2.4 Roads and Road Traffic

2.4.1 Road Network Configuration

1) Road Classification

According to the Regulatory Plan of Managua Road System and Parking Lot Regulations, urban road system is divided into the following classes:

(1) Primary Distributor System (Sistema Distribuidor Primario)
(2) Primary Collector System (Sistema Colector Primario)
(3) Secondary Collector System (Sistema Colector Secundario)
(4) Local Road System (Sistema de Calles)
(5) Cul-de-sac (Sistema de Callejones)
(6) Recreational Road System (Sistema Recreativo de Calles)

Urban road network system is composed basically by the higher four (4) categories; i.e. Primary Distributor, Primary and Secondary Collector and Local Road System.

The Primary Distributor System carries most of the trip entering and leaving the urban area, as well as most of the through movement bypassing the city center. In addition, significant intra-city travel, such as between central business districts and outlying residential areas, between major inner-city communities, and between major suburban centers, is served by the road of this category.

The Primary Collector System interconnects and supplements the Primary Distributor System, and includes all arterials not classified as the Distributor. The collector system places more emphasis on land access than the traffic mobility. The spacing of primary collector roads varies from 200 m to 750 m in the central business district (CBD) to 3 km to 5 km in the suburban fringes but is normally not more than 1.5 km in fully developed areas.

The Secondary Collector System provides both land access service and traffic circulation within residential neighborhoods and commercial and industrial areas. It differs from the Primary Collector System in the point that the roads of the secondary system reach residential neighborhoods, distributing trips from the primary roads to their ultimate destination.

The Local Road System comprises all remaining roads not included in one of the higher categories. It primarily permits direct access to abutting lands and connections to the higher systems.

The functions and specifications of the road systems are explained in Table 2.4.1. This Study will basically take into account the Primary Distributor and Collector, and Secondary Collector System, which form the framework of the urban road network system.

2) Road Length and Network Configuration

The total road length in the Study Area is estimated at approximately 1,100 km at present.

Table 2.4.2 summarizes the length of road by class.

Table 2.4.1
Functional Classification of Urban Road System

CRITERIA	PRIMARY DISTRIBUTOR SYSTEM	PRIMARY COLLECTOR SYSTEM	SECONDARY COLLECTOR SYSTEM	ROAD SYSTEM	CUL-DE-SAC	RECREATIONAL SYSTEM
Rank of Right of Way	40 – 100 m	27 - 39 m	18 – 26 m	14 – 17 m	12 – 13 m	Variable
Typical elements considered within the right of way	Traveled Ways, curbs, borders, sidewalks, walkway, green areas, bus turnouts, median and lateral separator.	Traveled ways, curbs, borders, sidewalks, walkways, green area, bus stops and median.	Traveled ways, curbs, sideways, walkways, green area, green belt.	Traveled ways, curbs, sideways, walkways, green area, green belt.	Traveled ways, curbs, green belts, sideways, walkways	Atmosphere element, green area, traveled ways, sideways, walkways, curbs, balconies, bus turnouts, parking lines.
Circulation Way	Double way	Double way	Double way	Double way	Double way	Double way
Regulation on some vehicles	Allow the circulation of mass transportation with high operation frequency; vehicles of services	Allow the circulation of mass transportation with high operation frequency; vehicles of services	Allow the circulation of mass transportation with low operation frequency, vehicles of municipality services.	Does not allow mass transportation, only school buses; vehicles of municipality services	Does not allow mass transportation only vehicles of service	Does not allow truck circulation or mass urban transportation.
Travel length	5 – 10 km	2 - 5 km	1 – 2 km	100 – 500 m	100 m	–
Operation Speed	50-65 km/h	50-65 km/h	40-50 km/h	20-30 km/h	Maximum 20 km/h	30 km/h
Travel demand	20.000-40.000 veh/d	5.000-20.000 veh/d	3.000-8.000 veh/d	1.000-3.000 veh/d	200 veh/d	3.000-8.000 veh/d
Access to private property	Controlled by marginal roads and/or standards given in the Parking Lot Regulation	Controlled by standards given in the Parking Lot Regulation	DIRECT	DIRECT	DIRECT	Controlled by standards given in the Parking Lot Regulation
Continuity of the System	Yes	Yes	Yes	Yes	Yes	Yes
Parking on the Traveled way	Prohibited	Prohibited	Prohibited	Minimum of one parking line controlled under regulation	Parking space in both ways	Only on turnouts especially designed
Frontage roads	According to Zoning and Land Use Regulation for the Area of the Municipality of Managua					
Spacing	1.50 km	Under 1.50 km	500-750 m	100-200 m	100 m	Not defined

Source: Plan Regulador de Managua

Table 2.4.2
Length of Roads by Road Classification in Managua, 1998

Class of Road	Length (km)	(%)
Travesia	4.52	0.4
Primary Distributor (Distribuidor Primario)	93.29	8.4
Primary Collector (Colector Primario)	34.70	3.2
Secondary Collector (Colector Secundario)	18.35	1.6
Sub-total	150.86	13.6
Local Road (Calle)	957.86	86.4
Total	1,108.72	100.0

Source: ALMA

The Travesia is the bypass partially constructed as the Outer Ring Road running through the peripheral area of the currently urbanized area of Managua. This should be understood as a special type of the Primary Distributor. Figure 2.4.1 shows the functional road classification of the existing road network.

2.4.2 Road Characteristics

1) Number of Lanes and ROW

As shown in Figure 2.4.2, the present road network of Managua is composed of 4-lane and 2-lane roads. Most of major arteries are of 4 lanes in the urbanized area. However, there are still many road sections of 2 lanes that should constitute the basic network of arterial roads. Also, the interurban arteries going to Masaya, León, Jinotepe and Mateare are of 2 lanes.

Figure 2.4.3 presents the current right-of-way (ROW) of the road network. From this figure, the following can be pointed out:

- Most of existing 4-lane roads can be widened to 6-lane roads using the existing ROW (27 m or more). Some parts of this surplus of ROW are used as side streets, medians, green belts and so on at present.

- On the contrary, most of existing 2-lane roads have a ROW of less than 18 m. This means that most of the present 2-lane roads are so because of the lack of ROW.

- In spite of the above, there are some roads that can be widened from 2 lanes to 4 lanes or more, using the existing ROW, such as:

  - Ave. Simón Bolivar in the West of Laguna de Tiscapa.
  - Ave. Batahola.
  - Carretera a Masaya.
  - Carretera Sur Via Panamericana (South of San Patricio).
  - Carretera Vieja a León.
  - Carretera Nueva a León.

The widening of these roads, however, should be evaluated in the light of future traffic demand.

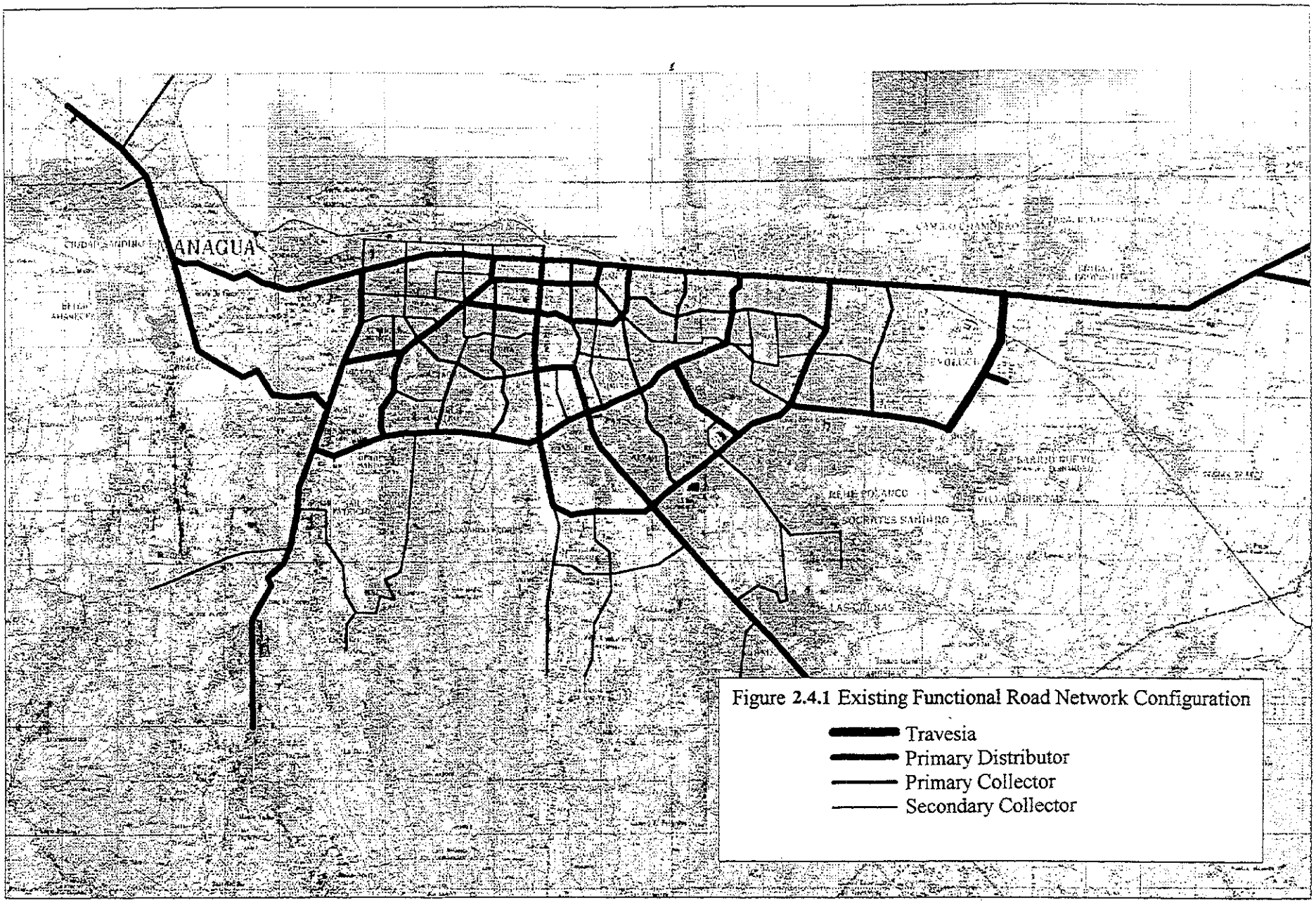


Figure 2.4.1 Existing Functional Road Network Configuration

Source: ALMA

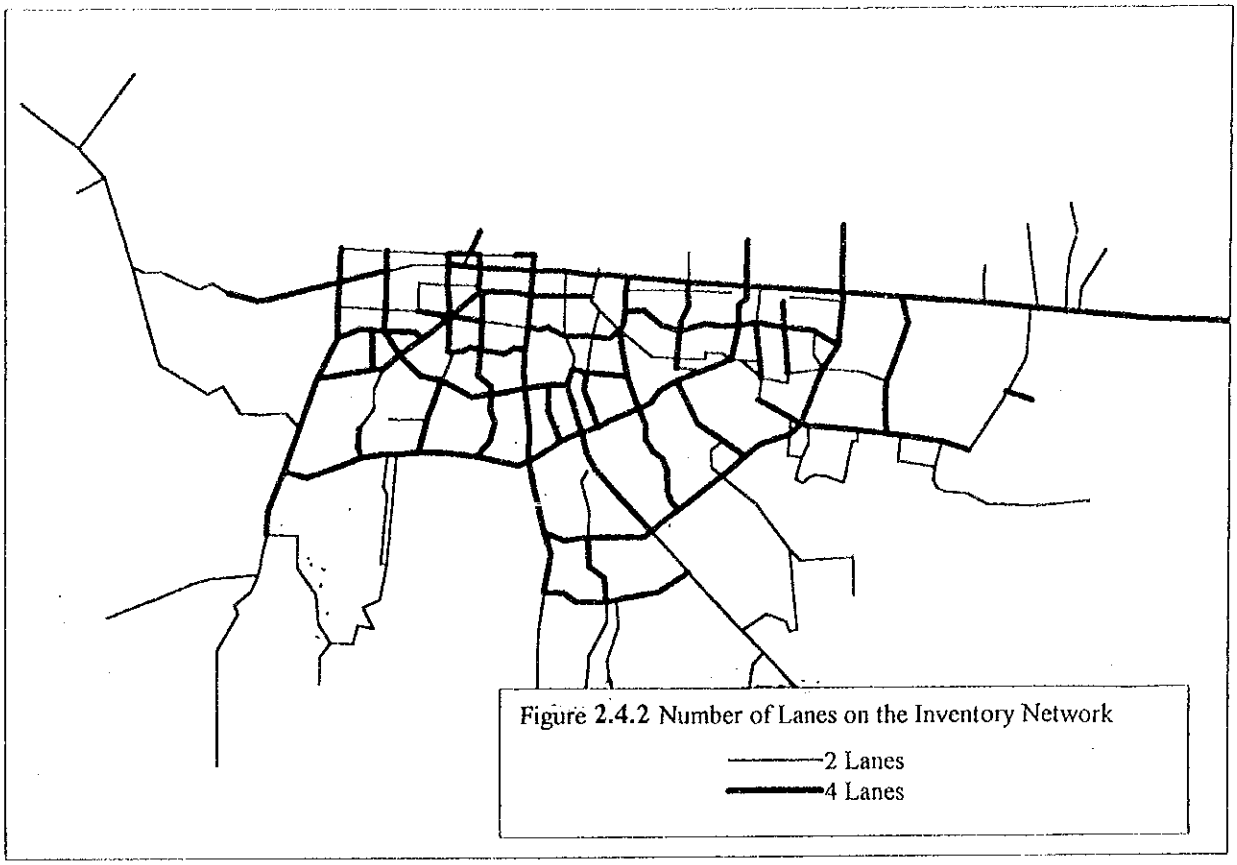


Figure 2.4.2 Number of Lanes on the Inventory Network

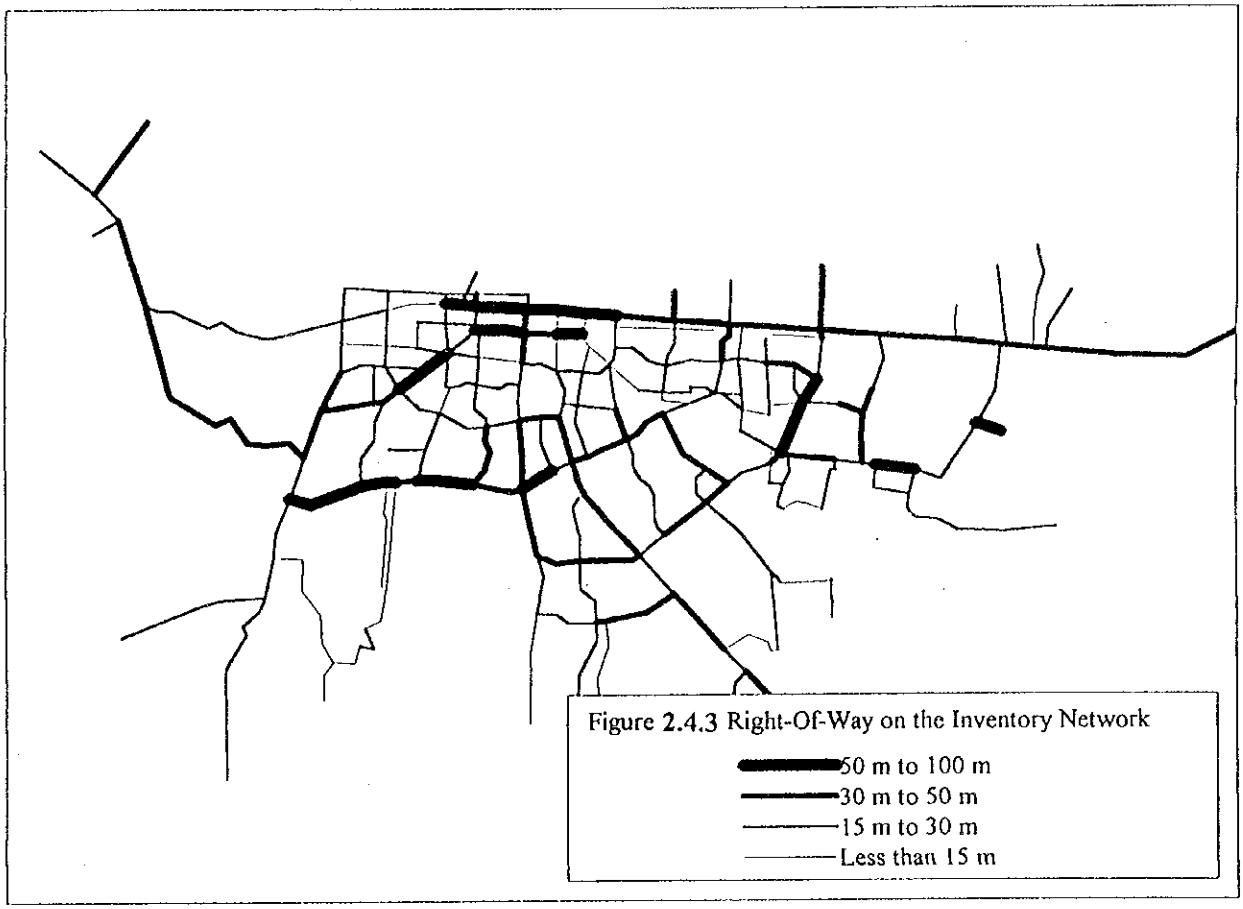


Figure 2.4.3 Right-Of-Way on the Inventory Network

2) **Type of Pavement**

Figure 2.4.4 shows the pavement type of the existing road network.

