3.6.3 Signal Plan

1) Objective

The signal installation objectives are:

a. To keep traffic flow order and increase the intersection capacity to assure normal traffic flow
b. To categorize the traffic ways
c. To assure pedestrian and vehicular crossings

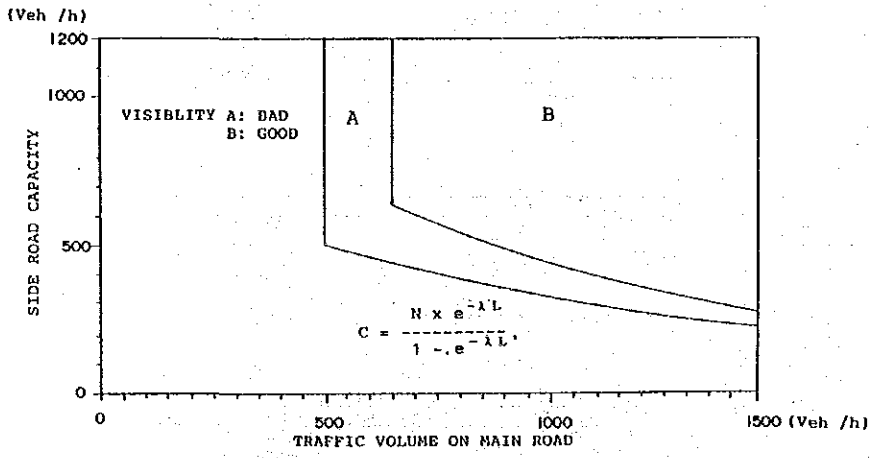
2) Conditions

Signal installation will be determined by pedestrian and vehicular traffic, but in the present it is based on the conditions that assure the traffic flow motion above.

Considering the objectives, stop light installation conditions are shown in TABLE 3-6-3.

TABLE 3-6-3 INSTALLATION CRITERIA OF TRAFFIC SIGNALS

Objective	Installation Criteria
Categorization of Traffic Flow	Intersections with the Private vehicle traffic.
Securing the Pedestrian Crossing	Intersections with the preferential pedestrian streets.
Securing the Vehicle Crossing	The traffic signals on the secondary road should be installed at the intersections where that traffic volume exceeds its capacity.



Where: C= Secondary street capacity in the non-signal (Veh./hour)intersection.
N= Main street capacity (on it/hour)
R= N/3600
L= Secondary street traffic crossing critical time
(5 sec: urban zone)
(6 sec: others)
L'= Critical time between the front and rear vehicles when crossing
(3 sec. with good visibility)
(5 sec. with bad visibility)

FIGURE 3-6-24 SIDE ROAD CAPACITY AT INTERSECTION WITHOUT TRAFFIC SIGNALS (URBAN AREA)

3) Signal Location

The installation year is 1992 and the existing signals were considered. Only the main vehicle traffic axis presents crossing difficulties. The locations of traffic signals is shown in TABLE 3-6-4 and FIGURE 3-6-25)

TABLE 3-6-4 INTERSECTIONS REQUIRING TRAFFIC SIGNALS

Road Type	Intersections
Vehicle Traffic Axis	EE.UU (Cnel.Bogado to R.de Francia) Brasil (Cnel.Bogado to R.de Francia) México (Cnel.Bogado to R.de Francia) Caballero (Cnel.Bogado to R.de Francia) Alberdi (Estrella to Ygatimí) 14 de Mayo (Estrella to Ygatimí) Montevideo (Cnel.Bogado to Ygatimí) Colón (Cnel.Bogado to Ygatimí)
Pedestrian Street	15 de Agosto (Humaitá to Eligio Ayala) Chile (Humaitá to Eligio Ayala) Yegros (Humaitá to Eligio Ayala) Tacuary (Herrera to F.R.Moreno)

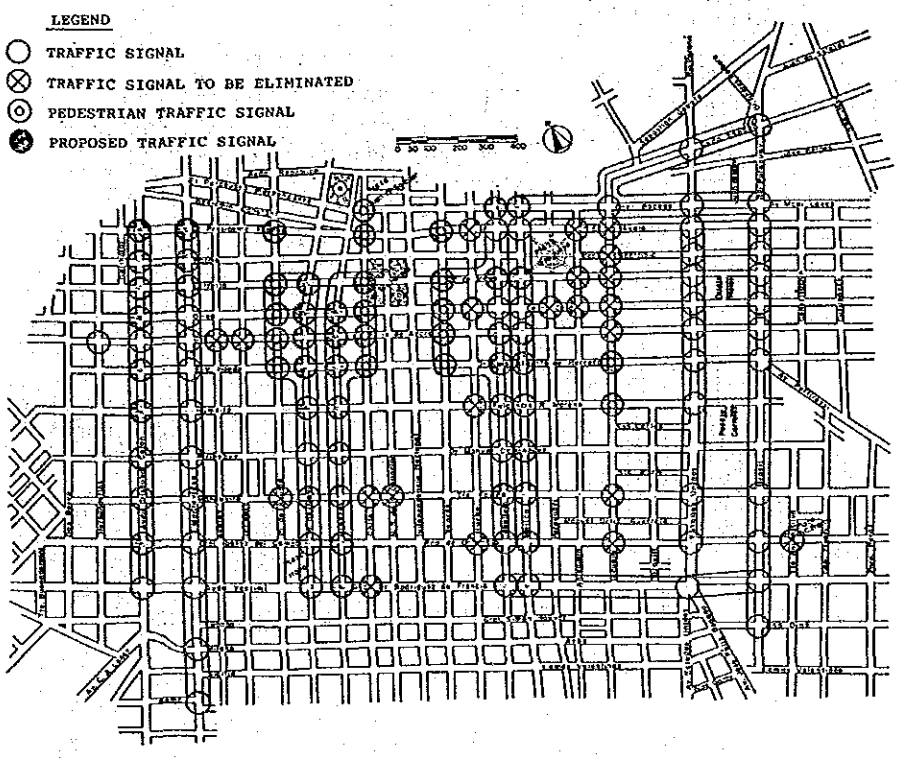


FIGURE 3-6-25 PROPOSED MICROCENTRO TRAFFIC SIGNAL SYSTEM (1992)

4) Command System

(1) Actual Command System

The actual signal command system in the Microcentro are 6 synchronized street. They can be extended but actually the fixed time command is used. The general composition of the system is shown in FIGURE 3-6-26.

A) Individual Command

The local control existent is a CL-B Siemens type. Its technical characteristics are shown in TABLE 3-6-5.

B) Synchronized Command

It is controlled through the master commander. At present there are 4 master commanders, whose characteristics are shown in TABLE 3-6-6.

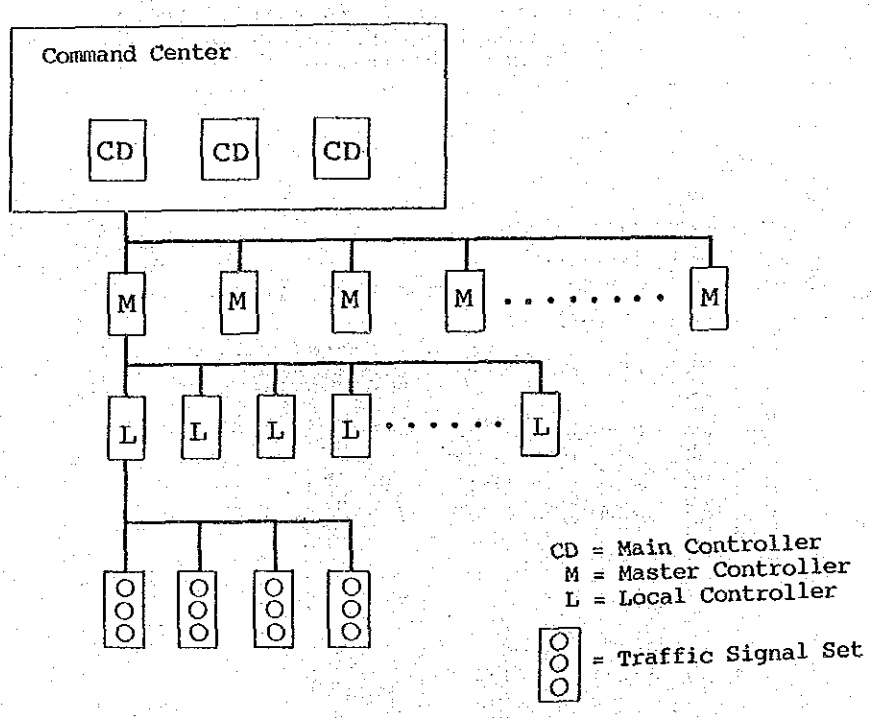


FIGURE 3-6-26 TRAFFIC SIGNAL SYSTEM SCHEME

TABLE 3-6-5 FUNCTION OF LOCAL CONTROLLER (CL-B)

Item	Specification
Type	Electromechanical
Voltage	220V, 50Hz (With adapter, it can be transformed to 60V.)
Critic Temperature Margin	-10 C to 55 C
Signals Set Number	4 signals / way sets Total : 16 sets for one intersection
Signal Code Stage Number per Period	18 max.
Phase Number	4 phase max.
Possibility of Command	- Fixed time independent command - Multiple program command (It needs watch programmer, adapter, detector connection possibility.) - Multiple program coordinate command (It needs watch programmer adapter which is not provided now, and detector connection possibility.) - Switch command system (Do not exist actually)
Signal Programming Numbers	3 programs max.
Yellow Flashing Light	It automatically starts 199 seconds after a damage, like signal interruption, command control lock or other situations.

TABLE 3-6-6 FUNCTION OF MAIN CONTROLLER

Item	Specification
Capacity	It will connect 20 local commanders max.
Sign Programs Number	3 programs max. (It needs programmer watch, which can not be connected to the detector.)

C) Central Command

The central command is installed in the municipality Juan de Salazar y Espinoza building. The master commanders (CD) are linked with the director commander and installed in the central commander room.

- Actually there are 3 CDs.
- One CD can command 8 CM as maximum. So with the existing CD, 24 CMs can be commanded.
- Actually there are just 4 synchronized groups.
- The CD can modify the CM program.
- Structurally is similar to the local command (CL).

(2) System Conditions

The following condition should satisfy the downtown signals system.

a. It should adjust to the traffic variation.
b. It should adjust to the actual system.
c. It should guarantee the normal traffic flow.
d. It should be easy to operate and maintain.
e. It should be able to carry out command system analysis.

(3) Analysis of Command System

TABLE 3-6-7 shows the conditions that the signal command system should hold. In consequence, the system to be used will be the time fixed multiple progressive command. The reasons are explained below:

TABLE 3-6-7 CHARACTERISTICS OF COMMANDING SYSTEM

	Adaptation to the variation of traffic flow	To guarantee the normal traffic (synchronization)	Maintenance & Operation Traffic Flow Measure	Maintenance & Operation Equipment Maintenance	Adaptaion to the present system	Supplementary Equipment
Fixed-Time Control (isolate)	x	x	x	x	O	-
Multi-Program Control	O	x	x	x	O	Automatic timer
Semi-Actuated Control	O	x	x	x	O	Master controller
Fixed-Time Green Wave Control	x	O	x	O	O	Master controller Automatic timer
Multi-Program Green Wave Control	O	O	x	O	O	Detector
Semi-Actuated Green Wave Control	O	O	O	O		Detector Computer
Full-Actuated Green Wave Control	O	O	O	O		Detector Computer

Note : O = easy, - = possible, x = difficult

a. The traffic volumes during the top hours in the morning and noon are large, but they sharply decrease on Saturday afternoons, Sundays and holidays (See FIGURE 3-6-27).
b. During the week, Monday to Friday the variation is really poor (See FIGURE 3-6-28).
c. Short distance between signal intersection
d. It offers a low horizontal control efficiency, because the traffic network is a square arrangement of one way streets.
e. The intersection saturation degree is not up to its limit, so it is not necessary to increase the signal efficiency.

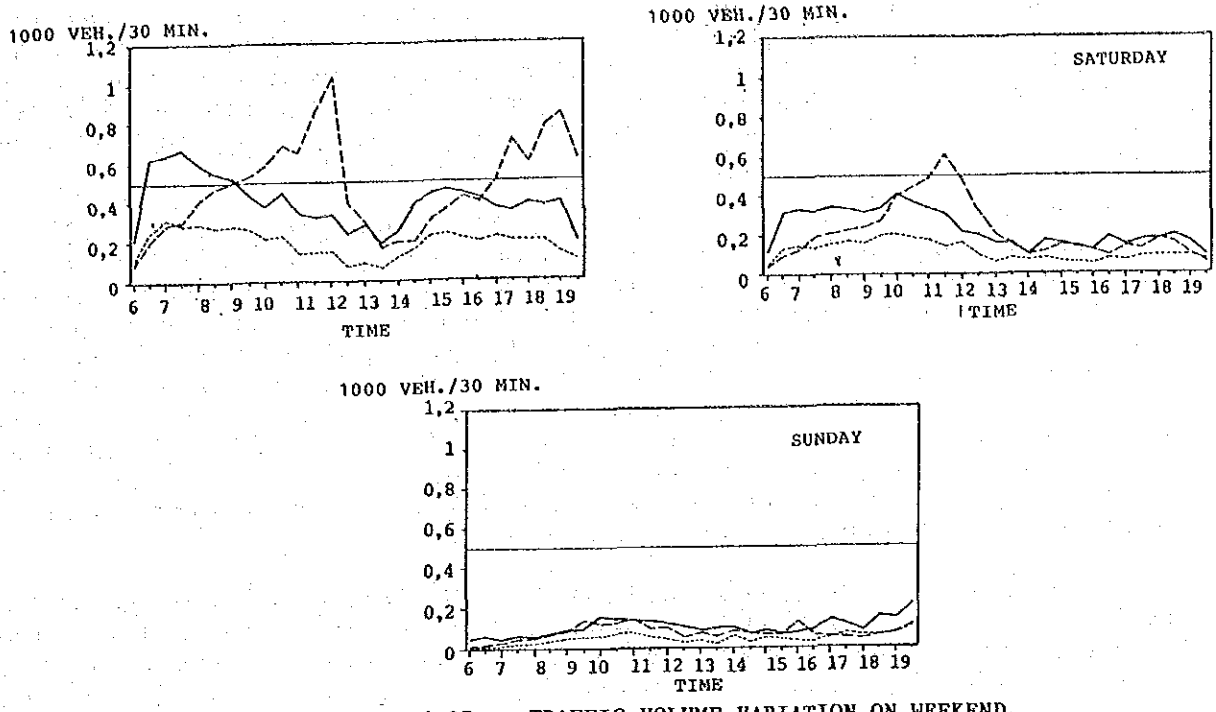
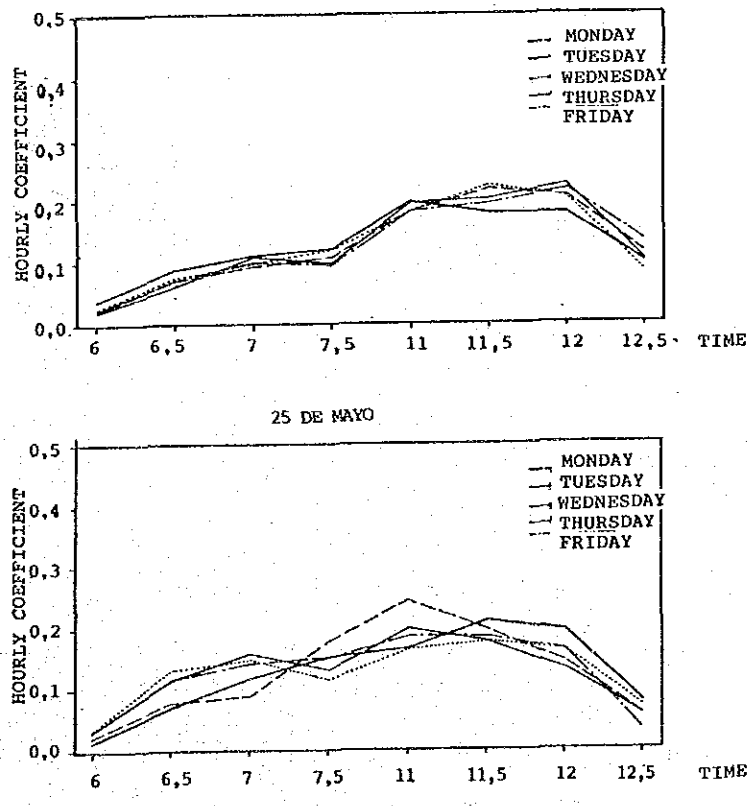


FIGURE 3-6-27 TRAFFIC VOLUME VARIATION ON WEEKEND



RESULT OF TRAFFIC COUNTING ON WEEKDAYS
AT THE INTERSECTIONS ON 25 DE MAYO STREET

HOURLY COEFFICIENT : 30 MIN. VOLUME/TOTAL VOLUME IN 4 HOURS OF (6:00-8:00) AND (11:00-12:00)

FIGURE 3-6-28 TRAFFIC VOLUME VARIATION ON WEEK DAYS

In the future, when traffic congestion occurs at various intersections for large periods, it is necessary to observe variations of the traffic flow with the help of a detector and start thinking of the synchronization that fits to the case. This provision will allow better traffic control and consequently, it will increase intersection capacity.

Besides the parameters for traffic signal control (cycle), it is necessary to gradually modify the mentioned system according to the variation of the traffic flow. Therefore, it is suggested to execute the renewal of the parameters through statistical analysis based on real traffic flow, observed constantly through the use of traffic detectors. Detectors will be set at the entrances and exits of the centro area, considering that these points are representative intersections with respect to the centro traffic flow (See FIGURE 3-6-29). Besides this provision, it would be convenient to periodically carry out traffic flow counts (once a year) at other intersections to determine the adequacy of the parameters.

Concerning the systematization, it would be convenient to purchase a computer for the command of the director controller, also for data processing, for data provided by the traffic detector. The computer should have the capacity to allow changes to the synchronization of the traffic signal system.

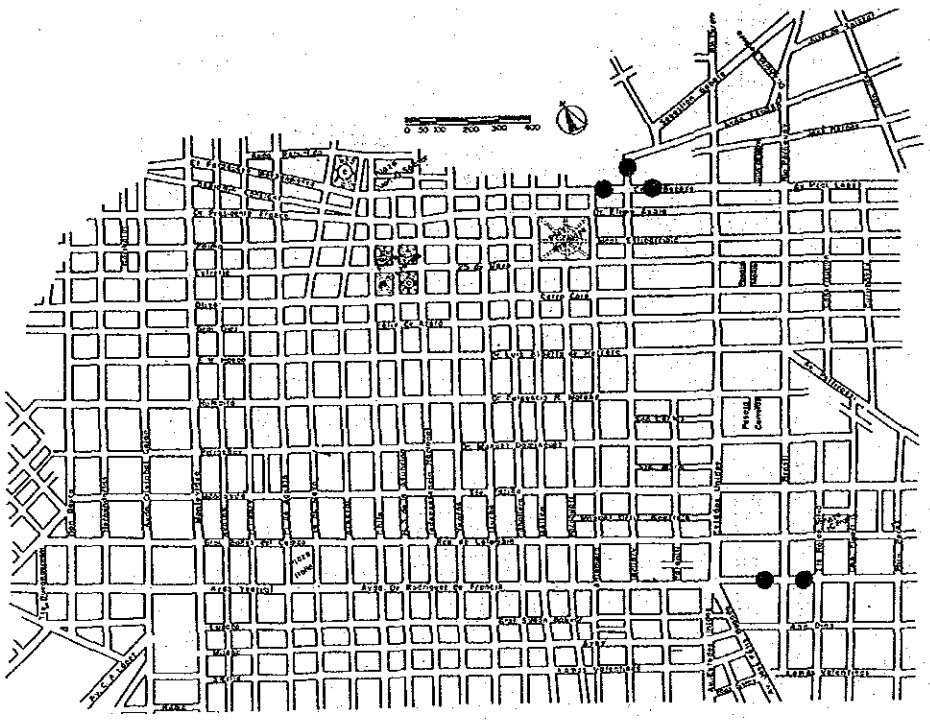


FIGURE 3-6-29 TRAFFIC DETECTOR LOCATIONS

5) Signal Set

(1) Actual Situation

As shown in FIGURE 3-6-30 most of the signals are used on simple posts (columns). However, considering the visibility wire columns have been used only at a small rate lately. There is just one pedestrian stop light and it is installed in the intersection of L.A. Herrera and Tacuary.

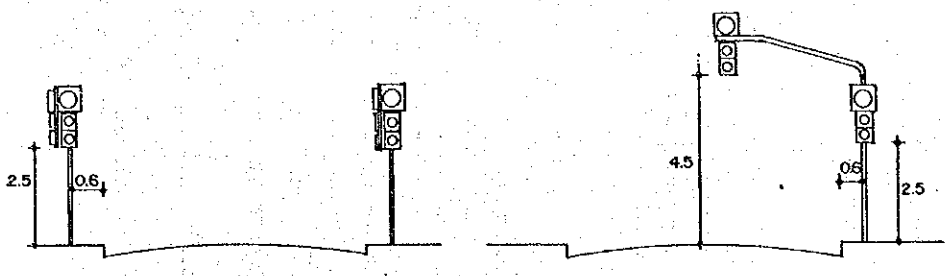


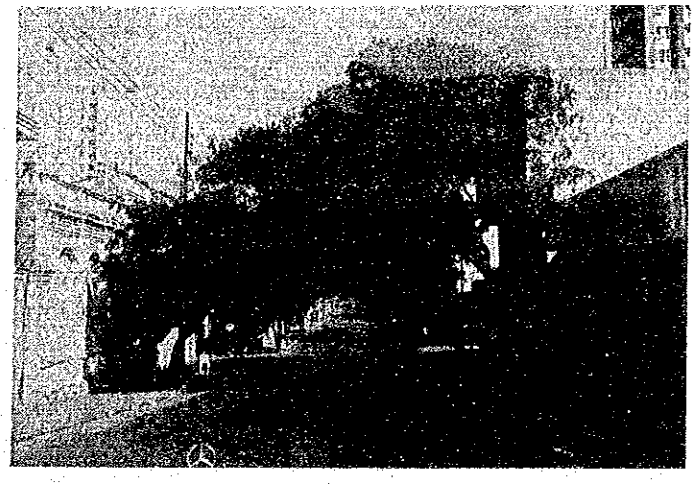
FIGURE 3-6-30 TYPES OF TRAFFIC SIGNALS (STRUCTURE)

Most of the lamps have 200 mm diameter, but considering the traffic security the diameter of the red light has been increased to 300 mm lately. One of the actual main problems is the bad visibility of the stop-lights sign. The causes are listed below:

- Tree branches obstruction (PHOTO 3-6-2)
- Electric power network obstruction
- Commercial sign obstructions
- Signals columns are in a bad location

The intersections with signal visibility problems are shown in FIGURE 3-6-31.

PHOTO 3-6-2 OBSTRUCTED TRAFFIC SIGNAL BY TREES



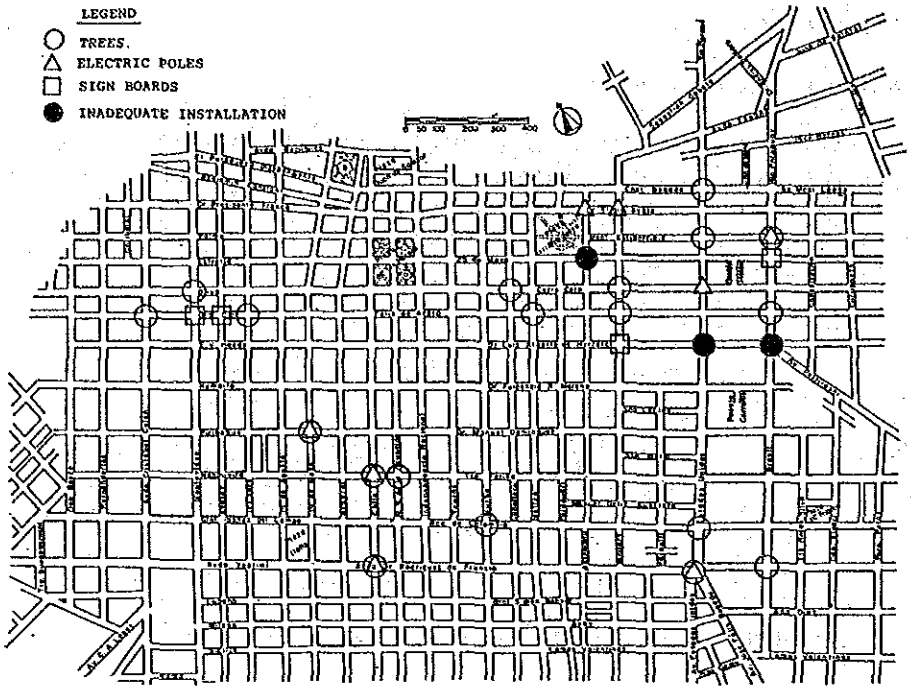


FIGURE 3-6-31 TRAFFIC SIGNALS WITH FAIR VISIBILITY

(2) Signals Location Plan

The type of signal will be the same. The reasons are explained below:

a. The drivers are used to the actual system.
b. The actual visibility problems can be solved by trimming the trees, with commercial sign installation rules and with few modifications in the electric power network.
c. The wire columns present view problems because those streets are narrow (9.00m wide streets and 2.00m for each side walks) with small intersection distance.

The placing of signals can be done considering the following points:

a. to guarantee the visibility
b. to facilitate the pedestrian visibility
c. to set up a 2 signal set (minimum in each corner to assure the security)
d. one of the signals set will be set up on the corner passing the intersection.
e. the actual columns will be used, but to improve the visibility on wider intersections, wire columns will be used.

The signal distribution is shown in FIGURE 3-6-32. However, considering the circulation of the intersection street, the following 5 types are suggested:

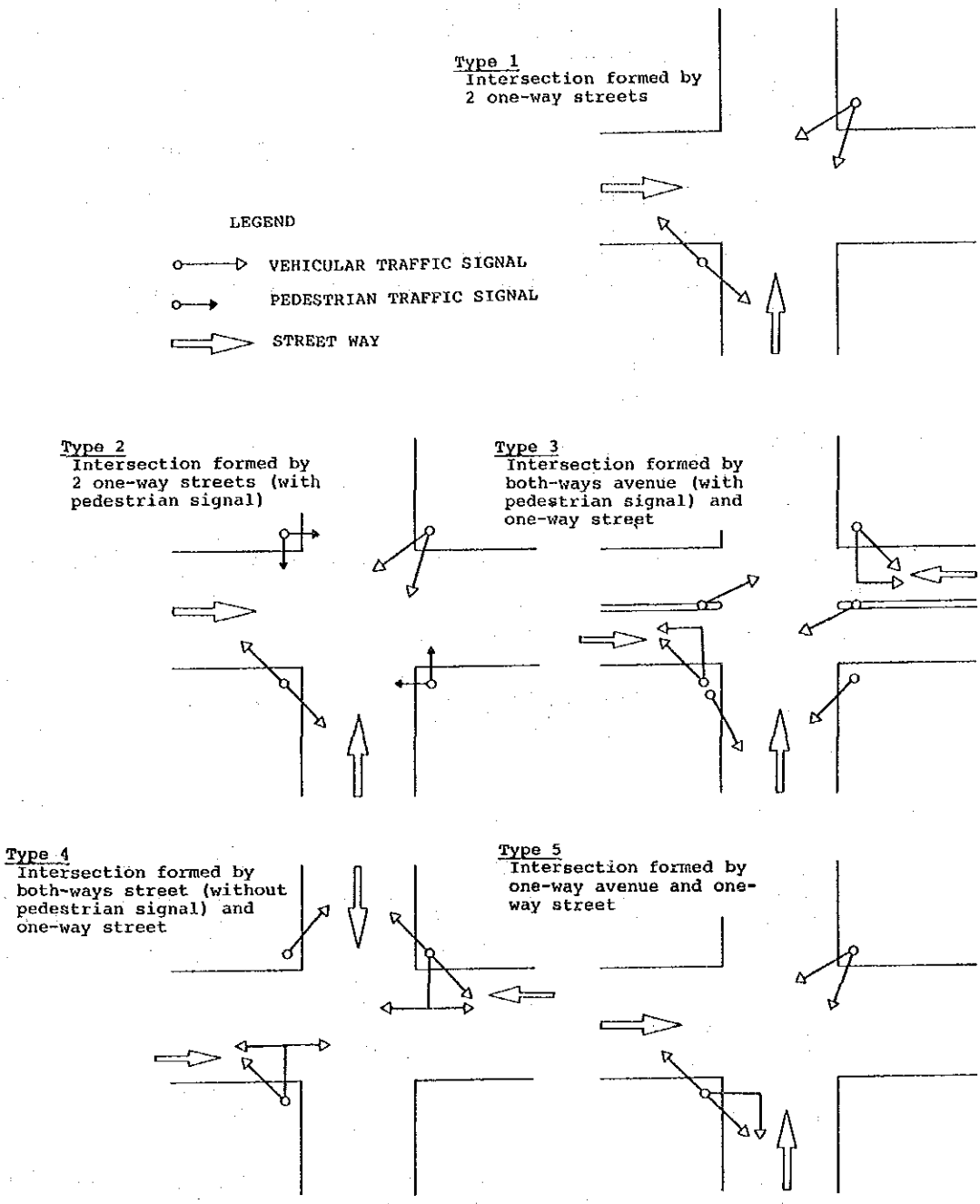


FIGURE 3-6-32 TYPES OF TRAFFIC SIGNALS (FUNCTION)

Type 1: intersections formed by one way streets
2 simple columns
4 signal sets
Type 2: intersections formed by one way streets
(with pedestrian signals)
4 simple columns
2 vehicular signal sets
2 pedestrian signal sets

Type3: intersections formed by two way Avs.
(with central median) and one way street
4 simple columns
2 wire columns
8 vehicular signal sets

Type 4: intersections formed by a two ways streetanda one way street
1 simple column
2 wire column
8 vehicular signal sets

Type 5: intersections formed by one way avenue and aone way street
1 simple columns
1 wire columns
5 signal sets

(3) Points of View

A) Visibility

To guarantee stop light visibility, case should be taken in the following aspects:

a. Tree covered and Branch Trimming Rules

It is recommended a prohibition to plant trees on the corners less than a distance of 5 m from the edge of the side walk in each direction.

b. CommercialSignRules

Commercial signs caused problems with stop light visibility, so the use of raised signs must be restricted intersections. Also, raised commercial signs do not allow visibility of signal signs so they must be restricted on streets with stop lights.

