

## 2.5 Vehicle Registration

There are about 200 municipalities (Counties) in Paraguay at present, and vehicles should be registered at these municipalities. The number plates are issued by the municipalities and the registration fee forms a part of their own revenue. The registered vehicle numbers do not match with the vehicle numbers within a municipality, because the applicants for the vehicle registration do not need to be residents of the municipality, and the fees for the issuance of number plates are different municipality by municipality. The number of vehicles registered in the metropolitan area in 1996 is shown in Table 2-5-1.

**Table 2-5-1 Registered Vehicles in 1996**

Counties	Autos	Pick-ups	Trucks	Others	Sub Total	Population	Car Ownership Veh/1,000
Asunción	60,107	20,721	3,943	2,349	87,120	545,964	159.6
Fdo. de la Mora	21,808	7,211	2,584	760	32,363	121,469	266.4
Lambaré	22,143	7,489	1,236	534	31,402	128,821	243.8
Limpio	2,899	1,369	462	211	4,941	46,641	105.9
Luque	9,748	3,738	806	432	14,724	151,468	97.2
M.R.Alonso	11,505	4,664	1,436	584	18,189	50,806	358.0
Nemby	2,545	1,355	590	89	4,579	50,316	91.0
San Antonio	1,924	715	180	66	2,885	19,636	146.9
San Lorenzo	5,339	3,138	1,441	662	10,580	185,064	57.2
Villa Elisa	6,472	2,238	1,025	264	9,999	38,468	259.9
Villa Hayes	1,081	738	237	80	2,136	32,055	66.6
Metropolitan Area Total	145,571	53,376	13,940	6,031	218,918	1,370,708	159.7
Paraguay	212,783	92,700	31,549	10,476	347,508	4,955,238	70.1
Rate of Metropolitan Area (%)	68.4	57.6	44.2	57.6	63.0		

Source: Statistical Annual Report, 1996

Twenty-eight percent of the population in the country was concentrated in the metropolitan area in 1996, while 63.0% of vehicles was concentrated in the same area. The average vehicle ownership in the metropolitan area was 160 veh./1,000 inhabitants, and the vehicle ownership in such suburban cities as Fdo. de la Mora, Lambaré, M.R.Alonso and Villa Elisa was high. The average vehicle ownership in the metropolitan area is 2.3 times higher than the national average. The car ownership in Tokyo has been stopped from increasing beyond 150 veh./1,000 inhabitants by such vehicle owner controls as garage obligation or parking controls, and by the development of the public transport network. While in the Nagoya metropolitan area in Japan, where vehicle private car use is more common than in Tokyo, the vehicle ownership reaches 250 veh/1,000 inhabitants. In the Asunción metropolitan area, the vehicle ownership is at the point where it may select Tokyo or Nagoya Type.

Fig. 2-5-1 shows the trend of vehicle registration. The vehicle number is increasing year by year, and the growth factor of the 4 years between 1992 and 1996 was 1.4. The shares of the vehicles numbers in the metropolitan area show a constant rate in the same period, and the growth factor is almost the same as the national average, which implies that the vehicle ownership increased rapidly taking into account the population increase of about 1.1 times in the same period.

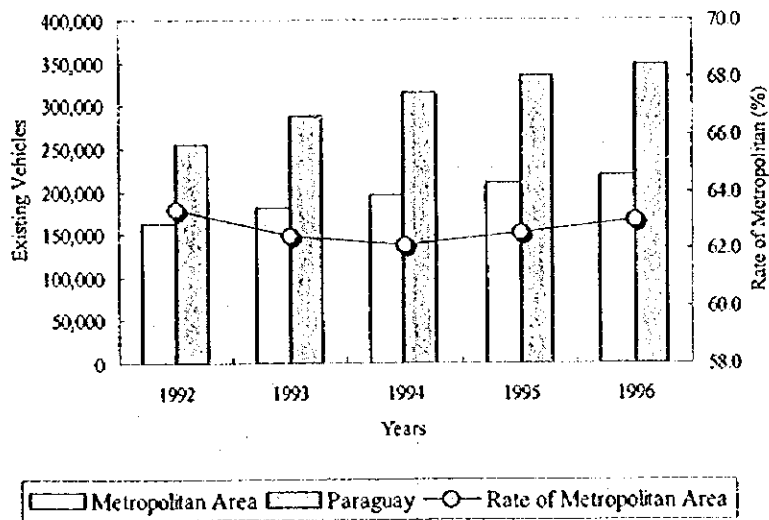


Fig. 2-5-1 Trend of Vehicle Registration

## 2.6 Financial Situation

### 2.6.1 Financial Balance of Asunción City

The revenue of Asunción City in 1996 was 92,913 million Gs. The major city revenue sources include 48.6% of taxes such as property tax, followed by 20.7% of fees such as car registration fee. Since 1992 when the constitution was modified, all the taxes excluding the tax on gambling belong to Asunción city, and the city is financially independent from the national budget. The revenue from taxes increased by 5 times in the period between 1992 and 1996, because of the increase of property tax, the new fee for solid waste collection, etc. The city estimates more increase of revenue in the next 3 years and a total revenue of 1 million US\$ in the year 2000, by the improvement in collection of arrears of taxes, which was estimated at 35 – 40%, and an increase of taxes from enterprises and high income families.

The current expenditure including wages of staff occupies 59,855 Gs. or 82% of the total expenditure in 1996, and the capital investment was only 8,024 Gs. or 11.1%.

**Table 2-6-1 Revenue of Asunción City**

(In million Gs.)

Item	1990	1991	1992	1993	1994	1995	1996	Ratio
<b>1. CURRENT REVENUES</b>	10,071	13,886	21,463	39,913	59,573	71,931	87,287	93.9
1.1. Tax Income *	7,630	10,210	16,172	34,697	46,193	56,860	67,806	73.0
1.1.1. Taxes	4,505	6,007	7,748	22,547	29,873	38,300	45,199	48.6
1.1.2. Charge	2,657	3,550	7,559	10,901	14,121	15,334	19,201	20.7
1.1.3. Given Away **	468	653	865	1,249	2,199			0.0
1.1.4. Others ***						3,226	3,406	3.7
1.2. Income not paid	915	1,529	2,399	4,094	8,983	11,438	12,451	13.4
1.3. Transfers ****	1,526	2,147	2,892	1,122	4,396	3,492	6,907	7.4
1.4. Donations ***						140	123	0.1
<b>2. CAPITAL INCOME</b>	1,783	5,274	3,819	5,199	13,460	7,231	5,626	6.1
2.1. Credit Resource	500	3,715	1,530	1,633	10,184	2,478	469	0.5
2.2. Fixed Active Selling	350	448	251	341	599	991	1,086	1.2
2.3. Private Loans	766	1,051	1,412	2,554	183			0.0
2.4. Other Capital Income	155	60	626	672	1,289	3,081	3,440	3.7
2.5. Capital Transfers						383	400	0.4
2.6. Capital Donation	12				1,205	298	230	0.2
<b>GRAND TOTAL</b>	<b>11,854</b>	<b>19,160</b>	<b>25,282</b>	<b>45,113</b>	<b>73,034</b>	<b>79,162</b>	<b>92,913</b>	<b>100.0</b>
Growing tax		1.62	1.32	1.78	1.62	1.08	1.17	

Source: Municipal Statistics Bulletin

\* Land Register Tax is collected by Asunción Municipality since 1993.

\*\* Includes Transfers from non-centralized Offices and Central Government.

\*\*\* Are part of non-paid income, according to the new classification.

\*\*\*\* Are part of current income according to classification. In others are included: (special contributions and other taxes)

**Table 2-6-2 Expenditure of Asunción City**

(In million Gs. of 1982 constant price)

Item	1990	1991	1992	1993	1994	1995	1996	Ratio
<b>1. CURRENT EXPENDITURES</b>	7,549	11,082	19,575	31,850	47,176	59,879	70,159	79.4
1.1. Operation	7,119	10,230	16,769	28,982	42,697	53,071	62,258	70.4
1.1.1. Personal Services	6,026	8,929	14,375	23,724	33,421	42,280	50,566	57.2
1.1.2. Non-personal services	626	808	1,271	3,607	6,906	7,274	7,071	8.0
1.1.3. Materials and Supply	467	493	1,123	1,651	2,370	3,517	4,621	5.2
1.2. Finance	11		758	1,522	2,111	1,163	978	1.1
1.3. Transfers	388	551	612	1,299	2,335	5,456	6,805	7.7
1.3.1. To the Public Sector			588	1,218	1,831	4,925	6,160	7.0
1.3.2. To the Private Sector	388	551	24	81	504	531	615	0.7
1.3.3. To International Organizations							30	0.0
1.4. Other Current Expenses	31	301	1,436	17	5	137	83	0.1
1.5. Return of Taxes				30	28	52	35	0.0
<b>2. CAPITAL EXPENDITURES</b>	4,082	7,286	3,907	9,817	18,538	8,024	8,700	9.8
2.1. Physical Investment	4,082	7,286	3,907	8,767	18,538	4,796	4,734	5.4
2.2. Capital Transfer*				1,050		3,228	3,966	4.5
2.3. Financial Investment								0.0
<b>3. FINANCING</b>	164	166	1,128	2,156	3,915	4,122	9,543	10.8
3.1. Repayment of Public Debts	164	166	1,128	2,156	3,915	2,960	4,939	5.6
3.2. Pending Payment						1,162	4,604	5.2
<b>Total Expenditures</b>	<b>11,795</b>	<b>18,534</b>	<b>24,610</b>	<b>43,823</b>	<b>69,630</b>	<b>72,024</b>	<b>88,402</b>	<b>100.0</b>
Growing Tax		1.57	1.33	1.78	1.59	1.03	1.23	

Source: Municipal Statistics Bulletin

\* Bus Terminal Purchase

## Chapter 3 Characteristic of Trips

### 3.1 Summary of Trips

#### 3.1.1 Zoning

In the 1984 study, the study area was divided into 25 zones in Asunción, integrating Barrios, 15 zones in the metropolitan area outside of Asunción, and 10 zones outside of the study area. In this study, the traffic zones in Asunción were established following the 1992 Census zones, which had 71 zones, and the same zone system for other areas. The total number of zones is 96. Table 3-1-1 shows the comparison of zone systems in 1984 and 1998. Table 3-1-2 and Fig. 3-1-1 show the zoning in Asunción.

**Table 3-1-1 Comparison of Zone Systems**

Area		1984 Zone	1998 Zone	
			Normal	Integrated
Study Area	Asunción	1-25	1-71	1-18
	Lambaré	26-28	72-74	19-21
	Fdo.de la Mora	29,30	75,76	22,23
	Luque	31	77*	24
	M.R.Alonso	32	78	25
	Villa Hayes	33	79	26
	Limpio	34	80	27
	San Lorenzo	35-37	81-83	28-30
	Nemby	38	84	31
	San Antonio	39	85	32
Villa Elisa	40	86	33	
Suburbs	Areguá	41	87	
	Capiatá	42	88	
	Ypane	43	89	
	Ypacarai	44	90	
	Ita	45	91	
Outside	Villeta	46	92	
	Chaco	47	93	
	Region Norte	48	94	
	Region Oriental	49	95	
	Region Sur	50	96	

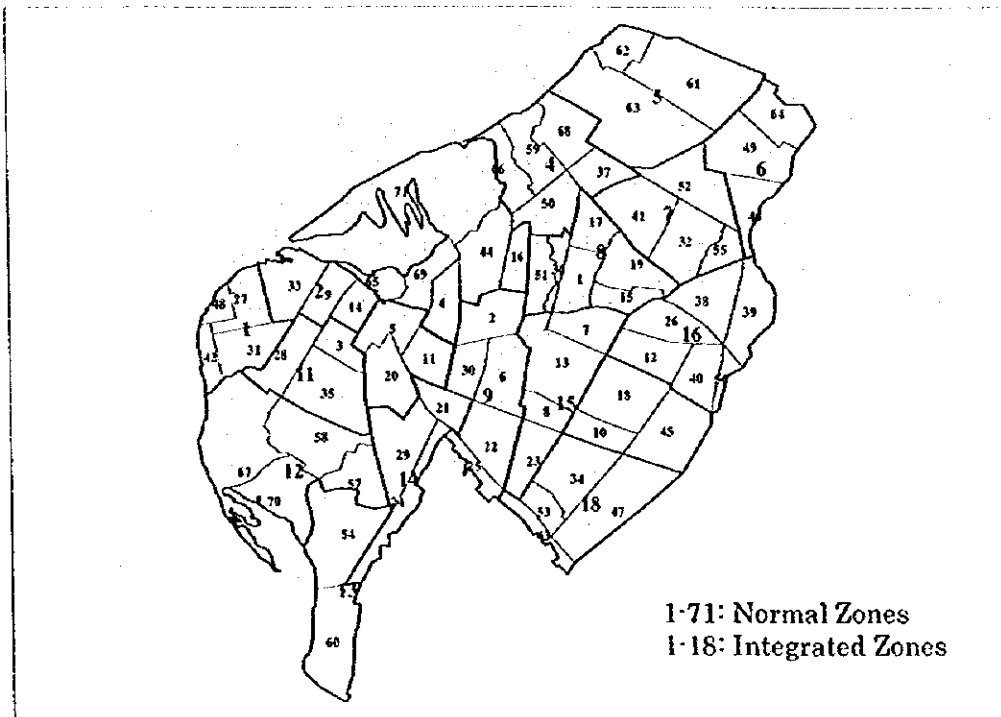
(Note: Luque zone (No.77) are divided in three (North, Center, South) at OD tables.)

**Table 3-1-2 Zoning in Asunción (1)**

Integrated	Normal	BARRIO	Integrated	Normal	BARRIO
1	27	San Antonio	4	37	Santisima Trinidad
	31	Carlos Antonio López		50	Virgen de la Asunción
	42	Sajonia		59	Virgen de Fátima
	48	Itá Pytá Punta		66	Tablada Nueva
2	9	La Encarnación	5	68	San Rafael
	14	Catedral		61	De las Residentas
	33	R. de Francia		62	Zeballos Cué
3	4	Las Mercedes	6	63	Botánico
	16	Virgen Del Huerto		46	Nú Guazú
	44	Jara	49	Loma Pyta	
	65	Ricardo Brugada	64	San Blas	
	69	San Felipe	7	32	Madame Lynch
71	Banco San Miguel	41		Mburucuyá	

**Table 3-1-2 Zoning in Asunción (2)**

Integrated	Normal	BARRIO	Integrated	Normal	BARRIO
7	52	Gral. Andrés Rodríguez	13	54	Santa Ana
	55	Salvador del Mundo		60	Itá Enramada
8	1	Santo Domingo	14	21	Pinozá
	15	Manorá		24	Pirizal
	17	Cañada de Ybyray		29	San Vicente
	19	Carmelitas	15	7	Villa Morra
	36	Santa Rosa		8	Tembetary
51	Bella Vista	13	Recoleta		
9	2	Mcal. López	16	23	Nazareth
	6	Mburicao		12	San Cristóbal
	22	Vista Alegre		26	Ycua Sati
	25	Panambi Reta		38	San Jorge
10	30	Bernardino Caballero	17	39	Itay
	5	San Roque		40	Luis A. De Herrera
	11	Ciudad Nueva		56	Santa María
11	20	Pettirossi	18	10	Los Laureles
	3	Gral. José E. Díaz		18	Mcal. Estigarribia
	28	Tacumbú		45	Villa Aurelia
12	35	Obrero	18	34	Hipódromo
	57	Republicano		43	Panambi Verá
	58	Roberto L. Pefit		47	San Pablo
	67	Bañado Tacumbú		53	Terminal
	70	Bañado			



**Fig. 3-1-1 Zoning in Asunción**

### 3.1.2 Surveys

In the 1984 study, the information on the trips were obtained from the home interview survey based on the household registration in ANDE, for about 43,000 persons, which was about 5.9% of the residents in the study area.

In this study, the information on the trips was obtained from car owner interview survey, based on the 1992 census, which had the information on the car ownership in a household, for about 11,000 households, and from the bus on board survey on 6 main corridors of Av. Artigas, Av. España, Av. Mcal. López, Av. E.Ayala, Av. Fdo. de la Mora, and Av. J.F.Bogado. The bus on board survey was carried out by interviewing about 20% of passengers, and the results were expanded to the total number of passengers in a bus, the total number of buses which crossed the screen line.

The cordon line survey and screen line survey to supplement the main interview survey were carried out in almost the same manner as in the 1984 study.

The survey stations are shown in Fig. 3-1-2.

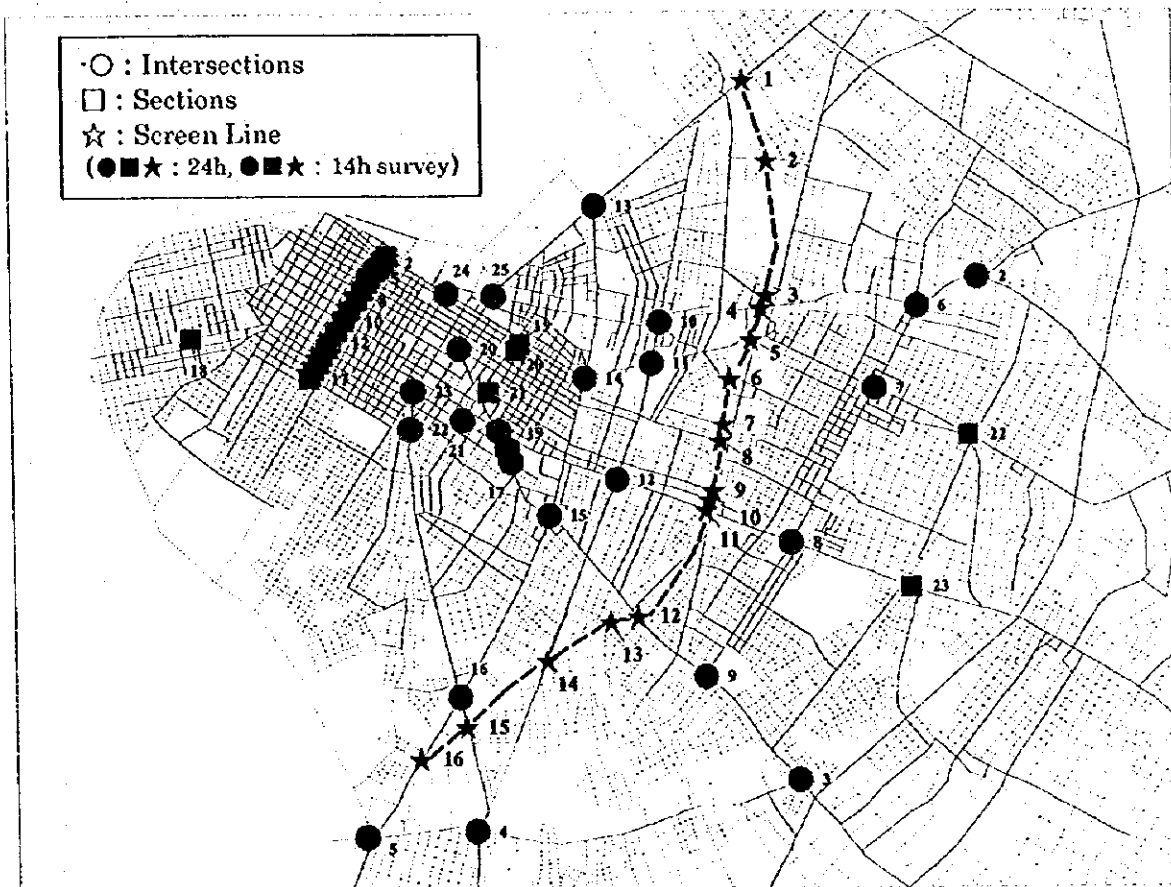
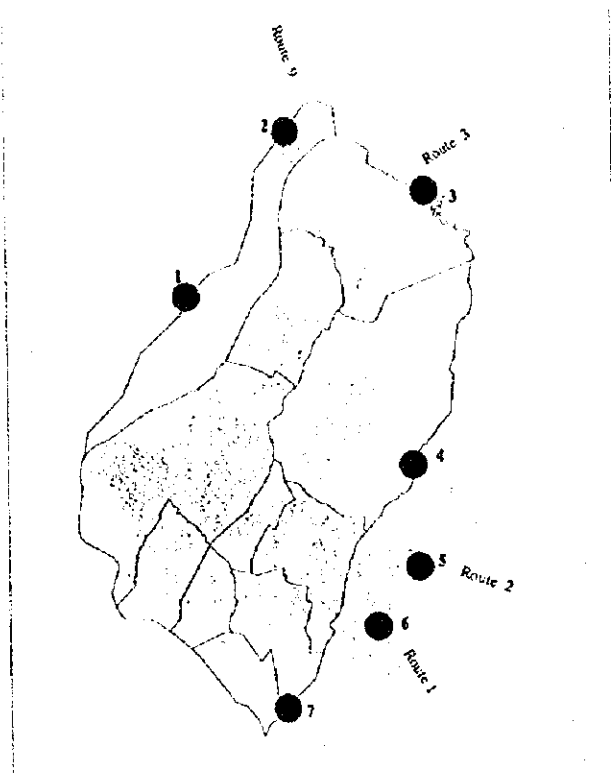


Fig. 3-1-2 (1) Traffic Count



#### Locations

1. Ruta a Falcón y desvío Chacoi
2. Ruta 9 y Lubripar (Estación de servicio)
3. Ruta 3 (Limpio) y Río Salado
4. Ruta Luque/Areguá y Arroyo Yuquyry
5. Ruta 2 y Arroyo Capiatá
6. Ruta 1 y Arroyo Paso Mburicá
7. Acceso Sur (Ruta Nembey-Ypané) y Arroyo Ytororó

Fig. 3-1-2 (2) Cordon Line

Table 3-1-3 Comparison of Major Surveys

1984 Study	1998 Study
Home Interview Survey (43,000 persons)	Car Owner Interview Survey (10,633 households) Bus On Board Survey (2,700 samples)
Cordon Line Survey (7 stations)	Cordon Line Survey (7 stations)
Screen Line Survey (20 stations)	Screen Line Survey (16 stations)
Traffic Count at Intersections (50 intersections)	Traffic Count at Intersections (25 intersections) Traffic Count at Road Sections (23 stations)

Table 3-1-4 Effective Sample Rate (1)

Zone No.	Zone name	No. of Households	No. of households with cars	No. of Valid answer	Valid answer Ratio(%)
1	Santo Domingo	559	428	90	21.0
2	Mcal. López	1,343	1,006	129	12.8
3	Gral. José E. Díaz	1,725	839	124	14.8
4	Las Mercedes	1,252	848	157	18.5
5	San Roque	1,986	1,043	145	13.9
6	Mburicá	1,559	1,016	149	14.7
7	Villa Morra	978	630	102	16.2
8	Tembetary	775	430	56	13.0
9	La Encarnación	1,383	609	88	14.4
10	Los Laureles	830	506	138	27.3
11	Ciudad Nueva	2,389	1,127	203	18.0
12	San Cristóbal	1,478	907	156	17.2
13	Recoleta	2,323	1,391	260	18.7
14	Catedral	1,071	482	87	18.0
15	Manorá	416	306	62	20.3
16	Virgen del Huerto	1,055	587	113	19.3
17	Cañada del Ybyray	347	178	35	19.7
18	Mcal. Estigarribia	1,652	992	103	10.4
19	Carmelitas	1,126	665	144	21.7
20	Pettrossi	3,129	1,286	166	12.9

Table 3-1-4 Effective Sample Rate (2)

Zone No.	Zone name	No. of Households	No. of households with cars	No. of Valid answer	Valid answer Ratio(%)
21	Pinzá	1,690	704	96	13.6
22	Vista Alegre	2,827	1,256	200	15.9
23	Nazareth	1,547	662	102	15.4
24	Pirizal	946	464	80	17.2
25	Panambl Reta	663	286	45	15.7
26	Ycua Sati	1,445	786	119	15.1
27	San Antonio	2,585	971	139	14.3
28	Tacumbú	2,950	1,226	199	16.2
29	San Vicente	3,300	1,472	303	20.6
30	Bernardino Caballero	1,667	596	120	20.1
31	Carlos Antonio López	3,151	1,384	192	13.9
32	Madame Lynch	1,600	833	150	18.0
33	Dr. Gaspar R. de Francia	2,635	839	150	17.9
34	Hipódromo	1,722	728	126	17.3
35	Obrero	4,606	1,593	261	16.4
36	Santa Rosa	413	157	15	9.6
37	Santísima Trinidad	919	353	57	16.1
38	San Jorge	938	408	49	12.0
39	Itav	527	288	160	55.6
40	Luis A. de Herrera	1,181	498	94	18.9
41	Mburucuvá	1,632	693	112	16.2
42	Sajonia	339	140	23	16.4
43	Panambl Vera	624	219	29	13.2
44	Jara	3,000	1,042	185	17.8
45	Villa Aurelia	2,112	799	139	17.4
46	Nu Guazú	5	3	1	33.3
47	San Pablo	4,480	1,445	205	14.2
48	Ita Pyta Punta	644	186	21	11.3
49	Loma Pyta	914	249	46	18.5
50	Virgen de la Asunción	1,929	491	66	13.4
51	Bella Vista	721	231	41	17.7
52	Gral. Andrés Rodríguez	1,209	339	58	17.1
53	Terminal	958	250	21	8.4
54	Santa Ana	1,043	384	53	13.8
55	Salvador del Mundo	702	181	26	14.4
56	Santa María	953	217	39	18.0
57	Republicano	1,967	545	76	13.9
58	Roberto L. Pettit	4,855	813	111	13.7
59	Virgen de Fátima	1,097	181	26	14.4
60	Ita Enramada	700	196	36	18.4
61	De las Residentas	2,427	391	50	12.8
62	Zeballos Cué	341	47	10	21.3
63	Botánico	1,588	192	50	26.0
64	San Blas	659	133	21	15.8
65	Ricardo Brugada	2,020	131	23	17.6
66	Tablada Nueva	900	114	14	12.3
67	Bañado Tacumbú	517	86	10	11.6
68	San Rafael	1,447	166	30	18.1
69	San Felipe	1,067	161	25	15.5
70	Bañado	208	7	1	14.3
71	Banco San Miguel	0	0	0	0.0
	Asunción Total	105,187	40,384	6,622	16.4
72	Lambaré—Norte	7,829	2,401	301	12.5
73	Lambaré—Oeste	2,992	644	119	18.5
74	Lambaré—Este	9,520	2,501	366	14.6
75	Fdo. de la Mora—Sur	12,120	3,207	502	15.7
76	Fdo. de la Mora—Norte	8,129	2,625	366	13.9
77	Luque	23,940	4,421	741	16.8
78	Mariano Roque Alonso	8,092	1,350	243	18.0
79	Villa Hayes	5,596	439	58	13.2
80	Limpio!	7,590	719	130	18.1
81	San Lorenzo—Norte	5,108	784	129	16.5
82	San Lorenzo—Central	11,879	3,272	476	14.5
83	San Lorenzo—Sur	11,279	1,844	275	14.9
84	Nemby	8,126	1,075	189	17.6
85	San Antonio	3,255	341	57	16.7
86	Villa Elisa	6,308	1,060	172	16.2
88	Capiatá (Outside of the Study Area)	17,824	2,195	373	17.0
	Total	360,520	69,262	11,119	16.1



### 3.1.3 Trip Numbers

The total trips, excluding pedestrian, bicycle and motorcycle trips, in the study area was estimated at 2.3 million, which is 1.6 times the 1984 figure, and 1.03 times the estimated figure for the year 2000 in the 1984 study.

The mode share of buses in 1998 is 50.2%, while it was 62.8% in 1984 and was estimated at 63.5% in the year 2000 in the 1984 study. The bus passenger share decreased more than the estimated figure.

**Table 3-1-5 Total Trips by Mode and Purpose**

Unit: trips/day

	To work	To school	To back home	For Business	For Shopping	For private	Others	Total	%	1984 %
Car	238,035	63,793	288,241	27,871	23,650	32,796	18,606	692,992	30.3	23.0
Small Truck	119,168	29,721	128,519	27,375	15,098	16,573	10,897	347,351	15.2	14.2
Large Truck	40,128	1,919	28,993	16,304	2,546	3,090	5,637	98,617	4.3	
Bus	344,025	64,712	558,069	34,398	28,938	85,480	34,592	1,150,214	50.2	62.8
Total	741,356	160,145	1,003,822	105,948	70,232	137,939	69,732	2,289,174	100.0	100.0
%	32.4	7.0	43.9	4.6	3.1	6.0	3.0	100.0		
1984 %	16.7	10.8	46.0	6.9	8.0	11.6	-	100.0		

The trip purpose share of "To back home" is the highest of 43.9%, which was 46.0% in 1984, followed by 32.4% of "To work", which was 16.7% in 1984, and 7.0% of "To school", which was 10.8% in 1984. The total of trips with purposes of "To work", "To school", "For private" and "To back home" reaches about 90% of all the trips. The share of "To back home" trips occupies almost half of all the trips.

### 3.2 Trip Generation and Attraction

Table 3-2-1 shows the 1998 trip generation/attraction by trip purpose. The zones within Asunción Municipality were integrated into 18 zones, following the sections in 1992 Census, for the purpose of comparison with other zones.

The highest trip generations/attractions are seen in the zones of Encarnación, located at the west side of Micro-Centro, followed by San Roque, located at the East side of Micro-Centro, San Lorenzo Central, Luque, and Recoleta.

The "To work" trip attraction/generation rates show the highest figure of 3.11 in Encarnación, followed by San Roque (1.42), Carlos A. López (1.36), and San Rafael (1.20). All these areas are located at Micro-Centro or its adjacent areas and have more business and commercial activities. The lowest was in Lambaré Este (0.39), followed by Ycua Sati (0.51) and San Lorenzo Norte (0.53), where most of the areas were occupied by residents.

The "To school" trip attraction/generation rates show the highest figure of 2.17 in Loma Pyta, followed by San Lorenzo Central (2.13), and Villa Hayes (2.09).