- Most of the roads are paved either by asphalt or block (interlocking pavement). Concrete is rare and earth is found only in some frontage roads.
- Primary Distributor is paved mainly by asphalt. Particularly, the interurban arteries are paved mostly by asphalt, except for a few concrete or block sections.

3) **Pavement Condition**

Based on the road inventory survey, pavement condition was assessed as follows:

i. Three (3) factors were taken into account: potholes, crack and rutting. Then the following points were given to the conditions of these factors:

-	Pothole	None (3),	Few (2),	Many (1)
-	Crack	None (3),	Few (2),	Many (1)
-	Rutting	None (3),	Slight (2),	Serious (1)

ii. When the total points is 9, the road section is evaluated as "Good", for 6-8 as "Fair", and for 3-5 as "Bad".

The result is presented in Figure 2.4.5. There are a number of sections with "Bad" pavement condition. These sections require immediate maintenance or rehabilitation.

4) **Sidewalk**

Most of the major roads in Managua are provided with sidewalks. In the central area of Managua, the sidewalks are mostly asphalt or concrete paved. However, in the outer areas, the sidewalks are often left unpaved. During the rainy season, this may cause a serious inconvenience to pedestrians. (See figure 2.4.6).

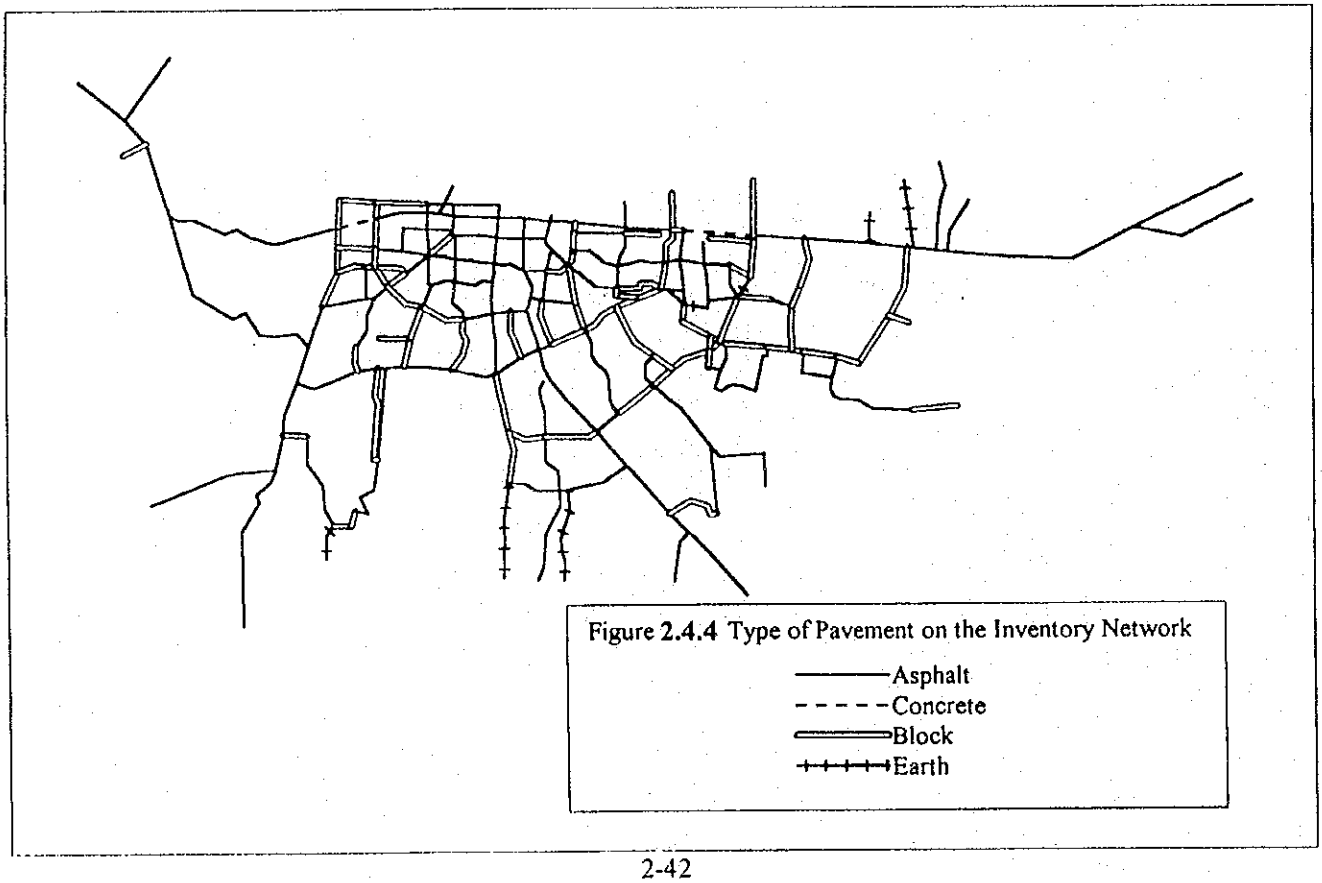


Figure **2.4.4** Type of Pavement on the Inventory Network

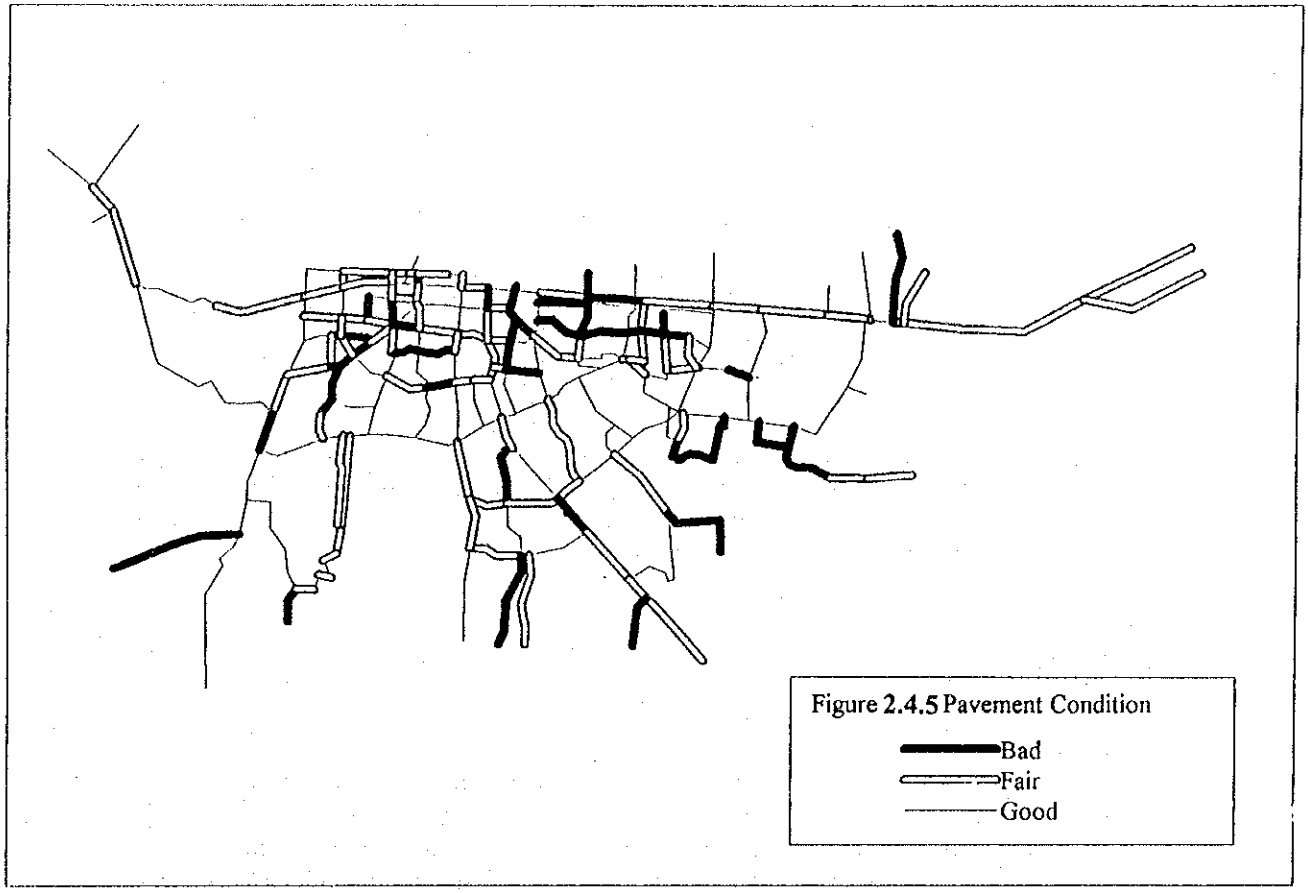


Figure 2.4.5 Pavement Condition

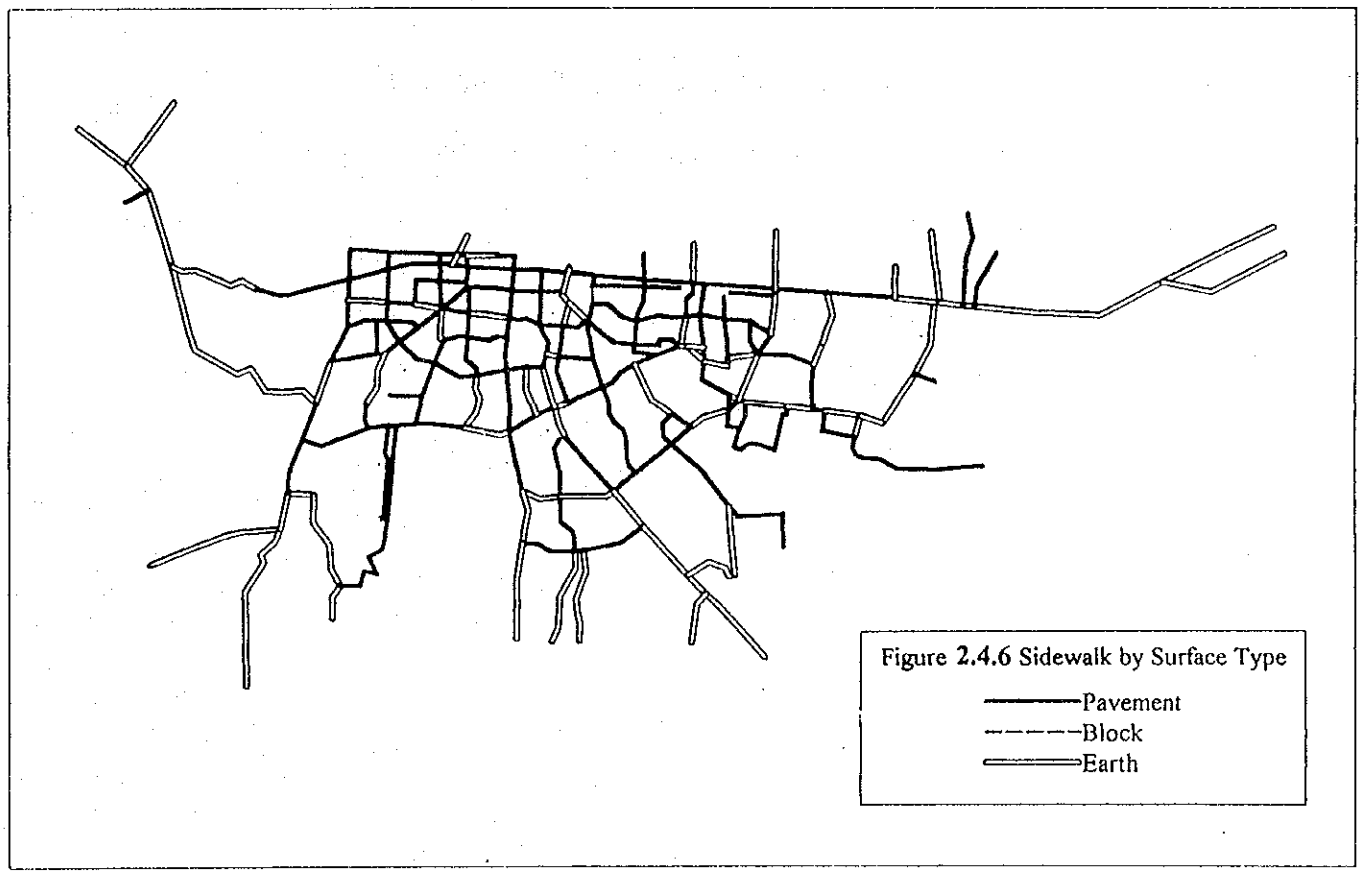


Figure 2.4.6 Sidewalk by Surface Type

2.4.3 Traffic Volume

Figure 2.4.7 illustrates the distribution of traffic volume (24 hours) estimated from the traffic count survey at major intersections in Managua. The most heavily trafficked road is Pista Pedro Joaquín Chamorro with a traffic volume of about 55 thousand vehicles per a day. Pista Juan Pablo II, Ave. Rubén Darío and Pista Portezuelo also show a large traffic volume of about 30 to 45 thousand vehicles.

Figure 2.4.8 and 2.4.9 show the traffic volume of bus and truck, respectively. Bus is concentrated in Pista Pedro Joaquín Chamorro, Pista Juan Pablo II, Pista Portezuelo, etc., while trucks are mainly found on arteries which have interurban functions, such as Pista Pedro Joaquín Chamorro, Carretera Sur and Pista Juan Pablo.

Figure 2.4.10 presents the volume/capacity ratio of these roads. Traffic volume was converted to passenger car units (PCV) by vehicle type and compared with the road capacity. The volume/capacity ratio is mostly less than 1.0 but over 1.0 on sections of arteries such as Pista Juan Pablo II and Carretera Sur, etc.

2.4.4 Traffic Characteristics

Vehicle Composition

Table 2.4.3 shows the vehicle composition by location. In the urbanized area of Managua Municipality (Stations of screenline surveys), cars (including passenger jeeps and taxies) shares largest percentage about 84%, other vehicles types such as buses, trucks and motorcycles share about 5%, respectively. While in the municipal boundary, the share of cars is lower at 65%, higher share of buses and trucks at 12% and 16%, respectively.