B) Operation and Maintenance

Frequently the signals are damaged or there are imperfections of the lamp. In consequence, it is necessary to establish a periodical change system for the lamps based on the statistics of the life time of lamps. (The life time of a lamp made in Germany is around 9 months), in Argentina it is around 3 months. So it will be necessary to keep a record of the dates that the lamps are changed.

3.6.4 Parking Plan

1) Parking Demand

Parking demand was calculated by purpose, based on the results of Person Trip Survey and the estimates of the future traffic attraction by zone (See FIGURE 3-6-33).

The Microcentro zones (originally 5 zones) were divided into 14 blocks, and parking demands by purpose by block (See TABLE 3-6-8) were estimated using future floor space by zone corresponding with parking purposes (See TABLE 3-6-13). Results are as follows:

a. Parking demand for all purposes will be of 49,975 veh./day in 1992 and 59,576 veh./day in the year 2000, that is to say 1.17 times and 1.40 times respectively more than in the year 1984 (See TABLE 3-6-10).

b. The largest demand is with the purpose of "work", which is estimated at 24,747 veh./day and 29,411 veh./day for the years 1992 and 2000 respectively.

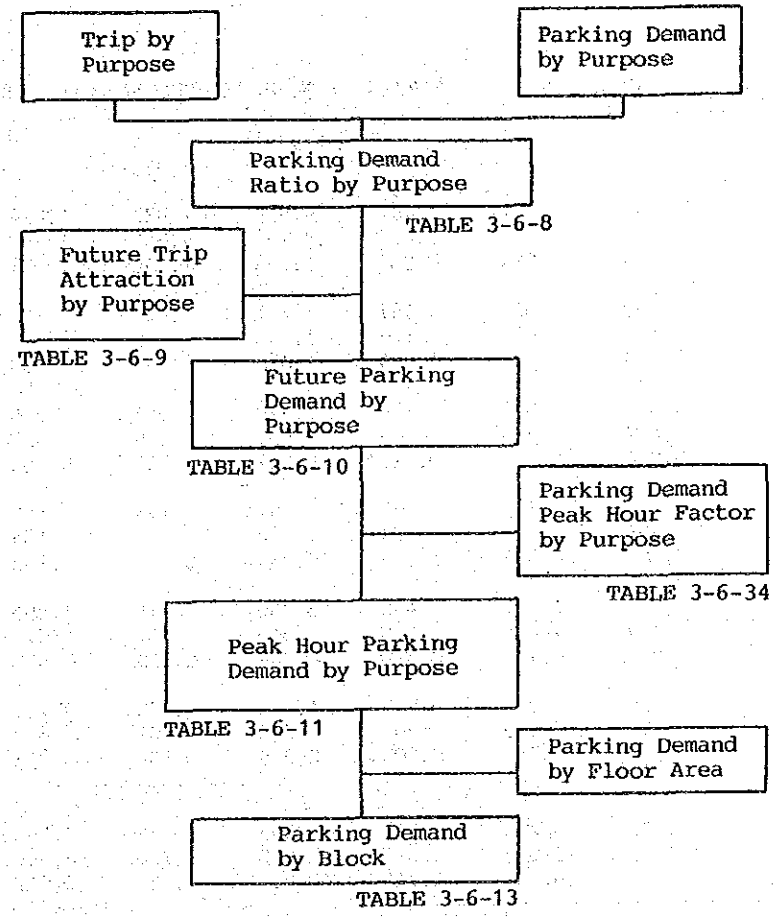


FIGURE 3-6-33 FLOW CHART TO ESTIMATE PARKING DEMAND BY BLOCKS AND PURPOSES

c. At the moment, the largest quantity of parked vehicles is observed between 9.00 o'clock and 12.00 o'clock, from which the 59.8% is with the purpose of "work" (See FIGURE 3-6-34).

d. The whole quantity of parked vehicles between 9.00 o'clock and 10.00 o'clock will rise to 18,720 units (year 1992) and 22,242 units (year 2000), from which the purpose "work" will represent 79%, with 14,799 units (year 1992) and 17,588 units (year 2000) (See TABLE 3-6-11).

e. Observed by block, the largest demand of parking is given in blocks 8 and 9 in the Microcentro proper, between 14 de Mayo and Yegros Streets. This is because of the demand of areas for administrative uses and consequently the great quantity of parking with the purpose "work" verified in those blocks.

f. Blocks 1 and 3 also present a maximum of parked vehicles higher than 2,000 units, for similar reasons to those exposed with respect to blocks 8 and 9 (FIGURE 3-6-10).

TABLE 3-6-8 PARKING DEMAND BY PERSON TRIP SURVEY

Zone	1	2	3	Subtotal	4	5	Subtotal	Total
Work								
Attra.(veh./day)	8,255	7,167	1,497	16,919	2,822	1,814	4,636	21,555
Park. (veh./day)	9,440	7,842	1,472	18,754	4,051	1,943	5,994	24,748
Ratio	1.144	1.094	0.983	1.108	1.436	1.071	1.293	1.148
Study								
Attra.(veh./day)	150	984	147	1,281	628	122	750	2,031
Park. (veh./day)	179	1,016	155	1,350	495	126	621	1,971
Ratio	1.193	1.033	1.054	1.054	0.788	1.033	0.828	0.970
Work Act.								
Attra.(veh./day)	2,638	2,021	820	5,479	964	540	1,504	6,983
Park. (veh./day)	2,437	1,833	665	4,935	689	532	1,221	6,156
Ratio	0.924	0.907	0.811	0.901	0.715	0.985	0.812	0.882
Shopping								
Attra.(veh./day)	721	851	95	1,667	186	158	344	2,011
Park. (veh./day)	698	793	103	1,594	129	184	313	1,907
Ratio	0.968	0.932	1.084	0.956	0.694	1.165	0.910	0.948
Private								
Attra.(veh./day)	1,319	1,941	440	3,700	1,716	1,295	3,011	6,711
Park. (veh./day)	1,107	1,496	240	2,843	957	1,072	2,029	4,872
Ratio	0.839	0.771	0.545	0.768	0.558	0.828	0.674	0.726
To home								
Attra.(veh./day)	517	332	963	1,812	2,530	3,267	5,797	7,609
Park. (veh./day)	77	119	200	396	401	689	1,090	1,486
Ratio	0.149	0.358	0.208	0.219	0.158	0.211	0.188	0.195
Total								
Attra.(veh./day)	13,600	13,296	3,962	30,858	8,846	7,196	16,042	46,900
Park. (veh./day)	13,938	13,099	2,835	29,872	6,722	4,546	11,268	41,140
Ratio	1.025	0.985	0.716	0.968	0.760	0.632	0.702	0.877

TABLE 3-6-9 FUTURE TRIP ATTRACTION

Year	Area	Work	Study	Work Act.	Shopping	Private	To home	Total
1992	1	7,647	835	1,953	1,853	2,996	1,599	16,883
	2	6,097	2,157	1,342	2,682	2,239	981	15,498
	3	1,154	819	509	419	813	1,602	5,316
	4	4,870	1,143	1,005	688	1,716	1,593	11,015
	5	1,496	1,325	618	395	1,757	2,623	8,214
	Total	21,264	6,279	5,427	6,037	9,521	8,398	56,926
2000	1	8,867	922	2,197	2,131	3,679	1,759	19,555
	2	7,183	2,526	1,531	2,981	2,796	1,026	18,043
	3	1,511	960	603	564	1,024	2,373	7,035
	4	5,694	1,268	1,161	923	2,178	2,605	13,829
	5	1,996	1,443	751	540	2,153	4,017	10,900
	Total	25,251	7,119	6,243	7,139	11,830	11,780	69,362

TABLE 3-6-10 DAILY PARKING DEMAND

Year	Area	Work	Study	Work Act.	Shopping	Private	To home	Total
1992	1	8,476	881	1,759	1,772	2,302	349	15,539
	2	6,758	2,274	1,208	2,564	1,721	214	14,739
	3	1,279	863	459	400	625	350	3,976
	4	6,299	946	817	626	1,157	300	10,145
	5	1,934	1,097	502	360	1,185	494	5,572
	Total	24,746	6,061	4,745	5,722	6,990	1,707	49,971
2000	1	9,828	972	1,978	2,038	2,827	385	18,028
	2	7,962	2,664	1,379	2,851	2,149	224	17,229
	3	1,675	1,013	543	539	787	519	5,076
	4	7,364	1,050	943	840	1,469	490	12,156
	5	2,582	1,194	610	491	1,452	756	7,085
	Total	29,411	6,893	5,453	6,759	8,684	2,374	59,574

TABLE 3-6-11 PARKING DEMAND BY PURPOSE AT PEAK HOURS

Year	Area	Work	Study	Work Act.	Shopping	Private	To home	Total
1992	1	5,069	115	296	386	320	23	6,209
	2	4,041	298	203	559	239	14	5,354
	3	765	113	77	87	87	23	1,152
	4	3,767	124	137	137	161	19	4,345
	5	512	64	37	35	73	14	735
	Total	14,154	714	750	1,204	880	93	17,795
2000	1	5,877	127	332	444	393	25	7,198
	2	4,761	349	232	622	299	15	6,278
	3	1,001	133	91	118	109	34	1,486
	4	4,404	138	158	183	204	32	5,119
	5	684	69	45	47	89	22	956
	Total	16,727	816	858	1,414	1,094	128	21,037

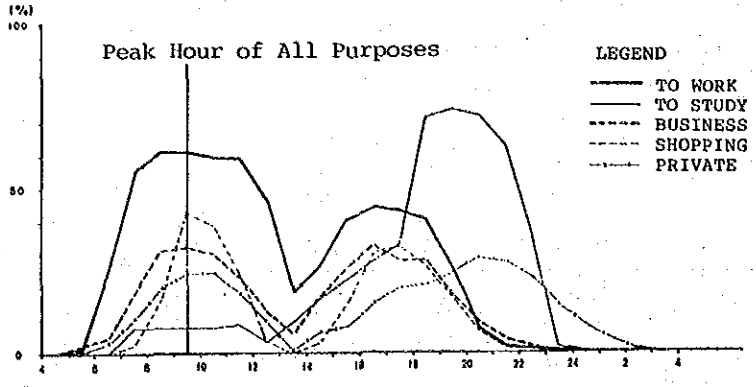


FIGURE 3-6-34 PARKING DEMAND HOURLY FLUCTUATION

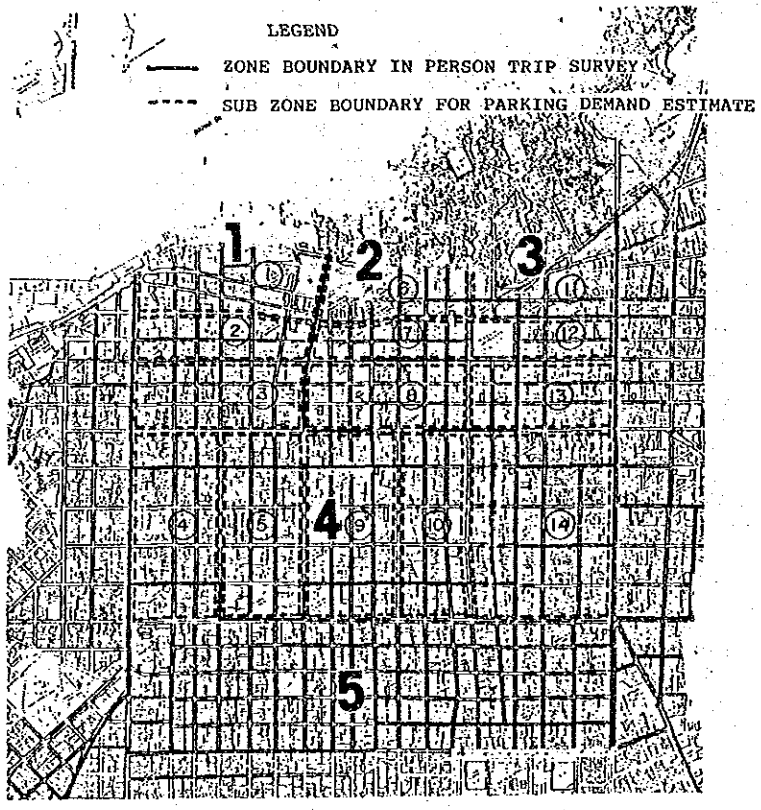


FIGURE 3-6-35 ZONING AND SUB ZONING

TABLE 3-6-12 RELATIONSHIP BETWEEN PARKING PURPOSE AND USE OF BUILDING

	Residence	Shop	Office	School	Hospital	Public Office
Work	O		O			
Study				O		
Business		O	O			
Shopping		O				
Private		O			O	O
Home	O					

TABLE 3-6-13 PARKING DEMAND BY SUB ZONE AND PURPOSE

Year	Area	Work	Study	Work Act.	Shopping	Private	Total
1992	1	1,826	0	71	52	53	2,002
	2	1,139	0	89	141	111	1,480
	3	1,686	52	107	149	118	2,112
	4	389	14	27	35	37	502
	5	801	10	26	24	27	888
	6	505	109	20	32	37	703
	7	837	144	52	155	28	1,216
	8	2,207	29	107	290	62	2,695
	9	2,345	99	81	90	205	2,820
	10	479	63	27	37	33	639
	11	31	3	8	12	6	60
	12	262	93	22	22	13	412
	13	661	17	56	105	14	853
	14	674	26	33	33	34	800
	Total	13,842	659	726	1,177	778	17,182
2000	1	2,079	0	79	59	65	2,282
	2	1,343	0	100	162	136	1,741
	3	1,960	57	120	171	145	2,453
	4	476	15	32	44	45	612
	5	951	11	30	31	35	1,058
	6	578	127	24	39	38	806
	7	1,004	169	60	173	76	1,482
	8	2,577	34	122	323	143	3,199
	9	2,688	110	93	111	123	3,125
	10	580	71	30	48	41	770
	11	41	4	9	16	7	77
	12	342	109	26	29	17	523
	13	844	20	65	124	43	1,096
	14	849	29	39	46	44	1,007
	Total	16,312	756	829	1,376	958	20,231

2) Capacity of Motorcar Parking

FIGURE 3-6-36 gives the location of the central areas for parking in the Microcentro. Most of them are spread from Humaitá/F.R. Moreno Street to the North, and with some exceptions, they are small public free areas, simply equipped for 20-50 units and it might be difficult to consider that they will continue be in use in the future as they are now.

Among the "parking areas" in TABLE 3-6-14, is given the state of use of those located along the main shopping center of Palma street (except the private use parking areas). The contents of the Table are the result of interviews to managers of parking areas. The information received might include some errors by design. Starting from it, however, the following could be deduced as reference.

a. The rotation ratio (quantity of parked vehicles per day to parking capacity) is equal to 1.01, whose value is unexpectedly low.

b. The parking fare varies according to the equipment of the parking areas, and they vary between Gs. 15,000 and Gs. 20,000 monthly, and Gs. 200 and Gs. 300 per hour. (The highest fare actually is Gs. 25,000 monthly, which is at the parking building located in a different block).

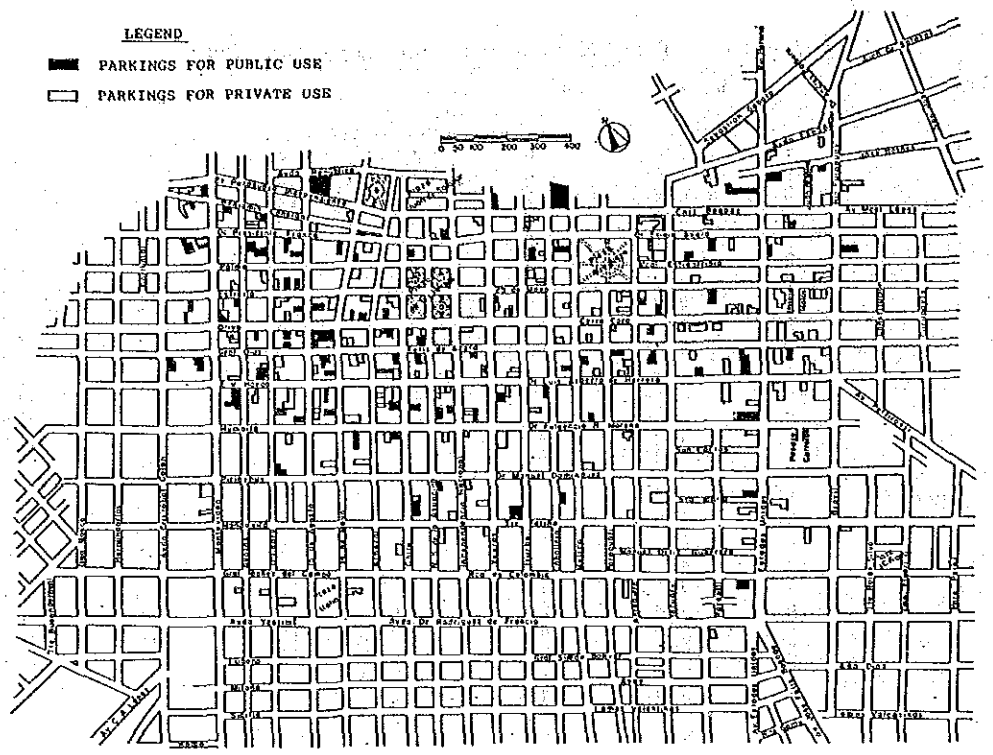


FIGURE 3-6-36 LOCATION OF EXISTING PARKINGS AREAS

c. The occupation ratio of parking space in the peak hour is equal to 0.68. It means that they have remaining space.

TABLE 3-6-15 shows the parking capacity by blocks. The values of the parking capacity on the road correspond to the case in which the parking will be restricted following the proposal described in this study, and were calculated at a length of 5 meters per vehicle. Findings are as follows:

a. The whole parking capacity is large in blocks 9 and 14. This is because it counts with very few main transit axis, and parking on the pavement is allowed in most of the streets.

b. Off-road parking is common in blocks 1 and 3.

TABLE 3-6-16 gives the future capacity of the parking spaces in relation with the future demand of the floor space, calculated on the basis of the Ordenanza that rules the proportion of the floor space area to be as designated parking areas.

Constructions for residential use were excluded for this calculation. In the year 1992, the parking capacity that will be increased will raise to only 170 units. This is due to the actual high density of the Microcentro and scarcity of space for construction of multi-storied buildings.

TABLE 3-6-14 CONDITION OF EXISTING PARKING

Location	Type	Parked Car					Charge (Gs)		
			Day		Peak H.				
		Capac.	No.	(%)	No.	(%)	Hourly	Daily	Monthly
1 Chile/Palma & Pte. Franco	Open Air	50		0.00		0.00	250		15,000
2 B. Constant & Alberdi	Build.	90	60	0.67	40	0.44	250	750	15,000
3 14 de Mayo/Pte. Franco & Benjamin Constant	Open Air	32	50	1.56	32	1.00	250		
4 Palma & 14 de mayo	Open Air	20	35	1.75	20	1.00	250		
5 Pte. Franco & 14 de mayo	Semi Open Air	30	40	1.33	30	1.00	150		15,000
6 15 de agosto/Pte. Franco	Semi Open Air	24	30	1.25	24	1.00	150		8,000
7 Pte.Franco/15 de agosto	Semi Open Air	50	70	1.40	50	1.00			
	Semi under ground						150	1,500	6,000
8 O'leary/Benjamin Constant	6 Stories Build.	130	50	0.38	50	0.38	200		9,000
9 O'leary/Pte. Franco	Semi Open Air	38	60	1.58	38	1.00	200		8,000
10 B. Constant/Montevideo	Semi							Weekly	
	Open Air	30	35	1.17	25	0.83	150	1,500	6,000
11 Montevideo/Oliva	2 stories Build.	52	39	0.75	30	0.58	250		15,000
12 Ayolas/Estrella	Open Air	33	40	1.21	30	0.91	250	1,200	6,000
13 Estrella/14 de mayo	With shed	30	50	1.67	30	1.00	250		18,000
14 Estrella/14 de mayo	3 stories Build.	50	70	1.40	50	1.00	250		12,000
15 15 de agosto/Palma	Semi Open Air	24	30	1.25	24	1.00	200	1,500	12,000
16 15 de agosto/Palma	Build.	30	50	1.67	30	1.00	200	2,000	12,000
17 Oliva/14 de mayo	Semi Open Air	14	20	1.43	14	1.00	200	2,000	15,000
18 Oliva/Alberdi	Open Air	45	80	1.78	45	1.00	250	1,500	16,000
19 Oliva/Chile	3 stories Build.	200	170	0.85	100	0.50	300	1,900	18,000 20,000 21,000
Total		972	979	1.01	662	0.68			

TABLE 3-6-15 NO. OF PARKING PLACES BY PARKING TYPE

Block No.	Private Parking	Public Parking	On-street	Total
1	364	575	518	1,457
2	118	331	470	919
3	457	927	458	1,842
4	30	35	630	695
5	170	142	602	914
6	47	502	120	669
7	75	68	348	491
8	324	422	504	1,250
9	332	233	1,477	2,042
10	38	96	562	696
11	80	35	0	115
12	102	60	241	403
13	456	264	331	1,051
14	135	79	1,762	1,976
Total	2,728	3,769	8,023	14,520

TABLE 3-6-16 PARKINGCAPACITY INCREASE BYTHE IMPLEMENTATION OFOBLIGATION SYSTEM

Block No.	Construction Surface Demand 1987	1992	2000	Increase of Construction Surface 1992	2000	Increase of Parking Capacity 1992	2000
1	144,585	145,676	146,513	1,091	1,928	6	10
2	171,505	175,390	178,413	3,885	6,908	20	35
3	209,486	214,231	217,219	4,745	7,733	24	39
4	52,815	55,017	57,000	2,202	4,185	12	21
5	43,345	49,997	52,455	6,652	9,110	34	46
6	55,220	55,393	55,562	173	342	1	2
7	89,600	91,146	92,666	1,546	3,066	8	16
8	167,510	169,868	172,187	2,358	4,677	12	24
9	159,815	162,502	164,764	2,687	4,949	14	25
10	45,290	47,001	48,682	1,711	3,392	9	17
11	16,254	16,818	17,152	564	898	3	5
12	50,065	51,375	52,164	1,310	2,099	7	11
13	46,915	80,422	82,925	33,507	36,010	168	181
14	58,700	63,776	68,103	5,076	9,403	26	48
TOTAL	1,311,105	1,378,612	1,405,805	67,507	94,700	344	480

*The constructed surface demand excludes homes and churches, so, the parking demand, generated per residence, has not taken into account.
*Consequently, buildings with more than 5 floors shall use 15% of the construction surface for parking places.
*1veh. = 30m^2.

3) Necessary Amount of Parking Facilities

The space for parking that must be equipped in each block is shown in TABLE 3-6-17. This required parking space was calculated except the purpose "Back home", assuming its parking space might be prepared in their house.

The consequence of the mentioned Table is as follows:

a. Block 8 requires 1,439 units in 1992, which is considerably larger than others.

b. Block 8 is followed by those located in the central zone which are 9 and 7.

c. Residential blocks 4, 5, 13 and 14 have sufficient parking spaces. That is because of large parking capacity on the roads in those blocks.

4) Parking Facilities

(1) Criteria

a. Parking facilities shall be prepared with the object to absorb in them the parking performed with the purpose "work". The causes that justify this object are:

- Parking with the purpose "work" is the most numerous and represents 80% of the whole parking need.

- Parking time of the purpose "work" is longer comparing with other purposes, therefore, such parking on the road influence the transit normal flow substantially and negatively (See TABLE 3-6-18).

b. The parking demand by other purposes different to "work" is relatively small as it can be appreciated in TABLE 3-6-19, so that said requirement can be correspond with parking on the road only.

c. Parking places shall be facilitated with respect to blocks 1, 2, 3, 6, 7, 8, and 9.

TABLE 3-6-17 REQUIRED PARKING CAPACITY

Block No.	Present Capacity	Increase by Obligation		Total Capacity		Demand		Required Capacity	
		1992	2000	1992	2000	1992	2000	1992	2000
1	1,457	6	10	1,463	1,467	2,002	2,282	539	815
2	919	20	35	939	954	1,480	1,741	541	787
3	1,842	24	39	1,866	1,881	2,112	2,453	246	572
4	695	12	21	707	716	502	612	-	-
5	914	34	46	948	960	888	1,058	-	98
6	669	1	2	670	671	703	806	33	135
7	491	8	16	499	507	1,216	1,482	717	975
8	1,250	12	24	1,262	1,274	2,695	3,199	1,433	1,925
9	2,042	14	25	2,061	2,072	2,820	3,125	764	1,058
10	696	9	17	705	713	639	770	-	57
11	115	3	5	118	120	60	77	-	-
12	403	7	11	410	414	412	523	2	109
13	1,051	168	181	1,219	1,232	853	1,096	-	-
14	1,976	26	48	2,002	2,024	800	1,007	-	-
TOTAL	14,520	344	480	15,034	15,241	17,182	20,231	2,318	5,231

Note: "Back home" trip is excluded from parking demand estimation.

TABLE 3-6-18 AVERAGE PARKING TIME BY PURPOSE

Purpose	Average Parking Time
Work	210
School	150
Business	120
Shopping	70
Private	120

Note: Average parking time in the zone 1,2 and 3 according to the P.T Survey result.

TABLE 3-6-19 ON-STREET PARKING CAPACITY AND PARKING DEMAND EXCEPT WORK TRIP

Block No.	On-Street Parking Capacity	Parking Demand Other Than "Work" Trip		Demand - Capacity	
		1992	2000	1992	2000
1	518	176	203	-342	-315
2	470	341	398	-129	-72
3	458	426	493	-32	35
4	630	113	136	-517	-494
5	602	87	109	-515	-493
6	120	198	228	78	108
7	348	379	478	31	130
8	504	488	622	-16	118
9	1,477	475	437	-1,002	-1,040
10	562	160	190	-402	-372
11	0	29	36	29	36
12	241	150	181	-91	-60
13	331	192	252	-139	-79
14	1,762	126	158	-1,636	-1,604
Total	8,023	3,340	3,921	-4,683	-4,102

(2) Parking Facilities

A) Location

Spaces for parking for blocks 1, 2, 3, 6, 7, 8 and 9 shall be planned. Placing of said spaces are as shown in FIGURE 3-6-37 which was determined based on the following conditions:

a. Basically, they must be located at an end of each block.

b. The areas of historical buildings and heights must be excluded.