Table 3-2-1 Trip Generation/Attraction by Trip Purpose in Study Area

Unit: trips/day

Integrated Zone	Generation					Attraction				
	To work	To school	Others	To home	Total	To work	To school	Others	To home	Total
1 C.A. López	20,104	6,391	12,797	37,912	77,204	27,275	7,864	14,585	30,460	80,184
2 Encarnación	56,561	16,690	39,114	219,625	331,990	175,785	24,154	59,665	76,257	335,861
3 Jara	26,989	6,348	13,581	32,412	79,330	21,209	8,042	11,069	37,220	77,540
4 San Rafael	18,101	4,465	8,909	28,218	59,693	21,728	3,564	11,174	23,925	60,391
5 Botanico	11,373	1,805	6,509	13,412	33,099	8,250	1,862	4,976	17,726	32,814
6 Loma Pyta	4,886	496	2,881	6,752	15,015	4,179	1,076	4,499	5,977	15,731
7 Mmc. Lynch	15,125	3,362	7,720	13,282	39,489	8,418	1,759	7,211	22,160	39,548
8 Sto. Domingo	19,198	5,761	8,506	16,022	49,487	10,659	4,566	6,244	26,578	48,047
9 Mburicao	30,207	8,285	18,869	33,082	90,443	24,579	9,541	12,972	41,367	88,459
10 San Roque	36,624	8,649	21,712	75,361	142,346	52,128	9,753	29,855	52,597	144,333
11 Obrero	31,527	5,046	13,813	44,250	94,636	31,895	5,368	15,521	43,130	95,914
12 Bañado	14,423	3,956	7,852	17,044	43,275	10,323	3,756	5,800	21,624	41,503
13 Ita Enramada	4,833	1,120	2,191	5,470	13,614	3,702	775	2,248	6,717	13,442
14 Pinoza	21,981	3,669	12,115	25,382	63,147	16,130	3,999	10,547	31,651	62,327
15 Recoleta	29,933	8,615	15,681	43,614	97,843	30,982	7,138	18,856	39,757	96,733
16 Ycua Sati	27,312	5,327	13,725	22,005	68,369	14,037	4,234	8,894	39,165	66,330
17 Villa Aurelia	15,821	3,706	8,529	15,656	43,712	13,826	3,646	7,290	19,215	43,977
18 Hipodromo	24,721	6,206	13,509	30,548	74,984	22,310	4,347	13,295	36,300	76,252
19 Lambaré Norte	18,136	2,012	7,581	17,334	45,063	13,544	2,907	6,286	22,208	44,945
20 Lambaré Oeste	7,113	1,724	5,176	8,789	22,802	5,620	913	4,322	11,697	22,552
21 Lambaré Este	16,089	1,844	7,162	9,469	34,564	6,347	1,421	4,825	21,495	34,088
22 Fdo. de la Mora Sur	31,237	9,614	14,787	34,512	90,150	25,220	6,882	13,023	43,949	89,074
23 Fdo. de la Mora Norte	32,670	9,183	16,422	32,894	91,169	20,729	4,563	12,930	51,722	89,944
24 Luque	49,237	7,412	20,511	41,004	118,164	29,561	5,051	17,435	65,057	117,104
25 M.R. Alonso	15,168	1,826	8,034	15,763	40,791	11,052	1,697	8,073	20,404	41,226
26 Villa Hayes	3,515	338	3,317	4,039	11,209	2,719	707	2,964	4,937	11,327
27 Limpio	10,307	2,004	4,745	15,153	32,209	11,178	2,164	6,144	13,133	32,619
28 San Lorenzo Norte	9,153	1,545	1,954	5,453	18,105	4,829	1,457	1,564	10,709	18,559
29 San Lorenzo Central	46,085	8,450	22,614	65,751	142,900	43,398	18,003	21,421	63,817	146,639
30 San Lorenzo Sur	17,187	2,915	7,455	14,412	41,969	11,258	2,172	5,073	23,150	41,653
31 Nemby	15,438	1,731	5,187	13,522	35,878	9,871	1,516	5,345	19,476	36,208
32 San Antonio	5,524	1,124	2,600	5,808	15,056	4,309	888	2,257	7,356	14,810
33 Villa Elisa	19,740	4,594	8,091	22,535	54,960	12,964	2,808	11,922	27,441	55,135
Study Area Total	706,318	156,213	363,649	986,485	2,212,665	710,014	158,593	368,285	978,377	2,215,269

### 3.3 Trip Distribution

#### 3.3.1 "To Work" Trips

Fig. 3-3-1 shows the trip distribution pattern of "to work" trips in 1998, in the form of desire line. The figure shows the trip demand between OD pairs which have more than 1,000 trips/day. The zones in Asunción were integrated into 18 zones. The high demand is seen between Luque and Micro-Centro, and San Lorenzo – Micro Centro corridor. It is characterized by the demands between surrounding cities of Limpio – Luque – San Lorenzo and Nemby which are seen in the figure, but was not seen in the desire line in 1984, though they are not high.

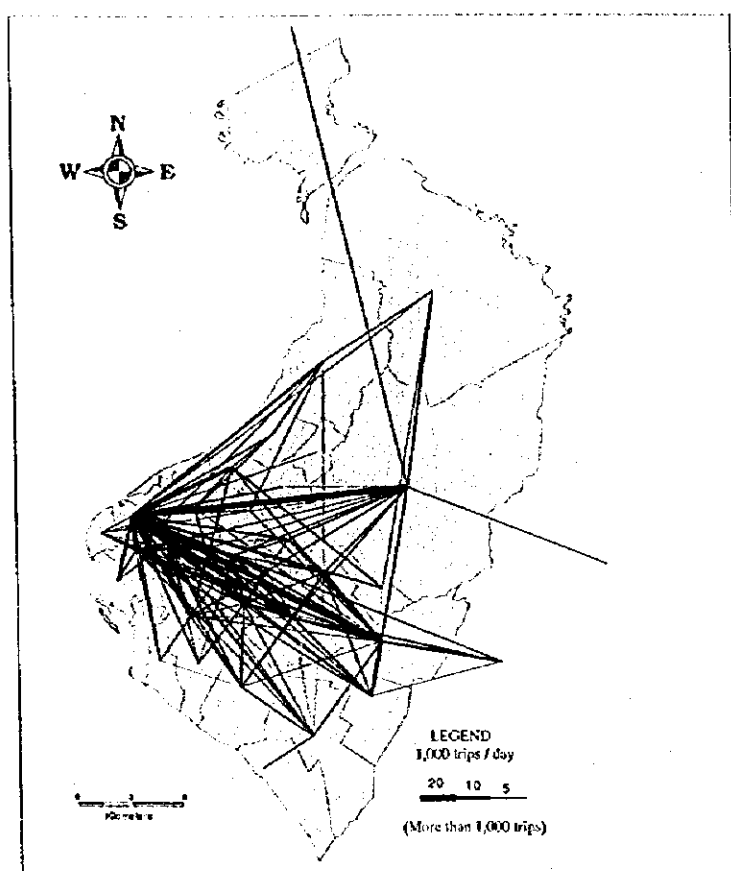


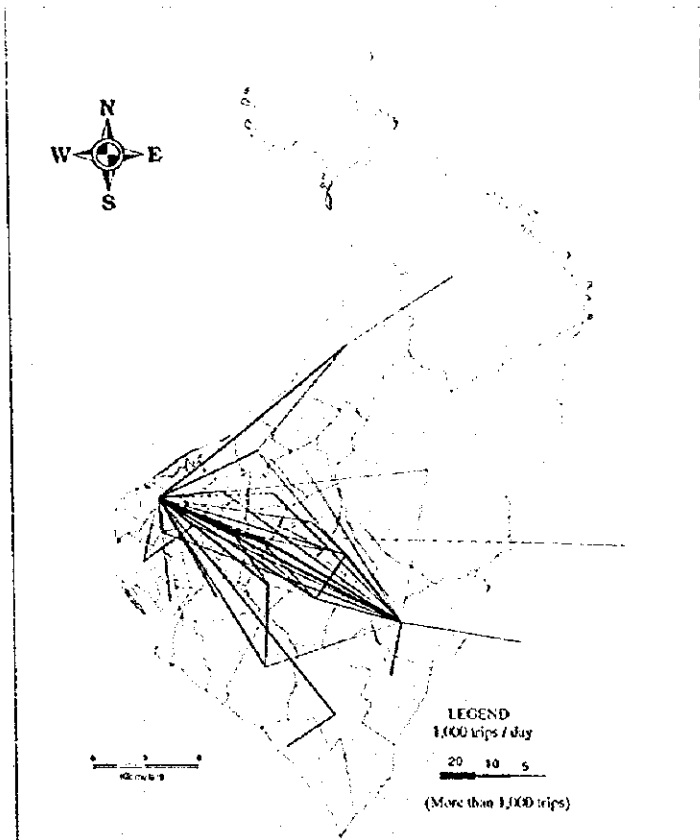
Fig. 3-3-1 Desire Line (Work Trip in the year 1998)

#### 3.3.2 "To School" Trips

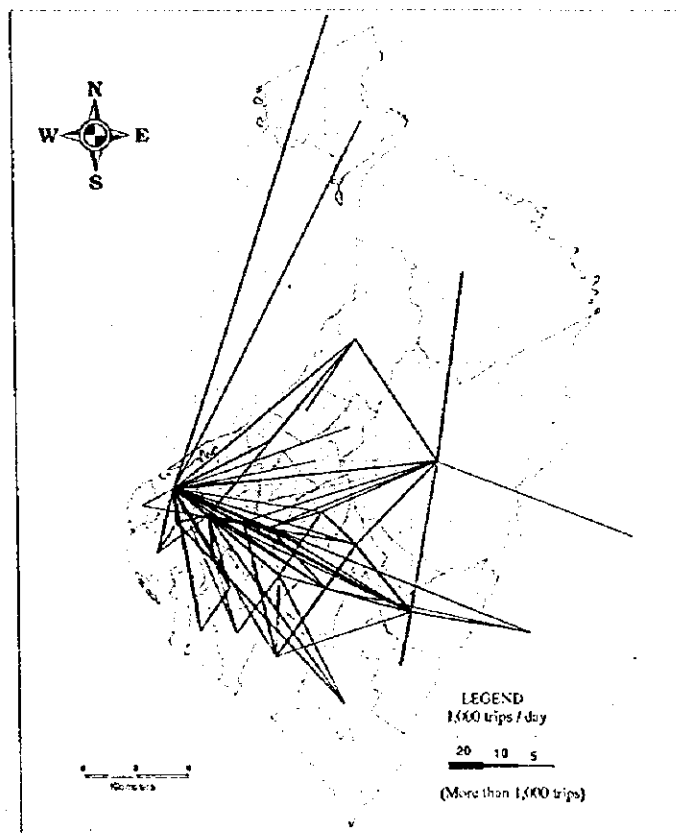
Fig. 3-3-2 shows the desire line of "to school" trips. Many flows are concentrated to San Lorenzo Central where Asunción University is located and Micro Centro where many colleges and institutes are located.

#### 3.3.2 Other Trips

Fig. 3-3-3 shows the desire line of other trips including "for business", "for shopping", "to private activities" and "other purposes".



**Fig. 3-3-2 Desire Line (To School Trip in the year 1998)**



**Fig. 3-3-3 Desire Line (Other Trips in the year 1998)**

### 3.4 Modal Split

#### 3.4.1 Mode Preference among private and public modes

The mode preference survey was carried out to know the possibility of private car users shifting to public transport. The private car users who answered that he/she would shift to public transport if some conditions of public transport would be improved were interviewed on the actual travel conditions by cars and the expected conditions of the alternative public mode.

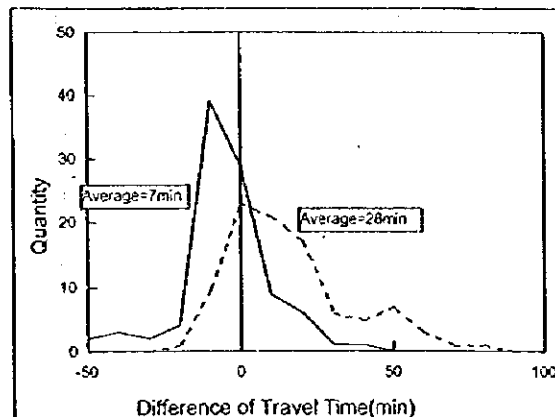
Table 3-4-1 shows the main conditions of public transport to be improved, by trip purpose, to shift from the private mode to the public, excluding congestion and convenience, because almost all the private car users were expected to answer that the improvement of congestion and convenience of public transport would be the main condition to shift.

Access distance from the house to the nearest bus station, waiting time, and travel time on board show similar percentages, while the transfer time shows a relatively low percentage, which implies that the present bus network densely covers the city and mostly provides direct routes from origins to destinations.

**Table 3-4-1 Answers by Category**

	To work	To school	Others	Total
<b>Quantity</b>				
Access distance	44	19	3	66
Waiting time	43	21	1	65
No. of transfer	16	4	1	21
Travel time	54	18	3	75
Egress distance	38	13	3	54
<b>Total</b>	<b>195</b>	<b>75</b>	<b>11</b>	<b>281</b>
<b>Percentage (%)</b>				
Access distance	22.6	25.3	27.3	23.5
Waiting time	22.1	28.0	9.1	23.1
No. of transfer	8.2	5.3	9.1	7.5
Travel time	27.7	24.0	27.3	26.7
Egress distance	19.5	17.3	27.3	19.2
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Fig. 3-4-1 shows the differences of travel time including waiting time and accesses of the present alternative public transport and the desirable conditions, and cars. The actual average travel time difference between private and public modes is 28min., and the car users answered they may shift to public mode, if the difference is reduced to 7min.



**Fig. 3-4-1 Travel Time Difference between Actual and Desirable Conditions**

Fig. 3-4-2 shows the travel cost difference of cars, including fuel cost and parking fee, and the fare of buses in actual and desirable conditions. The average travel cost of cars is calculated as higher than buses by 2,034 Gs. and car users do not expect a reduce than in bus fare to be one of the mode shift conditions, which implies that the main reason for car use is not for economical reasons.

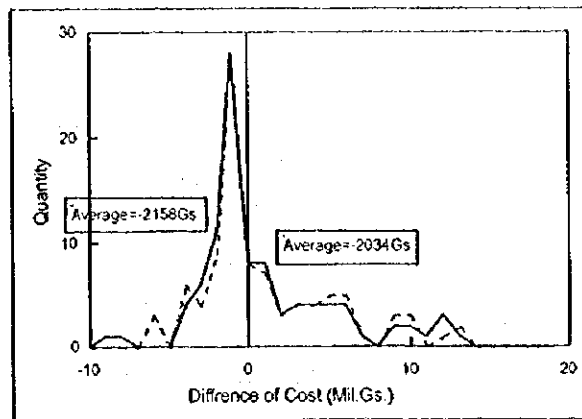


Fig. 3-4-2 Travel Cost Difference

The probability to select a mode can be expressed by the following logit type disaggregate model;

$$P_{car} = \frac{Exp(V_{car})}{Exp(V_{car}) + Exp(V_{bus})}$$

$$V_i = \sum \beta_k \times Z_{ik}$$

Where,  $P_{car}$  : Probability to select private cars

$V_i$  : Utility function

$\beta_k$  : Parameter of variable  $Z_k$

The parameters were calculated by Maximum Likelihood Estimation as shown in Table 3-4-2. The hit ratio to select the present mode was 0.693.

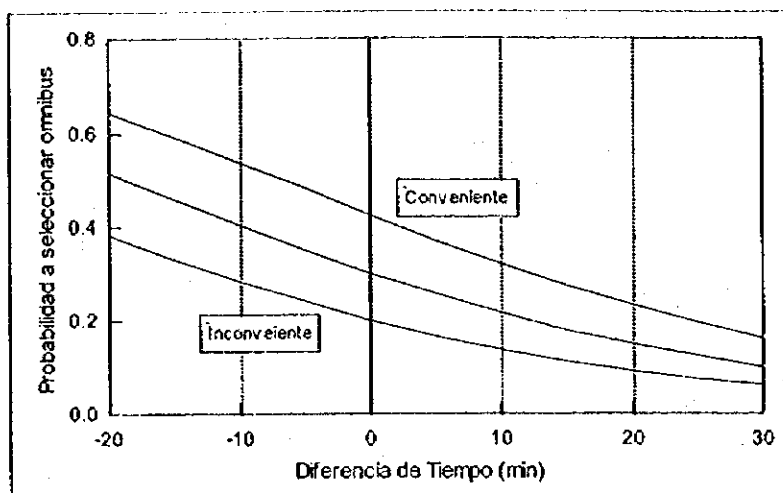
Table 3-4-2 Parameters of Disaggregate Model

Variable	Parameter	t-Value
1. Access distance (m)	-0.00306	-3.9755
2. Egress distance (m)	-0.00003	-0.4423
3. On board time (min)	-0.03029	-2.8746
4. Convenience (1/2/3*)	0.60951	5.1691

(Note) Convenience Level is as follows;

Level*	Cleanliness	Air Conditioner
1	Not clean	Without
2	Clean	Without
3	Clean	With

Fig. 3-4-3 shows the relationship between on board time, convenience and the probability to select buses. Only when the buses are convenient and there is not so much difference in on board time on buses and driving time of cars, half of the car users will select public transport (50% of probability), and if the buses remain in a condition similar to the present, and if the on board time is the same as for cars, only 1 car user out of 5 will select buses.

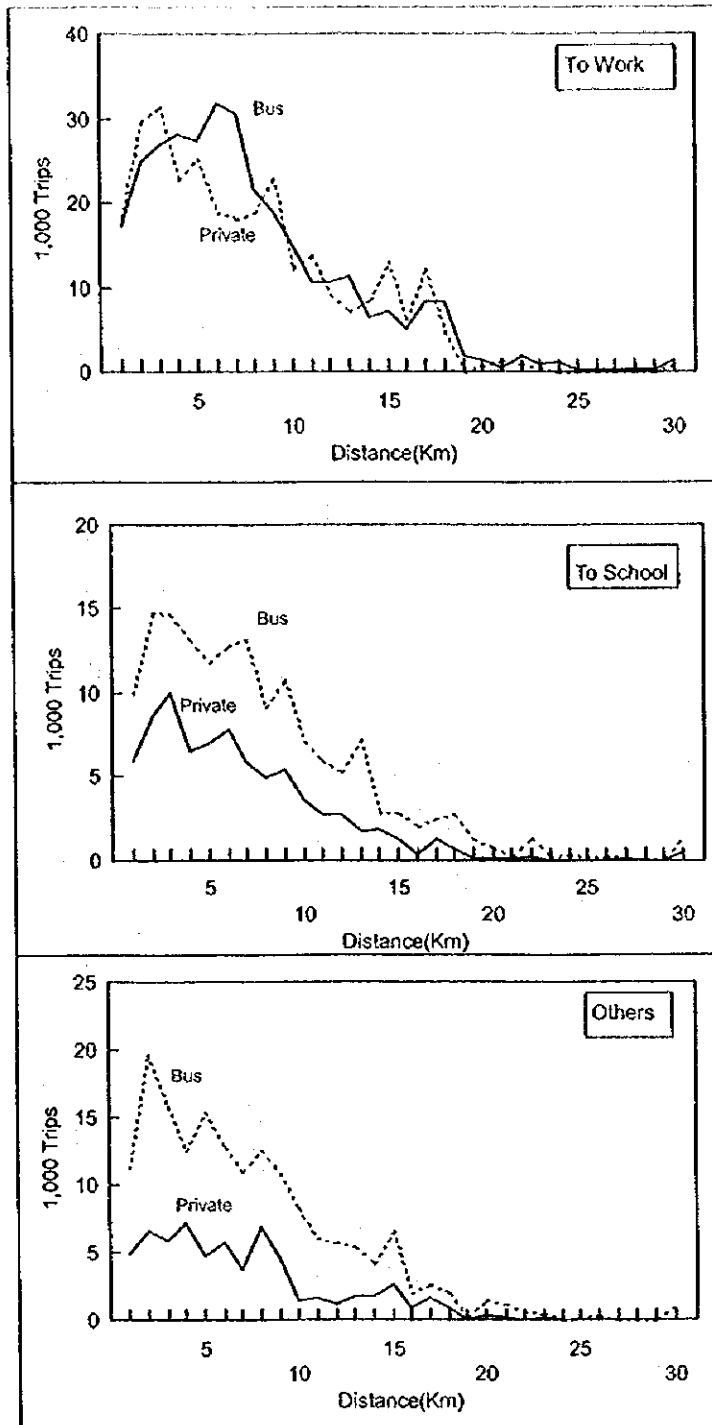


**Fig. 3-4-3 Probability to Select Buses**

### 3.4.2 Mode Selection Tendency

Fig. 3-4-4 shows the trip length distribution by private or public mode and by trip purpose. The "to work" trips shows the high public transport share for distances between 3 – 8 Km, however the share of public and private modes show similar tendencies for the rest of the distances. The "to school" trips show always more trips of public mode than private mode, however their tendencies are almost similar throughout the distances. The "other" trips show the same tendency as the "to school" trips.

Based on these results, it can be said that the travel distance does not affect the mode selection because of the relatively low travel cost of private vehicles and the relatively higher speed of public transport at present.



**Fig. 3-4-4 Trip Distance Distribution by Mode and Purpose**



### 3.5 Traffic Flow

#### 3.5.1 Vehicle Flow Change

##### (1) Traffic Flow at Metropolitan Area Border

Among the cordon line survey stations located on the metropolitan border, the station on Ruta 2 has the highest traffic flow of 16,800 veh/14h, followed by the station on Ruta 1 (9,300 veh/14h). The traffic flow for the east – west direction is the highest. Comparing 1984 traffic flow with that in 1998, the total flow increased by 2.10 times, and at the survey station on Ruta 2, it increased 2.47 times, and on Ruta 1, 1.91 times.

**Table 3-5-1 Traffic Flow at Metropolitan Area Border**

		Volume(14 Hours)		1998/1984
		1998	1984	
1	Ruta a Falcón	2,284	-	-
2	Ruta 9	2,711	-	-
3	Ruta 3	1,577	1,000	1.58
4	Ruta Luque	6,502	-	-
5	Ruta 2	16,797	6,800	2.47
6	Ruta 1	9,289	4,800	1.94
7	Ruta Ñemby	4,034	2,500	1.61
Total*		43,194	-	-
Total**		31,697	15,100	2.10

Total\* Total volume of surveying points in 1998

Total\*\* Total volume of surveying points in 1984

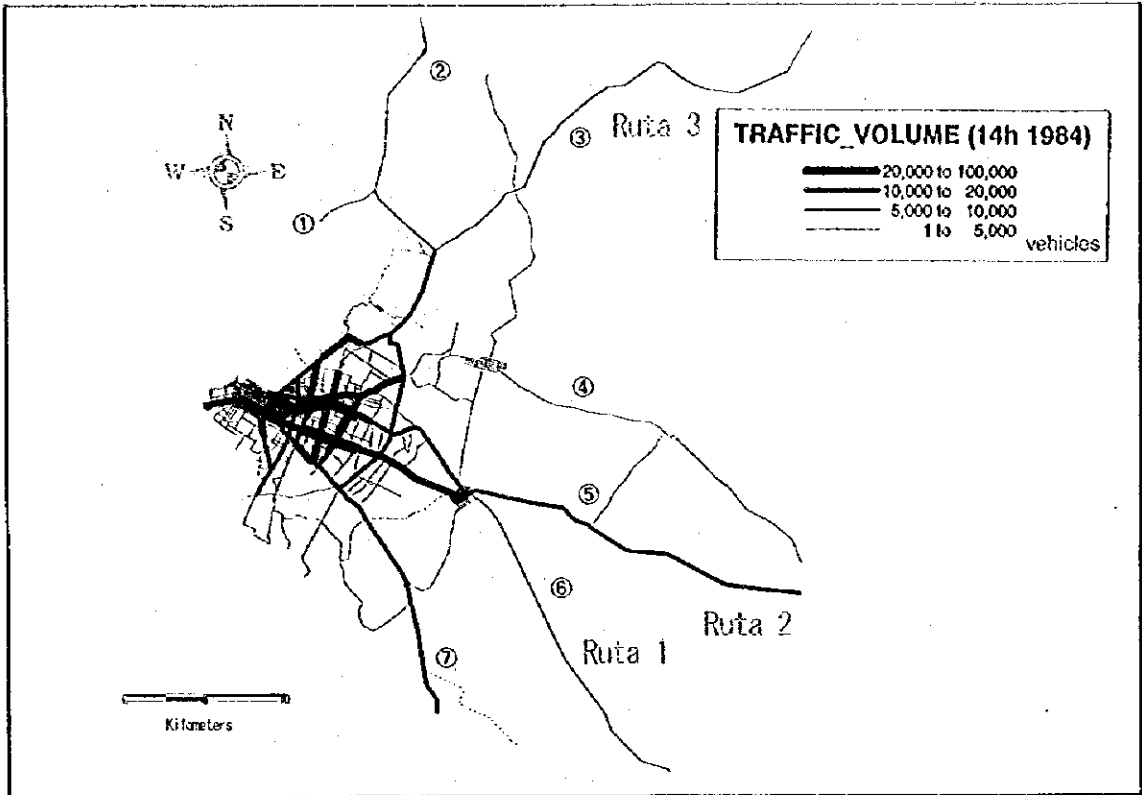


Fig. 3-5-1 Traffic Flow on Cordon Line (1984)

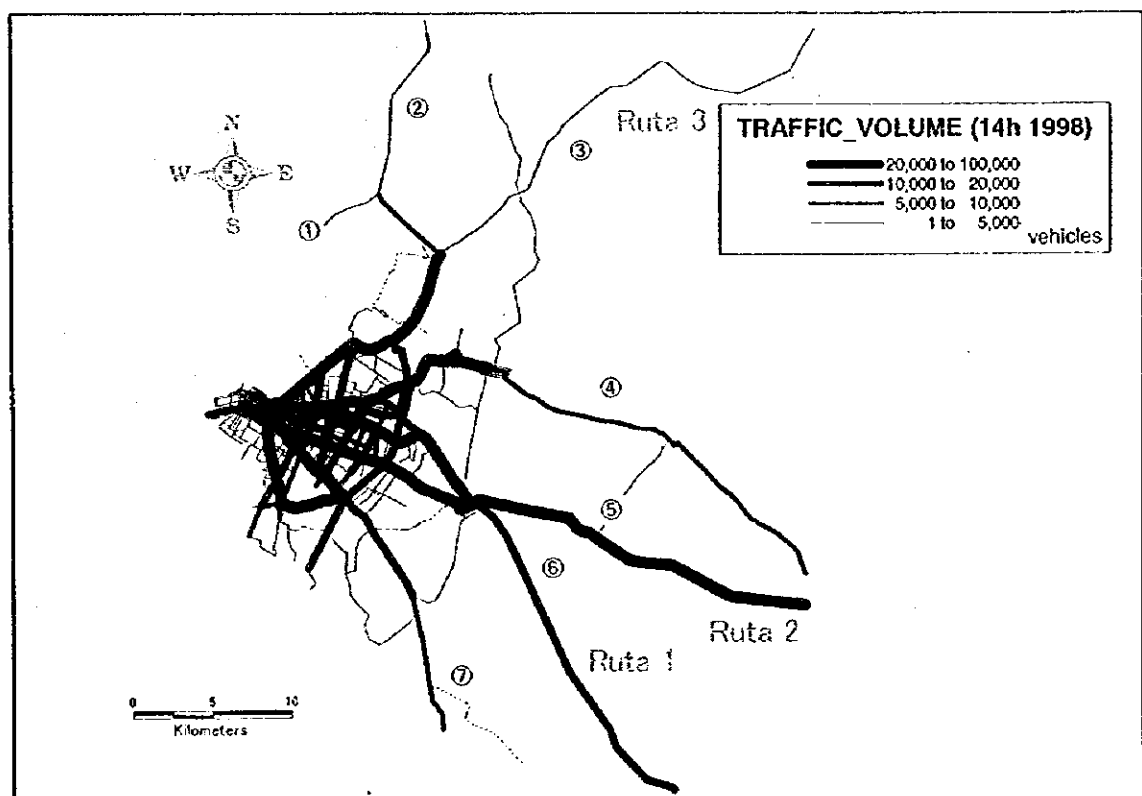


Fig. 3-5-2 Traffic Flow on Cordon Line (1998)

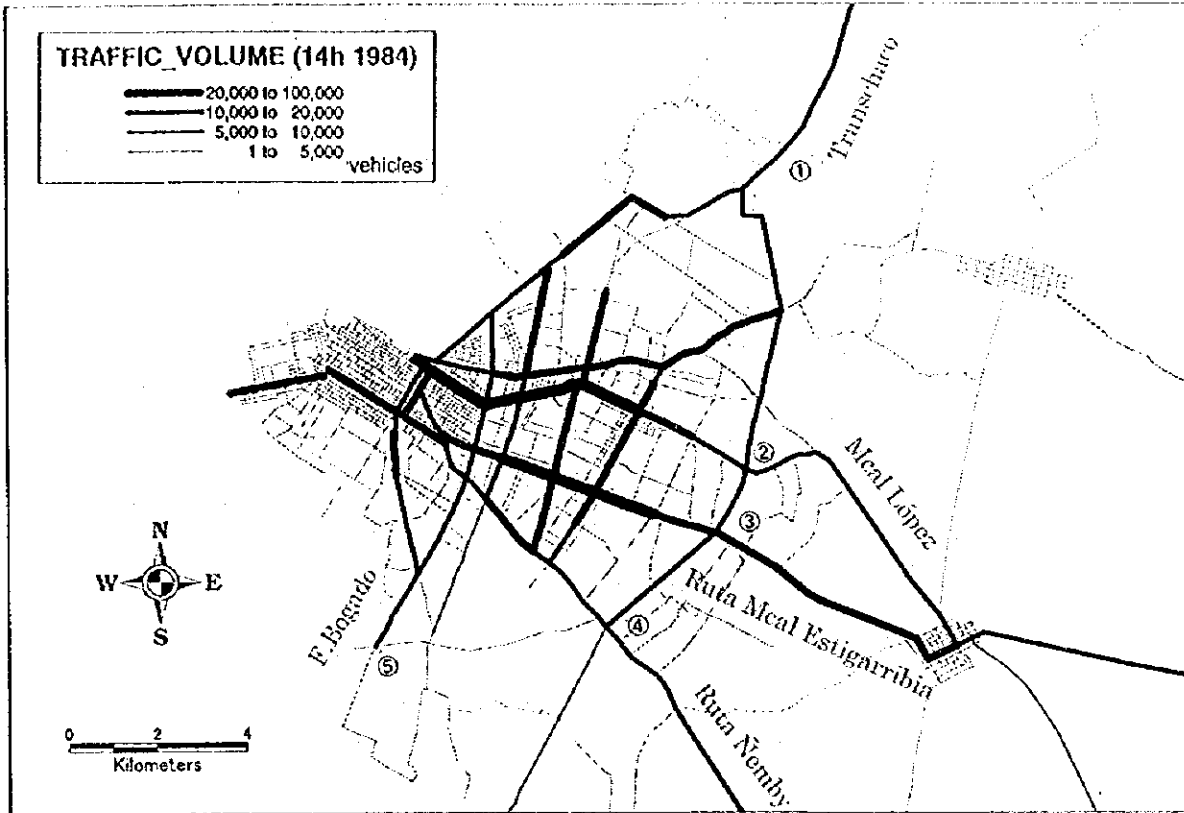
(2) Traffic Flow at Asunción City Border

The traffic volumes at the Asunción city border are shown in Table 3-5-2. These volumes adjusted based on 1996 traffic counts by Asunción City, because of construction work on Av. Mme. Lynch at present. The east - west traffic flows on Av. Mcal. López and Av. E.Ayala are 29,000 veh/14h and 28,000 veh/14h respectively, while the traffic from/to north on Ruta Transchaco shows the highest of 34,000 veh/14h, which may be generated from M.R.Alonso because of lower traffic flow at the border of the metropolitan area.