Table 2.4.3
Vehicle Composition (24 hours/both directions), 1998

(%)

Location	Car	Bus	Truck	Motorcycle	Bicycle	Others
Cordonline	65.0	12.3	16.1	4.1	2.2	0.3
Screenline	84.3	4.6	4.9	5.1	0.9	0.1

Source: Traffic Count Survey

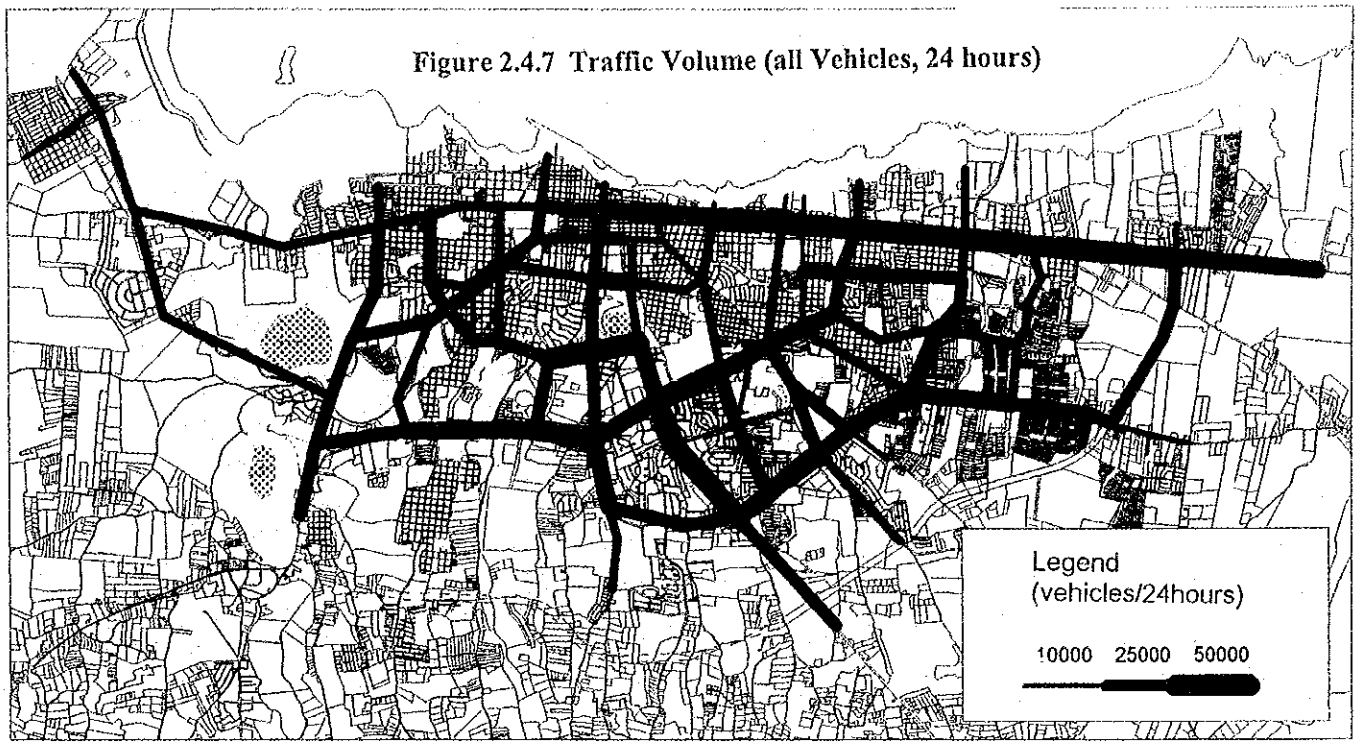


Figure 2.4.7 Traffic Volume (all Vehicles, 24 hours)

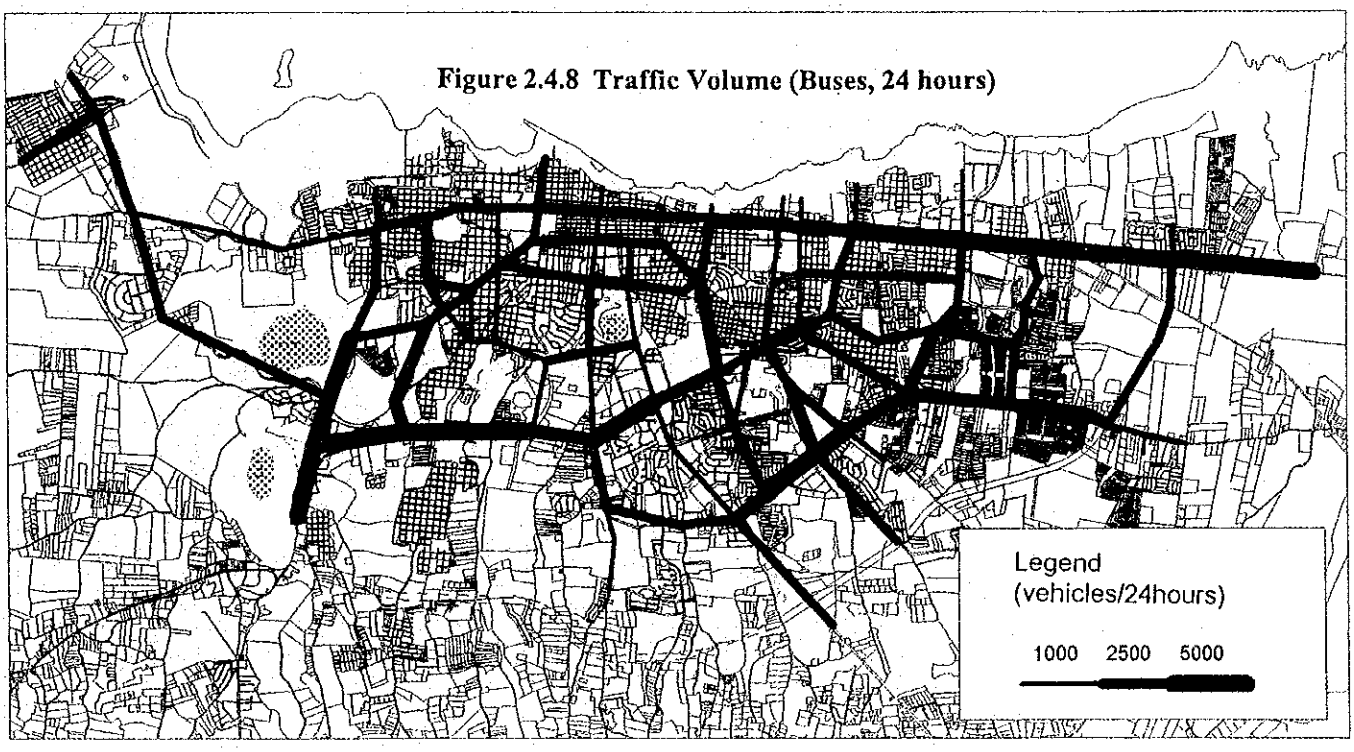


Figure 2.4.8 Traffic Volume (Buses, 24 hours)

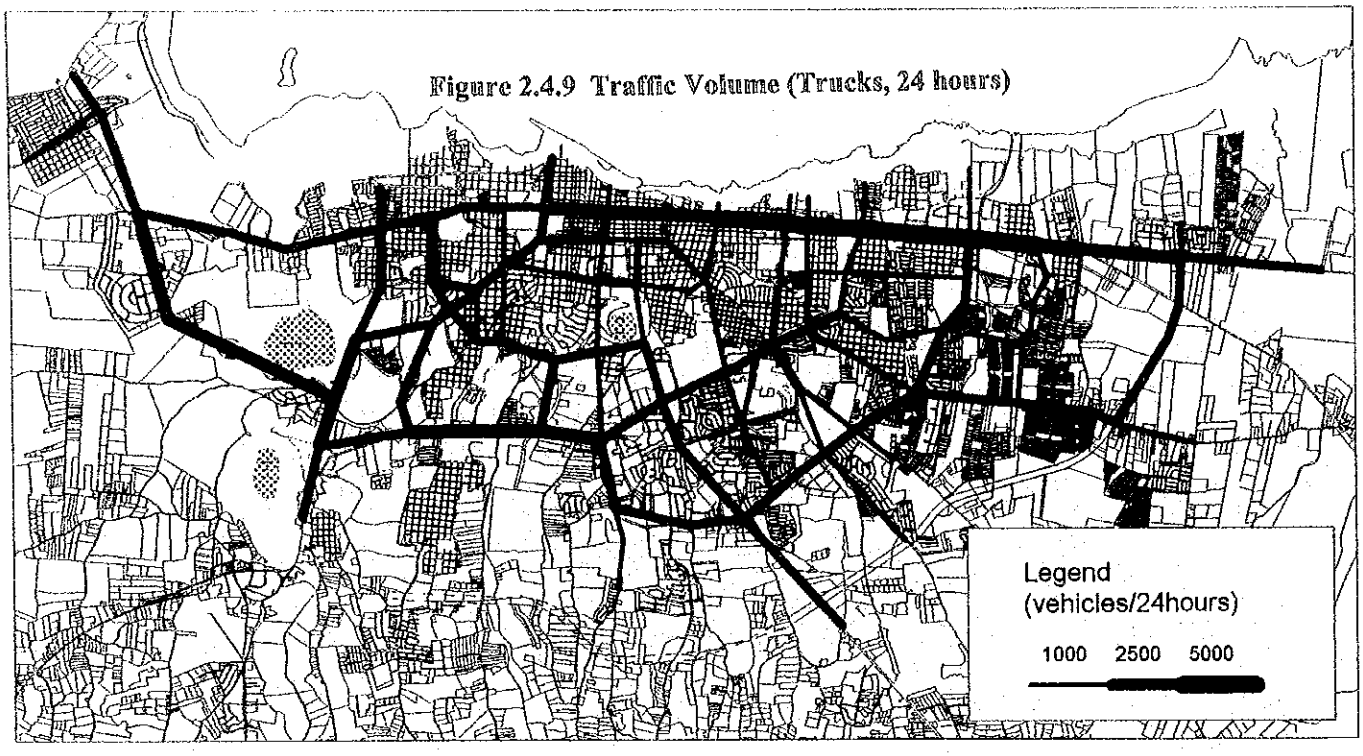


Figure 2.4.9 Traffic Volume (Trucks, 24 hours)

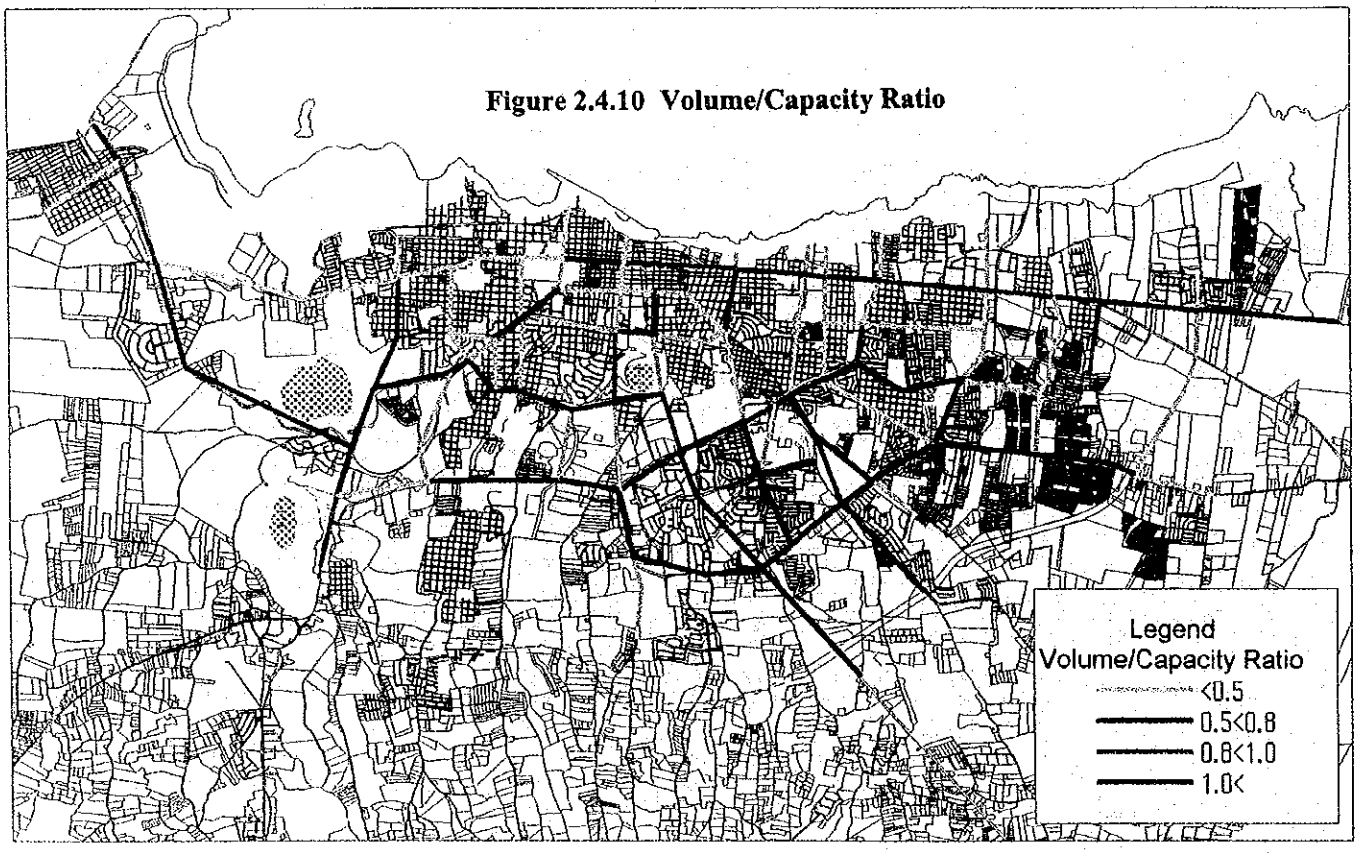


Figure 2.4.10 Volume/Capacity Ratio

Hourly Variation

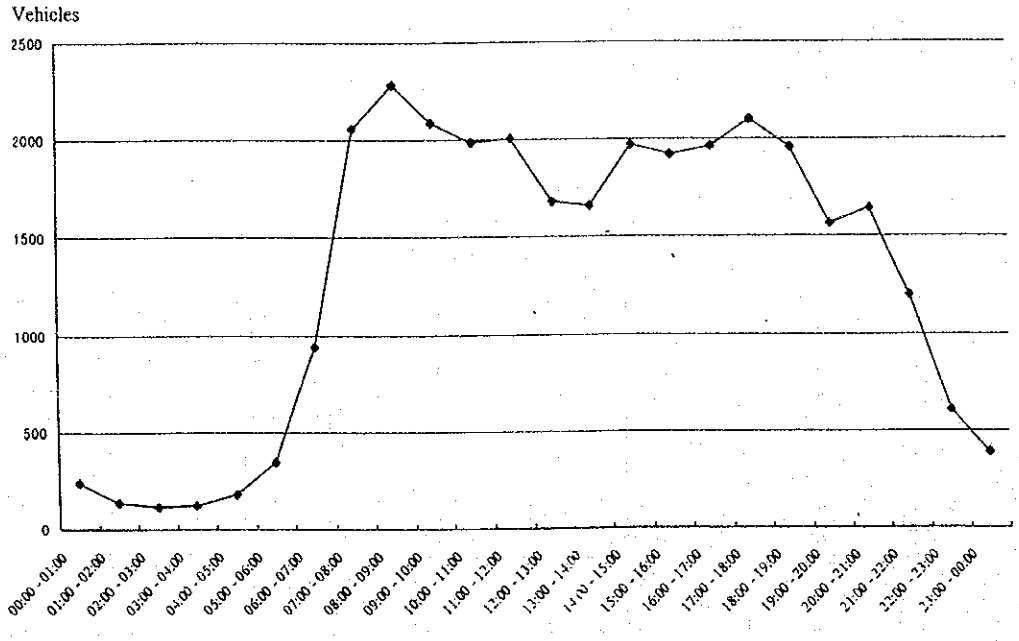
Table 2.4.4 shows the results of a 24-hour traffic count survey conducted at Pista Juan Pablo II. Figure 2.4.11 illustrates the hourly variation of traffic volume. Although this is only a sample, its pattern is typical, similar to other stations, i.e.:

Traffic volume starts to increase at 6:00 in the morning, reaches its peak around 8:00 in the morning, fluctuates at a 10 to 30% lower level in the daytime, reaches another peak at around 5:00 – 6:00 p.m., and decreases quickly after 9:00 p.m.