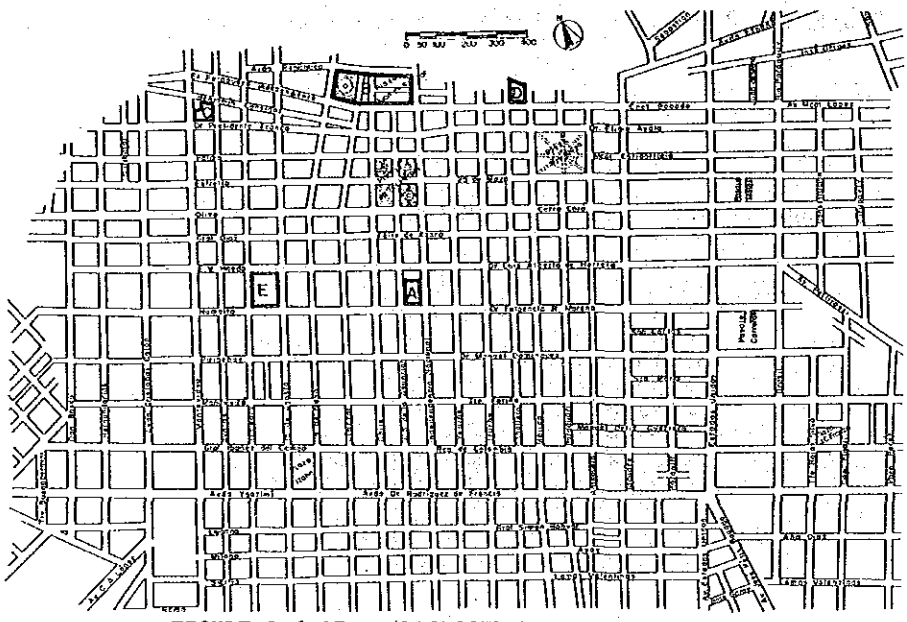


FIGURE 3-6-37 PROPOSED PARKING LOCATION

c. In case that there is no proper space inside a block, it will be located in another, at a walking distance no longer than 500 meters from the first.

Parking facilities of each block are compared and indicated in TABLE 3-6-20. Of them, parking C is located in an area where, by an Ordenanza, the buildings cannot be higher than four stories, but considering the public nature of parking buildings,it's construction is planned at six stories.

TABLE 3-6-20 SUMMARY OF PROPOSED PARKING CHARACTERISTICS

	Type	Land Surface (m^2)	Building Surface (m^2)	Vehicle Capacity (units)	Present land use	Location	Note
A	6 floor Parking Building	6,730	37,760	1,445	House Shop Parking	N.S. de la Asunción, Ind. Nacional, E.V. Haedo & Humaitá	Responds to the demand of Block No. 9.
B	2 floor Underground Parking	28,560	57,113	1,900	Plaza	Av. Republica & El Paraguayo Independiente	Responds to the demand of Block No. 8.
C	6 floor Parking Building	4,040	24,240	808	Restau-rant Shop	Montevideo, Ayolas, Pte. Franco & Benjamin Constant	Responds to the demand of Block No. 1.
D	6 floor Parking Building	5,740	34,440	1,148	Parking	Caballero, México & Cnel. Bogado.	Responds to the demand of Blocks No. 6 and 7.
E	6 floor Parking Building	12,000	48,000	1,600	Hotel House Parking	J.E. O'leary, 15 de Agosto, E.V. Haedo & Humaitá.	Responds to the demand of Blocks No. 2 and 3.

With these parking buildings, the parking demands of each block shall be satisfied, such as given in TABLE 3-6-21. According to that table, the capacity will exceed the demand for the year 1992, however in the year 2000, deficiencies shall be generated in blocks 1, 6, 7 and 8.

In order to prevent such a situation, the following items were considered:

- Demands of blocks 6 and 7 shall be satisfied through the use the free land adjacent to parking A as a supplementary parking area.
- Demand of block 1 shall be satisfied with on road parking in the streets located at the west of Colón Avenue.
- Demands of block 8 shall be absorbed in Parking building A (block 9) and partially with the remaining dead space caused by the construction of Av. Costanera (north of parking B).

TABLE 3-6-21 BALANCE OF DEMAND AND CAPACITY AFTER CONSTRUCTION OF NEW PARKING AREAS

Parking	Block	Parking Capacity	Present Capacity	Proposed Capacity	1992		2000	
					Demand	Balance	Demand	Balance
A	9	1,000	53	947	764	183	1,058	-111
B	8	1,900	0	1,900	1,433	467	1,925	-25
C	1	800	32	768	539	229	815	-47
D	6				33		135	
	7				717		975	
Sub Total		1,100	350	750	750	0	1,110	-360
E	2				541		787	
	3				246		572	
Sub Total		1,350	83	1,267	787	480	1,359	-92

Notes: Excess demand in the blocks 6 and 7 will be covered by Parking D.
Excess demand in the blocks 1 and 8 will be covered by on-street parking in Sajonia and Parking A.

B) Circulation

a. Entrances Required

The number of necessary entrances and exit in each parking area depends on the system to issue the cards and collect the fares. Generally, this procedure, by vehicle, takes from 15 to 25 seconds to issue the card, and from 20 to 40 seconds to collect the fare. Therefore, it is necessary to create enough entrances and exits according to the number of vehicles concentrated within the installation.

The calculation of the same was performed estimating the range of parking concentration of the "work" purpose, consequently the fare system will be monthly, thus simplifying the whole procedure.

If the necessary entrances and exits are estimated, considering that the required time for any of these purposes is of 15 seconds/unit, and employing the generation and concentration rate of the parking demand (entrance peak = 0.297; exit peak = 0.315), with "to work" is as shown in FIGURE 3-6-38 and TABLE 3-6-23, they would be as indicated in TABLE 3-6-22.

TABLE 3-6-22 NO. OF REQUIRED ENTRANCES AND EXITS

Parking	Capacity	Peak Hour Traffic		No. of Required	
		Entrance	Exit	Entrance	Exit
A	1,000	297	315	2	2
B	1,900	564	599	3	3
C	800	238	252	1	2
D	1,100	327	347	2	2
E	1,350	401	425	2	2

Note: Entrance peak hours ; 6:00-7:00 0.297
Exit peak hours ; 12:00-13:00 0.315
It is assumed that it should take 15 seconds a vehicle to come-in and go-out.

TABLE 3-6-23 NO. OF PARKED VEHICLES WITH WORK PURPOSE BY HOUR

Hour	No. of Vehicles Coming-in	Going-out	Parking	proportion Coming-in	Going-out
4	297	0	297	0.011	0.000
5	6,106	0	6,403	0.224	0.000
6	8,104	59	14,448	0.297	0.002
7	1,661	107	16,002	0.061	0.004
8	347	282	16,067	0.013	0.010
9	81	358	15,790	0.003	0.013
10	86	96	15,780	0.003	0.004
11	118	3,524	12,374	0.004	0.129
12	735	8,598	4,511	0.027	0.315
13	3,366	1,045	6,832	0.123	0.038
14	4,790	815	10,807	0.175	0.030
15	1,303	529	11,581	0.048	0.019
16	197	420	11,358	0.007	0.015
17	78	813	10,623	0.003	0.030
18	21	3,772	6,872	0.001	0.138
19	0	4,647	2,225	0.000	0.170
20	25	1,506	744	0.001	0.055
21	0	422	322	0.000	0.015
22	0	234	88	0.000	0.009
23	0	52	36	0.000	0.002
24	0	0	36	0.000	0.000
1	0	18	18	0.000	0.001
2	0	18	0	0.000	0.001
3	0	0	0	0.000	0.000
Total	27,315	27,315		1.000	1.000

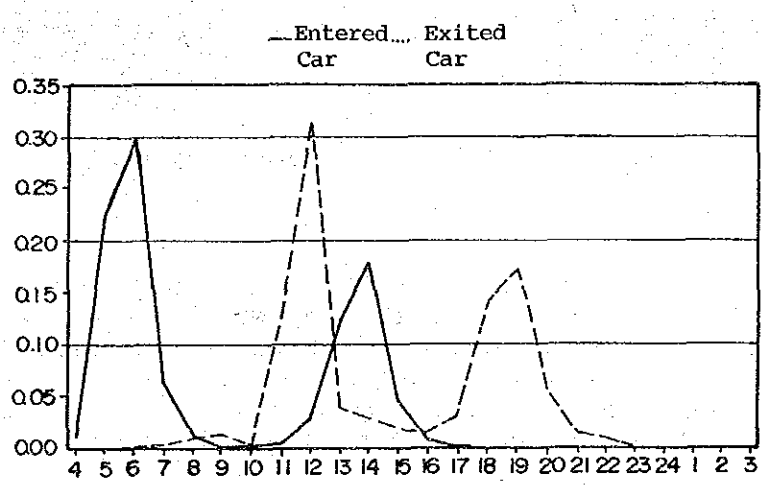


FIGURE 3-6-38 HOURLY FACTOR FLUCTUATION OF ENTERING AND LEAVING CARS WITH WORK PURPOSE, IN TERMS OF MAXIMUM PARKED CARS, IN P.T ZONES OF 1 TO 3

b. Circulation

The access and exit to/from parking shall be made through the private car transit axis, but to reduce the influence of vehicles entering and leaving from parking, the entrances and exits shall be located on the side streets, not on the main ones.

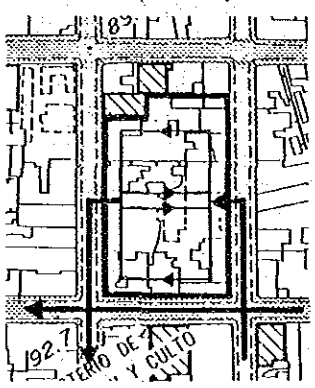
PARKING A

Attending to the minimum influence on the surrounding streets, the concentration type shall be adopted.

TABLE 3-6-24 EVALUATION OF TRAFFIC MOVEMENT FOR PARKING "A"

Aspects	Concentrated Type	Dispersed Type
1 Access to principal artery	Good	Good
2 Enter and Exit	Fair	Good
3 Dead space	Good	Fair
4 Circulation within parking	Good	Good
5 Influence on adjacent streets	Good	Fair

Concentrated Entrance/Exit Type



Dispersed Entrance/Exit Type

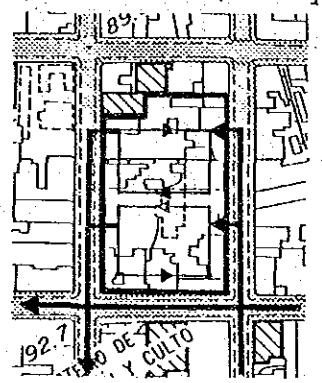


FIGURE 3-6-39 TRAFFIC FLOW AT PARKING "A"

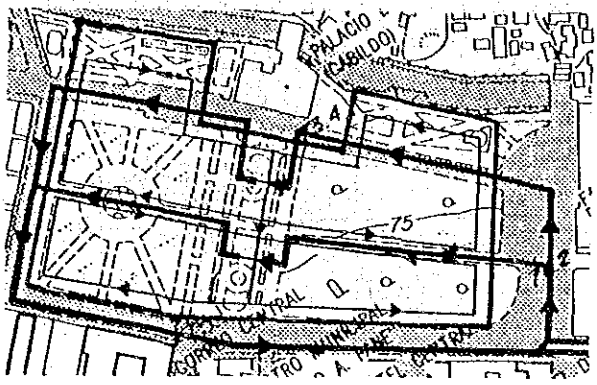
PARKING B

If the concentration type is adopted, the entrances and exits shall be placed in the center of the Plaza and will damage the landscape view of the Government Palace and the Plaza itself. Consequently, considering the influence on the surrounding streets, the dispersion type in the clock likewise direction shall be adopted.

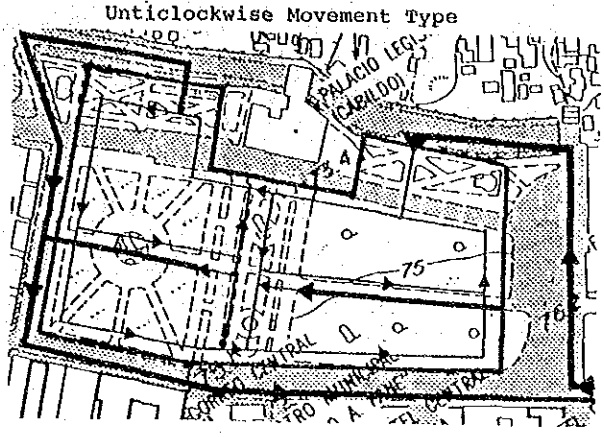
TABLE 3-6-25 EVALUATION OF TRAFFIC MOVEMENT FOR PARKING "B"

Aspects	Concentrated Type	Dispersed Unticlockwise Type	Dispersed Clockwise Type
1 Access to principal artery	Good	Good	Good
2 Entering and Exiting	Fair	Good	Good
3 Dead Space	Fair	Good	Good
4 Circulation within parking	Good	Fair	Fair
5 Influence on adjacent streets	Good	Good	Fair
6 Influence on plaza	Fair	Good	Good

Concentrated Entrance/Exit Type



Dispersed Entrance/Exit and
Unticlockwise Movement Type



Dispersed Entrance/Exit and
Clockwise Movement Type

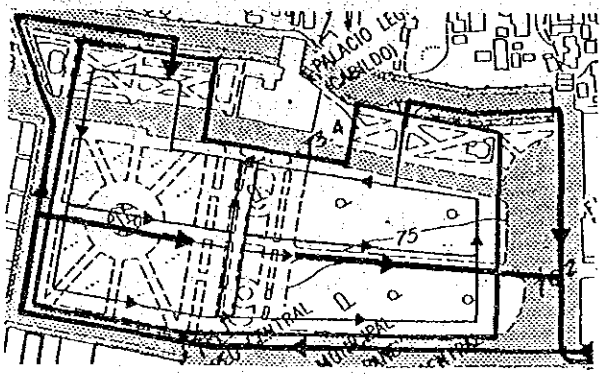


FIGURE 3-6-40 TRAFFIC FLOW AT PARKING "B"

PARKING C

In this case, comparatively small traffic on the private car transit axis is expected. Considering the easy access to the main streets, the concentration type shall be adopted.

TABLE 3-6-26 EVALUATION OF TRAFFIC MOVEMENT FOR PARKING "C"

Aspects	Dispersed Type (1)	Dispersed Type (2)	Concentrated Type
1 Access to principal artery	Fair	Fair	Good
2 Entering and exiting	Good	Good	Good
3 Dead Space	Fair	Fair	Good
4 Circulation within parking	Good	Good	Good
5 Influence on adjacent streets	Good	Good	Fair

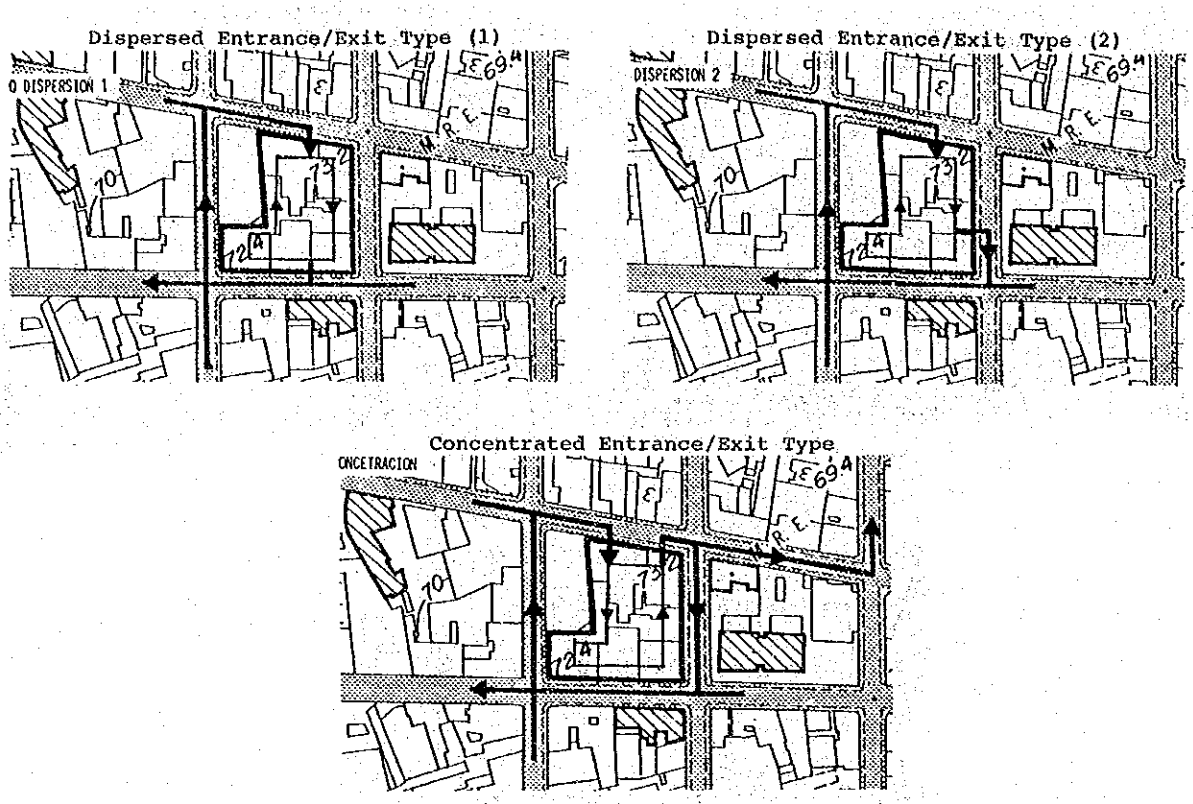


FIGURE 3-6-41 TRAFFIC FLOW AT PARKING "C"

PARKING D

With attention to the easy access to the private car transit axis and the minimum influence on the around streets, the anti clockwise concentration type shall be adopted.

TABLE 3-6-27 EVALUATION OF TRAFFIC MOVEMENT FOR PARKING "D"

Aspects	Dispersed Anticlockwise Type	Concentrated Anticlockwise Type	Concentrated Clockwise Type
1 Access to principal artery	Good	Good	Fair
2 Entering & Exiting	Good	Fair	Fair
3 Dead Space	Fair	Good	Good
4 Circulation within parking	Good	Good	Good
5 Influence on adjacent streets	Fair	Good	Good

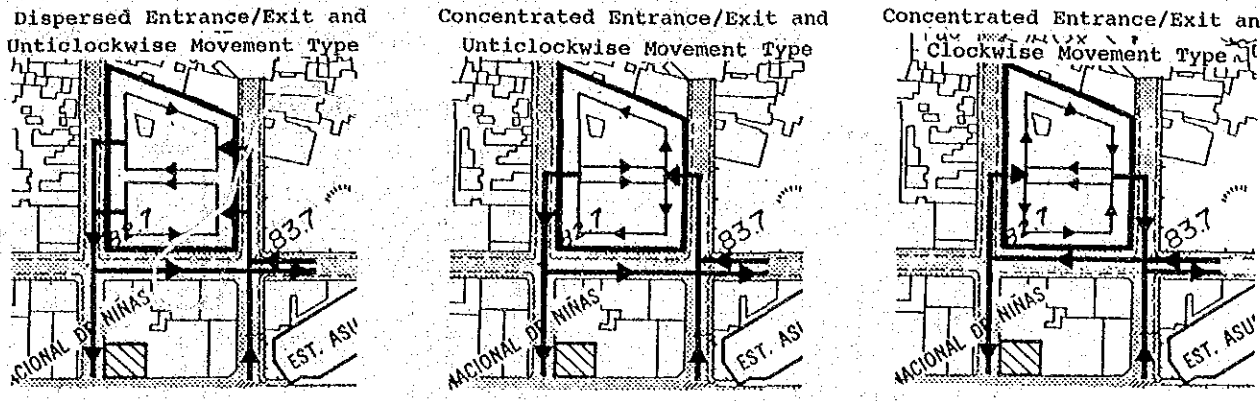


FIGURE 3-6-42 TRAFFIC FLOW AT PARKING "D"

PARKING E

Considering the minimum influence on the surrounding streets, the concentration type shall be adopted.

TABLE 3-6-28 EVALUATION OF TRAFFIC MOVEMENT FOR PARKING "E"

Aspects	Dispersed Type	Concentrated Type
1 Access to principal artery	Fair	Fair
2 Entering and Exiting	Good	Fair
3 Dead space	Fair	Good
4 Circulation within parking	Good	Good
5 Influence on adjacent streets	Fair	Good

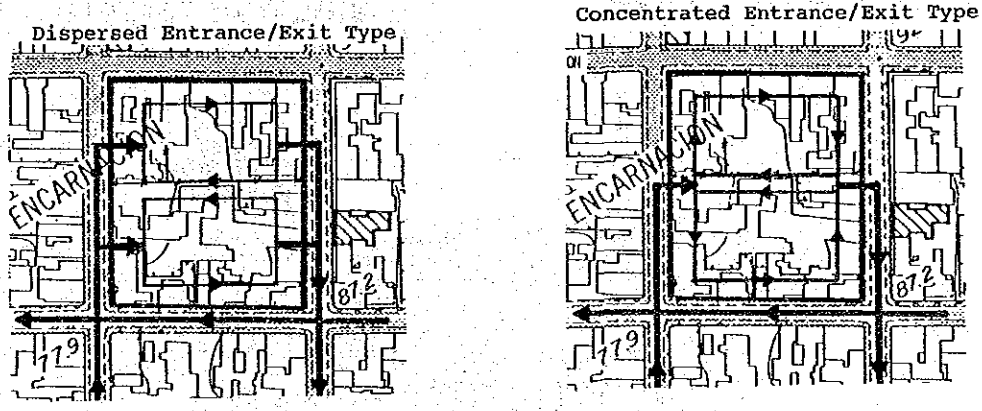


FIGURE 3-6-43 TRAFFIC FLOW AT PARKING "E"

c. Displacement

Conforming to displacement circulation plan, the traffic flow for the whole public road network shall be as shown in FIGURE 3-6-44.

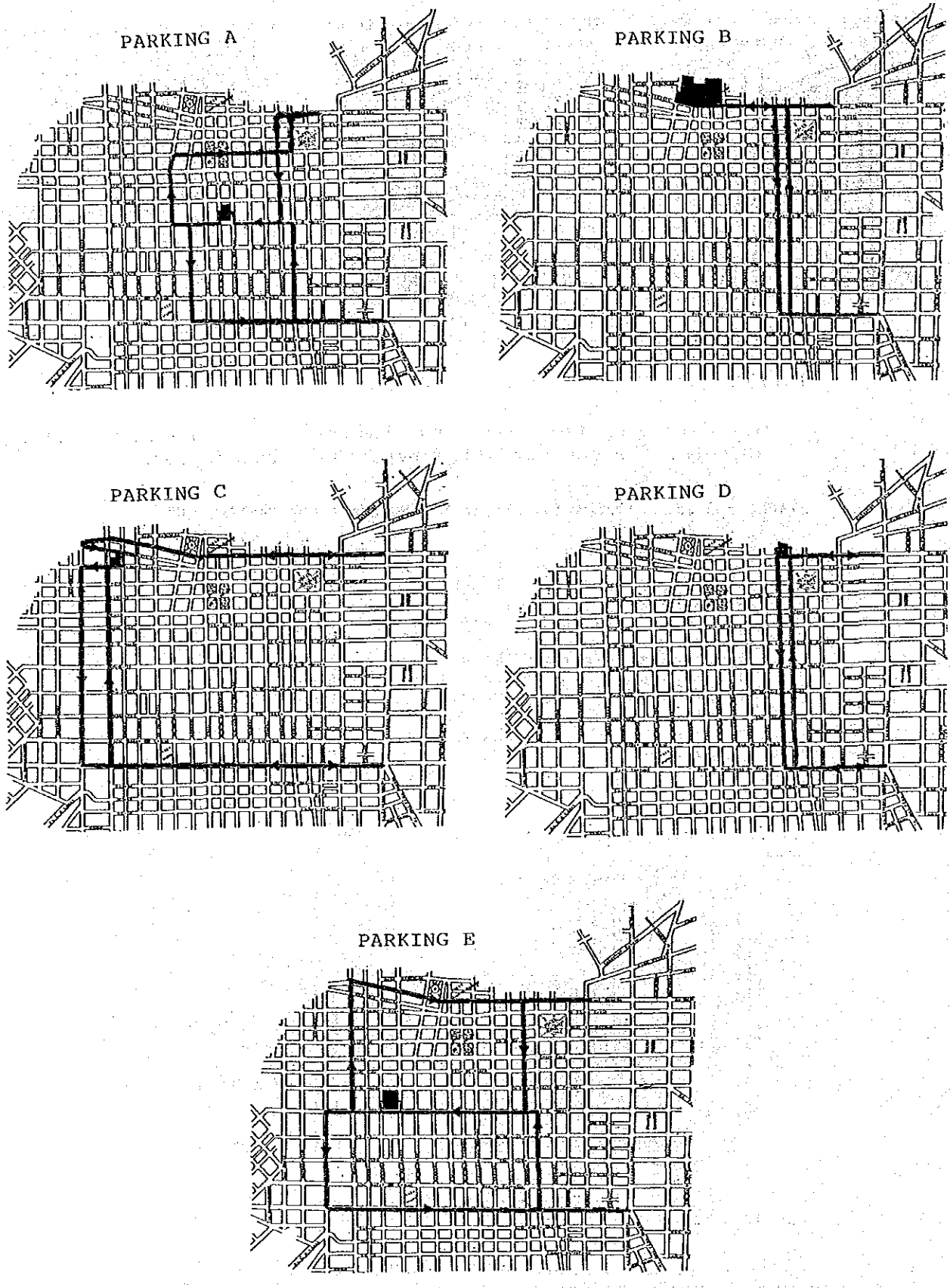


FIGURE 3-6-44 TRAFFICFLOW APPROACHING AND LEAVING PARKING AREAS

Synthesizing all this, we have:

a. Parking A and E are next to private motorcar transit axes, but when the entrances and exit are constructed on the North-South direction streets, they will be able to reduce the influence on those transit axes.

b. Parking B is next to the private motor car transit axis, the influence on the transit of said axis shall be attempted to be reduced, placing the entrance and exit on the beach and on Av. Costanera.

c. Parking C is not near any private motorcar transit axis, but the location of entrances and exits being on the mixed transit street (Pte. Franco), influence on the same shall be attempted to be reduced.

d. Parking D is located next to the junction formed by 2 private motorcar transit axis, whose concentration volume in peak hours of midday in the same will be 628 units/hour in 1992, therefore, a signal intersection shall be used.

C) Possibilities of Land Expropriation

In TABLE 3-6-29, the conditions present land use condition and the land occupancy of the zones objected for parking construction are shown.

TABLE 3-6-29 PROPERTY SURVEY RESULTS OF PROPOSED PARKING SITES

Block	A	B	C	D	E	TOTAL
No. of Land Owner	21		11		33	65
Building age						
To be demolished				1	1	2
10 years	1					1
20 years			1		4	5
30 years	6		2		7	15
40 years	2		1		5	8
50 years	2		2		4	8
more than 50 years			2		2	4
Total	11	0	8	1	23	43
Building use						
Resident	5		2		18	25
Clerk	1					1
Hotel					1	1
Parking	2		1	1	2	6
Deposit					1	1
Office					1	1
Shop	5		3		1	9
Workshop				1		1
Custom Agency			1		1	2
Bar			1		1	2
Others					1	1
Total	13	0	8	2	27	50
Floor Number						
1 story	6		6		21	33
2 stories	4		1		2	7
3 stories	1		1		1	3
Total	11	0	8	0	24	43

Note: Land for parking B is located at a park which belongs to the MCA.

Expropriation possibility evaluation with respect to the preceding Table is shown in TABLE 3-6-30.

There really exist some differences according to the placement of the parking areas, but it is estimated that in general, such operation is practicable.

TABLE 3-6-30 POSSIBILITY OF LAND ACQUISITION

Aspects	A	B	C	D	E
Acquisition					
Build. No.	x	o	-	-	x
Build. Status	-		-	-	-
Present Land Use	-	o	-	o	x
Build. Floor No.	-	o	-	o	-
Build. Age	x	o	-	o	-

Note : o = Easy, - = Relatively easy
x = Possible

D) Individual Problems

Parking B

- The trees on this parking cannot have deep roots due to the shallow land layer (2.0m) that the place will have.
- Nearby the parking area, there are public buildings such as the Government Palace, Police of the Capital City, among others, and it is presumed that they will use the parking area. The way to collect the rent and to decide the fare shall be studied.
- Being adjacent to the Cathedral, the construction must be made by stages, with the object to prevent parking problems to the people coming to it.

Parking C

- Located near the Government Palace. Its use will be difficult during the time in which the transit around the Palace is restricted or controlled.
- The building height shall be limited.

5) Regulation of Collective Parking Construction

At present, any building with more than three floors, is obligated to construct a collective parking area, according to established Order No. 1822/78, whose minimal areas are:

a. Four floors: 60% of the ground-floor area.
b. More than four floors: for each additional floor, 15% of each corresponding floor will be added.

Fifteen percent of the total building surface will be used as parking.

The real situation of parking demand by building height is as shown in TABLE 3-6-31.

a. In any case, the parking surface does not satisfy the demand.

b. Since it is an administrative building (office), there is a difference between the required parking surface of a bank and a public institution.

c. The buildings which are not affected by Order No. 1822/78 also generate a high parking demand.