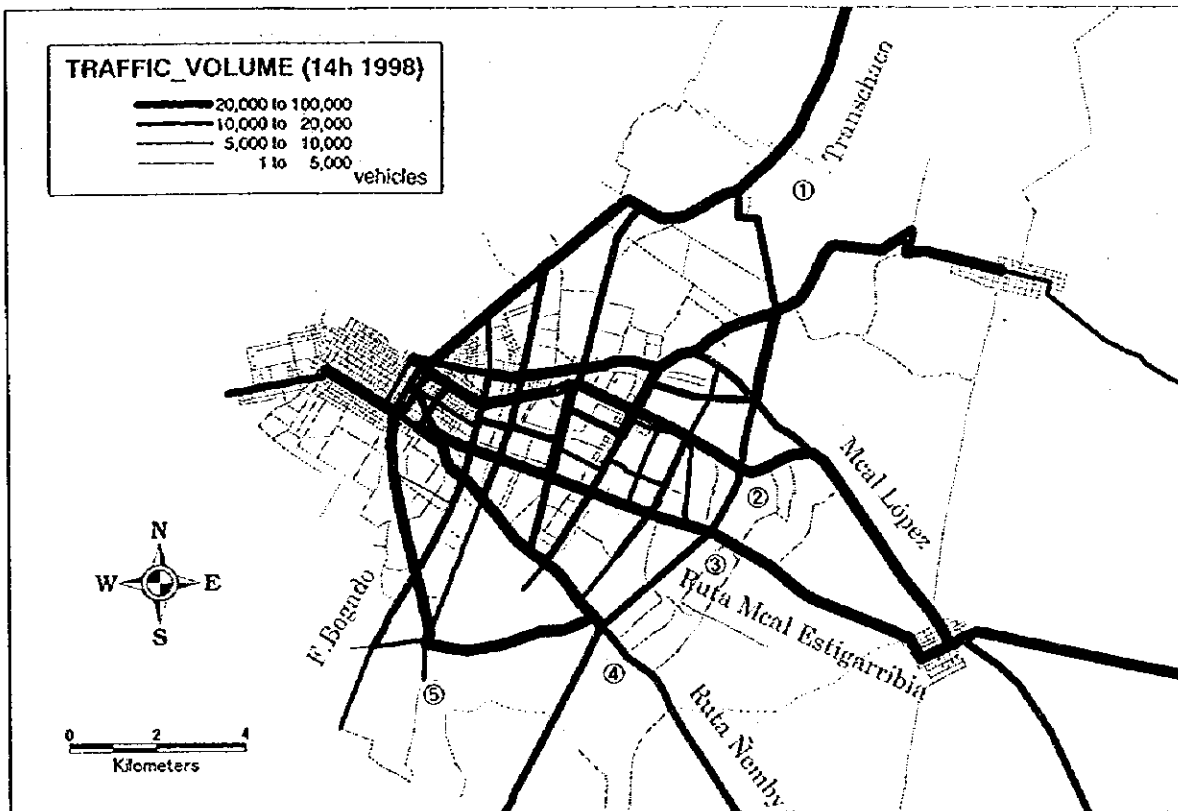
Comparing 1998 traffic flows with that in 1984, the total flow increased by about 4.0 times, and that on Ruta Transchaco shows the highest increase of 7.49 times. This rapid increase is caused partially by the widening of Ruta Transchaco from 2 lanes in 1984 to 4 lanes.

**Table 3-5-2 Traffic Volume at Asunción City Border**

		Volume(14 Hours)		1998/1984
		1998	1984	
1	Transchaco	33,718	4,500	7.49
2	Av.Mcal López	29,245	5,100	5.73
3	Ruta Mcal. Estigarribia (Ruta 2)	28,221	11,800	2.39
4	Ruta Nemby	13,844	3,800	3.64
5	Félix Bogado	22,559	6,740	3.35
	Total	127,587	31,940	3.99



**Fig. 3-5-3 Traffic Flow in Asunción City (1984)**



**Fig. 3-5-4 Traffic Flow in Asunción City (1998)**

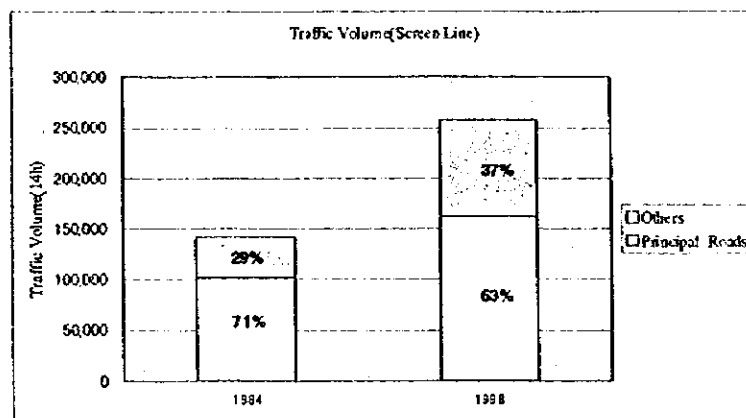
### (3) Traffic Flow Within Asunción City

The traffic flows in Asunción city show higher flows on radial trunk roads. The highest flow of 37,600 veh/14h is seen on Av. Mcal. López, followed by 26,800 veh/14h on Av. E.Ayala. The highest flow among the circular roads is seen on Av. Choferes del Chaco between Av. Mcal. López and Av. E.Ayala.

The traffic flow pattern in 1998 is not so different from the 1984 flow pattern, however, the total flow crossing the screen line increased by 1.81 times. The traffic flow from the direction of Lambaré shows the highest increase of 3.38 times, and the flow on Av. F.J.Bogado shows an increase of 3.35 times. The share of traffic flows on the trunk roads at the screen line was 73% in 1984, while it decreased to 63% in 1998. The growth factor of the total traffic flow at the screen line is 1.81 times, while that of the total of trunk roads is as low as 1.60 times and that of other roads is 2.35 times, which implies that the traffic detoured avoiding the road congestion on the trunk roads to use local roads, which were unpaved in 1984 and are paved at present. This tendency is especially remarkable along Av. E.Ayala.

**Table 3-5-3 Traffic Volume at Screen Line**

	Street			Section		
	Volume(14 Hours)		1998 /1984	Volume(14 Hours)		1998 /1984
	1998	1984		1998	1984	
1 Artigas	27,596	11,979	2.30	37,423	15,270	2.45
2 Gubetich	9,827	3,291	2.99			
3 Chaves	12,345	-	-	32,510	17,460	1.86
4 España	20,165	17,460	1.15			
5 Mcal. López	37,560	25,223	1.49	67,242	43,351	1.55
6 Chaco Boreal	9,544	6,589	1.45			
7 Las Perlas	1,214	1,133	1.00			
8 25 de Mayo	18,924	10,406	1.82			
9 Teodoro S. Mongelós	10,580	442	23.94			
10 José A. Flores	10,901	10,466	1.04	48,619	34,128	1.42
11 E. Ayala	27,138	23,220	1.17			
12 Fernando de la Mora	26,773	16,768	1.60	28,266	18,985	1.49
13 Madre Ravasco	1,493	2,217	0.67			
14 B. Guggiari	7,990	1,158	6.90	43,219	12,802	3.38
15 Félix Bogado	22,559	6,741	3.35			
16 Perón	12,670	4,903	2.58	/	/	/
Av. Principales	161,791	101,391	1.60			
Others	95,488	40,605	2.35			
Total	257,279	141,996	1.81	257,279	141,996	1.81



**Fig. 3-5-5 Traffic Flow by Road Classification**

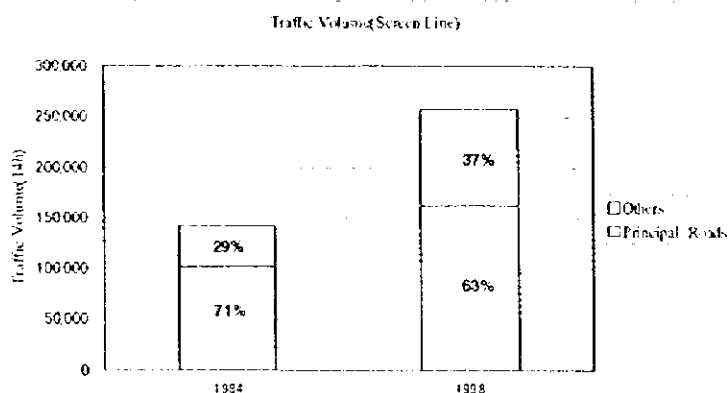
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12 Fernando dela Mora	26,773	16,768	1.60			
13 Madre Ravasco	1,493	2,217	0.67	12,670	4,903	2.58
14 B. Guggiari	7,990	1,158	6.90			
15 Félix Bogado	22,559	6,741	3.35	161,791	101,391	1.60
16 Perón	12,670	4,903	2.58			
Av. Principales	161,791	101,391	1.60	95,488	40,605	2.35
Others	95,488	40,605	2.35			
Total	257,279	141,996	1.81	257,279	141,996	1.81



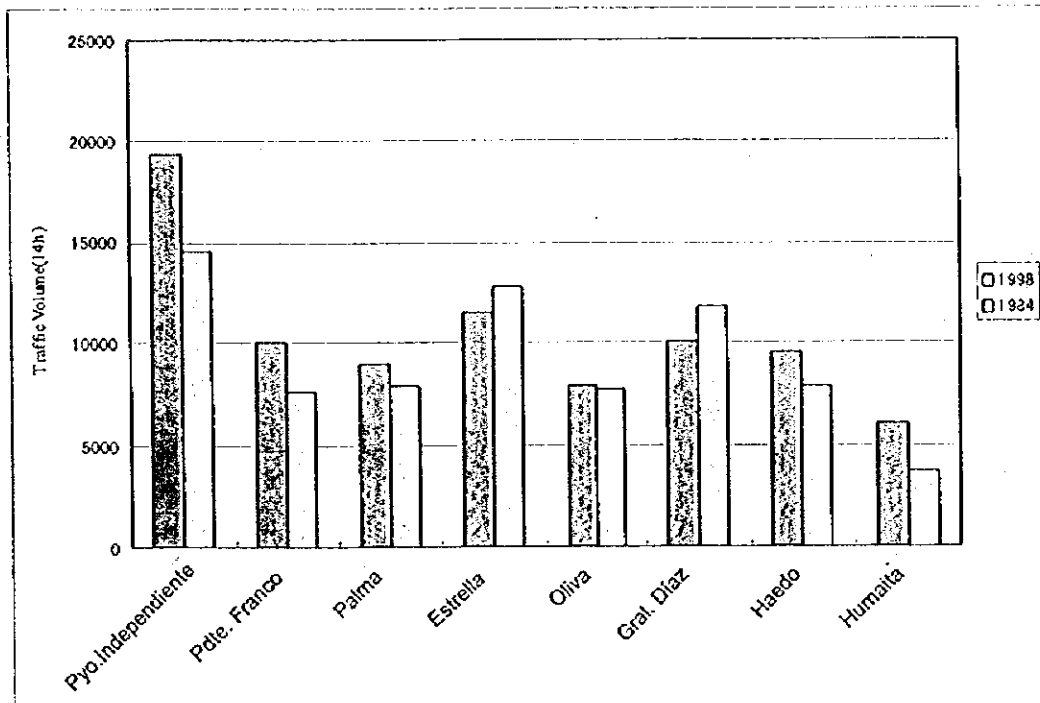
**Fig. 3-5-5 Traffic Flow by Road Classification**

(4) Traffic Flow in Micro-Centro

The section traffic volume between Chile and Alberdi from Praguayo Independiente to 5<sup>th</sup> Av. is 150,000 veh/14h. The roads which show the highest traffic volume are Paraguayo Independiente and Av. R. Francia – Ygatimi, both are 2 ways, and the volume is about 20,000 veh/14h. Comparing these flows with 1984 survey results, the total section volume increased by 1.13 times, and there is no big difference. However, the traffic flows on Estrella and Gral. Diaz, which had high traffic volumes, decreased, and the flows on other roads increased. The traffic concentration to specific roads is alleviated.

**Table 3-5-4 Section Traffic Flow in Micro Centro**

Street	Volume(14 Hours)		1998/1984	Direction
	1998	1984		
1 Pyo. Independiente	19,364	14,600	1.33	Both sides traffic
2 Pdte. Franco	10,013	7,600	1.32	East-West
3 Palma	8,922	7,900	1.13	
4 Estrella	11,491	12,800	0.90	West-East
5 Oliva	7,904	7,700	1.03	
6 Gral. Díaz	10,010	11,800	0.85	East-West
7 Haedo	9,590	7,900	1.21	West-East
8 Humaita	6,033	3,700	1.63	East-West
9 Piribebuy	4,042			West-East
10 Manduvirá	9,033			East-West
11 Ibañez	6,428			West-East
12 Ygatimi	20,921	10,600	1.97	Both sides traffic
13 Lugano	1,735			East-West
14 Ytororó	5,985			West-East
15 Sicilia	2,780			East-West
16 Roma	6,796			West-East
17 Dupuis	8,525			East-West
Total (1-17)	149,572			Surveying points in 1998
Total**(1-8)	83,327	74,000	1.13	**Pyo.Independiente-Humaita



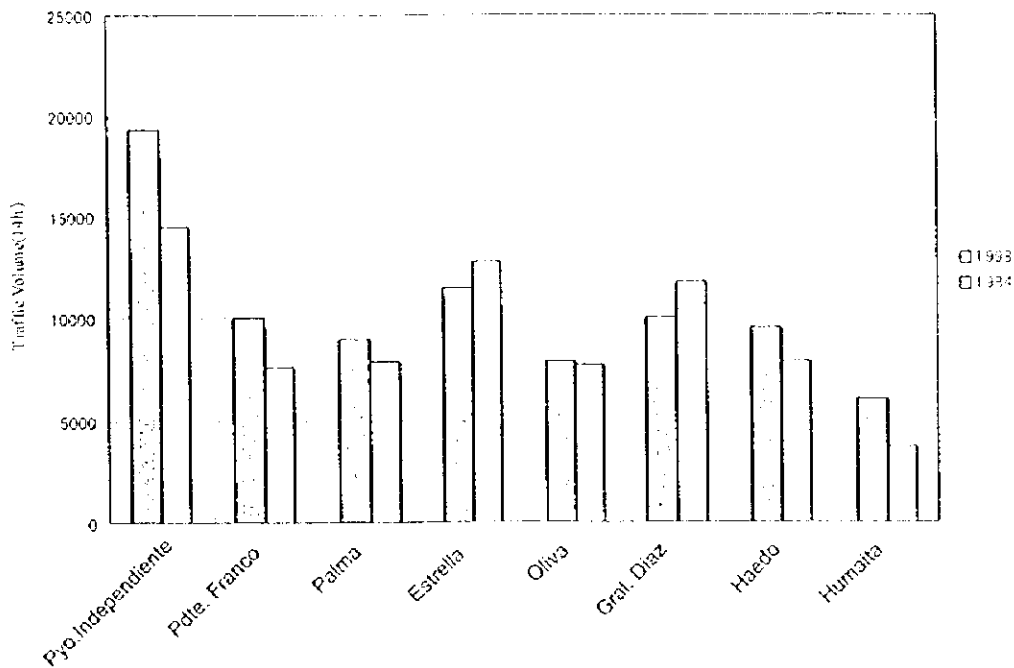
**Fig. 3-5-6 Traffic Volume on Each Street**

(d) Traffic Flow in Micro-Centro

The section traffic volume between Chile and Alberdi from Paraguayo Independiente to 5<sup>th</sup> Av. is 150,000 veh/1-h. The roads which show the highest traffic volume are Paraguayo Independiente and Av. R. Francia - Ygatimi, both are 2 ways, and the volume is about 20,000 veh/1-h. Comparing these flows with 1984 survey results, the total section volume increased by 1.13 times, and there is no big difference. However, the traffic flows on Estrella and Gral. Diaz, which had high traffic volumes, decreased, and the flows on other roads increased. The traffic concentration to specific roads is alleviated.

**Table 3-5-4 Section Traffic Flow in Micro Centro**

Street	Volume(14 Hours)		1998/1984	Direction
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16 Roma	6,796			West-East
17 Dupuis	8,525			East-West
Total (1-17)	149,572			Surveying points in 1998
Total** (1-8)	83,327	74,000	1.13	**Pyo. Independiente-Humaita



**Fig. 3-5-6 Traffic Volume on Each Street**



### 3.5.2 Traffic Composition

Traffic compositions of the principal roads in 1998 and 1984 are shown in Fig. 3-5-7, and are characterized by the following;

- There is no big difference on Av. E.Ayala, Av. Fdo. de la Mora, and Av. J.F.Bogado
- The bus share on Av. Mcal. López increased remarkably from 1.7% to 7.6%
- The bus share on Av. Artigas decreased remarkably from 32.2% to 8.3%, and the share of passenger car increased.
- The share of heavy truck on Av. España increased from 1.3% to 4.2%

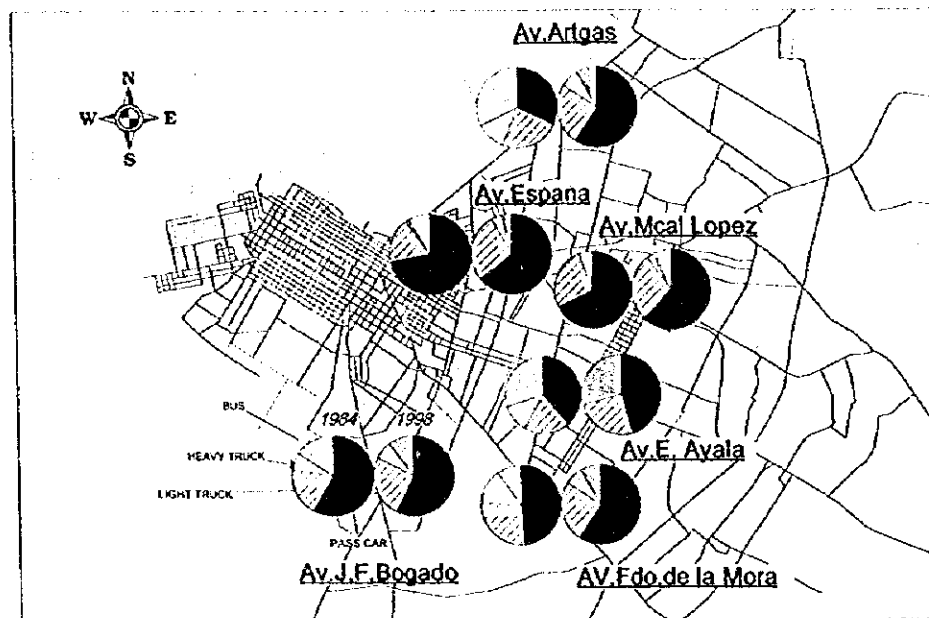


Fig. 3-5-7 Traffic Composition

Table 3-5-5 Traffic Composition

Street	Year	Unit: %.			
		Car	Small Truck	Large Truck	Bus
AV. ARTIGAS	1984	31.9	24.2	11.7	32.2
	1998	59.4	24.8	7.5	8.3
AV. ESPAÑA	1984	72.1	18.0	1.3	8.6
	1998	64.5	27.1	4.2	4.2
AV. MCAL. LÓPEZ	1984	68.0	26.3	4.0	1.7
	1998	62.1	27.8	2.5	7.6
AV. E. AYALA	1984	38.8	19.5	11.9	29.7
	1998	45.7	25.1	6.8	22.4
AV. FDO. DE LA MORA	1984	48.9	27.0	14.1	10.0
	1998	59.4	24.8	7.5	8.3
AV. J.F. BOGADO	1984	58.1	19.2	7.0	15.7
	1998	57.4	25.1	7.3	10.3

Bus flows are shown in Fig. 3-5-8. The bus flows are high on the main trunk roads and the highest flow is seen on Av. E.Ayala. The lowest flow among the main radial roads is seen on Av. España.

Truck flows are shown in Fig. 3-5-9. The truck flows from North direction of Transchaco to Asunción city divert to the flows on Av. Artigas and on Av. Mme. Lynch. The flows towards Ruta 1 and 2 pass also Av. Mme. Lynch.

### 3.5.2 Traffic Composition

Traffic compositions of the principal roads in 1998 and 1984 are shown in Fig. 3-5-7, and are characterized by the following;

- There is no big difference on Av. E.Ayala, Av. Fdo. de la Mora, and Av. J.F.Bogado
- The bus share on Av. Mcal. López increased remarkably from 1.7% to 7.6%
- The bus share on Av. Artigas decreased remarkably from 32.2% to 8.3%, and the share of passenger car increased.
- The share of heavy truck on Av. Eapaña increased from 1.3% to 4.2%

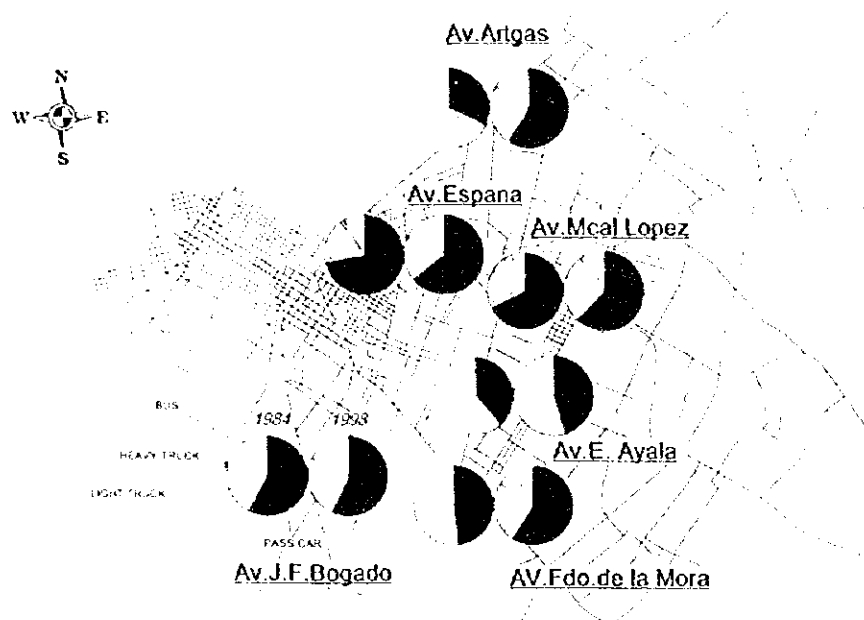


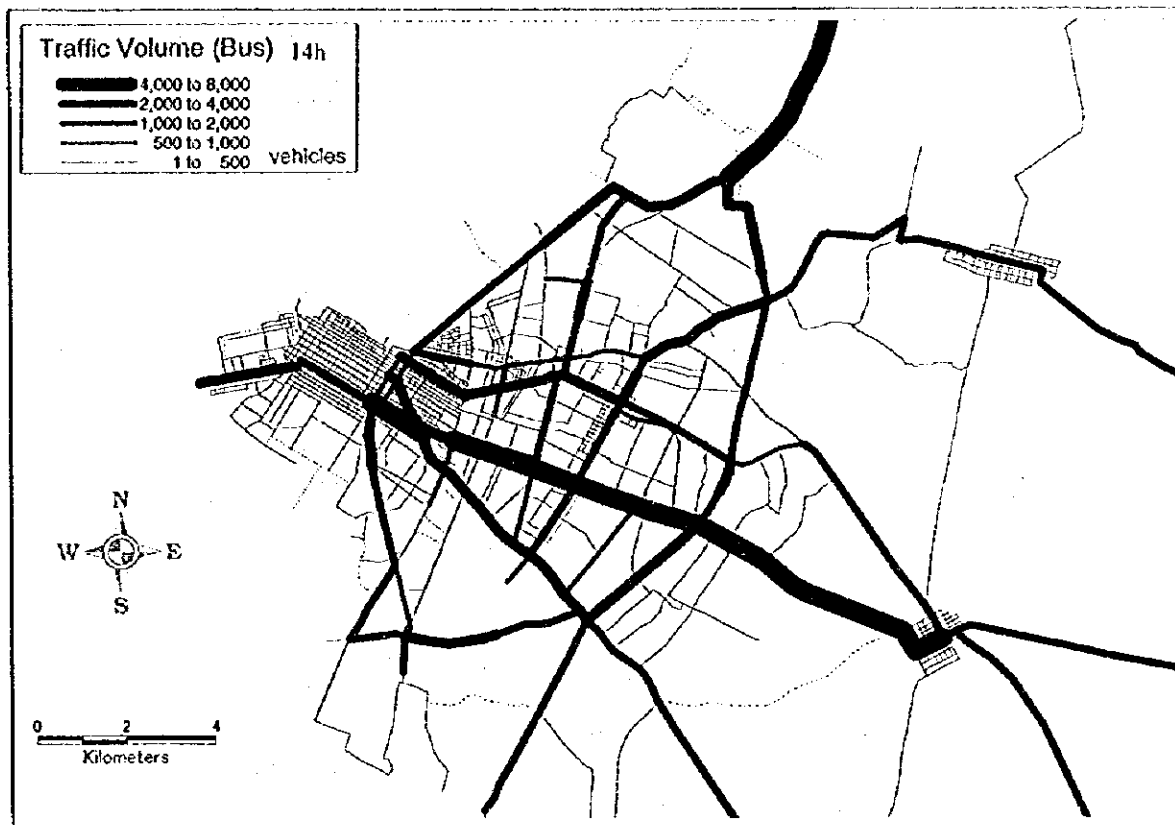
Fig. 3-5-7 Traffic Composition

Table 3-5-5 Traffic Composition

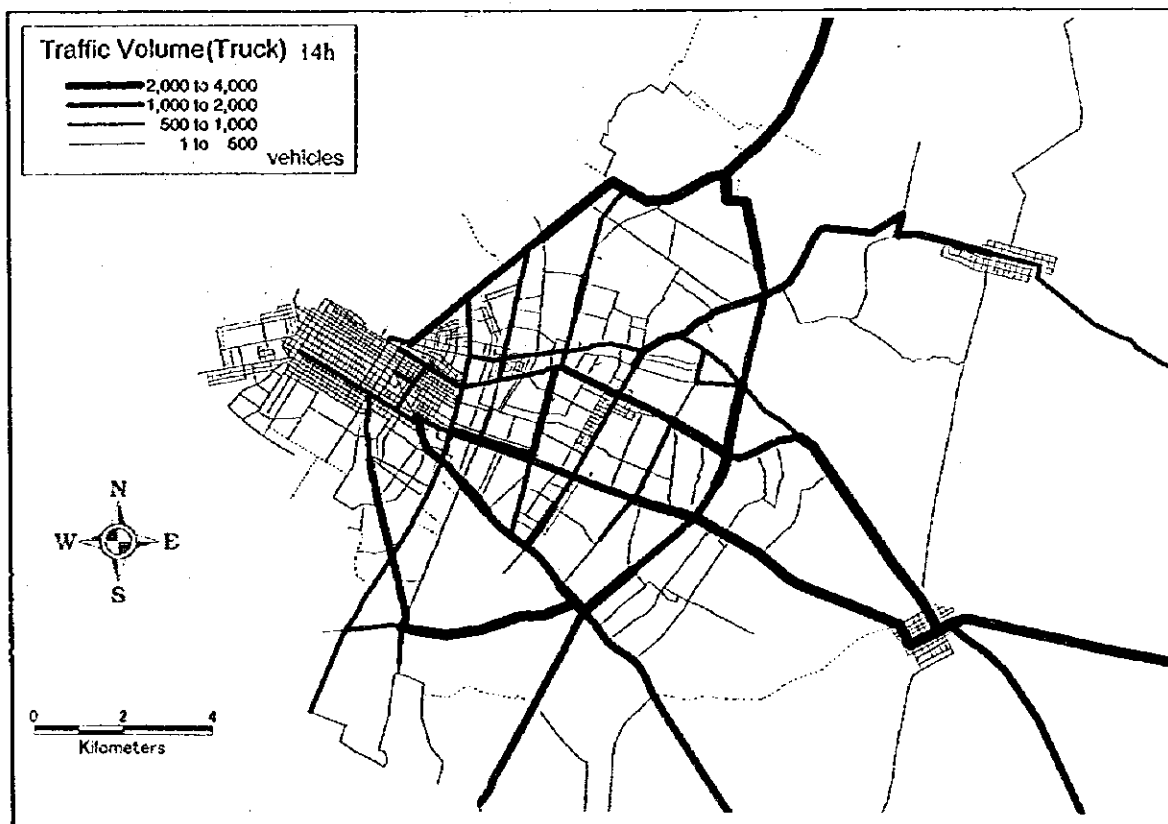
Street	Year	Unit: %.			
		Car	Small Truck	Large Truck	Bus
AV. ARTIGAS	1984	31.9	24.2	11.7	32.2
	1998	59.4	24.8	7.5	8.3
AV. ESPAÑA	1984	72.1	18.0	1.3	8.6
	1998	64.5	27.1	4.2	4.2
AV. MCAL. LÓPEZ	1984	68.0	26.3	4.0	1.7
	1998	62.1	27.8	2.5	7.6
AV. E. AYALA	1984	38.8	19.5	11.9	29.7
	1998	45.7	25.1	6.8	22.4
AV. FDO. DE LA MORA	1984	48.9	27.0	14.1	10.0
	1998	59.4	24.8	7.5	8.3
AV. J.F. BOGADO	1984	58.1	19.2	7.0	15.7
	1998	57.4	25.1	7.3	10.3