Table 2.4.4
Traffic Volume by Vehicle Type and by Hour
(Pista Juan Pablo II)

Time	Car	Taxi	Large Bus	Mini Bus	Motor Cycle	Bicycle	Light Truck	Large Truck	Truck Trailer	Others	Total
07:00-08:00	1,015	582	172	101	111	26	25	24	25	3	2,084
08:00-09:00	1,169	672	169	82	88	26	29	40	29	6	2,310
09:00-10:00	1,133	533	142	60	94	21	54	46	54	4	2,141
10:00-11:00	1,132	450	133	57	114	15	34	49	34	3	2,021
11:00-12:00	1,167	440	138	78	94	12	30	49	30	1	2,039
12:00-13:00	1,070	293	118	62	73	12	12	38	12	1	1,691
13:00-14:00	990	350	125	62	51	9	39	32	39	1	1,698
14:00-15:00	1,192	372	135	92	93	17	31	35	31	2	2,000
15:00-16:00	1,098	410	146	66	105	12	35	40	35	5	1,952
16:00-17:00	1,098	443	155	86	78	29	34	38	34	1	1,996
17:00-18:00	1,156	479	181	68	108	36	41	31	41	0	2,141
18:00-19:00	1,076	439	166	65	107	29	39	27	39	7	1,994
12h Total	**13,296**	**5,463**	**1,780**	**879**	**1,116**	**244**	**403**	**449**	**403**	**34**	**24,067**
19:00-20:00	807	520	104	45	55	14	16	5	16	1	1,583
20:00-21:00	900	502	108	29	75	7	15	8	15	1	1,660
21:00-22:00	592	424	76	33	47	9	9	10	9	0	1,209
22:00-23:00	283	241	22	28	23	1	5	2	5	0	610
23:00-00:00	183	171	2	13	16	0	3	2	3	0	393
00:00-01:00	109	103	1	11	9	0	4	1	4	0	242
01:00-02:00	50	72	0	5	8	0	3	2	3	0	143
02:00-03:00	38	61	0	9	5	0	2	1	2	0	118
03:00-04:00	45	59	2	8	8	3	0	1	0	0	126
04:00-05:00	65	73	13	11	7	0	7	3	7	0	186
05:00-06:00	108	104	75	10	13	15	10	9	10	3	357
06:00-07:00	333	267	155	50	48	20	13	43	13	4	946
12h Total	**3,513**	**2,597**	**558**	**252**	**314**	**69**	**87**	**87**	**87**	**9**	**7,573**
Total0	.16,809	8,060	2,338	1,131	1,430	313	490	536	490	43	31,640

Figure 2.4.11
Hourly Variation of Traffic
(Pista Juan Pablo II)



Ratio of Daytime/Nighttime Traffic

The ratios of 12-hour traffic to 24-hour traffic by vehicle type and location of survey stations are shown in Table 2.4.5. The ratios are calculated about 0.79 – 0.85. Trucks show higher ratio in the urbanized area, while lower in the Municipal boundary.

Table 2.4.5
Ratio of Daytime/Nighttime Traffic (12/24 hours), 1998

Location	Car	Bus	Truck	Motorcycle	Bicycle	Others	Total
Cordonline	0.81	0.80	0.79	0.85	0.81	0.86	0.81
Screenline	0.80	0.79	0.83	0.82	0.83	0.84	0.80

Source: Traffic Count Surveys

Ratio of Peak-hour Traffic

The ratios of peak-hour traffic to 24-hour traffic are presented in Table 2.4.6. Peak-hour ratio is about 9-9% of the 24-hour traffic. Peak-hours are mostly between 16:00 and 18:00 in the afternoon.

Table 2.4.6
Ratio of Peak-hour Traffic, 1998

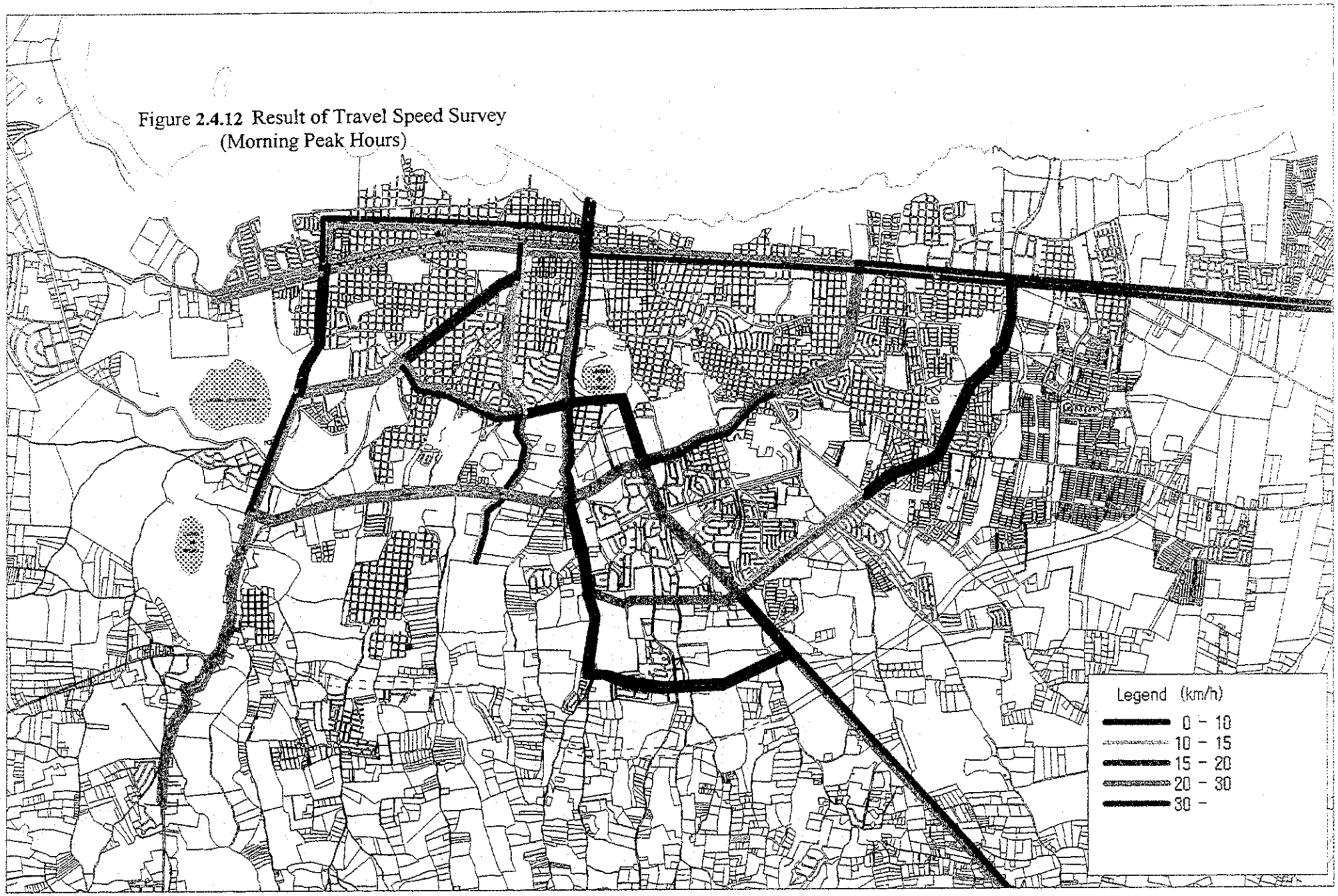
Location	Station	Traffic Volume		Peak-hour Ratio (%)	Peak Time Period
		24-hour	Peak-hour		
Cordonline	1	6,127	494	8.1	13-14
	2	1,892	151	8.0	17-18
	3	15,120	1314	8.7	17-18
	4	17,131	1534	9.0	7-8
	5	886	81	9.1	16-17
	6	3,130	264	8.4	17-18
Screenline	1	3,613	392	10.8	16-17
	2	35,352	2621	7.4	17-18
	3	9,081	902	9.9	10-11
	4	24,586	2128	8.7	10-11
	5	38,074	32713	9.8	17-18
	6	17,599	1647	9.4	17-18
	7	44,083	3054	6.9	8-9

Source: Traffic Count Surveys

2.4.5 Travel Speed

Figure 2.4.12 shows the travel speed by section and by direction during morning peak hours for the eight (8) surveyed routes. Judging from this figure, most of arteries of Managua have a travel speed of 20 km,/h or more. Only some sections of Paseo Naciones Unidas, Pista Portezuelo, Paseo República de Chile y Ave. Simón Bolívar have a travel speed of less than 20 km/h. Particularly, Paseo Naciones Unidas has sections of which travel speed of less than 10km/h.

Figure 2.4.12 Result of Travel Speed Survey
(Morning Peak Hours)



2.5 Public Transport System

2.5.1 Bus Routes

At present there are 39 bus routes operated in the Municipality of Managua as listed in Table 2.5.1. The service coverage of buses is illustrated in Figure 2.5.1.

- Most of the major arteries of Managua are serviced by bus. The interurban arteries such as Carretera a Masaya, which are not serviced by city buses at present, are covered by inter-city bus services. Generally speaking, the service network of city buses is dense in the urbanized areas. The newly developing outer areas, however, have a poor access to bus services.

- The length of bus routes ranges from 10 km to 26 km. The average length is about 18 km. The routes, in general, are not straight between terminals, and often make turns to visit major sources of passenger generation. This practice may make the bus operation more profitable by forcing passengers to transfer under the current flat fare at 1.40 Córdobas per ride.

2.5.2 Bus Operational Characteristics

Scheduled Speed

The schedule speed can be calculated by route from Table 2.5.1. It ranges from 10.5 km/h (Route 159) to 28.1 km/h (Route COOSPETECS), however, most of the routes have a scheduled speed of 17 to 23 km/h. The levels of services in this regard are considered very high as compared to other congested capital cities. This is due to the current traffic situation, where no serious traffic congestion is observed yet.

Service Hours

The service hours vary by route as shown in Table 2.5.1. The starting time ranges from 3:30 to 5:05 with a typical time at 5:00. The closing time, however, has a wide range from 18:00 to 23:15. Most of the routes stop operation between 21:00 and 22:00.

Headway

All the routes have a service headway of 1 to 15 minutes. Some routes have a fixed headway all the day, while others change headway depending on the time of the day.

Occupancy and Load Factor

The occupancy of buses varies depending on route, section and time of the day. Table 2.5.2 summarizes the results of the bus occupancy survey as a total of all routes observed in 13 stations.

Table 2.5.1
Existing Bus Routes, 1998

Sequential	Route	Terminals		Route	Service	Scheduled	Scheduled
No.	Code	From/to	To/from	Lenght Km.	Hour	Headway (mins.)	Travel Time (mins.)
1	6	Colonia El Periodista	Bo. Camilo Chamorro	26.00	5:00 - 21:00	8, 10, 12 and 15	78
2	101	Mercado Mayorista de Managua	El Pantanal	25.00	4:45 - 21:00	5 and 6	80
3	102	Mercado Mayorista de Managua	Acahualinca	22.50	5:00 - 21:00	15, 10, 7 and 5	68
4	103	Villa Libertad	35 Ave. W. El Seminario	19.50	5:00 - 22:00	9 and 8	49
5	104	Barrio Hialeah	Mercado Mayorista	25.00	5:00 - 21:30	8 and 10	65
6	105	Barrio Camilo Ortega	Unidad de Propósito	20.60	5:00 - 22:00	8	57
7	106	El Seminario	Café Soluble	23.50	5:00 - 21:30	6 and 8	65
8	107	Barrio Camilo Ortega	Mercado Oriental	12.70	5:00 - 22:00	10, 8 and 5	43
9	108	Reparto Shick	Jardines de Sta. Clara	17.50	5:00 - 22:00	8	54
10	109	Reparto Shick	Parque Central	12.60	5:00 - 22:00	8 and 9	54
11	110-C	Mercado Ciudad Sandino	Reparto Serrano	15.50	5:00 - 22:00	10 and 8	47
12	110-R	Mercado Mayorista de Managua	El Seminario	18.00	4:40 - 20:00	10, 7, 6 and 5	48
13	111	Laureles Norte	Colonia Miguel Bonilla	20.00	5:00 - 21:00	8 and 10	60
14	112	Villa Libertad	Centro Civico	21.00	5:00 - 22:00	10, 8 and 5	60
15	113	Zona 6 Ciudad Sandino	Mercado Oriental	19.00	4:30 - 21:30	1, 8, 10 and 15	47
16	114	Villa José Benito Escobar	Refinería (Fte. Mayco)	22.00	5:00 - 22:00	10, 8 and 5	60
17	115	Zona 5 Ciudad Sandino	Mercado Oriental	14.50	4:30 - 22:30	15, 12 and 10	55
18	116	Villa Libertad	El Seminario	17.50	5:05 - 22:05	7 and 8	55
19	117	Unidad de Propósito	Rotonda Rubén Darío	23.00	5:05 - 22:05	9 and 10	63
20	118	Los Laureles	El Seminario	21.30	5:00 - 22:00	10	65
21	119	Villa Fraternidad	Refinería (Fte. Mayco)	21.80	5:00 - 22:00	7	65
22	120	Mercado Mayorista de Managua	El Seminario	18.80	4:40 - 23:15	10, 6, 5 7, 8 and 15	54
23	123	Centro Civico	Barrio La Fuente	18.10	5:00 - 21:15	8	50
24	125	Bello Amanecer	Mercado Oriental	15.00	4:30 - 22:00	8, 10 and 15	40
25	154	Barrio Camilo Ortega	Mercado Oriental	14.00	5:00 - 18:00	10	40
26	158	Barrio Camilo Ortega	Mercado Oriental	13.00	4:30 - 19:00	6	40
27	159	Mercado Mayorista de Managua	Acahualinca	10.00	4:50 - 19:00	7	57
28	163	Laureles Sur	Mercado Oriental	13.50	4:30 - 20:00	5 and 6	43
29	164	Villa Cuba	Mercado Oriental	17.00	4:24 - 20:00	10, 6 and 5	57
30	165	Naciones Unidas	Bro. Las Torres (frente Sandak)	18.60	5:00 - 10:00	10 and 8	48
31	167	Laureles Sur	Malecón	13.00	5:00 - 19:00	7	41
32	168	Laureles Sur	Colonia Miguel Bonilla	14.00	5:00 - 21:30	5 and 6	55
33	170	Villa José Benito Escobar	Mercado Oriental	11.00	4:30 - 20:00	4	36
34	172	Mercado Ciudad Sandino	Mercado Oriental	19.50	4:15 - 21:35	7 and 8	45
35	175	Marvin Marín	Cine México	15.00	5:00 - 22:00	10	52
36	261-MR-4	Villa Roma	Mercado Central	15.50	5:00 - 22:00	5 and 6	35
37	262	Los Vanegas	Mercado Oriental	20.00	5:00 - 20:00	15, 7 and 8	52
38	266	Zona Franca	Mercado Oriental	11.00	5:00 - 20:00	4	30
39	COOSPETECS	Mercado Ciudad Sandino	Mercado Oriental	15.00	3:30 - 21:00	3	32

