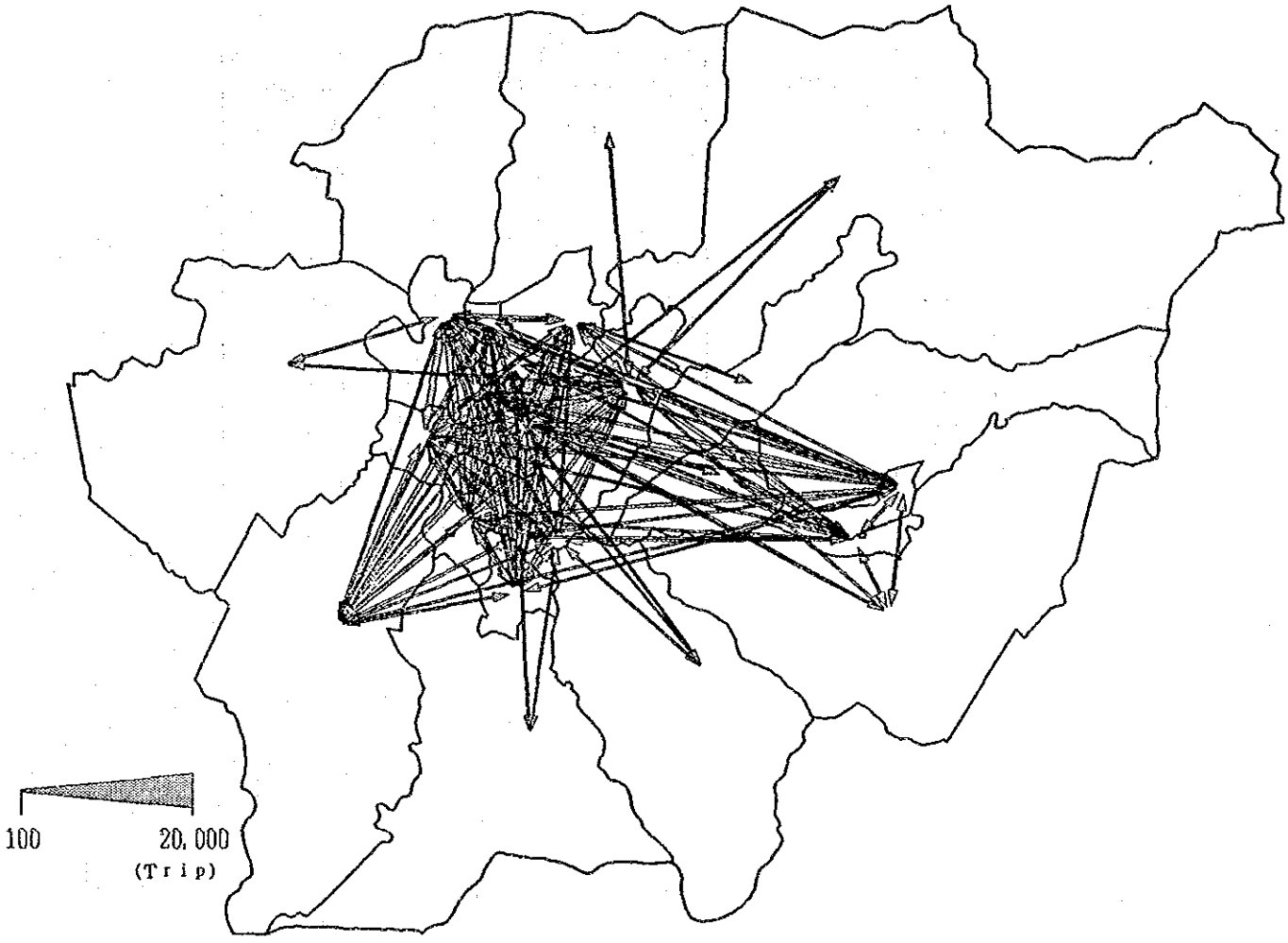


FIG. 4.27 PRESENT TRAFFIC DESIRE LINE (PERSON)
- ALL PURPOSES, BY BUS -

(10) Access Modes to Buses

Bus, minibus and tempo are largely used as access modes to buses. The shares of these modes in all the modes of transport are 0.8 percent for bus, 0.9 percent for minibus and 1.8 percent for tempo. Whereas, the shares of passenger car and bicycle are very small. The share of walk is 96 percent as shown in Table 4.7.

TABLE 4.7 ACCESS MODES TO BUSES

Access Mode	Number of Trips	Percentage
Bus	1,449	0.9
Minibus	1,612	0.9
Taxi	224	0.1
Tempo	3,258	1.8
Passenger Car	103	0.1
Motorcycle	200	0.1
Bicycle	288	0.2
Walk	174,922	96.0
Total	182,056	100.0

4.3 Characteristics of Road Traffic

4.3.1 Traffic Volume

According to the estimate made by the Study team, number of vehicles registered in Bagmati zone is 54,776 (excluding rickshaws and hand carts) in 1990/91 as shown in Table 3.2. Compared to same figure in 1980/81 which is 26,750, the number of vehicles registered has become more than double during the last ten years. The annual rate of growth in this period is 7.4%.

According to the Traffic Police, on the other hand, out of about 88,000 vehicles plying throughout the country, more than 65,000 vehicles of all types ply in the 700 km long streets (within the Ring Road) of Kathmandu Valley alone. About 35,000 bicycles add to the city's traffic congestion (Rising Nepal, January, 1992).

The trend of recent traffic increase is characterized by drastic increase in passenger cars including tempos and auto-rickshaws. These increased number of slow vehicles on the streets are becoming major cause of congestion on road and reduction of average vehicle speed.

According to traffic survey carried out by the Study team, traffic volumes on the Ring Road are at the level of 5,000 - 7,000 vehicles (including bicycles). Traffic volume along Arniko Highway is about 9,000 vehicles near the eastern edge of the Ring Road while traffic on Tribhuvan Highway is about 5,000 vehicles near the western edge of the Ring Road. Bagmati bridge, Thapathali, is intensively used for the traffic which plys between Kathmandu and Patan. The daily traffic volume on this bridge is about 48,000 vehicles. Concentration of traffic in the downtown area is another aspect of urban traffic, traffic volumes on major arterial roads in this area are in the range of 25,000 - 40,000 vehicles as shown in Fig. 4.28 and Table 4.8.

Although it is impossible to make comparative analysis in time series because of the lack of historical data, traffic in the urban area is estimated to be on the increase at considerably high rate.

The traffic pattern in the Study area has begun to show that of urban traffic. This could be seen in following facts :

- Mixing of traffic on arterial roads.
- No distinct peak hours especially on the streets in the city center.
- No distinct difference of traffic volumes by direction of road during peak hours.

In addition, traffic pattern in the Study area is getting more integrated among the three cities. This could be seen in such large traffic volumes on the boundaries of the cities :

Kathmandu - Lalitpur	:	48,000 (at Bagmati bridge, Thapathali)
Kathmandu - Bhaktapur	:	9,000 (at Koteswar, Arniko Highway)

It is expected that traffic on most of the major roads would get saturated in the near future should no effective scheme of road development be introduced.

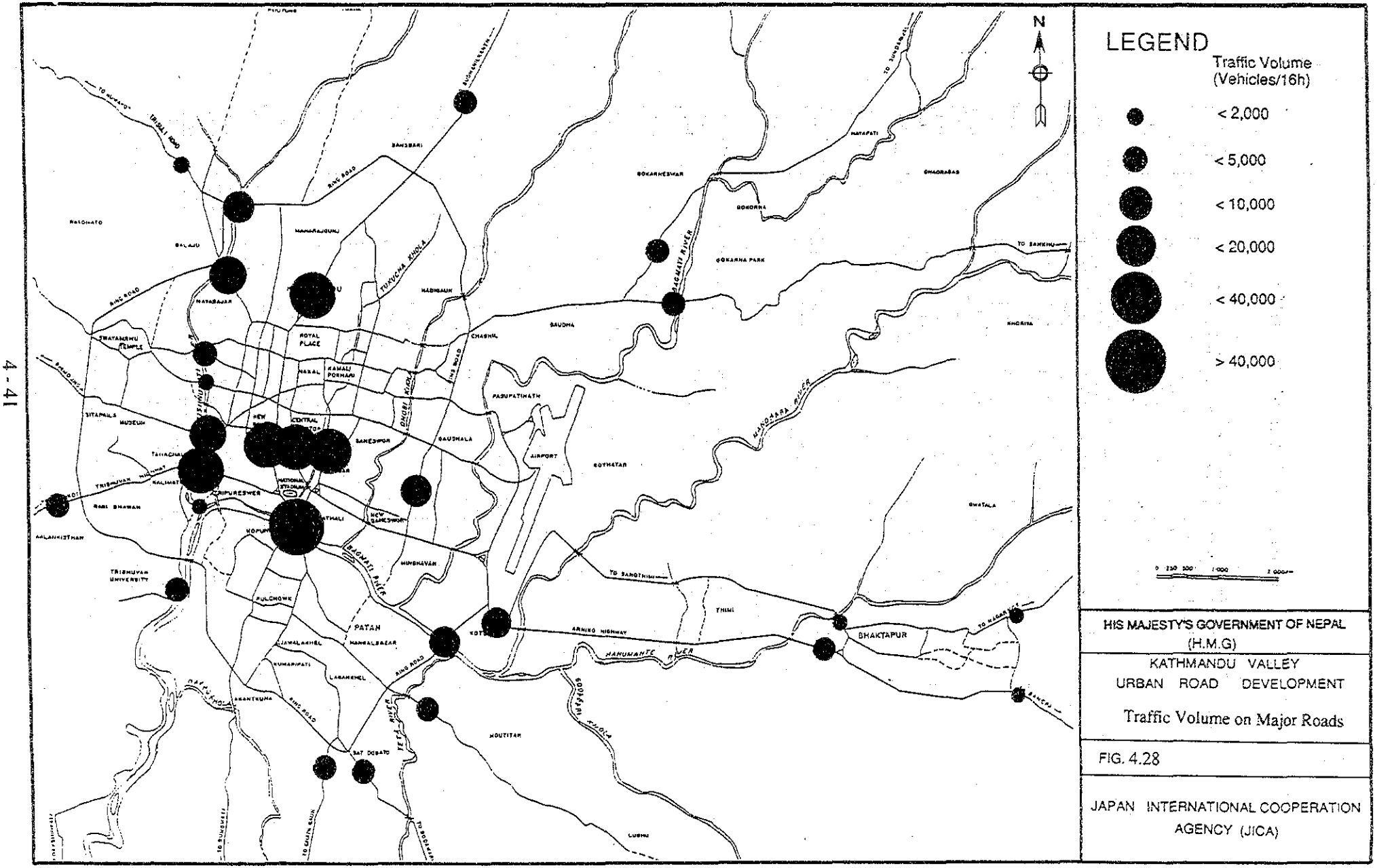

N
LEGEND
Traffic Volume
(Vehicles/16h)
< 2,000
< 5,000
< 10,000
< 20,000
< 40,000
> 40,000
HIS MAJESTY'S GOVERNMENT OF NEPAL
(H.M.G)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
Traffic Volume on Major Roads
FIG. 4.28
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

TABLE 4.8 TRAFFIC VOLUME

Vehicle (%)

Point	16h (6:00-22:00)						24h	Peak Hour*
	Direction 1	Direction 2	Total	Motorized	Heavy Vehicle	Public Transport		
B1	1,443	1,495	2,938	1,983	95	986		295
	(49.1)	(50.9)	(100.0)	(67.5)	(3.2)	(33.6)		(10.0)
B2	1,603	1,595	3,198	1,757	178	635		337
	(50.1)	(49.9)	(100.0)	(54.9)	(5.6)	(19.9)		(10.5)
B3	4,126	4,673	8,799	7,388	1,228	2,751		859
	(46.9)	(53.1)	(100.0)	(84.0)	(14.0)	(31.3)		(9.8)
B4	1,802	1,728	3,530	1,333	239	335		477
	(51.0)	(49.0)	(100.0)	(37.8)	(6.8)	(9.5)		(13.5)
B5	2,197	2,112	4,309	2,372	388	612		514
	(51.0)	(49.0)	(100.0)	(55.0)	(9.0)	(14.2)		(11.9)
B6	1,580	1,669	3,249	1,566	155	553		410
	(48.6)	(51.4)	(100.0)	(48.2)	(4.8)	(17.0)		(12.6)
B7	2,012	1,998	4,010	2,946	443	912		458
	(50.2)	(49.8)	(100.0)	(73.5)	(11.0)	(22.7)		(11.4)
B8	2,313	2,445	4,758	4,183	1,416	1,773	4,905	442
	(48.6)	(51.4)	(100.0)	(87.9)	(29.8)	(37.3)	(103.1)	(9.3)
B9	1,098	1,167	2,265	912	47	239		275
	(48.5)	(51.5)	(100.0)	(40.3)	(2.1)	(10.6)		(12.1)
B10	279	289	568	328	65	123		68
	(49.1)	(50.9)	(100.0)	(57.7)	(11.4)	(21.7)		(12.0)
B11	2,333	2,253	4,586	4,066	811	1,589		454
	(50.9)	(49.1)	(100.0)	(88.7)	(17.7)	(34.6)		(9.9)
B12	609	545	1,154	687	71	290		132
	(52.8)	(47.2)	(100.0)	(59.5)	(6.2)	(25.1)		(11.4)
B13	770	782	1,552	391	16	99		173
	(49.6)	(50.4)	(100.0)	(25.2)	(1.0)	(6.4)		(11.1)
B14	722	892	1,614	1,329	283	499		164
	(44.7)	(55.3)	(100.0)	(82.3)	(17.5)	(30.9)		(10.2)
B15	975	1,244	2,219	2,142	1,207	748		191
	(43.9)	(56.1)	(100.0)	(96.5)	(54.4)	(33.7)		(8.6)
B16	3,424	3,366	6,790	5,449	1,092	1,750		742
	(50.4)	(49.6)	(100.0)	(80.3)	(16.1)	(25.8)		(10.9)
B17	23,608	24,657	48,265	31,279	194	13,015		4,628
	(48.9)	(51.1)	(100.0)	(64.8)	(0.4)	(27.0)		(9.6)
B18	961	893	1,854	585	0	0		234
	(51.8)	(48.2)	(100.0)	(31.6)	(0.0)	(0.0)		(12.6)
B19	13,446	12,558	26,004	19,932	780	9,440		2,313
	(51.7)	(48.3)	(100.0)	(76.6)	(3.0)	(36.3)		(8.9)
B20	4,989	5,285	10,274	4,394	8	1,069		916
	(48.6)	(51.4)	(100.0)	(42.8)	(0.1)	(10.4)		(8.9)
B21	989	922	1,911	462	0	0		192
	(51.8)	(48.2)	(100.0)	(24.2)	(0.0)	(0.0)		(10.0)
B22	1,626	1,574	3,200	1,991	10	868		319
	(50.8)	(49.2)	(100.0)	(62.2)	(0.3)	(27.1)		(10.0)
B23	5,388	6,442	11,830	7,466	327	3,296		1,125
	(45.5)	(54.5)	(100.0)	(63.1)	(2.8)	(27.9)		(9.5)
B24	2,692	2,739	5,431	3,712	450	1,231		559
	(49.6)	(50.4)	(100.0)	(68.3)	(8.3)	(22.7)		(10.3)
B25	11,445	11,633	23,078	16,919	179	7,699		2,184
	(49.6)	(50.4)	(100.0)	(73.3)	(0.8)	(33.4)		(9.5)
B26	38,990	0	38,990	31,131	755	14,381		4,061
	(100.0)	(0.0)	(100.0)	(79.8)	(1.9)	(36.9)		(10.4)
B27	0	37,671	37,671	30,150	941	14,629		4,004
	(0.0)	(100.0)	(100.0)	(80.0)	(2.5)	(38.8)		(10.6)
B28	12,954	14,427	27,381	19,519	386	7,596	27,694	2,823
	(47.3)	(52.7)	(100.0)	(71.3)	(1.4)	(27.7)	(101.1)	(10.3)
B29	4,264	4,365	8,629	5,499	62	1,815		971
	(49.4)	(50.6)	(100.0)	(63.7)	(0.7)	(21.0)		(11.3)

* Ratio (%) = Peak hour/16th
* Regarding the location of survey points, refer Fig. 4.2.

4.3.2 Vehicle Composition

The roads in the Study area are heavily used for slow vehicles including tempos, motorcycles and bicycles. The proportions of these vehicles to the total lie between 40% and 80%. Larger proportion has been recorded on the streets in the central area while the Ring Road and National Highways have smaller proportion. The proportion of these vehicles at Bagmati Bridge is 73.2%.

The proportions of trucks on the Ring Road are 15.5% and 11.4% on eastern section of the road (near Koteswar) and northern section (near Balaju) respectively. Arniko and Tribhuvan Highways have also shown large proportions of trucks. The proportion of trucks on Arniko Highway is 12.0% in the section near Koteswar while that on Tribhuvan Highway near Kalankisthan is as high as 25.1%.

The proportions of passenger cars are approximately in the range of 10 - 20%, which is relatively small compared with other cities in the world. This fact suggests that motorization in the Study area is still at the beginning stage.

High proportions of minibuses and buses are recorded at eastern section of the Ring Road (15.0% near Koteswar), Tribhuvan Highway (13.9% near Kalankisthan) and Arniko Highway (24.9% near Bhaktapur) as shown in Fig. 4.29.

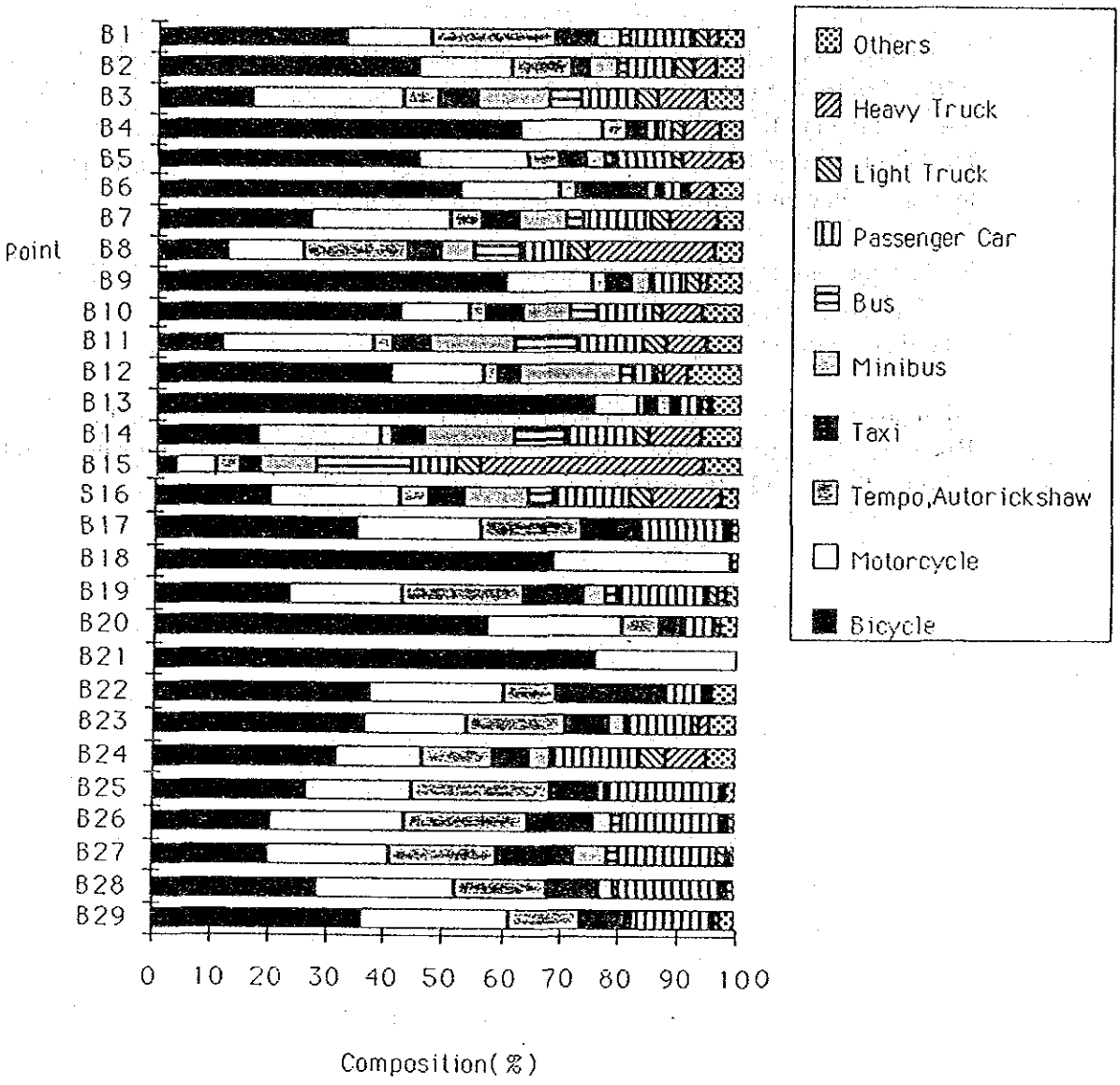


FIG. 4.29 VEHICLE COMPOSITION

TABLE 4.9 TRAFFIC VOLUME BY VEHICLE TYPE

Vehicle/16h

(%)

Point	Bicycle	Motor-cycle	Tempo, Autori-ckshaw	Taxi	Mini Bus	Bus, Trolley Bus	Passen-ger Car	Light Truck	Heavy Truck	Others	Total
B1	955	425	620	196	124	46	327	71	49	125	2,938
	(32.5)	(14.5)	(21.1)	(6.7)	(4.2)	(1.6)	(11.1)	(2.4)	(1.7)	(4.3)	(100.0)
B2	1,441	496	324	99	160	52	264	93	126	143	3,198
	(45.1)	(15.5)	(10.1)	(3.1)	(5.0)	(1.6)	(8.3)	(2.9)	(3.9)	(4.5)	(100.0)
B3	1,411	2,312	518	594	1,067	482	841	304	746	524	8,799
	(16.0)	(26.3)	(5.9)	(6.8)	(12.1)	(5.5)	(9.6)	(3.5)	(8.5)	(6.0)	(100.0)
B4	2,197	492	149	107	60	19	90	70	220	126	3,530
	(62.2)	(13.9)	(4.2)	(3.0)	(1.7)	(0.5)	(2.5)	(2.0)	(6.2)	(3.6)	(100.0)
B5	1,937	799	236	179	155	42	444	78	346	93	4,309
	(45.0)	(18.5)	(5.5)	(4.2)	(3.6)	(1.0)	(10.3)	(1.8)	(8.0)	(2.2)	(100.0)
B6	1,683	556	95	383	47	28	139	29	127	162	3,249
	(51.8)	(17.1)	(2.9)	(11.8)	(1.4)	(0.9)	(4.3)	(0.9)	(3.9)	(5.0)	(100.0)
B7	1,064	955	209	257	326	120	461	127	323	168	4,010
	(26.5)	(23.8)	(5.2)	(6.4)	(8.1)	(3.0)	(11.5)	(3.2)	(8.1)	(4.2)	(100.0)
B8	575	619	875	237	286	375	385	153	1,041	212	4,758
	(12.1)	(13.0)	(18.4)	(5.0)	(6.0)	(7.9)	(8.1)	(3.2)	(21.9)	(4.5)	(100.0)
B9	1,353	333	55	98	69	17	125	56	30	129	2,265
	(59.7)	(14.7)	(2.4)	(4.3)	(3.0)	(0.8)	(5.5)	(2.5)	(1.3)	(5.7)	(100.0)
B10	240	64	17	35	47	24	55	8	41	37	568
	(42.3)	(11.3)	(3.0)	(6.2)	(8.3)	(4.2)	(9.7)	(1.4)	(7.2)	(6.5)	(100.0)
B11	520	1,194	168	279	658	484	520	174	327	262	4,586
	(11.3)	(26.0)	(3.7)	(6.1)	(14.3)	(10.6)	(11.3)	(3.8)	(7.1)	(5.7)	(100.0)
B12	467	182	24	43	203	20	51	11	51	102	1,154
	(40.5)	(15.8)	(2.1)	(3.7)	(17.6)	(1.7)	(4.4)	(1.0)	(4.4)	(8.8)	(100.0)
B13	1,161	118	19	31	40	9	73	15	7	79	1,552
	(74.8)	(7.6)	(1.2)	(2.0)	(2.6)	(0.6)	(4.7)	(1.0)	(0.5)	(5.1)	(100.0)
B14	285	343	30	85	247	137	193	45	146	103	1,614
	(17.7)	(21.3)	(1.9)	(5.3)	(15.3)	(8.5)	(12.0)	(2.8)	(9.0)	(6.4)	(100.0)
B15	77	152	97	71	220	360	163	96	847	136	2,219
	(3.5)	(6.8)	(4.4)	(3.2)	(9.9)	(16.2)	(7.3)	(4.3)	(38.2)	(6.1)	(100.0)
B16	1,341	1,546	347	390	737	276	908	236	816	193	6,790
	(19.7)	(22.8)	(5.1)	(5.7)	(10.9)	(4.1)	(13.4)	(3.5)	(12.0)	(2.8)	(100.0)
B17	16,986	10,092	8,231	4,351	254	179	7,381	131	15	645	48,265
	(35.2)	(20.9)	(17.1)	(9.0)	(0.5)	(0.4)	(15.3)	(0.3)	(0.0)	(1.3)	(100.0)
B18	1,269	564	0	0	0	0	0	0	0	21	1,854
	(68.4)	(30.4)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(1.1)	(100.0)
B19	6,072	5,118	5,338	2,648	1,004	450	4,084	398	330	562	26,004
	(23.4)	(19.7)	(20.5)	(10.2)	(3.9)	(1.7)	(15.7)	(1.5)	(1.3)	(2.2)	(100.0)
B20	5,880	2,381	661	389	19	0	585	48	8	303	10,274
	(57.2)	(23.2)	(6.4)	(3.8)	(0.2)	(0.0)	(5.7)	(0.5)	(0.1)	(2.9)	(100.0)
B21	1,449	462	0	0	0	0	0	0	0	0	1,911
	(75.8)	(24.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)
B22	1,209	712	294	564	10	0	242	30	10	129	3,200
	(37.8)	(22.3)	(9.2)	(17.6)	(0.3)	(0.0)	(7.6)	(0.9)	(0.3)	(4.0)	(100.0)
B23	4,364	2,043	1,981	849	346	120	1,232	175	207	513	11,830
	(36.9)	(17.3)	(16.7)	(7.2)	(2.9)	(1.0)	(10.4)	(1.5)	(1.7)	(4.3)	(100.0)
B24	1,719	819	630	354	188	59	778	227	391	266	5,431
	(31.7)	(15.1)	(11.6)	(6.5)	(3.5)	(1.1)	(14.3)	(4.2)	(7.2)	(4.9)	(100.0)
B25	6,159	4,266	5,329	1,956	292	122	4,416	101	57	380	23,078
	(26.7)	(18.5)	(23.1)	(8.5)	(1.3)	(0.5)	(19.1)	(0.4)	(0.2)	(1.6)	(100.0)
B26	7,859	9,215	8,156	4,357	1,169	699	6,797	274	56	408	38,990
	(20.2)	(23.6)	(20.9)	(11.2)	(3.0)	(1.8)	(17.4)	(0.7)	(0.1)	(1.0)	(100.0)
B27	7,521	8,102	6,796	4,964	2,110	759	6,364	571	182	302	37,671
	(20.0)	(21.5)	(18.0)	(13.2)	(5.6)	(2.0)	(16.9)	(1.5)	(0.5)	(0.8)	(100.0)
B28	7,862	6,525	4,192	2,505	670	229	4,706	222	157	313	27,381
	(28.7)	(23.8)	(15.3)	(9.1)	(2.4)	(0.8)	(17.2)	(0.8)	(0.6)	(1.1)	(100.0)
B29	3,130	2,152	1,078	678	51	8	1,203	63	54	212	8,629
	(36.3)	(24.9)	(12.5)	(7.9)	(0.6)	(0.1)	(13.9)	(0.7)	(0.6)	(2.5)	(100.0)

* Regarding the location of survey points, refer Fig. 4.2.

4.3.3 Traffic Fluctuation

(1) Hourly Variation of Traffic

Hourly variations of traffic at Kalankisthan on Tribhuvan Highway and at Singh Durbar in downtown area are given in Fig. 4.30 and 4.31. Traffic on these roads is rather uniformly distributed during the day time. Peak-hour of traffic lies during 9:00 - 10:00 in the morning and 17:00 - 18:00 in the evening at Kalankisthan. On the other hand, peak hour at Singh Durbar lies during 10:00 - 11:00 in the morning and 16:00 - 17:00 in the evening.

(2) Daily Variation of Traffic in the Week

The result of one-week traffic counts at Singh Durbar (B8) gives some information about daily variation of traffic in the week as shown in Fig. 4.32. Traffic is rather uniformly distributed throughout the week except for Saturday, that is a holiday in Nepal.

(3) Daylight Traffic Ratio

Daylight traffic ratios defined by 24-hour traffic versus 16-hour (6:00 - 22:00) traffic have been calculated based upon 24-hour traffic counts at Kalankisthan (B28) on Tribhuvan highway and at Singh Durbar (B8) in City center. The daylight traffic ratios on these two points are 103.1 and 101.1 respectively. The above figures suggest that roads in the Study area are rarely used during the night time, regardless of function of roads.