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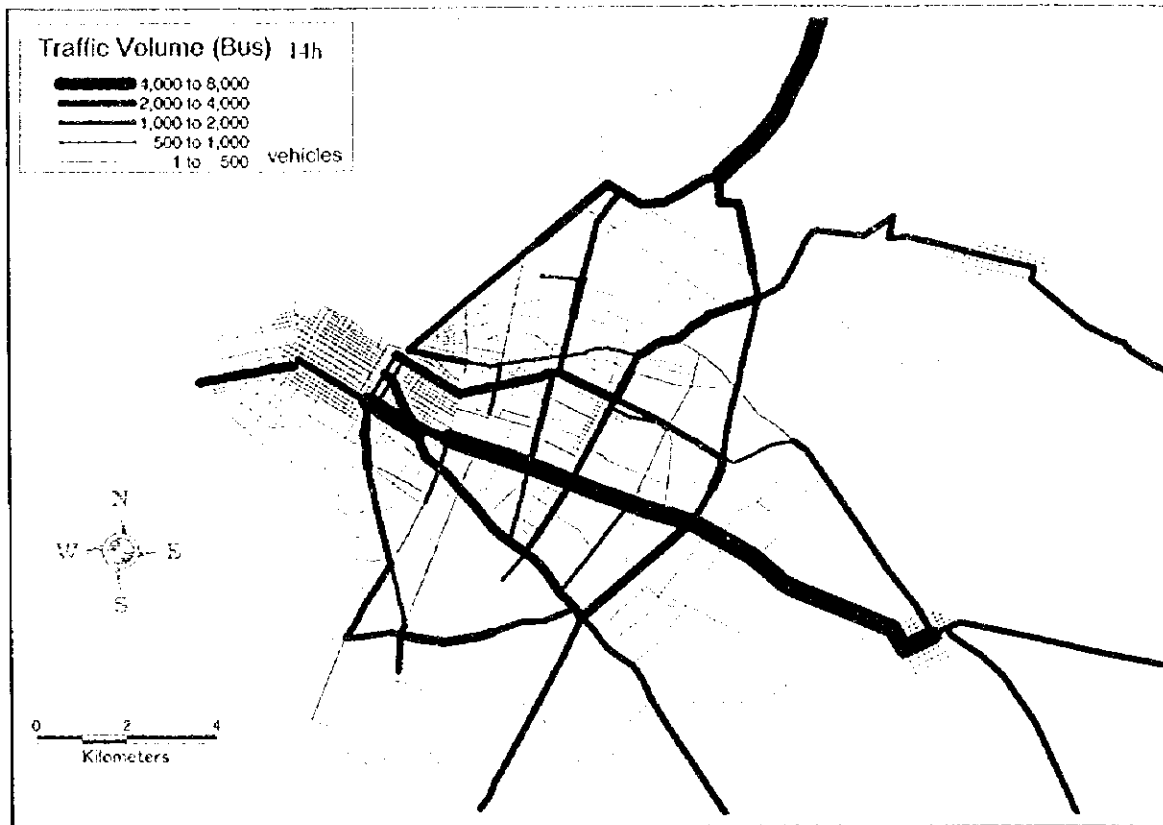
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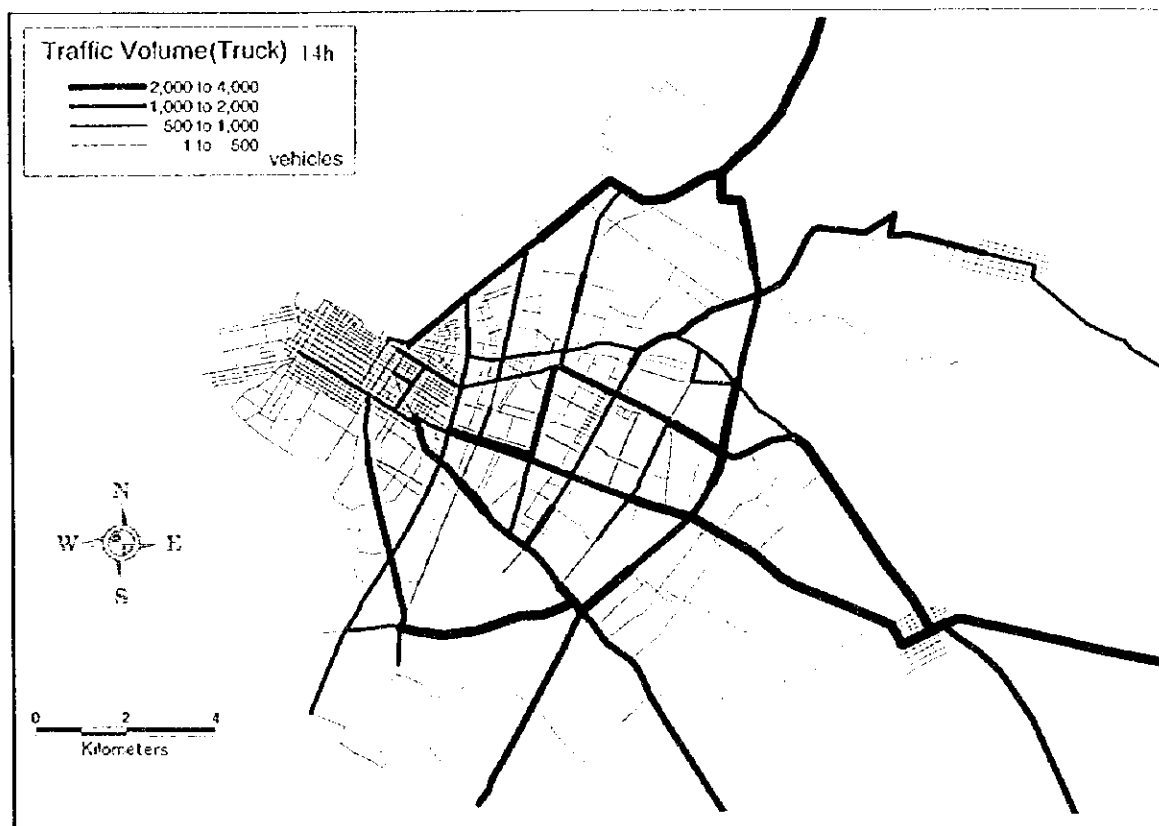
**Fig. 3-5-8 Traffic Flow of Buses (1998)**



**Fig. 3-5-9 Traffic Flow of Trucks (1998)**



**Fig. 3-5-8 Traffic Flow of Buses (1998)**



**Fig. 3-5-9 Traffic Flow of Trucks (1998)**

### 3.5.3 Hourly Fluctuation

The hourly fluctuation of traffic on the screen line is shown in Fig. 3-5-10. The peak hour traffic to Micro-Centro appears at 7:00 – 8:00 in the morning, and the Peak Hour Factor (PHF) is 9%. The peak hour traffic to sub-urban area appears twice at 11:00 – 12:00 in the mid-day and 17:00 – 18:00 in the evening. The PHFs are 8 – 9%. This hourly fluctuation pattern does not change comparing with that in 1984, however, the PHF in the morning to Micro Centro increased from 7.5% in 1984 to 9% at present.

The hourly fluctuation at Micro-Centro (Fig. 3-5-11) shows that the mid-day peak from sub-urban area decreased from 14% in 1984 to 11% at present, while implies the tendency that the people having the custom to back home for lunch decreased.

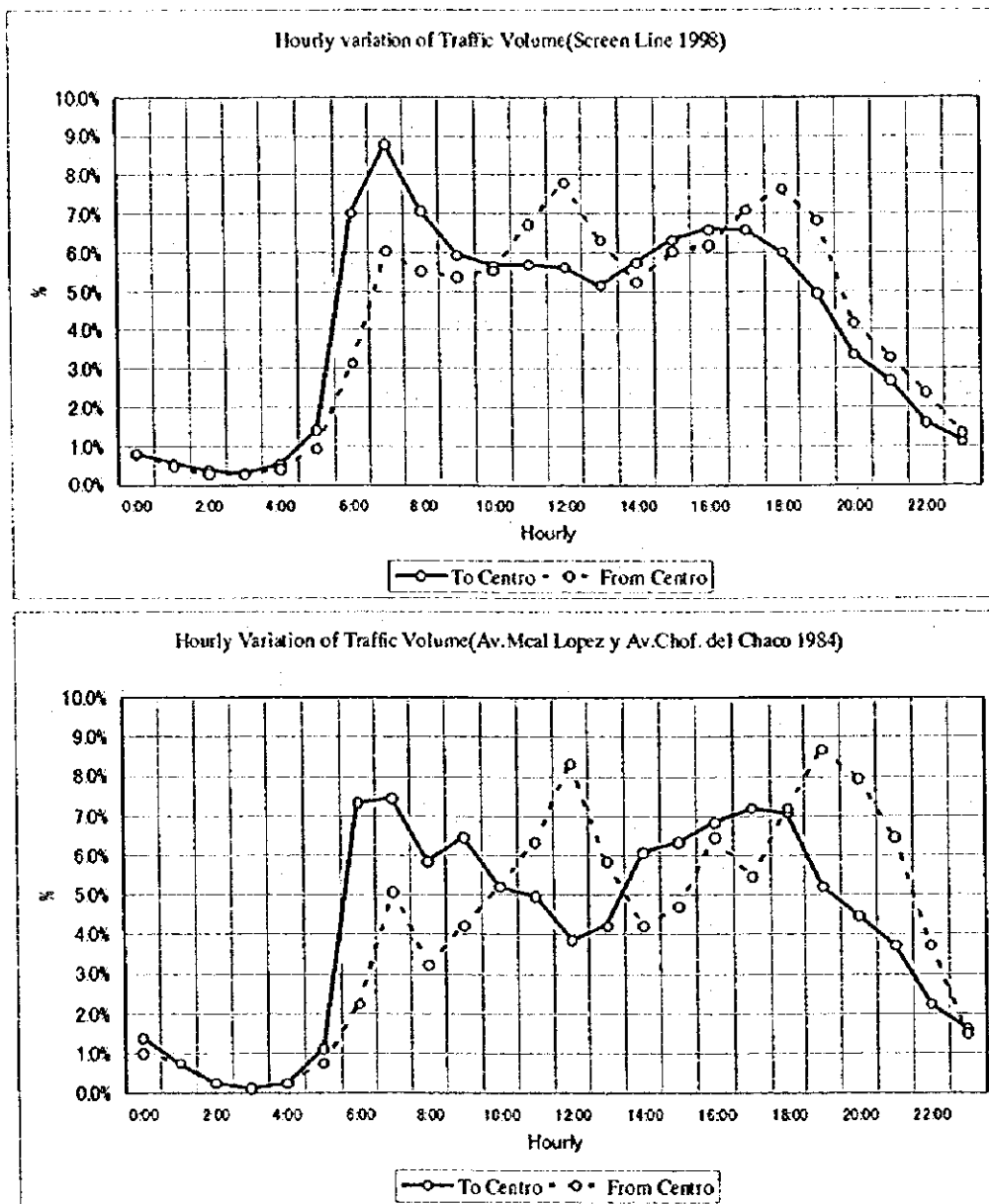
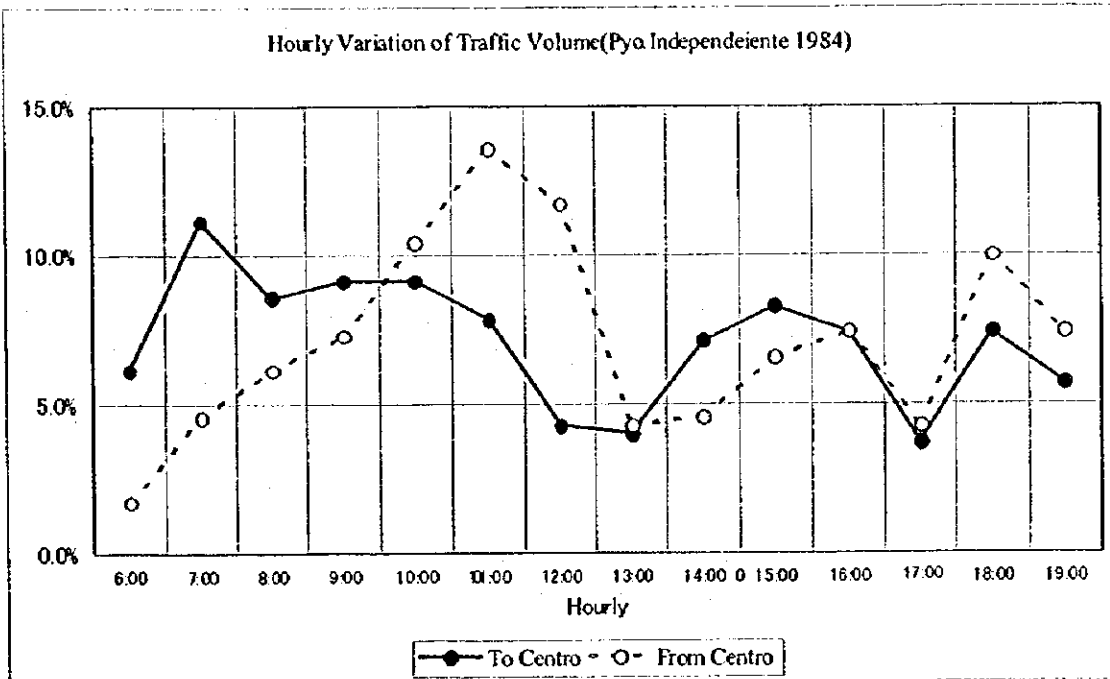
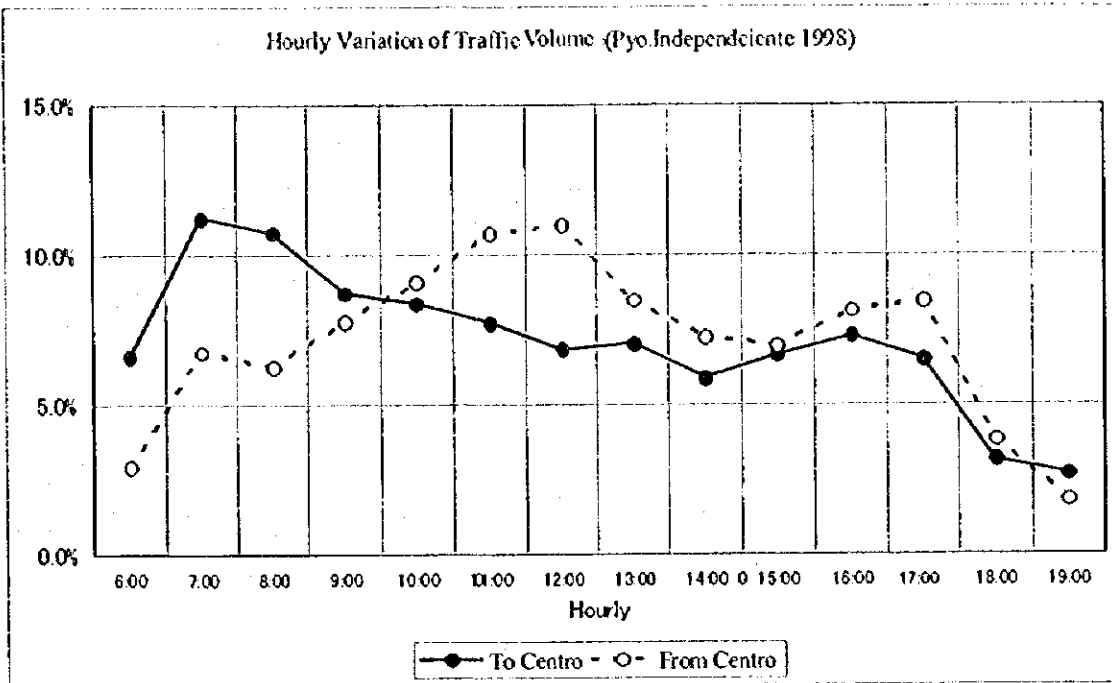


Fig. 3-5-10 Hourly Fluctuation of Traffic Volume (Screen Line)



**Fig. 3-5-11 Hourly Fluctuation of Traffic Volume (Micro-Centro)**

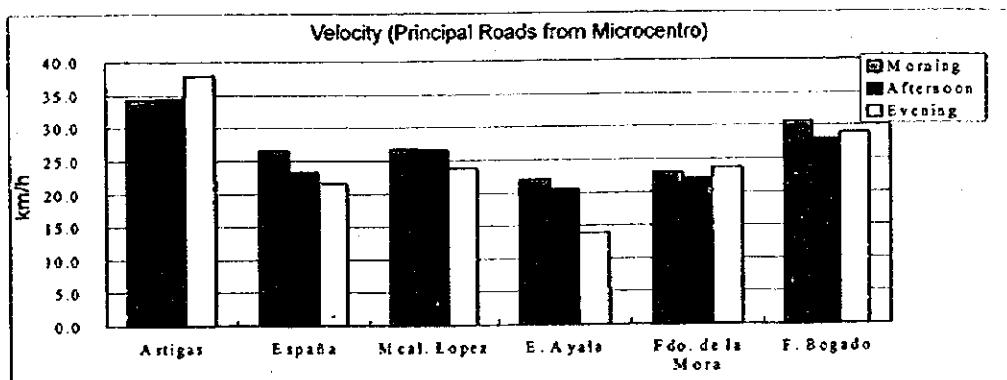
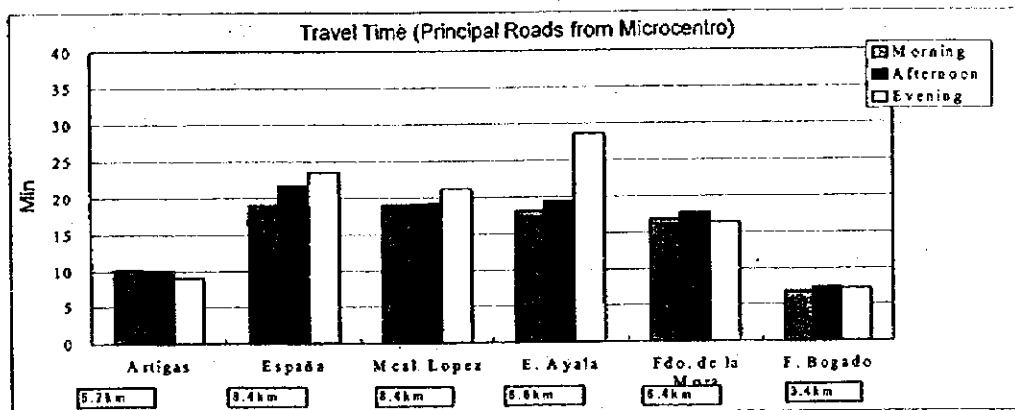
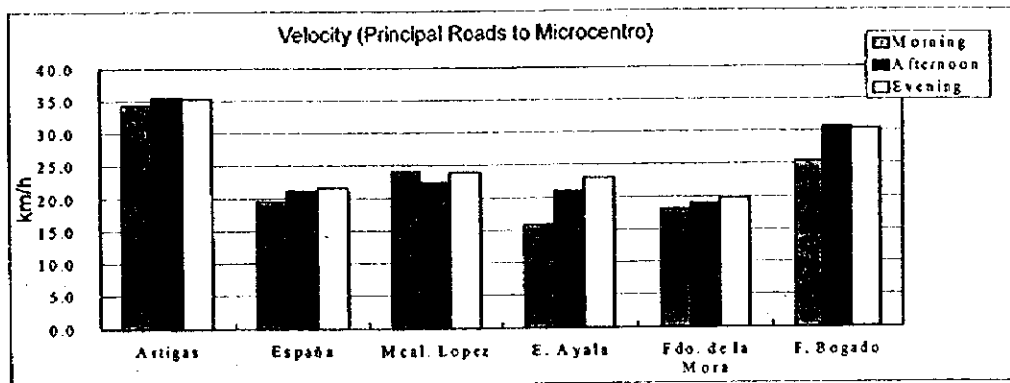
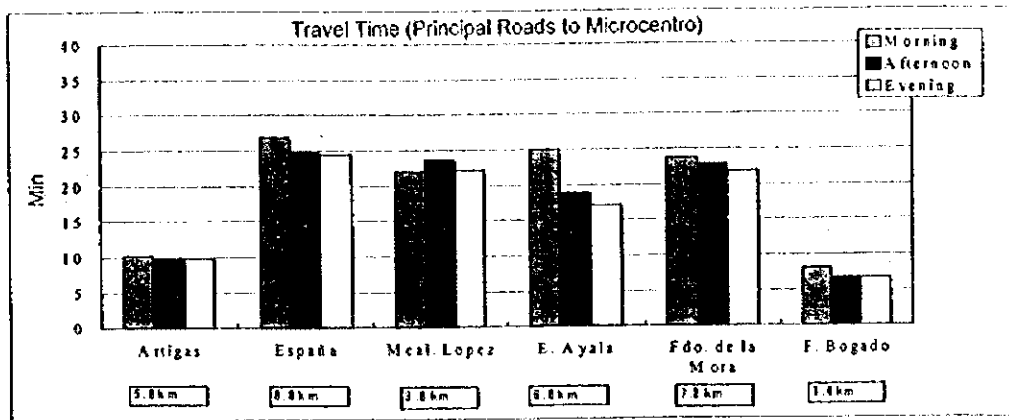
### 3.5.4 Travel Time

Fig. 3-5-12 shows the travel times and speeds on the main radial roads at morning and evening peak hours. The roads with travel speeds of more than 30 Km/h are Av. Artigas and Av. F. Bogado, and the travel speeds on other roads are less than 30 Km/h at both peak hours. Av. España shows the congested situation with travel speed of about 16 Km/h in the morning peak hour to Micro-Centro direction and about 14 Km/h in the evening peak hour to sub-urban areas.

Fig. 3-5-13 shows the travel times and speeds on the main circular roads at morning and evening peak hours. All the roads show travel speeds of less than 30 Km/h. The roads where the travel speeds change remarkably by hour are Av. Choferes del Chaco, Av. Kubitscheck and V. Gral. Santos. The travel speed in the evening to the North on Av. Choferes del Chaco, and that in the morning to the North on Av. Kubitscheck, and on Av. Gral Santos, are low.

Fig. 3-5-14 shows the travel speeds to Micro-Centro in the morning peak hour and Fig. 3-5-15 shows that to sub-urban areas in the evening. From these figures, the bottle-necked intersections are;

- Av. E. Ayala – Av. Defensores del Chaco
- Av. E. Ayala – Av. De la Victoria
- Av. E. Ayala – Av. Rca. Argentina
- Av. E. Ayala – Av. Kubitscheck
- Av. Aviadores del Chaco – Av. San Martin
- Av. Kubitscheck – Av. Mcal. López
- Av. Kubitscheck - 25 de Mayo
- Av. Mcal. López - Brasil
- Av. Peru – Azara
- Brasil - Herrera



**Fig. 3-5-12 Travel Time & Travel Velocity (Av.Principal)**



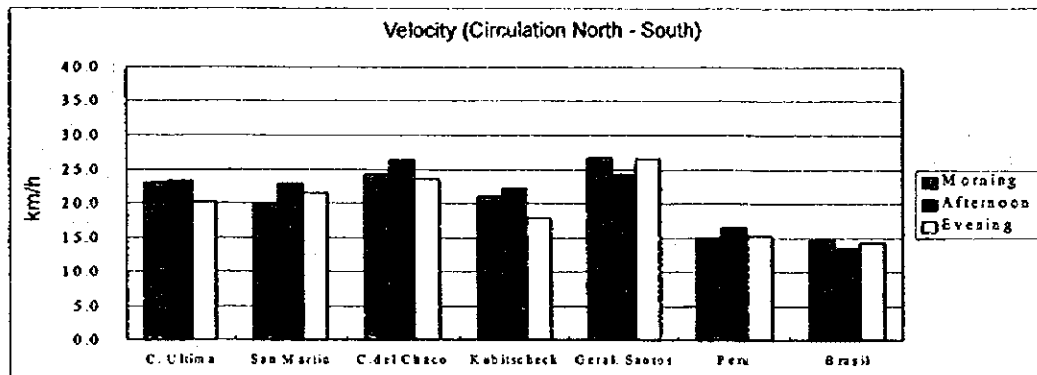
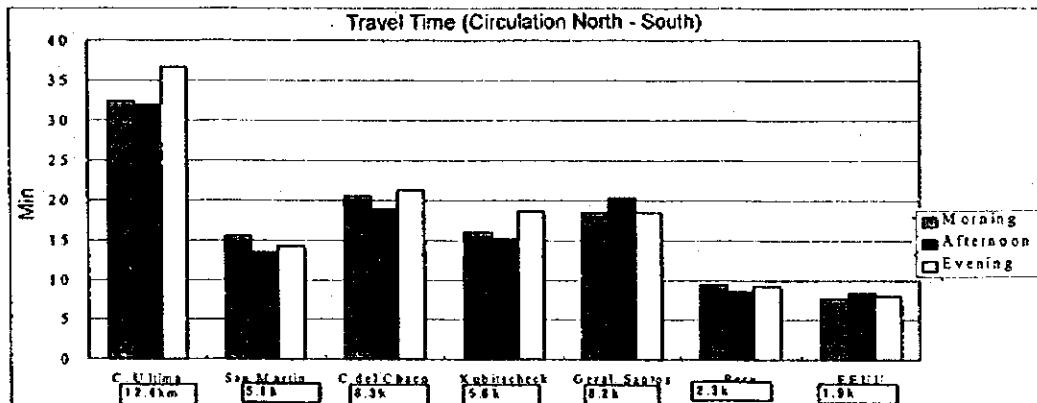
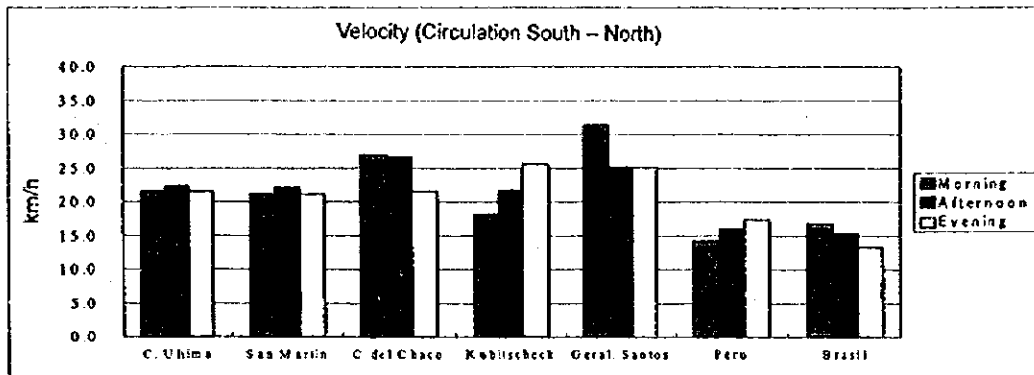
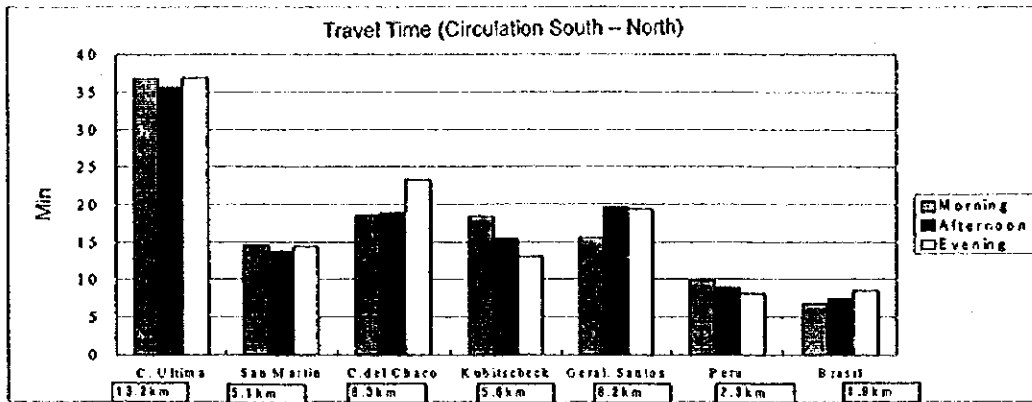


Fig. 3-5-13 Travel Time & Travel Velocity (Secundaria)