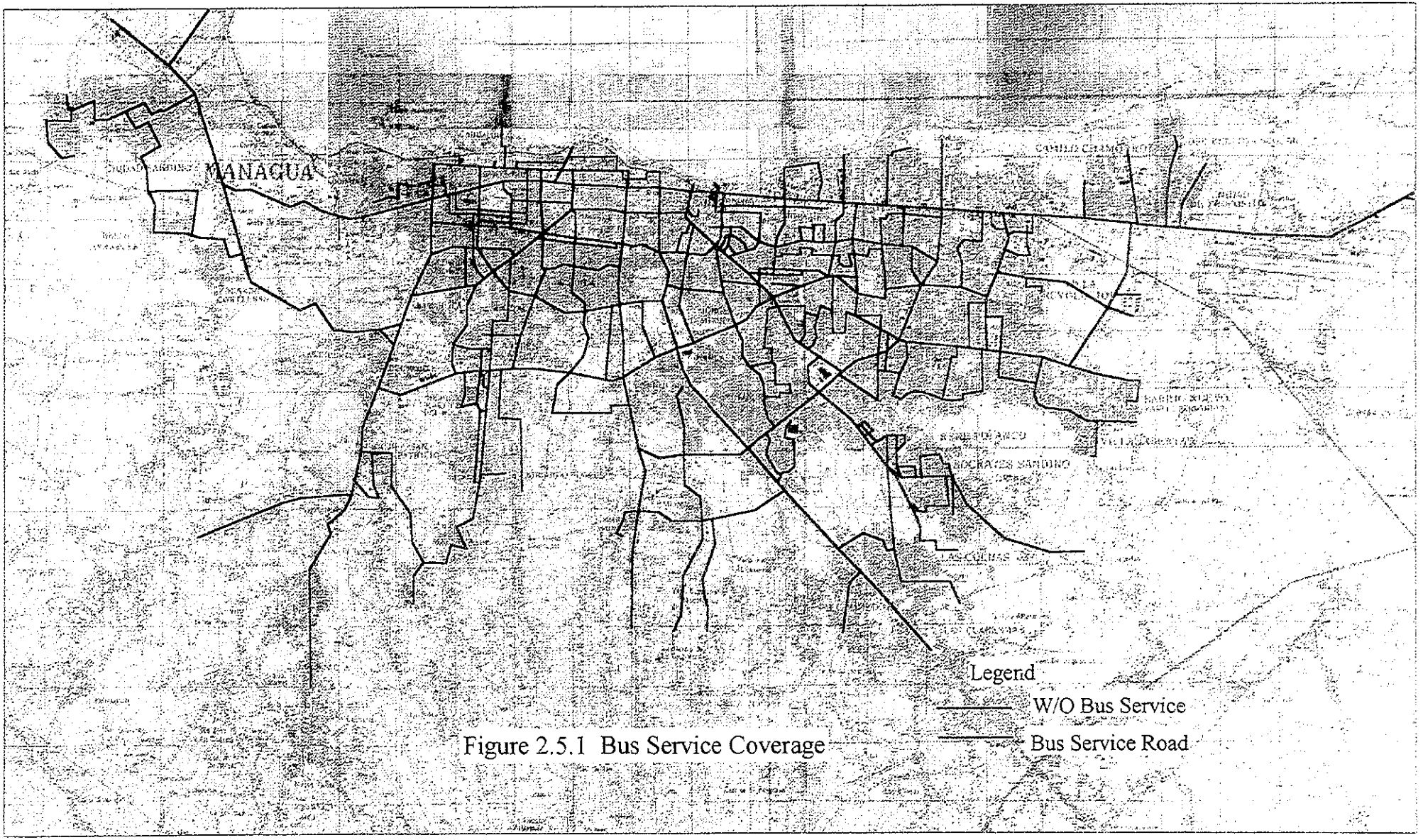


Figure 2.5.1 Bus Service Coverage

Table 2.5.2
Occupancy and Load Factor of Buses, 1998

Time	No. of Buses Surveyed	No. of Pass. Counted	Total Seating Capacity	Ave. Occupancy (pass./bus)	Ave. Load Factor (%)
07:00 – 07:59	686	29,562	28,469	43.1	103.8%
08:00 – 08:59	603	21,640	25,405	35.9	85.2%
09:00 – 09:59	601	20,006	24,235	33.3	82.6%
10:00 – 10:59	581	18,254	23,940	31.4	76.2%
11:00 – 11:59	597	19,269	24,923	32.3	77.3%
12:00 – 12:59	555	19,891	22,955	35.8	86.7%
13:00 – 13:59	564	15,502	23,650	27.5	65.5%
14:00 – 14:59	556	16,564	23,124	29.8	71.6%
15:00 – 15:49	552	17,739	22,929	32.1	77.4%
16:00 – 16:49	570	21,019	23,494	36.9	89.5%
17:00 – 17:59	571	26,116	23,643	45.7	110.5%
18:00 – 19:00	553	27,107	23,549	49.0	115.1%
Total	**6,989**	**252,669**	**290,316**	**36.2**	**87.0%**

- Average occupancy and average load factor were calculated at 36.2 passengers/bus and 87.0%, respectively. The load factor was calculated against the seating capacity.

- Both average occupancy and load factor are high in the morning and evening peak hours and low in the inter-peak hours (13:00 – 15:00).

2.5.3 Number of Bus Passengers

Table 2.5.3 shows the number of bus passengers by route. There are 930 operating city bus units at present, and each unit carries about 740 passengers a day. This fact implies that the city bus system of the Municipality of Managua is transporting approximately 690 thousand passengers a day at present. However, these figures are based on the interviews with bus operators. Compared to the result of the Person-Trip Survey (about 822 thousand bus passengers per day), this may be an underestimate.

2.5.4 Utilization of Bus Units

Table 2.5.4 shows the bus units utilization by company/cooperative.

- Out of the total of 1,087 units owned, 930 units or 85.6% are operational.

- Average seating capacity of bus units ranges 16 to 64 by company/cooperative with an aggregate average at 46.

- Average year of the make of bus units varies from 1978 to 1989 by company/cooperative with an aggregate average at 1984.

- The units are extensively used seven (7) days a week in most companies/cooperatives. The average is 6.6 days a week.

Table 2.5.3
No. of Bus Passengers by Route, 1998

Route	No. of Units Allocated[1]	No. of Passengers Transported per Day	Ave. No. of Passengers per Day per Unit
6	25	17,064	682.6
101	46	39,100	850.0
102	47	32,900	700.0
103	11	4,776	434.2
104	21	21,000	1,000.0
105	15	16,456	1,097.1
106	36	22,425	622.9
107	62	n.a.	n.a.
108	16	13,920	870.0
109	9	7,029	781.0
110	60	28,272	471.2
111	26	23,400	900.0
112	62	n.a	n.a.
113	42	25,830	615.0
114	62	n.a.	n.a.
115	34	16,533	501.0
116	14	13,766	983.3
117	14	18,400	1,314.3
118	13	14,479	1,113.8
119	16	20,160	1,260.0
120	61	28,752	471.3
123	24	17,160	715.0
125	45	10,828	240.6
154	16	11,500	718.8
157	4	1,800	450.0
158	20	15,850	792.5
159	19	12,800	673.7
163	37	29,600	800.0
164	15	n.a.	n.a.
165	27	20,200	748.1
167	21	14,600	695.2
168	27	25,940	960.7
170	25	11,595	463.8
172	27	4,888	181.0
175	16	8,950	559.4
262	29	19,600	675.9
266	21	15,600	742.9
267	25	10,000	400.0
110C	51	7,170	651.8
MR4	40	n.a.	n.a.
Total	**930 (118)[2]**	**602,343[3]**	**741.8[3]**

Source: Bus Operators Interview Survey

Note: 1) Some bus units are shared by two (2) or more routes. The total does not sum due to this reason.
2) Figure in parenthesis is the number of units that have no passenger information.
3) Calculated for 812 units that have passenger information.

Table 2.5.4
Utilization of Bus Units by Company/Cooperative, 1998

Company/Cooperative	No. of Units Owned		Ave. Seating Capacity of Operational Units	Ave. Year of Operational Units	No. of Passengers Transported per Day	Ave. No. of Operating Days/ Week
	Operational[1]	Total				
Coop. 22 de Octubre	24	24	56.3	1985	17,160	7.0
Coop. 25 de Abril	11	11	42.5	1980	7,170	7.0
Coop. Andrés Castro	47	47	60.4	1981	32,900	6.0
Coop. Cambio en Marcha	14	17	62.9	1982	9,240	5.9
Coop. de Transp. "Camilo Ortega"	40	40	32.3	1983	29,150	7.0
Coop. de Transp. "Camilo Chamorro"	25	28	49.5	1979	11,595	7.0
Coop. de Transp. La Divina Luz, Code 164	15	15	57.8	1979	n.a.	7.0
Coop. de Transp. Unidos 17 de Oct.	25	25	52.3	1989	17,064	7.0
Coop. Democracia en Marcha	18	24	20.2	1986	5,940	7.0
Coop. Iván Montenegro	27	34	55.4	1982	25,940	7.0
Coop. Las Jaguitas	29	29	34.9	1981	19,600	6.0
Coop. Nicarao	26	33	55.6	1980	23,400	6.0
Coop. Pedro J. Chamorro	42	42	53.1	1984	25,830	6.0
Coop. Ricardo Morales Aviles	40	40	49.9	1987	28,400	7.0
Coop. Samuel Mairena	40	40	n.a.	1986	n.a.	7.0
Coop. Transp. Unidos	7	7	51.6	1984	6,496	6.0
Coop. Unidad y Esfuerzo R.L.	34	41	54.9	1983	16,533	5.9
Coop. Unitarios, R.L.	28	31	54.2	1987	26,880	7.0
Coop. Casimiro Sotelo	37	37	57.7	1980	29,600	6.0
Coop. Colón	62	62	39.7	1989	n.a.	7.0
Coop. Cospetecs, R.L.	25	25	16.0	1986	10,000	7.0
Coop. Nueva Nicaragua Democrática	27	29	45.6	1986	20,200	6.6
Coop. Omar Baca	21	21	44.8	1985	21,000	7.0
Coop. Reconciliación	16	16	37.9	1984	8,950	6.0
Coop. de Transp. Unidos R.L.	26	26	42.2	1983	24,128	6.0
Cootrasude	21	23	30.3	1984	14,600	7.0
COTRANSPAV R.L.	108	225	39.1	1989	108,507	6.8
Emp. 30 de Mayo Ruta 106	13	13	51.8	1978	7,000	7.0
Empetrunsa	9	9	64.4	1985	6,185	6.8
ETBUSA	46	46	56.3	1980	39,100	6.0
Marlón Zelaya	27	27	29.3	1985	9,775	7.0
Total	930 (118)[2]	1087	45.9	1984	602,343	6.6

Source: Bus Operators Interview Survey

Note: 1) Some bus units are shared by two (2) or more routes. The total does not sum due to this reason.
2) Figure in Parenthesis is the number of units that have no passenger information.

2.5.5 Bus Terminal

Table 2.5.5 summarizes the number of bus terminals by function and location type including four (4) interurban bus terminals. Figure 2.5.2 and 2.5.3 indicate the location of bus terminals by function and location type, respectively.

Out of 45 terminals, four (4) are interurban, three (3) are both interurban and urban, and the remaining 38 are urban. Out of the 38 urban terminals, 11 are merely turning circuits using the existing roads. In general, the level of facilities is poor in urban terminals, while all interurban terminals have off-road facilities.

Table 2.5.5
Number of Bus Terminals by Function and Location, 1998

		Off-Road	Local Road	On-Road	Total
Terminal	Urban	14	10	3	27
	Inter-urban	4	0	0	4
	Urban and Inter-urban	3	0	0	3
Turning Circuit		0	7	4	11
Total		21	17	7	45

2.5.6 Taxi

Table 2.5.6 is the summary of the taxi survey conducted at five (5) selected locations. Major findings are:

- About 76% of the taxis are owned by drivers themselves.
- On average, one taxi makes 32 paid trips running 274 km a day. Gross daily income is around 300 Córdobas and the net income is around 120 Córdobas a day after various expenditures.
- The drivers usually work six (6) days a week for 10 hours a day on average.

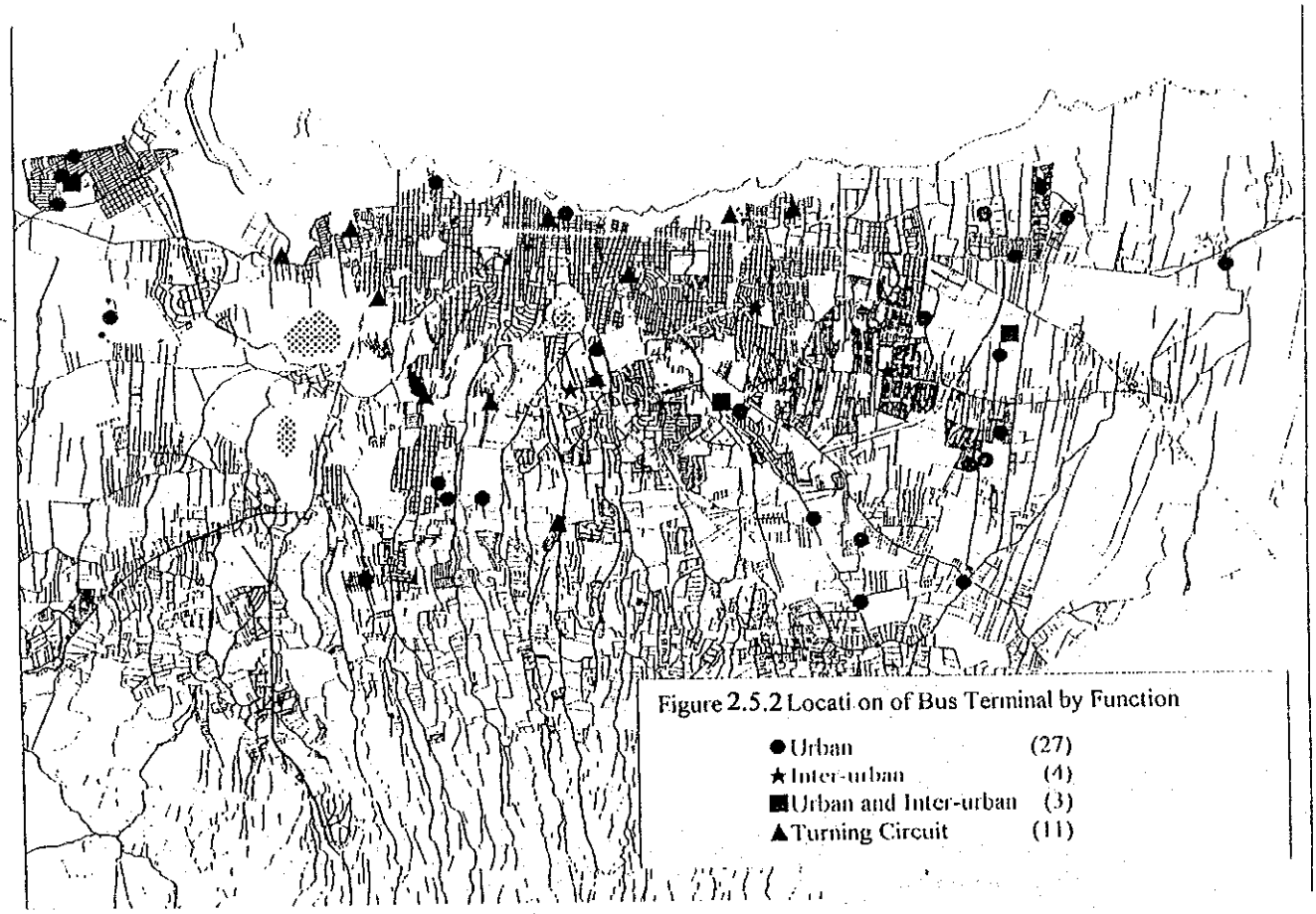


Figure 2.5.2 Locati on of Bus Terminal by Function

- ● Urban (27)
- ★ Inter-urban (4)
- ■ Urban and Inter-urban (3)
- ▲ Turning Circuit (11)