TABLE 3-6-31 REAL SITUATION OF PARKING DEMAND BY BUILDING TYPE

	Office A (Bank)	Office B (Public Office)	Office C	Shop
A Number of floors	1	7	7	2
B Total building surface (m^2)	440	2,950	12,030	4,640
C Parking surface(m^2)	8	225	0	52
D Number of employees	120	126	506	365
E Private car users	84	40	36	8
F E/D proportion	0.70	0.32	0.07	0.02
G Required parking surface (m^2)*	2,520	1,200	1,080	240
H Parking surface proportion (G/B)	5.78	0.41	0.09	0.02

* Therequiredparking surface was established in 30 m^2per unit, including circulation area.

Consequently, the real parking situation does not always coincide with the Order, therefore it is necessary to have an Order which can fit the real situation. Concerning the indicated amount, it would be convenient to determine it with the future analysis. However, it is proposed to change the Order content as follows:

a. To vary the proportion of parking surface according to the type of use.

   Buildings could be classified according to the purpose in: office, shop and house.

   According to the results of study, there is a great difference between a bank and a public office, but it cannot be clearly distinguished due to the lack of data. The proportion of obligatory parking surface is necessary for those buildings destinated to be an office is 30%, which is the average for public institutions.

b. The parking construction regulations must be defined by the total construction surface, and not by the number of floors of the building.

There are buildings which generate a great parking demand, although they are low rise buildings, such as Office A and Shop, which should also apply to the regulation.

c. Shops are obligated to construct parking areas for customers.

The parking demand generated by shop employees is very low, but according to the distribution of trips with shopping purposes, and according to the transport means at the centro area, the private vehicle occupies 25% of the total (See FIGURE 3-6-45). Consequently, bigger shops must be obligated to construct parking area for customers.

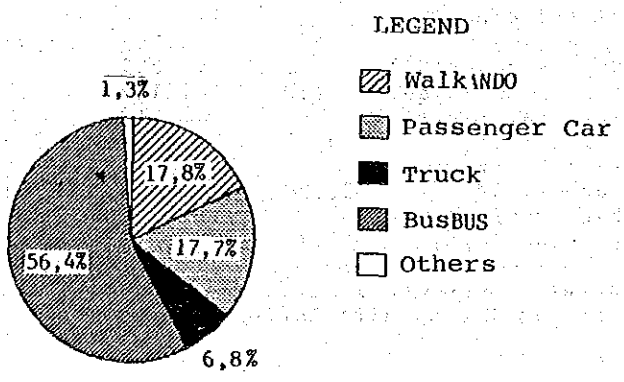


FIGURE 3-6-45 MODAL SPLIT OF SHOPPING PURPOSE TRIP

3.6.5 Sidewalk and Mall Plan

1) Exclusive Pedestrian Street

(1) Actual Condition of Palma Street

A) Actual Conditions of Commercial Activities

Along Palma Street, between México Street and Colón Av. about 1.3km, a total of 216 commercial shops are gathered, whose characteristics are mentioned as follows:

a. Characterized by commercial activities of luxury products such as boutiques, jewelry stores, toy shops, optical shops, sport shops, among others. Those kind of shops occupy 76% of the frontage.

b. There are 3 great shops and group of 4 gallery type retail shops.

c. Scarce quantity of restaurants (3% of the whole).

d. Most of the shops are concentrated between Colón Avenue and 14 de Mayo Street.

TABLE 3-6-32 NO. OF SHOPS BY SECTION

Section	length	No. of shop
Colón Av.-14 de Mayo	0.56	128
14 de Mayo-Ind. Nac.	0.34	37
Ind. Nac.-México	0.31	51

The section Colón Av./Yegros St. is the one which has physical continuity of commercial activities. Passing from Yegros St., it misses such continuity, due to the existence of faculties, museums, unused buildings, etc.

B) Physical Characteristics

- 1.3km length in East-West direction with two plazas
- The width of both sidewalks is 2.0 meters each.
- The tram rail goes along it for its whole length (they pass each other at 15 minute intervals approximately).
- In general, the buildings are of 1 or 2 stories, some of them are of 4-5 stories.
- The west trimming to the Plaza de los Heroes is not planted.

C) Pedestrian Flow

According to the result of a study (See FIGURE 3-6-14) surveyed on Saturday in the morning, (there is a large concurrence of people and they concentrate principally in the trimming between Yegros and O'leary Streets.

D) Activities Performed on Palma Street

At Palma Street and at Plaza de los Heroes the following activities are used to be administrated.

- DENIDE's fair
- Cruz Roja's fair
- Puafe's fair
- 14 de Mayo (National Independence Day) parade
- 15 de Agosto (Asunción's Foundation Day) parade
- Coneb's fair
- Artisans fair
- Cycling
- Marathon
- Food and Plant fair
- Artistic concerts

E) Results of the Questionnaire on Pedestrianizing

a. ManagerandSales Girl working in ShopsofPalmaStreet
(See TABLE 3-6-33)

According to the inquiring performed to the managers and employees of commercial shops, 9 of 15 persons interviewed gave affirmative answers. Six negative answers were:

- Reduction of customers, because of becoming inconvenient for customers who use vehicles.

- Experience of previous pedestrianizing on Saturdays (until midday) was negative.

b. Professionals, StudentsandPedestriansinGeneral
(See TABLE 3-6-34).

Answers obtained from the pedestrians of Palma Street, professionals and students were almost all positive. Among their reasons are mentioned:

- More comfort for the pedestrians.
- Most of South American cities have pedestrian streets.
- They do not think that the shops will decrease their sales.

(2) Criteria for the Reform of Palma Street into an Exclusively Pedestrian Street

A) Section for Exclusive Pedestrian Street

Considering the study of pedestrian flow, the present situation of buildings along Palma Street, vehicle flow in the Microcentro area, etc., a section of Palma Street has been assigned to be equipped as an exclusive pedestrian street. The section is from O'leary St. to Yegros St., totaling 7 blocks. As for the sections Colón Av.-O'leary St. and Yegros St.-México St., the sidewalks will be widened for the convenience of pedestrians.

TABLE 3-6-33 COMMENTS ON PROJECT OF TURNING PALMA STREET INTO PEDESTRIAN STREET (COMMERCIAL HOUSES)

(COMMERCIAL HOUSES)

No.	Shop Type	Charge	Answer	Reason	Comment
1	Store	Employee	x	From the commercial view point, it is an obstacle, because for the customers its much easier to accede by car.	Lack of knowledge
2	Restaurant	Owner		Not interested in giving an answer.	None.
3	Corean Store	Owner	x	It is not convenient, because sales rate will decrease.	Experience on pedestrian traffic on saturdays has been negative.
4	Optic	Employee	o	It is convenient due to the facility people will have to go along the street.	None.
5	Store	Employee	x	Customers rate will decrease.	Experience on pedestrian traffic on saturdays has been negative.
6	Store	Employee	o	Sales rate will not decrease.	None.
7	Drug-store	Secretary	o	Sales rate could increase & it is very practical.	She compares it with Florida street of Buenos Aires.
8	Store	Owner	x	Sales rate will decrease.	Experience on pedestrian traffic on saturdays has been negative.
9	Optic	Employee	o	It is very practical for those who come shopping, & consequently sales rate could increase.	None.
10	Corean store	Employee	x	From the commercial view point it is not convenient because the decreasing vehicular traffic will bring about a lower number of customers.	None.
11	Restaurant	Employee	o	Commercial advantage & much comfortable for the people.	None.
12	Toys Shop	Employee	o	Would make the pedestrian traffic much easier.	She compares it with Florida street of Buenos Aires.
13	Store	Employee Employee	x o	Customers rate will decrease. It would be easier for the people to accede.	None. She compares it with Florida street of Buenos Aires.
14	Restaurant	Employee	o	Pedestrian traffic would increase & so would the customers rate.	None.
15	Restaurant	Owner	o	It would be a good idea, though there would not be much difference.	Neutral comment.

Note: o= positive, x= negative, -= no answer.

TABLE 3-6-34 COMMENTS ON PROJECT OF TURNING PALMA STREET INTOPEDESTRIAN STREET (OTHERS)

No.	Charge	Answer	Reason	Comment
1	Student	o	Palma is a commercial area and only in few places is necessary to accede by car. It will be much comfortable.	None.
2	Professio-nal	o	It is necessary, important & urgent. As a street is *not longer satisfying* the requirements due to the traffic congestion.	None.
3	Student	o	Practicity, hierarchization & embellishment of the city.	None.
4	Professio-nal	o	Palma, as a trading area shoud turn into a pedestrian area.	None.
5	Professio-nal	o	Positive idea, but a few points should be improved.	None.
6	Professio-nal	o	Positive idea, but a few points should be improved.	None.
7	Student	o	It is very uncomfortable to go along the street, due to the traffic congestion & to its narrow sidewalk.	She lived 18 years in Switzerland.
8	Tradesman	-	Not a bad idea, but at the beginning would be damaged.	Italian. He takes in count of most of the cities in South-America have pedestrian streets.
9	Student	o	The double line parking *makes the pedestrian* traffic difficult.	At night, it should *for vehicular traffic.*
10	Professio-nal	o	Positive idea, but a few points should be improved.	None.
11	* General Public	o	Supported idea & also necessary. Mainly, it is thought that sales rates of stores will not decrease but, might increase. It is necessary to improve a few points.	None.

* Summary of answers, from a group of 10 people (more or less), who were passing along.

B) Planning Concept

a. Definition of 4 Sections

Transaction Zone

This section has the initial point of the pedestrian street, as well as the transition area between the space for pedestrian and vehicles.

Entertainment Zone

Space for shopping and walking within the malls.

Events Zone

Taking into consideration its location close to the Plaza de los Heroes, this space will be used for concerts, theaters, etc. in the open air. This place will be for recreation not for commercial activities.

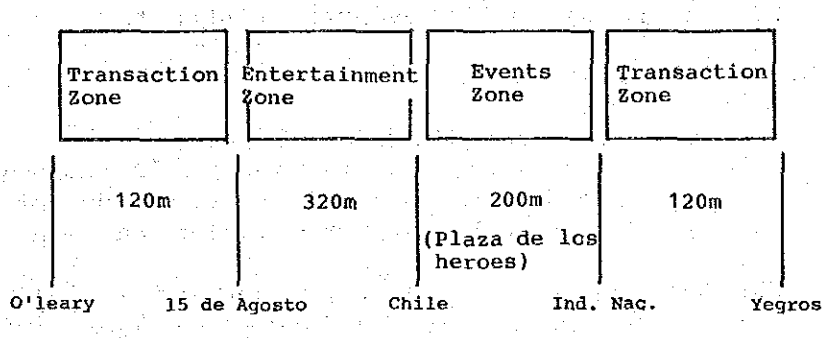


FIGURE 3-6-46 ESTABLISHMENT OF FOUR AREAS

b. Reinforcement of Green Areas

The main objective of the mall is to preserve the spaces for pedestrian activities. The environment has to be improved through vegetation on the stone or concrete buildings facade, with the purpose of harmonizing the involving environment and offering shadow.

c. Symbolization

The characterizing factor of Palma Street, between O'leary and Yegros Streets are: Plaza de los Heroes, shops, tramway, etc.

In order to improve the pedestrian environment even more, symbolic equipment installation could be proposed. An arch on both ends of the pedestrian tram could be installed in order to define the spaces exactly.

C) Using Exclusively Pedestrian Streets

Activities that shall be contained in the exclusively pedestrian street are mentioned as follows:

- Shopping activities
- Pedestrian safety circulation, through the equipment of the pedestrian walk.
- Granted pedestrian street equipment
- Fairs performed on weekends
- Permanent installation of kiosks
- Parades
- Tram
- Open air confectionery shop

D) Equipping Criterion

- To guarantee continuous pedestrian space
- To create enough spaces for vehicles parking, which will be the means of transport for people who converge to shop.
- Equipping of access streets for pedestrian from the bus and taxi stops up to the pedestrian street.

E) Physical Limitation

- The average street width is of 14m.
- A 2m width for the tramway and 4m for emergency vehicles (such as ambulance, fire truck, etc.) should be guaranteed. The tramway will be included inside the emergency vehicles space.
- The pedestrian should be guaranteed a width of 3m on both sides of the street in front of the shops should be guaranteed.

F) Pedestrian Equipment

The following equipment should be installed along the street:

- Sanitary equipment: Ashtrays, garbage cans, etc.
- Information: Information boards, clocks, show cases, public phones, etc.
- Decorations: Public lighting, sculptures, flower pots, stands, flags, monuments, arches, pergolas, etc.
- Control: Vehicle stoppers, etc.

The equipment should be installed in a linear way, due to the characteristic of the mall and to the available space.

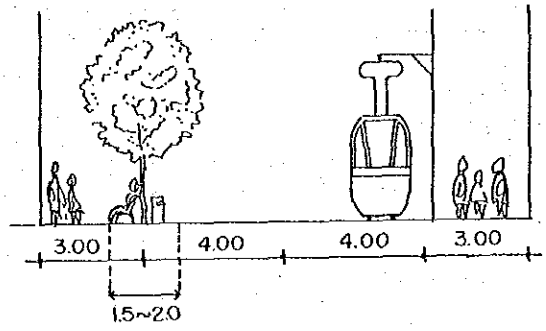
G) Equipment Location Policy

- Transaction Zone: Located on both ends of the pedestrian street. In order to accentuate the pedestrian space, a dense vegetation is necessary at the extremes as well as the installation of the information, decorative and control equipment. The arch and monuments will also be installed in this place.

- Entertainment Zone: This is the most active place, and therefore, decorative installation and sanitary equipment will be installed in groups, at the certain points, in such way to facilitate pedestrian free movement.

- Event Zone: In this place, pedestrian flow is relatively slow, therefore, the decorative and sanitary equipments will be concentrated, considering the equipment to be installed at the Plaza next to this section.

The already mentioned characteristics should be granted to each section. Besides, at the ends of each block, public phones and information equipment will be installed. The mentioned pedestrian equipment will be installed as a whole along the established strip (See FIGURE 3-6-47), except at the ends of the pedestrian street.



Without Transferring the tramway

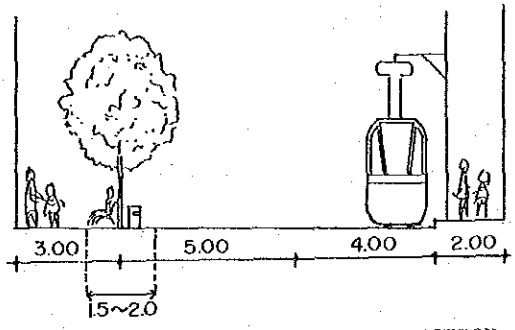


FIGURE 3-6-47 MALL CROSS SECTION

H) Cross Section

To keep pedestrian comfort, it is desirable to keep the existing level difference between the sidewalk and the street. For that purpose, the reinstatement of the tramway must be carried out and it must be transferred toward the central median in order to obtain more space for the northern sidewalk. Cross section of Palma Street is shown in FIGURE 3-6-23.

a. North Sidewalk (3.0 meters)

In order to raise the security and comfort of pedestrians, kiosks shall be moved to the center of pedestrian space.

b. Tram (2.0 meters)

The street elevation and the tram transfer will be carried out in order to guarantee the 3.0 width pedestrian space starting at the construction line of the northern section.

c. Central pedestrian space (6.0 meters)

- With the object of maintaining continuity with sidewalks, slopes of 2% to the south sidewalk, keeping the present height of the rail.
- A free space shall be created exclusively for pedestrians, with the corresponding equipments to that effect.
- Moving of the kiosks
- Space for fairs
- Space for parades
- Trimming of 2.0 meters at the side of the rail shall be kept free for clearance for access of emergency vehicles and services.

d. Trees (1.5 meters)

- Trees shall be planted at 3 meters from the south sidewalk.
- Around the trees, benches and other shall be placed.

e. South Sidewalk (3.0 meters).

- It is a space to guarantee the security and comfort of the pedestrians.
- The area located east of the Panteon de los Heroes will be large enough to constitute the "event zone".

The transfer of the tramway presents many problems. However, even though the transfer were difficult, it will keep the present width of the northern sidewalk of 2.0m, meanwhile, the southern sidewalk and the current street will have the same level (See FIGURE 3-6-47). For that purpose, the oblique sidewalk curb will be implemented on the northern sidewalk in order to give space continuity. Planting and Central pedestrian equipping will not vary, with or without the tramway transfer.

(3) Pedestrian Street Equipment

Considering the periodic performance of fairs and parades in a year, fixed objects shall not be installed.

A) Planting

To offer shadow during the summer season, planting will be carried out in a linear way (one line), on the southern side of the

pedestrian street, taking into account the sun movement and the tram location. Besides, there is dispersed and grouped planting, but according to the building type, use and space characteristics, variants would be carried out.

a. Plant Types

Those plants that have 2 to 3 meters of diameter top crown shall be suggested. Several recommended plants are enlisted below:

Naranja jhai (sour orange tree)	Tree
Crespon rosa (pink crape)	Shrub
Reseda	Creeper
Jazmin	Creeper
Santa Rita	Creeper

b. Location and Distance

In general, naranja jhai will be the basic plant, and accompanying this, will be the other plants different in each block. The combinations are:

- Naranja + Jazmin + Crespon Rosa
- Naranja + Reseda + Crespon Rosa
- Naranja + Santa Rita
- Naranja + Crespon Rosa

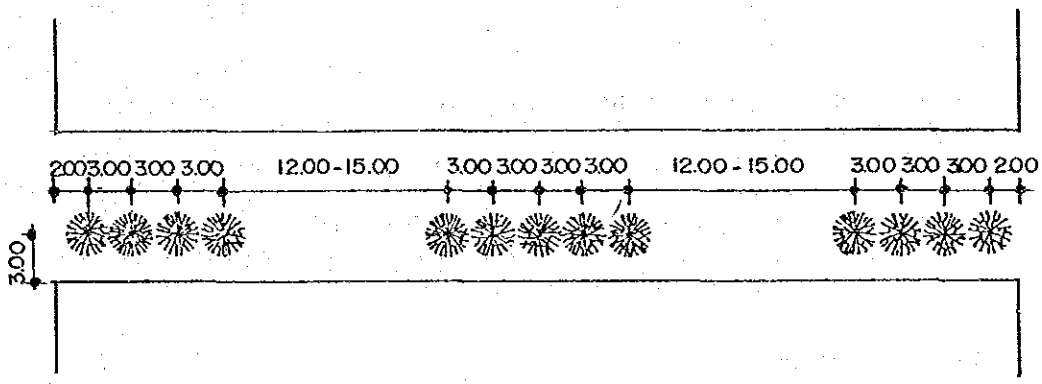


FIGURE 3-6-48 STREET VEGETATION LAYOUT PLAN

B) Illumination

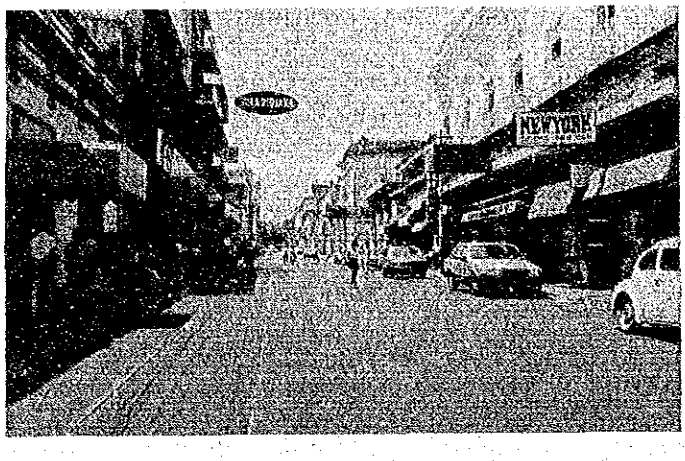
The lighting columns should be from 5 to 6 meters, since the objective is to supply illumination to pedestrians at night. It would be very convenient to use glass or iron materials in order to reduce the maintenance cost, although the initial investment is high.

C) Location of Commercial Signs

The placing of commercial signs shall be regulated (attached parallel to the frontal wall), to give more visibility to pedestrians, as well as improving the general aspect of the route. The reasons are:

a. Municipality Order forbids the placement of signs at a height less than 3 meters.
b. Approximately 65% of the buildings have old spanish decorations, so that it will be profitable keeping that decoration.

PHOTO 3-6-3 COMMERCIAL SIGN BOARDS OVER THE STREETS



D) Paving Material

Paving tile "vainilla" type shall be used in its whole length, whose use is designated by the Municipality Order. They can be mentioned owing to following reasons:

- National product and less cost
- Little aging
- Well combined with the marble structures placed along the mentioned way
- Using thicker material on the limited road is wise for penetration of emergency service vehicles, transport services and Tram services

E) Other Equipment

Equipment related to sanitation, resting and information services shall be located close to the planting and illumination system and aparting from traffic service space.

The necessary equipment is:

- Benches
- Pergola (inside garden)
- Trash can
- Public phone
- Guiding map
- Ashpan

(4) Points that must be attended in the Implementation

A) Consideration for the Shops along the Street

According to the performed interview about the pedestrianizing of the Palma Street, there are shops that do not agree with such modifying, because they are anxious about decreased sales. Therefore, for the implementation, the following points shall be considered:

a. Allow the shops to place the sale of their products in the middle of the street (by turn).

b. Sales goods of fairs shall not compete with any existing shop.

c. The tables of the fair shall be placed in the center of the street.

B) Regulations Accompanying Pedestrianizing

a. Regulations on Vehicle Passing

Vehicle passing will be regulated along Palma Street, from Independencia Nacional Street up to 15 de Agosto Street, in order to guarantee pedestrian safety.

b. Regulation about Parking

Besides the walking access from the bus stops to the commercial zone, at present there are patterns by which people can access with their own vehicle to the zone closer to downtown and park on the pavement to go shopping.

Therefore, it is necessary to apply some measurements for this case.

TABLE 3-6-35 and FIGURE 3-6-49 show the timing distribution on Palma street and those crossing it. According to this, more than 50% of the vehicles park less than 30 minutes, and more than the 80% park less than 90 minutes. Those that park more than 2 hours are between 1.3-15% of the total, but the timing proportion of parking with respect to the total parking time is 11-59%, which shows the enormous influence that that causes this last group.

c. Regulation about Vehicle Access

Vehicles to which access to pedestrian street shall be permitted, are those of an emergency and service nature. However, the access time for the latter shall be ruled by the Ordenanza Municipal No. 6115 (during working days from 13:00 - 15:00 hours and from 19:00 - 6:00 hours).

d. Regulations concerning Commercial Signs

As it was mentioned above, the use of projecting signs, shall be forbidden for landscaping preservation.

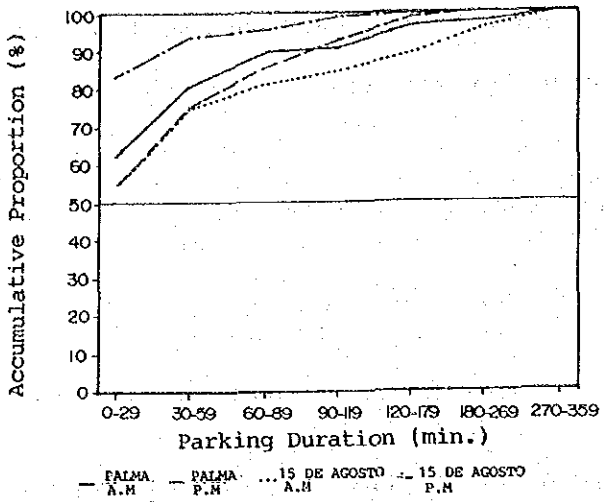


FIGURE 3-6-49 DISTRIBUTION OF PARKING DURATION AT PALMA AND 15 DE AGOSTO STREETS

TABLE 3-6-35 PARKING DURATION DISTRIBUTION

	PALMA						15 DE AGOSTO					
	A.M.			P.M.			A.M.			P.M.		
	Time	No.	Aver.	Time	No.	Aver.	Time	No.	Aver.	Time	No.	Aver.
0- 29	707	55	12.9	1257	134	9.4	734	69	10.6	616	46	13.4
30- 59	708	16	44.3	687	16	42.9	1018	24	42.4	815	18	45.3
60- 89	609	8	76.1	205	3	68.3	635	9	70.6	674	9	74.9
90-119	98	1	98.0	527	5	105.4	394	4	98.5	626	6	104.3
120-179	755	5	151.0	133	1	133.0	766	5	153.2	721	5	144.2
180-269	215	1	215.0	200	1	200.0	1880	9	208.9	193	1	193.0
270-359	610	2	305.0	0	0		1421	5	284.2	0	0	
Total	3702	88	42.1	3009	160	18.8	6848	125	54.8	3645	85	42.9

e. Regulation about the Installation of Sales Wagon

The existing kiosks shall be moved to the center of the street. With respect to the new installations, only those that will not compete with the products of permanent shops shall be permitted.

C) Maintenance and Control

Impelling the formation of Traders Association of the zone is recommended in order to control and maintain various works such as cleaning, removing of objects and signs in transgression, organization of fairs, etc.

D) Preventing Crime

Crime tends to be produced when there is a concentration of people; for this reason strict control shall be carried out.

2) Preferential Street for Pedestrians

A) Location

Streets with North/South direction joining bus stops with the Palma street.

15 de Agosto (between Pte. Franco and Humaitá)
Chile (between Pte. Franco and Humaitá)
Yegros (between Eligio Ayala and F.R. Moreno)

When river side parking is constructed, it will be extended until Paraguayo Independiente Street.

B) Sidewalk Width

Widening to 4.0 meters (actual 2.0 meters) in order to increase the pedestrian comfort. The pavement shall be the same as used for the exclusively pedestrian street, that is, "vainilla" type tile.

C) Planting

The planting shall be carried out on the both sidewalks of the street, in order to offer shadow. The type of plant will be the Naranja jhai, with 3-4 meters of separation between them.

3.6.6 Traffic Control Planning

The premise of this proposed plan is to complete achievement of transit control.

1) Regulation on Parking

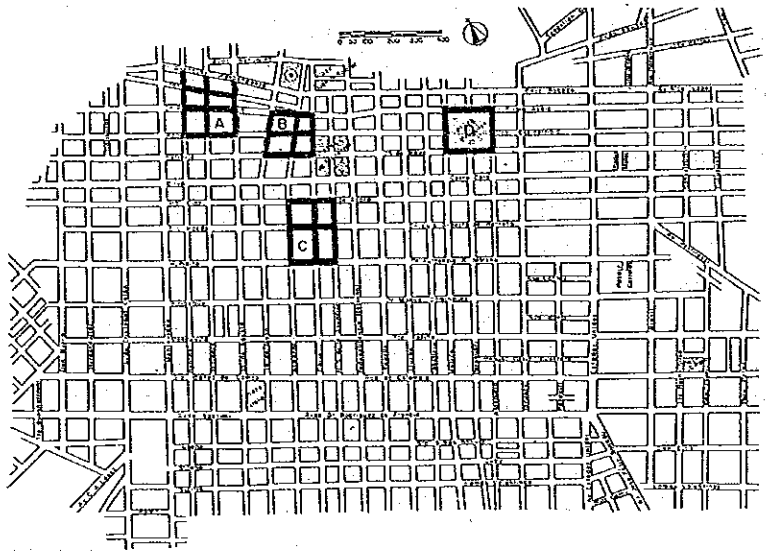
Undue parking on the pavement causes enormous damage delays in transit flow, due to considerable reduction of the road capacity caused by the narrowing of the pavement, therefore, strict controls of such transgressions shall be required. According to the field survey, 63% of the vehicles do it without paying (See TABLE 3-6-36). So, it might be said that the situation of the control system does not function well. To improve that situation, the followings are proposed.

(1) Area

The area shall be the present area. That is, the area limited between *Brasil St., Hernandarias St., Cnel. Bogado/El Paraguayo* Independiente St. and Rodríguez de Francia Av./Ygatimí St.

TABLE 3-6-36 SITUATION OF ROAD PARKING PAYMENTS

Location	Ticket	Free Pass	Pass for Veterans	Not Paid	Total
A	62	22	4	117	205
B	37	6	2	107	152
C	26	4	1	63	94
D	33	13	1	79	126
Total	158	45	8	366	577
Percent	27.4	7.8	1.4	63.4	100.0



(2) Controlled Parking Area

The sectors that permit parking on the pavement are as shown in FIGURE 3-6-50. Once the building for parking is constructed, the parking on the pavement should be forbidden near such equipment.