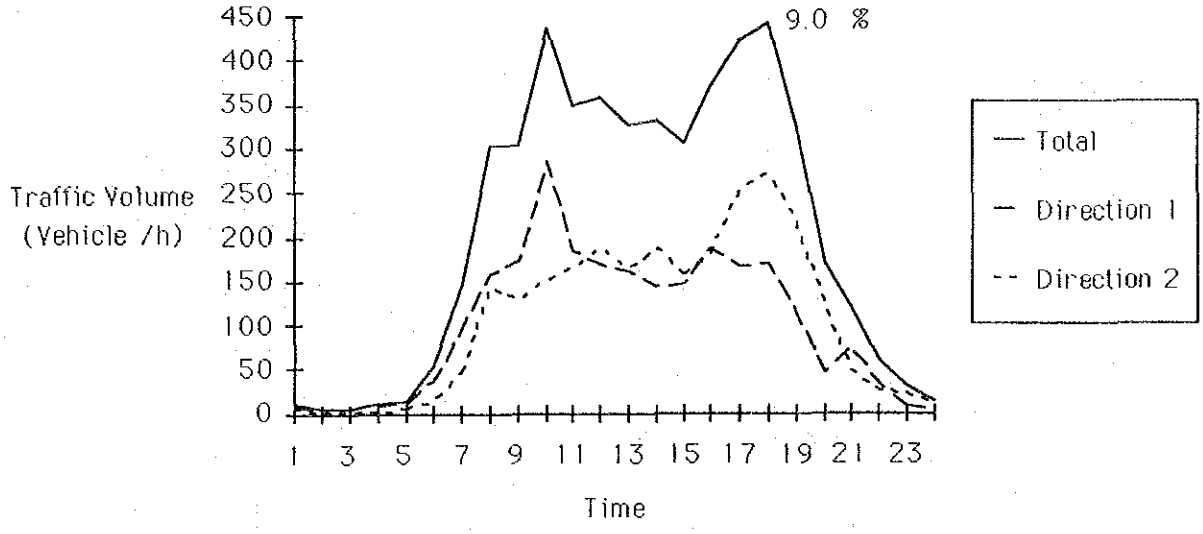


FIG. 4.30 HOURLY FLUCTUATION OF TRAFFIC (Kalankisthan, B8)

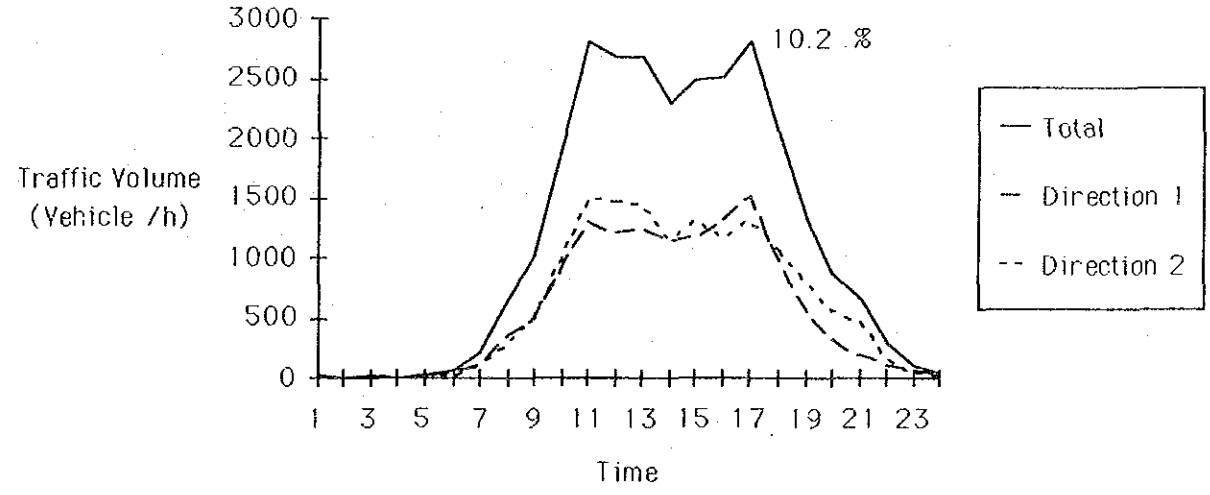


FIG. 4.31 HOURLY FLUCTUATION OF TRAFFIC (Singh Durbar, B28)

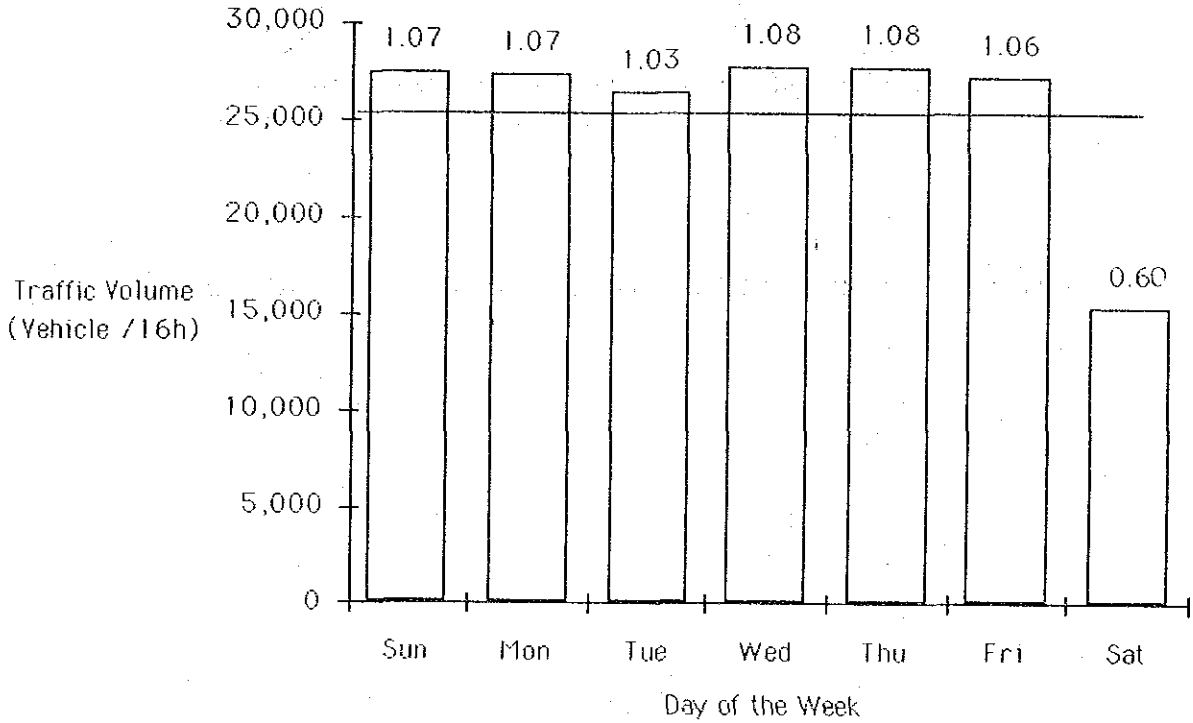


FIG. 4.32 DAILY VARIATION OF TRAFFIC IN THE WEEK (Singh Durbar, B28)

4.3.4 Traffic Distribution

Traffic distribution in terms of vehicle number in the Study area has been obtained through the integration of results of Person Trip Survey and Roadside OD Survey. The result is expressed in traffic desire line as shown in Fig. 4.33 and 4.34 and Table 4.10 and 4.11. The characteristics of traffic distribution are described as below:

- Total number of trips by vehicle in the Study area is about 340 thousand including bicycle of which about 100 thousands trips are those trips by public transport.

- The number of trips which have both trip ends within Kathmandu city is about 226 thousands which account for about 65% of the total trips while those trips which have both trip ends within the Lalitpur city and Bhaktapur city are as small as about 20 thousands and 4 thousands respectively.

- Strong concentration of traffic is seen in Kathmandu city due to inflow of traffic from other areas.
  Number of traffic which has either generating place or attraction in Kathmandu city is about 78 thousands of which major OD pairs are as follows:

  - Kathmandu City ⇔ Lalitpur City : 54 thousands
  - Kathmandu City ⇔ Kathmandu Rural : 13 thousands

- Almost same tendency is seen about public transport. Total number of traffic by public transport which has either generating place or attraction in Kathmandu city is about 22 thousands of which major OD pairs are as follows:

  - Kathmandu City ⇔ Lalitpur City : 15 thousands
  - Kathmandu City ⇔ Kathmandu Rural : 4 thousands
  - Kathmandu City ⇔ Bhaktapur City : 1 thousand

- There exists consolidated nature about the traffic flow within the area so called Greater Kathmandu while the traffic flows among Bhaktapur to Greater Kathmandu is relatively smaller.

FIG. 4.33 PRESENT TRAFFIC DESIRE LINE * (VEHICLE)
- TOTAL -

* Over 1,000 trips only

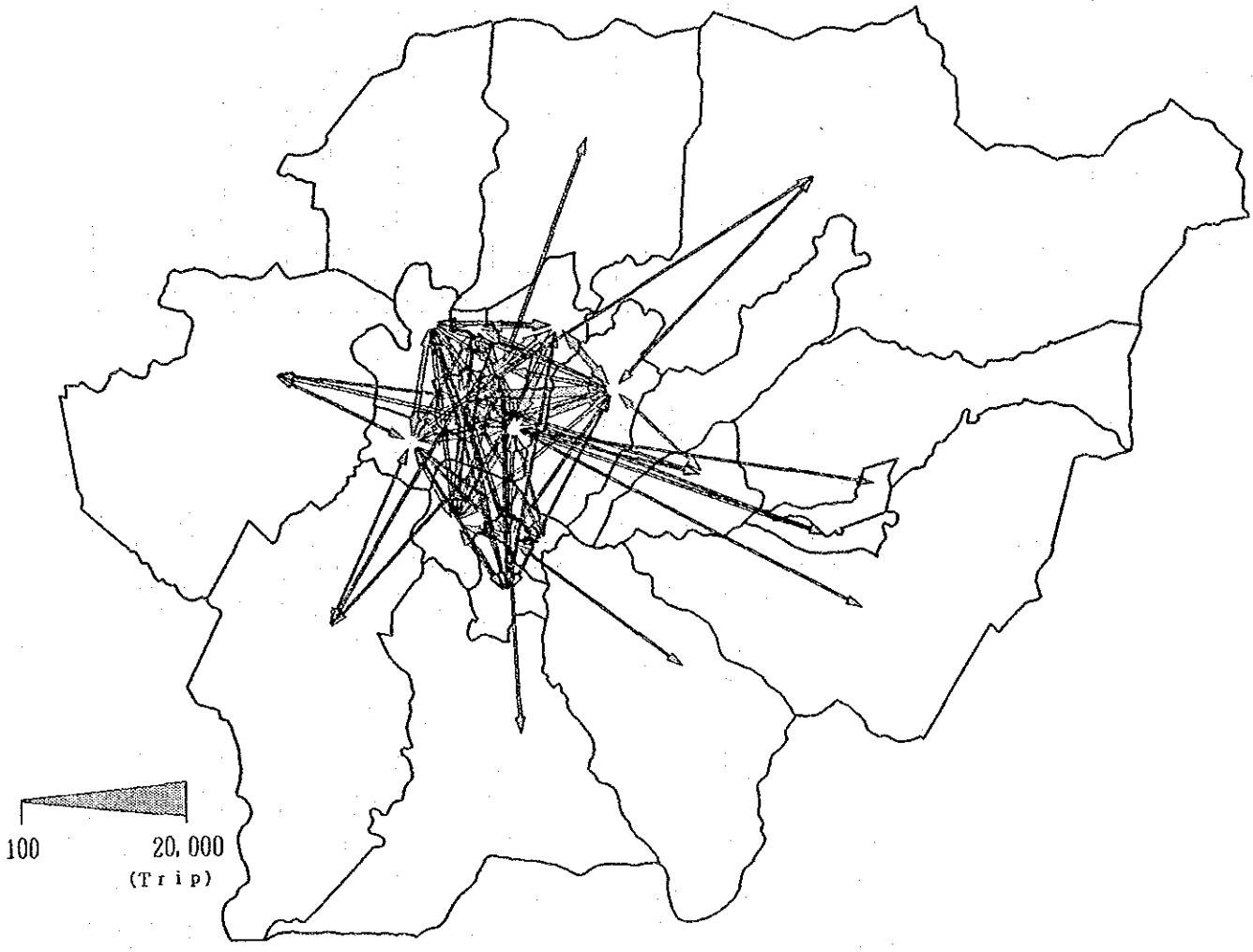


FIG. 4.34 PRESENT TRAFFIC DESIRE LINE (VEHICLE)
- PUBLIC TRANSPORT -

TABLE 4.10 TRAFFIC DISTRIBUTION
- TOTAL -

Unit : Vehicle

Destination Origin	Kathmandu City	Patan City	Bhaktapar City	Kathmandu rural	Lalitpur Rural	Bhaktapar Rural	Outside	Total
Kathmandu city	225,695	27,231	1,276	6,597	1,260	1,759	1,307	265,125
Patan city	26,909	20,192	164	569	2,511	305	130	50,780
Bhaktapar city	1,236	159	4,446	41	3	1,129	80	7,094
Kathmandu rural	6,403	523	62	954	55	69	37	8,103
Lalitpur rural	1,614	2,676	0	55	69	35	19	4,468
Bhaktapar rural	1,673	223	841	55	66	123	46	3,027
Outside	1,082	98	63	34	14	19	17	1,327
Total	264,612	51,102	6,852	8,305	3,978	3,439	1,636	339,924

TABLE 4.11 TRAFFIC DISTRIBUTION
- PUBLIC TRANSPORT -

Unit : Vehicle

Destination Origin	Kathmandu City	Patan City	Bhaktapar City	Kathmandu rural	Lalitpur Rural	Bhaktapar Rural	Outside	Total
Kathmandu city	74,477	7,769	506	2,036	165	437	470	85,860
Patan city	7,036	2,254	57	98	479	71	18	10,013
Bhaktapar city	523	54	229	6	0	83	13	908
Kathmandu rural	1,788	58	6	84	4	15	0	1,955
Lalitpur rural	89	487	0	4	3	2	2	587
Bhaktapar rural	364	35	83	6	7	8	8	511
Outside	418	12	9	7	0	2	0	448
Total	84,695	10,669	890	2,241	658	618	511	100,282

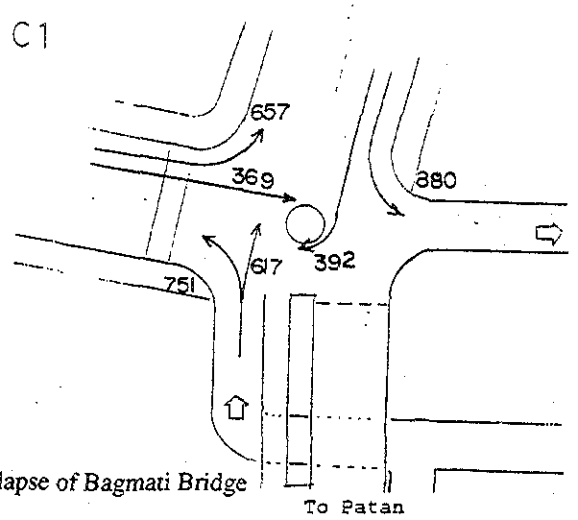
4.3.5 Intersection Traffic

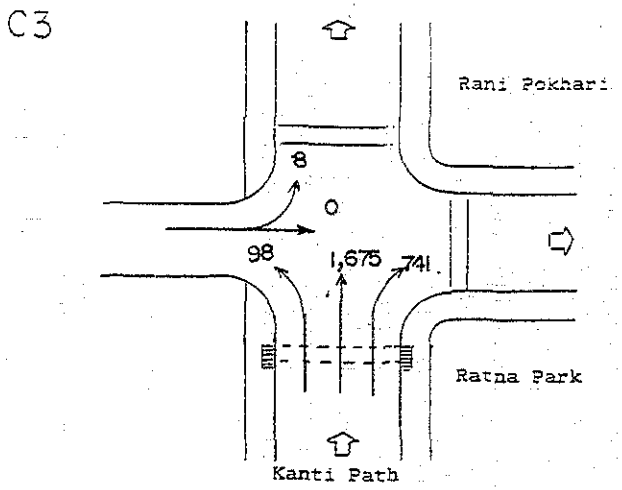
The results of traffic counts at major intersections in the central area are given by direction in Fig. 4.35 and 4.36 while the traffic volumes around these intersections are given in Fig. 4.37 and 4.38. Traffic volumes differ by direction and by junction. Maximum hourly entry traffic has been recorded at Maitighar junction (4822 vehicles : 10:00 - 11:00) while the minimum hourly entry traffic at Bhotahiti junction (2522 vehicles : 10:00 - 11:00). It seems some of the lanes at junctions are almost at saturation level. Peak-hour of traffic at these junctions lies 10:00 - 11:00 in the morning and 16:00 - 17:00 in the afternoon. Degree of saturation for each of the intersection are calculated as shown in Table 4.12 along with the information about traffic accident nearby these intersections. These information suggest the urgency of improvement works of capacity enhancement at such intersections as Thapathali (C1), Keshar Mahal (C4), Durbar Marg (C5) and Maitighar (C8).

TABLE 4.12 DEGREE OF SATURATION AT INTERSECTION

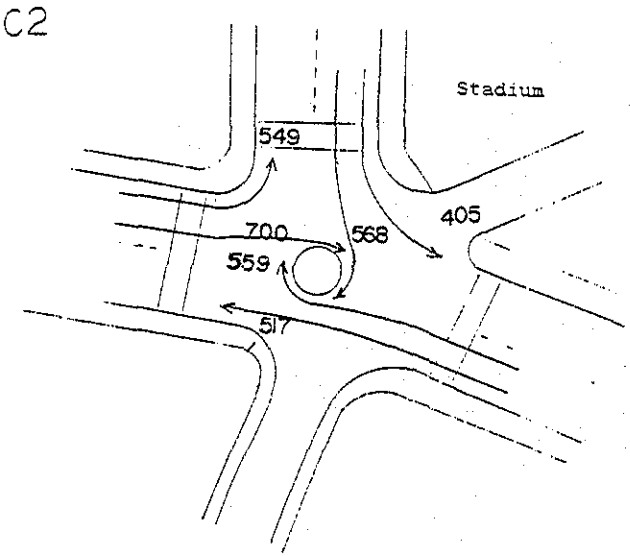
No. of Inter-section	Name of Inter-section	Type of Intersection		Degree of Saturation		Traffic Congestion	Traffic Accidents
		Signal Control	Rotary Control	Morning 10:00-11:00	Evening 16:00-17:00		
C1	Thapathali	X	X	1.37	1.29	XX	XX
C2	Tripureswar		X	0.74 - 0.86	0.74 - 0.84	X	
C3	Bhotahiti			0.75	0.83		
C4	Keshar Mahal	X	X	1.02	1.29	XX	
C5	Durbar Marg		X	0.95 - 1.02	0.85 - 1.01	XX	
C6	Putali Sadak	X		0.59	0.60		XX
C7	Singh Durbar	X	X	0.89	0.76	X	XX
C8	Maitighar		X	0.73 - 1.10	0.89 - 1.13	XX	XX

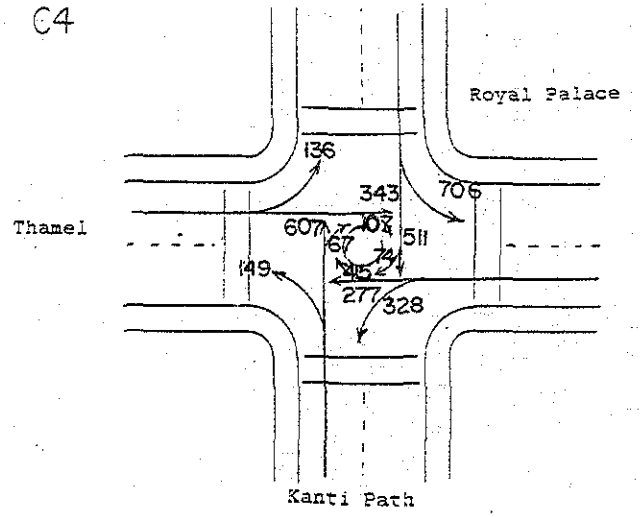
XX : Serious
X : Considerable





In the condition of collapse of Bagmati Bridge
(Refer Appendix 8-2)





Unit:Vehicles/h
(Excluding Bicycle)

FIG. 4.35(1) TRAFFIC VOLUME BY DIRECTION (10:00 - 11:00)

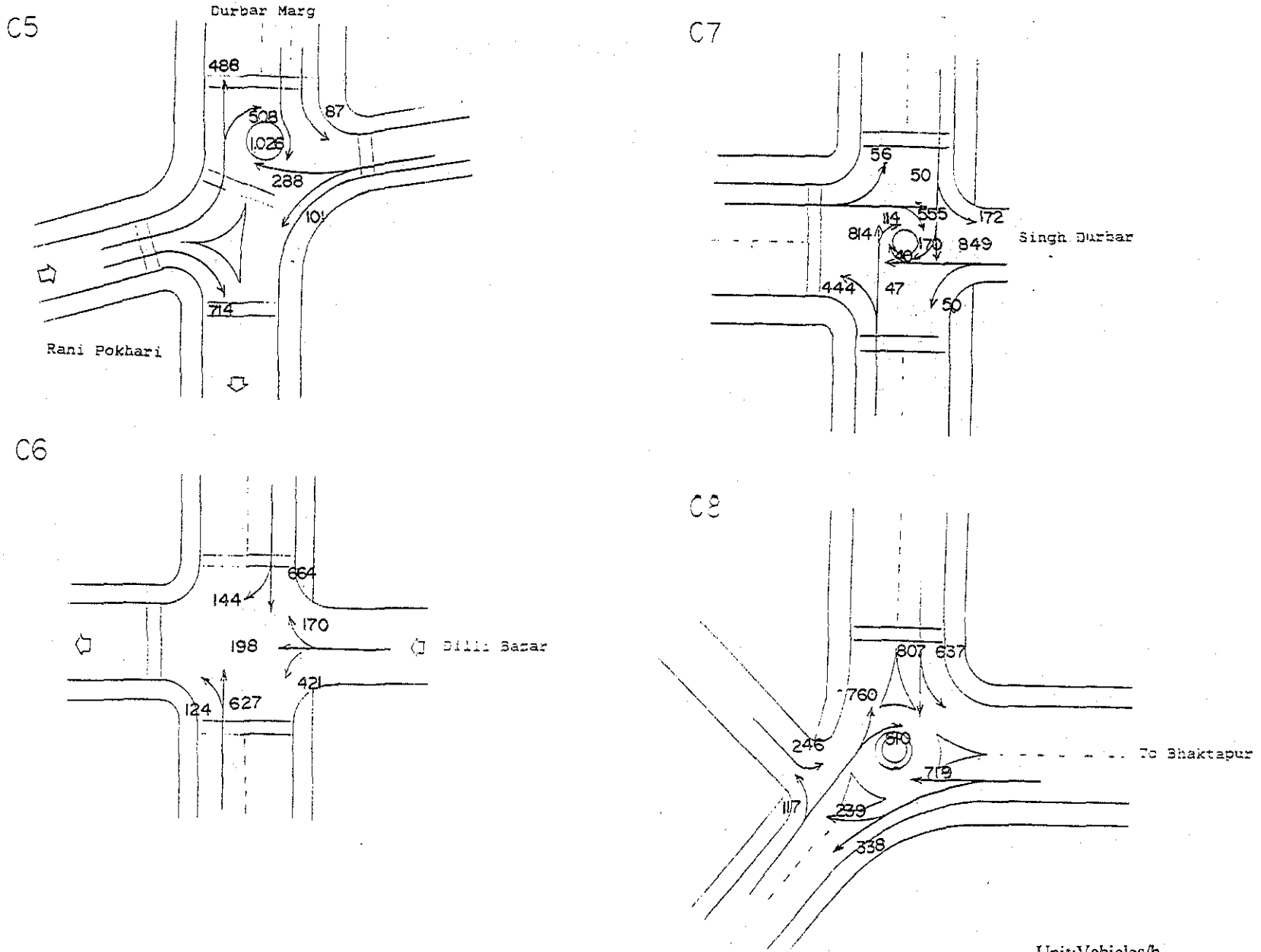
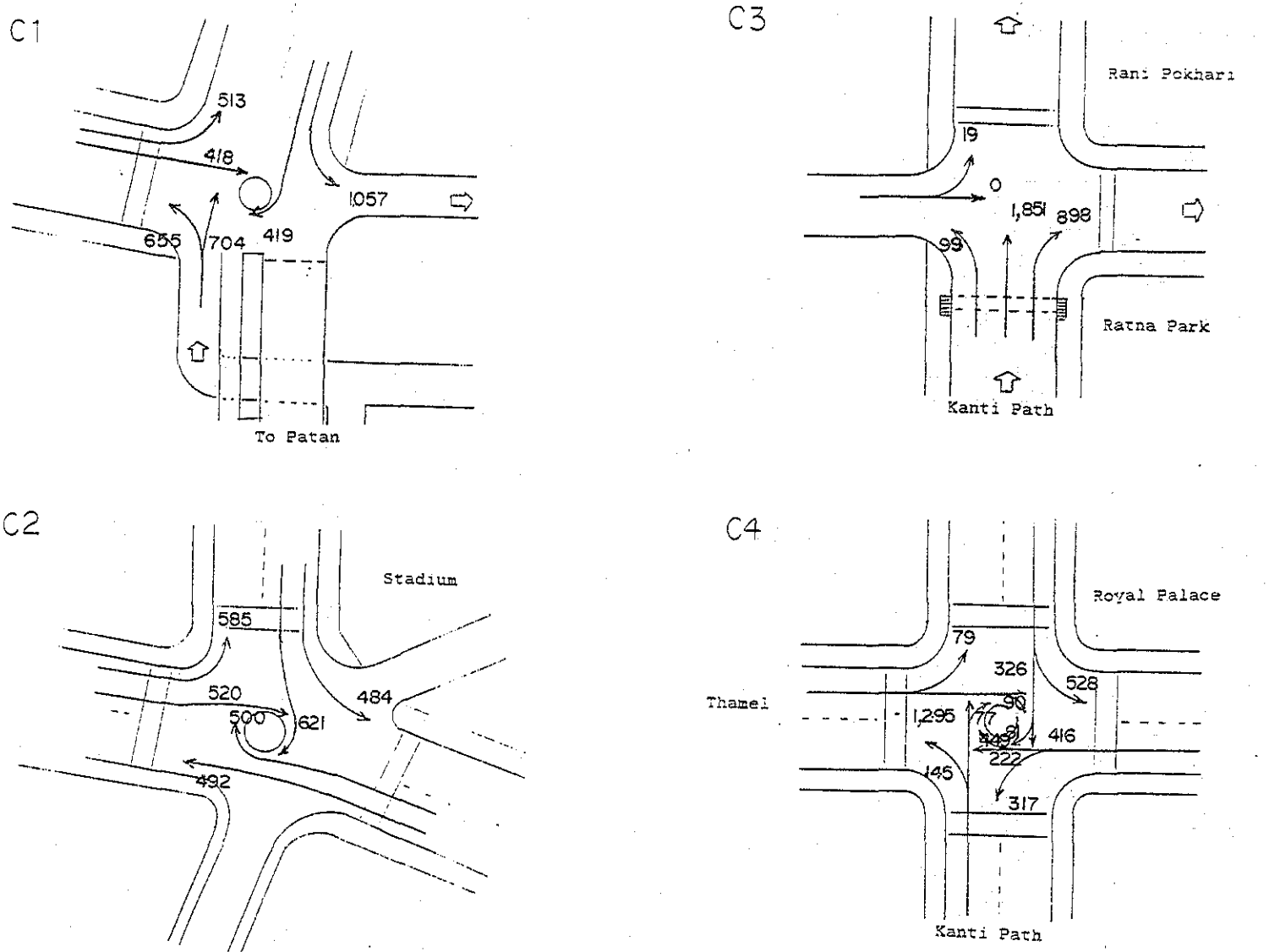


FIG. 4.35(2) TRAFFIC VOLUME BY DIRECTION (10:00 - 11:00)
(CONTINUED)

Unit:Vehicles/h
(Excluding Bicycle)



Unit:Vehicles/h
(Excluding Bicycle)

FIG. 4.36(1) TRAFFIC VOLUME BY DIRECTION (16:00 - 17:00)