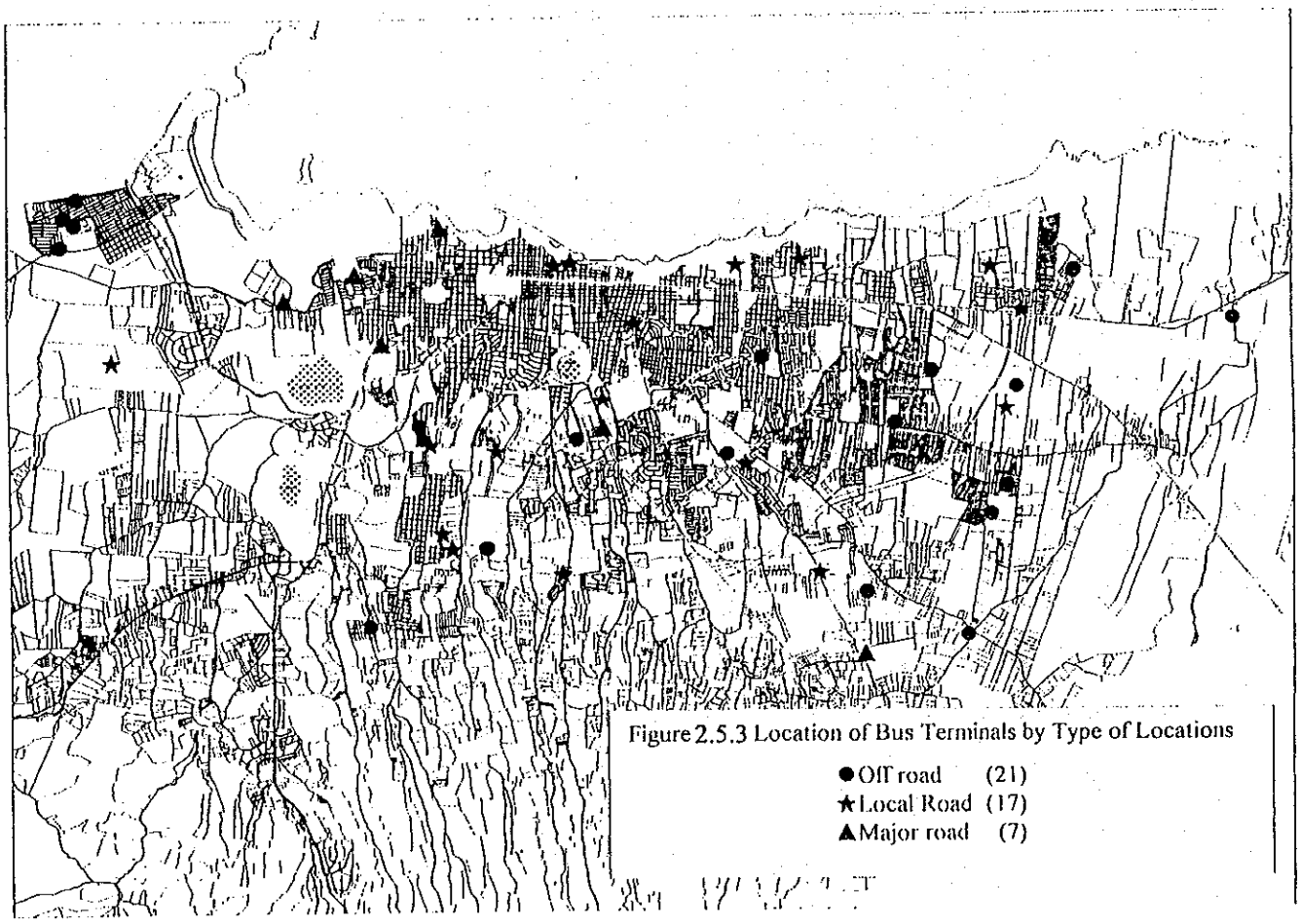


Figure 2.5.3 Location of Bus Terminals by Type of Locations

- ● Off road (21)
- ★ Local Road (17)
- ▲ Major road (7)

Table 2.5.6
Characteristics of Taxi Operation and Taxi Drivers at Selected Location, 1998

	At front of MITRAB	At front of RUCFA	Plaza España	Iglesia El Carmen	Roberto Huembes	Total
1. Is the owner of the vehicle? (Yes)	10	8	6	7	7	38
(No)	-	2	4	3	3	12
2. No. of trips paid/day	25	32	29	33	42	32
3. Ave. Km. Run/day	236	275	249	296	313	274
4. Ave. Km run paid/day	191	140	185	188	267	194
5. Working hours/day	9	11	11	10	9	10
6. No. of worked days / week	6	6	6	7	6	6
7. No. of drivers assigned to this vehicle	2	1	1	1	1	1
8. No. of operational days of this vehicle during the last week	6	6	6	6	6	6
9.1 Ave. Gross Income / day	334	318	252	268	334	301
9.2 - Every day	334	318	252	268	334	301
9.3 - Holidays (resting days)	323	343	231	253	312	292
10.1 Ave. Expenses / day	186	219	168	170	154	179
10.2 - Maintenance and rent payments	55	150	28	8	21	31
10.3 - Fuel and Oil	104	140	119	125	117	121
10.4 - Others (specify)	16	10	21	25	16	18
11. Net Income / day	148	99	84	98	181	122
12. How long do you drive taxi? (years)	12	18	12	7	16	13
13. Driver's age	38	41	41	43	42	41
15. No. of dependants	5	5	4	5	6	5
16. Family Income / month	5,038	3,092	2,516	2,660	4,720	3,605

2.5.7 Regulations on Public Transportation

Current Regulations

The General Law of Transport (Ley General de Transporte) provides the framework for the transport industry in Nicaragua at present by defining the types of public transport service, basic procedure of obtaining authorization for the service and the procedure of sanctions.

The Regulatory Law for Issuing and Obtaining the License of Function in Land Transport (Ley Reglamentaria para la Emisión y Obtención de las Licencias de Funcionamiento en el Transporte Terrestre) determines the regulations more clearly that the public transport industry has to follow:

1. License of Function (Licencia de Funcionamiento)

   This is a permission from the Ministry of Transport and Infrastructure (MTI) to a company or cooperative which wishes to provide public transport service. It specifies the duration of the license (2, 3 or 5 years depending on the administrative purpose), number of units and the route alignment together with the location of stops. For the permission, the applicant should prepare various documents explaining its proposal and financial status.

2. Card of Operation (Tarjeta de Operación)

   This is a permission from the regional offices of MTI to each of the vehicle units used in the proposed service. The validity is one (1) year in principle.

Namely, the public transport industry is regulated both on the organizational aspect and on the mechanical aspect of the vehicle units. In addition, the fare of bus is regulated at 1.40 Córdobas / ride by MTI at present. The fare of taxi, however, is not regulated and left for free negotiation.

Future Direction

MTI is currently preparing a proposal for the Regulations for Providing Public Transport Services for Passengers (Reglamento para la Prestación del servicio de Transporte Público de Pasajeros). The regulatory framework is basically the same as at present. However, the proposal contains a number of new aspects such as:

1. Definition of express and semi-express bus services (limitation of bus stops, etc.)

2. Classification of taxi service into "Ruleteros" (free operation without any specific station) and "De Parada" (with specific station).

3. Classification and specification of different types of bus terminal (interurban, suburban, urban and rural) ---- provision of toilet facilities, cafeteria, waiting space, etc.

4. Specification and location of bus stop (size of bus bay, provision of bench and shelter, interval of stops, distance from intersection, etc.)

5. Limitation of the age of vehicle units by type of service (e.g. 12 years for urban buses)

6. Regulation on the density of passengers on board (e.g. 7 passengers / m^2 for urban buses)

7. Regulation on the provision of safety facilities of vehicle units (e. g. Emergency exit)

In general, the basic policies on public passenger transport service conceived by MTI are towards diversification, safety and convenience of service.

2.6 Traffic Management

2.6.1 Intersection Management

Intersections are an inevitable part of any urban road system. Driving around any city, one notices that a large majority of urban streets have many intersections, where drivers decide whether to go straight or turn to another street. An intersection can be defined as an area where two or more roads join or cross, including the roadway and roadside facilities for traffic movement.

In general, there are three (3) types of intersections: (1) intersection at-grade, (2) grade separation without ramps, and (3) interchange. At-grade intersection has at least five (5) principal ways of controlling traffic, depending on the type of intersection and the volume of traffic. They are: (1) Stop Signs, (2) Yield Signs, (3) Intersection Channelization, (4) Roundabout, and (5) Traffic Signal. Traffic Signal is one of the most important and effective methods of controlling traffic at the intersection.

In general, traffic signal is installed at the intersection to:

- Improve overall safety.
- Decrease average travel time, and consequently increase capacity of the intersection.
- Equalize the quality of service for all or most traffic streams.

There are basically three types of signals available; (1) pre-timed, (2) semi-actuated, and (3) fully actuated. Their characteristics are:

(1) Pre-timed

- Preset times and phases.
- Constant cycle length.
- Simple and inexpensive.
- Less efficient for fluctuating demand.
- Effective in progressive signal system.
- Can be operated on different timing plans.

(2) Semi-actuated

- Vehicle detector for the minor street.
- Green is always on for the major street unless minor-street actuation occurs.
- Two-phase plan is common.
- Cycle length varies from cycle to cycle.
- Good for low to moderate traffic demand on the minor street.
- Usually installed when the major traffic stream has no space to filter in.
- Can be used in overall progressive signal system.

(3) Fully Actuated

- All approach roads have vehicle detectors.
- Each phase is subject to the minimum and maximum green time.
- Some phases can be 'skipped' if no demand is detected.
- A phase is terminated when there is no further actuation within a specified time interval or when the maximum green time has been reached.
- Cycle length varies from cycle to cycle.
- Most flexible form of signal control

- Most efficient use of available green time
- Best used at isolated intersections that are not coordinated with other signals.
- May be used in progressive signal system.

Figure 2.6.1 shows major intersections and their control systems in the Study Area. There are approximately 180 intersections on the existing arterial network including Primary Distributors, Primary Collectors and Secondary Collectors.

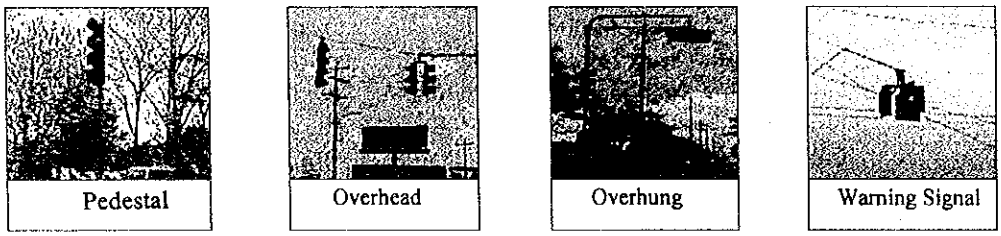
Out of the 180 intersections, only one (1) intersection is provided with an underpass structure, five (5) intersections are roundabouts, and 58 intersections are signalized. Other intersections are operated with "Stop" signs on minor traffic flow directions.

Most of the major intersections, particularly between Primary Distributors and Primary Collectors, are roundabouts or have been signalized. However, twelve (12) major intersections have not been signalized yet, although most of them are already listed in the development plan of ALMA.

Besides those major intersections, most of the minor intersections in the lower-class road network including Secondary Collectors are not signalized. The total number of non-signalized intersections reach about 120 locations.

The present signal operation in Managua applies the pretimed control system. It is a conventional system not sufficient to control heavy traffic demand on the major roads. Two to four types of phasing plans are installed as shown in Figure 2.6.2, based on the geometric and demand features of each intersection. At present, three (3) types of signals and one type of warning signal are installed in the Municipality of Managua as shown in Figure 2.6.3.

Figure 2.6.3
Existing Type of Signal Equipment



Accounting to the Signal and Traffic Sign Survey, most of the signals are well maintained, but insufficient signal-phasing plan was observed at some intersections. In particular, there are three (3) different patterns when the phase changes from "left turn" to "through (straight)", as shown in Figure 2.6.2. This may make drivers confused. Another observation is signal operation on progressive intersections. For instance, the signals on Carretera a Masaya, change their phases independently from others, disturbing the through traffic unnecessarily.

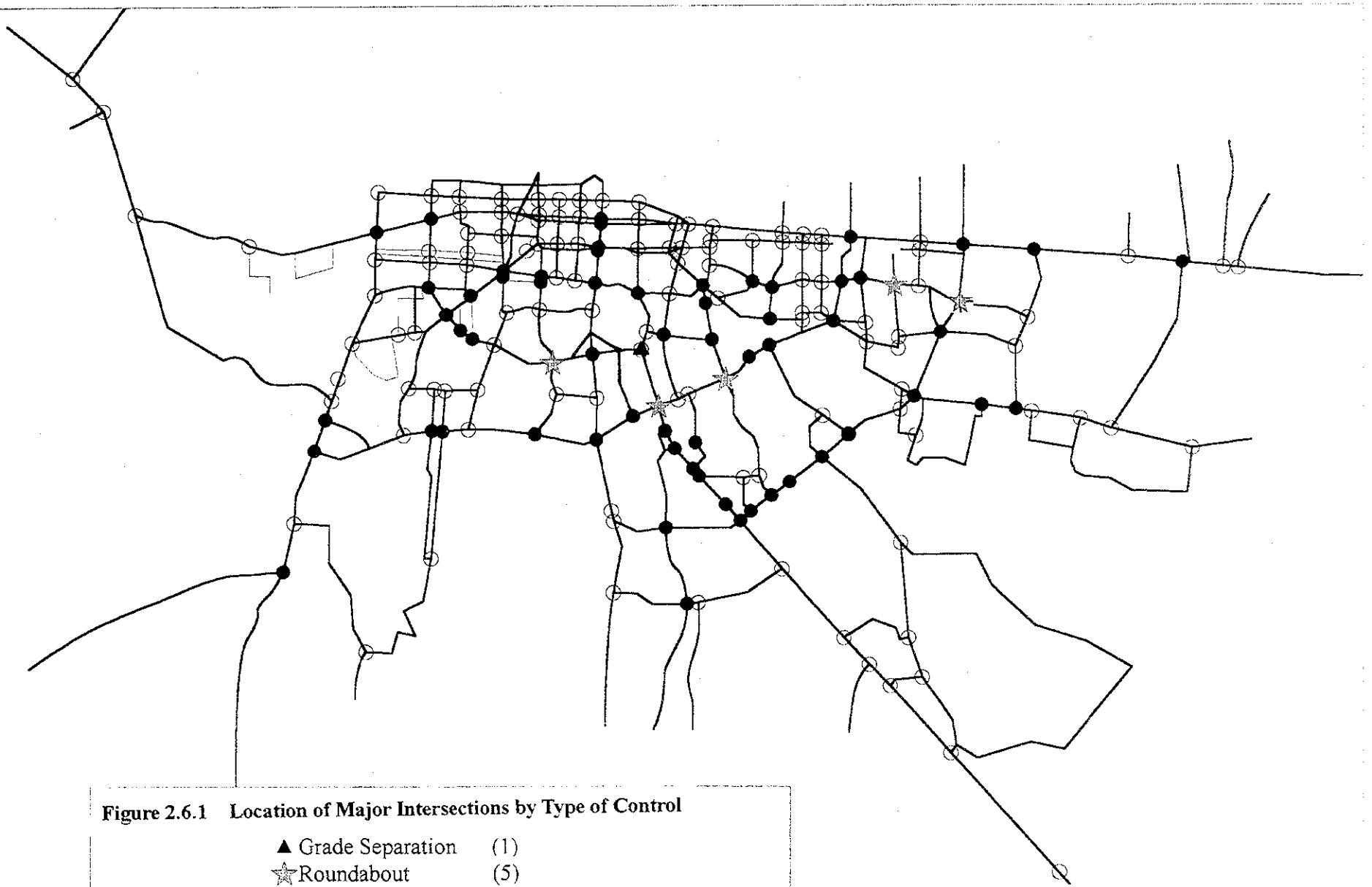
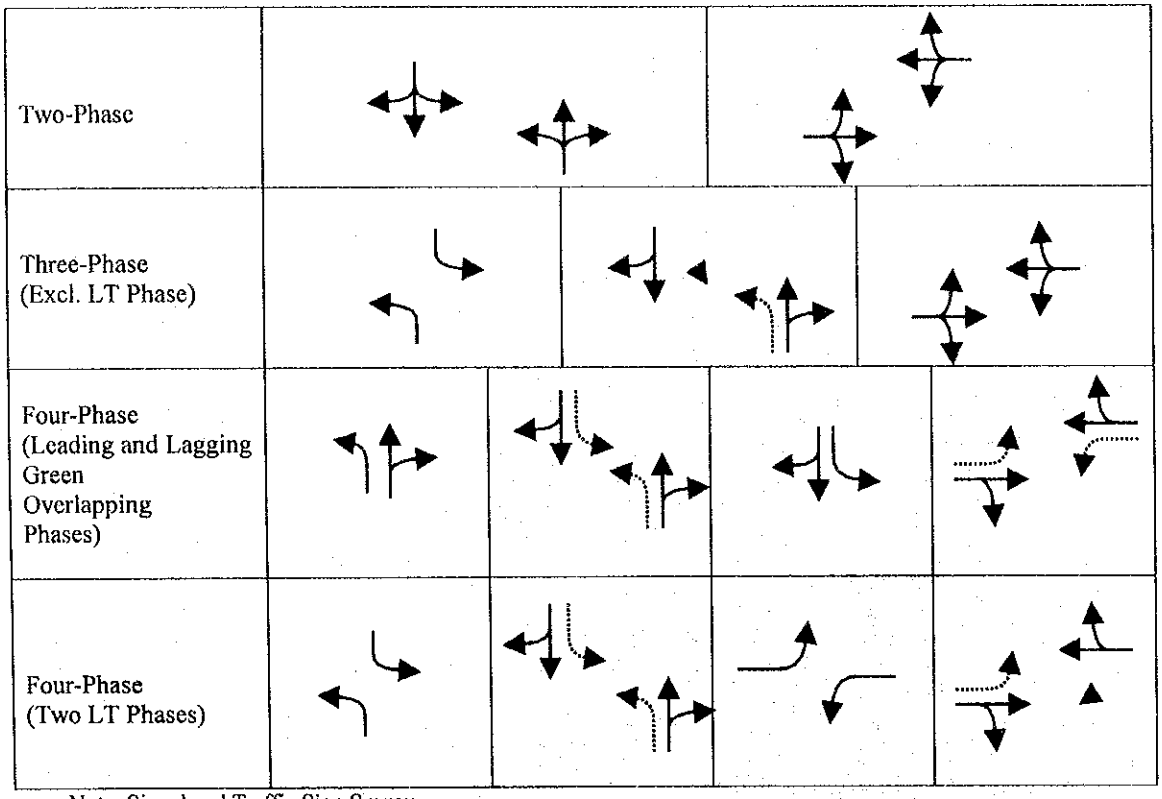