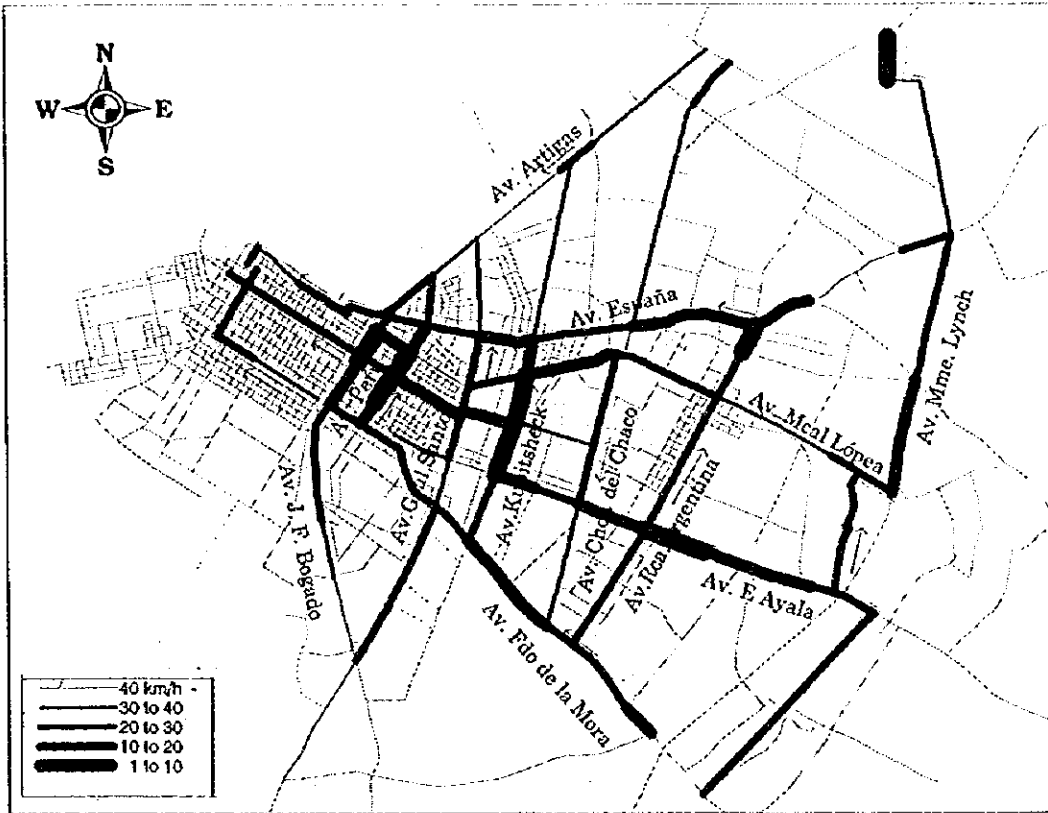


Fig. 3-5-14 Travel Velocity (to Microcentro in the morning)

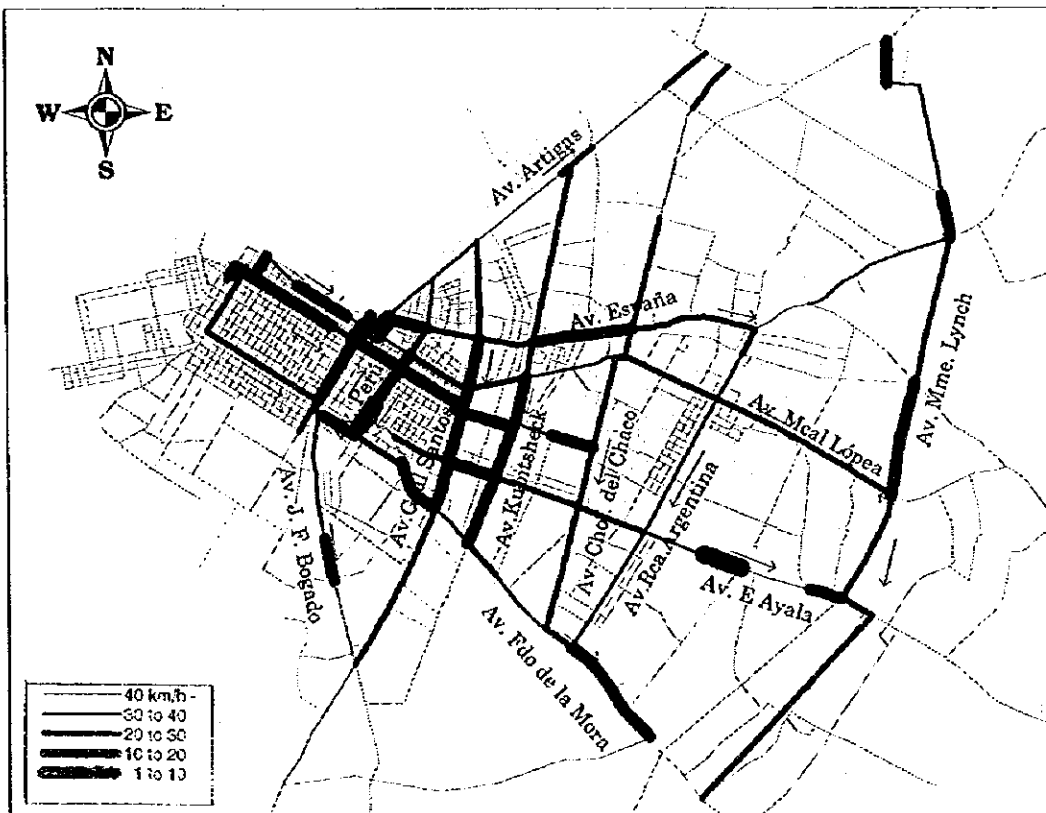


Fig. 3-5-15 Travel Velocity (from Microcentro in the afternoon)



## Chapter4 Present Public Transport

### 4.1 Outline of Public Transport

The public transport in the Study area consists of buses and taxis, both are operated by the private sector. Until 1997, a tramway was operated by the public sector, ATE, for about a 4.5 Km line, however it stopped operation because of annual deficit and effect on road congestion, and partially because of introduction of one-way system, which flows in the opposite direction, in Micro Centro.

The 2,274 buses registered at MOPC, belong to 53 private bus companies operating on 96 routes having origins or destinations in Asunción, and on 162 routes out-side of Asunción in the Study area. Another 232 buses belonging to 6 private bus companies are operating on 12 routes including branch routes within Asunción City. The bus fare within the Metropolitan area is fixed at 850 Gs. (0.28 US\$, 1US\$=3,000 Gs.).

The totally 1,267 taxis are registered at the municipality of Asunción in 1998, of which 980 taxis belong to 2 radio communication unions of APTA and Trans Taxi Ltd. The taxi operation is approved by the municipality on an individual bases, and they are assigned to 76 official taxi stations and 40 unofficial stations allocated in the city.

### 4.2 Bus Operation

#### 4.2.1 City Law

The city law No. 26.031/90 and No.26.337/91 of Asunción stipulate the bus operations as follows;

- The municipality taking into account the population density, demand, social condition, etc will plan the bus routes.
- The municipality will awe the concession to operate buses on a route to an enterprise through bidding. The concession period is 5 years.
- The minimum operating conditions are shown in Table 4-2-1.

**Table 4-2-1 Minimum Operation Conditions of Public Buses**

Item	Description	Remarks
Starting time	4:30 in the morning	
Ending time	1:00 in the midnight	
Minimum head 5:30-8:30, 11:00-13:30,17:30-20:00 23:00- Others Sunday and holidays	3 min 20 min 8 min 20 min	
Bus size Width Length Height Passenger capacity	2.60m max. 13.20m max 1.85m max 20 seats min	

There is no description about tariff and its decision making process. The latest bidding was held in 1985, and in 1991, when the Municipality tried to open a new bidding based on this

city law, most of the bus companies shifted to register in MOPC, because this city law is applied only to the buses operating within Asunción City. If a route starts from other neighboring cities such as Fdo. de la Mora or San Lorenzo, the bus route is classified as an inter-city bus, and it is under the jurisdiction of MOPC. Presently 6 lines out of 59 lines operating within the study area have their origins and destinations within Asunción city, and the other 53 lines belong to the inter-city buses.

Because the bus operation approval is given only to enterprises, there are cases where individual bus owners will join under the name of a bus company but they operate their buses individually.

#### **4.2.2 Regulations in MOPC**

The law No. 468 in 1974 stipulates that the operation of the inter-municipality public transport should be approved by the Land Transport Department of MOPC. The frequencies and fleet are subject to the approval of MOPC.

The resolution No. 751/96 stipulates if an inter-city public passenger transport company would like to change its route, time, frequencies or vehicle fleet, it should apply to the Transport Vice Ministers' cabinet of MOPC, together with the approval from "Asociación de Transportadores del Interior del Paraguay (ATIP)", "Unión de Transportistas del Área Metropolitana (UTAM)", and "Centro de Empresarios del Transporte de Pasajeros del Área Metropolitana (CETRAPAM)". After the submission of the application, if the transport advisory committee (Consejo Asesor del Transporte) agree that the application is reasonable, the application will be approved and will be registered by the Land Transport Department of MOPC in accordance with relative laws.

The buses operating in the Study area and having their origins or destinations in the different cities, are considered as inter-city buses, and are regulated by this resolution. Bus routes are registered in a descriptive manner with origins, destinations, and main through points, together with frequency. Because MOPC covers all the inter-city and international bus routes, and the traffic policies cover the inter-city roads, bus operation within the urban area are practically not monitored and some bus operators change their routes and frequencies without notice to MOPC.

The tariff level in the urban area is, since 1994, decided by presidential decree based on information from the Tariff Adviser Committee (Consejo Asesor de Tarifa) of MOPC.

#### **4.2.3 Bus Operators**

The present bus lines operating within Asunción metropolitan area are registered in MOPC as shown in Table 4-2-2. 2,248 buses belonging to 58 bus companies are operating on 174 lines including branch lines, however, there is no bus operation monitoring system in MOPC and the buses are not operating as registered. In 1984, 1,537 buses belonging to 41 bus companies were operating on 44 main lines, therefore, there was an increase of 711 vehicles or 46.3% of buses and 17 new companies had joined the bus service in the metropolitan area.

The maximum frequency of a bus, assuming 100% of buses registered in the table are operating, is calculated at 9.1 times/day on the line 33 operating between Fdo. de la Mora and Barrio Obrero via Micro Centro, and the average frequency is 5.2 times/day.

Table 4-2-2 Present Bus Operator

ZONE	LINES No.	Company	Passenger / Day	Length (Km)	Operating frequency By bus	Operating km/bus/day	Bus Fleet	Employee (person)
7	1	YSAPY" SRL	19,495	42	5.5	231	26	45
1	2 y 7	GUARANI" SRL	35,636	54	5	270	62	113
6	3	YCUA SATI" SRL	21,389	43	6	258	65	138
6	4	SAN VICENTE" SRL	3,325	28	8	224	36	86
1	5	LA CHAQUEÑA" SATC	3,229	100	2.5	250	18	36
7	6	CAPELLANES DEL CHACO" SRL	30,776	25	6	150	64	141
6	8	SAN ISIDRO" SRL	24,918	42	5	210	47	130
6	9	PARAGUAY" SRL	7,756	28	6	158	26	47
4	10	LA VICTORIA" SRL	14,964	48	6	288	49	91
2	11.1	AREGUÁ" SRL	19,295				25	
2	11.2	AREGUÁ" SRL (Turismo)	18,603	60	6	360	50	115
4	12	CURUPAYTY" SRL	36,182	60	5	300	100	171
7	13.1	CONQUISTADOR" SA	7,155	48	5.5	264	54	139
7	13.2	CONQUISTADOR" SRL	18,604					
6	14	Tta. ADOLFO ROJAS SILVA" SRL	4,784	30	7	210	46	130
5	15	AUTOMOTORES GUARANI" SACI	60,780	63	8	378	111	98
7	16	TITAN" SRL	10,071	34	6.5	221	27	69
4	17	SAN CRISTOBAL" SRL	7,376	49	4	196	26	50
5	18	29 DE SETIEMBRE BOQUERÓN" SRL	14,218	60	6.5	390	66	110
3	19	YBERA" SA	31,715	90	4	360	79	156
3	20	CHOFERES DEL CHACO" SRL	57,590	70	5	350	93	220
4	21	SAN FERNANDO" SRL	38,638				55	
4	22	FDO. DE LA MORA" SRL	10,136	62	4	248	41	86
6	23	LAMBARÉ" SRL (Turismo)	39,121	60	4.5	270	60	135
1	24	SAN JOSÉ" SA	45,232	80	4	320	76	210
5	25	AMISTAD" SA	14,166	48	5	240	35	140
4	26	LINCE" SRL	34,523	70	5	350	58	102
3	27	SAN LORENZO" CISA	22,318	68	5.5	374	59	163
2	28	Gral. AQUINO" SRL	15,245	29	4.5	130.5	29	62
3	29	PANCHITO LÓPEZ" SA	31,009	50	6	300	62	75
2	30	VANGUARDIA" SA	27,232	73	4	292	116	240
6	31	VIRGEN DEL PILAR" SRL	19,866	40	6	240	51	158
5	32	CIUDAD DE GUARAMBARÉ" SRL	8,498	80	4.5	360	38	77
4	33	FRATERNAL" SRL	23,942	160	5	800	47	215
1	34	CIUDAD DE LIMPIO" SRL	12,959	60	4.5	270	45	93
1	35	CAMPAMENTO CERRO LEÓN" SACI	15,107	55	4	220	37	
1	36	UNIÓN" SRL (Turismo)	21,867	72	6	432	70	133
7	37.A	SAN CAYETANO" SRL	15,059	36	6	216	23	40
7	37.B	SAN CAYETANO" SRL	28,795	40	6	240	36	77
5	38	Mcal. LÓPEZ" SRL	35,181				64	
5	39	FENIX" SRL /11 de JULIO S.A	13,600	70	5	350	58	61
6	40	29 DE JUNIO" SRL	19,737	74	5	370	72	144
6	41	1º DE DICIEMBRE" SRL	5,438	36	8	288	35	
1	42	CONSUL MARIANO R. ALONSO" SA	19,196	68	5.5	374	43	129
3	43	LA CAPIATEÑA" SA	22,153				35	
1	44	LOMA PYTÁ" SA	52,190	36	6	216	48	112
3	45	CIUDAD UNIVERSITARIA" SRL	28,400				53	
1	46	VILLA HAYES" SRL	3,220	88	3	264	17	
5	47	AUTOMOTORES YPANÉ" SRL	16,660	32.5	7	227.5	30	51
1	48	SAN ISIDRO" SRL	4,242		3		20	
1	49	LA LIMPEÑA" SRL	29,914	105	4	420	48	86
3	50	SAN AUGUSTO" SRL	11,998	92	4.5	414	53	150
2	51	JULIO CORREA" SRL	29,928	78	5	390	40	52
3	52-1	LA CANDELARIA" SA	5,253	60	5	300	15	42
3	52-2	LA CANDELARIA CAPIATÁ" SRL	3,771				32	
3	53	CIUDAD DE CAPIATÁ"	6,825	70	4.5	315	23	55
5	54	CENTRAL" SA (Turismo)	7,459				12	
3	55	EL INTER" SRL	25,102	52	4.5	234	76	211
3	56	LA SAN LORENZANA" SA (Turismo)	20,766	56	6	336	38	117
	59	LA GRAN CAPIATEÑA" SA	7,022					
5	232	LA VILLETANA" SA		160	3.5	560	61	
		Average	20,644	61.5	5.2	302.7	48.39	113
		Total	1,238,639	3,135	270	15,439	2,881	5,301

The biggest, smallest and average bus fleet in bus companies are 116, 12 and 48 buses. The smallest bus company is operating bus service from Emboscada to Lambaré, and most of this line is out-side the metropolitan area.

In 1994, the project COMI proposed to classify these bus companies into 7 zones by the location of their suburban terminals, to establish bus operating associations which were expected to provide joint maintenance wareshops and appropriate bus assignment among the bus companies belonging to the same zones. The zones are shown in Table 4-2-3.

**Table 4-2-3 Bus Zones**

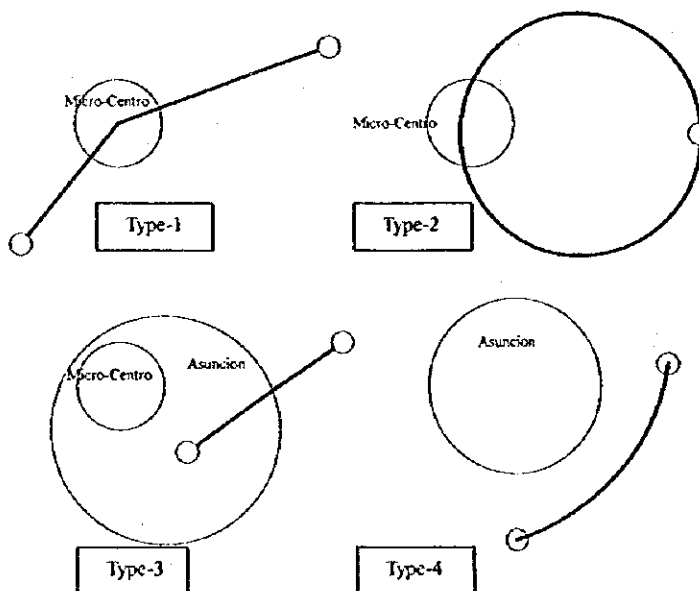
Zone	Description	No. of Company	Fleet	Av. Fleet
1	M.R.Alonso, Limpio, Villa Hayes, Benjamin Aceval	12	386	32.2
2	Luque, Areguá	4	204	51.0
3	San Lorenzo, Capiatá	12	485	40.4
4	Fdo de la Mora	7	258	36.9
5	Villa Elisa, Nemby, San Antonio, Ypane	9	314	34.9
6	Lambaré	9	369	41.0
7	Asunción	6	232	38.7
Total		59	2,248	38.1

### 4.3 Bus Operation Characteristics

#### 4.3.1 Bus Routes

##### (1) Route Pattern

The present bus routes can be classified into 4 types as shown in Fig. 4-3-1. Type-1 has the starting terminal in the suburban area, and runs to another suburban terminal via Micro-Centro. Type-2 has circular routes via Micro-Centro. Type-3 starts at suburban terminal and runs to city center close to Micro Centro. Type-4 has starting and end terminals in the suburban area.



**Fig. 4-3-1 Present Route Types**

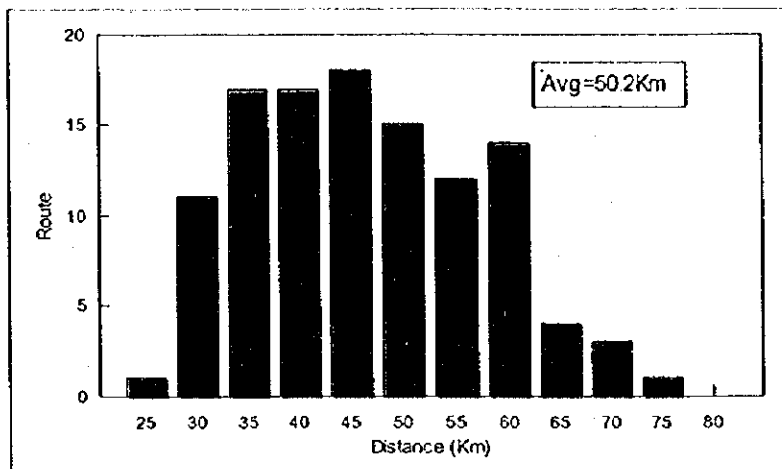
The analysis of the present bus routes, aggregated from 174 routes to 108 routes eliminating minor branch routes, shows the share of bus route by type as shown in Table 4-3-1. About 70% of the present bus routes are classified as type-1, and the bus routes running through Micro Centro represent 3/4 of all the bus routes.

**Table 4-3-1 Bus Routes by Type**

Type	No. of Routes	Ratio (%)
Type-1	76	70.4
Type-2	5	4.6
Type-3	13	12.0
Type-4	14	13.0
Total	108	100.0

**(2) Route Length**

The distribution of the round trip route distance is shown in Fig. 4-3-2. The average of 108 routes is calculated at 50.2 Km. which was 47.5 Km in 1984. The longer route distances may be caused by the wider urbanization in the Asunción metropolitan area, and a decrease in the operational efficiency.



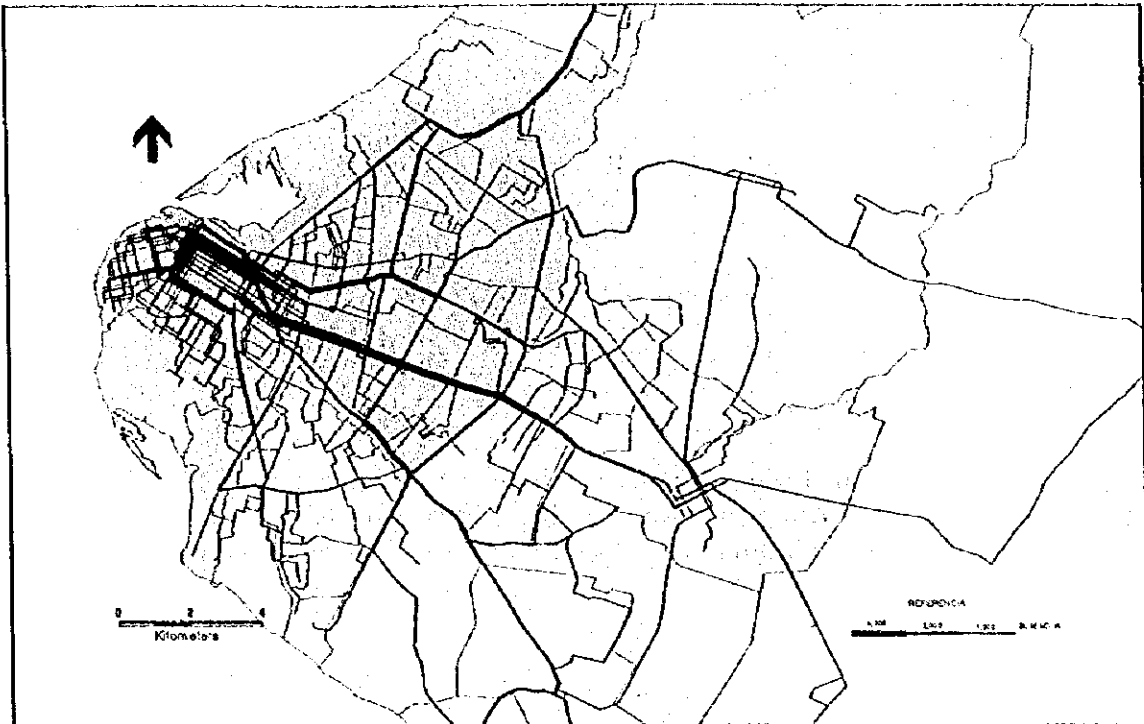
**Fig. 4-3-2 Route Distance Distribution**

**4.3.2 Bus Flow**

**(1) Frequency on Road Links**

Fig. 4-3-3 shows the accumulated bus frequency on road links based on the registered frequencies to MOPC. High concentration of bus operation is seen on Av. E.Ayala and Gral. Diaz and Herreira in Micro Centro, where about 8,000 buses are operating in a day.





**Fig. 4-3-3 Bus Frequency in 1998**

**(2) Bus Passenger Demand on Present Bus Network**

Fig. 4-3-4 shows the 1998 bus passenger demand assigned on the present bus network. Also high concentration of bus passengers on Av. E.Ayala and Gral. Diaz and Herrera in Micro Centro is seen. The highest number of passengers on Av. E.Ayala is estimated at about 400,000 passengers/day.

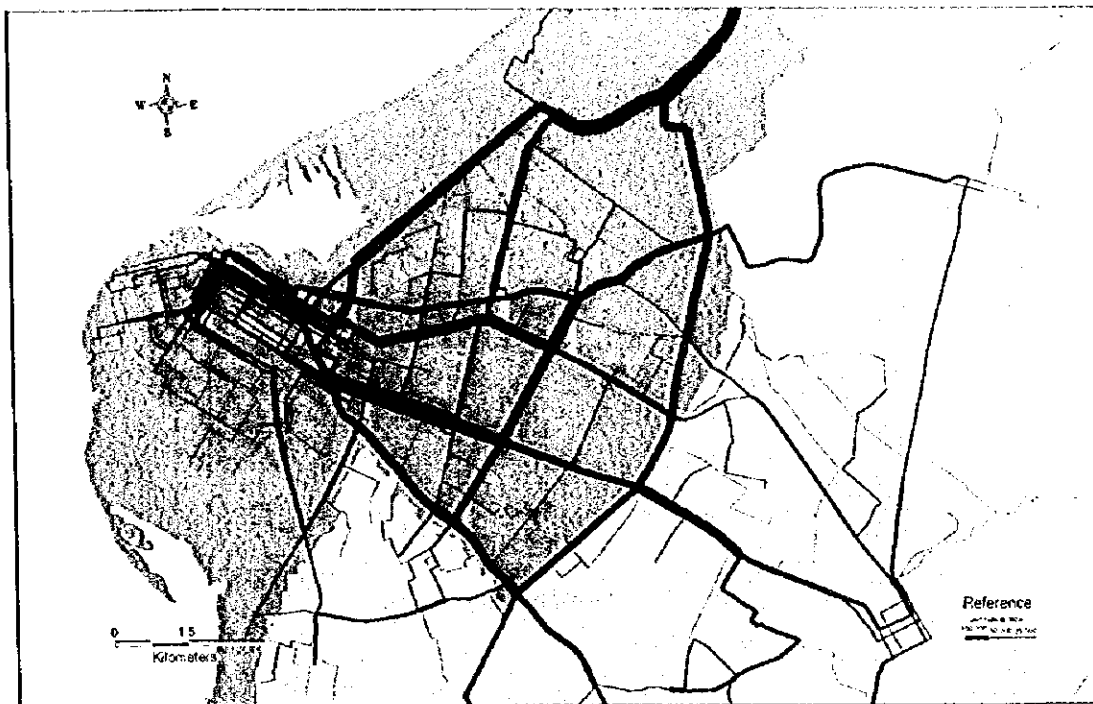


Fig. 4-3-4 Bus Passenger Demand in 1998

(3) Screen Line Flow

Table 4-3-2 shows the bus flow crossing the screen line. The daily flow is counted at 21,827 buses including chartered buses, and the maximum hourly flow on Av. E.Ayala is counted at 272 buses, which is almost the upper limit of the bus flow on one lane.

Table 4-3-2 Bus Flow on Screen Line

Screen Survey Point No.	Bus on a Regular route	Other Buses	Total	Max./hour/oneway	Notes
1	3,371	0	3,371	137	Av. Artigas
2	844	29	873	35	
3	0	39	39	5	
4	995	0	995	37	Av. Espana
5	3,250	107	3,357	126	Av. Mcal.López
6	0	31	31	7	
7	193	8	201	9	
8	0	44	44	6	25 de Diciembre
9	0	67	67	14	
10	0	6	6	2	
11	7,295	50	7,345	272	Av. E.Ayala
12	2,502	187	2,689	102	Av. Fdo.de la Mora
13	343	4	347	19	
14	108	34	142	11	
15	709	157	866	37	Iro de Marzo
16	1,428	26	1,454	63	Av. Gral.Santos
Total	21,038	789	21,827	882	

(4) Hourly Fluctuation

Fig. 4-3-2 shows the hourly fluctuation of buses crossing the screen line. The in bound buses have their peak hour between 7:00-8:00 in the morning and out bound buses between 19:00-20:00 with peak hour factors of 7.34 and 6.45 respectively.

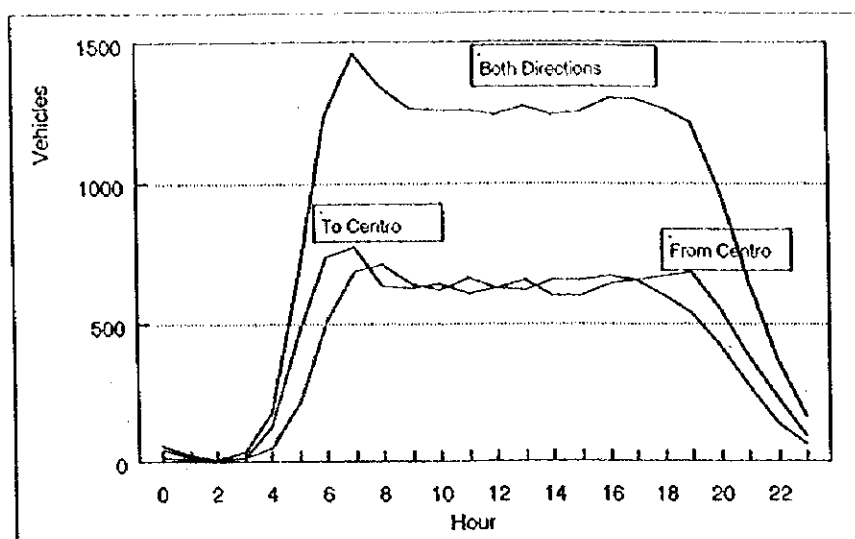


Fig. 4-3-5 Bus Hourly Fluctuation

#### 4.3.4 Bus Fleet

The average bus fleet age was 15 years (produced in 1979), and the highest bus age was 16 years (produced in 1978). The bus fleet numbers by year shows the peaks in 1978 and 1979, and in 1993, when the Paraguay economy was good, however, bus owners recently try to renovate buses within a certain period of operational life, by the introduction of a modern accounting system.

Most of the buses have Benz chassis and Marcopolo body, fabricated in Brazil. The seat capacity of 66 is the longest and no long body bus nor buses with 3 doors has been observed. There are no air-conditioned buses operating on the urban bus services, however, for tourist buses or long distance buses including international services, air-conditioned buses are operating. Air suspension to lower the bus floor for handicapped or aged passengers is not used because of the road condition paved by Empederado.

All the buses are operated by diesel engines. Buses are maintained at work shops of each bus company, where emission is not controlled because of lack of inspection equipment and monitoring by the public sector, and the maintenance engineers are not licensed.

### 4.4 Issues on Present Transport Situation

#### 4.4.1 Bus, Only One Public Transport Mode

Bus service is almost the only mode of public transport in the Asunción metropolitan area. Although there are taxi services, people cannot rely on them because of the fare and limited availability. The Railroad only makes one round-trip between Asunción and Ypacarai on weekends and has not served as an urban transport mode to date. Moreover, there are no paratransit systems that can supplement the bus service. In sum, the bus is actually the only reliable mode of travel for those who do not own automobiles.