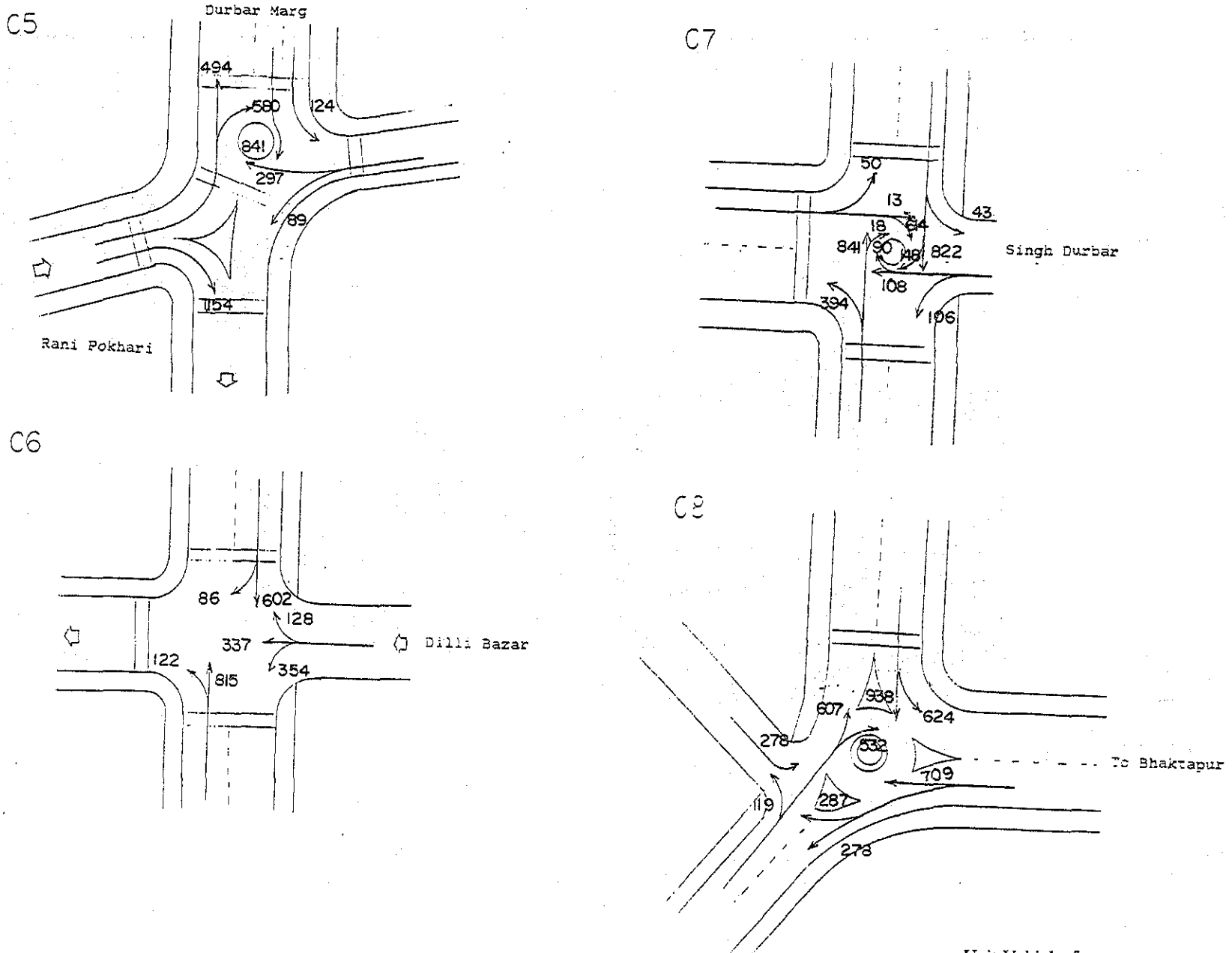
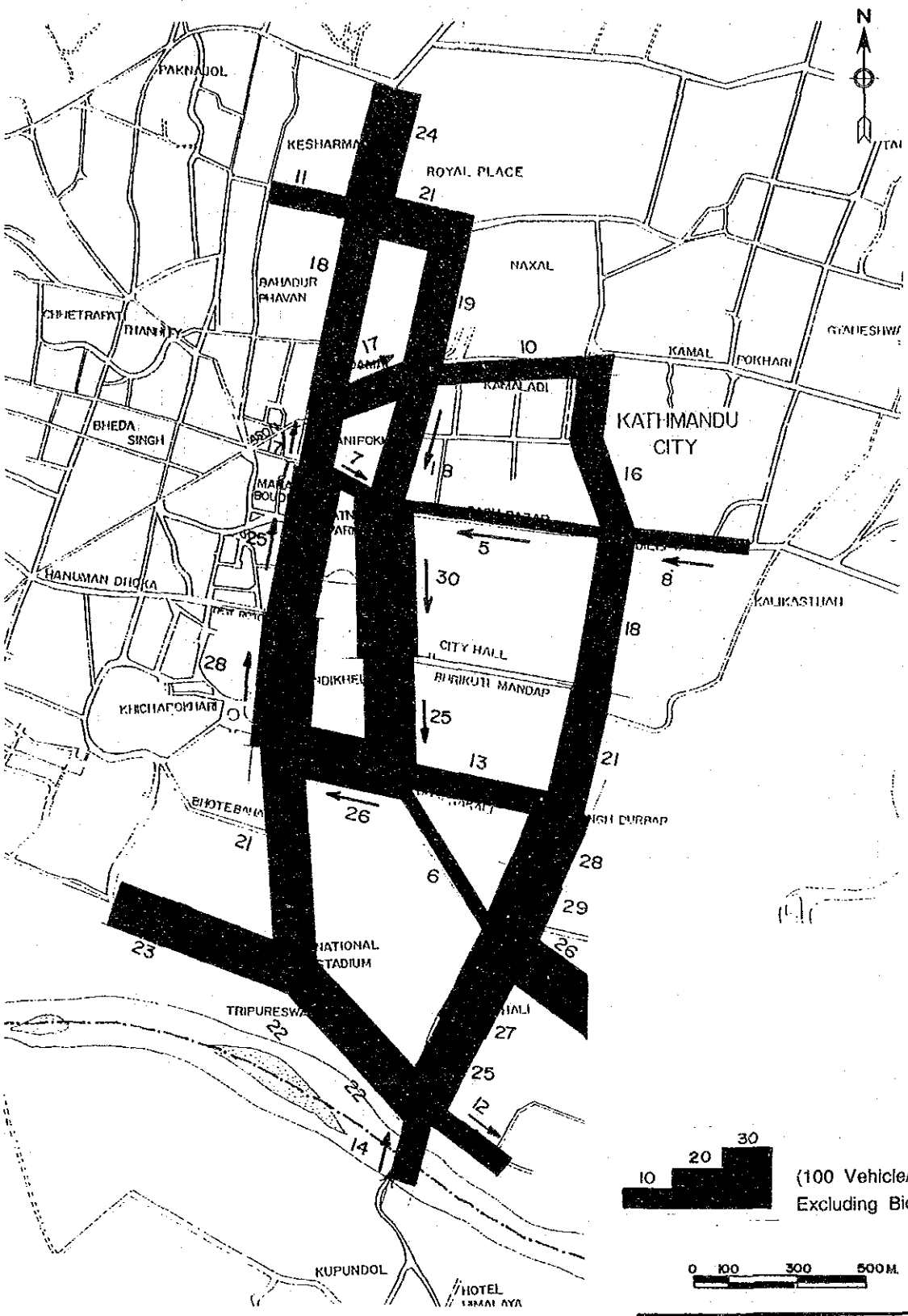
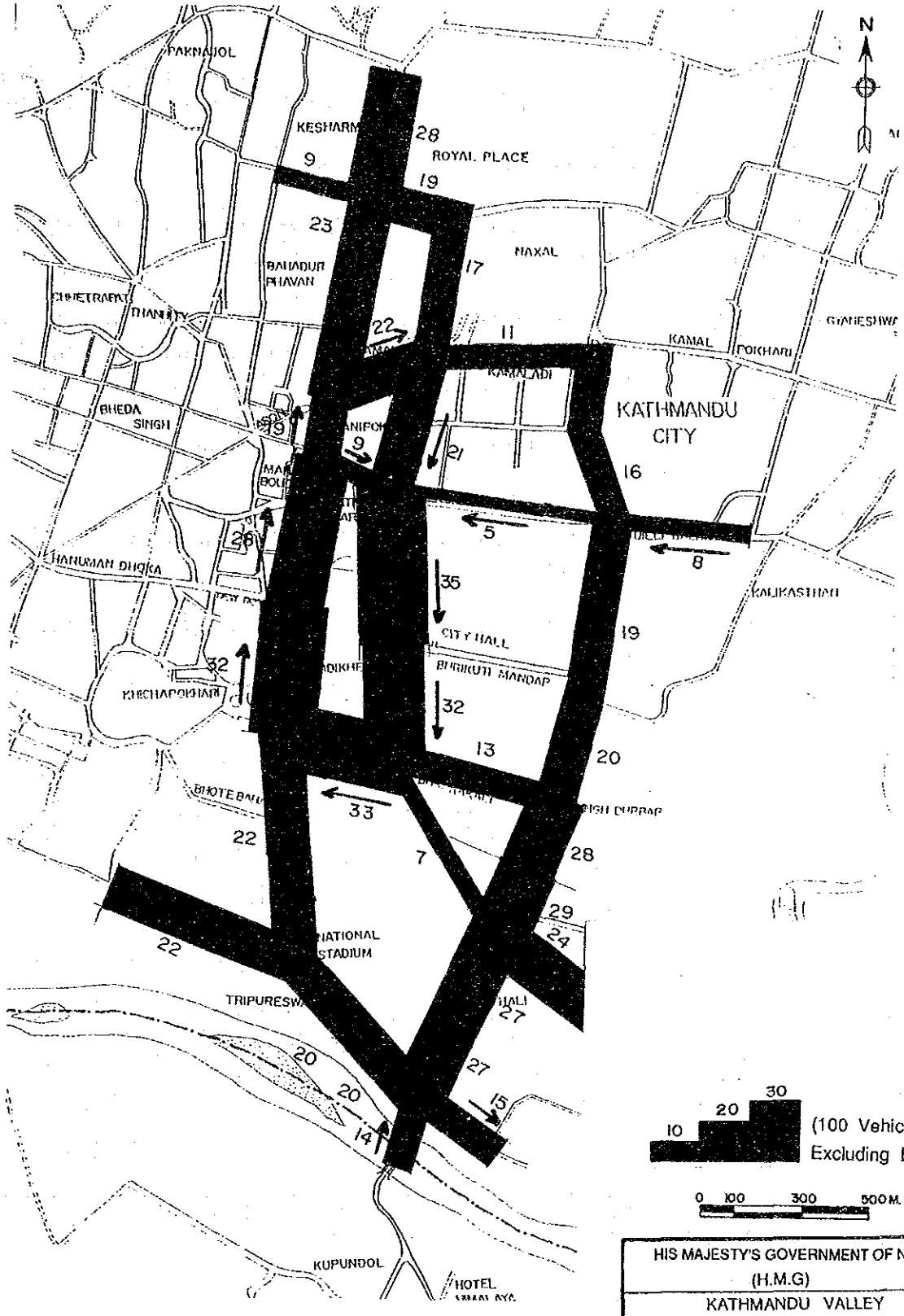


FIG. 4.36(2) TRAFFIC VOLUME BY DIRECTION (16:00 - 17:00)
(CONTINUED)

Unit:Vehicles/h
(Excluding Bicycle)



HIS MAJESTY'S GOVERNMENT OF NEPAL (H.M.G)
KATHMANDU VALLEY URBAN ROAD DEVELOPMENT
TRAFFIC VOLUME IN CORE AREA (10:00 - 11:00)
FIG. 4.37
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



HIS MAJESTY'S GOVERNMENT OF NEPAL (H.M.G)
KATHMANDU VALLEY URBAN ROAD DEVELOPMENT TRAFFIC VOLUME IN CORE AREA (16:00 - 17:00)
FIG. 4.38
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

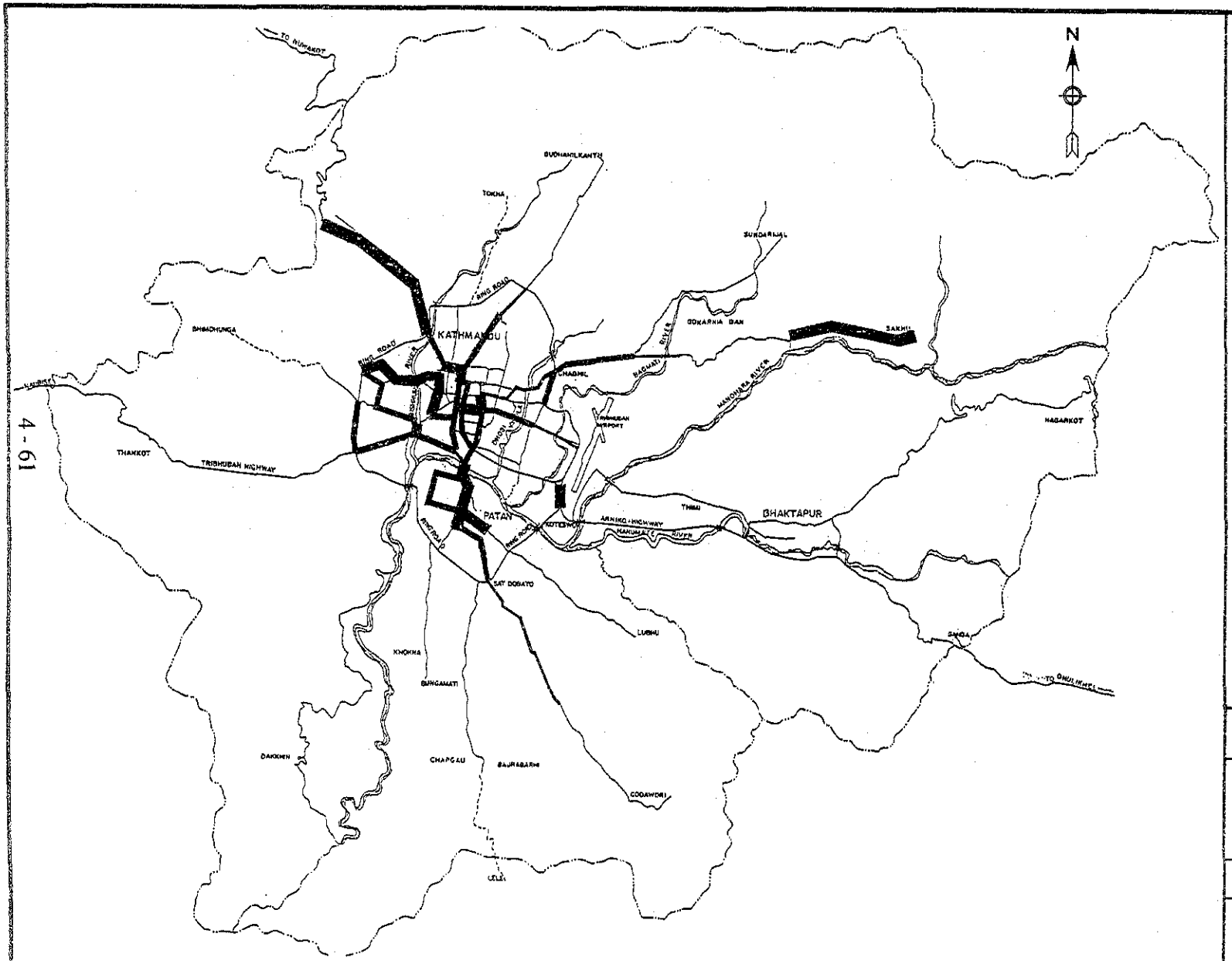
4.3.6 Vehicle Speeds

Average vehicle speeds on major roads are measured as shown in Table 4.13 and Fig. 4.39. Characteristics of vehicle speeds by type of road are described as below:

- Average vehicle speeds differ by road geometry,
- Average vehicle speeds tend to decrease with the increase in traffic. Mixing of traffic is another reason for slow-down of vehicle speed,
- About 40 km/h of vehicle speed has been recorded on the section of the Ring Road except for such congested areas as Koteswar and Chabahil where roadsides are used for parking,
- About 40 km/h of vehicle speed has been attained on the section between the Ring Road and section on Arniko Highway,
- Average vehicle speed on Tribhuvan Highway is about 25 km/h because of narrow carriageway of this road, and
- On most of the roads in the area within the Ring Road, average vehicle speed is about 20 km/h.

TABLE 4.13 AVERAGE VEHICLE SPEED

Type of Road	Name of Road	Average Vehicle Speed (km/h)	Main Reason for Slow-down of Vehicle Speed
Highway	Tribhuvan Highway (city area)	26	Narrow carriageway
	Arniko Highway	45	
Feeder Road	Trisuli Road	13	Road geometry
District Road	Sankhu Road	20	Road geometry
Ring Road	near Koteswar	18	Roadside parking
	near Chabahil	24	Roadside parking
	near Kalankisthan	25	Roadside parking
	other section	40 - 55	
City Road		around 20	Mixing of traffic



4-61

LEGEND

- Vehicle Speed < 20 km/h (Average)
- Vehicle Speed < 30 km/h (Average)
- Vehicle Speed < 30 km/h (Peak Hour)

0 50 100 200 400 k m

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

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT

VEHICLE SPEED

FIG. 4.39

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

CHAPTER 5

FORMULATION OF URBAN AND TRANSPORTATION DEVELOPMENT STRATEGIES

5. FORMULATION OF URBAN AND TRANSPORTATION DEVELOPMENT STRATEGIES

5.1 Urban Development Strategies

5.1.1 Urban Development Strategies

For the formulation of integrated road development master plan, it is inevitable to formulate urban development strategies in consistent manner with those of ever proposed in related studies. Especially, the KVUDPP Study which was completed by ADB in 1991, has almost same objectives and goals as this Study. Therefore, first of all, their vision towards the future urban development and development strategies proposed have to be reviewed.

Regarding urban land-use policy, KVUDPP Study proposed the so called "Least Intervention Concept" through the comparison of three (3) different options relative to the stances for urban development as explained hereunder.

Option 1 Satellite town

This is a concept to create satellite towns in the suburban area of Greater Kathmandu. This concept entails the policy of segregation of working and living places to some extent and requires strong intervention from public sector. However, considering the nature of urban development pattern in the Study area, in which mixing of land uses are prevailing everywhere due mainly to the residents' tendency of seeking of residence in the proximity of working places. Furthermore, this concept involves great investment in transportation sector.

Option 2 Growth Corridors

This is a concept which direct urban area to certain direction. From the past tendency of expansion of the urban area, in which expansion has proceeded in concentric manner, it seems rather difficult to reverse this trend. It is a natural tendency that Greater Kathmandu would expand to the east along the Kathmandu - Bhaktapur corridor. However it seems not practical to direct all the development exclusively in this direction.

Option 3 Continuation of prevailing trends with least intervention

This concept should be defined as continuation of existing trend under the necessary monitoring methods. This is a concept of leading the expansion of urban area in accordance with the dynamism of development with minimal level of intervention which includes,

- Urban expansion in the area where the provision of infrastructure is sufficient is to be encouraged,

- Urban expansion in the area where the introduction of new infrastructure is costly is to be discouraged,

- Urban expansion to the prime agricultural area should be discouraged,

- Urban expansion or location of new urban facilities coordinated with economic principle should not be discouraged,

- External diseconomy to any of the newly developed area is to be minimized, and

- Environmental impact of new development is to be minimized.

Through the comparison of the above three (3) Options, KVUDPP Study has assumed Option 3 in its formulation of urban development strategy due to the following reasons:

- Dynamism of urban economy should not be hampered,

- The developing process of the area is too rapid to direct it to specific pattern, and

- Cost for intervention is smallest.

5.1.2 Future Urban Trend

Prevailing tendency of urban development is considered as the most appropriate criteria for the estimation of future urban trend. With all the planned guidance of land use by agency concerned, existing trend of urban expansion would continue within foreseeable future. This will be proceeded such that:

- Expansion of the urban area will proceed revolving around the two core cities in Kathmandu Valley,

- The city of Bhaktapur will be completely combined with Greater Kathmandu due to inclination of expansion of the urban area along the east-west corridor of the Valley,

- Due to geographical constraint, western part of Greater Kathmandu will remain undeveloped within foreseeable future. Especially, the area located in the north of Tribhuvan Highway will be difficult to be urbanized,

- With the expected population increase in the urban area, urbanization will be proceeded along the most of the radial roads. Starfish shaped urban area will be formed centered around the city centers of Kathmandu and Lalitpur (Patan),

- The city of Bhaktapur, which has long been isolated from the Greater Kathmandu will be exposed to the wave of urbanization and will become one of the cores of urban area in Kathmandu Valley, and the city itself would expand its urban area, and

- With the further population increase, the agricultural area in between the legs of starfish shaped urban area will be exposed to the urbanization. This would result in outward shift of Greater Kathmandu.

The above trend is illustrated in Fig. 5.1

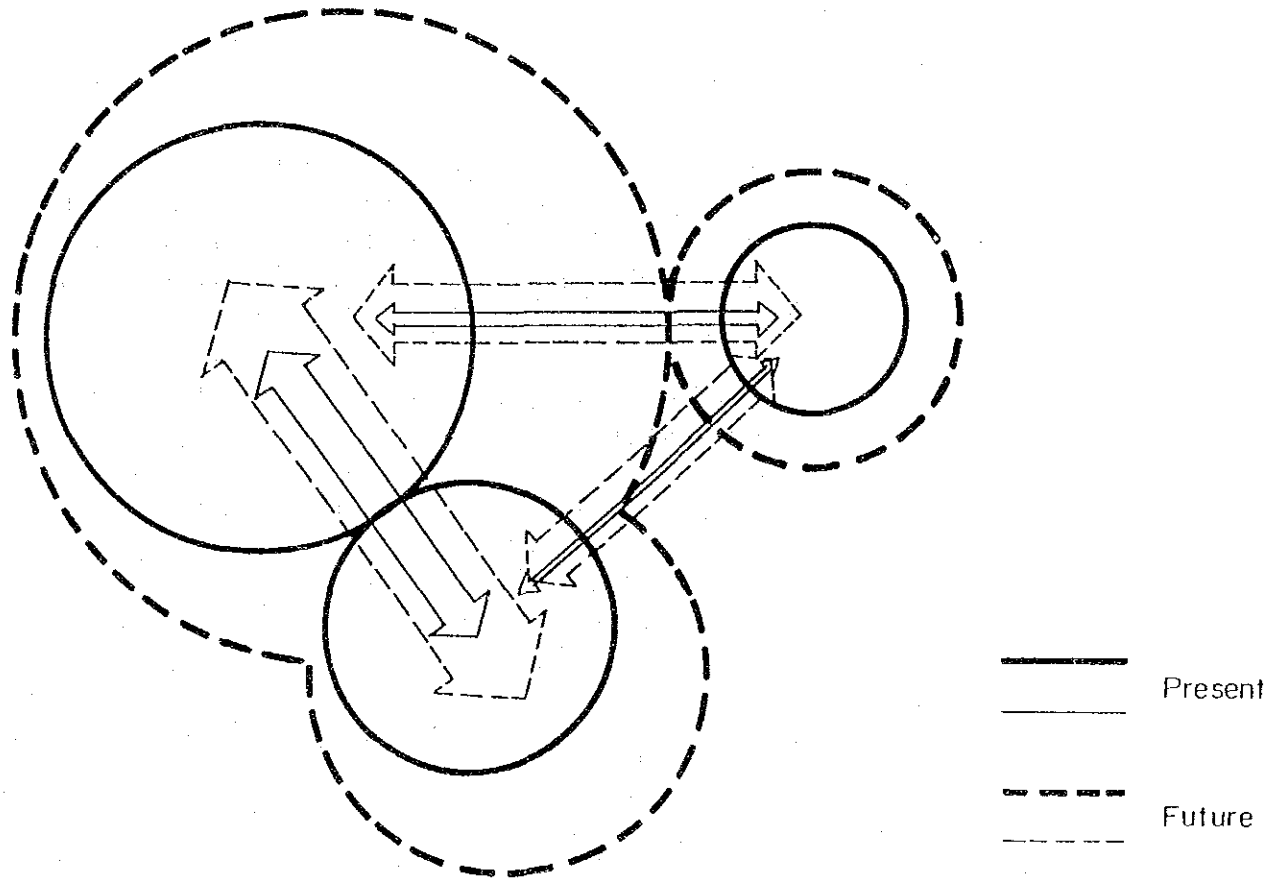


FIG. 5. 1 FUTURE URBAN TREND

5.1.3 Strategy for Urban Development

(1) Expansion of Urban Area

In the context of above option of future urban development, KVUDPP Study proposed the process of urban expansion as shown in Fig. 5.2 Urban area is expected to almost reach urban expansion boundary set up by DHUD in the beginning of 21st century. The expansions of urban area for the years of 1997 and 2015, which are the target years of this Study, have been estimated as shown in Fig. 5.3. Urban area which is estimated at about 550 ha and 1,160 ha for the year of 1997 and 2015 respectively which are 1.4 times and 2.1 times of that of urban area in 1991.

(2) Land-use in Urban Area

1) Land-use in Urban Area

KVUDPP Study has not made detailed mention as to land-use for every sub-divisions of land in urban area. However, in line with the urban expansion as explained above, existing land-use pattern, which is characterized by its disorderliness with no distinction among different land-uses, is to be proposed as to be improved for better one.

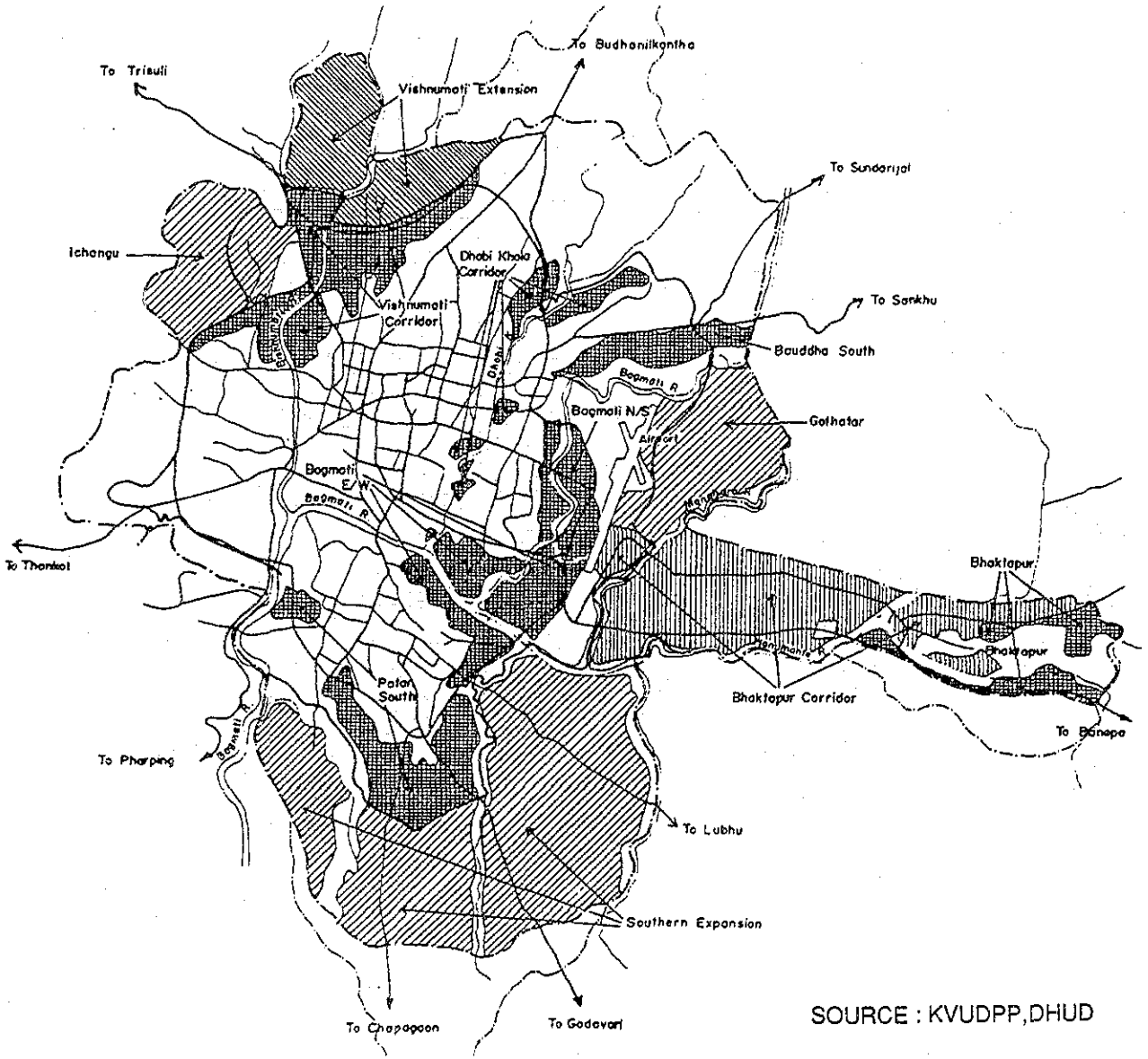
The Study team has analyzed about probable land-use for every sub-division of urban area standing on the following assumption:

- Classification of land-use will become more distinct in which specialization in specific land-use will be promoted,

- Existing characteristics in land-use by each sub-division of area will be preserved in which central area will remain as the center of commercial and business activities while more manufacturing land-use will take place in the area surrounding central and sub-urban areas, and

- Urban fringes will be predominantly used for residential purposes and some educational institutions.

The outline of land-use is illustrated in Fig. 5.4.



SOURCE : KVUDPP,DHUD

LEGEND

- Municipality Boundary
- Urban Expansion Area
- River & Stream
- Major Road
- Minor Road

GENERAL PRIORITY, SEQUENCE (1)

- 1991 onwards
- 1996 onwards
- 2001 onwards
- 2006 onwards
- Later
- DHUD Addition to Expansion Area

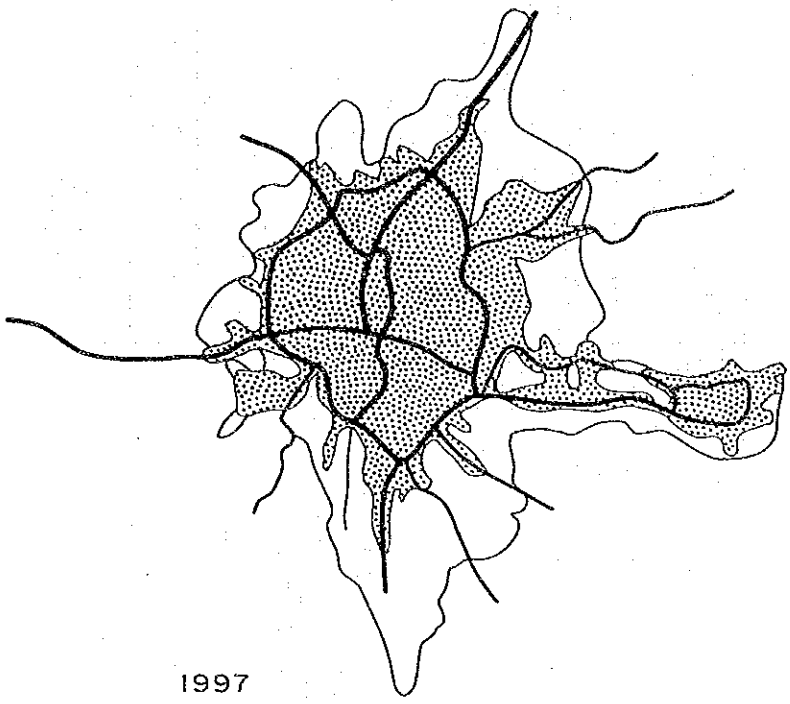
(1) Priority timing to be monitored and reviewed frequently

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

KATHMANDU VALLEY URBAN ROAD DEVELOPMENT ACCELERATED DEVELOPMENT AREAS

FIG. 5.2

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



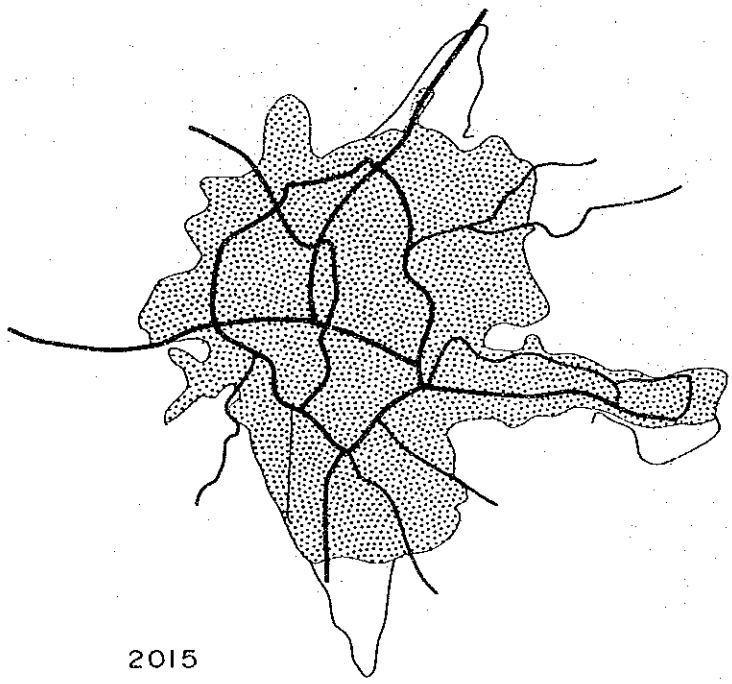
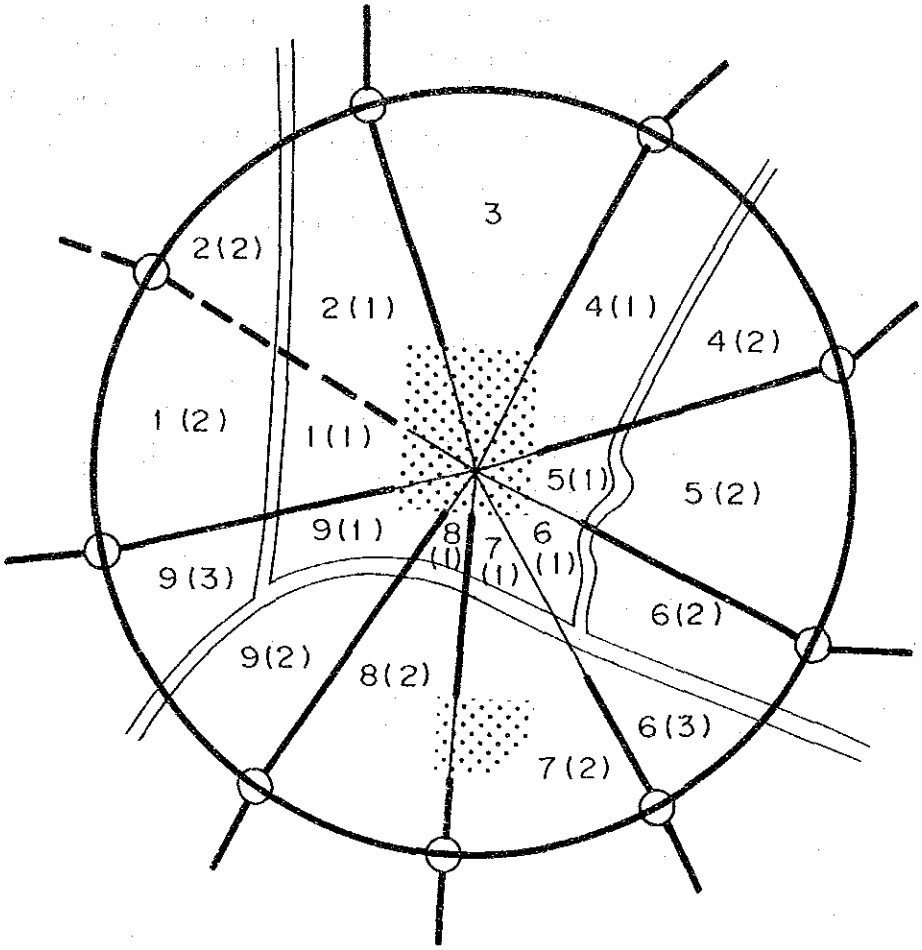


FIG.5.3 EXPANSION OF URBAN AREA



Land-use	Sub-division of Urban Area
Residential	1(1), 1(2), 5(2), 6(1), 7(1), 7(2), 8(2), 9(1)
Commercial	8(1), 9(3)
Industrial	2(1), 2(2), 3, 4(2), 6(2), 6(3)
Governmental / Institutional	4(1), 5(1), 9(2)

City Center ○ Potential Junction

FIG. 5.4 OUTLINE OF LAND-USE IN URBAN AREA

2) Prospect of Land-use Density

The tendency of intensive land-use pattern in the urban core will continue as well as that of less intensive land-use pattern spreading in the outskirts of urban area. However, it is not realistic to assume that further concentration will take place in the urban core. Population density in urban core is deemed to have already reached its saturation level which has brought about following diseconomies:

- Slumming of the central area,
- Shortage of available infrastructure,
- Shortage of land, and
- High land prices.