Figure 2.6.1 Location of Major Intersections by Type of Control

Figure 2.6.2
Common Signal Phase Plans in Managua



Note: Signal and Traffic Sign Survey

Pattern 1	Left Turn	(Yellow)	Through
Pattern 2	Left Turn	(Blinking)	Through
Pattern 3	Left Turn		Through
	(Green)		Green

Complication on the existing phasing system

2.6.2 Parking

Motorists want to park right in front of his or her door to avoid walking, but this luxury is not always possible. Street space is more effectively used by moving traffic, and parking is often prohibited on the street.

There are some basic considerations for parking useful to examine the existing conditions and to determine future planning direction, as follows:

- To compromise between the curb space devoted to parking and that devoted to traffic.
- To make provision for parking delivery and other service vehicles and for short-term and long-term parkers.
- To design parking lots and their approaches so that street traffic is not adversely affected by the access and egress of vehicles.
- To ensure that business establishment along the street is benefited by good parking arrangements.
- To ensure a certain balance between parking policies and public transit policies.

- To preserve environment of the neighborhood by restricting parking and enforcing land-use control.
- To control parking supply and demand through the pricing mechanism; e.g. encouraging short-term parking and discouraging long-term parking will contribute to enhance the functions of the central business district (CBD).

Figure 2.6.4 shows the present situation of on-street parking obtained from the Road Inventory Survey. At present, there is no proper form of on-street parking defined by markings or parking meters. Therefore, the Road Inventory Survey observed the number of parked vehicles and judged whether it is Many or Few or None. According to the result of the survey, most of the Primary Distributors are free from parked vehicles. Of course, all sections of the primary roads are prohibited of on-street parking.

The sections where many parked vehicles were observed are the old urban areas in the east and west of the old CBD (Los Robles and Máximo Jerez).

On the other hand, off-street parkings were found in the major new development areas, particularly along Carretera a Masaya, such as Metrocentro, San Francisco, Camino de Oriente, and so forth. Most of the commercial and business areas provide sufficient parking spaces for their staff as well as customers and visitors, and parking charge is not imposed in general. Figure 2.6.5 shows the distribution of off-road parkings used commonly by motorists.

As mentioned above, parking problem may not be serious in Managua at present because of the small number of vehicles. Normally, parking problem starts from old urban areas developed before the motorization era, due to their insufficient infrastructure and high density. However, in the case of Managua, the earthquake destroyed the old CBD and this may be one of the reasons of the absence of parking problem.

Although the problem is not so serious, a contrast between old urban areas and new developed areas can be observed. The parking demand in the old urbanized area exists along the arterial roads where small venders and shops are located, while the demand in new urban areas is scattered to a limited number of points, such as shopping centers. The contrast will be taken into account in the preparation of future parking development policy.

Present parking policy in the Municipality of Managua is to enhance the provision of compulsory parking spaces in all new developments. However, for the existing urbanized areas, the policy has not been established yet.

2.6.3 Road Traffic Management

Traffic signs and markings are used for establishing a street or highway system that is clearly understood by its users; drivers and pedestrians. Specifically, traffic signs and markings fulfil the following functions: regulation of traffic (e.g. speed limits), turn prohibition, alerting and warning drivers and pedestrians regarding roadway conditions, and guiding traffic along appropriate routes to destination.

These functions apply to all control devices, including signals, markings and channelizations. Naturally, control devices must meet the basic requirements such as attracting attention and conveying a clear and simple meaning.

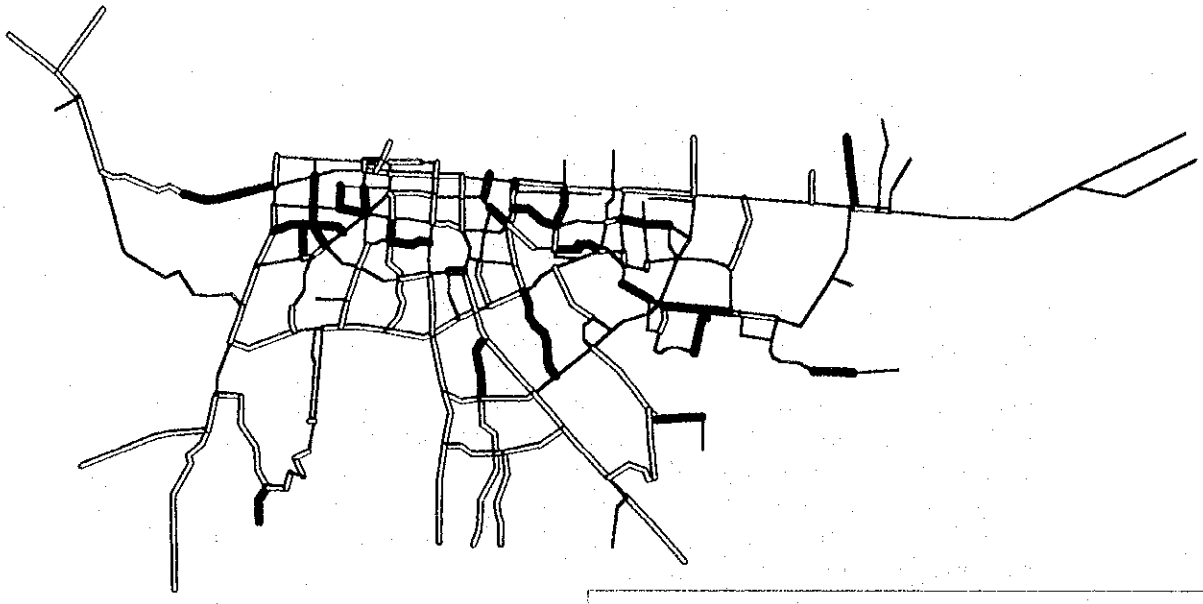


Figure 2.6.4 Existing Situation of On-Street Parking

Many
Few
None

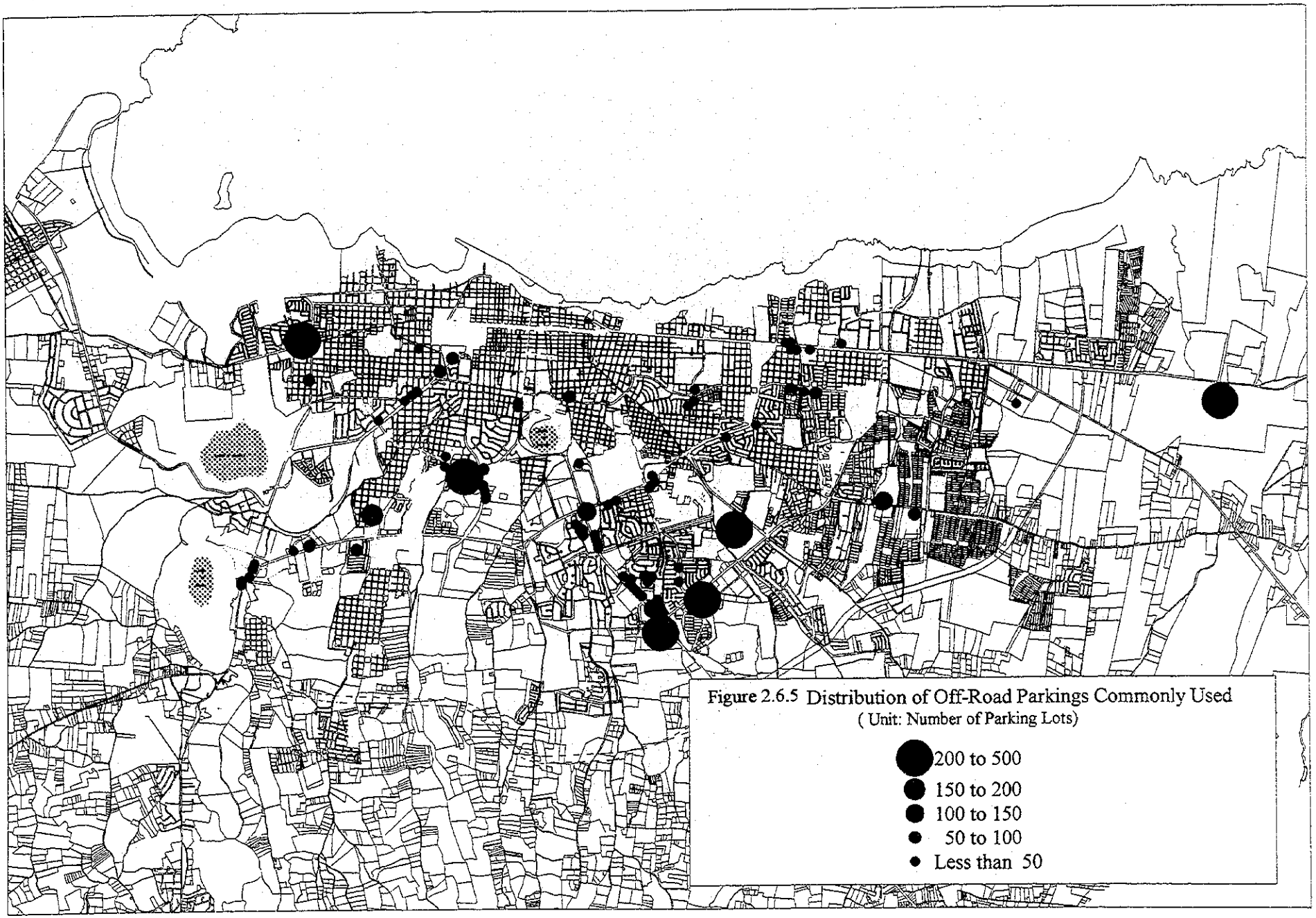
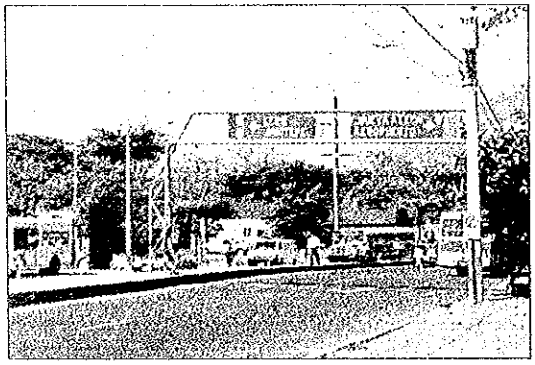


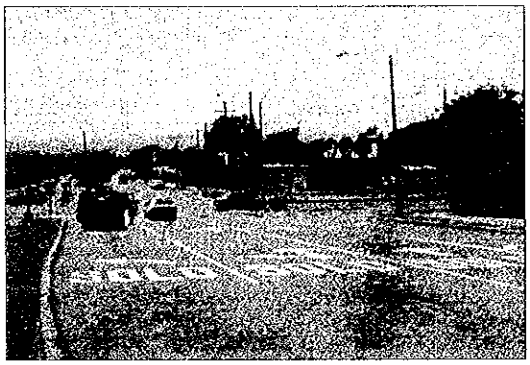
Figure 2.6.5 Distribution of Off-Road Parkings Commonly Used
(Unit: Number of Parking Lots)

In Managua, the installation and design standards for the signs and markings have been established. However, there are some differences found at existing intersections, even at major intersections as shown in Figure 2.6.6 (Photo).

Figure 2.6.6
Existing Traffic Sign and Marking



(a) 7 Sur (Clear Information Sign)



(c) Int. Av. Bolivar (Clear Road Marking)

(b) Puente El Riguero (Minimum Road Signs but No Marking)

(d) Linda Vista (Poor Marking)

Figure 2.6.7 and Figure 2.6.8 show existing traffic signs and marking conditions respectively. Although the installation and design standard are well prepared, insufficient numbers of signs and poor road markings are observed on many road sections, except for the sections on Carretera a Masaya and Pista Juan Pablo II. Insufficient budget and lack of equipment will be the main reasons for the existing situation.