#### 4.4.2 Institution

The private sector operates the bus system. Permission for bus operation within a single city is granted by the corresponding municipality, and that for operation over more than one city is given by the Ministry of Public Works and Communications (MOPC). In many cases, operators get operating permission from municipalities and then begin to operate intermunicipal routes with permission from MOPC. There is very little coordination between municipalities and MOPC. After getting permission operators do not seem to be obliged to submit any kind of reports or documents except when they change routes or the number of buses. Therefore there exists little data on bus operation. Also it is not clear which office has real responsibility to control bus administration.

Recently the government is trying to change this situation and a new law is being examined in parliament.

#### 4.4.3 Bus Operating Companies

Among bus companies in the metropolitan area, six are registered in Asunción and operate 232 bus vehicles running on 12 routes. Fifty-three are registered with MOPC and operate 2,247 buses on 96 routes. In general, bus companies are small in scale and have more than one owner.

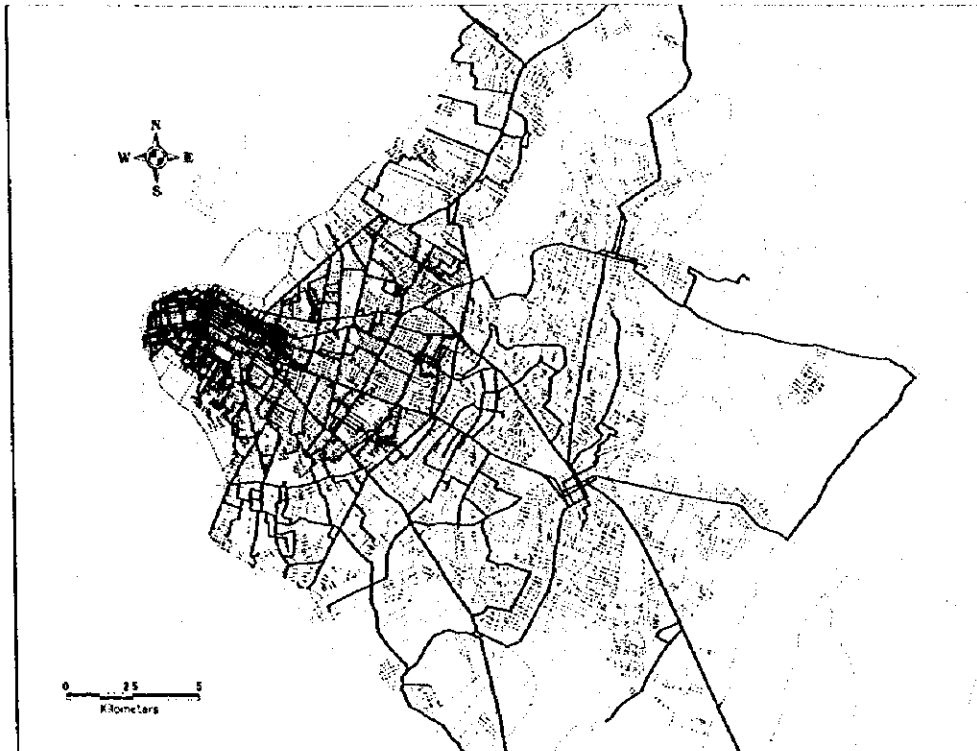
#### 4.4.4 Problems with Bus Operation

##### (1) Bus Route

- Many bus lines originate in the suburbs and have their own routes, but on entering Asunción, they concentrate on the trunk roads. Bus services are very frequent and thus convenient for bus users on trunk roads, but they are scarce and unreliable on local roads.
- The extension of bus routes is inevitably long and complex. Some of the routes include unpaved roads as well. The average round-trip distance is around 50km. Comparative cities have shorter distances of bus lines, such as 24km for Guatemala.

##### (2) Efficiency

As described above, the transport efficiency is rather low on trunk roads, and the operation of bus companies in general is inefficient as well. A basic index to measure bus service performance, a quotient of the number of daily passengers over the total number of operating buses (passenger/vehicle/day), is 551 passengers much lower than Guatemala's 854. It is much lower than what is recommended by the World Bank as a range of the required number of passengers, of between 1,000 to 1,200 passengers. A quotient of the total daily passengers over the total travel distance (passenger/vehicle km) is 1.7, lower than Guatemala's 4.5, and Panama's 3.7.



**Fig. 4-4-1 Bus Routes in Asunción Metropolitan Area**

### **(3) Bus Fleet**

Bus fleets have become larger and more modern. Thirty-six percent of the bus fleet are vehicles manufactured after 1996, but over 10% are still more than 20 years old. They often cause problems of noise and air pollution.

### **(4) Safety**

Bus users often feel uncomfortable and unsafe because bus drivers tend to handle buses very roughly using high speeds. This is because salaries of bus drivers depend on how many round trips they make, and thus they tend to compete with each other.

### **(5) Fare Structure**

Currently, the bus fare in the metropolitan area is uniformly set at Gs850. Since 1994, a committee within MOPC has reviewed and revised the fare.

Because of the simplicity of the fare structure, it is easy to understand for users, and operators could spare capital investment. On the other hand, further growth of the metropolitan area will probably generate more demands for transfers. In order to improve the convenience of the bus, it is important to introduce new measures. For instance, transfer tickets allow passengers to make transfers without any additional cost anywhere in the metropolitan area. One-day passes let users to ride buses freely for a day once they purchase one. A pass system would be very helpful for commuters and students who use the bus on a daily basis.

## **(6) Operation Feasibility**

Because the fare is determined by only factoring in the average number of users and operation costs, many of the bus companies that have inefficient operation are not in good financial conditions. They often fall into a vicious cycle where they have no choice but to leave their buses deteriorate for aging, operational efficiency drops, and user credibility declines, which finally leads to further deterioration of their operation. Many of them are small-scale operators and have weak management basis. It is, therefore, necessary to encourage an integration of bus companies and create a decent management structure to provide reliable, regular services to citizens.



# Chapter 5 Road Network and Transport Facility Conditions

## 5.1 Road and Urban Projects Administration

The inter-city roads and the intra-urban roads are administrated by MOPC and each city respectively, however, all the roads within Asunción City are considered as intra-urban roads and are administrated by Asunción City. Besides these organizations, AGA was established for the infrastructure development in Asunción metropolitan area in close cooperation with AMUAM. Basically AGA is involved in design and construction, and will not be involved in maintenance works.

## 5.2 Road Network

### 5.2.1 Network

The cities in Asunción metropolitan area are connected by such trunk roads as Rutas 1, 2 and 3, Ruta Ñemby, and other circular roads, however the following neighboring cities are not connected by paved roads:

- Villeta - San Antonio
- San Antonio - Villa Elisa
- Villa Elisa - Lambaré
- M.R.Alonso - Luque
- San Lorenzo - Villa Elisa

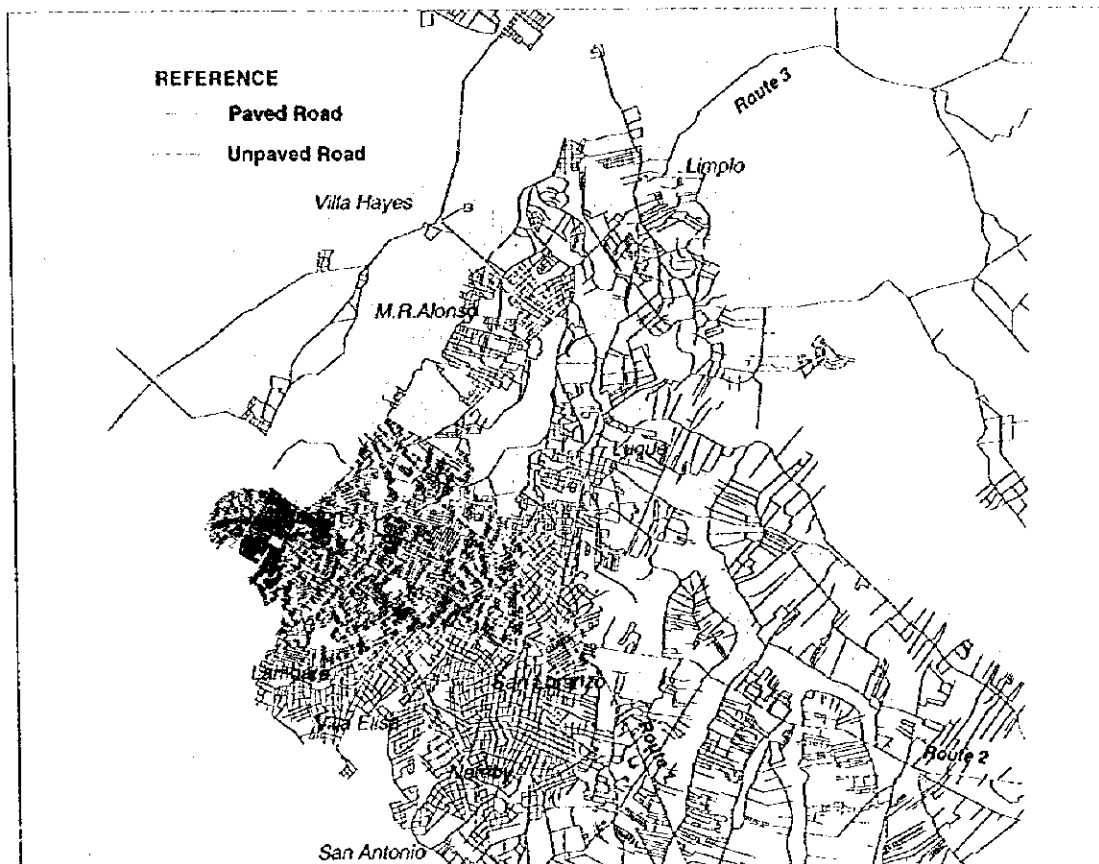


Fig. 5-2-1 Road Network (Metropolitan Area)



circular roads, including Av. Mme. Lynch at the city border. The trunk circular roads are Av. Rca. Argentina, Av. Choferes del Chaco, Av. Kubitscheck, Av. Gral. Santos and Av. Peru, and are located at an interval of about 1 – 2 Km.

Micro-Centro is surrounded by two way streets of Paraguayo Independiente, and Ygatim – Av. R.Francia at the North and South, and one way streets of Colon and EEUU at East and West. The road network in Micro-Centro consists of 1 – 2 lane one way streets.



**Fig. 5-2-2 Road Network (Asunción City)**

## 5.2.2 Road Condition

### (1) Lane and Cross Section

The lane numbers in the road network are shown in Fig. 5-2-3. The lane numbers of most of the inter-city roads are 2 lanes except for Ruta 2, which has 4 lanes. The road section on Av. Mcal. Estigarribia in Fdo. de la Mora, between the end of Av. E. Ayala and Rutas 1 and 2 has 6 lanes, however it narrows to a pair of 2 lane roads in San Lorenzo, and does not have continuity.

In the road network in Asunción City, the trunk radial and circular roads are 4 lane roads, however, the network lacks continuity and is not completed because of the existence of 2 lane links at the following sections;

- Av. Artigas (Av. Gral. Santos – EEUU)

- Av. Gral. Santos(25 de Mayo - Av. Artigas)
- Av. Choferes del Chaco (Av. E.Ayala -- Av. Mcal. López)

The main cross sections of the trunk roads in Asunción city are shown in Fig. 5-2-4. The figure shows the actual cross sections and the cross sections stipulated in the city law. According to the city law, the lane numbers of the trunk roads are designated to be 4 – 6 lanes, while the actual lane numbers of most of the trunk roads are 2-lanes less than the designated figures. Among the 2 lane sections of the trunk roads above, the right of way of Av. Choferes del Chaco is designated as 22.15m with an actual carriageway width of 9.75m and sidewalk width of 12.4m, therefore there is possibility for widening to 4 lane roads. The actual carriageway widths of Av. España and Av. Peru are 10 – 12m and are operated as 2 lane roads, however this width sometimes allows 3 vehicles operation and is a satisfactory width. The actual structure of Av.Ayala has four lanes plus parking spaces, but the City Ordinance designates it as a 50m width road with a median strip of 3m.

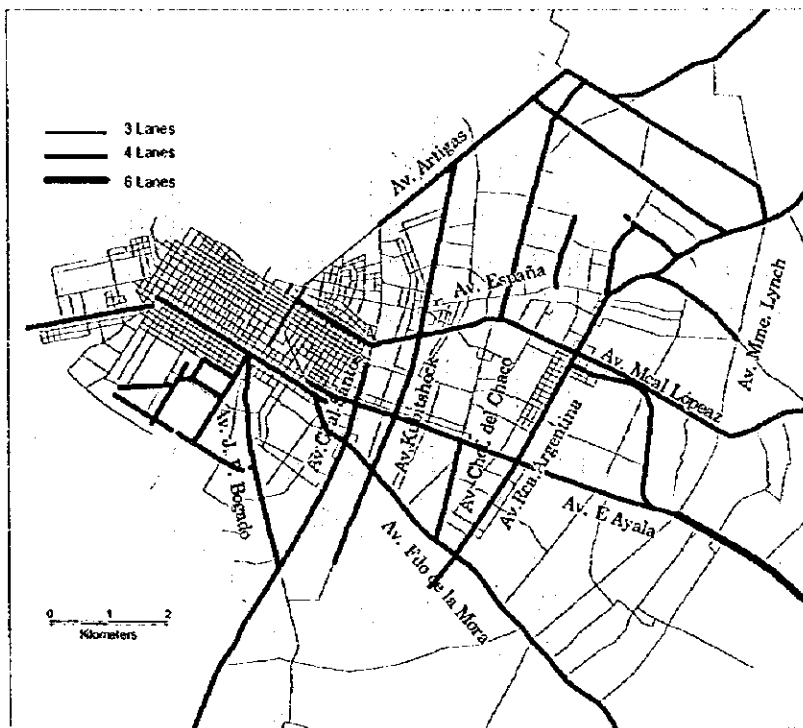


Fig. 5-2-3 Number of Lanes



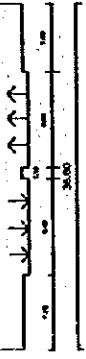
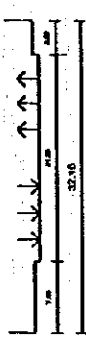
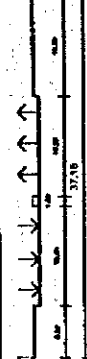
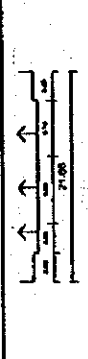

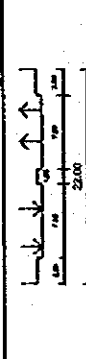
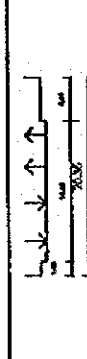
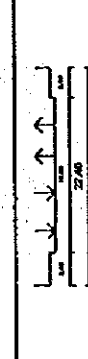
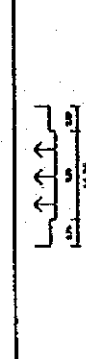

AVENUE		ACTUAL SITUATION	REGULATION
Avda. Eusebio Ayala y	Genl. Aquino		
	Rca. Argentina		
Avda. Mcal. Estigarribia y	Mimo. Lynch		
Mcal. J. F. Estigarribia y	Pitiantuta (Fdo. de la M.)		
Mcal. J. F. Estigarribia y	Ruta 1 (San Lorenzo)		
Avda. Mcal. Lopez y	Mimo. Lynch		
	Eugenio A. Caray		
	Avda. Venezuela		
	Avda. Peru		
	Avda. Brasil		

Fig. 5-2-4 Road Section Profile (1)

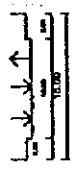


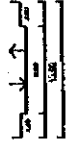
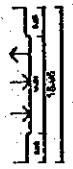
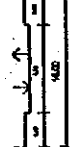
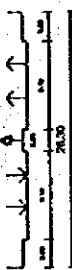

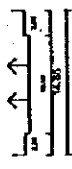

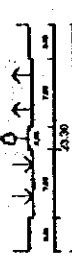

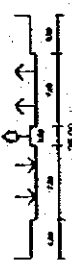

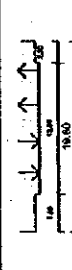

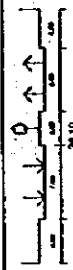
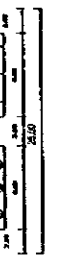


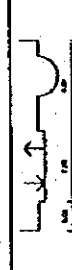

AVENUE		ACTUAL SITUATION	REGULATION
Avda. Espa y	Rio Paraguay		
	Padre Cardozo		
	Venezuela		
Avda. Gral. Artigas y	San Martin		
	Avda. Espa		
	Avda. Venezuela		
Avda. Jose F. Bogado y	Avda. terr. Presidente		
	Blas Garay		
	Gral. Santos		
Avda. Mme. Lynch y	Avda. Aviladores del Chaco		
	Avda. Mical Lopez		

Fig. 5-2-4 Road Section Profile (2)

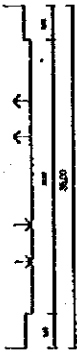


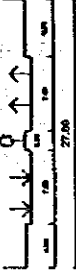


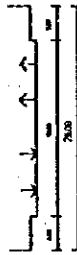
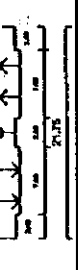

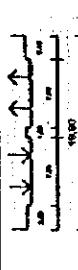
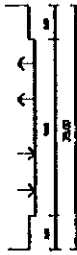
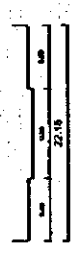

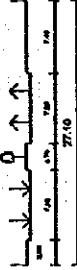

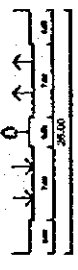
AVENUE	REGULATION	ACTUAL SITUATION
Avda. Defensores del Chaco y Tte. Lopez		
Avda. Argentina y Rca. Argentina y Fco. de la Mora		
Avda. E. Ayala		
Avda. San Martin y Avda. Aviedores del Chaco		
Avda. Stmo. Sacramento y e Itapua		
Avda. Choferes del Chaco y 25 de Mayo		
Avda. Kubistchek y 25 de Mayo		
Avda. Fco. de la Mora		

Fig. 5-2-4 Road Section Profile (3)



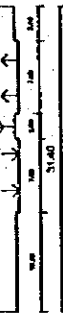
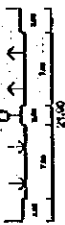
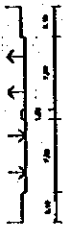
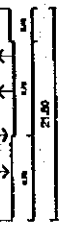
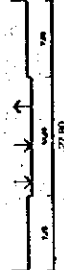
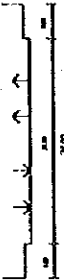
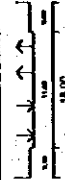
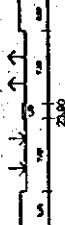


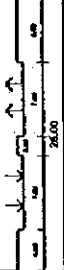
AVENUE		ACTUAL SITUATION	REGULATION
Avda. Gral. Santos y	Cachque Lambare		
	Avda. Jose F. Bogado		
	Avda. Fdo. de la Mora		
	Avda. E. Ayala		
Avda. Peru y	Ana Diaz		
	Avda. Pettrossi		
	Juan de Salazar		
Avda. Fdo. de la Mora y	Proceres de Mayo		
	Avda. Kubitschek		
	Rca. Argentina		

Fig. 5-2-4 Road Section Profile (4)

## (2) Pavement

The pavement conditions are shown in Fig. 5-2-5. Most of the trunk roads are asphalt paved. The pavement road share in Asunción city is calculated at 35%, which is higher than the 1984 figure. The paved road share is especially high in the high quality residential areas expanding from Micro-Centro to the East. This situation was caused because most of these pavement works were carried out by a system called "Prentista", whereby the residents along the roads are obliged to share the pavement cost, and in the areas where relatively high income groups reside, the system has been applied. Therefore, the paved roads are not always connected with each other. In cities other than Asunción, the central areas of San Lorenzo and Luque are asphalt paved. The other roads are mostly paved by stone called "Empederado", which is bad for vehicle operation.

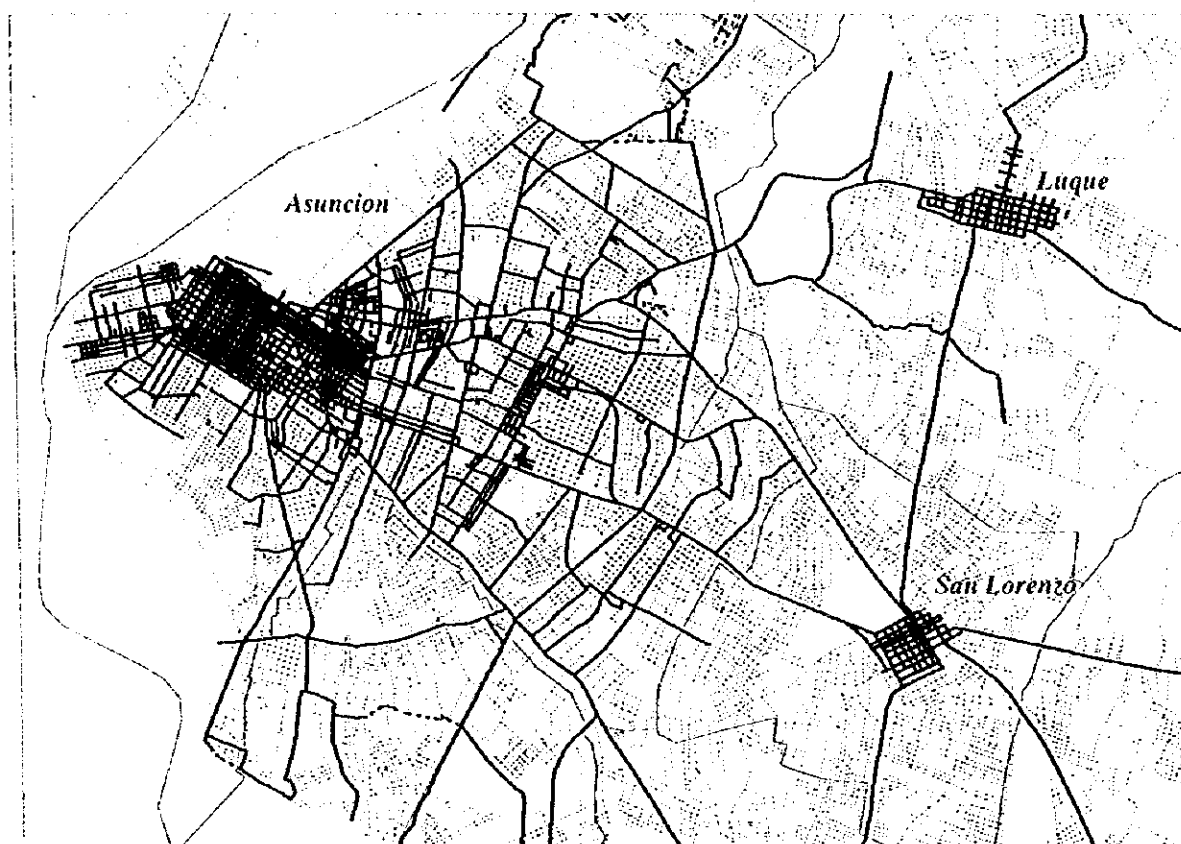
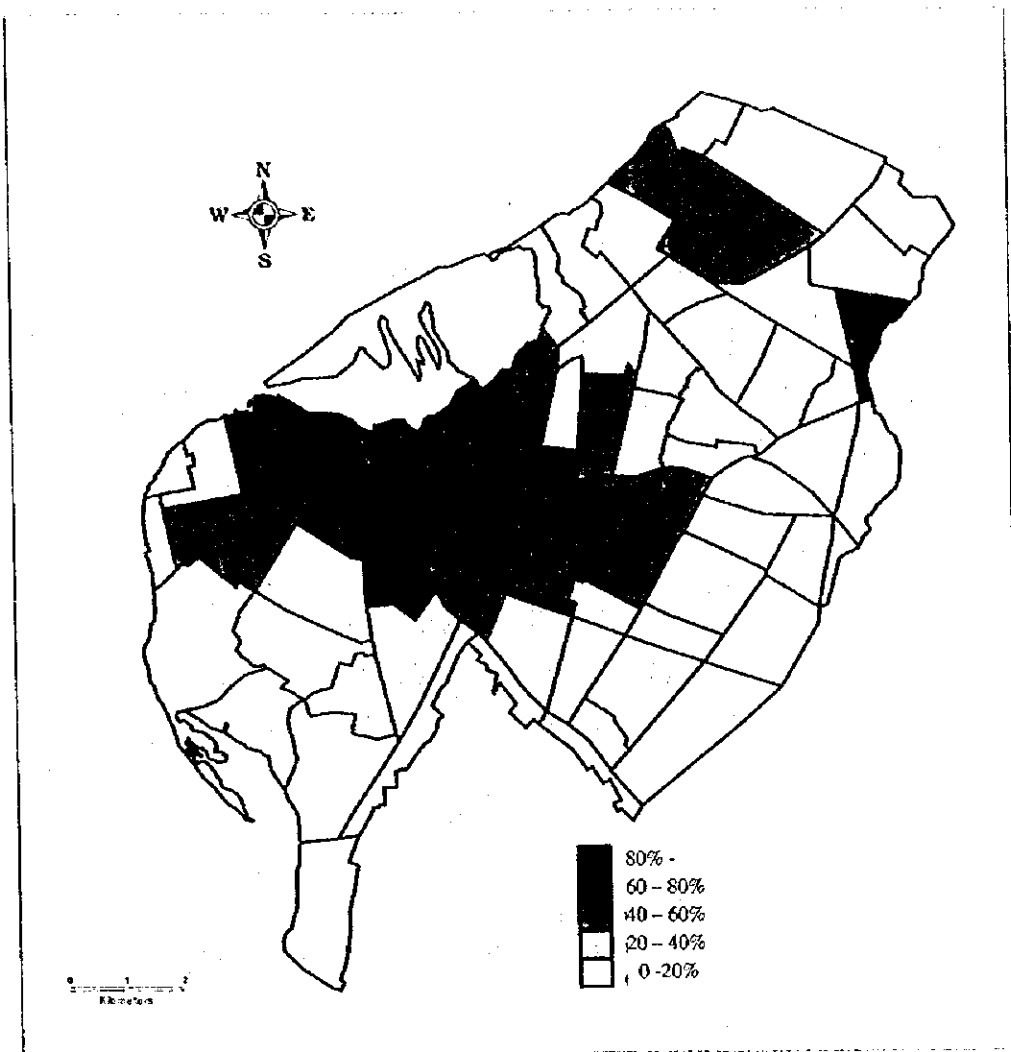


Fig. 5-2-5 Pavement Condition



**Fig. 5-2-6 Pavement Density**

In accordance with the city law, when 80% of residents facing a street agree to pave the road, the pavement work will be approved by the Municipal Assembly upon application. After the approval of the pavement work, the work will be contracted to a contractor through bidding, and the contractor will collect the construction cost from the residents facing for the street. If residents do not have a car, or enough income to pay the contractor, or for any other reasons, they will be exempted from payment or will be given a discount or can pay by settlement within a maximum period of 48 months. Once the street has been paved, it will be maintained by the municipality and will not be subject to the frentista system for at least 15 years. The frentista system is applied to almost all the municipalities in the metropolitan area.

Table 5-2-1 shows the road investment records in Asunción City by source of funds. The share of the investment by the frentista system was 81-90% of all the road investment, which was spent mainly for road pavement either by asphalt or empedrado, while the road investment from public funds was mainly for bridge construction, repairwork and so on.



**Table 5-2-1 Road Investment in Asunción by Funds Source** Unit : Million Gs

	1995	1996	1997
Frentista	5,895.0	17,365.8	1,057.7
Public Funds	631.4	925.7	244.7
Total	6,526.4	18,291.5	1,302.4
Percentage			
Frentista	90.3%	94.9%	81.2%
Public Funds	9.7%	5.1%	18.8%

The pavement costs by pavement type in 1998 are listed in Table 5-2-2. There is no big difference between stone and asphalt pavements. However, In Paraguay, it is a common practice that roads are paved with grabel first and later, depending on the needs, covered with asphalt on the surface. The cost for asphalt pavement may be only for the surface course and does not include the cost for the base course Also the cost in the table does not include the cost for storm water drainage, sidewalk pavement, and other auxiliary facilities.

**Table 5-2-2 Cost of Pavement**

Pavement Type	Cost (Gs./m <sup>2</sup> )
Stoned Pavement	25,290
Asphalt	33,300
Cement Concrete	34,521

Source: Municipalidad de Asunción

The payment amount of a resident for the asphalt pavement on stoned pavement road with 36 months settlement and 2% monthly interest is calculated at 78,387 Gs., assuming the standard obligation area of 12m x 5m. This amount is equivalent to about 4% of the average family income.

The frentista system has the advantage that the cost will be shared among the direct beneficiaries, however the system has the contradiction that many people prefer to have empedrado pavement in front of their houses to avoid the heavy and high speed traffic, while car users prefer to drive their cars on asphalt pavement, and it has disadvantages in that;

- The system mainly aims to improve local streets and the work is implemented block by block, therefore it is not suitable to apply to transport corridor improvement
- The work does not include facility improvement to affect a wider area than a block such as storm water drainage, etc.

### (3) Sidewalk

Almost 100% of the roads within the urban area have sidewalks, however, Av. Mcal. Estigarribia, which was improved as a part of the national highway (Ruta), and Av. Aviadores del Chaco, which was planned as an expressway to the airport and is called an Autopista (Motorway), do not have sidewalks although the area along these two roads is urbanized. The sidewalks along the streets within Micro-Centro are not wide enough to accommodate the pedestrian demand.

### (4) Drainage

Storm water drainage is installed in Micro-Centro and along a few other roads, which are connected to the streams (Arroyos), therefore, the storm water runs on most of the road surfaces and it obstructs the traffic flows when it rains. The storm water itself runs out within 1 – 2 hours

because of the topographic undulations, however, it tends to wash out the base course materials, which damages the pavement. The sections with serious drainage problems, according to an interview with drivers, are shown in Fig. 5-2-7.