As to areas surrounding urban core the density will increase at considerably higher rates while in the newly urbanized areas the increasing rate will remain lower due to availability of land. The above tendency is illustrated in Fig. 5.5.

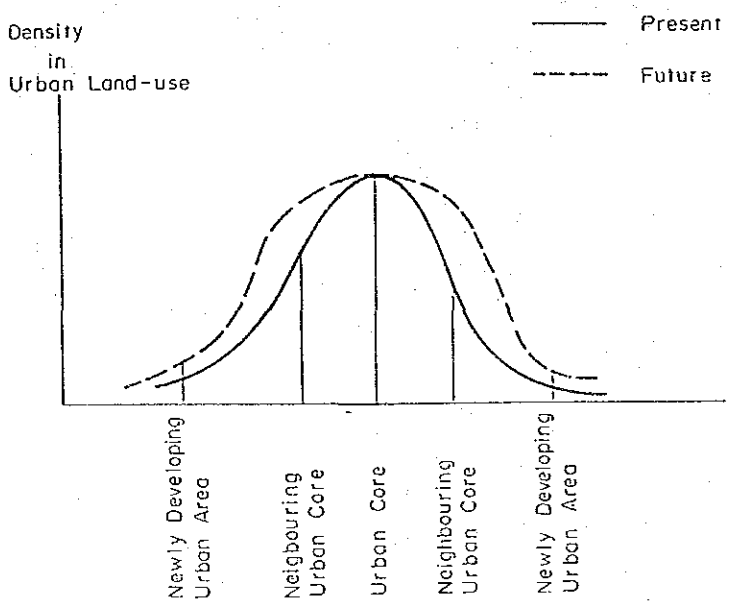
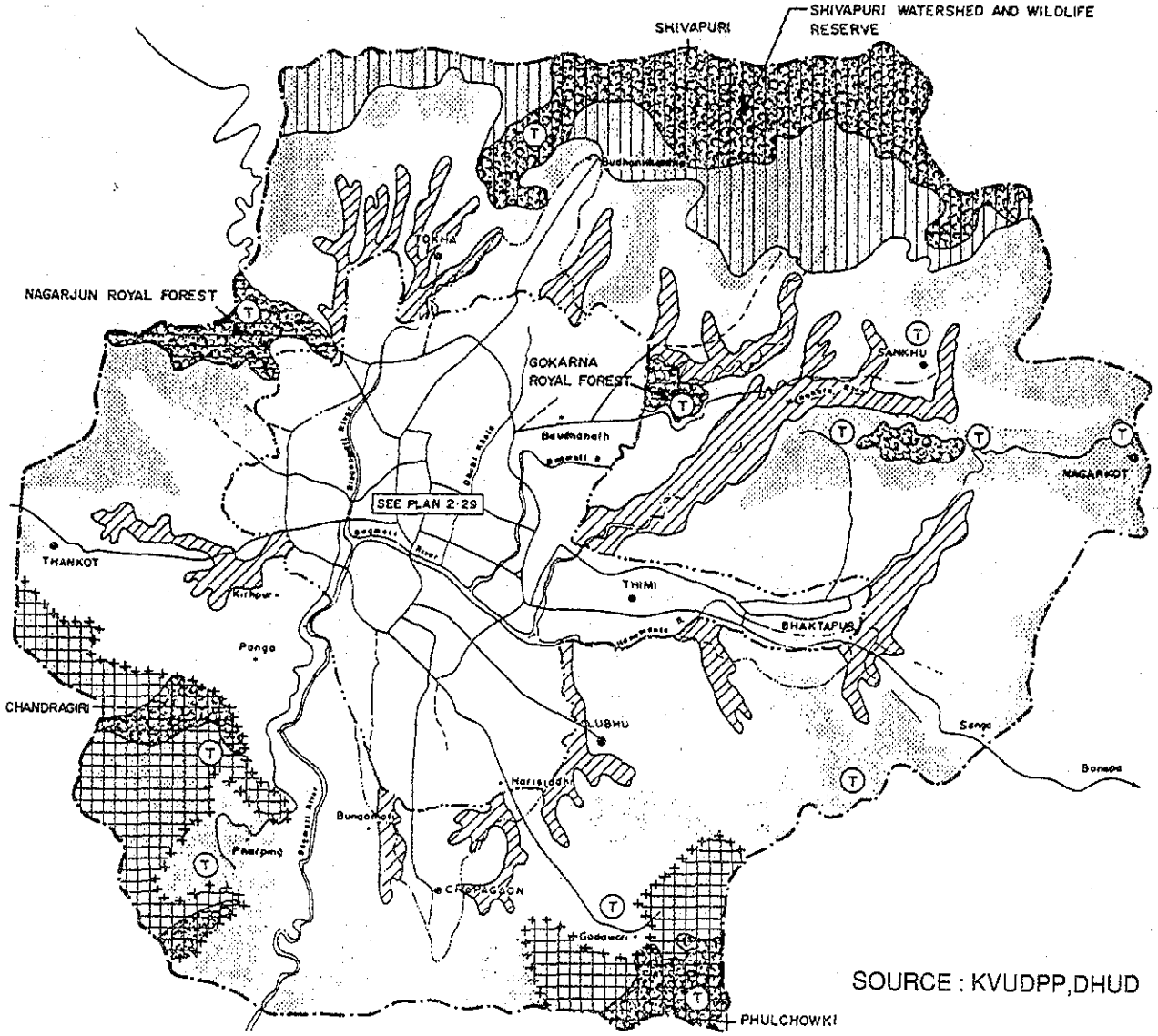


FIG. 5.5 PROSPECT OF LAND-USE DENSITY

(3) Land-use in Rural Area

Land-use development in rural area should be controlled at minimum level for the protection of further deterioration of ecology in the Valley. KVUDPP Study also has proposed minimum development concept except for development of tourist spots as shown in Fig. 5.6. Haphazard urban sprawl should be controlled in this area for the protection of watershed and wild life as well as agricultural lands. Orderly and well planned development is strongly recommended in this area.



LEGEND

- Study Area Boundary
- Roads (Surfaced)
- Roads (Unsurfaced)
- Rivers & Streams
- Hills
- Urban Expansion Area

EXISTING LAND USE CONTROLS

- Royal Forests
- Watershed and Wildlife Reserves

PROPOSED LAND USE CONTROLS

- No Development of Flood Plains
- Watershed and Wildlife Reserves

PERMITTED USES

- Tourism / Recreation (T)
- DHUD Addition to Expansion

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

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
LAND USE PLAN
FOR RURAL DEVELOPMENT

FIG. 5.6

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

5.1.4 Identification of Land-use Potential

(1) Introduction

For the understanding of inclination and intensity of future land-use, land-use potential has been analyzed based on existing information about present land-use and population density in the potential urban area. Identification of land-use potential has been done through the application of "allowable population density" which is deemed maximum population density to control further congestion. Traffic zone-wise areas by land-use classification are obtained by the land-use map prepared by KVUDPP Study as shown in Table 5.1.

(2) Methodology

(a) Allowable Population Density

Allowable population densities are set up as below:

Core Area	:	850 / ha *	(In the case where high density residential development is allowed)
Residential Area	:	170 / ha	

(b) Maximum Population Size by Traffic Zone

Maximum population size by traffic zone has been estimated through the following formula:

Maximum Population Size
= Area of Residential Area × Allowable Population Density

(c) Identification of Land - use Potential in terms of Residential Development

Land-use potential by traffic zone has been identified simply through the comparison of present population size and theoretical allowable population obtained above. The result is given in Table 5.2 .

(d) Identification of Land-use Potential in terms of Size of Available Land

Besides the above, land-use potential has been identified through the absolute size of vacant land applying following criteria:

Area with least development potential: Size of vacant land: 0 ha
Area with some development potential : Size of vacant land: 0 ~ 50 ha
Area with enough development potential : Size of vacant land: over 50 ha

---

* Set up from population densities in zone 114 and 115 most of which parts are composed of core area.

TABLE 5.1 SIZE OF AREAS BY CLASSIFICATION OF LAND-USE AND BY TRAFFIC ZONE

Zone No.	Area	Land Use (ha)						
	(ha)	Core	Residential	Vacant	Transport	Industrial	Institutional	Forest
101	119	0	71	0	0	0	48	0
102	82	0	74	8	0	0	0	0
103	631	0	360	189	0	0	63	19
104	75	0	60	11	0	0	4	0
105	578	0	376	202	0	0	0	0
106	498	0	149	75	224	0	0	50
107	360	0	198	126	11	0	25	0
108	173	0	87	10	0	0	52	24
109	67	23	34	10	0	0	0	0
110	409	0	327	82	0	0	0	0
111	435	0	165	178	0	0	52	39
112	469	23	225	117	0	70	0	33
113	80	64	0	16	0	0	0	0
114	76	61	0	8	0	0	8	0
115	29	20	0	0	0	0	9	0
116	175	18	96	40	0	0	21	0
117	102	0	56	0	5	0	10	31
118	216	0	140	0	0	0	76	0
201	421	0	240	122	8	0	51	0
202	267	0	160	53	0	0	45	8
203	274	0	175	175	0	28	81	14
204	248	37	62	124	0	12	12	0
205	44	35	9	0	0	0	0	0
206	48	24	24	0	0	0	0	0

TABLE 5.2 COMPARISON OF ACTUAL AND MAXIMUM POPULATIONS

Zone No.	Pop. 1991 <A>	Max. Pop. Residential (170/ha) <B>	<C> = <A> - <B> (ha)	Max. Pop. Core Area * (850/ha) <D>	<E> = <C> - <D>	Max. Pop. Core Area (170/ha) <F>	<G> = <C> - <F>
101	6,691	12,138	-5,447	0	-5,447	0	-5,447
102	8,288	12,546	-4,258	0	-4,258	0	-4,258
103	29,749	61,144	-31,395	0	-31,395	0	-31,395
104	8,592	10,200	-1,608	0	-1,608	0	-1,608
105	37,380	63,689	-26,309	0	-26,309	0	-26,309
106	24,831	25,398	-567	0	-567	0	-567
107	41,213	33,660	7,553	0	7,553	0	7,553
108	9,983	14,705	-4,722	0	-4,722	0	-4,722
109	20,329	5,695	14,634	19,933	-5,299	3,987	10,647
110	30,074	55,624	-25,550	0	-25,550	0	-25,550
111	19,491	28,101	-8,610	0	-8,610	0	-8,610
112	20,281	38,270	-17,989	19,933	-37,922	3,987	-21,976
113	28,813	0	28,813	54,400	-25,587	10,880	17,933
114	45,330	0	45,330	51,680	-6,350	10,336	34,994
115	19,190	0	19,190	17,255	1,935	3,451	15,739
116	19,208	16,363	2,845	14,875	-12,030	2,975	-130
117	12,753	9,537	3,216	0	3,216	0	3,216
118	32,068	23,868	8,200	0	8,200	0	8,200
201	25,925	40,795	-14,870	0	-14,870	0	-14,870
202	11,757	27,234	-15,477	0	-15,477	0	-15,477
203	15,300	29,815	-14,515	0	-14,515	0	-14,515
204	28,019	10,540	17,479	31,620	-14,141	6,324	11,155
205	15,856	1,496	14,360	29,920	-15,560	5,984	8,376
206	20,346	4,080	16,266	20,400	-4,134	4,080	12,186

* In the case where high density residential development is allowed in the core area.

(3) Evaluation

From the above, following results have been obtained:

(a) Identification of land-use potential in terms of residential development

R_1 : Traffic zones with no possible development potential: 107, 115, 117, 118

R_2 : Traffic zones with some development potential on the condition that high density land-use policy is applied : 109, 113, 114, 204, 205, 206

R_3 : Traffic zones with some development potential :
102, 104, 106, 108

R_4 : Traffic zones with sufficient development potential :
101, 103, 105, 110, 111, 112, 116, 201, 202, 203

(b) Identification of land-use potential in terms of the size of vacant land

V_1: Traffic zones with no possible development potential :
101, 115, 117, 118, 205, 206

V_2: Traffic zones with some development potential:
102, 104, 108, 109, 113, 114, 116

V_3: Traffic zones with sufficient development potential
103, 105, 106, 107, 110, 111, 112, 201, 202, 203, 204,

The above results are presented in matrix form as shown in Table 5.3 while Fig. 5.7 gives the zone-wise degree of land-use potential based on the following criteria :

Area of low land-use potential :
R_1 & V_1, R_1 & V_2, R_2 & V_1, R_2 & V_2

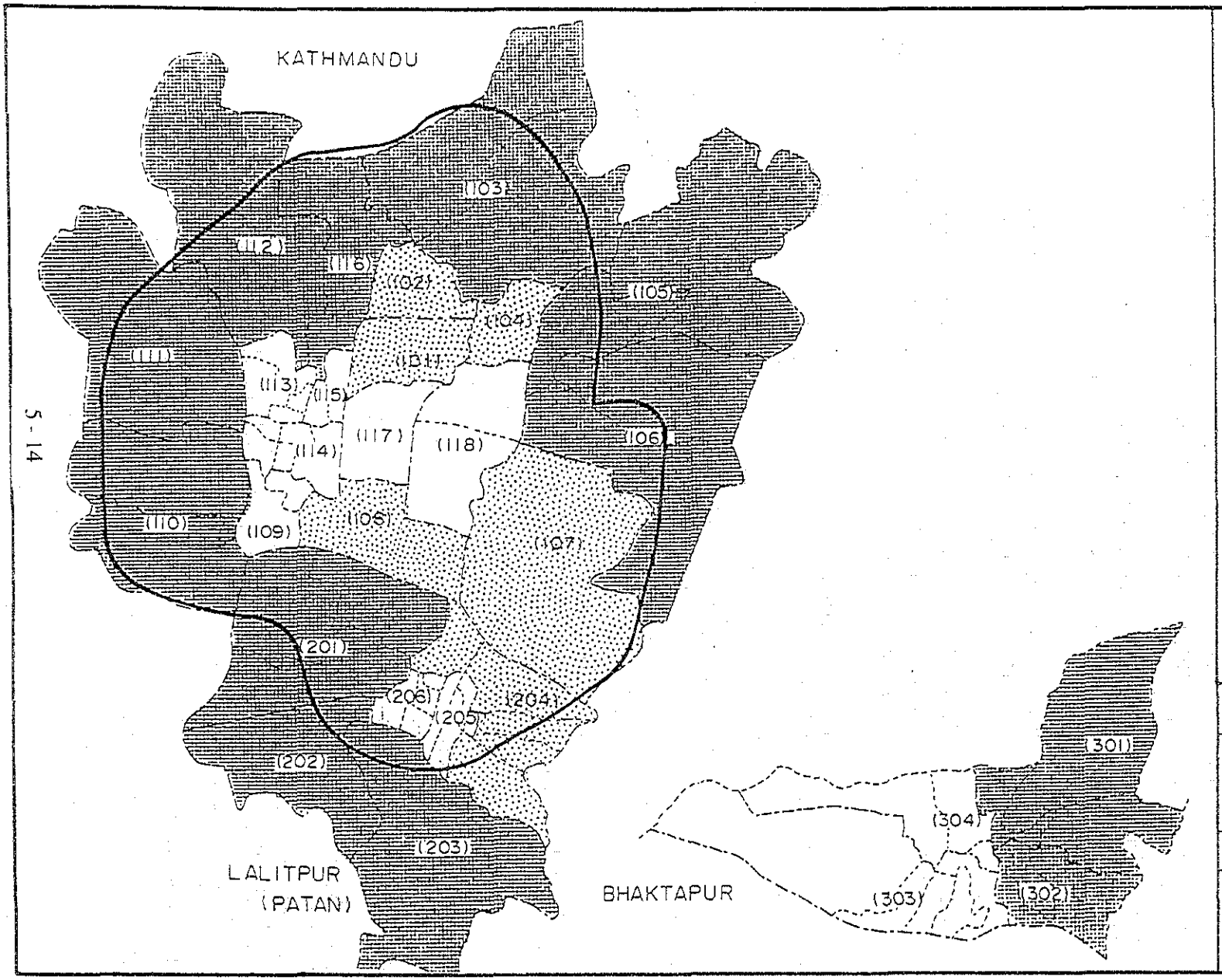
Area of some land-use potential :
R_1 & V_3, R_2 & V_3, R_3 & V_1, R_3 & V_2, R_4 & V_1

Area of high land-use potential :
R_3 & V_3, R_4 & V_2, R_4 & V_3

As to the city of Bhaktapur of which no land-use data is available, traffic zone 301 and 302 are judged to possess sufficient land-use potential as per the observation by the Study team.

TABLE 5.3 IDENTIFICATION OF LAND-USE POTENTIAL

Potential in terms of Population / Potential in terms of Vacant Land	R1 (Least)	R2 (Less)	R3 (Some)	R4 (Sufficient)
V1 (Least)	115, 117, 118	205, 206	–	101
V2 (Some)		109, 113, 114	102, 104,108	116, (301), (302)
V3 (Sufficient)	107	204	106	103, 105, 110, 111, 112, 201 202, 203



LEGEND

- No Potential
- Some Potential
- Sufficient Potential

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

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
IDENTIFICATION OF LAND—USE
POTENTIAL

FIG. 5.7

JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

5.1.5 Population Projection

(1) Population by Major Area

Populations by major area in the Study area in 2015 have been obtained as shown in Table 5.4 applying area-wise annual population growth rates set up by KVUDPP Study.

TABLE 5.4 AREA-WISE POPULATION IN 2015

Area	Population	Annual Growth Rate *
Kathmandu District	1,355,000	3.0
Urban	946,000	3.5 *
Rural	409,000	2.0 *
Lalitpur District	436,000	2.9
Urban	268,000	3.5 *
Rural	168,000	2.0 *
Bhaktapur District	290,000	2.2
Urban	110,000	2.5 *
Rural	180,000	2.0 *
Total Kathmandu Valley	2,081,000	2.8
Urban	1,324,000	3.4
Rural	757,000	2.0

* Annual growth rate set up by KVUDPP Study.

(2) Traffic Zone-wise Population

Traffic Zone-wise population has been obtained through the break down of above area-wise population by the following step-wise procedure:

Step 1. Future populations by major area have been decomposed into traffic zones applying the dividing quotients which were estimated through the regression analysis on traffic zone-wise population data in 1971, 1981 and 1991.

Step 2. Zone-wise populations obtained in the first step have been adjusted so as to satisfy the following condition:

- Population in the zones which were identified as "little potential zone" in the previous study is to be contained at the level of 170 ppha of population density unless the high density residential development is allowed.

Step 3. The surplus population calculated in the above step has been distributed proportional to the sizes of population obtained in the first step to the zones possessing high development potential.

The result of population is presented in Table 5.5.

TABLE 5.5 POPULATION DISTRIBUTION BY TRAFFIC ZONE

Traffic Zone No	1991 Population (Thousand)	1991 Density (ppha)	2015 Population (Thousand)	2015 Density (ppha)	Annual Growth (%) 1991 - 2015
101	7	57.9	7	60.6	0.2
102	8	101.5	14	170.0	2.2
103	30	47.1	89	141.5	4.7
104	9	114.3	13	170.0	1.7
105	37	64.6	86	149.1	3.5
106	25	49.9	62	125.2	3.9
107	41	114.4	61	170.0	1.7
108	10	57.8	23	132.0	3.5
109	20	301.4	33	484.7	2.0
110	30	73.6	69	170.0	3.6
111	19	44.8	56	129.8	4.5
112	20	43.2	77	164.1	5.7
113	29	360.4	36	452.3	1.0
114	45	559.5	51	675.7	0.5
115	19	652.6	22	735.6	0.5
116	19	109.7	30	170.0	1.8
117	13	125.2	17	170.0	1.3
118	32	148.7	37	170.0	0.6
201	26	61.6	59	140.6	3.5
202	12	44.1	27	100.6	3.5
203	15	32.3	36	76.1	3.6
204	28	113.2	42	170.0	1.7
205	16	357.9	18	403.4	0.5
206	20	421.8	23	475.5	0.5
301	16	88.5	28	153.3	2.3
302	10	77.6	16	124.8	2.0
303	19	105.6	30	170.0	2.0
304	16	155.4	18	170.0	0.4
401	11	14.6	31	40.9	4.4
402	15	12.8	23	19.8	1.8
403	27	3.9	36	5.1	1.2
404	29	5.6	115	21.9	5.9
405	37	7.9	99	21.4	4.2
406	26	7.7	39	11.7	1.8
407	25	8.8	88	31.4	5.4
408	32	9.1	45	12.9	1.5
409	34	20.6	67	40.7	2.9
410	19	4.0	29	6.0	1.7
501	21	6.6	41	12.9	2.8
502	32	12.1	76	28.6	3.6
503	21	7.2	53	17.8	3.9
504	30	13.2	61	27.1	3.0
601	32	31.6	63	62.1	2.9
602	30	9.6	56	18.1	2.6
603	24	6.7	39	10.7	2.0
604	26	7.2	40	11.3	1.9
	1,063	16.6	2,081	32.5	2.8

5.2 Transportation Development Strategy

5.2.1 Development Principle

(1) Establishment of Traffic Policy

In the context of traffic issues pointed out in Chapter 3 and 4, traffic policies towards future urban traffic are set up as below:

- Reduction of mixed traffic

  This includes functional classification of road in which separation of pedestrian and vehicle is promoted in the process of road development.

- Traffic improvement putting priority on public transport

  Public transport would continue to be major modes of transport in the Study area as full-fledged motorization has not yet taken place and probably would not take place in the near future mainly due to economic reasons.

- Smooth transition to ride & ride system

  For the realization of efficient transportation system, ride & ride system, for instance, from trunk road bus service to feeder road bus services is to be realized in conjunction with road development.

- Promotion of collector service in the city center

  With the clearer distinction of urban land-use in the expanding urban sphere, traffic inflow, especially by heavy vehicles are to be controlled at minimal level: Collector service to and from the points of loading/unloading would contribute to the reduction of through traffic by heavy vehicles.

- Reduction of out-dated modes of transport

  Three-wheeler, tractor and hand carts are becoming nuisance on road traffic. These modes of transport are to be replaced by more modern modes of transport, say mini-buses and trucks.

- Reduction of heavy occupancy vehicles

  In conjunction with the above point, heavy occupancy vehicles such as tempos which carry a large number of passengers for their size are to be controlled especially in arterial roads in urban area.

- Prospect of bicycle

  In the light of premature nature of regional economy, bicycle will become more vital mode of transport in the near future. However, some bicycles would be replaced by mini-bus or bus in the long run.

(2) Road Development

Apart from the quality of each of the roads, the Valley is fairly well provided with road network, especially, the city areas have minimum level of roads as a network although existing road network will become out of function in the near future should the past trend of increase in traffic volume continue on the existing road network.

The roads in the Study area, by and large, is far below the satisfactory standard. Carriageway usually is narrow and most of the roads have no enough space for sidewalk. Some of the main roads are unpaved and have no facility of side drainage and/or pedestrian crossing while round-about method of intersections are still on use even at the major intersections of arterial roads which are approaching saturated levels during peak hours.

For the overall level-up of urban traffic condition, it is strongly recommended to improve existing roads and intersections at least to the level that ameliorates present congestion level and enhance safety level. Prompt rehabilitation scheme should be introduced after the identification of bottleneck points in urban traffic and accident- prone areas.

Although the road network in the Study area, especially that of city area is fairly well provided. However, for more functional enhancement of road network, some of the road linkages must be improved or newly constructed. Enhancement of road capacity over Bagmati River and construction of linkage roads which connect the Ring Road and city area of Lalitpur in short-cut manner are probable plans proposed in this connection.

Concentration of urban facilities to central area is one of the factors behind road congestion. However, there is no more available space for construction of new road to cope up with growing traffic demand in the central area. In this circumstance, upgrading of the existing roads and/or control against inflow of traffic into the central area by traffic management measures would be effective measures to be undertaken, along with such road development as Inner Ring Road to absorb through-traffic in the surrounding area.

The role of transportation in the promotion of regional economy is another aspect in the formulation of road development plan. It is anticipated that Kathmandu city will expand eastward and area between Kathmandu city and Bhaktapur city will be urbanized in the near future. Thus road network

planning should be done to facilitate as well as guide present trend of fast urbanization considering industrial promotion.

Connotation of road development differ by area. For instance, road development plan in the central area is different from those of urban fringes and suburban areas. As far as present Study area is concerned, it might be reasonable to apply following principles in the planning of road development :

Central Area	:	Road development to control further concentration of traffic into the area.
Urban Fringe	:	Road development to promote functional linkage between central area and suburban area.
Suburban Area	:	Road development aimed at promotion of residential development and regional economy.

(3) Public Transport

Public transport is a vital part of urban transport. Historically, roads in the Valley have been developed for the operation of public transport. At present, public transport service is made in rather chaotic manner by buses, trolley buses, mini-buses, tempos and auto-rickshaws.

Service provided by public mass transport is far below the satisfactory level. Over- crowding, left-of-passengers and malfunction of fleets are daily events. Vehicles used for the public transport are usually old and total number is not sufficient. Fleets are prone to malfunction during the operation due to poor maintenance and poor road condition.

Growing demand for public mass transport compared to existing service has brought about a number of "transportation-poor" or people who cannot use any mode of transport. This has sometimes resulted in such passenger transport by tractor and increasing number of heavy occupancy vehicles. More frequent and sufficient public mass transport operations are requested for the relief of these transportation-poor. This will be done through such method :

- To put more number of fleets,
- To review operation schedule taking into account actual travel pattern of users, and
- To review operation routes considering actual distribution pattern of users.

Inefficient public mass transport service by public sector has invited many private companies to involve a variety of public transport services. This could be seen in such increased services by minibus, tempo and autorickshaw. However, these services are provided rather in disorganized manner,

especially the lack of coordination among companies and authorities are becoming major reasons behind disjoint services and sometimes duplication of services.

Lack of integrity of bus stops by companies is another aspect of inefficient bus services as well as it becomes major cause of road congestion. No sign of bus stop as well as no posted information about timetable and destination make it further difficult for users to use these means of transport, especially for strangers.

Road-side on-off boarding and alighting of passengers are major causes of intrusion of pedestrians into the roads and resulting traffic accidents. Bus stops, at least bus bays and waiting spaces with shelter along with more number of zebra crossings are to be provided in the nearby area. Autorickshaw is functioning as a convenient mode of public transport on major streets in the cities. However, increasing number of these vehicles are disturbing smooth flow of traffic on the roads especially on arterial roads.

The role of public transport in the Study area is very essential. Especially, at this stage of motorization in which passenger cars are not major modes of road transportation, more efficient method of public transportation operation as well as management are required. First of all, this could be done by upgrading existing service as a short-term solution as mentioned above.

Second, more efficient service will be attained by the introduction of stricter functional hierarchy among different services of public transport as well as that of road in the urban area. Such classification as primary bus service route exclusive for middle distant bus service, secondary service routes for mini-buses and tempos and feeder service routes by autorickshaws might be effective measure.

As long as long-term measure is concerned, heavy buses are to be regulated on the streets in central urban core as seen in most of the cities in the developed countries. These streets are to be used exclusively for pedestrians, light vehicles and mini-buses for the enhancement of urban amenity. Relocation plan of existing long distance bus terminal from city center (Ratna Park) to suburban area (Balaju) is an initial step in this direction. This tendency would be followed by construction of local bus terminals on vital points on the Ring Road.

The role of the ring-shaped roads in public transportation would become more vital in future. Circulating public mass transport services connecting vital areas along the road, would promote efficient urban transportation system.

From the above recognition, principles for future public transport development are set up as described below :

- Improvement of service through the improvement of facilities,
- Integration of management,
- Functional classification of service network and integration among them,
- Restriction against plying of heavy buses in the urban core.

(4) Traffic Management

At present, a variety of traffic management measures are being undertaken in the Study area. However, in spite of these measures, overall situation of road traffic is getting worse which could be seen in such facts as increase in traffic accidents and degradation of environment.

Traffic management is defined as a method of using existing infrastructure most efficiently until renovation is done on existing infrastructure. Methodology of traffic management are classified into the following groups :

- Legal measure,
- Administrative measure,
- Physical measure,
- Engineering measure,
- Educational measure.

As to the legal measure, a variety of Acts about vehicle use and road use have been formulated since 1960s. It could be said that, apart from their effectiveness, minimal level of legal background is already provided in the Study area. However, these acts have just remained as a written form and are not actually observed. For the more control of such misconduct, more stringent enforcement of legal measures are advised. Introduction of strict penalty system against the violator is an effective measure to realize desirable traffic situation.

At present, a variety of traffic control measures, including one-way traffic regulation and parking control, are undertaken. However, no satisfactory achievement has been attained so far in the growing demand for road traffic. The deteriorating traffic flow and traffic pattern, which is represented by mixing of traffic on low capacity roads, is making the method of execution of traffic management more difficult.