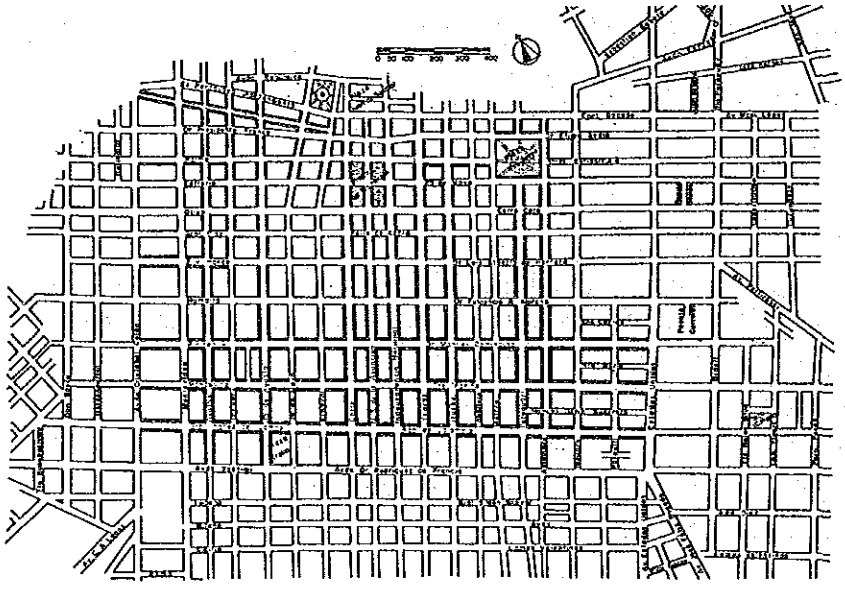


FIGURE 3-6-50 PROPOSED CURB PARKING

(3) Controlled Hours

From Monday to Friday

7:00 - 12:00 and 15:00 - 19:30 in summer
6:30 - 12:00 and 15:00 - 19:00 in winter

Saturdays

7:00 - 12:00 in summer
6:30 - 12:00 in winter

(4) Control Method

a. Divide the area into 60 sectors, and to each will correspond one controller. Every 48 hours, the controller shall change the control sector (See FIGURE 3-6-52).

b. The control shall be performed not only in the controlled parking trimming, but in the forbidden spaces inside the sector.

c. Considering the average parking time, the control must be performed at least every 30 minutes.

d. Control detail

- Parking card sales
- Control of vehicles in transgression, unpaid parking, double parking, parking in prohibited places.
- Intervention in transit accidents.
- Arrest of violators (crossing on a red signal, not respecting the stop signal, transit opposite permitted direction).

(5) Parking Time Control

The maximum permitted parking time shall be 2 hours in the transversal streets with the Palma Street and 3 hours in the proposed control zone.

(6) Penalty for Parking Violations

Parking violations, especially those of double parking and no parking zones, shall be penalized with severity, due to the enormous negative influence caused to the motorcar transit. The monthly off-road parking fare may be taken as a reference, which is from Gs. 15,000 to 20,000 (present penalty is Gs. 3,000).

(7) Parking Fare

There is a great difference in the parking fare on and off-road (Gs. 50 and Gs. 200 - to Gs. 300 each hour respectively), therefore, this must be readjusted. The parking fare on the pavement could be 60 or 70% of the off-road parking, as a reference.

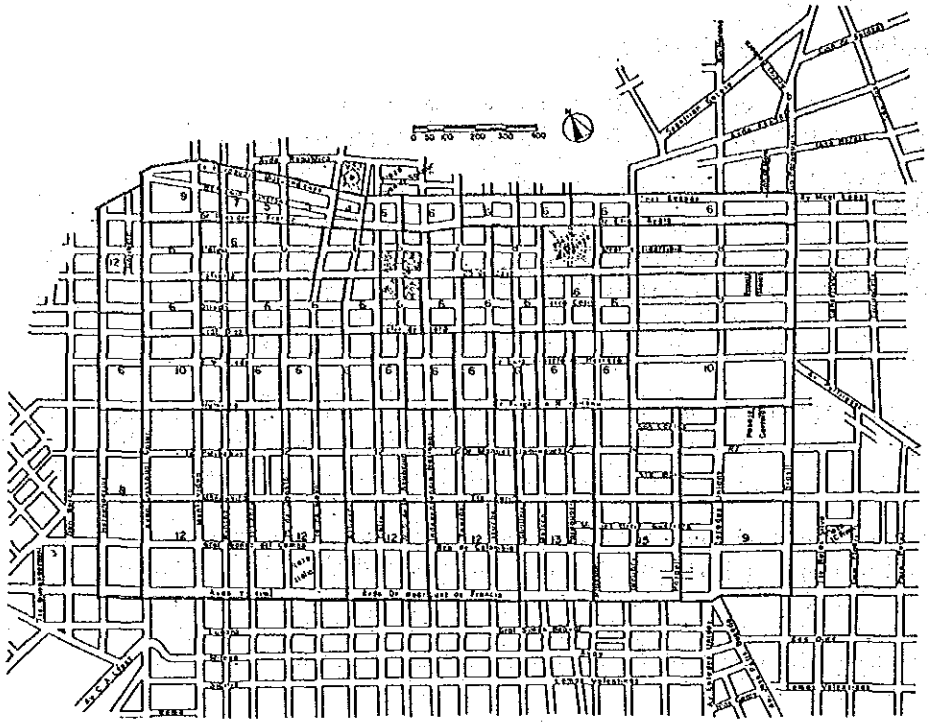


FIGURE 3-6-51 ACTUAL PARKING CONTROL UNIT BLOCKS

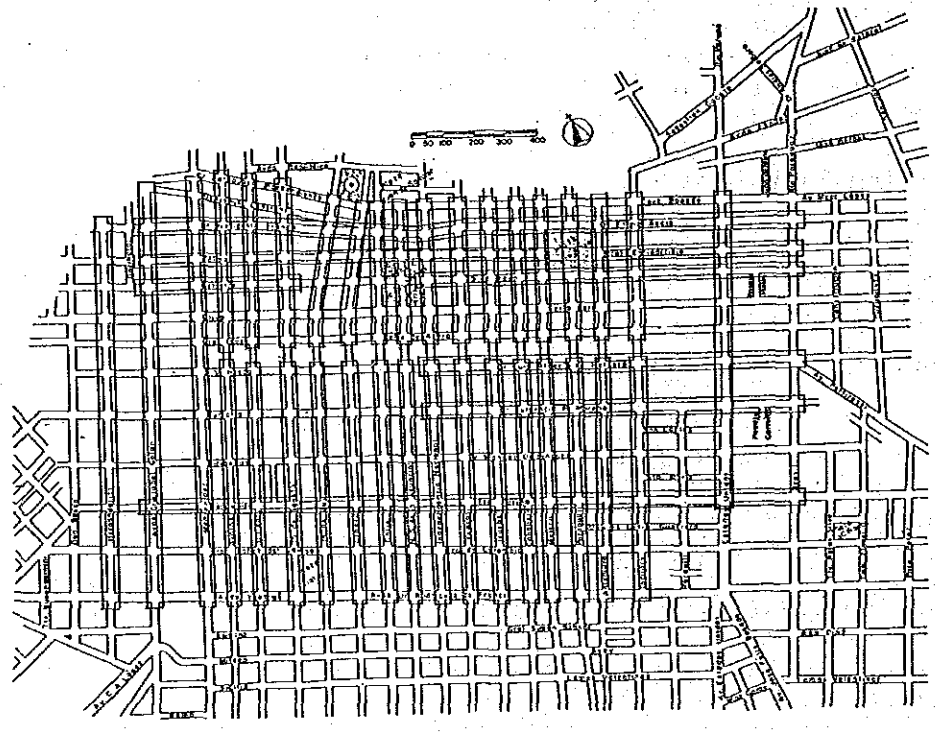


FIGURE 3-6-52 PROPOSED PARKING CONTROL UNIT BLOCKS

The quarterly parking card (Gs. 8.500) and the "Espacio Reservado" (reserved space) (Gs. 12,000/year) are much lower compared with the common parking card. Therefore, they shall be adjusted.

The medium duration of parking in commercial zones is from 30 to 60 minutes, therefore, a 30 minute card should be issued in order to prevent unnecessary expenses for the vehicles owners (See TABLE 3-6-37).

TABLE 3-6-37 AVERAGE PARKING DURATION BY AREA

(Unit:min.)

Area	Street	Hour	
		6:30-12:30	15:00-19:00
Commercial Area	Pte.Franco O'leary and Ayolas	24.6	32.6
	O'leary Pte.Franco and B.Constant	27.7	29.6
	Palma 15 de Agosto and O'leary	44.5	18.6
	15 de Agosto Palma and Pte.Franco	54.0	42.9
Administration Area	Alberdi Humaitá and Haedo	61.9	74.6
	Humaitá Alberdi and 14 de Mayo	56.0	146.3
Residential Area	Piribebuy Caballero and México	90.3	33.0
	Caballero Humaitá and Piribebuy	58.5	33.0

(8) *Others Points to be considered*

A) Supervising Controller

According to previous experience, 4 supervisors are needed, at the rate of 15 blocks per supervisor, to attend the 60 controllers that will be working in their respective blocks, in order to reinforce the control system. Furthermore, transportation means (motorcycle) and other necessary expenses shall be considered.

B) Controllers Authority

Present controllers are not municipal officials, and their support is the commissions for the parking card sales and penalties. As a consequence of this situation, their authority is restricted, which results in disobediece of regulations by drivers. Therefore, it is necessary to intensify their control, giving more authority to controllers (accepting them officially as municipal officials), and with the cooperation of transit police of the city.

2) Traffic Regulations

(1) Regulation of Circulation

In order to establish the sectorial separation of the transit that fits the use of the proposed ground, the crossing of intersections of Humaitá/F. R. Moreno Streets shall be forbidden, except the private and public motorcar transit axis. For the purpose of physical control, a speed bump shall be installed in the middle of the intersection, on the mentioned streets (See FIGURE 3-6-53).

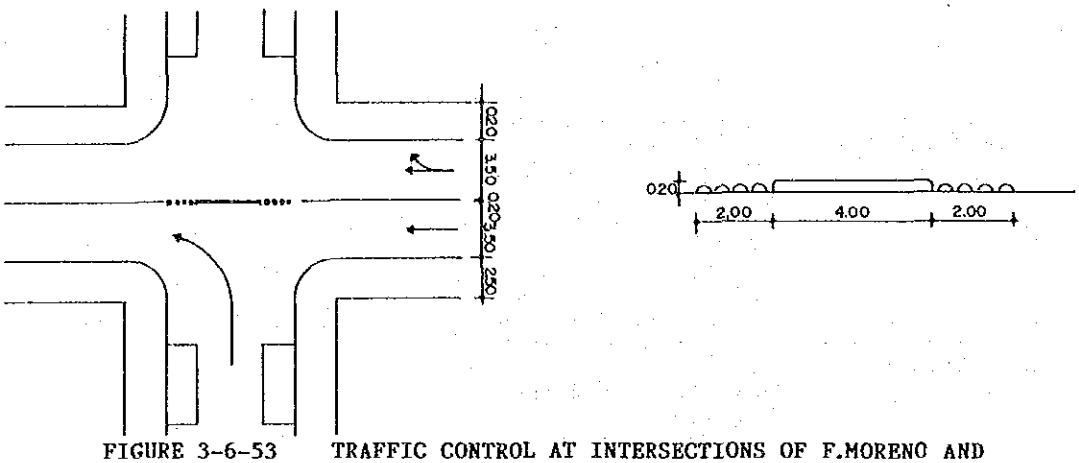


FIGURE 3-6-53 TRAFFIC CONTROL AT INTERSECTIONS OF F.MORENO AND HUMAITA

(2) Stop Signs

Street ranking is shown in TABLE 3-6-38. In the non-signaled intersections, the vehicles riding the secondary streets will be obliged to stop before crossing the main streets. To ensure road priority, stop signs and road markings shall be placed. For the reinforcement of this measure, strict control by the transit police and education in traffic safety before the issuance of driver's licenses is proposed.

TABLE 3-6-38 PROPOSED STREETS HIERARCHY

East-West / North-South	Principal Artery (two way)	Principal Artery (one way)	Artery for Local Traffic	Bus Exclusive artery
Principal Artery (one way)	○	○	○	○
Artery for Local Traffic	○	○	○	○
Bus Exclusive artery	—	○	—	—

Note : ○ ;Priority Street

(3) Speed Regulation

Circulation speed in the Microcentro shall be restricted in order to guarantee pedestrian safety, since the basic criteria is to give preference to pedestrians.

The maximum allowed speed shall be 40km/hour. The signal synchronization shall be done in basis to velocity.

(4) Vehicle Passing Regulation for Palma Street

Vehicle passing will be regulated on the section between Independencia Nacional and 15 de agosto Streets. The blocks of the streets adjacent to Palma Street and those between the said section will be destinated for parking. For that purpose, a 10m area will be created (next to Palma Street), in such way that vehicles can carry out maneuvers to change directions (See FIGURE 3-6-54).

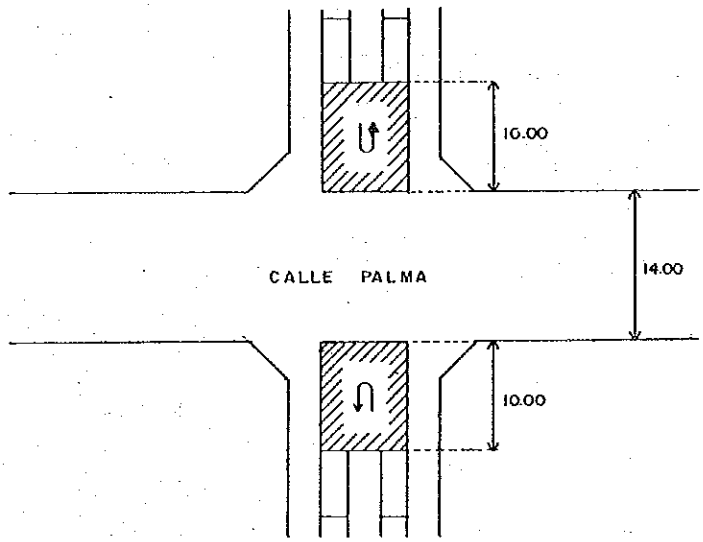


FIGURE 3-6-54 U-TURN ZONE OF PALMA STREET

3) Pavement and Traffic Sign Marking

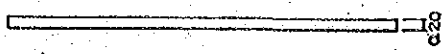
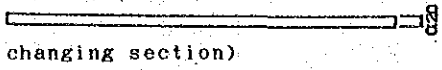
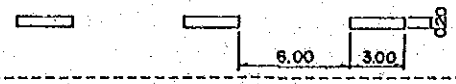
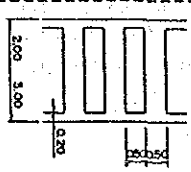
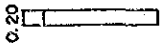
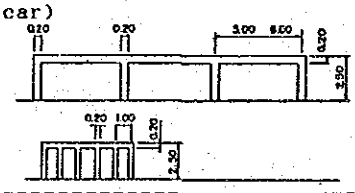
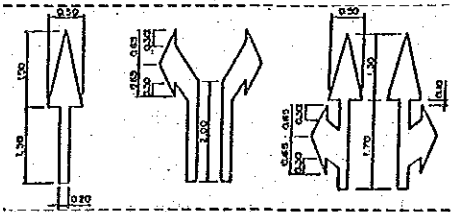
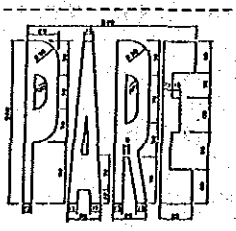
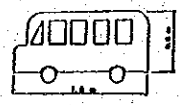
Traffic control is necessary to define the rules of vehicles and pedestrian flow. For this purpose, pavement markings and traffic signs are requires.

(1) Pavement Marking Plan

TABLE 3-6-39 shows the types pavement marking, whose main signs are described as follows:

At present, low resistance paint is employed for marking pavement, therefore an annual work concerning these signs is required. Thermoplastic glass bead must be employed to improve their endurance as well as their visibility for night driving. This procedure will be necessary once every 4 to 5 years, according to the traffic volume.

TABLE 3-6-39 ROAD MARKING FOR PARKING CONTROL

Types	Location	
Street Central Line	Street Center	(More than 4 lanes)  (2 lanes) 
Lane line	Lane limit	(No lane changing section)  (Lane changing section) 
Pedestrian crossing	Areas to orientate pedestrian crossing	
Stop line	At the intersections where temporary detention or stop light detention must be done (1m before the pedestrian crossing).	
On road parking area	Streets were parking is aloowed.	(Passenger car) (Bicycle) 
Traffic direction	At the intersections before reaching the intersections & where the lane number increases or decreases.	
Temporary detention "STOP"	Before the stop line of non preferencial intersections without stop light.	
Bus preferencial sign	At the bus exclusive lane. One for each block.	

a. Lane Lines

The prohibition to change lanes is applied mainly near the intersection. This measure should be taken 30m before the stop line.

b. Pedestrian Crossings

Pedestrian crossings in the arteries within the centro vary. Therefore, a standard is required. Furthermore, although the width of the pedestrian strip depends on the quantity of pedestrians, it is established at 2.0m for all arteries (taking into consideration that streets are narrow) and 3.0m in case of preferential streets for pedestrian.

c. Stop Line

When marking the stop line, two aspects must be taken into account; the visibility of the signal as well as the intersection.

d. Parking Place

Each parking area shall be 2.5m x 5m.

e. Arrow Direction Only

Most of streets within the centro are one way, therefore, marking must be defined in order to keep security.

f. "STOP" Marking

This is located at the entrance of an intersection without a signal for a non-preferential artery.

(2) Traffic Signs

The traffic signs to be employed for the traffic control are "STOP", "Parking", "Taxi" and "Bus Stop" (See FIGURE 3-6-55).

The "STOP" traffic sign will be used together with the "STOP" marking. The "Parking" sign is to be used if possible on each block.

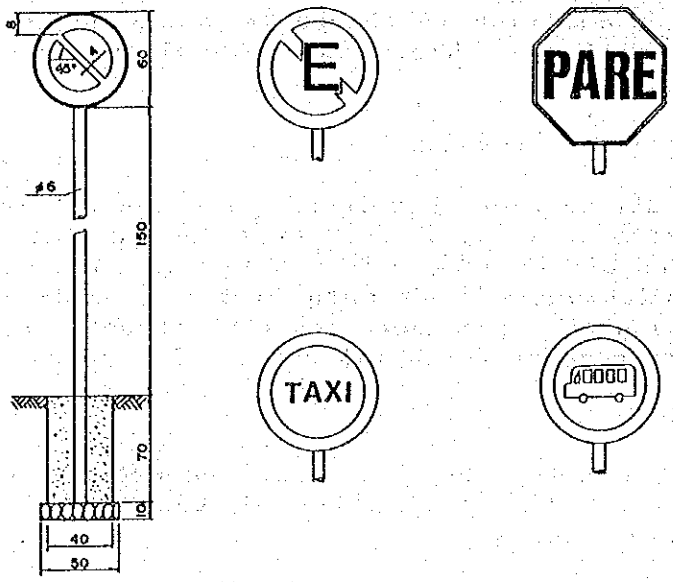


FIGURE 3-6-55 TRAFFIC SIGNS

3.7 ESPAÑA EXTENSION

3.7.1 Cross Section Elements

1) Projection of the Traffic Demand

The results of the projection of the extension of España Av. for the years 1992 and 2000, estimating the building of 2 and 4 lanes, are as shown in FIGURE 3-7-1.

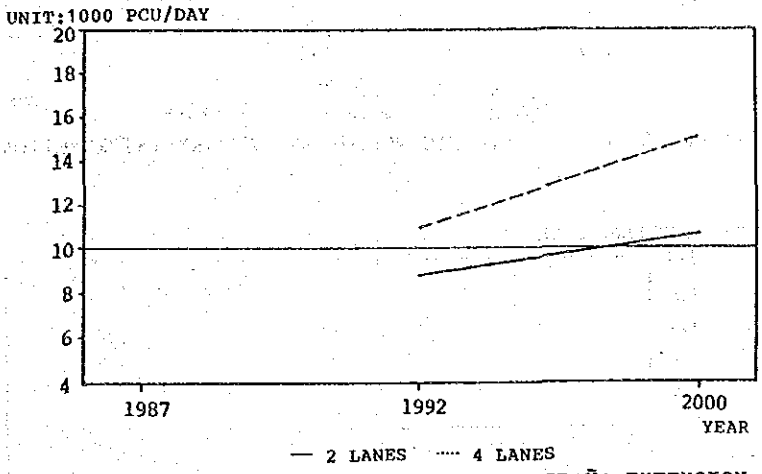


FIGURE 3-7-1 TRAFFIC VOLUME ON ESPAÑA EXTENSION

The traffic volume in case Avenue is equipped with 2 lanes would be 9,000 pcu/day in the year 1992 and 11,000 pcu/day in the year 2000. Considering that the capacity of an avenue with 2 lanes is 9,000 pcu/day, the traffic volume in the year 1992 will be almost up to the capacity. In the year 2000 its congestion rate becomes 1.2.

In case the Avenue is equipped with 4 lanes, a volume of 11,000 pcu/day is foreseen for the year 1992 and of 15,000 pcu/day in the year 2000. This means that it would have 20% - 30% more traffic than if it is equipped with 2 lanes. So comparing both volumes with the capacity of a 4 lane road, assuming service level the Mme.Lynch Avenue, which is of 40,000 pcu/day, it is estimated that some extra capacity will be left. When the prolongation is of four lanes, there will be España Av. sections where the congestion rate would be over 1.5 because that this reform attract traffic.

FIGURE 3-7-2 shows the influence that will be produced on the Tacuary intersection by España Av. extension. The access and egress volume in peak hours is 2,800 veh./hour and for the year 2000 it will be 3,300 veh./hour. With the extension, this volume would be reduced to 2,700 veh./day even up to the year 2000. In the same way, the saturation flow rate which is 0.90 and will grow up to 1.19, with the extension. Even in the year 2000, it will stay under 0.90 (See FIGURE 3-7-3).

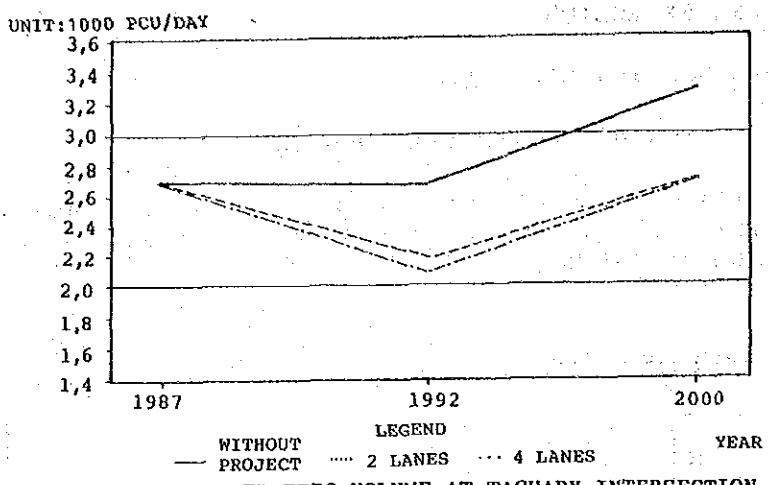


FIGURE 3-7-2 TRAFFIC VOLUME AT TACUARY INTERSECTION

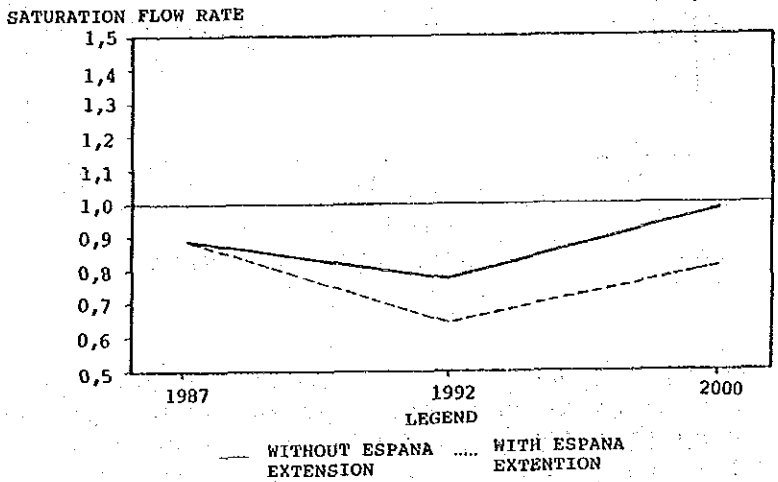


FIGURE 3-7-3 SATURATION FLOW RATE AT TACUARY INTERSECTION

2) Cross Section

In FIGURE 3-7-4, the cross sections are shown and vary with the No. of lanes chosen.

3.7.2 Route Selection

The aspects that must be studied are the following:

1) Starting Point

At the starting points, 2 Institutions with which we must deal, are observed. They are Comisaria No. 5 and History Museum "Andres Barbero".

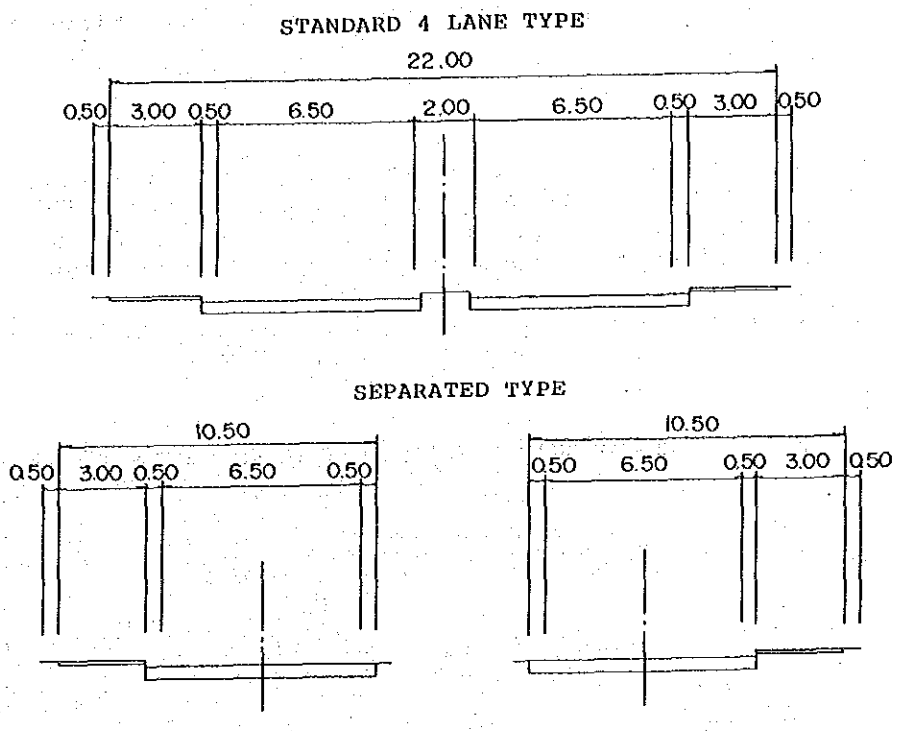


FIGURE 3-7-4 TYPICAL CROSS SECTIONS OF ESPAÑA EXTENSION

2) Train Maneuver Area

Since the prolongation passes through this area, this road could be closed during the hours the trains are maneuvered. But the train's frequency of departure and arrival is three times a day only. This will not cause great congestion.

3) Crossing the Storm Water Drainage

At the back of the Train Station there is a big drain which is in bad condition and with no protection; created erosion and holes of 20 meters. To cross this section, two alternatives are considered: one is building a bridge, and the other is to fill the holes by extending the drainage.

4) The Joining Point to the Microcentro

The alternatives to be considered are the following:

a. The joining of México and Caballero Streets, which are the closest ones.

b. The joining with the 14 de Mayo and Independencia Nacional Streets, in the neighborhood of the area which produces large demands.

c. The joining with Iturbe and Yegros Streets, with the purpose of conserving the pedestrian road in the Microcentro area.

5) Chacarita

Between España Av. extension and Asunción's Bay, there is an area of many illegal residences called "Chacarita". The people live there in very poor conditions. Possibilities of acquiring these lands, which are occupied by an irregular population, should be studied.

The proposed alternatives and their characteristics and problems are summarized in TABLE 3-7-1 and FIGURE 3-7-5.