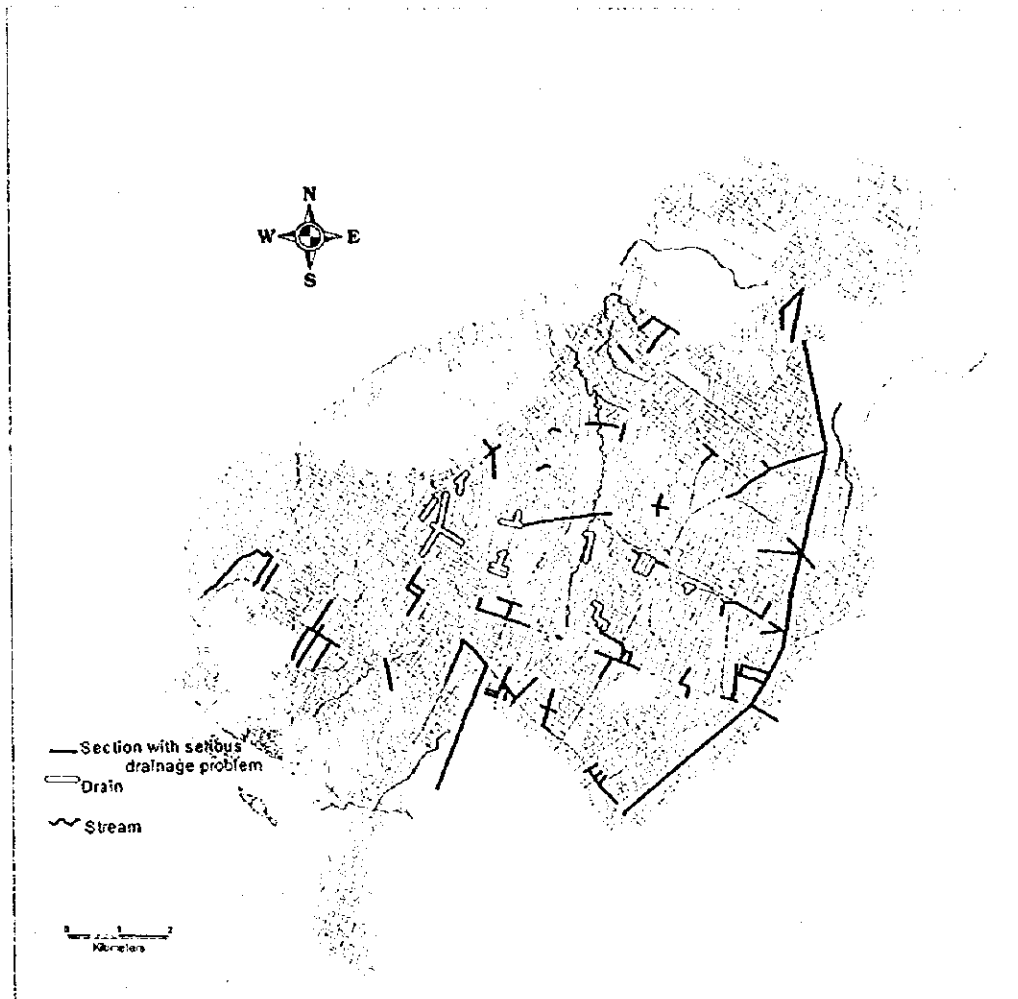


Fig. 5-2-7 Sections with Serious Drainage Problems

#### (5) Central Median

Central medians are provided on most of the 4 lane roads. The widths of central medians are 1 – 2m, and vegetation is provided. The 4 lane road section on Av. Mcal. López, between the intersections with Brasil and Av. Choferes del Chaco is not separated by a central median. Generally pedestrians cross the road anywhere, not only at intersections, with a stop at centers to wait for passing vehicles. On the non-separated section of Av. Mcal. López, shelters called "PELICAN" are installed at the road center for the safety of pedestrians who cross the road. To allow pedestrians to cross roads anywhere is a problem, however, it is recommended, to secure the safety of pedestrians, to install exclusive signals, prior to the installation of shelters.

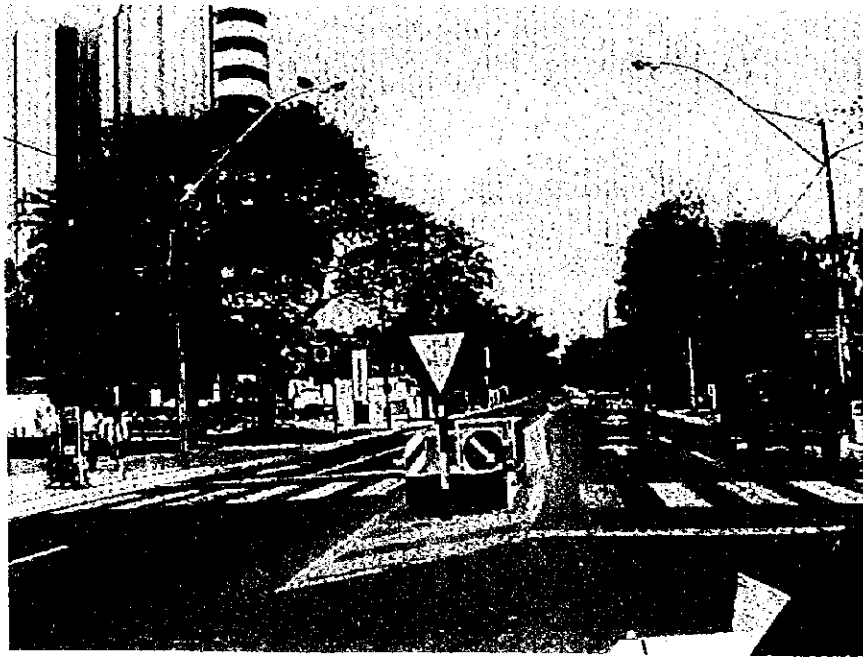


Photo 5-2-1 PELICAN

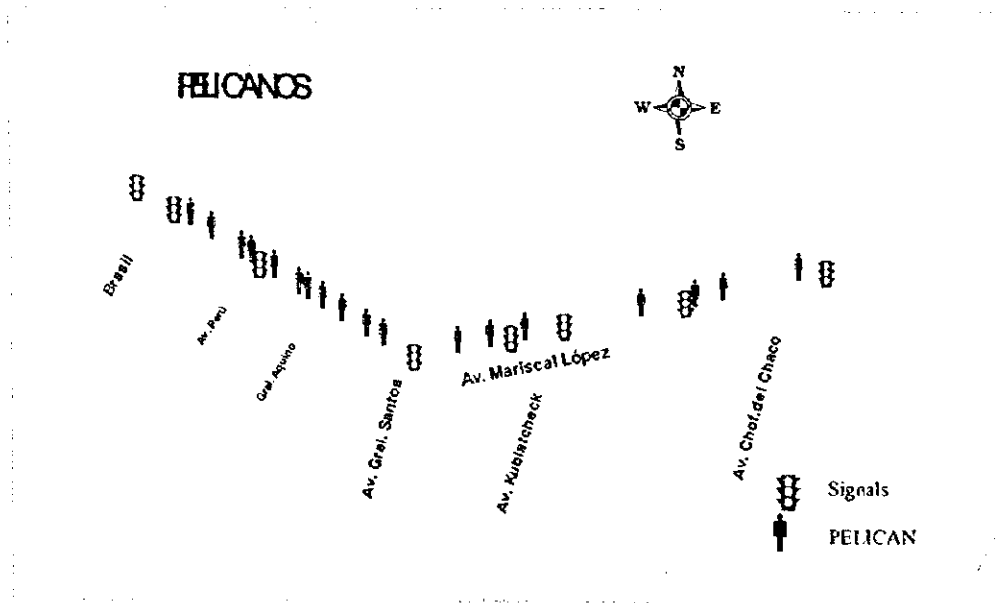


Fig. 5-2-8 PELICAN

### 5.2.3 Traffic Capacity

#### (1) Saturation Flow Rate

Fig. 5-2-9 shows the distribution of the observed head-ways on 4 lane roads at evening peak hours. The average of head-ways less than 3.0 seconds is 1.82 sec. and the saturation flow rate is calculated at 2,000 veh./h.

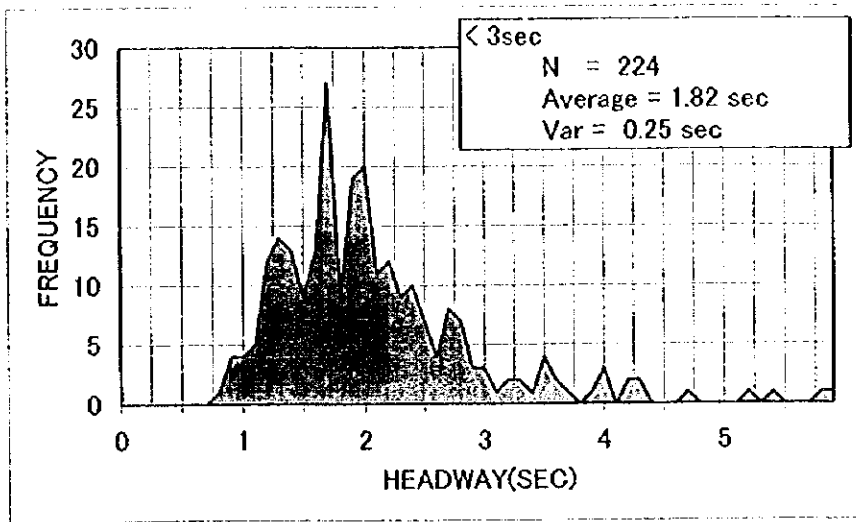


Fig. 5-2-9 Distribution of Head-Ways

#### (2) Capacity by Roads and Vehicle Characteristics

The relationship between the highest 30 one hour flows converted from 15 min. observed flows, and the surface types and the share of heavy vehicles are shown in Fig. 5-2-10 and 5-2-11. There is a high co-relationship on the 4 lane roads between observed flows and the share of heavy vehicles. The passenger car unit (pcu) by the share of heavy vehicles are calculated from the figure as shown in Table 5-2-3, and the pcu is 2.7 at the share of heavy vehicles of 10%. There is a co-relationship between the observed flows and the share of heavy vehicles even on empedrado roads. The pcu by the share of heavy vehicles is calculated, from the figure, as shown in Table 5-2-4, and the pcu is 2.3 at the share of heavy vehicles of 10%. The maximum observed flow was 250 vehicles/hour on 2 lane roads.

Table 5-2-3 PCU (Asfaltado)

Percentage of Heavy vehicles	0%	5%	10%	15%	20%	25%	30%	35%
Adjustment Factor	1.00	0.93	0.86	0.79	0.71	0.64	0.57	0.50
PCU	-	2.5	2.7	2.8	3.0	3.2	3.5	3.9

Table 5-2-4 PCU (Empederado)

Percentage of Heavy vehicles	0%	5%	10%	15%	20%	25%	30%	35%
Adjustment Factor	1.00	0.94	0.89	0.83	0.78	0.72	0.66	0.61
PCU	-	2.2	2.3	2.3	2.4	2.6	2.7	2.8

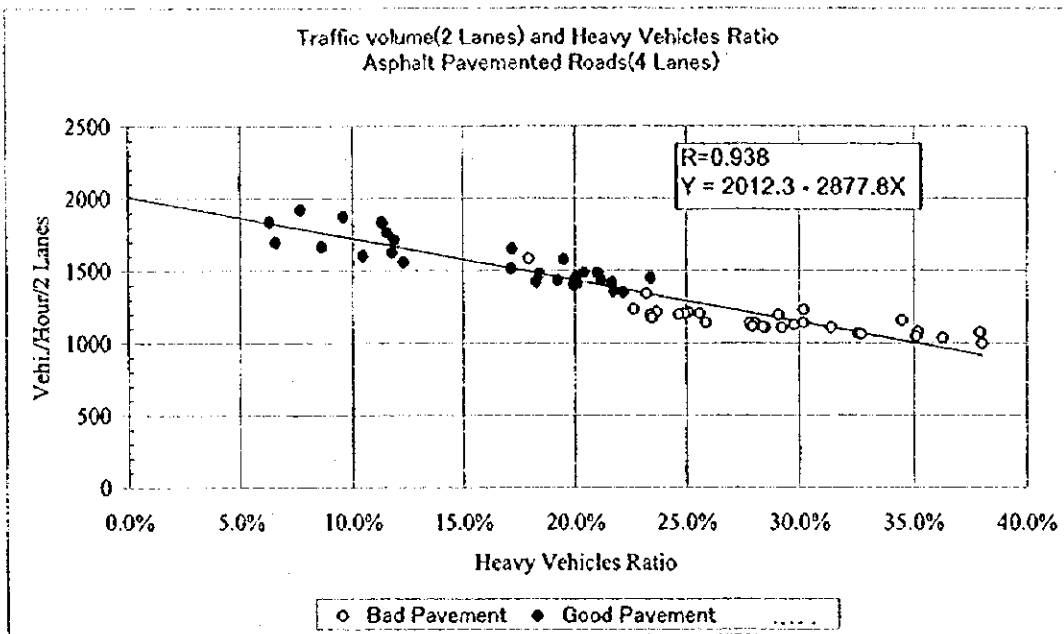


Fig. 5-2-10 Traffic Volume and Heavy Vehicles Rate (Asphalted Road)

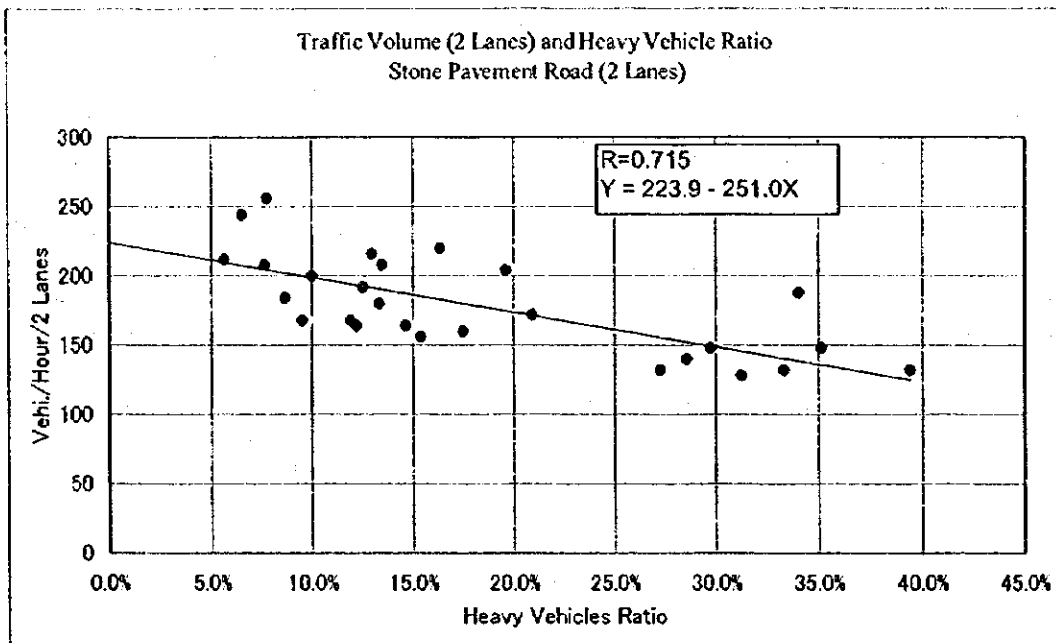


Fig. 5-2-11 Traffic Volume and Heavy Vehicles Rate (Stone Pavemented Road)

### 5.3 Traffic Signal

There are 178 signalized intersections in Asuncion city. Most of the intersections of trunk roads are signalized. Most of signals are for vehicles, and those for the exclusive use of pedestrians are few. The signals are installed in the same line as stop lines, therefore, pedestrians cannot see the signals at the intersection with one way streets.

Most of the signals are controlled by electro-mechanical controllers with fixed phases, and some are controlled by electronic controllers with variable phases, however, they are changed to blink in the night time, and the operation does not match the change of traffic flow. The relationship between cycle times and the shares of green times on main flows at the intersections where traffic counts were carried out, shows that there are many intersections with a cycle time of more than 120 sec. This situation implies a low service level. There is no signal installation manual, and the signals are installed by experience, and the phases are decided at the sites. Also there is no continuous monitoring data and the signal control systems are rarely changed afterwards.

The signal control center was established in January, 1998, and the green wave system was started on EEUU and Brasil, however, the system is not operating well because of low reliability of the system with frequent system downs the phases and off-sets were not set based on the monitoring data, and there is no good cooperation with the municipal traffic police (PMT), which causes the malfunctioning of actuated signals by parked vehicles on detectors.

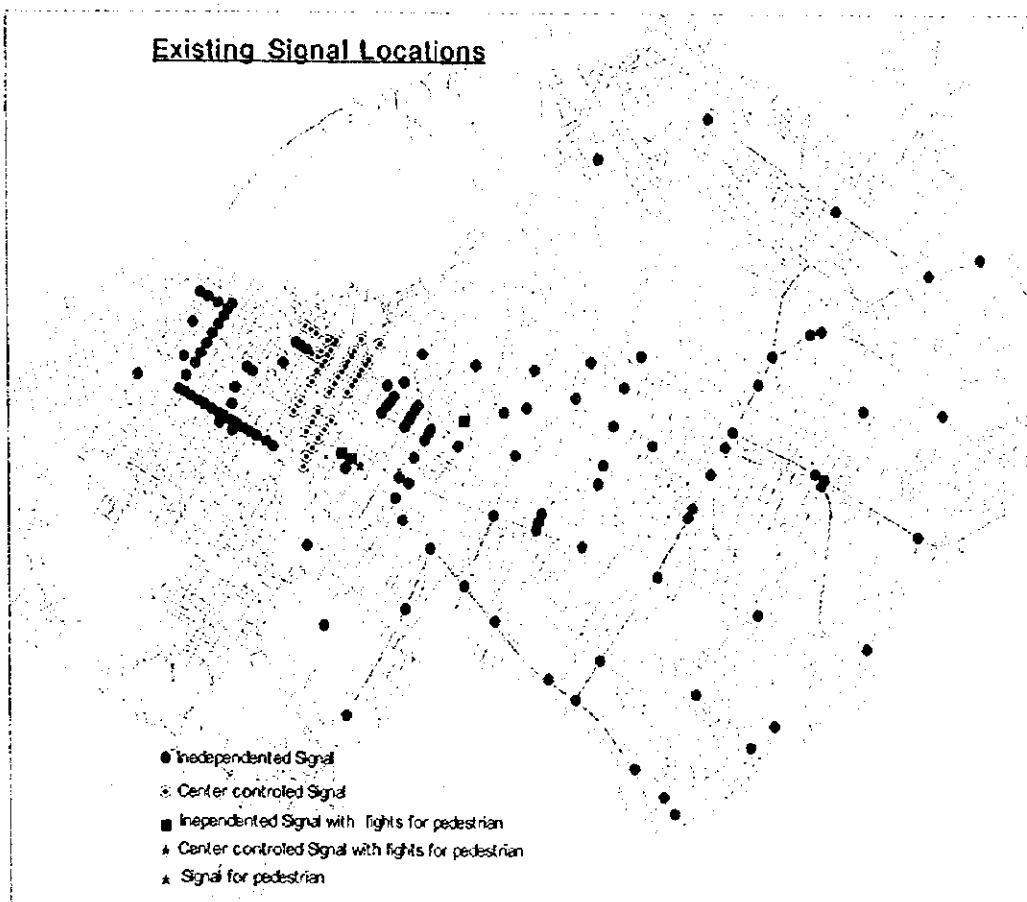
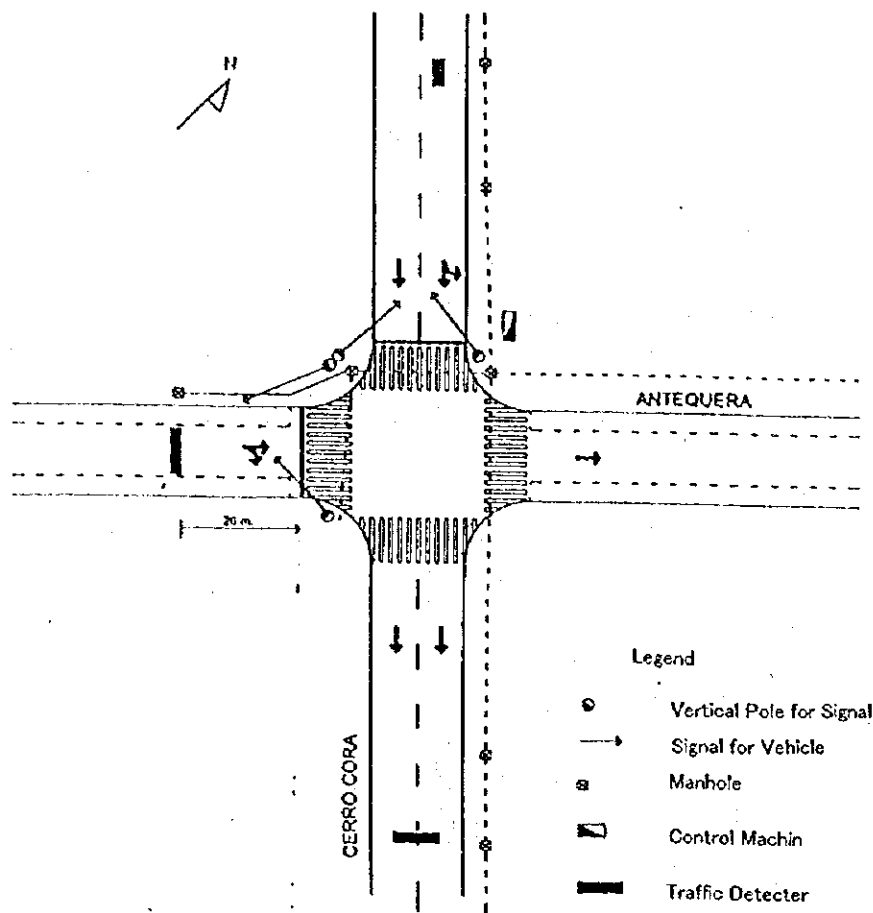


Fig. 5-3-1 Existing Signal Locations



**Fig. 5-3-2 Present Signal Light Installation**

**Table 5-3-1 Type of Control Machine**

Type of Control Machine	Number
Electronic	19
Electronic(Isolate)	60
Electric Machine	56
Gertrude	43
<b>Total</b>	<b>178</b>

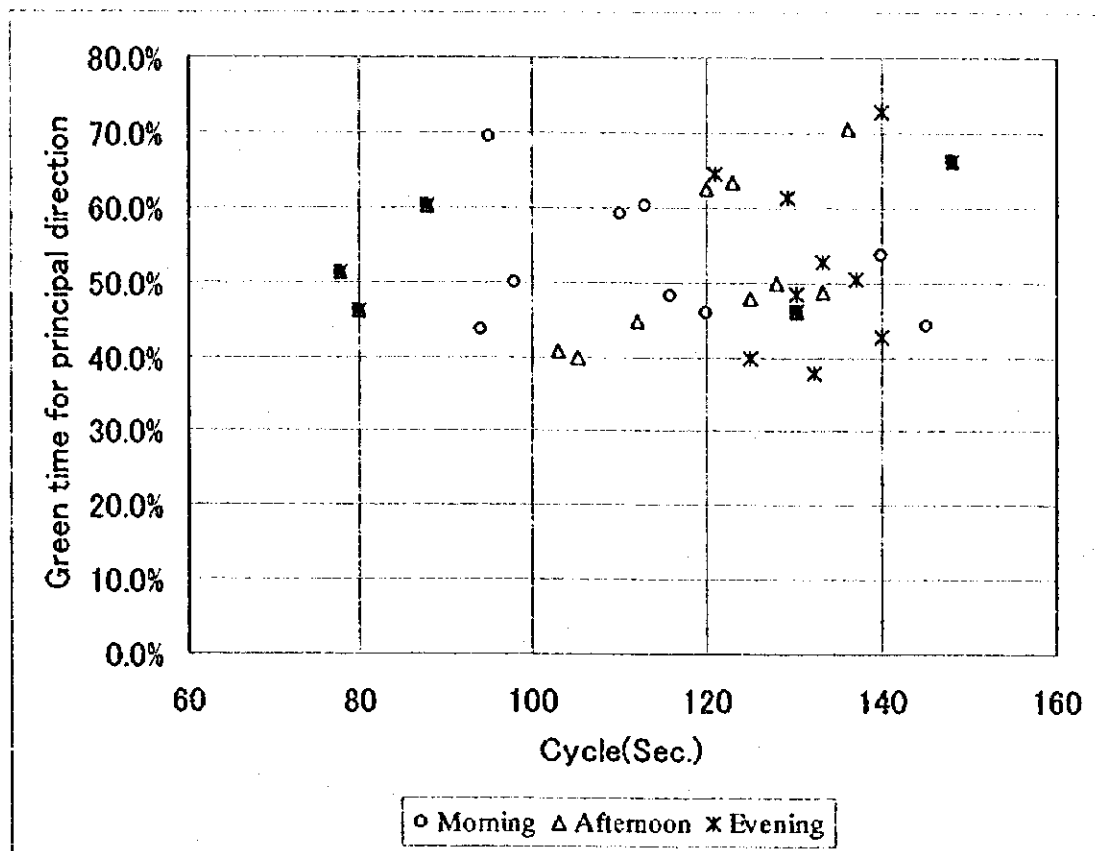


Fig. 5-3-3 Cycle Time & Rate of Split for Principle Direction

#### 5.4 One-way Control

All the streets in Micro-Centro, except for Paraguayo Independiente and Av. R.Francia – Ygatimi, which run to the North and South fringes, are one way controlled. Also in the expanded Micro-Centro beyond EEUU and Brasil, up to Av. Peru, all the roads are one way controlled. There was a change of one way system, from 1984 system, on EEUU and Brasil, where one way directions were reversed. On Brasil, the flow is controlled from North to South at present to divert the increasing traffic from the South via Av. E.Ayala and Av. J.F.Bogado to Micro Centro on Brasil. The one way systems are operating in the central areas of San Lorenzo and Luque to disperse the concentrated traffic.





**Fig 5-4-1 Oneway Regulation**

## **5.5 Parking Facilities**

### **5.5.1 Curb Parking**

#### **(1) Parking within Asunción City**

According to the city law, on-street parking is prohibited on the main streets in Asuncion. However, on Av. E. Ayala, which is one of the most important streets in Asunción, for example, much on street parking of business, commercial and customers vehicles is observed because of many small scale commercial activities along the street. The people seem not to respect the city law and no on-street parking control in this area is observed.

#### **(2) Parking within Micro-Centro**

In the Micro-Centro area, on street parking is allowed with parking charges mainly on North-South streets and it is prohibited mainly on East-West streets. The whole area is sub-divided into 2 zones as shown in Fig.5-5-1, and the charges for on-street parking are different by zone, i.e. 1,350 Gs./hour in zone 1 and 900 Gs./hour in zone 2. The on-street parking capacities are 1,750 lots in zone 1, 2,750 lots in zone 2. The total capacity is 4,500 lots. The maximum allowed parking duration is limited to 2 hours in zone 1, and 4 hours in zone 2.

The onstreet parking is managed by a private entity, CEA (Control de Estacionamiento de Asuncion), which was appointed by the Municipality. The management period is from 8:00 to 20:00 from Monday to Friday, and 8:00 to 15:00 on Saturday.

Curb Parking Control Zone (C.E.A)

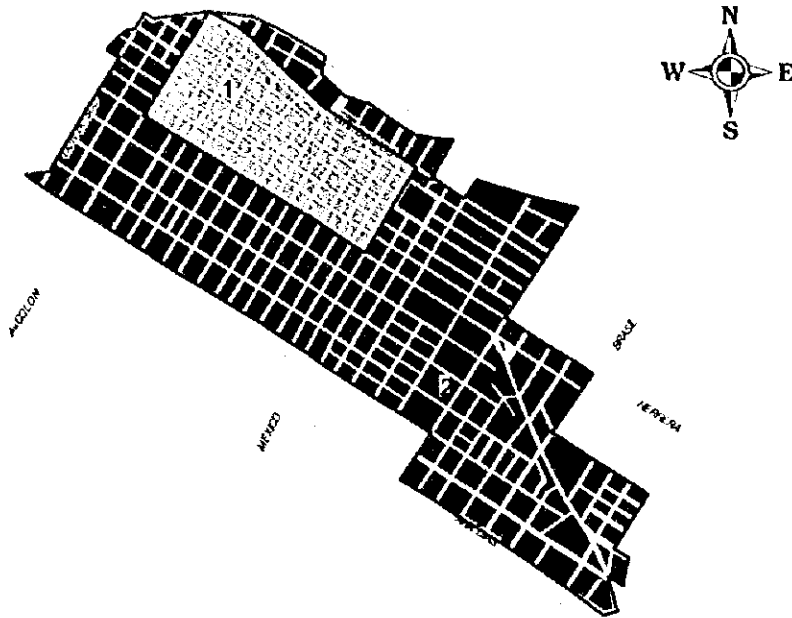


Fig. 5-5-1 Parking Control Area

**(3) Curb Parking Management by CEA**

CEA has been involved in the on-street parking in Micro-Centro since 1993 in accordance with its contract with the Municipality. The contract was made through bidding among several competitive entities for number of parking lots to be managed, management system and the amount of deposit. The scope of the contract is limited to the collection of parking charges and the monitoring of illegal parking. The illegal parking will be exposed and reported to PMT (Policia Municipal de Transit) by CEA, and the penalty will be enforced by PMT, working together with CEA staff.