Besides the legislative and administrative measures, physical measures which direct smooth traffic flow are indispensable measures to be undertaken in the traffic management. Such measures as construction of more parking spaces, providing more zebra crossings with traffic signals are measures being classified in this category of management.

For the effective implementation of traffic management, the above five (5) methodologies should be applied in a combined manner. Taking the issue of roadside parking, for instance, not only the legal measure of penalizing the violators and/or regulation on roadside parking, but also the construction of sufficient number of parking spaces have to be followed. On-going traffic management, in this respect, is conducted in rather disorganized manner and their application is fragmental.

Increased traffic volumes on the urban roads have brought about following diseconomies to the society :

- Decrease in transport efficiency,
- Increase in traffic accidents,
- Degradation of environment.

The purpose of traffic management, at least short-term is concerned, is to check the further deterioration of the above and to improve the situation under the given service level of existing infrastructure.

One of the serious issues in road traffic at present is increasing number of traffic accidents, especially those accidents which involve pedestrians. Intrusion of pedestrians into the carriageway and crossing of roads at the place where there is no designation are major causes behind it. More facilities for the safety of pedestrians are to be provided along with the reinforced traffic management measure to protect pedestrians.

Considering the above, as to the traffic management, following principles are set up:

- Strict enforcement of legal measures,
- Combination of legal, administrative, physical, engineering and educational measures,
- Integration of agencies concerned,
- Satisfaction of basic human need (safety).

5.2.2 Development Strategy

(1) Strategy of Short - term Development Plan

The basic attitude towards the formulation of short - term development plan is to give minimal level of improvement on transportation infrastructure and management measure so as to extract maximum service from the existing infrastructure. This would be mainly done through the improvement of existing bottlenecks, both in physical and administrative/managerial terms. Simple improvement of existing bottlenecks would stimulate the whole system of urban traffic to function organically.

In addition, in the formulation of short-term development plan, emphasis should be put more on uplifting the bottom of the society. To provide minimal level of transport services to the public and to provide facilities to guarantee the safety on roads are subjects to be considered in this respect. With this consideration, two of the major targets for the short-term development plan are set up as below :

- Improvement of bottlenecks in urban road,
- Relief of the transportation-poor.

Concrete strategies to attain the above targets are proposed in Table 5.6.

(2) Strategy of Middle-term Development Plan

Middle-term development plan is interpreted as transient process towards the achievement of long-term goals. In this stage of planning, direction towards the attainment of long-term goal is to be decided. It might be a first step towards comprehensive transport network and land-use development plan to be attained in the long-term plan. From the above recognition, targets for the middle-term plan are set up as below :

- Formation of skeleton for long-term plan,
- Minimization of concentration to central area.

Concrete strategies to attain the above are proposed in Table 5.7.

(3) Strategy of Long-term Development Plan

The goals for the long-term development plan are to realize efficient road transport system in the Valley in which transportation, as a system, is to be well-balanced with other urban related infrastructure. Road network is to be designed so as to enhance the utilities of urban functions and control the negative factors or dis-economies of society at lowest level. With this consideration, the targets for the long-term development plan are set up as below:

- Establishment of well-balanced road transportation system as a capital of nation,
- Homogeneous development of the Valley.

Concrete strategies to attain the above target are proposed in Table 5.8.

TABLE 5.6 STRATEGIES FOR URBAN TRANSPORT DEVELOPMENT (short-term)

	Target for Development	Traffic Management			Public Transport	Road Development
		Legal / Administrative Measure	Institutional Measure	Facility Improvement		
Short-term	* Improvement of bottlenecks in urban traffic * Relief of the transportation-poor	* Attachment of parking code into building code and introduction of penalty system * Enforcement of vehicle inspection system * Enforcement motor vehicle act * Coordination of policies among agencies * Traffic Engineering Institute to be established under MOWT to coordinate all traffic problems	* Control on roadside parking * Control on roadside on-loading and off-loading * Control on illegal activities on right-of-way (workshop roadside stall, hawker)	* Construction of public parking spaces * Improvement of intersection facitilies * Improvement of pedestrian stream (crossing point, fence between carriage way and pedestrian walk, pelican crossing) * Construction of truck yards along the Ring Road	* Increase in fleet number and frequency (bus, mini-bus) * Integration of bus stops/ bus service routes and coordination among companies * Improvement of facilities at bus terminal/bus stops (bus bay, shelter, sign) * Route regulation for three-wheelers	* Improvement of arterial road for operation of public transport * Strengthening of north-south corridor through the city of Kathmandu * Enhancement of crossing capacity over Bagmati River * Improvement / construction of road links in critical parts on road network and vital places of regional transportation * Strengthening of east-west linkages in Kathmandu * Integration of bridge construction with road improvement plan

TABLE 5.7 STRATEGIES FOR URBAN TRANSPORT DEVELOPMENT (middle-term)

	Target for Development	Traffic Management			Public Transport	Road Development
		Legal / Administrative Measure	Institutional Measure	Facility Improvement		
Middle-term	* Formation of skeleton for long-term plan * Minimization of concentration to central area	* Revision of traffic law to cope with changing traffic demand and pattern (monitoring system) * Introduction of traffic accident data base and analysis (monitoring system)	* Control on road-side parking in fringe area		* Location of long-distance and local bus terminals at fringe of urban area	* Connection between long distance bus terminal and city center * Improvement of vital radial roads

TABLE 5.8 STRATEGIES FOR URBAN TRANSPORT DEVELOPMENT (long-term)

	Target for Development	Traffic Management			Public Transport	Road Development
		Legal / Administrative Measure	Institutional Measure	Facility Improvement		
Long-term	* Establishment of well-balanced road transport system as a capital of nation * Homogeneous development of the Valley		* Regulation on heavy vehicle operation in the central area	* Introduction of bus terminal for east-bound buses	* Introduction of ride and ride system * Introduction of exclusive bus lanes	* Linkage among potential developing places in wider scopes in the light of Outer Ring Road Concept * Introduction of Inner Ring Road for efficient Inkage of central area * Improvement of radiating roads from the cities of Kathmandu, Lalitpur and Bhaktapur

CHAPTER 6

ROAD DEVELOPMENT PLAN

6 ROAD DEVELOPMENT PLAN

6.1 Basic Orientation of Road Development Master Plan

6.1.1 Introduction

As mentioned in the previous Chapter the urbanization of the Study area would continue at fairly high speed. The urban area is expected to reach 790 ha and 1,160 ha in 1997 and 2015 respectively which is 1.4 and 2.1 times as large as the existing area. Population also is expected to increase to 1.2 and 2.0 times of that of 1991 in 1997 and 2015 respectively while the total traffic volumes in 1997 and 2015 are expected to reach 1.4 and 2.6 times of that of 1991 respectively.

With the expansion of urban area and increase in population, the urban activities will become more diversified one and traffic situation is expected to become more serious. Urban expansion would proceed following the past trend in which expansion of urban area will proceed in rather sprawling manner which would entail more provision of infrastructure including roads.

The role of the Valley would become more important in the national economy. It is expected that a great number of urban facilities including administrative, business, commercial and educational facilities, would be newly located in the urban area.

According to the past trend of urban expansion and availability of land, the expansion of urban area to the eastward would continue. Especially, the area which is located between Kathmandu and Bhaktapur will be exposed to early wave of urbanization and urban expansion will proceed even in the eastern part of Bhaktapur. Bhaktapur city, which has long been isolated from the area which is called "Greater Kathmandu" would be completely integrated into Greater Kathmandu. The functional linkage among the three cities in the Valley would be strengthened as shown in Fig. 6.1.

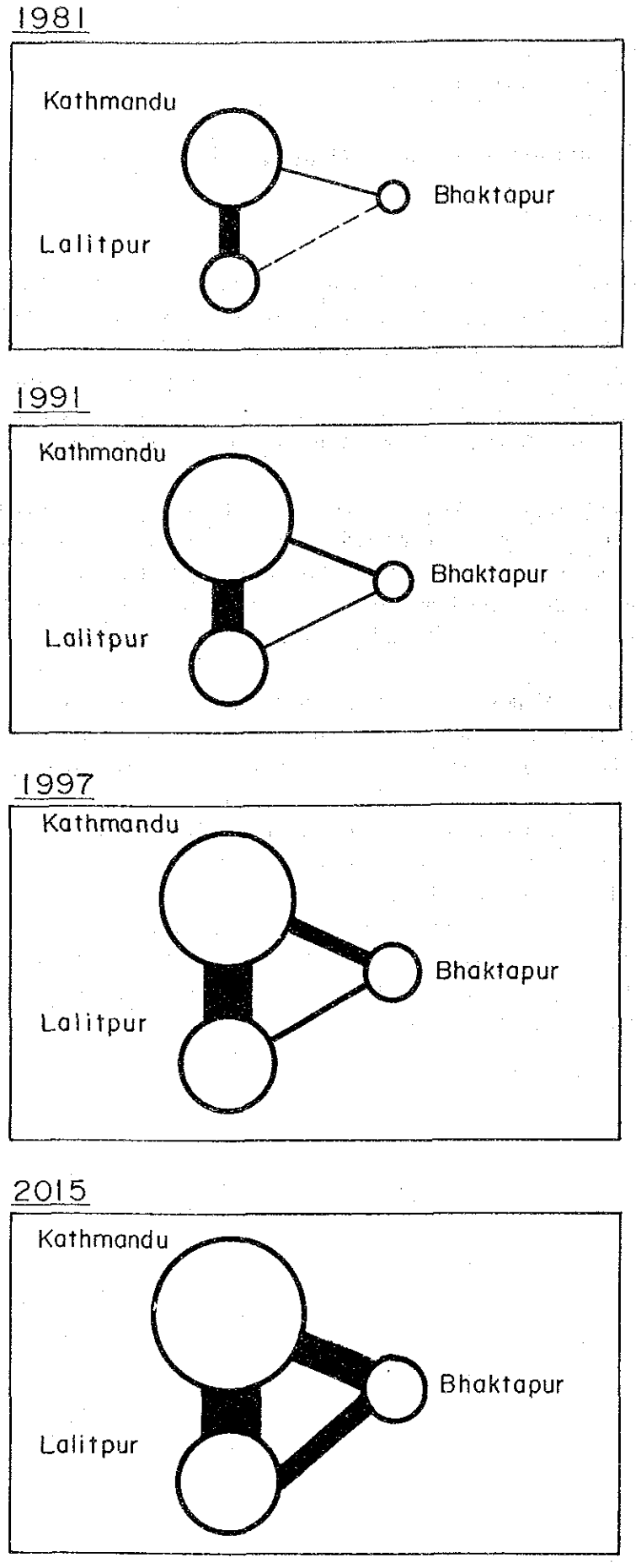


FIG. 6.1 FUNCTIONAL LINKAGE AMONG THREE (3) CITIES

Expansion of urban area would promote the specialization of land-use to some extent under proper guidance. It is expected that the central area would be rather exclusively used for such administrative, business and commercial purposes as a capital of nation while its surrounding area will be used rather for residential and industrial purposes.

In these circumstances, the traffic demand would increase in wider area and its pattern would become a more diverse one.

The traffic situation in the Study area has very outdated nature which is oriented in the past failure of urban planning and/or urban expansion proceeded with unexpectedly high speed. These could been seen in such facts as great rise in number of bottle-neck points which hamper smooth traffic flow and existing "transportation-poor" who are unable to even receive the minimum level of transportation services.

6.1.2 Present Road Development Proposal

Various road development proposals are going on in the Valley.
The following are the current and potential projects and proposals for Kathmandu Valley in the transport sector:

(1) Road and Bridge Projects

Road and bridge projects currently undertaken are listed below and their locations are illustrated in Fig.6.2.

1) The Projects assisted by Japanese Government

Reconstruction of 6 Bridges in Kathmandu (Phase 1)..... Completed
No.2 Bishnumati (Dallu) Bridge
No.4 Dhobi Khola (Kalo Pul) Bridge
No.6 Dhobi Khola (Handigaon) Bridge
No.7 Dhobi Khola (Babar Mahal) Bridge
No.8 Mahadev Khola Bridge
No.9 Manmatta Bridge

Reconstruction of 4 Bridges in Kathmandu (Phase 2)...Under Construction
No.12 Bagmati (Teku) Bridge
No.13 Kodku Khola Bridge
No.22 Mahadev Khola Bridge
No.23 Shankhamul Pedestrian Bridge

2) The Project assisted by Asian Development Bank (ADB)

The Second Road Improvement ..... Under Construction
Resurfacing and Resealing of 117 km of roads in the Valley including:
- Tribhuvan Highway (Kathmandu - Thankot)
- Arniko Highway (Kathmandu - Banepa)
- Trisuli Feeder Road (Kathmandu - Kakani)
- Kathmandu - Godawari District Road
- Kathmandu - Dakshinkali District Road
- Part of Ring Road

3) The Project assisted by the World Bank/IDA

Road Flood Rehabilitation Project .....Under Construction
Reconstruction of 4 Bridges in Kathmandu Valley including;
No.1 Bishnumati (Shobha Bhagawati) Bridge
No.5 Dhobi Khola (Rato Pul) Bridge
No.11 Naikap Bridge
No.20 Nakhu Khola Bridge on the road to Bagmati

(2) Public Transport Projects

1) The Project assisted by Japanese Government

Construction of New Central Bus Terminal at Balaju .....Under Construction (Fig. 6.2)

2) The Project assisted by Chinese Government

Extension of Trolley Bus System ..... Under Study

(a) Link from Tripureswar to Tribhuvan University via Kalimati,
(b) Link from Thapathali to Patan Dhoka and Pulchok,
(c) Link from Koteswar to Pashuputi via Tribhuvan International Airport, and
(d) Around the Ring Road

(3) Existing Highway Planning Proposals

1) Department of Roads (DOR)

A number of long-standing proposals for the improvement of the road system within Kathmandu Valley have been made by DOR, out of which the most important ones are presented below and illustrated in Fig. 6.3.

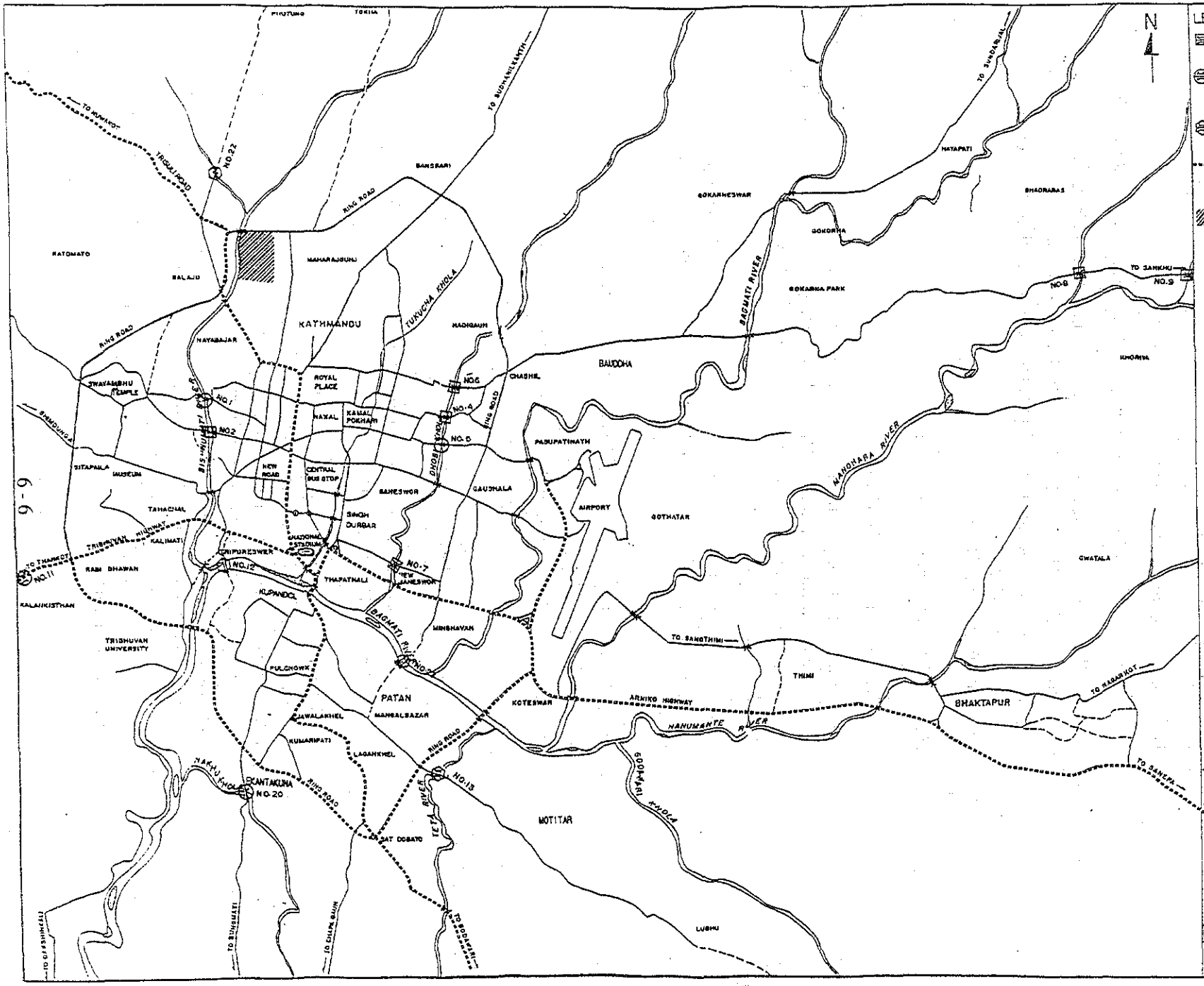
(a) Widening of the road from New Baneswar to Old Baneswar(2-lanes)
(b) Widening of the road from Kamal Pokhari to Gausala (2-lanes)
(c) Construction of new road around Singh Durbar (2-lanes)

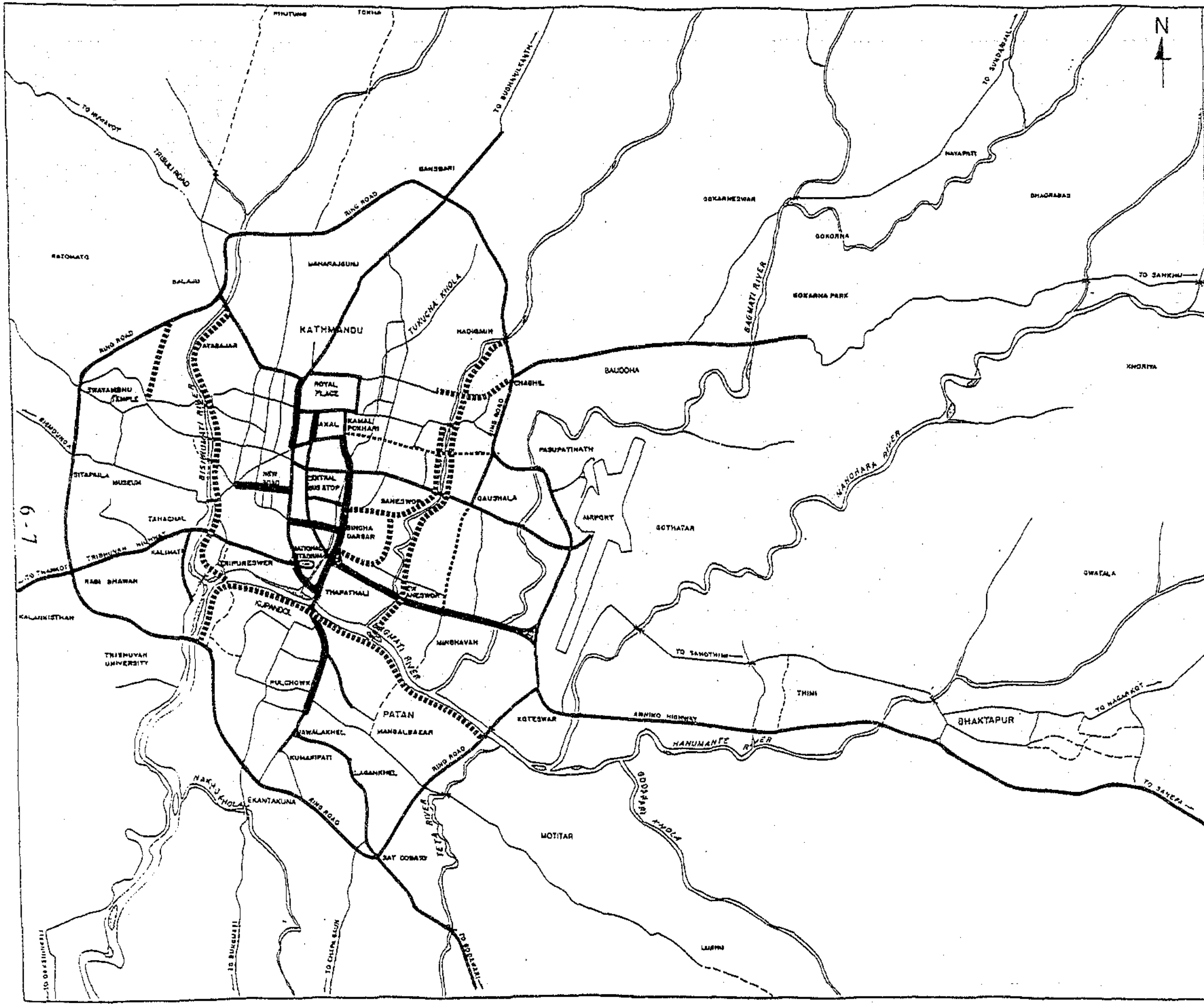
2) Ministry of Housing and Physical Planning (MHPP)

MHPP has also a long-standing proposal for the road network within the urban area in Kathmandu and Lalitpur cities. The important proposals made by MHPP are also presented below and illustrated in Fig. 6.3:

(a) East-West New Road Corridor along the south bank of Bagmati River
(b) North-South New Road Corridor along Bishnumati River
(c) North-South New Road Corridor along Dhobi Khola

MHPP has a Guided Land Development (GLD) scheme which cover most of the residential areas of north and eastern Kathmandu and Lalitpur. The purpose of the scheme is to develop the land as well as to reserve the right-of-way for future expansion of the existing primary and secondary roads to higher standards as shown in Fig.6.4. In addition, they have planned to develop the access roads to the new urban settlements, however, these roads are adequate only for the local roads and access abutting houses and properties, and do not provide an appropriate network of roads because of its narrow and poor geometric standards.


N
LEGEND :-
BRIDGE UNDER CONSTRUCTION BY JICA
BRIDGE UNDER CONSTRUCTION BY WORLD BANK / IDA
PROPOSED BRIDGE SITE BY JICA
ROAD RESURFACING AND RESEALING WORKS UNDER SRIP (ADB)
PROPOSED CETRAL BUS PARK
KATHMANDU
PATAN
BHAKTAPUR
BAUDDHA
PASUPATINATH
GOKARNESWAR
GOKARNA PARK
BAGMATI RIVER
MANOHARA RIVER
HANUMANTE RIVER
TUKUCHA KHOLA
RING ROAD
TRIBHUVAN HIGHWAY
ARNIKO HIGHWAY
AIRPORT
GOTHATAR
MOTITAR
LUBHU
THIMI
KOTESWAR
TRIBHUVAN UNIVERSITY
SWAYAMBHU TEMPLE
DURBAR SQUARE
NAYABAJAR
MAHARAJGUNJ
BANESWOR
GAUSHALA
CHABHIL
BALAJU
KATOMATO
SITAPAILA
TAHACHAL
KALIMATI
KUPANDOL
PULCHOWK
MANGALBAZAR
LAGANKHEL
KUMARIPATI
SANKHU
NO.1
NO.2
NO.4
NO.5
NO.6
NO.7
NO.9
NO.11
NO.12
NO.13
NO.20
NO.22
0 250 500 1000 2000m
SCALE 1:20,000
HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG)
KATHMANDU VALLEY URBAN ROAD DEVELOPMENT
ON-GOING TRANSPORT PROJECTS
FIG.NO.- 6.2
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) NOV.1991-MARCH 1992



LEGEND :-

MHPP. SCHEMES

DOR SCHEMES

0 250 500 1 000 2 000m

SCALE 1:25,000

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG)

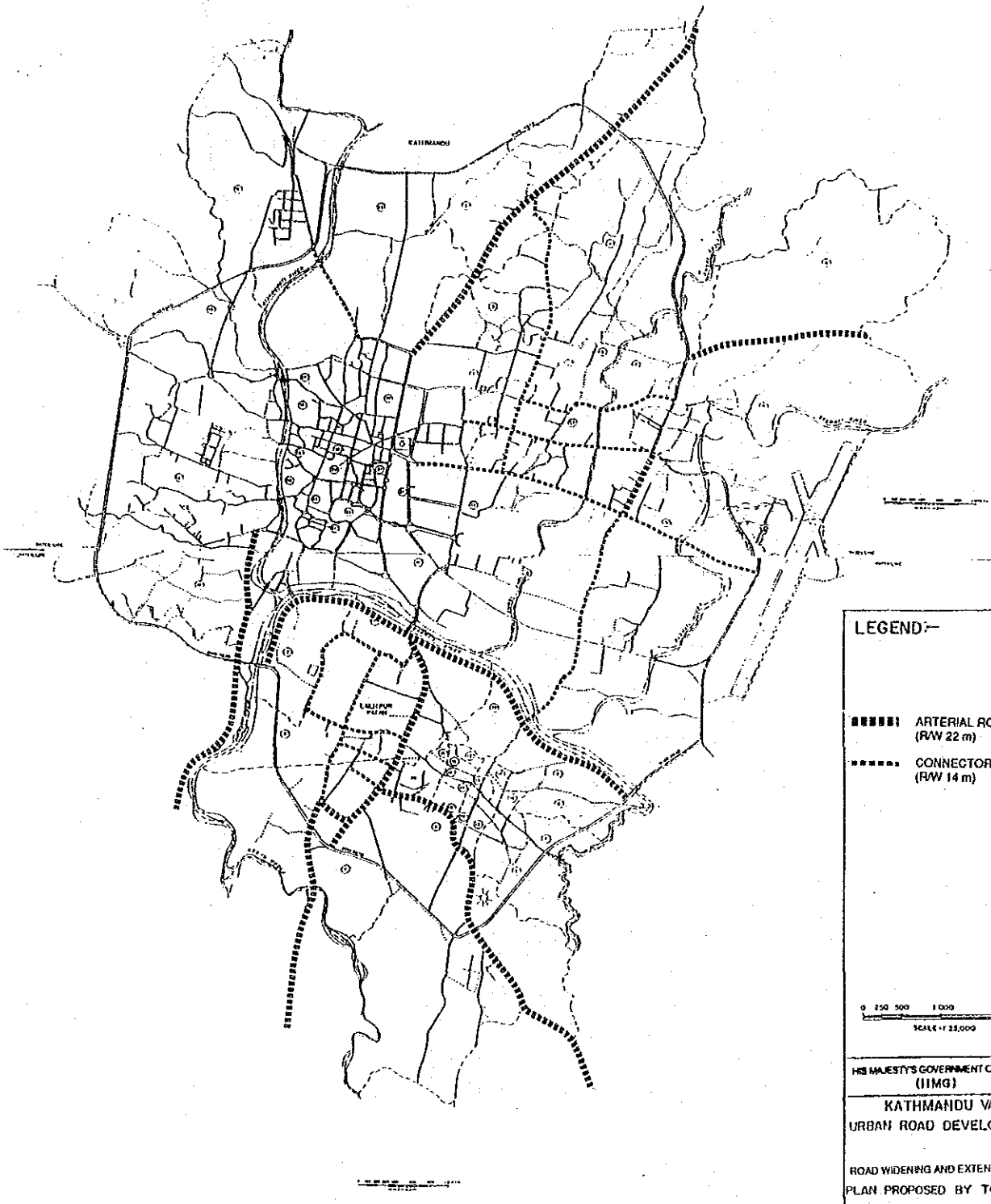
KATHMANDU VALLEY URBAN ROAD DEVELOPMENT

EXISTING HIGHWAY PLANNING PROPOSALS

FIG.NO.- 6.3

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) NOV.1991 – MARCH 1992

ROAD WIDENING AND EXTENSION PROPOSED BY TOWN DEVELOPMENT COMMITTEE



LEGEND:-

ARTERIAL ROAD (R/W 22 m)

CONNECTOR ROAD (R/W 14 m)

0 250 500 1000 2000m

SCALE 1:25,000

HIS MAJESTY'S GOVERNMENT OF NEPAL (HMG)

KATHMANDU VALLEY URBAN ROAD DEVELOPMENT

ROAD WIDENING AND EXTENSION PLAN PROPOSED BY TOWN DEVELOPMENT COMMITTEE

FIG.NO.- 6.4

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA) NOV.1991-MARCH1992

6.1.3 Road Development Concept

(1) Road Development Concept

The above orientation of future road development justify the following objectives in road development in the Study area .

- Road development as a center of national economy,
- Road development in the wave of outwards shift of urban area,
- Road development to streamline the traffic in central area,
- Road development for the integration of three (3) existing city centers, and
- Road development with impending necessity to improve existing bottleneck points and alleviation of transportation-poor.

1) *Road development as a center of national economy*

The role of the valley in the national economy is expected to become more vital and transportational linkage with other parts of the nation has to be strengthened. Sindhuli Road, which is scheduled to open within the 1990s and connecting the Valley with Eastern Terai in short-cut manner would strengthen the transportational linkage between those areas while the proposed Hatauda-Kathmandu Road would accelerate the linkage of traffic between the Valley and the Western Terai after the completion. Above facts justify the necessity of improvement plan of east-west transportation corridor in the valley as illustrated in Fig. 6.5.

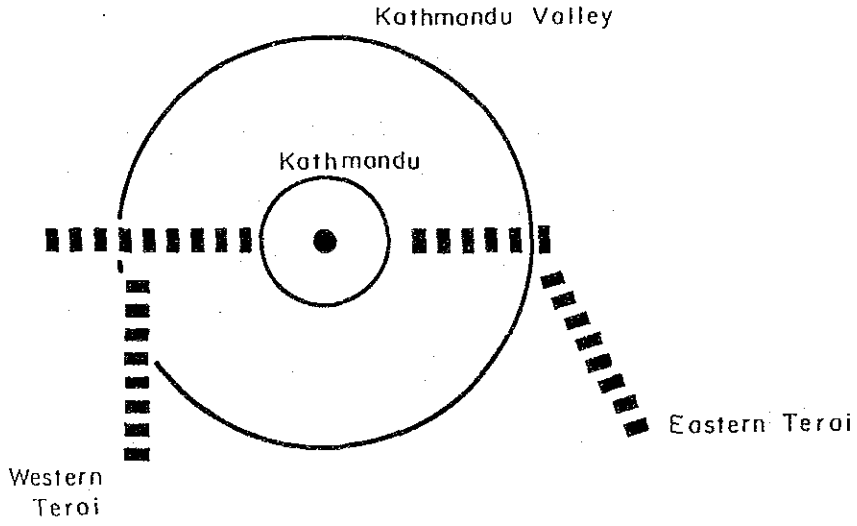


FIG. 6.5 CONCEPT OF STRENGTHENING PLAN OF EAST-WEST CORRIDOR

2) Road Development in the Wave of Outward Shift of Urban Area

The tendency of outward shift of urban area would continue until it will reach urban boundary. Urban expansion will proceed along the radial roads in the middle term as shown in Fig. 6.6 (1).