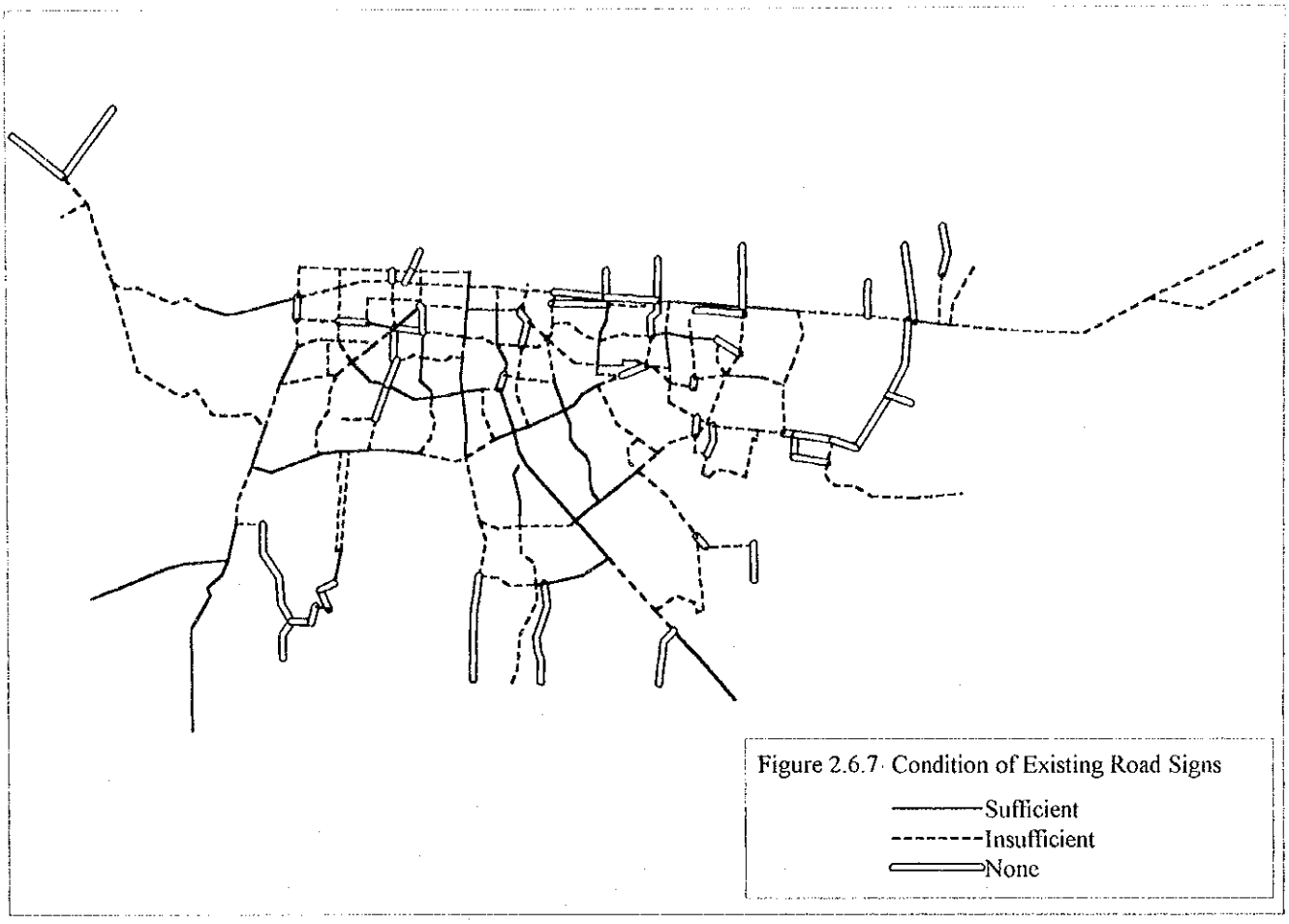


Figure 2.6.7 Condition of Existing Road Signs

Sufficient
Insufficient
None

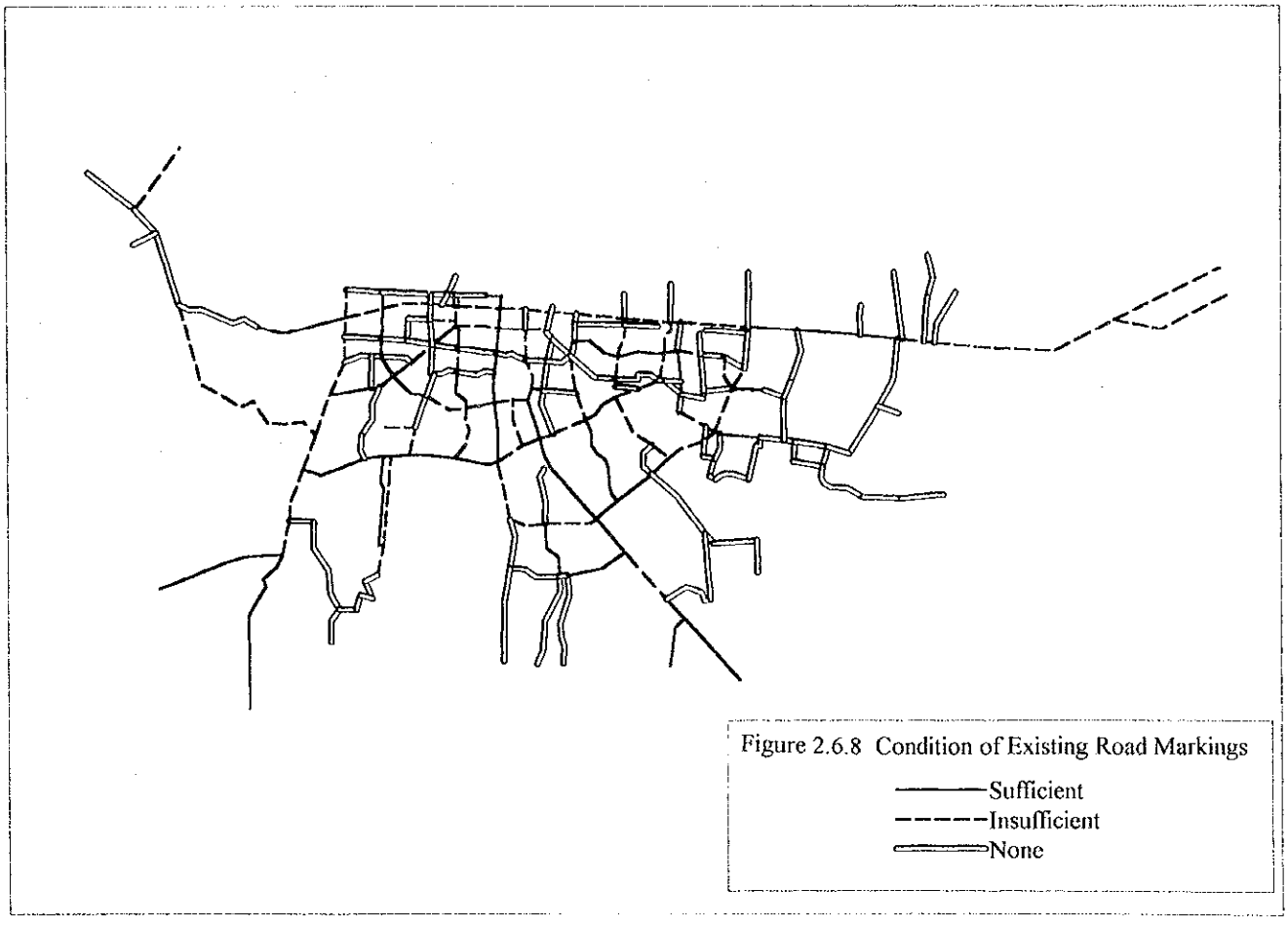


Figure 2.6.8 Condition of Existing Road Markings

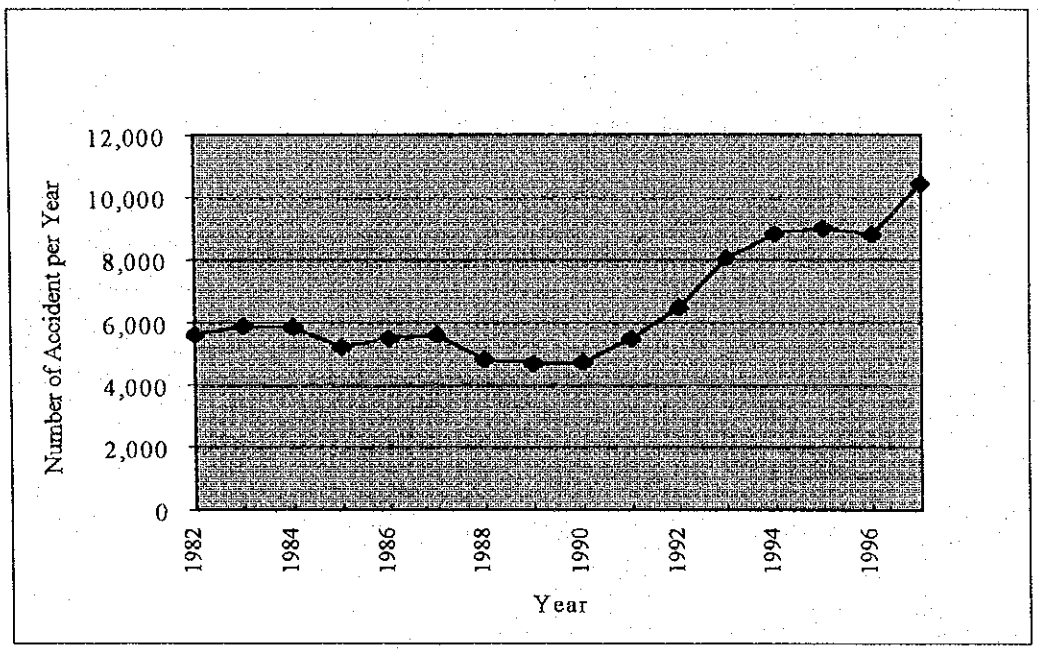
Sufficient
Insufficient
None

2.7 Traffic Safety

2.7.1 Historical Trend of Traffic Accidents

The number of traffic accidents in Nicaragua is almost proportional to the number of registered vehicles (see Section 3.3). As shown in Figure 2.7.1, it has been steadily increasing since 1991.

Figure 2.7.1
Number of Accidents in Nicaragua (1982 to 1997)



Source: Policía Nacional

By department, Managua has the highest share at nearly 70% of the national total as indicated in Table 2.7.1. Its share, however, has a declining tendency from 73% in 1993 to 66% in 1997. As compared to its share of 50% in the number of registered vehicles, the rate of accidents is considerably higher than the national average. Within the Municipality of Managua, District No. 4 has the highest number of accidents, followed by District No. 5 and then District No. 3, as shown in Table 2.7.2.

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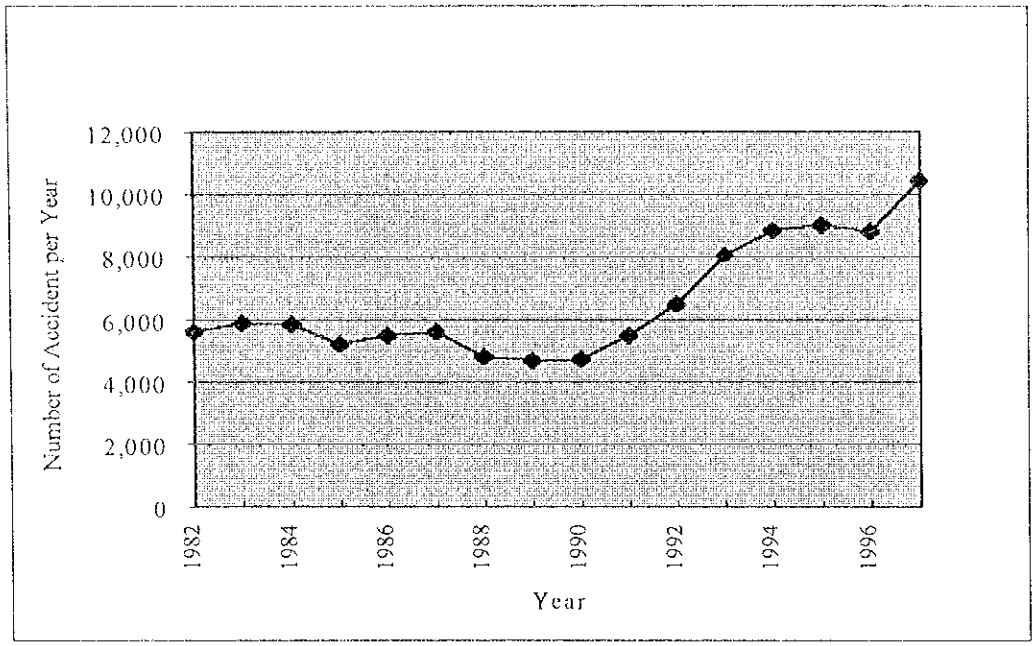

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Table 2.7.1
Number of Traffic Accidents by Department
(1993 to 1997)

DEPARTMENT	YEAR					TOTAL	%
	1993	1994	1995	1996	1997		
ESTELI	142	177	259	286	199	1,063	2.36%
NUEVA SEGOVIA	29	64	83	92	135	403	0.89%
MADRIZ	56	48	68	91	119	382	0.85%
LEON	247	271	251	374	615	1,758	3.90%
CHINANDEGA	190	220	264	233	280	1,187	2.63%
MANAGUA	5,903	6,312	6,285	5,818	6,897	31,215	69.31%
GRANADA	150	259	228	295	385	1,317	2.92%
CARAZO	142	188	218	193	151	892	1.98%
RIVAS	101	151	166	131	127	676	1.50%
MASAYA	298	247	222	207	221	1,195	2.65%
CHONTALES	188	223	277	222	263	1,173	2.60%
BOACO	72	78	147	129	146	572	1.27%
ZELAYA CENTRAL	6	37	50	89	111	293	0.65%
RIO SAN JUAN	8	40	49	44	75	216	0.48%
MATAGALPA	309	299	261	377	393	1,639	3.63%
JINOTEGA	124	98	63	81	110	476	1.06%
RAAN	56	51	53	66	125	351	0.78%
RAAS	43	57	66	55	72	293	0.65%

Source: Policía Nacional

Table 2.7.2
Number of Accidents by District in Managua Department in 1997

DISTRICT	ACCIDENTS	DEATHS	INJURIES
DISTRICT #1	181	9	89
DISTRICT #2	908	6	193
DISTRICT #3	1,231	21	186
DISTRICT #4	1,652	22	211
DISTRICT #5	1,555	27	92
DISTRICT #6	959	17	99
DISTRICT #7	126	9	138
(DISTRICT #8)	285	12	108
TOTAL	6,897	134	1,116

Note: District No. 8 is located outside the Municipality of Managua
Source: Policía Nacional

2.7.2 Type and Cause of Traffic Accidents

Table 2.7.3 and 2.7.4 present the type of traffic accidents and their causes in Nicaragua, respectively. 80% of accidents are collision of vehicles with other vehicles. The causes of accidents are "Incorrect turns", "Failure to keep enough distance", "Failure to stop", "Intercepting of row", "Careless backing up", etc. in the urban area. In the rural areas, "Excessive speed" comes to the second and "Pedestrian imprudence" comes to the fifth, instead of "Failure to stop" and "Careless backing up". According to the analysis done by Policía Nacional (National Police), the following is pointed out as underlying reasons of traffic accidents:

- Badly maintained road network
- Insufficient signalization
- Increase in the number of vehicles
- Poor mechanical condition of vehicles

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Table 2.7.3
Type of Traffic Accidents, 1997

Type of Accident	Accidents	Deaths	Injuries			Material Damages C$	US$ (9.45=1)
			Serious	Mild	Total		
Acc w/Pedestrians Involved	834	159	349	397	746	0	
Vehicle Collision	8,311	113	548	1,011	1,559	60,801,226	6,433,992
Overturn	448	90	404	434	838	4,163,464	440,578
Collision w/Fixed Objects	332	12	33	78	111	759,133	80,331
Hit and Run Accident	160	27	17	27	44	78,653	8,323
Accident w/Animals	134	3	16	18	34	845,241	89,443
Others	205	35	36	73	109	36,750	3,889
Total	10,424	439	1,403	2,038	3,441	66,684,467	7,056,556

Source: Policía Nacional

Table 2.7.4
Causes of Accidents, 1997

Cause of Accident	Urban			Rural		Sub-total	TOTAL	
	Major St.	Side St.	Sub-total	Highway	Road			
Failure to Stop	279	699	978	51	8	59	1,037	9.9%
Intercepting of Right-of-way	524	356	880	168	3	171	1,051	10.1%
Excessive Speed	186	277	463	355	10	365	828	7.9%
Incorrect Turns	692	1,495	2,187	645	15	660	2,847	27.3%
Traffic Sign Violation	149	77	226	38	1	39	265	2.5%
Pedestrian Violation	7	32	39	23	3	26	65	0.6%
Failure to Keep Enough Distance	691	469	1,160	274	20	294	1,454	13.9%
Passenger Fallout	15	38	53	48	22	70	123	1.2%
Driving Against Traffic	62	78	140	36	1	37	177	1.7%
Mechanic Failure	52	155	207	138	18	156	363	3.5%
Pedestrian Imprudence	126	238	364	155	15	170	534	5.1%
Careless Backing Up	235	328	563	72	1	73	636	6.1%
Inexperienced Driver	87	212	299	122	10	132	431	4.1%
Distractions While Driving	25	52	77	30	2	32	109	1.0%
Bad Road Conditions	28	14	42	24	10	34	76	0.7%
Running Out of the Road	3	0	3	7	0	7	10	0.1%
Driving without Proper Supervision	16	27	43	35	0	35	78	0.7%
Animals on the Road	0	16	16	74	4	78	94	0.9%
Driving on the Wrong Side of Road	38	37	75	91	9	100	175	1.7%
Physical Exhaustion	1	10	11	14	0	14	25	0.2%
Unknown	5	18	23	19	4	23	46	0.4%
TOTALS	3,221	4,628	7,849	2,419	156	2,575	10,424	100.0%

Source: Policía Nacional