TABLE 3-7-1 COMPARISON OF ESPAÑA AV. EXTENSION ALTERNATIVES

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1.Junction	*Curve ofEspaña Av. and Tacuary Street *Ind.Nac. and Costanera *Paraguarí	*Intersection of España Av. and Tacuary Street *Ind.Nac. and Costanera	*Curve of España Av. and Tacuary Street *Yegros and Tacuary *Paraguarí	*Curve of España Av. and Tacuary Street
2.Main Obstacles	*Railway-yard *Restaurant *Zone of Chacarita (50 houses approx.)	*Restaurant *Zone of Chacarita (70 houses approx.)	*Railway-yard *Part of high school *Zone of Chacarita (0 houses approx.)	*Railway-yard *Restaurant *Zone of Chacarita (6 houses approx.)
3.Length of the Road	875m (680m)	1,060m (940m)	635m (475m)	470m (325m)
4.Length of the Bridge	83m	170m	83m	-
5.Length of the Walls	355m (H=7m)	355m (H=7m)	160m (H=9m)	-
6.Length of the Sewer	100m	145 + 90 = 235m	100m	100m
7.Cost of Works (mill.Gs)				
Filling	1,324	1,437	988	675
Bridge	1,467	1,929	1,132	-

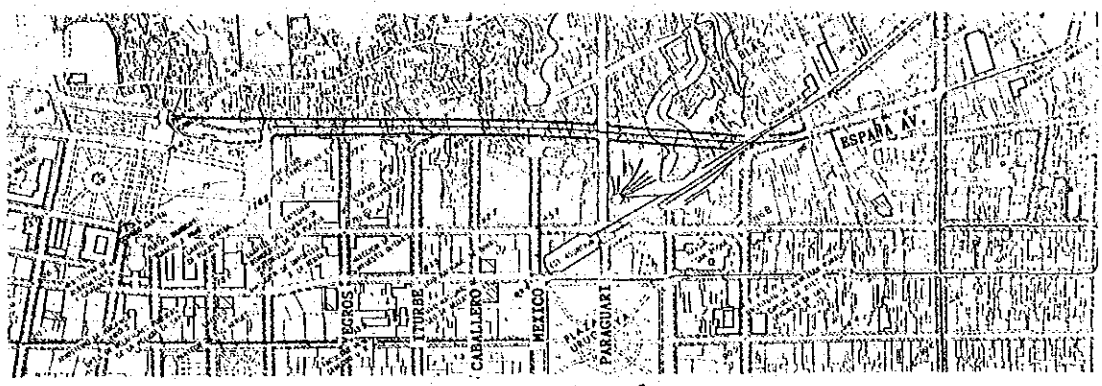
3.7.3 Improvement of Tacuary Intersections

1) Reasons of the Inclusion of the Tacuary Intersection Improvement

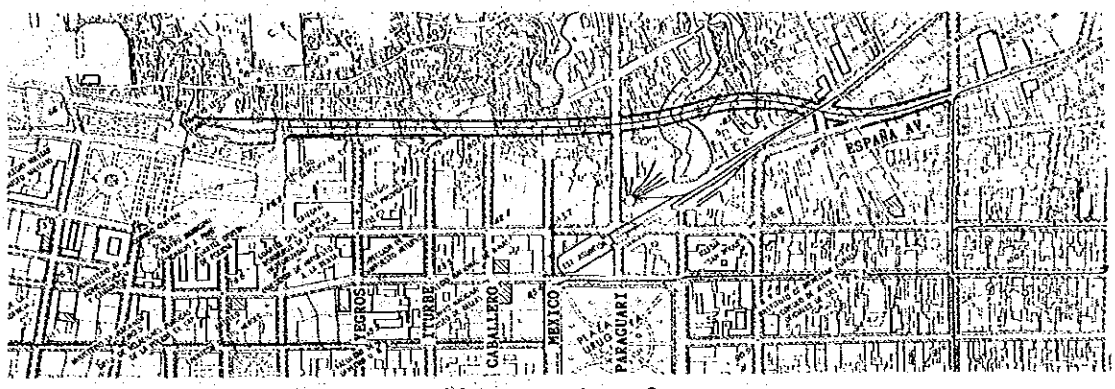
If extension of España Avenue is performed to 14 de Mayo Street, there might be difficulties in 1992 because:

a. The lineal outline goes through a section of Chacarita, treatment involves a series of problems of a social and political nature.

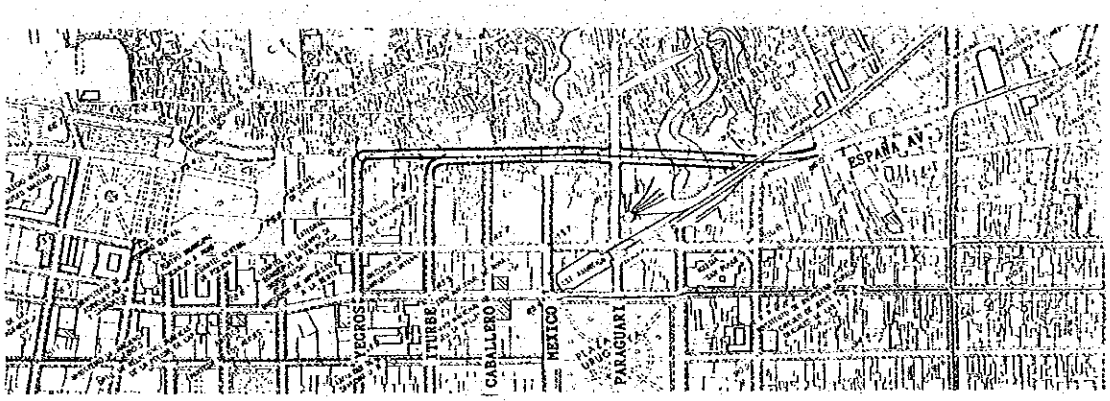
b. The meaning of the extension of España Av. was that, according to the Master Plan, it was to offer accesses to downtown through East/West oriented streets and distribute traffic through North/South oriented streets. This idea was abandoned however, because the exclusively pedestrian street is cut by Independencia Nacional and 14 de Mayo Street of North/South orientation.



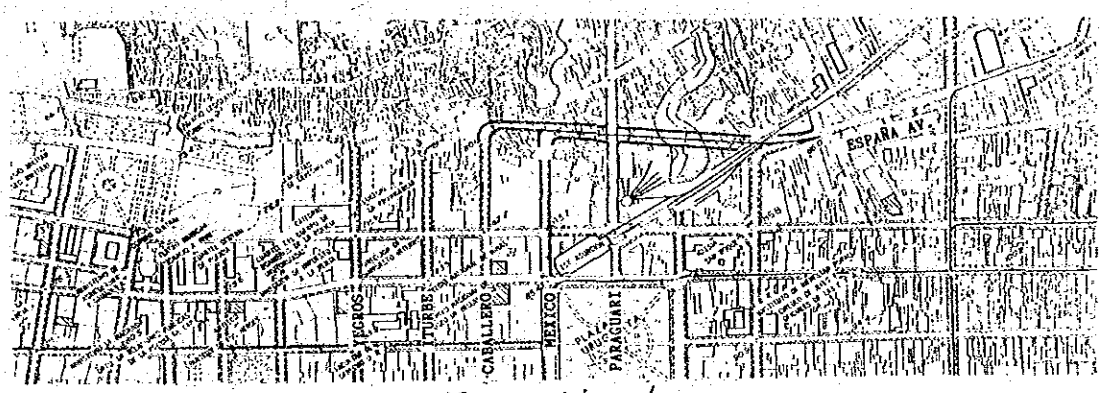
Alternative-1



Alternative-2



Alternative-3



Alternative-4

FIGURE 3-7-5 ALTERNATIVES OF ESPAÑA EXTENSION

In consequence, looking to 1992, the extension of Caballero Street has been contemplated and determined as a motorcar transit axis, with the object of lightening the traffic congestion verified at present at the intersection of Cnel. Bogado and Tacuary Streets, by transferring a part of the flow to Caballero and México Streets.

Then, as an alternative to España Av, extension, improvements of Cnel. Bogado and Tacuary Streets intersection were studied.

2) Analysis of Intersections Capacity

(1) Analysis Conditions

Although proposed parking areas are constructed adjoining Costanera Avenue destinated to users of center sector, the access flow to the intersection shall not be modified (See TABLE 3-7-2).

The analysis shall be performed with respect to the peak hours of the morning (7:00-8:00); of the afternoon (11:30-12:30) and off peak hours (9:00-10:00).

TABLE 3-7-2 SECTION TRAFFIC VOLUME INTO MICROCENTRO

Section	1987	1992	Growth Rate(%)	2000	Growth Rate(%)
North-South	15,846	26,080	1.65	29,328	1.85
East -West	70,800	57,523	0.81	74,193	1.05
Total	86,646	83,603	0.96	103,521	1.19

(2) Traffic and Signal Conditions

The present traffic volume is as indicated in FIGURE 3-7-6. The signal phasing is as indicated in TABLE 3-7-3.

(3) Analysis Results

According to the signal phasing, the volume/capacity relation (V/C) exceeds 1.0 in the peak hours in the Mcal. López Av. access and in the afternoon peak hours in left turns of the Cnel. Bogado street access. The V/C limit exceeds 1.0 in the afternoon peak hours, for which it can be deduced that the traffic can not be absorbed with present signal phasing.

However, according to the signal phasing proposed, the V/C limit decreases to 0.93, less than 1.0, indicating that the treatment of traffic in the intersection is possibly rendered.

Consequently, looking to 1992, traffic shall be able to be improved, and the necessity of the extension of España Avenue will be reduced.

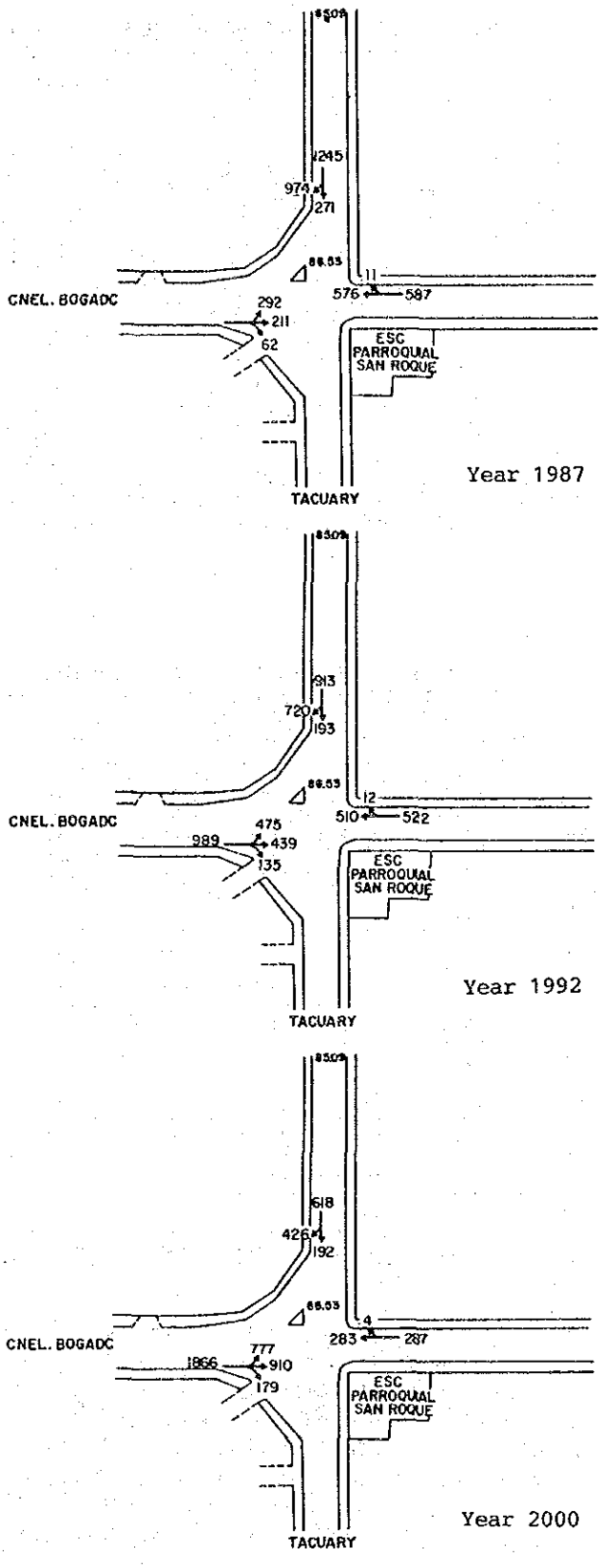
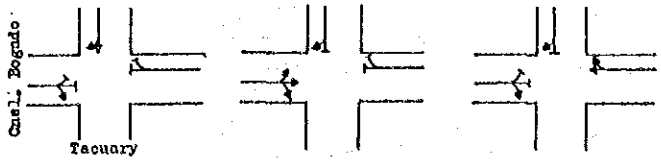


FIGURE 3-7-6 INTERSECTION TRAFFIC VOLUME AT TACUARY AND CNEL. BOGADO

TABLE 3-7-3 PRESENT SIGNAL PHASING (TACUARY INTERSECTION)

Phase	1	2	3
			
Green	15"	35"	25"
Yellow	3"	0"	3"
Totally Red	2"	1"	2"

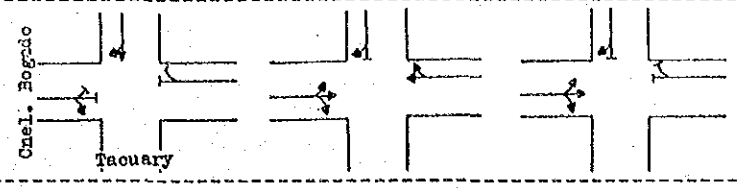
Note: It allows right turns without traffic lights on the intersection of España Avenue and Cnel. Bogado.

TABLE 3-7-4 CALCULATION OF INTERSECTION CAPACITY UNDER PRESENT SIGNAL PHASING (TACUARY INTERSECTION)

Time	Entrance Direct.	Vehicle Flow	Hourly Volume (1)	Capacity (veh./1h of green) (2)	Volume/ Capacity (1)/(2)	Green /Cycle (3)	Capacity (veh./ hour) (2)x(4)	Volume/ Capacity (1)/ ((2)x(4))	Sturation Flow Rate	Critical Sturation Flow Rate
7:00	West	↱	301	1,432	0.21	35/86	583	0.52		
to		→	217	1,508	0.14	61/86	1,170	0.20	0.74	0.85
8:00	East	←	623	1,724	0.36	25/86	501	1.24		
	North	↓	296	1,643	0.19	15/86	287	0.96		
9:00	West	↱	429	1,439	0.30	35/86	586	0.13		
to		→	452	1,515	0.30	61/86	1,075	0.42	0.73	0.84
10:00	East	←	537	1,716	0.31	25/86	499	1.08		
	North	↓	212	1,685	0.12	15/86	294	0.12		
11:30	West	↱	855	1,439	0.59	35/86	586	1.46		
to		→	1,001	1,515	0.66	61/86	1,075	0.93	0.88	1.01
12:30	East	←	286	1,716	0.19	25/86	499	0.59		
	North	↓	194	1,643	0.12	15/86	287	0.68		

However, for the year 2000, the traffic volume shall increase 1.19 times more than the present and V/C limit will increase to 1.0, which means the intersection of Tacuary and Cnel. Bogado Streets shall be congested, and it shall be convenient that the enlargement of España Av. is constructed to Caballero and México Streets, and distribute the transit that shall concentrate in the said intersection. Also, a connection of said extension in the future to Costanera Av. is proposed to structure another access trunk way to the Microcentro.

TABLE 3-7-5 PROPOSED SIGNAL PHASING (TACUARY INTERSECTION)

Phase	1			2			3		
									
Time	M	F	MD	M	F	MD	M	F	MD
Green	21	15	11	45	37	16	10	24	49
Yellow	3	3	3	(3)	(3)	(3)	3	3	3
Totally Red	2	2	2	(2)	(2)	(2)	2	2	2

Note: M = Peak hour in the morning.
F = Off peak hour.
MD = Peak hour at midday.
* Allows turning to the right without traffic light at the intersection of Espana Avenue and Cnel. Bogado.

TABLE 3-7-6 CALCULATION OF INTERSECTION CAPACITY UNDER PROPOSED SIGNAL PHASING (TACUARY INTERSECTION)

Time	Entrance Direct.	Vehicle Flow	Hourly Volume (1)		Capacity (veh./1h of green) (2)	Volume/ Capacity (1)/(2)	Green /Cycle (3)	Capacity (veh./ hour) (2)x(3)	Volume/ Capacity (1)/ ((2)x(3))	Saturation Flow Rate	Critical Saturation Flow Rate
7:00 to 8:00	West		2	186	618	0.30	45/86	323	0.56	0.61	0.69
			3	115	1,432	0.08	10/86	166	0.69		
				217	1,508	0.14	55/86	964	0.23		
	East			623	1,724	0.36	45/86	902	0.69		
	North			276	1,643	0.17	21/86	401	0.69		
9:00 to 10:00	West		2	186	699	0.31	37/86	257	0.72	0.60	0.68
			3	241	1,439	0.17	24/86	454	0.53		
				452	1,515	0.30	61/86	1,075	0.42		
	East			539	1,716	0.31	37/86	738	0.73		
	North			212	1,685	0.13	15/86	294	0.92		
11:30 to 12:30	West		2	92	540	0.17	16/86	100	0.92	0.82	0.93
			3	763	1,439	0.53	49/86	820	0.93		
				1,001	1,515	0.66	65/86	1,145	0.87		
	East			286	1,716	0.17	16/86	319	0.90		
	North			194	1,643	0.12	11/86	211	0.92		

TABLE 3-7-7 CALCULATION OF PROPOSED INTERSECTION CAPACITY FOR YEAR 2000 (TACUARY INTERSECTION)

Time	Entrance Direct.	Vehicle Flow		Hourly Volume (1)	Capacity (veh./1h of green) (2)	Volume/ Capacity (1)/(2)	Green /Cycle (3)	Capacity (veh./ hour) (2)x(3)	Volume/ Capacity (1)/ ((2)x(3))	Saturation Flow Rate	Critical Saturation Flow Rate
			2	221	618	0.36	45/86	323	0.68		
7:00	West		3	137	1,432	0.10	10/86	166	0.83		
to				258	1,508	0.17	55/86	964	0.27	0.80	0.91
8:00	East			741	1,724	0.43	45/86	902	0.82		
	North			328	1,643	0.20	21/86	401	0.82		
			2	221	599	0.37	37/86	257	0.86		
9:00	West		3	286	1,439	0.20	24/86	454	0.63		
to				538	1,515	0.36	61/86	1,075	0.50	0.72	0.81
10:00	East			641	1,716	0.37	37/86	738	0.87		
	North			252	1,685	0.15	15/86	294	0.86		
			2	109	540	0.20	16/86	100	1.09		
11:30	West		3	908	1,439	0.63	49/86	820	1.11		
to				1,191	1,515	0.79	65/86	1,145	1.04	0.97	1.10
12:30	East			340	1,716	0.20	16/86	319	1.07		
	North			231	1,643	0.14	11/86	211	1.09		

3) Intersection Treatment Problems

The congestion at peak hour in the morning is due to the stopping of vehicles coming from España Avenue, since there is no possibility to make a right turn to enter Cnel. Bogado Street. Therefore, it is necessary to create the intercrossing lane above Cnel. Bogado Street.

The permanent turn right of España Av. presents a large transit volume and the space for vehicles circulating in that direction is small. With stopping of some three vehicles, the turning right arm would be blocked. This reduces the traffic capacity of the intersection. The construction of an exclusive route for turning is required to solve this.

In the signal phasing proposed, the left turn outlet of Cnel. Bogado St., shall be carried out in the second phase, too, whenever Mcal. López Av. entrance flow should permit. Also, the turning that shall be performed during a green light of Cnel. Bogado St. is the third phase. This method exists actually in Paraguay in some intersections, but as they are scarce. It is convenient that in its beginning it will be controlled by policemen of the Security Department until the population has been educated in this regard.

3.8 PLAN FOR THE URBAN BUS TERMINAL LOCATED IN MUNICIPAL MARKET NO. 4

3.8.1 Terminal's Functions

1) Lightening Congestion

The activities of loading and unloading passengers on the streets will cause of great congestion especially due to the mixed traffic of public buses and private cars. The congestion becomes greater when there is a considerable number of parked cars on the way or when there are a lot of bus passengers. This kind of congestion is seen in the Market No. 4 area. Therefore, the construction of a Bus Terminal with exclusive space would eliminate the loading and unloading activities of bus passengers on the streets, assuring normal traffic flow.

2) Reduction of the Number of Buses that Enter into the Microcentro Zone

The urban bus routes of Asunción city and its Metropolitan Area is concentrated in the Microcentro area, and causes less operation efficiency in this area. This efficiency increases when approaching the Microcentro area, reaches the peak at the entrances, and decreases again afterwards. From the traffic axis point of view, the efficiency of the bus lines which come from E. Ayala and Fernando de la Mora Avenues and enter into the Microcentro through Gaspár R. de Francia Avenue, decreases from 20% to 30% after Market No. 4. The efficiency of the bus lines which came from España and Artigas Avenues decreases 30% after passing the Plaza Uruguaya.

According to the Microcentro traffic planning, three of the six main avenues that have an east-west direction will be exclusive bus ways, and one avenue will be used both by buses and private vehicles. These are the major avenues that can be used by the buses for their routes.

For these reasons the number of new buses that can be put in circulation in the future is limited. Therefore the number of buses that enter in the Microcentro should be reduced in future. For this effect, installation of a bus terminal in the surroundings is needed.

52.5% and 29.2% of the total amount of buses that enter into Microcentro area pass through the Market No. 4 and the Plaza Uruguaya respectively. Therefore the best place for a bus terminal is adjacent Market No. 4, and straight ahead of Plaza Uruguaya where another terminal is required.

3) Increased Bus Passengers

As seen in FIGURE 3-8-1, the present problem of Market No. 4 is the existence of congestions of private and public vehicles, caused by the unorganized distribution of bus stops in that area.

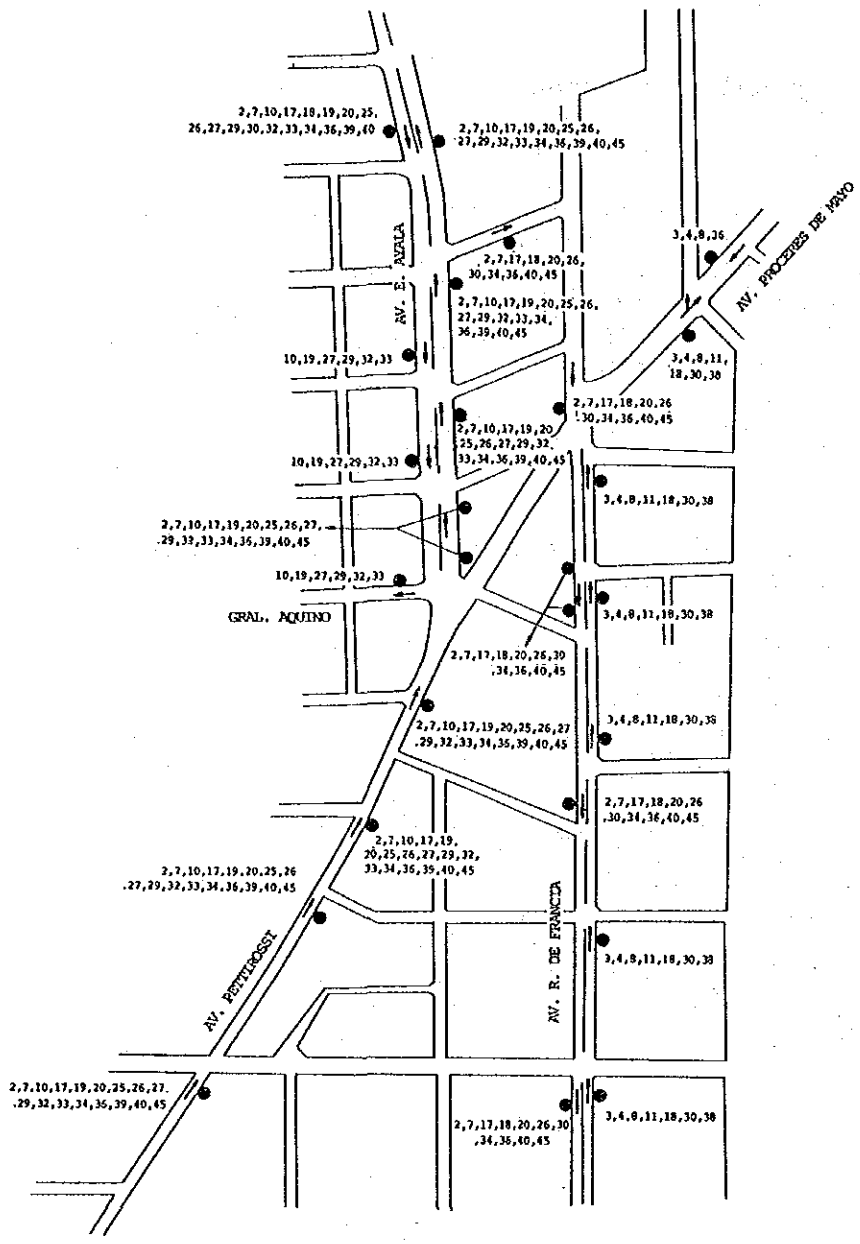


FIGURE 3-8-1 PRESENT CONCENTRATION CONDITION OF BUS LINES NEARBY THE MUNICIPAL MARKET NO.4

4) Reactivating the City

The area for the installation of the new bus terminal located next to Market No. 4, is used now by many illegal businesses and shops. By the construction of a bus terminal, this area could be reorganized.

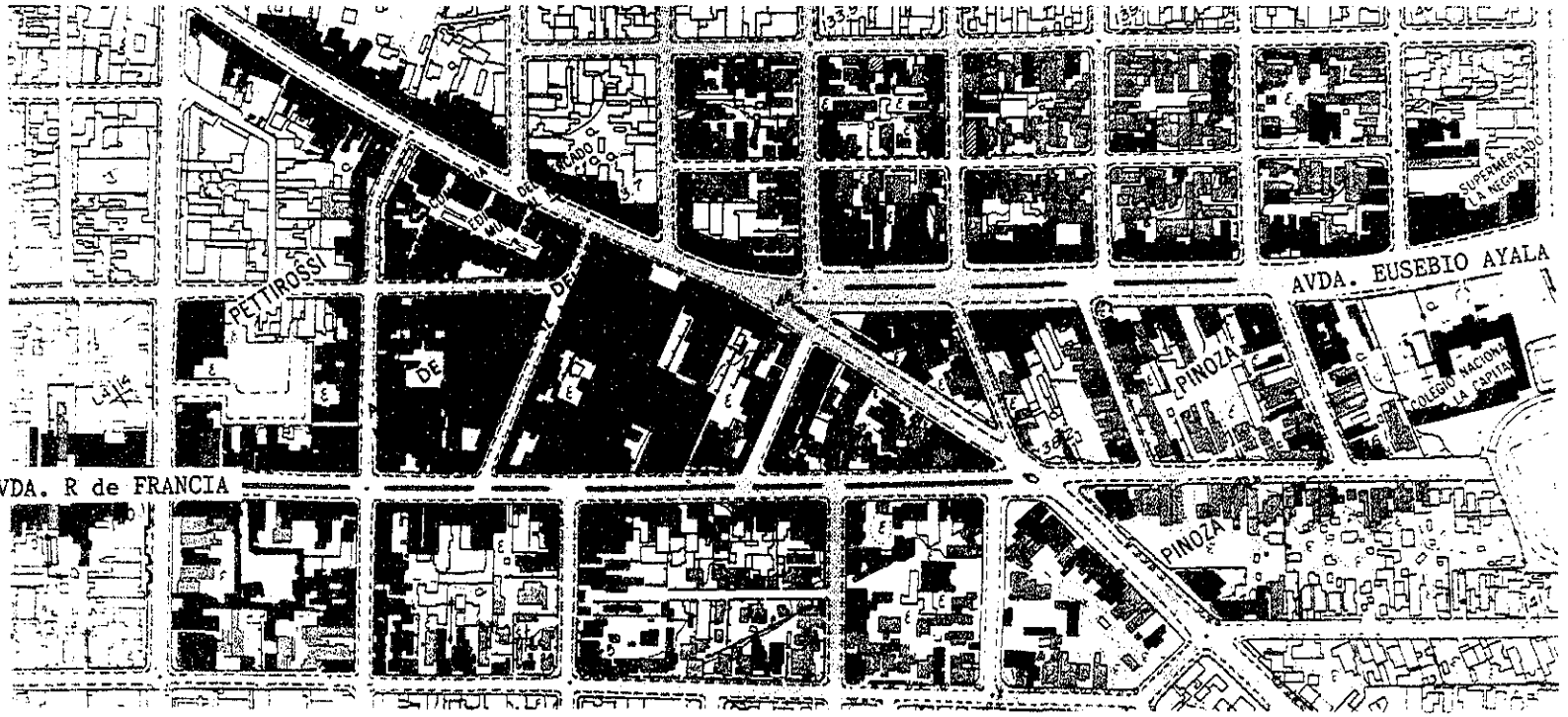


FIGURE 3-8-2 ACTUAL LAND USE AROUND MUNICIPAL MARKET NO.4

3.8.2 Bus Terminal Plan

1) Zone

The zone adjacent to Market No. 4 is located at the starting point of E. Ayala Avenue and is located only one kilometer away from the Microcentro. This avenue has the highest traffic volume within all the avenues of Asunción.