However, this expansion process, after a certain point, will be directed to the area between these radial roads and it is expected that concentric land-use pattern will be realized centered around the existing urban cores.

Road planning is to be compiled in the expectation of above disposition of urban expansion so as to promote well-ordered development in the frontage and to provide efficient transportation network in newly developed areas.

The above concept is illustrated in Fig. 6.6 (2) in which concept of another ring shaped road, preferably in the middle of the new urban area, has been introduced.

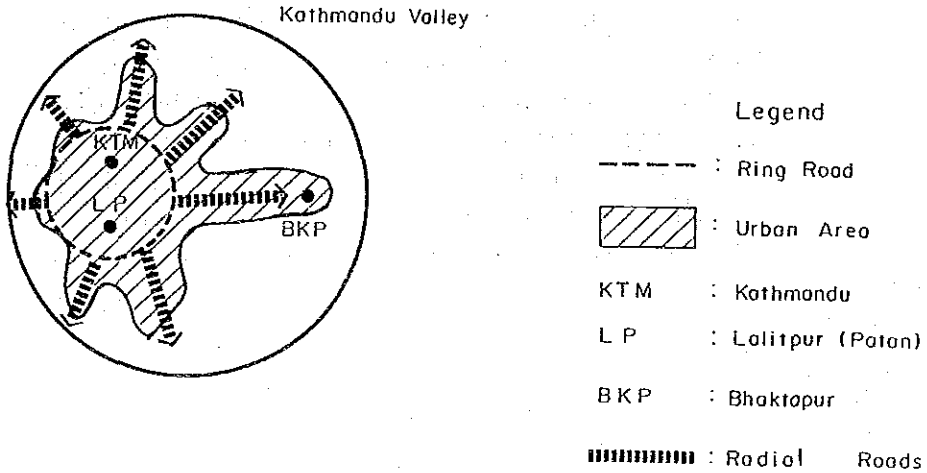


FIG. 6.6 (1) CONCEPT OF ROAD DEVELOPMENT PLAN IN THE EXPANSION OF URBAN AREA IN THE MIDDLE-TERM

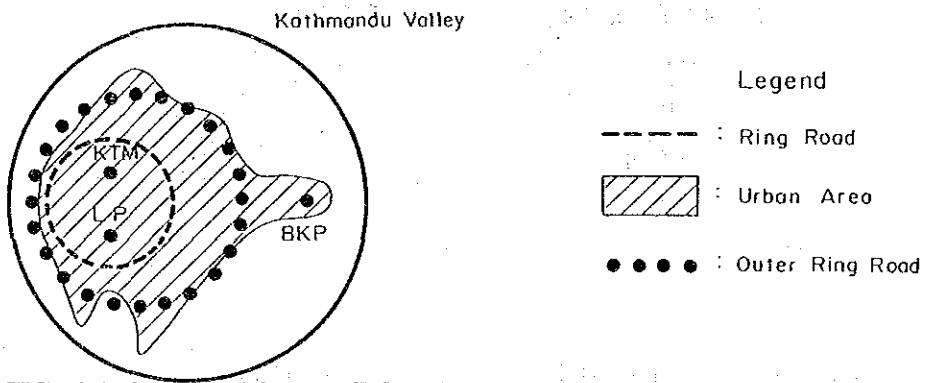


FIG. 6.6 (2) CONCEPT OF ROAD DEVELOPMENT PLAN IN THE EXPANSION OF URBAN AREA IN THE LONG-TERM

3) Road Development for the Integration of Three (3) Existing City Centers

Under capacity of bridges over Bagmati river and substandard roads between Kathmandu and Bhaktapur and between Lalitpur and Bhaktapur are constraints in the smooth linkage in urban traffic as well as interdependent activities in regional economies. Road development concept in this category seeks for integration of three city centers for the promotion of more consolidated economic activities as is illustrated in Fig. 6.7.

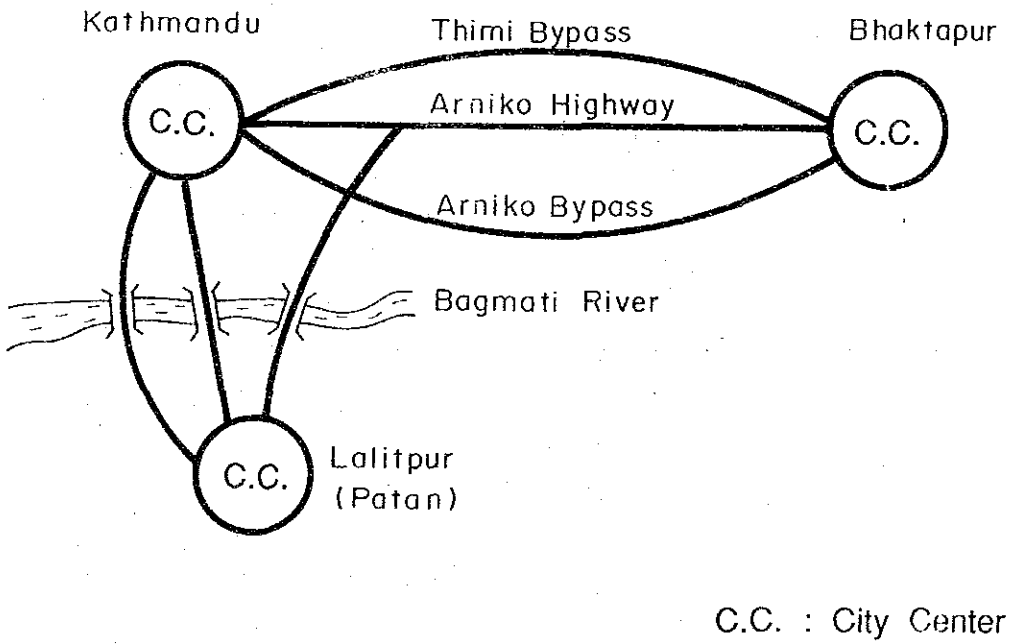
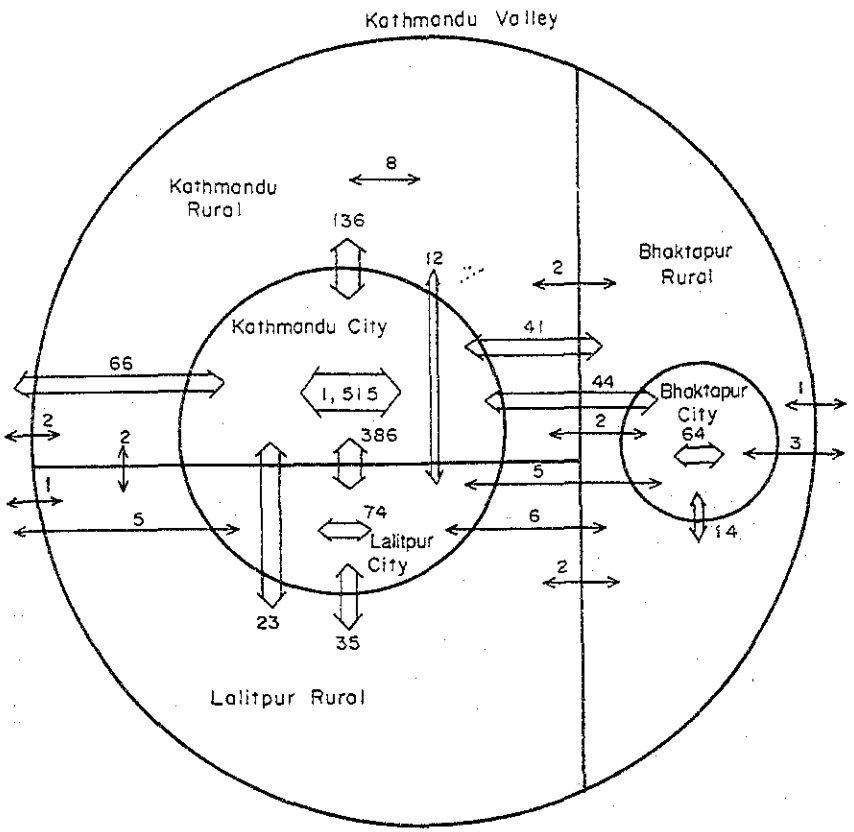
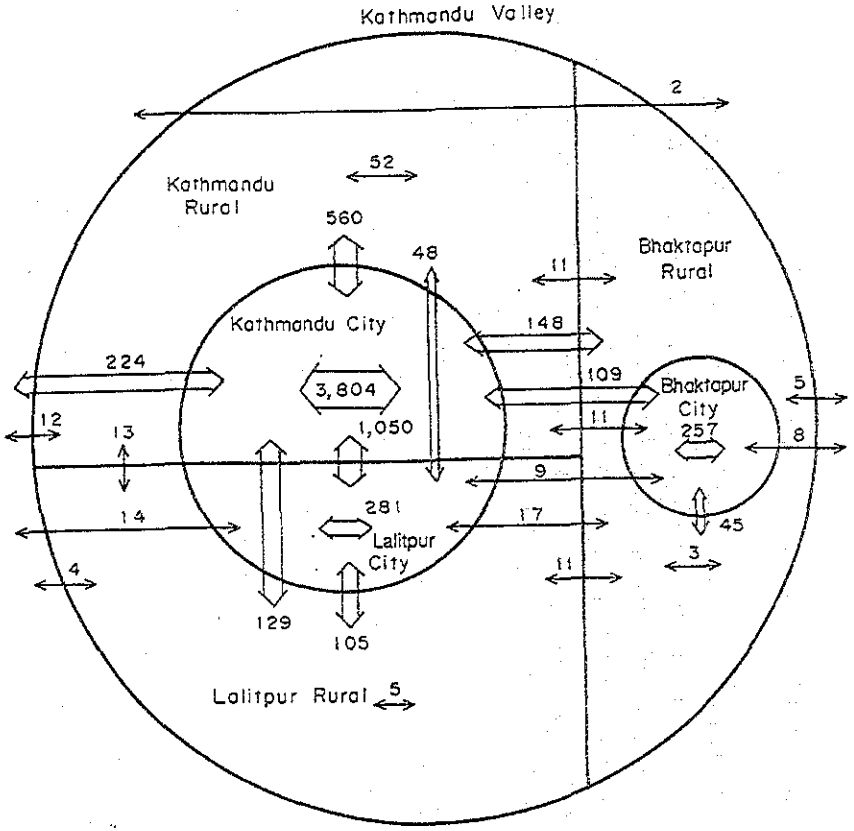


FIG. 6.7 INTEGRATION OF THREE (3) CITY CENTERS



Total 2,454
(100pcu)
Excluding Bicycle
More than 100pcu only

FIG. 6.8 TRAFFIC DISTRIBUTION AMONG MAJOR AREAS (EXISTING)



Total 6,939
(100pcu)
Excluding Bicycle
More than 100pcu only

FIG. 6.9 TRAFFIC DISTRIBUTION AMONG MAJOR AREAS (2015)

4) Road Development to Streamline Traffic Flow

In spite of expanding urban area to a wider area in the Valley, the central areas of Kathmandu would remain as the place of traffic generation and attraction. While the lack of circular road in the central area is forcing roundabout to the traffic which has resulted in inefficiency in traffic flow and a great number of through traffic. For the improvement of these diseconomy and realization of well-ordered traffic flow in the area, road development in the central area is inevitable. Introduction of Inner Ring Road seems to be a most effective measure to improve the situation along with many measures of traffic management which are proposed in Chapter 8. The above concept is illustrated in Fig. 6.10.

Widening of Kantipath from 2-lanes to 4-lanes might be necessary to cope with the anticipated future traffic demand in the long term in between northern Kathmandu and the central area of the City. In addition, the widening of Bijeswari - Swayambhu road to 2-lanes might also be required to meet the future traffic demand in between western part of Kathmandu and the central area of the City.

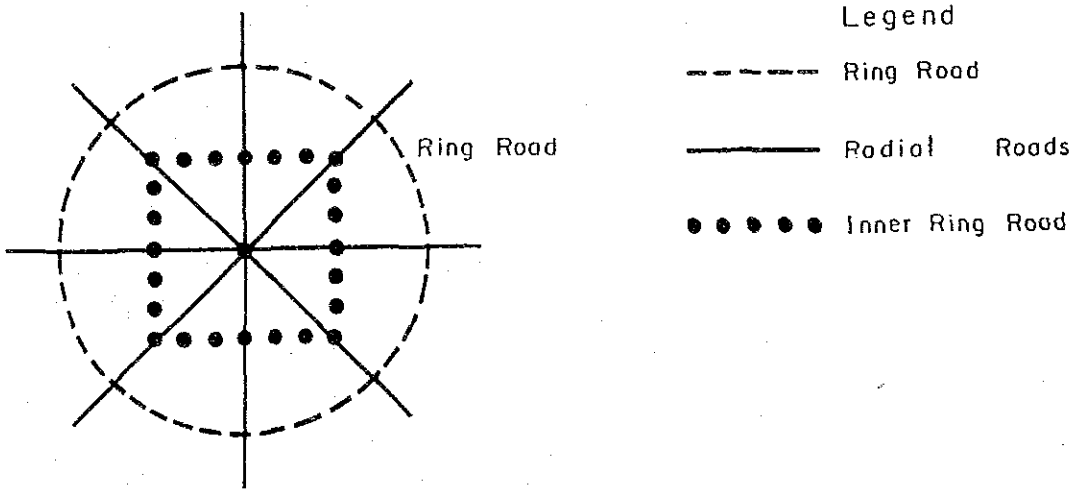


FIG. 6.10 CONCEPTUAL PLAN OF ROAD IMPROVEMENT IN CENTRAL AREA

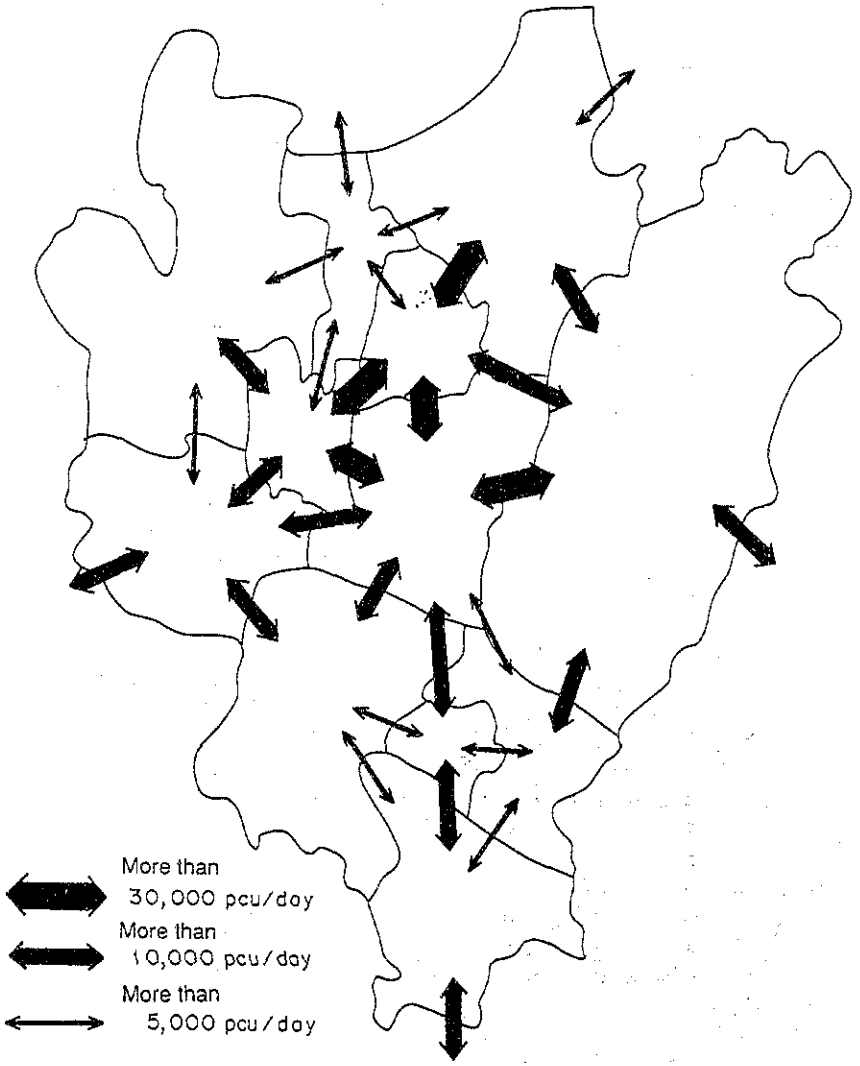


FIG. 6.11 TRAFFIC DISTRIBUTION IN GREATER KATHMANDU (EXISTING)

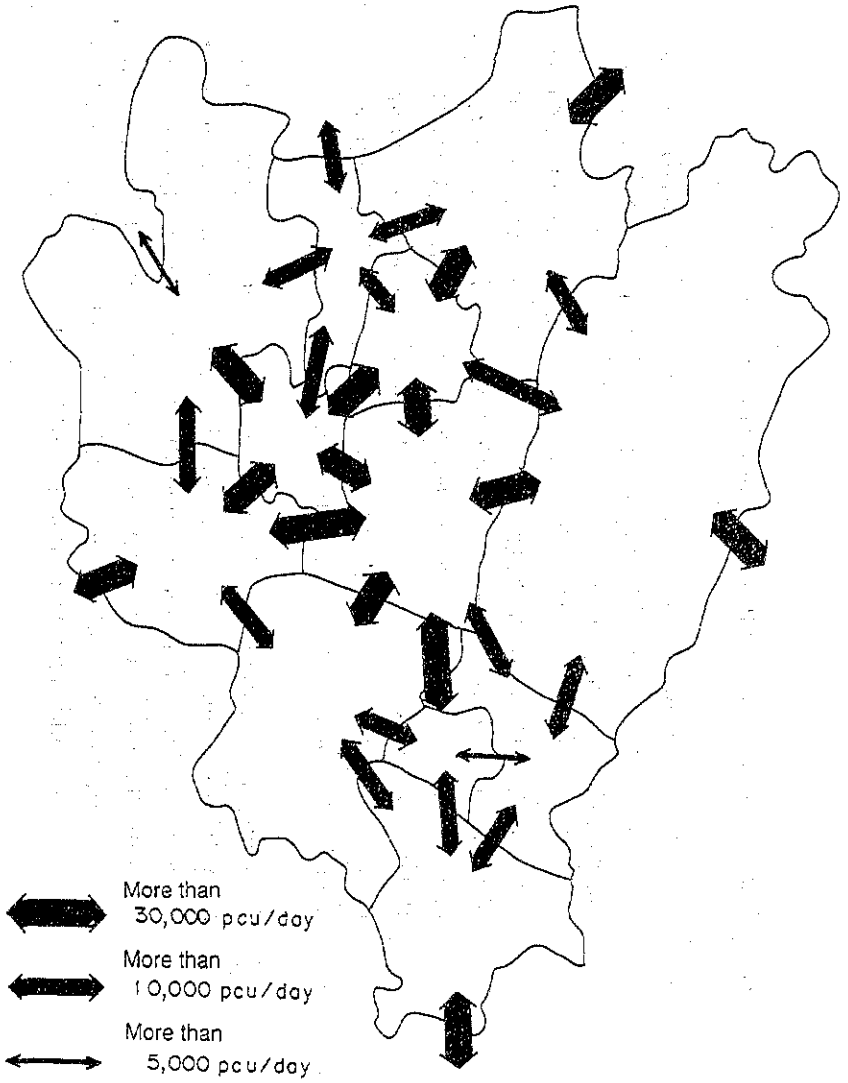


FIG. 6.12 TRAFFIC DISTRIBUTION IN GREATER KATHMANDU (2015)

5) Road Development with Impending Necessity to Improve Existing Bottleneck Points and Alleviation of Transportation-poor

Insufficient capacities of radial roads from the cities of Kathmandu and Lalitpur (Patan) as well as the river crossing capacity over Bagmati river are great bottlenecks in the urban traffic flows. These are also forcing great inefficiency to public transport users which has resulted in creation of "transportation-poors" or people who cannot receive sufficient transportation services. In this category of road development concept, these "bottleneck points" in the urban traffic are focussed. This category includes such road development plan as access road construction to long-distant bus terminal at Balaju as shown in Fig. 6.13.

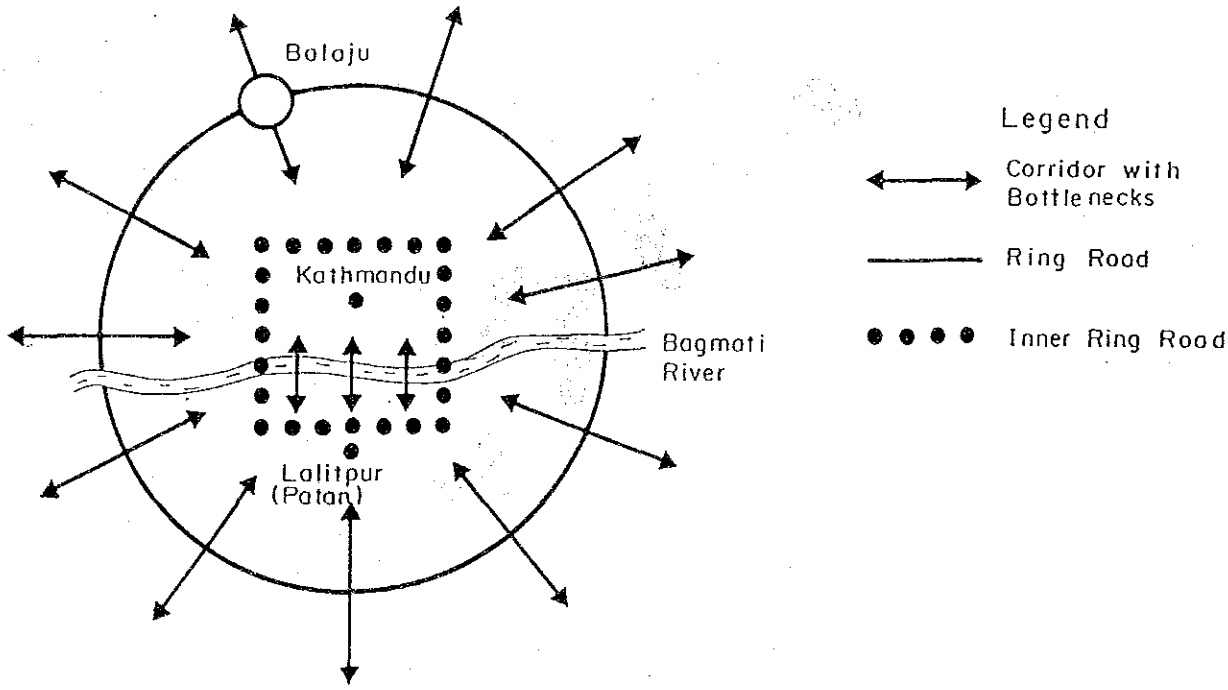


FIG. 6.13 CORRIDORS WITH BOTTLENECK POINTS

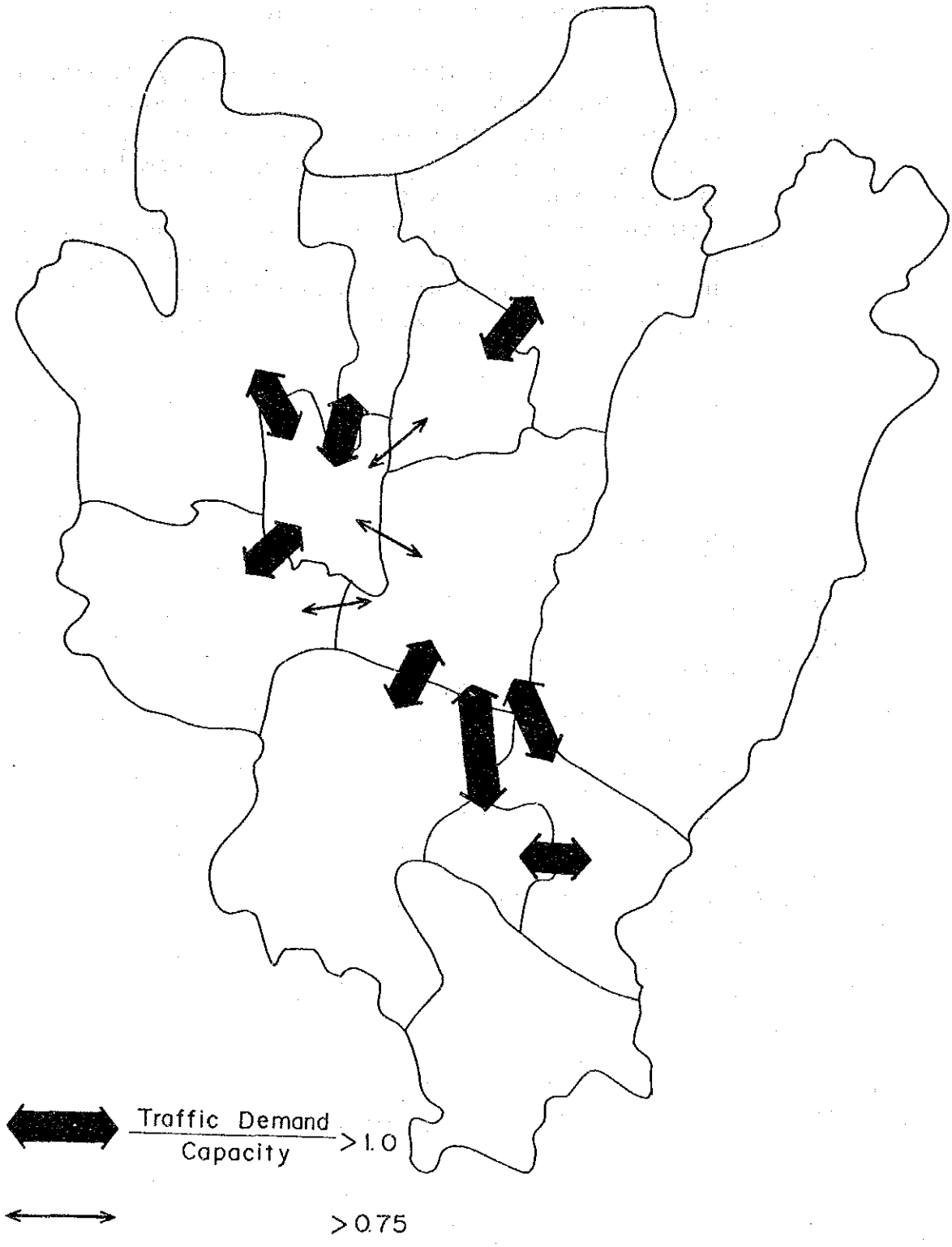


FIG. 6.14 IDENTIFICATION OF EXISTING BOTTLENECK POINTS IN TRAFFIC

(2) Skeleton of Future Road Network

In consideration of the above concepts of road development, probable future road network is proposed as shown in Fig. 6.15.

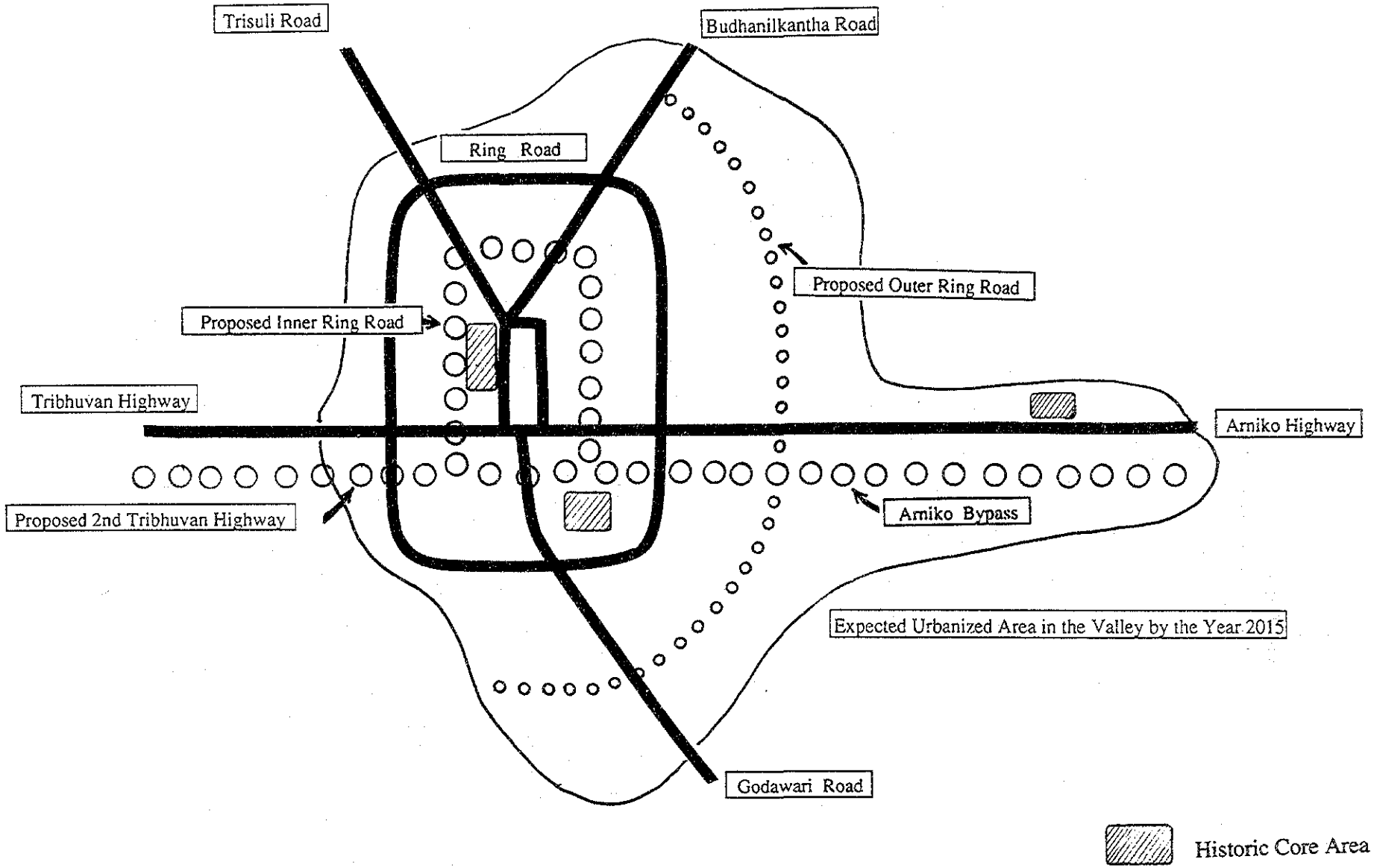


Fig. 6.15 SKELETON OF FUTURE ROAD NETWORK

6.2 Future Road Network in 2015

6.2.1 Concept for Future Road Network

Road development plan for the year 2015 has been made taking into consideration land-use development plan, anticipated future traffic demand as well as the characteristics of traffic in the Valley. The basic concepts of road planning could be summarized as follows :

(1) Improvement of road network to facilitate the existing and anticipated future traffic movement,

(2) Improvement of road network to assist the existing road network to operate more efficiently, and

(3) Improvement of road network for formulating the basic framework of urbanized areas.