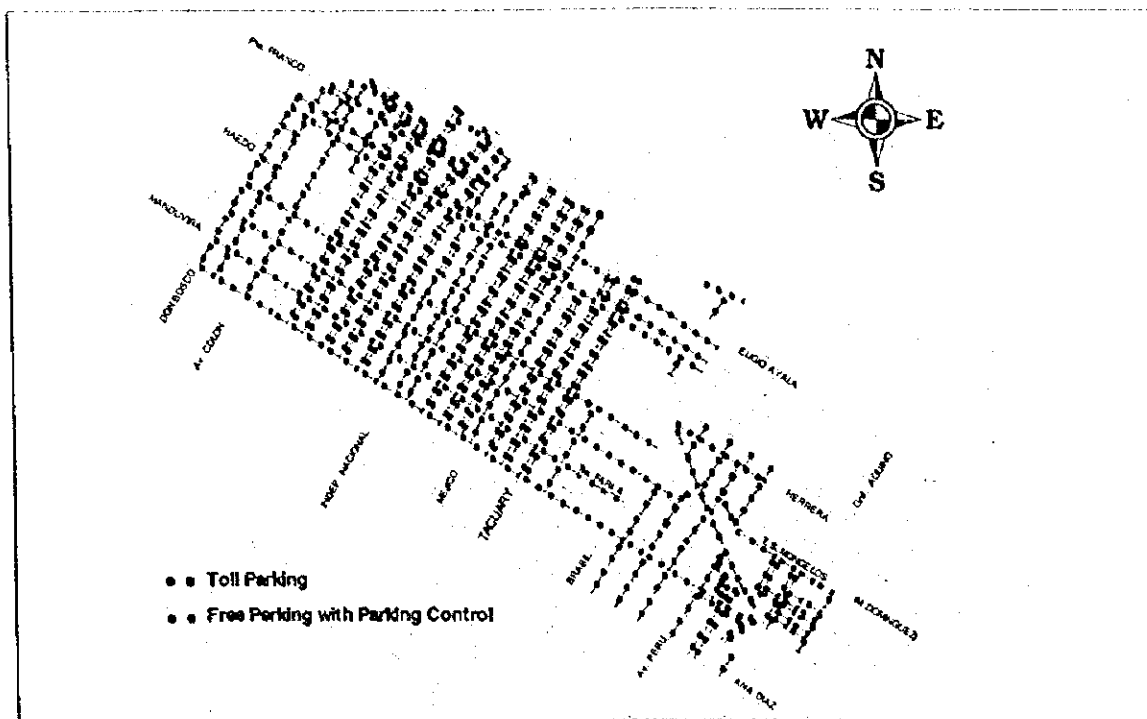


Fig. 5-5-2 Control Street

Table 5-5-1 Staff for Curb Parking Administration

Section	Persons	Organization
Parking monitor	46	CEA
Traffic police	13	PMT
Supervisor	2	Municipality
Complaints staff	6	Municipality

The operating cost of CEA includes the wages for monitoring staff and 190 million ± 43 million Gs. of monthly deposit to the Municipality, which will be decided by the monthly turn-over from the parking charges, and the difference between the turn-over and operating cost can be counted as the gross profit. If 100% of the parking lots are occupied, the cost will be only 28% of all the turnover as shown in Table 5-5-2, and the expenditure and turn-over will balance at an occupancy rate of 30 – 50%.

Table 5-5-2 Expenditure and Revenue of CEA

Description	Month (Gs)
<b>Income (Utility Percentage=100%)</b>	
Zone 1	1,752 vehicles x 220 Hours/month x 1,350 Gs
Zone 2	2,746 vehicles x 220 Hours/month x 900 Gs
Total	1,064,052,000
<b>Expenses</b>	
Monitoring Staff*	46 Persons X 2,400,000 Gs/month/person.
Monthly deposit	190,000,000
Total	300,400,000
Expenses/Income	28%

Obs. \*1: Minimum salary x 4

The locations of on-street parking lots are planned by the Municipality, and CEA does not have any right to change them. The parking charges can be changed after approval of the municipality of the application from CEA.

The parking charges are collected basically by a pre-paid system. The following types of

parking ticket should be displayed within a car for the monitoring of CEA staff. The parking tickets include the following 3 types.

a. Parking Ticket sold by Auto-Vender

A driver should buy a parking ticket from the auto-vender by token, and he should display it at the front within the car. The ticket is valid from the time he bought it by hour.

b. Parking Meter

A driver should operate the parking meter, when he starts the parking, inserting the same token as for the parking tickets.

c. Electronic Pre-paid Parking Ticket

A driver should buy a rechargeable electronic pre-paid ticket at a price of about 40 US\$, and should charge it in accordance with the pre-paid amount. When he parks his car, he should set the parking zone number and starting time and should display it at the front within the car. The advantage of this device is that the parking charge will be deducted by minutes, therefore the users of this device are increasing despite the relatively high price of the device.

A clamp is installed on illegally parked cars by the monitoring staff and after one hour, a wrecker will remove the car. The penalty charge is 42,000 Gs, which is 3 times the minimum daily wage, and an additional fee for the wrecker of 70,000 Gs. will be charged.

5.5.2 Off-Road Parking Facilities

(1) Off-Road Parking Facilities in Micro Centro

The off-road parking facilities, which serve for public use on hourly, weekly, monthly or annually contract bases, in Micro-Centro are located all over the area as shown in Fig.5-5-4 and 5-5-5. The parking lots are 2,862 and 5,264 in the zones 1 and 2 respectively and the total is 5,728. The total of these off-street parking lots and on-street parking lots is 10,226. Most of these parking facilities are attached to commercial and business buildings and there are few exclusive parking buildings. There is much unpaved parking at vacant lots, which may be changed to other use. The parking fee is 1,000 – 3,500 Gs/h, or 4,000 – 23,000 Gs./day, which is more expensive than that of on-street parking. The average occupation ratio is 67 %, and there are more spaces than demand.

Table 5-5-3 Capacity of Parking Facility in Microcentro

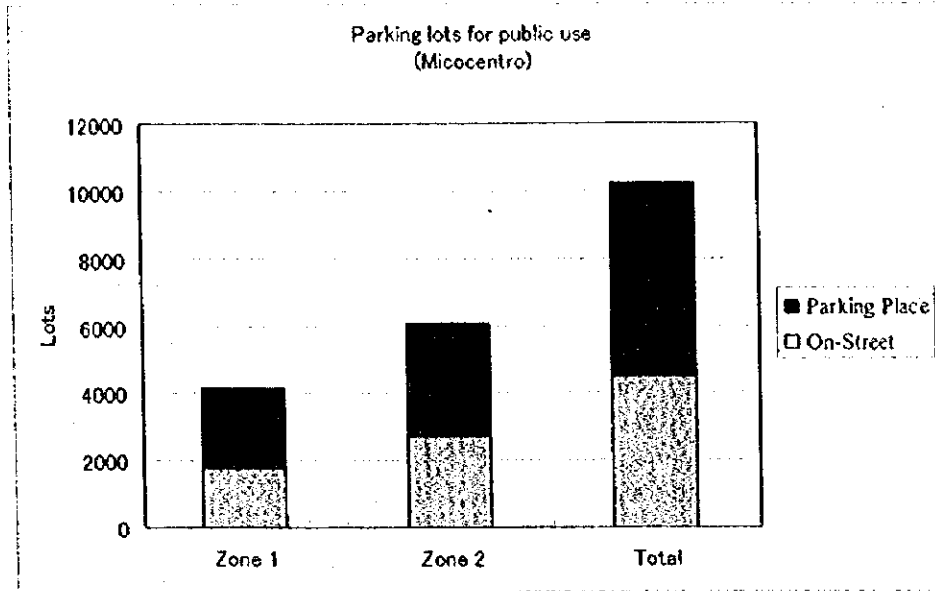
Unit: Lots

	On-street	Parking Facility			Total
		Public	Commerce	Total	
Zone 1	1,752	2,369	20	2,389	4,141
Zone 2	2,746	2,891	448	3,339	6,085
Total	4,498	5,260	468	5,728	10,226

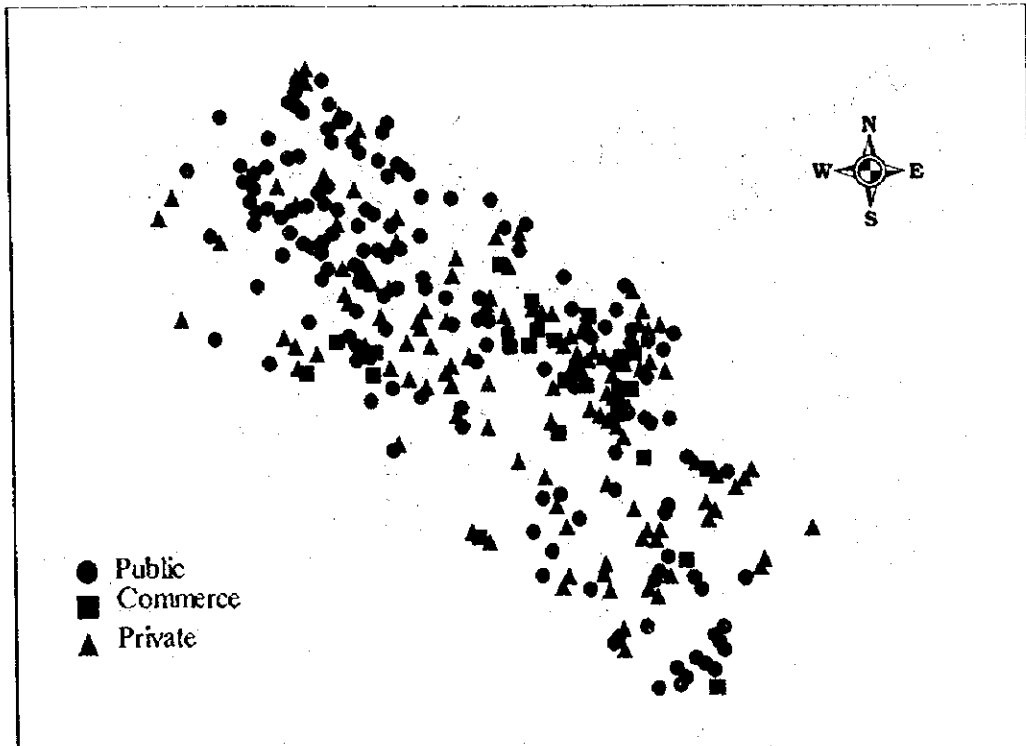
**Table 5-5-4 Parking Fee**

Unit:Gs

	Zone 1				Zone 2			
	On-street	Parking facility			On-street	Parking facility		
		Average	Min.	Max.		Average	Min.	Max.
Hour	1,350	2,380	1,500	3,500	900	2,220	1,000	3,000
Day	-	9,230	4,000	23,000	-	7,000	4,000	15,000
Month	-	113,780	80,000	180,000	-	98,120	50,000	150,000



**Fig. 5-5-3 Capacity of Parking Facility for Public Use**



**Fig. 5-5-4 Location of Parking Lot**

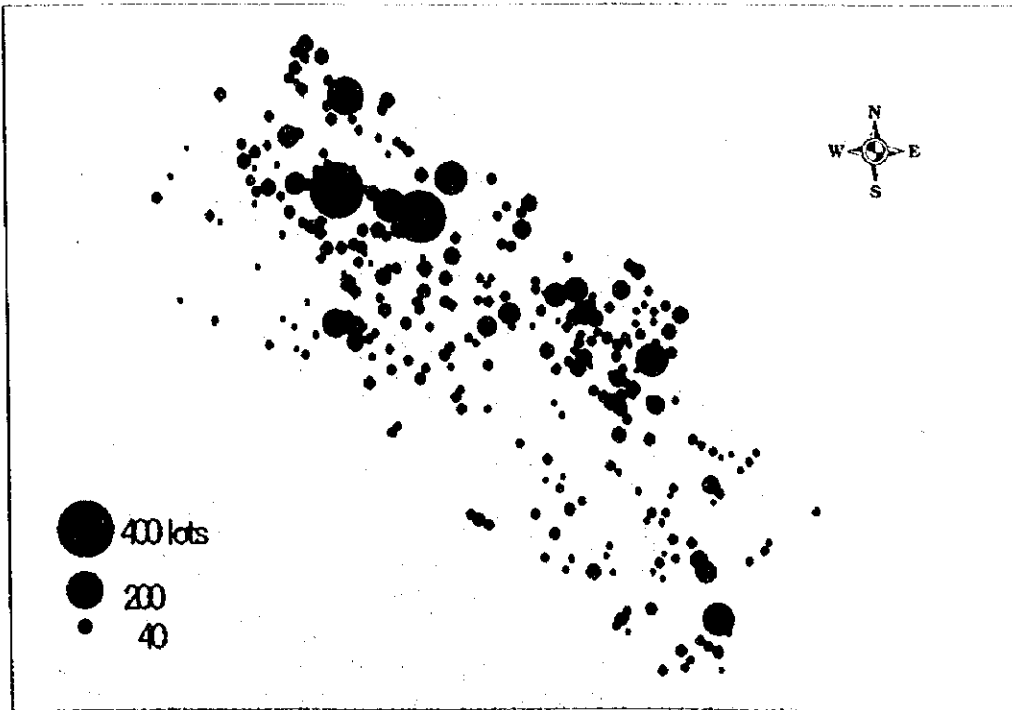


Fig. 5-5-5 Capacity of Parking Facility

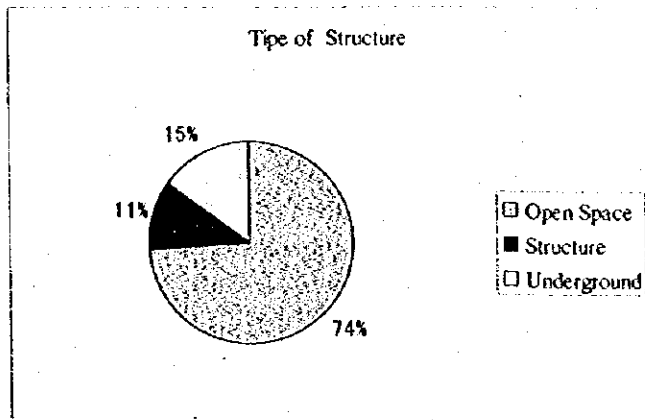


Fig. 5-5-6 Type of Structure

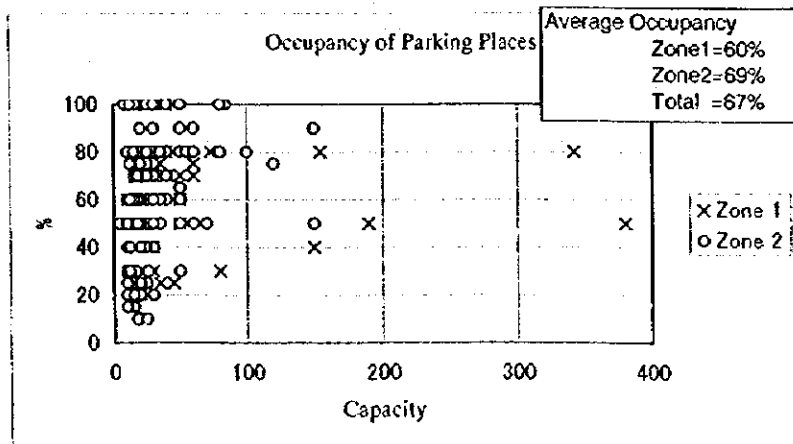


Fig. 5-5-7 Occupancy of Parking Place

## (2) Under-ground Parking at Plaza de los Heros

Based on "Feasibility Study on Urban Transportation Facilities in Asuncion Metropolitan Area, 1988, JICA", the 1<sup>st</sup> under-ground parking was constructed at Plaza de los Heros by BOT in 1990. After a concession period of 20 years, the facility will be transferred to the Municipality. The capacity is 342 lots with 2 stories, and commercial facilities are attached to increase the turn-over from the rent. The parking charge is 2,600 Gs/hour, which is higher than that of on-street parking, however, occupancy rate is as high as about 80% because of the close location to the city center.

## 5.6 Traffic Accidents

The registered traffic accidents in 1997 were 8,354, which is 2,500 less than that of the previous year. The accident rate to traffic flow in 1997 was 11.04, which is more than that in 1984.

**Table 5-6-1 Accident Rate**

Year	Accidents (a)	Trips (Vehi.) (b)	(a/b*1000)
1983	3,346	346,849	9.65
1997	8,354	756,440	11.04

Data of Trips : CETA 1984/1998

Most of the accidents occurred due to carelessness, however it is characterized by the fact that 13% of the accidents were caused by ignorance of traffic signals. Most of these accidents were caused by cars entering at the yellow time at the change of signal phases, and it systems from the problem of drivers who do not respect the signals, and also a signal phase system with short periods of all red and yellow times as well. The share of accidents in motion shows the highest of 23% when changing lanes, followed by 13% when overtaking, which implies a problem of driving manners in the urban area. Also it is characterized by the fact that 21% of accidents occur by cars being driven in opposite directions. This situation may be caused by the existence of many one way streets in the city, and by insufficient traffic signs and pavement markings as well. The share of traffic accidents by vehicle classification is 68% for passenger cars and light trucks, however the share for buses is which is high 17%, comparing with the vehicle numbers, and it arises from the problems of safe operation of buses. These accidents are mainly caused by excess competition of buses on the same routes, and by sudden turns to pick up passengers on the routes without fixed bus stops.

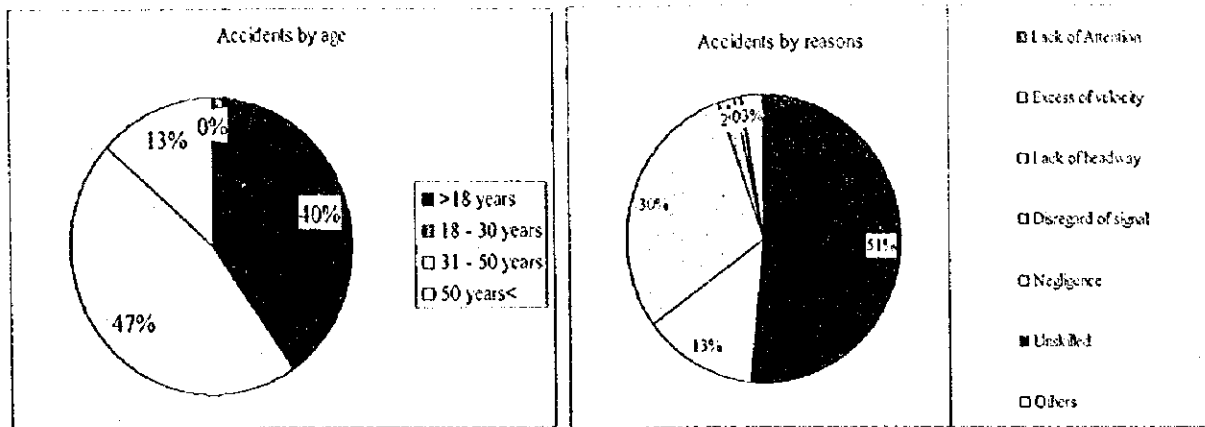


Fig. 5-6-1 Accidents by Age

Fig. 5-6-2 Accidents by Reasons

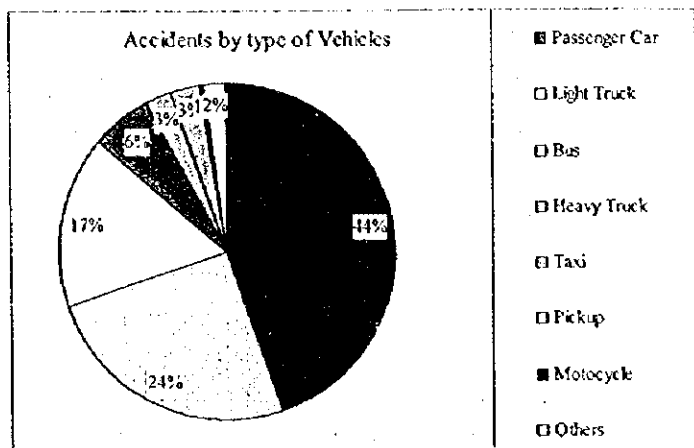


Fig. 5-6-3 Accidents by Type of Vehicles

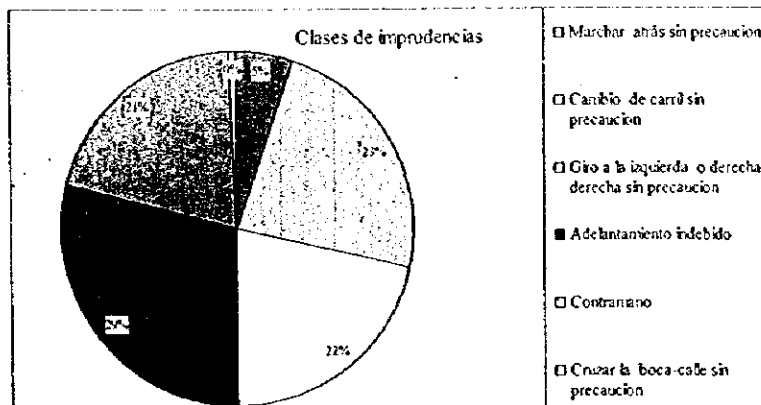


Fig. 5-6-4 Accidents by Behavior

The accident numbers at intersections in Asuncion from January – August in 1998 are shown in Fig.5-6-5. The intersection with the highest accident rate is the intersection of Autopista with Av. Mme. Lynch, where a round about is installed and the left turn traffic conflicts with through traffic. In general, the intersections with trunk roads and the intersections in Micro-Centro with one way streets have high accident rates. The highest number of accidents is seen in Micro Centro at the connecting links with Av. E.Ayala and Av. R.Francia, where Mercado 4 causes traffic congestion.



Fig.5-6-6 shows the worst 20 intersections in terms of traffic accidents. Most of them are located on Av. E.Ayala, Av. Mcal Lopez, and Av. Fdo de la Mora, and are signalized.

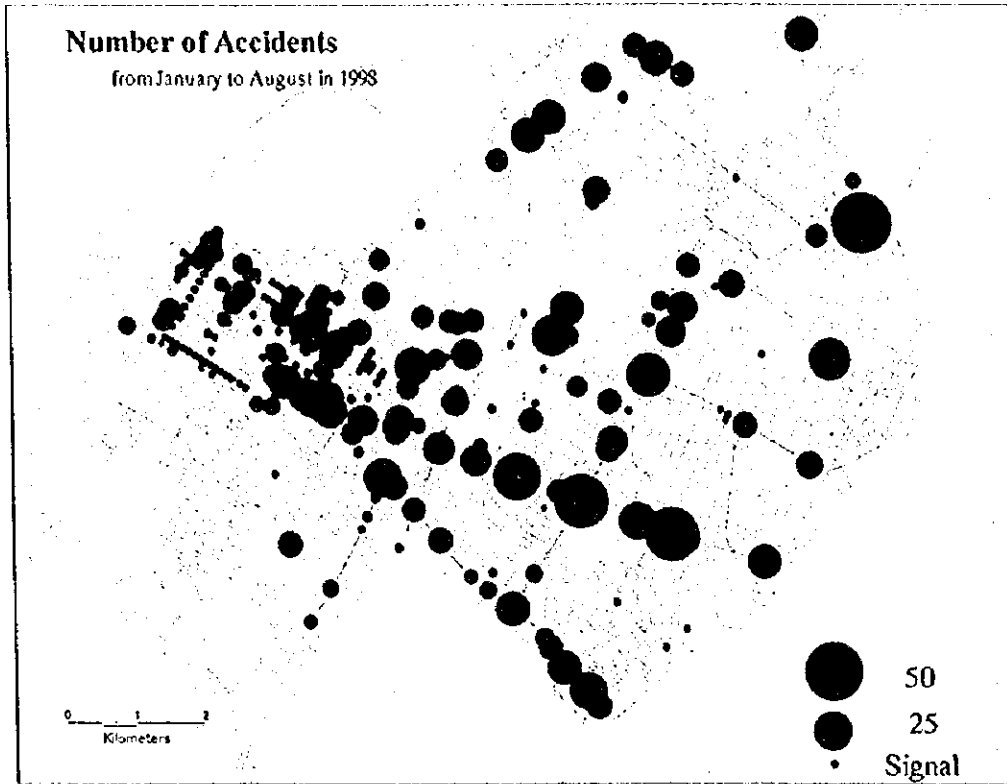


Fig. 5-6-5 Accidents by Intersections (Jan-Aug, 1998)

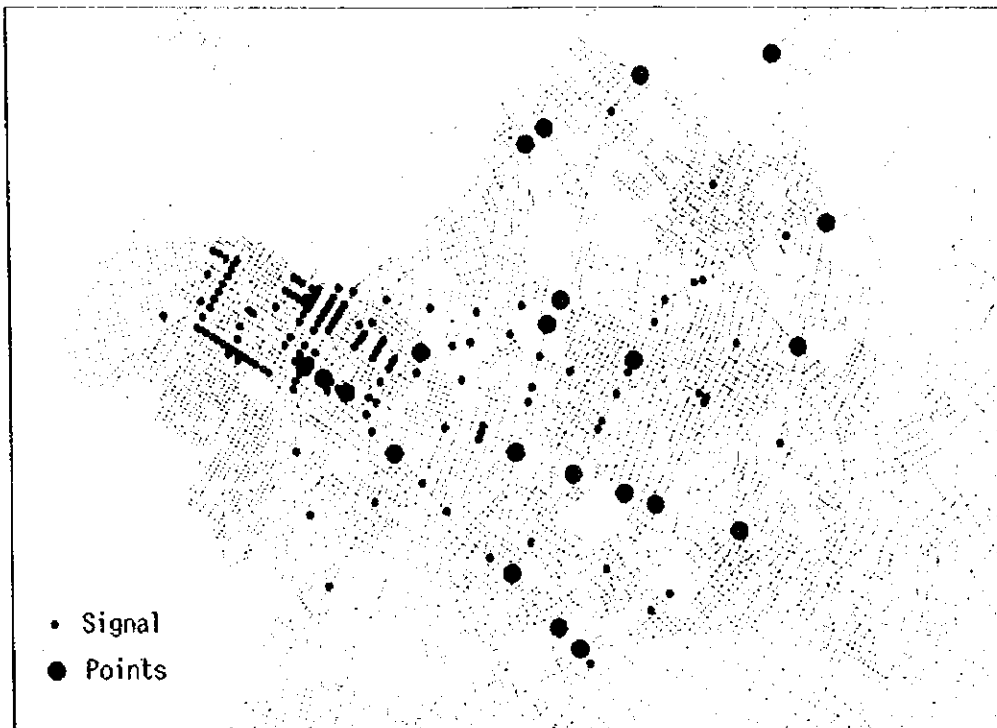


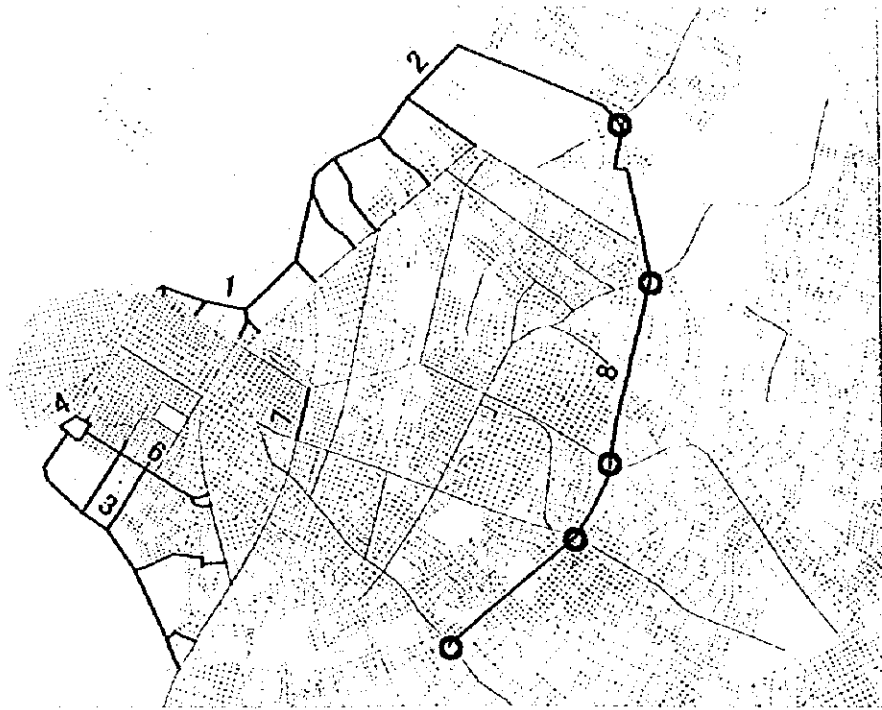
Fig. 5-6-6 Worst 20 Intersections in Terms of Traffic Accidents

## 5.7 Road Network Development Projects

The road development projects shown in Table 5-7-1 are under planning. Among these projects, the project of Av. Mme. Lynch widening to 4 lanes is under construction by MOPC with WB funds, and will be completed by the year 2000, however, the completion by the year 2000 may be doubtful. A part of the project to widen Av. E. Ayala to 6 lanes is planned to commence from the beginning of 1999 by AGA. The target years of other projects are described, however, the detailed plans or the funding source have not yet for decided, therefore, completion by the target years is doubtful.

**Table 5-7-1 Mainly Development Projects**

	Project	Year	Organization	Place	Resume	Costs (x1000Us\$)
1	Paseo Costanero Norte (1)	2003	Asunción Municipality MOPC	Colon - Av.Gnel.Santos	Length=4Km 3 access roads 6 lanes 60km/h	20,000
2	Paseo Costanero Norte (2)	2010	Asunción Municipality MOPC	Av.Gnel.Santos - Av.Transchaco	Length=8Km 4 acces roads 4 lanes 80km/h	40,000
3	Paseo Costanero Sur	2010	Asunción Municipality MOPC	Colon - Av.Felix Bogado	Length=6km 5 access roads 4 lanes 60km/h	8,305
4	Anfi Teatro	2010	Asunción Municipality	Cantera Tacumbu		
5	Av.E.Ayala Improvement	2003	Asunción Municipality AGA	Av.Mme.Lynch - Mercado Cuatro	Length=6.6km 6 lanes 60km/h	6,600
6	Av.Ita Ybate Pavement	2003	Asunción Municipality	Montevideo - Av.Felix Bogado	4 lanes	
7	Av.Gnel.Santos Improvement	2003	Asunción Municipality	Av.E.Ayala - Av.Mcal.Lopez	4 lanes	
8	Mme.Lynch Improvement	2000	MOPC	Av.Fdo de la Mora - Av.Trabschaco	4 lanes 4 flyovers	



**Fig. 5-7-1 Location of Development Projects**