In this zone there are many shops, supermarkets, electronic shops and bars. The number of passengers who disembark from buses doubles the number in the Microcentro. There are many new tall buildings where high priced objects are sold (See FIGURE 3-8-2).

25 of the 41 existing bus lines are concentrated in this zone, and the number of buses which pass through this zone is more than 7,000 per day. At the peak hours, buses, private cars and pedestrians overflow the streets and cause the serious traffic problems.

2) Terminal's Characteristics

The characteristics for the bus terminal are shown in TABLE 3-8-1.

The characteristics are classified in four types;

a. lineal terminal
b. long bus stop (located away from the streets)
c. terminal for regulating schedules, and
d. terminal for transferring

These types are categorized based on the following two characteristics:

a. installation place: on or off the road, and
b. bus line: if it will have a rerouting premise or not (if transfer will be an obligation or not)

TABLE 3-8-1 BUS TERMINAL CLASSIFICATION

Characteristics	Linear Terminal	Main Stop	Regulation Terminal	Transfer Terminal
Location	On road	Off road	Off road	Off road
Bus lines	Actual	Actual	Partial restruc-turation	Restruc-turation

Considering the intensive traffic congestion and less efficiency of the bus operations in the Microcentro, there is no doubt that the rerouting of the bus lines will be effective, and will solve those problems in future. But the problem is that there are 40 bus enterprises which are in constant competition offering high quality services, so that an administrative regulation will be needed to promote the rerouting of the bus lines, which means that this rerouting must be done in the long term.

The economic option would be to use a road as a bus terminal. This idea would be a solution only for the short-term, because lots of problems will appear when this idea is used in an almost definitive way. So the terminal has to be installed off the road.

The terminal for the hourly schedule regulation is what is mostly needed, but considering the operative difficulties, it would be better to establish a terminal as a long bus stop, remaining possibilities to change it into one for schedule regulation or a transferring terminal.

TABLE 3-8-2 CHARACTERISTICS OF BUS TERMINAL ALTERNATIVES

Type	Summary	Advantages	Disadvantages	Necessary Studies
Linear Bus Terminal	To integrate bus stops on the E.Ayala and Fdo.de la Mora Avs.to the low traffic section produced by the construction of the viaduct which connects E.Ayala Av. and R.de Francia Av.	Low construction cost.	*Number of lines which can be used will be limited, due to the extension of space for boarding and disembarking. *Difficulty of bus circulation to secure the bus terminal function.	*Review of land use along the avenue. *Review of traffic control.
Large Scale Bus Stop	To load and unload passenger at the exclusive and independent space out of the road, in order to avoid the congestion caused by the stopping of buses on road.	Road traffic congestion will be lighter.	*Relatively high construction and building cost.	*The method to collect access charge to ensure income resources.
Operational Control Bus Terminal	Depending on the schedule, it works as a return point to increase the operation performance.	Road traffic congestion will be lighter. Bus numbers in Microcentro will be reduced.	*Relatively high cost. *Difficulty to manage bus operation.	*Study on managing bus operation *The method to collect access charge to ensure the income resources.
Transfer Terminal	Used as a transfer point, for the lines divided in suburban and MIcro Centro lines, to reduce the number of buses in MIcro Centro and thus to increase the operational performance.	Road traffic congestion will be lighter. Bus number in MIcrocentro will be reduced. Operational performance will turn higher.	*High construction cost. *Bus rerouting premise. *Transfer of passenger. *Unfair if only a few lines will be modified, more bus terminals would be needed.	*Political guidance for bus rerouting. *Readjustment of rerouting. *The method to collect access charge to ensure the income resources.

3.8.3 Demand Forecast

1) Estimation Result

Estimation results for the following three cases are shown in TABLE 3-8-3.

case 1: when there is no change in the operation efficiency and the vehicle capacity

case 2: when only the operation efficiency increases

case 3: when only the vehicle capacity grows

In all cases, demands were estimated principally on the basis of the present bus network, because of the difficulties to implement the bus rerouting proposed in the Master Plan in the rather short period.

The operation efficiency, which represents the percentage of congestion on the most congested section at the peak hour, was supposed to be 80% based on trends recorded in the period 1984 to 1987. By the year 2000, 50% of buses are supposed to be changed to bigger ones with the capacity of 90 passengers per vehicle, which is the highest among the buses in operation in Asunción at present.

If the operation efficiency and the vehicle capacity remain in the present level, 13,670 buses per day or 1.5 times of the present number, will be needed in the year 2000. However, the operation efficiency has been increasing and the buses have been changing to bigger ones in recent years. Therefore, if only the increase of the operation efficiency is assumed, 11,280 buses per day in the year 2000 will be required. If both the increase in the operation efficiency and the vehicle capacity is assumed, 9,020 buses per day in the year 2000 will be required. The latter figure is almost same as the actual number of 9,140 buses per day.

TABLE 3-8-3 BUS TERMINAL DEMAND ESTIMATE BY CASE

Case 1: Actual vehicle capacity and operative performance

Year	Actual road network	Suggested road network
1987	9140	-
1992	11440	12060
2000	13670	16320

Case 2: Operative performance increase

Year	Actual road network	Suggested road network
1987 (66%)	9140	-
1992 (76%)	9930	10470
2000 (80%)	11280	13460

Case 3: Operative performance increase + bigger vehicles implementation

Year	Actual road network	Suggested road network
1987 (66%-60 p/u)	9140	-
1992 (76%-66 p/u)	9030	9520
2000 (80%-75 p/u)	9020	10770

2) Network Capacity

The network capacity determines the maximum limit of the estimation results. FIGURE 3-8-3 shows the relationship between cumulative probability and the number of buses loading and unloading at a bus stop by the bus traffic volume. According to this figure, with the installation of four berths, 80% of the buses can operate without long pauses, when loading and unloading on the streets where

there is bus traffic of less than 70 buses/30 minutes and 60% of buses can do the same if there are more than 70 buses/30 minutes. 4 and 5 detention areas for the streets with the bus traffic volume of less than 70 buses/30 min. and those with more than that can handle 70% of the total without serious delay.

The number of berths needed to coyer any variation of bus traffic would not change so much. It implies that the buses will not arrive at bus stops at even intervals, they will arrive in groups due to the effects of traffic signals, and the groups of buses will not grow over a certain limit. Besides, it would not be possible for the bus volume to surpass 200 units/h which is actually recorded, estimating that the number of bus users will increase in future and could be absorbed through the implementation of larger vehicles and the increase of transport performance.

Consequently, six detention areas in a bus stop is considered as the practical maximum in the Study. Then the capacity for each bus stop can be calculated at 240-360 units per hour, and the lane capacity at 3,700 to 5,500 units/day x lane for one direction with the assumption of average turn over rate of 1.0 to 1.5 min. per berth and the peak hour index of 6.5%. The peak hour index in the Microcentro and the E. Ayala Avenue is less, compared to other points. Therefore in the Study, 4,500 units/day x lane for one direction is considered as the network capacity.

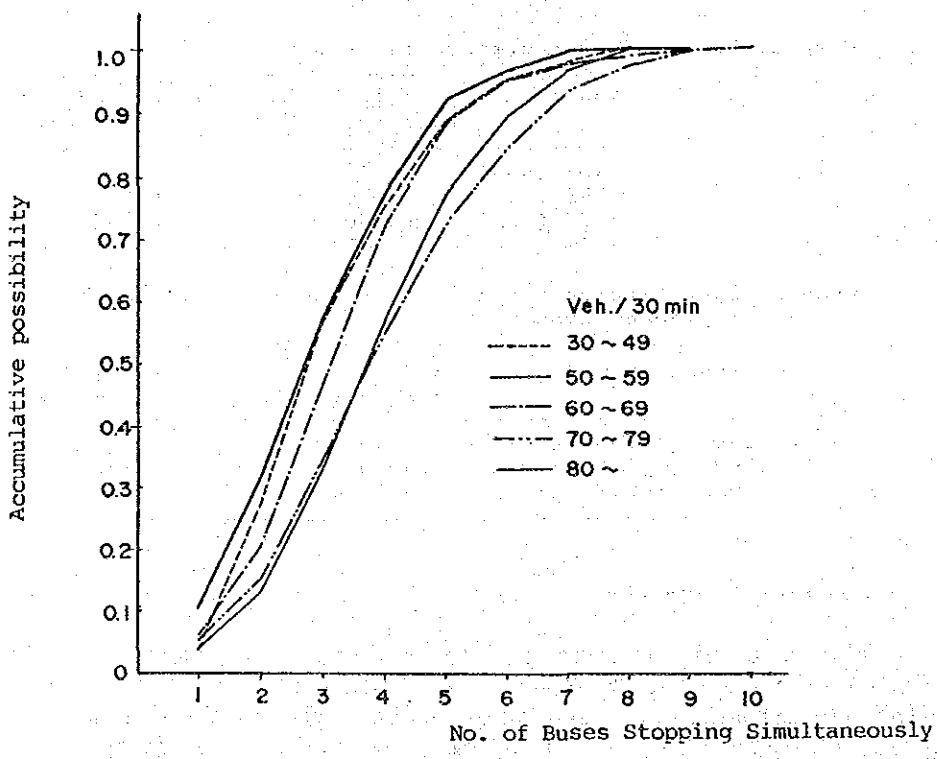


FIGURE 3-8-3 ACCUMULATED POSSIBILITY OF BUSES WHICH STOP AT BUS STOPS SIMULTANEOUSLY

3) Bus Terminal Capacity

The Bus Terminal Capacity was set at 12,000 buses/day. The reasons are;

a. When the growth of the operation efficiency and the use of new bigger vehicles is not considered, the demand will overpass the network capacity.

b. When the growth of the operation efficiency and the use of new bigger vehicles is considered, the number of vehicles in the terminal would be of 9,020 buses, in the case of the present network, and of 10,770 buses in the case of the proposed network.

c. Consequently, the capacity will be set at 12,000 buses per day, including 10% contingency over the capacity.

3.8.4 Location Plan

For the terminal location selection, there are certain points to be considered;

a. The viaducts position. This viaduct will join Eusebio Ayala and Rodríguez de Francia Avenues. There are great economic advantages by constructing both the terminal and the viaduct at the same location. The construction of the viaduct demands land expropriation, and if possible the use of the free space under the viaduct as a part of the bus terminal would be desirable.

b. The position of the viaduct can be decided freely using control points such as the National High School (Colegio Nacional de la Capital) and Market No. 4, between A and B shown in FIGURE 3-8-4.

The location of the Bus Terminal will be determined based on expropriation cost and the convenience needed for the bus terminal.

The pre-qualified points for the installation of the terminal are shown in FIGURE 3-8-5, supposing that the necessary area is of 1.5 hectares. The comparisons from the different points of view;

- the estimated cost
- the topographic conditions
- the traffic conditions etc.

and the evaluation of the alternatives are shown in TABLE 3-8-5.

The costs differences are nearly 10% of the maximum. Therefore, this would not be a determining factor. Because of the short distance between the terrains, there is hardly any topographic differences. From the bus circulation point of view, Alternative A is the worst because of the distance that buses will need to cover, from Rodríguez de Francia and Fernando de la Mora Avenues. Alternative C

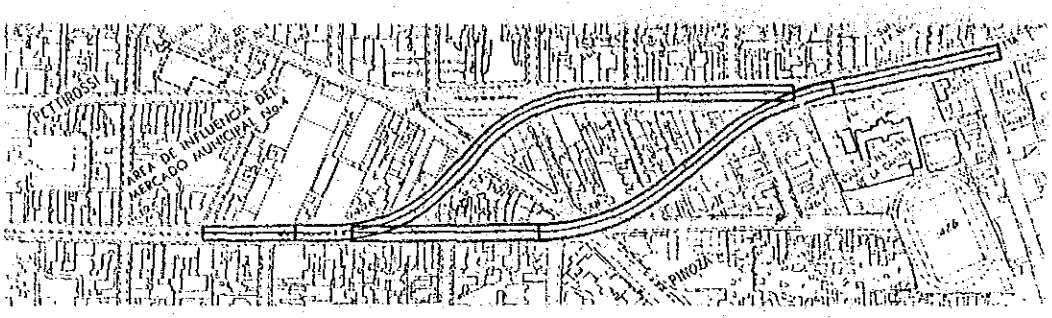


FIGURE 3-8-4 LOCATION OF ALTERNATIVE VIADUCT ROUTES

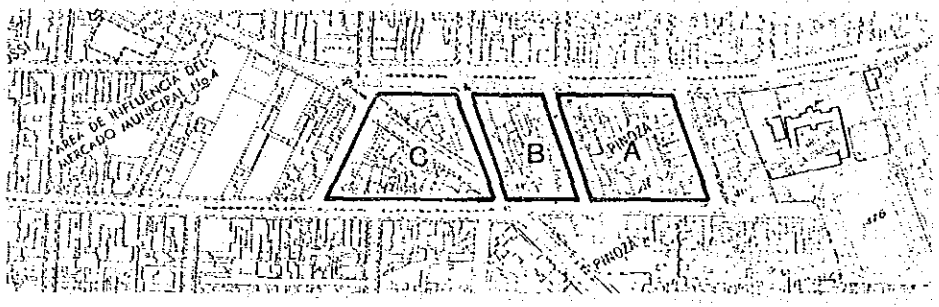


FIGURE 3-8-5 ALTERNATIVE AREA FOR BUS TERMINAL

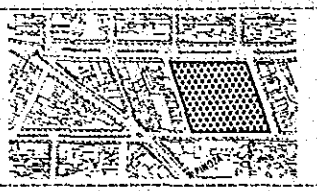
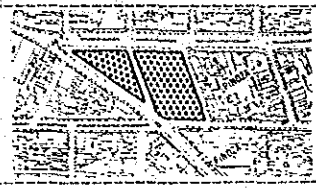
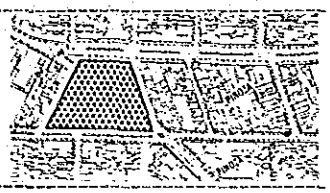
TABLE 3-8-4 EVALUATION OF ALTERNATIVES OF BUS TERMINAL

Land	Construction Cost	Topographic Conditions	Bus movement line	Influence on traffic	Users Access
A	G	R	B	R	B
B	B	B	R	R	R
C	R	R	G	G	G

Note: G(Good), R(Regular), B(Bad)

has the best conditions of the three Alternatives, A, B and C. Alternative C is the most desirable from the view point of the form of the intersection at R. de Francia and F. de la Mora Avenues and also for the passengers, it is the nearest to Market No. 4. Alternative C is the one that will cost less for the expropriation and compensation because out of 13,700 square meters of the area needed to construct the bus terminal, 2,700 square meter is occupied by illegal businesses who are conscious of their situation. Considering all of the mentioned factors above, Alternative C was finally chosen.

TABLE 3-8-5 COMPARISON OF BUS TERMINAL LOCATION

Aspects	A	B	C
1.Location			
2.Area(m^2)	13,600	13,400	13,700
3.Construction Cost (Mill.Gs)	1,224.4	1,349.4	1,290.5
4.Topographical Condition	Difference of altitude : 7m in north-south direction, 4m in east-west direction. Max. gradient : 5.7%	Difference of altitude : 10m in north-south direction, 4m in east-west direction. Max. gradient : 7.3%	Difference of altitude : 10m in north-south direction, 2m in east-west direction. Max. gradient : 6.8%
5.Bus Circulation	Buses from R.Francia and Fdo. de la Mora Avenue can not approach terminal under present traffic control system. Small curve radius from Fdo. de la Mora Avenue should be improved.	Complicated movement for buses from R.Francia Avenue.	No problem.
6.Influence on Private traffic Francia Avenue	Congestion at intersection of R.de Francia and Próceres de Mayo is expected.	Alternative route for Yuty Street from Próceres de Mayo and R.de Francia Avenues to E.Ayala Avenue is required.	Yuty Street should be changed to 2 way street to secure a route for traffic from E.Ayala Avenue to R.de *as an alternative route for* Próceres de Mayo Street.
7.Accessibility for Bus Passengers	Farthest from Market No.4 Longest walking distance for passengers.	Nearer to Market No.4 A structure to cross Próceres de Mayo is required.	Nearest to Market No.4

3.8.5 Bus Circulation Plan

FIGURE 3-8-6 shows the bus traffic volume in the years 1987 and 2000 for one day. In accordance to this figure, 25% of the buses which come from E. Ayala Avenue turn to Gral. Aquino Street to the Microcentro, and 75% turn to R. de Francia Avenue in 1987. This tendencies will not change a lot, so that the values in 1987 will be used for analysis.

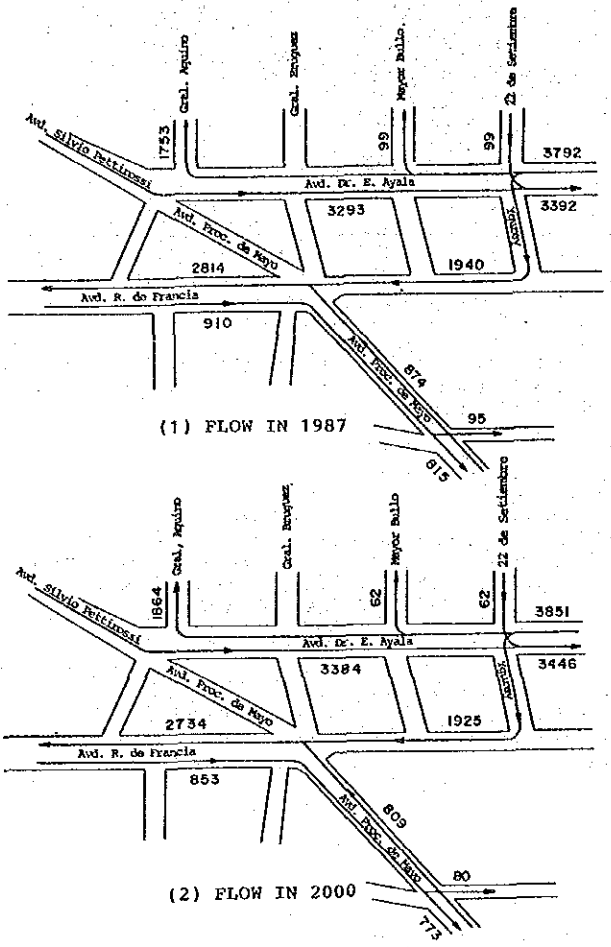


FIGURE 3-8-6 BUS TRAFFIC VOLUME AROUND BUS TERMINAL

The buses which come from the Microcentro pass through Pettirossi Street, go to Eusebio Ayala Avenue. All buses which come through F. de la Mora Avenue, go over R. de Francia Avenue and vice versa.

The bus stops for the buses that go from R. de Francia Avenue to Fernando de la Mora Avenue will be transferred to another place because of the construction of the viaduct that will join E. Ayala and R. de Francia Avenues.

Taking those conditions into account, totally five alternatives are shown in FIGURE 3-8-7.

Alternative 1

The buses that go from E. Ayala Avenue to Gral. Aquino St. and from Pettirossi St. to E. Ayala Avenue, will be handled on streets where no more traffic congestion will be expected because of the viaduct construction and only the ones which pass through R. de Francia Avenue will use the terminal out of the street. Pairs of entrances and exits will each be located on R. de Francia, F. de la Mora and E. Ayala Avenues. From the circulating point of view, this alternative presents no problems, however only a little over 40% of buses which pass through Market No. 4 area will use the terminal.

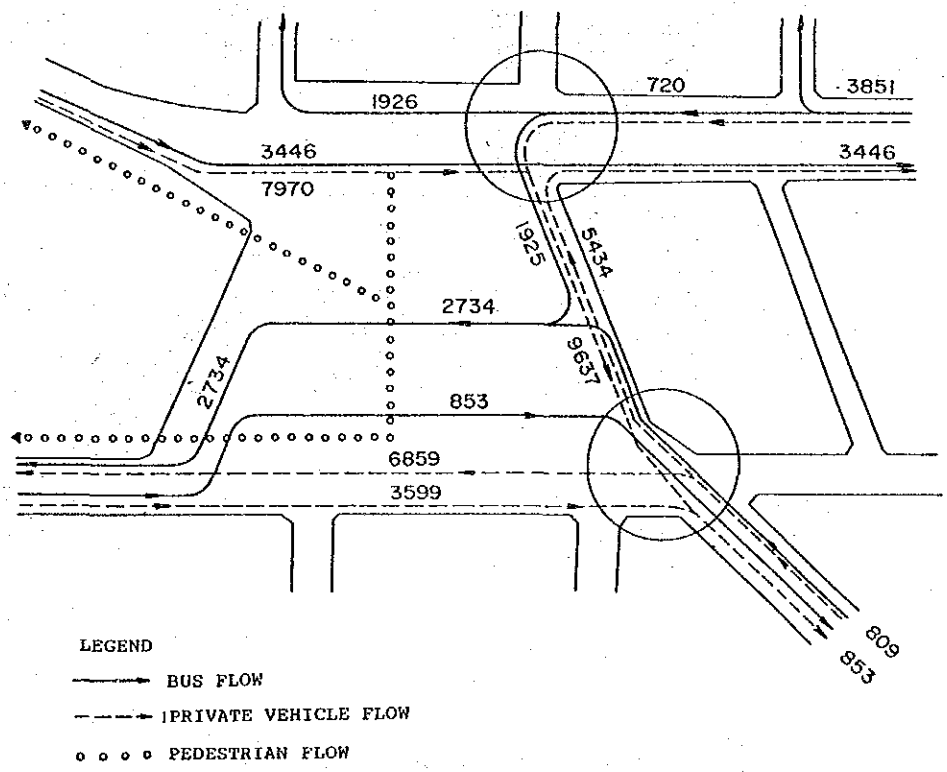


FIGURE 3-8-7 BUS FLOW ALTERNATIVES (1)

Alternative 2

In this alternative, all the buses which had no access to the terminal in alternative one, will have access. Yuty Street was selected as the access to the terminal, so that the other street should be prepared for the private vehicles which use Yuty Street at present, in order to minimize traffic congestion on that street.

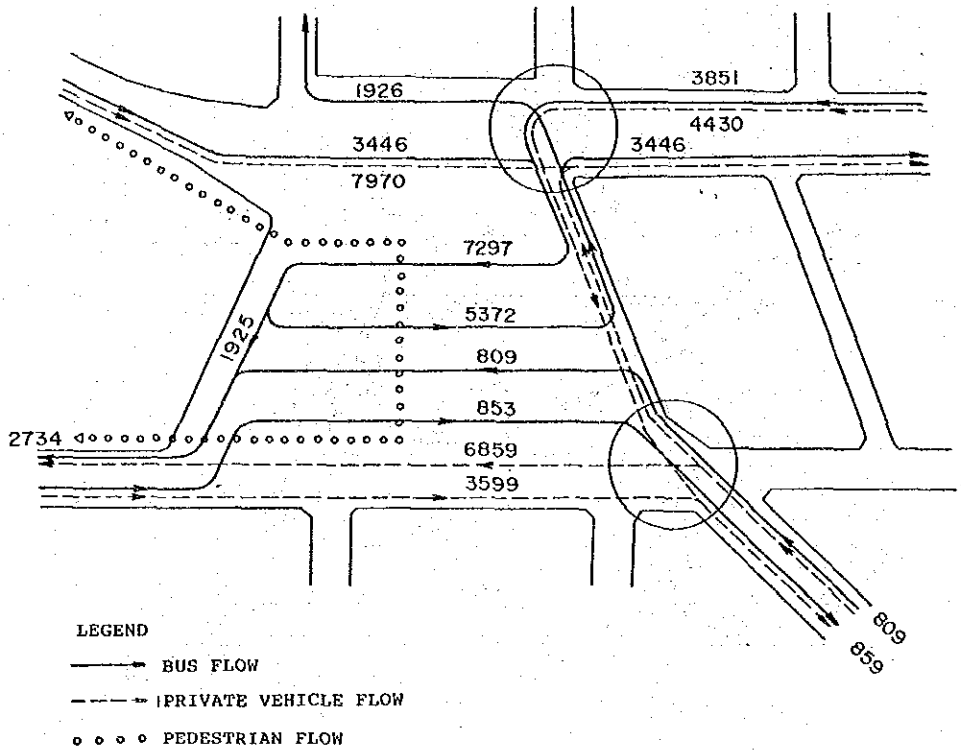


FIGURE 3-8-7 BUS FLOW ALTERNATIVES (2)

Alternative 3

In this alternative, the terrain was set in a North-South direction. The circulating lines of the buses which pass through Pettirossi Street to E. Ayala Avenue are not well organized, so that the use of the North-South direction is not convenient in terms of the topographic conditions.

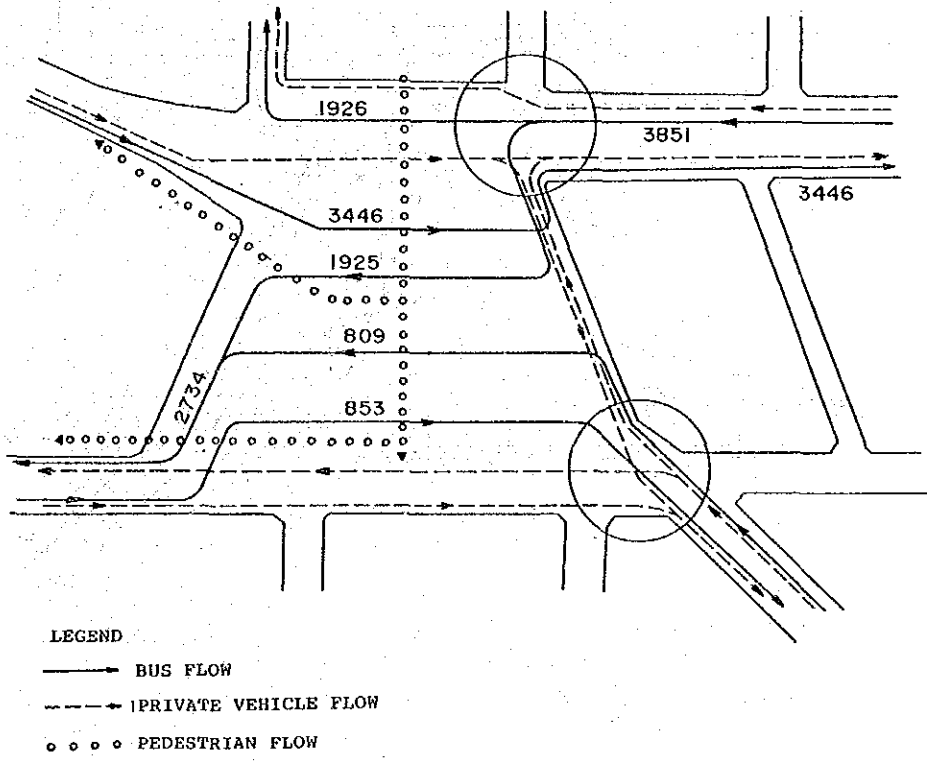


FIGURE 3-8-7 BUS FLOW ALTERNATIVES (3)

Alternative 4

The access and exit for the buses are located on E. Ayala Avenue, in the Market No. 4 area. The circulation of this alternative is quiet well organized in comparison to the former three alternatives, but the private vehicles that travel through Pettirossi Street to E. Ayala Avenue cross with the bus traffic in the terminal's east-west sectors.

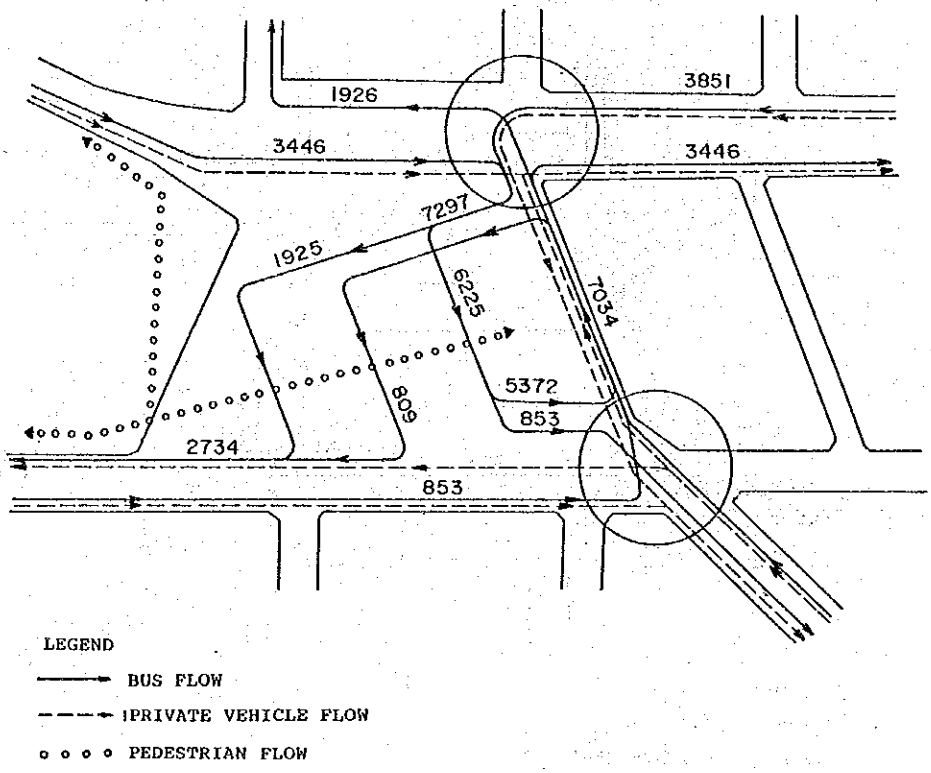


FIGURE 3-8-7 BUS FLOW ALTERNATIVES (4)

Alternative 5

In this alternative the loading and unloading platforms are on E. Ayala Avenue. These platforms will be located on the free spaces produced by the new viaduct. These platforms will be used by those buses which take Gral. Aquino Street, in order to avoid double conflicts of the buses and private vehicles which come from Pettirossi Street. The pedestrian bridges for passengers will be extended up to the platform located on E. Ayala Avenue for more convenience. E. Ayala Avenue will be included in the terminal, so that the vehicles which come from Pettirossi Street to E. Ayala Avenue will cross it longitudinally.