6.2.2 Road Development Plan

The road development proposal has been prepared by the Study team taking into account the basic concept established in the preceding paragraphs. The concept of road development for the year 2015 is outlined as given below:

(A-1) Road development as a capital of nation

Kathmandu Valley is served with two national highways, namely Tribhuvan Highway and Arniko Highway which extend in the east -west direction in the Valley. These highway must be improved for formulating not only the basic frame of road network in the Valley but also an axis of national transport corridor of the nation.

Arniko Bypass connecting Kathmandu with Banepa and 2nd Tribhuvan Highway have been planned for the long-term taking into consideration possible national road development project, namely Sindhuli Road Construction Project.

- Construction of Arniko Bypass,
- Construction of 2nd Tribhuvan Highway.

(A-2) Road development in the wave of outward shift of urban area

(1) The expansion of urban areas will proceed along the major district roads radiating from the Ring Road. These radial roads are used as the main bus routes between the expanded urban areas and the central area of Kathmandu city. Widening of the following primary district roads are proposed to

transport services on major bus routes:

- Sundarijal Road
- Sankhu Road
- Lubhu Road
- Chapagaon Road
- Bungamati Road
- Bhimdhunga Road
- Tokha Road
- Phutung Road

(2) Rapid increase of population has forced urban sprawl in the urban fringes. In Kathmandu, urbanization is rapidly proceeding in the eastern and southern parts of urban fringes. The Outer Ring Road is planned to enhance urban development outside the existing Ring Road. It should involve all urbanized areas in the Valley in the land-use plan of 2015 and is expected to function as a collector road in areas outside the Ring Road. The Outer Ring Road should be properly connected with the primary radial district roads.

- Construction of Outer Ring Road
  (Budhanilkantha - Thimi - Lubhu - Bungamati).

In addition, the following roads have been proposed to prevent urban sprawl or disordered land-use development in the area near Airport and Thimi town:

- Thimi North-South Ladder Step Roads,
- Gothatar Service Road (East of Airport).

(A-3) Road development for the integration of three (3) Existing City Centers

Thimi and Bhaktapur will be integrated into Greater Kathmandu due to inclination of expansion of the urban area along the east-west corridor. Improvement of transport corridor of Thimi and Bhaktapur are proposed so as to improve the accessibility to each urban core in the Valley.

- Widening of Koteswor - Thimi - Bhaktapur Feeder Road,
- Baneswor - Thimi Shortcut through a tunnel under Tribhuvan Airport.

(A-4) Road development to streamline traffic flow inside the Ring Road

(1) Kathmandu and Lalitpur Cities
The road network is proposed to promote urban development inside the Ring Road as well as to disperse the traffic in the central areas of the city and avoiding its excessive concentration and to reduce the traffic load on arterial

roads located inside the Ring Road. The proposed road development plan inside the Ring Road consists of the following items:

- The Inner Ring Road

  Stage construction is proposed taking into consideration the construction cost as well as prospect of future traffic demand.

  1st Stage : 2-lane road
  2nd Stage : 4-lane road (long-term)

- Linkage of the Inner Ring Road with the Ring Road

  L-1 Bijeswari - Swayambhu - Ring Road West (widening of the existing road to 2-lanes)

  L-2 Teku - Ring Road South

  L-3 Dhobi Khola at Thapathali - Ring Road East South,

  L-4 Hadigaun - Ring Road East North

- Widening of Kantipath

  Kantipath should be widened to 4-lane road in the long-term plan in order to cope up with the increase of future traffic demands on this road:

  - Kantipath from Keshar Mahal - Ring Road North (widening of the existing road from 2-lanes to 4-lanes)

(2) Bhaktapur City

The core area of Bhaktapur city is identified as a historic core area to be preserved and no penetration of motorized traffic should be allowed into the area. The widening of existing road around Bhaktapur (herein referred to as Bhaktapur Ring Road) is planned from 1-lane to 2-lane road so that it could improve accessibility to the historic core area.

- Widening of Bhaktapur Ring Road from one-lane to 2-lane road

(A-5) Road development with impending necessity to improve existing bottleneck and alleviation of transportation-poor

(1) Widening of Bagmati Bridge at Kupandol

At the moment, there is only one vehicular bridge across Bagmati River while traffic demand between Kathmandu and Lalitpur cities have been remarkably increasing in the past few years due to rapid urbanization of Lalitpur city. (This bridge collapsed on August 1991 due to subsidence of bridge foundation caused by Bagmati River and reconstructed on March 1992).

Expansion of capacity of Bagmati Bridge is urgently needed to improve the bottleneck situation. A New Bagmati Bridge with 2-lanes is proposed just besides the existing bridge to meet the growing traffic demand as well as to secure the alternative route across Bagmati River.

- Construction of New Bagmati Bridge with 2 lanes.

(2) Provision of Access to the New Bus Terminal at Balaju

New bus terminal is now under construction at Balaju and is expected to be completed by March 1993. The existing road connecting Nayabazar with the Ring Road is planned to be used for access to the new terminal, however, it is only one-lane road with 4.0 m width and the capacity may not be enough in the near future.

Proposed linkage connecting the Inner Ring Road with the existing Ring Road would be used as a part of access from Nayabazar to the new bus terminal. Proposed access is planned to extend the linkage up to Nayabazar and connected directly with the Bishnumati Link proposed by ADB in future, which will reduce the traffic in the city road by dispersing the traffic to Bishnumati Link.

- Construction of road connecting Nayabazar and the Ring Road.

(3) Widening of New Baneswar - Old Baneswar

The existing road connecting new Baneswar with old Baneswar is narrow (one-lane road) with poor pavement and geometric conditions while the present traffic volume on this road is quite large. It is proposed to widen this road to 2-lanes to facilitate traffic demand and to secure the safety of large numbers of pedestrians and commuters on this road

- Widening of New Baneswar - Old Baneswar.

(4) Improvement of Patan Access

To cope up with the rapid urbanization of Lalitpur city, the following access from the Ring Road to the city center in Lalitpur are recommended to be improved:

- Extension and widening of Jhamsikhel - Ring Road,
- Widening of Jawalakhel - Ring Road,
- Widening of Sat Dobato - Ring Road.

6.2.3 Alternatives of the Inner Ring Road

(1) Alternative Route Study

The Inner Ring Road could be divided into four sections taking into account the characteristics of terrain conditions as shown in Fig.6.16. To determine the base route of the Inner Ring Road, various options have been studied and evaluated by each section as follows:

1) North section

Option 1-A : Construction of New East-West Link
(Indian Embassy - Bisalnagar - Sano Gaucharan)
Option 1-B : Widening of Existing Road
(Bijeswari - Tangal Durbar - Sano Gaucharan)

2) Bishnumati section

Option 2-A : Bishnumati Link Road (east bank)
Option 2-B : Bishnumati Link Road (west bank)
Option 2-C : Bishnumati Link Road (east bank - west bank)

3) Bagmati section

Option 3-A : Bagmati Link Road (north bank)
Option 3-B : Bagmati Link Road (south bank)
Option 3-C : Bagmati Link Road (south bank - north bank)

4) Dhobi Khola section

Option 4-A : Dhobi Khola Link Road (west bank)
Option 4-B : Dhobi Khola Link Road (east bank)
Option 4-C : Dhobi Khola Link Road (west bank - east bank)

Fig.6.17 through 6.20 show the location of options by each section.

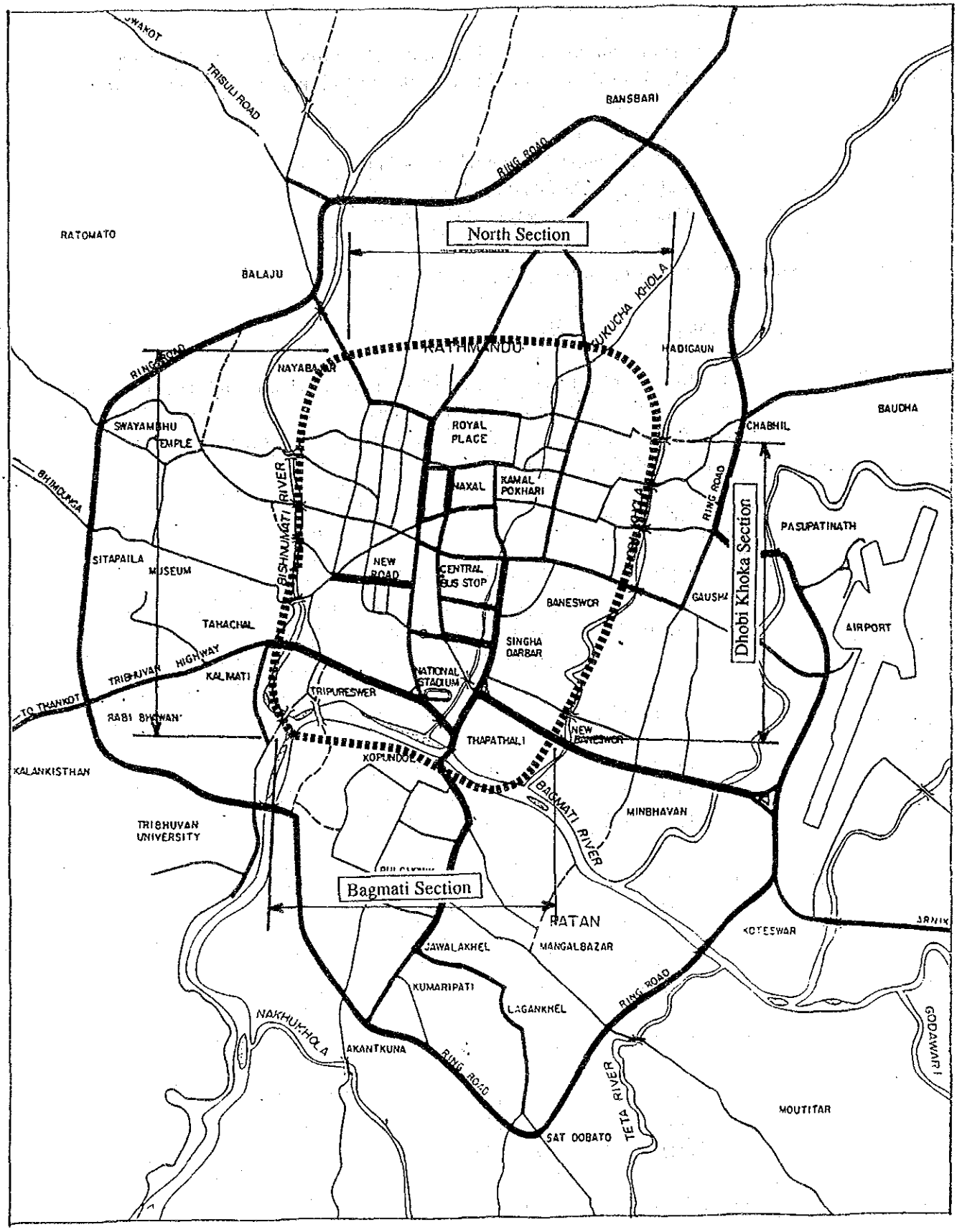
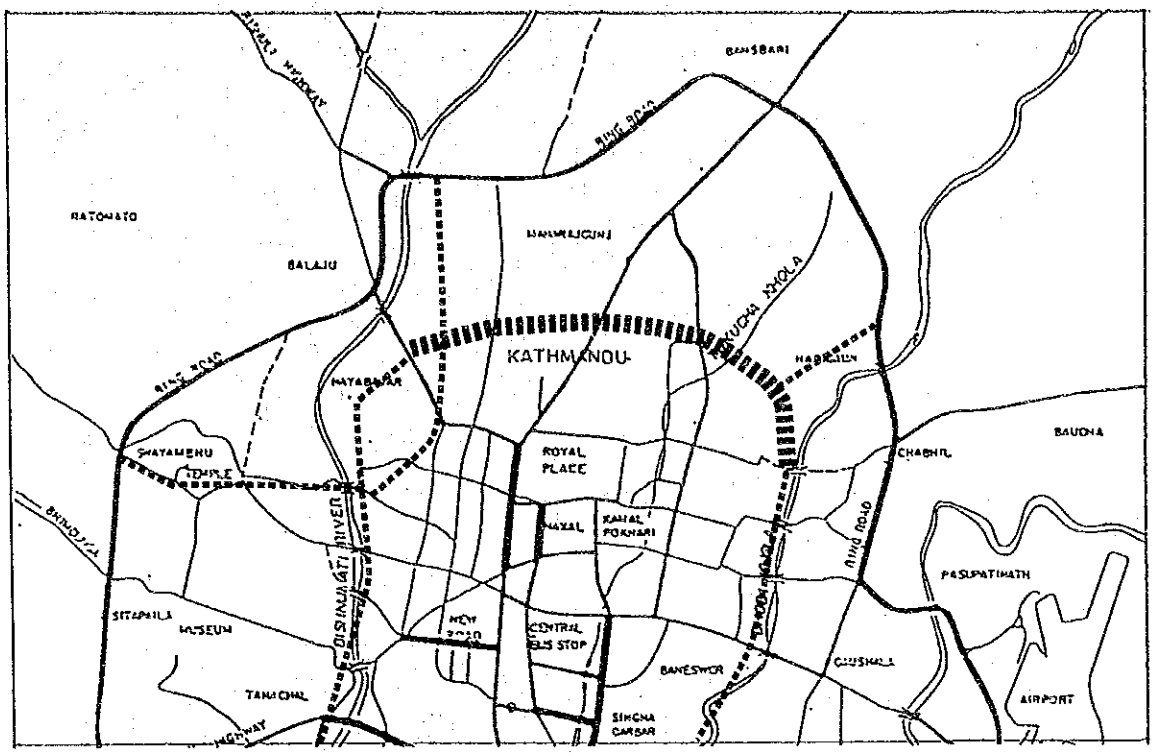
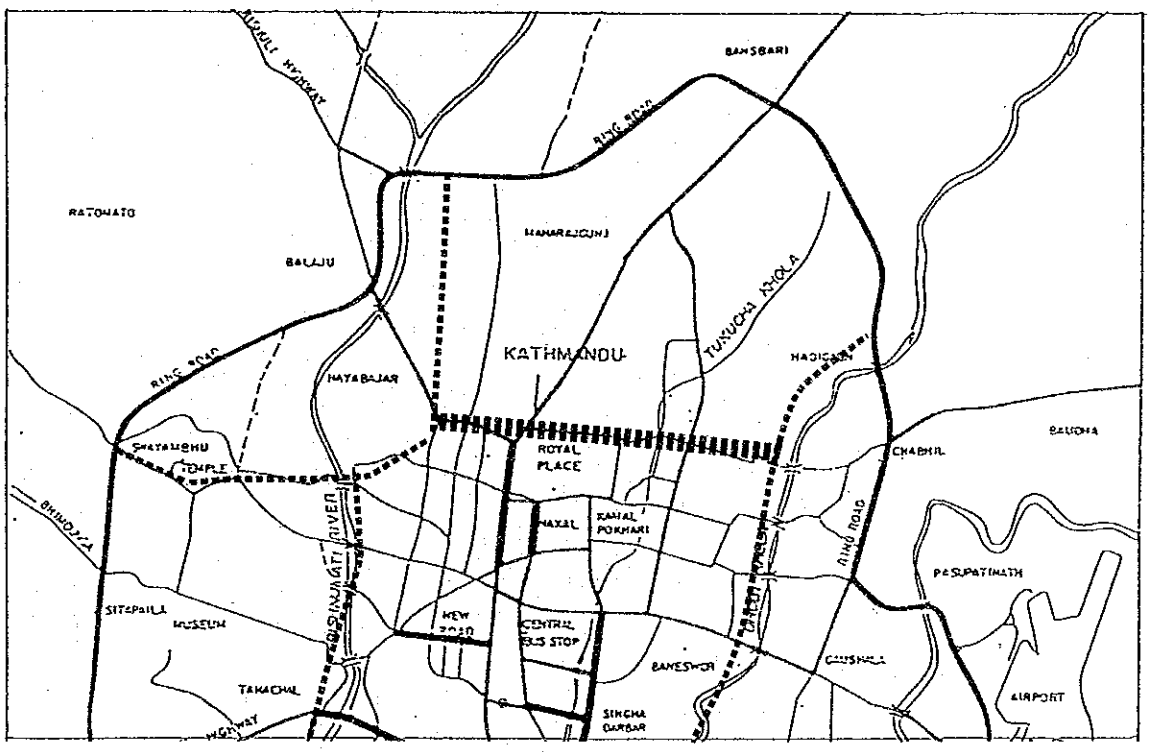


FIG. 6.16 PROPOSED INNER RING ROAD



Option 1-A: New East West Link
(Indian Embassy - Bishalnagar - Sano Gaucharan)



Option 1-B: Widening of Existing Road
(Bijeswari - Tangar Durbar - Sano Gaucharan)

FIG. 6.17 NORTH SECTION OF INNER RING ROAD

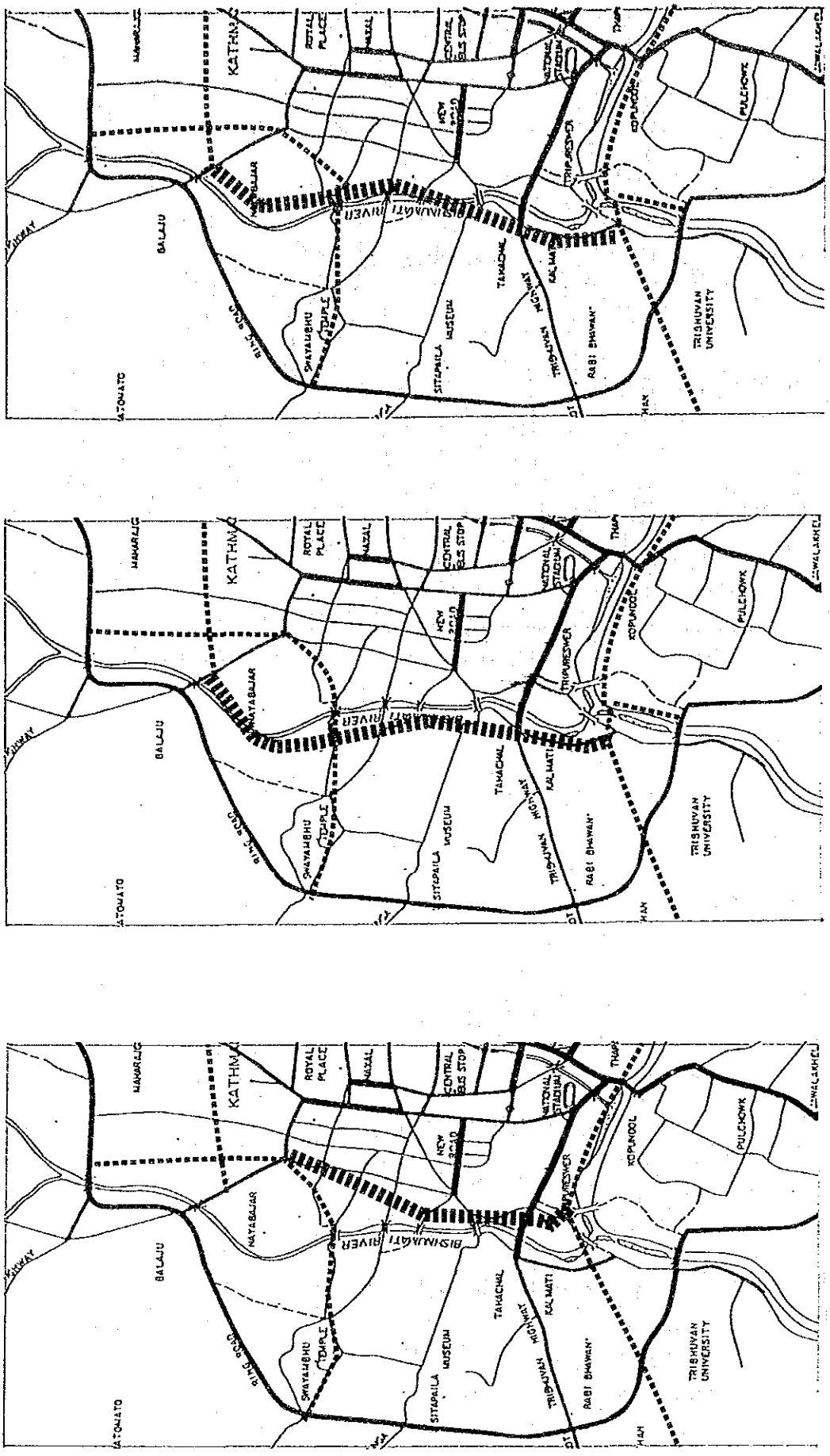
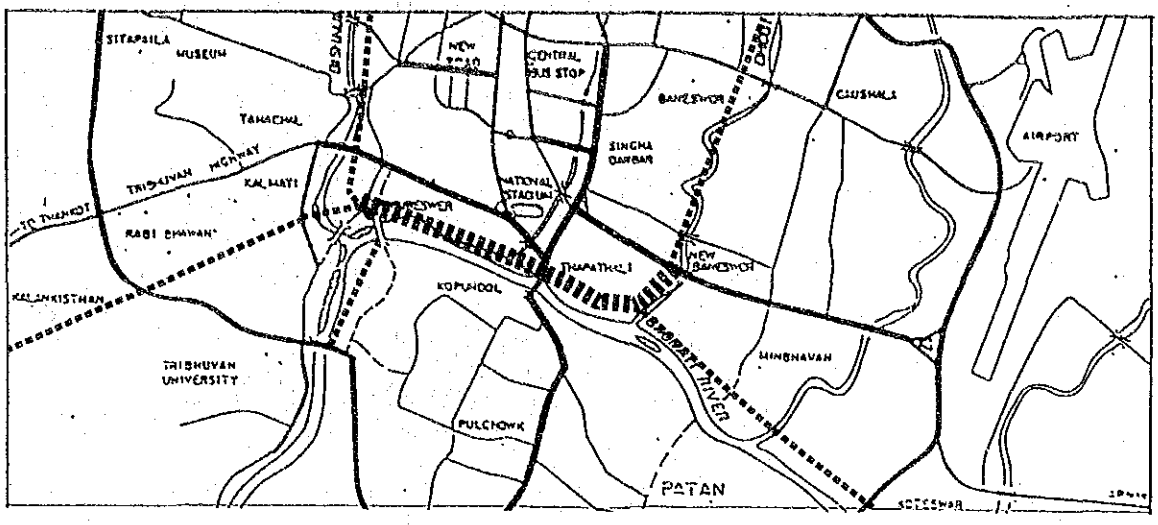
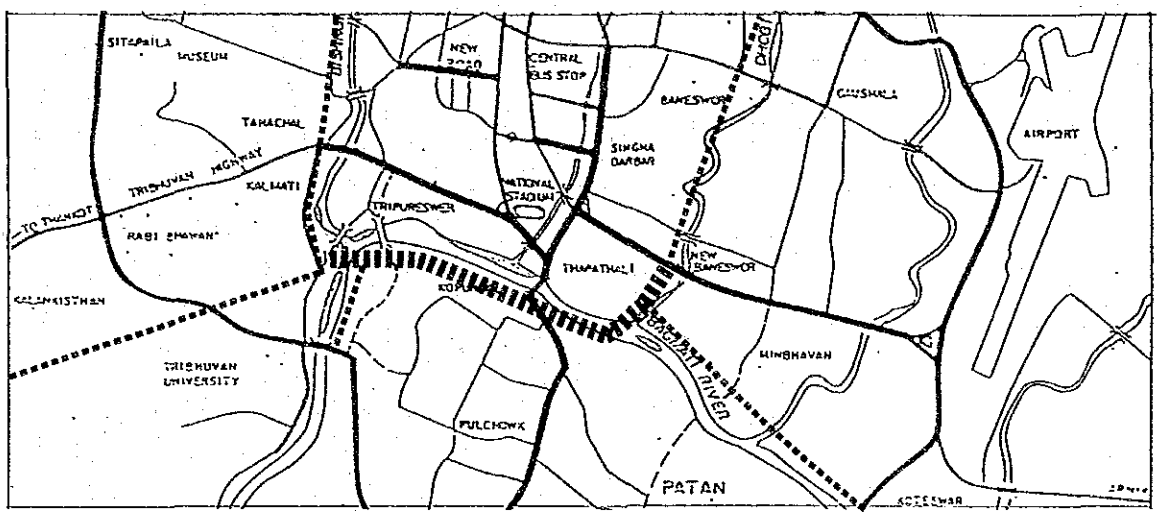


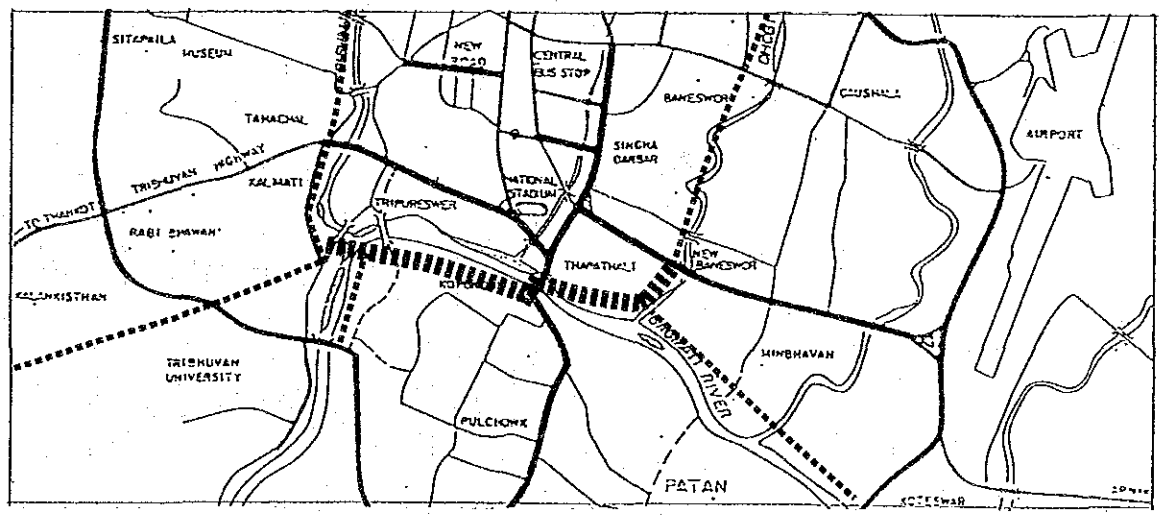
FIG. 6.18 BISHNUMATI SECTION OF INNER RING ROAD



Option 3-A: Bagmati Link Road
(North bank)



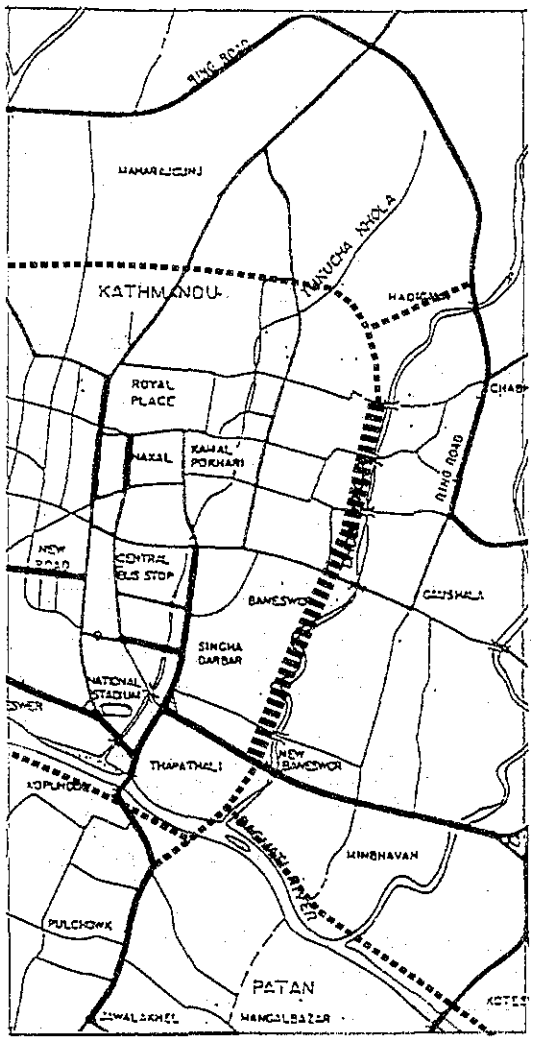
Option 3-B: Bagmati Link Road
(South bank)



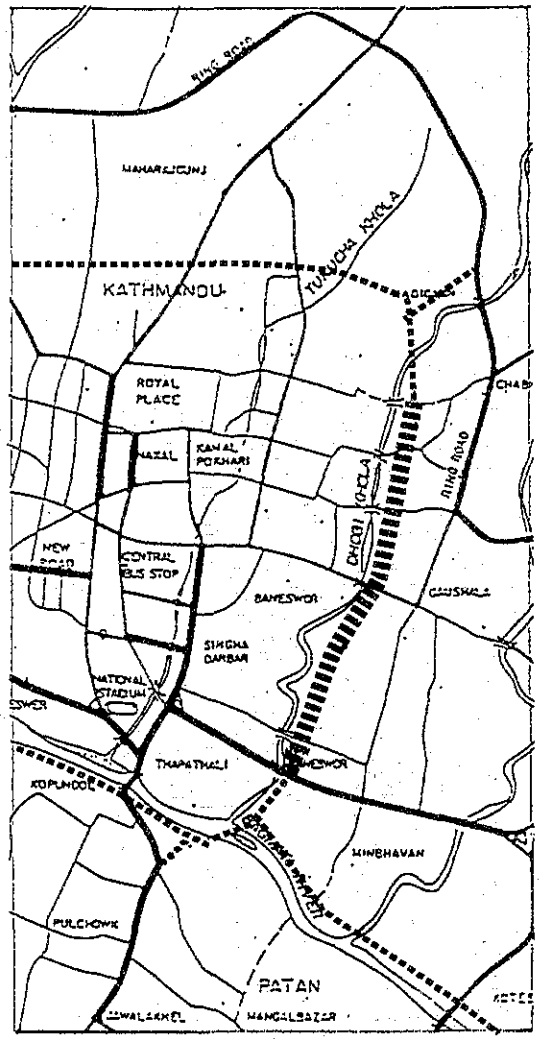
Option 3-C: Bagmati Link Road
(South bank - North bank)

FIG. 6.19 BAGMATI SECTION OF INNER RING ROAD

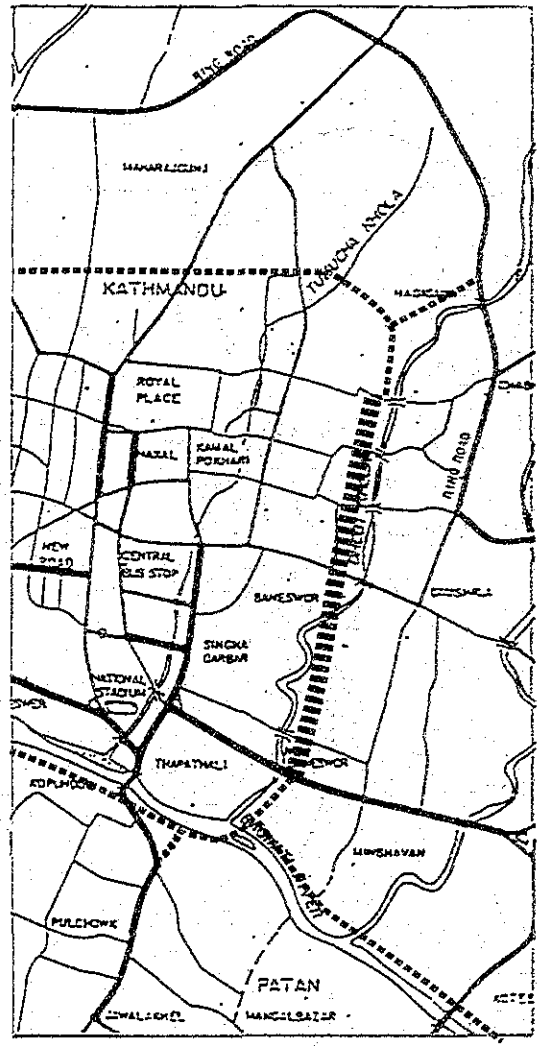
FIG. 6.20 DHOBI KHOLA SECTION OF INNER RING ROAD



Option 4-A: Dhobi Khola Link Road
(East bank)



Option 4-B: Dhobi Khola Link Road
(West bank)



Option 4-C: Dhobi Khola Link Road
(East bank - West bank)

(2) Evaluation of Each Option

The evaluation was done taking account of the engineering aspects as well as the impact on socio-economic activities in the Valley. A simplified criteria shown in Table 6.1 were introduced for the evaluation and the result of evaluation is presented in Table 6.2 and summarized below:

1) East-west transport corridor in northern part of Kathmandu city
   Option 1-A : New East-West Link
   (Indian Embassy - Bishalnagar - Ring Road East)

2) Bishnumati transport corridor
   Option 2-C : Bishnumati Link Road (east bank - west bank)

3) Bagmati transport corridor
   Option 3-C : Bagmati Link Road (south bank - north bank)

4) Dhobi Khola Transport Corridor
   Option 4-A : Dhobi Khola Link Road (west bank - east bank)

TABLE 6.1 CRITERIA FOR EVALUATION OF VARIOUS OPTIONS

	Marks		
	Grade A (3 points)	Grade B (2 points)	Grade C (1 point)
A. Engineering View Points			
- Construction cost	Small	Moderate	Large
- Consistency with Other Road Development Plan	Good	Moderate	Poor
- Balance of Road Network	Good	Moderate	Poor
- Land/House Acquisition Cost	Small	Moderate	Large
- Traffic Flow	Good	Moderate	Poor
B. Socio-economic View Points			
- Enhancement of Land-use Development	Good	Moderate	Poor
- Accessibility to Public Transport	Good	Moderate	Poor
- Effect on Religious/Cultural Monuments	Small	Moderate	Large
- Historic Core Preservation	Good	Moderate	Poor
- River Enhancement	Large	Moderate	Small

Table 6.2 EVALUATION OF EACH OPTION FOR PROPOSED INNER RING ROAD

Evaluation Items	Evaluation of Each Option for Inner Ring Road										
	(1) North Section of Inner Ring Road		(2) Bishnumati Section			(3) Bagmati Section			(4) Dhobi Khola Section		
Option:	1-A	1-B	2-A	2-B	2-C	3-A	3-B	3-C	4-A	4-B	4-C
A. Engineering View Point											
A-1. Construction Cost	B	A	A	C	B	A	B	C	C	B	A
A-2. Consistency with Other Road Developement Plan	A	B	B	A	A	B	A	C	A	A	A
A-3. Balance of Road Network	A	B	B	A	A	B	A	C	A	A	A
A-4. Land/House Acquisition Cost	B	A	C	B	A	C	A	B	C	C	B
A-5. Local Traffic Movement and Flow	A	B	B	C	A	C	A	B	A	A	A
B. Socio-economic View Points											
B-1. Enhancement of Land-use Development	A	B	B	A	B	C	A	B	A	B	A
B-2. Accessibility to Public Transport Services	A	B	B	B	B	C	A	B	A	A	A
B-3. Effect on Relegious/Cultural Monuments	A	A	B	A	B	C	A	A	-	-	-
B-4. Historic Core Reservation	-	-	B	A	B	C	A	A	-	-	-
B-5. River Enhancement	-	-	A	A	A	A	A	A	A	A	A
Total Score:	25	19	21	24	25	16	29	17	20	20	23
Recommended Option:	O				O		O				O

Note: Mark A = 3 points, Mark B = 2 points, Mark C = 1 point

6.3 Lane Number of Proposed Road

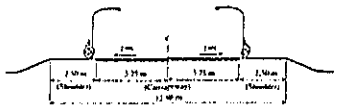
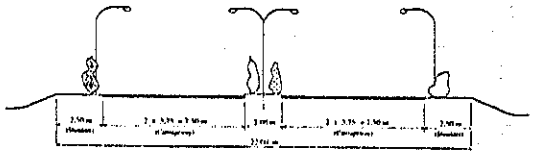
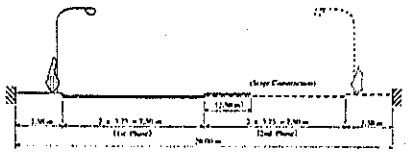
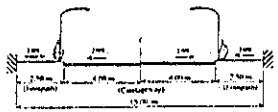
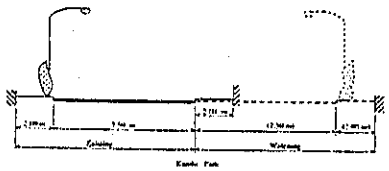
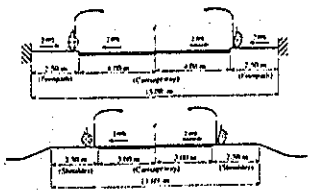
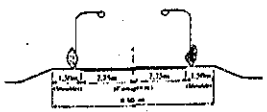
In formulating the typical cross sections of the proposed road, the following factors were considered:

1) Functional classification,

2) Future traffic demand,

3) Environmental conditions including difficulty of land acquisition.

The typical cross-sections as shown in Fig. 6.21 were proposed for the year 2015 along with lane number as well as the required width of right-of-way.

Proposed Road	Carriageway Width (m)	Right-of-way Width (m)	2 Lanes Road	4 Lanes Road
(1) National Highway				
- Amiko Bypass	2 x 3.75	50 (30)		
- 2nd Tribhuban Highway	2 x 2 x 3.75 (w/Median)	50 (30)		
(2) Inner Ring Road	4 x 3.75+FP	30 (14)		
Outer Ring Road	2 x 3.50	30 (20)		
Thimi Feeder Road	2 x 3.50	30 (14)		
(3) City Roads (Class A)				
- Kantipath	4 x 4.00+FP	30 (20)		
- New Bagmati Bridge	2 x 4.00+FP	30 (14)		
- Bhaktapur Ring Road	2 x 4.00	30 (14)		
(4) City Road (Class B)				
- Access to New Bus Terminal	2 x 4.0+FP	20 (14)		
- New Baneswar-Old Baneswar	2 x 4.0+FP	20 (14)		
- Patan Access	2 x 4.0+FP	20 (14)		
- Teku Access	2 x 3.0	20 (14)		
- Bagmati Riverside Road	2 x 3.0	20 (14)		
- Swayambhu Road	2 x 3.0	20 (14)		
(5) Primary District Roads				
- Sundarijal Road	2 x 2.75	20 (14)		
- Lubhu Road	2 x 2.75	20 (14)		
- Chapagaun Road	2 x 2.75	20 (14)		
- Bungamati Road	2 x 2.75	20 (14)		
- Bhimdhunga Road	2 x 2.75	20 (14)		
- Tokha Road	2 x 2.75	20 (14)		
- Phuntung Road	2 x 2.75	20 (14)		

( ) Min. Width

LEGEND

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

KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT

Proposed Standard Cross Sections of Arterial Roads for the Recommended Road Network in 2015

FIG. 6.21

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

6.4 Traffic Demand Forecast

6.4.1 Outline of Future Traffic Demand Forecast

(1) Objective of Future Traffic Demand Forecast

Objective of future traffic demand forecast is described below:

1) To evaluate road network proposed in the master plan in terms of traffic volume,

2) To prepare fundamental data for benefit estimate of road development projects proposed in the plan.

(2) Target Year :

- 1997 (Short-term plan)
- 2015 (Long-term plan)

(3) Method for Future Traffic Demand Forecast

Future traffic demand has been forecasted applying the four-step forecasting method which consists of i) trip generation/attraction, ii) trip distribution, iii) modal split, and iv) traffic assignment.

Major steps in the process of the traffic demand forecast are explained in Appendix 6-1.

(4) Trip Production

Future traffic volumes in this Study area have been forecasted by using trip production rates in consideration of future population and future income level.

TABLE 6.3 FUTURE TRAFFIC VOLUME

Year	Traffic Volume (Vehicle/day)		Population (1,000 persons)	
	Number	Expansion Factor	Number	Expansion Factor
1991	218,945	1.00	1,063	1.00
1997	297,004	1.36	1,253	1.18
2015	576,203	2.63	2,081	1.96

(5) Trip Generation/Attraction

Future zone-wise generated/attracted traffic volumes have been obtained through the decomposition of total traffic volume proportional to the sizes of future zone-wise population.

(6) Traffic Distribution

In the stage of making OD matrices, information from person trip survey and that of roadside OD survey were utilized. Two types of OD matrices from different sources were first prepared and then they were combined.

Components of OD matrices have been estimated applying Frator method in which components of present OD matrices have been given as the initial values.

Future OD matrices are shown in Appendix 6-2.

(7) Modal Split

Future traffic volumes have been estimated by vehicle types applying growth rates of classified vehicles which have been estimated in relation with future income levels as shown in Table 6.4.

TABLE 6.4 TRAFFIC GROWTH RATE

Vehicle Types	Future Growth Rate (% per annum)		Remarks
	1991-1997	1997-2015	
Motorcycle	7.7	3.8	
Taxi	0	0	To be held at present level
Bus	10.4	2.6	
Passenger Car	9.7	6.1	
Truck	4.5	6.8	
(Reference) GDP	5.1	-	Eighth Plan (1993 – 97)

TABLE 6.5 FUTURE COMPOSITION BY VEHICLE TYPE

Vehicle Type	Composition (%)		
	1991	1997	2015
Motorcycle	29.6	34.0	34.0
Taxi	42.2	32.0	17.1
Bus	3.6	4.8	3.9
Passenger Car	17.4	22.3	33.4
Truck	7.2	6.9	11.7
Total	100.0	100.0	100.0

Modal split analysis has been done solely in the relation between bus and pedestrian/bicycle users taking the characteristics of traffic behaviors in the Study area into account. Following logistic type model have been introduced in which parameters have been estimated from existing data:

$$P_{ij} = 1/(1 + 0.134 \times EXP(-0.185 X_{ij})$$

where

P_{ij} : Share of bus in the trip between Zone i and j

X_{ij} : Difference in travel times between those by walk and by bus in the trip between Zone i and Zone j.

Total number of trips by bus and by walk/bicycle by zone pair in the future OD matrices have been decomposed into travel mode applying theoretical values of P_{ij} calculated from the above formula.

(8) Traffic Assignment

Traffic assignment has been done by what is called "Q-V method" or the method which reflect the relation between traffic volume (Q) and travel speed (V). This method involves following procedures:

1) Preparation of Network Data

In conjunction with the future transport development plans, link data have been prepared in which length of links, link conditions including the capacity of roads and number of lanes are described so as to reflect actual road condition in the plans.

2) Establishment of Q-V Relation

For each link of the road network to which vehicles are assigned, the relation between traffic volume and travel speed has been set up as shown in Table 6.6. In this relation, it is assumed that travel speed decreases with the increase in traffic volume as shown in Fig. 6.22.

TABLE 6.6 Q-V FORMULA

QV Code	Road Classification	Location	Number of Lanes	V max. (km/h)	V min. (km/h)	Q max. (pcu/day)
1	Highway	Urban	2	60	10	15,000
2	Highway	Urban	4	60	10	57,000
3	Highway	Rural	2	60	10	22,000
4	Feeder, District Road	Rural	1	40	10	500
5	Feeder, District Road	Rural	2	40	10	14,000
6	Ring Road	Urban	2	60	10	19,000
7	City Road (A)	Urban	1	60	10	500
8	City Road (A)	Urban	2	60	10	13,000
9	City Road (A)	Urban	4	60	10	50,000
10	City Road (B)	Urban	1	50	10	500
11	City Road (B)	Urban	2	50	10	10,000
12	City Road (B)	Urban	4	50	10	37,000
13	Inner Ring Road	Urban	4	60	10	72,000

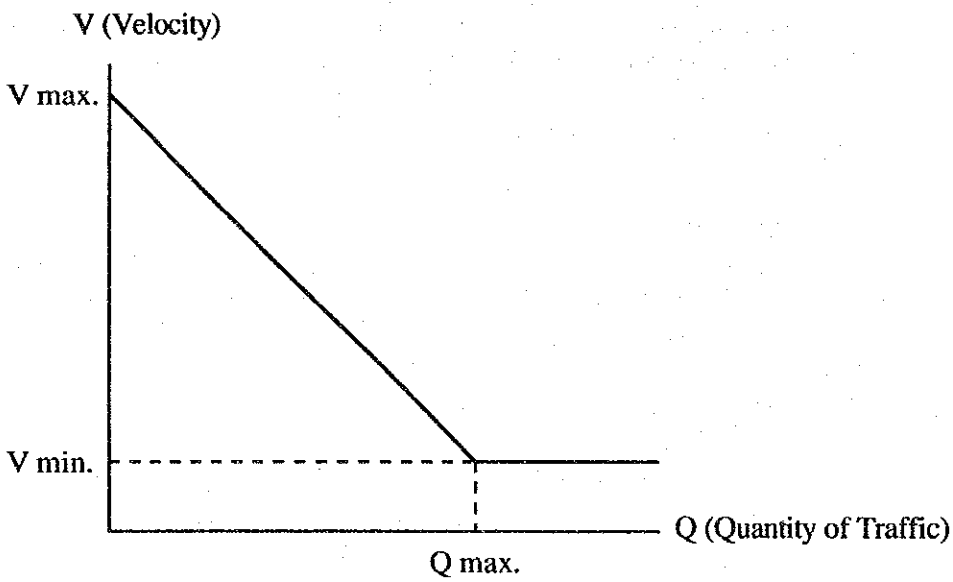


FIG. 6.22 QV FORMULA

3) Traffic Assignment

OD traffic to be assigned has been equally divided into 10 pieces for each OD matrices. A 10% of the volume is first assigned to the road network applying "minimum travel time principle" and the resultant travel time is computed for the assignment of next 10%. This process is repeated until all the volume has been assigned.

6.4.2 Result of Future Traffic Demand Forecast

Traffic assignment has been made on the proposed road network in Kathmandu Valley for the year 2015. Fig.6.23 and Fig.6.24 show the future road network by lane number and forecasted traffic demand in 2015 on it.

Fig.6.25 shows the traffic congestion on each arterial road calculated on the basis of the road capacity and future traffic volume. The congestion level on the arterial road inside the existing Ring Road is moderate ranging from 1.0 to 1.75. No serious congestion would be expected on the major arterial roads in Kathmandu Valley in the year 2015 with the exception of some city roads in and around the core historic areas in Kathmandu city.

This result shows the future road network proposed in this study is totally proper. The situation of future traffic flow in terms of alternatives of road development concept is analysed below:

(1) Road development as the capital of nation

Traffic demand on the highways as the national east-west corridor is shown in Table 6.7.

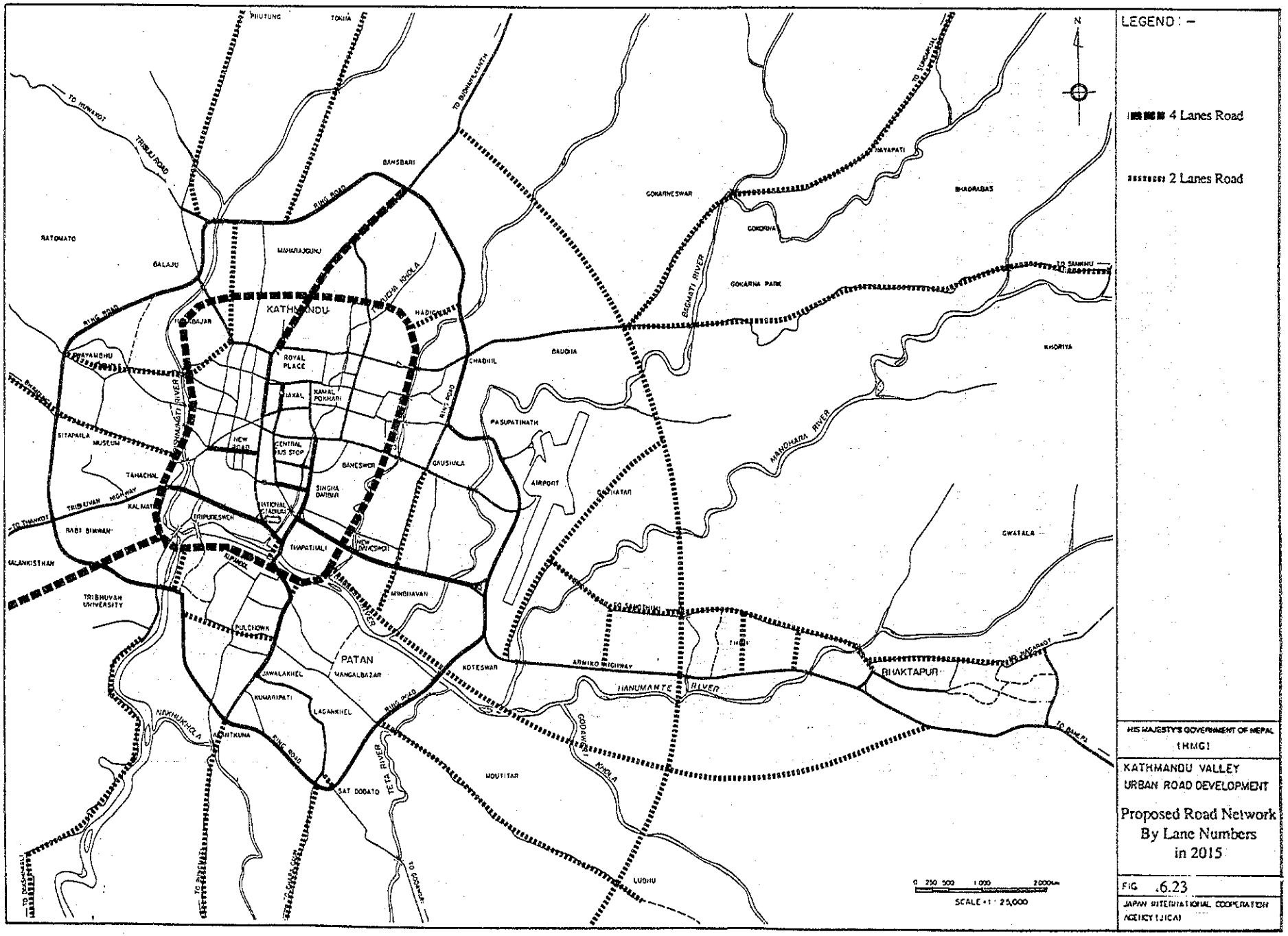
Traffic demand at Thankot, western part of this corridor, on Tribhuvan Highway are 10 thousand pcu/day in 1997 and 25 thousand pcu/day in 2015. Congestion rates based on present capacity are 0.6 in 1997 and 1.7 in 2015, which show the necessity of increasing capacity on Tribhuvan Highway by 2015.

On the other hand, traffic demand and congestion rate at Sanga, eastern part of this corridor, on Arniko Highway are 13 thousand pcu/day and 0.9 in 2015 respectively. To increase capacity at inter-city section on Arniko Highway is not necessary from the point of view of traffic volume. But congestion rate at Thimi is as high as 2.1, which shows the necessity of widening or construction of bypass to increase capacity.

TABLE 6.7 TRAFFIC DEMAND ON HIGHWAYS

Year	Traffic Demand (1,000 pcu/day)		
	Tribhuvan Highway	Arniko Highway	
	Thankot	Thimi	Sanga
1991	9 (0.6)	11 (0.7)	3 (0.2)
1997	10 (0.6)	18 (1.2)	5 (0.4)
2015	25 (1.7)	31 (2.1)	13 (0.9)

( ) : Congestion Rate


LEGEND : –
4 Lanes Road
2 Lanes Road
N
KATHMANDU
PATAN
BHAKTAPUR
RATNAMATO
BALAJU
BANSBARI
GOKARNESWAR
BHADRABAS
GOKARNA PARK
KHORIYA
BAUDHA
PASUPATINATH
AIRPORT
GWATALA
MINBHAVAN
KOTESWAR
MOUTITAR
LUGHU
SATDOBATO
LAGANKHEL
PULCHOWK
JAWALAKHEL
MANGALBAZAR
KUMARIPATI
TRIBHUVAN UNIVERSITY
RING ROAD
ARNIKO HIGHWAY
BISHNUMATI RIVER
DAGMATI RIVER
MANOHARA RIVER
HANUMANTE RIVER
GODAVARI KHOLA
NAKHUKHOLA
TEKU RIVER
SCALE = 1 : 25,000
HIS MAJESTY'S GOVERNMENT OF NEPAL
(HMG)
KATHMANDU VALLEY
URBAN ROAD DEVELOPMENT
Proposed Road Network
By Lane Numbers
in 2015
FIG. 6.23
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

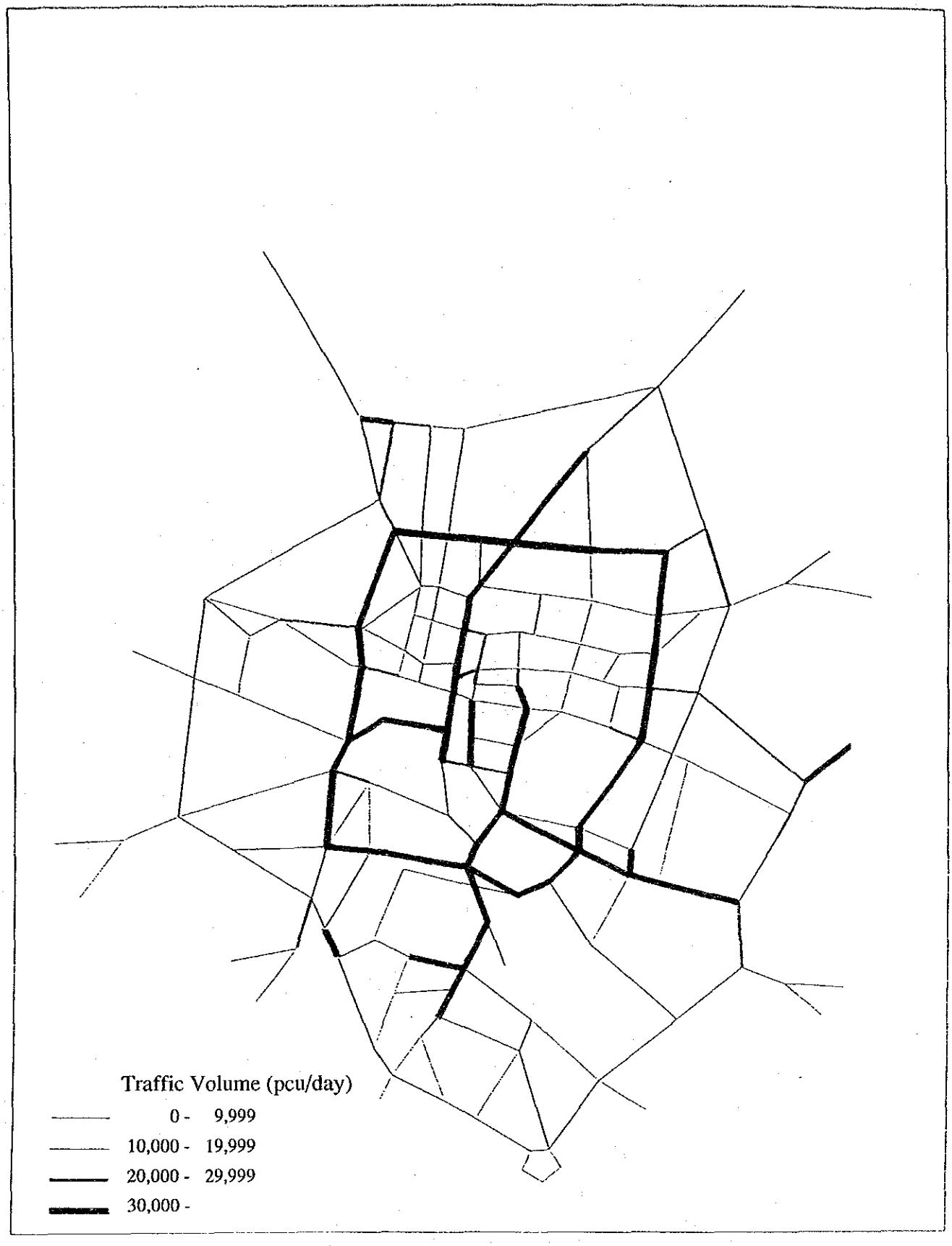


FIG. 6.24 TRAFFIC VOLUME ASSIGNED (2015 - PROPOSED NETWORK)

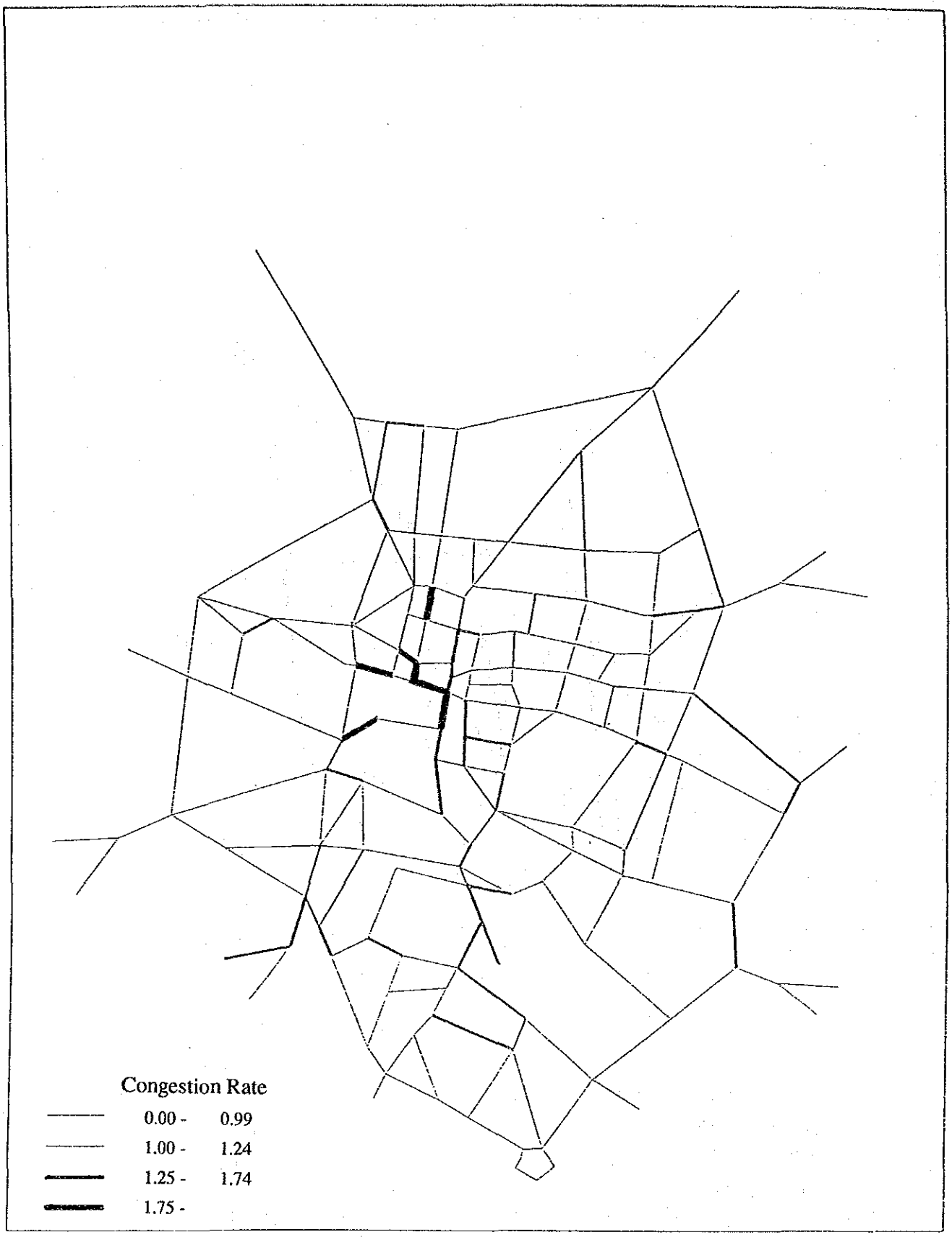


Fig.6.25 CONGESTION RATE (2015 - PROPOSED NETWORK)

(2) Road development in the wave of outward shift of urban area

1) Radial roads

Major radial district roads are located between the Ring Road and the newly developed rural area. These radial roads should be improved to provide minimum public transportation services to all area in the Valley as well as to make the suitable road network for the metropolitan area.

Traffic demand on district roads is shown in Table 6.8. Most of these roads in which number of lanes is only one should be improved to two lanes.

TABLE 6.8 TRAFFIC DEMAND ON DISTRICT ROADS

Number of Lanes	Name of Road	Traffic Demand (1,000 pcu/day)		
		1991	1997	2015
1	Lubhu Road	2	2	6
2	Godawari Road	4	4	13
1	Chapagaon Road	2	3	8
1	Bungamati Road	1	1	2
1	Dakshinkali Road	2	2	3
1	Bhimdhunga Road	1	1	1
1	Tokha Road	–	3	6
1	Phutung Road	–	2	4
2	Budhanilkantha Road	2	4	12
1	Sankhu Road	2	3	5
1	Sundarijal Road	1	3	9
1	Nagarkot Road	1	1	2