Comparing all the alternatives, alternative 5 is the best for circulation, alternative 4 is the best for the terminal's advantages. Therefore in the Study, alternative 4 was chosen. The conflicts of buses and private vehicles at intersections in alternative 4 does not have so serious a problem as studied in the chapter 3.3.

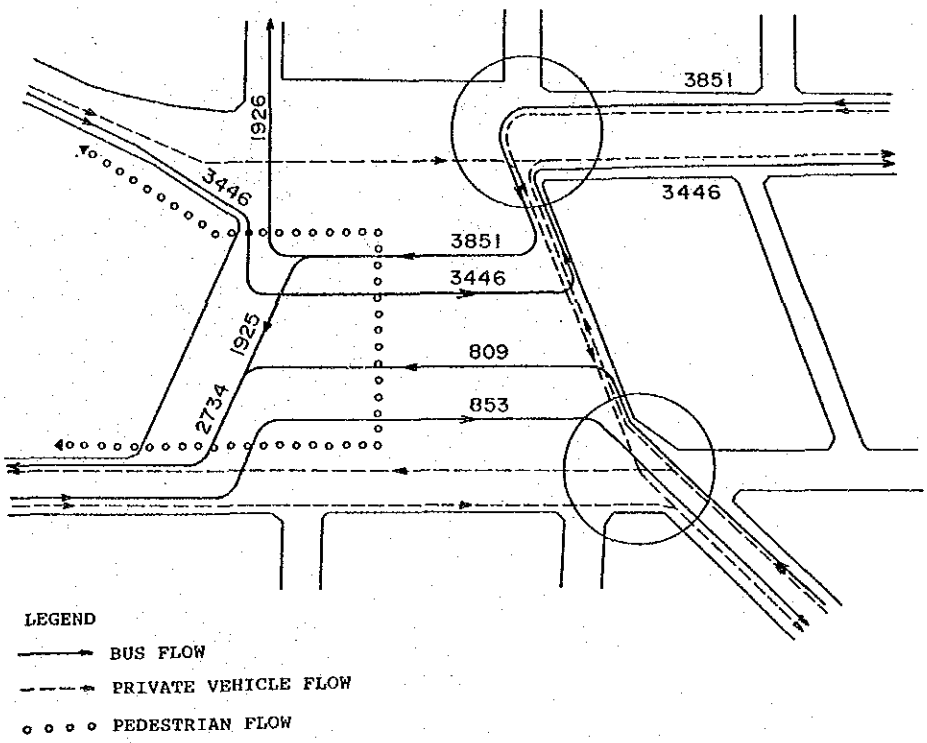


FIGURE 3-8-7 BUS FLOW ALTERNATIVES (5)

4. PRELIMINARY DESIGN

4. PRELIMINARY DESIGN

4.1 ROAD DESIGN STANDARDS

4.1.1 Road Design Standards

In Paraguay, any arteries located within an urban area basically belong to the Municipality. Those arteries which comprise part of the National Road Network could be under the MOPC's jurisdiction.

In the Metropolitan Area, all the arteries within the Township of Asunción have been under the Municipality's jurisdiction since 1980, as established by Resolution No. 818/80. However, the planned arteries or those which are to be improved by MOPC, such as J.F. Bogado Avenue and others, will be transferred to the Municipal Government after the improvement projects are finished.

Most of the artery improvement projects by MOPC have been executed with foreign loans (the World Bank, etc.) and through international bid. In such projects, the design standards recommended by AASHTO are fulfilled, converting the British Engineering System (i.e. feet, yard, etc.) to the metric system.

On the other hand, within Asunción City, the construction projects of artery improvements which were executed by the local entities, do not follow the road construction standards. In the case of Asunción city, the Municipal Code describes only the minimum width and the maximum longitudinal slope in the part of the construction of new urban development.

Most parts of the projects for arteries in the Study are improvement. Basically, these arteries should be planned respecting the current geometry, but in case some important obstacles require changes of geometry, the AASHTO standards as shown in TABLE 4-1-1 will be applied following the MOPC instances. Also, concerning the new sections, clothoid curves will be employed as transition curves.

4.1.2 Intersection Design Standards

1) Minimum Curve Radius at the Corner of Intersection

The minimum curve radius at the corner of an intersection is 15 meters.

2) Exclusive Lane for Left Turn

The exclusive lane could be divided into:

- Waiting lane
- Speed change lane
- Transition lane

TABLE 4-1-1 GEOMETRIC DESIGN STANDARD

Design Speed	30 mph (48.28 = 50km/h)	40 mph (64.37 = 60km/h)	50 mph (80.47 = 80 km/h)
1. Horizontal Alignment			
Minimum Radius			
e = 0.04	92m (302')	175m (573')	291m (955')
e'= 0.06	83m (273')	155m (509')	259m (849')
Transition Curve Length			
e = 0.04	46m (150')	58m (190')	69m (225')
e = 0.06	49m (160')	58m (190')	64m (210')
2. Sight Distance			
Minimum Stopping Sight Distance	61m (200')	99m (325')	145m (475')
Minimum Passing Sight Distance	335m (1100')	457m (1500')	549m (1800')
3. Vertical Alignment			
Maximum Grade & Length Limitation			
Flat Area	8% 137m (620')	7% 162m (530')	6% 189m (620')
Rolling Area	9% 125m (410')	8% 137m (450')	7% 162m (530')
Hilly Area	11% 125m (410')	10% 137m (450')	9% 125m (410')
Vertical Curve Radius			
Crest	914m (3,000')	1829m - 2468m (6000' - 8000')	3353m - 4877m (11000' - 16000')
Sag	1219m (4,000')	1829m - 2133m (6000' - 7000')	2743m - 3353m (9000' - 11000')

Source: A policy on geometric design of highways and streets, 1984, AASHTO

The waiting lane length was determined for each intersection as shown in TABLE 4-1-2, according to estimates for future traffic turning demands.

At the other intersections such as R. de Francia and Perú Avenues, Madame Lynch and Santa Teresa Avenues, and Madame Lynch and Aviadores del Chaco Avenues, the waiting lane was determined at 20m as a minimum requirement.

The transition lane extension was planned to insure the required length for each design speed. The dimensions for the speed change lane and the exclusive lane are indicated in TABLE 4-1-3. The 60 km/h design speed was employed in the Study on R. de Francia, E. Ayala and Mme. Lynch Avenues and Mcal. Estigarribia Road, considering them as main arteries; and 40 km/h on the remaining avenues, which are considered as secondary arteries. The same design speed as for the main arteries was employed for Mcal. López Avenue (See FIGURE 4-1-1).

Furthermore, the lane width will be 3m. Consequently, the center median width will be reduced from 3m to 1.75m.

TABLE 4-1-2 WAITING LANE LENGTH BY AVENUE

Intersection	Artery	Waiting lane length (m)
Kubitscheck	- Kubitscheck	50
	- B. Guggiari	50
	- E. Ayala (centro)	20
	- E. Ayala (S. Lorenzo)	20
	- Choferes del Chaco	20
	- Medicos del Chaco	50
Republica Argentina	- San Martín	70
	- Rca. Argentina	70
De la Victoria	- R.I.18 Pitiantuta	20
	- De la Victoria	50
Madame Lynch	- Madame Lynch	100
	- Defensores del Chaco	20
Fdo. de la Mora	- Pitiantuta	100
	- Pitiantuta	20
Mcal. López	- Mme. Lynch (to E.Ayala)	20
	- Mme. Lynch (to Aviadores del Chaco)	50
	- Mcal. López (to centro)	100
	- Mcal. López (to S. Lorenzo)	50

TABLE 4-1-3 DESIGN STANDARD OF EXCLUSIVE LANE FOR LEFT TURN

Design speed (km/hour)	Speed change lane (m)	Transition lane (m)
60	30	40
40	15	30

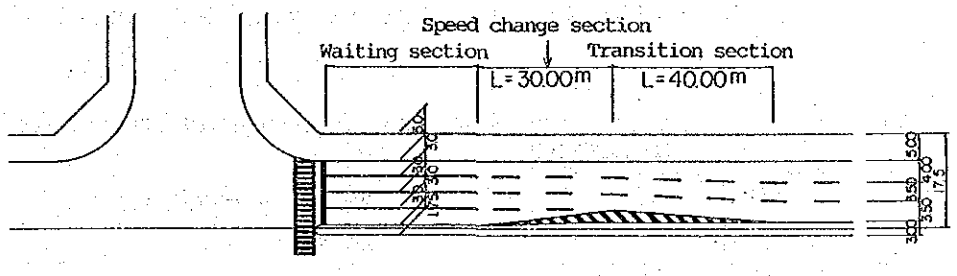


FIGURE 4-1-1 STANDARD DESIGN OF THE GRADE INTERSECTION

4.1.3 Transition Lane of Viaduct Section and Normal Section

The transition section from the normal 3 lane section to the 4 lane (one way) at the viaduct is shown in FIGURE 4-1-2. At the junction of the main lane of viaduct and frontage road at the viaduct, a parallel section will be inserted in order to improve traffic flow and visibility.

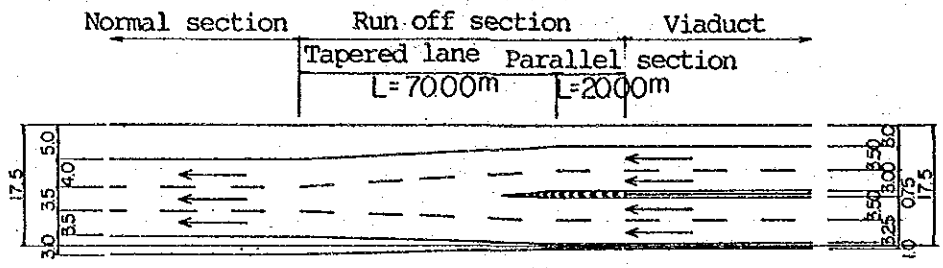


FIGURE 4-1-2 TAPER PLAN OF VIADUCT AND NORMAL SECTION

4.1.4 Improvement of the Tacuary Intersection

The standards shown in TABLE 4-1-4, have been employed for the improvement of the Tacuary intersection. The storage lane length will be 65m, considering straight going traffic volume at peak hours in the year 2000, and assuming an average vehicle length of 7m, and a signal cycle of 120 seconds.

7m x 328veh./(3600sec./120sec.) = 65m

In relation to the length weaving section (LWS), there are no well established standards for the arteries, but the following formula has been proposed, assuming that the obtained value represents a very high security.

LWS= Design speed (km/h) x No. of lanes of a street x 2

According to the calculation, the weaving length of the Tacuary intersection requires an extension of 80m, but with this length it affects the sewerage, and therefore, it was reduced to 70m, with 30m of the speed deceleration lane, which convergence will be of 2.5m. However, due to the existence for the curve, the junction at that point was adopted.

TABLE 4-1-4 DESIGN STANDARD FOR THE IMPROVEMENT OF THE TACUARY INTERSECTION

Items	Design standards
Design speed	40 km/h
Minimum curve radius	15m
Width of the right turn lane	5.5m
Lanes width	3.25m (minimum)
Storage lane width	65m
Converging lane length	70m
Length	23m
Length of the speed reduction lane	30m

4.2 ALIGNMENT DESIGN

4.2.1 Horizontal Alignment

1) Gaspár R. de Francia Avenue

(1) Between Colón and EE.UU Avenues

The current median strip has mostly straight alignment within each section. Deflections of the median strip can be observed between section, but there is difference, and therefore, would not be a problem to be taken into consideration for horizontal alignment. The median strip curb stone are to be readjusted together with the overlay projects to grant continuity to the median strip.

(2) Between EE.UU. and Peru Avenues

At the grade intersection formed by the EE.UU Avenue, there is a 2m deflection, and therefore, the improvement of the horizontal alignment is necessary. It was done on the east part of EE.UU Avenue, not affecting the building of the "Ministerio de Industria y Trabajo", which is located at the west part.

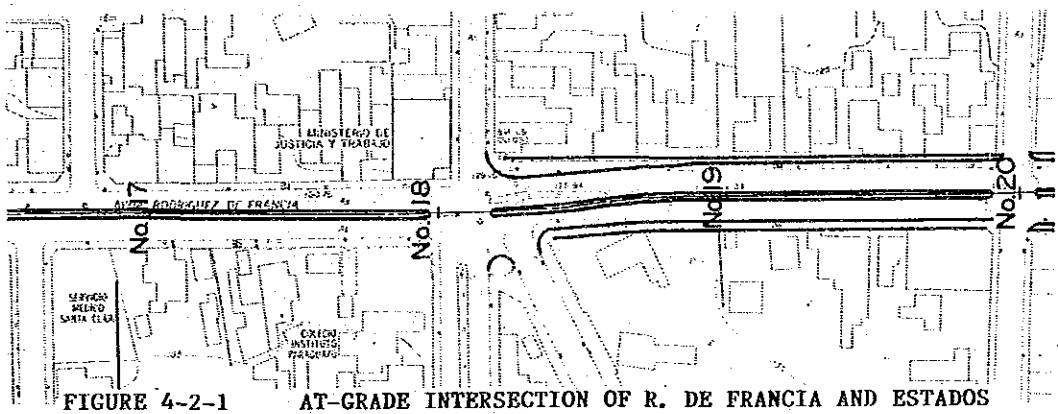


FIGURE 4-2-1 AT-GRADE INTERSECTION OF R. DE FRANCIA AND ESTADOS UNIDOS AVENUES

2) Connecting Viaduct

The connecting bridge between Eusebio Ayala - R. de Francia Avenues presents the following problems:

a. There is no other alternative but to cross the city blocks which are currently occupied by houses, offices and other installations.

b. If pretended to assure 4 lanes on the viaduct and 2 lanes for each frontage street (streets for traffic circulating from R. de Francia Avenue to Próceres de Mayo Avenue and vice-versa) at the R. de Francia Avenue part (8 lanes in total), the widening of the R. de Francia Avenue must be done, since it is not enough with the present 23m width.

Concerning point a), it improves vehicle transit if projected with largest curve radius, but it would be difficult to square the required length in a city block.

On the other hand, when reducing the radius, vehicle transit will worsen, increasing the risk of traffic accidents. At present, the horizontal alignment is projected, adopting the design speed of Eusebio Ayala Avenue at 60 km/h, with minimum radius curves of about 160m, determined by AASHTO standards, in order to square the necessary length into a city block.

Besides, observing the actual conditions along the avenue, it would be appropriate to keep the 60 km/h design speed in R. de Francia Avenue, which is located in the direction of centro from the connecting viaduct.

Concerning point b), the widening of the southern part of the avenue was selected due to the following reasons:

a. Large malls are installed on the north part of R. de Francia Avenue, such as "Santo Domingo" and "Bonanza", which implicates a greater indemnification of real estate than on the southern part of it. Some shops are also installed on the southern part, but of a relatively smaller scale.

b. The widening of both sides, keeping the central line of the current street, is not the best alternative, due to the increase of land owners which would have to be indemnified.

3) E. Ayala Avenue / Mcal. Estigarribia Road

(1) Between Connecting Viaduct to Mme. Lynch Avenue

The arteries alignment of the this section was done considering the central line of the present artery.

The viaduct in North - East direction exists at the intersection with Gral. Santos Avenue, whose side piers reach as far as the widening line of the present design. Concerning this point, it has been projected to reduce the median strip width in such a way as to use the present viaduct (See FIGURE 4-2-2). However, there is a difference between the vertical clearance (H = 4.74m) of this viaduct and the adopted clearance for the Study (H = 5.00m), so its reconstruction will be necessary in future. Also, the parts corresponding to the frontage road(slow speed lane) are lower than those of the main street, thus making it necessary to regulate or prohibit greater vehicles traffic.

In the case of 35m widening, part of the building of the Police Station No. 7, located next to point No. 43 + 50 would be affected, but it could be avoided through the reduction of the projected sidewalk width of 5m (See FIGURE 4-2-3). In the case of the 50m widening, it would be necessary to deviate the almost straight E. Ayala Avenue only at the point where the Police Station is located, but this is not convenient from the point of view of vehicle transit.

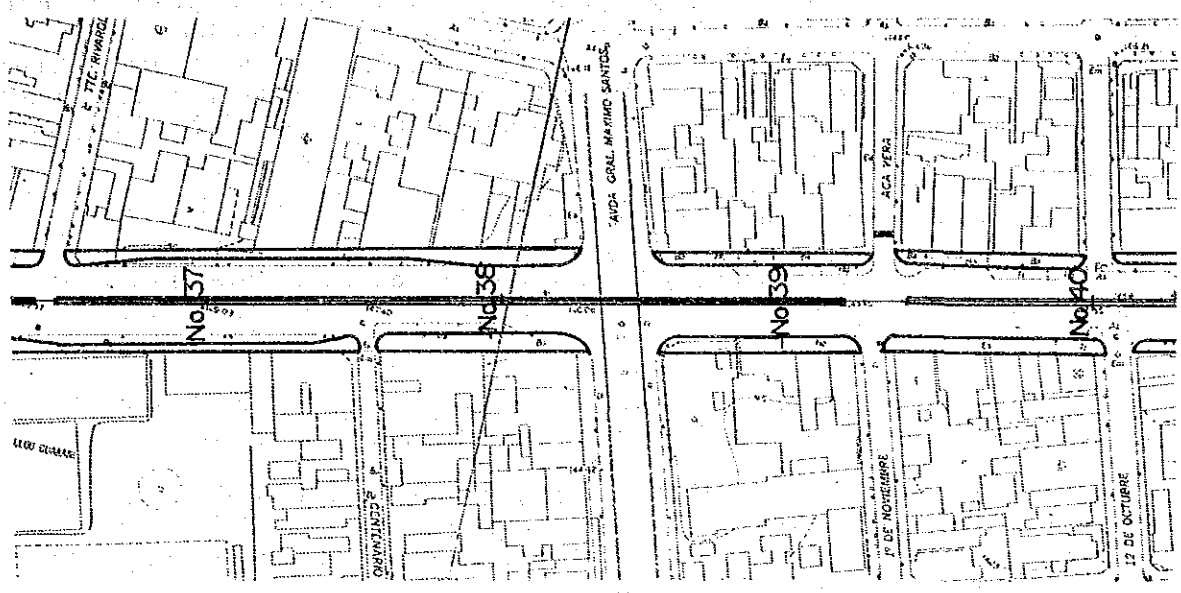


FIGURE 4-2-2 CROSSING POINT OF E.AYALA AND GRAL. SANTOS AVENUES

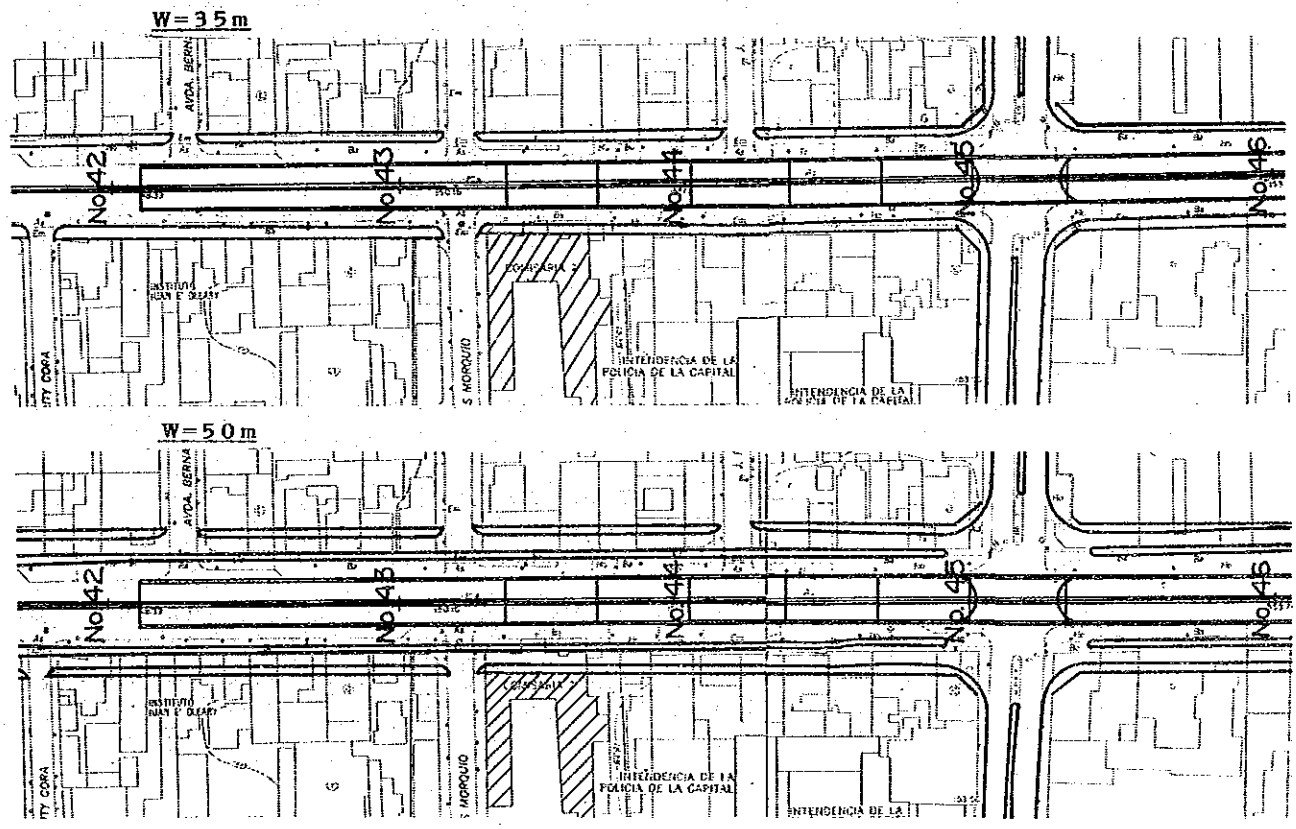


FIGURE 4-2-3 PLAN OF EUSEBIO AYALA AVENUE (SECTION NO. 43+50)

Military land is located north of section No. 59 + 00. When widening to 35m, part of it will be affected. Consequently, in order to avoid this problem, the sidewalk width was reduced to 1-3m (the present width of the sidewalk is of 3m), and also, the central median will be transferred 1m south (See FIGURE 4-2-4). With the widening to 50m, besides the land, the guard booth will be also affected, but it will not reach the main building.

(2) Between Mme. Lynch to San Lorenzo

With respect to the intersection formed with Mme. Lynch Avenue, the R = 400m curve has been introduced, fitting to the current right of way.

Next to points No. 101 and 102, the buildings of Police Station No. 25 and Fernando de la Mora Municipality are located.

In the case of 35m widening, it does not affect any of the buildings, but in the case of 50m widening, it does affect half of the front yard of the Police Station and a minimal part of the Municipality (See FIGURE 4-2-5).

4) España Avenue Extension

The extension has been projected, maintaining España Avenue's present direction, establishing the initiation point at the curve with Tacuary Street, in order to avoid affecting the Antropological Museum and Police Station No. 5. This goes across the ditch and joins with Paraguarí Street, and finally intersect with México and Caballero Streets. The projection of this alignment was done taking into consideration the probable future extension in such way to favor intersection with Independencia Nacional Street and Costanera Avenue.

5) Madame Lynch Avenue

The section between E. Ayala and Santa Teresa Avenues was projected establishing the central line of the right of way in the middle of the current channel with the streets on both sides.

Starting at the Santa Teresa Avenue, the west street goes across the channel and joins with the east sector one, forming a 4 lane road which is located at the east side of the channel.

Concerning the section between Santa Teresa Avenue and Aviadores del Chaco Avenue, it has been taken the high voltage electric wiring as the central line of the right of way, which goes between the channel and the current road, in order to avoid transferring the ANDE towers.

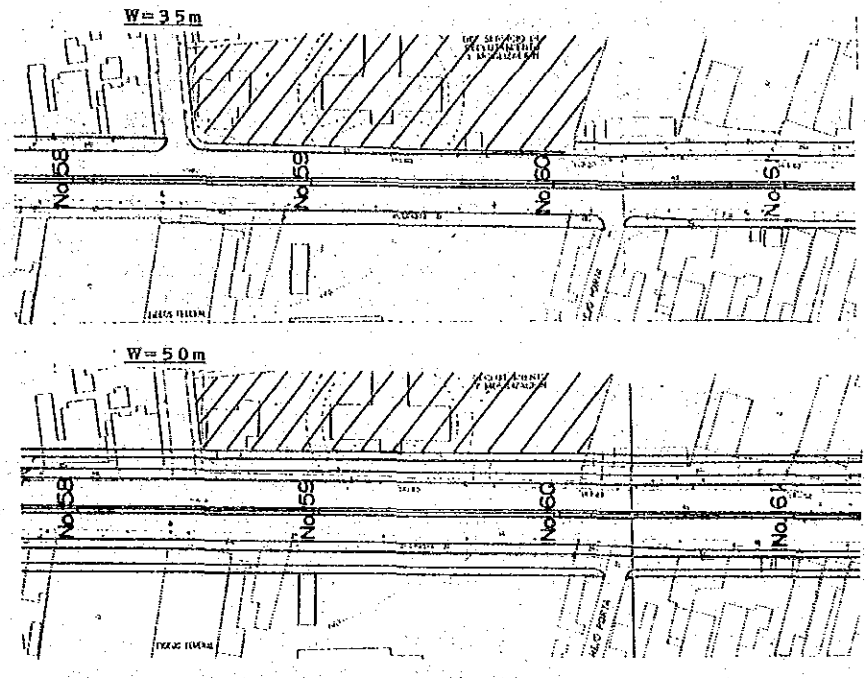


FIGURE 4-2-4 PLAN OF EUSEBIO AYALA AVENUE (SECTION NO. 59+10)

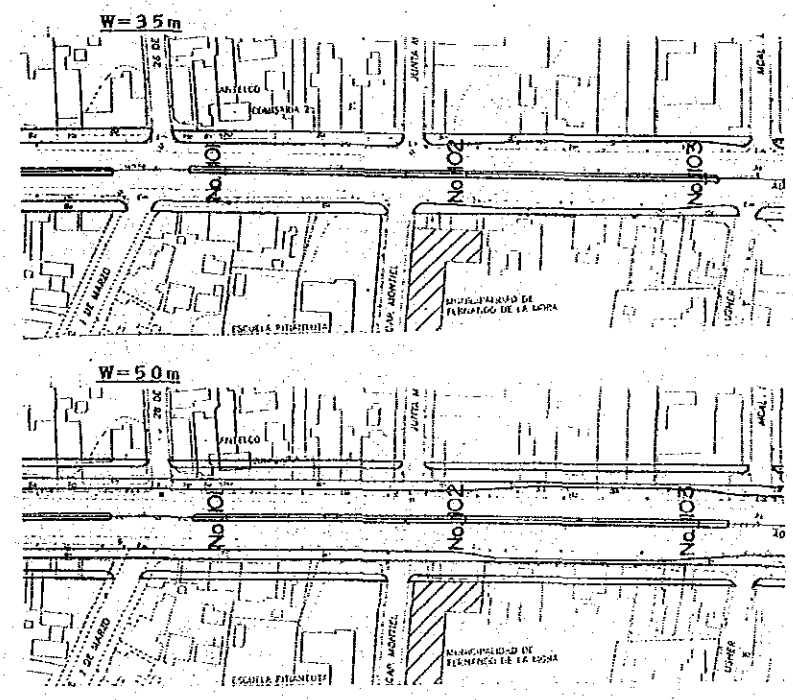


FIGURE 4-2-5 PLAN OF MCAL. ESTIGARRIBIA ROAD (SECTION NO. 101+00 AND 102+00)